Phase 7 Watershed Model Plans

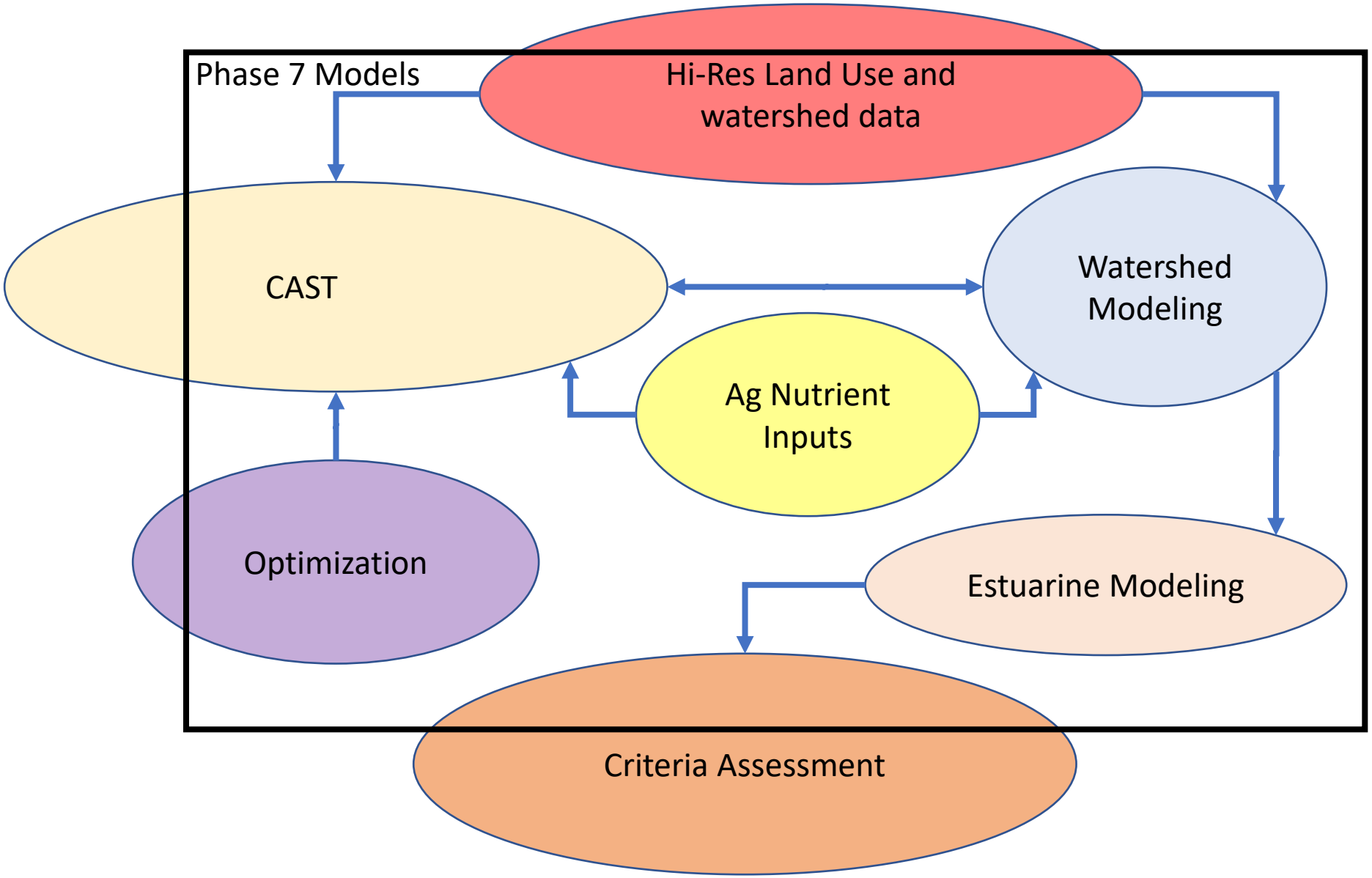
CBPO Staff

Gopal Bhatt, Isabella Bertani, Lewis Linker and others

MWG

6/20/2023

Phase 7 Development Tracks



Web page

- Overview
- Seven Projects
  - Descriptions
  - Documents
- Linked from
  - Modeling Workgroup
  - WQGIT
  - Many WQGIT WGs

Phase 7 Model Development | Ch

chesapeakebay.net/what/programs/modeling/phase_7_model_development

CBPO Scheduler | Sign in to Concur... | Citi Commercial Car... | Chesapeake Bay Ge... | https://gis.chesape... | Priority Agricultural... | Priority Agricultural... | Mid-Atlantic IDF Cu...

Chesapeake Bay Program
Science. Restoration. Partnership.

Search

Discover the Chesapeake | Learn the Issues | State of the Chesapeake | Take Action | In the News | Who We Are | What We Do

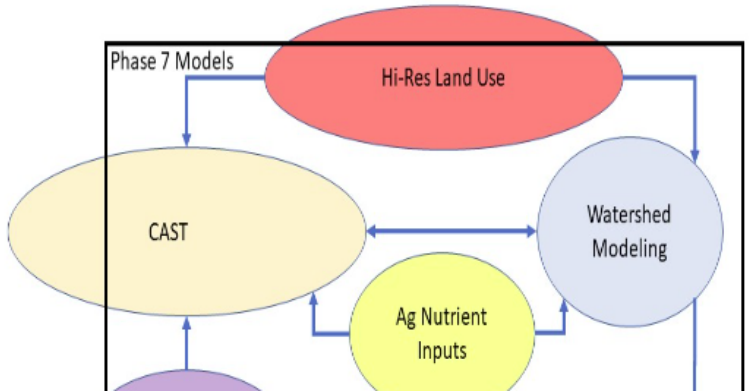
WHAT WE DO > PROGRAMS & PROJECTS > PHASE 7 MODEL DEVELOPMENT

Phase 7 Model Development

The Chesapeake Bay Program is updating its modeling and analysis tools used in the Chesapeake Bay TMDL.

Currently in development, the Phase 7 Modeling Tools will be used by the partnership to inform decisions related to nutrient and sediment reduction goals outlined in the Chesapeake Bay Watershed Agreement. Integral to this updated suite of tools is the ability to project climate change effect through 2035. The model, which will be ready for use by 2027, consists of six interrelated projects:

1. High Resolution Land Use
2. Chesapeake Assessment Scenario Tool (CAST)
3. Optimization
4. Agricultural Inputs
5. Watershed Modeling
6. Estuarine Modeling
7. Criteria Assessment



Modeling

Phase 7 Model Development

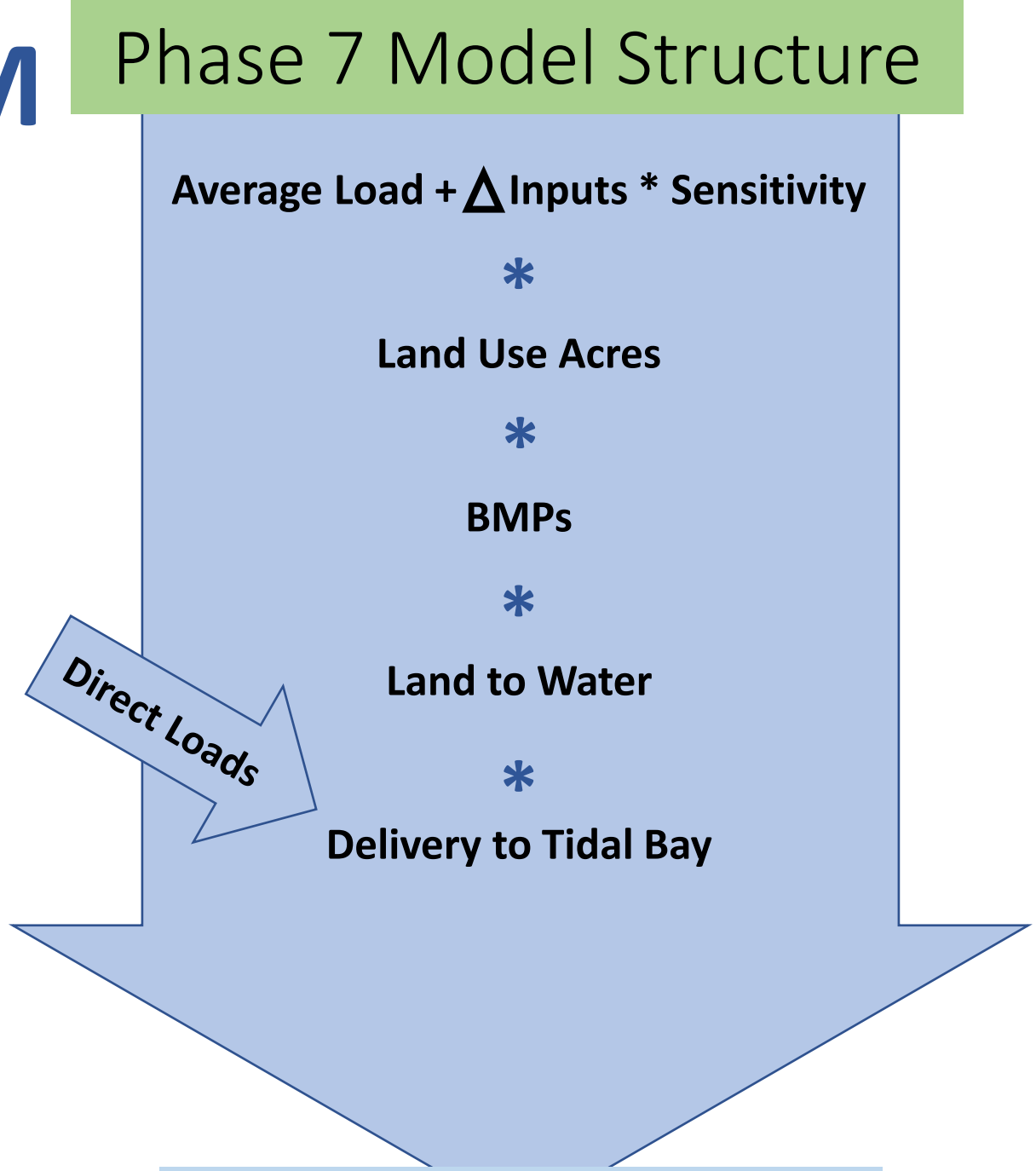
Programs & Projects

Modeling
Monitoring
Quality Assurance
Resource Lands Assessment
Chesapeake Bay TMDL
Watershed Implementation Plans
BMP Verification

