ICPRB Spill Modeling Capabilities

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Interstate Commission on the Potomac River Basin (ICPRB)

October 25, 2023

Overview

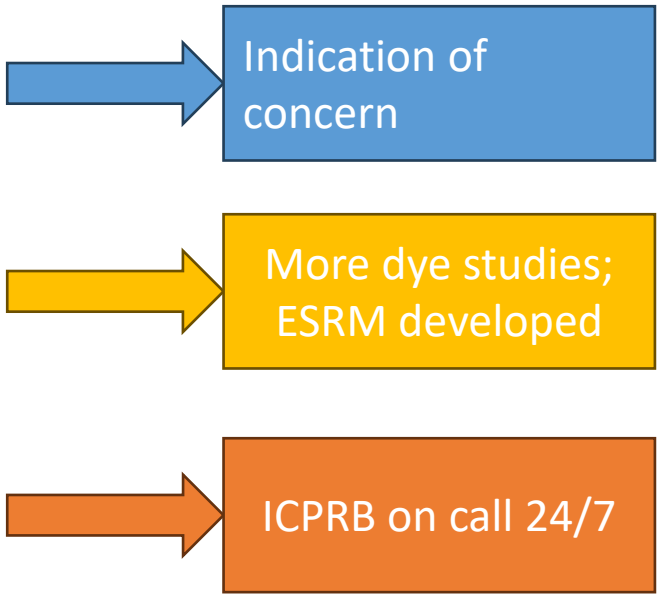
- Why is ICPRB involved?
- Early events and modeling
- How at risk is the Potomac River?
- What models do we currently use?
- What are our plans for the future?

Why is ICPRB involved?

- Mission: protect waters of the Potomac basin
- ICPRB's CO-OP Section works closely with DC area utilities
  - CO-OP established in 1979
  - Supports water supply operations during drought

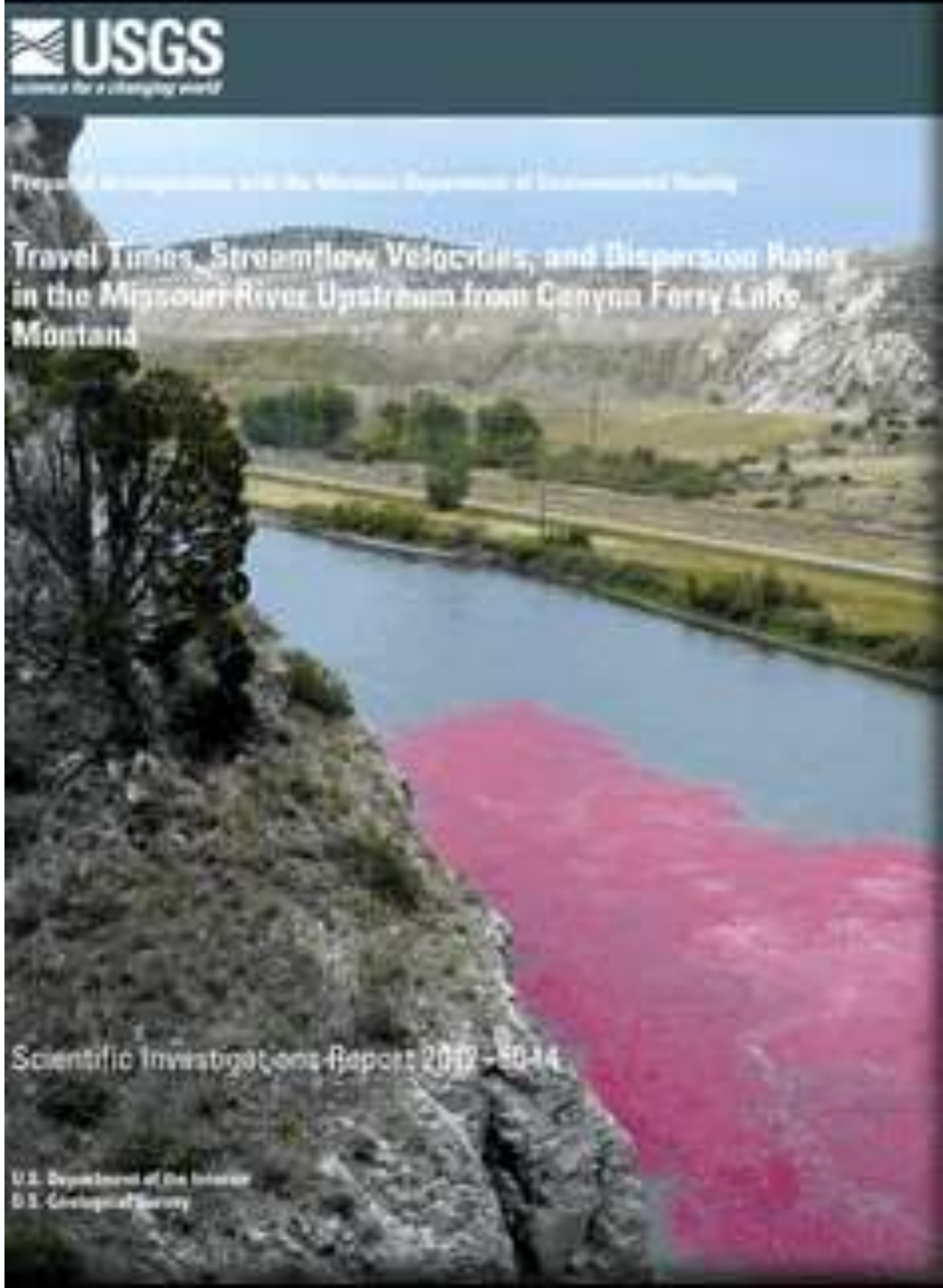
Early events & modeling

- Early Potomac dye studies: 1964-1972
- Wakeup call: tanker truck aniline spill near Shepherdstown, 1981
- Big event: Colonial Pipeline diesel fuel release, 1993



