RISCOS

ASSOCIAÇÃO PORTUGUESA DE RISCOS, PREVENÇÃO E SEGURANÇA

MULTIDIMENSÃO E TERRITÓRIOS DE RISCO

III Congresso Internacional
I Simpósio Ibero-Americano
VIII Encontro Nacional de Riscos

Guimarães

2014

MARINE STORMS AND COASTAL RISK ALONG THE GULF OF BISCAY AREA: WINTER 2014

Domingo F. Rasilla
Departamento de Geografía, Urbanismo y OT, Universidad de Cantabria
domingo.rasilla@unican.es

Carolina Garmendia
Departamento de Geografía, Urbanismo y OT, Universidad de Cantabria
carolina.garmendia@unican.es

Juan Carlos García-Codron
Departamento de Geografía, Urbanismo y OT, Universidad de Cantabria
garciaj@unican.es

Victoria Rivas
Departamento de Geografía, Urbanismo y OT, Universidad de Cantabria rivasv@unican.es

ABSTRACT

Coastal storms are one of the most remarkable natural risk affecting coastal areas, and climate change might enhanced the intensity and frequency of those extreme events. The Gulf of Biscay area show evidences of historical episodes of storminess which remarkable consequences upon natural environment and human activities. The use of coastal spaces has increased during the last decades worldwide, and the Northern coast of the Iberian Peninsula has followed the same trend, increasing the amount of elements at risk.
An outstanding episode of coastal storminess was suffered by the northern coast of the Iberian Peninsula experienced during the January-February period of 2014. Impacts on the coastal environment were spread.
A comprehensive analysis of oceanographic and meteorological data has been carried out to characterize the event and to place it in relation with the recent climate evolution of the Gulf of Biscay area.
Key words: marine storms, coastal risk, Gulf of Biscay.

Introduction

The coastal regions of Western Europe experienced, during the 2013-2014 winter, an outstanding episode of coastal storminess. The magnitude and extension of the impacts in countries like Ireland or the UK raised the interest of public, as reflected by the numerous Media entries. However, the effects of such stormy weather spread out through other regions, such as the northern coast of the Iberian Peninsula.

The objetive of this contribution is to characterize the event through the analysis of the impacts on the coastal environment and its oceanography and meteorological background, placing it in relation with the recent climate evolution of the area. For such purposes, a comprehensive analysis of oceanographic (tide gauges, buoys) and meteorological data (synoptic reports, a circulation pattern catalogue and a cyclone track database, both derived from NCEP/RENALYSIS data), plus an analysis of the damages through newpapers, insurance reports and official statistics was carried out.

Oceanographic and atmospheric background

The analysis of significant wave height from two bouys offshore the western and northern coast of Spain shows three episodes of severe storminess (Figure 1). An earlier period, from mid-December 2013 to early January 2014, affected specially to the galician coast. A second episode, encompassing the end of January and the beginning of February, was equally severe in both sectors. A final storm, during the night of March 3th-4th, was specially severe along the northern coast.

http://dx.doi.org/10.14195/978-989-96253-3-4_57

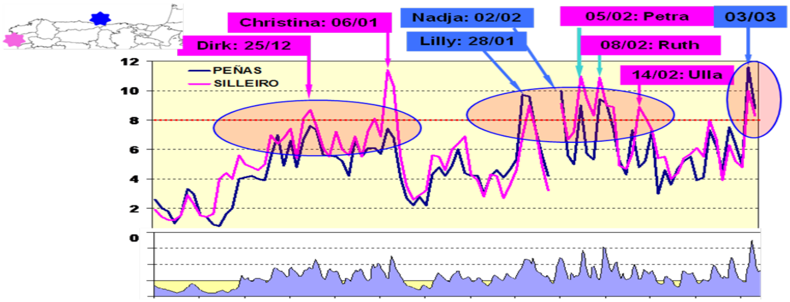

Figure 1: Maximum daily Significant Wave height from two buoys from December 1st 2013 to March 5th 2014. The 8 m SWH equals the long-term daily 95th percentile.

However, no previous wave records were broken during the winter, since SWH values, although close to 12 m, did not exceeded the record wave heights during storm Klaus (24/02/2009). Consequently, the excepcionality of the event resulted by the persistence of a high energetic, but not extreme, climate wave (Figure 2). It displays the seasonally (DJF) accumulated values of Hs^2, a comon measure of wave energy, derived from two wave models (Dodet et al, 2010), at the closest grid points to the city of Santander.
Besides waves, storm surges can help to rise sea beyond the normal levels. Nevertheless, as shown by figure 3, the surge values where moderated in comparison with examples from nearby coasts, where surges in excess of 1 m are common. Only when a coincidence exists between a large surge and a high tide a remarkable sea level rise can be possible, enhancing the probability of damages on the coast.

