Modeling Climate Change for the Chesapeake Bay TMDL

Gary Shenk and the CBPO modeling team

10/30/19

Presentation to CHAMP

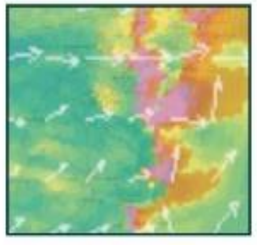
Less of This

More of This

Data and Model Inputs

Pollution Control Data
Land Use Data
Point Sources Data
Septic Data
U.S. Census Data
Agricultural Data

Land Use Change Model



Airshed Model

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Soil Data

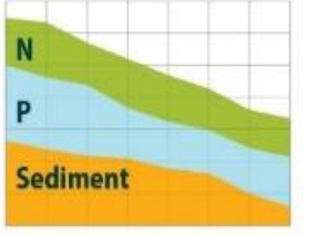
Phase 6 Watershed Model/CAST

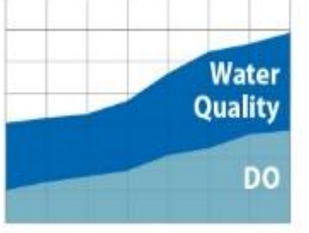
Estuary Model

Model Outputs

Prediction of Impacts

BMP Implementation Results

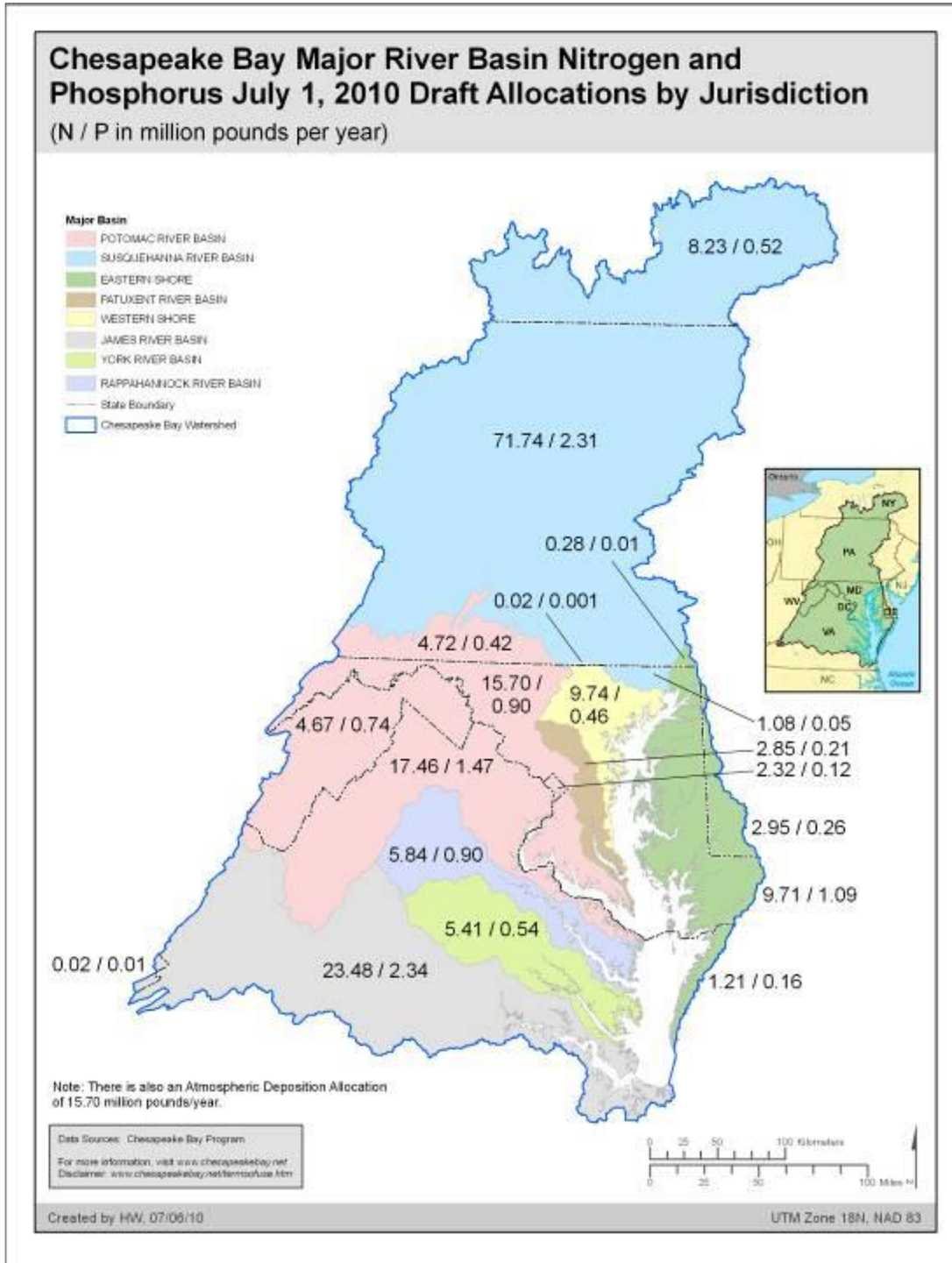




Total Maximum Daily Load

- 2010 TMDL
  - Limits to nitrogen, phosphorus and sediment
  - Allocations by State and basin
  - Plans developed to meet Allocations
  - 2025 Achievement date

- 2017 Midpoint Assessment
  - Update of targets, consistent with allocations
  - Updated plans to meet targets
  - Additional time to consider climate change



CBP Climate Basics

- Critical period for dissolved oxygen is 1993-1995
  - Selected as having a return period for wetness of 10 years
- Hydrologic averaging period is 1991-2000
  - Selected as an ‘average’ 10-year period
- Management questions
  - What would loads look like in a 1991-2000 that was translated through 30 years of climate change to 2025?
  - What would oxygen attainment look like during a 1993-1995 that was translated through 30 years of climate change to 2025?
  - What would loads have to be in 1991-2000 such that standards are attained with a 1993-1995 period translated to 2025?
- Take a first look at 2035, 2045, and 2055

