# Delft3D Flexible Mesh test
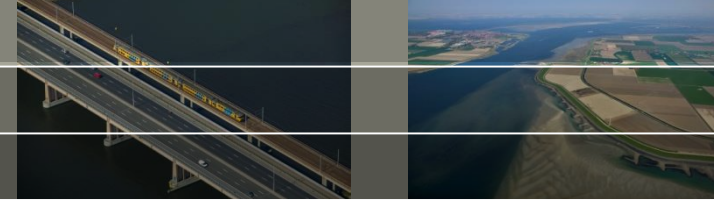
*Opportunities for using Delft3D-FM (v. 6.02.13.7545) in Delft3D-GeoTool applications*

Helena van der Vegt

December 2018

Morphological results currently differed greatly between Delft3D4 and Delft3D-FM, even when the input conditions were kept as close as possible.

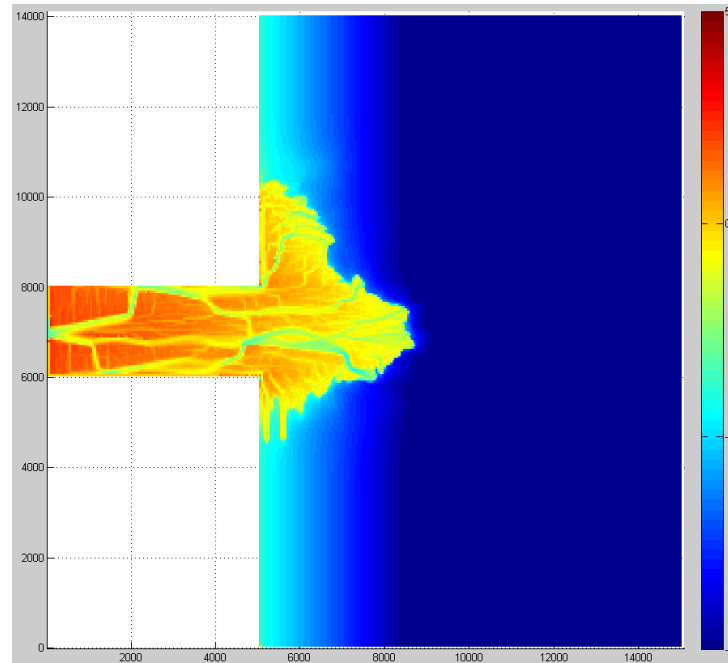Testing included over 50 simulation configuration, ranging from simple to very complex

The results indicate that the current development stage of Delft3D-FM is not yet sufficient for inclusion into Delft3D-GT

We recommend that the test be repeated in a few months (after further development of Delft3D-FM), to reassess feasibility

## Bathymetry after 160 hydrodynamic days



**Waves**
Perpendicular to coast
0.2m amplitude

**Discharge**
With 6 sed fractions
Constant

**Tide**
Semidiurnal
1m amplitude

**Sediment transport:** Engelund-Hansen
With used-defined suspc
= % of sed fraction transported in suspension

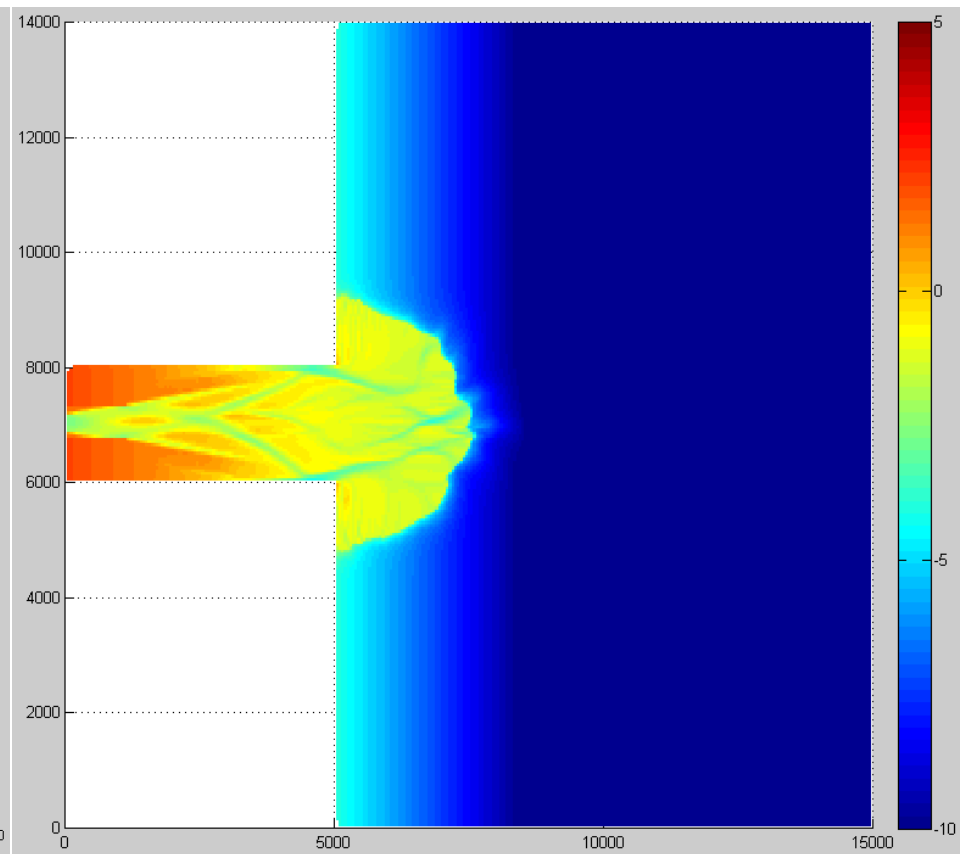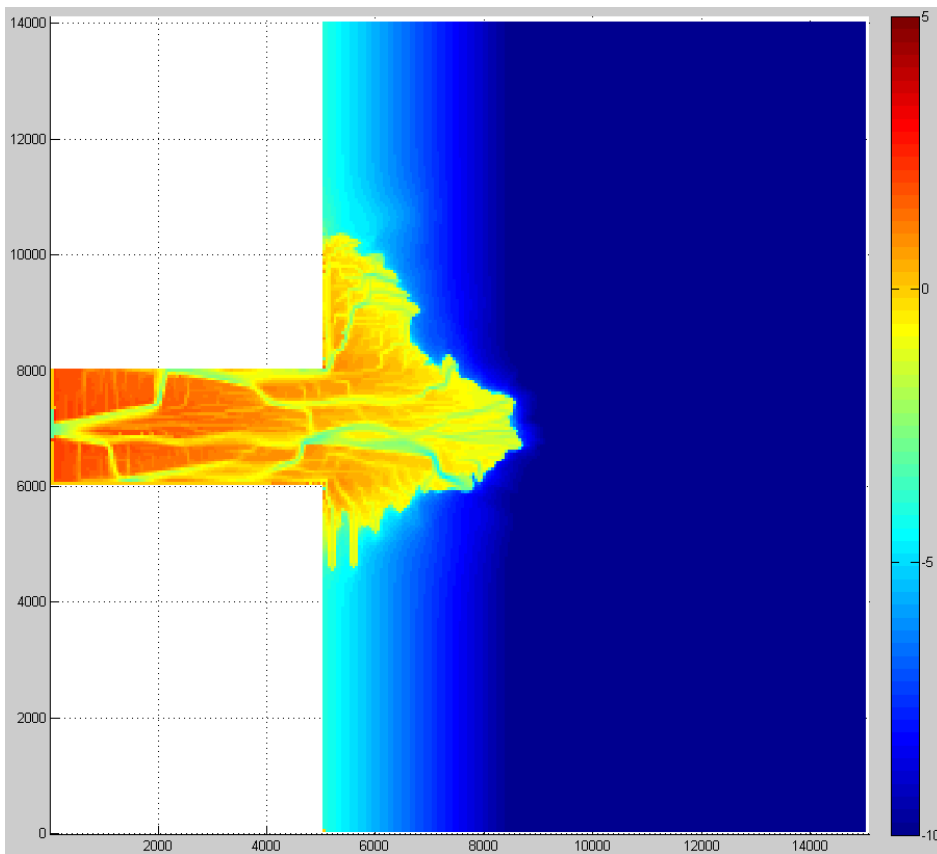|  | Grain size | suspc |
|---|---|---|
| Very coarse sand | 1 mm | 0.7 |
| Coarse sand | 0.75 mm | 0.75 |
| Medium sand | 0.375 mm | 0.8 |
| Fine sand | 0.2 mm | 0.85 |
| Very fine sand | 0.1 mm | 0.9 |
| Cohesive fraction | N/A | N/A |

**Deltares**
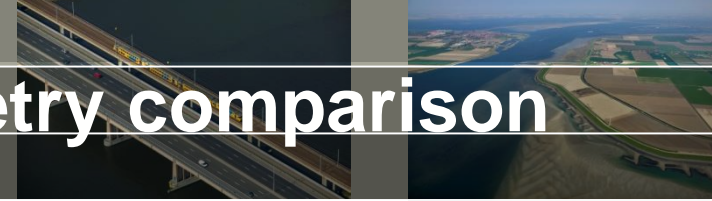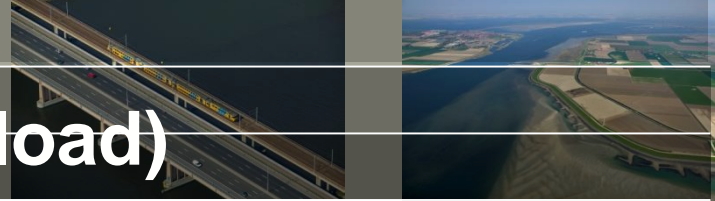
## Delft3D-FM overall more "diffuse" bathymetry

- For EH transport with suspc variable, simulations ignore the suspc definitions (See next 2 slides)
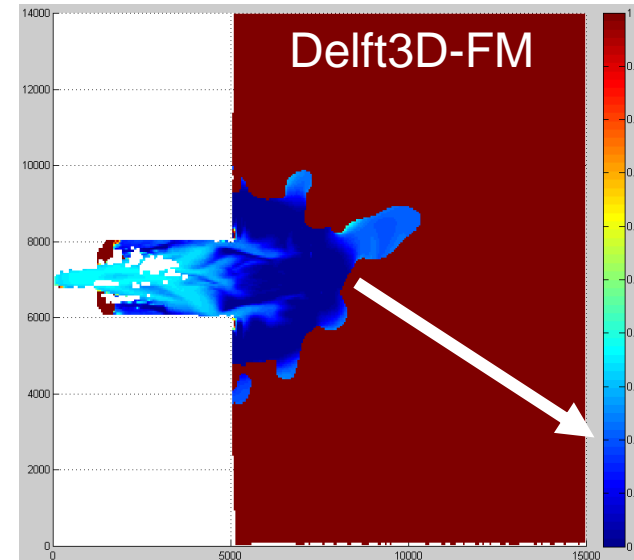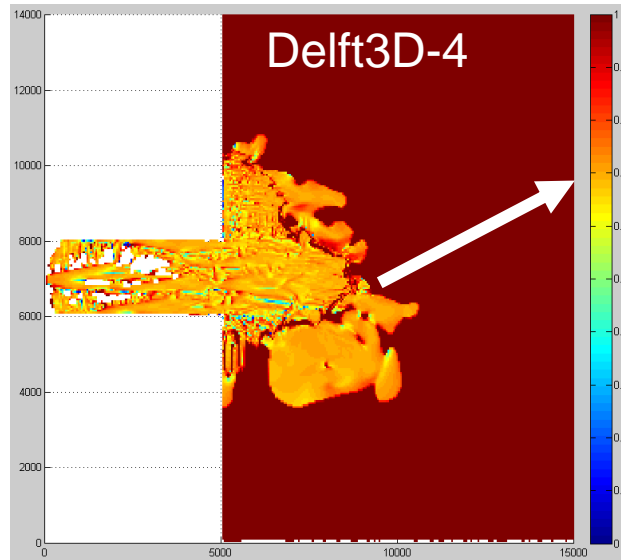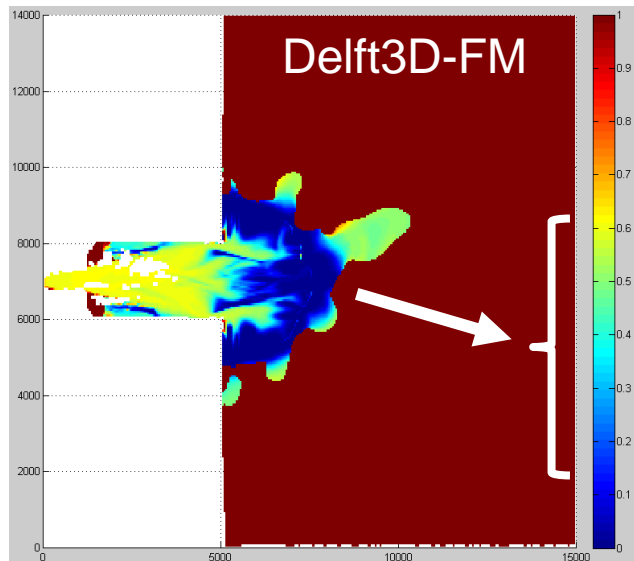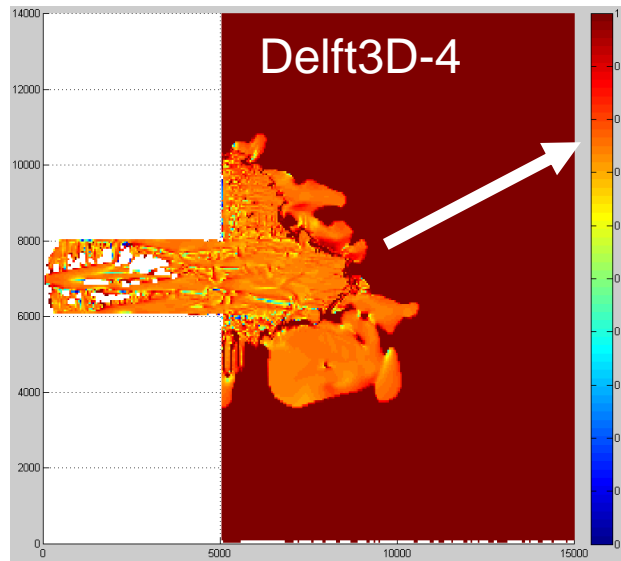
Delft3D-4

Delft3D-FM

Very coarse sand fraction
Suspc = 0.7

Coarse sand fraction
Suspc = 0.75
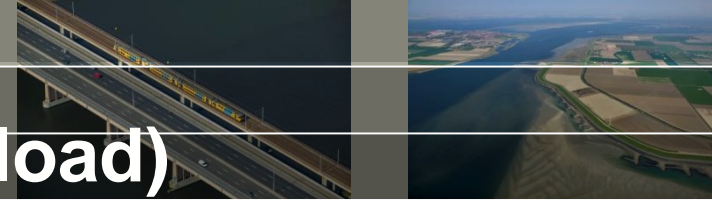
Medium sand fraction
Suspc = 0.7

Fine sand fraction
Suspc = 0.75

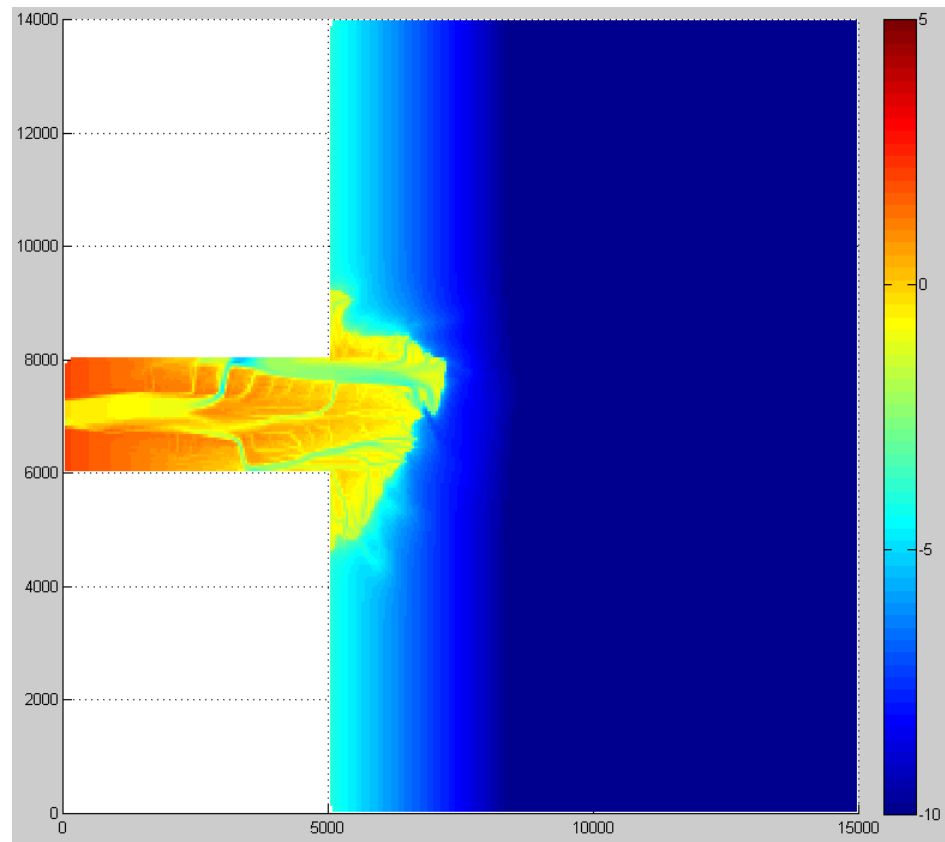Deltares
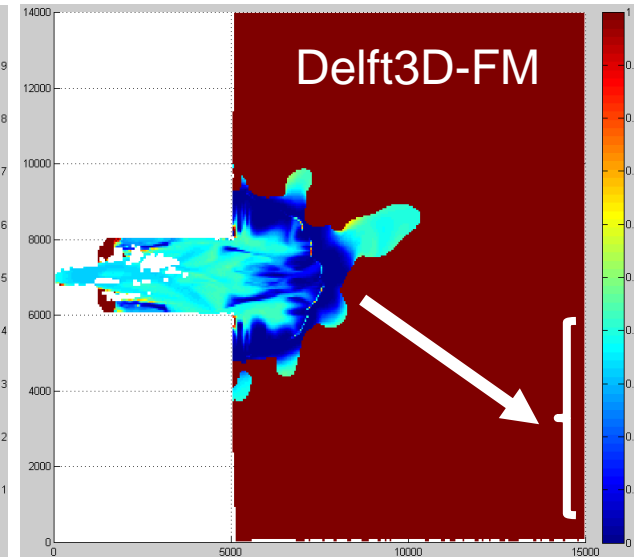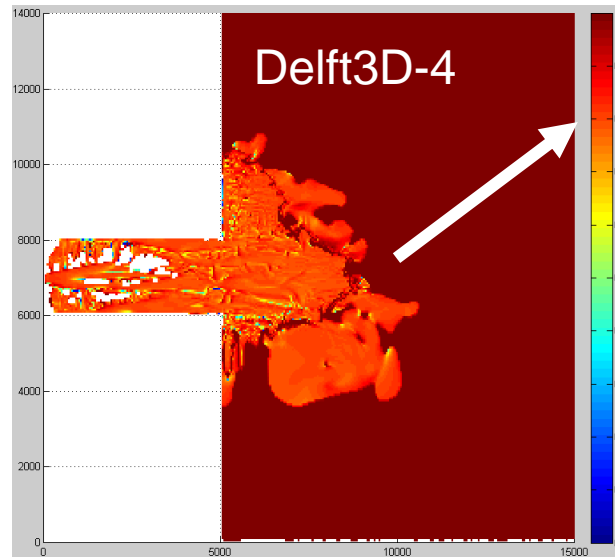
## Delft3D-FM overall more "diffuse" bathymetry
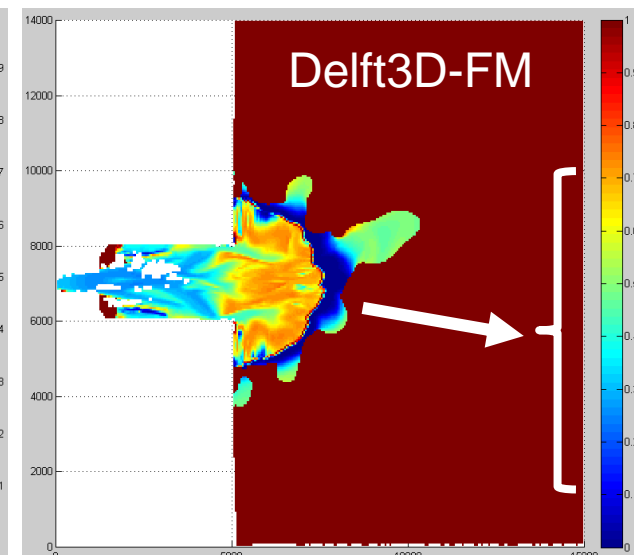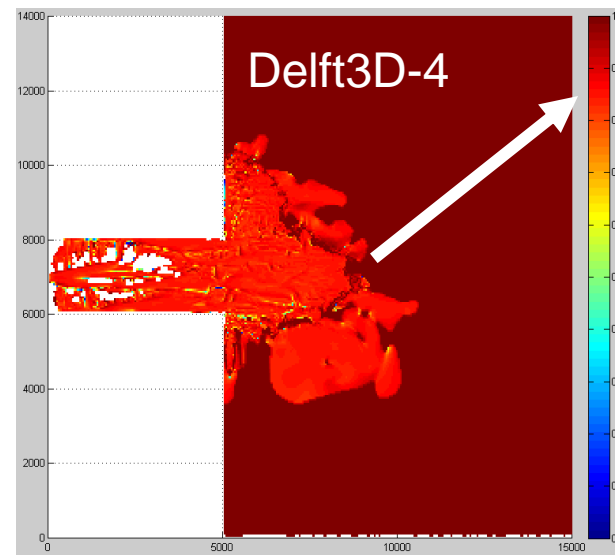
- Also for van Rijn transport formula bathymetry is much more "diffuse"

### Delft3D-4
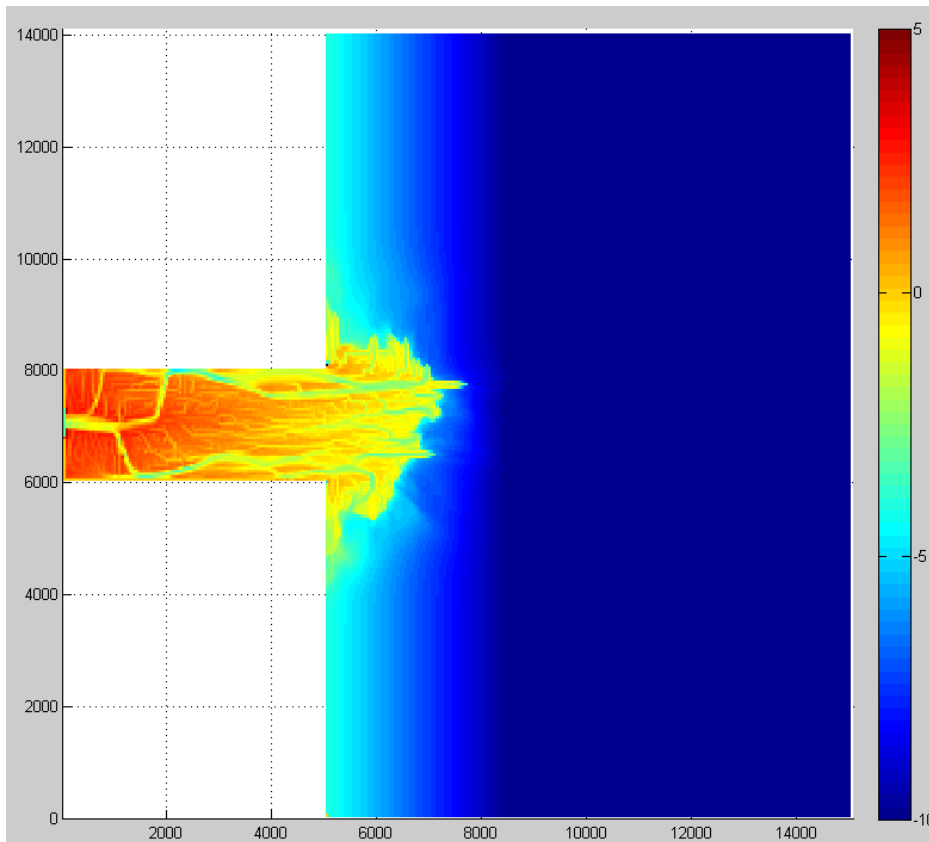
### Delft3D-FM
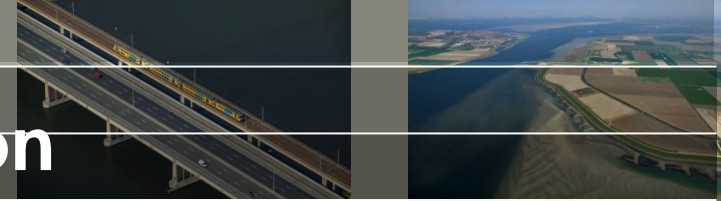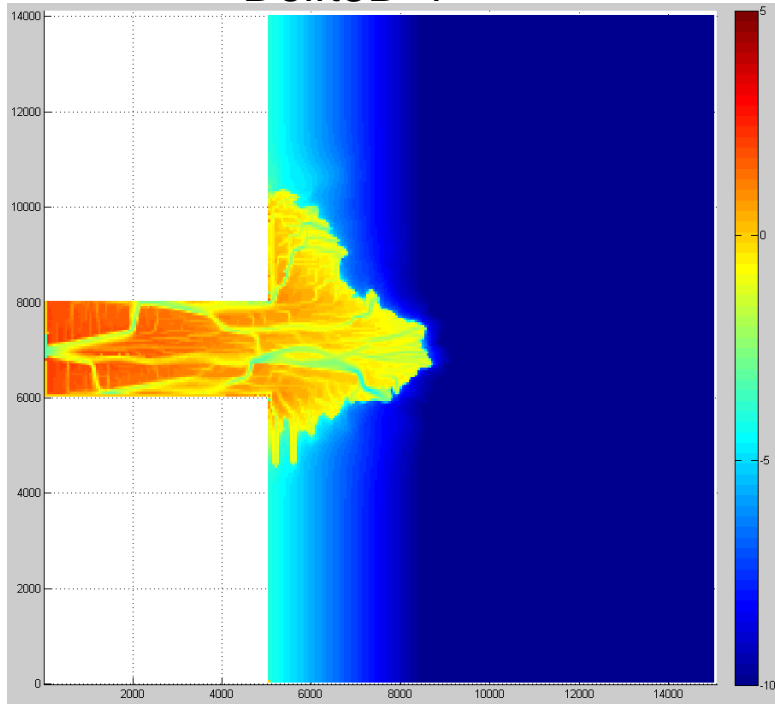
Decreasing timestep in Delft3D-FM improves correspondence *slightly*

Delft3D-FM

Delft3D-4



Dt = 30s
(same as D3D4)

Dt = 10s

Deltares
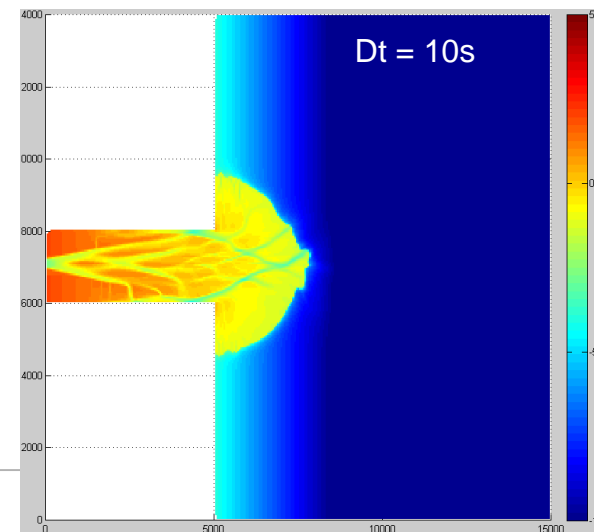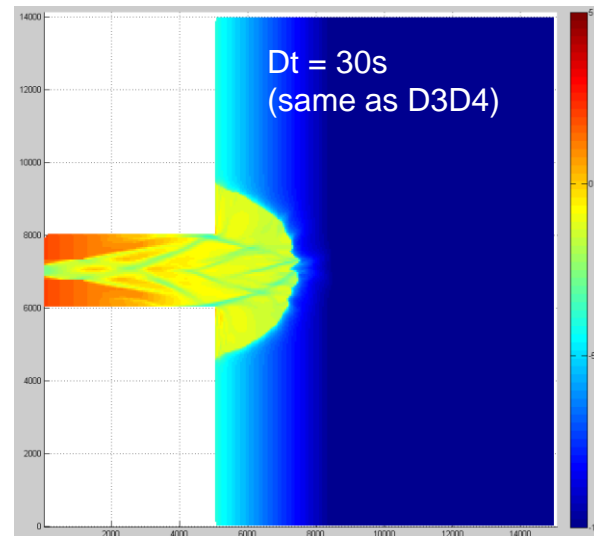
- We hypothesized that using a triangular grid available in FM would lead to a more natural channel network
- Findings: In reality the number of cells required to simulate a triangular grid model with similar resolution if mu greater and the simulation slower. Due to the diffuse morphological features seen in the Delft3D-FM model it was not possible to study the channel network.



triangles = 100m, t=71

FM original, t=71

D3D4 original, t=71
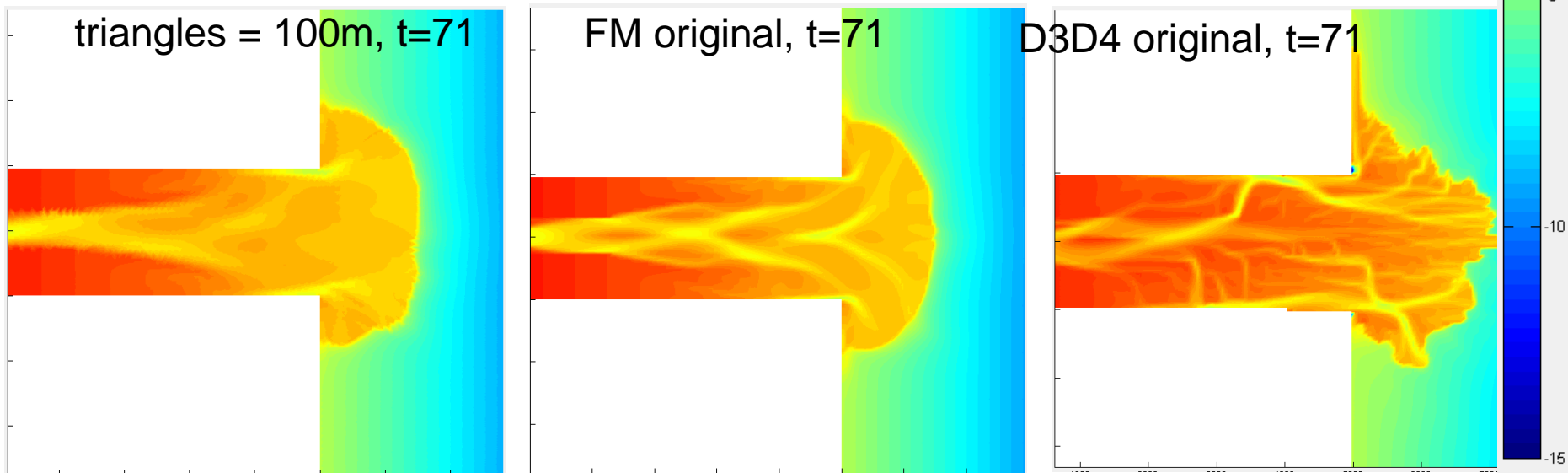
# Results in full

# Findings:
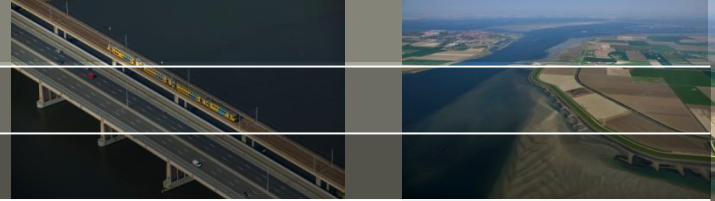
- Delft3D-GT type models compared
  - (Based on GT-model "Model_1 coarse_sand_delta"):
  - *Models presented here stored at P:\1230788-turbiditycurrents\Helena\FM_functionality_test\GT_CoarseSand*
  - FM results in coastline too smooth compared to D3D4 model
  - FM results seem overall more diffuse
  - FM results in variable Suspended:Total load values across the domain, even though single value assigned in .sed file.
  - FM bed load concentration too large (compared to D3D4)
  - FM suspended load concentrations too small (compared to D3D4)

**Deltares**
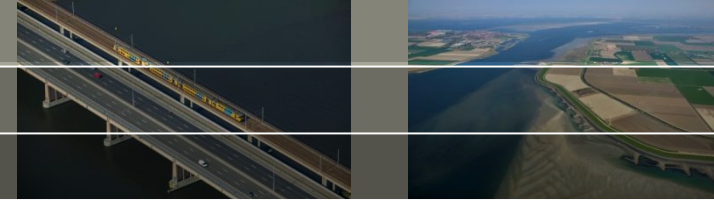
| | Value "suspc" parameter (.sed file) | Bed load | Suspended load | Total load | Ratio |
|---|---|---|---|---|---|
| Very coarse sand | 0.7 | FM larger than D3D4 | FM smaller than D3D4 | similar | FM much too low (0-0.4) and variable, largest values proximal |
| Coarse sand | 0.75 | Similar | FM smaller than D3D4 | FM smaller than D3D4 | FM too low (0-0.6) and variable, largest values proximal |
| Medium sand | 0.8 | FM larger than D3D4 | FM smaller than D3D4 | similar | FM much too low (0-0.4) and variable, largest values proximal |
| Fine sand | 0.85 | FM larger than D3D4 | FM smaller than D3D4 | similar | FM much too low (0-0.7) and variable, largest values distal |
| Very fine sand | 0.9 | FM larger than D3D4 | FM smaller than D3D4 | similar | FM much too low (0-0.8) and variable, largest values distal |
| Coarse silt | N/A | N/A | FM smaller than D3D4 | N/A | N/A |

**Deltares**

# Comparison: GT Model_1 Coarse sand delta

Delft3D-4
(0_9_Origional_ThetSD0)

Delft3D-FM
(9_3_inisedthick_update_mor)

