SEDIMARE

Sediment Transport and Morphodynamics in Marine and Coastal Waters with Engineering Solutions

Multi-model approach to scour in dynamic areas

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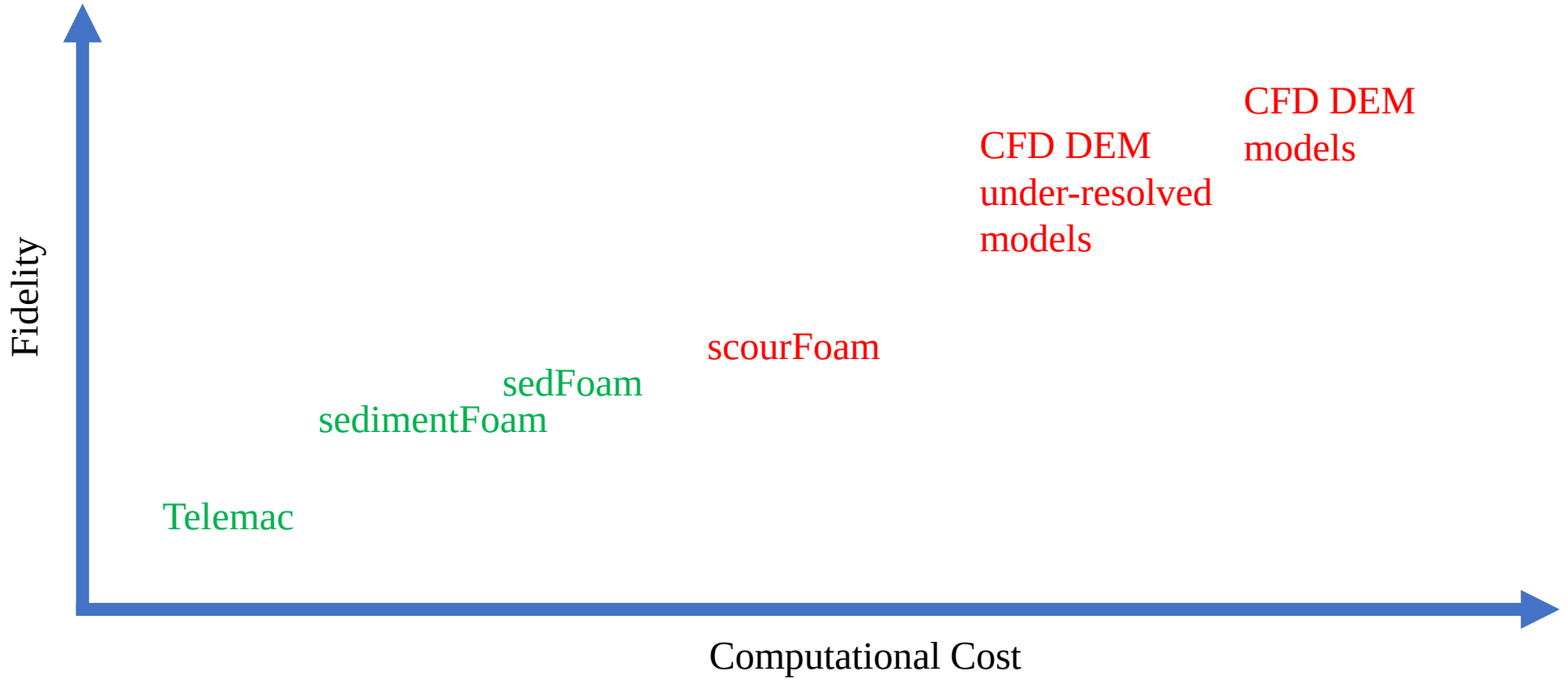
Contents

