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High-Resolution Nonhydrostatic Outfall Plume Modeling: Cross-Flow Validation

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ABSTRACT

Marine outfalls discharge wastewater on the inner shelf and are designed to encourage rapid effluent mixing sufficient to maintain a submerged wastefield. A high-resolution nonhydrostatic Regional Ocean Modeling System (ROMS) model was used to resolve concomitantly the intermediate- and far-field submarine plume development. ROMS simulations were validated with cross-flow laboratory experiments. Generally, results showed that the nonhydrostatic high-resolution ROMS is capable of resolving plume dynamics in typical cross-flow conditions. Top-of-plume elevation was quantified and found to be highly variable. The ROMS model is relatively insensitive to changes in horizontal effluent input parameterization. Multiple grid resolutions were tested, and good model–data agreement was achieved in low to medium cross-flow experiments. Additional resolution improved high cross-flow results. This intermediate- and far-field three-dimensional nonhydrostatic model resolves plume development over multiple spatiotemporal scales and can include natural oceanic processes currently absent in many plume models. Integrated outfall plume and marine process modeling will advance future wastewater management.

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