Environmental Flows – Chesapeake Bay Program's Watershed Model for Hydrology

Scientific and Technical Advisory Committee (STAC) – December 2022

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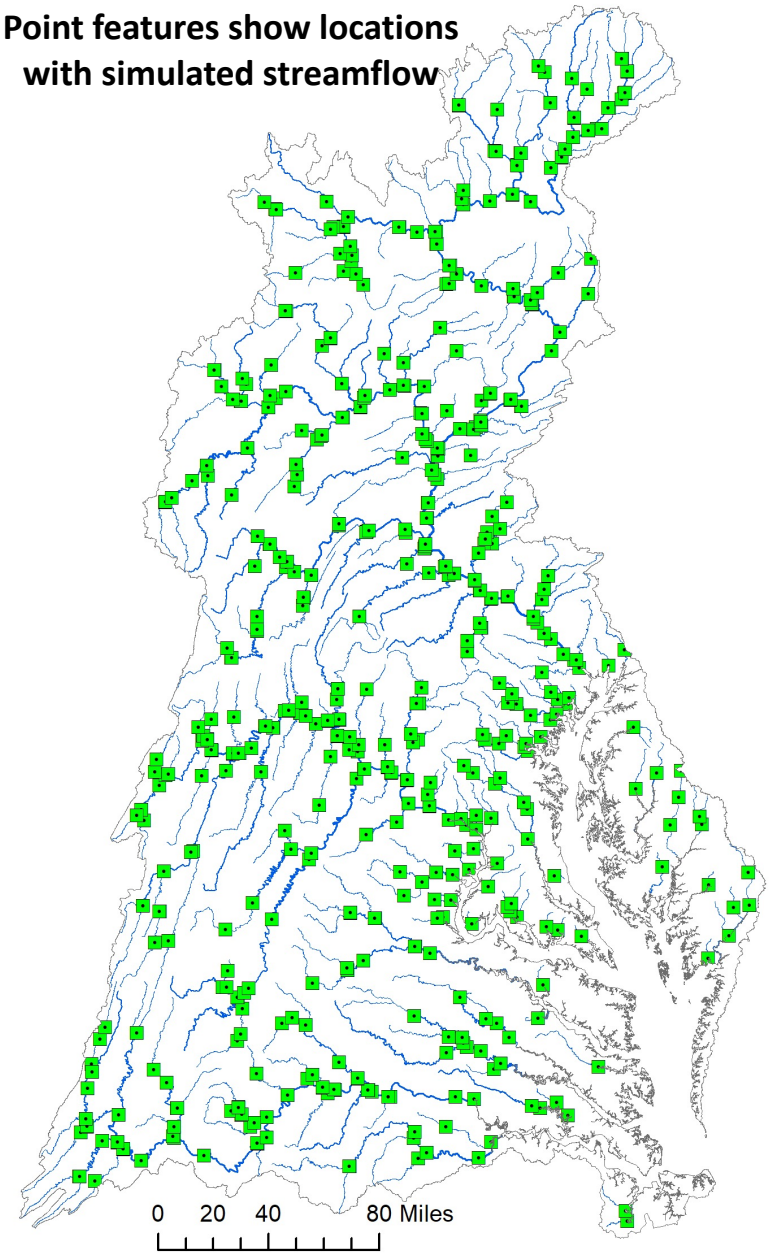
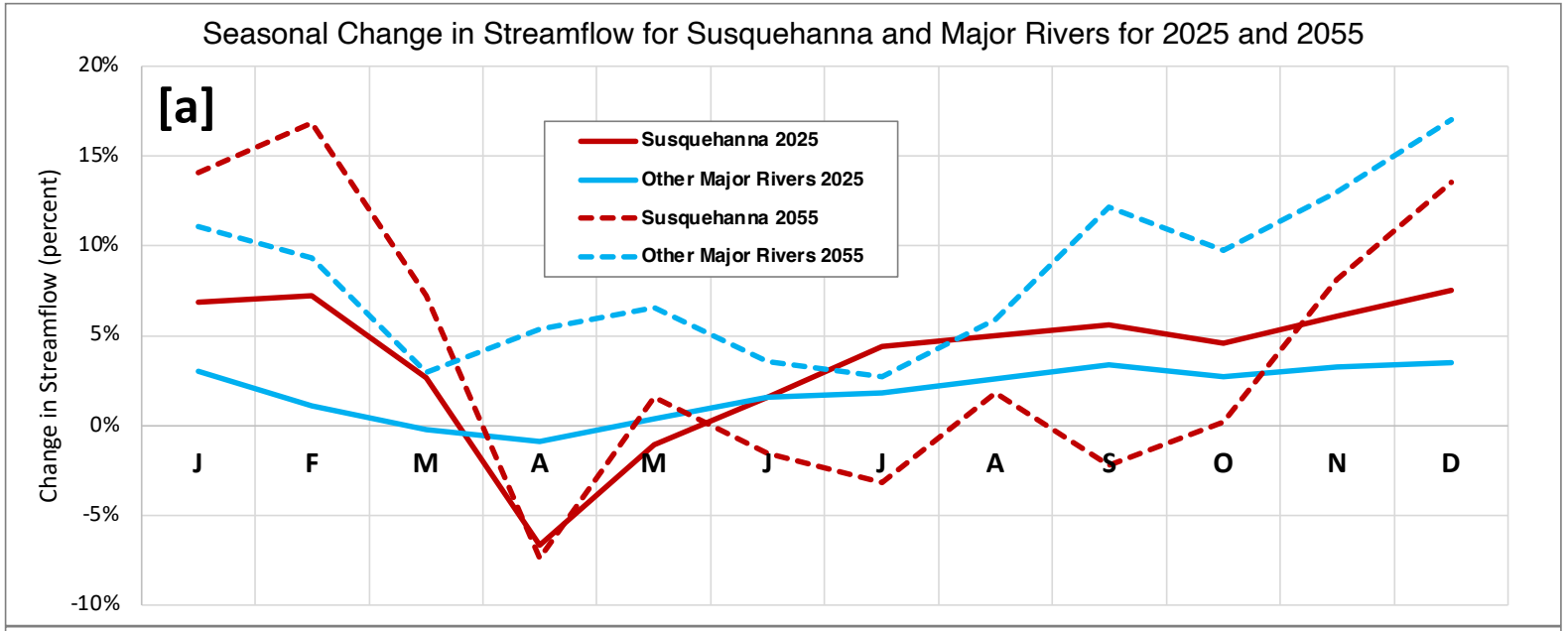
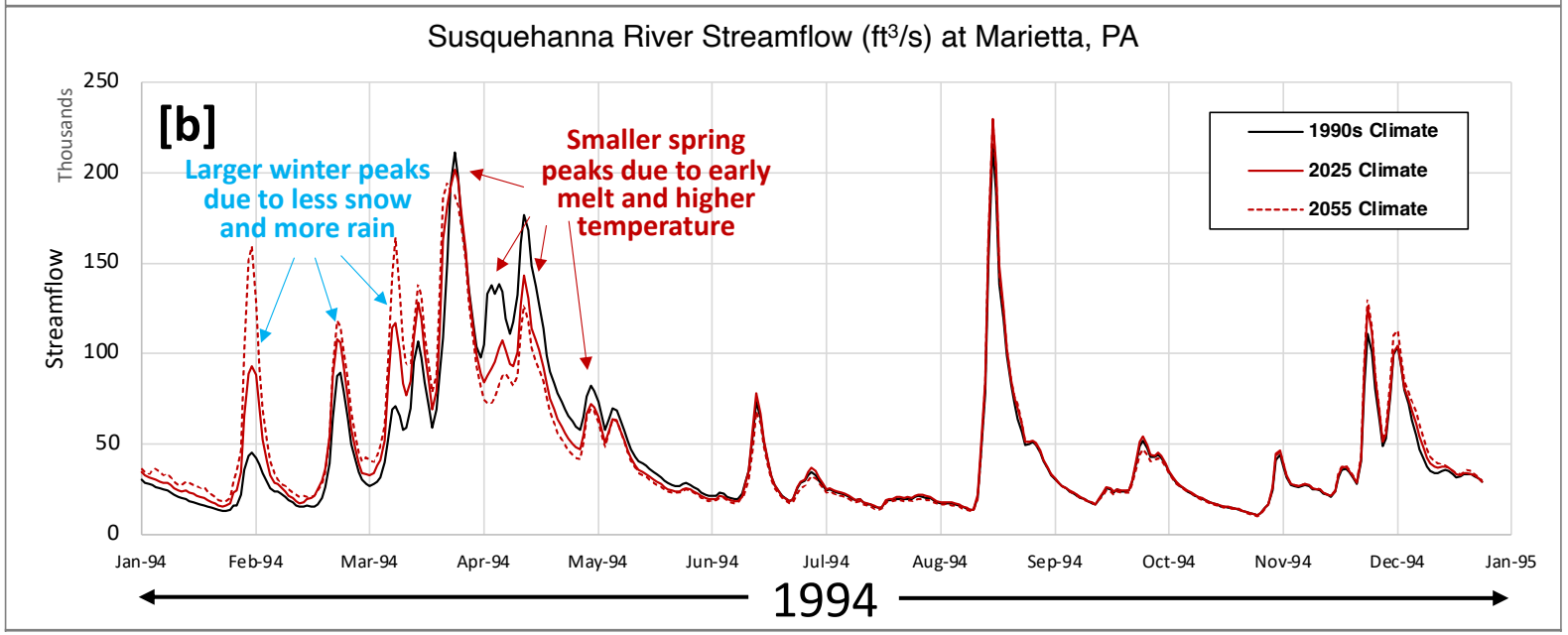
Phase 6 Chesapeake Bay Program *Dynamic* Watershed Model



