

An economic analysis of the impact of climate change on agriculture

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How will climate change over century?

- Warming of 1.5-4.5°C by 2100
- Precipitation generally up
- Warmer towards poles- especially north pole
- Precipitation changes highly variable across place and season
- Local effects uncertain though warming trend likely everywhere

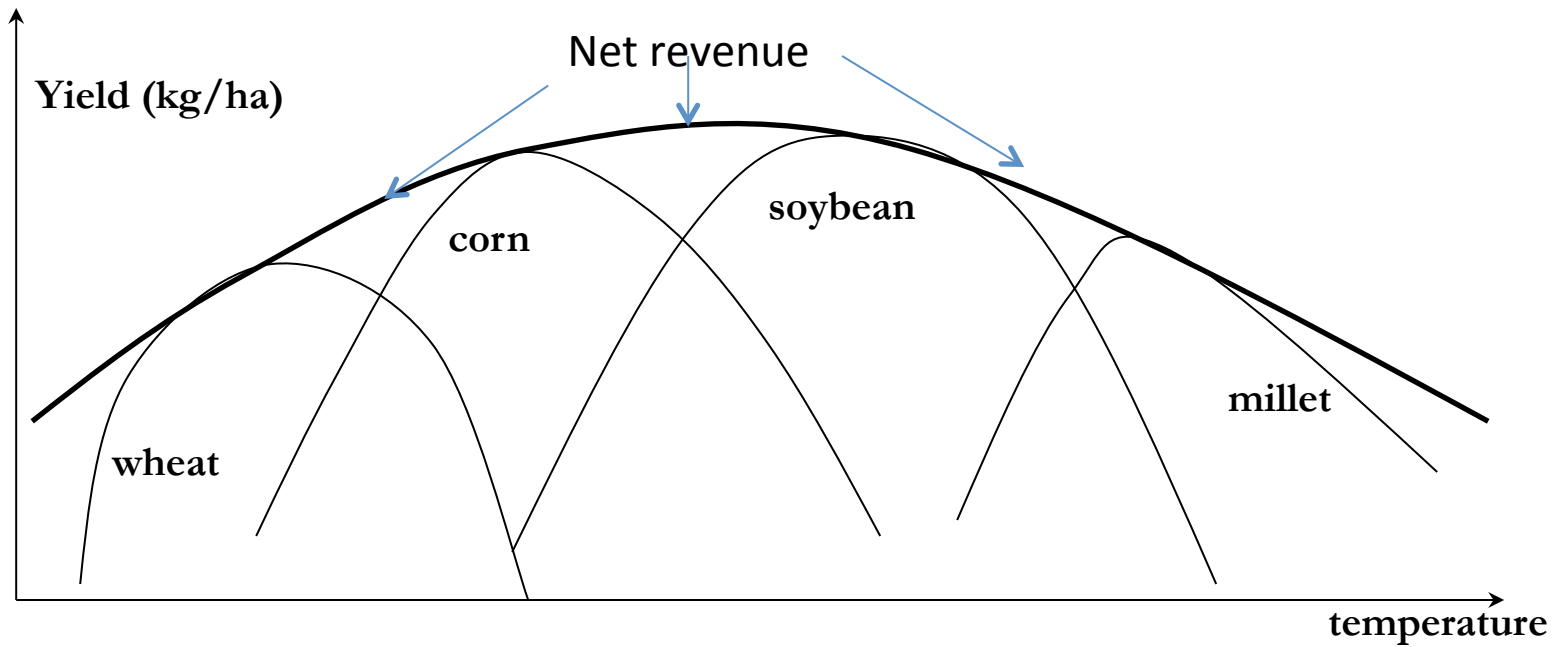
How do we learn about climate sensitivity?

- Greenhouse experiments
 - Crop Models
- Cross sectional yield studies
- Cross sectional net revenue studies
- Intertemporal yield and net revenue studies

