APPLICATION OF THE GNOME OIL SPILL MODEL TO THE POTOMAC RIVER

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Potomac River Basin Drinking Water Source Protection Partnership
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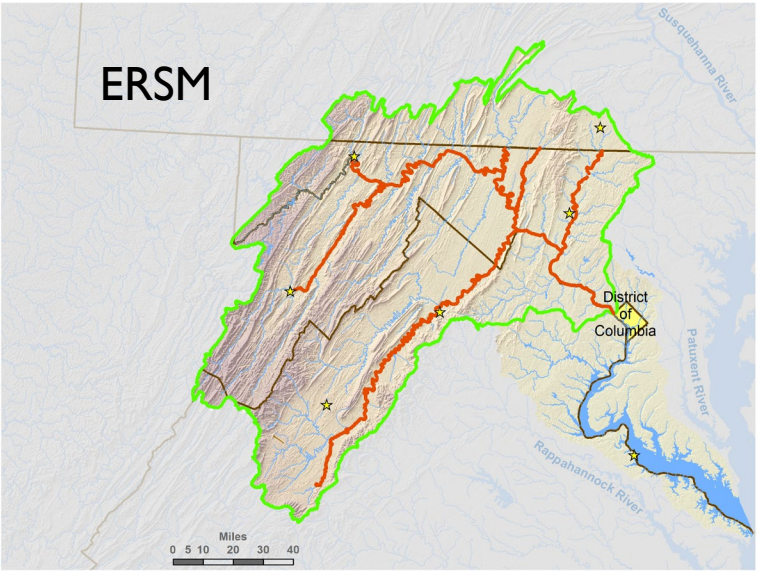
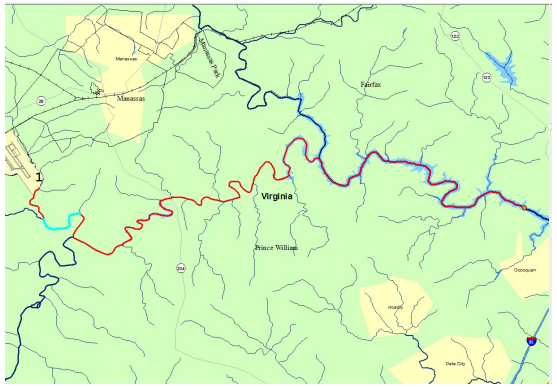
OPERATIONAL SPILL MODELING AT ICPRB

- 1D models
  - Emergency River Spill Model (ERSM) – ICPRB
  - IC Water – US Army/Leidos
- Advantages
  - Quick to run
  - Few data inputs
- "1D" assumptions
  - Completely soluble contaminant
  - Complete vertical mixing
  - Complete lateral mixing
- Limitations
  - Constant flows

ICPRB's current operational tools





2D SPILL MODEL OF THE POTOMAC RIVER

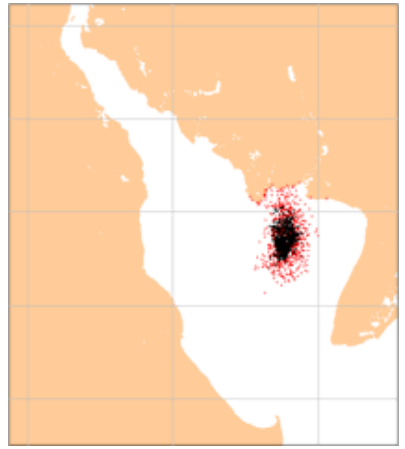
- Estimate arrival times of floating contaminants at downstream water supply intakes.
- Predict both the longitudinal and transverse movement of a contaminant plume
- Consider two-dimensional flow patterns in the river.
  - Contaminant transport model (GNOME)

  → 2D steady and unsteady flow (CATS)

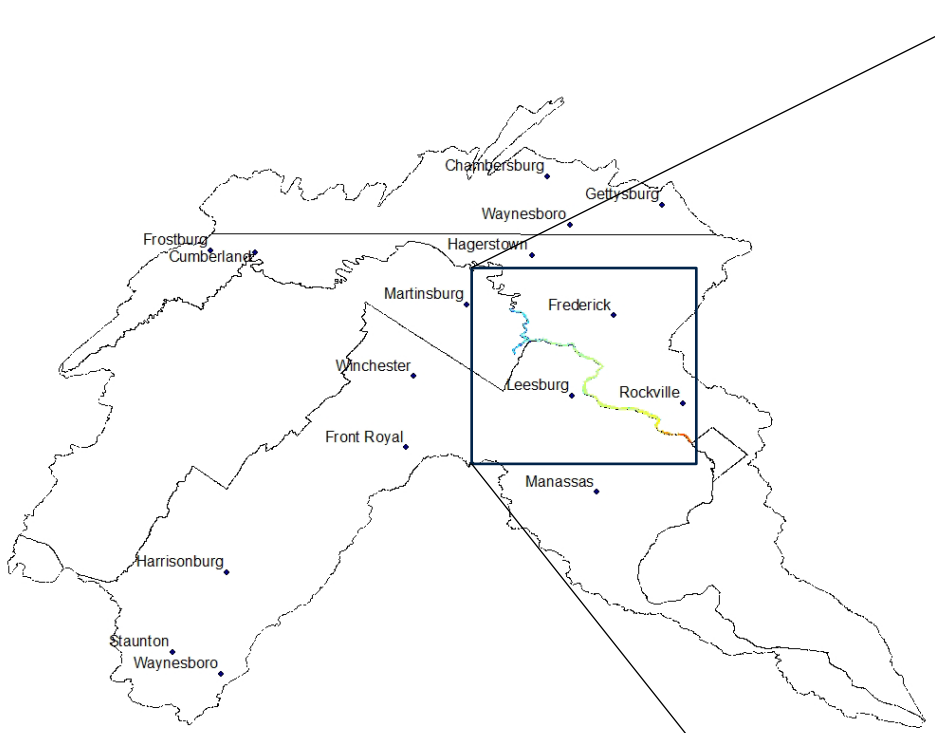
  →2D unsteady flow (Delft3D, IRIC)
- Use bathymetric LiDAR data from Little Falls to Shepherdstown.