- Approx. HUC-10 scale sub-watersheds and rivers.
- Model provides hourly time series of streamflow at about 600+ locations.
- Watershed Model was calibrated at about 250 streamflow stations.
- It provides the ability to simulate **changes in watershed hydrology for the scenarios of land use, and climate change (rainfall, intensity, phenology, growing days, etc.)**, which may be useful for an assessment of floods and droughts and changes in environmental flow statistics.

CBP 2021 Climate Change Assessment





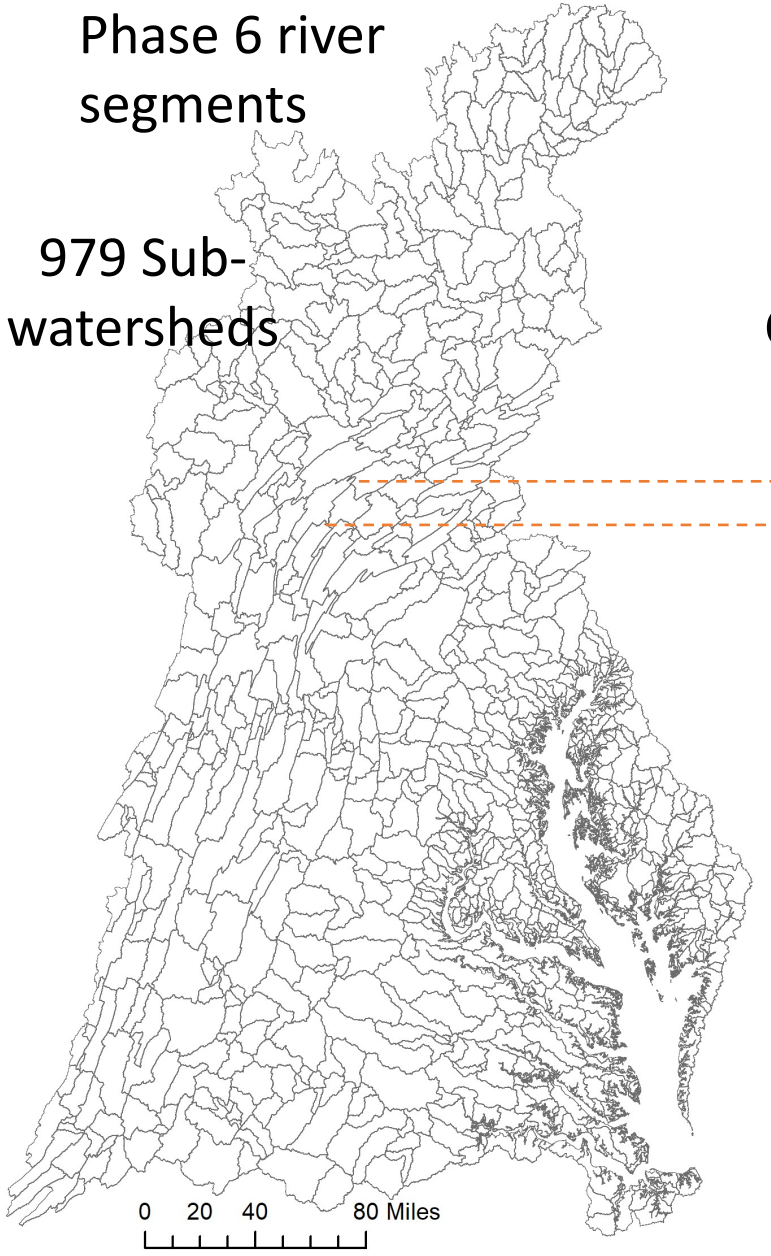
- Model results provide: **[a]** seasonal change due to 30 to 60 years of climate change, and **[b]** underlying event scale changes in streamflow (showing 1994 as an example).

