Coupled Groundwater/Surface-Water
Modeling using GSFLOW
ID2447
October 7-11, 2019
BLM-CA Multi-Use Conference Room, 2800 Cottage Way, Sacramento, CA

Instructors:

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Monday

INTRODUCTION

8:30 am– 8:45 am Welcome—Describe Course Objectives (Niswonger)
Introduce Instructors, short overview of GSFLOW

8:45 am– 9:45 am Introduction to PRMS (Regan)

1. Overview: What is a watershed model?
    a. Processes
    b. PRMS view of the hydrologic cycle
    c. PRMS simulation capabilities (contrasted with full GSFLOW)
2. Physical processes modules
    a. Description of modules
    b. Module parameterization
    c. Data and control files

9:45 am–10:00 am **BREAK**

3. Discretization of Time and Space (Regan)
    a. HRUs, GWRs, Lakes, stream segments-Streams and lakes represented in PRMS-only simulations
    b. Scale and resolution
    c. Model units (temp_units, precip_units, elev_units)
    d. Conversion of units between PRMS and MODFLOW
    e. Polygon and grid HRU delineation
    f. Cascades
4. Advanced PRMS capabilities (surface depressions, restart)

10:45 am– 11:30 am PRMS and the NHM (Regan)

1. Application of PRMS for NHM
    a. Purpose of NHM

b. Discretization and parameterization
c. New capabilities (dynamic parameters, water use, MODSIM, stream temperatures, aq)

11:30 am–12:00 pm Introduction to MODFLOW (Niswonger)

12:00 pm–1:15 pm **LUNCH**

1:15 pm–2:45 pm Introduction to MODFLOW (Niswonger)

Simulation of groundwater flow

1. Conceptualization
2. Groundwater flow equation
3. Discretization of time and space
4. Processes and packages

MODFLOW processes and packages

1. Groundwater flow process
    a. Flow package (UPW)
2. Standard MODFLOW stress packages
    a. GHB, WEL, and CHD
3. Advanced stress packages
    a. SFR, UZF, LAK, MNW
4. Steady state and transient MODFLOW models

2:45 pm–3:30 pm Integration of PRMS and MODFLOW (Regan/Niswonger)

1. Purpose for integrating PRMS and MODFLOW (Regan)
2. Design
    a. Coupled regions
    b. PRMS integrated components (soilzone iterations, GVRs, UZF,SFR,LAK)
    c. Operational sequence

3:30 pm– 3:45 pm **BREAK**

3:45 pm– 5:00 pm PRMS Model construction

1. PRMS GUI (Regan, 30 minutes)
    a. Downsizer, Blodget tool, GDP, PRMS GUI
    b. HRU-style PRMS models and data and control files
    c. Climate distribution
    d. Control and data files (construction and options)
    e. Parameter adjustment using PRMS GUI

2. GSFLOW-Arcpy (Niswonger)
    a. Intro and data needs (overview)
    b. Pre-processing
    i. Create model boundary (Jupyter notebook)
    ii. Use soil data viewer to ready soil rasters for scripts
    c. Gsflow-Arcpy components overview
        1. Configuration and remap files
        2. Scripts and execution order
        3. HRU_params data base
        4. CRT filling and stream network
        5. Veg and soils
        6. Climate distribution
    d. Creation of PRMS parameter files using Jupyter Notebook
        1. Adding subbasins to model points
        2. Stream thresholds
        3. Climate zones

Tuesday

8:30 am– 10:30 am PRMS Model construction continued (Niswonger)

10:30 am–10:45 am **BREAK**

10:45 am– 12:00 pm MODFLOW Model construction (Alzraiee)

3. Creating MODFLOW files with flopy
4. Model top (HRU_params)
    a. SFR input file (HRU_params, python script, RR demo)
    b. Hydrogeology/model layers (hydrogeo concept to layers/numerical issues
    c. UZF, LAK input files

12:00 pm–1:15 pm **LUNCH**

1:15 pm– 3:00 pm MODFLOW Model construction continued (Alzraiee)

3:00 pm–3:15 pm **BREAK**

3:15 pm– 4:15 pm Overview GSFLOW output/post processing (Alzraiee/Niswonger/Regan)

1. Intro to water budget utility, mapped output for PRMS, subbasin output to statvar, PRMS and GSFLOW water budget output (Regan)
2. Intro to pyGSFLOW, VTK files, and ParaView for post processing with demo, cell by cell output (Alzraiee)

4:15 pm– 5:00 pm Calibration of PRMS models (Regan)

1. Introduce concept of decoupled calibration of PRMS and MODFLOW models
2. Describe standard methods (stepwise, LUCA etc.)

Wednesday

8:30 am– 10:00 am Calibration of PRMS models (Regan) (Continued)

1. PRMS Sensitivity Analysis
2. Sensitive PRMS parameters
3. PRMS Sensitivity to model structure

10:00 am– 10:15 am **BREAK**

10:15 am– 12:00 pm PRMS Calibration exercise (Sagehen, Jupyter Notebook)

1. Manual calibration to solar radiation and PET
2. Adjustment of soilzone and GWR parameters to match streamflow (manual calibration with Ayman's prmspy (Notebook exercise)
    a. Approaches for regular HRUs (subbasin regionalization)

12:00 pm–1:15 pm **LUNCH**

1:15 pm– 2:45 pm Calibration of MODFLOW models (Alzraiee, Morway)

1. Introduction to theory and application of calibration with Kalman Filter
2. Example demonstration
3. Introduction to theory and application of calibration with Pest
4. Example application

2:45 pm– 3:00 pm **BREAK**

3:00 pm– 4:00 pm Calibration of GSFLOW models (Alzraiee, Morway)

1. Concept of leveraging calibrated PRMS and MODFLOW models
2. Overview of parameters adjusted for GSFLOW calibration
3. Present basin procedure used for Russian River calibration (Alzraiee)

Thursday

8:30 am– 1:45 pm Objectives/setup (intro by Niswonger, everyone)

1. Break class into groups (Sagehen, other application, gsflow-arpy scripts or irregular HRUs?)
2. Setup paths, notebooks for sagehen, config file, remap files

1:45 pm– 3:15 pm MODSIM-GSFLOW (Morway)

1. Introduction
2. Purpose and scope
3. Examples

3:15 pm– 4:00 pm Work in groups on GSFLOW models

4. Each person describes project, status, challenges
5. Determine goals for class, first steps, data needs
6. Begin developing model input files

Friday

8:30 am– 10:00 am Continued group work on individual applications (everyone)

10:00 am–10:15 am **BREAK**

10:15 am– 12:00 pm Continued group work on individual applications

12:00 pm–1:15 pm **LUNCH**

1:15 pm– 3:00 pm Continued group work on individual applications

3:00 pm– 3:15 pm Final remarks, rap up

3:15 am **END OF CLASS**