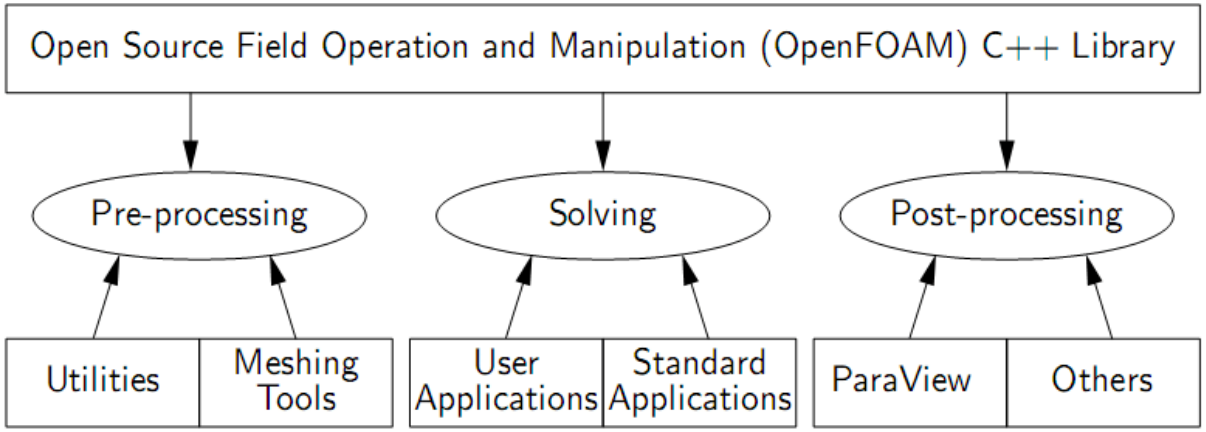
Objective & State of the Art

- To investigate and develop methods for extracting/deriving information from the CFD model to improve the accuracy and resolution of the large-scale simulations.



OpenFOAM

- An open-source CFD toolbox that provides ready-to-use **solvers**, **utilities**, and **libraries**.
- Offers a versatile collection of efficient, **object-oriented C++ modules**.
- Utilizes the **Finite-Volume Method (FVM)** to solve systems of partial differential equations on any **3D unstructured** polyhedral cell mesh.
- Supports efficient **parallelization**.



sedFoam: Numerical Modelling

Inputs

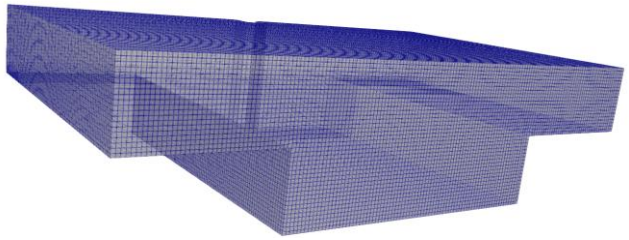
Experimental Data

- Obtaining the transport properties of sand and water phase used in Flumes experiment.
- Use the geometrical dimensions of cofferdam models.
- Using the input flow velocity

Solver

Two-phase Eulerian RANS OpenFOAM

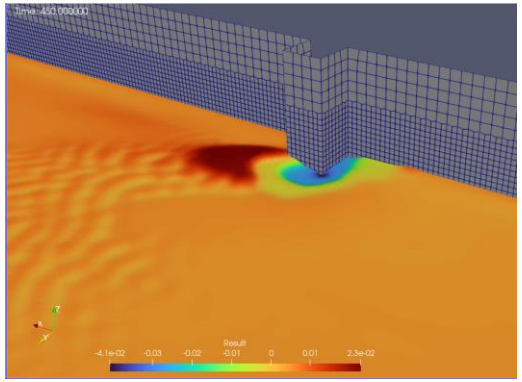
- Creating 3D domain
- Using sedFoam :
  - Granular Rheology properties (muI)
  - Interfacial properties (drag model)
  - Transport properties
  - Modified Two-phase RAS equations



Outputs

Scour Depth

- Estimation of volume fraction of water and sand to predict the bed formation.
- Comparison with experiments



Experimental Data

- To develop a numerical model for the behaviours of scour using experiments performed on cofferdam models
- General Purpose Flume
  - Dimensions (25m long, 2.4m wide and 0.9m deep)
  - 0.5m deep bed with medium grained sand.
  - Flow discharge, Flow velocity and Water levels are recorded.
  - Duration of experiment: 50-75 hours

