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Characterization of extreme sea level at the European coast

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Extreme high sea levels arise as a combination of storm surges and particular high tides events. Future climate simulations not only project changes in the atmospheric circulation, which induces changes in the wind conditions, but also an increase in the global mean sea level by thermal expansion and ice melting. Such changes increase the risk of coastal flooding, which represents a possible hazard for human activities. Therefore, it is important to investigate the pattern of sea level variability and long-term trends at coastal areas.

In order to analyze further extreme sea level events at the European coast in the future climate projections, a new setup for the global ocean model MPIOM coupled with the regional atmosphere model REMO is prepared. The MPIOM irregular grid has enhanced resolution in the European region to resolve the North and the Mediterranean Seas (up to 11 x 11 km at the North Sea). The ocean model includes as well the full luni-solar ephemeridic tidal potential for tides simulation.

To simulate the air-sea interaction, the regional atmospheric model REMO is interactively coupled to the ocean model over Europe. Such region corresponds to the EuroCORDEX domain with a 50 x 50 km resolution. Besides the standard fluxes of heat, mass (freshwater), momentum and turbulent energy input, the ocean model is also forced with sea level pressure, in order to be able to capture the full variation of sea level. The hydrological budget within the study domain is closed using a hydrological discharge model. With this model, simulations for present climate and future climate scenarios are carried out to study transient changes on the sea level and extreme events.

As a first step, two simulations (coupled and uncoupled ocean) driven by reanalysis data (ERA40) have been conducted. They are used as reference runs to evaluate the climate projection simulations. For selected locations at the coast side, time series of sea level are separated on its different components: tides, short time atmospheric process influence (1-30 days), seasonal cycle and interannual variability. Every sea level component is statistically compared with data from local tide gauges.