

# HOW CHESAPEAKE BAY PROGRAM IS ADDRESSING CLIMATE CHANGE

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COG staff background information

WRTC Meeting  
November 9, 2018



Metropolitan Washington  
Council of Governments

# Outline

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- Schedule
- Model Information
- Preliminary impact on Phase III WIP Targets
- Next Steps
- Note: all graphics in this presentation were derived from materials presented to the Chesapeake Bay Modeling Workgroup

# Climate Change Decision Framework

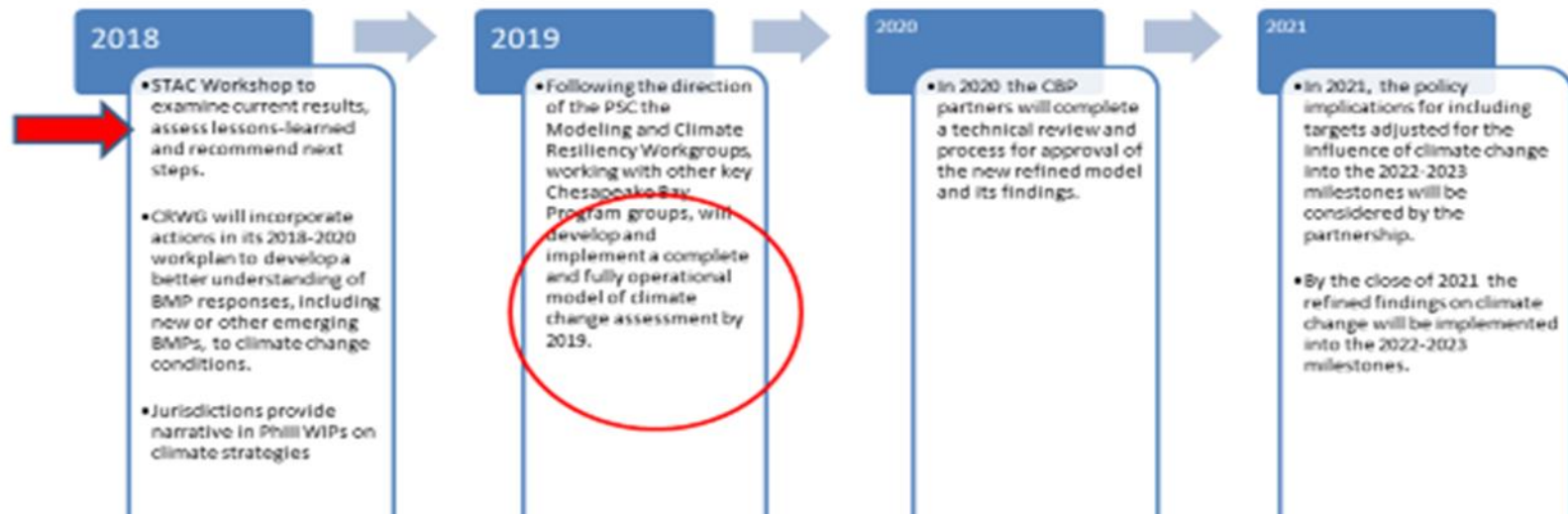
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- Bay TMDL must address climate change; however, need to do so on a quantitative basis held off until 2022
  - Allows time for model upgrades to better simulate impacts
  - Allows time for Bay partner jurisdictions to figure out how they can respond
  - Likely will require substantial additional nutrient and sediment reductions
- Bay partners must include qualitative approach in Phase III WIPs; have option of starting quantitative approach early

# Schedule for Incorporating Climate Change into Bay TMDL

WIP = watershed implementation plan

## Translating the PSC Decision into a Workplan Factor Climate Change Impacts into the Phase III WIPs



- Climate change model (by altering existing models) by end of 2019
- Addressing load impacts quantitatively by end of 2021
- Use “management practices” that are more effective (resilient) and that are sited based on climate change impacts

