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Inter-annual variability of the Mediterranean thermohaline circulation in Med-CORDEX simulations

Maria Vittoria Struglia (1), Mario Adani (2), Adriana Carillo (1), Giovanna Pisacane (1), Gianmaria Sannino (1), Jonathan Beuvier (3), Tomas Lovato (4), Florence Sevault (5), and Vassilios Vervatis (3)

(1) ENEA - CLIM Lab, Rome,Italy (mariavittoria.struglia@enea.it), (2) ENEA - INAT Lab, Bologna, Italy, (3) Mercator Océan, Ramonville St-Agne, France, (4) Fondazione CMCC - ODA division, Bologna, Italy, (5) CNRM Météo-France, Toulouse, France

Recent atmospheric reanalysis products, such as ERA40 and ERA-interim, and their regional dynamical downscaling prompted the HyMeX/Med-CORDEX community to perform hind-cast simulations of the Mediterranean Sea, giving the opportunity to evaluate the response of different ocean models to a realistic inter-annual atmospheric forcing. Ocean numerical modeling studies have been steadily improving over the last decade through hind-cast processing, and are complementary to observations in studying the relative importance of the mechanisms playing a role in ocean variability, either external forcing or internal ocean variability.
This work presents a review and an inter-comparison of the most recent hind-cast simulations of the Mediterranean Sea Circulation, produced in the framework of the Med-CORDEX initiative, at resolutions spanning from 1/8° to 1/16°. The richness of the simulations available for this study is exploited to address the effects of increasing resolution, both of models and forcing, the initialization procedure, and the prescription of the atmospheric boundary conditions, which are particularly relevant in order to model a realistic THC, in the perspective of fully coupled regional ocean-atmosphere models.
The mean circulation is well reproduced by all the simulations. However, it can be observed that the horizontal resolution of both atmospheric forcing and ocean model plays a fundamental role in the reproduction of some specific features of both sub-basins and important differences can be observed among low and high resolution atmosphere forcing. We analyze the mean circulation on both the long-term and decadal time scale, and the represented inter-annual variability of intermediate and deep water mass formation processes in both the Eastern and Western sub-basins, finding that models agree with observations in correspondence of specific events, such as the 1992-1993 Eastern Mediterranean Transient, and the 2005-2006 event in the Gulf of Lion.
Long-term trends of the hydrological properties have been investigated at sub-basin scale and have been interpreted in terms of response to forcing and boundary conditions, detectable differences resulting mainly due either to the different initialization and spin up procedure or to the different prescription of Atlantic boundary conditions.