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40th anniversary of the August 1983 floods in the Basque Country

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Summary

Editors Board

The Consorcio de Compensación de Seguros digital magazine “Consorseguros” (CCS) is published every six months,
its content particularly addressing matters related to the Consorcio’s activities in
various fields of insurance, reflecting on and analysing them.

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Summary

Editorial

Last August marked the 40th anniversary of what today is still the highest loss event in the history of the Consorcio de Compensación de Seguros and extraordinary risk insurance, namely, the 1983 floods in the Basque Country. Those of us of a certain age can still remember the pictures of the devastation in Bilbao and the area of the Bilbao estuary. The floods caused havoc not just in the Basque Country but also in Navarre and Cantabria. As regrettable and catastrophic as they were in terms of both personal injury and property damage, they were also a wake-up call and an opportunity to undertake far-reaching changes, changes that can be seen today when we walk through the most hard-struck areas, which are now places of interest to tourists that offer world-class services. The situation also resulted in new approaches by the institutions in charge of water and land management, weather forecasting and insurance coverage. This issue of our magazine looks back at that terrible episode, its causes and effects, and the profound impact it had on a number of key institutions, such as the river basin management authorities, the then National Meteorological Institute (INM, for its Spanish initials), now named the State Meteorological Agency, and the Consorcio de Compensación de Seguros (CCS) itself.

The floods caused havoc not just in the Basque Country but also in Navarre and Cantabria. As regrettable and catastrophic as they were in terms of both personal injury and property damage, they were also a wake-up call and an opportunity to undertake far-reaching changes, changes that can be seen today when we walk through the most hard-struck areas, which are now places of interest to tourists that offer world-class services. The situation also resulted in new approaches by the institutions in charge of water and land management, weather forecasting and insurance coverage.

Starting with the last one, two articles focus on the CCS's role in the events. One has been written by the then CCS Head of Department, Pilar González de Frutos, who would go on to be the Consorcio's Managing Director for Operations, later the Director-General of Insurance Affairs and Pension Funds, and after that the President of Unespa [Spain's Insurers Association]. She is clearly one of the most prominent figures in the Spanish insurance industry in recent times. Pilar recounts her experience managing that loss event in 1983 and explains how the CCS handled the situation. Back then, the Consorcio was operationally and structurally quite different from what it is today, and it underwent sweeping changes that have given it its present form. Similarly, Belén Soriano, the CCS's Assistant Director for the Technical Area and Reinsurance, has compiled all the data and reports concerning that loss in the CCS's records and has produced an interesting article discussing the economic impact of the event. She also brings us some thoughts from that time on whether or not the CCS should use reinsurance to protect against this type of highly catastrophic events.

The weather conditions that brought about that episode are discussed in an interview with Ángel Rivera, then a meteorologist with the INM, who was deeply involved in the work of weather forecasting and in the restructuring of meteorology procedures and capabilities in Spain in the wake of that event and earlier flooding in the Valencian Region in 1982.

José María Sanz de Galdeano Equiza, Director of Planning and Works, and Aitziber Urquijo Luengo, Head of Hydraulic Works, with the Basque Water Authority have assessed the hydrological aspects of that flood event and the measures since taken to mitigate the impact of similar episodes today.

It has already been noted how important the CCS's data are to enable us to describe the event. Francisco Espejo and Urko Elosegi, with the CCS's Subdirectorate of Research and International Relations, have taken some of those data and analysed the spatial and seasonal distribution of losses from natural hazards covered by the extraordinary risk insurance scheme. Their findings are helpful in enhancing our understanding of those risks so that they can be reduced.

Institutions like the CCS make up a group of protection gap entities that operate in certain countries, usually in the form of public-private partnerships. The recently published *Disaster Insurance Reimagined* by Paula Jarzabkowski and her team discusses the role of entities of this kind. One of the authors, Eugenia Cacciatori, of the Bayes Business School of the City, University of London, reviews that book.

Rounding off this issue of Consorseguros Digital is a consideration of a highly topical case-law issue, the classification of personal mobility vehicles, namely, electric bikes, as motor vehicles, by José Antonio Badillo, the CCS's Regional Representative in Madrid and a leading specialist on the subject, which greatly influences whether third-party liability insurance is needed for accidents involving these vehicles.

Historical documentation on the August 1983 flooding in the Basque Country

Belén Soriano Clavero
Assistant Director, Technical Area and Reinsurance
Consorcio de Compensación de Seguros

This year has seen the 40th anniversary of the worst event in the history of the Consorcio de Compensación de Seguros (CCS) in its coverage of extraordinary risks, namely the August 1983 flooding in the Basque Country. In this article we shall therefore try to gather together and give some structure to the information available in CCS files and documentation from that era in regard to the economic fallout from the event, both to chronicle the episode and leave on record that this data remains accessible.

All the amounts are expressed in euros, either in nominal terms or inflation-adjusted as indicated. All the data, tables and charts or figures used to illustrate them are from the CCS's own research.

Information contained in technical notes

The Actuarial Report to approve the extraordinary risk rate which was passed under a Resolution of 28 November 1986 by the Directorate-General for Insurance Affairs reflects the following claims experience for 1983 as a whole:

According to actuarial report on 1987 extraordinary risks rate

1983	No. Claims	COMPENSATIONS			Average cost updated 2022 in euros
		Nominal in euros	Updated 2022 in euros	%	
Overflow flooding	13,555	162,038,541	612,639,782	72%	45,197
Wave battering	6	31,346	118,515	0%	19,753
Hurricane	237	304,368	1,150,763	0%	4,856
Rain	16,959	58,917,924	222,758,512	26%	13,135
Snow	5	136,531	516,200	0%	103,240
Hail	247	453,407	1,714,254	0%	6,940
Landslide	4	16,472	62,279	0%	15,570
Terrorism	1,041	2,592,656	9,802,384	1%	9,416
Total año 1983	**32,054**	**37,352,200,455**	**848,762,688**	**100%**	**26,479**

Table 1.

The figures which appear in this actuarial report (given against a pink background in Table 1) are the number of claims and nominal compensation which we set out in euros and group by cause for the whole of 1983.

A significant item of input from these figures is the distribution of loss numbers categorised by causes which CCS covered up to 31-12-1986 — which then included rain, wind and hail — given that thereafter information of this sort was treated collectively (together with hurricanes) under the heading of an atypical cyclonic storm.

The other figures are calculated based on those previously and are compensation pay-outs expressed in inflation-adjusted euros as of 31-12-2022, the percentage distribution of compensation by cause and the average cost restated for inflation in euros.

It is worth noting that in 1983 the most substantial causes were flooding from overflows and rain, at 72% and 26% respectively of overall compensation.

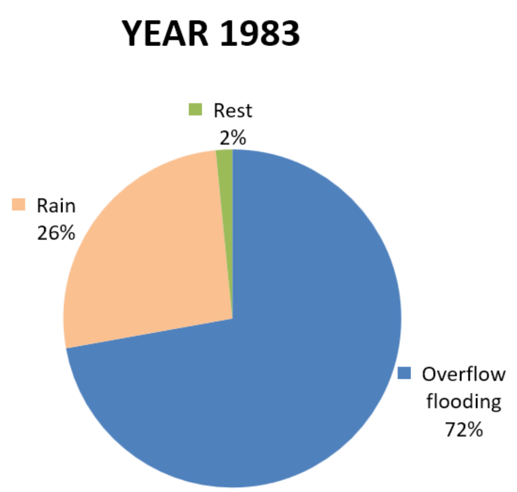

Figure 1.

We might also point to what an outlier the high average cost is for that year, at way above the average for the dataset reviewed (according to the Extraordinary Risk Statistics available on CCS website), as can be seen in Figure 2 below (with amounts adjusted as of 31-12-2022):

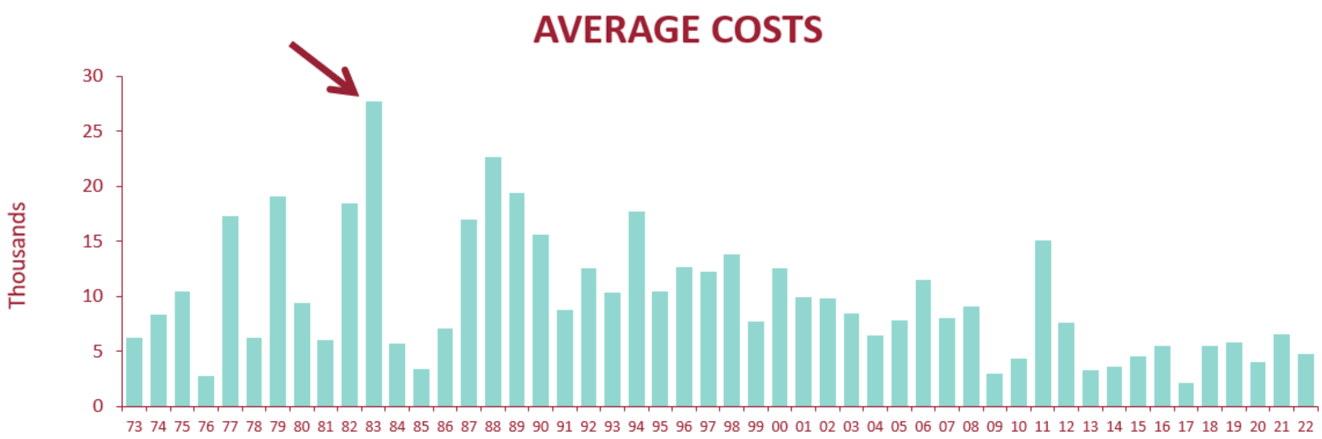

Figure 2.

The cited actuarial report makes no express reference to the 1983 loss event in the Basque Country but instead takes that particular year as a whole, in which there was also another especially major event in the form of the flooding in Catalonia and the Valencian Region in November, the cost of which came to roughly 6.5% of that of the August event, although this does not detract from the fact that it was a remarkable event.

What is nonetheless crystal clear is that the August loss event in the Basque Country is the incident which really left its mark on the claims experience that year, since it accounted for some 88% of the total.

One and a half years later, **the Actuarial Report to approve the extraordinary risk rate which was passed under a Resolution of 20 May 1988 by the Directorate-General for Insurance Affairs** once again reflects the following claims experience for 1983 as a whole:

According to actuarial report on 1988 extraordinary risks rate

1983	No. Claims	COMPENSATIONS			Average cost updated 2022 in euros
		Nominal in euros	Updated 2022 in euros	%	
Overflow flooding	15,173	181,832,916	685,777,527	72%	45,197
Wave battering	7	35,088	132,663	0%	19,753
Hurricane	265	340,704	1,288,142	0%	4,856
Rain	18,984	65,951,624	249,351,717	26%	13,135
Snow	6	152,830	577,824	0%	103,240
Hail	276	507,535	1,918,904	0%	6,940
Landslide	4	18,439	69,714	0%	15,570
Terrorism	1,165	2,902,170	10,972,605	1%	9,416
Total year 1983	**35,881**	**251,291,307**	**950,089,098**	**100%**	**26,479**

Table 2.

On this occasion only total nominal compensation pay-outs (against the pink background) are included, which have risen from 224 million euros to 251 million euros, revealing a claims experience 12% above that previously given.

This assumes the following hypotheses, namely that (i) the claims percentages (i.e. compensation) remain at similar levels according to causes, although these are not in fact shown in this actuarial report, and (ii) the average cost per cause is the same, while all the other information is given.

This all leads one to conclude that the events of 1983, coming in the wake of significant claims in 1982 that included very serious flooding in the Valencian Region in October (at a cost of 26.9% of the 1983 loss event in the Basque Country), brought about: (i) a new system of demarcation of risks covered pursuant to Spanish Royal Decree 2022/1986 endorsing the Extraordinary Risk Regulations, as well as (ii) examination of potential re-insurance for this activity; in other words, given such an inauspicious situation, CCS delved deeper in its research into risk prevention and measures aimed at reducing risks.

Figure 3 shows claims (with amounts inflation-adjusted as of 31-12-2022) for the dataset from the last 50 years, where, in relative terms, emphasis is placed on the seriousness of the claims experiences in 1982, and most especially 1983, compared to more recent loss events such as the windstorm Klaus in 2009, the Lorca earthquake in 2011 and the flooding in the south-east of the peninsula in 2019, all this in spite of the increase in insurance activity in Spain over the period for the data series under review.

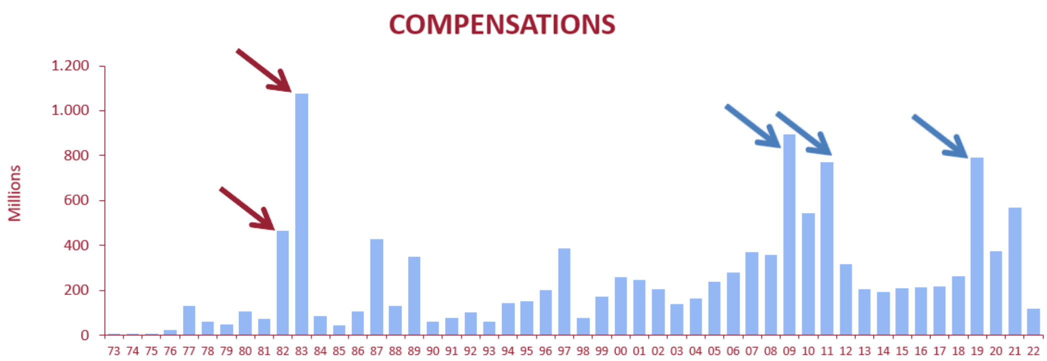

Figure 3.

Figure 4 shows how sums insured have ballooned from 1.6 trillion euros in 1990 (no data prior to this year is available) to 6.5 trillion euros in 2022 in inflation-adjusted terms:

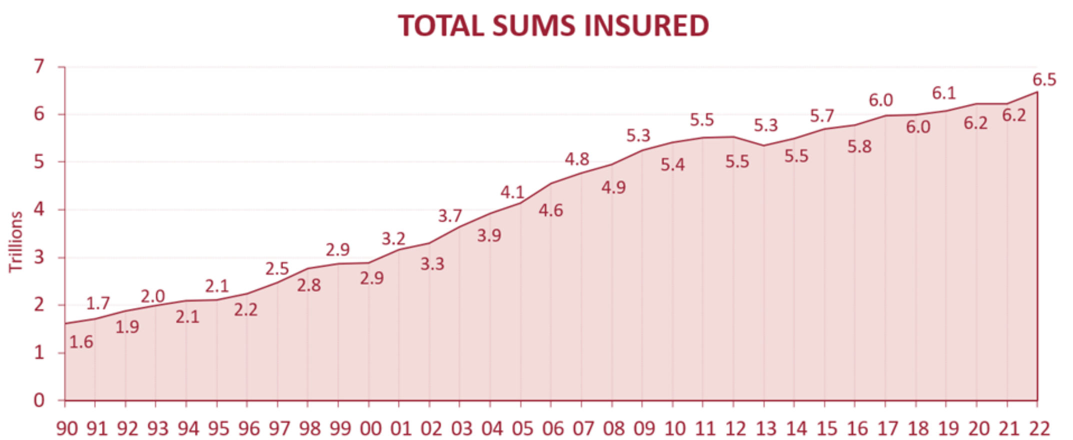

Figure 4.

Information in the re-insurance studies

Against this backdrop, in the years leading up to 1990 a study was conducted into potential for re-insuring extraordinary risks, whereby CCS would be the body ceding risks and firms in both domestic and international markets would act as re-insurers. In the end re-insurance of this kind was not used for reasons given later on.

The CCS report, where the body defines its re-insurance aims, states as follows:

> The alternative explored by CCS at the time as a possibility for being passed on for re-insurance was a catastrophe type event, i.e. non-proportional excess of loss reinsurance, without including rain damage or loss which CCS had ceased to cover in 1987.
>
> Such an event might be defined as one where the claims incurred were between 210 and 360 million euros in 1990, i.e. re-insurance coverage of 150 million euros in excess of 210 million euros.
>
> In the past this had occurred on just a single occasion, that of the August 1983 event in the Basque Country. For this event a return period based on a maximum prudential basis of 50 years was set, although in subsequent studies this interval was substantially increased.
>
> Other alternatives were assessed such as defining a catastrophic event as one where the claims incurred were between 120 and 210 million euros in 1990, i.e. re-insurance coverage of 90 million euros in excess of 120 million euros.

