STAC Science Updates

Lisa Wainger, PhD, STAC Chair
& University of Maryland Center for Environmental Science

Three Science Issues with Potential Policy Implications

Courtesy of Chesapeake Bay Program

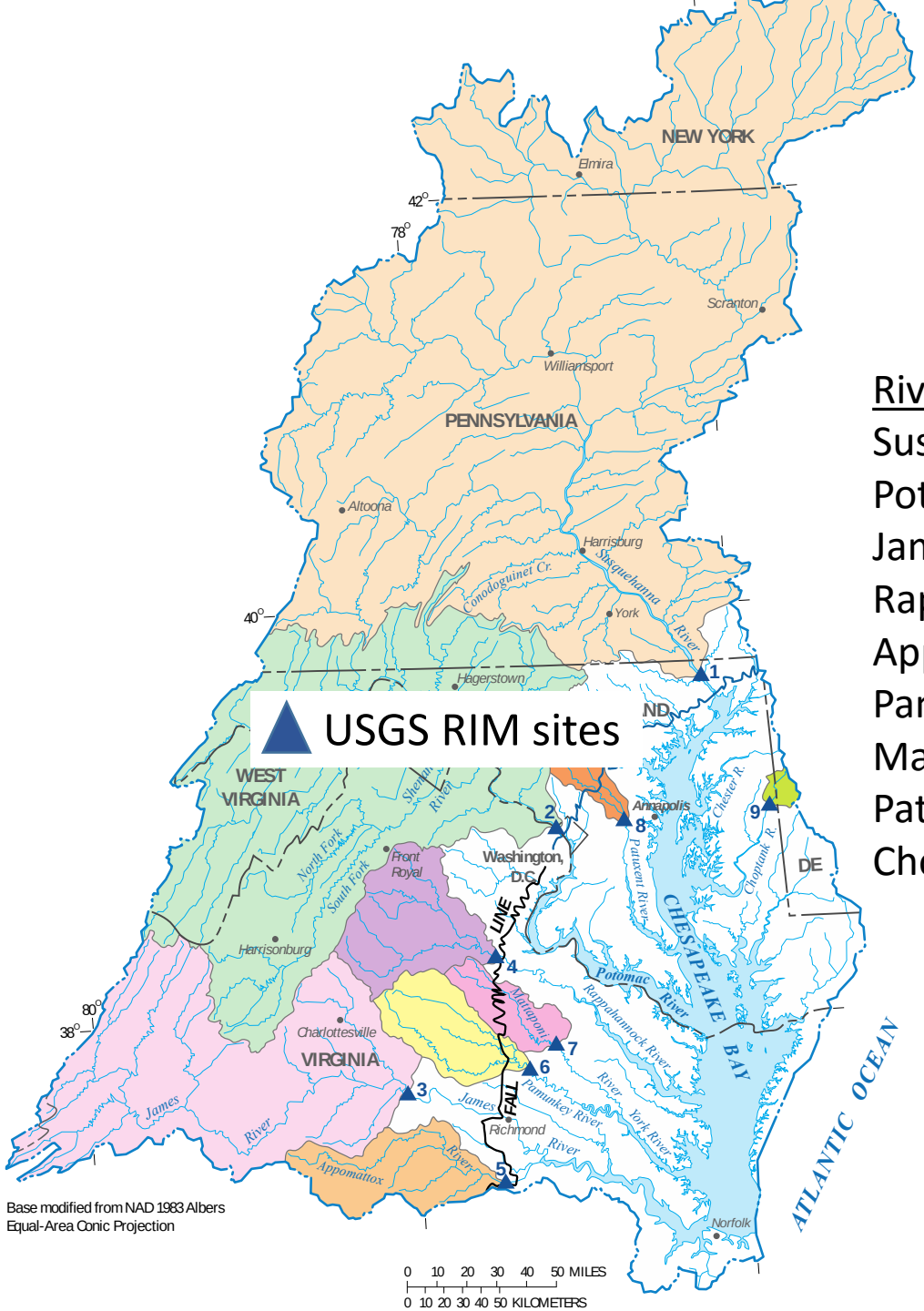
1. P trends in Bay
2. Lag times being incorporated into Bay watershed model
3. Invasive catfish

