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HIGH IMPACT STORMS AFFECTING THE IBERIAN PENINSULA DURING 2017-2019 EXTENDED WINTERS

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MOTIVATION

The occurrence of an increasing number of **high impact storms over southwestern Europe** (e.g. Klaus, 23-24 January 2009 and Xynthia, 27-28 February 2010; Liberato et al. 2011; 2013) has led to the **meteorological services of France** (Météo-France), **Portugal** (IPMA) and **Spain** (AEMET) **to assign names to storms**, since 1st December 2017. This new list of named storms has the **main objective to better inform the general public and media** while contributing to increasing public awareness to high impact storms and associated warnings and timely safety recommendations.

The Institute of Meteorology of the Freie Universität Berlin has named all pressure systems in Central Europe since 1954; since 1998, lows are given male names and highs are given female names in odd years, and vice versa in even years. **This new list built by the southwestern Europe meteorological services has the main difference of naming only high impact storms.**

DATA AND METHODS

- ERA5 Reanalysis (Hersbach *et al.* 2019) for Euro-Atlantic region (90°W–25°E; 15°N–65°N)

- 850 hPa equivalent-potential temperature (θe) using ERA5 and following Bolton's formula (Bolton, 1980)

- The events are ranked and classified into the groups (Karremann *et al.* 2016)

- Two cases studies are analyzed

- Composites of meteorological fields for the considered 12 events

- For all these storms the instant of maximum intensification is considered – the minimum pressure position

Named storms in the extended winters 2017-2018 and 2018-2019 causing serious impacts over IP

