2019 Climate Change Assessment – Watershed Modeling Progress Update

Modeling Workgroup Conference Call – May 2019

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[1] Penn State, [2] US EPA – Chesapeake Bay Program Office

Presentation outline

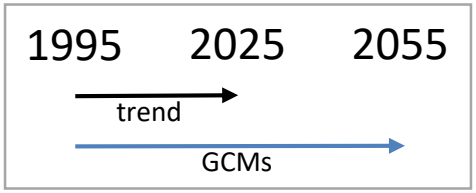
1. **Updated results that incorporate decisions from April 2019 Modeling Workgroup Meeting**
   - **in the climate change assessment of 2025, 2035, 2045, and 2055**
   - **in the evaluation of land cover land use change impacts on climate change assessment.**

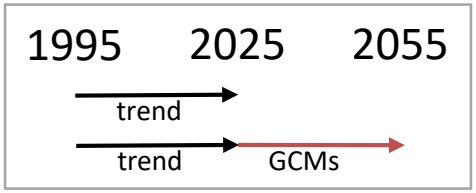
How rainfall volume delta change is estimated for climate change scenarios beyond Year 2025

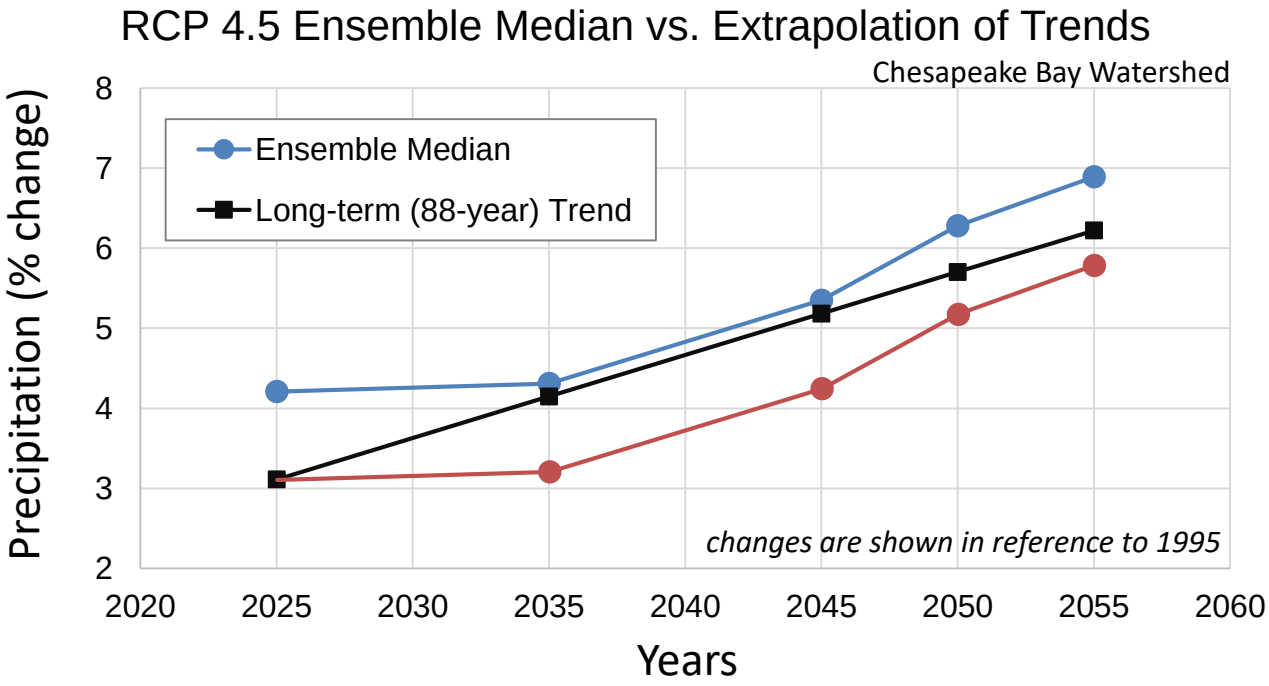
- An alternative would be to estimate delta change for the periods beyond 2025 by adding GCM delta for a future year and 2025 to the trend-based delta for 2025.

Hybrid vs. **Proposed**

(delta change for GCMs *wrt* 2025)







***Ensemble**: 31-member ensemble of RCP4.5 GCMs; **Trend**: extrapolation of long-term (1927-2014) trends;*

[1] https://www.chesapeakebay.net/channel_files/35723/20190402_-_bhatt_-_mwqm_-_2019_climate_change_assessment.pdf

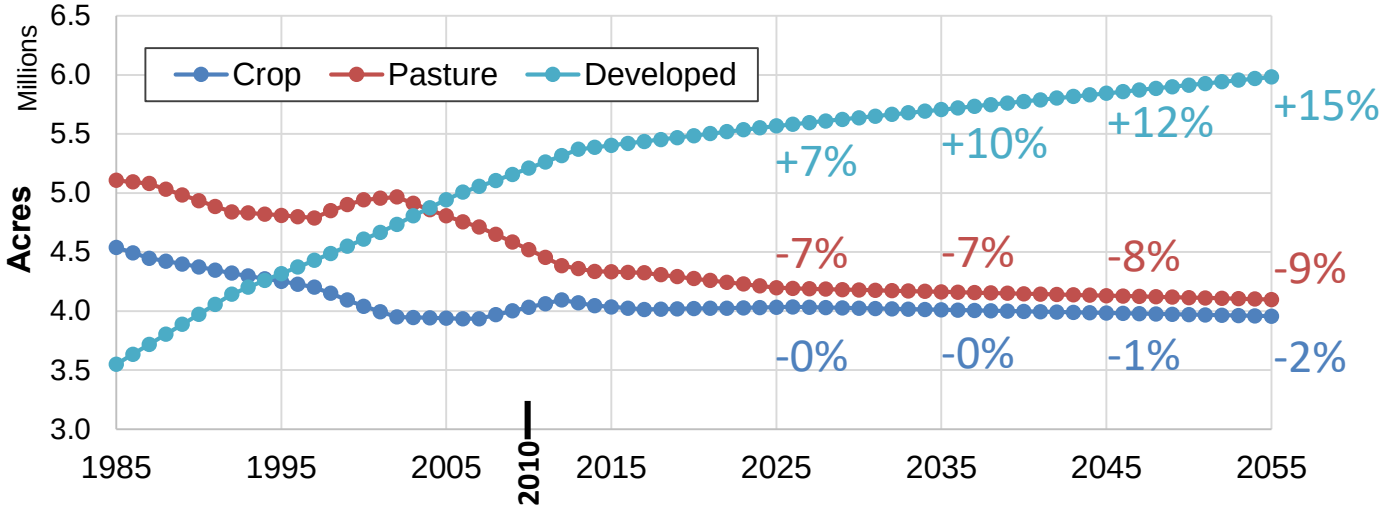
Evaluation of land cover land use change impacts on climate change assessment

- Land use effects the baseline nutrients and sediment loads, and therefore the marginal differences in loads with climate change.
- The future projections of land use and populations on sewer and septic systems were estimated using Chesapeake Bay Land Change Model (CBLCM Version 4 – *Claggett, P., et al.*)

