Climate Change, CHAMP, and the Chesapeake Bay Program

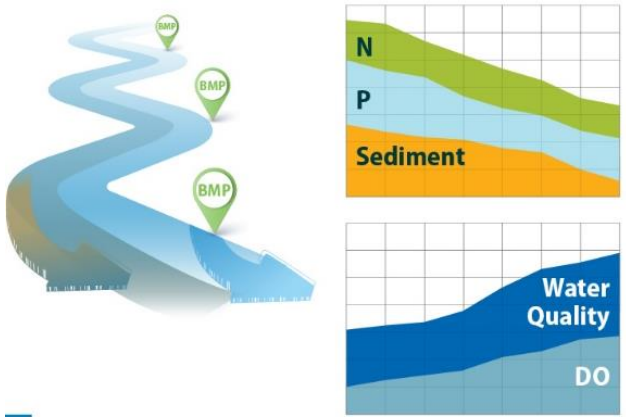
Gary Shenk

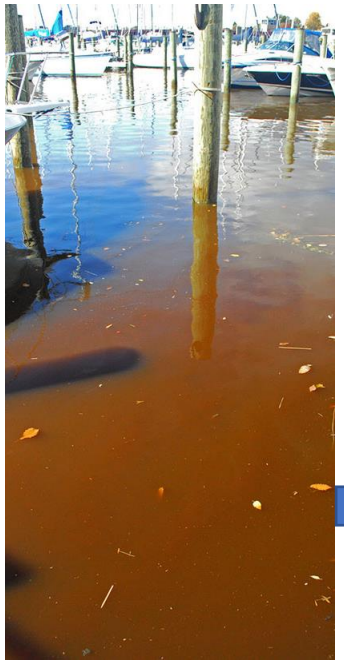
6/23/2021

CHAMP meeting

TMDL

BMP Implementation Results





COST = ~$1B/year

Principals' Staff Committee (State Secretaries, EPA Regional administrator,…)

Decision on climate change– 3/2018

1. Develop narrative strategy now
2. Understand the Science in 2019
    1. Update models
    2. New estimate of load changes
3. Decide in 2021

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PSC Climate Decision 2021

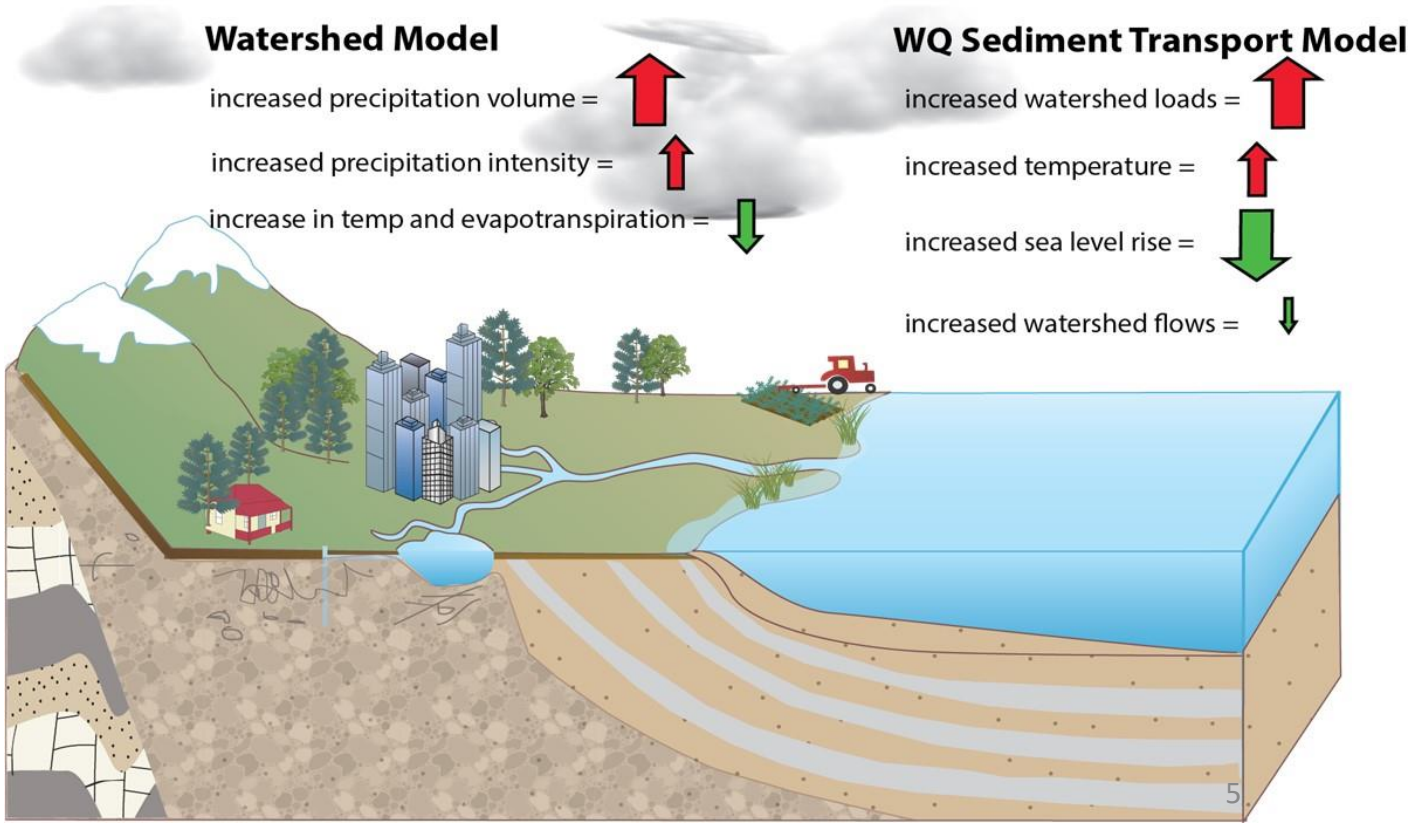
- Accept updated models
- Accept recommended adjustments to TMDL planning targets, increasing the level of effort toward nutrient reduction
- Develop new models and methods for shallow water
- Reassess in 2025 for 2035 climate

