Workshop on Watershed Modeling with GSSHA
April 11-13, 2017
Artic Hydrology in GSSHA
April 14, 2017
Hydrologic Engineering Center Davis, California

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*.
- Simulating Artic hydrology with GSSHA in the one day course feature on April 14.

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, and best management practice design and testing of flood mitigation measures. This course will feature new developments in sediment transport and artic hydrology.

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 sediment transport. A one day course on Artic Hydrology will feature snow melt accumulation and melt, simple methods in GSSHA to simulate seasonally frozen soil, and soil water/thermodynamic modeling in GSSHA for seasonally frozen soils as well as permafrost regions.

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) interface software. You will also understand how, when, and why you might be able to apply the tools to specific studies as well as understand the input data requirements. This class provides the user with sufficient background to easily set up a sophisticated hydrological model.

Who Should Attend?
The course is intended for anyone interested in flooding, the effects of landscape changes on hydrology, and/or analyzing best management practices and flood control measures, sediment transport and cold regions hydrology. Experience with hydrologic modeling and numerical methods are a plus but not absolutely 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 and *GSSHA* developer and soil erosion and frozen soil expert Dr. Nawa Raj Pradhan, USACE-ERDC, GSSHA developer and snow hydrology expert Mr. Michael Follum, USACE-ERDC, hydraulics/sediment transport expert and SEDLIB developer Gary Brown, USACE-ERDC, and WMS expert Cody Alberts, Aquaveo LLC.

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: Your own computer with the latest version of the Watershed Modeling System (WMS) software installed. 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. These materials will also be available at the course.

All tutorials except the last day will be doable with the version of GSSHA installed by WMS. The last day will require a special experimental version to do the GSSHA/GIPL simulations. You can download the installation package here: http://www.gsshawiki.com/GSSHA_Download. Scroll down to the bottom of the page and find the **Experimental Versions** section and download the GSSHA70GIPL installation package and install on your computer. The experimental GSSHA/GIPL version will be available at the course as well.

Fees, access, other: The course is offered free of charge by dedicated civil servants, just trying to make it great. The course is taught at the Hydrologic Engineering Center, 609 Second Street, Davis, CA. http://www.hec.usace.army.mil/. PDHs are awarded based on contact hours. There are 30 possible contact hours.

VTC – The course will be broadcast via internet and teleconference. Information is below:

www.webmeeting.att.com
Meeting Number: 8774119748
Code: 1445950

Teleconference
Phone Number: 1-877-411-9748
Access Code: 1445950
Pass Code: 3803

Information: For information about the course contact: Charles W. Downer charles.w.downer@usace.army.mil. For local Davis, CA information contact Dr. Billy E. Johnson billy.e.johnson@usace.army.mil.

Location: The course will be taught in the class room at the Hydrologic Engineering Center at 609 Second St. Davis, California 95616-4687. More information on the location can be found here: http://www.hec.usace.army.mil/visitors/

Schedule: The basic course is three days, followed by a one day artic hydrology section. The afternoon of Day 3 is comprised of extensive training on sediment transport, including new in-stream sediment transport features in GSSHA.

Day 1 – Introduction to GSSHA and Building a Basic GSSHA Model with the Hydrologic Wizard
Day 2 - GSSHA Model Applications
Day 3 - GSSHA Advanced Topics
    Morning – Groundwater
    Afternoon – Sediment transport
Day 4 – Artic Hydrology

A detailed itinerary follows.

DETAILED SCHEDULE

Day 1 Tuesday, April 11. 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, April 12, 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 13, 2017 GSSHA Advanced Topics

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	14:00	30	Lecture	Sediment Transport – Pres 21
14:00	14:15	15	Lecture	Sediment Transport Interface – Pres 21A
14:15	15:00	45	Workshop	Sediment Transport – Tutorial 53
15:15	15:30	15	Break	
15:30	16:00	30	Lecture	In-stream sediment transport
16:00	16:45	45	Workshop	In-stream sediment transport
16:45	17:00	15	Lecture	Additional resources – Presentation 23

Day 4, Friday April 14, 2017 Artic Hydrology

Start	Finish	Duration	Activity	Topic
08:00	08:30	30	Lecture	Artic 1 - Continuous simulations with snow – Pres 19
08:30	09:15	45	Workshop	Artic 1A - Continuous simulations with snow - Tutorial 64
09:15	09:45	30	Lecture	Simple frozen soil options in GSSHA
09:45	10.00	15	Break	
10:00	10:30	30	Workshop	Simple frozen soil options in GSSHA
10:30	10:50	20	Lecture	Soil thermodynamics modeling theory
10:50	11:20	30	Lecture	Modelling effects of frozen soil and hydrological dynamics in permafrost regions
11:20	12:20	60	Workshop	Simulation of frozen soils and hydro -Simulating soil temperature profile. -Active layer hydraulic conductivity. -Watershed discharge.
12:20	13:30	70	Lunch	
13:30	14:00	30	Discussion	Simulation of frozen soils and hydro