Initial Assessment of Climate Change in the Chesapeake Bay Watershed

STAC Workshop on Adapting to Climate Change
In the Chesapeake Bay
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Lewis Linker[1], Thomas Johnson[2], and Gary Shenk[1]

1. EPA Chesapeake Bay Program Office

2. EPA ORD Global Change Research Program

Overview:

- The CBP assessment of TMDL climate change affects will be in the 2017 Assessment as called for by the CBP and the CB Executive Order.

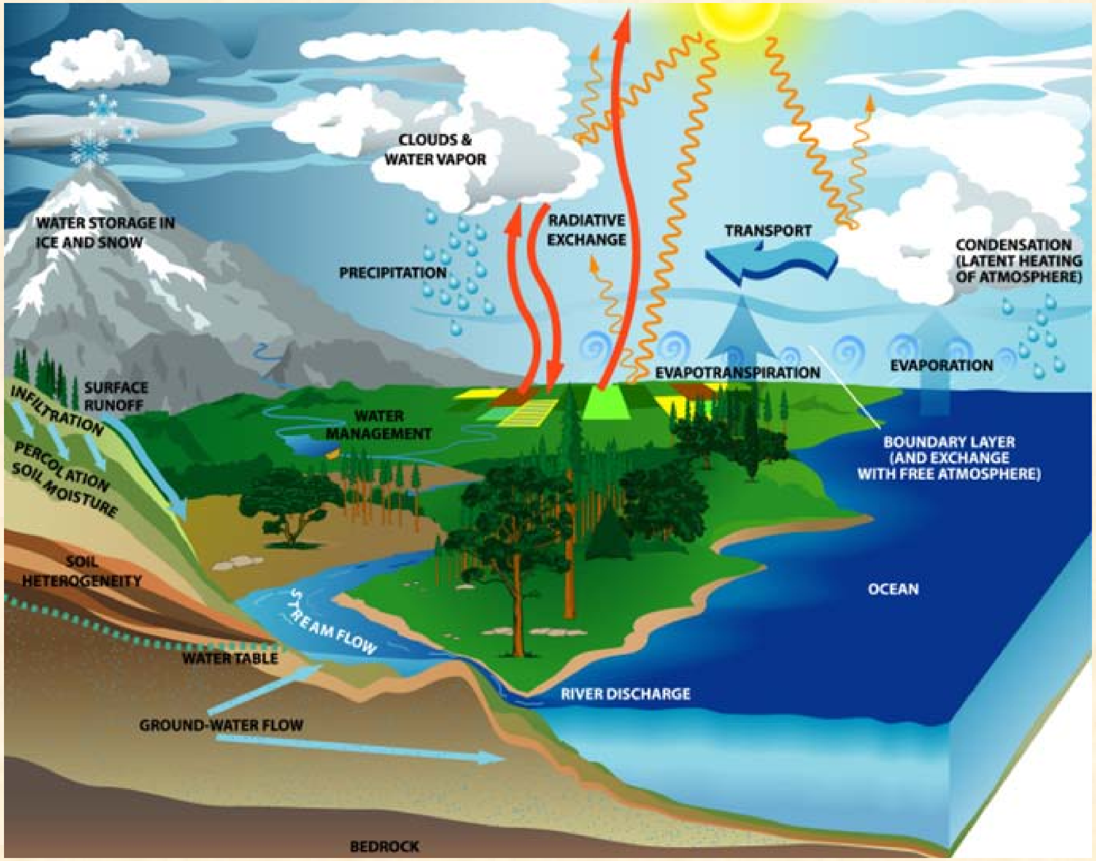
- Presented here is a proof-of-concept using the CBP models to assess climate change in the watershed.

- Guidance and assistance in this work were provided by Chris Pyke and Raymond Najjar.

Estimated Climate Change Effects in the Chesapeake Region

In our region, temperatures are estimated to increase with a high degree of certainty, and precipitation to increase, especially at higher rainfall events, with a moderate degree of certainty.