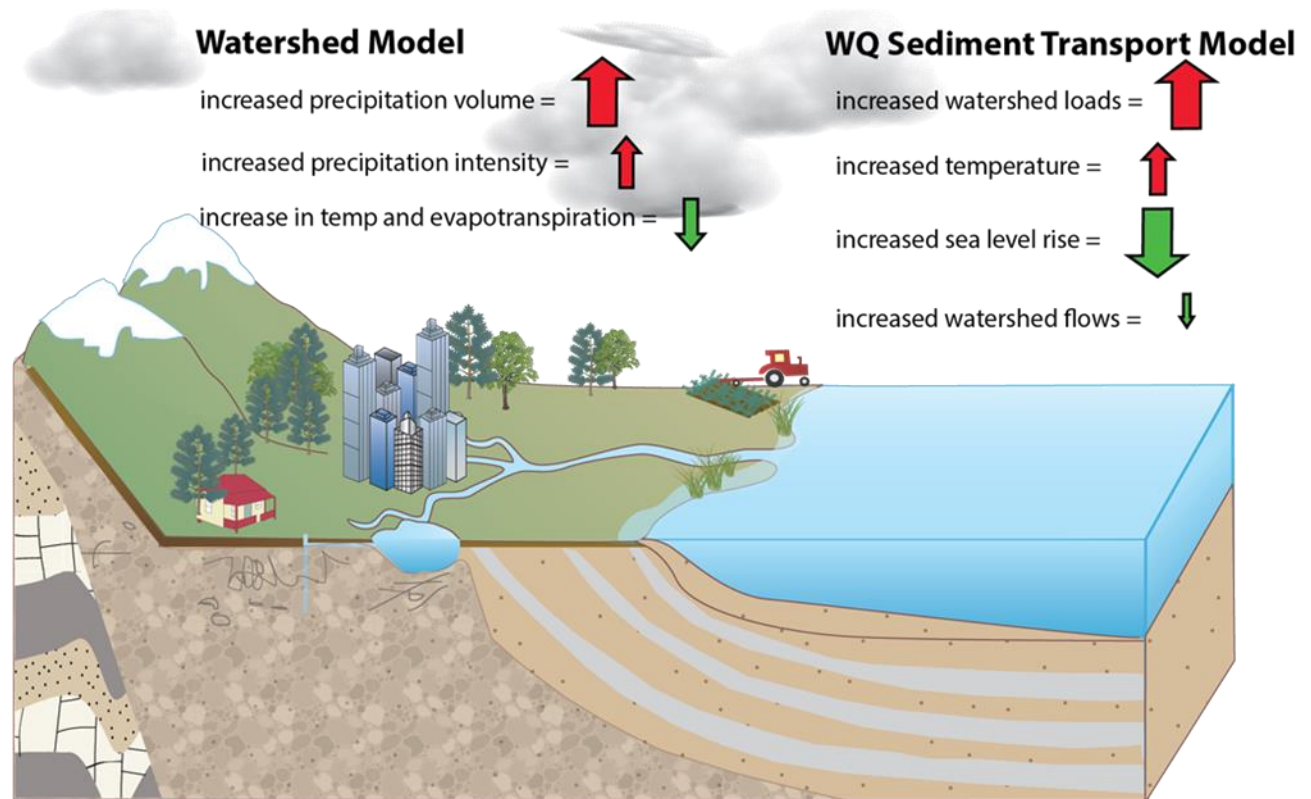
# Major Factors

## Watershed Model:

- Precipitation volume & intensity
- Temperature (snow melt) and evapotranspiration
- Translates (via HSPF) into increased flow & associated nutrients and sediment loads

## Water Quality Model

- Increased loads (from WSM)
- Temperature effects
- Sea level rise and increased flows



# Methods

## For precipitation:

- For 2025, extrapolate 87-year data record (PRISM)
- For 2050, use average of GCMs (“ensemble”)

