AN OIL SPILL MODEL FOR NORTHERN PERSIAN GULF WATERS

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ABSTRACT: In this paper, simulation of oil spill due to weathering and tidal currents in Persian Gulf is performed. Here, water current and wind-induced velocities are taken into account including many significant processes such as advection, surface spreading, evaporation, emulsification and dissolution. A grid with 339 points on Persian Gulf have been generated. By using, WAve Model (WAM) and Cressman analysis on the whole grid, wind velocity and direction, wave height and wave period have been determined. Tidal constituents have been obtained from co-tidal charts and then tidal stream from tidal analysis program have been calculated to determine advection properties. So, a portal have been provided to present simulating of the surface movement of oil slick by Lagrangian approach for the northern of Persian Gulf waters. Sample simulations for oil spill are presented and a comparison of wind and tide data and water surface level for the domain of solution with the observed data, numerical results and an another software shows good conformity.

Key words: *Persian Gulf, oil slick, Spill model*

1. INTRODUCTION

The prediction and simulation of the trajectory and weathering of oil spills are essential to the development of pollution response and contingency plans, as well as to the evaluation of environmental impact assessments [1]. A major oil spill can contaminate the shorelines, causes a long-term damage to the aquatic environment for fisheries, wildlifes, harbor facilities and the health of mankind. To prepare for such accidents, many government agencies have prepared oil spill contingency plans. An important component of these plans is the usage of mathematical models to predict the transport and fate of oil slicks [2]. Generally, the transport and fate of spilled oil can be affected by physical, chemical and biological processes. Oil spill in water bodies is governed by different processes such as spreading, advection, turbulent diffusion, evaporation, dispersion, dissolution, photo-oxidation, biodegradation and sinking/sedimentation [3,4,5,6]. In this paper, a 2-D trajectory model have been developed for Prediction of oil slick motion based on the particle approach. The amount of oil released in Persian Gulf is distributed among a large number of particles tracked individually. In this research, a two-dimensional trajectory model have been developed by consideration of spreading, advection, evaporation, emulsification and dissolution of oil slick, by One Particle Model [7,8] and other effects such as photo-oxidation, biodegradation and sinking / sedimentation are long-term effects and were not considered in this research.

2. WIND DATA, TIDE AND TIDAL STREAM

To produce the wind data, Cressman analysis has been used. The wind velocity and direction have been taken from synoptical stations near Persian Gulf and then extended to the grid points considering the curvature of earth. This value named F_x has been calculated for the grid points by the below relation:

$$F_x = \left[\sum_{i=1}^{n}(W_{i,j} \times F_o)\right] / \sum_{i=1}^{n} W_{i,j} \quad , \quad W_{i,j} = \max(0, \frac{R^2 - r_{i,j}^2}{R^2 + r_{i,j}^2}) \qquad (1)$$

Where F_o is the data from stations, F_x is the value in grids, R is influence radius and $W_{i,j}$ is weight function of the station related to the grid points. In this work wind data have been generated by a Fortran house-made program. Tide raising forces Constituents are included a pair of semi-diurnal constituents M_2 for moon and S_2 for sun, a pair of diurnal constituents K_1 and O_1 for moon, diurnal constituents K_1 and P_1 for sun, M_f and M_m for moon and others. In this work, 4 main constituents have been considered by using Admiralty Method of Tidal Prediction NP 159 and mean level has been determined by the below formula for the Persian Gulf considering seasonal streams:

$$ML = M_2 + S_2 + K_1 + O_1 + 0.15 \qquad (2)$$