

BASEMENT Users' Meeting online 2021

**Investigation of landslide tsunami
using BASEMENT (version 2.8)**

Jiang Yujie, Li Jian

China University of Geosciences (Wuhan)

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BASEMENT Anwendertreffen 2021

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Outlines

- Why I choose BASEMENT to study my project (Landslide tsunami)?**
- Modelling an experimental landslide tsunami (Sue's experiment)**
- Investigate an physical experiment of landslide tsunami (Monai Experiment)**
- Future work**

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➤ Why I choose BASEMENT to study my project (Landslide tsunami)?

- I. Friendly interface , powerful function**
- II. OpenMP multi-threads parallelisation**
- III. Built-in visualization(BASEvis)**
- IV. Output files within multiple formats**

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- **Modelling an experimental landslide tsunami (Sue's experiment)**

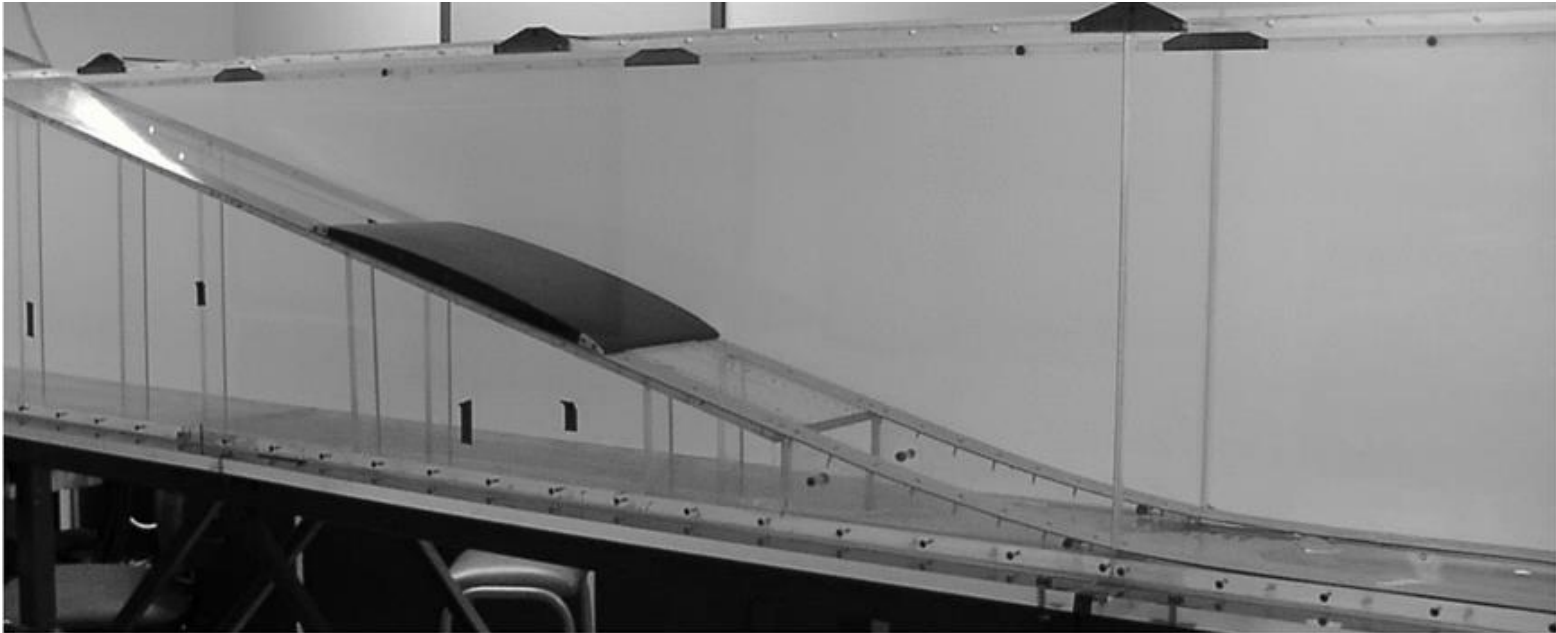


Figure 1 Experimental set-up for submarine landslide-induced tsunami(Sue,2006)

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➤ Modelling an experimental landslide tsunami (Sue's experiment)

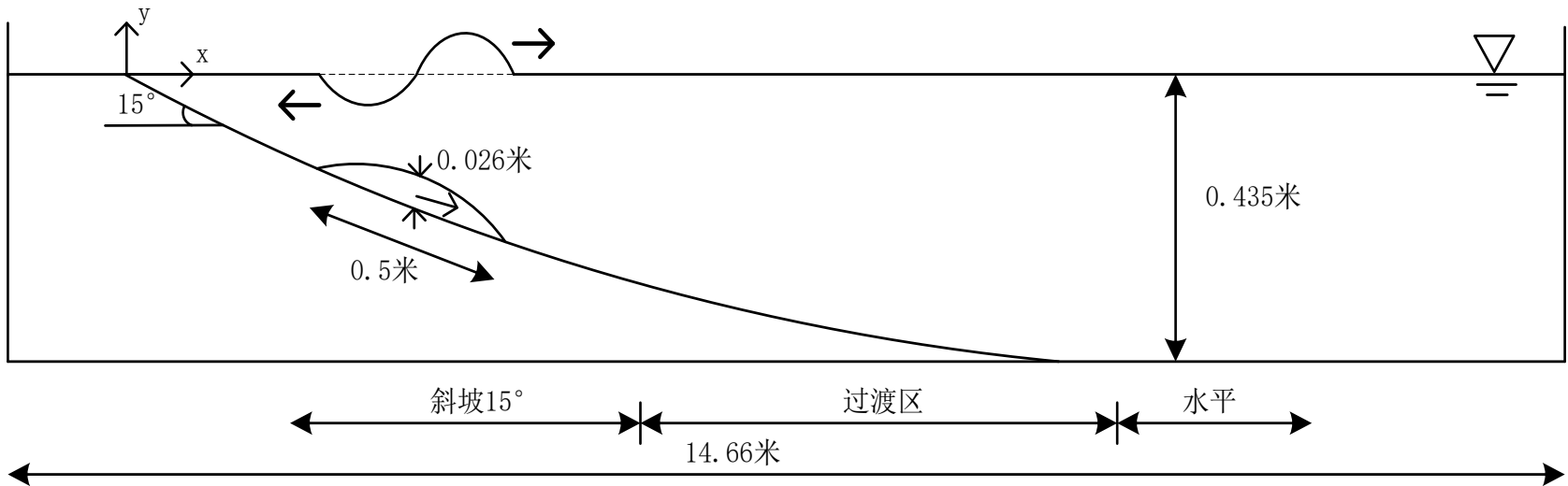


Figure 2 Slide view of the experiment (Sue, 2006)

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➤ Modelling an experimental landslide tsunami (Sue's experiment)

