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Advanced marine oil spill modelling for short term forecasting and applications to the Mediterranean Sea

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Accidents involving oil tankers or offshore platforms, incidental releases of bunker fuel from ships or the illegal and continuous discharge of oil from ships along transportation routes are possible sources of spills. The success in the management of an oil spill depends on several factors such as the ability to detect the spills and the capabilities to forecast the drift of oil over time.
This environmental concern over oil spills has led to the development of an advanced marine oil spill model for short term forecasting, MEDSLIK-II. This model is based upon the existing MEDSLIK model (Lardner et al, 2006). MEDSLIK-II is designed to predict the geographic position and chemical changes of an oil slick and uses a lagrangian representation of the oil slick using a Lagrangian formalism, i.e. the oil slick is represented by a large number of component particles which move following particle trajectory equations and are transformed by physical and chemical processes.
The novel characteristics of MEDSLIK-II are a proper representation of high frequency currents and wind fields in the advective components of the particle trajectory equations, the introduction of the Stokes drift velocity and the initialization of the oil slick position and slick shape using remote sensing data. The model uses the recently available operational oceanographic analyses and forecasts (Pinardi et al, 2003) as part of the deterministic components of the particle trajectory equations and it puts forward the corrections needed to account for missing or not well resolved transport processes by the analyses and forecasts available.
In MEDSLIK-II the oil particles are also dispersed by turbulent fluctuation components that are parameterized with a random walk scheme. In addition to advective and diffusive displacements, the oil spill particles change due to various physical and chemical processes that transform the oil (evaporation, emulsification, dispersion in water column, adhesion to coast).
The model has been validated with surface drifters data, with satellite data and in-situ data in different Mediterranean regions.
MEDSLIK-II oil spill model has been used to provide timely information on the oil spill evolution forecasting during several emergency cases in the Mediterranean sea. Moreover, MEDSLIK-II has been also part of the first Italian continuous and operational oil spill monitoring system, the PRIMI (PRogetto pilota Inquinamento Marino da Idrocarburi) system, which is an operational system providing earlier detections of an oil slick and predictions of its transport and dispersion.

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