Organizing to Advance Solutions in the Sahel Agriculture and Extreme Heat

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Outline

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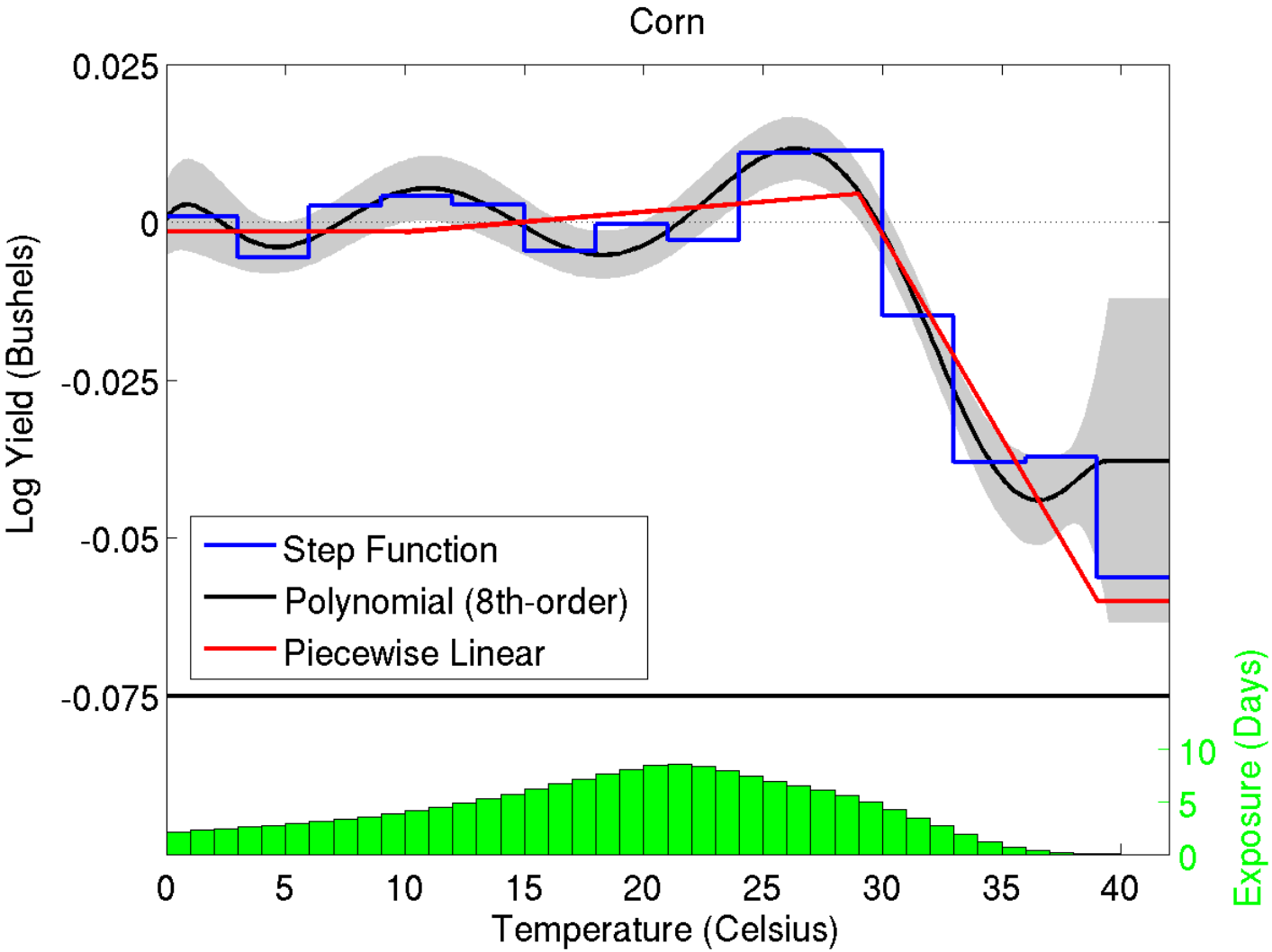
Effect of Temperatures on Maize Yields

- Examining yearly fluctuations in yields
  - US: fine-scale weather data (4km x 4km grid)
- Crucial importance of "extreme" heat
  - Best predictor: temperatures above 29°C (84°F)