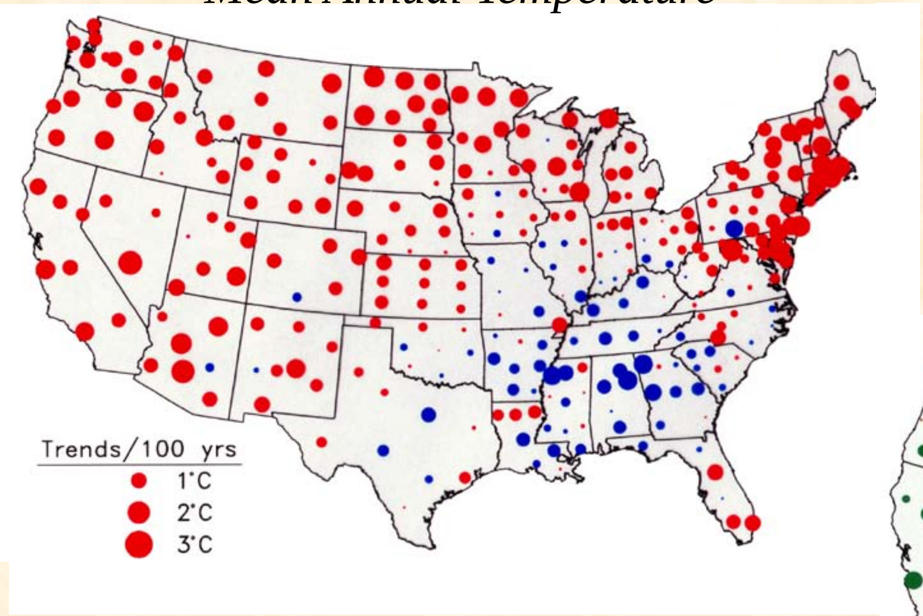
How this effects flow in the watershed hangs in a hydrologic balance between precipitation and evapotranspiration.



About half the annual Chesapeake watershed precipitation inputs are lost by evapotranspiration.

Observed Temperature and Precipitation Trends (1901-1998)

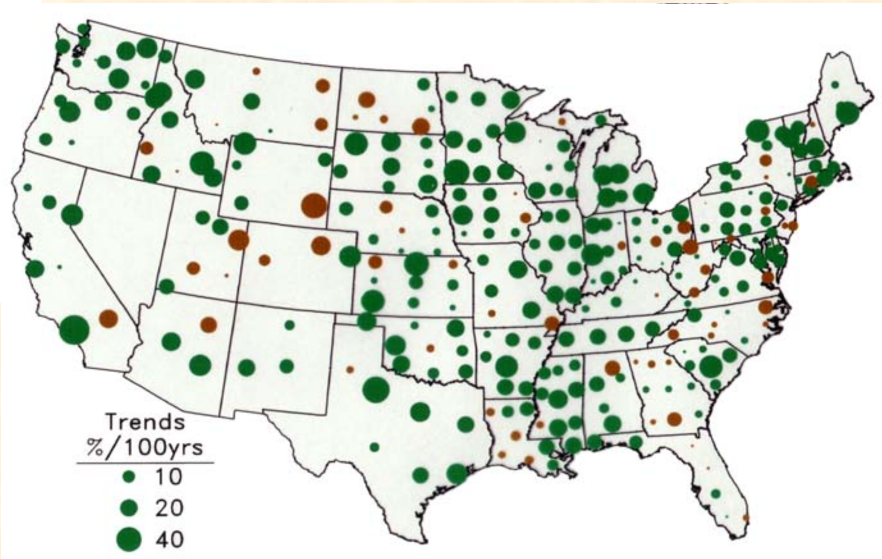
Mean Annual Temperature



Red = increase
Blue = decrease

Looking back over the observed record for the last century.

Annual Precipitation Total



Green = increase
Brown = decrease

Treatment of Precipitation Changes

Many GCMs estimate significant increases in precipitation intensity, defined by an increase in annual precipitation and the number of dry days, consistent with observations over the past century. Increased intensity estimates are particularly for precipitation estimates for middle and high latitudes including the Chesapeake watershed. Three different methods were used for dealing with GCM precipitation estimates.

- Constant: GCM estimates of precipitation increases distributed evenly over the Phase 5 1985 to 2000 precipitation inputs.
- Flash 30: GCM estimates of precipitation increases distributed over the highest 30% of precipitation events.
- Flash 10: GCM estimates of precipitation increases distributed over the highest 10% of precipitation events.