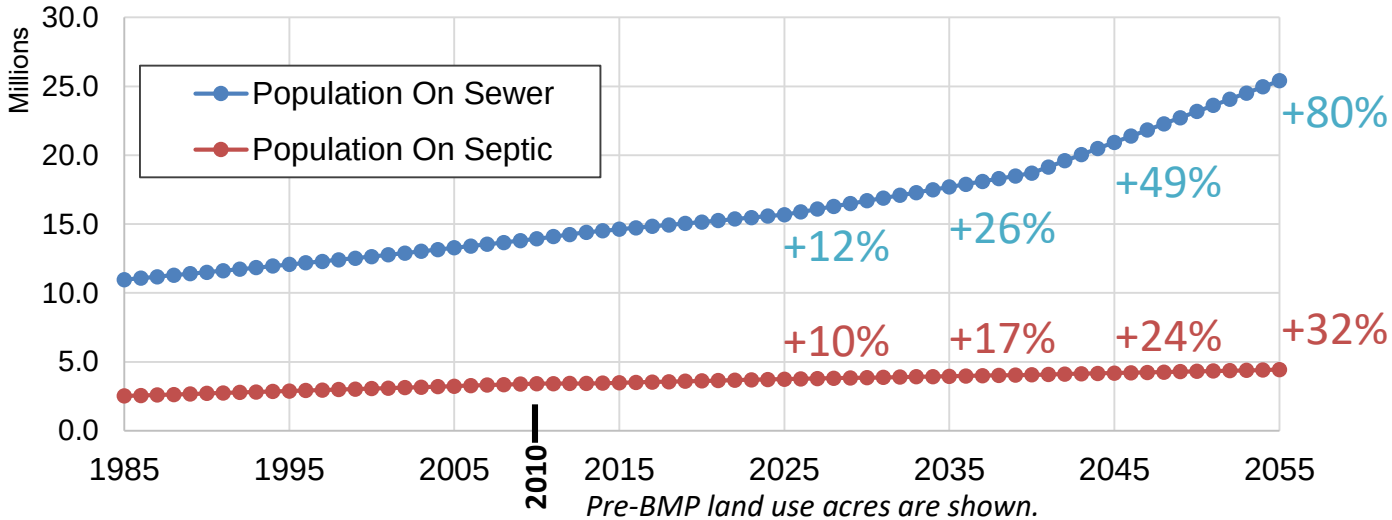
County-level demographic population projections for 2020, 2030, and 2040 were downloaded from each jurisdiction's official projection provider. Projections beyond 2040 were developed by the CBPO through linearly extrapolating trends from 2010 – 2040.

[1] https://www.chesapeakebay.net/channel_files/35723/20190402_-_bhatt_-_mwqm_-_2019_climate_change_assessment.pdf

Land use acres - Chesapeake Bay Watershed



Population - Chesapeake Bay Watershed



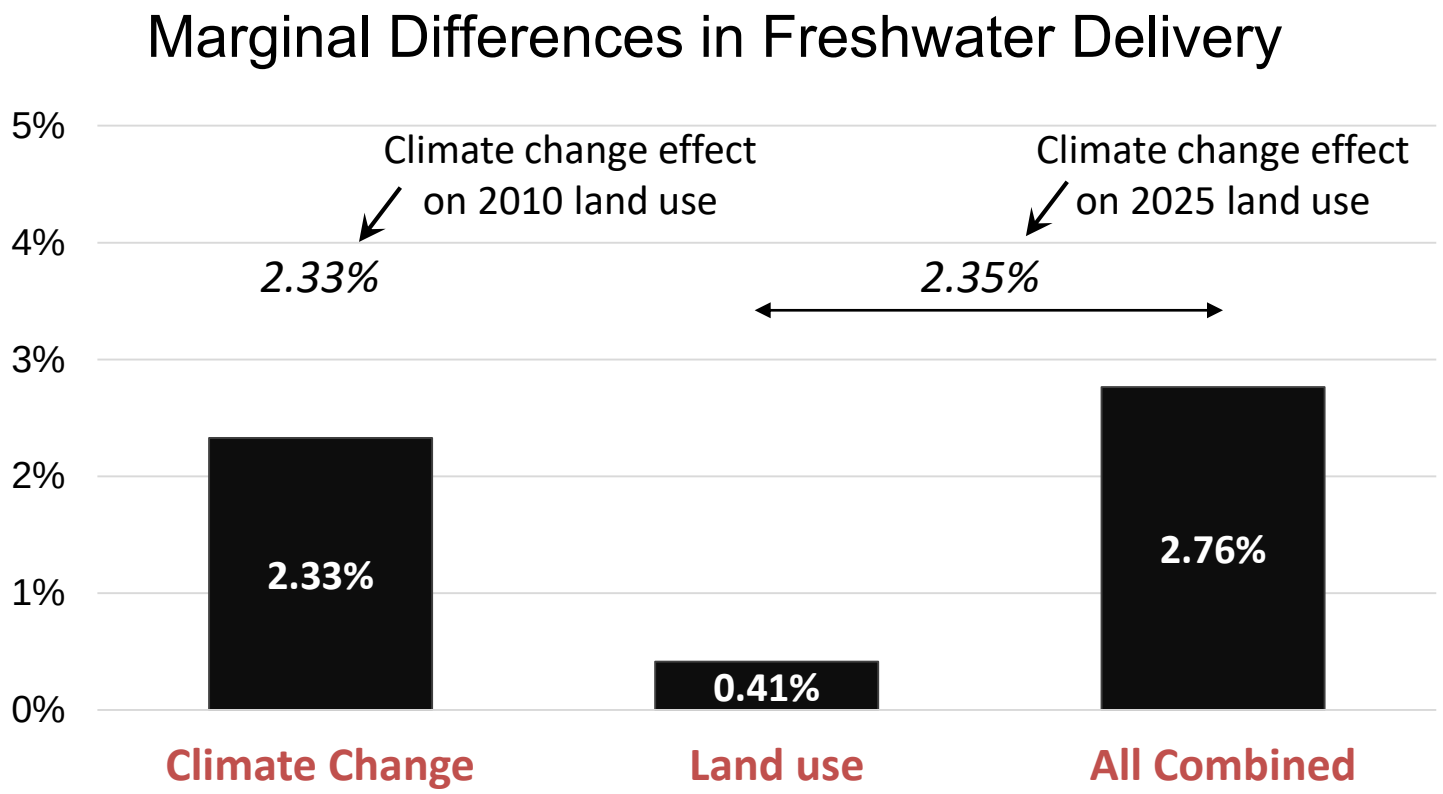
Pre-BMP land use acres are shown.

Percent changes are shown with respect to 2010 (with WIP2 level of effort)

[1] https://www.chesapeakebay.net/channel_files/35723/20190402_-_bhatt_-_mwqm_-_2019_climate_change_assessment.pdf

