JRC SCIENTIFIC AND POLICY REPORTS

Current status and Best Practices for Disaster Loss Data recording in EU Member States

A comprehensive overview of current practice in the EU Member States

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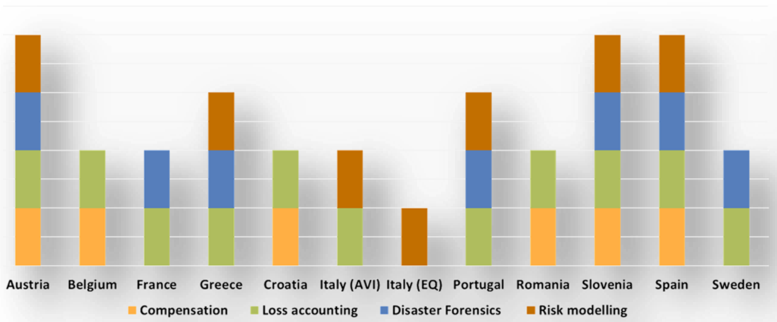
2014



EUR 26879 EN

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JRC92290

EUR 26879 EN

ISBN 978-92-79-43549-2

ISSN 1831-9424

doi:10.2788/18330

Luxembourg: Publications Office of the European Union, 2014

Abstract

This report presents a state of the art for recording disaster loss data in European Union member states. It summarizes the contribution of experts from 15 EU Member States. A comparative analysis shows that methodologies for disaster loss data collection and recording in Europe are heterogeneous and that the available loss databases vary in their level of completeness and detail. Also IT systems vary in purpose, complexity and openness. This precludes a reliable and representative aggregation of loss data at the EU level.

This report provides recommendations to European Union Member States that would help increase the quality of (shared) loss data within the current policy framework. It is recommended to continue the consultative process in a third phase with the aim of expanding the network of Member States ready to participate, tackling remaining technical issues in the EU framework for disaster loss recording and assisting Member States in implementing better loss data recording processes..

ABSTRACT

This report presents a state of the art for recording disaster loss data in European Union member states. It summarizeǎ the contribution of experts from 15 EU Member States. A comparative analysis shows that methodologies for disaster loss data collection and recording in Europe are heterogeneous and that the available loss databases vary in their level of completeness and detail. In addition, IT systems vary in purpose, complexity and openness. This precludes a reliable and representative aggregation of loss data at the EU level.

This report provides recommendations to European Union Member States that would help increase the quality of (shared) loss data within the current policy framework, and in particular for the targets and indicators of the post-2015 framework for disaster risk reduction. It is recommended to continue the consultative process in a third phase with the aim of expanding the network of Member States ready to participate, tackling remaining technical issues in the EU framework for disaster loss recording and assisting Member States in implementing better loss data recording processes.

EXECUTIVE SUMMARY

Disaster risk is increasing. Population growth in exposed areas, an increase in extreme weather events and rapid disaster-prone economic development all contribute to an increase in casualties and economic losses due to natural hazards. One third of development aid, adding up to 3 trillion euro, was lost due to disasters in the past 30 years[1]. The capacity of developing and developed societies to carry the losses is limited and not well understood. Estimates of future losses are hampered by low quality historical loss data. **We must measure losses better**.

In the run-up to the World Conference on Disaster Risk Reduction (DRR) in 2015, disaster loss data have repeatedly been singled out as **essential evidence for sound policy making** and evaluating progress in reducing disaster risks. Already a key priority in the EU disaster prevention framework, the **2014 EU Council Conclusions on risk management capability** (13013/14) reiterate the importance and invite the European Commission to take actions to encourage the EU Member States to develop systems, models or methodologies for collecting and exchanging data on ways to assess the economic impact of disasters on an all-hazard basis.

Recording disaster loss data is important, but **no internationally agreed definitions or accounting practices exist** for disaster loss data, making national and global statistics incomplete and unreliable. The awareness about the utility of loss data is also often lacking, in particular in countries where the penetration of private and Public Private Partnerships (PPP) natural disasters insurance coverage is low or where public compensation schemes are small or non-existent. **Utility extends beyond accounting** (for compensation schemes and policy monitoring) and includes **prevention policy** (through forensic data) and **risk assessment** (through the reduction of the various sources of uncertainty propagation along the components of risk models).

To identify the gaps and challenges for recording loss data in Europe and identify and promote the opportunities for policy making, the Directorate General Joint Research Centre was tasked in 2013 to establish an **expert working group** with members from EU Member States **to report on the current state of the art in Europe and recommend best practices and guideline**s. Fifteen Member States participated to three meetings organized in 2014. The working group benefited also from an exchange of information with the United Nations Agency for DRR (UNISDR) and an international working group addressing Loss Data affiliated with the Integrated Research on Disaster Risk (IRDR), as well as various academic and scientific institutions. The EU and the IRDR DATA working group held a joint meeting in May 2014.

This report aims at presenting the state of the art and best practices for recording disaster loss data in EU member states. It is a follow-up of the 2013 study “Recording Disaster Losses: Recommendations for a European approach” which formulated a conceptual framework for the use and application of loss data and challenges for technical requirements in the EU context.

[1] World Bank. http://www.globalresiliencepartnership.org.

Based on contributions from 15 Member States and analysis in the EU Disaster Loss Data Working Group, the **main findings** of this study indicate that:

- **12 out of 15 participating Member States** have established and maintained a loss database (public or semi-public). France, Germany (partial access), Greece, Italy and Sweden have publicly accessible national disaster databases. Austria, Croatia, France, Greece, Italy, Portugal, Romania, Slovenia and Spain regularly update their disaster databases. France, Greece, Portugal and Slovenia have countrywide and multi-hazard loss databases, some of them supported by legislation and strong mandate (Slovenia). Belgium, Germany, Italy and Spain have databases with partial loss recording (e.g. disaster-specific, limited to floods).
- Croatia, UK and Netherlands do not have a national loss database, and Bulgaria is in the process of establishing one. Belgium is in the process of devolving the national database to separate regional databases.
- The processes of loss data collection (measuring loss) and recording (storing data in a structured database) significantly differ across the surveyed countries. There is a **lack of guidelines and standards** for loss data collection and recording, in particular for **human and economic losses**, which prevents data from being shared in a comparable way between the surveyed countries and from being aggregated at EU or global level.
- **IT systems supporting the loss data recording vary significantly** across Member States. Some are simple tables and others are federated database systems across various governmental levels or integrated systems linked to other governmental databases, private or Public Private Partnerships (e.g. cadastre, insurance records, hazard database)
- The terminologies used for **peril classification** and the types of loss indicators also vary between the countries but are compatible, which allows their translation into a common classification system and methodological framework.
- The **drivers for disaster loss data recording** are mainly linked to (semi) public national compensation schemes (Belgium, Croatia, France, Slovenia, Spain, Sweden), existing EU or national legislation (e.g. EU Flood Directive or Solidarity Fund) and improving prevention and response mechanisms (e.g. Austria for landslides, avalanches and flash floods; Italy for flood management in Umbria and Sicily).

The overview of the current practices in recording disaster loss data in EU Member States shows that the methodologies implemented in each country are appropriate for their purpose. However, to make the databases compatible with requirements for sharing data among Member States and with international organisations they all would require adjustments. The loss recording practices also would need to be strengthened to make the data useful at national level beyond narrowly defined objectives, e.g. for prevention policy and risk assessment.

The recommendations drawn from the analysis can be summarized as follows:

- The **role and utility of loss data** should be discussed across government departments, including emergency management, urban planning, and government budget and across all government scales and participative governance fora (local to national). High-level requirements should be informed by public and private needs across sectors.

Implementation might be embedded in a Public-Public Partnership (PUP) and/or Public Private Partnership (PPP) to **ensure participation and ownership of all stakeholders**.

- Loss data should be recorded in **advanced (distributed) IT systems**, implementing an appropriate data model (linked to or integrated with other government databases) and supporting user-friendly data visualization and sharing options for a wide range of users.
- **Summary or aggregate statistics** (aggregation level to be defined by the Member State) should be shared using an open data policy in a common data standard to support trans-boundary and international risk reduction processes (including the post-2015 Framework). **Minimum requirements for a data-sharing standard** aligned with current practices are proposed in this report.

It is also recommended to continue the work of JRC and the EU Disaster Loss Data Working Group. A third phase would be needed to (1) build a conceptual framework for human and economic loss data, (2) establish guidelines and best practices for loss data recording at local and national level, (3) expand the expert network of the Working Group to include all EU countries and (4) assist Member States with technical advice on the implementation of minimum requirements for sharing loss data.

ACKNOWLEDGEMENTS

The authors wish to acknowledge all contributors to this report.

We are grateful to the working group participants namely:

- The experts from Member States for providing a thorough overview on the status of disaster loss data recording in their respective countries,
- The experts from CIMA foundation, FEEM, ICORP, the European Environment Agency and Politecnico di Milano for their valuable comments,
- International experts from UNISDR, Swiss Re, Munich Re, CRED and
- The IRDR data working group chairs and co-chairs.

Particular acknowledgements go to the major contributors namely: Jaroslav Mysiak (FEEM), Ana Jaksic (ACPDR, Slovenia), Roland Nussbaum (ONRN, France), Scira Menoni (Politecnico di Milano, Italy), Roberto Rudari (CIMA Foundation, Italy), Xavier Romão and Esmeralda Paupério (Faculdade de Engenharia da Universidade do Porto, ICORP, Portugal), Annegret Thieken (Universität Potsdam, Institut für Erd- und Umweltwissenschaften, Germany), Almudena Bustamante Gil (Procivil, Spain) and Delilah Al Khudhairy (European Commission, Joint Research Centre).

CONTENT

TERMINOLOGY

The terminology used in this document is largely based on existing definitions, with some adapted and new terms.

DISASTER

Source: UNISDR, 2009[2]

A disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope with using its own resources.

Comment: Disasters are often described as a result of the combination of: the exposure to a hazard; the conditions of vulnerability that are present; and insufficient capacity or measures to reduce or cope with the potential negative consequences. Disaster impacts may include loss of life, injury, disease and other negative effects on human physical, mental and social well-being, together with damage to property, destruction of assets, loss of services, social and economic disruption and environmental degradation (UNISDR, 2009).

DISASTER RISK

Source: UNISDR, 2009

The potential disaster losses, in lives, health status, livelihoods, assets and services, which could occur to a particular community or a society over some specified future time period.

Comment: The definition of disaster risk reflects the concept of disasters as the outcome of continuously present conditions of risk. Disaster risk comprises different types of potential losses, which are often difficult to quantify. Nevertheless, with knowledge of the prevailing hazards and the patterns of population and socio-economic development, disaster risks can be assessed and mapped, in broad terms at least (UNISDR, 2009).

DISASTER IMPACT

Source: NRC, 1999[3]

The impact of a disaster represents the overall effects, including positive and negative effects, of the disaster.

Comment: Still, in most cases, one refers to the impacts of disasters that are predominantly undesirable. Furthermore, these impacts include market-based impacts (e.g. destruction of property or a reduction in income) and non-market effects (e.g. loss of life, environmental consequences, loss of cultural heritage or psychological effects suffered by individuals).

[2] UNISDR terminology on disaster risk reduction, 2009. http://www.unisdr.org/we/inform/terminology#letter-r

[3] National Research Council, 1999. The Impacts of Natural Disasters: A Framework for Loss Estimation, March 1999

DISASTER DAMAGE

Source: ECLAC, 2003[4]

Total or partial destruction of physical assets existing in the affected area.

Comment: Damage occurs during and immediately after the disaster and is measured in physical units (i.e. square meters of housing, kilometres of roads, etc.). Its monetary value is expressed in terms of replacement costs according to prices prevailing just before the event (ECLAC, 2003). Direct damage is a physical damage to properties due to direct physical contact with the hazard, i.e. the physical destruction of buildings, inventories, stocks, infrastructure or other assets at risk (Smith and Ward, 1998[5]).

DISASTER LOSS

Source: NRC, 1999

The losses of a disaster represent marked-based negative economic impact. These consist of direct and indirect losses.

DIRECT LOSS

Source: adapted from ECLAC 2003 and Benson and Clay, 2000[6]

Direct loss is the monetary value of physical damage to capital assets.

Comment: Direct losses can be roughly equated with stock losses.

INDIRECT LOSS

Source: adapted from Benson and Clay, 2000

Indirect loss refer to the damage to the flow of goods and services.

Comment: Indirect loss include lower output from damaged or destroyed assets and infrastructure and loss of earnings due to damage to marketing infrastructure such as roads and ports. Indirect loss may also include costs such as those associated with the use of more expensive inputs following the destruction of cheaper sources of supply.

[4] Economic Commission for Latin America and the Caribbean (ECLAC), 2003. Handbook for Estimating the Socio-Economic and Environmental Effects of Disasters.

[5] Smith, K. and Ward, R.: Floods: Physical processes and human impacts, John Wiley & Sons, Chichester, 1998.

[6] Benson, C. and E. L. Clay (2000). Developing countries and the economic impacts of natural disasters. Managing disaster risk in emerging economies. A. Kreimer and M. Arnold. Washington, The World Bank: 11-21.

AFFECTED PEOPLE

Source: JRC

Number of persons that were directly or indirectly affected in some way due to the disaster.

Comment: definitions of affected people vary widely among disaster loss databases and publications. To make it an effective metric, a precise definition is necessary. The proposed definition follows the logic of ECLAC for economic disaster losses, and is based on a rigorous definition of various groups of affected people.

DIRECTLY AFFECTED

Source: JRC

Directly affected people suffer the disaster's direct effects and are always within the affected (damaged) area.

Comment: The primary level of affected population suffers the direct effects of the disaster and can be found in the direct path of the natural disaster. The directly affected people are a subset of exposed people (people living in the affected area). The impact on this group includes fatalities, people in need and impaired, which are further defined as follows.

Increasing priority of needs

			Main fields	Definitions	Breaking down the fields (general options: by gender, by age, by vulnerable groups, ...)
DIRECTLY AFFECTED primary level by ECLAC	People that suffered impacts on their physical integrity		Fatalities	Mortality	Killed Missing
DIRECTLY AFFECTED primary level by ECLAC	People that suffered impacts on their physical integrity	PEOPLE IN NEED	Injured/disease/in need of medical assistance	People that are in need of immediate medical assistance as a direct result of the disaster	
DIRECTLY AFFECTED primary level by ECLAC	People that suffered impacts on their livelihood	PEOPLE IN NEED	Evacuated	People that are removed from a place of danger to a safer place. Breaking down that field is related to the management of different disaster phases.	EARLY WARNING: Pre-event; Post-event RESPONSE CAPACITY: Sheltered by emergency services; Sheltered by private arrangements; Relocated; Without shelter RECOVERY: Permanently homeless; Temporarily homeless; Not homeless
DIRECTLY AFFECTED primary level by ECLAC	People that suffered impacts on their livelihood	PEOPLE IN NEED	Isolated	People that suffer physical damage of infrastructure which threatens their basic livelihood conditions (limited access to water, food, electricity, ...) but they have not been evacuated	
DIRECTLY AFFECTED primary level by ECLAC	People that suffered impacts on their livelihood		Impaired	People that suffer physical damage of their property but are not in need	
INDIRECTLY AFFECTED			**Secondary level** - within affected area (by ECLAC)	People that suffer of a disaster's indirect effects (e.g., loss of flow, deficiencies in public service)	
INDIRECTLY AFFECTED			**Tertiary level** - outside affected area (by ECLAC)	People that suffer of a disaster's indirect effects (e.g., loss of flow, deficiencies in public service)	

- **Fatalities**: Mortality= killed + missing
  - **Killed:** Corresponds to the number of people who died during the disaster, or some time after, as a direct result of the disaster.
  - **Missing:** Number of persons whose whereabouts as from the effects of the disaster are unknown. It includes people presumed dead without physical evidence. Data on dead and missing persons are mutually exclusive.
- **People in need:** Injured + Evacuated +Isolated
  - **Injured:** People that exhibit physical evidence of being in need of immediate medical assistance as a direct result of the disaster

- **Evacuated**: People that are removed from a place of danger in the area where the disaster occurred to a safer place. Breaking down this field is related to the management of different disaster phases.
  - **Sheltered**: People that moved to live in another location temporarily.
  - **Relocated**: People that moved to live in another location permanently.
  - **Permanently homeless**: People whose homes are destroyed.
  - **Temporarily homeless**: People whose homes are damaged and need repair.
  - **Not homeless**: People who were most probably evacuated before the event and they can return to their homes once the alert situation is over.
- **Isolated**: People that suffer physical damage of infrastructure which threatens their basic livelihood conditions (limited access to water, food, electricity…) but they have not been evacuated.

- **Impaired**: Number of persons whose individual or collective property and/or services have suffered serious damage directly associated to the event.

It is possible to further establish two groups of directly affected people as follows:

- **People that suffered impacts on their physical integrity**: Killed + Missing + Injured
- **People that suffered impacts on their livelihood**: Evacuated + Isolated + Impaired

Note that the people in first group may also suffer impact on livelihood. To ensure mutually exclusive definitions, it is recommended to count them in the first group using the rule of priority of needs (e.g. the need of medical assistance is prioritized over the need of shelter).

INDIRECTLY AFFECTED

Source: JRC, adapted from ECLAC (2003)

Indirectly affected people suffer indirect effects of the disaster and can be within or outside the affected area, which divides them into secondary and tertiary level of indirectly affected people respectively.

1 INTRODUCTION

Disaster risk is increasing. Population growth in hazard exposed areas, an increase in extreme weather and climate events and rapid economic development in disaster-prone all contribute to an increase in casualties and economic losses due to natural hazards. One third of development aid, adding up to 3 trillion euro, was lost due to disasters in the past 30 years[7]. The capacity of developing and developed societies to absorb the losses is limited and not fully understood. Estimates of future losses are hampered by low quality historical loss data. **We must measure losses better**.

"Until relatively accurate estimates are available, the true economic losses in natural disasters will remain poorly understood and the benefits of disaster mitigation activities only imprecisely evaluated" (NRC, 1999)

"The policy imperative is clear: how can we reduce losses from natural hazards when we do not know how such losses are counted and when and where they occur?" (Gall et al.,2009)

In the run-up to the World Conference on Disaster Risk Reduction (DRR) in 2015, disaster loss data have repeatedly been singled out as **essential evidence for sound policy-making** and evaluating progress in reducing disaster risks. Already a key priority in the EU disaster prevention framework, the 2014 EU Council Conclusions on risk management capability (13013/14) reiterate the importance and invite the European Commission to take actions to encourage the EU Member States to develop systems, models or methodologies for collecting and exchanging data on ways to assess the economic impact of disasters on an all-hazard basis.

Recording disaster loss data is important, but **no internationally agreed definitions or accounting practices exist** for disaster loss data, making national and global statistics incomparable and unreliable. De facto practices exist in individual organisations (reinsurance companies or academic institutions) but these are not fully aligned, and are not suitable for national loss data recording. UNISDR, with EU funding, is currently assisting up to 60 countries to establish loss databases based on Desinventar[8], yet another de facto standard. In all these initiatives, definitions differ, terminology is not standard and objectives vary widely. In addition, non-technical factors, such as different thresholds, funding restrictions, and competing mandates, meant that loss data archives are often incomplete and impossible to compare.

Awareness of loss data and their utility for policymaking and DRR is also often lacking. **Utility extends beyond accounting** (for compensation schemes and policy monitoring) and includes

[7] World Bank. http://www.globalresiliencepartnership.org.
[8] Inventory system of the effects of disasters (http://www.desinventar.org/)

prevention policy (through forensic data) and **risk assessment** (through the development of accurate and localized damage functions for risk models).

To identify the gaps and challenges for recording loss data in Europe and identify and promote the opportunities for policy making based on evidence, the Directorate General Joint Research Centre was tasked in 2013 to establish an **expert working group** with members from EU Member States **to report on the current state of the art in Europe and recommend best practices and guidelines**. Fifteen Member States participated to three meetings organized in 2014. The working group benefited also from an exchange of information with the United Nations Office for DRR (UNISDR) and an international working group addressing Loss Data affiliated with the Integrated Research on Disaster Risk (IRDR), as well as various academic and scientific institutions. The EU and the IRDR DATA working group held a joint meeting in May 2014.

This report aims at presenting the state of the art and best practices for recording disaster loss data in EU member states. It is a follow-up of the 2013 study “Recording Disaster Losses: Recommendations for a European approach” which formulated a conceptual framework for the use and application of loss data and challenges for technical requirements in the EU context.

Specifically, this report presents a comparative analysis of loss data recording approaches in the European Union countries at national level (Chapter 3). It aims at identifying the common basis in methodology and technical specifications of collecting and recording losses, and at determining areas that can benefit guidance or standardization (Chapter 4).

To structure the analysis, the report uses a conceptual framework that was developed in 2013 by the Joint Research Centre (JRC) and further expanded in 2014 (Chapter 2). The framework was used to assess the current state of the art for recording disaster loss data in EU Member States. The framework covers loss accounting, disaster forensics and risk modelling as key applications.

One of the main efforts during the series of the EU loss data workshops was to build and expand a network of experts in Member States willing to participate in the process of the development of the European disaster loss guidelines. They contributed in part by describing their current system, including limitations and opportunities for the improvements along with the existing legislation that mandates the institutions and corresponding resources. As such, the information in this report is based on information provided by Member States and not the results of JRC internal analysis.

The report further aims at identifying best practices in EU Member States (considering different circumstances) and providing recommendations to improve disaster loss data recording in EU Member States (Chapter 5 & 6).

1.1 WHY DO WE NEED DISASTER LOSS DATA?

Disaster loss data recording is the result of a systematic, (nationally) consistent, coordinated process to collect human, physical, and economic losses as well as social and environmental consequences immediately following an emergency or a disaster.

It is worthwhile to distinguish (i) value of loss assessment for individual events, and a (ii) systematic collection of loss data for significant disasters. An almost forensic level of analysis of a single extreme event, in isolation, can reveal weaknesses of current risk management practices and identify opportunities for a reform. It can help to collect evidence about the cost-efficiency and benefits of disaster prevention and protection, or to what extent the costs of DRR is distributed equitably among those who benefit most from them. In some cases, the damages and losses are a result of a negligent behaviour and hence subject of liability the extent of which needs to be determined. The loss assessment is important here as well.

A systematic collection of loss data, beyond the above scope, allows for calibration of loss and damage models, a better scrutiny of medium- to long term economic shocks or social disruption induced by natural disasters and a comparison of seemingly similar events in the same or in different places (e.g. the Central European floods in 2002 and 2013). Loss data collections are useful, with many limits, also for identifying trends and patterns in the data over time.

In Groeve et al. (2013), a conceptual model including three applications for loss data was defined. The loss data are used for accounting, for forensic analysis and for risk modelling. In the current report, an additional dimension is identified relating to compensation purposes. Table 1 gives an overview.

- **Disaster loss compensation**[9]

A fair and efficient solidarity mechanism and effective insurance markets are complementary approaches to recover from disasters. Most disaster loss databases in Europe are based on a collection of claims used in these compensation mechanisms (e.g., in Belgium the damage and loss database CALIS is used for calculating the compensation to be awarded the victims of extreme events of natural hazards).
At EU level, the Solidarity Fund (EUSF), with an annual ceiling at 500 million euro, requires loss data collected within a given timeframe to substantiate claims. The eligibility to EUSF funds is dependent on the amount of disaster losses under certain conditions and fixed thresholds [22].

- **Disaster loss accounting**

Loss accounting aims at documenting the trends and, along with probabilistic risk models, at understanding the potential exposure of society to disasters. Aggregated statistics (e.g. average annual losses) over the national territory as well as trends in losses can partially help measuring

[9] In this text, we use compensation to include post-disaster cost covering schemes, including indemnification, state aid and insurance.

and evaluating disaster risk reduction policies. "High-quality loss data of good temporal and spatial resolutions can be coupled with ancillary data like disaster risk management expenditures or demographic information. Combining these data makes it possible to evaluate the effectiveness of policies and to determine whether these expenditures are making a difference in loss trends"[10]. According to MunichRe[11], the EU suffered overall losses of 21b euro in 2013, equivalent to 0.14% of GDP. With climate change, the expected annual losses will likely triple to 0.4% of GDP in EU by the end of this century [31]. However, figures vary widely because of the absence of standard loss metrics (e.g., SwissRe typically estimates 10 to 20% more losses than MunichRe). Nations must decide what constitutes an acceptable level of disaster losses given limited resources for prevention measures. Loss data therefore informs decisions on balancing prevention budget with loss compensation funds.

- **Disaster forensics**

When implemented well, the process of disaster loss data recording generates crucial and unique evidence for disaster forensics to identify loss drivers by measuring the relative contribution of exposure, vulnerability, coping capacity, mitigation and response to the disaster, with the aim to improve disaster management from lessons learnt. Disaster forensics collected for individual events is critical evidence for evaluating the effectiveness of specific disaster prevention measures, and disaster prevention policy as a whole. Disaster forensic studies rely largely on loss data. For example, Forensic Disaster Analysis (FDA) of the Center for Disaster Management and Risk Reduction Technology (CEDIM)[12] is developing an online information service that gives real-time estimation of possible damage (amount of loss) before and during a winter storm event over Europe. The system builds on a loss database including all past storm events (Forensic Atmo project).

- **Risk modelling**

The worst disasters have not happened yet. This is a key message from UNISDR's Global Risk Assessment 2013 [55]. Losses of future disasters are estimated through risk models. These require accurate loss data for calibrating and validating model results and in particular, to infer vulnerabilities, loss exceedance curves and fragility (or damage) curves. Disaster risk model typically comprise three main modules: hazard, exposure and loss. The latter combines the hazard module and the exposure module to calculate different risk metrics, such as annual expected loss (AEL) and probable maximum losses (PMLs) for various return periods. The AEL and PML are used to compliment historical analysis and are particularly useful for decision makers in assessing the probability of losses and the maximum loss that can result from major future events.

The information on losses required for these four applications are overlapping but differing in terms of its drivers, end-users, timeframe and granularity (Table 1). The latter ranges from detailed loss at asset level (e.g. for individual compensation claims), through aggregate statistics or estimates at municipality, regional and national levels (e.g. reporting to the post-2015

[10] Source: Text is from Melanie Gall, Christopher T. Emrich, and Susan L. Cutter, "Who Needs Loss Data," input paper prepared for the 2015 Global Assessment Report on Disaster Risk Reduction, available at www.preventionweb.net/gar.
[11] http://www.munichre.com/en/reinsurance/business/non-life/natcatservice/annual-statistics/index.html
[12] https://www.cedim.de/english/2451.php

Framework for DRR), and all the way to globally aggregated trends and statistics (e.g. used in climate change discussions). To be cost effective, the **scale** (granularity) of recording losses and the **scope** (coverage) of loss databases should be optimized based on the requirements of the application area. Table 1 also shows the relevant legislation and agreements, interested stakeholders, what loss period is more relevant and what kind of loss data needs to be recorded.

Table 1. Application areas of disaster damage and loss data

Use	Compensation	Accounting	Forensics	Risk modelling
Driver	Fair and efficient solidarity mechanism and/or insurance market	Avoiding sovereign insolvency Balance prevention budget and loss compensation	Evaluate prevention measures (disaster management procedures, training, technology, etc.) and protection Improve prevention policy	Accurate risk assessment based on locally relevant loss exceedance curves Develop economic models to estimate indirect losses
Relevant legislation and agreements	National legislation on compensation of victims and government aid Insurance policy EU solidarity fund State Aid	National legislation on disaster prevention and risk assessment EU Council Conclusions on a Community framework on disaster prevention within the EU HFA-2 EU White Paper on Climate Change Adaptation	EU Council Conclusions on a Community framework on disaster prevention within the EU EU Council conclusions on risk management capability Union Civil Protection Mechanism	EU Flood directive HFA-2 EU Council Conclusions on a Community framework on disaster prevention within the EU
Loss period	Now (event based)	Cover future losses Monitor trends in losses	Now (event-based)	Use archive to estimate future losses
Interested stakeholders	Member States with public compensation scheme Insurance industry	Member States with high annual average losses and/or high maximum probable loss European Union Financial system United Nations Civil society	Member States Emergency Management authority Regional and local emergency management authorities (for improved prevention and response protocols)	Member States potentially affected by climate change Scientific community (early warning, disaster risk, crisis management, climate change) Insurance Industry EU Member States and Institutions
Scale required for loss recording	Asset-based	National / regional aggregates	Event-based	Asset-based (sampling)

What needs to be recorded	Direct monetary losses	Direct monetary losses Human losses Uncertainty	Direct (and indirect) monetary losses Human losses Dynamics of impacts (population movements, evacuations), response (decisions, actions) and hazard (evolution)	Direct and indirect economic losses Human losses Specific asset-related information (number of floors, water height, local soil type, level of damage, etc.) Narrative Uncertainty

1.2 National Level: Process View

The applications of loss data are interwoven and stakeholders typically are involved in multiple strands at once. At national level and seen as a process, loss data recording can be described as in Figure 1.

Disaster loss data collection involves a number of stakeholders, such as decision makers, scientists and practitioners with each their responsibility and function.

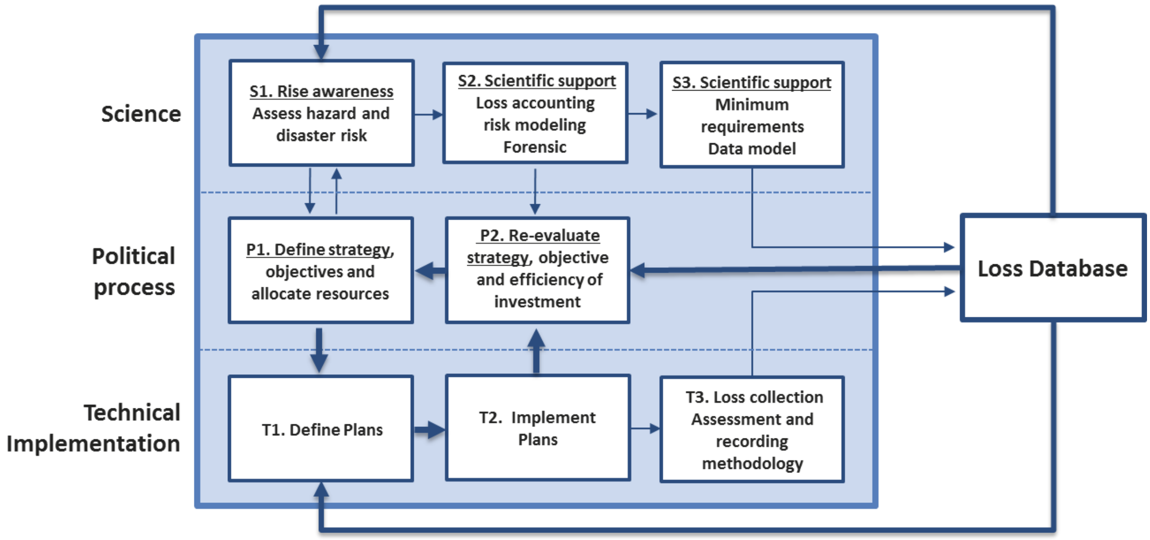

Figure 1. Conceptual information flow for the implementation of crisis management plans and the role of disaster loss data within this process

Disaster risk awareness, unless made obvious by a disastrous event, is often brought to attention as an issue for the safety of societies by academia/and or practitioners (S1 in the figure 1). Policy makers may act on the scientific evidence by establishing a national risk assessment, and there from defining disaster risk reduction objectives through the allocation of resources and drafting legislation (P1). It is then taken up by the mandated bodies that draft the implementation plan (T1) and execute the plans (T2). The appropriateness of risk reduction and prevention measures is evaluated over time (P2, e.g. through peer review processes or internal review processes) and the objectives may be re-evaluated and resources may be then allocated accordingly. That is often carried out with the support of scientists using disaster risk and other models (S2). Eventually losses are stored in the loss database. Loss data trends are used by policy makers to track the value of investment, reporting and accounting for losses over time, by implementers to better plan DRR measures and by scientist for improving future models.

1.3 EUROPEAN UNION: STRONG LEGAL BASIS

Disaster risk and resilience[13] are not confined within national borders [23]. The European dimension of loss databases is particularly important to understand and manage the trans-boundary effects of disasters such as loss trends and spatial patterns to measure efficiency of DRR policy on national and European levels as well as to contribute to the international dimension. This implies also that risk data, including disaster loss data, need to be comparable at EU level.

Disaster loss data falls in the policy areas for which there is a shared competence (Article 4 of the Treaty on the Functioning of the European Union (TFEU)) between EU and Member States (e.g. internal market – state aid); or areas in which EU competence is limited to coordination of supplementary actions (e.g. civil protection) (Article 6 TFEU). Promoting improvements in the knowledge base for disaster management including disaster loss database is a key priority of the **EU disaster prevention framework** agreed in EU council conclusion of 30 November 2009 [11].
In particular, the following current EU legislation addresses disaster loss data:

- The **European Union Solidarity Fund** (EUSF) [16] [22] was established to support eligible countries, i.e. Member States or countries involved in accession negotiation with the Union, that are affected by a major disaster triggered by natural disasters to cover emergency relief costs. However, guidelines for declaring losses are not precise and are open for interpretation, resulting in very different quality of claims.
- The reformed **Union civil protection legislation** from 2013 [18] coupled with **the Council conclusions on Further Developing Risk Assessment for Disaster Management within the European Union** from 2010 [12] cover prevention actions and risk management within EU. This includes the obligation of Member States to share a summary of the national multi-hazard risk assessments (by the end of 2015 and every three years thereafter). In order to improve the knowledge base on disaster risk the sharing of best practice, specific knowledge, expertise and non-sensitive information will be facilitated. Past disaster loss data are essential evidence for risk assessment.
- The **Floods Directive** [21] calls for establishing mechanisms to assess flood hazard, risk and impact in Europe and requires that a flood risk management plan is designed and implemented.
- The **INSPIRE Directive** [20] provides a standardization of terminology, and technical standards that apply also to Natural Risk Zones, as well as established methodologies to implement data standards at EU level.

[13] Resilience is defined as the ability of a system, community or society exposed to hazard to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions [37][37].

- The **Green Paper on Insurance of Natural and Man-made Disasters [24]**, on the potential for the European Union to facilitate and support increased coverage of appropriate disaster risk insurance and financial risk transfer markets, as well as regional insurance pooling. Insurance industry has an interest in obtaining reliable disaster loss figures to calculate insurance premiums, financial worst case scenarios and provide an opportunity to include incentives to reduce risks.
- The **EU Strategy on adaptation to climate change [3]** sets out the strategy to contribute to a more climate-resilient Europe. One of the actions is building a solid knowledge base on the (future) impact and consequences of climate change for better-informed decision-making and to assess how effective the various adaptation measures are.
- The **State aid regulation,** on selective basis that distorts (or threatens to distort) free-market competition is, according to the Article 107 of the TFEU, incompatible with the EU internal (single) market [47]. The coma 2(b) of the same Article declared an aid to make good the damage caused by natural disasters admissible, provided that any intention to grant a similar aid is (i) timely notified to the European Commission (EC) (Article 108 TFEU), and (ii) the EC raises no objection. As a part of the State Aid Modernisation initiative [6], the Commission has revised and simplified both *de minimis* aid regulation and the General Block Exemption Regulation. The categories for which block exemptions can be applied were substantially extended in 2013 to include, among others, the aid in favour of making good the damage caused by natural disasters and aid making good the damage caused by certain adverse weather conditions in fisheries. Besides, the Commission Regulation 651/2014 exempted aid to make good damage caused by natural disasters from the obligation to notify the state aid, pursuant to the following conditions: First, the regulation declared 'earthquakes, landslides, floods (in particular floods brought about by waters overflowing river banks or lake shores), avalanches, tornadoes, hurricanes, volcanic eruptions and wildfires of natural origin' (ibid, recital 69 and Article 50(1)) as events constituting a natural disaster, while excluding damage arising from adverse weather conditions (frost, hail, ice, rain or drought). Second, the damaging event has to be recognised by competent authorities as a natural disaster; a clear causal link needs to be established between the disaster and damage suffered; and the total payments for making good the damage, including the payments under insurance policy, may not exceed 100 per cent of eligible damage costs. Third, the aid scheme has to be introduced within three years, and any aid granted within four years after the disaster. Fourth, the eligible damage costs include material damage incurred as a result of disaster and loss of income resulting from suspension of activity for a period of six months after the disaster event occurred (the damage assessment based on repair cost or economic value of the affected asset before the disaster should be certified by accredited experts or insurance undertaking).
- The **Solidarity clause of the European Treaty [47].** Article 222 of TFEU invokes solidarity, in the most explicit way in cases of a terrorist attack, or a natural or man-made disaster. The Solidarity clause should not be confused with the EU Solidarity Fund, although the latter is often seen as a part of the former. Furthermore, the article 122 of the TFEU empowers the Council to grant additional financial assistance, in spirit of solidarity, to the MS 'threatened with severe difficulties caused by natural disasters or exceptional occurrences beyond its control'. A proposal in the sense of the Article 222(3) of the TFEU was released in December 2012 as an umbrella framework of the existing instruments and policies, notably the European

Union Internal Security Strategy, the European Union Civil Protection Mechanism, the European Union Solidarity Fund, and the Common Security and Defence Policy.

- The **European Programme for Critical Infrastructure Protection [9].** In the aftermath of the 9/11 terroristic attacks in the United States, Madrid and London, the European efforts to protect critical infrastructure to human-made and natural hazards intensified by adoption of the European Programme for Critical Infrastructure Protection (EPCIP) and, later, the European Council's Directive 2008/114/EC. Initiated by the European Council in 2004, the EPCIP was conceived as a blueprint to critical infrastructure protection in Europe. The Programme embraced, among others, all-hazards approach, sector-by-sector accomplishment, and stakeholder 'cooperation'.
- The **Environmental Liability Directive [19]**. The Union's primary and secondary legislation has a little sway over the liability regimes across the Member States. Generally, the damage for which third parties are held liable are excluded from the eligible damage in the state aid regulation and the solidarity aid. An exemption is the liability for damage caused to environment addressed by the Environmental Liability Directive (ELD; 2004/35/CE). The Environmental Liability Directive was adopted in 2004 but applies only to activities that caused environmental damage after the full transposition of the Directive into national legislative frameworks (i.e. April 30th, 2007). The Environmental Liability Directive does not supplant civil liability insofar only the damage caused to environment (i.e. protected species and habitats, water and land) is comprised. Consequently, personal injuries, damage to property or economic losses incurred to third parties are not tackled, as they are subject of civil liability claims.

