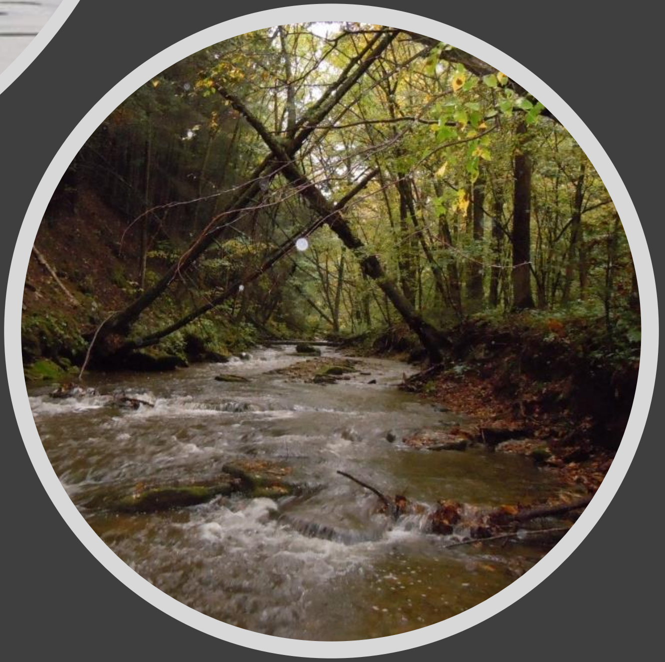

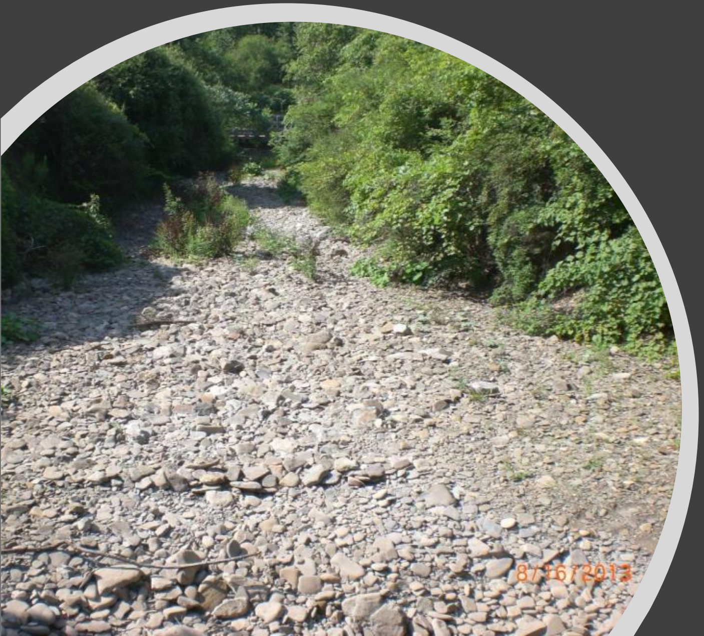

Current USGS Related Environmental Flows Activities

Kelly O. Maloney

USGS, Eastern Ecological Science Center at Leetown

kmaloney@usgs.gov

Chesapeake Bay Program's STAC Quarterly Meeting

Environmental Flows Theme

07 December 2022

USGS

Current USGS Related Environmental Flows Activities

Three main approaches to establish flow-ecology relationships:

1) Modeling to link ecological endpoints to flow metrics derived from gage hydrographs.

2) Modeling to link ecological endpoints to outputs from hydrodynamic models.

3) Field based focused studies to intensively link ecological endpoints to measures of the hydrologic regime.

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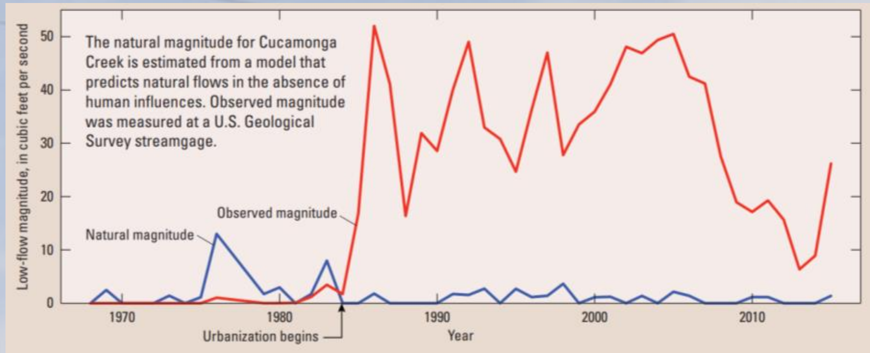
National Effort Quantifying Flow Alteration