## For temperature:

- Use average of GCMs

GCM = global climate change model

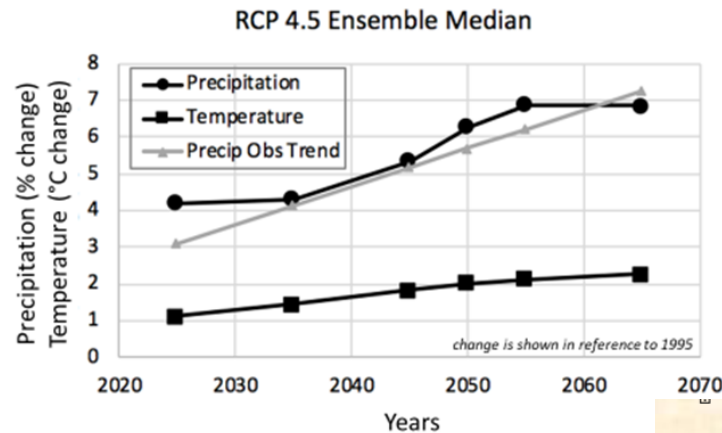
Year	Precipitation		Temperature	
	Trend	Ensemble	Trend	Ensemble
2025	x	–	–	x
2035	?	?	?	?
2045	?	?	?	?
2050	–	x	–	x

- Selections highlighted in yellow are the STAC and CBP climate resiliency workgroup recommendations and CBP approved approaches for the 2017 Climate Change assessment.
- For 2035 and 2045 the Modeling Workgroup (September 2018) recommended (a) combining the two sources using weighted means for rainfall, (b) using the ensemble for temperature. Both approaches are consistent with the STAC 2016 Climate Change Workshop recommendations of observed precipitation trends for 2025 and ensemble precipitation estimates for 2050.

# Methods – More Details

2017 Assessment

## Summary of precipitation and temperature



**Trend:** extrapolation of long-term (88-year) trends  
**Ensemble:** 31-member ensemble of RCP4.5 GCMs

RCP = Representative  
 Concentration Pathways

Updated Ensemble members		
ACCESS1-0	FGOALS-g2	IPSL-CM5A-LR
BCC-CSM1-1	FIO-ESM	IPSL-CM5A-MR
BCC-CSM1-1-M	GFDL-CM3	IPSL-CM5B-LR
BNU-ESM	GFDL-ESM2G	MIROC-ESM
CanESM2	GFDL-ESM2M	MIROC-ESM-CHEM
CCSM4	GISS-E2-H-CC	MIROC5
CESM1-BGC	GISS-E2-R	MPI-ESM-LR
CESM1-CAM5	GISS-E2-R-CC	MPI-ESM-MR
CMCC-CM	HadGEM2-AO	MRI-CGCM3
CNRM-CM5	HadGEM2-CC	NorESM1-M
CSIRO-MK3-6-0	HadGEM2-ES	
EC-EARTH	INMCM4	

