



EUROPEAN COMMISSION
JOINT RESEARCH CENTRE

13 September 2018, 14:00 UTC

Tropical Cyclones FLORENCE in the USA and ISAAC in the Caribbean

Orange alert for USA
30 Aug 2018 - ongoing

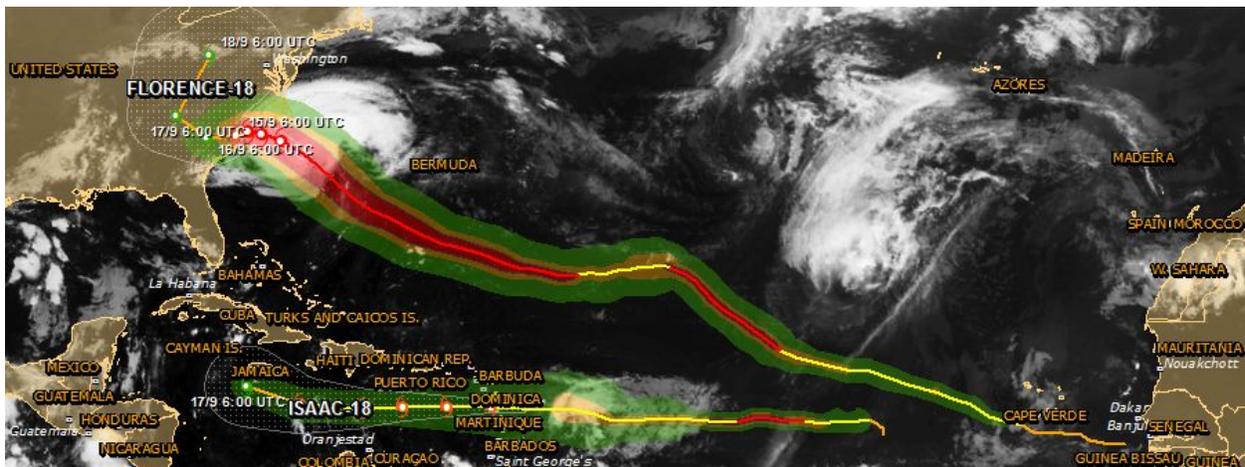


Figure 1 - TCs FLORENCE in the USA and ISAAC in the Caribbean
(as of 13 Sep 2018, 09:00 UTC)

1 Executive Summary

- As of 13 September 09:00 UTC, four Tropical Cyclone systems are active in the Atlantic Ocean (**FLORENCE**, **ISAAC**, **HELEN**, **JOYCE**) and another one could develop over the next few days over the Gulf of Mexico (see Figure 2). In this report, an analysis of the possible impact of **FLORENCE** and **ISAAC** is presented.
- FLORENCE** is forecast to reach the coast of North Carolina or South Carolina on **14 September** morning (UTC), as a Category 2 Hurricane (max. sustained winds up to **160-170 km/h**). After the landfall it could move slowly near or over the coast of South Carolina on 15 September. Up to 1.7 million people have been ordered to evacuate across South Carolina, North Carolina and Virginia as a result of the imposed presidential order. Georgia declared a state of emergency, following the Carolinas, Virginia, Maryland and Washington DC.

- **ISAAC** is forecast to continue moving westward over the Atlantic Ocean, slightly strengthening, but remaining a Tropical Storm. It is expected to move across the central Lesser Antilles and into the eastern Caribbean Sea on **13 September**.
- The Joint Research Centre (JRC) is following the event through the information automatically collected and analysed in the Global Disasters Alerts and Coordination System (GDACS). GDACS issued a **RED** alert for TC FLORENCE in USA, then decreased to Orange and currently as a Green for reduced winds. TC ISAAC has always been declared as Green.
- The Copernicus Emergency Response Mapping service was activated by ERCC on request of the US FEMA on 11 September for several coastal locations in North and South Carolina.

2 Situation Overview

2.1 Meteorological Situation

2.1.1. Active TC systems in the area

As of 13 September 09:00 UTC, four Tropical Cyclone systems are active in the Atlantic Ocean (**FLORENCE, ISAAC, HELEN, JOYCE**) and another one could developed (50% of chance of formation) over the next 48 h over the Gulf of Mexico (see Figure 2). In this report, an analysis of the possible impact of **FLORENCE** and **ISAAC** is presented upon a request of the ERCC. At the moment the most powerful and threatening tropical cyclone is the first one and most of the description below is related to it.

GDACS ALERT	TC NAME	CATEGORY (SSHS)		EXPOSED COUNTRY	EXPOSURE PERIOD	LANDFALL
		Peak	Landfall			
	FLORENCE	Cat. 4 Hurricane	Cat. 2 Hurricane	USA	13-17 Sep	14 Sep, near Wilmington (North Carolina, USA)
	ISAAC	Tropical Storm	Tropical Storm	CARIBBEAN especially these Lesser Antilles: Martinique, Dominica, and Guadeloupe	13-14 Sep (Lesser Antilles) 14 - 18 Sep (Caribbean Sea)	13 Sep, Dominica
	HELEN	Cat.2 Hurricane	Tropical Storm	Azores (Portugal)	15-16 Sep	Near/over W Azores on 15 Sep
	JOYCE	Sub-Tropical Storm	Sub-Tropical Storm	Azores (Portugal)	17-18 Sep	Near/over W and central Azores on 17-18 Sep

Table 1 - Active Tropical Cyclones in the Atlantic basin (as of 13 Sep. 09:00 UTC).

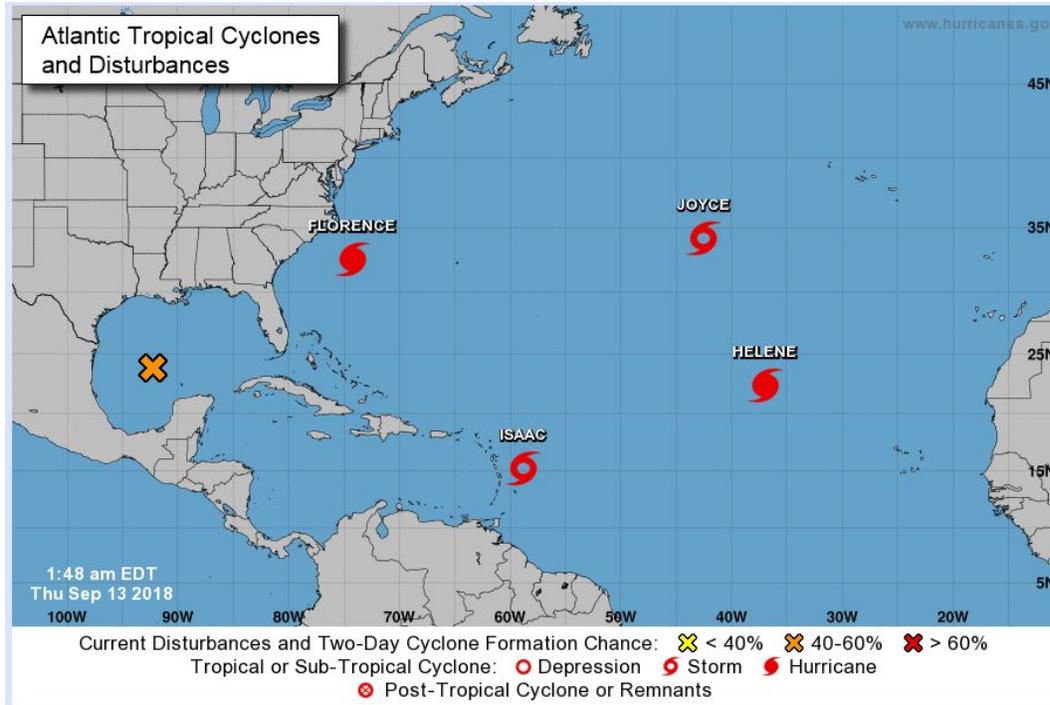


Figure 2 - Tropical Cyclones and Disturbances in the Atlantic basin
(as of 13 Sep 2018, 09:00 UTC, source: NOAA-NHC)

2.1.2. Tropical Cyclone FLORENCE

- PAST:** Tropical Cyclone FLORENCE formed near Cape Verde islands on 30 August and started moving west-northwest, strengthening on 30 August - 5 September (becoming Major Hurricane¹), weakening on 6-8 September (becoming again a Tropical Storm), regaining strength on 9-11 September, becoming again a Major Hurricane, and on 12 September it has started slightly weakening again becoming a Category 2, while the size of the wind field has increased.
- CURRENT:** On 13 September at 09:00 UTC, its centre was located approx. 325 km east-southeast of Wilmington (North Carolina, USA) and 405 km east-southeast of Myrtle Beach (South Carolina, USA), with maximum sustained winds of 175 km/h (Category 2 Hurricane).
- FORECAST** (as of 13 September, 09:00 UTC TC data): it is forecast to reach the coast of North Carolina or South Carolina (possible landfall area: near Wilmington, area of the border between the two states) on 14 September morning (UTC), as a Category 2 Hurricane (max. sustained winds of 160-170 km/h). After the landfall it could move slowly near or over the coast of South Carolina on 15 September, weakening into a Tropical Storm, and inland over eastern and western South Carolina on 16 September, weakening into a Tropical Depression.
- UNCERTAINTY:** It is forecast to reach North Carolina or South Carolina, probably the area of Wilmington, on 14 September morning (UTC), but there is still some uncertainty on the area of the landfall: some models provide a possible landfall in the southern areas of North Carolina, other in the northern areas of South Carolina, while most of the models agreed that it will be a

¹ **Major Hurricane:** A tropical cyclone with maximum sustained winds of 178 km/h or higher, corresponding to a Category 3, 4 or 5 on the Saffir-Simpson Hurricane Wind Scale (<http://www.nhc.noaa.gov/aboutsshws.php>).

strong Category 2 (close to Category 3) Hurricane when it reaches the coast, however small changes in strength might be expected before the center reaches the coast (see figure below and ECMWF in Annex 6.2).

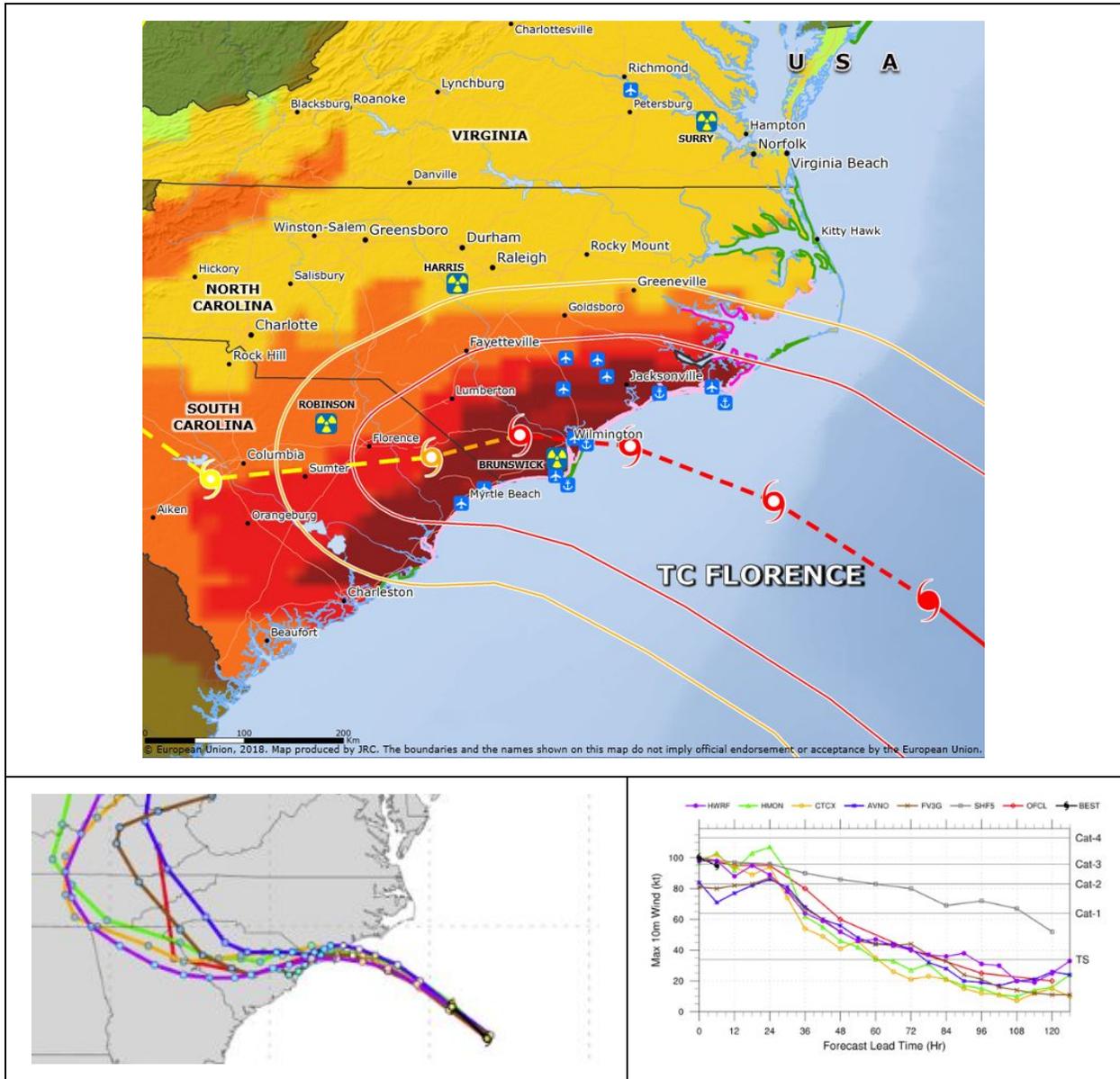


Figure 3 - TC FLORENCE uncertainty track/intensity (as of 13 Sep, 09:00 UTC).
Sources: GDACS, JRC (TOP), NOAA-HWRF (BOTTOM)

Warnings in effect

As of 13 September, 09:00 UTC (NOAA-NHC), there are the following warnings/watches in effect:

Hazard	Warning		Watch	
STORM SURGE	* South Santee River South Carolina to Duck North Carolina		* Edisto Beach South Carolina to South Santee River South Carolina	
	* Albemarle and Pamlico Sounds, including the Neuse and Pamlico Rivers		* North of Duck North Carolina to the North Carolina/Virginia border	
WIND	Hurricane	Tropical Storm	Hurricane	Tropical Storm
	* South Santee River South Carolina to Duck North Carolina * Albemarle and Pamlico Sounds	* North of Duck North Carolina to the North Carolina/Virginia border * Chesapeake Bay south of New Point Comfort	* Edisto Beach South Carolina to South Santee River South Carolina	-

Table 2 - TC FLORENCE Warnings/Watches in effect
Source: NOAA-NHC

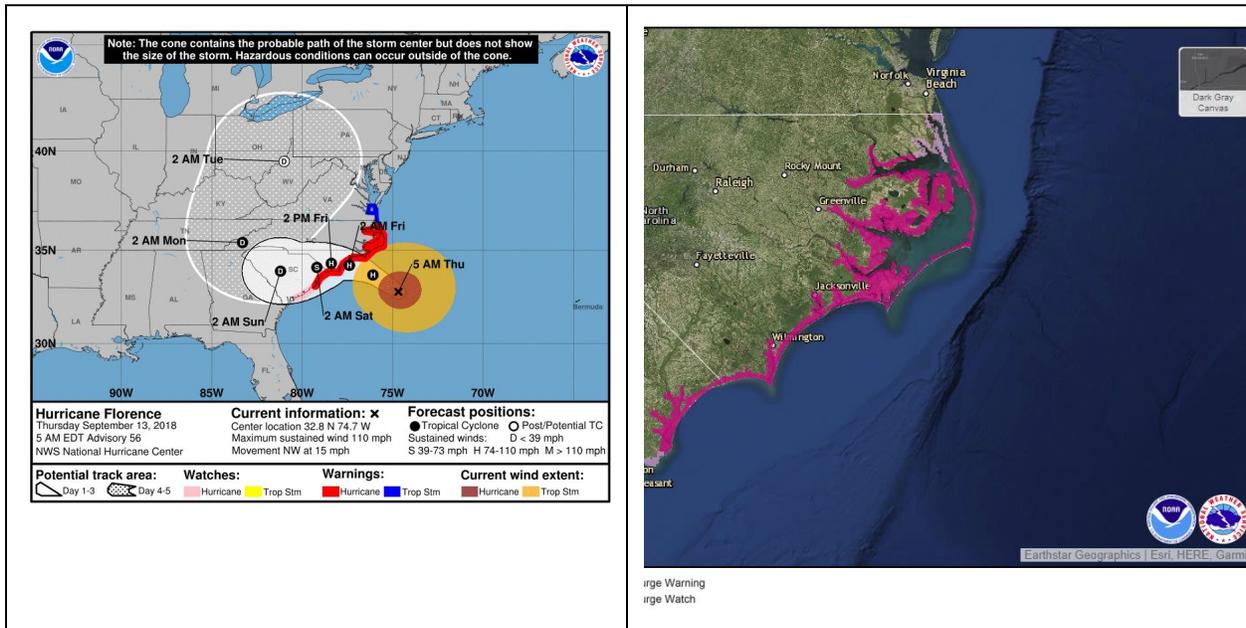


Figure 4 - TC FLORENCE Tropical Storm and Hurricane Warnings/Watches in effect (left panel), Storm surge Warnings/Watches in effect in the landfall area (right panel). Source: NOAA

Flood Watch in effect (National Weather Service, USA)

Flash Flood Watch remains in effect

from 8 AM EDT this morning through Saturday evening (15 Sep 2018)

(<https://forecast.weather.gov/wwamap/wwatxtget.php?cwa=rah&wwa=flash%20flood%20watch>)

The Flash Flood Watch continues for

* A portion of central North Carolina, including the following areas, Chatham, Davidson, Edgecombe, Franklin, Nash, Randolph, Wake, and Wilson.

