



# Domestic and International Implications of Future Climate for the Value of U.S. Agriculture

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## Motivation

The environment, agriculture, and the global economy are all deeply interconnected.

Certainly yield changes across agricultural commodities impact the financial value of agriculture in the United States, but how? And to what extent?

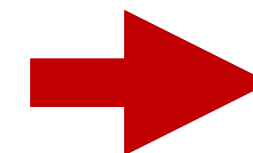
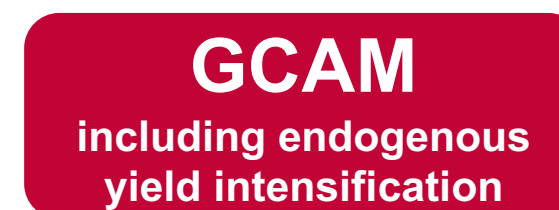
Specifically, how do changing yields in the United States alone impact the value of U.S. agriculture? How does that compare to the indirect impacts from changing yields outside the U.S. via commodity prices?

# Scenario design

Archive of local yield time series  
5 global circulation model RCP 8.5  
drivers to 7 global gridded crop model  
(GGCM) runs: 35 different possible  
agricultural futures over space and time.



Yield changes due to  
climate are  
exogenous multipliers  
on exogenous yield  
changes due to  
technological  
progress




Socioeconomic  
and  
Environmental  
Indicators

- The predictions vary by GGCM:
  - One model may predict a 20% increase in one crop's yield in one location.
  - Another model may predict a 20% decrease for the same crop in the same location.
- We leverage the spatial and temporal heterogeneity across the 35 agricultural scenarios available.

# Use the full range of these results to draw conclusions about the economic *mechanisms* that will shape the future value of U.S. agriculture

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**GCAM**  
including endogenous  
yield intensification

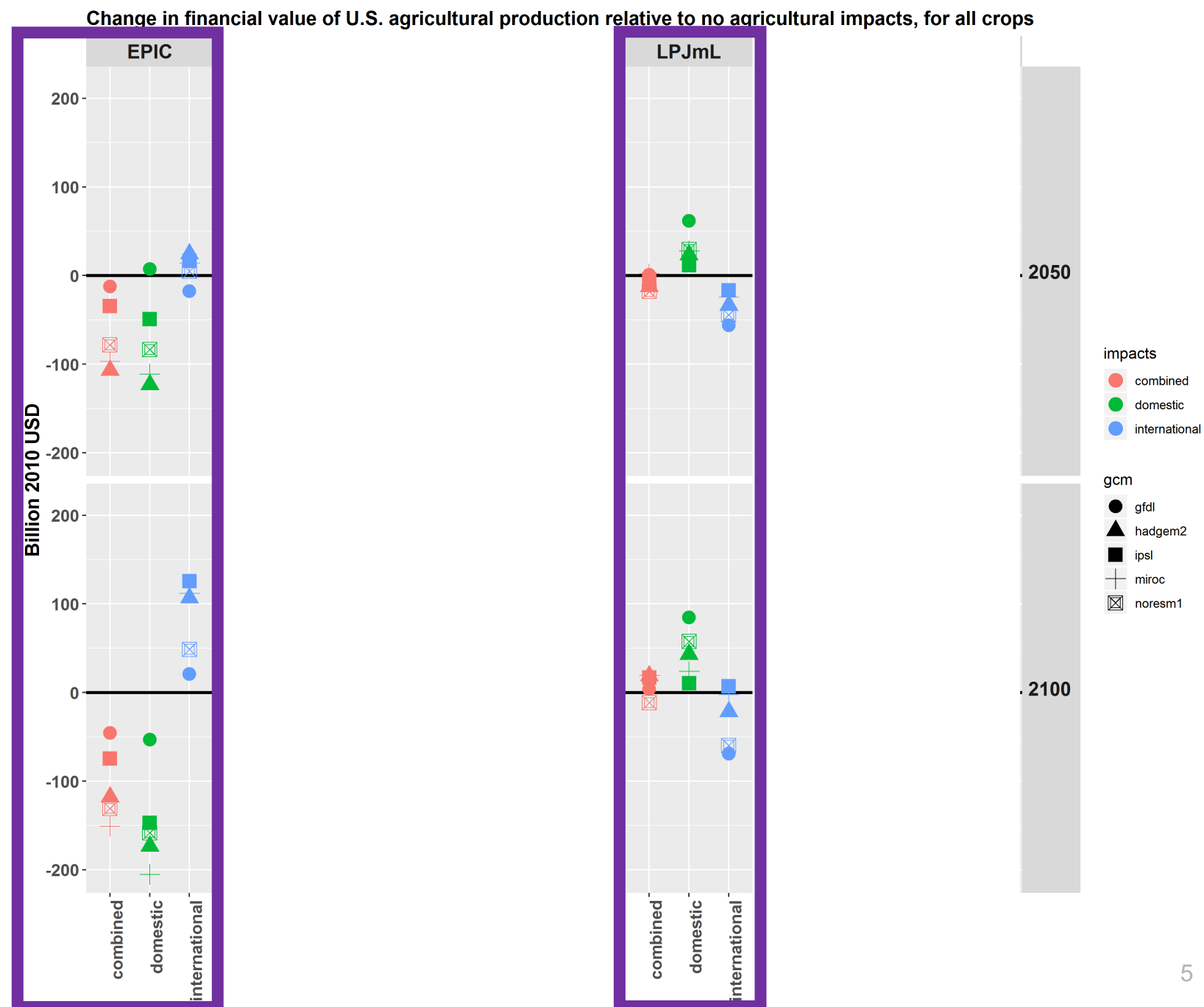
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For each of the 35 cases we run three alternative variants that

