Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Turbulent plumes from ice melting into a linearly stratified ocean

ANDREW WELLS, University of Oxford, SAMUEL MAGORRIAN, University of Manchester — The melting of submerged marine glacier termini and ice shelves floating atop the ocean has important implications for ice sheet dynamics and sea level rise. When vertical or inclined ice faces melt into a warm salty ocean, the fresh meltwater rises in a buoyant plume along the ice-ocean interface and the resulting turbulent heat transfer provides a feedback on melting rates. We apply a turbulent plume model to consider the dynamics of well-mixed meltwater plumes rising along planar ice faces through a linearly stratified ocean, with vertical gradients of background ocean temperature and salinity. When the driving buoyancy force is dominated by salinity differences, the flow develops in a repeating series of layers, with the meltwater plume accelerating along the slope, rising past its neutral density level, and then separating from the ice face and intruding into the background ocean. We determine approximate scaling laws for the layer heights, melting rates and flow properties as a function of the background ocean temperature and salinity. These scaling laws provide a good collapse across a range of numerical solutions of the plume model, and may prove useful as a simple parameterisation of glacial melting in stratified Greenland fjords.

Andrew Wells
University of Oxford

Date submitted: 01 Aug 2015

Electronic form version 1.4