Cast/CalCast/DM

Phase 7
CAST

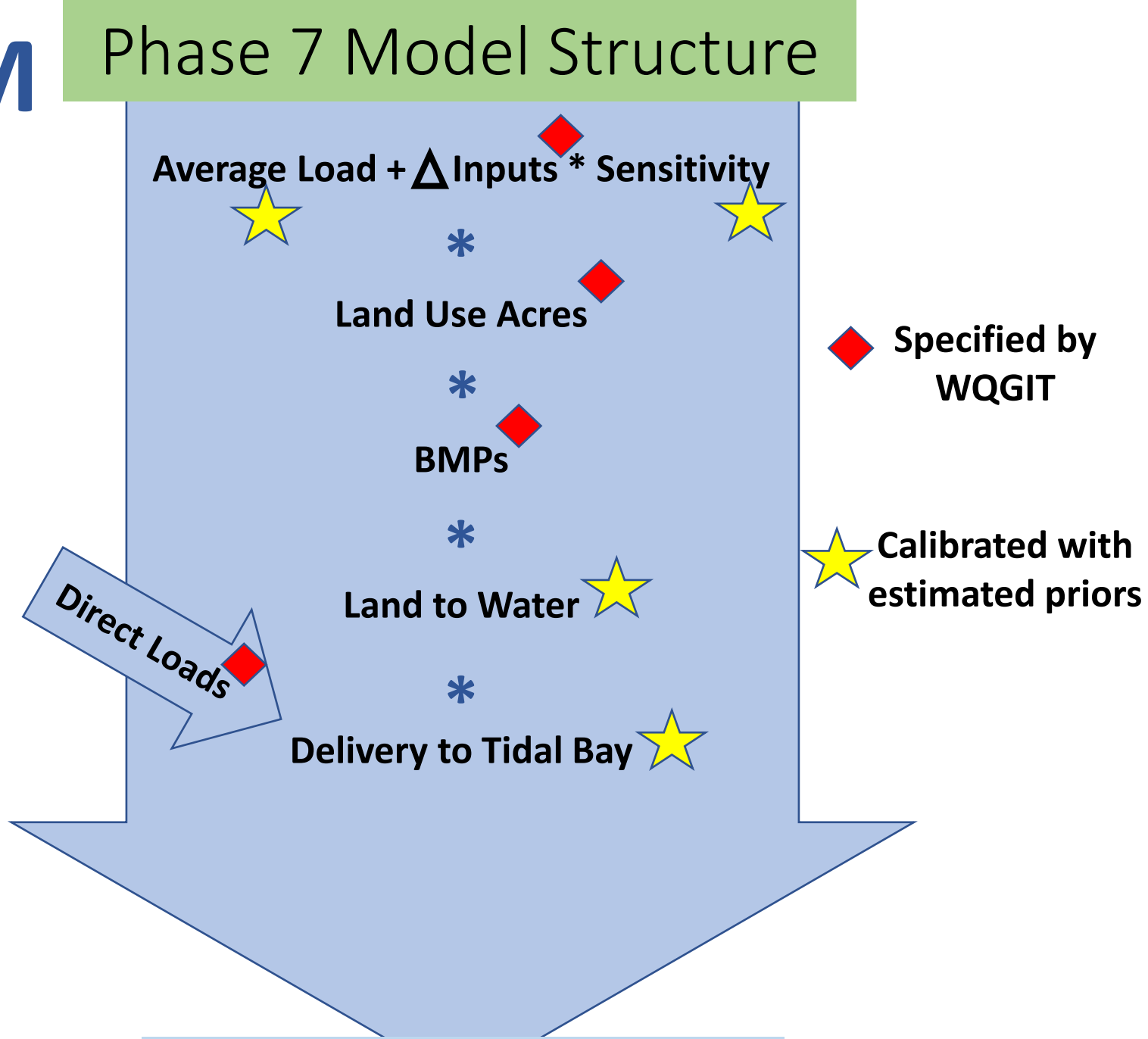
Deterministic
Scenario Tool:
1 set of loads for 1
set of inputs



Cast/CalCast/DM

Phase 7
CalCAST

Tool for finding parameters that best match observations

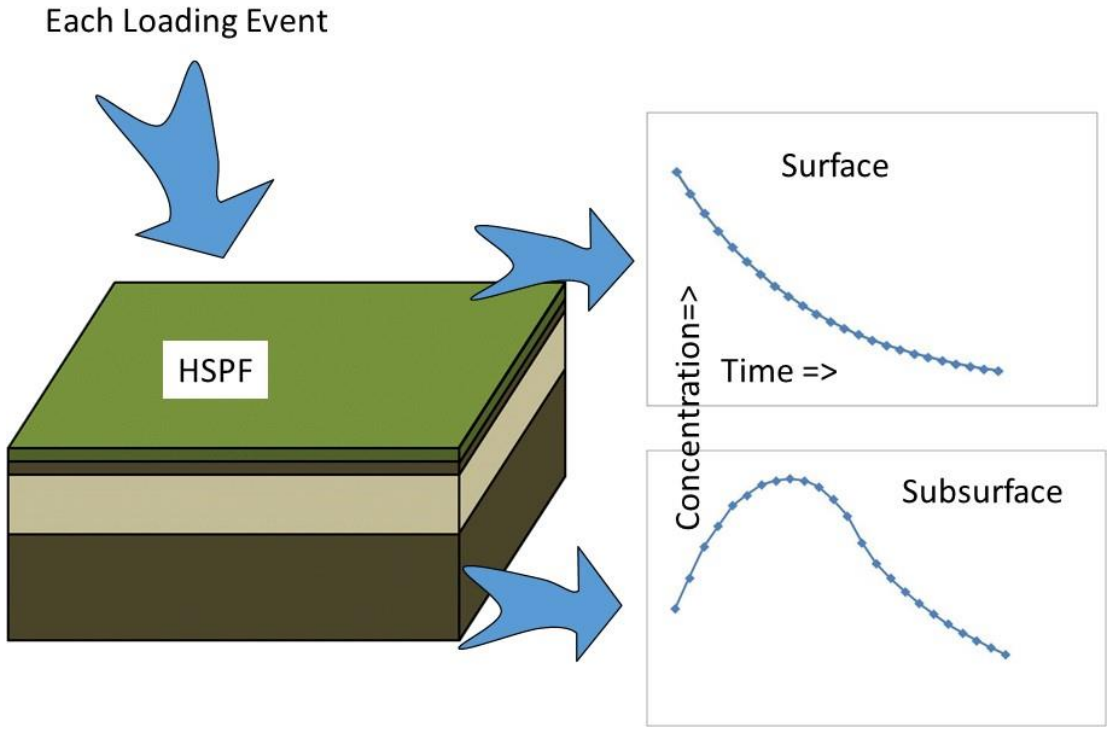


Cast/CalCast/DM

Phase 7
Dynamic Model

Tool for

- loading estuarine models
- Comparing against observations
- Other potential collaborative projects



Watershed Model Plan – Big Picture

2022	2022	2022	2022	2023	2023	2023	2023	2024	2024	2024	2024	2025	2025	2025	2025	2026	2026	2026	2026
1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Work plan			Build	Work plan	Build Models			Work plan	Build Models			Work plan	Build Models			Review Models			