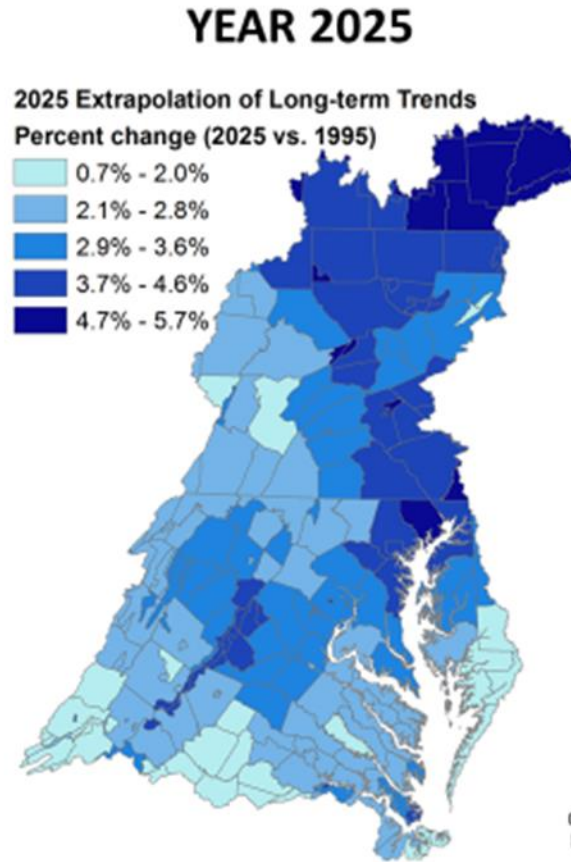
**31 member ensemble**



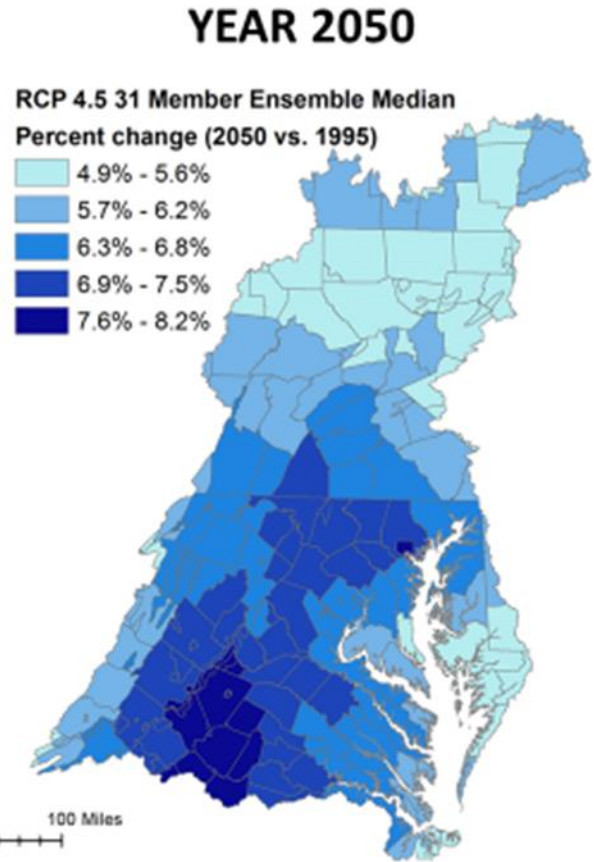
# Precipitation: Results

Data quantified mostly at county scale

Bay Program looking at various methods of disaggregating annual rainfall into smaller time steps



**3.11% increase in average annual rainfall volume**



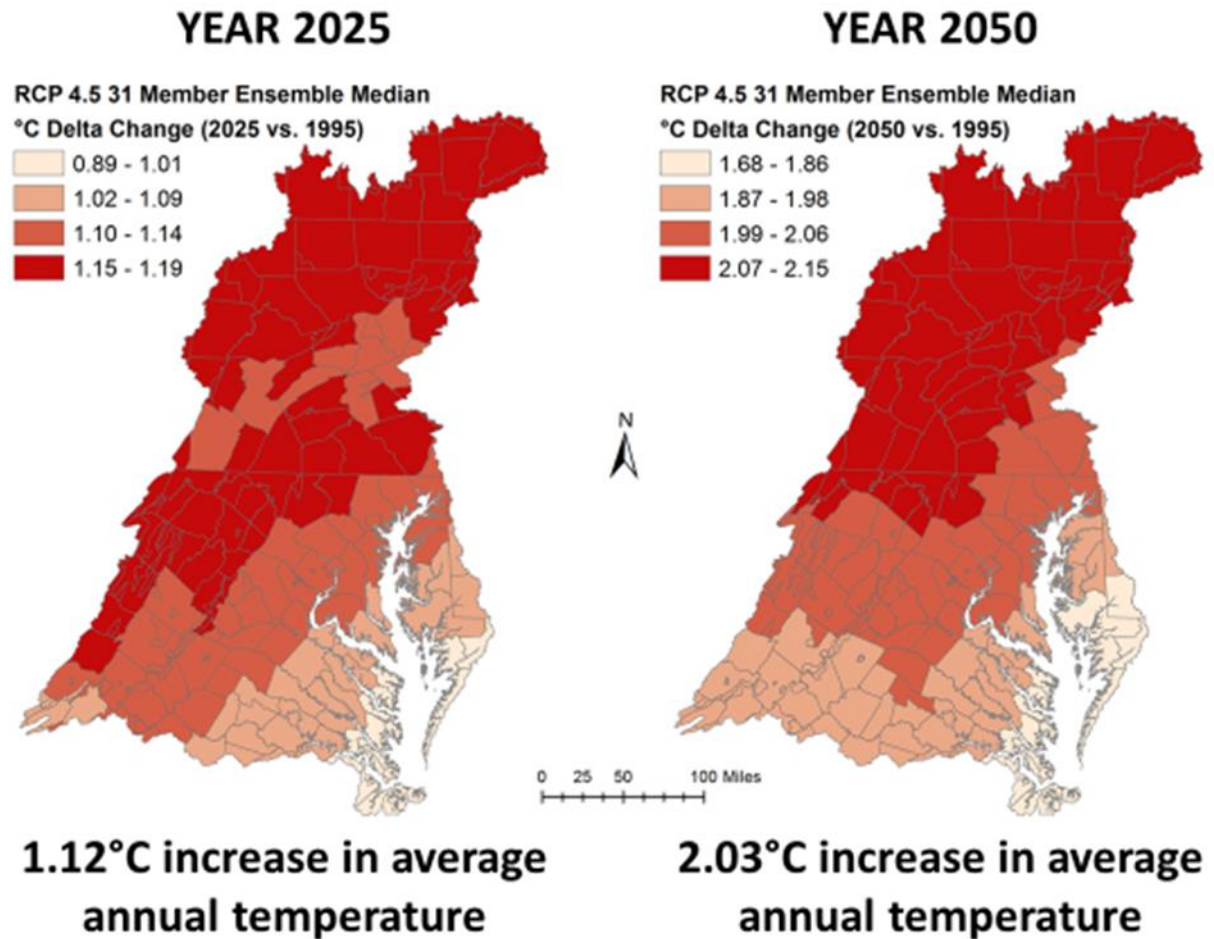
**6.28% increase in average annual rainfall volume**



