Consideration of Climate Change in the 2017 Mid-Point Assessment

Gary Shenk

Presentation to STAC

6/11/2013

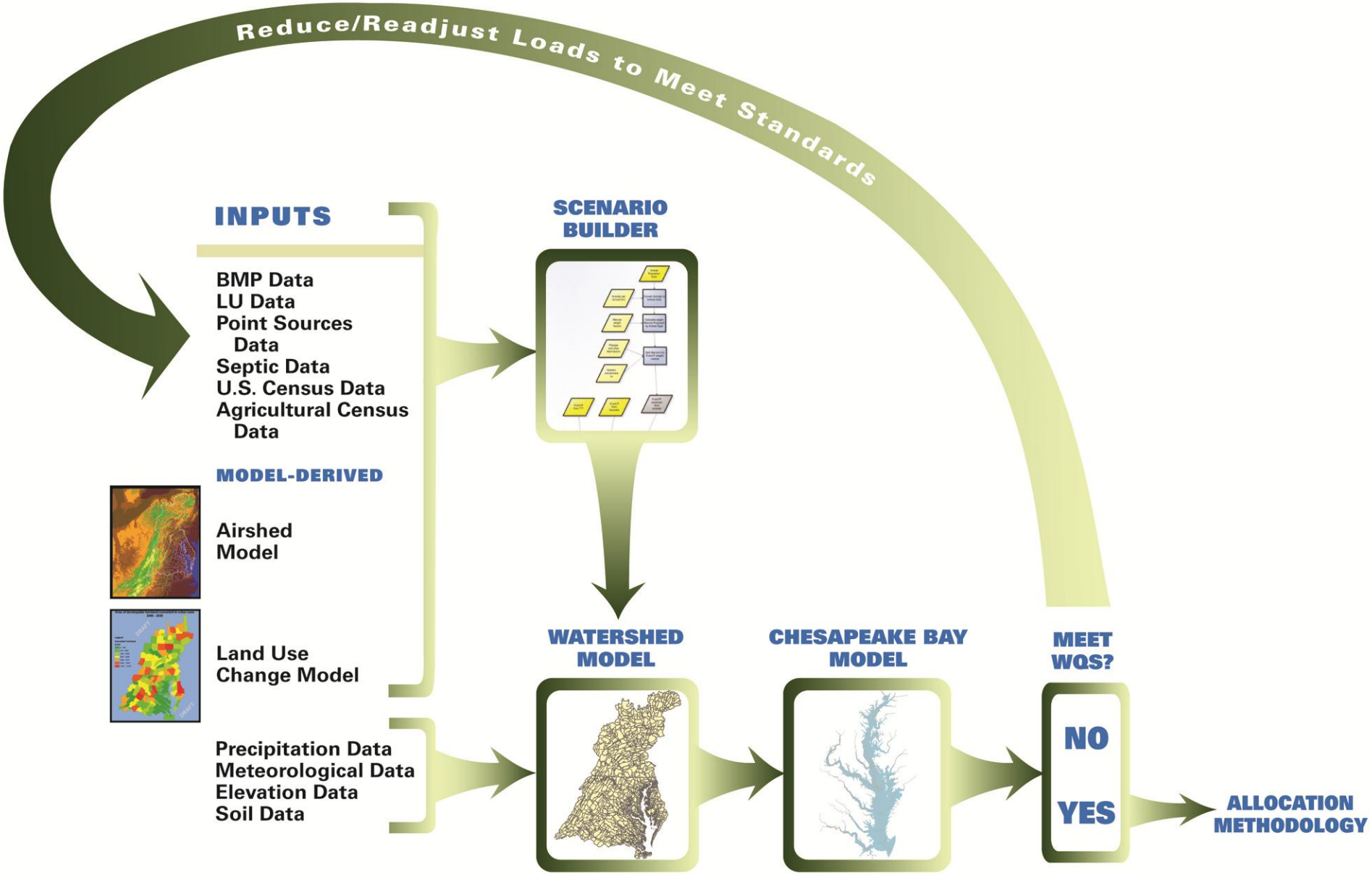
CBP Commitments

- Executive Order (May 12, 2009) "assess the influence of climate change on the Chesapeake TMDL by 2017."

