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Effects of Climate Change on Water Quality in the Yaquina Estuary, Oregon

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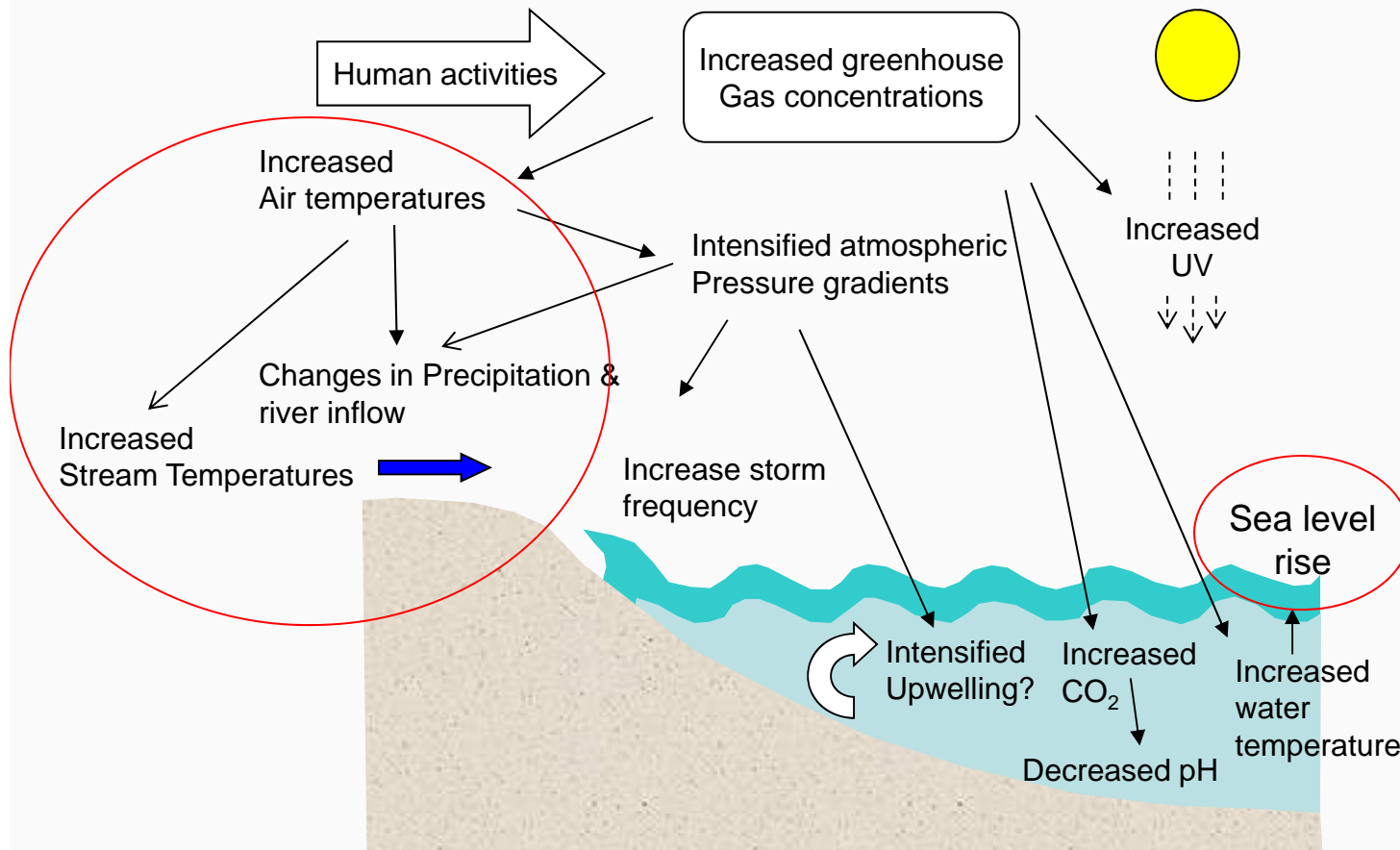
Study Background



Predicting CC threats to key estuarine habitats & ecosystem services.

US EPA, USGS, USDA, USFS, USFWS, Oregon DSL
Nature Conservancy, OCCRI, OIMB, PSU





Modified from Harley et al. (2006)