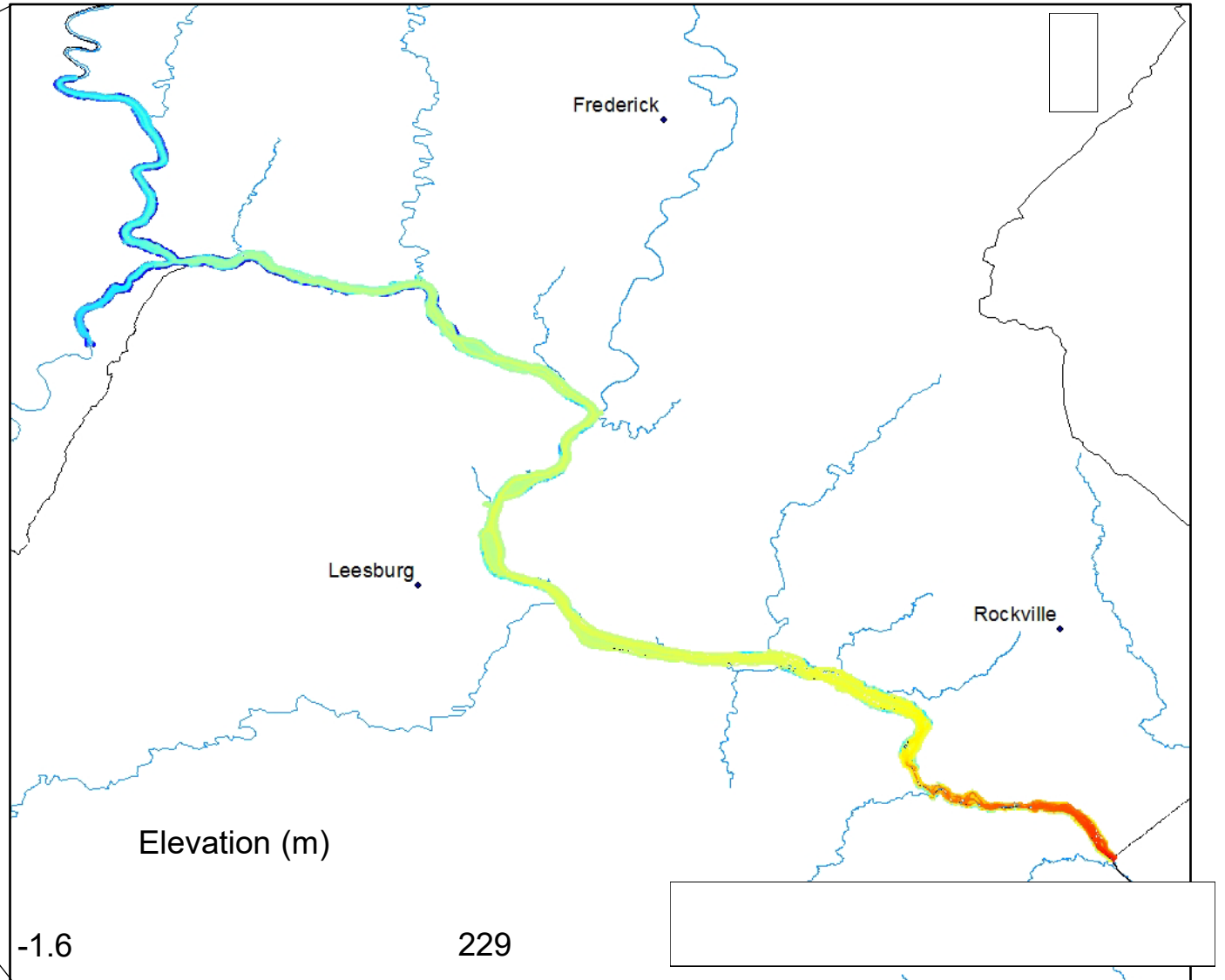
GNOME MODEL

- General NOAA Operational Modeling Environment
- Publicly available
- Predicts movement of oil on water bodies with varying winds, currents and other processes.
- Predicts chemical and physical changes (weathering) of oil on water surface.
- Study effects of uncertainty in current and wind observations and forecasts.

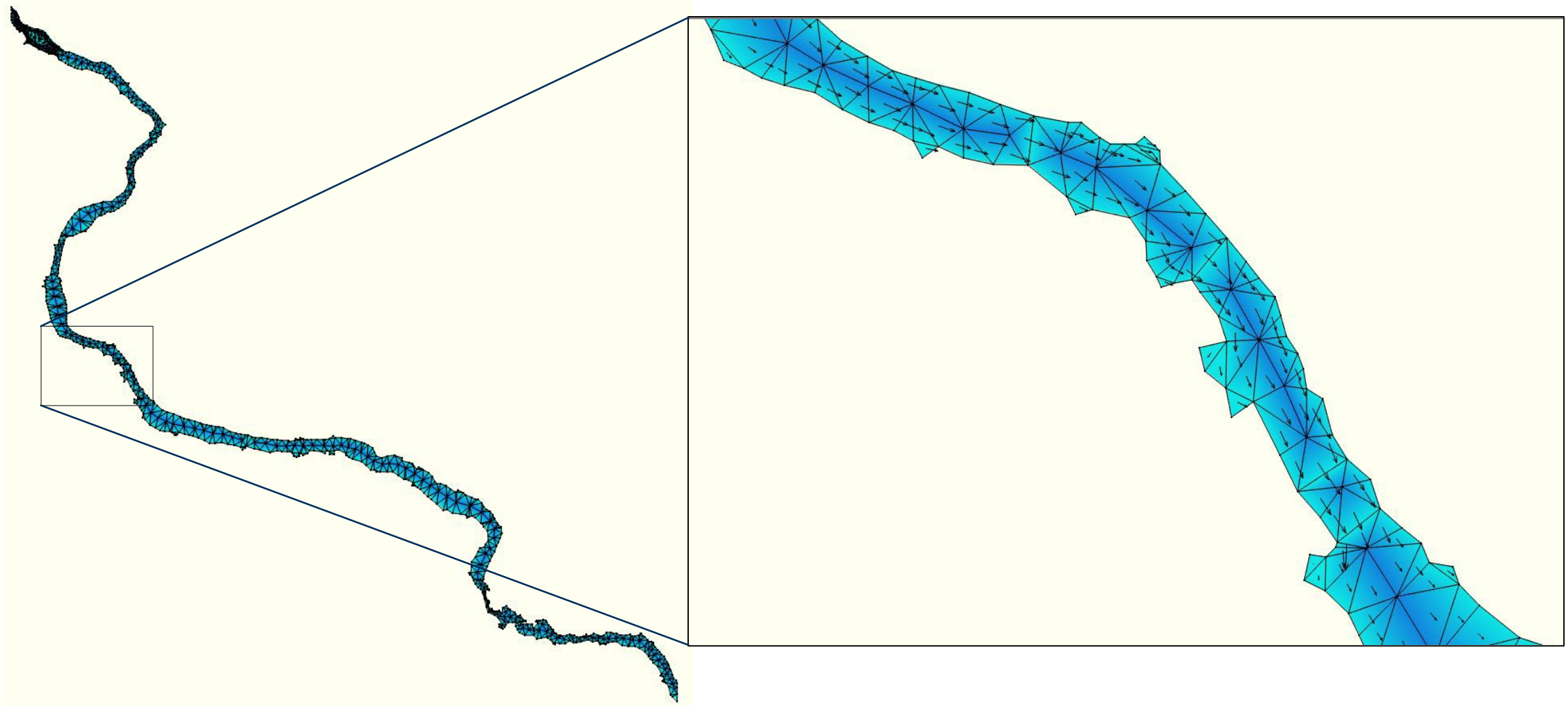


2D SPILL MODEL OF THE POTOMAC RIVER





CURRENT ANALYSIS AND TRAJECTORY SIMULATION (CATS)



CONTAMINANT TRANSPORT MODEL (GNOME)