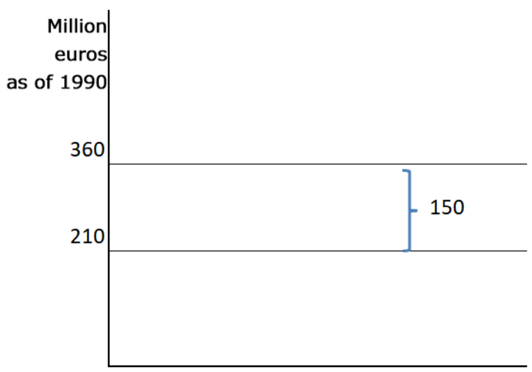

Figure 5.

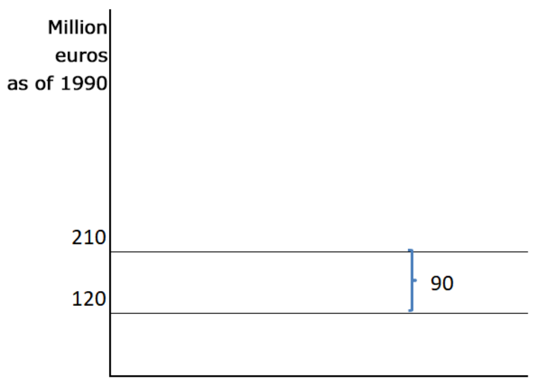

Figure 6.

> And likewise, the possibility was looked at of passing on accumulations of several major events all falling in the same year without any need for any one of them to reach the established thresholds, although they would have to overall, i.e. stop loss reinsurance.

The re-insurance broker with which CCS was working on this issued a report dated 23-01-1990, in which (with the consensus of the international re-insurance market as regards expectations with respect to the market's worldwide capacity) it was stated that the aim of re-insurance would essentially be to cover the events of 1983 in Bilbao entailing a cost of 203 million euros at 1983 prices (just for flooding), because as from January 1987 rain damage was no longer covered.

For the first time we find (in the reports characteristic of the technical area) a valuation for the August 1983 Basque Country event, albeit merely for flooding; even though as the years went by, this amount became more specific to the point where the event was closed off at the amount which is given in the section "Information contained in Extraordinary Risk Statistics", which now embraces flooding and rain.

To gain an understanding of the re-insurance options taken into account in 1990, it must be recalled that these were years when inflation was running high, as is illustrated in Table 3:

In million euros

YEAR	CPI (%)	Assessment of the August 1983 event in the Basque Country -only flooding-
1983	12.2	203
1984	9.0	221
1985	8.2	239
1986	8.3	259
1987	4.6	271
1988	5.8	287
1989	6.9	307
1990	6.5	327

Table 3.

Another consideration to bear in mind is the geographical extent to factor in, as the event also affected Navarre and Cantabria (mostly the latter).

The broker suggested excess of loss re-insurance coverage above a deductible of 120 million euros per event and said that a deductible of less than 120 million euros in 1990 would entail a premium which CCS would be unable to assume.

Coverage above 120 million euros was offered in four separate ranges, each with its premium rate, up to 240 million euros in excess of the deductible, which would include the events in Bilbao in 1983 with an additional margin.

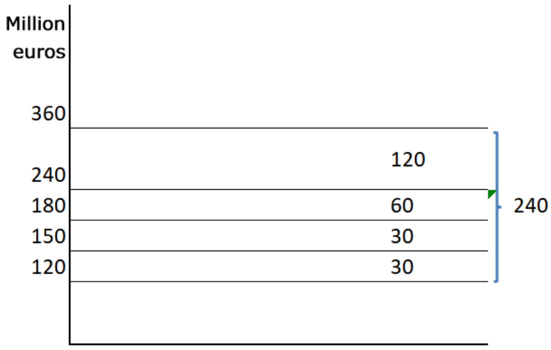

Figure 7.

As a major component, in its report the broker includes a necessary time limit on an event and proposes a ceiling of 168 hours (7 days) and therefore the possibility of restoring coverage should the time limit in any single event be exceeded.

Other brokers and re-insurers provided proposals on similar terms, which were updated in the years that followed, yet re-insurance was not taken out at any time for the reason which is laid out further below.

The re-insurance assessment must be understood in the context of the situation referred to at the time as a "Claims deviation provision" for risks to items, personal risk and civil liability on the part of a driver which, as of 31-12-1990 had a balance of 82 million euros.

Information in studies of coverage of extraordinary risks

The first such study dates from 1989; there are later studies but they do not provide any further information on the event which concerns us here.

Under the heading of "Study of extraordinary risk coverage – 1989" information is given which is highly relevant for these purposes, such as:

- The fact that the most significant risks which the CCS handled in 1957-1987 are identified, where, under the section titled "North – Flooding and Rain – 1983", compensation of some 268 million euros at 1983 levels is allocated to this event:

Place	Cause	Year	Compensation paid-out (In million euros)
Valencian Region	Flood	1957	2
Seville	Flood	1961	1
Barcelona	Rain	1962	4
Girona	Flood	1970	1
Barcelona	Flood	1971	11
Barcelona	Rain	1971	2
Barcelona	Hail	1974	2
Biscay	Flood	1975	4
Biscay	Rain/Flood	1975	4
Galicia / Asturias	Wind/Rain	1978	2
Valencian Region	Snow	1980	7
Barcelona	Hail/Rain	1980	2
Araba-Alava/Gipuzkoa	Rain	1980	1
Biscay	Rain	1980	1
Araba-Alava/Gipuzkoa	Flood/Rain	1981	1
Madrid	Terrorism	1982	4
Eastern Spain/Aragon/Catalonia	Flood/Rain	1982	84
North	**Flood/Rain**	**1983**	**268**
Valencian Region/Catalonia and Andalusia	Flood/Rain	1983	12
Valladolid	Hail	1984	2
Valencian Region/Catalonia/Galicia and Murcia	Flood	1987	105

Table 4.

This table allows us an indication of the magnitude of the event in relation to others which occurred in the preceding and immediately subsequent years.

- The two models of claims incurred are analysed: (i) that for Eastern Spain and Catalonia zones, where extraordinary claims incurred are characterised by being more frequent, i.e. they have shorter recurrence or return periods and economic consequences which the report described as controlled and foreseeable; whereas (ii) in contrast to this there is a depiction of the model for the Northern zone (Biscay and Gipuzkoa), which is rated as catastrophic.

- It looks at the characteristics of the event studied relative to previous weather-related observations, such as, for example:

  - The fact that the rains in August 1983 were unprecedented in the zone, since the highest values of monthly falls recorded were below the downpours from 24 to 26 August 1983, which were the heaviest over the 120 years since records had been kept:

Observatory	Maximum monthly rainfall recorded mm					
Bilbao	October 1885 349	December 1906 355	March 1869 360	February 1931 417	December 1874 495	**24-26 August 1983 480**

Table 5.

  - The fact that, according to the figures recorded over 20 years, the maximum daily rainfall was also below the value for the downpour of 26 August 1983:

Observatory	Maximum daily rainfall recorded mm/day	
Bilbao	145	**26 August 83 398**

Table 6.

- Along with the meteorological aspects, the study explores hydrological and geological elements, as well as those pertaining to human-made actions.

- It says “in expert opinion the return period is likely to be at least a thousand years” and points out that the economic consequences, were the event to recur, would be impossible to quantify *a priori* because they depend on the condition and level of insurance cover of the property affected, the improvement work at the trouble spots at river basins and dispensing with rain coverage (among other aspects) and, what we can now say is that this all also depends on the addition of business interruption within the CCS’s extraordinary risk coverage system.

- It was concluded that, even with substantially shorter return periods, the CCS might be in a position to take on an equivalent event within a short time-frame provided that the projection assumptions established in any of the 16 scenarios of 30-year simulations were satisfied.

The projection assumptions laid down related to:

- A particular pattern of claims experience featuring 4 separate models, all of which were conservative.
- Growth of sums insured and, by extension, of surcharges too (given that no change of premium rates was assessed) according to two alternatives: constant cumulative annual growth of 3% or 4%.
- A net return on the reserve of 3% per annum.
- Baseline reserve: two options (i) -150 million euros according to data as of 31-12-1988 or (ii) zero euros.

In the worst-case scenario of the 16 involved, the CCS found that it was in a position to assume a catastrophic event such as that in the Basque Country in 1983 in a period of 20 years; whereas in the best-case scenario the comparable time-frame was cut back to 10 years. We are given to understand that this was one of the key reasons for opting not to take out re-insurance.

Information in the extraordinary risk statistics

The definitive figures on the Basque Country event of August 1983, having processed and made the pay-outs for all the claims files, are given in the tables in this section.

It should be borne in mind that the compensation pay-outs are shown firstly at their nominal amount in euros in the year of the loss event and then in inflation-adjusted euros as of 31-12-2022 with the relevant CPI levels for the dataset. Account is not taken of other variables such as: (i) increases in insurance levels, (ii) the introduction of business interruption coverage, (iii) improvement to mechanisms for reducing loss or damage or (iv) the discarding of rain coverage.

Reference here is made to property damage and no information is available in regard to any bodily injury coverage.

Claims by regional autonomy:

Region	Number of claims	Compensations nominal euros	Compensations euros 2022	%	Average cost euros 2022
BASQUE COUNTRY	24,802	248,266,591	938,653,172	99%	37,846
CANTABRIA	761	2,192,060	8,287,797	1%	10,891
NAVARRE	101	254,983	964,053	0%	9,545
TOTAL	**25,664**	**250,713,635**	**947,905,022**	**100%**	**36,935**

Table 7.

As mentioned earlier, the event mainly affected the Basque Country, specifically Biscay, though also Cantabria and, to a lesser extent, Navarre.

Claims breakdown by cause:

Cause	Number of claims	Compensarions nominal euros	Compensarions euros 2022	%	Average cost euros 2022
FLOOD + WAVE BATTERING	11,403	183,870,460	695,182,505	73%	60,963
RAIN	14,261	66,843,175	252,722,517	27%	17,722
TOTAL	**25,664**	**250,713,635**	**947,905,022**	**100%**	**36,935**

Table 8.

For these purposes the proportions of claims files and pay-outs per cause from Table 1 (which relates to the whole of 1983) have been retained, since no strict itemisation for that specific event is available.

Claims breakdown by range:

RANGE BY CLAIM (euros 2022)	NUMBER OF CLAIMS	COMPENSATIONS NOMINAL euros	COMPENSATIONS euros 2022	%	AVERAGE COST euros 2022
From 0 to 2,300 euros	14,631	2,229,423	8,429,068	1%	576
From 2,301 to 5,700 euros	3,564	3,568,381	13,491,434	1%	3,785
From 5,701 to 11,400 euros	14,631	2,229,423	8,429,068	2%	576
From 11,401 to 22,700 euros	3,564	3,568,381	13,491,434	3%	3,785
From 22,701 to 56,800 euros	14,631	2,229,423	8,429,068	6%	576
From 56,801 to 113,600 euros	3,564	3,568,381	13,491,434	6%	3,785
From 113,601 to 227,200 euros	14,631	2,229,423	8,429,068	8%	576
From 227,201 to 568,100 euros	3,564	3,568,381	13,491,434	12%	3,785
From 568,100 to 1,136,200 euros	114	24,351,128	92,067,415	10%	807,609
From 1,136,201 to 2,272,300 euros	71	29,255,479	110,609,923	12%	1,557,886
From 2,272,301 to 5,680,800 euros	39	40,156,185	151,823,609	16%	3,892,913
From 5,680,801 to 11,361,600 euros	12	26,917,162	101,769,147	11%	8,480,762
From 11,361,600 to 22,737,200 euros	5	20,541,151	77,662,552	8%	15,532,510
More than 22,737,200 euros	1	10,820,523	40,910,530	4%	40,910,530
TOTAL	**25,664**	**250,713,635**	**947,905,022**	**100%**	**36,935**

Table 9.

Summary:

Notable aspects of the event under review here:

- It was caused by flooding, wave battering and direct rain damage.
- I took place from 24 to 26 August 1983.
- It mostly impacted the Basque Country, though also Cantabria and Navarre.
- It was the largest event covered by the CCS in its history.
- It has such a long return period that it is hard to quantify.
- It involved high average costs.
- It prompted legislative reform with respect to the risks covered.

40 years after the 1983 floodings

Pilar González de Frutos
Head of Department of Consorcio de Compensación de Seguros in 1983

Description of the event

26 August 1983 is a date that has been burned into the memory of the inhabitants of the Basque Country and elsewhere.

That was the day torrential rains poured down, reaching over 500 l/m^2 in 24 hours, a level with an estimated return period of 500 years that has not been repeated since that day.

What today is known as a cut-off low is not a common event in northern Spain, but at that time one swept in from the east pulling with it large masses of very cold air aloft that produced extremely heavy rains.

More than a hundred towns were declared disaster areas, with Llodio, Barakaldo, Arrigorriaga, Basauri, Galdácano and the Old Town and Peña districts of Bilbao being particularly hard hit.

Not only that, but persistent rains had been falling in the preceding days, saturating the ground, which was unable to absorb the water that came down, so the water quickly ran off into the rivers, causing them to overflow.

Figure 1. Flooding in the Recalde district of Bilbao (Biscay) on 26 August 1983.
Source: EFE News Agency.

The Nervión River discharged large amounts of water into the Bilbao estuary coinciding with a high tide that prevented the water from flowing out to sea and flooding large areas of the Old Town of Bilbao to depths of up to 3 metres.

The flooded area ran from Cantabria to Navarre and even reached as far as the northern part of Burgos Province.

More than a hundred towns were declared disaster areas, with Llodio, Barakaldo, Arrigorriaga, Basauri, Galdácano and the Old Town and Peña districts of Bilbao being particularly hard hit.

The flood damage is calculated to have reached 200,000 million pesetas of the time, around 1,200 million euros, though the worst was the loss of human life. The death toll came to 34 and 5 missing.

The Consorcio de Compensación de Seguros' response

To get a better idea of the huge scale of the undertaking the Consorcio faced, it will be helpful to stop for a moment and consider the legal framework and the resources available at the time.

The Consorcio was one of the four autonomous bodies operating under the auspices of the Directorate-General for Insurance Affairs, the others being the National Traffic Risk Guarantee Fund, the Compulsory Passenger Insurance Board and the Central Insurance Fund.

Its services were all centralised, and it was staffed by twenty-odd civil servants.

It had no regional offices, instead there were what were known as regional claims adjusters, independent contractors tasked with appraising losses who gathered information on the details of events and their repercussions and sent it in to the Consorcio for a decision to be taken on whether a weather event was to be declared an extraordinary insurance event. The adjusters' own addresses were used as the addresses for reporting damage and claims.

It cannot be omitted that in 1983, under the Consorcio's 1954 Enabling Act [Ley de 16 de diciembre de 1954] and the 1956 Implementing Regulations to that Act [Reglamento de 13 de abril de 1956], an event had to have been declared to be an extraordinary event for losses to be covered and entitlement to compensation by the Consorcio. More on this point later.

Furthermore, as an autonomous body, the Consorcio's operations were subject to administrative law, and any payments it issued were subject to prior approval by the General Comptroller of the State Administration.

The aftermath of the event, with such high losses and the large number of claims (some 26,000) to be processed, despite low levels of insurance coverage, made a comprehensive restructuring of resources and processes necessary.

On the resources side, the first step was to set up an office in Bilbao. Good coordination between the central government and the regional government of the Basque Country and their respective administrative services enabled an office to be opened at the office of the Regional Tax Agency at Federico Moyúa Square, headed by Miguel de la Mano Boj, a tax and insurance inspector working in Bilbao seconded to the post by the Finance Ministry. New administrative staff were hired.

Additional technical and administrative personnel were also hired to bolster the central services. This required special approval by the Finance Ministry's Personnel Costs Department. These staff members underwent a specially designed crash training course.

A massive effort to assess losses was also made. Many new loss adjusters had to be hired. They were coordinated and supervised by Consorcio's regional loss adjusters sent to the Basque Country.

All processing of the huge case load was done entirely by hand, without the aid of any computing equipment. The details of every claims application were all entered in ledgers by hand, so accessing records was quite a labour-intensive task subject to inadvertent human error.

Every claim had to include the corresponding policy and the premium payment receipt. The policy was needed so that it did not have to be requested from the insurance companies, some of whose own files of paper documents kept in the basements at their offices in Bilbao had been damaged.

The receipts were used to check that the Consorcio had been paid the right surcharge. The surcharge was calculated on the premium, not on the insured sums, and this made it necessary to check that the proper rate had been used. It should be noted that back then insurance rates were regulated by the government, not set freely. Charging an improper surcharge was considered a serious violation by the insurer resulting in assessment of a penalty and application of the equity rule, reducing the compensation paid to the insured.

Compensation had to be approved either by the Consorcio's Management Board, chaired by the Director-General of Insurance Affairs, or by a delegated Committee. Compensation in amounts greater than 100,000 pesetas had to be approved by the full Board. Smaller amounts were approved by the Committee.