* Flash flooding of creeks, rivers, streams, nearby roadways, and washouts of area bridges are likely. Storm total amounts of more than 6 inches of rainfall is possible, with localized amounts in excess of 10 inches.

2.1.3. Tropical Cyclone ISAAC

- **PAST:** Tropical Cyclone ISAAC formed over the Atlantic Ocean on 7 September and started moving west, towards the Caribbean, slightly strengthening, becoming a Tropical Storm.
- **CURRENT:** On 13 September at 09:00 UTC, its centre was located approx. 170 km east of Dominica (Lesser Antilles), with max. sustained winds of 75 km/h (Tropical Storm).
- **FORECAST** (as of 13 September, 09:00 UTC TC data): Over the next 12 h, it is forecast to continue moving westward over the Atlantic Ocean, slightly strengthening, but remaining a Tropical Storm. It is expected to move across the central Lesser Antilles and into the eastern Caribbean Sea on 13 September. Its center could pass over/near Dominica on 13 September afternoon (UTC). Afterwards it is forecast to continue moving west, across the Caribbean Sea, over the next few days. There is still a large uncertainty on the track after the 3-days forecast (see Figure below).
- **UNCERTAINTY:** After the passage of the Lesser Antilles, it is expected to continue moving west, over the Caribbean Sea, for the next few days. There is still a large uncertainty after the 3-days forecast, most of the models provide a track close to Jamaica, but some of them have a possible track over Haiti (see Figure below). Regarding the intensity, most of the models agreed on the decrease of the maximum sustained wind speed, after the passage over the Lesser Antilles.

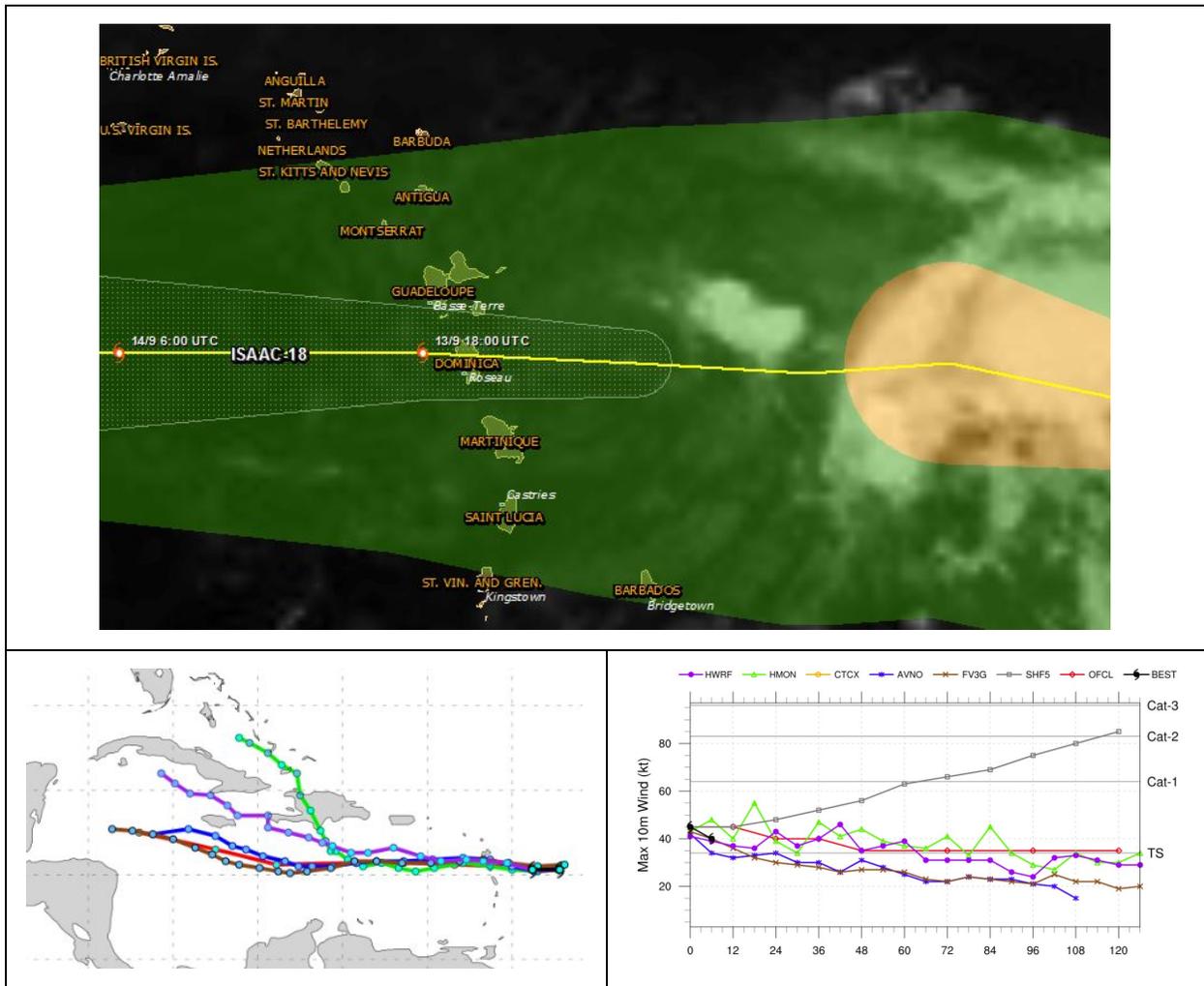


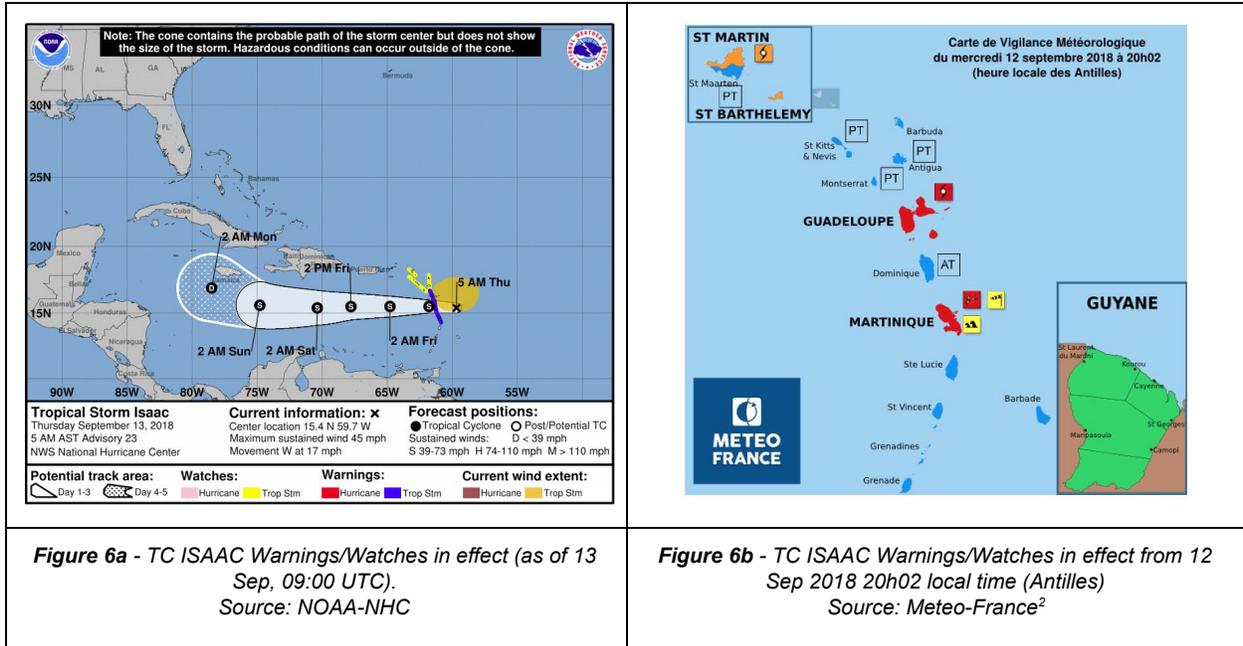
Figure 5 - TC ISAAC uncertainty track/intensity (as of 13 Sep, 09:00 UTC).
Sources: GDACS (LEFT), NOAA-HWRF (RIGHT)

Warnings in effect

As of 13 September, 09:00 UTC ([NOAA-NHC](#)), there are the following warnings/watches in effect:

Hazard	Warning	Watch
	Tropical Storm	Tropical Storm
WIND	<ul style="list-style-type: none"> * Martinique * Dominica * Guadeloupe 	<ul style="list-style-type: none"> * Antigua * Barbuda * Montserrat * St. Kitts and Nevis * Saba and St. Eustatius * St. Martin and St. Maarten

Table 3 - TC ISAAC Warnings/Watches in effect (as of 13 Sep, 09:00 UTC).
Source: NOAA-NHC



Meteo-France

Meteo-France has placed the French territories of Martinique and Guadeloupe under a RED ALERT (Tropical Storm Warning) and under an ORANGE ALERT (Tropical Storm Watch) the northern (French) part of St. Martin valid from 12 Sep 2018 20h02 local time (Antilles).

Meteorological Department of Sint Maarten

A TROPICAL STORM WATCH IS IN EFFECT FOR (Netherlands territory) SINT MAARTEN³

2.2 Impact Analysis of the tropical cyclones

The possible impact (strong winds, heavy rains and storm surge) of Hurricane FLORENCE in the USA and Tropical Storm ISAAC in the Caribbean over the next few days are shown below.

Note: This Section is focused mainly of the possible impact of FLORENCE, because as of today, it is the most significant event, however it should be noted that the forecast of ISAAC over the Caribbean Sea has to be monitored carefully also during the next days due to the uncertainty on the forecast track after 3 days.

2.2.1. Tropical Cyclone FLORENCE in the USA

OVERVIEW: Hurricane-force winds, **very heavy rains** and **high storm surge** could especially affect the coastal areas of North Carolina and South Carolina (USA) on 13-16 September. Heavy rains could also

² Meteo-France: <http://www.meteofrance.gp/vigilance-antilles-guyane>

³ Meteorological Department of Sint Maarten: <http://www.meteosxm.com/tropical-weather-update/>

affect the rest of these two states, as well as southern and central Appalachians on 15-17 September, with the risk of flooding. Few tornadoes are also possible in eastern North Carolina on 14 September.

The major risk is related to the very heavy rains and large storm surge, combined with the tides, that could produce severe floods in several coastal areas of North Carolina and South Carolina. Moreover it is expected to move very slowly along the coast, causing a long period of heavy rainfall and storm surge in the area.

Wind

- Hurricane Force strong winds (up to 160-170 km/h, with higher gusts) could affect the coastal areas of Northern Carolina and north-eastern areas of South Carolina. Strong winds could also affect the rest of North Carolina, South Carolina and Virginia. Since it is a large hurricane, the Hurricane-force winds could extend outward up to 130 km from the center and the tropical-storm-force winds up to 300 km. Few tornadoes are possible in eastern North Carolina on 14 September.

*Potentially most affected areas: **North Carolina** (especially coastal areas), **South Carolina** (especially north-eastern areas).*

Rainfall

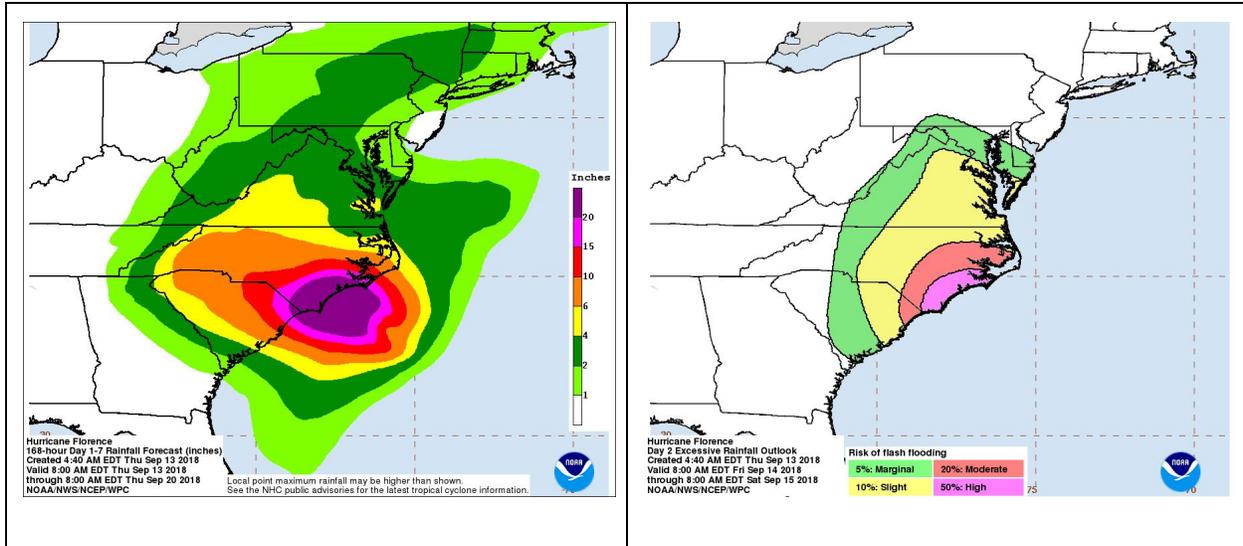
- **USA:** it is expected to produce very heavy rains (see table and figure below) over several areas of North Carolina and South Carolina, especially in the area of Wilmington. This amount of rainfall is significant higher than normal⁴ and could cause severe flash flooding and river floods (see Table and Figure below). These areas will be also affect by a large storm surge and tides (see Section 3).

Areas	Forecast
Coastal North Carolina into far northeastern South Carolina	508-762 mm, isolated amount of 1,016 mm
Rest of South and North Carolina into southwest Virginia	152-305 mm, isolated amount of 610 mm

Table 10 - Rainfall forecast and areas potentially affected (as of 13 Sep, 09:00 UTC, [NOAA-NHC](#))

*Potentially most affected areas: **North Carolina** (especially coastal areas) and **South Carolina** (especially north-eastern areas), south-westestern Virginia.*

⁴ Mean Total Rainfall in Sep in Myrtle Beach (approx: 100 km SE of Wilmington): 154 mm



Storm surge

Extended storm surge is forecasted by NOAA and other organizations. For a detailed analysis of the Storm surge please refer to chapter 3.1.

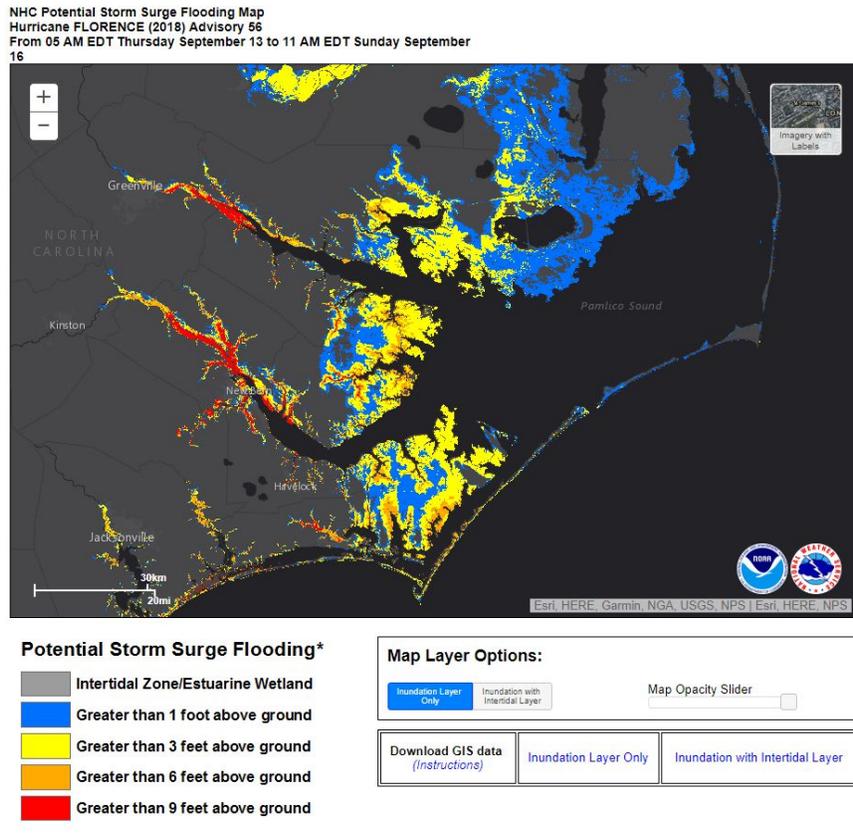


Figure 8 - Storm surge forecast by NOAA⁵

⁵ https://www.nhc.noaa.gov/refresh/graphics_at1+shtml/212431.shtml?inundation#contents

2.2.2. Tropical Cyclone ISAAC in the Caribbean

OVERVIEW: Tropical Storm force winds and heavy rains could affected the Lesser Antilles, especially Dominica, Martinique and Guadeloupe over 13-14 September.