- We haven't evaluated the impact on environmental flow statistics.

Phase 7 Watershed Model Development (ongoing)

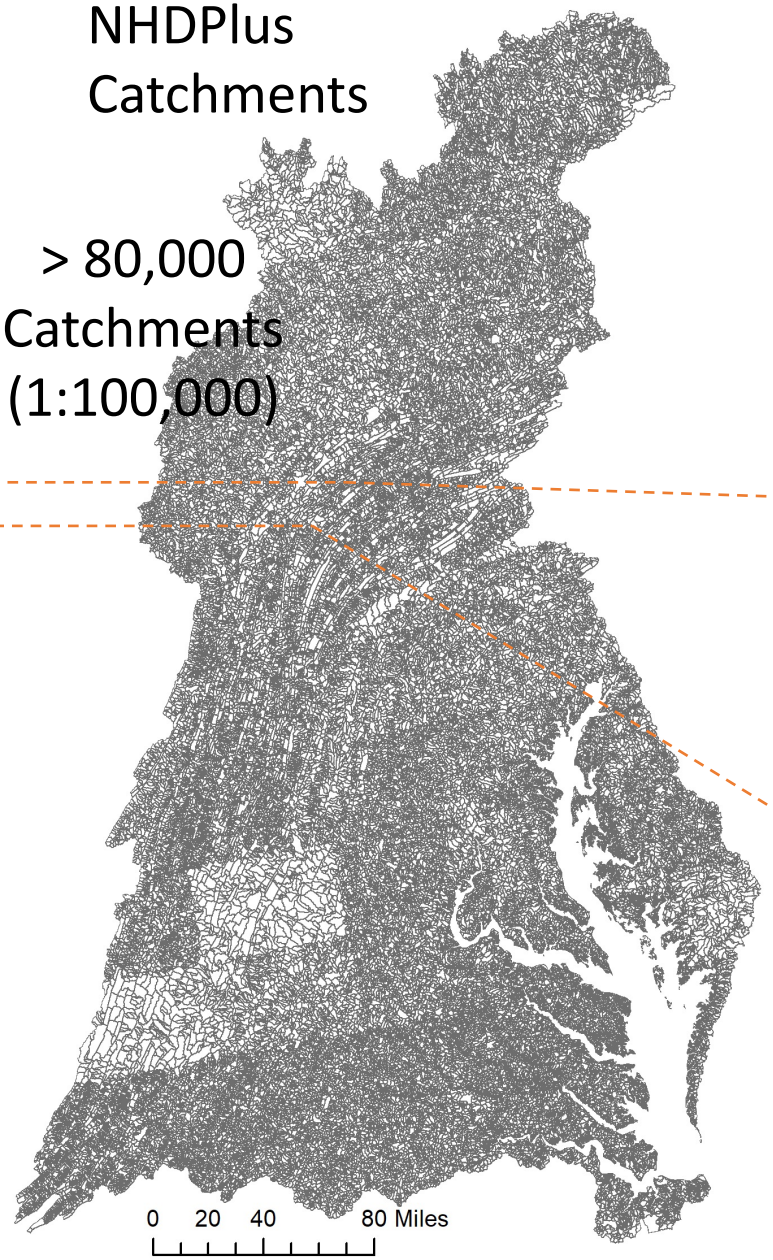
Phase 6 river segments

979 Sub-watersheds

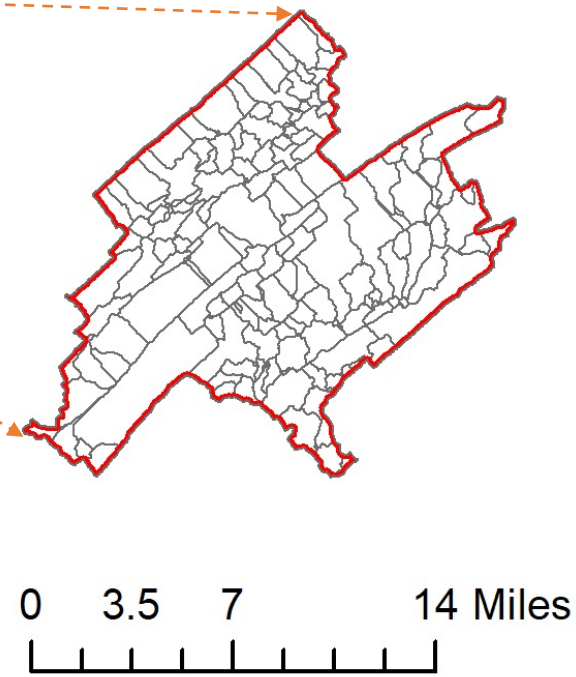


NHDPlus Catchments

> 80,000 Catchments (1:100,000)