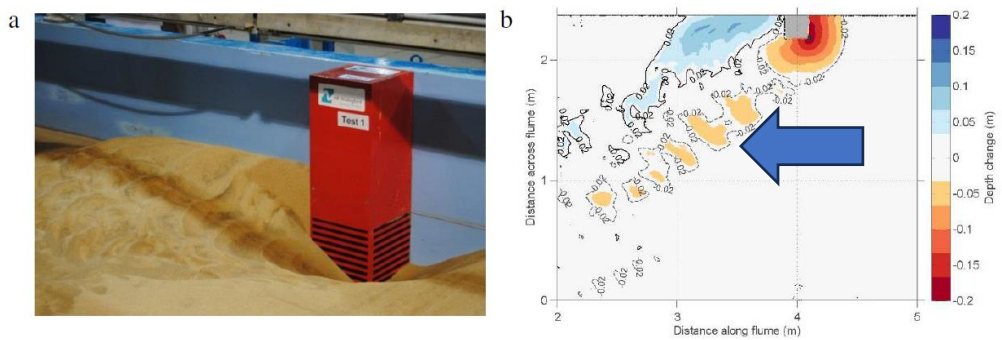
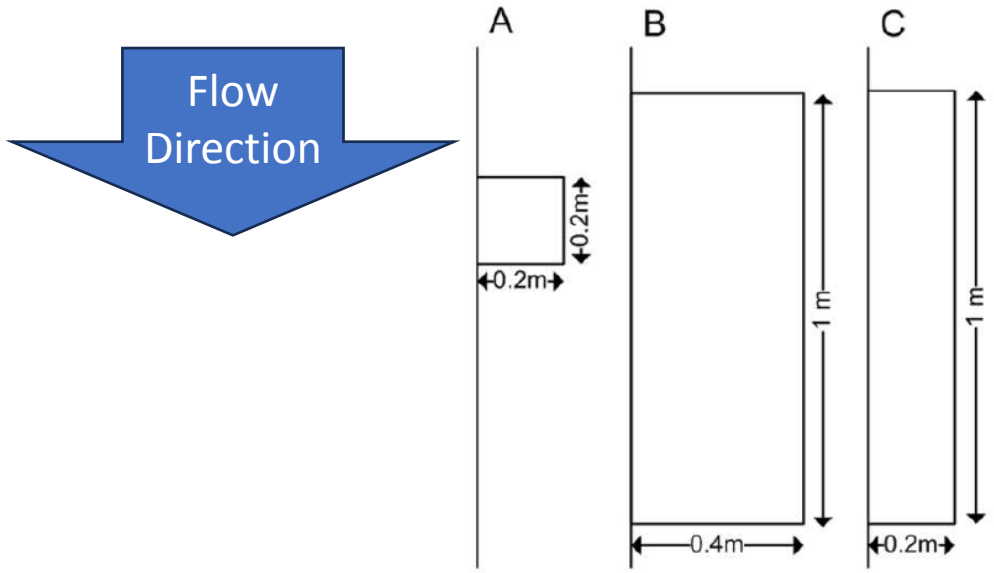


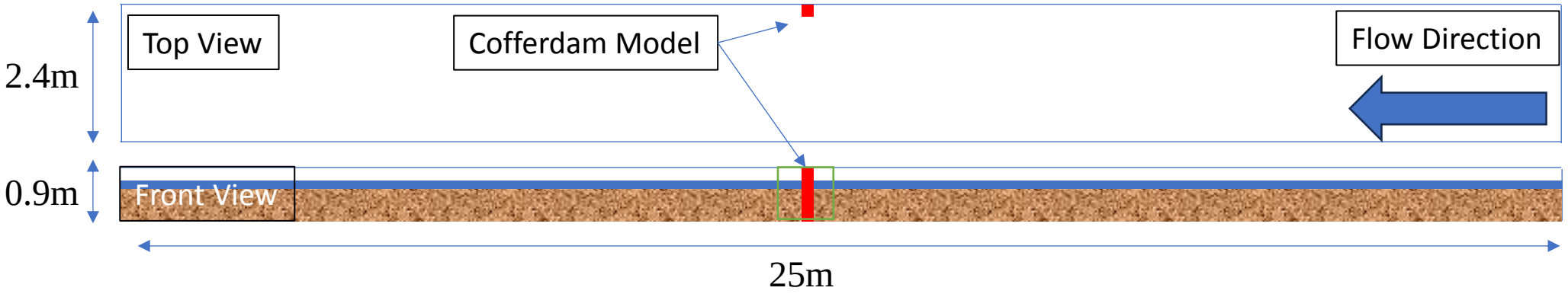
Figure 2: Test 1 result (flow from right to left); a. photograph of the post-test result (black and red graduations at 10 mm spacing) and b. difference in bed elevation between start and end of test.

