

# How historical information can improve estimation and prediction of extreme coastal water levels

Thomas Bulteau, Déborah Idier, Jérôme Lambert, Manuel Garcin

► **To cite this version:**

Thomas Bulteau, Déborah Idier, Jérôme Lambert, Manuel Garcin. How historical information can improve estimation and prediction of extreme coastal water levels. AGU Fall meeting, American Geophysical Union, Dec 2016, San Fransisco, United States. hal-01363905

**HAL Id: hal-01363905**

**<https://hal-brgm.archives-ouvertes.fr/hal-01363905>**

Submitted on 12 Sep 2016

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

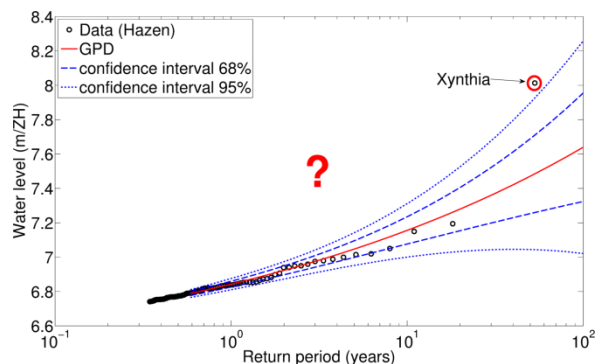
# How historical information can improve estimation and prediction of extreme coastal water levels

Thomas Bulteau<sup>1\*</sup>, Déborah Idier<sup>1</sup>, Jérôme Lambert<sup>1</sup>, Manuel Garcin<sup>1</sup>  
IBRGM, French Geological Survey, France  
\* [t.bulteau@brgm.fr](mailto:t.bulteau@brgm.fr)

**Key Words:** uncertainties; Bayesian analysis; Xynthia.

## Abstract:

The knowledge of extreme coastal water levels is useful for coastal flooding studies or the design of coastal defences. While deriving such extremes with standard analyses using tide gauge measurements, one often needs to deal with limited effective duration of observation which can result in large statistical uncertainties. This is even truer when one faces outliers, those particularly extreme values distant from the others. In a recent work (Bulteau et al., 2014), we investigated how historical information of past events reported in archives can reduce statistical uncertainties and relativize such outlying observations. We adapted to the specific case of coastal water levels a Bayesian Markov Chain Monte Carlo method initially developed in the hydrology field (Reis and Stedinger, 2005). We applied this method to the site of La Rochelle (France), where the storm Xynthia in 2010 generated a water level considered so far as an outlier. Based on 30 years of tide gauge measurements and 8 historical events, the results showed a significant decrease in statistical uncertainties on return levels when historical information is used. Also, Xynthia's water level no longer appeared as an outlier and we could have reasonably predicted the annual exceedance probability of that level beforehand (predictive probability for 2010 based on data till end of 2009 of the same order of magnitude as the standard estimative probability using data till end of 2010). Such results illustrate the usefulness of historical information in extreme value analyses of coastal water levels, as well as the relevance of the proposed method to integrate heterogeneous data in such analyses.



Classical extreme value analysis on La Rochelle tide gauge measurements. The outlying observation circled in red (Xynthia's observed water level) leads to large uncertainties on extreme return levels estimates.

## Reference:

Bulteau, T., Idier, D., Lambert, J., Garcin, M. (2015). How historical information can improve estimation and prediction of extreme coastal water levels: application to the Xynthia event at La Rochelle (France). *Nat. Hazards Earth Syst. Sci.*, 15, 1135-1147.  
Reis, D.S., Stedinger, J.R. (2005). Bayesian MCMC flood frequency analysis with historical information. *J. Hydrol.*, 313, 97-116.