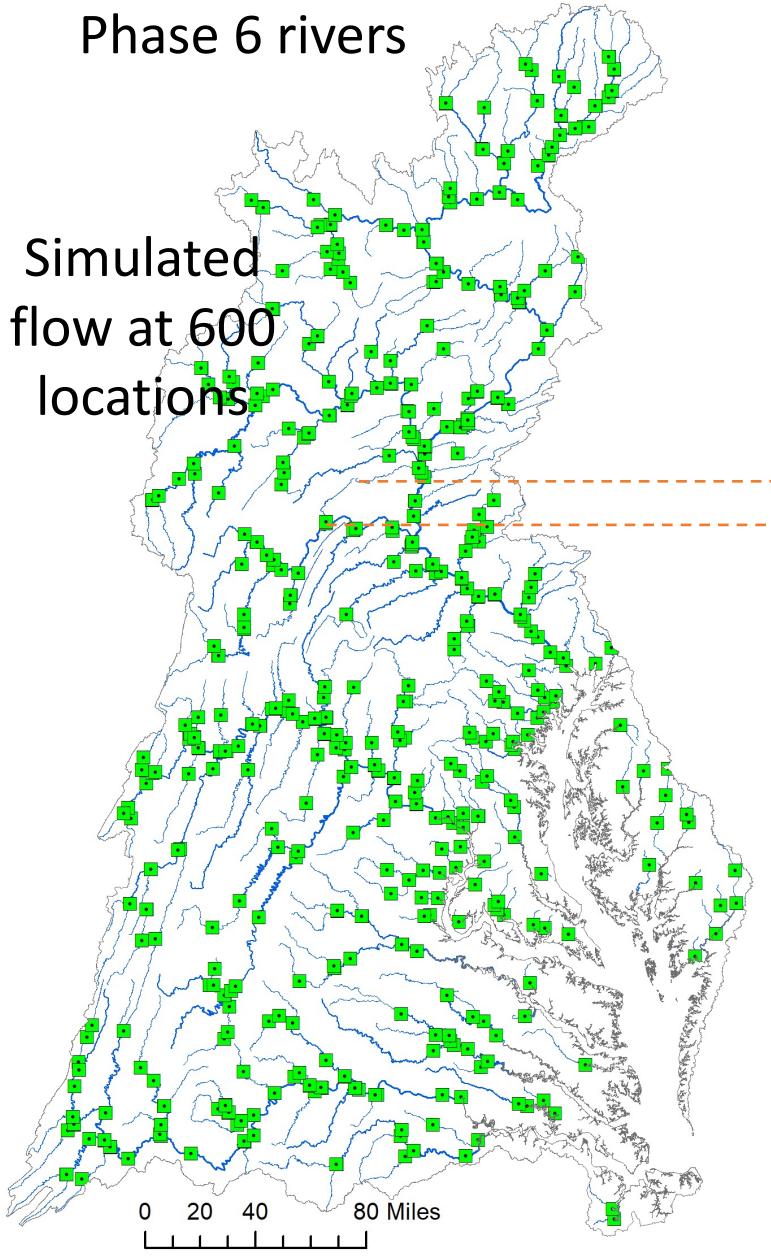
- Simulation at NHD catchments would be considerably finer scale than that of Phase 6 (approx. 80x)
- Ability to represent watershed characteristics at finer scale