160 days – Very coarse sand fraction (suspended load : total load)
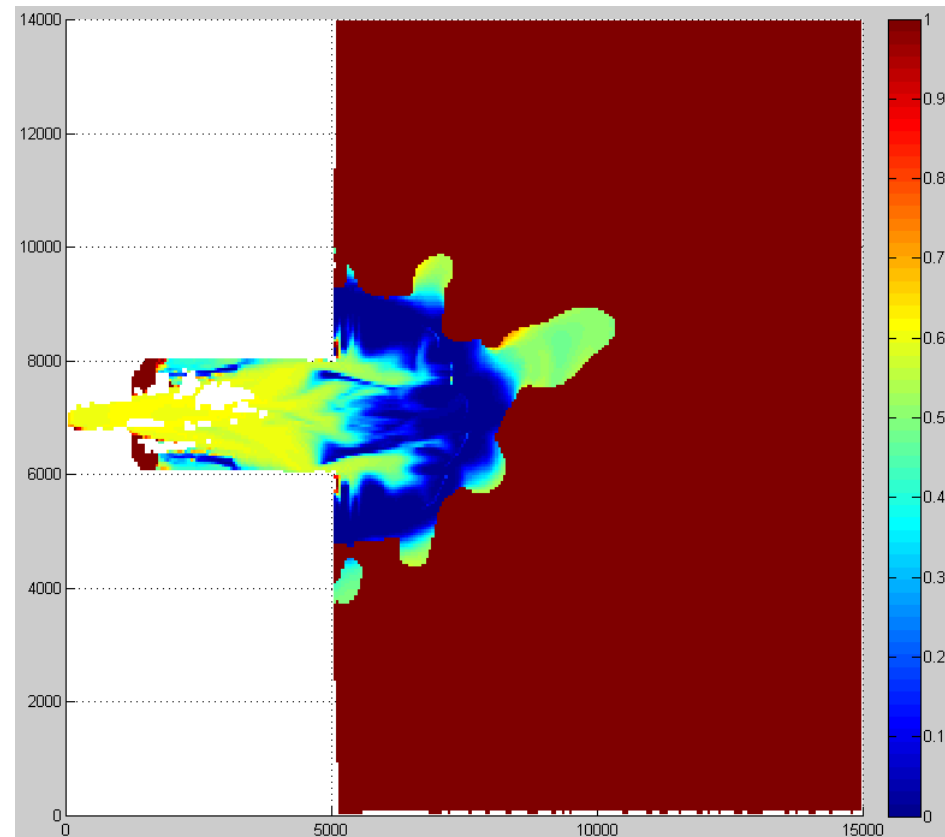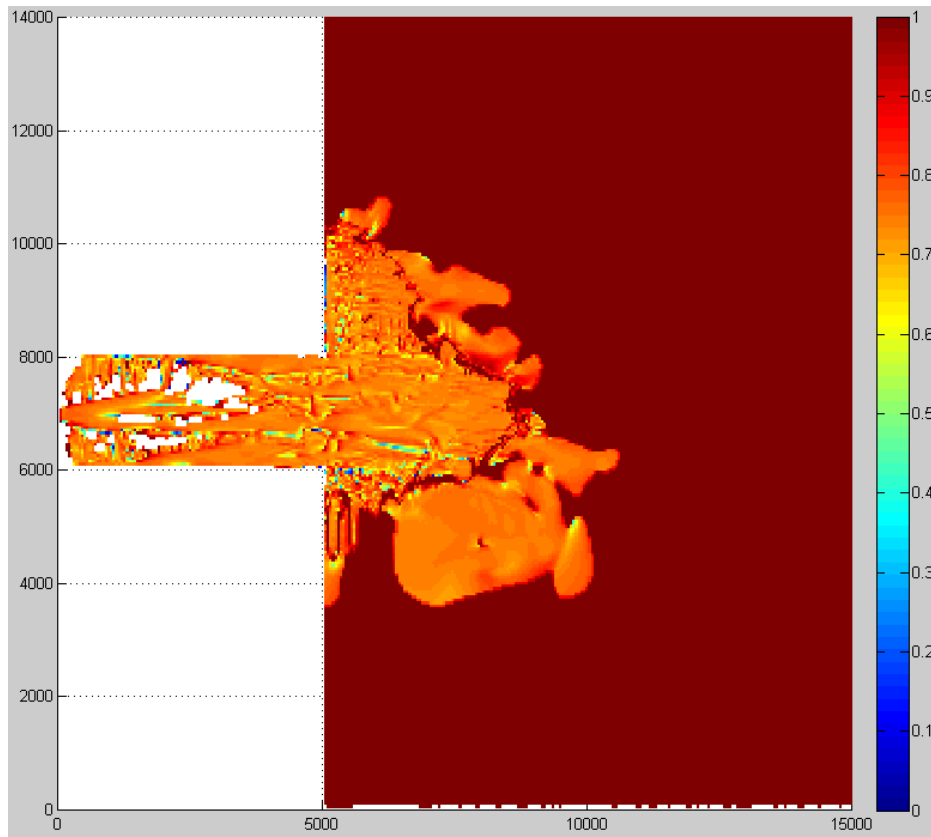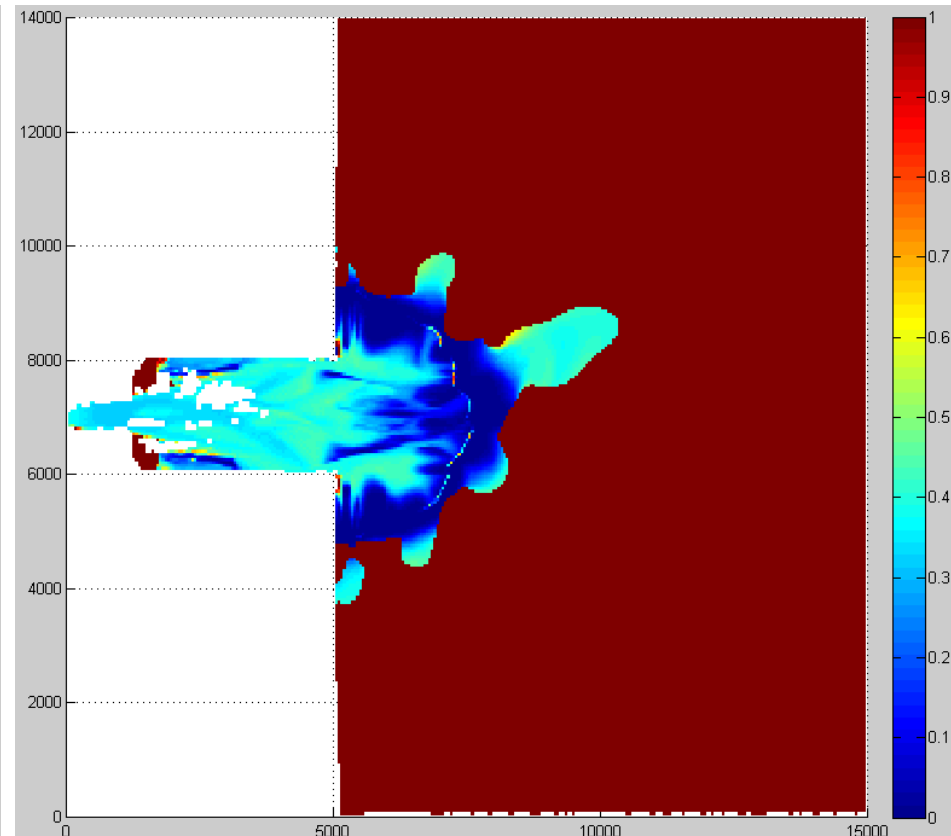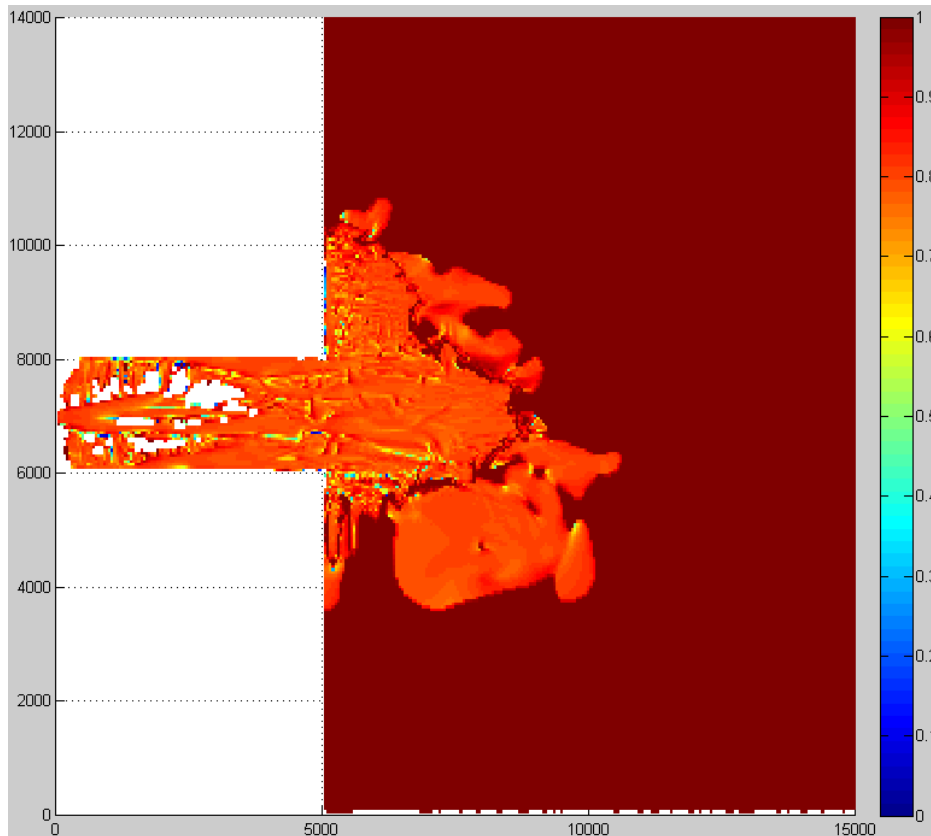The transport definition file defines this to be 0.7 for very coarse sand…
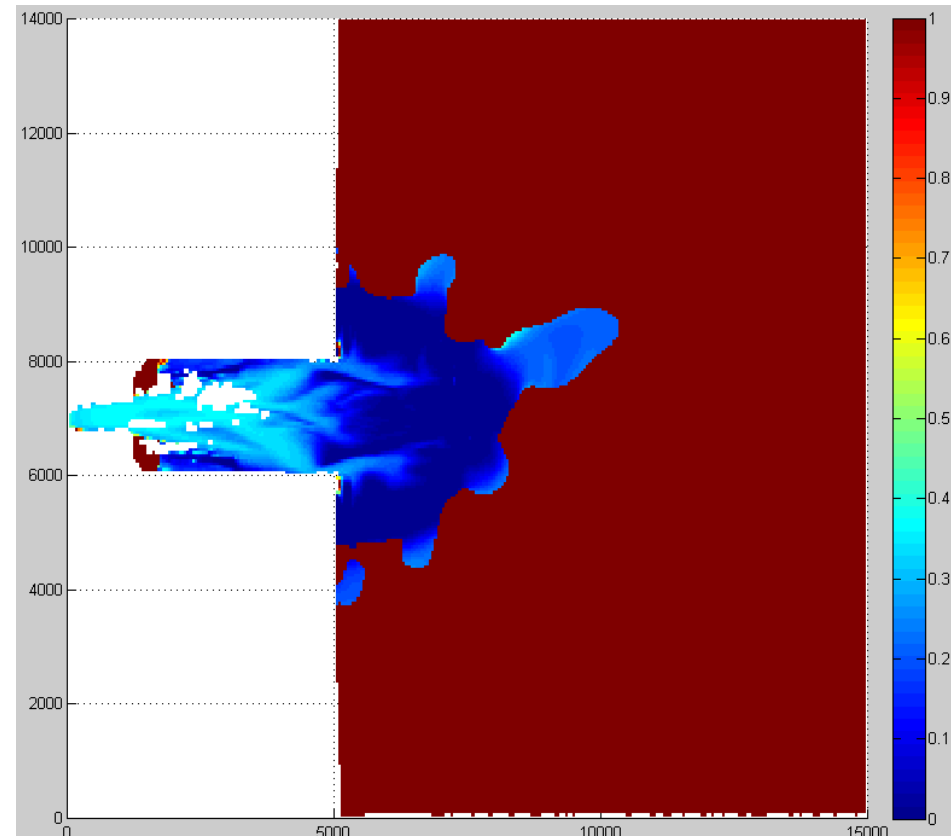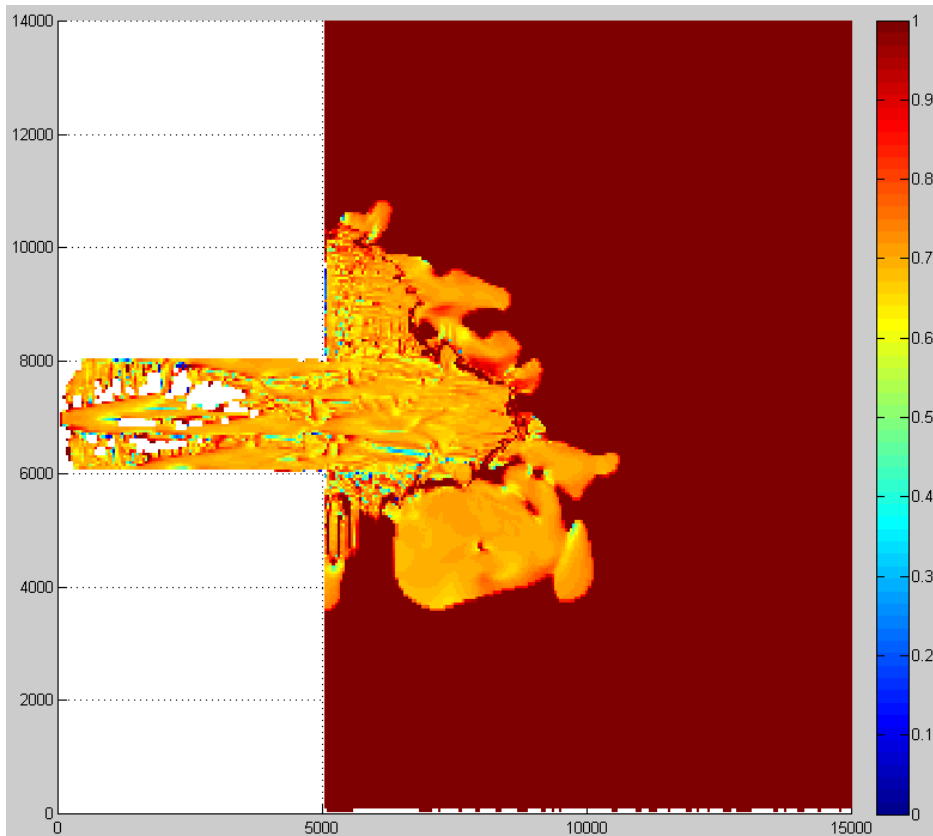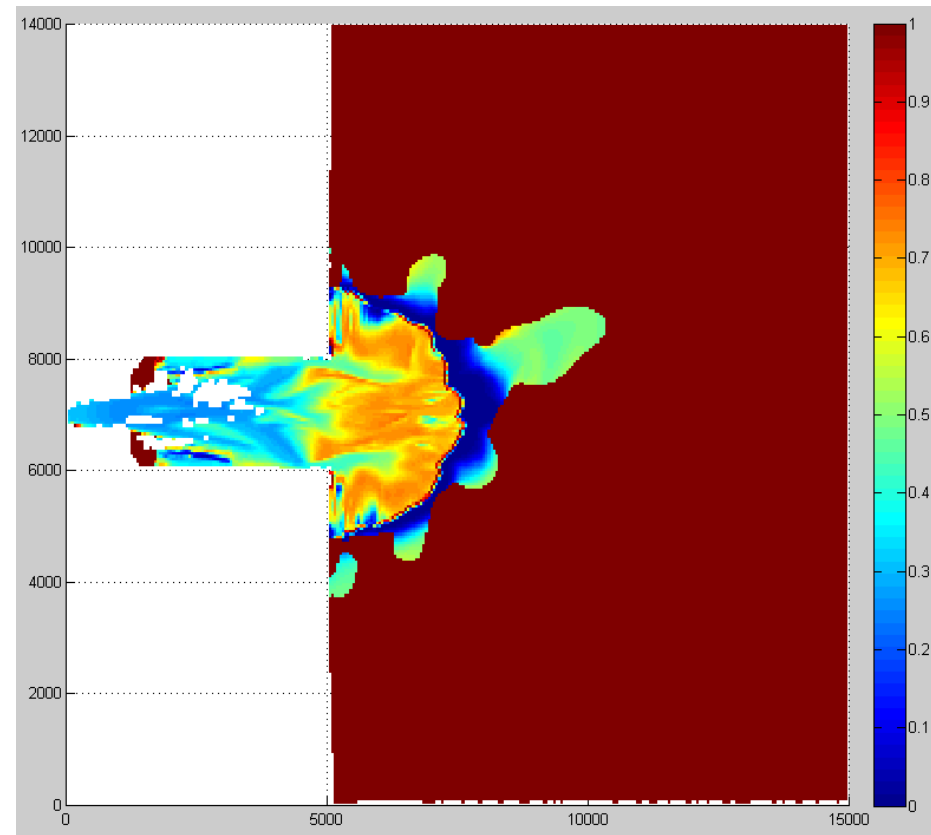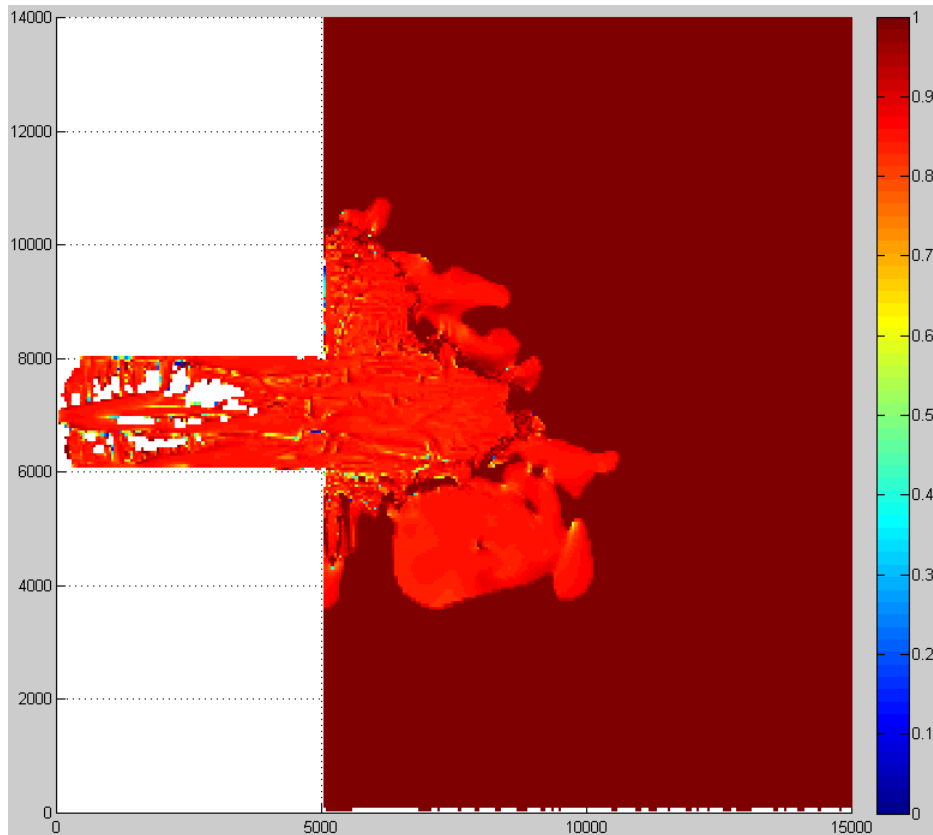
# Comparison: GT Model_1 Coarse sand delta

Delft3D-4
(0_9_Origional_ThetSD0)

Delft3D-FM
(9_3_inisedthick_update_mor)

160 days – Coarse sand fraction (suspended load : total load)
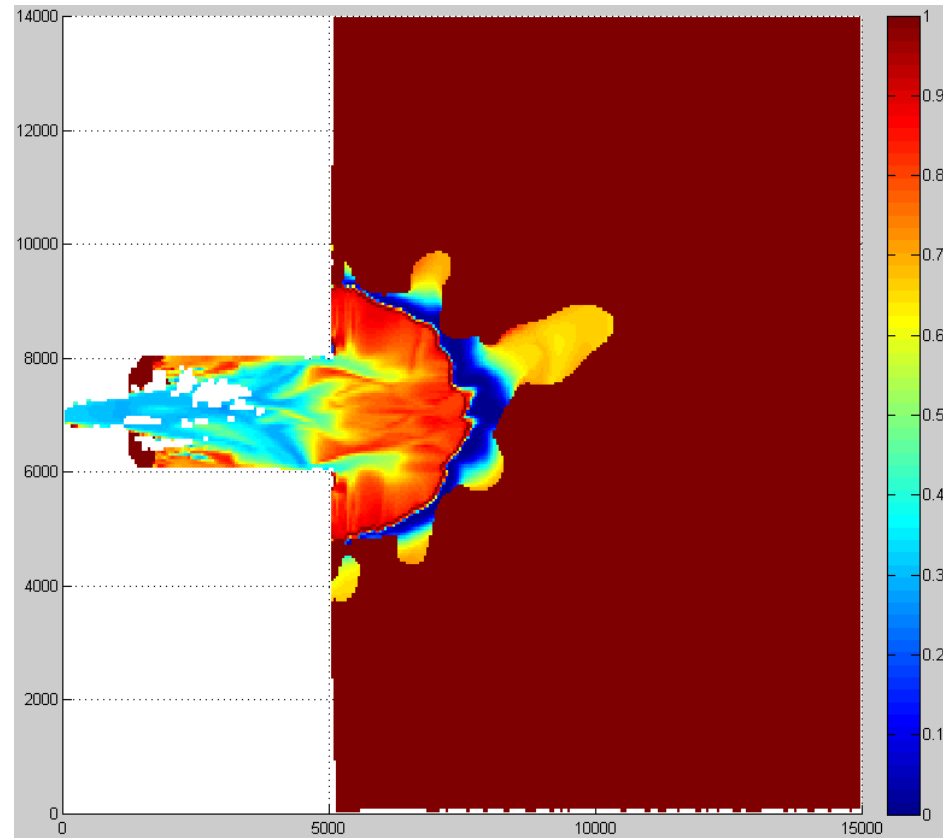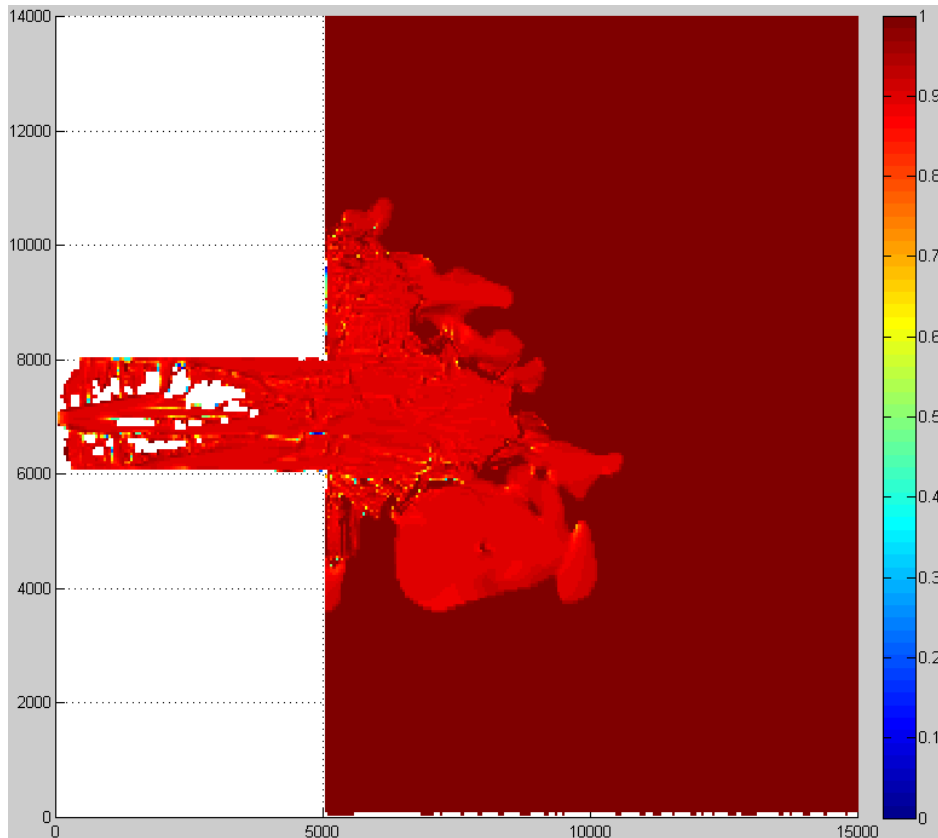The transport definition file defines this to be 0.75 for coarse sand…

# Comparison: GT Model_1 Coarse sand delta

Delft3D-4
(0_9_Origional_ThetSD0)

Delft3D-FM
(9_3_inisedthick_update_mor)

160 days – Medium sand fraction (suspended load : total load)
The transport definition file defines this to be 0.8 for medium sand…

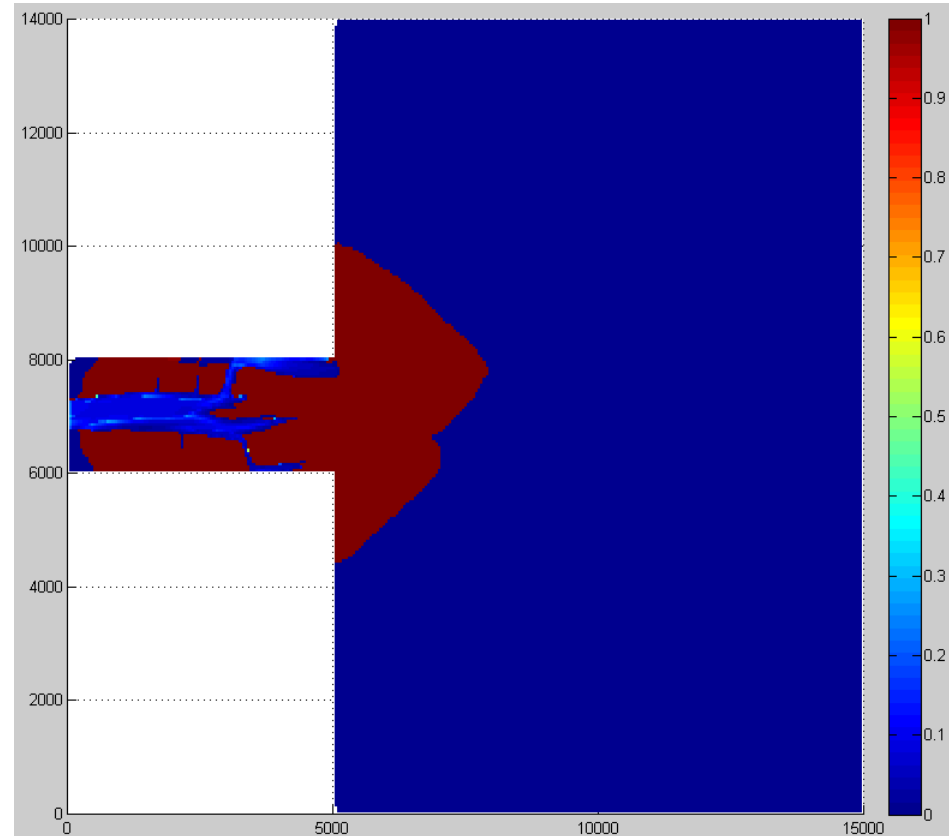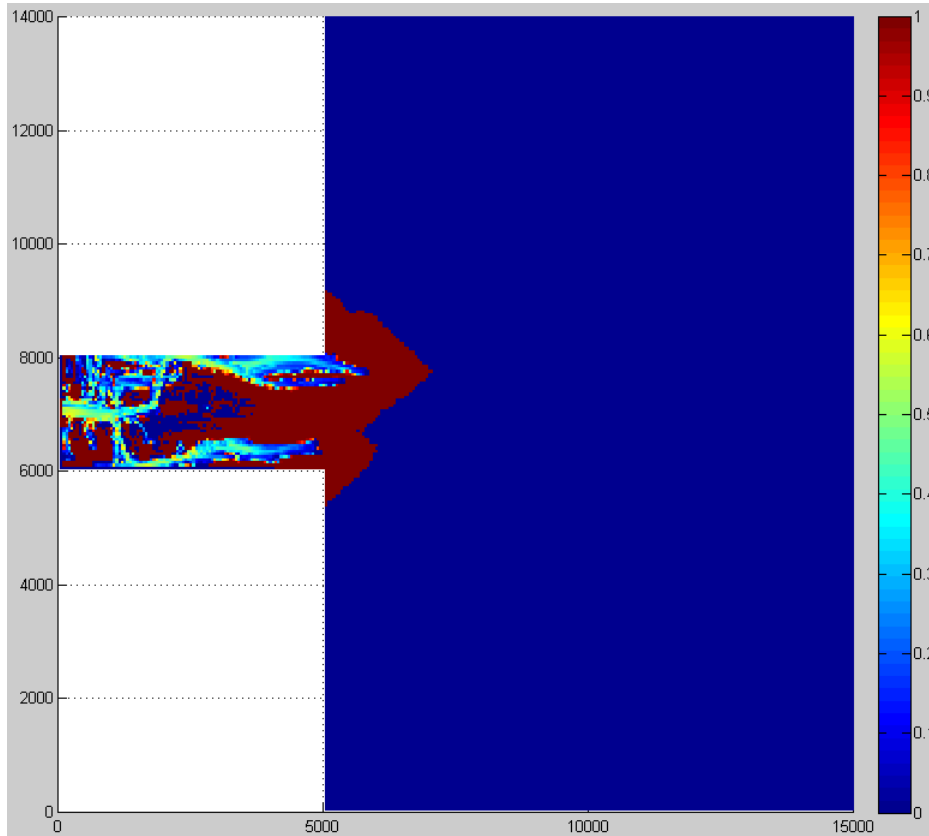# Comparison: GT Model_1 Coarse sand delta

Delft3D-4
(0_9_Origional_ThetSD0)

Delft3D-FM
(9_3_inisedthick_update_mor)

160 days – Fine sand fraction (suspended load : total load)
The transport definition file defines this to be 0.85 for fine sand

# Comparison: GT Model_1 Coarse sand delta

Delft3D-4
(0_9_Origional_ThetSD0)

Delft3D-FM
(9_3_inisedthick_update_mor)

160 days – Very fine sand fraction (suspended load : total load)
The transport definition file defines this to be 0.9 for very fine sand

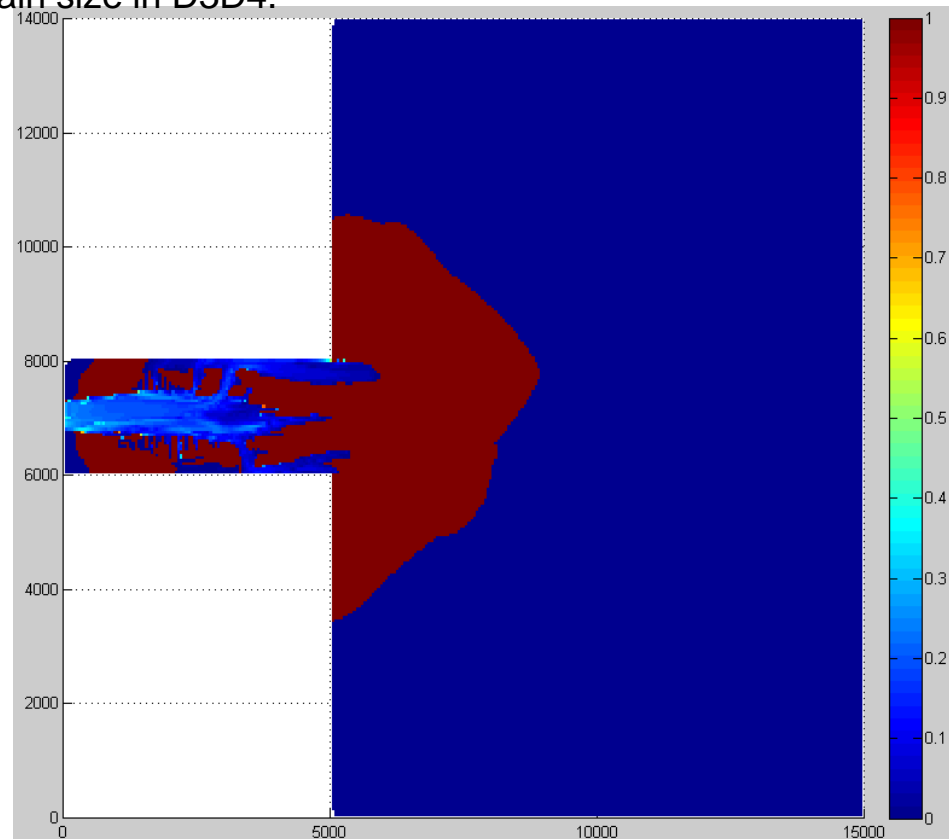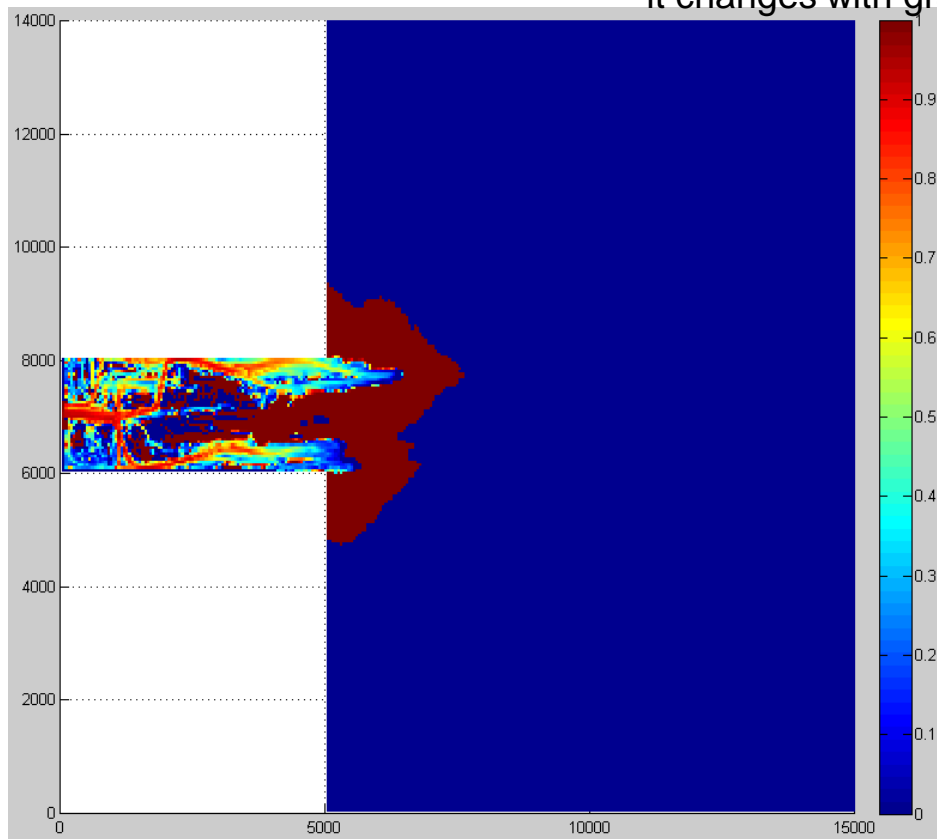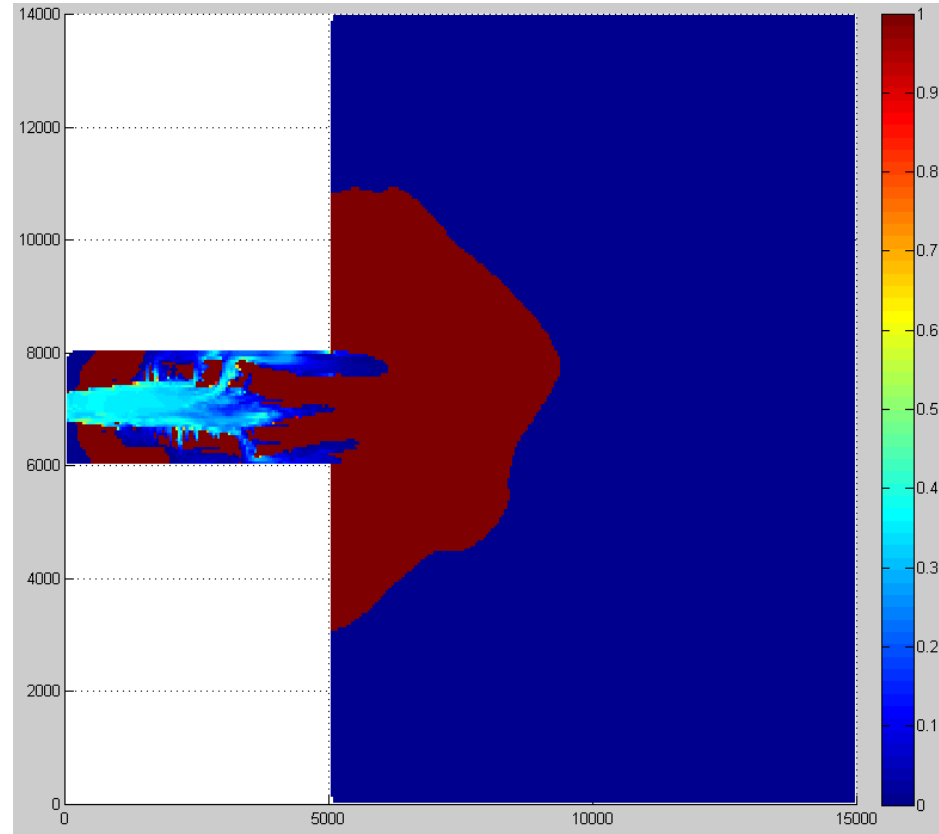# Comparison: GT Model_1 Coarse sand delta

Delft3D-4
(0_9_Origional_ThetSD0_mor_vanRijn2004)

Delft3D-FM
(9_3_inisedthick_update_mor_vanRijn2004)

95 days – Very coarse sand fraction (suspended load : total load)
Almost no suspended load in FM

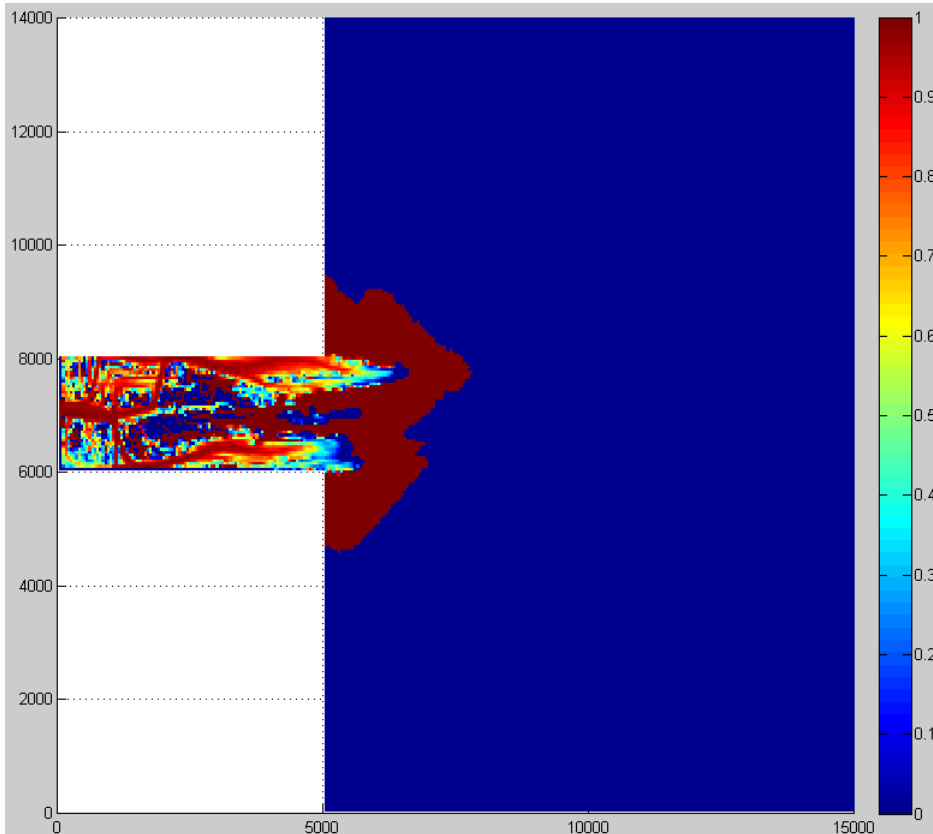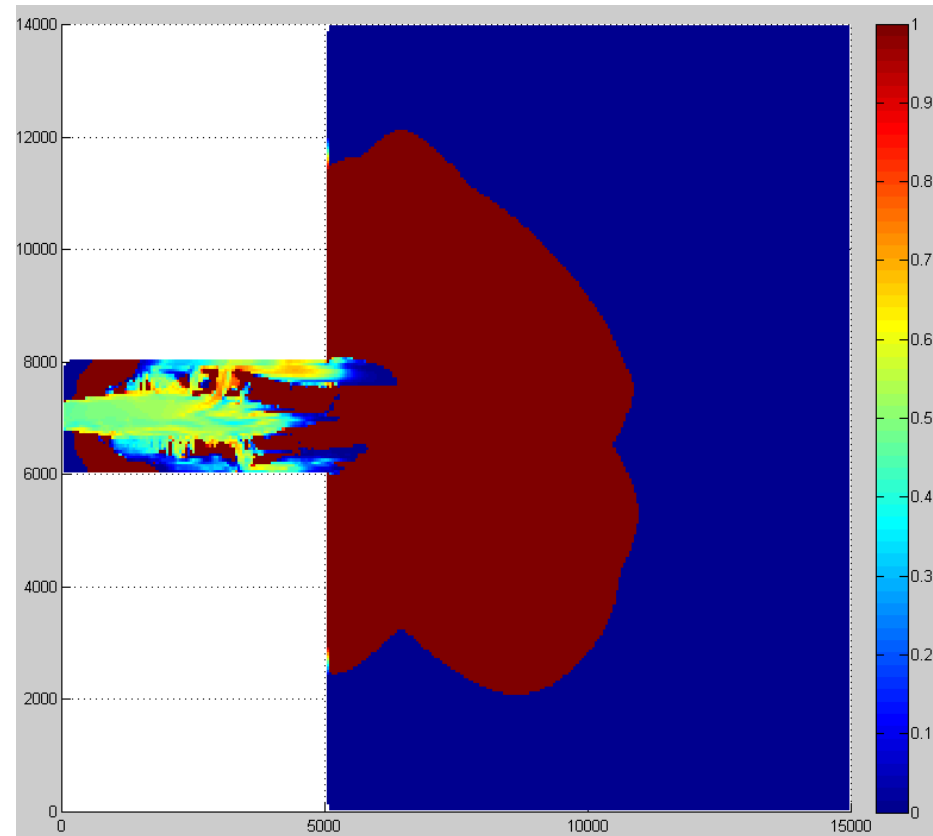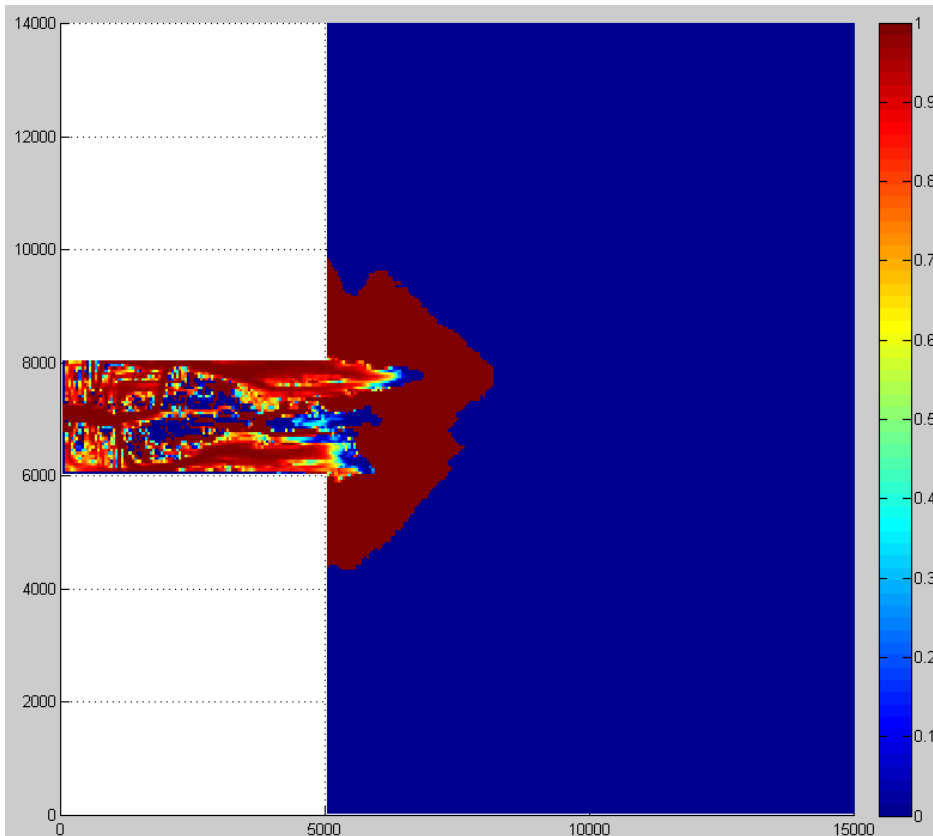# Comparison: GT Model_1 Coarse sand delta

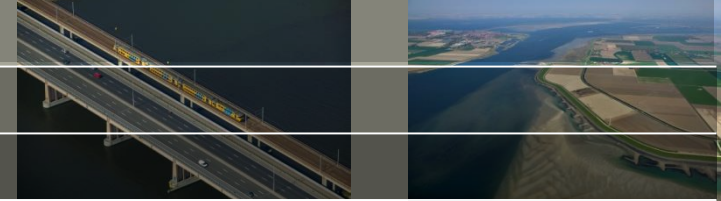Delft3D-4
(0_9_Origional_ThetSD0_mor_vanRijn2004)

Delft3D-FM
(9_3_inisedthick_update_mor_vanRijn2004)

95 days – Coarse sand fraction (suspended load : total load)
The transport definition file defines this to be 0.75 for coarse sand…



**Deltares**

# Comparison: GT Model_1 Coarse sand delta

Delft3D-4
(0_9_Origional_ThetSD0_mor_vanRijn2004)

Delft3D-FM
(9_3_inisedthick_update_mor_vanRijn2004)

95 days – Medium sand fraction (suspended load : total load)
Again almost no suspended load in FM – strangely, this ratio seems to stay the same for all fractions in FM, while it changes with grain size in D3D4.