Note: The possible impact of ISAAC is focused on the Lesser Antilles (especially Dominica and Martinique and Guadeloupe), but it should be noted that also other areas of the Caribbean could be affected, because, after having passed the Lesser Antilles, it is expect to move over the Caribbean Sea for the next few days, but the uncertainty is still very high. JRC will continue monitoring the possible track of ISAAC throughout the Caribbean also during the next few days.

Wind

- **LESSER ANTILLES:** Tropical Storm force winds, heavy rains and a moderate storm surge could affected the Lesser Antilles, especially Martinique, Dominica, and Guadeloupe over 13-14 September during its passage. Afterwards it is forecast to continue moving west, over the Caribbean Sea, for the next few days, but there is still a large uncertainty.

Potentially most affected areas: Lesser Antilles, especially **Dominica, Martinique and Guadeloupe.**

Rainfall

- **LESSER ANTILLES:** ISAAC is expected to produce heavy rains (locally total acc. 50-100 mm, isolated amount of 150 mm) across Martinique, Dominica, and Guadeloupe. Rainfall (10-40, isolated amount of 75 mm) are expected across Puerto Rico and the southern US Virgin islands, and 25 mm over the rest of Windward and Leeward Islands. It could produce heavy rainfall also in other areas of the Caribbean, like Haiti, Dominican Republic, Jamaica, depending of the forecast TC track, but at the moment the uncertainty is still very high (see Section 2.1.3). The total rainfall accumulation forecast for the next 10 days (GLOFAS, ECMWF, 12 Sep, 12:00 UTC) is shown below.

Potentially most affected areas: Lesser Antilles, especially **Dominica, Martinique and Guadeloupe.**

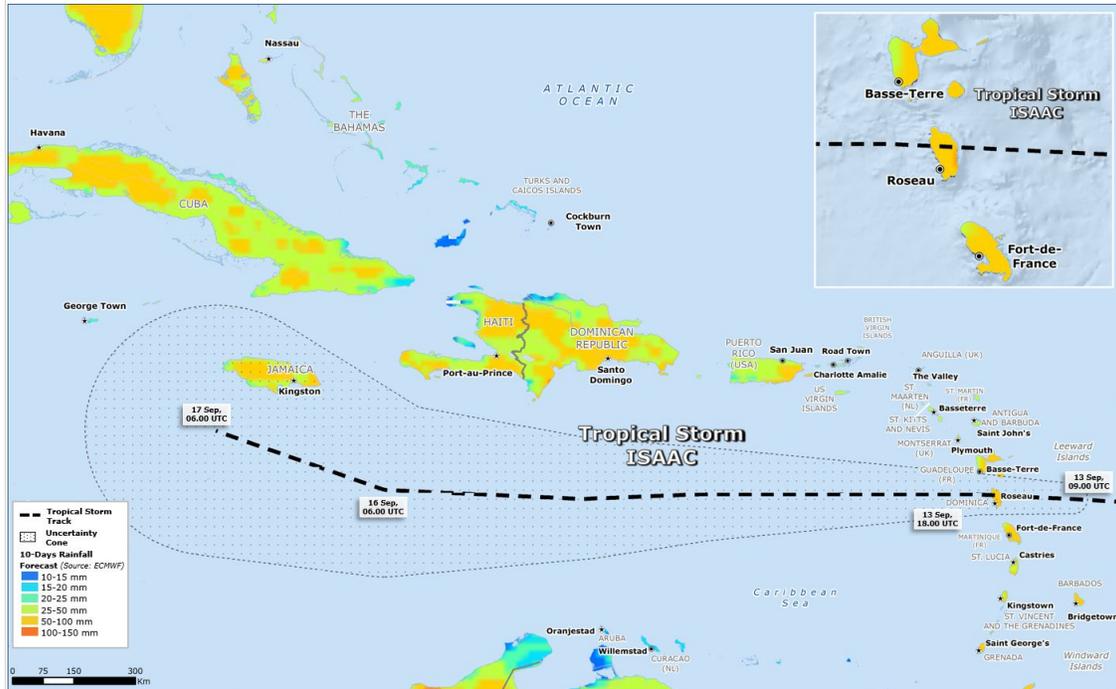


Figure 9 - TC ISAAC in the Caribbean, Track (GDACS, NOAA) and Total rainfall forecast for the next 10 days based on ECMWF, GLOFAS

Storm surge

Low storm surge is forecasted for this event.

2.3 Humanitarian impact and Preparedness

Up to now no relevant humanitarian impact has been caused by the events as the TCs are still over the sea.

Preparedness actions are taking place.

2.2.1. Tropical Cyclone FLORENCE

- **South Carolina:** Emergency Declaration (EM-3400) declared on 10 Sep. Mandatory Evacuations for Coastal Counties (Horry, Georgetown, Charleston, Berkeley, and Dorchester counties and for Edisto Beach) effective from Tuesday, September 11 at Noon local time.
- **North Carolina:** Emergency Declaration (EM-3401) declared on 10 Sep. A mandatory evacuation has been ordered for some coastal and low lying areas.
- **Virginia:** Emergency Declaration (EM-3403) declared on 11 Sep. A mandatory evacuation has been ordered for coastal areas (Zone A).

The mandatory evacuation involves more than **1.7 Million people** (figures below).

Affected countries

Country
United States

Affected provinces

Region Province	Country	Population
North Carolina	United States	6.8 million people
South Carolina	United States	3.6 million people

Affected populated places

Name	Region Province	Country	City class	Population	Distance
Wilmington	North Carolina	United States	City	75000 people	340 km
Florence	South Carolina	United States	City	30000 people	496 km

Table 4 - FLORENCE: Population of the potentially affected provinces (source: GDACS, 13 Sep, 9:00 UTC)



Figure 10 - Residents evacuate from coastal areas near Wallace, N.C. (source: USA today, credits: Andrew Caballero-Reynolds, AFP/Getty Images).



Figure 11 - Wrightsville Beach, North Carolina, prepared for Hurricane Florence by boarding up with wood covered in the names of TCs the store has previously survived. (source: Fox News, credits: Andrew James/WWAY News).

Nuclear Power Plants (source US NRC⁶)

The Nuclear Regulatory Commission resident inspectors at nuclear plants in the Carolinas and Virginia are reviewing the plant operators' preparations in advance of Hurricane Florence.

The NRC is also sending additional inspectors to those plants and will activate its regional incident response center in Atlanta, to provide around-the-clock staff support during the storm. **Brunswick** NPP south of Wilmington, N.C., could face hurricane-force winds, major storm surges and heavy rain.

Other plants near the storm's projected path are also taking precautions. Plant procedures require operators to shut down the reactor well before hurricane-force winds arrive on site. In preparing for Hurricane Florence, the staffs at Brunswick, **Surry** in southeastern Virginia, **Harris** near Raleigh, **Robinson** near Hartsville, and some other plants are working through their severe weather procedures.

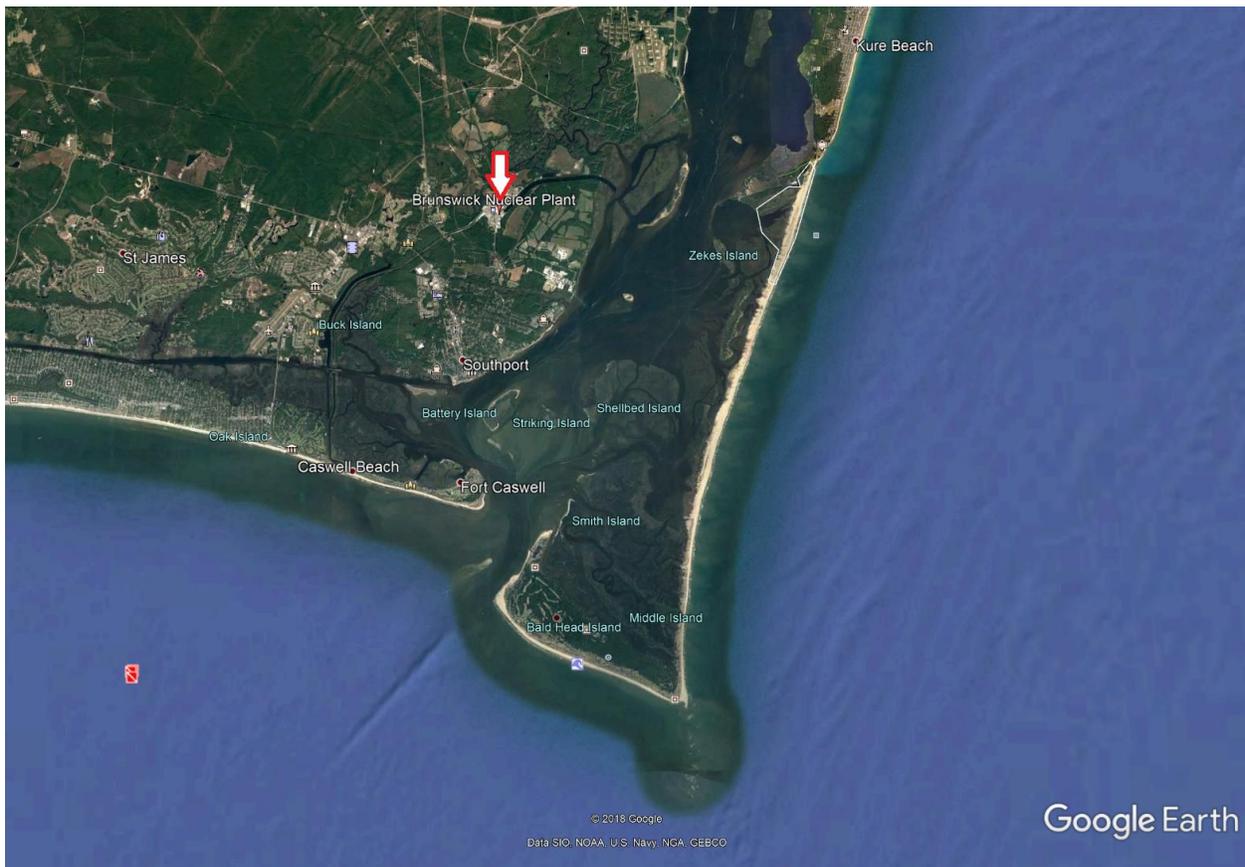


Figure 12 - Location of Brunswick NPP.

⁶ <https://www.nrc.gov/reading-rm/doc-collections/news/2018/18-032.ii.pdf>

Power Plant	#Units	Type	Power	Max vel (km/h)	Storm Surge (m)
Brunswick	2 Units	BWR	767+754 MW	77.	1.6
Robinson	1 Unit	PWR	683 Mw	25.	-
Harris	1 Unit	PWR	860	35.	-
Sarry	2 Units	PWR	781+781 MW	49.	0.09

2.2.2. Tropical Cyclone ISAAC

Preparedness actions are ongoing in the countries with deployment of teams under the Regional Response Mechanism led by the Caribbean Disaster Emergency Management Agency (CDEMA). Regarding the preparedness status of the exposed Countries, the map below shows the current preparedness plan for the Caribbean area.

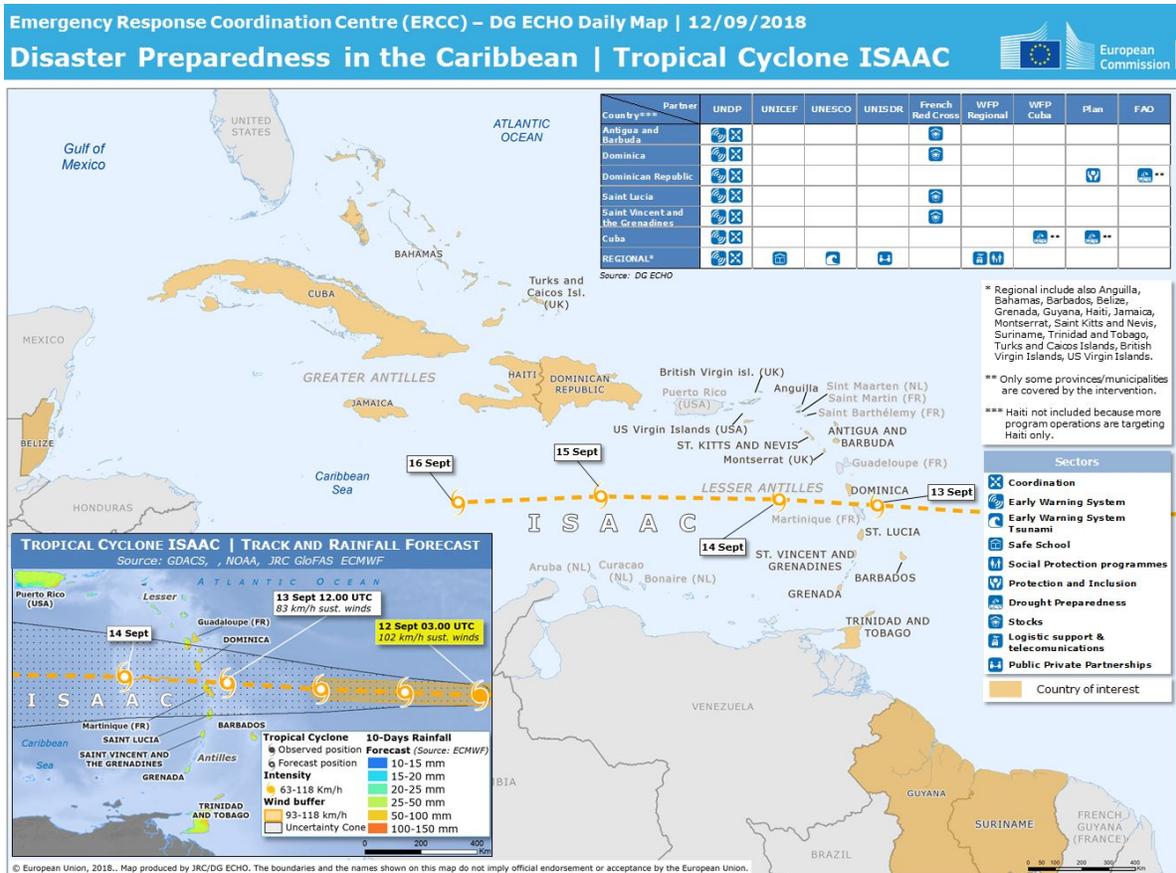


Figure 13 - Disaster Preparedness in the Caribbean | Tropical Cyclone ISAAC (12 September 2018 ECHO Daily map)

3 JRC contributions

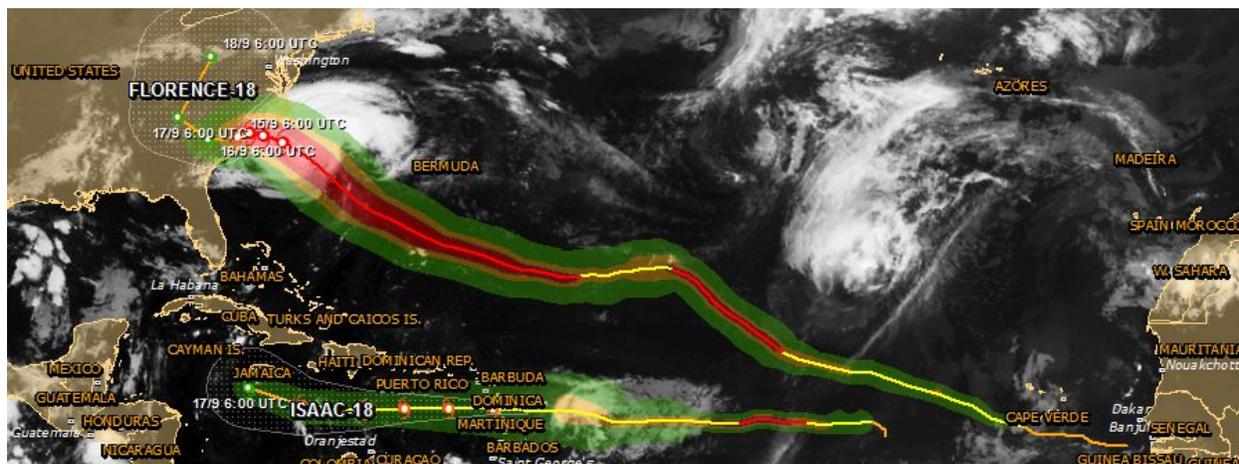


Figure 14 - Tropical Cyclone FLORENCE and ISAAC (source GDACS)

In the period after the end of ARISTOTLE services and the beginning of the new 24h service that is being prepared, JRC supplies ERCC with a similar service during working hours.