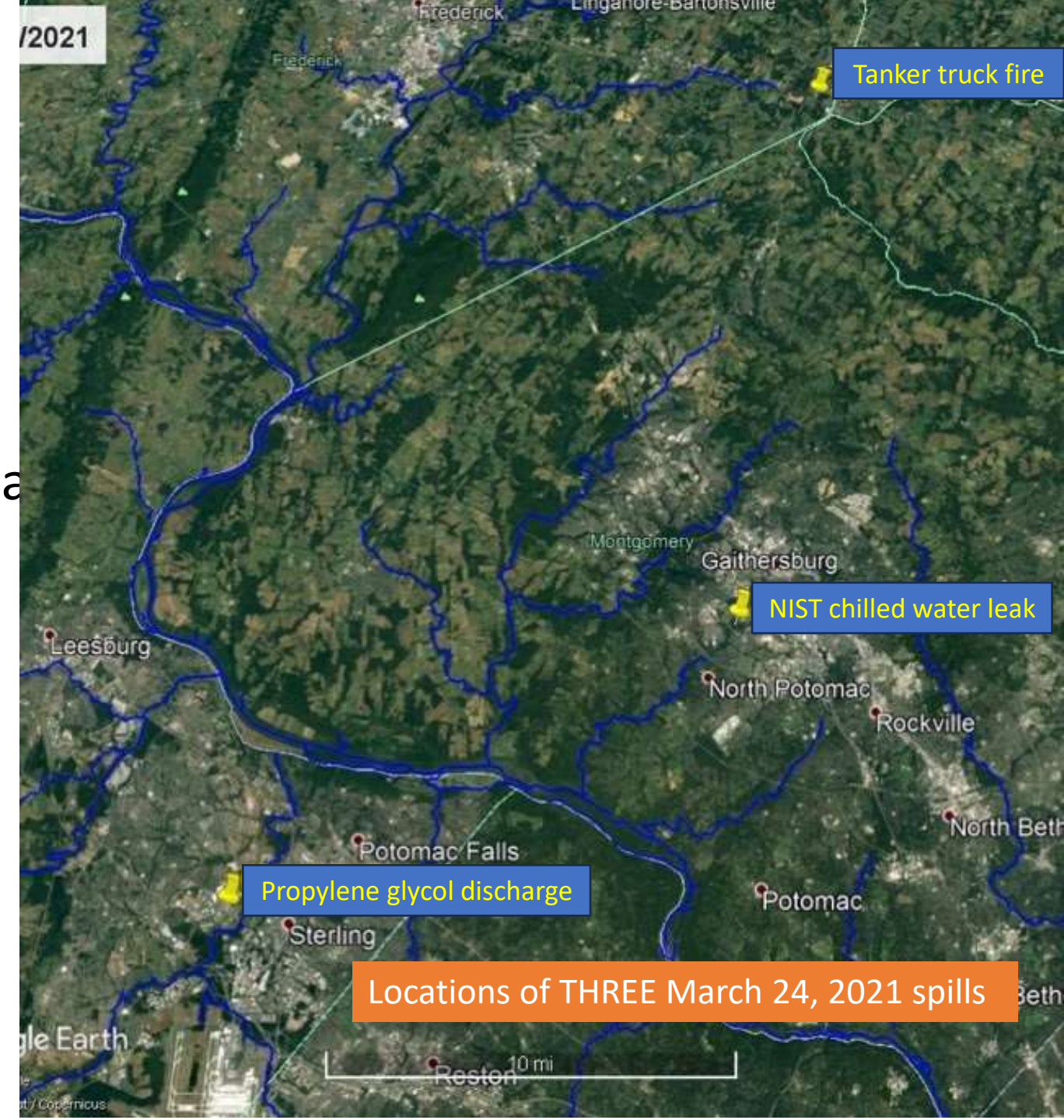
Potomac basin dye studies

- Potomac River mainstem
  - 1964 – USGS
  - 1981 – USGS for DC DES, FCWA, ICPRB, MD DNR, WSSC
- Antietam and Conococheague Creeks
  - 1969, 1970 – USGS for MD Geological Survey
- Monocacy River
  - 1970 – MD Geological Survey with USGS
- South Branch Potomac River
  - 1972 – WV Geological and Economic Survey
  - 1982 – USGS
- Shenandoah River (+ Shenandoah South Branch + South River)
  - 1983, 1984 – USGS for ICPRB & VA Water Control Board



