

How might Chesapeake Bay triblets respond to climate change?

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Revisiting Coastal Land-Water
Interactions: The Triblet Connection

Frederick, MD

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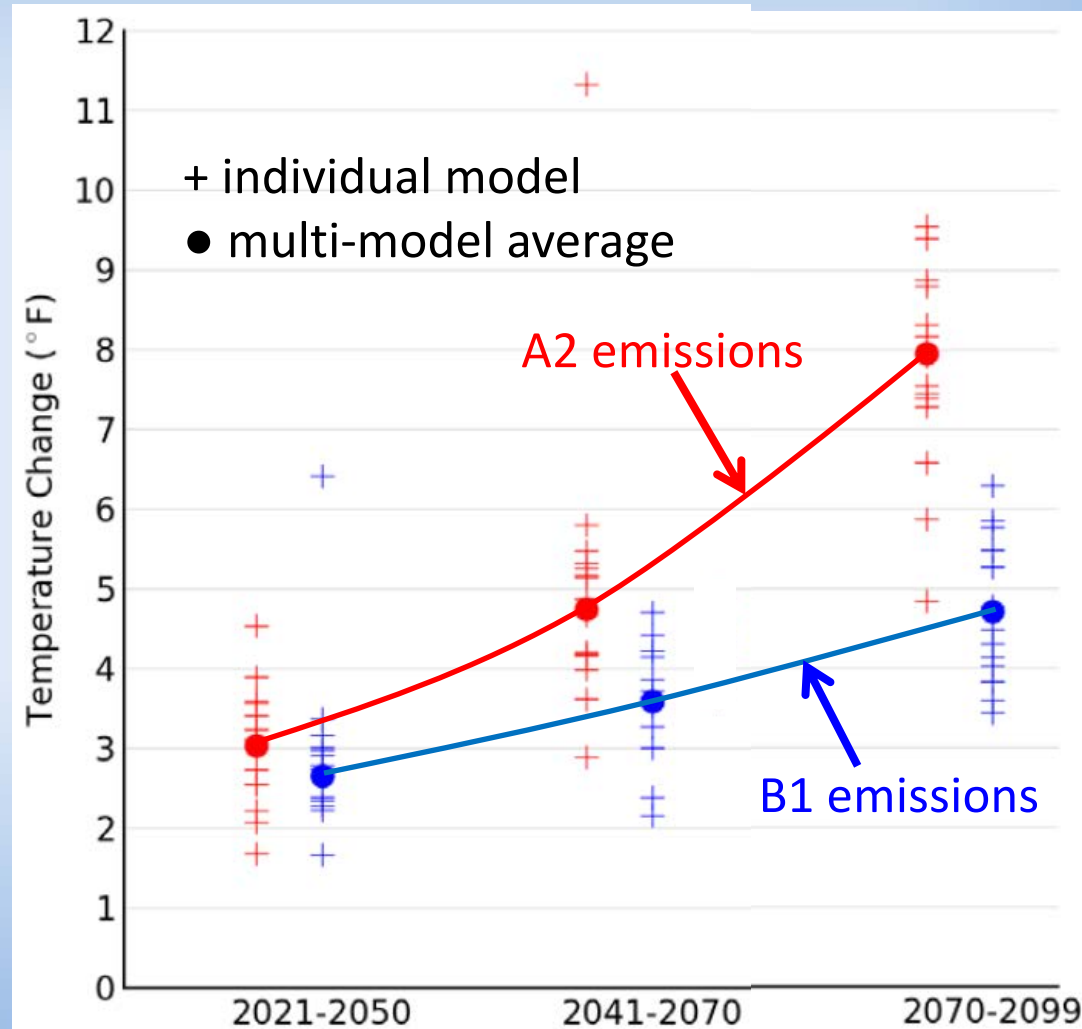


What's changing in the climate that's relevant to triplets?