Effect of Temperatures on Maize Yields

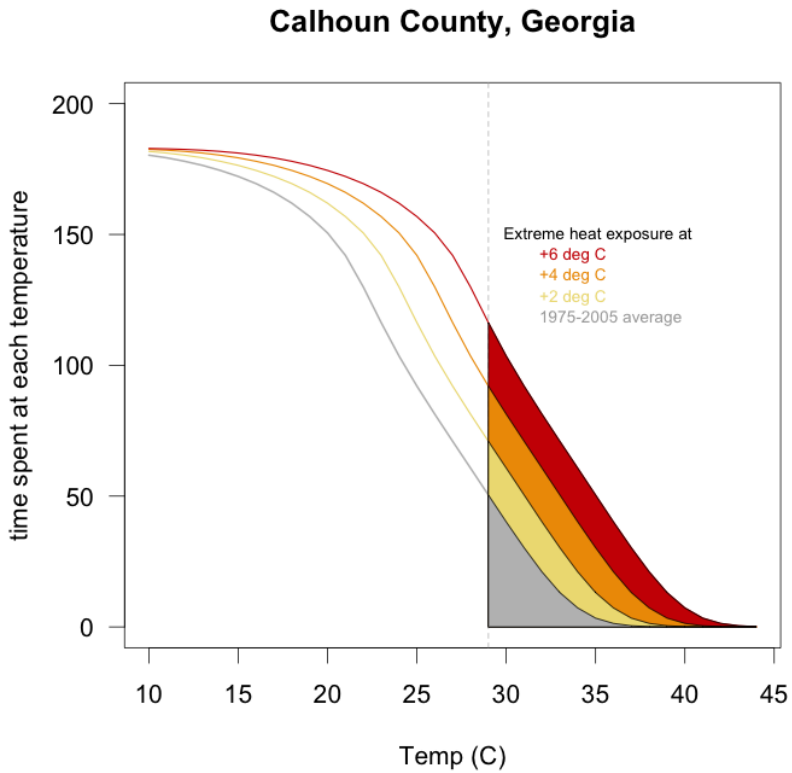


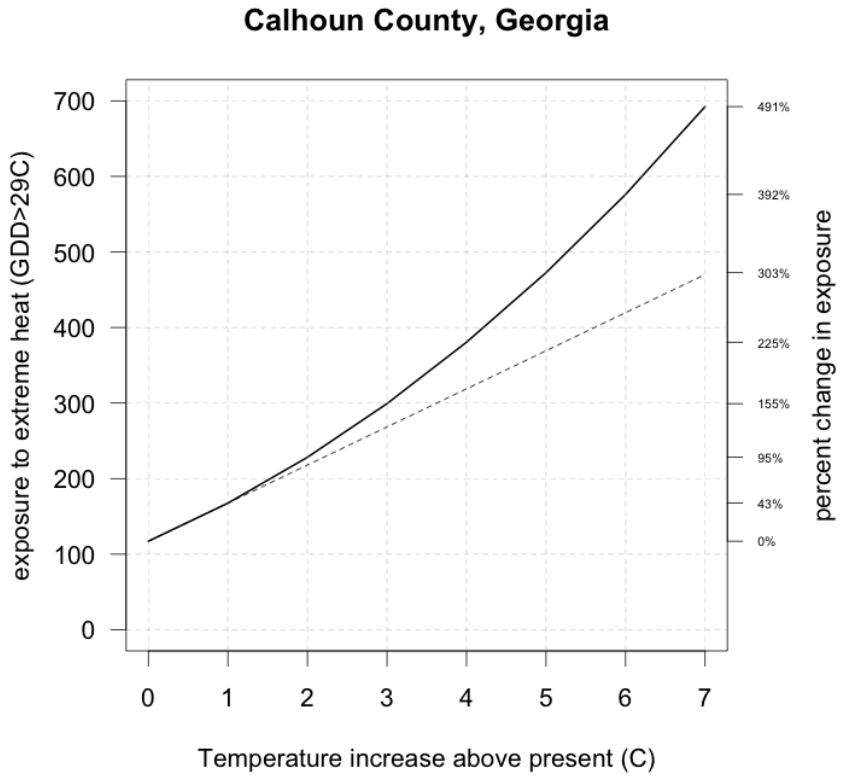
Source: Schlenker and Roberts, *PNAS* (2009)

Effect of Temperatures on Maize Yields

- Examining yearly fluctuations in yields
  - US: fine-scale weather data (4km x 4km grid)
- Crucial importance of "extreme" heat
  - Best predictor: temperatures above 29°C (84°F)
- 0.7% decline for each 24hour exposure for each degree above 29°C
  - 10 days at 30°C: 7% decline
  - 1 day at 39°C: 7% decline
- Heat versus rainfall
  - Water balance (supply and demand for water)
  - Precipitation
    - Impacts water supply
  - Heat (Double whammy)
    - Impacts water supply (more evaporation)
    - Impacts water demand of crops

Effect of Climate Change on Extreme Heat

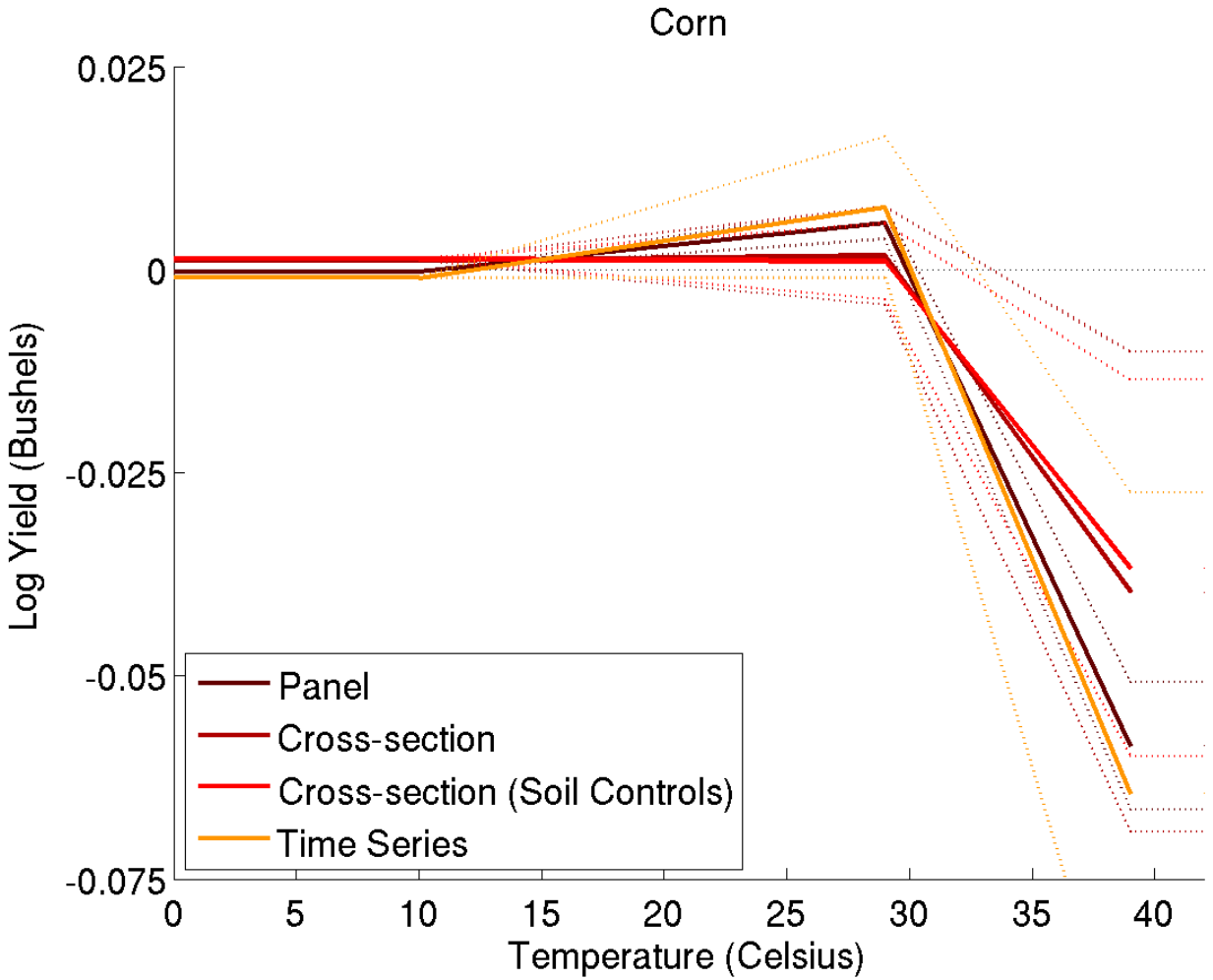




Source: Burke (2012)

