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Discussions

The relationship between precipitation and insurance data for flood damages in a region of the Mediterranean (Northeast Spain)

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Abstract. Floods in the Mediterranean region are often flash floods, where short and intense precipitation is usually the main driver behind the events. Determining the link between the causes and impacts of floods can help better characterise the level of flood risk. However, up until now limitations in quantitative observations for flood-related damages have been a major obstacle when attempting to analyse flood risk in the Mediterranean. Flood-related insurance damage claims, which could provide a proxy for flood impact and cover the last 20 years, are now available in the Mediterranean region of Catalonia, in northeast Spain. This means a comprehensive analysis of the links between flood drivers and impacts is now possible. The objective of this paper is to analyse the possible relationship between precipitation and flood damage compensation for the period of 1996-2015. Results show high correlation values between daily precipitation and insurance data on a regional, basin and local scale. These results confirm the hypothesis that precipitation is the main contributing factor to damages caused by flash flood events. The relationships between precipitation and damage shown provide insights into the flood risk in the Mediterranean and are promising for supporting flood management strategies.

1 Introduction

Flooding is the main natural risk in the world. Between 2005 and 2014, more than 85,000,000 people were directly affected by flood events annually, and around 6,000 people were killed on average each year due to floods (UNISDR, 2015). The main factors involved in flood risk analysis are the hazard, or the likelihood of a natural phenomenon causing damages, and the vulnerability, that is, the characteristics and circumstances of a community/system that make it susceptible to potential flood damage (UNISDR, 2009; Kundzewiczet al., 2014; Winsemiuset al., 2015). Vulnerability can include exposure and other societal factors such as early warning systems, the construction capacity to cope with natural hazards, and disaster recovery capabilities (Jongman et al., 2014; Nakamura and Llasat, 2017).

A large number of authors are making efforts to create appropriate methodologies to analyse the impacts of floods, due to the significant consequences of this phenomenon (Messner and Meyer, 2006; García et al, 2014). Indeed, progress is being made on incorporating the impact and vulnerability analysis in flood risk assessment, although the limitations of the impact data (availability and quality) make it difficult to carry out these studies (Elmer et al., 2010; Petrucci and Llasat, 2013; Jongman et al., 2014; Papagiannaki, et al., 2015; Thiekenet al., 2016).

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Insurance data may provide a good proxy for describing flood damages (Barredo et al., 2012). Several recent works have used this kind of data to explore flood drivers and impacts. For instance, in several European regions researchers have noted a significant influence of precipitation on flood insurance data (see for instance Spekkers et al., 2013, 2015 for Netherlands; Zhou et al., 2013 for Denmark; Sampson et al., 2014 for Ireland; Moncoulon et al., 2014 for France; Torgersen et al., 2015 for Norway). This data is very valuable for establishing causal relationships between the costs of flood damage and precipitation extremes, for developing risk maps, and for being used as a validation tool for damage models (Zhou et al., 2013). These studies agree on the potential of insurance data to assess the damage caused by pluvial and urban floods.

The Mediterranean region is prone to flash floods, where torrential rain concentrated in small catchments can turn in extraordinary runoffs and cause catastrophic damage (Llasat et al., 2014, 2016a). It is therefore expected that flood insurance data will be strongly related to heavy rainfall. However, relatively few studies exist for this region (Freni et al., 2010, Papagiannaki et al., 2015; Bihan et al., 2017). This may be due to limitations in insurance data records and difficulties in assessing the reliability of the spatial scale of the data. In Spain, insurance data can be only collected from the Spanish public reinsurer, the "Insurance Compensation Consortium" (*Consorcio de Compensación de Seguros*, or CCS), a public institution that compensates homeowners for the damage produced by floods, which plays a role similar to that of a private insurance company (Barredo et al., 2012). However, they only provide aggregated data and it is not possible to carry out analysis as detailed as for central Europe, or to access information collected during post-event surveys (Elmer et al., 2010). Floods account for more than 70 % of total insurance compensation paid out for extraordinary natural risks in Spain for the period of 1971-2015, amounting to a total of €5,564.3 million (CCS, 2016).

In this study we analyse the possible relationship between precipitation and damages caused by flood events in an area affected mainly by flash floods: Catalonia, in northeast Spain (Llasat et al., 2014). The starting hypothesis is that in this region precipitation is the main factor responsible for damage, since the majority are episodes produced by in situ precipitation and flash floods. The relationship between precipitation and insurance data is assessed considering different spatial aggregation of the data, determining the best range of applicability. Specifically, this study considers three difference spatial scales belonging to what is called a meso-scale within the scales described in Messner and Meyer (2006): (i) regional (Catalonia as a whole), (ii) basin (catchments in Catalonia) and (iii) local (the Metropolitan Area of Barcelona). The results of this study can help to better understand flood risk in Mediterranean areas by analysing drivers and impacts, and specifically estimating flood damage when high rainfall amounts are forecast.