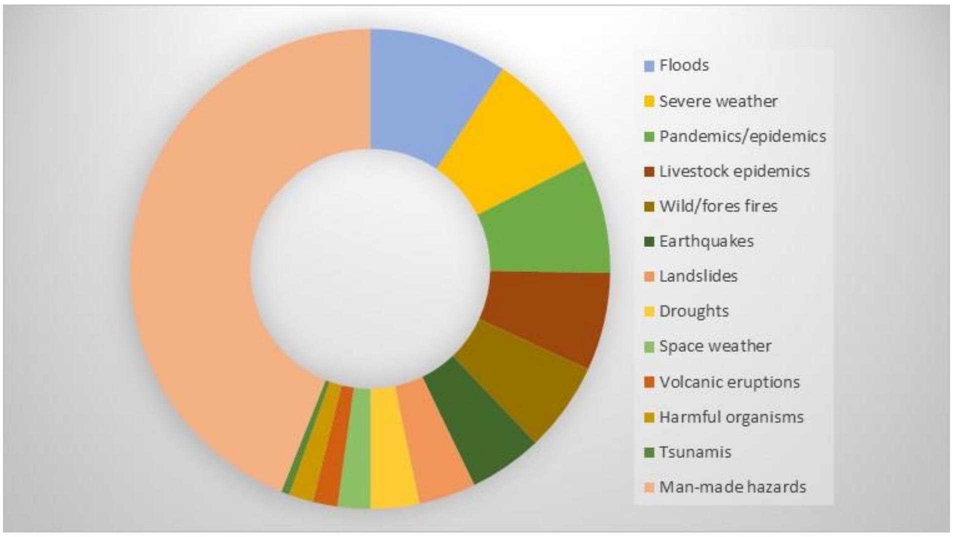

Figure 2: Major risks in Europe (source: ECHO Factsheet – Disaster Risk Management – 2014 SWD (2014)134, Overview of natural and man-made disasters in the EU. Based on national risk assessment data from 17 Member states and Norway)

1.4 International level: Post-2015 Framework for Disaster Risk Reduction

The EU disaster prevention strategy is fully in line with the 2005-2015 Hyogo Framework for action (HFA) [49]. HFA identifies loss data collection systems as a key priority. The 3rd World Conference on Disaster Risk Reduction, Sendai, Japan in March 2015 United Nation Members will adopt the successor arrangement to the Hyogo Framework of Action, referred to as the Post-2015 Framework for Disaster Risk Reduction.

The EU Council, in its conclusions on the Post 2015 Hyogo framework for action of 5 June 2014 [8] confirmed the commitment of the European Union and its Member States to play an active and constructive role in the on-going negotiations. The EU Council in the run-up to the Sendai summit on the basis of the five key principles[14] and fully respecting the non-binding nature of the Post 2015 HFA. Disaster loss data is identified as a key issue for improving accountability, transparency and governance. The collection and sharing of non-sensitive data on disaster losses, hazards and vulnerabilities are encouraged in an open data policy.

Targets and indicators based on disaster loss data

Building on the HFA, the Post-2015 Framework for DRR aims to achieve the "substantial reduction of disaster losses, in lives, and in the social, economic and environmental assets, of communities and countries." Several measures for the implementation of this framework are suggested, including the following measure: "systematically record and account for all disaster loss and impact". Global targets and outcome indicators are proposed for the implementation of this framework and for measuring progress.

At the time of writing, the following zero draft global targets are being discussed:

- reduce disaster mortality by [a given percentage in function of number of hazardous events] by 20[xx];
- reduce the number of affected people by [a given percentage in function of number of hazardous events] by 20[xx];
- reduce disaster economic loss by [a given percentage in function of number of hazardous events] by 20[xx];
- reduce disaster damage to health and educational facilities by [a given percentage in function of number of hazardous events] by 20[xx]; and
- increase number of countries with national and local strategies by [a given percentage] by 20[xx].

Evidently, disaster losses represent an essential component of the discussed targets. Reducing disaster loss is a proxy for achieving sustainability and growth. To measure achievement of the global targets, outcome indicators based on disaster losses are suggested. While not all countries have national disaster loss databases, the adoption of these indicators will represent a strong incentive for the systematically recording loss data.

Important elements to consider for setting metrics and targets that are sound include the following:

- **Use of clear terminology**: definition of metrics must be clear and unambiguous. In particular terminology on human and economic loss indicators varies widely in the various

[14] EU key principles for the post 2015 HFA: (i) Improving accountability, transparency and governance; (ii) Role of targets and indicators to measure progress and encourage implementation; (iii) Strengthening the contribution to sustainable and smart growth; (iv) Addressing vulnerabilities and needs in comprehensive framework; and (v) Ensuring coherence with the international agenda [7].

scientific and practitioner communities involved in DRR. A clear and consistent set of definitions (e.g. the ones proposed in this report) is necessary.

- **Distinguish between extensive and intensive disasters**. Extreme events can cause the majority of the losses and inevitably skew loss statistics in a short time window. Excluding losses of extreme events leads to better trends for extensive disasters, which are addressed typically through prevention policies. Losses of intensive disasters should be accounted for, but should not feature in trends. Instead, they inform policies on resilience. The threshold between extensive and intensive disasters may be expressed in terms of return periods.
- **Time window**. The time window in which losses are considered (be it summed or averaged) is important. It should be long enough to average the yearly variability of losses, but it should be short enough to be relevant to policy making within the duration of the DRR framework. It is also linked to the threshold between extensive and intensive disasters.
- **Direct versus indirect economic losses**. There is a debate on whether it is better to report on direct losses or also include indirect losses (see Terminology section for the definitions we use). From an economist point of view, both should be considered, but from a practical point of view it is costly to measure both direct and indirect losses. A trade-off may be to consider only direct losses for (frequent) extensive disasters and to consider both direct and indirect for (rare) intensive disasters, and set targets separately.
- **Baselines**. Human and economic losses vary according to the size of the country's population and economy. Therefore, loss metrics must be offset with a baseline, related to the size of the population and the economy.
- **Feasibility versus usability**. Ambitious reporting requirements may result in very useful data for global and national DRR policy making, but may not be compatible with existing loss recording practices in countries. A trade-off must be made between the state of the art (described in this report for the EU) and improvements that result in usable statistics.

1.5 Previous studies on disaster loss data recording in the EU

The lack of a common framework for disaster loss data recording within the EU is not new. In the last decade, several research projects, dedicated studies and EU initiatives attempted to portray the loss data recording profiles of EU Member States. Many of these studies were hazard specific (i.e. for floods or for fires only) or looked at the existing practices from the perspective of climate change or insurance penetration. Below a non-exhaustive list of disaster loss assessment and recording practices in Member States and accession countries:

- **NEDIES project** (Natural and Environmental Disaster Information Exchange System) addressed the existing practices in 10 Member States (Austria, Bulgaria, Cyprus, Finland, Greece, Hungary, Latvia, Romania, Spain and Sweden) across different aspects: type of disasters, existence of damage estimation procedures, existence of legislation, mandated governmental institution, existence of a disaster loss database, inclusion of intangible damage, use of damage estimation results. This survey showed that at the national level, the damage estimation is driven by a procedure aimed at financial reimbursement and that despite the heterogeneities in the practices there was a consensus on the need for a structured archive, such as a database warehouse within each country. Among the recommendations put forward was the need for a commonly accepted reporting system in each country, with an agreed set of database fields geared to collect damage and loss data allowing comparisons across Europe. However, in 2002, when this study was completed, the participating Member States considered that it was premature to have a common damage estimation methodology before first building a common understanding and an agreed set of definitions (systems of classification) [5].

- The EEA [26], analyzed **major natural and technological disasters and their impacts** for the period 1980–2009 [26]. The main sources of information on disaster losses included EM-DAT and NatCatSERVICE databases complemented with additional national sources of information where available. This report addressed the data gaps and information needs per type of disaster. The study shows that: i) improvements in loss data collection (mainly for floods) in recent decades could bias trends over time, ii) from a European perspective, it is desirable to establish more comprehensive information systems which would allow analysing and assessing the overall impact of different hazard types in Europe with a view of providing a more comprehensive and sound base for DRR.

- On a request by DG Internal Market and Services (DG MARKT), the JRC conducted, in 2011, a scientific exercise, aimed at drawing a picture of i) the **relevance of various natural catastrophes in the EU Member States** and ii) the development of the Natural Catastrophes insurance markets. This study collected quantitative information on the size of economic losses (historical and simulated losses) and processed from a number of different sources. The main source of information on historical losses was EM-DAT complemented with a variety of other sources specific for each Member States and each natural disaster type. This study includes the total economic losses including direct (i.e. damage to infrastructure, crops, housing) and indirect (i.e. loss of revenues, unemployment, market destabilization) losses spilled over the local economy. The study highlights the shortcomings of current loss data including: absence of common definitions, missing data, heterogeneous data and ambiguity in year the amount is referring to. Despite the incompleteness of the data used in this study, the scientific exercise could be read as a first step in the development of an EU database on natural disasters and of a methodology to analyse and compare disaster risk and insurance practices across EU Member States.

- Since 2011, the concept of a **European Flood Impact Database** has been explored as joint initiative by the European Environment Agency (EEA) together with European Topic Centre on Climate Change impacts, vulnerability and Adaptation (ETC/CCA) and the JRC. In 2011, a survey has been conducted among selected EEA member countries addressing the availability of national databases and information systems on flood events and impacts [27]. Some 18 EEA countries have responded to the survey indicating the existence of a large number of very heterogeneous data collection campaigns. Insights from the survey indicated the practical difficulties in combining the existing data. In view of a European Flood Impact Database, some steps towards a common understanding, e.g. including common criteria in both data collection as well as thresholds for events to be recorded were deemed necessary.

- The **European Forest Fire Information System** (EFFIS), established in 2000 by the JRC and DG Environment, verifies, stores and manages the forest fire data provided each year by individual EU Member States and other European countries. At present, the database contains fire data from 21 countries [4]. It is the largest repository of information on individual fire events in Europe. As of 2014, EFFIS became part of the Forest Information System for Europe (FISE), following the new EU Forest Strategy adopted in 2013[15]. The database stores information related to the fire event (location, time, cause) and to the burned area (burned area by type of vegetation cover: forest, wooded, natural or agricultural land). Information on injuries, loss of human lives and economic losses is not foreseen in the database. However, many countries estimate the economic losses on yearly basis without recording this information into the European database (e.g. the economic losses are assessed based on the value of young forest burned or as the timber value in Romania. Sources: Ministry of Environment and Climatic Changes; Department for Waters, Forests and Fishery, Romania).

1.6 PRINCIPLES FOR DISASTER LOSS DATA

Many of the drawbacks from existing loss databases arise from the violation of a few key principles. First, lack of clarity in definitions of loss indicators, leading to uncertainty on how to classify people or losses and on how to interpret data. For example, “affected population” can encompass anyone from those killed or severely injured, to people suffering minor nuisances but located far from the disasters (e.g. cancelled vacation). It is also important that people and losses are counted only once: the sum of killed, missing and injured should be unambiguous. Second, loss databases must be comprehensive. Often, loss databases only cover insured losses or only public losses; or they only cover losses for a few disaster types; or they only cover losses in a few sectors. For many purposes, what really counts is having knowledge of the total losses (even if based on extrapolation or estimates). Third, data across loss databases must be comparable. Individual events (e.g. major flood on Danube) should be unambiguously defined in all databases so data can be aggregated or compared. Using standard classifications for hazard types, geographical units and sectors is important. Finally, to make loss data useful in the future for third users, data need to be transparent and accompany by both metadata (where did the loss value come from? what method was used?) and other contextual information, including an uncertainty assessment (what is the range of uncertainty?) and a narrative.

In summary, we claim that proper disaster loss data recording should be based on the following **principles**:

[15] http://ec.europa.eu/agriculture/forest/strategy/

- **Precise** – indicator fields must have clear terminology and mutually exclusive definitions that are consistently applied.
- **Comprehensive** – the loss indicators should cover all loss/damage in terms of spatial, sectorial and loss ownership coverage in order to be an objective reflection of the extent of the disaster
- **Comparable** – Loss data are event based and therefore accompanied with the event identifier number. Disaster effects should be comparable among the event of the same hazard types as well among the events of different hazard types, across countries and across sectors.
- **Transparent** – loss values should be geo-referenced, accompanied with temporal information and an assessment of uncertainty.

1.7 Loss Recording standards versus Loss Sharing standards

The focus of this study is on minimum requirements for disaster loss data sharing.

Recording loss data is complex (see also next chapter) and a proper data recording methodology should consider local legislation, context and practices. Common guidelines and principles across the EU are desirable, yet, it is not useful and feasible to standardize this process completely. However, for sharing loss data across organisations, among EU Member States and with EU institutions and international organisations the complexities of loss data recording may be simplified in aggregate figures. This makes it feasible to agree on a common data exchange format (a standard).

One example relates to sectors. Each Member State may record disaster loss data by sector, but using a list of sectors matching their internal organisation. It would be impossible to agree on a common list of sectors, as this is linked to the countries internal political organisation. However, if data on all sectors must be shared, the internal distribution in sectors becomes irrelevant. The countries would have to add up losses across all sectors, and make the aggregate number available.

Setting sharing standards at EU level also has an enabling effect. If the loss data sharing standard specifies reporting on losses in all sectors, contributors are obliged to build loss data recording systems that are aware of sectors, making the national systems better and more useful for national purposes.

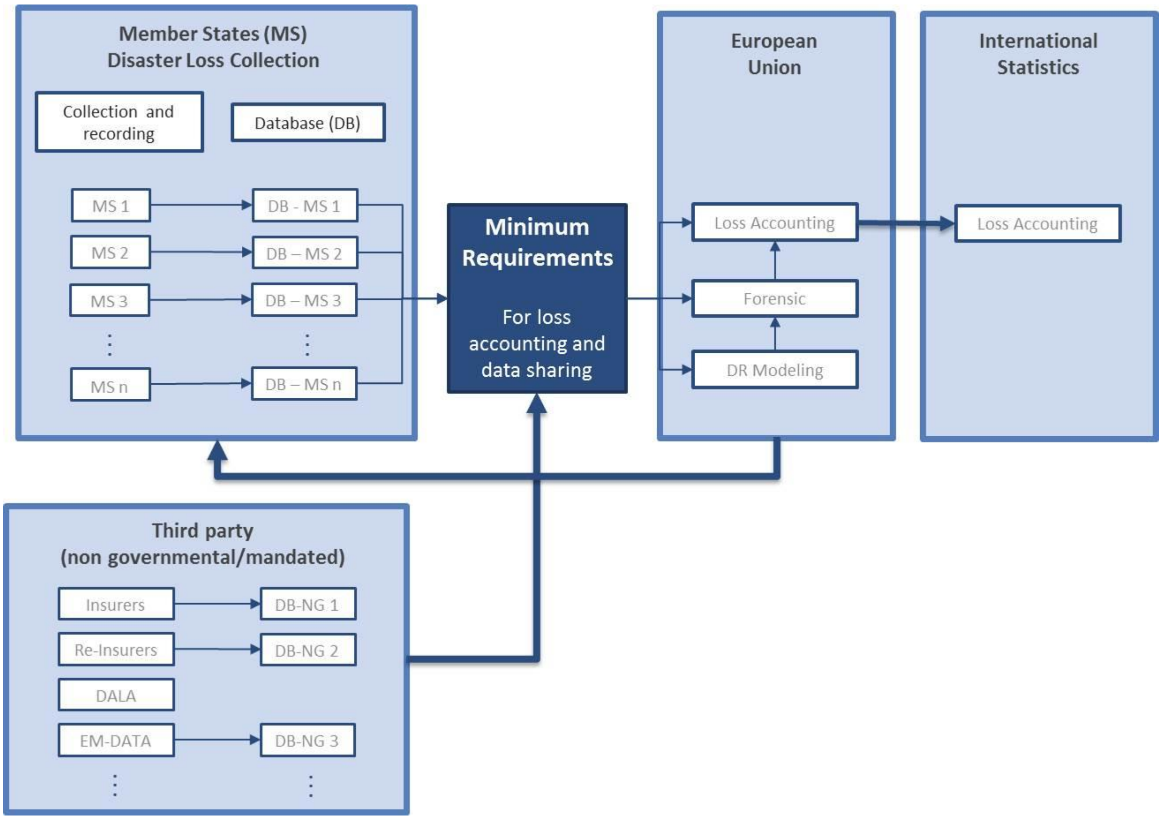

Figure 3: Minimum requirements

Figure 3 conceptualizes the processing flow from collection of loss data to evaluation for sharing and usage at European level. European Union Member States (MS) collect loss data from the field through an assessment and recording process. The loss information is captured and available in a number of national loss database reviewed in this document (Disaster Loss collection). The work in this report addresses minimum requirements for data sharing among Member States and with EU institutions and international institutions, mainly for supra-national loss accounting.

Third party organizations other than government institution may also collect loss data. For example, insurance and re-insurance companies may make available data that can be shared with the interested users. International loss databases may provide data when finer scale data are not available. International organizations may collect data for disaster needs assessment that are not typically stored in a national database. If these data satisfy the same minimum requirements for data sharing, they can be used to complement national loss data.

2 ANALYSIS FRAMEWORK: THE PROCESS OF THE DISASTER LOSS DATA COLLECTION, RECORDING AND SHARING

As in any business process, specifications of technical systems stem from high-level use requirements. To derive meaningful technical requirements for disaster loss data recording, we adopt a systems analysis[16] approach. Technical requirements for disaster damage (in physical units) or loss (in monetary units) data derive from the purpose and use of the loss database system. The purpose can be loss accounting, forensic and risk modelling, each with their high-level requirements. The high-level requirements can be broken down in a number of questions that require a response.

Once the high-level requirements are identified [17], we can clarify what information we need to generate (Figure 4). The generation of information relies on linking different information sources through a **data model**. The data model –with links to other government databases such as cadastre – will determine the data that need to be collected (Figure 4: arrow 2). Once the process is defined then questions may be answered by interrogating the database (Figure 4: arrow 4) populated by the appropriate data (Figure 4: arrow 3). The required knowledge may be generated by interrogating the database in a number of ways and then combining the results to provide the proper answer to the decision making process.

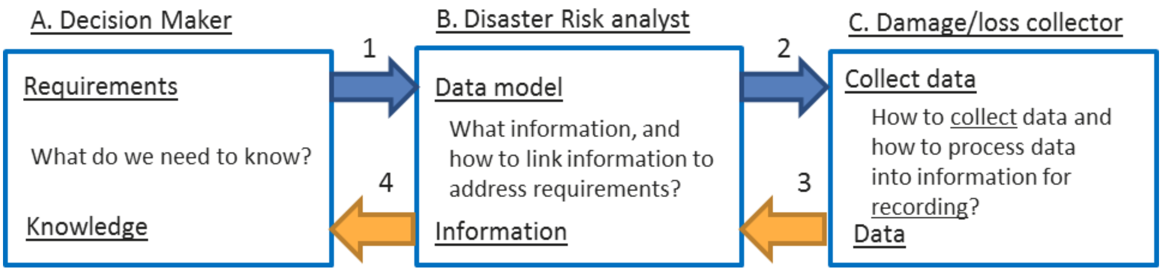

Figure 4. Requirements determine the data model that in turns determines the data to be collected

Typical questions expected to be answered using disaster loss data are:

- What perils are generating losses?
- What assets are being damaged?
- What is the degree of the damage?
- Where are losses occurring geographically?
- What are the trends of disaster damage in the agricultural sector?
- Which country has the highest exposure of the transport sector to natural disasters?
- Which region in the EU is most resilient to a 10-year flood event? And why (type of housing, protection of the river, elevation of built-up)?
- Which disaster type affects economic losses most?

[16] Systems analysis is the process of studying a procedure or business in order to identify its goals and purposes and create systems and procedures that will achieve them in an efficient way. For an introduction and further links, see http://en.wikipedia.org/wiki/Systems.

The questions above will determine the variables that need to recording and that in turn will guide the data collection/gathering process. That data flow process is depicted in Figure 4 as the blue arrow process.

The collection of data has two distinct phases supported by specific methodologies:

- Gathering data from the field (**methodology of data collection**)
- Processing, aggregating, and storing information (**methodology of recording** – arrow 3)

Generating information involves adding meaning to information by synthesising and analysing it. Knowledge emerges when the information is related back to a concrete situation in order to establish explanations and lessons learnt (Figure 4: arrow 4).

Europe might be a data rich environment, yet data may still not be sufficiently processed to derive information and knowledge for decision making. Most of the focus in Europe is still on data collection for compensation or post disaster reporting rather than for knowledge generation. Poorly planned data gathering processes results in unreliable data, which are difficult to compare and collate among different loss databases. Incompatible loss databases cannot be integrated at EU level to inform EU-wide policy.

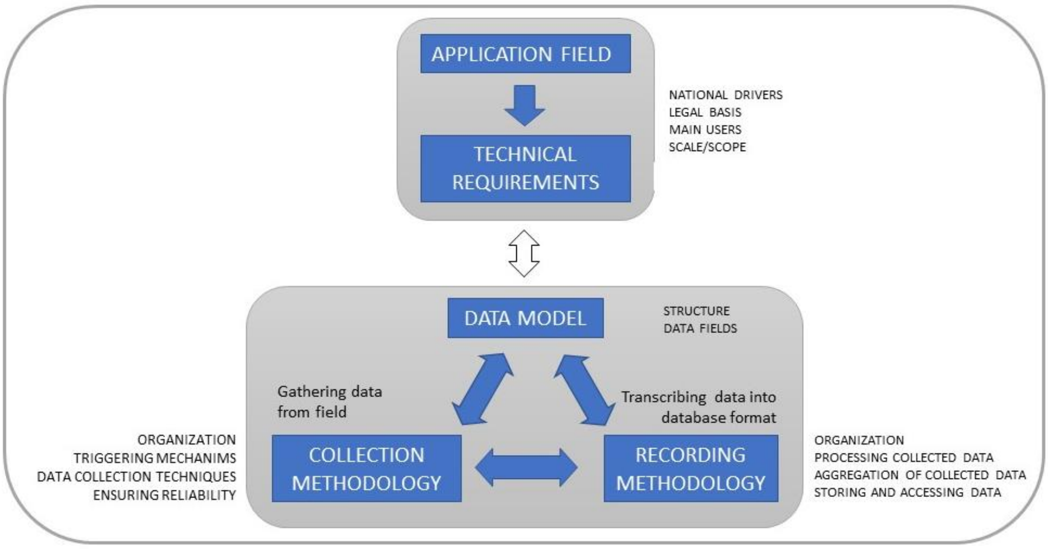

Figure 5. Disaster loss data collection, recording and sharing

The methodology for collecting data and the methodology for recording information represent two consecutive processes that are important in assuring quality, consistency and transparency of data. Both of them are based on a common data model (Figure 5). In fact, often the collecting and recording damage/loss data are carried out by the same organization.

2.1 Methodology of collection

A loss data collection methodology identifies the timing, the means and the actors. That relates to the purpose of the loss database.

- **Mandated organization: who is responsible?**
  The mandated organization may correspond to i) the local civil protection, ii) national or regional loss data collection centres and iii) hazard specific or sectorial national authorities, or iv) non-governmental actors like Non-Governmental Organizations and academic institutions. The mandated organization is responsible for establishing sufficient capacity of qualified staff, regular training of assessors to collect and achieve consistent quality of data as well as their coordination during the emergency.
- **Triggering mechanism: which events are part of the database?**
  Disaster thresholds (or entry criteria) are used to trigger the recording of damage/loss in a database. The triggering mechanism is a protocol of reporting controlled by a mandated authority and often supported by a legal instrument. Without a clearly defined triggering mechanism, there will be uncertainty on the completeness of the loss database.
- **Techniques of data assessment**
  Technical requirements for loss data identify the scale of assessing losses as well as technical details on what is assessed. Together they determine the appropriate techniques of data collection such as desk research of media reporting or government reports, sectorial field assessment, sampled surveys, official reporting mechanism such as insurance or compensation claims, police reports or emergency intervention reports and remote sensing (satellite or airborne assessments). Whichever technique is chosen, it should be compatible with the data model to ensure consistency. It is usually achieved with assessment forms prepared in advance. Assessment forms should include date and location of data assessment, name of assessor as well as the technique used beside the fields related to the loss indicators, which are described in section 2.3.
- **Ensuring reliability of information: assessing uncertainty at the source**
  The quality of the data will depends on the technique of data collection, the training level of the surveyor (e.g., familiarity with the technique, the understanding of the assessment forms, specialist background) and the capacity of staff involved in the assessment process. That quality needs to be recorded and to be saved with that data and will be determine the reliability of the data.

2.2 Methodology of recording

A methodology of recording explains how data should be stored once field data have been collected. The data need to be organised into a manageable database of pre-defined (standardized) formats and fields ready to be analysed efficiently. This involves transcribing data into a systematic format, entering the information obtained from each field assessment group or organization and organising it into one overall structured database. While this may be straightforward for techniques that use predefined forms compatible with the database, it may be more challenging for other techniques such as media-based evidence, satellite-derived information or information from non-governmental actors (e.g. insurance industry).

- **Mandated organization: who is responsible?**
  The mandated recording organization develops and maintains the information management system for storing data of different formats based on the data model. It is responsible for the training of personal to process the collected data before they are entered into the system and takes care of existing links (and compatibility) to external databases. The mandated organization may be different from the one that collects the data.
- **Processing of the collected data: data curation**
  Processing of the collected data encompasses, but is not limited to,
  - calculation of codified values of database fields accompanied with method used
  - identification of unclear or missing values that should be investigated,
  - assessment of data quality with the level of uncertainty,
  - conversion into the unit defined by methodology,
  - utilization of external references for the validation and verification process,
  - applying an event identifier to provide relations to background information which is not (primarily/necessarily) part of disaster loss database, e.g., hazard event characteristics.
- **Aggregation of collected data: data analysis**
  Aggregation of data requires an appropriate format (common denominators and definitions), rules (e.g., simple summation), available classifications (e.g., to sort assets into different sectors, NUTS[17]) as well as characteristics associated with the affected elements. The information can be scaled up from a smaller geographical unit of analysis to a larger one or even down when the phenomenon/assessment scale (damage of the infrastructure, indirect losses) is larger than the scale of reporting unit. The same process is applied when data are aggregated by different hazard specific or sectorial national authorities.
- **Storing and accessing information: IT system**
  The recording methodology must be supported by a software application that provides the basis for interacting with the disaster loss database. While the data model should capture subtle information of the technical requirements, the user interface must be able to deal with the complexity of the data model and show the searched selection as well as respect all the restrictions (e.g., privacy-related data) regarding the sharing policy.

[17] NUTS is a Nomenclature of territorial units for statistics (NUTS 1,2,3 and Local Administrative Unit LAU 1, 2) as a single coherent system for dividing up the EU's territory in order to produce regional statistics for the Community and entered into force in 2003.

2.3 Model of disaster loss database

A data model is the description of the objects together with the definition of the data fields as well as relationships among the objects. It determines the logical structure of a database, and in which format data can be stored, organized and manipulated.

It is outside the scope of this document to propose a full data model. The data model must be locally developed by the mandated organisations responsible for collecting and recording data. The model must take into account local requirements, including factors such as language, staff management, and access and security. However, we can discuss conceptually the elements of the data model that are important and that should be reflected in national data models.

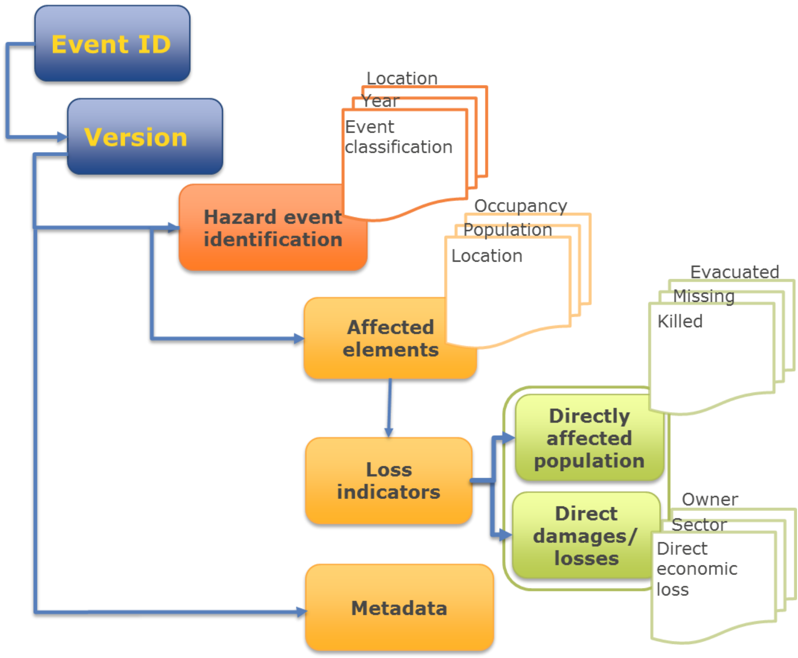

Figure 6. Conceptual data model for loss data. The loss from an event (blue) is caused by a hazard (dark orange) affecting one or more buildings, towns or regions in terms of human or economic values (light orange).

Figure 6 shows a conceptual data model used for further discussions in this document. It starts from a **disaster event**, identified unambiguously (likely with an event identifier). There may be several **versions** of loss records associated to the event, e.g. through updates and corrections (where data becomes available), temporal versions to capture event dynamics (evolution of losses), or estimates of different organisations. For each version, the loss record contains **three elements** as well as **metadata**. Metadata contains information such as entry date, author, validation status and other data fields not directly related to loss data. The three elements are hazard, affected element and loss indicators (Table 2). See [17] for a more detailed discussion on data fields and standards relevant to hazard, affected element and loss indicator data.

- **Hazard event**: a disaster loss database is an event–based database, i.e. loss data are related to a specific hazard event which should be uniquely identified (spatially and temporally), classified to provide basic summary statistics (e.g., aggregation by hazard type, year), and recorded by severity level to relate to the probability of occurrence for calculation of average annual losses.

- **Affected elements**: an affected element can be an asset (building), municipality or administrative unit, and has its own spatial location. The type of the affected element defines the associated loss indicators as well as the methodology of collection. Other pre-event characteristics of the affected elements allow even more profound analysis in all application fields, such as loss accounting by spatial unit, sectors or loss ownership; disaster forensic expertise of lessons learnt based on hazard dependent characteristics; and exact location of affected elements for risk modelling.
- **Loss indicators describing damage/loss object**: a numeric value (a quantity expressed in a unit, e.g. monetary loss in 2010 euro), class value (e.g. damage grading) or textual description (e.g. narrative) of loss. Loss indicators are dependent not only on the type of affected element (population, property/sector, natural environments) but they may also be hazard dependent, especially at asset level for the disaster forensics and risk assessment purposes. Nevertheless, at the higher scale of aggregation loss indicators should allow comparability of damage/losses among different hazard types, which requires universality and independence from the type of hazard event. For disaster forensics and risk modelling the connection of the loss indicators to hazard information is crucial. This can be done within the loss database or by links to external information sources.

Information on hazard characteristics and affected elements do not necessarily have to be included completely in the loss database but can instead refer to external databases. Such links require proper event and asset identifiers. Loss indicators are the core of the disaster loss database. Definitions of the fields, the format of their codified value (as well as a variety of information about the codified value that also needs to be collected, managed and shared to assure their quality) should follow standard definitions to provide comparability and consistency. We will discuss standards and best practices further in chapter 4.3.

Table 2: Information needs for the loss data model [17]

Data element		Standards or best practices to be considered
Hazard event identification	geographical information	Country code (ISO 3166-1 alpha-3 specification) Minimal spatial unit (NUTS classification - LAU2 level) Coordinates (latitude, longitude) of point or polygon
	temporal information	Event date and time: UTC time (h) Period: start date (dd/mm/yyyy) - end date (dd/mm/yyyy)
	hazard event classification	INSPIRE - HazardCategoryValue IRDR peril classification and hazard glossary
	event type specific attributes	Small set of severity indicators (e.g. like in GDACS) for search purposes and probability of occurrence calculation
	hazard event identification number	Modified GLIDE number, used to link to more detailed hazard databases
Affected elements	Geo-referenced exposed element	Country code (ISO 3166-1 alpha-3 specification) Minimal spatial unit (LAU2) Coordinates (latitude, longitude)

	Characteristics	General Hazard dependent
Loss indicators describing damage/loss of affected elements	Name of data field	Loss indicator
	Value of data field	Value Physical unit
	Time stamps	Date (dd/mm/yyyy) of entry and update Date of measurement and validity options for time dependent fields
	Source and source type	Types: Official emergency management agency, Official sectorial institutions, Academic and Scientific files maintained by research institutions, Media releases
	Uncertainty	Methodology to describe uncertainty (statistical, interval, estimate, etc.) Reliability of sources (different priorities, different information)

3 COMPARATIVE ANALYSIS OF MEMBER STATES

The report presents the results of analysis of Member states databases though their member states representatives (Table 3). The details of the analysis are reported in Annex 1 (section 8). The information was collected based on the guidelines discussed in Chapter 2 and the JRC report [17] and is structured as follows:

- **National drivers for loss data**: legal basis, application areas, scale and scope, main users.
- **Methodology of collection**: mandated organization, triggering mechanism, data assessment technique, quality assurance.
- **Methodology of recording**: mandated organization, processing of the collected data, and aggregation of collected data, storing and accessing data.
- **Model of disaster loss database**: structure of the disaster loss database (hazard event identification, affected elements, loss indicators), data fields with definitions and format.
- **Public communication**: open data sharing policy, risk register.

3.1 LOSS DATA NETWORK

Loss data in Europe are collected by different research and governmental institutions. More than one loss database may be available within a country. Often these loss databases are not related and serve different application areas or categories of users (i.e. governmental, academic, insurances). When a legal basis exists, the loss database is often a constituent part of the disaster risk management policy. Table 2 and Table 3 show the current EU Loss data network and other international experts who are the part of the EU Loss Data Working group.

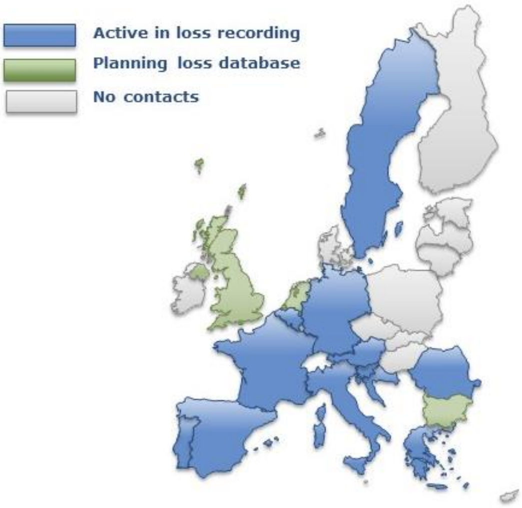

Figure 7: Current (September 2014) situation in Europe

Table 3: EU Loss data network

	Country	Contact	Database	Organization
1	Austria	Rudolf Schmidt	Yes	Federal Ministry of Agriculture, Forestry, Environment and Water Management
2	Belgium	Georges Pletinckx	Yes	FOD Binnenlandse Zaken, SPF Intérieu
3	Bulgaria	Lyubomira Raeva	Yes/No	Ministry of Interior, DG Fire Safety and Civil Protection
4	Croatia	Jasminka Dejanović	Yes	Ministry of Finance
5	France	Roland Nussbaum	Yes	MRN (ONRN)
6	Germany	Annegret Thieken	Yes	Universität Potsdam; Institut für Erd- und Umweltwissenschaften;
7	Greece	Charalampos (Haris) Kontoes	Yes	NOA/ISARS
8	Italy	Roberto Ruddari Scira Menoni	Yes No	CIMA Foundation Politecnico di Milano
9	Netherlands	Linda van den Brink	?	Geonovum
10	Portugal	João Verde	Yes	ANPC - National Authority for Civil Protection
11	Romania	Doina Hategan	Yes	General Inspectorate for Emergency Situations
12	Slovenia	Ana Jaksic	Yes	ACPDR - Administration for Civil Protection and Disaster Relief
13	Spain	Almudena Bustamante Gil	Yes	Procivil
14	Sweden	Karoline Sjölander	Yes	Swedish Civil Contingencies Agency (MSB)
15	United Kingdom	David Demeritt	No	Kings College London

Table 4: Other international experts.

	International organization	Contact	Database
1	Cambridge Architectural Research Ltd.	Emily So Antonios Pomonis	GEMECD
2	CRED (Centre for Research on the Epidemiology of Disasters)	Regina Below	EM-DAT
3	EEA (European Environment Agency)	Andre Jol Wouter Vanneuville	-
4	FEEM (Fondazione Eni Enrico Mattei)	Jaroslav Mysiak Lorenzo Carrera	-
5	ICOMOS- ICORP (International Committee on Risk Preparedness)	Xavier Romao Esmeralda Paupério	ICORP
6	IRDR (Integrated Research on Disaster Risk)	Susan Cutter	SHELDUS
7	Munich RE	Jan Eichner	NatCatSErvice
8	NOAA	Adam Smith	
9	Swiss RE	Lucia Bevere	Sigma CatNet
10	UNISDR (United Nations International Strategy for Disaster Reduction)	Julio Serje	DesInventar
11	WMO (World Meteorological Organization)	Jochen Luther	-

Based on the structured survey used in the workshops, the practices, methodologies and databases of Member States can be compared, highlighting different strengths, different applications and different standards. The second source of information is the actual loss data shared by Member States, according to commonly agreed specification[18].

The purpose of the analysis is to identify common elements within:
- Context, methodology, mandate
- Hazard identification and classification
- Loss indicators (human, economic)
- Summary statistics (aggregation)

The specific objectives are:
- Current compatibility of EU loss data inventories with international standard.
- Lessons learnt from available inventories of loss recording systems.
- Towards common structure: guidelines on methodology of recording losses.
- Identifying minimum common fields with definitions.

In the current version of the document, the analysis is limited by the partial feedback; with more feedback, a more complete analysis will be possible. According to the information provided by Member States, the tables bellow reflect a comparative state of the art.

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[18] Data:
- By municipality (if possible), or the lowest level of administrative unit available
- By event (if possible), or aggregated by year and peril type
- For the past 20 years (if possible), or as far back as possible

Human indicators:
- Fatalities (sum of dead and missing)
- Injured
- Mobilised: removed (temporarily or permanently) from their home
- Isolated: in need of emergency response, but not mobilized (e.g. without electricity or water)

Damage indicators:
- Number of damaged or destroyed
- Houses, Schools, Hospitals, Infrastructure, Crops (ha), Roads (m)

Economic indicators:
- Direct tangible losses (monetary value of physical damage to property)
- If possible: disaggregated over all sectors and all loss owner categories
- If possible: the official maximum absolute values
- If possible: with a qualification of the uncertainty of those estimates

3.2 CONTEXT, METHODOLOGY, MANDATE

The three tables below show an overview of the purpose of loss databases, the methodology for collecting loss data and the methodology for recording loss data.

