



## **A Review of the Turkish Straits System: Challenges for Modeling, Inter-Basin Coupling and the Environment**

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The Turkish Straits System (TSS), a highly energetic, strongly stratified system of hydraulically controlled, turbulent, upper ocean and straits intensified exchange flows, governs the coupling Mediterranean and Black Seas, and largely influences their combined mixing and renewal characteristics. The modeling of such a system is a 'grand challenge' not only because of the need to account for an existing mosaic of complex nonlinear and topographically controlled processes, but also because of the absolute need to capture the fine scales of the two straits, Dardanelles and Bosphorus and their exits, which dominate and determine the response of the system. A stepwise and complementary strategy has been used to develop models that explain the individual as well as systemic behavior, utilizing the variable resolution ROMS model for studies of the Bosphorus, the curvilinear coordinate MITgcm and the unstructured grid FEOM model for studies of the entire TSS, fully resolving the influence of the fine-scale processes at straits. A review of the modeling development and the results at different levels of complexity are given, along with inter-model comparisons and partial observational verification of the results. Details of the strait currents, mixing, fluxes, hydraulic controls, energy fluxes, Marmara Sea circulation, time-dependent response to atmospheric forcing and sensitivity to the selected parameterizations are discussed in relation to available observations. It is shown that the different components of the TSS have widely varying time scales of response, while the straits alone are responsible for the faster elements. The TSS cases with closed boundaries, including a realistic range of artificially produced net barotropic flow have demonstrated the expected changes in Marmara Sea circulation. Realistic coupling of the TSS model with the adjacent basins, taking full account of the hydrological cycle is a formidable problem where progress is currently being made. The implications on the environmental status of the TSS are reviewed, especially in regard to a proposed new canal that may increase the current threats to the environment.