The right-hand-side term of (13) is

$$\frac{\partial}{\partial t}(H_\theta q^2) = mn R_q + \cancel{mn}\frac{\partial}{\partial s}\left[\frac{K_Q}{\cancel{mn} H_\theta}\frac{\partial}{\partial s}(q^2)\right] + \cancel{mn}\frac{2H_\theta K_M}{\cancel{mn}}\left[\left(\frac{\partial u}{\partial z}\right)^2+\left(\frac{\partial v}{\partial z}\right)^2\right]$$

$$+ \cancel{mn}\frac{2H_\theta K_H N^2}{\cancel{mn}} - \cancel{mn}\frac{2H_\theta q^3}{\cancel{mn} B_1 l}$$

or

$$\boxed{\frac{\partial}{\partial t}(H_\theta q^2) = mn R_q + \frac{\partial}{\partial s}\left[\frac{K_Q}{H_\theta}\frac{\partial}{\partial s}(q^2)\right] + 2H_\theta K_M\left[\left(\frac{\partial u}{\partial z}\right)^2+\left(\frac{\partial v}{\partial z}\right)^2\right] + 2H_\theta K_H N^2 - \frac{2H_\theta q^3}{B_1 l}} \quad (22)$$

$\frac{1}{s} m \frac{m^2}{s^2} = \frac{m^3}{s^3}$ $\quad \frac{1}{m}\frac{1}{m}\frac{m^5}{s^3} = \frac{m^3}{s^3}$ $\quad \frac{1}{\cancel{m}}\frac{m^2}{s}\frac{m^2}{s^2} = \frac{m^3}{s^3}$ $\quad m\frac{m^2}{s}\left(\frac{m}{s}\frac{1}{m}\right)^2 = \frac{m^3}{s^3}$ $\quad m\frac{m^2}{s}\frac{1}{s^2} = \frac{m^3}{s^3}$ $\quad \frac{m^2}{m}\frac{m^2}{s^2}\frac{m}{s} = \frac{m^3}{s^3}$

where

$$\boxed{R_q = -\frac{\partial}{\partial\xi}\left(\frac{H_\theta u q^2}{n}\right) - \frac{\partial}{\partial\eta}\left(\frac{H_\theta v q^2}{m}\right) - \frac{\partial}{\partial s}\left(\frac{H_\theta \Omega q^2}{mn}\right) + \frac{H_\theta}{mn}\mathcal{D}_q} \quad (23)$$

$m\frac{m}{s}\frac{1}{1/m}\frac{m^2}{s^2} = \frac{m^5}{s^3}$ $\quad \frac{m^5}{s^3}$ $\quad m\frac{1}{s}\frac{1}{1/m}\frac{1}{1/m}\frac{m^2}{s^2} = \frac{m^5}{s^3}$ $\quad \frac{m^5}{s^3}$

horizontal mixing

(1) Laplacian

$$\frac{H_\theta}{mn}\mathcal{D}_q = A_H\,\mathcal{L}(q^2) = A_H\left[\frac{\partial}{\partial\xi}(F_q^\xi) + \frac{\partial}{\partial\eta}(F_q^\eta)\right] \quad (24)$$

$\frac{m^2}{s}\frac{m^3}{s^2} = \frac{m^5}{s^3}$

where

$$F_q^\xi = \frac{m}{n}H_\theta\frac{\partial}{\partial\xi}(q^2) \quad (25)$$

$$F_q^\eta = \frac{n}{m}H_\theta\frac{\partial}{\partial\eta}(q^2) \quad (26)$$

$m\frac{m^2}{s^2} = \frac{m^3}{s^2}$