- Temperature
- Precipitation
- Streamflow
- Sea level
- Tidal range

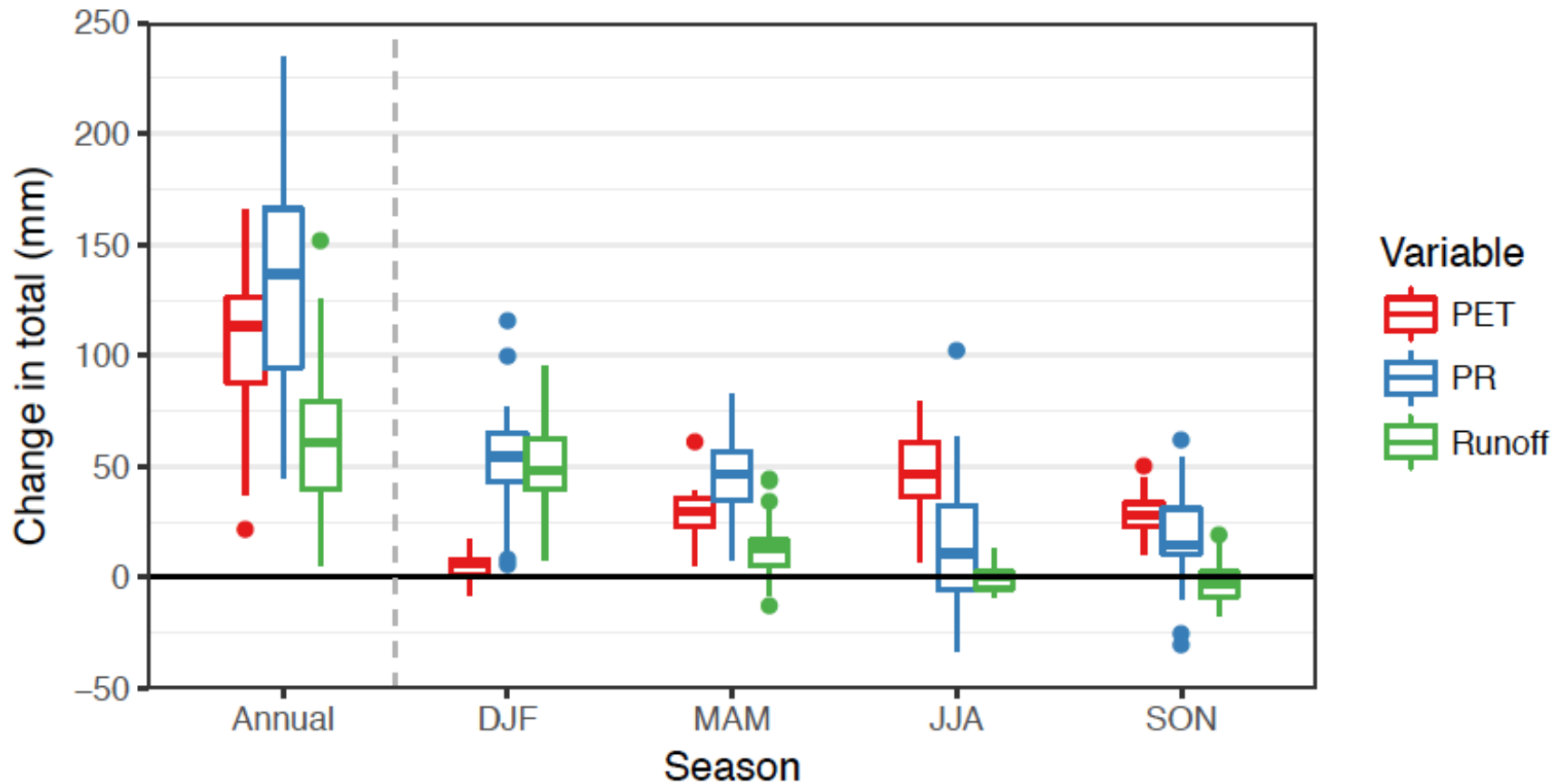
- Continued warming is projected
- Emissions scenario really matters by mid century

Projected 21st century temperature change in the Northeast US from 15 global climate models under two climate scenarios