The study is organised as follows. After the Introduction, the section on "Methods" describes the study region, the observed data and the methodology used. Then, the "Results" section presents the results obtained for the three different scales. Finally, the "Conclusions" section summarises the main findings of this study.

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2 Methods

This study has been carried out on different spatial scales, from the entire region (Catalonia) to basins and local scales (Barcelona) (Fig. 1). The period of the study is 1996-2015, when insurance data is available for damages.

2.1 Study region

First of all we considered Catalonia as a whole. This region is located in the northeast of the Iberian Peninsula. Its surface is 32,108 km^2 and it is characterised by three mountain ranges (Fig. 1a): the Pyrenees in the north (maximum altitude above 3,000 MASL) and parallel to the Mediterranean coast (SE-NE) between the Pre-Littoral mountain range (maximum altitude around 1,800 MASL) and the Littoral mountain range (maximum altitude around 600 MASL). This marked orography is key for the development of flash floods, both from a hydrological point of view (small torrential catchments) and due to meteorological factors (for example, the orography forces water vapour to rise from the Mediterranean, triggering instability; Llasat et al., 2016a). The region is divided into 42 districts and 948 municipalities, with a total population of 7.5 million, most of them living along the coast (Fig. 1b), where more than 70 % of the flood events occur (Llasat et al., 2014), which makes it a very vulnerable area.

At a basin scale, we analysed the Catalan basins that have recorded the highest number of flood events, which are: Maresme, Llobregat, Besòs, Ter, streams in the MAB, Tarragona Sud and Segre. Next, we studied the Maresme basin in detail, where the greatest number of flood episodes was registered (68 for the period of study) and the Ter basin, where a total of 38 flood events were recorded between 1996 and 2015.

Finally, we considered the Metropolitan Area of Barcelona (MAB, 534.7 km^2) (Fig. 1a), which consists of the city of Barcelona (1,608,746 inhabitants in 101.3 km^2) and 35 municipalities. Although it represents less than 2 % of the area of Catalonia, the area contains 48 % of the population (IDESCAT, 2016). It is affected by an average of more than 3 flood episodes per year, most of which are flash floods due to very convective local precipitation (Llasat et al., 2014). The city of Barcelona is crossed by 20 streams with their source in the Serra de Collserola (Littoral mountain range), and they are covered as part of the Barcelona drainage system, managed by the Barcelona Water Cycle (*Barcelona Cicle de l'Aigua* or BCASA). The United Nations International Strategy for Disaster Reduction (UNISDR) marked Barcelona as a resilient city and a model city for dealing with floods (Nakamura and Llasat, 2017), as it has a permanent surveillance and warning system running on hydraulic modelling that includes 15 rainwater tanks (13 underground and 2 open) that allow for better flood prevention. As a result, flood damages have decreased over time (Barrera-Escoda et al., 2006) while the daily rainfall threshold associated with damaging floods has increased (Barrera-Escoda and Llasat, 2015).

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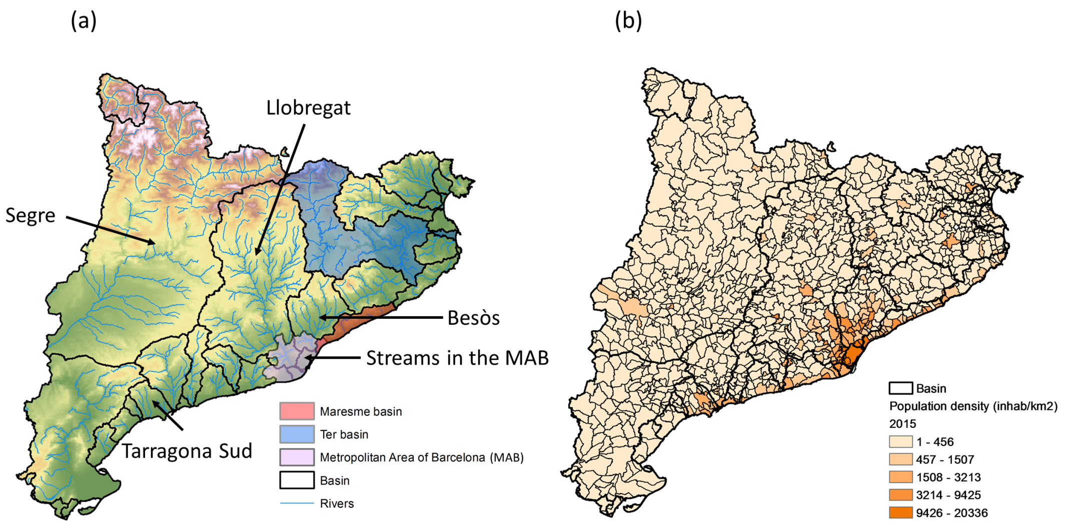

Figure 1: (a) Map of Catalonia showing the basins cited in the text and the Metropolitan Area of Barcelona (MAB); (b) distribution of the municipal population density in 2015.

