Crop Yield Calculations for Estimating Nutrient Application and Long-term Loads

UPDATE: 2/9/24

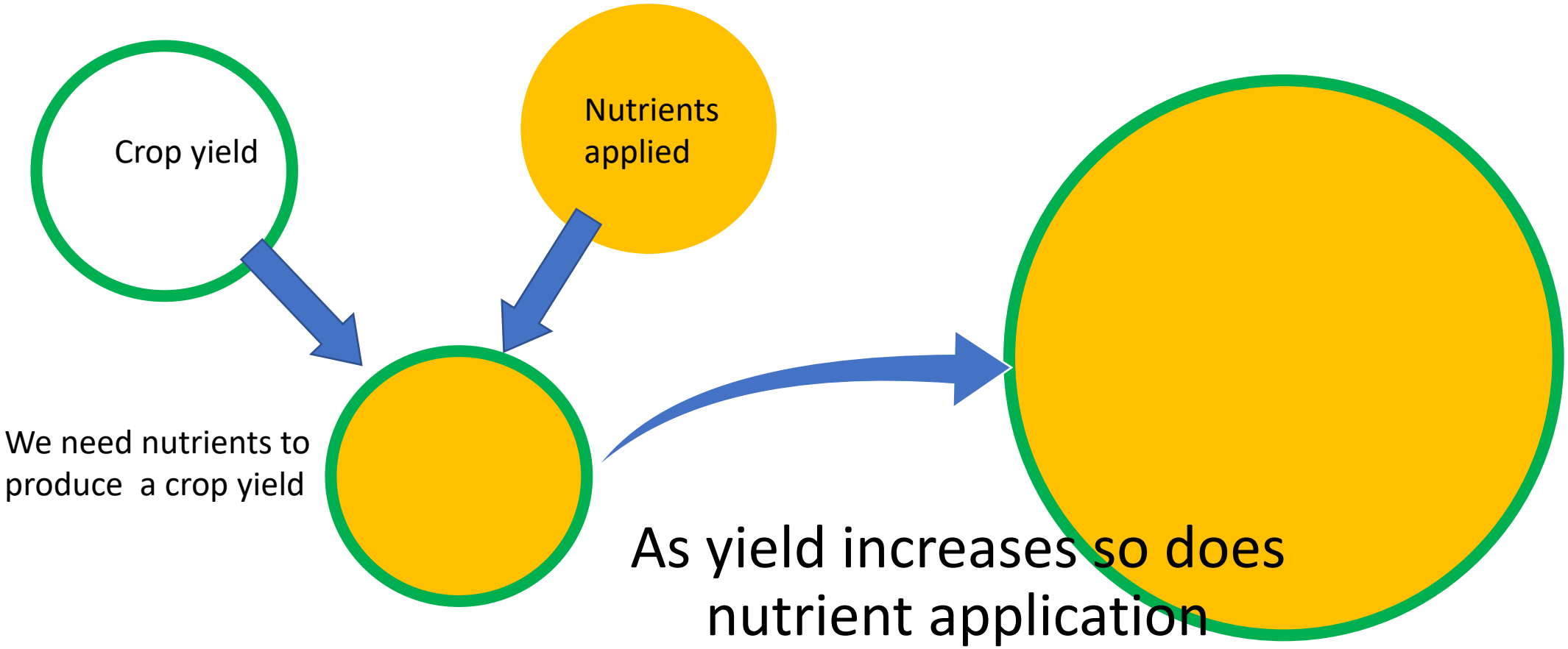
