Workshop on Watershed Modeling with *GSSHA*

June 20-23

National Water Center, Tuscaloosa, Alabama

You will learn the basics of:

- *Gridded Surface Subsurface Hydrologic Analysis* (*GSSHA*) model, developed at the U.S. Army Corps of Engineers, Engineering Research and Development Center and the University of Wyoming
- *Dept. of Defense Watershed Modeling System* (*WMS*), developed by Aquaveo LLC
- Spatial data needed to estimate distributed *GSSHA* model parameters, including data requirements, basics of *GSSHA/WMS* and how to find and use spatial geographic data to develop GSSHA models using the *WMS Hydrologic Model Wizard*.

The *GSSHA* model with *WMS* support constitutes a complete watershed analysis system that can be used for a variety of hydrologic science and engineering computation and design evaluation, such as flood simulation, hydrologic impacts of land use change, best management practice design, and testing of flood mitigation measures.

Course Layout:

Through a combination of lectures and experiential applications, the course features the spatially distributed modeling components of this system. The course begins with an overview of the capabilities of the *WMS* to ensure maximum benefit from the hands-on portions of the class. Attendees will learn to use *WMS* to set up *GSSHA* models that include overland flow, infiltration, distributed rainfall, hydraulic structures, continuous simulations, flood inundation mapping, and groundwater/surface water interaction.

Outcome:

Having completed this course, attendees will gain a working knowledge of the U.S. Army Corps of Engineers (USACE), Engineer Research and Development Center (ERDC) *GSSHA* model that is supported by the Watershed Modeling System (*WMS*) graphical user interface software. Attendees will also understand how, when, and why to apply the tools to specific studies as well as understand input data requirements. This class provides users with sufficient background to easily deploy a sophisticated hydrological model.

Who Should Attend?

The course is intended for anyone interested in watershed hydrology, including flooding, the effects of landscape changes on hydrology, and/or analyzing best management practices and flood control measures, as well as groundwater/surface water interactions. Experience with hydrologic modeling and numerical methods are a plus, but not required. Some college-level background in hydrologic science and/or engineering is required.

Instructors: This short course will be taught by the lead *GSSHA* developer Dr. Charles W. Downer USACE-ERDC, *GSSHA* application expert Steven J. Turnbull USACE-ERDC, and *GSSHA* co-creator, developer, and instructor extraordinaire Fred L. Ogden, National Water Center.

Utility: Once *GSSHA* models are developed, they can be archived and run in the LINUX supercomputer environment. The *GSSHA* code is parallelized using OpenMP for execution on

multi-core CPUs and is being parallelized by USACE-ERDC for execution in a distributed memory environment.

Requirements: Attendees will provide their own computer. Licenses for Watershed Modeling System (*WMS*) 10.1 software will be provided. This software can be downloaded from http://www.aquaveo.com/downloads.

You will be provided with information to license *WMS* at the start of the course.

You can download the tutorials here: http://www.aquaveo.com/software/wms-learning-tutorials and PDFs of the presentations can be downloaded from the main page of GSSHA wiki http://gsshawiki.com/Gridded_Surface_Subsurface_Hydrologic_Analysis. These materials will also be available at the course.

Fees, access, other: The course is offered free of charge by dedicated civil servants, just trying to make it great. The course will be taught at the National Water Center, 205 Hackberry Lane Tuscaloosa, AL 35401 http://water.noaa.gov/. PDHs are awarded based on contact hours. There are 21 possible contact hours. Participants from the NOAA Summer Innovators Program will have the opportunity to incorporate *GSSHA* into project work, and get to know the *GSSHA* developers.

Information: For information about the course contact Charles W. Downer charles.w.downer@usace.army.mil. For local Tuscaloosa information, including the National Water Center, contact Dr. Fred L. Ogden Fred.Ogden@noaa.gov.

Location: The course will be taught in the National Water Center, 205 Hackberry Lane Tuscaloosa, AL 35401. More information on the location can be found here: http://water.noaa.gov/about/nwc

Schedule: The basic course is two days, followed by a one day field experiment on Day 3, followed by one day of groundwater/surface water modeling on Day 4.

Day 1 – Introduction to *GSSHA* and Building a Basic *GSSHA* Model with the Hydrologic Wizard
Day 2 - *GSSHA* Model Applications
Day 3 – Field Experiment
Day 4 – Groundwater/surface Water Interactions

A detailed itinerary follows.

