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# Modelling the Mediterranean sea over the last 40 years using high resolution dynamical downscaling of the ERA40 reanalysis

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The Mediterranean Sea is known to show a high interannual variability in terms of air-sea fluxes, deep water formation, surface circulation and other physical processes. It also experiences decadal variability as proved by the Eastern Mediterranean Transient event and the existence of long-term trends in the deep layers with an increase in temperature and salinity. Therefore simulating and understanding the evolution of the Mediterranean Sea over the last decades can be considered as quite a challenging task for the ocean and climate modelling community. Achieving such a goal requires to work with high resolution models forced by a high resolution atmospheric forcing that follows the observed chronology. In agreement with this statement, we performed a dynamical downscaling of the ERA40 reanalysis with the ARPEGE-Climate model (Atmosphere General Circulation Model with a stretched grid) in order to obtain a better resolution over the Mediterranean area. In this configuration, ARPEGE-Climate was focused on the area of interest (50 km horizontal resolution over the Mediterranean Sea) and driven by the ERA40's large scales through a spectral nudging method. A 40-year long simulation (1961-2000) was carried out with this method. The air-sea fluxes (radiative and turbulent fluxes) were extracted from this simulation and then used to force a Mediterranean version of the OPA model whose horizontal resolution reaches about 10 km. The surface temperature relaxation was computed using the ERA40 SST dataset. Climatological river runoff fluxes along with an additive constant correction were applied to make the water budget realistic. However, no surface salinity relaxation was applied letting free the spatial and temporal variability of this field. This simulation enables us to study the interannual variability and the trends of various physical processes in the Mediterranean basin such as the formation of the

main Mediterranean water masses (LIW, EMDW, WMDW). Among them, it is worth noting that the dynamical downscaling of the air-sea fluxes improved the modelling of the WMDW formation. Besides, the temporal evolution of the heat content as well as of the Eastern Mediterranean Transient are well represented. This simulation can be considered as a first step towards a 40-year reanalysis of the Mediterranean Sea in which only realistic air-sea fluxes and SST would be imposed. In the future, improvements should be done in the choice of the initial conditions, in data assimilation and also in taken into account the interannual variability of all the forcings (river runoff fluxes, Atlantic characteristics).