Table 5: Overview of the purpose of loss databases by Member States

Purpose of loss database									
Member State	Application areas			Scale/Scope	Legal basis	Compensation scheme	Main users	Hazard types	Time period covered
	Loss accounting	Disaster forensic	Risk modelling						
AT	•	•	•	Asset/Nat	•		Federal agency for torrent and avalanches control, Ministry	Floods, avalanches, slope movements, stone fall	
BE	•			Asset/Region	•	•	Ministry	All	
BG				Asset/Nat	•		Ministry of Interior, DG Fire Safety and Civil Protection	All emergency situations based on daily reports from local units for fire safety and civil protection	1995-2014
FR	•	•		Asset/Nat			All stakeholders categories in particular policy decision makers	Specific indicators (A): Floods Storm, Hail Snow subsidence, No specific indicators so far (B level): earthquake, landslide, avalanches, …)	1995-present (last year available 2010) for specific indicators
DE		•	•	Asset/Nat			academia, consultancy	Floods	1978-present
EL	•	•	•	Asset/Nat			Ministry of Env-Directorate for Forest and Natural Env. Protection, Antiseismic Planning and Protection Organisation, Earthquake Rehabilitation Service, Civil Protection	Forest fires, Floods, Landslides, Earthquakes, Volcanoes	1978-present
HR	•			Asset/Nat		•	Ministry of Finance		2014-present
IT	•		•	Municip/Nat			Institutions, Civil Protection System, Planning Authorities	Floods, landslides	1966-2013
PT	•	•	•	Municip/Nat			Organizations under the Ministry of Internal Affairs and Ministry for Agriculture and Sea; Universities; Mass Media	All	
RO	•			Municip/Nat	•	•*	Ministry of Internal Affairs, Ministry of Regional Development and Public Administration, Ministry of	Heavy snow, frost, snow storm, floods	

							Environment and Climate Change		
SI	•	•	•	Asset/Nat	•	•	Ministry of agriculture and environment, Ministry of Infrastructure and Spatial Planning	Earthquake, subsidence, flood, landslide, avalanche, high snow, strong wind, ice or sleet, frost, drought, storm, hail and industrial accident	
ES	•	•	•	Municip/Nat	•	•	Local, regional and national institutions: University, Insurances, Engineering , Consulters, Scientifics	Flood (completed), Other natural disasters (in process)	100BC-2013
SE	•	•		Municip/Nat			National agencies, rescue services (municipal), university students, media	Storms, avalanches, landslides, rock fall, extreme precipitation, floods, coastal erosion, forest fire, extreme temperature	1950-present

*Losses are covered by natural disaster fund directly or collateral for residential building in case of floods, earthquakes and landslides

Table 6: Overview of the methodology of collection for Member States loss databases

Methodology of collection											
Member State	Common methodology of collection	Mandated organization			Triggering mechanism and entry criteria	Data collection techniques					Quality assurance process
		Mandated	Academic/Project	Private		Desk research (media, government reports)	(Sectorial) field assessment teams	Official reporting mechanism (e.g.,	Remote sensing	Intervention reports of emergency units	
AT		local mandate at provincial level or insurance sector task					•				Ad hoc (MAXO)
BE		•			Legal criteria					•	System
BG		DG Fire Safety and Civil Protection						•			System
FR	•	B level = State administration, State agencies and affiliated local authorities	•	B level = Direct insurance companies via CCR & MRN (FFSA-GEMA)	B level = Insured property losses	•		•			A level = System for specific indicator B level = specific processes
DE	Collec. forms		•		Representative cases		•		•		System (NUSAP)
EL		•	•	•			•		•		Ad hoc
HR	Collec. forms	•									
IT		Department of Civil Protection		•		•	•	•			Ad hoc
PT					The intervention of civil protection agents					•	Ad hoc
RO	•	County Inspectorates for Emergency Situation				•	•	•			Ad hoc
SI	Collec. forms	Administration for Civil Protection and Disaster Relief			Estimate of direct damage to property exceeds 0.3% GDP		•				System
ES	Collec. forms	Civil Protection Units (provincial distribution) and several agencies			Existence of damage	•	•	•	•		System
SE		different agencies			If there is something to learn from the hazard no matter size	•					System

System – systematically

Table 7. Overview of the methodology of recording for Member States loss databases

Methodology of recording												
Member State	Information management system	Mandated organization			Processing of collected data						Aggregation (scaling, dimensions)	Public Access (user interface)
					External references			Uncertainty handling				
		Mandated	Academic/Project	Private	Hazard database (e.g., USGS earthquake catalogue)	Exposure database (e.g., cadaster)	Loss data (e.g., surveys, forensic studies, assessment reports)	Level of uncertainty awareness	Reducing the uncertainty (e.g., external databases)	Dealing with imperfections		
AT	•	Austrian Service for Torrent and Avalanche Control						Some value fields		MAXO		
BE								No				
BG	•	DG Fire Safety and Civil Protection						Only for key fields				
FR	•	B level administrations acting as loss data producers	ONRN as a A level PPP agreement	B level private loss data producers	•	•	•			Qualitative	NUTS	•
DE	•		GFZ Potsdam				•	All fields		NUSAP	NUTS, sectors	•
EL	•	Ministry of Infrastructures, Transport, and Networks				•	•		Cadastre, remote sensing		NUTS, sectors	
HR	•	State Commission									•	
IT	•	Department of Civil Protection						No			NUTS	•
PT	•	National Authority for Civil protection					•	For most value fields	Ministry for agriculture, wildfire database	Storing multiple values, estimates	NUTS, sectors	
RO	•	General Inspectorate for Emergency Situations						No			NUTS, sectors	
SI	•	Administration for Civil Protection and Disaster Relief				•	•	For most value fields	register of spatial units, the business register, farm register		NUTS, sectors	

ES	•	General Directorate of Civil Protection and Emergencies					•	For most value fields	Consorcio de Compensación de Seguros and Subvenciones Database		NUTS, sectors	
SE	•	Swedish Civil Contingencies Agency					•					•

3.3 HAZARD EVENT IDENTIFICATION AND CLASSIFICATION

Hazard event identification (Table 8) allows attributing the losses to a peril. The attribution includes locational information (geographical unit of reporting), temporal (date, time, duration) and event type information.

The attribution assumes a common peril classification. This review of European Loss data uses the IRDR peril classification that was put together through international consultation to facilitate attribution [33]. The IRDR peril classification system distinguishes three levels: family, main events and perils. Based on the hazard definitions provided by Member States we can assess to what extent they are convertible to the Main Event level of the IRDR classification (Table 9).

Table 8: Overview of the hazard event identification within Member States loss databases

Hazard event identification												
Member State	Geographical location of hazard			Temporal information of hazard				Event type specific attributes			Hazard event classification (standard used)	Hazard event identification number
	Subnational units	Lat/Lon (points, footprints)	Standard used	Date and time	Period (from - to)	Month (uncertain beginning/ending)	Spatio-temporal dynamic information	All hazard data is recorded in the LD	Some key data is recorded in the LD	Reference to external database		
AT		•	ISO3, NUTS, INSPIRE, WGS84	•				•			Internal	Internal
BE	•		Property address, cadastre data	•				•			Internal	Internal
BG		•	ISO3, NUTS, LAU2, INSPIRE, WGS84, UN GeoOntology	•					•		Internal	
FR	•	•	INSPIRE, L93	•	•				•	•	Internal	Internal
DE	•	•								•	Internal	Internal

EL	•	•		•				•			Internal, INSPIRE	Only Individual records
HR	•											
IT	•	•		•	•						CRED/ MunichRE/ IRDR	Internal
PT	•	•	NUTS, ETRS89, WGS84	•				•			Internal	Internal
RO	•		country	•					•		Internal	Individual records
SI		•			•			•			Internal	Internal
ES	•		INSPIRE, ETRS89, country	•			•	•			Internal	Internal
SE	•	•	SWEREF	•					•		CRED/ MunichRE/ IRDR	Internal

Table 9: Conversion to IRDR peril classification – natural hazards only. The hazard events without any match are represented with grey stripes (Portugal has approved the proposed conversions of the perils).

MS	Hazard events as recorded by MS \ Main event classification (IRDR)	Earthquake	Mass Movement	Volcanic Activity	Flood	Landslide	Wave Action	Convective Storm	Extratropical Storm	Extreme Temperature	Fog	Tropical Cyclone	Drought	Glacial Lake Outburst	Wildfire	Animal Incident	Disease	Insect Infestation	Impact	Space Weather
AT	Floods				x															
	Avalanches		x			x														
	Slope Movements		x																	
	Stone falls		x																	
BE	Hail							x		x										
	Floods				x															
	Long duration rain							x												
	Intense rainfall							x												
	Intense rainfall with hail																			
	Tectonic movements	x						x												
	Storm							x												
	Tornado							x												
	Heavy snow							x		x										
BG	All																			
FR	Floods				x															
	Storms							x												
	Hail							x		x										
	Snow/Ice							x		x										
	Droughts												x							
	Earthquakes	x																		
	Landslides		x																	
	Avalanches		x			x														
DE	Floods				x															
EL	Floods				x															
	Forest fires														x					
	Landslides		x																	
	Earthquakes	x																		
	Volcanic activity			x																
IT	Floods				x															
	Landslides	x	x			x														
PT	Floods				x															
	Strong winds							x	x											
	Snow fall							x		x										
	Mass Movement		x			x														
	Earthquakes	x																		
	Heat waves									x										
	Cold waves									x										
	Biological																x			
	Droughts												x							
	Wildfires														x					
	Coastal flooding						x													
	Cave collapse																			
	Volcanic activity			x																
RO	Heavy snow							x		x										
	Heavy rain							x		x										
	Storms and blizzards							x		x										
	Frost									x										
	Glaze									x										
	Heat waves									x										
	Hail							x		x										
	Droughts												x							
	Natural river overflow				x															
	Rise of groundwater level																			
	Earthquakes	x																		
	Landslides		x																	
	Forest fires														x					

MS	Hazard events as recorded by MS / Main event classification (IRDR)	Earthquake	Mass Movement	Volcanic Activity	Flood	Landslide	Wave Action	Convective Storm	Extratropical Storm	Extreme Temperature	Fog	Tropical Cyclone	Drought	Glacial Lake Outburst	Wildfire	Animal Incident	Disease	Insect Infestation	Impact	Space Weather
SI	Landslides		X																	
	Avalanches		X			X														
	High snow							X		X										
	Strong winds							X												
	Ice or sleet							X		X										
	Frost									X										
	Droughts												X							
	Storms																			
	Hail							X												
	Industrial accidents																			
ES	Droughts												X							
	Earthquakes	X																		
	Extreme temperature									X										
	Heat waves									X										
	Coastal/lake floods				X															
	Flash floods				X															
	Plain floods				X															
	Valley floods				X															
	Avalanches		X			X														
	Landslides		X			X														
	Mudflow		X			X														
	Rock fall		X																	
	Collapse and subsidence												X							
	Volcanic activity			X																
	Tsunami	X					X													
	Tidal wave						X													
	Forest fires														X					
	Urban-forest fires														X					
	Hurricane											X								
	Tornado							X												
	Tropical Storms											X								
	Storms							X												
	Winter Storms							X												
	Hail							X												
	Heavy rain							X												
	Lightning							X												
	Extra-terrestrial body/meteorit																		X	
SE	Storms							X												
	Avalanches		X			X														
	Landslides		X			X														
	Rock fall		X					X												
	Extreme precipitation																			
	Floods				X															
	Coastal erosion						X	X												
	Forest fires														X					
	Extreme temperature																			
	Droughts												X							
	Storms							X												
	Hail							X												
	industrial accidents																			

3.4 Affected elements

Table 10 Overview of the affected element description within Member States loss databases

Affected elements																		
Member State	Geographical location			Population			Property - characteristics (based on standard)						Property - dimensions					
							Immovable property						Sectors			Loss Ownership		
							Building vs. Civil work			Human-made landscape environment								
	Only hazard is geo-referenced	Subnational units	Lat/Lon (point, footprint)	Age, gender, marital status, education	Risk category (e.g., ECLAC)	Operative CPU	Structure type and use	Structural properties (material, age, stories, size)	Hazard specific structural characteristics	Land cover/Land use classification	Properties (area)	Movable property (vehicles, crop, livestock, products)	Sectorial approach like ECLAC and Solidarity Fund	Mapped to national governmental departments	Other	Public	Individual/business	Insurance
AT	•												•	•				
BE		•		•											•			
BG			•	•			•					•	•				•	•
FR		•						•										•
DE		•	•	•					•	•	•	•				•	•	•
EL		•	•					•								•	•	
HR		•																
IT		•	•															
PT	•			•		•	•					•			•	•	•	
RO		•			•		•					•		•				
SI		•	•				•	•				•	•	•		•	•	
ES		•					•					•		•				
SE	•															•		

3.5 LOSS INDICATORS (HUMAN, ECONOMIC)

Table 11: Overview of the existing loss indicators within Member States loss databases (For the definitions of terms, it is recommended to refer to [17]).

Loss indicators													
Member State	Affected Population							Damage/Loss					
	Directly					Indirectly	Based on standard	Direct (destruction of physical assets)			Indirect (changes to econom. flows)		Total loss (in monetary value)
								Tangible		Intangible (cultural heritage, natural env.)	Tangible	Intangible (loss of future usage)	
	Killed	Missing	Injured	Evacuated	Others			Physical damage	Monetary loss				
AT							Internal	•					
BE									•				
BG	•		•					•					
FR	(B) •	(B) •	(C) •	(B) •	Major events only	(C) •		(B) •	(A) •	(C) •	(C) •	(C) •	
DE								•	•	•			
EL	•							•	•				
HR								•					
IT	•	•		•	Homeless, victims, affected		UNDP/UNISDR (DesInventar)	•					
PT	•		•		Assisted		Internal	•	•				
RO	•	•	•	•	Affected and Total		Internal	•	•		•		•
SI	•		•		Rescued			•	•		•		•
ES	•	•	•	•	Victims, sheltered, confined, damaged		Internal	•	•				
SE	•	•	•	•	Isolated		UNDP/UNISDR (DesInventar)	•		•	•		

3.6 STRENGTHS AND CONCERNS

Based on the contributions from 15 Member States, the main findings of this study indicate that:

- **12 out of 15 participating Member States** have established and maintained a loss database (public or semi-public). France, Germany (partial access), Greece, Italy and Sweden have publicly accessible national disaster databases. Austria, Croatia, France, Greece, Italy, Portugal, Romania, Slovenia and Spain regularly update their disaster databases. France, Greece, Portugal and Slovenia have countrywide and multi-hazard loss databases, some of them supported by legislation and strong mandate (Slovenia). Belgium, Germany, Italy and Spain have databases with partial loss recording (e.g. disaster-specific, limited to floods).
- Croatia, UK and Netherlands do not have a national loss database, and Bulgaria is in the process of establishing one. Belgium is in the process of devolving the national database to separate regional databases.
- The processes of loss data collection (measuring loss) and recording (storing data in a structured database) significantly differ across the surveyed countries. There is a **lack of guidelines and standards** for loss data collection and recording, in particular for **human and economic losses**, which prevents data from being shared in a comparable way between the surveyed countries and from being aggregated at EU or global level.
- **IT systems supporting the loss data recording vary significantly** across Member States. Some are simple tables and others are federated database systems across various governmental levels or integrated systems linked to other governmental databases (e.g. cadastre, insurance records, hazard database)
- The terminologies used for **peril classification** and the types of loss indicators also vary between the countries but are compatible, which allows their translation into a common classification system and methodological framework.
- The **drivers for disaster loss data recording** are mainly linked to (PPP/semi) public national compensation schemes (Belgium, Croatia, France, Slovenia, Spain, Sweden), existing EU or national legislation (e.g. EU Flood Directive or Solidarity Fund) and improving prevention and response mechanisms (e.g. Austria for landslides, avalanches and flash floods; Italy for flood management in Umbria and Sicily).

Table 12 provides an overview of the main strengths and weaknesses that could be distilled from the information provided by Member States.

Table 12. Overview of the main strengths and weakness of national disaster loss databases

Member State	Strengths	Concerns
AT	- Handling of uncertainty even if not for all the fields - Use of spatial-related data (e.g. cadastre, aerial images, etc.) - Use of expert-opinion related data	- It is not possible at this stage to obtain standardized loss reports at the national level. - Absence of standards for insuring consistency of loss data at the local level.
BE	- Publication of summary statistics (at the several aggregation levels) to the public.	- The database does not include information on small events. Only events that are officially recognized as disasters are included. - Only summary reports are available to the public.
BG	NA	- There is no national system to record systematically disaster losses. - There are also no common indicators and standards to collect data regarding human, material and economic losses.
HR	- On-going implementation of an information system for managing and storing loss data by sector and property type.	-There are also no common indicators and a methodology for recording and accounting data losses.
FR	- Open-source data sharing platform with structured access to databases accessible, to all public and private stakeholders. - Possibility to derive information for a set of indicators (including losses) at municipality level or departement level - Provision of lessons learnt reports. - Existence of a quality assurance process for delivering the indicators. - Indicators are accompanied by a metadata file compliant with the European INSPIRE directive. - Indicators are very well documented (definition, uncertainty, limitations of use, etc.). - Existence of a public on-line cartographic tool for mapping the indicators	-The specific indicators are, so far, only insured losses (and asset exposures) - The recorded hazard types for deriving the specific indicators are limited to three main hazard types.
DE	- Use of computer-aided telephone interviews for data collection. - Existence of quality standards - Existence of standards for flood damage assessment, developed by sector. - Data collection is performed according to a detailed survey procedure. - The database contains two types of attributes: Minimum attributes (minimum standard) and core attributes (not essential but important)	- The database is not aimed at loss accounting but only at damage function development - It covers flood damage only (pluvial and fluvial damage), - The coverage of flood events is incomplete: it is not possible to aggregate from asset level to municipality level.

		- Only a part of the database can be searched and accessed by the public via the internet.
EL	- Damage data is collected based on an exhaustive field work. - Loss data can be aggregated at the regional or national levels. - Use of spatial data linked to the damage records (cadastre, satellite/aerial images). - Collection of environmental information (slope, forest density, etc.) and meteorological data related to the fire event (humidity, wind, etc.)	- The database covers fire events only. - No information on quality assurance procedure.
IT	- Collection of databases federated at the national scale. - Use of DesInventar standards - Loss indicators are defined by sectors - The data can be consulted through the Flood Catalogue portal	- Loss/Damage indicators for assets are graded on a qualitative scale - No information on quality assurance procedure.
PT	- Quality assurance is performed through a referencing to external databases - The hazard event classification of hierarchical (family, group and events). - Existence of a detailed definition and classification of human loss indicators and damage/loss indicators.	- Loss data collection after emergencies is not mandatory for database insertion. - There is not a field assessment methodology for loss data recording. - Database records are not readily accessible to the public
RO	- Data model terminology is defined by the legislation. - Property assets are classified into different sectors. - Loss indicators are converted to monetary value by a dedicated commission of experts.	- Legal definition exists only for severe weather and flood events - The database is available only to authorities.
SI	- Existence of a binding legislation for damage evaluation, - Broad usage of the database by different institutions and for different purposes: research, urban planning, risk management, etc. - There are dedicated trained commissions for the collection of damage data - Damage assessment is performed according to a standard procedure including damage forms appropriate to the type of affected asset. - Quality assurance is performed on the basis of an inspection. - The database is a multipurpose tool. - Use of external data sources (e.g. land cadastre, register of buildings, etc.).	- The database contains links to external registers and privacy related information making it inaccessible to the public.

	- There a detailed definition of damage, loss indicators and hazard types. - Loss indicators are defined in the context of a standardized economic loss estimation based on a continuously updated price lists	
ES	- Database includes historical and present events - Contrast analysis between historical information and meteorological and hydrological forecast systems during emergency situations, giving support for flooding emergency management - Cross-checking of the received data with official reports. - Annual validation of the recorded data. - Inclusion of climate/hydrological data for describing the flood event. - Existence of an internal human loss indicator framework. - Includes geo-referenced loss data records.	- Database limited to floods - Information contained in the database is available upon request
SE	- Broad usage of the database (research purposes, crisis management, risk analysis, etc.) - Hazard type based on hazard classification standard: CRED/MunichRE/IRDR - Use of DesInventar for the human loss indicators - All material is publicly shared	- There is no common methodology of collection neither clear entry criteria. - Lack of coherent harmonization of investigation and reporting approaches. - Uncertainty is handled for all the fields in narrative format. - Information on hazards is updated every one to two years. - Economic losses are provided by insurance companies and the database doesn´t show the methodology used.

3.7 SUMMARY STATISTICS

For most purposes at national or international level, summary statistics as required. To test the ability of current databases to provide these, the Member States and JRC agreed to share data for the following four reports:

- Loss for the whole country by hazard type from 2000 to 2014 (format: graph)
- Flood (or another hazard type) loss from 2000 to 2014 per NUTS2[19] level (regions, provinces or districts) by loss owner (format: a series of maps). Loss owner categories are: government, business, individual, and insurer.
- Loss for the whole country by sector and by year (format: table)
- List of top 10 municipalities by loss in 2010 (format: table)

Similar analysis can be done for the number of hazard events and human loss indicators. Possible dimensions then are hazard type, year and NUTS2. The most useful aggregated statistics at EU level will need to be identified and agreed on by all Member States. This may be a useful next step of the EU Loss Data Workgroup.

Summary data (aggregated by different dimensions) are useful for the trend analysis but with the aggregation process they lose the relation with the specific events. As such, they are not useful anymore for the calculation of the average annual losses that are often used as a part of the cost-benefit tool for disaster risk management. Actual losses are the losses actually experienced in the event and take into account the unique features of the event and measure the severity of the event by its impact.

[19] EUSF's definition of regional natural disaster and conditions of the activation of the Fund is set at NUTS2 level [15].

3.7.1 SHARED DATA

Table 13 shows which Member States shared their data and the structure of their data. At this point, it should be considered that JRC already hosts a loss database of forest fires in Europe called European Forest Fire Information System (EFFIS)[20]. The summary statistics consider the terminology of the Member States provided in Annex 1: State of the art in the member states. For the time being, we were not able to establish common terminology due to lack of exact definitions of data fields of provided loss databases. The shared statistics are not considered as comprehensive and thus cannot be used to have a complete overview of losses. In the following, we chose to show some examples of the statistics provided by Member States to illustrate the type of data that can be shared following the minimum requirements set up in this document.

Table 13: The structure of loss databases shared by Member States

Shared loss databases												
Member State	Dimensions						Hazard types	Human indicators	Damage indicators	Economic indicators (monetary value)		
	Event	Year	Hazard type	NUTS	Sector (for property)	Loss ownership (for property)				Direct loss	Indirect loss	Total loss
AT	•	2005-2014	•	•			Slope movements, stone fall, avalanches, floods			•		
BE	•	1993-2013	•	•	•		Hail, floods, Storms, heavy snow, tornado, heavy rain, tectonic movements	•	•	•		
BG	•	2000-2013	Only fires	•			Fires	•				

[20] http://forest.jrc.ec.europa.eu/effis/

FR		A level 1995-present (2010 last year available) B level Longer periods	•	INSEE code[21]		A level Only insured losses B level More details	A level Floods, Subsidence, storms B level Other hazards	• B level For major events only	• A and B levels	•	•	•
DE[22]	•	1978-2006	•	•	•		Floods			•		
IT	•	1966-2012	•	•			Floods, landslides	Fatalities	Agriculture, live stocks, public and private properties			
PT		2006-2014	•	Districts, Municipalities (LAU1)[23]				Deaths, severely injured, not severely injured, assisted, others, total, operative victims, non-operative victims				
RO	•	2012-2014, 2008*-2013* (others)	•	•	•		Floods, Heavy snow, Others*[24]	Deaths, injured, isolated, missing, saved, total evacuated (moved to relatives/ dedicated shelters/ local administrations buildings)				
ES	•	1-2010	•	•	•	•	Floods	Deaths, injured, evacuated	Buildings, Infrastructure, Industry, Public services, Agriculture/ Livestock	•		
SI		2007-2014	•				Droughts Floods Sleet Storms with hail					•
SE	•	1999-2014	•	•			Falling rocks/landslides, Flooding of watercourse, storm damage,	Fatalities, major injuries, minor injuries	Environmental damage			

[21] INSEE codes (known as COG) are given to various administrative units, notably the French communes (they do not coincide with postcodes). The 'complete' code has 8 digits and 3 spaces within, but there is a popular 'simplified' code with 5 digits and no space within: 2 digits (département) and 3 digits (commune) for the 96 départements of Metropolitan France. Within NUTS classification, NUT2 unit equals departments and LAU2 to commune.

[22] http://ig1-dmz.gfz-potsdam.de:8080/howas21/

[23] Administratively, Portugal was divided into districts (distritos), municipalities (municípios or concelhos) and civil parishes (freguesias). While NUTS hierarchy is defined as NUTS1 (national), NUTS2 (regions), NUTS3 (subregions), LAU1 (municipalities) and LAU2 (civil parishes). Regions are the Portuguese NUTS2 subdivisions, based not at the district level, but at the municipal one, leading to large inconsistencies between district and region limits.

[24] Managed by different national authorities.

3.7.2 SUMMARY STATISTICS: BELGIUM

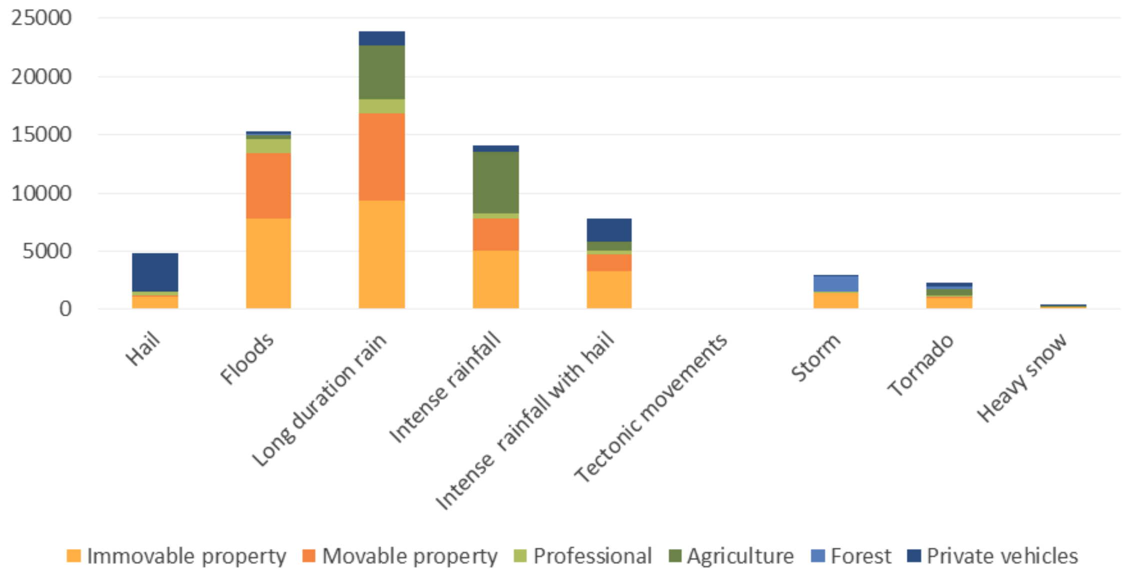

Figure 8: Belgium- Number of affected properties by hazard between 1993 and 24/09/2013 (data source: http://www.calamites.be)

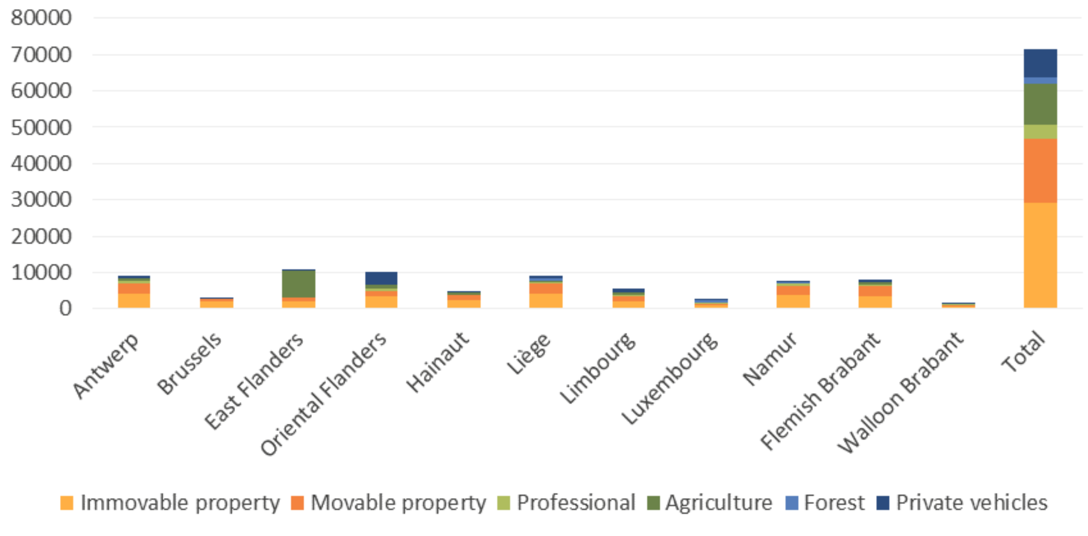

Figure 9: Belgium- Number of affected properties (NUTS2 level) between 1993 and 24/09/2013 (data source: http://www.calamites.be)

Table 14: Belgium- Economic Loss in Euros (NUTS2 level) between 1993 and 24/09/2013 (data source: http://www.calamites.be)

Province	Immovable property	Movable property	Professional	Agriculture	Forest	Private vehicles	Total
Antwerp	13962444	3496306	5070856	19903846	29450	546156	43009058
Brussels	2209017	524618	398630	0	0	160380	3292645
East Flanders	5893735	971079	1564547	92150231	3686	66630	100649908
Oriental Flanders	12328576	1728221	5906053	15744338	34292	4589113	40330593
Hainaut	7908326	1318655	983714	4129527	423689	225134	14989045
Liège	11729634	2868842	2200459	1929436	4668340	1182643	24579354
Limbourg	7739746	1408560	3994271	16464375	536280	1542177	31685409
Luxembourg	4962179	549095	1317233	113603	5095540	17085	12054735
Namur	13343287	3284843	3901487	385091	4400974	310937	25626619
Flemish Brabant	10299235	3534588	5817736	17933272	343109	225980	38153920
Walloon Brabant	1936683	490530	234652	981330	158278	179877	3981350
Total	92312862	20175337	31389638	169735049	15693638	9046112	338352636

3.7.3 SUMMARY STATISTICS: BULGARIA

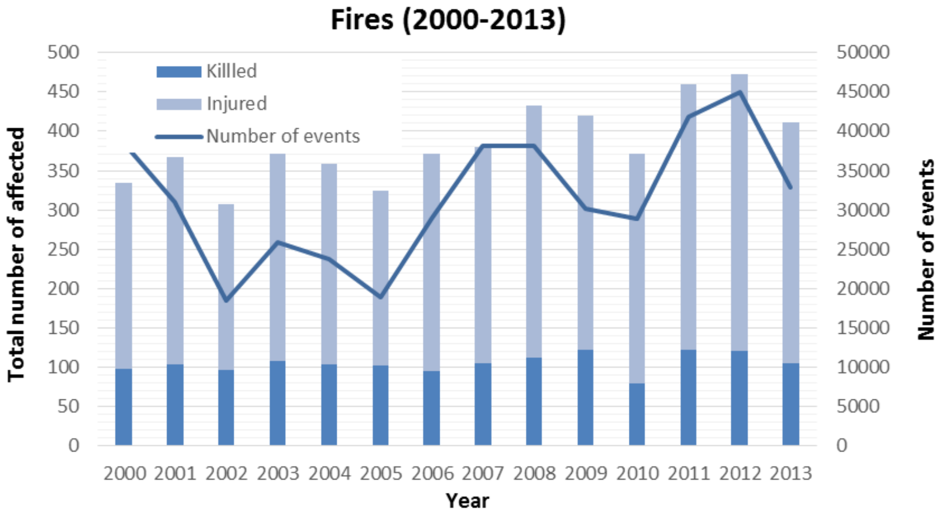

Figure 10: Bulgaria- total number of killed and injured by fires and number of events

Table 15: Bulgaria- number of killed and injured by fires for the period 2000-2013

NUTS2	Killed	Injured
Severozapaden	226	417
Severen tsentralen	202	400
Severoiztochen	183	518
Yugoiztochen	187	509
Yugozapaden	412	1235
Yuzhen tsentralen	264	832

Table 16: Bulgaria- List of top ten provinces (NUTS3 level) by total number of killed and injured by fires in 2013

No	NUTS3	Total number of killed and injured
1	Sofia City	64
2	Varna	50
3	Plovdiv	48
4	Burgas/Haskovo	23
5	Veliko Tarnovo	17
6	Vratsa	15
7	Shumen	14
8	Blagoevgrad	13
9	Pernik	12
10	Pleven/Yambol	11

3.7.4 SUMMARY STATISTICS: FRANCE

ONRN (LEVEL A) provides only cartographic statistics of cumulated insured loss data (intervals) at the municipality grid (in maps or tables) for floods over the period 1995-2010 (at the department grid – CRESTA zones for France - for storm losses): e.g.
Map accessible on the link http://www.onrn.fr/site/rubriques/indicateurs/cartographie.html by ticking (left part of the screen) under "*Inondations*" the line "*coût cumulé des sinistres*"

LEVEL B

The following table and diagram are examples of loss data made available from CCR and/or FFSA-GEMA through MRN.

Catégorie d'assurance	Exercice de survenance	Désignation de l'événement / mois de survenance	Nombre de décès	en M€ constants*
Cat Nat	1988	Inondations Nîmes / octobre	10	620
Cat Nat	1989 à 2002	Subsidence	0	4 910
Cat Nat	1990	Inondations de Besançon / février	0	302
Tempête	1990	Tempête Daria / février	21	2 647
Incendie	1990	Incendie usine de fabrication de produits chimiques / février	0	147
Incendie	1990	Incendie dans un entrepot / août	0	141
Cat Nat	1992	Inondations Vaison la Romaine / septembre	47	450
Incendie	1992	Explosion raffinerie de la Mède/novembre	6	687
Cat Nat	1993	Inondations Bouches du Rhone / septembre	10	234
Cat Nat	1993	Inondations du Rhone / octobre	0	342
Cat Nat	1993-1994	Inondations du Nord / décembre-février	10	198
Incendie	1994	Explosion centrale de chauffe/mars	1	119
Cat Nat	1995	Inondations du Nord / janvier-février	15	589
Incendie	1996	Incendie du Crédit Lyonnais / mai	0	399
Incendie	1996	Incendie d'Eurotunnel / novembre	0	277
Cat Nat	1999	Inondations de l'Aude / novembre	36	453
Cat Nat	1999	Inondations Tempête Lothar et Martin / décembre	0	266
Tempête	1999	Tempête Lothar et Martin / décembre	92	10 724
Cat Nat	2000	Inondations de Bretagne / décembre	0	105
Incendie	2001	Explosion usine AZF /septembre	31	729
Cat Nat	2002	Cyclone Dina, Réunion/janvier	0	128
Cat Nat	2002	Inondations du Gard / septembre	24	994
Cat Nat	2003	Inondations du Rhône / décembre	7	917
Cat Nat	2003	Subsidence *(hors victimes de la canicule)*	0	1 944
Cat Nat	2004-2010	Subsidence	0	685
Cat Nat	2005	Inondations Gard - Hérault / septembre	2	115
Cat Nat	2007	Cyclone Dean Guadeloupe / août	2	217
Incendie	2008	Incendie d'Eurotunnel / septembre	0	217
Cat Nat	2008	Inondations du Centre-Est / novembre	0	174
Tempête	2009	Tempête Klaus / janvier	11	1 824
Tempête	2009	Tempête Quinten / février	1	217
Cat Nat	2010	Inondations Tempête Xynthia / février	53	780
Tempête	2010	Tempête Xynthia / février	0	769
Cat Nat	2010	Inondations du Var / juin	25	644
Cat Nat	2011	Inondations du sud de la France / novembre	2	215
Tempête	2011	Tempête Joachim / décembre	0	200
36		Total tous événements > 100 M€ de la période	406	34 380
1,5		*Moyenne annuelle tous événements*	*17*	*1 433*
Tempête		Total événements > 100 M€ constants depuis 1988	125	16 381
Tous evts CatNat		Total événements > 100 M€ constants depuis 1988	243	15 283
CatNat Subsidence		Total événements > 100 M€ constants depuis 1988	0	7 540
CatNat Inondations		Total événements > 100 M€ constants depuis 1988	241	7 399
CatNat Cyclone		Total événements > 100 M€ constants depuis 1988	2	344
Technologique		Total accidents > 100 M€ constants depuis 1988	38	2 716

Table 11: France – Number of killed people (1988-2011) and total economic loss by hazard type

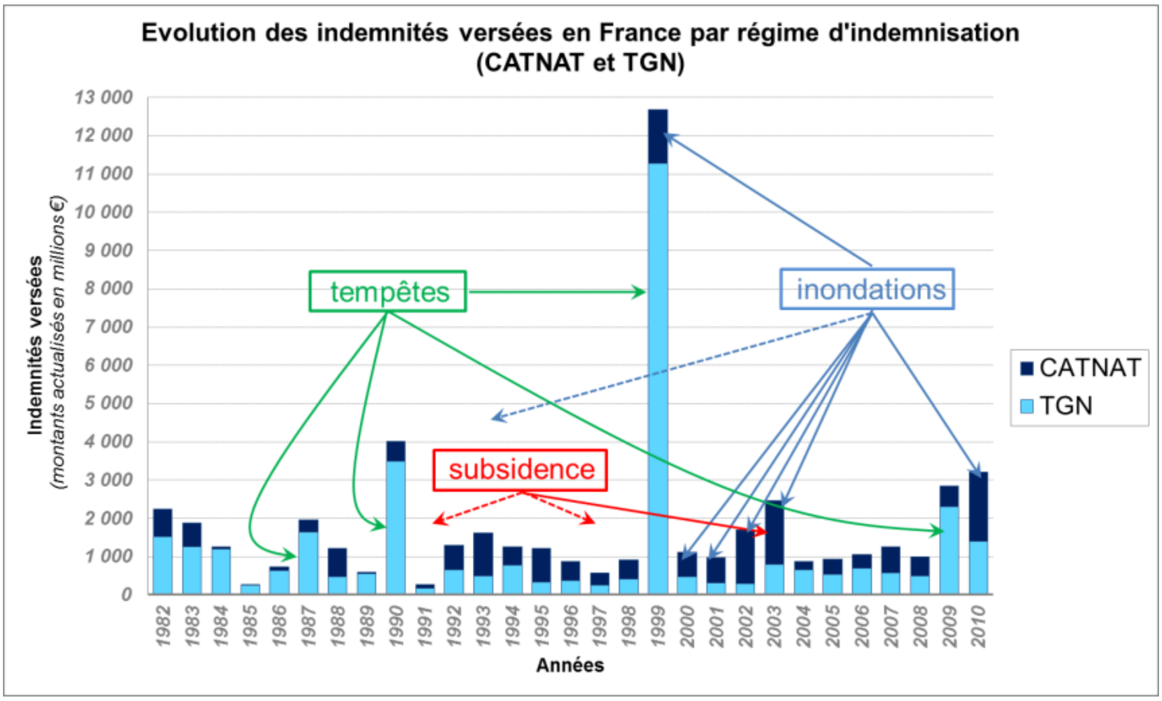

Figure 17: France – Evolution of compensations between 1982 and 2010 according to the compensation system (CATNAT and TGN (Tempête, Grêle et Neige))

Moreover, CCR and/or FFSA-GEMA through MRN might be able to provide estimates of cumulated insured losses, split per hazard (floods, subsidence, windstorm), over a period of time since 1995

- at country level
- for the most affected municipalities,

3.7.5 SUMMARY STATISTICS: PORTUGAL

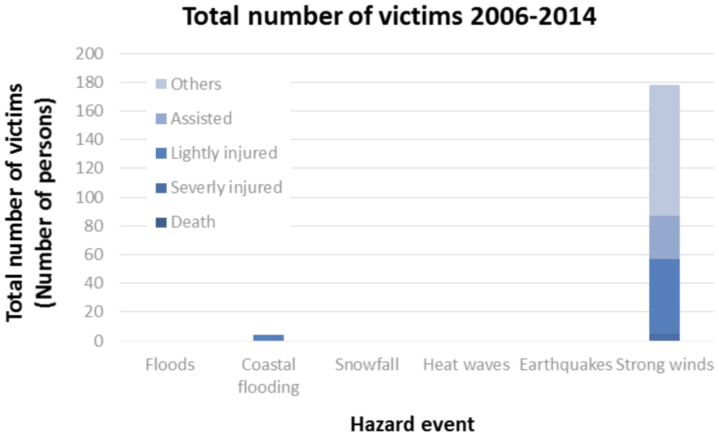

Figure 12: Portugal – total number of victims (2006-2014) by natural phenomena broken down by severity

Table 18: Portugal – total number of victims by year and by hazard families

	Total number of victims									
Hazard families	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
Mixed Hazards	790	437	573	828	1089	1147	683	1019	193	6759
Natural Hazards	0	0	7	0	57	0	57	0	61	182
Protection and Assistance	16054	18134	22401	19009	19484	19468	20359	19237	8903	163049
Technological Hazards	37570	48040	44432	45612	44394	40929	37356	37729	16670	352732
Total	54414	66611	67413	65449	65024	61544	58455	57985	25827	522722

Table 19: Portugal – total number of victims by year and by natural phenomena

	Total number of victims									
Natural Hazards/Natural Phenomena	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
Floods	0	0	0	0	0	0	0	0	0	0
Coastal flooding	0	0	0	0	0	0	0	0	4	4
Snowfall	0	0	0	0	0	0	0	0	0	0
Heat waves	0	0	0	0	0	0	0	0	0	0
Earthquakes	0	0	0	0	0	0	0	0	0	0
Strong winds	0	0	7	0	57	0	57	0	57	178
Total	0	0	7	0	57	0	57	0	61	182

Table 20: Portugal – top 10 municipalities by total number of victims for natural phenomena

		Total number of victims 2006-2014						
No.	Municipality	Floods	Coastal flooding	Snowfall	Heat waves	Earthquakes	Strong winds	Total
1	FARO					0	57	57
2	PAREDES						57	57
3	TOMAR						48	48
4	FERREIRA DO ZÊZERE						9	9
5	SANTARÉM	0					7	7
6	PORTO		4					4
	Total	0	4	0	0	0	178	182

3.7.6 SUMMARY STATISTICS: ROMANIA

Table 21: Romania- Total loss by hazard type and by year

Hazard type	Total economic loss (in millions lei)											
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	TOTAL
Floods	91	143	2681	312	2790	1210	936	1854	61	2153	899	13130
Landslides	0	0	0	103	40	60	128	10	80	0	0	421
Earthquake	0	0	0	0	0	0	0	0	0	0	0	0
Severe weather phenomena	0	0	0	14	927	372	333	434	430	539	626	3675
Forest fires	26	91	46	128	810	404	1061	136	1466	7424	448	12040
Total	117	234	2727	557	4567	2046	2458	2434	2037	10116	1973	29266

3.7.7 Summary statistics: Slovenia

Table 22. Slovenia: total economic loss by hazard type and by year

Hazard type	Droughts	Floods	Sleet	Storms with hail	Total
2007		186 398 862,20			186 398 862,20
2008				82 454 415,79	82 454 415,79
2009				16 826 170,47	16 826 170,47
2010		220 914 845,30		3 317 996,35	224 232 841,65
2011				2 328 423,22	2 328 423,22
2012	56 165 261,59	310 908 750,01			367 074 011,60
2013	106 152 002,81				106 152 002,81
2014			429 415 980,17		429 415 980,17
Total	162 317 264,40	718 222 457,51	429 415 980,17	104 927 005,83	1 414 882 707,91

3.7.8 Summary statistics: Spain

Table 23: Spain: total economic loss by sector and by year for floods

Total economic loss [Pesetas]						
Sectors/Year	Residential	Infrastructure	Agriculture and Livestock	Industry	Public services	Total
1992	0	279,707,485	25,000,000	36,637,500	129,670,000	471,014,985
1993	0	200,000,000	10,000,000	20,000,000	0	230,000,000
1994	33,534,236	2,736,437,955	72,155,748	30,014	386,146,441	3,228,304,394
1995	785,681,896	955,474,281	93,121,175	2,288,541,469	1,007,643,754	5,130,462,575
1996	325,839,018	2,149,167,701	1,079,431,526	1,326,238,000	848,828,641	5,729,504,886
1997	1,137,734,255	5,105,497,006	7,439,360,367	1,726,482,598	2,776,301,636	18,185,375,861
1998	200,000,000	66,147,959	87,812,020	0	272,672,958	626,632,937
1999	272,989,346	396,505,198	54,200,918	0	59,644,782	783,340,244
2000	5,937,525,166	11,902,757,735	8,020,208,351	1,620,719,391	11,179,231,604	38,660,442,247
2001	1,225,259,593	6,140,945,319	3,080,073,615	268,346,288	4,396,241,111	15,110,865,926
2002	0	200,000,000	0	0	0	200,000,000
Total	9,918,563,510	30,132,640,639	19,961,363,720	7,286,995,260	21,056,380,926	88,355,944,055

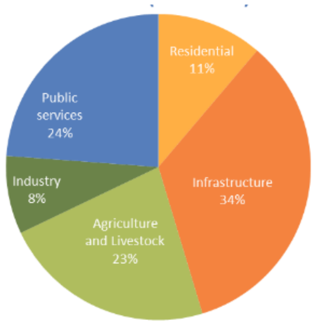

Figure 13: Spain- total economic loss (1992-2002) disaggregated among sectors

Table 24: Spain – top 10 municipalities by total economic loss (1992-2002)

No.	Top 10 municipalities	Total economic loss 1992-2002 [Pesetas]
1	Totana	2,834,961,594
2	Ourense	2,329,727,472
3	Alcora/Alcora, L'	2,150,000,000
4	Albolote	1,991,057,500
5	Lerma	1,629,000,000
6	Sarria	1,600,000,000
7	Ecija	1,580,391,990
8	Carcaixent	1,481,164,397
9	Cartagena	1,381,364,781
10	Algar de Palancia	1,352,430,532

4 GAPS AND ASPIRATIONS

This section is forward-looking: given the state of the art in EU Members States, what are the perceived weaknesses and gaps, and what are the options to address these in a realistic way. In which areas is collaboration between Member States desired, and what will the benefits be for Member States and the EU as a whole?