Joseph Delesantro

ORISE Fellow, CBPO Modeling Team

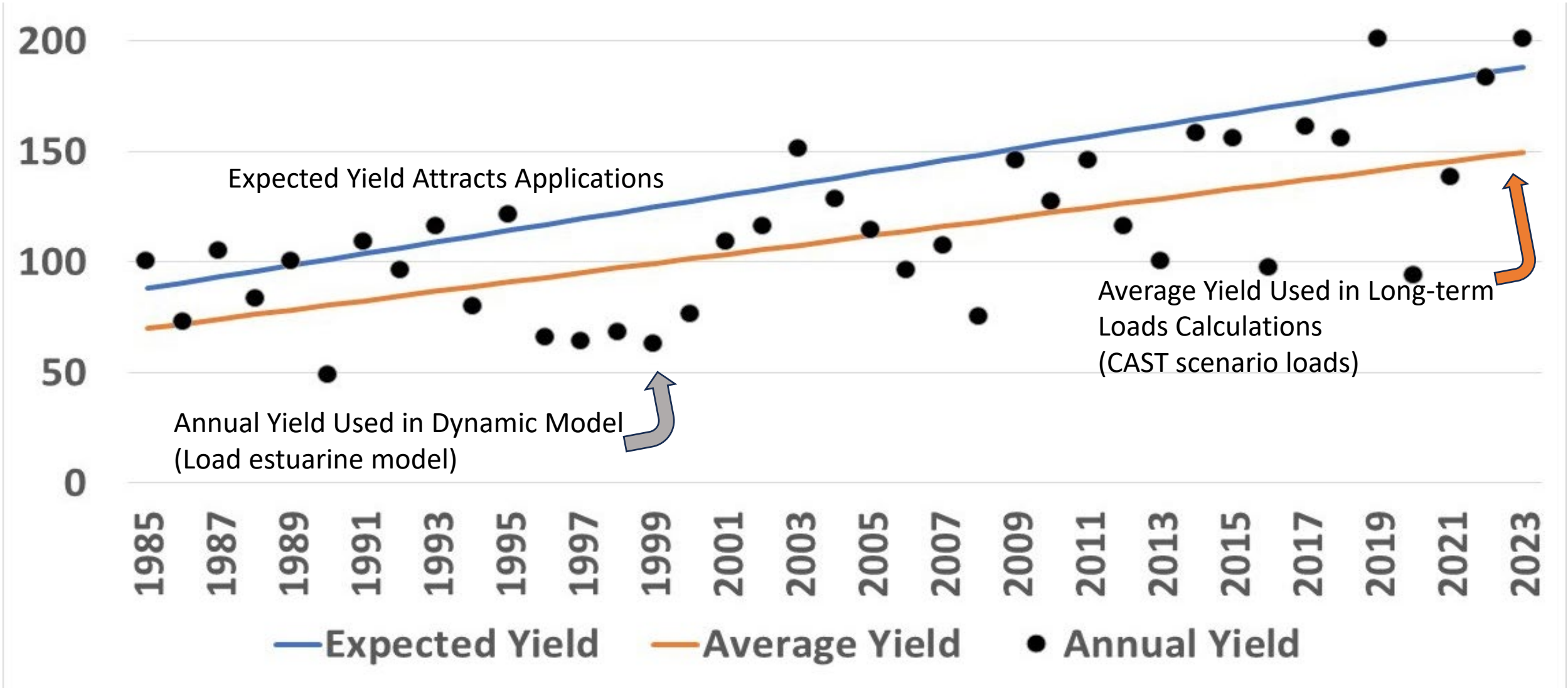
Photo: WILL PARSON/CHESAPEAKE BAY PROGRAM