Richard J.S Whitehouse, 2021

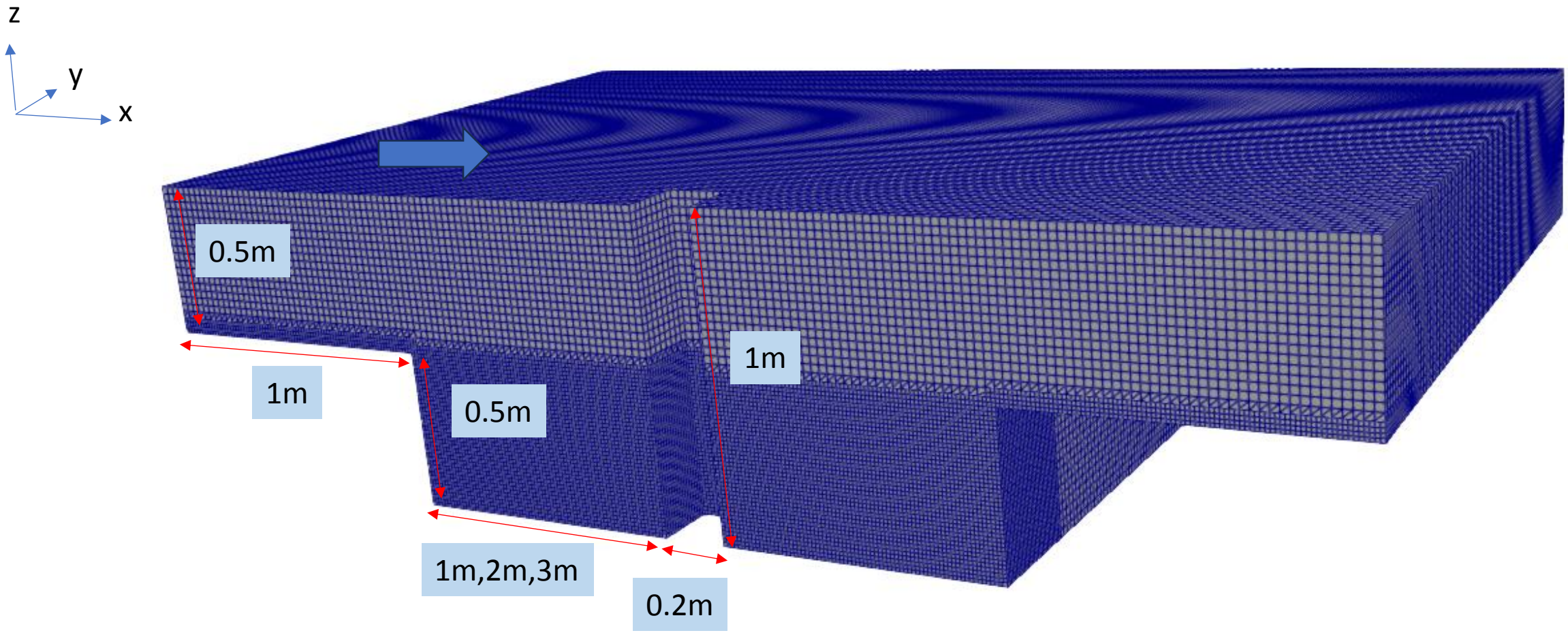
Experimental Data

- Inputs from Experiments
  - Grains (quartz sand):
    - d_{10}= 0.326mm
    - **d_{50}= 0.525mm**
    - d_{90}= 0.673mm
  - Flow speeds : **0.177m/s, 0.244m/s** (currents)
  - Water depths : **0.2m, 0.1m**
- Geometries of cofferdams
- Dimensions of the Flume