The JRC provides updated information on TC FLORENCE MANGKHUT since 10th September for the ECHO Daily Flash reports, available at <http://erccportal.jrc.ec.europa.eu/ECHO-Flash>.

As a preparedness action on mid July 2018, under the request of the Emergency Response and Coordination Centre (ECHO/ERCC) the JRC analysed the relevant past events and seasonal forecast in the Caribbean area. The report is available at:

http://portal.gdacs.org/GDACSDocuments/013-TC_Seasonal_Forecast_CaribbeanRegion.pdf

In terms of operational systems the following ones have been activated:

- GDACS, Global Disasters Alerts and Coordination System
- GLOFAS, Global Flood Awareness System
- Copernicus EMS, Emergency Mapping Service

3.1. GDACS System for FLORENCE and ISAAC

JRC is responsible for the operation of GDACS (www.gdacs.org) that plays a major role in alerting the international community to humanitarian emergencies during natural disasters. The alerts of GDACS (Green, Orange, Red) are based on the severity of the event, the population involved and the vulnerability of the countries (see Annex). GDACS also sends e-mail and SMS alerts to subscribed recipients.

The JRC is closely following TC **FLORENCE** because of the strength and the possible impact, and it is following **ISAAC** due to the vulnerability of the countries potentially affected, that were severely affected last year by Hurricane IRMA and MARIA. The present report was done at the request of the ERCC.

Event alert

FLORENCE: GDACS has issued the first **ORANGE** Alert for this event in the USA on 9 September at 03:00 UTC, reclassified as **RED** alert on 10 September at 15:00 UTC, then again to Orange on 11 September and to GREEN on 13 September at 03:00 UTC, depending on the variation of the forecasted track (different number of exposed people) and intensity.

According to the latest bulletin (13 Sep, 09:00 UTC), the GDACS alert level is GREEN (for high winds) for this event in the USA with 1.7 million people in Category 1 or higher strength winds (> 120 km/h).

ISAAC: the GDACS alert level for ISAAC has been always **GREEN**.

The possible impact due to winds, rainfall and storm surge for these two TCs are shown below, while the automatic GDACS reports can be found at these addresses:

- FLORENCE: <http://www.gdacs.org/report.aspx?name=FLORENCE-18> .
- ISAAC: <http://www.gdacs.org/report.aspx?name=ISAAC-18>

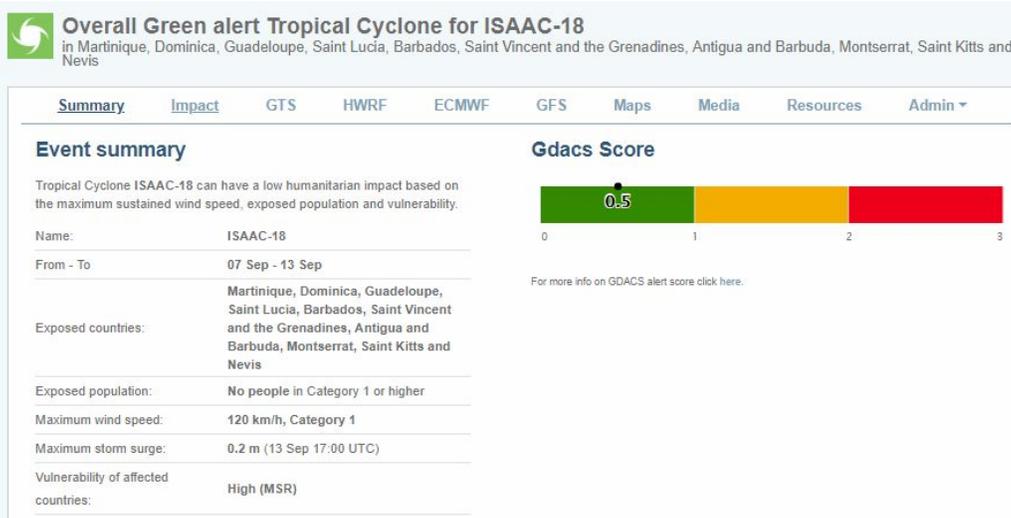
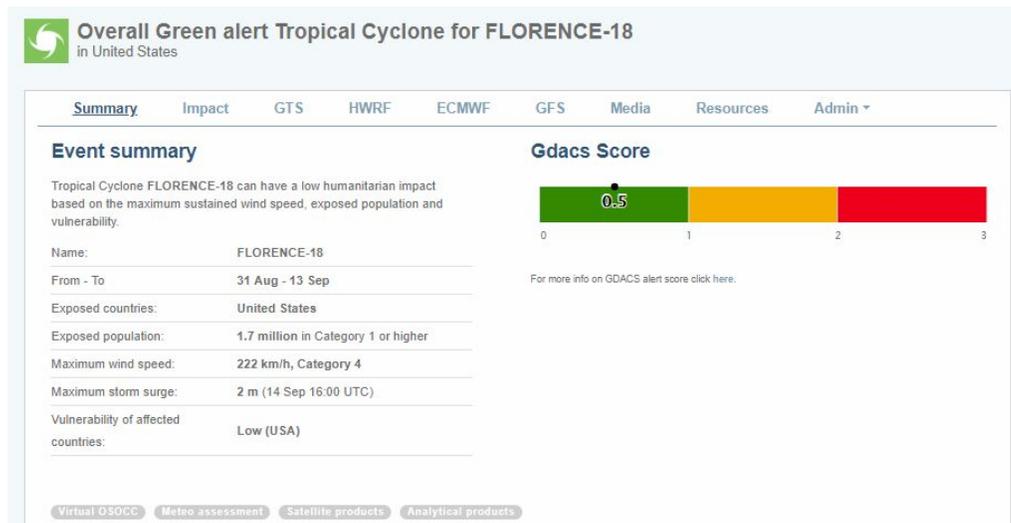


Figure 15 - Automatic GDACS impact estimation (as of 13 Sep 2018, 09:00 UTC).

FLORENCE (Top), ISAAC (Bottom).

Bulletin Timeline

Advisory	Alert color	Date (UTC)	Category	Wind speed	Population in Tropical Storm	Population in Cat.1 or higher	Location (lat, lon)
1	Green	30 Aug 2018 15:00	Tropical depression	46 km/h (29 mph)	no people	no people	12.9, -18.4
2	Green	30 Aug 2018 21:00	Tropical depression	46 km/h (29 mph)	no people	no people	12.9, -19.4
3	Green	31 Aug 2018 03:00	Tropical depression	56 km/h (34 mph)	no people	no people	13.2, -20.9
4	Green	31 Aug 2018 09:00	Tropical depression	56 km/h (34 mph)	no people	no people	13.6, -21.4
5	Green	31 Aug 2018 15:00	Tropical depression	56 km/h (34 mph)	no people	no people	13.7, -22.7
6	Green	31 Aug 2018 21:00	Tropical depression	56 km/h (34 mph)	no people	no people	13.8, -24.7
7	Green	01 Sep 2018 03:00	Tropical depression	56 km/h (34 mph)	no people	no people	14.2, -25.5
8	Green	01 Sep 2018 09:00	Tropical storm	65 km/h (40 mph)	no people	no people	14.5, -26.7
9	Green	01 Sep 2018 15:00	Tropical storm	74 km/h (46 mph)	no people	no people	14.8, -27.8
10	Green	01 Sep 2018 21:00	Tropical storm	74 km/h (46 mph)	no people	no people	15.6, -29
50	Green	11 Sep 2018 21:00	Category 4	222 km/h (138 mph)	no people	no people	27.5, -67.1
51	Green	12 Sep 2018 03:00	Category 4	222 km/h (138 mph)	no people	no people	28.4, -68.7
52	Green	12 Sep 2018 09:00	Category 4	213 km/h (132 mph)	no people	no people	29, -70.1
53	Green	12 Sep 2018 15:00	Category 4	213 km/h (132 mph)	no people	no people	29.8, -71.3
54	Green	12 Sep 2018 21:00	Category 3	194 km/h (120 mph)	no people	no people	30.9, -72.5
55	Green	13 Sep 2018 03:00	Category 2	176 km/h (109 mph)	810000 people	no people	32, -73.7
56	Green	13 Sep 2018 09:00	Category 2	176 km/h (109 mph)	2.9 million people	24000 people	32.8, -74.7
56	Green	13 Sep 2018 18:00	Category 2	176 km/h (109 mph)	6.8 million people	790000 people	33.7, -76.1
56	Green	14 Sep 2018 06:00	Category 2	167 km/h (103 mph)	11.2 million people	1.4 million people	34.2, -77.4
56	Green	14 Sep 2018 18:00	Category 1	130 km/h (80 mph)	11.9 million people	1.3 million people	34.3, -78.4
56	Green	15 Sep 2018 06:00	Tropical storm	93 km/h (57 mph)	12.9 million people	no people	34.1, -79.2
56	Green	16 Sep 2018 06:00	Tropical depression	56 km/h (34 mph)	no people	no people	33.9, -81.2
56	Green	17 Sep 2018 06:00	Tropical depression	46 km/h (29 mph)	no people	no people	35.4, -83.3
56	Green	18 Sep 2018 06:00	Tropical depression	37 km/h (23 mph)	no people	no people	39.5, -81

Actual track of the current bulletin
 The alert for forecast greater than 3 days is limited to Orange level.

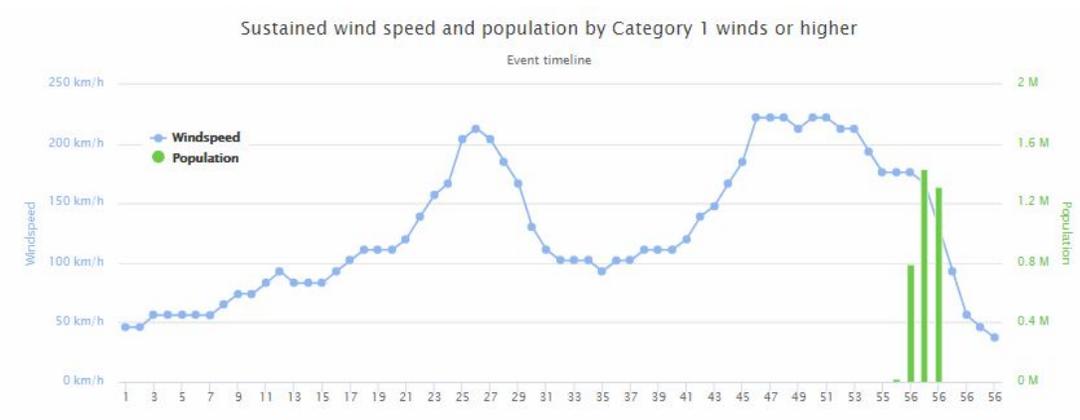


Figure 16 - GDACS Alert for Tropical Cyclone FLORENCE - Event Timeline, population exposed, max. sustained winds (Category: Saffir-Simpson Hurricane Scale, see Annex), as of 13 Sep 2018, 09:00 UTC.

Storm Surge Estimations

According to the JRC HyFlux2 storm surge calculation (using as input the data of the bulletin of 11 Sep 2018 21:00 UTC) and using the standard GDACS model, the areas potentially most affected are all along the North and South Carolina, USA, with a maximum value

- **2.0 m** in Surf City and Ocean Beach: on 14 Sep. at 16:00

Other models have also been used to estimate the possible surge. Using ECMWF as meteorological forcing conditions and Delft3d by Deltares as computer code, the maximum height is

- **2.6 m** in the river close to Merrimon on 14 Sep. at 04:15

NOAA estimations of the surge indicate higher values

- Between **2.7 m** and **3.9 m** in Cape Fear NC to Cape Lookout NC, including the Neuse, Pamlico, Pungo, and Bay Rivers (bulletin of 13 Sep 02:00)

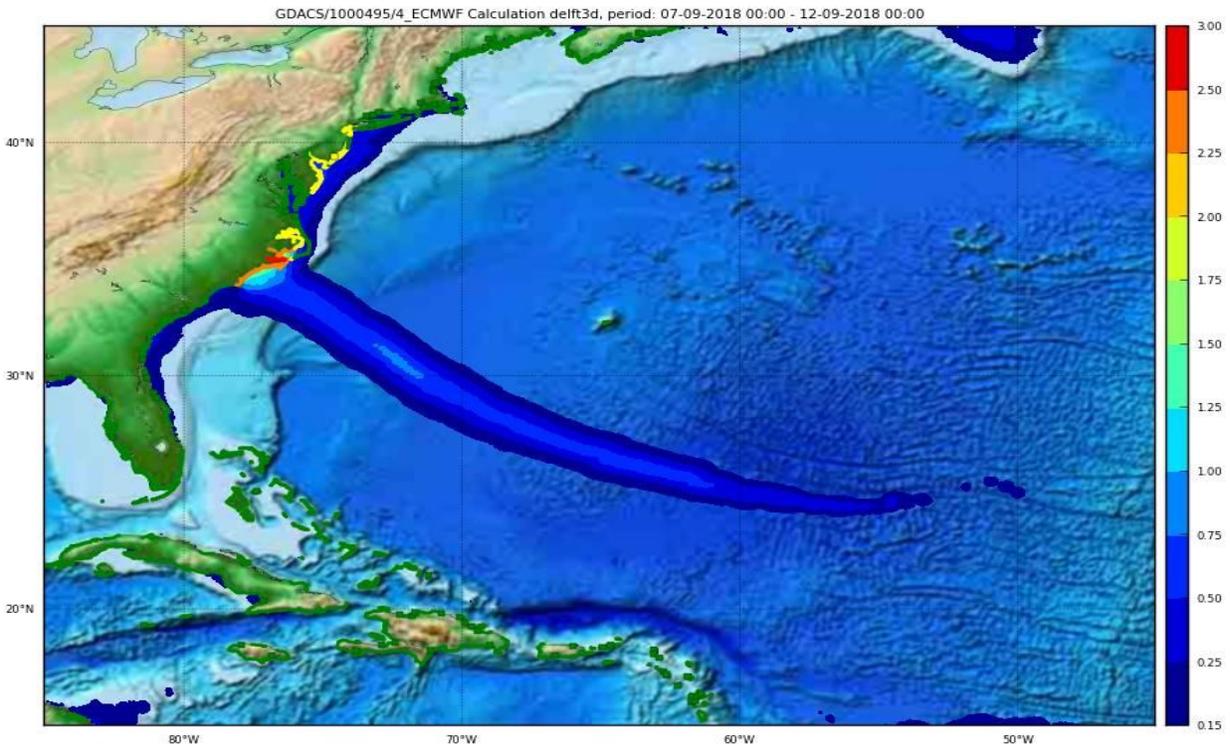


Figure 17 - Storm surge over the track of FLORENCE-18

The list of locations for storm surge is shown below (Fig. 13).

Affected locations

Date	Name	Country	Alert	Storm surge height (m)
14 Sep 2018 08:00:00	Duck Creek	United States		1.7m
14 Sep 2018 08:00:00	Willis Landing	United States		1.7m
14 Sep 2018 08:00:00	Bear Creek	United States		1.7m
14 Sep 2018 08:00:00	Swansboro	United States		1.7m
14 Sep 2018 08:00:00	Bucks Corner	United States		1.7m
14 Sep 2018 08:00:00	Cedar Point	United States		1.7m
14 Sep 2018 08:00:00	Cape Carteret	United States		1.7m
14 Sep 2018 08:00:00	Bogue	United States		1.7m
14 Sep 2018 08:00:00	Emerald Isle	United States		1.7m
14 Sep 2018 08:00:00	Ocean	United States		1.7m
14 Sep 2018 08:00:00	Indian Beach	United States		1.7m
14 Sep 2018 07:45:00	Broad Creek	United States		1.6m
14 Sep 2018 08:00:00	Ocean City Beach	United States		1.5m
14 Sep 2018 08:00:00	Thomas Landing	United States		1.5m

Figure 18 - Reference locations for storm surge calculations using ECMWF/delft3d .

The detailed impact for Storm Surge in the landfall area is shown in the Figure 14; for this figure the ECMWF/delft3d calculation was used. This calculation was performed using the meteorological parameters of 12 Sep 12:00.

These values could still change due to the track/intensity uncertainty and do not include the possible effects on China because storm surge is calculated only for 3 days forecast.

Note: JRC storm surge calculations don't include wave, tide and river effects. It is important to note that in the area of a delta river, the storm surge may be higher. The torrential rains that may affect the mountains areas during the passage of a Tropical Cyclone may increase the river flow and its outflow could be blocked by the incoming storm surge. This could create floods in the surrounding areas of the cities close to a delta river.