**Deltares**

# Comparison: GT Model_1 Coarse sand delta

Delft3D-4
(0_9_Origional_ThetSD0_mor_vanRijn2004)

Delft3D-FM
(9_3_inisedthick_update_mor_vanRijn2004)

95 days – Fine sand fraction (suspended load : total load)
Still less suspended load in FM
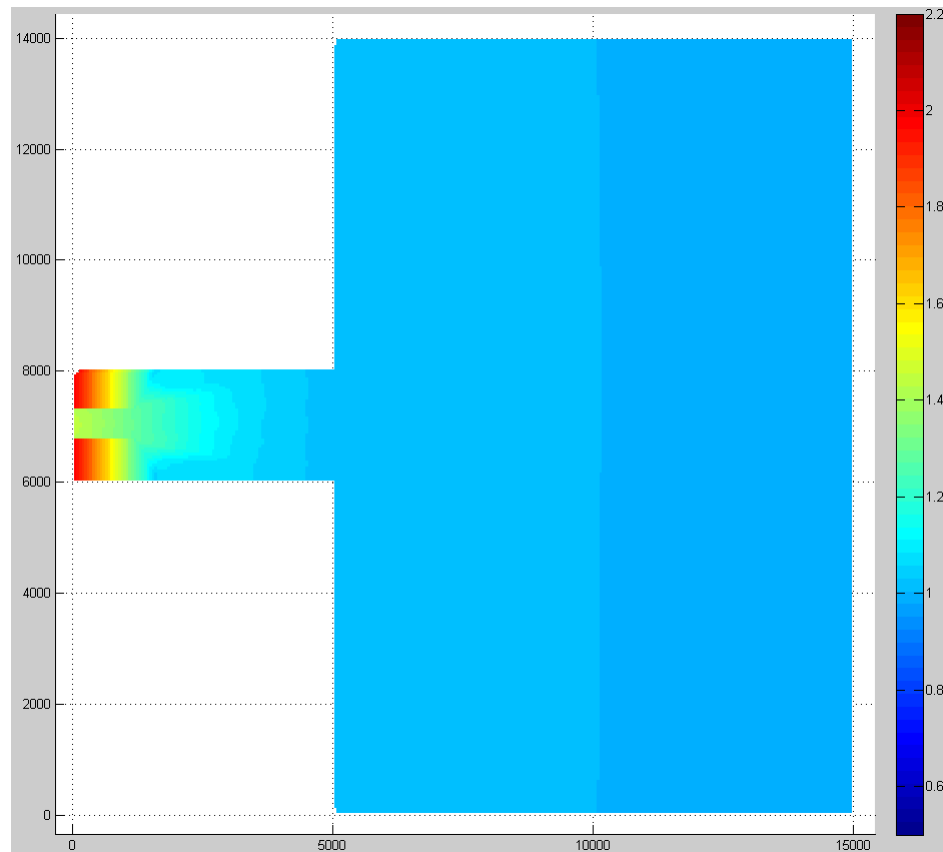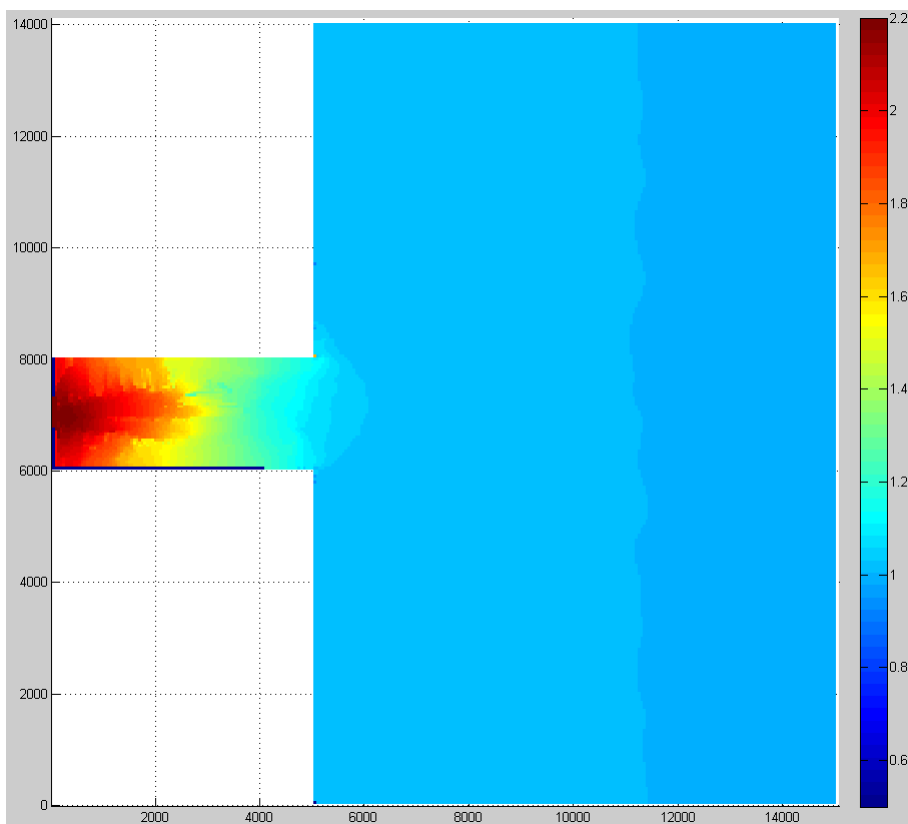


**Deltares**

# Comparison: GT Model_1 Coarse sand delta

Delft3D-4
(0_9_Origional_ThetSD0_mor_vanRijn2004)

Delft3D-FM
(9_3_inisedthick_update_mor_vanRijn2004)

95 days – Very fine sand fraction (suspended load : total load)
The transport definition file defines this to be 0.9 for very fine sand
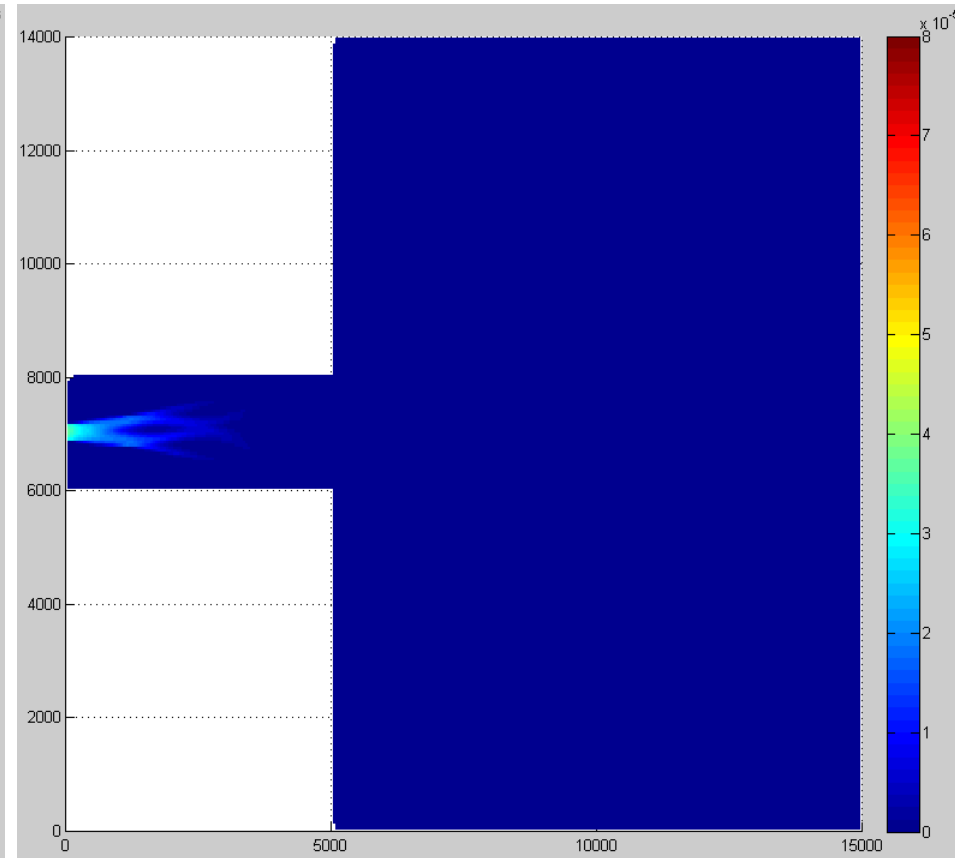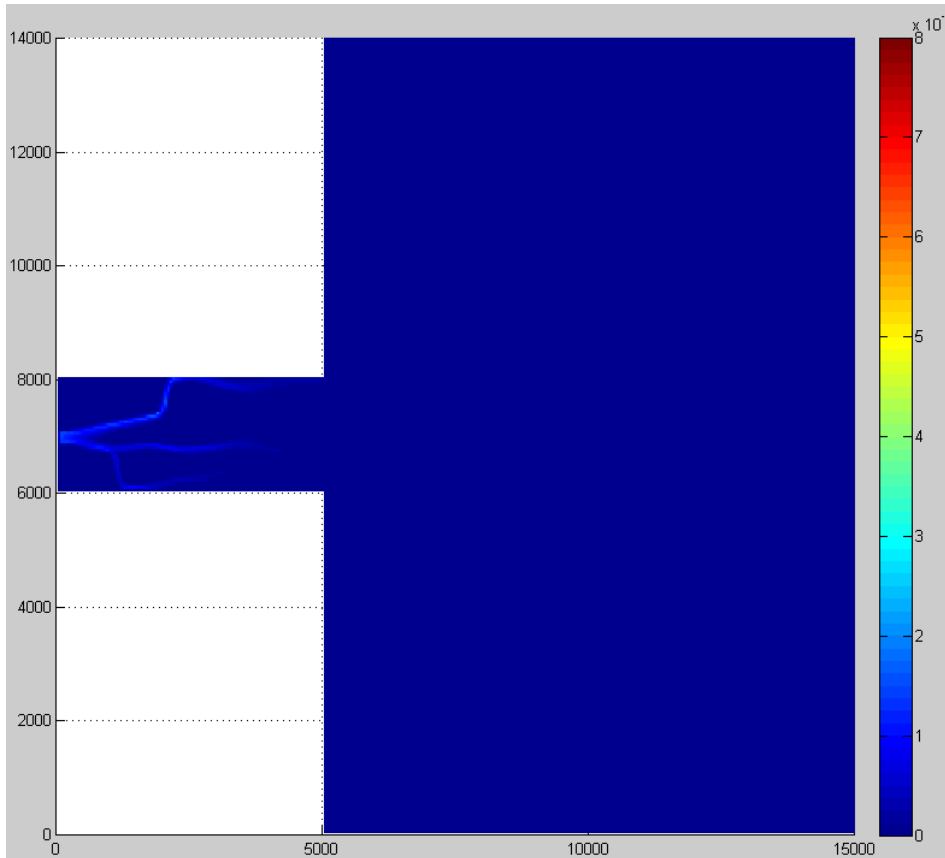
**Deltares**

# Results:
## Engelund-Hansen transport

# Comparison: GT Model_1 - Coarse sand delta

Delft3D-4
(0_9_Origional_ThetSD0)

Delft3D-FM
(9_3_inisedthick_update_mor)

160 days – Bathymetry
FM show a smoother bathymetry gradients and very smooth shoreline (overly smooth?)
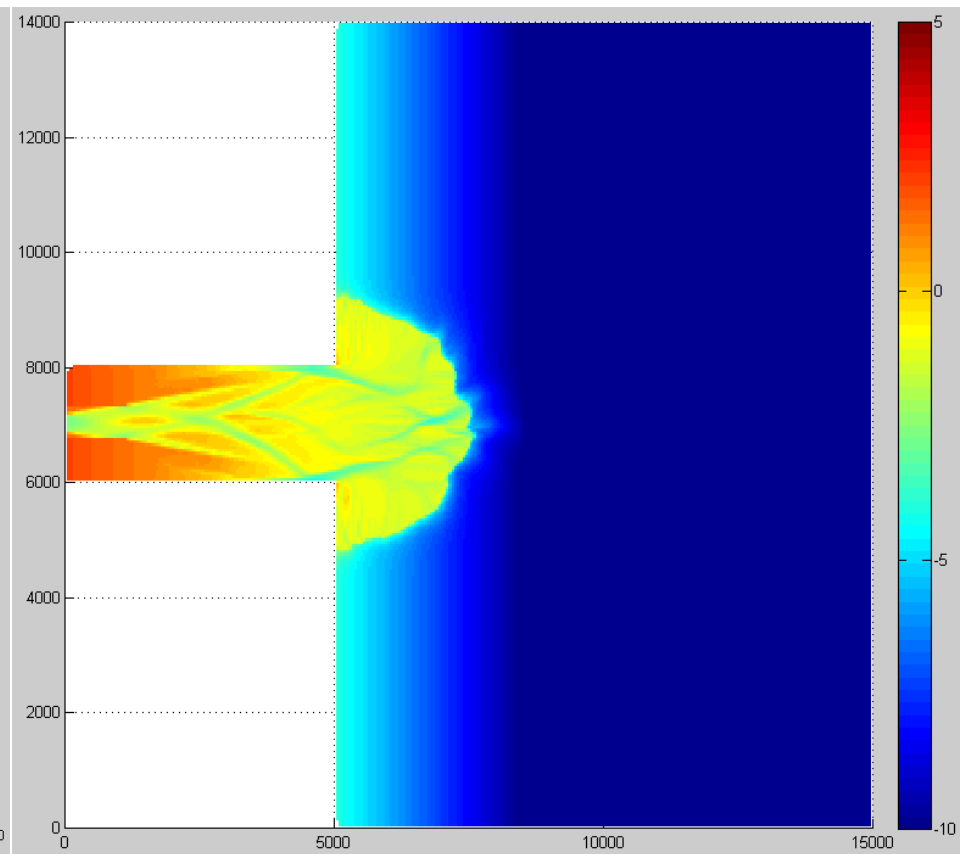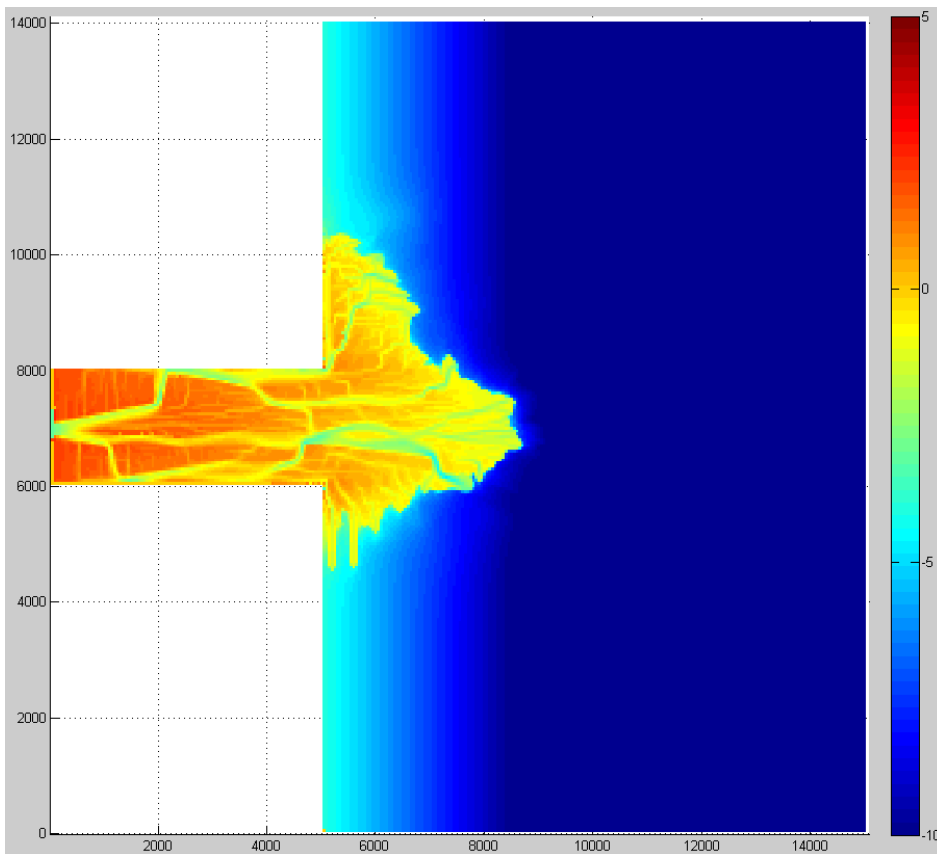
Deltares

# Comparison: GT Model_1 Coarse sand delta

Delft3D-4
(0_9_Origional_ThetSD0_mor_vanRijn2004)

Delft3D-FM
(9_3_inisedthick_update_mor_vanRijn2004)

160 days – Velocity
FM velocity decreases much more proximal to distal (left to right) in FM,
which corresponds to the less channelized bathymetry
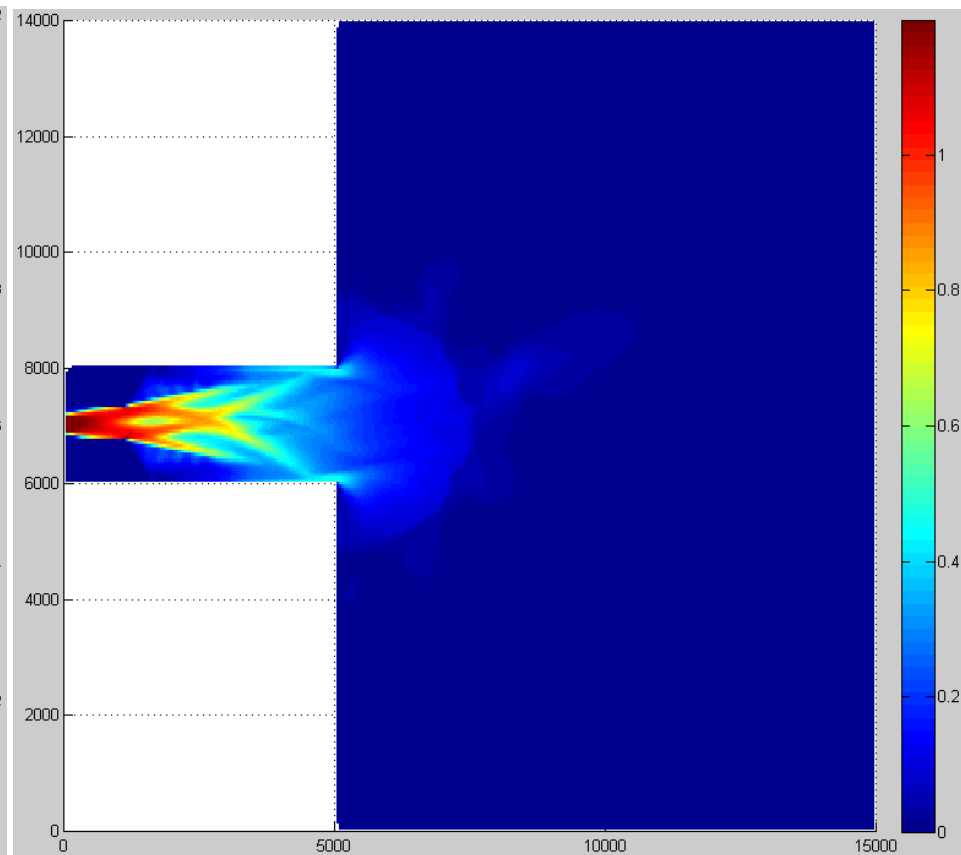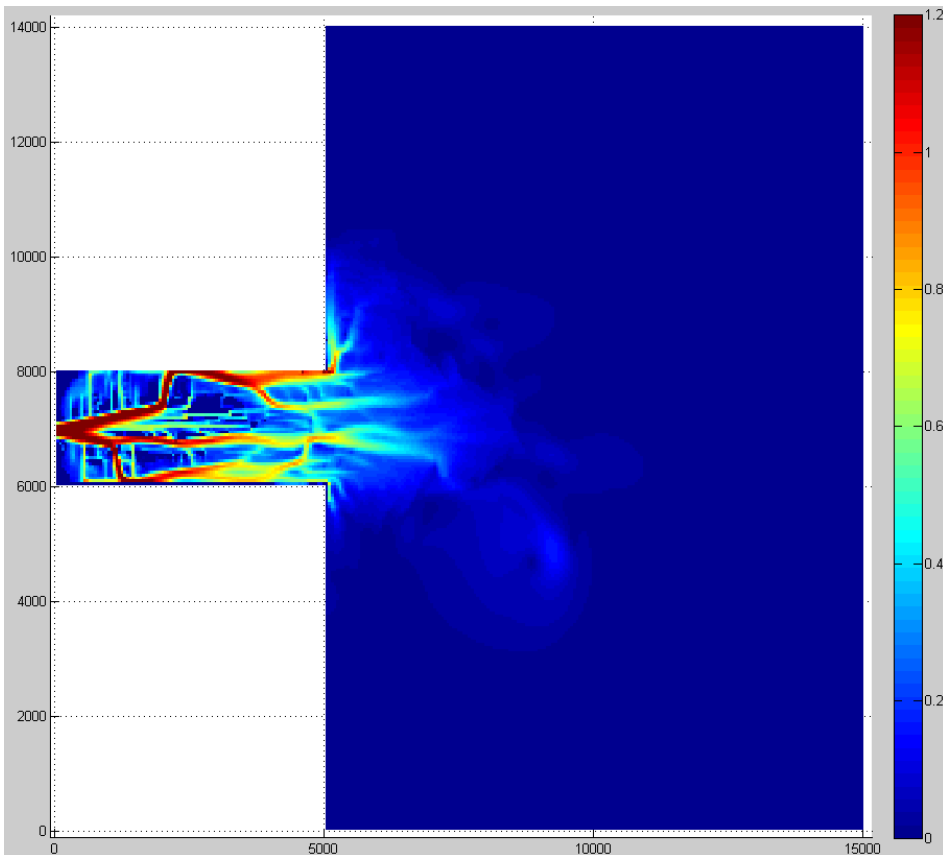
**Deltares**

# Comparison: GT Model_1 Coarse sand delta

Delft3D-4
(0_9_Origional_ThetSD0_mor_vanRijn2004)

Delft3D-FM
(9_3_inisedthick_update_mor_vanRijn2004)

## 160 days – water level
FM show a much smaller backwater effect
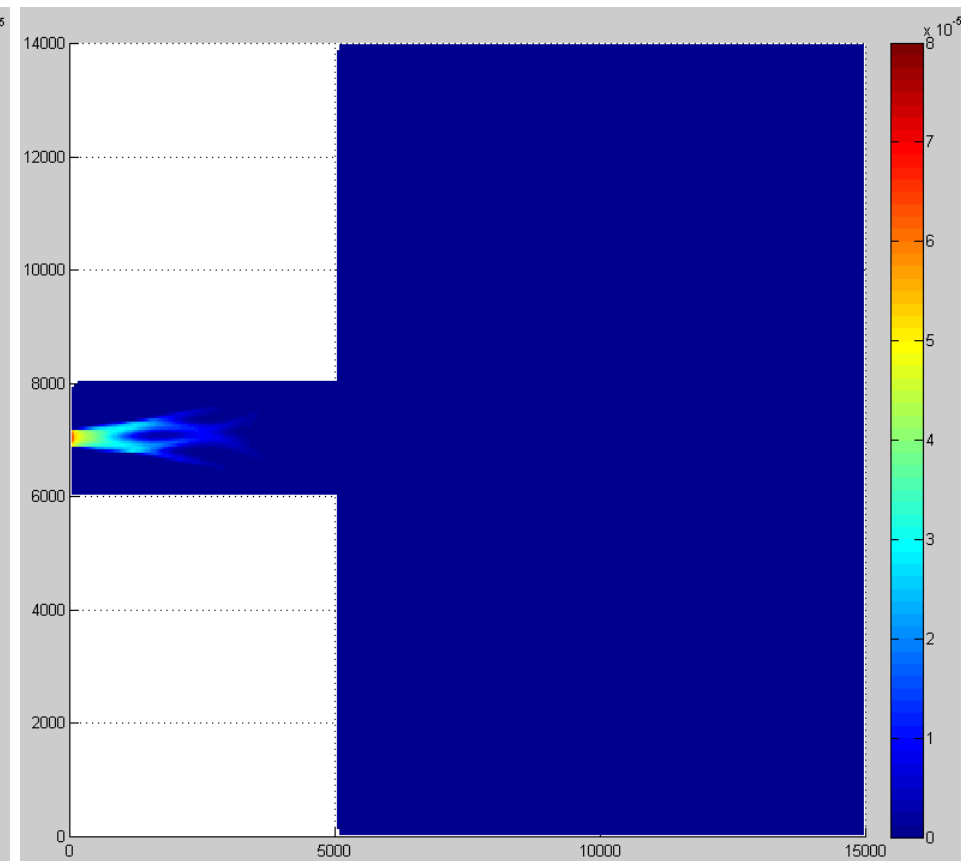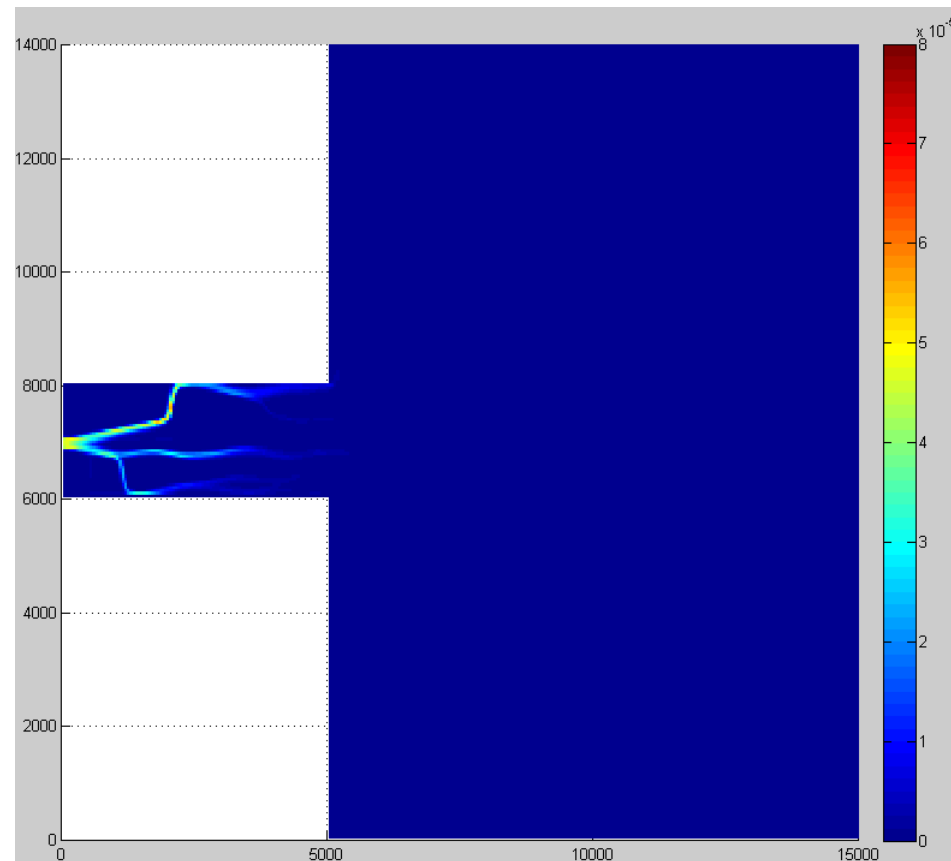


**Deltares**

**very coarse sand fraction**

Delft3D-4
(0_9_Origional_ThetSD0)

Delft3D-FM
(9_3_inisedthick_update_mor)
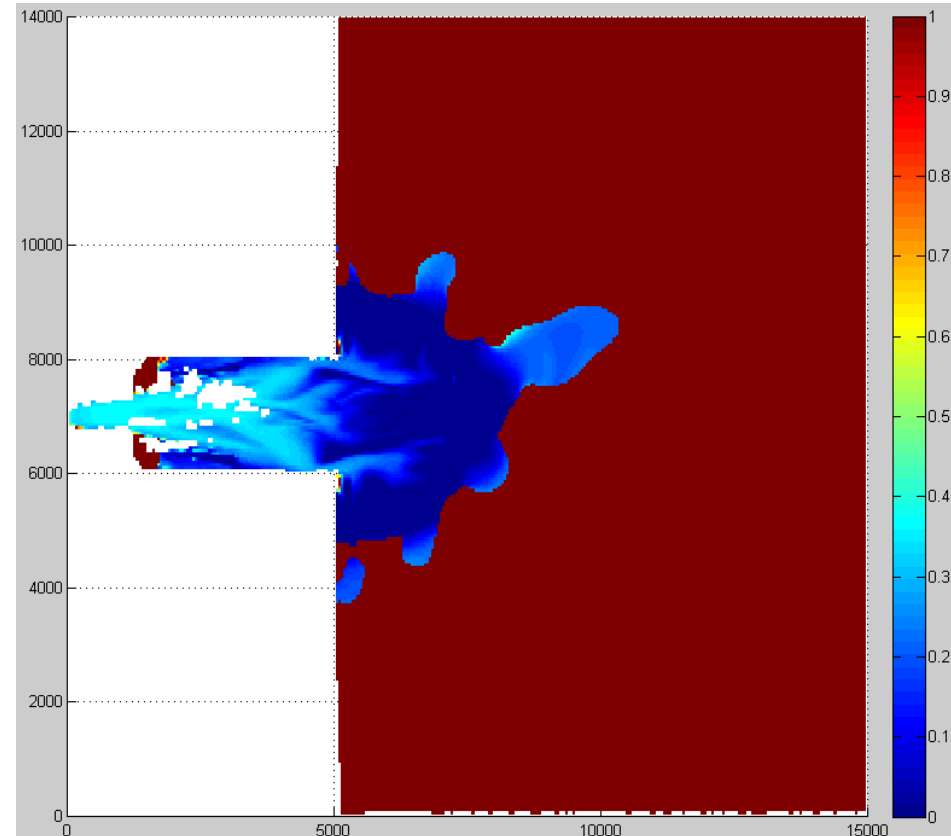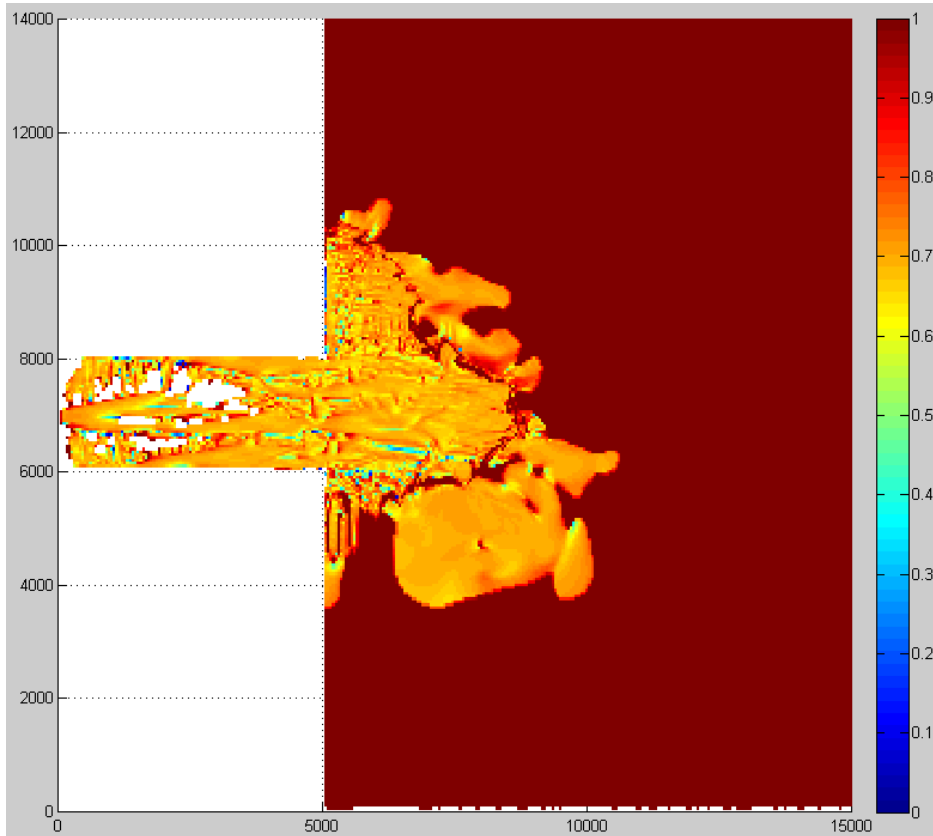
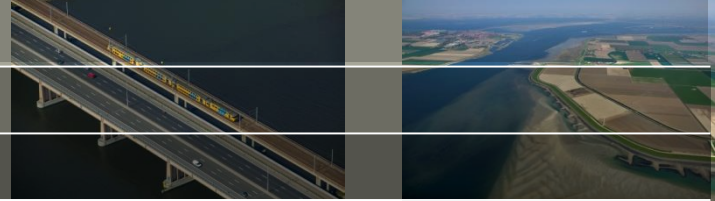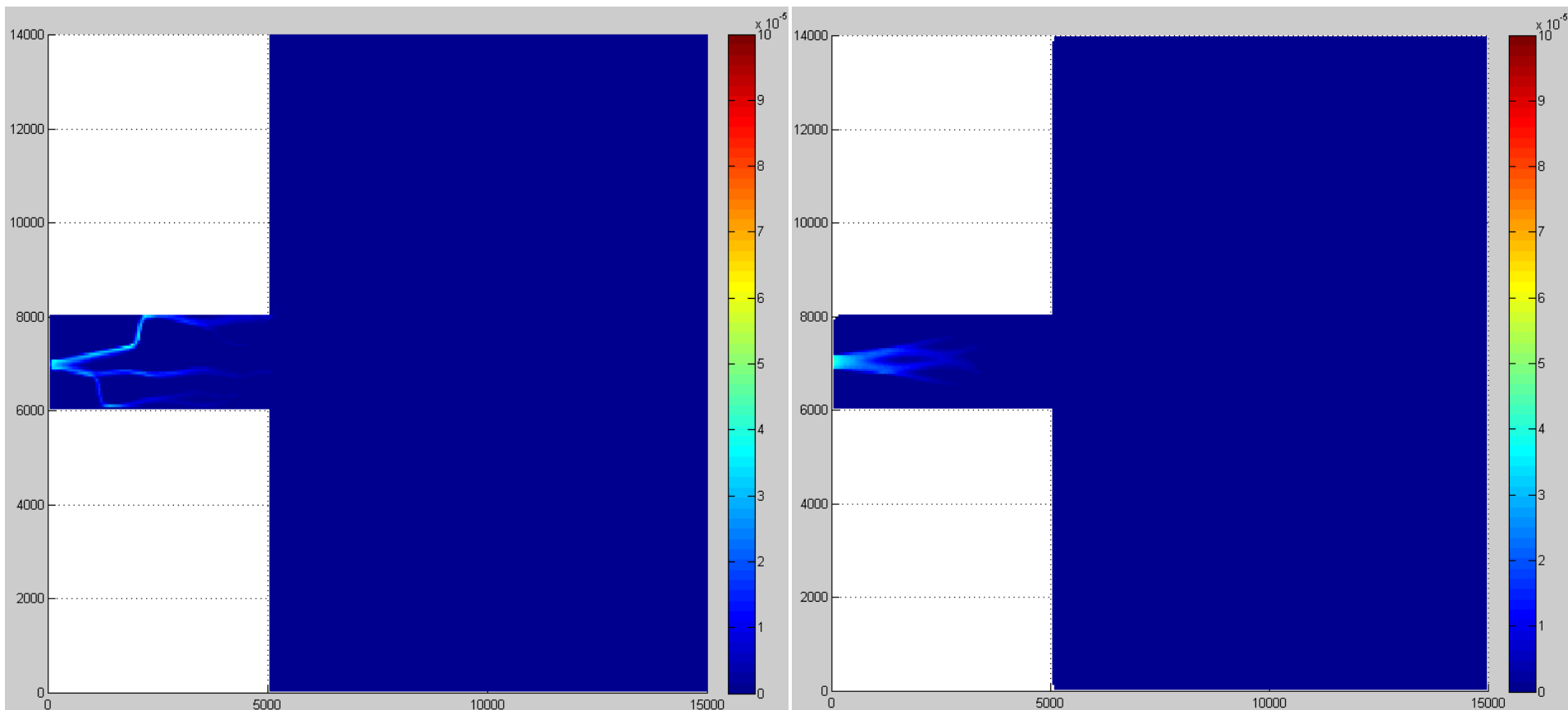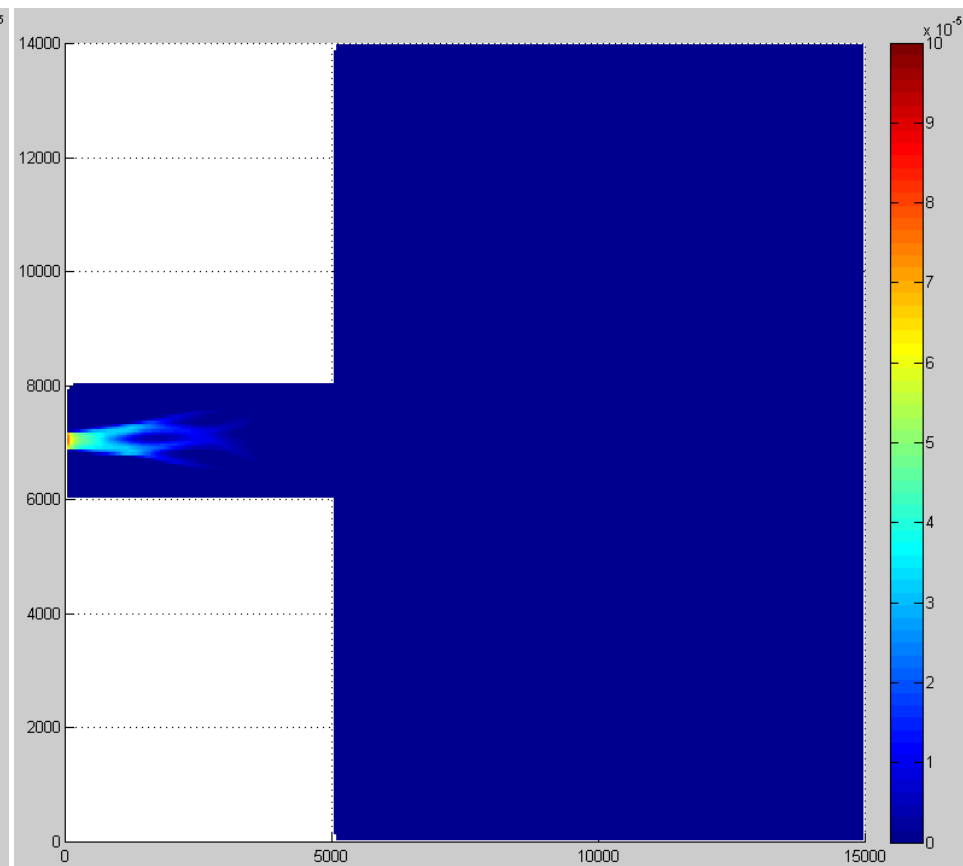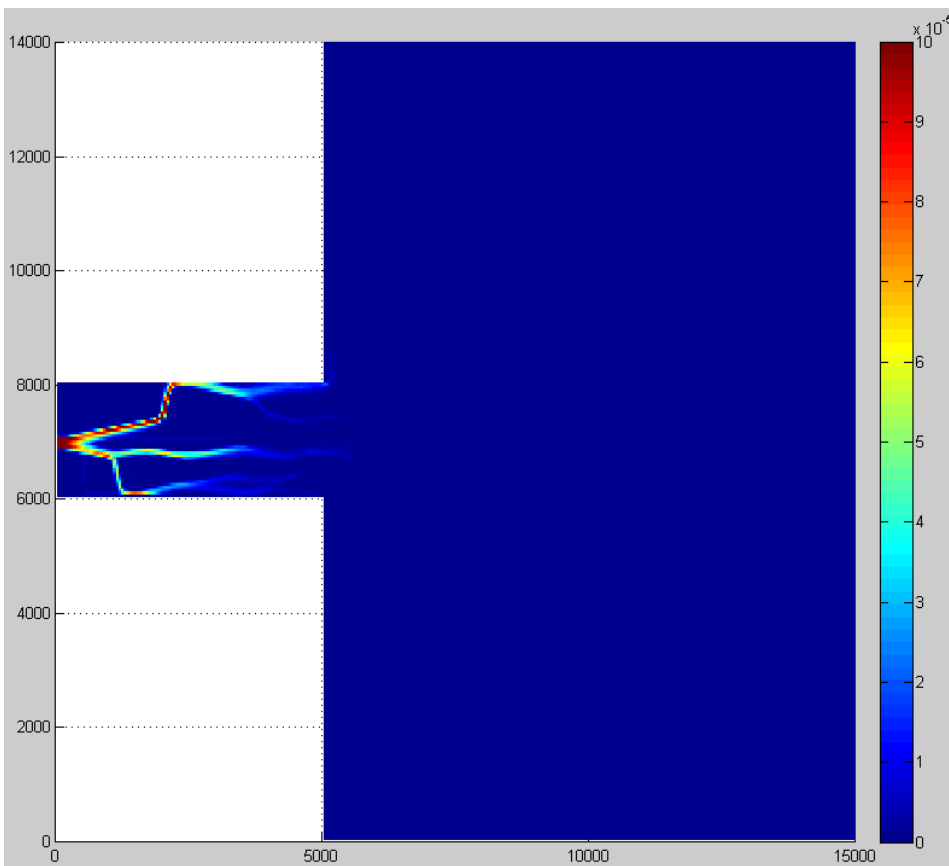160 days – Very coarse sand fraction (bed load)
FM BL larger in proximal area

Delft3D-4
(0_9_Origional_ThetSD0)

Delft3D-FM
(9_3_inisedthick_update_mor)

160 days – Very coarse sand fraction (suspended load)
..