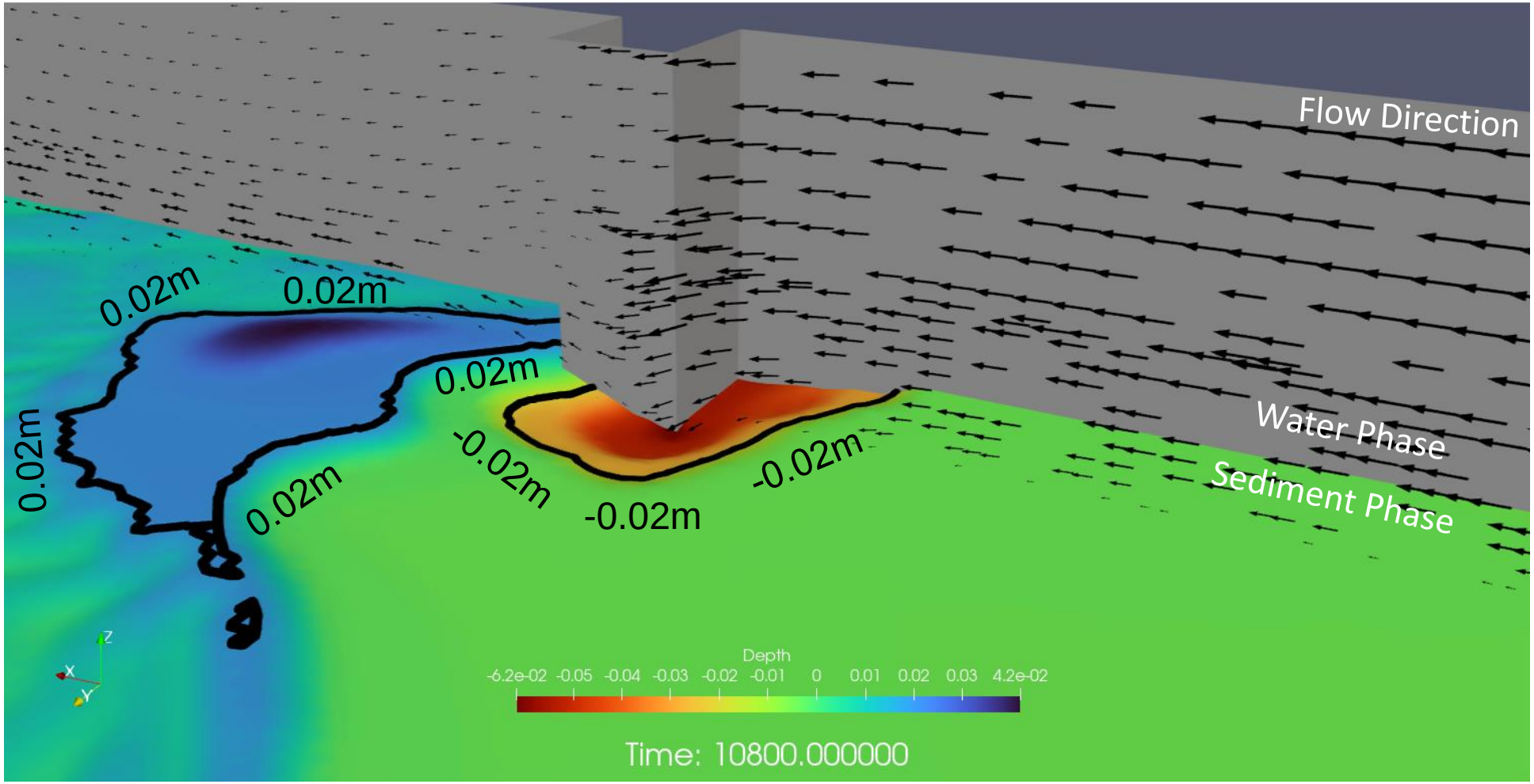
Domain



Total Cells = 596844

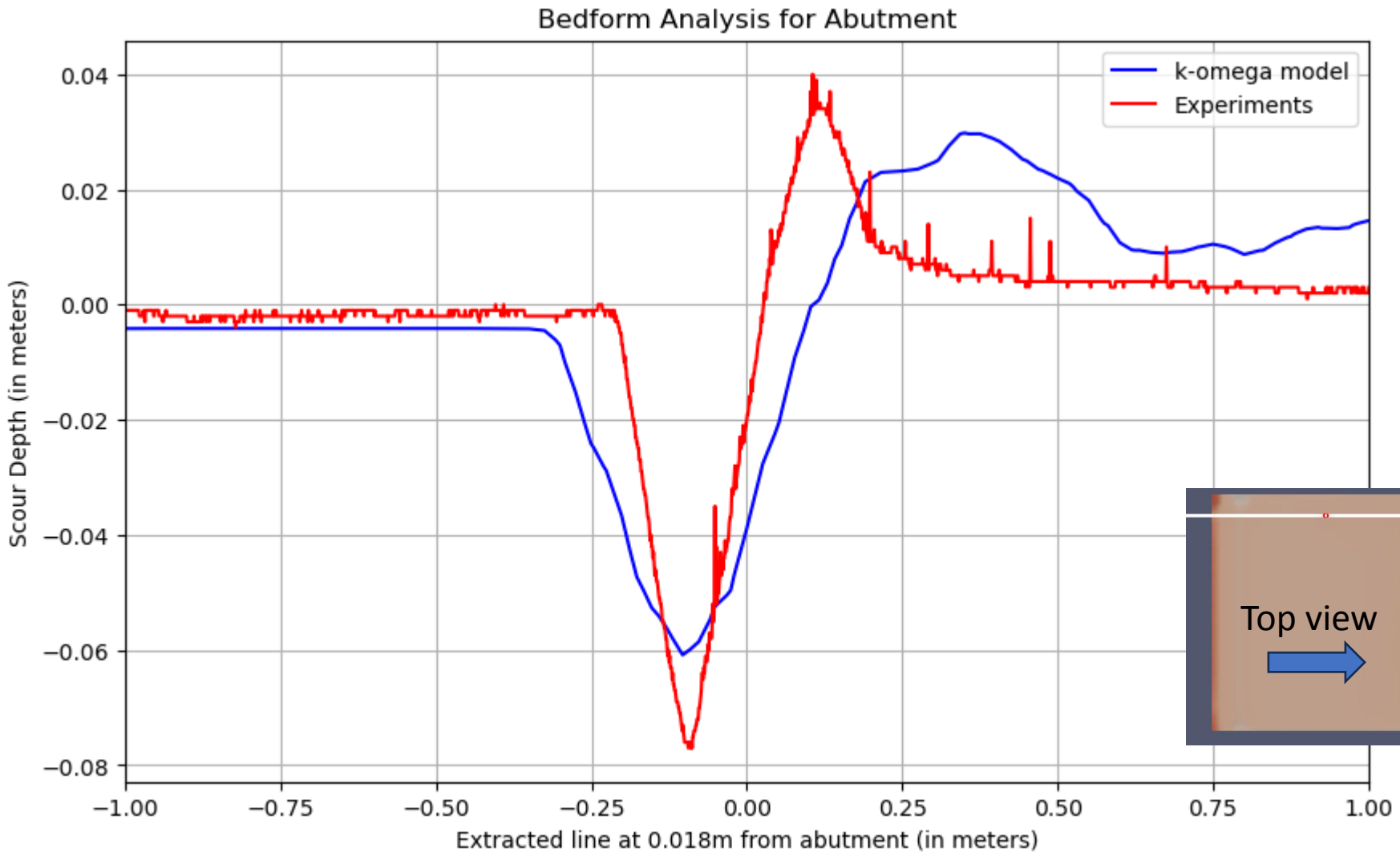
Results

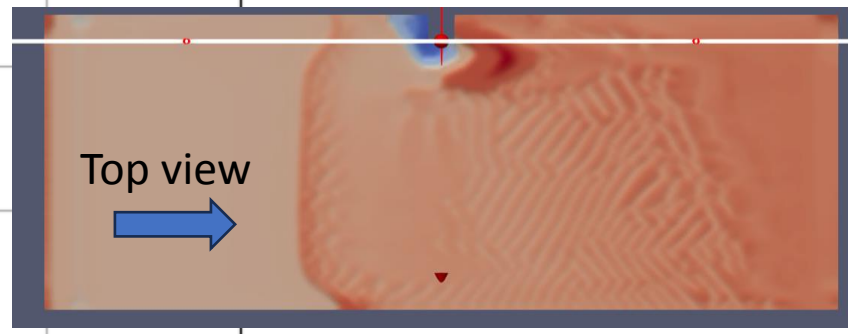
Bedform evolution (Surface Elevation) after 3 hours