Climate Change Impacts Are Expected to Vary With Estuary Type

Marine

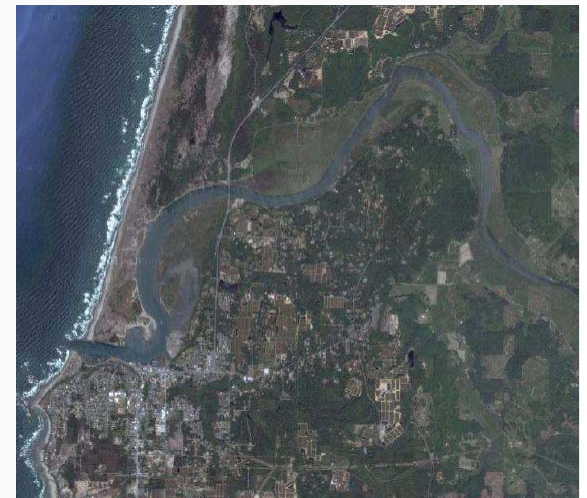
Riverine



Netarts



Yaquina



Coquille

Methods



Downscaled Scenarios from NARCCAP

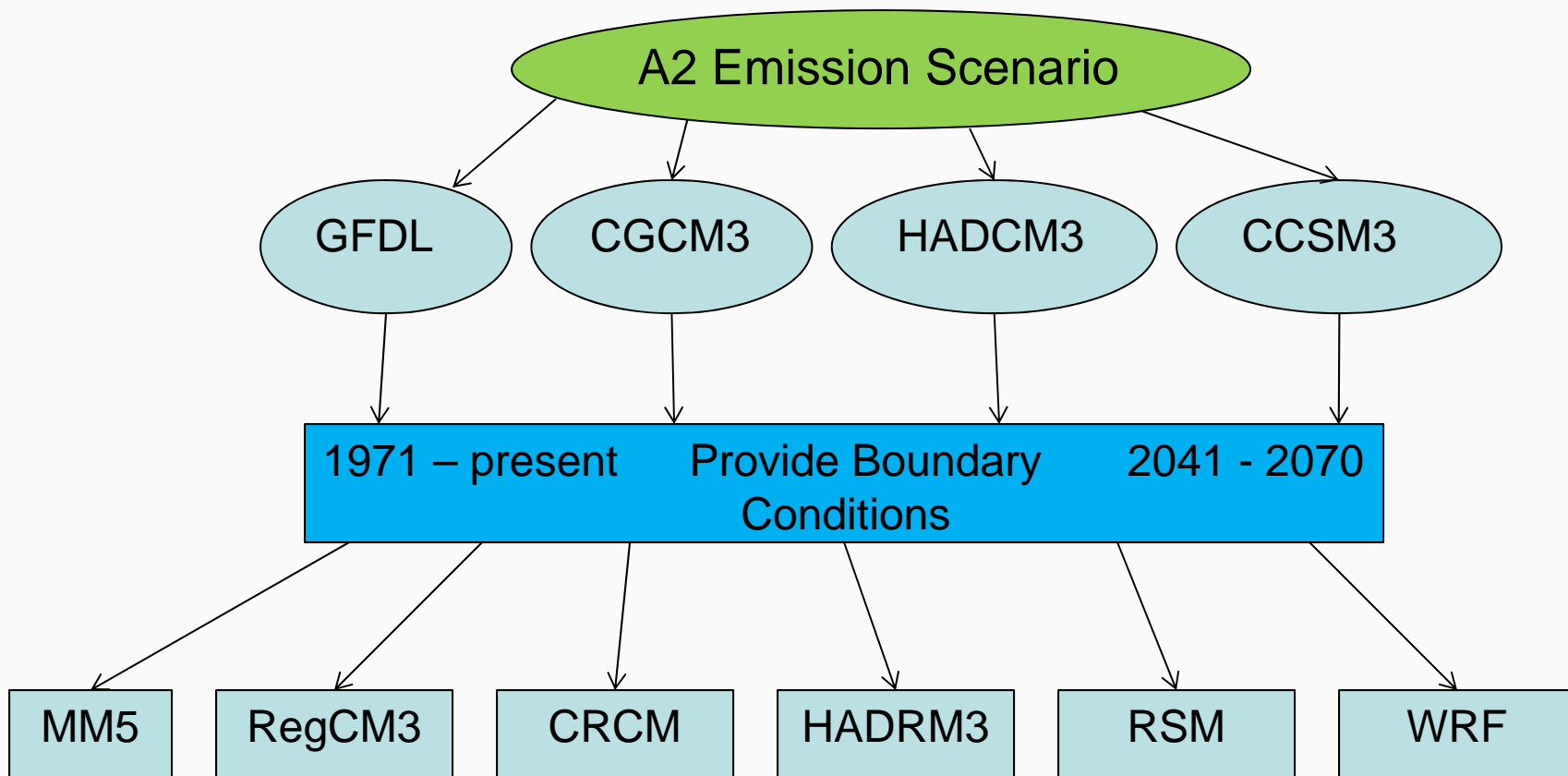
Freshwater Inflow Model

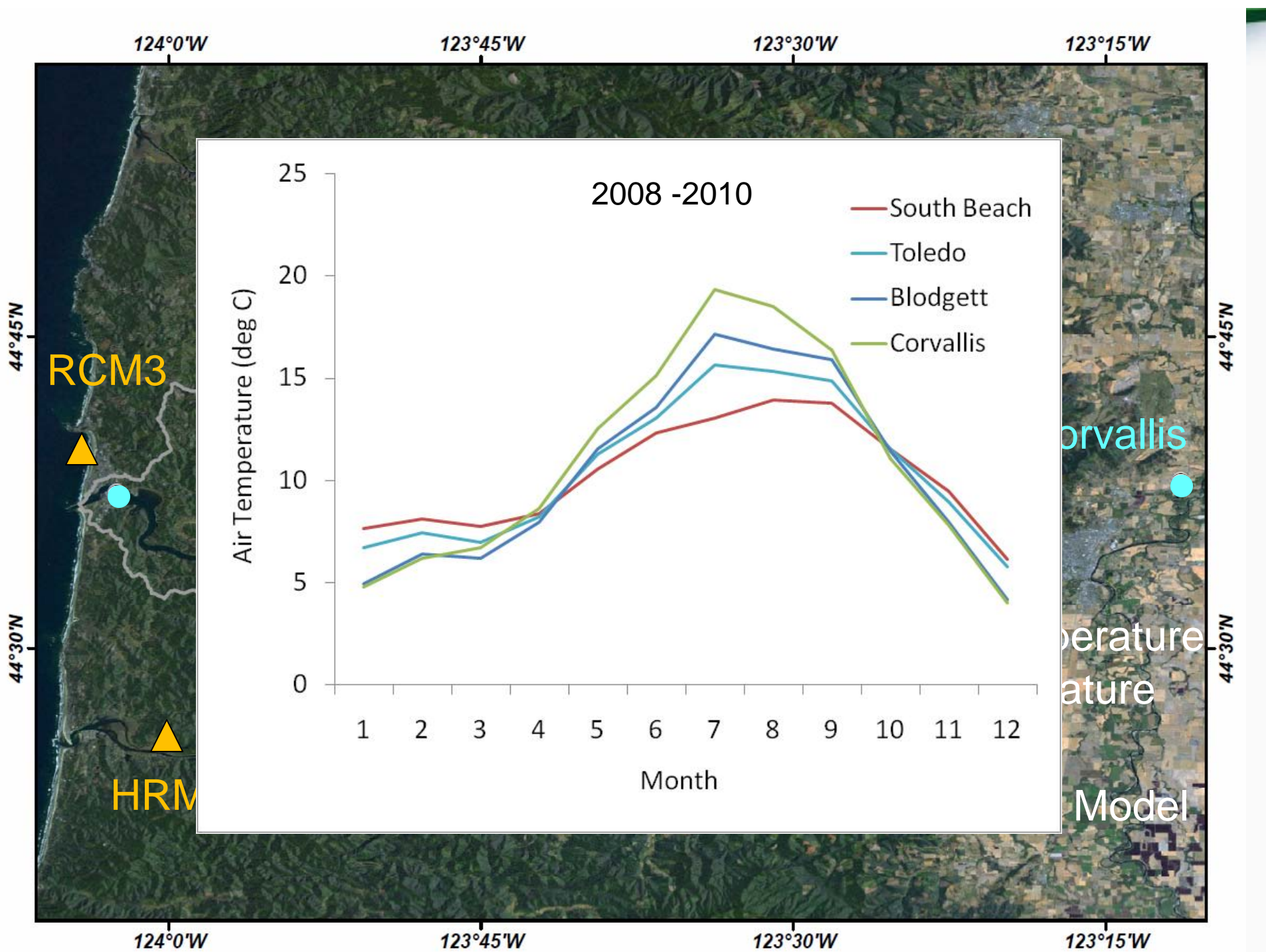
Estuary Hydrodynamic Model

- Steady freshwater inflow cases for sea level ranging from present conditions to 1.5 m rise
- Simulations of annual cycle (2004) with increase in air temperature and stream temperature + sea level rise

