Project Synthesis

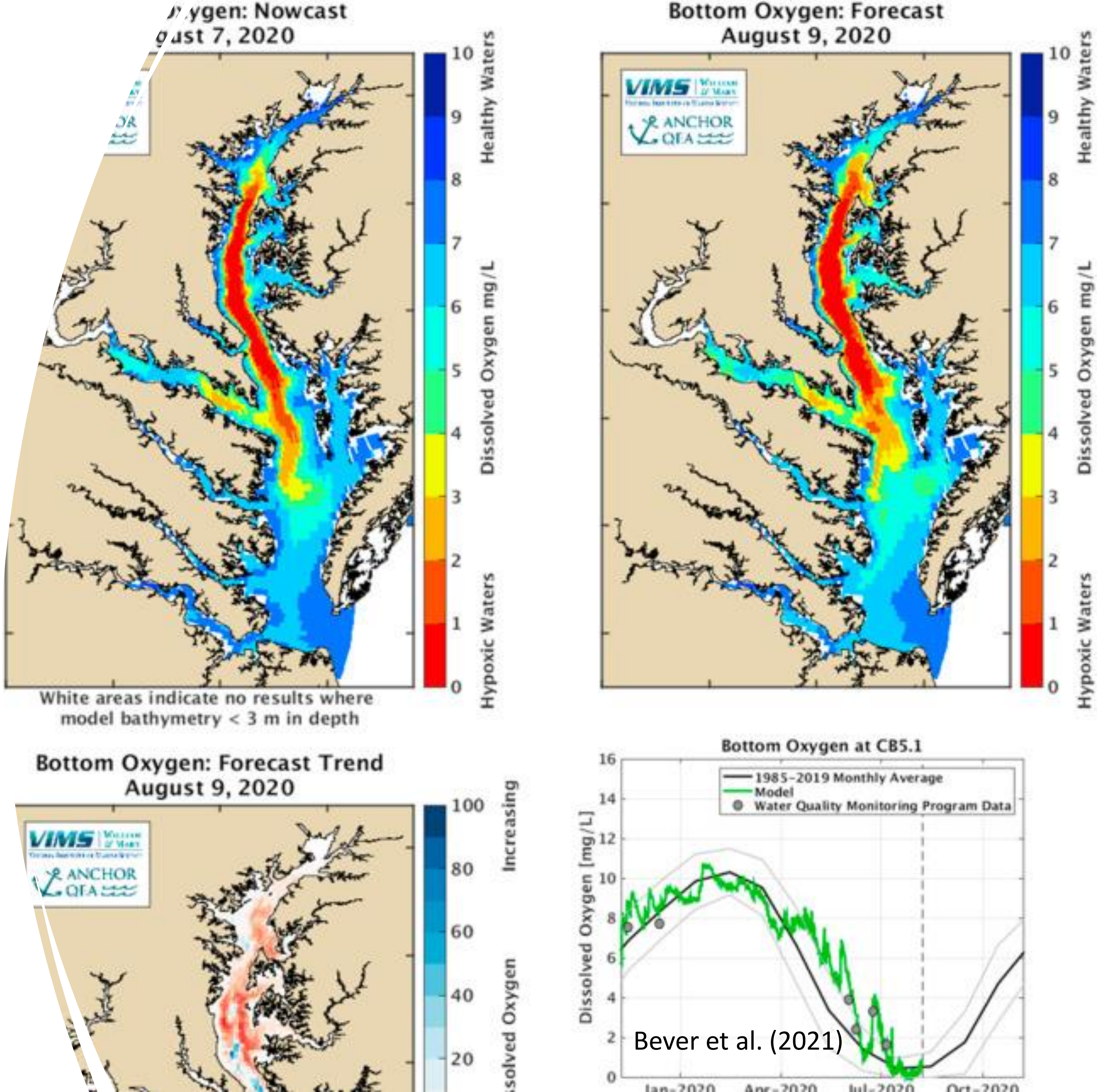
Using multiple models

Predicted impacts of climate change on the success of alternative management actions in the Chesapeake Bay

