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# The Regional Earth System Model (RegESM) using RegCM4 coupled with the MITgcm ocean model: First assessments over the MED-CORDEX domain

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In the framework of global climate studies, there is an increasingly growing concern about the vulnerability of the Mediterranean region, where high population density and intense exploitation activities pose severe questions on the sustainability of terrestrial water management, both for the present and the future. Ocean modeling studies suggest that the Mediterranean thermohaline circulation could be weakened in conditions of global greenhouse warming, an event which would undoubtedly affect regional climate, possibly triggering global feedback processes. Experiments with the atmosphere-ocean coupled system confirmed that a good comprehension of Mediterranean processes requires the explicit inclusion of the feedbacks between the atmospheric and the oceanic components, thus achieving a complete, fully coupled description of the Mediterranean hydrological cycle, at the same time gaining new insights in our current ability to reproduce the atmospheric hydrological processes and to close the hydrological balance. These issues are addressed by the upgraded PROTHEUS system which was jointly developed by ENEA and ICTP.
Here we present a first evaluation of the performances of the new PROTHEUS system (called PROTHEUS 2.0) composed by the regional climate model RegCM4 (Giorgi et al. 2012) coupled with both the ocean model MITgcm (Marshall J. et al. 1997a,b) and the HD river model (Max-Planck's HD model; Hagemann and Dümenil, 1998) using RegESM (Regional Earth System Model) as a driver.
The three-component (atmosphere, ocean and river routing) fully coupled model exchanges sea surface temperature (SST) from the ocean to the atmospheric model, surface wind stress, energy and freshwater fluxes from the atmosphere to the ocean model, surface and sub-surface runoff from the atmospheric component to the river routing model (Max-Planck's HD model; Hagemann and Dümenil, 1998). In order to have water conservation within the system, the river routing component sends the calculated river discharges to the ocean model.
The evaluation is presented for the MED-CORDEX region using three simulations: the first one uses the regional climate model RegCM4 driven by the perfect boundary conditions provided by ERA-Interim and prescribed SST; the second one is performed only with the ocean component driven by a downscaled ERA-Interim data; and the third one is performed with the fully coupled modeling system (RegCM4 ,MITgcm and HD).