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The Modeling System for simulation of the Oil Spills in the Black Sea

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Experience of many oil spill response actions worldwide, including the recent "Prestige" accident, demonstrates importance of forecasts of weather and sea state to predict movement and fate of oil spill. Now, increasing computational resources allow coupling of oil spill models to models of weather, circulation and wave forecast. The modeling system for simulation of the accidental oil spill includes 3D oil spill and fate model OILTOX, circulation and sediment transport model THREETOX and wave forecast model WAVEWATCH III coupled with the weather forecast model MM5. OILTOX is a model for simulating oil transport and fate in five interactive "phases": oil-on-surface, oil-in-water, oil-on-bottom, oil-on-suspended sediments, and oil-at-shoreline. It is being developed to support response on oil spill in the Black and Azov seas and large river reservoirs in the Ukraine. The model describes the main transport and weathering processes. The model of surface slick describes the spreading due to gravity and surface tension force, advection by wind and surface currents, evaporation, emulsification, oil-shore interaction, entrainment of oil into the water by breaking waves and resurfacing entrained droplets. OILTOX is a Lagrangian model that uses a Gaussian "spillet" representation to describe the concentration field as the sum of contributions from a collection of "spillets". "Spillets" are distributed among phases and possess a set of specifics for phase properties (volume, density, viscosity, water content etc.). A new Lagrangian numerical approach allows simulation of the spreading of an elongated slick with spatially variable thickness for both instantaneous and continuous spills. It takes into account interactions of "spillets" in ensemble by calculation of horizontal gradients of pressure in the slick as sum of contributions from derivatives of heights of surface "spillets". Similar methods were developed in plasma physics for simulation of collisionless systems by "particle-particle" methods. Coupled with the two-equation turbulence model, dispersion model allows simulate oil concentration with depth. The horizontal and vertical turbulent diffusion processes are simulated by use Lagrangian stochastic modeling technique based on the random walk method for the Gaussian "spillets". Algorithms of evaporation, emulsification, partitioning, sedimentation and oil-shore interaction are based on state-of-art published researches. The hypothetical scenario of an oil spill of 75 000 tons of crude oil on the north-western shelf of the Black Sea was considered.