Why crop yields matter

- Yields and nutrient applications are tied together



*EXAMPLE
DATA ONLY

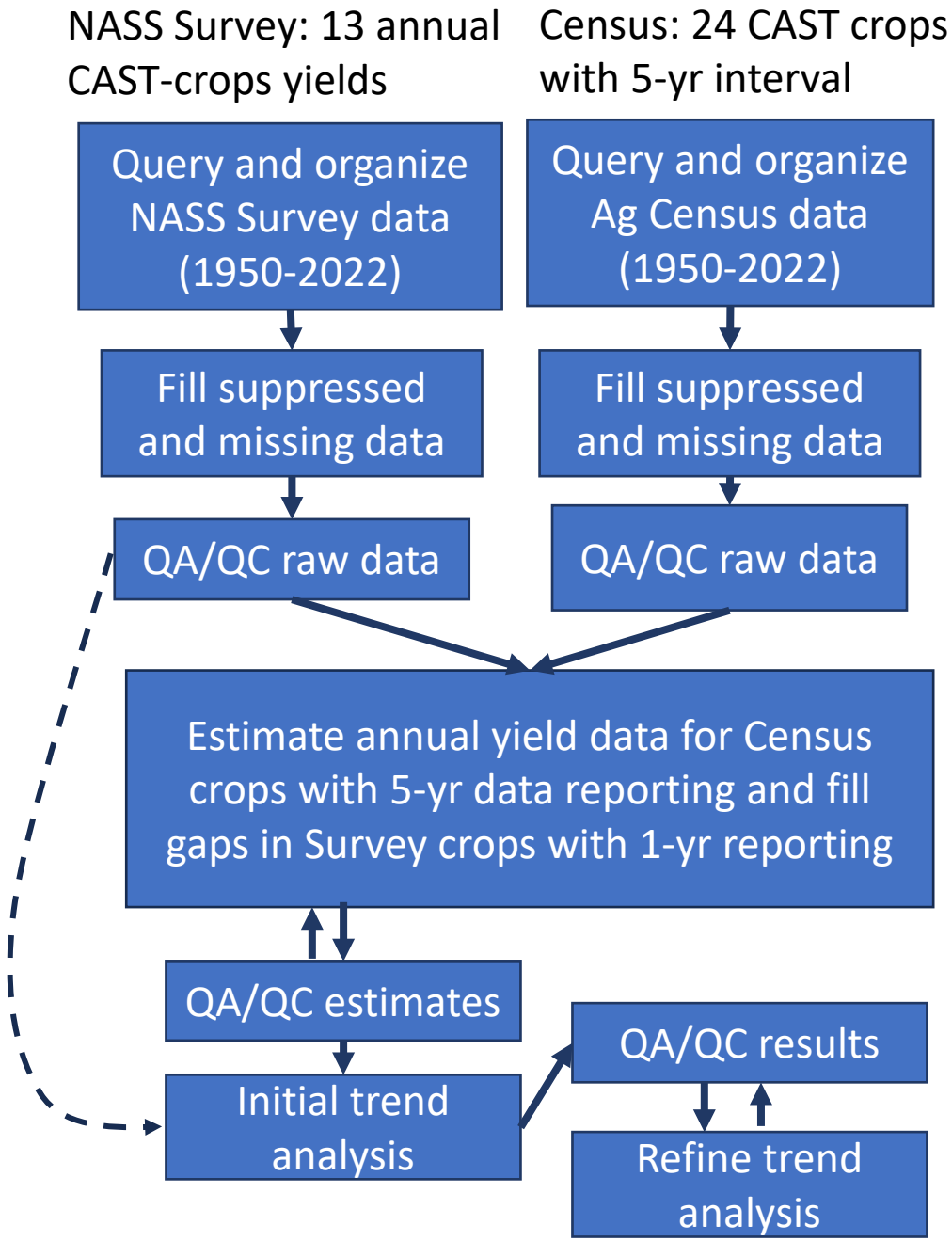


Planned path for investigation

Goals:

- Estimate farmer yield expectations at the county level which drive the application of nutrients.
- Estimate various yield trends to support several potential scenarios.

Approach: Use trend analysis of long-term annual crop yields.