- Medium-crude oil
- 100 barrels
- Constant flow

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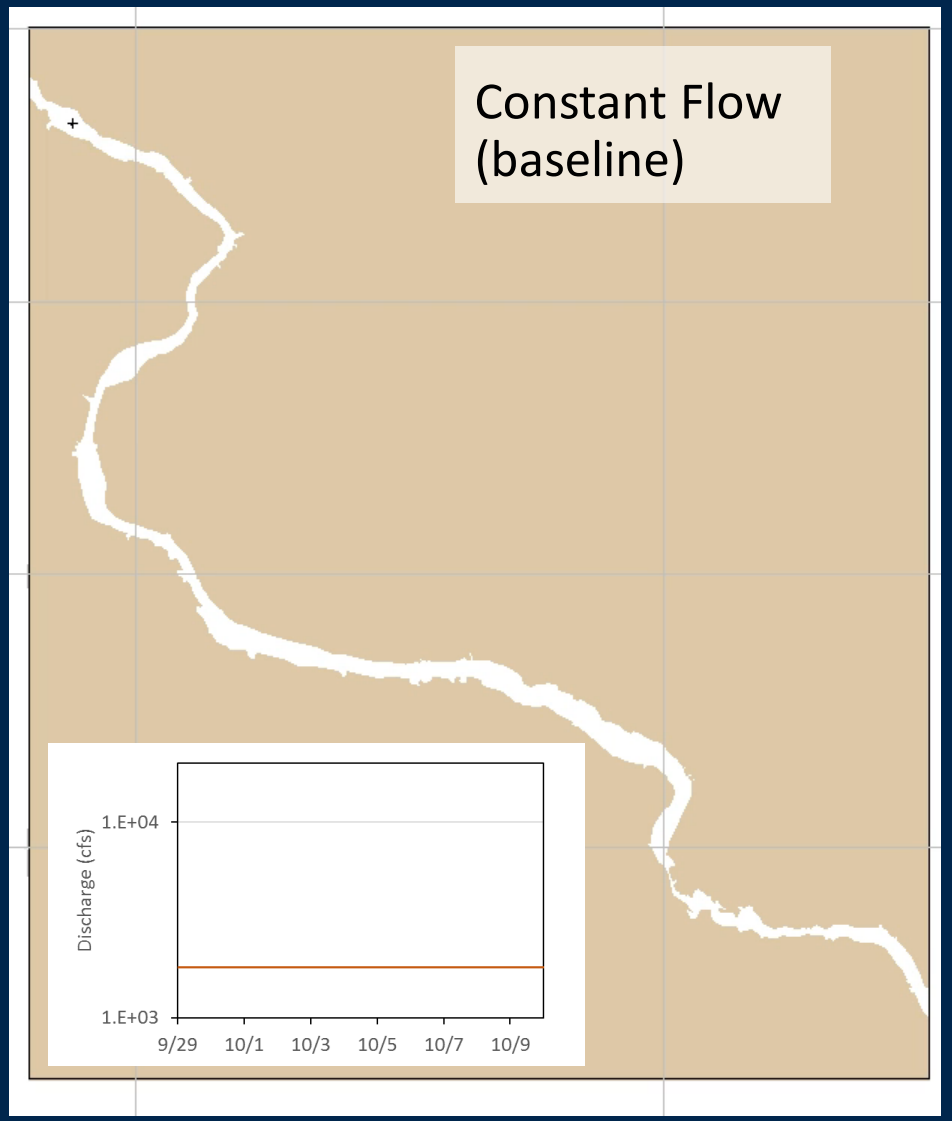
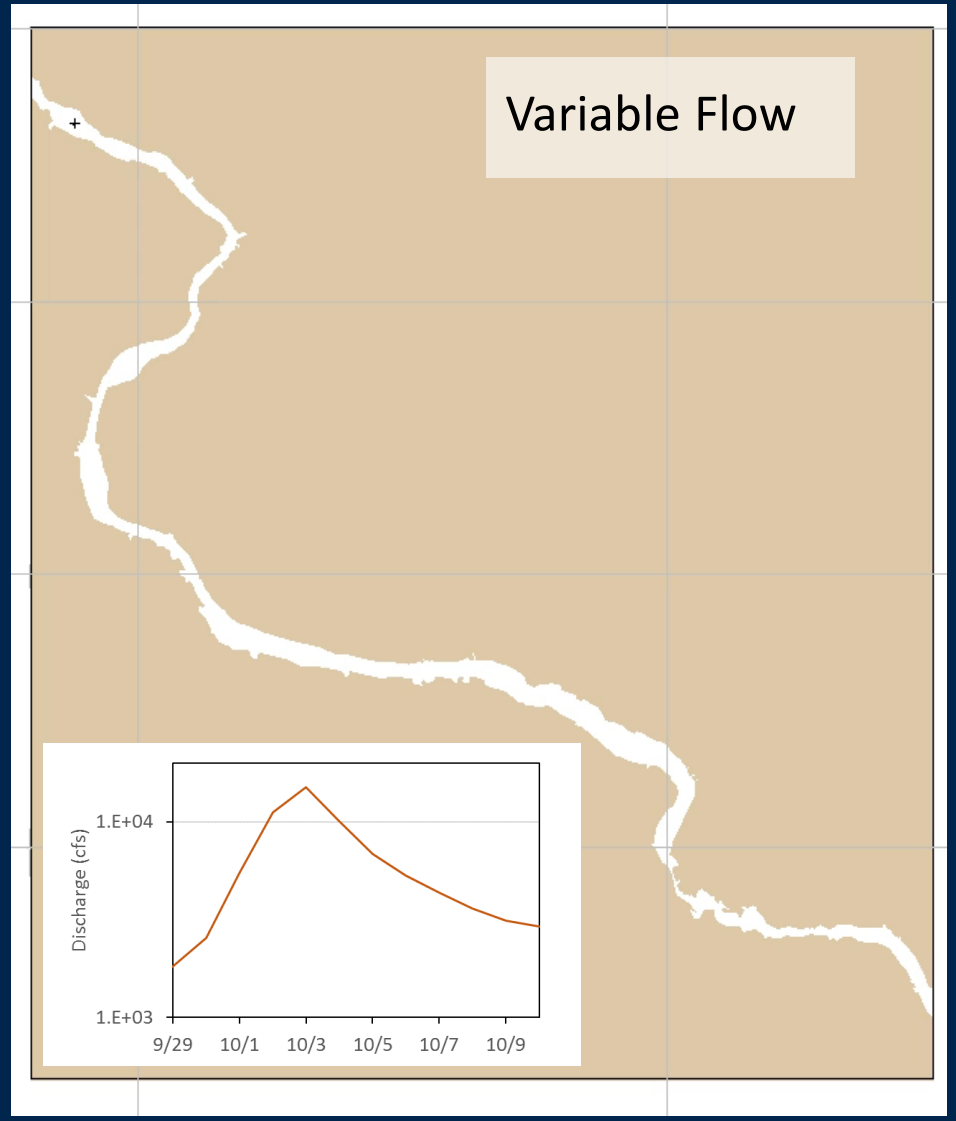
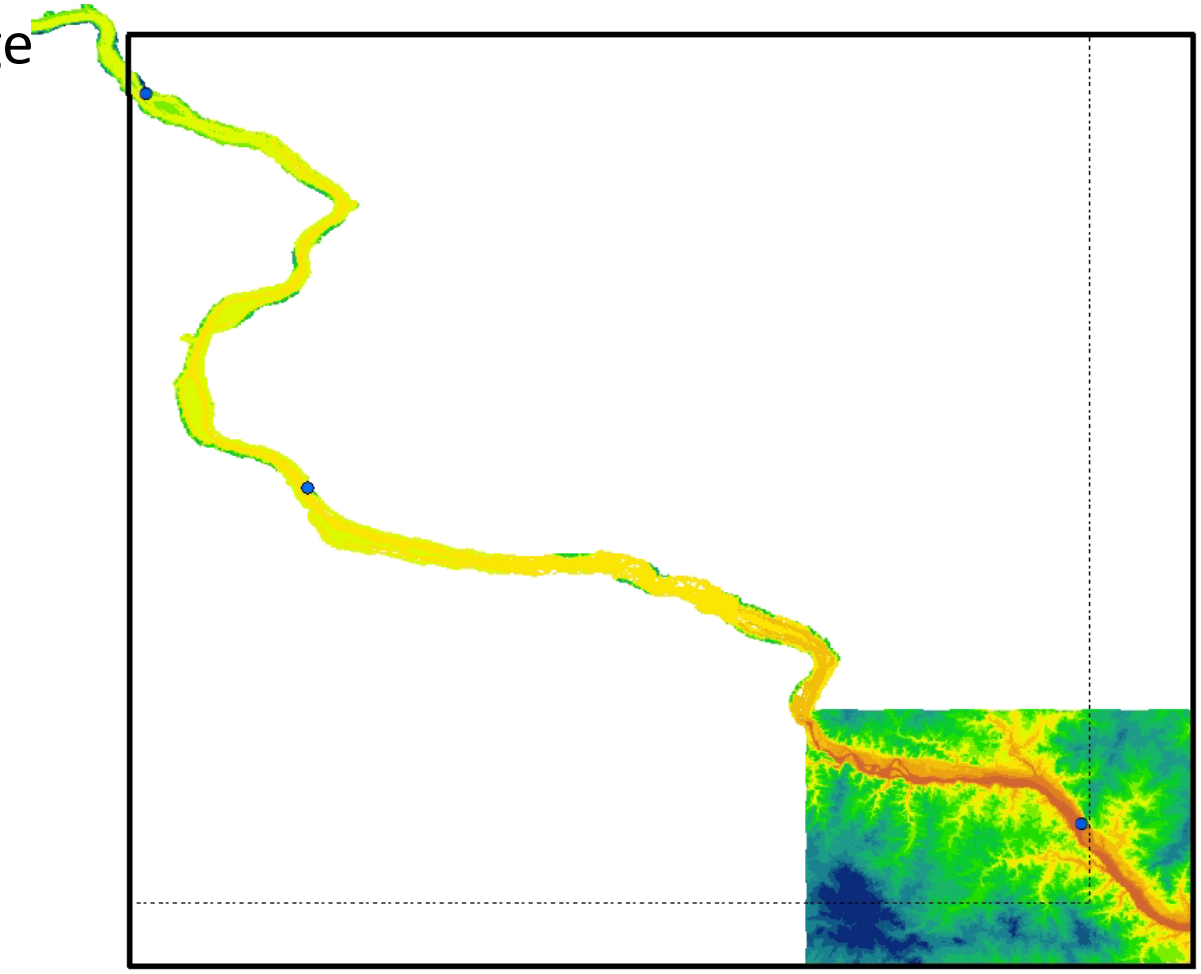


