JRC Scientific and Technical Reports

Armed Conflicts and Natural Resources

Scientific report on Global Atlas and Information Centre for Conflicts and Natural Resources

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Executive Summary

The project “Global Atlas and Information Centre for Conflicts and Natural Resources” had the aim to collect and to analyse the data related to the link between armed conflicts and natural resources. Four pilot study areas were selected: African Great Lakes, Horn of Africa, Western Africa and Central Asia. The project was composed of three parts: the collection and analysis of relevant datasets, statistical conflict modelling and the creation of a data repository accessible through a dedicated website.

The following datasets were collected for the pilot study areas:

- Conflict events
- Mineral and natural resources
- Land cover
- Spatial distribution of population and economic activity
- Spatial estimation of electrification rates
- Digital elevation model
- Other supporting geographic layers

The collection of conflict events was particularly challenging. The conflict events were extracted from news articles available from the internet using advanced information mining system, the JRC’s European Media Monitoring System (EMM). Each conflict event was analysed separately and inserted in a database in appropriate format. The resulting conflict event database has high level of detail and its reliability is inherited from the news articles. In spite of the short time coverage (from 2006-2010 for selected countries), it provides detailed insight to the conflict situation in the pilot study areas.

The collection of other datasets was more straightforward with the quality and limitations inherited from their original sources. Most of the used datasets were freely available for academic research.

Furthermore, the built-up layer for Liberia was derived from satellite remote sensing using data from the synthetic aperture radar (SAR). Although this layer was not used in subsequent conflict modelling, the tested methodology has potential to derive built-up layers with unprecedented detail at regional and continental scales.

The statistical conflict modelling was used to investigate the link between the location of natural resources and occurrence of armed conflicts. The model was constructed using data for the Democratic Republic of Congo, Guinea, Liberia and Sierra Leone, where data covers the period 2006-2010. Spatially disaggregated data provide insight into the conflict occurrence, location of natural resources (mineral deposits), socio-economic conditions, land cover and terrain. The model, which is implemented in open source software, was used to describe and to highlight the most relevant conditions governing the conflict occurrence. After the model was constructed, it was further used to make predictions of a conflict risk.

The public website (http://nareco.jrc.ec.europa.eu) was established and contains the following major thematic sections:

- Data: contains data compiled by JRC and links to other datasets
- Documents: the links and the references to major document used during the project
- Event timelines: interactive visualisation of conflict events occurrence
- Static maps: the geographic representation of selected datasets and countries
- Interactive maps: interactive visualisation of conflict events location and other data layers
- Conflict modelling: introduction to conflict modelling with model flowchart
- Links: internet links to the partners and other relevant organizations

The website has free access and data compiled by the JRC are publicly available.

Since the project had a rather wide scope of describing a broad range of conflict situations, the results are rather general. Based on them and on the experience gained during the project, a country-focused approach can be adopted. The conflict event collection, ancillary data acquisition as well as the conflict model remain very similar; however, more refined analysis relevant to particular country or group of countries can be achieved. Also, the satellite remote sensing can be used more effectively for collection of supporting data. The collaboration with the organizations focusing on specific conflict situations can be further deepened and the analysis of conflict situation and conflict risk prediction can be tuned based on the need and feedback of the stakeholders.

1. Introduction

There are numerous examples in recent history that show the malefic role that natural resources can play in conflicts. They are often managed inadequately and irresponsibly, illegally exploited and traded, contributing directly or indirectly to tensions, insecurity and armed conflicts, particularly in developing countries. The control of scarce resources is and has been a very important contributor to fuelling and sustaining conflict.

At the same time natural resources play an important role in post conflict situations. They can become a peace asset in peace agreements and as such they are very relevant in peace building, post-conflict recovery and reconstruction. The failure to address the governance of natural resources can delay the return to peace and can prompt a relapse into conflict.

The lack of suitable data and information represents a critical limit in the design of appropriate actions of prevention and response to on-going crises related to illegal natural resources exploitation. Relevant data collection and analysis addressing the links between conflicts and natural responses can provide fundamental support for the policies developed by the governments, international organizations and civil society.

The main purpose of this work is to contribute towards enhancing the understanding of the link between the exploitation of natural resources and conflicts in specific parts of the world, and to develop recommendations and scientific-based evidence to support policy developments.

In order to address these issues and to strengthen the European Union's ability to anticipate or respond to political crises for conflicts and natural disasters, the European Commission launched the Instrument for Stability (IfS) in 2007. It has been designed to ensure the delivery of integrated and effective community assistance to developing countries and to strengthen civilian expertise for peace-building activities. Among its priorities there is the enhancement of a conflict-sensitive, transparent, legal and equitable management of natural resources. Several studies on that topic were supported through the IfS; the Global Atlas and Information Centre for Conflicts and Natural Resources project is one of them.

1.1 Project Objectives

The project had the following objectives:

- To establish an information centre that collects and maintains all types of relevant information related to the exploitation and degradation of natural resources and conflicts
- To statistically model the link between natural resources and conflicts
- To set up a web site for sharing the data and the project outputs

Several datasets have been collected and constructed. Detailed datasets on conflicts and natural resources are fundamental for a good analysis of the problem. At the same time they are an essential resource for the entities that work on the field in order to acquire a thorough knowledge on the issues they are going to encounter.

The collected data were used as an input for the statistical conflict modelling. The statistical conflict model reveals the relationships between the conflict occurrence and the conditions which might govern the conflict ignition with the special emphasis on the location of natural resources. The model takes into account the geographic location of the data records; this allows a detailed understanding of the conflict occurrence.

Both an external public website and a restricted web-community have been created, in order to give open access to all the data and results. They include various datasets and documents, static and interactive maps and charts, conflict modelling outputs and relevant links.

The project was developed in collaboration with a series of international partners who conduct studies, programmes and research in the field. These include:

- Groupe de recherche et d'information sur la paix et la sécurité (GRIP)
- Isituto per gli Studi di Politica Internazionale (ISPI)
- Northern Uganda Data Centre
- Resource Consulting Services Limited
- The International Peace Information Service (IPIS)

- The Norwegian University of Science and Technology (NTNU)
- The United Nations Environment Programme (UNEP)
- The World Bank (WB)

1.2 Report Structure

The report is structured into three main parts. The first part describes the creation and collection of the datasets used in the project (conflict event dataset, datasets on natural resources and datasets derived from satellite remote sensing). The second part is focused on description, implementation and results of the statistical conflict modelling, while the third part describes the outputs available on the web portal.

2. Dataset collection

2.1 Cartographic representation of the datasets

All datasets used in the project were originally geo-located in a variety of cartographic systems. The cartographic system selected for this project was World Mollweide equal area cartographic projection with reference ellipsoid and datum defined according to the European Petroleum Survey Group (EPSG) as EPSG:54009. This cartographic system projects the focused countries (see chapter 2.2.2) with an acceptable geometric distortion.

All datasets represented in vector or raster form were converted into this cartographic system. Special attention was paid to the conversion of raster data. The raster datasets were converted from their original cartographic projection to the Mollweide projection with the pixel size of 0.5, 1, 5 or 10 km. The origin of each raster dataset was bound to the coordinates [0, 0]; this ensures a smooth overlay and manipulation with rasters of various spatial resolutions.

The parameters of the projection are shown in Table 1.

Table 1. Parameters of World Mollweide projection

Name of the projection:	World Mollweide
EPSG code:	54009
Projection type:	Equal area
Datum:	WGS-84
Spheroid:	WGS-84
False Easting:	0
False Northing:	0
Central Meridian:	0
Linear Unit:	Meter

2.2 Conflict Event Dataset

2.2.1 Existing conflict events datasets

Several conflict datasets have been established by other organizations, for example the UCDP/PRIO Armed Conflict Dataset (CSCW 2009), the Armed Conflict Location and Event Data (ACLED) (Acled 2010), the Penn State Event Data Project Website (PENNSTATE 2010), the Correlates of War (COW 2007), and others (Eck, 2005). For the purpose of this project, the following two were selected.

The first one is the ACLED developed by the Centre for the Study of Civil War of the International Peace Research Institute, Oslo. It covers the period 1997 – April 2009 for 50 countries and contains information on the date, location, conflict event type and involved actors. More details are found on the ACLED website: http://www.acleddata.com/.

The second dataset was built by the JRC, including several countries that are not available in the ACLED dataset. For compatibility reasons the JRC dataset follows the structure of the ACLED and adds more features relevant to the project.

2.2.2 Description of the JRC conflict events dataset

The JRC conflict events dataset has been built using the search queries of the European Media Monitor application (EMM) (EMM 2010). The EMM constitutes an innovative and unique tool that gathers text from news portals worldwide in 45 languages. It classifies the articles, analyses the news texts by extracting information from them, aggregates the information, issues alerts to the user and produces intuitive visual representations of the information found. The EMM allowed us to look for the conflict event articles using a range of pertinent keywords. We searched only articles written in English.

The media articles describing conflict events were coded into the dataset. If one conflict event was reported in more than one newspaper and/or during more than one day in a row, the event was coded only once.

The spatial and time coverage of the JRC conflict event dataset is presented in Table 2.

The dataset is open to anybody, who can update it according to their specific need.

Table 2. Spatial and time coverage of the JRC conflict event database.

Region	Time frame
African Great Lakes	
Democratic Republic of Congo (DRC)	01/2006 – 03/2010
Uganda	01/2008 – 03/2010
Burundi	01/2008 – 03/2010
Rwanda	01/2008 – 03/2010
Tanzania	01/2008 – 03/2010
Horn of Africa	
Ethiopia	01/2008 – 03/2010
Eritrea	01/2008 – 03/2010
Djibouti	01/2008 – 03/2010
Somalia	01/2008 – 03/2010
Sudan	01/2008 – 03/2010
Central Asia	
Kazakhstan	01/2008 – 03/2010
Kyrgyzstan	01/2008 – 03/2010
Tajikistan	01/2008 – 03/2010
Turkmenistan	01/2008 – 03/2010
Uzbekistan	01/2008 – 03/2010
Western Africa	
Guinea	01/2006 – 03/2010
Liberia	01/2006 – 03/2010
Sierra Leone	01/2006 – 03/2010

2.2.3 Definition and codes

For the sake of consistency with other datasets that already exist the data structure was inspired by the codebook of the Armed Conflicts and Events Dataset (ACLED) developed by the Peace Research Institute Oslo (PRIO). We used the same definitions for conflict actors, conflict events and the description of battle events. As a result, we coded the events described in Table 3.

Table 3. Codes of event types.

Event Code	Event type	Event description (from ACLED Codebook (Raleigh et al., 2010))
1	Battle- No Change of Location Control	A battle where the control of the fighting location is not exchanged. This is the most frequent event. If the government controls an area and fight with rebels but win, this is the correct code. If rebels control a location and fight with government forces, this is the correct code. If two rebels are fighting and the group in control of the location still has authority in that location, this is the correct code.
2	Battle- Rebel Control Location	A battle where rebels win control of location. This is the correct code if, after fighting with another force, a rebel group acquires control of a location. If two rebel groups fight and the group which did not begin with control acquires it, this is the correct code.
3	Battle- Government Regains Control	A battle where the government regains control of a location previously lost in a government-rebel battle. This event type is solely used for government reacquisition of control.
4	Headquarters or Base Establishment	A rebel group establishes a base or headquarters. This event can be nonviolent, but must be coded when a semi-permanent base is established by a group.
5	Non-Violent Rebel Presence	This event means to record activity by rebel groups that does not involve active fighting but are within the context of the war/dispute. Examples include recruitment drives, incursions or rallies.
6	Rioting/Protesting	Protest involves a group involved in non-violent public meeting against a government institution. Rioting is a violent form of protest. The actors for this group are noted as 'protestors (country)' or 'rioters (country). Interaction with government forces is not mandatory.
7	Violence Against Civilians	Violence against civilians occurs when any armed groups attacks unarmed civilians within the context of a larger conflict. Rebels, governments, and militias can all perpetrate violence against unarmed civilians. This is the only event that can involve civilians.
8	Non-Violent Transfer of Location Control	This event is for situations where rebels or governments acquire control of a location without engaging in a violent act.

We also created a new field that shows what kinds of actors were involved in the conflict. The purpose of this field is to show better what types of actors are engaged in the conflict. It simplifies the usual actor coding especially when the actors are numerous. The codes and corresponding type of engaged actors are summarized in Table 4.

Table 4. Coding table for engaged actors (source: JRC)

Actors engaged code	Actors engaged type	Actors engaged description
1	Non-State Actor vs. Non-State Actor	Each of the actors engaged is either a militia or a rebel group. Non-State Actor also includes militias or rebel groups acting on behalf of a government but which are not formally part of it.
2	Non-State Actor vs. Government Force	One of the actors is a militia or rebel group, whereas the other actor is part of any of the branches of the government.
3	Non-State Actor vs. Civilians	One of the actors is a militia or rebel group, whereas the other actor is a civilian group, armed or unarmed.
4	Civilians vs. Government Force	A group of civilians, armed or unarmed, engages with any of the branches of the government.
5	Civilians vs. Civilians	The event involves more than one group of civilians in opposition, armed or unarmed.
6	Government Force vs. Government Force	The event involves more than one group of government forces in opposition.
7	Unknown Actor vs. Civilians OR Government Force OR Non-State Actor	One of the actors is not identified, so it is difficult to assess its type (rebel group/government troops or civilians)
8	Single Actor	A conflict event that involves only one actor, for example rioting/protesting that doesn't involve interactions with security forces, rebel group presence, looting or destroying buildings/properties without interacting with another actor.

Given that the dataset is based on media reporting, conflict events that might have occurred but were not reported in news sources are not included. As a result, the absolute number of conflict events that occurred in reality might be higher than what our database indicates.

To identify the geographical coordinates of the conflict events, we used various sources available online, including the JRC Gazetteer (Joint Research Centre 2010), Google Earth, and the Falling Rain Genomics Global Gazetteer (Falling Rain Genomics Inc, 2010). Where the exact geo-location of the event could not be identified or found, we noted the smallest known administrative unit (GAUL 2009) (usually a territory, county, region or province) and calculated the centroid geographical coordinates of the unit.

The dataset also includes the number of victims reported in the news article. We used the victim's classification shown in Table 5. Counts of victims in each class were given one of the accuracy tags described in Table 6. The summary of number of victims for each country is given in Table 7 and in Annex 7.3

Table 5. Classification of conflict victims

Victim class	Description
Dead	number of people reported killed
Injured	number of people reported injured
Raped	number of people reported raped
Displaced	number of people reported displaced
Kidnapped	number of people reported kidnapped
Detained	number of people reported detained, or captured, or arrested or imprisoned

Table 6. Accuracy tags used for counts of victims

Tag	Description
c	certain or almost certain (according to article). "At least 4 people" or "more than 4 people" are recorded as "4; certain"
r	reasonable (it is likely that the margin of error is less than 50%; if 100 is recorded, the likely number is between 50 and 150)
g	pure guess; it could be very wrong
i	impossible to say, but almost certainly more than zero (preferably, the coder tried to make a guess)

Table 7. Estimated number of documented victims

Country	Time frame	N. events	Dead	Injured	Raped	Displaced	Kidnapped	Detained
Burundi	01/2008– 03/2010	14	145	14	0	0	5	3
DRC	01/2006 – 03/2010	337	5992	1140	32	1025828	822	1513
Djibouti	01/2008 – 03/2010	1	2	50	0	0	0	0
Eritrea	01/2008 – 03/2010	9	133	119	0	0	0	2
Ethiopia	01/2008 – 03/2010	51	1437	267	0	10000	0	0
Guinea	01/2006 – 03/2010	75	378	62	5	0	0	169
Kazakhstan	01/2008 – 03/2010	6	0	0	0	0	0	0
Kyrgyzstan	01/2008 – 03/2010	18	17	0	0	0	0	115
Liberia	01/2006 – 03/2010	28	20	40	0	10000	0	28
Rwanda	01/2008 – 03/2010	16	11	99	0	0	0	7
Sierra Leone	01/2006 – 03/2010	26	5	65	0	0	0	3
Somalia	01/2008 – 03/2010	616	4200	5814	0	249700	0	56
Sudan	01/2008 – 03/2010	288	4968	1131	0	266639	419	93
Tajikistan	01/2008 – 03/2010	17	32	3	0	0	0	31
Tanzania	01/2008 – 03/2010	17	90	320	0	0	0	0
Turkmenistan	01/2008 – 03/2010	2	20	15	0	0	0	0
Uganda	01/2008 – 03/2010	42	343	17	0	0	0	23
Uzbekistan	01/2008 – 03/2010	10	8	0	0	0	0	1
Total		1573	17801	9156	37	1562167	1246	2044

Important note: *The numbers above are based only on a limited number of English web pages. Not all possible news sources were used and no reporter reached many conflict areas. These numbers probably underestimate the real number of victims, and the error varies across countries. Some articles report thousands of victims, hence missing a single article may introduce very large biases; some numbers were estimated by the coder because the article gave a literal, non-numeric estimate (see Table 6). Consequently the reported numbers are just the minimal documented numbers of victims we found.*

2.2.4 Challenges encountered

One of the main challenges encountered was related to the geo-location of the events. Different ways of spelling the same place names (especially in the case of Arab speaking regions) caused significant challenges in the process of identifying the geographical coordinates. Lack of precise location information in some news articles only permitted to identify broad locations, such as provinces rather than towns; in some cases several villages with the same name where found in different locations. Where these circumstances arose, the final decision on which coordinates to use was made on the basis of a qualitative interpretation of the news text.

Additional challenges worth noting arose as a result of the non-automatic nature of this information extraction process. Searches for news sources, for example, are limited to English and therefore may not reach local media in different languages. Furthermore, both the process of extracting events and the eventual analysis based on the resulting dataset needed to be accompanied by a process of questioning and scrutiny of the degree of reliability of news sources found and used. Media can be subjective in their reporting, can under or over-report certain issues in certain locations, particularly in areas of conflict, and thus the extraction of information is susceptible to biases.

Overall, the non-automatic extraction of armed conflict events is a highly time-consuming process. We were not too specific with the searches, in order to ensure that the maximum number of events was identified and coded. As a result, broad searching demanded a process of sorting and filtering through both articles that were not pertinent to the scope of the project and articles that referred to the same event.

The automatic extraction of events from news sources would facilitate the gathering and coding of conflict events by clustering news articles that refer to the same event, extracting information directly into a database, searching in many languages, and automatically accessing details regarding the geographical coordinates.

Currently available systems of automatic extraction were attempted for the purpose of this armed conflict event database, but were not found as accurate and comprehensive as non-automatic extraction. Current automatic extraction searches identified fewer events, incorrect locations and incorrect types of events. They also did not cluster events successfully and thus produced duplicate entries for the same events. Lastly, the lack of source references would have resulted in the need to

manually search them, as sources are needed to back our database and to double-check the events themselves when evaluating accuracy.

2.2.5 Results and short statistical overview for selection of countries

The dataset currently includes 1573 conflict events entries, for all countries, during the whole period of time.

For the period 2008-2009, the Horn of Africa is by far the region with the highest number of conflict events (76%), followed by the African Great Lakes (17%). In West Africa and Central Asia a similar number of conflict events were registered (Figure 1).

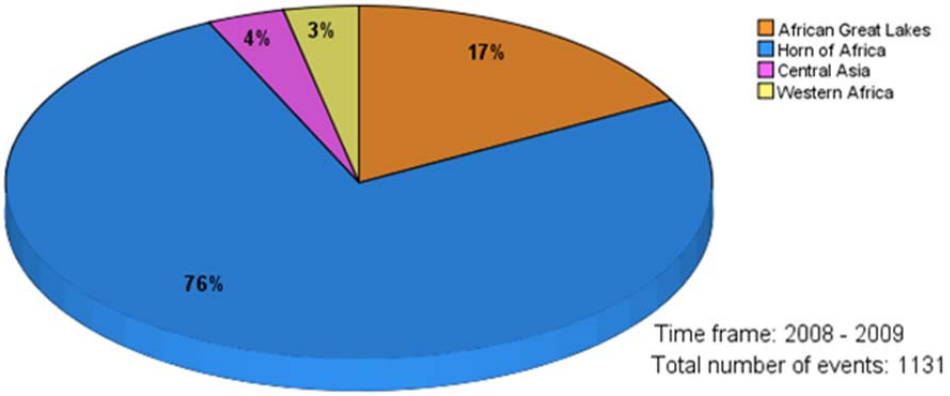


Figure 1. Conflict events distribution among focused areas.

In the Horn of Africa the country with the highest number of conflict events in 2008-2009 is Somalia (63%) followed by Sudan (31%) and Ethiopia (6%). The majority of these conflict events consisted in battles which did not lead to a change of the location control, followed by events involving violence against civilians (31%) – see Figure 2. A more detailed summary of conflict events for Somalia and Sudan follows.

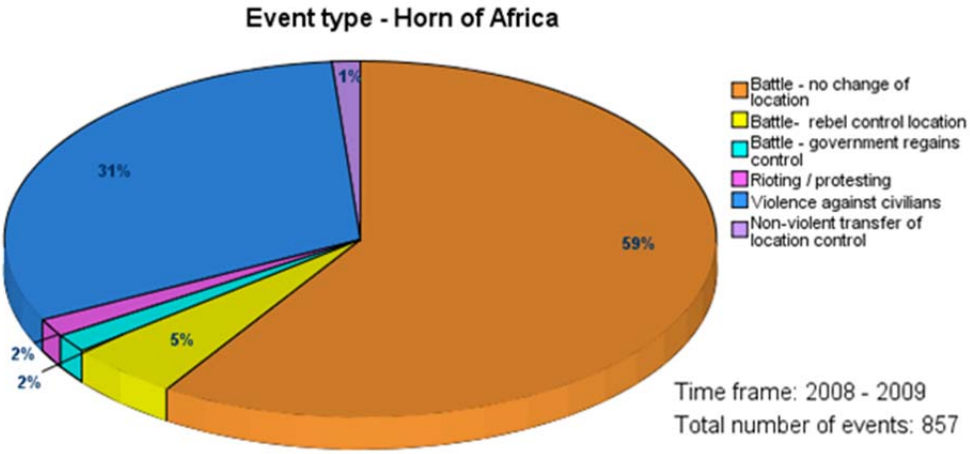


Figure 2. Types of conflict events in Horn of Africa

In Somalia more than half of the conflict events for 2008 and 2009 took place in the region of Banadir (56%), followed by Hiraan (8%) and Bay (6%). A total of 60% of the events are battle with no change of location, while 27% consist in violence against civilians, the percentage of the latter decreased slightly from 2008 (30%) to 2009 (25%). Looking at the actors involved, 41% of the events engaged non-state actors versus government force while in 20% of the cases one of the actors is unknown (Figure 3).

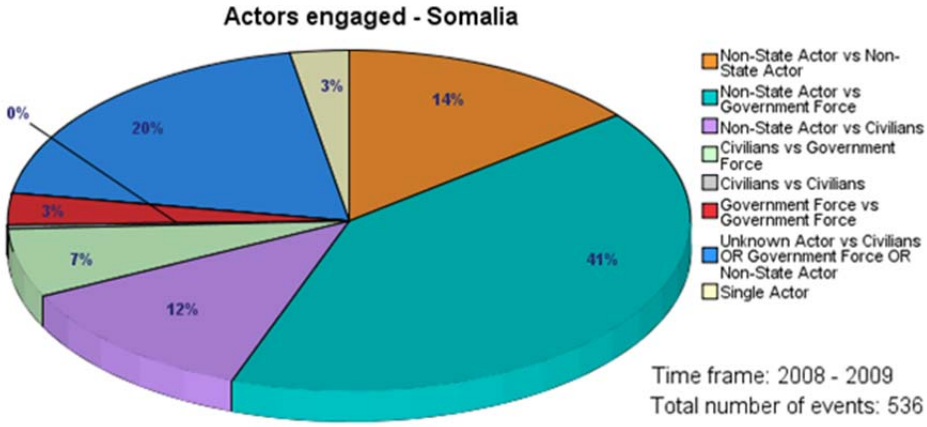


Figure 3. Actors involved in conflict in Somalia

In Sudan, 43% of the total number of events in 2008 and 2009 were in the three Darfur regions, 24% in Jonglei and 10% in Western Equatoria. While in 2008 only 3% of the conflict events were in Jonglei, in 2009 the percentage increased drastically to 42%. In Northern Darfur the events decreases from 25% in 2008 to 10% in 2009. The situation is similar also in the other Darfur regions. In Southern Darfur they decreased from 20% in 2008 to 9% in 2009, while in Western Darfur from 18% in 2008 to 8% in 2009. The proportion of violence against civilians was very high, 41% of the total number of events, while 55% consist in battles with no change of location (Figure 4).