1. Trends in nutrient inputs to Bay (2005-2014)

Bob Hirsch, USGS

Data sources

1. 9 monitoring sites of river inputs (flow-normalized) (78% of watershed)
2. Wastewater discharges (WWTPs)
3. Non-point source loads
4. Atmospheric N deposition



Rivers included

Susquehanna
Potomac
James
Rappahannock
Appomattox
Pamunkey
Mattaponi
Patuxent
Choptank

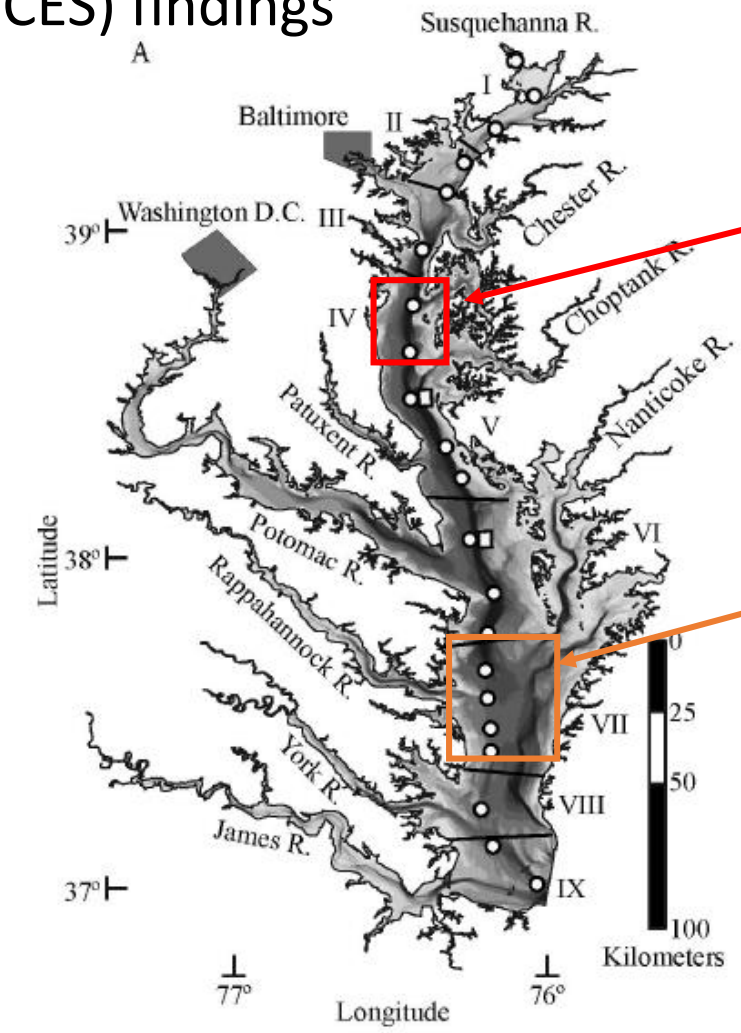
Changes in nutrient inputs 2005-2014

Hirsch Preliminary Findings

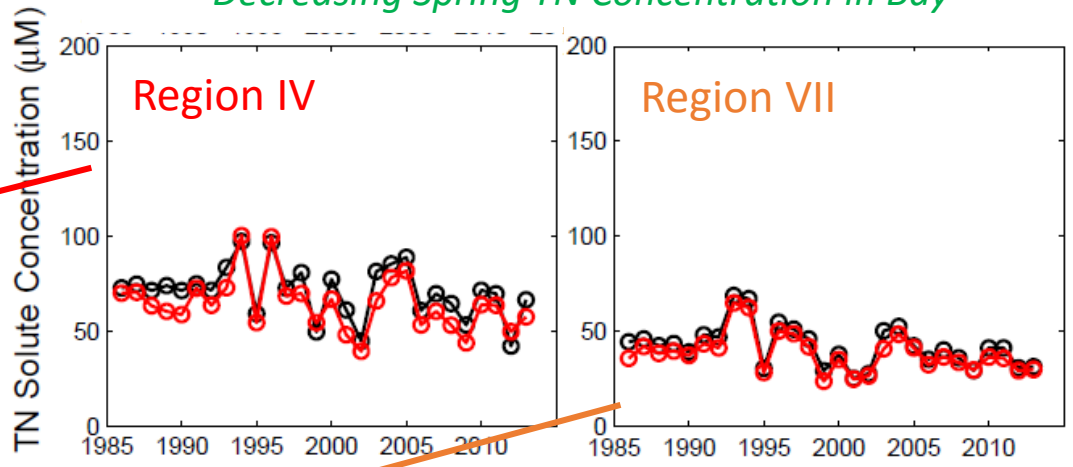
- Total **nitrogen decreased** about **7%**
- Total **phosphorus increased** about **10%**.
- This general pattern is a continuation of trends seen since about 1995.
- It is difficult to project this trend into the future, but an upcoming STAC workshop (January 13-14) will focus on the role of Conowingo dam and other factors.

