3.2 Potential enthalpy

Potential enthalpy h^0 is the enthalpy that a fluid parcel would have if its pressure were changed to a fixed reference pressure p_r in an isentropic and isohaline manner. Because heat fluxes into and out of the ocean occur mostly near the sea surface, the reference pressure for potential enthalpy is always taken to be p_r = 0 dbar (that is, at zero sea pressure). Potential enthalpy can be expressed as the pressure integral of specific volume as (from McDougall (2003) and see the discussion below Eqn. (2.8.2))

$$\begin{aligned} h^0\left(S_\mathrm{A},t,p\right) = h\left(S_\mathrm{A},\theta,0\right) = \tilde{h}^0\left(S_\mathrm{A},\theta\right) &= h\left(S_\mathrm{A},t,p\right) - \int_{P_0}^{P} v\left(S_\mathrm{A},\theta\left[S_\mathrm{A},t,p,p'\right],p'\right) dP' \\ &= h\left(S_\mathrm{A},t,p\right) - \int_{P_0}^{P} \hat{v}\left(S_\mathrm{A},\eta,p'\right) dP' \\ &= h\left(S_\mathrm{A},t,p\right) - \int_{P_0}^{P} \tilde{v}\left(S_\mathrm{A},\theta,p'\right) dP' \\ &= h\left(S_\mathrm{A},t,p\right) - \int_{P_0}^{P} \hat{v}\left(S_\mathrm{A},\Theta,p'\right) dP', \end{aligned} \tag{3.2.1}$$

and we emphasize that the pressure integrals here must be done with respect to pressure expressed in Pa rather than dbar. In terms of the Gibbs function, potential enthalpy h^0 is evaluated as

$$h^0\left(S_\mathrm{A},t,p\right) = h\left(S_\mathrm{A},\theta,0\right) = g\left(S_\mathrm{A},\theta,0\right) - \left(T_0+\theta\right) g_T\left(S_\mathrm{A},\theta,0\right). \tag{3.2.2}$$