CHAMP Project Meeting
23-24 June 2021

CHAMP Project Goals

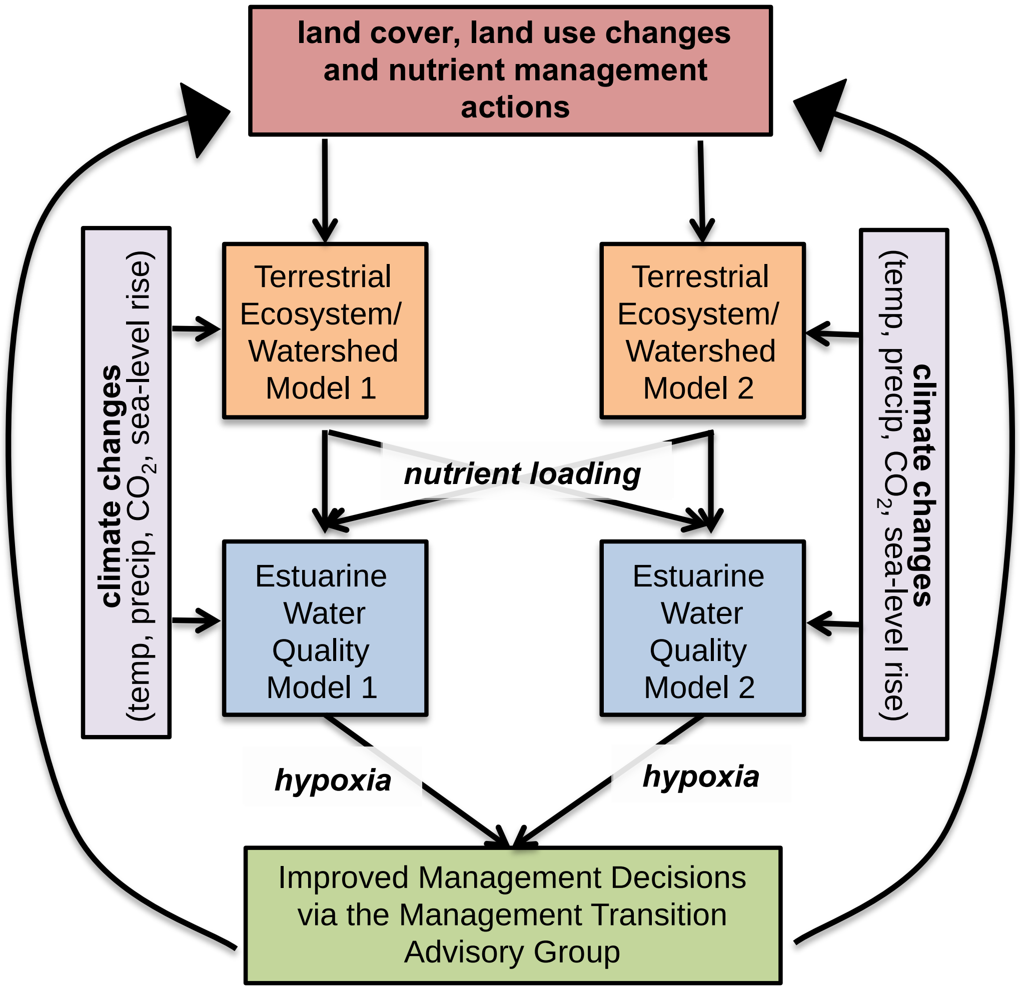
- Quantitatively predict the impacts of:
    - future changes in climate and anthropogenic nutrient inputs on the spatial and temporal extent of hypoxia in the Chesapeake Bay
    - climate change on the effectiveness of various alternative management actions designed to reduce hypoxia and improve water quality
- Use modeling strategy to identify effects of climate-related changes in temperature, salinity, sea level rise versus anthropogenic-related effects from land use, land cover and management practices
- Comparative model approach



