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Satellite-calibrated modelling of wave set up and run up on cliffs: a validation on the West coast of France

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During severe storms, big cyclopean blocks weighting over 6 tons have been observed to move from the top of the western cliff of Bannec Island (West Coast of France), at an elevation 4 m above the highest astronomical tide. This uninhabited island is regularly flooded by the same events, in spite of a high elevation on the exposed coastline.

A field experiment was set up in the winter 2008-2009, and extreme water levels were recorded (4 m set-up and over 7 m run-up). Although these are the largest ever recorded surge levels on the French coast, these are not unexpected given the steep slope of the cliff, which is close to 1 on 1. An unstructured high resolution model of the west coast of France, was developed and calibrated over the period 2003-2010 using altimeter data from ERS, JASON, ENVISAT and GFO. A particular attention was paid to to very large wave heights (Hs > 12 m).

The wave model is verified locally and the computed Hunt parameter (sqrt(g*Hs)*Tm01) is found to correlate very well with run-up levels recorded on the cliff ($r > 0.94$). This good correlation is used to reconstruct the forcing for past events for which local measurements are not available. The long time series of altimeter data is critical for the calibration of past storms because the ECMWF analyzed winds used to force the wave model have a time-dependent bias.