There are 42 GCM Scenario Inputs Developed for the Monocacy Watershed for 2025 and 2085

National Center for Atmospheric Research (NCAR) Global Climate Model

A2 Emission Scenario

Constant Precip. Change

Flash 30 Precip. Change

Flash 10 Precip. Change

B2 Emission Scenario

Constant Precip. Change

Flash 30 Precip. Change

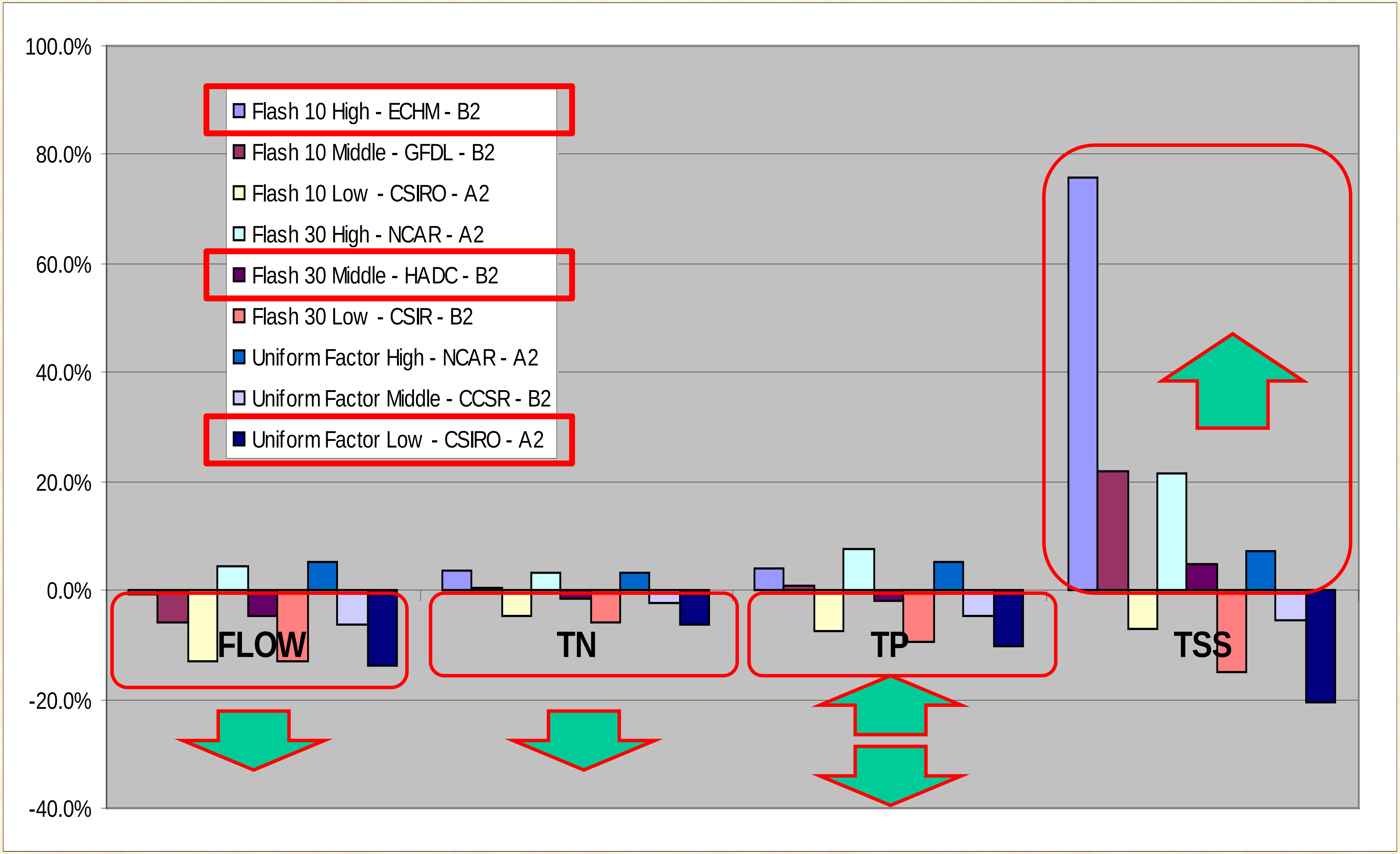
Flash 10 Precip. Change

Seven GCMs x 2 emission scenarios x 3 precipitation treatments gives a total of 42 GCM inputs available for the Chesapeake watershed for estimated 2025 and 2085 temperatures and precipitation.

