

FIU

Applied Research
Center



DOE-FIU Cooperative Agreement Annual Research Review – FIU Year 2

Project 2 – Task 6 Highlights From Year 2

Aubrey Litzinger (DOE Fellow)

Worlds
Ahead

Advancing the research and academic mission of Florida International University

Subtask 6.2: Model Development

Overall Needs:

- Evaluate the long-term integrity and performance of the Waste Isolation Pilot Plant (WIPP) repository by:
 - Improving the understanding of the regional and local groundwater flow surrounding the Waste Isolation Pilot Plant (WIPP),
 - Determining the impact of land-use changes on water levels and water chemistry in the surrounding area.

Objectives:

- Develop a groundwater-basin model using ASCEM toolsets to determine the spatial distribution of recharge and groundwater flow rates which will be used to estimate the rate of halite dissolution and rate of propagation of the shallow dissolution front.
- The proposed work will therefore include the utilization of Advanced Terrestrial Simulator (ATS), an open-sourced, ecosystem-based, integrated, distributed hydrology simulator developed by ASCEM.

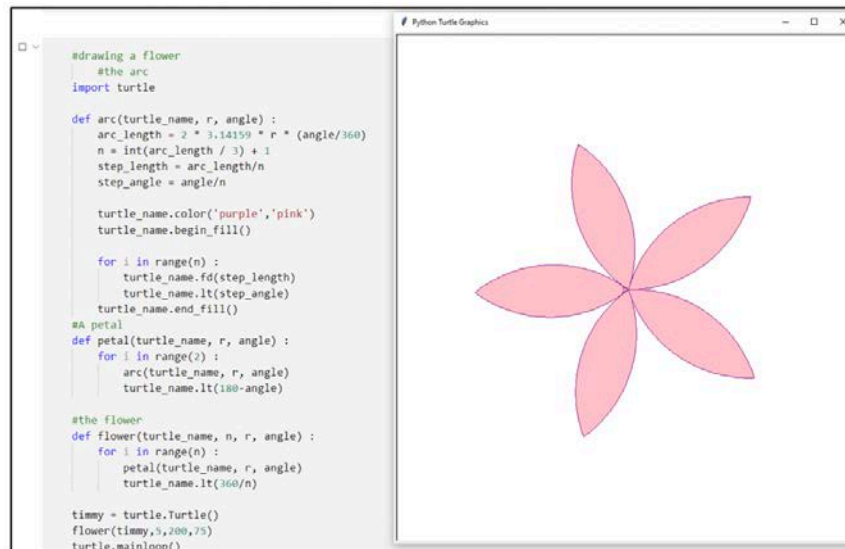


Subtask 6.2: Model Development

FIU Year 2 Highlights:

ARC Research

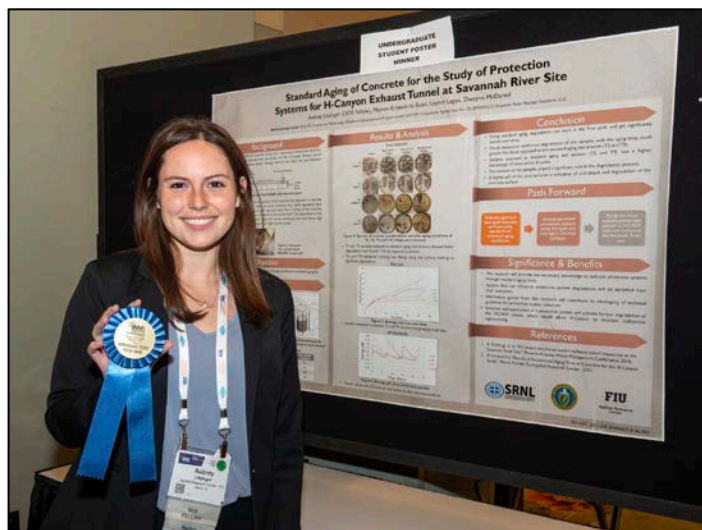
- Joined Task 6 in Jan. 2022.
- Practiced new tools that would assist the project.
 - ArcGIS & QGIS
 - Python
 - Jupyter Lab
- Participated in Waste Management Symposium 2022.
- Graduated with B.S. in Env. Engineering in Spring 2022.
- Will begin M.S. program in Fall 2022 and remain with the DOE Fellows Program.