Bever et al. (2021)

Four Themes

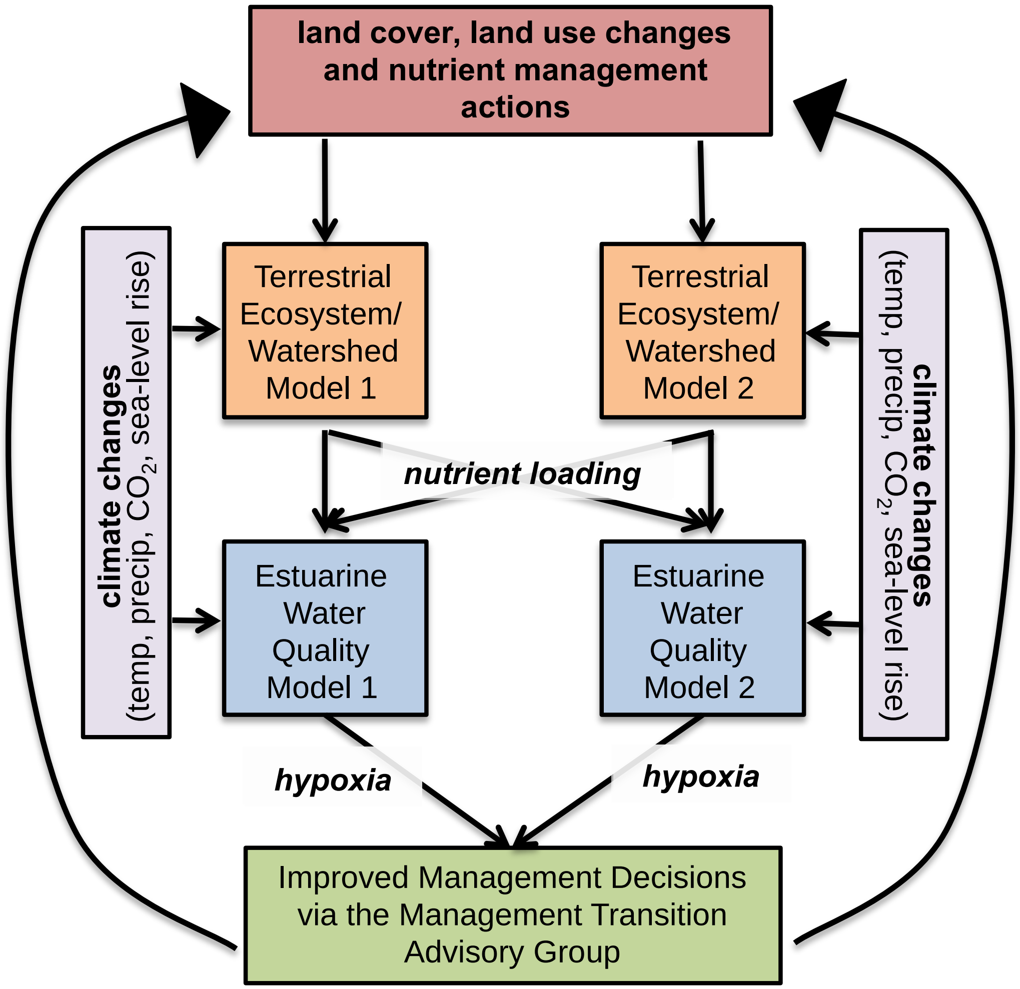
- Diagnosis
  - 1985-2015 – hindcasts (nutrient loading, oxygen, chlorophyll)
- Prediction
  - to 2050
- Attribution
  - Relative effects
- Decision support
  - Assess alternative management strategies
  - *This is the value-added part of project*