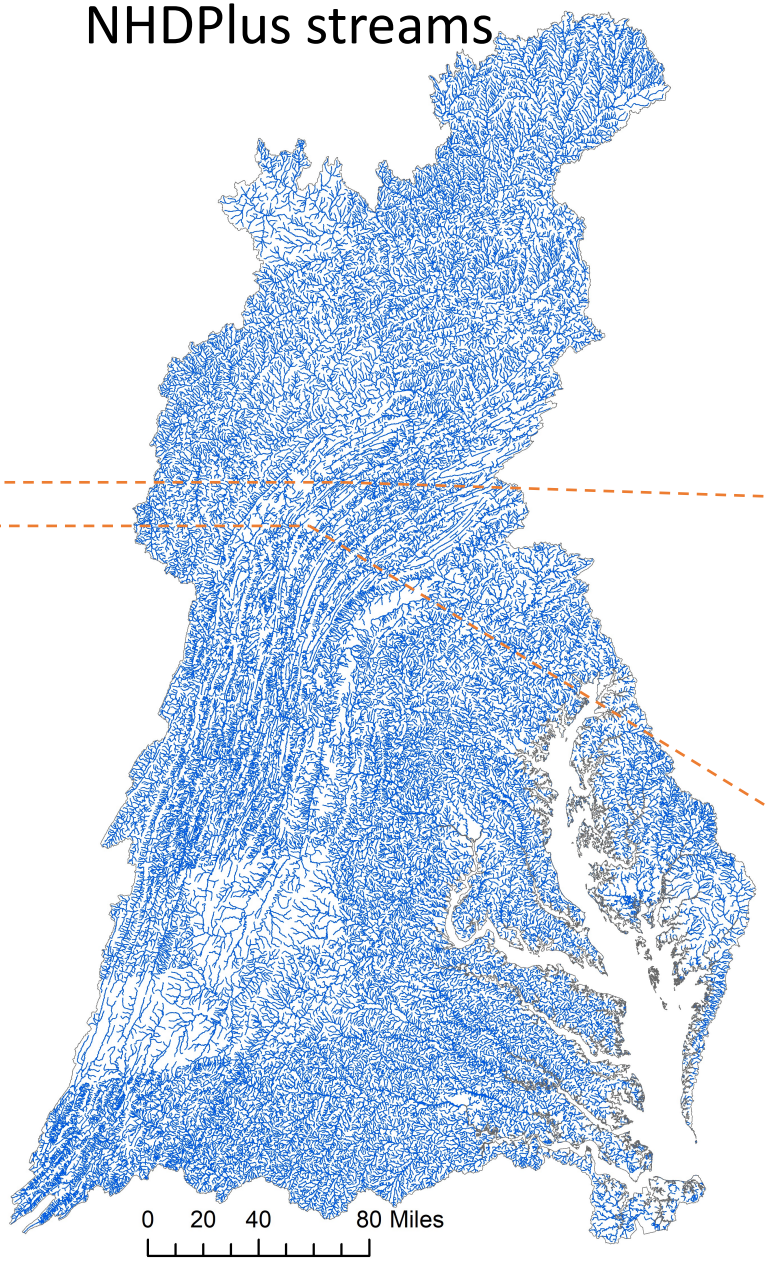
Phase 7 Watershed Model Development (ongoing)

