European Commission

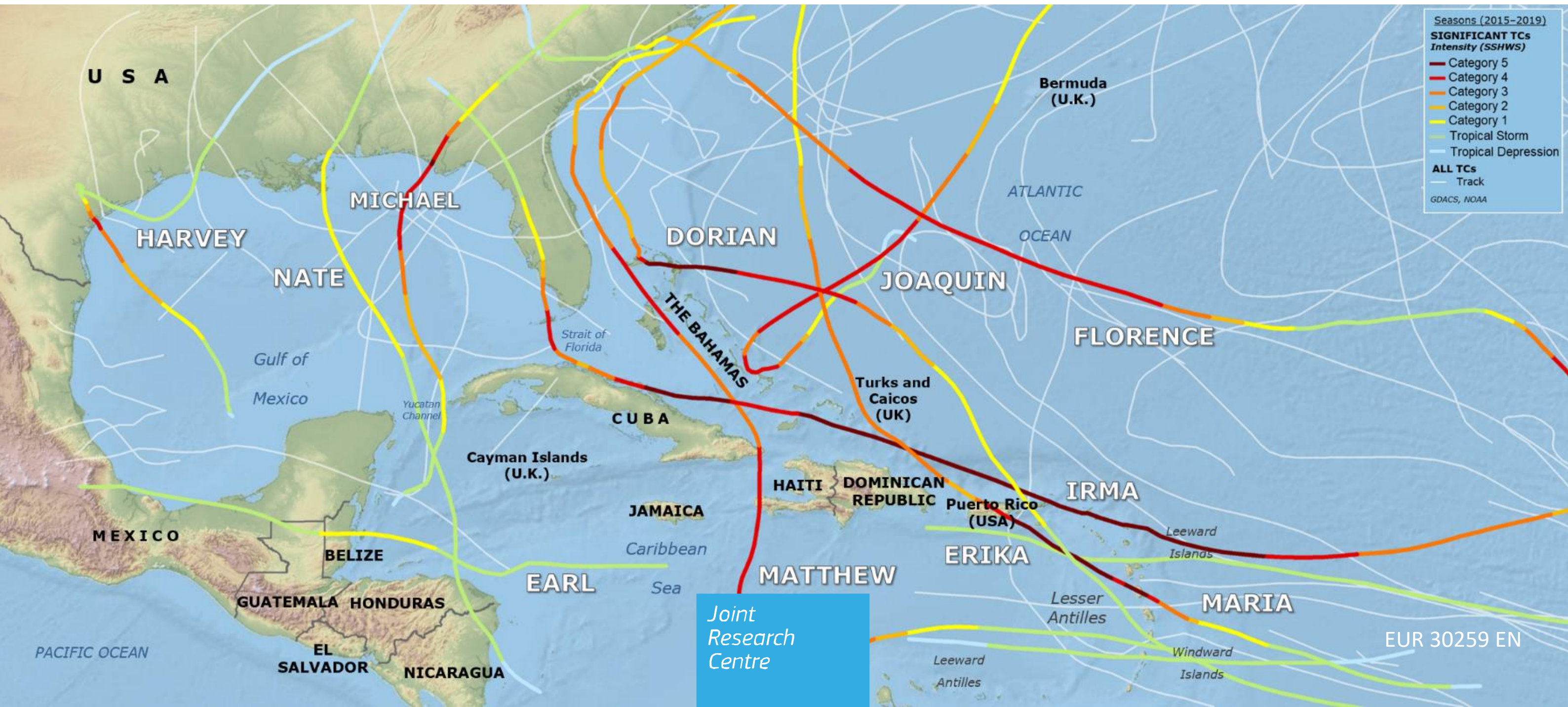
JRC TECHNICAL REPORT

2020 - Atlantic Hurricane Season

Past events, current situation, seasonal forecast and COVID-19 situation

Pamela Probst, Alessandro Annunziato, Chiara Proietti, Chiara Fonio, Marzia Santini, Stefano Paris, Luca Giustolisi

2020



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Abstract

The official "**Atlantic Hurricane Season**" (North Atlantic Ocean, Caribbean Sea and Gulf of Mexico) starts on **1 June** and ends on **30 November.** On average, 12 "named storms" (Tropical Storm or higher strength) occur each season, with an average of 6 becoming Hurricanes and 3 Major Hurricanes, while the climatological peak of activity is around 10 September.

The Tropical Cyclones (TCs) could affect several vulnerable islands of the Caribbean area, causing damage and fatalities that could require international assistance from the humanitarian community.

The past five seasons (2015-2019) have been analysed considering the TCs impact and the international humanitarian support provided. For the most significant events (e.g. **MATTHEW** in 2016, **IRMA** and **MARIA** in 2017, **DORIAN** in 2019), the Global Disasters Alerts and Coordination System (**GDACS**) issued a RED alert (at least three days in advance), timely alerting the international community.

According to the official **NOAA's 2020 Atlantic Hurricane Season Outlooks**, as well as most of the other seasonal forecasts published by other agencies, the TC activity for this season is forecasted to be **above average**. However, given the large uncertainty associated with the long term forecasts those estimations should be considered only indicative. NOAA will update its seasonal forecast in August 2020 before the typical peak of the season.

This year the **COVID-19 pandemic emergency** is likely to affect the **preparedness** and **response activities** for the Hurricane season. It is therefore essential to consider it, adapting the evacuation plans and preparing people well in advance to follow new guidelines due to this multi-risks and complex situation. The guidelines might vary across countries, depending on the spread of the virus and the adopted containment measures. This report provides an update of the current pandemic emergency in the area and an overview of the guidelines issued so far.

In this context, an **Early Warnings System** able to estimate the correct impact of TCs well in advance is even more essential for decision makers to take more informed decisions and make plans accordingly, also considering the potential effects of the climate change on the TCs activity.

JRC is closely monitoring the TCs situation through **GDACS** (www.gdacs.org)**.** The COVID-19 emergency is also monitored, through the **JRC COVID-19 Dashboard** (https://covid-statistics.jrc.ec.europa.eu/), which covers also the Caribbean, and other activities. In addition, JRC has also prepared a new GDACS section on the COVID-19 situation in the affected countries.

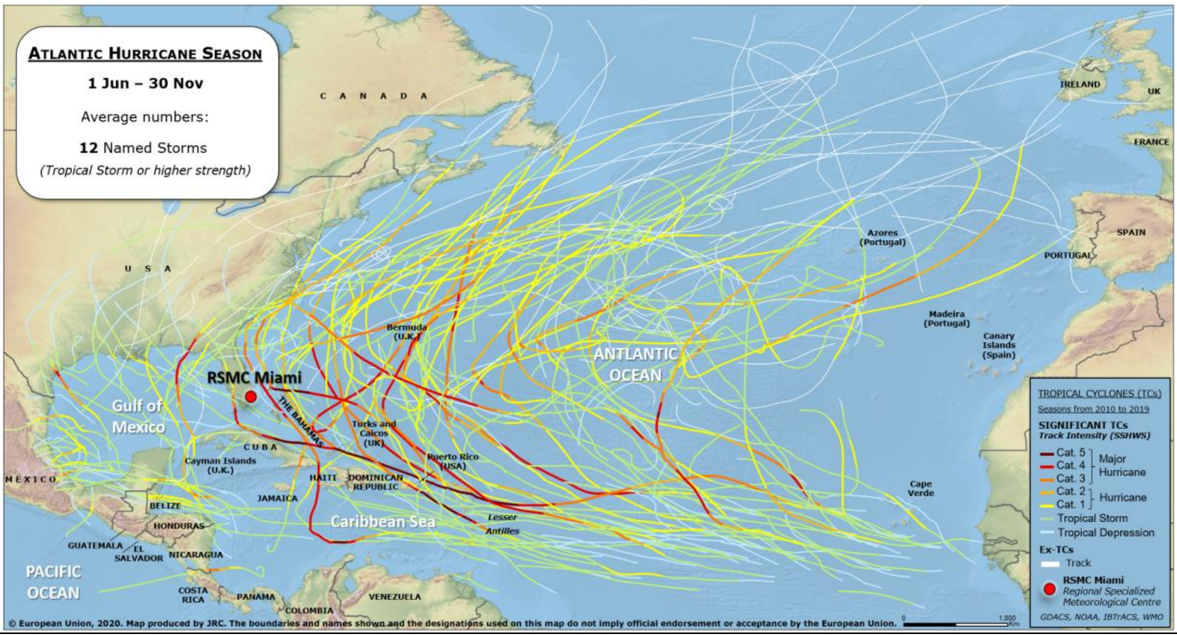
1 Introduction

The Tropical Cyclones (TCs) season in the Atlantic Basin (North Atlantic Ocean, Caribbean Sea and Gulf of Mexico) officially starts on **1 June** and ends on **30 November**.

On average, 12 "named storms" (Tropical Storm or higher strength, see Annex 3) occur each season, with an average of 6 becoming Hurricanes and 3 Major Hurricanes. The highest activity is from August to late October, with the climatological peak around 10 September (see Fig. 2a). The official TC Regional Specialized Meteorological Centre (RSMC) of this basin is the **RSMC Miami** - **NOAA National Hurricane Center (NOAA-NHC).**

The TCs affecting this basin since 2010 and the main characteristics are presented below, while more information can be found on the World Meteorological Organization (WMO) Tropical Cyclone Programme website[1], WMO Severe Weather Information Centre[2] and in the WMO Global Guide to Tropical Cyclone Forecast[3].

TCs in the Atlantic basin: North Atlantic Ocean, Caribbean Sea and Gulf of Mexico	
Season	**1 June - 30 November**
RSMC	RSMC Miami - NOAA National Hurricane Center (NOAA-NHC, https://www.nhc.noaa.gov/)
Exposed areas[4] in alphabetical order	Anguilla (UK), Antigua and Barbuda, Aruba (NL), Azores (PT), Bahamas, Barbados, Belize, Bermuda (UK), British Virgin Islands (UK), Caribbean Netherlands (Bonaire, Saba, Sint Eustatius), Cayman Islands (UK), Canada, Cape Verde, Colombia, Costa Rica, Cuba, Curaçao (NL), Dominica, Dominican Republic, Grenada, Guadeloupe (FR), Guatemala, Haiti, Honduras, Jamaica, Martinique (FR), Mexico, Montserrat (UK), Nicaragua, Panama, Puerto Rico (US), Saint Barthélemy (FR), Saint Kitts and Nevis, Saint Lucia, Saint Martin (FR), Saint Vincent and the Grenadines, Sint Maarten (NL), Trinidad and Tobago, Turks and Caicos Islands (UK), Venezuela, US Virgin Islands, United States. *Remnants of a TC (or the ones becoming extra-TCs) could also affect parts of western Europe, like France, Ireland, Portugal, Spain, UK (e.g. OPHELIA in 2017 in Ireland and UK).*



Tab. 1 - Main characteristics of the Northern Atlantic basin: start/end dates of the season, Regional Specialized Meteorological Centre – RSMC and area potentially exposed to TCs.

Fig. 1 - All TCs of the Northern Atlantic basin (2010-2019), TC average number and RSM

Data sources: NOAA IBTrACS, NOAA NHC, WMO[5].

[1] https://www.wmo.int/pages/prog/www/tcp/index_en.html
[2] https://severeweather.wmo.int/
[3] https://cyclone.wmo.int/
[4] Some of these countries (e.g. like Mexico) are affected by the TCs of the Atlantic and East Pacific Basins
[5] https://severe.worldweather.wmo.int/

The average number of TCs that form over the Atlantic is smaller compared to the numbers of NW Pacific and NE/Central Pacific, but it is higher compared to the other TC basins (see Tab. 2).
The TCs that form in this basin could affect several vulnerable islands of the Caribbean area, causing fatalities and damage that could require international assistance, like MATTHEW in 2016 in Haiti, the devastating Hurricanes IRMA and MARIA in 2017 and only last year, the very intense Hurricane DORIAN that hit the Bahamas leaving a trail of destruction.

Basin	Tropical Storm or stronger *(Vmax≥63km/h)*	Hurricane/ Typhoon/Cyclone *(Vmax≥119km/h)*
NW Pacific	26.0	16.5
NE/Central Pacific	16.6	8.9
Atlantic	12.1	6.4
Aus SW Pacific	9.9	5.2
SW Indian	9.3	5.0
Aus SE Indian	7.5	3.6
N Indian	4.8	1.5
Globally	**86.0**	**46.9**

Tab. 2 - Average TC number by basin (source: NOAA[6])

According to UN OCHA (Latin America and the Caribbean: Natural Disasters 2000-2019[7]), the countries most affected since 2000 in the region were **Cuba**, **Mexico** and **Haiti**, with **5 000 fatalities**, **29 million people affected** and total damages estimated at around 39 000 million USD (36 000 million EUR). The same report shows that more than 85% of those fatalities were registered in Haiti, one of the most vulnerable areas of the Caribbean. More information on the humanitarian impact for the period analysed can be found in Annex 4.

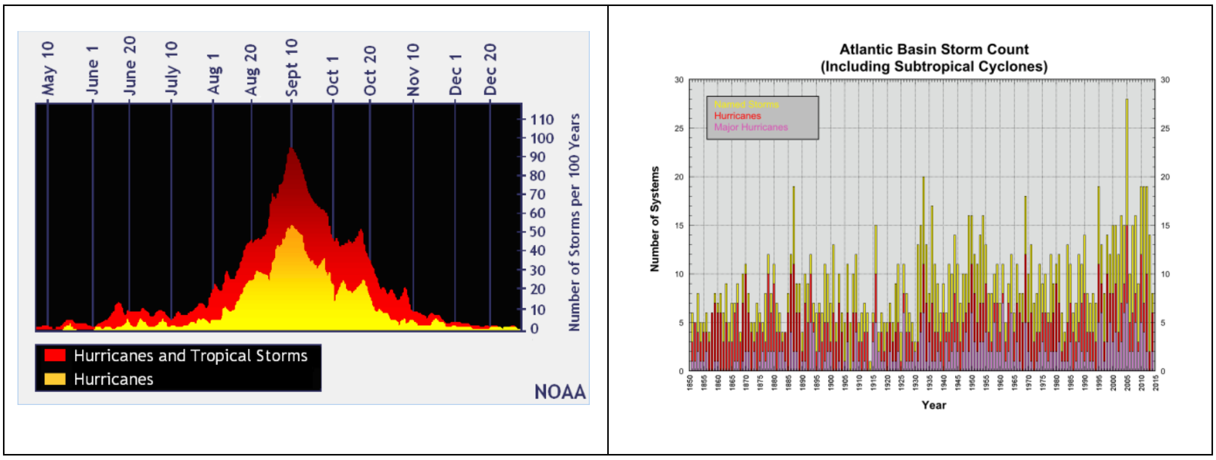


Fig. 2 - Number of Tropical Storms and Hurricanes per 100 years distinguished by month (LEFT, Fig. 2a, source: NOAA[8]) and number of systems (see Annex 3) by year (RIGHT, Fig. 2b, source: NOAA[8]).

In this context, the **Joint Research Centre (JRC)** has supported the **Emergency Response Coordination Centre (ERCC)** of DG ECHO for more than 15 year following all emergencies with various activities, like the **Global Disasters Alerts and Coordination System** (GDACS, see Annex 2), producing ECHO Daily Maps and JRC Reports, as well as with the Copernicus Emergency Management Service.
For the Atlantic Hurricane basin, JRC has already produced a detailed report in 2018:

- 2018 - Caribbean: Past events, current situation and seasonal forecast: https://www.gdacs.org/Public/download.aspx?type=DC&id=155.

For this reason, only the most relevant information has been included in this report, focusing on the last five seasons (**Section 2**), current situation (**Section 3**) and on the new seasonal forecast (**Section 4**). Given the current **COVID-19 pandemic emergency**, an additional Section on the potential effects of this virus on the TC preparedness and response activities has been added (**Section 5**). Concluding remarks are in **Section 6**, while additional information can be found in **Annexes 1-6** and in the previous JRC reports (see **References**).

[6] https://www.aoml.noaa.gov/hrd-faq/#records-and-rankings
[7] https://www.humanitarianresponse.info/en/operations/latin-america-and-caribbean/document/latin-america-and-caribbean-natural-disasaters-2000
[8] Source of Fig.2a and Fig.2b: NOAA https://www.nhc.noaa.gov/climo/

2 Past events (2015-2019)

A short overview of the last five Atlantic Hurricane seasons (**2015-2019**) is presented in Section 2.1, while the detailed analysis of the most significant events occurred during this period is in Section 2.2.

2.1 Overview: Impact, frequency and GDACS alerts

All TC tracks over the period 2015-2019, categorised by season, are shown in Fig. 3. Of these TCs, JRC has analysed the following aspects:

- ❑ Humanitarian impact by TC season (Fig. 4a) and areas affected (Annex 4)
- ❑ Total number of TCs by season and intensity (Fig. 4b) and by month (Fig. 4c)
- ❑ Alerts issued by GDACS (Fig. 5).

The past fourth Atlantic Hurricane seasons were above-average, while the 2015 one was below-average, due to strong **El Niño conditions**[9], which **reduced** the number of TCs in this basin (see Annex 5.1).