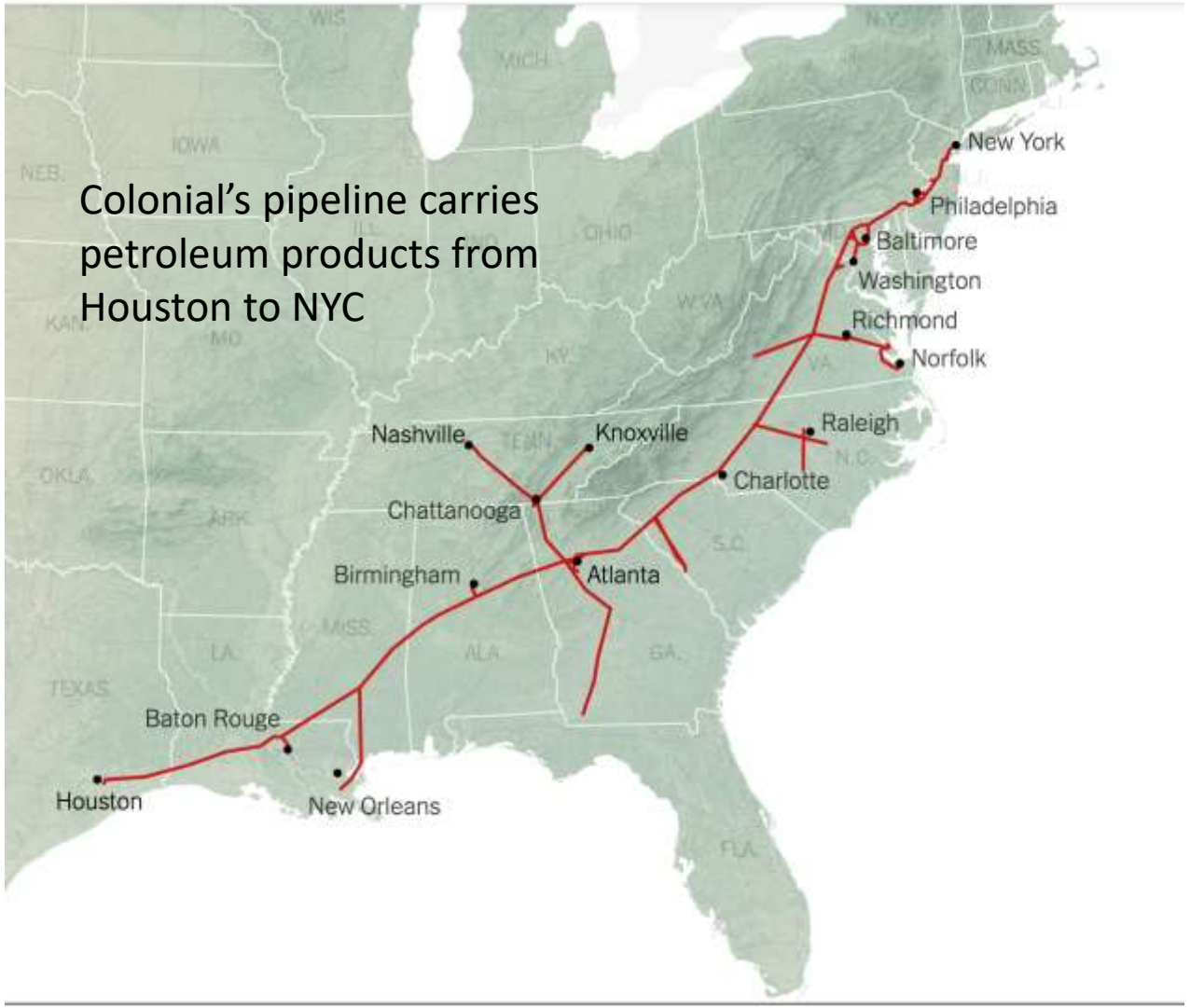
Wakeup calls

- Tanker truck spill into Potomac River, aniline, 1981
- Luke paper mill spill into Potoma North Br, latex, 2015
- Potomac River “sheen” event, 2016
- March 24, 2021 – 3 spills!



A big one: 1993 Colonial Pipeline rupture

- Rupture released 407,736 gallons of No. 2 fuel oil into Sugarland run
- Plume entered Potomac River by evening
- Fairfax Water – on western side of river – Potomac intake shut down for 14 days
- No oil migrated to WSSC's or Washington Aqueduct's intakes on eastern side of river
- ICPRB CO-OP
  - Testified at Senate hearing
  - Began 24/7 spill support – via "beeper"



What models do ICPRB staff currently use?

- ERSM (Emergency River Spill Model)
  - 1D model for dissolved contaminants
  - Excel application
- ICWATER
  - 1D model for dissolved contaminants
  - ArcMap 10.5 application
- Oil spill model
  - 2D model for floating contaminants
  - DELFT3D flow model + NOAA's GNOME