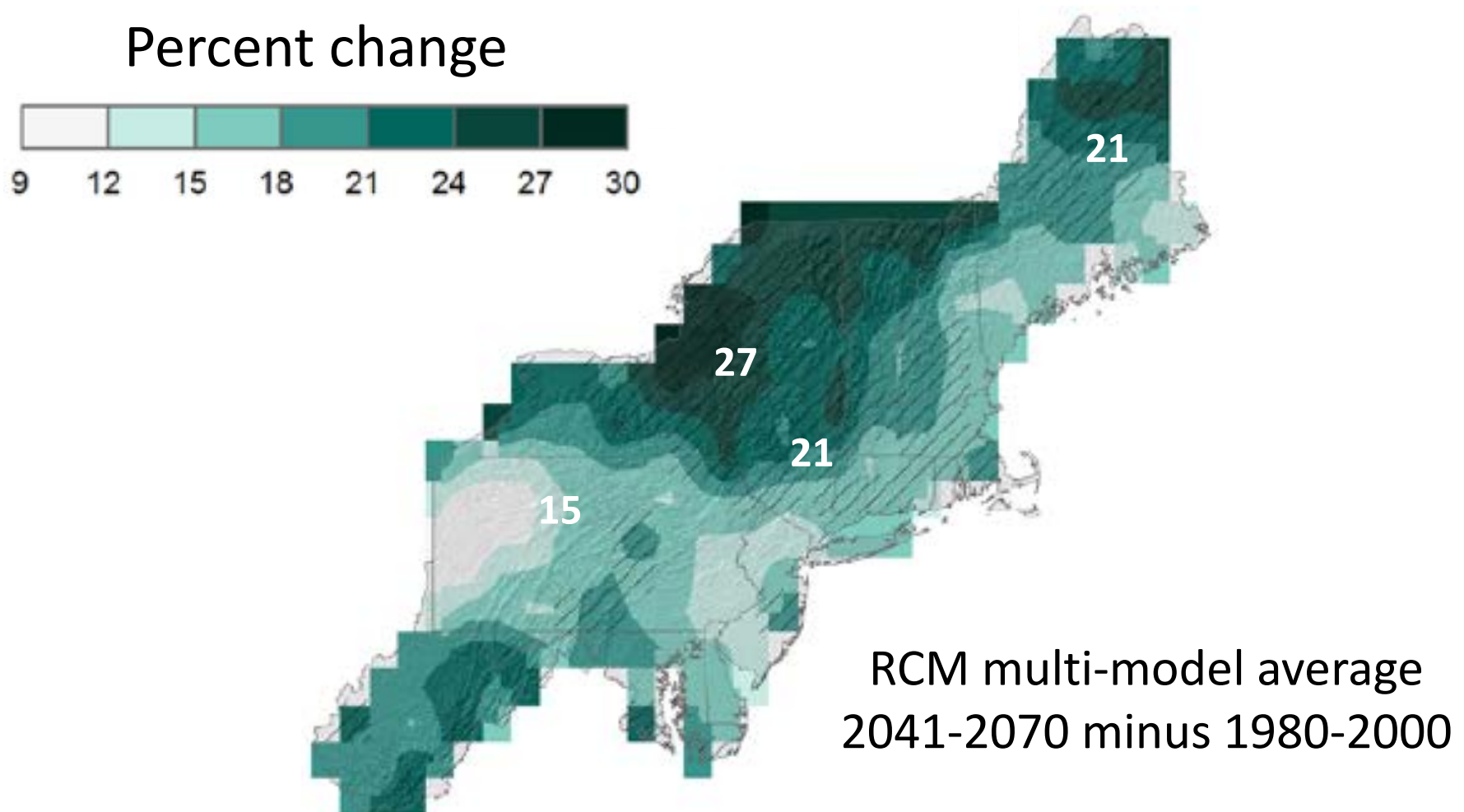
Kunkel et al. (2013a)

- More precipitation and evapotranspiration
- More runoff, particularly in winter



