# An analysis of flooding economic impact in Urumea area

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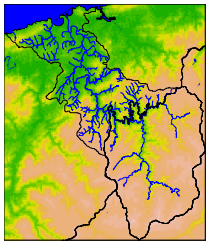
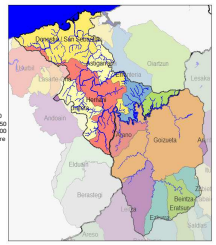
## Abstract

Severe weather phenomena impact the Basque society and economy in many ways, from disruption in various sectors and substantial damages in infrastructure to human and economic losses. Particularly flooding is the natural event that causes the most disaster damage in Basque Country.

In this work we focus on flood impact produced in Urumea area during this century. Urumea river is sited in the East part of Basque Cantabric Basin, flowing to the Bay of Biscay through the city of San Sebastian. Is a representative river for this part of the country, with rather steep slope and short concentration time. In Urumea basin high precipitation events, flash-floods and associated impact are relatively usual.

In this study we use, as a reference for impact, the losses from flood damage paid by Spanish Insurance Compensation Consortium (CCS) during last twenty years. Data are analyzed and presented in different ways grouped per date, period, amount, damage type, location, etc. The final objective is to contribute to knowledge of impact characteristics in this area, increasing awareness and preparedness in flash-floods events.



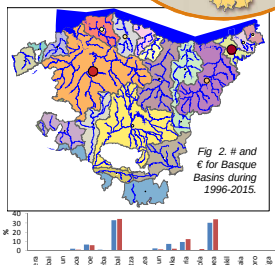


Fig 1. Geographic characteristics and municipalities in Urumea Basin.

Fig 2. # and € for Basque Basins during 1996-2015.

## Introduction

In the Basque Country, north of the iberian Peninsula, rivers flows in two main watersheds, the Cantabric and the Mediterranean (see Fig. 1 and 2). In the Cantabric basins high precipitations rates and steep slopes of around 1000 meters in few kilometers promotes flooding with certain regularity. Nevertheless, the rivers of the Mediterranean slope have less incidence rate of floods due to less precipitation rates and slopes (see Fig 2). Is important to note that Mediterranean basins are mainly in the territory of Alava the largest (2,963 km²) of the three provinces in the Basque Autonomous Community but the less industrial, inhabited and flat part of the territory. On the other hand in Bizkaia (2.217 km², 1.141.000 inhabitants) and Gipuzkoa (1980 km²), 700.000 inhabitants ) are occupied by many river´s valleys highly populated and with industrial activities. If we consider those different geographical and sociological factors, it is not strange that 95% of the economic impact of floods occurs in the Cantabrian basin and particularly more than 30% in Ibaizabal basin (1.800 km²) and an amount slightly lower in Urumea Basin with six times less extension (270 km²) (see Fig 2).

The Urumea river is 56,91 km long from its source in a mountainous area of Ezkurra (695 m) to the city of Donostia-SanSebastian (capital of Gipuzkoa), its catchment has 272,4 km². Half the length of the river and one third of the total area of its basin are outside Gipuzkoa, in Nafarroa Urumea basin has two distinct parts: the highest part of the basin, with very little human occupation and the heavily modified and altered zone that begins in Hernani and extends to Astigarraga and its mouth in San Sebastian. The average slope of the main course is 1,26%, reaching 16,45% in higher areas. In some sections both the main course and minor components, especially in the upper basin has a high torrentiality (see Fig 1). The lower stretch of the river has wide and flat banks fit for crops and urban development, which has resulted in the most inhabited drainage basin in Gipuzkoa, (213.000 inhabitants). The main towns on the river are Hernani (19.700 inhabitants), with the first industrial estates upstream locating on its banks, Astigarraga (3.800), renowned for its cider houses, and a final long stretch snaking through different parts of Donostia-SanSebastian (186.500 inhabitants) (see Fig 1).

Is important to note that CCS gives compensation for the damages produced by Extraordinary Risks (natural phenomena and events of a political or social nature), on the condition of holding a policy in the field of damages to goods, or life and/or accidents, with any insurance company.. When giving compensation, the CCS will take into account the same goods, the same insured capital and any other conditions (first loss, compensation limits, etc.) established in this insurance policy for the aforementioned contingencies.

## Methodology

Original data consist on a excel file from CCS with accepted claims corresponding to "floods" for Basque Country during period 1996-2015. Information is structured in date, municipality, town, zip code, risk type and economic amount. Original data present gaps (void cells), different type of inhomogeneity (different names for same place or municipality, language, etc.), inconsistencies (in between zip code, location and municipalities) and errors (e.g. claims far away from littoral areas).

