1 1D uniform sediment

Quality Assurance

Date	Author	Initials	Review	Initials	Approval	Initials
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Purpose

The purpose of this validation case is to examine the performance of the Engelund-Hansen sediment transport formation in a 1D or line model. The performance of the 1D model are compared with 2D because the 2D model is validated. Furthermore, the 1D hydrodynamics have been tested in previous scenarios. A schematised straight channel is modelled. The test case reference number is . . .

Linked claims

Claims that are related to the current test case are:

- The Engelund-Hansen sediment transport formulation in a 1D line model is correctly programmed, according to a comparison with a 2D model.
- The difference in the sediment transport and consequently the morphological changes between the 1D line model and the 2D model result for the accepted small differences in hydrodynamics between models.

Approach

Three different grids are designed and combined with two bathymetries. Each of the grids models a straight channel but the first grid has a width of 5 cells, the second a width of 1 cell and the third is a 1D grid, see Figure 1. The bathymetries are a flat channel and a channel with a trench, see Figure 2. These schematisations are combined to verify the claims.

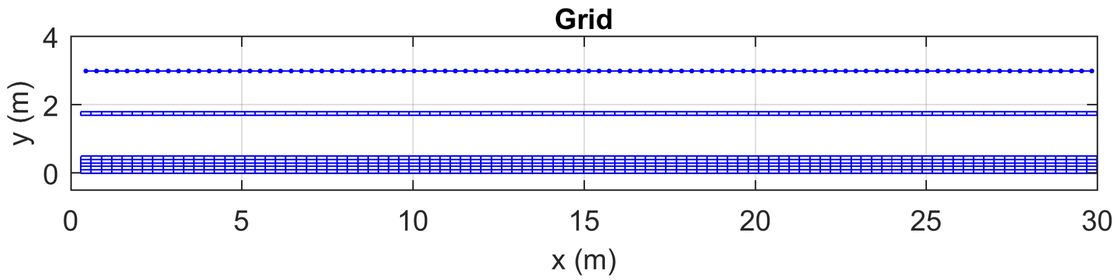

Figure 1: Figure of the different grids. The top grid shows the 1D grid, the middle a quasi-2D grid and the bottom the full 2D grid.

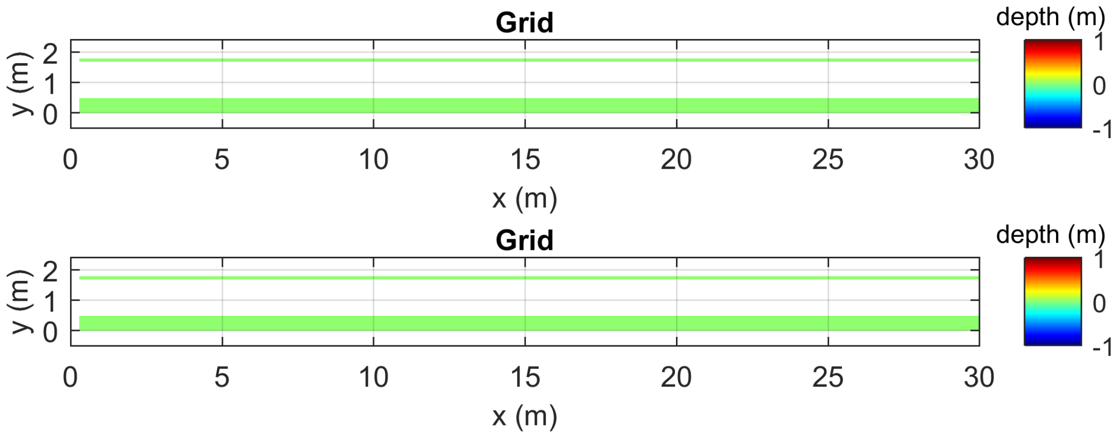

Figure 2: The two bathymetries used for this cases. The top bathymetry represents the flat channel and the bottom bathymetry shows the trench.

Conclusion

The results show that the sediment transport and the induced morphological changes in 1D gives equal results as in the 2D case. Tiny differences can be related to the accepted differences in the hydraulics between a 1D and 2D schematisation.

Model description

In this test case we use a network composed of 3 straight channels in a single schematisation. The schematisation consists of or 3 flat channels or 3 channels with each a trench. For the flat channel the bottom is kept at a constant depth of -0.4 m. For the trench a longitudinal bottom slope i_b is prescribed to be 0.012 and the channel starts at a depth of -0.39. Each channel as a length of 30 m. The width of the 2D channel is set to 0.5 m. The line model and the quasi-2D model have a width of 0.1 m. In the 2D model a discharge Q of 0.09945 m^3/s is prescribed as an upstream boundary condition. In the 1D and quasi-2D the discharge is reduced according to the width to

0.0199 m^3/s. For the flat channel and the A discharge Q of 0.09945 m^3/s is prescribed as an upstream boundary condition. The Nikuradse roughness height is set to 0.025 m and evaluated using the White-Colebrook formula. The downstream boundary condition is water level set to 0 m.

In this test-case a uniform sediment grain size $D_{50} = 1.4 \cdot 10^{-4}$ is used.

The default parameters in the morphological setup are mainly used. Nevertheless, in the following section important related setup of morphology and sediment files used are described as follows:

- Sediment file $< *.sed >$:

```
[Sediment]
Name                 = #Sediment_sand#                   Name of sediment fraction
SedTyp               = sand                              Must be "sand", "mud" or "bedload"
RhoSol               =  2.6500000e+003         [kg/m3]   Specific density
SedDia               =  1.4000000e-004         [m]       Median sediment diameter (D50)
CDryB                =  1.6000000e+003         [kg/m3]   Dry bed density
IniSedThick          =  5.0000000e-001         [m]       Initial sediment thickness layer-bed
FacDSS               =  1.0000000e+000         [-]       FacDss * SedDia = Initial SS dia
TraFrm               = 1
ACAL                 = 1.0
```

Sediment transport equation is the transport relation by Engelund, F. and E. Hansen (1967).

- Morphology file $< *.mor >$:

The morphological update $MorUpd$ and bed composition update $CmpUpd$ are switched off to check the total transport. Then it is switched on to check the bed level change. Consequently, it results in 4 schematisations with each 3 channels, see Table 1. $MorFac$ is equal to 18 and the spin-up interval from the start time until the start of morphological changes $MorStt$ is 5.0 minutes.

Schematisation	Bathymetry	Morphological changes
1	Flat Channel	Unable
2	Trench	Unable
3	Flat Channel	Able
4	Trench	Able

Table 1: Overview of the different schematisations.

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Results

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Analysis of results

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References

Engelund, F. and E. Hansen (1967). *A monograph on Sediment Transport in Alluvial Streams*. Teknisk Forlag, Copenhagen.