Multiscale analysis of water level time series and surge-water level interactions

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We consider here water level time series recorded in the Eastern English Channel and the North sea by the SHOM (Service Hydrographique et Oceanographique de la Marine, France) in the ports of Boulogne-sur-mer, Calais and Dunkerque, every hour from 1956 to 2010. Water level is a complex quantity, influenced by deterministic astronomic forcing (tides, daily cycle, etc.) and also by stochastic forcing: water temperature, atmospheric pressure, turbulence. The deterministic forcing are strong and can be used to reconstruct synthetic water level predictions, also provided hourly by the SHOM. Stochastic forcing exist at all scales from minutes to centuries. Here we use the 2 datasets (measurements and model reconstruction) to explore their statistical and dynamical properties. We consider return times statistics for different water level thresholds. We show that the measured time series has some scaling properties (between day and year) that are not shown by the synthetic series, indicating that this is a signature of the stochastic forcing.

By considering conditional statistics, we also show that there are some interactions between surge statistics and water level data. This indicates that surge (either positive or negative) are not independent of the water level information, showing that predictions of water level can be improved if such relation is taken into account.