Differences are shown with respect to WIP2 on 2010 land use

2025 sensitivity scenarios



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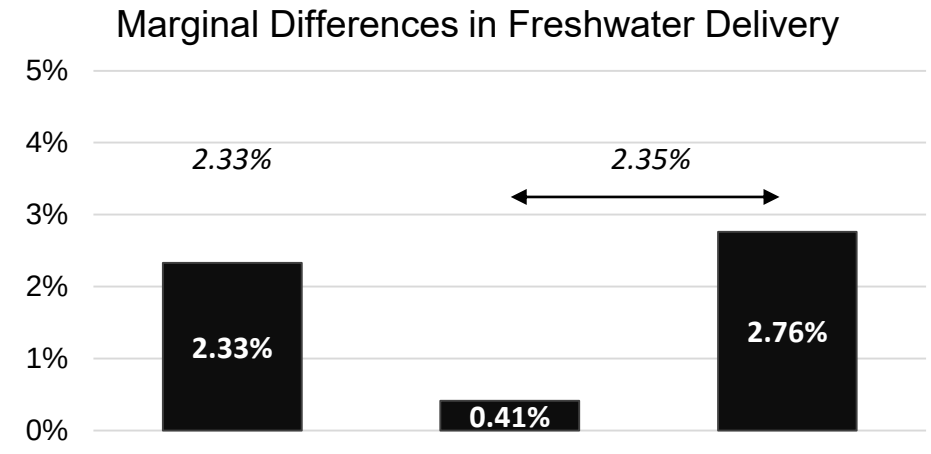
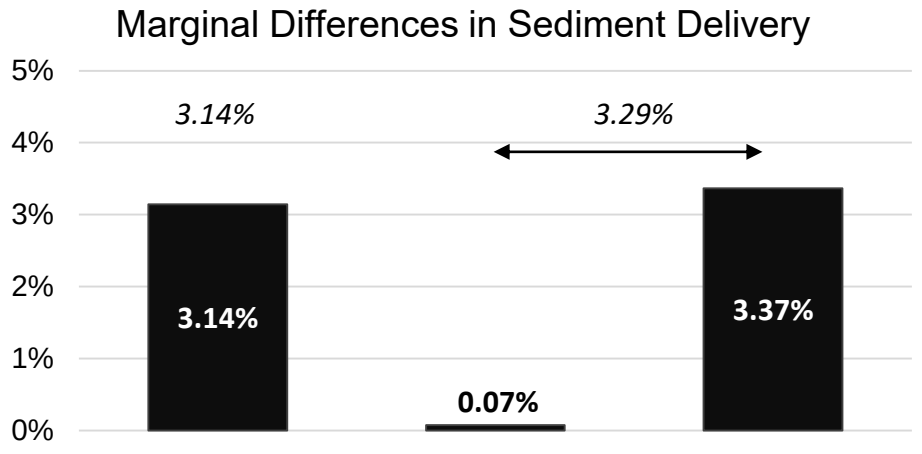
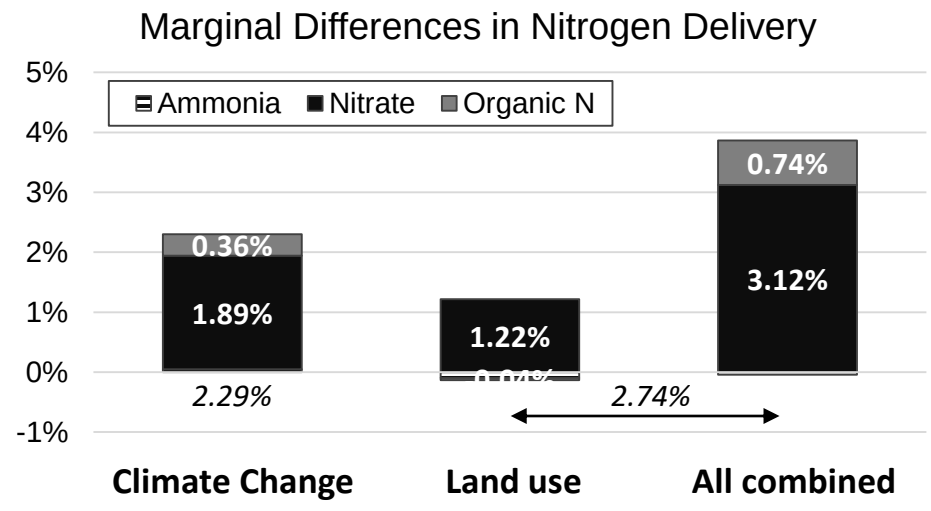
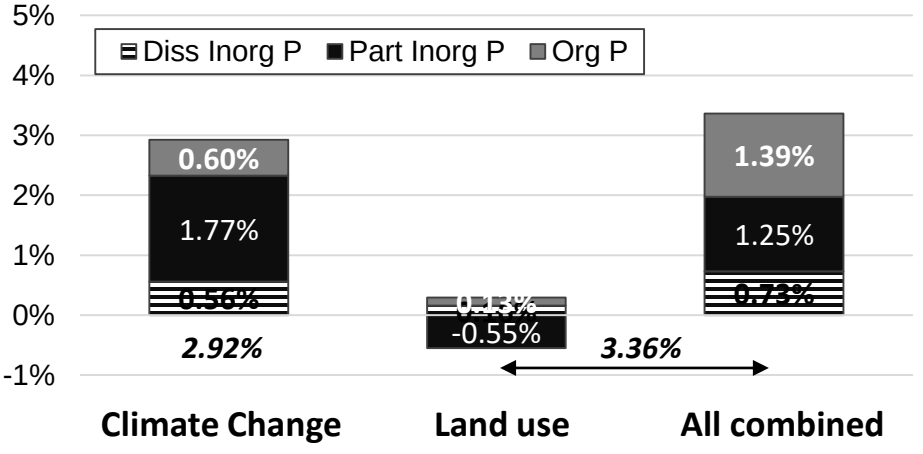
2025 sensitivity scenarios