After administrative processing, payment of compensation had to be approved by the General Comptroller of the State Administration, which gave rise to a severe bottleneck. Ultimately, this procedure had to be replaced by postponing review until a later time.

The Consorcio's ordinary procedure for paying compensation to insured parties was to authorise payment by the insurer and then to reimburse the insurer afterwards. As an exception, in this case compensation was paid directly to the insured by cheque drawn on accounts the Consorcio had opened at branches of the Bank of Spain. Each cheque was sent out together with the corresponding receipt, also drawn up by hand and hand delivered to the Bilbao office once a week.

The cash needed for the indemnity payments was obtained by selling off nearly all of the Consorcio's investment holdings in liquid assets. The cash shortfall was covered by a special loan from the Bank of Spain paid back from the surcharges collected in subsequent years. Premium consumption that year stood at 745% of the surcharges collected.

As already pointed out above, an enormous effort was made to manage the incident and adapt processing procedures, and ultimately the Consorcio was able to complete its handling of the greater share of the claims within one year. Total indemnities paid out by the Consorcio came to the equivalent of 948 million euros of today, the average compensation being EUR 36,935, one of the highest in the Consorcio's entire time series as a result of the large number of companies that had been affected. These data have been retrieved from the Consorcio's statistics report.

The distance to watercourse issue

Rule 8 of the 13 April 1956 Implementing Regulations stipulated that:

"The Consorcio shall pay indemnities for flood damage caused by the direct action of water from rivers, canals, watercourses, or streams that overflow their normal banks or from coastal flooding by the ocean or the sea. The indemnity paid will be 100% of the assessed damage to insured property located more than 300 metres distant from or at a height of more than 7 metres above the water; 60% for a distance of less than 300 metres and a height of more than 4 metres; and 40% if that height or that distance is not reached. Distance is to be calculated from the river bank and height from the normal mean water level; in the case of damage caused by the ocean or the sea, it is to be calculated from the equinoctial spring tide water mark".

Figure 2. Bilbao (Biscay) flood: the *Consulado de Bilbao* washed aground at the Uribitarte wharf on 27 August 1983. Source: EFE News Agency.

Given the nature of the event and the affected areas, applying the provisions of that Rule would obviously have sharply reduced the compensation paid out, since virtually no-one had paid the additional surcharge that was required to set aside those reductions to indemnities.

There was heated debate early on as to whether or not to apply Rule 8, revolving around such factors as whether the damage had been caused by flood or by the heavy rains, the imprecise nature of the reference points in Rule 8, i.e., the actual meaning of normal mean water level, the actual location of the river bank, etc.

The reductions to the indemnities were applied based on the details reported by the loss adjusters, and this gave rise to a plethora of lawsuits that were taken all the way up to the Spanish Supreme Court. The Supreme Court's rulings greatly decreased the amounts of the Consorcio's initial reductions to the indemnities based on the co-occurrence of two causes, extraordinarily heavy rains and river overflow.

The situation created by this progressive reinterpretation of this rule on compensation for this peril grew so complicated that it eventually led to this provision on heightened flood risk's being eliminated entirely in successive reworkings of the legislation.

Subsequent events

The experience gained had immediate repercussions.

The devastation that took place and the huge losses incurred resulted in a restructuring of industry in the Basque Country and a painstaking reorganisation of the city.

Purchases of insurance rose in the areas where the Consorcio had paid out compensation for losses, since aside from some government assistance, the uninsured had received no compensation for their losses and government pay-outs took a long time.

The events revealed a need to revise and update the cases that were covered by Consorcio under the existing legislation. In consequence, a Ministerial Decree was issued on 30 December 1983 ordering the Directorate-General of Insurance Affairs to set up a working group for that purpose. The upshot of the working group's efforts was new Implementing Regulations [Reglamento de 29 de agosto de 1986], which set forth objective definitions of the cases entitled to coverage and ended the requirement for a disaster declaration by the administration for payment of indemnities by the Consorcio. The new Implementing Regulations made the cases of entitlement to coverage by the Consorcio much more transparent and objective and expedited claims processing.

The amount of time that has gone by since then makes it advisable to conduct a fresh review of the events that are covered by the Consorcio, notwithstanding a series of advances made over the years.

The difficulties that had been encountered in processing the claims from this event under the administrative legislation governing the Consorcio as an autonomous body would years later lead to the Consorcio's being changed into an independent agency with greater scope of authorised action whose relationship with the insured is governed by private law.

That relationship between the Consorcio and the insurers has been made tighter, since cooperation between the two is essential in the interest of the insured.

State of meteorology and weather conditions that led to the flooding in the Basque Country in August 1983

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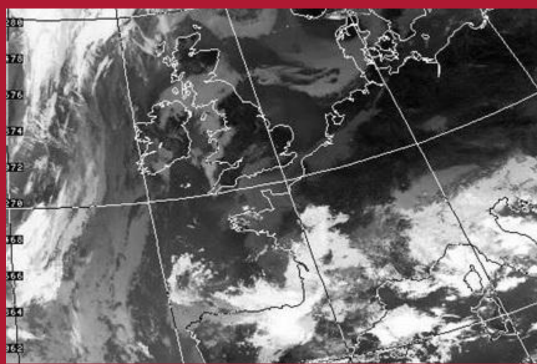
Introduction

Issue no. 19 of the *Consorseguros Digital magazine* [Consorcio Magazine Online] is dedicated to the flooding in the city of Bilbao and a series of other towns in the provinces of Biscay and Álava, considered to have been the greatest natural disaster ever to strike the Basque Country in Spain. The analysis of the weather conditions that produced this event and the severe floods in Eastern Spain in 1982 proved to be a watershed moment for weather forecasting in Spain, marking the launch of a far-reaching plan to revamp both the operating procedures and the technology of what was then named the National Meteorological Institute.



The models therefore predicted a scenario of high instability but by no means the torrential rains that came about in the end. "Heavy cloud cover with moderate rain showers, more frequent in the eastern half (of the Bay of Biscay)" was the official forecast for the day in question.

With this in mind, we have interviewed Ángel Rivera. This article starts off by recapitulating some highlights of his career before segueing into the interview proper.

Ángel Rivera worked as a certified meteorologist with the State Meteorological Agency, formerly the National Meteorological Institute [*Instituto Nacional de Meteorología* (abbreviated INM in Spanish)], for 38 years until his voluntary retirement in March 2012. After stints at the Almería and Girona airports, he transferred to the Central Weather Forecasting Service in Madrid in 1978, where he worked under Mariano Medina and Francisco García Dana. He was an active participant in the INM's Technology Revamp and held a series of technical and organisational postings, working on weather forecasting in the Mediterranean region. From 1990 to 2005 he was head of the Forecasting Department and oversaw the organisation of the then newly created National Forecasting System and the Weather Warning Programme. From that date until his retirement, he was the AEMET's Head of Communications and spokesman. From the mid-1990s he was in nearly daily contact with the mass media and appeared on numerous radio and television shows while also working with the print media, newspapers and magazines.

He was a founding member and president of the Association of Weather Communications Specialists [abbreviated ACOMET in Spanish] and published a memoir of his career entitled “Recuerdos del tiempo” [Memories of the Weather] in September 2013. That book was followed by another three books for popular audiences, “Meses y tiempos” [Weather by the Month], “Compartiendo el tiempo” [Weather Talk] and “El tiempo compartido” [Shared Weather[1]]. His most recent book, “Recuerdos del tren” [Railway Chronicles], this time on railways, again intended for popular audiences, was published in June 2021. He is currently quite active on social media, where he writes two blogs about his two passions, weather forecasting and the history of railways in Spain.

Interview

What were the weather conditions that produced the flooding in eastern Cantabria, particularly in the region of the Bilbao estuary, in August 1983?

That was quite an unusual case. There was a current of winds from the northeast in the upper levels of the atmosphere that was dynamically highly unstable. This gave rise to a small low-pressure area aloft —what would today be called a cut-off low— that in turn led to tremendous convection and probably produced a structure known as a mesoscale convective system that can cause heavy precipitation to fall in just a few hours. Thus, those heavy rains falling in the Basque Country, amounting to more than 500 mm in some places in 24 hours, caused heavy flooding in some locations, including Bilbao and its surrounding areas.

The convective activity was fed by a flow of maritime air from the northeast at the surface and low altitudes, and the sea water temperature in the Bay of Biscay that August could well have contributed to the heavy rainfall. This produced a large influx of warm, moist air, the best “fuel” for convective processes.

Could the INM issue warnings about situations of this kind back then? How have its capabilities changed since that time?

We had only been receiving the first maps from the European Centre for Medium-Range Weather Forecasts (ECMWF) for a few years, and they still had very low spatial resolution and still rather rudimentary convective parameterization, making detailed representation of phenomena of this nature impossible. The models therefore predicted a scenario of high instability but by no means the torrential rains that came about in the end. “Heavy cloud cover with moderate rain showers, more frequent in the eastern half (of the Bay of Biscay)” was the official forecast for the day in question.

Also, back then, we were starting to get images from the first generation of Meteosat satellites. However, not only were these images received a half hour’s delay from when they were taken; interpreting them was still no easy matter. So they were not a big help to be able to issue short-term warnings or to arrange suitable monitoring. The high-resolution images the INM obtained afterwards did help us study the situation that had arisen and design a system to monitor adverse atmospheric weather conditions.

[1] All titles play with the double meaning of the word ‘tiempo’ in Spanish that means both ‘time’ and ‘weather’.

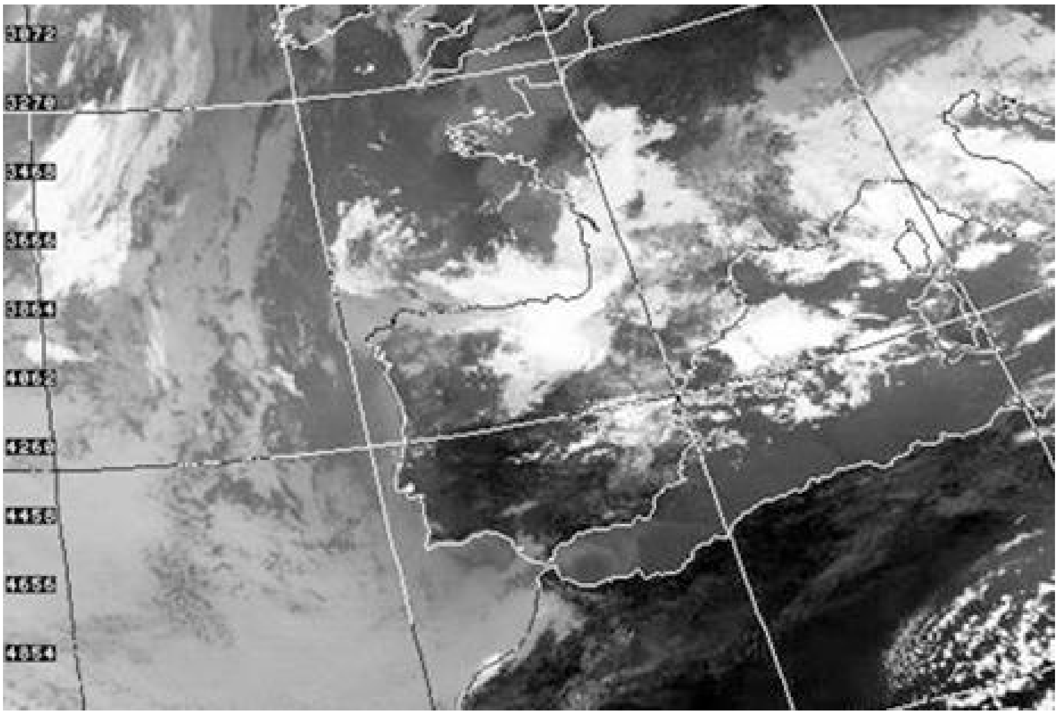


Figure 1. Satellite image of 26 August 1983.
Source: University of Dundee.

Professionally speaking, what do you remember about managing that scenario and similar situations like the flooding in Eastern Spain (in Tous) the year before?

I was on holiday at the time, so I was not on the job when the episode in the Basque Country took place, but I was at work at the time of the Tous event in 1982. In that case we knew that there was a high risk of very heavy rains, but with the tools available at the time, we were only able to pinpoint the area at risk as running from the Ebro River mouth to the Murcia region. That was the best we could do with the maps we were working with in 1982. They did not have a high enough spatial or temporal resolution, and from the standpoint of physics they were not suitable for more accurate forecasting. They did not have tools capable of predicting precipitation, or what tools they did have were inadequate. For that reason, the forecast made on the morning of the day before made reference only to scattered cloudbursts and storms over Eastern Spain. At a meeting on the afternoon of the day in question, various meteorologists concluded, based on new data, that the situation was more dangerous than it had seemed at first, and it was decided to issue an advisory of some sort. But back then there was no effective system for issuing warnings or for informing the public, at most some hourly news bulletins broadcast by Radio Nacional de España [Spanish National Public Radio] that included a brief weather report prepared by INM meteorologists. The situation was discussed with them and they did mention it, but I don't think they did so in any way that could be considered by the populace to be an actual alert. On the other hand, the Service of Hydrological Meteorology higher-ups did contact water resources management administrators to advise them of the potentially adverse situation so that measures could be taken. Basically, it seems to me that we did the best we could with the technical tools that were available to us and the scant means available for getting the word out.

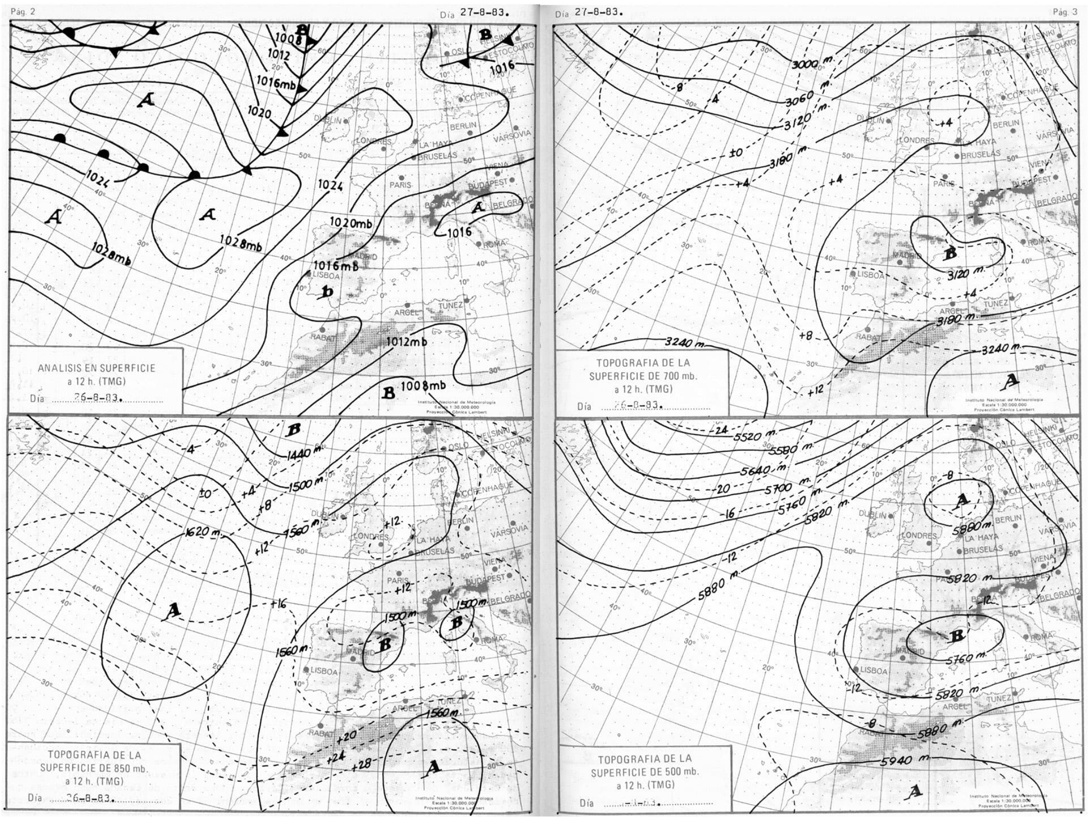


Figure 2. Pressure fields at surface level and 850, 700, and 500-hPa geopotential fields (at altitudes of approximately 1,500, 3,200, and 5,800 m) at 12:00 noon on 26 August 1983 showing a cut-off low at middle and high levels located over the northeastern part of mainland Spain.
Source: National Meteorological Institute's Boletín Meteorológico Diario [Daily Weather Bulletin] for 27 August 1983.

What changes did the INM undergo subsequent to the events in the summers of 1982 and 1983?