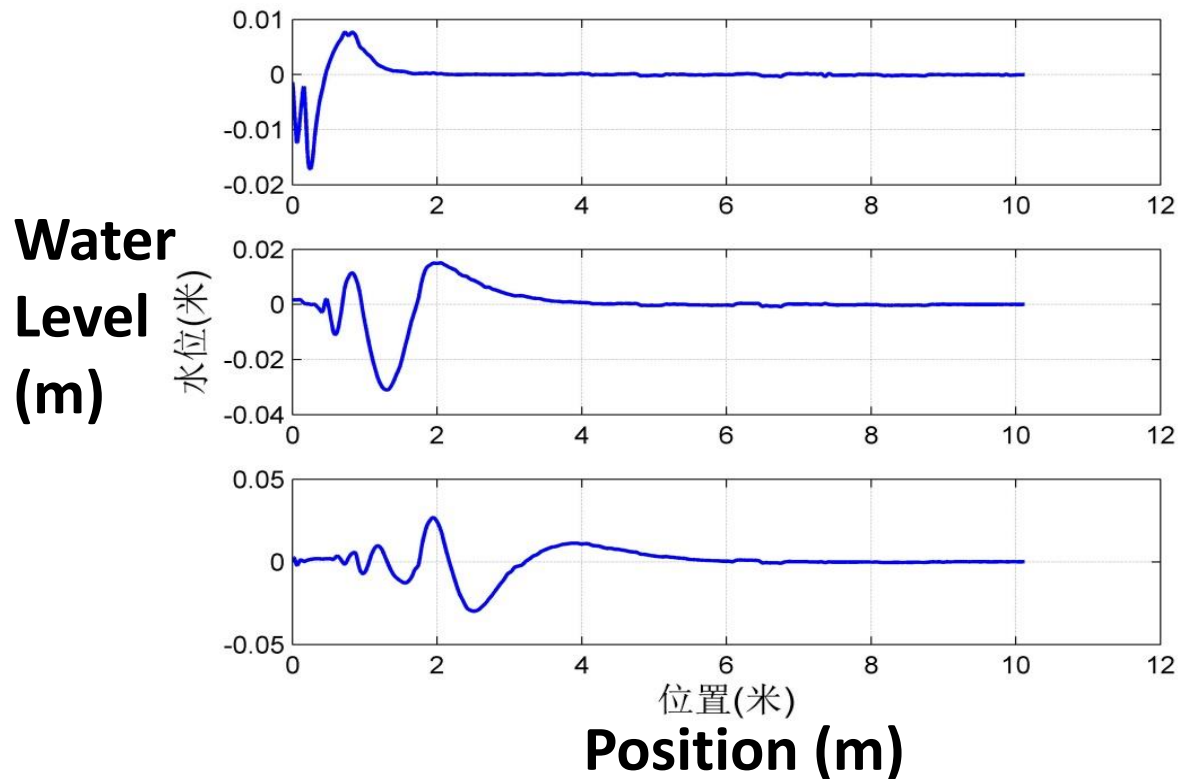
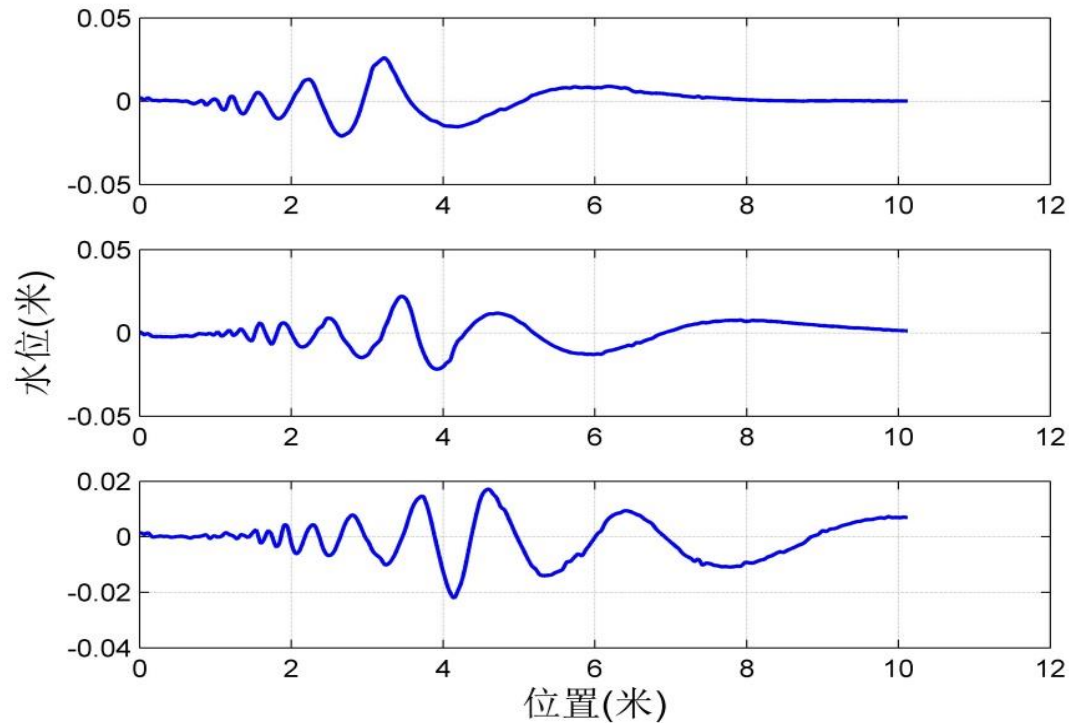


Figure 3 Experimental results of water levels at $t=0.6, 1.6, 2.6s$ (Sue, 2006)

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➤ Modelling an experimental landslide tsunami (Sue's experiment)



**Figure 4 experimental result of water levels at
t=3.6,4.6,5.6s(Sue,2006)**

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➤ Modelling an experimental landslide tsunami (Sue's experiment)

Tsunami wave propagation process reproduced by

BASEMENT:

- I. Domain discretized by BASEmesh**
- II. Initial simulation with input waves by BASEMENT**
- III. Event-driven water levels were created by CGNSview tool**
- IV. Compare the simulated results with measured results**

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The screenshot displays the CGNSview application window. On the left, a 'Node Tree' shows a hierarchical structure of simulation data. A red box highlights a series of 'FlowEle' nodes under the 'Depth' category, with values ranging from 1.600000 to 8.000000. An arrow points from this box to a large red text block on the left side of the image.

The main window shows the 'Node Description' for a selected node: '/base/zone_unstructured/FlowEle' with a value of 0.600000. Below this, the 'Link Description' and 'Data Description' are visible. The 'Data Description' shows a data type of 'R8', dimensions of '8511', and a size of '68088' bytes. At the bottom of the data description, there are buttons for 'create', 'modify', 'read', 'clear', and 'delete'.

The 'Node Data' section contains a large grid of numerical values, representing the simulated water level data. A red box highlights this data grid, with an arrow pointing from it to a large red text block on the right side of the image.

At the bottom of the window, the status bar shows 'Line 1 (1)' and 'Values/Line 10'.

5 snapshots of simulated water level corrected with Sue's observational data

Observational tsunami wave water level data

CGNSview window

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➤ Modelling an experimental landslide tsunami (Sue's experiment)

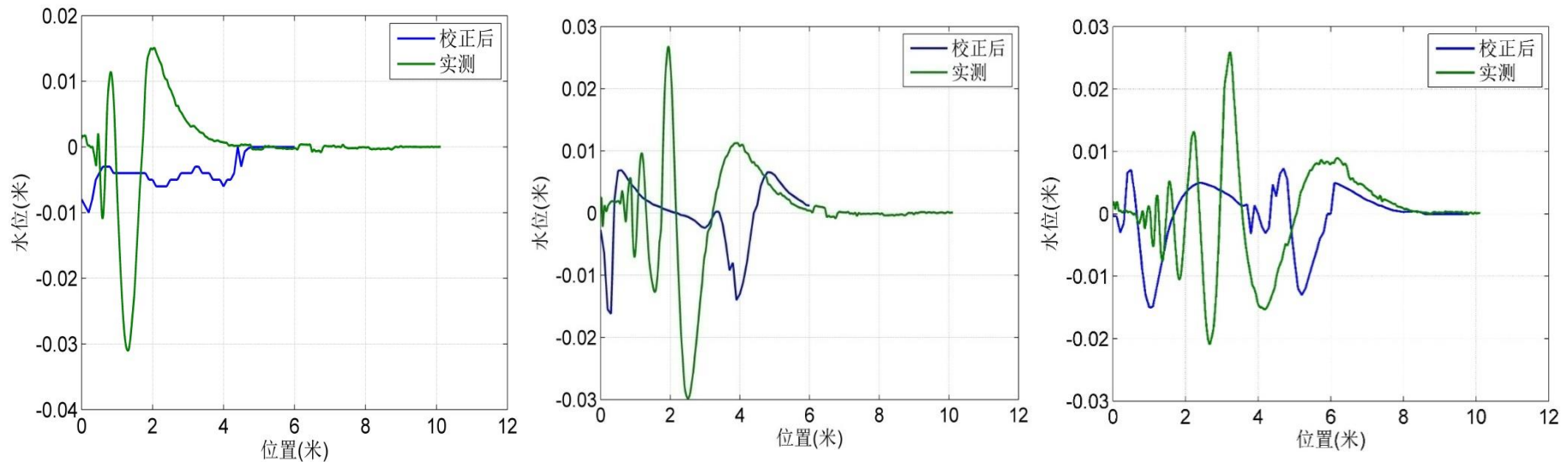


Figure 5 The comparison between measured and corrected results at t=1.6s,2.6s,3.6s

