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Long-term evolution of sea level probability in large ungauged areas

Fernando J. Mendez, Roberto Minguez, Ana J. Abascal, Sonia Castanedo, and Inigo J. Losada
Environmental Hydraulic Institute. Universidad de Cantabria, Santander, Spain (mendezf@unican.es)

Coastal zones are particularly vulnerable to climate variability and change. One of the major concerns is sea level rise and how climate change effects will vary by region, and over time. A key issue within risk assessment methods in coastal areas is the characterization of sea level, i.e., the probability distribution of sea level in a given horizon year. The observed hourly sea level, after averaging out surface waves, has three components: mean sea level, tidal level, and surge level. Mean sea level and surge levels are stochastic variables whereas tidal level is deterministic. In this work, we make use of the recent state-of-the-art data bases and statistical methodologies to obtain reliable long-term trends of the statistical distribution of (i) monthly mean sea level; and (ii) hourly sea level. The work focuses on Southamerica, a large area which is practically ungauged.

The analysis is based on 1950-2009 monthly mean sea level series of a global 1ºx1º gridded-data set from instrumental data (tidal gauges in the period 1950-2001 and satellite in the period 1993-2009), which are used to characterize: a) long-term global-average trends, which can be projected locally using the Trend-EOF technique, and b) the de-trended data local anomalies (residuals). Using the obtained trends, hourly tidal time series from TOPEX data base and hourly surge level from a barotropic sea level reanalysis (ROMS model, 0.25º spatial resolution, forcing: NCEP/NCAR atmospheric reanalysis), it is possible to determine the probability of exceeding different sea level thresholds on different sites for a given horizon year. The method is especially suitable to be integrated within risk assessment frameworks to study local consequences on sea level rise at a particular site.