4.1 LEGAL FRAMEWORKS (INCLUDING EXISTING NATIONAL LAW AND EU REGULATIONS)

The establishment of national loss databases is guided by the overall institutional and legal context of disaster risk reduction within Member States and at the EU level. An examination of the information provided by Member States finds that only Austria, Belgium, Bulgaria, Romania, Slovenia, Spain and Sweden have binding legislation.

However, this does not guarantee the development of a loss database and funds for its maintenance and does not cover the establishment of standards or guidelines for loss data recording. There is a need for a sustained engagement at country level in order to institutionalize the collection and recording of loss data following a common and agreed methodology. In addition, a mechanism for public investment must be put in place to insure the maintenance of loss databases.

Neither is legislation required to have loss databases. France, Germany, Greece, Hungary, Italy and Portugal claim that loss data is not supported by legislation. While few of these countries have complete all-hazard loss databases, some have high quality databases. In France, the disaster aid and compensation is a public-private partnership with the insurance industry and the loss database is a result of that partnership.

In addition to national/regional legislations, the legal instruments of the EU (detailed in section 1.3) relating to DRR and loss data sharing can influence decisions, even at local level:

1) The EU disaster prevention framework [11]
2) The European Union Solidarity Fund (EUSF) [16] [22]
3) The reformed Union civil protection legislation [18]
4) The Council conclusions on Further Developing Risk Assessment for Disaster Management within the European Union [12]
5) The Floods Directive [21]
6) The Green Paper on the insurance of natural and man-made disasters [24]
7) The EU Strategy on adaptation to climate change [3]
8) The State aid regulation [47]
9) The Solidarity clause of the European Treaty [47]

These legal instruments stress the need for comparable loss data, (eventually aggregate data collected from insurance companies), including visualization and mapping tools that can be shared with public sector agencies, the researchers and the private sector to improve risk assessment. They also encourage the development of systems, models and methodologies for collecting and sharing loss data. They provide a framework to what can be done by the European Commission and opportunities to establish loss databases across all the EU Member States. However, there is currently no specific EU legislation addressing disaster loss databases.

4.2 IMPLEMENTATION MECHANISMS (ROLE OF PPP; PUP)

There are several funding mechanisms for the implementation of national loss databases that help in covering the expenses of creating the database, populating it and maintaining it.

4.2.1 PUBLIC FUNDING

Most loss databases in Europe are maintained with public funding. Some are quite small efforts while others are part of core government processes (e.g. compensation).

4.2.2 PUBLIC PRIVATE PARTNERSHIP (PPP)

Broadly, Private-Public Partnerships (PPP) refer to arrangements between the public and private sectors whereby some of the services that fall under the responsibilities of the public sector are provided by the private sector, with clear agreement on shared objectives for delivery of public infrastructure and/ or public services [25]. The EU recognizes the importance of PPP as a critical instrument for risk prevention. The Green Paper on Insurance of Natural and Man-Made Disasters is a step to the development of PPP policy on insurance of disasters [24].
At the national level, Mission Risques Naturels (MRN) in France, is an example of an initiative taken by all members of the national insurance market to participate in risk knowledge and awareness raising development, in the formulation of disaster prevention policies and to provide a technical interface between insurance association and public authorities at the national, European and territorial level. The developed PPP with CCR, state and territorial authorities on information sharing (ONRN agreement), is considered as a good practice and a model to be reproduced because it allowed more systematic and an improved loss recording, which reinforced the insurance strategic role in disaster loss recording and data sharing.

4.2.3 PUBLIC PUBLIC PARTNERSHIP (PUP)

In the narrowest sense Public-Public Partnerships (PuP) entail cooperative arrangements between two or more public entities, i.e. public authorities and other institutions, publicly owned, managed and financed and subjected to public control and oversight [3].
In the context of natural disasters with the EU, an example of PuP is the Natural Hazard Partnership (NHP)[26] developed in the UK between 12 technical and scientific agencies to work together in order to provide society with information research and analysis of natural hazards. Since its creation, the NHP has significantly increased the coordination among different stakeholders, avoiding duplication (which was previously an issue). At the moment, however,

[25] http://ppp.worldbank.org/public-private-partnership/overview/what-are-public-private-partnerships
[26] http://www.metoffice.gov.uk/nhp/

there is no mechanism for systematic collection and account of disaster data loss and damage. A disaster loss database is currently being discussed as being part of the NHP projects. This could potentially fill an existing gap [54].

These schemas demonstrate that the establishment of loss databases and their maintenance can be conducted through partnerships that rely on cost-sharing as a method of financing the collection, recording and sharing of loss data.

To a large extent, the ONRN scheme developed in France since 2012 can be considered both as a PPP and as a PuP as it involves as well many partnership agreements with public local authorities, the regional risk observatories (e.g. agreements between ONRN and 1) Observatoire Régional des Risques en Région Provence Alpes Cote d'Azur (ORRM-PACA) 2) Institut d'Aménagement et d'Urbanisme de la région Ile de France (IAU-IdF)).

4.3 STANDARDIZATION / CLASSIFICATION

4.3.1 LOSS DATA COLLECTION/RECORDING METHODOLOGIES

The collection and recording of loss data require a minimum level of guidance at the national level, if not standards, in order to be able to compare aggregated loss data at the EU level. This is evident from the exercise in Chapter 3. Some existing operational procedures in Member States can be considered as good practices, representing models to be reproduced (and adapted) within other EU Member States:

- In Slovenia, the government has developed a detailed methodology for determining, assessing and documenting the damage at the national, regional and municipal level. Therefore, several organizations and governmental institutions may be involved in the process of loss data recording depending on the scale of the data collection (local, regional or state level), on the type of disaster and on the affected sectors (e.g. agriculture, water, etc.). The data collection procedure is also governed by a set of rules enforced by national legislation. Assessment forms tailored to the type of damage are used in the field. Loss data recording also follows a standard methodology with a loss database linked to external sources (i.e. the register of buildings and farmlands, land cadastre). This approach ensures the collection of high quality data, which are verified at different levels of the aggregation process.
- In Spain, Greece and Germany, remote sensing based data collection techniques are also used in addition to more conventional techniques (desk research, official reports, etc.). Remote sensing capabilities have been demonstrated for damage detection mainly in large-scale disasters. Aerial imagery is more suitable to obtain detailed inventories. Both techniques can be used for loss data collection and the results integrated into a GIS platform. These approaches can be used also for building geospatial loss databases, enabling the analysis of loss data from a spatial dimension.
- In Italy, at lot of work has been done at regional level (e.g. in Umbria) to develop standard forms for collecting flood loss data. This was a participative process involving academic institutions and local government, ensuring buy-in of all stakeholders. The procedure for field data collection after the floods covered the following aspects: development of the forms for

collecting data in field, explaining how to use the forms in the field and the professional requirements for surveyors, development of an instruction kit for training surveyors, explaining how to input the collected data into a computerised version for the valuation of losses [37].

Outside the EU and at the international level, many good practices for loss data collection can be reported such as the initiative of the Federal Emergency Management Agency (FEMA) in the United Sates to develop a comprehensive toolkit for loss data collection to be implemented at community level. It includes: damage assessment forms by sector (residential, business, public facilities, and agriculture), loss estimation forms, infrastructure damage assessment forms, a damage assessment level guide (including detailed definitions of the terminologies) and a uniform disaster situation report.

As for recording methodologies, UNDP issued guidelines for the implementation of disaster loss databases using the DesInventar methodology [48], including recommendations for the recording of loss data. These guidelines are based on the experiences of the UNDP in implementing disaster loss databases in Asia. The main lessons learned are the need for: a systematic approach in recording disaster losses, strict division of duties, clear documentation, strict quality assurance, data validation and staff training.

4.3.2 PERIL CLASSIFICATION

As evidenced in Chapter 3, the terminology and the definitions used for hazards vary between Member States. Consequently, the databases are very difficult to compare. Despite this diversity, the typologies are compatible. The exercise of Table 9 for mapping the terminologies into the IRDR peril classification, though not straightforward, shows that it is possible to find a correspondence between the national classification system and a standard hazard terminology such as the one produced by the DATA working group of IRDR. The peril classification defined in [33] is designed for operational use in loss databases. The plan is to implement it over time in implemented global databases such EM-DAT, NatCatService and Sigma, as well as in national databases such as DesInventar and SHELDUS. It represents a good starting point for a discussion within Member States on the possible extension of this terminology to accommodate other types of hazards.
This classification distinguishes three levels: the **event family** (the most generic), the **main event type** and **peril** (the most specific) (Table 25). As a minimum requirement, it is recommended that Member States would be able to translate their hazard definitions to the **main event** of the IRDR Peril classification as already done in Table 9 for Member States part of the EU Loss Data Working group.

Family	Main event	Peril
Geophysical	Earthquake Mass Movement Volcanic Activity	Ash Fall Fire following EQ Ground Movement Landslide following EQ Lahar Lava Flow Liquefaction Pyroclastic Flow Tsunami
Hydrological	Flood Landslide Wave Action	Avalanche: Snow, Debris Coastal Flood Coastal Erosion Debris/Mud Flow/Rockfall Expansive Soil Flash Flood Ice Jam Flood Riverine Flood Rogue Wave Seiche Sinkhole
Meteorological	Convective Storm Extratropical Storm Extreme Temperature Fog Tropical Cyclone	Cold Wave Derecho Frost/Freeze Hail Heat Wave Lightning Rain Sandstorm/Dust storm Snow/Ice Storm Surge Tornado Wind Winter Storm/Blizzard
Climatological	Drought Glacial Lake Outburst Wildfire	Forest Fire Land fire: Brush, Bush, Pasture Subsidence
Biological	Animal Incident Disease Insect Infestation	Bacterial Disease Fungal Disease Parasitic Disease Prion Disease Viral Disease
Extraterrestrial	Impact Space Weather	Airburst Collision Energetic Particles Geomagnetic Storm Radio Disturbance Shockwave

Table 25. Peril classification at the Family, Main Event and Peril levels following the IRDR Peril Classification and Hazard Glossary [33]. The association of perils with main events is solely a suggestion. Some perils may change their main event association based on the actual event and loss trigger.

In the IRDR peril classification, the association between perils and main events is not a one-to-one relationship. A peril can be linked to one or more main events. For instance, a snow avalanche may be triggered by an earthquake, which would be considered a mass movement/geophysical event, or a snow avalanche may be caused by the weight and/or instability of the snow pack, which would define it as a landslide/hydrological event. This is highlighted in Figure 14, in which the different possible associations between perils and main events were established (considering only the four main events: geophysical, hydrological, meteorological and climatological events that directly affect the physical environment). This figure shows that few perils exhibit a one-to-one relation (e.g. Lava flow, Ash fall), rendering it difficult to have a standard classification and aggregation from perils to main events. Therefore, the decisions about classification and aggregations from perils to main events would have to be made on a case-by-case basis.

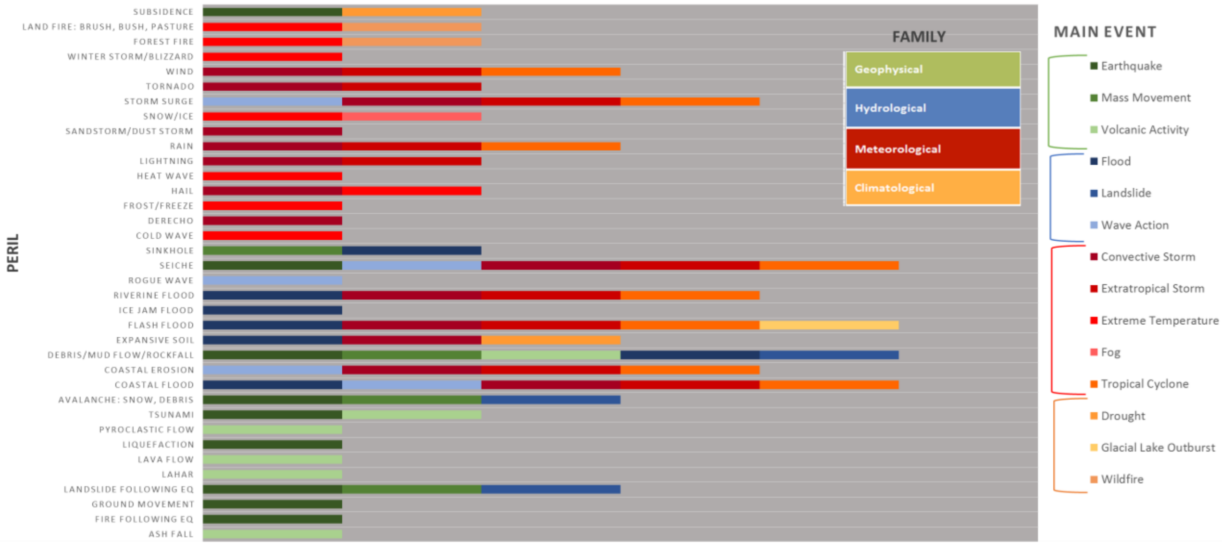

Figure 14. Possible associations between perils and main events following the IRDR peril classification.

4.3.3 Framework for human impact loss indicators

Terminology on human losses is difficult to define. Even fatalities can be ambiguous: due to differences in legal contexts, missing people are considered dead after a varying number of years in different countries. Other terms, such as affected people, are much more ambiguous, and often not well defined in a loss data recording methodology.

The minimum solution is that each database provides clear and unambiguous definitions for human losses. These must enable a loss data analyst to classify each person in one and only one category, to avoid double counting. It will then also allow studying the similarity and incompatibilities between different databases, enabling discussion on common definitions.

The Human Loss Data Framework[27] proposed here refers to structure discussions on terminology and definitions of human impact indicators. Its goal is to disaggregate people affected by disaster into different fields (=human impact indicators) according to the following principles:

- **Precise**: impact indicators must have clear and preferably mutually exclusive definitions (one person is counted only once);
- **Comprehensive**: impact indicators must cover all affected people (every affected person is counted);
- **Measurable**: impact indicators are measured by public, private or media organizations, or can be assessed in the field under current emergency management practices;
- **Practical**: impact indicators must match existing practices (one to one match with fields in existing databases) or required changes are kept to a minimum.

[27] IRDR DATA is also planning to develop a human and economic loss data framework, but the timeline of development is not compatible with the EU process. Both working groups are exchanging information frequently to harmonize approaches.

The Human Loss Data Framework (Table 26) shows a breakdown based on people **directly and indirectly affected.** A similar approach has been used in ECLAC [25] and adopted in the JRC publication on loss data [17]. Directly affected people suffer the disaster's direct effects immediately after the disaster and are always within the affected (damaged) area. Indirectly affected people suffer indirect effects of the disaster and can be within or outside the affected area, which divides them into secondary and tertiary level of indirectly affected people.

The directly affected people are a subset of exposed people (people living in the affected area). The second level of disaggregation (main fields in Table 26) is based on the people's need during or immediately after the disaster, i.e. fatalities, injured, evacuated, isolated and impaired. The main challenge is to define human impact indicators into mutually exclusive fields that can be aggregated to a total number of **people in need**. For example, one person can be injured, evacuated and homeless. One option could be to introduce a rule of priority of needs (e.g. the need of medical assistance is prioritized over the need of shelter). Another option would be to have different classifications (e.g. by status of health, status of shelter, status of evacuation) each summing up to a total number of people in need (vertical columns in Table 26). However, it may be that it is necessary to break with the first and second principle.

A third level of disaggregation can follow requirements that are more specific. For example, disaggregation of fatalities into killed and missing is very common among different loss databases. In the case of the evacuated, the situation is much more complicated. Breaking down that field can be imposed by the management requirement of different stages of the disaster cycle. In our case, we identify the disaggregation that corresponds to the requirements of the early warning, response and recovery stages. Disaggregation should follow again two rules: mutual excusive definition and total sum of the subgroups should be equal to the value of the field before the disaggregation. In Table 26 aggregation/summation is allowed in the vertical direction and is not possible in the horizontal direction, since definitions are not mutually exclusive. Furthermore, Table 26 allows identifying the minimum fields needed to be filled in to calculate the missing values by simple subtraction and addition. For example, if the number of evacuated, sheltered and relocated is known the number of people currently without shelter can be calculated.

The term **"sheltered"** refers to temporary solution, while **"relocated"** refers to permanent solution of satisfying the shelter need. Permanently homeless are people whose houses are destroyed, temporarily homeless are people whose houses are damaged and need repair, while not homeless refer to people who were most probably evacuated before the event and they can return to their houses once the alert situation is over. The question is whether they should be counted under people in need. Besides, we can be quite certain that relocated is the subset of permanently homeless. If the number of permanently homeless is obtained from the number of destroyed houses (using the conversion that one house equals one family and equals four persons) there is a certain level of uncertainty due to the expected double counting. It is quite probable that some of those persons could be already assigned under the field of injured or killed.

Following the temporal component, it is expected that the **people's need changes with time**. Therefore, it is necessary to allow them to be re-assigned to another human impact indicator field (e.g., from injured to evacuated/permanently homeless).

It is possible to further establish two groups of directly affected people as follows:
People that suffered impacts on their physical integrity: Killed + Missing + Injured
People that suffered impacts on their livelihood: Evacuated + Isolated + Impaired

Note that the people in first group may also suffer impact on livelihood. To ensure mutually exclusive definitions, it is recommended to count them in the first group using the rule of priority of needs (e.g. the need of medical assistance is prioritized over the need of shelter).
The detailed definitions of the components of the Human Loss Data Framework are given in the terminology section (on page 10).

The choice of terminology and definitions will be driven by the primary use of the loss database. For global accounting purposes, the primary concern is to capture available data (from media and government reports). The principles of precision and comprehensiveness are less important than those of measurability and practicality. This is different for risk and loss modelling applications, where loss and damage curves must be derived from historical loss data. For the latter application, precision and comprehensiveness are essential.

Table 26: Human impact indicators

<table>
<thead>
<tr><th colspan="3"></th><th colspan="2">Main fields</th><th>Definitions</th><th colspan="3">Breaking down the fields
(general options: by gender, by age, by vulnerable groups, ...)</th></tr>
</thead>
<tbody>
<tr><td rowspan="9">Increasing priority of needs</td><td rowspan="7">DIRECTLY AFFECTED
primary level by ECLAC</td><td rowspan="3">People that suffered impacts on their physical integrity</td><td colspan="2" rowspan="2">Fatalities</td><td rowspan="2">Mortality</td><td colspan="3">Killed</td></tr>
<tr><td colspan="3">Missing</td></tr>
<tr><td rowspan="4">PEOPLE IN NEED</td><td>Injured/disease/in need of medical assistance</td><td colspan="4">People that are in need of immediate medical assistance as a direct result of the disaster</td></tr>
<tr><td rowspan="4">People that suffered impacts on their livelihood</td><td rowspan="2">Evacuated</td><td rowspan="2">People that are removed from a place of danger to a safer place. Breaking down that field is related to the management of different disaster phases.</td><td>EARLY WARNING</td><td>RESPONSE CAPACITY</td><td>RECOVERY</td></tr>
<tr><td>Pre-event
Post-event</td><td>Sheltered by emergency services
Sheltered by private arrangements
Relocated
Without shelter</td><td>Permanently homeless
Temporarily homeless
Not homeless</td></tr>
<tr><td>Isolated</td><td colspan="4">People that suffer physical damage of infrastructure which threatens their basic livelihood conditions (limited access to water, food, electricity, ...) but they have not been evacuated</td></tr>
<tr><td colspan="2">Impaired</td><td colspan="4">People that suffer physical damage of their property but are not in need</td></tr>
<tr><td rowspan="2">INDIRECTLY AFFECTED</td><td rowspan="2"></td><td colspan="2">Secondary level - within affected area (by ECLAC)</td><td colspan="4" rowspan="2">People that suffer of a disaster's indirect effects (e.g., loss of flow, deficiencies in public service)</td></tr>
<tr><td colspan="2">Tertiary level - outside affected area (by ECLAC)</td></tr>
</tbody>
</table>

The Human Impact Framework can be used to understand how existing databases are structured. Based on existing definitions available in different databases cited we show how current human impact indicators fit into the proposed schema. Comparability is based on the definitions and not on the name of the field. Coloured areas represent concepts that are covered in the described database.

Table 27: Existing EM-DAT human impact indicators

	not disaggregated the same way which hinders the comparabilty					
EM-DAT		**Main fields**	**Definitions**	**Breaking down the fields (general options: by gender, by age, by vulnerable groups, ...)**		
DIRECTLY AFFECTED primary level by ECLAC		**Fatalities**	Mortality	**Killed**		
				Missing		
	PEOPLE IN NEED	**Injured/disease/in need of medical assistance**	People that are in need of immediate medical assistance as a direct result of the disaster			
		Evacuated	People that are removed from a place of danger to a safer place. Breaking down that field is related to the management of different disaster phases.	EARLY WARNING	RESPONSE CAPACITY	RECOVERY
				Pre-event	**Sheltered by emergency services**	**Permanently homeless**
				Post-event	**Sheltered by private arrangements**	**Temporarily homeless**
					Relocated	
					Without shelter	
		Isolated	People that suffer physical damage of infrastructure which threatens their basic livelihood conditions (limited access to water, food, electricity, ...) but they have not been evacuated			
		Impaired	People that suffer physical damage of their property but are not in need			
INDIRECTLY AFFECTED		**Secondary level** - within affected area (by ECLAC)	People that suffer of a disaster's indirect effects (e.g., loss of flow, deficiencies in public service)			
		Tertiary level - outside affected area (by ECLAC)				

Table 28: Existing DesInventar human impact indicators

	not disaggregated the same way which hinders the comparabilty					
	aggregated value available					
DesInventar		**Main fields**	**Definitions**	**Breaking down the fields (general options: by gender, by age, by vulnerable groups, ...)**		
DIRECTLY AFFECTED primary level by ECLAC		**Fatalities**	Mortality	**Killed**		
				Missing		
	PEOPLE IN NEED	**Injured/disease/in need of medical assistance**	People that are in need of immediate medical assistance as a direct result of the disaster			
		Evacuated	People that are removed from a place of danger to a safer place. Breaking down that field is related to the management of different disaster phases.	EARLY WARNING	RESPONSE CAPACITY	RECOVERY
				Pre-event	**Sheltered by emergency services**	**Permanently homeless**
				Post-event	**Sheltered by private arrangements**	**Temporarily homeless**
					Relocated	
					Without shelter	
		Isolated	People that suffer physical damage of infrastructure which threatens their basic livelihood conditions (limited access to water, food, electricity, ...) but they have not been evacuated			
		Impaired	People that suffer physical damage of their property but are not in need			
INDIRECTLY AFFECTED		**Secondary level** - within affected area (by ECLAC)	People that suffer of a disaster's indirect effects (e.g., loss of flow, deficiencies in public service)			
		Tertiary level - outside affected area (by ECLAC)				

4.3.4 FRAMEWORK FOR DAMAGE/ECONOMIC LOSS INDICATORS

Economic losses are even more difficult to define than human losses. They stem from damage to residential and industrial buildings and interruption of flows of people, energy, goods and other resources (e.g. water). The full economic impact across economic sectors is rarely known immediately after an event.

Several initiatives exist for damage/economic loss estimations, including the DALA (Damage and Loss Assessment (DALA); the framework for Loss Estimation developed by the National Research Council (U.S.) and National Research Council; and the HAZUS Natural hazard loss estimation methodology.

From the existing initiatives, the widely used DALA methodology provides a standardized tool for the monetary evaluation of disaster damage (in physical assets, capital stock, material goods) and losses (in flows of goods and services, income, costs) that arise due to the temporary absence of the destroyed assets. It represents an interesting framework for damage/economic loss indicators for a consistent recording of loss data in EU Member States.

On the basis of DALA methodology, the framework proposed here is meant to define a structure for reporting damage and economic losses, in a way it would be useful for supporting trans-boundary and international risk reduction processes. Bearing in mind that loss databases are expected to be implemented at national level in Member States while, for loss data-sharing, only summary or aggregated statistics are needed, the following recommendations are given:

- Damage/economic data should be event based (i.e. data must be related to the specific event);
- Only direct damages and direct losses (in national currency need to be reported;
- If direct physical damage is recorded, an economic model can be used to transform the data into total monetary losses. The losses are predominantly related to the assets' susceptibility to the hazard characteristics [35]. In Meyer et al., 2012 [35] an overview of methods for estimating direct costs including applications and examples is provided.
- To determine the overall amount of disaster impacts, damage and losses for all affected sectors must be included, avoiding possible gaps or double accounting;
- The sectors to be considered, as defined within DALA are: **Social sectors** (housing, education/research, culture/recreation, health sector), **Infrastructure sectors** (public administration, energy, drinking water and sanitation, transport, communications) and the **Productive sectors** (agriculture, forestry, trade and industry, tourism). However, for loss data-sharing purposes, only the sum of losses over all sectors is needed. (For transparency, this can be accompanied by a list of the sectors that have been considered and those that are missing).
- It is recommended to define the type of the owner (individuals, business, government, non-governmental organizations). This allows providing statistics on losses in the public sector, the industry sector, private citizens, etc. Separate from the owner type of the building, the losses of a particular building are typically born partially by the insurance industry, partially by the owner and partially by public funds (e.g. disaster compensation

funds). Therefore, also who bears the losses (individuals, business, government, non-governmental organizations and insurance companies) should be recorded. In case not all losses are recorded (e.g. only insured losses), it is recommended to develop a method for estimating the total losses across all loss-bearing entities (e.g. applying a multiplication factor on insured losses). When sharing loss data, the total loss should be shared.

Table 29 summarizes the proposal for a framework for damage/economic loss indicators that can be implemented at municipality, regional and national. For data sharing among Member States and international organisations, summary data (not disaggregated by loss owner and sector) will be more appropriate. The aggregated data can be reported in the final row of Table 29 (highlighted in grey). The terminology, presented at the beginning of this report (page 10), provides the definitions of the terms used in the damage/economic losses framework.

Table 29. Aggregation of loss data: example of reporting sheet (all in monetary value). Such sheets can be created at municipality, regional and national levels.

Direct loss to affected elements (€)						
Sector	**affected elements**	**Loss owner**				
		insurer	individual	business	NGO	government
housing	building					
	content/equipment					
	vehicles					
	landscape					
education research	building					
	content/equipment					
	vehicles					
	landscape					
culture recreation	building					
	content/equipment					
	vehicles					
	landscape					
health	building					
	content/equipment					
	vehicles					
public adminis tration	building					
	content/equipment					
	vehicles					
energy	building/civil work					
	content/equipment					
	landscape					
drinking water and sanitation	building/civil work					
	content					
tra	building/civil work					

Total loss (€)						
sectors	**Loss owner**					
	insurer	individual	business	NGO	government	
housing						Total Housing
education research						Total education research
culture recreation						Total culture recreation
health sector						Total health sector
public adminis tration						Total public administration
energy						Total energy
drinking water and sanitation						Total Drinking water and sanitation
tra						Total

	content					
	landscape					
comm	building/civil work					
	content					
agriculture forestry	building					
	content/equipment					
	stock/crop					
	vehicles					
	landscape					
trade and industry	building					
	content/equipment					
	stock/crop					
	vehicles					
	landscape					
tourism	building					
	content					
	landscape					

						Transport
comm						Total Communication
agriculture forestry						Total Agriculture and forestry
trade and industry						Total Trade and industry
tourism						Total Tourism
Totals per owner ship	insurer	individual	business	NGO	government	**Total over all sectors**

4.3.5 SOURCES OF UNCERTAINTY AND QUALITY ASSURANCE

Loss database should be evidence-based and transparent, therefore we should be aware of the imperfections, not ignore them. We should push forward a good treatment of uncertainty and give as well a good example to policy makers how to deal with this information [34].

A first step in handling of uncertainty is to be aware of it at different levels of data collecting: fitness for use (i.e., how well data model fits to application field), measurement errors while collecting data, processing errors while recording data and interpretation errors while communication it. A second step is to be transparent when showing/visualizing the uncertainty at different levels. Only then, the overall quality of data can be assessed and users can use the data in their work.

Approach to loss data quality assessment:

- It is related to current system within the country
- Based on the uncertainty handling within the methodologies used

Different categorization of uncertainty and the most suitable method for visualization of the uncertainty of loss data are presented in Annex 2: Study of uncertainty for quality assessment of loss data. The proposed approach merges an update of the uncertainty classification framework of Skeels et al., 2010 [43] and the *Pedigree* parameter of the NUSAP method. The proposed adaptation of the classification framework proposed in Skeels et al., 2010 [43] establishes a hierarchy and connectivity between the following six types of uncertainty:

- Measurement
- Completeness
- Inference
- Human error
- Disagreement
- Credibility

Pedigree, is a concept first used in uncertainty analysis in [66] where a set of criteria is used to assess several aspects related to the information flow and the knowledge used to characterize the data under analysis. Pedigree is a matrix where problem-specific criteria are graded according to a numerical scale. Since, for each of these criteria, a description is assigned to each value of the scale, the Pedigree matrix represents, thus, a tool suitable for the quantification of qualitative assessments associated to different components of the uncertainty involved in the process being analysed. The structure of the Pedigree matrix has no formal requirements since the rating scale as well as the number and type of criteria are selected according to the needs of each problem.

Applying the uncertainty types and the Pedigree concept to the process of loss data collection and recording results in three Pedigree matrices shown in Table 48, Table 49 and Table 50 of Annex 2 : Study of uncertainty for quality assessment of loss data. These matrices combine different uncertainty identification and criteria specific for loss data and cover the whole process of data collection and recording. An average score of Pedigree matrix can be established for each phase of the process (i.e. for the data collection methodology as shown in Figure 15 and the global average (i.e., the average of all Pedigree matrices scores) presents the quality assessment of the current system in the country.

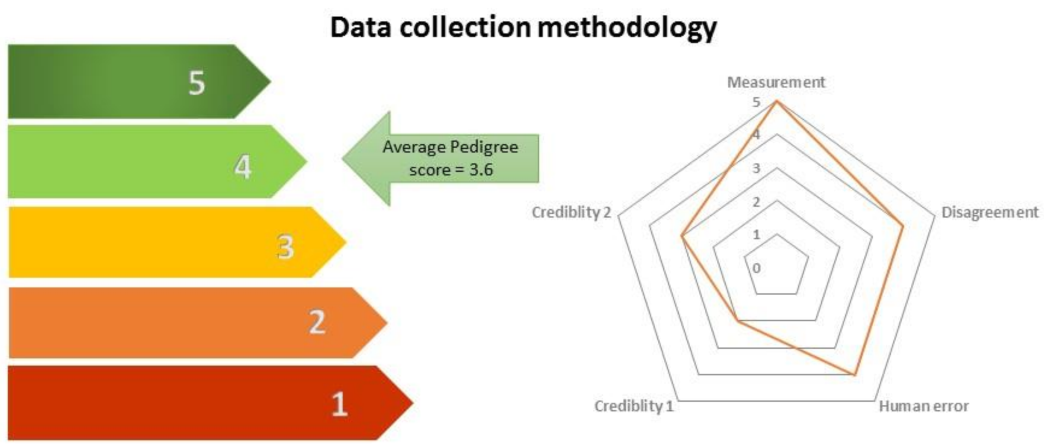

Figure 15. Uncertainty criteria and Pedigree matrix used for qualifying the methodology of loss data collection. For the grading of each criterion, it is recommended to refer to Table 48.

4.4 DATA POLICY

Accountability in the current HFA framework is voluntary but future frameworks should set of standards and mechanisms to ensure that different actors can be held accountable for their actions (or failure to act). Attaining these objectives within the EU calls for an open data policy on loss data, including the development of common loss indicators, interoperable data and agreed loss data collection protocols.

Besides, considering that the principle of transparency is characteristic of a good governance in the national context, it is then recommended that loss data would be shared among EU countries, with EU institutions and international organisations. Loss data at asset level is not necessary; aggregation of data geographically at regional or national levels can be sufficient for accountability and data-sharing purposes with the EU and at the international level.

It is also recommended that national loss databases would be open and interoperable to allow for easy data exchange and information sharing between different systems. If loss databases are owned by a public sector body, then the principles set out by the European legislation on reuse of public sector information[28] can be applied. The objective of this directive (commonly known as the Public Sector Information Policy) is to facilitate and enhance an effective cross-border use of public sector data, without affecting the existence or ownership of intellectual property rights of public sector bodies. The principles cover, among other materials, databases held by public sector bodies in the Member States, at national, regional and local levels, such as ministries, state agencies, municipalities, as well as organisations funded for the most part by or under the control of public authorities (e.g. meteorological institutes).

The Shared Environmental Information System (SEIS) is an example of a best practice at EU level for exchanging between Member States and with EU stakeholders. Public authorities across Europe collect a vast range of environmental data but different practices of classification and reporting make it difficult to access them and use them for cross-border analyses. The shared environmental information system (SEIS) aims to fulfil this gap by interconnecting existing databases, promoting the use of standards and making data accessible to all. It establishes a legal framework for the development and operation of a European reporting system for obligatory reporting and information exchange between Member States and the EC under Community environmental legislation [56].

In the case of loss data, the EU Open Data Portal[29] (supported by the PSI legal framework), or national equivalents, can be then used as platforms for hosting the aggregated statistics on loss data and for making them available to a larger group of stakeholders.

[28] Directive 2003/98/EC of The European Parliament and of the Council of 17 November 2003 on the re-use of public sector information
[29] https://open-data.europa.eu/

5 GUIDELINES

5.1 PURPOSE: SHARING AMONG MEMBER STATES AND WITH EU/UN

Several incentives can be expected from the establishment of the guidelines for loss databases and from cross-national sharing of loss data:

- Having a **common framework for evaluation**, including historical datasets, would allow Member States to have an overall picture of loss trends and hence be able to make a **comparison of progress towards increased resilience across countries**. It will also give the Member States a partial idea on the effectiveness of their disaster management and reduction policies relatively to the policies of other Member States. This would also provide an incentive to improve the disaster loss accounting methods and procedures.
- Rationalization of the loss data collection and recording processes is in the interest of Member States, not only to get access to compensation mechanisms more quickly and more easily, but also for **facilitating compliance with other EU Directives** (e.g. the Flood Directive) and the guidelines issued by the European Commission regarding the **Risk Assessment and Mapping for Disaster Management** [10].
- Shared-data on losses is particularly important for Member States to better understand the **trans-boundary effects of disasters** and accordingly to better think the coordination and management of future disasters.
- At the international level, having a common framework for loss data recording and comparable datasets can facilitate the **monitoring of progress in disaster risk reduction within the EU** and the implementation of a Post-2015 Framework for Disaster Risk Reduction as part of the EU commitment to the HFA. Data availability, accessibility, sharing and comparability are among the priorities of the EU as expressed in the EU Communication on The Post 2015 Hyogo Framework for Action: Managing Risks to achieve Resilience (COM, April 2014).