Conceptual Model

Approach

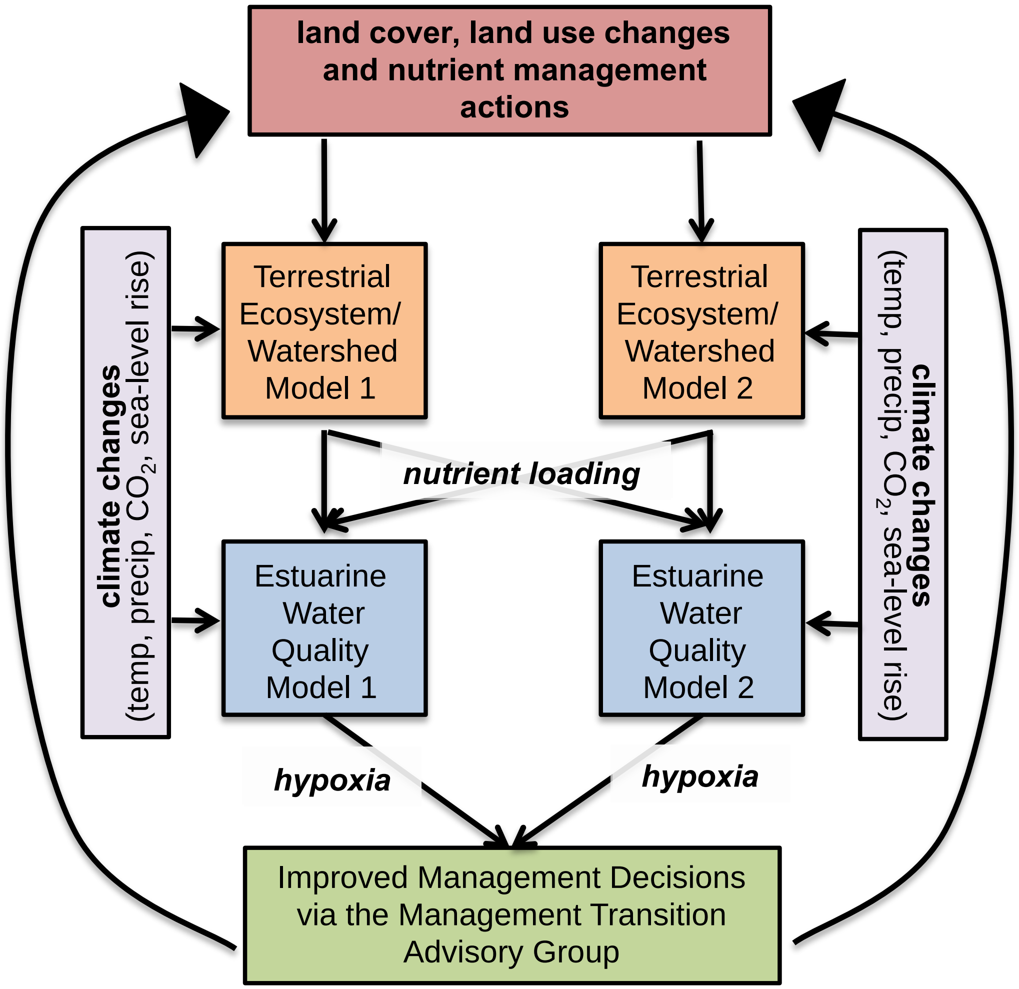
- Models
  - Watershed model
    - DLEM, CB Phase 6, SAPRROW, WRTDS
  - Estuarine water quality model
    - ROMS-ECB, CBP
- *Inner boxes*
  - Model evaluations
  - Metrics for assessing skill of individual models & data needs
  - Model intercomparisons
  - Key results
- *Climate box*
  - Multivariate Adaptive Constructed Analogs (MACA) delta vs. daily forcing product (1980-2065)
  - Forcing field evaluations and metrics