In this basin, every year thousands of people are affected by TCs, with hundreds of fatalities, especially in the Caribbean area (see Annex 4). Hurricane **MATTHEW**, which hit Haiti in 2016, caused the highest number of fatalities (nearly 600), while the **2017** was the **most devastating season** in terms of damage and TCs intensity (**6 Major Hurricanes**[10]), see WMO. During this season, Hurricanes **IRMA** and **MARIA** caused extensive damage in the Caribbean and **HARVEY** in the USA, as well as **NATE** in Central America. Another deadly season was the 2019, with Hurricane **DORIAN** (strongest Hurricane to hit the Bahamas with max. 1-min sustained winds nearly to 300 km/h) which left a trail of destruction in these islands. For most of these events GDACS issued a Red Alert and the international assistance has been required (see Tab. 3 in Section 2.2).

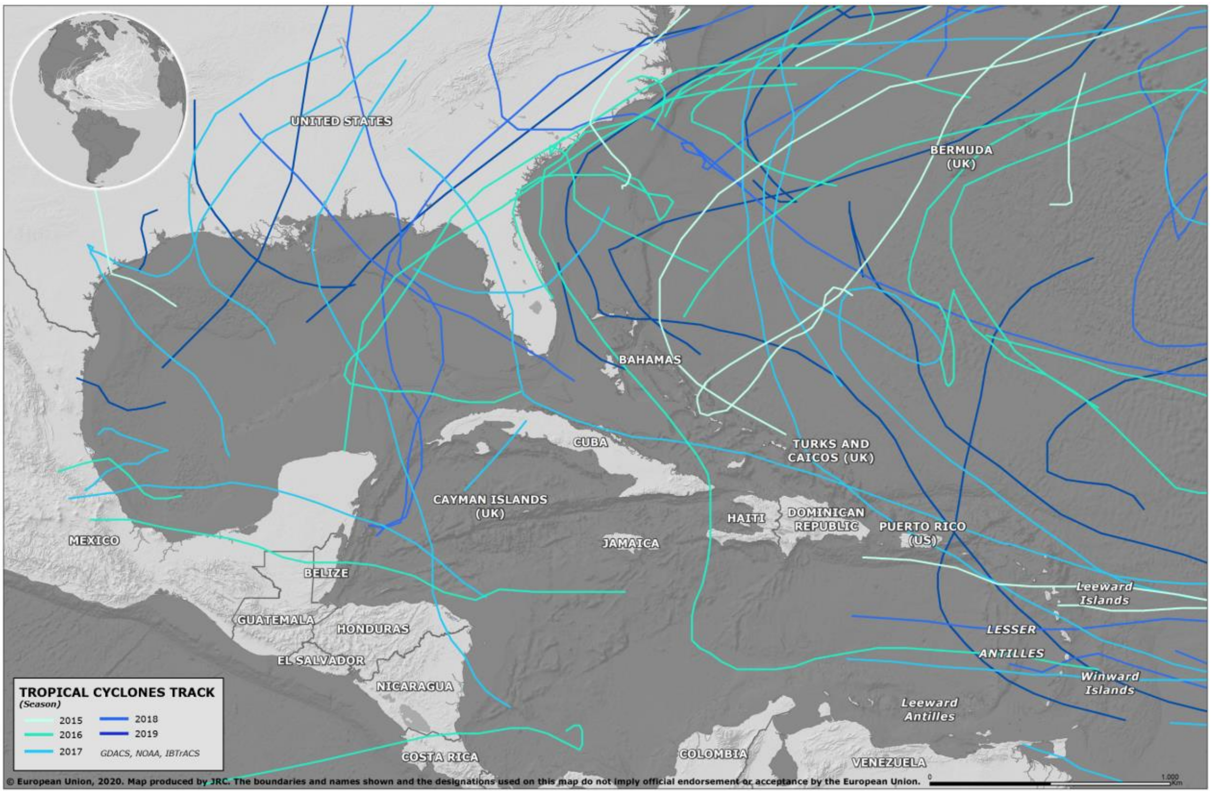


Fig. 3 - Tropical Cyclones in the Atlantic basin by season for the period 2015-2019.

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[9] Collins, M. and Roache, D. R., *The 2015 Hurricane season in the North Atlantic: An analysis of Environmental Conditions, Hurricane Risk*, Springer, 2019.

[10] Hurricanes reaching Category 3 and higher are considered **Major Hurricanes**, due to their potential significant impact (damage and loss of life).

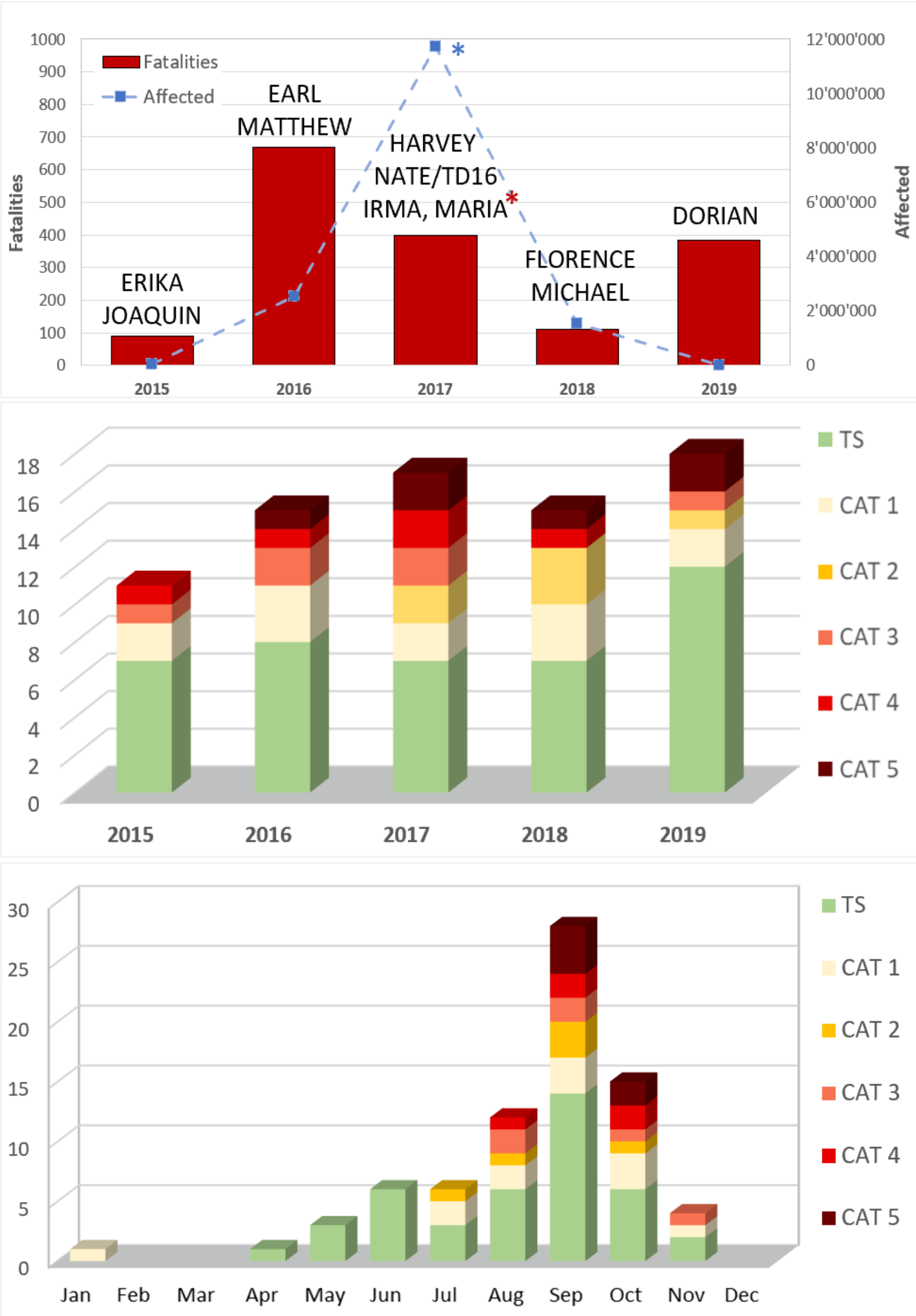

Fig. 4 - TOP (Fig 4a): Number of fatalities and people affected by TC season (from 2015 to 2019), considering the total impact in the countries listed in Table 1, as well as the name of the most significant TCs of the season.

* Only direct fatalities have been included (number of indirect fatalities could be significantly higher, see Pag. 11).

* 10 million people affected due to the passage of IRMA (see comments in Annex 4).

MIDDLE (Fig 4b): Total number of named storms (Tropical Storms or higher strength) by season and intensity (where TS=Tropical Storm, Cat 1-5 = Hurricane Category 1-5, see Classification in Annex 3).

BOTTOM (Fig 4c): Total number of TCs by intensity and month (average dates).

Sources: Impact (EM-DAT), TCs (GDACS, NOAA, IBTrACS)

GDACS Alerts (2015-2019)

The Global Disasters Alerts and Coordination System (GDACS, www.gdacs.org) includes the estimation of the impact, also due to this type of events, to alert the international humanitarian community and support preparedness activities. A detailed description of this system is provided in Annex 2, while all Tropical Cyclone GDACS Alerts (Green, Orange and Red) for the period 2015 - 2019 are shown in Fig. 5.

Every year between 1 and 3 Orange Alerts have been issued by GDACS, while the number of Red Alerts vary from 0 (in 2015) to a maximum of 2 (in 2017) in this TC basin.

Specifically, for these seasons, GDACS issued **5 Red Alerts** (**MATTHEW** in 2016, **IRMA** and **MARIA** in 2017, **FLORENCE**[11] in 2018 and **DORIAN** in 2019) and **10 Orange Alerts** (see Fig. 5). For 4 out of 5 Red Alerts the **international assistance** has been required (see Tab. 3, Section 2.2). The impact of FLORENCE was firstly overestimated but, after the new forecasts became available, the alert was reduced to Green.

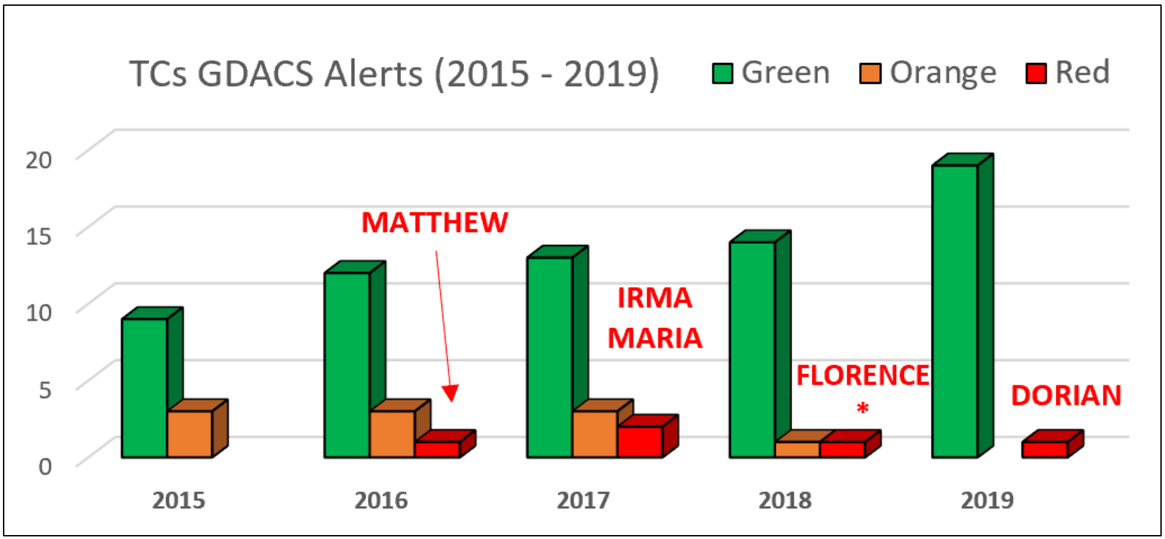

Fig. 5 - All TCs GDACS Alerts (Green, Orange, Red) issued for the Atlantic Basin (max. alert sent to the users). The Name of the TCs GDACS Red Alert is also indicated (source: GDACS). (*) The GDACS Alert of FLORENCE has been reduced to Orange than to Green, after the new forecasts became available.

Note: For TC NATE, which heavily affected Central America, GDACS provided only a Green Alert and not a Red nor an Orange Alert, since it reached a max. intensity of Category 1 Hurricane and most of the damage was related to the heavy rainfall (TC NATE + pre-disturbance) for a prolonged period of time with consequent widespread **floods** and **mudslides**. GDACS doesn't include all these aspects in the algorithm, but JRC is currently working on refining the algorithm, combining all these effects.

Early Warning Systems are essential **to reduce the impact of the TCs**. It is essential for people to closely follow the latest forecast and advisories (see links in the References), because a TC could quickly form and intensify. For example, a devastating Category 5 Hurricane could be only a Tropical Storm or a Category 1 only a couple of days before landfall, like Hurricane **MARIA** in **2017**, which **intensified from Category 1 to 5** in **less than 1 day** before making landfall in Dominica.

For the most significant events, GDACS issued a RED alert at least three days in advance, **timely alerting the international community**.

[11] JRC has in the meantime improved the alert algorithm reducing the initial false alerts. Specifically, to avoid false alerts as much as possible, or significant changes of the alert level due to very early forecast and subsequent change of track direction/ intensity, the alert level related to forecast data with more than 3 days lead time is limited to Orange Alert, even if a Red Alert is estimated.

2.2 Relevant past events

The most significant TCs have been selected for this section, considering at least one of these parameters:

- number of fatalities > 30
- economic loss and humanitarian > 1000 Million Euro
- economic support from UN OCHA
- EUCPM activation
- EU Solidarity Funds request

Tab.3 on Pag. 12 contains the following information for **12 TCs** identified.

TC Information

- TC time period: from the formation until its dissipation (sources: GDACS, NOAA)
- TC intensity: information provided for the peak intensity (sources: GDACS, NOAA)
    - Classification based on the maximum 1-min sustained winds (vmax) and the category of the Saffir-Simpson Hurricane Wind Scale (SSHWS), see Annex 3.
        - vmax ≤ 62 km/h (Tropical Depression-TD)
        - vmax 63-118 km/h (Tropical Storm-TS)
        - vmax ≥ 119 km/h (Hurricane, Category from 1 to 5)

Impact

- Humanitarian and economic impact: information on the direct losses are provided, in terms of number of direct fatalities (sources: NOAA) and direct economic losses (source: EM DAT[12])
    - **Direct fatalities**: fatalities occurring as a direct result of the forces of the TC, including people who drowned in storm surge, rough seas, rip currents and freshwater floods, as well as casualties resulting from lightning and wind-related events.
    - **Indirect fatalities**: fatalities occurring from other indirect factors like heart attacks, house fires, electrocutions from downed power lines, vehicle accidents on wet roads.

    The number of "indirect fatalities" could be considerably higher than the direct ones.

    In the case of Hurricane MARIA in 2017, the number of fatalities is highly uncertain: the official number in Puerto Rico is 65, but various studies[13] suggested that hundreds (possibly thousands) may have died during its aftermath, when lack of electricity, water and access to medical cares affected many people.

- Affected area: the most affected countries.

Early Warning System

- GDACS Alert level: Red/Orange/Green alert issued (max. alert sent to the users);

Response

- Humanitarian response: total amount of the requested funds (source: UN OCHA, https://fts.unocha.org) and amount of which provided from European Commission's Humanitarian Aid and Civil Protection Department.
- EUCPM Activation: mode of activation.
- European Union Solidarity Fund (EUSF): total EUSF aid (source: EC, https://ec.europa.eu/regional_policy/en/funding/solidarity-fund/).
- Copernicus EMS activations: activation code for Rapid Mapping and Risk & Recovery activations.