5.2 THRESHOLD FOR RECORDING AN EVENT

Recording a hazard event loss accounting entails a definition of the term “disaster”. It also requires a reasoning on the necessity, or not, for specifying a threshold or entry criteria for including an event in the loss database. Based on UNISDR terminology on disaster risk reduction [50], a disaster is defined here as “a serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources”.

The different scopes of loss databases bring out different practices in the specifications of the entry criteria. The necessity, or not, of defining a threshold for loss data-sharing needs, should take into consideration Member States practices, the EU regulations and existing international standards:

- Many Member States have specific criteria for triggering loss estimation supported by legal basis:

  - In Slovenia, loss estimation is triggered when the economic loss estimation at the national level will exceed 0.03% of the national budget.
  - In France, individual loss records are triggered by the NatCat abnormal intensity of a natural hazard (e.g. one in ten years return period for a flood event at municipality level).
  - In other countries like Italy, the criteria depend on each region for the regional databases.

- In EM-DAT database, the thresholds are applied when at least one of the following criteria is met: i) ten or more people reported killed; (2) 100 or more people reported affected; (3) declaration of a state of emergency; and/or (4) call for international assistance (Below et al. 2009).
- In NatCatSERVICE, loss data set is created as soon as harm to humans (fatality, injury, homelessness) happens or property damage occurs.
- In DesInventar, no thresholds are applied. An event can be included as soon as there are social losses.
- In SHELDUS, there is no imposed criteria in terms of damage/losses to be entered in the database.
- The new Solidarity Fund regulation [16] redefines the criteria for the "regional natural disasters". A direct damage in excess of 1.5% of the GDP of that region at NUTS2 level is being set as a threshold for the activation of the Fund.

Whether an entry criterion for recording an event is needed or not depends on the concept of the database and the use of information. For shared summary loss data and aggregated statistics, disasters at all scales should be considered without any significant (imposed) thresholds, other than those set within Member States. This way, it will be possible to consider many small and medium disasters that once accumulated may represent a significant portion of the losses. One has to be aware, however, of the minimum threshold that is used in national databases.

5.3 MINIMUM REQUIREMENTS FOR DATA MODEL

Minimum requirements in this chapter refer mainly to the data model of the database for the loss accounting purpose. In fact, not all fields are required for a data-sharing standard, however the indication that some will be and that an effort for improving the current situation is taking place will possibly trigger motivation at the national level to do the same but addressing more specific, numerous and detailed issues.

Table 30. Minimum requirements for the data model

Data model	Loss accounting	Data-sharing	HFA-2	UNISDR (DesInventar)
Hazard event identification				
Geographical location				
National unit (NUTS1)	•	•	•	•
Subnational units (NUTS2)	•	To be defined by the MS		•
Subnational units (NUTS3)	•			•
Lat/Lon (points, footprints)				
Temporal information				
Year	•	•	•	•
Duration (in days)	•			•
Month (beginning/ending)	•			
Event type specific attributes				
Severity key data				•
Reference to external database				
Hazard event ID	•	•		•
Hazard event classification	•	• (Main event)	•	•
Affected elements				
Geographical location				
Subnational units	•			
Lat/Lon (points, footprints)				
Population				
Age, Gender, marital status, etc.				
Property				
Occupancy classification, height, no.stories, hazard dependent classification, etc.				
Loss Indicators				
Directly affected population				
Killed	•	•	•	•
Missing	•	•	•	•
Evacuated	•	•	•	•
Isolated				
Victims				•
Direct damage/loss				
Physical damage	•	•		•
Direct economic loss	•	•	• (Total and as % of GDP)	•
Sector	•	•		•

		(Total)		
Owner (private, business, public, etc.)	●	● (Total)		
Who bears the loss	●	● (Total)		
Quality assurance				
Sources	●			●
Data collection methodology	●	●		
Data recording methodology	●	●		

From the data reported by Member States, the following table shows the degree of compliance with the proposed minimum requirements.

Table 31. Compliance of Member States data models with the minimum requirements

Minimum requirements for data-sharing															
Member State	Hazard event identification					Affected elements			Loss indicators					Quality assurance	
						Property characteristics			Affected population			Direct damage/loss			
												Tangible damage/loss			
	National unit (NUTS1)	Subnational units (NUTS2)	Year	Hazard event ID	Hazard event classification	Sectors	Loss ownership	Who bears the loss	Killed	Missing	Evacuated	Physical damage	Direct economic loss	Assessment methodology	Recording methodology
AT	●	●	●	●	●	●						●	●	●	●
BE	●	●	●	●	●	●	●	●				●	●		
BG	●	●	●		●	●	●		●			●		●	
FR	●	●	●	●	●		●∗		●	●	●	●	●	●	●
DE	●	●	●	●			●					●	●	●	●
EL	●	●	●		●		●		●			●	●		
HR	●	●													
IT	●	●	●	●	●				●	●	●	●			
PT	●	●	●	●	●	●	●		●	#	#	●	●	#	#
RO	●	●	●		●	●			●	●	●	●	●		
SI	●					●	●	●				●	●	●	●
ES	●	●	●	●		●			●	●	●	●	●		
SE	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

∗ Only insurance

Feasible but require a software modification

5.4 Cost/benefit analysis for implementing/sustaining loss database (by Member States)

5.4.1 Slovenia

AJDA provides a uniform solution for all municipalities, uniform processing of required forms, a reduction of data processing errors, makes obtaining data *ex officio* redundant, provides better communication between the general government and local communities, a friendlier and uniform working environment to its users, a centralised system of monitoring requests by municipality and procedure, and the same and regular updating of information for all user levels. AJDA is user friendly and offers a range of types of processing and printouts of input data. This has reduced costs on the general government level since there is no need to for MAFF and MESP to duplicate data input. Data is transferred by MAFF and MESP electronically. The costs of developing AJDA were repaid as early as the first year of its production – the use of the application made the input of requests by AAMRD redundant since all data had been provided in the form of an XML file. Moreover, input of data by MESP was no longer necessary, and there was no need to hire students to do this job. The cost of postage was reduced by 30–40%. Savings are also reflected in the reduced costs of production of the application for data input by AAMRD and MESP, since this data is already acquired by ACPDR. This enables a faster preparation of programmes for eliminating consequences of natural disasters and, at the same time, contributes to accelerating the disbursement of state aid to claimants.

5.4.2 France

To address the cost issue for implementing /sustaining a loss database, according to the French State of the Art presentation (section 8.5) , one should consider a holistic approach of the dynamic landscape as it is in reality, including the three levels (A = national and regional IDM4DRR platform; B = Invidual institution producing operationnally loss data; C = institutions or mainly projects which do not producte operationally loss data, but contribute to the developmenet of now compoenents or functionalities for the loss data reporting system.

Although it seems to introduce complexities at first sight, it simplifies the approach to a large extent, as it considers the cost-benefit analyses having been justified particularly at B level, where each institution producing loss data has already justified the C/B of the functionnality through it's own process. As an example, in France, the direct insurance companies and CCR already incorporate the production and storage of insured loss data in their own activities.

Therefore the proposal made by the chairman of the French insurance association and immediately supported by the other public and private stakeholders, of developping a national observatory of natural risks (ONRN = level A) was immediately accepted and considered as beeing a project at marginal costs with maximal benefits. In practice, each member of the ONRN agreement is mainly providing contributions in kind, involving staff members into the common project and rather marginal financial resources (to develop and maintain the ONRN web portal, to meet with the end users committee, for communication actions, etc). In total the permanent staffing the the common project can be estimated at 5-6 collaborators-year.

6 FINAL RECOMMENDATIONS

This report presented an overview of best practices and knowledge gaps in recording disaster loss data in the EU. Based on the contributions from Member States and the analysis of the status of loss data in the EU, it is possible to extract the following key issues and recommendations considering different circumstances and scopes of disaster loss databases:

1) Agreed terminologies

One of the main sources of incompatibilities between the existing loss databases is the lack of precise and agreed definitions of hazards and loss indicators. A consensus must be reached between Member States on the hierarchy and terminology of natural hazards. Fortunately, major steps have already been taken in this direction as shown by the IRDR peril classification initiative. Besides, the establishment of consistent databases relies on a **definition of the minimum set of loss indicators** and an **agreement on the terminology relating to loss categories**. Only then, it would become feasible to aggregate disaster loss data from the national level, up to the European and global levels for statistical analysis and accountability purposes.

2) Data collection at the local level

The key for a successful mechanism is to **engage actors at local level**. It is at this level in fact that the physical damage has been suffered and people can testify on the impacts of the disasters on their homes, working places and services. Generally, the municipalities are appointed as primary data collectors for an extreme event, backed by higher-level governmental agencies or offices (regional or national depending on the country's political arrangement). For loss data collection and recording, the role of civil protection actors is also crucial. It is therefore essential to empower the municipalities with the tools and the expertise for establishing and maintaining loss databases.

3) Handling uncertainty

Uncertainties are inherent in every step of the disaster loss data analysis framework. Disaster losses can only be estimated with variations in estimates. Given the inherent complexity of loss assessment, it is essential to **establish a framework for handling uncertainties in a transparent way.** It must be clear that the scale of recording losses influences directly the uncertainty of aggregated losses. Collecting data at asset level will decrease the uncertainty of loss indicators and increases the transparency of total economic loss caused by a hazard event.

4) Building a process for loss data collection and recording

Member States are encouraged to **build a process for loss data collection and recording at the national level** considering best practices learned from existing systems and the guidelines identified, in this report, through the comparative analysis of Member States. To guide the implementation of these practices, a data model is proposed in this report encompassing three distinct entities: hazard event identification, affected elements and loss indicators. This model is meant for serving the four application areas of loss data: compensation, loss accounting, forensic studies and risk modelling.

5) Design of an advanced IT system

Essential to this process is the design and the maintenance of a loss Information Technology infrastructure (IT) to facilitate and optimize data collection, storage and interpretation. Many of the requirements that may be thought of in terms of damage data collection at various scales (local, regional and national) may clearly benefit significantly from a well-designed IT system including an appropriate data model (linked to or integrated with other government databases) and supporting user-friendly data visualization and sharing options for a wide range of users. Additionally GIS platforms can be easily integrated to the IT systems, to provide mapping representation that can support better decision-making.

6) Supporting legislation and active involvement of local governments

A successful and sustainable framework for loss data management is driven by strong national legislation that provides evidence of **political commitment**. A sustained engagement at country level is needed in order to institutionalize the collection and recording of loss data following a common and agreed methodology. Increased national government investments and official development assistance are encouraged for IT infrastructure, remote sensing imagery for collecting loss data, and for establishing and maintaining loss databases. The **role and utility of loss data** should be discussed across government departments, including emergency management, urban planning, and government budget. High-level requirements should be informed by public and private needs across sectors.

7) Encouraging PuP and PPP

Implementation of loss databases should be embedded in a Public-Public Partnership (PUP) or Public Private Partnership (PPP) to **ensure participation and ownership of all stakeholders**. Engaging the private and public sectors into the process through partnerships that rely on cost-sharing represent a solution for supporting the development and maintenance of national loss databases. In particular, the creation of PPP would allow developing open-access models and pilot innovative loss data management mechanisms (e.g. the French model).

8) Information sharing

Summary or aggregate statistics (aggregation level to be defined by the Member State) should be shared using an open data policy in a common data standard to support trans-boundary and international risk reduction processes (including the post-2015 Framework). **Minimum requirements for a data-sharing standard** aligned with current practices are proposed in this report.

Finally, it is desirable to have more Member States volunteering to study the feasibility, scope and technical definition of loss data guidelines. Member States would be invited to analyse the existing practices in their institutions and evaluate the costs and benefits of implementing the guidelines according to different implementation scenarios. Based on the findings of this report, the next step will be to work together with Member States on a “Proposal for guidelines for recording disaster loss data in the EU”. It will facilitate collection and sharing of sound and common, comparable and interoperable data on disaster losses in an open data policy.

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8 ANNEX 1: STATE OF THE ART IN THE MEMBER STATES

8.1 AUSTRIA (AT)

Contact point: Rudolf Schmidt, Federal Ministry of Agriculture, Forestry, Environment and Water Management, Austria
Name of the loss database: Austrian Service for Torrent and Avalanche Control (WLV)
Language: German

8.1.1 NATIONAL DRIVERS FOR LOSS DATA

The Austrian Service for Torrent and Avalanche Control (WLV) was founded in 1884 as a department of the (imperial) Ministry of Agriculture and performs the function regarding the protection of the people, their habitat and settlement-area against the natural hazards of torrents, avalanches and erosion (caused by rock-fall, landslides, debris-flow and fine-sediment erosion). Today the protection against torrents and avalanches is laid down in the Austrian Constitution of the Federal Government. On the basis of the Forest Act of 1975 the Federal Government attends this task via a decentralised agency immediately subordinated to the Ministry of Life the Austrian Service for Torrent and Avalanche control. Administrative departments are organized in 7 headquarters, 27 regional offices and 3 technological staff offices.
At federal level, data are collected for loss accounting (cost benefit analysis), disaster forensic (prevention measures) and risk assessment, while at local level, loss data is collected for compensation accounting. More specifically the disaster related data are needed:

- to assess the natural hazard related vulnerability landscape of Austria (based on process, intensity, duration etc.),
- to ex-post analysis of disasters/events (including determining regional- and hazard-based damage functions),
- for the planning of appropriate protection/prevention measures,
- long-term financial planning of public subsidies and capacity building,
- for performance evaluation of existing infrastructure,
- development/improvement of life-cycle based data (for maintenance/reconstruction purposes/strategies).

Austria has developed GIS-based software for documenting event data related to emergency actions for alpine natural hazards. Part of the documentation refer to physical damage assessment at asset scale. The database is continuously updated and sustained. The main users are the Federal agency for torrent and avalanches control and the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management.
Scale/scope: Asset scale/National scope

8.1.2 METHODOLOGY OF COLLECTION

Mandated organization: In the current legal context, the most detailed data are assessed under local mandate, whether the competence of the province or insurance sector task.

Triggering mechanism: Alpine hazards are small scale hazards...
Techniques used to asses data: sectorial field assessment teams?
Quality assurance process: ad hoc? For some data fields regarding the event identification quality is documented by four categories (MAXO): M- measured, A-assumed, X-unclear, to be measured, O: not determinable

8.1.3 METHODOLOGY OF RECORDING

Mandated organization: The Austrian Service for Torrent and Avalanche Control (WLV) has developed GIS-based software for documenting event data related to emergency action and part of it covers physical damage of assets.
Processing of data: External references; Uncertainty handling
Aggregation: The federal government cannot easily set standards to improve the consistency of loss data assessed at the local level. Austria is working on data sharing policies and mechanisms where federal funding would be linked to providing standardized loss reports.
Storing and accessing information: These data and information are made available by web to the WLV subunits.

8.1.4 MODEL OF DISASTER LOSS DATABASE

WLV is gathering/compiling/maintaining data on:

- *Basic spatial-related data* (DTM (laser scan), cadaster, torrent/avalanche catchments, administrative borders, aerial images etc.).
- *Basic process-related data* (geology, soil type, vegetation cover, land use, hydrology, meteorology, sediment resources etc.).
- *Hazard-related data* (localization, triggering mechanism, displacement processes/scenarios, frequency/intensity, elements at risk, process-/susceptibility maps, hazard maps, hazard zone maps etc.).
- *Event-related data* (localization, process type, losses/damages, historical events etc.).
- *Project-related data* (localization, kind of measure, financial management etc.).
- *Protective infrastructure-related data* (kind of infrastructure, localization, level of functionality and performance etc.)
- *Expert opinion-related data* (localization, for what kind of administrative procedure, imposed requirements and orders etc.).

Disaster loss data can be found among event-related data (may be more thorough description of the slides from Figure 24).

Figure 16: Structure of event-related information

Hazard event identification

All hazard event type specific attributes are recorded in the database. The geographical location is recorded with the point (lat/lon) or footprint using different standards (ISO3, NUTS, LAU2, INSPIRE, WGS84, UN Geontology). The time of the hazard event is recorded with date and time. For hazard event classification an internal standard (Table 34) is used, while hazard events can be grouped by internal event identifier.

Table 32: Hazard event definitions in Austria

No.	Hazard type	Definition
1	**Floods**	Floods develop from extreme precipitation, which results in torrential catchments in a rapid rise in the run-off and thus in inundations in the valleys. According to the geology in the catchment areas a flood event can erode by the force of the discharging water great masses of solid material (erosion), transport it as bed load through the torrent and deposit it on the debris cone. In steep torrents extreme bed load transport events can result in the formation of **mudflows**.
2	**Avalanches**	Avalanches are masses of snow, which cause, when falling down rapidly on steep slopes or into ditches as a consequence of the kinetic energy or blast wave or due to their deposits, great damage or destruction in the endangered areas and constitute also an acute threat to the lives of persons also within buildings. Depending on the type of movement one can differentiate between **flowing avalanches** and **powder avalanches**.
3	**Slope movements**	Slope movements can occur in the form of “slow” creeping or gliding movements or in the form of “fast” slides and slope type debris flows. The most frequent forms with an immediate damaging effect occurring are deep-seated rotational slides or shallow translational slides.
4.	**Stone fall**	The fall of individual rock debris which is loosened from rocky escarpments and cliffs by weathering or mechanical influences (frost, tree roots). Stone fall results frequently in severe damage of buildings and endangers on long sections the transport routes in the Alps. The fall of greater rock masses is called **rock fall** or rockslide.

8.2 Belgium (BE)

Contact point: Georges Pletinckx, FOD Binnenlandse Zaken, SPF Intérieur
Name of the loss database: CALIS
Language: French, Dutch or German depending on the language of the affected area.

8.2.1 NATIONAL DRIVERS FOR LOSS DATA

Since 1976, a legal base was established in Belgium to compensate the victims of extreme events of natural hazards. The victims should prepare the claims which are then investigated case by case by the Provincial Governor.

8.2.2 METHODOLOGY OF COLLECTION

When a disaster strikes the municipalities gather data from the field (number of the victims, estimated amount of damage) and send them to the Provincial Governor that makes a formal request to the Ministry of Interior for the declaration of the event as a natural disaster. The Directorate of Disasters verifies whether the emergency situation meets the criteria and submits a draft Royal Decree to the Council of Ministers to recognize the event as a disaster.

8.2.3 METHODOLOGY OF RECORDING

After publication in the Belgian Official Journal of the Royal Decree of recognition, the victims have three months to apply for compensation. The Services of the Governor encode relevant data in the CALIS database, including affected persons (address, account number), the exact location of the damage, and the amounts of damage (various categories). The software then calculates the compensation awarded. Data is then collected in a central database. It then adds the data of disbursements.

8.2.4 MODEL OF DISASTER LOSS DATABASE

The database is implemented in an Oracle database.

8.2.5 PUBLIC COMMUNICATION

At regular intervals, a statistical document is updated on the website of the Directorate of Disasters (http://www.calamites.be). The Directorate is responsible for communication, including parliamentary questions or press.

8.3 BULGARIA (BG)

Contact point: Lyubomira Raeva, Ministry of Interior, DG Fire Safety and Civil Protection

8.3.1 NATIONAL DRIVERS FOR LOSS DATA

In Bulgaria there is no national system to record systematically disaster losses. There are also no common indicators and standards to collect data regarding human, material and economic losses. Therefore Bulgaria is welcoming the development of EU standards and the opportunity to exchange good practices and knowledge between the Member States.

In 2014 the Council of Ministers of the Republic of Bulgaria has adopted a National Strategy for DRR for the period 2014-2020. According to the Road map developed to the Strategy, a single

Bulgarian disaster loss database should be established. In this regard the National platform for DRR in Bulgaria has initiated the creation of an expert working group, composed of representatives from different government structures, science and academia, private and insurance business. The group will be tasked with the development of the system.
Regarding the recording of incidents within the country, DG Fire Safety and Civil Protection – Ministry of Interior maintains an information system about all emergency situations within the country which are recorded based on daily reports from local units for fire safety and civil protection. Until 1999 only data on fires with material losses were entered into the system. For fires without material losses and performed rescue activities only basic data was entered into the system. After 1999 all emergency events are entered into the system based on data for each dispatch of a duty team.

8.4 Croatia (HR)

Contact point: Jasminka Dejanović, Ministry of Finance of the Republic of Croatia
Name of the loss database: Disaster Damage Register
Language: Croatian

8.4.1 National drivers for loss data

The Ministry of Finance, as a state administration body, is competent for receiving and processing claims for damages, as well as paying financial equivalents thereof in accordance with financial possibilities, which are often limited. The Ministry of Finance has just started with the development of a computer application for the accounting of information on natural disaster losses at asset level. There is a strong need to create conditions for all natural disaster loss data to be collected and processed at a single point.

8.4.2 Methodology of collection

Mandated organization: At local level (municipalities, towns) damage assessment commissions have been established.
Triggering mechanism: In accordance with the Rules of Damage Assessment these commissions draft reports and in cases where the damage exceeds 3% of GDP, local governments declare the state of emergency and send a claim for damages to the Ministry of Finance.

8.4.3 Methodology of recording

Mandated organization: A State Commission for the damage estimation was established as a central body that collects and processes damages caused by natural disasters. At the national level, the operation of the recording and accounting data losses system requires the maintenance of software and database and regularly checking the validity of data in accordance with a specific protocol. In this sense, it will be useful to have a standardized loss indicators and methodology proposed by the EC.

Croatia is in the phase of establishing the Disaster Damage Register, an information system for managing and storing loss data. It accommodates

- a software application solution
- training of users,
- the production of the manual for data processing before entering into database
- procurement of computer equipment.

8.4.4 MODEL OF DISASTER LOSS DATABASE

The Disaster Damage Register is divided into four parts:

1. A register of damages to agriculture,
2. A register of construction damages (damages caused to houses, coast, roads, bridges etc),
3. A register of damages caused to equipment and costs of damage repairs, and
4. A single Register that will link all three systems.

In January 2014, the Register of damages to agriculture was completed and became fully functional. By the end of the year 2014 also the Register of construction damages will become functional.

The data model consists of

- hazard event data (hazard type, geographical area, temporal information, etc),
- damage/loss indicators to property,
- property data (users and owners of the assets).

8.5 FRANCE (FR)

Contact point: Roland Nussbaum, Association of French Insurance Undertakings, for Natural Risk Knowledge and Reduction (MRN), member of the Management Committee of ONRN

Name of the loss database: The National Observatory for Natural Hazards - ONRN (www.onrn.fr), as an integrated national loss, exposure and risk prevention policy database [41]*

Language: French

(*) The conceptual framework suggested by this report (§ 1.2. – Requirements for disaster loss data collection) expresses:

- Principles required for disaster loss data: precise, comprehensive, comparable, transparent.

- Categories of application: loss accounting, disaster forensics, risk modelling,

For a clear, realistic and holistic picture of the current national situation, one has to consider this ongoing process, where many actors in the country participate, either jointly or individually, at an operating stage already or still at research/pilot stage, for integration of their methods, results and achievements, at a later stage, into operating loss databases or modules. These differences in scope and maturity of projects on loss data collection, as defined by this report, will therefore be encompassed into the 3 following levels, for each detailed answer under this chapter (as well as under § 3):

Level A – National and regional IDRM4DRR[30] platforms, already sharing operationally, sometimes in a PPP agreement, involving an increasing number of national data producers, producing and

[30] Information and Knowledge Management for Disaster Risk Reduction

sharing operationally specific loss data / indicators, which aim at meeting all the principles required and all categories targeted under the framework of this report,
Level B – Individual institutions, already members of level A platform or not, which produce operationally loss data, meeting the principles, but in a more limited scope, and targeting all the categories of applications or only part of them. In most cases, the information and data publicly released by these institutions, which are not yet integrated into the specific indicators of level A can nevertheless be accesses through the web portal of level A.
Level C - Individual institutions or mainly (research) projects, which do not produce operationally loss data, but contribute to the development of new components (e.g. damage functions, models) or functionalities (assessing sanitary impacts of catastrophes). By definition they are not aiming at being comprehensive but perhaps at improving preciseness, comparability etc., of existing operational procedures, and do not either cover all the categories of application, as they mostly target to improve a component of one of them. Again for level C, some the results/reports publicly released by these projects can already be accessible through level A web portal.

Concrete examples of institutions and/or projects are provided to illustrate answers for each of these 3 levels, when appropriate.

8.5.1 National drivers for loss data

Level A
The National Observatory for Natural Hazards (ONRN) is a data sharing platform useful for the decision making processes and the activities of the stakeholders involved in risk prevention. It has been initiated through a partnership of direct insurance companies, represented by the Association of French Insurance Undertakings, for Natural Risk Knowledge and Reduction[31]), the Central Reinsurance Company[32] and the French State central Administration (Ministry of Ecology, Sustainable Development and Energy, The General Directorate for Risk Prevention[33]), established on May 2012, after the Xynthia storm and the Var flood events, that both occurred in 2010.
This observatory addresses the following needs:

- improving and capitalizing on knowledge of hazards, risk exposure, loss data / lessons learnt, risk reduction policies and procedures in progress and the challenges they present,
- providing the basis for an evaluation and prospecting system,
- contributing to risk prevention management and governance,
- supporting the economic analysis of crisis management and prevention,
- contributing to improving a risk management culture.

Main users are all stakeholders categories, in particular policy decision makers.
The ONRN platform offers mainly (level A) a geographic interface and the possibility to download a set of specific indicators, calculated at municipality grid on :

  - current assets exposure (split between inhabitants and professional activities),

[31] Mission des sociétés d'assurances pour la connaissance et la prévention des Risques Naturels - MRN, an association created by the FFSA and GEMA, www.mrn.asso.fr
[32] Caisse Centrale de Réassurance – CCR – www.ccr.fr and https://erisk.ccr.fr/faces/erisk-accueil.jsp
[33] Ministère de l'Ecologie, du Développement durable et de l'Energie (MEDDE), la Direction Générale de la Prévention des Risques (DGPR) - http://www.developpement-durable.gouv.fr/-Sites-Portail-Risques-.html

- cumulated insured losses for the time period of 1995-2010 onwards,
- progress of public reduction procedures (PPR and PAPI in case of floods)

These indicators cover all categories of floods, storm and subsidence (geotechnical drought damages affecting housing).

Scale/Scope: ONRN specific indicators are collected at asset scale and delivered at municipality to national scope.

ONRN webportal provides also a structured direct access to “level B” sources of loss data information: databases (e.g. event databases) and reports (e.g. Lessons learnt reports for major events since 30 years) of the different data producers either partners of ONRN or identified by ONRN (access per categories of hazards, etc.)

Level B

Examples of loss data producers are ONRN partners (also accessible through www.onrn.fr) such as

- the French State, ministry of ecology and sustainable development (MEDDE), together with State agencies and affiliated local authorities: regional observatories, floodplain managers:
    - Lessons learnt reports[34] by MEDDE/CGEDD, the French State Central Administration Inspectors, for major events only, since the 80’
    - Data bases such as:
        - « Base de données historique des séismes » (SISFRANCE[35]) in cooperation with BRGM, EDF, IRSN
        - « BD Pluies extrèmes en France métropolitaine”[36] (Meteo France), with two levels of data recording :
            - The most achieved one, operating since 1958 onwards
            - A less sophisticated one, with the 300 highest records and their impacts since 1766
        - « Enquête permanente sur les avalanches[37] » (IRSTEA), since 1900
        - « Base de données historique des inondations » (BDHI, still in development)
- CCR for major NatCat events since 1982 (also accessible through level A[38]
- The member associations of MRN (FFSA-GEMA[39]):
    - in parallel to CCR for NatCat events (flood, subsidence mainly)
    - Directly for storms, hailstorms and weight of snow on roofs[40]

Level C

[34] http://www.onrn.fr/site/rubriques/_informations-thematiques/_sinistralite-et-retours-dexperiences/evenement.html

[35] http://www.onrn.fr/site/basesdedonnees/brgm---sisfrance.html and direct link : http://www.sisfrance.net/

[36] http://www.onrn.fr/site/basesdedonnees/meteo-france---pluies-extremes.html

[37] http://www.onrn.fr/site/basesdedonnees/irstea---epa-et-clpa.html

[38] And https://erisk.ccr.fr/faces/erisk-accueil.jsp

[39] FFSA - French Federation of Insurance Companies - 248 companies representing 90% of the French Insurance market, The remaining 10% are: certain mutual insurance companies without intermediaries which are members of the Mutual Insurance Companies Group (Groupement des entreprises mutuelles d’assurances – GEMA); certain companies that do not belong to any professional organizations. http://www.ffsa.fr/sites/upload/docs/application/pdf/2010-09/annualreport2009.pdf

[40] http://www.onrn.fr/site/rapportannuel/http---www.mrn.asso.fr-system-files-tempetes_grele_neige_2012.pdf.html

Examples of Institutions / projects operating at this level, aiming at improvements into the loss data collection/assessment process, are:

- Institut national de veille sanitaire (InVS), with an ongoing epidemiologic research programme on the impacts of natural and manmade catastrophes to human health[41] and two recent studies on events:
  - Xynthia, 2010[42]
  - Var Flood, 2010[43]
- Various research projects (examples)
  - on the impact of uncertainty in flood hazard modelling and vulnerability assessments on damage estimations[44]
  - on the development of loss damage curves for housing in the case of storm surge[45]
  - on the development of a flood events national database according to the NatCat trigger, in matching insurance market loss records to local public authorities recordings[46]

8.5.2 METHODOLOGY OF COLLECTION

Mandated organization:

Level A

ONRN is not responsible for disaster loss data collection.

But as indicated ONRN provides also access, through its webportal to most of other event data bases available in France (level B and C)

LEVEL B

Data producers are responsible for disaster loss collection (see explanation above for insured loss data assessment).

Triggering mechanism:

LEVEL A (for insured losses)

Triggering mechanism is dependent as well on level B actors

LEVEL B

For loss data indicators, one should note that the triggering for flood coverage under French NatCat insurance system is a 1 in 10 yrs return period flood event, with property damage at the scale of a municipality. This creates a very significant amount of events to monitor at national level (about 200 on average per year in the last ten years): therefore the events database is still in development.

For lessons learnt reports addressing major disasters only, the triggering mechanism is a political decision involving consideration of the fatalities.

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[41] http://www.invs.sante.fr/Dossiers-thematiques/Environnement-et-sante/Catastrophes-naturelles-et-industrielles/Contexte-enjeux-dispositif-de-surveillance

[42] http://www.invs.sante.fr/Dossiers-thematiques/Environnement-et-sante/Catastrophes-naturelles-et-industrielles/Etudes-autour-de-catastrophes/L-experience-de-Xynthia

[43] http://www.invs.sante.fr/Dossiers-thematiques/Environnement-et-sante/Catastrophes-naturelles-et-industrielles/Etudes-autour-de-catastrophes/Inondations-dans-le-Var

[44] J. ELEUTERIO, 2012, PhD Dissertation, Strasbourg University

[45] C. ANDRE et al., 2013, Contribution of insurance data to cost assessment of coastal food damage to residential buildings, insights gained from JOHANNA (2008) and XYNTHIA (2010) storm events, EHESS, 8 August 2013 and PhD Dissertation, University of Western Brittany

[46] D. BOURGUIGNON, 2014, PhD in preparation, University of Montpellier.

Techniques used to assess data:
LEVEL A:
Dependent on level B
LEVEL B
The loss data available through ONRN specific indicators are, so far, only insured losses, collected by (level B) the loss adjusters of direct insurance companies. These data are aggregated at portfolio level of each insurance company and are aggregated again at national market level by CCR.
Due to the very high penetration of property damage insurance against natural events, for both personal and commercial lines (including business interruption in the latter case), the availability of an insured loss assessment, through the described procedure, is sufficient to estimate the related overall economic loss, for an individual event or territory or for a series of events over a certain period of time.
Empirical evidence has shown with sufficient stability over time and space that insured losses in France represent about 60 % of the total economic losses, at least for floods and storms.
Quality assurance process:
LEVEL A:
ONRN specific indicators are delivered through a quality assurance process
LEVEL B:
Each data producer has an own quality assurance process

8.5.3 METHODOLOGY OF RECORDING

Mandated organization/ Processing of data/ Aggregation:
LEVEL A: ONRN is not responsible for loss data recording (level B) but produces a series of specific loss indicators. The first studies generated a set of 26 indicators:

- Relating to flooding, drought and storm insurance coverage, (storm coverage includes coverage against property damage caused by hail and weight of snow on roofs)
- that are already developed internally by each of the three founding partners of ONRN,
- that can be reported at municipal or department level.

For each indicator the following documents are produced and can be downloaded:

- a data at municipality level in Excel format, for direct use in standard geomatic softwares;
- a metadata file compliant to the European INSPIRE directive;
- a document including:
  - the definition of the indicator,
  - the relevance of the indicator and its level of use,
  - mobilized data and methods development,
  - limitations and precautions regarding data development methodologies and usability,
  - results and key figures,
  - examples of use,
  - links to other analyzes,
  - contact details of organization responsible for producing the indicator.

The scope covered by these indicators will be progressively extended, to all main hazards, but also to crisscross the different indicators (exposure, losses and progress of risk reduction public procedures) at different scales[47]. Such exercise incorporating disaster loss data at fine territorial grid helps the policy maker to identify and prioritize those territories, which require further attention, in the implementation of risk reduction policies and tools.

LEVEL B

Each data producer is responsible for its specific methodology of data recording.

Storing and accessing:

LEVEL A

The ONRN specific indicators are downloadable on line, at municipality or *departement* (i.e. for France: CRESTA[48] zone grid), together with definition, uncertainties and limitations of use, together with metadata following INSPIRE standard.

LEVEL B

Storage is carried out by each data producer.

Free access is guaranteed to data of State administrations, but the private data producers (insurance companies on an individual basis) do not give access to their data.

8.5.4 Model of disaster loss database

LEVEL A

The ONRN website comprises a cartographic tool for consulting, downloading and reusing indicators on:

- Property damages (housing/businesses and their contents/activities, subject to insurance compensation between 1995 – 2010
- The economic and human assets at flooding risk
- The progress made in the implementation of prevention measures

Hazard event identification

ONRN specific indicators only some key data related to the hazard event.

Geographic location of the event is defined with the subnational unit, temporal information with date and time.

All other relevant external hazard databases are available through links in the webportal to data producers (level B)

Definition of hazard types

LEVEL A

For ONRN specific indicators, three hazard types are documented so far :

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[47] See Legisletter N° 2 of EU FP7 ENV KNOW-4-DRR Project: "A new information and knowledgemanagement system (IKMS) for disaster risk reduction in France:ONRN", and particularly the screenshots of interactive maprsfrom www.onrn.fr allowing to compare exposure/loss records and progress of public prevention policy at territorial level (link: http://www.know4drr.polimi.it/legisletter/)

[48]Catastrophe Risk Evaluating and Standardizing Target Accumulations (https://www.cresta.org/) - The CRESTA organisation was established by the insurance and reinsurance industry in 1977 as an independent body for the technical management of natural hazard coverage. CRESTA's main goal is to establish a uniform and global system to transfer, electronically, aggregated exposure data for accumulation risk control and modelling among insurers and reinsurers. Today, the standards are generally accepted and applied throughout the insurance industry worldwide. Although the information provided here is available to everyone, it is aimed primarily at the insurance industry.

- Floods (all categories together),
- Subsidence (effects of geotechnical draughts on buildings) / *sécheresse géotechnique*
- Winter Storm

LEVEL B

General classification of hazard types by French Administration:

- Floods / *Inondations* (5 sub-categories, two levels of subcategories for there of them: riverine, flash and stromsurge / *par débordement de cours d'eau, par ruissellement et coulee de boue, par submersion marine*)
- Soil movement / *Mouvements de terrain* (7 subcategories, two levels of subcategories for 5 of them)
- Earthquake / *Séismes*
- Avalanche / *Avalanches*
- Volcanic eruption / *Eruption volcanique*
- Forest Fire / *Feux de forêt*
- Atmospheric event / *Phénomènes liés à l'atmosphère* (6 subcategories, two levels of subcategories for 2 of them: storm, snow and icefall / *tempête, chutes de neige et pluie verglaçante*)

LEVEL C : extreme variety of examples

Affected elements

LEVEL A

For ONRN specific indicators, the affected elements documented so far are:

- For exposure indicators :
    - Persons at risk,
    - Jobs potentially affected
- For loss indicators :
    - Insured property damage (personal and commercial lines, including the public assets that are insured).

LEVEL B

For forensic / lessons learnt reports, there is a further breakdown between:

- Persons (Fatalities, Injured, affected)
- Housing
- Economic activities, with details on agricultural activities in particular,
- Public buildings

LEVEL C

As an example, the further breakdown of "persons injured/affected", used by InVs for epidemiologic studies of impacts to human health (in French[49]):

- ***Effets liés à une exposition directe aux inondations***

[49] Courtesy Dr Philippe PIRARD, Yvon MOTREFF, InVS

  - *Immédiats (heures-jours)*
    - *Traumatismes, noyades, maladies infectieuses, intoxications chimiques, stress aigu*
  - *Différés (semaines-mois-ans)*
    - *Etat de stress post-traumatique*
- ***Effets indirects des inondations***
  - *Immédiats (heures-jours)*
    - *Aggravation pathologie chronique (isolement, déplacement, détérioration hygiène, stress etc.)*
    - *Décès (intox CO, accident de la voie publique, etc.)*
    - *Gastro-entérite (contamination de l'eau potable, etc.)*
    - *Stress (évacuation, etc.)*
    - *Différés (semaine-mois-ans)*
    - *Aggravation pathologie chronique, perte qualité de vie, décès, etc.*
    - *Pathologie respiratoire (moisissure dans maison)*
    - *Dépression (pertes matérielles, habitat, travail, relogements, etc.)*

Loss indicators

LEVEL A

Most of the loss data available so far as ONRN specific indicators are insured losses, provided by the insurance market and aggregated by CCR, while indicators on human losses and other economic losses can be tracked down through major events monographies (lessons learnt reports, at LEVEL B).

LEVEL A

The definition of each indicator is provided in a fiche downloadable on the ONRN website[50]

Example, for cumulated flood loss at municipality level (in FR): *« Cet indicateur porte sur les coûts indemnisés par les assureurs au titre du régime d'indemnisation des Catastrophes Naturelles pour le péril des mouvements de terrain différentiels consécutifs à la sécheresse et à la réhydratation des sols en France métropolitaine, agrégés sur la période 1995-2010. Ces coûts ne concernent que les biens assurés autres que les véhicules terrestres à moteur et ils sont nets de toute franchise. »*

LEVEL B

Each loss data producer has implemented its definition for its own area of competence/interest. Therefore a medium/long term main objective for LEVEL A (ONRN) to strive towards harmonizing efforts towards compatibility of LEVEL B loss indicators.

8.5.5 PUBLIC COMMUNICATION

LEVEL A

As an open source data sharing media, ONRN webportal allow all categories of stakeholders, public and private, easy access to all available sources of genuine data on natural hazards in France

[50] http://www.onrn.fr/site/rubriques/indicateurs/cartographie.html

including a set of specific indicators, for a better understanding of these phenomena and their impacts.
In summary, the ONRN produces and disseminates through its website:

- General Information for a non-expert audience on the various natural hazards, exposure to risk, how to protect and, where appropriate, how to react in case of disaster (e.g., risk register).
- Thematic information for a more informed public indexed by thematic and geographical areas and contains:
    - inventories of existing public databases covering different hazard types and regions, which can be accessed from the website,
    - projects and reports on natural hazards in France,
    - a list of events that impacted the France since 1982,
    - ONRN specific indicators, which provide new knowledge on natural hazards,
    - A directory of stakeholders with specialist knowledge of natural hazards.