1. Limit change to the U.S. alone,
2. Limit change to everywhere except the U.S., or
3. Apply the change across the whole world.

# Direct domestic effects have financial consequences for U.S. producers on the same order of magnitude but opposite in sign to indirect financial impacts

- This occurs across diverse combinations of impacts for different crops in different places.
- The same economic mechanisms are robust across large agricultural response uncertainty.
- Value has two components: global market price, and quantity produced in the U.S.
- So are changes driven more by price response, or physical production response?





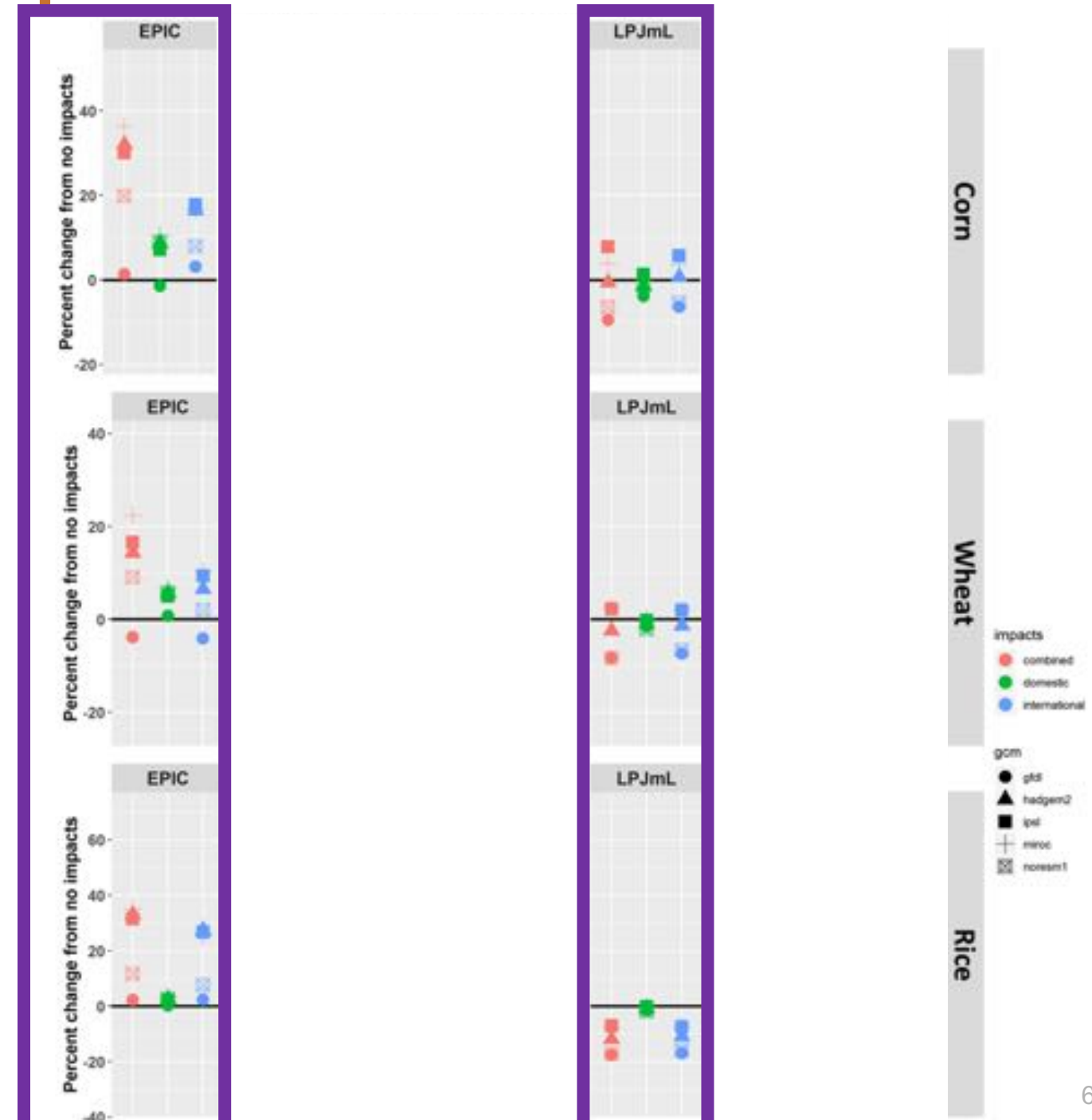
# Different drivers of response in different cases

Price changes in 2100 for 3 example crops suggest that:

- In the domestic case, you have smaller price changes -> Value changes are being made up by domestic production changes.
- In the international case, with larger price changes, U.S. value changes are being driven in response to changes in the global market price via ROW production changes.