Updates

- Incremental improvements to annual yield estimates:
  - Added growing season weather metrics
  - Added climatic event metrics, extreme wet and dry
  - Added economic predictors
- Application of annual yield estimation to partial data crops
- Exploring options for using weather data to inform weather independent yields
- Generating a suite of metrics to describe the yield estimates and trend analyses

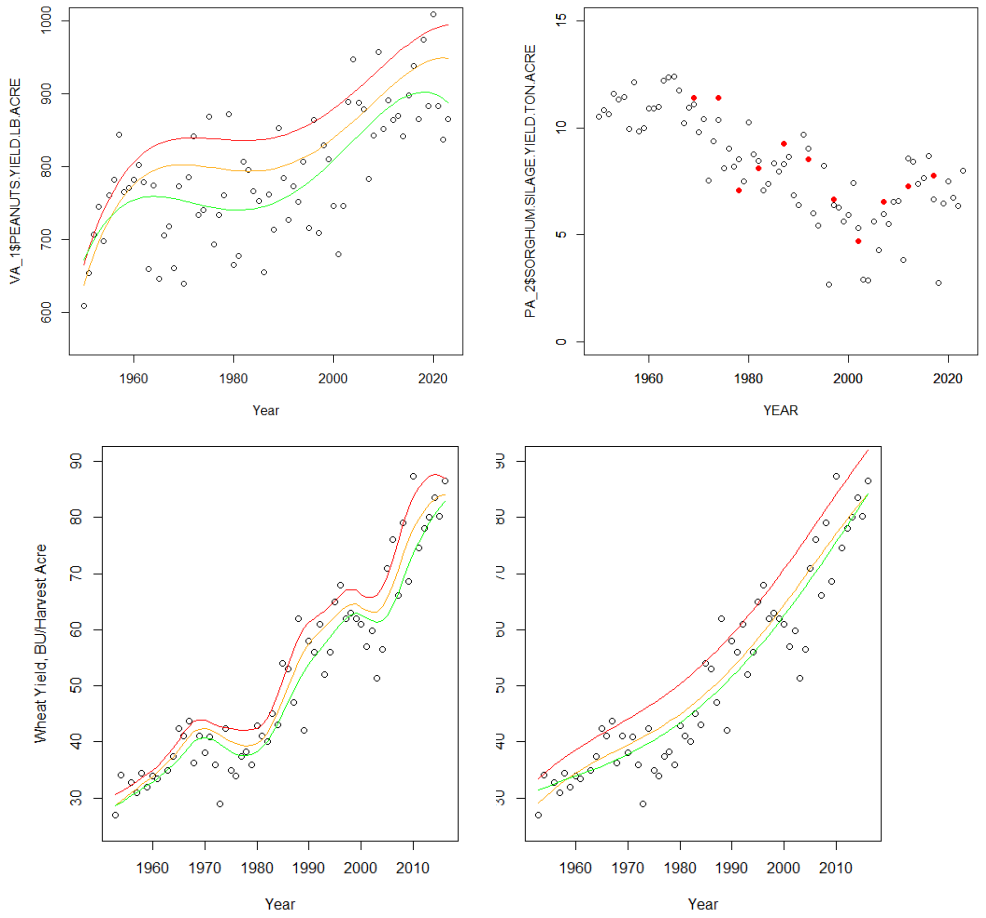
Exploring options for using weather data to inform weather independent yields

Yields for long-term loading calculations are meant to be weather independent. Can we use the weather data to generate these estimates.

- GAMs
  - To isolate the effect of time on yields, we need to account for the effect of other variables (i.e., weather).
- Normalization of yields by weather predictors
  - $Y \sim c_1 * t + \underline{c_2 * weather}$

Generating a suite of metrics to describe the yield estimates and trend analyses

- Generating thousands of these plots
- We need a way to iterate without visually inspecting all of the generated data
- A suite of metrics to quickly assess the changes to numerical methods and flag issue to bring to the working group
  - “Smoothness”
  - Change metrics
  - Fit



Generating a suite of metrics to describe the yield estimates and trend analyses

- Smoothness and change metrics
  - Lag-one autocorrelation
  - Coefficient of variation of the change between timesteps
  - “Anomaly detection”-variation greater than one standard deviation in a timestep
  - Deviation from smoothing line
  - Directional symmetry – is the value consistently increasing or decreasing and how does the trend compare to the data?
- Fit
  - Adjusted R^2