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➤ Modelling an experimental landslide tsunami (Sue's experiment)

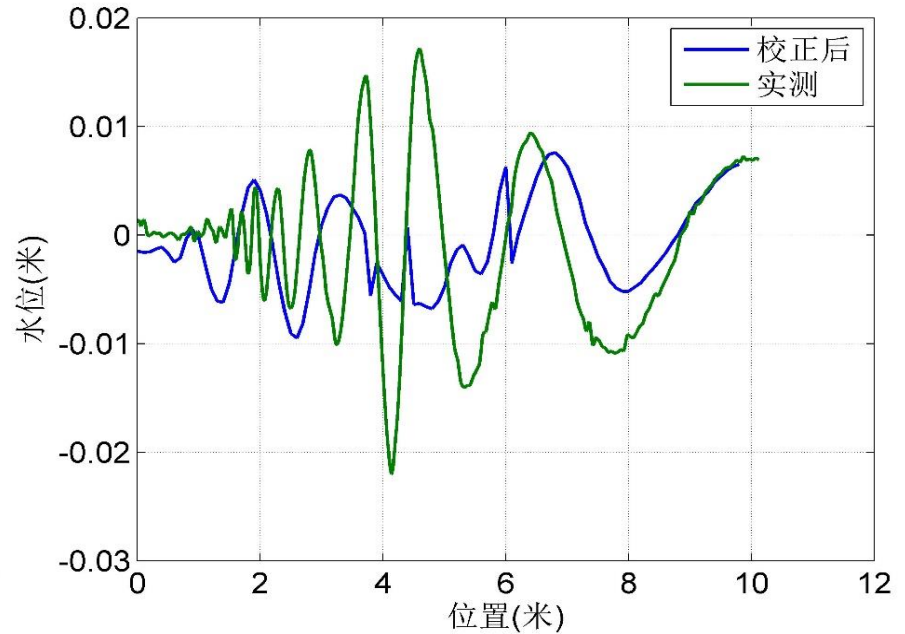
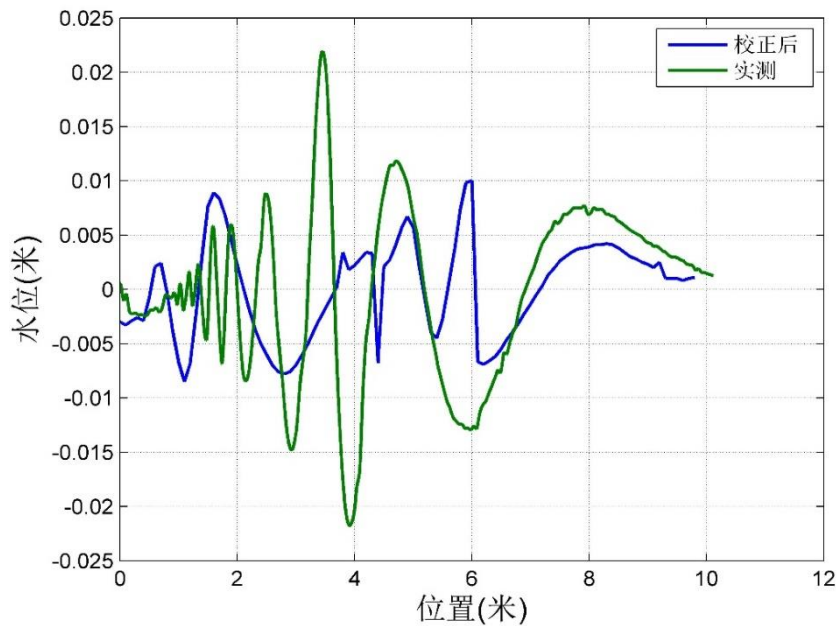


Figure 6 The comparison between measured and corrected simulated results at t=4.6s, 5.6s.

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➤ Modelling an experimental landslide tsunami (Sue's experiment)

Preliminary results:

- I. The landslide process plays an significant role in the whole landslide tsunami waves.**
- II. It's hard to simulate the real wave propagation process by the pure hydrodynamic code for landslip events.**
- III. Coupled simulation between geomechanic and hydrodynamic models could be more suitable to reproduce the real process especially at the starting stages**

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- Investigate an physical experiment of landslide tsunami (Monai Experiment)

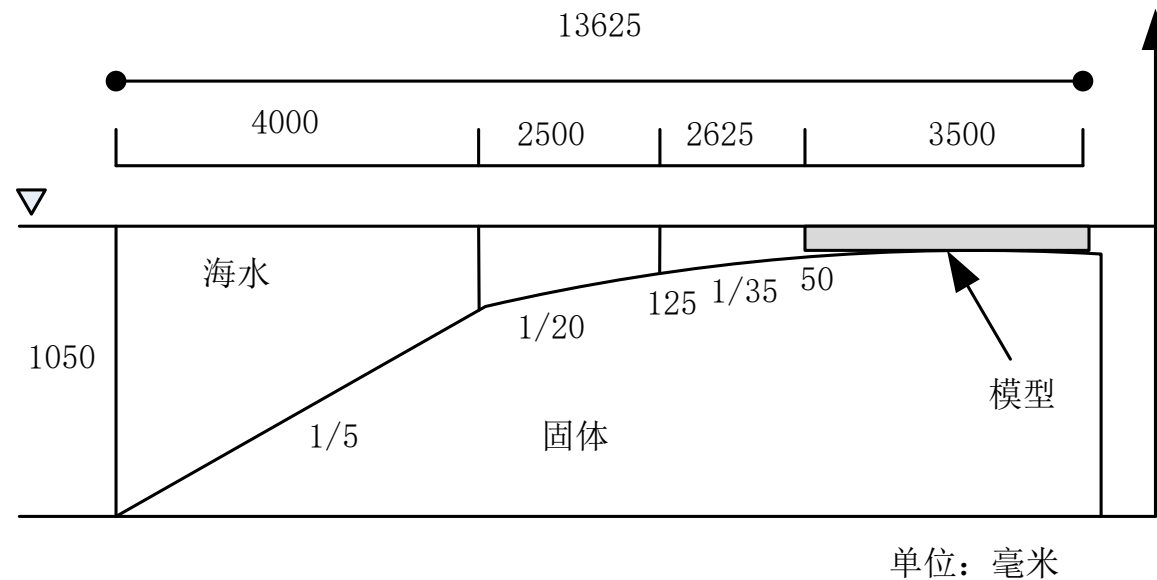


Figure 7 The physical setup of Monai experiment(NOAA)

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- Investigate Monai experiment on landslide tsunami