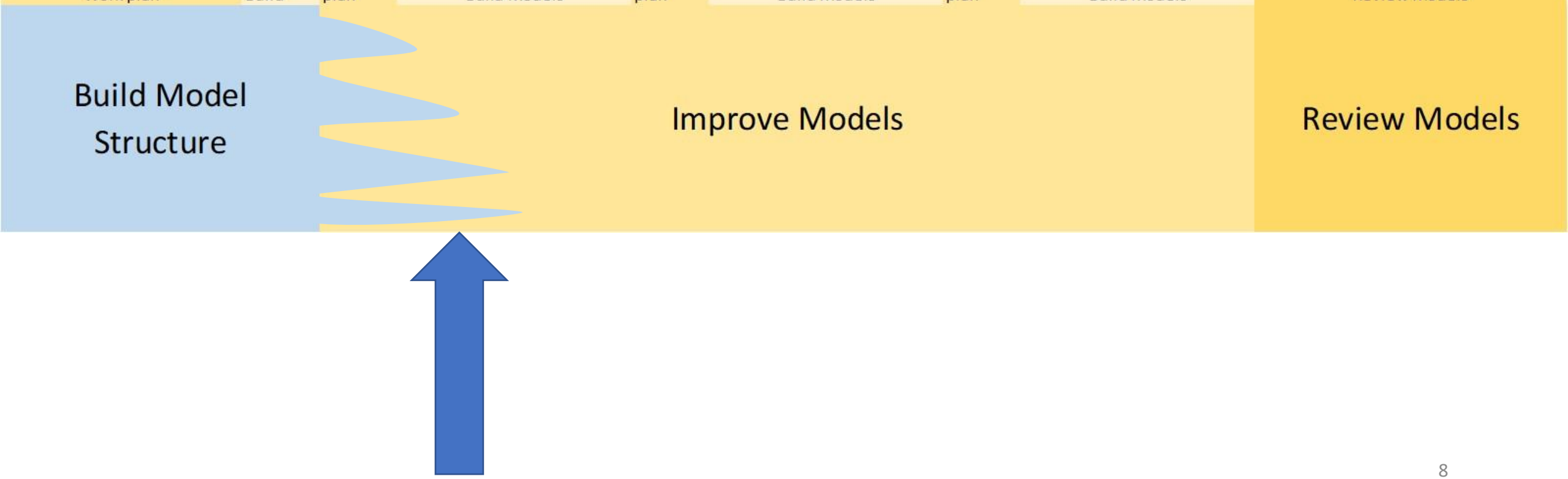
Build Model Structure

Improve Models

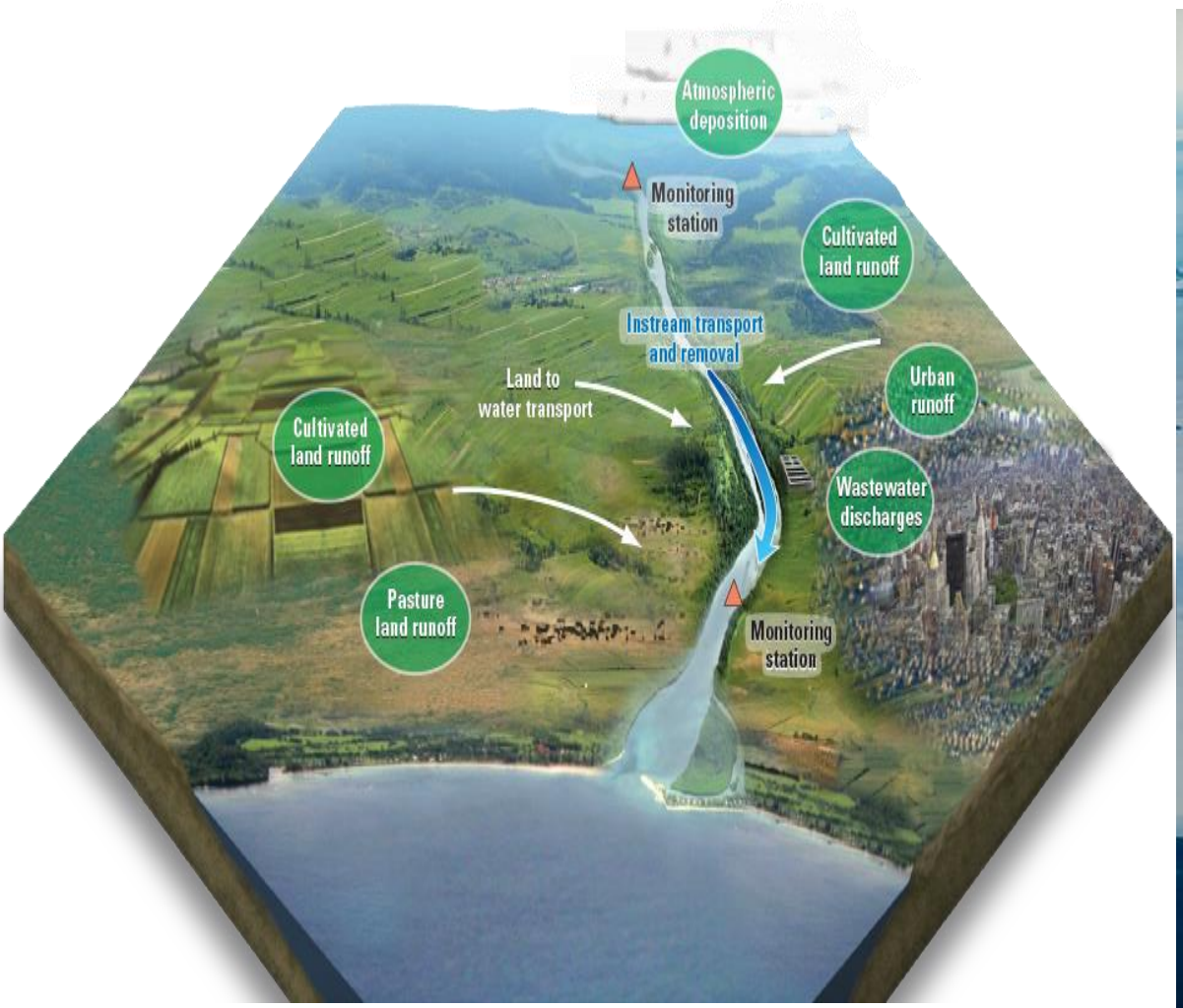
Review Models

Watershed Model Plan – Big Picture

2022	2022	2022	2022	2023	2023	2023	2023	2024	2024	2024	2024	2025	2025	2025	2025	2026	2026	2026	2026
1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Work plan			Build	Work plan	Build Models			Work plan	Build Models			Work plan	Build Models			Review Models			



Theory



Practice


Photo: Chesapeake Bay program

Goals for the end of 2025

- Model Structure
  - CalCAST and the Dynamic Model run at the NHD scale for flow, sediment, and nutrients
  - CAST running on scale of WQGIT's choosing
- Output quality – As good or better than previous phase
  - Spatial apportionment of loads by land use and region
  - Change in loads over time due to
    - Management actions
    - Climate change
  - Accuracy of spatial and temporal loads to the estuary in calibration period
- Documentation – all 20 sections complete

Goals for the end of 2025

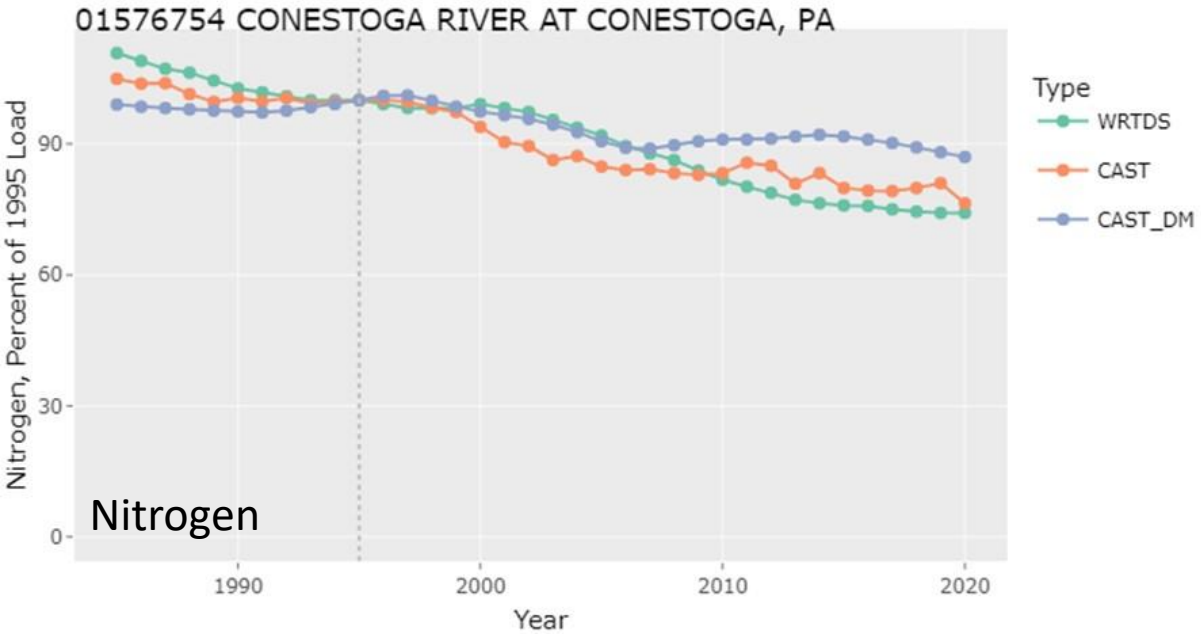
- Model Structure
  - CalCAST and the Dynamic Model run at the NHD scale for flow, sediment, and nutrients
  - CAST running on scale of WQGIT's choosing
- Output quality – **As good or better than previous phase – for what purpose?**
  - Spatial apportionment of loads by land use and region
  - Change in loads over time due to
    - Management actions
    - Climate change
  - Accuracy of spatial and temporal loads to the estuary in calibration period
- Documentation – all 20 sections complete

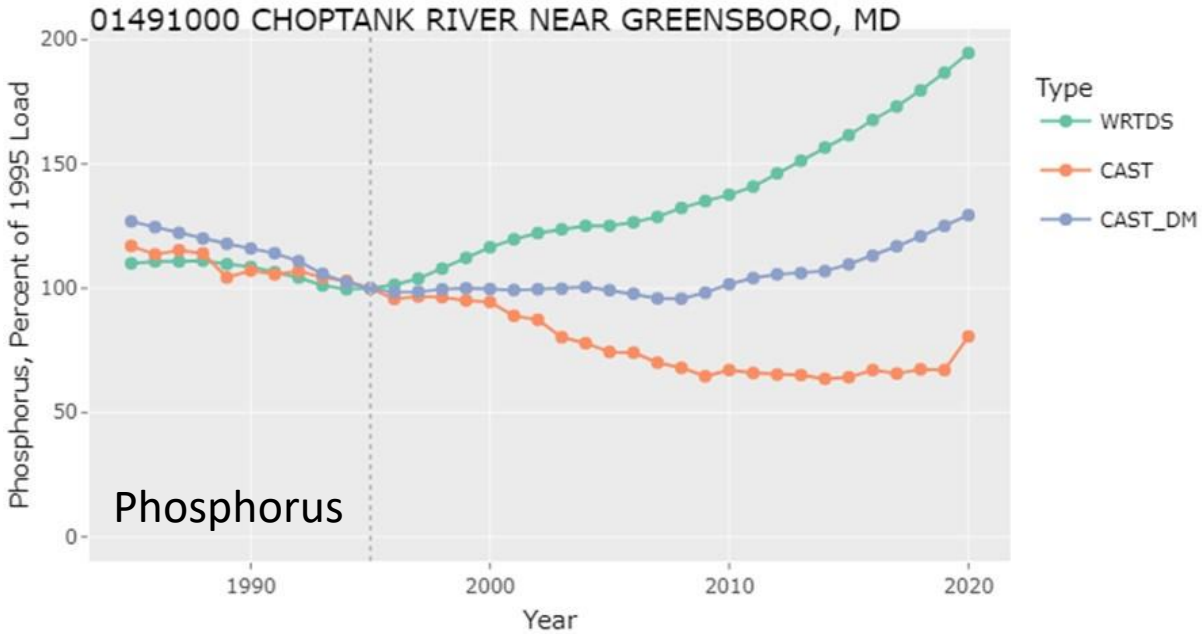
What people think makes a model good (my opinion about other's opinions)

- CBP modeling workgroup
  - Spatial accuracy of load/acre rates
  - Match concentration distribution at stations
  - Hydrology statistics
  - Involved in development
- Stakeholders
  - Does it have their inputs?
    - Land use
    - Fertilizer use
    - Management actions
  - Were they involved in the development?
  - Do the answers match their expectation?

Long-term Anthropogenic Change in Load.

