

SEDIMENT MODELING AND IT'S APPLICATION IN HUDSON RIVER

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Motivation:

To monitor and predict pathways of chemical contaminant in Estuary, Rivers, Ocean and etc.

Basic Research Method

The Governing Equations

$$\nabla \cdot \vec{v} + \frac{\partial W}{\partial z} = 0$$

$$\frac{\partial U}{\partial t} + \vec{v} \cdot \nabla U + W \frac{\partial U}{\partial z} - fV = -\frac{1}{\rho_0} \frac{\partial P}{\partial x} + \frac{\partial}{\partial z} \left(K_M \frac{\partial U}{\partial z} \right) + F_x$$

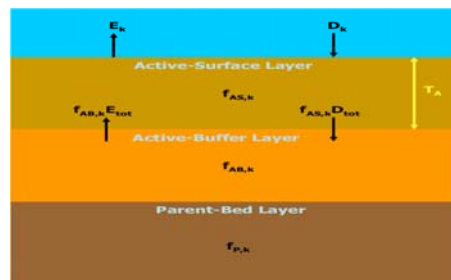
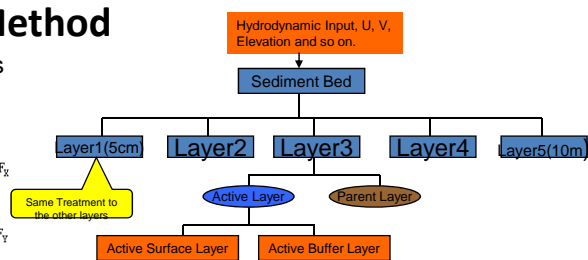
$$\frac{\partial V}{\partial t} + \vec{v} \cdot \nabla V + W \frac{\partial V}{\partial z} + fU = -\frac{1}{\rho_0} \frac{\partial P}{\partial y} - \frac{\partial}{\partial z} \left(K_M \frac{\partial V}{\partial z} \right) + F_y$$