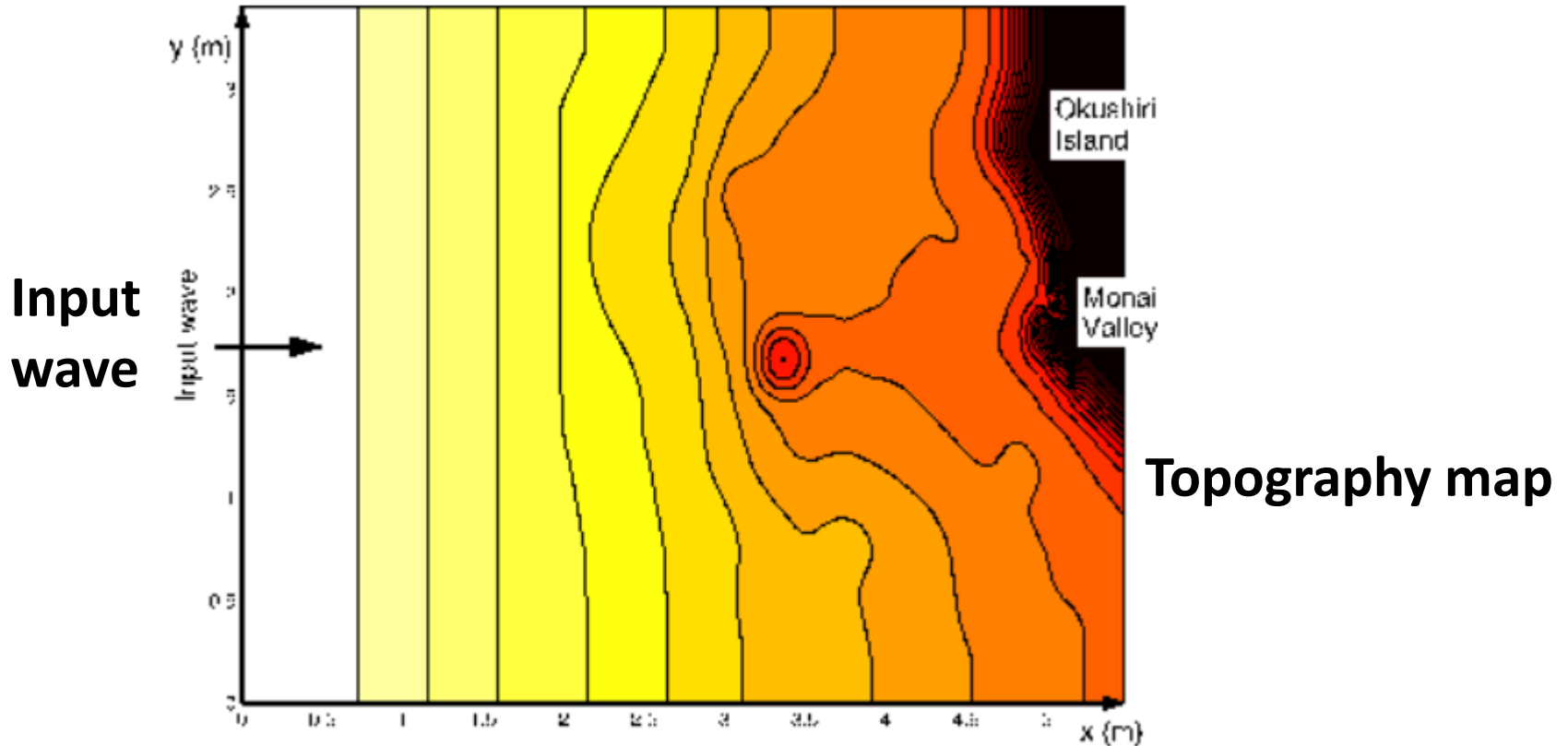


Figure 8 Configuration of Monai simulation(NOAA)

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➤ Investigate Monai experiment on landslide tsunami

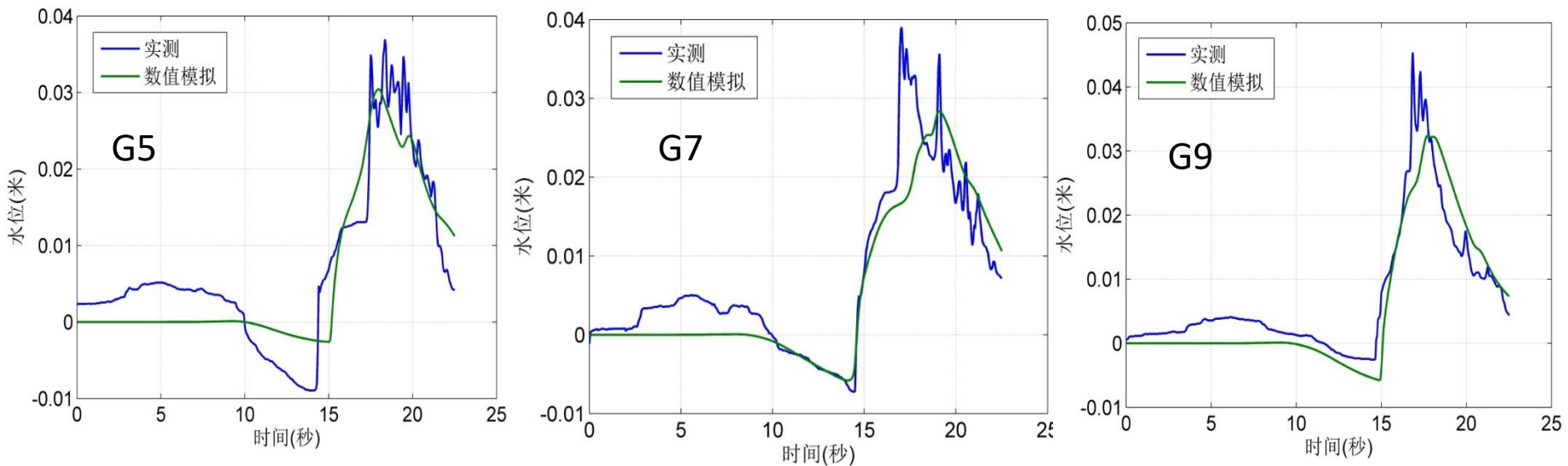


Figure 9 Comparison between measured and simulated water levels at 3 positions for model validation

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➤ Investigate Monai experiment on landslide tsunami

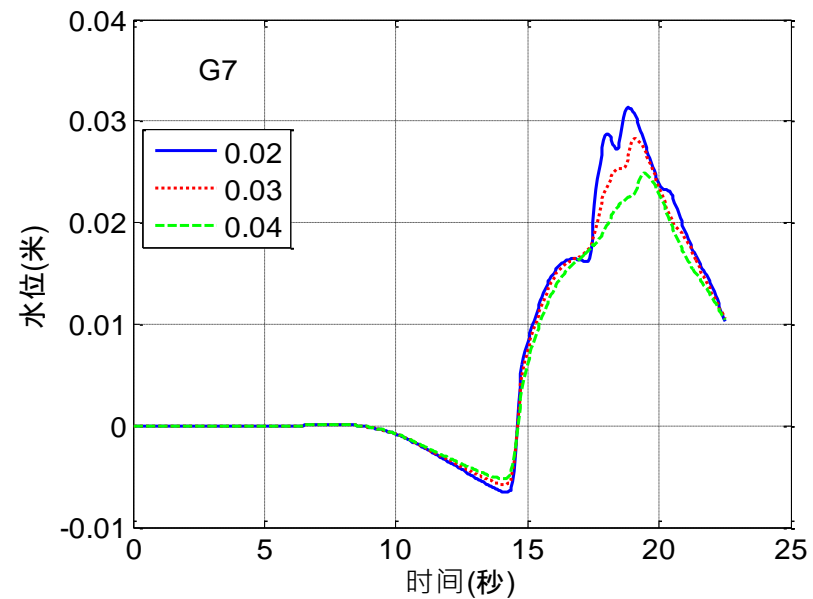
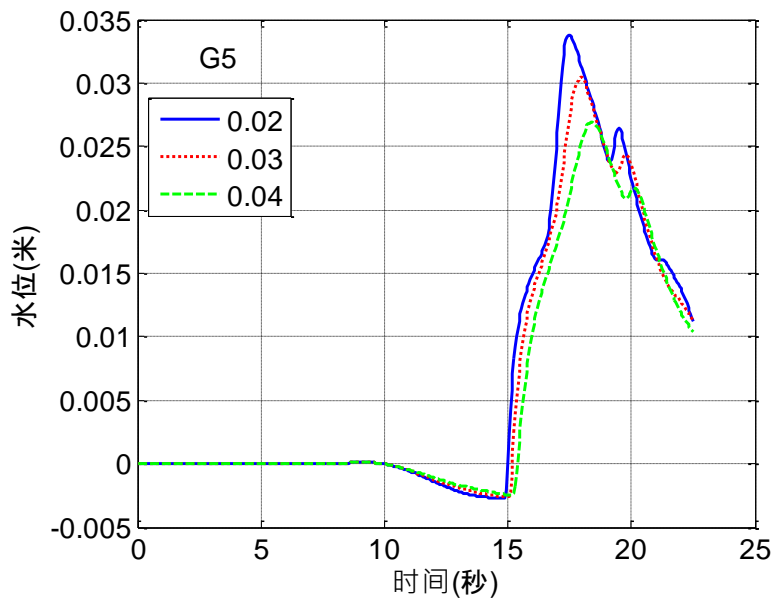