Reduced N inputs are reflected in Bay N concentrations but early season chl-*a* trend varies

J. Testa (UMCES) findings



Decreasing Spring TN Concentration in Bay



Early season chlorophyll-a increasing

Early season chlorophyll-a decreasing

Management questions and implications

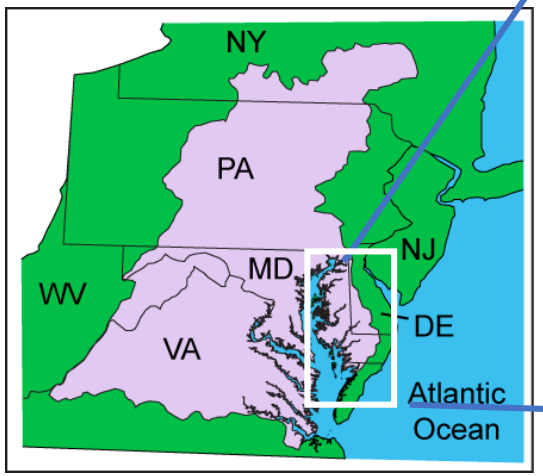
- Sources of P not well understood
  - bioavailable dissolved P vs particulate P - important for understanding ecological impacts
- Concern has been raised that increased P could promote toxic algae but needs further investigation
  - High P is associated with toxic algae blooms in freshwater lakes
  - Upper Bay has fresh water – like lakes
  - BUT – is well-flushed – unlike lakes
- STAC is hoping to explore this area more fully at next meeting
- Collaboration among researchers (USGS, CBP, UMCES) is ongoing to examine whether in-water P conditions track with P inputs.