2.2 Data

The flood damage data comes from the compensation for floods paid by the Spanish Insurance Compensation Consortium (CCS). The CCS compensates for damages caused to people and property by floods and other adverse weather events covered by an insurance policy. The data is available for the 1996-2015 period. For flood events we use the INUNGAMA (Barnolas and Llasat 2007, Llasat et al., 2016a) and PRESSGAMA (Llasat et al., 2009) databases, which report the flood episodes that have occurred in Catalonia on a municipal, district and basin level (Table 1).

Population data was obtained from the Statistical Institute of Catalonia (*Institut d'Estadística de Catalunya*, IDESCAT).

We use daily precipitation data provided by the meteorological station network run by the Spanish State Meteorological Agency (*Agencia Estatal de Meteorología,* or AEMET). To ensure temporal homogeneity, we have only considered the stations located in Catalonia with more than 90 % of valid data over the 1996-2015 period (Fig. 2). For the MAB we also considered 30-minute weather data obtained from the network of automatic meteorological stations belonging to the Meteorological Service of Catalonia (*Servei Meteorològic de Catalunya,* or SMC).

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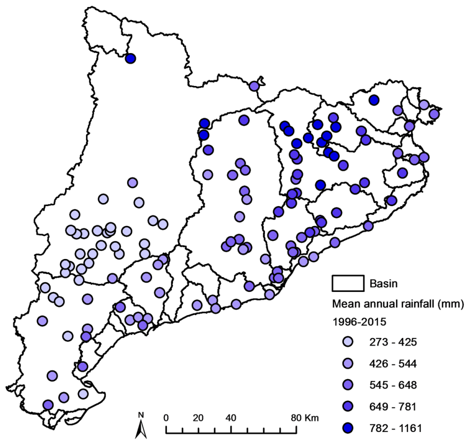

Figure 2: Pluviometric stations and average annual precipitation (1996-2015).

Table 1 shows the data used for the different spatial scales studied: regional (Catalonia), basin (specifically Maresme and Ter basins) and local (MAB) areas.

2.3 Methodology

The CCS database includes more than 58,000 records of claims paid for floods in Catalonia provided at a postal code level for the 1996-2015 period (no previous information is available with this level of detail). To compare this data with the other variables we aggregated them at a municipal level. This task was made more difficult by the fact that a municipality can include different postcodes and one postcode can correspond to two municipalities. These difficulties were solved by aggregating the municipal postcodes and looking at press information. The compensations were adjusted to the value of the euro in 2015, following the methodology defined by the Spanish National Institute of Statistics (INE, 2007). This consists of using the exchange rate in the Consumer Price Index (CPI) between two periods to adjust the values shown in euros. Finally, to calculate the total damages per episode, we took the payments made during the period for the episode and the following 7 days. We used this 7-day window since this is the period of time that the CCS allows insurance claims to be made. When the time lag between two episodes is less than 7 days, damages are associated with the first event, if the date of the claim was before the first day of the second episode. The event duration is identified in the INUNGAMA database. The PRESSGAMA database was used for a description of the event and the affected places.

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In order to analyse the potential links between precipitation and flood damages throughout Catalonia as whole, we explored four different configurations. We decided to do this as floods could happen in areas that are far away from the regions where the highest precipitation occurred. More specifically, the scheme used to correlate precipitation and damages is illustrated in Fig. 3 and is described below. We calculated:

1) The correlation between the maximum 24 h precipitation recorded in Catalonia during the event and the total amount paid by the CCS for the damages that occurred in the region;
2) The correlation between the maximum 24 h precipitation recorded in the basins where river or pluvial floods occurred and the total amount paid by the CCS for damages that occurred in the entire region;
3) The correlation between the maximum 24 h precipitation recorded in the basins where river or pluvial floods occurred and the total amount paid by the CCS for damages that occurred in the affected basins;
4) The correlation between the maximum 24 h precipitation recorded and the total amount paid by the CCS in each basin affected by river or pluvial floods.