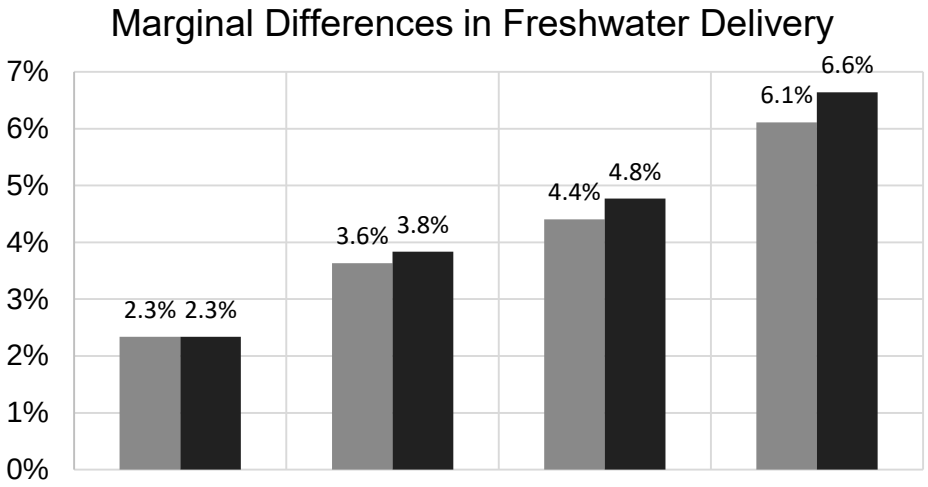


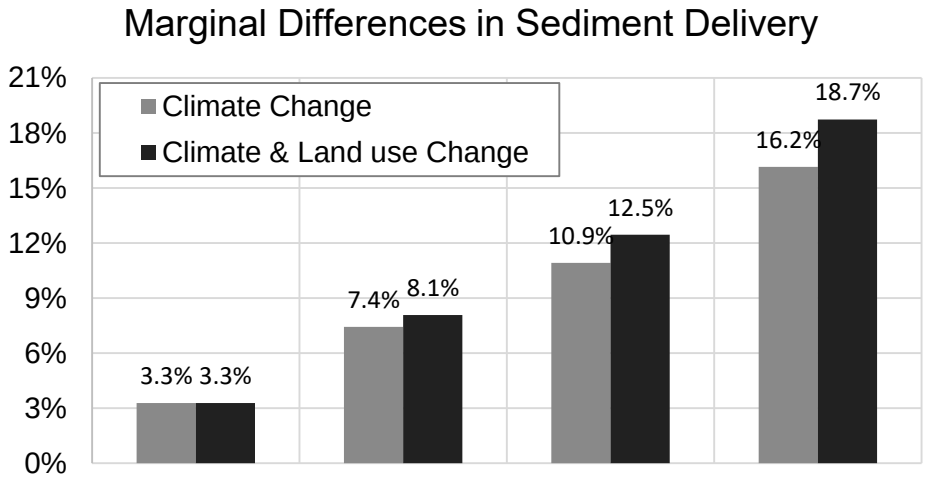


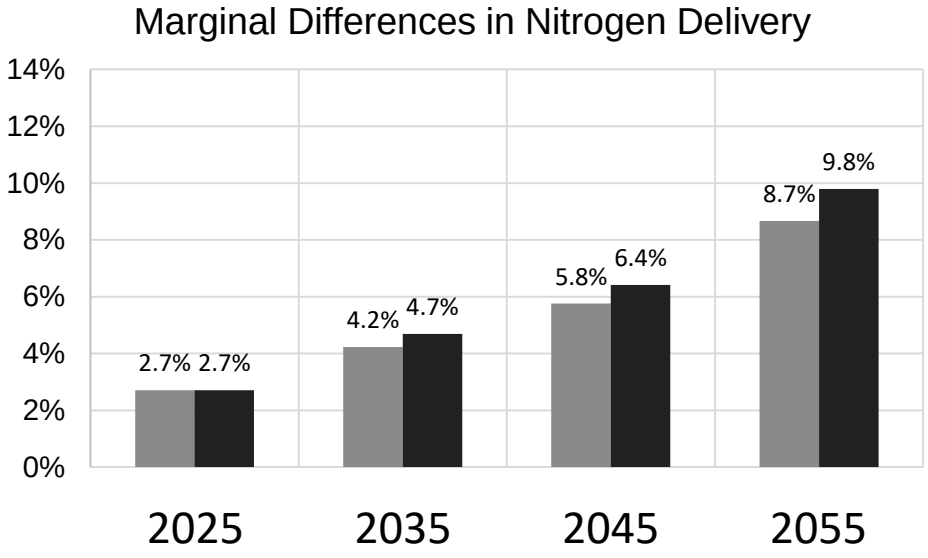
Going forward use WIP2 on 2025 land use for climate change assessments until WIP3 is available.

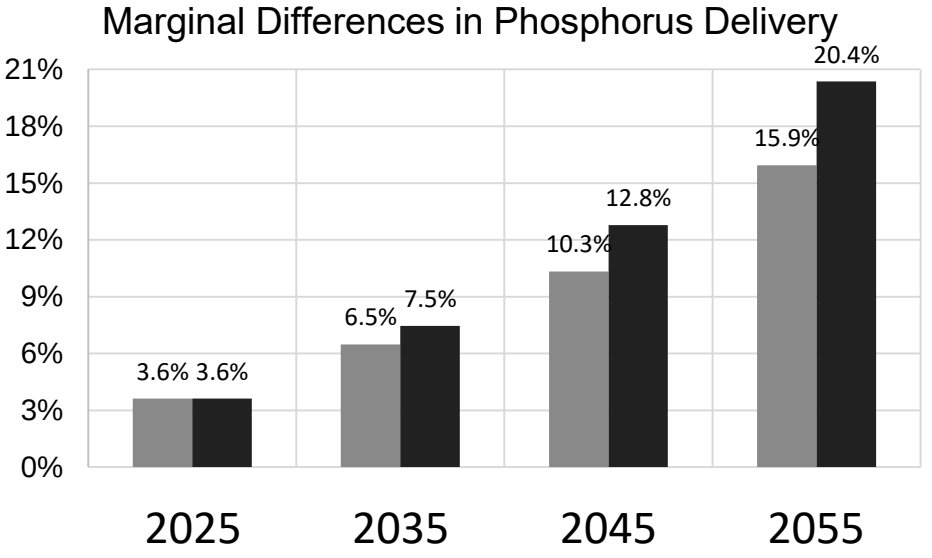
Differences are shown with respect to WIP2 on 2025 land use

2025, 2035, 2045, & 2055 Summary









*E.g., 2035 scenario includes (a) WIP2 on **2025 land use** & 2035 climate, (b) WIP2 on **2035 land use** & 2035 climate.*

Summary and Conclusions

- Climate change assessment for 2025, 2035, 2045, and 2055 were shown.
- Land use change projections were included, which slightly compounds the climate change effects.

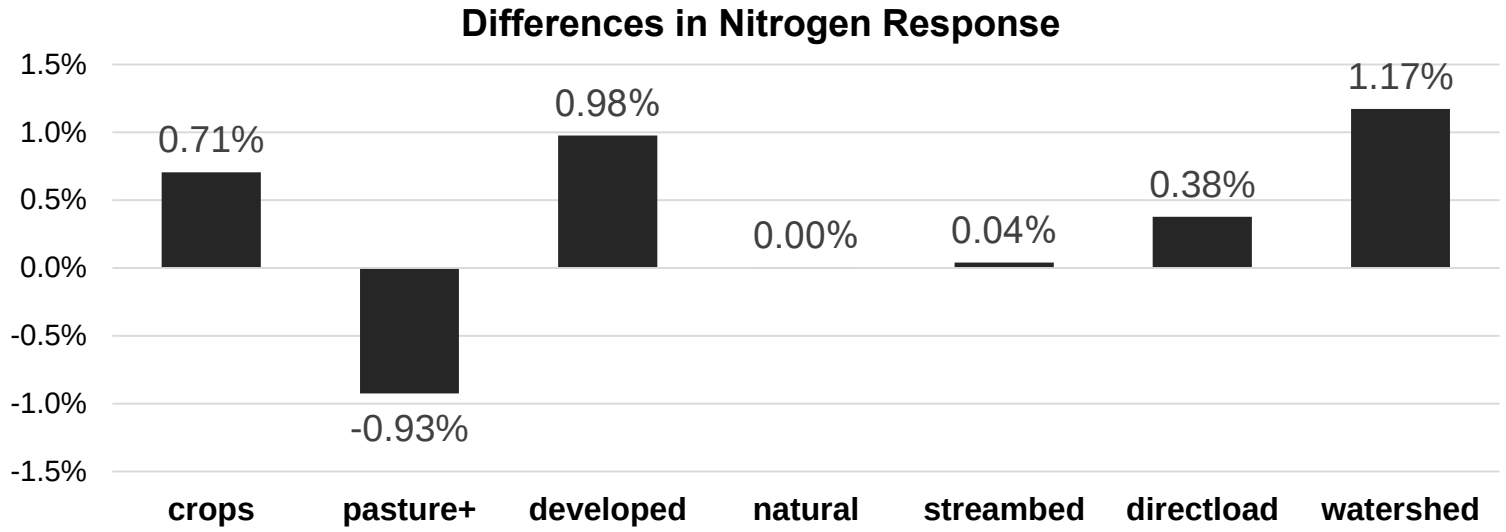
- Trend-based rainfall projections (estimated from annual rainfall data) did not have any monthly/seasonal component.
- Analysis did not include future impacts of socio-economic pressures, crop yields, growing degree days, atmospheric deposition, and best management practices (BMPs) etc.