1D contaminant transport models

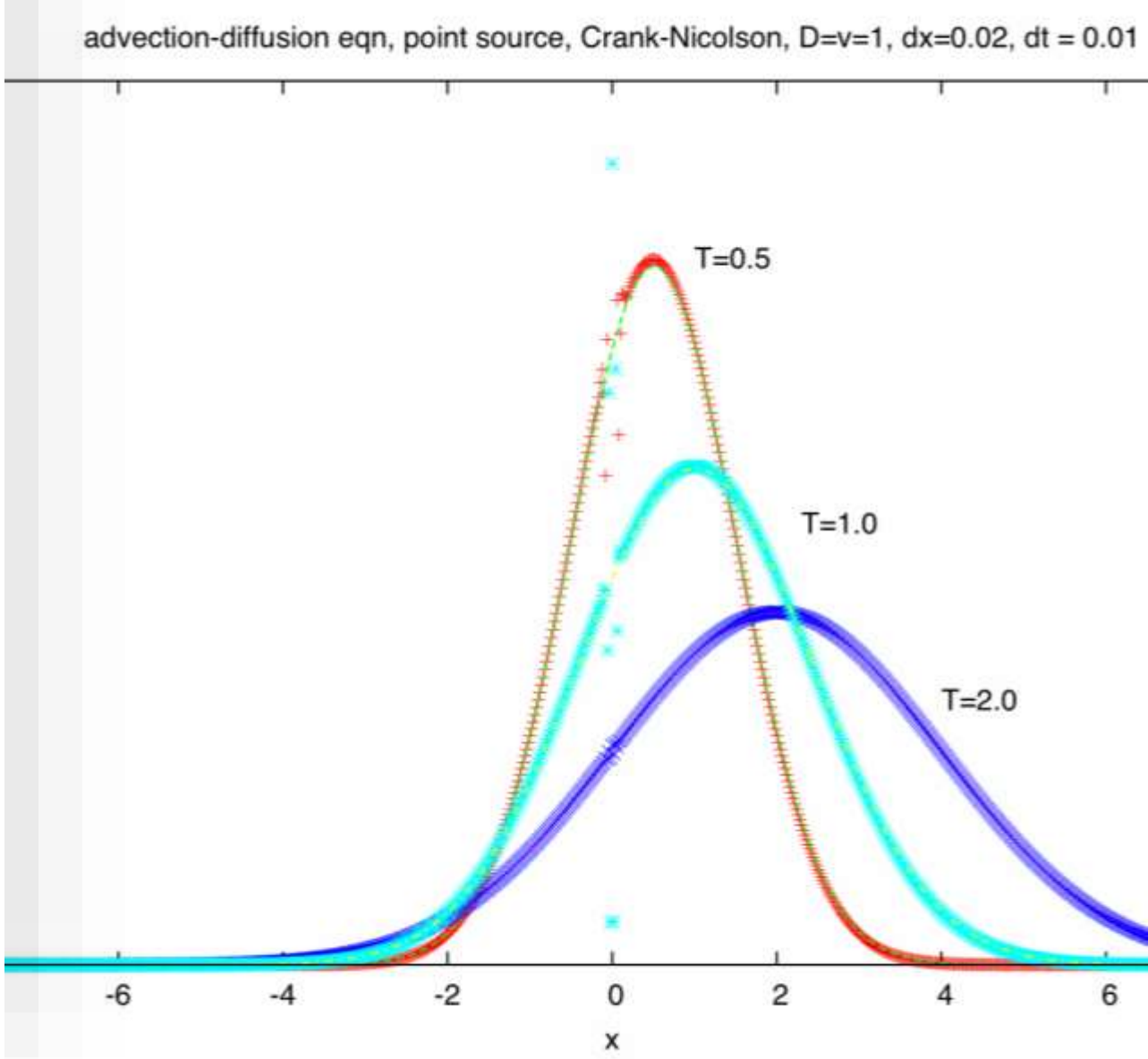
- Few data inputs → quick to run
  - Need time of release & river flow
  - Identity of contaminant – optional
  - Duration of release – optional
  - Quantity of release – optional

- "1D" simplifying assumptions
  - Completely soluble contaminant
  - Complete lateral mixing
  - Complete vertical mixing

Animas River, Gold King Mine spill, 2015

1D contaminant transport models

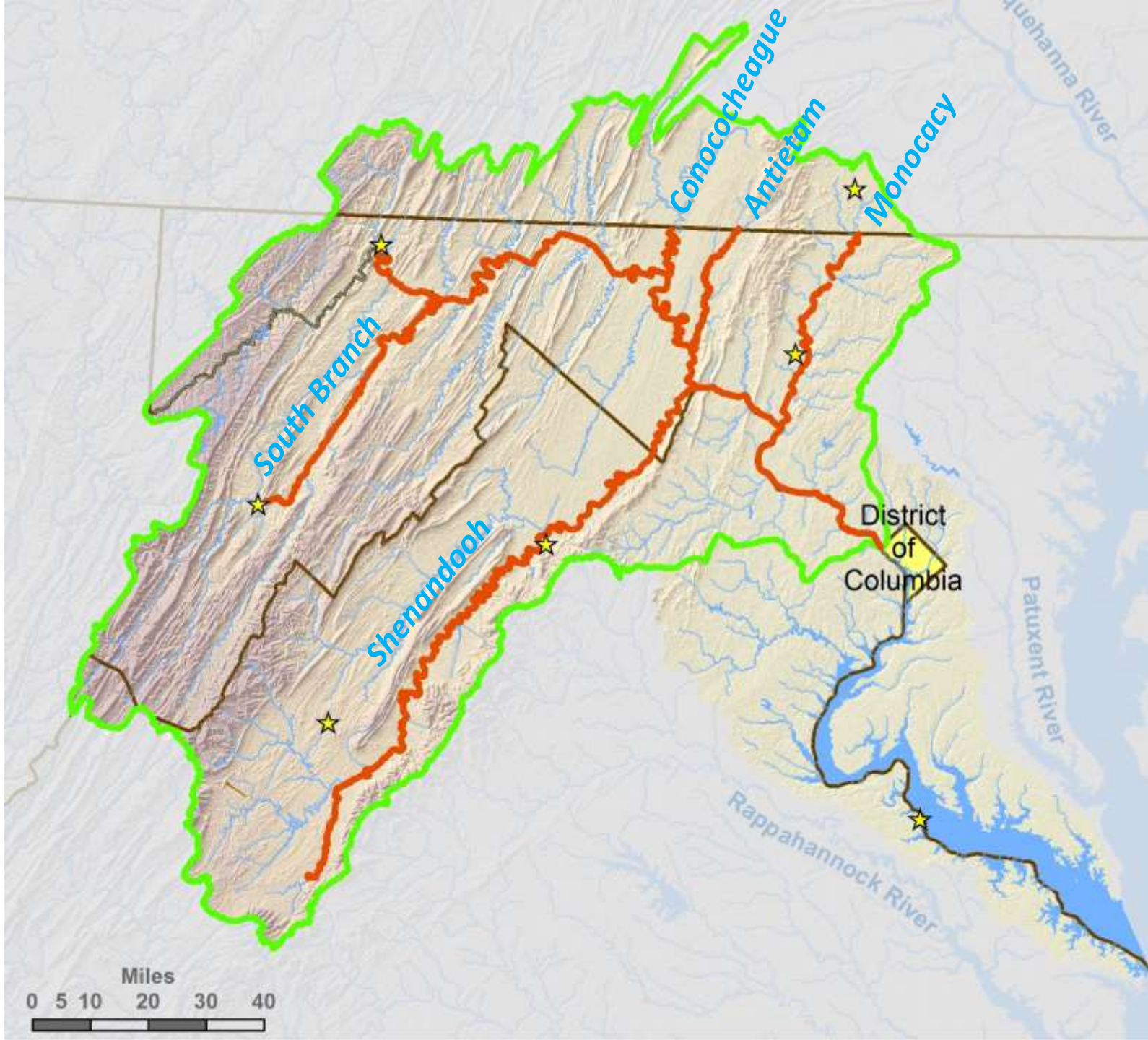
- Physical processes modeled
  - Longitudinal advection
  - Longitudinal dispersion
  - Contaminant decay
- Data inputs
  - USGS real-time stream flows
  - Contaminant decay rates
- Model outputs
  - Peak concentrations
  - Travel times of plume peak, leading edge, trailing edge