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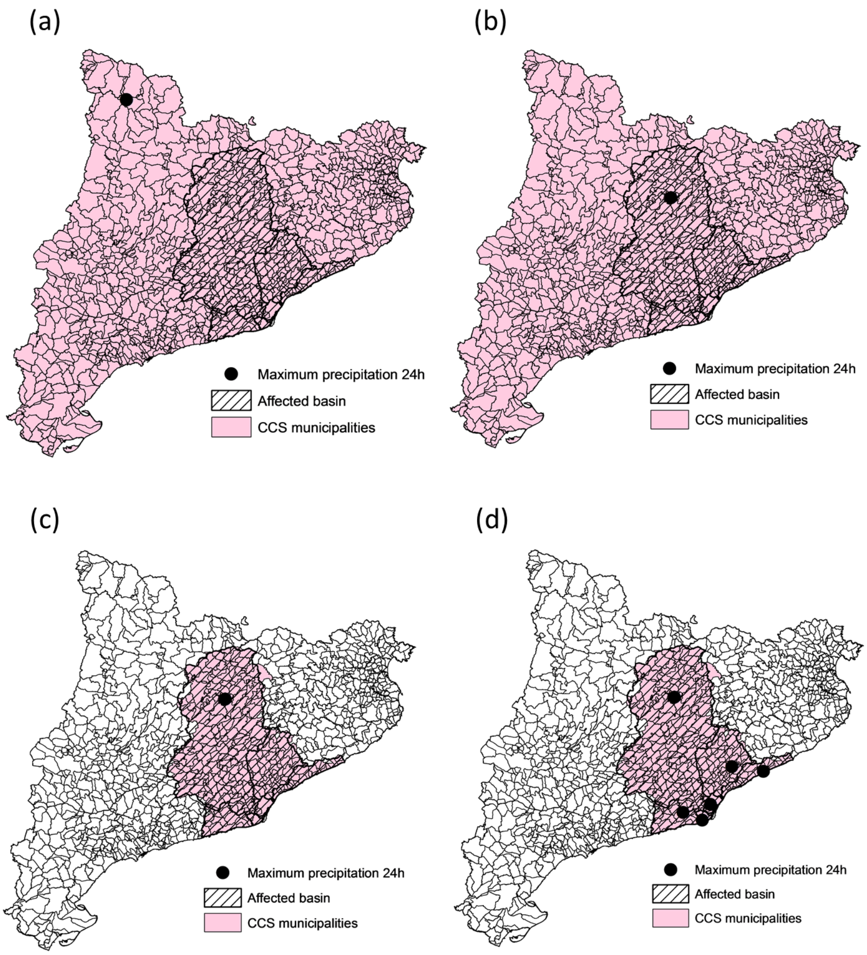

Figure 3: A schematic view of the analysis carried out to find the scale with the highest correlation between precipitation and flood damage. The pink shaded area shows the municipalities considered when aggregating damage. The dashed area shows the catchment affected by floods. The black circles show the areas with maximum precipitation in 24 h in: (a) the region as a whole; (b), (c) all the affected catchments; (d) each affected catchment.

When looking at the basin scale, we analysed the correlation between precipitation and compensation paid for 7 basins. Those

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that have recorded a number of flood events above the 75th percentile (26 flood events). These basins are (from more to less flood events recorded): Maresme, Llobregat, Besòs, Ter, streams in the MAB, Tarragona Sud and Segre. Moreover, for the Maresme and Ter basins, we carried out a more in-depth analysis (Sect. 3.2.2), looking for correlations between compensations, flood episodes and the population at a municipal level. The Maresme basin is a torrential basin affected for by flash flood events and with a high permanent population density that increases in the summer (Llasat et al., 2010). The Ter basin is important both in terms of water resources and for agriculture and tourism, including both rural and urban areas, as well as hydraulic systems for flood prevention (dams and retention dams). For informative purposes, the city of Girona, the biggest city in the basin, was affected by 22 catastrophic flood episodes between 1301 and 2012 (Barrera-Escoda and Llasat, 2015). In order to better understand the relationship between flood events, compensation and population in a heterogeneous basin like the Ter basin, it has been divided in different sub-basins based on the population density of each municipality.

Finally, in the MAB the relationship with compensation was analysed for three periods of rainfall accumulation: 30 minutes, 24 hours and for the whole event.

All correlation calculations were carried out using the Spearman test.

3 Results

3.1 Analysis for the entire region

3.1.1 Flood episodes

The total number of flood episodes recorded in Catalonia for the 1996-2015 period was 166. Around 49 % of the episodes occurred during the months of July, August and September, with the latter month having the highest percentage of episodes (22 %). The most severe or catastrophic episodes occurred in autumn, with 77 % of the events between September and November (Llasat et al, 2016). The compensation paid by the CCS for floods for this period in Catalonia was €436.4 million.

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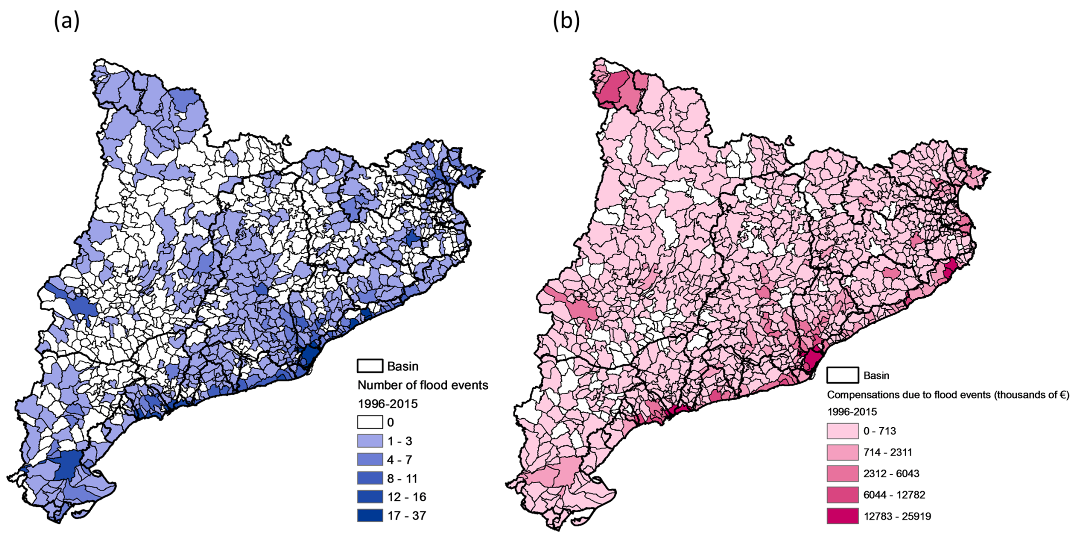