Modeling updates 2019

During 2019, the Modeling workgroup oversaw improvements in the CBP's ability to simulate the effects of climate change. Based on input from STAC and the partnership, upgrades were made to model inputs and processes. Changes were made to model inputs of rainfall, air temperature, wetland area change, sea level rise, and ocean temperature and salinity. Watershed delivery of nitrogen, phosphorus, and sediment were modeled using improved processes to capture the effects of climate changes on watershed loads. The estuarine algal simulation was improved, and the model results were validated using multiple model comparisons and analysis of observed data.

Modeling workgroup oversaw updates to CBP suite of models (~25 modifications)

- Climate inputs
- Response of watershed
- Estuarine processes



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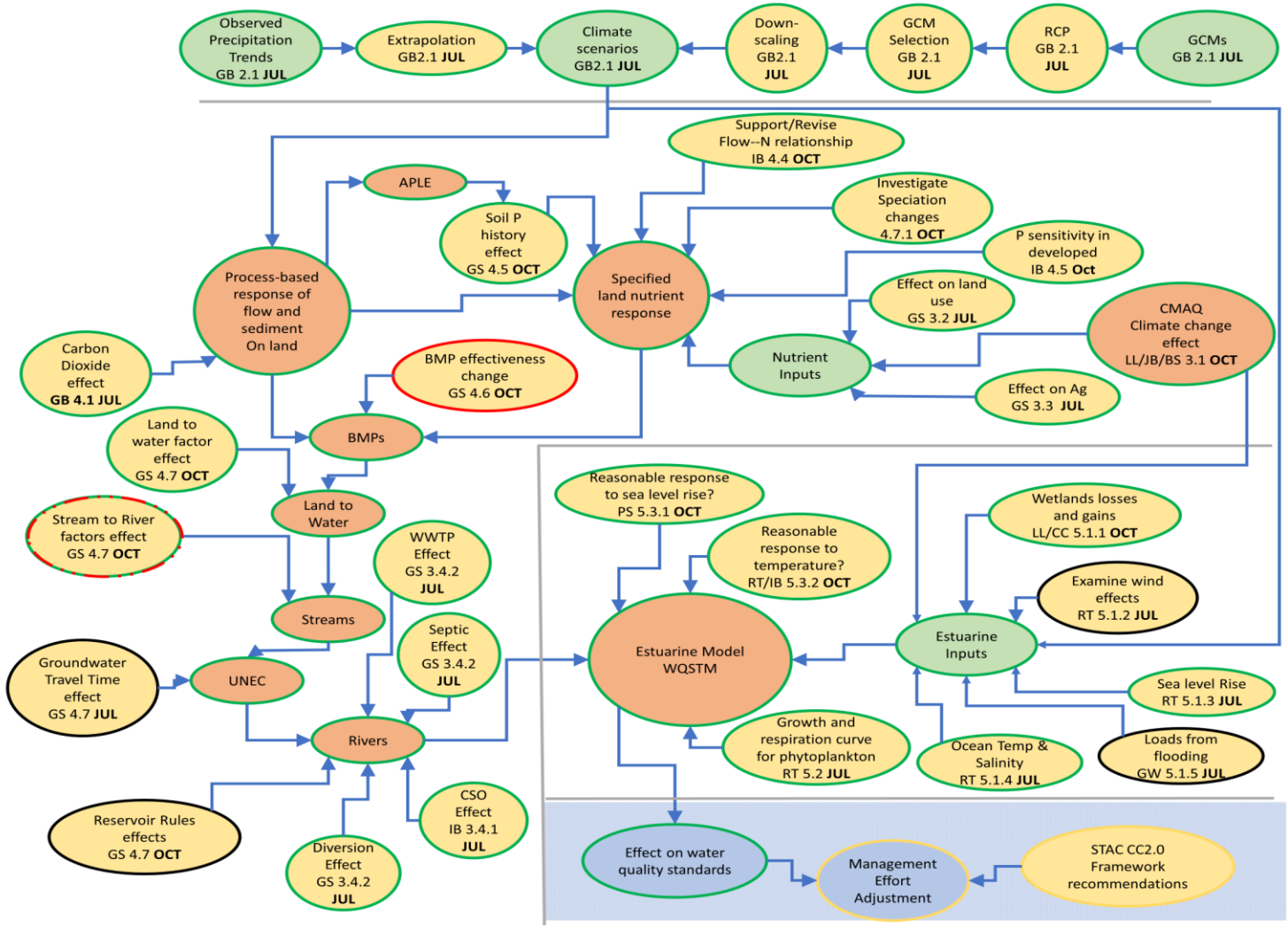
Elements of Chesapeake Water Quality Climate Risk Assessment

Model
Data Set
Endpoint
Project/Decision

Complete
In Process
Not included But important
Not included minor

Initials indicate the responsible person
Numbers indicate the section of the documentation