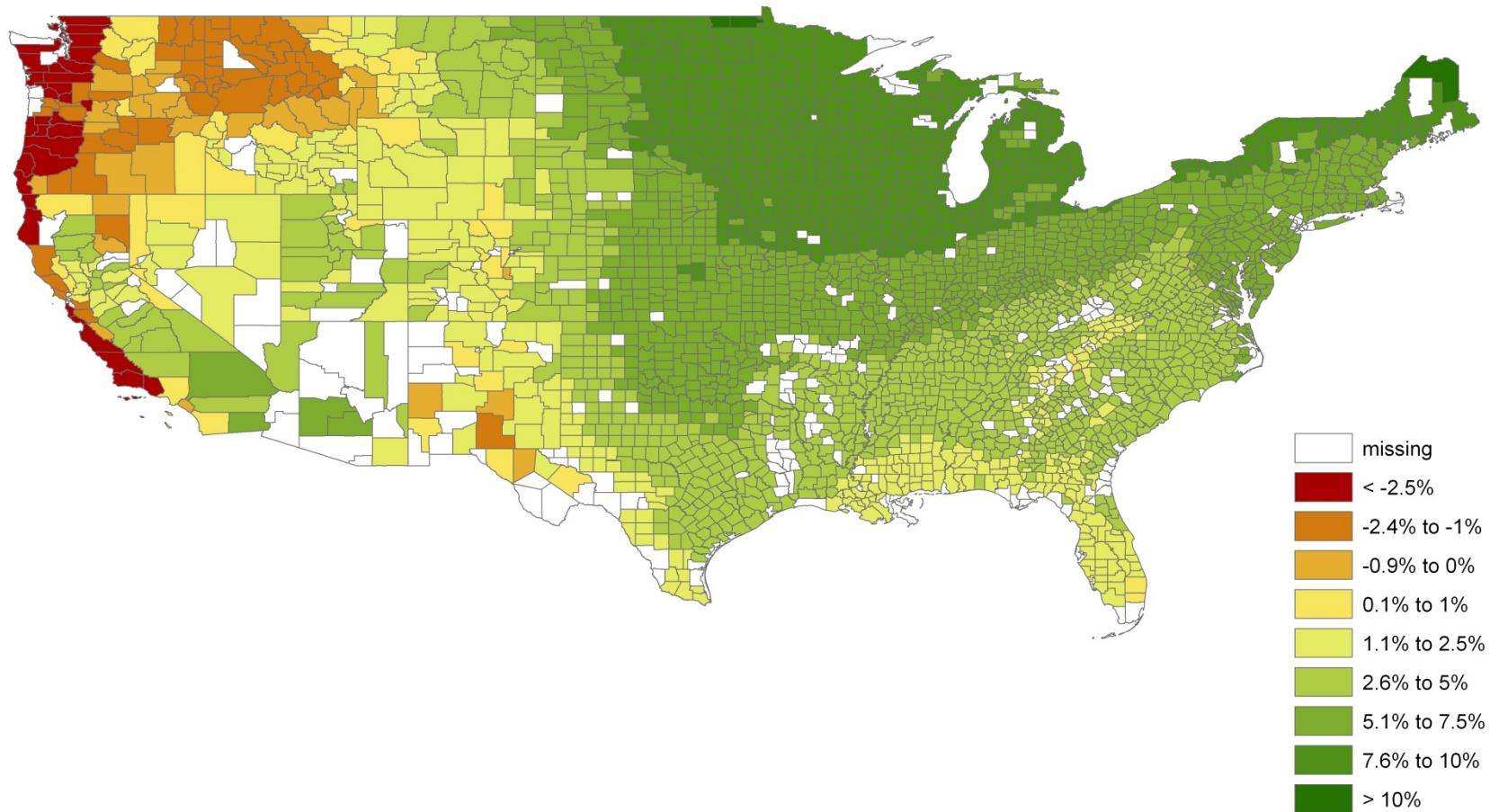
What will happen to agriculture?

- Most crop yields have steep hill-shaped temperature and precipitation gradients-preferred climates
- Farmers tend to grow crops in their preferred climate
- Changes in temperature will therefore be harmful to crop yields if they stay where they currently are located
- Increases (decreases) in precipitation would likely be beneficial (harmful) in semi arid locations