Results

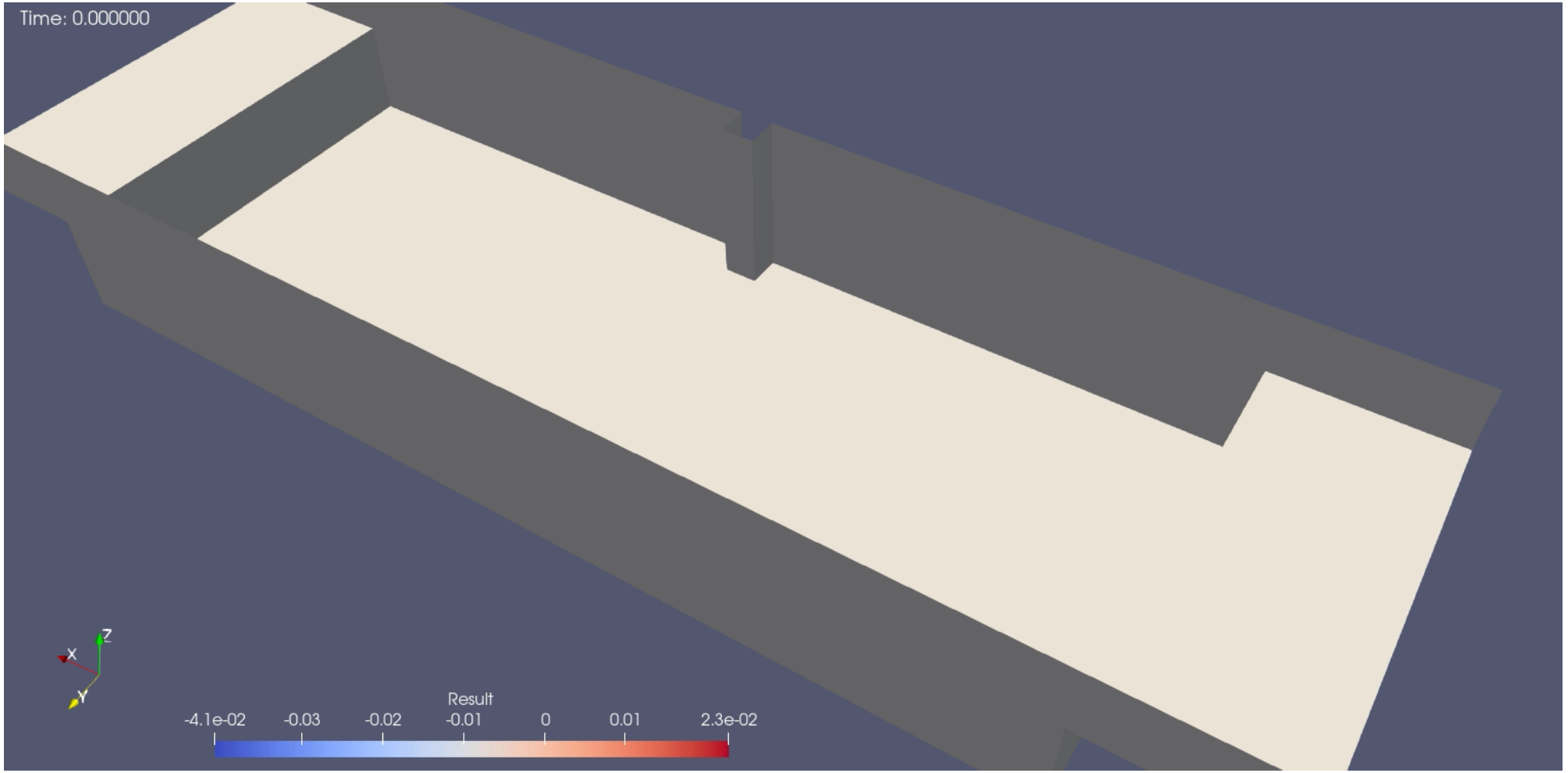
Bedform comparison at 3hr (scour depth: surface elevation)





Results

Bedform evolution (Surface Elevation)



Thank you for your attention!