Project 2 (Subtask 6.2 & 6.3)

HYDROLOGY MODELING OF BASIN 6 OF THE NASH DRAW NEAR THE WIPP

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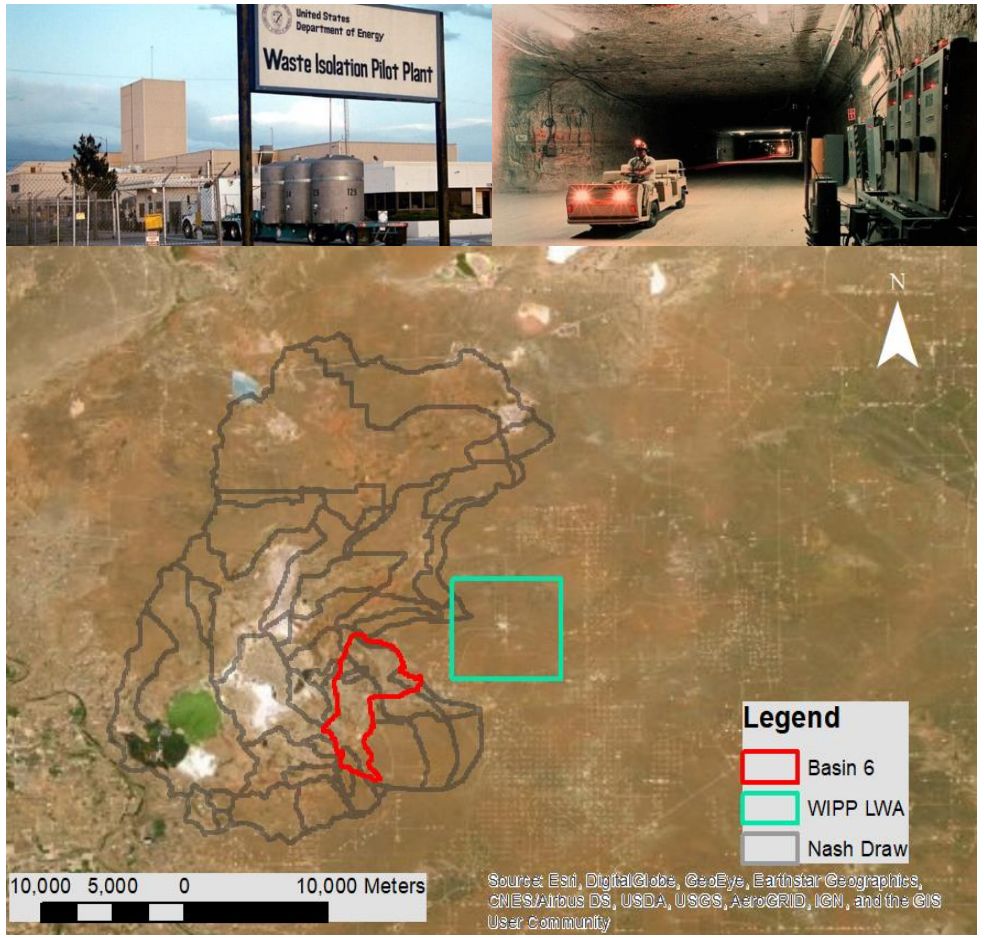
Hydrology Modeling for Basin 6 of the Nash Draw Near the WIPP

Overall Needs:

- DOE-EM scientists are concerned about the vulnerability of karst topography and subsurface geology to climate extremes in the region surrounding WIPP and the potential impact on the long-term performance of the repository.
  - How vulnerable is regional hydrology to land-use changes and climate extremes?
  - How do karst features, such as sinkholes, influence groundwater recharge?
  - How will groundwater changes due to climate extremes affect the dissolution rates of subsurface geologic layers?

Objectives:

- Perform a hydrogeological study of a small basin in the Nash Draw region, west of WIPP, by developing an integrated hydrological model using the **Advanced Terrestrial Simulator (ATS)** to assess surface and subsurface characteristics and regional groundwater recharge.
- Evaluate the potential effects of climate extremes and topographical depressions, such as sinkholes, on groundwater recharge in the region.
- Assess how extreme changes in groundwater recharge, modeled using ATS, could influence halite dissolution rates and impact the long-term performance of the WIPP.