Those two events ushered in sweeping changes in weather forecasting in Spain. Specifically, they drove a modernising push that resulted in the technical and operational restructuring of the INM, with the government's full support. To begin with, a technology revamp was designed to equip the INM with cutting-edge technical infrastructure, both weather monitoring systems and computing equipment to process numerical weather prediction models. So high-resolution satellite image receiving equipment was purchased, an extensive network of radars and lightning discharge detection systems was installed and a computer system that was groundbreaking for the time was built to integrate and process the data collected from all those different sources. At the same time, a programme to train meteorologists in these new methods was undertaken with extensive involvement of meteorologists from the United States, and gradually the INM's outlying network was thoroughly restructured into eleven regional forecasting groups called Weather Watch and Forecasting Units [abbreviated GPV in Spanish].

In addition, and just as importantly as the preceding preparations, a system for issuing alerts to the general public in cases of severe weather events was designed and put in place in close cooperation with the Directorate General of Civil Protection. This in turn gave rise to a series of "Previmet" (in Spanish, Predicción y Vigilancia Meteorológica [*Weather Watch and Forecasting*]) plans. At first they focused on individual phenomena at specific times of year, leading to the "Mediterranean Previmet" plan in 1987 and subsequently to the "Windstorm Previmet" and the "Snowstorm Previmet". At any rate, it soon became clear that what was needed was a single overarching "Previmet" covering all forms of adverse weather phenomena in operation all year round. This approach first gave rise to the "National Severe Weather Watch and Forecasting Plan" [abbreviated PNPVFA in Spanish], which a number of years later became Spain's "Meteoalerta" system, a part of Europe's "Meteoalarm" network.

Do you think the citizenry understand the risks posed by these extreme events? Over these past 40 years, has there been any change in society's perception of severe weather?

There has been spectacular improvement in weather forecasting, with huge strides in communications technology and methods. So people now consider weather reporting to be much more reliable, especially adverse weather alerts. Even so, in my opinion there is still a long way to go. While certain regions have implemented mobile telephone messaging systems to alert the populace to severe weather events in their jurisdictions, these systems are needed in all regions. Clear criteria for sending out alerts of this kind must be put in place and explained to the populace, and people have to be made aware of how these messages should be used. In addition, the alerts should contain more information besides details about the weather. Alerts should tell people how they might be affected and explain what measures can be taken.

This means that the criteria for sending out alerts should be based not just on whether certain quantitative weather thresholds have been reached or exceeded but should focus on the potential impact on the populace. Obviously, a consensus about who will be in charge of issuing the alerts needs to be reached. The meteorological services themselves? The Civil Protection authorities? I have spoken out about my own thoughts on the subject any number of times: I think the best solution would be to create a single operational unit made up of meteorologists, Civil Protection technicians, and possibly some social psychologists.

Whatever the case, the preceding approach may well be rapidly outstripped by the tremendous advances being made in artificial intelligence. It looks as if in just a few years' time we will be carrying a specialised risk advisory service around in our own pockets, with our mobile phones issuing advisories well in advance based on real-time "smart" processing, where necessary with extrapolation of the potential risks likely to arise, together with recommendations concerning suitable protective or mitigating measures. If this comes to pass, the questions that could arise might revolve around the quality and reliability of the data sources, whether the advisories are in line with official alerts, and potential liability in case of mistakes or losses attributable to those advisories.

The August 1983 floods in the Basque Country: events and lessons

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The city of Bilbao was founded by Diego López de Haro, *the Intruder*, in 1300. Over the course of time there have been numerous floods that have been entered into the historical record in various historic documents because of the damage they have caused. Making allowance for the uncertainties hidden by the fog of time, there appear to have been 42 episodes of flooding up to the fateful 1983 flood, with the first flood on record dating from 1403. Other episodes of flooding with less rainfall and smaller water volumes took place in the areas of the Basque Country closer to the Bay of Biscay in May, June, July and August 1977, six years before the 1983 flood, particularly in Biscay. They did not cause any victims, but they did do damage.

Since then government administrations set about first of all to rebuild and then to seek to explain and quantify what had happened, to draw what lessons were to be learned and thus what approaches and steps could be taken with a view to tackling flood risk now and in the future.

Subsequently, there was another flood in the Basque Country that sadly took 15 lives in 1988. The victims included a Portuguese family that was driving across the Deba River channel in their car, when the family was trapped in what turned into a floating coffin, which is not unknown in circumstances of that kind. From that time to the present there has been no further loss of life from flooding in the Basque Country, though several floods have caused extensive property damage.

One of the authors of this article had recently finished his university degree in geology and was living and working in Granada in 1983, where he indulged in wide-ranging interests. One such interest was what had taken place in southeastern Spain 10 years earlier, in 1973, an episode which in the region of the Granada coastal area came to be known as the “storm cloud”, when, as one colleague put it, “the floodgates of heaven opened”. Enormous flash floods through the watercourses running down to the Mediterranean Sea caused hundreds of victims. In just a few hours the torrent of silt rushing down from the Sierra Nevada range built up a delta that reached half a kilometre out to sea off the river mouth in Albuñol, Granada, near the border with Almería province. Ocean currents had washed it away after a few months.

When that young geologist turned on the radio on that bright, sunlit, Andalusian Saturday morning on 27 August 1983 and the first thing he heard were the words “Garaikoetxea, head of the Basque Regional Government, has taken command of military personnel”, the last thing he would have imagined was that the floodgates of heaven had also opened in the Basque Country, where his work would later take him and keep him up to this day. In the atmosphere of those times, the announcement startled him into thinking that some sort of non-natural and probably much more deadly havoc had taken place.

Looking back to August 1983, it is commonly held that what happened was unprecedented, that nothing like it had ever been seen before and that despite limited experience with situations of this kind, the institutional response and society's reaction were commendable. This last statement is indeed true. While it was not actually completely unprecedented, the fact is that no flood had ever before caused so much harm to people and the economy in Bilbao and many other towns in the Ibaizabal and Nervión river basins and large parts of Biscay. However, this was basically for the simple reason that human habitation was sparser in earlier times, with fewer people and less commercial and industrial infrastructure in the path of a river which, when it reverts to nature and rises up, takes its territory back with a vengeance that only nature can display.

The heavy, ongoing and reckless settlement of floodplains throughout a good part of the twentieth century, secondarily intensified by the fact that a truly outlandish amount of rain fell in August 1983, made for a diabolical event that the weather forecasting, communications and operational technologies of the day were ill equipped to handle.

Since then government administrations set about first of all to rebuild and then to seek to explain and quantify what had happened, to draw what lessons were to be learned and thus what approaches and steps could be taken with a view to tackling flood risk now and in the future.

After a period of rain, the problems started with heavy rainfall in Gipuzkoa on 25 August 1983, causing some of the main rivers, chiefly the Oria, Urola and Deba, to overflow their channels, leading to heavy flooding in some towns on the 26th. In fact, Civil Protection personnel and volunteers were sent to Gipuzkoa from Biscay. Yet this was just a warm-up for the actual shock that came on 26 and 27 August, right in the middle of Bilbao's main annual city festival, held right on the banks of the Nervión River in the heart of the Old Town.

The rain came down hardest right in the Nervión and Ibaizabal river basins and in the area between them and the coast of Biscay. In particular, upriver from Bilbao around the junction of the Nervión and Ibaizabal rivers and a broad swath spreading out towards the Mungia region and the coast between Bermeo and Gernika. In this small area over 200 mm were recorded between 9:00 a.m. on the morning of the 26th and the same time on the 27th, spiking to over 400 mm between the junction of the Nervión and Ibaizabal rivers and Bilbao.

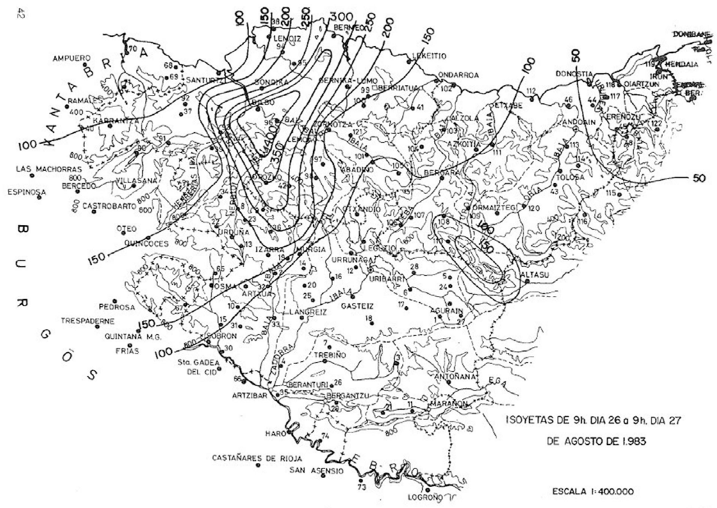

Figure 1. Rainfall from 9:00 a.m. on 26 August to the same time on 27 August 1983.
Source: Biscay Provincial Council, 1984: "Torrential rains. August 1983: Quantifying the Disaster".

These two rivers in fact form a single river basin system that empties into the ocean at the Bilbao estuary. According to reports, the most precipitation fell not at the headwaters but in the middle and lower courses where the two rivers meet and some kilometres upriver. The rainfall was so heavy and so concentrated in these sections just above the industrial centres of Galdakao, Basauri, Etxebarri and Bilbao itself that swells arrived abruptly and simultaneously with no time or space for any natural flood abatement to occur. This took place on river plains that had furthermore, been hemmed in and built up thanks to urban industrial and residential development on lands stolen from the rivers.

The combined flow of the two rivers on reaching Bilbao was more than 3,000 m^3/s. In itself this figure might not say much. But to put things in perspective, flow rates approaching 1,000 mm^3/s in this section are highly likely to cause appreciable damage, even today. That volume of flow came from combining the water carried by the Nervión at Basauri, around 1,650 mm^3/s, and by the Ibaizabal, around 1,400 mm^3/s at Galdakao. With all the reservations attaching to assertions of this kind, the return period for this flood event can quite possibly be put at more than 500 years.

The estimated peak flow rate of the Nervión at Llodio was 550 mm^3/s. At Saratxo (Amurrio), just 14 kilometres upriver, it was 180 mm^3/s. There were tributaries feeding in between those two locations, but not so sizeable as to account for that increase in the flow rate. As just mentioned above, the reason for this was that despite heavy rains upriver of Amurrio in the upper course of the Nervión, rainfall was not as intense as in the middle and lower courses of the river.

Water levels in Old Town of Bilbao reached as much as six metres above street level. In some districts like Iturrigorri, the torrent picked up and carried away solid material from an old, completely exposed quarry, burying some streets in debris up to the first storey of the buildings.

The splendid historical casino building in Bermeo, literally built over the Artike canal, collapsed when its foundation, the platform overlaying the channel, could not take the pressure and buckled upwards. The pictures look like scenes shown on television after a bombardment.

While the most common images of the disaster come from Bilbao, there was only one death, a man nicknamed *Madriles* who was spending the night in a shop and was trapped when the waters rose. The official death toll in Biscay as a whole and the Bay of Biscay catchment area of Álava, like Llodio, came to 34, with 5 more persons listed as missing. Most of the deaths occurred along the Nervión and Ibaizabal rivers and then from the junction of the two down to Bilbao. Some bodies washed up on the beaches of the portion of the bay known as the Outer Cove.

Damage was very great. According to some estimates just for Biscay made at the time, the damage was around 150,000,000,000 pesetas, directly equivalent to some 900 million euros, with 40% of the damage located in Bilbao. Industrial infrastructure suffered about half of the damage.

In 1984 the Biscay Provincial Council published a detailed account in a book entitled “Torrential Rains. August 1983. Quantifying the Disaster”, with large volumes of data of all kinds. It includes an in-depth discussion of the need for technical improvements aimed at predicting phenomena of this type but contains no explanation of the root causes or how to address them. The most far-seeing conclusions comes in one of the paragraphs at the end, which reads: “... what we think is basic is to address such aspects as afforestation of the upper and middle courses of the rivers, designing bridges with ample clearance, restricting building on floodplains and more effectively keeping the river beds clear of building rubble and refuse”. It seems somewhat vague, especially the last part, but it was written 40 years ago.

Contrast that book with another study written in 1978 after the 1977 floods in Biscay just six years earlier. Its author was Antonio Altadill Torné, a distinguished engineer with what was then the Northern Spain Basin Authority who was for years in charge of the Authority's Planning Office. This latter study was entitled "River channel and water drainage improvements in Biscay". Altadill was at the forefront of his profession, and he did explain the reasons why things were the way they were in several places in his study. The first section of his conclusions stated that the primary reason was "Building in lowlands or regions prone to flooding. This is widespread in all areas (...) and entails filling in the land and strangling the river beds, resulting in greater flooding of the river margin on the opposite side and all those located upriver". This same conclusion is reached numerous times, case by case. For instance, when describing what happened in Arrigorriaga, the author wrote, "The factories themselves caused the floods by strangling the river channels and being built in locations exposed to floods".

As discussed below, these ideas have evolved over time into a robust body of standards and regulations focusing on prevention as an essential tool to avoid repeating the mistake of locating vulnerable infrastructure in areas prone to flooding and to apply construction to try to mitigate the legacy of flood risk inherited from poor land management in the past.

In the meantime, major actions were undertaken in the first years after the floods, e.g., drawing up a "Comprehensive Flood Prevention Plan" that included the first flood risk map in the Basque Country. That plan was implemented through the rest of the 1980s up to 1993. It contained extremely valuable hydrological information on the courses of the rivers flowing through the Bay of Biscay watershed and the Zadorra River flowing through the Mediterranean watershed. That study was an initial step and to some extent set the tone for all the flood risk studies and mapping done since then. But it did not actually propose any regulations or legislation addressing land use based on the level of flood risk.

Right away, various government administrations undertook construction projects in the immediate aftermath, for instance, replacing or modifying bridges, e.g., in Tolosa, and work on the river channels, to greater or lesser effect, e.g., in Llodio or in the La Peña district in Bilbao.

A few years later massive work on reconditioning the river channels began, as time went on less hastily planned, increasingly environmentally-friendly projects, up to today, when both ecological and hydrological considerations go hand in hand, seeking nature-based solutions.

From 1993 to the present, around 325 million euros have been invested in the Basque Country, nearly all by the Basque Regional Government (for the past 15 years under the auspices of the Basque Water Authority), mainly in the area of the bay of Biscay watershed, where the risk is higher both for the vulnerable population (currently around 70,000 in areas subject to 100-year flood events) and for vulnerable economic activity.

The largest investments have been made for the Urumea River (75 million euros) and in the Nervión-Ibaizabal rivers and the adjacent areas, most affected by the 1983 flood in Biscay (105 million euros). The remaining 145 million euros has been spent on the other river basins in the Basque Country, in particular 25 million euros on the Oria River.

Bilbao is obviously still a high-risk area. Some storm tanks have been built and more particularly the city government has dug a canal through the former Zorrozaurre peninsula, making it into an island. The result is a one-metre drop in water level in the area subject to 500-year flood events and progressive abatement upriver, so levels drop in the vicinity of City Hall and do not reach the Old Town, where the worst flooding occurred in 1983. There is no easy fix, because the river has been boxed in. A proposal to build tunnels to drain off some of the water from higher up above Bilbao into the estuary below the city has been made. However, the plan is not yet ripe, and before it can be put into effect, there are uncertainties and issues that first need to be addressed, including hydrological considerations, and not least its extremely high cost.

In contrast, work to renovate management measures on the Nervión is under way at Llodio, where some of the first management works were built but proved to be inadequate. In addition, 11 years after the first stage was started, the third stage of work to improve the Ibaizabal to one kilometre downriver from the junction with the Nervión has just been completed at Galdakao, at a total cost of 36.2 million euros.

A population of some 5,200 people who were affected by the 100-year flood lives in the management area. The intent is to make the river channel capable of draining off those flood waters so that hypothetically at least no-one in that area would now be affected by a flood event of that kind. The average annual damage to be expected in the area that would be affected by a 500-year flood is now estimated at around 0.7 million euros, down from the 7 million euros estimated before the work was carried out. It is thus apparent that the work would pay for itself in just six years. From that point on, everything would be net profit depending on the estimated average annual amount of damage. So works of this kind bring tremendous benefits.

Figure 2. Flood-prone areas before and after the management work to the Ibaizabal River.
In blue, by 500-year floods; in yellow, by 100-year floods and in red, by 10-year floods.
Source: Basque Water Authority.

The third stage of the work on the Ibaizabal also exemplifies one of the Basque Water Authority's design objectives: to protect, and indeed preserve, the cultural heritage present in the section where the work is carried out. In this case the Medieval Mercadillo Bridge was a conspicuous barrier to flood waters and in point of fact was in peril of being swept away by the 1983 flood. Therefore, an alternative channel was built bypassing the bridge and in addition the river bed generally has been widened so that the high water can continue to pass under the bridge, no longer a barrier to flow. Not only that, the bridge has been restored under the direction of the Spanish Cultural Heritage authorities.