Climate Change Processes and Dependencies



Climate

Watershed

Estuary

Management

Elements of Chesapeake Water Quality Climate Risk Assessment

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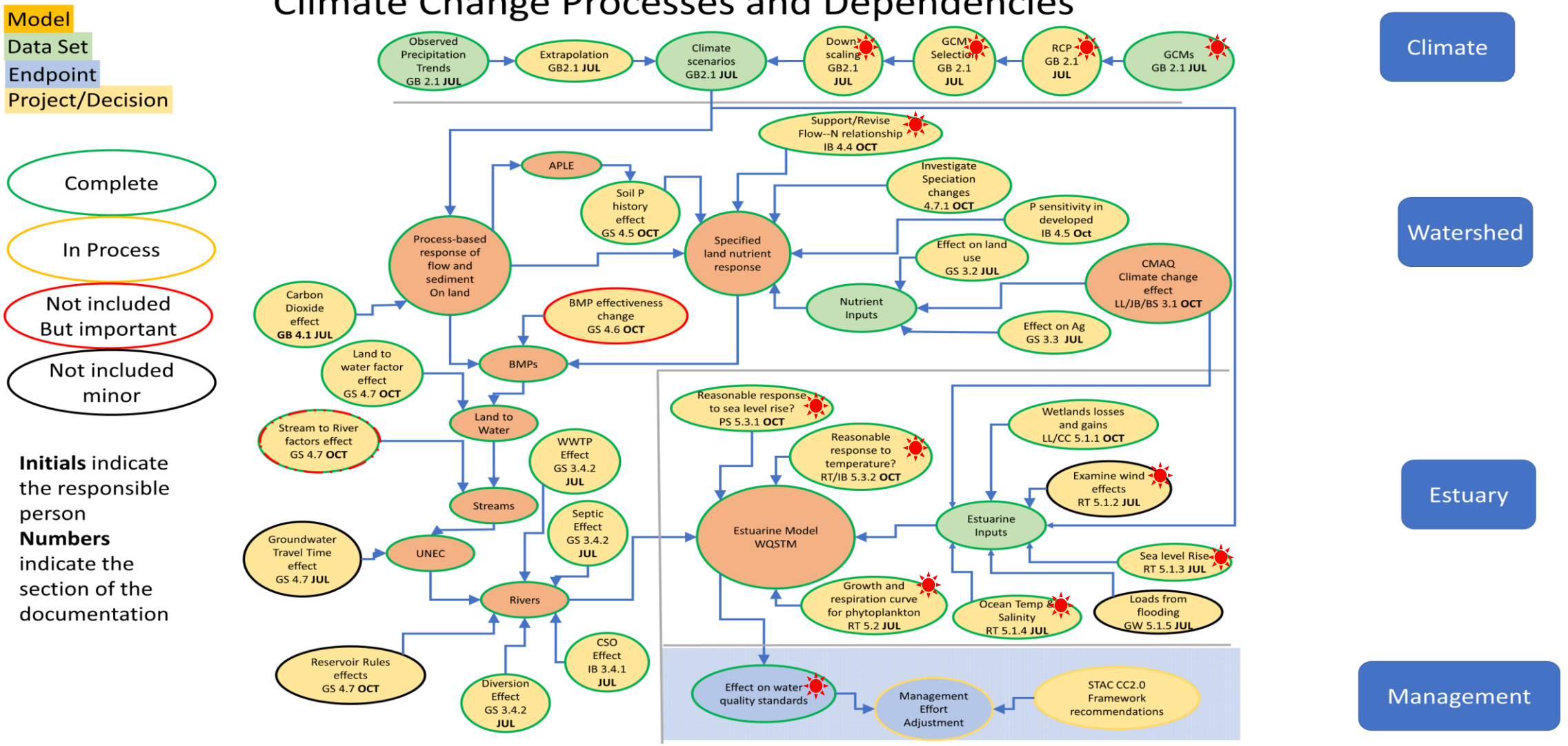
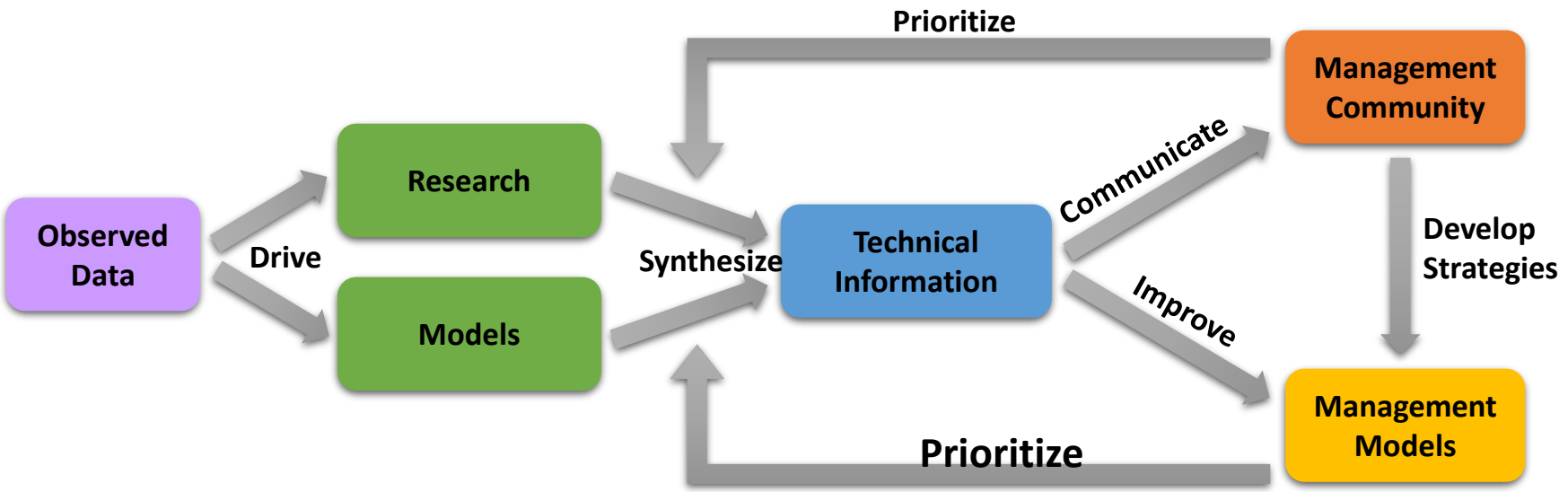
☀ CHAMP-influenced process

