Welcome to EF5 Training

University of Oklahoma/HyDROS
Module 1.1
Outline – Day 1

WELCOME

• Goals
• System requirements
• What are EF5 and CREST?
• Contents and organization of training course
• Introduction to OU, HyDROS, and NASA-SERVIR
• Installing QGIS and TauDEM

INTRODUCTION TO HYDROLOGICAL MODELS

EF5 OVERVIEW

DEM DERIVATIVES
Goals of Training Course

Locate and process forcing data
Rainfall, potential evapotranspiration

Locate and process digital elevation models (DEM) and create derivatives
Diagnose problems  Develop workflow

Run EF5 and learn customization options
Batch files, control files

Interpretation and analysis of model results
Flood forecasting  Drought monitoring
Confidence and uncertainty

Improving model results
Manual calibration  Meaning of parameters
Automatic calibration  Evaluation of model skill

Give you the ability to set-up, run, calibrate, and use the model independently!
System Requirements

Personal computer with Windows 7, 8, or 8.1

Administrator privileges for installing software

~4 gigabytes disk space

QGIS requires 1.2 GB
.NET Framework 3.5 SP1 requires 500 MB
The training course file package is around 2GB

Microsoft Excel, Word, and PowerPoint
Both 32-bit and 64-bit versions of EF5 are available

- ef5_32.exe
- ef5_64.exe

32-bit and 64-bit versions of QGIS are also included in the software folder

- Choose your version based on the version of Microsoft Windows on your computer
- QGIS-OSGeo4W-2.6.1-1-Setup-x86_64.exe
- QGIS-OSGeo4W-2.6.1-1-Setup-x86.exe

TauDEM will install and run on either 32- or 64-bit operating systems

Internet access is desirable but is only required when installing TauDEM on a computer not already equipped with .NET Framework 3.5
What are EF5 and CREST?

**EF5 stands for Ensemble Framework for Flash Flood Forecasting**

- It is scalable to different resolutions
- EF5 can forecast the entire continuum of floods

**EF5 is not a single hydrologic model – it is a framework for hydrologic modeling**

- Multiple model cores and physics schemes are possible

**CREST stands for Coupled Routing and Excess Storage**

- CREST is a hydrologic model developed by NASA (National Aeronautics and Space Administration) and OU (the University of Oklahoma)

- CREST-like model physics are part of EF5
What are EF5 and CREST?

Multi-model ensemble
- Expandable with new models and physics
- Multiple solutions → an idea of uncertainty in a forecast

User-friendly

Cross-platform
- Windows, Linux, Mac OS X

Flexible precipitation inputs
- TRMM, MRMS, Stage IV
Contents of Training Course

DOCUMENTS
- Papers about hydrologic modeling
- EF5 user manual
- Checklists and instructions for various course components

EXAMPLES
- 7 pre-packaged EF5 examples

PRESENTATIONS
- 16 training modules

SOFTWARE
- QGIS 2.6.1 for 64-bit Windows
- QGIS 2.6.1 for 32-bit Windows
- TauDEM 5.2
- EF5 for 32-bit Windows
- EF5 for 64-bit Windows

DATA
- Precipitation/PET forcing
- HydroSHEDS DEM
- Papers about hydrologic modeling
- EF5 user manual
- Checklists and instructions for various course components

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- QGIS 2.6.1 for 64-bit Windows
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DATA
- Precipitation/PET forcing
- HydroSHEDS DEM
DATA

- PET – Monthly potential evapotranspiration from FewsNET
- Precipitation – 3-hrly global precipitation estimates from NASA Tropical Rainfall Measurement Mission
- HydroSHEDS – Hydrological data and maps based on shuttle elevation derivatives at multiple scales
- Observations – Observed stream flow for training examples
Contents of Training Course

DOCUMENTS

- Workshop Outline
- EF5 ReadMe
- 6 Quick Guides/Checklists
  - Installing QGIS and TauDEM
  - Hydrological Model Evaluation
  - Processing DEMs and Derivatives
  - EF5 Control File
  - EF5 Parameters
  - Properties of Example Basins
- 6 Scientific Papers
  - CREST physics, DREAM calibration, TRMM precipitation, and examples of CREST in use
Contents of Training Course