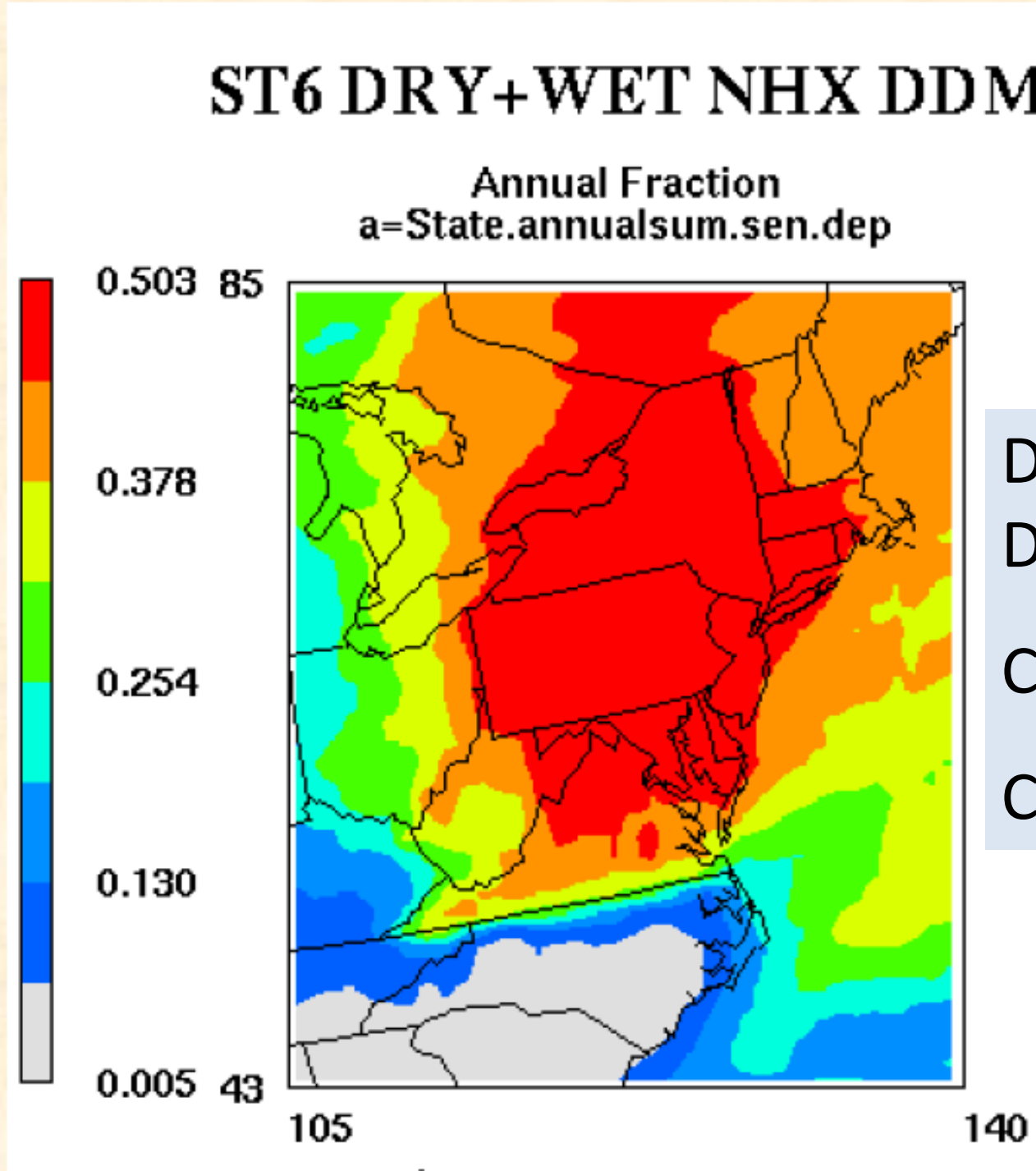
- 2010 TMDL Documentation Section 10.5
  - EPA and its partners are committed to conducting a more complete analysis of **climate change effects on nitrogen, phosphorus, and sediment loads and allocations** in time for the mid-course assessment of Chesapeake Bay TMDL progress in 2017 as called for in Section 203 of the Chesapeake Executive Order 13508 (May 12, 2009). To do that will require **building the capacity** to quantify the impacts of climate change at the scale of the Bay TMDL—92 Bay segments and their surrounding watersheds at the scale of the Phase II Watershed Implementation Plans' target loads—and incorporate that information into the **full suite of Bay models** and other decision support tools. EPA has committed to take an adaptive management approach to the Bay TMDL and incorporate new scientific understanding of the effects of climate change into the Bay TMDL, in this case during the mid-course assessment.