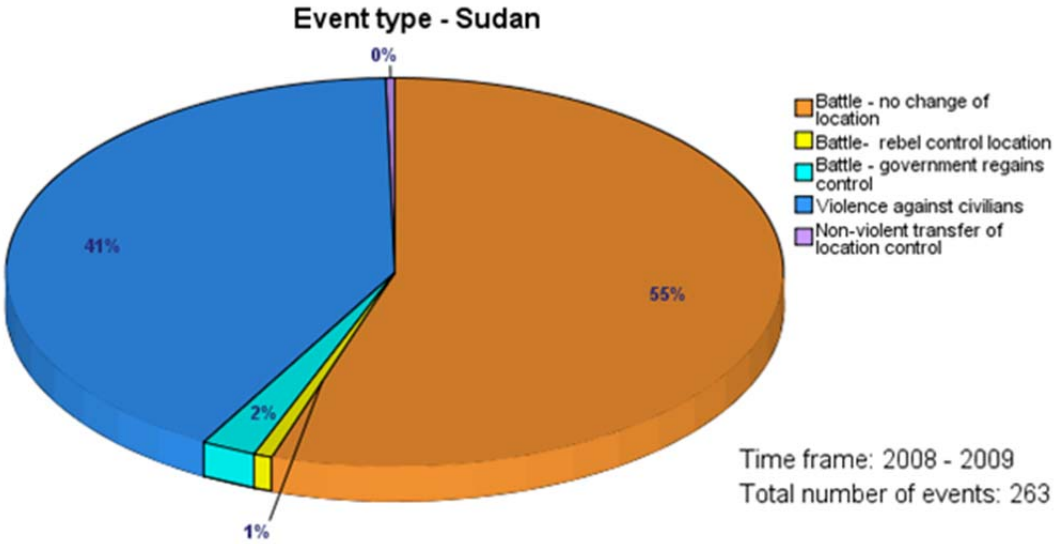


Figure 4. Types of conflict events in Sudan

During the same period of time, in the African Great Lakes region, the Democratic Republic of Congo accounted for the majority of the conflict events (65%), followed by Uganda (18%). In this region, the majority of conflict events consisted in violence perpetrated against civilians (53%) contrary to the other regions, in which the majority of events consisted in battles. This result is supported by the data obtained in terms of actor involvement. In the African Great Lakes region, 41% of all conflict events involved non-state actors against civilians, whereas 39% involved non-state actors and government forces (Figure 5).

Focusing on the Democratic Republic of Congo, the most conflictive region of the country is Nord-Kivu, where more than 44% of the conflict events of 2006-2009 were registered. The second conflictive region is the Province Orientale.

The main types of conflicts were battle with no change of location (47%) and violence against civilians (36%) (Figure 6). The highest number of battles with no change of location was in 2006 (40%) and 2007 (30%). In the same time the violence against civilians almost doubled in 2008 compared to 2007.

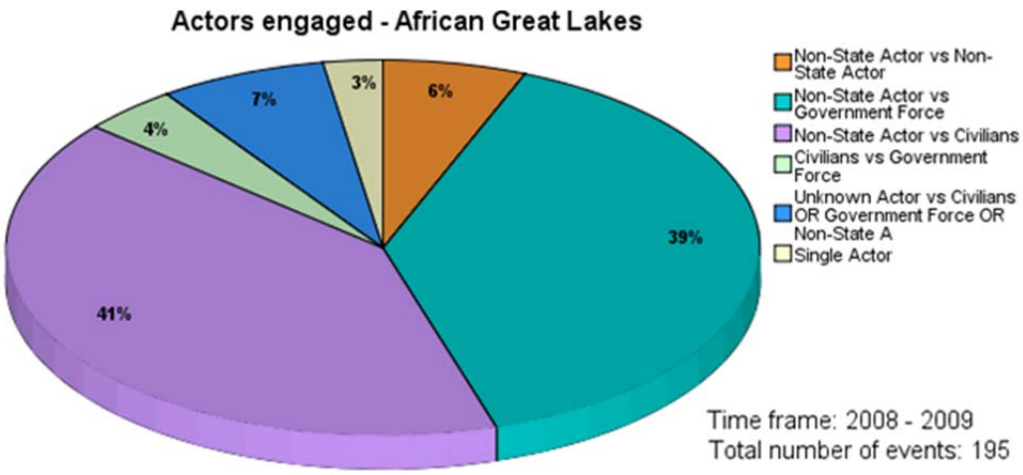


Figure 5. Actors involved in conflict in African Great Lakes

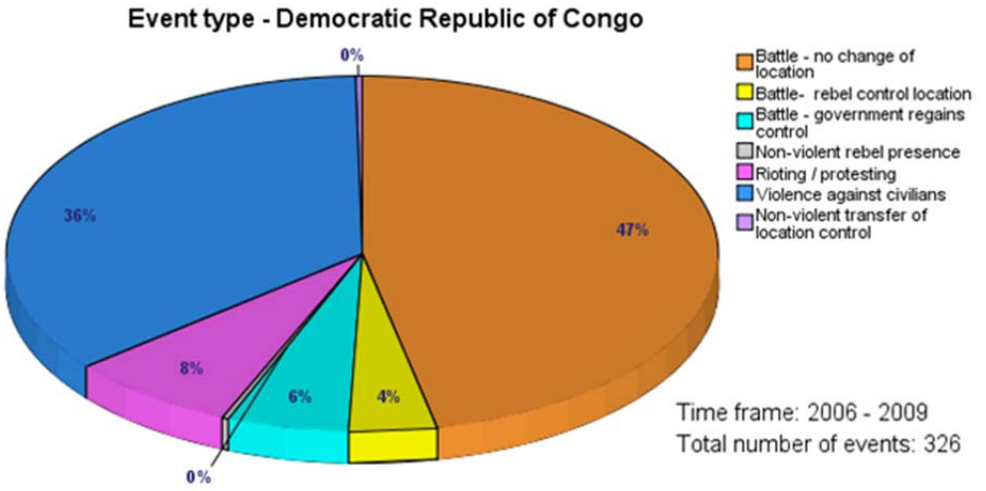


Figure 6. Types of conflict events in Democratic Republic of Congo

In Western Africa, from 2006 to 2009, most conflict events were registered in Guinea (56%) while Liberia and Sierra Leone had the lower share of the region's events (22%). About half of the events occurred in 2007. The three main types of events encountered are rioting (36%), violence against civilians (35%) and battle with no change of location (27%).

Central Asia is the region for which the lowest number of conflict events where recorded. During the period 2008 – 2009, Tajikistan shows the highest number at 17 events or 42% of the total while Turkmenistan shows the lowest number of events at 2. Most events involved battles with no change of control over location (45%). A total of 50% of all the conflict events in this region engage non-state actors versus government force. A very important indicator for the Central Asia region is the number of conflict events per year, which increased dramatically from 2008 to 2009. Only 10% were in 2008 while 90% in 2009.

The number and type of victims for each country was summarized in Table 7 and in Annex 7.2 and is graphically represented in Figure 7 and Figure 8. It is necessary to emphasize that number of victims is based only on a limited number of English web pages. Not all possible news sources were used and no reporter reached many conflict areas. These numbers probably underestimate the real number of victims, and the error varies across countries. Some articles report thousands of victims, hence missing a single article may introduce very large biases; some numbers were estimated by the coder because the article gave a literal, non-numeric estimate (see Table 6). Consequently the reported numbers are just the minimal documented numbers of victims we found.

More plots of conflict events for all four regions are in Annex 7.1. The conflict event timelines for each country are in Annex 7.3.

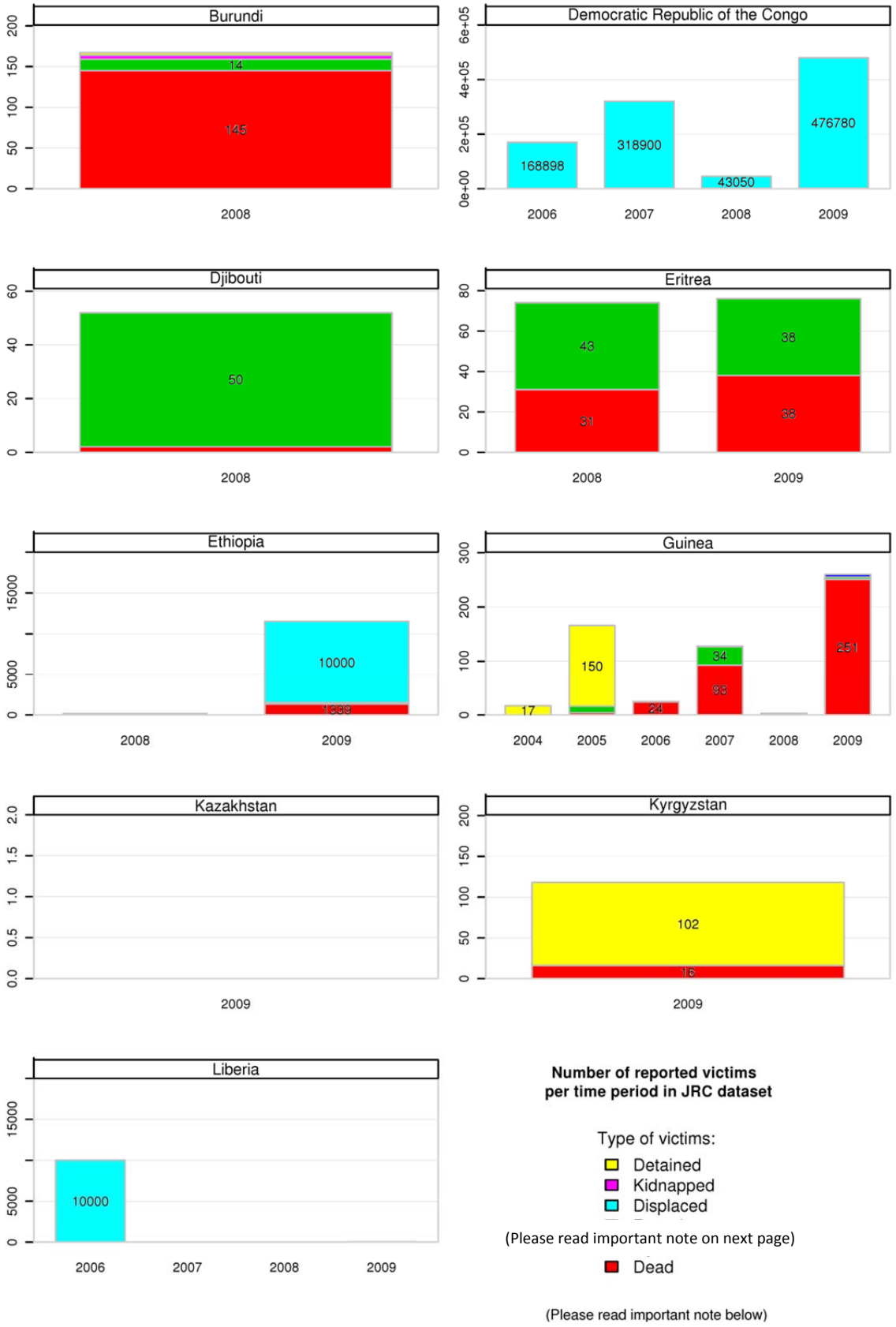


Figure 7. Number of reported victims (part 1).

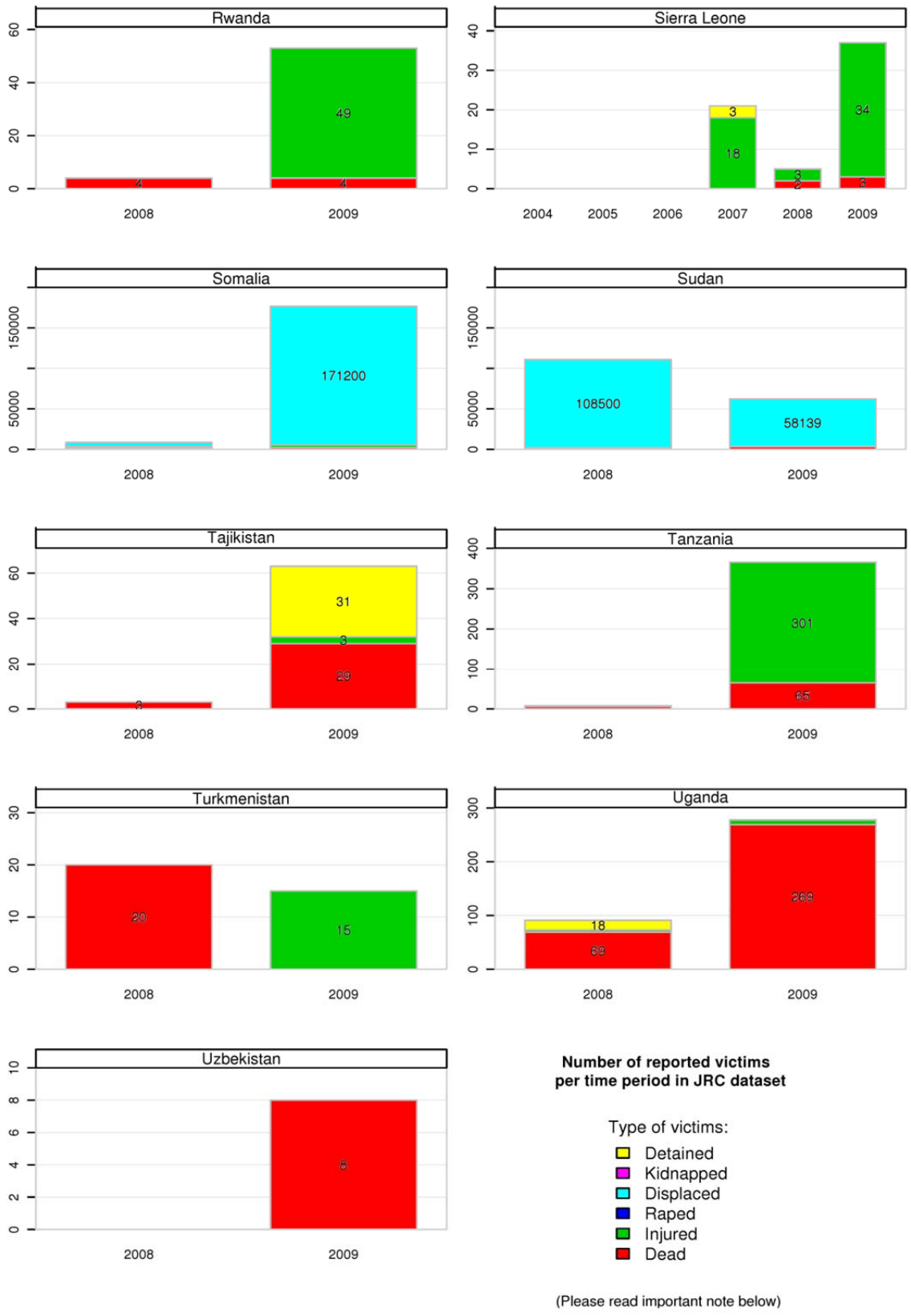


Figure 8. Number of reported victims (part 2).

Important note: *The plots above are based only on a limited number of English web pages. Not all possible news sources were used and no reporter reached many conflict areas. These numbers probably underestimate the real number of victims, and the error varies across countries. Some articles report thousands of victims, hence missing a single article may introduce very large biases; some numbers were estimated by the coder because the article gave a literal, non-numeric estimate (see Table 6). Consequently the reported numbers are just the minimal documented numbers of victims we found.*

2.3 Natural and Mineral Resources Datasets

The primary source of information about mineral resources was data coming from Mineral Resources Data System (MRDS) (USGS 2010b) maintained by U.S. Geological Survey (USGS) (USGS 2010c).

The MRDS is a mineral resources data system that describes deposit name, location, commodity, deposit description, geologic characteristics, production, reserves, resources, and references. It covers about 100 mineral commodities for approximately 180 countries. The data are available free of charge in vector format.

As supplementary dataset on mineral resources, the Mining Data Bank (MDB) maintained by the Secretariat of the African, Caribbean and Pacific group of States (ACP) was used (Groupe ACP 2010). Unfortunately, the web portal includes only output raster maps without proper georeferencing; this hampers its practical usage. As a test and for comparison with MRDS, the mineral map of Liberia was downloaded, georefecenced with a geographic information system (GIS) software and the geolocation of mineral resources was obtained through vectorization. The MDB dataset was found to be richer than MRDS, however the need to georeference each map for each country and the subsequent vectorization of mineral locations forbade practical usage of this dataset.

For oil and gas fields locations in Central Asia, the U.S. Energy Information Administration (EIA) (EIA 2010) documents were used. The country profiles with location of oil and gas fields were used to assemble georeferenced dataset usable in GIS.

2.4 Datasets derived from satellite remote sensing

Within the project several datasets derived completely or partially from satellite remote sensing were used. Satellite imaging provides a tool for efficient collection of consistent data about land surface and allows the derivation of information related to the land surface. The datasets used in this project were derived from the sensor which allows large coverage of land mass in an acceptable time period.

2.4.1 MODIS Land Cover map

The land cover map is derived from the satellite imagery of Moderate Resolution Imaging Spectroradiometer (MODIS) aboard the Terra and Aqua satellites. The MODIS Land Cover product (MCD12Q1) is available for the years 2001-2008. For each year, the year-round daily MODIS imageries were used to derive the land cover map. The land cover classes were extracted according to their known spectral and temporal characteristics. The theoretical basis and details about the algorithm used to derive land cover classes is available from the MODIS product website (Strahler et al., 1999).

The MODIS Land Cover product MCD12Q1 includes five land cover maps with a different level of classification details. For the purpose of this project the International Geosphere-Biosphere Programme (IGBP) land cover classification was used. The IGBP global land cover classification contains 17 main land cover classes (Loveland & Belward, 1997). They are listed in Table 8.

Table 8. IGBP Land Cover Classes (Loveland & Belward, 1997)

Land Cover Class	Numerical Code	Description
Water bodies	0	Oceans, seas, lakes, reservoirs, and rivers. Can be either fresh or salt water bodies.
Evergreen needleleaf forest	1	Lands dominated by woody vegetation with a percent cover > 60% and height exceeding 2 meters. Almost all trees remain green all year. Canopy is never without green foliage.
Evergreen broadleaf forest	2	Lands dominated by woody vegetation with a percent cover > 60% and height exceeding 2 meters. Almost all trees remain green year round. Canopy is never without green foliage.
Deciduous needleleaf forest	3	Lands dominated by woody vegetation with a percent cover > 60% and height exceeding 2 meters. Trees shed their leaves during the dry season; e.g. Siberian Larix.
Deciduous broadleaf forest	4	Lands dominated by woody vegetation with a percent cover > 60% and height exceeding 2 meters. Consists of broadleaf trees with an annual cycle of leaf-on and leaf-off periods.
Mixed forest	5	Lands dominated by woody vegetation with a percent cover > 60% and height exceeding 2 meters. Consists of mixtures of either broadleaf or needleleaf trees and in which neither component exceeds 60% of landscape
Closed shrublands	6	Lands with woody vegetation with a height less than 2 meters. The total percent cover, including the herbaceous understory, exceeds 60%. The shrub foliage can be either evergreen or deciduous.
Open shrublands	7	Lands with woody vegetation with a height less than 2 meters, and sparse herbaceous understory. Total percent cover is less than 60%. The shrub foliage can be either evergreen or deciduous.
Woody savannas	8	Lands with and herbaceous understory, typically graminoids, and with tree and shrub cover between 30-60%. The tree and shrub cover height exceeds 2 meters.
Savannas	9	Lands with an herbaceous understory, typically graminoids, and with tree and shrub cover between 10-30%. The tree and shrub cover height exceeds 2 meters.
Grasslands	10	Lands with herbaceous types of cover, typically graminoids. Tree and shrub cover is less than 10%.
Permanent wetlands	11	Lands with a permanent mosaic of water and herbaceous or woody vegetation. The vegetation can be present in either salt, brackish, or fresh water. Only wetlands covering extensive areas (i.e., more than 500 km2) will be mapped (e.g., Sud, Okavanga, Everglades).
Croplands	12	Lands where crops comprise > 60% of the total land cover.
Urban and built-up	13	Places that are dominated by the built environment
Cropland/Natural vegetation mosaic	14	Lands with mosaics of crops and other land cover types in which no component comprises more than 60% of the landscape.
Snow and ice	15	Lands under snow/ice cover for most of the year.
Barren or sparsely vegetated	16	Lands with exposed soil, sand or rocks and has less than 10% vegetated cover during any time of the year.
Unclassified	254	
Fill Value	255	

The product MCD12Q1 is organized in tiles and can be downloaded from the Warehouse Inventory Search Tool (WIST) (WIST 2010). The tiles were assembled together and were transformed into the previously described cartographic representation. The example of MODIS Land cover for Sierra Leone for year 2001 is shown in Figure 9.

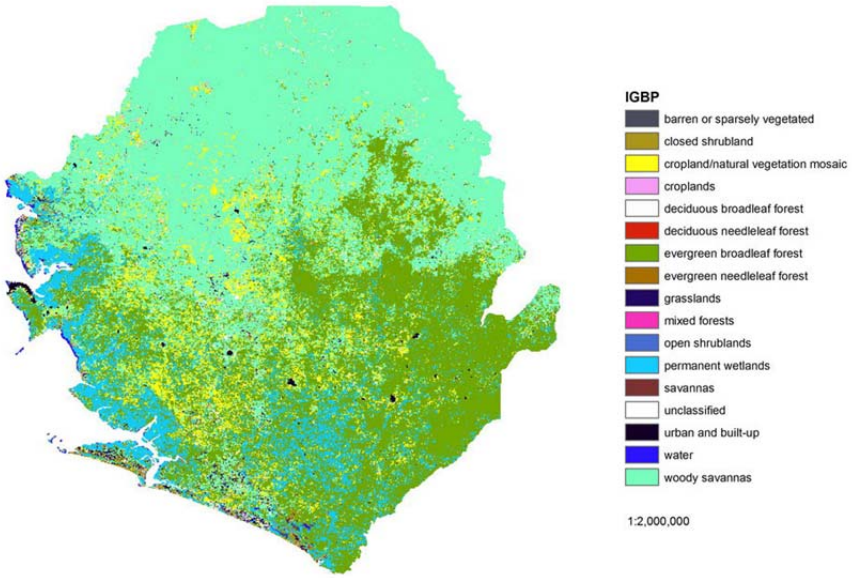


Figure 9. Land Cover Map for Sierra Leone in 2001 based on MODIS data.

2.4.2 LandScan 2008 population grid

LandScan 2008 is the proprietary global dataset which contains spatially disaggregated population counts at the spatial resolution of 30”x30” (approximately 1x1 km). The dataset was derived from heterogeneous sources including census information, administrative boundaries, land cover maps, satellite imagery, coastlines and other spatial data, which were combined using multi-layered spatial modelling.

The first version of LandScan dataset was produced in 1998 and is updated approximately every year. The version used in this project for population counts is from 2008. More documentation is provided on the LandScan website (ORNL 2010).

2.4.3 DMSP-OLS nightlight data and derivative datasets

The products are derived from satellite data acquired by the Operational Linescan System (OLS) onboard the satellites from Defence Meteorological Satellite Program (DMSP). The satellites of DMSP are flown on polar orbits and its OLS sensors are designed to collect global cloud imagery. OLS is capable to cover the entire Earth twice a day. During the night the visible band signal of OLS is intensified to detect moonlit clouds. The boost in gain enables the detection of lights present on the Earth’s surface (Elvidge et al., 2009). The light’s intensity connected with other ancillary data was used to derive other datasets. Those relevant to the project are listed below.

2.4.3.1 Global Distribution of Economic Activity

This product was derived from the combination of DMSP-OLS nightlight data for year 2006, LandScan 2006 population grid, official GDP statistics and informal economy estimates (Ghosh et al., 2010). The regression model was used to derive unique coefficients which were multiplied with the sum of lights to derive the total economic activity spatially disaggregated to 1 km grid. Data are available for download at the product website (NOAA 2010b).

2.4.3.2 Estimation of Electrification Rates

This product was derived from the combination of DMSP-OLS nightlight data for the year 2006, LandScan 2006 population grid and extent of electrification at national level drawn from International Energy Agency’s World Energy Outlook (Elvidge et al., 2011). The electrification rate is defined as a ratio between population living in areas where night light is detected versus total population at national and

subnational level. The subnational level corresponded to the administrative divisions within the countries. Data are available for download at the product website (NOAA 2010a).