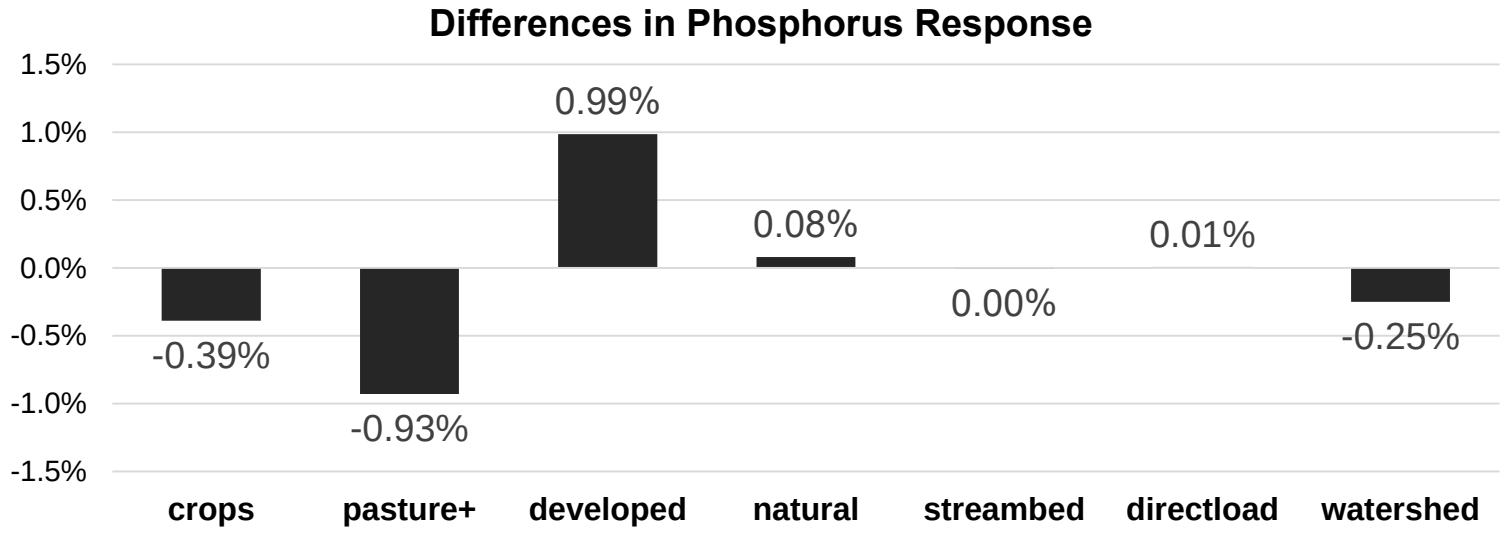
Next Steps

- Potential future model refinements that would result in changes in loads:
  - Nitrogen response (or sensitivity) to flow changes – either overall or land use specific
  - Phosphorus response – developed land use sensitivity etc.
  - Changes in nutrient speciation with climate (or flow)
  - CSO response with changes in rainfall volume and intensity

  - Seasonal changes in 2025 rainfall volume
  - Changes in climate forcing – e.g., downscaling
  - Process responses – e.g., riverine scour of organic nutrients
  - Changes in BMP effectiveness response with climate change

WIP2 level of effort on 2025 vs. 2010 land use

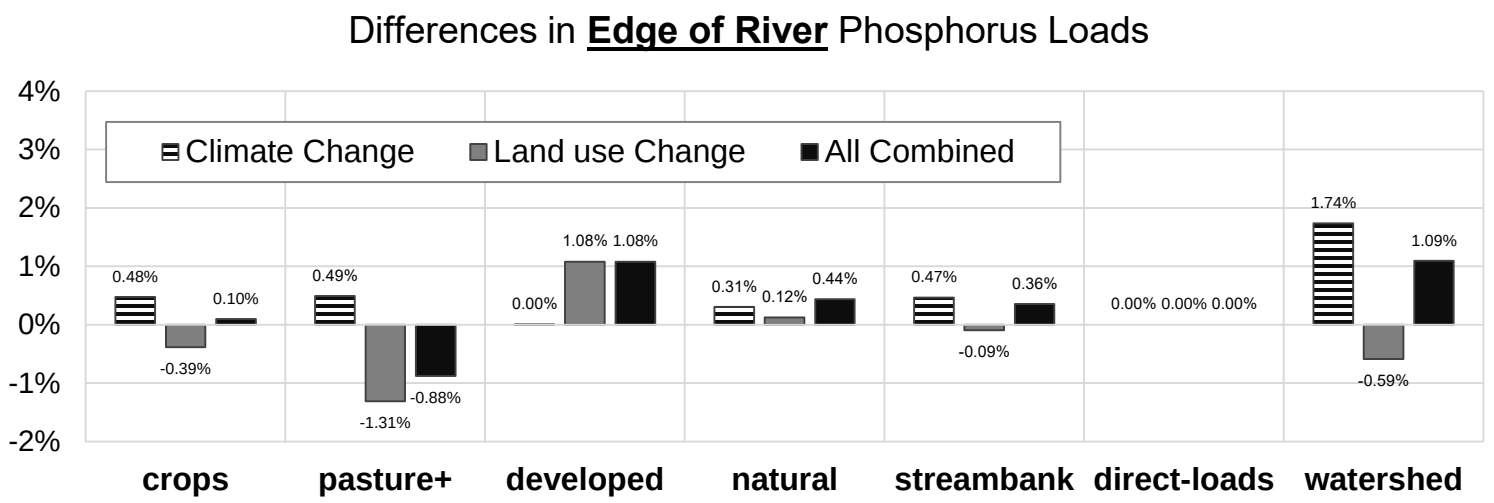


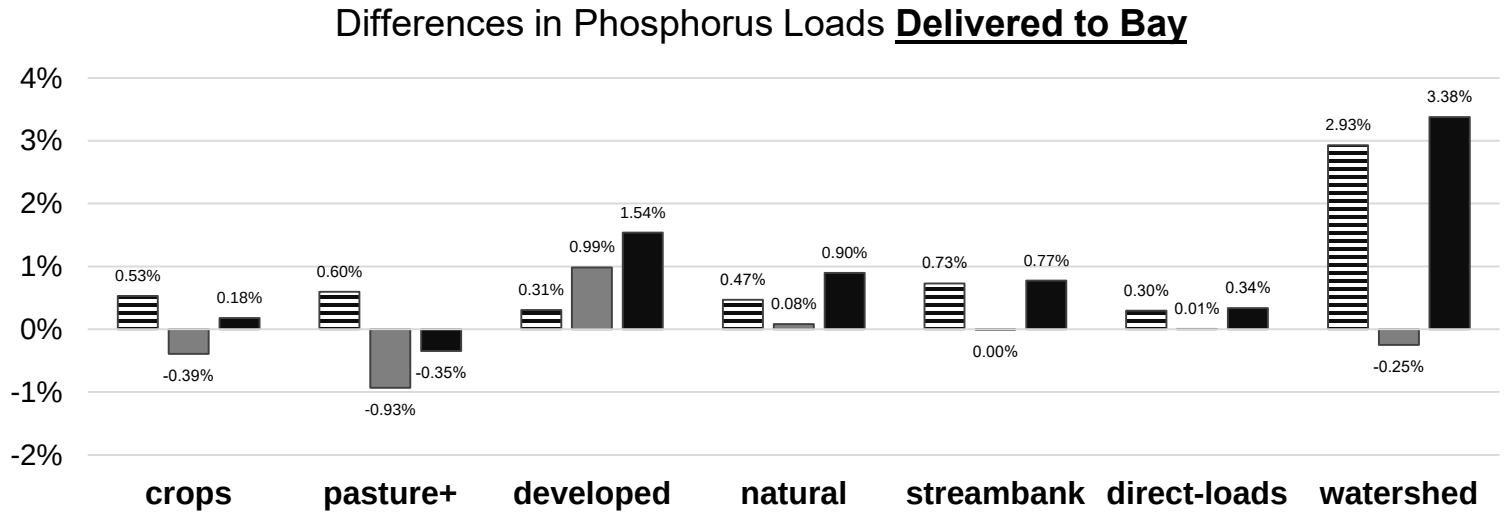


Figures show load sources contributing to the differences in delivered nitrogen and phosphorus loads due to land use change