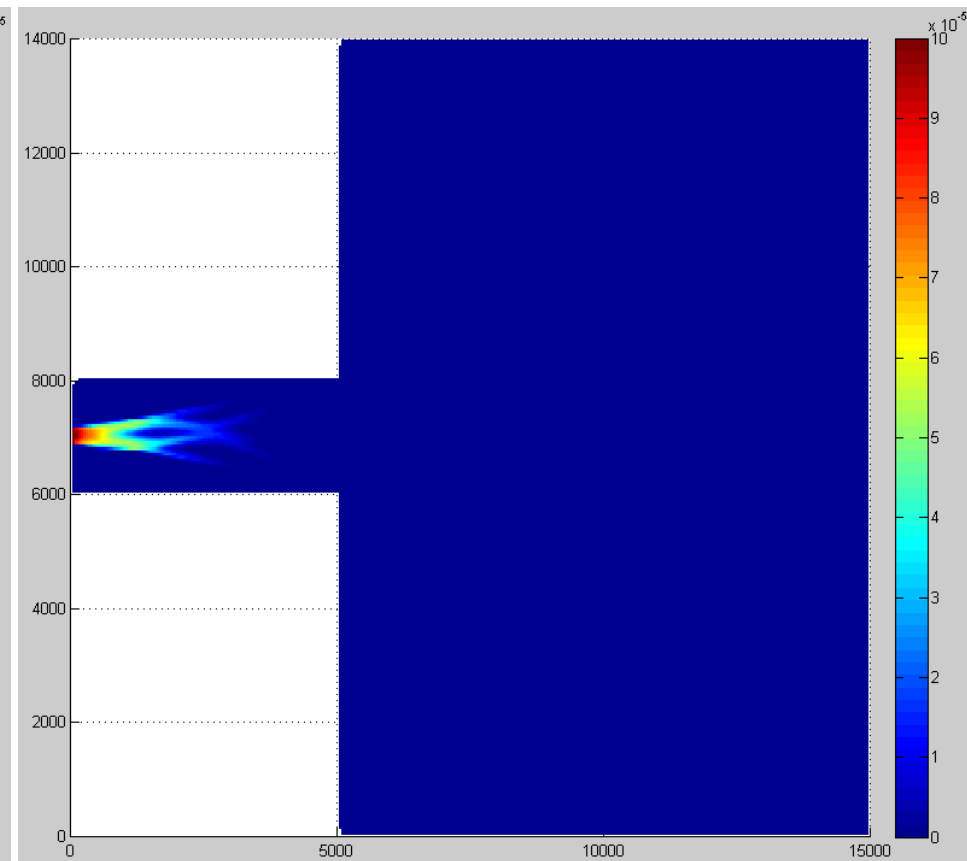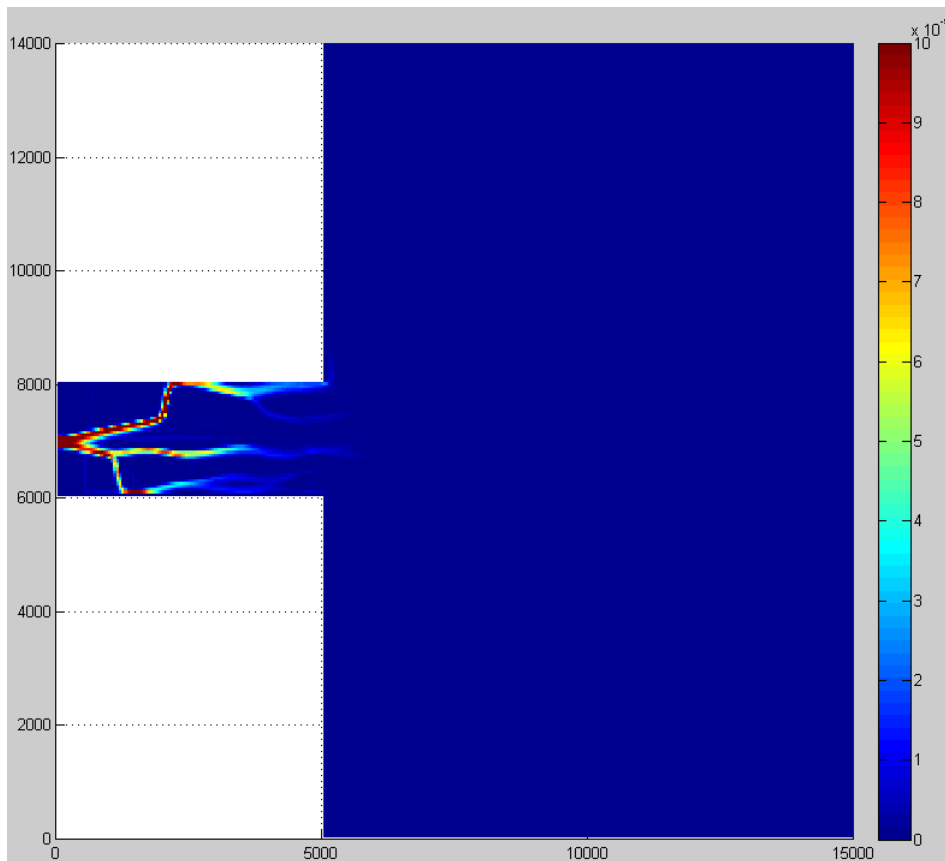**Deltares**

# Comparison: GT Model_1 Coarse sand delta

Delft3D-4
(0_9_Origional_ThetSD0)

Delft3D-FM
(9_3_inisedthick_update_mor)

160 days – Very coarse sand fraction (total load)
..



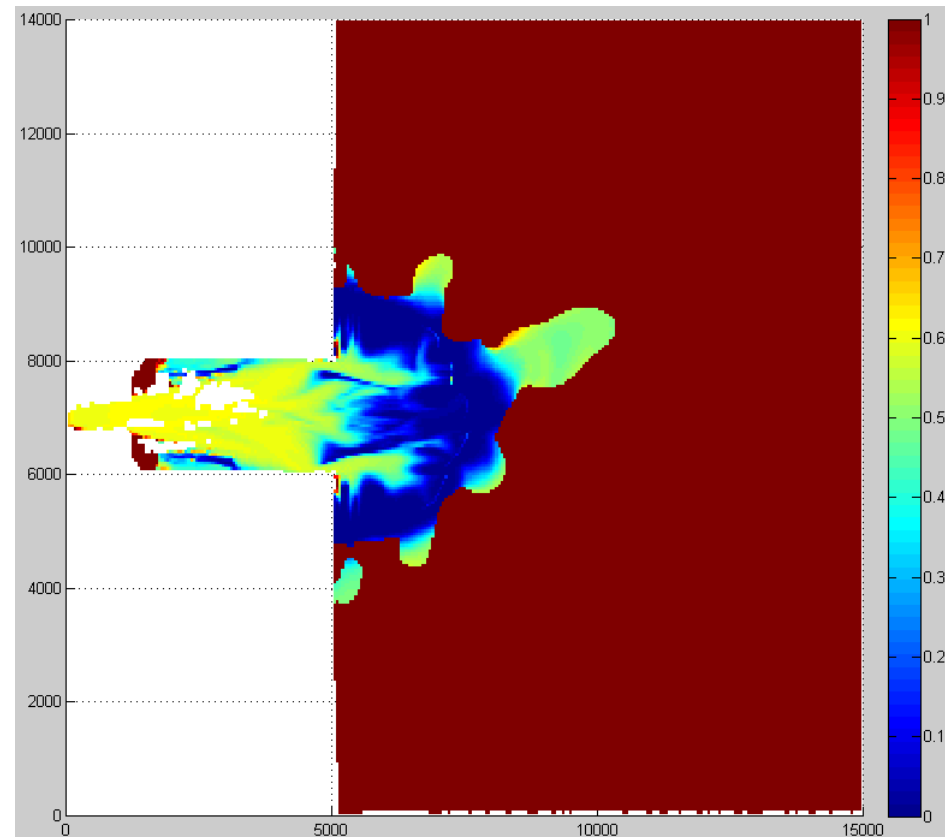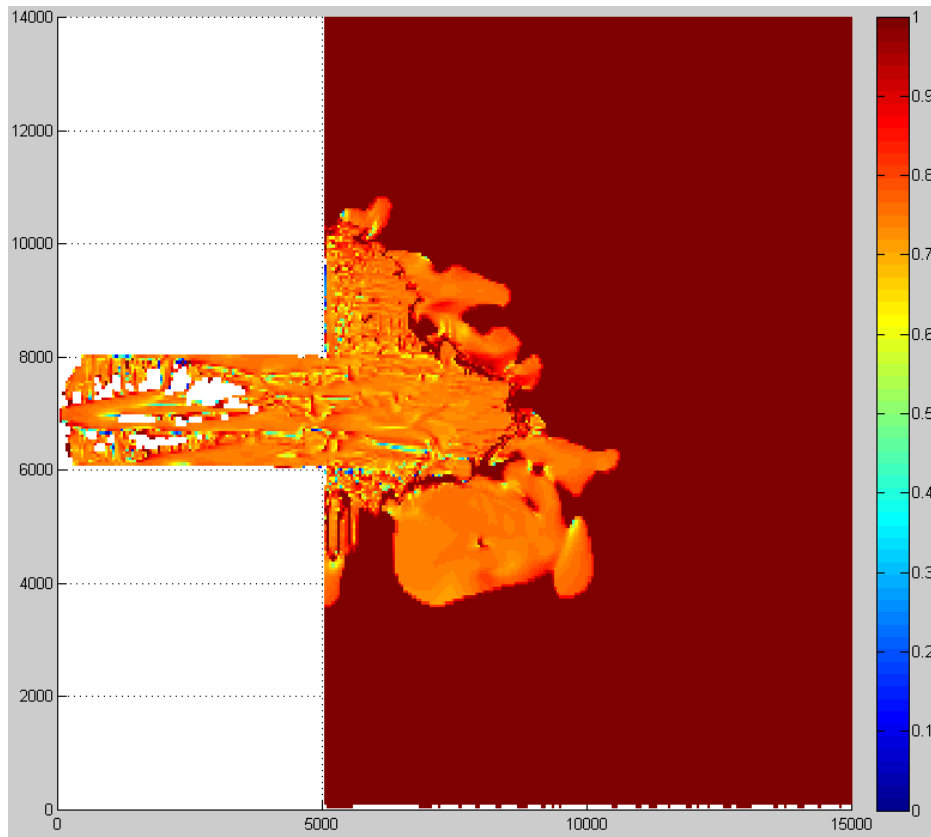**Deltares**

# Comparison: GT Model_1 Coarse sand delta

Delft3D-4
(0_9_Origional_ThetSD0)

Delft3D-FM
(9_3_inisedthick_update_mor)

160 days – Very coarse sand fraction (suspended load : total load)
The transport definition file defines this to be 0.7 for very coarse sand…



**Deltares**

# coarse sand fraction

Delft3D-4
(0_9_Origional_ThetSD0)

Delft3D-FM
(9_3_inisedthick_update_mor)

160 days – Coarse sand fraction (bed load)

..



**Deltares**

Delft3D-4
(0_9_Origional_ThetSD0)

Delft3D-FM
(9_3_inisedthick_update_mor)

160 days – Coarse sand fraction (suspended load)
..



**Deltares**

# Comparison: GT Model_1 Coarse sand delta

Delft3D-4
(0_9_Origional_ThetSD0)

Delft3D-FM
(9_3_inisedthick_update_mor)
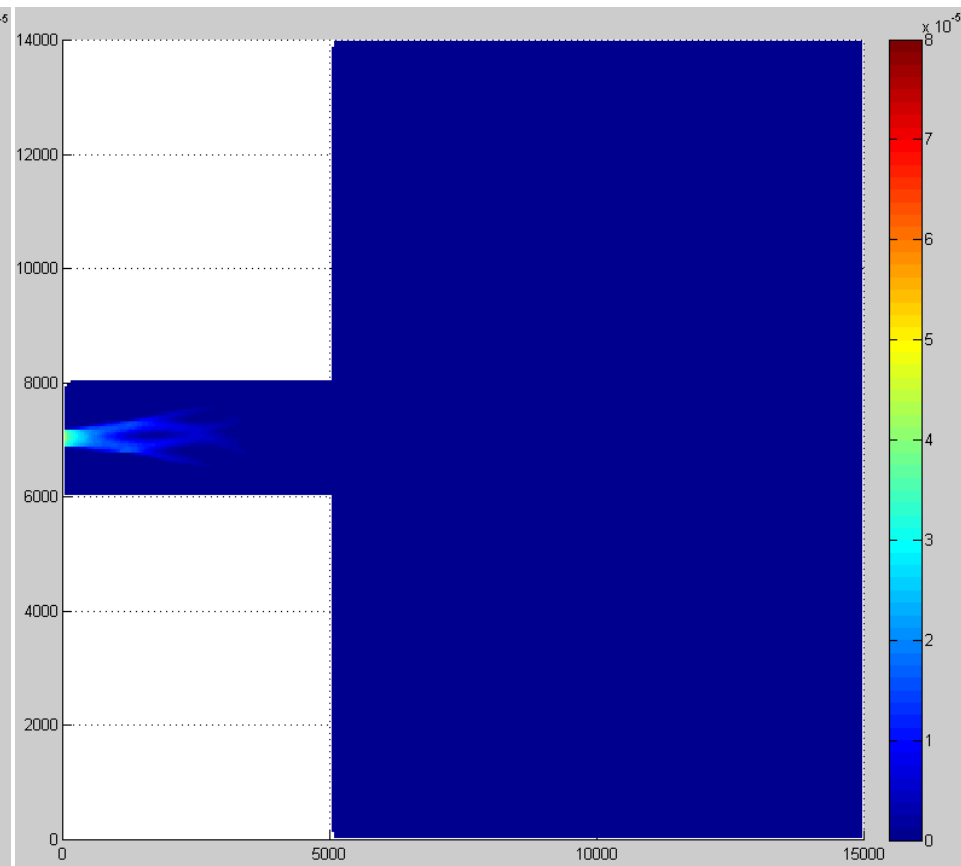
160 days – Coarse sand fraction (total load)
..



**Deltares**

Delft3D-4
(0_9_Origional_ThetSD0)

Delft3D-FM
(9_3_inisedthick_update_mor)

160 days – Coarse sand fraction (suspended load : total load)
The transport definition file defines this to be 0.75 for coarse sand…



**Deltares**

**medium sand fraction**

# Comparison: GT Model_1 Coarse sand delta

Delft3D-4
(0_9_Origional_ThetSD0)

Delft3D-FM
(9_3_inisedthick_update_mor)

160 days – Medium sand fraction (bed load)
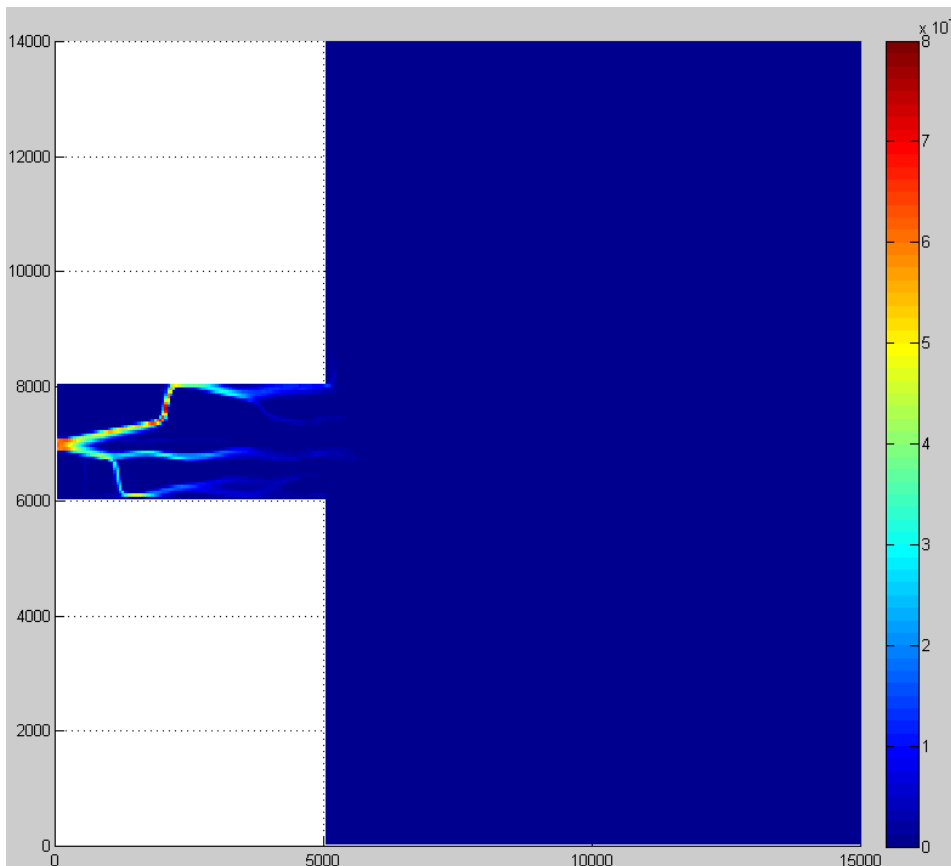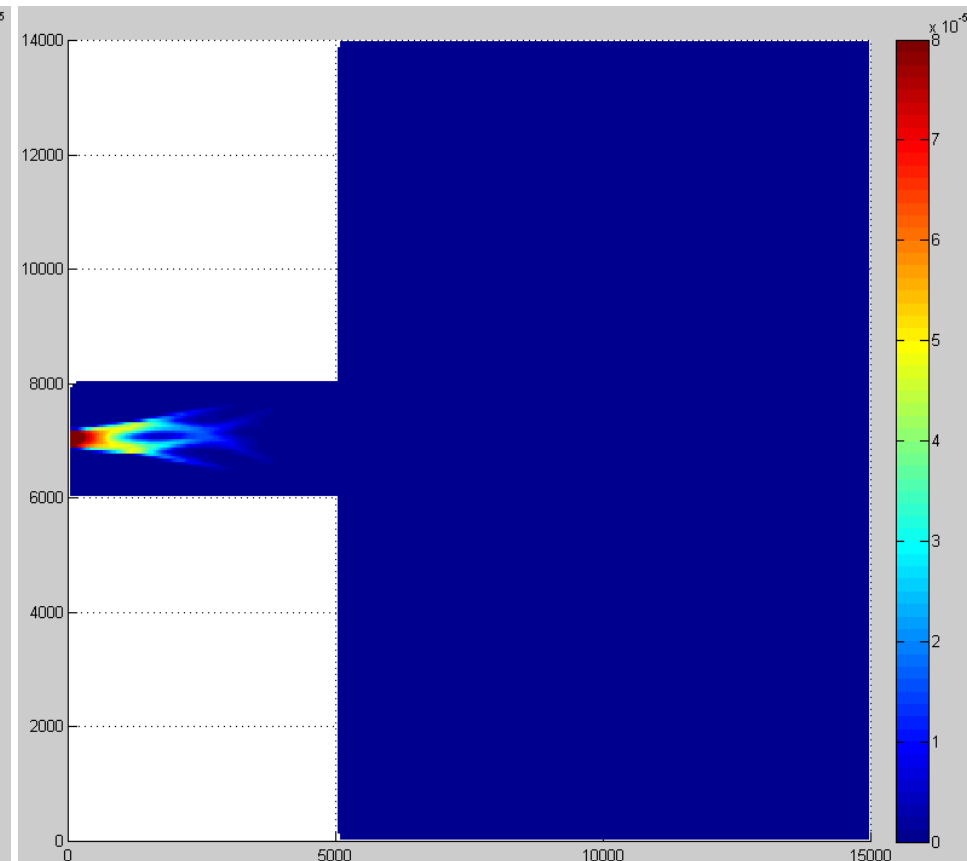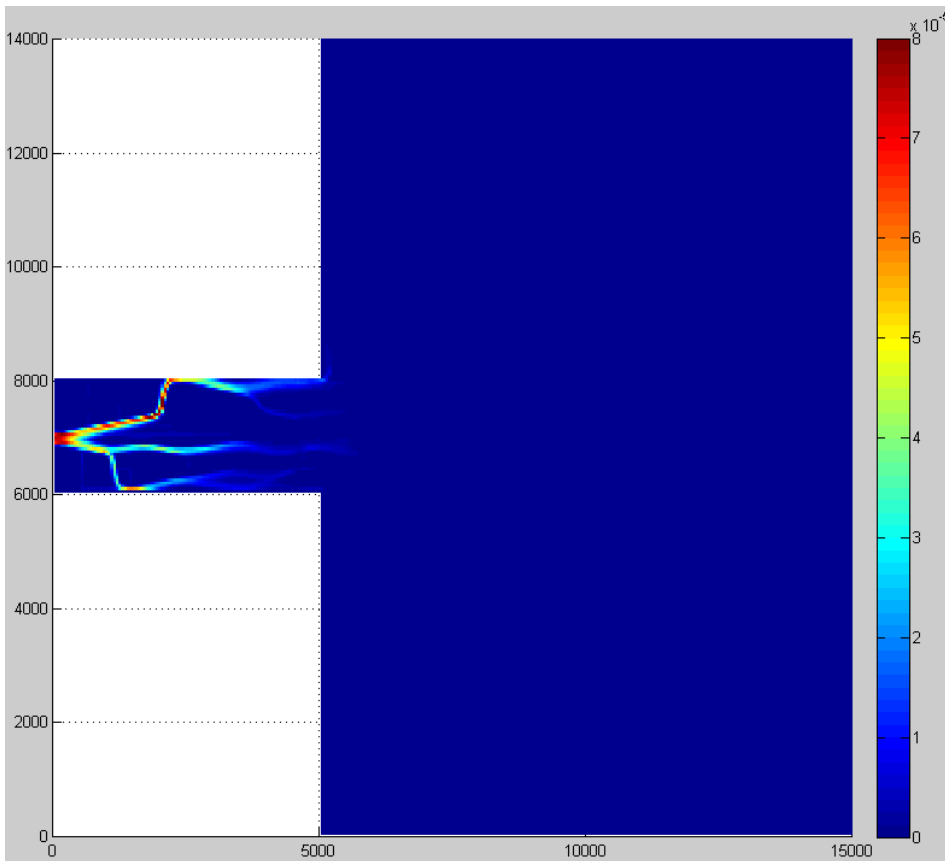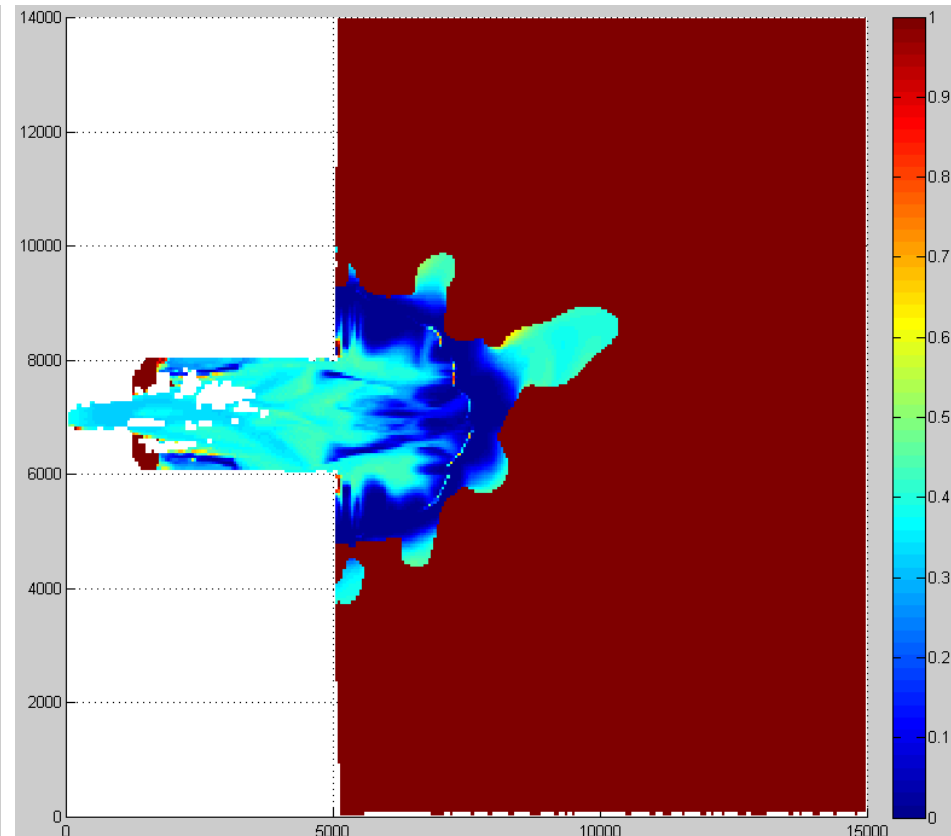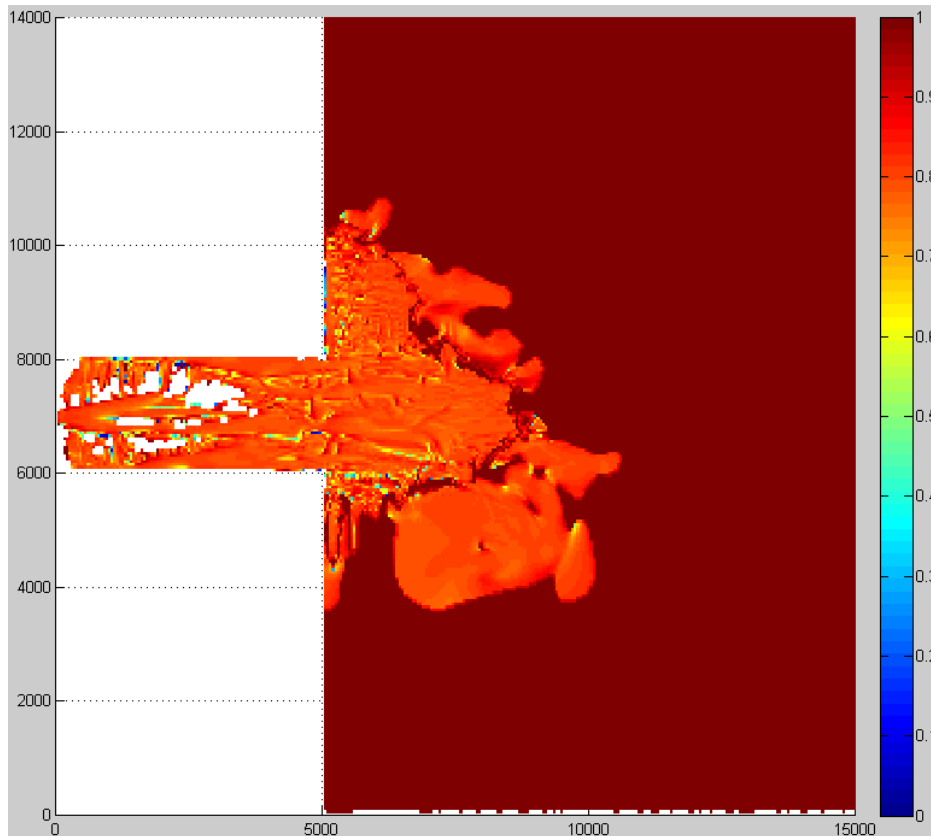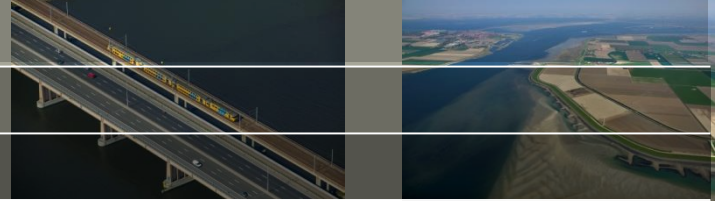..

# Comparison: GT Model_1 Coarse sand delta

Delft3D-4
(0_9_Origional_ThetSD0)

Delft3D-FM
(9_3_inisedthick_update_mor)

160 days – Medium sand fraction (suspended load)
..



**Deltares**

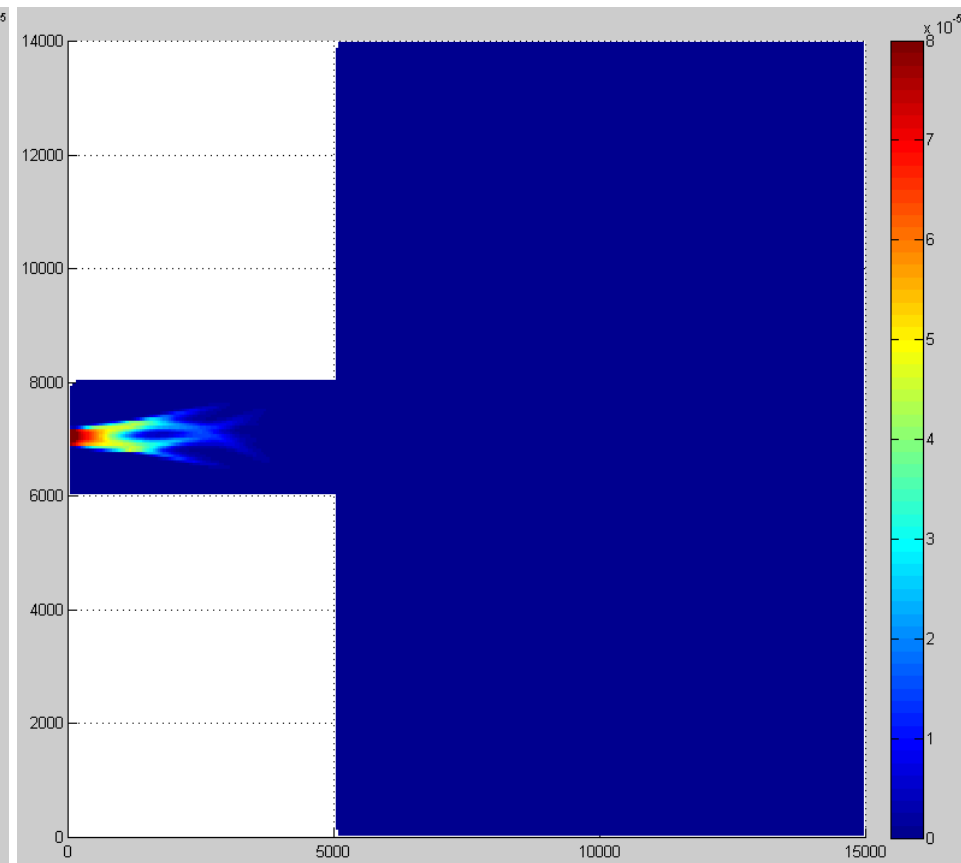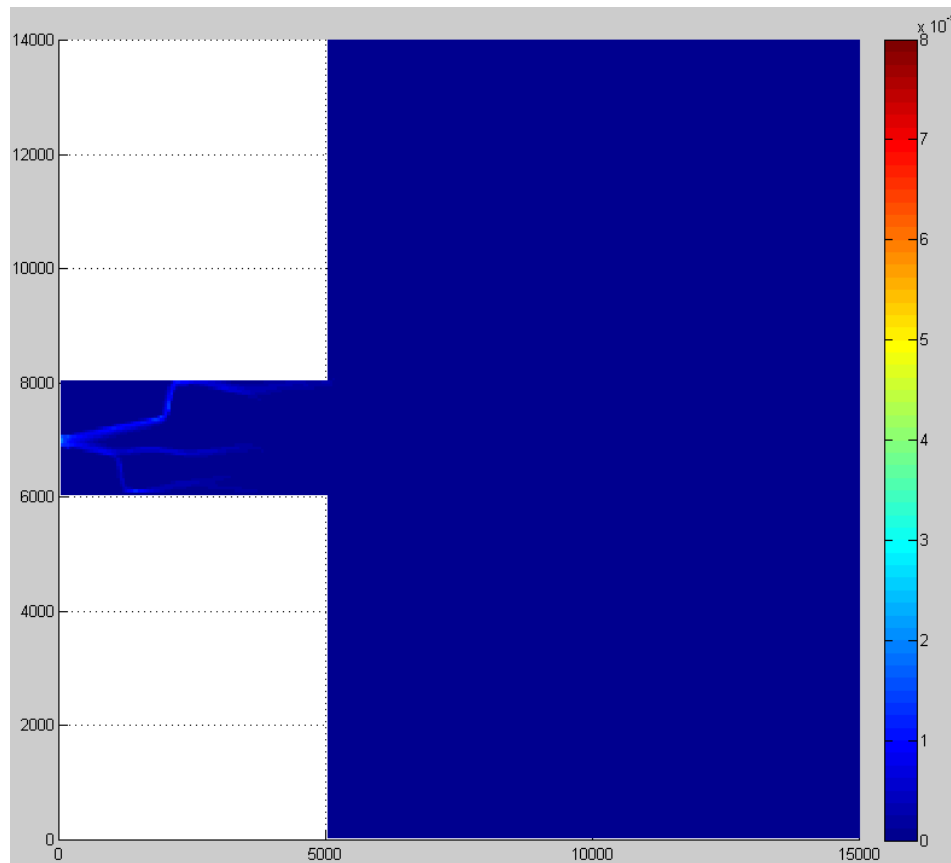# Comparison: GT Model_1 Coarse sand delta

Delft3D-4
(0_9_Origional_ThetSD0)

Delft3D-FM
(9_3_inisedthick_update_mor)

160 days –Medium sand fraction (total load)
..