2.4.4 Built-Up Area Index derived from SAR data

The possibility to use Synthetic Aperture Radar (SAR) data for detection of built-up areas was tested for Liberia.

SAR is a coherent, side-looking, imaging radar operating from a moving platform (airborne or space-borne) which utilises the flight path of the platform to simulate an extremely large antenna or aperture electronically, and that generates remote sensing imagery. The main advantages of SAR are the possibility of acquiring also during the night, since they are active sensors and do not rely on the passive reflection of sunlight from the earth surface, and the possibility to acquire in every meteorological conditions, as SAR can "see" through the clouds.

The radar sensor used to perform the urban analysis of Liberia is the ASAR (Advanced Synthetic Aperture Radar) sensor, mounted on board of the ENVISAT-1 satellite, launched in March 2002. Envisat flies in a sun-synchronous polar orbit of about 800 km altitude. The repeat cycle of the reference orbit is 35 days and for most sensors, including ASAR, provides a complete coverage of the globe within one to three days.

The European Space Agency (ESA) is putting in place a repository of the ASAR acquisitions over the entire globe resampling the data at 75 meters resolution. The data available at the moment in the ESA are all the data acquired from 2005.

2.4.4.1 Algorithm description

The anisotropic rotation invariant built-up presence index is based on the idea that built-up structures have a certain spatial dimension and can be discriminated from the background by their known spatial relationships (Pesaresi & Gerhardinger, 2010; Pesaresi et al., 2008). In particular, built-up structures are, to some extent, anisotropic at the scale of the urban areas. Its applicability to SAR data has been demonstrated (Gamba et al., 2008). The implementation of the index follows the rules listed below:

1) Determination of GLCM (Grey level co-occurrence matrix) matrix window size from average building size and SAR system resolution.
2) Calculation of the texture measure *contrast* for ten different displacement vectors based on the predefined matrix window size.
3) Scaling and integration using the *min* operator.
4) Local adaptive filtering to compensate the backscattering generated by the reliefs illuminated by the SAR sensor.

The agreement between SAR-derived built-up areas (determined by high value of built up index) was compared with GoogleEarth® imagery with promising level of agreement. The processing of global dataset is underway as part of exploratory research at the JRC.

2.5 Other datasets

2.5.1 Geographic thematic layers

Several complementary geographic layers were used during the project for map production and conflict modelling purposes. They are listed in Table 9. All of them were converted to the previously described cartographic standards (see chapter 2.1).

Table 9. Supplementary geographic layers.

Source of dataset	Layers
Global Discovery (Global Discovery 2009)	Places (capitals, major cities, cities, etc.) Mountains Airports Railways Coastline
Collins Bartholomew, 2009 (http://www.bartholomewmaps.com)	Mountains Roads
Global Administrative Unit Layers, (FAO, 2008) (http://www.fao.org/geonetwork/srv/en/metadata.show?id=12691)	Administrative boundaries
ESRI, 2007	Cities
Global Lakes and Wetlands Database (GLWD), WWF-US, 2004, (http://www.worldwildlife.org/science/data/item1877.html)	Water bodies

2.5.2 GTOPO30

GTOPO30 is a global digital elevation model (DEM) with a horizontal grid spacing of 30 arc seconds (approximately 1 kilometre). GTOPO30 was derived from several raster and vector sources of topographic information and it is freely publicly available (USGS 2010a). Each grid cell contains its elevation above sea level.

Terrain roughness for a given cell was computed based on the standard deviation of all cells within a 5-km radius around the focal cell. This allows having a measure of “flatness” independently of the elevation above sea level.

3. Conflict Modelling

3.1 The Purpose of Conflict Modelling

A model is a simplified representation of reality. In a scientific context, it is supported by a theory and designed to better understand the reality and to make predictions. Thanks to a simplified representation of reality, the models make the analysis easier. However, precisely because of the simplification they may lead to incorrect predictions. Therefore interpretation of their results should always be carried out with caution.

In the framework of this project, conflict modelling had the following purposes:

1) To better understand the reality of conflict: what is a conflict? What kind of conflicts are currently going on? What are the circumstances that may increase the risk of conflict?

2) To make predictions: what are the most likely places of conflict in the future? How will conflict risk change should circumstances change? How effective is one conflict prevention strategy compared to another?

According to the science philosopher Karl Popper, theories must be built on hypotheses, from which propositions should be deduced (the hypothetico-deductive method). Those propositions should then be compared to the real world; if one proposition is contradicted by the facts only once, then the entire theory should be rejected. While this rule is useful in physics, it needs to be adapted to fit the social sciences, as individuals and societies do not behave in a deterministic way. Consequently it will always be possible to find counter examples even for theories that could potentially be very useful for policy action. For instance, a "deterministic" theory stating that "diamond mines continuously trigger conflicts in their vicinity" will easily be rejected simply by finding one example of a diamond mine within a peaceful area. However, the following "probabilistic" theory is more useful: "diamond mines tend to increase the risk of conflict in their vicinity". Therefore statistical methods are used to measure the risk of conflict and to see if it is higher near diamond mines, everything else being equal. The statistical methods also tell us the level of confidence we can have in the results.

3.2 Variable Description

Because conflicts are not deterministic phenomena, the choice has been made to use a statistical modelling approach.

3.2.1 Spatial granularity

In past decades, the traditional approach for modelling conflicts has been to use an aggregation of data at the country-year level. This is because most conflicts were international (hence the aggregation at the national level).

In the context of this project, however, the aggregation at the country level is not appropriate. Now many conflicts are internal disputes, taking place inside country borders. In addition, conflict events are distributed unevenly: they tend to be clustered in a few regions. Finally, other variables are not spatially uniform, e.g. natural resources are distributed unevenly within national territories.

Consequently the level of analysis that has been chosen is highly disaggregated: the territory under consideration has been divided into cells of one square kilometre each. This value was chosen as it fits the spatial resolution of most of the datasets that were used.

3.2.2 Time granularity

In the traditional approach, grouping data at the yearly level fitted the annual structure of international statistical datasets provided by international organizations. With a spatial granularity at the country level, it is possible and recommended to use a high time granularity, taking advantage of daily event data (Kauffmann, 2007). However, in the framework of this project, it would have been difficult to have both very high time and space granularity for reasons related to processing power capacities. Given that the focus was on natural resources, the priority has been put on having a high spatial granularity and only a yearly granularity. However, the model was designed in a way that permits future improvements in this matter.

3.2.3 Data structure

The unit of analysis in the model is cell-year (each cell being a square kilometre). Apart from the conflict events dataset described in chapter 2.2, other data listed in Table 10 were used as inputs into the statistical model.

Table 10. Modelling input data

Name	Derived from	Described in section
Distance to mines	Natural and Mineral Resources Datasets	2.3
MODIS Land Cover	MODIS Land Cover map	2.4.1
Population	LandScan 2008 population grid	2.4.2
Economic activity	Global Distribution of Economic Activity	2.4.3.1
Electrification rate	Estimation of Electrification Rates	2.4.3.2
Terrain roughness	GTOPO30	2.5.2
Distance to roads	Geographic thematic layers	2.5.1

For each unit, the dependent variable was defined as the victim density (number of fatal casualties in the given year for a given cell). Considering the spatial accuracy of the conflict event dataset, victims were "spread" in the neighbourhood of the event location before computing the victim density.

The independent variables were measured for the same cell, for the current year when time series were available (MODIS Land Cover data) or for the closest available year (except for the variable based on previous neighbouring events, see below).

Figure 10 shows the data used for modelling (extract for DRC). The maps of Figure 10 illustrate clearly the fact that variables are not spatially uniform at the national level. In addition, Figure 10 shows that events tend to occur where there were previous events (Figure 10 shows an example for 2008 and 2009). Consequently, it is important to take jointly the spatial and time interdependence. This was implemented in the model by measuring, for every location, the intensity of previous-year conflict events in the neighbourhood of this location.

The socio-economic conditions in a given place are considered to be related to the following factors: land cover, economic activity (GDP), electrification rate and distance to roads. The ease of hiding for violent fighting groups is measured by land cover and terrain roughness. The risk is low in desert areas, and this is captured by a logarithmic transformation of the population. The influence of natural resources (the "greed" factor) is measured by the distance (in km) to the closest mine.

The data structure requires having the same time span for all countries.[1] For this reason, only the four following countries were kept: Democratic Republic of the Congo, Guinea, Liberia and Sierra Leone, for a period from January 2006 to March 2010[2].

Due to the limited number of countries (four) in this version of the model, it was not appropriate to add a set of country-specific variables (such as political regime for instance): in the best case, their linear combinations would have been equivalent to country-specific dummy variables with little explanatory power; in the worst case it would have introduced singularities and made estimation impossible. However, one regional variable was introduced (electrification rate). It shows that the implementation problem is already solved for areal data—be they regional or national data; the latter could be introduced as soon as more countries are inserted in the model.

[1] This is the ideal data structure; still it is possible to overcome this limitation with a slightly more complex data structure.

[2] For 2010, the yearly mean intensity was computed based on the data for the first quarter.

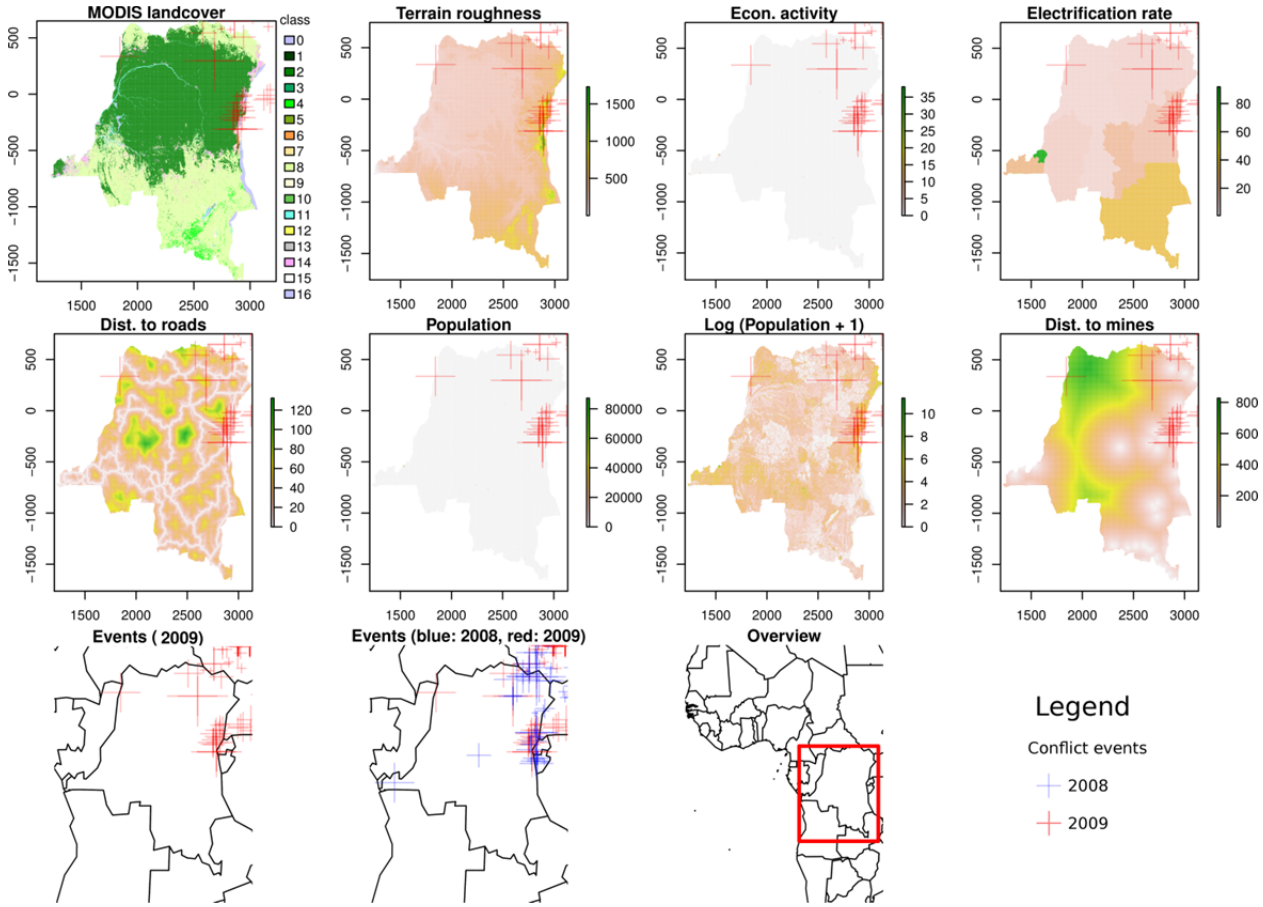


Figure 10. Data used for conflict modelling (DRC extract for 2009)

3.3 Statistical Specification

There are many potential statistical specifications for the model but some are not appropriate. For instance, using the classical multivariate linear model would give incorrect results because the dependent variable is left-censored: the number of victims in a cell cannot be negative. Since conflict events are rare events, the number of victims in many cells is zero. Using a linear model would bias the estimated parameters of the model.

One answer to this type of problem is to use the tobit model (Tobin, 1958), which was chosen here. This model assumes that there exists an unobserved, uncensored variable y* which bears some systematic relationship with the observed dependent variable y:

$$y_i = \begin{cases} y_i^* & \text{if } y_i^* > 0 \\ 0 & \text{if } y_i^* \leq 0 \end{cases}$$

The model we use is a multivariate tobit model, in which the latent variable is a function of a linear combination of the covariates, with a normally distributed error term. If we interpret the latent variable as the “latent level of violence”, we can interpret the above equation in the following way: the number of victims (y) is positive when the “latent level of violence” (y*) is positive and they grow together. When the “latent level of violence” is negative, the number of victims is null. We never observe the real “latent level of violence” (y*) but we can estimate it. The higher this estimate is, the higher the probability that the number of victims is strictly greater than zero; if the number of victims is strictly greater than zero, its expected value is positively related with the estimated value of the latent variable. Thus, factors that increase the “latent level of violence” increase both the probability of violent events and the intensity of events. Both the probability and intensity of events are estimated in a single process,

based on the same variables. The latent variable itself is modelled as a linear combination of the independent variables.

3.4 Model Results

The model was estimated with the R statistical software[3], using the "survival" package, by maximizing the log-likelihood. Using a free, libre and open-source software like R has many scientific advantages in terms of reliability, transparency and portability (Kauffmann, 2008).

The estimated parameters along with the standard deviation of the estimates, the test statistic and the p-value are given in Table 11.

Table 11. Estimated parameters of the model

	Value	Std. Error	z	p
(Intercept)	-7.54114	8.59e-02	-87.7411	0.00e+00
urban and built-up	1.55052	9.33e-02	16.624	4.67e-62
evergreen needleleaf forest	1.08208	5.79e-01	1.8703	6.14e-02
grasslands	0.71097	1.38e-01	5.1662	2.39e-07
barren or sparsely vegetated	0.59059	7.40e-01	0.7977	4.25e-01
permanent wetlands	0.56666	7.39e-02	7.6654	1.78e-14
cropland/natural vegetation mosaic	0.50705	3.03e-02	16.7495	5.71e-63
croplands	0.21441	1.38e-01	1.5481	1.22e-01
other land covers	0.04413	8.95e-01	0.0493	9.61e-01
water	-0.08673	1.04e-01	-0.8309	4.06e-01
mixed forests	-0.22951	8.91e-01	-0.2575	7.97e-01
woody savannas	-0.31583	2.33e-02	-13.5771	5.47e-42
deciduous broadleaf forest	-0.48172	9.05e-02	-5.3221	1.03e-07
savannas	-0.7765	1.07e-01	-7.2815	3.30e-13
closed shrubland	-1.17317	2.74e-01	-4.2749	1.91e-05
victPrev	0.83807	2.27e-02	36.9956	1.35e-299
distToMine	-0.00423	1.16e-04	-36.4074	3.25e-290
roughness	0.0021	4.04e-05	51.872	0.00e+00
econ	0.1824	9.76e-03	18.6846	6.61e-78
log(pop2008 +1)	0.19933	6.64e-03	30.0422	2.76e-198
elec	-0.02297	1.04e-03	-22.0017	2.77e-107
distToRoads123	-0.01984	7.92e-04	-25.0512	1.69e-138

The most useful part in Table 11 is the sign of the parameters (in the "value" column). A positive sign indicates that an increase in the variable increases the risk and the intensity of violent events in the given place and year.

Hence, previous deadly events in the neighbourhood (victPrev) increase the level of violence.

Similarly, the closer to mine location (i.e. the lower distToMine) the higher is the level of violence. This seems to be in favour of the "greed" theory saying that fighting is more likely near mineral resources (conflicts over the control of natural resources). Additionally, the first 14 variables measure how the risk changes depending on the land cover (in comparison to the evergreen broadleaf forest land cover, which is the most common land cover in the area of interest); they show that the risk varies significantly depending on the land cover.[4] In particular, cropland and grassland have positive parameters, which may indicate armed competition over land as a natural resource used for pasture and cultivation.

Once the parameters are estimated, the model can be used for prediction. The result of this operation is shown in Figure 11 below.[5] The numerical values should be interpreted in an ordinal (e.g. indicating order) not in a cardinal (indicating quantity) way. Areas with low risk of violence (and low

[3] R Development Core Team (2010). "R: A language and environment for statistical computing". R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0, URL http://www.R-project.org/.

[4] The land cover dummy variables are the only one for which the coefficients can be directly compared (in an ordinal fashion). The other variables have heterogeneous units and thus the absolute values of their coefficients cannot be directly compared.

[5] It is possible to compute a predicted risk for 2011 (to make a forecast) but this would mean using data that were collected before 2010 for most variables and would probably not be very informative. It is probably better to use the prediction computed for 2010 to get an idea of the spatial pattern of the risk for 2011.

intensity of predicted violence) are in green. Areas with high risk are shown in light pink. Those match very well with the effective locations of conflict events marked with red crosses[6].

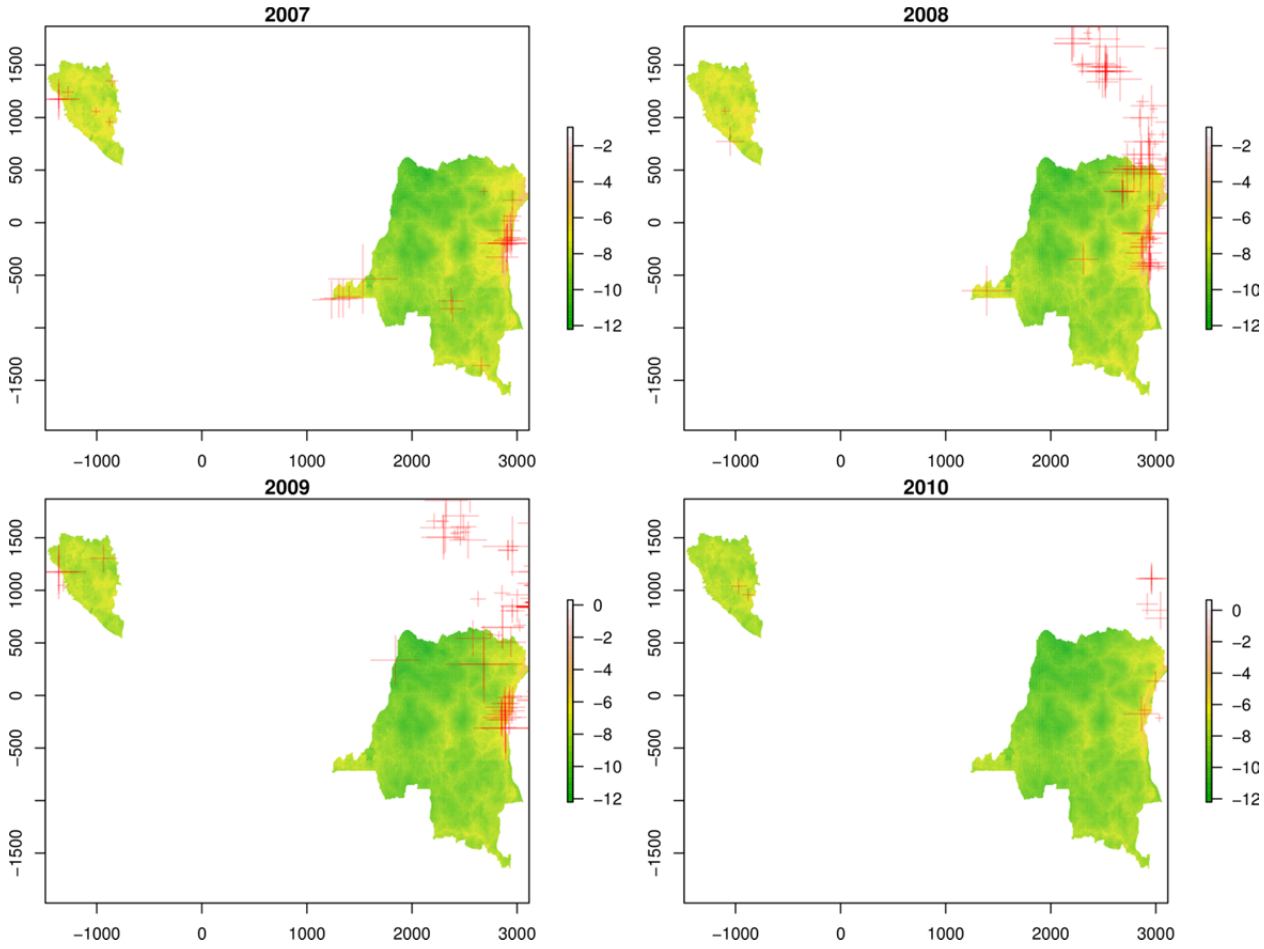


Figure 11. Predicted latent variable (2007-2010) and effective locations of violent events

It is possible to have a more precise picture of the goodness-of-fit of the model by looking at Figure 12. Figure 12 shows all cells (for all years), ordered by increasing predicted risk, along with the real number of victims in those cells (this number is also reported on the curve, in red). For instance, looking at the lower-left part of the plot, if we consider the 5% less risky cells, we see that there were 3 victims in those cells. If we consider the 10% less risky cells, we note that there were 18 victims in those cells, etc. In the upper-right part, we see that in total (100%) there were 3139 victims.[7] If we take the 95% most risky cells, we find the place and year of 1748 victims (approximately 55%). This means that the 5% most risky cells are those where almost half of the killings take place. Conversely, the 40% less risky cells are the place of "only" 118 victims (less than 4% of all victims). This illustrates that the model can be an efficient tool in finding, for a given year, where most of the killings will take place and where are the largest peaceful areas.

[6] The size of the red crosses is proportional to the number of dead people.

[7] Victims for whom the event location was too imprecise were not included in the model.

