

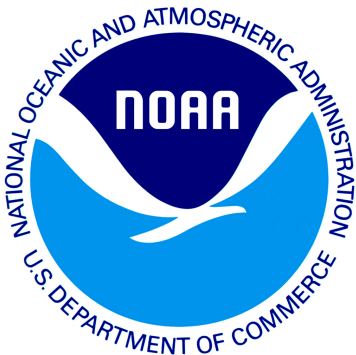
# Chesapeake Hypoxia Analysis & Modeling Program (CHAMP):

Predicting impacts of climate change on the success of management actions in reducing Chesapeake Bay hypoxia

## CHAMP PIs:

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# CHAMP goals

## Develop a Chesapeake Bay scenario-forecast modeling system to:

- Isolate future impacts on Chesapeake hypoxia of climate change from those due to anthropogenic nutrient inputs
- Determine whether the WIPs/TMDLs will successfully reduce hypoxia (and meet WQS) under future climate conditions

# CHAMP goals

## **NOAA requirement:**


→ Must maintain continual engagement by a Management Transition Advisory Group (MTAG) to ensure our outputs are timely and in a useful form for the regional management of hypoxia

## **The CHAMP team is proposing:**

→ MTAG = Modeling Workgroup, engaged through semi-annual CHAMP reports at Quarterly Meetings

# CHAMP models

## Use multiple models in Chesapeake scenario-forecast modeling system:

- Three watershed models:
  - CBP WSMp6 (**CBP: Shenk/Linker**)
  - DLEM (**Auburn: Tian**)
  - Sparrow (**USGS: Ator**)

Up to six model combinations
- Two estuarine models:
  - CBP WQSTM (**CBP: Shenk/Linker/?**)
  - ChesROMS-ECB (**VIMS: Friedrichs**)
- Oyster population model (**ODU: Hofmann**)
  - To examine impact of hypoxia on living resources

# CHAMP models

## ODU (Hofmann) Oyster Model:

- Model simulates post-settlement population dynamics (growth, reproduction, mortality)
- Includes larval submodel, Dermo/MSX disease submodels
- Inputs are T, S, food (POC), turbidity, bottom velocity
- Outputs are total number, population size frequency, reproductivity capacity, disease prevalence
- Applied in time dependent (1D) model at specific locations in Chesapeake Bay
- To do: include explicit oxygen dependencies on physiological processes

# CHAMP simulations

## Four types of watershed+estuarine simulations:

- Realistic hindcasts (1985-2016)
- Future simulations (2017-2050)
- Factorial future simulations (2017-2050)  
    climate change vs. land use/population change
- Decision support: alternative management scenarios

# CHAMP forcing fields

## Forcing fields for Future Simulations:

For an “apples to apples comparison” all model combinations must use same future forcing fields:

- Future Atmospheric Deposition (**Bash**)
- Population/Land use Change (**Shenk/Linker**)
- Temperature, Precipitation, Winds, Humidity (**Najjar**)

(CBP is assembling CHAMP website where all forcing will be available, for use by other research teams as well.)

# CHAMP climate scenarios (Najjar)

- **Estuarine model requires atmosphere—estuary heat & freshwater fluxes, so many downscaled products are not useful since they only provide temperature and precipitation (not wind, humidity, radiation...)**
- Propose using: Multivariate Adaptive Constructed Analogs (MACA) statistical downscaling method (Abatzoglou and Brown, 2011)
- Variables provided: air temperature, precipitation, humidity, wind speed, downwelling radiation
- Spatial resolution: 4 km
- Scenarios available: RCP4.5 and RCP8.5
- GCMs will be selected to bracket the projected future climate
- Wind direction is unavailable from MACA; will consider using raw model output from GCMs interpolated to the estuarine grid



# CHAMP preliminary results

## Hindcasts with/without TMDL reductions:

- WSMp5 + WQSTM produces similar WQS  
as WSMp5 + ChesROMS-ECB (Irby 12/16)  
  
→ Increases our confidence in the TMDL
- To do: How will WSMp6 + WQSTM compare to  
WSMp6 + ChesROMS-ECB?

# CHAMP preliminary results

## Initial climate change results (Irby):

Increased precipitation in winter + reductions in summer:

- Bottom DO decreases in summer of  $\sim 0.5\text{-}0.8$  mg/L
- Bottom DO increases in winter of  $\sim 0.1\text{-}0.2$  mg/L

- ✧ Although the impact of climate change on absolute DO concentrations may be small, the impact on attainment of WQS may be significant (changing by several %)

# CHAMP Summary

- ✧ Opportunity for academic research to impact management decisions
- ✧ Opportunity for Modeling Workgroup to suggest management-oriented (hypoxia focused) research questions that need addressing