(f) Flux Form of Tracers equations in (ξ, η, s, t)

Using the Flux form of the material derivative (4.6), after multiplying by $\frac{H_\theta}{mn}$, (1.2) becomes

$$\frac{\partial}{\partial t}\left(\frac{H_\theta T}{mn}\right) + \frac{\partial}{\partial \xi}\left(\frac{H_\theta u T}{n}\right) + \frac{\partial}{\partial \eta}\left(\frac{H_\theta v T}{m}\right) + \frac{\partial}{\partial s}\left(\frac{H_\theta \Omega T}{mn}\right) =$$

$$\frac{H_\theta}{mn}\frac{1}{H_\theta}\frac{\partial}{\partial s}\left(\frac{K_H}{H_\theta}\frac{\partial T}{\partial s}\right) + \frac{H_\theta}{mn}\left(\mathcal{D}_T + \mathcal{F}_T\right)$$

rearranging,

$$\boxed{\frac{\partial}{\partial t}\left(\frac{H_\theta T}{mn}\right) + \frac{\partial}{\partial \xi}\left(\frac{H_\theta u T}{n}\right) + \frac{\partial}{\partial \eta}\left(\frac{H_\theta v T}{m}\right) + \frac{\partial}{\partial s}\left(\frac{H_\theta \Omega T}{mn}\right) = \frac{\partial}{\partial s}\left(\frac{K_H}{H_\theta mn}\frac{\partial T}{\partial s}\right) + \frac{H_\theta}{mn}\left(\mathcal{D}_T + \mathcal{F}_T\right)}$$

4.22

Similarly, (1.3) becomes.

$$\boxed{\frac{\partial}{\partial t}\left(\frac{H_\theta S}{mn}\right) + \frac{\partial}{\partial \xi}\left(\frac{H_\theta u S}{n}\right) + \frac{\partial}{\partial \eta}\left(\frac{H_\theta v S}{m}\right) + \frac{\partial}{\partial s}\left(\frac{H_\theta \Omega S}{mn}\right) = \frac{\partial}{\partial s}\left(\frac{K_H}{H_\theta mn}\right)\frac{\partial S}{\partial s}\Big) + \frac{H_\theta}{mn}\left(\mathcal{D}_S + \mathcal{F}_S\right)}$$

(4.23)