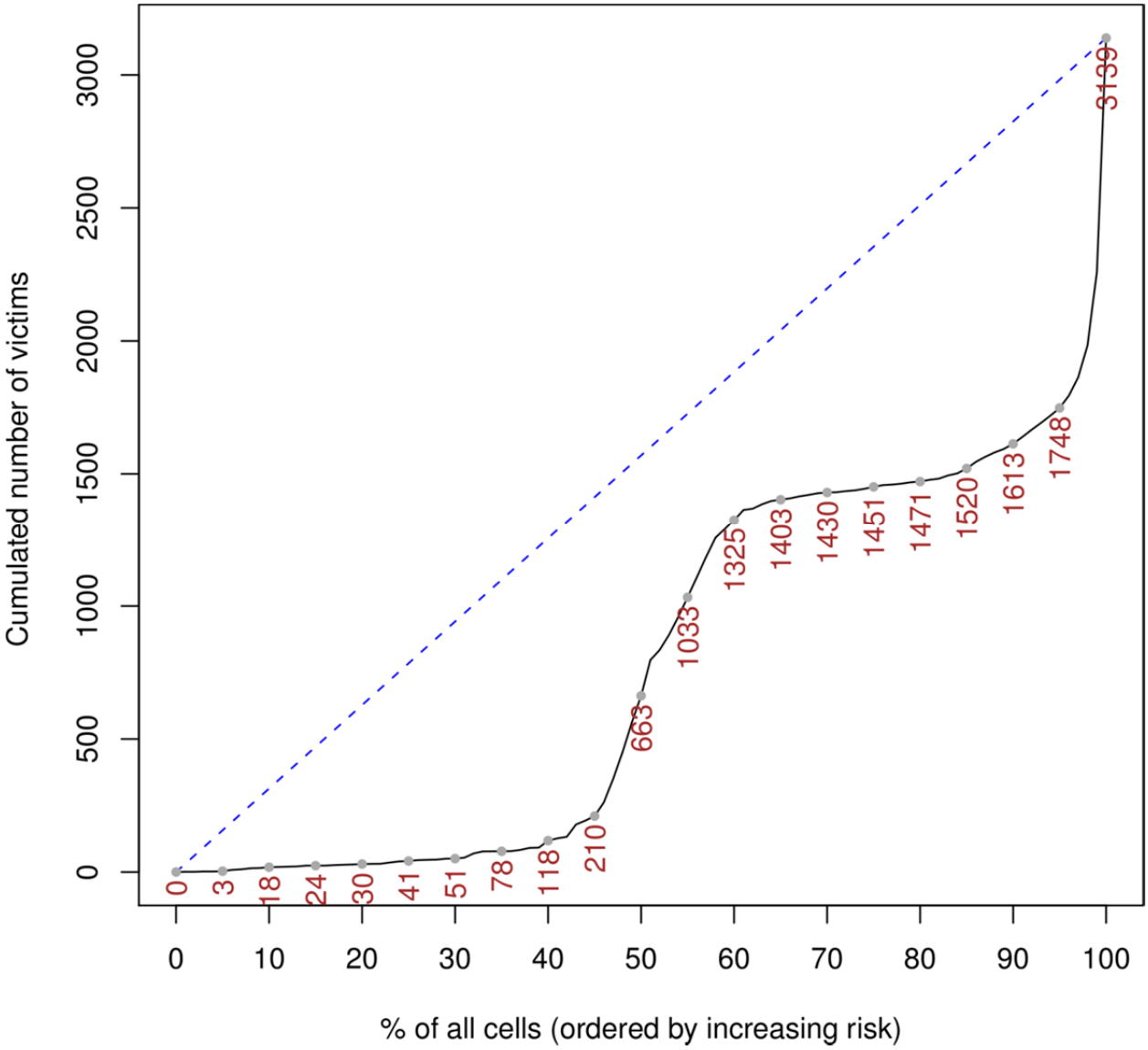


Figure 12. Risky cells and cumulated number of victims

4. Project website

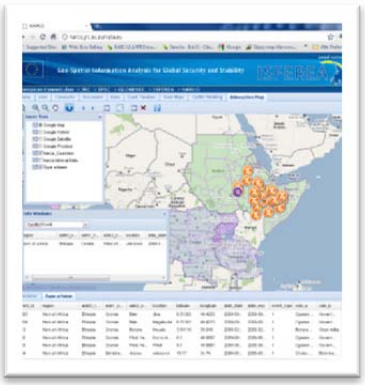
To ease the access to the outputs of the projects, the public website was set up on the internet address:

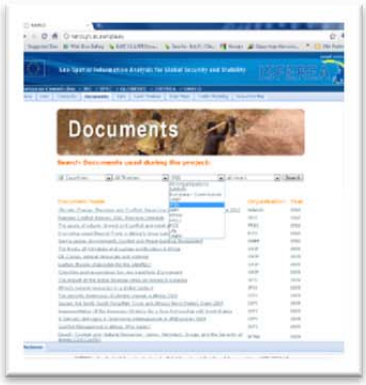
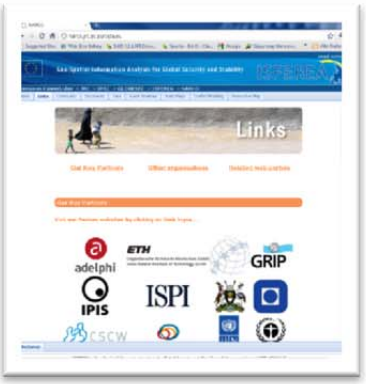
http://nareco.jrc.ec.europa.eu

It includes several thematic sections described in Table 12. The website serves as an introductory information source to the relationship between conflicts and natural resources. In addition to the outputs of the project, it also contains selection of documents, links and data of other organizations active in the topic.

Examples of the outputs available from the website are in Annex 7. Annex 7.1 contains conflict event summaries for each region, annex 7.3 conflict event timelines for each country and annex 7.4 contains maps of mineral resources and spatial distribution of conflict events for Democratic Republic of Congo, Liberia, Somalia and Sudan.

Table 12. Thematic layout of the website of the project.

Thematic section	Description	
Data	Contains downloadable JRC conflict event dataset and derived statistics. The links to other datasets used in project available from project partners and other organizations are also included.	
Event Timelines	Allows an interactive display of the conflict events for each country. Detailed metadata about each event is coupled with short (abstract) and full (news article) description. Each event record includes the link to the Interactive Map where it can be displayed. See Annex 7.2. for conflict event timelines of each country.	
Interactive Map	Serves as a geographic browser of the conflict event dataset and other geographic layers. It is possible to query JRC conflict event database and display the result on the interactive map. All the metadata as well as short and full description about the conflict event(s) are accessible.	
Conflict Modelling	Includes description and flowchart of the statistical conflict model.	

Static Maps	Contains examples of geographic, mineral and conflict maps for selected focused countries. The standardized map production chain allows preparation of the maps for other focused countries if required. See Annex 7.4 for map examples.	
Documents	Contains documents relevant to the project. The documents created by JRC are available for download while the links are provided for the documents of the partners and other organizations. Documents are organized in database which allows thematic filtering.	
Links	The internet links to the partners and other relevant organizations are provided. For easier navigation, the organizations are grouped according to their type. Important part of this theme is the links to other web portals containing data relevant to the conflicts and natural resources.	
Community	Provides access information to a restricted web forum which was established to share information, documents and ideas with project partners and other interested parties. Registration is necessary for the access.	

5. Conclusions and Suggestions

Datasets collection was a challenging task. The conflict event dataset was prepared by experienced researchers who analysed each conflict event and stored it in the database with appropriate attributes. There was an attempt to replace this time-consuming task with an automatic conflict event harvesting using specialized information text mining algorithms. However, the accuracy and the relevance turned out to be not as good as with human analysis. More research is necessary to increase the accuracy of these automatic methods for reliable collection of conflict events from internet media. The lengthy process of conflict event collection on wide geographic coverage and its high level of detail impeded the compilation of the dataset with longer time span. Despite of these drawbacks, the JRC conflict event dataset provides valuable information about conflict location, duration and intensity for 18 countries covering consistently the period from 2008 to 2009 (2004 to the first quarter of 2010 for some countries). Altogether 1573 conflict events were collected and analysed. The highest number of events in the observed period was recorded in Somalia (616 events) followed by the Democratic Republic of the Congo (337) and Sudan (288).

Most of the other datasets were available free of charge and their acquisition and pre-processing was straightforward. The mineral and mine datasets were rather general, compiled from different sources with varying level of reliability. There are several existing datasets (see chapter 2.3) with better expected accuracy, but their procurement is lengthy and sometimes unclear.

The statistical conflict model was built in a way which allows flexibility in the data input. This means that the model can be used with more detailed datasets and with longer time span. It was also implemented in a way which allows computer parallelization[8], so large datasets can be digested by the model without compromising the computational speed. Since the model is estimated using a cross-platform and open source software, its distribution does not have technical or proprietary limits.

For the set of four countries on which the model was tested, the latter indicates that the conflict locations tend to be closer to the mines. Among the other influential variables are the level of economic development, the population distribution, the land cover and land use, and the orography. Violence seems to be a self-sustaining phenomenon, as violent events are clustered in time and space. In a country-wide context, the model provides overview of zones with higher conflict risk and of peaceful areas. The results show that a model with data disaggregated at the local level gives many insights that a country-year model cannot provide.

Since the project had a rather wide scope trying to describe a broad range of conflict situations in 3 different geographic regions covering 18 countries, the obtained results are rather general. Based on them and on the experience gained during the project, a country-focused approach can be adopted. The conflict event collection, ancillary data acquisition as well as the conflict model would remain very similar; however, a more refined analysis relevant to a particular country or group of countries can be achieved. Also, the satellite remote sensing can be used more effectively for the collection of more detailed supporting data. The collaboration with the organizations focusing on specific conflict situations can be deepened and the analysis of conflict situation and conflict risk prediction can be tuned based on the need and feedback of the stakeholders.

[8] Parallelization of the computer program allows to employ more computers to accomplish computationally intensive tasks with high speed in short time

6. References

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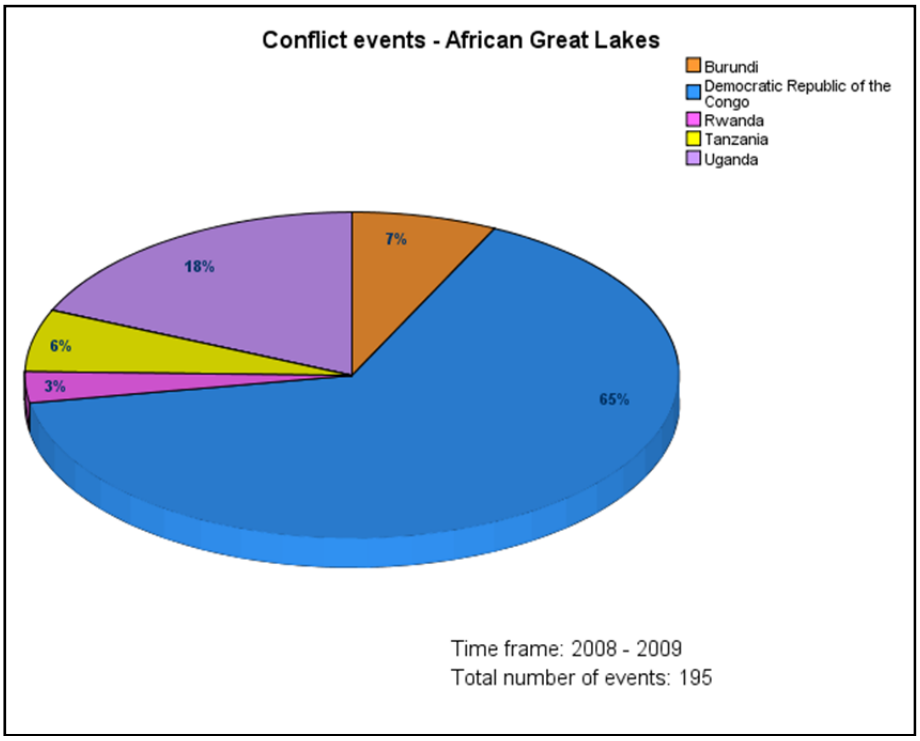
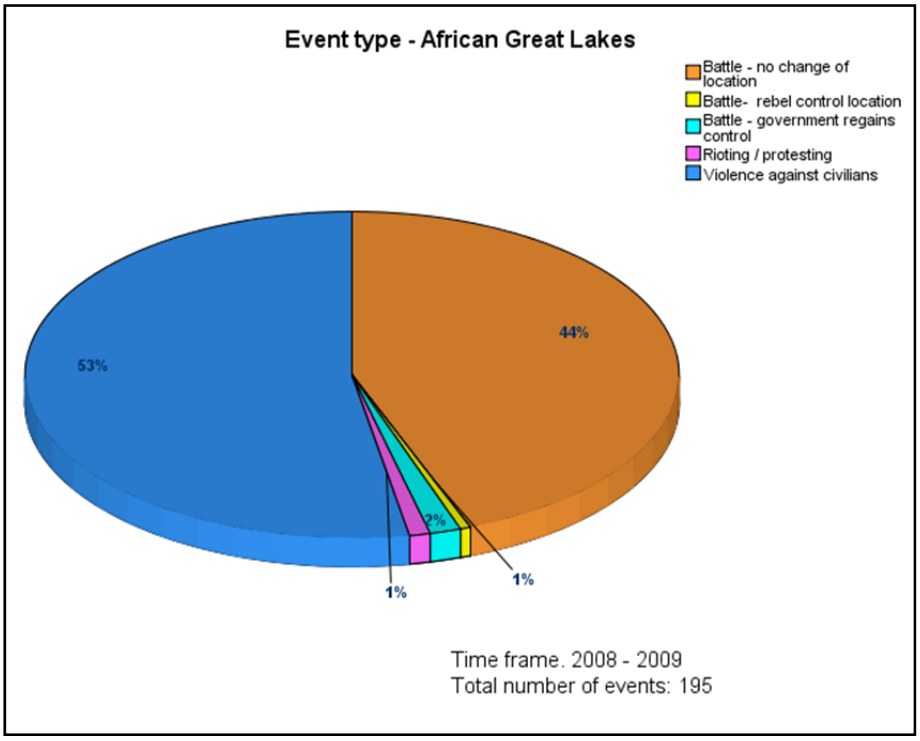
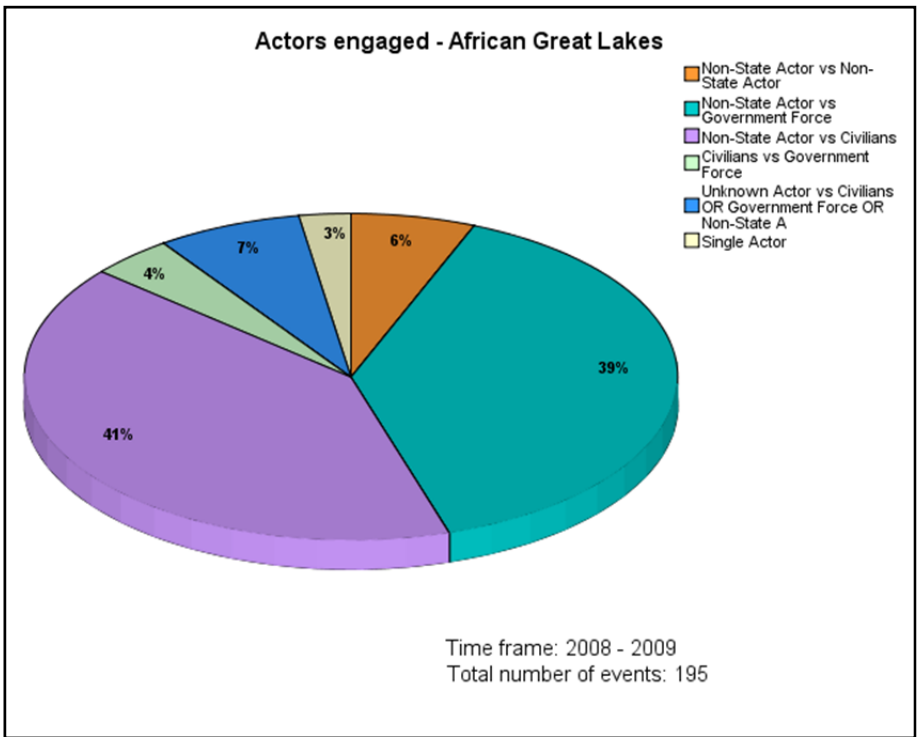
7. Annexes

