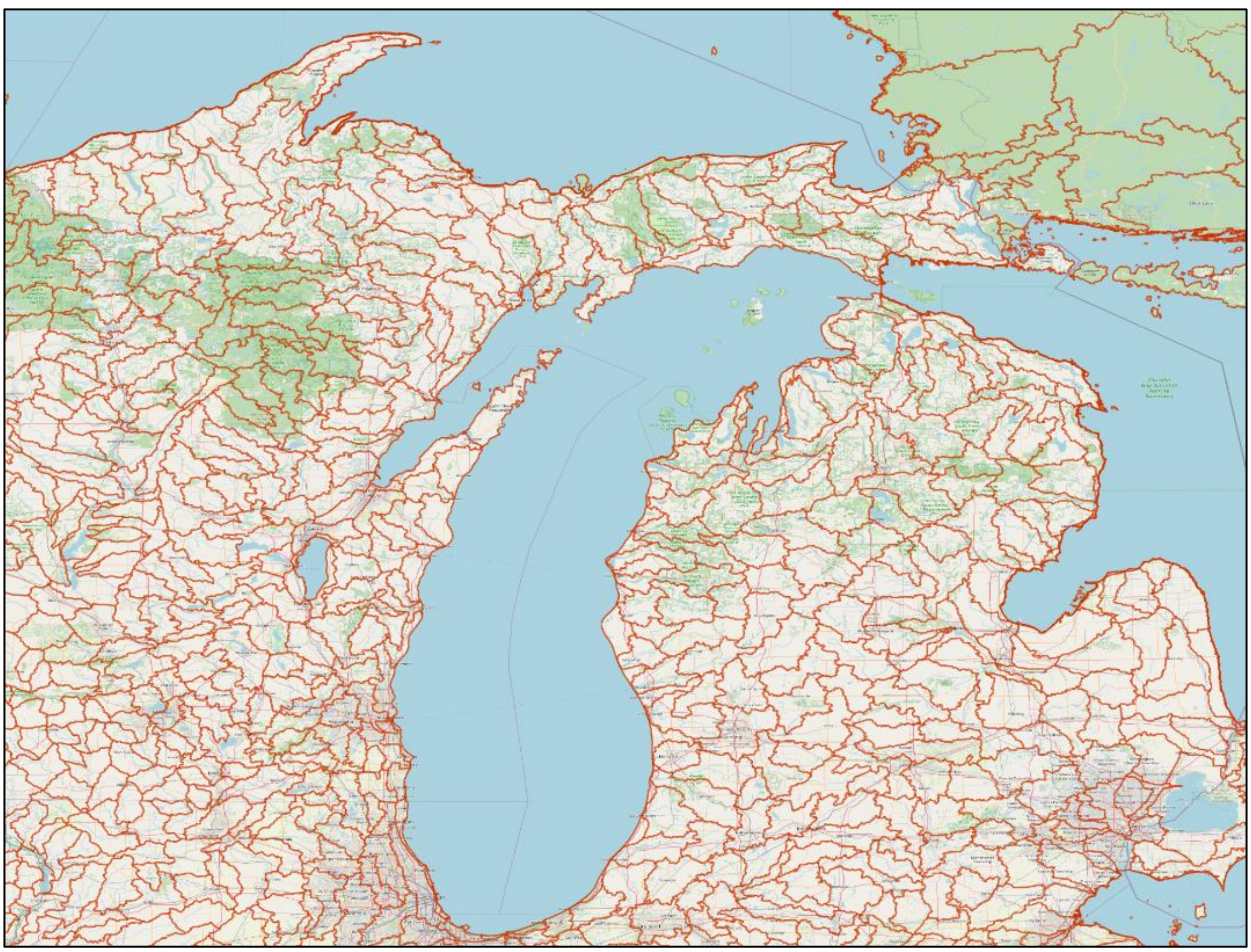
MAGNET4WATER SwaNET SAMPLE PROJECT

Large-Scale Coupled Surface Water and Groundwater Modeling

Using MAGNET4WATER (M4W) SwaNET and IGW-NET

Project Summary

In this project, students will select a large watershed from anywhere in Michigan for coupled surface water (watershed) modeling and groundwater modeling. The models are coupled in the sense that the simulated recharge (output) from the watershed model will be used as recharge input to the groundwater model. Students will utilize the watershed models to examine the impact of land use change and climate change on the water balance, peak runoff, and other aspects of the watershed system. The developed groundwater model will be used for source water delineation in a subregion of interest.