A derived data file is prepared after manual depuration of raw data solving most part of detected problems and extraction of claims for Urumea Basin area based on location information (zip codes and municipality). Data analysis is performed applying different techniques after segmentation of data in various categories considering type of affected property. Counting and statistics values are calculated focusing on #, €, D and M. Different R (R core Team 2013) and excel tools are used for depuration, data analysis, and reporting, including PivotTables and thematic maps.


## Discussion

The data analyzed correspond to the compensation of authorized claims for flood damages during the period 1996-2015 by the CCS. An amount of **99.760.000** euros (**€**) corresponding to **9.441** accepted claims (#) during **108** different **days** (D) with some degree of damage impact.

Damages are negligible in the Nafarroa part of the Basin, and are produced mainly in three different Gipuzkoan municipalities. **Donostia, Hernani** and **Astigarraga** registering 77% , 13% and 9% of #, corresponding to 72% , 9% and 19% of the economic amount (€) during 78, 35 and 43 days respectively. This is explained considering the particular characteristics of occupation, urban and industrial use of these areas. Remark the highest ratio of 23.000 €/# in **Hernani** as a consequence of relative influence of industrial damages in this area.

If we consider the type of damage, we found that **business** (shops, stores, warehouses, etc) account for 18% of # with a value of 35% of € produced during 52% of the days (56days). **Industrial** category account for 5% of #, 25% of € and 27% days (29), **civil works** 0.1% #, 2% € , 10% days (11), **offices** 2% #, 16% € for 14% days (15), **motor vehicles** 20% #, 6% €, 26% days (28), **housing** (homes and communities) 56% #,16% €,62 days (66). On average each # represents 10K€, 21K€ for business, 56K€ for industrial, 127€ for civil works, 91K€ for offices, 3K€ for vehicles and 3K€ for housing..

In **business** related claims (#) highlight a particular case for Donostia where more than 4.000K€ in damages where produced in a single reclamation during 01/06/1997 in a warehouse. In **Industrial** claims stand out Donostia during 01/06/1997 with two # for more than 4.000K€. In **civil works** case damages are registered just in Donostia mainly due to railways interventions and particularly for one episode in 01/06/1997 (1.000K€). Regarding with **offices**, two claims during same day account for more than 12.000 K€ also in Donostia (82%). In **motor vehicles** and **housing** remark again Donostia with 87% and 82% of # corresponds to 83% and 78% of € respectively.

Although during last twenty years damages are produced during 108 different days, just during 21 days damages are register for more than 100.000 €, and during 20 days with more than 10 #. Two particular days account for 72% of # and 83% of total €. During **01/06/1997** and **06/11/2011** the **45%** and **27% of** # and **53% and 30%** of € were produced respectively.

In relation to the type of damage and date when is produced, regarding **business** 37%, 17% and 13% of # and 47%, 28% and 4% of € are produced during 01/06/1997, 06/11/2011 and 25/0872002 days, respectively. In **industrial** case 47% and 30% of # and 44% and 45% of € during 01/06/1997 and 06/11/2011. For **civil works** all claims are produced in 11 days, highlighting 01/06/1997 day with 68%. In **offices** case 01/06/1997 account for 58% of # and 94% of €. In **vehicles** claims, 58% in 01/06/1997 and 30% 06/11/2011 . In **housing** 01/06/1997 stand out for 42% # and 36% € and 06/11/2011 for 30% # and 44% €.

In fig 8. we can see the monthly and yearly distributions of #,€ and D. Remark the effects od two most harmful episodes. In both case with a cut-off low in high levels. June episode driven by a MCS and intensity of precipitations, November case by a very active frontal event and persistent precipitations(see details on meteorological characterization in Egaña et al 2016 – POSTER H62: EMS2016-311).

| URUMEA BASIN : 1996-2015 | # | K€ | D | K€/# | K€/D | #/D |
|---|---|---|---|---|---|---|
| GIPUZKOA | 8.432 | 99.707 | 106 | 941 | 941 | 89 |
| ASTIGARRAGA | 1.213 | 8.928 | 43 | 208 | 208 | 29 |
| DONOSTIA-SANSEBASTIAN | 7.305 | 71.296 | 82 | 869 | 869 | 89 |
| HERNANI | 812 | 18.728 | 35 | 535 | 535 | 23 |
| URNIETA | 82 | 756 | 6 | 126 | 126 | 14 |
| NAFARROA | 9 | 52 | 6 | 9 | 9 | 2 |
| EZKURRA | 2 | 3 | 2 | 2 | 2 | 1 |
| GOIZUETA | 2 | 6 | 2 | 3 | 3 | 1 |
| LEITZA | 4 | 43 | 2 | 21 | 21 | 2 |
| ZUBIETA | 1 | 0 | 1 | 0 | 0 | 1 |
| TOTAL/MEAN | 9.441 | 99.760 | 108 | 924 | 924 | 87 |