Watershed Model

increased precipitation volume =

increased precipitation intensity =

increase in temp and evapotranspiration =

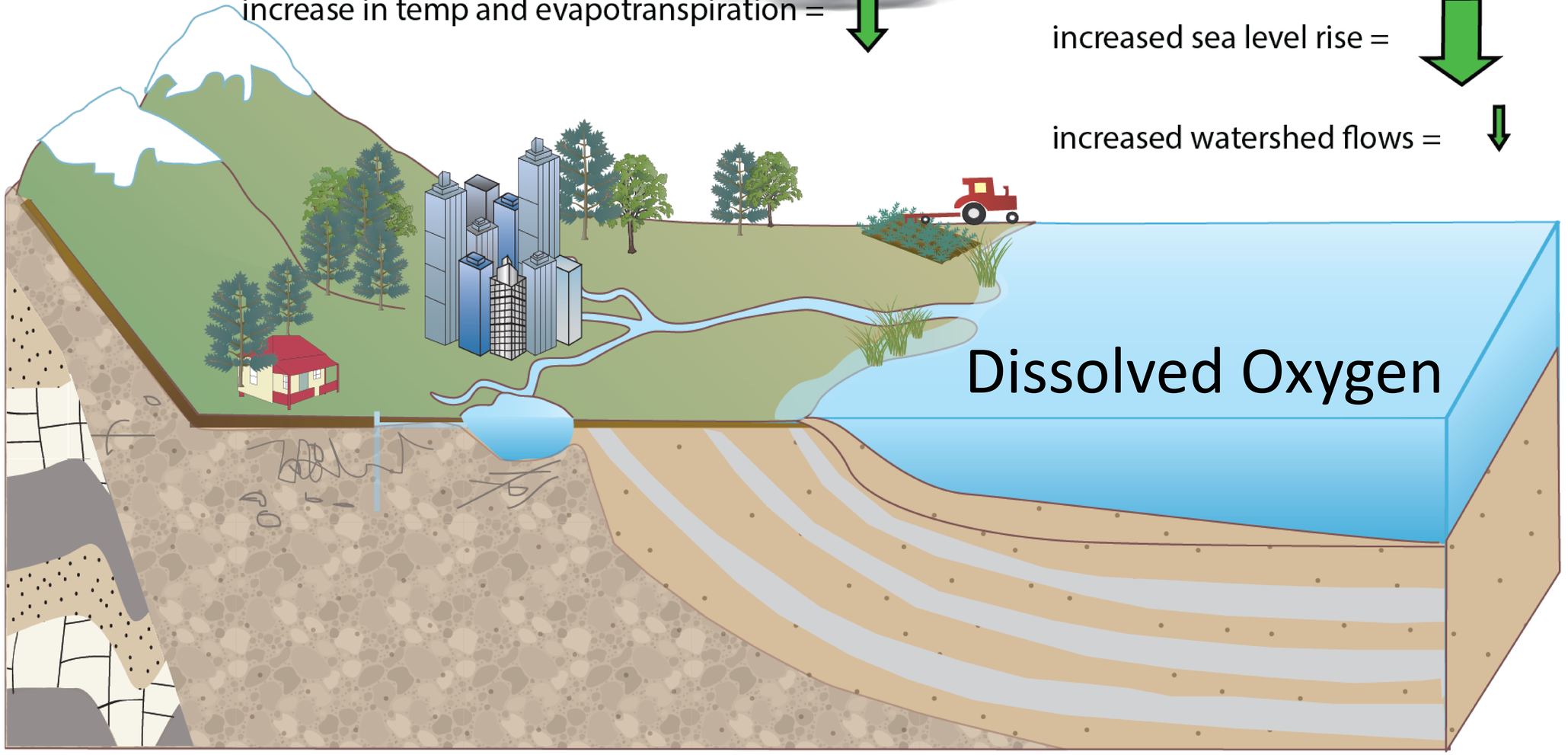
WQ Sediment Transport Model

increased watershed loads =

increased temperature =

increased sea level rise =

increased watershed flows =



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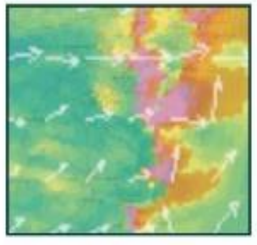

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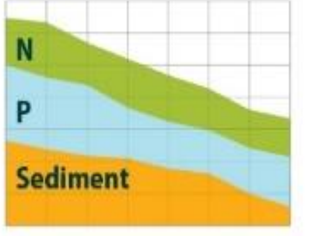
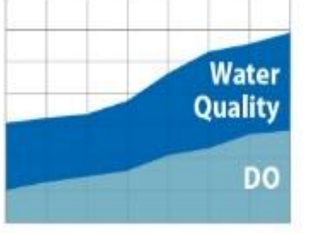




Watershed

Support/Revise Flow--N relationship

Investigate Speciation changes

Soil P history effect

Carbon Dioxide effect

Process-based response of flow and sediment On land

Specified land nutrient response

P sensitivity in developed

Effect on land use

Effect on Ag

Nutrient Inputs

BMP effectiveness change

BMPs

Land to water factor effect

Land to Water

Stream to River factors effect

Streams

Groundwater Travel Time effect

UNEC

Reservoir Rules effects

Rivers

Diversion Effect

CSO Effect

WWTP and septic Effect

CMAQ Climate change effect

Loads from flooding

Estuary

Wetlands losses and gains

Growth and respiration curve for phytoplankton

Reasonable response to temperature?

Reasonable response to sea level rise?