Differences are shown with respect to WIP2 delivery on 2010 land use

Phosphorus delivery

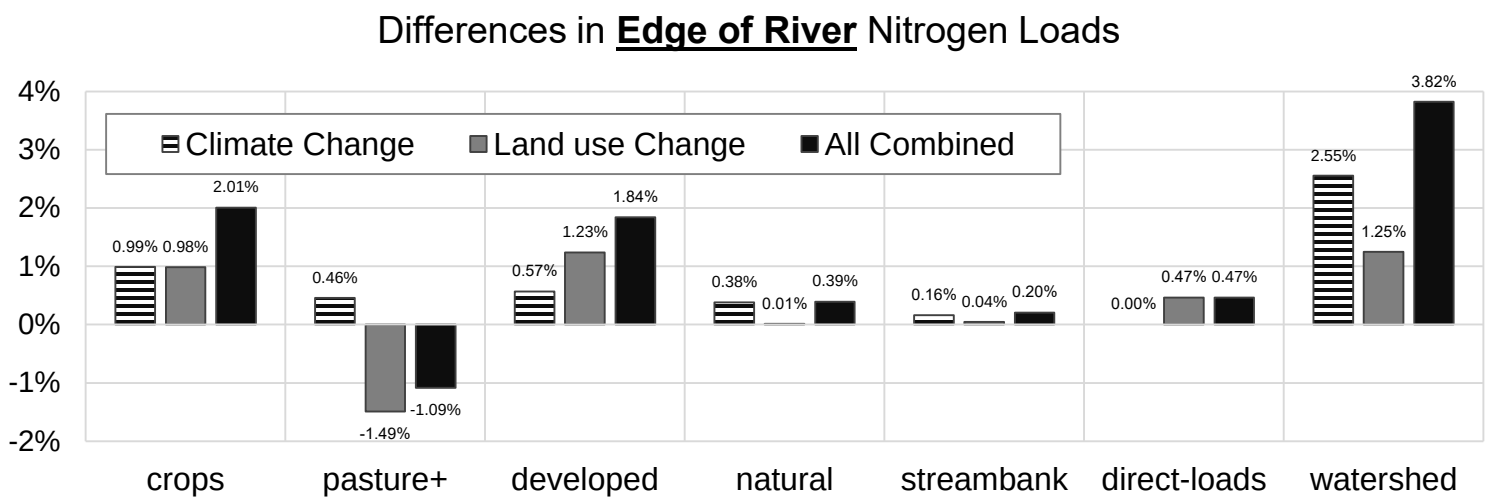


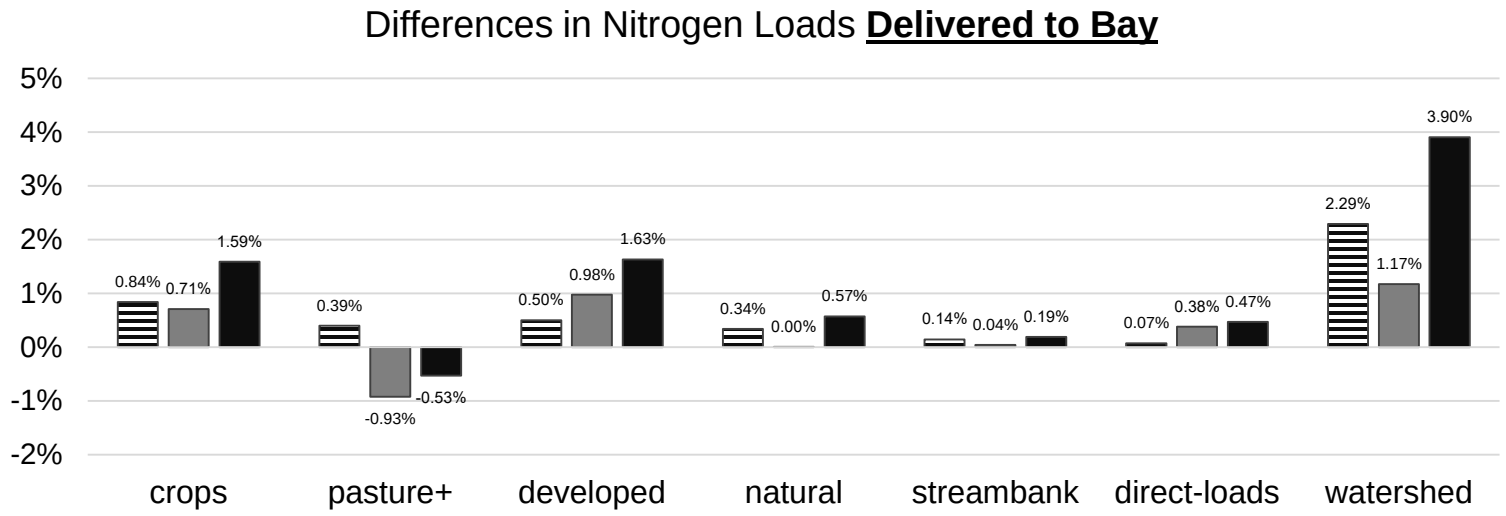


Climate change on 2025 land use had higher riverine response, particularly due to larger developed footprint.