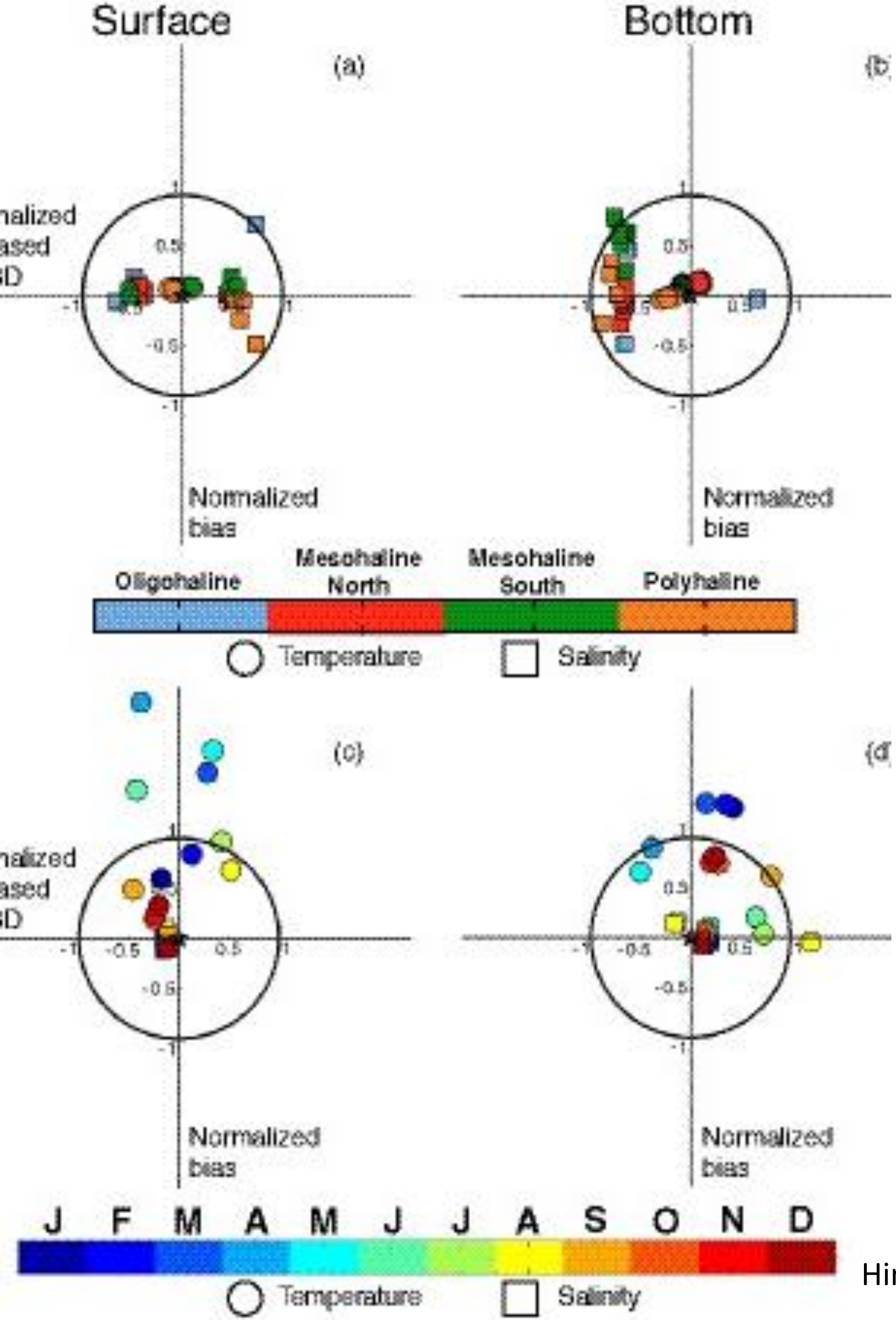
Conceptual Model

Approach

- *Cross-arrows - implementation*
  - Sea level rise
  - Nutrient loading
  - Hypoxia
- Hindcasts
  - Early 1900s to present
  - Key results
    - Trends
    - Controls
    - What would have happened if management regulations not imposed
    - Insights into relative effects of climate and local (watershed) controls
- Projections
  - What will happen under different forcing and management scenarios