EXAMPLES

Connecticut
Cobb Creek
Bogota
Nzoia
Indus
Wang Chu
Okavango
PRESENTATIONS

• Day 1
  – Welcome
  – Introduction to Hydrological Models
  – EF5 Overview
  – DEM Derivatives

• Day 2
  – Rainfall and PET
  – Manual Calibration
  – Automatic Calibration
  – Interpreting and Using Model Output

• Day 3
  – DEM Practice
  – Calibration Practice
  – Drought
  – Cobb Creek Example

• Day 4
  – Connecticut River Example
  – Bogota River Example
  – Create Your Own Example (or Indus River Example)
  – Conclusions and Wrap-Up
SOFTWARE

- Quantum GIS (QGIS)
  - Standalone installer of version 2.6.1 for 64-bit Windows
  - Version 2.6.1 32-bit installer also included

- TauDEM
  - Version 5.1.2 self-extracting zip file install package

- EF5
  - Version 0.2 Windows-compiled executable file for 32-bit systems
  - Version 0.2 Windows-compiled executable file for 64-bit systems
Introduction to OU

Norman, Oklahoma

Nearly 30,000 students

Home to the National Weather Center (600 meteorologists and hydrologists):

- National Severe Storms Laboratory
- School of Meteorology
- Advanced Radar Research Center
- Hydrometeorology and Remote Sensing Laboratory (HyDROS)
HyDROS Laboratory

QPE – QUANTITATIVE PRECIPITATION ESTIMATES
- Merging satellite, rain gauges, and weather radars
- Expertise with PERSIANN, CMORPH, TRMM, MRMS
- Improvements to ground radar and satellite estimates

HYDROLOGIC MODELING
- EF5
- CREST
- HyPRO
- Data assimilation
- Coupling with snow models and landslide models
- Global, regional, and local modeling

FLASH (FLOODED LOCATIONS AND SIMULATED HYDROGRAPHS) PROJECT
- Suite of flash flood forecasting tools in United States
- Includes hydrologic models and other rainfall-driven tools
SERVIR is a joint venture between NASA and USAID (United States Agency for International Development)

- Satellite-based observation data
- Science applications
- Improve environmental decision making in developing nations

Centers throughout the world

- Marshall Space Flight Center in Huntsville, Alabama
- CATHALAC in Panama
- RCMRD in Kenya
- ICIMOD in Nepal

Floods, fires, droughts, frost
QGIS Installation

Start by moving your EF5_training folder to your Desktop

Navigate to the EF5_training\software folder

Select QGIS-OSGeo4W-2.6.1-1-Setup-x86_64.exe (for computers with 64-bit Windows)

Select QGIS-OSGeo4W-2.6.1-1-Setup-x86.exe (for computers with 32-bit Windows)

Answer “Yes” at the prompt →
“Welcome to the QGIS Brighton (2.6.1) Setup Wizard”

Click “Next”

Agree to the license terms – “I Agree”

“Choose Install Location” – C: \Program Files\QGIS Brighton is fine – click “Next”

“Choose Components” – only install “QGIS” – click “Install”
QGIS Installation

This process should take 2-3 minutes – click “Finish”

You’ll now see six icons on your Desktop

We’ll be using **QGIS Desktop 2.6.1**

Go ahead and open it – exit the tip window when it appears
In the “Processing” menu, select “Toolbox” and a new window pane will appear in the right side of QGIS.

At the bottom of the “Processing Toolbox” select “Advanced interface.”

