

**Introduction to Modeling River Flow and Morphodynamics within the IRIC Interface:** January 9-11, 2018, SSJDC Delta-Suisun Marsh Conference Room, 1450 Halyard Dr Suite 6, West Sacramento CA 95691

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 in Sacramento, the students will learn and use the following:

-FaSTMECH: Quasi-steady, two and 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.

-Johannesson-Parker Meander Evolution Model: Semi-empirical predictions of the evolution of channel centerlines. Useful for making estimates of the future behavior of meandering rivers.

-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).

EvaTRiP (Evaluation Tools for River environmental Planning): \*NEW!\* Uses output from iRIC flow solvers along with user-specified relations to evaluate a variety of river variables including the necessity of river bank protection, spatial regions of critical grain size, areas of terrestrial plant growth, and a variety of fish habitat parameters.

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 if necessary. 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 Jonathan Nelson and Richard McDonald from USGS with their collaborators Yasuyuki Shimizu, Ichiro Kimura, and Tomoko Kyuka from Hokkaido University, Masahiko Sekine from Yamaguchi University, and Eric Larsen from UC Davis. All software and the class are freely available.

## Class Schedule

Tuesday, January 9

- 8:00 Introduction to the iRIC interface and solvers with iRIC demonstration  
Lecturer: Dr. Jonathan Nelson and technical staffs, USBS
- 9:15 Data requirements and importing data (FaSTMECH Tutorial 1, Exercise 1)  
Lecturer: Dr. Jonathan Nelson and technical staffs, USBS
- 9:45 Break
- 10:00 Generating simple grids and mapping data on to them (FaSTMECH Tutorial 1, Exercise 2)  
Lecturer: Dr. Jonathan Nelson and technical staffs, USBS
- 11:00 Description of FaSTMECH 2d and 3d  
Lecturer: Dr. Jonathan Nelson and technical staffs, USBS
- 11:30 Running solvers and visualizing results (FaSTMECH Tutorial 1, Exercise 3)  
Lecturer: Dr. Jonathan Nelson and technical staffs, USBS
- 12:00 Lunch Break
- 1:00 Calibrating roughness for a real river example (FaSTMECH Tutorial 2)  
Lecturer: Dr. Jonathan Nelson and technical staffs, USBS
- 2:00 Break
- 2:15 Installation and application of Johannesson-Parker meander migration model  
Lecturer: Dr. Jonathan Nelson and technical staffs, USBS
- 4:00 End

Wednesday, January 10

- 8:00 Description of Nays2dh approximations and methods  
Lecturer: Prof. Yasuyuki Shimizu, Hokkaido University
- 8:45 Flow simulation for a simple channel with structures (Nays2dh Tutorial 1)  
Lecturer: Prof. Yasuyuki Shimizu, Hokkaido University
- 9:45 Break
- 10:00 Calculation of morphologic change in a simple meander bend (Nays2dh Tutorial 2)  
Lecturer: Prof. Yasuyuki Shimizu, Hokkaido University
- 11:00 Flow and morphodynamics in a real river (Nays2dh Tutorial 3)  
Lecturer: Prof. Yasuyuki Shimizu, Hokkaido University
- 12:00 Lunch Break
- 1:00 Introduction to inundation modeling in iRIC using NaysFlood  
Lecturer: Dr. Tomoko Kyuka, Hokkaido University
- 1:30 Flood inundation model for an urban area (NaysFlood Tutorial 1)  
Lecturer: Dr. Tomoko Kyuka, Hokkaido University
- 2:45 Break
- 3:00 Tsunami runup in a river with NaysFlood (NaysFlood Tutorial 2)  
Lecturer: Dr. Tomoko Kyuka, Hokkaido University
- 4:00 End

Thursday, January 11

- 8:00 Introduction to 3-d modeling in iRIC using NaysCube  
Lecturer: Prof. Ichiro Kimura, Hokkaido University
- 9:00 Computing 3-d flow in a real river (NaysCube Tutorial 1)  
Lecturer: Prof. Ichiro Kimura, Hokkaido University
- 9:45 Break
- 10:00 Computing three-d flow and morphodynamics for a real river (NaysCube Tutorial 2)  
Lecturer: Prof. Ichiro Kimura, Hokkaido University
- 11:00 Computing secondary flows of the second kind (NaysCube Tutorial 3)  
Lecturer: Prof. Ichiro Kimura, Hokkaido University

12:00 Lunch

1:00 Introduction to EvaTRiP with new tutorials

Lecturer: Prof. Masahiko Sekine, Yamaguchi University

4:00 End of course