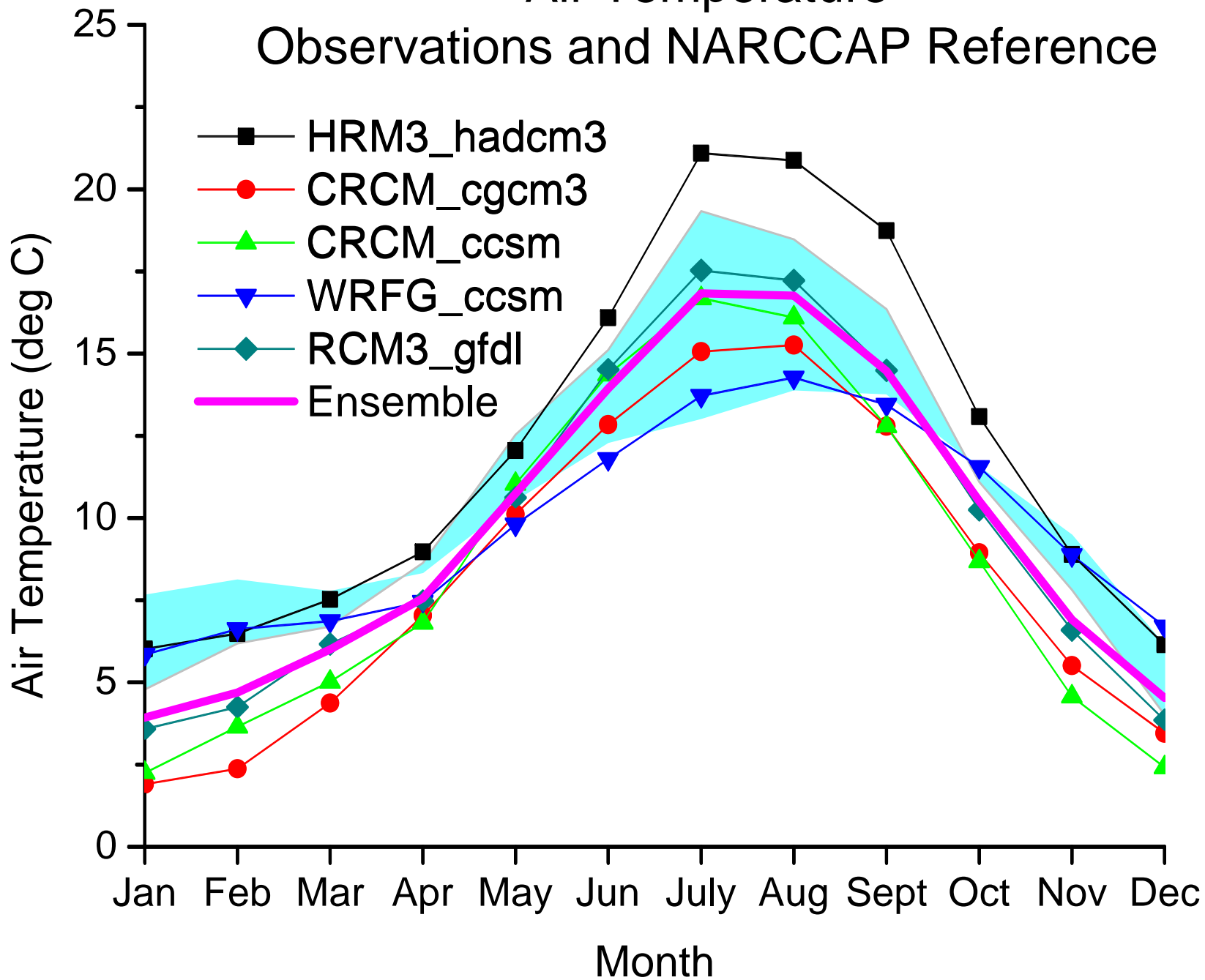


NARCCAP Projections

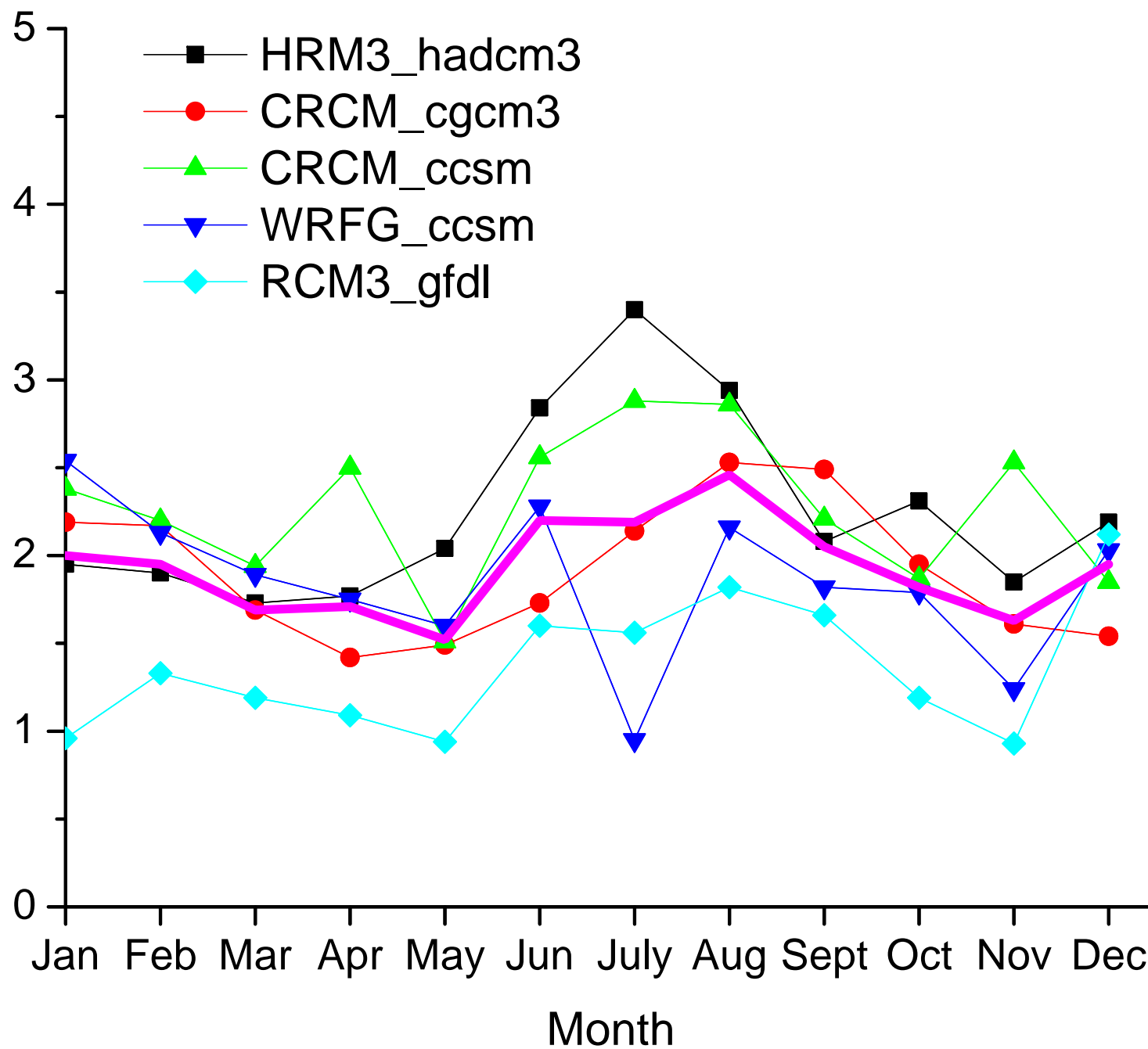




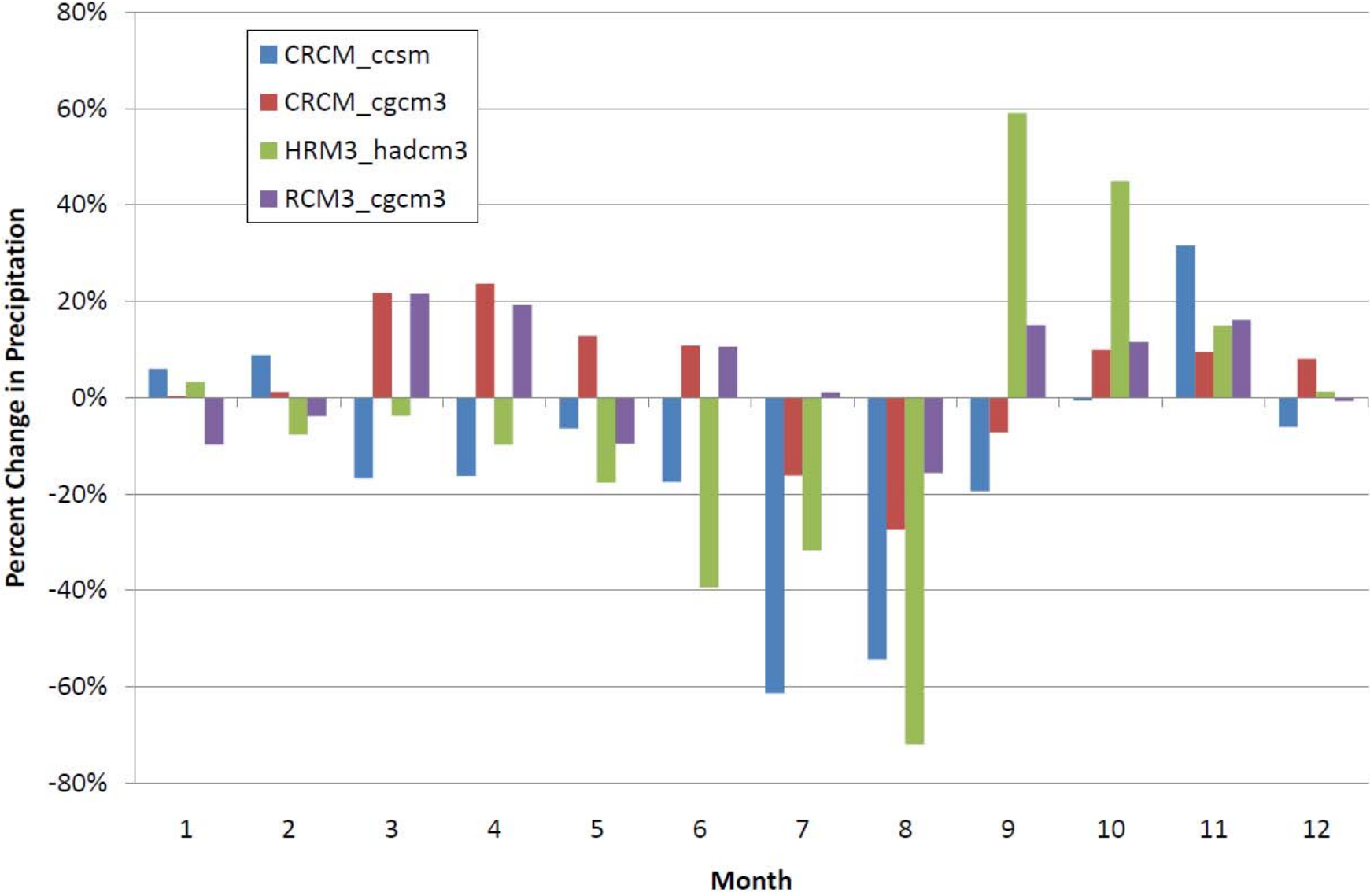
Air Temperature Observations and NARCCAP Reference



Difference Between Future and Reference
Air Temperature (deg C)



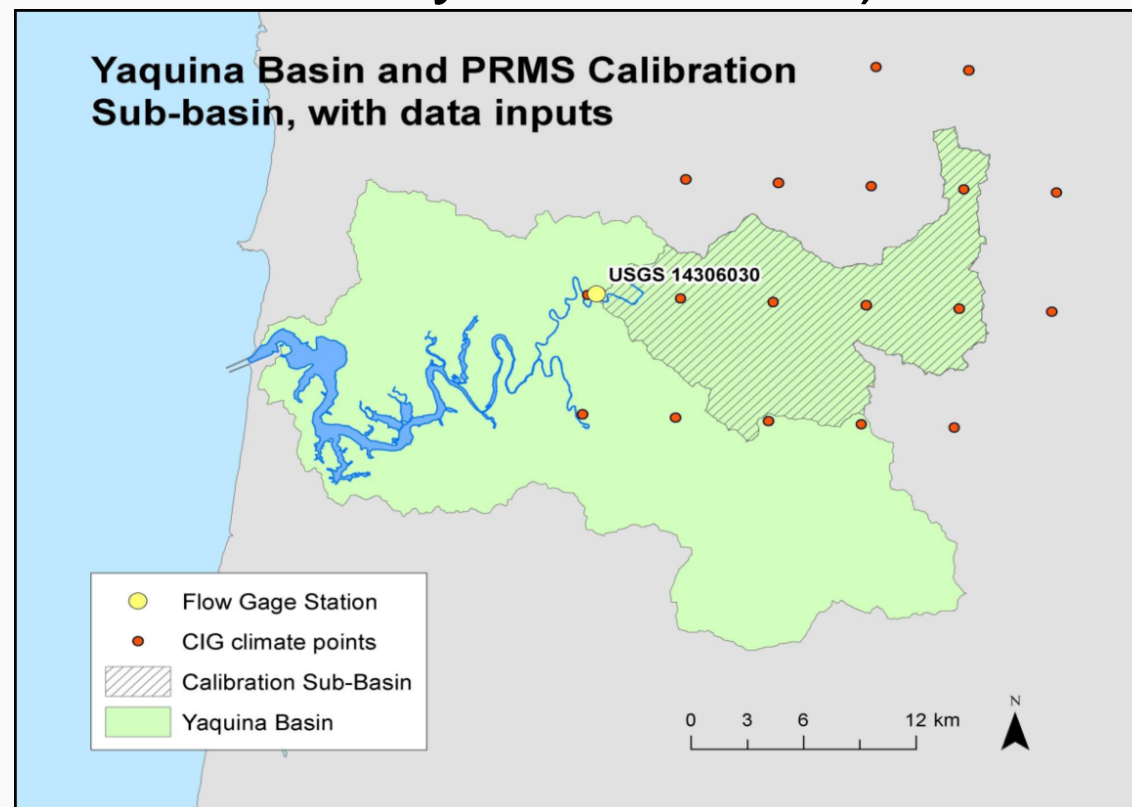
Percent change in precip. from reference to future period, Yaquina