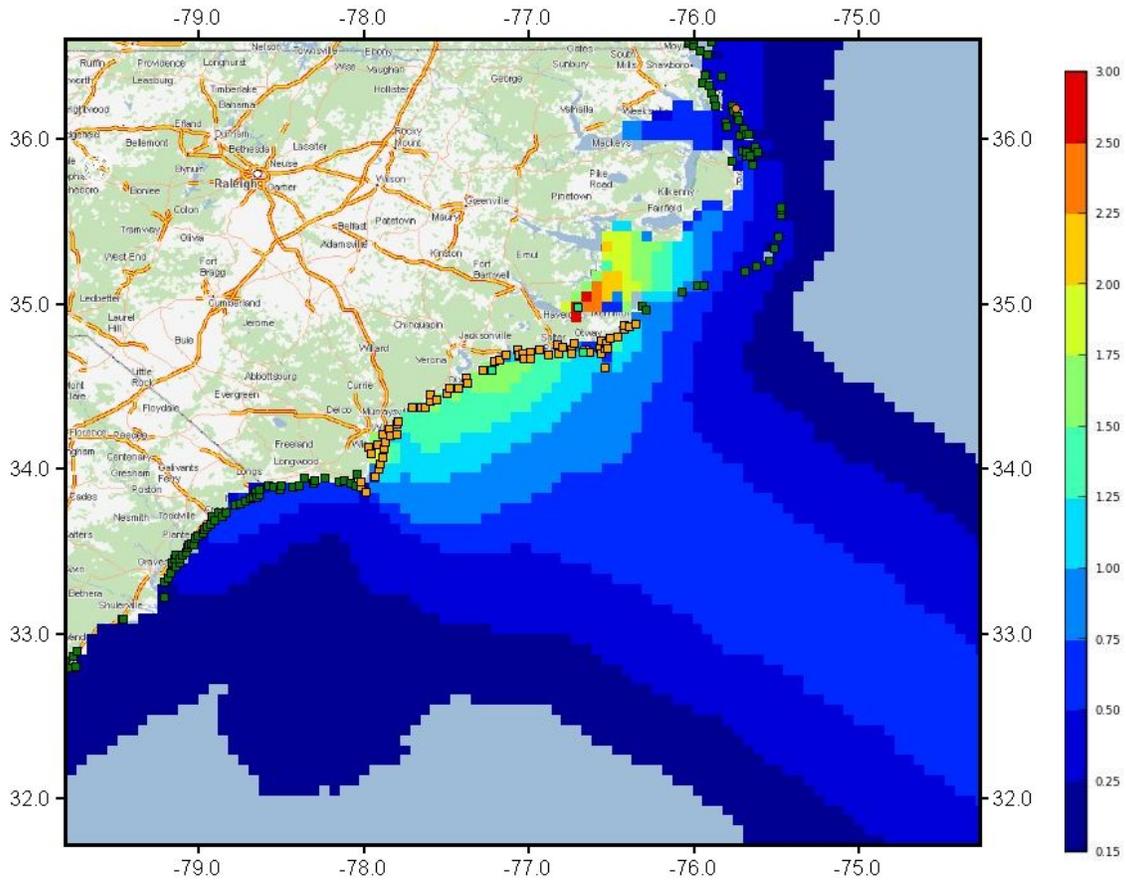


Figure 19 - Storm surge impact in the US coast close to the landfall area

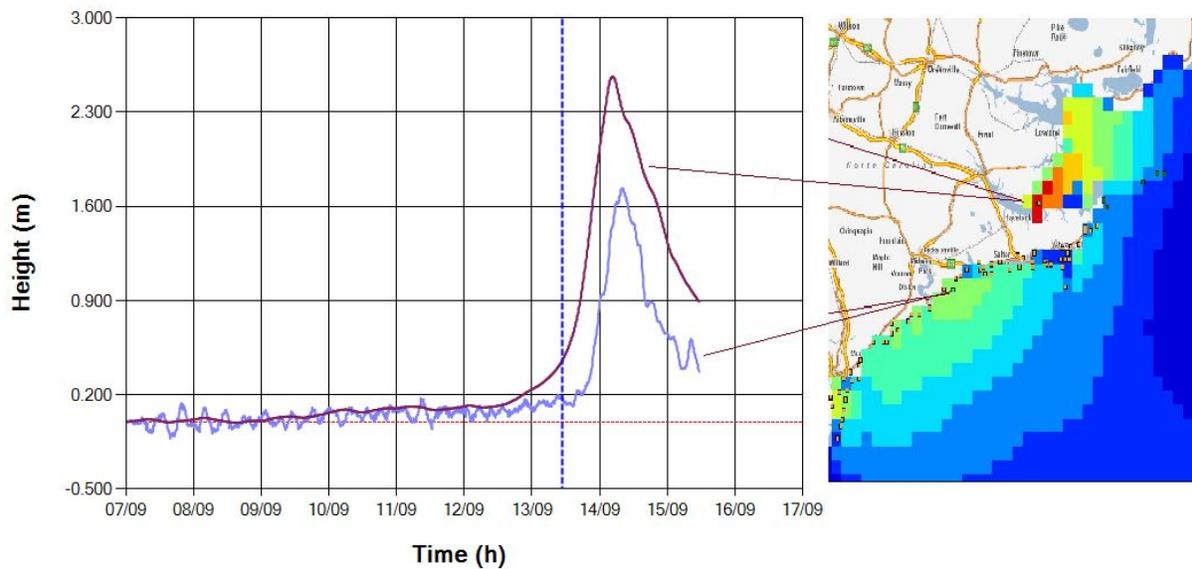


Figure 20 - Storm surge estimated in two locations along the US coast, close to the landfall
 It is possible to note that in some bays the surge may be particularly relevant, reaching about 2.5 m

- **LESSER ANTILLES:** ISAAC is not expected to produce a large storm surge in the Lesser Antilles. JRC calculations indicate a max. 0.1 m in Dominica and 1.2 in Guadeloupe. However some coastal flooding is possible also due to a combine effect with the rainfall and near the coast the storm surge will be accompanied by large waves.

Potentially most affected areas: **Dominica, and Guadeloupe**

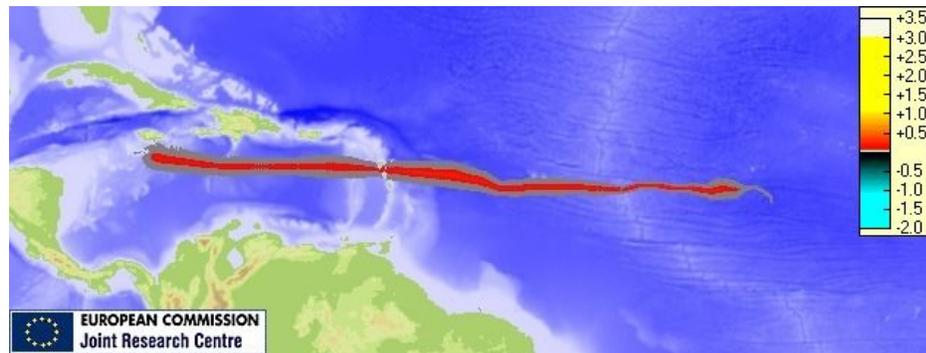


Figure 21 - Storm surge due to ISAAC in the Caribbean (JRC, GDACS)

3.2. GLOFAS System

The Global Flood Awareness System (GloFAS), jointly developed by the European Commission and the European Centre for Medium-Range Weather Forecasts (ECMWF), is independent of administrative and political boundaries. It couples state-of-the-art weather forecasts with a hydrological model and with its continental scale set-up it provides downstream countries with information on upstream river conditions as well as continental and global overviews. GloFAS is part of the Copernicus Emergency Management Service.

According to the latest forecast from 13 September 2018 GloFAS predicts a **high probability of river floods with a magnitude higher than 20 year return periods** for the coastal areas of South Carolina (see Figure 22). River discharges will start increasing from 15 September onwards with peak discharges predicted around 18/19 September

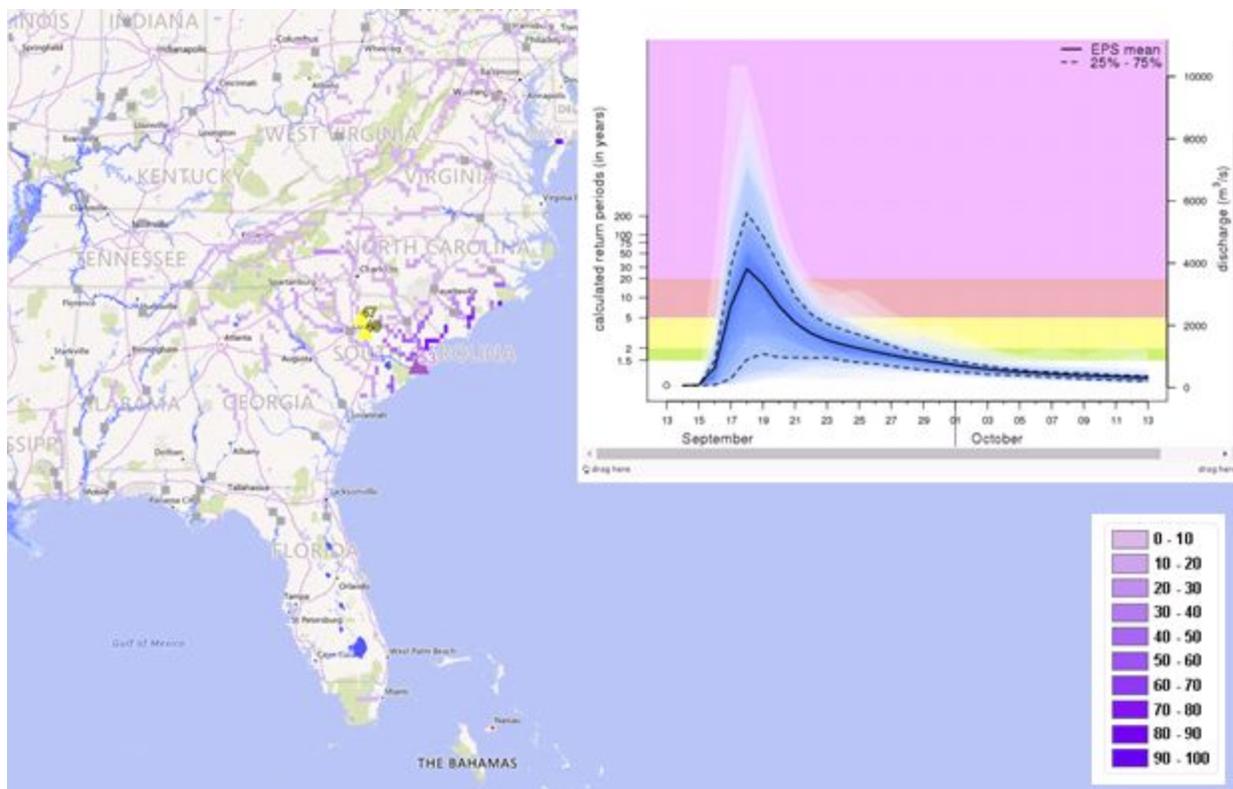


Figure 22 - GloFAS forecast from 13-09-2018 for the South Carolina, US. Purple shaded pixels denote the probability [%] to exceed a 20 year return period flood. The hydrographs depicts the predicted river discharge at the outflow of the Black River (Winyah Bay).

3.3 Copernicus EMS activation

The Copernicus Emergency Management Service (EMSR311) was activated by the EU Delegation in Washington on behalf of the US Federal Emergency Management Agency (FEMA) on 11 September at 14:00 UTC. The request is for providing information on flood extent and damages to infrastructure, landslides, etc. for vast areas in South Carolina, North Carolina and Virginia (see preliminary areas below).

The planning for production and related satellite taskings will be finalised in the afternoon of 13 September according to the last updates on the hurricane's track and expected impact. First satellite acquisitions will be from SAR (radar) sensors, among them Sentinel-1 which will acquire over the area on 14-15 September. Other sensors might be tasked to complete the coverage. Imagery for damage assessments (optical) will be tasked once the weather conditions improve.

Resource optimisation is sought with the International Charter for Space and Major Disasters which was activated on 12 September following a request from FEMA (activation 585) and for which DG ECHO-ERCC has asked official data access (according to procedures which are in place since April 2018, see chapter 4.3). Currently, we are waiting to receive information from the Charter on their tasking and production plans which will influence the planning of Copernicus EMS production and tasking.

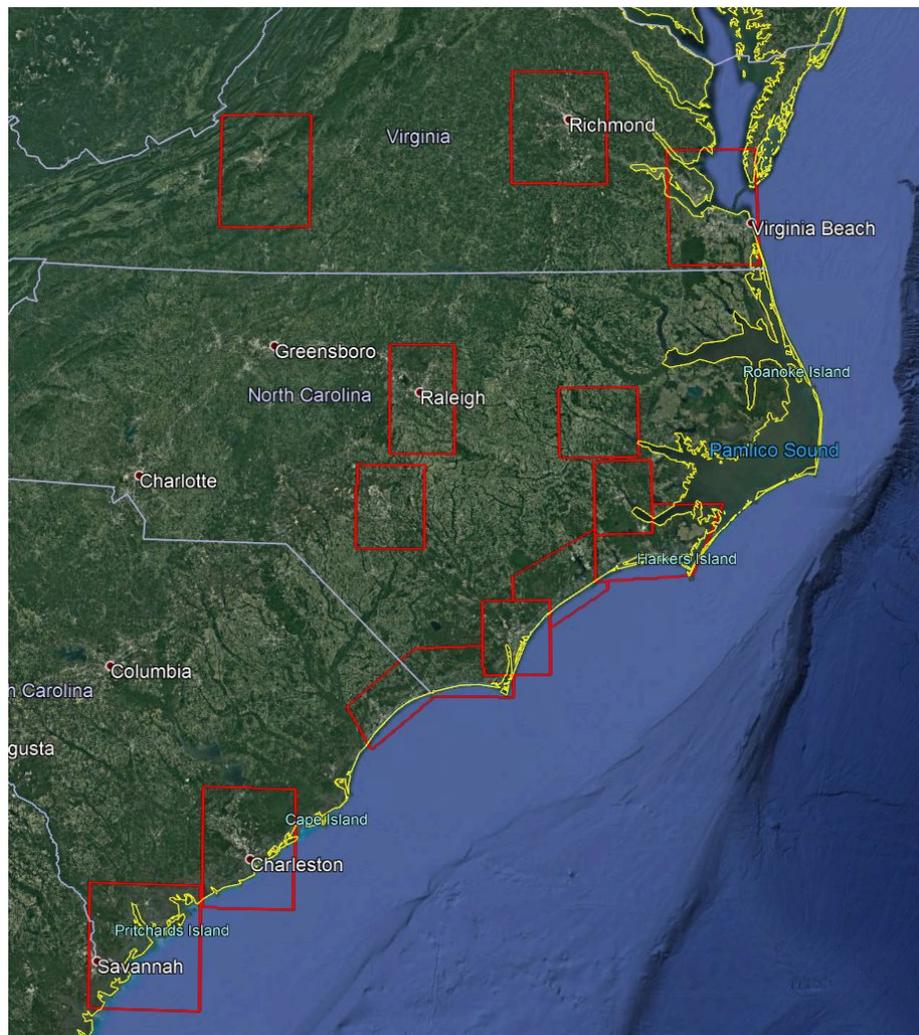


Figure 23 - Preliminary areas of interest of Copernicus EMS

More information and updated information is available at
<http://emergency.copernicus.eu/mapping/list-of-components/EMSR311>

4 Other information

4.1 Virtual OSOCC Activation

None.

4.2 International Charter for Space and Major Disasters

Following a request from the US Federal Emergency Management Agency (FEMA) the Charter was activated on 12 September (activation 585). In the frame of the collaboration agreement between Copernicus EMS and the Charter which was signed in April 2018, DG ECHO-ERCC has asked on 12 September access to the Charter data to be used in the Copernicus EMS assessments.

More information on the Charter call is available at
<https://disasterscharter.org/web/guest/activations/-/article/cyclone-in-united-states-activation-585->

5 Expected Updates

The report will be updated if relevant changes will be identified.