Figure 10 Influence of different friction coefficients on water levels

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➤ Investigate Monai experiment on landslide tsunami

Based on the initial simulation , Sediment transport is introduced to discuss the effect of topography change and water level

Added type	Porosity	Grain size	Inlet Suspended sediment concentration
Bed load	40%	0.5/1/1.5mm	0
	40%/45%50	0.5	0
	40%	0.5	1e-5/5e-5/1e-4 m ³ /s
Suspended load	40%	0.5	5e-5 m ³ /s

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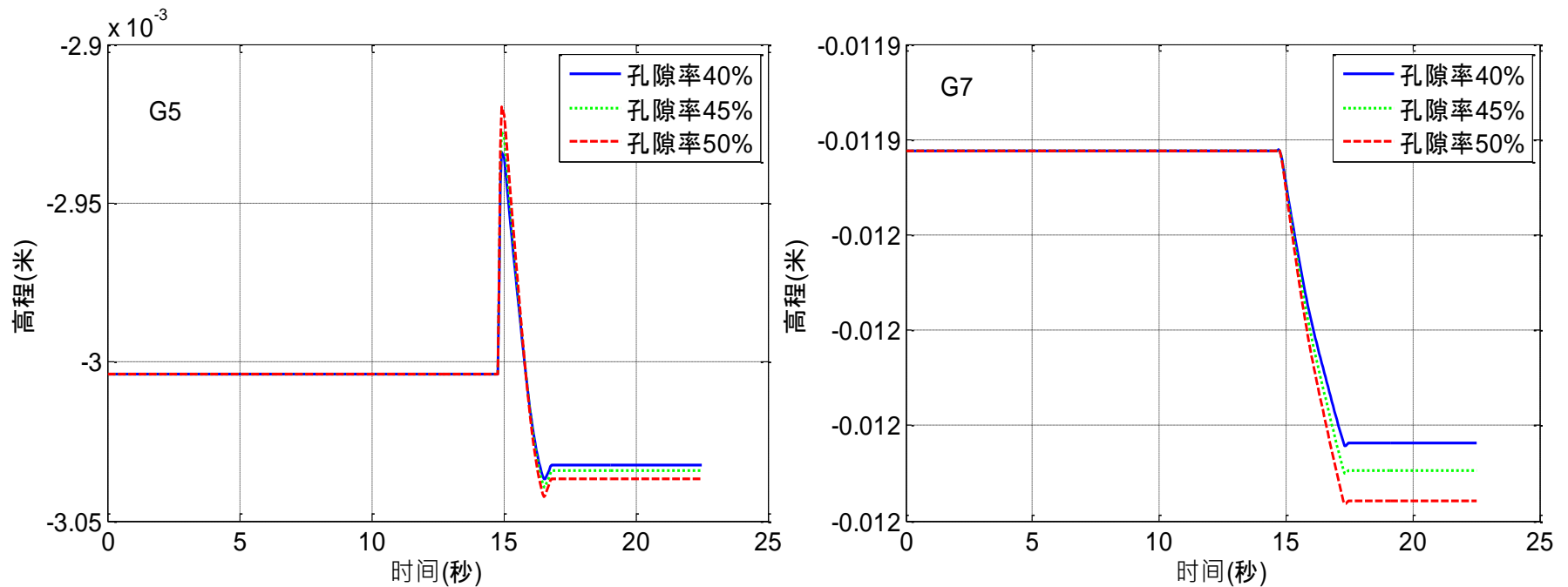


Figure 10 Effect of sediment porosity on the topography evolution at 2 exact positions

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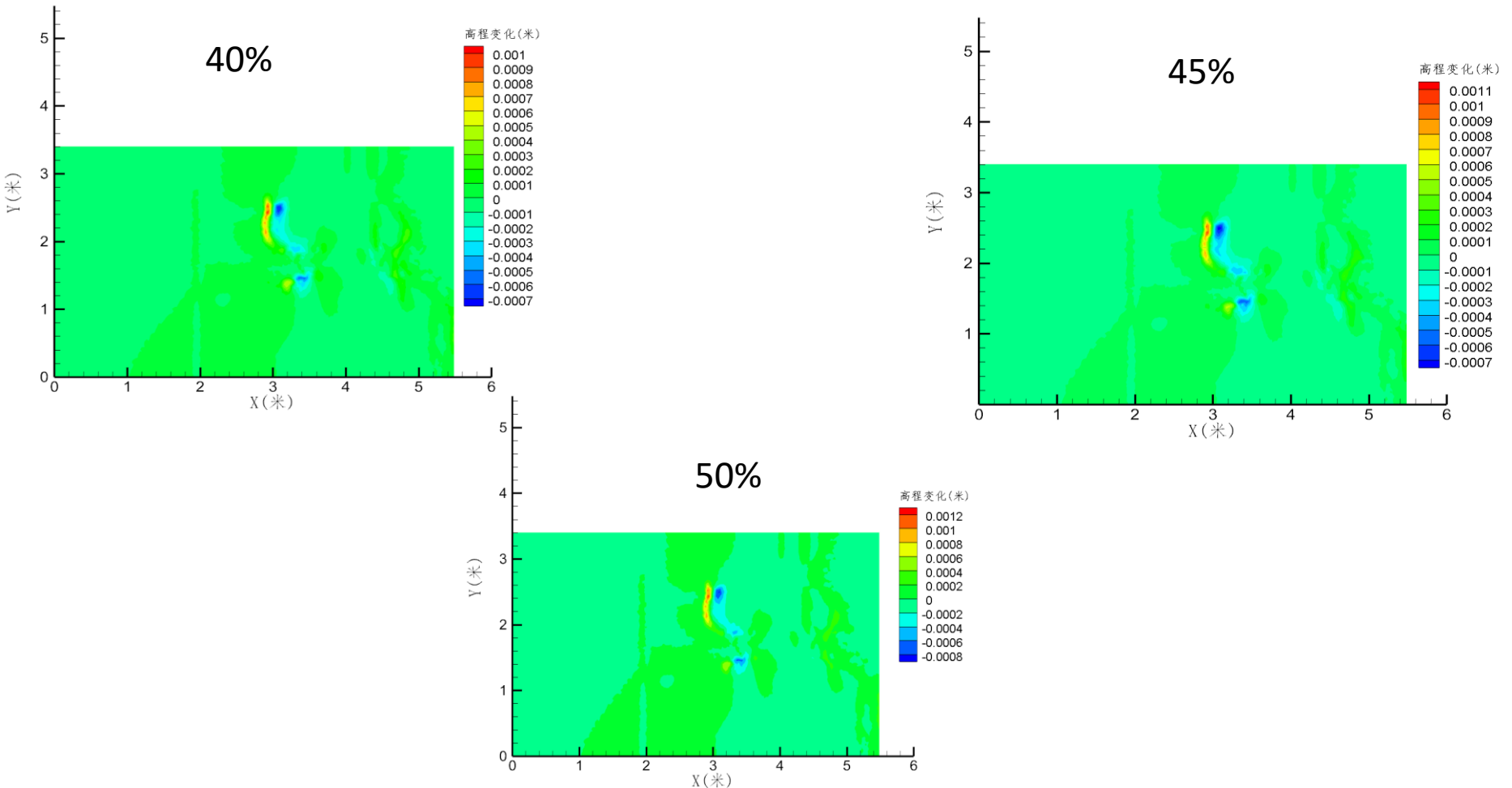


