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THREE DIMENSIONAL NUMERICAL SIMULATION OF THE EXCHANGE FLOWS AT THE STRAIT OF HORMOZ

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Introduction

The Persian Gulf is a semi-enclosed marginal sea with characteristics of low precipitations and high evaporation rates. It is only connected with the open oceans through the Strait of Hormuz. High evaporation from the Persian Gulf surface leads to increased salinity and thus increases the density of surface waters. The dense surface waters while moving towards the Strait of Hormuz sink to deep parts of the Persian Gulf to achieve neutral buoyancy depth. At the east of the Strait of Hormuz, where the Persian Gulf is connected to the Oman Sea, these dense salty waters can be observed with velocities towards the exit of the Gulf, so called Persian Gulf Outflow. On the other hand, the fresh Oman Sea waters enter to the Persian Gulf as surface waters in the vicinity of Iranian Coasts to replace of the evaporated waters and also the exited outflow [1], [2]. The general circulation pattern in the Strait of Hormuz can be described with these mechanisms.

Generally, the seasonal changes in ocean current characteristics are a function of atmospheric conditions on the sea. In the present work, the numerical modeling of the Persian Gulf are performed using an ocean model namely POM[4], with including all the atmospheric forcing factors as well as tide, to better understand the features of the water exchange and circulation patterns at the Strait of Hormuz and also its seasonal variations.

Method

The POM is a three dimensional sigma coordinate ocean model based on the primitive equations of motion with hydrostatic approximation assumption. The detail of the model are presented in numerous literature such as [3],[4]. In this study, all the model inputs were prepared form available archive oceanographic data and some field measurements. The model was initiated form calm condition with the mean climatic definitions of temperature and salinity. After about five successive integrations the numerical solutions showed a steady manner. Here the results of the last year of the simulations are presented.

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Conclusions

The results of the model show that the surface salinity of the Persian Gulf reaches to its maximum values during late autumn and winter. This leads to intensify the main branch of the Persian Gulf Outflow that is observed on the deep parts of the Strait of Hormuz. In addition, the main branch of the dense waters (Persian Gulf Outflow) is originated from the northwestern parts of the Persian Gulf and moves along the main Gulf axis while sinking on the bottom. During cold months of the year the other branch of the dense waters flows from between 54.5°E and 56 E° longitudes, adjacent to UAE. This current moves toward the Hormuz Strait and join the main Outflow branch. Of course, this is negligible in comparison with the main outflow of Persian Gulf, originating from northwestern areas.

With the air temperature increase, decrease of surface evaporation and consequent decreasing the salinity, the saline and warm waters of surface layers penetrate more slowly into deeper parts of the Hormuz strait. It is due to decrease in surface water density in comparison with that of winter. Therefore, the role of northwesterly wind (the significant wind over the Persian Gulf) in transporting the dense waters out of the Persian Gulf is more noticeable during warm months of the year. This could be observed as saline center eddies with mid diameter of about 50 km moves toward the center of Hormuz Strait. For example, Figure 1 shows the mean monthly of salinity and circulations resulted from the model simulation during Sep. 2009, and a suggested diagram for the water circulation in the Strait of Hormuz [5].

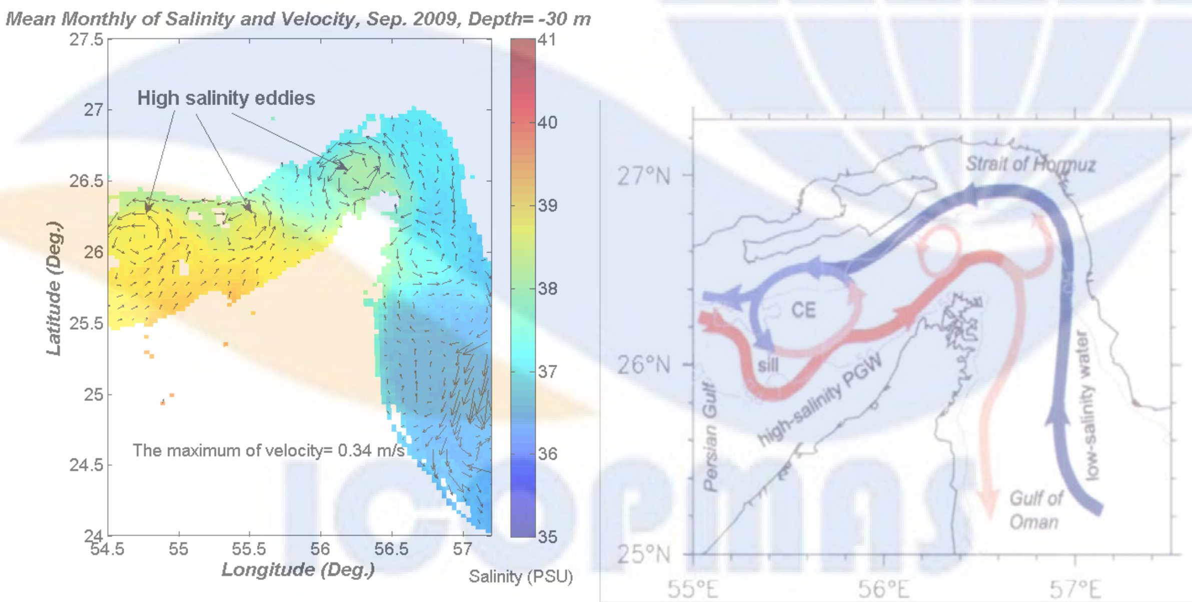

Fig. 1) results of the model simulation of the September 2009 (left) and a schematic diagram of the circulation at the Strait of Hormuz (right) [5].

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