Adaptation to Extreme Heat

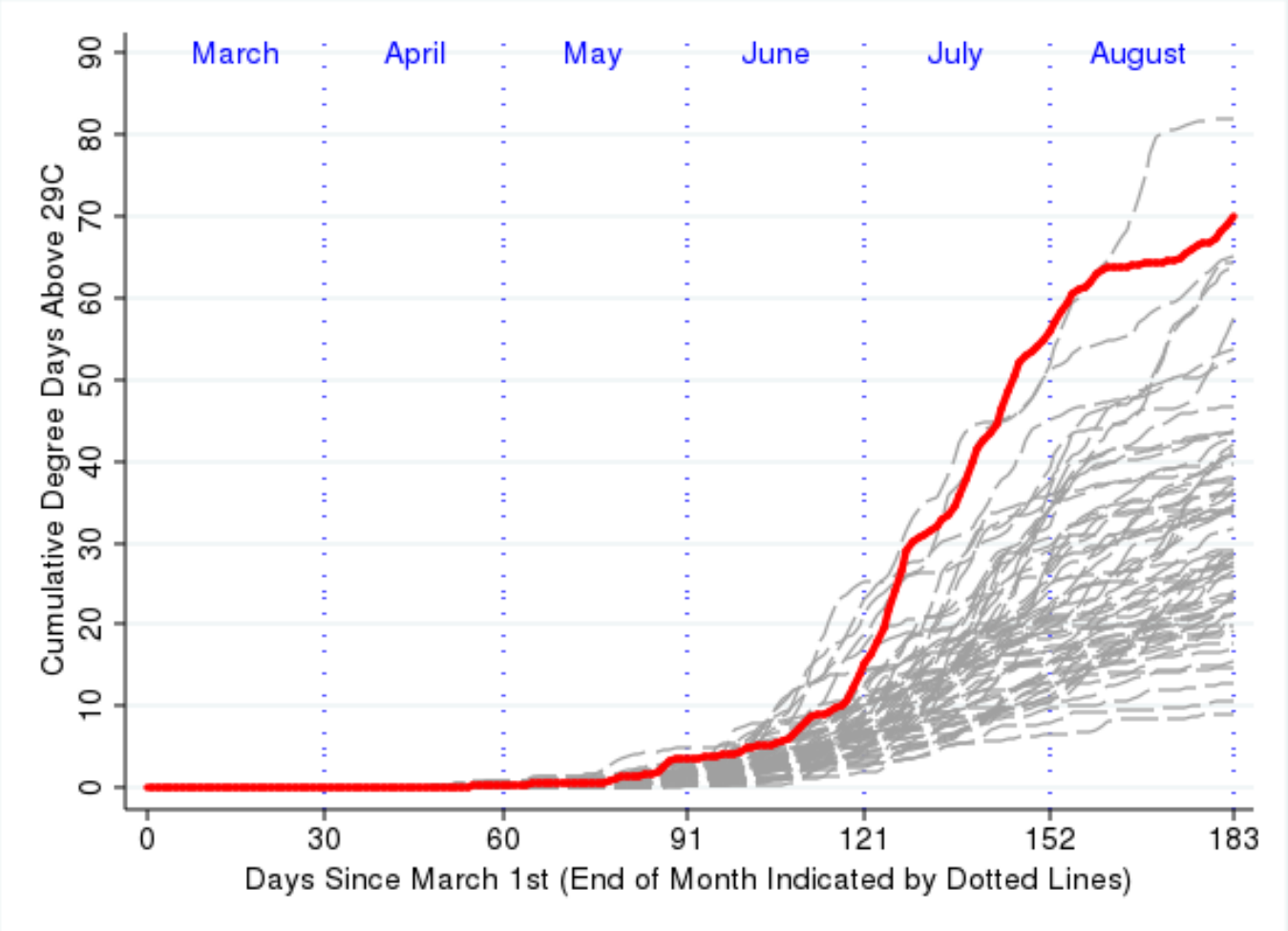
Does difference in climate (average weather) explain production differences?



Source: Schlenker and Roberts, *PNAS* (2009)

Technological Progress - What is Happening in 2012?

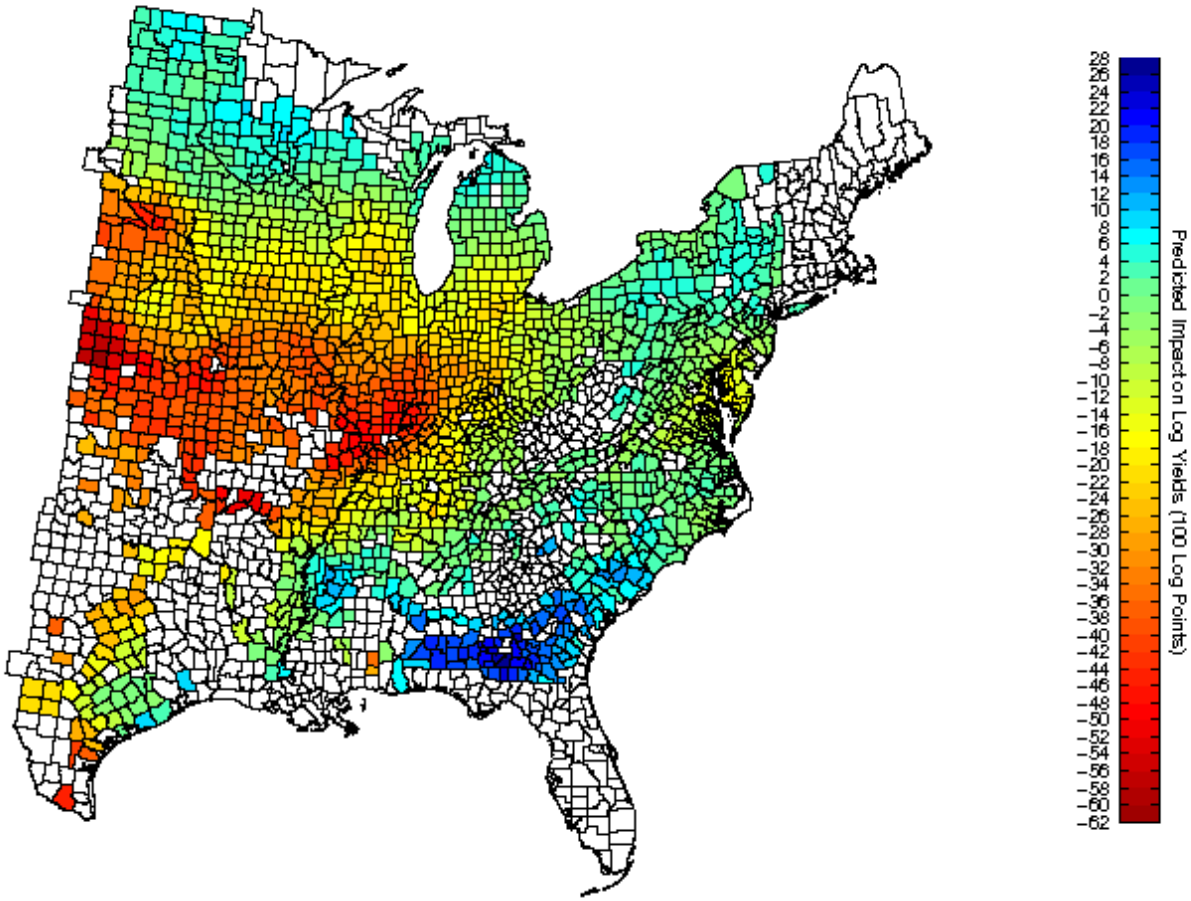
Putting 2012 into perspective (relative to 1950-2011)



Source: Berry, Roberts, and Schlenker (2012)

Technological Progress - What is Happening in 2012?