# Temperature: Results

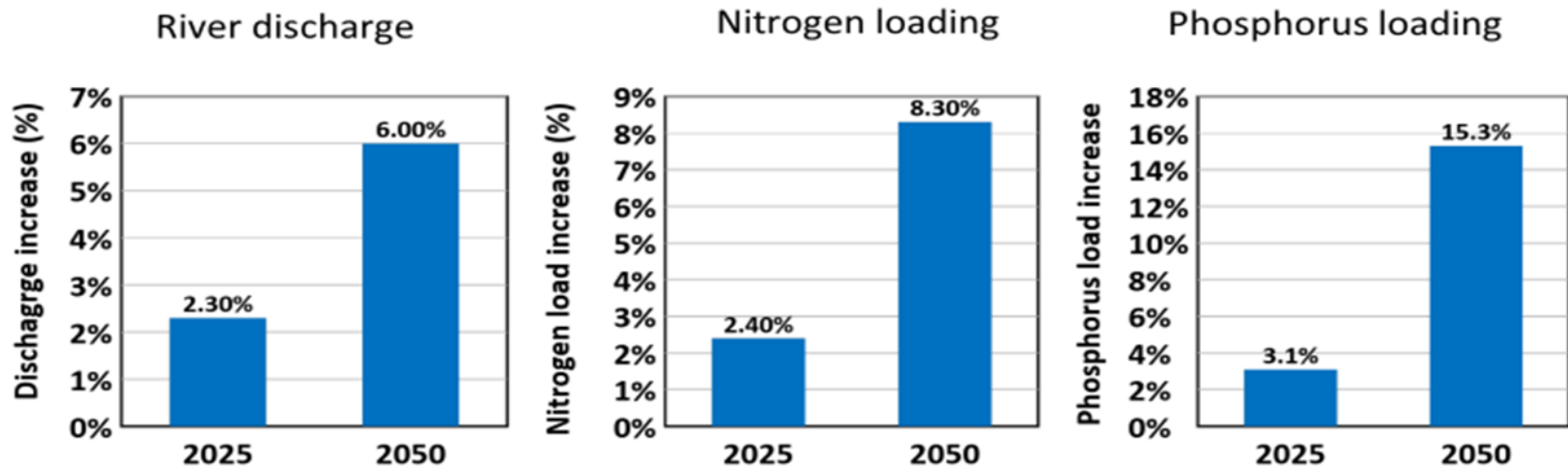
Data quantified mostly at county scale

More uniform than precipitation data - ?