- Multiple STAC recommendations

Chesapeake Bay Partnership Models



CMAQ CC study by 2016



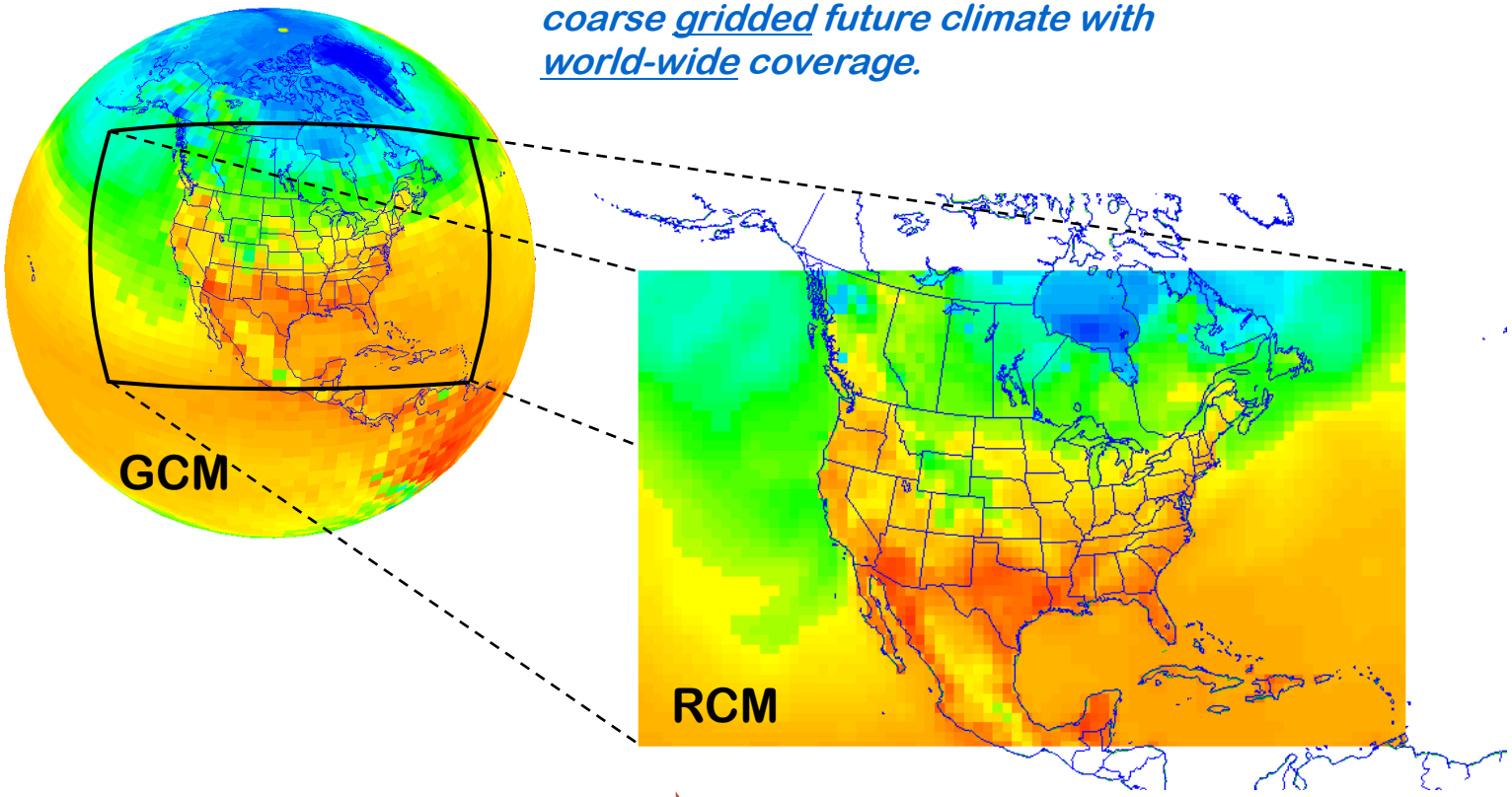
Dynamic Downscaling

Coupled WRF/VIC

CMAQ to 2050

Dynamical Downscaling with WRF

Global climate model (GCM) creates coarse gridded future climate with world-wide coverage.

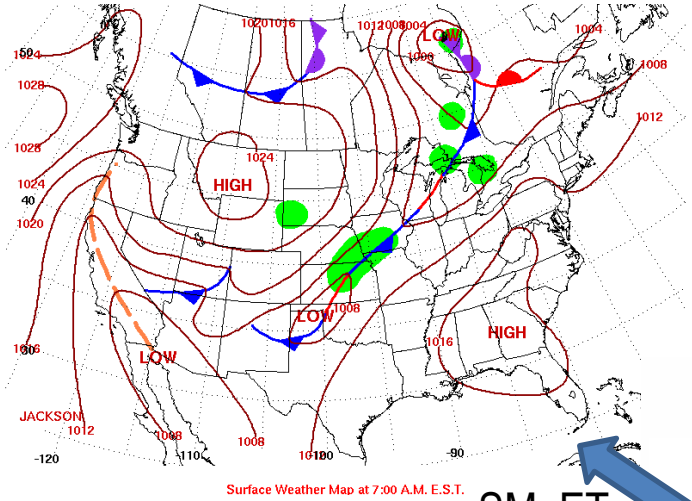