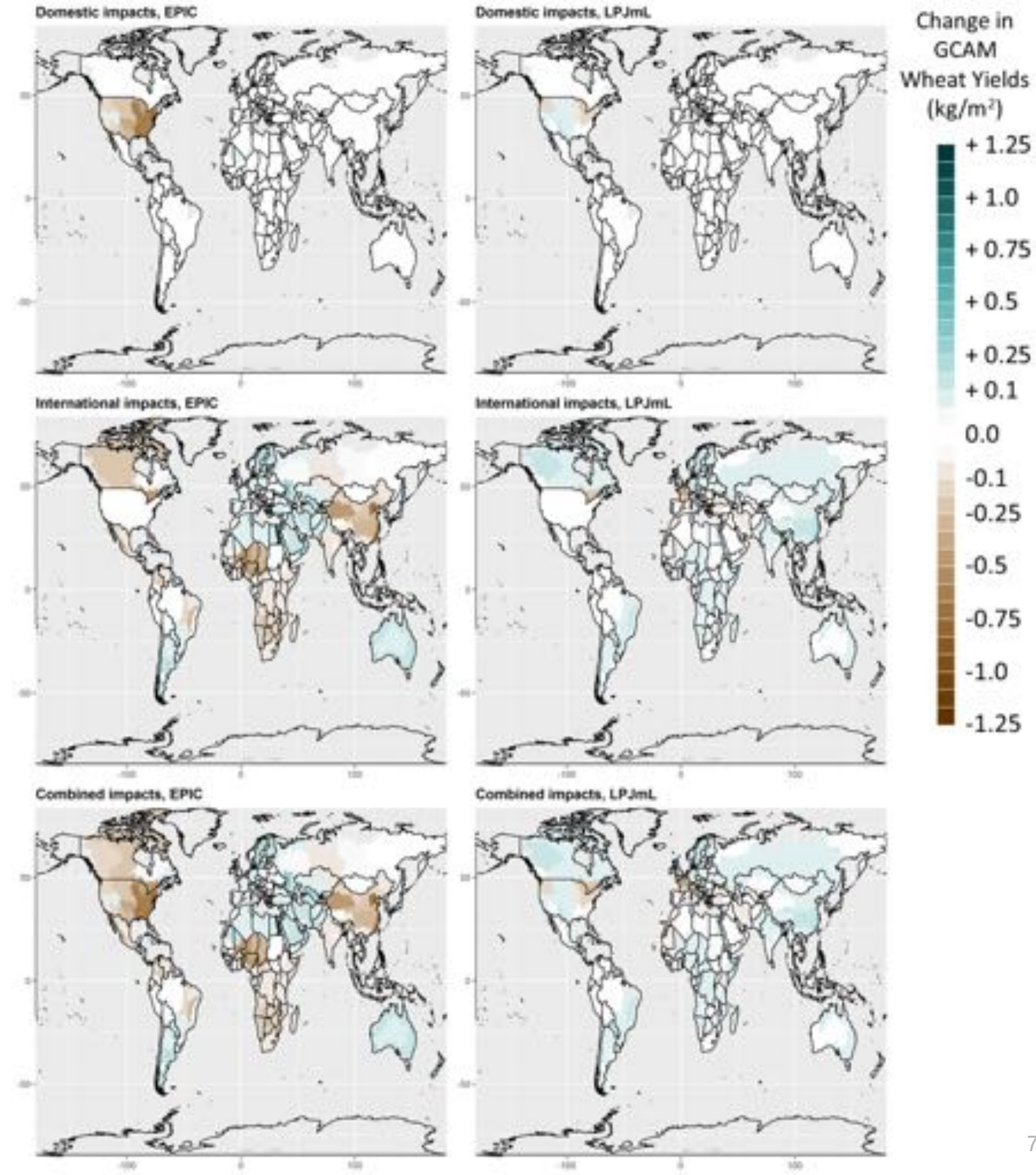
This makes sense, the U.S. is a KEY agricultural producer but not a MAJORITY agricultural producer for many crops.

How different ARE these yield impact scenarios anyway?