DETAILED SCHEDULE

Day 1 Tuesday, June 20. Introduction to GSSHA and Building a Basic GSSHA Model with the Hydrologic Wizard

Start	Finish	Duration	Activity	Topic
08:30	08:45	15	Greeting	Introduction of Instructors/Attendees
08:45	09:30	45	Lecture	Introduction to Hydrologic Modeling – Presentation 1
09:30	10:15	45	Lecture	Introduction to *GSSHA* – Presentation 2
10:15	10:30	15	Break	
10:30	10:45	15	Lecture	*WMS* overview using digital spatial data Presentation 4
10:45	11:00	15	Lecture	Images and projections – Pres 5
11:00	11:25	25	Workshop	*WMS* basics and images – Tutorial 40 through 7
11:25	12:00	30	Demo	Using the *WMS Hydrologic Model Wizard*
12:00	13:00	60	Lunch	
13:00	13:20	20	Lecture	Watershed delineation using DEMs – Presentation 7
13:20	13:40	20	Lecture	Overland flow modeling in *GSSHA* – Presentation 8
13:40	13:50	10	Lecture	Basic model setup in *WMS* – Pres 9
13:50	14:10	20	Workshop	Basic model setup with *WMS* with the *Hydrologic Wizard* - Tutorial 47 sec. 8
14:10	14:40	30	Lecture	Stream routing – Presentation 12A
15:40	14:55	15	Lecture	Assigning channel properties with *WMS* – Presentation 12B
14:55	15:10	15	Break	
15:10	15:30	20	Workshop	Adding streams to your model with the *Hydrologic Wizard* – Tutorial 47 Sec. 9
15:30	15:45	15	Lecture	Developing index maps with spatial data - Presentation 10
15:45	16:15	30	Lecture	Modeling infiltration – Pres 11A
16:15	16:25	10	Lecture	Using *WMS* to develop infiltration inputs – Presentation 11B
16:25	16:45	20	Workshop	Adding overland processes to your model using the *Hydrologic Modeling Wizard* – Tutorial 47 Section 10-16
16:45	17:00	15	Recap of 1st day	

Day 2, Wednesday, June 21, 2017 GSSHA Model Applications

Start	Finish	Duration	Activity	Topic
08:00	08:15	15	Lecture	Distributed rainfall – Presentation 14B
08:15	09:15	60	Workshop	Distributed rainfall – Tutorial 49
09:15	09:30	15	Break	
09:30	09:45	15	Review	Distributed rainfall
09:45	10:15	30	Lecture	Hydraulic structures and embankments – Presentation 15
10:15	10:30	15	Lecture	Using *WMS* to develop land-use change scenarios – Pres 17
10:30	12:00	90	Workshop	Land use change – Tutorial 50 & 51
12:00	13:00	60	Lunch	
13:00	13:45	45	Lecture	Continuous simulations - Pres 18 ABC
13:45	14:45	60	Workshop	Continuous simulations – Tutorial 52
14:45	15:00	15	Review	Continuous simulations
15:00	15:30	30	Lecture	Flood inundation modeling – Pres 20&21
15:30	15:45	15	Break	
15:45	16:45	60	Workshop	Flood inundation modeling – Tut 55

Day 3, Thursday, April 22, 2017 - Rainfall Simulator Field Experiments, led by Dr. Ed Kempema, Univ. of Wyoming and Dr. Fred Ogden, NWC

Soil parameters for infiltration modeling in urbanized areas is an active need for hyper-resolution hydrological modeling in cities. Construction in urban areas typically involves removal of topsoil, compaction of the subsoil by construction activities, replacement of the same or different topsoil, and covering with sod. The end result is a layered soil with high infiltration capacity in the sod and topsoil, with very low infiltration capacity in the compacted subsoil. This situation is very different from the native soils that existed pre-construction, and may differ strongly from the soil types indicated on maps that were generated before urban development.

In this portion of the course we will perform repeat measurements of soil infiltration capacity and behavior in urban lawns using a rainfall simulator of the USDA-ARS Walnut Gulch design. This computer controlled rainfall simulator applies rainfall to a 2m x 6m area at user selectable rainfall rates up to 300 mm h^{-1}. By measuring applied rates of rainfall and resulting runoff we can directly measure infiltration at the 12 m^2 scale in result to rainfall. The rainfall simulator apparatus is shown below during a test in Panama, December, 2016.

Day 4, Friday, June 23, 2017 Groundwater and Groundwater/Surface Water Interaction

Start	Finish	Duration	Activity	Topic
08:00	08:45	45	Lecture	Groundwater Modeling Fundamentals 30
08:45	09:15	30	Lecture	Groundwater Modeling in *GSSHA* 31
09:15	10:00	45	Lecture	Using *WMS* to develop groundwater model inputs - Pres 32
10:00	10:15	15	Break	
10:15	11:15	60	Workshop	Basic Groundwater Modeling – Tut 59
11:15	12:15	60	Workshop	Surface groundwater interaction – Tut 60
12:15	13:30	75	Lunch	
13:30	13:45	15	Lecture	Additional resources – Presentation 23
13:45	14:00	15	Award Certificates	
14:00			End of Course	
14:00	14:15	15	Break	
14:15	16:30	135	Project activities for SI participants.	