Regional climate model (RCM) generates gridded higher-resolution climate predictions over focal area.

More detail in local effects from:
- *scale-appropriate physics*
- *topography & land/water interfaces*
- *urban areas (population centers)*
- *precipitation patterns*

Coupled WRF-VIC System (at 12 km)

WRF



SM, ET

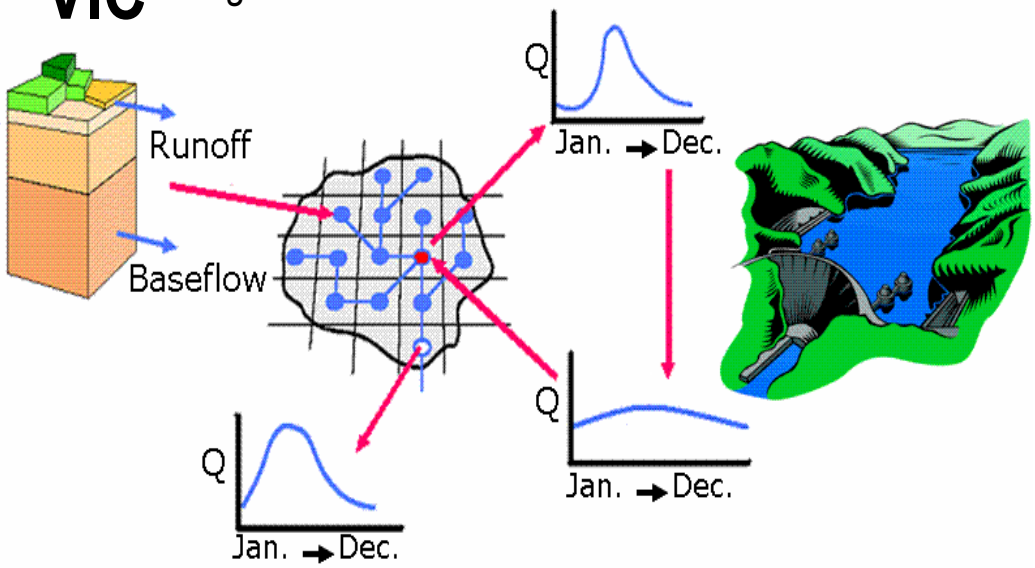
CESM Coupler

P, T

VIC

VIC Model Features:

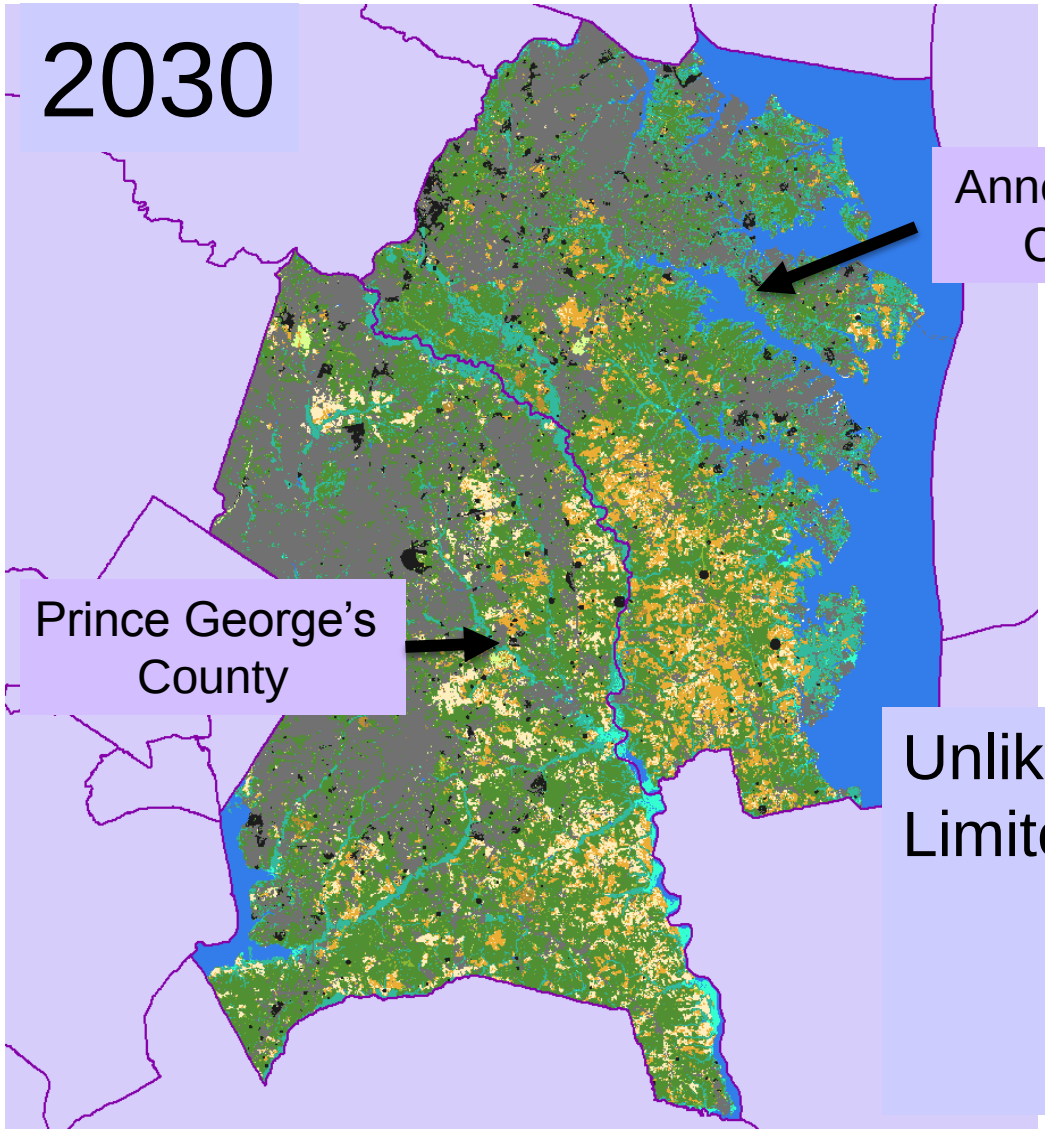
- Multiple vegetation classes in each cell; fraction of the cell
- Sub-grid elevation band
- Sub-grid runoff variability
- Typically 3 soil layers used
- Non-linear soil moisture dependence of baseflow generation



