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Sensibility analysis of the Western Mediterranean Transition inferred by four companion simulations

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The Western Mediterranean Transition (WMT) is a strong event occurring during the winter 2004-2005 in the Western Mediterranean resulting in the formation of a large amount of Western Mediterranean Deep Water (WMDW). The newly formed WMDW then invaded the whole Western Mediterranean in a relatively short period of time.

Our modeling study compares four companion eddy-resolving simulations obtained by running the NEMO code in regional Mediterranean configurations differing only by the horizontal or the vertical resolution grid. The first configuration MED12v50, considered as our reference, is well described in Beuvier et al. (2012) and refers to a 1/12° ORCA grid with 50 vertical levels. The second configuration MED12v75 refers to a 1/12° ORCA grid with 75 vertical levels. The third and the fourth configurations refer to a 1/36° ORCA grid with 50 and 75 vertical levels, MED36v50 and MED36v75 respectively. All the simulations used MEDATLAS climatology in October 1998 as an initial condition and were forced from 1998 to now by the ARPERA atmospheric fields, at about 50km resolution.

The first study of the reference simulation MED12v50 has shown the role of deep mesoscale cyclones in transporting a large amount of new WMDW in the southwestern Mediterranean, in agreement with altimetry data. The companion simulations are compared to highlight the improvments obtained by increasing the resolution compared to the reference simulation. The comparison focuses on the 2004-2006 period and quantifies the differences in terms of horizontal patterns and rate of the WMDW formation, mesoscale eddy characteristics and drift, and bottom circulation towards the Channel of Sardinia and the Strait of Gibraltar. For example, the increase in the horizontal resolution consequences :

- an increase of the horizontal extent of the convection maximum in March 2005,
- an increase of the rate of formation for density ranged between 29.10 and 29.11 kg.m-3 in better agreement with the estimate of Schroeder et al. (2008),
- a decrease in the diameter of cyclones by 20km (80 km against 100km in the reference run)
- an increase of the deep cyclone southern drift velocity with higher bottom speed, in better agreement with the satellite data.