2.- General s vertical coordinate

@ The vertical coordinate used in SCRUM is a terrain-following coordinate, such that

$$z(x,y,s,t) = (1+s)\zeta(x,y,t) + h_c s + (h(x,y) - h_c)\, C(s) \qquad (2.1)$$

where $C(s)$ is a set of s-curves, defined by

$-1 \le s \le 0$

$z(s=0) = \zeta(x,y,t)$

$z(s=-1) = -h(x,y)$

$$C(s) = (1-b)\frac{\sinh(\theta s)}{\sinh\theta_R} + b\,\frac{\tanh[\theta(s+\frac{1}{2})] - \tanh(\frac{\theta}{2})}{2\tanh(\frac{\theta}{2})} \qquad (2.2)$$

$C(s=0) = 0$; $C(s=-1) = -1$

where $\zeta(x,y,t)$ is the free surface, h_c is a constant chosen to be the minimum depth of the bathymetry or a width of surface or bottom boundary layer in which higher resolution is required; $h(x,y)$ is the bottom topography, and θ and b are the surface and bottom control parameters.

$$0 \le \theta \le 20 \qquad (2.3)$$

$$0 \le b \le 1 \qquad (2.4)$$

It is convinient to define,

$$H_\theta \equiv \frac{\partial z}{\partial s} = (s+h_c) + (h-h_c)\frac{\partial C}{\partial s} \qquad (2.5)$$

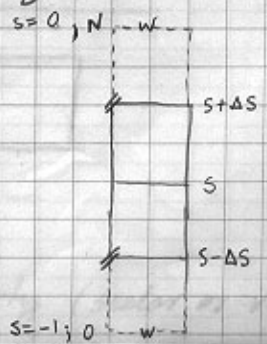
where

$$\frac{\partial C}{\partial s} = (1-b)\frac{\cosh(\theta s)}{\sinh\theta}\theta + b\,\frac{\coth(\frac{\theta}{2})}{2\cosh^2(\theta(s+\frac{1}{2}))}\theta \qquad (2.6)$$

Vertical tranformation identity

$$\frac{\partial}{\partial z} = \frac{1}{H_\theta}\frac{\partial}{\partial s}$$

$$\delta_z = \frac{1}{H_\theta \Delta s}\delta_s$$



s is divided in number of levels equal parts

$\Delta s = \frac{1}{N}$

N: number of levels