LEVEL B
Under Aarhus convention, public access to environment e.g. risk data is guaranteed, as soon as they are available. On the contrary, data communication of private data, is dependent to the willingness of the data producer(s), therefore the improvement provided by the ONRN agreement, increasing public access to part of the private data, on an aggregated basis.

8.6 Germany (DE)

Contact point: Annegret Thieken, Universität Potsdam; Institut für Erd- und Umweltwissenschaften (Institute of Earth and Environmental Science);
Name of the loss database: HOWAS21[51](maintained by Helmholtz-Zentrum Potsdam Deutsches GeoForschungsZentrum GFZ)
Language: German

8.6.1 National drivers for loss data

HOWAS21 was established at GFZ Potsdam[52] in 2007 as a part of the academic research project MEDIS - Methods for Estimating Direct and Indirect losseS (Funding: Federal Ministry of Education and Research, Duration: July 2005 - June 2008, Project code 0330688). HOWAS21 covers flood damage only (pluvial and fluvial floods).
The main purpose to record losses is to derive representative cases in order to get damage functions for vulnerability models and forensic analysis rather than establishing loss data for accounting. However, there is an opportunity to link this database to a loss accounting database.
Scale/Scope: The data are collected through surveys at asset level. The recorded cases are representative for the investigated flood events, but the coverage is incomplete, i.e. aggregation of data from the asset level in e.g. one municipality does not provide the total loss in that municipality.

[51] http://ig1-dmz.gfz-potsdam.de:8080/howas21/
[52] Helmholtz-Zentrum Potsdam Deutsches GeoForschungsZentrum GFZ

Momentarily there are 5500 cases. A part of the data origins from the old HOWAS-data base that was gathered and maintained by the LAWA which is the German Working Group on water issues of the Federal States and the Federal Government represented by the Federal Environment Ministry German from 1978 to 1993. Further, it contains new data, mainly from computer-aided telephone interviews with property owners who suffered flood damage in 2002, 2005 and 2006. Data from flood events in 2010, 2011 and 2013 will be added within the next two years.

8.6.2 METHODOLOGY OF COLLECTION

Mandated organization: There is no clear mandate. HOWAS21 offers the possibility to store data that were collected by different research organizations and consulting companies, e.g. via systematic interviews organized with the lists of addresses of flooded assets and appointment made by telephone. Data have to fulfil certain quality standards in order to be integrated in HOWAS21 (see below). Statistics of affected/not affected owners as well as willing/unwilling to participate are known for some campaigns.

So far the following organizations fed data in HOWAS 21:

- ALPS - Centre for Natural Hazard and Risk Management GmbH (http://www.alp-s.at)
- German Reinsurance AG (http://www.deutscherueck.de/)
- German Research Centre for Geosciences - GFZ (http://www.gfz-potsdam.de)
- German Institute for Economic Research (DIW Berlin) (http://www.diw.de)
- Hydrotec Engineering Company for Water and Environment mbH (http://www2.hydrotec.de)
- City of Dresden (www.dresden.de)
- LAWA Federal / State Working Group on Water (http://www.lawa.de/Startseite.html)
- University of Lüneburg, INFU - Institute for Environmental Communication (http://www.leuphana.de/institute/infu.html/)

Triggering mechanism: It is aimed to gather data from heavy and superregional flood events in Germany. Focus is made on representative cases to cover the whole variability of losses and potential influence factors.

Assessment technique: Standards for flood damage assessment and flood loss data collection containing a basic set of attributes were developed; [44][45][28]. To derive a catalogue of relevant items a multi-step online survey was conducted using the Delphi-approach with a panel of 55 experts from (re-)insurances, engineering companies, public water agencies and scientific institutions [28]. The manual [44] outlines the theoretical framework for flood loss assessment and suggests criteria for loss documentation. For the latter, the core attributes for each sector were supplemented by evaluation methodologies (e.g. measurement units, check lists). In addition, suggestions for meta-data, general event documentation and aggregated damage reports are presented.

Quality assurance: During the assessment process collected data are associated with the information on the acquisition campaign and meta-information about data loss related to quality assurance[53]:

- **Information on the acquisition campaign**

[53] http://ig1-dmz.gfz-potsdam.de:8080/howas21/

- Assessment team - information about the polling company or management unit, which performs the survey. Indicating the name and address.
- Client - information on the funding source of the survey. Indicating the name and address.
- Start of the campaign - the date on which the survey campaign was launched. Specified as DD: MM: YYYY.
- Campaign end - the date on which the survey campaign has ended. Specified as DD: MM: YYYY.
- Principal intention - Textual description of the purpose of the survey.
- Data type - the type of data collected (possible values: (1) empirical data, i.e. data of a real flood or (2) Synthetic / analytical data, i.e. specification of a fictitious flooding scenarios (what if)
- Data type Description - detailed textual description of the data type.
- Type of survey - Classification of the Survey type. (possible values: (1) survey by experts (surveyors / reviewers), (2) survey / assessment by (trained) lay, (3) Affected survey
- Description of survey - detailed textual description of survey.
- Sample - the sample classification (possible values: (1) full survey, (2) sampling - cluster sampling, (3) sampling - random sample, (4) sampling - stratified random sample).
- Sample description - detailed textual description of the sample.
- Survey method - classification of the survey method (possible values: (1) on-site survey; telephone information / Stakeholders interviews, (2) Written information / Stakeholders interviews, (3) Web-based information / Stakeholders interviews).
- Survey Method Description - detailed textual description of the survey method.
- Data preparation - Textual information on the originally collected information and subsequent rearrangements of the original data, such as coding of open questions, conversion of numerical data, reclassifications. If available, if necessary, attach a log to an external file.
- Data controller - the person who has performed the validation. Indication of the name.
- Test facility - a facility that performed the validation (possible values: (1) acquiring site, (2) Client, (3) other).
- Test equipment Description - Textual description of the device, which has carried out the validation, if it has not acted to Soaring office or the principal. Indicating the name and address.
- Test date - the date on which data were examined. Specified as DD: MM: YYYY.
- Data base - Textual description of the data sets and methods used for the validation is based (e.g., 2D modeling results; building surveys).
- Campaign Name - Unique Short Name of survey campaign. Specified as name, letter or number abbreviations.
- Citation - Indicates how the record should be cited in publications, etc.
- Data usage - Textual information about restrictions on the use of data, existing data sharing agreements, etc.

- **Meta-information about data loss**
  - Recording date - Specified as DD: MM: YYYY.

- Assessor of damages - the person who collected information on the object or interviewed the person concerned. Indicating the name and address.
- Measurement method for the indicators referring to water levels parameters (possible values: (1) measurement, (2) calculation of information, (3) estimate by affected, (4) estimate by experts, (5) modelling/simulation).
- Method used for building replacement value (possible values: (1) building evaluation by experts on site, (2) Asset value method - calculation according to NHK, (3) Asset value method - calculation according to valuation bow VdS 772 10/88 (01), (4) comparison approach, (5) assessment of the person concerned
- Method used for the real value of the building (possible values: (1) Income approach (eg 20 x annual basic rent), (2) Asset value method - calculation according to NHK, (3) Asset value method - calculation according to valuation bow VdS 772 10/88 (01) (insurance method), (4) Sales value in the opinion of the person concerned, (5) Sales value in the opinion of an expert, (6) Comparison approach
- Method for damage assessment (possible values: (1) assessment based on evidence, (2) Assessment based on standardized fixed values, (3) expert opinion, (4) estimate of acquirer, (5) estimate of the person concerned
- Measuring method for geo-referencing (possible values: (1) GPS, (2) Geocoding)
- Furthermore, the quality of derived loss function is assessed by a modified NUSAP approach.

8.6.3 METHODOLOGY OF RECORDING

Mandated organization: The administration of the database is done by the GFZ Potsdam.
Processing of the collected data: GFZ Potsdam is responsible for:

- data review
- maintenance of consistent data
- assigning the access rights
- verifying the user request
- invitation of the advisory panel
- providing selected analyzes

Aggregation of collected data:
Storing and accessing data: There are three user groups that have access to the database in varying degrees:

- World: The interested public can search in the database and access a range of general information and evaluations. The user interface has an option to search in the database according to selected criteria. These include the structured query, filtered by catchment area, regions (provinces & municipalities), periods (event year), sectors, collection methods, campaign, and a combination of these criteria.
- Registered User group I: This group includes all institutions that provided a certain amount of data with appropriate quality in HOWAS21. They have full access to the entire database and form an advisory panel.

- Registered User Group II: Users from academia and non-commercial projects, who did not provide data, can apply for a restricted login database. In return, the advisory committee shall be informed of project results.

All data claims in HOWAS21 are anonymous and privacy issues are respected at all times. For example, processing loss data with modeled flow rates of the events, which requires a precise geographical localization, is carried out in advance.

8.6.4 MODEL OF DISASTER LOSS DATABASE

HOWAS 21 provides data on direct tangible flood damage/losses to individual buildings, structures and surfaces associated with a higher-level flood event, a survey campaign for different damage sectors or types of objects.

There are two type of attributes, minimum criteria (minimum standard) and core criteria. The minimum criteria are indispensable for a feed of the record in HOWAS 21. The core criteria contain information for the evaluation of flood damage data that are considered to be very important and therefore should be considered in the assessment of damage. However, their presence is not essential for the inclusion of a record in HOWAS 21

The minimum criteria are:

- Damage sector - assignment of each data set to a damage sector.
- Loss - an indication of the financial damage occurred.
- Water level - indication of water levels are highest during the event. Indicating possible as effective water level above ground level (GOK).
- Flood event - Temporal assignment to a flood event. Indicating possible as the date of the start of the event at the object.
- Spatial localization - Spatial allocation to a flood event. Indicating possible as coordinates X and Y or roughly as zip code number or municipality.
- Survey Method - indication of the survey method of data.

All core attributes per sector were grouped into four main entities as shown in Figure 25 for the residential sector.

- flood characteristics (in place of **hazard event identification**),
- object characteristics (in place of **affected elements**),
- damage information (in place of **loss indicators**)
- information about precautions taken.

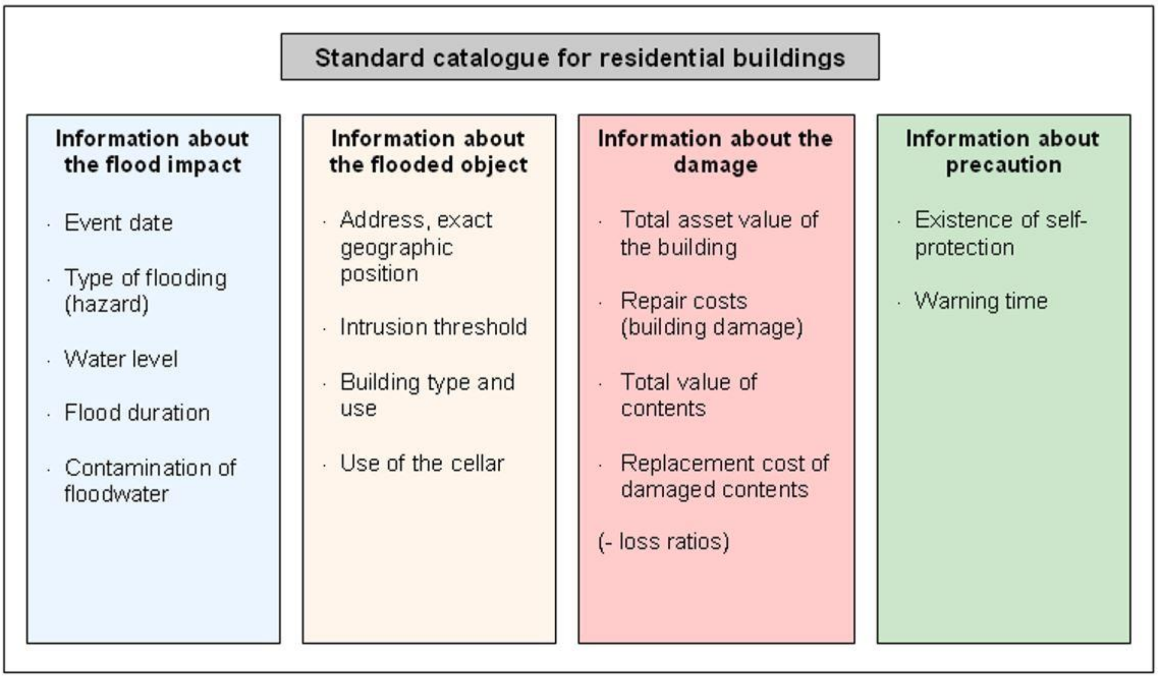

Figure 17: HOWAS21 data model for residential sector [46]

Flood type are classified based on different triggering meteorological event:

- Flood due to prolonged rainfall
- Flood due to heavy rain at high antecedent soil moisture
- Flash floods as a result of storms or summer local heavy rain
- Floods caused by snowmelt
- Flood due to a combination of rainfall and snowmelt.

Flood loss datasets general standards for the collection of damage data were developed for five different sectors:

- the residential,
- commercial (including industrial sites and public infrastructure except for transportation)
- agricultural sector
- transportation and
- water management (including damage to water courses and flood defense).

They have been designed as part of a multi-stage survey of experts in the flood analysis for each of the aforementioned sectors [28][45].

8.6.5 Public communication

As outlined above, a part of the database can be searched and accessed by the public (user group *World*) via the internet.

8.7 Greece (EL)

Contact point: Charalampos (Haris) Kontoes, NOA/ISARS

Name of the loss database: Fire Disaster Database (Ministry of Environment, Energy & Climate Change), Fire Brigade event database (Ministry of Public Order and Citizen Protection) and Asset

Loss database for fires, floods, earthquakes, landslides and volcanoes (Ministry of Infrastructures, Transport, and Networks)
Language: Greek

8.7.1 NATIONAL DRIVERS FOR LOSS DATA

The loss data are collected for loss accounting, disaster forensic and risk modelling used by policy, expert teams and research community at local and national level. Main users are Ministry of Environment, Directorate for Forest and Natural Environment Protection, Anti-seismic Planning and Protection Organization, Earthquake Rehabilitation Service, Civil Protection, etc. There are more than one organization collecting event/loss data:

- Ministry of Environment, Energy & Climate Change, Special Secretariat for Forests General Directorate of Development & Forest Protection is responsible for Fire Disaster Database,
- Ministry of Public Order and Citizen Protection, National Fire Brigade Authority is responsible for Fire Brigade event database and
- Ministry of Infrastructures, Transport, and Networks, Earthquake Rehabilitation Service for Asset Loss database for fires, floods, earthquakes, landslides and volcanoes. Asset Loss database is very comprehensive database at asset level and national scope with temporal coverage from 1978 to 2014, continuously updated and sustainable.

8.7.2 METHODOLOGY OF COLLECTION

Fire Disaster Database: Reporting takes place on the basis of the single fire event. Mandated organization for the assessment process is national Forestry services at municipality level. The data are aggregated at the level of the region and country.
Fire Brigade event database: Reporting takes place on the basis of the single call event during the operations and immediately after the fire end. Mandated organization for the assessment process is the Fire Control Center of Operations that send collected data to the State authorities on daily basis.

Asset Loss database

Triggering mechanism/Techniques used to assed data: When damages on building stock and infrastructures occur, they are recorded based on exhaustive field works. A traffic light qualitative reporting scheme is used based on red buildings (destroyed), yellow, partially destroyed and, green (no affected). That first assessment is following almost immediately after the first shock for precise recordings and rapid damage assessment.

8.7.3 METHODOLOGY OF RECORDING

Fire Disaster Database: The data are aggregated at the level of the region and country by Ministry of Environment, Energy & Climate Change.
Fire Brigade event database: Collected data are sent to the State authorities on daily basis.

Asset Loss database

Mandated organization: The data are aggregated at the level of the municipality, region and country by Ministry of Infrastructures, Transport, and Networks.

Processing of the collected data: Database is linked to the cadastre where available. BEYOND centre also records and maps the damages using satellite/airborne images at national level due to fires, earthquakes, and other types of disasters.
Aggregation of collected data:
Storing and accessing data:

8.7.4 MODEL OF DISASTER LOSS DATABASE

Fire Disaster Database content covers:

- Name & contact details of the public servant reporting the event.
- Forestry service data (name of the region, code id, Municipality id, Forest id, ZIP code)
- Data relating to fire ignition (date, time, etc), fire brigade first attack (date, time), army intervention (if any).
- Duration of the fire
- Cause identification (known/unknown; if known select from a number of more than 30 listed different cases of natural or human induced causes).
- Forest damages reporting (types of forest, corresponding surface).
- Other damages such as agricultural farms, settlements, houses, livestock, other activities (type, and surface).
- Public/Private land (Surface).
- Meteorological data during the fire crisis (station id, wind, temperature, humidity).
- Slope, aspect, rock, canopy underlying density, forest density, ignition point, fire type.
- Means and methods used for firefighting (numbers of firefighters, soldiers, volunteers, number and types of vehicles, airplanes, helicopters).
- Cost for personnel, cost for machinery.
- Participation of Local Forestry Service experts, vehicles, and other machinery.

Asset Loss database

Hazard event identification

All hazard data is recorded in database. Geographical location of hazard event is recorded by subnational units, latitude and longitude of footprints. Hazard classification used is the combination of INSPIRE HazardCategoryValue and internal standard.

Affected elements

Information about the affected object include the name of municipality, name of the owner, building classification etc., land use code, and type of construction.

Loss Indicators

The database loss indicators cover human losses, physical damage and economic losses such as information relating to the type of damages, repairs, and loans for making restorations.

8.8 ITALY (IT)

Contact point: Roberto Rudari, CIMA Research Foundation
Scira Menoni, Politecnico di Milano
Name of the loss database: AVI database for hydrogeological events and Earthquake database
Language: Italian

8.8.1 NATIONAL DRIVERS FOR LOSS DATA

AVI (Aree Vulnerate Italiane) AVI database for floods and landslides spans from late 1800 to 2013 and it is continuously updated by CNR-IRPI with the institutional endorsement from the Italian Civil Protection Department. AVI database is fundamentally an event catalogue for research purposes, however, due to its National coverage and relative richness has been used for institutional evaluations even recently (e.g., National Risk Assessment Plan for Italy). Its sustainability is subject to funding, as it is mainly a DB that is compiled from journalistic sources and media. From 1950 to January 2011 has been put in the EU Flood Directive DB Schema; temporarily becoming the National Flood DB. The process is driven by legal requirements of the Flood Directive, and is supervised by the Civil Protection Department; data collection is a responsibility of the regional level. At the moment it is more event counting database compiled to produce flooding and landslide risk maps. The main users of the AVI database are different Institutions, Civil Protection System and Planning Authorities. The database has a national scope. The minimum geographical unit for data recording is the municipal scale, but a good percentage of events are recorded with more precise Geolocation.
In the near future the National official catalogue for floods will be a collection of the regional data bases federated at national scale. The AVI archive will be maintained as a complementary archive at National Scale to be mainly used for research purposes. The two information sources will be constantly maintained synchronized and compliant. A prototype of such Catalogue exists and it is based on a modified version of the EU Flood Directive schema[54]. Forms established in order to evaluate the residual risk pending on assets in the immediate aftermath have been elaborated and will be adopted shortly. Such forms contain important data for damage evaluation end context information that in the future will feed the Catalogue, enhancing its sustainability.
Instituto Nazionale di Geofisica e Vulcanologia collects earthquake event data covering historical records from 1005 to 2011 for risk modelling. It is continuously updated and sustainable. The main users are Civil Protection, Research centres, Public administrations.

[54] http://apps.cimafoundation.org/ImpactsArchive/

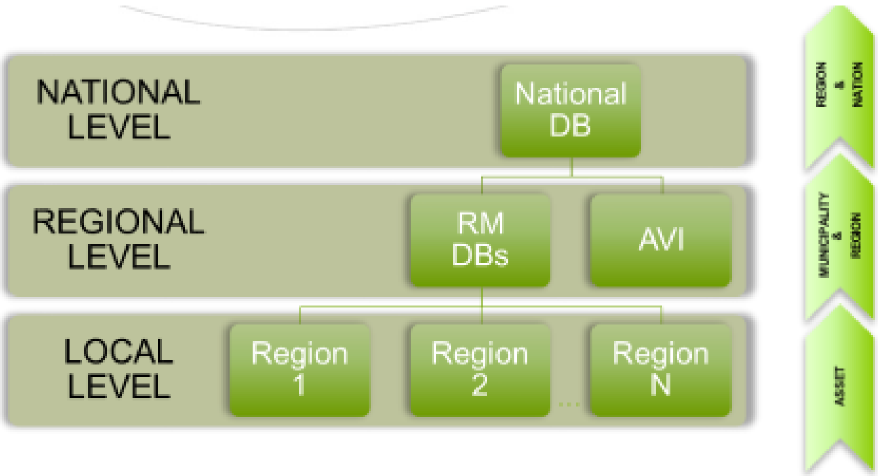

Figure 18: The flood catalogue in Italy

8.8.2 METHODOLOGY OF COLLECTION

Mandated organization: Collection procedure is upon the Regions, under the supervision of the Italian Civil Protection Department and ISPRA – Ministry of Environment. Municipalities, depending on their dimension and capacity often are the ones collecting data on the territory regarding floods and landslides damages.
Triggering mechanism: the triggering mechanism depends on each region for the regional databases.
Data collection technique: Flood losses are assessed immediately after the disaster through collection of municipal and regional claims for the compensation purposes to national funds.
Quality assurance: N/A

8.8.3 METHODOLOGY OF RECORDING

Mandated organization: The AVI National flood database is maintained by CNR-IRPI under the coordination of the National Department of Civil Protection. The Federated databases will be maintained by the different Regions coordinated at national Level by the National Department of Civil Protection.
Aggregation: Records can be accessed singularly or aggregated at different administrative units level. The municipality level remains the reference administrative unit for data recording and consultation.
Storing and accessing information: each Regional database is stored locally and then federated at national level. The data are disseminated through the Flood catalogue portal[55]

[55] http://apps.cimafoundation.org/ImpactsArchive/

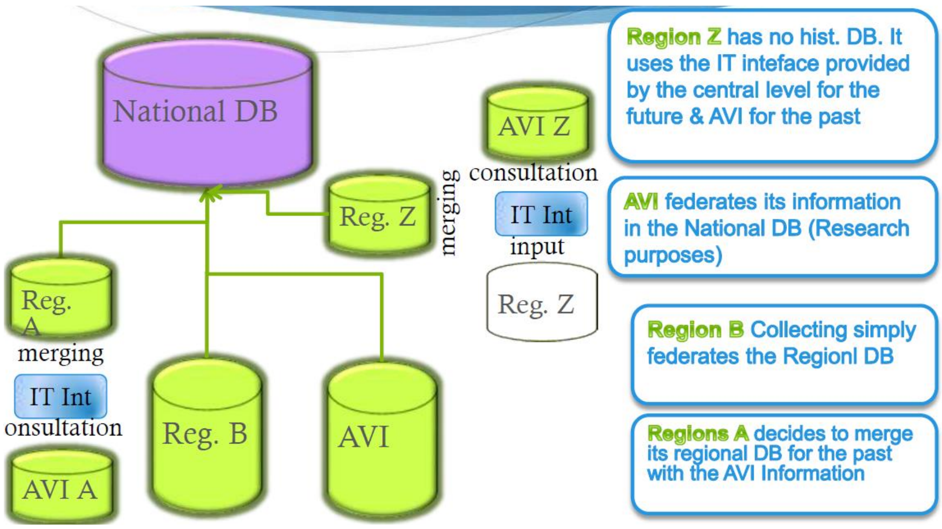

Figure 19: The federated databases in Italy is maintained by different Regions and coordinated at the national level.

8.8.4 MODEL OF DISASTER LOSS DATABASE

AVI Data model consists of the:

- detailed data of the flood event
- human loss and physical damage indicators in agreement with the DesInventar methodology.

Hazard event identification

All hazard data are recorded in the database. Hazard event information covered in the flood catalogue are:

- Event origin: fluvial, groundwater, sea water, artificial water bearing infrastructure, no data available;
- Event mechanism: natural exceedance, defense exceedance, defense or infrastructural failure, blockage/restriction, no data available;
- Event characteristics: flash flood, snow melt flood, other rapid onset, medium onset flood, slow onset flood, debris flow, high velocity flow, deep flow, no data available.

Hazard event is geo-referenced by NUTS3 administration level and lat/lon footprint of the flooded area. Temporal information of the hazard event is given with the date of commencement and its duration. Hazard classification follows CRED/MunichRE peril classification. There is internal hazard event identifier.

Loss indicators

Loss indicators in the flood catalogue covers the following elements:

- economic: economic, property, infrastructure, rural land use, economic activity, not applicable;
- social: human health (social), human health, community, not applicable;
- environmental: environment, water body status, protected areas, pollution sources, not applicable;
- cultural: cultural heritage, cultural assets, landscape, not applicable

Loss/Damage indicators for assets are graded on a qualitative scale: very high (VH), high (H), medium (M), low (L), insignificant (I), unknown (U).

8.8.5 PUBLIC COMMUNICATION

The data can be consulted through the Flood Catalogue portal. The portal is still in its experimental phase and it is password protected. All institutional actors have access to the portal.

8.9 NETHERLAND (NL)

In the Netherlands loss data are not recorded by one organization nor it is very well organized:

- Rijkswaterstaat is responsible for the registration of accidents / disasters involving ships on the water and traffic on land.
- The ministry of Infrastructuur en Milieu, ministry of Binnenlandse Zaken and the provinces have developed the national Risicokaart (map of risks) after several major disasters
- The Netherlands is divided into Safety regions (Veiligheidsregio's) who have a role in recording data on disasters.
- The new institute Instituut Fysieke Veiligheid (= physical safety; http://www.ifv.nl/). A national institute supporting the safety regions.
- Finally the national coordinator for counter-terrorism and safety (Nationaal Coördinator Terrorismebestrijding en Veiligheid, NCTV; http://www.nctv.nl/). It is unclear if this organization maintains a dataset on disasters in our country, despite efforts to get clarification about this.

INFORMATION MODEL: PUBLIC ORDER AND SAFETY

In addition, there is a Dutch information model about safety (Information Model Openbare Orde En veiligheid, IMOOV, http://www.geonovum.nl/wegwijzer/standaarden/informatiemodel-imoov-uml-model-versie-11). However, this model is quite high-level. It was published in 2008 but is not being used in practice.

The information model describes disasters and incidents, focusing mostly on actions taken and related risk management measures. However it also models the disaster or incident's effect in terms of the affected area and with a textual description, as well as listing the number of affected objects: vehicles, buildings, terrains, infrastructural objects, animals, flora and/or humans (categorized by 4 triage levels).

The information model also has a list of disaster types (translated from Dutch):

- Air traffic disaster
- Accident on water
- Traffic accident on land
- Accident with flamable/explosive material
- Accident with poisonous substance
- Nuclear accident
- Threat to public health
- Disease epidemic
- Accident in tunnel
- Fire in large building

- Collapse of large building
- Panicked crowd
- Large scale disturbance of order
- Flooding
- Natural fire
- Extreme weather
- Failure of utilities
- Disaster at distance

8.10 PORTUGAL (PT)

Contact point: Joao Verde, National Authority for Civil Protection
Name of the loss database: SADO
Language: Portuguese

8.10.1 NATIONAL DRIVERS FOR LOSS DATA

Since 2006 the Ministry of Internal Affairs (through the National Authority for Civil Protection) established a Civil Protection intervention database under public funding to support decision making for civil protection operations. It is not primarily designed for loss accounting and therefore does not provide data for compensation at this time. The input is triggered through the emergency operations, being that loss data collection after emergencies is not mandatory for database insertion even though the system allows recording such data (e.g. fields for physical damage and loss value at asset level). Its data is frequently used for risk modelling and partially fit for forensic purposes while providing the exact location of the event. The main users are Organizations under the Ministry of Internal Affairs and Ministry for Agriculture and Sea, Universities and Mass Media.
In Portugal there is another loss database not linked to any governmental organization which was developed by the DISASTER national research project led by Prof. José Zêzere (http://riskam.ul.pt/disaster/en/). The project developed a GIS database covering floods and landslides that occurred in Portugal from 1865 to 2010. The database registers dead, injured, missing, evacuated and displaced people.

8.10.2 METHODOLOGY OF COLLECTION

A field assessment methodology for loss data recording on this database is not established at this time.

8.10.3 METHODOLOGY OF RECORDING

Mandated organization for recording the information and maintenance of the database is National Authority for Civil protection. Specification for data model and the software have been deeply influenced by the tradition and practice of fire fighters, only recently have begun to broaden the scope.

Processing of the collected data: For assuring the quality of data they refer to external databases. In the case of wildfires, the Civil Protection database overwrites estimates with definitive loss data taken from the national wildfire database (only lost hectares). To ensure the correct relationship the correlation between the internal record and identifier of the external database is recorded. There is an option to store multiple values, estimates or different version for most value fields to handle with the uncertainty.
Aggregation: The software allows aggregation of collected data from smaller to larger spatial unit of analysis based on NUTS classification and other national administrative units.
Storing and accessing: The database is operated on a secure and redundant platform, being accessed on a client/server fashion over TCP/IP. Only authorized users are allowed on the database, and multiple user profiles exist depending on their specific needs. Database operations are audited for accountability and quality assurance.

8.10.4 MODEL OF DISASTER LOSS DATABASE

Data model allows to record event data as well as human loss and physical damage/loss indicators.
Hazard event identification
All hazard data are recorded in the database with the internal event identifier. Geographical location is recorded with subnational units affected, longitude/latitude or footprint using variety of standards (NUTS, ETRS89, WGS84). Temporal information of the event is defined with date and time. The **hazard event classification** used is internal and rather extensive. It distinguishes three levels: family, group and events. Hazard classification at the family and group level is:

- Natural hazards
  - Natural phenomena
- Technological hazards
  - Urban fires
  - Fires in equipments and products
  - Fires in Transports
  - Accidents
  - Industrial and technological accidents
- Mixed hazards
  - Rural fires/Wildfires
  - Waste fires
  - Compromising safety of structures or service
- Protection and assistance
  - Health assistance
  - Conflicts
  - Prevention and assistance
- Operations and alert states
  - Operations
  - Alert states.

Event level of natural phenomena encompasses:

- Floods
- Strong winds

- Snowfall
- Earthquakes
- Heat waves
- Cold waves
- Droughts
- Coastal flooding
- Cave collapse
- Volcanic activity
- Meteorite fall

Data fields referring to **human loss indicators** are shown in Table 35 :

Table 33: Human loss indicators in Portuguese database

Date/Time	Severity					Type of Victim		Total
	Deaths	Severely Injured	Lightly Injured	Assisted	Others	APC*	Others	

First, the total number of victims are broken down by severity of human impact:

- Deaths – number of killed
- Severely injured - injures that require hospital care for a period of 24 or more hours.
- Not severely injured - injures that either do not require medical assistance or if hospital care is required, only for a period under 24 hours.
- Assisted - those that have been helped in any way, just not in relation to injuries.
- Others - a rarely used field and it usually relates to people with minor injuries who do not want to be helped/assisted.
- Total number of victims – the sum of deaths, severely injured, lightly injured, assisted and others

Second, the total number of victims are brokendown by the type of victim :

- APC (Agentes de Proteccao Civil – Operative victims of any organization considered by law as a civil protection agent)
  - From the National Authority for Civil Protection
  - Firefighters
  - Military
  - Other APC
- Other (Not operative victims)
  - Civillian
  - Foreigners

The Operative Victims and Not Operative Victims are a partition Total number of victims, that is, they're part of that total and only serve the purpose of dividing the total according to the nature of the victim, if it is an operative, or not.

Furthermore, for any type of victim, we can record the following:

- Encarcerated (Yes/No)
- Gender
- Age
- Other uncategorized details/info (free text)

Table 34. Human loss indicators used by GDPCE Spain translated into the human loss indicator framework proposed by the JRC (see section 4.3.3)

<table>
<tr><th>Portugal</th><th colspan="2">Main fields</th><th>Definitions</th><th colspan="3">Breaking down the fields
(general options: by gender, by age, by vulnerable groups, …)</th></tr>
<tr><td rowspan="7">DIRECTLY AFFECTED
primary level by ECLAC</td><td colspan="2" rowspan="2">Fatalities</td><td rowspan="2">Total mortality</td><td colspan="3">Killed</td></tr>
<tr><td colspan="3">Missing</td></tr>
<tr><td rowspan="4">PEOPLE IN NEED</td><td>Injured/disease/in need of medical assistance</td><td colspan="4">People that are in need of immediate medical assistance as a direct result of the disaster</td></tr>
<tr><td rowspan="2">Evacuated</td><td rowspan="2">People that are removed from a place of danger to a safer place. Breaking down that field is related to the management of different disaster phases.</td><td>EARLY WARNING</td><td>RESPONSE CAPACITY</td><td>RECOVERY</td></tr>
<tr><td>Pre-event
Post-event</td><td>Sheltered by emergency services
Sheltered by private arrangements
Relocated
Without shelter</td><td>Permanently homeless
Temporarily homeless</td></tr>
<tr><td>Isolated</td><td colspan="4">People that suffer physical damage of infrastructure which threatens their basic livelihood conditions (limited access to water, food, electricity, ….) but they have not been evacuated</td></tr>
<tr><td colspan="2">Victims</td><td colspan="4">People that suffer physical damage of their property but are not in need</td></tr>
<tr><td rowspan="2">INDIRECTLY AFFECTED</td><td colspan="2">Secondary level - within affected area (by ECLAC)</td><td colspan="4" rowspan="2">People that suffer of a disaster's indirect effects (e.g., loss of flow, deficiencies in public service)</td></tr>
<tr><td colspan="2">Tertiary level - outside affected area (by ECLAC)</td></tr>
</table>

Damage/loss indicators cover physical damage to property and its monetary conversion that is direct tangible losses. The data on estimated value is extremely scarce at the moment, usually only done for wildfires. Intangible damage refer to damage of natural environment while cultural heritage is not considered. There are three types of tables within a data model to cover physical damage indicators depending on the type of assets: elements, deployed assets and assorted equipment

Table 35: Physical damage indicators for elements in Portuguese database

Physical Damage						
Date/Time	Element (what?)	Quantity	Unit	Description	Where?	Estimated Value

The "Element" can be any of the following:

- Environmental
  - Pollution/Contamination
    - Aquatic
    - Atmospheric
    - Infrastructure
    - Soil
- Property
  - Animals
    - Injured
    - Dead
  - Burnt Area (Wildfire)
    - Agricultural
    - Forest Stands
      - (several types of forest stands can be defined, eg. Pine, Oak, …)
    - Shrubs
  - Buildings
    - Administrative

        - Commerce and transportation platforms/stations
        - Sports and Leisure
        - Schools
        - Theaters/Show rooms
        - Housing
        - Strategic
        - Hospitals/Healthcare
        - Hotels and Restaurants
        - Industrial
        - Museums and art galleries
    - Infrastructure
        - Dams and Levees
        - Railways
        - Roads
        - Bridges and overpasses
        - Others
    - Vehicles
- Estate
    - Structural damage

Furthermore, the "Quantity" relates to the "Unit", which can be: hectares, units (non dimensional), kilograms, kilometers, liters, cubic meters. There is also a possibility for "miles" and "nautical miles".

Table 36: Physical damage indicators for deployed assets in Portuguese database

Damages in deployed assets					
Date/Time	Entity (owner)	Asset	Inoperative (Yes/No)	Description	Estimated Value

Table 37 allows for the collection of damages in any equipment, vehicle or good/asset deployed to an operation. The "Entity" is the owner of the damaged good or asset. As a consequence of the damage, the asset might (or might not) be rendered "Inoperative", which flags it as unavailable for subsequent requests.

Table 37: Physical damage indicators for assorted equipment in Portuguese database

Damages assorted equipment					
Date/Time	Entity (owner)	Asset	Equipment	Quantity	Estimated Value

In Table 38 it is assumed that assorted equipments are part of another asset (e.g., the asset is a vehicle, and the equipment is a fire hose), therefore the equipment must be recorded in relation to some Asset.

8.10.5 PUBLIC COMMUNICATION

Database records are not readily accessible to the public. Even though there isn't any classified information on this database, there are privacy concerns that recommend having this as a reserved system. Public requests for information are met on a case by case basis. The National Authority for Civil Protection does publish on a near real-time basis some details for the major ongoing operations through their website.

8.11 Romania (RO)

Contact point: Doina Hategan, General Inspectorate for Emergency Situations
Name of the loss database:
Language: Romanian

8.11.1 National drivers for loss data

Romania has an application for assessing and recording losses for floods and snow emergencies and a legal system that guarantees its sustainability. Other hazard types are recorded as well but are not part of this application and often ha. The mandated organization is the Ministry of Internal Affairs that mobilizes the County Inspectorate for Emergency Situation and field experts. The losses are reported at the national level. So the losses are assessed at municipality scale and recorded at national scope. Data are used by the Ministry of Internal Affairs, Ministry of Environment and Climate Change and the Ministry of Regional Development and Public Administration to deal with loss accounting and risk management.

8.11.2 Methodology of collection

Mandated organization: The mandated organizations for gathering data from the field are County Inspectorates for Emergency Situation (41 counties and municipality of Bucharest – NUTS3).
Triggering mechanism: Beginning of the event
Techniques of data assessment: Official reports made by local specialized agencies
Ensuring reliability of information: Field assessment

8.11.3 Methodology of recording

Mandated organization: Web-based application for the management of the emergency situation generated by severe weather phenomena and floods is developed and maintained by General Inspectorate for Emergency Situations.
Processing of the collected data/aggregation of collected data/storing and accessing data: Web-based application allows input and centralization of operative data of interest in real-time as well as issuing reports immediately after the disaster and reports covering larger period of time whenever is necessary.
The loss database is independent and there are no links to other databases.

8.11.4 Model of disaster loss database

The data model terminology is defined by legislation.

Hazard event identification

Geographical location of hazard is defined by subnational units and temporal information is defined with date and time format. It covers two hazard types: severe weather and floods defined in Table 39. Other types of natural hazard manifesting on Romanian territory such as earthquake, landslides and forest fires are mentioned in the legislation as well but without having a specific legal definition.

Table 38: Hazard types covered in Romanian databases

Hazard type	Definition (English)	Definition (Romanian)
Severe weather phenomena	Heavy rain, heavy snow, storms and blizzard, frost, glaze, heat wave, hail and drought	Ploi torenţiale, ninsori abundente, furtuni şi viscole, depuneri de gheaţă, chiciură, polei, îngheţuri timpurii sau târzii, caniculă, grindină şi secetă
Floods	Natural river overflow caused by the increase of water flow due to extreme precipitation and/or sudden snow melt or by occurrence of blockages formed by insufficient length of bridge section, ice jams or debris, landslides, mudslides, avalanches, as well as flooding on the flanks;	Inundaţii, ca urmare a revărsărilor naturale ale cursurilor de apă cauzate de creşterea debitelor provenite din precipitaţii şi/sau din topirea bruscă a stratului de zăpadă sau a blocajelor cauzate de dimensiunile insuficiente ale secţiunilor de scurgere a podurilor şi podeţelor, blocajelor produse de gheţuri sau de plutitori (deşeuri şi material lemnos), alunecări de teren, aluviuni şi avalanşe de zăpadă, precum şi inundaţii prin scurgeri de pe versanţi;
	Accidents and failures of hydro technical buildings;	Inundaţii provocate de incidente, accidente sau avarii la construcţiile hidrotehnice;
	Rise of groundwater level	Inundaţii produse de ridicarea nivelului pânzei de apă freatică

Affected elements are geo-referenced by subnational units and property assets are classified into different sectors.