Daren Carlisle, Ken Eng, Taylor Woods, Kelly Maloney,
Karen Ryberg, Matthew Cashman, Mike Meador

USGS gaged sites (~4000, ~2000 reference)

Types of Flow Metrics:

- High and low flows (magnitude, frequency, & duration)
- Seasonal timing (more/less flow events, & shifts)

Observed Conditions:

- Calculated at gaged locations record or by using models (e.g., LSTM graphical neural network)

Prediction of Expected Natural Flows at non-Reference gages:

- Machine learning dynamic models (predicts time-series of year – month specific flows and/or annual time series) using antecedent hydroclimate.

Measure of Alteration:

- Each flow metric was then categorized as Inflated, Diminished, & Indeterminant based on the ratio of Observed/Naturally Expected.

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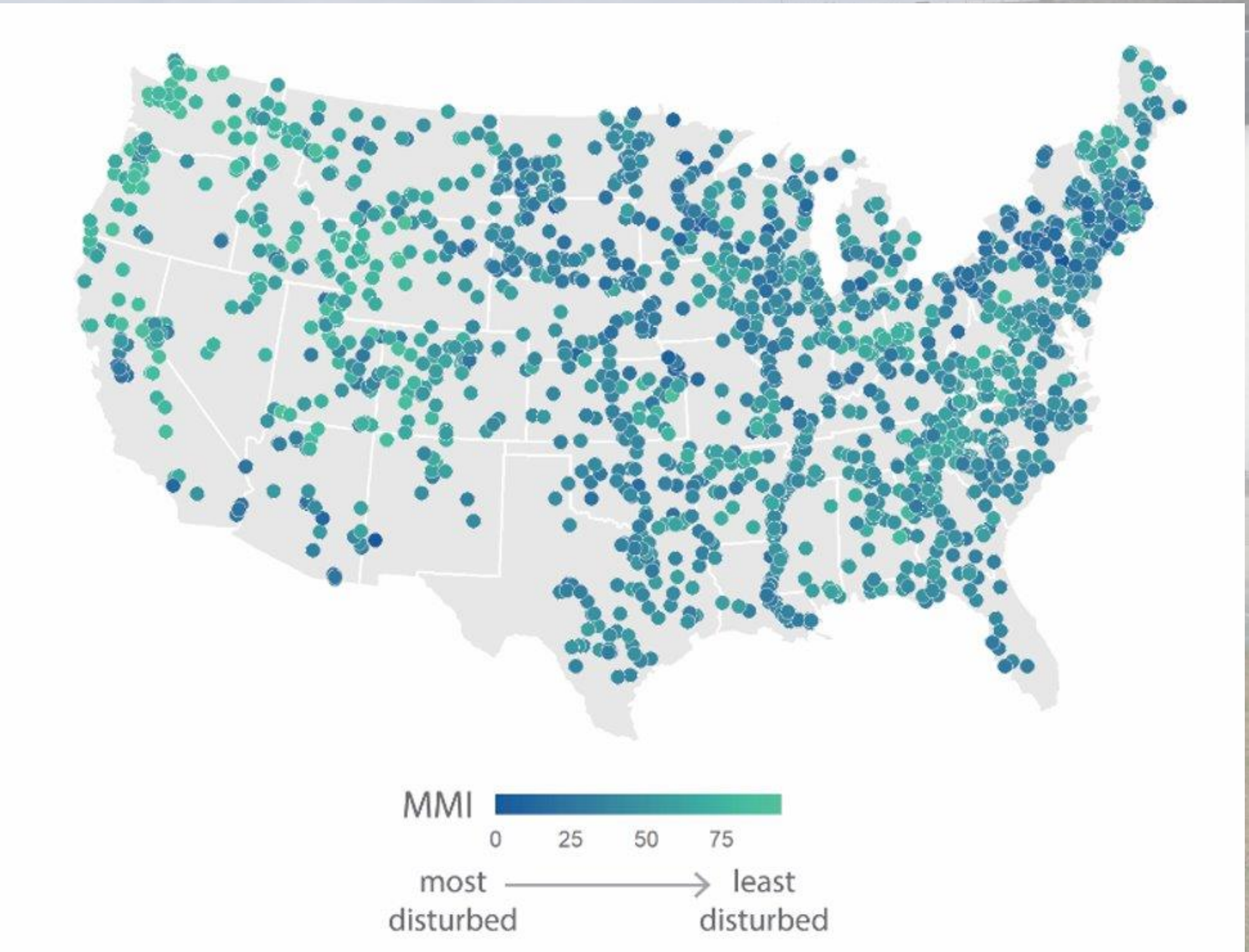
National Effort Quantifying Flow Alteration