Climate Change Processes and Dependencies



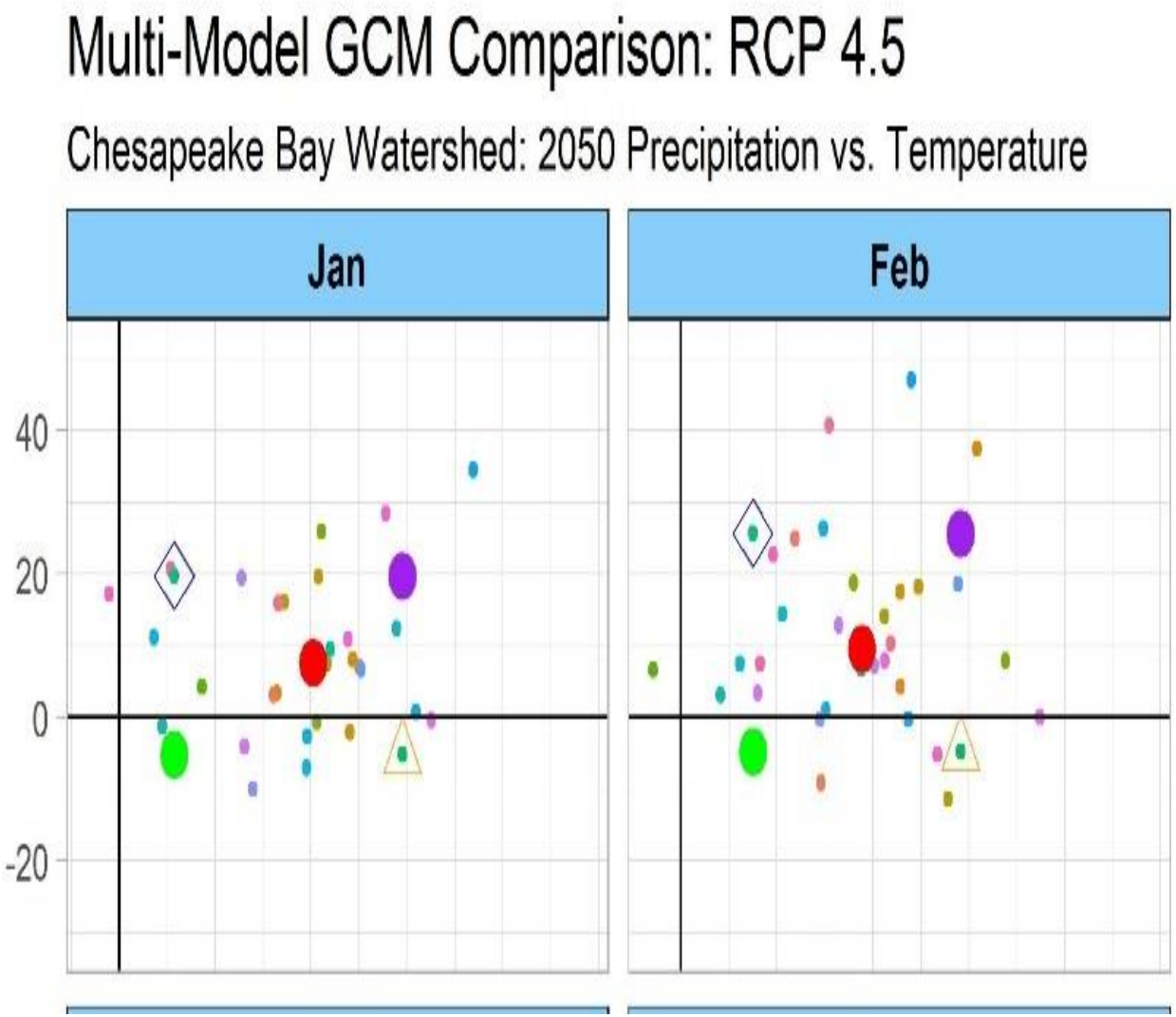
How Monitoring, Research, and Modeling Inform the Chesapeake Bay Program



USGS science for a changing world

CHAMP helped us think about how to use GCMs to express uncertainty in the 2025 analysis

CHAMP may provide methods for substantive changes in how we deal with climate inputs for the 2035 analysis



CBP CC documentation:

