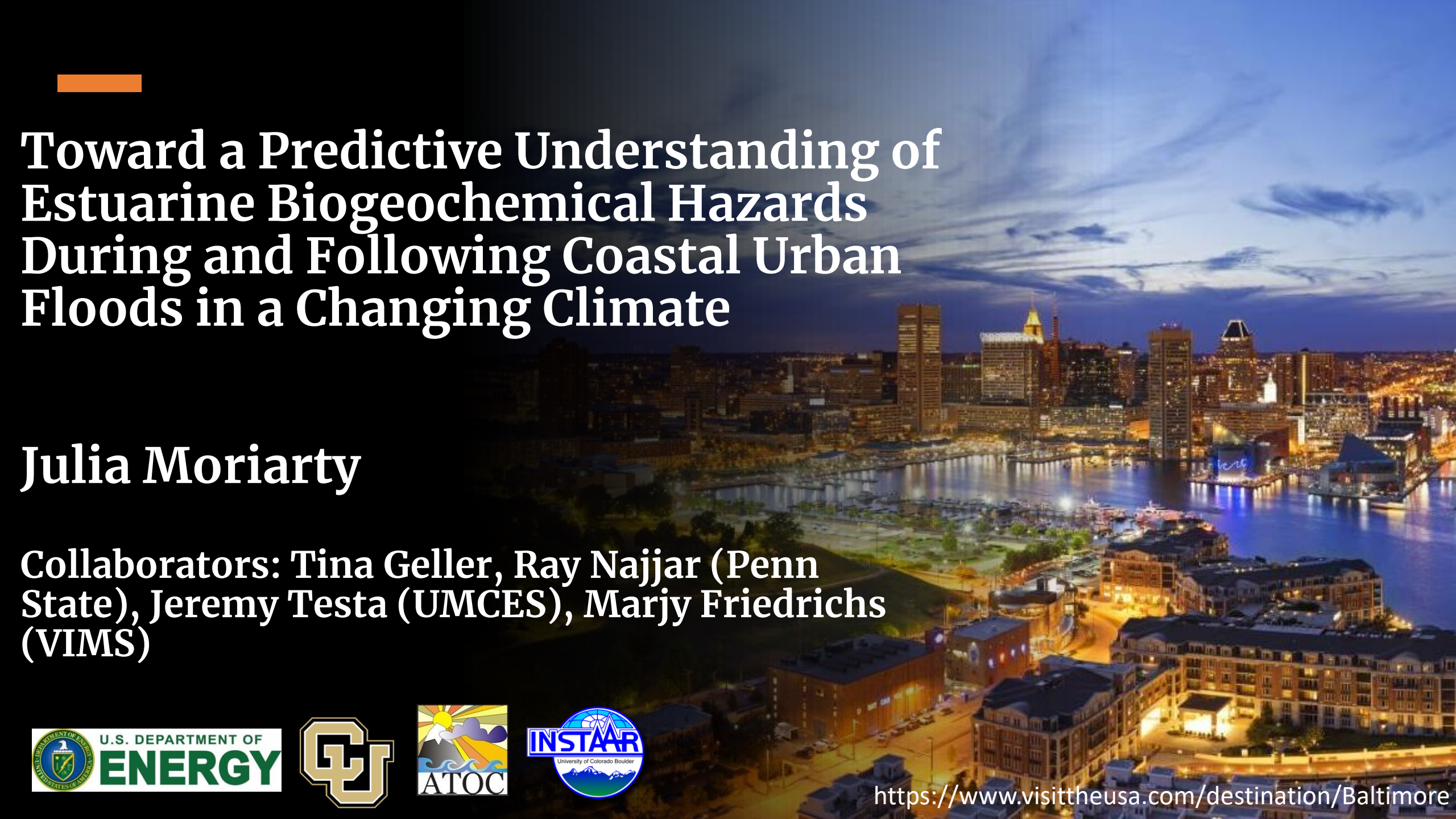
Toward a Predictive Understanding of Estuarine Biogeochemical Hazards During and Following Coastal Urban Floods in a Changing Climate

