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Session AS4.6 – The atmospheric water cycle: processes, dynamics and characteristics

North Atlantic SST variability and high impact storms affecting the Iberian Peninsula

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Motivation

- The Iberian Peninsula (IP) has experienced on recent years an increasing number of high impact cyclones (e.g. Klaus, 23-24 January 2009 and Xynthia, 27-28 February 2010; Liberato *et al.* 2011; 2013) associated with extreme precipitation events, flooding and damage to infrastructure.

- However until now not enough evidence has been gathered to confirm a general and significant increase in the frequency and intensity of these events in the north-eastern Atlantic.

- In fact, according to Karremann *et al.* (2016) the maximum in recent years is comparable to other stormy periods in the 1960s and 1980s, suggesting that their frequency of occurrence undergoes strong multi-decadal variability.

Data and methods

- ECMWF ERA5 reanalysis (Hersbach *et al.* 2019) data for the period 1979-2019 for the North Atlantic Ocean;
  - SST (°C) and MSLP (hPa) fields;
- Analysis performed for the extended winter (October to March – ONDJFM);
- Composite mean and anomaly analysis (reference period 1981-2010);
- Daily precipitation days for the IP taking into account the area affected and its average intensity (Ramos *et al*. 2014);
- Storms that provoked serious impacts over IP;
  - For all these storms the intensification period is considered.

High impact storms on IP

Table 1 – Named storms in the extended winter 2017-2018 and 2018-2019

Names of the storms		Date, position and minimum pressure of the storms			
SW European Group	Met Fu Berlin	Date (dd/mm/yyyy UTC)	Latitude (°N)	Longitude (°E)	Minimum Pressure (hPa)
2017-2018					
Ana	Yves	11/12/2017 06	48	-2	958
Carmen	Ingmar	01/01/2018 06	49	-6	989
Emma	Ulrike	26/02/2018 06	42	-35	963
Félix	Yuliya	11/03/2018 00	45	-11	967
Gisele	Zsuzsa	14/03/2018 12	51	-18	965
Hugo	Carola	23/03/2018 18	49	-10	969
2018-2019					
Beatriz	Yaprak	07/11/2018 06	55	-28	958
Carlos	Cornelia	15/11/2018 06	51	-48	947
Diana	Halka	29/11/2018 12	58	-16	949
Gabriel	Oskar	29/01/2019 18	47	0	985
Helena	Quirin	31/01/2019 12	52	-15	971
Laura	Cornelius	06/03/2019 18	56	-8	974

In Table 1 the names of the storms that provoked serious impacts over IP in the last two extended winters (2017-2019) are registered and for all these storms we consider the instant of maximum intensification – the position where the low attains the minimum pressure.

In the extended winter 2017-2018, the IP and France were affected by a total of 9 named storms, 6 of them had serious adverse impacts over IP and particularly in mainland Portugal; and of the total of 13 named storms in the extended winter 2018-2019, we only consider 6 for the same reason.

See EGU2020-21874 Gonçalves *et al.* 2020

SST composite anomalies

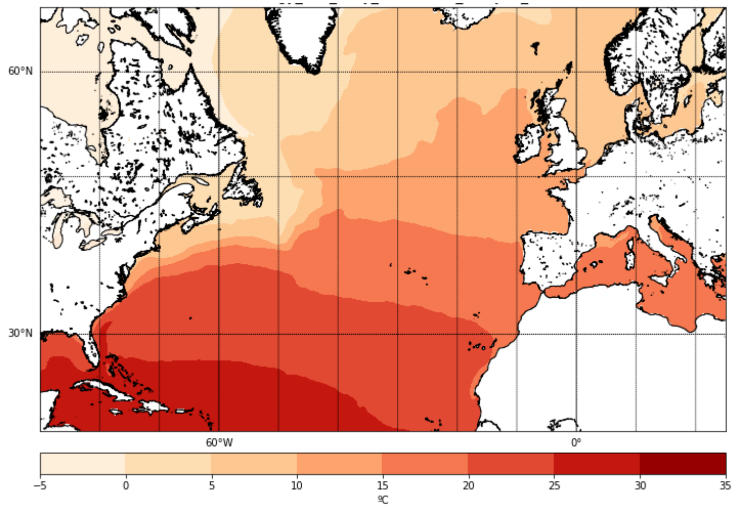


Figure 1 — SST climatology (ONDJFM 1981-2010)

