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Methodology for filling gaps and forecast in sea level: Applications to the eastern English Channel and the North Atlantic Sea (western France)

Imen TURKI (1), Benoit LAIGNEL (2), Nabil KAKEH (3), Laetitia CHEVALIER (4), and Stephane COSTA (5)

(1) UMR CNRS 6143 Continental and Coastal Morphodynamics'M2C' University of Rouen, 76821 Mont-Saint-Aignan Cedex, France., (2) UMR CNRS 6143 Continental and Coastal Morphodynamics'M2C' University of Rouen, 76821 Mont-Saint-Aignan Cedex, France., (3) Environmental Hydraulics Institute 'IH Cantabria', University of Cantabria, c/Isabel Torres 15, 39011 Santander, Spain., (4) UMR CNRS 6143 Continental and Coastal Morphodynamics'M2C' University of Rouen, 76821 Mont-Saint-Aignan Cedex, France., (5) University of Caen Low Normandy, Geophen UMR-CNRS LETG 6554, France.

This research was carried out in the framework of the program Surface Water and Ocean Topography (SWOT) which is a partnership between NASA and CNES. Sea level is a key variable in marine, climate, and coastal process studies. In this research, a new methodology was implemented for filling gaps and forecasting the sea level by combining classical harmonic models to high statistical methods. In agreement with previous studies, this work indicates that sea level heights are correlated to climate conditions of sea level pressures (SLP). After averaging out surface waves from the mean sea level, the deterministic tides and the stochastic processes of residual surges were investigated using classical harmonic analyses and a statistical model of autoregressive moving average (ARMA), respectively. The estimation of the residual surges was also investigated together with the SLP. This new methodology was applied to the Atlantic sea and the eastern English Channel (western France). Results have shown that the developed model reproduces the observations with RMSE of 4.5 cm and 7 cm for 12 days and 30 days of gaps, respectively. For medium scales of 6 months, the RMSE reaches 9,2 cm. Larger scales more than 10 months were also statistically reproduced. Accordingly, the proposed model seems to be more promising for filling gaps and estimating the sea level at short- to large- time scales. This new methodology presents a coherent, simple, and easy tool to estimate the deterministic nature of tidal processes and the stochastic framework of residual surges.
Key words: sea level forecast, astronomical tides, residual surges, ARMA, sea level pressure.