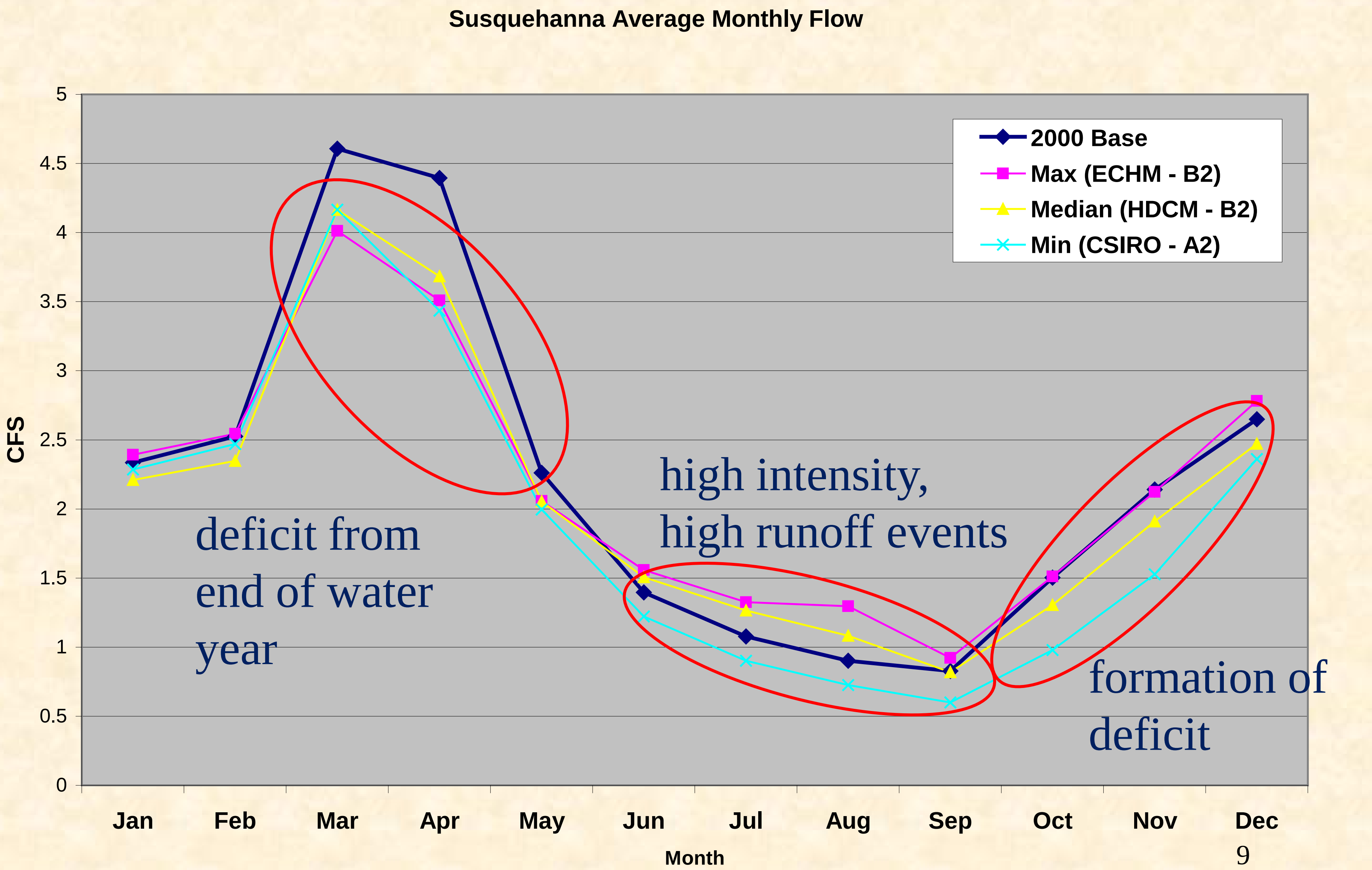
Of the 42 GCM Inputs, 9 Were Chosen For Full Runs of the Phase 5 Watershed Model

- Initially, all 42 scenarios were run on a representative watershed (Monocacy) and the loads were examined.
- The maximum, minimum, and median loads of nitrogen determined the three scenarios chosen from each of the constant, flash 30, and flash 10 precipitation treatments for a total of 9 full Chesapeake watershed runs at 2025 temperatures and precipitation.
- For the 9 full Chesapeake watershed runs, a 2000 Base Scenario was used which is based on the average flow and loads of the 1985 to 2000 simulation period and uses the 2000 land use, BMPs, and point source flows and loads.