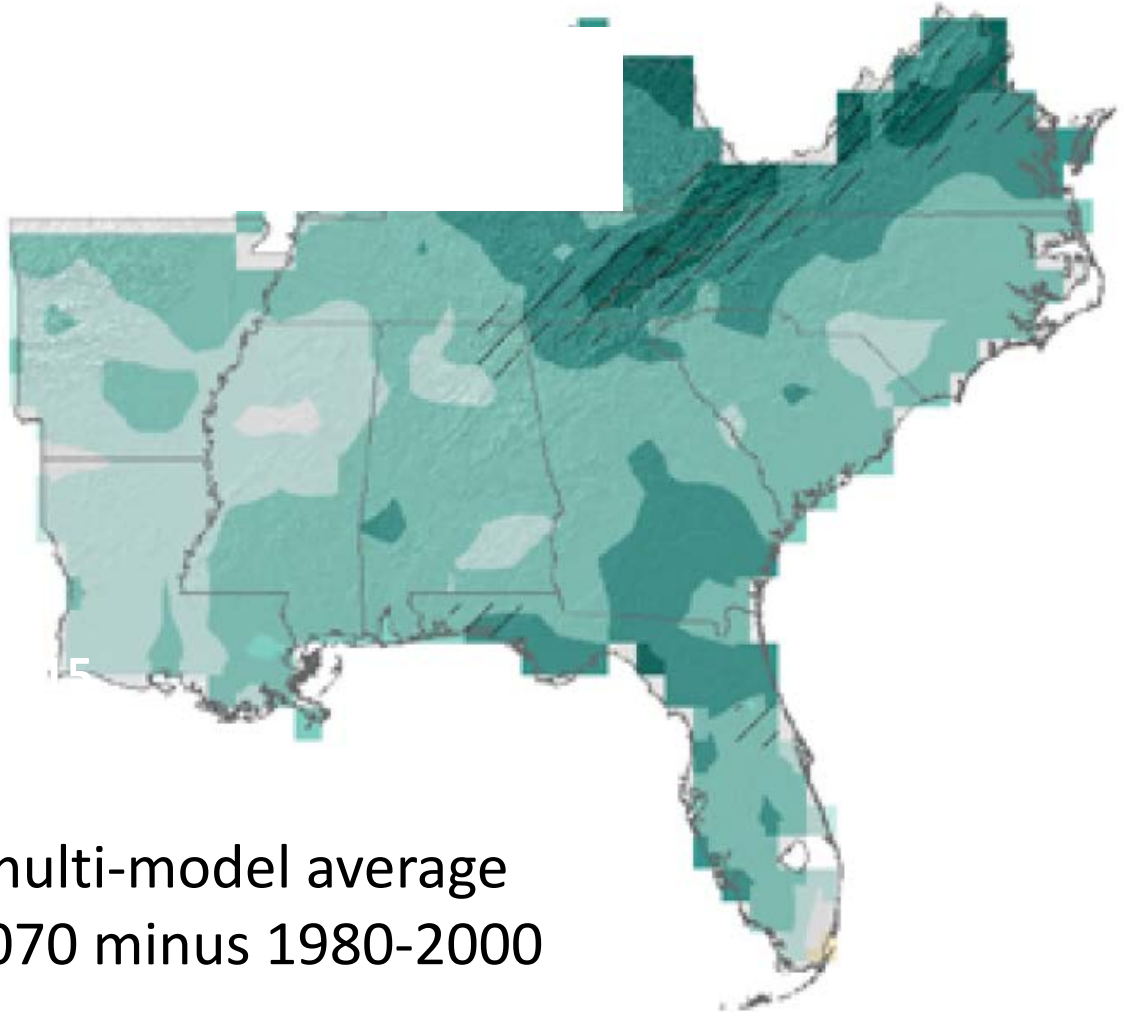
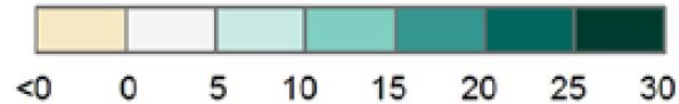
Precipitation projected to be more extreme