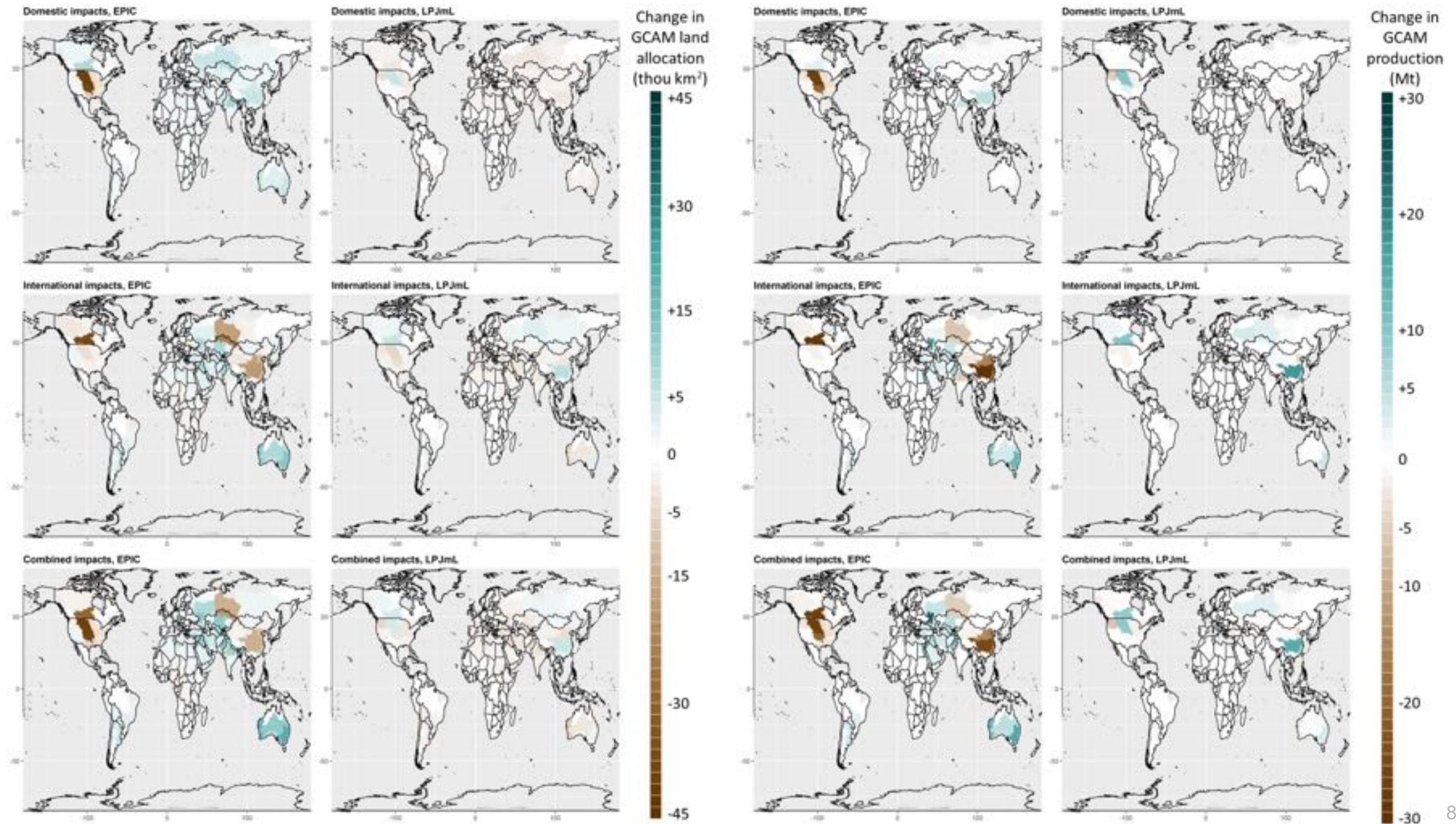
# GCAM output yield changes in two distinct impact scenarios

- Combination of applied yield impacts and endogenous yield response from GCAM (shifting across hi vs lo, irr vs rfd Wheat).
- It's almost boring how clean those yield change boundaries are across the maps.





# More complex dynamics occurring





## Conclusions + future directions

- Even given the enormous uncertainty in future agricultural changes, the importance of international effects on the value of U.S. production and net exports is robust across the varying scenarios studied here, consistent with the work of Baker et al. and suggested by previous studies.
- In addition, the work strongly suggests that the international and domestic impacts of future climate on agricultural yields will have offsetting implications for the value of U.S. agricultural production.
- Need to develop a deeper and richer understanding of how future climate may affect the agricultural system across the globe.
  - Exploiting the tools in the GCAM ecosystem for more quantitative approaches
  - Other RCPs
  - SSPs
  - Water constraints
  - Consumer perspective
  - Subnational analysis

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# Thank you

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