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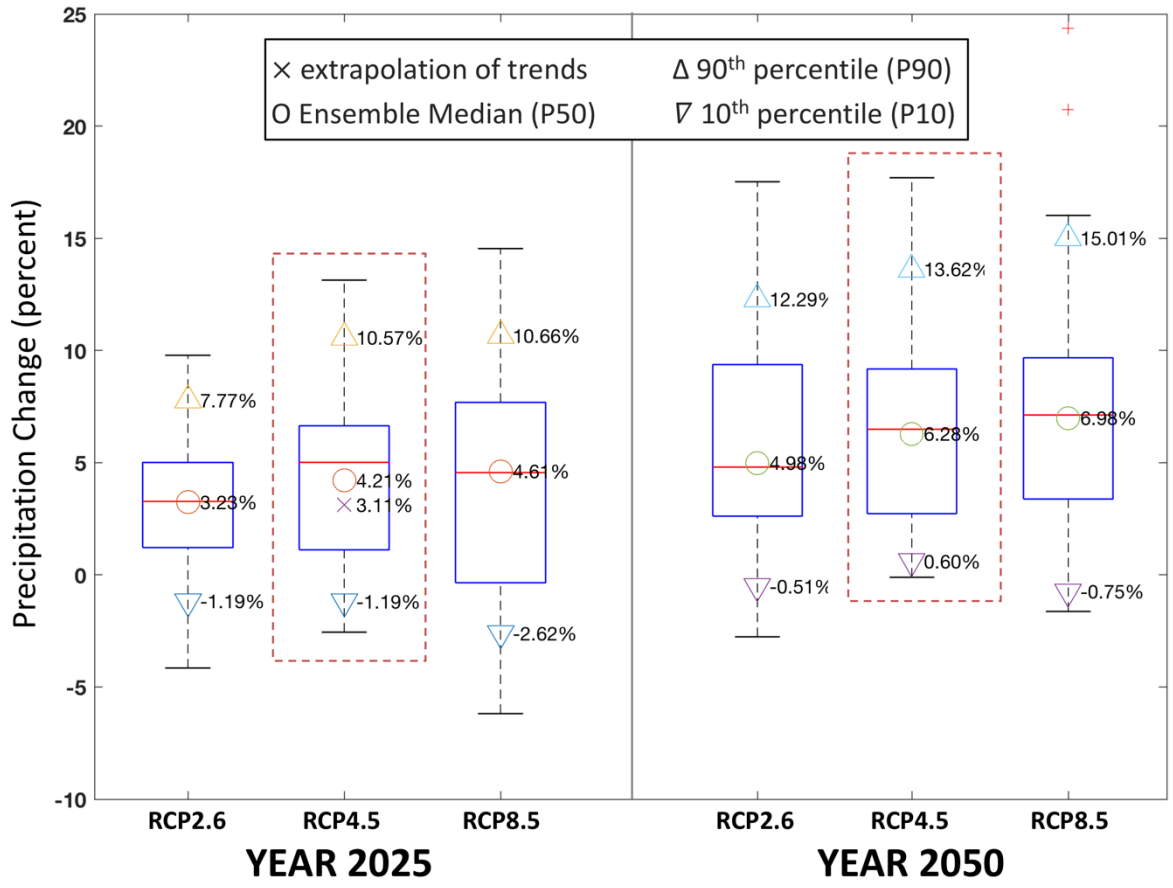
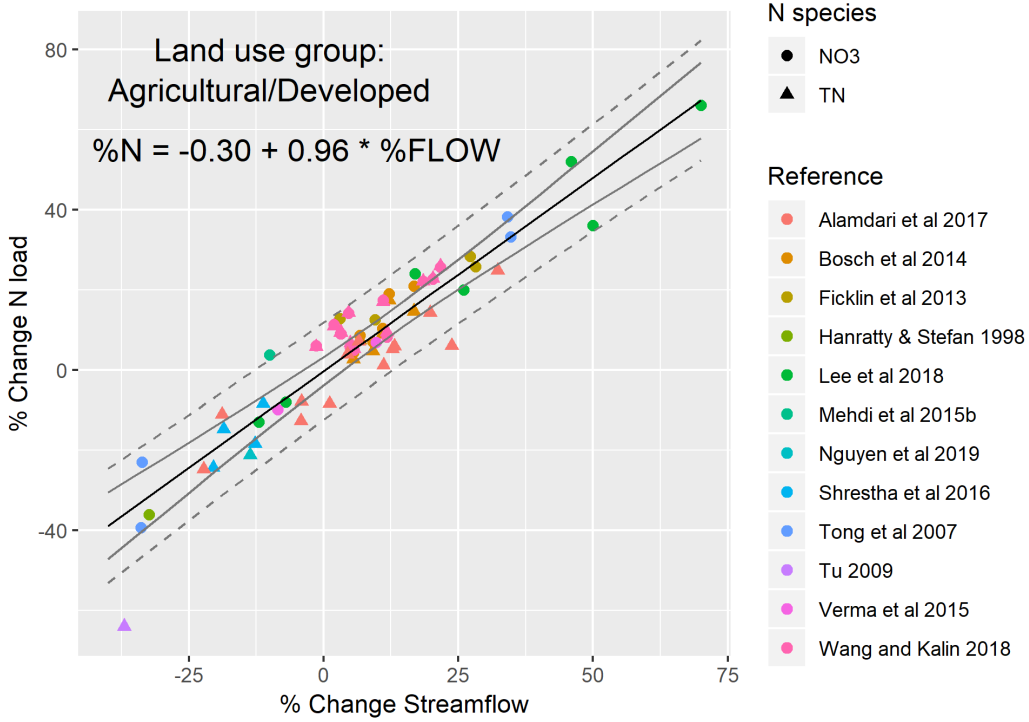


CBP CC documentation:

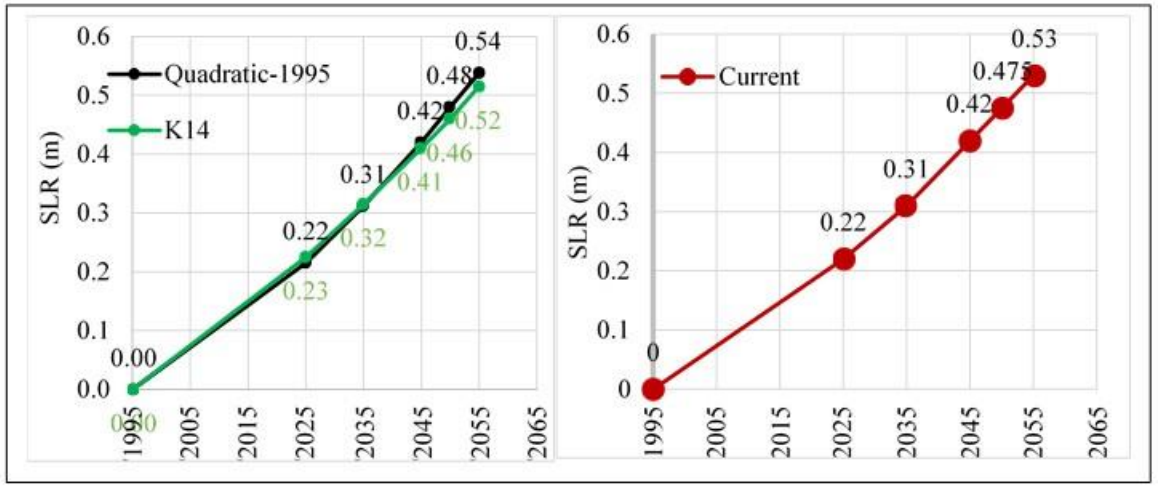
Predictions of changes in nitrogen delivery

CHAMP will provide produce additional metrics of change that are specific for the Chesapeake



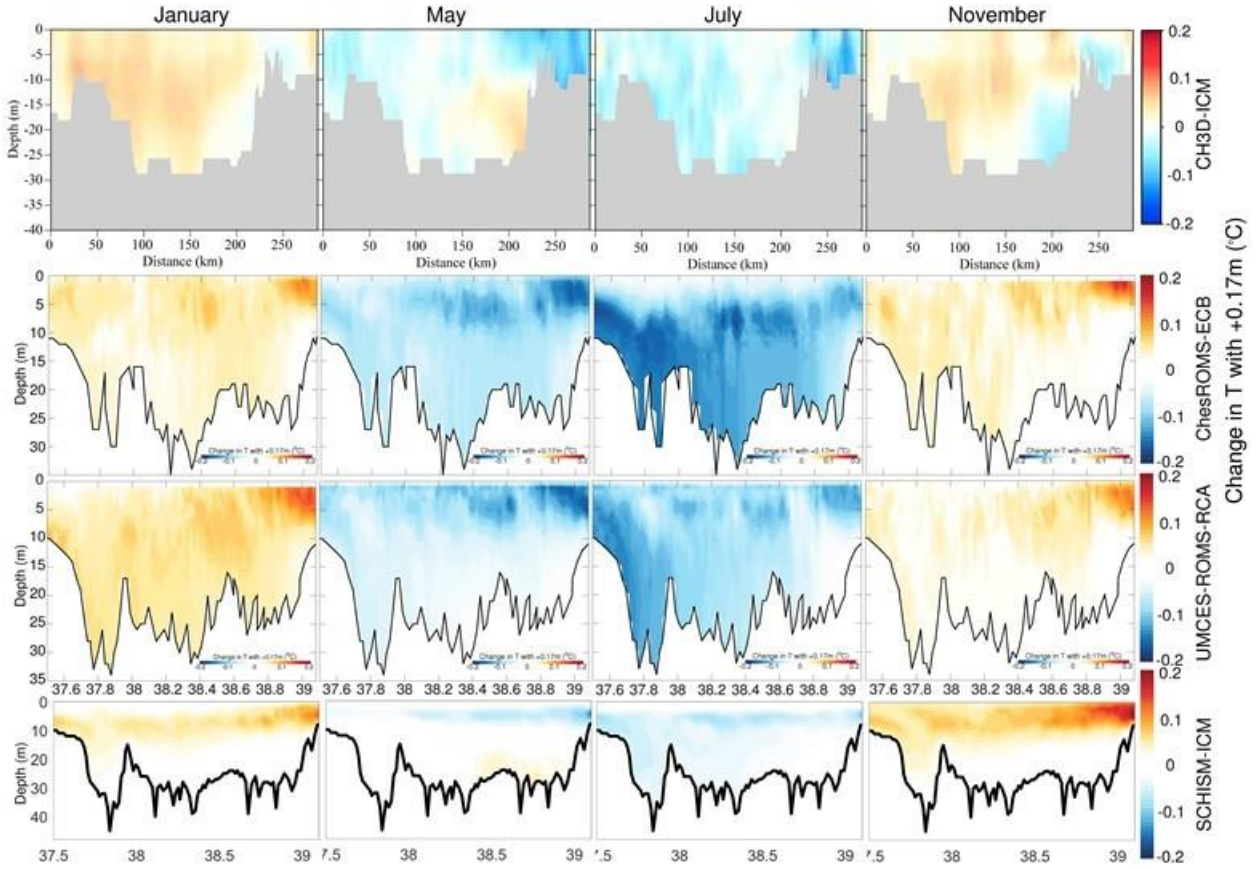
CBP CC documentation:

CHAMP provided discussion for SLR



CBP CC documentation: *Figure 5-8: Projection of sea level rise by 2025, 2035, 2045 and 2055 as compared to 1995 using the probabilistic method (K14) and the Quadratic Function (left panel) and the average between the two (right panel) which are the final numbers that the Climate Resiliency Working Group recommended to use for assessing climate change impact on water quality in the Bay.*

CHAMP provided validation of modeling effects



CBP CC documentation: A model intercomparison was conducted by Pierre St-Laurent under the direction of Dr. Marjorie Friedrichs at the Virginia Institute of Marine Science for the impacts of SLR on hypoxia over the period 1991-1995.