Change in extreme precipitation: number of days > 1 inch



Change in extreme precipitation: number of days > 1 inch

Percent change



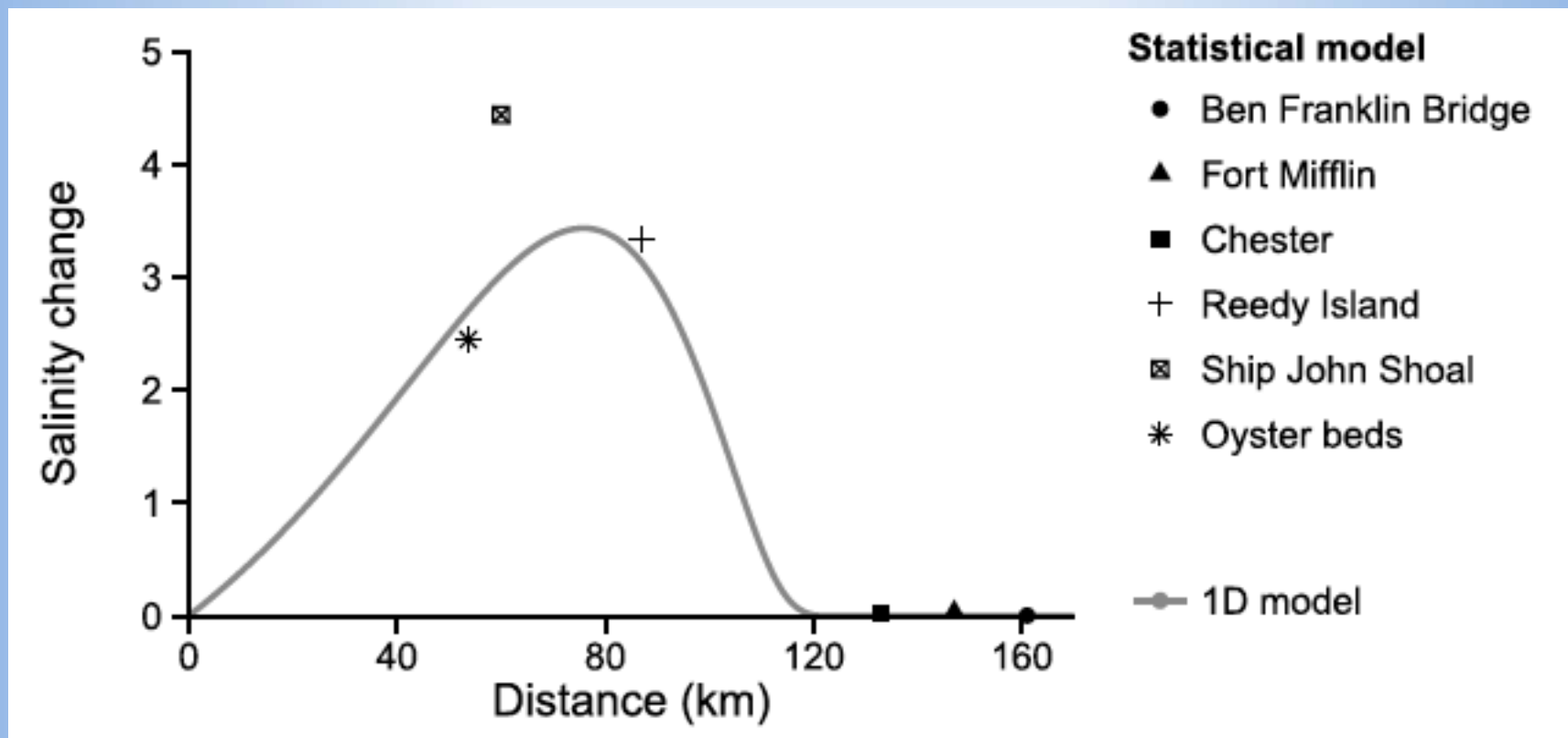
RCM multi-model average
2041-2070 minus 1980-2000

Sea-level rise

- “Likely” sea-level rise for Baltimore under RCP8.5 scenario is 0.67–1.24 m by 2100
- This range reflects the 67% confidence interval
- Source: Kopp et al. (2014)