In the “Processing” menu select “Options…”

Navigate to Providers -> TauDEM (hydrologic analysis) and check “Activate.”
Now it’s time to install TauDEM

Navigate to \EF5_Training\software and open TauDEM512.exe

Answer “Yes” to the UAC prompt

Select “OK” at TauDEM Install

Select “Setup” and then TauDEM will begin either the Microsoft Visual C++ 2010 x86 installation or the Microsoft HPC Pack 2012 MS-MPI installation
If Microsoft Visual Studio has to be installed (if not, skip below to the HPC Pack 2012 installation):

Click “Setup” and then accept the license terms
Click “Install” and then “Finish”

The Microsoft HPC Pack 2012 installer will automatically pop up:

Click “Next” and the accept the license terms
The default location is fine
Click “Install”
Now you may need to install the .NET Framework version 3.5

If you get this dialog box, click “Yes”
Otherwise, skip ahead to Slide 28
Select .NET Framework 3.5 SP1 on the website that pops up

.NET Framework and .NET SDKs

The .NET Framework is the easiest way to build apps on the Microsoft platform. You can download Visual Studio Express for free, and be coding in just a few minutes. You can also use the .NET SDKs and targeting packs to build apps for a given Microsoft platform, such as Microsoft Azure.

.NET Framework Downloads
- .NET Framework 4.6 Preview
- .NET Framework 4.5.1
- .NET Framework 4.0
- .NET Framework 3.5 SP1

Visual Studio Express (free)
- Windows 8
- Windows Desktop
- Windows Phone
- Web and Azure

.NET SDK Downloads
- Visual Studio 2013
- Visual Studio 2012
- Visual Studio 2010

Team blogs and social
- .NET | @dotnet | Facebook
- ASP.NET | @aspnet | Facebook
- EF | @ef | Facebook

Get Help
Click the red “Download” button

Microsoft .NET Framework 3.5 Service Pack 1

Then click “No thanks and continue”
Click the boxed link (at right) →

Then click “Run” at the bottom of the browser window
At the “Windows Features” pop-up, click “Download and install this feature”
Windows will download the required files (this process may take a significant amount of time, depending on your internet connection).

Then click “Close” →

Reopen TauDEM512.exe
Click “Next”

The default location is fine

At “Confirm Installation”, click “Next”

Congratulations – TauDEM has been successfully installed!

Click “Close” to exit
Now return to QGIS and select “Options…” from the “Processing” menu

Navigate to “Providers” and “TauDEM (hydrologic analysis)”

Type `C:\Program Files\Microsoft HPC Pack 2012\Bin` next to “MPICH2/OpenMPI bin directory”

Type `C:\Program Files\TauDEM\TauDEM5Exe` next to “TauDEM command line tools folder”

Make sure QGIS saves this setting by clicking somewhere else inside the “Processing options” dialog

Click “OK”
Navigate to QGIS’s “Layer” menu, “Add Layer” and “Add Raster Layer…”

In the dialog box, go to \EF5_training\data\HydroSHEDS and open “test_dem.tif”

In the “Processing Toolbox”, search for “Pit Remove” and double-click
In the “Pit Remove” dialog box, select “test_dem” as your “Elevation Grid” and for “Pit Removed Elevation Grid” click “Save to file…”

Save the grid to \\EF5\training\examples\colombia\basic\dem.tif

Now click “Run”
QGIS should now have two maps in the central window: “test_dem” and “Pit Removed Elevation Grid”.

If you received an error when running Pit Remove, something went wrong in the installation process.

Check the file paths in the “Processing” menu “Options…” dialog.

You can also try rerunning the TauDEM installer to see if something went wrong the first time.
Why QGIS and TauDEM?

**QGIS is flexible**
- Literally thousands of available plug-ins exist
- QGIS runs on Windows, Mac, Linux, and other systems
- ArcGIS runs only on Windows

**QGIS is free and open-source**
- It costs you nothing and has a community of thousands of users and supporters
- Commercial solutions like Esri’s ArcGIS cost thousands of dollars per workstation
- Commercial support for QGIS is available from third parties

QGIS is licensed under the Creative Commons Attribution-ShareAlike 3.0 license.
[www.qgis.org](http://www.qgis.org)

TauDEM was developed by David Tarboton of Utah State University with support from the US Army Corps of Engineers System Wide Water Resources Program. TauDEM is available under the terms of GNU General Public License v2.
[hydrology.usu.edu/taudem/taudem5/index.html](http://hydrology.usu.edu/taudem/taudem5/index.html)
The next module is

INTRODUCTION TO HYDROLOGICAL MODELS

You can find it in your \EF5_training\presentations directory

Module 1.1 References
EF5 Training Doc 1 – Installation of QGIS and TauDEM, (March 2015).