Basin 6 and the Nash Draw in reference to the WIPP.

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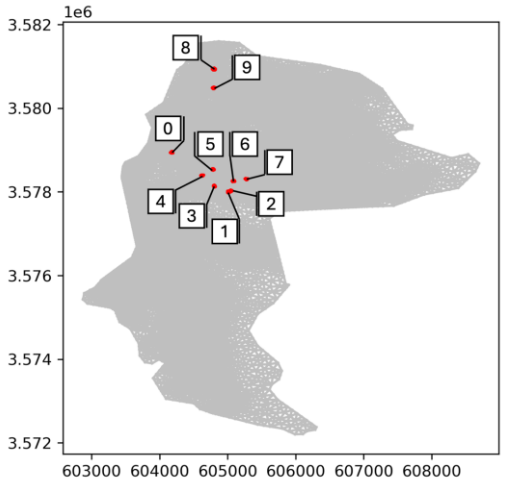
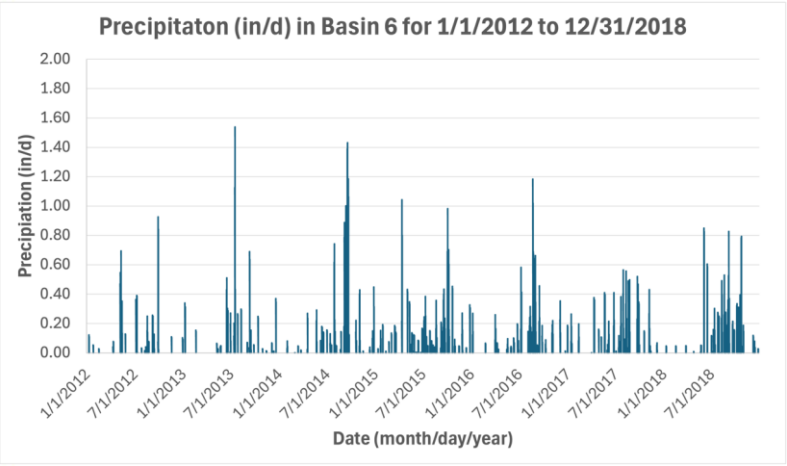
ATS Model Development for Basin 6

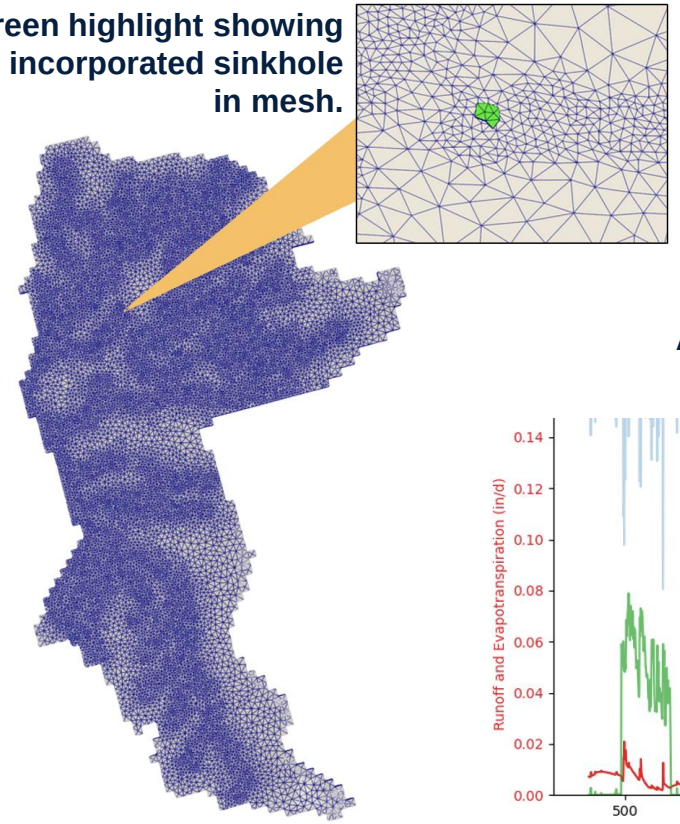
Data Collection → Mesh Generation → ATS Model Development



10 sinkholes added to Basin 6 model (left) and meteorologic data from 2012 to 2018 was used as input (bottom).