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

EMMA STORM – Synoptic conditions and large-scale dynamics

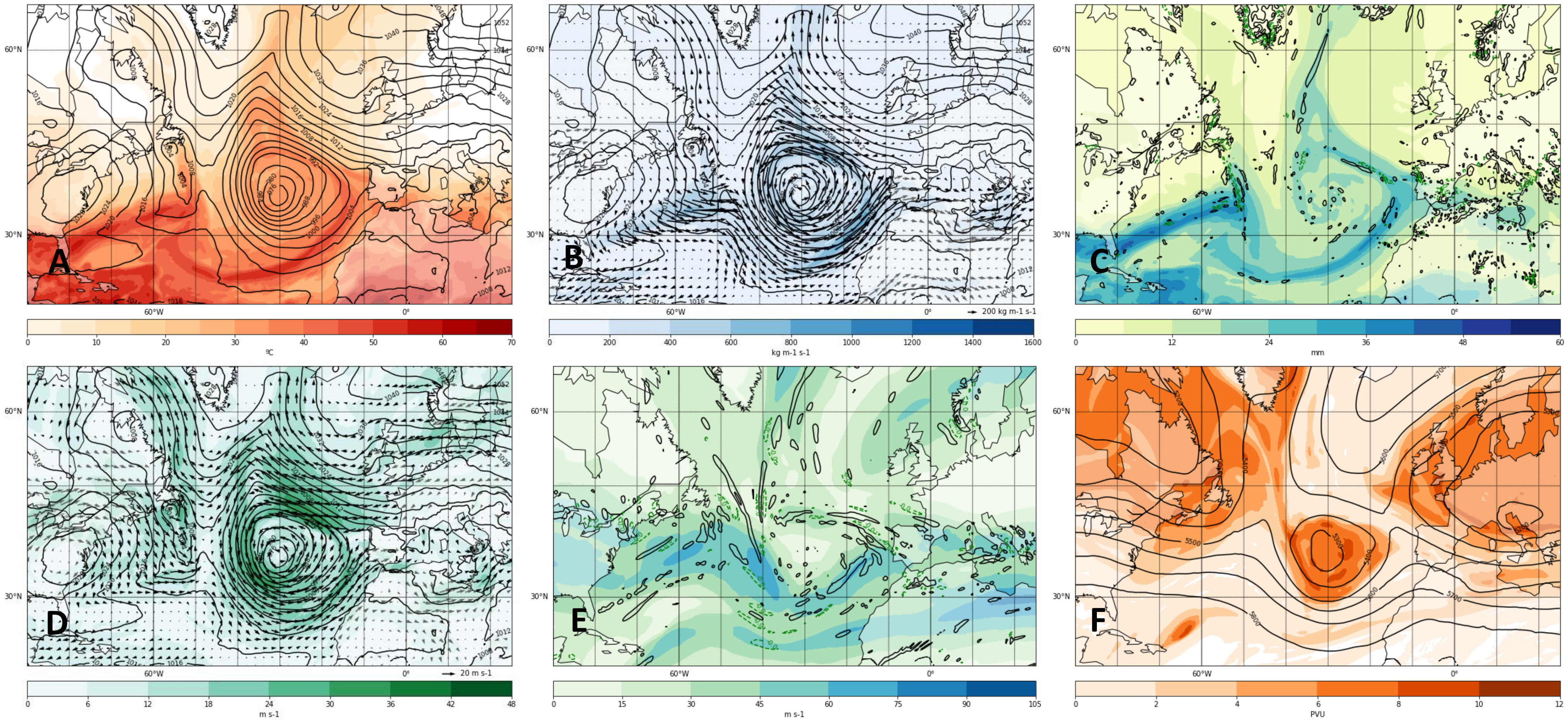

Figure 1 – Analysis of Emma storm in the instant of higher impacts in the IP on 27/02/2018 at 12 UTC:

A) *θe* field at 850 hPa (shaded; ◦C, see colorbar) and MSLP field (contour interval 4 hPa); **B)** IVT ($kgm^{-1}s^{-1}$) intensity and direction (vectors) and MSLP field (contour interval 4 hPa); **C)** TCWV (shaded; mm, see colorbar) and Divergence (contours every $8x10^{-5}$ s^{-1}, delimiting areas above $4x10^{-5}$ (black solid lines) and below $-4x10^{-5}$ (dashed green lines) at 900 hPa; **D)** Wind Speed (ms^{-1}) and vector wind at 900 hPa (shaded; ms^{-1}, see colorbar) and MSLP field (contour interval 4 hPa); **E)** Wind Speed (shaded; ms^{-1}, see colorbar) and Divergence (contours every $8x10^{-5}$ s^{-1}, delimiting areas above $4x10^{-5}$ (black solid lines) and below $-4x10^{-5}$ (dashed green lines) at 250 hPa, and Geopotential height (contours every 150 gpm) at 500 hPa; **F)** Upper tropospheric potential vorticity distribution (shaded; PVU) at 250 hPa and Geopotential height (contours every 150 gpm) at 500 hPa.

