Spatial and Temporal Wave Variability at the Basque Coast: From wave energy at regional scales to runup of individual waves

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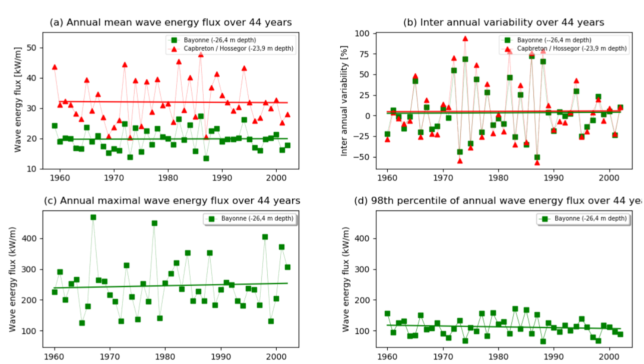
The Basque Coast, located in the southeastern corner of the Bay of Biscay, is subject to a highly variable wave regime - both spatially and temporally. Accurate computations of the nearshore wave processes are often necessary to improve coastal risk management and to assess the local potential for wave energy exploitation.

Here, we pay attention to the variability of the local wave regime computed from offshore to nearshore and up to the beach level. The third generation spectral wave model SWAN builds a 44-year wave hindcast over the South Aquitaine coastal area and consequently describes the spatio-temporal variability of the wave climate. Especially near steep bathymetric features, such as the Capbreton submarine canyon, pronounced longshore gradients become evident. Regarding the temporal variability, some seasonal variability is observed but no significant long-term trend of an inter-annual variability can be identified.

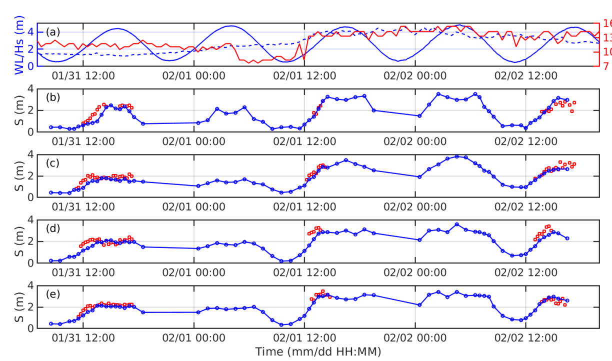
Wave breaking can induce critical loads on offshore structures. This work also focuses on wave-load estimations based on bulk parameters from a simplified wave breaking probability to characterize the survivability of wave energy converts. This facilitates operational planning and identification of potential sites for the installation of devices.

The use of phase-resolving models is becoming increasingly popular when focusing on small spatial scales and complex environments such as embayed beaches, where features such as rocky islands or engineered shorelines influence the wave regime. Here, the BOSZ model is utilized to compute wave-by-wave transformations and swash zone processes in the complex environment of Grande Plage of Biarritz. Comparisons with field data show that the model is able to reproduce the overall cross-shore wave transformations as well as swash processes with low errors under a wide range of conditions (tide levels and wave conditions). Both the temporal and spatial variability of the swash are well captured by the model.

Spectral analyses highlight that the significant swash height computed for high frequencies ($f \geq 0.05$ Hz) contains the highest variability and also shows strong sensitivity to the wave conditions. Based on numerical data, it appears that the nearshore morphology plays a key role in the distribution of wave energy at a local scale and strongly influences the alongshore distribution of the runup.



Wave energy variability in South West France computed by a 44-year SWAN hindcast.



Top panel: Wave conditions during a field campaign. Lower panels: Significant swash height observed (red) and computed (blue) at four longshore locations.