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The extreme flood event of October 22 - November 8, 2006 over the Iberian Peninsula: Associated mechanisms

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The authors acknoledge the support from the EXMERISK PROJECT (TED2021-129152B-C43) MCIN/AEI y Unión Europea NextGenerationEU/ PRTR)

MedGU Mediterranean Geosciences Union

Introduction / Research Motivation

Floods are complex phenomena that can originate from different causes and are considered one of the most damaging for the infrastructures, economy, ecosystems, and even causing human loss. Those originating from heavy rainfall are expected to increase in the future as precipitation intensifies in some regions. This is why multiple studies have investigated and are currently investigating the mechanisms that cause and modulate the occurrence of floods. In this study, we assess the flood event induced by heavy precipitation that affected the Iberian Peninsula (IP) from October 22, 2006, to November 8, 2006, which caused considerable infrastructure damage and human fatalities. According to the global flood database of the Dartmouth Flood Observatory, it was the longest flood event (18 days) that affected the IP during the 1999-2021 period. The objective was to investigate the mechanisms that induced heavy rainfall over the IP causing the flood.

Acknowledgement

M.S. and A. P-A thank the support from the Xunta de Galicia No. ED481D–2024/017 and ED481B–2023/016. R. S. acknowledge the grant RYC2021–034044-I funded by Ministerio de Ciencia, Innovación y Universidades, Spain. Authores are also supported by the project Excelencia-ED431F-2024/03 funded by the Xunta de Galicia. This work has been possible thanks to computing resources provided by CESGA and RES .

Materials and Methods

The Lagrangian moisture source diagnostic model FLEXPART proposed by Sodemann et al. (2008) was used. It is derived from the water budget equation and implemented in the Lagrangian Atmospheric moisture tracking (LATTIN; Perez-Alarcon et al., 2024) tool. This model permitted to track backward in time the parcels and air masses that lost humidity and caused the heavy rainfall, allowing us to identify those regions from where air masses uptake before precipitating, considered as sources of moisture.

Results

- Precipitation peaks were very high in the initial days, on October 22 and 24. In these days occurred significant positive anomalies of precipitation. The flood event was characterized by precipitation peaks much higher than expected on those days, indicating an unusual extreme event compared to average climatological behaviour.
- The region with the highest positive anomalies (dark green colours) is located in the southwestern IP, suggesting that this area was the most affected by excessive precipitation.

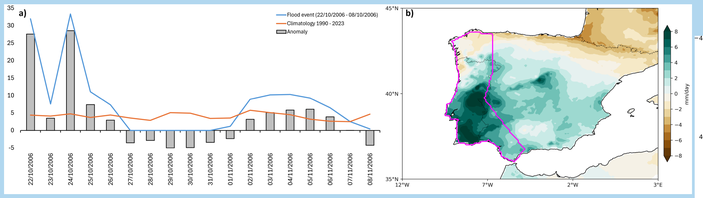


Figure 1. (a) Daily precipitation (blue line) and anomaly (grey bars) for the flood event (October 22 - November 8, 2006) compared to the climatology (1990-2023, orange line) in the IP. **(b)** Spatial distribution of precipitation anomalies during the event. Precipitation from EOBS data.

Results

- Intensification of moisture transport from the Atlantic.
- Both the moisture sources and the VIMF anomalies indicate a concentration and anomalous flow of moisture towards the affected region, which favoured the occurrence of the flood event. This pattern not only shows an increase in moisture sources but also an intensification in the moisture transport flow, which is characteristic of flood events.

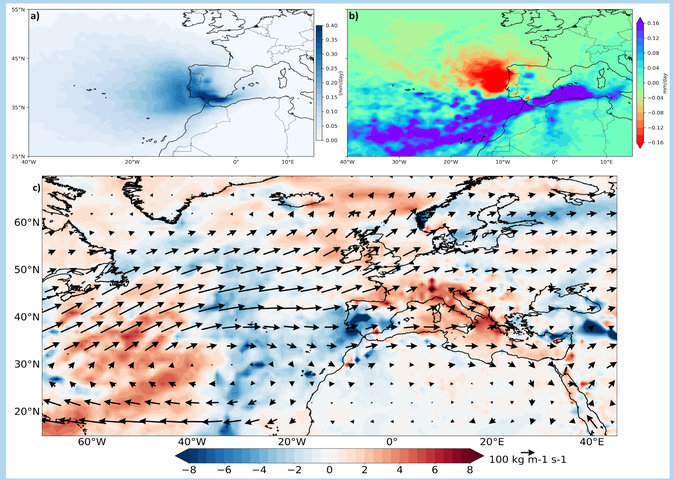
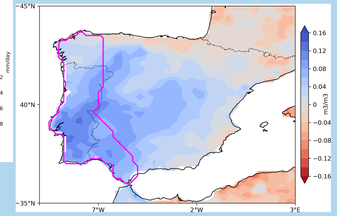


Figure 2. (a) Mean pattern of moisture sources during the flood event **(b)** Anomaly of moisture sources (E-P)>0 during the flood event, and **(c)** Mean vectors of northward eastward flux (arrows) and anomaly (shaded).



Elevated moisture levels in southwestern Iberia, with positive anomalies concentrated in the flood region, indicating substantial soil saturation during the event.

Figure 3. Soil moisture anomaly during the flood event period.

Discussion and Conclusions

The results show that this event was triggered by the influence of the extratropical storm located over the northeastern Atlantic, which imposed intense southeast zonal flow anomalies bringing moisture that favoured the occurrence of heavy rainfall during various days. The principal moisture sources were identified in the subtropical Atlantic Ocean to the southeast of the IP. In addition, over the IP prevailed the convergence of the vertically integrated moisture flux and intense rainfall, leading to strong positive anomalies of the soil moisture, principally in the central region of Portugal and central west Spain. The soil water content during previous days favoured the saturation and the later onset of the flood. This study is the beginning of a more extensive work plan for the attribution of the occurrence of floods due to heavy rains in the IP, and for the development of knowledge about these phenomena.

References

[1] Sodemann, H., Schwierz, C., & Wernli, H. (2008). Interannual variability of Greenland winter precipitation sources: Lagrangian moisture diag-nostic and north Atlantic oscillation influence. https://doi.org/10.1029/2007JD008503.

[2] Pérez-Alarcón, A. Fernández-Álvarez, J. C. Nieto, R., Gimeno, L. (2024). LATTIN: A Python-based tool for Lagrangian atmospheric moisture and heat tracking. Software Impacts, DOI: 10.1016/j.simpa.2024.100638