HELENA STORM – Synoptic conditions and large-scale dynamics

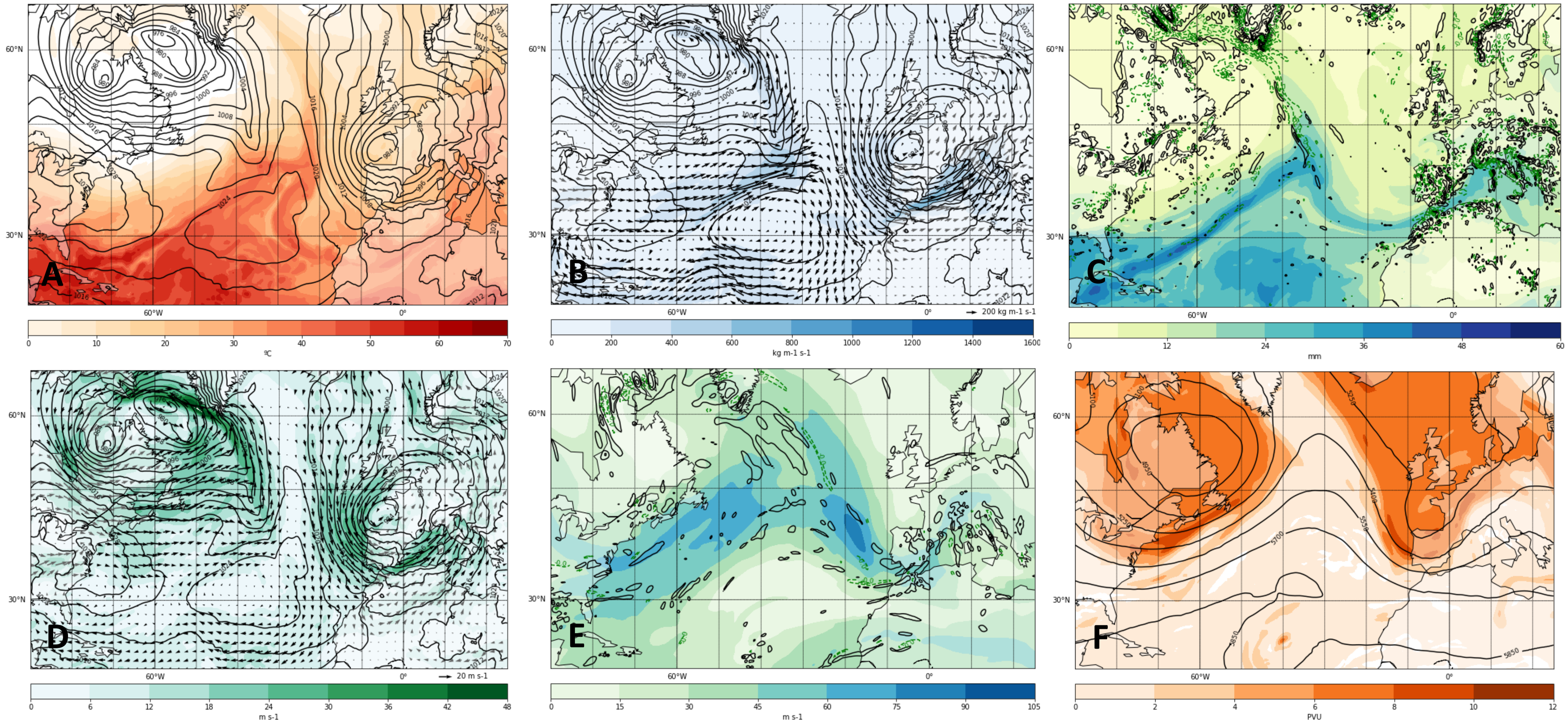

Figure 2 – Analysis of Helena storm in the instant of higher impacts in the IP on 01/02/2019 at 12 UTC:

A) *θe* field at 850 hPa (shaded; ◦C, see colorbar) and MSLP field (contour interval 4 hPa); **B)** IVT ($kgm^{-1}s^{-1}$) intensity and direction (vectors), and MSLP field (contour interval 4 hPa); **C)** TCWV (shaded; mm, see colorbar) and Divergence (contours every $8x10^{-5}$ s^{-1}, delimiting areas above $4x10^{-5}$ (black solid lines) and below $-4x10^{-5}$ (dashed green lines) at 900 hPa; **D)** Wind Speed (ms^{-1}) and vector wind at 900 hPa (shaded; ms^{-1}, see colorbar) and MSLP field (contour interval 4 hPa); **E)** Wind Speed (shaded; ms^{-1}, see colorbar) and Divergence (contours every $8x10^{-5}$ s^{-1}, delimiting areas above $4x10^{-5}$ (black solid lines) and below $-4x10^{-5}$ (dashed green lines) at 250 hPa, and Geopotential height (contours every 150 gpm) at 500 hPa; **F)** Upper tropospheric potential vorticity distribution (shaded; PVU) at 250 hPa and Geopotential height (contours every 150 gpm) at 500 hPa.

IMPACTS OF STORMS

All the studied storms had strong winds that caused numerous adverse impacts and several people were injured.

Associated with strong winds, these storms still had large amounts of water vapour, which gave rise to events of heavy precipitation and snowfall, thus causing numerous damages on populations (AeMet, 2020; EDP, 2018; IPMA, 2020; Météo France, 2020).

Figure 3. Photos documenting the strong impacts of Emma storm in North of Portugal on 26-28 February 2018. Photos by: Loureiro. S, 2018 and Fernandes. A, 2018.

COMPOSITE ANALYSIS: 12 high impact storms

High values of *θe* confirm a maximum availability of latent and sensible heat in the instant of maximum intensification of the storms, which supports the contribution of moist diabatic processes as in the case of other intense storms (e.g. Liberato, 2014). The high values of wind speed and water vapour (Figure 4) allow justifying the flooding events associated with heavy precipitation and windstorms during the passage of most of these extratropical storms.