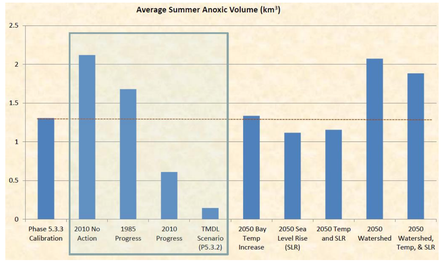
Wind effects

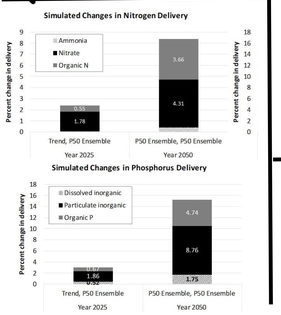
Estuarine Inputs

Estuarine Model WQSTM

Sea level Rise

Ocean Temp





Climate

GCMs

RCP

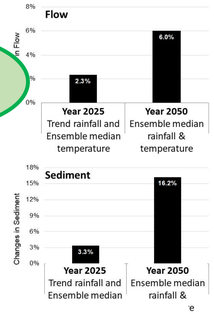
GCM Selection

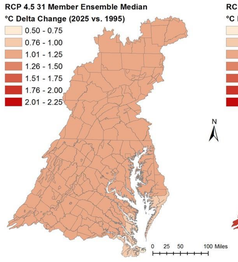
Down-scaling

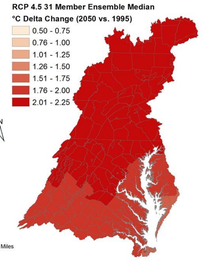
Climate scenarios

Observed Precipitation Trends

Extrapolation







Management

CB Seg	Designated Use	Designated Use Total Volume	Red Percent WIP + Conow	Red Volume WIP + Conow	Red Percent WIP + Conow + CC	Red Volume WIP + Conow + CC
CB3MH	DW	864	0.05%	0	0.05%	0
CB4MH	DW	2854	5.52%	158	6.50%	186
MDSMH	DW	2097	1.09%	23	1.51%	32
VA5MH	DW	1605	0.00%	0	0.00%	0
POMMH	DW	1839	0.00%	0	0.00%	0
CB3MH	DC	390	0.00%	0	0.00%	0
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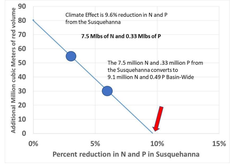

Jurisdiction	1985 Baseline	2013 Progress	Climate Change
NY	18.71	15.44	0.400
PA	122.41	99.28	4.135
MD	83.56	55.89	2.194
WV	8.73	8.06	0.236
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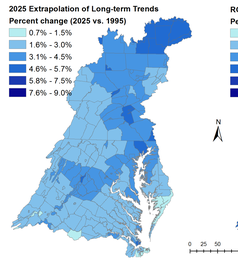
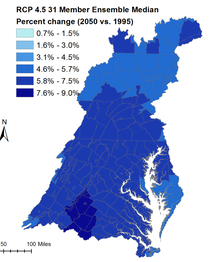
BasinWide	331.15	248.54	9.09





Effect on water quality standards

Management Effort Adjustment

STAC CC2.0 Framework recommendations

Included

Not included But important

Not included minor

Model | Project/Decision

Data Set | Endpoint

CBP Climate Work Plan

Plan	Model	Review	Decide
2018	2019	2020	2021
STAC Workshop Climate Resiliency WG to investigate BMP response Jurisdictions provide narrative in WIP3s on climate strategies Modeling WG develop climate scenarios	Modeling WG, direct Modeling team to develop climate change assessment for TMDL with input from CRWG and WQGIT	Technical Review of Models	Climate change considerations will be implemented into the 2022-2023 milestones.

CBP 2019 MWG Climate Work Plan

February	April	July	October	November
Climate Topics	Climate Topics	July 16-17 Technical Decisions on Climate Topics Draft documentation emailed 6/28	October 8-9 Technical Decisions on Climate Topics Draft documentation emailed 9/24	Delivery of model results based on October decisions

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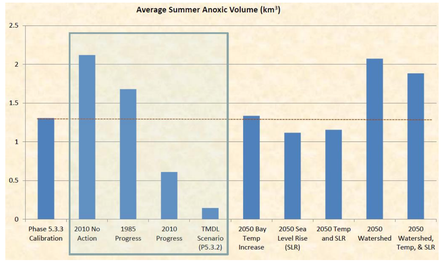

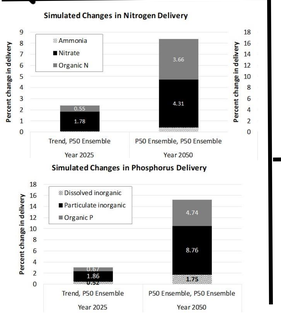

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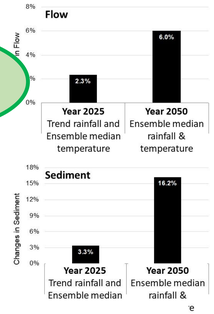

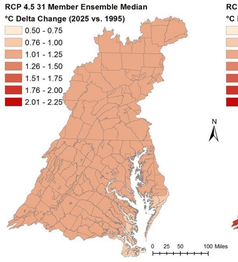

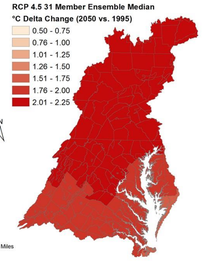

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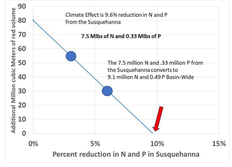

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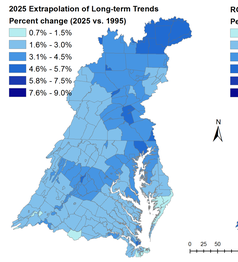