Predicted yield impacts (Model)



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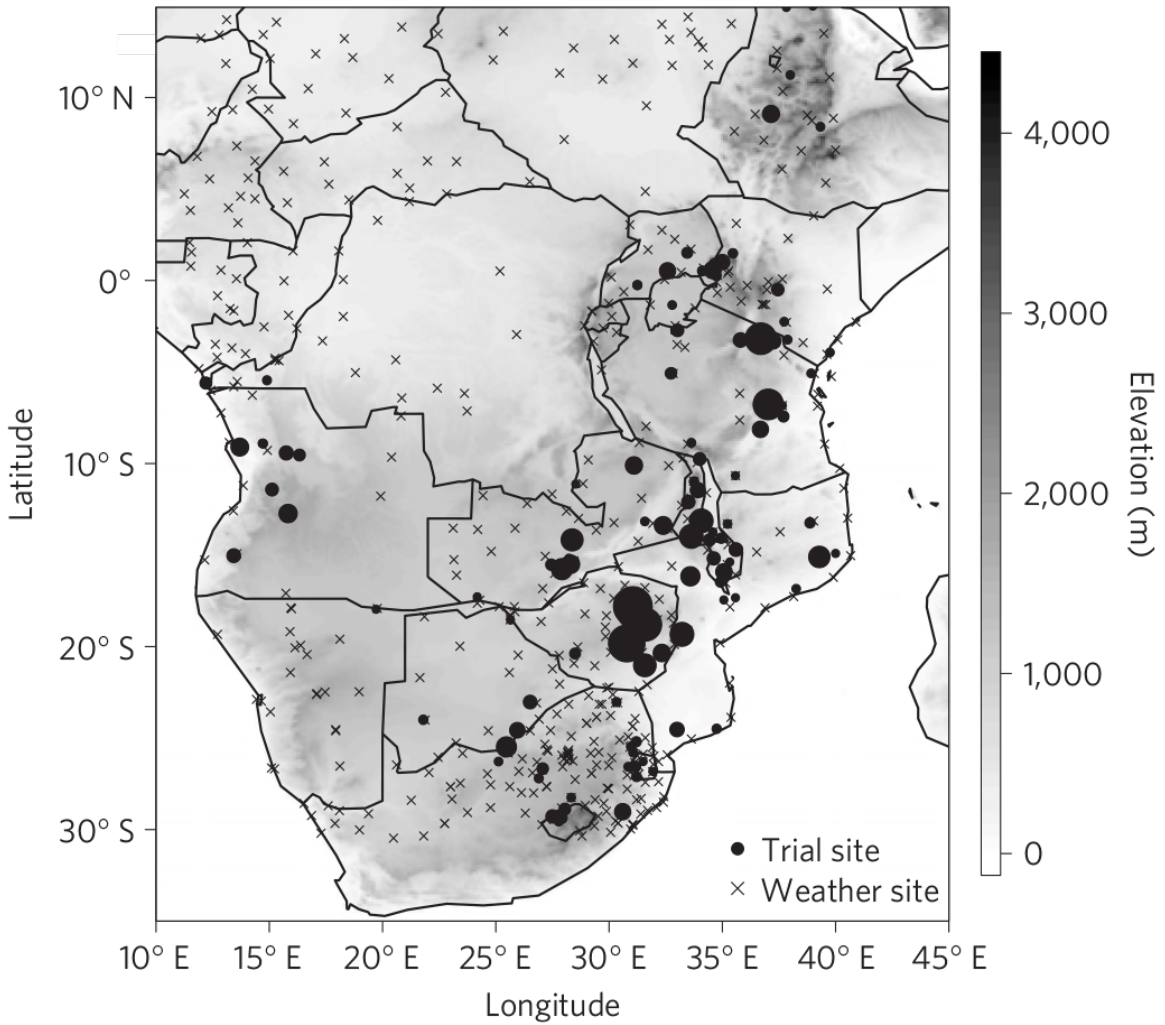
Warming and Yields - Field Trials



Source: Lobell, Baenzinger, Magorokosho, and Vivek *NCC* (2011)

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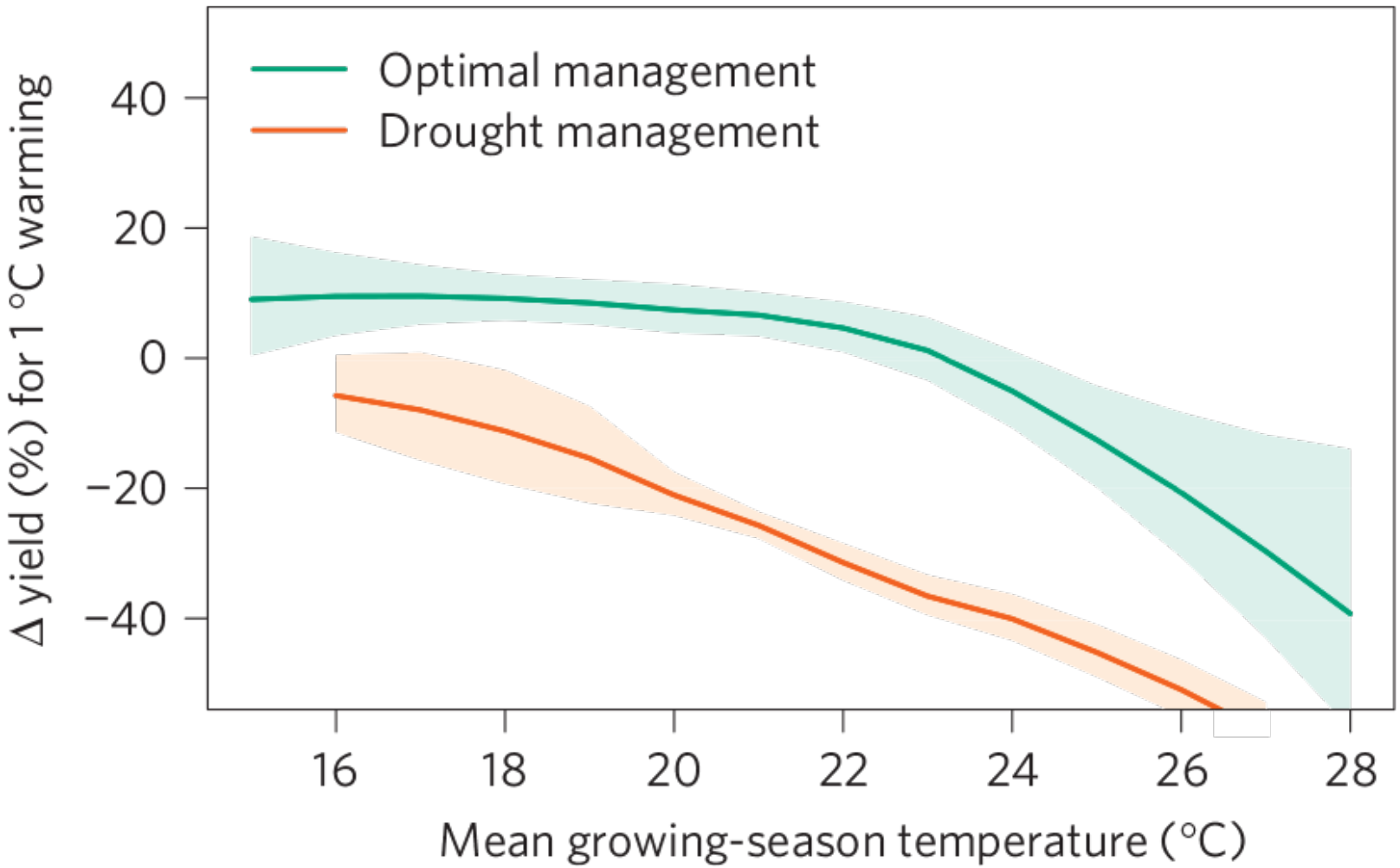