# WSM Loads: Results

## Changes in river discharge and nutrient loading in the 2025 and 2050 climate change scenarios

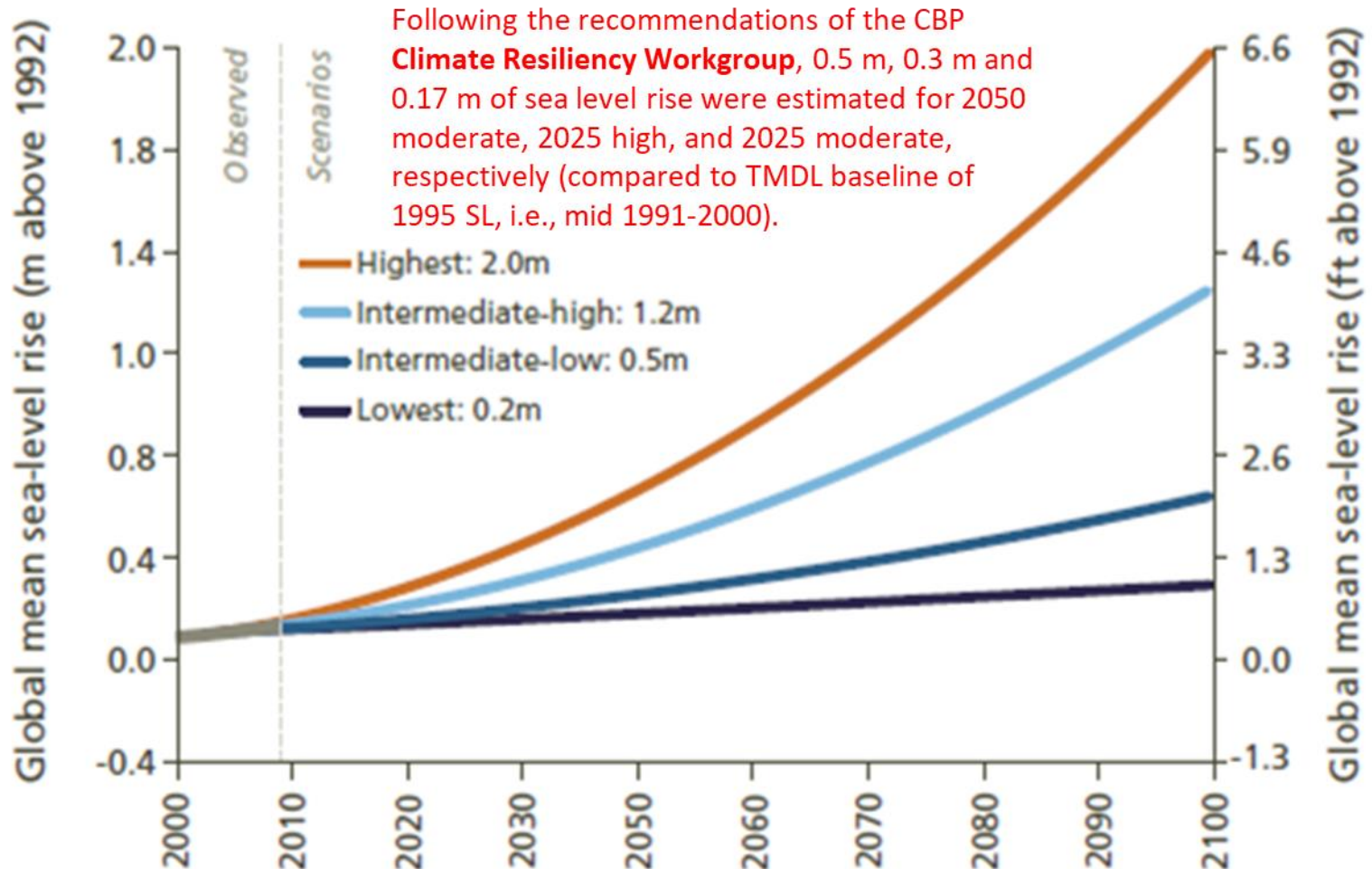


From Gopal Bhatt



# Sea Level Rise Estimates

Separate group within CBP responsible for sea level rise estimates



From Parris et al. (2012). *Global Sea Level Rise Scenarios for the United States National Climate Assessment*. NOAA Technical Report OAR CPO-1. (1992 used as the starting year)



