

# A More Accurate Two-phase Hydro-sediment-morphodynamic Model

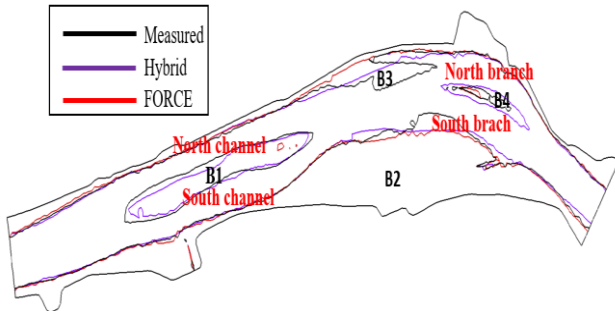
## Achieving Reduction in the Computational Cost

Binghan Lyu, Peng Hu\*, Ji Li, Zhixian Cao, Wei Li and Zhiguo He

### Background



Fig.1 Satellite imagery of Taipingkou Waterway.



### Case Study (Palumbo et al., 2008)

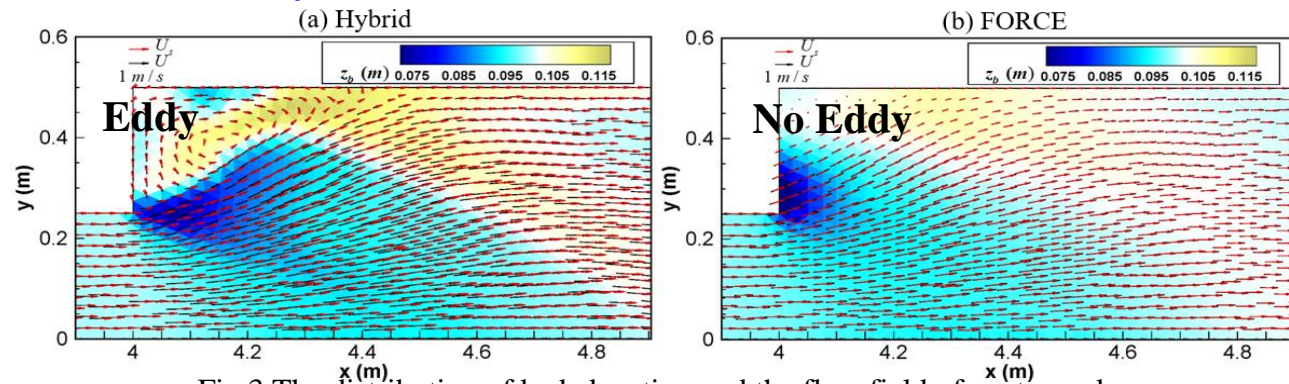


Fig.3 The distribution of bed elevation and the flow field of water and sediment in  $t=4s$ : (a) Hybrid (b)FORCE.

### Two-phase model

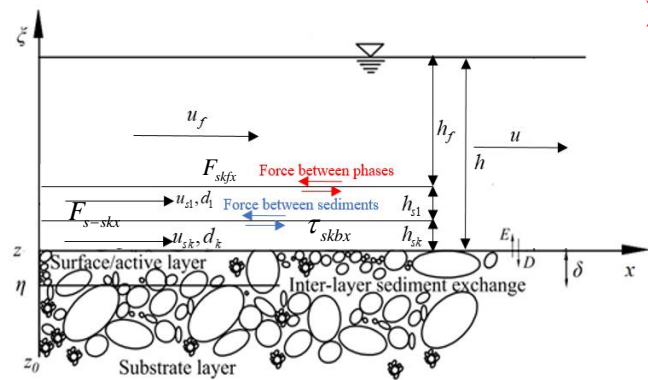


Fig.2 Sketches of the two-phase hydro-sediment-morphodynamic model

#### Interaction Force

$$\tau_{skbx} = (\rho_s - \rho_f) g h c_k \tan \phi_{bed} \frac{u_{sk}}{\sqrt{u_{sk}^2 + v_{sk}^2}}$$

$$F_{skfx} = \rho_f D_{rk} h (u_f - u_{sk})$$

$$F_{s-skx} = \frac{1}{2} C \rho g h^2 c_k \frac{\partial}{\partial x} \left( \frac{c_k}{C} \right) - \rho_s \frac{c_k}{C} c_{sd} (u_{sk} - \bar{u}_s) h c_k - \rho_s v_d h c_k \frac{\partial}{\partial x} \left( \frac{c_k}{C} \right)$$

### Numerical Methods

- Discretization: **Shock-Capturing Finite Volume Methods**
- Time Step: **Hybrid LTS/GMATS (Hu et al. 2019)**
- Convection Flux: **Hybrid HLLC-FORCE Operator**

➤ Hybrid scheme can effectively improve calculation accuracy.

➤ Compared with the improvement of calculation accuracy, the extra time cost can be ignored.

**If you are interested in more information, please join my group !**

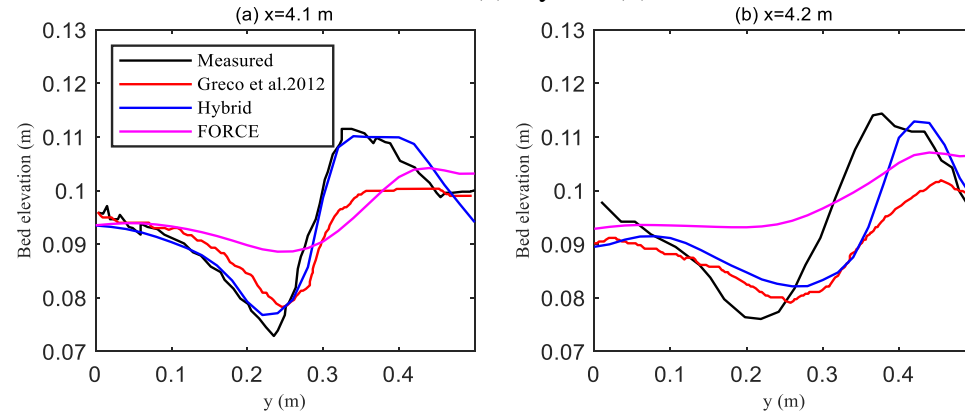


Fig.4 Bed elevation along with the y-direction at (a)  $x=4.1$  m, (b)  $x=4.2$  m