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Gravity Currents in the Cabbeling Regime

Recently, the dynamics of flows beneath ice cover in lakes has garnered much interest in the GFD community. Much focus has gone into characterizing vertical flows beneath ice, while less has gone into characterizing the impact of horizontal flows beneath ice. We know that horizontal flows play a major role in the transport of nutrients, as well as impacting CML temperature. In this talk, we describe one such example of the interactions of horizontal flows and vertical flows induced from freshwater cabbeling (the mixing of parcels with equal density but different temperature). This talk presents numerical simulations of the evolution of freshwater gravity currents where intruding and ambient temperatures are on different sides of the temperature of maximum density. A setup like this might occur in the springtime from a riverine inflow. We will highlight how the initial intrusion flows along the upper surface of the domain and mixes with ambient water, and due to cabbeling, generates a coherent bottom current. We will introduce a control parameter (essentially the inverse of the non-dimensional temperature of maximum density), which is key to the evolution of the system, and we will show how the maximum horizontal extent of the initial intrusion varies with it. We show that for some cases, the maximum extent of the initial intrusion controls some of the important characteristics of the coherent bottom current. Finally, we will highlight some of the key characteristics (head height and temperature distribution) of the bottom current.