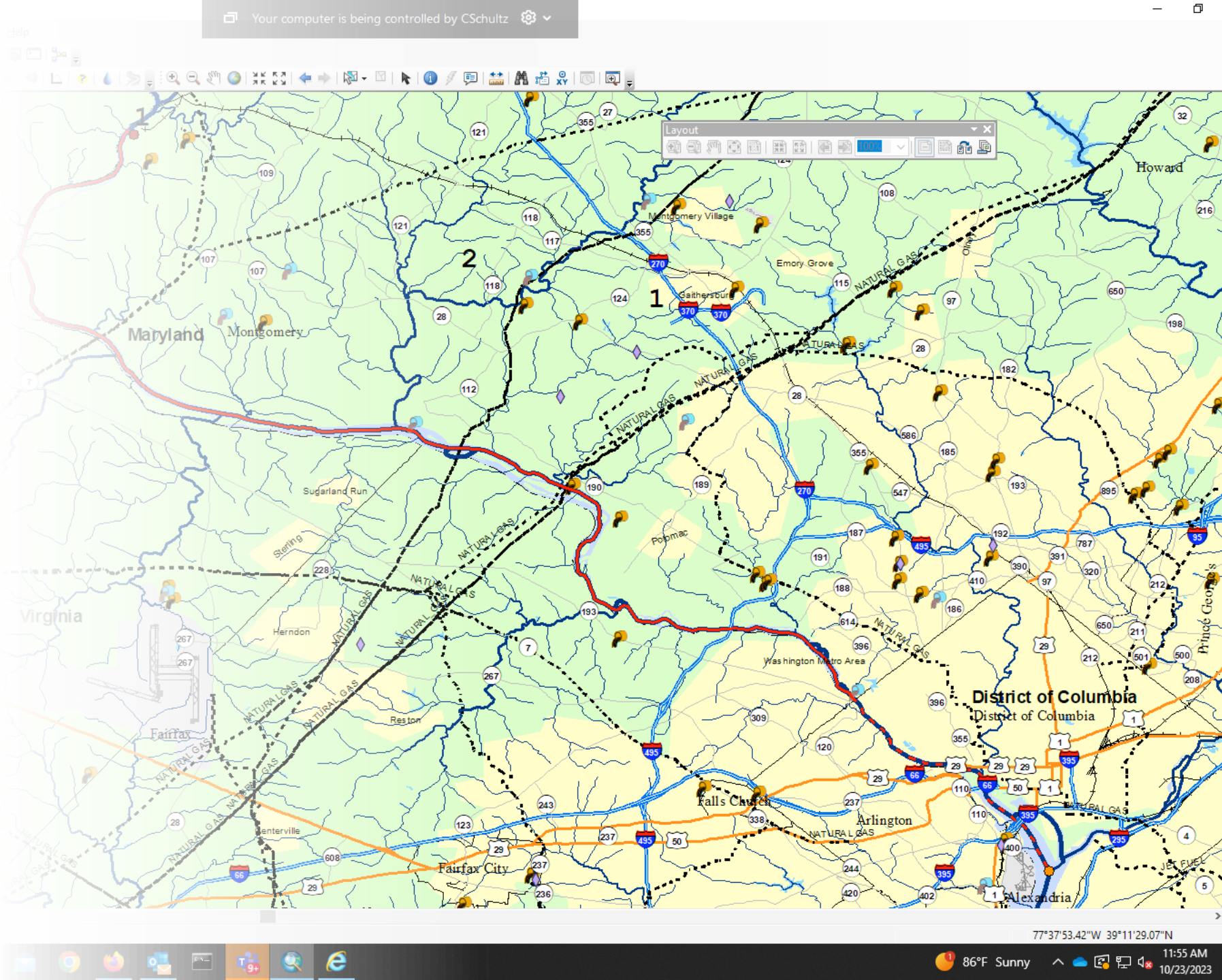
ICPRB's current 1D models

	ESRM	IC Water
User interface:	Microsoft Excel application	ArcGIS
Spatial extent:	Most of Potomac basin above Little Falls	All of Potomac basin + Occoquan + Patuxent
Spatial scale:	Major tribs	Small streams
Flow inputs:	Flows at multiple locations	Flow at single location
Data support:	6 dye studies for flow/velocity relationships	None –> theoretical flow/velocity relationships

ERSM


Conococheague
Antietam
Monocacy
South Branch
Shenandoah
District of Columbia
Patuxent River
Rappahannock River
Miles
0 5 10 20 30 40