# Comparison: GT Model_1 Coarse sand delta

Delft3D-4
(0_9_Origional_ThetSD0)

Delft3D-FM
(9_3_inisedthick_update_mor)

160 days – Medium sand fraction (suspended load : total load)
The transport definition file defines this to be 0.8 for medium sand…

# fine sand fraction

Delft3D-4
(0_9_Origional_ThetSD0)

Delft3D-FM
(9_3_inisedthick_update_mor)

160 days – Fine sand fraction (bed load)
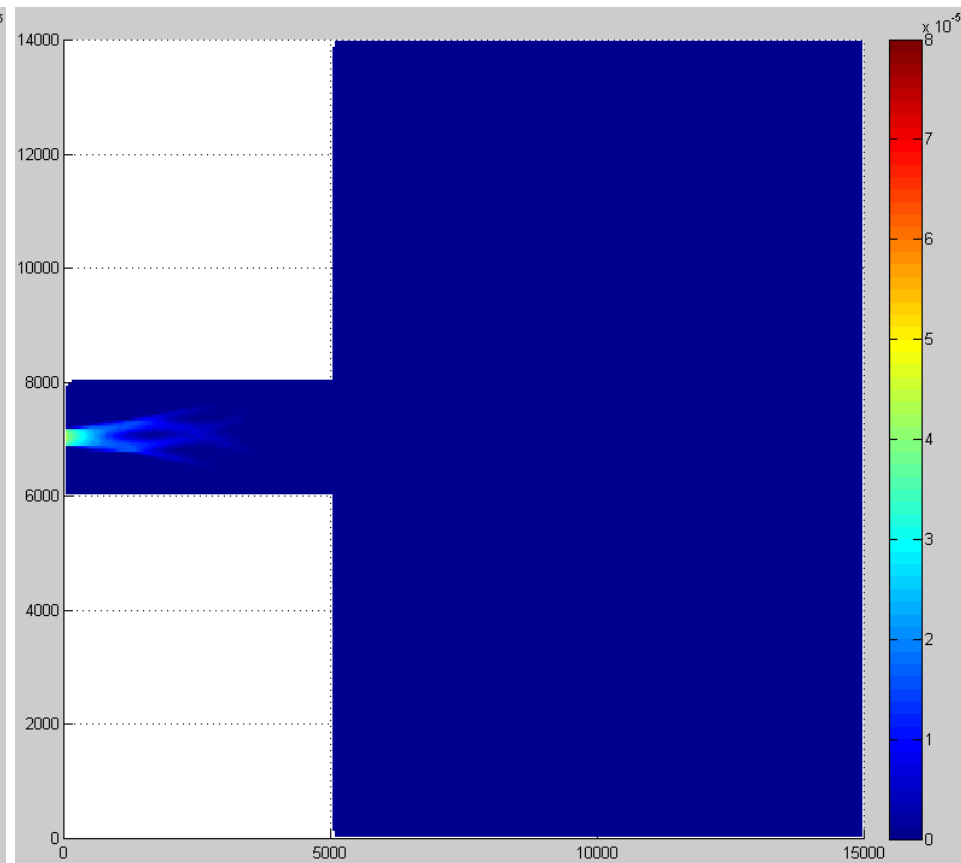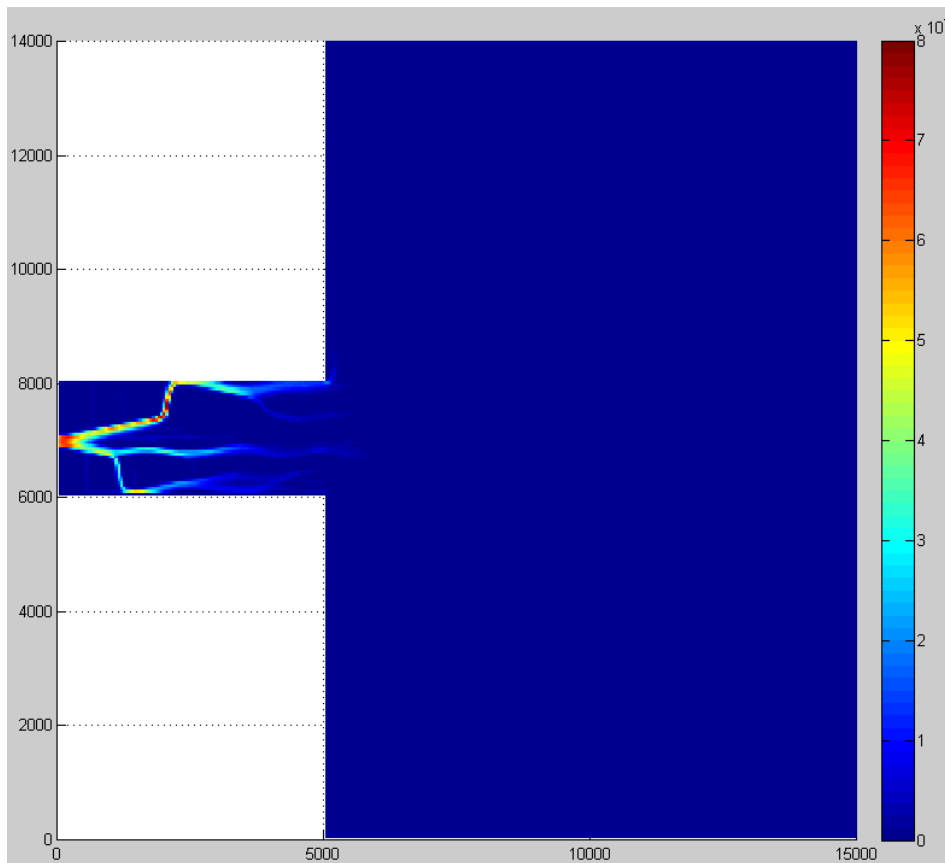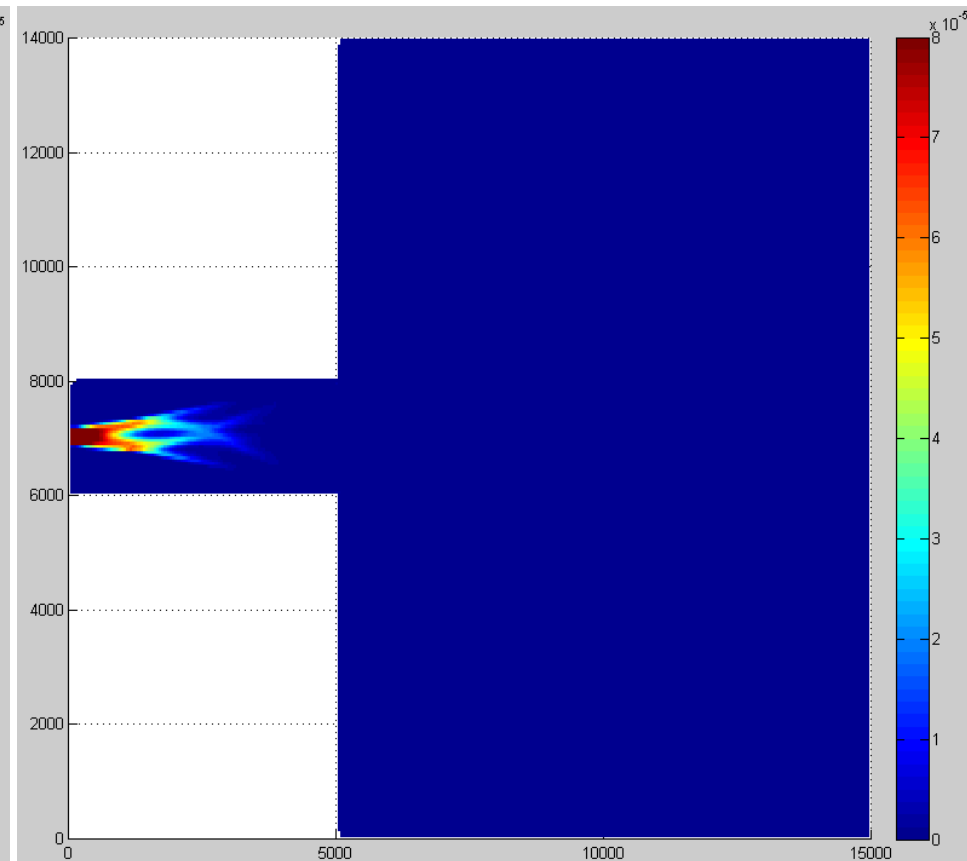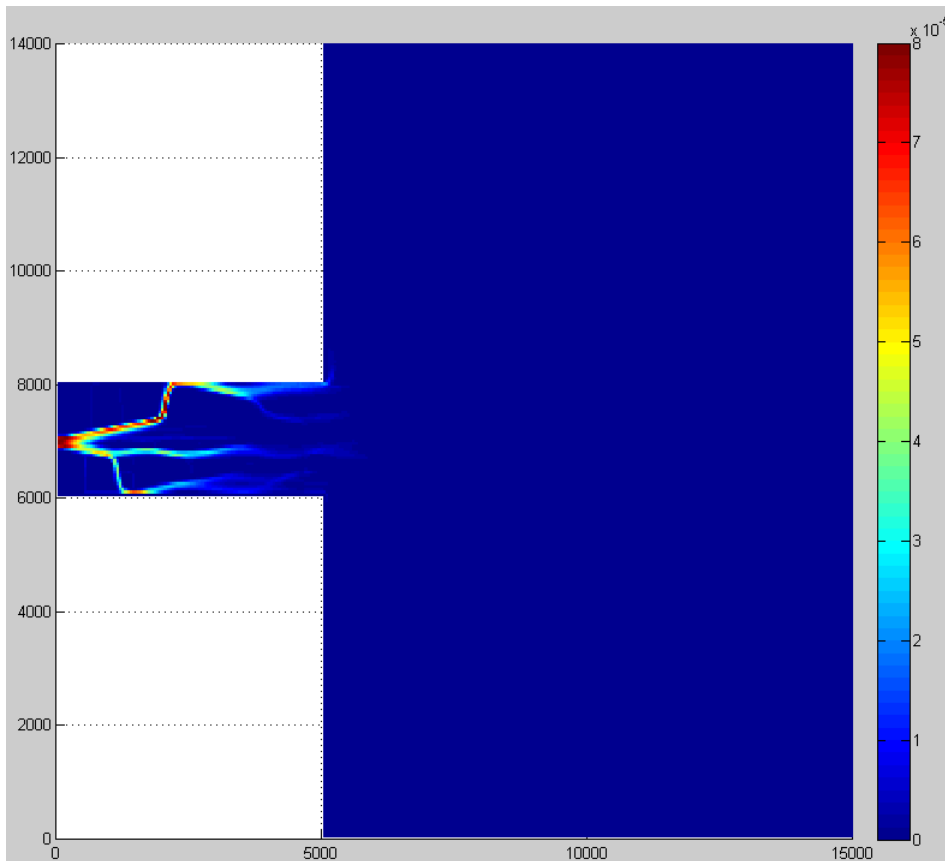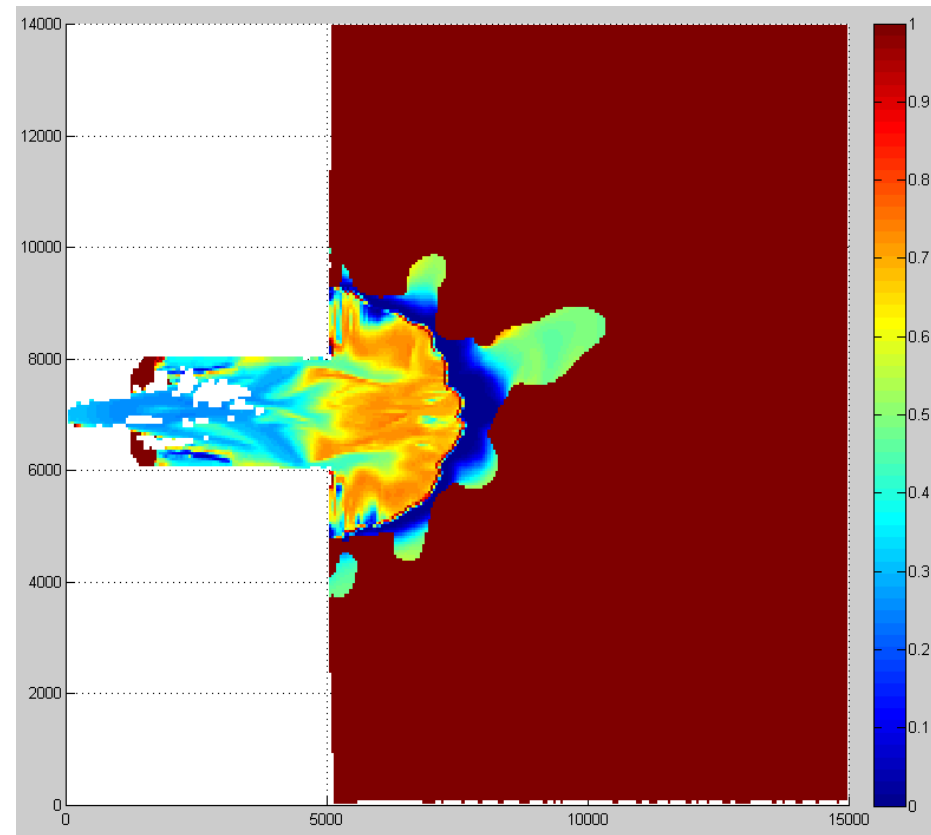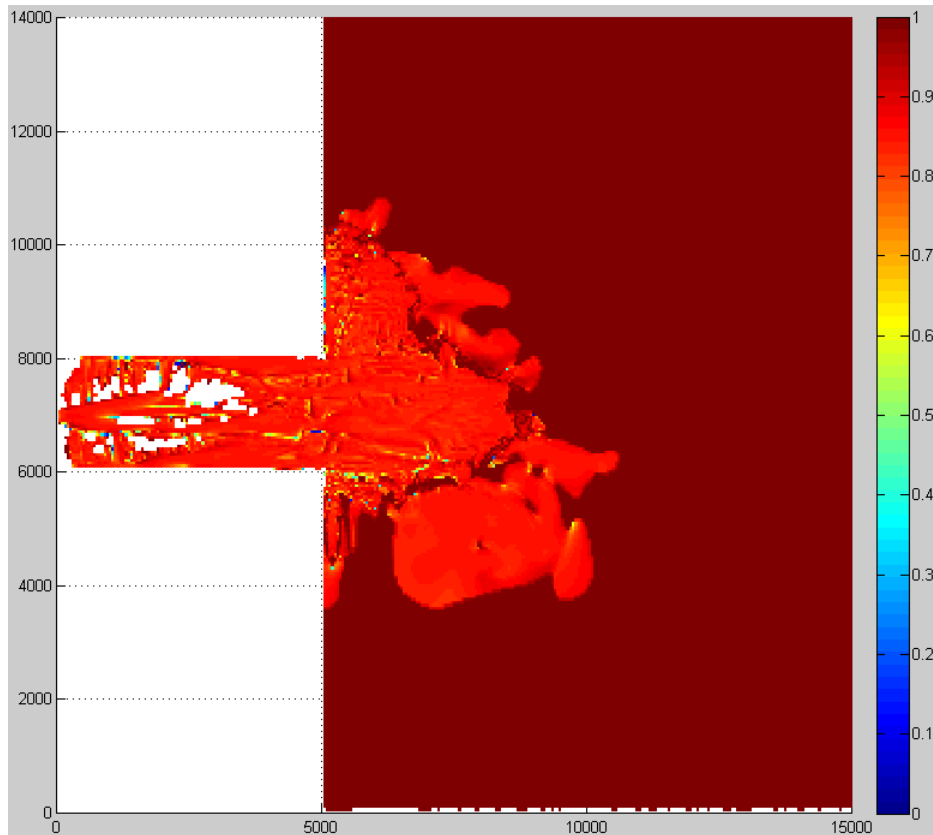..

# Comparison: GT Model_1 Coarse sand delta

Delft3D-4
(0_9_Origional_ThetSD0)

Delft3D-FM
(9_3_inisedthick_update_mor)

160 days – Fine sand fraction (suspended load)
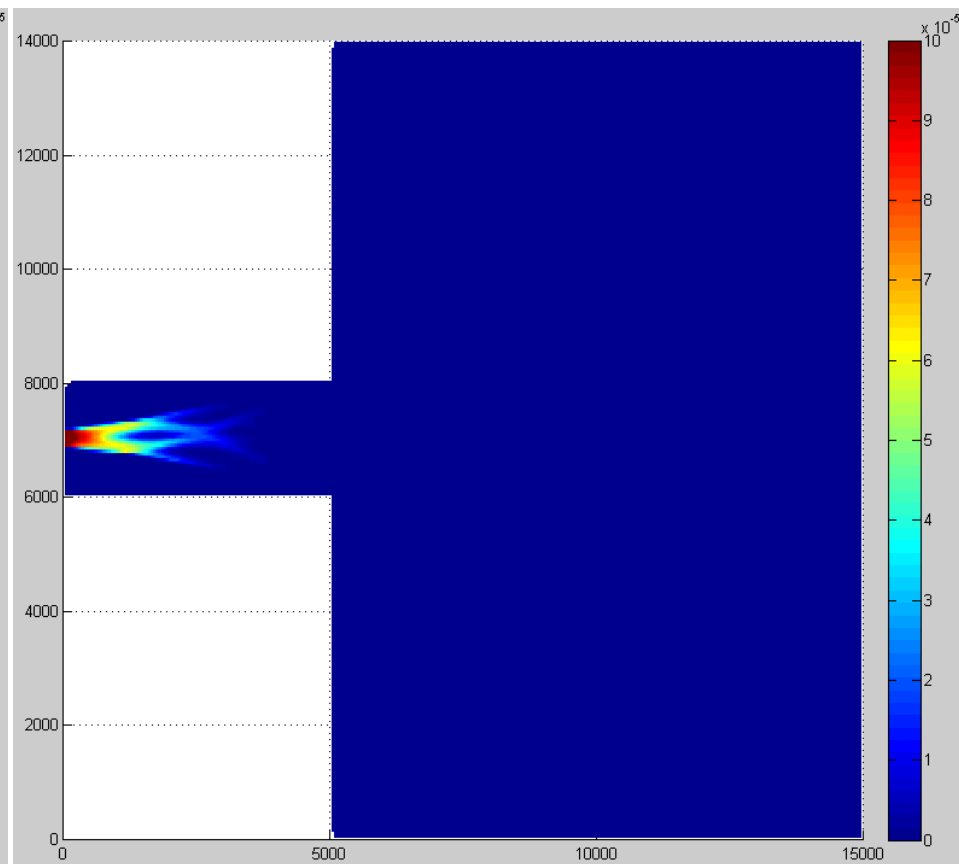..

# Comparison: GT Model_1 Coarse sand delta

Delft3D-4
(0_9_Origional_ThetSD0)

Delft3D-FM
(9_3_inisedthick_update_mor)

160 days – Fine sand fraction (total load)

# Comparison: GT Model_1 Coarse sand delta

### Delft3D-4
(0_9_Origional_ThetSD0)

### Delft3D-FM
(9_3_inisedthick_update_mor)

## 160 days – Fine sand fraction (suspended load : total load)
The transport definition file defines this to be 0.85 for fine sand

# very fine sand fraction
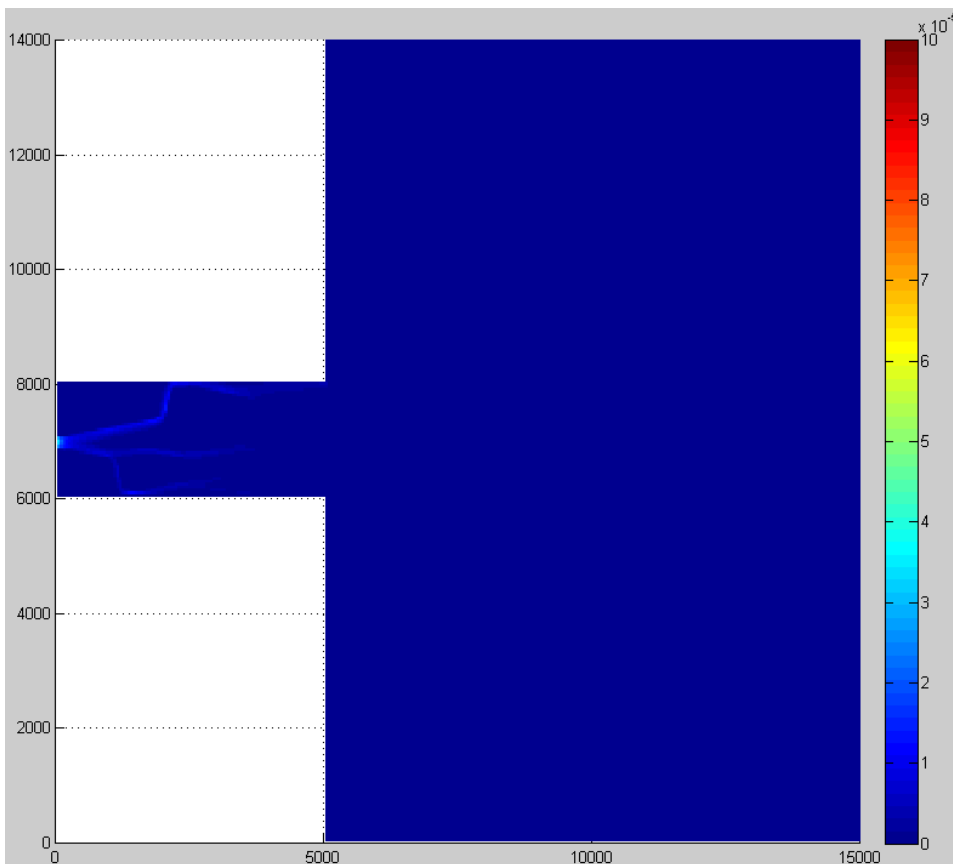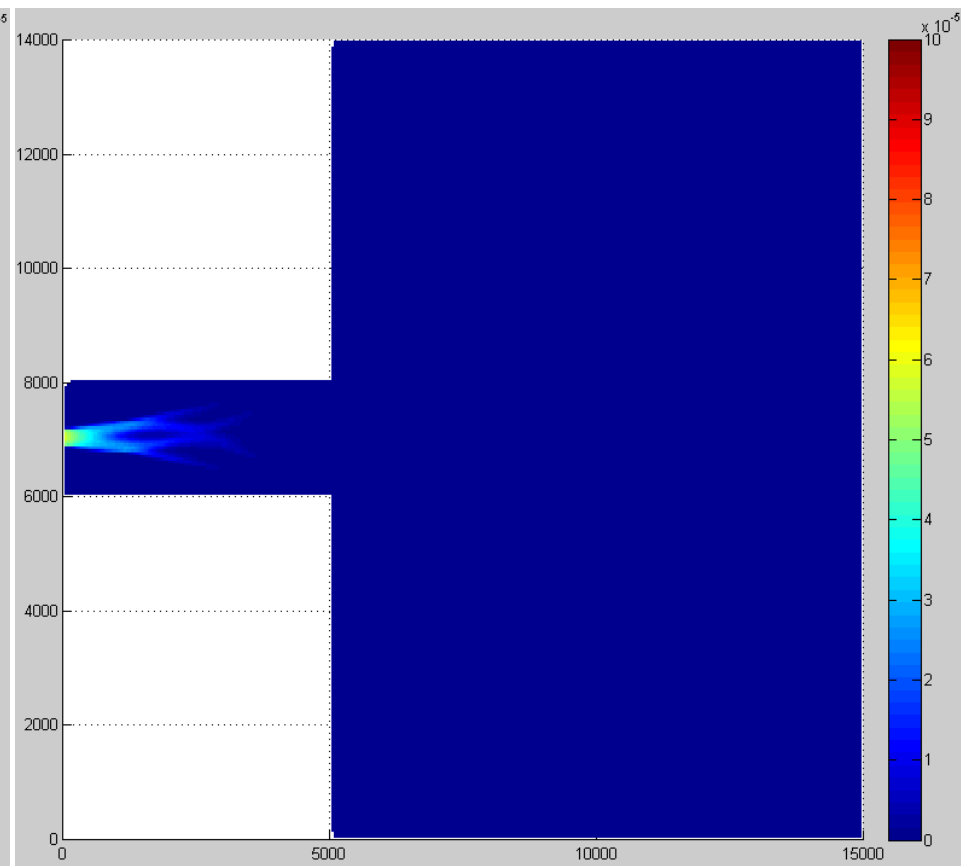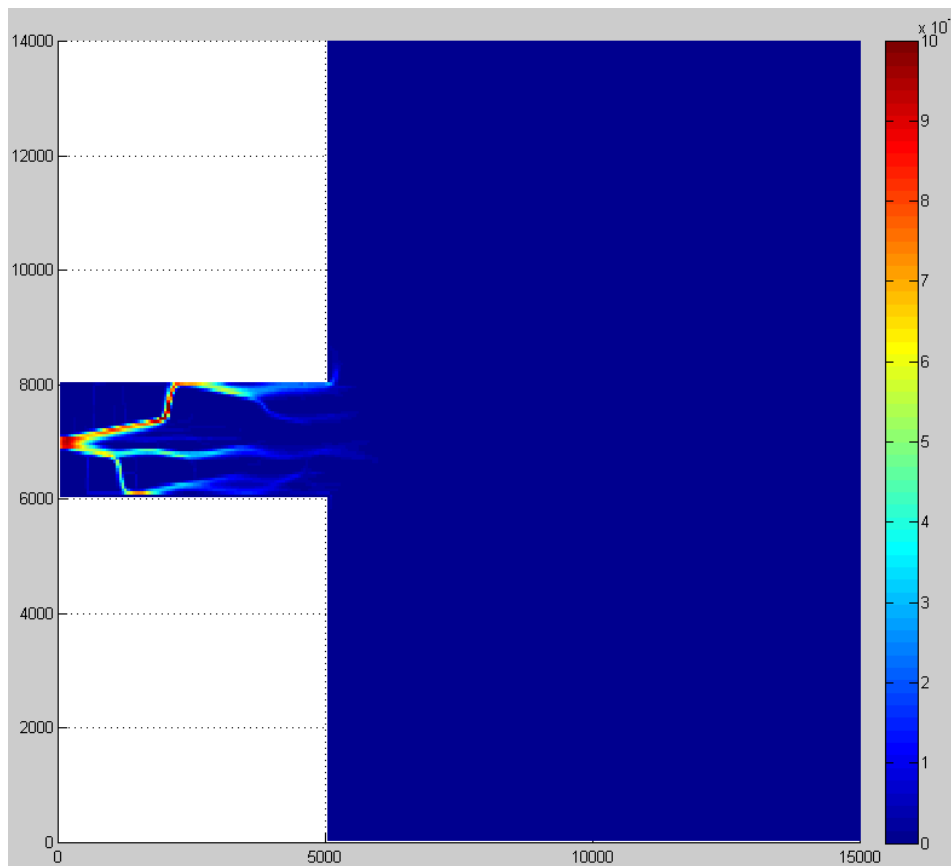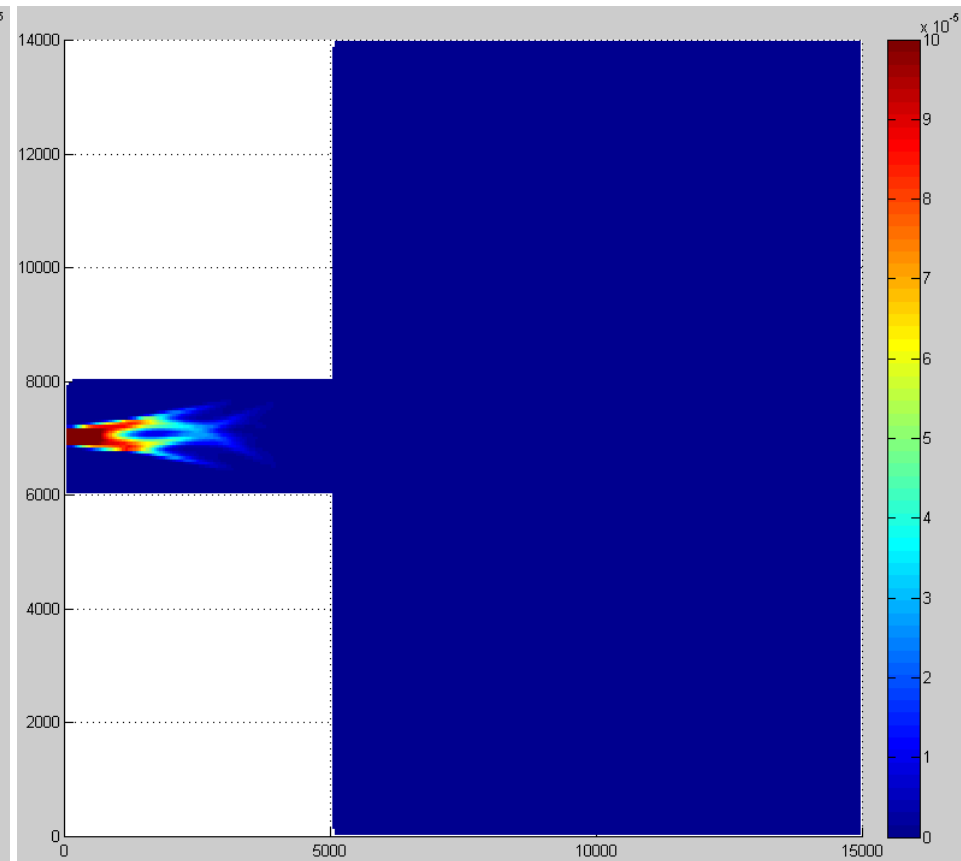
# Comparison: GT Model_1 Coarse sand delta

Delft3D-4
(0_9_Origional_ThetSD0)

Delft3D-FM
(9_3_inisedthick_update_mor)

160 days – Very fine sand fraction (bed load)
..



**Deltares**

Delft3D-4
(0_9_Origional_ThetSD0)

Delft3D-FM
(9_3_inisedthick_update_mor)

160 days – Very fine sand fraction (suspended load)
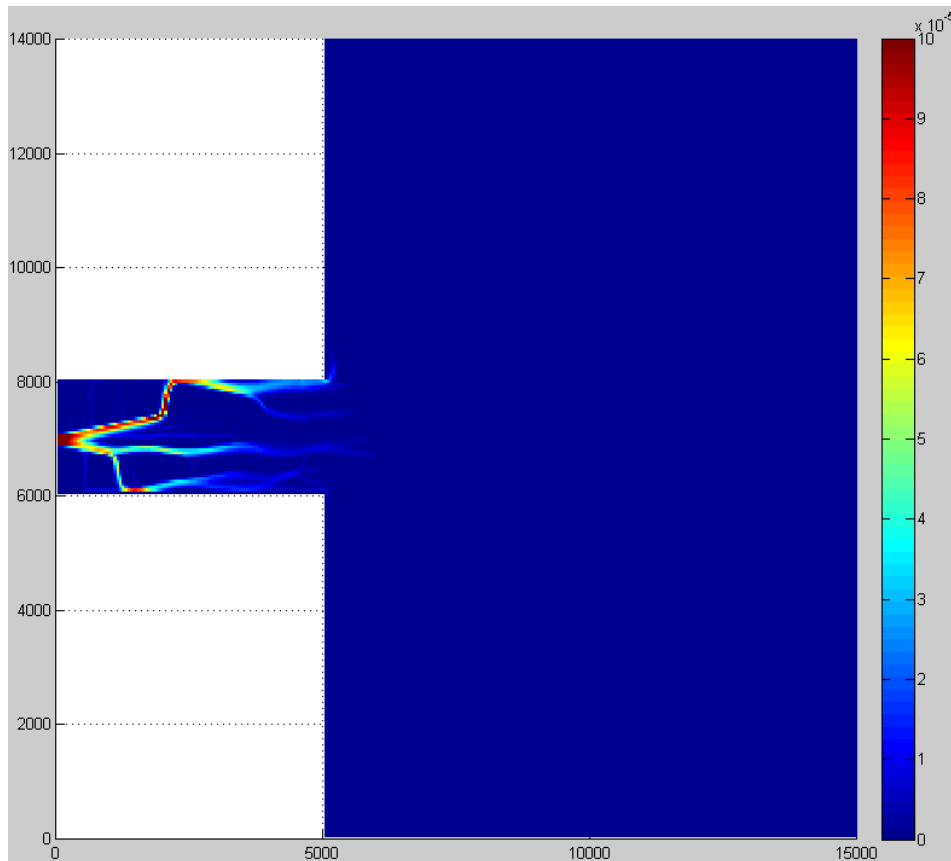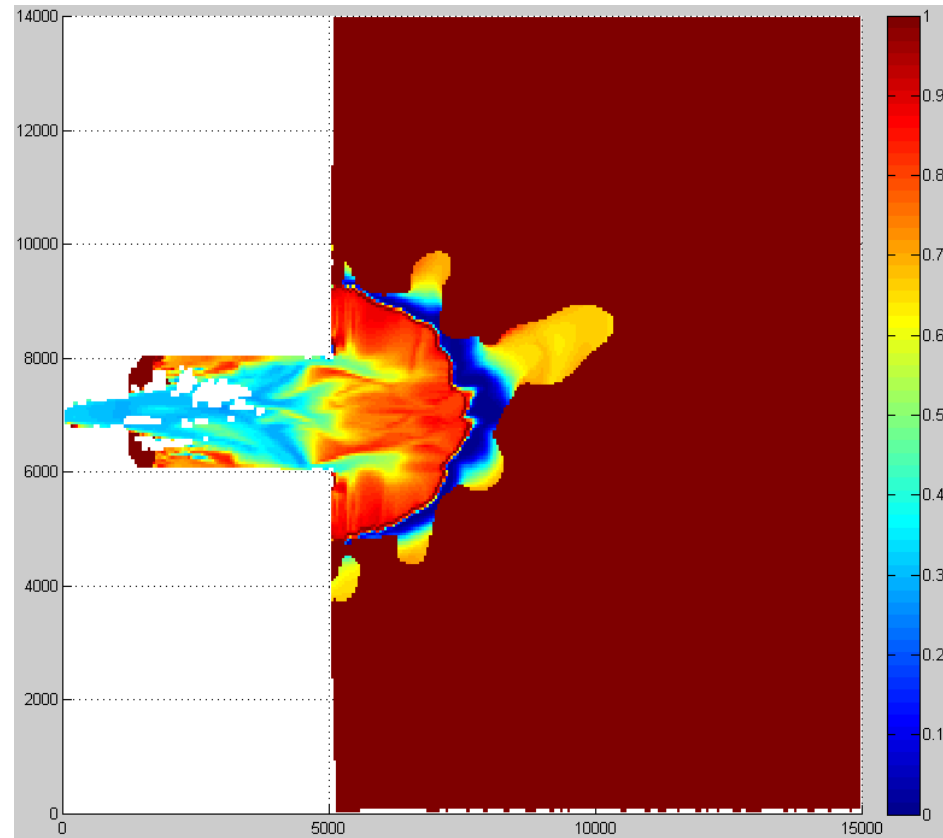..

Delft3D-4
(0_9_Origional_ThetSD0)

Delft3D-FM
(9_3_inisedthick_update_mor)

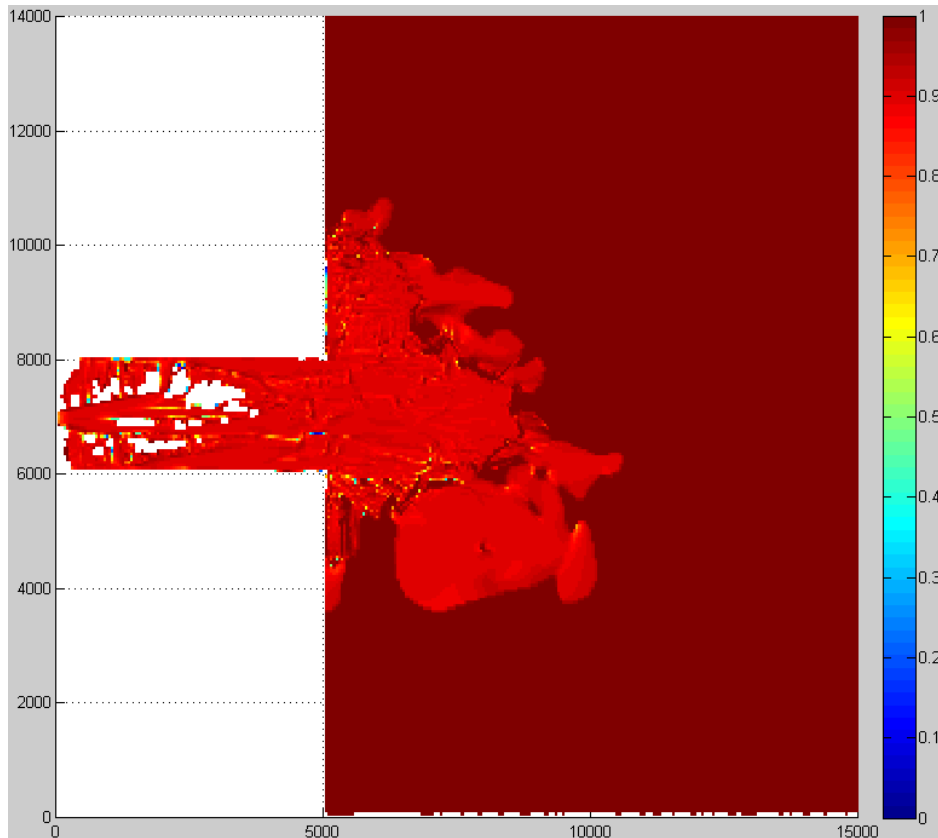160 days – Very fine sand fraction (total load)
..


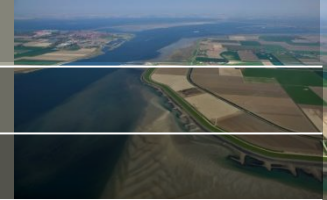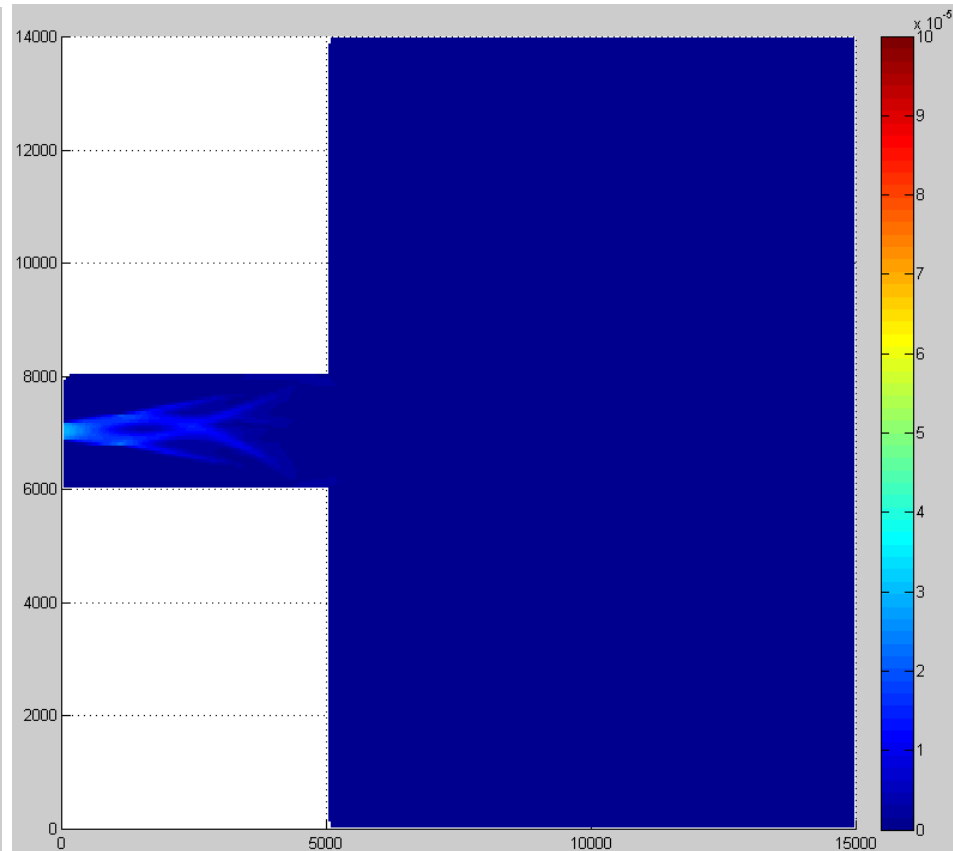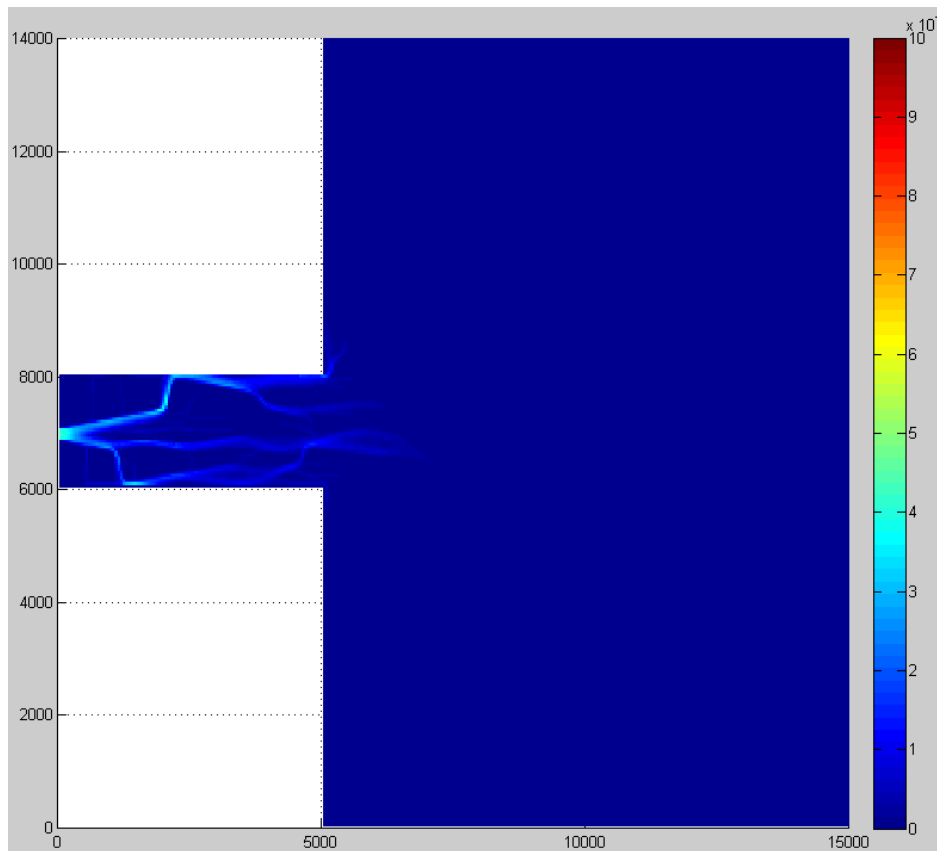
Deltares

# Comparison: GT Model_1 Coarse sand delta

Delft3D-4
(0_9_Origional_ThetSD0)

Delft3D-FM
(9_3_inisedthick_update_mor)

160 days – Very fine sand fraction (suspended load : total load)
The transport definition file defines this to be 0.9 for very fine sand

# coarse silt fraction

# Comparison: GT Model_1 Coarse sand delta
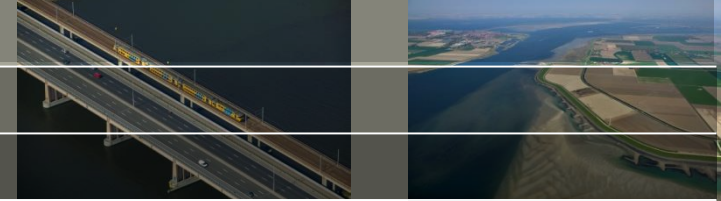
Delft3D-4
(0_9_Origional_ThetSD0)

Delft3D-FM
(9_3_inisedthick_update_mor)

160 days – Very fine sand fraction (suspended load)
..