VIC: Variable Infiltration Capacity Hydrologic Model

Developed at the University of Washington

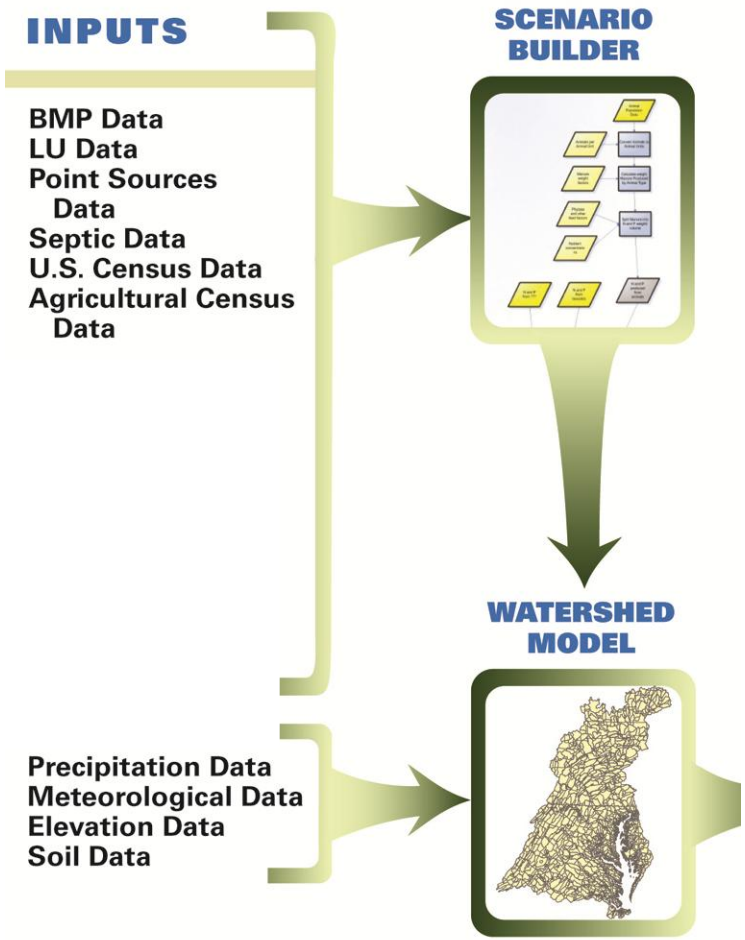
Land Use Change Model



Unlikely to consider CC for MPA.
Limited possible effects:
Loss of land/salination due to SLR

Watershed Model

- Extremely complex climate interactions
  - Weather
  - BMP effectiveness
  - Agricultural characteristics
  - Nutrient processing
- Relying on partnerships

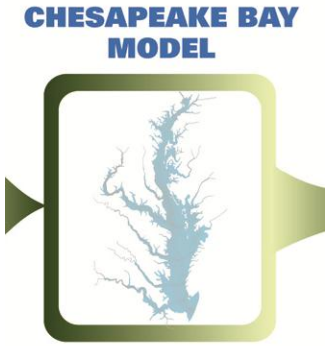


Estuarine Models - CBPO

- CH3D hydrodynamics with modified meteorology, watershed inputs, sea level, and shoreline geometry.

- Water quality and living resource model runs
  - Modified hydrodynamics
  - Modified watershed loads

