Interannual variability of the Caspian Sea three-dimensional circulation, sea level and air-sea interaction

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Abstract

A three-dimensional primitive equation model including sea ice and air-sea interaction is used to study climatic circulation and water mass variability in the Caspian Sea under the influence of realistic mass, momentum and heat fluxes. The water budget of the landlocked Caspian Sea is extremely sensitive to climatic variability in the surrounding areas, its surface level dynamics is characterized by strong seasonal and decadal variations, which reflect processes occurring in regional climate system. In order to explore these links as well as the climate of the Caspian Sea we develop a numerical model of enclosed sea dynamics, capable to simulate large, up to 10 meters, interannual sea level variations. One of the specific features of the model is that it allows for flooding and drying of coastal area. It is the coastline movement that determines the response of the Caspian Sea level to nonzero water budget. Due to the shallowness and flatness of the Caspian Sea bottom this response is nontrivial and its prediction requires as accurate description of coastal dynamics as possible. Using this model we reconstruct the evolution of the Caspian Sea level and other physical characteristics in the second half of the 20th century. The results of this study suggest that it is crucial for the model to adequately describe processes occurring in the surface and bottom boundary layers, as well as in the coastal region of the sea, in order to predict its level change.