Results:
   van Rijn 2004 transport

Deltares

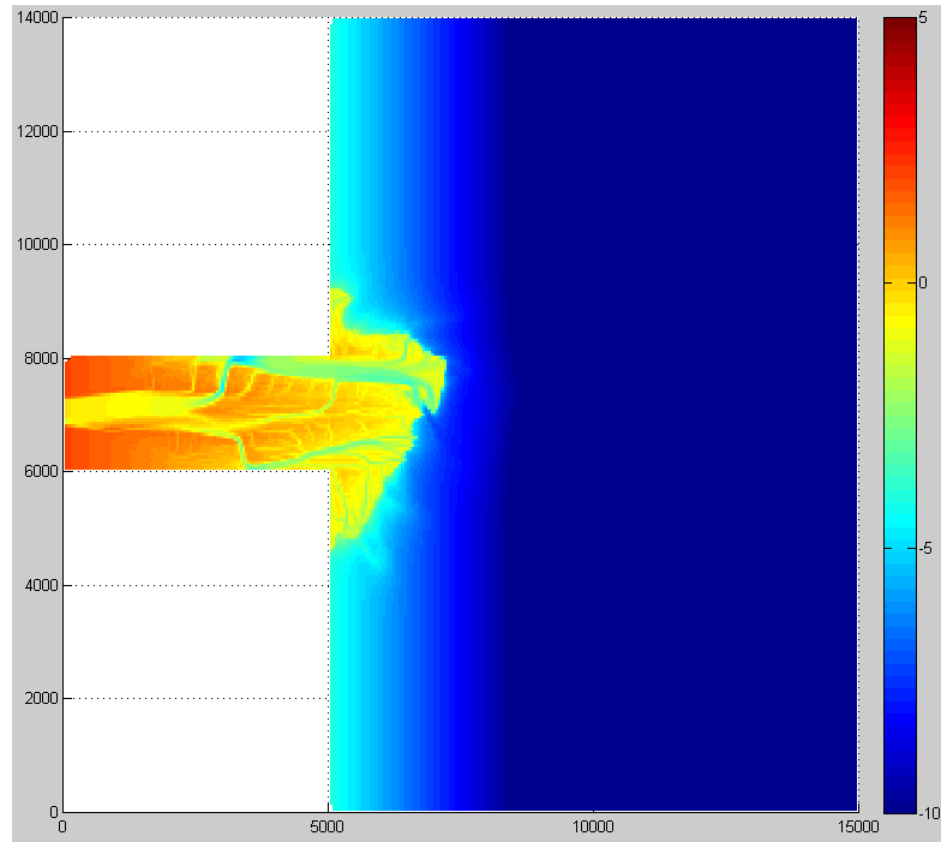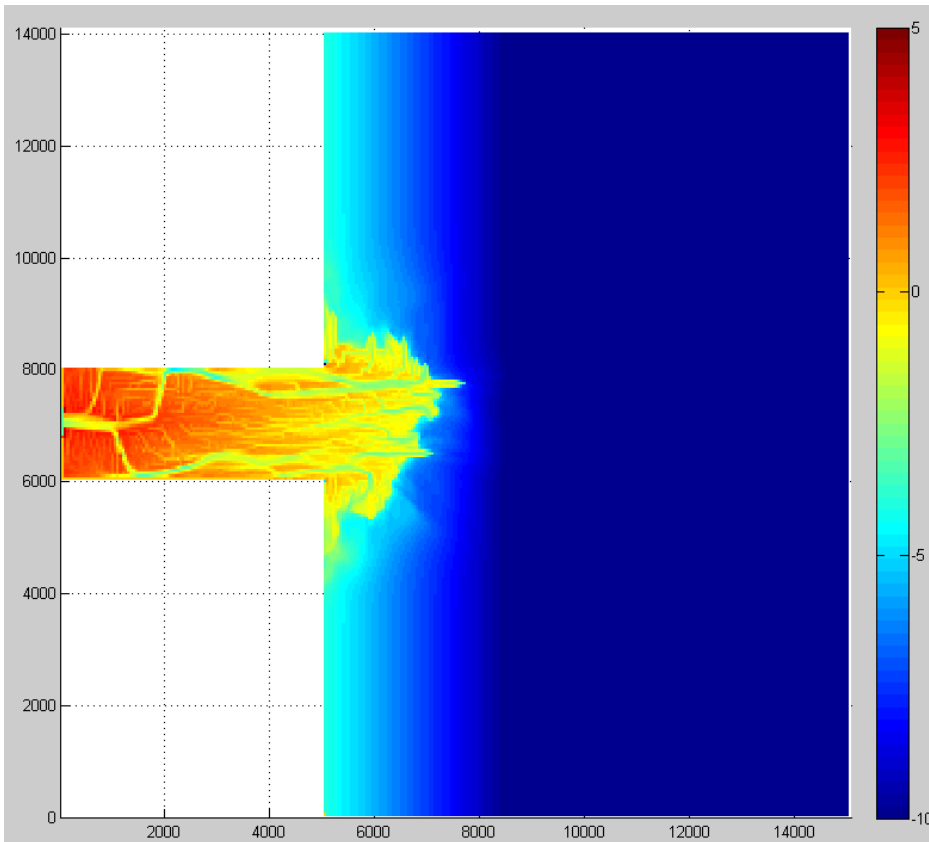# Comparison: GT Model_1 - Coarse sand delta

Delft3D-4
(0_9_Origional_ThetSD0_mor_vanRijn2004)

Delft3D-FM
(9_3_inisedthick_update_mor_vanRijn2004)

95 days – Bathymetry
Similar differences to EH transport formula

**Deltares**

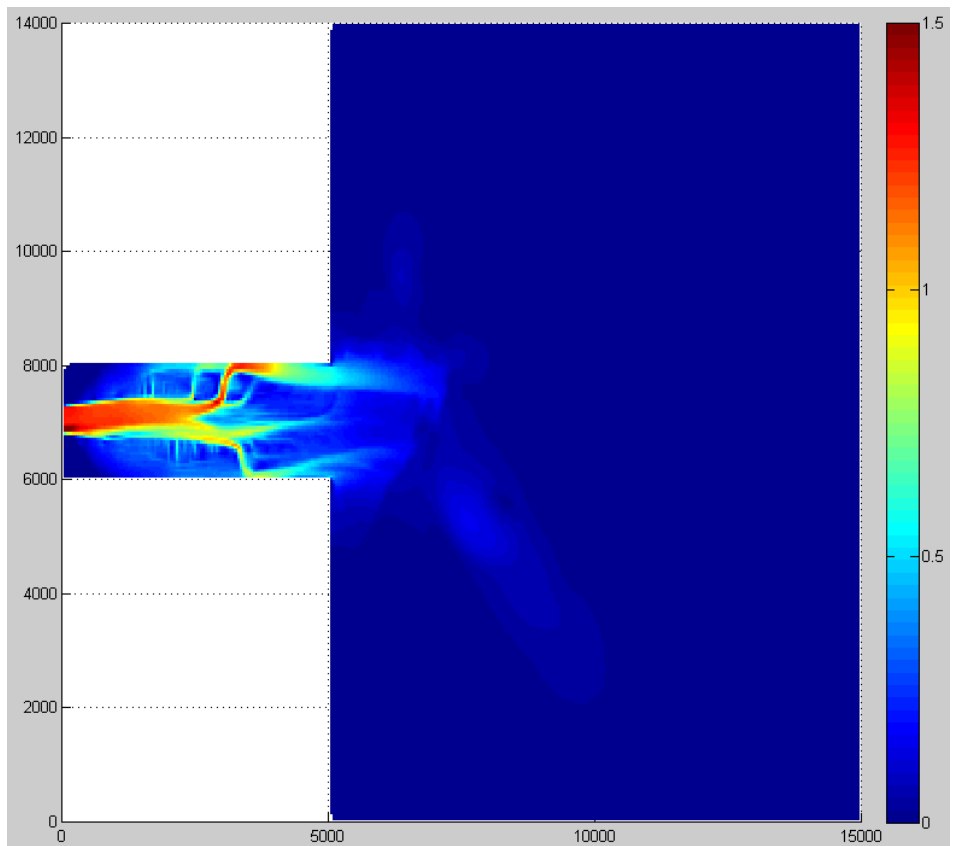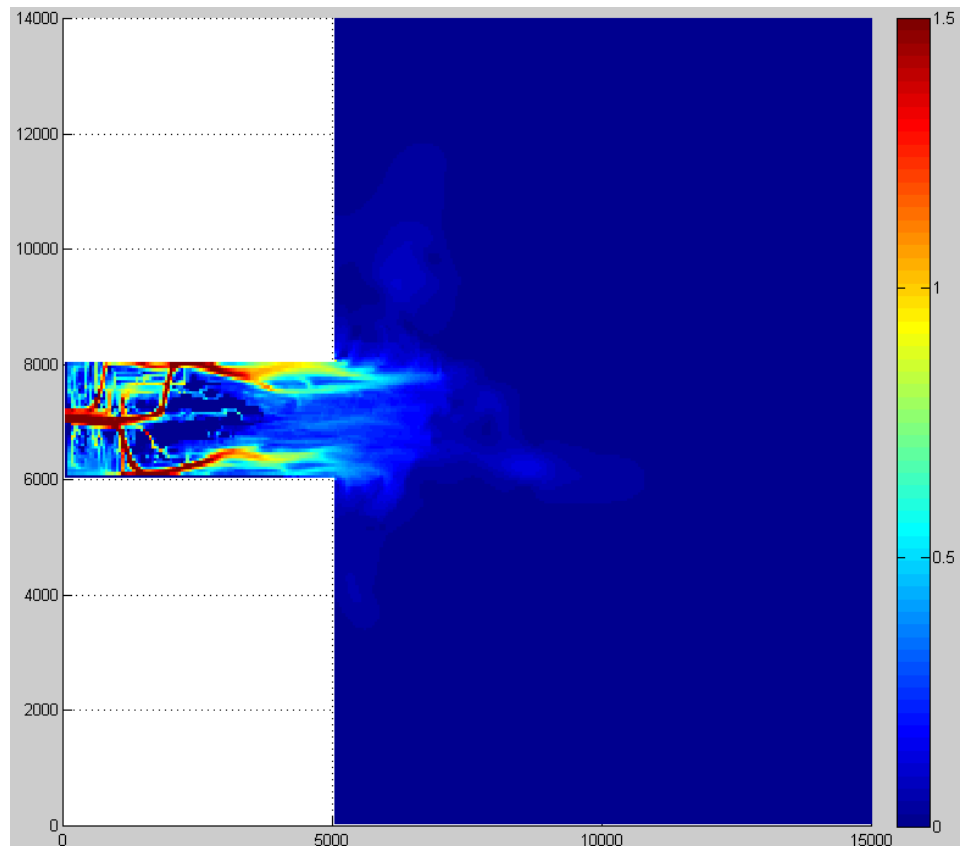# Comparison: GT Model_1 Coarse sand delta

Delft3D-4
(0_9_Origional_ThetSD0_mor_vanRijn2004)

Delft3D-FM
(9_3_inisedthick_update_mor_vanRijn2004)

## 95 days – Velocity
Similar differences as with EH transport



**Deltares**

**very coarse sand fraction**

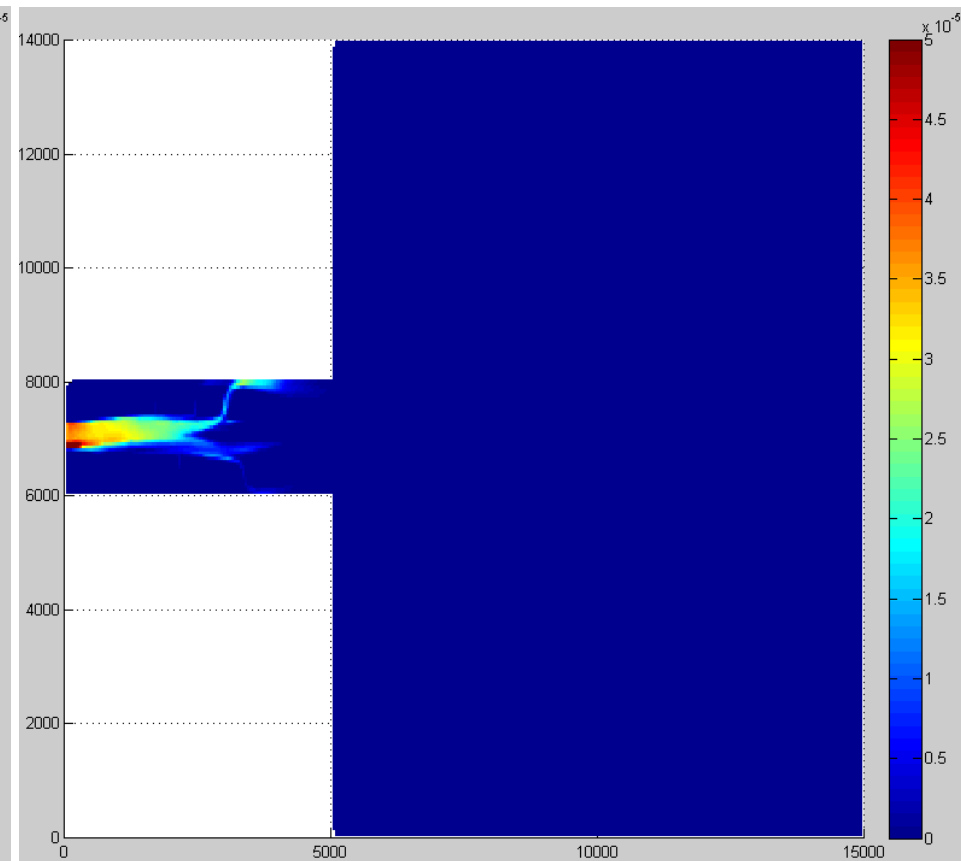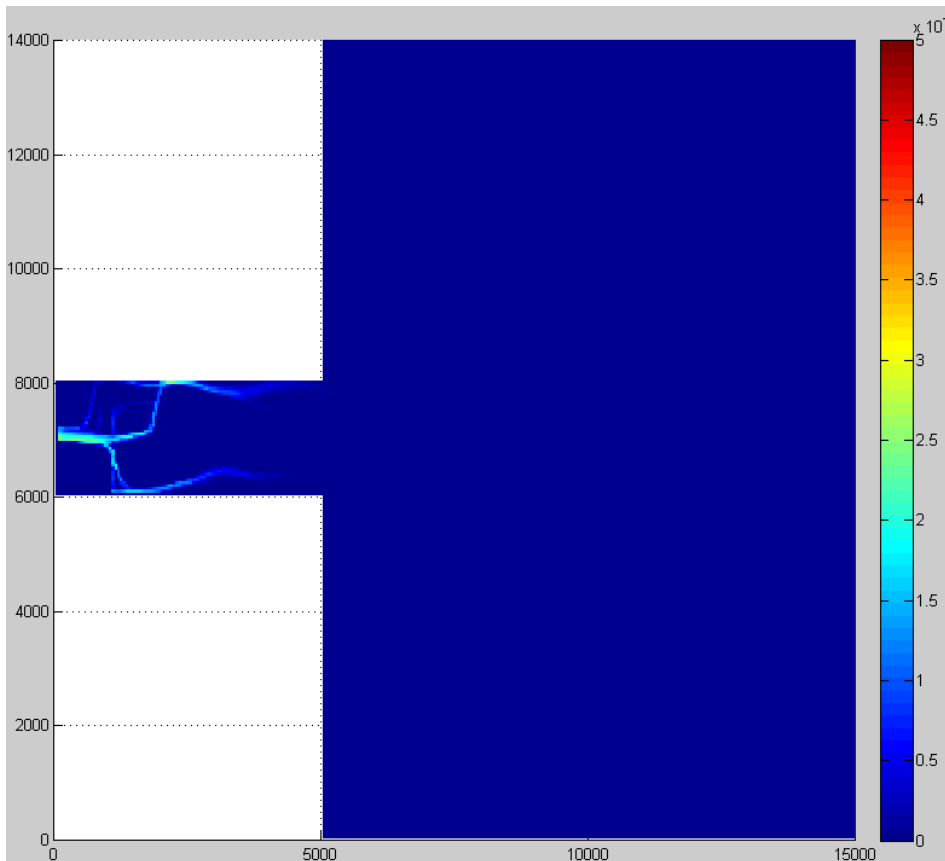# Comparison: GT Model_1 Coarse sand delta

Delft3D-4
(0_9_Origional_ThetSD0_mor_vanRijn2004)

Delft3D-FM
(9_3_inisedthick_update_mor_vanRijn2004)

95 days – Very coarse sand fraction (bed load)
FM BL larger in proximal area (similar to with EH)
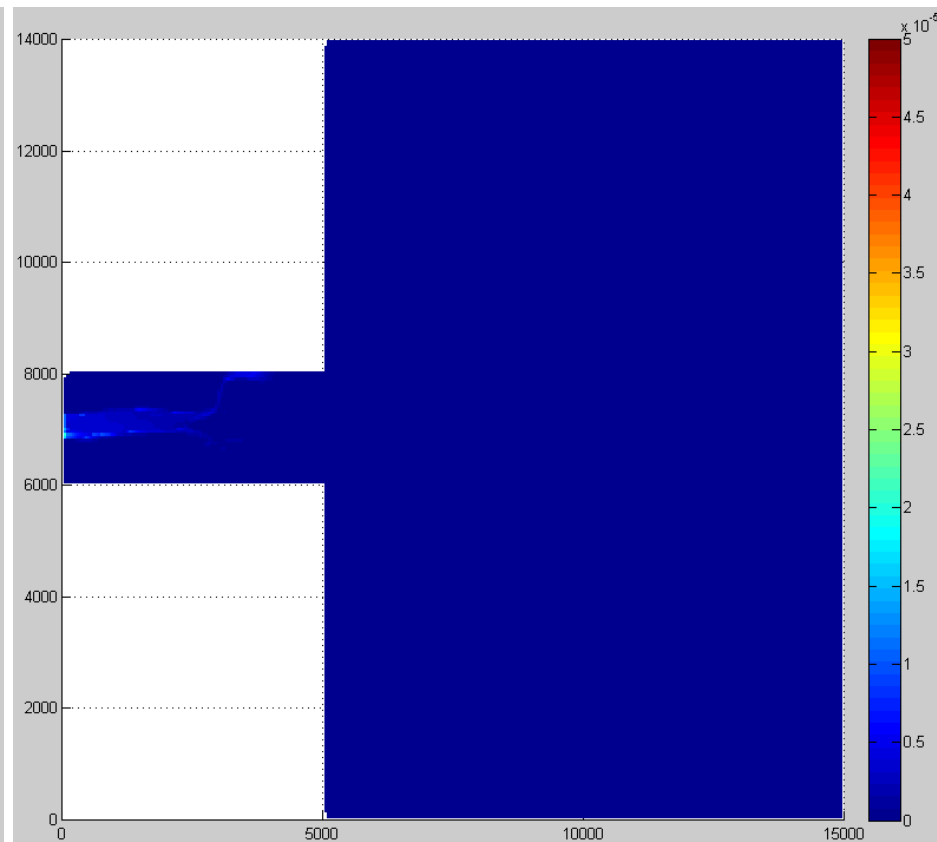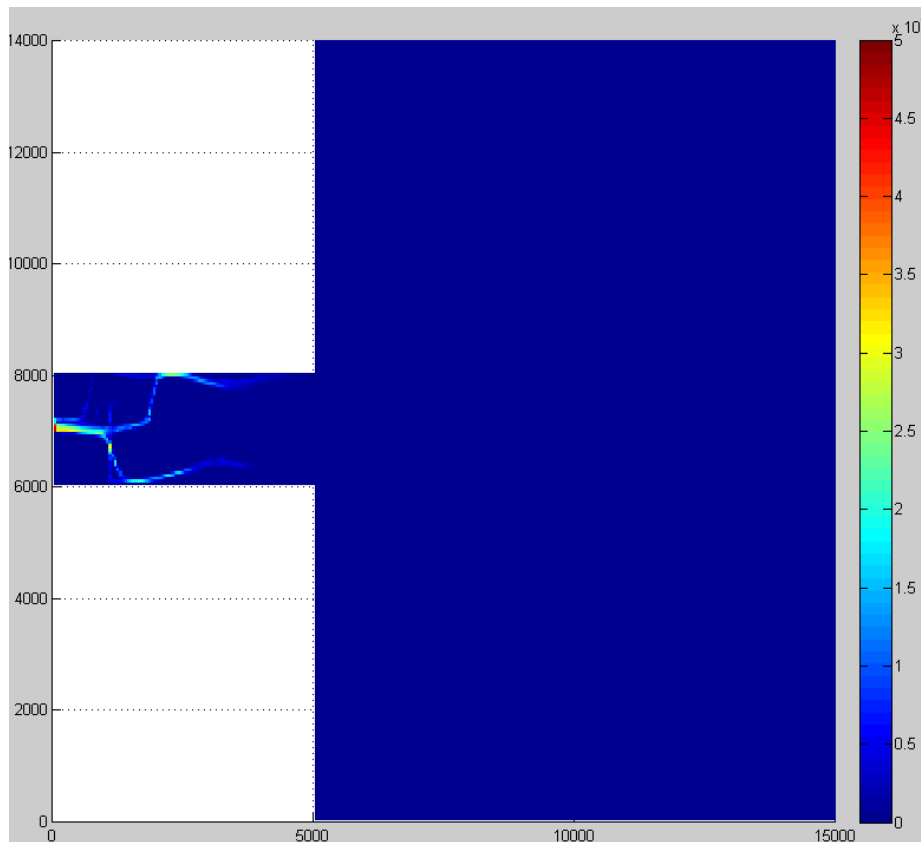


**Deltares**

Delft3D-4
(0_9_Origional_ThetSD0_mor_vanRijn2004)

Delft3D-FM
(9_3_inisedthick_update_mor_vanRijn2004)

95 days – Very coarse sand fraction (suspended load)
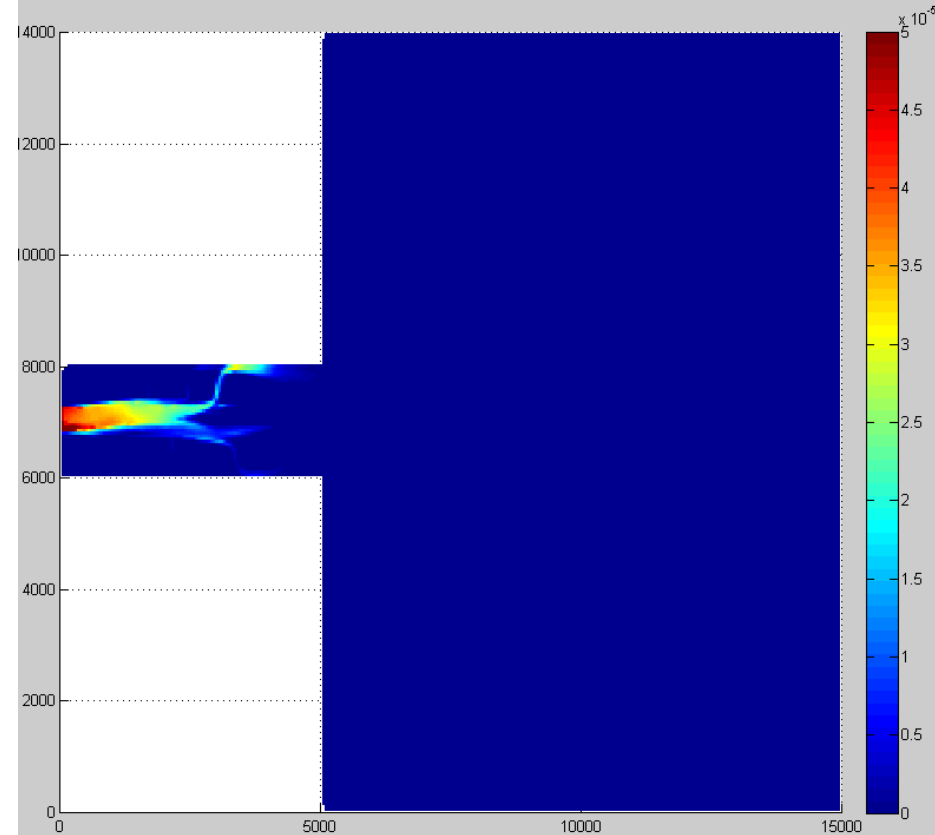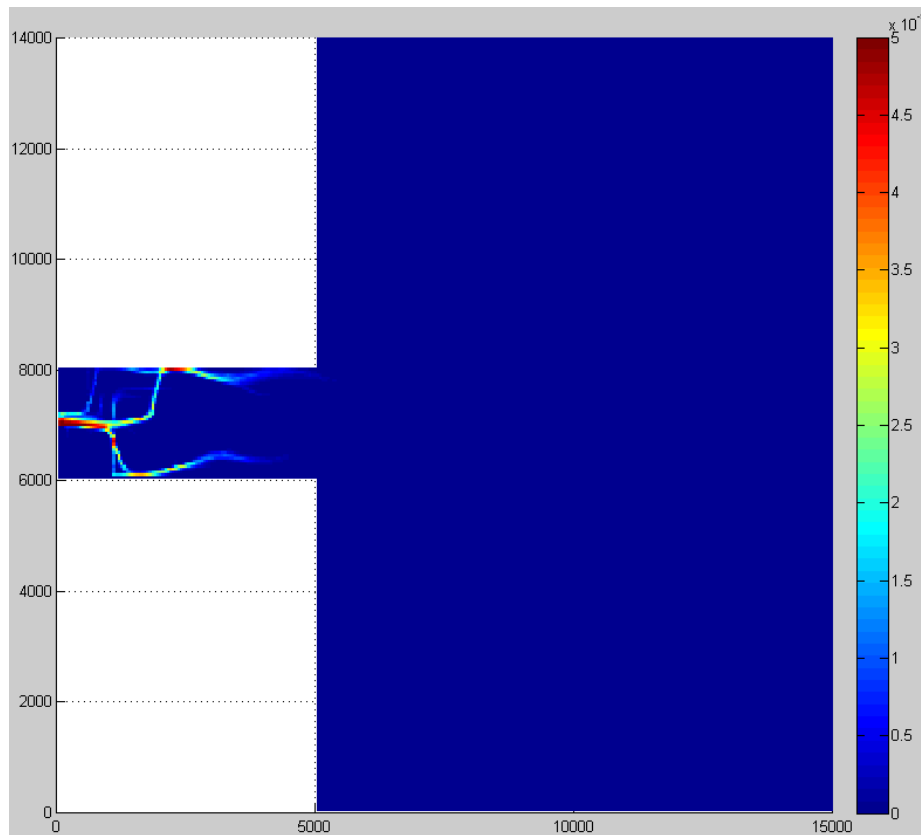Similar to EH, but FM even smaller SL than D3D4.

Delft3D-4
(0_9_Origional_ThetSD0_mor_vanRijn2004)

Delft3D-FM
(9_3_inisedthick_update_mor_vanRijn2004)

95 days – Very coarse sand fraction (total load)
..

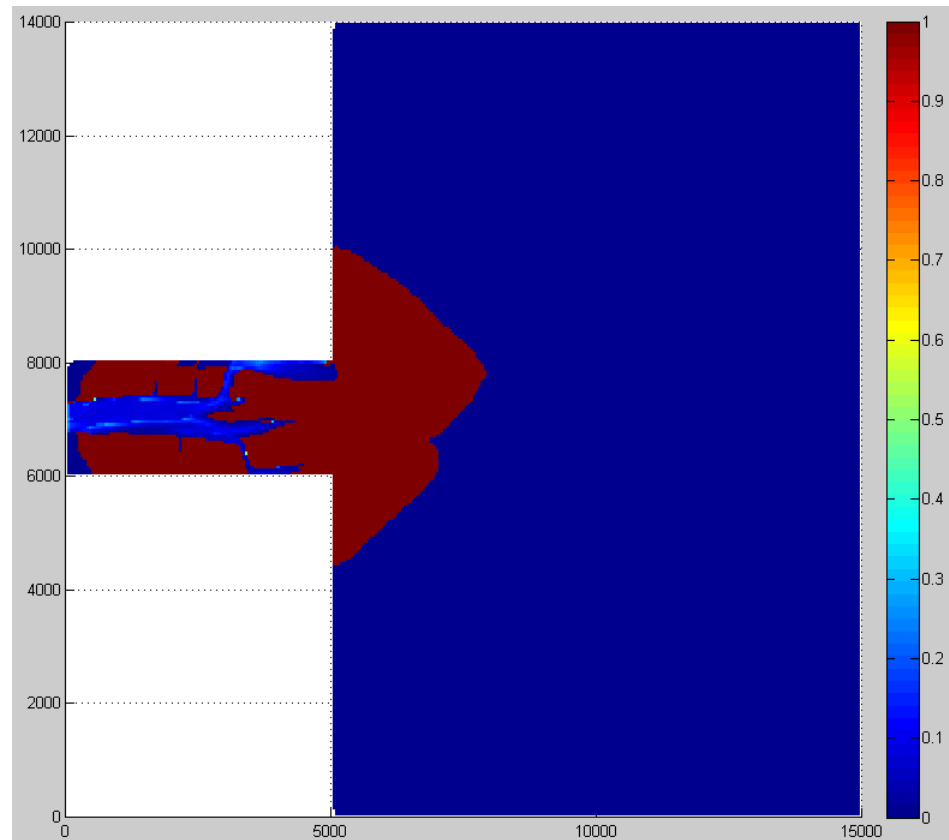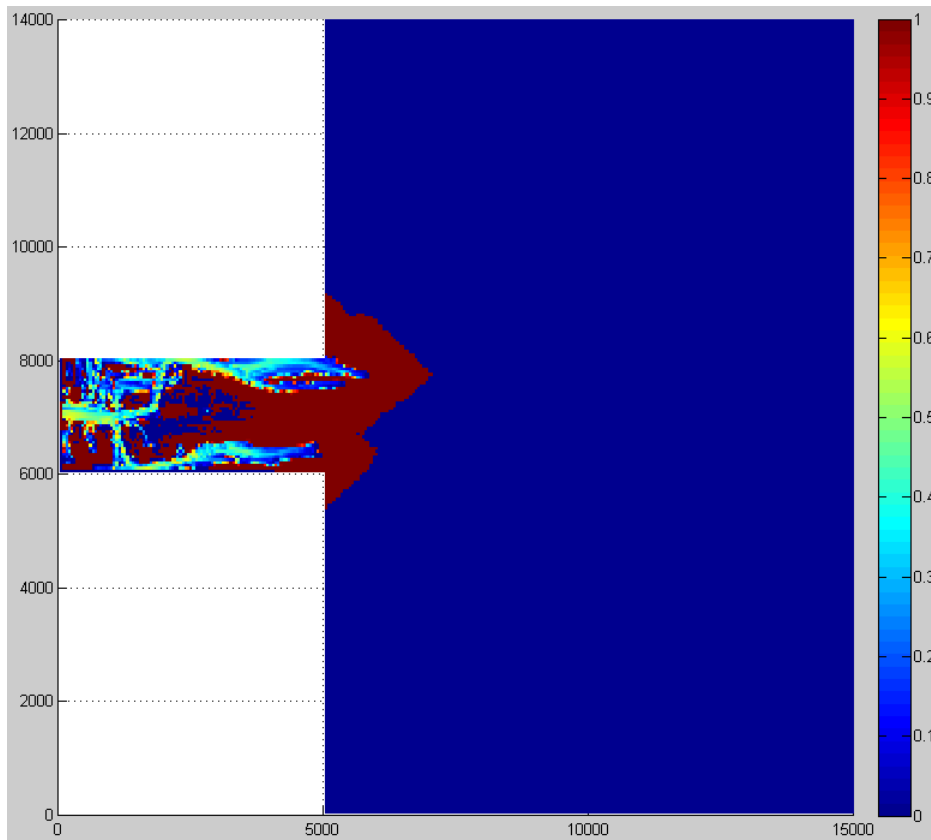# Comparison: GT Model_1 Coarse sand delta

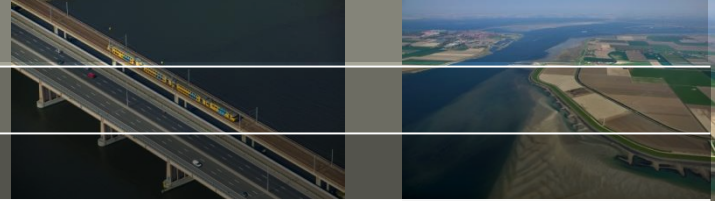Delft3D-4
(0_9_Origional_ThetSD0_mor_vanRijn2004)

Delft3D-FM
(9_3_inisedthick_update_mor_vanRijn2004)

95 days – Very coarse sand fraction (suspended load : total load)
Almost no suspended load in FM



**Deltares**

**coarse sand fraction**

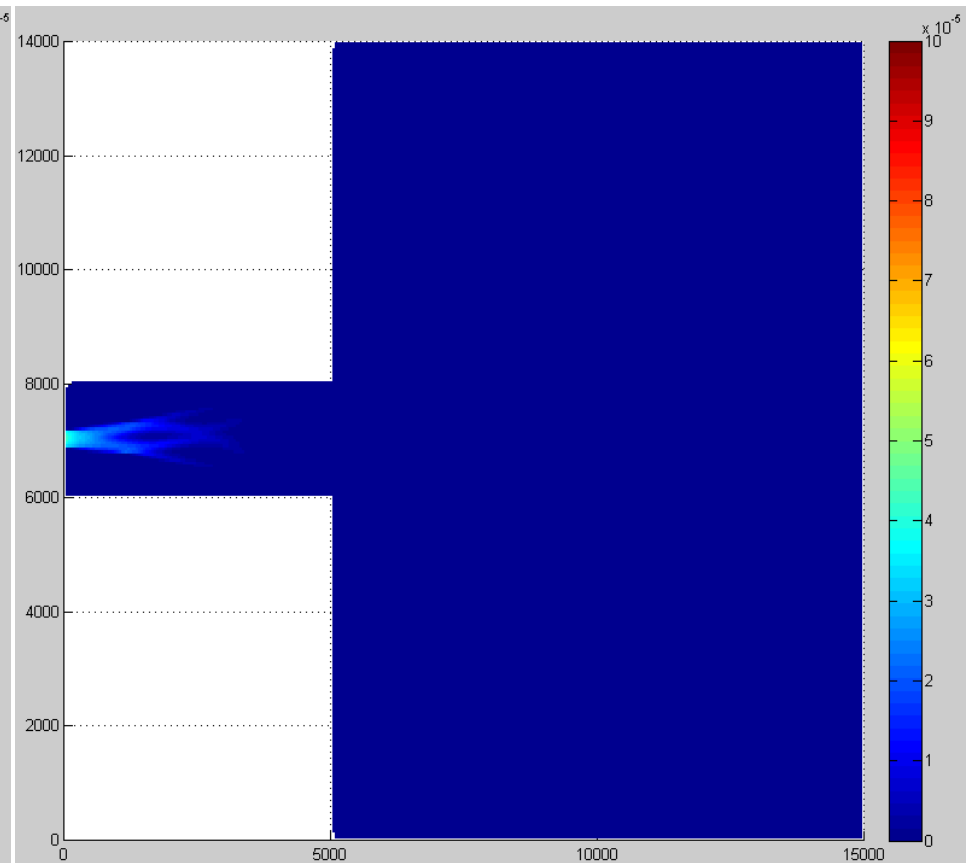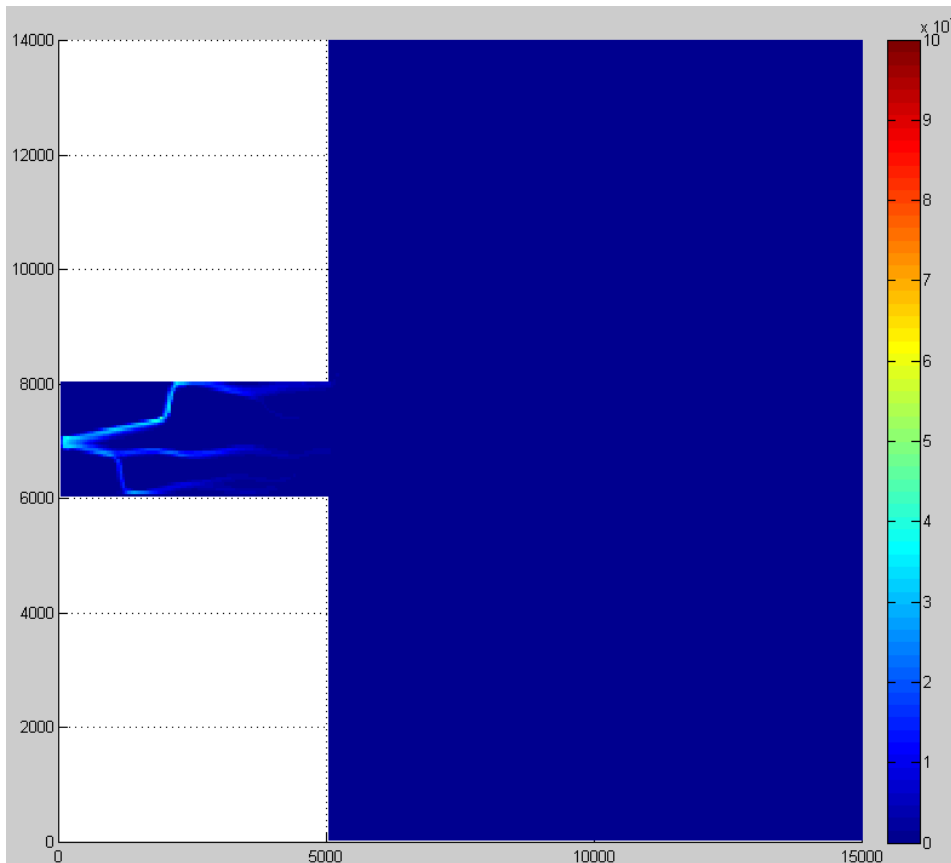# Comparison: GT Model_1 Coarse sand delta

Delft3D-4
(0_9_Origional_ThetSD0_mor_vanRijn2004)

Delft3D-FM
(9_3_inisedthick_update_mor_vanRijn2004)

95 days – Coarse sand fraction (bed load)

..