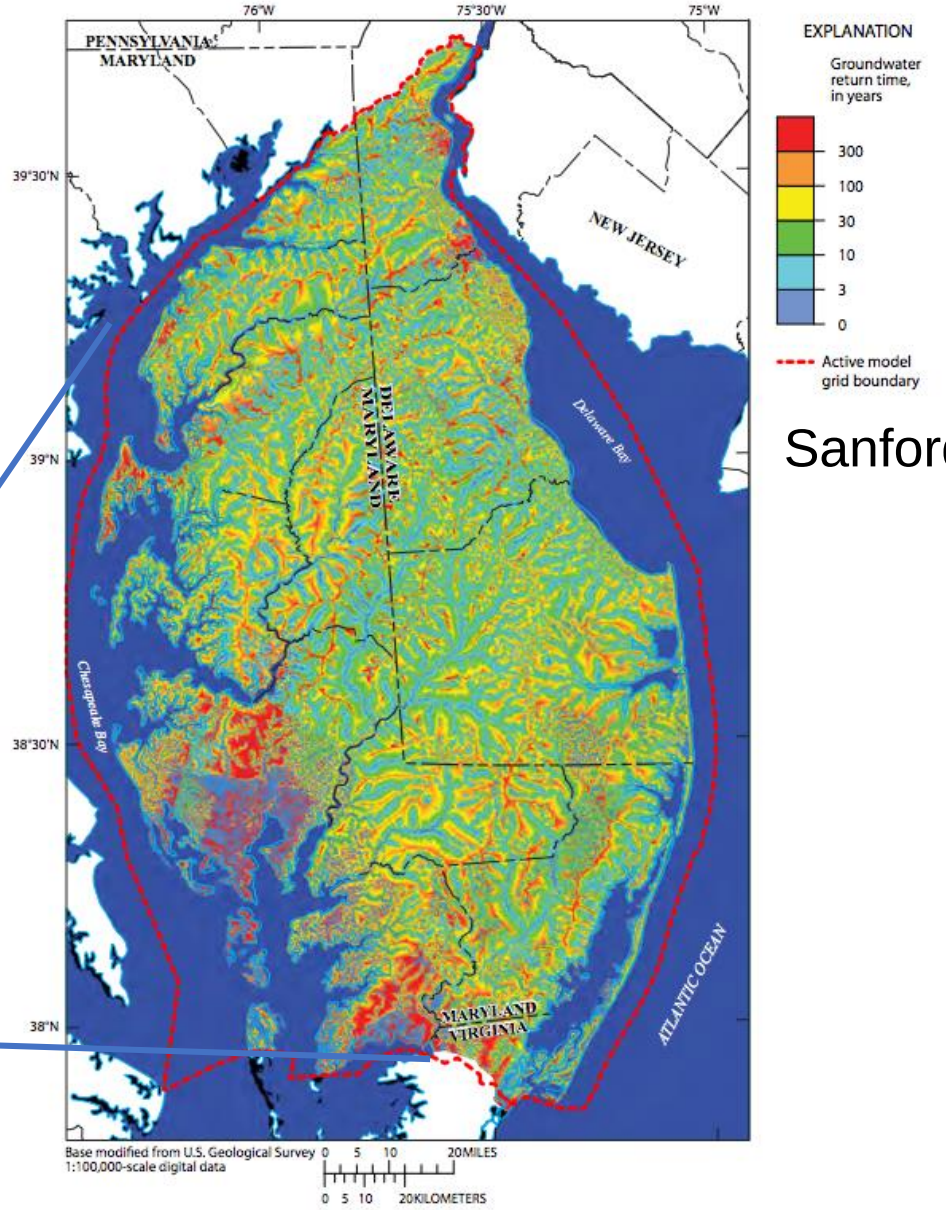
2. How groundwater lag times were incorporated into the Chesapeake Bay Watershed Model (CBWM)

1. STAC raised concerns that ignoring lag times could mis-represent Bay response to management efforts
2. Groundwater lag times were being modeled by USGS – but not in a way that the watershed model could use them
3. Ciaran Harman and his team at Johns Hopkins University, stepped in to fill the gap
   - (leveraged funding from National Science Foundation)

USGS modeling provides a detailed map of groundwater lag times

- Colors show time required for water (or soluble N) to move via groundwater into streams
- Built using data from numerous wells and age tracer data
- High spatial detail
- No temporal detail (steady state)



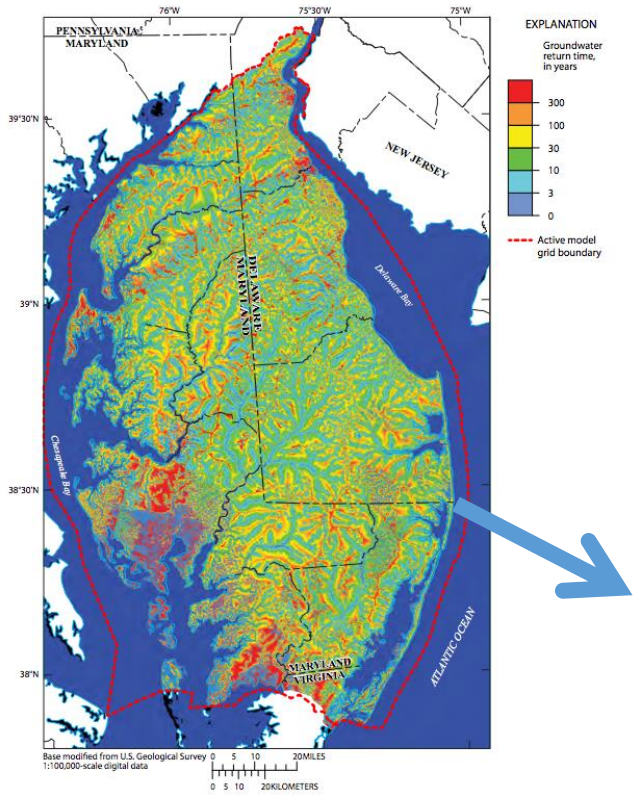


Sanford et al 2012

JHU model bridges USGS and CBWM model
To capture location & weather effects on nitrate-N discharge