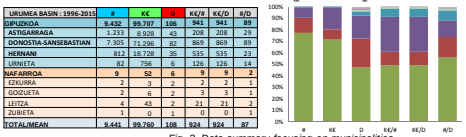



Fig 3. Data summary focusing on municipalities.

| 1996-2015 | # | K€ | D | K€/# | K€/D | #/D |
|---|---|---|---|---|---|---|
| BUSINESS | 1.705 | 35.114 | 57 | 21 | 616 | 30 |
| INDUSTRIAL | 442 | 24.516 | 29 | 55 | 845 | 15 |
| CIVIL WORK | 14 | 1.785 | 11 | 127 | 162 | 1 |
| OFFICES | 177 | 16.068 | 15 | 91 | 1.072 | 12 |
| MOTOR VEHICLES | 1.845 | 5.925 | 28 | 3 | 212 | 66 |
| HOUSING | 5.258 | 16.351 | 66 | 3 | 248 | 80 |
| MEAN | 1.574 | 16.627 | 34 | 11 | 484 | 34 |

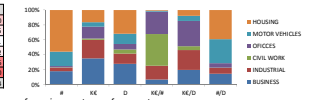



Fig 4. Data summary focusing on type of property.

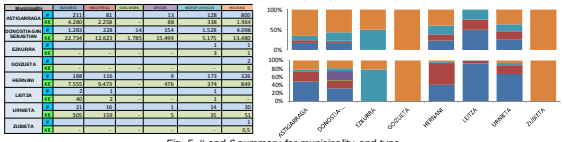



Fig 5. # and € summary for municipality and type.

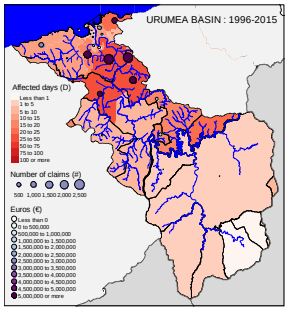



Fig 6. D, # and € detailed by zip code.

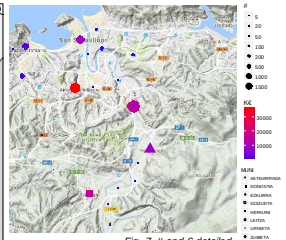


Fig 7. # and € detailed by district (when available) and municipality.

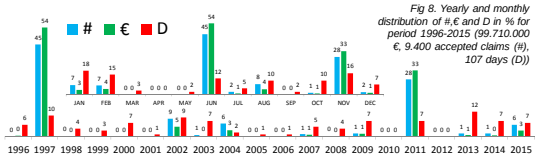



Fig 8. Yearly and monthly distribution of #,€ and D in % for period 1996-2015 (99.710.000 €, 9.400 accepted claims (#), 107 days (D))

## Remarks & conclusions

Flood damages and economic impact result from the interplay of complex societal and hydro-meteorological factors.

In this work insurance claims data are analyzed for a selected Basin in the Basque Country, with a high concentration of population and floods events. Urumea basin is representative of a small Cantabric river basin with high flood impact potential, Urumea river flows through very populated and industrial areas.

During last 20 years we have108 different days (D) with accepted claims, but just 21 days damages are register for more than 100.000 €, and during 20 days with more than 10 #. Two particular days account for 72% of # and 83% of total €.

The CCS data represent just a portion of the total economic impact. Mostly due to the different degree of penetration on insurance (density of the insurance and the economic value of the property is not the same in every area) and to different considerations inherent to the "extraordinary risk" compensation system (not all type of policy entitles to compensation and not all goods ,type of damages or causes are covered). Usually different rates are applied depending on type of property insurance (e.g. Housing 0.09 per thousand or certain civil works 1.95 per thousand).

In order to extract full conclusions about economic impact ,due to floods, using insurance claims data, many factors must be considered. Those affecting potential exposure to flood event, as physical characteristics (river flow, river side conditions, etc.), or socioeconomic aspects (distribution of human population and goods). Those affecting actions taken during episodes (early warning, dam operations, etc..). Those related with preventive measures applied, previous damages or even chance. And those related with the insurance politics and cultural aspects (characteristics and amount of the insured assets, compensation policies, etc,). All of this factors must be considered in a temporal perspective.

The direct use of number of accepted claims (#) and economic quantity (€ ) seems to be useful as a proxy of impact and extension of damages, particularly in the context of very severe events. But is not possible to use directly as a measure of total losses. .Number of accepted claims (#) can be used to characterize the extension of damages produced in a given event, better than €. Claims from Housing and Cars seems to be the better indication for extension of damages, especially during less severe episodes.

Although the raw claim data contain location information (zip code, municipality and city name), often presents inconsistencies . It would be useful to have georeferenced claims with exact location of damage. It would be very useful , especially when particular spatial aggregations are needed, as is the case for watershed/river damages studies.

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