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Interannual variability of temperature over 50 years in the Bay of Biscay described by global simulations

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The aim of this study is to better understand the different overriding mechanisms that control the evolution of the temperature in the Bay of Biscay, through realistic simulations over a period of 50 years. Before performing and analyzing our own numerical experiments with a spatial resolution of 4 km, we compared two global simulations, ORCA-G70 and ORCA-GRD100 ($\frac{1}{4}^\circ$ resolution) carried out from the ocean circulation model NEMO by the DRAKKAR group with inter-annual climatologies (WOA04, Levitus et al. 2005 and Bobyclim, Michel et al. 2009). Both simulations differ in their vertical resolution (46 levels in G70 and 75 levels in GRD100) and atmospheric forcings.
The comparison of the two simulations shows an underestimation of the absolute temperature in GRD100 approximately 0.4°C in the first 300 meters for the entire period of the simulation (1958-2004) compared to G70, although the net air-sea heat flux is significantly higher in GRD100 (2.92 TW for GRD100 and 0.20 TW for G70). Several parameters can explain this apparent contradiction. On one hand, the wind is more intense in GRD100 and can contribute to the heat penetration on depth. On the other hand, the thermal balances at different depths show a great disparity between both simulations, especially in terms of advective transport.
However, the temperature anomaly in the two global simulations is very close to observations (climatology) in the first 400 meters. The standard deviation is higher in the mixed layer (0.29°C for both simulations ORCA) and lower in the intermediate layers (0.15°C for G70 and to 0.13°C for GRD100). Moreover, the calculation of the surface linear trend of temperature in GRD100 (0.14°C.decade-1) is closer to the observations W0A04 (0.19°C.decade-1) while it is only (0.10°C.decade-1) in G70. The GRD100 simulation provides a better evolution than G70. These analysis confirm the suitability of the simulation GRD100 to drive a regional numerical experiment at higher resolution in the Bay of Biscay.
The first experiments during a short period of our regional model (4 km spatial resolution, based on MARS3D code) showed consistency in the forcings used and give realistic results in temperature. This regional approach will be used to explore and understand the main mechanisms involved in the evolution of the temperature at multi-decadal scales.