7.1 Conflict events summaries

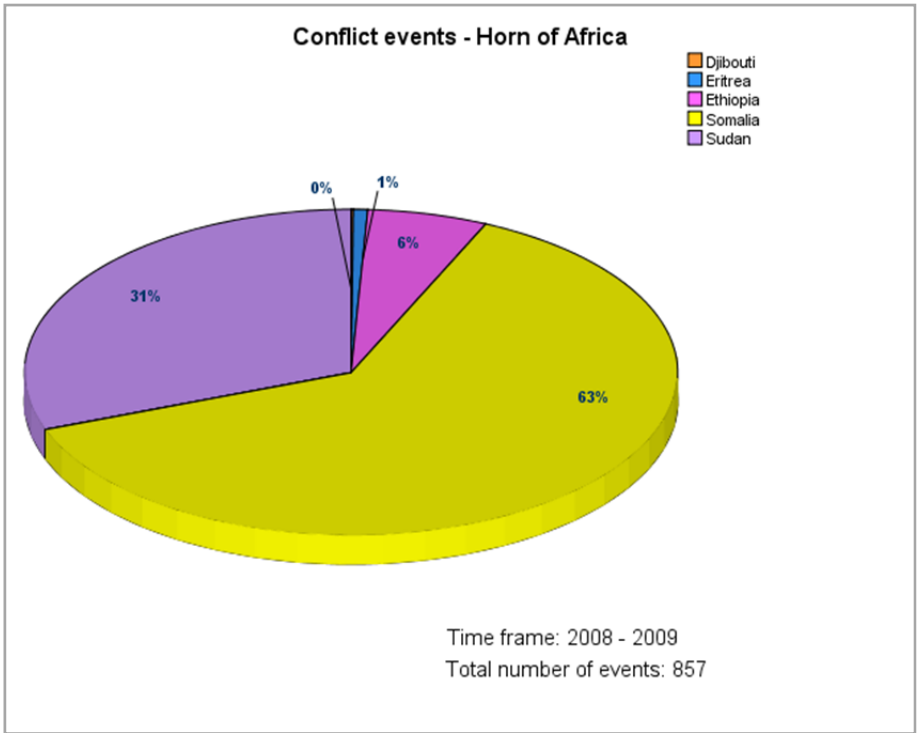
7.1.1 African Great lakes

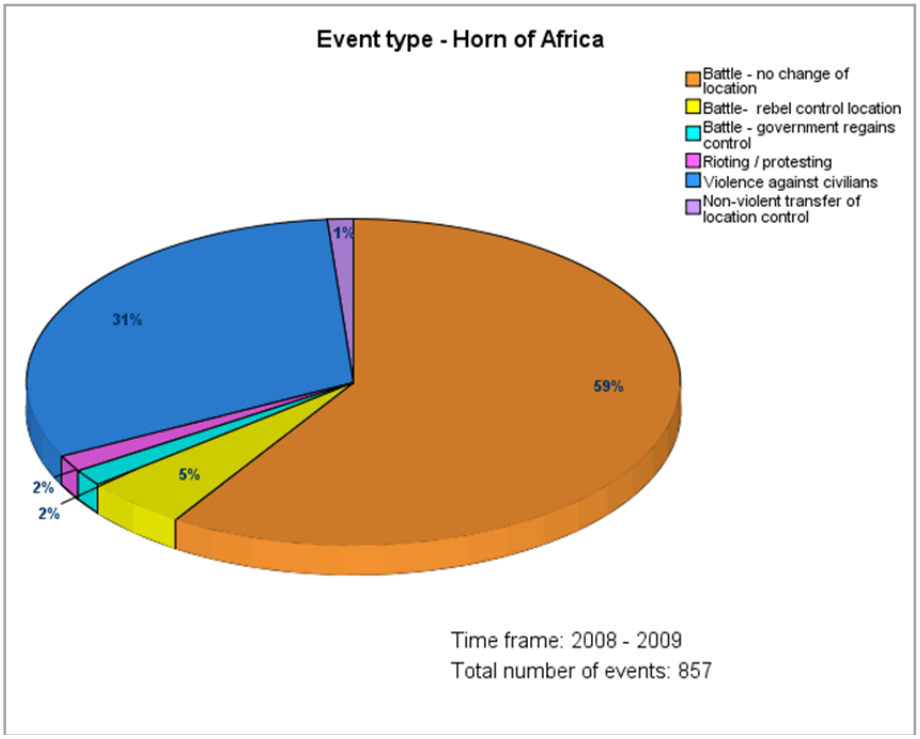


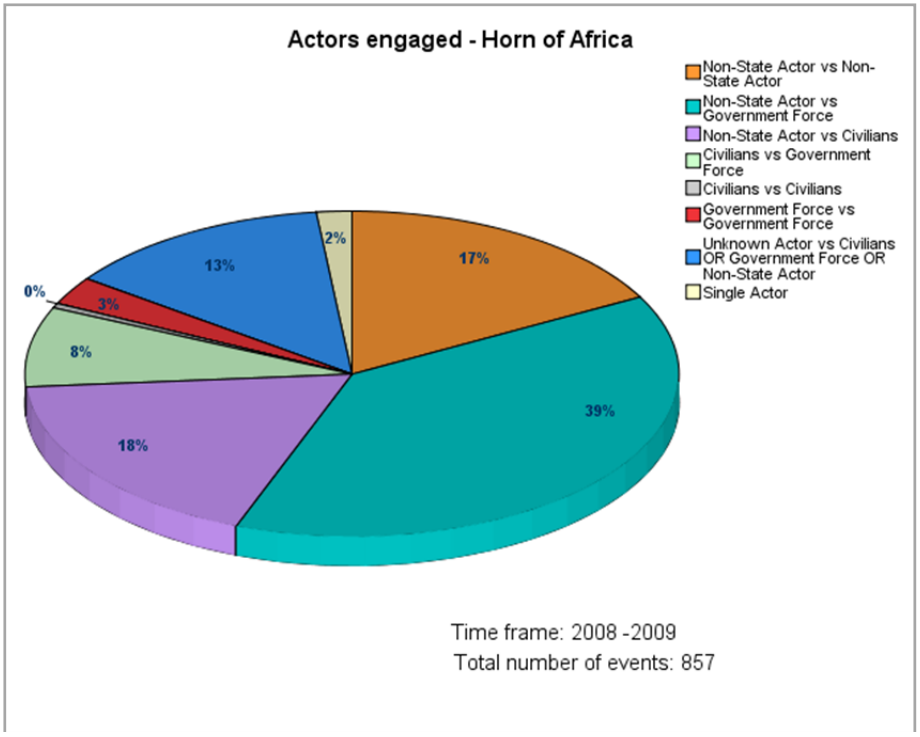




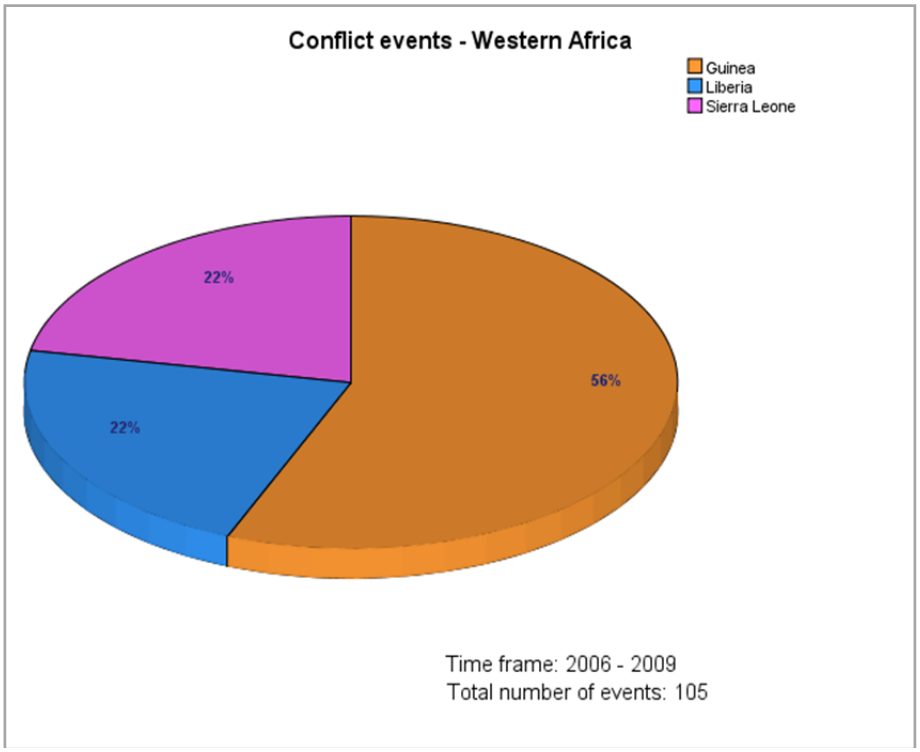
7.1.2 Horn of Africa

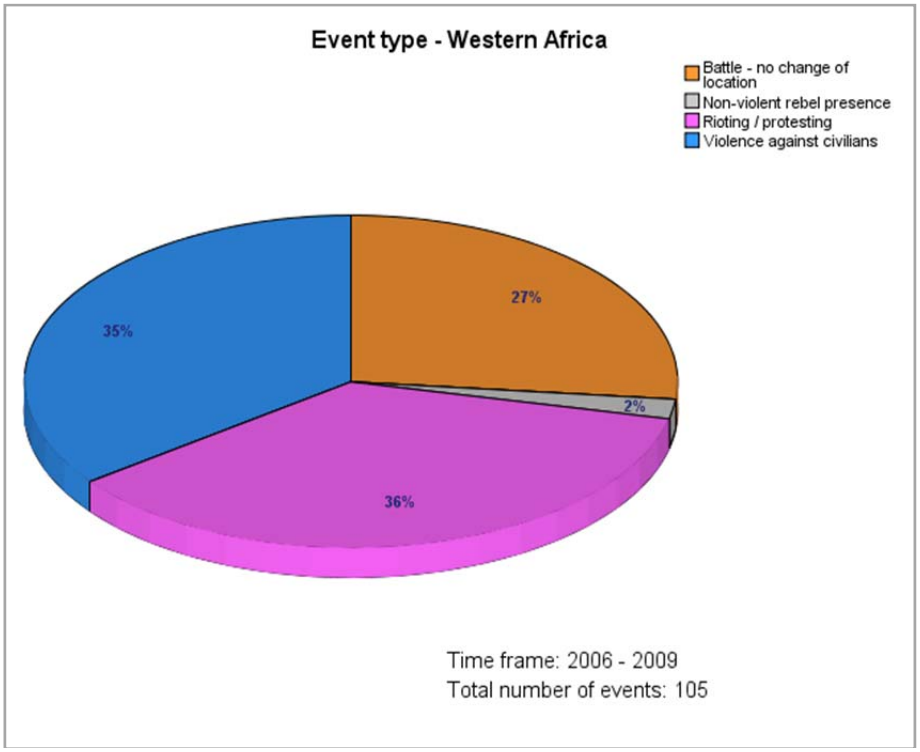


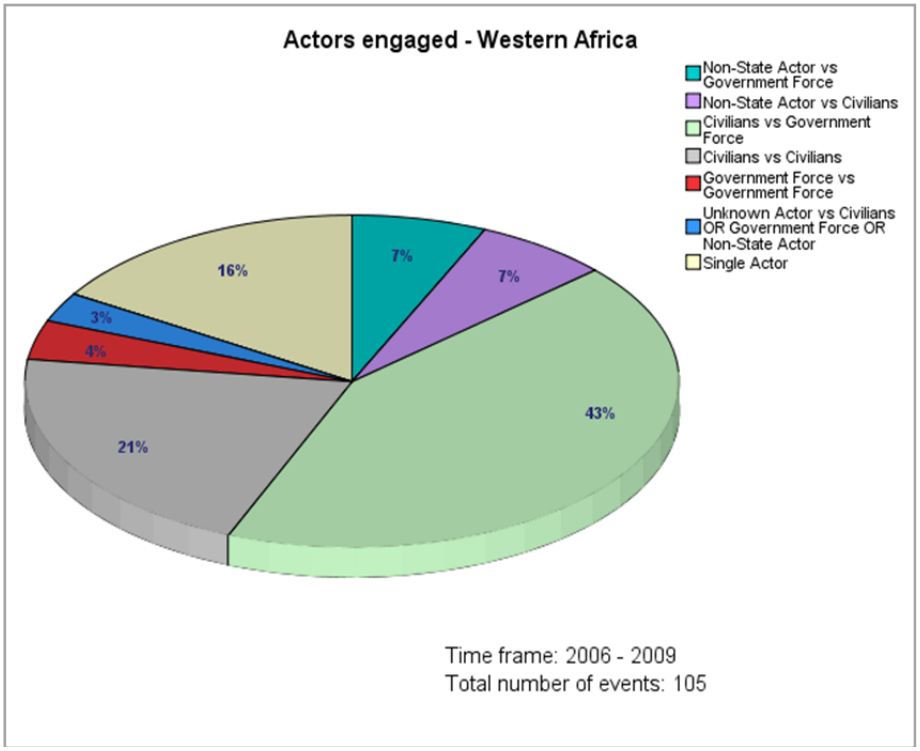

Event type - Horn of Africa
Battle - no change of location
Battle- rebel control location
Battle - government regains control
Rioting / protesting
Violence against civilians
Non-violent transfer of location control
1%
31%
59%
5%
2%
2%
Time frame: 2008 - 2009
Total number of events: 857


Actors engaged - Horn of Africa
Non-State Actor vs Non-State Actor
Non-State Actor vs Government Force
Non-State Actor vs Civilians
Civilians vs Government Force
Civilians vs Civilians
Government Force vs Government Force
Unknown Actor vs Civilians OR Government Force OR Non-State Actor
Single Actor
2%
17%
13%
0%
3%
8%
39%
18%
Time frame: 2008 -2009
Total number of events: 857

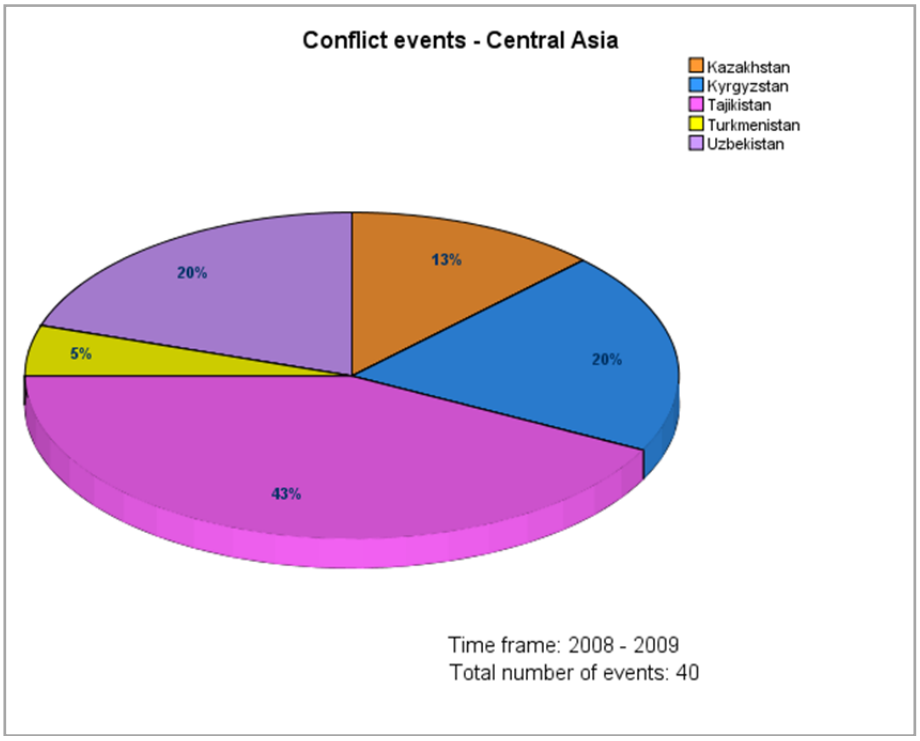
7.1.3 Western Africa

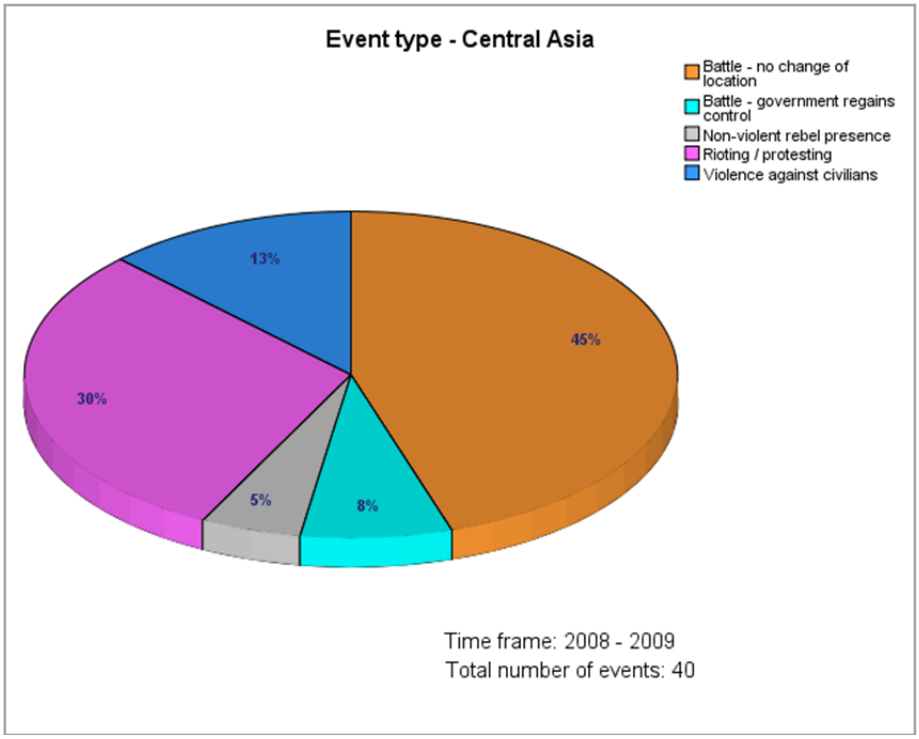


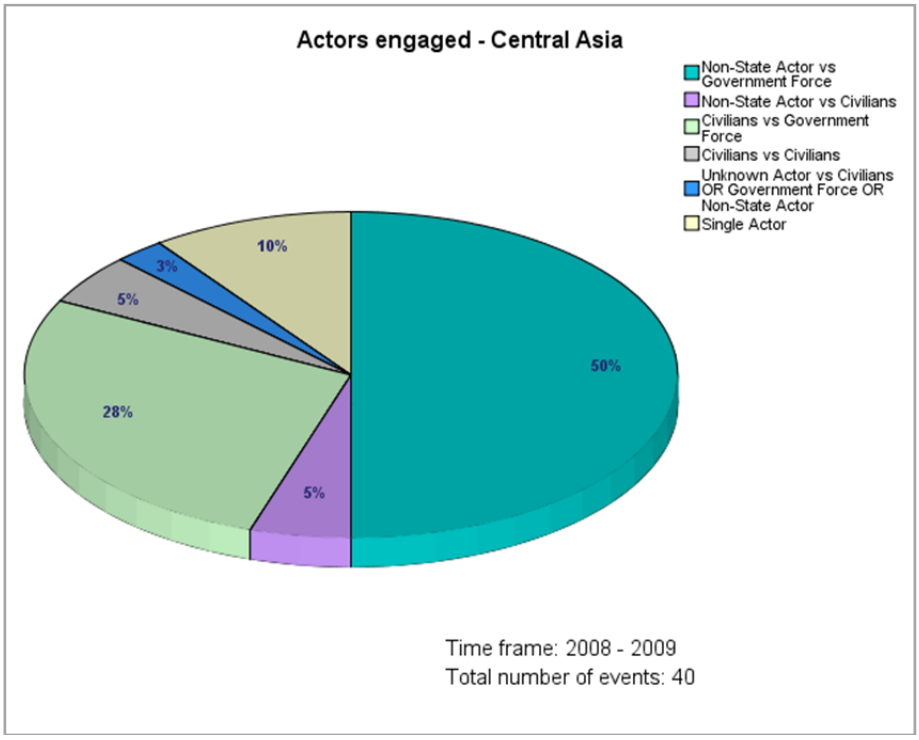




7.1.4 Central Asia




Event type - Central Asia
Battle - no change of location
Battle - government regains control
Non-violent rebel presence
Rioting / protesting
Violence against civilians
45%
8%
5%
30%
13%
Time frame: 2008 - 2009
Total number of events: 40


Actors engaged - Central Asia
Non-State Actor vs Government Force
Non-State Actor vs Civilians
Civilians vs Government Force
Civilians vs Civilians
Unknown Actor vs Civilians OR Government Force OR Non-State Actor
Single Actor
50%
5%
28%
5%
3%
10%
Time frame: 2008 - 2009
Total number of events: 40

7.2 Summary of conflict victims for each country

Country	Year	N. events	Dead	Injured	Raped	Displaced	Kidnapped	Detained
Burundi	2008	14	145	14	0	0	5	3
	2006	104	381	195	23	168898	7	1141
Democratic	2007	95	1134	786	1	318900	18	35
Republic of the	2008	71	2165	118	1	43050	99	156
Congo	2009	56	2277	41	3	476780	657	181
	2010q1	11	35	0	4	18200	41	0
Total		337	5992	1140	32	1025828	822	1513
Djibouti	2008	1	2	50	0	0	0	0
	2008	2	31	43	0	0	0	0
Eritrea	2009	4	38	38	0	0	0	0
	2010q1	3	64	38	0	0	0	2
Total		9	133	119	0	0	0	2
Ethiopia	2008	11	98	83	0	0	0	0
	2009	40	1339	184	0	10000	0	0
Total		51	1437	267	0	10000	0	0
	2004	5	0	0	0	0	0	17
	2005	8	4	12	0	0	0	150
	2006	8	24	0	0	0	0	1
Guinea	2007	35	93	34	0	0	0	1
	2008	7	3	0	0	0	0	0
	2009	9	251	4	5	0	0	0
	2010q1	3	3	12	0	0	0	0
Total		75	378	62	5	0	0	169
Kazakhstan	2009	5	0	0	0	0	0	0
	2010q1	1	0	0	0	0	0	0
Total		6	0	0	0	0	0	0
Kyrgyzstan	2009	8	16	0	0	0	0	102
	2010q1	10	1	0	0	0	0	13
Total		18	17	0	0	0	0	115
	2006	3	0	9	0	10000	0	0
	2007	8	1	6	0	0	0	14
Liberia	2008	4	13	0	0	0	0	0
	2009	8	2	20	0	0	0	14
	2005*	4	0	5	0	0	0	0
	2010q1	1	4	0	0	0	0	0
Total		28	20	40	0	10000	0	28
	2008	4	4	0	0	0	0	0
Rwanda	2009	2	4	49	0	0	0	0
	2010q1	10	3	50	0	0	0	7
Total		16	11	99	0	0	0	7
	2004	1	0	0	0	0	0	0
	2005	1	0	0	0	0	0	0
	2006	1	0	0	0	0	0	0
Sierra Leone	2007	11	0	18	0	0	0	3
	2008	8	2	3	0	0	0	0
	2009	3	3	34	0	0	0	0
	2010q1	1	0	10	0	0	0	0
Total		26	5	65	0	0	0	3
	2008	283	1653	1739	0	5000	0	6
Somalia	2009	254	2068	3263	0	171200	0	50
	2010q1	79	479	812	0	73500	0	0
Total		616	4200	5814	0	249700	0	56
	2008	118	1653	470	0	108500	148	12
Sudan	2009	144	3096	551	0	58139	269	50
	2010q1	26	219	110	0	100000	2	31
Total		288	4968	1131	0	266639	419	93
Tajikistan	2008	2	3	0	0	0	0	0
	2009	15	29	3	0	0	0	31
Total		17	32	3	0	0	0	31
	2008	4	6	2	0	0	0	0
Tanzania	2009	8	65	301	0	0	0	0
	2010q1	**5**	19	17	0	0	0	0
Total		17	90	320	0	0	0	0
Turkmenistan	2008	1	20	0	0	0	0	0
	2009	1	0	15	0	0	0	0
Total		2	20	15	0	0	0	0

Country	Year	N. events	Dead	Injured	Raped	Displaced	Kidnapped	Detained
	2008	18	69	4	0	0	0	18
Uganda	2009	18	269	9	0	0	0	0
	2010q1	6	5	4	0	0	0	5
Total		42	343	17	0	0	0	23
	2008	1	0	0	0	0	0	0
Uzbekistan	2009	7	8	0	0	0	0	0
	2010q1	2	0	0	0	0	0	1
Total		10	8	0	0	0	0	1
Grand Total		1573	17801	9156	37	1562167	1246	2044

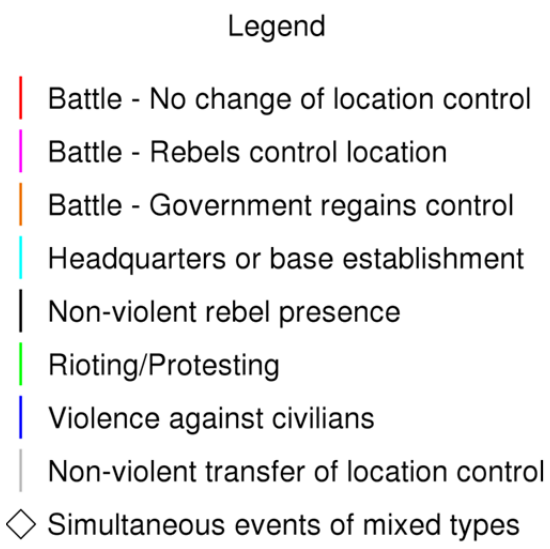
Important note: *The numbers above are based only on a limited number of English web pages. Not all possible news sources were used and no reporter reached many conflict areas. These numbers probably underestimate the real number of victims, and the error varies across countries. Some articles report thousands of victims, hence missing a single article may introduce very large biases; some numbers were estimated by the coder because the article gave a literal, non-numeric estimate (see Table 6). Consequently the reported numbers are just the minimal documented numbers of victims we found.*

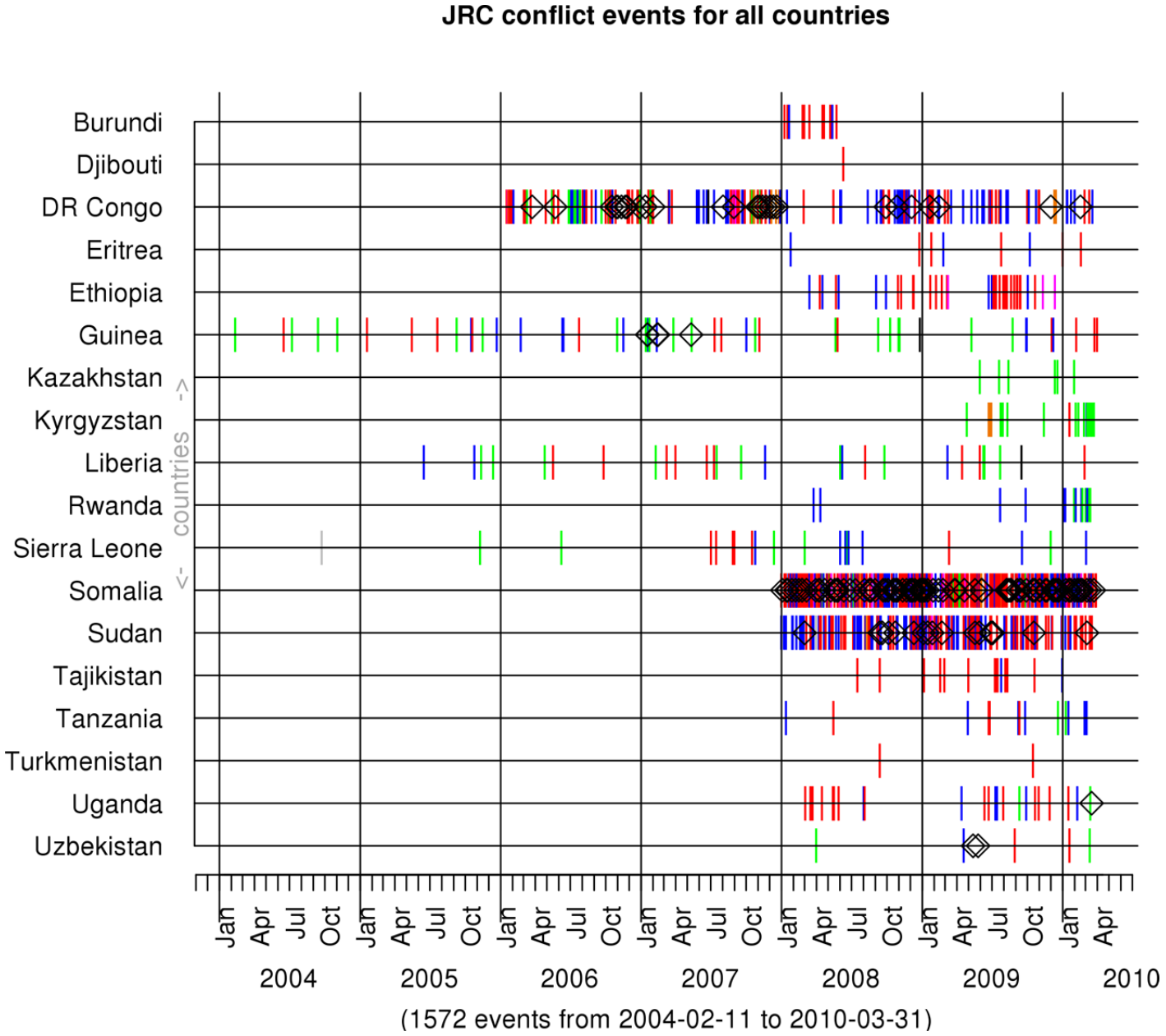
7.3 Conflict events timelines for administrative units in each country

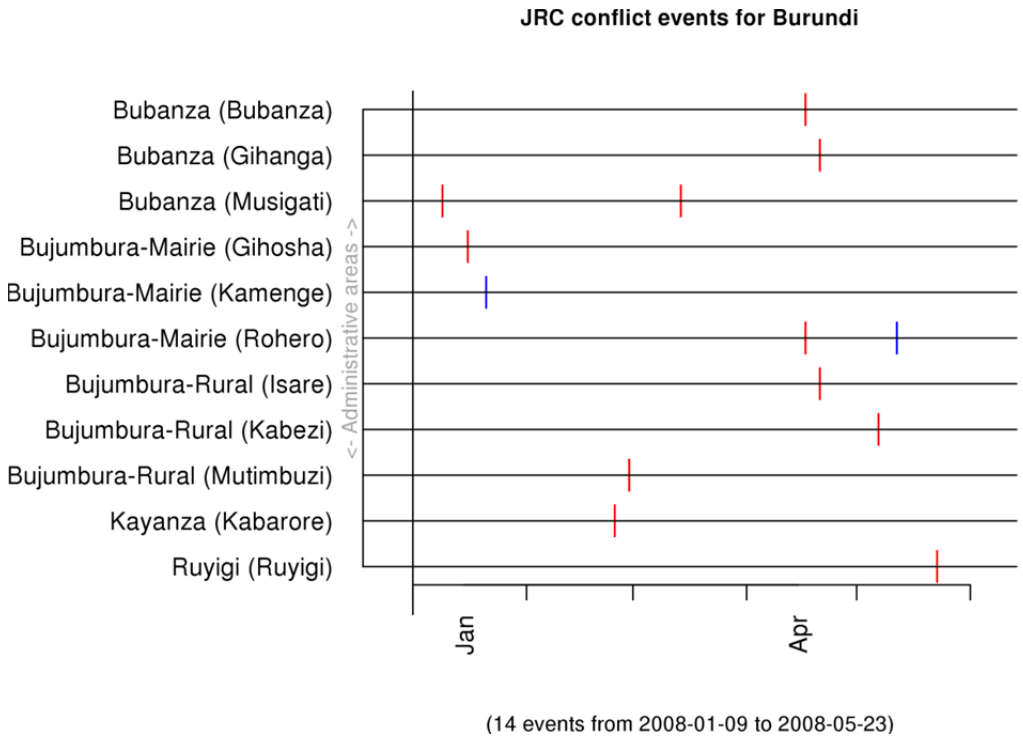
On the timeline diagrams of the next pages, the type of conflict event is colour-coded using the legend below.

