# Experimental Investigations of Natural Convection Phenomena in the Estuarine Waters of Isfjorden, Arctic Region

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This study investigates the unique, continuous upwelling flow lines at the river-sea boundary in Isfjorden, Arctic. To elucidate the mechanism behind this previously undocumented phenomenon, we designed custom acrylic tanks and syringe arrays to simulate the polar estuarine environment. Through controlled experiments, we systematically excluded the Kármán vortex street and temperature gradients as primary causes. Experimental data and particle size analysis confirmed that these flow lines are driven by natural convection plumes resulting from minute density differences. When low-salinity seawater (~4 psu) interacts with freshwater, it generates a slow, stable convection with accelerations within ±20 mm/s^2. This stable flow entrains fine riverbed silt to form mushroom-shaped structures that reach the water surface. Conversely, larger salinity differences (>5 psu) induce unstable vortices. We conclude that this natural phenomenon strictly requires a low-salinity marine environment, directly reflecting the "Arctic freshening" caused by severe glacier and sea ice melting. Consequently, these macroscopic flow lines hold significant potential as a novel, visual indicator for monitoring global warming and polar marine environmental changes.

**Awards Won:**