Next step is to use paired gage:biological data to build a calibrated model that links flow alteration to stream fish communities.



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Evaluate Hydrologic Metrics (HM) for basins in the Chesapeake Bay Watershed

Sam Austin

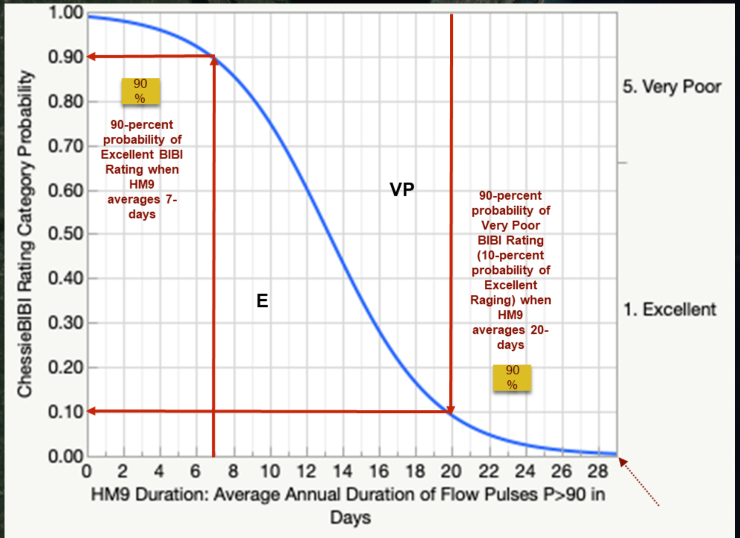
Q. *“Do locally computed HM show promise as indicators of Chessie BIBI Stream Health and ecological limit criteria?”*

Scope – to estimate likelihood of Chessie BIBI stream health indicator rating as functions of HMs computed for 647 basins.

-

Methods – maximum likelihood logistic regression, random forest modeling.

Results – Chessie BIBI rating probabilities as function of HMs.



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Linking Altered Flow to Stream Condition (Chessie BIBI)

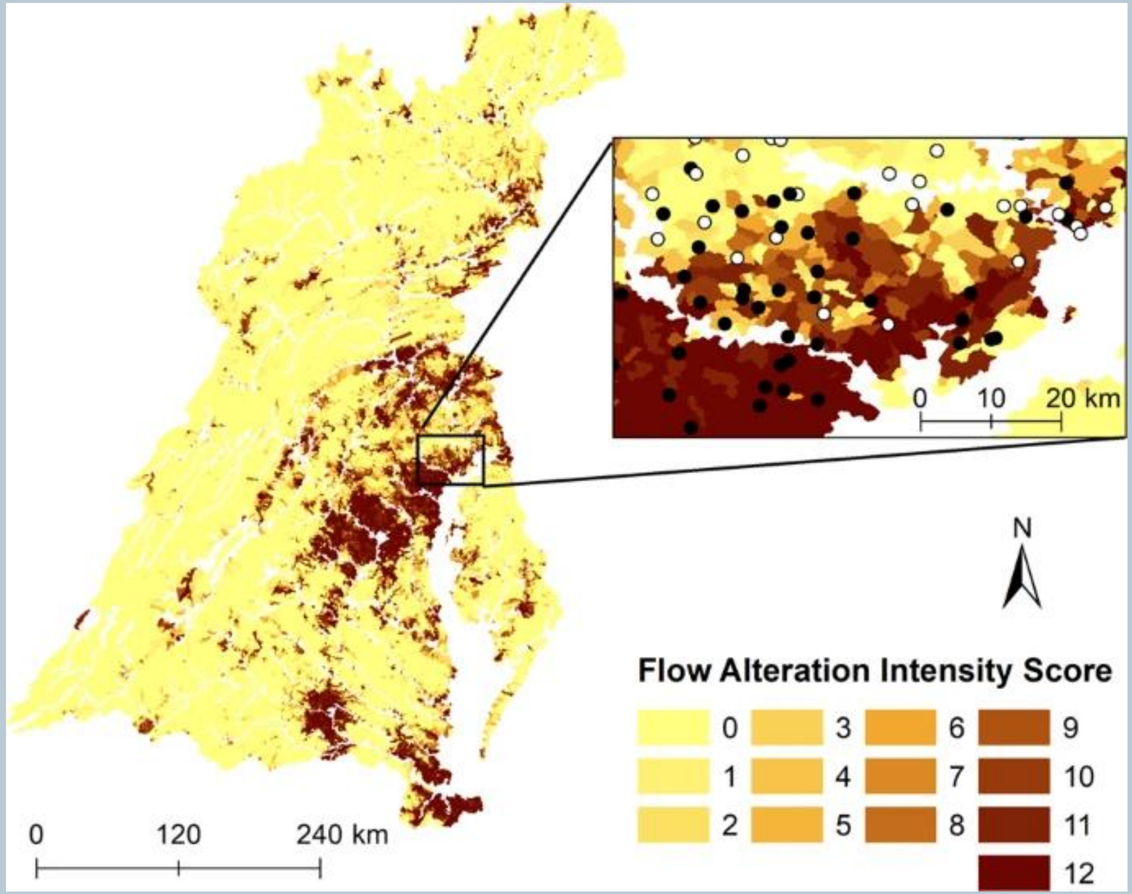
Maloney et al. recently completed (2021)

