Probabilistic forecast of coastal waves and total water level for flood warning applications at Reunion Island (Indian Ocean)

Lecacheux S [1], Bonnardot F. [2], Paris F. [1], Rousseau M. [1], Pedreros R. [1], Nicolae-Lerma A. [1], Quetelard H. [2], Barbary D [2].

[1] BRGM, 3 avenue Claude Guillemin 45060 Orléans, France. s.lecacheux@brgm.fr, f.paris@brgm.fr, m.rousseau@brgm.fr, r.pedreros@brgm.fr, a.nicolaelerma@brgm.fr.

[2] Direction Régionale de Météo-France Océan-Indien, 50 boulevard du Chaudron, 97540 Sainte-Clotilde. francois.bonnardot@meteo.fr, hubert.quetelard@meteo.fr, david.barbary@meteo.fr

Reunion being an isolated island, the coastal impacts of tropical cyclones transiting nearby is tightly related to the relative position of the track and the wind intensity. Thus, the forecast of cyclone-induced waves and water level with 48-72h lead-time should be conducted in a probabilistic manner.

Using ensemble tracks and intensity forecasts developed by Quetelard et al. (2017), the method developed in this study is based on 3 steps:

(1) Considering that the use of parametric models lead to an underestimation of wave heights distant from the cyclone eye, the vortex is bogused into the large scale wind field provided by ECMWF's IFS model for each track and time step. A short simulation is run with Meso-NH model so that it can balance with the large scale conditions.

(2) For waves and water level, an optimized chain of classical wave and surge models (Wavewatch3 and MARS2DH) was implemented from 10km to 100m resolution at the coast.

(3) Finally, a method was developed to compute efficiently wave-induced setup at 10m resolution all around the island. It is based on a delimitation of homogeneous coastline segments (regarding on morphological and exposition criteria) and simulations of setup for each segment with 1D cross-shore profiles of SWAN model.

This chain was tested for 3 historical cyclones (Bejisa, Dumile and Felleng). Forecasts were produced every 6 hours from 72h to 24h before the cyclone's closest position from the island. The computation of different scores (Brier, Continuous Rank probability, ROC curves) and the comparison with measurements enable to conclude that such forecasts upgrade the precision and the level of information compared to present deterministic forecasts. Perspectives of different kinds of exploitation of the results for flood warning applications are also investigated.

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