Julia Moriarty

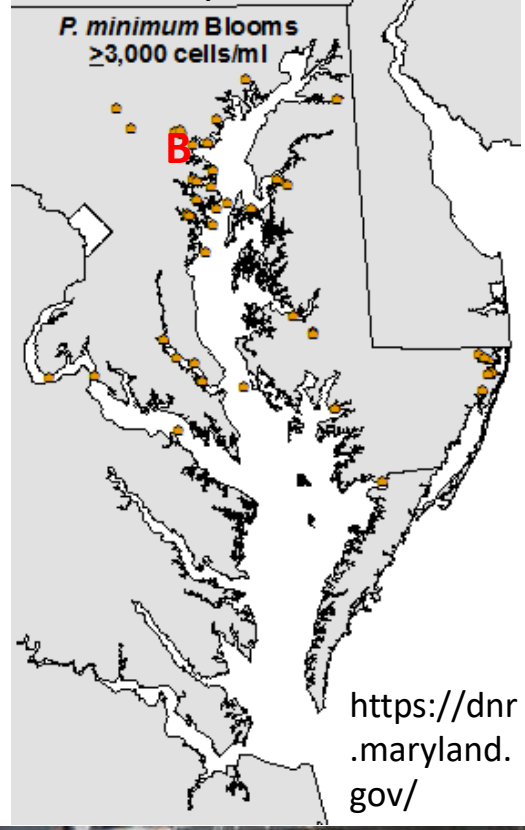
Collaborators: Tina Geller, Ray Najjar (Penn State), Jeremy Testa (UMCES), Marjy Friedrichs (VIMS)



https://www.visittheusa.com/destination/Baltimore

City Flooding Impacts Estuarine Biogeochemistry

- Contaminants (e.g. Fecal coliform)
- [Harmful] algal blooms & hypoxia
- Cities motivated by Clean Water Act, tourism, fisheries



https://dnr.maryland.gov/

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Baltimore agrees to hefty fine, consent decree over wastewater treatment plants

Lillian Reed 11/2/23 12:54 p.m. EDT, Updated 11/2/23 1:29 p.m. EDT

The two digesters at the Back River Wastewater Treatment Plant near Baltimore. (Kristian Bjornard/Wikimedia

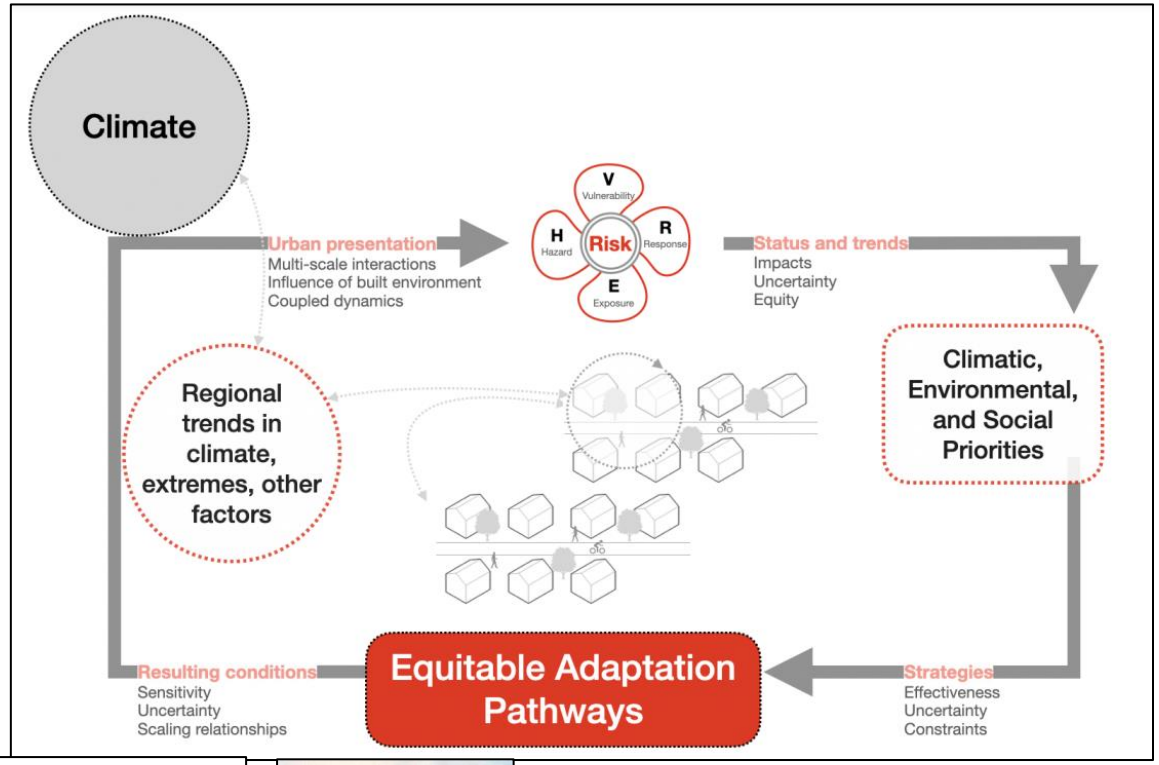
CDC Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™

