Abstract

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Modeling of Oil Spills Damage Assessment in Marine Environment

During the last years, oil spills attracted the attention of both the public and the media. Global awareness of the risks of oil spills and the damage they do to the environment has been triggered by the immediate and catastrophic results of major accidents. In spite of the recognized great value of the marine environment, it still receives different types of pollutants from different sources. Recognition of spilled oil at sea on the shoreline may be the first indication of an oil spill. The effect of oil spills can be far reaching, posing both an environmental and an economic threat. Recreational activities, local industry, fisheries, and marine life are among the resources that can be adversely affected by oil spills. The severity of environmental damages caused by oil spillage depends on the quantity and type of oil involved, location of the spillage area/environmental sensitivity, time of year and weather conditions. The movement of spilled oil in the marine environment may cause serious damage to a marine environmental system. Thus, an accurate prediction of oil spill is very important to minimize environmental and economical damages due to unexpected oil spill accident. Currently, oil fate trajectory and the environmental impact assessment of oil spill are based mostly on the oil spill prediction models which simulate not only the trajectory (Advection process) but also some fate processes as spreading and evaporation. In this study, a theoretical investigation of oil slick behavior due to the density-driven currents and surface currents effect was implemented simultaneously with a numerical solution. Furthermore, an Oil Spill Decision Support System (OSDSS) has been developed. It contains two integrated modules: the first one is concerned with the oil spill trajectory (Module I: Advection Model) that has been established in consideration of wind, and surface current on the sea surface, while the second module is dedicated for the environment damage assessment with special reference to shorelines and coral reefs of Egypt, (Module II: Oil Spill Damage Assessment Model “OSDAM”). The OSDSS model was initiated to provide the best possible quantitative information on oil spills for contingency planning and oil spill response purposes through its ability to predict the trajectory of the spill with time and assess the damages in marine environment. The developed Advection Module has a new special feature: The magnitude velocity, direction, and the distance travelled by the oil slick after any time following spillage can be determined as well as the trajectory of the oil slick after any time interval appears on Geographic Information System (GIS) directly. Moreover, the back tracking of the oil slick to allocate the original/suspected sources of the spill is very important in unknown pollution’s source. The OSDAM module is developed and embedded in the OSDSS to facilitate the calculations of the environmental damage assessment for planners and assessors in case of oil spills in the Egyptian coastal water. On the other hand, a quick method has been developed to determine the oil spill trajectories by using a simple charts for Sidi Kerir area at the North-West coast of Mediterranean sea near Alexandria (between Latitude 31° 08' 32” to 32° 34' N and Longitude 29° E to 29° 30" 5' E) using the normal metrological condition in this area. The reason for choosing Sidi Kerir to develop such quick and simple method is that this area holds the off-shore oil terminal of the Arab Petroleum Pipelines Company (SUMED) with high risk of oil leakage. Similar charts can be easily prepared for other places of high pollution risks (e.g. Ras Gharep, El-Sokhana, and other sites on red sea and Gulf of Suez). For validation purposes, a comparative studies were carried out between the outputs of OSDSS and the well-known validated Canadian SL-ROSS oil spill model, which show very close agreement between both results. Moreover, for reality verification, OSDSS results were fully matched with a real oil spill incident data.