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TITLE: Mediterranean Sea response to climate change in an ensemble of twenty first century scenarios

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ABSTRACT:

The Mediterranean climate is expected to become warmer and drier during the twenty-first century. Mediterranean Sea response to climate change could be modulated by the choice of the socio-economic scenario as well as the choice of the boundary conditions mainly the Atlantic hydrography, the river runoff and the atmospheric fluxes. To assess and quantify the sensitivity of the Mediterranean Sea to the twenty-first century climate change, a set of numerical experiments was carried out with the regional ocean model NEMOMED8 set up for the Mediterranean Sea. The model is forced by air?sea fluxes derived from the regional climate model ARPEGE-Climate at a 50-km horizontal resolution. Historical simulations representing the climate of the period 1961?2000 were run to obtain a reference state. From this baseline, various sensitivity experiments were performed for the period 2001?2099, following different socio-economic scenarios based on the Special Report on Emissions Scenarios. For the A2 scenario, the main three boundary forcings (river runoff, near-Atlantic water hydrography and air?sea fluxes) were changed one by one to better identify the role of each forcing in the way the ocean responds to climate change. In two additional simulations (A1B, B1), the scenario is changed, allowing to quantify the socio-economic uncertainty. Our 6-member scenario simulations display a warming and saltening of the Mediterranean. For the 2070?2099 period compared to 1961?1990, the sea surface temperature anomalies range from +1.73 to +2.97 °C and the SSS anomalies spread from +0.48 to +0.89. In most of the cases, we found that the future Mediterranean thermohaline circulation (MTHC) tends to reach a situation similar to the eastern Mediterranean Transient. However, this response is varying depending on the chosen boundary conditions and socio-economic scenarios. Our numerical experiments suggest that the choice of the near-Atlantic surface water evolution, which is very uncertain in General Circulation Models, has the largest impact on the evolution of the Mediterranean water masses, followed by the choice of the socio-economic scenario. The choice of river runoff and atmospheric forcing both have a smaller impact. The state of the MTHC during the historical period is found to have a large influence on the transfer of surface anomalies toward depth. Besides, subsurface currents are substantially modified in the Ionian Sea and the Balearic region. Finally, the response of thermosteric sea level ranges from +34 to +49 cm (2070?2099 vs. 1961?1990), mainly depending on the Atlantic forcing.

SOURCE: Climate dynamics

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