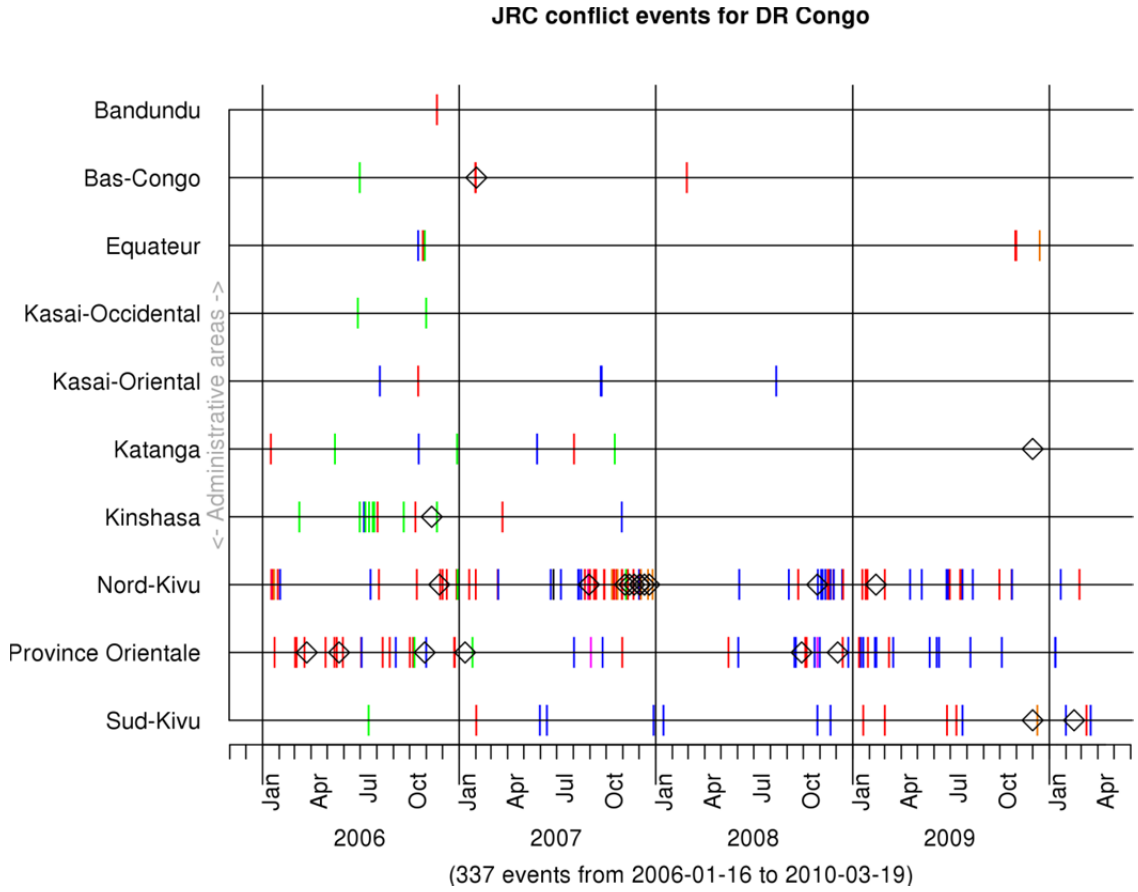
Depending on the area covered by a given timeline, each line corresponds to either a country, a region or a province. When two levels of administrative groupings are used, the smallest level is written within parentheses (Burundi, Eritrea, Kirghizstan, Rwanda, Sierre Leone, Tajikistan, Tanzania and Uzbekistan).

Interactive versions of those timelines are available online at http://nareco.jrc.ec.europa.eu/ by clicking on the “Event Timelines” tab.

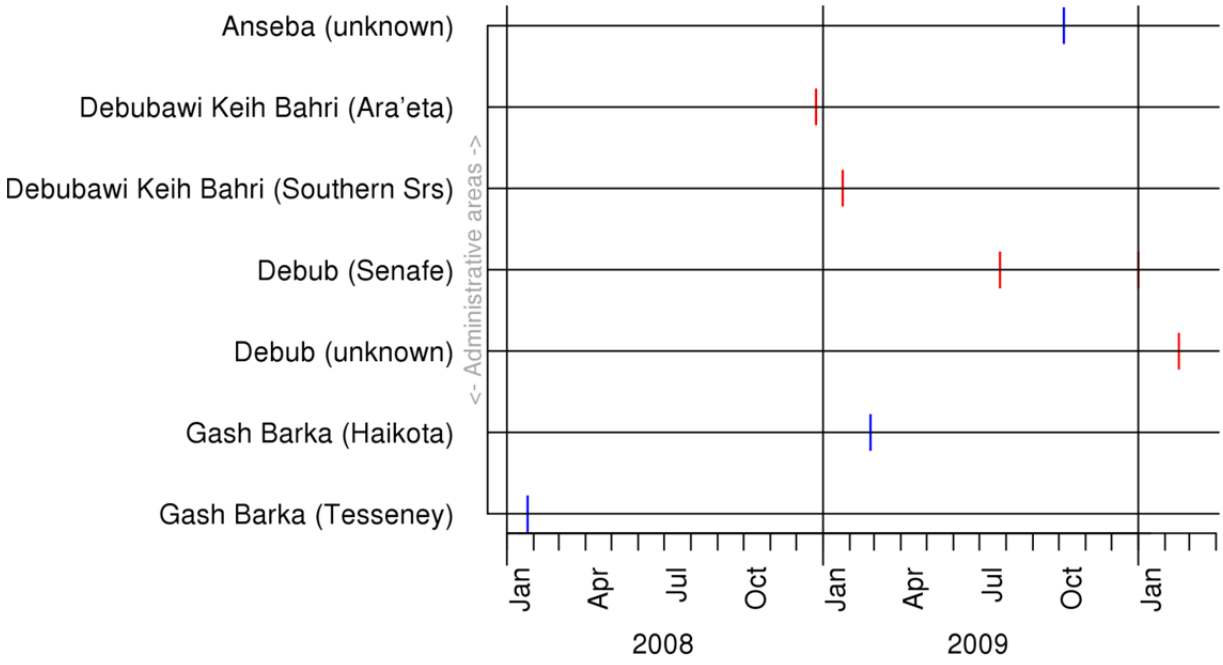



JRC conflict events for all countries
Burundi
Djibouti
DR Congo
Eritrea
Ethiopia
Guinea
Kazakhstan
Kyrgyzstan
Liberia
Rwanda
Sierra Leone
Somalia
Sudan
Tajikistan
Tanzania
Turkmenistan
Uganda
Uzbekistan
countries
->
<-
Jan
Apr
Jul
Oct
2004
2005
2006
2007
2008
2009
2010
(1572 events from 2004-02-11 to 2010-03-31)


JRC conflict events for Burundi
Bubanza (Bubanza)
Bubanza (Gihanga)
Bubanza (Musigati)
Bujumbura-Mairie (Gihosha)
Bujumbura-Mairie (Kamenge)
Bujumbura-Mairie (Rohero)
Bujumbura-Rural (Isare)
Bujumbura-Rural (Kabezi)
Bujumbura-Rural (Mutimbuzi)
Kayanza (Kabarore)
Ruyigi (Ruyigi)
<- Administrative areas ->
Jan
Apr
(14 events from 2008-01-09 to 2008-05-23)

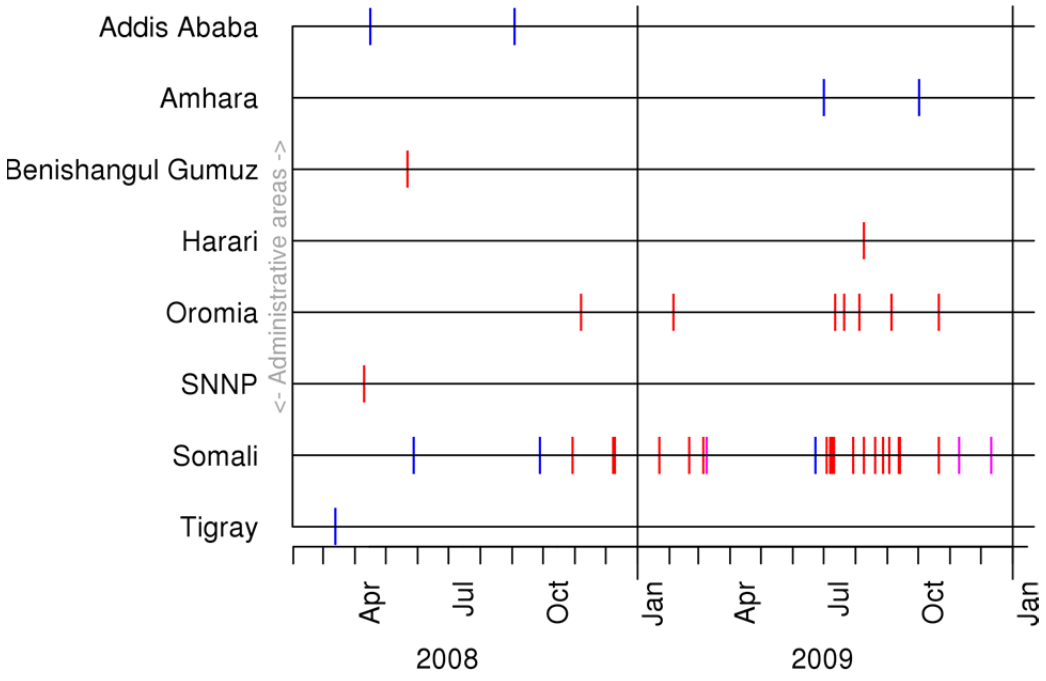

JRC conflict events for DR Congo
Bandundu
Bas-Congo
Equateur
Kasai-Occidental
Kasai-Oriental
Katanga
Kinshasa
Nord-Kivu
Province Orientale
Sud-Kivu
<- Administrative areas ->
Jan
Apr
Jul
Oct
2006
2007
2008
2009
(337 events from 2006-01-16 to 2010-03-19)

JRC conflict events for Eritrea

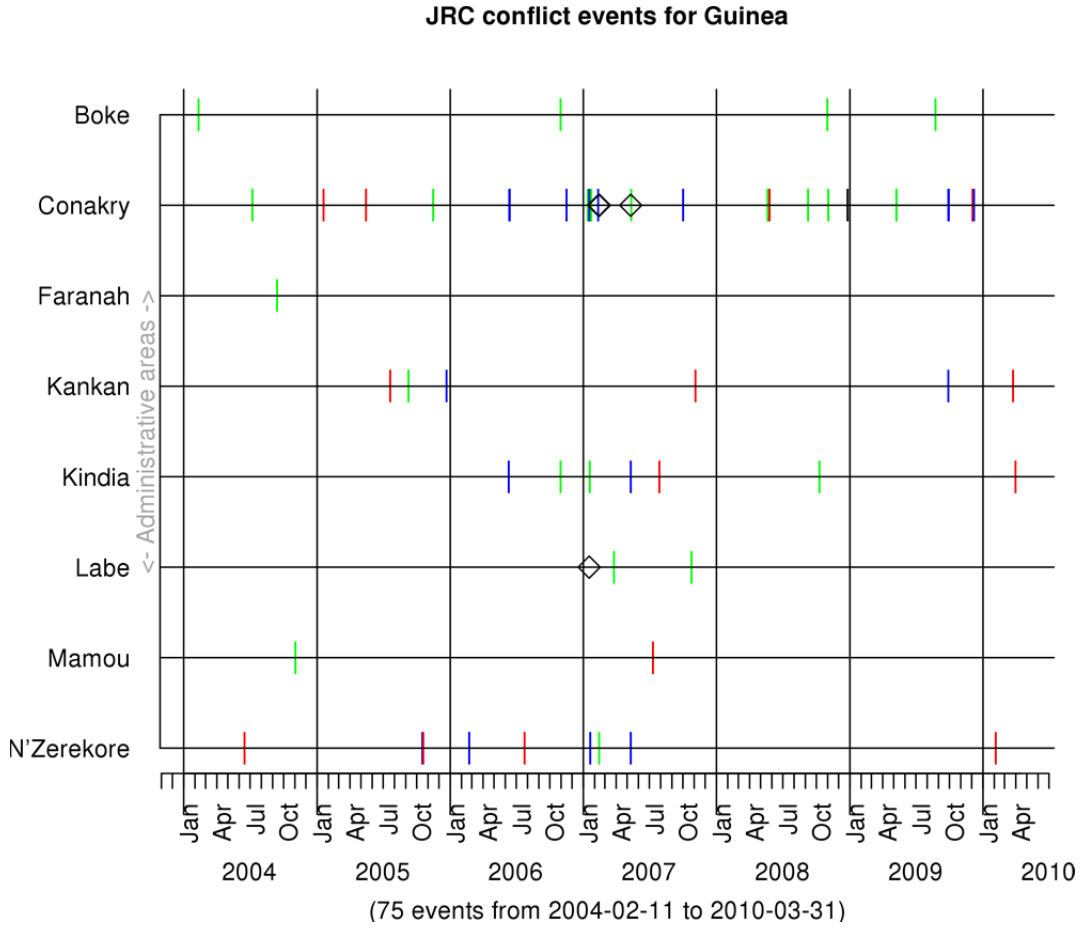


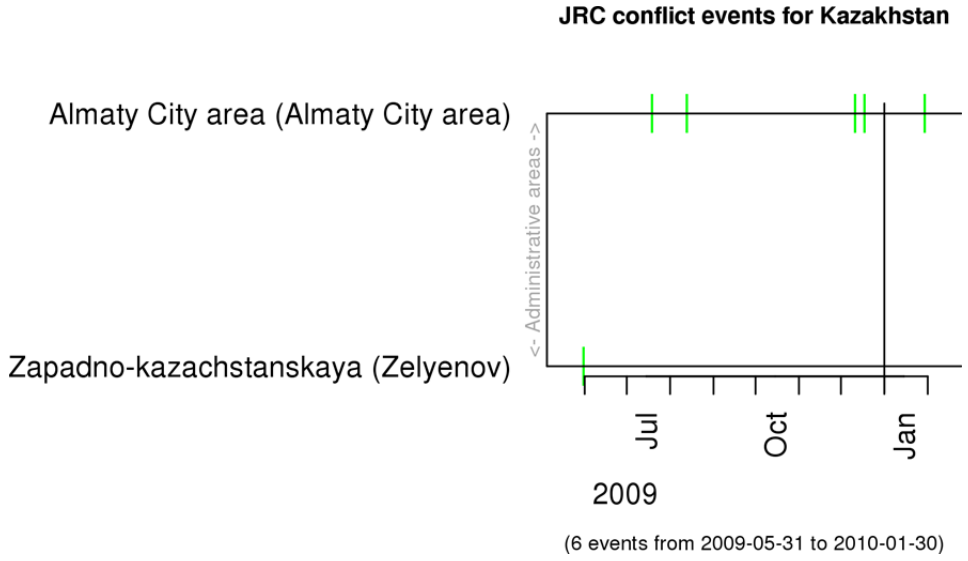
(9 events from 2008-01-25 to 2010-02-17)

JRC conflict events for Ethiopia

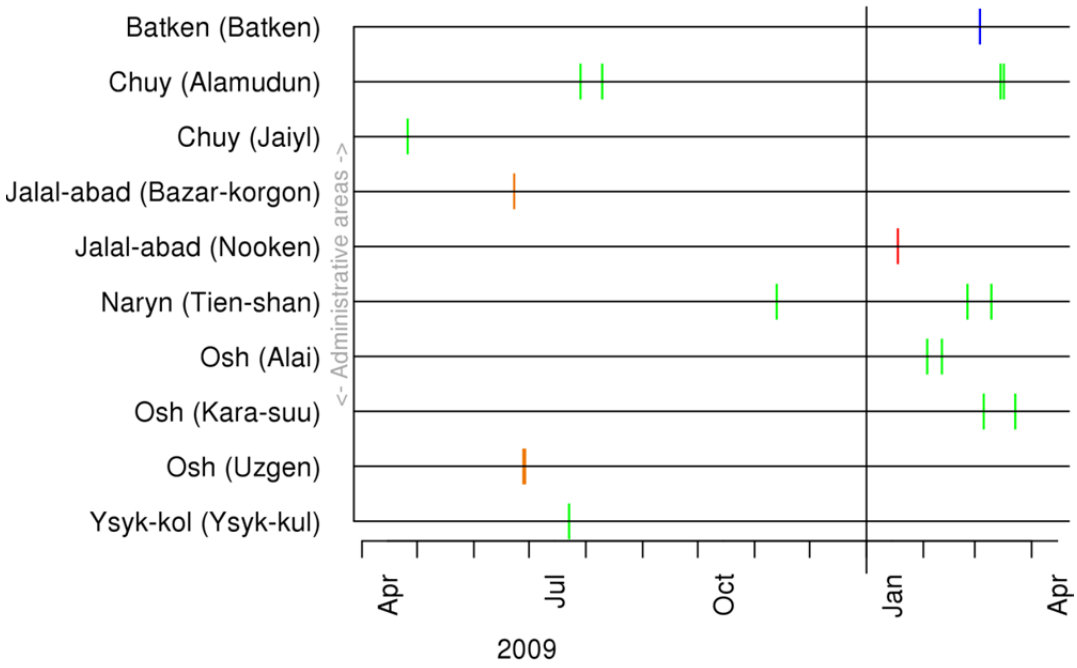


(51 events from 2008-03-13 to 2009-12-11)


JRC conflict events for Guinea
Boke
Conakry
Faranah
Kankan
Kindia
Labe
Mamou
N'Zerekore
<- Administrative areas ->
Jan Apr Jul Oct
2004
2005
2006
2007
2008
2009
2010
(75 events from 2004-02-11 to 2010-03-31)

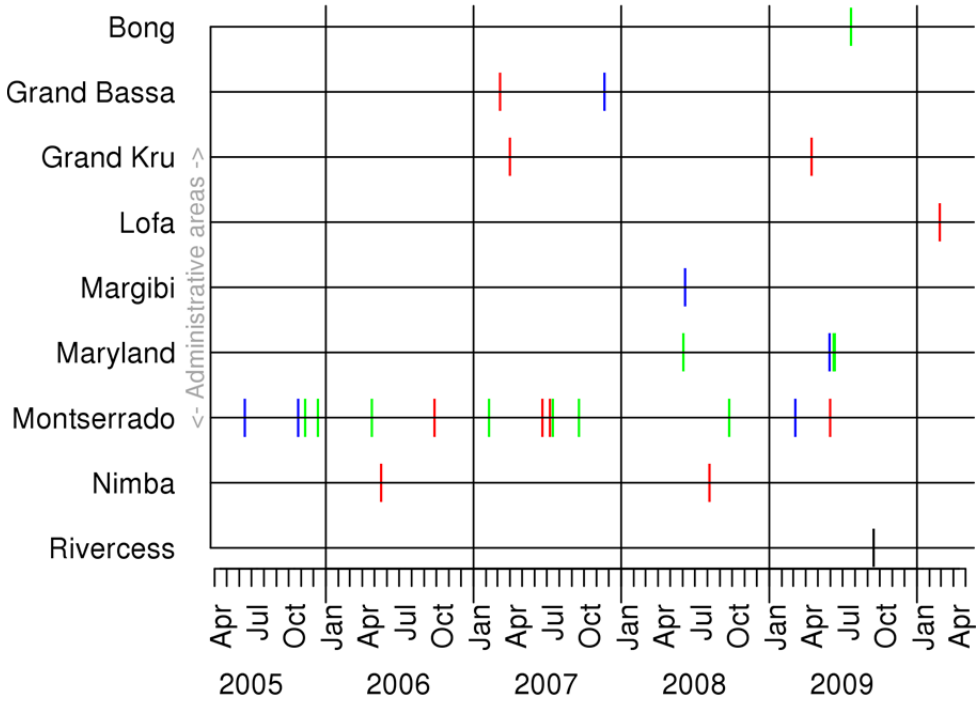

JRC conflict events for Kazakhstan
Almaty City area (Almaty City area)
Zapadno-kazachstanskaya (Zelyenov)
<- Administrative areas ->
Jul
Oct
Jan
2009
(6 events from 2009-05-31 to 2010-01-30)

JRC conflict events for Kyrgyzstan

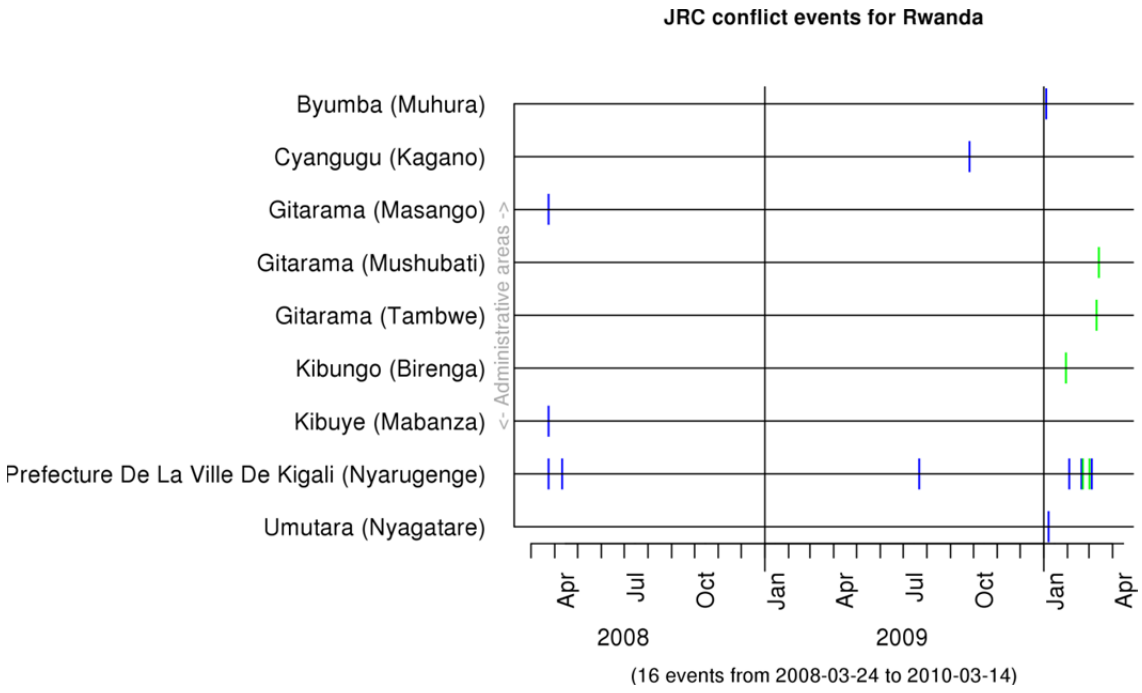


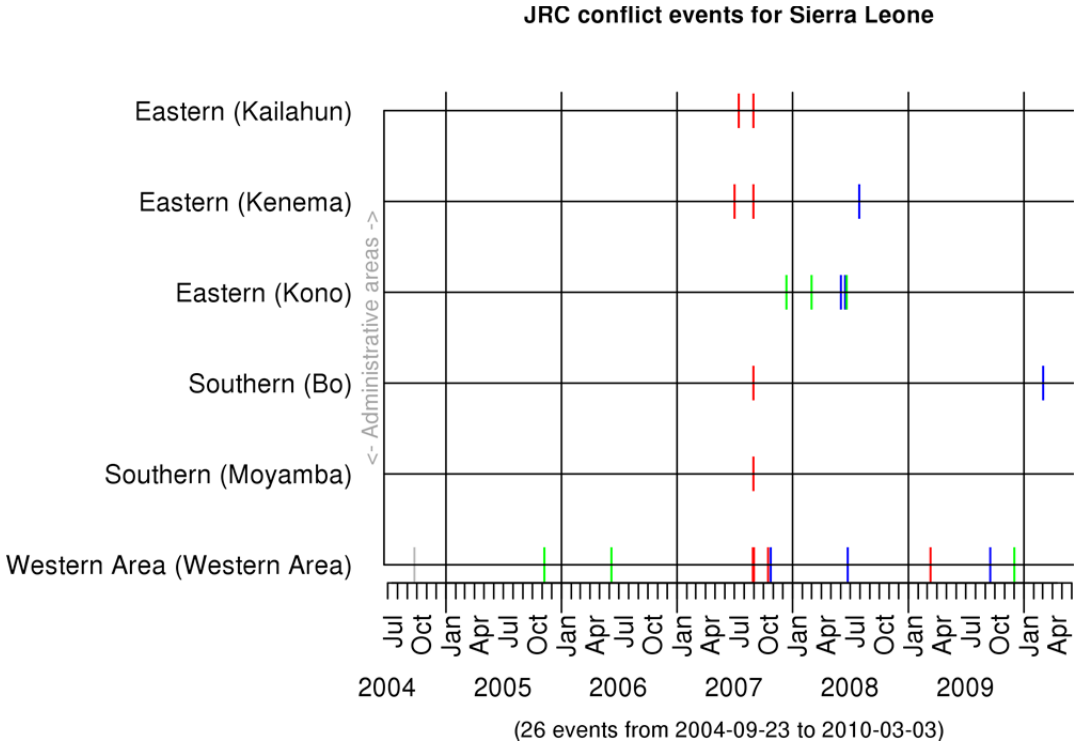
(18 events from 2009-04-26 to 2010-03-23)