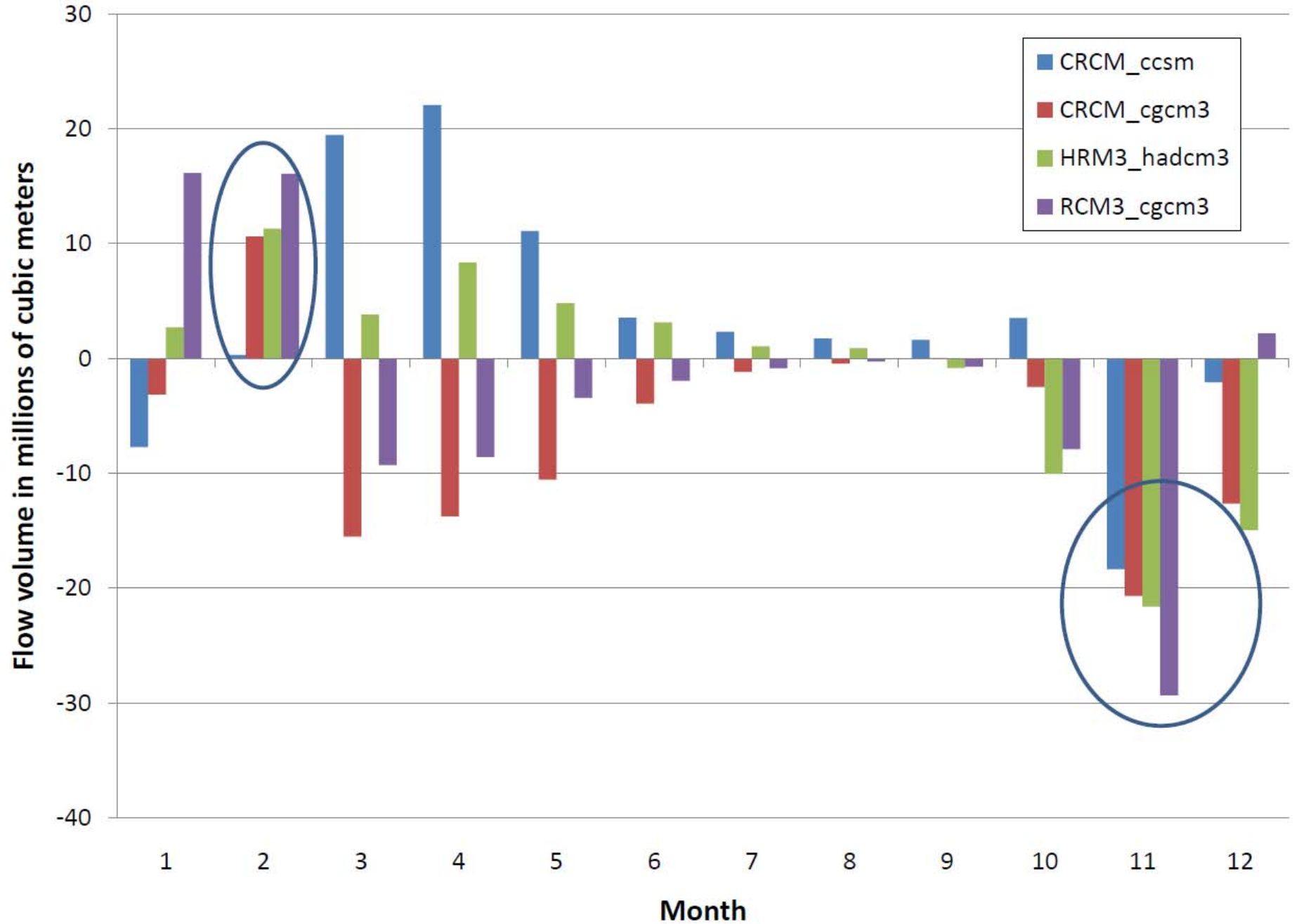
Freshwater Inflow



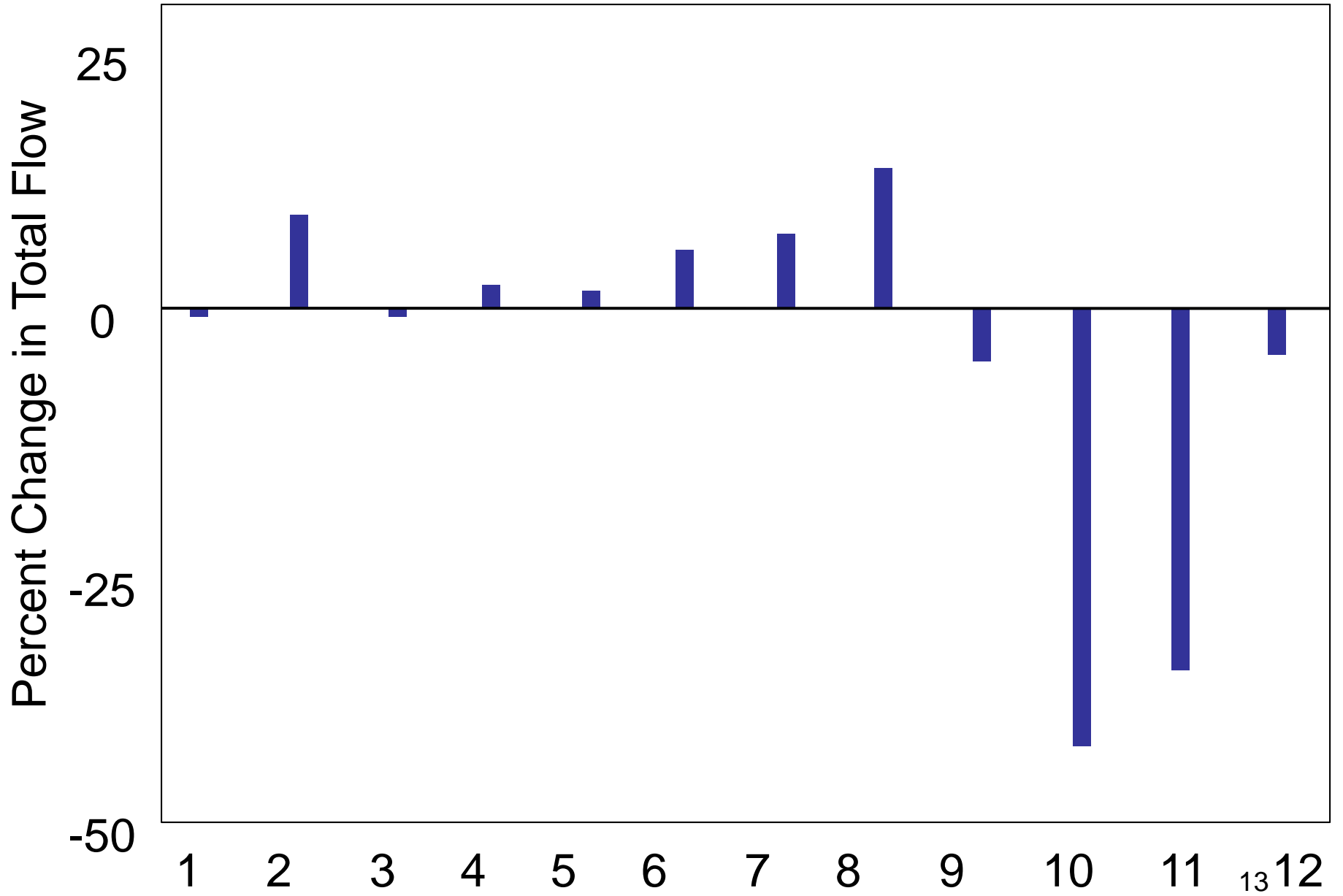
- Precipitation Runoff Modeling System (PRMS; Leavesley et al. 1983)



Projected Absolute Change in Yaquina Flow



Ensemble Mean



Estuarine Modeling



Response Variables: Salinity & Temperature

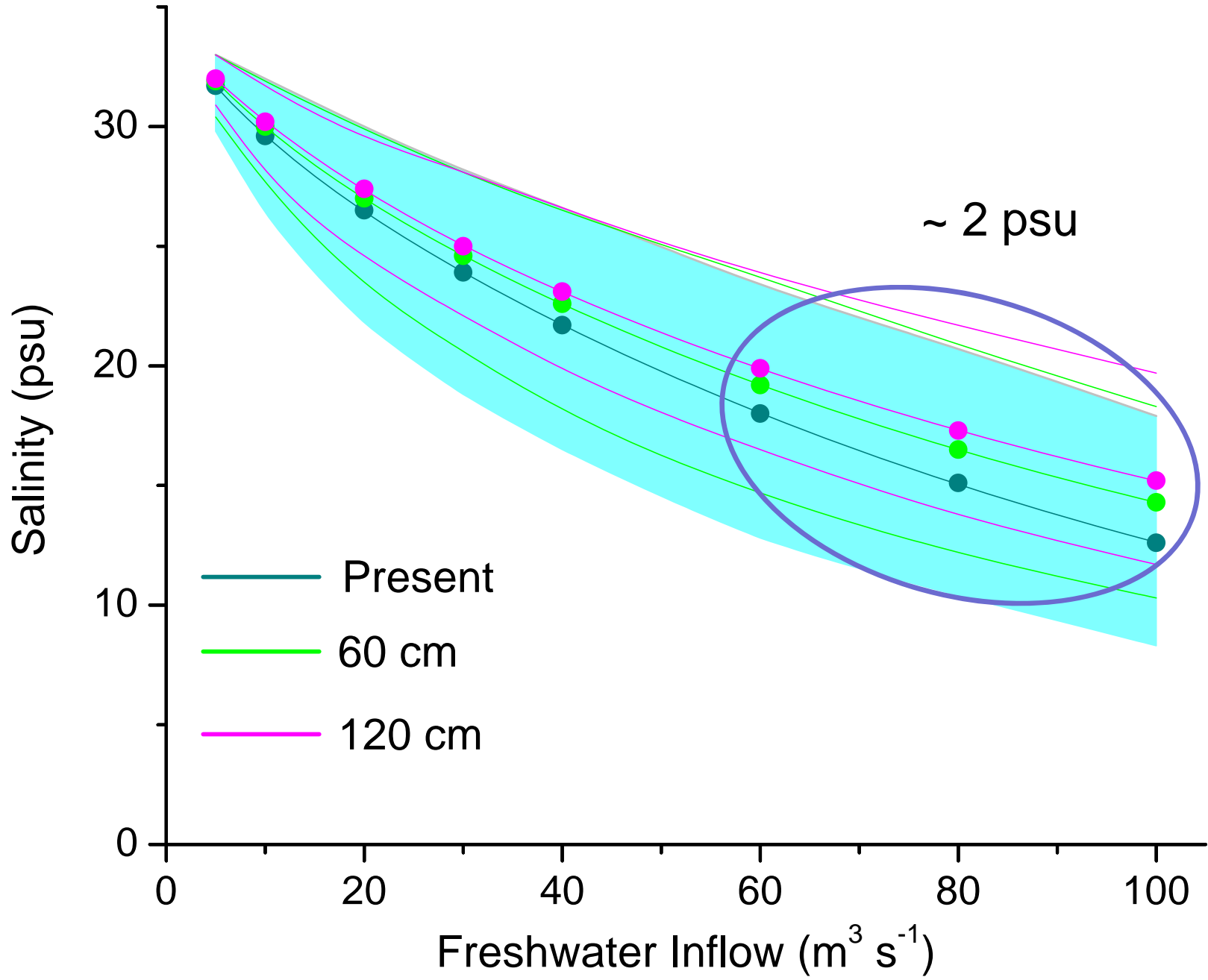
Steady Discharge Simulations

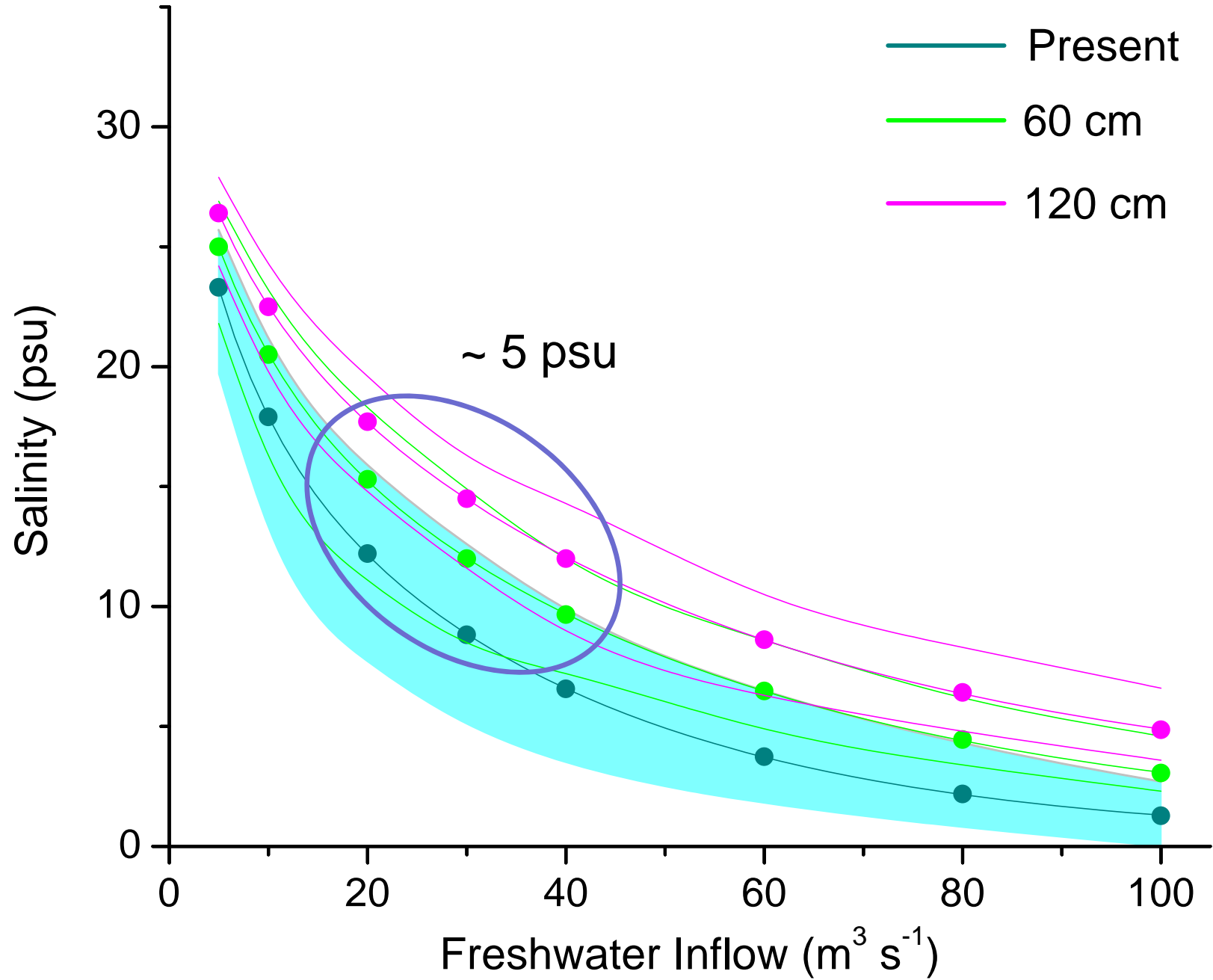
Includes freshwater inflow & tidal forcing