Conceptual Model



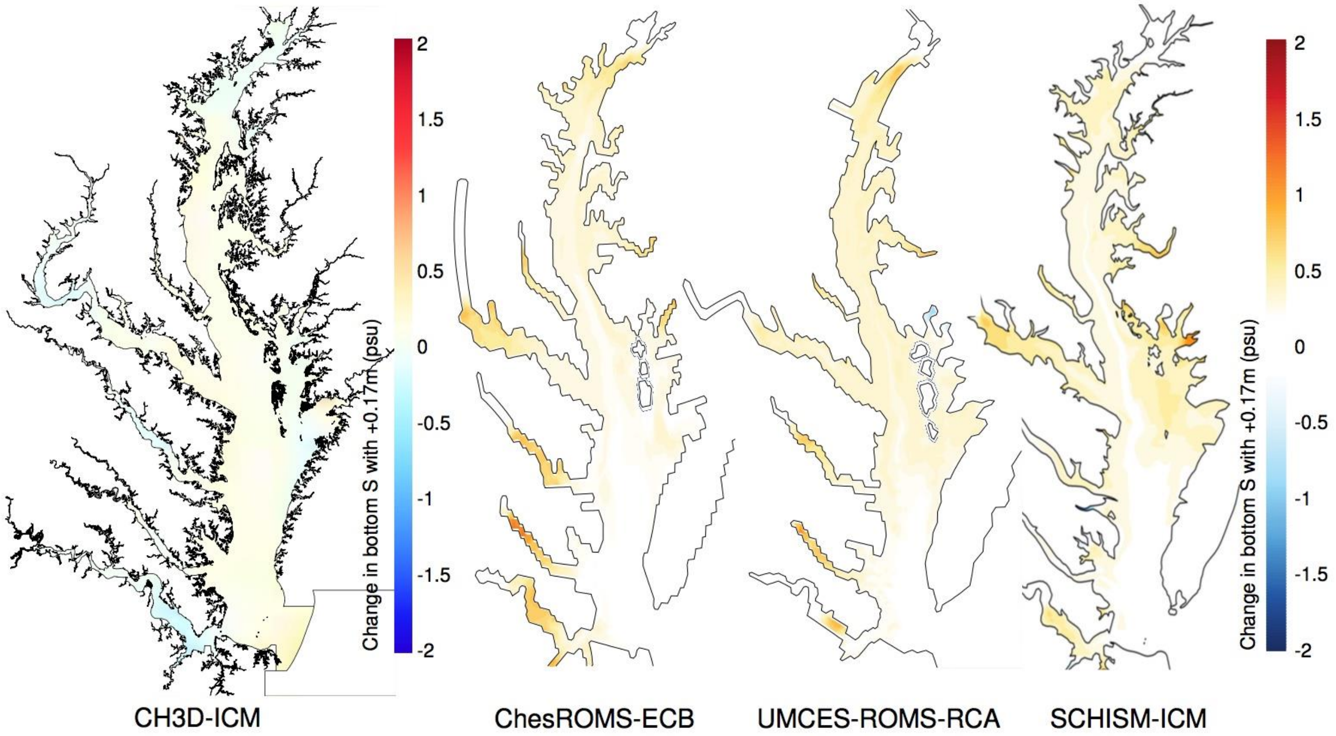
What has CHAMP done?

- Model implementation – highlights
  - Skill assessment
  - Metrics
  - Data needs
- Intercomparisons – watershed and water quality models
  - Skill assessment/metrics
- Learning from the past to guide the future
  - Case study – **sea level rise** (hypoxia/nutrient loading)
  - Hindcasts – trends, process control
  - Key results
  - Insights that inform how current conditions developed

Hinson et al. (2021)