Figure 3. The Mercadillo Bridge in Galdakao after the August 1983 floods. The height attained by the water is clearly visible.
Source: Biscay Provincial Council, 1984: "Torrential rains. August 1983. Quantifying the Disaster".

Figure 4. The Mercadillo Bridge during a flood event prior to the management work and before being restored.
Source: Basque Water Authority.

Figure 5. The Mercadillo Bridge in Galdakao after the work was completed.
Source: Basque Water Authority.

Figure 6. The Mercadillo Bridge during a flood in December 2021, operating with unfinished works.
Source: Basque Water Authority.

In other cases, like Vitoria-Gasteiz on the Zadorra River, or the management work on the Cadagua River in Zalla (Biscay), the objective has been to bring the floodplain back to its former natural ecological conditions insofar as possible based on old aerial photographs to replicate the previously existing flood abatement areas that had been filled in, so that they can once again be flooded and in that way help abate flooding and lessen risk in places where until now flooding had posed a threat to the inhabitants. These improvements have taken nearly 2,000 people out of the reach of 100-year floods at a cost of around 10 million euros.

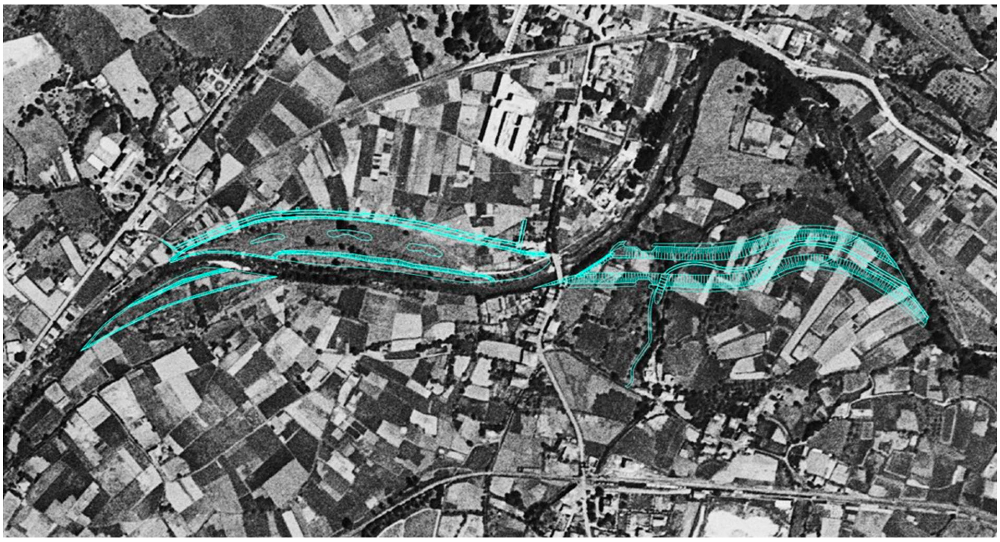

Figure 7. Old aerial photograph of the Cadagua River in Mimetiz (Zalla) with the areas to be recovered to receive flood waters drawn in.
Source: geoEuskadi viewer and the Basque Water Authority.

Figure 8. Additional water channel and recovered floodplain by the Cadagua River in Mimetiz (Zalla).
Source: Basque Water Authority.

Figure 9. The Cadagua River during a flood with the recovered floodplain acting as an additional channel.
Source: Basque Water Authority.

There is of course still much work to be done to protect vulnerable industrial and residential areas against flooding, especially those situated haphazardly during the last century, a poisoned flood risk legacy that needs to be corrected over time. The current Eastern Bay of Biscay River Basin Management Plan (Spanish Royal Decree 197/2023 of 21 March 2023) and hence the Water Management Plan for that same area, basically where the 1983 flood event took place, allocate investments of 101 million euros between now and 2027. The priority is to achieve a cost (both financial and environmental) – benefit (in terms of the number of people protected, damage averted and possible environmental improvements) balance yielding the most efficient use of public funds, while accepting that some small population centres could still remain exposed to situations with severe impacts.

In any event, besides the protective measures that have been taken and the preventive measures that will be discussed below, preparatory measures have also been taken. Namely, the Basque Government's Meteorology and Emergency Response Service, tasked with implementing operational civil defence and weather forecasting strategies, and the Basque Water Authority have for decades been working together to develop predictive hydrometeorological models that are run every day. The Basque Water Authority has developed a tool named UHATE (sluice in Basque) that during high water episodes can be used to test management proposals for impoundments and forecast river behaviour based on previously made weather forecasts and real-time data inputs of such parameters as water and precipitation levels from nearly a hundred hydrological and weather monitoring stations located all across the Basque Country. Clearly, the goal is to be able to provide Civil Protection with suitable information to enable it to deploy its personnel in the interest of preventing loss of life and reducing damage. In places, like Bilbao, where sufficiently effective structural protective measures are not yet in place, the expectation is that the tools currently available will ensure that no lives are lost.

If there is one thing we have learned, it is that the most effective medium and long-term measure for managing flooding is to avoid creating new situations exposed to risks, i.e., to locate new human settlements and vulnerable economic activities outside the risk footprint, which we are able to pinpoint better day by day. If you do not want to be run over by a train, stay off the railway tracks.

The first Basque Territorial Management Guidelines with clear recommendations for preventive measures were issued in 1997. Still, it took years for them to be enacted in legislation.

Starting in 2003, the predecessor of today's Basque Water Authority (the then Basque Regional Government's Department of Water Management) has been including a document designated "Flood exposure-based restrictions on land use" in its reports on urban development plans. Though a purely internal document not backed by any legislation, it was used to draw up technical reports, draw attention to risks and propose restrictions. Restrictions are specified using a double entry matrix: first, whether or not the land in question has been developed, and second, whether the intended use is vulnerable to 10, 100, or 500-year floods. Later on, a new item was specified, the Preferential Flow Zone, which replaced the 10-year flood zone as a benchmark.

Ten years later, in 2013, those "restrictions" were finally made into law compulsory for planning purposes and they were included with only minor changes in the urban planning and territorial management document entitled River and Stream Margin Sectoral Territorial Plan for the Basque Country. Next, they were included in the regulations of the 2015 Eastern Bay of Biscay River Basin Management Plan (under the responsibility of the Basque Water Authority and the Bay of Biscay Basin Authority) and from there the Basin Authority extended them to all of the Bay of Biscay Basins.

In 2016, for the first time anywhere in Spain, these regulations in the River Basin Management Plan were transposed, with minor alterations, from the Bay of Biscay region into national legislation in Spanish Royal Decree 638/2016, which amended the Implementing Regulations to the Public Water Management Plan (Spanish Royal Decree 849/1986). The Eastern Bay of Biscay River Basin Management Plan now in effect was approved by Spanish Royal Decree 29/2023 in January 2023. It is the only water management plan that aside from some minor changes, has kept its flood protection regulations intact. Today, those regulations, from their humble beginnings in that internal document the Basque Water Authority used when evaluating each individual urban development plan, benefit all of Spain.

These prevention policies are, furthermore, absolutely essential in a climate change scenario. Climate change, whatever its effects, will only worsen the problem of potential flooding, though it will not cause floods in areas not already subject to flood risk. Torrential rains may become more frequent, and the water levels assigned to certain return periods may have to be corrected, most likely upwards. The train may come by more often or go by faster, but it will only run on its tracks. The only choice that will let us gradually correct the risks that we have inherited, the perilous historic liabilities that have been handed down to us, is to stay out of its way.

While prevention is the way forward, now and in the future, close cooperation among the water management disciplines (meteorology, hydrology, water management works and the reconstruction of aquatic ecosystems) and with civil protection and land management will be called for. That cooperation is already a success story in the Basque Country, where those three facets have been working together for decades, comprising the three legs of a stool that help us all pull together to advance flood risk management.

That may well be the main lesson: effective cooperation. The stool is totally stable on all three legs, there is no wobbling, no rattling, but if you take away one of the legs, it will come crashing down. Back in 1983, that stool had not yet been built.

Geographical and temporal description of extraordinary risk loss data arising from natural causes

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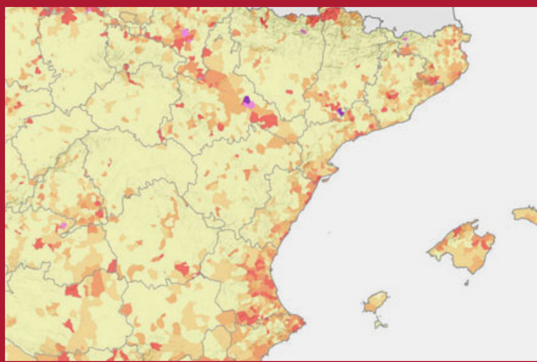
Introduction and background

Insurance is among the most detailed and accurate sources of information available for researching catastrophe risks. In most countries there is a common problem of accessibility of data (which is typically dispersed among the dozens or even hundreds of insurers who usually operate in a market), given that there are sometimes issues of confidentiality or involving sales policy when it comes to making it obtainable for researchers. An additional problem is availability itself and the demand (and take up) for this product. The norm in the vast majority of jurisdictions is to take out policies specific to certain catastrophe risks on a separate, voluntary basis. It seems appropriate to assume that those people who wish to take out these forms of coverage are those who have most exposure to the hazard in question, meaning that a problem of adverse selection tends to arise, which translates into a high premium cost, in turn leading to lower market penetration of the insurance cover, with the outcome that the data is not only dispersed, but also biased and relatively scarce.



The relationship between the values of costs of compensation pay-outs, the assets insured and the natural events which bring about claims that arise in a territory shows varying characteristics depending on the scale or detail of aggregation whereby they are observed.

Only a few countries have insurance market regulatory mechanisms which facilitate the pooling of certain hazard risks to bypass the adverse selection problem, cut back on the cost of premiums and maximise penetration for the insurance. One such country is Spain, where it is mandatory to extend coverage for almost all property insurance to a set of “extraordinary risks”, which encompass flooding, wind-storm phenomena or certain geological risks such as earthquakes, tsunamis and volcanic eruptions. For such extraordinary risk insurance, a surcharge is applied for those policies taken out with any private insurer operating in the Spanish market which is used so that a public sector insurer, namely the Consorcio de Compensación de Seguros (CCS), can pay out compensation for loss or damage caused by such hazards to all property insured. This means that the situation in Spain is relatively far more conducive to studying such natural risks on the basis of the data on loss or damage insured because:

1. The vast majority of insured property is also automatically covered against extraordinary risks, eliminating the protection gap that exists in other countries around us.

2. The compensation pay-outs for hazards of this kind are the sole responsibility of just a single institution, Consorcio de Compensación de Seguros, which has an extensive set of detailed data on indemnities for the said extraordinary risks.

Among the goals of CCS is promoting risk prevention and reduction by working in partnership with other institutions and engaging in activities which help to keep the impacts of catastrophe events to a minimum. There is no doubt that the data on claims experiences kept by CCS are an extremely useful source when it comes to achieving these supplementary goals.

Methodology

This paper conducts an analysis of the geographical and temporal component of the data on compensation pay-outs and exposure of property items insured in combination. These two pieces of information come from different reporting systems within CCS and exhibit different structures and characteristics at source.

Determining the geographical elements in the analysis

The relationship between the values of costs of compensation pay-outs, the assets insured and the natural events which bring about claims that arise in a territory shows varying characteristics depending on the scale or detail of aggregation whereby they are observed.

The operational information that exists at the CCS includes, among other items, the geographical data comprising the post code and municipality for claims handled. A post code established in Spain allows analysis of a small area, which (particularly in highly populated territory) provides a significant improvement of the detail which the data affords at municipal level, thereby permitting more granularity of the information and a more insightful understanding of the characteristics and needs of different areas within these municipalities. In the processing of geographical data, the post code can function as an *aggregator* which enables positioning of information in compliance with the regulations on personal data protection. Furthermore, it is an item of data that is commonly gathered and integrated within the activities of a whole host of sectors (such as the insurance industry) and is widely used in compiling market research (Sereno, 2009).

Based on assignment of the post code and municipality which each of the compensation handling procedures has and the estimated figure for sums of capital per post code which the Surcharge Information System (SIR) provides (a system that has been applied since 2019 whereby insurers report the post code where all their insured risk is located that is subject to the extraordinary risk surcharge to the CCS), all the supra-municipal areas can be linked together which make up different magnitudes of aggregation that are equivalent to the administrative levels in Spain and the European Union. This produces valuable data with which to facilitate planning and decision-making with the aim of designing highly efficient strategies that become drivers of management initiatives to find out about and reduce risks.

Transformation and modelling of the data

Linking data on compensation and exposure per post code, municipality, province, region, hydrographic district, or the NUTS-1, 2 and 3 European statistical areas, requires applying data cleansing processes and transformations to each of the two sources individually with the goal of ultimately joining together geographical areas, aggregating and calculating analytical variables.

Modelling the temporal aspect consisted of characterising each element of processing based on the hydro-meteorological season of the year according to the date of occurrence and identifying if it took place in spring (March, April, May), summer (June, July, August), autumn (September, October, November) or winter (December, January, February). "Seasonality" of this kind enables observation of loss events associated with hydro-meteorological phenomena in a manner that is readily recognisable for the reader.

For geographical or spatial analysis of the data and graphical depiction of it, the data on all of the administrative areas must be identified using the same one-to-one codes which the publishing authorities[1] provide of the geographical layers used, so it is essential to carry out additional procedures of verification, standardisation and enhancement of information to enable combination of this sort for the entire area over which CCS operates[2].

Selecting the period and improving the quality of aggregate data

CCS has historical data on compensation paid out from as far back as the institution's very beginnings in operation. Nevertheless, the information on individualised case handling began to be managed in digital format in 1996, thus creating a historical record which allows optimal processing and analysis of the past 27 years of operational activity.

Analysis of the individualised information reveals a certain number of records where values were possibly logged erroneously from the outset. This is the case for certain territorial variables which are subject to geo-processing in this study, such as the post code. Since this item of data is ordinarily provided by people who take out a policy or file a claim, on occasion there are times when the person gives the post code which they believe to be correct but this turns out to be inaccurate. Databases contain case files that cannot be directly allocated to existing post codes, though they may potentially belong to the same province, regional autonomy or any administrative district at a higher level. This is true of codes which have the first two digits (which identify the province) but end in triple zero, such as '10000', '28000' and '35000'. These are non-valid post codes according to Spain's current post code system. By categorising such cases as handwriting errors, and purely for the purposes of conserving completeness of information on the monetary sums in areas ranked as provinces or higher and to endow the data as a whole with full statistical robustness for supra-municipal aggregate figures, we propose implementing a post code standardisation process which entails identifying them using the "closest" correct post code for the location in question and applying the criterion of totalling the costs of claims for non-valid records, though using a post code that is identifiable within the same province as the nearest which ends in 1, which is usually to be found in the centre of the capital of the province.

For data on the cost of loss events, this allows some 120 million euros, out of the figure of almost 8.5 billion euros, which is the sum total of all compensation relating to natural causes in Spain from 1996 to 2022, to be reallocated from province level upwards by assigning another geographical location to a total of 22,952 procedures out of 1,533,892 (1.49%).

If we apply the same criterion to insured property data, we can manage to reinstate around 1.2 billion euros out of the figure of almost 6.5 trillion euros (which is estimated to be the sum total of all sums insured in Spain as of 31 December 2022) to the sum totals from province level upwards and can pinpoint another location for a total of 7,361 policies out of 60,651,203 (0.01%).

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[1] Municipal, provincial and autonomic limits in the BDLJE (Database of Jurisdictional Limits in Spain), National Geographic Institute.
Hydrographical districts from the Ministry for Ecological Transition and the Demographic Challenge.
Post codes for Spain from the National Post Office.
Nomenclature of territorial units for statistics (NUTS) from EUROSTAT.

[2] Domestic soil: Peninsular Spain, autonomous cities of Ceuta and Melilla, and the Balearic and Canary Islands.

Causes and aggregated areas: Resulting geodata

The set of data transformed and homogenised by area enables it to be filtered by the type of cause it is desired to observe. For the purposes of the study which we present in this edition of the magazine we have examined the effect of flood (riverine and pluvial), coastal flood, and geological causes, such as earthquakes, tsunami, and volcanic eruptions for the full historical period from 1996 to 2022 and also the impact of windstorms – or, according to the regulations' wording, atypical cyclonic storms (ACSs) – over the past 11 years. The reasoning behind these different time periods stems from the fact that, whereas for flooding (both fluvial and pluvial) and coastal flooding the same criterion for coverage has been applied since 1996, for ACSs (strong windstorms) the threshold for coverage has been changeable along the years but homogeneous for 2012-2022, which is the period we study in detail here.