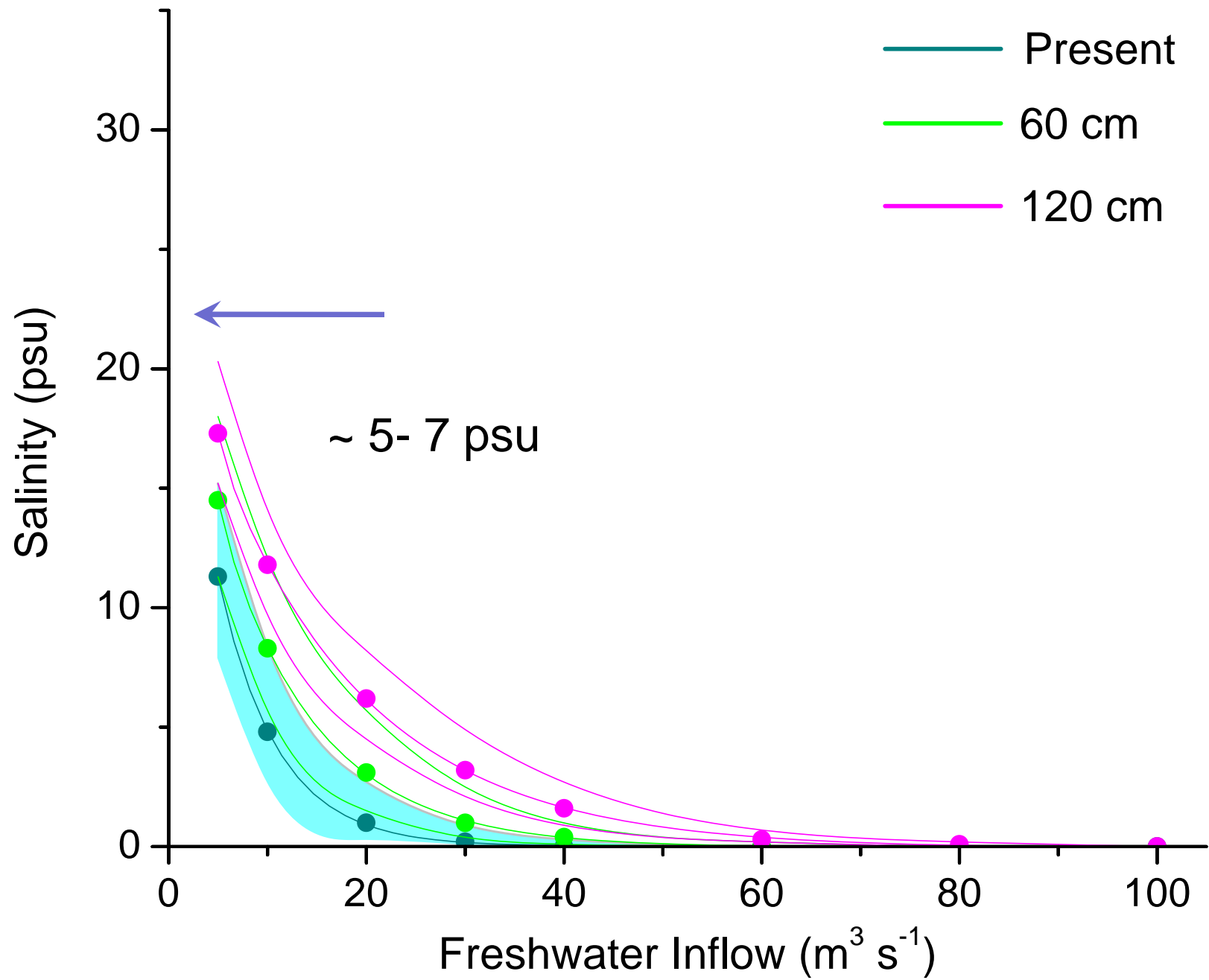
Annual average used to impose temperature gradients.

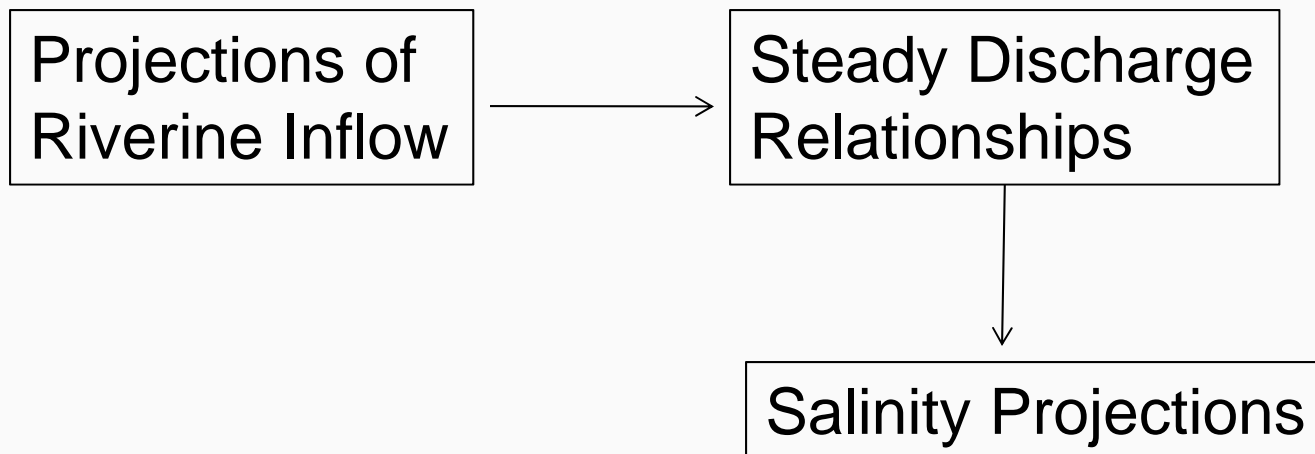
Sea level varied from present to +1.5 m

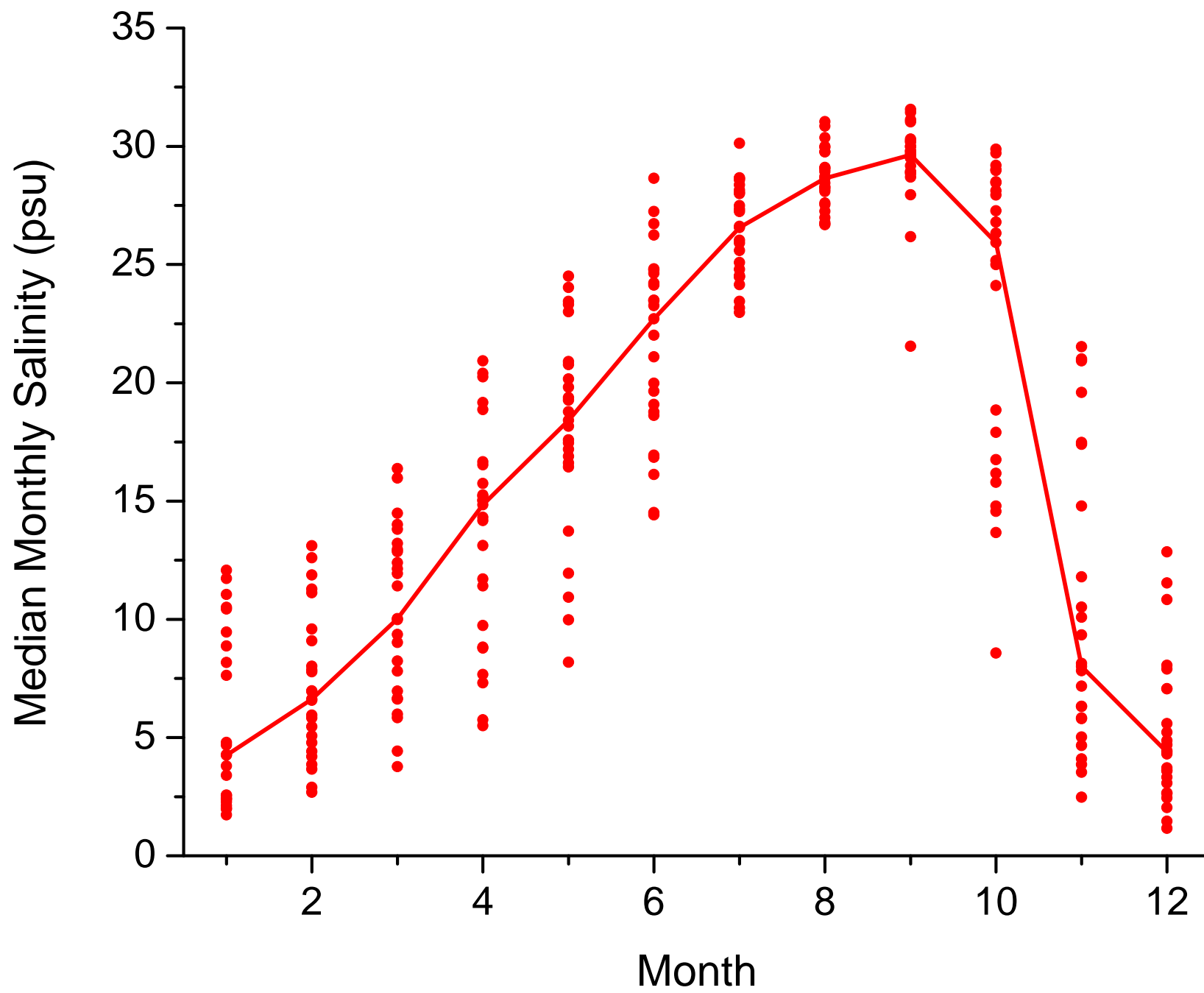
Simulations of the effect of increased air temperature and sea level rise.