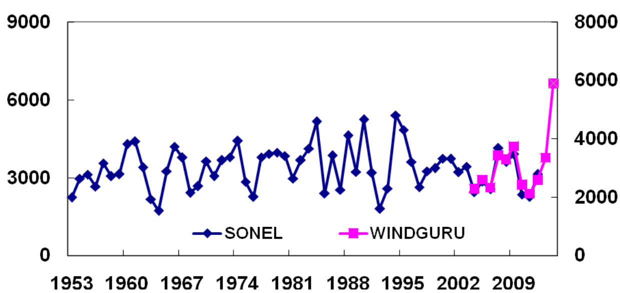

Figure 2: Wave energy evolution from two wave models (http://www.sonel.org/ and http://www.windguru.cz/).

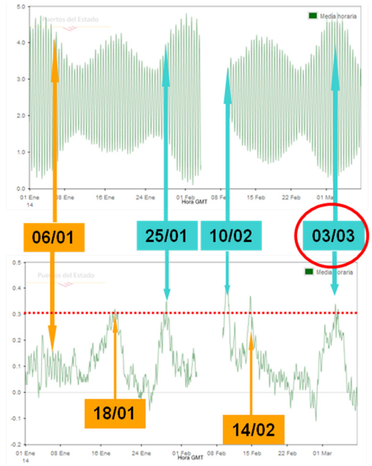

Figure 3: Sea level (upper panel) and non tidal residuals (surges, lower panel) measured in the tide gauge of Bilbao from January 1st to March 5th.

The analysis of the atmospheric conditions conductive to both wave storms and surges reveals subtle differences between both phenomena (Figure 4). Wave storms result from strong westerly winds blowing through a long fetch, developed around the equator side of deep lows crossing the British Islands. Conversely, anomalous surges coincide with lows crossing the Bay of Biscay.

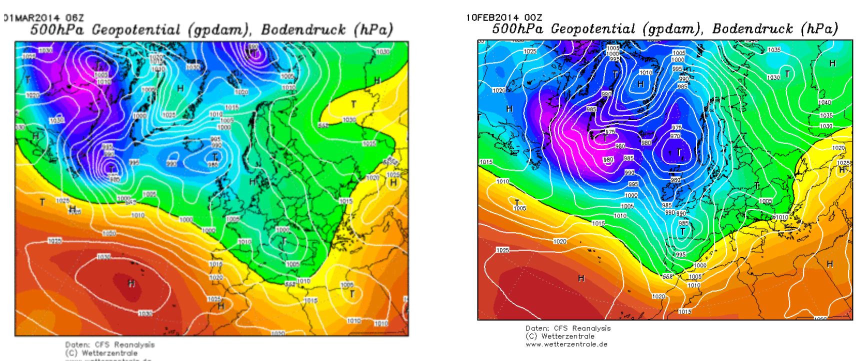

Figure 4: Sea level pressure maps corresponding to a severe wave storm (Christine, 03/03/2014) and an elevated surge (Stephanie, 18/02/2014). Source: www. wetterzentrale.de

Temporal and spatial pattern of damage

The impact of these stormy episodes on the coastal environment was remarkable since they affect both public and private property. Urban promenade seafronts and other coastal infrastructures were flooded and sediment remobilization ending into huge beach erosion.

Moreover, urban furniture, dwellings, commerces, and vehicles suffered generalized damages. In a first approach, a rough procedure to quantify the damage is to evaluate economical investment in rehabilitation of original conditions, beach nourishment and compensation of losses. The provisional budget was estimated in 40 million euros; by now, the investment undertaken by Public Insurance Office (CCS) and Spanish Coastal Authority (MAGRAMA) is reaching more than 70 million euros.

The monetary impact of storms has an unequal temporal and spatial distribution. The major amount corresponds to the one produced in February (figure 5), in all the regions of the studied area, and it is concentrate on the eastern end of the Cantabrian zone (figure 6) (63,5% only in the Basque Country littoral). Therefore, this analysis reveals that damage produced by coastal stroms do not only depend on the intensity of natural process (hazard) but also on the type of coast and the existing goods, that is, the elements at risk (exposition) and their vulnerability.