[12] Values converted to EUR from USD

[13] NOAA: https://www.nhc.noaa.gov/data/tcr/AL152017_Maria.pdf; Milken Institute of Public Health: https://prstudy.publichealth.gwu.edu/sites/prstudy.publichealth.gwu.edu/files/reports/Acertainment%20of%20the%20Estimated%20Excess%20Mortality%20from%20Hurricane%20Maria%20in%20Puerto%20Rico.pdf

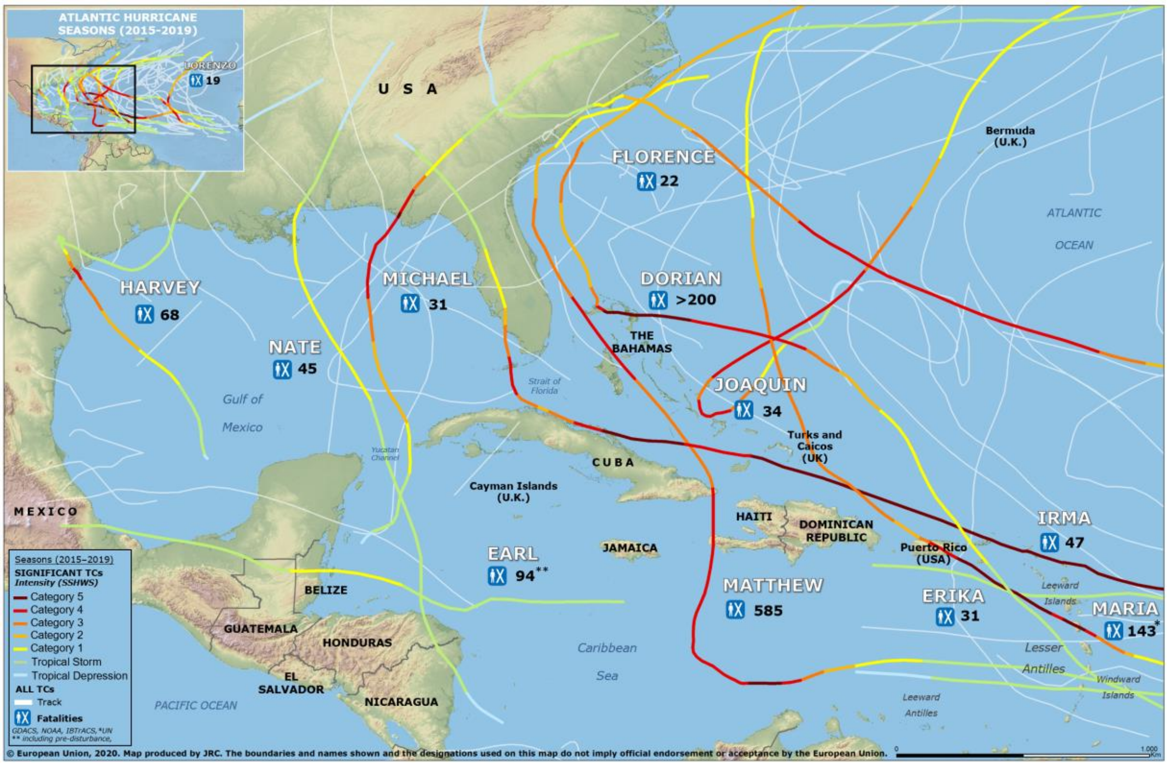

Fig. 6 - Relevant TCs in the Atlantic basin (2015 – 2019) and number of fatalities (see Tab. 3).

	TC INORMATION		IMPACT			EWS	RESPONSE				
	Name	Peak Intensity *SSHWS*	Direct Fatalities	Direct Econ. Loss (Million Euro)	Areas mostly affected (all affected area in the row below)	GDACS Max. Alert Level	Humanit. funds (OCHA) ≈Million euro	of which from ECHO (≈Million Euro)	EU Solidarity Funds (REGIO) (≈Million Euro)	EUCPM activation	Copernicus EMS activation
2019	**LORENZO** 22 Sep–2 Oct	Cat 5 *259 km/h*	19	-	Azores (Portugal), USA	Green	-	-	Activated, amount not yet defined	-	EMSR395
2019		All affected areas: Azores (Portugal), Ireland, USA									
2019	**DORIAN** 24 Aug–7Sep	Cat 5 *296 km/h*	> 200	7 544	The Bahamas, USA	Red	19.5	0.5	-	RfA: 1 Sep – 1 Oct	EMSR385
2019		All affected areas: Dominican Republic, Haiti, Lesser Antilles, Puerto Rico, The Bahamas, Turks and Caicos Islands									
2018	**MICHAEL** 7-11 Oct	Cat 5 *259 km/h*	31	14 720	Central America, USA	Orange	-	-	-	-	EMSR322
2018		All affected areas: Cuba, El Salvador, Honduras, Mexico, Nicaragua, USA									
2018	**FLORENCE** 31 Aug–17 Sep	Cat 4 *241 km/h*	22	12 880	USA	Red (*)	-	-	-	-	EMSR311
2018		All affected areas: Bermuda, Canada, Cape Verde, USA // (*) GDACS Alert revised to Green, after the new forecasts became available									
2017	**NATE** 4-8 Oct	Cat 1 *148 km/h*	45	400	Central America, USA	Green	-	-	-	-	-
2017		All affected areas: Cuba, El Salvador, Honduras, Mexico, Nicaragua, USA									
2017	**MARIA** 16–30 Sep	Cat 4 *278 km/h*	143*	64 108	Dominica, Puerto Rico	Red	25.4	4.2	48.9 (IRMA+MARIA)	RfA: 21 Sep - 06 Nov	EMSR246, EMSR245, EMSR243
2017		All affected areas: Dominican Republic, Lesser Antilles (especially Dominica), Puerto Rico, Turks and Caicos Islands, The Bahamas, USA									
2017	**IRMA** 30 Aug-12Sep	Cat 5 *287 km/h*	47	62 663	USA, Caribbean Islands	Red	40.3	4.6	48.9 (IRMA+MARIA)	Pre-alert: 5 Sep - 3 Oct Monitoring: 18 Sep -18 Oct RfA: 14 Sep – 23 Oct	EMSR241, EMSR236, EMSR234, EMSR233, EMSR232, EMSN049
2017		All affected areas: Cuba, Dominican Republic, Haiti, Lesser Antilles, Puerto Rico, The Bahamas, Turks and Caicos Islands, USA									
2017	**HARVEY** 17 Aug-1 Sep	Cat 4 *213 km/h*	68	87 400	USA	Red	-	-	-	-	EMSR229
2017		All affected areas: Barbados, Belize, Guyana, Lesser Antilles, Mexico, Nicaragua, Suriname, USA									
2016	**MATTHEW** 28 Sep–9 Oct	Cat 5 *269 km/h*	585	13 984	Haiti	Red	125.5	1.6***	-	Pre-alert: 3 Oct - 11 Nov RfA: 4 Oct – 2 Feb	EMSR186, EMSN051, EMSN050
2016		All affected areas: Canada, Colombia, Cuba, Dominican Republic, Haiti, Jamaica, Lesser Antilles, Puerto Rico, The Bahamas, Turks and Caicos Islands, USA, Venezuela									
2016	**EARL** 2-6 Aug	Cat 1 *139 km/h*	94**	-	Mexico, Belize	Orange	-	-	-	-	-
2016		All affected areas: Belize, Cayman Islands, Dominican Republic, Guatemala, Haiti, Honduras, Jamaica, Lesser Antilles, Mexico, Puerto Rico									
2015	**JOAQUIN** 28 Sep-7 Oct	Cat 4 *250 km/h*	34	1 647	The Bahamas	Green	-	-	-	-	-
2015		All affected areas: Azores (Portugal), Bermuda, Cuba, Haiti, The Bahamas, Turks and Caicos Islands, USA									
2015	**ERIKA** 24-28 Aug	TS *85 km/h*	31	444	Dominica	Orange	-	-	-	-	-
2015		All affected areas: Cuba, Dominica, Dominican Republic, Haiti, Puerto Rico, USA									

Tab. 3 – TC information, impact, Early Warning System and response of the relevant TCs in the Atlantic basin (2015 – 2019).

Data sources: TC information (GDACS, NOAA Best Track), Humanitarian impact (NOAA Final Reports, EM DAT, *UN OCHA (https://reliefweb.int/sites/reliefweb.int/files/resources/20191203-ocha-desastres_naturales.pdf), ** including pre-disturbance), Response (ECHO, UN OCHA, Copernicus EMS, see previous JRC report), *** further economic support has been provided, see: https://ec.europa.eu/echo/news/eu-adds-35-million-post-hurricane-matthew-aid-haiti_en.

3 Current Situation

As mentioned in Section 1, the Atlantic Hurricane season typically runs from 1st June to 30th November. The list of the “names” of the 2020 season is shown in Tab. 4. So far, two Tropical Storms have already formed in May 2020, before the start of the season, and a third one formed at the beginning of June.

2020 Atlantic Hurricane Season		
Arthur (May 2020)	Hanna	Omar
Bertha (May 2020)	Isaias	Paulette
Cristobal (1 June – ongoing)	Josephine	Rene
Dolly	Kyle	Sally
Edouard	Laura	Teddy
Fay	Marco	Vicky
Gonzalo	Nana	Wilfred

Tab. 4 - List of the names for the 2020 Atlantic Hurricane Season
(source: NOAA-NHC[14], as of 4 June 2020)

<u>May 2020 (before the official start of the season)</u>

- ❑ Tropical Storm ARTHUR (16-19 May 2020) formed over the Atlantic Ocean, between Florida (USA) and the Bahamas and moved north-east over the sea along the USA coast, close to North Carolina, then it turned east and south-east, dissipating on 19 May.

  https://www.gdacs.org/report.aspx?eventid=1000668&episodeid=10&eventtype=TC

- ❑ Tropical Storm BERTHA (27 May 2020) formed over the Atlantic Ocean on 27 May, close to the coast of South Carolina, and it made landfall the same day near Charleston, then it crossed South Carolina and North Carolina, dissipating.

  https://www.gdacs.org/report.aspx?eventid=1000670&episodeid=3&eventtype=TC

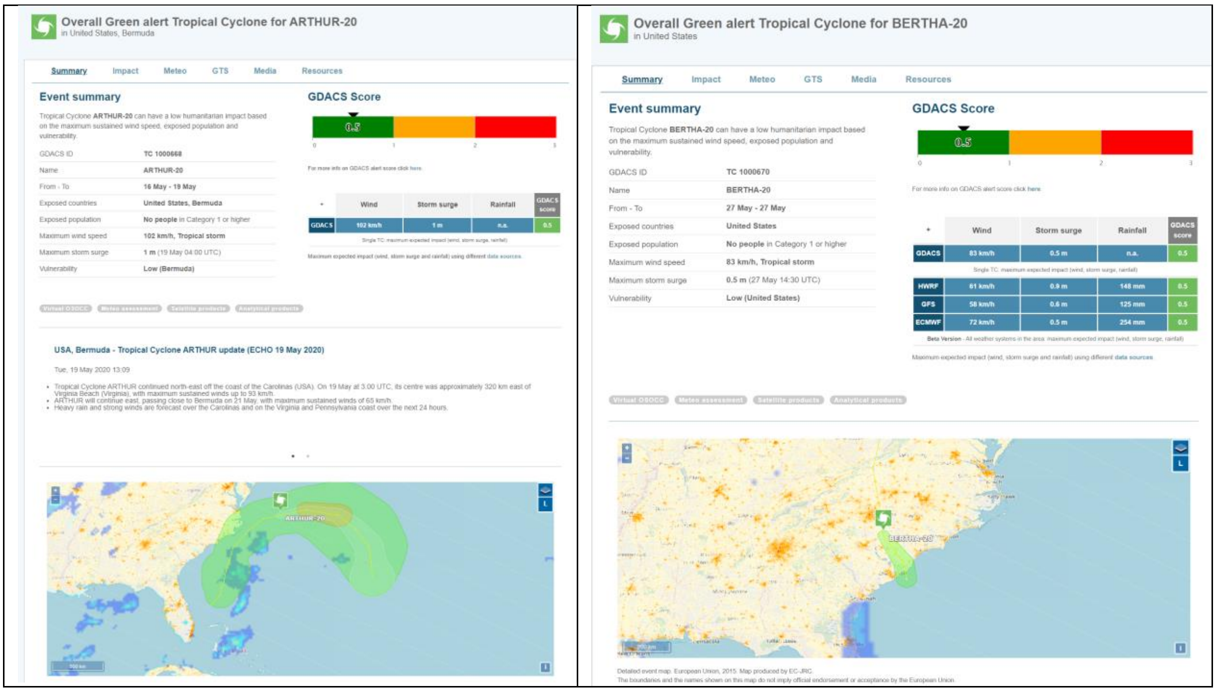

Fig. 7 - Tropical Storm ARTHUR (LEFT, **Fig. 7a**) and BERTHA (RIGHT, **Fig. 7b**) in May 2020 over the Atlantic Ocean (GDACS).

[14] https://www.nhc.noaa.gov/aboutnames.shtml

<u>On-going events:</u> 1 active TC over the Gulf of Mexico *(as of 4 June, see NOAA-NHC, GDACS)*

Tropical Storm CRISTOBAL (1 June - on-going) formed over the Gulf of Mexico, close to the Mexican coast, on 1 June. It made landfall along the coasts of the State of Campeche (Mexico) on 3 June, then it started turning north, toward the Gulf of Mexico and USA. **CRISTOBAL** is currently affecting Mexico, Guatemala, Honduras and El Salvador with additional rainfall. These areas have been recently severely affected by Tropical Storm **AMANDA** (NE Pacific basin), with at least 27 fatalities and nearly 150 000 people affected. Some humanitarian assistance has been delivered although, it is not sufficient to fully meet the huge needs resulting from the storm and amid challenges posed by the COVID-19 pandemic (see ECHO Flash 4 June[15]). More information can be found at:

- GDACS: https://www.gdacs.org/report.aspx?eventid=1000672&eventtype=TC
- NOAA-NHC: https://www.nhc.noaa.gov/graphics_at3.shtml?start#contents

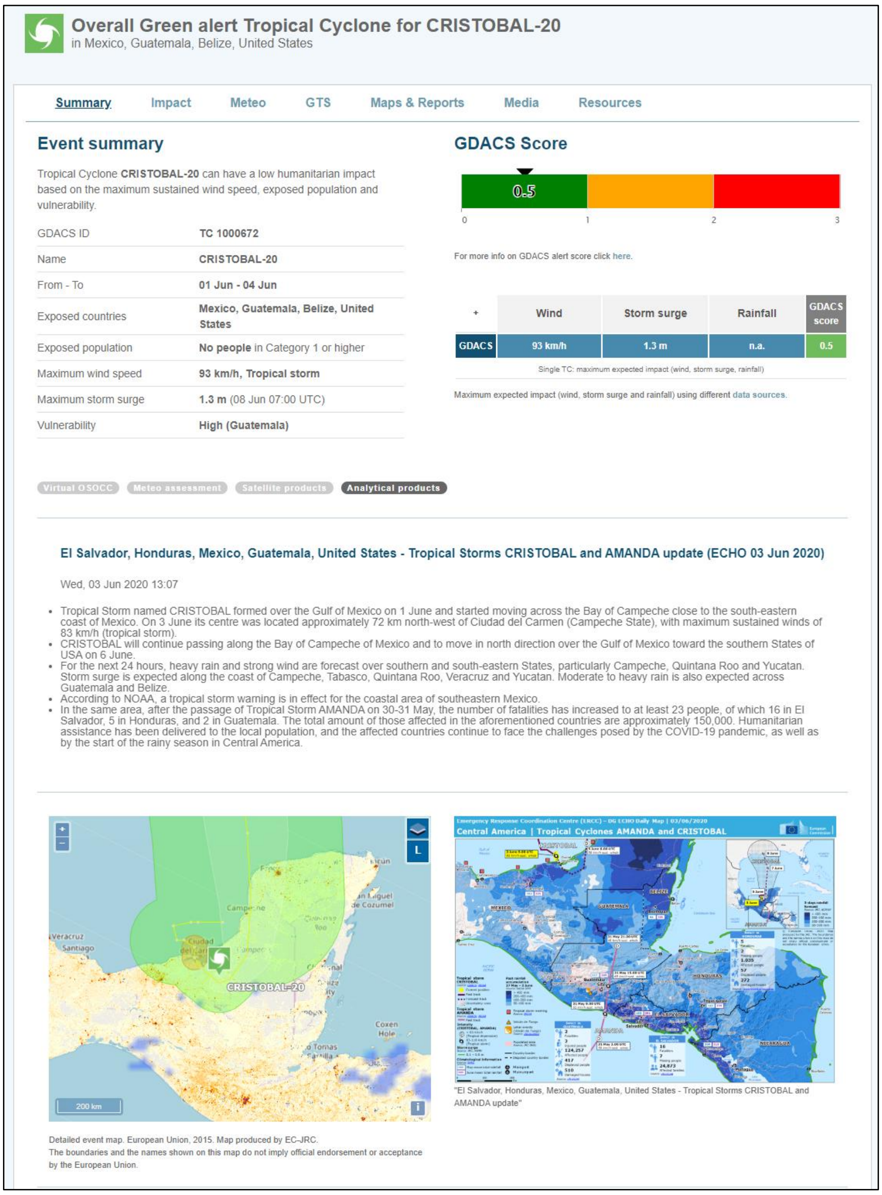

Fig. 8 - Tropical Storm CRISTOBAL in June 2020 (source: GDACS).

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[15] https://erccportal.jrc.ec.europa.eu/ECHO-Flash

4 Seasonal Forecasts

Seasonal forecasts of TCs activity have been developed since 1980 for different regions, using different methodologies, and every year these forecasts are published by several national meteorological centres and scientific agencies, showing for example how many TCs (distinguished by intensity) could form during a season and/or how many of them could affect a particular area (see WMO[16]).

For the Atlantic basin, the "official" forecast is the **NOAA Atlantic Hurricane Season Outlook[17]**. Typically, NOAA publishes it by the end of May (around 20-25 May), with an updated version early in August (see NOAA archive[18]). For the specific forecasts issued by the national weather services, please refer to the relevant links included in the References.

As shown in Section 2, the Atlantic Hurricane season typically has on average 12 named storms (Tropical Storm or higher strength, see Annex 3), with 6 Hurricanes (H) and 3 Major Hurricanes (MH), but the **past four seasons** had an **above-normal activity** and consequently highest numbers. Only between 1998 and 2001, fourth consecutive seasons above-normal occurred in the Atlantic basin (see NOAA[19]).