Figure 4: (a) Municipal distribution of flood events; (b) municipal distribution of total compensation for floods paid by CCS. Period: 1996-2015.

Figure 4 shows the number of flood episodes and the total number compensation paid for floods by the CCS on a municipal level. Coastal municipalities were the most affected by flood events (Fig. 4a) and where there was the most damage (Fig. 4b). This is the region where most of the population of Catalonia and the most tourism are concentrated, which makes it a very exposed and vulnerable area.

3.1.2 The relationship between precipitation and flood damages

Table 4 shows the result of the correlations between the accumulated precipitation in 24 h and the compensation paid by the CCS, applying the 4 methodologies described in section 2. In every case, the results show a positive and significant correlation. This result is consistent with the fact that most floods are caused by high-intensity rainfall in basins where the time concentration is very small. This means 24 h precipitation could be considered a good indicator for flood risk. The best results are obtained using criteria number 3, only considering the basins affected by floods (Fig. 5). The fact that the correlation decreases considering the basin individually (criteria 4), suggests that there are not necessarily more damages where more precipitation occurs, since differences in vulnerability and exposure between one basin and the next may play an important role.

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Figure 5 shows the correlation between 24 h precipitation and compensation using criteria 3. This graph makes it possible to discern a precipitation threshold from which significant damage is observed. For instance, the lines show that for the events where the 24 h precipitation was above 100 mm, damages exceeded €30,000, except in one case where the compensation did not surpass € 5,000, because it mainly affected a rural region with a low population.

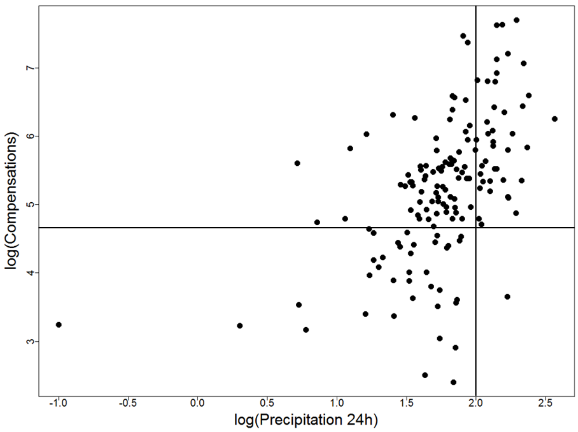

Figure 5: Scatter plot (in log scale) between precipitation in 24 h and compensations paid by CCS for flood episodes recorded in Catalonia between 1996 and 2015, using the criteria number 3.

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3.2 Analysis at a basin scale

3.2.1 Flood episodes

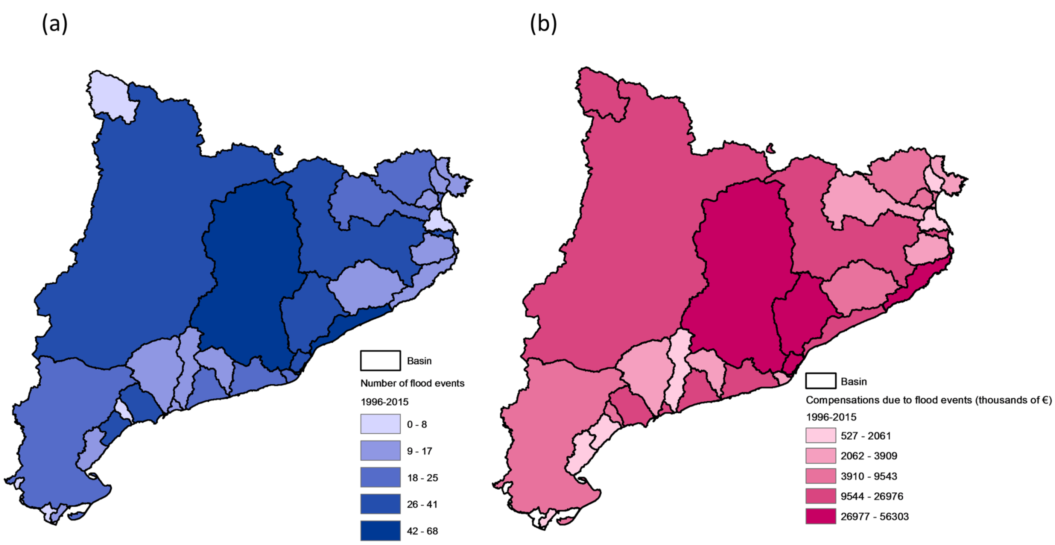

Figure 6: (a) Number of flood events per basin; (b) total compensation paid by the CCS per basin. Period: 1996-2015.