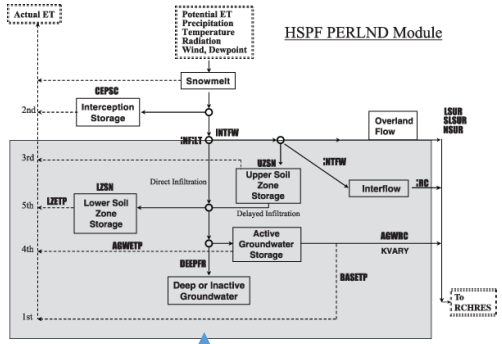
USGS model

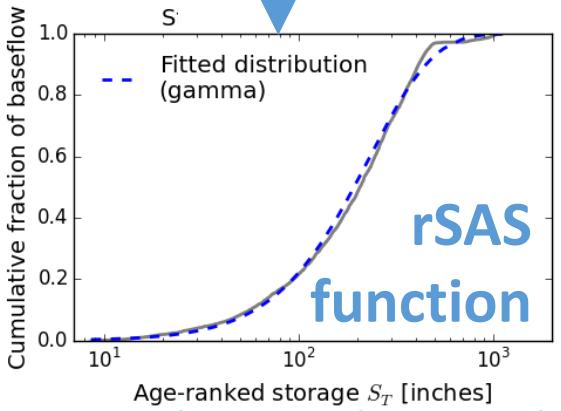
Ward Sanford et al



Always drizzling in this model (weather does not change)