Flow-Normalized trends since 1995

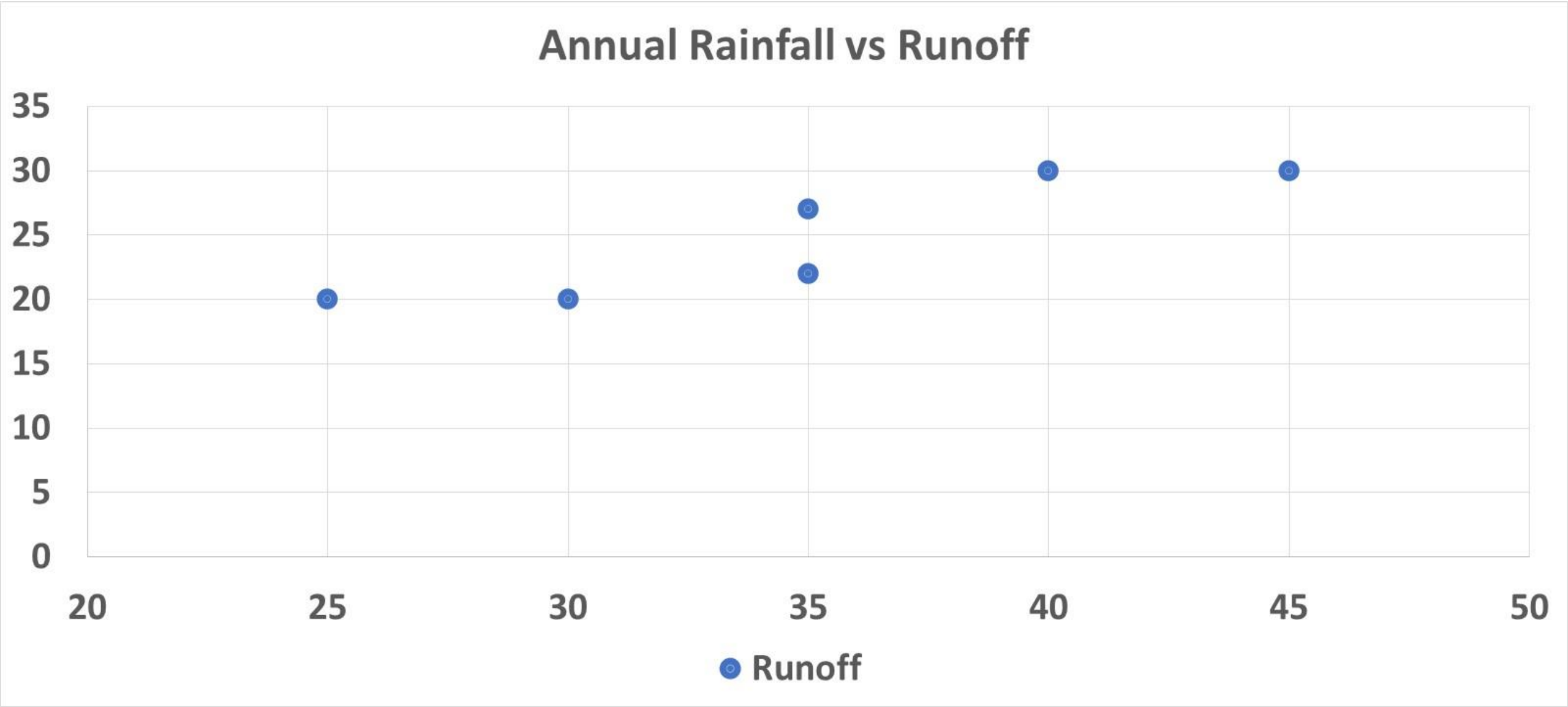




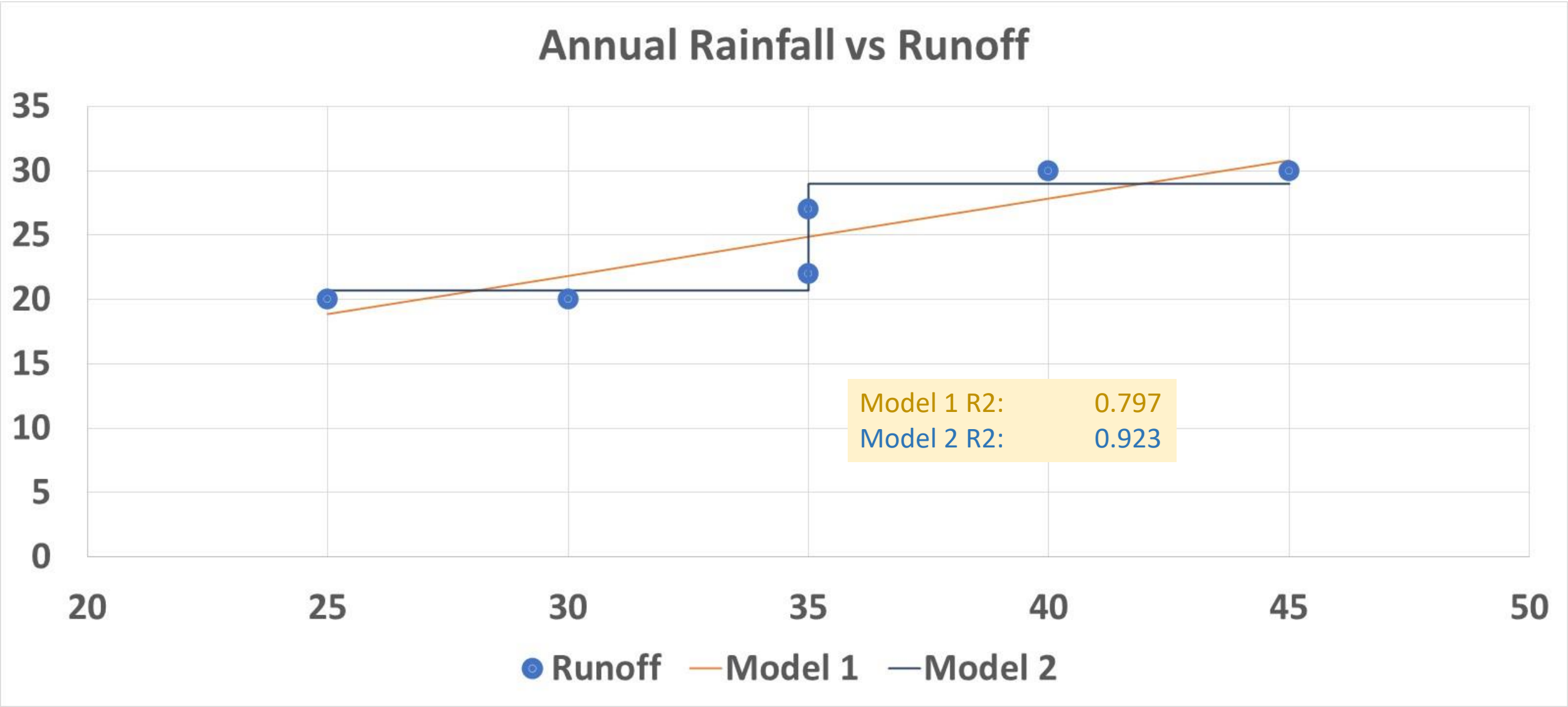
https://zhangqian0324.shinyapps.io/CBNTN_TMDL_Indicator/

What's important? Predicting the FN trends!

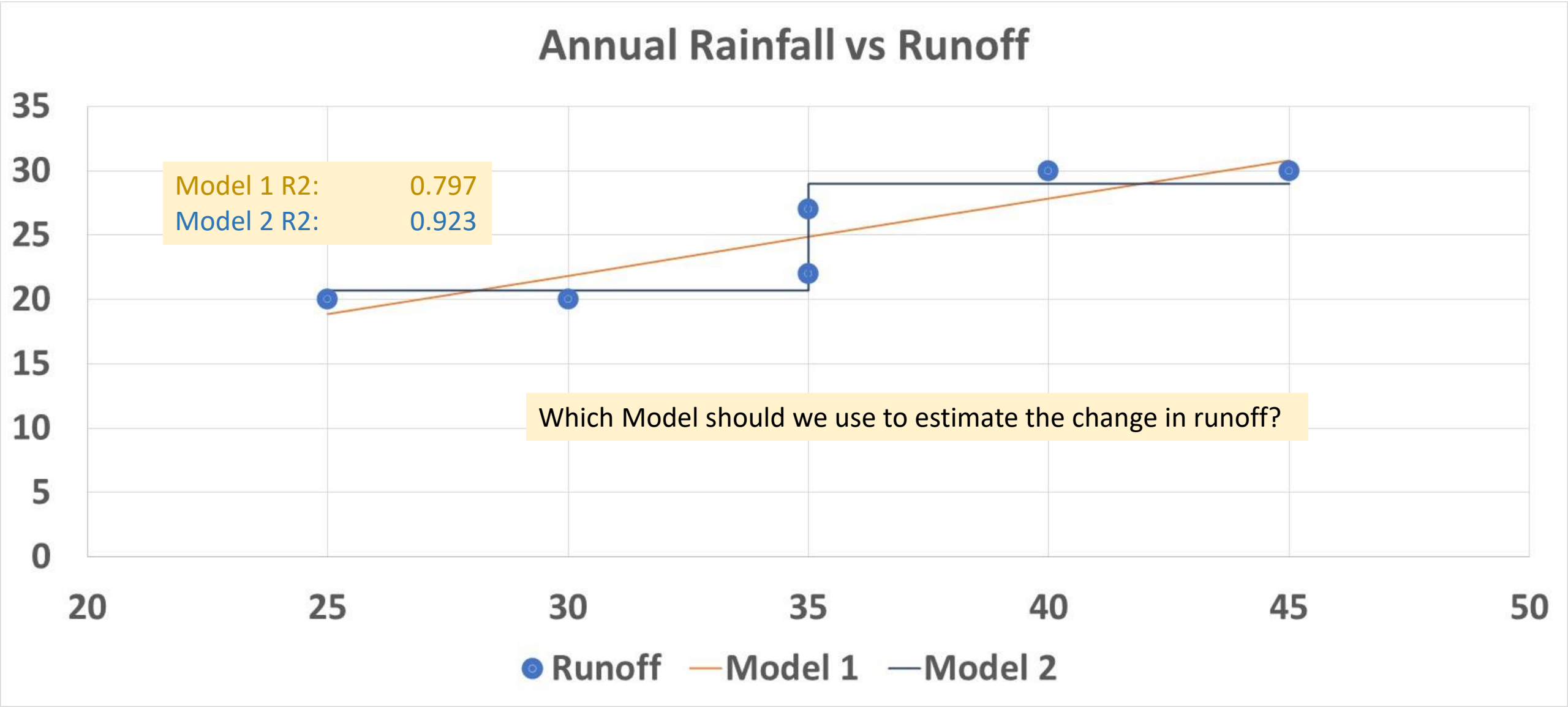
Right for the right reason – modeling 101



Right for the right reason – modeling 101



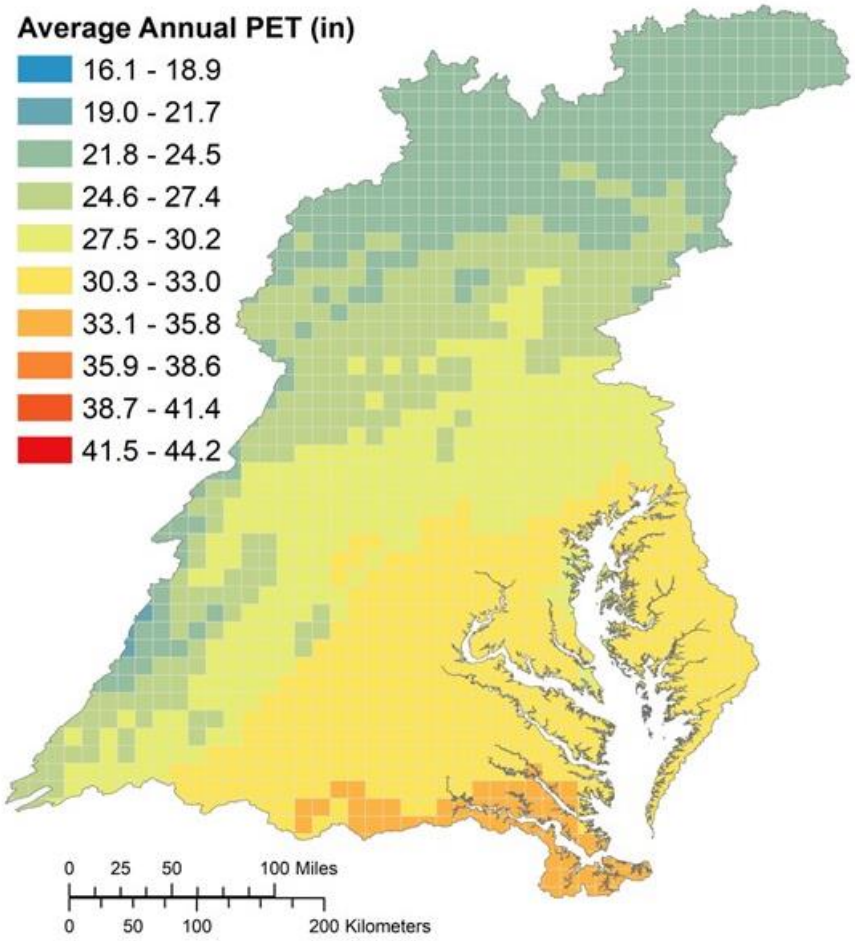
Right for the right reason – modeling 101