Figure 11 The different porosity on seafloor topography changes

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➤ Investigate Monai experiment on landslide tsunami

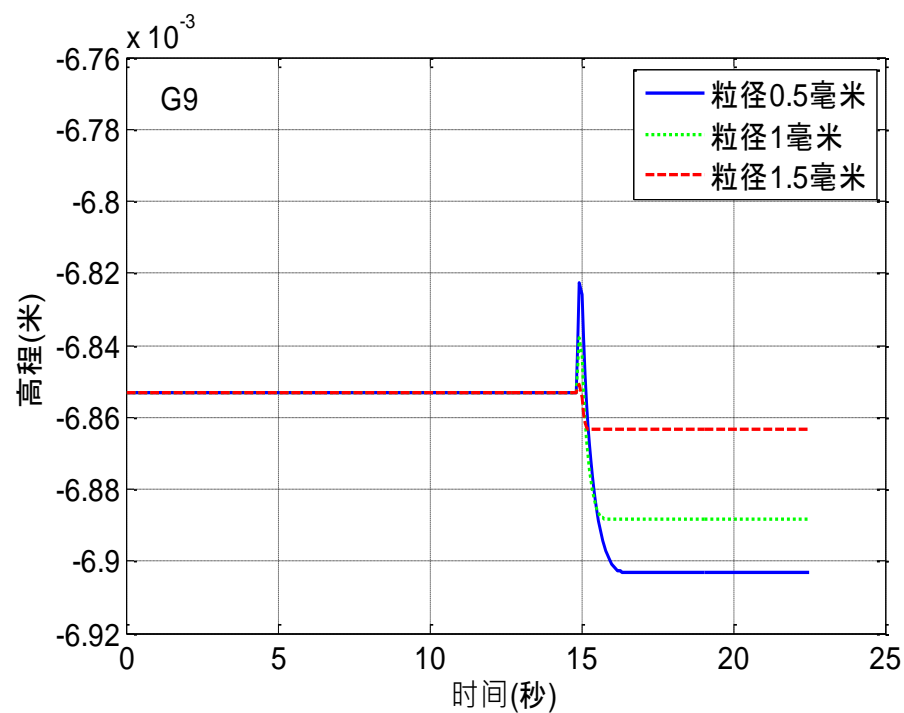
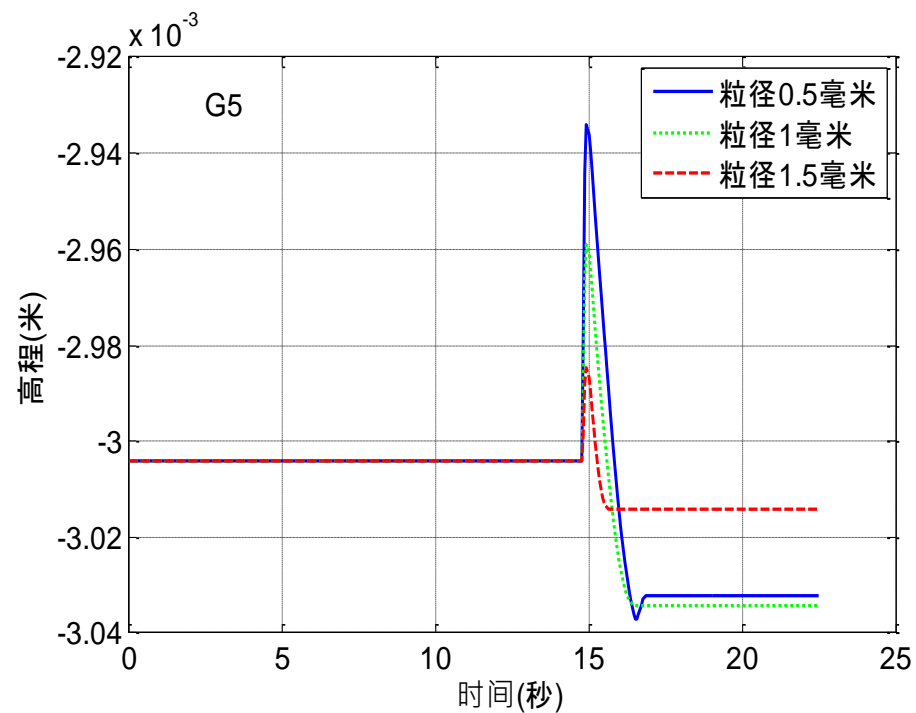


Figure 11 Influence of different grain size on water levels at 2 exact positions

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➤ Investigate Monai experiment on landslide tsunami

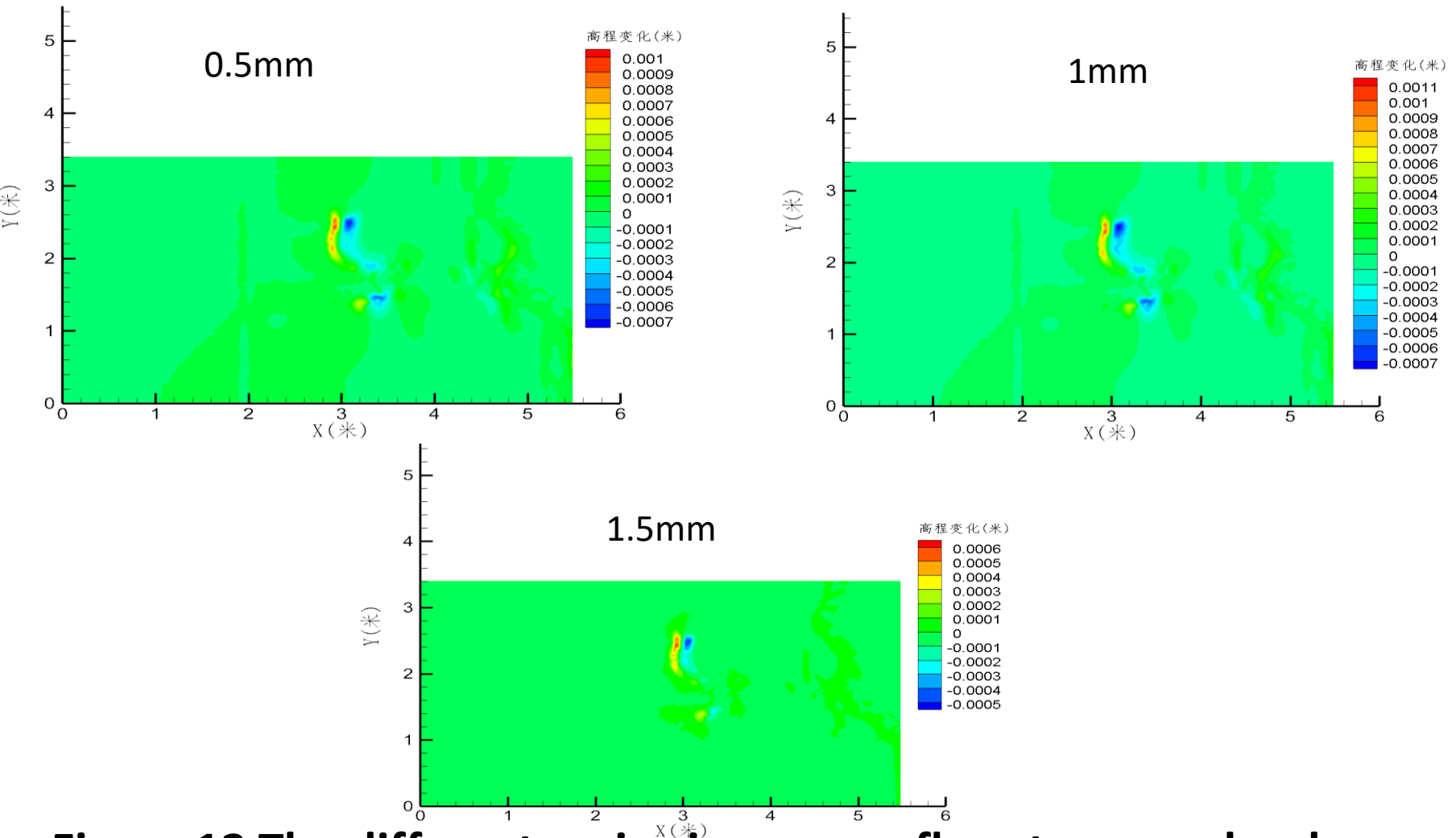


Figure 12 The different grain size on seafloor topography changes

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➤ Investigate Monai experiment on landslide tsunami