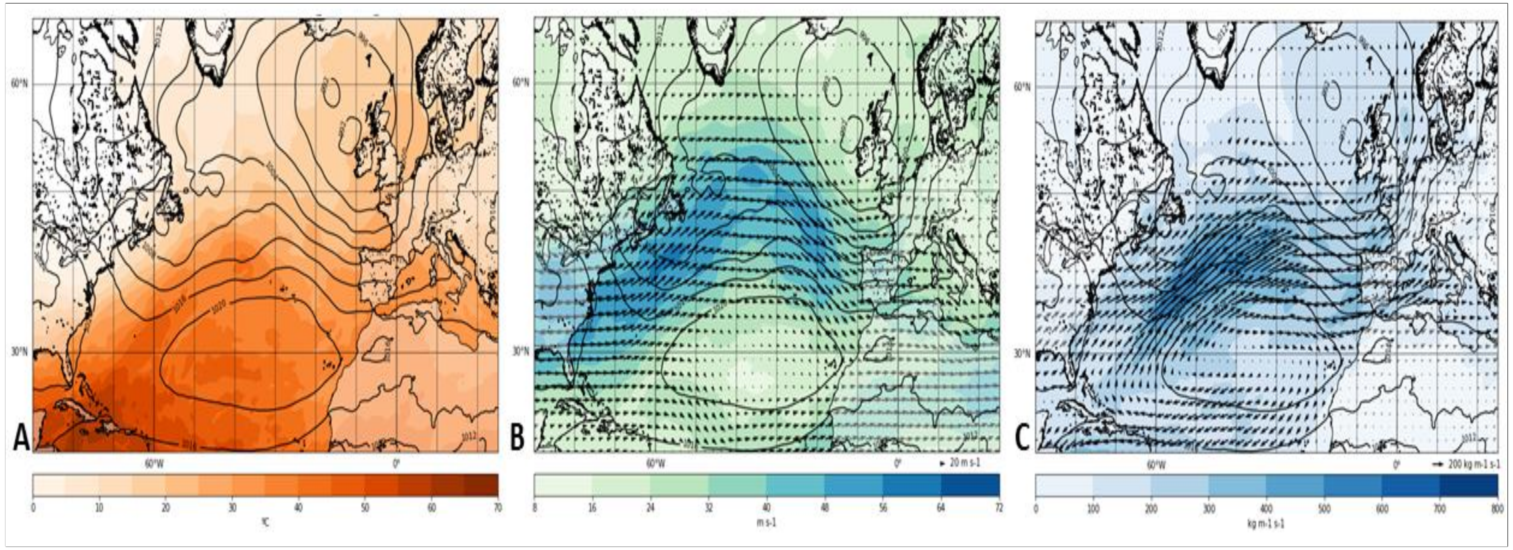

Figure 4. A) Composites of the MSLP and θ_e (◦C) field at 850 hPa; **B)** Composites of the wind speed (ms^{-1}) and direction at 250 hPa and MSLP; **C)** Composites of IVT ($kgm^{-1}s^{-1}$) and MSLP for the 12 events of **2017-2019 extended winters**.

COMPOSITE ANALYSIS: 2017-2019 EXTENDED WINTERS

The MSLP composites (Figure 5) show that low-pressure systems are centered over the British Islands and affect the IP and France, with a mean minimum pressure of 992 hPa, considering the 12 events (extended winter 2017-2019); these are more intense for each winter 2017-2018 and 2018-2019.

These results highlight that **these storms correspond to the North group** according to the classification of Karremann *et al.* (2016).

