EGU22-13451, updated on 16 Aug 2022
https://doi.org/10.5194/egusphere-egu22-13451
EGU General Assembly 2022

Quantifying the roles of tide, wind, and density gradient on volume transports in the Persian Gulf

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This modeling study investigates how density gradient, wind and tide control water exchanges through the Strait of Hormuz in the Persian Gulf. The 3D model simulates the intraseasonal and interannual variability of the volume transports. Model results reveal a two-layer transport through the Strait of Hormuz mainly due to density gradients between the Persian Gulf and the Indian Ocean. Both wind and tides affect the exchange flow, however the tidal impacts dominate those from winds. Earlier estimates of the annually-averaged volume transports amounted to approximately 0.2 Sv. With the high-resolution model used in this study, volume transports increase by more than 2.5 times and reaching about 0.6 Sv. The dominant wind in the Persian Gulf is the northwesterly wind, which oppose the inflow from the Indian Ocean. A model experiment without wind confirms that annual mean inflow rates increase. On the other hand, the monthly net-transport (inflow rate - outflow rate) correlates with the wind magnitude when the model is run with complete forcing. Winds mostly affect extreme (maximum) daily flow rates but the flow rates driven by tides typically fluctuate around their annual mean values. Finally, this study reveals the seasonal cycle of the volume exchange with stronger exchange in early winter and summer than in spring and fall.