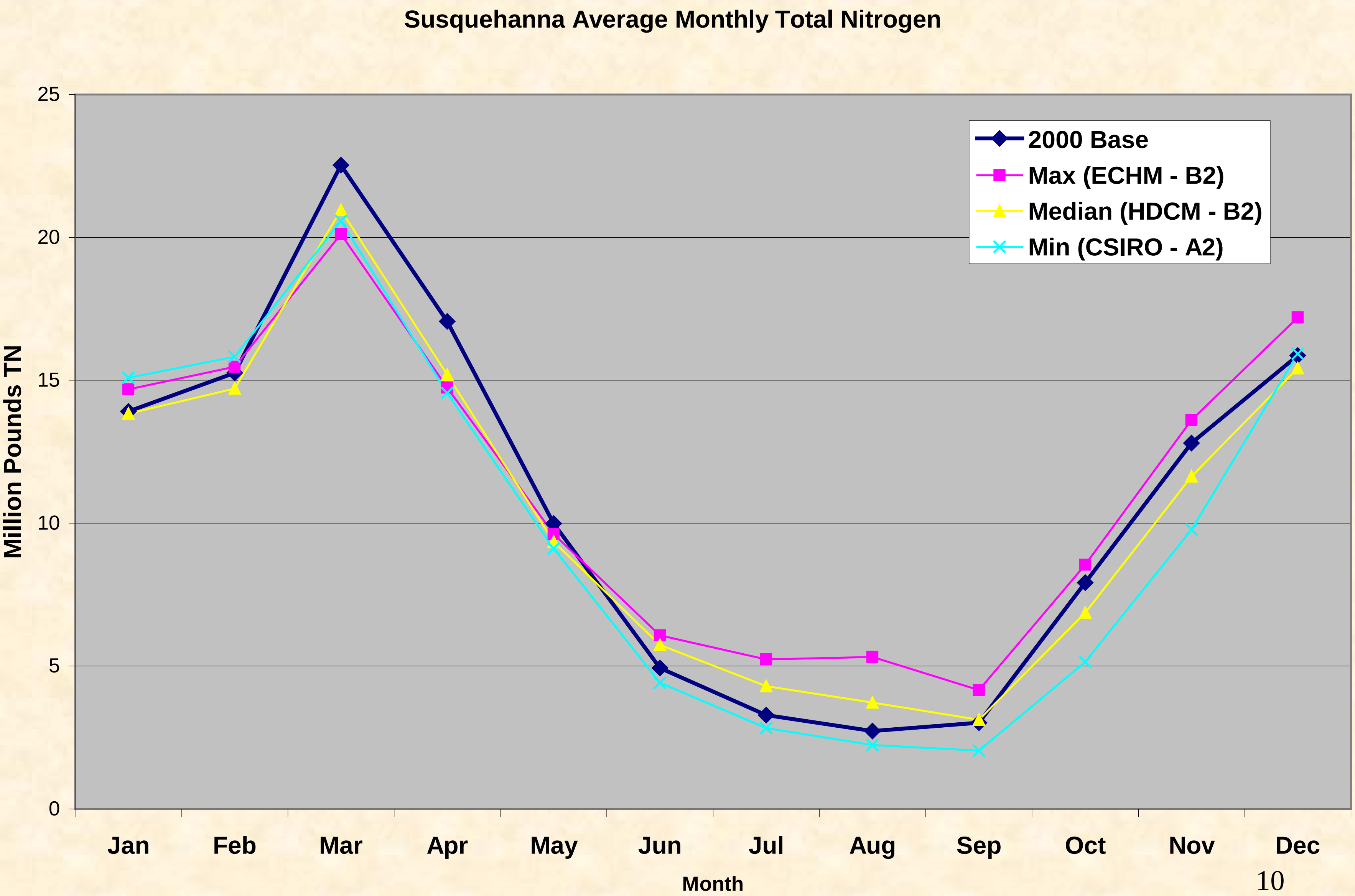
Summary of the 2025 Flow, Nutrient, and Sediment Loads From The Chesapeake Watershed



