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Modelling salt finger formation using the Imperial College Ocean Model

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We present numerical simulations of salt finger formation produced using the Imperial College Ocean Model (ICOM) which is a finite element model using adaptive meshing. Our aim is to validate the model against published data and to develop the capability to simulate salt finger formation using adaptive meshes.

Salt fingering is a form of double-diffusion which occurs because heat diffuses more quickly than salt. When an area of warm, salty water overlies an area of colder, fresher water, an initial perturbation can lead to some of the water from the lower layer moving into the top layer. Its temperature then increases more quickly than its salinity, so that the water is less dense than its surroundings and it will rise up more. This process repeats to form salt fingers, with salt fingers also forming in the downward direction.

Salt fingers play a role in oceanic mixing, in particular they are responsible for maintaining thermohaline staircases such as the C-SALT staircase which have been observed extensively, particularly in the tropics. The study of salt fingers could therefore improve our understanding of processes in the ocean, and inform the design of subgrid parameterisations in general circulation models.

We used the salt finger formation test case of Oezgoekmen et al (1998) in order to validate ICOM. The formation of salt fingers is modelled by solving the Navier-Stokes equations for a two-dimensional rectangular area of Boussinesq fluid, beginning with two layers of water, the top warm and salty and the bottom cold and fresh, with parameters chosen to match the test case of Oezgoekmen et al (1998).

The positions of the interfaces between the fingering layer and the mixed layers as well as the finger growth rate and the kinetic energy are plotted against time. The results are compared with those of Oezgoekmen et al (1998). We present results from structured meshes and preliminary results using adaptive meshing.