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Implementing algorithms for modelling and prediction of sea level change using threshold models

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The aim of this work is to present how threshold time series models can be used to model sea level change recorded in gridded time series data and to predict such time-varying maps. This task is carried out mostly in R, the Language and Environment, using satellite altimetric gridded time series from the Archiving, Validation and Interpretation of Satellite Oceanographic data (AVISO).

During El Niño/Southern Oscillation (ENSO) warm and cold episodes sea level anomalies exceed certain thresholds, principally in the equatorial Pacific and in the tropical Indian Ocean. This encourages to use threshold autoregressive models to predict sea level change, particularly in the aforementioned locations. It is likely, however, that during the ENSO mode one should use the models which differ from those suitable for normal environmental conditions. Associated with this is a notion of threshold that allows one to determine various models if a certain limit value is attained or exceeded.

Firstly, having the global mean sea level anomaly data spanning the time interval from 1992 onwards, available courtesy of AVISO, the autoregressive threshold model is fitted in R. Subsequently, the global mean sea level change univariate time series is forecasted, and various lead times are adopted. Secondly, based on the gridded delayed-time data as well as their near-real time equivalents provided by AVISO, predictions of sea level change determined as a function of latitude and longitude, and with various lead times, are produced. Due to the fact, that the near-real time data are being automatically updated at the local server in Wroclaw, Poland, it is possible to generate new predictions every day automatically.

Such a forecasting process, which intrinsically involves the automated verification and quality control modules, is based on the above-mentioned threshold models as well as polynomial-harmonic deterministic empirical functions.