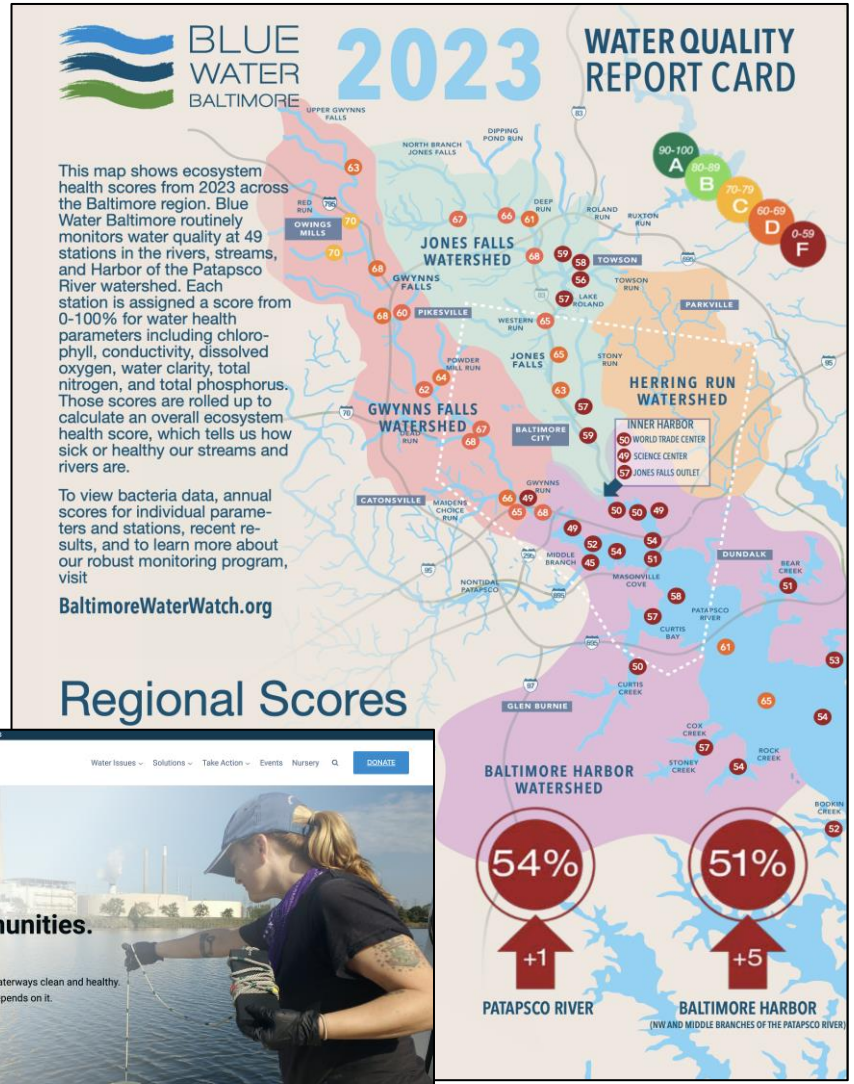
Themes

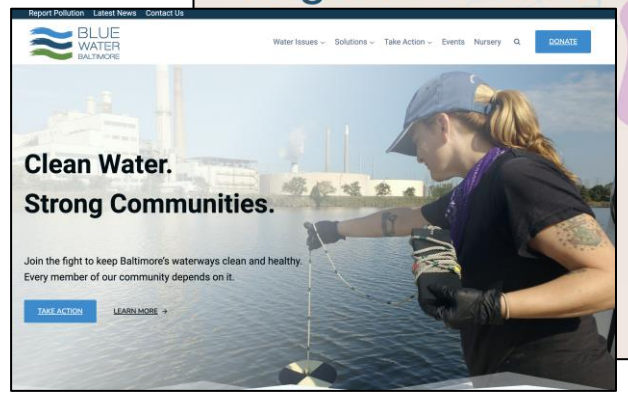
1. When cities flood, when and where are contaminants and nutrients from rivers, flooded sewers, and other sources transported, and how do they impact estuarine biogeochemistry?
2. How do changes in storm characteristics, water temperatures, and other aspects of climate change impact the results?
3. What aspects of this are predictable (or not) in different climates and locations?

Part 1: Baltimore Focus Site: Collaboration with BSEC IFL

Ray Najjar, PSU







BSEC (Baltimore IFL)