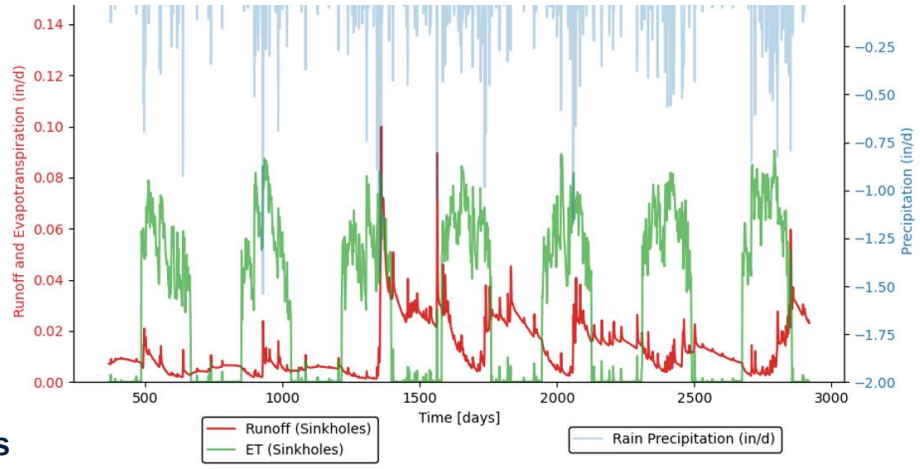
Green highlight showing an incorporated sinkhole in mesh.



High-resolution mesh was generated in Python module, Watershed Workflow.

- Two ATS models developed:
  - **With** sinkholes
  - **Without** sinkholes

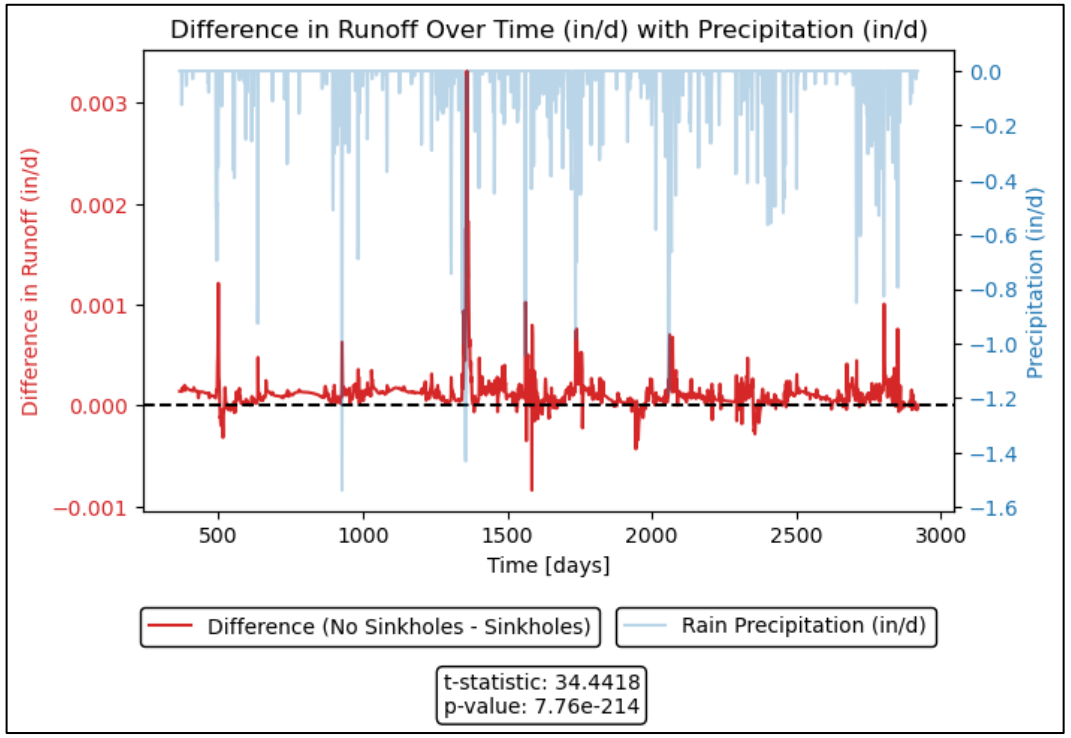
ATS model output of runoff and ET from simulation with sinkholes.