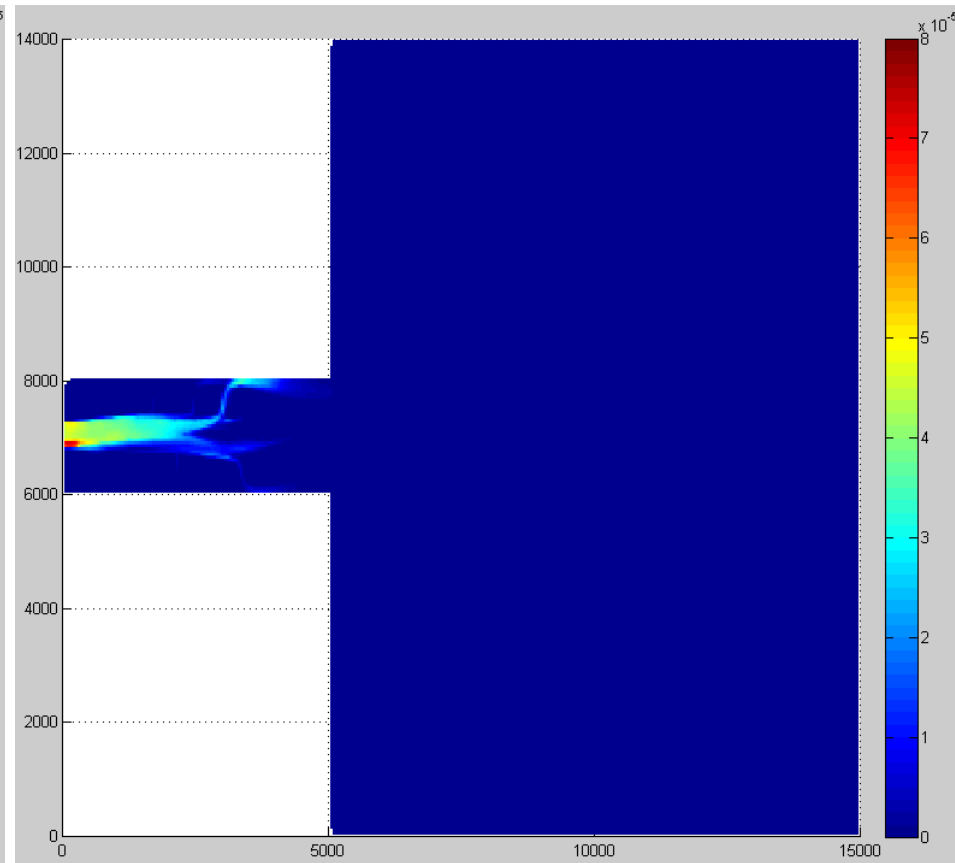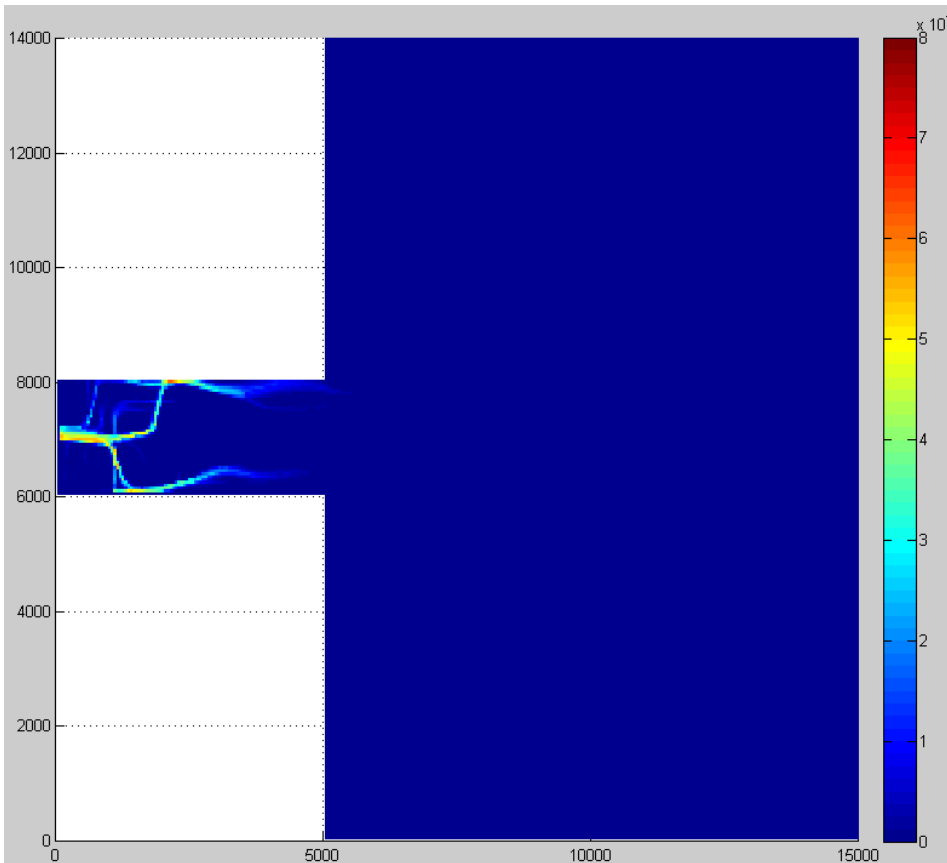# Comparison: GT Model_1 Coarse sand delta

Delft3D-4
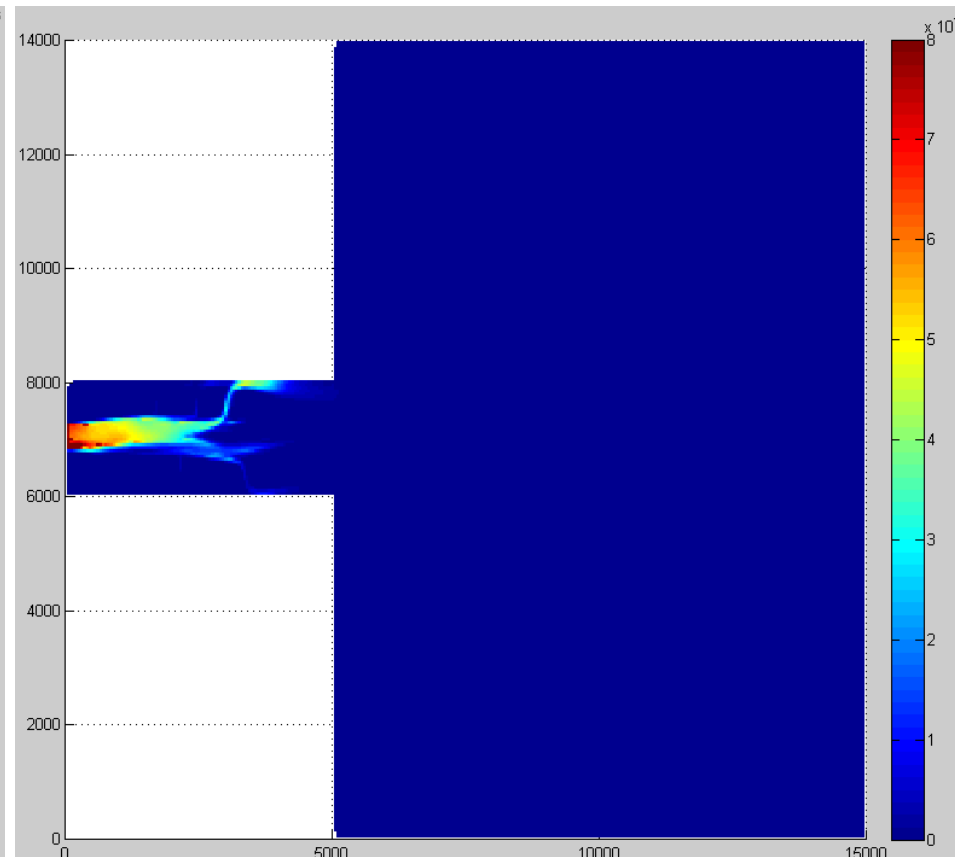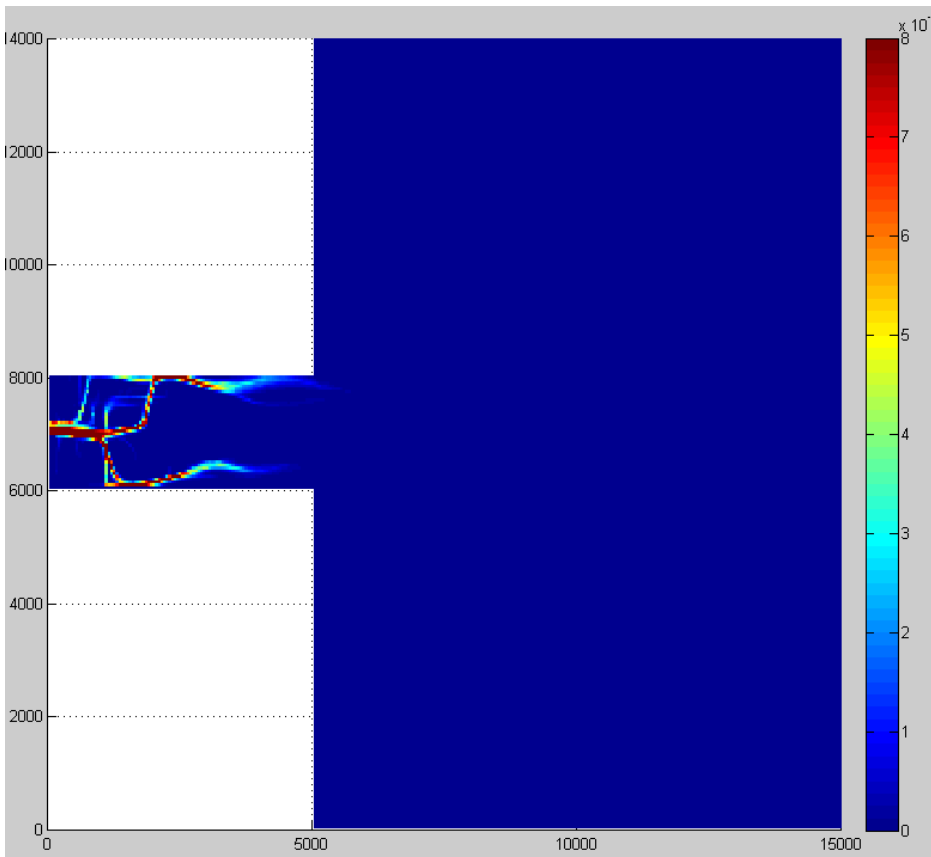(0_9_Origional_ThetSD0_mor_vanRijn2004)

Delft3D-FM
(9_3_inisedthick_update_mor_vanRijn2004)

95 days – Coarse sand fraction (suspended load)
..



**Deltares**

# Comparison: GT Model_1 Coarse sand delta

Delft3D-4
(0_9_Origional_ThetSD0_mor_vanRijn2004)

Delft3D-FM
(9_3_inisedthick_update_mor_vanRijn2004)

95 days – Coarse sand fraction (total load)
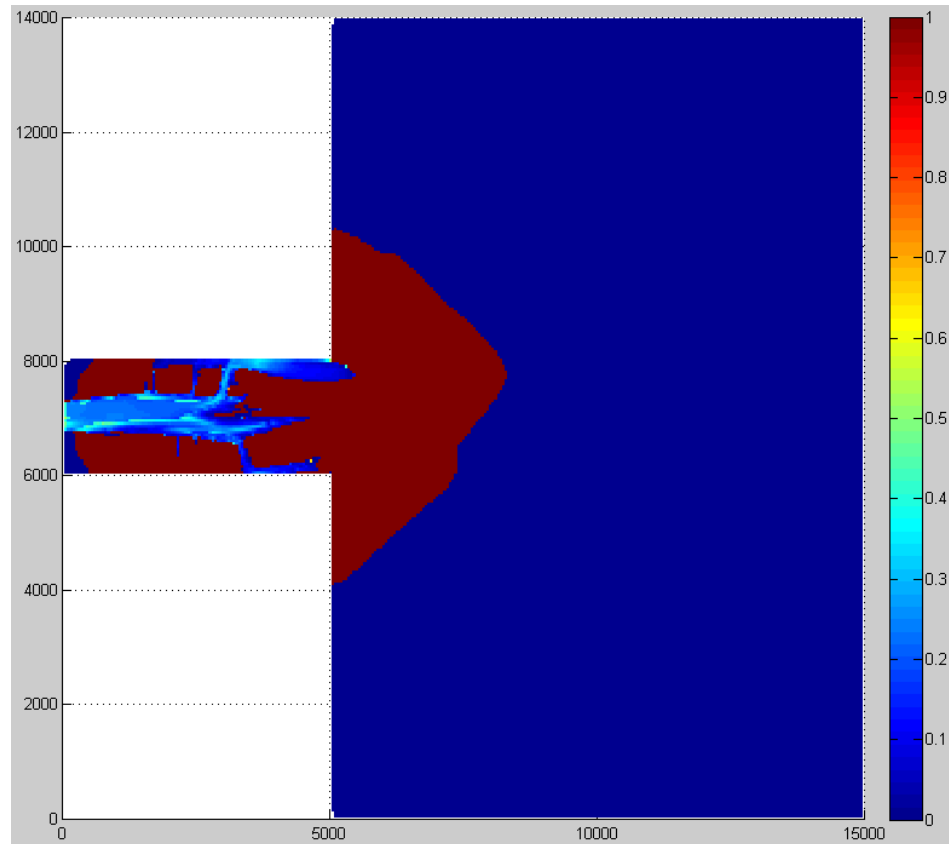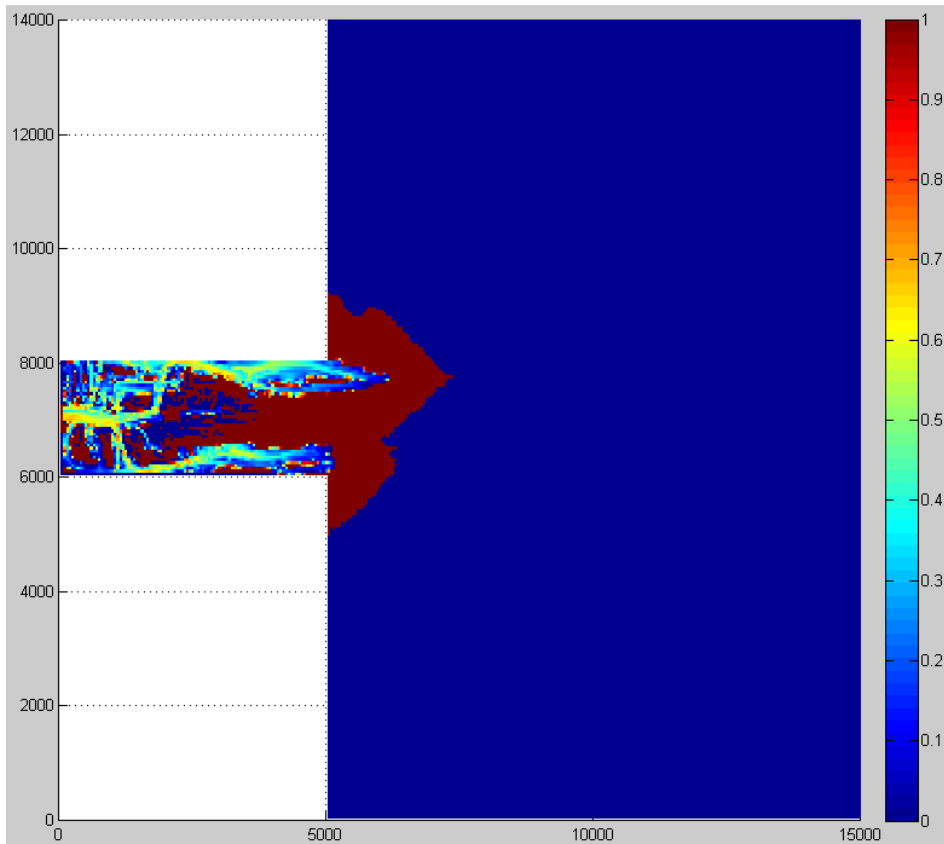..



**Deltares**

Delft3D-4
(0_9_Origional_ThetSD0_mor_vanRijn2004)

Delft3D-FM
(9_3_inisedthick_update_mor_vanRijn2004)

## 95 days – Coarse sand fraction (suspended load : total load)
The transport definition file defines this to be 0.75 for coarse sand…



**Deltares**

**medium sand fraction**

Delft3D-4
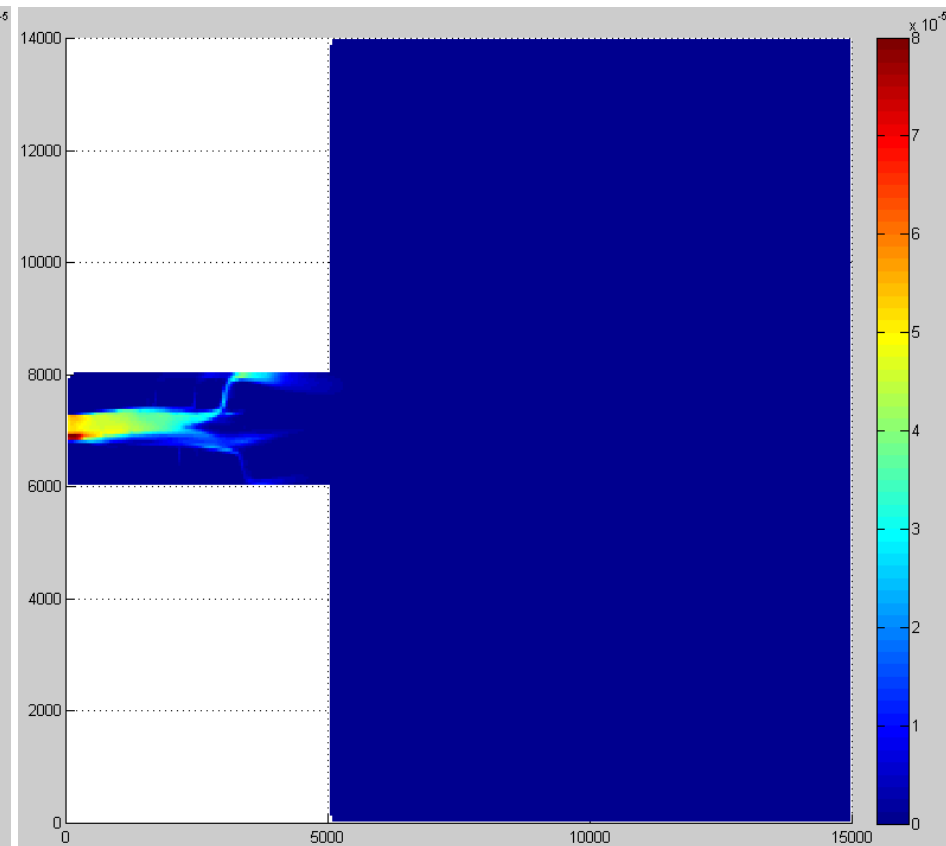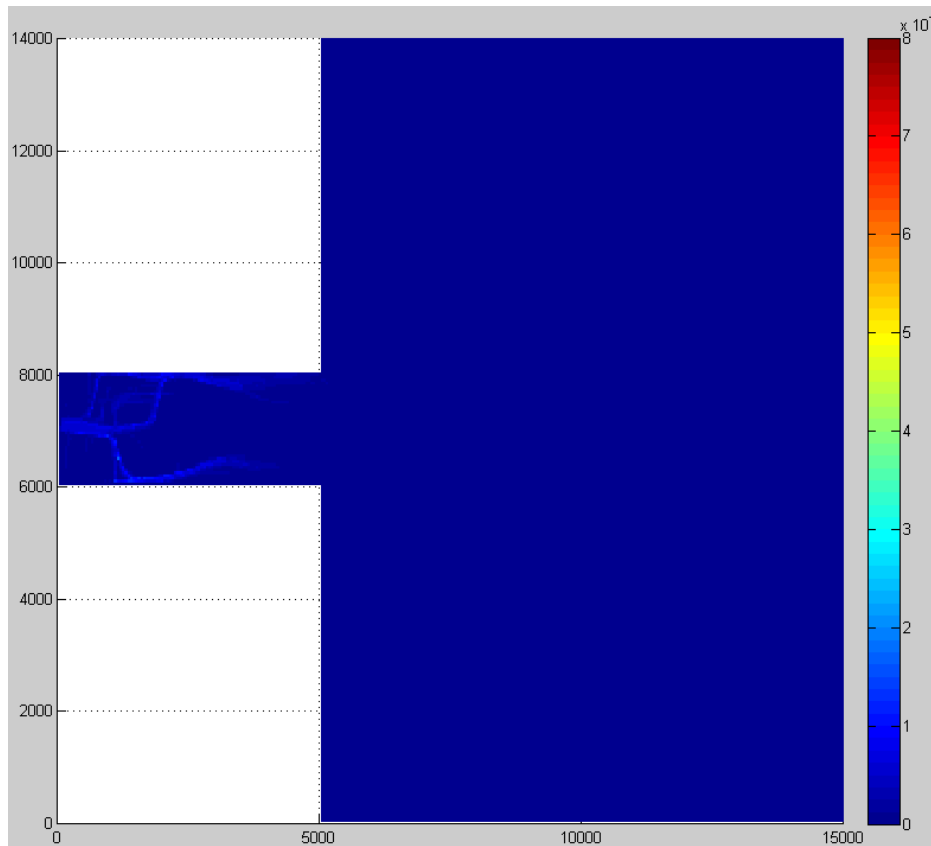(0_9_Origional_ThetSD0_mor_vanRijn2004)

Delft3D-FM
(9_3_inisedthick_update_mor_vanRijn2004)
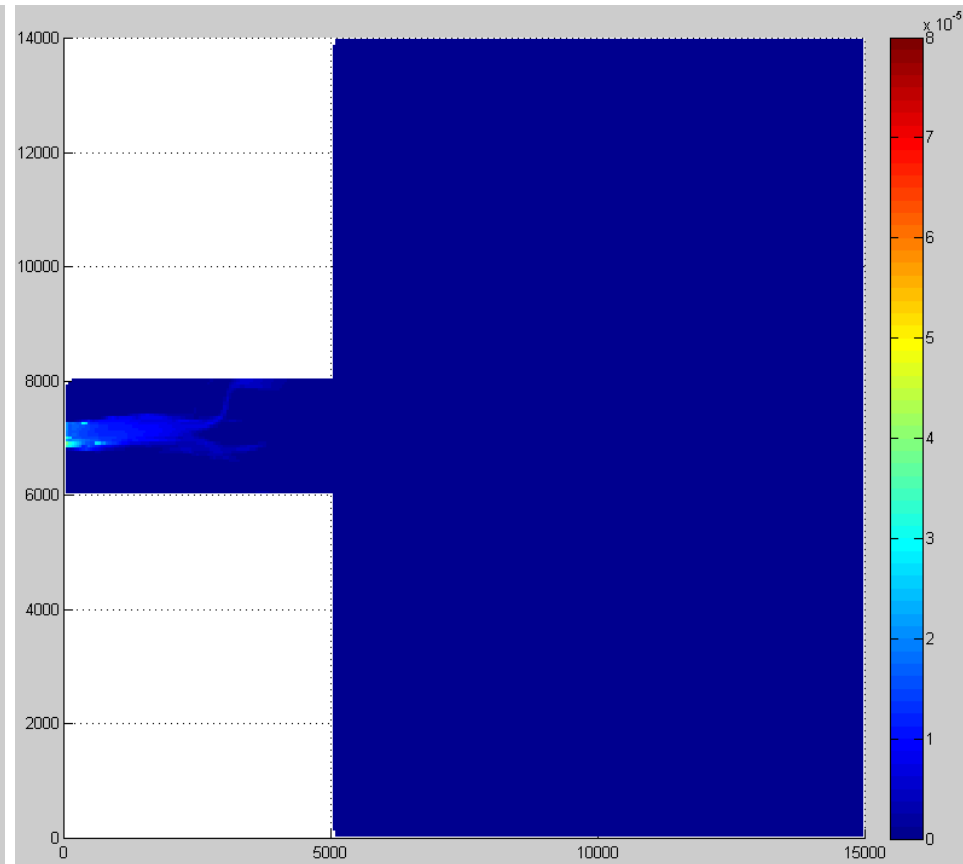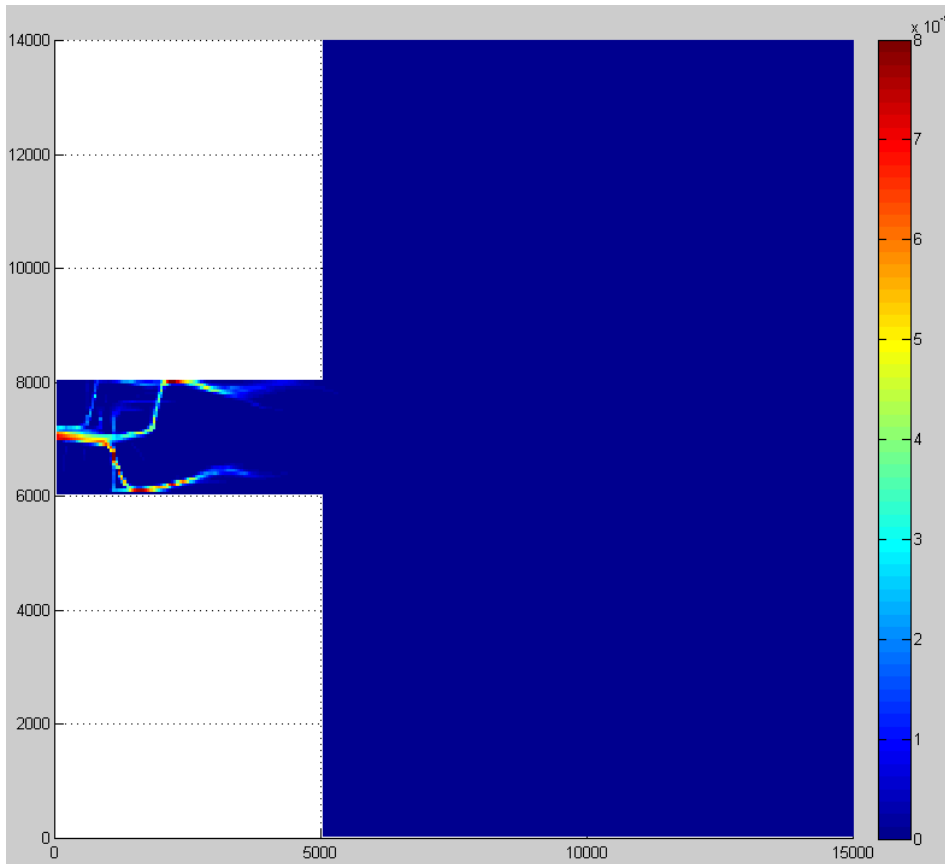
95 days – Medium sand fraction (bed load)
..

Delft3D-4
(0_9_Origional_ThetSD0_mor_vanRijn2004)

Delft3D-FM
(9_3_inisedthick_update_mor_vanRijn2004)

95 days – Medium sand fraction (suspended load)
..



**Deltares**

# Comparison: GT Model_1 Coarse sand delta

Delft3D-4
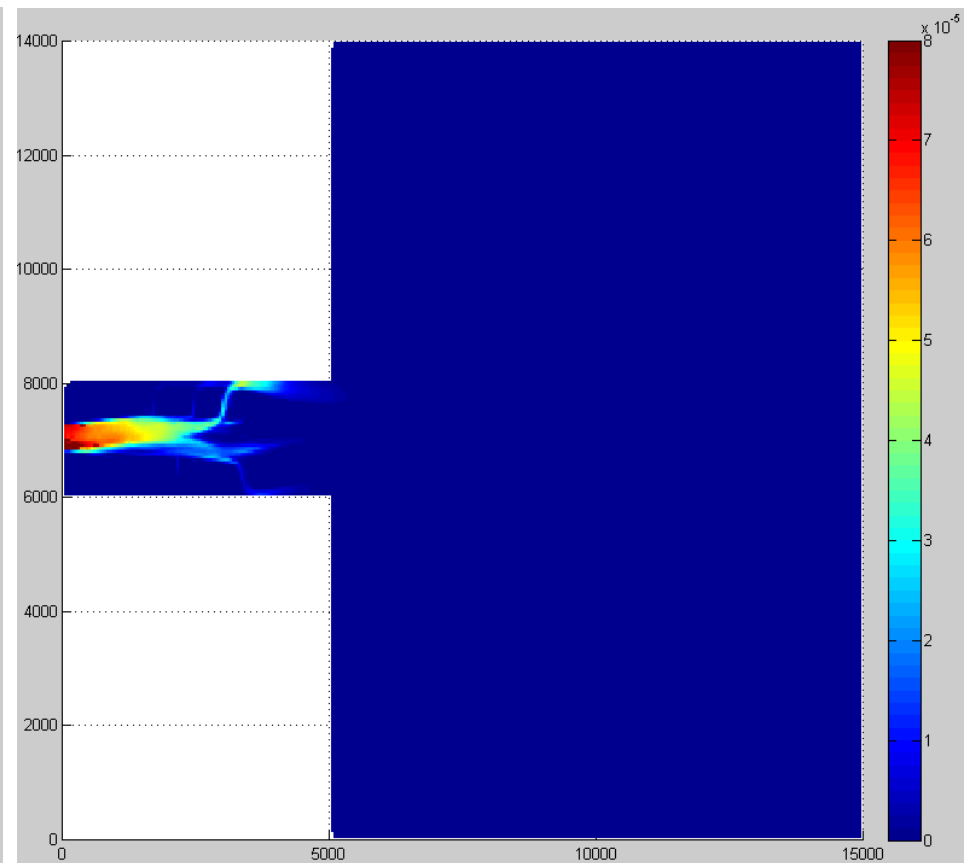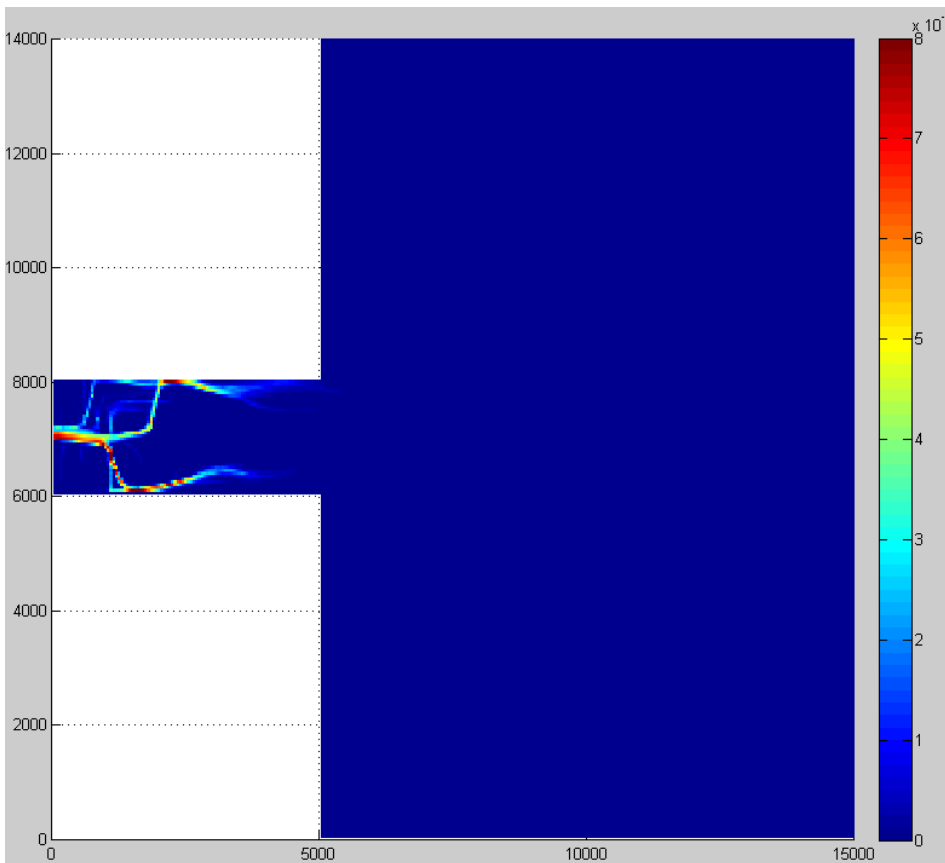
(0_9_Origional_ThetSD0_mor_vanRijn2004)

Delft3D-FM

(9_3_inisedthick_update_mor_vanRijn2004)

95 days –Medium sand fraction (total load)

..



**Deltares**

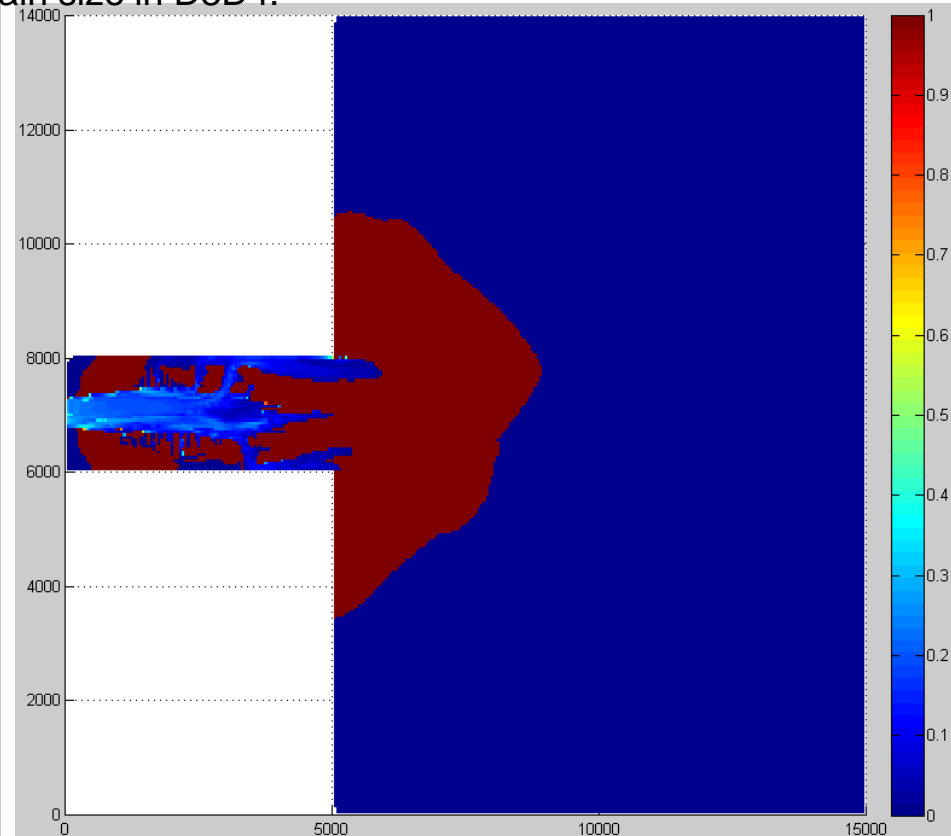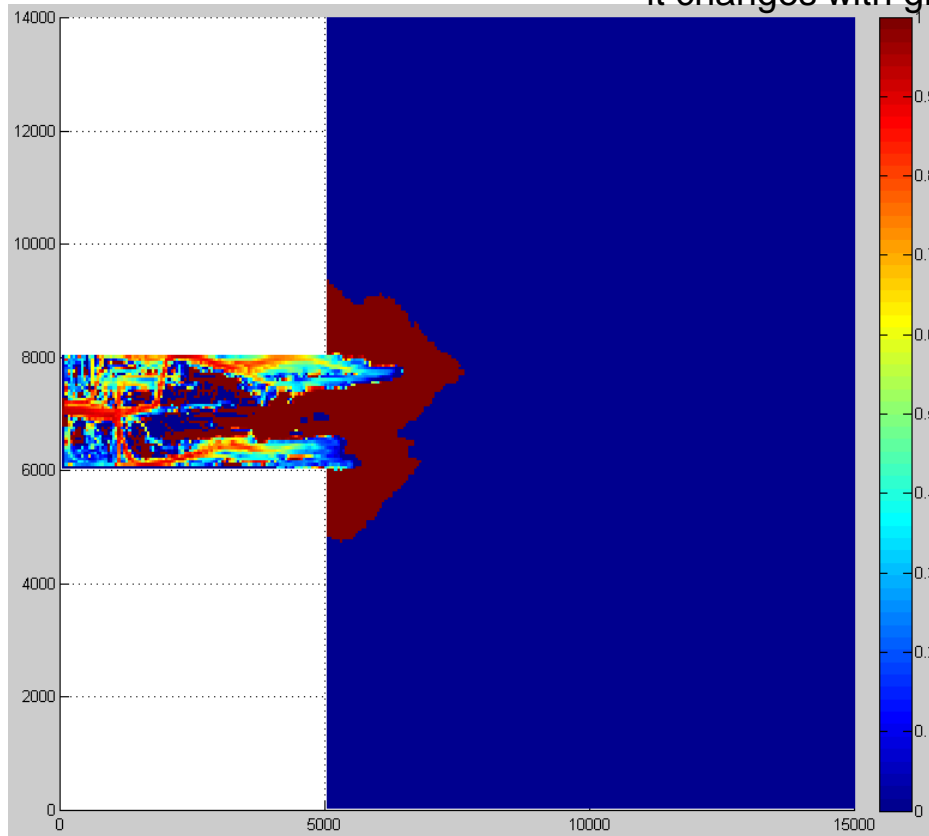# Comparison: GT Model_1 Coarse sand delta

Delft3D-4
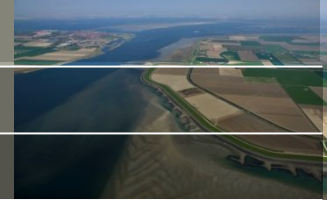(0_9_Origional_ThetSD0_mor_vanRijn2004)

Delft3D-FM
(9_3_inisedthick_update_mor_vanRijn2004)

95 days – Medium sand fraction (suspended load : total load)

Again almost no suspended load in FM – strangely, this ratio seems to stay the same for all fractions in FM, while it changes with grain size in D3D4.



**Deltares**

# fine sand fraction

Delft3D-4
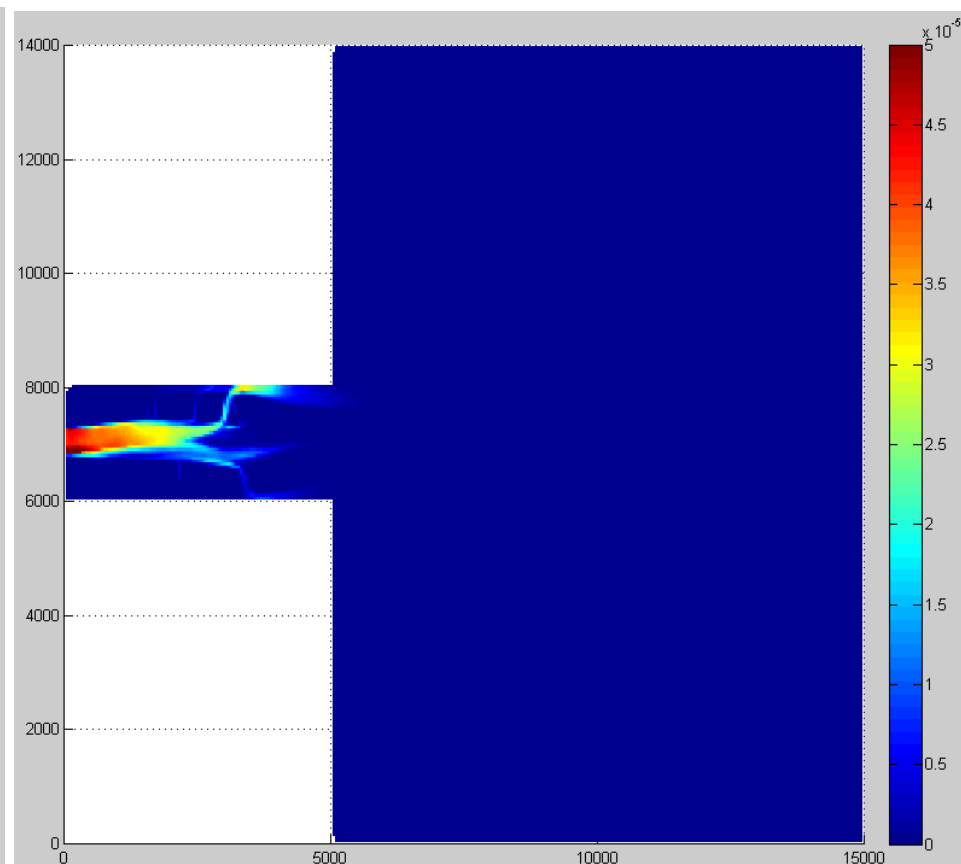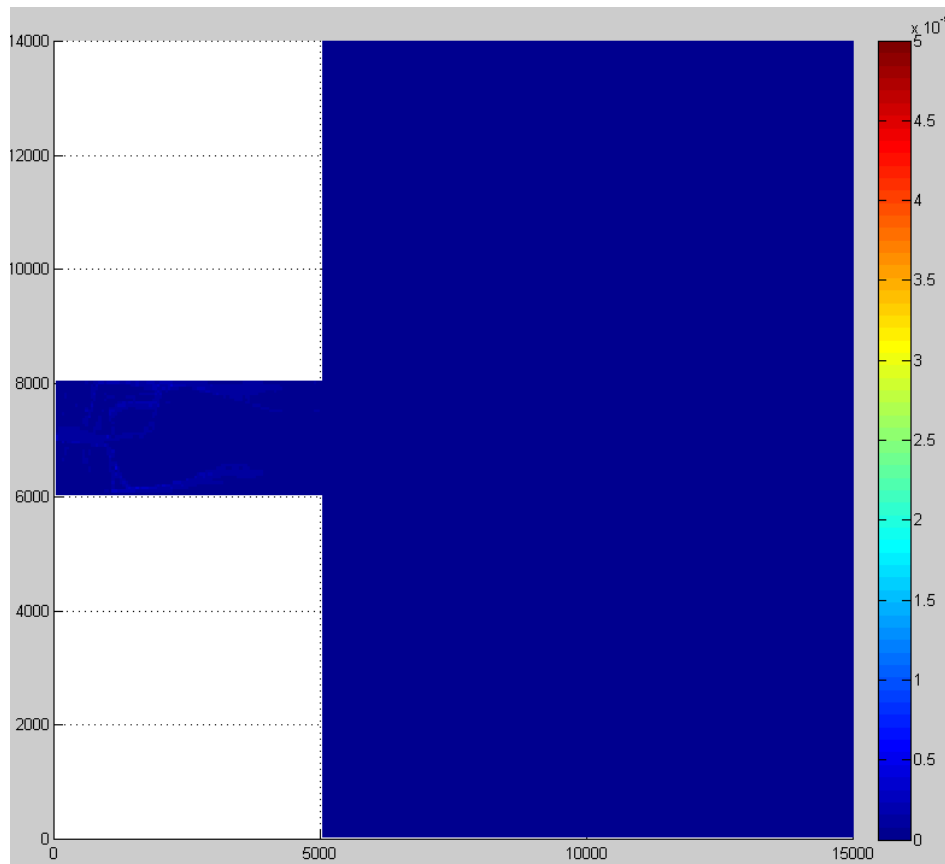(0_9_Origional_ThetSD0_mor_vanRijn2004)

Delft3D-FM
(9_3_inisedthick_update_mor_vanRijn2004)

95 days – Fine sand fraction (bed load)
..