According to the official **NOAA's 2020 Atlantic Hurricane Season Outlooks** (May 2020), as well as most of the other seasonal forecasts published by other agencies (see Tab. 5), the TC activity for this season is forecasted to be **above-average**.

In particular the **NOAA's outlook** for the 2020 Atlantic Hurricane Season indicates that an **above-normal** season is most likely with:

- *60% chance of an **above-normal** season ("with the possibility of being extremely active")***,**
- *30% chance of a near-normal season,*
- *10% chance of a below-normal season.*

Above-normal activity during the 2020 Atlantic Hurricane season is most likely

It should be noted that the seasonal forecasts and the average number of events per season, include all TCs that form over the water and (i) **either remain offshore** or (ii) make **landfall** or (iii) **move close to the coasts.**

As of 4 June, Tropical Storms Arthur, Bertha and Cristobal have already formed in the Atlantic basin.

Centres	Issued	Number of events [21,22,23]	Activity		Average, Climate Mean[20]
NOAA[21]	21 May 2020	13-19 (NS), 6-10 (H), 3-6 (MH)	Above-normal	↑	12 (NS), 6 (H), 3 (MH)
UK Met Office[22]	20 May 2020	9-17 (NS), 5-9 (H), 2-4(MH) *Most likely: 13 (NS), 7 (H), 3 (MH)*	Above-normal	↑	
CSU[23]	4 Jun 2020	19 (NS), 9 (H), 4 (MH)	Above-normal	↑	

Tab. 5 - 2020 seasonal forecasts (extended-range) based on the main weather centres
where: TS=Tropical Storm, H=Hurricanes, MH=Major Hurricanes, "NS" "named storm" (TS or higher strength), Annex 3
Sources nr. of events: NOAA[21], UK MetOffice[22], CSU[23]

[16] https://public.wmo.int/en/bulletin/seasonal-tropical-cyclone-forecasts
[17] The 2020 Atlantic hurricane season outlook is an official product of the NOAA Climate Prediction Center (CPC). The outlook is produced in collaboration with hurricane experts from the NHC and the Hurricane Research Division (HRD).
[18] https://www.cpc.ncep.noaa.gov/products/outlooks/hurricane-archive.shtml
[19] https://www.noaa.gov/media-release/active-2019-atlantic-hurricane-season-comes-to-end
[20] Period used for the climate means: 1981-2010.
[21] NOAA 2020 Atlantic Hurricane Season Outlook, NOAA-CPC[17]: https://www.cpc.ncep.noaa.gov/products/outlooks/hurricane2020/May/hurricane.shtml
[22] North Atlantic tropical storm seasonal forecast 2020, UK Met Office: https://www.metoffice.gov.uk/research/weather/tropical-cyclones/seasonal/northatlantic2020
[23] ATLANTIC SEASONAL HURRICANE ACTIVITY, Forecast for 2020 Hurricane Activity (as of June 4, 2020), Colorado State University (CSU): https://tropical.colostate.edu/forecasting.html

Notes:

- ➢ Tropical depressions and low pressure systems in general, including the remnants of a TC in general could produce large amounts of rainfall and consequent flood and landslide events, damage and fatalities, and could have a high humanitarian impact.
- ➢ A large number of smaller events could cause strong rainy conditions for a prolonged period and thus increase the vulnerability of the affected country.
- ➢ The TC movement velocity is also a key aspect because if a TC is very slow it could affect a country for a long period causing consequent floods, like Hurricane DORIAN in the Bahamas last year.

As reported by NOAA, the combination of several climate factors could contribute to an **above-normal activity** in the Atlantic this year (text extracted from NOAA[24] website):

> *El Nino Southern Oscillation (ENSO) conditions are expected to either remain neutral or to trend toward La Nina, meaning there will not be an El Nino present to suppress hurricane activity. Also, warmer-than-average sea surface temperatures in the tropical Atlantic Ocean and Caribbean Sea, coupled with reduced vertical wind shear, weaker tropical Atlantic trade winds and an enhanced west African monsoon all increase the likelihood for an above-normal Atlantic hurricane season.*

> → More on information on the conditions required for the TC formation can be found at: https://oceanservice.noaa.gov/facts/how-hurricanes-form.html

There is still some **uncertainty** on these forecasts, also depending from the forecast of the **ENSO conditions**, which currently has a large uncertainty (see in Annex 5). Therefore, those estimations should be considered only indicative. NOAA will update its seasonal forecast in August before the typical peak of the season.

The Seasonal Forecasts are very important in view of the key preparedness actions to reduce the impact of these phenomena. However, it should be noted that damaging TCs can occur whether the season is active or relatively quiet and it only takes one event to cause a disaster. It is therefore essential that the local and international humanitarian organizations are well prepared for the hurricane season before it starts and during the on-going season. This is even truer, this year, with the **COVID-19 pandemic emergency ongoing, which will** have an impact on the **preparedness and response activities** of the Hurricane season (see **Section 5**).

The COVID-19 situation has also already "**influenced the forecasts"**, due to a reduction on the quantity and quality of **weather observations**, forecasts, atmospheric and climate monitoring, linked for example to a reduction of the measurements taken from aircraft and surface-based weather observations. More information can be found on the WMO website[25].

[24] https://www.noaa.gov/media-release/busy-atlantic-hurricane-season-predicted-for-2020

[25] https://public.wmo.int/en/media/press-release/covid-19-impacts-observing-system

5 TCs & COVID-19

The **COVID-19 pandemic emergency** has already reached Northern and Central America, as well as the vulnerable islands of the Caribbean and it could further increase in several areas, based on the current data. However, the evolution of the spread of the virus strongly depends on the containment measures introduced in the various countries (see Section 5.2).

This "multi-risk situation" (TCs & COVID-19) could increase the vulnerability of the people at risk, including refugees and migrants, as well as the ones living in the areas strongly affected by the previous hurricane seasons (e.g. the Bahamas due to the passage of DORIAN in 2019), complicating the disaster management. This situation has already occurred in other TC basins over the past few months, during the passage of other significant TCs, like TC HAROLD in Vanuatu, Fiji and Tonga, Typhoon VONGFONG (AMBO) in the Philippines and Cyclone AMPHAN in India and Bangladesh (see Annex 6).

This COVID-19 emergency can therefore have an effect on the TC **preparedness and response activities** and the presence of the TCs in these areas could complicate the management of the emergency and could cause insurgence of new cases as a consequence of the difficulty to respect the *social distancing* inside the shelters. Hence, it is crucial to consider the COVID-19 emergency in the evacuation plans: governments have in fact already included it or are in the process of doing so, through adaptation or preparation of the new plans.

> It is essential to **avoid the overlapping of the peak of COVID-19 with the one of the Hurricane season** which is typically **between Aug and Oct** (see the areas "most likely affected"[26] by month in **Fig. 9**) by increasing the containment measure as much as possible to reduce the number of cases before the arrival of this period.

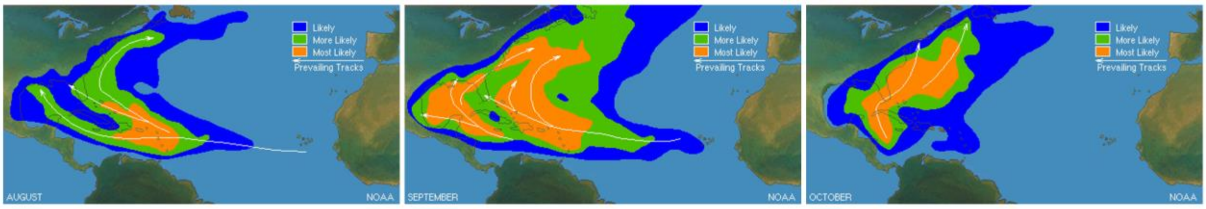

Fig. 9 - Climatological Areas of Origin and Typical Hurricane tracks by month AUG, SEP, OCT (source: NOAA[26])

A short overview on the new web pages that JRC is preparing on COVID-19, which will be implemented in GDACS, is in Section 5.1 and in Annex 6, while the current COVID-19 situation in the Atlantic Basin - in terms of numbers (positive cases and fatalities) and containment measures - is presented in Section 5.2, as well as the potential effects which could have on the "normal" preparedness and response activities of the Hurricane Season in Section 5.3

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[26] Source of Fig. 9: https://www.nhc.noaa.gov/climo/. Extracted from NOAA website: "*The figures show the zones of origin and tracks for different months during the hurricane season. These figures only depict average conditions. Hurricanes can originate in different locations and travel much different paths from the average. Nonetheless, having a sense of the general pattern can give you a better picture of the average hurricane season for your area*".

5.1 GDACS & COVID-19

The current COVID-19 pandemic emergency is extremely composite and complex, with over **6 million confirmed positive cases** around the world and nearly **380 000 deaths** (as of 3 June). Since the very beginning of this emergency, JRC has monitored and modelled the expected development of the ongoing COVID-19 pandemic situation mostly focusing on Europe, developing new tools and reports, also thanks to the collaborations with the international scientific community. Specifically, JRC has developed the following:

EC-JRC COVID-19 Dashboard: https://covid-statistics.jrc.ec.europa.eu.

The dashboard includes:

- **Epidemiological data:** number of positive cases, fatalities, increments and trends, etc. It is updated on a daily basis. The level of detail is "sub- national", and a webgis interface allows to explore this information, combining various data functionalities.
- **Governmental containment measures** adopted by 35 Countries (34 Participating countries to the EU Civil Protection Mechanism + Switzerland) to contain the spread of the virus. The database is fed through data on a daily basis coming from authoritative sources and secondary data review. A team of experts is populating the database by focusing on key areas, such as social distancing, International and national mobility, etc.

While this database is focused mainly on Europe, it also includes epidemiologic data at global level (e.g. positives cases and fatalities).

The information collected in the Dashboard serves as a basis for the so called EC-JRC FactSheet which provides a short overview on the on-going COVID-19 situation on the affected country, in order to identify the major features of the virus spreading in each country of EU27.

In addition, JRC has also created an INFORM[27] Covid-19 Risk Index[28] to support the specific decision-making needs of humanitarian and other organisations.

The INFORM Covid-19 Risk Index is primarily concerned with structural risk factors, i.e. those that existed before the outbreak. It does not consider the current evolution of the pandemic, nor the mechanisms behind potential indirect impacts - for example how it could lead to increased food insecurity and conflict, worse health outcomes for other diseases, or less effective responses to new crises and disasters.

This tool was particularly useful in the very first phase of the crisis, where covid-19 outbreak didn't evolve yet into a global pandemic, and the epidemic evolution in most of the countries was mostly unknown. The rapid evolution of the global pandemic changed the scenario, and the containment measures that the governments put in place to reduce the impact of the Covid-19 changed the pre-existing risk drivers used in the model (i.e. the lockdown dramatically reduced the movement of people and the probability of contacts and thus the risk of spreading).

Therefore, JRC is developing a tool that can help monitor in a more dynamic way how crisis risk is changing as a result of the Covid-19 pandemic. The INFORM Covid-19 WARNING will identify and monitor risks where Covid-19 could cause or exacerbate humanitarian crises. The purpose is to provide a more dynamic and up-to-date picture of how the pandemic is evolving and how it interacts with other hazards, vulnerabilities and coping capacities to affect crisis risk.

[27] INFORM is a multi-stakeholder forum for developing shared, quantitative analysis relevant to humanitarian crises and disasters. INFORM includes organisations from across the multilateral system, including the humanitarian and development sector, donors, and technical partners. The Joint Research Centre of European Commission is the scientific and technical lead for INFORM (https://drmkc.jrc.ec.europa.eu/inform-index/).

[28] Poljansek, K., Vernaccini, L. and Marin Ferrer, M., INFORM Covid-19 Risk Index, EUR 30240 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-19203-9, doi:10.2760/596184, JRC120799

Thanks to the above activities and given the importance of the current COVID-19 situation during emergencies, as well as in the preparedness plans (see Section 5.3), JRC is preparing a **new Section** in **GDACS on COVID-19** situation for each GDACS event. The new section is under development and could include the parameters shown in Tab. 6 and a series of relevant plots.

GDACS & COVID-19	
Information	**Sources**
Epidemiological situation (number of cases, fatalities, statistics, timeline, etc)	EC-JRC COVID-19 Dashboard[29]
Governmental containment measures (social distancing, International and national mobility, etc)	Europe: EC-JRC COVID-19 Dashboard[29] Global: ACAPS COVID19 Government Measures Dataset[30]
INFORM COVID-19 Risk Index (risk for humanitarian crisis)	INFORM[31]
Documentations Documents & links on preparedness and response plans on COVID-19 emergency (see Section 5.3)	National governments, International organizations, Regional Specialized Meteorological Centres (RSMCs), Tropical Cyclone Warning Centres (TCWCs), National Meteorological and Hydrological Services (NMHSs), etc.

Tab. 6 – New GDACS tab for the COVID-19 Situation (still UNDER DEVELOPMENT).

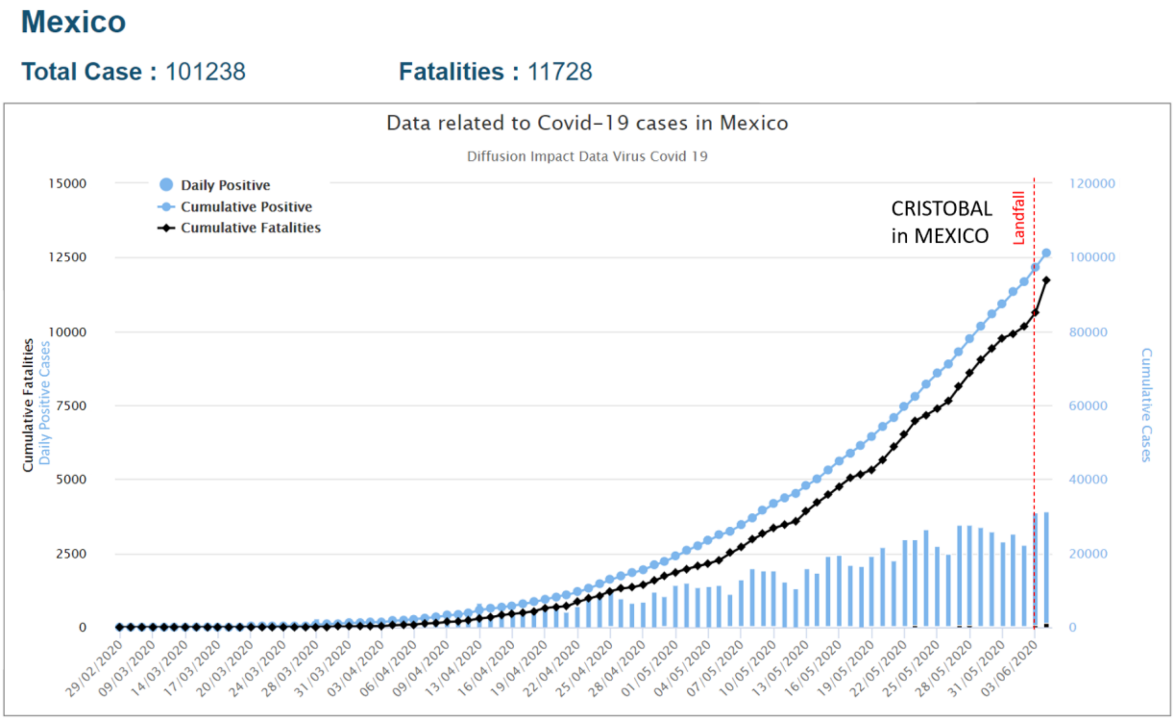

Fig. 10 - New GDACS webpage for the COVID-19 situation in Mexico for Tropical Storm CRISTOBAL (as of 4 June). (Source: GDACS web pages UNDER DEVELOPMENT)

[29] https://covid-statistics.jrc.ec.europa.eu/
[30] https://www.acaps.org/covid19-government-measures-dataset
[31] https://drmkc.jrc.ec.europa.eu/inform-index/

5.2 COVID-19 current situation

5.2.1 Cases and fatalities

The current situation (as of 2 June) in the areas potentially affected by the Atlantic Hurricane season, in terms of cumulative number of positive cases is reported in the Figures 15-19, using the database recently developed by EC-JRC COVID-19 Dashboard[32], as well as ECDC[33] and WHO COVID-19 Dashboard[34]. More information on the COVID-19 situation can be found also at Pan American Health Organization (PAHO)/WHO[35], CDEMA[36], CARICOM[37] and CARPHA[38].

The COVID-19 timeline of cumulative positive cases in the Atlantic Hurricane Basin is shown in Fig. 11. The countries reporting the highest impact, in terms of **cumulative number** are (as of 2 June 2020, see Annex 1):

- **USA**, which is the country mostly affected worldwide, with **1.8 million** of positive **cases** and over **100000 fatalities**, followed by **Mexico** (93435 cases, 10167 fatalities) and **Canada**[39] (91624 cases, 7326 fatalities).
- In the Caribbean area, **Dominican Republic** (17572 cases, 502 fatalities) is the most affected country, followed by **Puerto Rico** (3873 cases, 136 fatalities), **Haiti** (2226 cases, 45 fatalities) and **Cuba** (2083 cases, 83 fatalities)**.**
- In Central America, **Panama** (13837 cases, 344 fatalities) is especially affected, followed by **Honduras** (5362 cases, 217 fatalities), **Guatemala** (5336 cases, 116 fatalities) and **El Salvador** (2582 cases, 46 fatalities). → Central America is also affected by TCs that form over the NE Pacific basin.
- **Colombia** has also a high number of cases (30493 cases, 969 fatalities), but the northern coastal areas are rarely affected by TCs.