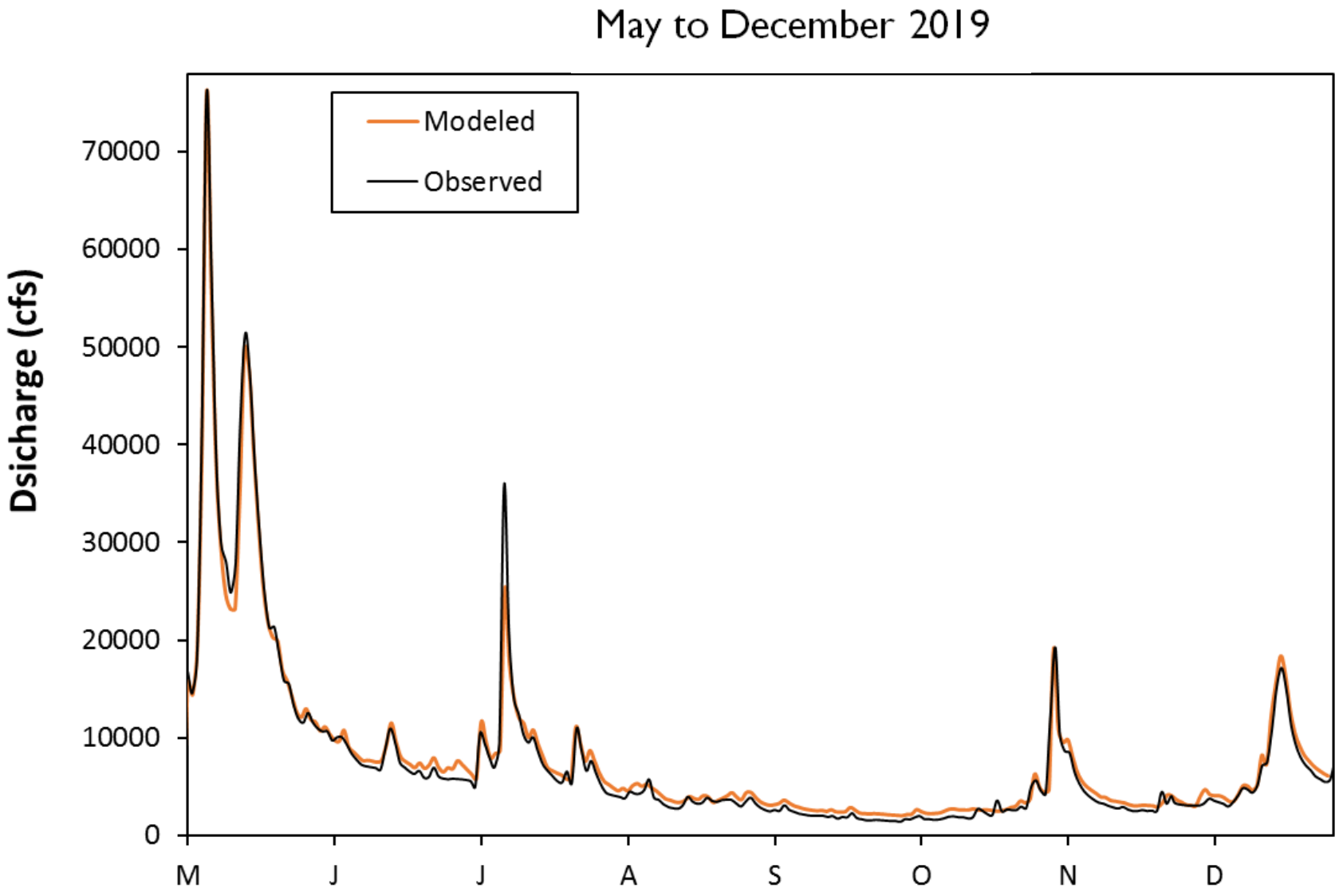


UNSTEADY FLOW MODEL (DELFT3D/IRIC)