Differences are shown with respect to WIP2 delivery on 2010 land use

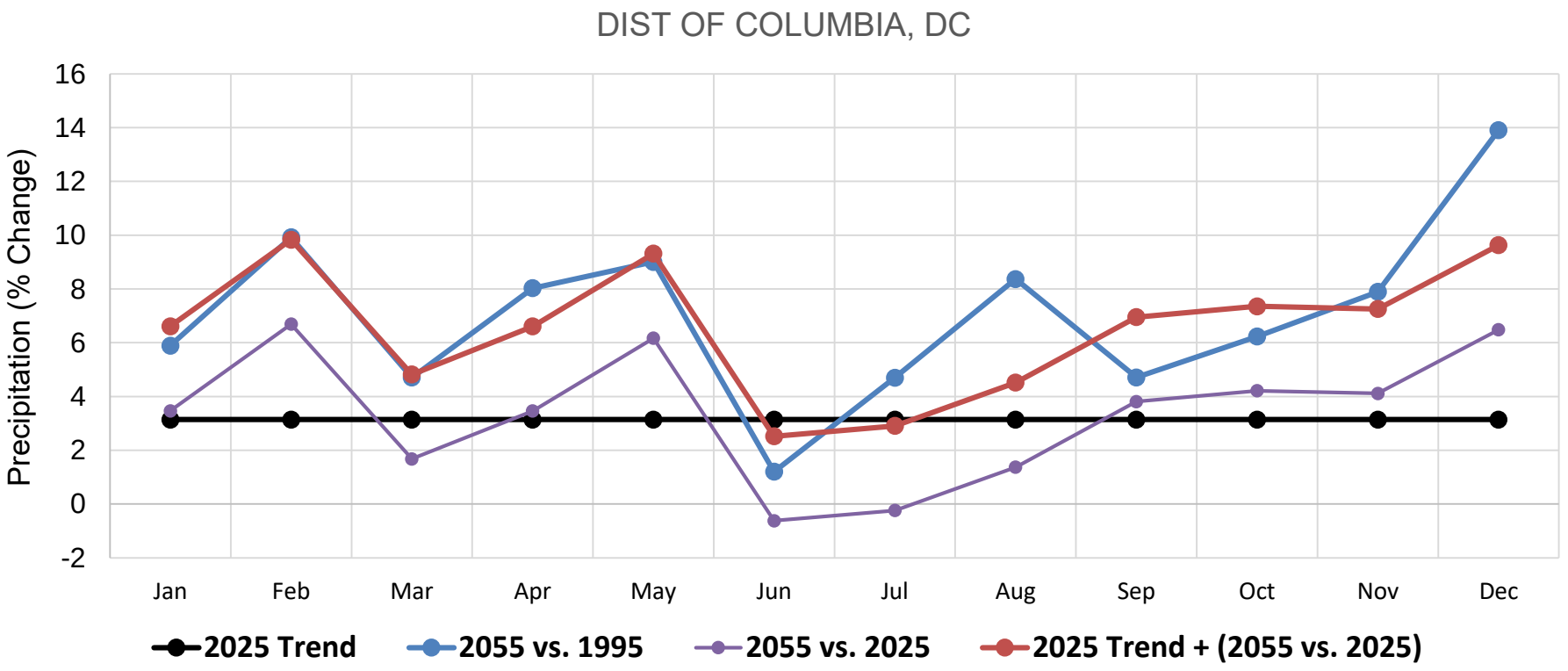
Nitrogen delivery



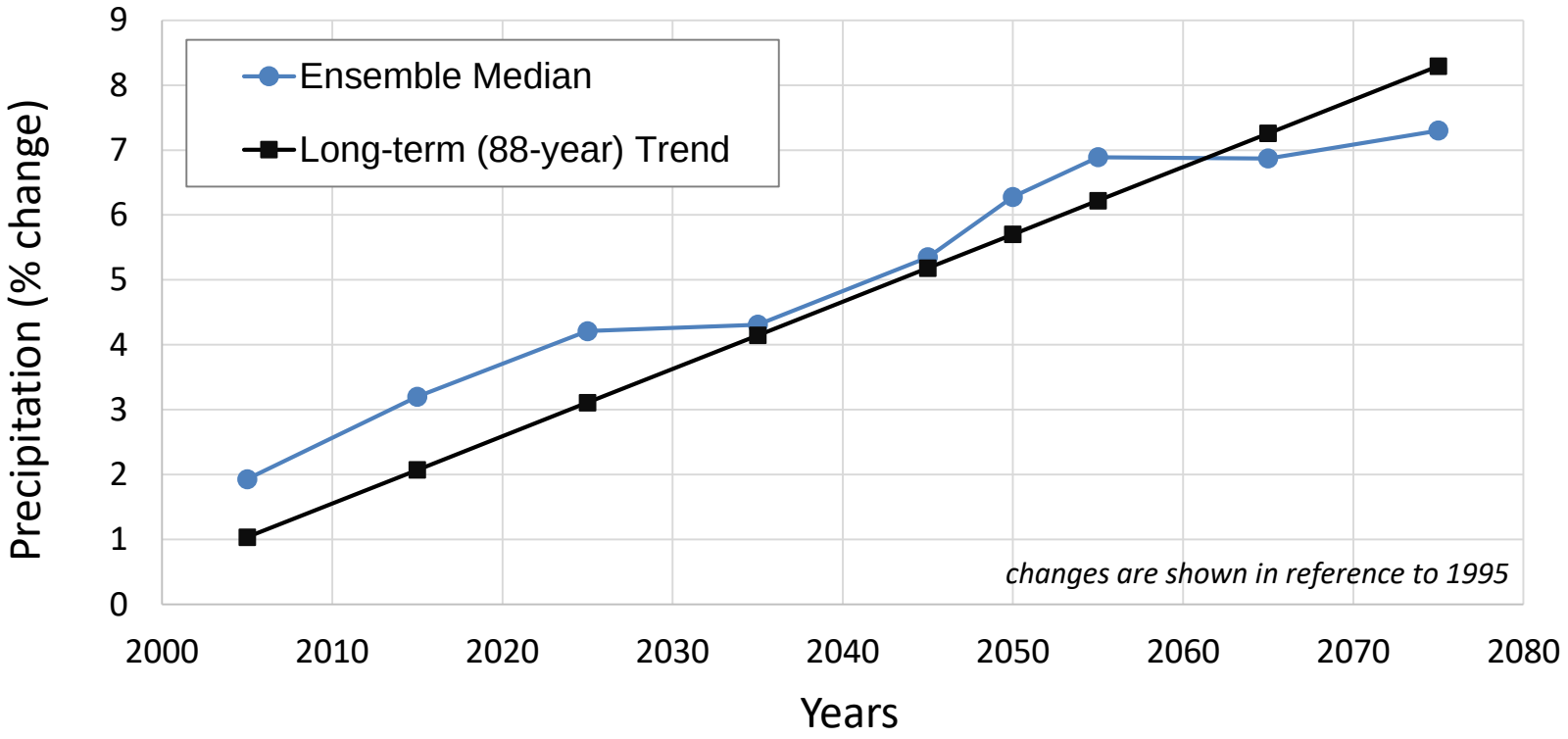


Climate change on 2025 land use had higher riverine response, particularly due to larger developed footprint and crops.

E.g., Rainfall volume delta change for Year 2055



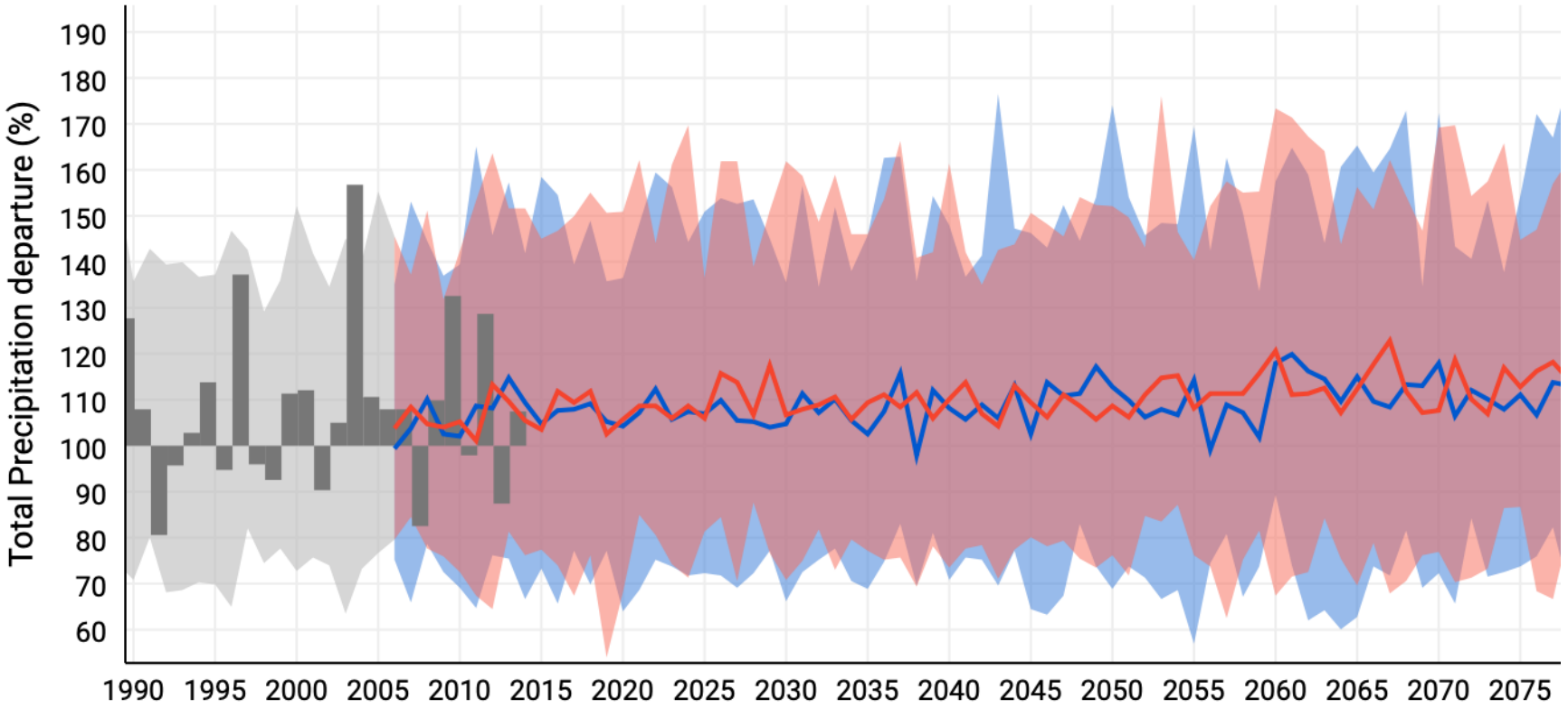
RCP 4.5 Ensemble Median vs. Extrapolation of Trends



***Ensemble**: 31-member ensemble of RCP4.5 GCMs; **Trend**: extrapolation of long-term (1927-2014) trends;*

Expanded analysis period include data points for 2005, 2015, 2065, and 2075.
A number of years are common in the 2005 (1991-2020 – 1981-2010) and 2015 (2001-2030 – 1981-2010) delta change calculations.