As shown in Section 1 as well as in the Jan 2020 UN OCHA report[40], the countries most affected by TCs in the region over the period 2000-2019 have been **Cuba**, **Mexico** and **Haiti**, with most of the fatalities registered in Haiti. In addition, among the countries listed above, USA, Mexico, Dominican Republic, Cuba and Haiti are the ones with the highest INFORM index of Physical exposure to TCs (see Fig. 12).

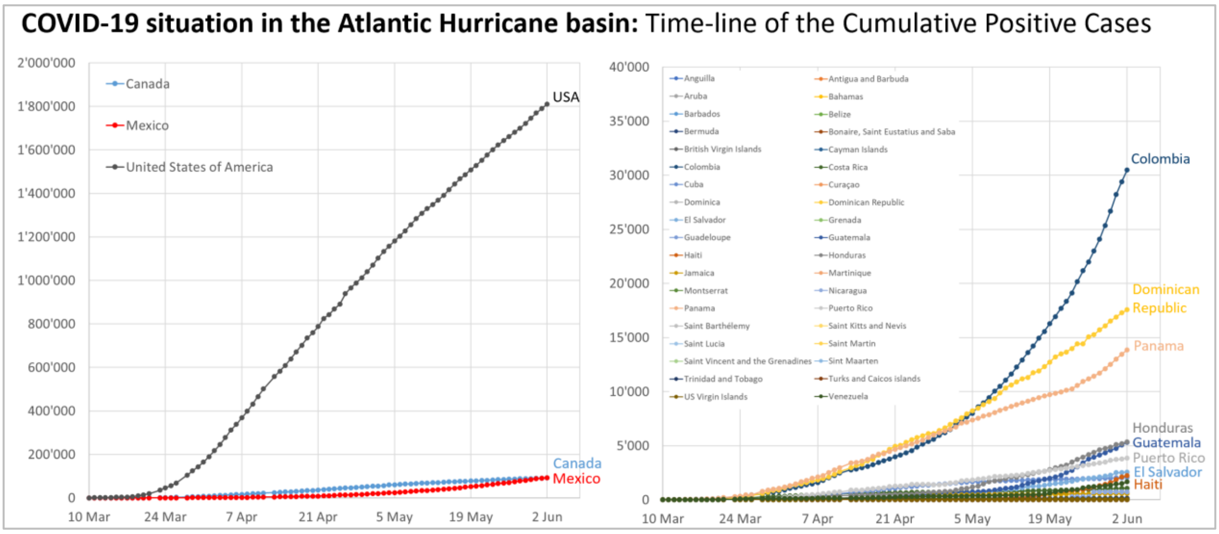

Fig. 11 - COVID-19 timeline of cumulative positive cases in the Atlantic Hurricane Basin (as of 2 June 2020, EC-JRC COVID-19 Dashboard, ECDC, WHO). LEFT (Fig. 11a): The countries with the highest numbers: USA, Canada and Mexico. RIGHT (Fig. 11b): Central and Southern America (ONLY the countries affected by TCs, see Tab. 1).

[32] https://covid-statistics.jrc.ec.europa.eu/
[33] https://www.ecdc.europa.eu/en/geographical-distribution-2019-ncov-cases
[34] https://covid19.who.int/
[35] https://ais.paho.org/phip/viz/COVID19Table.asp
[36] https://www.cdema.org
[37] https://caricom.org/
[38] https://carpha.org/What-We-Do/Public-Health/Novel-Coronavirus
[39] Affected mostly only by TC remnants/EX-TCs (see Annex 3)
[40] https://www.humanitarianresponse.info/en/operations/latin-america-and-caribbean/document/latin-america-and-caribbean-natural-disasaters-2000

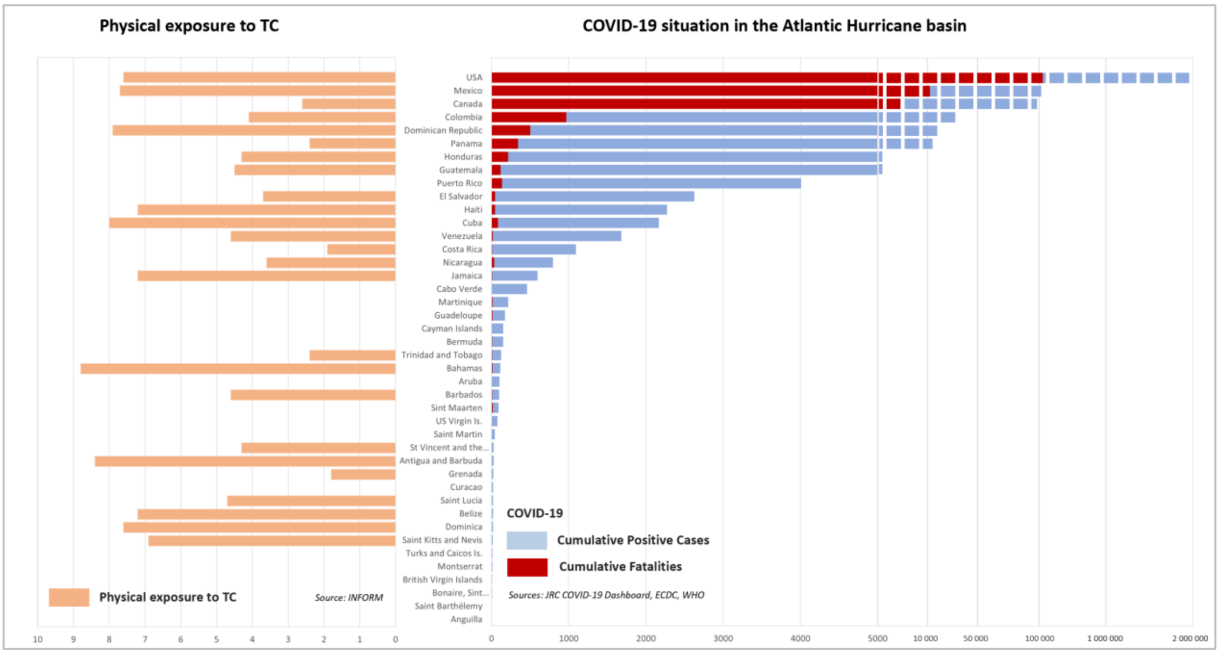

Fig. 12 - LEFT: Physical exposure to TC (data source: INFORM). RIGHT: Current COVID-19 situation (as of 2 June) in the Atlantic Hurricane basin[41] (data sources: JRC COVID-19 Dashboard, ECDC and WHO).

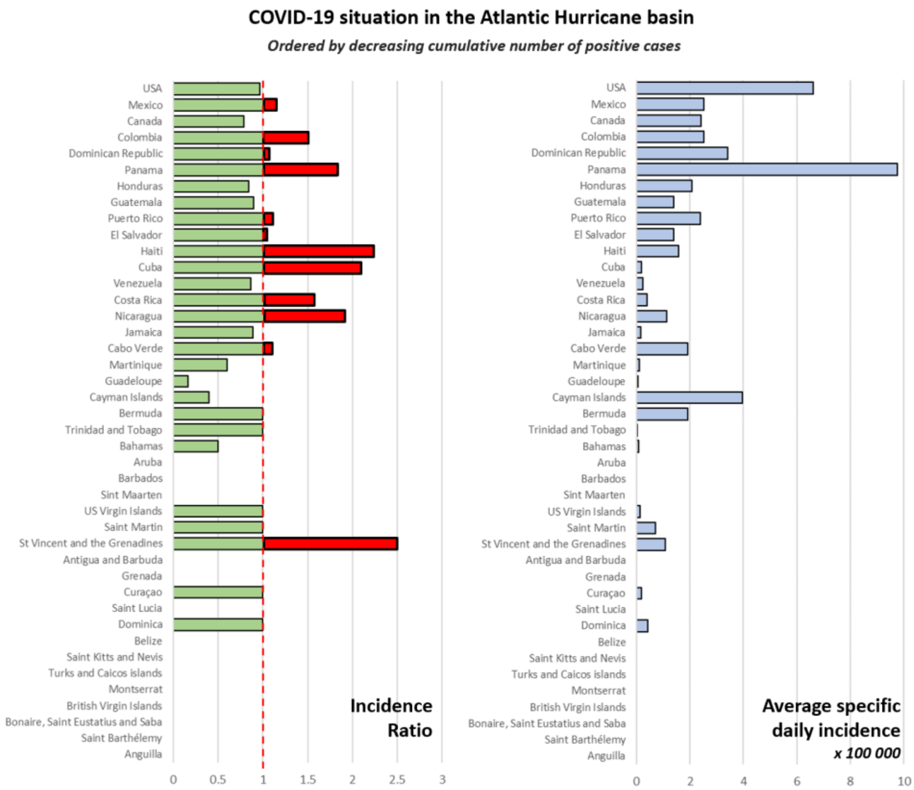

Fig. 13 – LEFT (Fig. 13a) Incidence Ratio, RIGHT (Fig. 13b) Average specific daily incidence per 10000 (as of 2 June, JRC). Countries ordered by decreasing number of cumulative positive cases.

[41] The COVID-19 situation in Colombia and Venezuela has been also included in the Fig. 16-19, because the northern coastal areas (including small islands of Caribbean Sea) of South America could be also rarely affected by TCs, while Canada has been included, due to the possible passage of TCs remnants/Ex-TCs. Note: Central America is also affected by TCs forming over the NE Pacific Ocean.

The Incidence Ratio (as of 2 June 2020) for the areas potentially affected is presented in Fig. 13a, where:

$$\begin{matrix} Incidence \\ Ratio \end{matrix} = \frac{sum\ of\ daily\ positive\ cases\ last\ week}{sum\ of\ daily\ positive\ cases\ previous\ week}$$

This is not the reproduction number Rt, but it expresses the current tendency of the contagion, to **increase** (**above 1**) or **decrease** (**below 1**). The advantage of using this parameter respect to Rt is that it is less dependent on the quality of the data, it does not consider the drop in cases confirmed over weekends and should be more accepted, as based on a simple calculation. According to these values, several countries in the Caribbean area are still in the growth phase (Incidence ratio > 1), including Haiti, Cuba and Mexico, which are typically heavily affected by TCs (see Pag. 20 and Annex 4).

JRC has also calculated the Average 7d Daily Incidence and the Average specific daily incidence (see Fig. 13b) as reported in the equations below:

$$Average\ 7d\ Daily\ Incidence = \frac{sum\ of\ daily\ positive\ cases\ last\ week}{7\ days}$$

$$\begin{matrix} Average\ specific \\ daily\ incidence \end{matrix} x\ 10^5 = \frac{sum\ of\ daily\ positive\ cases\ last\ week\ x\ 10^5}{7\ days * population} = \frac{Daily\ Incidence}{population}\ x\ 10^5$$

Note: the population of each countries has been calculated using the JRC Global Human Settlement Layer (GHSL), see https://ghsl.jrc.ec.europa.eu/

The results (based on the data of 2 June 2020) show that the countries having the highest average specific daily incidence are Panama and USA, followed by Cayman Islands and Dominican Republic.

Fig. 14 - Atlantic Hurricane Seasons 2011-2019 & COVID-19 Situation (as of 2 June 2020). Average Specific Daily Incidence.

All the COVID-19 maps on the results of these analyses **by countries** are shown in **Annex 1** in Fig. 17-Fig. 18.

5.2.2 National containment measures

For all countries the main goal to respond to the COVID-19 emergency is to control the pandemic by slowing down the transmission and reducing mortality associated with the virus. This is achieved by introducing various national containment measures, depending on the phases of the virus spread.
The main aim of these measures is to reach or maintain a steady state of low level or no transmission, eventually also adopting a so-called status of "lock-down"[42].
More information on the recommended approaches to manage this emergency can be found in WHO[43] and CDC[44] dedicated websites, while the current measures and actions at the national level can be found in the interactive maps of UN-ECLAC[45] and in the ACAPS COVID19 Government Measures Dataset[46].

5.3 Potential effects of COVID-19 on the TC preparedness and response activities

Planning for the 2020 hurricane season has already started and the various governments have revised their "typical plans", developing new ones with various activities to address all the containment measures adopted for the COVID-19 emergency (see WMO[47], FEMA, ready.gov[48], NOAA[49], CDC[50], UNDRR[51]), with the main priority to respect **social distancing as much as possible, ensure hygienic measures and especially protect the most vulnerable groups.**

More information can be found on the WMO website at: "Caribbean workshop on impact-based forecasting and risk scenario planning"[52].

The preparedness and response, as well as the on-going containment measures, might be different in the various affected areas, depending on the local development phase of the COVID-19 epidemic. Please refer to the latest information provided by the various governments and agencies listed in the References.

Three phases of the various measures can be distinguished (see source *ready.gov*[53]):

- ❑ **BEFORE TC ("Prepare for Hurricanes"):** *know "your" Hurricane risk for the area where you are living, make an Emergency Plan, gather supplies, for those with disability identify the need of additional help during the emergency, know the Evacuation Zone, recognise Warnings and Alerts, strengthen "your" home, prepare "your" business, help the neighbourhood, get Tech ready, etc.*

For COVID-19, special recommendations are directed to put attention on the preparation of personal safety items to protect from the virus, like **hygiene** and **cleaning items** and cloth face covering.

- ❑ **DURING TC ("Stay safe during a Hurricane"):**
  - *Stay informed: listen emergency information and alerts, doing immediately what it is requested by the authority.*
  - *Dealing with the weather: take the appropriate measures to protect you from winds and floods, and take refuge in the designed shelters or rooms protected from the severe weather. Take particular attention to the flood waters (do not walk, drive, cross bridges, etc.)*
  - *Personal Safety: follow the latest guidelines introduced for the **COVID-19** emergency in the affected country (social distancing avoiding crowds or gathering in groups); take cleaning items; use cloth face covering at the facilities.*

[42] To date, there is no unique, internationally agreed definition for this term. International organizations are adopting similar but yet different definitions for the word "lockdown", some of them even distinguishing between full and partial lockdown. In general, this term is used to describe a condition in which internal movements and ordinary activities/services of the society are heavily reduced by the national authorities in the attempt to diminish the virus spread. It is also used the term "Stay at home order".
[43] https://www.who.int/emergencies/diseases/novel-coronavirus-2019
[44] https://www.cdc.gov/coronavirus/2019-ncov/index.html
[45] https://eclac.maps.arcgis.com/apps/MapSeries/index.html?appid=57c96de0159641b095bd1c213c320ab9
[46] https://www.acaps.org/covid19-government-measures-dataset
[47] https://public.wmo.int/en/media/news/wmo%E2%80%99s-hurricane-committee-defers-consideration-of-storm-name-retirement
[48] https://www.ready.gov/hurricanes
[49] https://www.weather.gov/wrn/hurricane-preparedness
[50] https://www.cdc.gov/disasters/hurricanes/covid-19/prepare-for-hurricane.html
[51] https://www.undrr.org/news/covid-19-risks-complicating-caribbean-hurricane-season
[52] https://public.wmo.int/en/media/news/caribbean-workshop-impact-based-forecasting-and-risk-scenario-planning
[53] See https://www.ready.gov/hurricanes and https://www.weather.gov/wrn/hurricane-preparedness

For COVID-19, attention should be paid to follow the rules introduced for the **COVID-19** emergency in the **shelters**[54] and **protect the most vulnerable population**, including migrants and refugees, as well as people that might be heavily affected by the previous hurricane season like the Bahamas after the passage of DORIAN in 2019. If the TC occurs during the peak of the COVID-19 epidemic, there could be a **lack of medical equipment and other resources**, a reduction of **health systems capacities** (e.g. hospitals, ICUs, medical personnel) due to the response activities for the virus, as well as the **logistics operations** might be more complex than usual.

NOTE: It could be difficult to respect the adoption of the national containment measures during the passage of a hurricane (e.g. maintaining "social distancing" during the evacuation). It is therefore essential to consider it in the evacuation plans so that people are prepared well in advance and follow new guidelines. For this reason, the various governments are updating their TCs preparedness and response plans.

- ❑ **AFTER TC ("Returning Home after a Hurricane"):** *follow the rules of the previous hurricane season (e.g. listen to the local information and instructions, avoid wading in flood waters, etc.), follow guidelines for COVID-19 and be careful during* ***clean-up operations****.*

For COVID-19, search and rescue operations and international assistance provision might be over complicated by the adoption of containment measures (e.g. compulsory quarantine for all internationals entering the country).

For further details on the arrangements to provide humanitarian assistance despite the ongoing COVID-19 emergency, please refer to UN OCHA dedicated website[55] and its Global Humanitarian Response Plan[56] (May update), and at WHO[57], while the EU initiatives[58] to support tackling the coronavirus pandemic around the world is summarized in the April update of the related fact sheet.

