DEVELOPMENT OF A FLOOD EVENTS DATABASE FOR THE SPANISH MEDITERRANEAN COAST AND ITS APPLICATION TO IMPROVE FLOOD RISK AWARENESS

Montserrat Llasat-Botija[1,2], Erika Pardo[1,2], Laura Esbrí[1,2], Raül Marcos[1,2], and María Carmen Llasat[1,2]
[1]Department of Applied Physics, University of Barcelona, Barcelona, Spain (mllasat@meteo.ub.edu)
[2]Water Research Institute, University of Barcelona, Barcelona, Spain

With the participation of:
PID2020-113638RB-C22

Floods in Spanish Mediterranean coast

Figure 1. Study Area: in orange contours of the provinces; coastal municipalities are shaded in brown.

In the context of the C3RiskMed Spanish project, all the flood events that have affected the Spanish Mediterranean coast between 1980 and 2020 have been identified. Flood events from the Valencian Community, the Region of Murcia and Mediterranean Andalusia have been searched and classified.

This has been achieved by using the Civil Protection Catalog of Historical Floods and other sources such as newspaper archives and reports. This base allows us to characterize the different regions in terms of the flood impacts and to identify differences and commonalities to take into account in the design of adaptation measures. It will be also used to identify and characterize compound flood events.

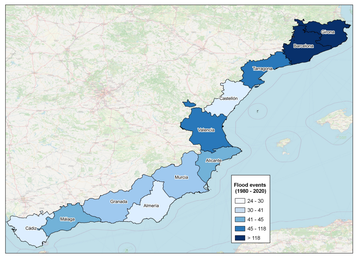


Figure 2. Map of the total number of events, at province level, between 1980 and 2020

A.C.	Provinces	Population (2021)	Area (Km^2)	N.events	CCS (M €2021)
Catalonia	*Girona*	784.941	5.910	119	181.66
	Barcelona	5.702.262	7.728	162	353.78
	Tarragona	823.435	6.303	118	164.12
Valencian C.	*Castellón*	587.632	6.632	24	121.90
	Valencia	2.593.243	10.806	53	523.78
	Alicante	1.887.036	5.817	45	495.18
Murcia R.	*Murcia*	1.518.279	11.313	38	403.96
Andalusia	*Almería*	730.430	8.775	29	118.07
	Granada	925.046	12.647	41	51.72
	Málaga	1.696.955	7.308	45	358.54
	Cádiz	1.244.000	7.435	30	147.51

Table I. Between 1980 and 2020, 298 events with notable damages and affecting at least one autonomous community (A.C.) of the study area have been identified.
Valencia was the province that received the largest compensation for flood damages followed by Murcia. Granada received the lowest amount.

A catastrophic event: 22-23 October 2019

Main characteristics of the event	
Main phenomena	Heavy rain, floods, sea waves (4 m),wind gusts>80km/h tornadoes, landslides, snowfalls
Max.Precip.total	292.6 mm (Prades)
Qmax	>1300 m^3/s (Espluga de Francolí)
N. flooded municipalities	341
Damages	Catastrophic damages in some municipalities. Bridges destroyed. >50 roads closed and railways (5 months for recovering). Important damages in forests and rivers.
Deaths	7
Total compensations by damages	44 M € (CCS)

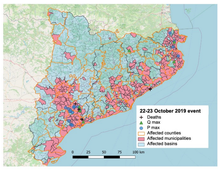


Figure 3. Municipalities of Catalonia affected by the October 2019 flood event. The map shows where the maximum river flow was identified (green triangle), the maximum precipitation (blue circle) and the location of deaths (black cross)

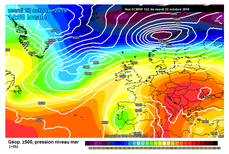


Figure 4. Reanalysis of October 22, 2019 at 12:00 h). The map shows the geopotential at 500 hPa and the surface pressure. Source: www.meteociel.fr/

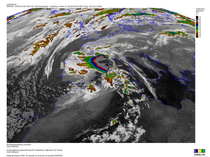


Figure 5. Meteosat IR image for October 23, 2019 at 00:00 h. A Mesoscale Convective System is clearly identified. Source: Servei Meteorològic de Catalunya from EUMETSAT.

The synoptic reanalysis of the event shows a deep low at the SW of Spain that is reflected as a cut-off low at 500 hPa. A warm and wet advection from the SE impinges over the Catalan Coast, where the Littoral mountains triggered the potential instability. This is a typical configuration for heavy rains in the Spanish Mediterranean Coast.

Figure 8. Pictures of the 2019 event. Up:Montblanc. (J.T.) Down: Espluga de Francolí (A. Roca).

Floods in Catalonia: the INUNGAMA database

The INUNGAMA flood database (Llasat et al., 2014) has been used as starting point. This database contains all the flood events that have occurred in Catalonia since 1900 and includes hydrometeorological and impact information for each event. This database has been updated until 2020.

