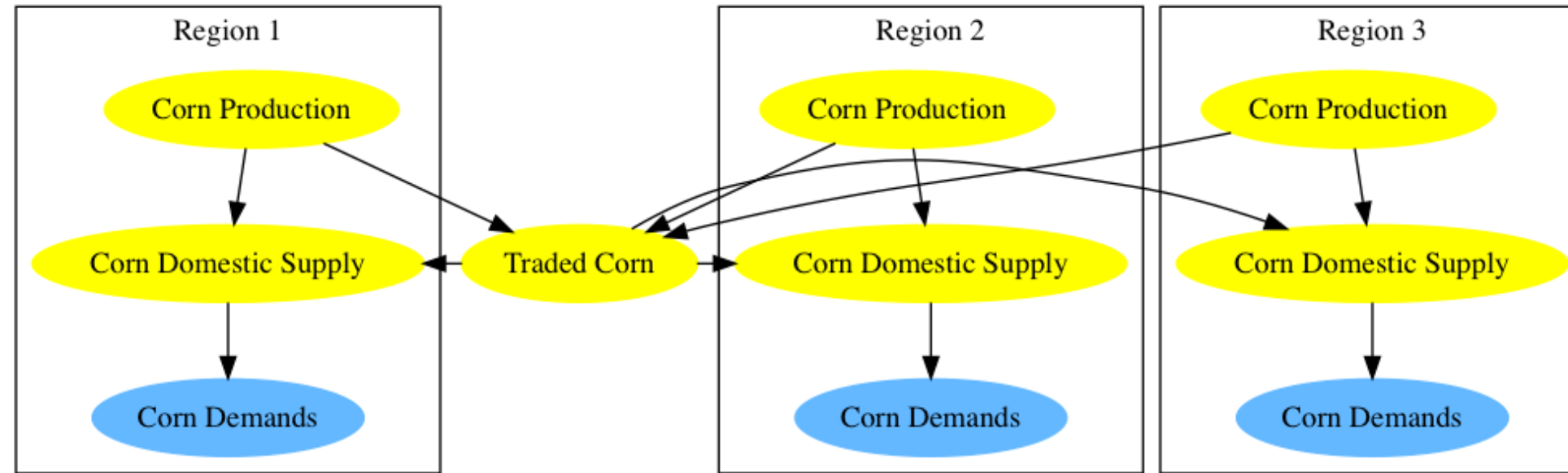




Water and Land Breakout Session: Land

Regionally-Differentiated Crop Markets with Global Trade: Simple Schematic



- Regional corn production is split between providing domestic supply and being sent to a global traded corn market.
- Correspondingly, regional demand is supplied by both own-regional production and imports from the global traded market.
 - An Armington-style distinction between domestic and imported goods.
- Gross trade is tracked as regions both import and export.

