Turbulent mixed convection in supraglacial channels

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Abstract

We present high-fidelity Direct Numerical Simulations (DNS) of idealized supraglacial channels, governed by the Boussinesq equations with a quadratic equation of state to model freshwater dynamics. The flow is driven by the competition between three forcing mechanisms, each quantified by a specific dimensionless control parameter: (i) a gravity-driven Poiseuille shear flow due to the channel slope, characterized by the friction Reynolds number (Re_{τ}); (ii) boundary thermal forcing with fixed ice temperature at the bottom (Dirichlet) and atmospheric heat bal
band spectral source term with bottom reflection, quantified by a radiative Rayleigh number (Ra_{rad}).
In the regime of interest (freshwater below 4 °C), the density anomaly promotes a Rayleigh − Bénard − like instab

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