# WQSTM Results: water quality attainment

## Estimate on water quality attainment in the Deep Channel Designated Use

Potential effect of climate change on attainment scenarios

Scenario	name	Base	2025SL R_17cm	2025Flo w	2025He at	2025All	2050SL R_50cm	2050Flo w	2050He at	2050All	WIP2	WIP2_2 025	WIP2_2 050
Nitrogen	loading	325TN	325TN	333TN	325TN	333TN	325TN	352TN	325TN	352TN	195TN	200TN	211TN
Phosphorus	loading	21.9TP	21.9TP	22.6TP	21.9TP	22.6TP	21.9TP	25.3TP	21.9TP	25.3TP	13.7TP	14.1TP	15.8TP
CB3MH	MD	7.02%	6.50%	7.56%	9.00%	8.41%	4.41%	8.58%	10.91%	9.20%	0.00%	0.00%	0.00%
CB4MH	MD	44.76%	42.07%	45.51%	47.66%	46.44%	36.45%	48.27%	51.11%	47.71%	5.02%	6.80%	9.61%
CB5MH_	MD	20.68%	18.39%	20.58%	22.04%	21.74%	15.67%	23.05%	24.54%	23.00%	0.00%	0.00%	0.00%
CB5MH_	VA	4.03%	2.65%	4.63%	6.16%	5.39%	0.48%	7.66%	8.74%	6.97%	0.00%	0.00%	0.00%
POTMH_	MD	15.47%	13.56%	15.68%	17.21%	17.06%	10.32%	17.16%	19.39%	18.77%	0.00%	0.00%	0.00%
RPPMH	VA	13.33%	16.00%	16.34%	20.42%	18.15%	14.40%	20.82%	24.57%	27.14%	0.00%	0.00%	0.00%
ELIPH	VA	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
CHSMH	MD	11.24%	17.08%	11.83%	12.84%	11.81%	14.53%	13.67%	16.18%	14.26%	0.00%	0.01%	1.19%
EASMH	MD	17.95%	17.20%	18.93%	20.54%	18.91%	14.72%	20.56%	22.64%	18.55%	5.62%	6.38%	6.45%



# Impact on TMDL Loads

Jurisdiction	1985 Baseline	2013 Progress	Climate Change	Phase III Planning Target
NY	18.71	15.44	0.400 (3.8%)	11.59
PA	122.41	99.28	4.135 (5.7%)	73.18
MD	83.56	55.89	2.194 (4.8%)	45.30
WV	8.73	8.06	0.236 (3.7%)	8.35
DC	6.48	1.75	0.006 (0.3%)	2.43
DE	6.97	6.59	0.397 (8.5%)	4.59
VA	84.29	61.53	1.722 (3.1%)	55.82
Basinwide	331.15	248.54	9.09 (4.6%)	201.25

Potential effect of climate change on 2025 target loads for WIP IIIs



# Recent STAC Climate Change Workshop Recommendations

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- Stick with current modeling framework
- Add in uncertainty
- Check current watershed model simulation for how nutrient species (nitrate) and (phosphate) respond to climate change
- Lack information on BMP siting and effectiveness

STAC = Scientific and Technical Advisory Committee

# Preliminary Conclusions

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- By 2025, effect of climate change on attaining water quality in the Bay is a net negative
  - 2017 model results suggest that by 2025 climate change would add the equivalent of 9 million additional pounds of nitrogen to the Bay
    - about 9 % above the current total nitrogen target for the Bay TMDL
- Models will be rerun with updated assumptions and new data in 2020

# COG Next Steps

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- WRTC Nov. 9 work session on climate change modeling
- Continue to track Bay modeling developments
- Weigh in on future policy decision (2021) to quantitatively incorporate climate change impacts into TMDL



# For More Information

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- CBP Climate Resiliency Workgroup
  - [https://www.chesapeakebay.net/who/group/climate\\_change\\_workgroup](https://www.chesapeakebay.net/who/group/climate_change_workgroup)
- CBP Modeling
  - [https://www.chesapeakebay.net/who/group/modeling\\_team](https://www.chesapeakebay.net/who/group/modeling_team)