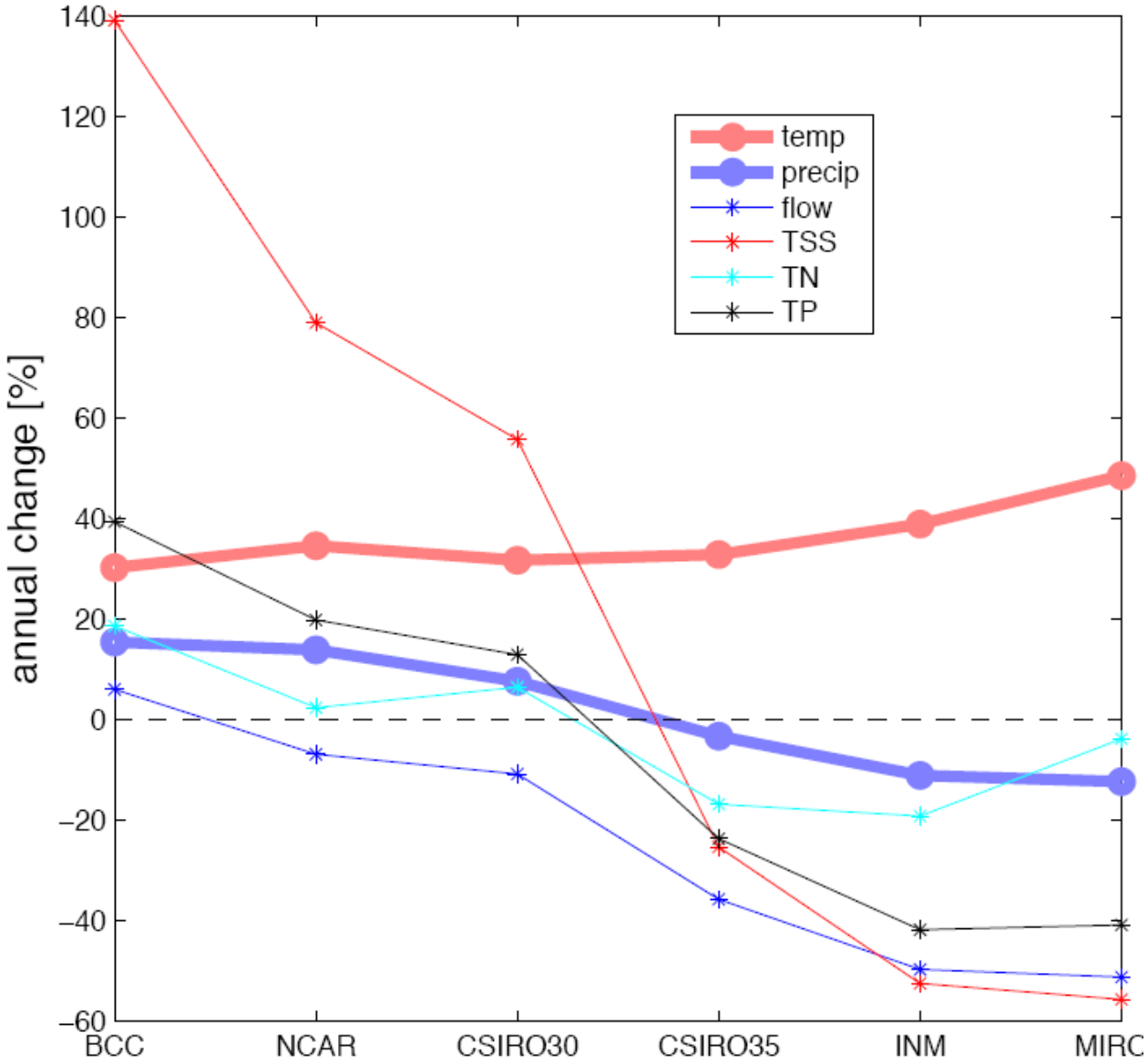
- Also informed by partnerships



Collaborations

- Generally, CBPO supplying models and collaborators supplying inputs and analysis.
- Current Collaborators
  - Penn State
  - USGS
  - EPA ORD
  - RAND
  - UMCES
  - Johns Hopkins
  - Virginia Tech