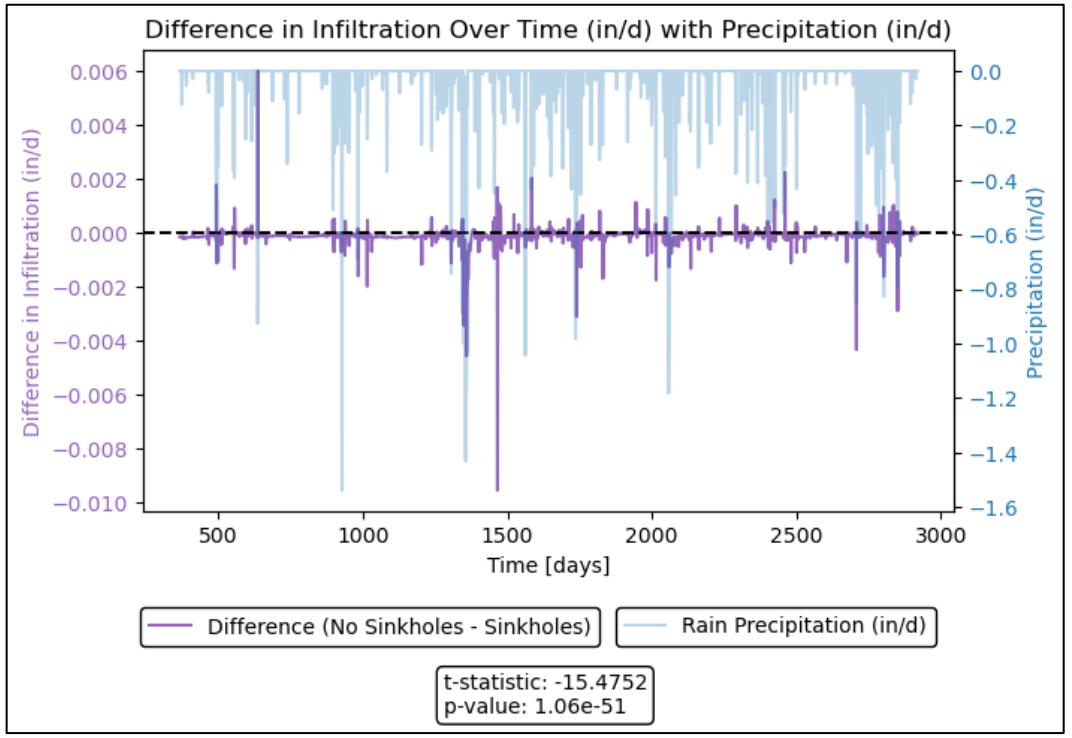


Role of Sinkholes: Runoff & Infiltration

- ATS model demonstrated sinkholes will **reduce runoff** and **increase infiltration** basin-wide.

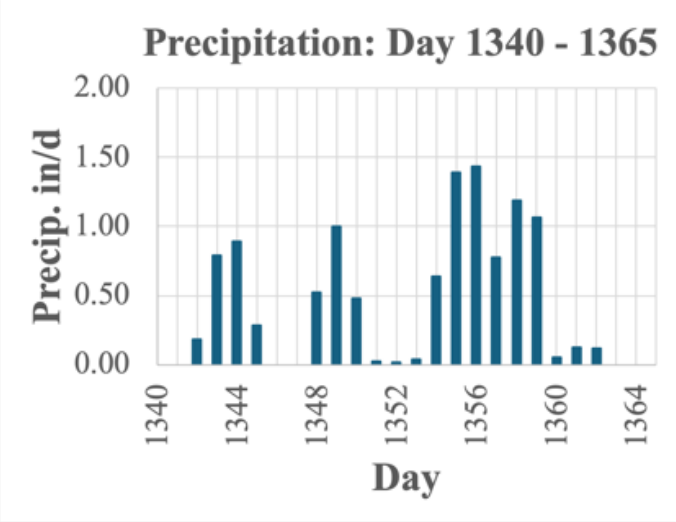
- Model shows sinkholes will occasionally have opposite effect (increased runoff) after multi-day precipitation events where soil becomes oversaturated, and subsurface water content increases.