Between 1980 and 2020 **301 flood events occurred**: 118 ordinary, 151 extraordinary, and 32 catastrophic (Fig.6) with a total of **131 deaths**. 60% of the episodes in Catalonia caused significant damage

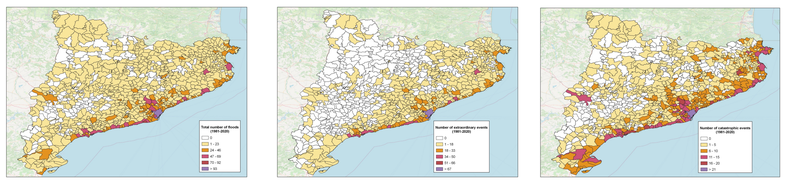


Figure 6. Total number of episodes at municipal level (a), extraordinary (b), and catastrophic (c).

An increase in the number of flood episodes is observed (mainly associated with minor events).

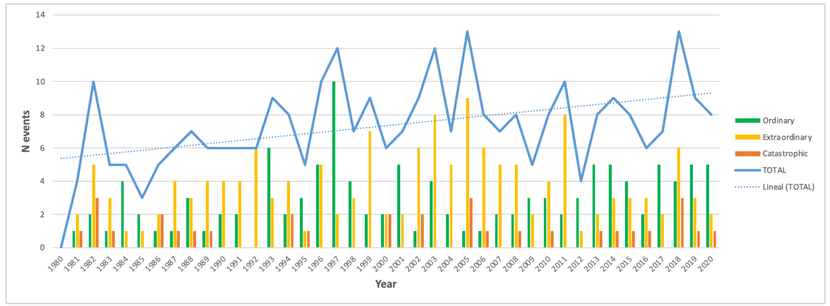
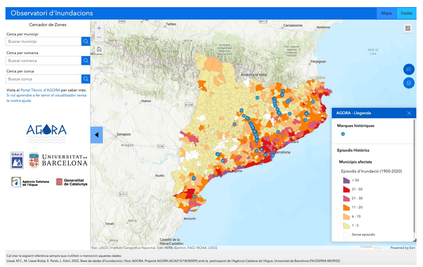


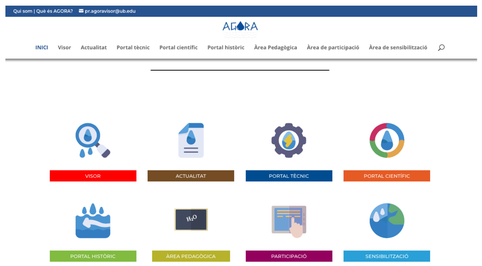
Figure 7. Evolution of flood episodes between 1980 and 2020. The total aggregation is displayed as well as the amount per category. The trend of the total number of episodes is also shown.

The Flood Observatory AGORA agora.ub.edu.

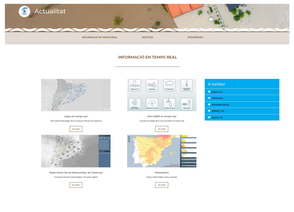
The INUNGAMA database can be applied to improve the resilience in front of floods in Catalonia, by creating an observatory of floods : **the AGORA Flood Observatory.** This consists of an online portal (agora.ub.edu) that contains multiple resources related to floods such as reports of historical events with different sections adjusted to different target audiences (i.e. the general population, schools, expert and/or technical audiences). This observatory also includes the AGORA viewer. This viewer allows interactive consultation of flood events by municipality, county, and river basin, either on a map or in a table (with event details). The observatory also offer technical and pedagogical material about floods for different target groups. The role of this Observatory as an adaptation tool is based on its potential as a decision support and planning tool and its contribution to the improvement of risk awareness of the population.

The viewer: to consult the risk of flooding in the territory in basis to past floods.

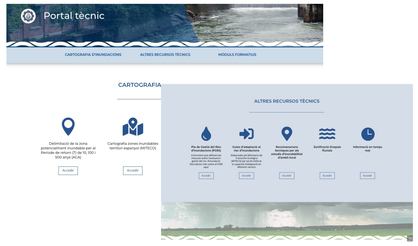




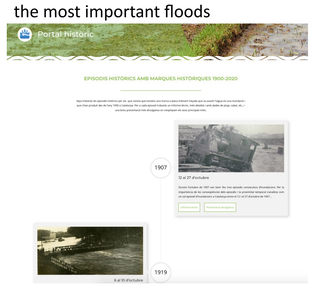
Present: information in real-time



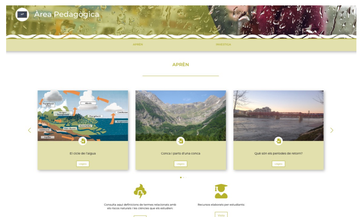
Technical portal: to deepen knowledge



Historical portal: a journey through the most important floods



Educative area: a space for schools



Participation Area: the space for citizen science activities and campaigns

Awareness-raising Area: a space to increase flood risk awareness

References

Llasat, M.C., Marcos, R., Llasat-Botija, M., et al. (2014). Flash flood evolution in North-Western Mediterranean. Atmospheric Research, 149: 230–243.

J.P. Martín-Vide et al, 2023, Large wood debris that clogged bridges followed by a sudden release. The 2019 flash flood in Catalonia. Journal of Hydrology: Regional Studies, Volume 47, doi.org/10.1016/j.ejrh.2023.101348.

Acknowledgements

This research has been done in the framework of the C3Riskmed project (MICINN-AEI/PID2020-113638RB-C22) funded by the Spanish Ministry of Science and Innovation and the AGORA project financed by the Water Catalan Agency.