Synthesis

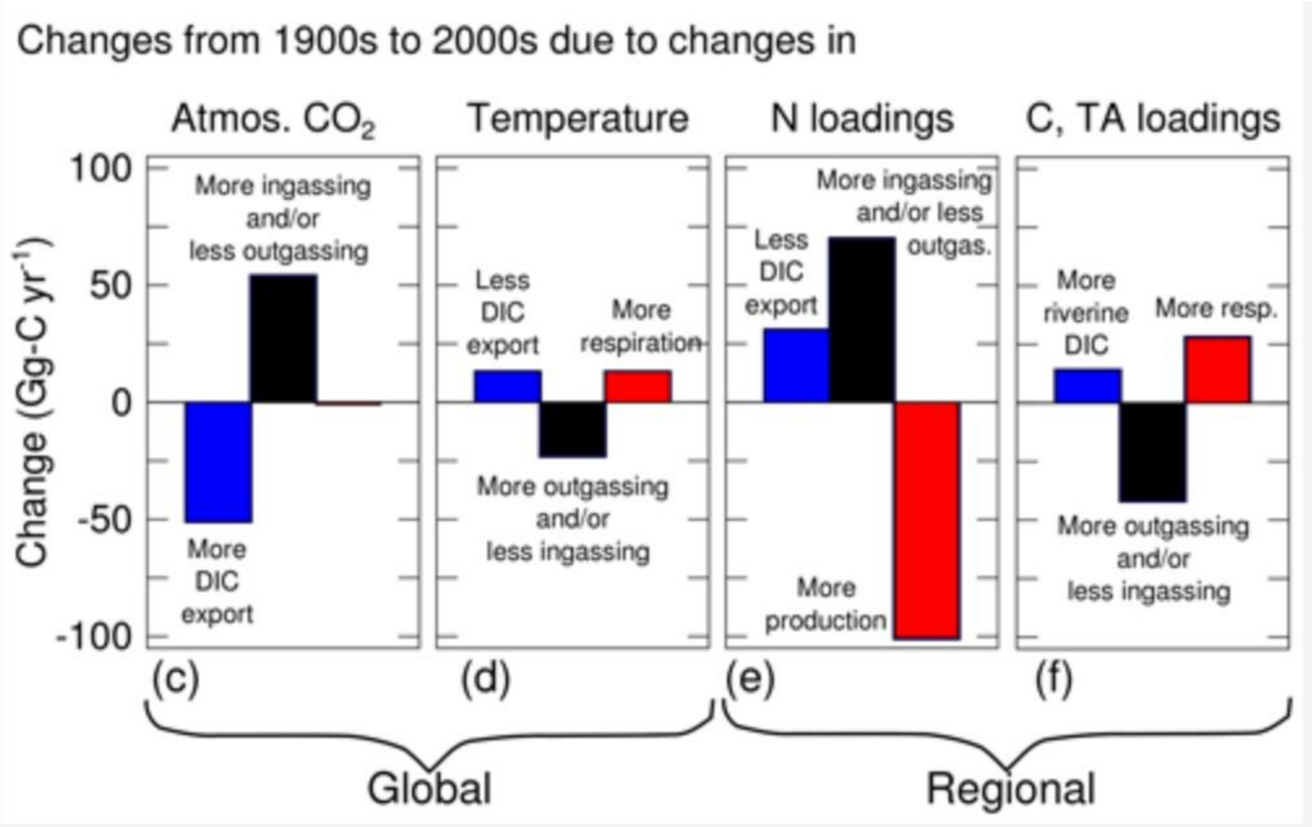
- What guidance is yielded by approach
  - Trade-offs between process, empirical and simulation applications
  - Estimation of uncertainty
- Testing different possible sources of uncertainty
  - What is important - implications for output and limited time and resources
- How to evaluate models
  - Validate DLEM with SPARROW
- Understand uncertainty and limitations Incorporation of model output to guide management strategies
- Analysis of watershed changes versus climate
  - Identification of effects and directions for mitigation
  - Perspectives for future



St-Laurent et al. (2019)

Synthesis

- Include estimates of uncertainty to make projections useful to management
- How to choose best estimate for projection and why
- Risk adverse choices and where this occurs in distribution
- Estimates of uncertainty are the linkages with management
- Use Chesapeake Bay as an example of how to develop models for management in other systems



St-Laurent et al. (2020)