Figure 6 shows the total number of flood events recorded (Fig. 6a) and the total compensation paid by CCS for flooding (Fig. 6b) in each basin. In general, there is a good correlation between the flood events recorded and the compensation paid, as expected. The Maresme basin was affected by 41 % of the recorded episodes with damages that add up to €26,976,181.34 between 1996 and 2015 (Fig. 6b), especially for damages to individuals (Table 3).

3.2.2 The relationship between precipitation and flood damages

Table 3 shows that most of the correlations are positive and statistically significant for the selected basins. The best results were obtained for the Maresme basin, with correlation of 0.7. This basin is made up of 30 municipalities and is characterised by a succession of villages crossed by torrential streams with their sources in the Littoral Range (Fig. 7), and where flash floods occur every year due to local convective precipitation events (Llasat et al., 2016a). These factors provide a possible explanation of the high correlation between precipitation and the damage caused.

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On the other hand, the worst results are found in the case of the Ter river basin. Although this basin is affected by both flash flood and flood events due to continuous rains, the latter are less frequent (Barriendos et al., 2003). In addition, the use of reservoirs to control overflows means the floods are mainly caused by intense local rains in the sub-basins. Contrary to the Maresme basin, the Ter is a large basin where there are many differences in land use: the lower part of the basin is much more urbanised than upstream (Fig. 7). This non-homogeneous behaviour can also be observed on the map of compensation paid by CCS (Fig. 4b).

Next, we analyse the basins that present the best and the worst correlations in more details, for the results for 24 h precipitation and compensation in the previous section (Table 3), for the Maresme and Ter basins respectively. In order to analyse these differences in more depth, a correlation analysis was carried out for each basin at a municipal level for the flood events recorded for the 1996-2015 period, the total compensations received for the same period and the population of the municipality in the year that the episode occurred. Table 4 shows these results for the two basins studied. As might be expected, in both cases the compensation is better explained by the population, since the compensations paid are higher where there are more people exposed to floods. Furthermore, in the case of the Maresme basin, the correlation result between flood events and compensation paid are quite high and significant (0.53) while in the Ter basin this value, despite being significant, is low.

For this reason, and taking into account the greater differences between municipalities in the latter basin, analysis was carried out while separating the Ter river basin into two groups, according to the population density of the municipalities, using a threshold of 85 % (263.7 inhabitants/km^2): we defined "urban" areas as those that surpasses this threshold, and "rural" areas as all the others. This population density threshold was chosen for presenting a better correlation result between the number of flood events and compensation. It is worth noting that similar results were obtained considering different percentiles, as reported below.

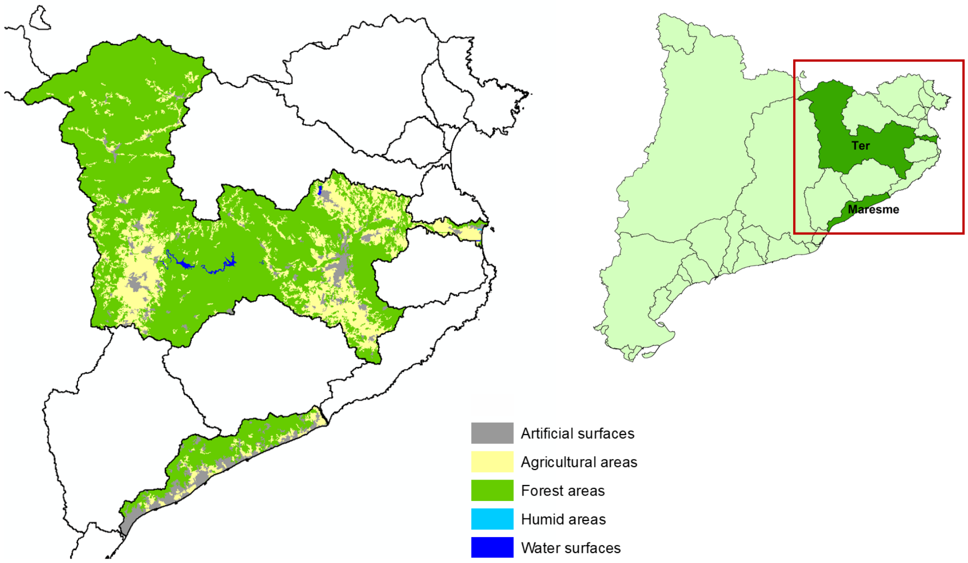

Figure 7: Land use (Corine Land Cover 2012) for the Ter and Maresme basins. The 5 land use categories of the Corine Land Cover Map are shown with the corresponding colour code.