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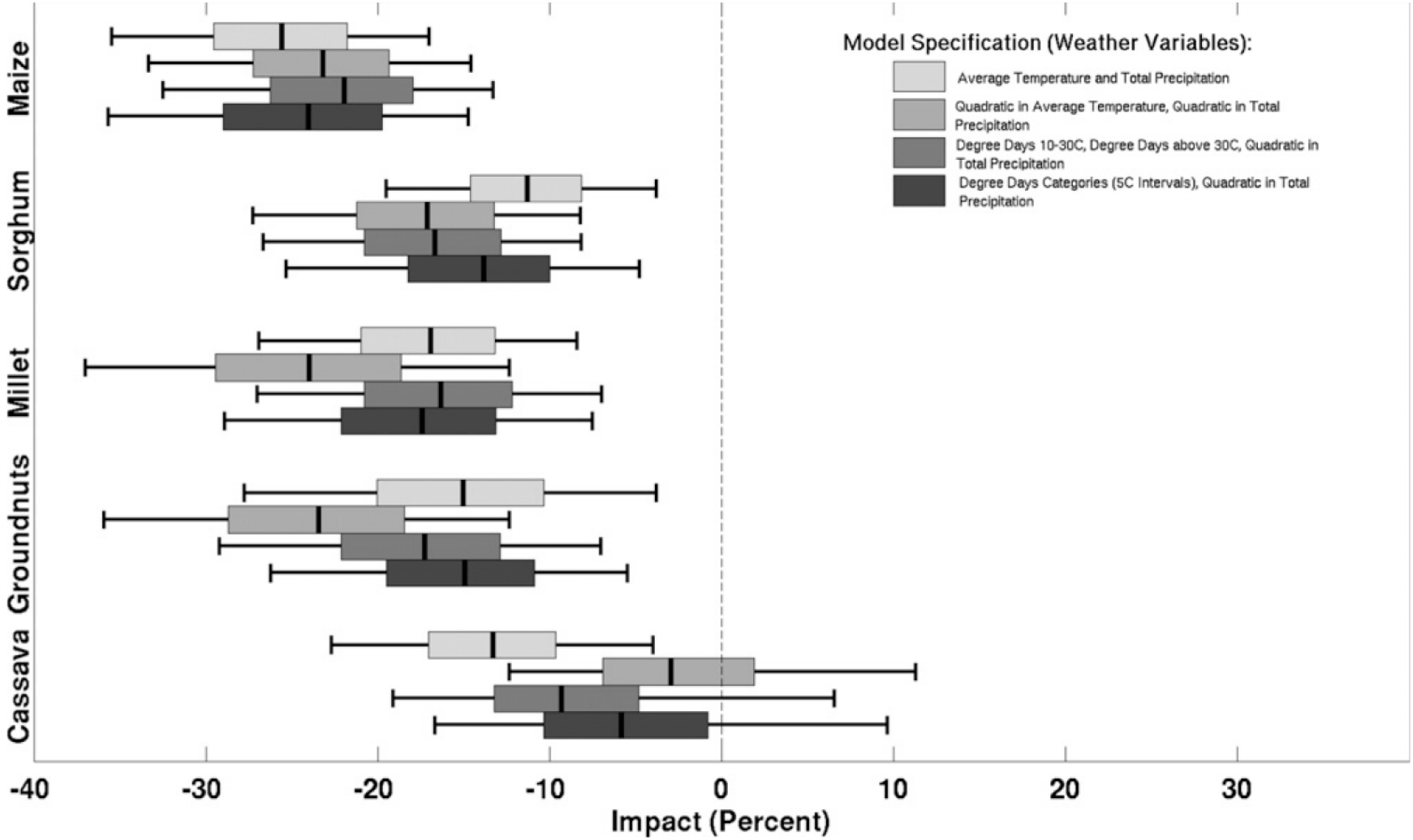
Warming and Yields - Subsaharan Africa



Source: Schlenker and Lobell *ERL* (2010)