6 References and contact points within JRC

Contact points within JRC: Disaster Risk Management Unit

- Alessandro Annunziato, alessandro.annunziato@ec.europa.eu (GDACS)
- Pamela Probst, pamela.probst@ec.europa.eu (GDACS Meteorologist)
- Chiara Proietti, chiara.proietti@ec.europa.eu (Humanitarian response)
- Thomas Petroliaqkis, thomas.petroliaqkis@ec.europa.eu (GDACS Meteorologist)
- Annett Wania, annett.wania@ec.europa.eu (Copernicus EMS activation)

- Ian Clark, ian.clark@ec.europa.eu
- Tom De Groeve, tom.de-groeve@ec.europa.eu

For updated information on the disaster, please consult the following web sites:

- GDACS: <http://www.gdac.org>
- ERCC portal: <http://ercportal.jrc.ec.europa.eu/>
- Copernicus EMS: <http://emergency.copernicus.eu/mapping/list-of-components/EMSR311>
- National Meteorological service:
 - USA: <https://www.weather.gov/>
 - Guadeloupe (France) : <http://www.meteofrance.gp/>
 - Martinique (France): <http://www.meteofrance.gp/>
 - Dominica: <http://www.weather.gov.dm/>

- Regional Specialized Meteorological Centres (RSMCs) and Tropical Cyclone Warning Centres (TCWCs):
 - RSMC Miami-Hurricane Center/NOAA/NWS National Hurricane Center, USA
<http://www.nhc.noaa.gov/index.shtml>
- NOAA-HWRF (Hurricane Weather Research and Forecasting system):
http://www.emc.ncep.noaa.gov/gc_wmb/vxt/HWRF/index.php
- JRC Emergency Report
Tropical Cyclones - 2018 Seasonal Forecast and Past Events in the Caribbean Region
http://portal.gdacs.org/GDACSDocuments/013-TC_Seasonal_Forecast_CaribbeanRegion.pdf

Annex 1 - Detailed Map on the Tropical Cyclone

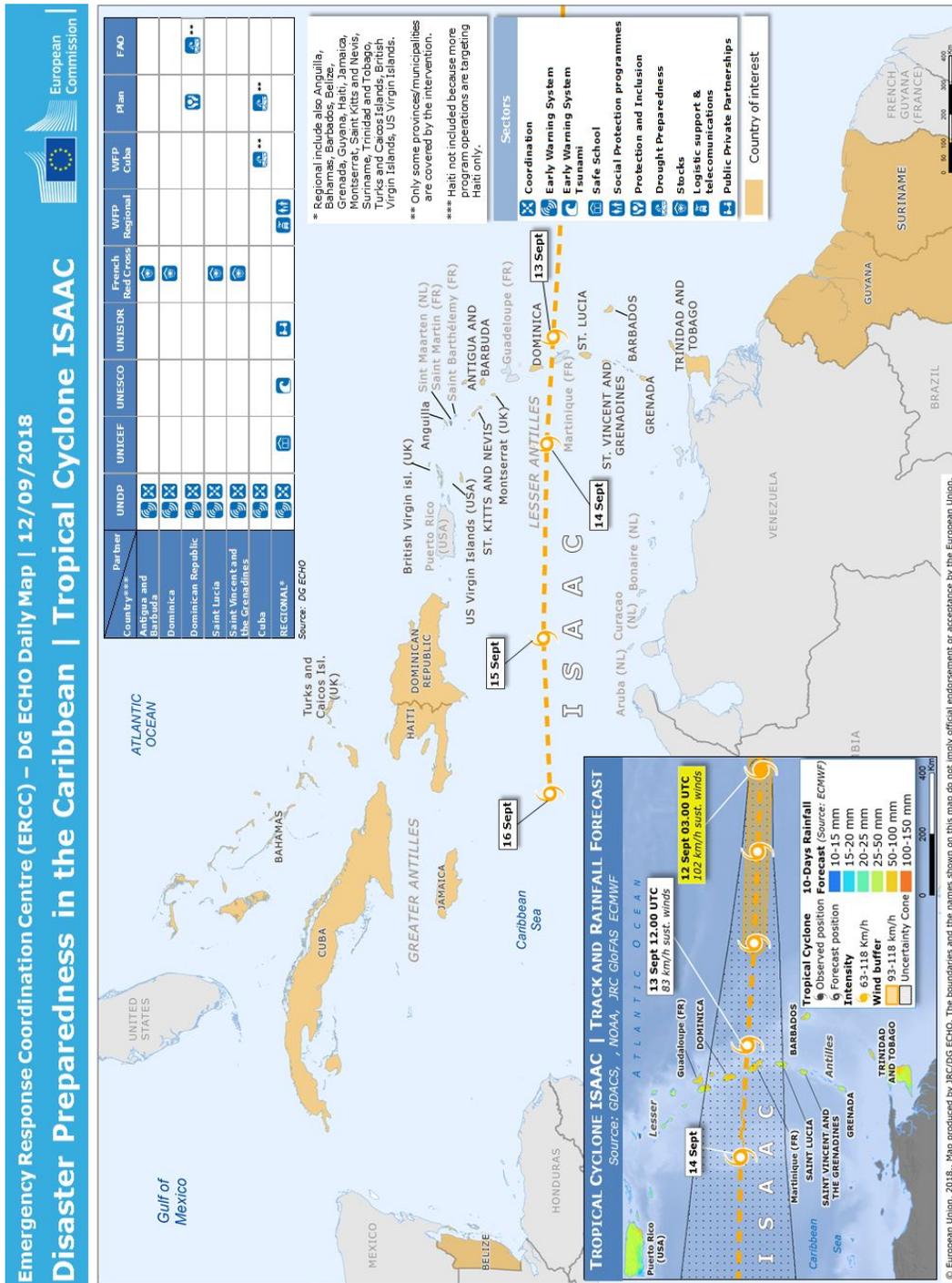


Figure A.1.1 - ECHO Daily map of 12 September 2018 - Disaster Preparedness in the Caribbean | Tropical Cyclone ISAAC

Annex 2 - GDACS Alerts

JRC is responsible for the operation of GDACS (Global Disaster Alerting 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 can be found in the GDACS Guidelines available at:

http://www.gdacs.org/Documents/GDACS%20Guidelines%202014_-_FINAL.PDF

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

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.

TC information:

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 -ECMWF).

→ ATLANTIC: NOAA-NHC data

Wind

The GDACS alert levels for the TCs are based on the risk formula that includes:

- TC wind speed⁷ (hazard)
- Population affected
- Vulnerability of the affected country

The equivalent Category based on the Saffir-Simpson Hurricane Wind Scale (SSHS), 1-min sustained winds, is also indicated in GDACS (see next page).

The overall alert for a Tropical Cyclone comes from **wind effects**.

⁷ GDACS, JTWC, NOAA wind information based on 1-min sustained winds; other centers: 10-min average (see: https://www.wmo.int/pages/prog/www/tcp/documents/WMO_TD_1555_en.pdf)

Recently, in order to avoid too much false alerts or flip-flop effects due to the too early forecast and change of track direction or intensity, the alert level for forecast data with more than 3 days lead time is limited to Orange Alert, even if Red Alert is estimated.

Storm Surge

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. It was implemented in the HyFlux2 code, routinely used in GDACS to model inundation due to tsunami run-up.

The GDACS alert levels are based on the maximum storm surge height:

- Green: < 1.0 m;
- Orange: 1.0m - 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.

TC Classification used in GDACS

The equivalent Category based on the Saffir-Simpson Hurricane Wind Scale (SSHS) is also indicated in GDACS. The SSHS is the official scale used by NOAA-NHC for the North Atlantic TC basin and is a scale from 1 to 5, based on the 1-min sustained wind speed and it estimates the potential property damage (see Table A.2.1).

Saffir-Simpson Hurricane Wind Scale (SSHS), source NOAA-NHC		
Hurricane CATEGORY	1-min sustained winds (km/h)	Types of Damage Due to Hurricane Winds
Cat. 1	119 - 153	Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.
Cat. 2	154 - 177	Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks
Cat. 3 <i>Major Hurricane</i>	178 - 208	Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes
Cat. 4 <i>Major Hurricane</i>	209 - 251	Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
Cat. 5 <i>Major Hurricane</i>	≥ 252	A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months

Table A2.1 -TC Classification (Saffir-Simpson Hurricane Wind Scale), used in GDACS.
(see NOAA-NHC: <http://www.nhc.noaa.gov/aboutsshws.php>)

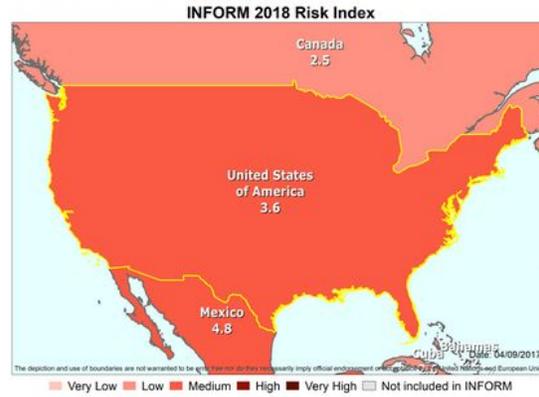
Annex 3 - INFORM

UNITED STATES OF AMERICA



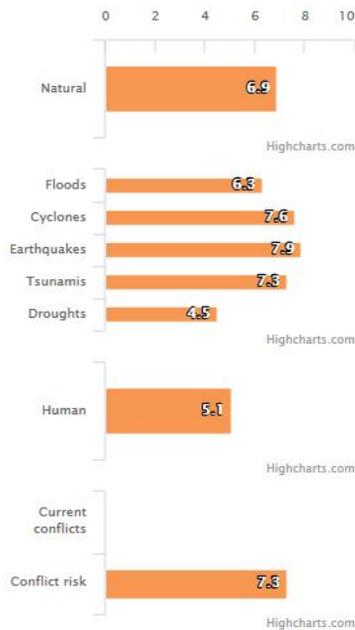
Northern America
High income

	Value	Rank	Trend
INFORM Risk	3.6	98	—
Hazard & Exposure	6.1	30	—
Vulnerability	3.5	85	—
Lack of Coping Capacity	2.2	163	—

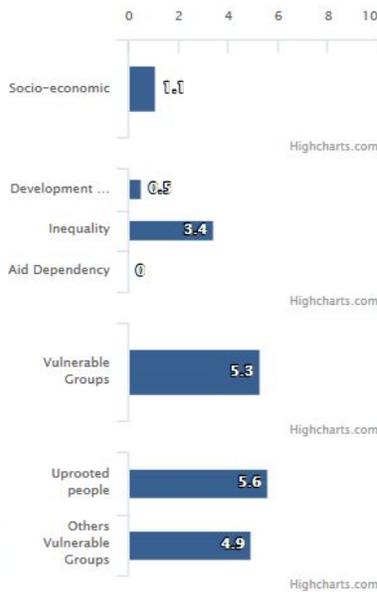


▼ RISK DIMENSIONS AND COMPONENTS

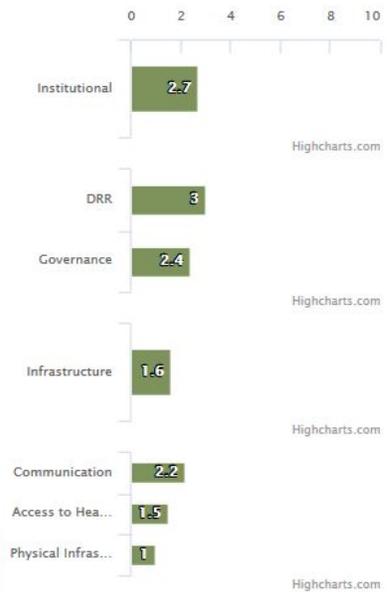
Hazard & Exposure



Vulnerability



Lack of Coping Capacity

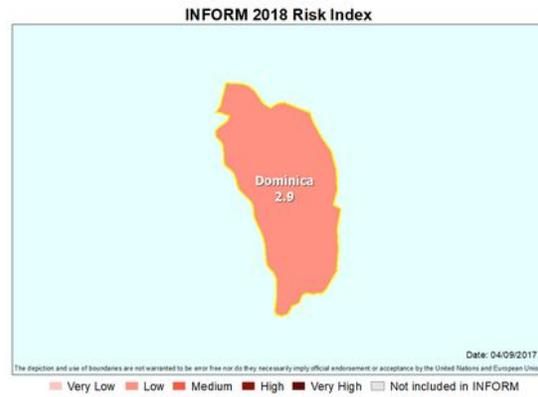


DOMINICA



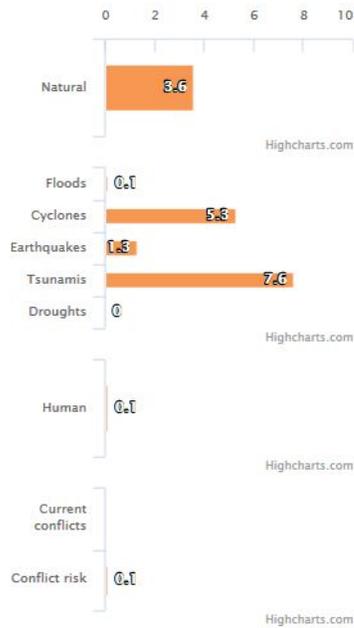
Caribbean
Upper middle income

	Value	Rank	Trend
INFORM Risk	2.9	117	—
Hazard & Exposure	2	144	—
Vulnerability	3.4	88	—
Lack of Coping Capacity	3.7	128	—



▼ RISK DIMENSIONS AND COMPONENTS

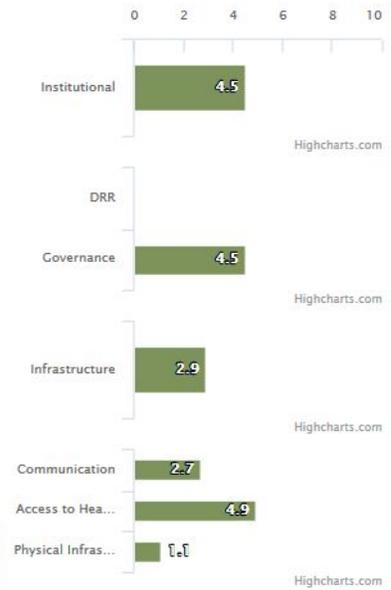
Hazard & Exposure



Vulnerability



Lack of Coping Capacity



Annex 4 - Historical TCs in the area

The official hurricane season for the Atlantic Basin (Atlantic Ocean, Caribbean Sea and Gulf of Mexico) is between June 1 and November 30. On average, 12 named storms (of tropical storm or higher strength) occur each season, with an average of 6 becoming hurricanes and 3 becoming major hurricanes. The climatological peak of activity is around mid September.

The JRC detailed analysis on the most significant TCs in the whole Caribbean Region can be found on the JRC Emergency Report available on GDACS at:

http://portal.gdacs.org/GDACSDocuments/013-TC_Seasonal_Forecast_CaribbeanRegion.pdf

The most significant recent TCs that affected North Carolina/South Carolina (USA) over the few years are shown in Annex 4.1., while the most significant of the Lesser Antilles (Dominica, Guadeloupe and Martinique) are in Annex 4.2.

Annex 4.1. USA - North Carolina / South Carolina

TC Name	Dates active	Category at peak intensity	Landfall	Fatalities	Areas mostly affected
MATTHEW	2016, Sep28-Oct9	Cat5 Hurricane	Southwestern coast of Haiti near Les Anglais	585 (most Haiti)	Windward Islands, Leeward Antilles, Venezuela, Colombia, Jamaica, Haiti, Dominican Republic Puerto Rico, Cuba, Turks and Caicos Islands, The Bahamas, Southeastern United States, Atlantic Canada
ARTHUR	2014, 01Jul-05Jul	Cat2	North Carolina	-	The Bahamas Eastern United States Eastern Canada Quebec
IRENE	2011, 20Aug-29Aug	Cat 3	North Carolina, New Jersey, New York	56	Hispaniola, Lesser Antilles, Greater Antilles, Turks and Caicos, Bahamas, East Coast of the United States, Atlantic Canada
EARL	2010, Aug25-Sep05	Cat4	Nova Scotia, Canada	5	

Annex 4.2. Lesser Antilles (Dominica, Guadeloupe and Martinique)

TC Name	Dates active	Category at peak intensity	Landfall	Fatalities	Areas mostly affected
BERYL	2018, 05Jul-09Jul	Cat. 1	Dominica	-	Dominica, Dominican Republic and Puerto Rico
MARIA	2017, Sep16-30 Sep	Cat. 5	North Carolina	146	Lesser Antilles(Dominica, Guadeloupe, Martinique, Saint Croix), Puerto Rico, Dominican Republic, Turks and Caicos Islands, The Bahamas, Southeastern USA, Mid-Atlantic States USA
ERIKA	2015, Aug25-Aug29	Tropical Storm		31	Lesser Antilles (Dominica), Greater Antilles, Florida
DANNY	2015, 18Aug-24 Aug	Cat 3	n.a.	-	Northern Leeward Islands, the Virgin Islands, Puerto Rico, and Hispaniola
BERTA	2014	Tropical Storm	landfall on Middle Caicos Island	2	Martinique, Lesser Antilles, Puerto Rico, Cuba, Turks and Caicos Islands, The Bahamas East Coast of the United States
ISAAC	2012, Aug21-Sep01	Cat1	Southeastern Louisiana	34	Leeward Islands, Puerto Rico, Haiti, Dominican Republic, Cuba, The Bahamas, South-Eastern United States (Louisiana), Midwestern United States
IRENE	2011, 20Aug-29 Aug	Cat 3	North Carolina	48	Guadeloupe, The Bahamas (Crooked, Acklins and Long Island), Northeastern United States (New Jersey, Massachusetts and Vermont)

Annex 5 - Weather forecasts for Specific Locations (Ensemble Meteograms)

5.1 - Product Description

Ensemble Meteograms contain information coming from both the deterministic single model high-resolution (HRES) operational forecast and the Ensemble Prediction System (EPS) comprising 50 ensemble (ENS) members plus one (control forecast).