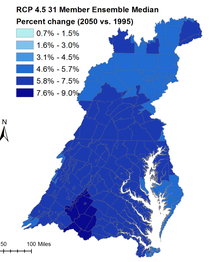

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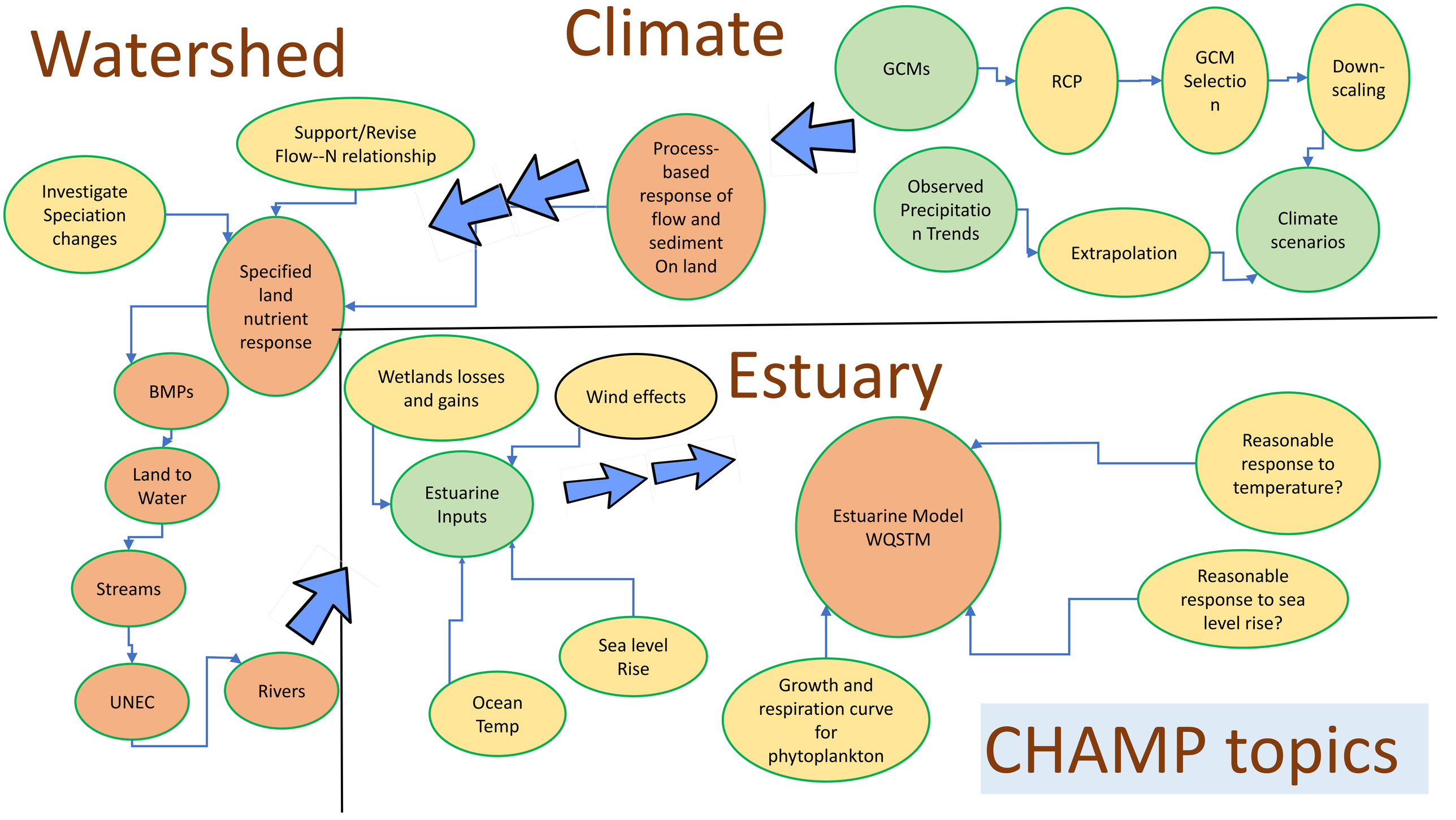
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CHAMP topics

Total Maximum Daily Load

- 2010 TMDL
- 2011 slight adjustments
- 2017 Midpoint Assessment
- 2025 goal
  - Assessment of progress?
  - Re-Assessment of climate change