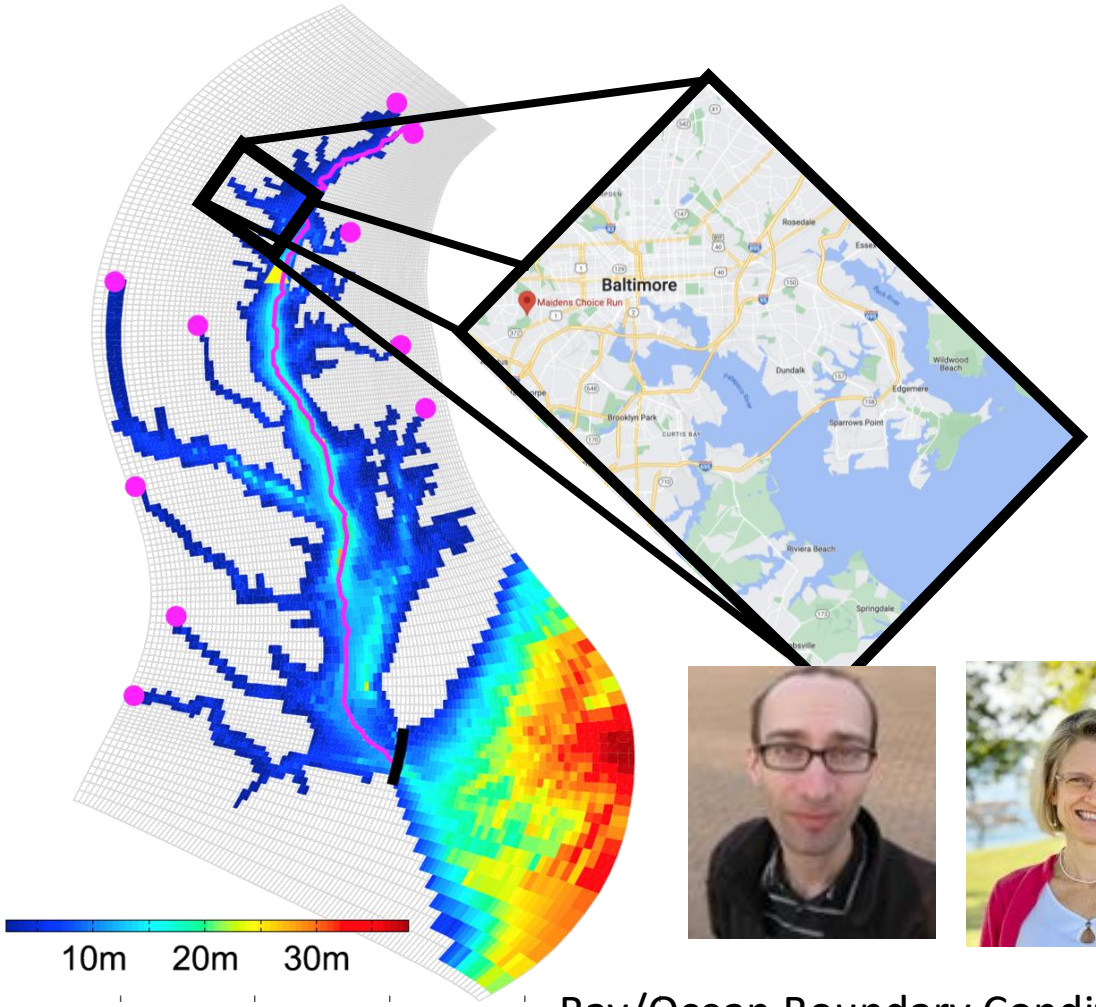
Ben Zaitchik, JHU

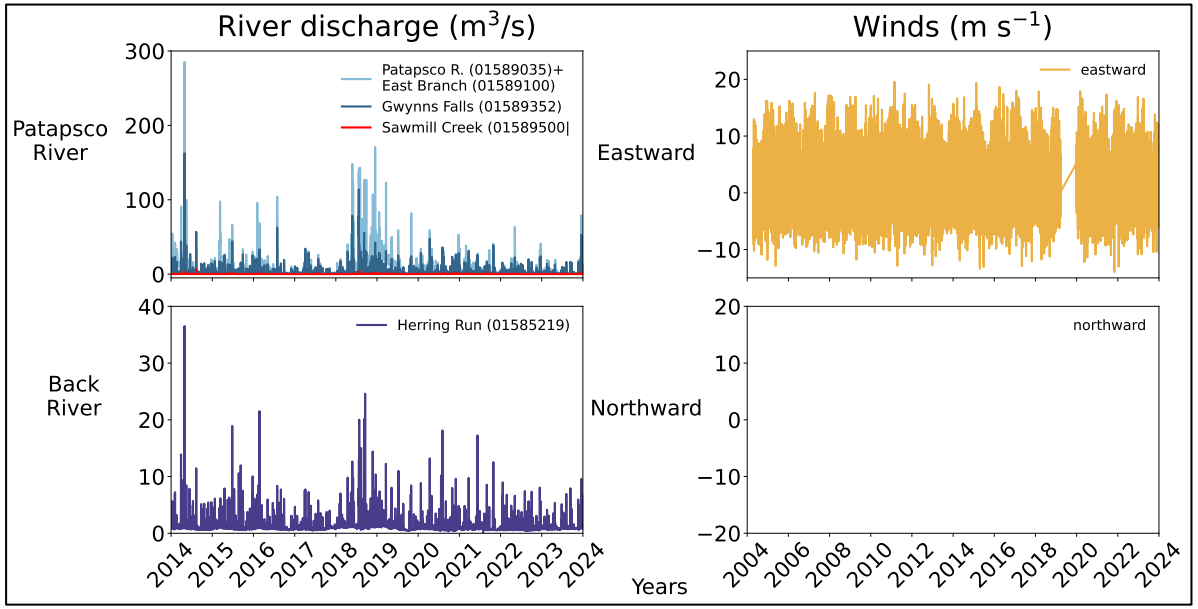
Part 1: Baltimore Focus Site: Hydrodynamic-Biogeochemical Model

Starting next week!

Tina Geller

Carisa J. DeSantos



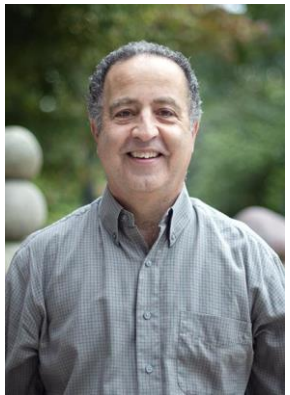


- ROMS-ECB model (~100 m resolution)
- Accounts for winds & atmospheric forcing, larger-scale ocean circulation, river & sewer input at boundaries
- Focus on individual events