The horizontal resolution of the HRES is ~8 km whereas the resolution of ensemble members (and the control) is ~16 km. HRES is denoted by blue, whereas the control forecast (of the ensemble) is denoted by red colour.

The values of the ensemble are contained in a box plot type of diagram that graphically depicts groups of numerical data through their quartiles while maximum and minimum values are highlighted by whiskers.

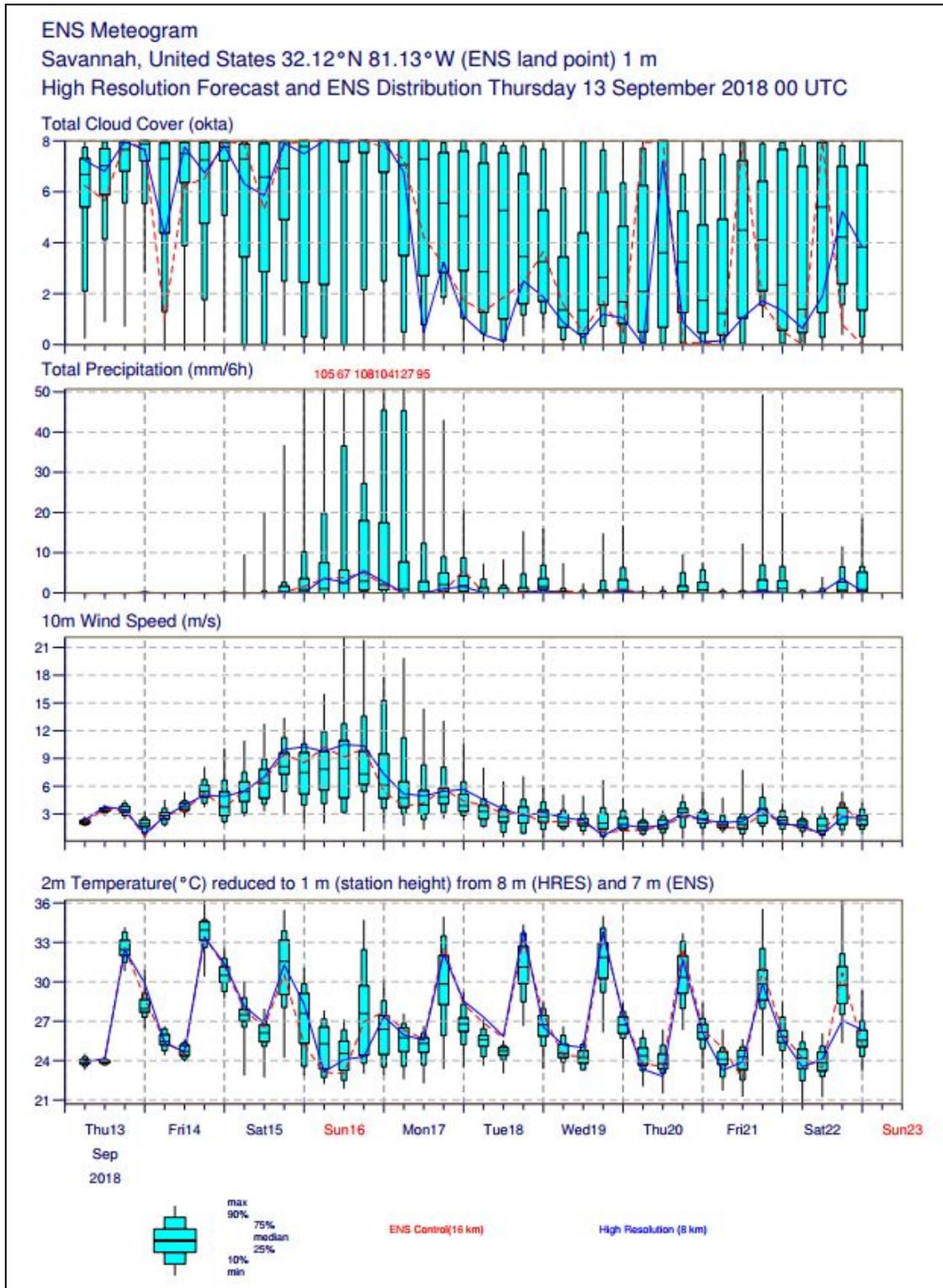
The first panel of meteogram contains the total (low - medium & high) cloudiness in octas. The second panel refers to the total (convective and large-scale) precipitation utilising values estimated over 6-hour intervals. The third panel refers to the instantaneous (averaged over 10 minutes) wind speed values. The fourth panel refers to the temperature at 2 meters height.

All Meteograms are based on the latest run of ECMWF HRES and EPS initiated from Wednesday 13 September 00 UTC (Analysis).

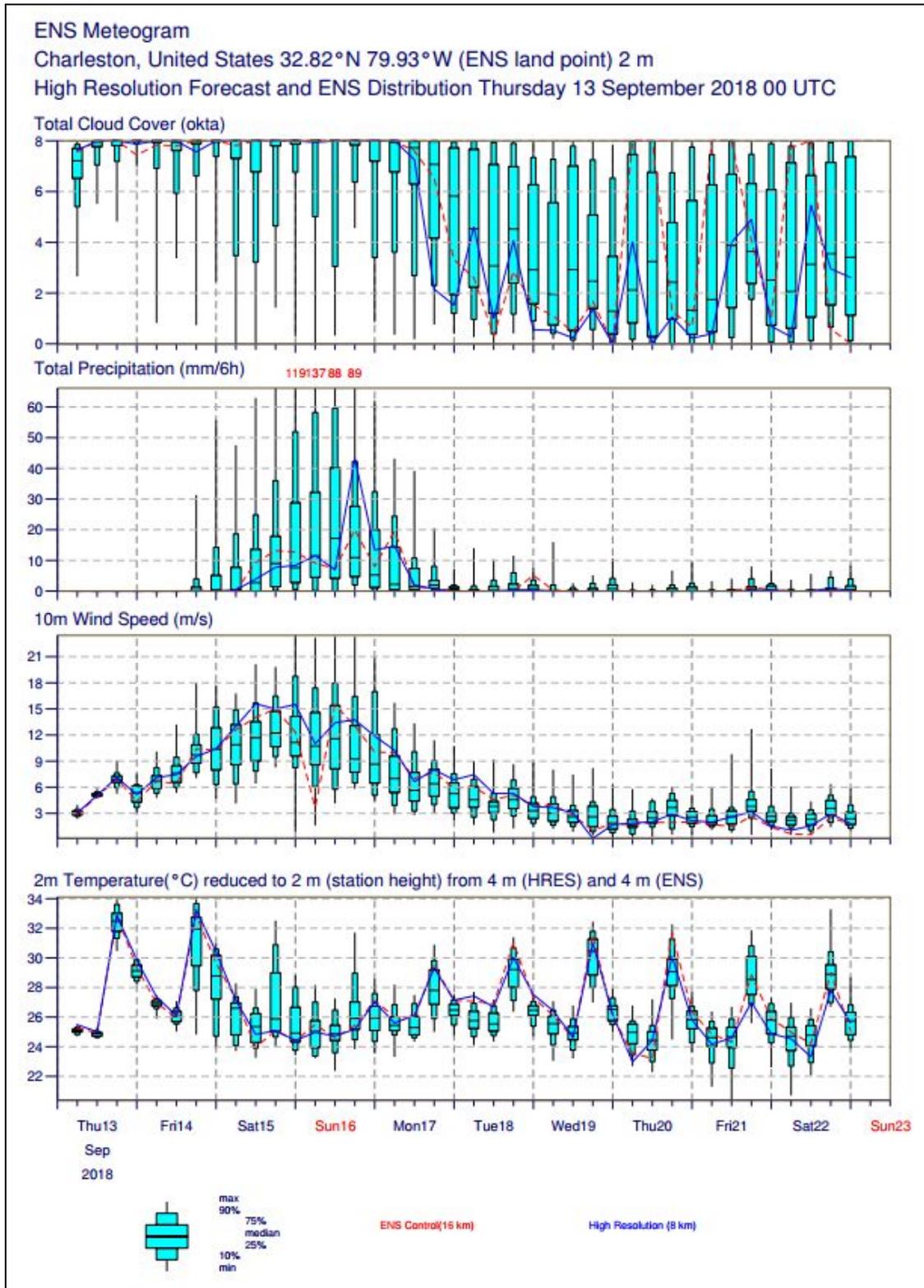
Points of Reference

- Savannah - Georgia, USA (Annex 5.2) - [TC FLORENCE]
- Charleston - South Carolina, USA (Annex 5.3) - [TC FLORENCE]
- Wilmington - North Carolina, USA (Annex 5.4) - [TC FLORENCE]
- Roseau - West Indies, Commonwealth of Dominica (Annex 5.5) - [TC ISAAC]
- Martinique - Lesser Antilles, France (Annex 5.6) - [TC ISAAC]
- Guadeloupe - Lesser Antilles, France (Annex 5.7) - [TC ISAAC]
- Cul-de-Sac - Sint Maarten, Antilles, Netherlands (Annex 5.8) - [TC ISAAC]

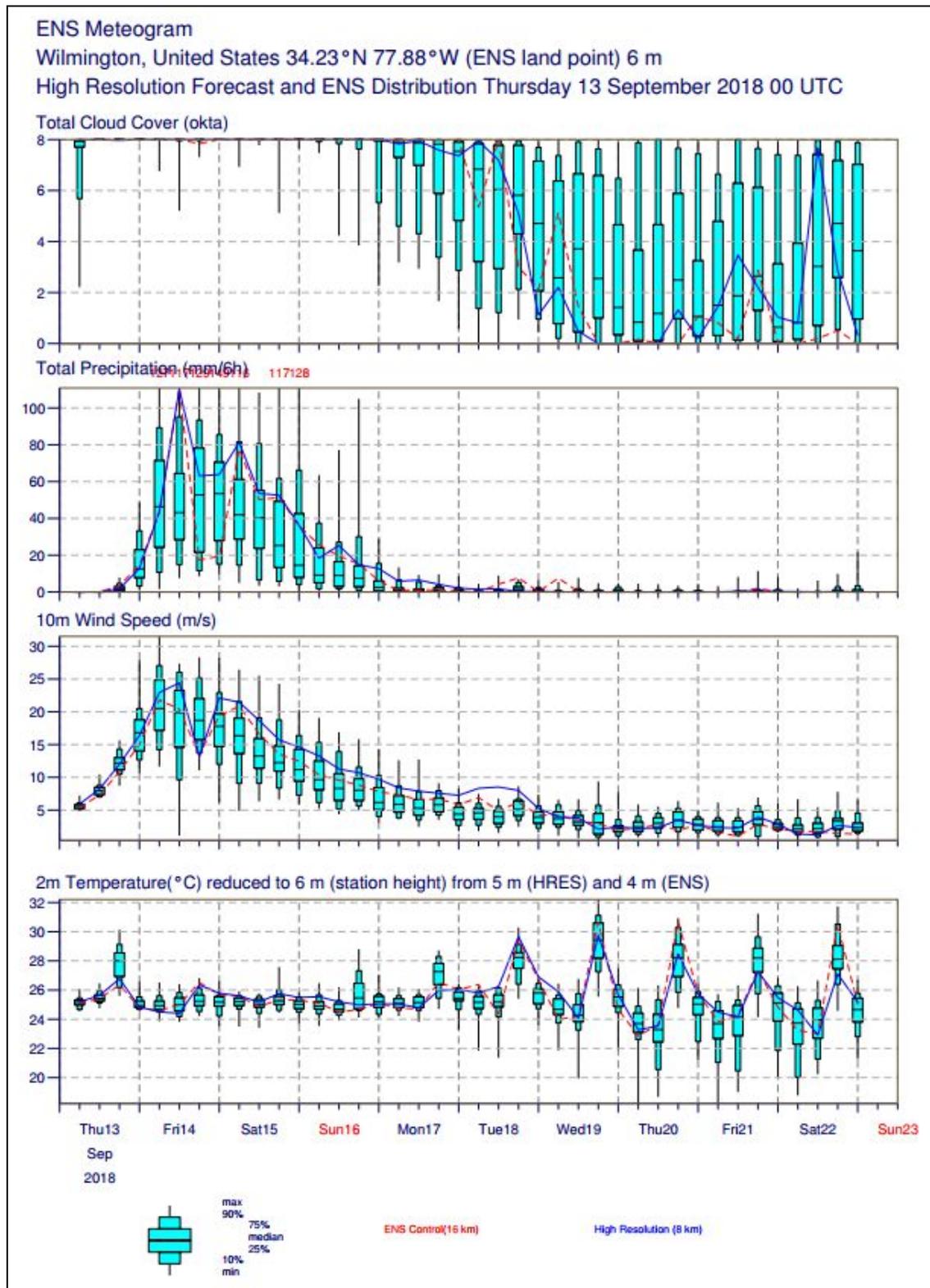
5.2 - Meteogram for the greater area of Savannah, Georgia (USA)



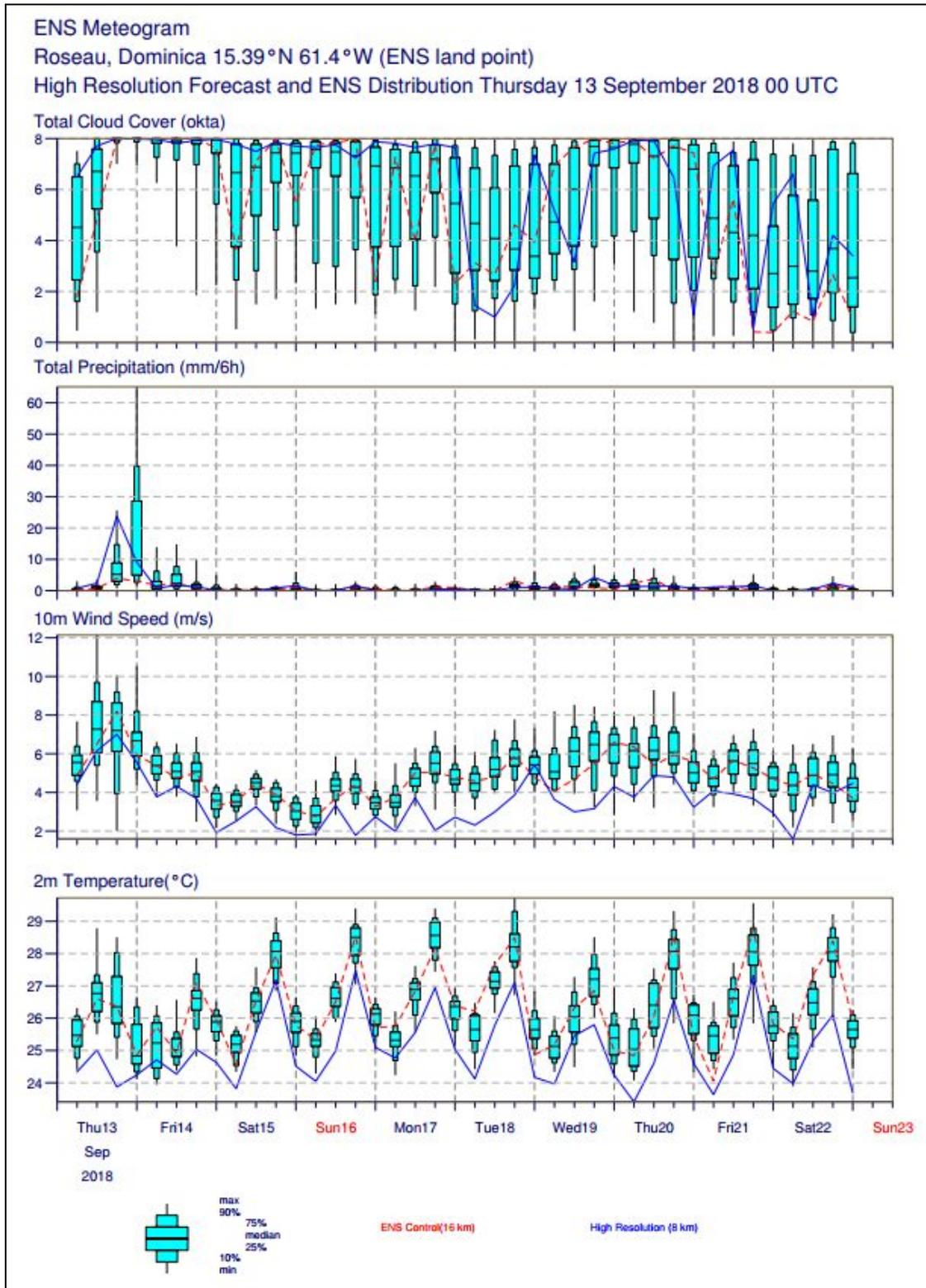
5.3 - Meteogram for the greater area of Charleston, South Carolina (USA)