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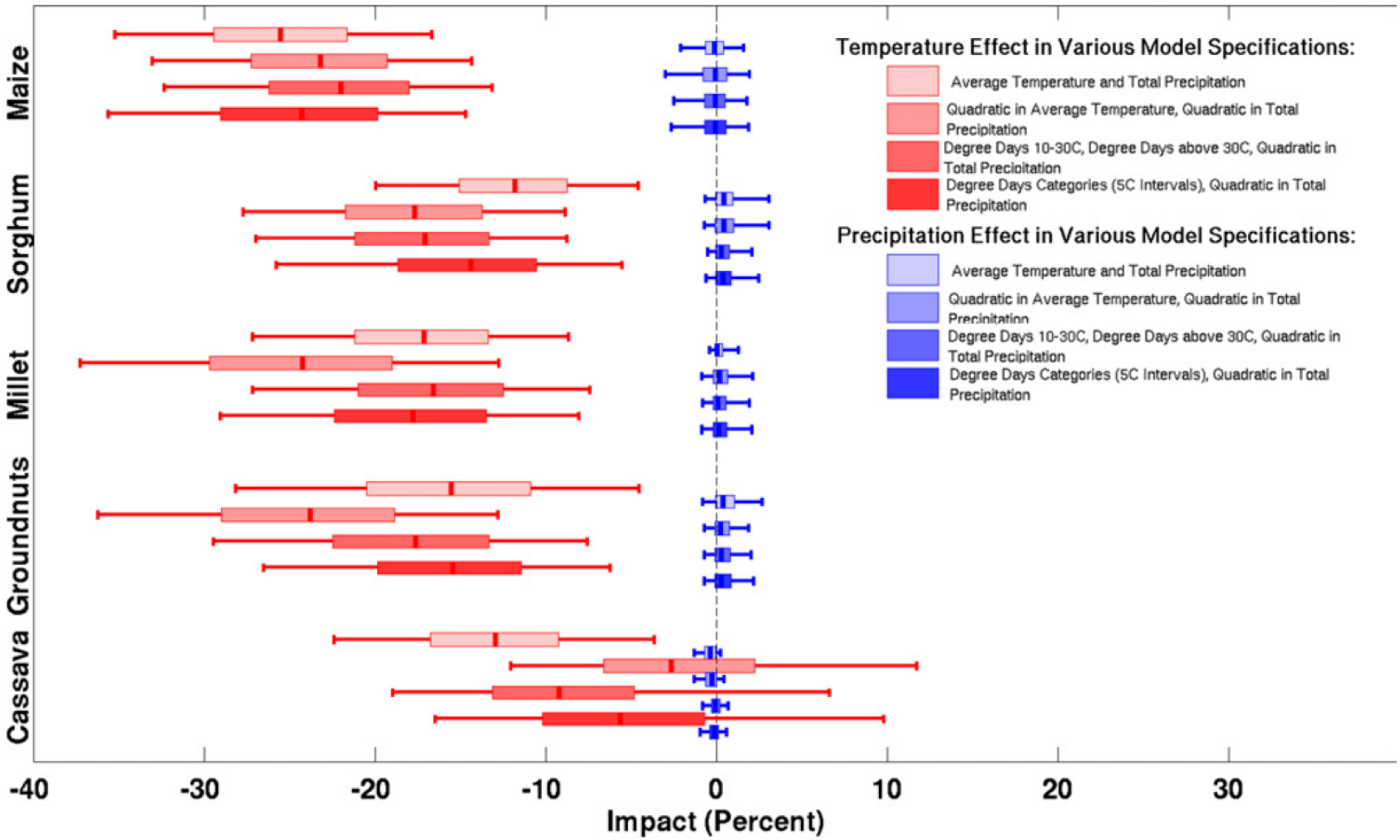

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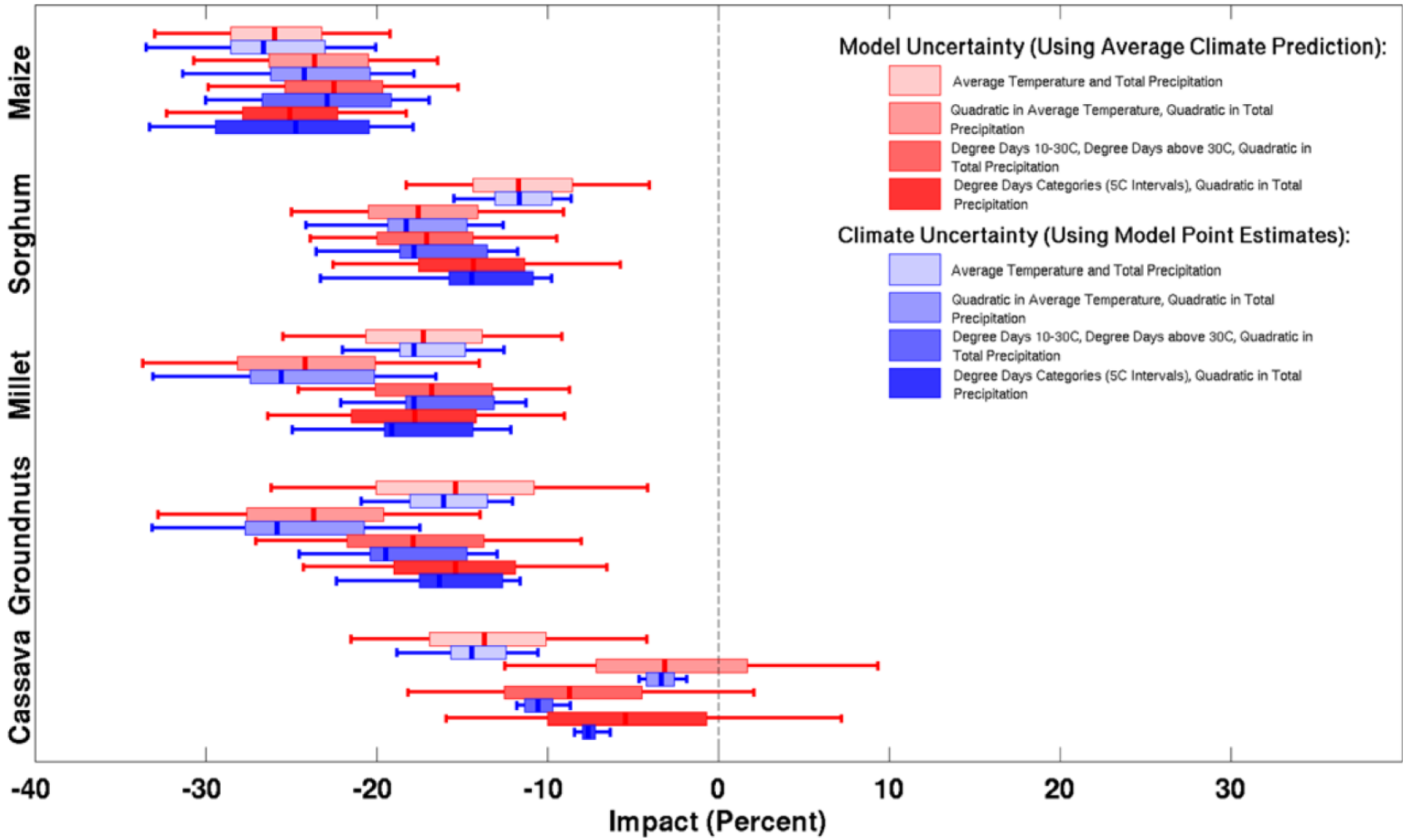