Environmental Management (2021) 67:1171–1185
https://doi.org/10.1007/s00267-021-01450-5

Check for updates

Linking Altered Flow Regimes to Biological Condition: an Example Using Benthic Macroinvertebrates in Small Streams of the Chesapeake Bay Watershed

Kelly Oliver Maloney[1] · Daren Milo Carlisle[2] · Claire Buchanan[3] · Jennifer Lynn Rapp[4] · Samuel Hess Austin[4] · Matthew Joseph Cashman[5] · John André Young[1]



12 Hydrologic metrics

Inflated, Diminished, & Indeterminant (Observed/Natural Expected)

Used machine learning to predict each HM status for streams in the watershed with drainages < 200 km^2

Degraded Chessie BIBI condition 3.8–4.7 more likely in a flow altered site (8.7–10.8 higher in urban sites).

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Potomac River Basin – Bathymetric Lidar, 2-D modeling and habitat

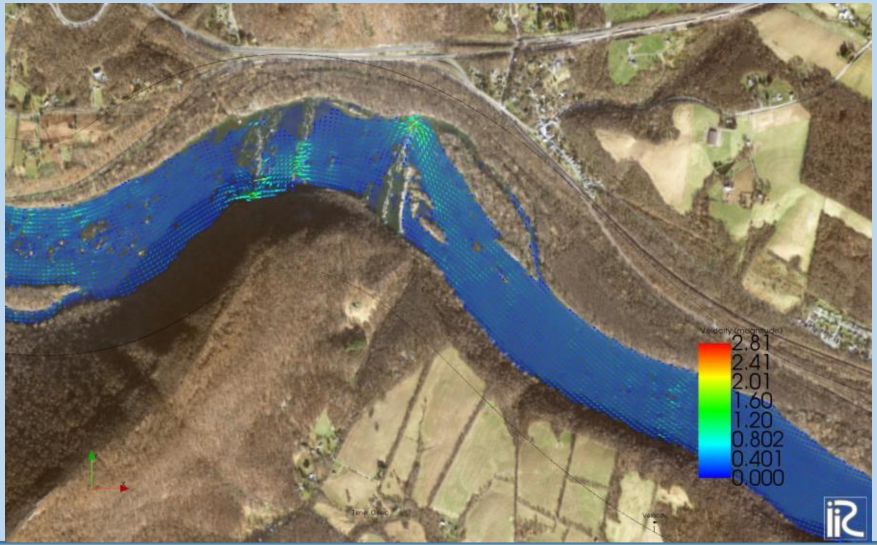
John Young (USGS – EESC)

