CENTERED MULTI-POINT FORWARD-BACKWARD SCHEME

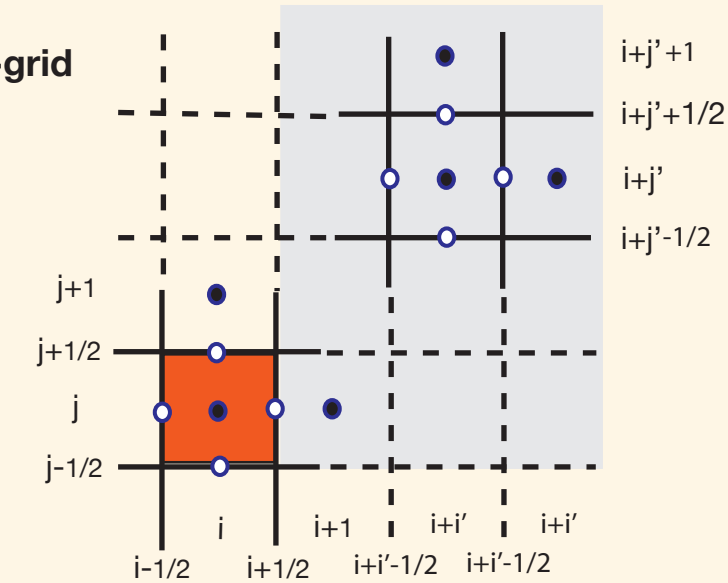
FOR LINEARIZED 2D SHALLOW-WATER EQUATIONS

$$\frac{\partial h}{\partial t} = -H\left(\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y}\right)$$

$$\frac{\partial u}{\partial t} = -g\frac{\partial h}{\partial x}$$

$$\frac{\partial v}{\partial t} = -g\frac{\partial h}{\partial y}$$

2D C-grid



Let $D^n_{i,j} \equiv u^n_{i+1/2,j} - u^n_{i-1/2,j} + v^n_{i,j+1/2} - v^n_{i,j-1/2}$, $HX^n_{i+1/2,j} \equiv h^n_{i+1,j} - h^n_{i,j}$, $HY^n_{i,j+1/2} \equiv h^n_{i,j+1} - h^n_{i,j+1}$.

$$h^{n+1}_{i,j} = h^n_{i,j} - \frac{H\Delta t}{d}\left[a_0 D^n_{i,j} + \sum_{i'=1}^{J}\sum_{j'=0}^{J} a_{i',j'}\left(D^n_{i+i',j+j'} + D^n_{i-i',j+j'} + D^n_{i-i',j-j'} + D^n_{i+i',j-j'}\right)\right]$$

$$u^{n+1}_{i+1/2,j} = u^n_{i+1/2,j} - \frac{g\Delta t}{\Delta x}\left[a_0 HX^{n+1}_{i+1/2,j} + \sum_{i'=1}^{J}\sum_{j'=0}^{J} a_{i',j'}\left(HX^{n+1}_{i+i'+1/2,j+j'} + HX^{n+1}_{i-i'+1/2,j+j'} + HX^{n+1}_{i-i'+1/2,j-j'} + HX^{n+1}_{i+i'+1/2,j-j'}\right)\right]$$

$$v^{n+1}_{i,j+1/2} = v^n_{i,j+1/2} - \frac{g\Delta t}{\Delta x}\left[a_0 HY^n_{i,j+1/2} + \sum_{i'=1}^{J}\sum_{j'=0}^{J} a_{i',j'}\left(HY^{n+1}_{i+i',j+j'+1/2} + HY^{n+1}_{i-i',j+j'+1/2} + HY^{n+1}_{i-i',j-j'+1/2} + HY^{n+1}_{i+i',j-j'+1/2}\right)\right]$$