
A new high resolution ocean circulation model of the Marmara Sea

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Abstract

Marmara Sea including Bosphorus and Dardanelles Straits (i.e. Turkish Strait Systems, TSS) is the connection between the Black Sea and the Mediterranean. The exchange flow that occurs in the Straits is crucial to set the deep water properties in the Black Sea and the surface water conditions in the Northern Aegean Sea. We have developed a new high-resolution unstructured grid model (U-TSS) for the Marmara Sea including the Bosphorus and Dardanelles Straits using the System of Hydrodynamic Finite Element Modules (SHYFEM). Using an unstructured grid in the horizontal better resolves geometry of the Turkish Straits. The new model has a resolution between 500 meter in the deep to 50 meter in the shallow areas, and 93 geopotential coordinate levels in the vertical. We conducted a 6 year hindcast simulation between 2016 and 2021 using lateral boundary conditions from CMEMS (<https://marine.copernicus.eu/>) analysis, in particular Black Sea Forecasting System (BS-FS) for the northern boundary and Mediterranean Sea Forecasting System (MS-FS) for the southern boundary. Atmospheric boundary conditions are from the ECMWF dataset.

Mean averaged surface circulation shows that there is a cyclonic gyre in the middle of the basin due to Bosphorus jet flowing to the south and turning to west after reaching the southern Marmara coast. The U-TSS model has been validated against the seasonal in situ observations obtained from four different cruises between 2017 and 2018. The maximum bias occurs at around halocline depth between 20 to 30 meters. We also found that root mean square error field is higher in the mixed layer interface. We conclude that capturing shallow mixed layer depth is difficult in the Marmara Sea due to the interplay of air-sea fluxes and mixing parametrizations uncertainties. Maximum salinity bias and rms in the new U-TSS model are around 3 psu which is a significant improvement with respect to previous studies. This new model will be used as an operational forecasting system and will provide lateral boundary conditions for the BS-FS and MS-FS models in the future.

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