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Dispersal of the Hudson River Plume in the New York Bight: Synthesis of Observational and Numerical Studies During LaTTE

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Abstract

Observations and modeling during the Lagrangian Transport and Transformation Experiment (LaTTE) characterized the variability of the Hudson River discharge and identified several freshwater transport pathways that lead to cross-shelf mixing of the Hudson plume. The plume's variability is comprised of several different outflow configurations that are related to wind forcing, river discharge, and shelf circulation. The modes are characterized by coastal current formation and unsteady bulge recirculation. Coastal currents are favored during low-discharge conditions and downwelling winds, and represent a rapid downshelf transport pathway. Bulge formation is favored during high-discharge conditions and upwelling winds. The bulge is characterized by clockwise rotating fluid and results in freshwater transport that is to the left of the outflow and opposed to classical coastal current theory. Upwelling winds augment this eastward flow and rapidly drive the freshwater along the Long Island coast. Upwelling winds also favor a midshelf transport pathway that advects fluid from the bulge region rapidly across the shelf on the inshore side of the Hudson Shelf Valley. A clockwise bulgelike recirculation also occurs along the New Jersey coast, to the south of the river mouth, and is characterized by an offshore veering of the coastal current. Modeling results indicate that the coastal transport pathways dominate during the winter months while the midshelf transport pathway dominates during summer months. Finally, because the time scales of biogeochemical transformations in the plume range from hours to weeks or longer, the details of both the near- and far-field plume dynamics play a central role in the fate of material transported from terrestrial to marine ecosystems.

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