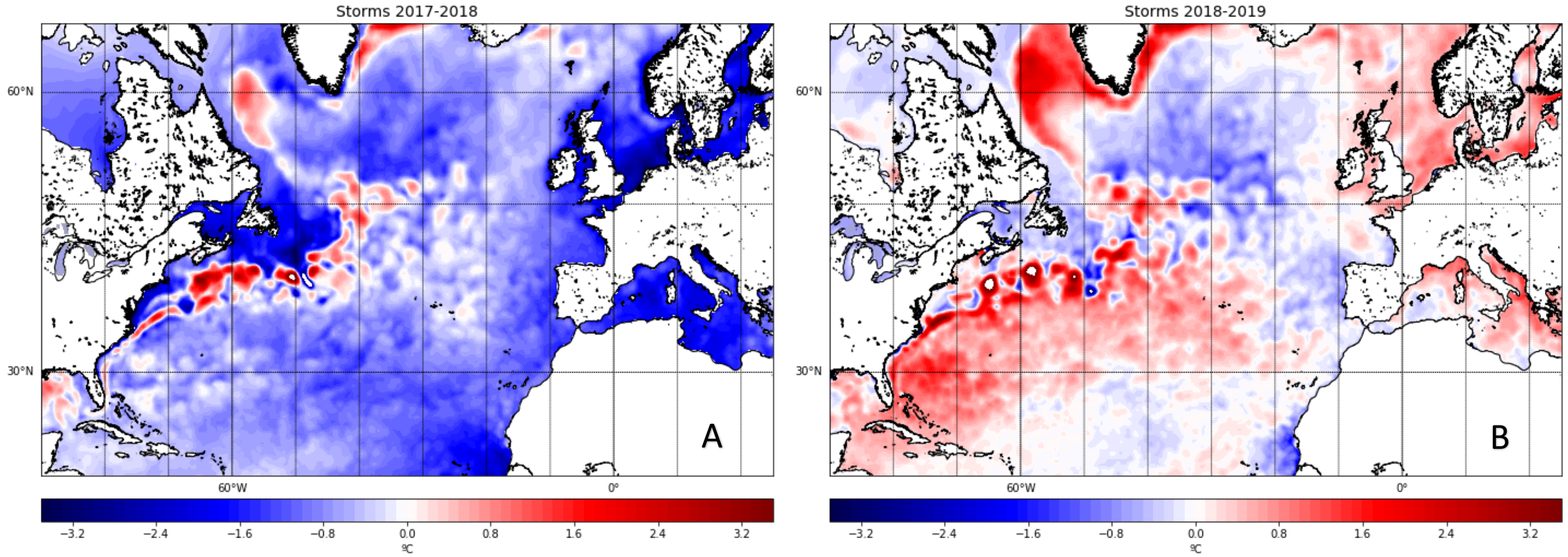


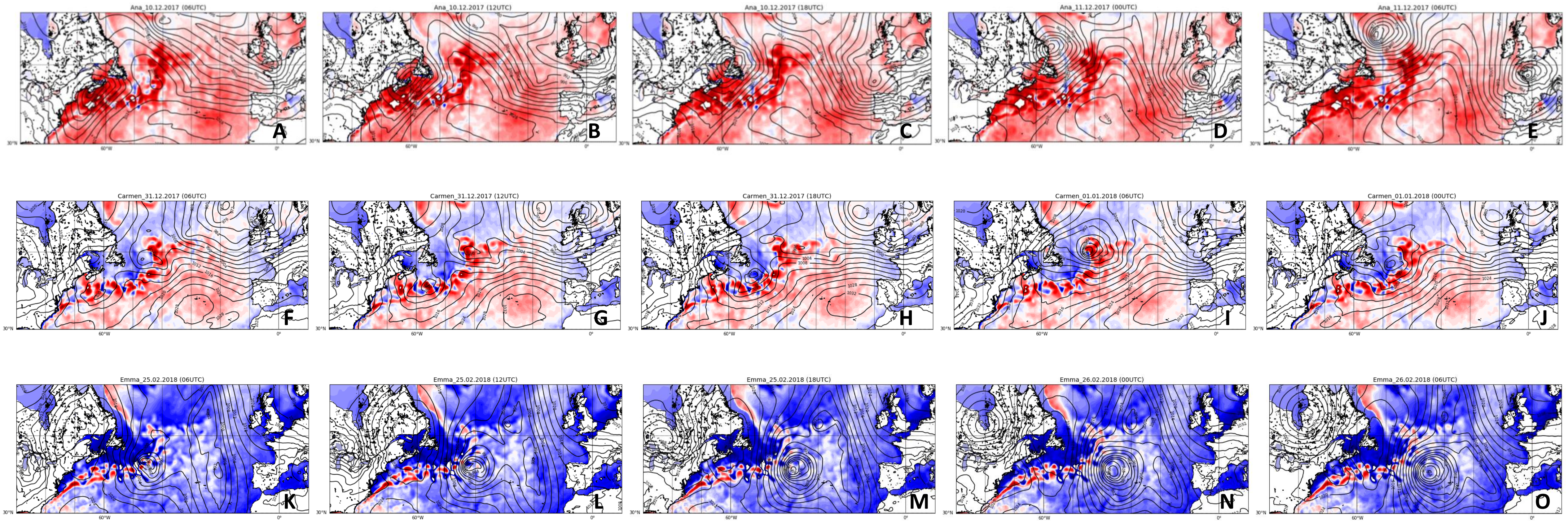
Figure 2 — SST composite anomalies. Figure 2.A 2017-2018 winter; Figure 2.B — 2018-2019 winter.

