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1 Straight channels in 1D and 2D: including 90 degree bend and effect of resolution

Quality Assurance

Date	Author	Initials	Review	Initials	Approval	Initials
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Version information

Date of study : 2019-02-06
Executable : Deltares, D-Flow FM Version 1.2.26.60016M, Jan 25 2019, 12:08:55
Location : `$HeadURL:https://svn.oss.deltares.nl/repos/openearthmodels/trunk/riverlab/schematic/f28_mor1d_bakprof_hydraulics/c32_Channels_1D_zigzag_1D_zero_bedslope_resolution/doc/chapters/case_text.tex$`
SVN revision : $Rev : 2585$

Purpose

There is an important difference between SOBEK3 and D-Flow FM. In SOBEK3, the flow equations are solved in 1D: although the user can introduce geographical "bends" in a model, the equations are still solved as if the river is a straight line. Since D-Flow FM is set-up as a model-code for 1D-2D-3D, this is not the case. Also in 1D, the equations are solved in a vectorized way. This means that if there is a bend between computational nodes, the computed velocity can be very different from that computed in SOBEK3. The previous case (f28-c30) gave insight in the effect of bends on water levels: backwater effects (opstuwing) at each bend. The question has risen whether this is physical or numerical. Therefore, in this test case we study whether the results from the previous case depend on the resolution of the grid.

Linked claims

- Bend effect independent of grid resolution.

Approach

In this case we compare a 1D straight channel with channels with a single 90^o bend with different horizontal resolution (different dx).

Model description

See the figure below for the used grids in this case.

Figure 1: Figure of the layout of the model.

Properties of the considered cases:

- All channels are 30 m in length. Width of channel is 0.3 m.
- Straight 1D-channel: dx=0.5 m.
- 1D-channels with a single 90^o bend: from left to right dx=0.25 m, 0.50m, 1.00 m.
- Water depth downstream boundary: 0.35 m.
- Discharge at upstream boundary: 0.08 m^3/s.

Results

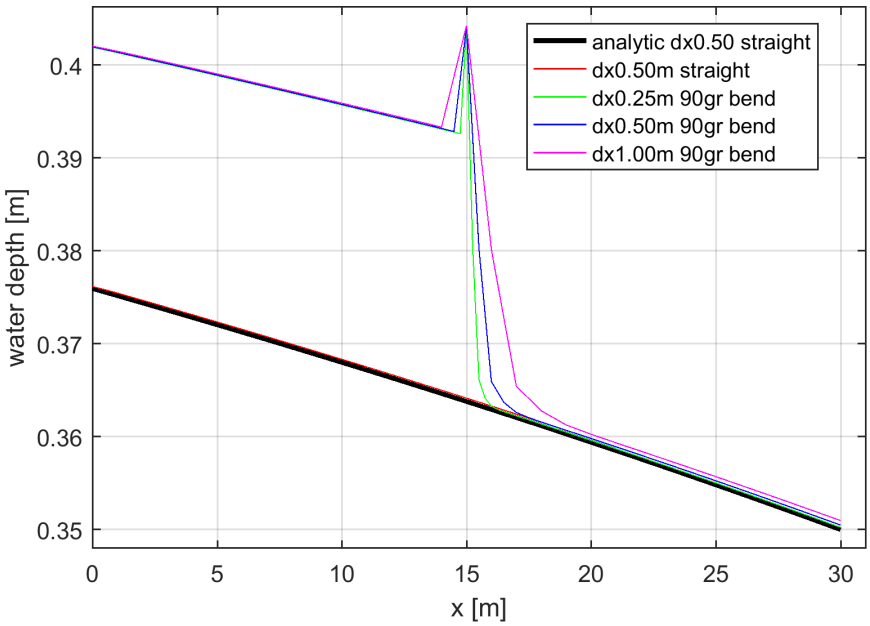

Figure 2: Comparison of water depth for straight channels and channels with a single bend with various grid resolution.

The backwater effect is independent of grid resolution (the apparent differences are only due to the relatively coarse grids). On hindsight, this result is probably logical. Two opposing effects "cancel out": the effect of a coarser grid and related numerical diffusion.

Conclusion

"Bend-effects" are independent of grid resolution. This gives reason to form a conceptual framework how to treat "bends" in 1D D-Flow FM applications.