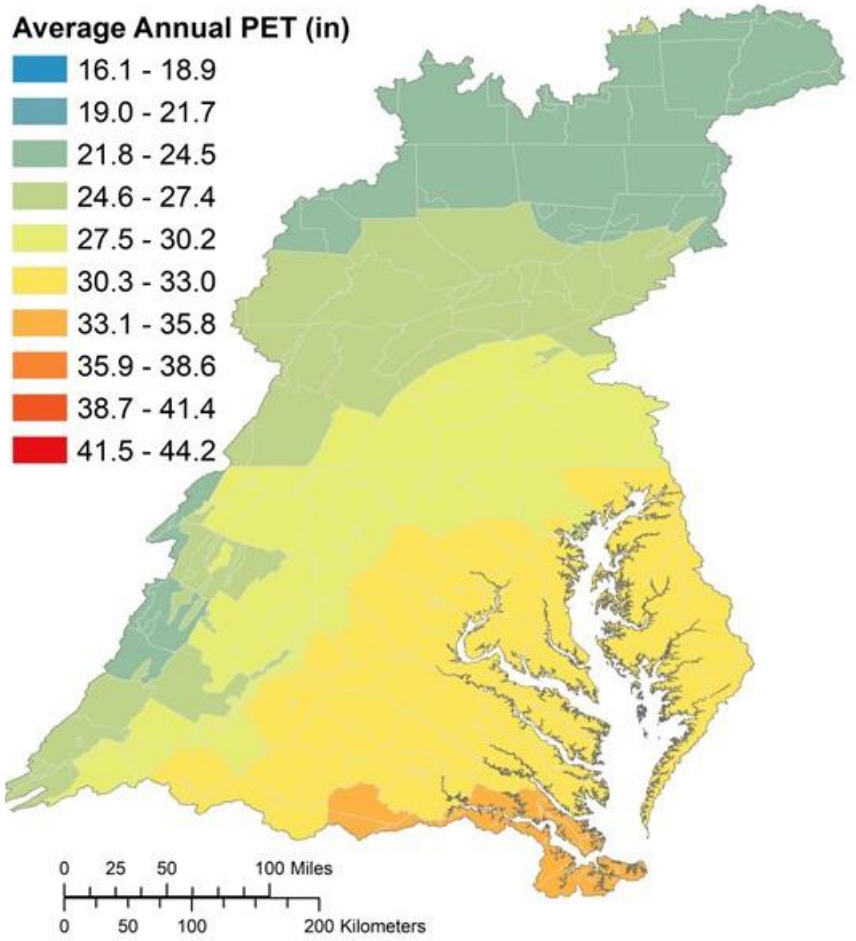
- Very easy to see the problems with the simple example
- How do we think about this as we are putting the models together?

