Drift and dispersion prediction using surface currents measured by high-frequency radars

High-frequency (HF) radars are coastal remote-sensing instruments capable of mapping the surface currents up to tens to hundreds of kilometers offshore, with a horizontal resolution of a few hundred meters to a few kilometers, and a temporal resolution of an hour. They measure a weighted depth-averaging of the near-surface Eulerian currents, with weights exponentially-decaying with depth from the ocean surface, at a rate determined by the radar frequency. In addition to these Eulerian currents, it has recently been demonstrated experimentally that they measure an additional Lagrangian current equals to half of the surface Stokes drift. Since both the surface Eulerian currents and the surface Stokes drift are required to predict the drift of floating contaminants such as oil and microplastics, HF radars are a unique measurement system for these applications. However, ocean drift and dispersion depend on interactions between flow structures, such as eddies, at all scales, including those that are not resolved by HF radars. In practice, ocean drift and dispersion prediction models add a stochastic component to the current velocities measured by the radars in order to represent unresolved current variations. A parameterization of this stochastic component must be chosen so that the effects of unresolved scales on ocean drift and dispersion are adequately represented.

We propose to design new GPS-tracked surface drifters that will mimic the weighted depth-averaging of the near-surface currents performed by HF radars, and to deploy a large number of these drifters in the area covered by four HF radars in the Saint-Lawrence estuary in Canada. Drifters will be initially deployed to cover a couple of radar grid cells of different size (a small one near the radar and a larger one far from the radar), so that the dispersion due to scales not resolved by the radar will be quantified. Drifter deployments in a range of environmental conditions (winds, waves, stratification, etc.) will be carried out in order to establish a parameterization of the stochastic component that must be added to the HF radar currents to predict the observed dispersion of surface drifters. Potential applications of this research involve search and rescue operations at sea, tracking the dispersion of oil and microplastics, and water quality.

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