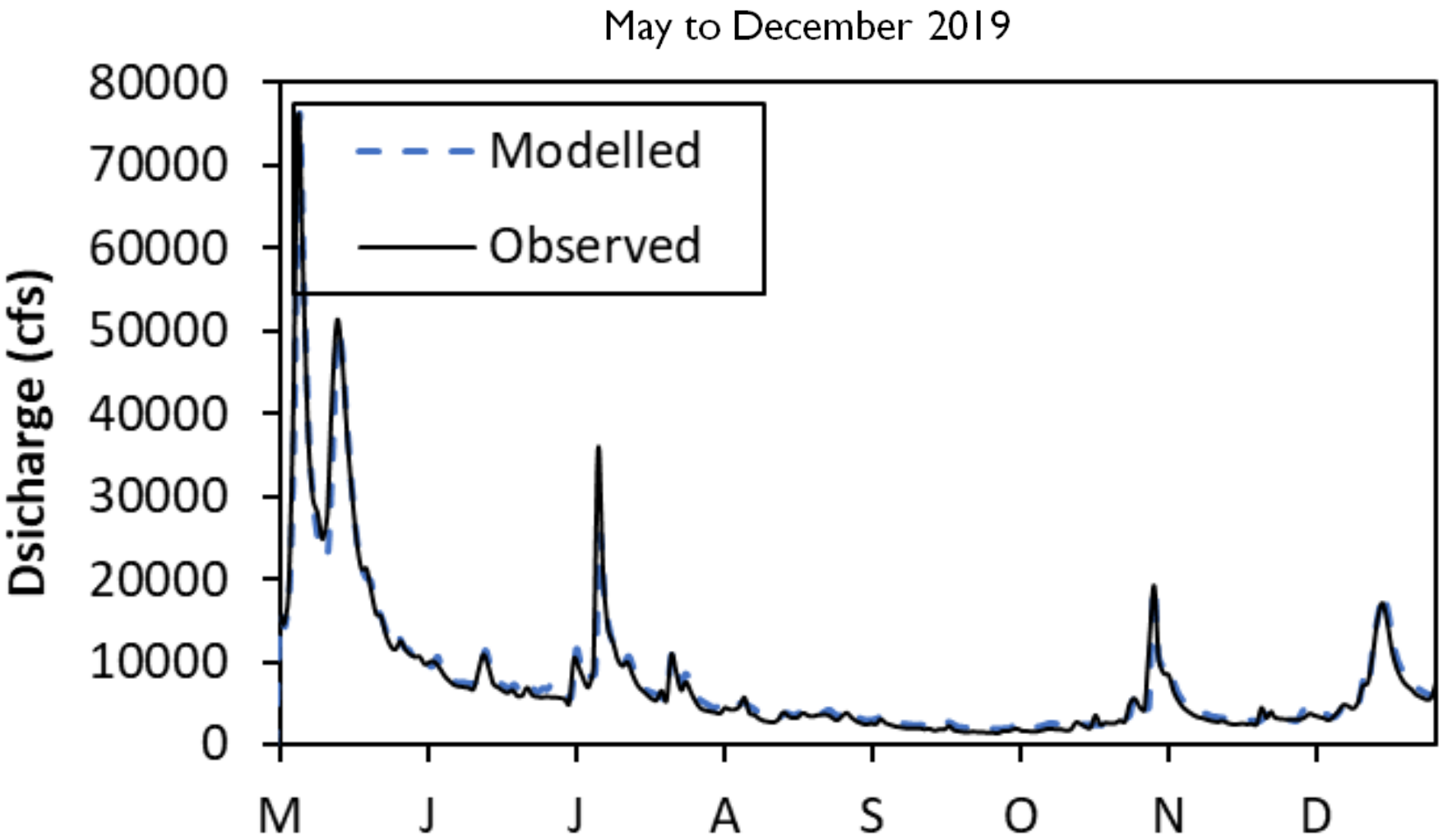
- Model Extent: Point of Rocks to Chain Bridge
- Model setup:
  - Resampled 30m DEM (LiDAR + NOAA NCEI)
  - Discharge boundary conditions at Point of Rock
  - Water level boundary condition below Little Falls
  - Run periods: 2019, 2010, 1993
  - 3 inflows (Monocacy, Goose, Seneca)



RIVER FLOW: UNSTEADY FLOW MODEL (DELFT3D)