As a product of the joining together and aggregation of all the pre-processed tables we achieve tables of alphanumeric information that are compatible for combining with their respective geometric layers and can visualise thematic maps based on the following attribute fields:

Column	Description
ID	Identifier for the unit of area.
numero_siniestros	Total number of losses (1996-2022 dataset).
coste_total	Compensation for property damage by post code regardless of the risk class (1996-2022 dataset).
coste_viviendas	Compensation for property damage by post code within the risk class of dwellings and home-owners' communities (1996-2022 dataset).
coste_vehiculos	Compensation for loss or damage to vehicles with a Spanish number plate by post code for the claim event (1996-2022 dataset).
coste_resto	Compensation for property damage by post code for the risk classes of offices, business and industrial risks, infrastructure and the rest (1996-2022 dataset).
numero_de_polizas	Number of current policies in force at 31-12-2022.
total_capitales	Value in euros of total sums insured for property damage by post code regardless of risk class as of 31-12-2022.
capital_viviendas	Value in euros of sums insured for property damage by post code within the risk class of dwellings and home-owners' communities as of 31-12-2022.
capital_vehiculos	Estimated value in euros of vehicles with a Spanish number plate by post code for the policy holder's address as of 31-12-2022.
capital_resto	Value in euros of sums insured for property damage by post code for the risk classes offices, business and industrial risks, infrastructure and the rest as of 31-12-2022.
dt_primavera	Compensation for property damage during spring-time (March, April and May) by post code regardless of the risk class (1996-2022 dataset).
dt_verano	Compensation for property damage in summer-time (June, July and August) by post code regardless of the risk class (1996-2022 dataset).
dt_otonno	Compensation for property damage throughout autumn (September, October and November) by post code regardless of the risk class (1996-2022 dataset).
dt_invierno	Compensation for property damage in winter-time (December, January and February) by post code regardless of the risk class (1996-2022 dataset).
est_max_dt	Season with the highest compensation for property damage by post code regardless of the risk class (1996-2022 dataset).

Column	Description
prop_max_dt	Value in proportion to the total of the season with the highest compensation for property damage by post code regardless of the risk class (1996-2022 dataset).
tasa_siniestralidad	Euros/year paid out in compensation per euro insured as of 31-12-2022.
tasa_sini_millon_aseg	Euros/year paid out in compensation per million euros insured as of 31-12-2022.

Table 1. Dictionary of data from tables in the historical record of estimates of costs of losses and sum insured according to causes and Spanish administrative areas.
Note: The cause described as an ACS (atypical cyclonic storm) takes in the 2012-2022 period.
Source: CCS.

Findings

Even though the source information has a resolution at post code level, in presenting the findings from this exercise we shall opt in favour of aggregation by municipality, which transpires as more intuitive from the reader's standpoint. On occasion we will aggregate the information by province or regional autonomy.

The exposure of insured property by municipality given in Figure 1 offers an unusually faithful reflection of Spain's population structure, with very high values insured on the coast and in the Guadalquivir and Ebro valleys, as well as in Madrid and its area of influence. The minimum brackets (large amount of municipalities which do not reach 100 million euros in total sum insured – amassing dwellings, industries, businesses, infrastructure and motor vehicles –) emerge in Castile and León, the mountainous regions in Aragon and Castilla-La Mancha, the Pyrenean foothills and other mountainous areas within the peninsular interior.

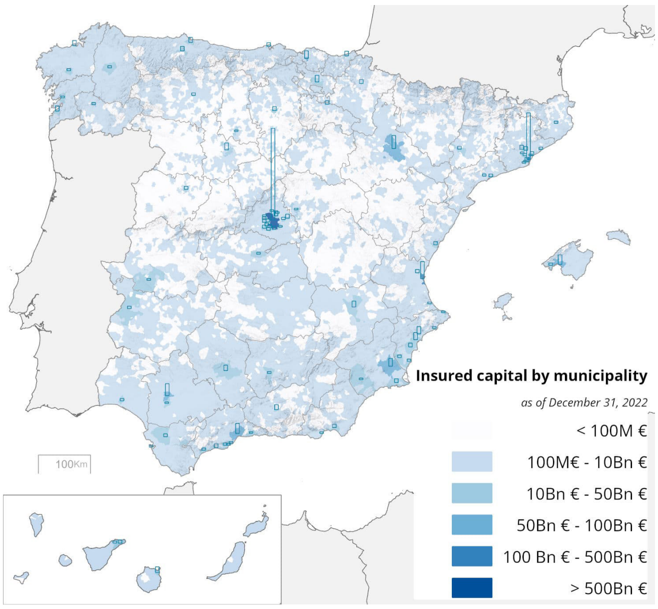

Figure 1. Capital insured for property (residential, commercial, industrial, infrastructure and motor vehicles) by municipal district as of 31 December 2022.

If we aggregate this information by regional autonomies in Figure 2, only two – Catalonia and the Madrid Region – top a trillion euros in the total sum insured, while Andalusia and Valencian Region fall within the bracket of 500 billion to one trillion euros of total capital insured. The autonomous cities of Ceuta and Melilla are (as one might suppose) the areas which have the least capital insured, with Cantabria and La Rioja falling within the group having 10 to 100 billion in insured capital, while all the other regional autonomies are within the 100-500 billion euro range. As we said earlier, the overall total sum insured is of the order of some 6.5 trillion euros.

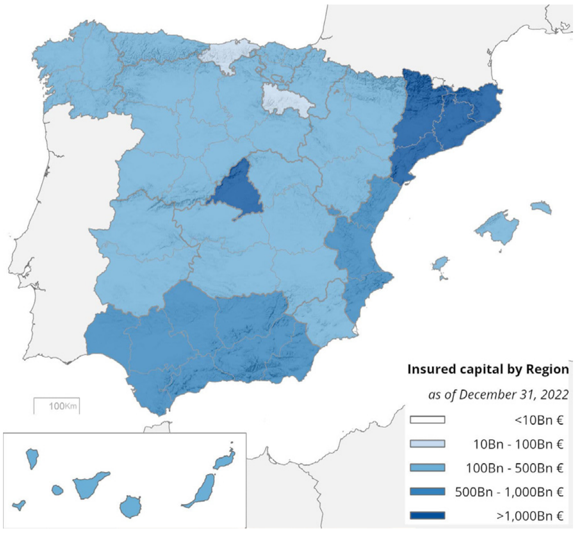

Figure 2. Capital insured for property (residential, commercial, industrial, infrastructure and motor vehicles) by regional autonomy as of 31 December 2022.

As for claims incurred on account of the natural causes under consideration (flooding, coastal flood, windstorm and geological causes), the annual average for compensation paid out over the period of 1996-2022 is depicted in Figure 3. There is a palpable two-fold reliance on, firstly, exposure (there are more compensation pay-outs in the larger municipalities such as Barcelona, Madrid and Valencia) and, secondly, the hazard level (which is the case in Lorca, for example), although, broadly speaking, in those municipalities which stand out in terms of total compensation (such as Malaga, San Sebastián, Murcia and Córdoba) it is the blend of both factors which is responsible for the high annual average compensation paid out.

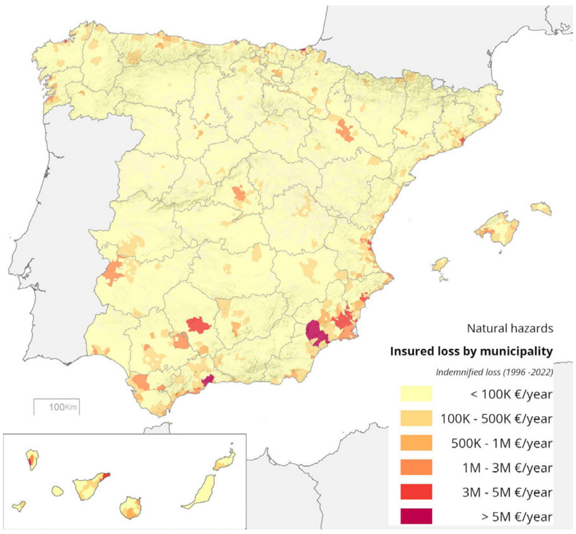

Figure 3. Annual average compensation paid out per municipality due to the natural causes considered in the study (flood, coastal flood, atypical cyclonic storms, earthquakes, tsunamis, and volcanic eruptions).

To avoid the distortion which zones with high exposure (sums insured) produce, from now on we will perform our analysis at municipal level on the basis of the division of the annual average for yearly compensation pay-outs by the annual exposure for 2022, which will give us a loss ratio in euros paid out per year and municipality for every million euros insured in it. We are aware that we are comparing average insured loss over 27 years with exposure for one particular specific year (2022). It is patent that, given that the exposure level over this period has tripled, the loss must have exhibited a similar pattern (which can be seen from the aggregated total of losses). In other words, we are under-representing the earlier claim events and this may impact the final conclusions, although it is also true that the growth occurred very rapidly in 1996-2010, when the total sum insured swelled (in terms of constant euro levels for 2022) from 2.24 trillion to 5.41 trillion. From 2011 to 2022, when the total sum insured reached 6.46 trillion euros, growth slackened, which is why exposure in major loss events such as the 2011 Lorca earthquake or the cut-off lows in 2012 or 2019, can be thought of as being relatively stable. In regard to totals, 51% of overall losses (remembering here that this is in constant euros) were caused in these last 12 years out of the total for the 27 years under review in the study.

Extraordinary floods (fluvial and pluvial flooding)

Figure 4 shows the annual average amount paid out in compensation in euros per million euros insured by municipal district on account of fluvial and pluvial flooding, which reflects a loss ratio that is relatively independent from cumulative exposure. The zones with higher loss ratios per flood are generally located along the coastline, in the central sections of the Guadalquivir, Ebro and Guadiana, and in the populated mid-mountain areas.

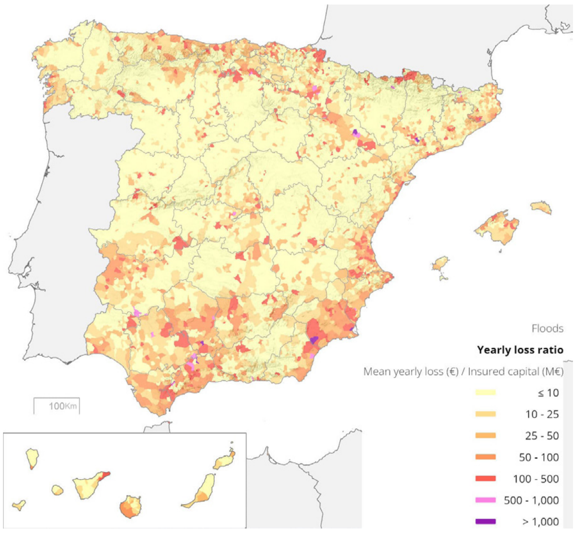

Figure 4. Loss ratio (average annual loss in euros / sum insured in millions of euros) by reason of extraordinary flooding per municipal district.

More precisely, the eastern, Mediterranean coast from Cape Gata to the Ebro Delta, together with certain areas of the Sierra de Tramuntana and the 'Llevant' of Majorca, as well as the Costa Brava, exhibit high or very high loss ratios. In certain zones, such as the Guadalentín valley, the Lower Segura or the Mar Menor basin, these rates are extraordinarily high.

Along the northern coast, the highest loss ratios are concentrated on Galicia's 'Rías Bajas' (southern half of the coastline) and the central and eastern Bay of Biscay coastline. As regards the valleys of the major rivers, there are very high loss ratios at certain points of the Ebro Axis and its main tributaries, such as the Arga or the Aragón, as well as along the Córdoba-Seville section of the Guadalquivir and in the Badajoz section of the Guadiana.

An interesting characteristic has become evident in the mid-mountain areas where there is a significant population, both in the Cantabrian range (especially on the southern side), the foothills of the Pyrenees in Navarre, the Catalan coastal ranges, as well as in Sierra Morena and the Baetic and Penibaetic systems (particularly in Malaga province). There are municipalities with high loss ratios, and some very high, while others are occasionally anomalously high, as a result of floods occurring along short river courses which with only a very brief response time in highly built floodplains. This is the same process present in the areas neighbouring the Strait of Gibraltar and generally speaking in all the coastal zones reported above.

In regard to the Canary Islands, the northern tip of Tenerife presents very high loss ratios and the loss ratio is substantial in the south-west of Gran Canaria and that of Fuerteventura.

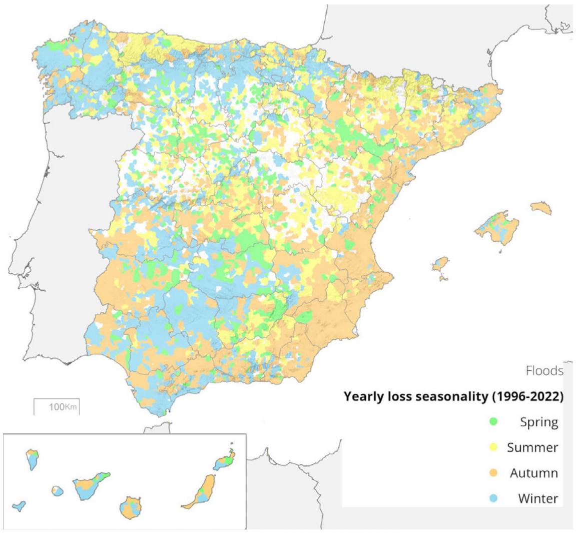

Figure 5. Seasonality of greatest frequency of flood losses by municipality.

The seasonality of the danger of flooding is illustrated in Figure 5. The map does not show the season of the year when it rains most but rather the season when CCS logs the most flood claims, which do not necessarily coincide. The biggest losses from flooding in autumn are concentrated along the entire Mediterranean coastline and the Balearic Islands, although they are also present in other zones such as in Andalusia between Córdoba and Malaga and the west of Extremadura. There is no doubt that the effects of cut-off lows clearly play a leading role in this geographical make-up.

The winter highs occur in areas exposed to Atlantic flows and result from the passing through of low-pressure systems in that particular season: Galicia, the Cantabrian mountain range, particularly on its southern side, the Central System, the Montes de Toledo, the Sierra Morena and large swathes of the Guadalquivir basin and the zone around the Strait, including the basins of the major rivers in Malaga. These flows, which generally run from the west or the south-west, see build-ups from huge rainfalls in these directions, which translate into floods and losses.

The spring is normally the season when there are less flooding (and here we wish to stress the difference between greater cumulative rainfall and the heavier downpours, which is what gives rise to flooding). Spring floods only predominate in scattered inland areas.

Summer highs appear in zones within the interior such as the Madrid Region, the Iberian system and also (which is something that is less intuitive) in the Central Pyrenees and along the Bay of Biscay coastline. Once again, there is a significant difference between the cumulative amount of rainfall, which, for example, is greater in winter on the Bay of Biscay coast, and very heavy downpours in only a short space of time, that are convectional in origin, and cause damage.

Coastal flooding

Interpretation of the regulations on extraordinary risks yields a definition of coastal flood as flooding of land caused by the sea or estuaries, or else by the action of sea swells that affects items located on otherwise dry land. The total amount of loss or damage on account of coastal flooding is not very considerable compared to that caused by extraordinary flooding (it is in the region of 4% of the former) yet we can draw some interesting conclusions from geographical representation of such floods, which is given in Figure 6. The loss ratios (here we should recall that we are not discussing outright loss or damage, but rather loss or damage arising relative to exposure) are highest in the Bay of Biscay and on the Costa Brava. They generally tend to be greatest along the east Bay of Biscay area, where municipalities such as Bermeo (Biscay) have substantial loss ratios, and next to the Mediterranean to the north of Cape Nao, where certain municipalities such as Colera and Portbou in Girona present notable loss ratios. The same occurs in Sant Adriá de Besós (Barcelona), Peñíscola (Castellón) and Escorca and Santa Margalida in Majorca.

That said, the highest loss ratios attributable to coastal flood emerge in the Canary Islands, where Valverde (on El Hierro) and Garachico (on Tenerife) record the highs. In this case they usually relate to episodes involving swells with large-scale surges which engage with favourable exposures in the archipelago.