ICWATER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Falls Church
Arlington
Alexandria
Washington Metro Area
District of Columbia
District of Columbia
Potomac
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77°37'53.42"W 39°11'29.07"N
86°F Sunny
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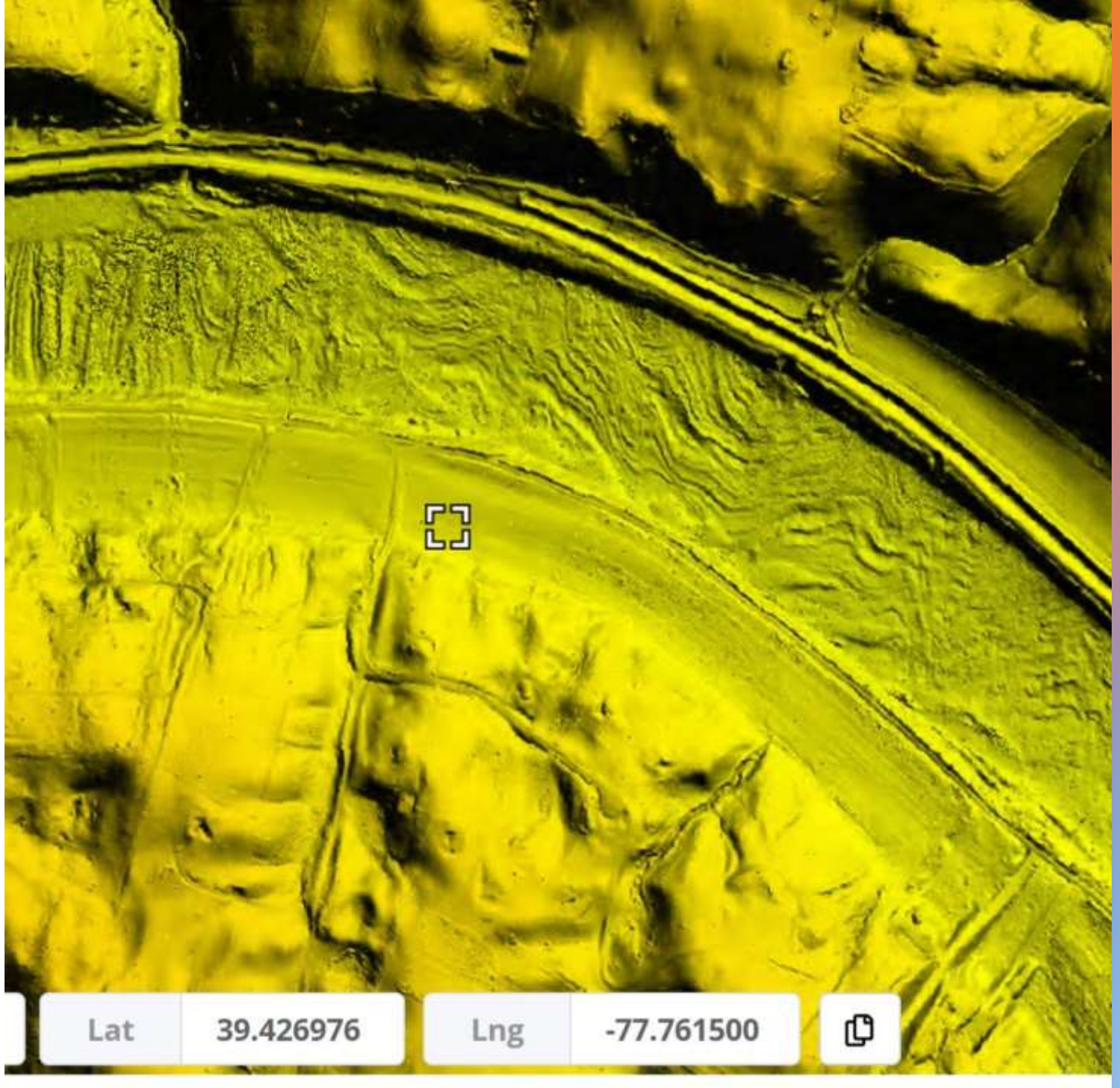
10/23/2023

ICPRB's oil spill model

- Made possible by ICPRB/USGS bathymetric LIDAR data project (2019-2021) (funding from CO-OP suppliers, USGS, DOEE)
- Current model extent: Potomac mainstem from Point of Rocks to Little Falls
- 2D flows simulated by DELFT3DOil fate and transport simulated by GNOME model (funding from DHS via MWCOG)

