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Direct Numerical Simulations of Saltfingers

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Double–diffusive processes occur when two fluids with different diffusivities are combined. The condition for saltfingers is that warm and saline water lies over cold and less saline water. Saltfingers are filaments of saline water. They have a width ranging from a few mm to a few cm. The filaments evolve through layers along the background gradients of temperature and salinity. The formation of saltfingers is nonlinear and depends on many parameters such as initial stability and the ratio of diffusivities (Lewis and Prandtl Number). Double diffusive processes, such as saltfingering, are thought to have an impact on large scale processes by modifying transport and mixing processes. However, the details of large scale effects as a result of small scale mixing by saltfingering are still unclear.

In particular, saltfingers are interesting for

- the evolution of staircases (ranges from $1 - 100$m e.g. in Caribbean and Mediterranean Sea) and lamination
- the exchange of material through interfaces and mixing between layers to understand the structure of the resulting turbulent fluxes of temperature and salinity.

We address the latter point of interest with direct numerical simulations of saltfingers. In order to determine vertical effective diffusivities we estimated the effective fluxes of temperature and salinity from these simulations. The fingerwidth, which is near the Kolmogorov dissipation scale, is resolved by the grid resolution on a μm–scale. Our simulations illustrate the origin and decay of the turbulent structure of saltfingers in a small domain. After turbulent fluxes of temperature and salinity weaken, saltfingers become stationary. Furthermore we find an exponential diffusive decay of the finger structure. Our simulations provide a useful measure for existing parameterizations and they close gaps in the parameter range.