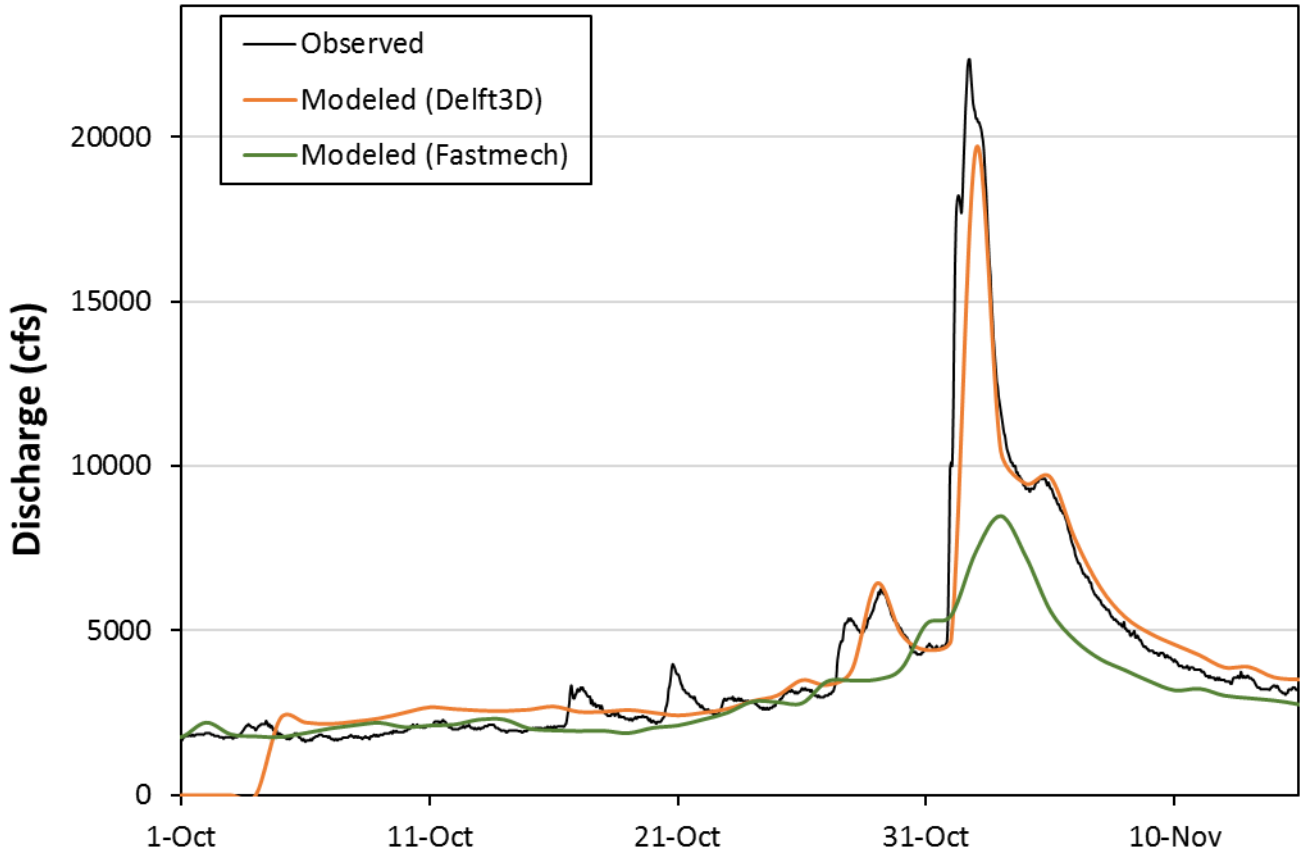


RIVER FLOW: IRIC-FASTMECH



RIVER FLOW: IRIC-FASTMECH/DELFT3D

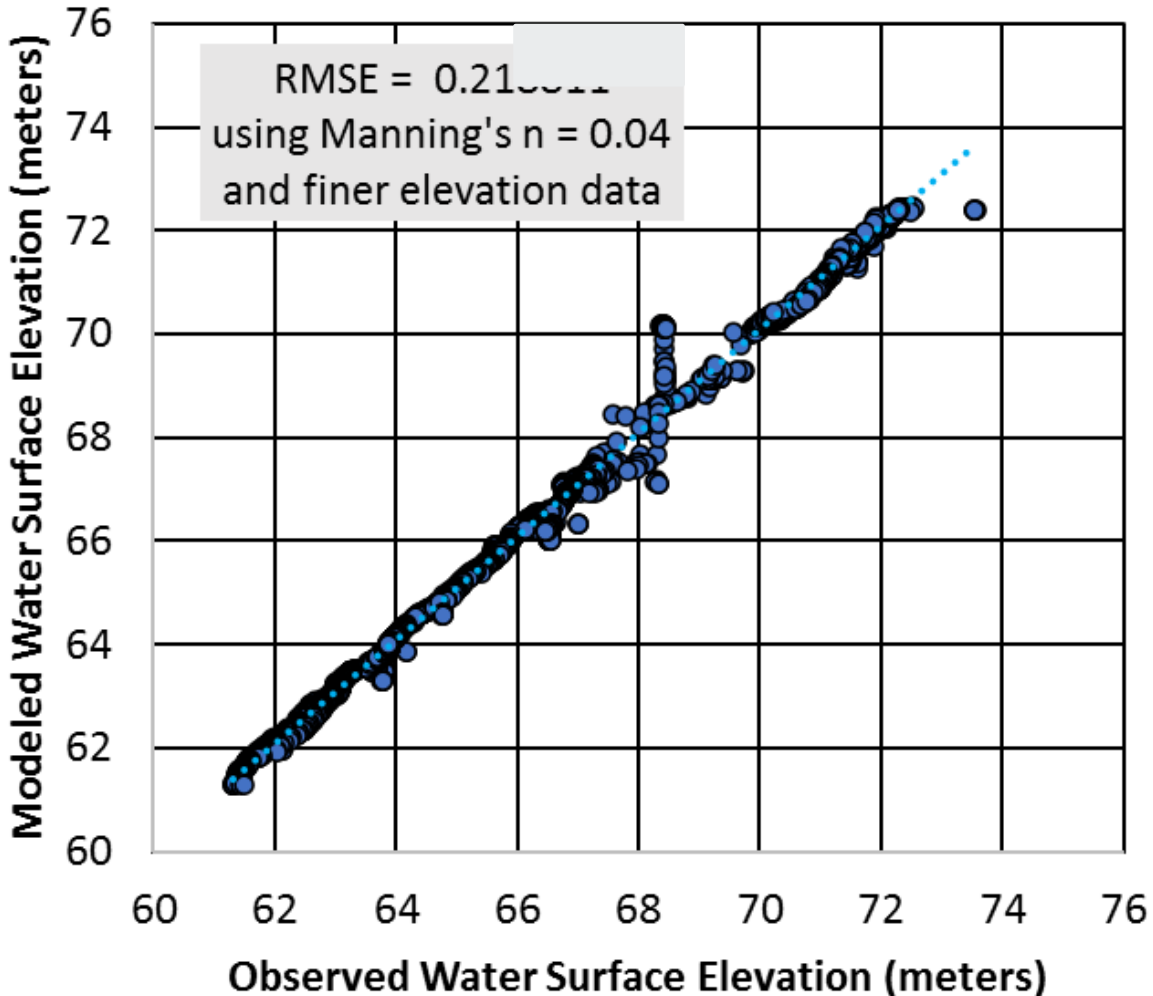
October – November 2019

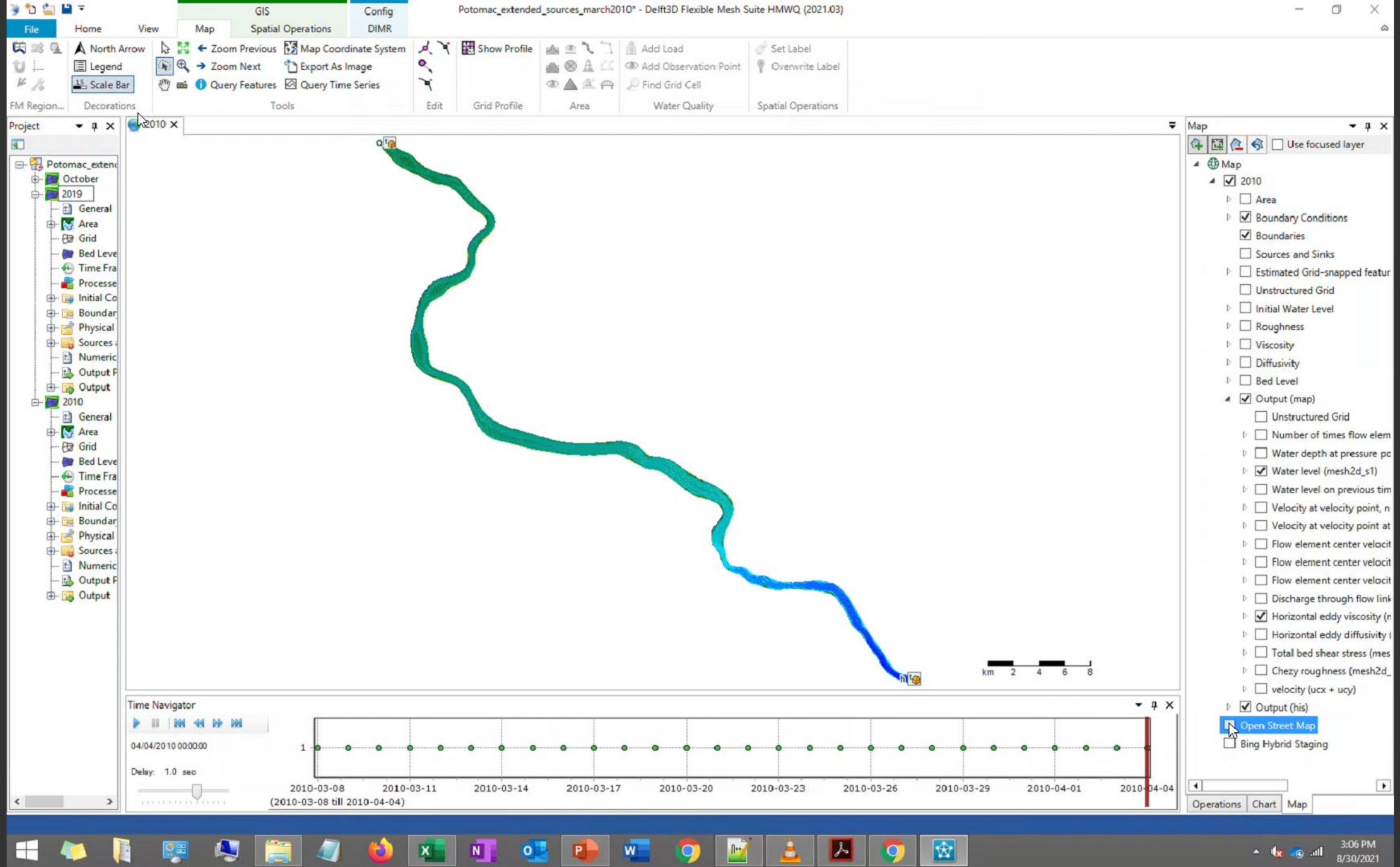


WATER SURFACE ELEVATION

October – November 2019

Short Section of River above Point of Rocks