2017-2018 **2018-2019** **2017-2019**

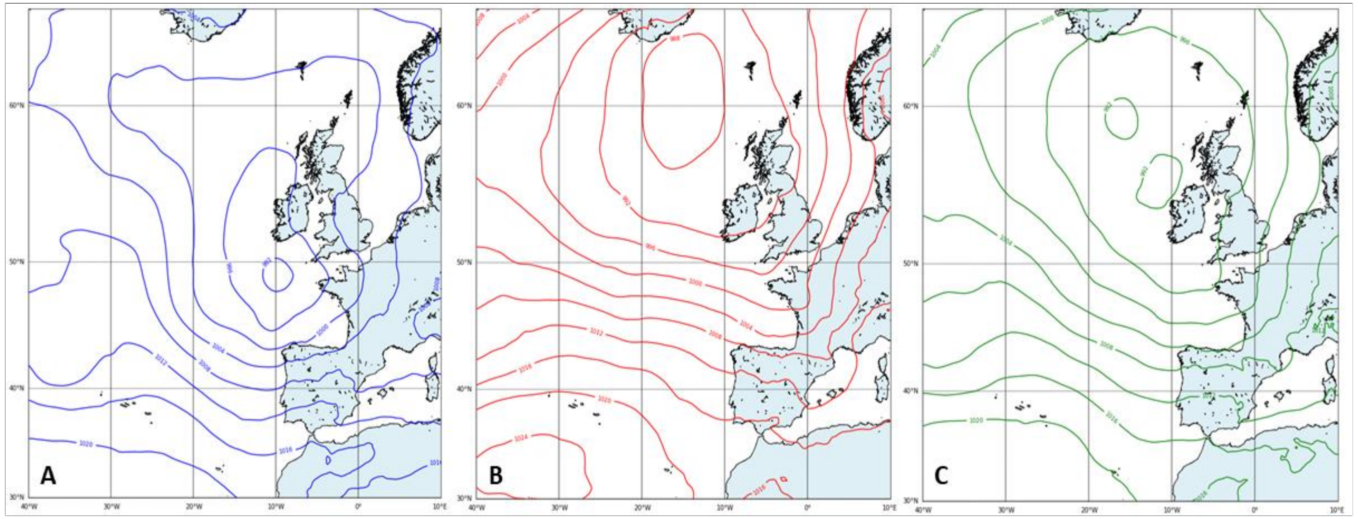

Figure 5. MSLP of storm composites; **A)** Extended winter 2017-2018; **B)** Extended winter 2018-2019; **C)** Extended winters 2017-2019.

CONCLUSIONS

- During these two extended winters IP was hit by **several extreme** and **high impact storms** that had numerous adverse **socioeconomic impacts** and even **human fatalities**.

- Results revealed that the **high values** of **upper level wind speeds** and **lower level moisture** in the instant of maximum intensification contributed for the **explosive development** and **intensification of the storms**.

- Composite analysis shows that the **low-pressure systems** are centered over the **British Islands** and affect the IP and France, with a **mean minimum pressure of 992 hPa**, when considering the 12 events (extended **winters 2017-2019**).

- These results highlight that these storms correspond to the **North group** according to the classification of **Karremann *et al.* (2016)**.

REFERENCES

Agencia Estatal Meteorología-AEMet, 2020. Borrascas con gran impacto: Información divulgativa y de otras temporadas, http://www.aemet.es/es/conocermas/borrascas

Bolton, D. (1980). Monthly Weather Review, https://doi.org/10.1175/1520-0493(1980)108<1046:TCOEPT>2.0.CO;2

EDP – Distribuição. (2018) Relatório da Qualidade de Serviço 2018, https://www.edpdistribuicao.pt/sites/edd/files/2019-05/Relatorio%20da%20Qualidade%20de%20Servico%202018.pdf

Hersbach, H. et al (2019) ECMWF Newsletter, doi: 10.21957/vf291hehd7

Instituto Português do Mar e da Atmosfera - IPMA, 2020, https://www.ipma.pt/pt/

Karremann, M.K. et al (2016) Atmospheric Science Letters, doi: 10.1002/asl.665

Liberato, M.L.R. (2014) Weather and Climate Extremes, https://doi.org/10.1016/j.wace.2014.06.002

Liberato, M.L.R. et al (2011) Weather, https://doi.org/10.1002/wea.755

Liberato, M. L. R. et al (2013) Natural Hazards and Earth System Sciences, https://doi.org/10.5194/nhess-13-2239-2013

Météo France, 2020, http://www.meteofrance.com/accueil

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