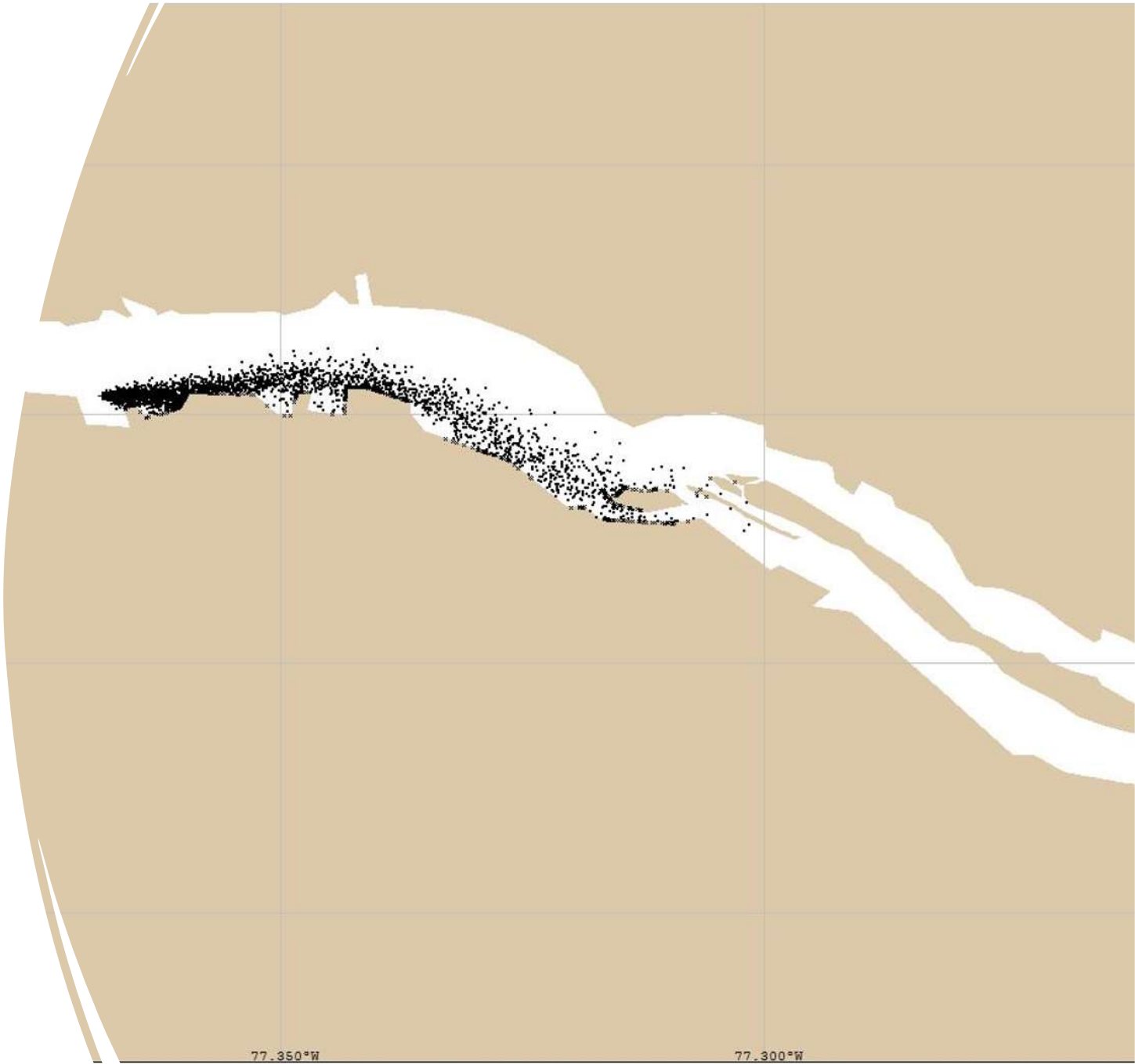


DELFT3D flow model

- Developed by Deltares
- Main inputs
  - Bathymetric data
  - Channel bed roughness coefficient
  - Flow at upstream USGS Point of Rocks gage; water level at downstream location
- Main outputs
  - Flow velocity vectors
  - Discharge

GNOME oil spill model

- Developed by NOAA
- Inputs
  - Flow velocity vectors
  - Release location & properties
  - Wind speed, …
- Outputs: longitudinal and transverse migration