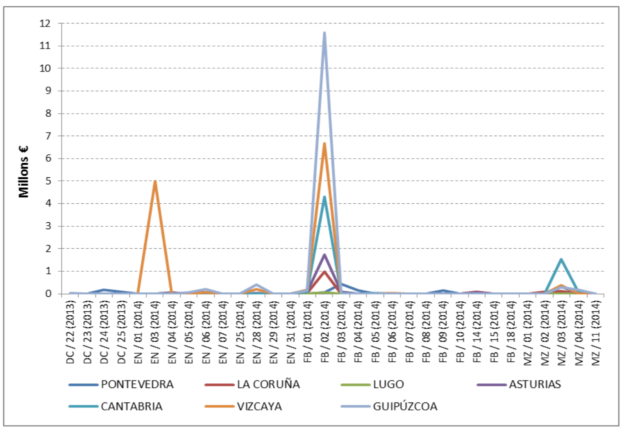

Figure 5.- Temporal distribution of investment in compensation of private losses (Public Insurance Office (CCS))

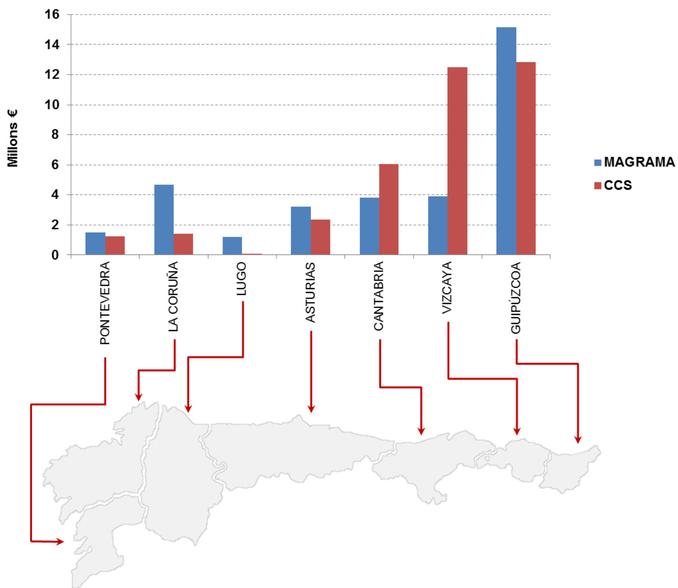

Figure 6.- Spatial pattern of economic losses (Public Insurance Office (CCS) and Spanish Coastal Authority (MAGRAMA))

A further, more precise analysis should have to consider the relationships between the magnitude of the storms with the main features of the shoreline: backshore land-use, number of potential beach visitors, population of the surroundings, and so on, and finally take into account the environmental non-market value of coastal areas.

Conclusion

The analysis of the oceanographic and atmospheric conditions associated with the 2013-2014 winter, as well as the impacts observed into the coast, shows that the whole episode was, indeed, remarkable. However, no extreme wind, wave or surge records were broken; instead, its exceptionality derived from the accumulation of energy during the whole period, characterized by the succession of storms. High seas (e.g. significant wave heights above 3 m) were persistent (almost 50 % of the time), pushed by strong westerly and northwesterly winds, conditions embedded into a long term trend of sea level rise in the Gulf of Biscay area.

More relevant for the future evolution of coastal landscapes is the long term trend rise of sea level. Analysis of tide gauges around our study area offers different values, depending on the area and period of analysis, but most of them coincide into an approximate value of 2 mm/yr (Marcos et al, 2005). Appling the well known Bruun rule (1962), such trend would result into an approximate beach retreat of 12 m.

Bibliografia

Bruun, P. (1962) - Sea level rise as a cause of shore erosion. *Journal of Waterways and Harbors Division*, ASCE 88, 117–130.

Consorcio de Compensación de Seguros (CCS) (2014) - *Notas informativas sobre los embates de mar producidos en los primeros días del mes de febrero de 2014 en la costa cantábrica y Galicia*. Ministerio de Economía y Competitividad, Gobierno de España, 4 de febrero y 3 de marzo de 2014. Consultado entre marzo y julio de 2014 en: http://www.consorseguros.es/web/le_n

Dirección General de Sostenibilidad de la Costa y del Mar. MAGRAMA. (2014) - *Plan Litoral. Obras de reparación por temporales*. Ministerio de Agricultura, Alimentación y Medio Ambiente, Gobierno de España. Consultado entre marzo y julio de 2014 en: http://www.magrama.gob.es/es/costas/temas/plan-litoral-obras-emergencia-temporales/default.aspx

Dodet, G.; Bertin, X. and Taborda, R. (2010) - Wave climate variability in the North-East Atlantic Ocean over the last six decades. *Ocean Modelling*, 31, p. 120-131.

Marcos, M.; Gomis, D.; Monserrat, S.; Álvarez-Fanjul, E.; Pérez, B. and García-Lafuente, J. (2005) - Consistency of long sealevel time series in the northern coast of Spain, *J. Geophys. Res.*, 110, C03008, doi:10.1029/2004JC002522.