Ecohydraulics
HYD254

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AUTOTUTORIAL 2: THE POWER OF TOPOGRAPHY

Background: 2D models are highly sensitive to topography. This is a key difficulty when simulating a real river to yield accurate predictions. However, when doing scientific exploration, sensitivity to topography is a powerful tool. In this exercise you will make and run 2D models with inverted channel topographies that have the same reach-scale dimensions and boundary conditions as in the quickstart tutorial, but different riffle-pool variations. Specifically, in one case ("in phase"), channel constrictions occur where the river is deep and channel expansions occur where the river is shallow (i.e. low bed elevation corresponds with low width, so the undulations in Z and W are in phase). In the other case ("out phase"), channel constrictions occur where the river is shallow and channel expansions occur where the river is deep (i.e. low bed elevation corresponds with high width, so the undulations in Z and W are out of phase). Run the models to learn how this affects hydraulics.

Objective: Gain more experience running 2D models and learn how to use 2D models for scientific exploration

Materials: InPhase_model.zp and Outphase_model.zip.

Homework assignment:

1) Create a 2D model for each case using the same boundary conditions you used in the quickstart tutorial. You should create a new map and mesh for each case.
    a) Use a 2-m mesh so the model runs faster
    b) When you make the map, make it rectangular and exclude the exterior most topo points, which are dry anyway. Using a rectangular map will allow you to use the Patch method of meshing.
    c) I suggest using a time step of 0.1 for both models, but the OutPhase model has higher velocities, so it is at risk of numerical instability and may require an even smaller timestep. If the results show the kinds of velocity blobs as illustrated in the textbook on p. 72, then reduce the time step to 0.01 or 0.001 and try again.

2) Compare and contrast the bankfull hydraulics of all three simulations you have now done. Explain why the phasing of bed undulations and width undulations causes the hydraulics to be different between the two new cases. Can you think of any practical applications of these findings?

3) Write up a brief summary of your work, including the map graphics for WSE, depth, and velocity for each simulation as well as your evaluation of the different synthetic river corridors.

Helpful info:

Please read the README text files to get the latest updates and troubleshooting tips before starting the tutorial.