Potomac_extended_sources_march2010* - Delft3D Flexible Mesh Suite HMWQ (2021.03)
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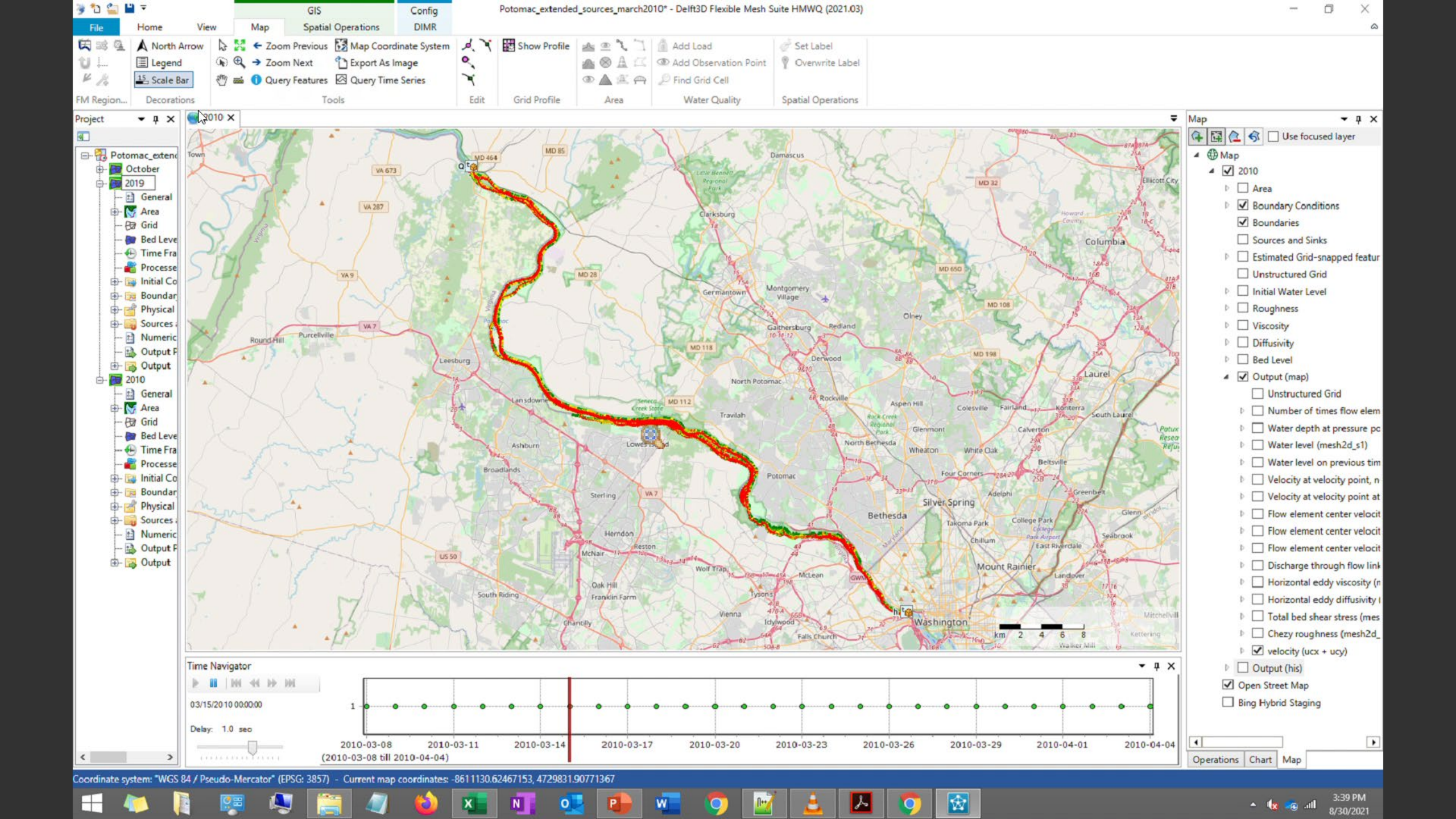
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Map
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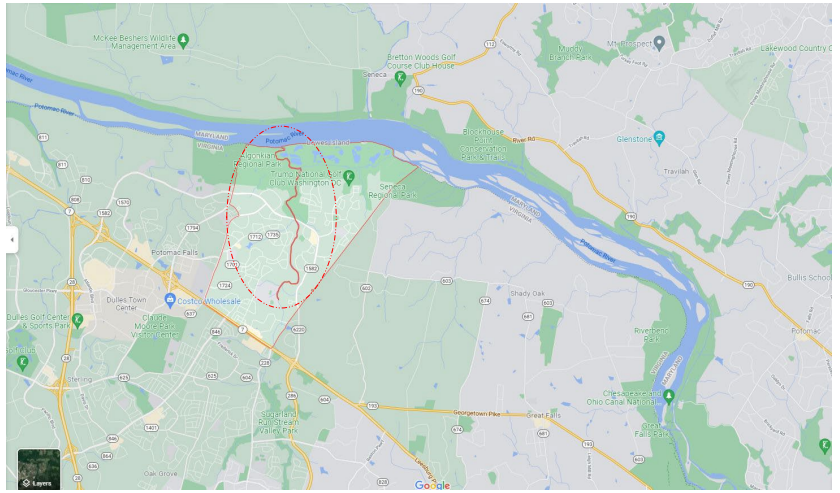
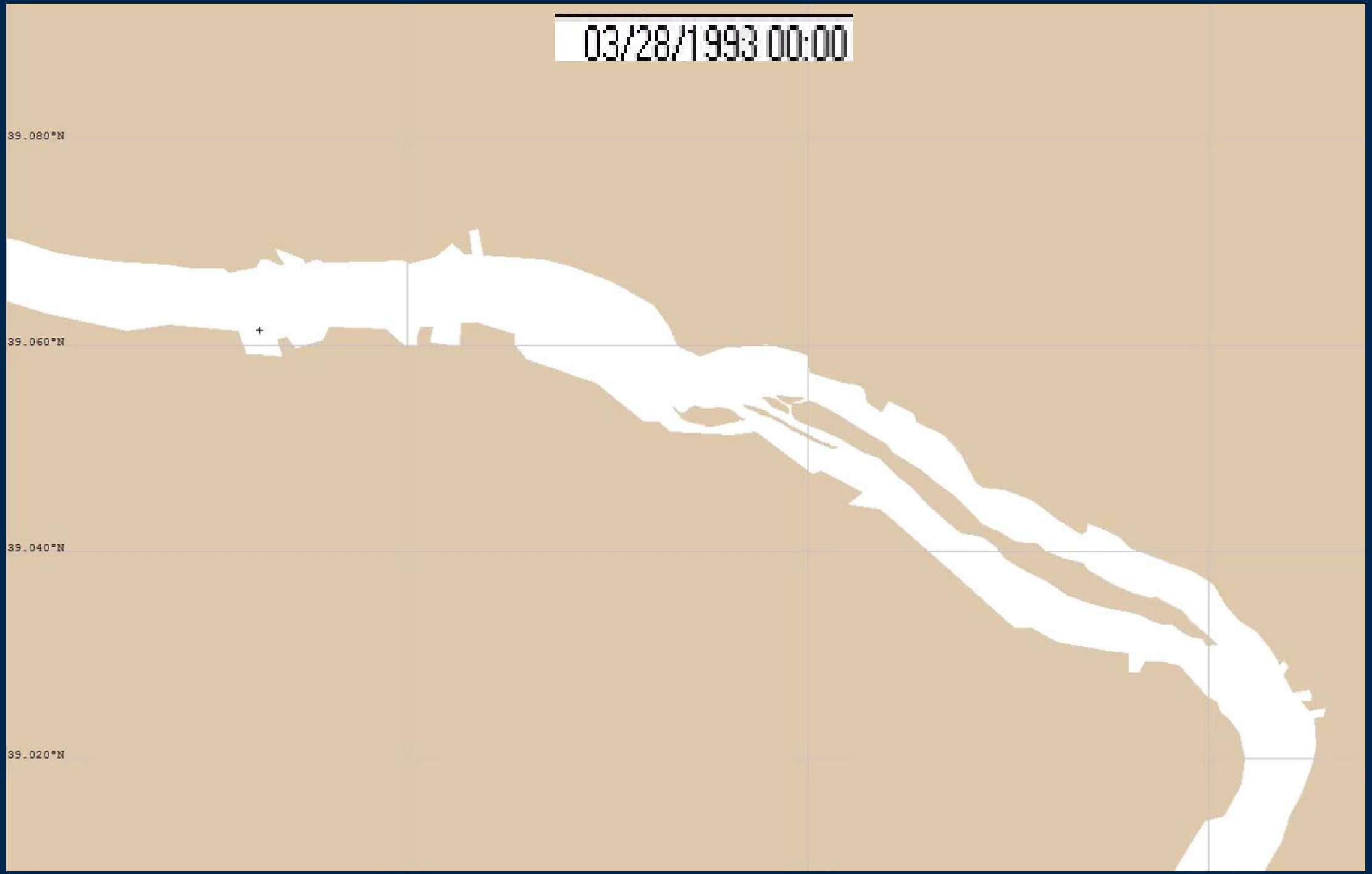
1993 OIL SPILL EVENT