Loss indicators

General Inspectorate for Emergency Situations uses the following indicators in their emergency situations reports:

- People directly affected;
- Physical damage – destroyed, damaged;
- Direct economic losses;
- Indirect economic losses;
- Total economic damages;

The following **human loss indicators** were set in internal regulations at General Inspectorate for Emergency Situations level and there are mostly used for fire interventions, but also for other emergency situations.

Table 39: General Inspectorate for Emergency Situations human loss indicator framework for fires

Human loss indicators	Definition (in English)	Definition (in Romanian)
Deaths (Decedaţi)	Number of dead people as result of fires (burned or asphyxiated) or other emergency situations (drowned, deadly injured in an accident etc.)	Numărul persoanelor decedate în urma incendiilor (arşi sau asfixiaţi) ori din alte situaţii (înecaţi, ca urmare a diverselor accidente etc.)
Injured/Disabled (Răniţi/mutilaţi)	Number of persons intoxicated with smoke or gases, burned or injured in an accident	Numărul persoanelor intoxicate cu fum sau gaze toxice, cu arsuri sau răniţi în urma accidentelor

The human loss indicators for other emergency situations (in particular, floods and heavy snow) consists of:

- Deaths;
- Injured;
- Isolated;
- Missing;
- Saved;
- Total evacuated (moved to relatives/accommodated in dedicated shelters/in local administrations buildings).

Table 40. Human loss indicators used by GDPCE Spain translated into the human loss indicator framework proposed by the JRC (see section 4.3.3)

<table>
<tr><th>Romania</th><th colspan="2">Main fields</th><th>Definitions</th><th colspan="3">Breaking down the fields
(general options: by gender, by age, by vulnerable groups, ...)</th></tr>
<tr><td rowspan="7">DIRECTLY AFFECTED
primary level by ECLAC</td><td colspan="2" rowspan="2">Fatalities</td><td rowspan="2">Total mortality</td><td colspan="3">Killed</td></tr>
<tr><td colspan="3">Missing</td></tr>
<tr><td rowspan="4">PEOPLE IN NEED</td><td>Injured/disease/in need of medical assistance</td><td colspan="4">People that are in need of immediate medical assistance as a direct result of the disaster</td></tr>
<tr><td rowspan="2">Evacuated</td><td rowspan="2">People that are removed from a place of danger to a safer place. Breaking down that field is related to the management of different disaster phases.</td><td>EARLY WARNING</td><td>RESPONSE CAPACITY</td><td>RECOVERY</td></tr>
<tr><td>Pre-event
Post-event</td><td>Sheltered by emergency services
Sheltered by private arrangements
Relocated
Without shelter</td><td>Permanently homeless
Temporarily homeless</td></tr>
<tr><td>Isolated</td><td colspan="4">People that suffer physical damage of infrastructure which threatens their basic livelihood conditions (limited access to water, food, electricity, ...) but they have not been evacuated</td></tr>
<tr><td colspan="2">Victims</td><td colspan="4">People that suffer physical damage of their property but are not in need</td></tr>
<tr><td rowspan="2">INDIRECTLY AFFECTED</td><td colspan="2">Secondary level - within affected area (by ECLAC)</td><td colspan="4" rowspan="2">People that suffer of a disaster's indirect effects (e.g., loss of flow, deficiencies in public service)</td></tr>
<tr><td colspan="2">Tertiary level - outside affected area (by ECLAC)</td></tr>
</table>

Figure 20: An example of human loss report

Data Start 01.01.2014 00:00:00 Data Sfarsit 01.05.2014 00:00:00 View Report

1 of 2 ? Find | Next

MINISTERUL AFACERILOR INTERNE
INSPECTORATUL GENERAL PENTRU SITUATII DE URGENTA

SITUATIA CENTRALIZATOARE PRIVIND EFECTELE INUNDATIILOR IN PERIOADA 01.01.2014, ora 05:00 -- 01.05.2014, ora 05:00

ASUPRA POPULAŢIEI ŞI A COLECTIVITĂŢILOR DE ANIMALE

ANEXA R-1

		Persoane					Persoane evacuate				Animale	
		Izolate	Ranite	Disparute	Decedate	Salvate	La rude	In tabere de sinistrati	In spatii adm. locala	TOTAL Persoane evacuate	Izolate	Salvate
JUDEŢUL BUZĂU	Total judet	12	0	0	0	0	7	0	0	7	0	0
JUDEŢUL DÂMBOVIŢA	Total judet	170	0	0	0	0	0	0	0	0	0	0
JUDEŢUL GIURGIU	Total judet	0	0	0	0	0	1	0	0	1	0	0
JUDEŢUL OLT	Total judet	3	0	0	0	0	153	0	58	211	200	0
JUDEŢUL PRAHOVA	Total judet	3	0	0	0	3	0	0	0	0	726	726
JUDEŢUL TELEORMAN	Total judet	147	0	1	0	8	166	0	45	211	0	1799
JUDEŢUL VRANCEA	Total judet	18	0	0	0	0	0	0	28	28	0	0
Total general		353	0	1	0	11	327	0	131	458	926	2525

Disaggregation of physical damage indicators is based on sectors (Table 41)

- Physical damage to property – destroyed, damaged;
- Damage to socio-economical and administrative buildings – schools, nursery, church, hospital, town hall etc.)
- Damage to cultural heritage – museums, monuments etc.;
- Damage to protected area – natural reservations, Natura 2000, UNESCO;
- Damage to bridges, highways, roads, railway,
- Damage to agricultural field, pastures, forests;
- Damage to public service network – water supply, sewers, electricity, telecommunications, gas;
- Flooded wells;
- Dead animals;
- Damage to hydro technical buildings;
- Damages caused by accidental pollution due to flooding.

These indicators are later on transformed in monetary value by a dedicated commission of experts designated by the County Prefect from all fields and associated with one of the sectors (Table 41)

Table 41: Division of sectors for assessed indicators

Social sector	• Buildings • Homestead • Public administration
Infrastructure	• Public services (energy, gas, drinking water and sanitation) • Transport and warehouses • Post offices and telecommunication • Financial activities
Economic sector	• Agriculture and auxiliary services • Forestry • Fishing and fish breeding

	• Industry • Trade and repairs • Hotels and restaurants

8.11.5 Public communication

The databases are only available to the authorities, and not to the public.
However processed information are made public available trough:

- reports of events/disasters happened - prepared by responsible institutions with the risk type management;
- National, Ministerial and County Emergency Situations Committees annual activity reports.

8.12 Slovenia (SI)

Contact point: Ana Jaksic, ACPDR - Administration for Civil Protection and Disaster Relief, Ministry of Defense.
Name of the loss database: AJDA
Language: Slovene

8.12.1 National drivers for loss data

In Slovenia damage evaluation is facilitated by a strong and binding legislation. Since 2003 the Republic of Slovenia has developed detailed methodology for determining, assessing and documenting the damage on the national, regional and municipal level (The Decree on the Damage Evaluation Methodology and The Act on the Recovery from the Consequences of Natural Disasters) that has been carried out by Administration for Civil Protection and Disaster Relief as the competent authority in accordance with the Act on Protection Against Natural and Other Disasters (2003, 2006, 2010). On the basis of the experience and regularly amendments the damage assessment methodology has been continuously upgraded.
It focuses only on natural hazards and looks at impacts on agriculture production, property (buildings and infrastructure) and economy. The scope of this initiative is the national level; its scale is at asset level. Damage evaluation is a state instrument which the Government of the Republic of Slovenia uses to assess damage cause by disaster and determine whether the conditions to involve the state in disaster recovery exist. In addition to insurance, this instrument is a component of systemic solutions for the elimination of the consequences of natural disasters. On the basis of the data gathered, the Government confirms a final assessment of damage to crops and property to prepare the recovery plan.
In the Republic of Slovenia, basic principles for the involvement of the state in disaster recovery are the following:

- that estimates of direct damage to property or agriculture exceed 0.03 per cent of planned state budget revenue;

- that the sum of resources allocated for the reconstruction of property according to the law[56], the resources allocated as payment of insurance amounts, and the resources allocated for reconstruction from the state and local budgets on the basis of other provisions shall not be greater than all the resources needed for the reconstruction of property;
- that the amount of resources for disaster recovery on property intended for economic activity, and in the implementation of supervision of the use of these resources does not signify the acquisition of advantages over competitors in such a way that it shall endanger or could endanger the market of goods or services;
- that the sum of the resources for the elimination of the consequences of damage in agriculture, allocated according to law, the resources allocated as payments of insurance amounts, and the resources allocated from the state and local budgets as direct payments in agriculture to address the consequences of natural disasters, in accordance with the rules governing indirect and direct payments in agriculture, is not greater than the market value of the loss of agricultural produce.

The main users are by the Ministry of Finance, the Ministry of Agriculture and the Environment, the Ministry of Infrastructure and Spatial Planning, the Ministry of Economic Development and Technology, the Tax Administration of the Republic of Slovenia, the Statistical Office of the Republic of Slovenia and the European Solidarity Fund.

Damage reports combined with studies of the legal, economic, social, psychological and other aspects of disasters are used also in disaster forensic and risk modeling purposes, i.e., learning from past event and identifying the cause to take action for better preparedness and model the future losses mainly through research organizations and institutes at the national level.

Institute of Agriculture is developing computer algorithms of drought prediction models using crops damage data due to drought. Reports on damage and the data in the AJDA information system are also used by the Ministry of Agriculture and the Environment to implement agricultural policy and prepare new policies (selection of more suitable crops for cultivation on light soils). Municipalities use the data to prepare municipal spatial plans, while the state uses them in the preparation of national spatial plans. Institute for Water of the Republic of Slovenia carried out the research using damage data of recent floods in 2012 along Drava River to model flood risk. The results of the research will be used in planning and the implementation of measures to improve flood control on the Drava and in the wider Danubian region.

8.12.2 METHODOLOGY OF COLLECTION

Mandated organization for damage assessment is Administration for Civil Protection and Disaster Relief in collaboration with the Association of Municipalities and Towns of Slovenia and the Association of Municipalities of Slovenia. In wider perspective when organizing or optimizing procedures for the evaluation and mutual provision of data, the following organizations are also involved: the Slovenian Environment Agency (ARSO), the Agency for Agricultural Markets and Rural Development (ARSKTRP), the Farmland and Forest Fund of the Republic of Slovenia, the Chamber of Agriculture and Forestry, the Agricultural Institute of Slovenia, the Institute for Water

[56] The Act on the Recovery from the Consequences of Natural Disasters (Official Gazette of the Republic of Slovenia, no. 114/2005, in effect since 30 November 2005);

of the Republic of Slovenia, faculties (Biotechnical Faculty, Faculty of Civil and Geodetic Engineering), the Statistical Office of the Republic of Slovenia (SURS), the Institute for the Protection of Cultural Heritage of Slovenia, the Slovenian Institute for Forests, the Eco Fund (Slovenian Environmental Public Fund which is the legal successor of the Environmental Fund of the Republic of Slovenia), the Surveying and Mapping Authority of the Republic of Slovenia, the Tax Administration, the Court of Auditors, insurance companies etc.

The system for damage assessment works at the local, regional and national levels of Civil Protection. At the local level, 211 municipal damage assessment commissions are comprised of agricultural and civil engineering experts (over 700 members) appointed by the mayor on the basis of a decision. At the level of 13 regions, regional commission are appointed to assess damage from natural and other disasters (159 members). At the state level, a state commission is appointed to assess damage from natural and other disasters (12 members). The members of the regional commissions and the state commission are appointed by the decision of the Government of the Republic of Slovenia and chosen from professionals from institutions and relevant ministries. The individual members who are not public officials have concluded work contracts to assess damage in the field, as well as eight Agriculture and Forestry Institutions with experts in agriculture.

The education and training of members of damage assessment commissions at all three levels is implemented on the basis of a special training program at the Training Centre for Civil Protection and Disaster Relief. The training includes members of municipal, regional and state damage assessment commissions for the actual damage assessment, as well as the employees in municipal management and Administration for Civil Protection and Disaster Relief branch offices for the use of the AJDA web application. Successful completion of the training is a prerequisite for working on a damage assessment commission.

Triggering mechanism: Loss estimation is triggered when the economic loss estimation at the national level will exceed 0.03% of the national budget. In the case of major disaster the mayor(s) communicates the losses to the regional headquarters of the civil protection, which after validation with field research reports transfers this to the national authority of the civil protection. Based on this early loss estimation the national authority of civil protection adopts in a matter of days a decision about the start of the collection process and passes it back to the municipality.

Data assessment technique: Since 2004, all damage assessment commissions have operated in accordance with the Rules of Procedure for Damage Assessment in Natural and Other Disasters and the Rules of Procedure of the Work of Damage Assessment Commissions. The Decree on the Damage Evaluation Methodology specifies the eight damage assessment forms appropriate for the asset level approach:

- Form 1: Assessment of damage to agricultural land and forests caused by a natural disaster,
- Form 2: Assessment of damage caused by natural disaster to crops in current agricultural production,
- Form 3: Assessment of damage to buildings caused by natural disaster (destroyed facilities),
- Form 4: Assessment of partial damage to buildings caused by a natural disaster,
- Form 5: Assessment of damage to civil engineering works (transport infrastructure, industrial piping, water facilities, etc.) caused by a natural disaster,
- Form 6: Assessment of damage caused by natural disaster to animals, poultry and fish)
- Form 7: Minutes on inspection and assessment of the damage to fixed and current assets - movable property and stocks caused by a natural disaster,

• Form 8: Minutes of the assessment of the loss of income (added value) after a natural disaster.
For the purposes of assessing damage to property, the AJDA application was upgraded in 2008, with a link to the register of buildings and farmland. Damage to property is estimated by damage assessment commissions at various levels: damage to cultural heritage structures is estimated by the Ministry of Culture, to watercourses by the Slovenian Environment Agency; to state roads and the energy industry by the Ministry of Infrastructure and Spatial Planning, and damage to forests by the Slovenian Institute for Forests with its own commissions. In the economy, damage was first evaluated only for facilities and fixed and current assets (movables and stocks). However, since the changes to the regulations in 2007, damage has also been estimated for losses of income. Damage assessment is implemented by the Ministry of Economic Development and Infrastructure.
Quality assurance: Damage assessment commission or the assessor must certify by signature the damage appraisal, the inspection report or the data on the basis of which damage shall be assessed. The injured party shall certify by signature that they have been informed about the damage appraisal, the inspection report or the data on the basis of which damage shall be assessed. On the basis of inspection and the collected documents, criteria used in the judgment shall also be determined. During the inspection, it is necessary to identify the location and the damaged item and to prepare a report which, if necessary, includes photographs of the initial state, sketches and measurement results, the description of injuries, the measured or assessed quantities, the degree of deterioration, and documents on the state of the damaged item before the damage event.

8.12.3 METHODOLOGY OF RECORDING

Mandated organization: Administration for Civil Protection and Disaster Relief also developed and is responsible for the maintenance of information system AJDA for documenting damage on agricultural products and property. It is intended for the centralized electronic capture and processing of applications by victims of natural disasters. It has a very good user authentication system.
AJDA is a technical tool to perform damage recording, in particular in order to facilitate data entry at the municipal level, to control data at the regional and the state level, for the subsequent processing of data to prepare materials for a final evaluation of damage to crops and property, for the completion of applications by victims to allocate funds to address the consequences of natural disasters and, consequently, for the preparation of decisions for victims on the allocation of funds for eliminating the consequences of natural disasters. It also enables other government agencies that assess damage to enter estimates. In this way, the procedures for allocating funds to victims have been significantly shortened.
Processing of the collected data/aggregation of collected data: The information system was basically developed as a web application in ASP.NET technology. Due to poor internet connections and the volume of data entered in a short period of time, it has been reconfigured into a system for a "client - server" application, which means that it is necessary to install the system on each computer separately, and only additionally entered data are exchanged. As input data for its work as well as part of the validation process, the information system uses external data sources from the national records: the register of buildings and agricultural land (the Surveying and Mapping Authority of the Republic of Slovenia – register of spatial units, land cadaster, data on buildings,

etc), the business register of Slovenia (AJPES), farm register (MKO) etc. This approach ensures the collection of high quality data which are verified at different levels of the aggregation process.

The processing of individual data at the primary level is executed through input forms. The information system also includes an analytical and graphic part (a part of the geographic information system, developed especially for such needs). Administration for Civil Protection and Disaster Relief annually updates price lists and publishes them on its website and has also issued a catalogue of model buildings and a manual for the evaluation of buildings.

Storing and accessing data: In the preparation of reports and materials for the Government of the Republic of Slovenia, and in preparation of the program for the elimination of the consequences of damage, ACDPR also cooperates with the Ministry of Agriculture and the Environment, Ministry of Economic Development and Technology, and the Ministry of Infrastructure and Spatial Planning. After the assessment of damage and the relevant decision by the Government of the Republic of Slovenia, databases are transferred to MKO in digital form for the purpose of preparing a program for eliminating the consequences of disasters. Data can also be transferred to eligible users for the purpose of making analyses.

As a rule, the final damage evaluation is prepared within two months after the disaster, and in agriculture before the harvest or at the latest within one month after the harvest. If the damage is assessed due to the same or different types of disasters over a long period of time specified by law, the deadline for preparing the final damage assessment begins to run from the expiry of the period specified by law.

In future, it is planned to link AJDA with the new register of property (instead of links to the register of buildings and agricultural land) and enable the direct completion of victims' applications with pre-prepared data from databases. There is also initiative to link AJDA Information System to Emergency Information system SPIN to upgrade the current disaster loss database with the human losses (killed, injured, rescued). SPIN is a real time Emergency Information System triggered by each interventions of civil protection unit. It is publicly accessible. The searching criteria allows the overview of the intervention by the type of the disaster, type of the intervention unit, month/year, local unit and provide the summary statistics of human loss indicators (killed, injured), number and cost of the interventions, number of the rescuers involved.

8.12.4 MODEL OF DISASTER LOSS DATABASE

Hazard event identification

Damage evaluation methodology[57] includes damage caused by natural and other disasters such as earthquake, subsidence (irruption of gas, water or slime), flood, landslide or avalanche, high snow, strong wind, ice or sleet, frost, drought, storm, hail and industrial accident. Frost shall also include hoar frost if it leads to spring or winter frost, whereas storm shall include heavy rain that causes damage to agricultural production. Landslide shall include landslide and irruption of gas, water or slime, which threaten a settlement or several settlements, civil engineering structures, particularly transport infrastructure facilities, or other large-scale property, and does not include slumps, rock falls and other similar natural phenomena caused particularly by intense rainfall and storms, or changes that occasionally occur on unrestored landslides.

[57]Decree on damage evaluation methodology (Official Gazette of the Republic of Slovenia, no. 67/03, government acts register 2002-1911-0067, in effect since 19 July 2003);

Hazard event identification includes type and time of the disaster.

Loss indicators

Damage is defined as the result of a disaster caused by a reduction in the quantity and quality, market and useful value to real and movable property with regard to time, type, form, scale and intensity of the disaster, and the result of the loss of revenue due to the disaster.
Damage case is a damage at asset level where at a given moment a certain disaster causes damage to property, agricultural production or holding.
Damage group consists of several cases of damage which arise from the same reason in the limited time period of 72 hours, and have the same or similar characteristics. In special situation, e.g., adverse weather conditions or by a massive outbreak of plant pests and animal disease, damage group also consists of several cases of damage which arise from the same or equivalent reason over a long period of time when the conditions in the regulations are fulfilled.
According to this methodology, damage is identified and assessed with regard to the following damage groups:

1. Land
    - 1.1. forests;
    - 1.2. agricultural land;
    - 1.3. land for construction.
2. Facilities:
    - 2.1. buildings (residential and non-residential);
    - 2.2. civil engineering structures;
        - 2.2.1. transport infrastructure facilities (roads, railways, bridges etc);
        - 2.2.2. distribution pipelines for water and waste water; 2
        - 2.2.3. water facilities and other similar facilities;
        - 2.2.4. electric power lines and telecommunications network.
3. Fixed and current assets:
    - 3.1. fixed and current assets – movable property and stocks;
    - 3.2. current agricultural production;
    - 3.3. multiannual plantations.
4. Cultural property:
    - 4.1. cultural and religious buildings, memorials, museums and other similar buildings;
    - 4.2. movable heritage (works of art and other similar works).
5. Loss of revenue in a holding;
6. Others

Damage is divided into:

- **primary damage** consisting of the urgent main and accompanying costs of full recovery of the damaged items, and the cost of repairs and replacement of damaged parts or components. The primary damage also includes the cost of clearing the site of damage , demolition of damaged or unserviceable parts, their removal and the necessary start-up costs;
- **secondary damage** including the costs for the operation of protection, rescue and relief forces and emergency protective or preventive measures for the protection of people, animals and other damaged items against greater damage or destruction. The secondary damage includes protective works, such as protective dykes, ditches, support structures, pumping, removal,

spurting, ploughing, additional fertilization and other similar measures. The secondary damage also includes the costs of protective measures and interventions (temporary relocation, temporary housing, vaccination, deratization and others) which provide the basic conditions for life, and the costs of model research and simulations, damage assessment and other activities for improving damage degree assessments.

The data fields of loss indicators are defined in the context of a standardized economic loss estimation based on a continuously updated price lists.

Affected element

Each damage case is associated with:

- General characteristics: location, type of damaged item, address or head office, ownership, type and time of the disaster, damage group, intended use and activity;
- Technical characteristics: such as the description of the situation and characteristics of the damaged item with regard to the purpose, type of use, age and technical data.

General and technical characteristics are referred to existing code lists or classifications defined by the regulations on the organization and functioning of the monitoring, notification and warning systems, as well as public records.

8.12.5 PUBLIC COMMUNICATION

The disaster loss database is not publicly accessible mainly because they are linked to external registers (e.g., register of property) and contain privacy-related information.

8.13 SPAIN (ES)

Contact point: Almudena Bustamante Gil, General Directorate of Civil Protection and Emergencies (DGPCE) of Ministry of Interior.

Name of the loss database: The National Catalogue of Historical Floods (CNIH) Database in Spain

Language: Spanish

8.13.1 NATIONAL DRIVERS FOR LOSS DATA

Flooding has been a major concern for Spanish government. In 1983, the National Civil Protection Commission constituted the Technical Committee for Flood Emergency (CTEI) to study measures to prevent or reduce the effects of flooding. It has collected historical flood studies (2,588 flood detected) of events that had occurred in different river basins in mainland Spain over the centuries and identified national areas at risk of flooding (1,036 localized areas). In late nineties Working Group on Flood Risk Analysis in Spain started to work on systematic and homogenized approach of data collection methodology at a national scale. In 1996, General Directorate of Civil Protection proposed methodological guideline for data collecting. The first phase of the proposal was the development of the National Catalogue of Historical Floods with the first record from 1st century BC. New legislation promoted the constitution of the several Working Groups (one for each basin) and DGPCE developed a work program with the different agencies involved (at national, regional and local level) to address risk assessment. The phases of the loss database development in chronological order:

- Constitution Basin Rivers Working Groups (1999-2002) - Civil Protection Unit (in each region they represent the national level of CP), River Basin Water Administration, Regional Meteorological Center, Regional Delegations of the Insurance Compensation Consortium, Regional offices of Spanish Geological Survey (IGME)
- Development of the Historic Flood Catalogs basin (2001-2006) - determining the starting episode, making the list of historic floods to be checked,
- Design of software application for managing The National Catalogue of Historical Flood (2005).
- Integration of Basin Rivers IH Catalogues in the National Catalogue (2006-2015).
- Publication of National Catalogue by river basins (2007-2014).
- Update the National Catalogue adding Compensation data of Insurances (2011) which includes geo-referenced loss data records.

The Spanish Historical Floods National Catalogue is being developed for the entire Spanish territory, including all the hydrological and water management land units, for historical and present events at municipality scale. It is continuously updated and sustained. The catalogue covers the main aims of the national scale project intended by the State general management level and provides the following facilities:

- Support for complex information management (loading, accessing, updating) at a wide territorial scale and a complex natural and socio-economic picture, access to historical information from a long modern time series (CTEI cards) being completed and assured.
- Help for quick and easy accessing to the Catalogue references and bibliographic related ones, graphic and mapping information access being also provided.
- Setting of essential connections between rainfall - water surface level - population and goods. Damages for some locations in the Hydrographic Basins.
- Contrast analysis between historical information and meteorological and hydrological forecast systems during emergency situations, giving support for flooding emergency management.
- A tool for historical flooding consulting over both national and single basin scope, immediate updating being helped and assured for new river and ephemeral flooding episodes.
- Support for decision making on emergency management strategies and completion of the Spanish National Data Base on Flooding Zones established by national normative.

The next challenge is to apply the same approach to earthquake damage database. The main driver for extension of disaster loss database is a legal requirement to compensate victims, i.e. the national insurance scheme (Consortium of Insurance Compensation) is funded from a percentage of private insurance contracts.

8.13.2 Methodology of collection

Mandated organization: Information gathering has been conducted by Civil Protection Unit (UPC´S) of the Government Delegation and Subdelegation (provincial distribution) and several agencies (National, Autonomous Regions and Municipalities concerned).
Triggering mechanism: Damage assessment is triggered at any event that causes damage.

Assessment technique: It is based on an assessment card approach to support systematic data assessment as well as later processing and analysis. A card for each flooding episode includes the following information fields:

- Updated map of the Basin containing the zone affected by the particular flooding.
- Flooding date.
- Flood duration period.
- Flooding causes.
- Damages recorded.
- Data and information sources.

Quality assurance: only official reports.

8.13.3 METHODOLOGY OF RECORDING

Mandated organization: General Directorate of Civil Protection and Emergencies (Ministerio Del Interior) maintains a software application for managing data loading, accessing and updating of the National Catalogue of Historical Floods.

Processing of data: When a flood occurs provisional general data are included in the National Catalogue, while final data are being formally recorded and validated on annual basis, since hydro-meteorological data and data of damage are available a few months after the occurrence of flooding.

The Department of Natural Hazards of DGPCE, produces a provisional list of floods by province from Information System for Emergency Management (SIGE) data and reports. Lists are sent to all Civil Protection Units of the Government Delegations in each province. When the list of flood events is confirmed, all the information concerning each flood event are reported in a format based on the data model. All received data are verified with other data in the DGPC (own reports, SIGE, Consortium of Insurance Compensation, Grants DGPCE, reports of other central government agencies...) and the Department of Natural Hazards entered the data in the computer application CNIH. The final annual database input is again confirmed by Civil Protection Unit of the Government Delegations.

Aggregation: Predefined format of the input data enables aggregation of data by different dimensions (years, event, sector, province, and municipality). User interface is a powerful tool for the data analysis and summary statistics of temporal and spatial distribution of events and losses.

Storing and accessing information: The computer application CNIH has a user interface.

8.13.4 MODEL OF DISASTER LOSS DATABASE

National Catalogue of Historical Floods is a database of historical flood events which are defined as all the rivers flood and / or flooding occurred in the different studied areas of the country that have had an impact on people and property, disrupting normal, since the dawn of history to the present.

Hazard event identification

All hazard data are recorded in the database. The flood types considered are:

- Floods due to precipitation in situ.
- Flood runoff, flood or overflow channels.

- Flooding due to failure or improper operation of hydraulic infrastructure.

For each event the following data are collected and the internal identifier is generated:

- Event generic data:
    - Basin (Name of the hydrologic land unit),
    - Card Number (Chronological position of the particular episode among the basin historical series catalogue),
    - Reference (documentary source for all the information on the card obtained for a single episode, if more sources are found than one card is filled for each. A later comparative analysis will allow to smooth the card catalogue),
    - Temporal information: start and end data, riverbank overflow duration in days, number of days of previous rainfall;
    - Name (can be given by the flooding local cause, the particular date, or simply the local common name).
    - Observations
- Climatic data:
    - Climate description.
    - Synoptic maps
    - Isohyet Map
    - Rainfall intensity
    - Recorded rainfall.
- Hydrologic data:
    - Hydrological description
    - Rivers.
    - Peak flows
    - Height of water in the channel.
    - Height of water in flooded areas.
    - Hydrographs / Limnigrams
- Affected zone (subnational unit, INSPIRE, ETRS89)
- Significant damages:
    - Affected population: number of dead, injured, evacuates at the municipality level)
    - Direct damage:
        - Buildings (number of affected houses at the municipality level)
        - Water infrastructure (type of the civil work, location, affected section, level of damage)
        - Transport infrastructure (type of the civil work, location, affected section, level of damage),
        - Agriculture and livestock (type of the crop/livestock, municipality, ha/number),
        - Industry
        - Basic Services (affected public service, drinking water and sanitation, electricity, telecommunication and road network).
    - Economic loss (?direct, indirect or total)

Hazard even classification of Compensation database covers wider set of hazard types (Table 42). The definitions are provided in Table 43.

Table 42: Natural hazard event classification used by Indemnity database, a part of the National Catalogue

Indemnity (DGPCE)		Consortium of Insurance Compensation	Subvention (DGPCE)
Hazard type	**Subtype**		
Drought (Sequías)			Sequía
Earthquake (Terremotos)		Earthquake (Terremoto)	Terremoto
Extreme temperature (Temperaturas extremas)	Cold wave (Frío Intenso) Heat Wave (Altas temperaturas)		Heladas
Flood (Inundaciones)	Coastal/lake flood (Inundación costeras) Flash floods (Flash floods) Plain flood (Inundación fluvial lenta) Valley flood (Inundación fluvial rápida)	Extreme flood (Inundación extraordinaria)	Flood – overflow (Inundaciones-Desbordamiento)
Slide (Movimientos del terreno)	Avalanche (Avalancha) Landslide (Deslizamiento) Mudflow (Flujo) Rockfall (Desprendimiento) Collapse and subsidence (Hundimiento y subsidencia)		Landslide (Deslizamientos) Rockfall (Desprendimientos) Collapse (Hundimiento)
Volcano (Volcanes)		Volcanic activity (Erupción volcánica)	Volcanic activity (Erupción Volcánica)
Wave/surge (Tsunamis/Rissagas)	Tsunami (Tsunami) Tidal wave (Rissaga)	Seaquake (Maremoto) Surge (Embate de mar)	Seaquake (Maremoto)_
Wildfire (Incendios Forestales)	Forest (Forestal) Urban-forest interface (Interfaz urbano-forestal)		Wildfire (Incendios forestales)
Windstorm (Tormentas)	Hurricane (Huracán) Tornado (Tornado) Tropical storm (Tormenta tropical) Storm (Vientos fuertes) Winter storm (Temporal de invierno) Hail (Pedrisco) Strong rain (Lluvias intensas) Lightning (Rayos)	Atypical cyclonic storms (Tempestad ciclónica atípica) Surge (Embate de mar)	Tornado (Tornado) Tropical storm (Tormenta tropical) Windstorm (Temporal de viento) Snowfall (Nevadas) Hail (Granizo-Pedrisco) Floods due to rainfall (Inundaciones por lluvias) Heavy rain/Storm (Lluvias torrenciales/Tormentas)
Other (Otros)		Extra-terrestrial body/meteorite impact (Caída de cuerpos siderales y aerolitos	

Table 43: Definitions of hazard events used by Indemnity database, a part of the National Catalogue

No.	Hazard type	Definition (in English)	Definición (in Spanish)	Official Source
1	**Drought (Sequía)**	Transient anomaly, more or less prolonged, characterized by a period of time with lower values than normal precipitation in an area	Anomalía transitoria, más o menos prolongada, caracterizada por un periodo de tiempo con valores de las precipitaciones inferiores a los normales en un área. **Sequía meteorológica**: Cuando se produce una escasez continuada de las precipitaciones. **Sequía hidrológica**: Aquella relacionada con periodos de caudales circulantes por los cursos de agua o de volúmenes embalsados por debajo de lo normal. **Sequía agrícola o hidroedáfica**: Déficit de humedad en la zona radicular para satisfacer las necesidades de un cultivo en un lugar en una época determinada **Sequía socioeconómica** Escasez de agua a las personas y a la actividad económica como consecuencia de la sequía	Observatorio Nacional de la Sequía (ONS)
2	**Earthquake (Terremoto)**	Sudden shaking of the ground that spreads in all directions, caused by a movement of the earth's crust or deeper point	Sacudida brusca del suelo que se propaga en todas las direcciones, producida por un movimiento de la corteza terrestre o punto más profundo	Reglamento del Consorcio de Compensación de Seguros (CCS)
3	**Cold Wave (Frío Intenso)**	Important air cooling or the invasion of very cold air over a large area. The temperatures reached during a cold wave fall within the minimum extreme values	Enfriamiento importante del aire o la invasión de aire muy frío sobre una zona extensa. Las temperaturas alcanzadas durante una ola de frío se sitúan dentro de los valores mínimos extremos.	METEOALERTA AEMET
4	**Heat Wave (Altas Temperaturas)**	They usually last a few days to a few weeks. The temperatures reached during a heat wave fall within the maximum extreme values	Calentamiento importante del aire o invasión de aire muy caliente, sobre una zona extensa. Suelen durar de unos días a unas semanas. Las temperaturas alcanzadas durante una ola de calor se sitúan dentro de los valores máximos extremos	METEOALERTA AEMET
5	**Flood (Inundaciones)**	Temporary submersion of normally dry land as a result of the unusual contribution, and more or less sudden, of an amount of water greater than is usual in a given area	Sumersión temporal de terrenos normalmente secos, como consecuencia de la aportación inusual y más o menos repentina de una cantidad de agua superior a la que es habitual en una zona determinada. Incluye los siguientes tipos: Inundación por precipitación «in situ», Inundación por escorrentía, avenida o desbordamiento de cauces (provocada o potenciada por precipitaciones, deshielo o fusión de nieve, obstrucción de cauces naturales o artificiales, invasión de cauces, aterramientos o dificultad de avenamiento, acción de las mareas; Inundación por rotura u operación incorrecta de obras de infraestructura hidráulica	Directriz Básica Inundaciones (DGPCE)

No.	Hazard type	Definition (in English)	Definición (in Spanish)	Official Source
6	**Extraordinary Flood (Inundación extraordinaria)**	Waterlogging terrain produced by the direct action of rainwater, from the lakes or having natural outlet, rivers or estuaries or natural watercourses, surface when they overflow their normal channels and sea storms on the coast	Anegamiento del terreno producido por la acción directa de las aguas de lluvia, las procedentes de deshielo o las de los lagos que tengan salida natural, de los ríos o rías o de cursos naturales de agua en superficie, cuando éstos se desbordan de sus cauces normales, así como los embates de mar en las costas	Reglamento del Consorcio de Compensación de Seguros (CCS)
7	**Avalanches (Avalanchas)**	Very rapid processes of mass falling rocks or debris flowing from steep slopes and may be accompanied by ice and snow	Procesos muy rápidos de caída de masas de rocas o derrubios que se desprenden de laderas escarpadas y pueden ir acompañadas de hielo y nieve.	Instituto Geológico y Minero de España
8	**Landslides (Deslizamientos)**	Mass movements of soil or rock sliding on one or more net breakage surfaces to overcome the shear strength of these planes to overcome the shear strength of these planes; ; mass usually moves together, acting as a unit on its way	Movimientos de masas de suelo o roca que deslizan sobre una o varias superficies de rotura netas al superarse la resistencia al corte de estos planos; la masa generalmente se desplaza en conjunto, comportándose como una unidad en su recorrido	Instituto Geológico y Minero de España
9	**Flows (Flujos)**	Mass movements of soil (clay or earth flows), debris (debris washes or "debris flow") or boulders (rock fragment washes) where the material is broken and behaves like a fluid	Movimientos de masas de suelos (flujos de barro o tierra), derrubios (coladas de derrubios o "debris flow") o bloques rocosos (coladas de fragmentos rocosos) donde el material está disgregado y se comporta como un fluido	Instituto Geológico y Minero de España
10	**Rockfall (Desprendimientos)**	Sudden free falls of blocks or masses of rock in layers independent of preexisting discontinuity (tectonic, laminated surfaces, tension cracks, etc.)	Caídas libres repentinas de bloques o masas de bloques rocosos independizados por planos de discontinuidad preexistentes (tectónicos, superficies de estratificación, grietas de tracción, etc.)	Instituto Geológico y Minero de España
11	**Subsidence (Hundimientos y Subsidencias)**	Movements vertical component, usually differentiating between sinking, or sudden movements, and subsidence, or slow movements	Movimientos de componente vertical, diferenciándose generalmente entre hundimientos, o movimientos repentinos, y subsidencias, o movimientos lentos	Instituto Geológico y Minero de España
12	**Volcanic Activity (Erupción volcánica)**	Escape of solid, liquid or gaseous material ejected by a volcano	Escape de material sólido, líquido o gaseoso arrojado por un volcán	Reglamento del Consorcio de Compensación de Seguros (CCS)
13	**Tsunami/Maremoto**	Violent agitation of the waters of the sea as a consequence of a shock seabed caused by forces acting inside the globe	Agitación violenta de las aguas del mar, como consecuencia de una sacudida de los fondos marinos provocada por fuerzas que actúan en el interior del globo	Borrador Directriz Básica Maremotos (DGPCE) Reglamento del Consorcio de Compensación de Seguros (CCS)
14	**Tidal wave (Rissagues o Risagas)**	Oscillation sea level in ports, coves and bays, caused by weather conditions in resonance conditions	Oscilación del nivel del mar en puertos, calas o bahías, motivadas por causas meteorológicas en condiciones de resonancia	METEOALERTA AEMET
15	**WIldfire (Incendio forestal)**	Fire spreads without control over forest land, affecting vegetation that was not destined to burn	Fuego que se extiende sin control sobre terreno forestal, afectando a vegetación que no estaba destinada a arder	Directriz Básica Incendios Forestales (DGPCE)

No.	Hazard type	Definition (in English)	Definición (in Spanish)	Official Source
16	**Tempestad ciclónica atípica (Atypical Cyclonic Storms)**	Extremely adverse weather and rigorous produced by: tropical cyclones violent character, intense cold storms with arctic air advection, tornados; extraordinary winds	Tiempo atmosférico extremadamente adverso y riguroso producido por: Ciclones violentos de carácter tropical , Borrascas frías intensas con advección de aire ártico, Tornados; Vientos extraordinarios	Reglamento del Consorcio de Compensación de Seguros (CCS)
18	**Tornados (Tornados)**		Borrascas extratropicales de origen ciclónico que generan tempestades giratorias producidas a causa de una tormenta de gran violencia que toma la forma de una columna nubosa de pequeño diámetro proyectada de la base de un cumulonimbo hacia el suelo.	Reglamento del Consorcio de Compensación de Seguros (CCS)
20	**Extra-terrestrial body/meteorite impact (Caídas de cuerpos siderales y aerolitos)**	Impact on the soil surface of bodies from outer space into the Earth's atmosphere unrelated to human activity	Impacto en la superficie del suelo de cuerpos procedentes del espacio exterior a la atmósfera terrestre y ajenos a la actividad humana	Reglamento del Consorcio de Compensación de Seguros (CCS)

Human loss indicators

Framework and definitions of human loss indicators used by GDCPE are described in Table 44 and Table 45. Table 46 translates the human loss indactors used by GDCPE into the human impact loss indicator proposed by the JRC 4.3.3. Comparability is based on the definitions and not on the name of the field. Colored areas represent concepts that are covered in the described database.