Table 5 shows that the correlations results are quite high considering the "urban" areas: the correlation value between flood events and damages is 0.60. If we consider a lower threshold to define "urban" areas, the 75th percentile (163.1inhabitants/km^2), then the correlation is still quite high (0.53). In addition, the correlation values between compensations and population are high as expected (0.67 for the 75th percentile and 0.81 for 85 %), as there are more claims where more people are exposed to risk. On the other hand, when considering the "rural" areas, the correlations are lower. These results can be explained by the poor availability of information in these regions, where it is probable that not all alluvial events were recorded and agricultural assets were not insured by the CCS

3.3 Metropolitan Area of Barcelona

3.3.1 Flood episodes

A total of 61 episodes of floods were recorded in the Metropolitan Area of Barcelona (Fig. 7a), which means an average of more than 3 episodes per year. The summer and autumn months were the ones with the highest number of flood episodes, with

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September being the first (31 %), followed by October (16 %). The compensation paid by the CCS for floods amounted to € 86.3 million, which represents 20 % of the total compensation paid by the CCS in Catalonia (Fig. 7b).

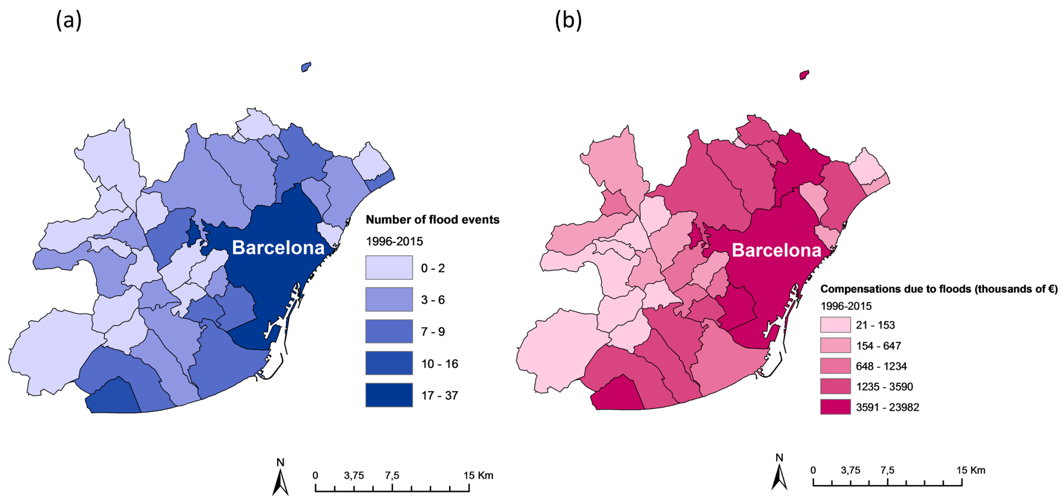

Figure 8: (a) Municipal distribution of the number of flood episodes in the MAB; (b) municipal distribution of the total compensation paid by the CCS in the MAB. Period 1996-2015.

Figure 8 suggests a relationship between the MAB municipal distribution for the number of flood episodes and the distribution of the total compensation paid by the CCS. The municipality of Barcelona recorded a total of 37 episodes between 1996 and 2015, all due to in situ precipitation and drainage problems in the city (Llasat et al., 2016b). The city of Barcelona is also notably the most compensated for floods (around € 19 million).

3.3.2 The relationship between precipitation and flood damages

Table 6 shows the results of the analysis of correlation the between precipitation variables and the damage for all flood episodes that affected the MAB between 1996 and 2015. The best-correlated variable with compensation paid by CCS is the maximum precipitation in 30 minutes, with a value of 0.64. This result, together with the strong correlation between precipitation in 24 h and accumulated precipitation, corroborates the hypothesis that most frequent type of flood in the study region is flash floods, that is to say, episodes caused by intense precipitation of a short duration (one day or less).

4 Conclusions

The Mediterranean is an area affected by flood events that produce significant socioeconomic damage. Catalonia, located to the west of the Mediterranean, is affected by an average of more than 8 episodes per year. The majority of the damage caused by these episodes is due to local events, with intense and short-lived rainfall and not river overflows (Llasat et al., 2014). Therefore, it is assumed that precipitation is the maximum contributing factor for damages caused by this type of episode. To corroborate this hypothesis, the relationship between precipitation and compensation paid by insurance companies at different spatial scales was studied.

