NEW VERSION OF MEDRYS, A MEDITERRANEAN SEA REANALYSIS DURING 1992-2013

J. Beuvier [1]*, M. Hamon [2], E. Greiner [3], M. Drévillon [2] and J. Lellouche [2]
[1] Mercator Océan / Météo-France - jonathan.beuvier@mercator-ocean.fr
[2] Mercator Océan
[3] CLS

Abstract

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 helps to understand the long-term water cycle over the Mediterranean basin in terms of variability and trends. This work describes the latest version of MEDRYS and its main results.

Keywords: Mediterranean Sea, Circulation models, Hydrography, Water convection

In this study, we use the regional ocean model NEMOMED12 [1], a Mediterranean configuration of NEMO [2], with a 1/12° (~ 7 km) horizontal resolution and 75 vertical z-levels with partial steps. At the sea surface, it is forced by a new atmospheric forcing dataset (ALDERA, [3]), coming from a dynamical downscaling of the ERA-Interim atmospheric reanalysis by the regional climate model ALADIN-Climate with 12-km horizontal and 3-hour temporal resolutions. The exchanges with the Atlantic Ocean are performed through a buffer zone, with a damping on 3D T-S and on sea level towards the ORA-S4 oceanic reanalysis [4]. This model configuration is used to carry a 34-year free simulation over the period 1979-2013. The reanalysis starts in October 1992 from the state of the free run at this date, and ends in June 2013.

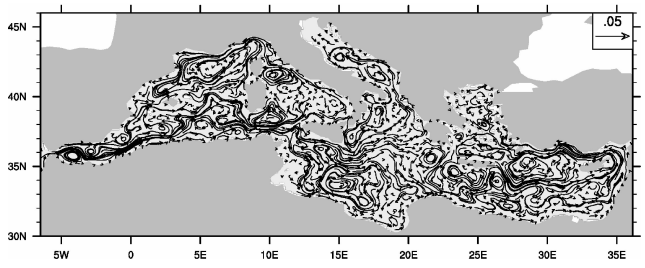

Fig. 1. Circulation at 40m-depth for MEDRYS, in average over 1993-2012; the reference arrow corresponds to 0.05 $m.s^{-1}$.

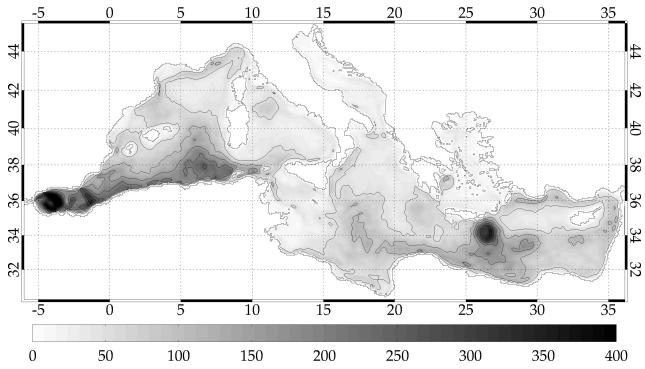

Fig. 2. Eddy Kinetic Energy (EKE, in $cm^2.s^{-2}$; contour every 50 $cm^2.s^{-2}$) at 40m-depth, for MEDRYS, in average over 1993-2012.

MEDRYS [3] uses the current Mercator Océan operational data assimilation system [5]. 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 this new version of MEDRYS, some modifications dedicated to the Mediterranean area (shorter analysis cycle, specific Mean Sea Surface Height field, new model-equivalent for the Sea Level Anomaly for example) have been introduced. Temperature and salinity vertical profiles from the newly released CORA4.1 database [6], altimeter data from AVISO and satellite SST [7] are jointly assimilated.

Regarding the heat and salt contents, and with respect to reference observational gridded products, the latest version of the reanalysis displays on average no bias in the surface (<0.01 psu and <0.3°C) and intermediate layers (<0.02 psu and <0.04°C), with well reproduced interannual variations. Only the deep layer shows small drifts both for temperature and variability, but lower than in the previous version. For the transports through the main Mediterranean straits, the data assimilation restores correct values, especially for the Strait of Gibraltar: +0.81 Sv, -0.76 Sv and +0.05 Sv respectively for in, out and net water transports. The mean surface circulation and its variability are also well reproduced, and non-permanent small-scale features, such as Ierapetra, Pelops or Bonifacio eddies, are well captured (Figure 1). This mesoscale activity is also highlighted by the EKE field (Figure 2), where high values can be seen in Alboran and Ierapertra areas, but also along the paths of the main coastal currents (Algerian, Lybio-Egyptian, Asia Minor and Liguro-Provencal currents).

References

1 - Beuvier, J., K. Béranger, C. Lebeaupin-Brossier, S. Somot, F. Sevault, Y. Drillet, R. Bourdallé-Badie, N. Ferry, and F. Lyard, 2012. Spreading of the Western Mediterranean Deep Water after winter 2005: time-scales and deep cyclone transport, *J. Geophys. Res.*, *117*, C07022, doi:10.1029/2011JC007679

2 - Madec, G., and the NEMO Team, 2008. NEMO ocean engine. *Note du Pôle de modélisation*, Institut Pierre-Simon Laplace (IPSL), France, n° 27, ISSN n° 1288-1619

3 - Hamon, M., Beuvier, J., Somot, S., Lellouche, J.-M., Greiner, E., Jordà, G., Bouin, M.-N., Arsouze, T., Béranger, F., Dubois, C., Sevault, F., Drévillon, M., Drillet, Y., 2015. Design and validation of MEDRYS, a Mediterranean Sea reanalysis over 1992-2013. *Oc. Sci. Disc.*, 12, 1815-1867, doi:10.5194/osd-12-1815-2015, *in revision to Oc. Sci.*

4 - Balmaseda, M.A., Mogensen, K., and Weaver, A., 2012. Evaluation of the ECMWF Ocean Reanalysis ORAS4, *Q. J. R. Meteorol. Soc.*, 139(674), 1132-1161, doi:10.1002/qj.2063

5 - Lellouche, J.-M., Le Galloudec, O., Drévillon, M., Régnier, C., Greiner, E., Garric, G., Ferry, N., Desportes, C., Testut, C.-E., Bricaud, C., Bourdallé-Badie, R., Tranchant, B., Benkiran, M., Drillet, Y., Daudin, A., and De Nicola, C., 2013. Evaluation of global monitoring and forecasting systems at Mercator Océan, *Oc. Sci.*, *9*(1), 57-81, doi:10.5194/os-9-57-2013

6 - Cabanes, C., Grouazel, A., von Schuckmann, K., Hamon, M., Turpin, V., Coatanoan, C., Paris, F., Guinehut, S., Boone, C., Ferry, N., de Boyer Montégut, C., Carval, T., Reverdin, G., Pouliquen, S., and Le Traon, P.-Y., 2013. The CORA dataset: validation and diagnostics of in-situ ocean temperature and salinity measurements, *Oc. Sci.*, *9*, 1-18, doi:10.5194/os-9-1-13 2013

7 - Reynolds, R. W., Smith, T. M., Liu, C., Chelton, D. B., Casey, K. S., and Schlax, M. G., 2007. Daily high-resolution blended analyses for sea surface temperature, *J. Climate*, *20*, 5473–5496