Summary of annual response to climate f



Penn State

- First cut watershed analysis
- Focus on total loads to the estuary

Ray Najjar
Maria Herrmann

USGS – hydrology only

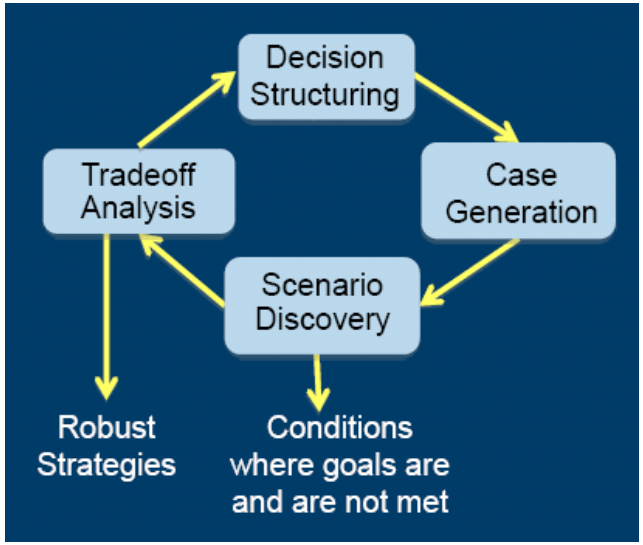
- 6 climate change models
  - BBCR, INM, CSIRO, NCAR, CCSM, MIROC
- 3 IPCC scenarios
  - A1B, A2, and B1)
- 4 time periods
  - 2030, 2040, 2060, 2090

- Investigate changes in peak flow, low flow, total supply

Mark Bennett

EPA-ORD / RAND

- Robust Decision Making
- Evaluating robust strategies with uncertainties related to BMP performance and projections of climate and land use

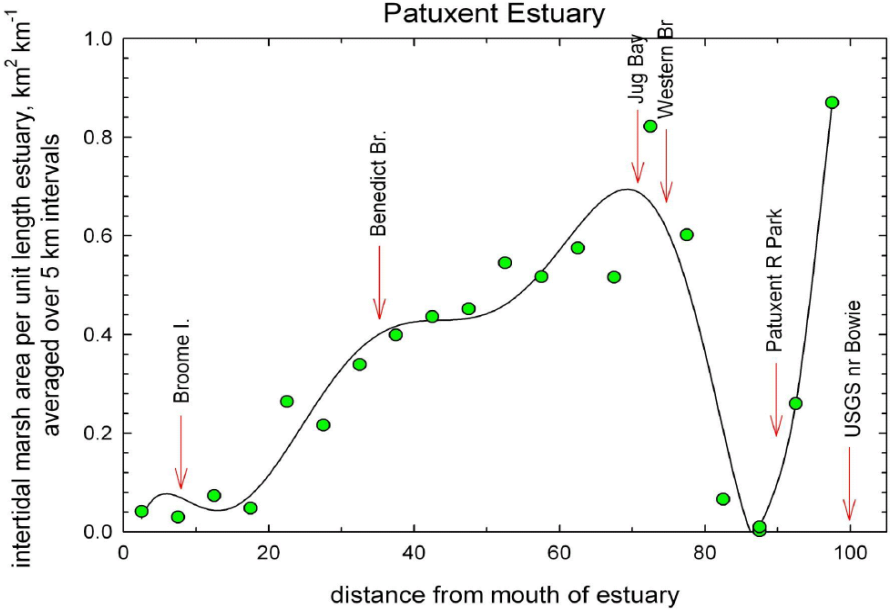


Susan Julius

UMCES

- Patuxent watershed and estuary
- Investigate Stream Restoration and intertidal Marsh performance
- Include stressors of land use change, SLR, temperature, etc.

Marsh area along the Patuxent



Michael Williams

Johns Hopkins

- Embedded Graduate Student
- Investigate terrestrial effects of climate change into for implementation in Phase 6
  - Soil and water temperature
  - Cropping changes
  - Nutrient cycling
  - …

Dano Wilusz
Bill Ball

VA Tech / UMCES / Penn State Proposal Stage

- Potential impact of CC to the TMDL and WIPs
- *Climate:* 10 RCMs through NARCCAP
- *Watershed:* CBP WSM
  - Improve CC effect on BMPs
  - Improve terrestrial nitrogen cycle climate effect
- *Estuary:* ROMS-RCA
  - CC-induced loading changes
  - Temperature
  - Sea level

David Sample
Ray Najjar
Ming Li
Zach Easton

CC Conclusions

- Commitment to address climate change in 2017 Mid-Point Assessment
- Questions have not yet been asked by management, but need to build tools now.
- Strong scientific interest and collaborations are making the assessment possible