We observed that the best correlation results (up to 0.6) between the two variables are obtained when the affected basins are taken into account, rather than the entire study region. However, we also found that when we analysed large and heterogeneous basins (like the Ter basin) the correlation was only 0.37, and better results are achieved considering sub-areas defined in terms of population density, whether "urban" or "rural" areas. In the urbanised areas the correlation is 0.60, while lower and non-significant correlations were obtained for the rural areas. On the other hand, in small and homogeneous, very urbanized basins, such as the Maresme basin, precipitation explains most of the damage caused by flood events (with a correlation of 0.68).

For the particular case of the Metropolitan Area of Barcelona, for which sub-daily rainfall data is available, a correlation above 0.60 was found for the maximum precipitation recorded in 30-min and damages, in spite of the lower correlation obtained for the precipitation accumulated in 24 h. These results suggest that prevention measures (such as rainwater retention tanks in the city of Barcelona) helped to mitigate the risk (for example, controlling water channels), but when precipitation is very intense and of short duration, these measures may not be sufficient.

These results confirm the hypothesis that precipitation is a key factor in explaining the damage caused by flood events in regions where flash floods and urban floods are the main type of floods, as is the case in this Mediterranean region. The strong relationships found in this study can be a useful tool for improving early warning systems and emergency management. For instance, from the correlation results obtained between precipitation and compensations it is possible to predict the damages caused by a certain precipitation threshold on a different spatial scale. Also, these links could provide a basis to predict flood damage in future scenarios of climate change.

Competing interests

The authors declare that they have no conflicts of interest.

Acknowledgments

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(HYdrological cycle in the Mediterranean EXperiment) and the Panta Rhei WG Changes in Flood Risk. We would like to thank AEMET and SMC for the meteorological and hydrological information provided for this study. Thanks also to BCASA for the detailed information about the system used to prevent and manage floods. Marco Turco was supported by the Spanish Juan de la Cierva Programme (IJCI-2015-26953). We would also like to acknowledge Hannah Bestow for the correction of the English language of this paper.

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Tables

Table 1: Summary of the data used. Precipitation refers to the number of meteorological stations considered; The number of flood episodes is the total sum for the period 1996-2015; The population is the total number of inhabitants in 2015; The damages refer to the compensation paid by the CCS for the 1996-2015 period in millions of euros.

1996-2015	CATALONIA	MARESME BASIN	TER BASIN	MAB	SOURCE
Precipitation 24 h	127	3	18	26	AEMET
Precipitation 30-min.	-	-	-	14	SMC
Number of flood events	166	68	38	61	INUNGAMA/ PRESSGAMA
Population	7,508,106	638,733	413,307	3,213,775	IDESCAT
N. of municipalities	948	30	105	36	IDESCAT
Damages	436.4	27	20.2	86.3	CCS

Table 2: The results of correlations between 24 h precipitation and CCS compensation for the 4 different criteria applied.

METHODOLOGY	CORRELATION VALUE
1: PPT 24 h Catalonia vs total damages Catalonia	0.57**
2: PPT 24 h basins vs total damages Catalonia	0.53**
3: PPT 24 h maximum of all affected basins vs total damages of affected basins	0.60**
4: PPT 24 h vs damaged basins affected (one by one)	0.43**

* p-value<0.05; **p-value<0.01

Table 3: The results of correlations between 24 h precipitation and CCS compensation for the selected basins (1996-2015).

BASIN NAME	BASIN SURFACE (km^2)	FLOOD EVENTS	CORRELATION VALUE
Besòs	1,024	41	0.43*
Ter	2,960	38	0.37
Llobregat	4,925	54	0.49**
Segre	11,267	29	0.42**
Maresme	338	68	0.68**
Streams in the MAB	93	36	0.47**
Tarragona Sud	338	32	0.43*

* p-value<0.05; **p-value<0.01

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Table 4: The correlation results for the Maresme/Ter basins.

	COMPENSATIONS	FLOOD EVENTS	POPULATION
COMPENSATIONS	-	-	-
FLOOD EVENTS	0.53**/0.20*	-	-
POPULATION	0.60**/0.42**	0.62**/0.34**	-

* p-value<0.05; **p-value<0.01

Table 5: The correlation results for the "urban"/"rural" areas of the Ter basin.

	COMPENSATIONS	FLOOD EVENTS	POPULATION
COMPENSATIONS	-	-	-
FLOOD EVENTS	0.60*/0.04	-	-
POPULATION	0.81**/0.35**	0.68**/0.25*	-

* p-value<0.05; **p-value<0.01

Table 6: The correlation results for compensation in the MAB area and different precipitation indices (period: 1996-2015).

	PRECIPITATION 24 h	30-MINUTE PRECIPITATION	ACCUMULATED PRECIPITATION	COMPENSATIONS
PRECIPITATION 24 h	-	-	-	-
30-MINUTE PRECIPITATION	0.39**	-	-	-
ACCUMULATED PRECIPITATION	0.97**	0.38**	-	-
COMPENSATIONS	0.31*	0.64**	0.31*	-

* p-value<0.05; **p-value<0.01