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Large-eddy simulation of oil slicks from deep water blowouts[1]

DI YANG, Department of Mechanical Engineering, Johns Hopkins University, MARCELO CHAMECKI, Department of of Meteorology, The Pennsylvania State University, CHARLES MENEVEAU, Department of Mechanical Engineering, Johns Hopkins University — Deep water blowouts generate plumes of oil droplets and gas bubbles that rise through, and interact with various layers of the ocean. When plumes reach the ocean mixed layer (OML), the interactions among plume, Ekman Spiral and Langmuir turbulence strongly affect the final rates of dilution and biodegradation. The present study aims at developing a large-eddy simulation (LES) capability for the study of the physical distribution and dispersion of petroleum (oil and gas) under the action of physical oceanographic processes in the OML. In the current LES, the velocity and temperature fields are simulated using a hybrid pseudo-spectral and finite-difference scheme; the oil/gas field is described by an Eulerian concentration field and it is simulated using a bounded finite-volume scheme. A variety of subgrid-scale models for the flow solver are implemented and tested. The LES capability is then applied to the simulation of oil plume dispersion in the OML, which is initially released from a point source below the thermocline. Graphical visualization of the LES results shows surface oil slick distribution consistent with the satellite and aerial images of surface oil slicks reported in the literature.

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