SST storm composite anomaly for 2017-2018 winter (Figure 2.A) shows an increase in ocean temperature over 1°C in certain Gulf Stream zones on the day the storms occurred. Similarly, the Labrador current has an anomaly over 1°C. Near the Iberian Peninsula the ocean temperatures remained about –1.5°C below the climatological normal.

For the 2018-2019 period (Figure 2.B), an increase in SST is visible throughout the study area, mainly in Gulf Stream and Labrador current. Near Greenland the temperature of the ocean at the surface increased by about 2 °C. The same was seen in the North Sea and the Mediterranean Sea.

Winter 2017-2018

(t-24h) **(t-18h)** **(t-12h)** **(t-6h)** **Minimum Pressure (t)**



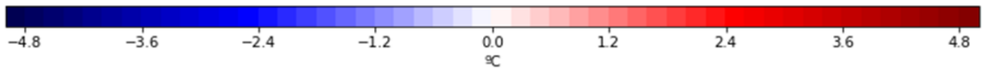


Figure 3 - MSLP field (contour interval 4hPa) and SST anomaly (°C) of winter storms 2017-2018:
Figure 3.A - 3.E) Ana for the 24h period before the minimum pressure (11/12/2017 06UTC, figure 3.E); Figure 3.F - 3.J) the same for Carmen (01/01/2018 06UTC, figure 3.J); Figure 3.K - 3.O) the same for Emma (26/02/2018 06UTC, figure 3.O).