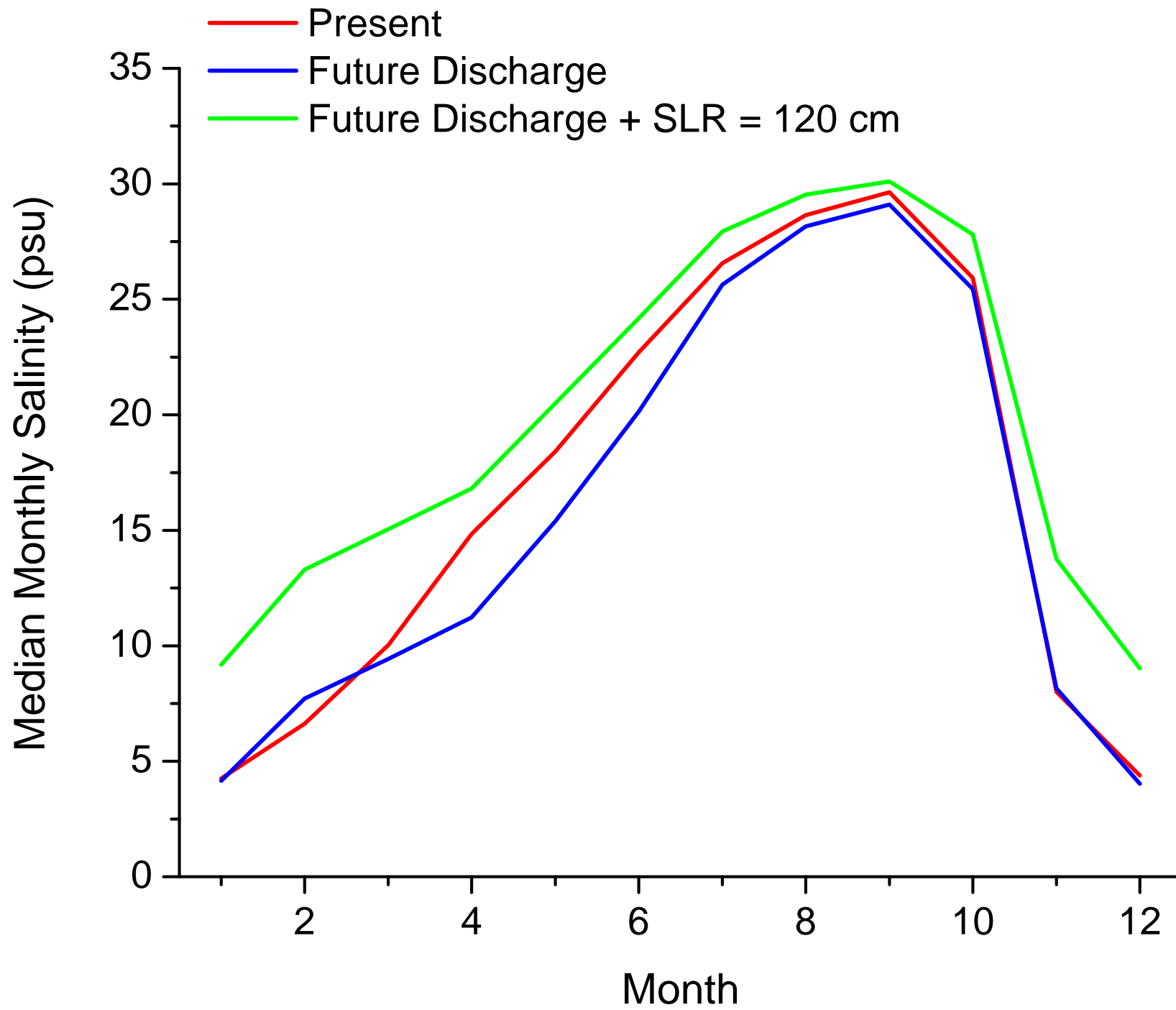












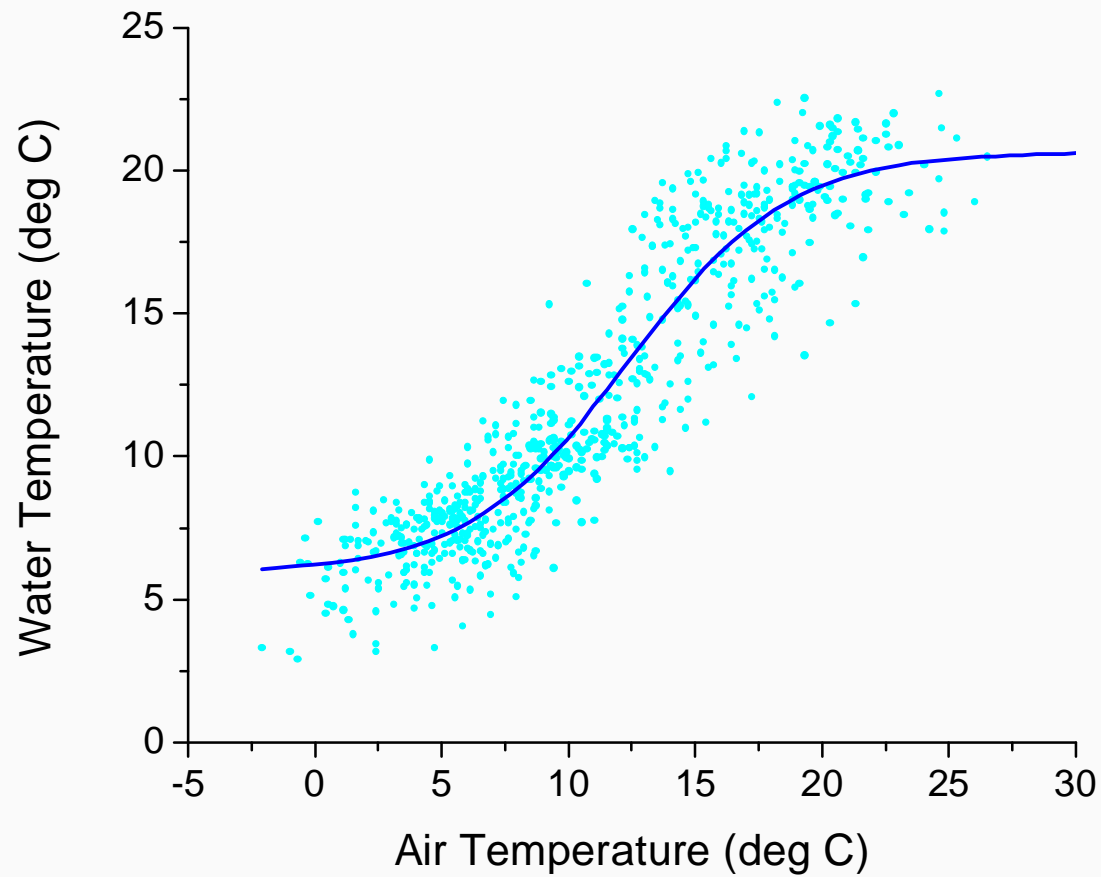


Climate Change Impacts on Estuarine Water Temperature

- Base Case of 2004
- Includes tidal forcing and river discharge
- Compared to 2004 observations
- Projected increase in air temperature and river temperature at Elk City