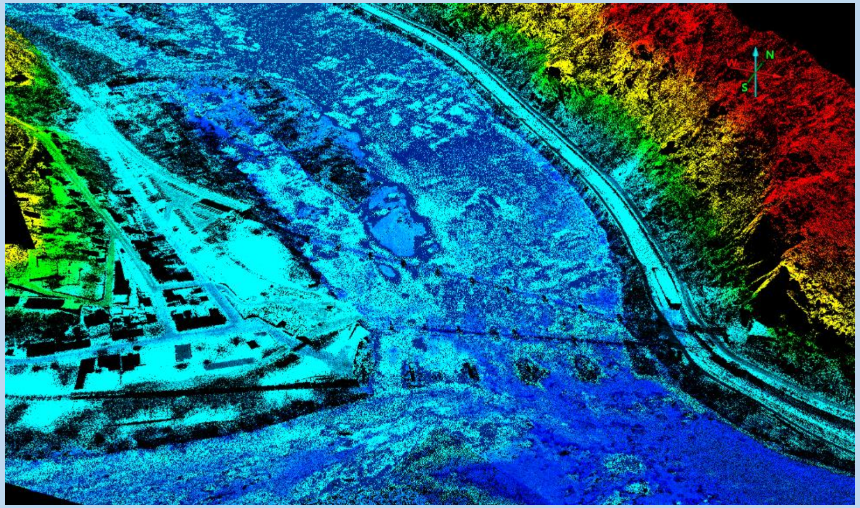
Interstate Commission on the Potomac River Basin. 2022. Potomac Environmental Flows Workshop, 2022. ICPRB Report ICP22-4.

A workshop was held in May of 2022 by the ICPRB to discuss:

1. Whether there are new approaches for determining environmental flows in large, relatively unregulated rivers like the Potomac?
2. What data, analysis tools, and assessments are needed to make a scientifically defensible change to flow-by requirements?

A key data source now available is a **bathymetric lidar dataset** covering 118 miles of the non-tidal Potomac which enables 2D hydrodynamic modeling of flow.





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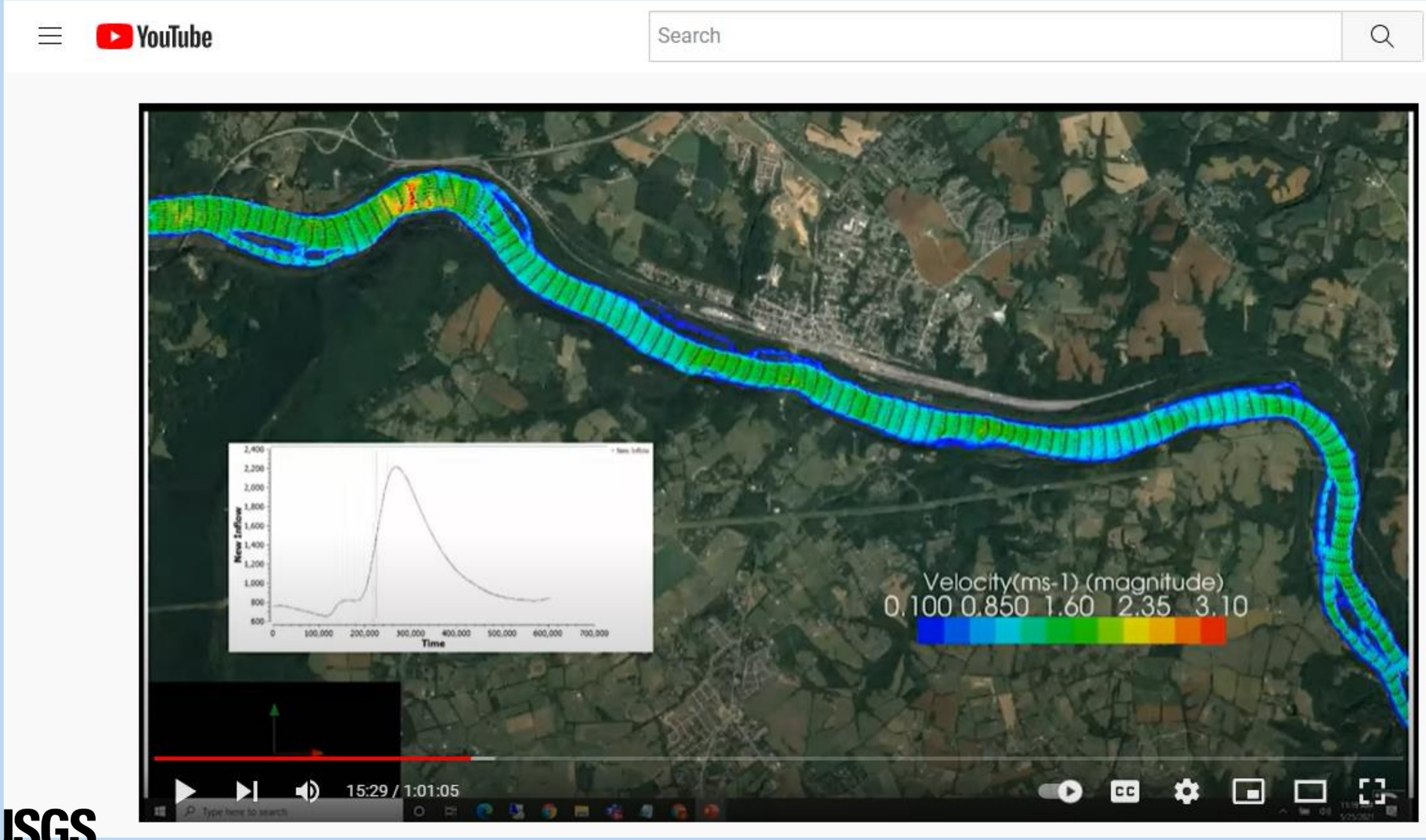
Potomac River Basin – Bathymetric Lidar, 2-D modeling and habitat