CBP watershed model



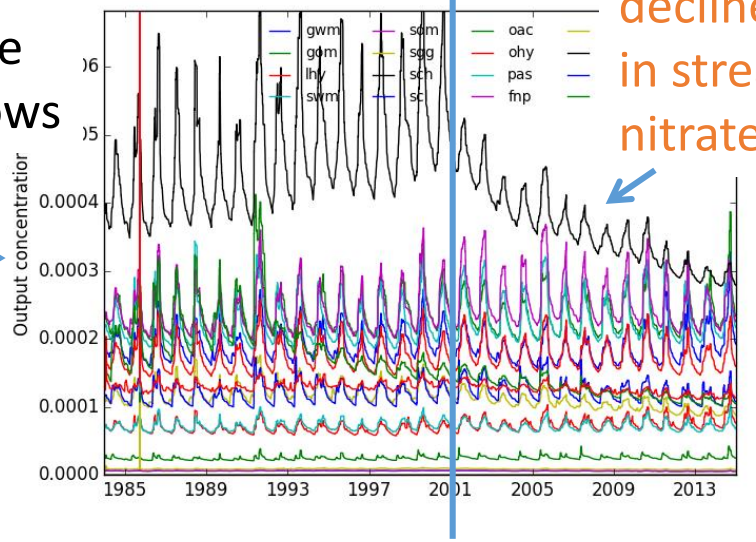


New mathematical approach captures ages of groundwater

Nitrate outflows

Change in land management

Gradual decline in stream nitrate-N

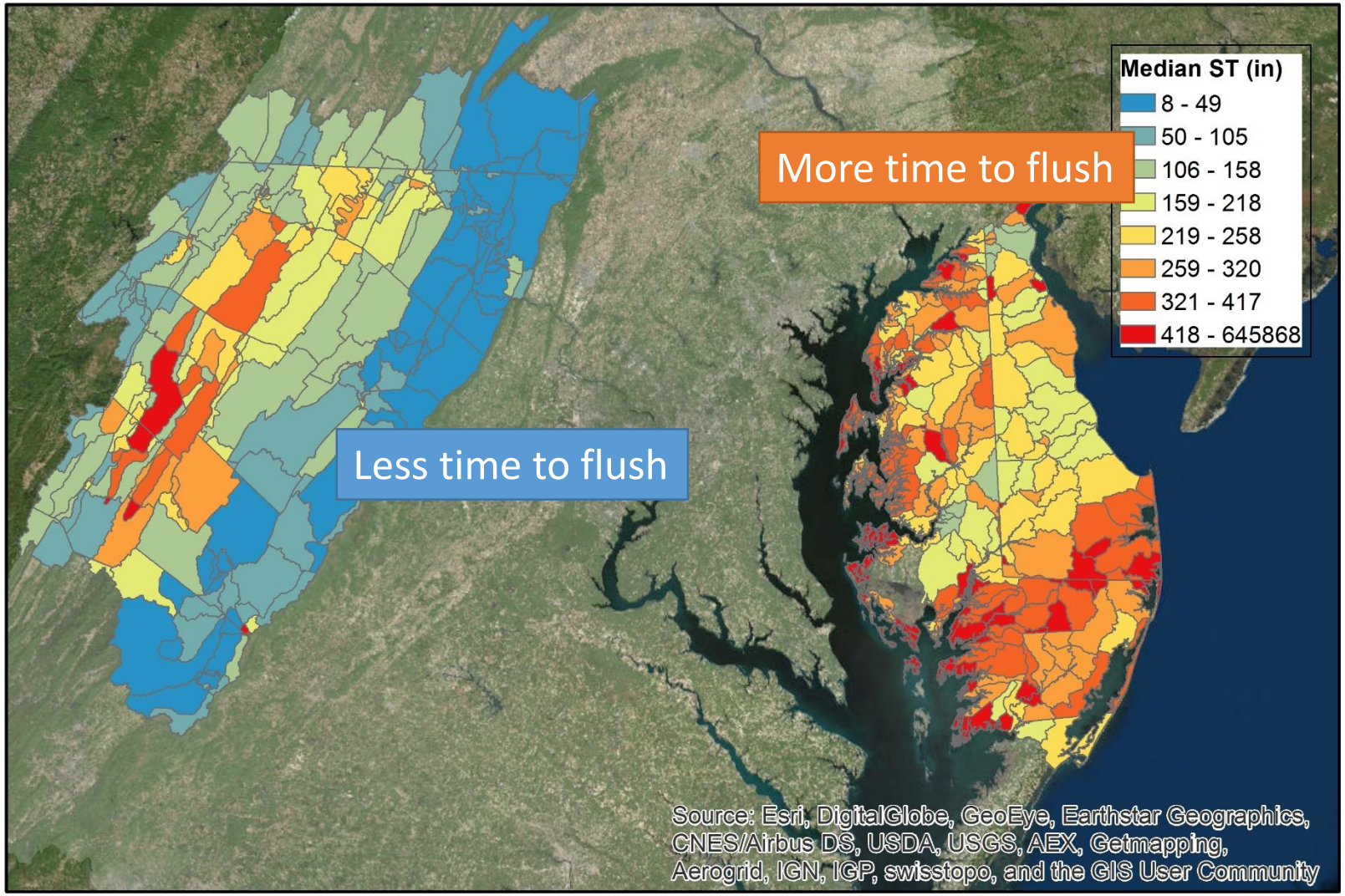


Results now reflect how groundwater age & weather affect nitrate-N delivery to Bay

Bridge enables CBWM to project how fast groundwater is flushing

- Groundwater flushing rate tells you how quickly a stream can respond to nitrogen reductions on the landscape

JHU researchers
Ciaran Harman
Dano Wilusz
Bill Ball



Management implications of incorporating groundwater lag times

- The watershed model scenarios will still be run without lags
  - BMPs will not be judged based on the length of time it takes for effects to be realized
- Lag times will be included in the P6 model with these benefits
  1. Better match between model output and observed data
  2. Helps differentiate locations with quick or slow responses (could inform BMP targeting)
  3. Provides ability to estimate the time to water quality improvements
  4. Informs adaptive management