Table 44: Human impact framework of GDCPE, Spain

<table>
<tr><td rowspan="11">Directly affected</td><td rowspan="5">Victims (Víctimas)</td><td colspan="2">Dead (Fallecidos)</td></tr>
<tr><td colspan="2">Missing (Desaparecidos)</td></tr>
<tr><td colspan="2">Injured (Heridos)</td></tr>
<tr><td rowspan="2">Sheltered (Albergados)</td><td>Permanent (Permanentes)</td></tr>
<tr><td>Provisional (Provisionales)</td></tr>
<tr><td rowspan="4">Evacuated (Evacuados)</td><td colspan="2">Self-evacuated (Auto evacuados)</td></tr>
<tr><td rowspan="2">Transferred (Desalojados)</td><td>Forced (Forzosos)</td></tr>
<tr><td>Preventive (Preventivos)</td></tr>
<tr><td colspan="2">Rescued (Rescatados)</td></tr>
<tr><td colspan="3">Confined (Confinados)</td></tr>
<tr><td colspan="3">Damaged (Damnificados)</td></tr>
</table>

Table 45: Definitions of human loss indicators used by GDPCE, Spain

Human loss indicators	Definition	Definición	Official Source
Victims (Víctimas)	People who suffer damage through no fault of or accidental cause	Personas que padecen daño por culpa ajena o por causa fortuita	Diccionario de la Real Academia Española (DRAE)
Dead (Fallecidos)	People whose cause of death derives directly from the emergency	Personas cuya causa de muerte deriva directamente de la emergencia	Guía Metodológica para la elaboración del CNIH; Área Riesgos Naturales de la DGPCE
Missing (Desaparecidos)	People who are in unknown whereabouts, without knowing if they live	Personas que se hallan en paradero desconocido, sin que se sepa si viven	Diccionario de la Real Academia Española (DRAE)
Injured (Heridos)	People who, regardless of the gravity of the injury, suffered any type of corporal damage as direct consequence of the emergency and require medical assistance	Personas que, independientemente de la gravedad de la lesión, han sufrido cualquier tipo de daño corporal como consecuencia directa de la emergencia y precisan asistencia médica	Guía Metodológica para la elaboración del CNIH; Área Riesgos Naturales de la DGPCE
Sheltered (Albergados)	People who need to be taken care of to cover all their basic necessities	Personas que precisan ser atendidas para cubrir todas sus necesidades básicas	Área Riesgos Naturales de la DGPCE
Evacuated (Evacuados)	People who, when being in danger, leave the place in which they are of directed form, spontaneous or with the help of the services of emergency	Personas que al encontrarse en peligro abandonan el lugar en que se encuentran de forma dirigida, espontánea o con ayuda de los servicios de emergencia	Guía Metodológica para la elaboración del CNIH; Área Riesgos Naturales de la DGPCE
Confined (Confinados)	People who must remain in safe places in order to avoid the exhibition to a danger	Personas que deben permanecer en lugares seguros a fin de evitar la exposición a un peligro	Área Riesgos Naturales de la DGPCE
Damaged (Damnificados)	People who have suffered damage of collective character or in its properties or have been modified their living conditions	Personas que han sufrido daño de carácter colectivo o en sus propiedades o han visto modificadas sus condiciones de vida	Área Riesgos Naturales de la DGPCE

Table 46: Human loss indicators used by GDPCE Spain translated into the human loss indicator framework proposed by the JRC (see section 4.3.3)

Spain		Main fields	Definitions	Breaking down the fields (general options: by gender, by age, by vulnerable groups, …)		
DIRECTLY AFFECTED primary level by ECLAC		**Fatalities**	Mortality	**Killed**		
				Missing		
	PEOPLE IN NEED	**Injured/disease/in need of medical assistance**	People that are in need of immediate medical assistance as a direct result of the disaster			
		Evacuated	People that are removed from a place of danger to a safer place. Breaking down that field is related to the management of different disaster phases.	EARLY WARNING	RESPONSE CAPACITY	RECOVERY
				Pre-event	**Sheltered by emergency services**	**Permanently homeless**
				Post-event	**Sheltered by private arrangements**	**Temporarily homeless**
					Relocated	
					Without shelter	
		Isolated	People that suffer physical damage of infrastructure which threatens their basic livelihood conditions (limited access to water, food, electricity, ….) but they have not been evacuated			
		Impaired	People that suffer physical damage of their property but are not in need			
INDIRECTLY AFFECTED		**Secondary level** - within affected area (by ECLAC)	People that suffer of a disaster's indirect effects (e.g., loss of flow, deficiencies in public service)			
		Tertiary level - outside affected area (by ECLAC)				

8.13.5 PUBLIC COMMUNICATION

The information contained in CNIH is available to all users who request it. Currently, DGPCE is managing the publication of CNIH on its website[58].

8.14 SWEDEN (SE)

Contact point: Karoline Sjölander, Swedish Civil Contingencies Agency (MSB), Lessons learned section.
Name of the loss database: Swedish Natural Hazards Information System – NDB (http://ndb.msb.se)
Language: Swedish and partly in English.

8.14.1 NATIONAL DRIVERS FOR LOSS DATA

Swedish Natural Hazard Information System, NDB, was created in 2005 and includes 100 events from 1950 onwards. Application areas of the database are loss accounting with a holistic approach where the aggregation of recorded impact is not possible and disaster forensic with emphasis on learning from past. Aim is to support societal planning, development in crisis management, education, and risk analysis. Therefore it is used by rescue services, municipalities and regional boards at the local level and national agencies, universities and media at national level. Opinions about needs and benefits were obtained from 25 different authorities, institutes and organization, e.g., Swedish Road Administration, Swedish Geotechnical Institute, Nordregio (Nordic Centre for Spatial Development), several municipalities, county administrative boards, as well as practitioners, planners and researchers. It includes nine different types of natural hazards with losses recorded at municipality scale and national scope.

[58] http://www.proteccioncivil.org/inundaciones-documentacion or http://www.proteccioncivil.org/inundaciones-ctei

8.14.2 METHODOLOGY OF COLLECTION

Mandated organization/triggering mechanism/data assessment technique/quality assurance: There is no common assessment methodology neither clear entry criteria; the main focus is if there is something to learn from the hazard no matter size. The loss data are collected at the municipality level by different agencies.

8.14.3 METHODOLOGY OF RECORDING

Mandated organization: Development and maintenance of the NDB is taken care by Swedish Civil Contingencies Agency (MSB), Lessons learned section.

Processing of data/Aggregation: NDB presents accident reports, investigations and in-depth analyses, together with societal additional costs and mappings of consequences from central and local governments, NGO's and private actors. The collection reveals large differences in quality, systematic approach, depth and extent, clearly consistent with the lack of coherent harmonization of investigation and reporting approaches.

The data get processed before entered in the database. Information is also compiled by MSB about hazard cause, pre-event prevention, early warning and preparedness, hazard evolution and response, consequences to human, society and environment and last, in focus, lessons observed or learned and preventive feedback.

Uncertainty is handled for all the fields in narrative format. It is often one or two years before information about the hazard is updated, due to the amount of data to be manually gathered and processed.

Storing and accessing information: All information is stored in a database at MSB. Experts use a client to reach and update the information. The database has a presentation mode and is publicly shared at http://ndb.msb.se.

8.14.4 MODEL OF DISASTER LOSS DATABASE

It includes nine different types of natural hazards: storms, avalanches, landslides, rock fall, extreme precipitation, floods, coastal erosion, forest fire, extreme temperature.

Hazard event is defined with

- geographical location (subnational unit, latitude/longitude and footprint using SWEREF 99 coordinate system),
- temporal information (start and end date, time),
- some event type specific attributes are recorded in database together with the cause of hazard description,
- hazard type based on hazard classification standard: CRED/MunichRE/IRDR

Affected elements are associated with

- subnational unit,
- type of the property (building vs civil work classification, crop) related to sectors

Loss indicators recorded are:

- human impact (fatalities, injured, evacuated, isolated) based on UNDP/UNISDR (Desinventar) definitions

- direct tangible damages (physical elements)
- direct intangible damages (environmental impact)
- business practices
- Economic losses are mainly provided by insurance companies and the database doesn´t show methodology used.

Table 47: Human loss indicators in Sweden translated into the human loss indicator framework proposed by the JRC (see section 4.3.3)

Sweden		Main fields	Definitions	Breaking down the fields (general options: by gender, by age, by vulnerable groups, ...)		
DIRECTLY AFFECTED primary level by ECLAC		Fatalities	Mortality	Killed		
				Missing		
	PEOPLE IN NEED	Injured/disease/in need of medical assistance	People that are in need of immediate medical assistance as a direct result of the disaster			
		Evacuated	People that are removed from a place of danger to a safer place. Breaking down that field is related to the management of different disaster phases.	EARLY WARNING	RESPONSE CAPACITY	RECOVERY
				Pre-event	Sheltered by emergency services	Permanently homeless
				Post-event	Sheltered by private arrangements	Temporarily homeless
					Relocated	
					Without shelter	
		Isolated	People that suffer physical damage of infrastructure which threatens their basic livelihood conditions (limited access to water, food, electricity, ...) but they have not been evacuated			
		Impaired	People that suffer physical damage of their property but are not in need			
INDIRECTLY AFFECTED		**Secondary level** - within affected area (by ECLAC)	People that suffer of a disaster's indirect effects (e.g., loss of flow, deficiencies in public service)			
		Tertiary level - outside affected area (by ECLAC)				

8.14.5 Public communication

All material is publicly shared (http://ndm.msb.se). The compilations offer holistic perspectives and thorough analyses of historical natural hazards.

8.15 United Kingdom (UK)

Contact point: David Demeritt, Kings College London
Name of the database: no database

8.15.1 National drivers for loss data

At present there is no UK-wide system for recording disaster losses nor any statutory basis for it. However several ongoing developments mean there is increasing interest within the UK government in recording disaster losses to support hazard impact modelling and provide information about disaster forensics to inform climate change adaptation planning.

Two initiatives, in particular, are worthy of note here in this regard. First, the UK Met Office has developed a Weather Observations Website (WOW) on which users can upload weather observations and data on impacts <http://wow.metoffice.gov.uk/>. Launched in June 2011, WOW has already amassed over 180 million observations. The Met Office is now working to improve its protocols for collecting weather impacts data through WOW and develop methods for using them to support an ongoing programme of hazard impact modelling.

Second, ClimateUK, a not-for-profit Community Interest Company set up at the behest of HM Government to promote local climate adaptation in the UK, has been developing a Severe Weather Impacts Monitoring System (SWIMS) to enable local authorities to collect disaster loss data to support climate adaptation planning <http://climateuk.net/resource/severe-weather-impacts-monitoring-system-swims>. First developed by Kent County Council, SWIMS to inform its own climate adaptation and disaster preparedness planning is now being promoted by ClimateUK, and a number of other local authorities across the UK have begun to use it as well. Uptake has been slow and rather uneven, but at present some 20 or so local authorities (out of 407 in England, Wales, and Scotland) are in the process of adopting SWIMS.

In addition, there are also now efforts by the British Geological Survey to incorporate impact and loss data in its National Landslide Database, which records landslides in Great Britain.

8.15.2 METHODOLOGY OF COLLECTION

WOW and SWIMS use quite different methods of data collection. Impact data in WOW is user generated, with users of the website able to upload data, including photographs, on weather events and impacts. Impacts are classified into seven categories (travel disruption; property or infrastructure damage; personal health & safety; utility disruption; service or business disruption; agriculture/habitat damage; disruption to camping/ events/ leisure) and within those categories users are invited to assign a 1-4 impact score based on qualitative descriptors derived from warning levels in the National Severe Weather Warning Service. There is also a free text field for qualitative description. The figure below shows an example of what can be recorded by WOW, in this case about the impacts of a severe convective storm that swept over northeast England on 28 June 2012, caused widespread disruption, and localized flooding, particularly in Newcastle.

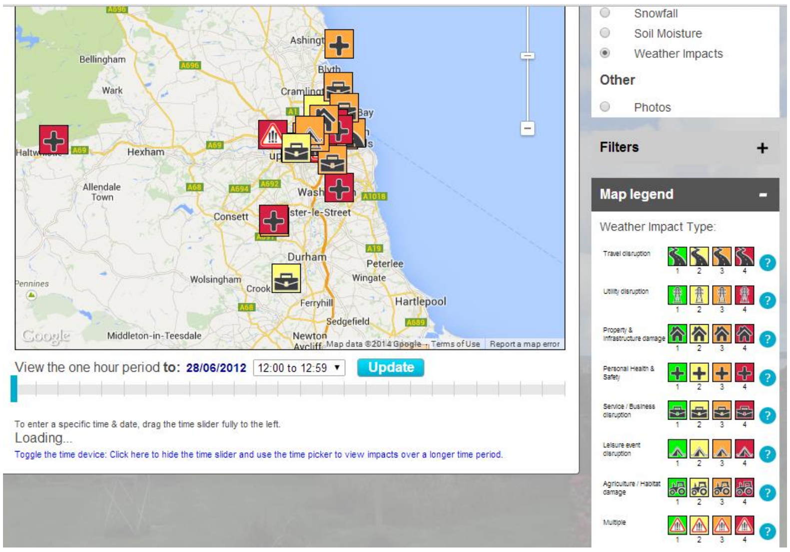

Figure 21. The Weather Observations Website (WOW) developed by the UK Met Office. In this screenshot, are shown the impacts of a severe convective storm that swept over northeast England on 28 June 2012.

SWIMS data is recorded by local authorities, but both the adoption of the system by local authorities and the engagement with it by local authority departments is strictly voluntary. When an ‘event’ is declared by the emergency planning department of the local authority, an email is sent out to participating units of the local authority. They are then invited to log in and record, using a series of structured pull down menus, the impacts, including estimated monetary costs, of that event on their service provision.

8.15.3 METHODOLOGY OF RECORDING

WOW data is curated by the Met Office, using a Google Cloud infrastructure capable of generating tabular and graphic views of data for different time period. The Met Office has dedicated staff and budgets for maintaining and enhancing WOW.

SWIMS data is collected by individual local authorities, and to date the role of ClimateUK has been limited to promoting its uptake by individual local authorities. There are no dedicated resources or institutional arrangements for collecting and aggregating SWIMS data, which would not be able to provide a national overview unless many more local authorities were to adopt it. Given the more than 25% real term budget cuts faced by local authorities in England over last several years, there is little capacity for collecting such data more systematically.

8.15.4 MODEL OF DISASTER LOSS DATABASE

Events in WOW are user defined, whereas the trigger in SWIMS is a declaration by the local authority emergency planning officer. In both cases however, the nature and scale of impacts is defined subjectively by users, though both WOW and SWIMS have used fixed categories to impose some degree of standardization and comparability.

8.15.5 PUBLIC COMMUNICATION

The information contained in WOW is publicly accessible to anyone through the internet. SWIMS data is not presently being collated centrally and so is only available by contacting each participating local authority one at a time.

9 ANNEX 2 : STUDY OF UNCERTAINTY FOR QUALITY ASSESSMENT OF LOSS DATA

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9.1 OVERVIEW

Achieving a high level of reliability in disaster loss estimates is seen to depend on two essential factors: the reliability of the type of procedure used for the quantification of a given loss component and the availability of adequate and sufficient data to perform such quantification. Both factors can be associated to a characteristic generally termed as *quality*. There are no specific criteria that data or processes must possess to have *quality*. Instead, *quality* is measured according to the ability of that datum or process to fulfil a certain need or objective. This lack of ability to fulfil needs or objectives is found to be the result of the existing *uncertainty* of the data or processes that are used. *Uncertainty* in these components is therefore a source of inaccuracy, errors, subjectivity and leads to failure in achieving a high level of *quality*. Hence, before grading a certain component of a disaster loss assessment framework in terms of its *quality*, a characterization of the sources of *uncertainty* that are involved must be performed.

The proposed approach to express the uncertainty in disaster loss data merges an update of the uncertainty classification framework of Skeels et al., 2010 [43] and the , the NUSAP (Numeral Unit Spread Assessment Pedigree) method [86], [87].

9.2 A GENERAL CLASSIFICATION FRAMEWORK TO MEASURE AND EXPRESS UNCERTAINTY IN DATA

The classification framework proposed in [43] is not developed using the general and typical categories of *aleatoric* and *epistemic* uncertainties as a basis. Instead, it establishes a hierarchy and connectivity between five types of uncertainty that can be related to factors that are *aleatoric* and/or *epistemic* in nature. These five uncertainty types are:

- Measurement Precision
- Completeness
- Inference
- Disagreement
- Credibility

Based on the description of the "Measurement Precision" uncertainty type provided in [43], it is found that a more adequate designation would be "Measurement" since this category is supposed to cover aspects related to both *precision* and *accuracy*. Therefore, the first category is termed Measurement hereon. This classification also establishes that, in a given process that defines data suitable to reach a certain objective, uncertainty can exist in different stages of that process. In this context, the framework developed in [43] characterizes a process using three stages, where each one is associated to a more advanced state of data processing. The three stages can be generally defined as:

- Stage 1 - Gathering and collecting data
- Stage 2 - Sorting and manipulating data
- Stage 3 - Transforming data to reach the objectives of the process

According to this framework, each stage is associated to one of the five types of uncertainty. Stage 1 is associated to Measurement, Stage 2 is associated to Completeness, and Stage 3 is associated to Inference. The remaining two types of uncertainty (Disagreement and Credibility) are said to span across all three stages. In addition, it is also found that Disagreement sometimes increases the Credibility uncertainty [43]. After a detailed analysis of this classification, it is possible to detect its inability to account for certain mechanisms related to human error. Therefore, the classification framework adopted herein includes a sixth type of uncertainty termed Human Error that is added to the original framework proposed in [43]. As Disagreement and Credibility, Human Error also spans across all three previously referred stages. Furthermore, in some occasions, Human Error also leads to an increase of Disagreement and/or Credibility uncertainties. The hierarchy and connectivity between the types of uncertainty covered by the framework adopted herein are illustrated in Figure 22. To understand more clearly the role of each component of this framework in defining the global uncertainty of a process, a detailed description of each type of uncertainty is presented in the following.

Before detailing the different types of uncertainty involved in the proposed uncertainty classification framework, it should be noted that such framework assumes that, in a given process, data will need to go through the three stages before being suitable to meet a certain objective (e.g. a subsequent decision-making procedure). However, certain processes may only require Stage 1 (i.e. the collected data is the exact data required for decision-making), or only Stage 1 and Stage 2 (i.e. the collected data needs some manipulation after which it is suitable for decision-making).

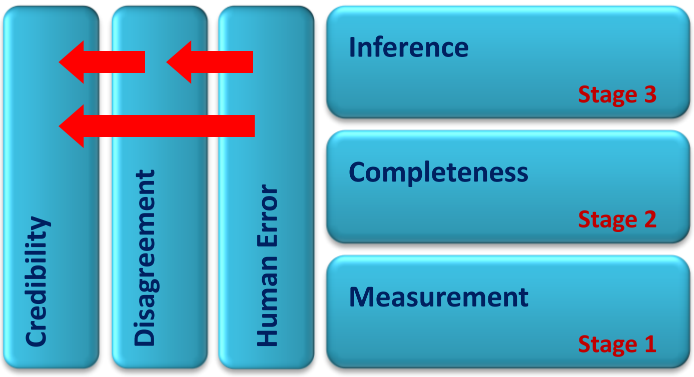

Figure 22. Hierarchy and connectivity between types of uncertainty.

9.2.1 MEASUREMENT – STAGE 1

The initial category proposed in [43] is modified in order to account for two sub-categories of uncertainty that were not differentiated originally: accuracy and precision. Both sub-categories cover variations, imperfections and limitations in measurements that produce quantitative data. Accuracy accounts for the closeness between the measurement of a quantity and its true value [70]. Hence, accuracy uncertainty addresses the weaknesses of the measurement technique being used and accounts for factors of *epistemic* nature.

Precision is related to the ability of obtaining the same results when a measurement is repeated under the same conditions. In some cases, the lack of precision might be due to limitations in the measurement technique being used, while in others, it might be the result of expected random variations in the actual phenomena being measured. Based on this description, this type of uncertainty is seen to account for factors of *aleatoric* and/or *epistemic* nature.

Both sub-categories of uncertainty can, sometimes, be explicitly expressed by a statistical model or by a range where the true value is probably in, for example using a confidence interval. However, this uncertainty is often not able to be represented since only the measured data that is known to be imprecise is available.

9.2.2 COMPLETENESS – STAGE 2

According to [43], this category is represented by three sub-categories of uncertainty: sampling, missing values and aggregation. Sampling is a strategy where a subset of individuals from a statistical population is selected in order to estimate characteristics of the whole population. Therefore, completeness uncertainty will inevitably exist when generalizing these estimates to the whole population. Such uncertainty is *aleatoric* if the sample (i.e. the subset of the whole population) is randomly selected. However, if a specific sample is selected instead (e.g. based on a set of pre-defined criteria) the selection procedure may introduce *epistemic* uncertainty due to the potential inadequacy of the criteria. For example, this particular issue can occur when selecting parameters or variables to measure a particular phenomenon that will later be used for analysis (i.e. inference). If the selected parameters are inadequate, an incomplete sample of data will be obtained that will introduce *epistemic* uncertainty into the later analyses.

Missing values in the data under analysis also lead to completeness uncertainty but their effect must be distinguished from those arising from sampling. Missing values are intended to be included but are not present in the data, while sampling implies deliberate extrapolation from a few values to cover a larger set of possible values. Datasets with information that is known to be erroneous should be considered incomplete since one obtains a subset of data with missing values after removing the incorrect values. Since this type of uncertainty is related to having inadequate data to perform a given analysis, it is categorized as being of *epistemic* nature.

Aggregating (i.e. summarizing) data is an irreversible procedure also causing uncertainty. Once data have been aggregated, part of the information is lost and data are no longer complete. As for the previous case, this type of uncertainty is also related to having inadequate data to perform a given analysis. Therefore, it is categorized as being of *epistemic* nature.

9.2.3 INFERENCE – STAGE 3

In a general three-stage process, inference assigns a meaning to the data. Therefore, outcomes of inference are inputs for a decision-making procedure that may follow. Inference is a broad category and may involve fitting the data into a model or transforming the data using a model to estimate new data. According to the description in [43], inference also includes three sub-categories of uncertainty: modelling, prediction and extrapolation into the past.

Modelling uncertainty is introduced when the model being considered is not an adequate representation of the data properties under analysis, i.e. if the model does not reflect the causal relations that produce the phenomenon being examined. This includes models of any kind such as physical models, probabilistic models, hypothesis-testing, diagnostic models or expert opinions.

Prediction involves inferring future events by creating a model for the causal relationship between current or past data and future occurrences. As for the previous case, uncertainty is introduced when the model being considered is not able to represent future outcomes of the phenomenon under analysis. Likewise, uncertainty from extrapolation into the past involves the use of data to reproduce or make inferences about past events. Again, uncertainty is introduced when the model being considered is not able to represent past outcomes of the phenomenon under analysis.

As can be seen, all three categories of uncertainty are directly related to the adequacy of the model being used to establish the required results. The difference between the three types of uncertainty is only at the level of what kind of inference is being performed with the model. Modelling uncertainty will occur when the inference being made is about the present (i.e. the model is used to reproduce the phenomenon under analysis using the existing data). On the other hand, prediction or extrapolation into the past uncertainties will occur when inference is about future or past outcomes of the phenomenon under analysis, respectively, for which there is no or not enough data. Since these types of uncertainty reflect the inability to reproduce a given phenomenon by lack of capacity or knowledge, they are found to be all of *epistemic* nature.

9.2.4 HUMAN ERROR – ALL STAGES

Human error is a critical element of human activity and professional practice. Human errors are considered a source of *aleatoric* uncertainty ([63], [64]) and can occur in any activity of the previous three stages that involves people. Even though this uncertainty may be difficult to quantify [71], its classification and analysis has been addressed using several different approaches (e.g. see reviews presented in [89], [79]). In order to express more clearly the uncertainty associated to human errors, it is helpful to describe them using a more detailed and categorized approach. Within the scope of the present framework, human errors are considered to be random events that are either unintentional or deliberate, following the taxonomy proposed in [80].

9.2.5 DISAGREEMENT – ALL STAGES

Disagreement can create uncertainty in any of the previously defined three stages. At Stage 1, disagreement happens when a given parameter is measured multiple times or is obtained from different sources and the measurements are not the same (as a result of human error or any other cause). At Stage 2, disagreement may occur, for example, when several non-identical but partially overlapping datasets representing the same phenomenon are available. At Stage 3, disagreement can occur when two (or more) different conclusions are drawn from the same data. This can happen when two (or more) experts analyse a certain dataset and come to different conclusions (again, as a result of human error or other causes), or it can happen when different mathematical models are applied to a certain dataset to perform an inference. The *aleatoric* or *epistemic* nature of the disagreement uncertainty depends on the nature of the factors leading to such uncertainty. For example, if the source is related to human error uncertainty, which is *aleatoric*, the resulting disagreement uncertainty will also be of *aleatoric* nature. A similar reasoning can be established for the case of the precision uncertainty of Stage 1 which can be of *aleatoric* and/or *epistemic* nature, thus leading to disagreement uncertainty of the same nature. A similar conclusion can be drawn with respect to the sampling uncertainty of Stage 2. On the other hand, since the remaining uncertainties of Stage 2 (missing values and aggregation), the Stage 1 accuracy uncertainty and the Stage 3 uncertainties are all of *epistemic* nature, the consequent disagreement uncertainty that may follow is also of *epistemic* nature.

9.2.6 Credibility – All stages

Credibility can also lead to uncertainty in any of the previously defined three stages. A source of information that produces data in conflict with other data, that produced unreliable data in the past, or is otherwise suspect for some reason (e.g. data with errors can lead to concerns about the correctness of other datasets coming from the same source) can lead to this type of uncertainty. Sources of information can be human (e.g. individuals or institutions) or non-human (e.g. machines, measurement tools, models) and credibility issues can be cast on both of them in different forms. For example, credibility could be questioned due to the methods used to get the data or concerns surrounding the biases or conflicts of interest with the creators of the data. A human source may also be considered untrustworthy based on past behaviour. Likewise, machines or measurement tools can also be considered untrustworthy based on past behaviour. In this case the credibility appears to be similar to measurement uncertainty. However, the difference is that credibility is a judgment made by the information user about the information source, rather than being a known accuracy/precision limitation mathematically expressible by the information source itself. As for the previous case, the *aleatoric* or *epistemic* nature of the credibility uncertainty depends on the nature of the factors that lead to such uncertainty. Furthermore, it is also noted that credibility and disagreement are often associated because when disagreement occurs, whether among people or among measurements, credibility is often called into question. Likewise, when human error occurs, credibility issues are also usually cast.

9.3 Some aspects related to the application of the uncertainty classification framework for the case of disaster loss data

A few considerations are made in the following to address the application of the proposed framework for uncertainty classification to represent the uncertainty of disaster loss data. Some issues mentioned previously are illustrated and discussed using examples of specific indicators of disaster loss data.

As previously noted, the proposed framework assumes that, in a given process, data goes through three stages before being suitable to meet a certain objective. However, for the particular case of characterizing disaster losses, the data being collected in Stage 1 can represent the actual loss indicator or it can be an auxiliary parameter that will serve as a proxy for the required loss data indicator. For example, when referring to human losses (e.g. the number of people killed) the loss indicator corresponds to the data being collected. Therefore, the existing uncertainty in the data for this case is only that which comes from Stage 1. Another example of this situation also related to human losses can be defined for the case where the loss indicator now represents the number of affected people. In this case, the final value of the loss indicator can be obtained after Stage 1 (e.g. if the data collection process is rigorous enough) or after Stage 2 if some data manipulation is required, e.g. see [72], [57]. In this latter case, the existing uncertainty in the data comes from both Stage 1 and Stage 2.

For the case where the loss indicator corresponds to the (direct) monetary losses resulting from damaged properties, two possible scenarios can be foreseen: 1) the total loss data is directly obtained from available sources (e.g. insurance companies) that provide the true monetary losses (e.g. based on insurance claims); 2) only part of the loss data is obtained as in 1) and the remaining monetary losses must be estimated. In this latter scenario, part of the collected data that is available is not the actual loss indicator but a proxy (e.g. damage levels of properties) that needs to be transformed into an estimate in the unit of the required loss indicator (the monetary value of the loss). Therefore, in this scenario, part of the value of the loss indicator will need to be established from Stage 3 and the existing uncertainty in this value comes from Stages 1, 2 and 3 (it is assumed that before Stage 3, some data manipulation in Stage 2 is required).

9.4 EXPRESSING UNCERTAINTY IN DISASTER LOSS DATA

Most standard statistical techniques that have been developed to handle uncertainty assume that it is due to variations in phenomena that can be precisely (i.e. numerically) measured. Such techniques usually consider that some sort of data distribution reflecting this uncertainty is available to allow the use of numerical simulation methods for uncertainty quantification and propagation. For this category of uncertainty analysis, it is, therefore, possible to use methods such as those based on Monte Carlo analysis, Latin Hypercube sampling, importance sampling, variance reduction techniques, perturbation analysis, sensitivity analysis, response surface-based approaches, the Fourier amplitude sensitivity test, the Sobol' variance decomposition or fast probability integration (e.g. see [68], [82], [84], [73], [83]). In addition, methods using non-probabilistic approaches such as those based on interval analysis or fuzzy analysis (e.g. see [58], [67]) are also available for this category of problems.

Even though the power and validity of these numerical methodologies is unquestionable, their use is, usually, only feasible in traditional science fields where sufficient hard data is available for numerical treatment. On the other hand, disaster loss data is often coarse and scattered, thus precluding the use of such refined mathematical manipulations. In other words, available data is frequently insufficient, thus unable to support the meaningful definition of adequate statistical descriptors suitable for mathematical treatment. In such cases, defining qualitative expressions of uncertainty is often the only available option. However, even though qualitative expressions of uncertainty are more difficult to define unequivocally, as well as more difficult to use in a numerical uncertainty propagation analysis, they have the potential to be more informative than statistical descriptors since they can include a large number of attributes [78].

Based on the descriptions and reviews in [81][87], the NUSAP (Numeral Unit Spread Assessment Pedigree) method is found to be suitable to characterize the uncertainty in disaster loss data, given its ability to capture both quantitative and qualitative dimensions of uncertainty and to represent them in a standardized and self-explanatory way. NUSAP is a system proposed in [66] originally developed to characterize and assess the multidimensional uncertainty in science for policy but it has also been successfully used and adapted in other research and science fields ([86], [62], [60], [61], [59], [65], [75], [76], [69]).

The NUSAP method involves five parameters that are used to characterize a certain datum. The five parameters are *Numeral*, *Unit*, *Spread*, *Assessment* and *Pedigree*. According to [66], parameters *Numeral*, *Unit* and *Spread* address the quantitative aspects of the datum being analysed, while *Assessment* and *Pedigree* are assigned to describe its more qualitative components. Depending on the datum under analysis, *Numeral* can be defined using an ordinary number representing a mean value or a best estimate but, when appropriate, it can also be defined using a more general quantity such as an expression of a number (e.g. a million). Parameter *Unit* usually expresses the scale of *Numeral* by defining its unit of measurement, but it can also contain additional information such as the date of the evaluation. According to [66], *Spread* is expected to represent the more quantifiable component of the uncertainty of the datum under analysis. Therefore, if sufficient data is available, *Spread* can be defined by the variance of the data, which could be determined by statistical methods such as those previously referred. However, data may often be insufficient to establish a meaningful statistic representing the variability of the datum. In some cases, available data may only allow the definition of an interval or a range of variation of the datum, which can be established using mathematical procedures or expert elicitation.

Assessment is the first parameter of NUSAP expressing qualitative judgments about the datum. Although *Assessment* can represent different aspects of the datum, it can be used to establish a global measure of expert judgement about the overall goodness, reliability or level of confidence associated to the value in *Numeral* or, if desired, in *Spread* instead. For example, this qualitative grade can be defined using qualifiers such as “optimistic/pessimistic”, “reliable/unreliable”, “official/unofficial” or “exact/accurate/estimate/guess”. Alternatively, in cases where there is sufficient data to carry out statistical analyses, the level of confidence can be defined by the statistical significance level used to derive the datum or its *Spread*. The final parameter of NUSAP, *Pedigree*, is a concept first introduced in uncertainty analysis in [66] where a set of criteria is used to assess several aspects related to the information flow and the knowledge used to characterize the datum under analysis. *Pedigree* is a matrix where problem-specific criteria are graded according to a numerical scale. Since, for each of these criteria, a description is assigned to each value of the scale, the *Pedigree* matrix represents, thus, a tool suitable for the quantification of qualitative assessments associated to different components of the uncertainty involved in the process being analysed. The structure of the *Pedigree* matrix has no formal requirements since the rating scale as well as the number and type of criteria are selected according to the needs of each problem.

Following the proposed framework to express the uncertainty of disaster loss data, a set of three *Pedigree* matrices are presented in Table 48, Table 49 and Table 50 where each one addresses one of the three previously defined stages. For each stage, the corresponding *Pedigree* matrix addresses the uncertainty components that were previously defined. As can be seen, the *Pedigree* matrix for Stage 1 (Table 48) does not include precision uncertainty in the measurement category. This choice was made because accuracy concerns are currently more relevant and have larger effects on the reliability of the disaster loss data being collected. This matrix also presents two criteria related to Credibility. One addresses the credibility of the source of the data while the other addresses the credibility among peers regarding the procedure that is used to collect data.

After grading each criterion, a global average *Pedigree* score can be established to reflect the overall *quality* of the process that lead to the datum under analysis [62]. In addition, a graphical representation of the grades of each uncertainty component can also be established for each *Pedigree* matrix as presented in Figure 23. Since each type of loss indicator being considered might involve different processes of data collection and processing, a set of *Pedigree* matrices should be defined for each one of the loss indicators. Furthermore, since the value of some of the loss indicators may be defined directly after Stage 1 or Stage 2 as previously noted, only the *Pedigree* matrices of the corresponding stages need to be defined for those cases.

Table 48: Pedigree matrix for Stage 1 - Gathering and collecting data

Grade	Criterion				
	Measurement	Human error	Credibility 1	Credibility 2	Disagreement
	Accuracy				
5	Data was collected following an approved standard or by the best available practice	Data was compared with independent measurements of the same variable	The reliability of the source of the data is indisputable (data is based on measurements and was verified)	There is total agreement among peers regarding the procedure used to collect data	There was agreement of data between all comparable assessments
4	Data was collected by a reliable method commonly used	Data was compared with independent measurements of closely related variable	The source of the data is found to be reliable by most people (data is partially based on assumptions or is unverified based on measurements)	A large majority of peers (90–100%) would use this procedure used to collect data	There was agreement of data between the majority of comparable assessments
3	Data was collected by an acceptable method but there is limited consensus on its reliability	Data was compared with measurements of the same variable that are not independent	The trustworthiness of the source of the data can't be established (data is unverified and partly based on assumptions)	Many experts (75%) would use this procedure used to collect data	There was agreement of data between some comparable assessments

2	Data was collected by a preliminary or unproven method with unknown reliability	Weak and very indirect validation of the data was performed	Data was obtained from an expert (data is qualified estimate)	Several experts (50%) would use this procedure used to collect data	There was no agreement of data in any comparable assessments
1	Data was collected by a purely subjective method with no discernible rigour	No validation of the data was performed	Data is a non-qualified estimate or of unknown origin	Few experts (25%) would use this procedure used to collect data	No cross-validation of data was possible

Table 49: Pedigree matrix for Stage 2 - Sorting and manipulating data

Grade	Criterion					
	Completeness			Human error	Credibility	Disagreement
	Sampling	Missing values	Aggregation			
5	Representative data was sampled from datasets collected from a large number of sites	The collected data has no missing values	Aggregated data is fully fit for assessment purposes and captures all the necessary features of the original data (the data presents an excellent fit to a well-known statistical model)	All the procedures for data manipulation were replicated by different people for cross validation	There is total agreement among peers regarding the procedure used to manipulate the data	There is agreement between all comparable datasets
4	Representative data was sampled from datasets collected from a sufficient number of sites	The collected data has an irrelevant number of missing values	Aggregated data is fit for assessment purposes and captures the most important features of the original data (the data presents a good fit to a reliable statistical model according to most fitting tests)	Some of the procedures for data manipulation were replicated by different people for cross validation	A large majority of peers (90–100%) would use this procedure used to manipulate the data	There is agreement between the majority of the comparable datasets
3	Representative data was sampled from datasets collected from a small number of sites	The collected data has some missing values but is still fit for use	Aggregated data is fit for basic assessment purposes and captures some features of the original data (no statistical model presents a significant fitting to the data according to most fitting tests)	Some of the procedures for data manipulation were cross checked by different people	Many experts (75%) would use this procedure used to manipulate the data	There is agreement between some of the comparable datasets
2	Incomplete data was sampled from datasets collected from a sufficient	The collected data has a significant amount of missing values and might not be fit for use	Aggregated data is not entirely fit for basic assessment purposes and captures only a few features of the original data (the statistical model used	A weak and very indirect validation of some procedures for data	Several experts (50%) would use this procedure used to	There is no agreement with any of the comparable datasets

	number of sites		to represent the data is highly subjective)	manipulation was carried out	manipulate the data	
1	Incomplete data was sampled from datasets collected from a small number of sites	The collected data has too many missing values to be fit for use	Aggregated data is unfit for assessment purposes and does not capture features of the original data (the statistical model used to represent the data is uniform)	No cross validation of the procedures for data manipulation was performed	Few experts (25%) would use this procedure used to manipulate the data	No datasets can be used to perform comparable assessments

Table 50: Pedigree matrix for Stage 3 - Transforming data to reach the objectives of the process

Grade	Criterion			
	Inference	Human error	Credibility	Disagreement
5	Inferences were made using an established theory validated by many tests and representing fully understood causal mechanisms	All the inference results were replicated by different people for cross validation	There is total agreement among peers regarding the procedure and model used to make inferences	There is agreement between the results of all comparable analyses
4	Inferences were made using a theoretical model validated by few tests and representing hypothesized causal mechanisms	Some of the inference results were replicated by different people for cross validation	A large majority of peers (90–100%) would use this procedure and model to make inferences	There is agreement between the results of the majority of the comparable analyses
3	Inferences were made using a computational model involving engineering approximations and approximated causal mechanisms	Some inference results were cross checked by different people	Many experts (75%) would use this procedure and model to make inferences	There is agreement between the results of some of the comparable analyses
2	Inferences were made using statistical processing involving simple correlations and representations of causal mechanisms	A weak and very indirect validation of some inference results was carried out	Several experts (50%) would use this procedure and model to make inferences	There is no agreement of results with any of the comparable analyses
1	Inferences were made using definitions involving weak representations of causal mechanisms	No cross validation was performed	Few experts (25%) would use this procedure and model to make inferences	No results can be used to perform comparable analyses

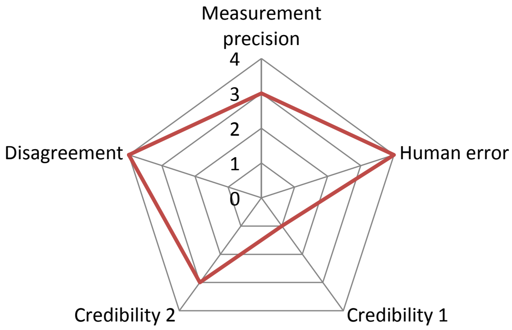

Figure 23. Example of a graphical plot for the Pedigree grades of the Stage 1 uncertainty components

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European Commission
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Title: **Current status and Best Practices for Disaster Loss Data recording in EU Member States**

Authors: Tom De Groeve, Karmen Poljansek, Daniele Ehrlich, Christina Corbane

Luxembourg: Publications Office of the European Union

2014 – 162 pp. – 21.0 x 29.7 cm

EUR – Scientific and Technical Research series – ISSN 1831-9424

ISBN 978-92-79-43549-2

doi:10.2788/18330

LB-NA-26879-EN-N

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ISBN 978-92-79-43549-2

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