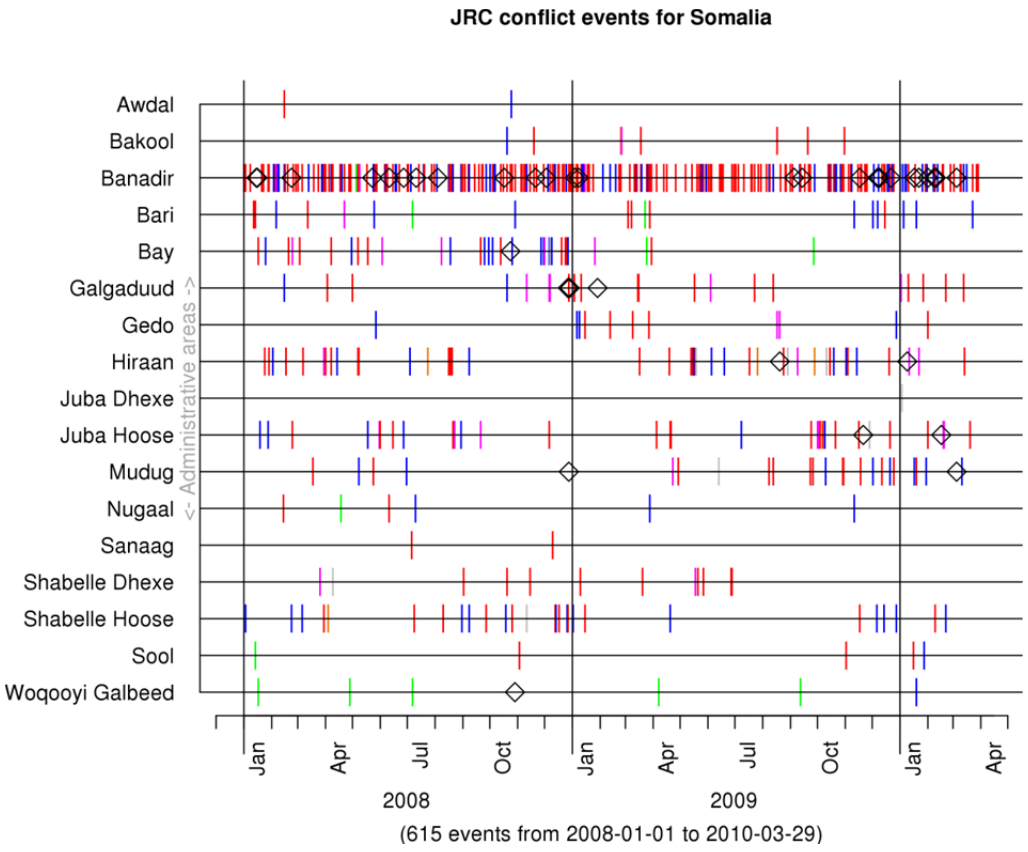
JRC conflict events for Liberia

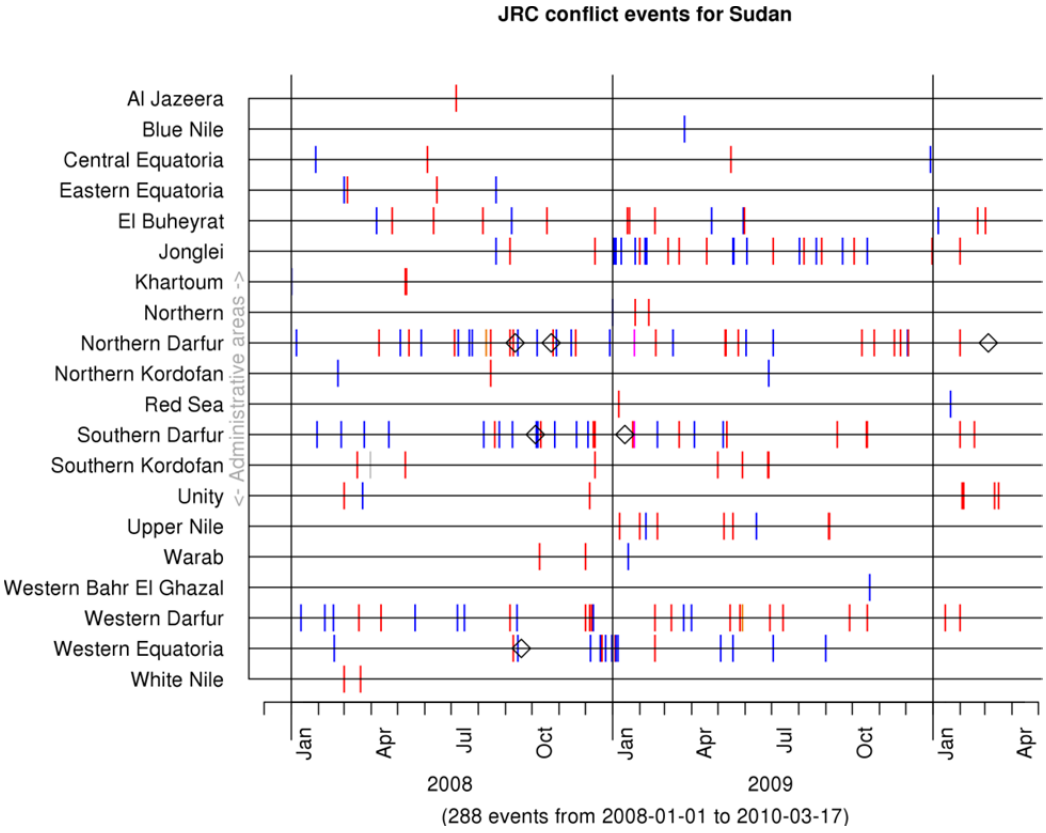


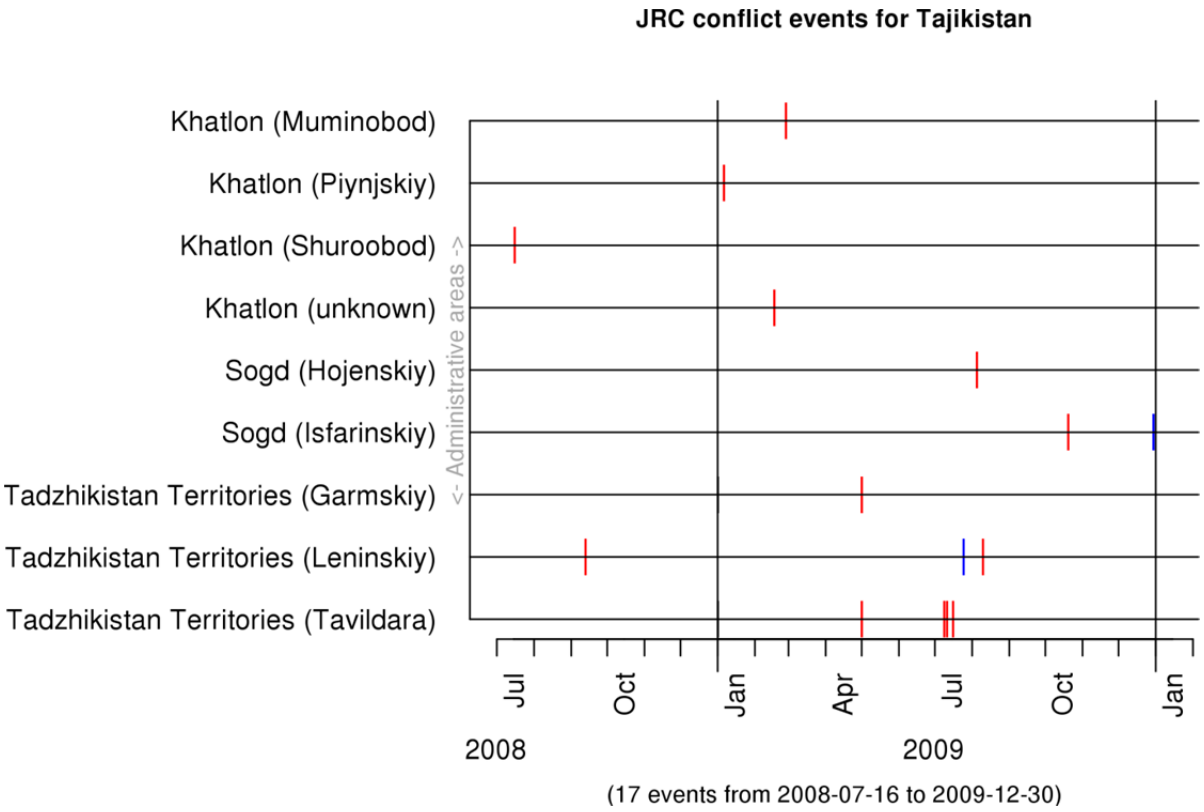
(28 events from 2005-06-15 to 2010-02-26)

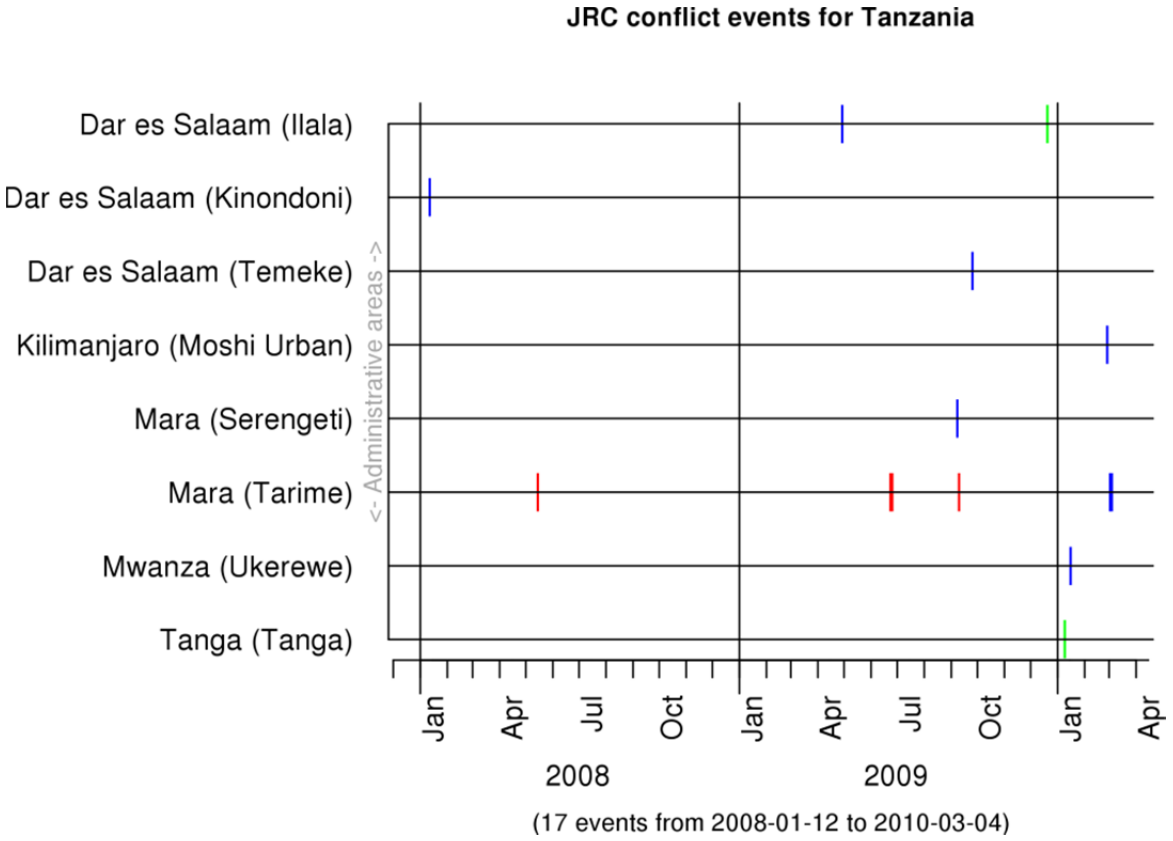

JRC conflict events for Rwanda
Byumba (Muhura)
Cyangugu (Kagano)
Gitarama (Masango)
Gitarama (Mushubati)
Gitarama (Tambwe)
Kibungo (Birenga)
Kibuye (Mabanza)
Prefecture De La Ville De Kigali (Nyarugenge)
Umutara (Nyagatare)
<- Administrative areas ->
Apr
Jul
Oct
Jan
Apr
Jul
Oct
Jan
Apr
2008
2009
(16 events from 2008-03-24 to 2010-03-14)

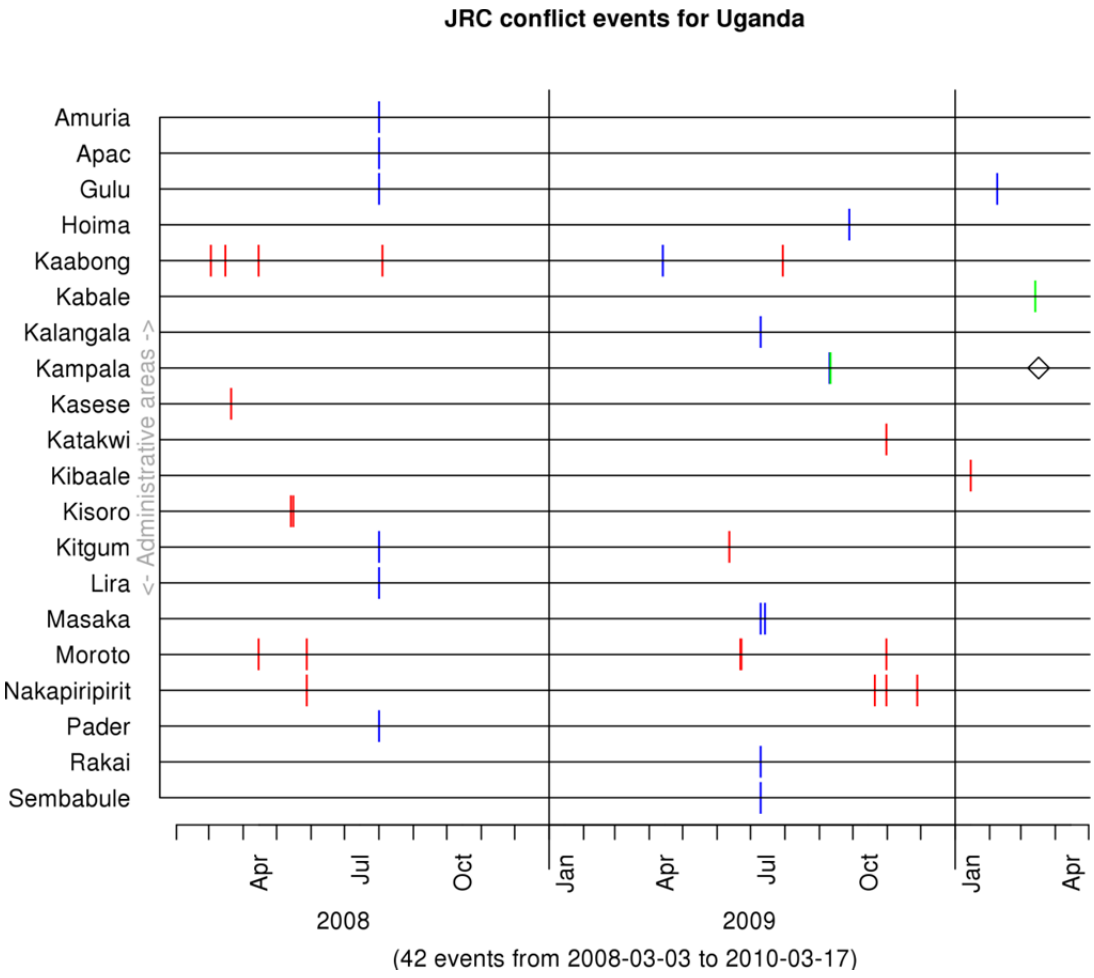

JRC conflict events for Sierra Leone
Eastern (Kailahun)
Eastern (Kenema)
Eastern (Kono)
Southern (Bo)
Southern (Moyamba)
Western Area (Western Area)
<- Administrative areas ->
Jul
Oct
Jan
Apr
2004
2005
2006
2007
2008
2009
(26 events from 2004-09-23 to 2010-03-03)

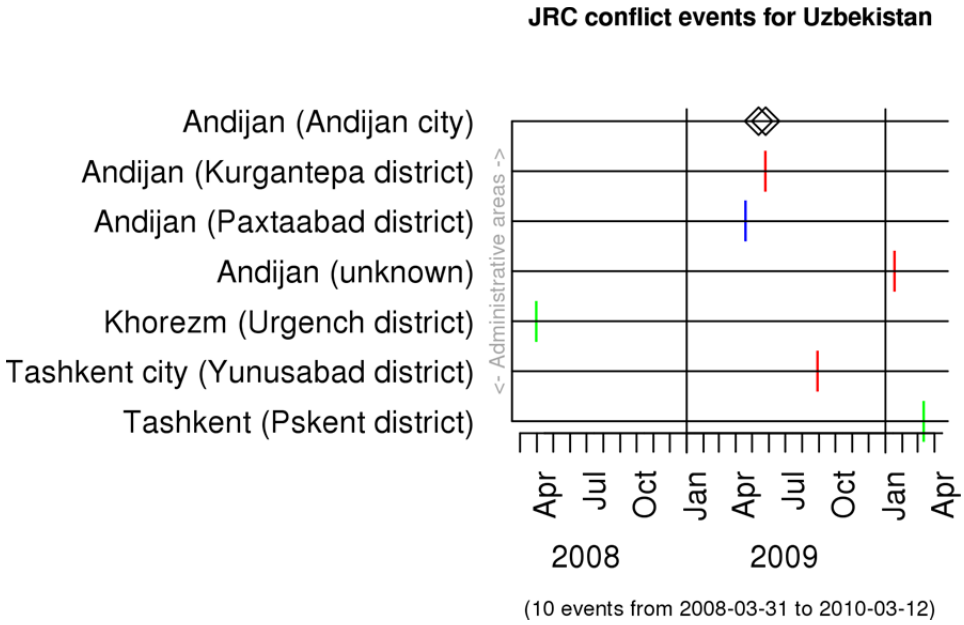

JRC conflict events for Somalia
Awdal
Bakool
Banadir
Bari
Bay
Galgaduud
Gedo
Hiraan
Juba Dhexe
Juba Hoose
Mudug
Nugaal
Sanaag
Shabelle Dhexe
Shabelle Hoose
Sool
Woqooyi Galbeed
-> Administrative areas <-
Jan
Apr
Jul
Oct
Jan
Apr
Jul
Oct
Jan
Apr
2008
2009
(615 events from 2008-01-01 to 2010-03-29)


JRC conflict events for Sudan
Al Jazeera
Blue Nile
Central Equatoria
Eastern Equatoria
El Buheyrat
Jonglei
Khartoum
Northern
Northern Darfur
Northern Kordofan
Red Sea
Southern Darfur
Southern Kordofan
Unity
Upper Nile
Warab
Western Bahr El Ghazal
Western Darfur
Western Equatoria
White Nile
-> Administrative areas <-
Jan
Apr
Jul
Oct
Jan
Apr
Jul
Oct
Jan
Apr
2008
2009
(288 events from 2008-01-01 to 2010-03-17)


JRC conflict events for Tajikistan
Khatlon (Muminobod)
Khatlon (Piynjskiy)
Khatlon (Shuroobod)
Khatlon (unknown)
Sogd (Hojenskiy)
Sogd (Isfarinskiy)
Tadzhikistan Territories (Garmskiy)
Tadzhikistan Territories (Leninskiy)
Tadzhikistan Territories (Tavildara)
<- Administrative areas ->
Jul
Oct
Jan
Apr
Jul
Oct
Jan
2008
2009
(17 events from 2008-07-16 to 2009-12-30)

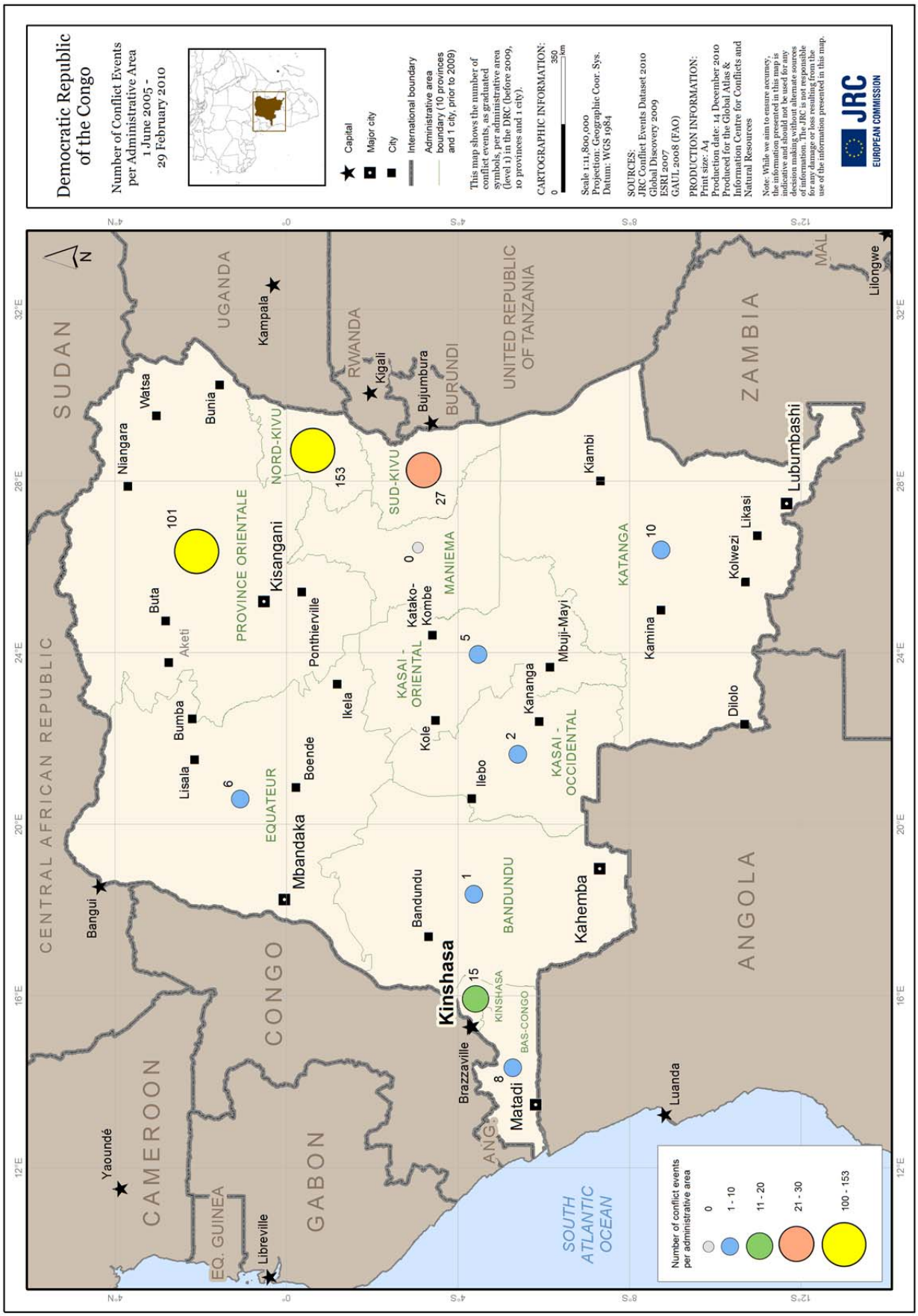

JRC conflict events for Tanzania
Dar es Salaam (Ilala)
Dar es Salaam (Kinondoni)
Dar es Salaam (Temeke)
Kilimanjaro (Moshi Urban)
Mara (Serengeti)
Mara (Tarime)
Mwanza (Ukerewe)
Tanga (Tanga)
<- Administrative areas ->
Jan
Apr
Jul
Oct
Jan
Apr
Jul
Oct
Jan
Apr
2008
2009
(17 events from 2008-01-12 to 2010-03-04)