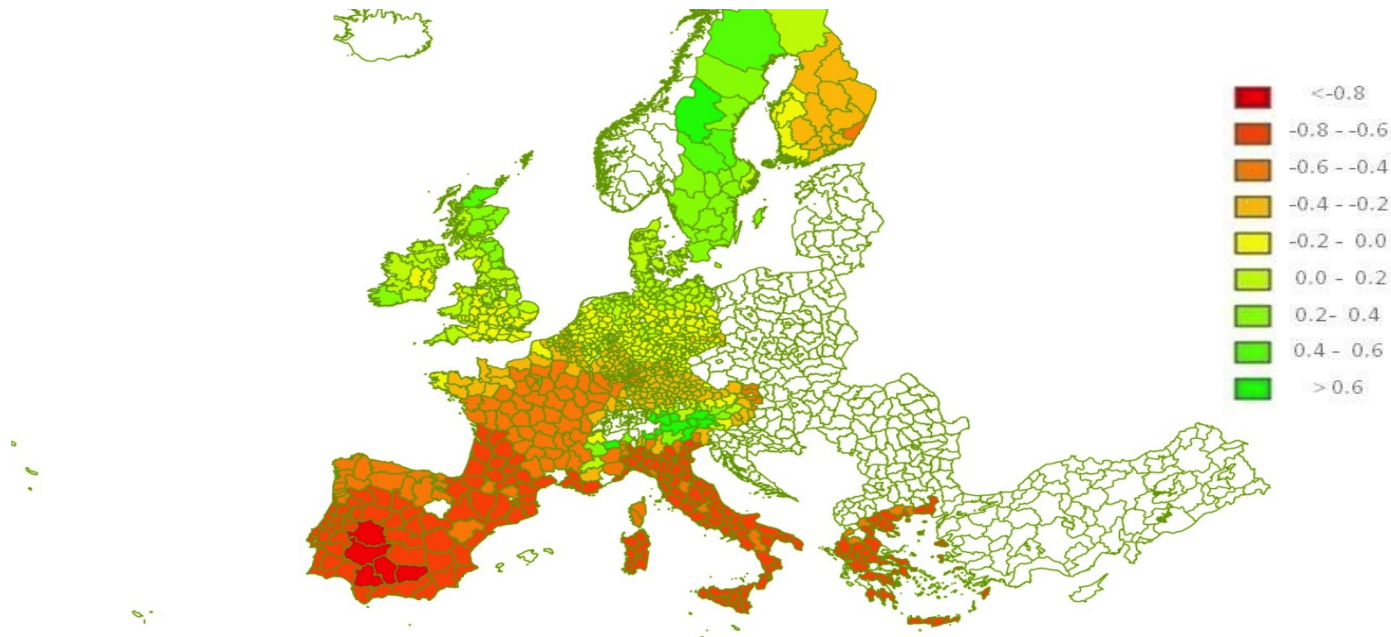
Crop Switching



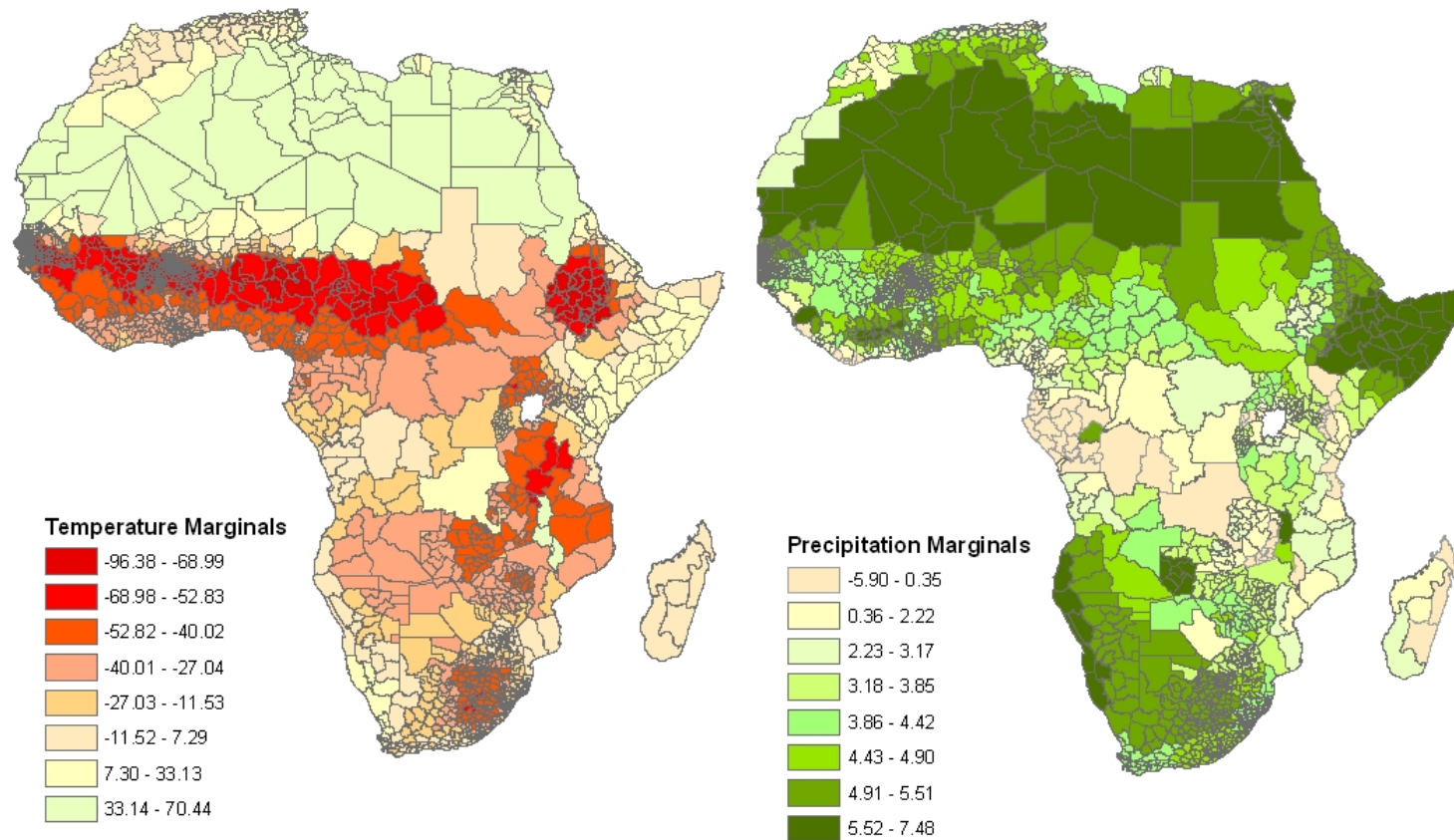
The Marginal Impact of Temperature on Land Value in the United States (percentage).



