Research

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The Arvand River Plume Detection by Using Numerical Modelling

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1-Introduction

The river plume is the result of sea, river, and atmosphere interaction and is also affected by the upstream events of the river; because of this, its properties are quite variable and complex. The structure and shape of the river plume have a characteristic effect on the biological, chemical, physical, sedimental, contamination, and river mouth features (Garvine, 1995). The structure of the river plume is classified into two categories. First, the front between the coastal waters and the plume is extending from the surface to the bottom, which is known as a "bottom-advected plume". Second, a buoyancy flux as a shallow layer locates on continental shelf waters and the coastal waters, which are denser, locates below it that is called a "surface-advected plume". Although these two plume types are similar in some cases, such as the density differences between the plume and the coastal streams and the effects caused by Coriolis force, have many differences concerning spatial scales and the characteristics of their flux and dynamics (Yankovsky and Chapman, 1997). Given the importance of this issue, this study used numerical simulations and revealed the plumed type of the Arvand River. The Arvand river is the biggest navigable river that discharged to the Persian Gulf with a shared watershed between four countries (54 million people) which, economically, politically, militarily, etc., has significantly high importance. The plume of the Arvand River is formed in the territory of the countries of Iran, Iraq, and Kuwait and affects the properties of the Persian Gulf's northwest water (Un-Escwa, 2013).

2-Methodology

For plume type detection by numerical simulation, the FVCOM model is used for temperature, salinity, and circulation modelling of the Persian Gulf's water. FVCOM is a 3D finite-volume model, which has unstructured-grid, free-surface, and governing equations of ocean circulation (Chen et al., 2006). The model used a horizontal grid of

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variable triangular elements and a vertical network with 20 Sigma layers. Temperature and salinity at the open boundary were used from the outputs of the HYCOM model. In addition, four main tidal components were applied to the model in the open border. After model stability, water column stratification and the shape and width of the estuary plume were investigated. Several different regional wind conditions were examined in the model to study the wind effect on the plume structure. the surface salinity contour of 37 ppt (which is different for each region) is used as the river plume boundary.

3- Results and Discussion

In windless conditions, the river plume was inclined to the south due to the water cycle in the northwest Persian Gulf and Coriolis force. When the wind acts on the model, the shape and extent of the plume change proportional to the wind. The plume was extended to the north due to south wind and was extended to the southeast due to northwest wind. The difference between the area of the plume in the two wind modes of 4 meters per second north and south is 300 square kilometers. The result shows salinity water column stratification, which means the river freshwater lay on salt sea water and moves offshore.

4-Conclusions

According to the stratification of the water column in the river mouth and the powerful influence of the wind condition on the plume, the Arvand River has a surface-advected plume. This issue is significant in the fishery, environment, and contamination aspects. Once this is clear, the best region for fishing can be determined by knowing the wind direction and speed. In addition, we can track the route of river-borne pollution and sediments.

Keywords: Surface Plume, Stratification, Persian Gulf, FVCOM, Khuzestan Province

5-References

Garvine, R.W. (1995). A dynamical system for classifying buoyant coastal discharges. Continental Shelf Research, 15(13), 1585-1596 .

Chen, C., Beardsley, R. C., & Cowles, G. (2006). FINITE VOLUME COASTAL OCEAN. Oceanography, 19(1), 78 .

Un-Escwa, B. (2013). United Nations economic and social commission for western Asia; Bundesanstalt für Geowissenschaften und Rohstoffe. Inventory of Shared Water Resources in Western Asia, Beirut .

Yankovsky, A.E., & Chapman, D. C. (1997). A simple theory for the fate of buoyant coastal discharges. Journal of Physical Oceanography, 27(7), 1386-1401.