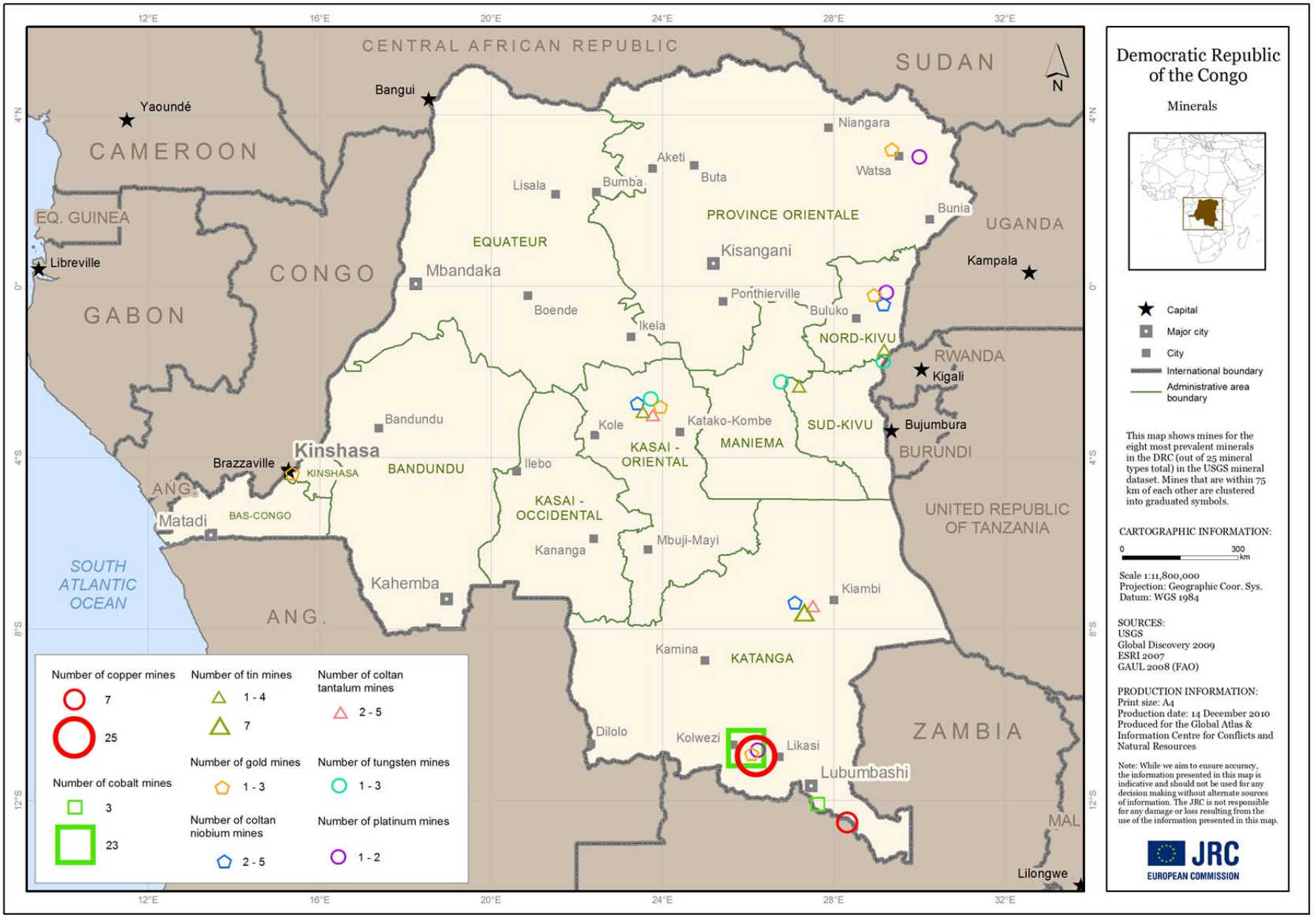

JRC conflict events for Uganda
Amuria
Apac
Gulu
Hoima
Kaabong
Kabale
Kalangala
Kampala
Kasese
Katakwi
Kibaale
Kisoro
Kitgum
Lira
Masaka
Moroto
Nakapiripirit
Pader
Rakai
Sembabule
<- Administrative areas ->
Apr
Jul
Oct
Jan
Apr
Jul
Oct
Jan
Apr
2008
2009
(42 events from 2008-03-03 to 2010-03-17)


JRC conflict events for Uzbekistan
Andijan (Andijan city)
Andijan (Kurgantepa district)
Andijan (Paxtaabad district)
Andijan (unknown)
Khorezm (Urgench district)
Tashkent city (Yunusabad district)
Tashkent (Pskent district)
<- Administrative areas ->
Apr
Jul
Oct
Jan
Apr
Jul
Oct
Jan
Apr
2008
2009
(10 events from 2008-03-31 to 2010-03-12)

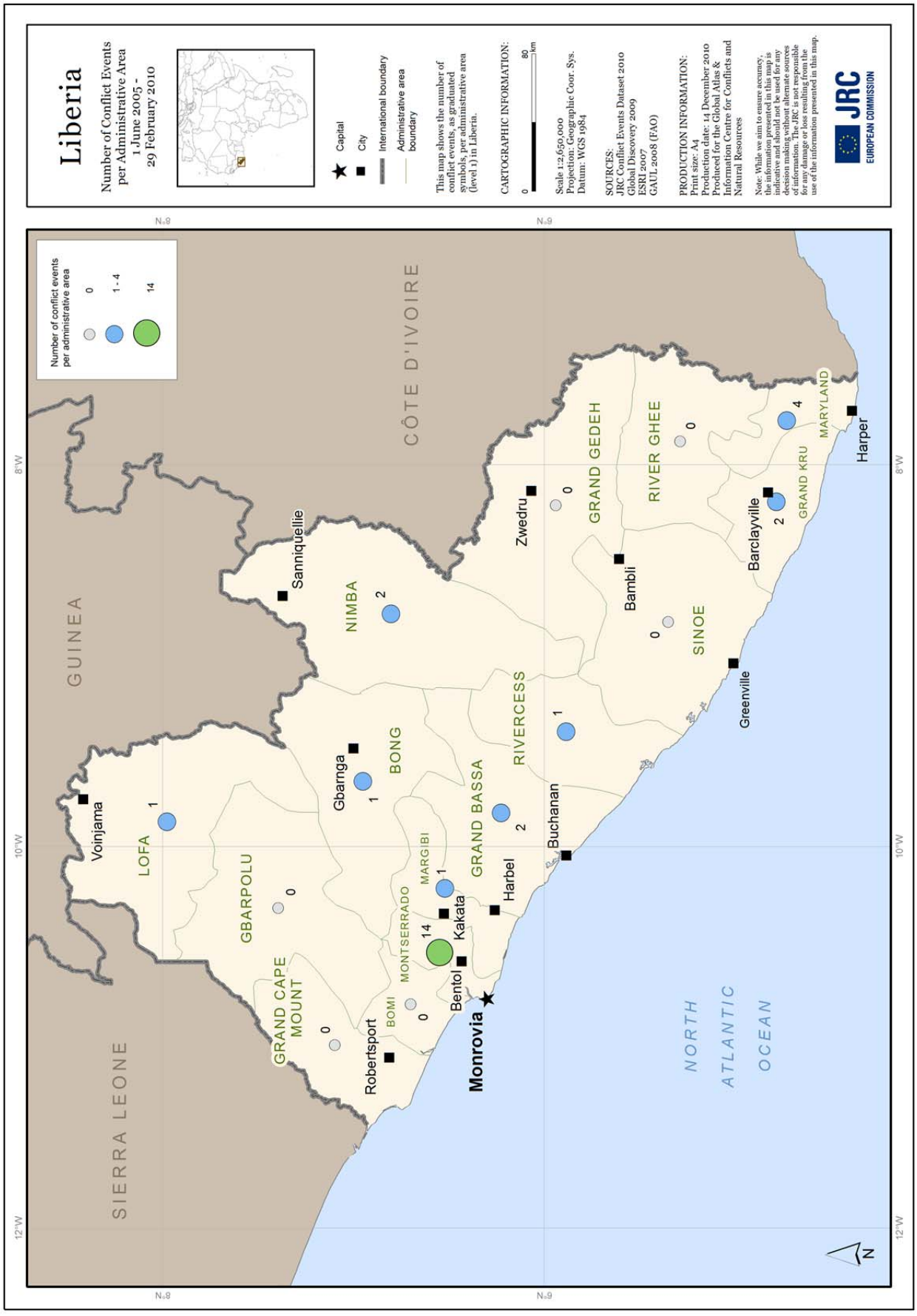
7.4 Maps of conflict events and major minerals for selected countries

7.4.1 Democratic Republic of Congo



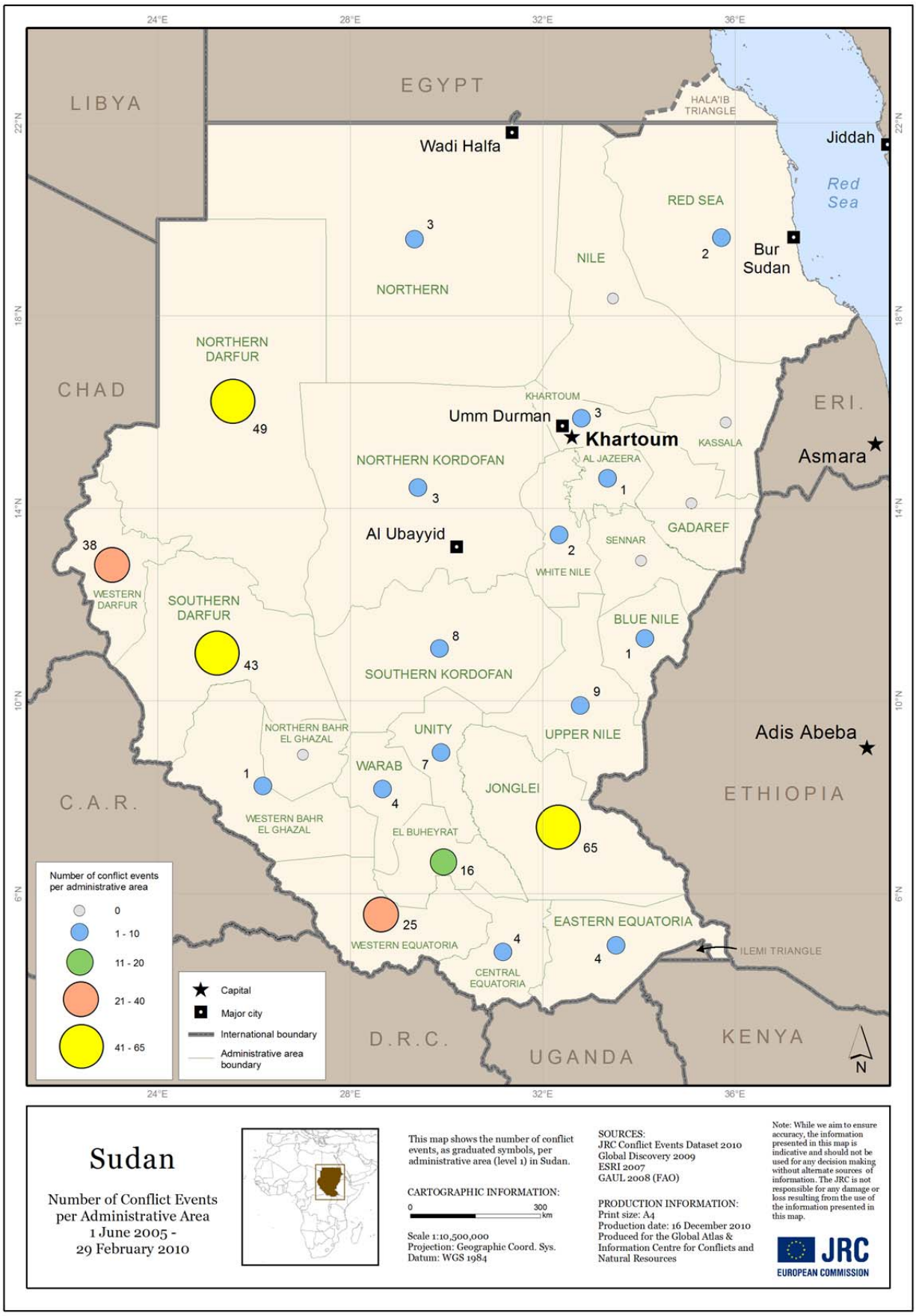

Democratic Republic of the Congo
Minerals
CENTRAL AFRICAN REPUBLIC
SUDAN
CAMEROON
EQ. GUINEA
CONGO
GABON
ANG.
UGANDA
RWANDA
BURUNDI
UNITED REPUBLIC OF TANZANIA
ZAMBIA
MAL
SOUTH ATLANTIC OCEAN
Yaoundé
Bangui
Libreville
Kampala
Kigali
Bujumbura
Kinshasa
KINSHASA
Brazzaville
Matadi
Lilongwe
Niangara
Watsa
Aketi
Buta
Bumba
Lisala
Bunia
PROVINCE ORIENTALE
EQUATEUR
Kisangani
Mbandaka
Boende
Ikela
Ponthierville
Buluko
NORD-KIVU
SUD-KIVU
Bandundu
BANDUNDU
Ilebo
Kole
Katako-Kombe
KASAI - ORIENTAL
MANIEMA
KASAI - OCCIDENTAL
Kananga
Mbuji-Mayi
BAS-CONGO
Kahemba
Kiambi
Kamina
KATANGA
Dilolo
Kolwezi
Likasi
Lubumbashi
Capital
Major city
City
International boundary
Administrative area boundary
Number of copper mines
7
25
Number of cobalt mines
3
23
Number of tin mines
1 - 4
7
Number of gold mines
1 - 3
Number of coltan niobium mines
2 - 5
Number of coltan tantalum mines
2 - 5
Number of tungsten mines
1 - 3
Number of platinum mines
1 - 2
This map shows mines for the eight most prevalent minerals in the DRC (out of 25 mineral types total) in the USGS mineral dataset. Mines that are within 75 km of each other are clustered into graduated symbols.
CARTOGRAPHIC INFORMATION:
0
300
km
Scale 1:11,800,000
Projection: Geographic Coor. Sys.
Datum: WGS 1984
SOURCES:
USGS
Global Discovery 2009
ESRI 2007
GAUL 2008 (FAO)
PRODUCTION INFORMATION:
Print size: A4
Production date: 14 December 2010
Produced for the Global Atlas & Information Centre for Conflicts and Natural Resources
Note: While we aim to ensure accuracy, the information presented in this map is indicative and should not be used for any decision making without alternate sources of information. The JRC is not responsible for any damage or loss resulting from the use of the information presented in this map.
JRC
EUROPEAN COMMISSION
12°E
16°E
20°E
24°E
28°E
32°E
4°N
0°
4°S
8°S
12°S
N

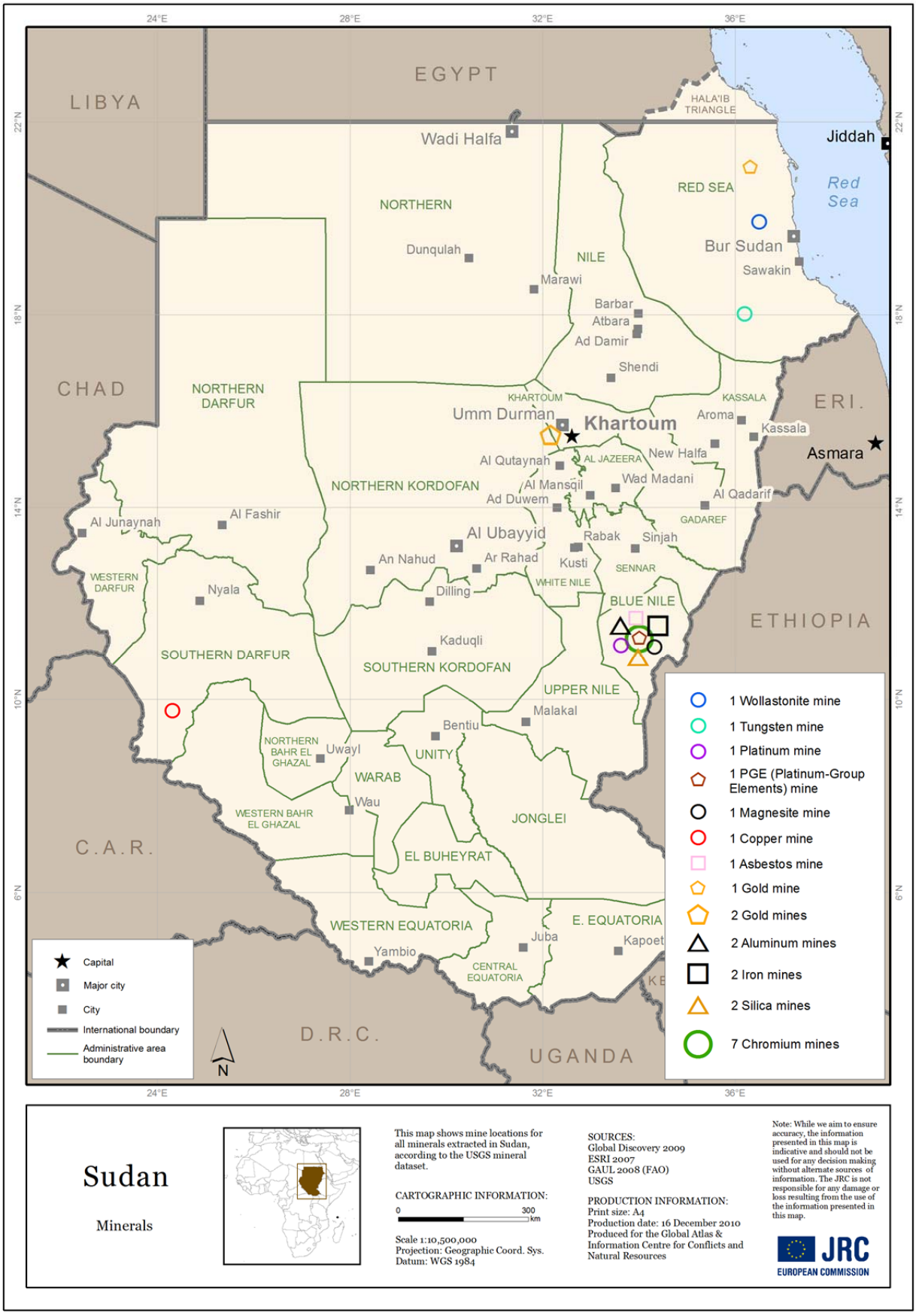
7.4.2 Liberia


Liberia
Number of Conflict Events per Administrative Area
1 June 2005 - 29 February 2010
Capital
City
International boundary
Administrative area boundary
This map shows the number of conflict events, as graduated symbols, per administrative area (level 1) in Liberia.
CARTOGRAPHIC INFORMATION:
0
80
km
Scale 1:2,650,000
Projection: Geographic Coor. Sys.
Datum: WGS 1984
SOURCES:
JRC Conflict Events Dataset 2010
Global Discovery 2009
ESRI 2007
GAUL 2008 (FAO)
PRODUCTION INFORMATION:
Print size: A4
Production date: 14 December 2010
Produced for the Global Atlas & Information Centre for Conflicts and Natural Resources
Note: While we aim to ensure accuracy, the information presented in this map is indicative and should not be used for any decision making without alternate sources of information. The JRC is not responsible for any damage or loss resulting from the use of the information presented in this map.
JRC
EUROPEAN COMMISSION
Number of conflict events per administrative area
0
1 - 4
14
GUINEA
CÔTE D'IVOIRE
SIERRA LEONE
NORTH ATLANTIC OCEAN
LOFA
GBARPOLU
GRAND CAPE MOUNT
BOMI
MONTSERRADO
MARGIBI
BONG
NIMBA
GRAND BASSA
RIVERCESS
GRAND GEDEH
RIVER GHEE
SINOE
GRAND KRU
MARYLAND
Voinjama
Gbarnga
Sanniquellie
Zwedru
Bambli
Barclayville
Harper
Greenville
Buchanan
Harbel
Kakata
Bentol
Monrovia
Robertsport
8°W
10°W
12°W
N.8
N.9
N


Liberia
Minerals
Number of mines
Gold
1 - 4
Iron
1 - 5
Platinum
1
Diamond
1
Capital
City
International boundary
Administrative area boundary
SIERRA LEONE
GUINEA
CÔTE D'IVOIRE
NORTH ATLANTIC OCEAN
Voinjama
LOFA
GBARPOLU
GRAND CAPE MOUNT
Robertsport
Sanniquellie
Gbarnga
BONG
NIMBA
BOMI
MONTSERRADO
MARGIBI
Bentol
Kakata
Monrovia
Harbel
GRAND BASSA
Zwedru
RIVERCESS
Buchanan
GRAND GEDEH
Bambli
SINOE
RIVER GHEE
Greenville
Barclayville
GRAND KRU
MARYLAND
Harper
12°W
10°W
8°W
8°N
6°N
N
This map shows mine locations for all mineral types extracted in Liberia according to the USGS mineral dataset and The Secretariat of the African, Caribbean and Pacific Group of States (ACP). The USGS data provides locations for iron, gold, and platinum, and the ACP data gives locations for iron, gold, and diamonds. Mines that are within 25 km of each other are integrated into a single symbol.
CARTOGRAPHIC INFORMATION:
0
80
km
Scale 1:2,650,000
Projection: Geographic Coor. Sys.
Datum: WGS 1984
SOURCES:
USGS
ACP
Global Discovery 2009
ESRI 2007
GAUL 2008 (FAO)
PRODUCTION INFORMATION:
Print size: A4
Production date: 14 December 2010
Produced for the Global Atlas & Information Centre for Conflicts and Natural Resources
Note: While we aim to ensure accuracy, the information presented in this map is indicative and should not be used for any decision making without alternate sources of information. The JRC is not responsible for any damage or loss resulting from the use of the information presented in this map.
JRC
EUROPEAN COMMISSION

7.4.3 Sudan


24°E
28°E
32°E
36°E
22°N
18°N
14°N
10°N
6°N
LIBYA
EGYPT
HALA'IB TRIANGLE
Wadi Halfa
Jiddah
Red Sea
RED SEA
NILE
NORTHERN
Bur Sudan
NORTHERN DARFUR
CHAD
KHARTOUM
Umm Durman
Khartoum
KASSALA
ERI.
Asmara
NORTHERN KORDOFAN
AL JAZEERA
Al Ubayyid
GADAREF
SENNAR
WHITE NILE
WESTERN DARFUR
SOUTHERN DARFUR
BLUE NILE
SOUTHERN KORDOFAN
NORTHERN BAHR EL GHAZAL
UNITY
UPPER NILE
Adis Abeba
WARAB
JONGLEI
C.A.R.
ETHIOPIA
WESTERN BAHR EL GHAZAL
EL BUHEYRAT
EASTERN EQUATORIA
ILEMI TRIANGLE
WESTERN EQUATORIA
CENTRAL EQUATORIA
D.R.C.
UGANDA
KENYA
N
Number of conflict events per administrative area
0
1 - 10
11 - 20
21 - 40
41 - 65
Capital
Major city
International boundary
Administrative area boundary
Sudan
Number of Conflict Events per Administrative Area
1 June 2005 - 29 February 2010
This map shows the number of conflict events, as graduated symbols, per administrative area (level 1) in Sudan.
CARTOGRAPHIC INFORMATION:
0
300
km
Scale 1:10,500,000
Projection: Geographic Coord. Sys.
Datum: WGS 1984
SOURCES:
JRC Conflict Events Dataset 2010
Global Discovery 2009
ESRI 2007
GAUL 2008 (FAO)
PRODUCTION INFORMATION:
Print size: A4
Production date: 16 December 2010
Produced for the Global Atlas & Information Centre for Conflicts and Natural Resources
Note: While we aim to ensure accuracy, the information presented in this map is indicative and should not be used for any decision making without alternate sources of information. The JRC is not responsible for any damage or loss resulting from the use of the information presented in this map.
JRC
EUROPEAN COMMISSION



Sudan

Minerals

This map shows mine locations for all minerals extracted in Sudan, according to the USGS mineral dataset.

CARTOGRAPHIC INFORMATION:

0 300 km

Scale 1:10,500,000
Projection: Geographic Coord. Sys.
Datum: WGS 1984

SOURCES:
Global Discovery 2009
ESRI 2007
GAUL 2008 (FAO)
USGS

PRODUCTION INFORMATION:
Print size: A4
Production date: 16 December 2010
Produced for the Global Atlas & Information Centre for Conflicts and Natural Resources

JRC
EUROPEAN COMMISSION

European Commission

EUR 24861 EN – Joint Research Centre – Institute for the Protection and Security of the Citizen
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Abstract
The project “Global Atlas and Information Centre for Conflicts and Natural Resources” had the aim to collect and to analyze data related to the link between armed conflicts and natural resources. Four pilot study areas were selected: African Great Lakes, Horn of Africa, Western Africa and Central Asia. The newly created conflict event dataset together with datasets of natural resources, economic activity, land cover and other datasets were used to describe conditions of armed conflicts through construction of statistical conflict model. The model was also used to identify the areas with elevated risk of armed conflict. All data, documents and results are available on the project website.

The mission of the JRC is to provide customer-driven scientific and technical support for the conception, development, implementation and monitoring of EU policies. As a service of the European Commission, the JRC functions as a reference centre of science and technology for the Union. Close to the policy-making process, it serves the common interest of the Member States, while being independent of special interests, whether private or national.

LB-NA-24861-EN-N

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