## Abstract View

Volume 15, Issue 11 (November 1985)

**Journal of Physical Oceanography**
Article: pp. 1542–1556 | Abstract | PDF (1.10M)

# Double-Diffusive Interleaving. Part II: Finite Amplitude, Steady State Interleaving

**Trevor J. McDougall**

*CSIRO, Division of Oceanography, Hobart, Tasmania, 7001, Australia*

(Manuscript received November 27, 1984, in final form June 7, 1985)

DOI: 10.1175/1520-0485(1985)015<1542:DDIPIF>2.0.CO;2

ABSTRACT

The exponentially growing solutions of the linear stability analysis of double-diffusive interleaving are allowed to grow to finite amplitude. At this stage the double-diffusive fluxes across the intrusion boundaries must be parameterized differently to those in the growing solution because every second finger interface becomes a diffusive interface in the steady state solution. Using the wavenumbers that are set by the initial, growing intrusions from the linear stability problem, together with the changed parameterization of the double-diffusive fluxes, it is shown that a steady state is reached. The ratio of the gradients of potential temperature and salinity along any particular intrusion is the same as in the linear stability analysis. When expressed in terms of density changes, this ratio is close to 0.9 rather than the commonly assumed value of 0.5 (being the buoyancy-flux ratio of a single salt finger interface). After solving for the velocity field, the isopycnal and diapycnal fluxes of potential temperature, salinity and density are formed. The diapycnal fluxes of potential temperature, salinity and density are all found to be up-gradient, implying negative diapycnal diffusivities for all three quantities. This is an unexpected and potentially important result. Following the approach of Garrett, a basin-average diapycnal diffusivity is estimated and is found to be of comparable size, but of opposite sign, to the modern day metric of $10^{-5}$ m$^2$ s$^{-1}$.