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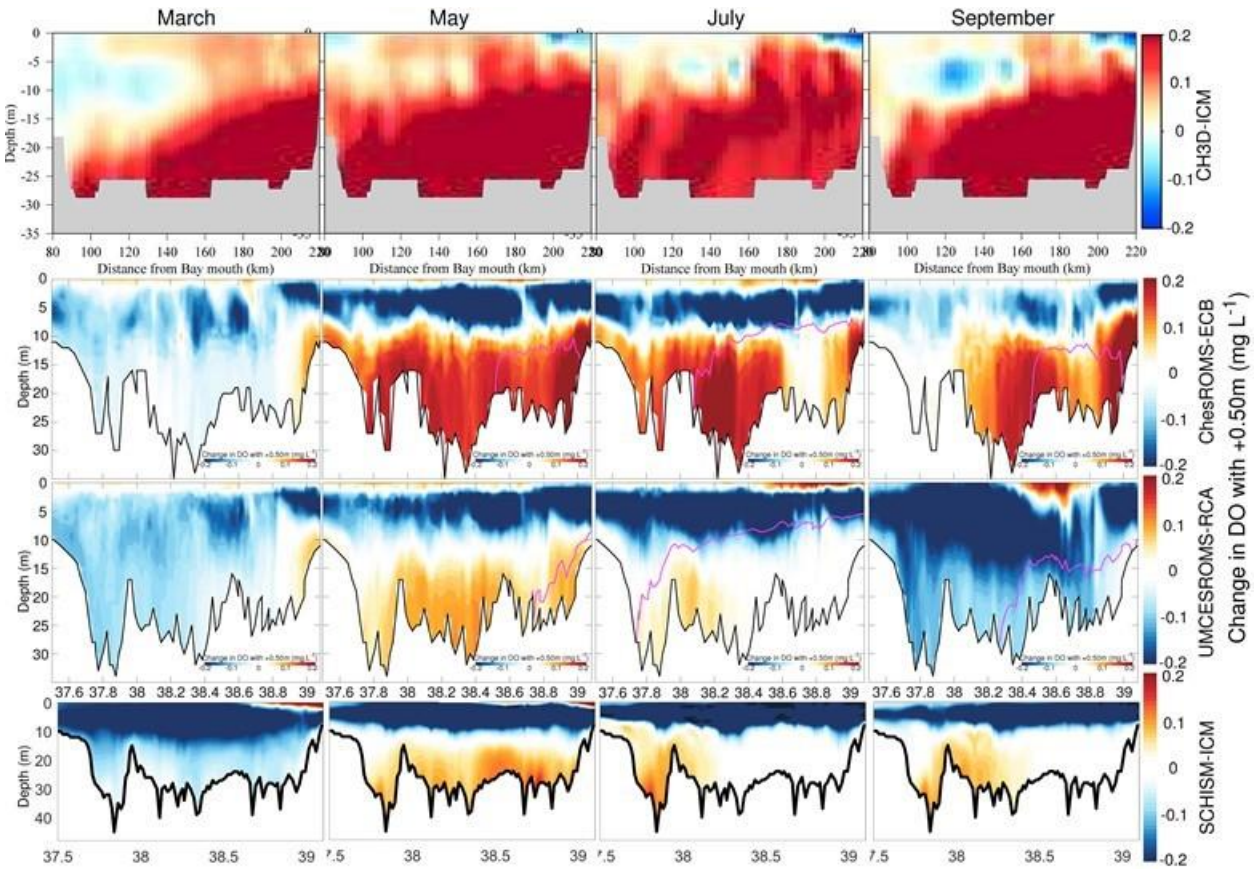

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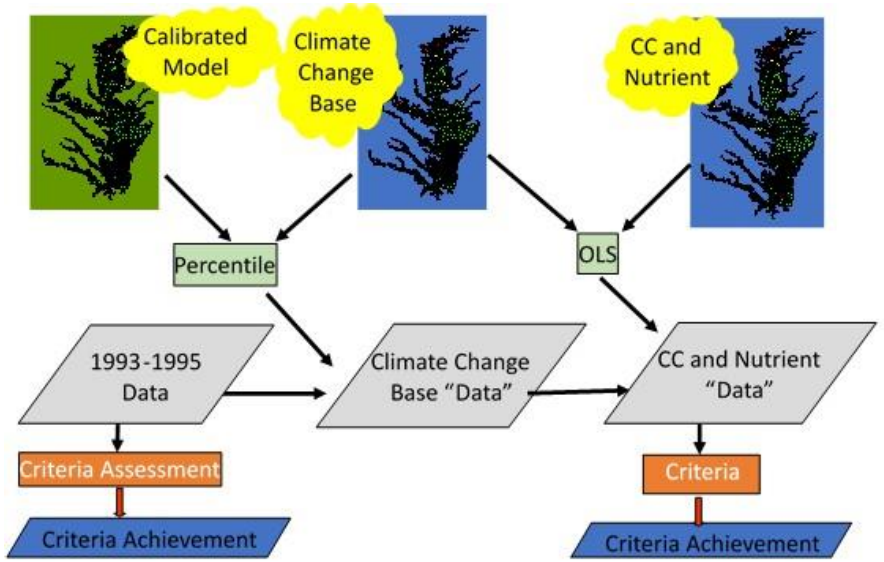
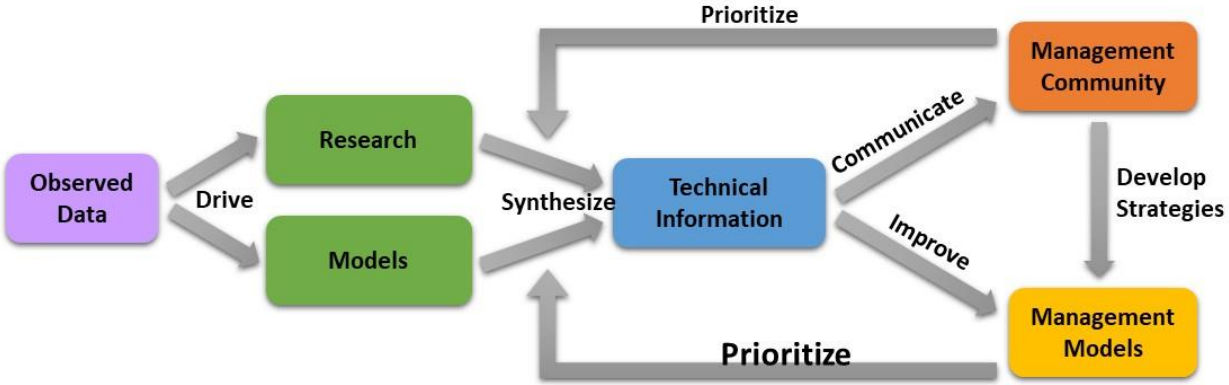
CHAMP provided discussion of how to apply a climate change model in scenarios