Separating planting and harvesting decisions in GCAM

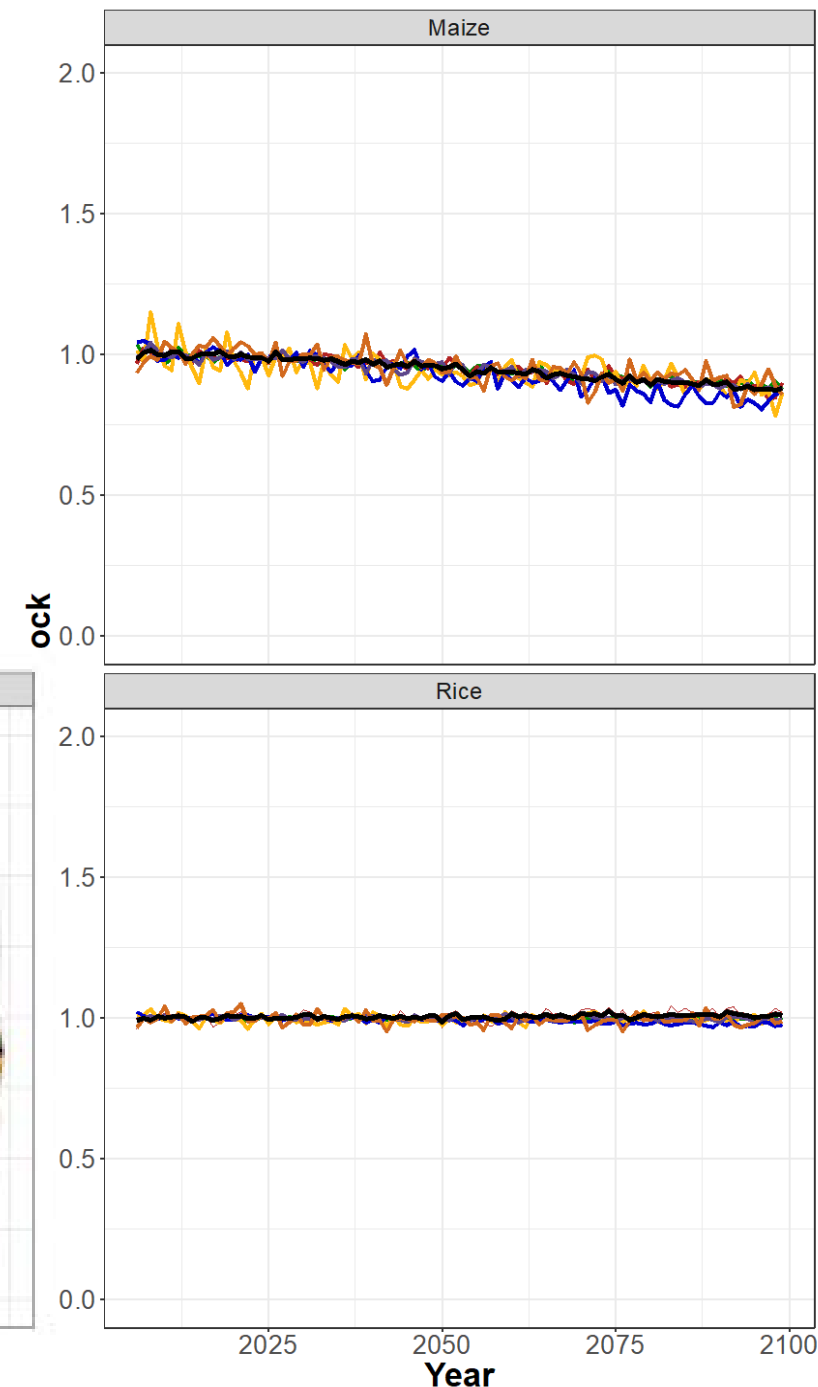
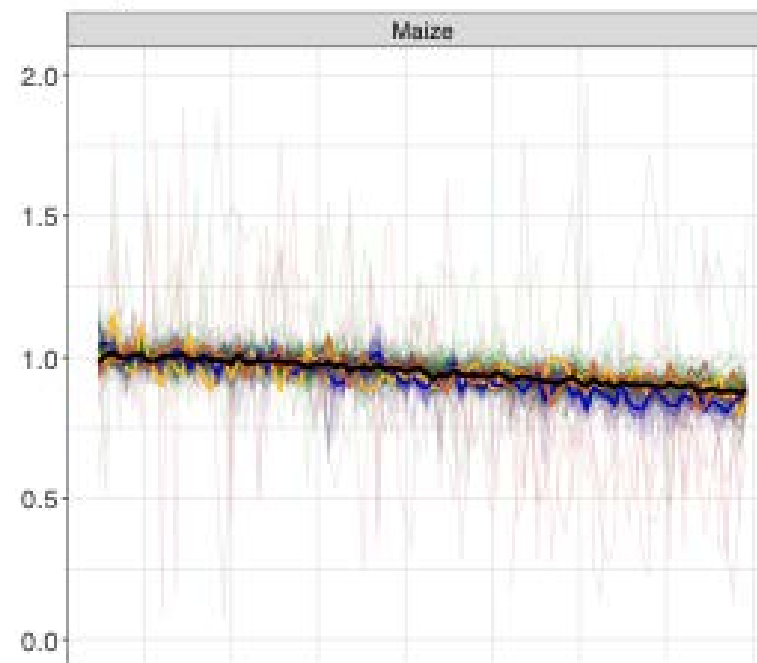
- Instead of having perfect foresight, farmers make decisions based on their expectations of prices and yield
- Adaptive expectation was incorporated into GCAM to separate planting and harvesting decisions
- The model is used for studying the interannual variability of climate impacts on agriculture
 - The trend and variability of climate impacts can be more useful than point estimations
 - Interannual variability in climate and biophysical shocks are transformed and transferred to crop market, and magnified by endogenous market fluctuations.