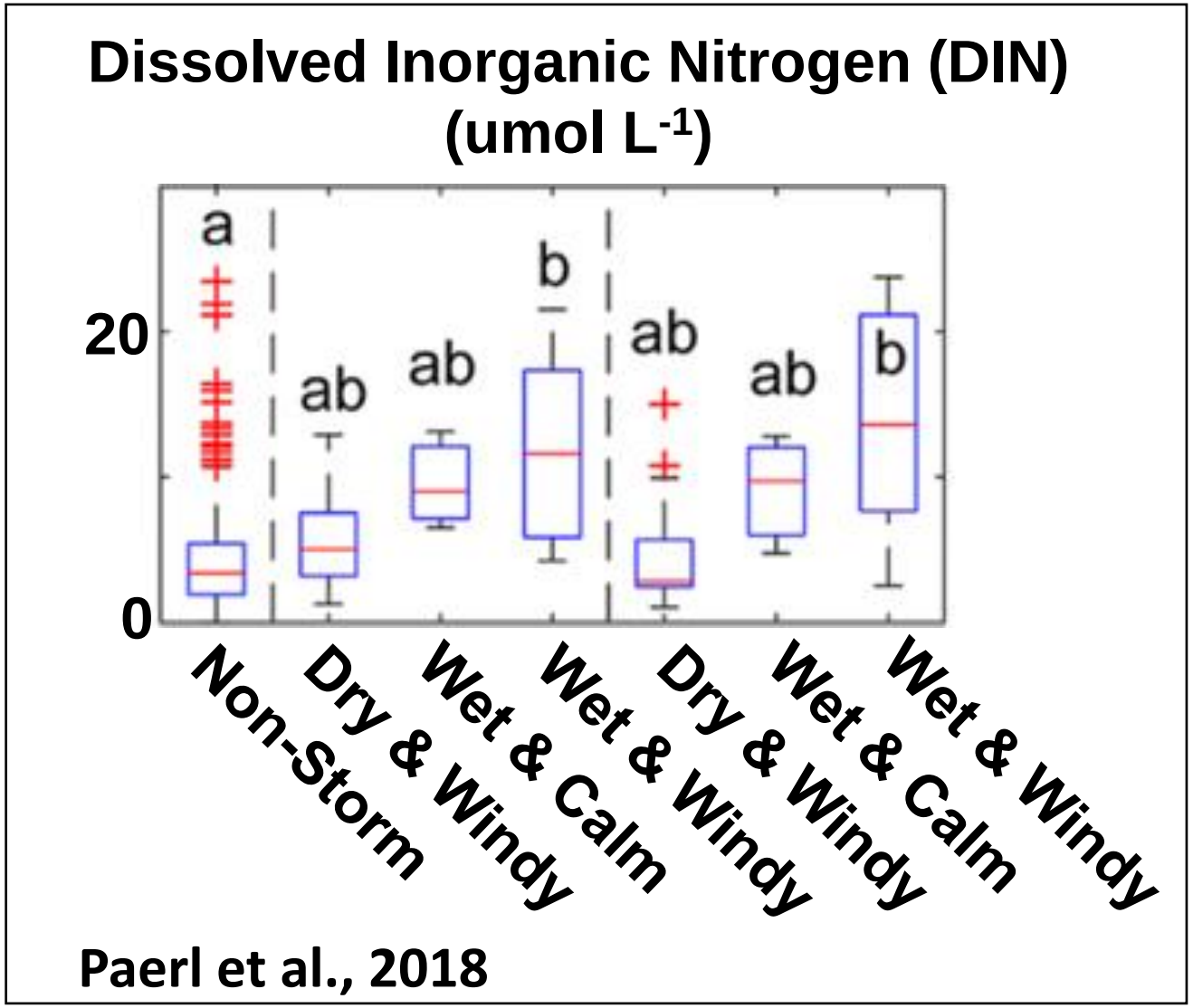
Bay/Ocean Boundary Conditions by ICOM's Marjy Friedrichs and Pierre St. Laurent (VIMS)

Part 2: Impact of Different Climates (Storm Characteristics) & Coastal Geometries on Predictability

- Motivation: How to upscale to other & future events?
- Will use sensitivity tests combined with machine learning