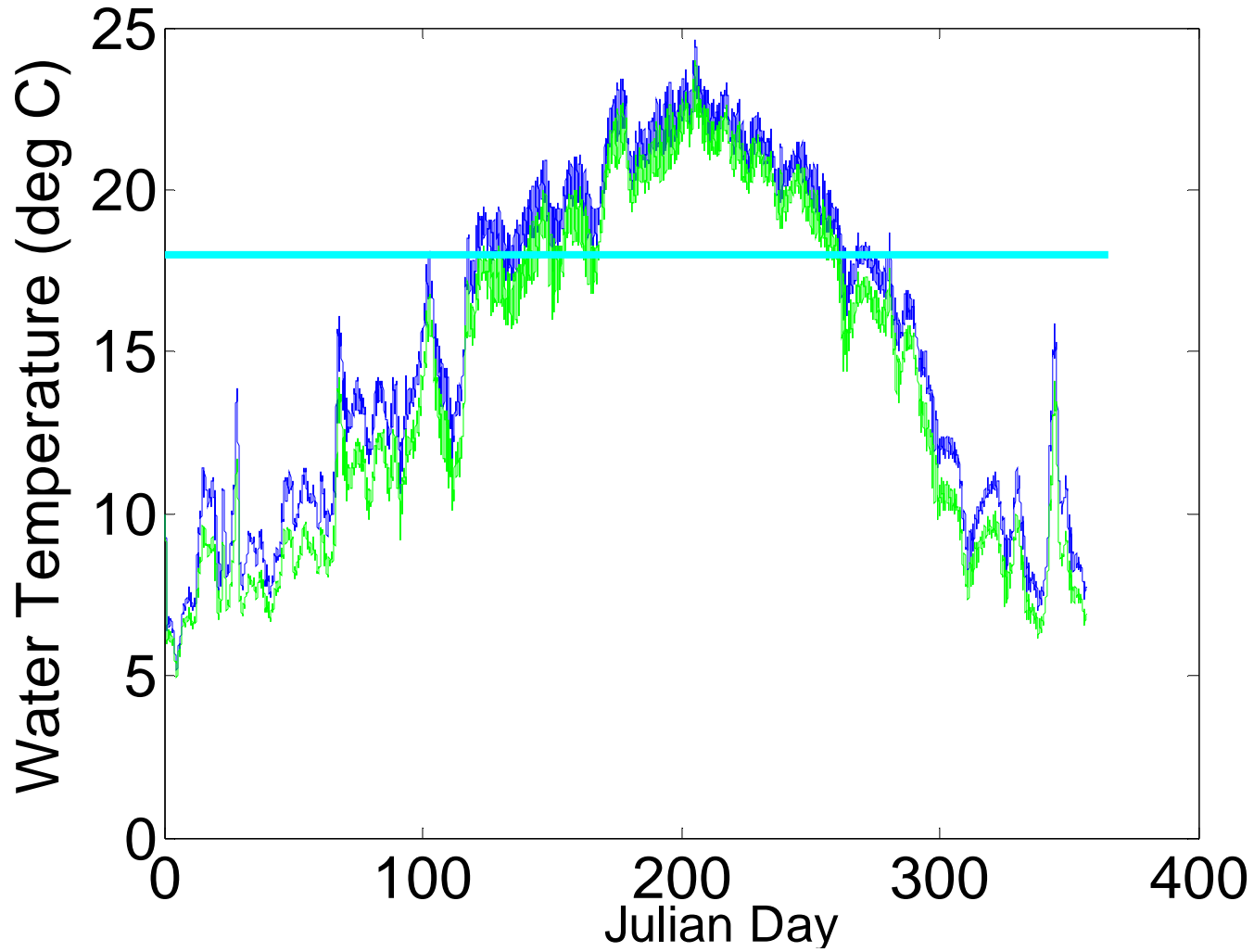
Water Temperature of Freshwater Inflow

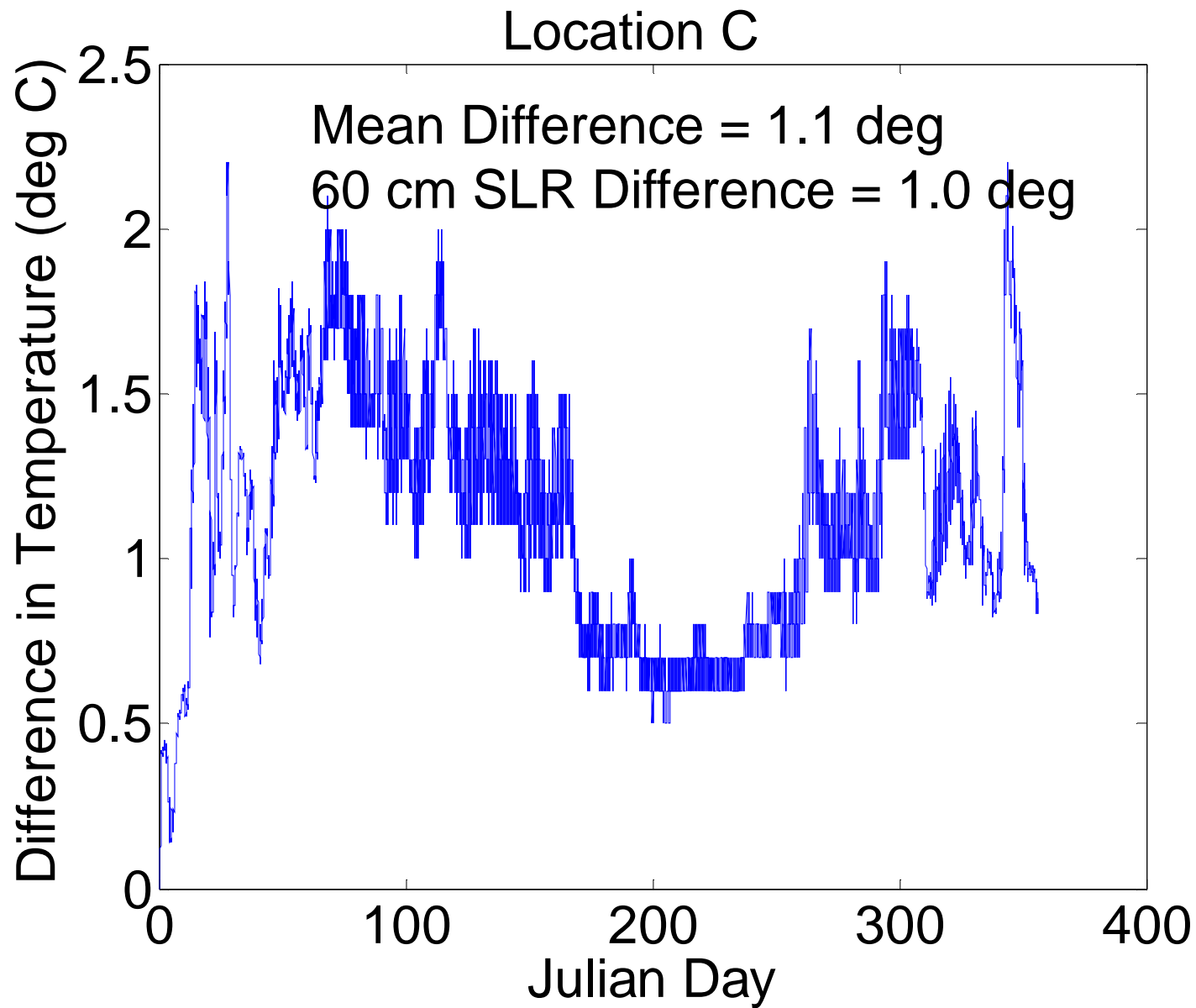


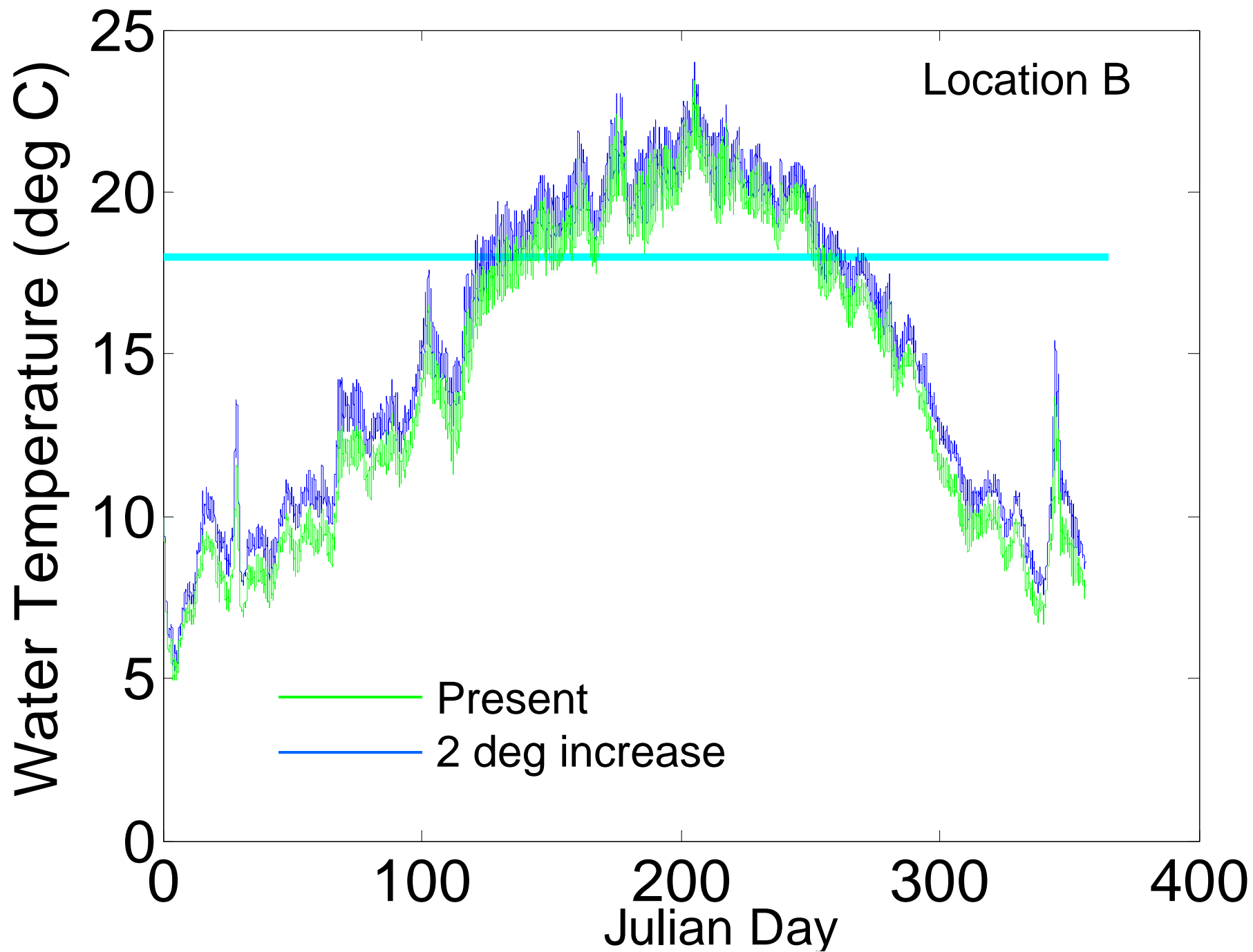


Location C

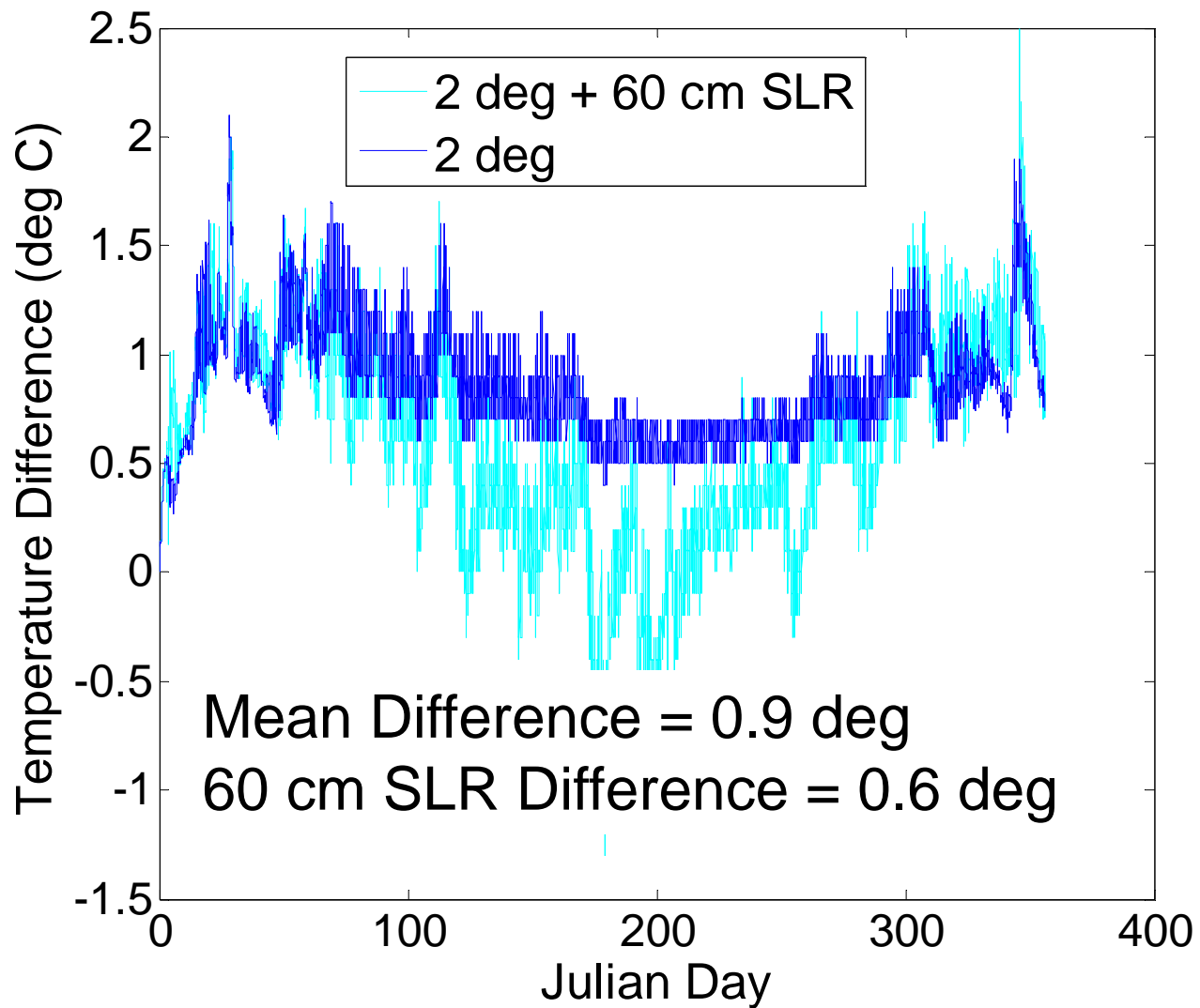
Present
2 deg increase





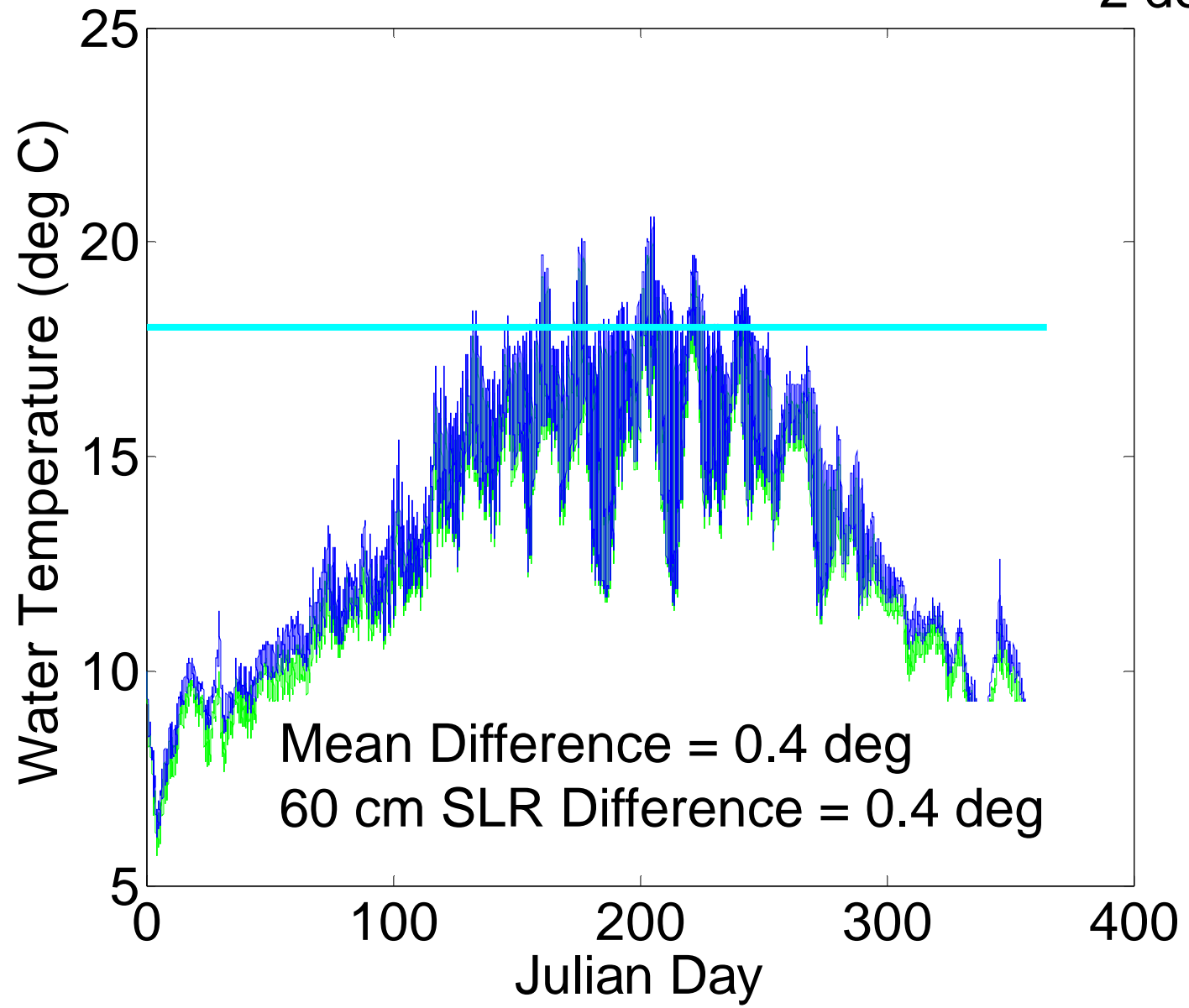


Location B



Location A

Present
2 deg increase



Conclusions



- High degree of uncertainty in future projections
- Need to present results in a manner that remain useful as projections evolve.
- Steady discharge simulations are a useful way to determine which portions of the estuary exhibit strongest response.