Future weather impacts on crop yields: Persephone

- AgMIP Coordinated Climate Crop Modelling Project (C3MP) emulator (site-specific crop models)
- Rainfed and irrigated impacts
 - C3MP models show more negative response for irrigated corn in UMRB than for rainfed in HadGEM_ES RCP 8.5 (2050)
- Four crops
 - Corn
 - Rice
 - Soybean
 - Wheat
- Long-term trends

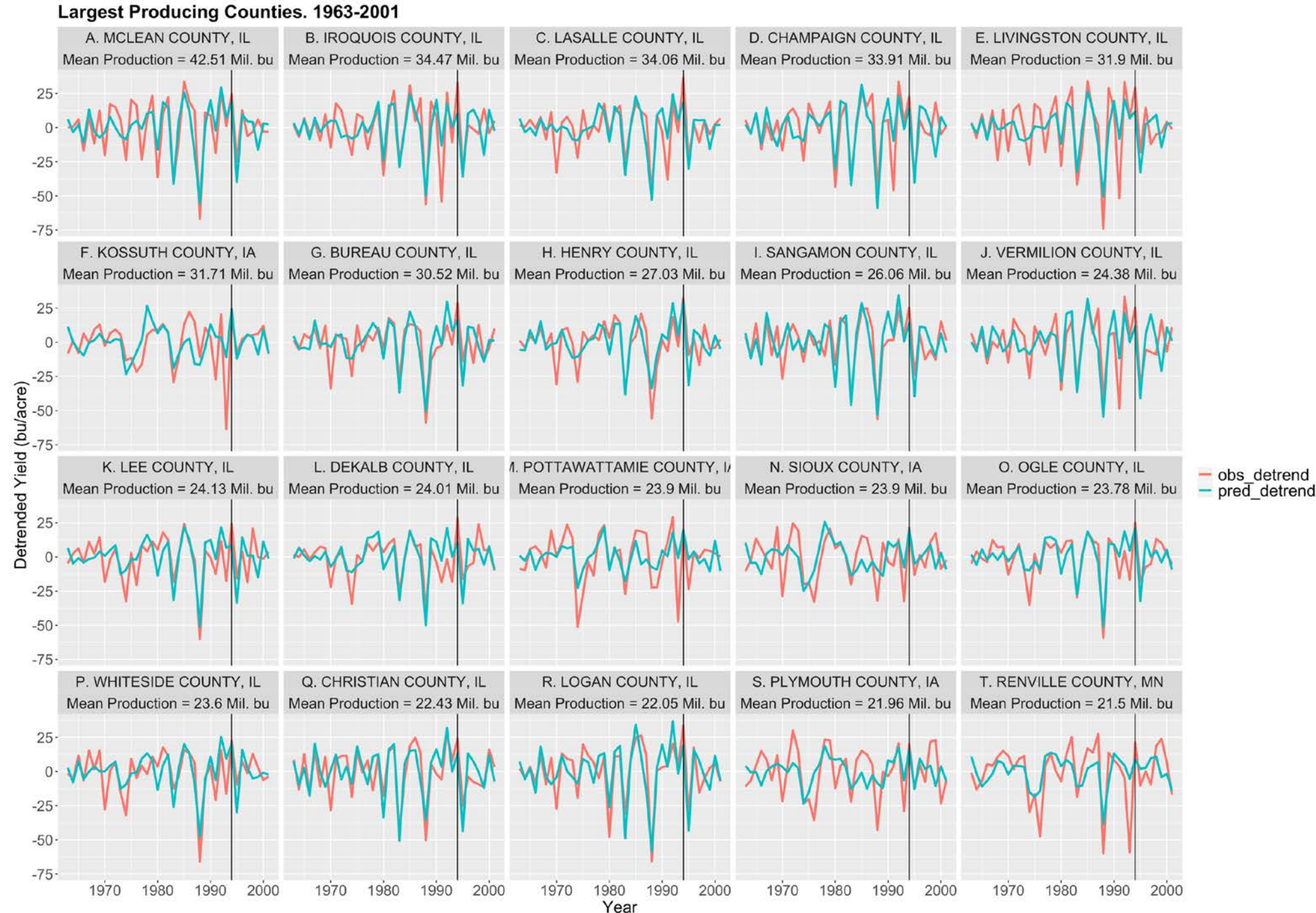
Future weather impacts on crop yields: Empirical (global)