Phase 6 PET

NLDAS – Native scale

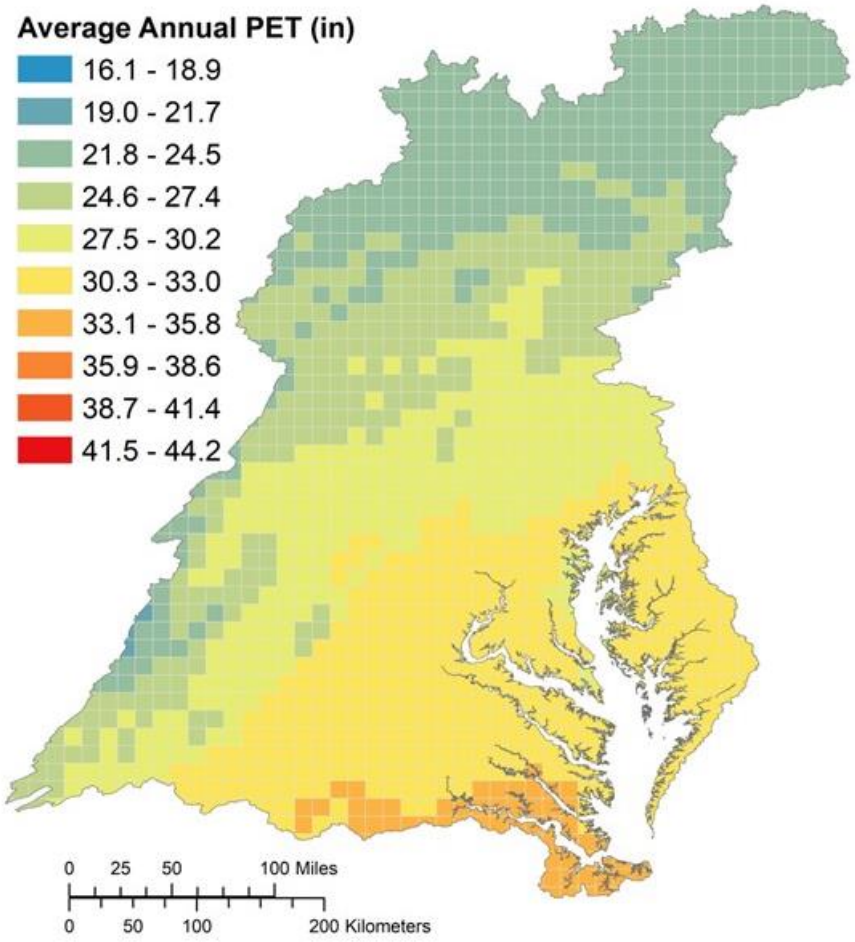


NLDAS – LRseg scale

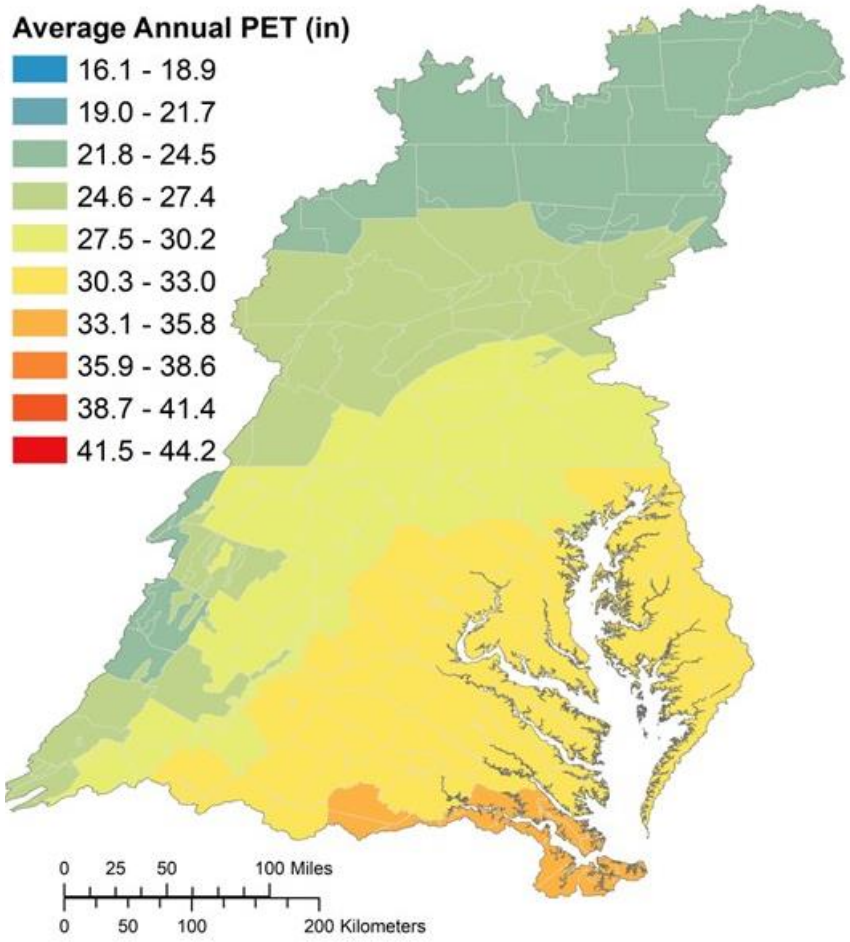


Phase 6 PET

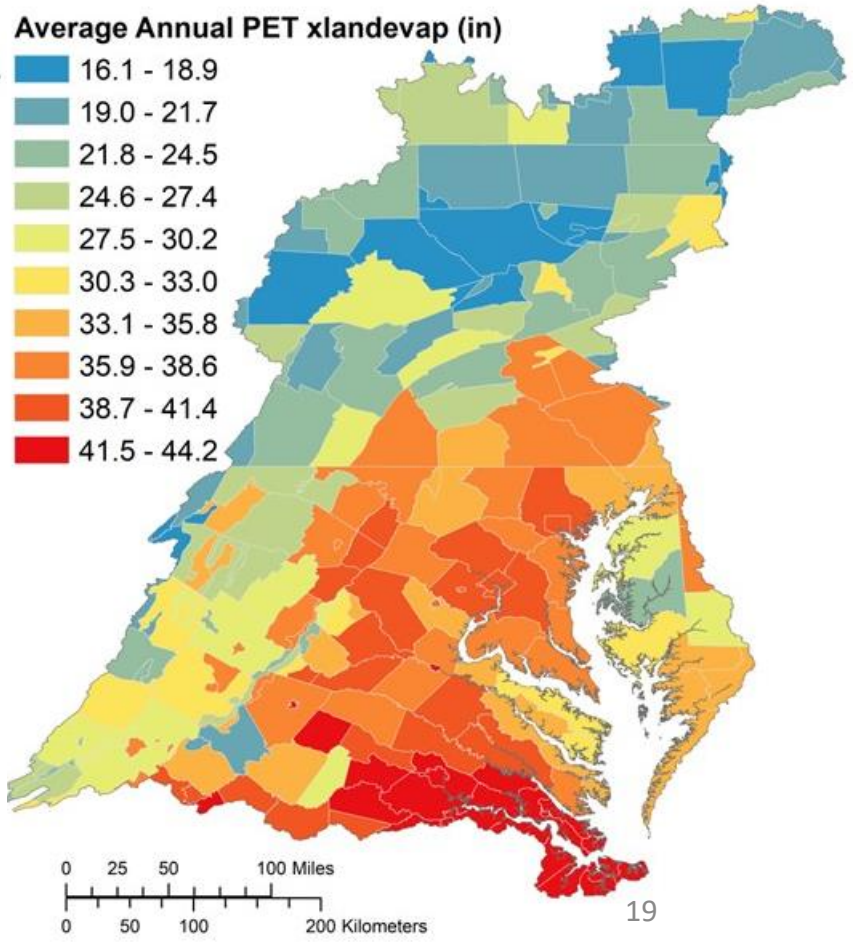
NLDAS – Native scale

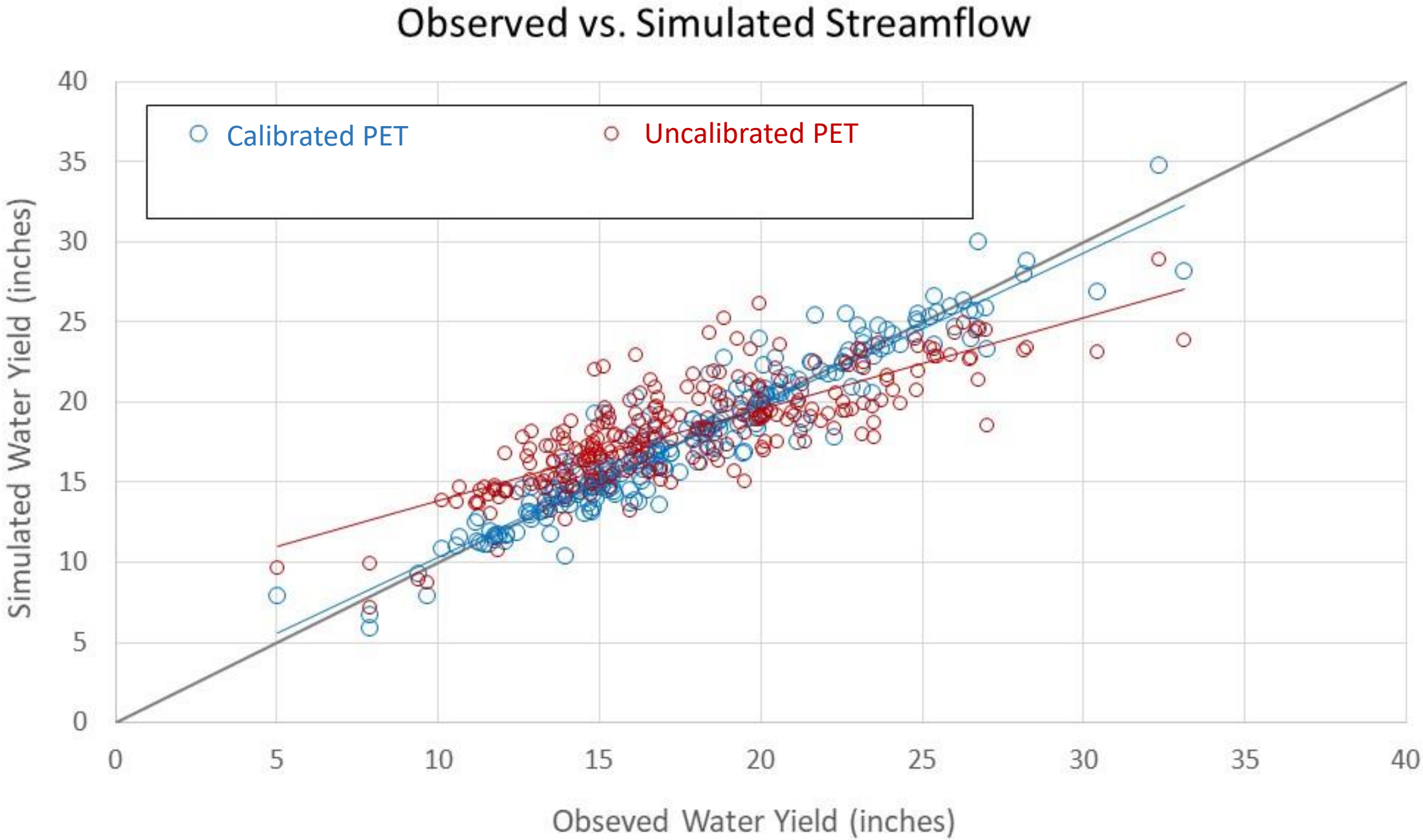


NLDAS – LRseg scale



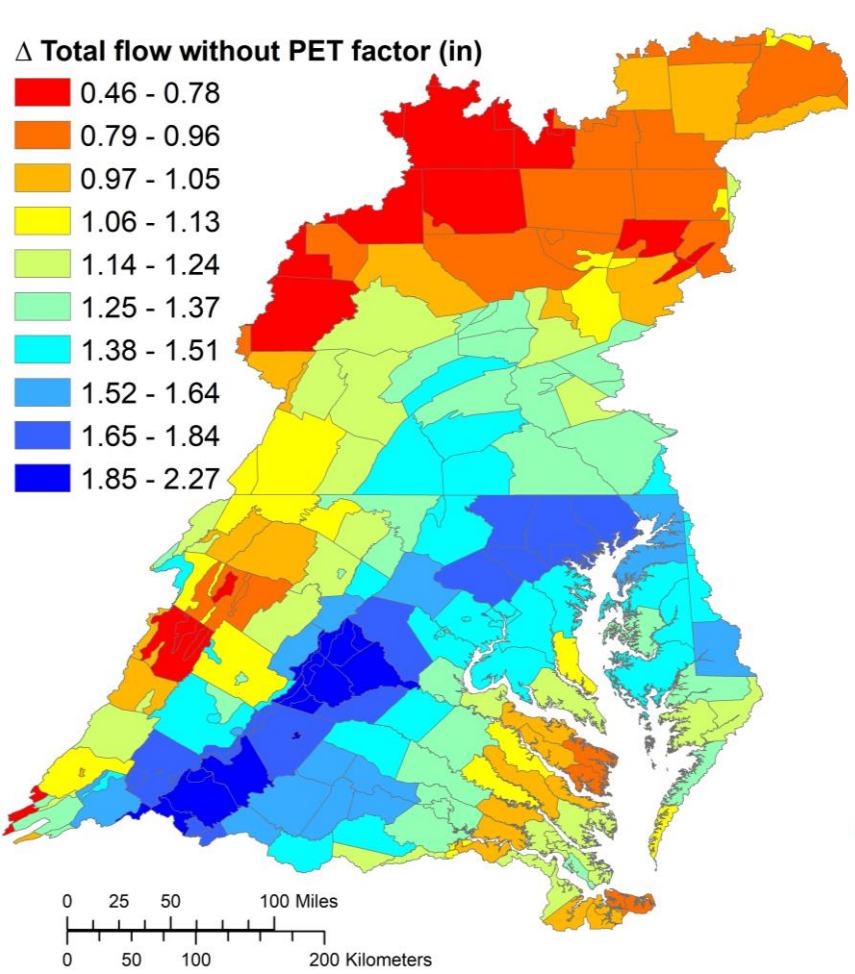
Calibrated PET



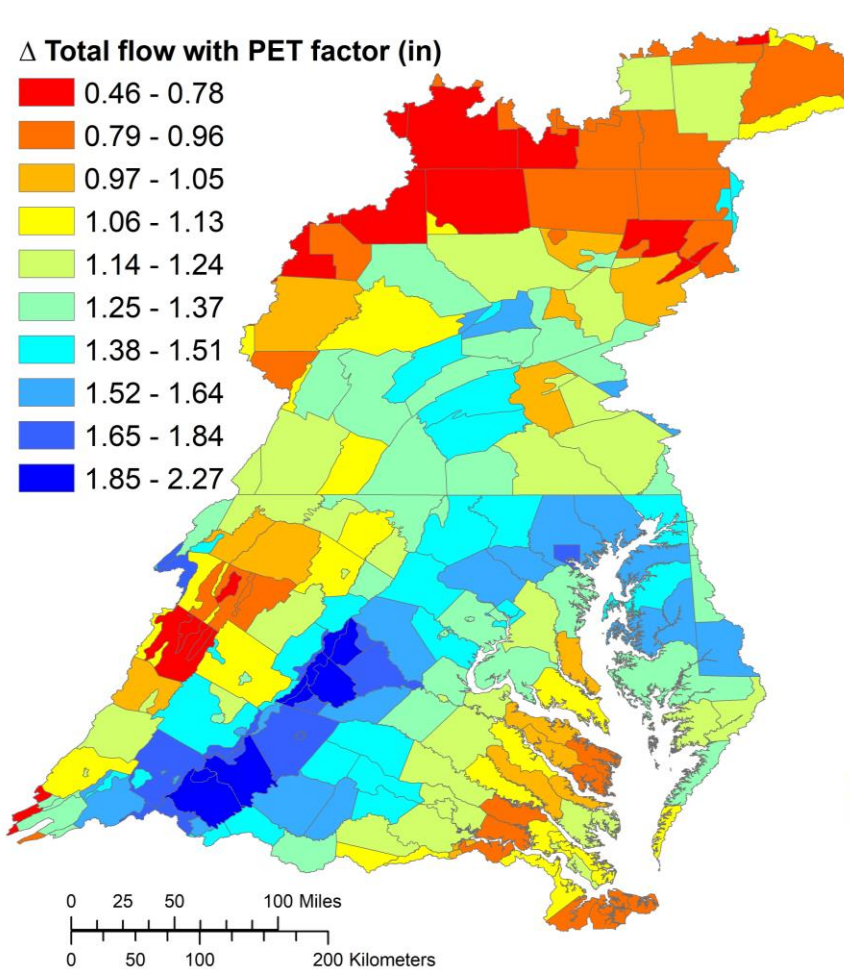

Observed vs. Simulated Streamflow
Calibrated PET
Uncalibrated PET
Simulated Water Yield (inches)
Obseved Water Yield (inches)
0
5
10
15
20
25
30
35
40

