Forecasting Effects of Climate and Land-Use Changes in the Chesapeake Bay Watershed

Joint USGS – STAC/PSU Project

In this project, we are:

Forecasting climate and LU changes

to

forecast changes in flow and water quality

≈USGS

Hay and Markstrom Method

- Monthly simulated precipitation and temperature data from 6 GCMs

- Choose 3 scenarios for each of the 6 GCMs

- 12-yr moving periods from 2001-2099

RESULT:

88 input files x 3 GCM scenarios x 6 GCMs =

1584 datasets

≋USGS

Utilize Existing Models

CBP Watershed Model (Phase 5)

and

USGS Land-change model (CBLCM)

TO

Run climate scenarios

and

Run climate + land-use change scenarios

USGS

Analyze Streamflow Output Files - USGS

- Annual mean runoff

- Mean seasonal runoff
      (a) November - April
      (b) May -October

- 7-Day low flow (7-consecutive days that generate the lowest average flow)

- Flow duration - 10th, 50th, and 90th percentiles of flow

(from climate change alone and from climate change + land-use change)

≋ **USGS**

Example Analysis for Streamflow Output

Range in mean monthly streamflow for the 6 GCMs and the 3 scenarios

FLINT RIVER BASIN, GEORGIA
RANGE IN MEAN MONTHLY VALUES FOR: 2030, 2060, and 2090
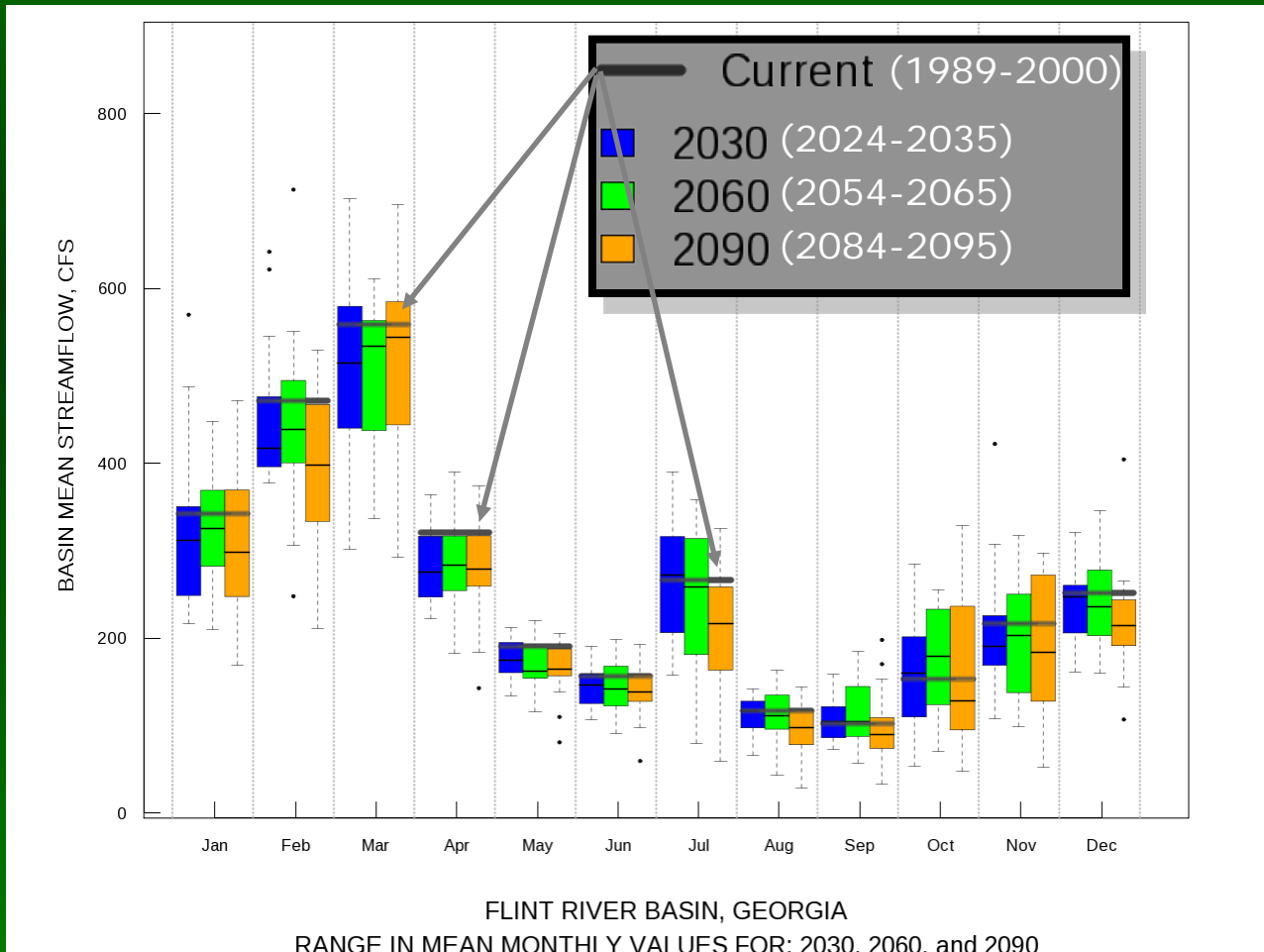
Summarize Forecasted Changes

- Bay watershed

- Major basins

- Ecoregions

- Physiographic provinces

≋USGS

Analyze Changes in Nutrient Loading - PSU

- Six models runs have been completed
  - Highest emissions scenario
  - Last 12 year window
  - All six GCMs

- Changes in nutrient and sediment loading from major tributaries (compared to base model run)

- Changes in loading from different land uses

≋USGS

Analyze Changes in Recorded Streamflow - USGS

- Identified over 100 basins with record >80 years

- Need to eliminate basins with significant land use change or impoundments

- Currently performing analysis

≋USGS

Future Needs

- Improve downscaled precipitation datasets
  - Information on peaks

- Include secondary climate impacts
  - Cropping practice changes
  - Irrigation changes

≋USGS

Forecast Effects on Aquatic Organisms

- Potential Impacts…
  - Ecological flow regimes
  - Fish disease/parasites
  - Spawning periods
  - Habitat shifts/loss
    - Forests
    - Wetlands
    - SAV
- Potential Activities
  - Prepare Conceptual models
    - Ecological flow regimes
    - Fish disease/parasites
    - Spawning periods
    - Habitat shifts/loss
  - Predict habitat loss
    - LU change model
    - Climate shifts