Sea-level rise increases salinity in the central portion of the estuary

Impact of 1 m of sea-level rise in Delaware Bay



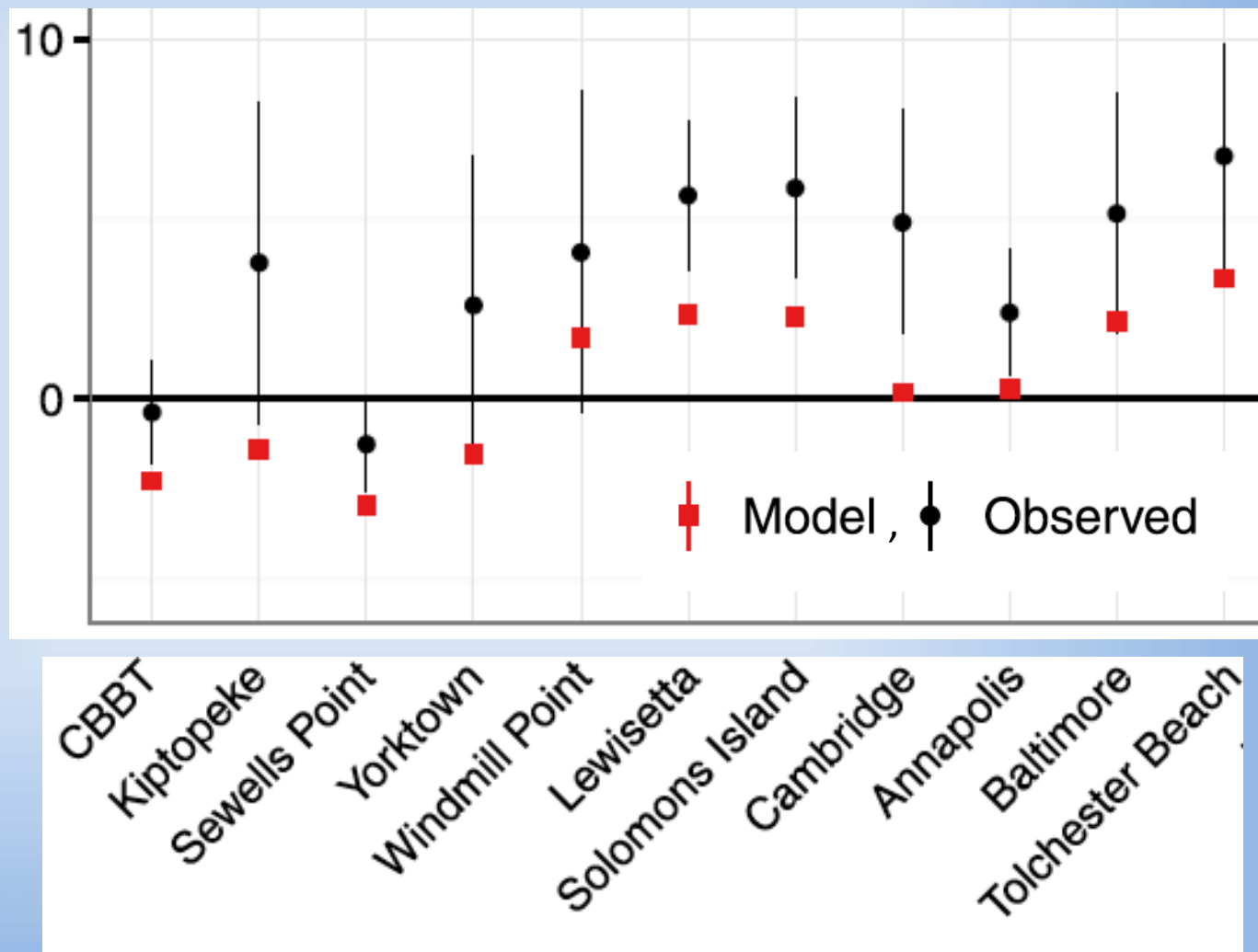
Ocean

River

Ross et al. (2015)

Tidal range is sensitive to sea level

Change in tidal amplitude per change in sea level (cm/m)



Ross et al. (2017)

What makes tributaries special in their response to climate change?

- Their watersheds are smaller and often more urbanized
 - Flashier systems will be more sensitive to changes in extreme precipitation
 - Urban heat island effect enhances thermal pollution of streams
- They are shallow
 - Sea level rise results in greater fractional increases in water depth
 - Salt intrusion length (L) sensitive to depth (h): $L = ah^2$

References

- Kunkel, K.E., Stevens, L.E., Stevens, S.E., Sun, L., Janssen, E., Wuebbles, D., Rennells, J., DeGaetano, A., Dobson, J.G., 2013a. Regional Climate Trends and Scenarios for the U.S. National Climate Assessment, Part 1. Climate of the Northeast U.S., NOAA Technical Report NESDIS 142-1. U.S. Department of Commerce, Washington, D.C., 79 pp.
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- Ross, A.C., Najjar, R.G., Li, M., Mann, M.E., Ford, S.E., Katz, B., 2015. Sea-level rise and other influences on decadal-scale variations of salinity in a coastal plain estuary. *Estuarine Coastal and Shelf Science* 157, 79-92.
- Ross, A.C., Najjar, R.G., Li, M., Lee, S.B., Zhang, F., Liu, W., 2017. Fingerprints of sea-level rise on changing tides in the Chesapeake and Delaware Bays. *Journal of Geophysical Research: Oceans* 122, 8102–8125.