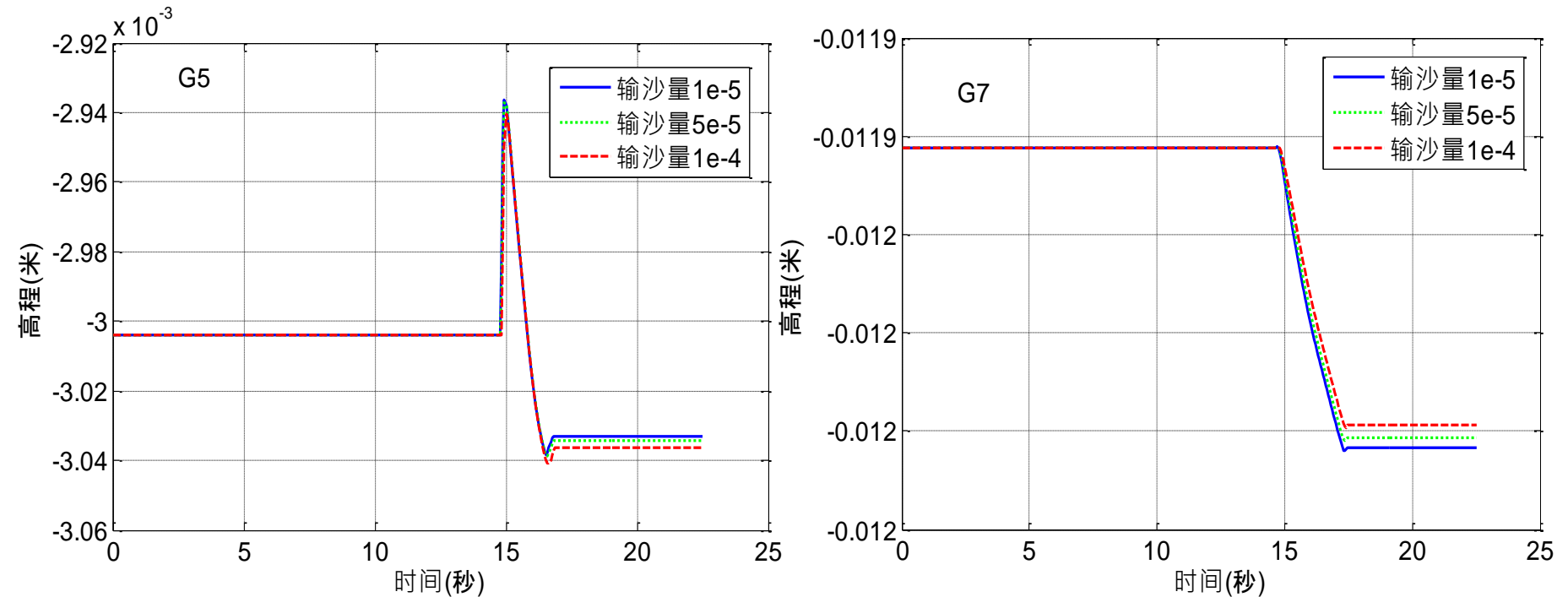


Figure 13 Influence of different sediment discharge on water levels at 2 exact positions

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➤ Investigate Monai experiment on landslide tsunami

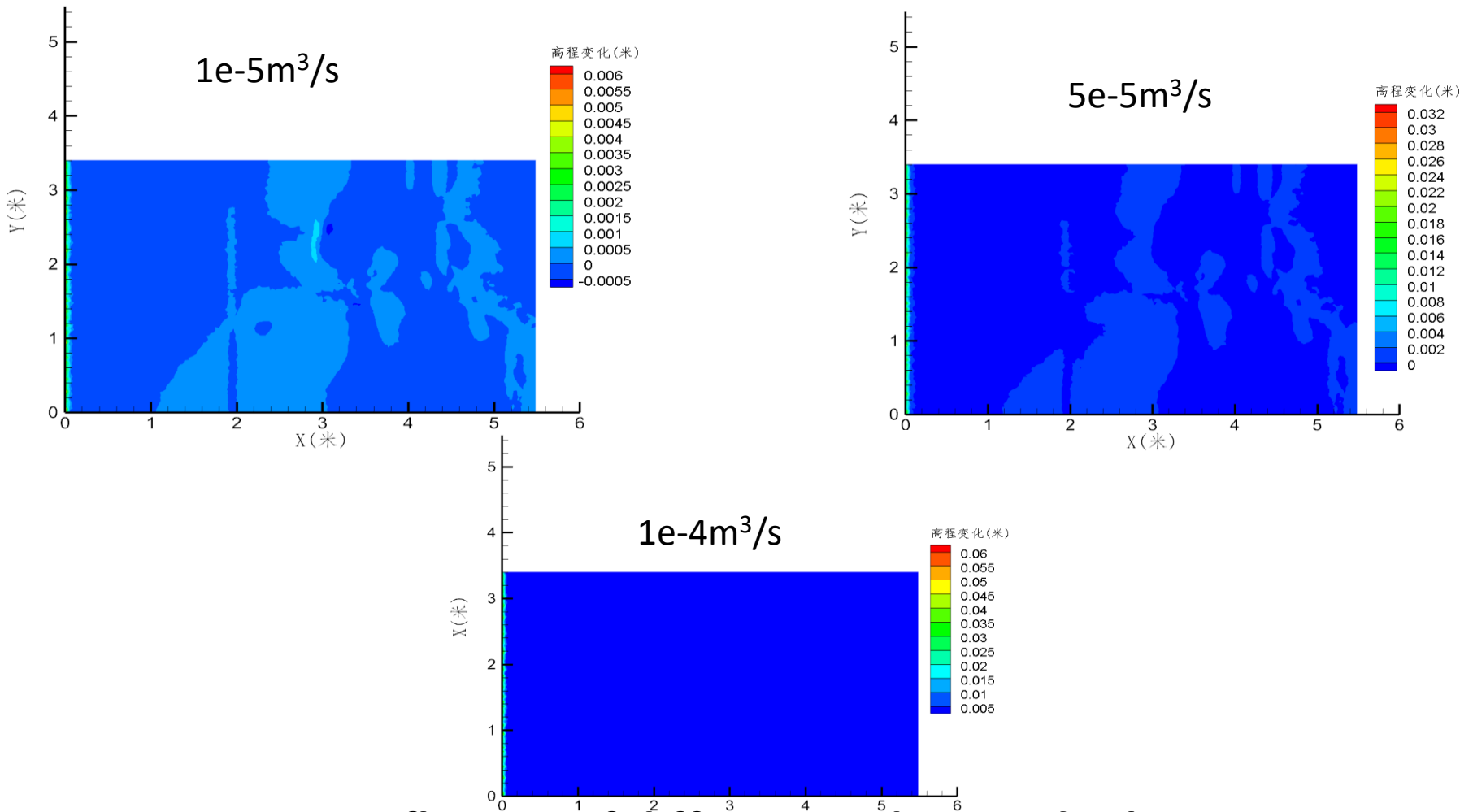


Figure 14 Influence of different sediment discharge on seafloor topography changes