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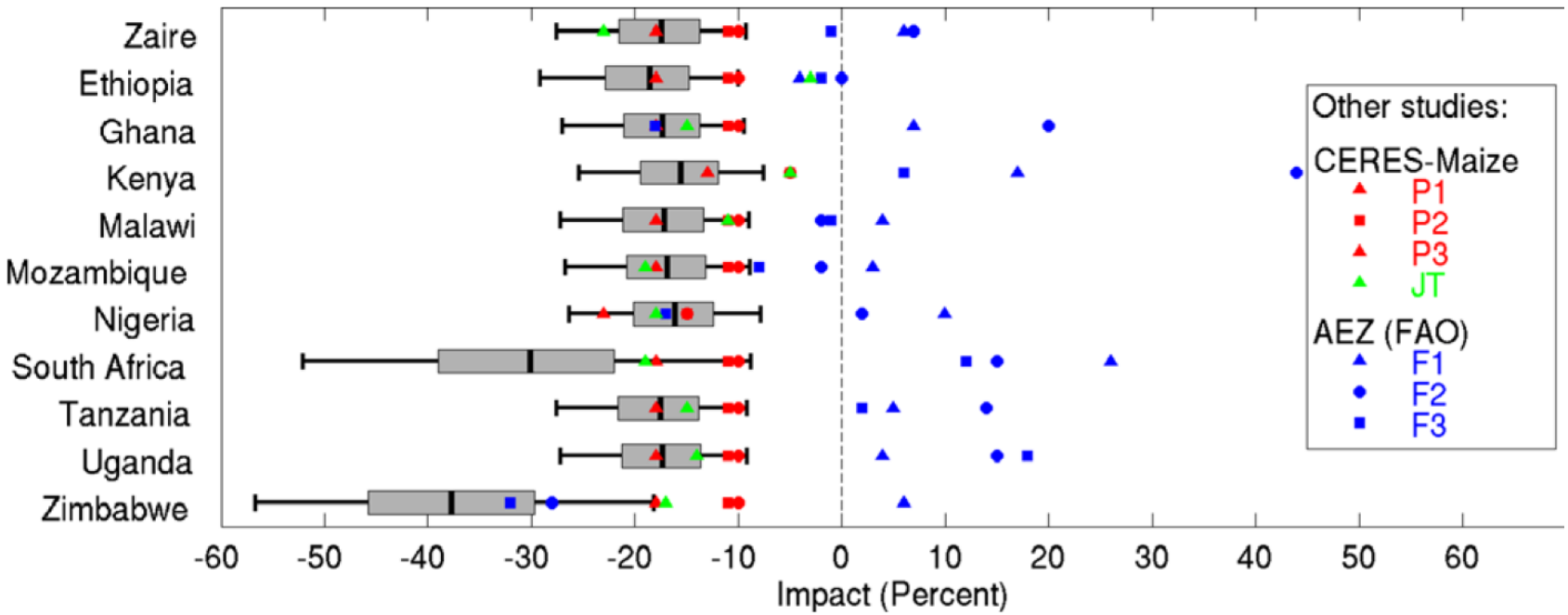

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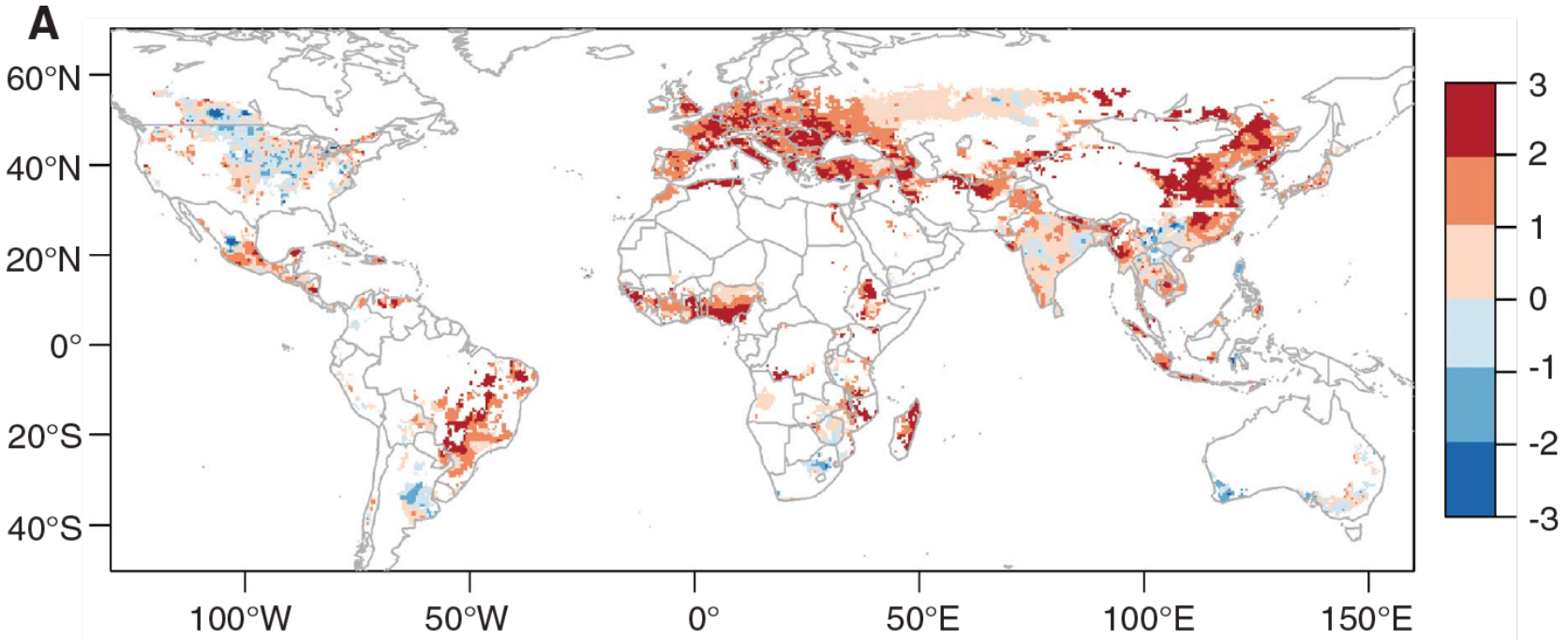
Global Perspective