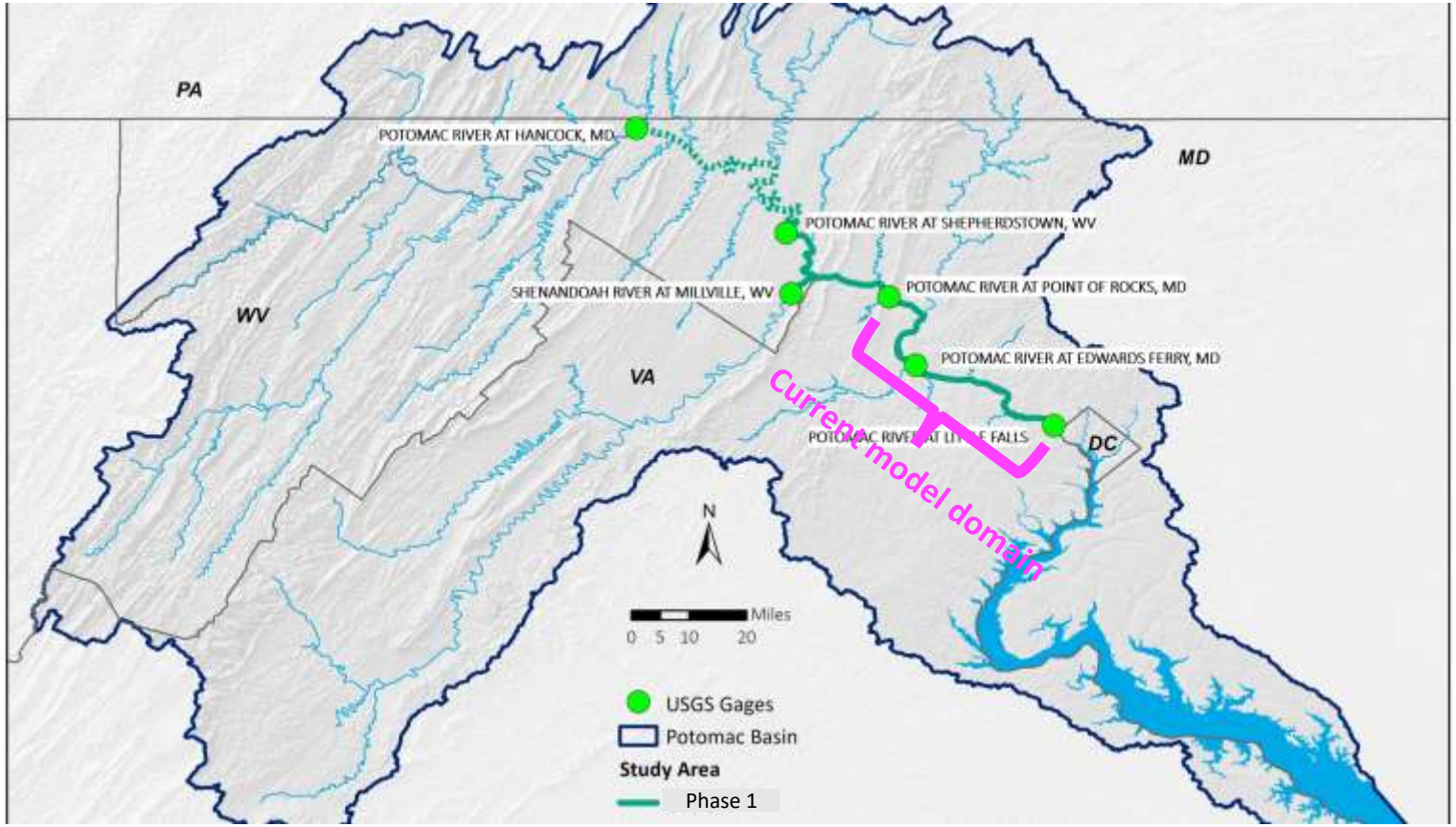
Next steps for ESRM

- FY2024: convert to R/Shiny app
  - Support from EPA 106 grant
  - Adding visual interface
  - Better ICPRB staff access – via cloud
  - Better platform for further development
- FY2025: further model development?
  - Improve spatial scale – adding small streams & overland flow
  - Add algorithms for taking into account changing flows

Next steps for ICPRB oil spill model

Potomac DELFT3D/GNOME enhancements

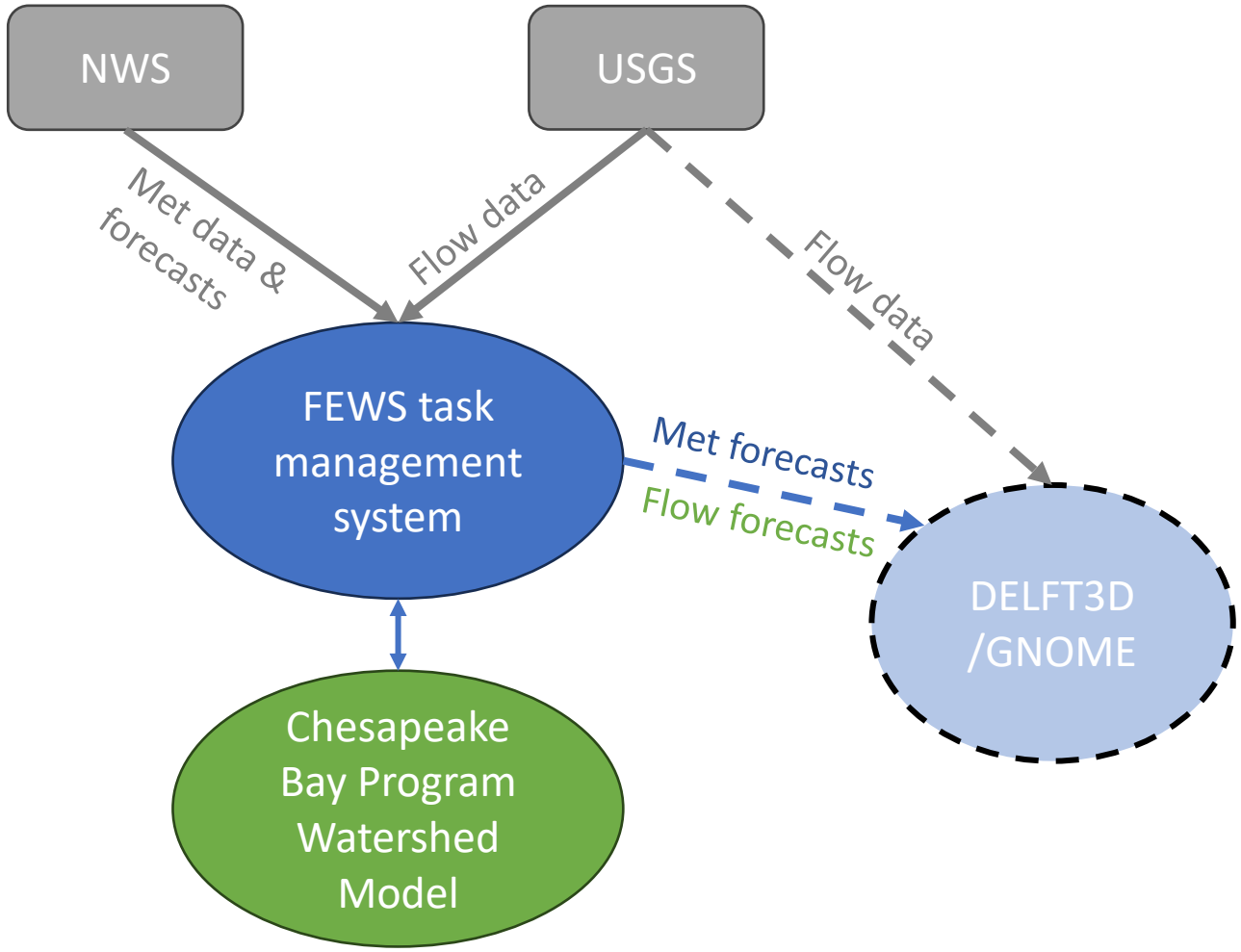
- Extend model domain
  - Currently Point of Rocks to Little Falls
  - Next step: Shepherdstown to Little Falls
  - Eventually: Hancock to Little Falls
- Refine model grid
- Add more river inflows and outflows
- Upgrade to PyGNOME



Next steps for ICPRB oil spill model

Incorporate into CO-OP's real-time forecast system

- FEWS* automatically downloads & processes data
- FEWS automatically runs Chesapeake Bay Program Watershed model
- FEWS could run DELFT3D/GNOME daily to facilitate quick configuration for real-time use



*Flood Early Warning System, Deltares

Questions?

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