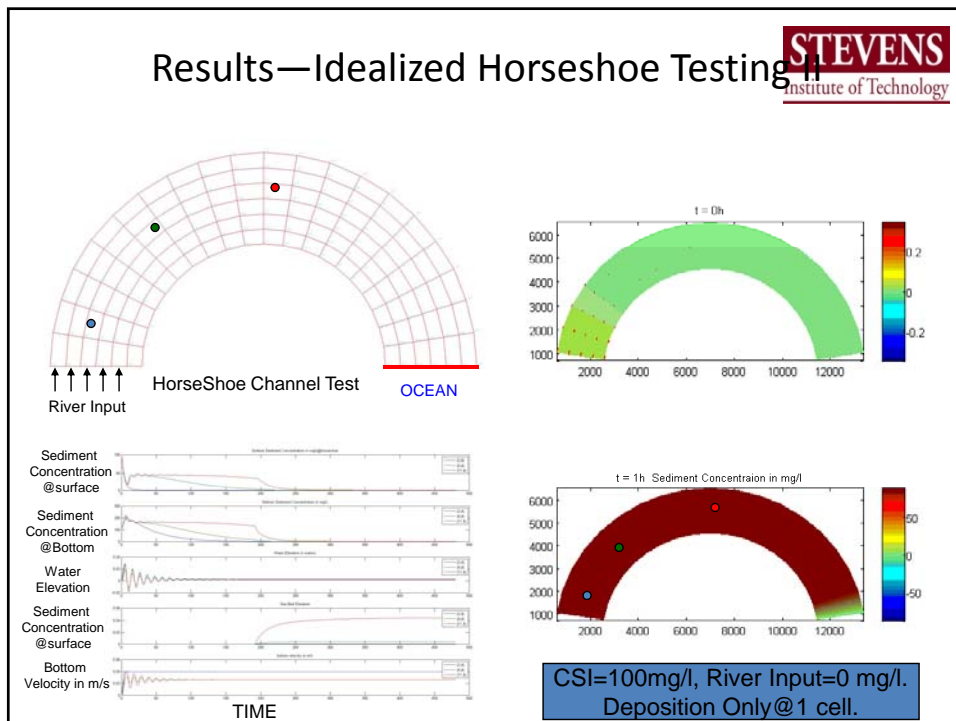
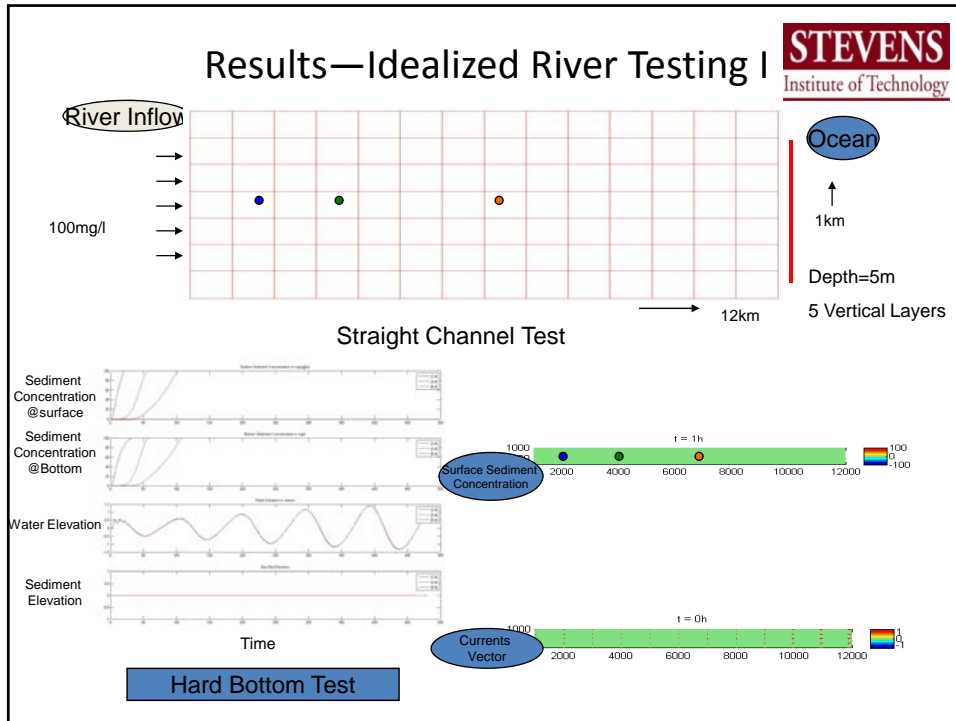
$$\rho_0 g = -\frac{\partial P}{\partial z}$$

The three-dimensional advection-dispersion equation for transport of sediment of size class k (k = 1,2)

$$\frac{\partial C_k}{\partial t} + \frac{\partial UC_k}{\partial x} + \frac{\partial VC_k}{\partial y} + \frac{\partial (W - W_{s,k})C_k}{\partial z} = \frac{\partial}{\partial x} \left(A_{II} \frac{\partial C_k}{\partial x} \right) + \frac{\partial}{\partial y} \left(A_{II} \frac{\partial C_k}{\partial y} \right) + \frac{\partial}{\partial z} \left(K_{II} \frac{\partial C_k}{\partial z} \right)$$

FLOW CHART





Advantages of this Research

- 1) three-dimensional transport of suspended sediment in the water column;
- 2) use of Sedflume core data to specify erosion rate parameters;
- 3) spatially variable bed properties;
- 4) sediment bed model that tracks temporal changes in bed composition (i.e., sediment particle size, sediment source);
- and 5) bedload transport of sand.



Future Product

- Apply SEDZLJ model to predict and monitor sediment transportation in Hudson River

Next Step Research

1. Complete Horseshoe Testing
2. Put SEDZLJ Model into Hudson River and Integrate it into NYHOPS

Limitations:

1. The theory of Sediment Transportation is still not fully understood.
2. Understanding of Sediment Classification need to be furthered
3. SedFlume Core data is different with realistic environment