- Months with largest change in discharge may not translate to largest change in salinity.



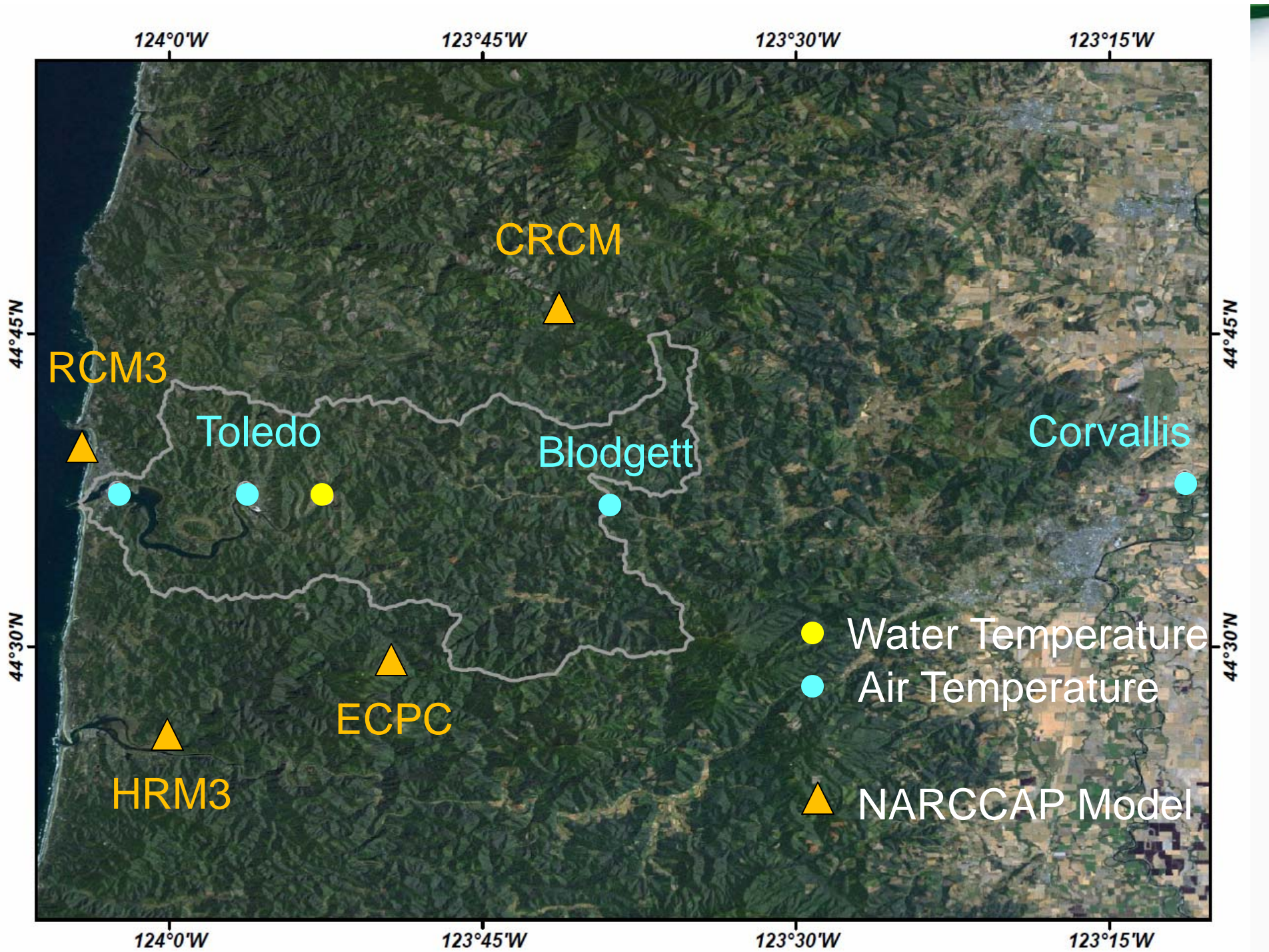
Future Research Directions

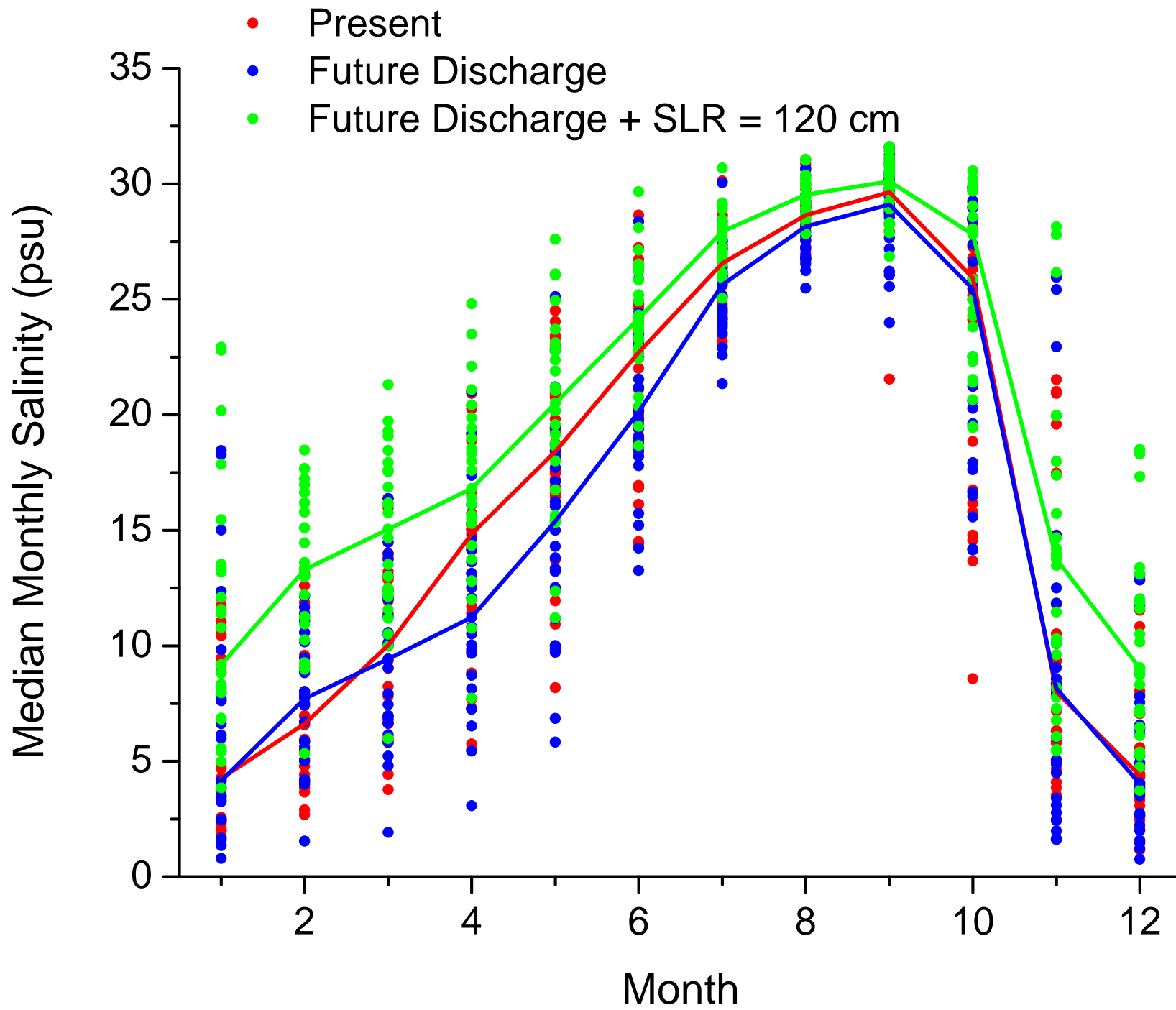
- Other metrics – salt delivery to wetlands
- Other types of estuaries
- More modeling of water quality
- Upwelling
- Link to biologic end points
- Incorporate water withdrawals



Acknowledgements

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Projected percent change in Yaquina total flow