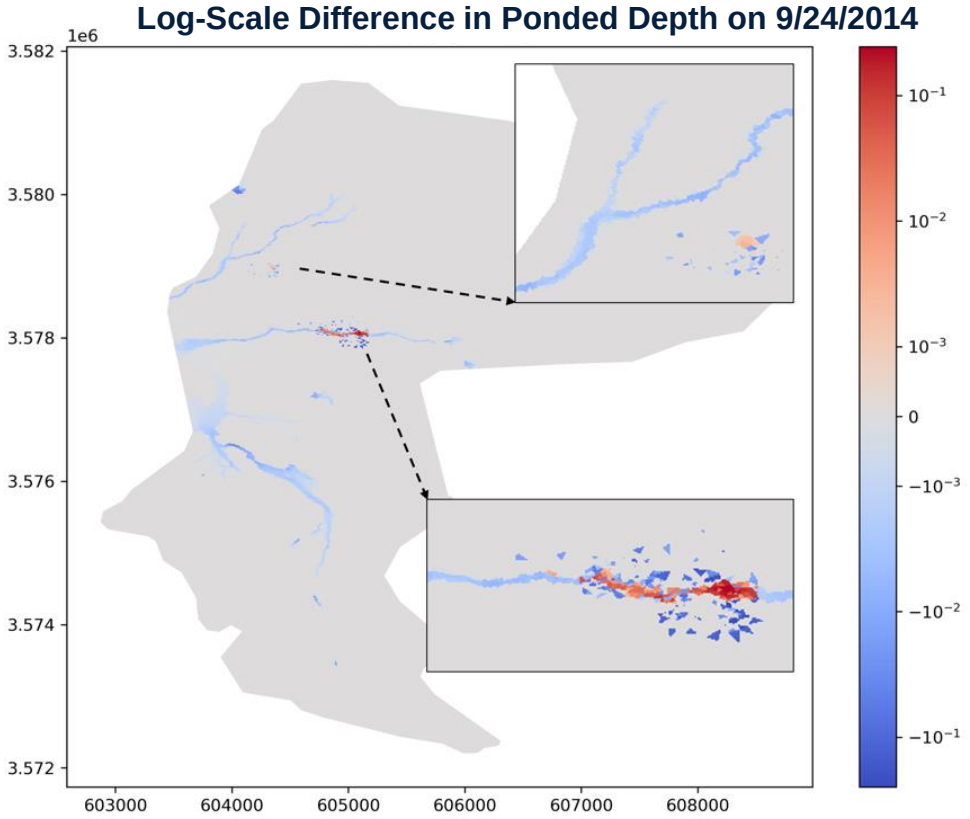




Role of Sinkholes: Surface Hydrology

- ATS simulated extreme multi-day precipitation event from 9/9/2014 to 9/24/2014 where 8.87 inches occurred over 15 days (71% of typical annual rainfall).
- Simulation **without sinkholes** typically had more ponded water.
- Simulation **with sinkholes** had more ponded water where sinkholes were present.
- Sinkholes with most dramatic effect on surface and shallow subsurface hydrology are in central region of Basin 6 and receive a significant amount of upstream flow.





Future Work

- Expand model across Nash Draw and into deeper subsurface.

- Calibrate ATS model using soil and water level data collected during fieldwork of summer 2023 and 2024.

- Use calibrated model to evaluate current and future climate on regional hydrology & groundwater recharge, so DOE-EM can better predict the rate of halite dissolution and propagation of shallow dissolution front.

WM2024 Roy G. Post Scholarship Winner

Summer 2024 Internship with Drummond Carpenter, PLLC

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Thank You. Questions?