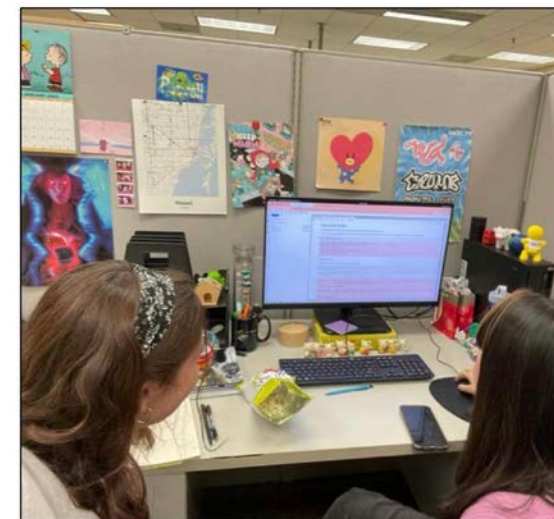
Learned python coding language to assist in building meshes.



Learned GIS to assist DEM Development.



Student poster competition at WM Symposium 2022.



Learning about the project from DOE Fellow, Gisselle Gutierrez.

Subtask 6.2: Model Development

FIU Year 2 Highlights:

ARC Research

- Used Docker Image created by DOE Fellow, Gisselle Gutierrez, to learn the workflow for creating a mesh.
- Meshes were generated using TINerator, a python module used to form unstructured triangulated meshes.
- Created meshes of Basin 6 and sub-basins of Basin 6 using DEMs of varying resolutions.
- Created a mesh of the Borden watershed, a small Canadian watershed used as a case study.

Loading TINerator
and adding the
DEM to the script.

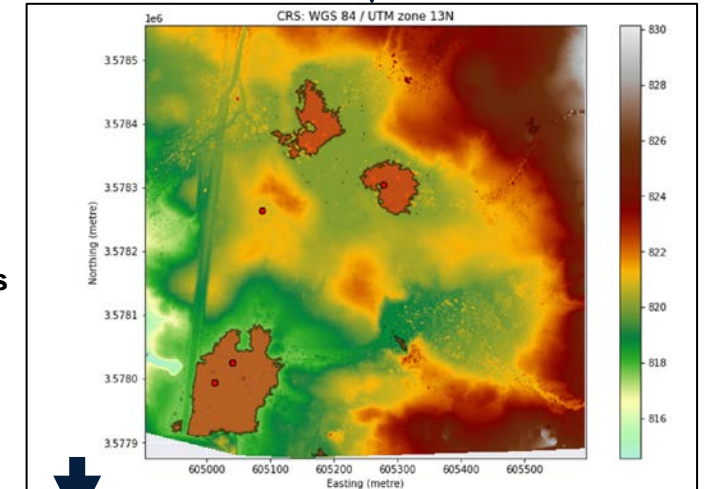
```
First, load the DEM from disk:

[10]: dem = tin.gis.load_raster("DEM/basin6_10m.tif", no_data=-9999.0)
dem.data[dem.data<=-9999.0] = -9999.0
dem.data[dem.data>1e5] = -9999.0
dem = tin.gis.reproject_raster(dem, "EPSG:26913")
#dem.no_data_value = dem.data[0][0]
dem.fill_depressions()
# +units=m +no_defs
print (dem.data[0,0])

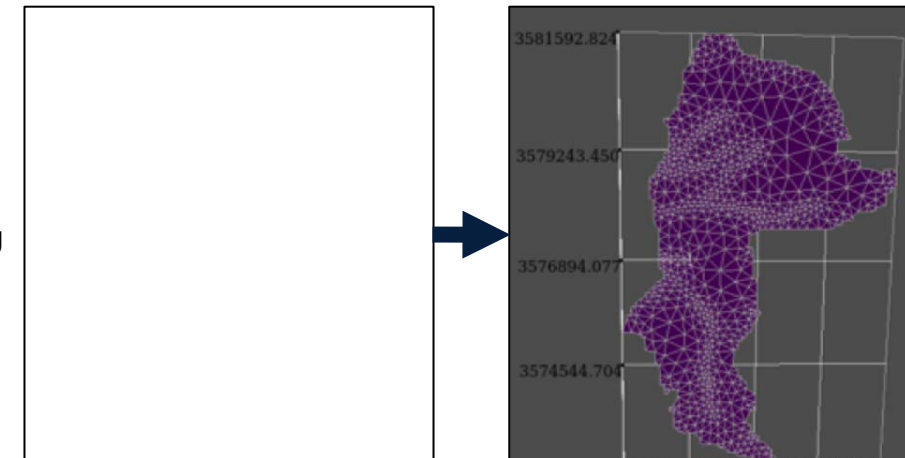
-9999.0

[14]: dem.plot( port = 8852)
```