Phase 6 rivers

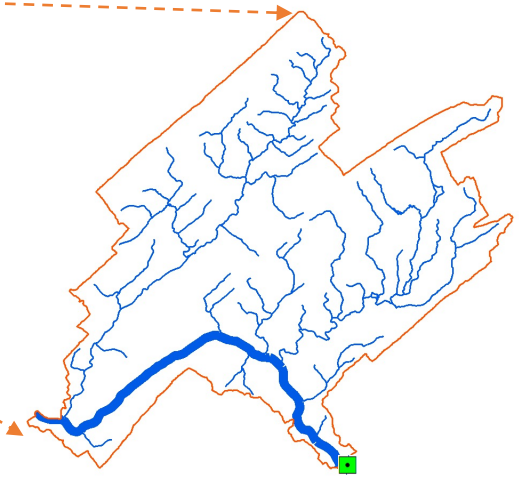
Simulated flow at 600 locations



NHDPlus streams

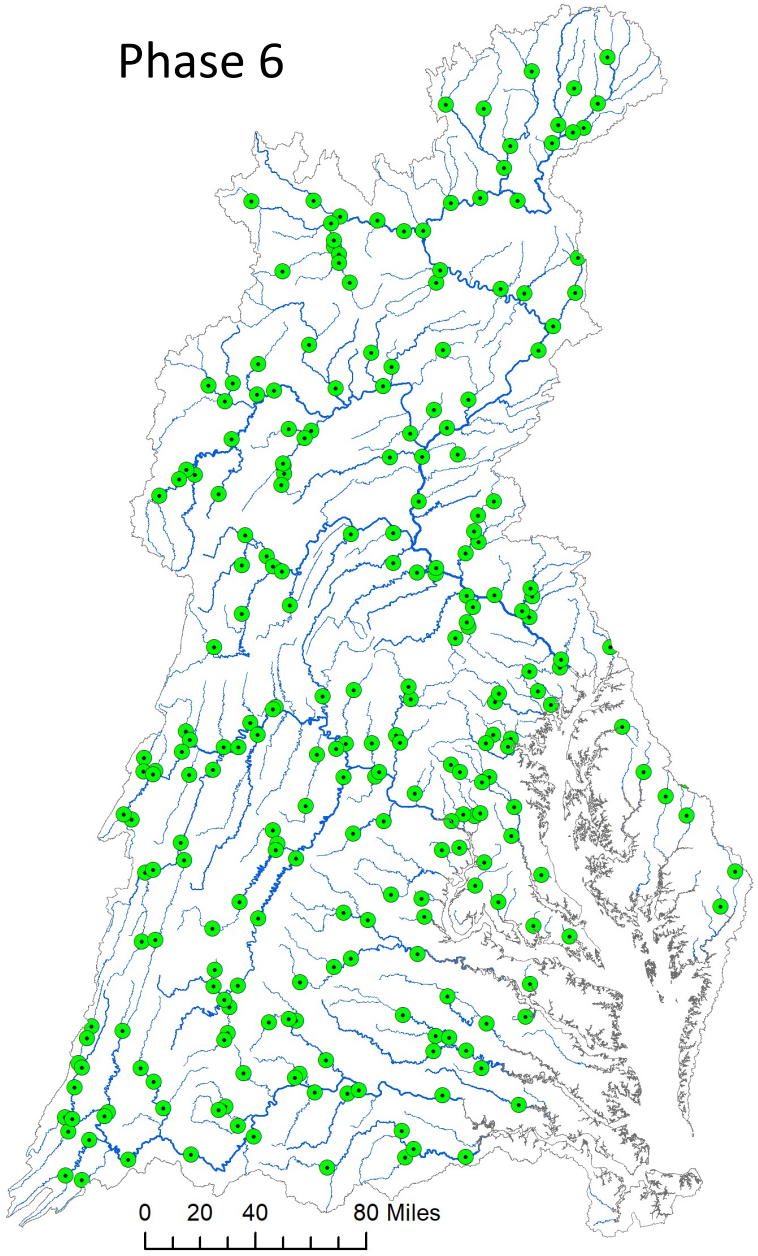


- Model outputs of riverine fluxes (streamflow timeseries) at finer spatial scales