3. STAC perspective on the invasive catfish management plan

Blue catfish (*Ictalurus furcatus)*

Flathead catfish (*Pylodictis olivaris)*

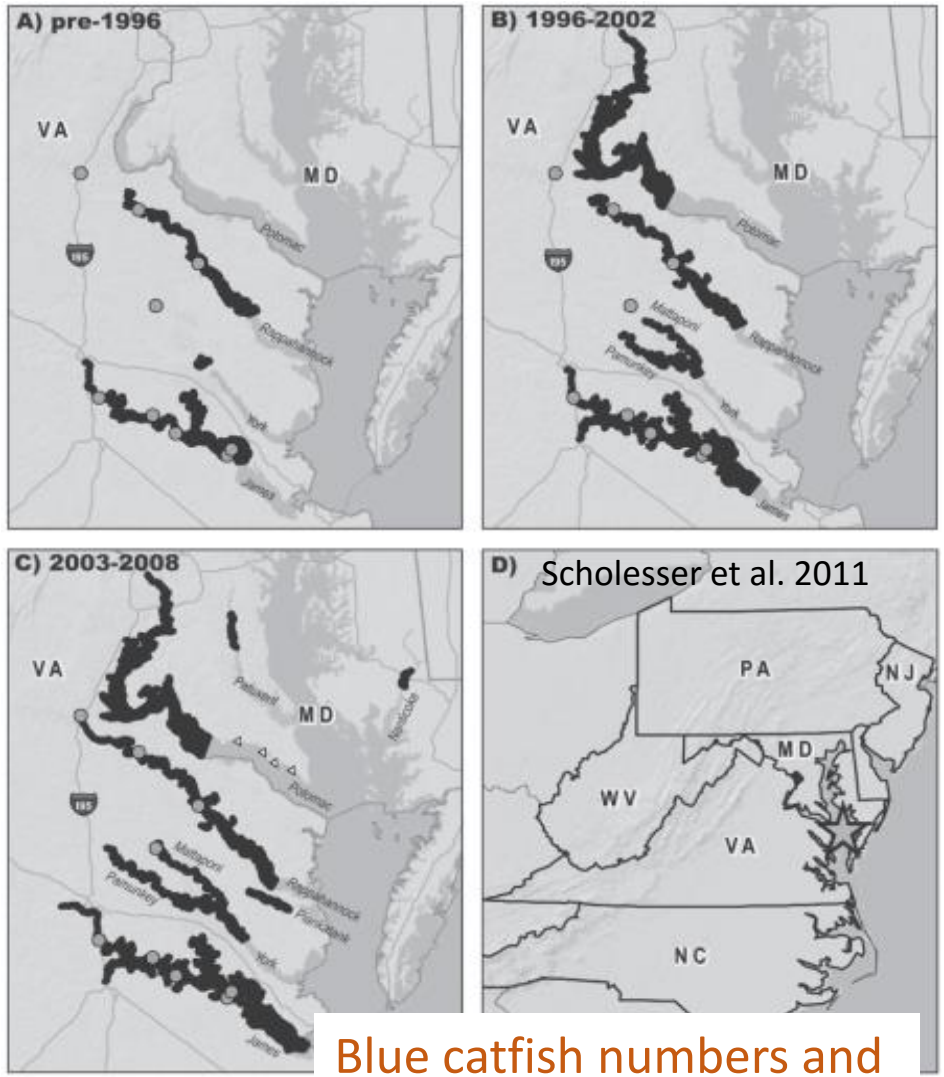
Photos from Bruce Vogt, NOAA Chesapeake Bay Office

