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Future relative sea level for the Mediterranean Sea: ensemble projections combining terrestrial ice melt, high resolution steric effects, tectonic, and glacial isostatic adjustment

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Climate change-induced variations in local sea level are expected to expose coastal areas to increased risks of extreme flooding and erosion, threatening the health and well-being of inhabitants and damaging coastal ecosystems. Predicting relative sea level rise at the local level is an extremely complex task, as such process is the result of the interaction of a variety of factors occurring on a wide range of temporal and spatial scales. Furthermore, actual impacts on coastal areas crucially depend on the occasional superposition on long-period trends of transitory fluctuations or exceptional extreme events, whose frequency and relative contribution are hard to project under muted climate conditions. The Mediterranean Sea is expected to be particularly vulnerable to future sea level rise, also due to the high population density along its coasts. Its geography and physical characteristics demand specific treatment of local, high-resolution features, while its connection with the Atlantic Ocean correlate local responses to the global scale. Future sea levels in the Mediterranean Sea are affected by long-term vertical tectonic movement, glacial isostatic adjustment (GIA) in response to the melting of the late-Pleistocene ice sheets, and by the elastic contribution of present melting (PM) of ice sheets, glaciers and ice caps. In addition, rising water temperatures and altered salinity are expected to induce steric variations in water volumes, a major component of sea level projections in the Mediterranean. In this work, GIA and PM have been modelled numerically by an updated version of the code SELEN, in which rotational feedbacks on sea level, migration of shorelines and time variations of the ocean function have been taken into account. The Sea Level Equation is complemented by regional ocean simulations of the Mediterranean circulation. For GIA we consider the recent ICE-6G(VM5a, Peltier et al., 2015) and the model progressively developed by Kurt Lambeck and collaborators (Purcell et al., 2016).
The contribution from on-going ice melting is derived from two different IPCC scenarios (RCP4.5 and RCP8.5), and the mass balances are taken from Slangen et al. (2004). The regional ocean model MedMIT16 (Sannino et al. 2015), forced by the state-of-the-art regional atmospheric climate scenarios made available by the EURO-CORDEX Program, provides the information needed to compute the high-resolution steric component as well as the regional impact of the incoming Atlantic flow through the Gibraltar Strait.