Overlaying sinkholes
into script.



Performing a watershed
delineation and creating
the mesh.

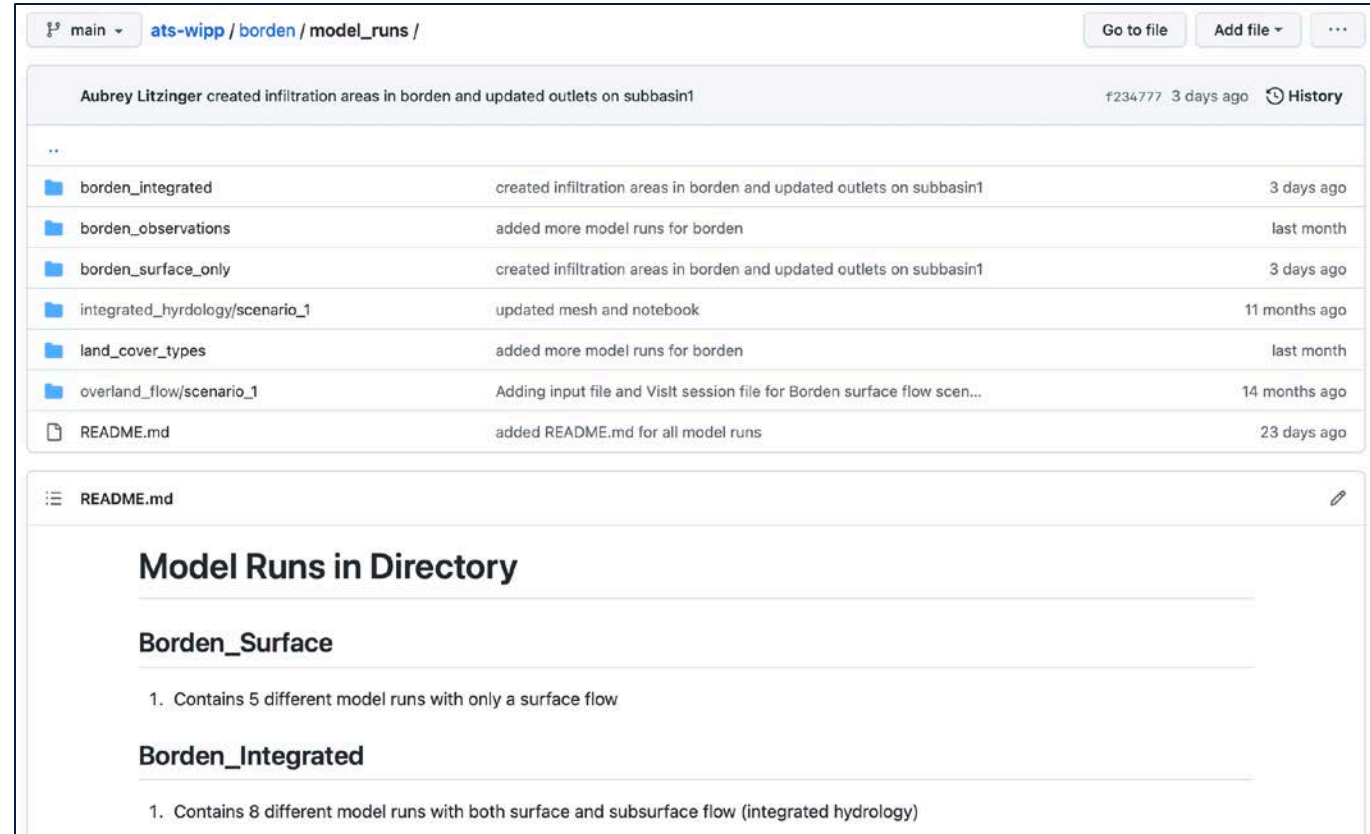


Subtask 6.2: Model Development

FIU Year 2 Highlights:

