Geophysical Research Abstracts
Vol. 17, EGU2015-12826, 2015
EGU General Assembly 2015

The Mediterranean interannual variability in MEDRYS, a Mediterranean Sea reanalysis over 1992-2013

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The French research community on the Mediterranean Sea and the French operational ocean forecasting center Mercator Océan are gathering their skills and expertises in physical oceanography, ocean modelling, atmospheric forcings and data assimilation, to carry out a MEDiterranean Sea ReanalYsiS (MEDRYS) at high resolution for the period 1992-2013. The reanalysis is used to have a realistic description of the ocean state over the recent decades and it will help to understand the long-term water cycle over the Mediterranean basin in terms of variability and trends, contributing thus to the HyMeX international program.
The ocean model used is NEMOMED12 [Lebeaupin Brossier et al., 2011, Oc. Mod., 2012, Oc. Mod.; Beuvier et al., 2012a, JGR, 2012b, Mercator Newsl.], a Mediterranean configuration of NEMO [Madec and the NEMO Team, 2008], with a 1/12° (about 7 km) horizontal resolution and 75 vertical z-levels with partial steps. It is forced by the 3-hourly atmospheric fluxes coming from an ALADIN-Climate simulation at 12 km of resolution [Herrmann et al., 2011, NHESS], driven by the ERA-Interim atmospheric reanalysis. The exchanges with the Atlantic Ocean are performed through a buffer zone, with a damping on 3D theta-S and on sea level towards the ORA-S4 oceanic reanalysis [Balmaseda et al., 2012, QJRMS]. This model configuration is used to carry a 34-year free simulation over the period 1979-2013. This free simulation is the initial state of the reanalysis in October 1992. It is also used to compute anomalies from which the data assimilation scheme derives required characteristic covariances of the ocean model.
MEDRYS1 uses the current Mercator Océan operational data assimilation system [Lellouche et al., 2013, Oc.Sci.]. It uses a reduced order Kalman filter with a 3D multivariate modal decomposition of the forecast error. A 3D-Var scheme corrects biases in temperature and salinity for the slowly evolving large-scale. In addition, some modifications dedicated to the Mediterranean area (more specific Post-Glacial-Rebound corrections, new model-equivalent for the Sea Level Anomaly for example) have been introduced. Temperature and salinity vertical profiles from the newly released CORA4 database, altimeter data and satellite SST and are jointly assimilated. Thus, the reanalysis benefits from the intensive observational field campaigns carried out during the HyMeX Special Observation Periods (SOPs) in fall 2012 and winter 2013 in the north-western Mediterranean Sea.
We assess here the ability of a MEDRYS1 to reproduce the general circulation and the water masses in the Mediterranean Sea. We present the misfit between the reanalysis and the assimilated observations, as well as differences between the reanalysis and its twin free simulation. We show diagnostics on the surface circulation variability, heat and salt contents and deep water formation over the whole period of the reanalysis, with also a focus on the impact of the HyMeX data during the SOPs time period.