A low intrusive method to simulate buoyant effluent plume in "Far-Field Hydrodynamics Models"

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Abstract

Coastal hydrodynamic models are not able to correctly resolve a buoyant water discharge on the ocean floor. Therefore, in most cases, a "near-field model", generally based on analytical or empirical approaches, solves the upwelling of the buoyant plume and its stabilisation in the water column. The advection and dispersion of polluting effluents is then taken over by a coastal hydrodynamics model, also called "far field model".

Recent development of non-hydrostatic extensions of these models allow to solve the whole dynamics of a low-density plume, but they are very expensive in computational resources. A low-intrusive method to simulate buoyant jets with far-field hydrodynamics models is investigated here. This method, called Quasi-Non-Hydrostatic, consists in introducing horizontal advection and diffusion of vertical velocity in coastal modelling trough dynamical buoyancy concept. The turbulence is modelled using a Large Eddy Simulations (LES) approach.

A single urban discharge is simulated by Hydrostatic, Quasi-Non-Hydrostatic and Non-Hydrostatic models and resulting characteristic quantities of the plume are then compared. An actual effluent discharge configuration is also simulated with the Quasi-Non-Hydrostatic method and compared to experimental data and near fields approaches.

The Quasi-Non-Hydrostatic appeared as a fast and robust method of modelling the dynamics of urban effluent or karstic discharges.