[54] It's important to check the updated evacuation shelters (regular shelters may not be open this year due to COVID-19).
[55] https://www.unocha.org/covid19
[56] https://www.unocha.org/sites/unocha/files/GHRP-COVID19_May_Update.pdf
[57] World Health Organization (2020) - COVID-19 Strategic Preparedness and Response Plan - OPERATIONAL PLANNING GUIDELINES TO SUPPORT COUNTRY PREPAREDNESS AND RESPONSE.
[58] https://ec.europa.eu/commission/presscorner/detail/en/fs_20_607

6 Conclusions

The Tropical Cyclones (TCs) season in the Atlantic basin (North Atlantic Ocean, Caribbean Sea and Gulf of Mexico) officially starts on **1 Jun** and ends on **30 Nov**. On average, 12 named storms (Tropical Storm or higher strength) occur each season (6 Hurricanes and 3 Major Hurricanes), with the highest number of TCs between Aug and Oct (peak: around 10 Sep). As of 4 June 2020, Tropical Storms ARTHUR and BERTHA have already formed in May, before the official start of the season, and CRISTOBAL has formed at the beginning of June.

The TCs that form in this basin could affect several vulnerable Caribbean islands, causing damage and deaths that could require international assistance, as shown in the analysis of the past five Atlantic Hurricane seasons (2015-2019) included in this report.

Specifically, 12 TCs have been selected and analysed in detail for this period, considering the impact on the affected areas (in terms of fatalities, direct economic losses) and the international humanitarian support (OCHA funding, EUCPM activation, EU Solidarity Funds). For the most significant events the Global Disasters Alerts and Coordination System (GDACS) timely issued a RED alert and international assistance has been required.

Over the period analysed, the season 2017 was particularly active and intense, with 6 Major Hurricanes, 3 of them (HARVEY, IRMA and MARIA) caused large damage and fatalities in the Caribbean and USA. Notably, there were Hurricane MATTHEW in 2016, which caused nearly 600 fatalities (mostly in Haiti) and Hurricane DORIAN in 2019, the most intense Hurricane ever recorded in the Bahamas, which left a trail of destruction.

The last fourth consecutive seasons have been above-normal and, according to the official **NOAA's 2020 Atlantic Hurricane Season Outlooks**, as well as most of the other seasonal forecasts, the TC activity for this season is forecasted to be again **above-normal**. However, given the uncertainty associated with the long term forecasts those estimations should be considered only indicative.

The preparedness actions play a key role in reducing the impact of these phenomena. It is therefore essential that the local and international humanitarian organizations are well prepared for the hurricane season in advance and during the on-going season. Following the forecast and advisories is essential because a TC could quickly form and intensify.

The **Early Warnings Systems** able to estimate the impact well in advance are essential, providing information to help the decision-makers to understand the situation and make plans accordingly to protect and save lives, like in the case of TC FANI in India in 2019, when millions of people were evacuated, limiting the fatalities due to the passage of this very intense TC.

This year the **COVID-19 pandemic emergency** could affect the **preparedness and response activities** of the Hurricane season. It is therefore crucial to consider it in the evacuation plans, considering that the response in the various affected areas might be different, depending on the local development phase of the epidemic. It should be noted that the complex situation due to the virus is also having an impact on the **forecasts**, due to a reduction on the quantity and quality of weather observations (e.g. the measurements acquired by airplanes), atmospheric and climate monitoring.

JRC is closely following the ongoing TCs situation through **GDACS** (https://www.gdacs.org/) and the COVID-19 emergency through the **JRC COVID-19 Dashboard** (https://covid-statistics.jrc.ec.europa.eu/). In addition, JRC has prepared a new GDACS section on the COVID-19 situation in the affected countries.

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JRC Emergency Reports:

- 2018 - Caribbean: Past events, current situation and seasonal forecast https://www.gdacs.org/Public/download.aspx?type=DC&id=155
- 2018 - NW Pacific Typhoons: Past events, current situation and seasonal forecast: https://www.gdacs.org/Public/download.aspx?type=DC&id=154
- 2018 - South Pacific Tropical Cyclones: Past events, current situation and seasonal forecast: https://www.gdacs.org/Public/download.aspx?type=DC&id=156
- 2018 - South West Indian Ocean Tropical Cyclones: Past events, current situation and seasonal forecast: https://www.gdacs.org/Public/download.aspx?type=DC&id=161

Relevant links:

- GDACS: https://www.gdacs.org/
- JRC COVID-19 Dashboard: https://covid-statistics.jrc.ec.europa.eu/
- INFORM: https://drmkc.jrc.ec.europa.eu/inform-index
- ERCC portal: https://erccportal.jrc.ec.europa.eu/
- Copernicus EMS: https://emergency.copernicus.eu/
- WMO Tropical Cyclone Programme: https://www.wmo.int/pages/prog/www/tcp/index_en.html
- WMO Severe weather Information Centre: http://severe.worldweather.org/
- RSMC Miami-Hurricane Center/NOAA/NWS National Hurricane Center, USA: https://www.nhc.noaa.gov/
- Reliefweb: https://reliefweb.int/
- VOSOOC: https://vosocc.unocha.org/
- UN OCHA:http://www.unocha.org/
- Disaster Charter: https://disasterscharter.org
- UNOSAT-UNITAR: https://www.unitar.org/unosat/
- EM-DAT - The Emergency Events Database - Université catholique de Louvain (UCL) - CRED, D. Guha-Sapir - www.emdat.be, Brussels, Belgium

COVID-19 situation monitoring and risk assessment platforms:

- EC-JRC COVID-19 Dashboard: https://covid-statistics.jrc.ec.europa.eu/
- ECDC: https://qap.ecdc.europa.eu/public/extensions/COVID-19/COVID-19.html
- WHO: https://covid19.who.int/
- UNESCO (COVID-19 Educational Disruption and Response): https://en.unesco.org/covid19/educationresponse
- ACAPS COVID19 Government Measures Dataset: https://www.acaps.org/projects/covid19/data

Tropical Cyclone (TC) information:

- WMO - Tropical Cyclone Programme: https://www.wmo.int/pages/prog/www/tcp/index_en.html
- WMO - Global Guide to Tropical Cyclone Forecasting: https://cyclone.wmo.int/

Tropical Cyclone (TC) - Past events:

- Joint Typhoon Warning Center Best Track: http://www.metoc.navy.mil/jtwc/jtwc.html?southern-hemisphere
- NOAA Historical TCs track: https://coast.noaa.gov/hurricanes/
- NOAA IBTrACS: https://www.ncdc.noaa.gov/ibtracs/

Tropical Cyclone (TC) - Formation, ongoing events and forecasts:

- WMO - Tropical Cyclone Forecaster website: http://severe.worldweather.wmo.int/TCFW/
- WMO - Seasonal Tropical Cyclone Forecast information: https://public.wmo.int/en/bulletin/seasonal-tropical-cyclone-forecasts
- NOAA - National Hurricane Centre: https://www.nhc.noaa.gov/
- NOAA-HWRF (Hurricane Weather Research and Forecasting system):

http://www.emc.ncep.noaa.gov/gc_wmb/vxt/HWRF/index.php

- NOAA Climate Prediction Center, CARIBBEAN & CENTRAL AMERICA: https://www.cpc.ncep.noaa.gov/products/international/camerica/camerica.shtml
- NOAA-NESDIS: Multiplatform Tropical Cyclone Surface Winds Analysis (MTCSWA): http://www.ssd.noaa.gov/PS/TROP/mtcswa.html
- RAMMB: http://rammb.cira.colostate.edu/research/tropical_cyclones/
- ECMWF: https://www.ecmwf.int/en/forecasts/
- TSR: http://www.tropicalstormrisk.com/
- Colorado State University: https://tropical.colostate.edu/

National Meteorological and Hydrological Services (NMHSs)

- Antigua and Barbuda: http://www.antiguamet.com/
- Bahamas: http://www.bahamasweather.org.bs/
- Barbados: http://www.barbadosweather.org/
- Belize: http://www.hydromet.gov.bz/
- Colombia: http://www.ideam.gov.co/
- Costa Rica: http://www.imn.ac.cr/
- Cuba: http://www.insmet.cu/
- Dominica: http://www.weather.gov.dm/
- Dominican Republic: http://onamet.gov.do/m/
- Guatemala: http://www.insivumeh.gob.gt/
- Haiti: http://www.meteo-haiti.gouv.ht/
- Honduras: http://www.smn.gob.hn/web/
- Jamaica: http://metservice.gov.jm/
- Mexico: https://smn.conagua.gob.mx/es/
- Nicaragua: https://www.ineter.gob.ni/
- Panama: http://www.hidromet.com.pa/index.php
- Saint Lucia: https://met.gov.lc/
- Trinidad and Tobago : http://www.metoffice.gov.tt/
- United States: https://www.weather.gov/

TCs Analysed:

- LORENZO-2019:
    - GDACS: https://www.gdacs.org/report.aspx?eventtype=TC&eventid=1000608
    - NOAA: https://www.nhc.noaa.gov/data/tcr/AL132019_Lorenzo.pdf
- DORIAN-2019:
    - GDACS: https://www.gdacs.org/report.aspx?eventtype=TC&eventid=1000588
    - NOAA: https://www.nhc.noaa.gov/data/tcr/AL052019_Dorian.pdf
- MICHAEL-2018:
    - GDACS: https://www.gdacs.org/report.aspx?eventtype=TC&eventid=1000517
    - NOAA: https://www.nhc.noaa.gov/data/tcr/AL142018_Michael.pdf
- FLORENCE-2018:
    - GDACS: https://www.gdacs.org/report.aspx?eventtype=TC&eventid=1000495
    - NOAA: https://www.nhc.noaa.gov/data/tcr/AL062018_Florence.pdf
- NATE-2017:
    - GDACS: https://www.gdacs.org/report.aspx?eventtype=TC&eventid=1000408
    - NOAA: https://www.nhc.noaa.gov/data/tcr/AL162017_Nate.pdf
- MARIA-2017:
    - GDACS: https://www.gdacs.org/report.aspx?eventtype=TC&eventid=1000404
    - NOAA: https://www.nhc.noaa.gov/data/tcr/AL152017_Maria.pdf
- IRMA-2017:
    - GDACS: https://www.gdacs.org/report.aspx?eventtype=TC&eventid=1000393
    - NOAA: https://www.nhc.noaa.gov/data/tcr/AL112017_Irma.pdf
- HARVEY-2017:
    - GDACS: https://www.gdacs.org/report.aspx?eventtype=TC&eventid=1000387
    - NOAA: https://www.nhc.noaa.gov/data/tcr/AL092017_Harvey.pdf
- MATTHEW-2016:
    - GDACS: https://www.gdacs.org/report.aspx?eventtype=TC&eventid=1000316
    - NOAA: https://www.nhc.noaa.gov/data/tcr/AL142016_Matthew.pdf
- EARL-2016:
    - GDACS: https://www.gdacs.org/report.aspx?eventtype=TC&eventid=1000282
    - NOAA: https://www.nhc.noaa.gov/data/tcr/AL052016_Earl.pdf
- JOAQUIN-2015:
    - GDACS: https://www.gdacs.org/report.aspx?eventtype=TC&eventid=1000220
    - NOAA: https://www.nhc.noaa.gov/data/tcr/AL112015_Joaquin.pdf
- ERIKA-2015:
    - GDACS: https://www.gdacs.org/report.aspx?eventtype=TC&eventid=1000203
    - NOAA: https://www.nhc.noaa.gov/data/tcr/AL052015_Erika.pdf

List of abbreviations and definitions

CDEMA	Caribbean Disaster Emergency Management Agency
CEMS	Copernicus Emergency Management Service
CSU	Colorado State University
EC	European Commission
ECDC	European Centre for Disease Prevention and Control
ECHO	European Civil Protection and Humanitarian Aid Operations
ECLAC	Economic Commission for Latin America and the Caribbean, UN
ECMWF	European Centre for Medium Weather Forecast
EM-DAT	Emergency Events Database, Centre for Research on the Epidemiology of Disasters (CRED), Université catholique de Louvain (UCLouvain)
ERCC	Emergency Response Coordination Centre of DG ECHO
GDACS	Global Disasters Alerts and Coordination System
GFS	Global Forecasting System
GHSL	Global Human Settlement Layer
GPM	Global Precipitation Measurement
HWRF	Hurricane Weather Research and Forecast System
IBTrACS	International Best Track Archive for Climate Stewardship
IRI	International Research Institute for Climate Society
JRC	Joint Research Centre
JTWC	Joint Typhoon Warning Center
NESDIS	National Environmental Satellite, Data, and Information Service
NHC	National Hurricane Centre
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
RSMC	Regional Specialized Meteorological Centre
SSCS	Storm Surge Calculation System
SSHWS	Saffir Simpson Hurricane Wind Scale
TC	Tropical Cyclone
TCWC	Tropical Cyclone Warning Centre
UN	United Nation
WHO	World Health Organization
WMO	World Meteorological Organization
WRF	Weather Research and Forecasting

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Annexes

Annex 1. Detailed maps

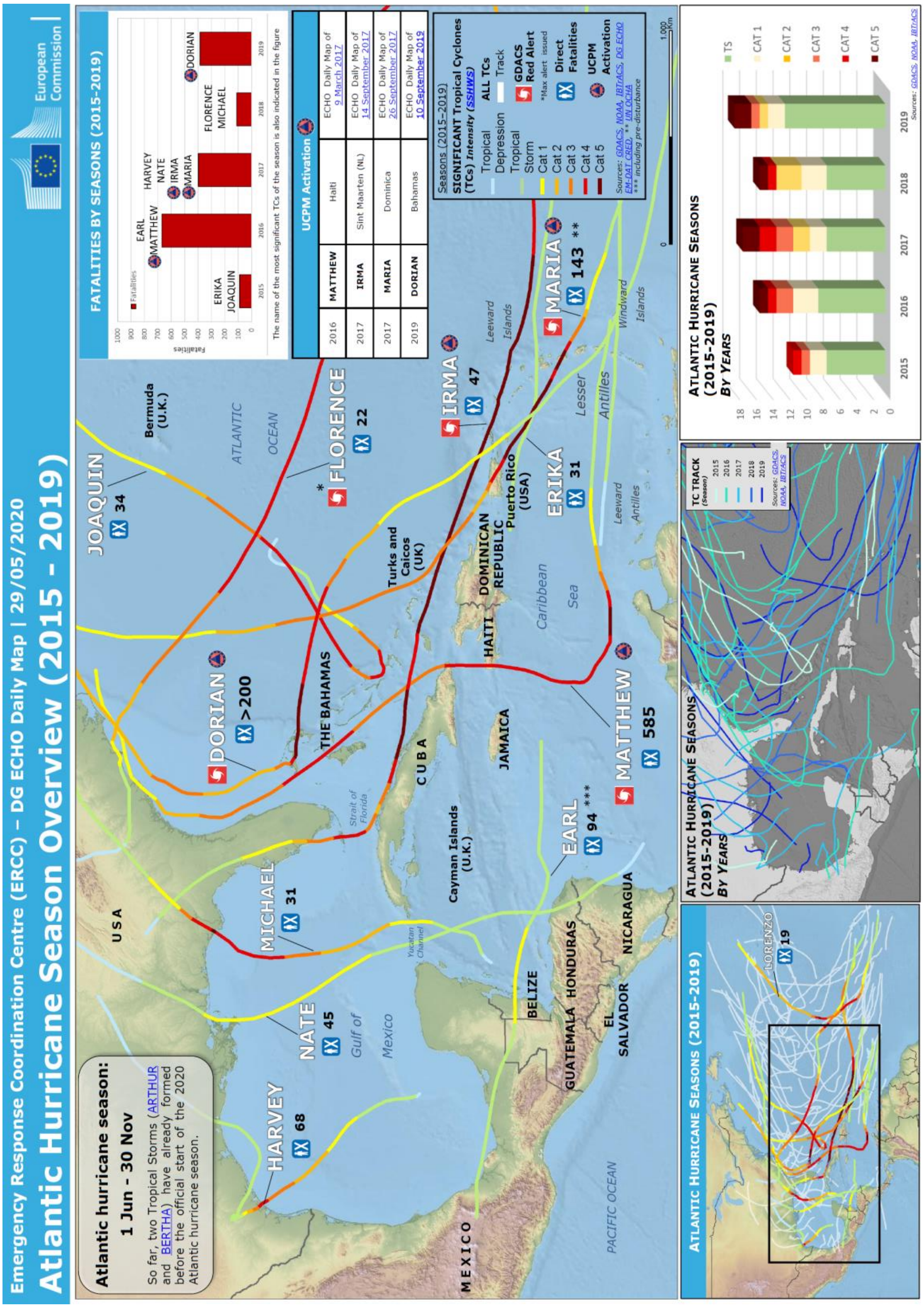


Fig. 15 - ECHO Daily Map of 29 May 2020 prepared by the JRC on the Atlantic Hurricane Seasons (2015-2019).