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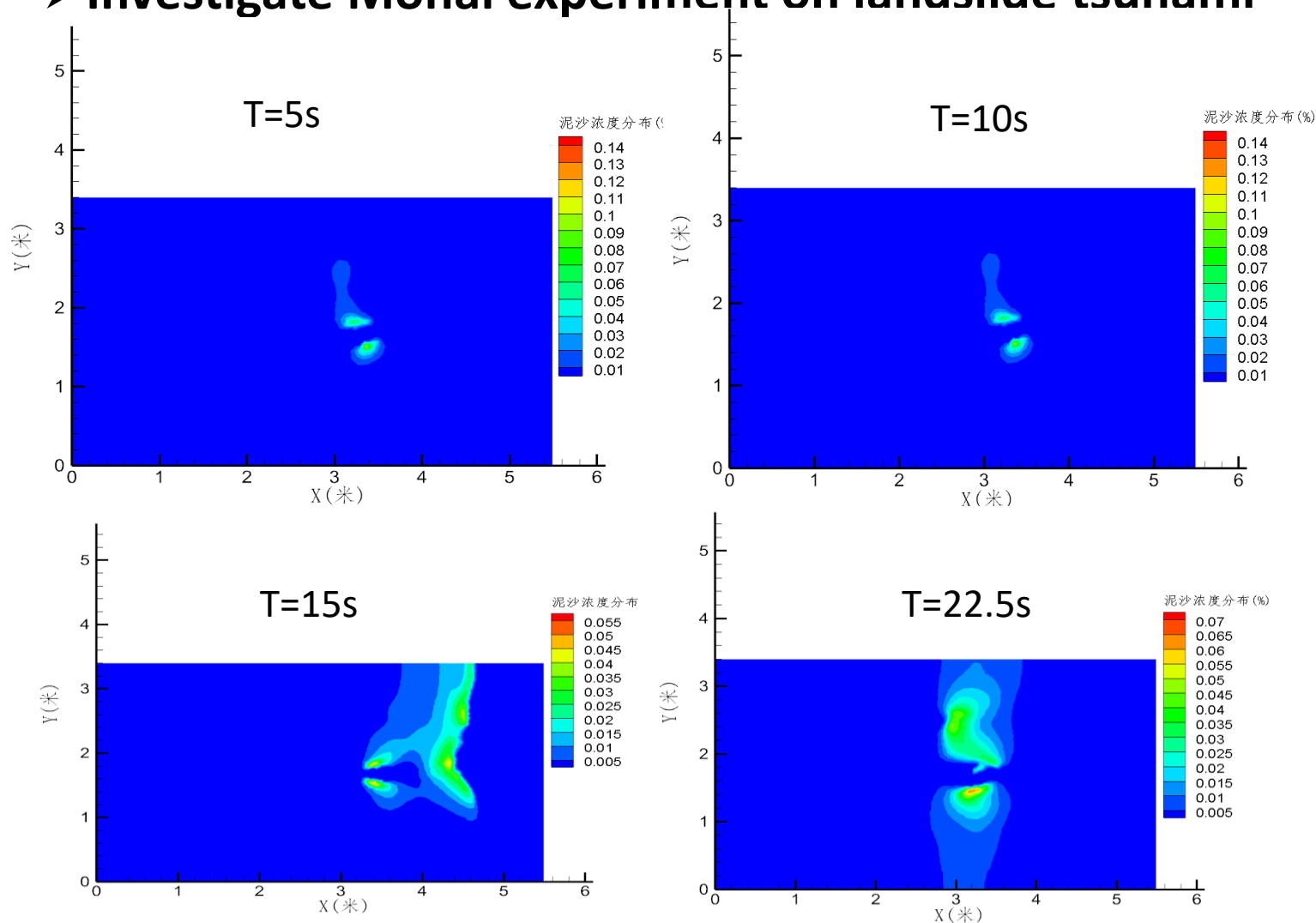


Figure 15 The snap shot of concentration distribution

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➤ Investigate Monai experiment on landslide tsunami

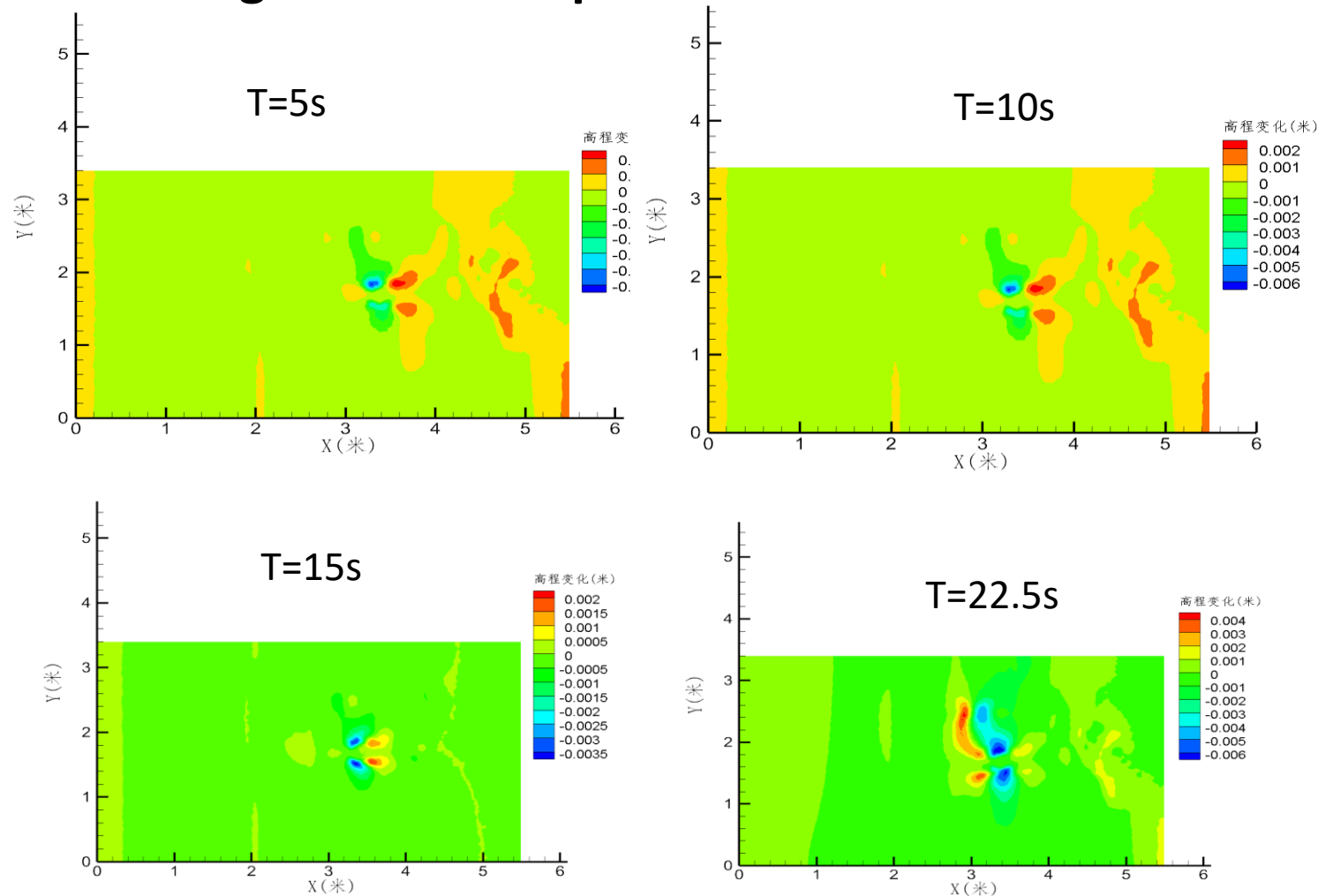


Figure 2 The snap shot of seafloor topography changes

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➤ **Investigate Monai experiment on landslide tsunami**

Preliminary results:

I. The parameters such as porosity, grain size and sediment concentration play an significant role both in water level and seafloor topography.

II. Tsunami-induced sediment transport results in sea floor topography changes that's the archive of geological event.

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➤ Future work

- I. Multi-grain components for sediment transport simulation will be considered, especially for the in-situ situation.**
- II. More accurate event-driven simulations will be adopted for landslide induced tsunami.**
- III. GPU parallelized computation (BASEMENT version 3.x) should be conducted.**

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Thank you for listening !