Jon Nelson and Paul Kinzel, USGS

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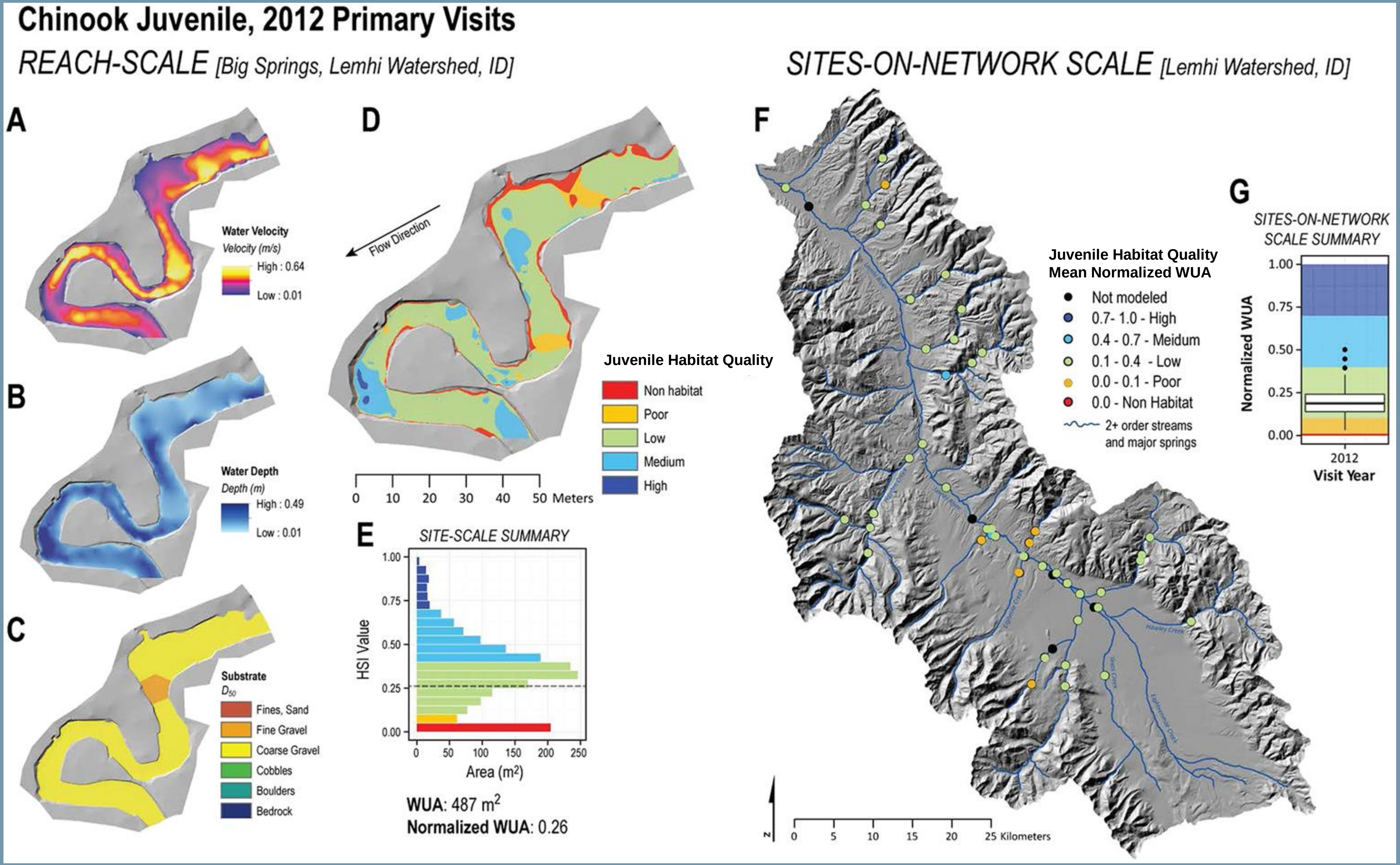
Upscaling site-scale ecohydraulic models to inform salmonid population-level life cycle modeling and restoration actions – Lessons from the Columbia River Basin (Wheaton et al. 2018)