2055 Climate Adjustment

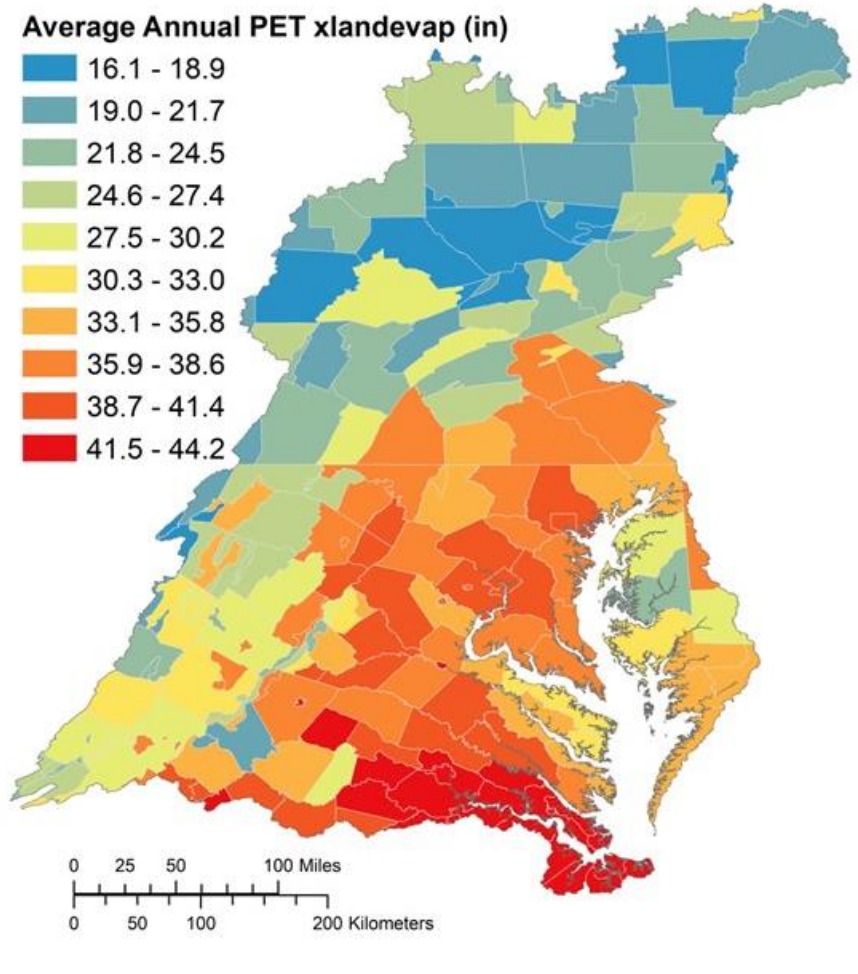
Without PET Factor



With PET Factor

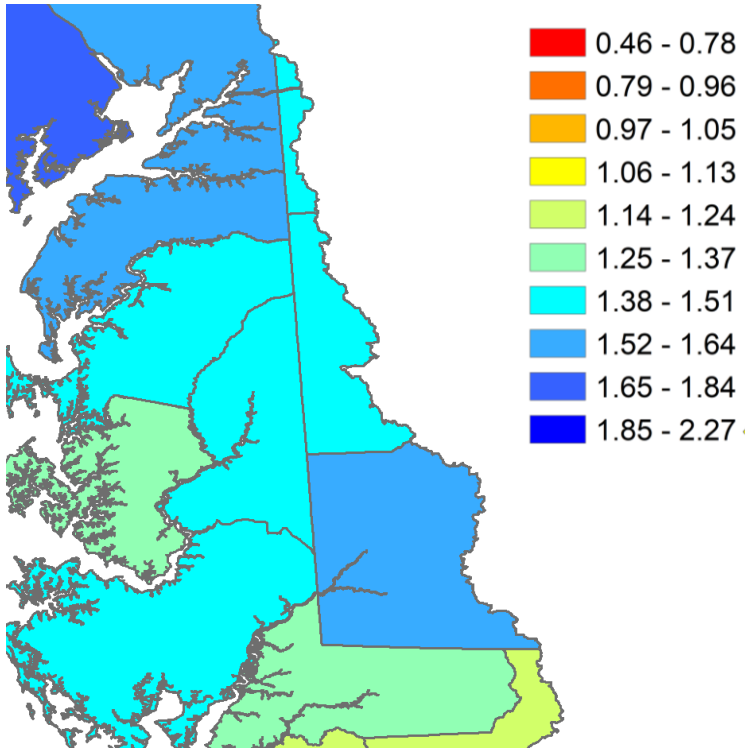


Calibrated PET

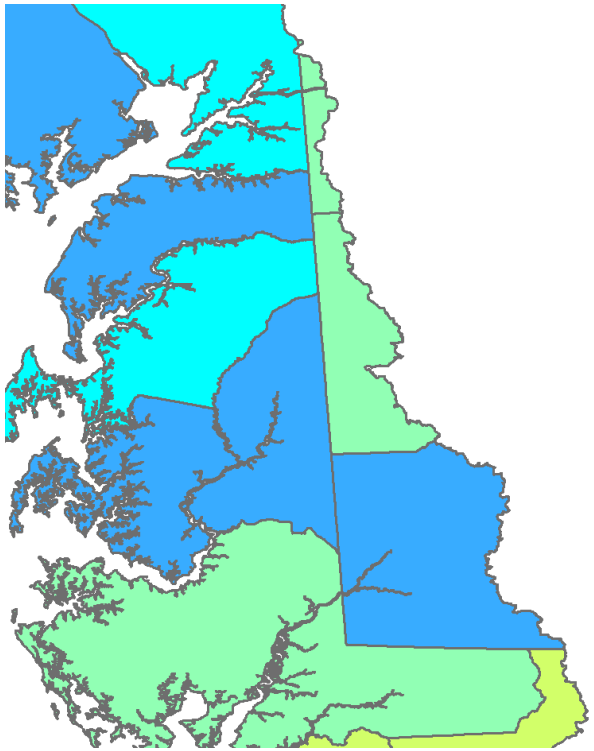


2055 Climate Adjustment

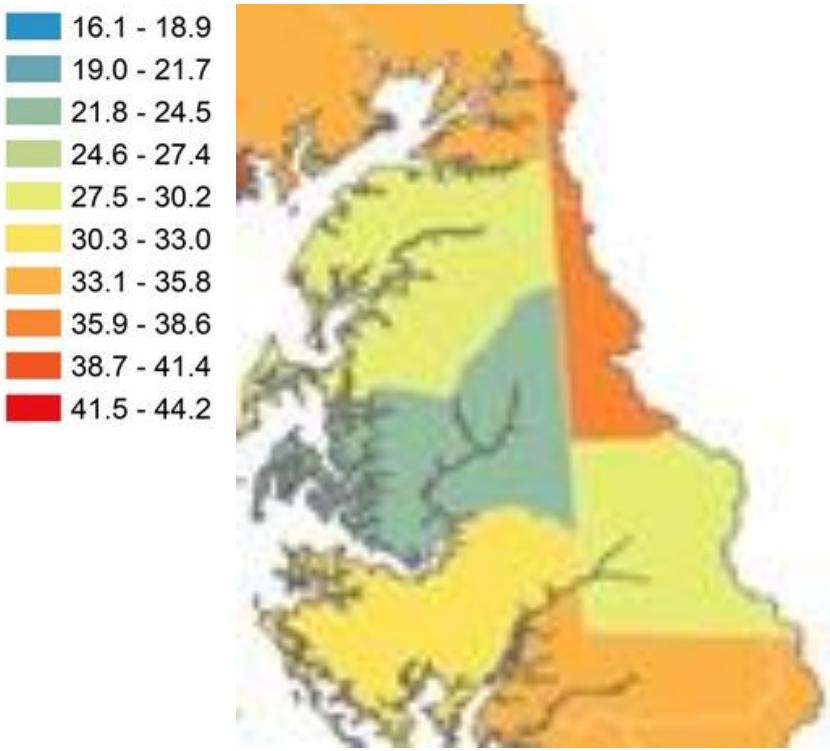
Without PET Factor



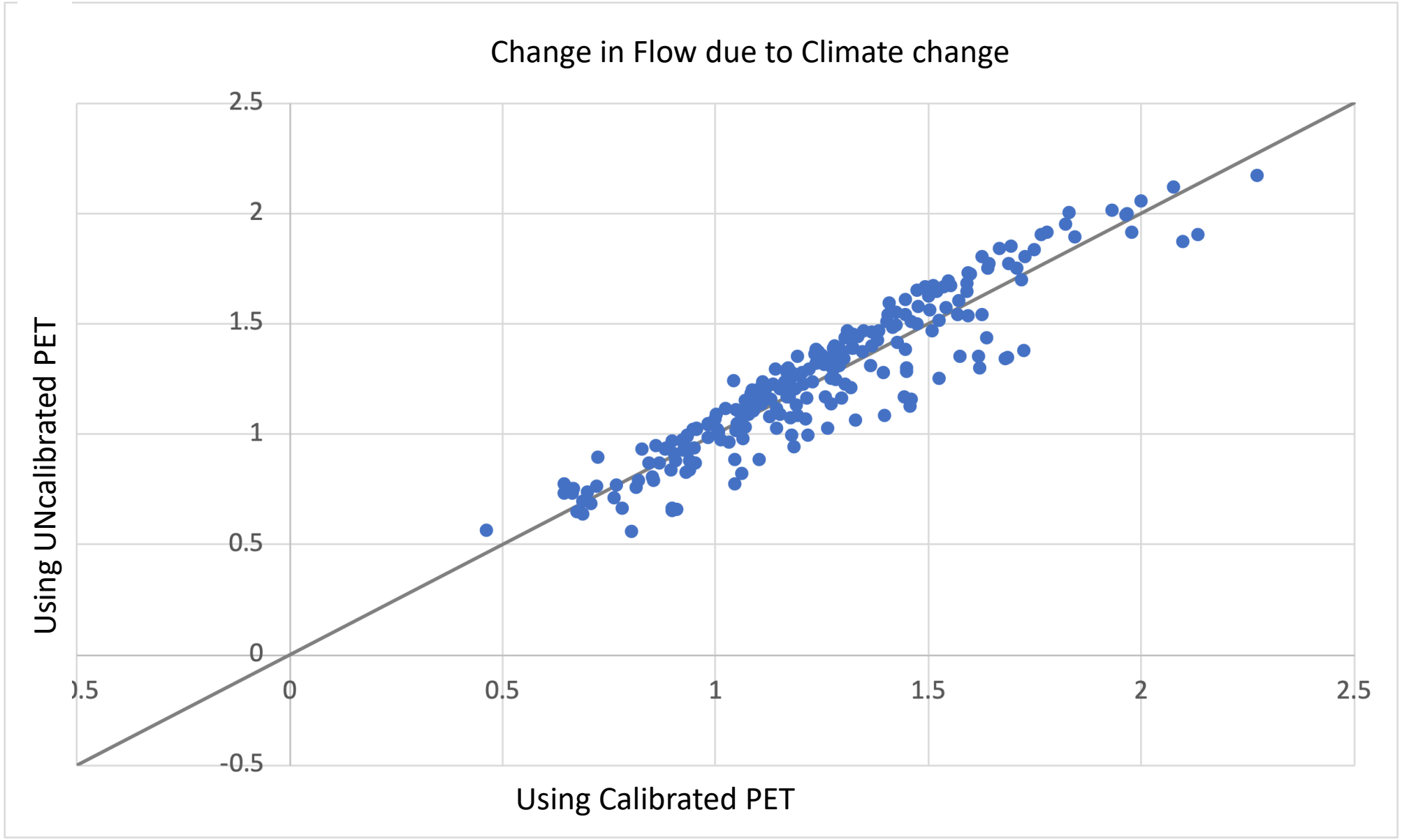
With PET Factor



Calibrated PET



Do we think that Caroline County MD should be about the same as Kent County DE or 1/3 higher?