- Rupture of section of a pipeline owned and operated by the Colonial Pipeline Company
- 400,000 gallons of diesel fuel into Sugarland Run in Reston, VA
- GNOME model set up
  - Spill date: March 28, 1993
  - Model run time: 3 weeks
  - Spill location : confluence of Potomac River and Sugarland Run.
  - Spill amount: 35,000 gallons over three days

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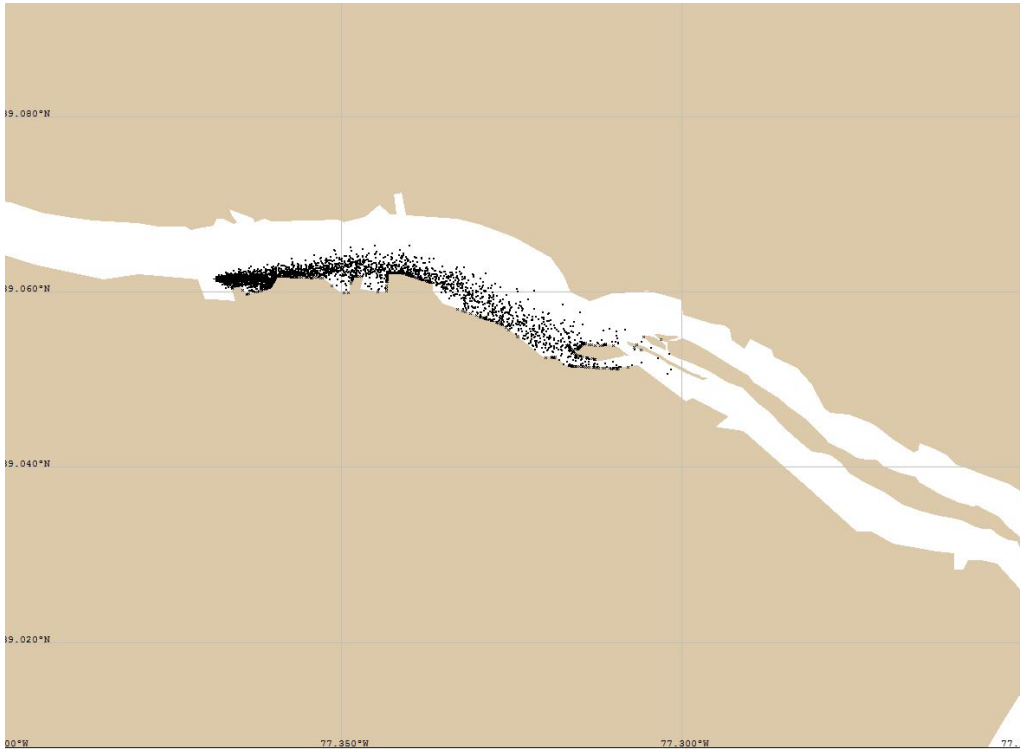
39.060°N
39.040°N
39.020°N

SUMMARY

- Constructed steady state and transient GNOME oil spill model for Potomac River.
- Flow models capture spatio-temporal variability of river flow and water velocities.
- Flow model run times vary with resolution and model type. Can be reduced using restart file and integrating flow model in LFFS.
- GNOME model was used to simulate 1993 oil spill model.
- New tool is an improvement over previously available tools.



FUTURE STEPS

- Enhance Potomac River models
  - Extend model domain up to Shepherdstown & Millville
  - Incorporate into CO-OP's real-time Low Flow Forecast System (LFFS)
  - Test particle tracking capability of iRIC model
  - Refine grids
- Build 2D Occoquan & Patuxent reservoir spill models