ECHO (med) 2100 BAU



Marginal impacts of Temperature and Precipitation

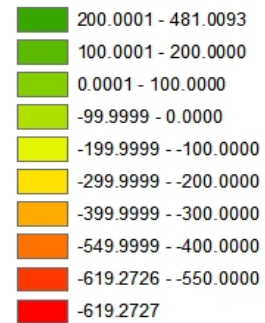


CCC 2100, Large Farms



Change of Land Value

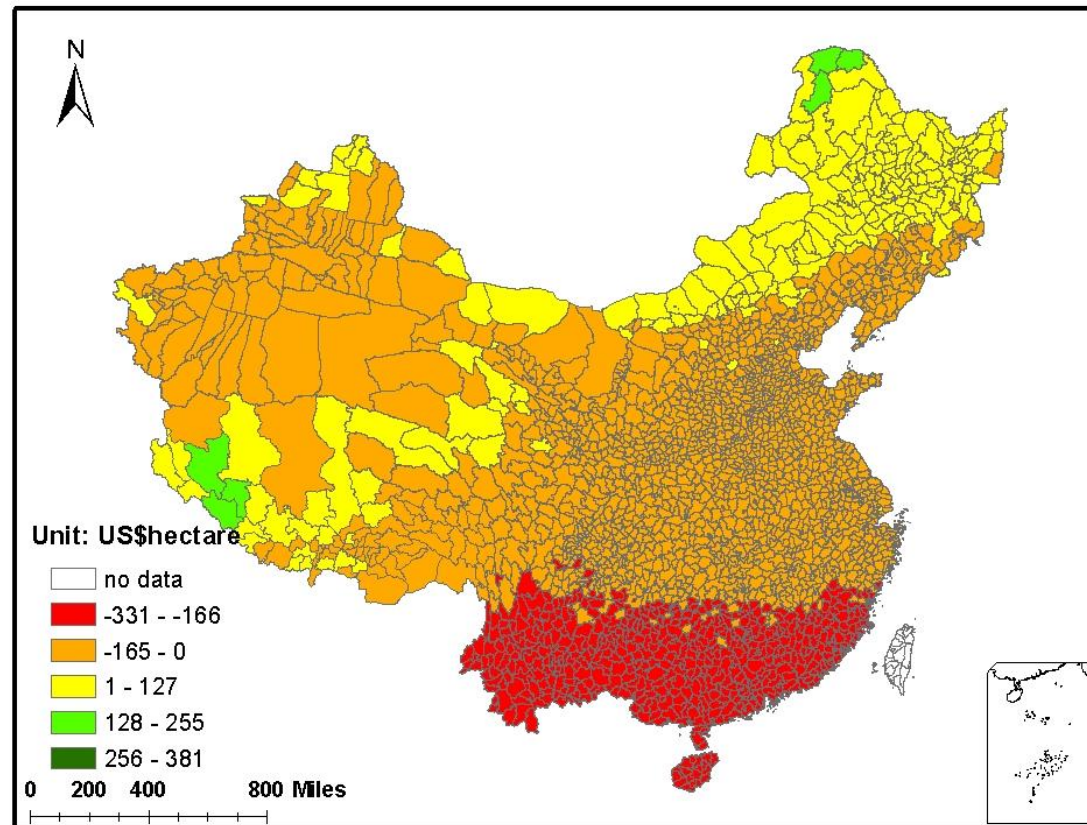
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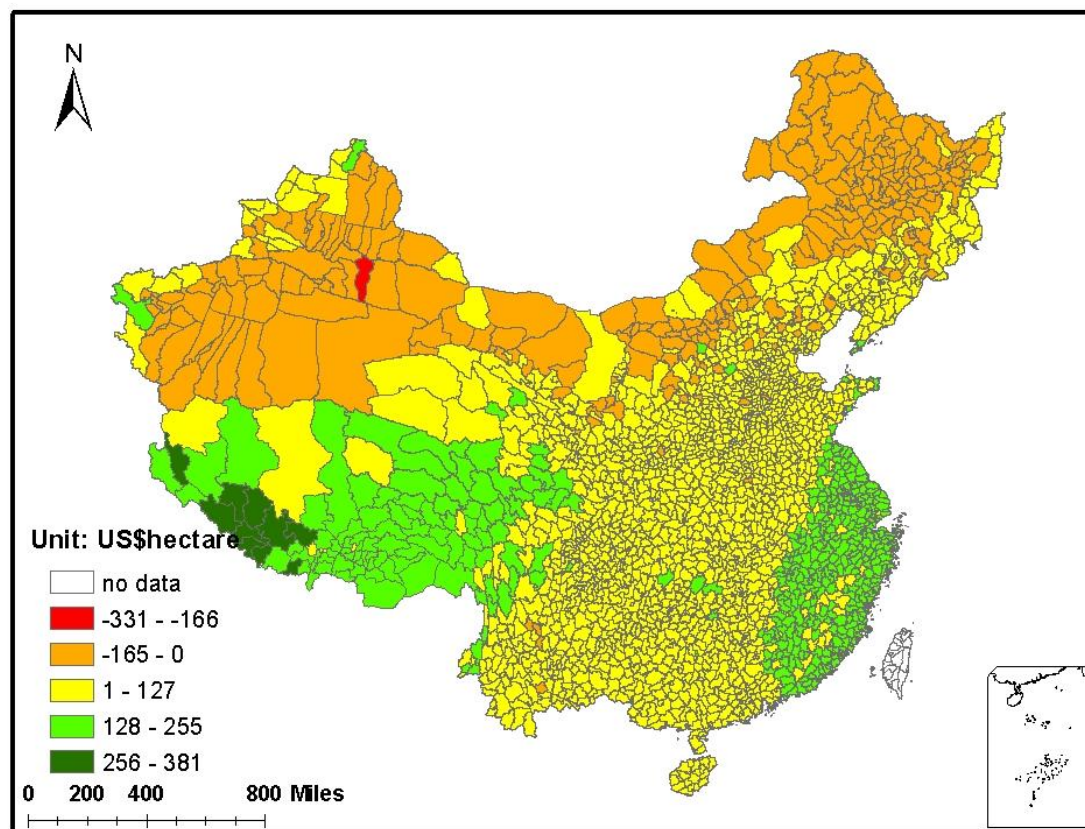
0 2.5 5 10 Decimal Degrees

NIGGOL SEO, YALE

Marginal temperature effect on rainfed farms in China



Marginal temperature effect on irrigated farms in China



Carbon Fertilization

- Doubling of CO₂ increases crop yields on average by 30%
- CO₂ will triple by 2100 implying an increase of almost 50% in crop yield
- This positive impact likely much larger than negative consequences of temperature rise by 2100
- Implies overall modest impact

Adaptation Is Key

- Crops must move poleward as climates warm to stay in optimal zone
- Irrigation can assist but is limited by available water supply
- Substitution from crops towards livestock in low latitudes
- Because farmer adaptation is in every farmer's interests, it will likely proceed without government policy

Distributional Impact by 2100

- Very likely mid to high latitude farmers will be net winners from climate change
- Low latitude farmers will be worse off
 - May be especially difficult for large modern low latitude farms and rainfed crop farms
- Consumers may not be affected- small price changes

Far Future Impacts

- If climate continues to warm unchecked beyond 4°C, harmful impacts will increase and beneficial impacts will shrink
- Global output will fall
- Agricultural prices will rise
- Large harmful effects especially to the poor and low latitude rural populations

Other Problems

- If mitigation begins to rely on crop biofuels, cropland will be diverted away from food and towards energy
 - Good outcome for farmers with high crop prices
 - Poor outcome for consumers
- Pressure could also increase on cropland if wood biofuel is used
 - Probably smaller impact because vast forestlands available
 - Eventually cropland moves to forest