Project: Modelling the interaction of surface currents and waves

During an international competition in December 2021 that aimed to forecast the position of 94 GPS tracked drifters (https://www.deltares.nl/en/news/deltares-usa-secures-second-place-in-forecasting-challenge-atlantic-ocean-with-new-development-in-particle-tracking/) a very striking feature during the evaluation was that none of the teams could effectively make use of wave data. This was unexpected, since the Stokes effect, that states that the orbits of waves are not closed but show a mean motion in the direction of the wave propagation has been know for quite some time (Stokes 1847; https://en.wikipedia.org/wiki/Stokes_drift). More recently the interaction has been studied in more detail and it was found that the interaction is more complex and that the mean needs a correction due to the Stokes-Coriolis forcing. So far our attempts to include these new formulations have not lead to better forecasts.

In this project, we aim to build a (first version of) a wave model that can be used as a numerical lab to study the wave-current interaction in detail. We aim to build this model using the Trixie.jl toolbox for numerical simulation of hyperbolic partial differential equations. The toolbox is written in Julia and makes use of discontinuous-Galerkin methods.

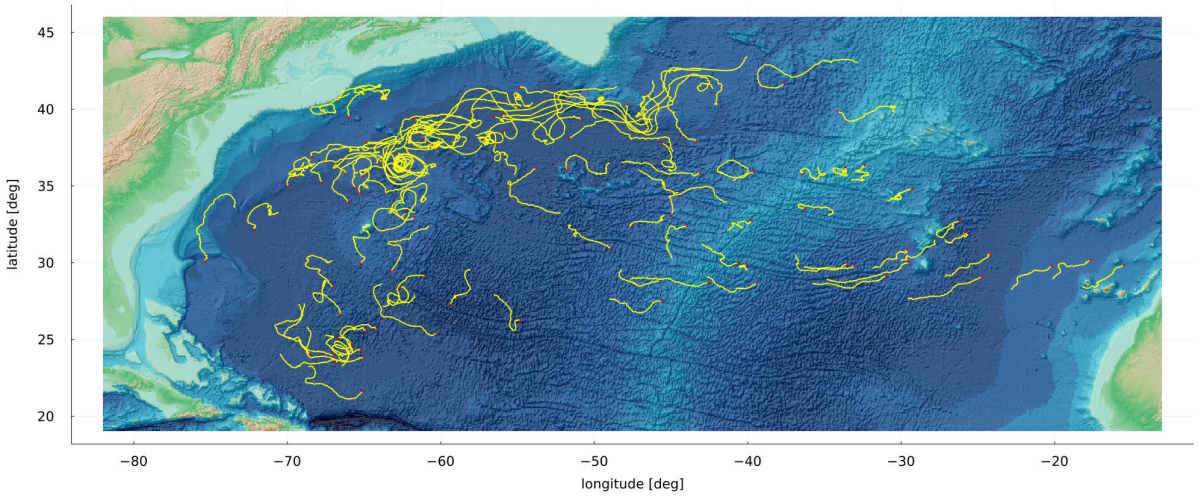

Figure 1 Track of the 94 drifters during the challenge

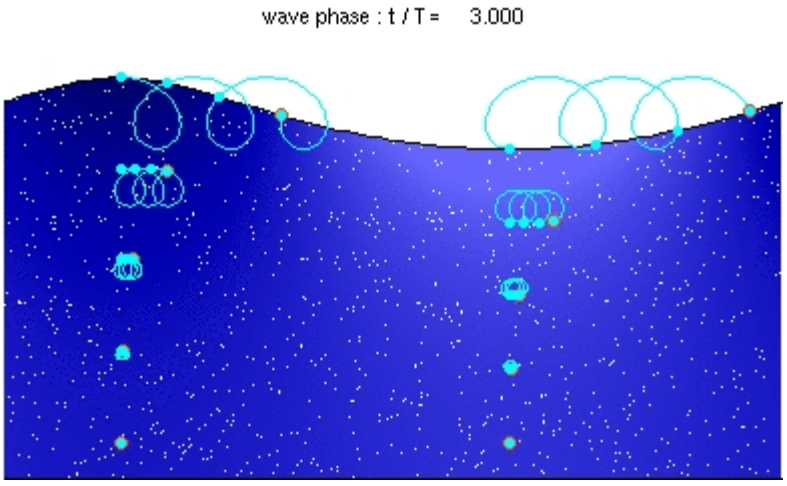

Figure 2 Particles showing Stokes drift (source wikipedia)