- Country-level data, weather variables weighted by harvested area
- Aggregate to any regional definition
- Projections for multiple ESMs, RCPs
- Many crops (currently 12)
- Interannual variability
- Aggregated rainfed and irrigated yield shocks
- Reduced form: quadratic max, min, mean growing season temp and precipitation
- Crop- and region-specific growing seasons



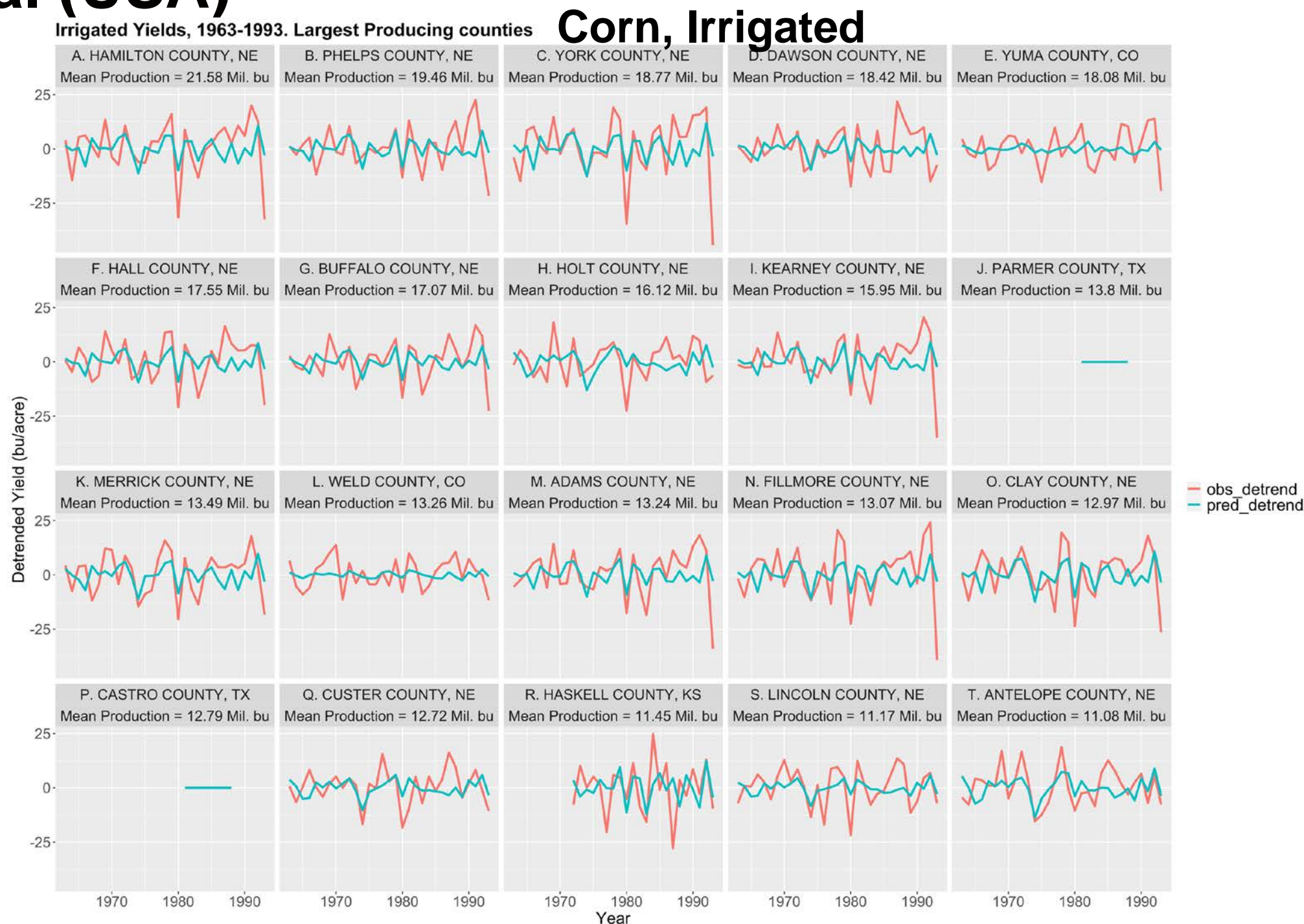
Future weather impacts on crop yields: Empirical (USA)