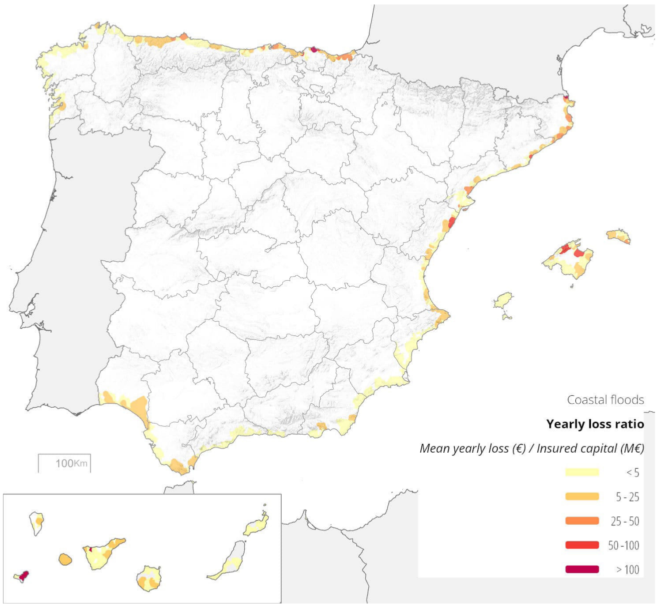

Figure 6. Loss ratio due to coastal flood by municipality.

The seasonality of loss or damage from coastal flood is illustrated in Figure 7. Normally this phenomenon is most frequent in winter on the Galician and Bay of Biscay coasts, as well as in Catalonia and the Canary Islands. The spring highs are notable on the Andalusian shoreline and in autumn along a sizeable portion of the Eastern coast (although the province of Alicante and some areas in that of northern Valencia exhibit winter highs, as does northern Ibiza, western Majorca and Ciutadella and Maó on Minorca).

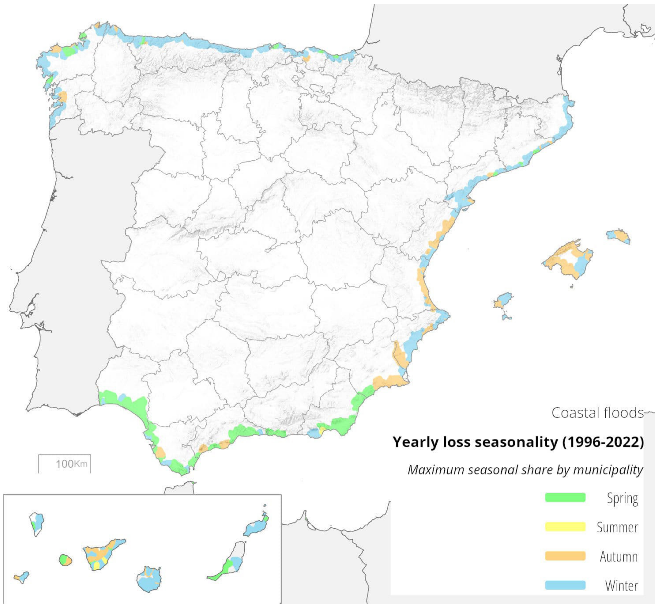

Figure 7. Seasonality of greatest frequency of loss from coastal flood by municipality.

Atypical cyclonic storms (strong windstorms)

CCS pays out compensation for loss or damage from very strong wind events when these involve gusts assailing a municipality of over 120 km/h in three seconds or present in the form of a tornado. These coverage thresholds were determined in 2011, for which reason the data series we examine in this section relates to the period running for the full years from 2012 to 2022, when these criteria were upheld. From 1996 to 2011 two different thresholds and coverage criteria were applied (see the article by Vilares and Asensio in edition 16 of this digital magazine), with the coverages used by CCS steadily becoming more and more extensive, which means that these are not comparable periods and we are leaving them out of this part of our study.

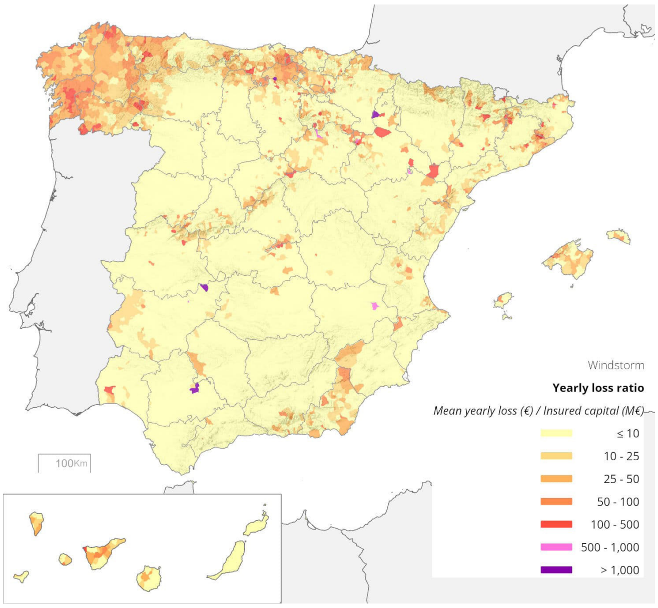

Figure 8. Loss ratio for atypical cyclonic storms by municipality.

Figure 8 makes it clearly noticeable that loss ratios on account of this hazard are higher in very particular areas: Galicia and the west Bay of Biscay portion, as well as the Cantabrian mountain range, with high loss ratio zones extending along the Iberian and Central system, albeit in a more isolated way, as well as the more easterly section of the Baetic and Penibaetic system, with the Balearic Islands included here. Other mountainous areas, such as the Catalan coastal ranges and, in a more isolated manner, the Pyrenees, also show relatively high loss ratios. On the Canary Islands the higher loss ratios occur among the more westerly islands, particularly in zones more open to the northwest. In flat areas, for example in the Ebro valley or points on the Southern Plateau or even in the Guadalquivir valley, points with high loss ratios can also be found, although one or two of them can be due to specific episodes which affect high-value facilities or premises, such as wind farms or other power and industrial installations, which can produce very high relative losses compared to the low exposure in their municipalities.

This is the hazard with the most marked seasonality. Figure 9 shows that in general wind loss takes place in winter as a result of high-impact, low-pressure storms passing through or cyclone formation processes, save for the case of very specific zones, for example in the centre and south of the Madrid Region and the Ebro Axis, where wind loss or damage is linked to summertime convectional processes. In other, more scattered zones in the southern third wind loss most frequently happens in autumn and is associated with the presence of cut-off lows.

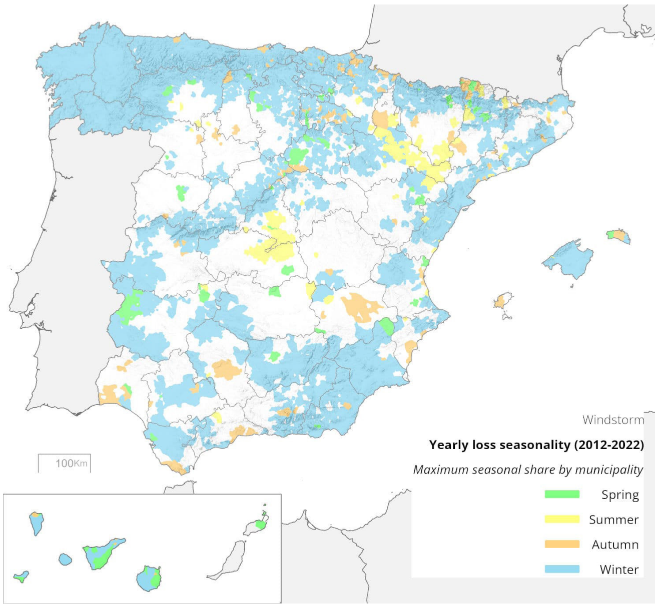

Figure 9. Seasonality of greatest frequency of loss or damage from atypical cyclonic storms by municipality.

Geological hazards

The geological hazards covered under extraordinary risk insurance are earthquakes (the most common), tsunamis (in the period under review only one has been compensated, where the loss was minimal, in 2003) and volcanic eruptions, which likewise only led to compensation on a single occasion with the eruption on the Cumbre Vieja massif on La Palma of 2021. It makes no sense to speak of seasonality with these hazards, although we can actually offer a geographical representation of the loss ratio, with the evident distortions caused by the two episodes of greatest significance and losses: the Lorca earthquake in 2011 and the cited eruption on La Palma, as shown in Figure 10.

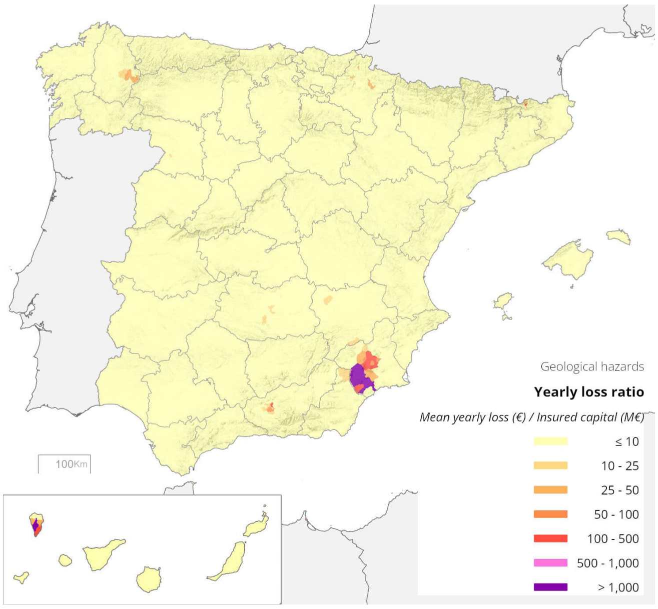

Figure 10. Loss ratio for geological hazards by municipality.

Obviously, the highest ratios on account of earthquakes are concentrated in the south-west of Murcia region, which was hit by the Lorca earthquake on 11 May 2011, though also by others such as in Mula in 1999 or La Paca in 2002. Other zones where we can note significant seismic claims incurred include the Granada Plain, which was affected by the earthquake swarm of 2021, the autonomous city of Melilla, where there was a major event in 2016, or other zones less severely impacted but involving relative frequency, such as the northern third of Navarre, El Ripollés in Girona or the Becerreá-Ancares region in Lugo.

The volcanic eruption at Cumbre Vieja on La Palma left its mark in terms of extremely high loss ratios in the municipalities of El Paso, Los Llanos de Aridane and Tazacorte, which were directly affected by the eruption, though also on account of the rest of the municipalities in the southerly two-thirds of the island, which were impacted by ash and tremors that related to the eruption process.

Maximum frequency of hazards by municipality

The concept of compensation falls within the philosophy of extraordinary risk insurance, and this appears in the name of our institution, across various different hazards which manifest themselves to a greater or lesser extent in several different geographical areas. Figure 11 shows which hazard has caused the most loss over the period under review in each municipality. As with all the loss compensated by CCS, where flooding represents two out of every three euros paid out, in terms of geographical representation it is flooding which predominates over large swathes of Spanish soil. It is possibly more time-effective to pinpoint the zones where other hazards (among those examined in this study) are those which give rise to proportionately more loss or damage.

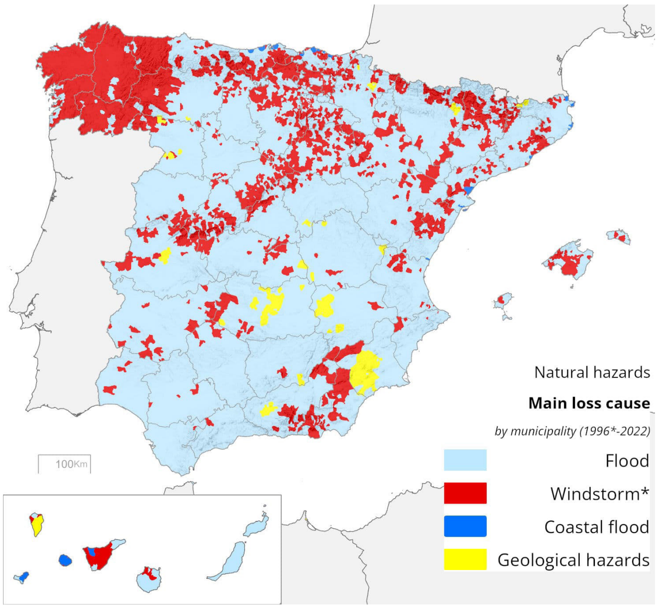

Figure 11. Classification of most losses per municipality according to the hazards considered within this study.

Wind predominates in virtually the whole of Galicia and the western portion of Asturias and León. It also prevails in the arc of municipalities which spans the Central and Iberian system and the Cantabrian mountain range, as well as in a sizeable part of the Pyrenean municipalities and the coastal Catalan ranges. Wind loss also predominates in Majorca, the eastern-most Baetic systems and the island of Tenerife, as well as in certain zones of the west and central Southern Plateau. Coastal flood is the most costly hazard on La Gomera and El Hierro, as well as in isolated municipalities on the Catalan, Basque and Bay of Biscay shoreline.

Geological hazards predominate in south-west Murcia, the Granada Plain, Melilla and the island of La Palma, yet also in certain municipalities in La Mancha and the aforementioned Pyrenean and Pyrenean foothill zones, as well as in certain points in the west of the provinces of Zamora and Cáceres.

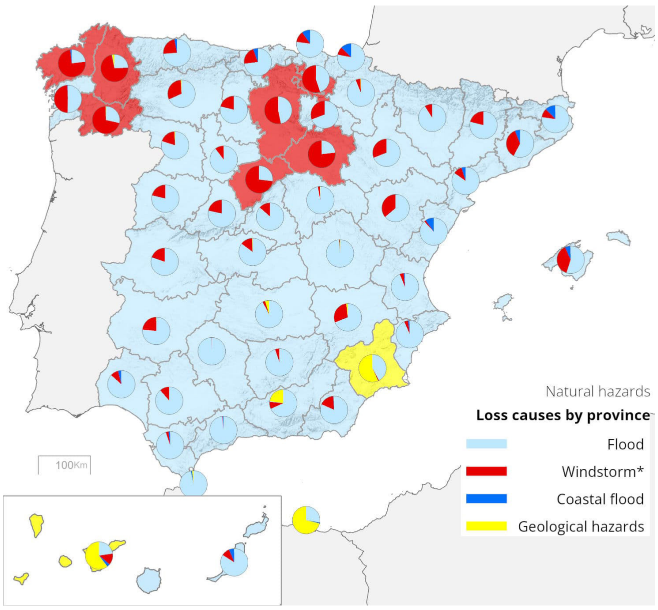

Figure 12. Most loss by province and proportionate distribution of them included in the period under review.

This information can be expressed in synthesis at provincial level in Figure 12, where it can be seen that, in the vast majority of provinces, it is flooding which is the extraordinary risk which brings about the most loss, except for in La Coruña, Lugo, Orense, Burgos, Álava, Segovia and Soria, which suffer most from wind events, and Murcia, Santa Cruz de Tenerife and the autonomous city of Melilla, where the most losses were produced in the period under review by geological hazards.

Conclusions

Based on purely economic data, sums insured and compensation paid out in relation to extraordinary risks for hazards that are natural in origin and considered herein, we have managed to extricate certain characteristics that relate to atmospheric processes and their seasonality or to geological processes, which reveals the immense importance of the flow of data which CCS stores in the context of its insurance functions as a basis for performing another of them, namely providing valuable greater insight into risks covered with a view to minimising them.

This knowledge is most important, if you will, in the context of the climate crisis in which we must act with greater diligence to reduce the vulnerability of property that is exposed to increasing levels of hazardousness.

Our gratitude

Thanks to the Technical and Re-insurance Sub-directorate of the CCS, which has gathered together, refined and prepared the basic data for this study.

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Electric cycles are not motor vehicles

Comment on the judgment by the Court of Justice of the European Union of 12 October 2023. Case C-286/22

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Introduction

There is no doubt that what are termed personal transporters or personal mobility vehicles (PMVs), Electronically Power Assisted Cycles (EPACs) and other similar rideables have burst onto the scene in our cities in recent years, which has brought about road safety problems as well as accidents involving riders of such vehicles themselves and other people. It has therefore become necessary for there to be a clear regulatory framework both to ensure the orderly use of such vehicles on public thoroughfares and avoid or reduce traffic accidents.

Thus far we have encountered a mixed bag of incomplete legislation with nationwide regulations thrown together with municipal by-laws, which, in our view have still not addressed the problems that arise, particularly as these concern road safety.

Thus far we have encountered a mixed bag of incomplete legislation with nationwide regulations thrown together with municipal by-laws, which, in our view have still not addressed the problems that arise, particularly as these concern road safety. In this regard we ought to clear up questions about classifying these sorts of vehicles, their characteristics, what riders need, identification and registration, the insurance that should apply to them, etc.

As things stand, since they are not held to be motor vehicles the legislation on civil liability insurance for road-going motor vehicles does not apply to them, and neither does the Criminal Code where this concerns road safety offences in articles 379 et seq. thereof. Thus, as regards the criterion of attributing civil liability, Article 1902 of the Civil Code is applied, which is the general rule observed in this area where no specific legislation exists. Hence, if, for example, a moped collides with a PMV or an EPAC, theoretically separate criteria for apportioning civil liability are applied, which appears striking to say the least.