Non-native catfish concerns

1. They eat everything
2. They outcompete native fish
e.g., In the James R. – now make up most of fish biomass

BUT
3. Also a highly prized trophy fishery

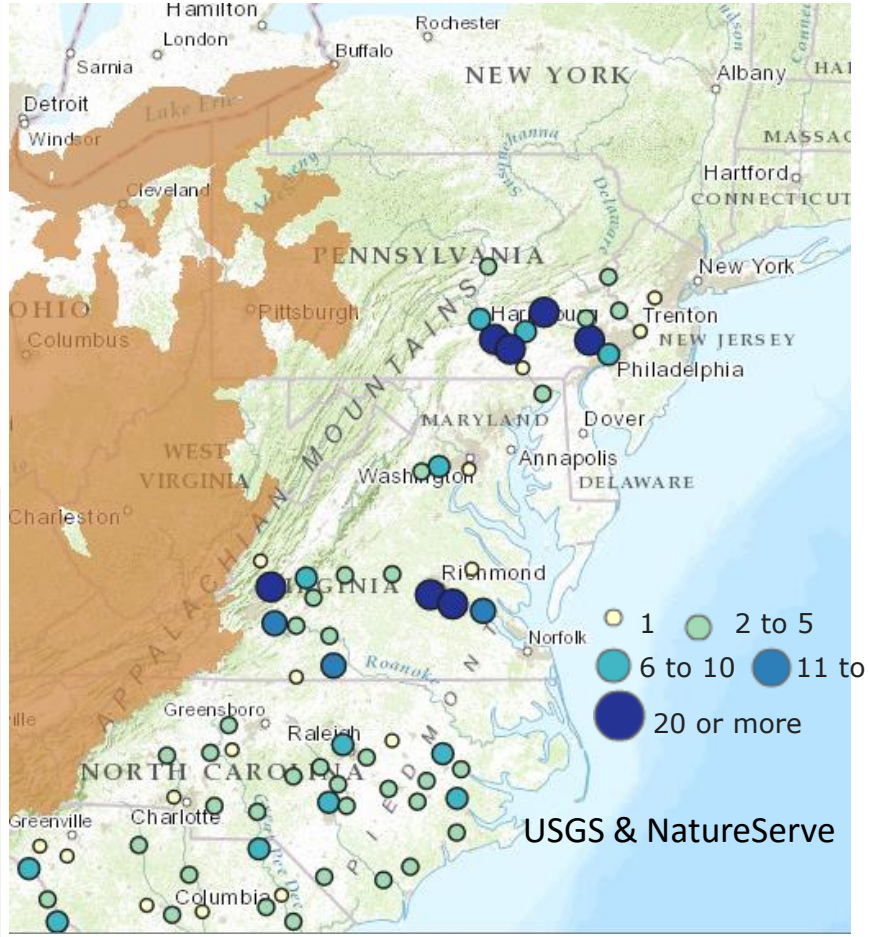
Blue catfish



Scholesser et al. 2011

Blue catfish numbers and range are increasing

Flathead catfish



Flatheads are widespread in upper reaches of tributaries

Invasive Catfish Task Force
Aims: Reduce the spread & minimize impacts

Proposed Actions

1. Conduct targeted removals (fishery independent)
2. Develop large-scale commercial fishery
3. Incentivize use of electrofishing gear (to enhance catch)
4. Establish monitoring programs
5. Establish risk-benefit considerations for barrier removal
6. Review current fishing policies and regulations across jurisdictions
7. Coordinated, consistent public outreach
   - to reduce introductions to new areas

STAC concerns about Invasive Catfish Task Force recommendations

1. Did not reflect outstanding science needs
    - Unanswered questions about toxins –
      Is there a need for consumption advisories due to mercury and PCBs?
    - Safety of electrofishing by commercial watermen (human and ecological)
2. Limited management planning across jurisdictions
    - A management plan would create incentives to work together to address questions and avoid conflicting actions
        - For example – Dams act as barriers to catfish; What are criteria for risk-benefit analysis of dam removal?
3. No plan to evaluate what is working
    - Uncertainties of management effectiveness suggest strong need to evaluate actions
        - For example, evidence from other areas (e.g., Georgia) suggest that targeted removals can have unintended consequences of enhancing fish recruitment and growth rates

STAC future priorities and example questions
Developed at STAC retreat

1. Climate & other types of system change
   - Are we identifying and responding to “canaries in the coal mine”?
2. Adaptive management needs to be fully embedded
   - How can we make restoration cost-effective by learning from implementation?
3. Living resources
   - What tools are needed to answer: Will fisheries respond to water quality improvements?
4. Human dimensions
   - How can people be engaged to innovate & promote restoration success?
5. Nutrient & sediment issues
   - How do we address the issue that former P sinks are becoming P sources due to saturation?