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Bosphorus Strait Exchange Flow Dynamics Focused on Numerical Ocean Models Intercomparison

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Basic flow structures of the Bosphorus Strait studied under idealized and realistic topographic configurations using a terrain-following ocean model (ROMS) are used to explain many of the experimental findings and to verify the fundamental hydrodynamic processes characterizing the behavior of the Strait. Later, selected case studies are made also using a z-level model (MITgcm) with an objective to compare the performance of the models. The steady-state solutions demonstrate the existence of unique sets of hydraulic controls that establish maximal exchange conditions. Various approximations are used to enhance the applicability of simple models to detect critical transitions at strategic sections under the influence of turbulent, stratified shear flows. Experiments with varying net barotropic volume flux indicate complex response to hydrographical conditions existing in the adjacent basins, which are in many ways quantitatively similar to those observed. The flow field with many well-known meanders and recirculation areas and mechanical energy dissipation at intensified turbulence areas, surface elevation and interface depth changes at hydraulic controls, the jet-like buoyant or negatively buoyant outflows into adjacent seas were successfully produced by the model.

A case study based on the flow conditions of September 1994 is constructed for the comparison of the ROMS (s-coordinate) and MITgcm (z-coordinate) models under realistic geometric and topographic conditions. The comparison of the response of the two models in terms of salinity, temperature and velocity fields suggest strong conformity between the two numerical solutions and both models were supported by the available data.