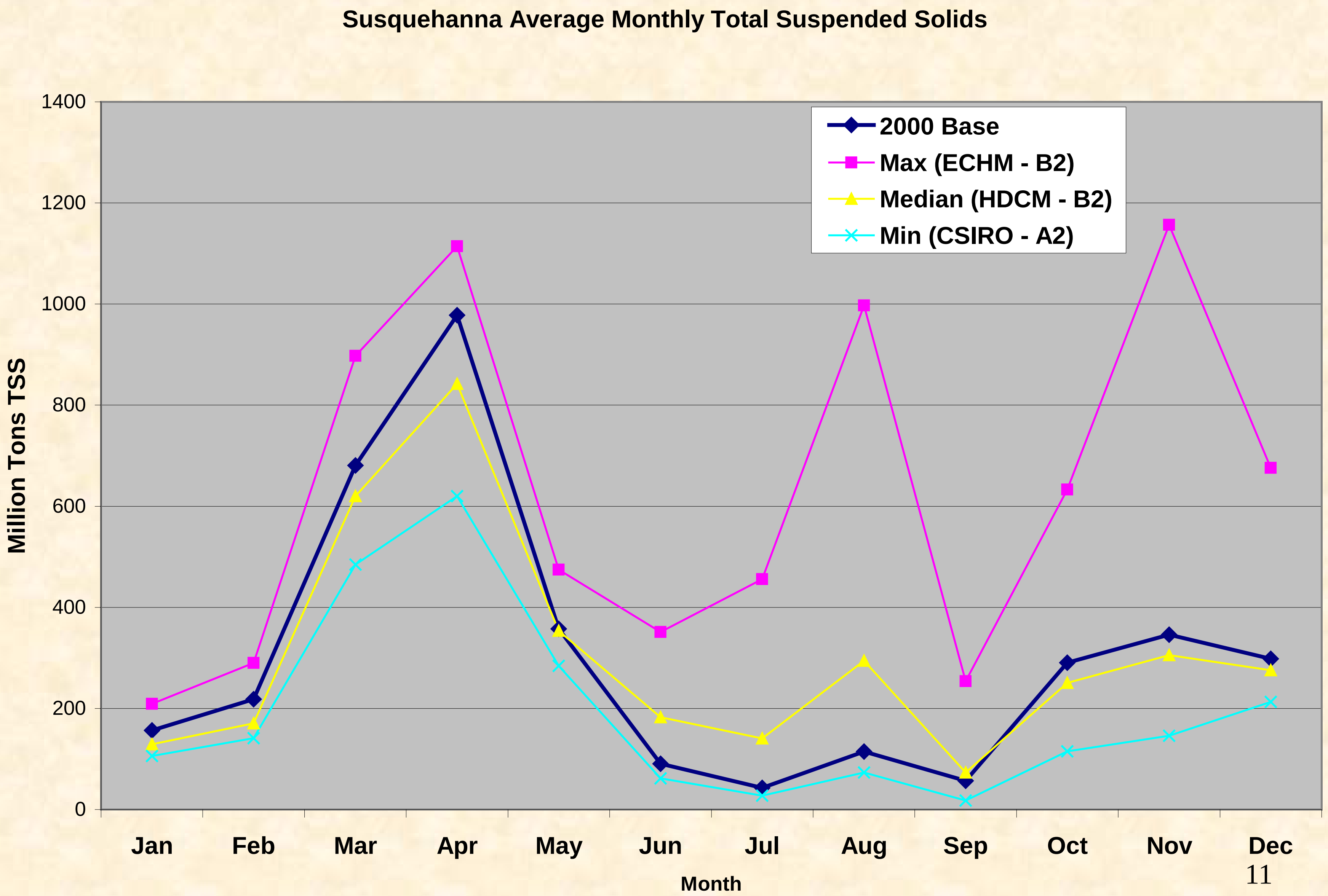
Estimated Susquehanna Monthly Average Flow for Base and Three Key 2025 Climate Change Scenarios



Estimated Susquehanna Monthly Average TN for Base and Three Key 2025 Climate Change Scenarios



Estimated Susquehanna Monthly Average TSS for Base and Three Key 2025 Climate Change Scenarios



Final Notes on Estimated Chesapeake Bay Climate Change

- Climate is changing and this has significant implications for our long-term Chesapeake Bay Program goals.
- We can use the Chesapeake Bay models of the watershed, estuary, and living resources with climate change tools to understand the vulnerability of Bay program goals to these changes.
- We can use the CB models to examine broader water resource issues such as securing an adequate water supply under expected climate change conditions.

Final Notes on Estimated Chesapeake Bay Climate Change - *continued*

- Next steps are to expand the analysis using the CBP models with more scenarios and the inclusion of land use as are underway in new USGS and EPA-ORD studies.
- The next generation of GCMs and downscaling techniques to qualify watershed flows and loads, Chesapeake Bay water quality, and other water resource issues will be welcome in the 2017 Assessment.