Streamflow Monitoring Data – Model Calibration & Evaluation

Phase 6



NHDPlus

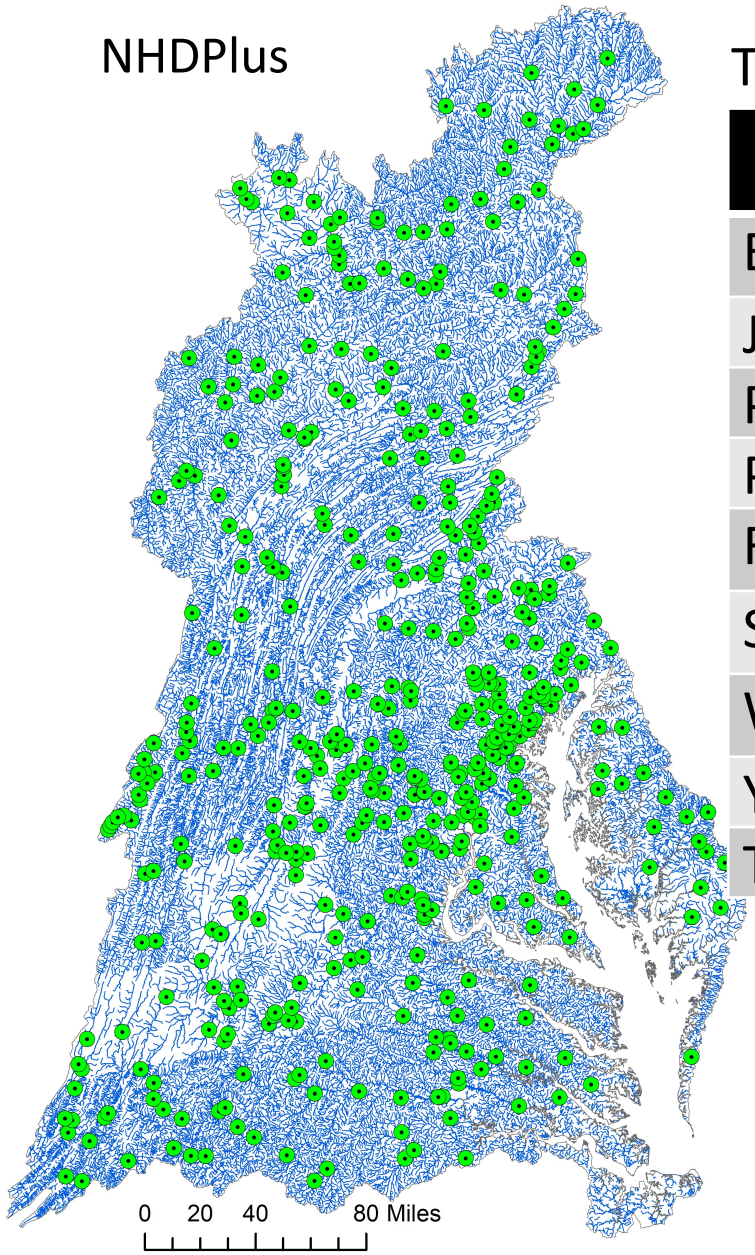


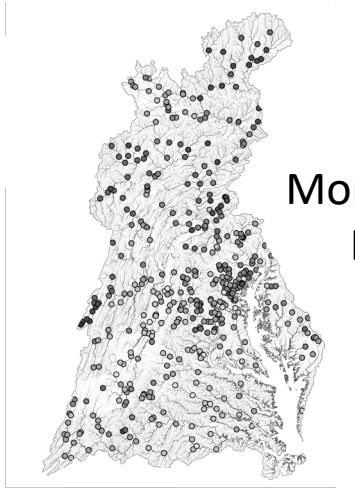
Table: Streamflow calibration stations

Major Basins	Phase 6	NHD
Eastern Shore	7	23
James	40	52
Patuxent	7	14
Potomac	68	141
Rappahannock	8	12
Susquehanna	101	159
Western Shore	7	49
York River	8	17
Total	247	**467**

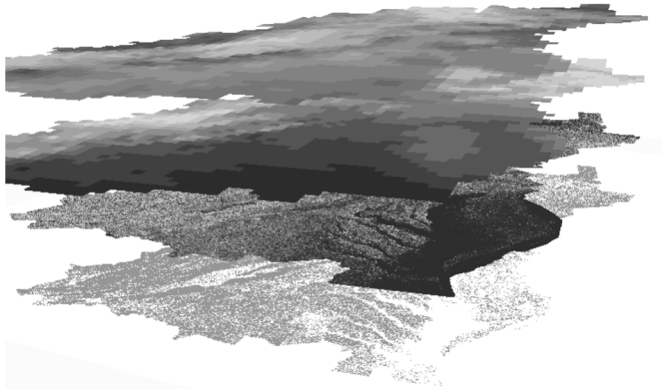
Stations with flow data during 1985 to 2019

i.e., finer-scale watershed data and monitoring

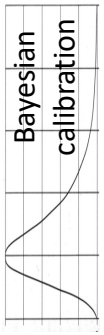
Linked Statistical and Process-based Models



Monitoring Data + Watershed characteristics & inputs



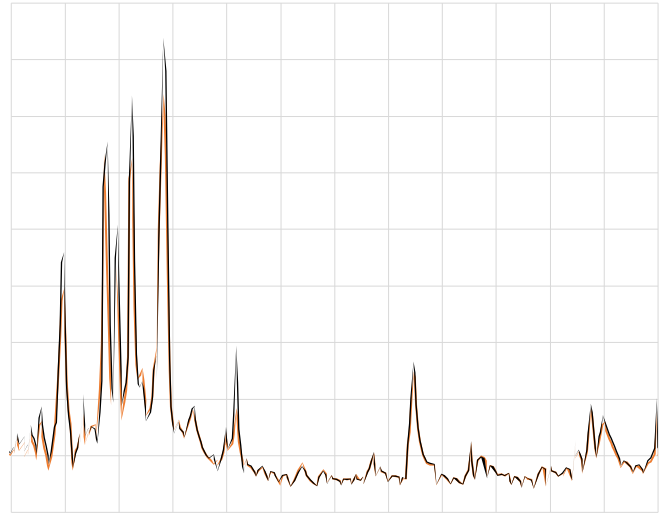
CalCAST spatial estimates



Average Annual flow estimates for land uses & NHD catchments

Dynamic Model hourly estimates

Meteorological inputs, DM parameters



- Currently, statistical models provide spatial estimates of total- and storm- flows
- Dynamic model uses them in the calibration of model parameters with respect to multiple hydrograph statistics (e.g., winter flow, summer flow, etc.)

Summary

- Brief review of the Phase 6 and ongoing development of the Phase 7 Chesapeake Bay Watershed Model.
- The Phase 7 model development will be completed by the end of CY 2025, and partnership review will occur during CY 2026, and it will be ready for application at the beginning of CY 2027.

- **There are opportunities for incorporating suggestions or resources that are out there that should be included for supporting shared management goals.**

- **What management actions are important for the environmental flows and should also be included in the model?**