Winter 2017-2018 *(cont.)*

(t-24h) **(t-18h)** **(t-12h)** **(t-6h)** **Minimum Pressure (t)**

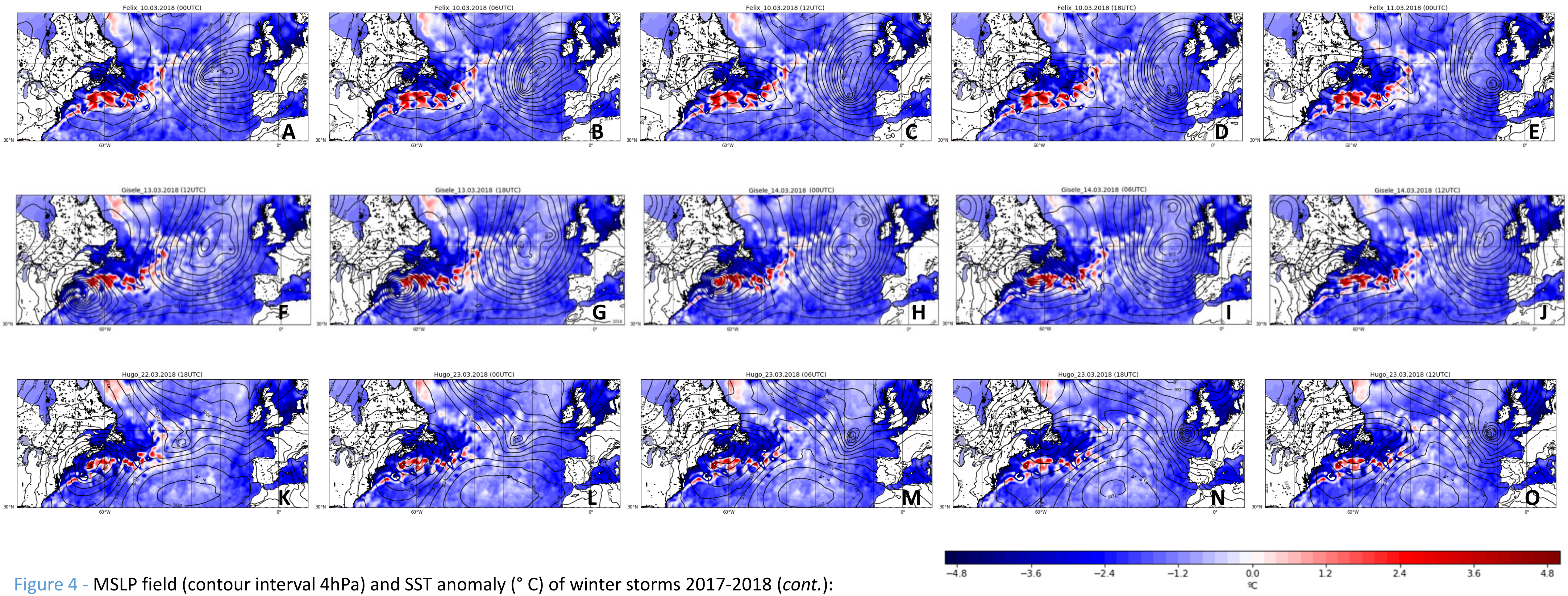
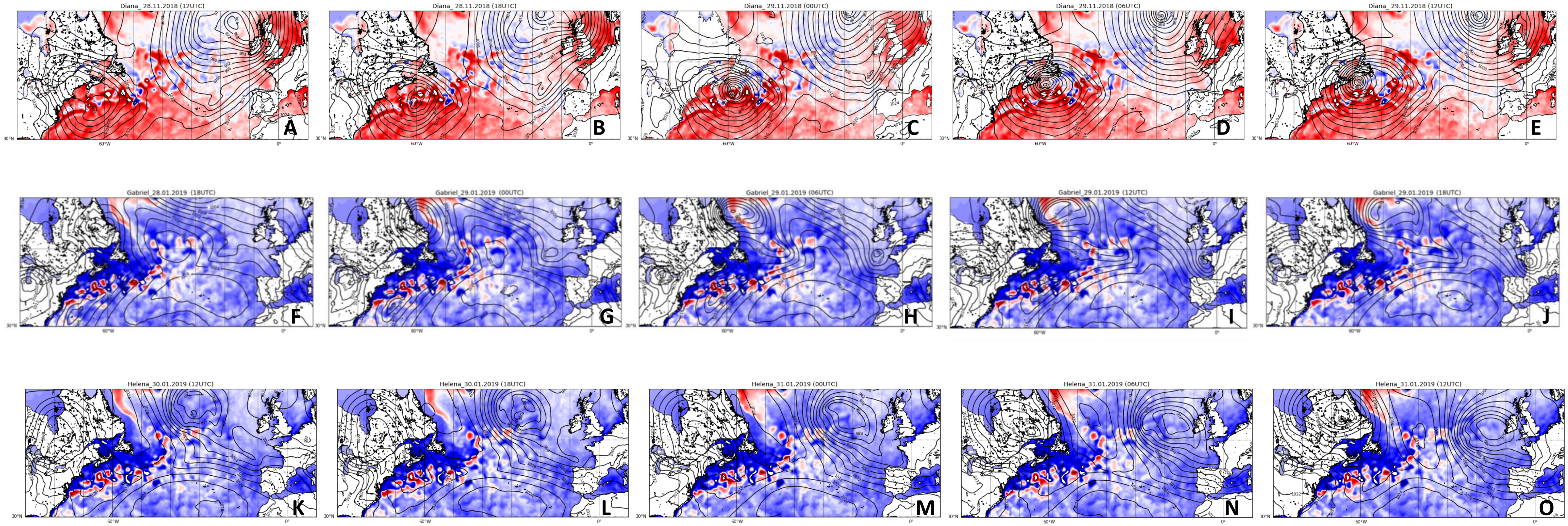


Figure 4 - MSLP field (contour interval 4hPa) and SST anomaly (° C) of winter storms 2017-2018 (*cont.*):
Figure 4.A - 4.E) Felix for the 24h period before the minimum pressure (11/03/2018 00UTC, figure 4.E); Figure 4.F - 4.J) the same for Gisele (14/03/2018 12UTC, figure 4.J); Figure 4.K - 4.O) the same for Hugo (23/03/2018 18UTC, figure 4.O).

Winter 2018-2019

(t-24h)	(t-18h)	(t-12h)	(t-6h)	Minimum Pressure (t)



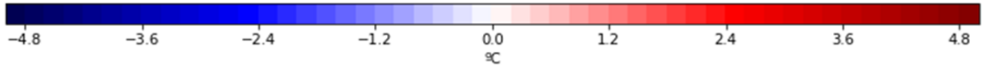


Figure 5 - MSLP field (contour interval 4hPa) and SST anomaly (° C) of winter storms 2018-2019: Figure 5.A - 5.E) Diana for 24h before the minimum pressure (29/11/2018 12UTC, figure 5.E); Figure 5.F - 5.J) the same for Gabriel (29/01/2019 18UTC, figure 5.J); Figure 5.K - 5.O) the same for Helena (31/01/2019 12UTC, figure 5.O)

Conclusions

- The extended winters 2017-2018 and 2018-2019 are characterized by the occurrence of several high impact storms over the IP: most storms had compound wind and precipitation extremes.
- High SST variability is observed during the periods of intensification of these high impact storms over North Atlantic.
- SST storm composite anomalies show an increase in ocean temperature over 1°C in certain North Atlantic regions, particularly in the Gulf Stream area on the day the storms occurred.

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