Summer Internship

- Attended a 10-week Internship at Los Alamos National Lab.
- The goal of the internship was to explore toolsets that could develop an integrated hydrology model for Basin 6.
- TINerator, Advanced Terrestrial Simulator (ATS), UNIX Systems, and GitHub were explored.

main ▾ ats-wipp / borden / model_runs /

Aubrey Litzinger created infiltration areas in borden and updated outlets on subbasin1 f234777 3 days ago History

File	Description	Time
..		
borden_integrated	created infiltration areas in borden and updated outlets on subbasin1	3 days ago
borden_observations	added more model runs for borden	last month
borden_surface_only	created infiltration areas in borden and updated outlets on subbasin1	3 days ago
integrated_hydrology/scenario_1	updated mesh and notebook	11 months ago
land_cover_types	added more model runs for borden	last month
overland_flow/scenario_1	Adding input file and VisIt session file for Borden surface flow scen...	14 months ago
README.md	added README.md for all model runs	23 days ago

README.md

Model Runs in Directory

Borden_Surface

1. Contains 5 different model runs with only a surface flow

Borden_Integrated

1. Contains 8 different model runs with both surface and subsurface flow (integrated hydrology)

All progress was tracked within a GitHub repository.



Subtask 6.2: Model Development

FIU Year 2 Highlights:

Summer Internship

- The Borden watershed was used to practice the workflow from developing the mesh to visualizing a simulation.
- Multiple types of ATS output features were practiced.
 - Runoff from outlets.
 - Infiltration into soil.
 - Water table and subsurface soil saturation.
 - Ponded water on the surface.
 - Adjusting simulation time and water sources.
 - Addition of specific regions.

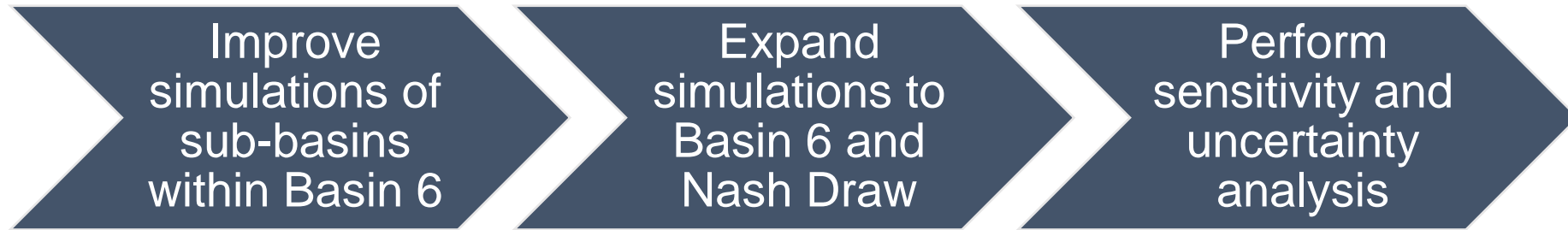


A 12-hour simulation with 6 hours of rain on the Borden watershed and the corresponding Runoff plot.



Subtask 6.2: Model Development

Future work



- Use DEM data collected.
- Set up meteorological forcing data into ATS input files.
- Incorporate soil physical properties into ATS model for validation, such as soil particle size distribution, bulk density, porosity, organic content, etc.
- Identify more surface features, for example, sinkholes and groundwater-surface sweeps.
- Continue collaboration with LANL to improve simulations.

Acknowledgments

- Dr. Leonel Lagos, *FIU*
 - Dr. Ravi Gudavalli, *FIU*
 - Dr. Pieter Hazenberg, *FIU*
 - Ms. Angelique Lawrence, *FIU*
 - Ms. Gisselle Gutierrez-Zuniga, *FIU*
 - Dr. David Moulton, *LANL*
 - Dr. Yu Zhang, *LANL*
 - Dr. Anderson Ward, *CBFO*
-
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Thank You. Questions?