Introduction to Modeling River Flow and Morphodynamics within the IRIC Interface: September 1-2, 2016, University of Moratuwa, Colombo, Sri Lanka

This class covers a broad spectrum of river modeling techniques within the International River Interface Cooperative (IRIC) public-domain modeling interface. The course will be taught in a workshop format starting with basic data input and stepping through the processes of grid generation, model execution, visualization, and verification. The interface incorporates a variety of computational modeling approaches including finite difference and finite volume models using both structured and unstructured coordinate systems; only a subset of the available techniques will be covered in this short class. Basic principles will be briefly covered, but the emphasis of this short course is hands-on application using data sets for realistic problems on real rivers and hill slopes. For the class at the University of Moratuwa, the students will learn and use the following:

-FaSTMECH: Quasi-steady, quasi- three-dimensional model for river flow with morphodynamics. Useful for long river reaches where high grid resolution is required for water-surface elevations and velocities, flood predictions, and bed morphology changes.

-Nays2DH: Fully unsteady, two-dimensional model for river flow and morphodynamics incorporating sophisticated turbulence treatments and advection schemes to ensure good treatment of unsteadiness effects. Useful for a wide spectrum of river problems including bed response to structures, bar evolution, spatial grain size sorting, and bank erosion.

-NaysFlood: Two-dimensional flooding inundation model with tools for multiple inflows and outflows, easy incorporation of satellite data, and generic coordinate system for easy treatment of very large domains. Useful for rapid estimates of flood inundation depths over complex areas (including urban flooding), especially where only topographic LiDAR or other coarse DEMs are available for topography.

-NaysCube: Fully three-dimensional flow, sediment transport and morphodynamics model with Reynolds-Averaged Navier Stokes (RANS) and several turbulence closures, including anisotropic models that yield turbulence-driven secondary flows. Useful for many river flow and sedimentation problems where complex 3-d structure with nonhydrostatic effects are important (e.g., flow and sedimentation around structures, changes in vertical structure due to high acceleration or deceleration).

Students should bring a laptop with at least 4 GB of ram and a few gigs of empty hard disk space. The system was designed for use with current 64bit PC operating systems or PC emulators on Macs. Users will need to have software installation capabilities on their laptops, so check with your administrator if necessary. Installations for 32bit PCs will also be provided. Bring data sets with topography, water-surface elevations, and any other data if you would like some assistance with your own projects. The class will be taught by Ichiro Kimura, Tomoko Kyuka, and Yasuyuki Shimizu from the University of Hokkaido and Jonathan Nelson from the US Geological Survey National Research Program. All software is freely available.

Class Schedule

Thursday, September 1

9:00	Introduction to the iRIC interface and solvers with demonstration
9:45	Data requirements and importing data (FaSTMECH Tutorial 1, Exercise 1)
10:30	Break
10:45	Generating simple grids and mapping data on to them (FaSTMECH Tutorial 1, Exercise 2)
11:45	Description of FaSTMECH approximations and methods
12:00	Running solvers and visualizing results (FaSTMECH Tutorial 1, Exercise 3)
12:30	Lunch Break
1:30	Green River flow computation and introduction to calibration and spatially variable roughness (FaSTMECH Tutorial 2)
2:30	Introduction to 3-d modeling in iRIC using NaysCube
3:15	Break
3:30	Computing 3-d flow in a real river (NaysCube Tutorial 1)
4:15	Computing 3-d flow and morphodynamics for a real river (NaysCube Tutorial 2)
5:00	Computing secondary flows of the second kind (NaysCube Tutorial 3)
5:45	End

Friday, September 2

9:00	Description of Nays2dh and NaysFlood approximations and methods
10:00	Flow simulation for a simple channel with structures (Nays2dh Tutorial 1)
10:45	Break
11:00	Calculation of morphologic change in a simple meander bend (Nays2dh Tutorial 2)
11:45	Flow and morphodynamics in a real river (Nays2dh Tutorial 3)
12:30	Lunch
1:30	Introduction to inundation modeling in iRIC using NaysFlood
1:45	Flood inundation for an urban area (NaysFlood Tutorial 1)
3:15	Break
3:30	Tsunami runup in a river using NaysFlood (NaysFlood Tutorial 2)
5:00	Final questions and discussion
5:30	End of course