This issue is producing truly contradictory case law in regard to the criterion for attributing liability on the part of riders, as well as the owners and lessors of this sort of vehicle.

Directive (EU) 2021/2118 on motor vehicle insurance

Directive (EU) 2021/2118 of the European Parliament and of the Council of 24 November 2021 amending Directive 2009/103/EC relating to insurance against civil liability in respect of the use of motor vehicles, and the enforcement of the obligation to insure against such liability, has defined what should be understood by a motor vehicle and a traffic event by taking into account the case law of the Court of Justice of the European Union (CJEU), which comprises, inter alia, its decisions in the cases concerning Vnuk (CJEU judgment of 4 September 2014, case C-162/13), Rodrigues de Andrade (CJEU judgment of 28 November 2017, case C-514/16) and Torreiro (CJEU judgment of 20 December 2017, case C-334/16)[1].

In regard to the concept of a 'vehicle', section 1 of Directive 2021/2118 amends Article 1 Directive 2009/103/EC and states that these are held to be "any motor vehicle propelled exclusively by mechanical power on land but not running on rails, with i) a maximum design speed of more than 25 km/h; or ii) a maximum net weight of more than 25 kg and a maximum design speed of more than 14 km/h."

As we can note, in defining what should be understood by 'vehicle' its scope fails to cover Electronically Power Assisted Cycles (EPACs), given that it requires that they be propelled 'exclusively' by mechanical power, which pre-requisite the cycles referred to do not satisfy.

Moreover, in regard to electric vehicles, Recital 4 of Directive 2021/2118 stipulates that light electric vehicles that do not fall within the definition of 'vehicle' should be excluded from the scope of Directive 2009/103/EC. Notwithstanding this, it offers Member States the option of requiring, under their national law, motor insurance, subject to conditions to be set by them, in respect of any motor equipment used on land that does not fall within that Directive's definition of 'vehicle', and for which consequently that Directive does not require such insurance.

As a result, so-called PMVs which do not have a specific design power do not qualify as 'vehicles' for the purposes of the Motor Vehicle Directive. As for EPACs, under no circumstances will they be considered to be a 'vehicle' in that they are not propelled 'exclusively' by mechanical power. This does not however hinder Member States from considering them to be 'vehicles' and requiring compulsory insurance by dint of the stipulations in Recital 4 of Directive 2021/2118. In fact as part of the work on transposing the Directive that is being carried out in Spain the Assessment Supervisory Committee has been commissioned to produce a reasoned report on establishing compulsory civil liability insurance for personal mobility and other motor vehicles which do not fall within the legal conception of what constitutes a 'motor vehicle' pursuant to the Directive.

[1] We recommend reading these articles from issues 9 and 12 of our e-magazine in which we refer to the three cases cited (Vnuk, Andrade and Torreiro):

- The obligation of the owner of a motor vehicle to take out insurance against civil liability: comments on the Opinion of the Advocate General of the Court of Justice of the European Union of 26 April 2018 in the question referred for a preliminary ruling C-80/2017 (A. Izuzquiza).
- The obligation on vehicle owners to take out compulsory insurance. Comment on the Judgment by the Court of Justice of the European Union of 4 September 2018 (Case C-80/17) (J. A. Badillo).
- The concept of a "traffic event" in EU jurisprudence (J. A. Badillo).

The judgment by the Court of Justice of the European Union of 12 October 2023

The CJEU judgment of 12 October 2023 (case C-286/22) examines whether Power Assisted Cycles according to what is laid down in Directive 2009/103/EC (in force at the time of events) qualifies as a vehicle for the purposes of the Directive referred to.

Even though the definition of a 'vehicle' in the Directive of 2009 is more concise than that of 2021, it says that a 'vehicle' should be understood to mean: *"any motor vehicle intended for travel on land and propelled by mechanical power, but not running on rails, and any trailer, whether or not coupled"*. Thus this Directive also alludes to those which are propelled by mechanical power.

The facts behind this ruling

The facts behind this ruling relate to a vehicle running over the rider of an Electronically Power Assisted Cycle in Belgium. The victim was seriously injured and died on 11 April 2018. Given that the incident constituted an accident to the victim *in itinere*, P&V, their employer's insurer for accidents in the workplace paid out indemnities and subrogated itself to their rights and those of their successors in interest. It subsequently filed a claim for the indemnities paid out to the insurer of the vehicle responsible for the accident.

Legal issue raised

The legal issue which is raised in this proceeding concerns whether an EPAC can be considered to be a vehicle on the terms articulated in the Directive of 2009, since, if this is the case, the victim to blame for the accident would not be entitled to any indemnity at all; whereas if it is held that the EPAC does not qualify as such, then the victim does in fact have the right to be indemnified.

This is because Article 29 of the (Belgian) Law of 21 November 1989 confers protection for all accident victims who are not drivers or riders of vehicles in those cases where they are to blame for the accident. In other words, they do not apply either involvement of blame or exclusive culpability on the part of the victim and so they have to be indemnified on account of the vehicles having a role in the accident. As can be noted, the 'vulnerable victim' concept in Belgian law is more protective than that laid down in Article 1 of our Law on civil liability and insurance in using motor vehicles.

Belgian lower court judgments

On account of this, P&V, which had paid out an indemnity to the victim, filed a lawsuit against KBC, the insurer of the vehicle which ran the victim over, with the Western Flanders Court for Minor Offences in an attempt to achieve reimbursement of its costs based on Article 1382 of the old Belgian Civil Code or Article 29 bis of the Law of 21 November 1989. KBC brought a counterclaim in which it sought a refund from P&V of a sum of money paid out inappropriately. In its answer to the claim, on the basis of Article 29 bis P&V alleged that it could not be maintained that the victim was the rider or driver of a motor vehicle.

Under a judgment of 24 October 2019, the above-mentioned court ruled that the driver of the vehicle in question was not accountable for the accident, but that, by dint of Article 29 bis as discussed, KBC was nevertheless obliged to indemnify the victim as well as P&V, which had subrogated itself to the rights and claims of said victim due to the fact that the victim was not driving or riding a motor vehicle and was therefore entitled to an indemnity in accordance with that same Article.

In response to an appeal filed by KBC, the insurer of the vehicle, the intermediate court of appeal handed down a judgment on 20 May 2020 in which it dismissed the appeal given that it was of the view that a cycle is not a motor vehicle in the sense outlined in the Law referred to if it uses an ancillary motor when mechanical propulsion alone cannot start the cycle moving or keep it going. Therefore, in light of the information furnished by the manufacturer of the EPAC, the court in question ruled that the cycle's motor only provided support for pedalling, including the motor's 'turbo' function, and that this function could only be activated having exerted muscle-power, whether by pedalling, walking with the cycle or pushing it. This inferred that the victim was not the rider of a motor vehicle in the sense conveyed in Article 1 of the Law of 21 November 1989, and that they could claim damages pursuant to Article 29 bis of said law as 'a vulnerable user of a public thoroughfare' as was the insurer of occupational accidents who was subrogated to the rights of the victim.

Its claims having been once more thrown out, KBC appealed to Belgium's Court of Cassation for a reversal of the afore-mentioned judgment, this being the court which raises the preliminary issue with the CJEU. The appellant maintained that, since Article 1 of the Law of 21 November 1989 makes no distinction between vehicles used for land travel that can exclusively be propelled using mechanical power and those which can additionally be propelled via mechanical power, only vehicles propelled exclusively through muscle-power lie outside the scope of application of that Law. Based on this it adduces that Belgium's court of first instance wrongly interpreted the concept of a 'motor vehicle' in contravention of Articles 1 and 29 bis of that Law, as well as particularly Article 1, point 1 of Directive 2009/103/EC.

In view of this appeal, Belgium's Court of Cassation opted to put the following preliminary issue before the CJEU: *Should Article 1, point 1 of the Directive [2009/103] be interpreted in the version thereof that applied prior to amendment thereof by Directive [2021/2118] where 'vehicle' is defined as "any motor vehicle intended for travel on land and propelled by mechanical power, but not running on rails, and any trailer, whether or not coupled" in the sense of a power assisted cycle* (a 'speed pedelec'), *the motor of which only operates in support of pedalling, meaning that the cycle is incapable of moving autonomously without the use of muscle-power but instead solely via driving force along with muscle-power, and where a cycle with power assisted pedalling equipped with a 'turbo' function whereby the cycle accelerates to a speed of 20 km/h without any pedalling when the 'turbo' button is pressed but where muscle-power is required to be able to use that function are not vehicles in the sense depicted in that Directive?*

As we have already pointed out, according to Belgian law deeming an EPAC to be a vehicle on the terms of Directive 2009/103/EC would produce the outcome that the victim would not be indemnified in this case through being culpable for the accident. That said, in the contrary case the victim would be entitled to the relevant indemnification, as would the insurer that had paid out damages for them and is subrogated to their claims and rights.

The decision by the Court of Justice of the European Union

The European Court once again reminds us that Directive 2009/103/EC is intended to guarantee the free movement of both vehicles normally parked in EU territory and the persons occupying them, and on the other hand, that the victims of accidents caused by such vehicles receive comparable treatment wherever the accident has taken place within the European Union, as well as to ensure the protection of victims of accidents which motor vehicles cause. This objective of victim protection has been one that has been constantly pursued and reinforced by the European Union's legislative authority.

Beyond this, as regards EPACs, which constitute the matter raised in the principal litigation, it states that machines that are not propelled exclusively by mechanical power and which therefore cannot travel overland without the use of muscle-power, such as cycles with power-assisted pedalling, yet which, on the other hand, can accelerate without pedalling up to a speed of 20 km/h, do not appear capable of causing bodily injury or property damage comparable in seriousness or amount to that which motorbikes, cars, lorries or other vehicles travelling on land and powered exclusively by mechanical force can occasion. For the CJEU the latter can attain speeds that are notably greater than such machines can reach and nowadays they are used more frequently on the roads. Therefore, the goal of protecting victims of traffic accidents caused by motor vehicles which is pursued by Directive 2009/103 does not require machines of this kind to be included within the concept of 'vehicles' in the sense described in Article 1, point 1 of this Directive.

Based on all the above reasoning it concludes that it is in order to address the preliminary issue raised by asserting that Article 1, point 1 of Directive 2009/103 must be interpreted in the sense that a cycle does not fall within the category of a 'vehicle' for the purposes of this decision if its electric motor merely assists pedalling and it has a function which allows it to accelerate without pedalling up to a speed of 20 km/h; a function which, nonetheless can only come into operation having exerted muscle-power.

Conclusions:

In light of the points raised in the preceding paragraphs, we may conclude the following:

1. Belgian law considers those persons who do not have vehicle driver or rider status as defined in Directive 2009/103/EC as vulnerable. Thus it is that in the case of anyone not classed as such passing along the road and then suffering an accident, they shall have to be indemnified jointly and severally by the insurers of the vehicles concerned regardless of whether there may or may not be culpability or fault exclusively or on an attendant basis on the part of the victim.

2. What is alluded to in the previous paragraph being the point of controversy in the Belgian courts, Belgium's Court of Cassation submits the issue for a preliminary ruling to the CJEU to determine whether EPACs qualify as vehicles for the purposes of Directive 2009/103/EC, given that whether or not the victim in the original litigation is indemnified will hinge on this.

3. The CJEU concludes that for the purposes of Directive 2009/103/EC a cycle does not fall within the category of a 'vehicle' if its electric motor merely assists pedalling and it has a function which allows it to accelerate without pedalling up to a speed of 20 km/h; a function which, nonetheless can only come into operation having exerted muscle-power.

4. Although in the case which concerns us here Directive 2009/103/EC applied, we ought to point out that pursuant to Directive 2021/2118, which is currently being transposed into Spanish law, an EPAC is not classed as a motor vehicle either, irrespective of the power it may have, given that the definition of a 'vehicle' mentions that it must be "propelled exclusively using mechanical power", which is a requisite that no EPAC of any description satisfies.

5. In any event, the foregoing represents no hindrance to Member States being empowered (pursuant to Recital 4 of Directive 2021/2118) to require motor vehicle insurance under their national law, subject to conditions to be set by them, in respect of any motor equipment used on land that does not fall within that Directive's definition of 'vehicle', and for which the Directive consequently does not require such insurance (PMVs or EPACs for example).

Review of *Disaster Insurance Reimagined*

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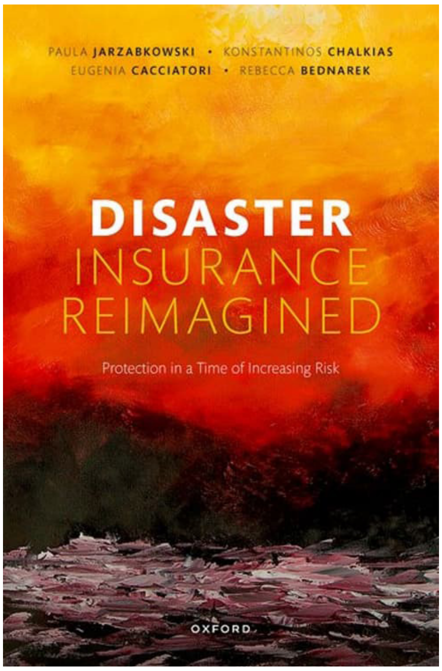
A warming climate will bring more extreme weather to a world in which the population, and the buildings and infrastructures it needs, are increasingly concentrated in urban centers located in flood plains, coastal areas, and other risky locations. Who will pay for the escalating losses that disasters will bring in such a world? Already, insurance is becoming unavailable or unaffordable in many areas at risk, for example in parts of California and Australia. The 'protection-gap', the difference between the economic losses of disasters and the share of those losses that are covered by insurance, which already is a considerable problem, is only likely to grow. Even when insurance is available to finance reconstruction, how do we ensure that rebuilding will facilitate adaptation, rather than putting things back as they were until the frequency and magnitude of losses make financing reconstruction impossible? *Disaster Insurance Reimagined* is a timely book, available in open access, written by Paula Jarzabkowski, Konstantinos Chalkias, Eugenia Cacciatori and Rebecca Bednarek, that addresses these questions on the basis of a five-year study of 17 'Protection Gap Entities' (PGEs) - not-for-profit entities that provide insurance in 49 countries. These PGEs, typically developed as collaborations between governments and the insurance industry, enable insurance to continue at a time when climate change, urbanization, global interdependence, and geo-political instability are making disaster insurance increasingly expensive or unavailable. Around the world, PGEs and the insurance instruments they use are becoming increasingly crucial in making sure that funds are available to rebuild after disasters.



Drawing on paradox theory and on practical examples from PGEs in different countries, the book offers a framework to understand how uninsurability emerges and how PGEs remedy it. In chapter 1, the authors explain how insurability exists in the sweet spot in which three core tensions (or paradoxes) balance. The paradox of knowledge means that insurance cannot exist when knowledge is absent and losses cannot be estimated, nor when losses are certain, but only in the grey areas in which only partial knowledge is available. The paradox of responsibility means that insurance exists in a zone where individual responsibility for the losses of disaster balances collective responsibility, so that the premium of the many can pay for the losses of the few. Finally, in the paradox of control, insurance can operate in a zone in which government control over the insurance market, in the form of various interventions, balances industry control, so that insurance can be sold for a profit. Chapter two explores how imbalances in the knowledge paradox are at the origin of various PGEs around the world, and how PGEs restore insurability by ignoring either the excess of knowledge or its lack. For instance, climate change and increasingly powerful modelling mean that losses for properties in areas at high risk of flood are becoming increasingly certain, leading to an imbalance in the knowledge paradox that means flood, for those properties, is no longer insurable. PGEs then can step in, ignore this excessive knowledge, and insure these properties despite the fact that are known to be at high risk. However, the three paradoxes need to balance not only internally, but also in relation to each other. So, a new balance in the knowledge paradox requires new balances in how responsibility is allocated between the individual and the collective, and how control of the market is shared between the government and the industry. Chapter 3 and 4 explore how different PGEs find different balances across these paradoxes in order to restore insurability. Chapter 5 then addresses the question of how PGEs can be designed so as to facilitate resilience and adaptation, explaining how their work can, but does not always, improve financial and physical resilience to disaster. Chapter 6 concludes by drawing the implications for a reimagined disaster insurance that can help us address the challenges of climate change.

The book provides an accessible discussion of disaster insurance, its complexities, and the transformation it needs to undergo in order to remain relevant and to contribute to meaningful disaster protection. PGEs and their work offer a path to re-imagining disaster insurance as a key tool in an ecosystem that has societal protection from disaster at its heart.

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