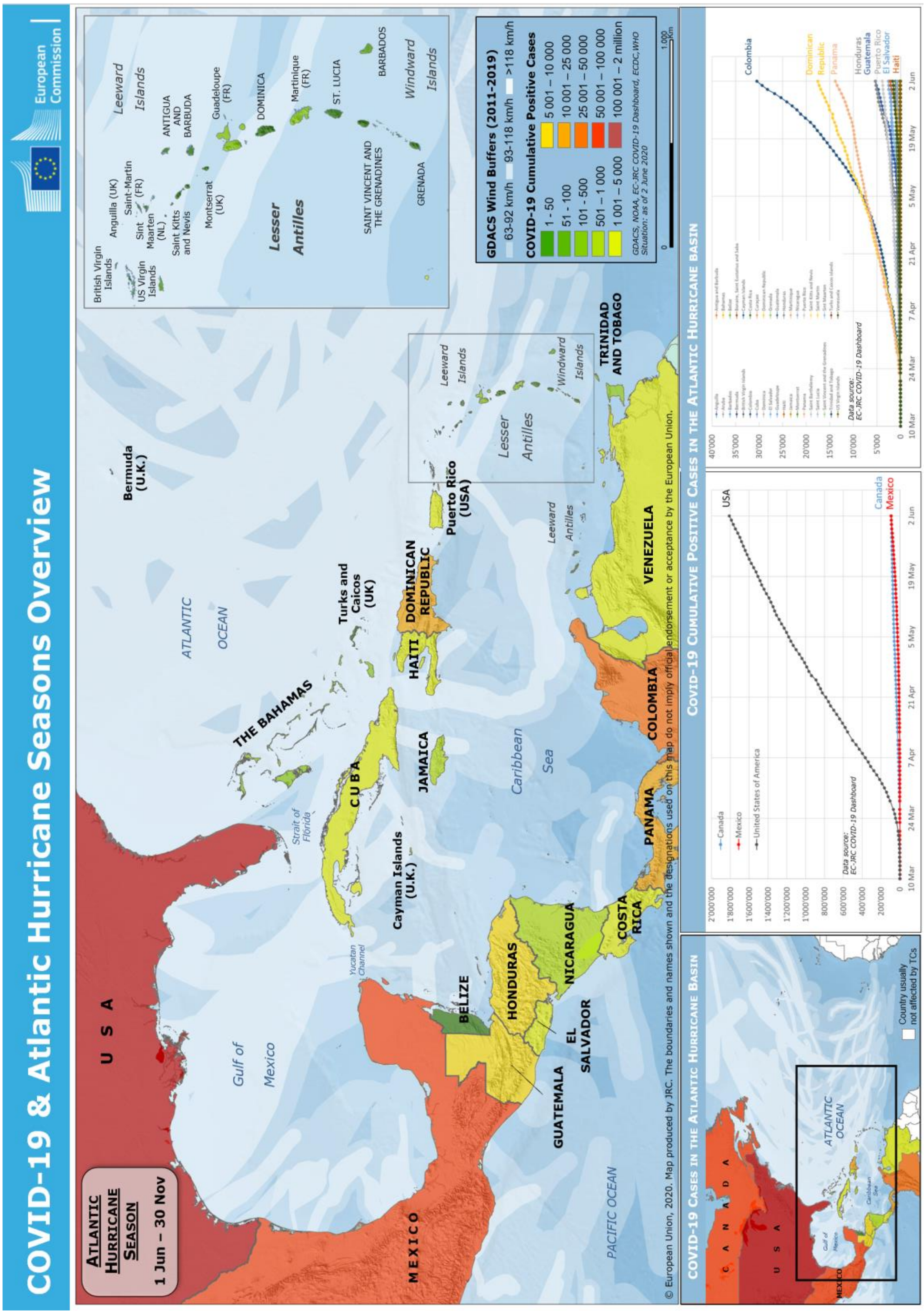


Fig. 16 - Detailed map on COVID-19 (as of 2 June 2020) & Atlantic Hurricane Seasons 2011-2019.

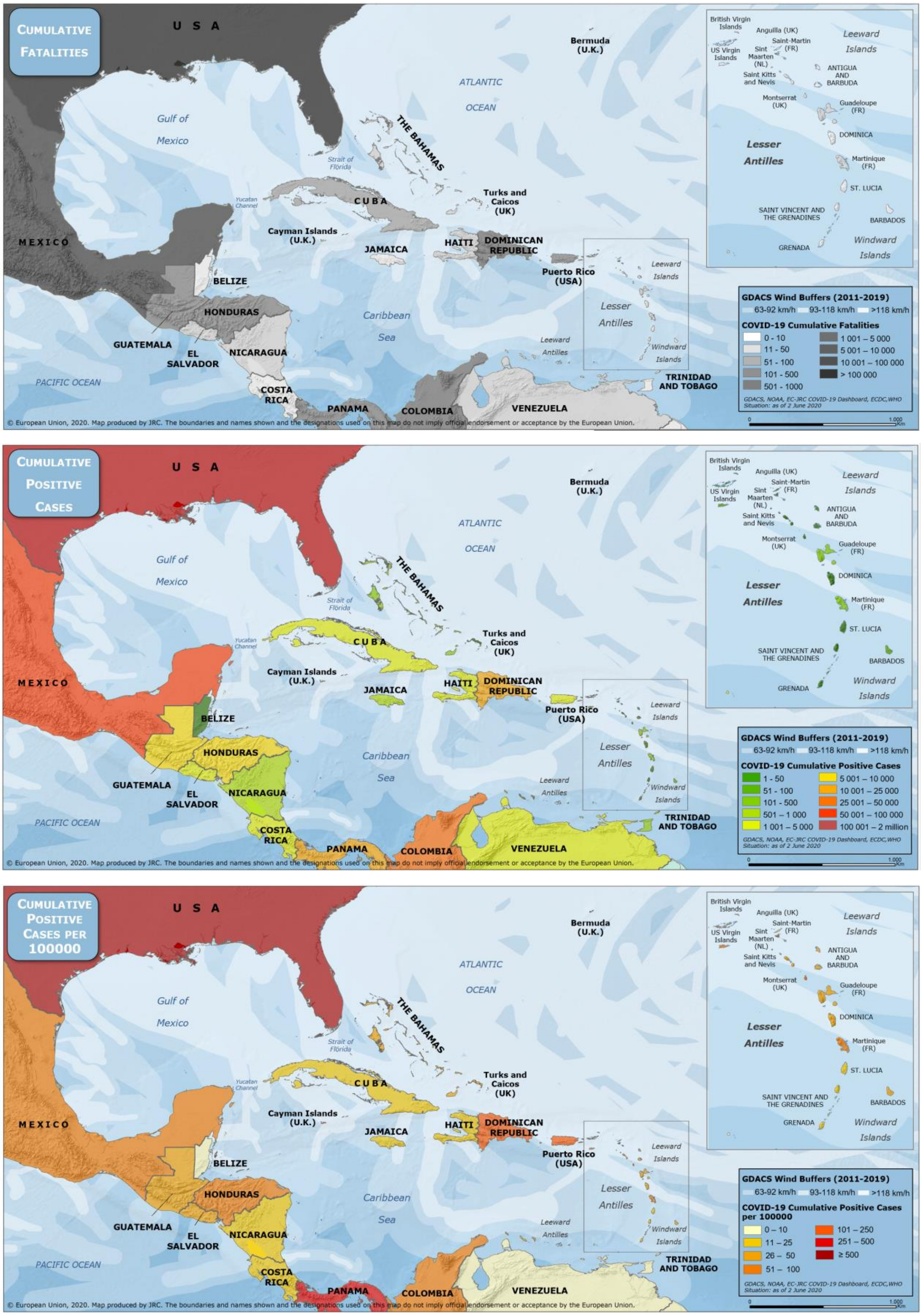


Fig. 17 - Atlantic Hurricane Seasons 2011-2019 & COVID-19 Situation (as of 2 June 2020). TOP (**Fig. 17a**): Cumulative fatalities. MIDDLE (**Fig. 17b**): Cumulative positive cases. BOTTOM (**Fig. 17c**): Cumulative positive cases per 100'000 pop.

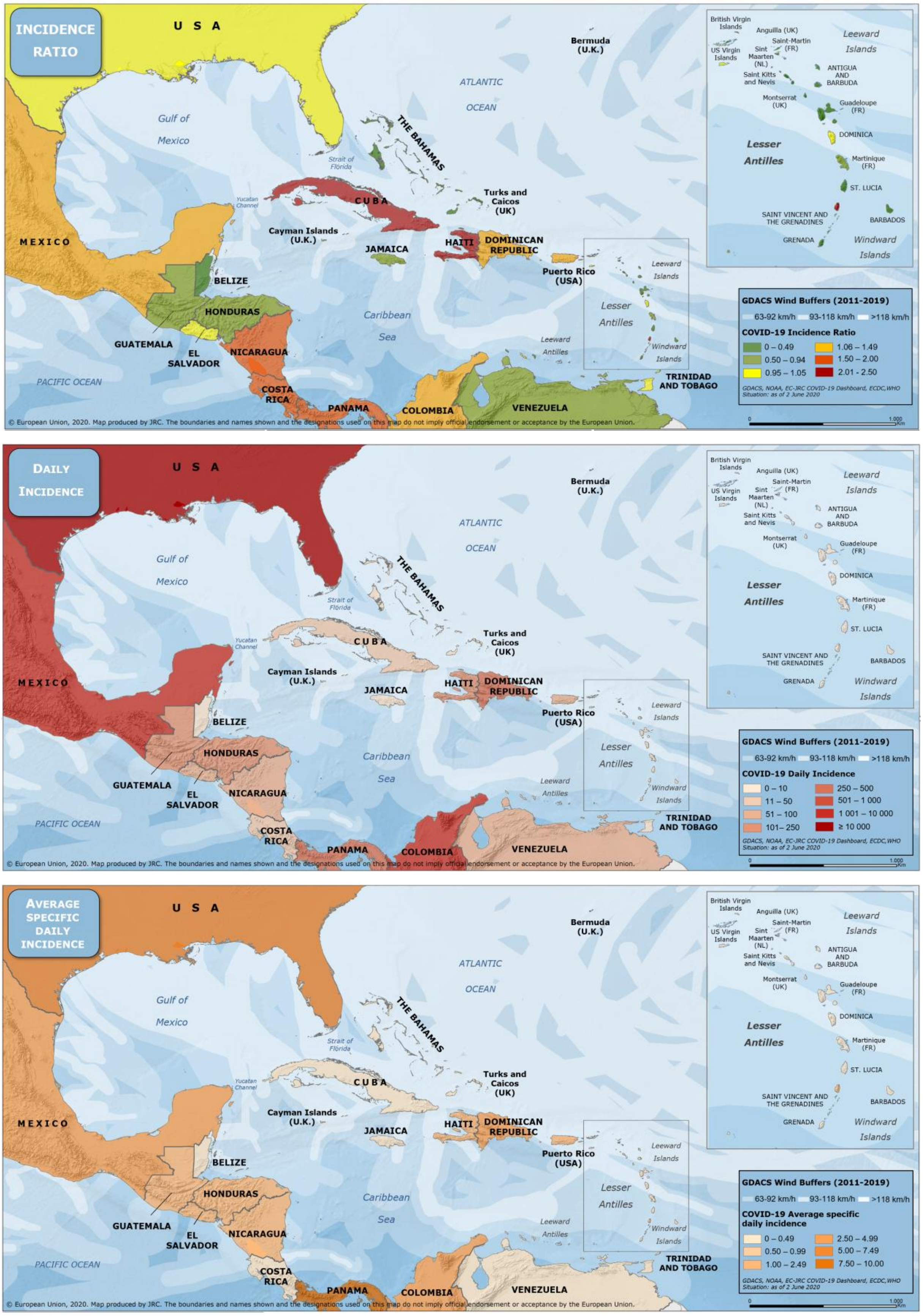


Fig. 18 - Atlantic Hurricane Seasons 2011-2019 & COVID-19 Situation (as of 2 June 2020). TOP (**Fig. 18a**): Incidence Ratio. MIDDLE (**Fig. 18b**): Average 7d Daily Incidence, BOTTOM (**Fig. 18c**): Average Specific Daily Incidence.

Annex 2. GDACS TC Alerts

JRC is responsible for the operation of GDACS (Global Disaster alert and Coordination System), that plays a major role in alerting the international community to humanitarian emergencies during natural disasters. The alerts of GDACS (Green, Orange, Red) are elaborated based on the severity of the event, the population involved and the vulnerability of the countries. GDACS also sends e-mail and SMS alerts to subscribed recipients. A detailed description of GDACS systems developed for TCs can be found at:
https://www.gdacs.org/Knowledge/models_tc.aspx

GDACS ALERTS		
	Green Alert	Moderate event, International Assistance not likely
	Orange Alert	Potential local disasters, International Assistance might be required
	Red Alert	Potentially severe disasters, International Assistance is expected to be required

Tab. 7 - GDACS Alert levels

Tropical Cyclones (TCs) are among the most dangerous natural disasters, causing every year extensive damage and deaths in several countries around the world. They have three destructive effects (strong wind, heavy rain and storm surge). GDACS includes the analysis of all TCs occurring worldwide.

<u>TC information:</u>
JRC set up an automatic routine that includes the TC bulletins produced by the National Oceanic and Atmospheric Administration (NOAA) and the Joint Typhoon Warning Center (JTWC) into a single database, covering all TC basins. This information is used in GDACS for the wind impact, and as input for the JRC storm surge system. JRC has recently developed new tools for the analysis of the TC impacts and included new sources (NOAA Hurricane Weather Research and Forecast - HWRF and Global Forecasting System - GFS, global high-resolution model of the European Centre for Medium Weather Forecast -HRES-ECMWF).

<u>Wind</u>
The GDACS alert levels for the TCs are based on the risk formula that includes:

- TC wind speed (hazard)
- Population affected
- Vulnerability of the affected country

The equivalent Category, based on the Saffir-Simpson Hurricane Wind Scale (SSHWS), 1-min sustained winds, is also indicated in GDACS (see Annex 3).
The overall alert for a Tropical Cyclone is currently based on the wind effect.

<u>Storm Surge</u>
Storm surge is an abnormal rise of water above the predicted astronomical tides, generated by strong winds and by a drop in the atmospheric pressure. The first storm surge system has been developed by JRC and included in GDACS in 2011, using the JRC HyFlux2 code (see Probst and Franchello, 2012), then a new system has been included using the atmospheric sources (NOAA-HWRF, NOAA-GFS, ECMWF-HRES) as input in the Delft3D code of DELTARES[59] (see Probst and Annunziato, 2017).
The GDACS alert levels are based on the maximum storm surge height:

- Green: < 1.0 m;
- Orange: 1.0 m - 3.0 m;
- Red: > 3.0 m.

It should be noted that the estimation of the sea level is strongly dependent on the initial data (wind velocity and direction). The sea level change according to each bulletin that was available.

JRC is preparing a new alert algorithm that will combine all the effects (wind, rain and storm surge).

[59] https://oss.deltares.nl/web/delft3d

Annex 3. TC Classification

Tropical Cyclone is a generic term used to describe "a warm-core non-frontal synoptic-scale cyclone, originating over tropical or subtropical waters, with organized deep convection and a closed surface wind circulation about a well-defined center" (source NOAA, https://www.nhc.noaa.gov/aboutgloss.shtml#t).

The distinction among the other terms is shown in the Tab. 8. This classification is used in this report, as well as in GDACS, where "Category" is used to distinguish the Hurricanes intensity and it is based on the Saffir-Simpson Hurricane Wind Scale (SSHWS, http://www.nhc.noaa.gov/aboutsshws.php).

The SSHWS is the official scale used by NOAA-NHC for the North Atlantic basin and is a scale from 1 to 5, based on the hurricane's 1-min sustained wind speed

Category	Knots	Km/h
5	≥ 137	≥ 252
4	113 - 136	209 - 251
3	96 - 112	178 - 208
2	83 - 95	154 - 177
1	64 - 82	119 - 153
Tropical Storm	34 – 63	63 - 118
Tropical Depression	≤ 33	≤ 62

Tab. 8 - TC classification used in GDACS and in the report, where the Hurricane Category from 1 to 5 is based on the Saffir-Simpson Hurricane Wind Scale - SSHWS (see NOAA-NHC[60])

In this report, three additional terms have been used:

- **Named storm**: it is used when the system reach a Tropical Storm or higher strength (winds ≥ 63 km/h and a specific name is assigned to this system (e.g DORIAN, IRMA, MARIA), see the list of the name of the 2020 Atlantic Hurricane Season in Tab.4, while more information at https://oceanservice.noaa.gov/facts/storm-names.html.
- **Major Hurricane**: "Hurricanes reaching Category 3 and higher are considered Major Hurricanes, due to their potential significant damage and loss of life."
- **Tropical Disturbance:** "Discrete tropical weather system of apparently organized convection originating in the tropics or subtropics, having a nonfrontal migratory character, and maintaining its identity for 24 h or more."

More information can be found at:

- https://www.nhc.noaa.gov/aboutsshws.php
- https://oceanservice.noaa.gov/facts/hurricane.html
- https://www.nhc.noaa.gov/aboutgloss.shtml?