Anne Arundel County – Annual Total Precipitation (anomaly)



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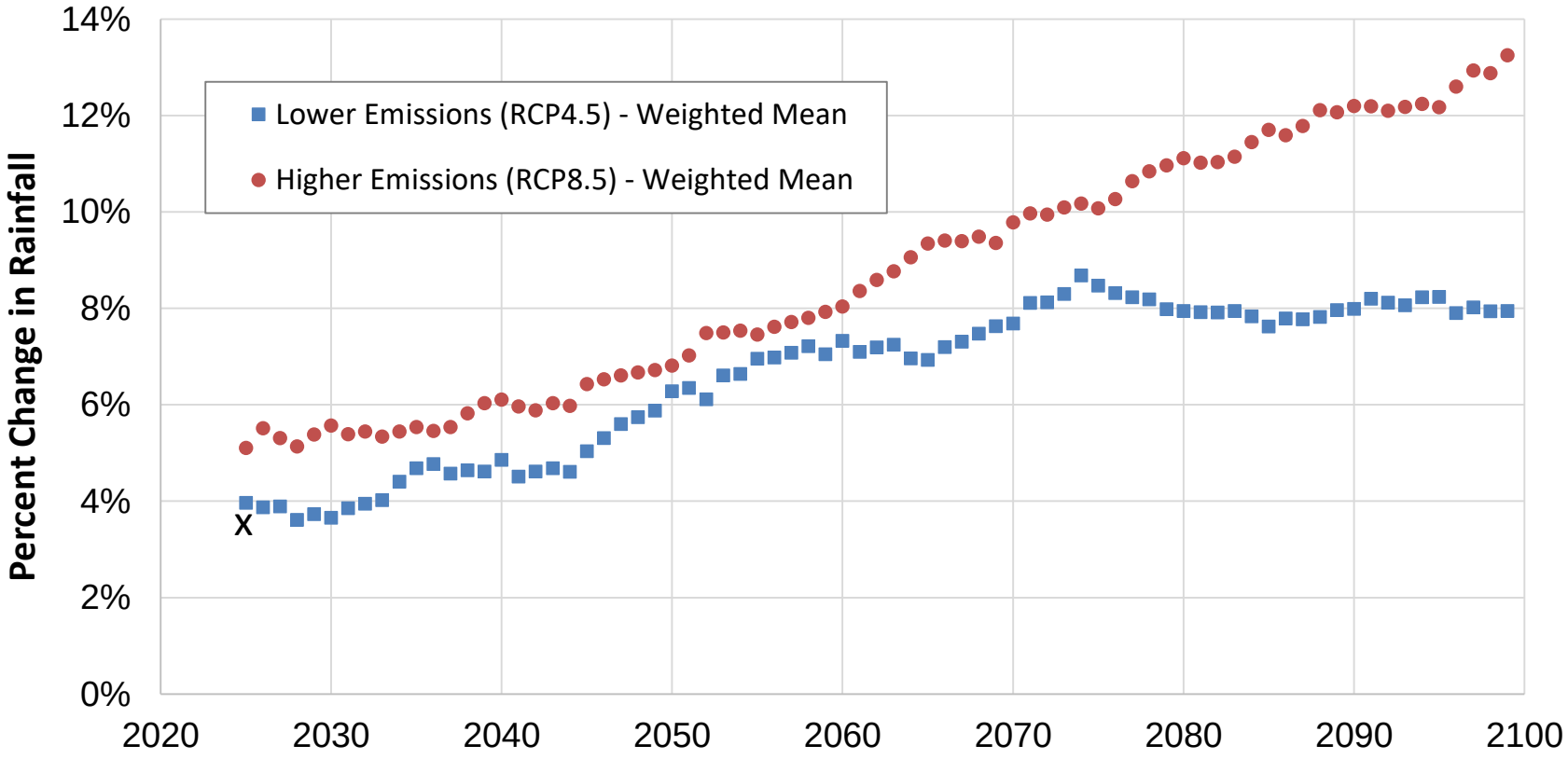

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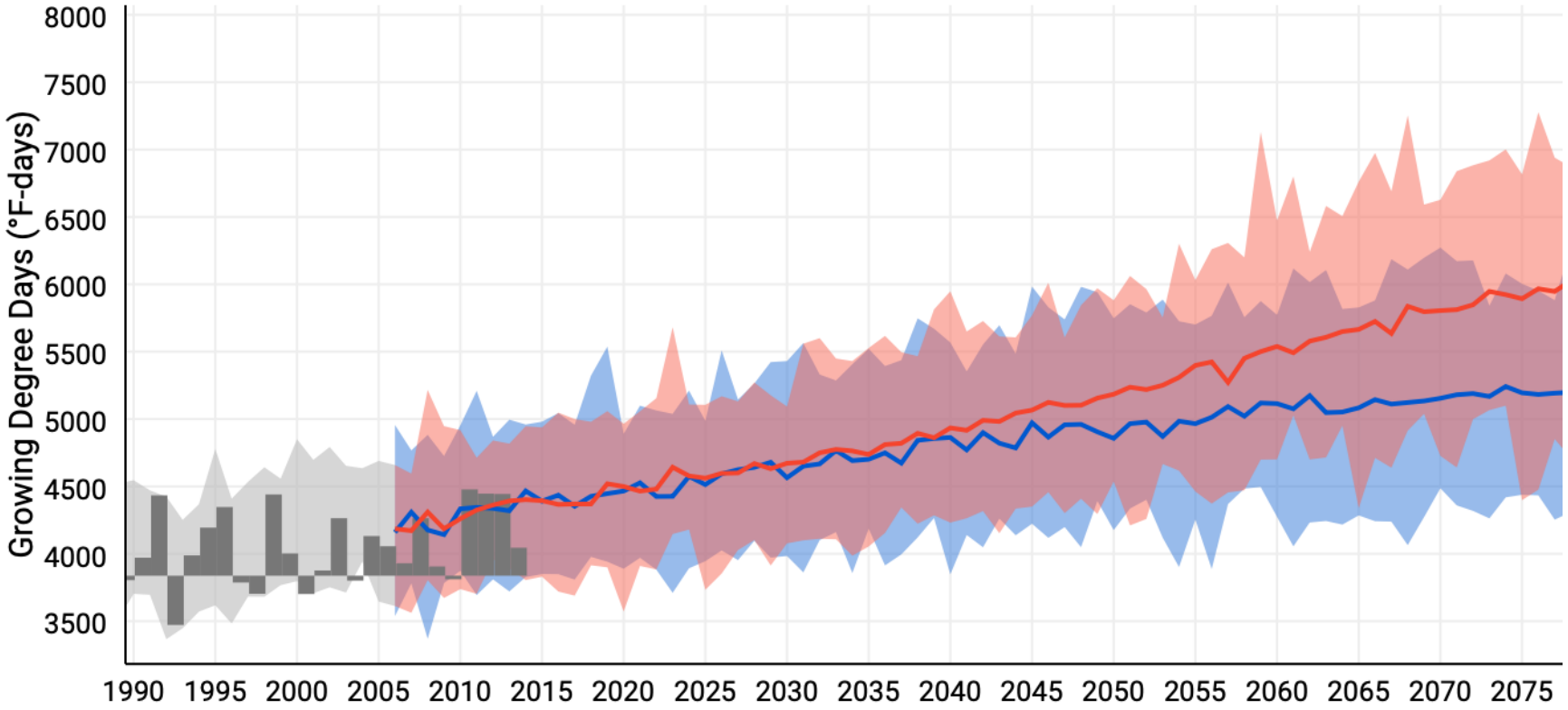
Anne Arundel County – Growing Degree Days (actual)



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