**Deltares**

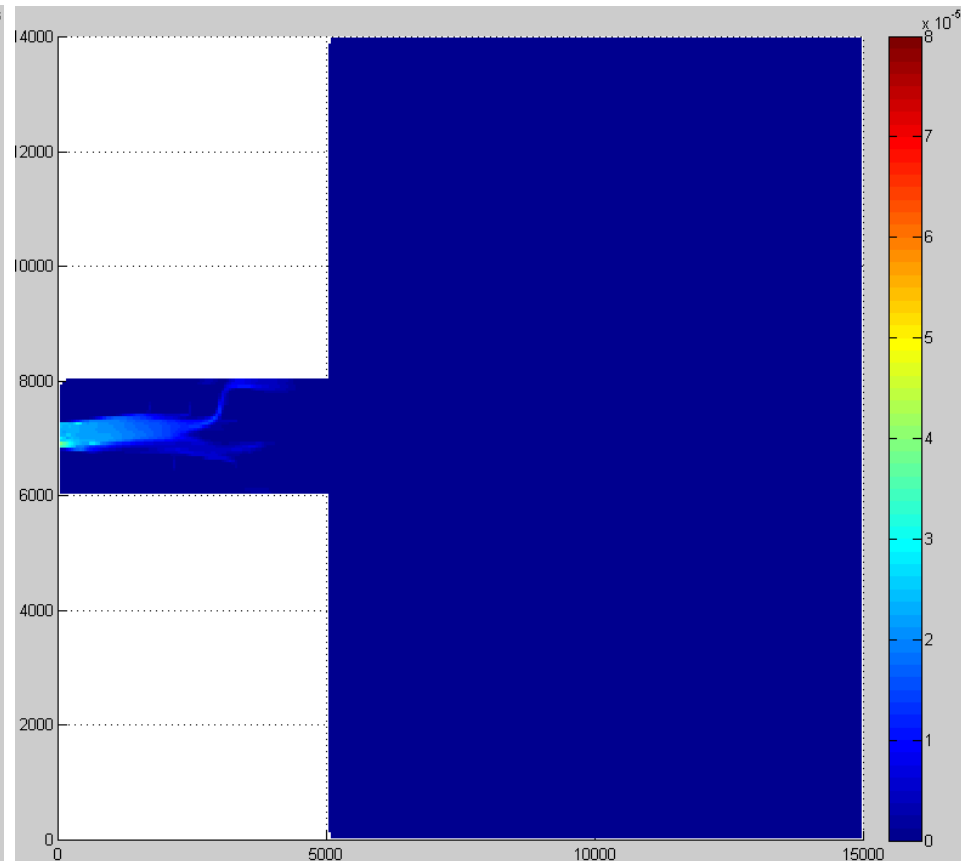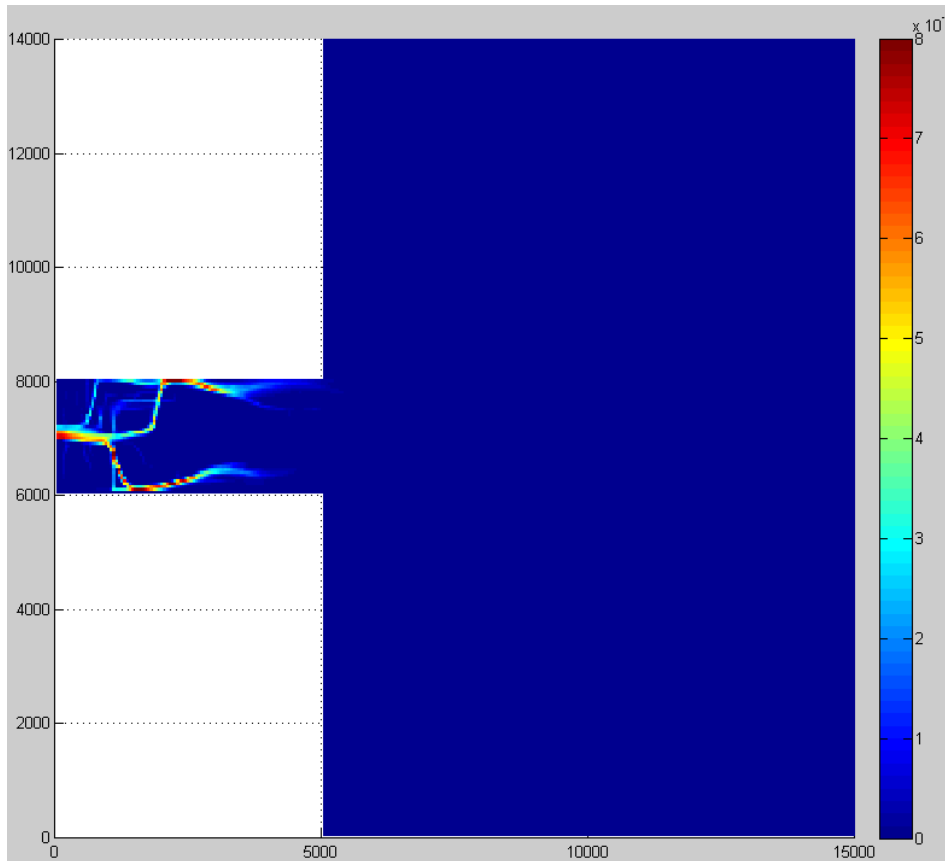# Comparison: GT Model_1 Coarse sand delta

Delft3D-4
(0_9_Origional_ThetSD0_mor_vanRijn2004)

Delft3D-FM
(9_3_inisedthick_update_mor_vanRijn2004)

95 days – Fine sand fraction (suspended load)
..

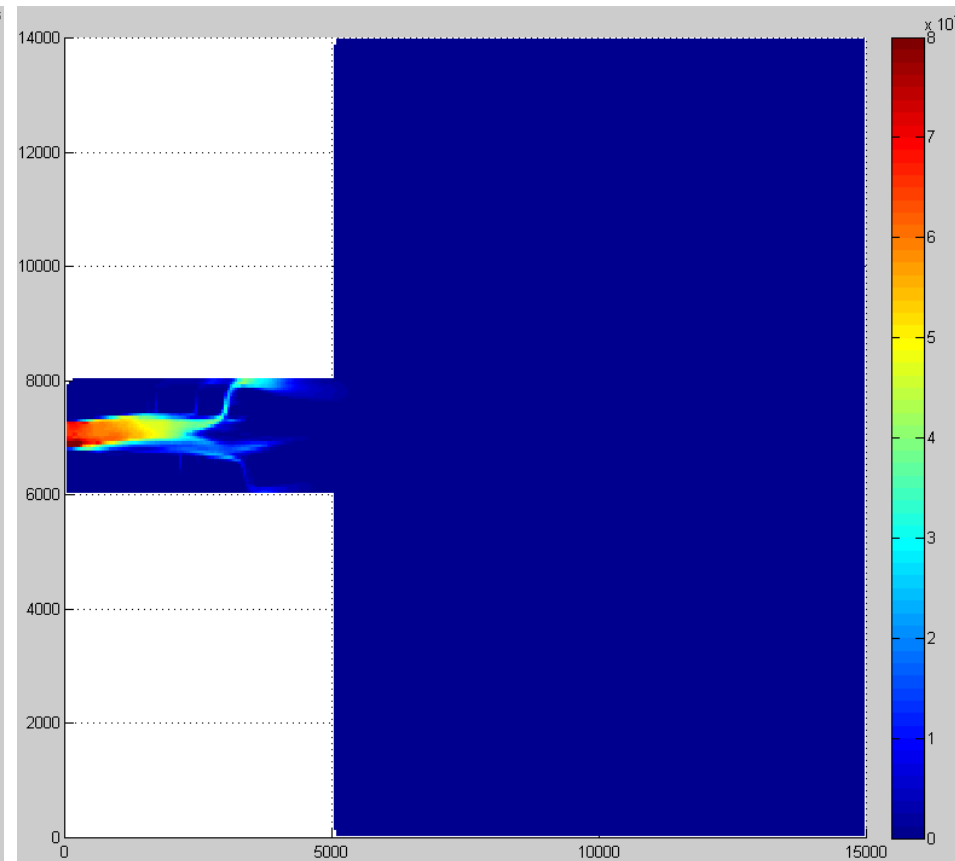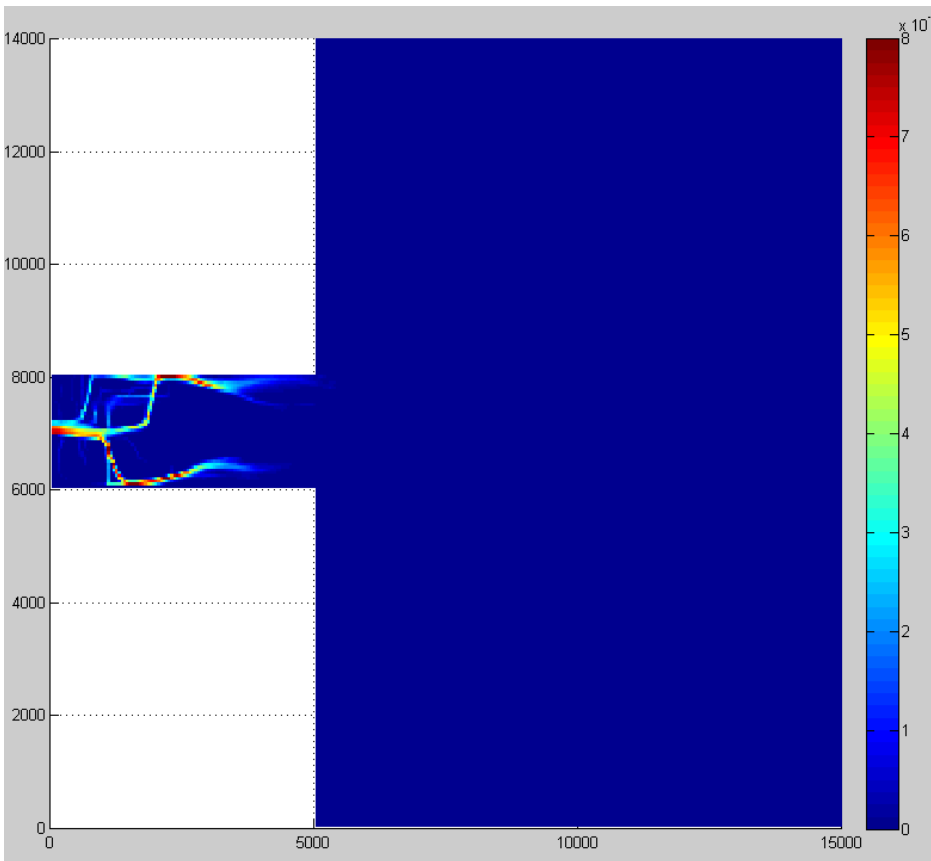# Comparison: GT Model_1 Coarse sand delta

Delft3D-4
(0_9_Origional_ThetSD0_mor_vanRijn2004)

Delft3D-FM
(9_3_inisedthick_update_mor_vanRijn2004)

95 days – Fine sand fraction (total load)
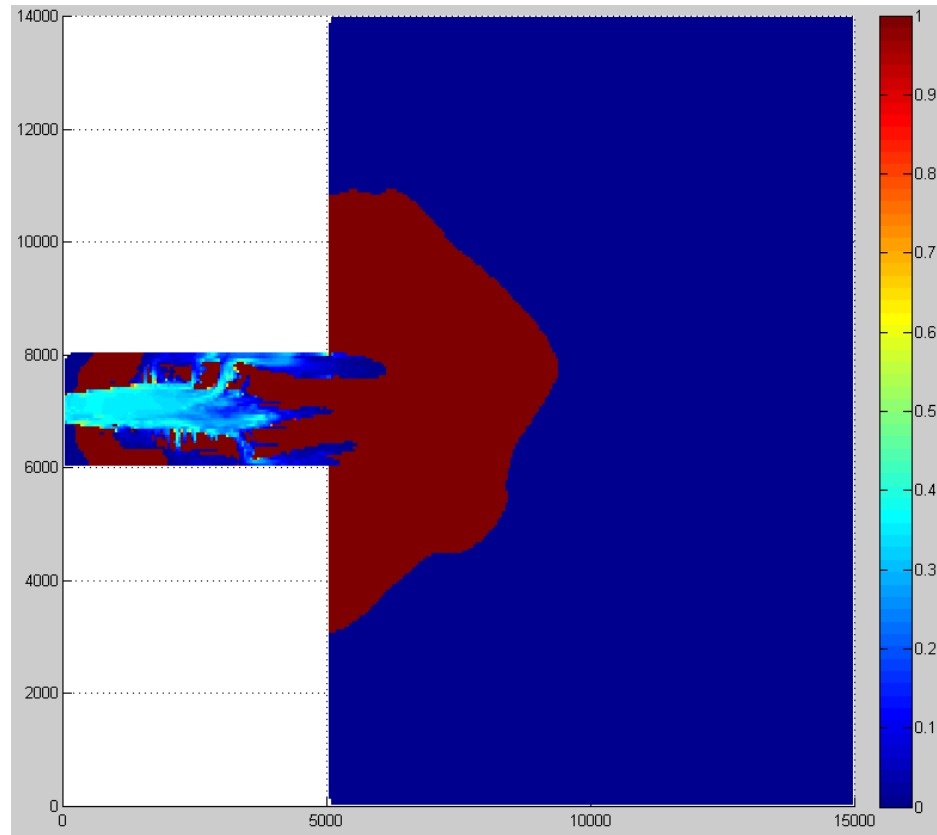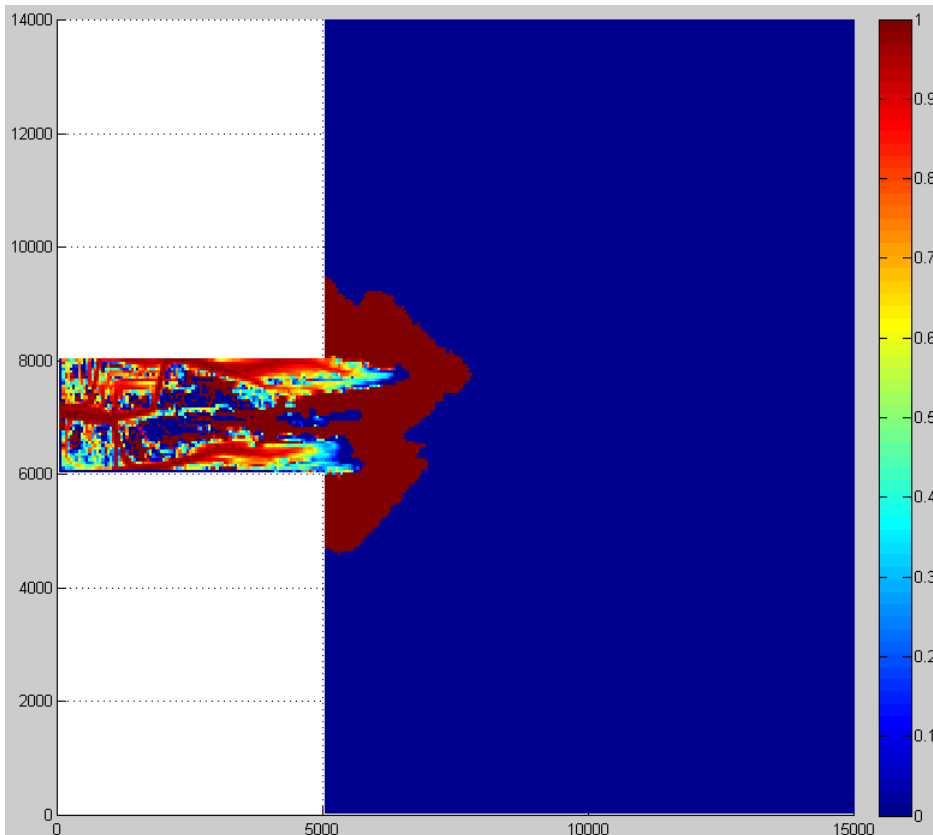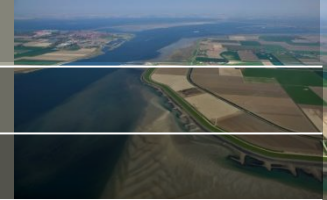..



**Deltares**

Delft3D-4
(0_9_Origional_ThetSD0_mor_vanRijn2004)

Delft3D-FM
(9_3_inisedthick_update_mor_vanRijn2004)

95 days – Fine sand fraction (suspended load : total load)
Still less suspended load in FM

**very fine sand fraction**

Delft3D-4
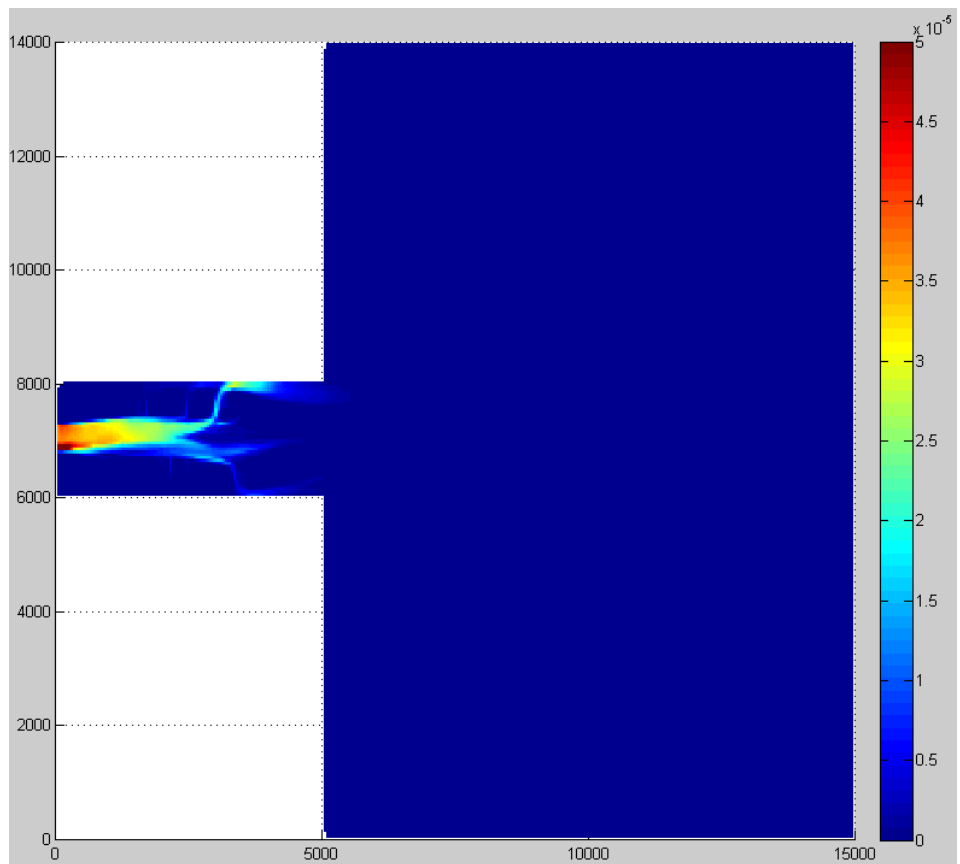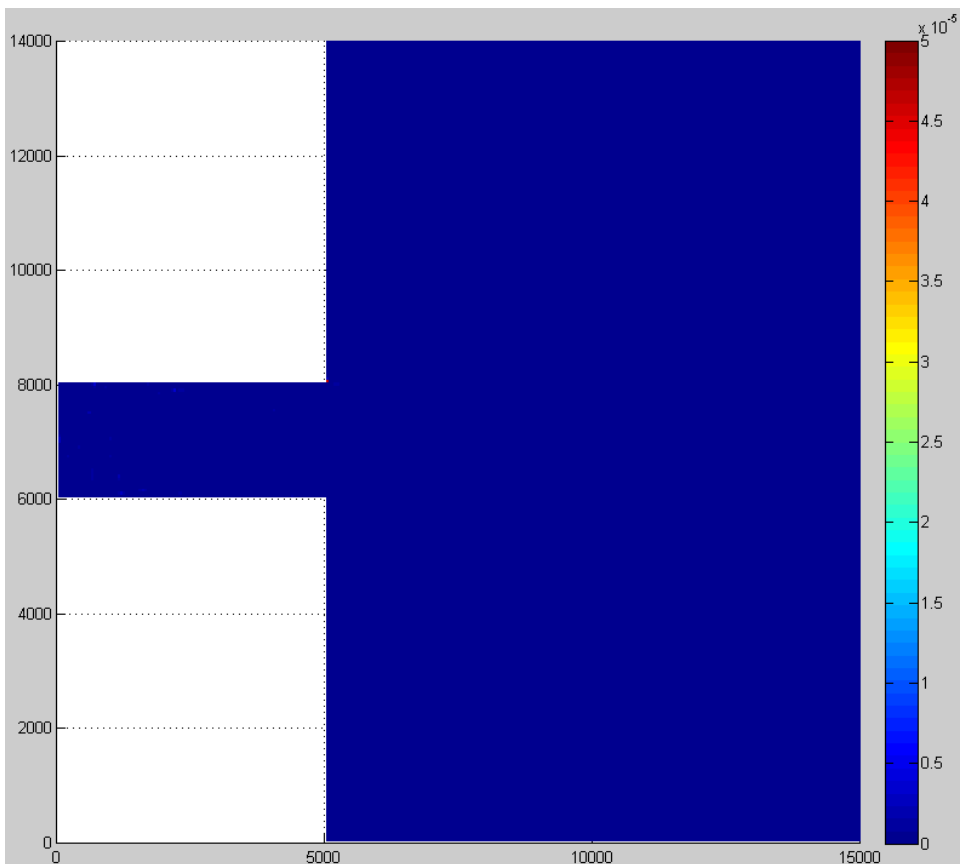(0_9_Origional_ThetSD0_mor_vanRijn2004)

Delft3D-FM
(9_3_inisedthick_update_mor_vanRijn2004)

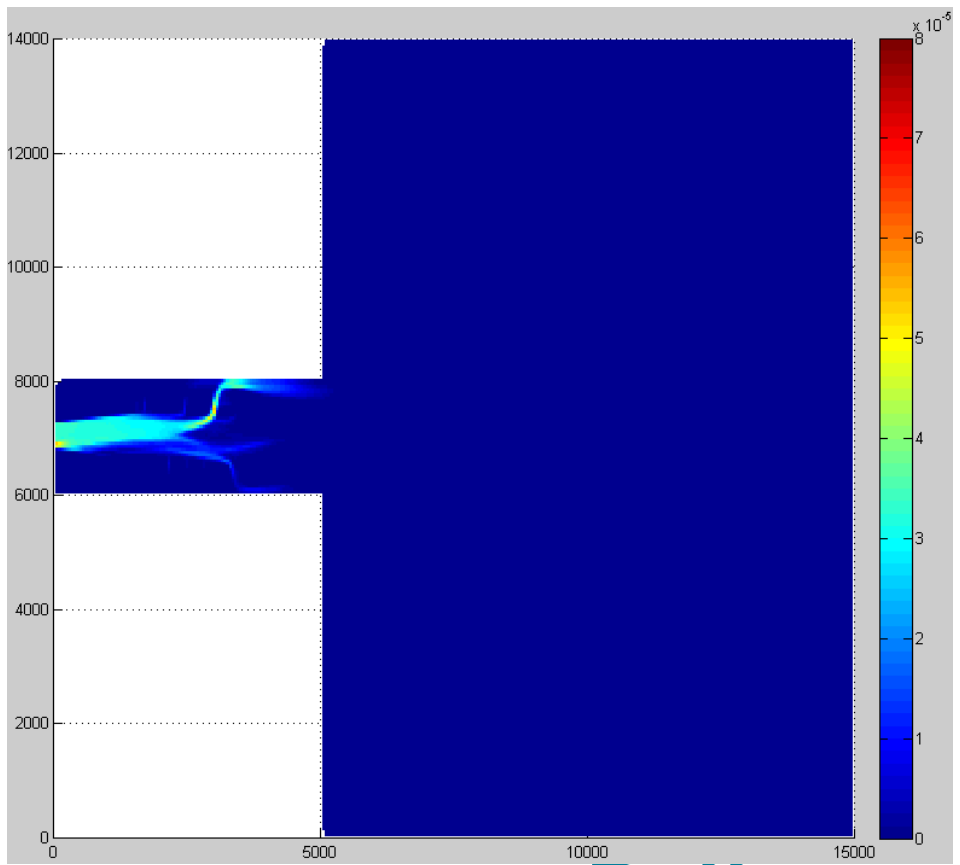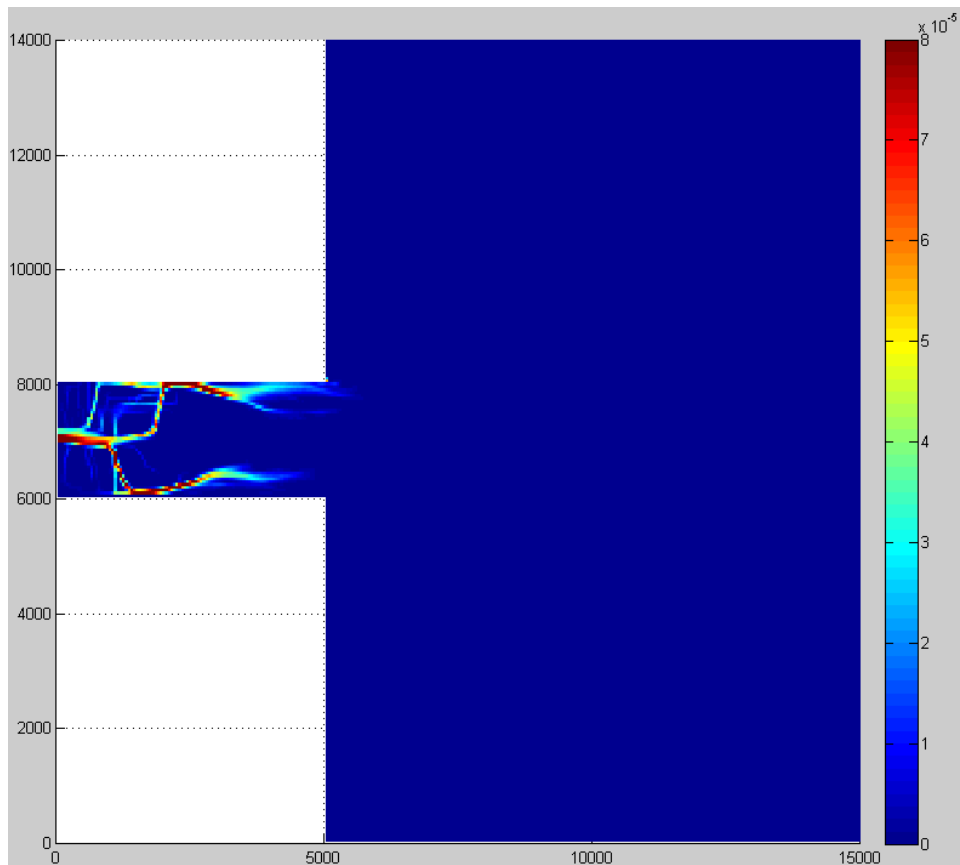95 days – Very fine sand fraction (bed load)
..

Delft3D-4
(0_9_Origional_ThetSD0_mor_vanRijn2004)

Delft3D-FM
(9_3_inisedthick_update_mor_vanRijn2004)

95 days – Very fine sand fraction (suspended load)
..



**Deltares**
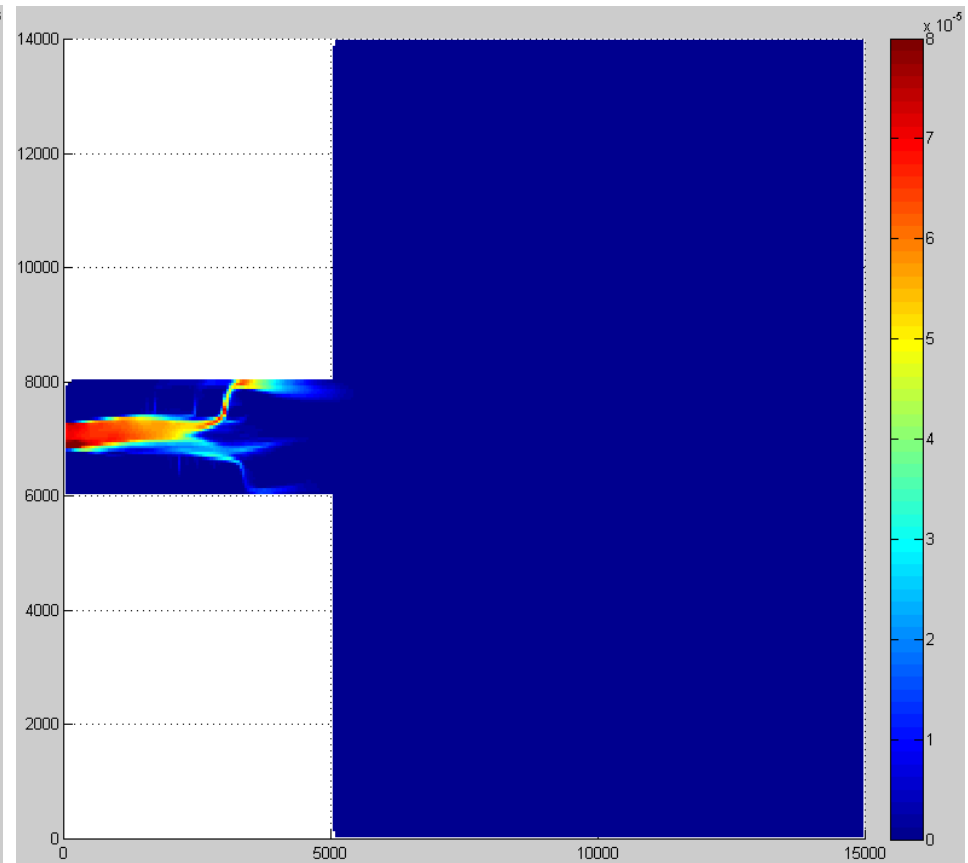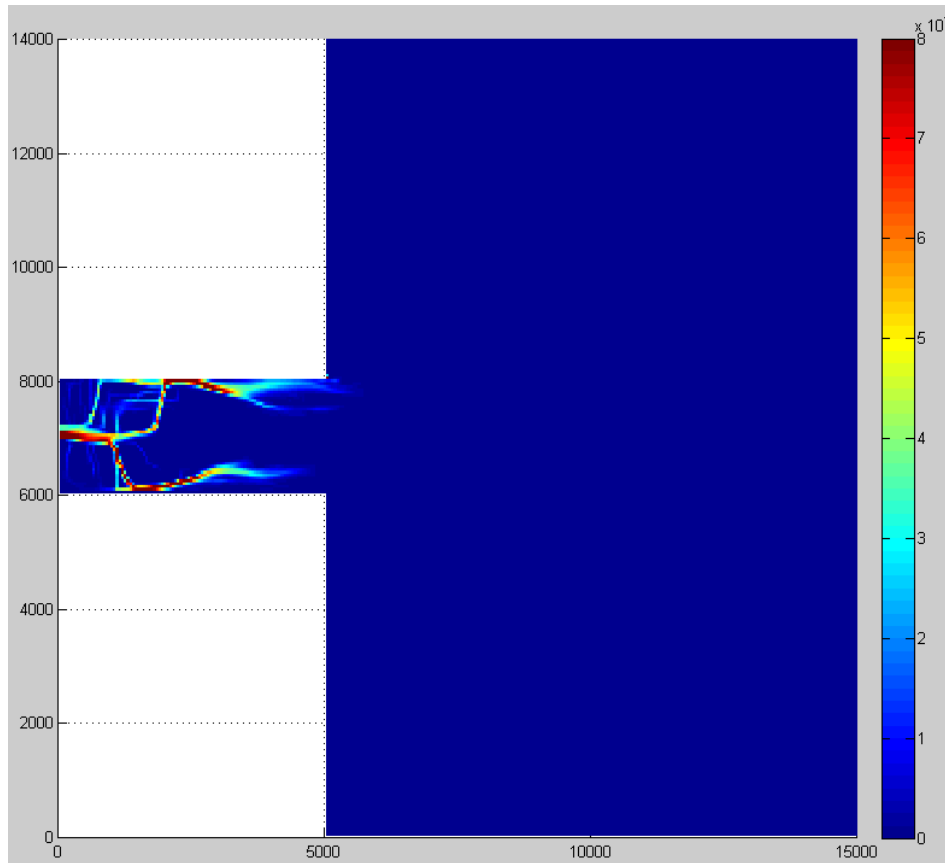
# Comparison: GT Model_1 Coarse sand delta

Delft3D-4
(0_9_Origional_ThetSD0_mor_vanRijn2004)

Delft3D-FM
(9_3_inisedthick_update_mor_vanRijn2004)

95 days – Very fine sand fraction (total load)
..



**Deltares**

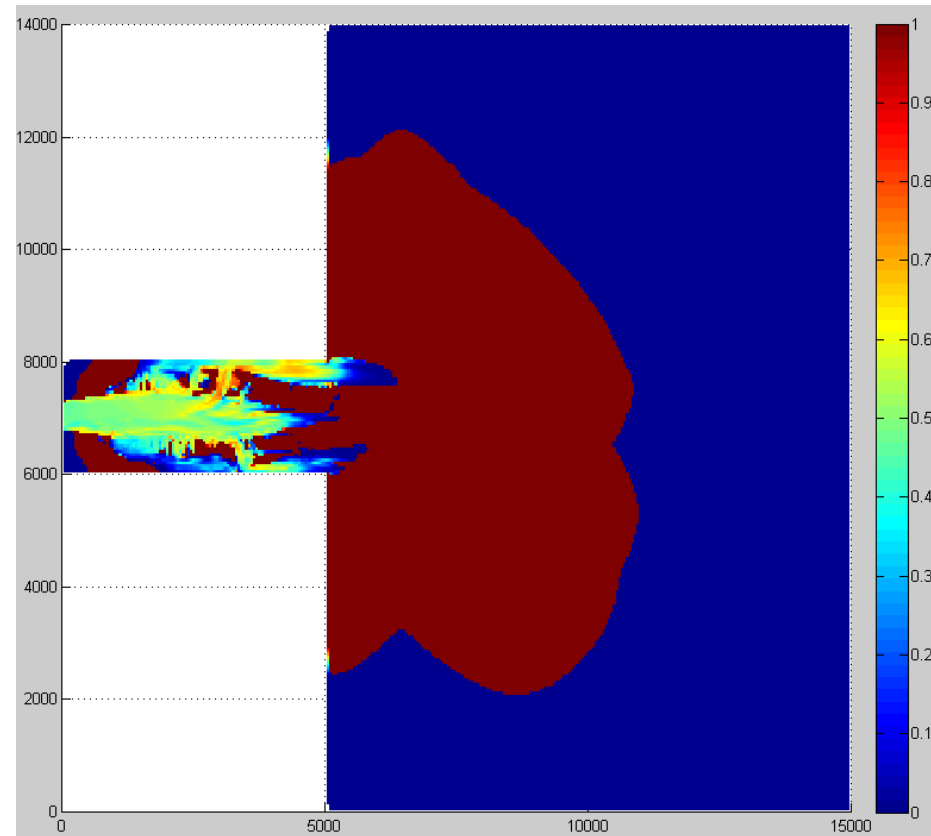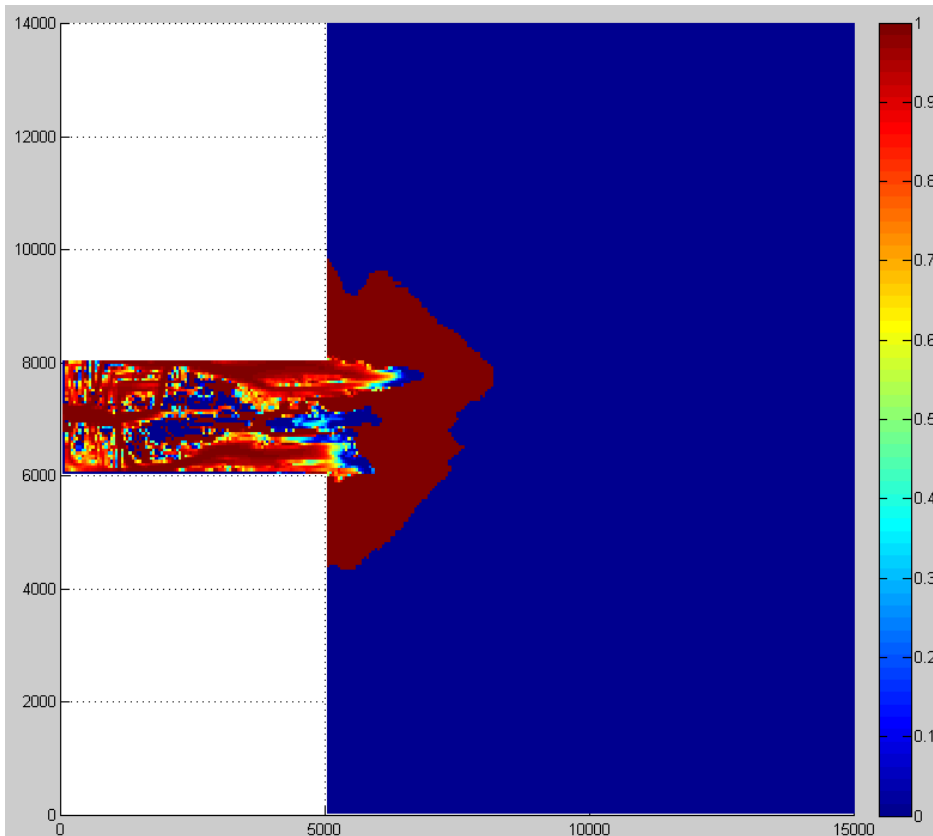# Comparison: GT Model_1 Coarse sand delta

Delft3D-4
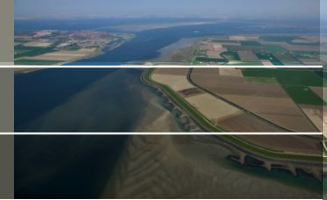(0_9_Origional_ThetSD0_mor_vanRijn2004)

Delft3D-FM
(9_3_inisedthick_update_mor_vanRijn2004)

95 days – Very fine sand fraction (suspended load : total load)
The transport definition file defines this to be 0.9 for very fine sand

# coarse silt fraction

# Comparison: GT Model_1 Coarse sand delta

Delft3D-4
(0_9_Origional_ThetSD0_mor_vanRijn2004)

Delft3D-FM
(9_3_inisedthick_update_mor_vanRijn2004)

95 days – Very fine sand fraction (suspended load)
..



**Deltares**