[60] http://www.nhc.noaa.gov/aboutsshws.php

Annex 4. Humanitarian impact (2015-2019)

A short analysis on the humanitarian impact for all seasons analysed (2015-2019) by countries is presented below. Note: This is only an overview on the areas with the highest number of fatalities reported over the period analysed and it is not a complete analysis on the areas generally affected during the hurricane season (the complete list of the areas considered in this analysis is in Tab. 1). For a more detailed analysis, also other aspects must be considered (e.g. economic damage, TC frequency, exposed population and affected, etc., see INFORM). More information can be found at: https://www.nhc.noaa.gov/climo/

Based on this analysis, the highest number of fatalities have been in:

- **Haiti**: the country with the highest number of fatalities, mostly due to Hurricane MATTHEW in 2016.
- **The Bahamas**: high number of fatalities, mostly due to Hurricane DORIAN in 2019.
- **USA**: the high number of fatalities in this country is not the result of one single TC, but the results of several TCs, like MATTHEW in 2016, IRMA and HARVEY in 2017, FLORENCE and MICHAEL in 2018. Also **Puerto Rico** has been strongly affected by Hurricane MARIA (see Section 2.2)
- **Lesser Antilles**[61]: several islands are affected every year, the one with the highest number of deaths during the period analysed is **Dominica**, due to the passage of MARIA in 2017 and ERIKA in 2015.
- **Mexico:** is particularly affected by TCs. It should be noted that this country, as well as Central America could be also affected by the NE Pacific Hurricane season, which starts on 15 May and finishes on 30 November.

Note: Analyzing also the number of people affected, the most affected areas result the same areas listed above plus **Cuba**, which has a high number of people affected (mostly during the passage of Hurricane Irma in 2017, see EM-DAT).

These affected areas are consistent with the UN OCHA report (Latin America and the Caribbean: Natural Disasters 2000-2019), which analysed a longer period (2000-2019), showing that the countries most affected by storms over this period in the region have been **Cuba**, **Mexico** and **Haiti**, with 5000 fatalities and 29 million people affected. Same report shows that more than 85% of those fatalities were registered in **Haiti**, one of the most vulnerable areas of the Caribbean.

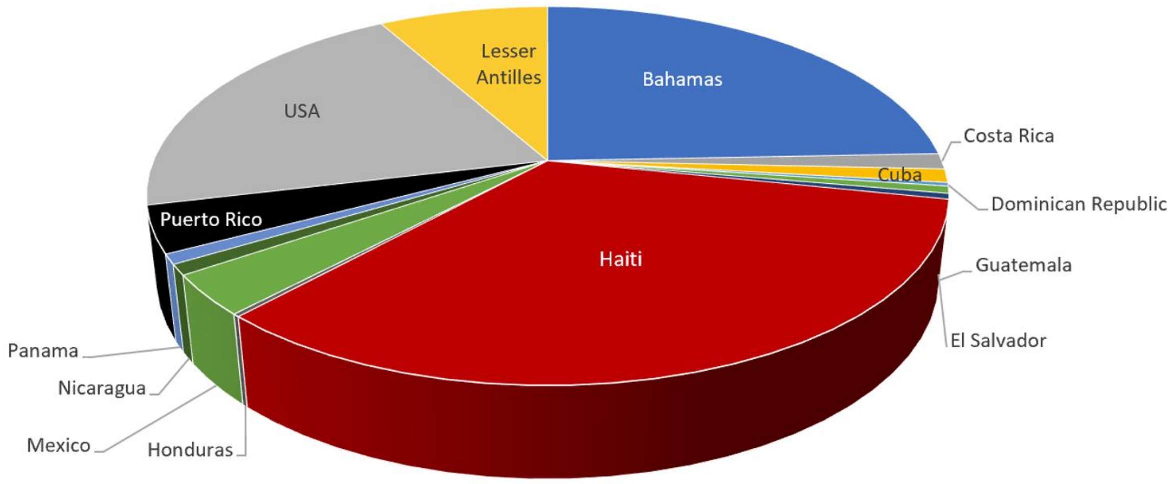


Fig. 19 – Fatalities by areas over the period analysed (2015-2019).
The values include only the Atlantic season and not the ones of the NE Pacific. Data source: EM-DAT

[61] **Lesser Antilles:**
Leeward Islands: Anguilla (UK), Antigua and Barbuda, British Virgin Islands, Dominica, Guadeloupe (FR), Montserrat (UK), Saint Martin (FR) / Sint Maarten (NL), Saint Barthélemy (FR), Saba (NL), Sint Eustatius (NL), St. Kitts and Nevis, US Virgin Islands.
Windward Islands: Barbados, Grenada, Martinique (FR), Saint Lucia, St. Vincent and the Grenadines, Trinidad and Tobago.
Leeward Antilles: Aruba (NL), Curaçao (NL), Bonaire (NL), Federal Dep. of Venezuela (VE), Nueva Esparta (VE)

Annex 5. TCs & ENSO

In this Section, more technical information is included focusing on the effects of the El Niño-Southern Oscillation (ENSO) on the TC activity and the 2020 TC seasonal forecast

El Niño-Southern Oscillation (ENSO) describes a period of fluctuation in the sea surface temperature and air pressure of the overlying atmosphere in the east-central Equatorial Pacific Ocean, which can have a large impact on the usual climate / weather pattern throughout the year (warm phase: El Niño, Cold phase: La Niña, sources: NOAA[62], WMO[63]). It could also affect the TCs in various parts of the world. In fact, various studies show that when **El Niño** is sufficiently strong could **reduce the TC activity in the Atlantic basin** (increase in other basins), conversely **La Niña** could **enhance** it in this basin (NOAA[64]). For example, in **2015**, **El Niño conditions reduced the number of TCs** in the Atlantic (season with below average activity), as shown in Fig. 4b.

The **uncertainty on the Atlantic hurricane activity forecast** is linked also to the **ENSO conditions forecasts**.

Atlantic seasonal hurricane activity	
El Niño	La Niña
"Fewer hurricanes due to stronger vertical wind shear and trade winds and greater atmospheric stability"	"More hurricanes due to weaker vertical wind shear and trade winds and less atmospheric stability"

Tab. 9 - Typical influence of El Niño (LEFT) and La Niña (RIGHT) on the Atlantic seasonal hurricane activity
(text source: https://www.climate.gov/news-features/blogs/enso/impacts-el-ni%C3%B1o-and-la-ni%C3%B1a-hurricane-season)

2020 ENSO Forecast:

According to the forecast of NOAA[65], there is a ~65% chance of **ENSO-neutral** condition during the summer 2020, with chances decreasing through the autumn (to 45-50%). The ENSO forecast is quite uncertain from summer through the upcoming winter. There is some tendency toward weak La Niña conditions developing during the second half of 2020 (WMO[66], CSU[67]).

Current ENSO conditions are available at NOAA:
https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/enso.shtml

[62] https://oceanservice.noaa.gov/facts/ninonina.html, https://www.ncdc.noaa.gov/teleconnections/enso/enso-tech.php
[63] https://public.wmo.int/en/About-us/FAQs/faqs-el-ni%C3%B1ola-ni%C3%B1a
[64] https://www.climate.gov/news-features/blogs/enso/impacts-el-ni%C3%B1o-and-la-ni%C3%B1a-hurricane-season
[65] https://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/ensodisc.pdf
[66] https://public.wmo.int/en/media/news/el-ni%C3%B1o-la-ni%C3%B1a-update-0
[67] https://tropical.colostate.edu/forecasting.html

Annex 6. COVID-19 & TCs in the other TC basins using the new GDACS resources

As shown in Section 5, the COVID-19 pandemic emergency has several effects on the preparedness and response activities. This complex situation has been already identified in other TC basins over the past few months during the passage of the following significant TCs:

- Tropical Cyclone HAROLD (GDACS Red Alert) in Vanuatu, Fiji and Tonga in April 2020, which caused extensive damage to homes, crops, roads, as well as contaminated water supplies (IFRC[68]). These areas were already facing the COVID-19 emergency, with several restrictions in effect to reduce the spread of the virus (UN[69], IDMC[70]). **As of 4 June, no COVID-19 positive cases have been reported in Vanuatu** (https://covid19.gov.vu/) **and Tonga** (http://www.health.gov.to/).
- Typhoon VONGFONG (GDACS Red Alert) in the Philippines in May 2020, which affected nearly 580000 people in Visayas and Mindanao (DSWD). Also in this case the virus situation complicated the evacuations to keep the social distancing and the various evacuation centers have been adapted to follow all the rules introduced to face the COVID-19, see more information in UN.
- Cyclone AMPHAN (GDACS Red Alert) in India and Bangladesh in May 2020: more than 3 millions of people have been evacuated before its passage and thousands of shelters have been set up, including COVID-19 preventive measures (see WMO, UN OCHA).

The time evolutions of the number of cases and fatalities (cumulative and daily variation) in the countries affected by VONGFONG (Fig. 20) and AMPHAN (Fig. 21) are presented in this Annex. These figures have been obtained from the new GDACS COVID-19 webpages that the JRC is preparing.

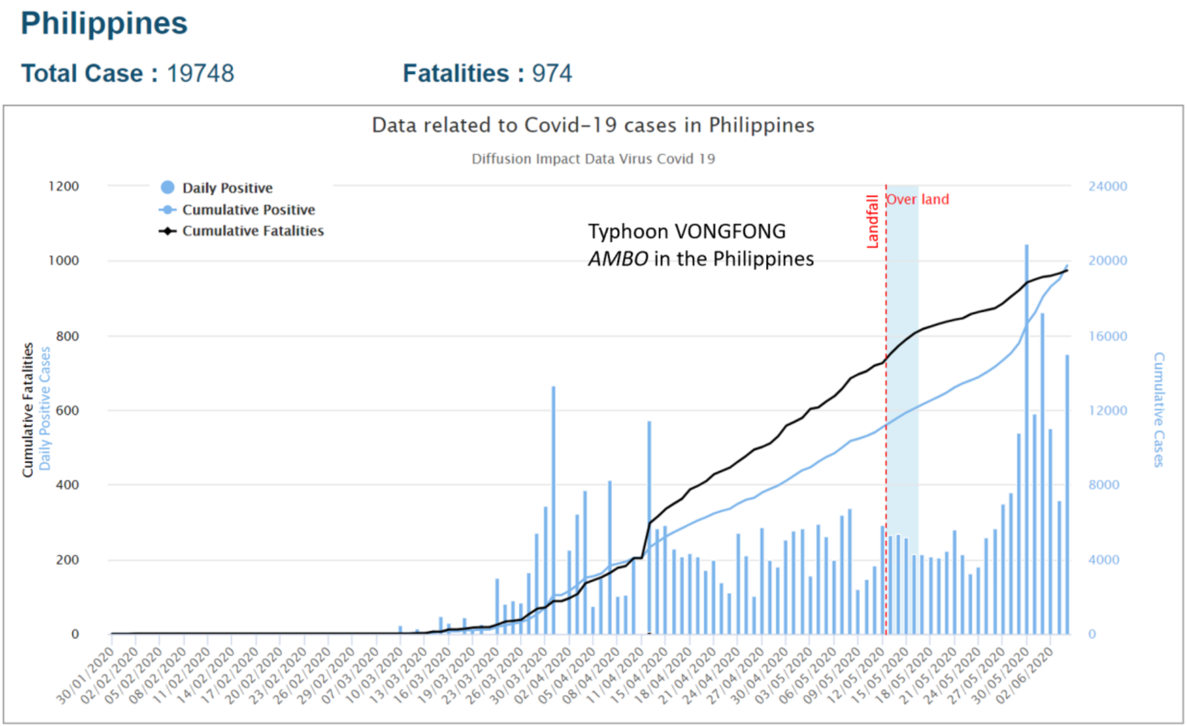
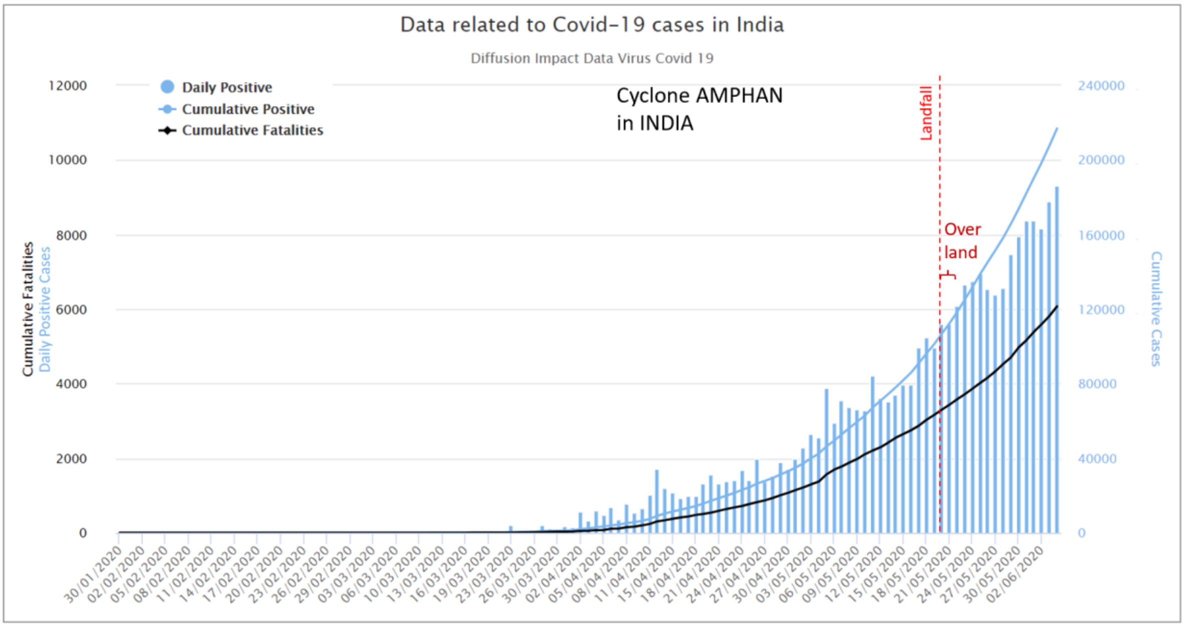


Fig. 20 - COVID-19 time evolution in the countries recently affected by Typhoon VONGFONG in the Philippines.
Source: GDACS

[68] https://media.ifrc.org/ifrc/2020/04/29/pacific-national-societies-respond-cyclone-harold-time-covid-19/
[69] https://www.un.org/en/un-coronavirus-communications-team/covid-19-shocks-too-big-handle-small-island-nations-un-warns
[70] https://www.internal-displacement.org/expert-opinion/tropical-cyclone-harold-and-covid-19-a-double-blow-to-the-pacific-islands

India

Total Case : 216919 **Fatalities :** 6075



Bangladesh

Total Case : 55140 **Fatalities :** 746

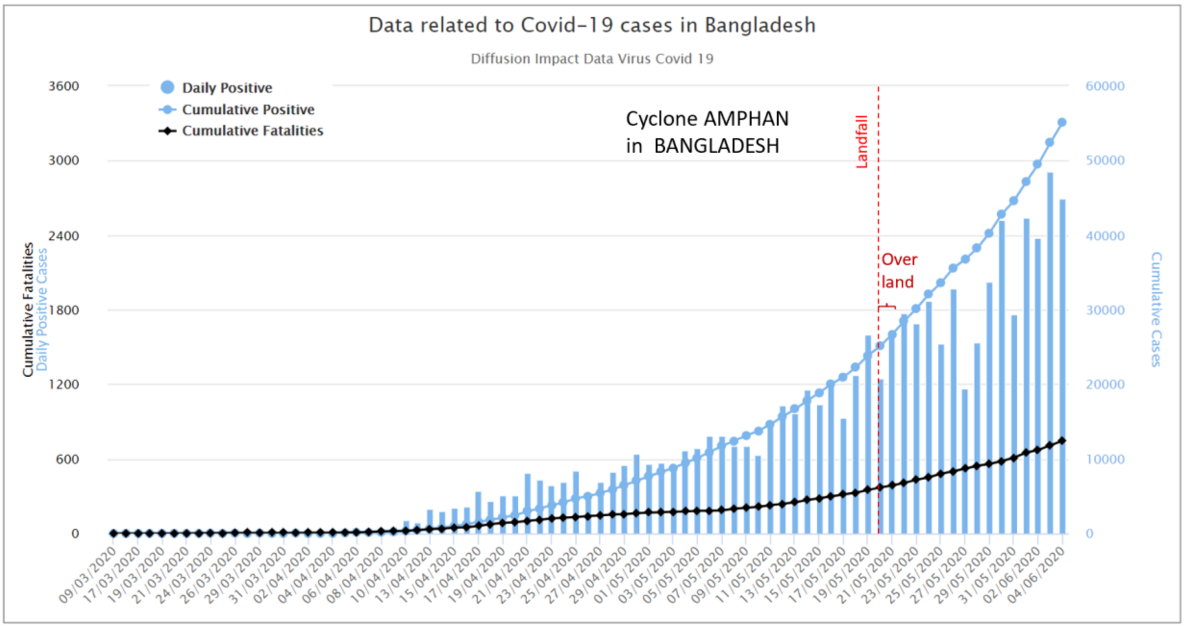


Fig. 21 - COVID-19 time evolution in the countries recently affected by Cyclone AMPHAN in India (TOP, Fig. 21a) and in Bangladesh (BOTTOM, Fig. 21b).
Source: GDACS

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