- US county-level data
- Many crops (potentially)
- Interannual variability
- Utilizes rainfed data to predict irrigated yields
- Structural design, crop-specific biophysical stages, temp and soil moisture
 - Corn: emergence, silking, denting
 - Wheat: heading, jointing
- Projections to ROW?



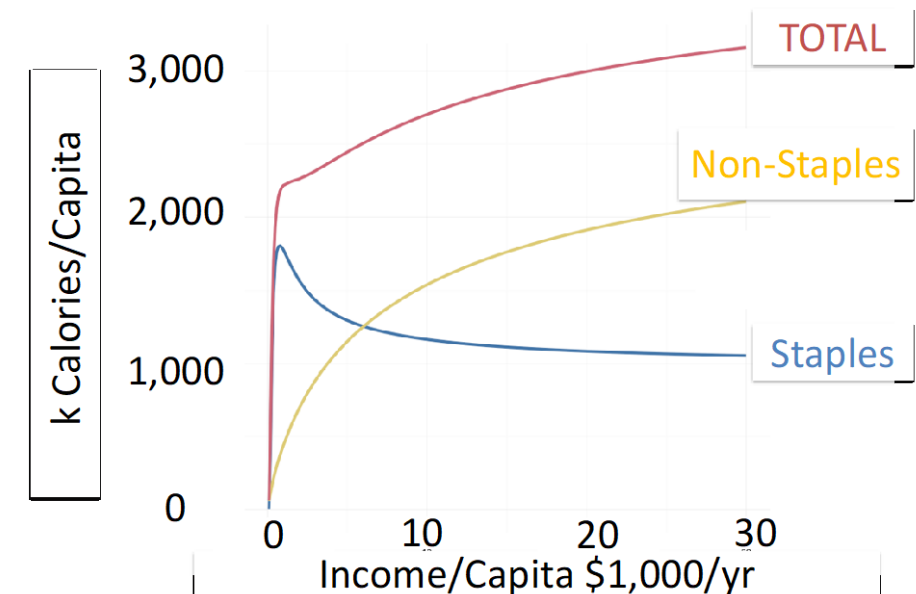
Future weather impacts on crop yields: Empirical (USA)

- Out of sample validation testing
- Rainfed: predictive value very good at capturing interannual variability, both training and testing
 - Effects of flooding are difficult to capture
- Irrigated: model less responsive than observed data
 - Explore uncertainty ranges around optimal value of soil moisture



Upcoming land development

- Energy inputs to agricultural production
 - Currently, agricultural energy use is accounted under the industrial sector
 - We have development branches in which crops directly consume liquid fuel inputs in all time periods
 - Future development tasks
 - ✓ Include an electric option in future time periods
 - ✓ For future modification, research linking yield level and energy intensity of crop production
- Yield gap implementation
 - Currently, maximum potential yield levels within any region/crop/basin are capped at 10% higher than the baseline assumed yields
 - Significant yield gaps exist at present, and even by 2050 in the assumed baseline yields
 - Our approach will use the Global Gridded Crop Model Inter-comparison (GGCMI) to estimate maximum attainable yields for each region/crop/basin, and parameterize the economic response for consistency with literature on yield price elasticity
- Food demand
 - Endogenous response to price and income
 - Different demand response for *staples* (grains, root/tuber) and *non-staples*
 - Calibrated to historical data





Thank you