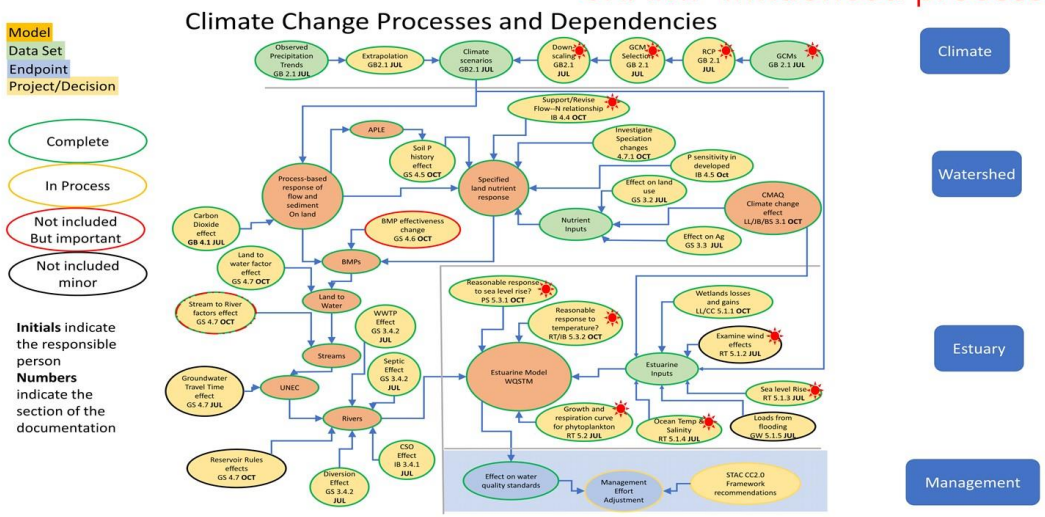


CBP CC documentation: *Figure 5-30: Two-step water quality criteria assessment procedure for management reduction scenarios under climate change condition (CC and Nutrient: Nutrient management scenario under climate change condition; OLS: Ordinary Least Square regression)*

CHAMP provided academic partnership throughout the analysis process



✷ CHAMP-influenced process



Section	Topic	July Approval	October Approval	November Approval	Does Not Require Approval
1	Introduction				X
2	Meteorology and precipitation	X			
3.1	Atmospheric deposition		X		
3.2	Land use	X			
3.3	Agricultural inputs	X			
3.4	Direct loads	X			
4.1	CO2 concentration response	X			
4.2	Hydrology simulation	X			
4.3	Sediment loss simulation	X			
4.4	Nitrogen loss sensitivity		X		
4.5	Phosphorus loss sensitivity		X		
4.6	BMP effectiveness		X		
4.7.1	Nitrogen speciation		X		
4.7.2	Groundwater lag	X			
4.7.3	Delivery effects		X		
4.8	Watershed simulation results			X	
5.1.1	Wetlands losses and gains		X		
5.1.2	Wind effects	X			
5.1.3	Sea level rise	X			
5.1.4	Ocean boundary	X			
5.1.5	Tidal flooding loads		X		
5.2	Growth curve modification	X			
5.3	Validation of model response		X		
5.4	Estuarine simulation results			X	
6	Management effort adjustment				

CBP CC documentation:

Final Decision

State	TN			TP		
	Dec 2017 PSC	L1st Climate increase	Adjusted L1st Proposed	Dec 2017 PSC	L1st Climate increase	Adjusted L1st Proposed
DC	0.006	0.006	0.007	0.001	0.001	0.001
DE	0.397	0.036	0.039	0.006	0.003	0.003
MD	2.194	1.061	1.142	0.117	0.111	0.111
NY	0.400	**0.699**	0.399	0.015	0.044	0.044
PA	4.135	1.683	1.811	0.143	0.095	0.095
VA	1.722	1.476	1.589	0.187	0.337	0.337
WV	0.236	**-0.054**	0.000	0.017	0.009	0.009
Total	9.089	4.908	4.986	0.485	0.599	0.599

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- Accept updated models
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- Develop new models and methods for shallow water
- Reassess in 2025 for 2035 climate