Investigating coastal inundation using a Bayesian joint inversion of GPS, Tide gauges, and Satellite Altimetry

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Abstract

Determining the potential risks associated with sea inundation is of great importance for many coastal communities. The knowledge of rates of sea level variations is also of fundamental interest for many academic disciplines. Accurately estimating current rates of inundation at the regional scale is however complicated by the interacting contributions of many factors, at various temporal and spatial scales.

Since the 1990s, satellite altimetry provides a direct measurement of absolute sea level change, albeit with large uncertainties near coastlines owing to near shore wave heights. In order to access variations of relative sea level, the measurement of the absolute vertical land motion is required as a reference frame and can be obtained from GPS observations. While tide gauges measure directly the relative sea level change at local stations, these suffer from a strong heterogeneity in terms of density of stations as well as the length of the time series. The signal is also affected by strong seasonal influences as well as local effects, sometimes of anthropogenic origin.

In order to better constrain estimates of potential sea level inundation, we have developed a Bayesian technique for the joint inversion of tide gauges, land based GPS stations, and satellite altimetry measurements of sea level.

We will show the results of cross-validation of these differing observations, in addition to the benefits for constraining coastal sea

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level rise obtained through joint inversion of these observations. We will demonstrate regional case studies in Europe, North America, and South East Asia. Our results show that by combining estimates of sea level rise and land uplift, predictions are less influenced by problematic tide gauges and the estimates of coastal sea level rise are generally more spatially smooth and perhaps more representative of broader regional inundation risks.