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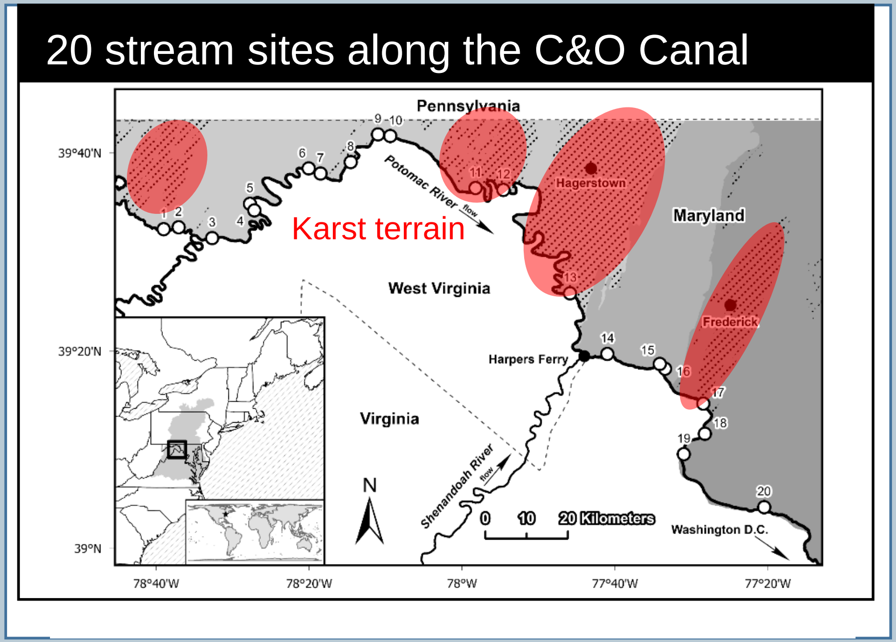
New framework to predict ecological responses to climate change in the Chesapeake Bay headwaters

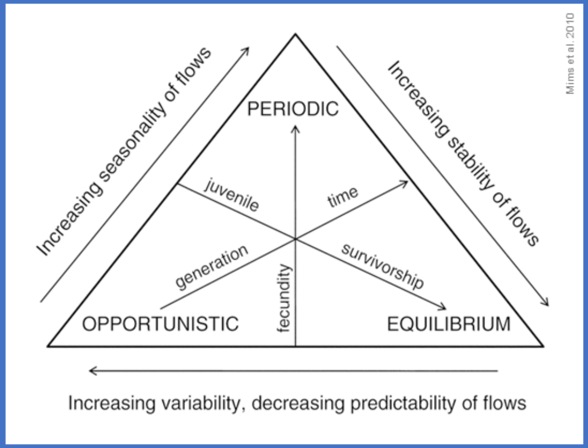
Nathaniel (Than) Hitt - EESC



Opportunistic strategists increased with low-permeability soils that produce flashy runoff dynamics and decreased with karst terrain (carbonate bedrock) where groundwater inputs stabilize stream flow and temperature

Hitt, N.P., Landsman, A.P. and Raesly, R.L., 2022. Life history strategies of stream fishes linked to predictors of hydrologic stability. Ecology and Evolution, 12(5), p.e8861.