Change in Flow due to Climate change
Using UNcalibrated PET
Using Calibrated PET
2.5
2
1.5
1
0.5
0
-0.5
0
0.5
1
1.5
2
2.5

Which is the better model? (my opinion)

- Spatial apportionment of loads by land use and region With Adj
- Change in loads over time due to
  - Climate change No Adj
  - Management actions With Adj
- Accuracy of spatial and temporal loads to the estuary in calibration period With Adj

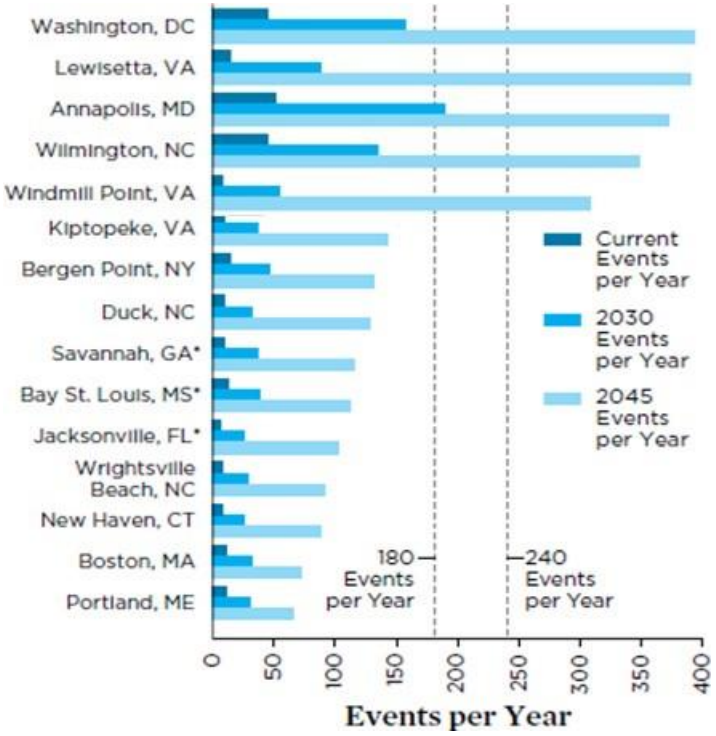
- Maybe a yet-to-be discovered model that lessens the need to calibrate PET will be better at all of them...

Right for the right reasons

- The idea behind the CalCAST-Dynamic model construction is to work through these kind of questions
- Investigate new predictive variables that lessen the need for site-specific calibration
- Continue to run sensitivity tests as part of development
- Probably still some measure of calibration at the end

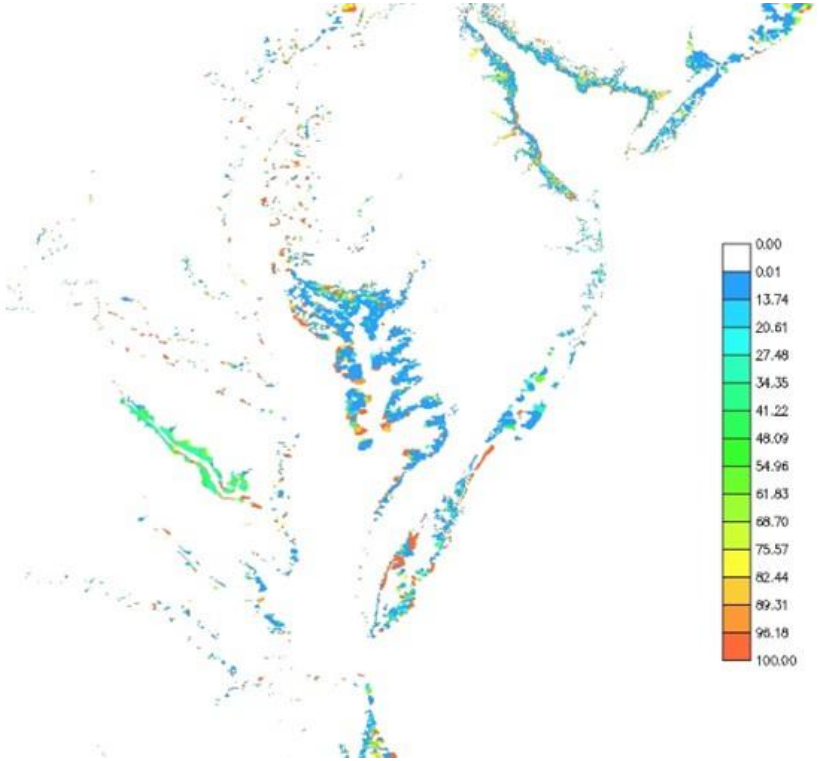
Tidal Flooding

- Margie Mulholland Measured the Muck
- Found that the nitrogen runoff from a single king tide was equal to the TMDL NPS load for the Lafayette River
- Noted that there would be an increasing trend over time
- Looking for good ideas on how to generalize.

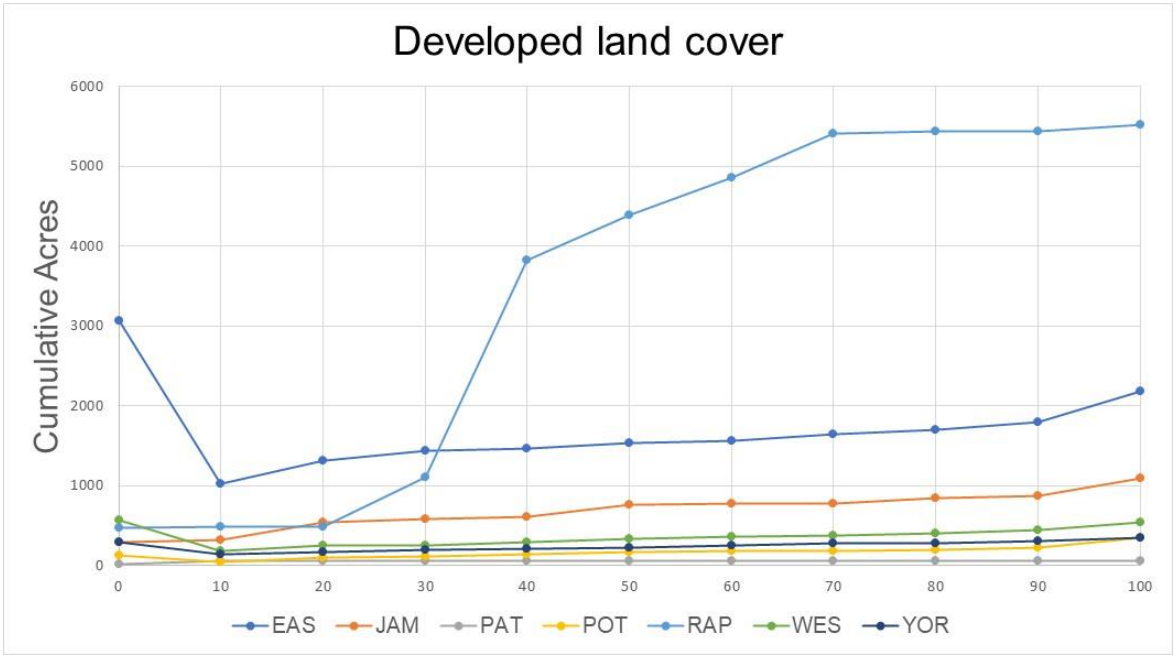


CBP-wide products – in development

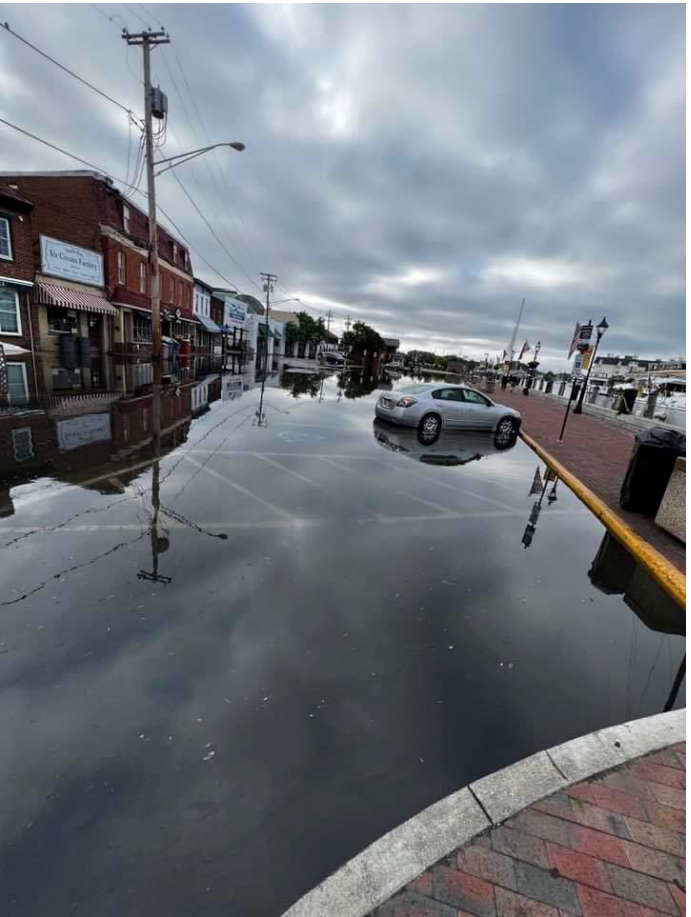
Joseph Zhang
Hyungju Yoo

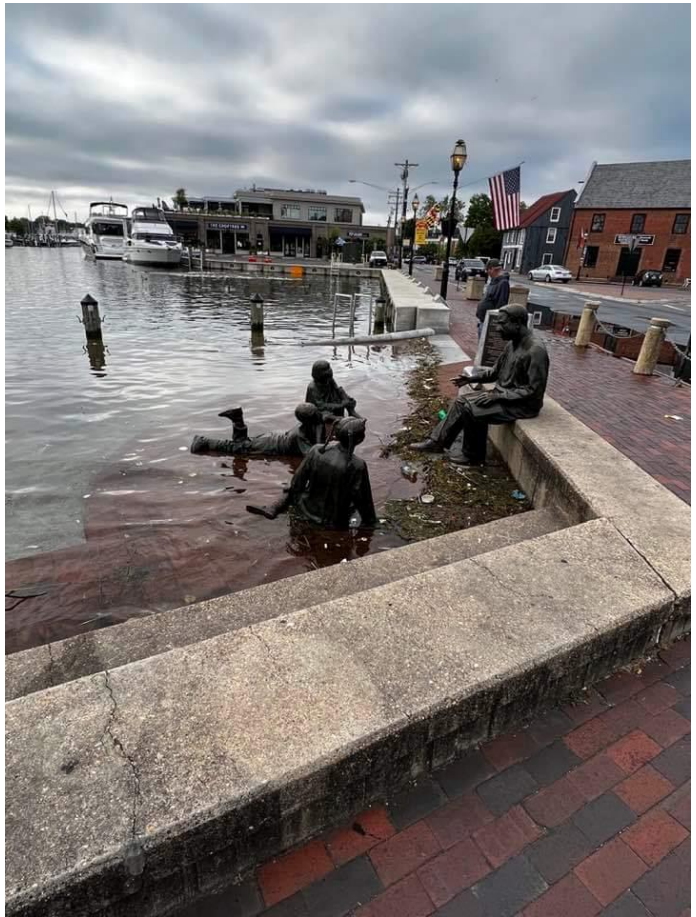


Gopal Bhatt



Facebook shots from Dave Wagner





Watershed Model Plan – Big Picture

2022	2022	2022	2022	2023	2023	2023	2023	2024	2024	2024	2024	2025	2025	2025	2025	2026	2026	2026	2026
1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Work plan			Build	Work plan	Build Models			Work plan	Build Models			Work plan	Build Models			Review Models			

Build Model Structure

Improve Models

Review Models

- Isabella
  - Gathering local data
  - Improving CalCAST
  - Hypoxia modeling
- Gopal
  - Working on watershed-estuarine transition zone (T-zone)
  - Additional scale-related processes

2055 Climate Adjustment

Calibrated PET