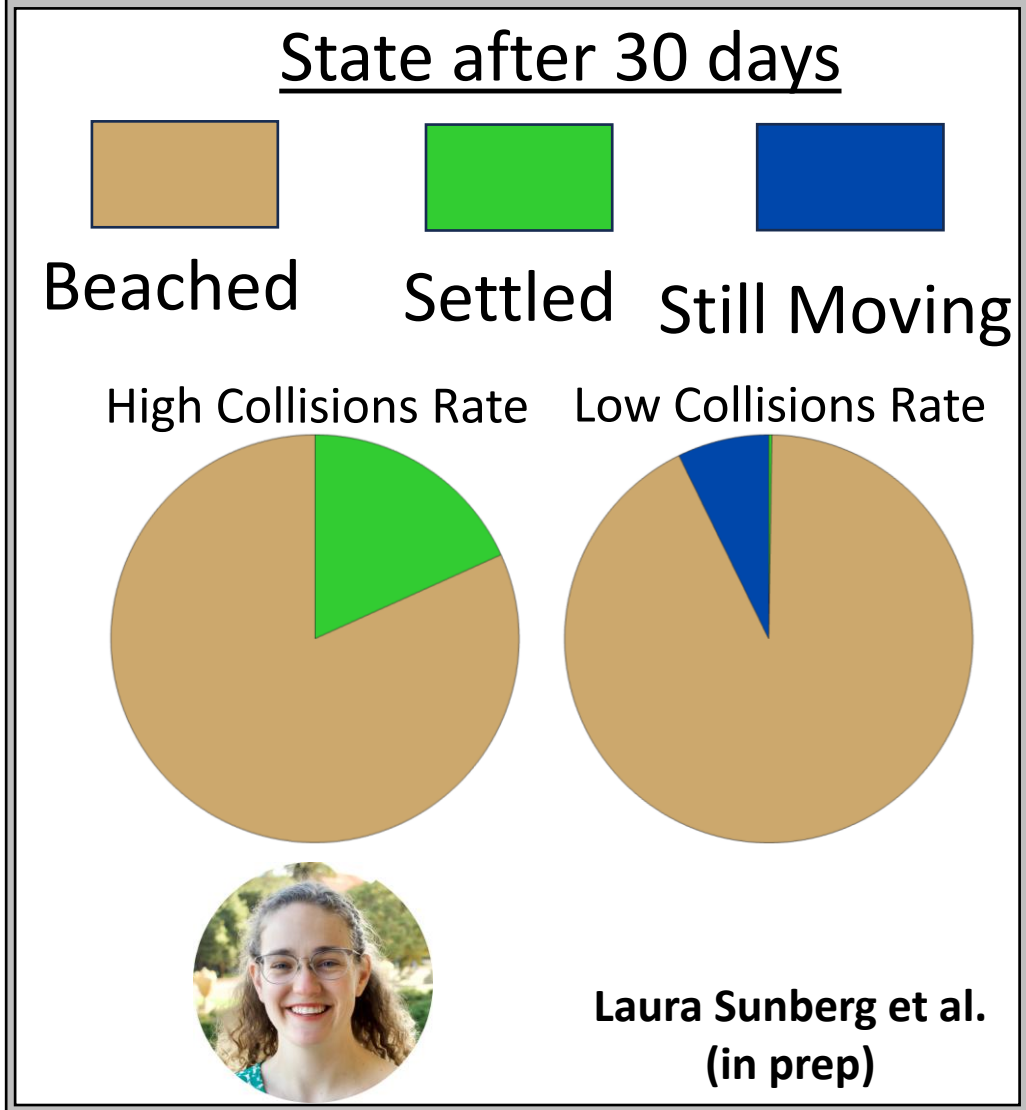
Machine Learning Collaboration with Ray Najjar and Aneesh Subramanian



Conclusions & Acknowledgements

- We are implementing a hydrodynamic model to analyze transport of bacteria (fecal coliform) in coastal urban estuaries such as Baltimore, Maryland
- This is part of an Early Career project focused on developing a predictive understanding of estuarine biogeochemistry during and following floods and storms, in modern and future climates
- Thank you to Ray Najjar (PSU), Ben Zaitcheck (JHU), Claire Welty (UMBC), Larry Band (UVA), Marjorie Friedrichs (VIMS), Pierre St. Laurent (VIMS), Aneesh Subramanian (CU)
- Funded by DOE's Regional & Global Model Analysis (RGMA) Program & Early Career Research Program grant DE-SC0024197. Support provided by CU's INSTAAR and ATOC
- Career Impacts:
  - Improve models of estuarine biogeochemistry for coastal urban applications
  - Learning about community-driven science via BSEC IFL & machine learning
  - New collaborations (e.g. ICOM, E3SM community)

Related Research:
Biofouling Impacts Microplastic Transport



Laura Sunberg et al. (in prep)