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The Importance of Modeling Non-hydrostatic Processes for Dense Water Reproduction in the Southern Adriatic Sea

Debora Bellafiore (1), William Mc Kiver (1), Georg Umgiesser (1,2)

(1) CNR-ISMAR, National Research Council – Institute of Marine Sciences , Venice, Italy (debora.bellafiore@ismar.cnr.it),
(2) Open Access Center for Marine Research, Klaipeda University, Klaipeda, Lithuania

In this work we use high-resolution numerical simulations to investigate how non-hydrostatic processes affect the propagation and dynamics of dense water along the margins of the Adriatic Sea to its southern end. Dense water formation commonly occurs in the shallow Northern Adriatic during Bora wind outbreaks, as a consequence of the combination of the cooling of surface waters by the cold winds and the salinity increase due to the reduced river inputs. These dense waters subsequently propagate southwards, following the shallow pathway along the Italian coast, over a period of weeks/months, eventually arriving in the Southern Adriatic Sea. The investigation is based on a new non-hydrostatic formulation of the 3D finite element model SHYFEM that has been checked with theoretical test cases and validated for the Adriatic Sea implementation. Results provide good agreement with the analytical solutions of test cases and good matches for the main hydrodynamic variables are obtained from the validation with measurements collected in the field campaign of March-April 2012 done in the South Adriatic.
The increased spatial resolution kept at the shelf border in the Southern Adriatic, in the so called Bari Canyon System, allowed for a thorough investigation of the spill of dense water, which break geostrophic balance, finding specific cascading pathways into the South Adriatic Pit. Interactions between the semi-enclosed basins large scale general circulation and the more local patterns due to the passage of dense water are discussed, in order to clarify the model capability to reproduce these processes within the existing modeling limits. The new non-hydrostatic formulation of the code allows us to identify the gravity flow from the shelf along the slope to the deepest areas of the basin, modulating the energy transfer between the shallow coast and the deep sea.