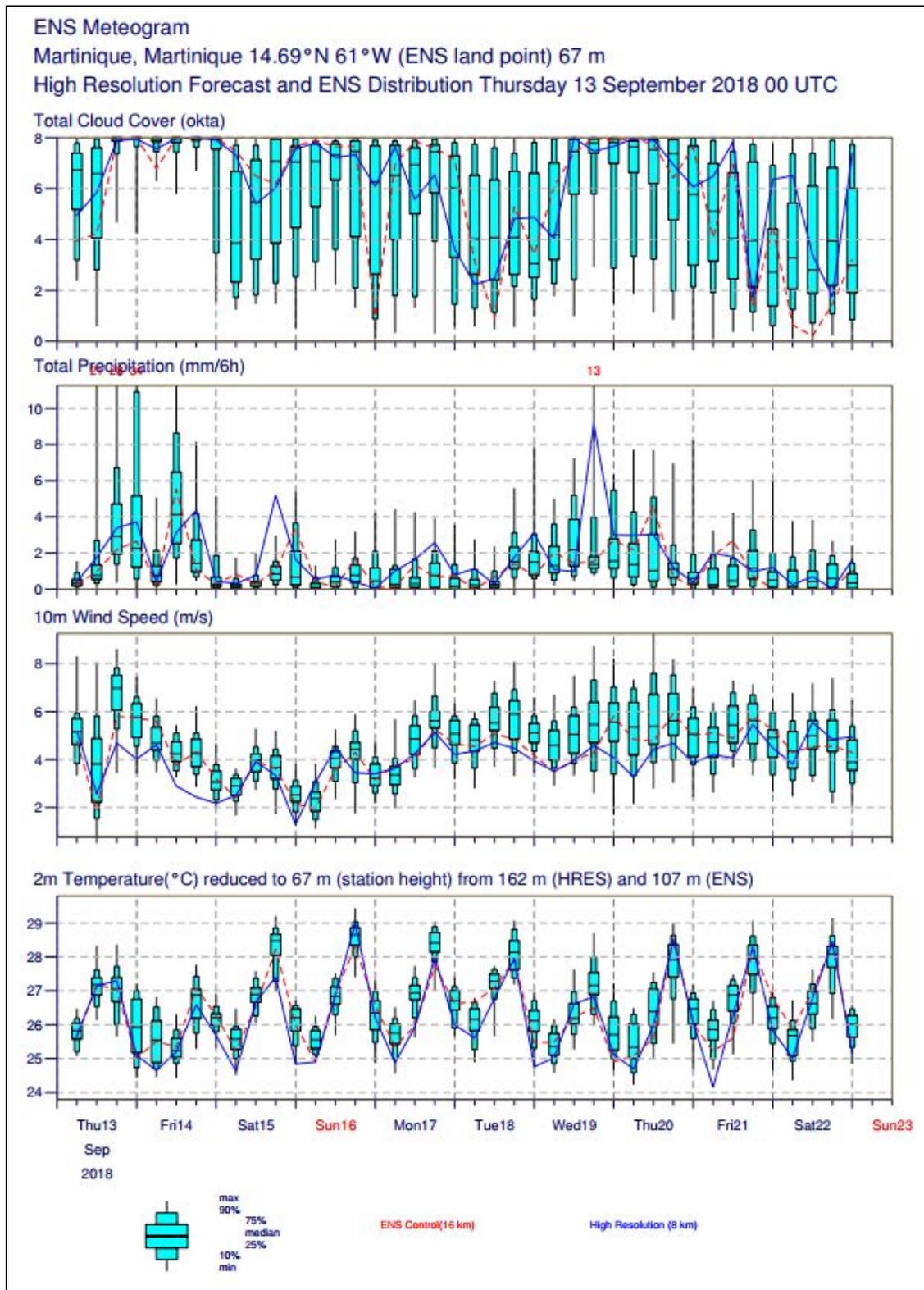
5.4 - Meteogram for the greater area of Wilmington, North Carolina (USA)



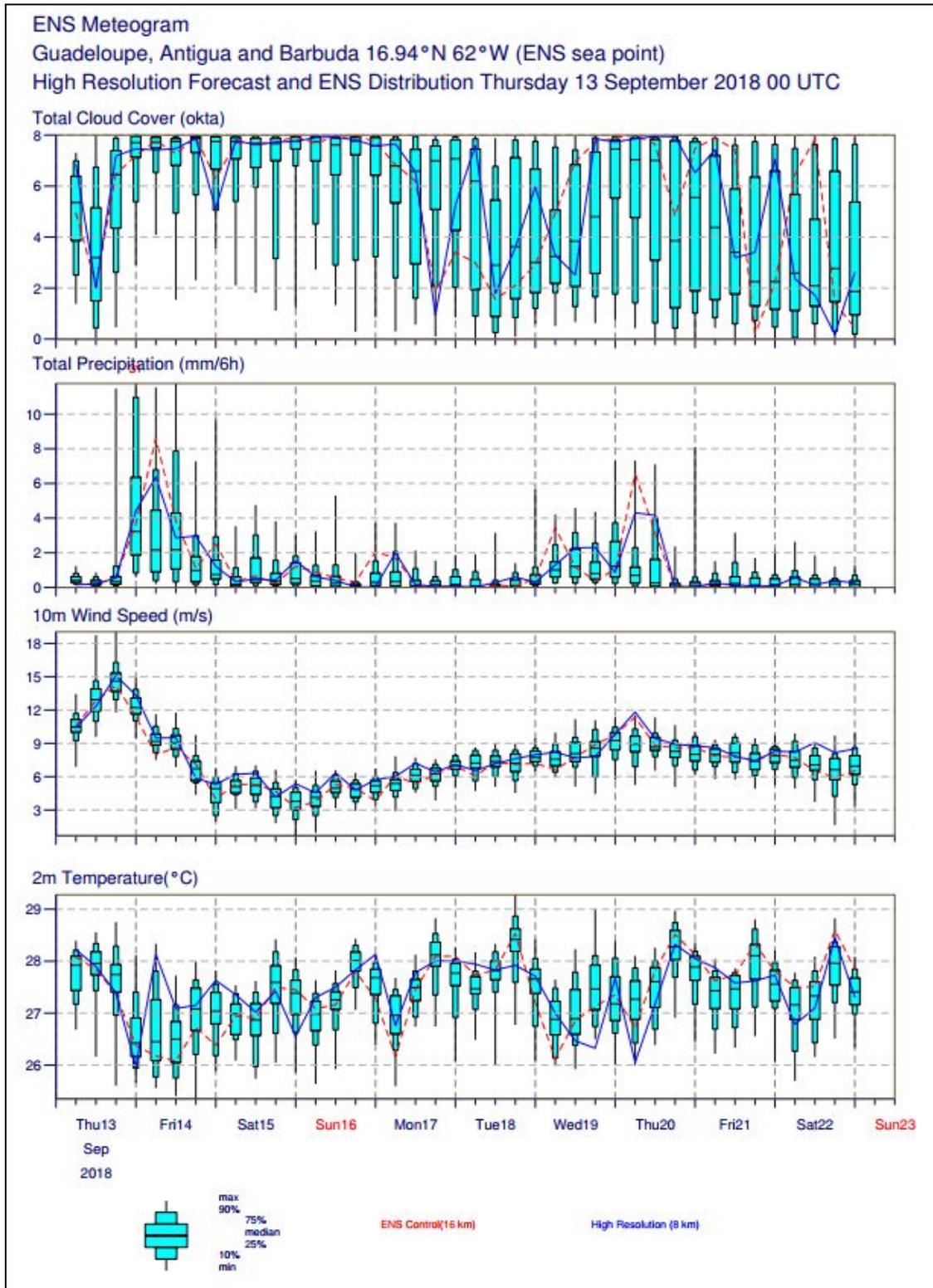
5.5 - Meteogram for the area of Roseau, West Indies (Commonwealth of Dominica)



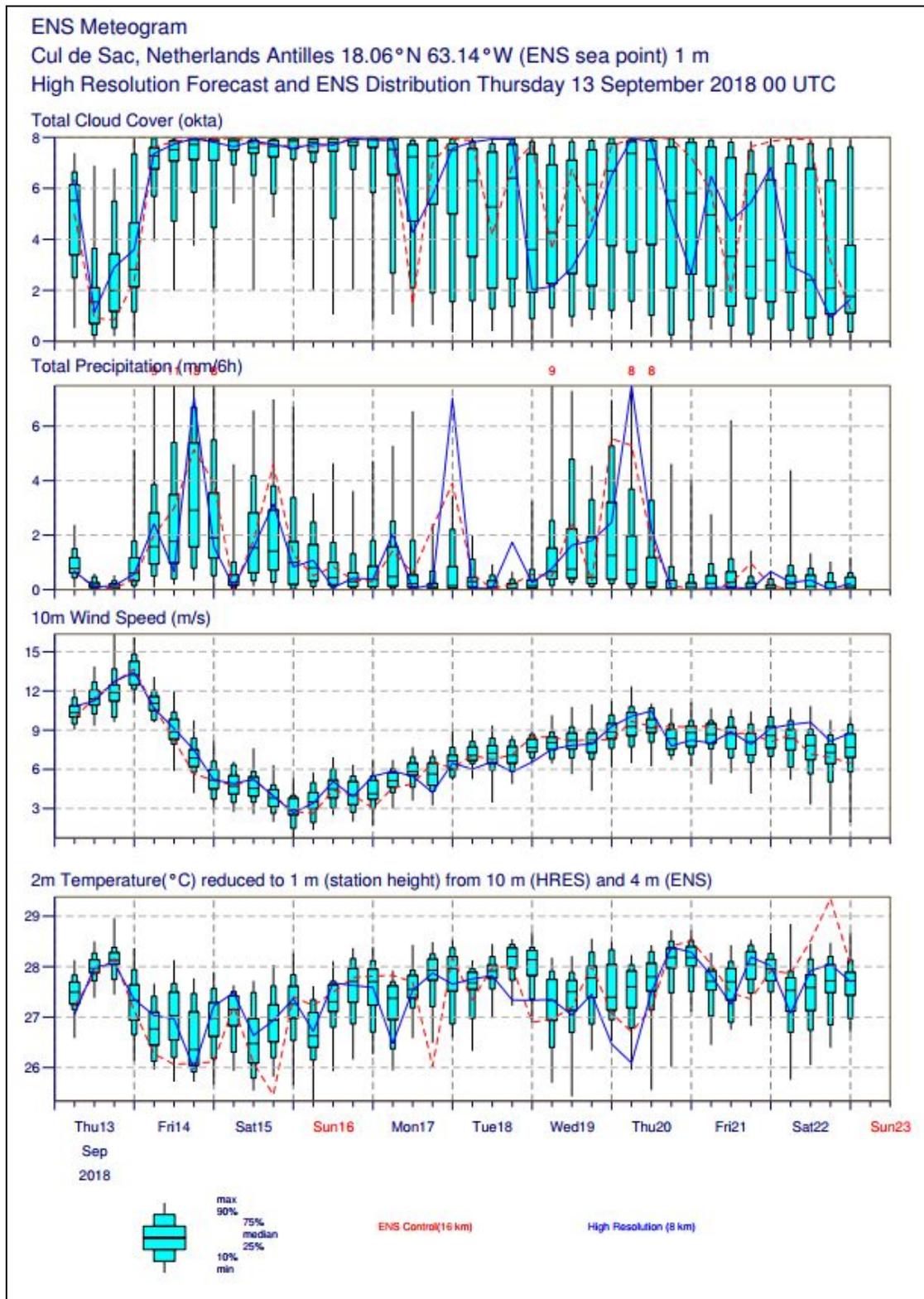
5.6 - Meteogram for the greater area of Martinique, Lesser Antilles (France)



5.7 - Meteogram for the greater area of Guadeloupe, Lesser Antilles (France)



5.8 - Meteogram for the area of Cul-de-Sac, Sint Maarten, Antilles, (Netherlands)



Annex 6 - Tropical Cyclone Strike Probability for TC FLORENCE and ISAAC (based on ECMWF HRES & Ensemble Prediction System)

6.1 - Product Description

These charts show the evolution of the position and intensity of tropical cyclones (TCs) in the ECMWF (European Centre for Medium-Range Weather Forecasts) high-resolution (HRES) and ensemble forecasts (comprising 50 plus one control equal probable members) based on the Ensemble Prediction System (EPS). They provide a measure of the uncertainty in the latest ECMWF forecast based on 13 Sep 2018 00 UTC. These products are generated for all TCs that have been officially observed at the initial time of the forecast. The main characteristics of Strike Probabilities are shown below (Fig. A6.1).

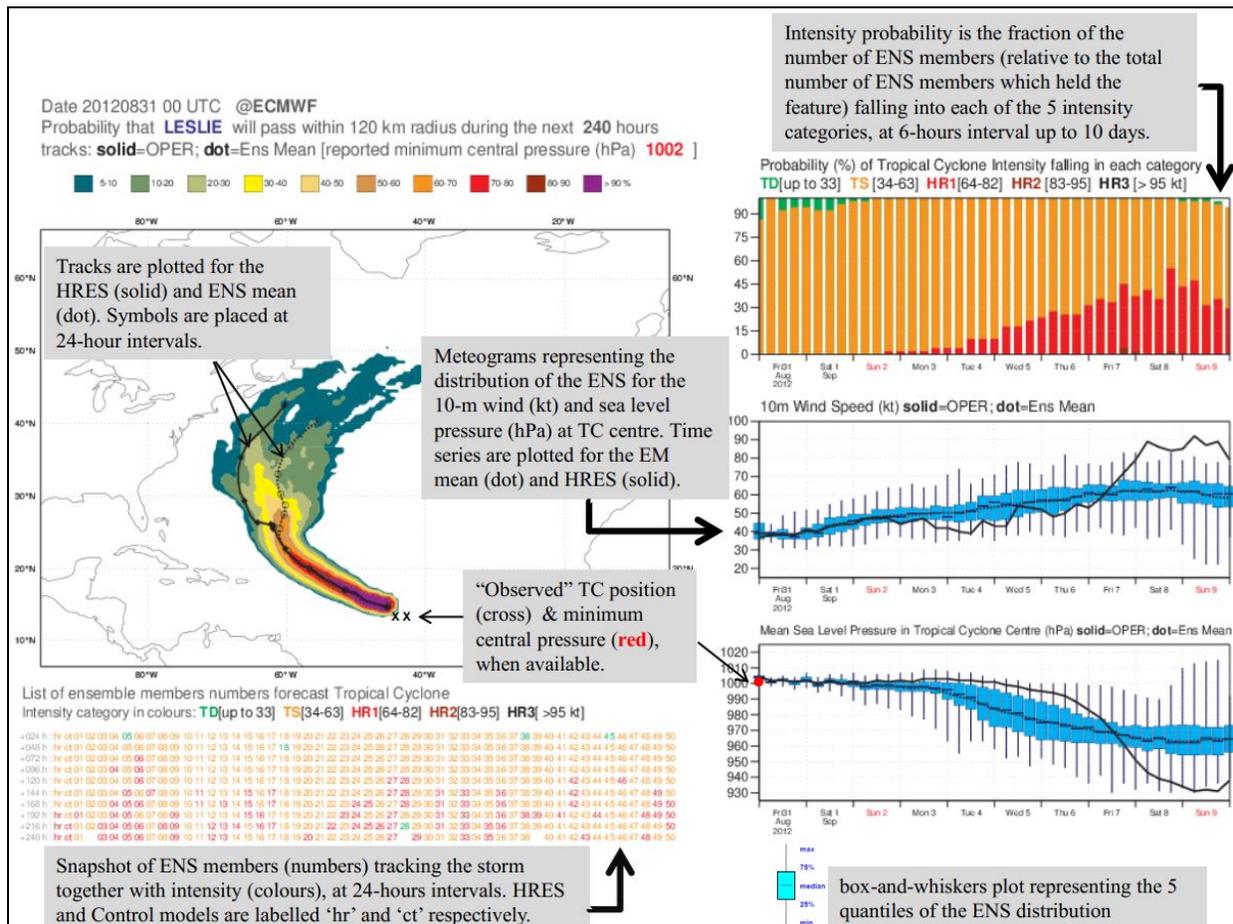


Figure A6.1 - Main characteristics of Strike Probabilities (Map).

For a quick-look graphical guide to interpreting these products see https://www.ecmwf.int/sites/default/files/tracks_example.pdf. A detailed explanation about the ECMWF Tropical Products and the tracking algorithm can be found at https://www.ecmwf.int/sites/default/files/TC_ShowGuide.pdf.

Current Annex 6 contains Strike Probabilities for TC FLORENCE (6.2) and TC ISAAC (6.3).

6.3 - Strike Probabilities for TC ISAAC