Modeling Objectives

The watershed modeling component of the project consists of:

- Developing a "baseline" surface water model of any selected watershed, using the following from the M4W Data Server:
  - Digital Elevation Model (including stream network topography)
  - 30m land use and land cover
  - 30m Soil type and soil properties
  - Historical climate data (precipitation, temperature, etc.)
- Assessing impact of land use change or crop management by comparing results of a modified model to results of the baseline model
- Assessing impact of climate change by comparing results of a model informed with future climate projection data to the results of the baseline model
- Computing the long-term steady (average) recharge from the transient simulated recharge, to be used as input to the groundwater model (baseline case only)

Groundwater modeling involves:

- Developing a steady-state groundwater model of the surficial aquifer (unconsolidated sediments) within the selected watershed, using the long-term average recharge output from the watershed model (baseline case only) and the following from the M4W Data Server:
  - Digital Elevation Model
  - Depth-to-bedrock (surficial aquifer thickness)
  - Vertically-averaged hydraulic conductivity of the unconsolidated sediments
  - Streams and rivers as internal boundary conditions
  - Lakes as internal boundary conditions
- Comparing the simulated heads to observed Static Water Levels and commenting on the performance of the model (and possible ways to improve the model)
- Creating a submodel in an area of interest, and using the submodel to delineate the source water area of a feature of interest (e.g., lake or wetland, a reach of a stream or river, or a part of a population center)

Deliverable

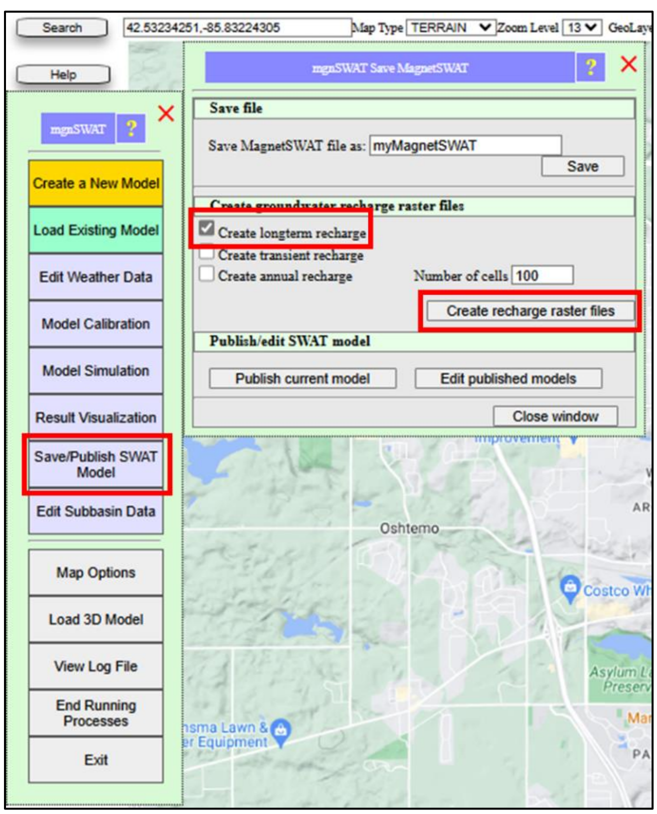
Please assemble a professional-level technical report that is complete, but concise. Make sure to document your entire procedure. Your discussion of impacts of land use change and/or climate change should be supported with data/quantitative analysis. You should include any detailed model results / graphics in support of your conclusions, when appropriate.

Make sure your report is professional and well written. It must be typed using a word processor. All illustrations, graphs, and figures must be computer generated. Grammar, spelling, sentence structure, and completeness will all factor into your grade in addition to your ability to complete the exercises.

ADDITIONAL INSTRUCTIONS/HINTS:

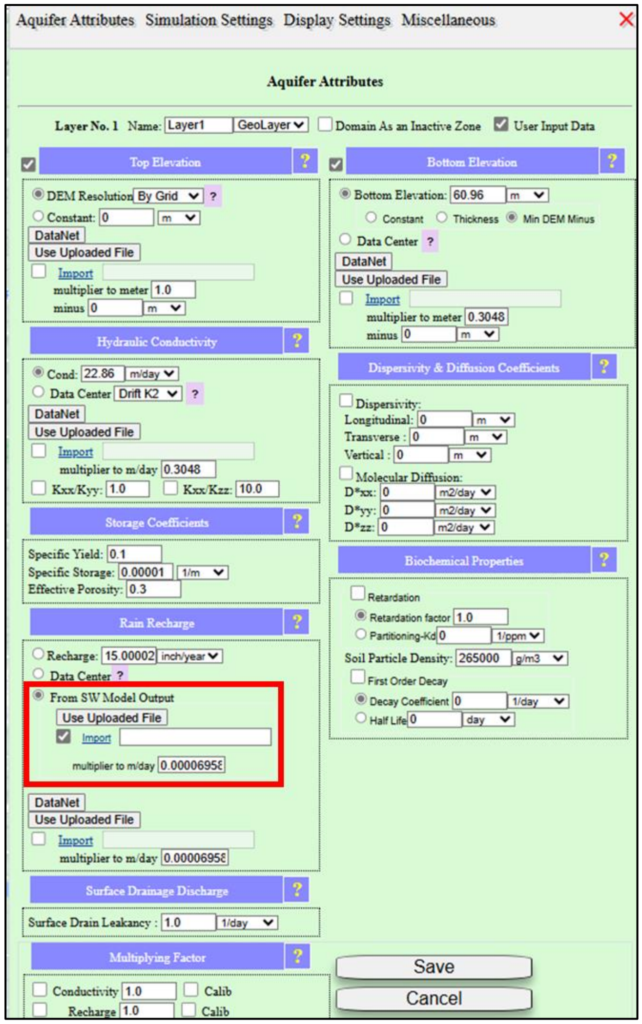
Surface Water Modeling:

- See the SwaNET tutorials and SwaNET AI Assistant for detailed instructions relating to the various aspects of building, running, and visualizing/analyzing model results
- Use a Level 4 Watershed (DataCenter 1 – US Only) as the watershed size during extraction. Use 90m DEM (using 30m will take much longer to prepare your model).
- Use the DataCenter option to extract watershed boundary, DEM, land use, and soil directly from the MAGNET4Water Data Server
- Use a historical time period (e.g., 2005-2015, or 2010-2022) to run your baseline model. Consider using the CCESS-CM2 historical datasets as input to your baseline model.
- To evaluate impacts of climate change, use the mgnSWAT CMIP Weather download tool to utilize the future climate data in your updated SWAT model.
- See the 'Update Landuse' tutorial or the 'Crop Management' tutorial for how to make these changes in your SwaNET model. Consider changing a significant number of subbasins within your watershed (e.g., convert forests in half of the subbasins to agricultural land).
- Use 3D visualization, water balance diagrams, time-series, and other visual analytics offered in SwaNET to document the baseline model, and to quantify/present the changes due to land use change / crop management / climate change.
- Use the tools in the 'Save/Publish SWAT Model' menu to create a long-term recharge raster file to be used in the groundwater model (see graphic below). The file, once generated, will be stored in your user folder on the MAGNET server for use later during groundwater modeling.



Groundwater Modeling:

- See the IGW-NET tutorials and IGW-NET AI Assistant for detailed instructions relating to the various aspects of building, running, and visualizing/analyzing model results
- Use the same watershed boundary from watershed modeling for your groundwater modeling (Conceptual Model Tools > DrawDomain > DM from Delineated Watershed)
- Use the DriftK2 option from the M4W Data Center to assign the hydraulic conductivity (spatially-variable, vertically-average) to your groundwater model
- Use the 'Streams and Lakes from Data Center' options under Simulation Settings (Domain Attributes menu) to automatically import these features as internal boundary conditions.
- Use the 'From SW Model Output' option in 'Rain Recharge' section of the Domain Attributes menu to select the simulated recharge from the watershed model as input to the groundwater model (see graphic below). Click 'Use Uploaded File' and select 'SWATMeanRech.T' for steady state (average) recharge.
    - To use recharge from SwaNET, you *must* use UTM PRJ system in your groundwater model; go to: DomainAttr > Miscellaneous > check box next to 'UTM Only' and click 'Save'
- Use the Calibration tool to import SWL data from the M4W Data Server and compare them to simulated heads. See the 'Model Calibration' tutorial for detailed instructions.
- Use nested submodels to simulate more details in an area of interest. See 'Model Hierarchy' tutorial for detailed instructions.
- Use reverse particle tracking to delineate the source water area (consider tracing back at least 10 years, if not more). See the 'Particle Tracking' tutorial for detailed instructions.


Aquifer Attributes Simulation Settings Display Settings Miscellaneous
Aquifer Attributes
Layer No. 1 Name: Layer1 GeoLayer Domain As an Inactive Zone User Input Data
Top Elevation
DEM Resolution By Grid
Constant: 0 m
DataNet
Use Uploaded File
Import
multiplier to meter 1.0
minus 0 m
Bottom Elevation
Bottom Elevation: 60.96 m
Constant Thickness Min DEM Minus
Data Center
DataNet
Use Uploaded File
Import
multiplier to meter 0.3048
minus 0 m
Hydraulic Conductivity
Cond: 22.86 m/day
Data Center Drift K2
DataNet
Use Uploaded File
Import
multiplier to m/day 0.3048
Kxx/Kyy: 1.0 Kxx/Kzz: 10.0
Dispersivity & Diffusion Coefficients
Dispersivity:
Longitudinal: 0 m
Transverse : 0 m
Vertical : 0 m
Molecular Diffusion:
D*xx: 0 m2/day
D*yy: 0 m2/day
D*zz: 0 m2/day
Storage Coefficients
Specific Yield: 0.1
Specific Storage: 0.00001 1/m
Effective Porosity: 0.3
Biochemical Properties
Retardation
Retardation factor 1.0
Partitioning-Kd 0 1/ppm
Soil Particle Density: 265000 g/m3
First Order Decay
Decay Coefficient 0 1/day
Half Life 0 day
Rain Recharge
Recharge: 15.00002 inch/year
Data Center
From SW Model Output
Use Uploaded File
Import
multiplier to m/day 0.0000695
DataNet
Use Uploaded File
Import
multiplier to m/day 0.0000695
Surface Drainage Discharge
Surface Drain Leakancy : 1.0 1/day
Multiplying Factor
Conductivity 1.0 Calib
Recharge 1.0 Calib
Save
Cancel