Stable stream flows support **equilibrium-type** fishes and **flashy** flows support **opportunistic-type** fishes

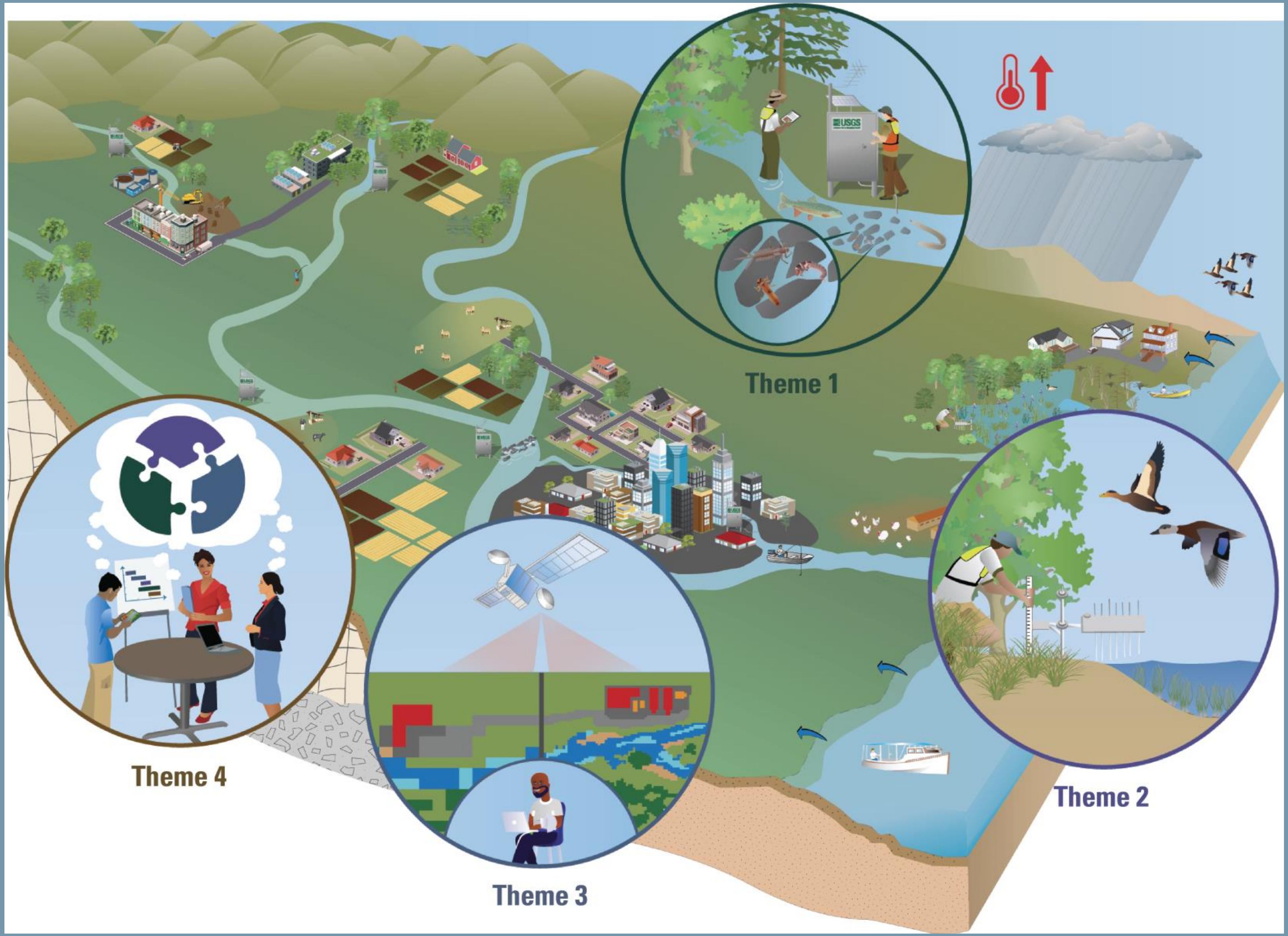


This provides a framework to understand **ecological responses to destabilized environmental conditions** under global climate change

USGS Chesapeake Science Themes

Landscape Approach

1. Stream health, fish habitat and aquatic conditions
2. Coastal habitats and waterbirds
3. Landscape data and change
4. Integrate science and inform decisions



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