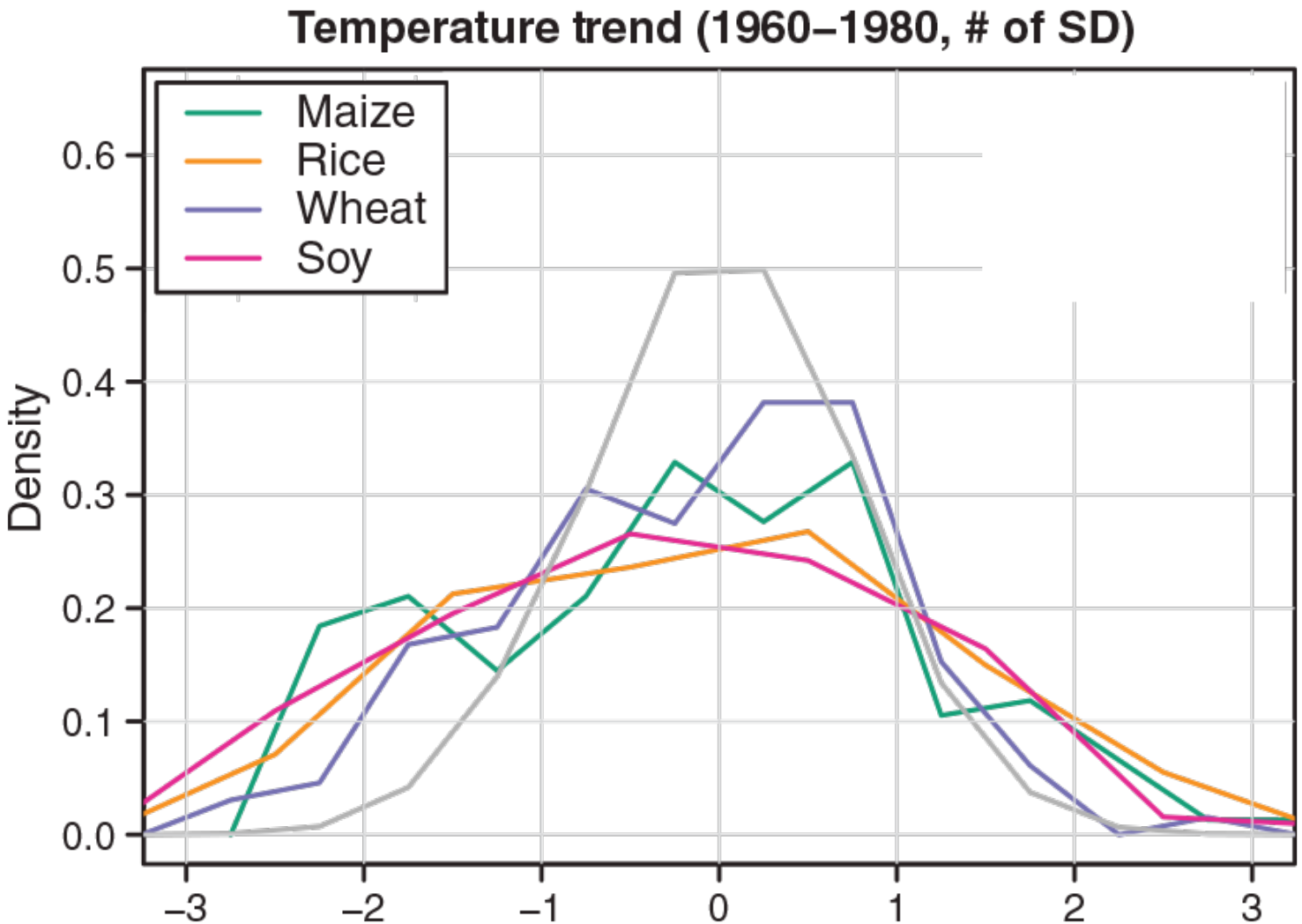
Temperature trends (1980-2008)

Measured in standard deviations of annual growing-season fluctuations



Source: Lobell, Schlenker, and Costa-Roberts *Science* (2011)

Global Perspective - Trends in Countries



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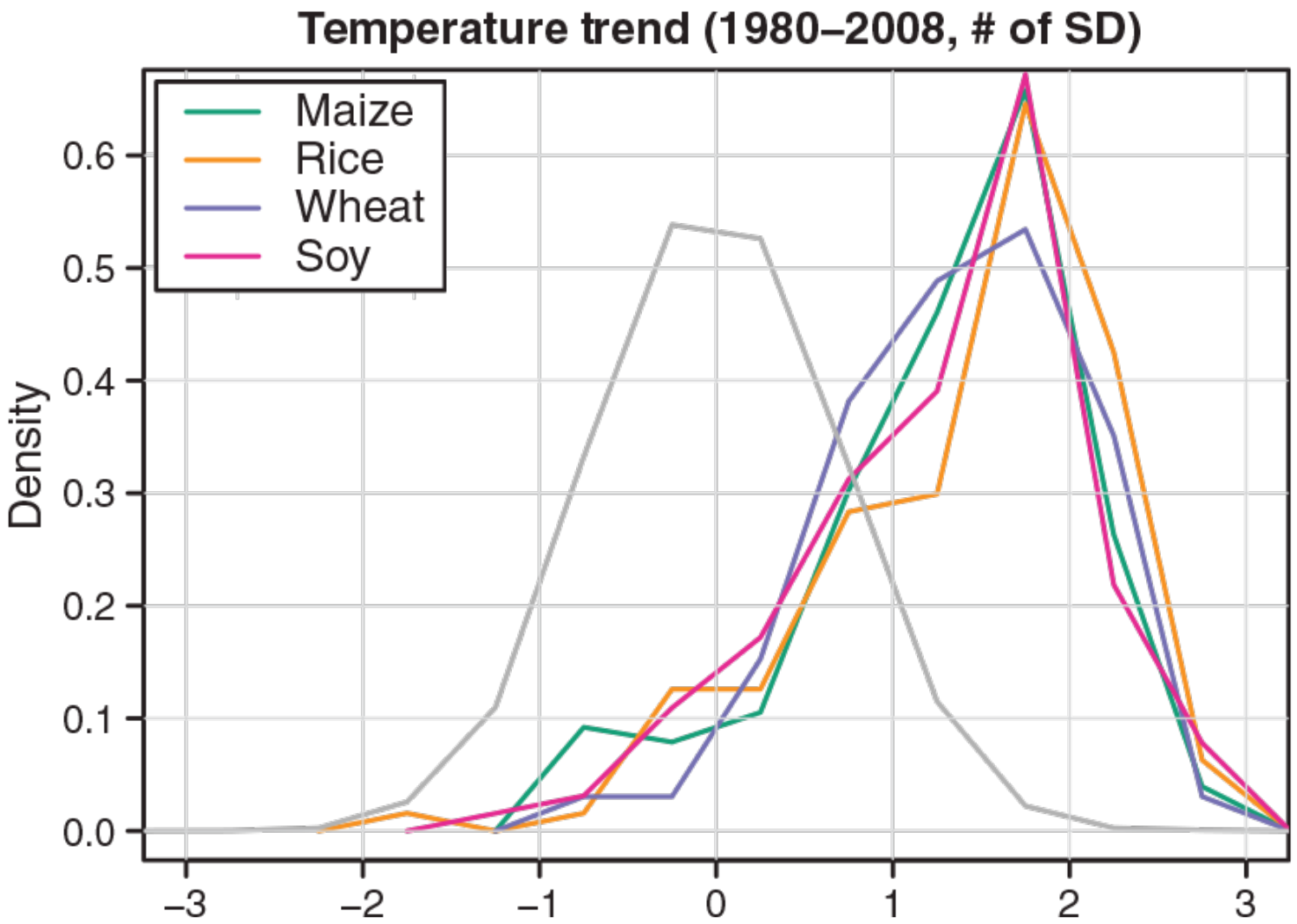

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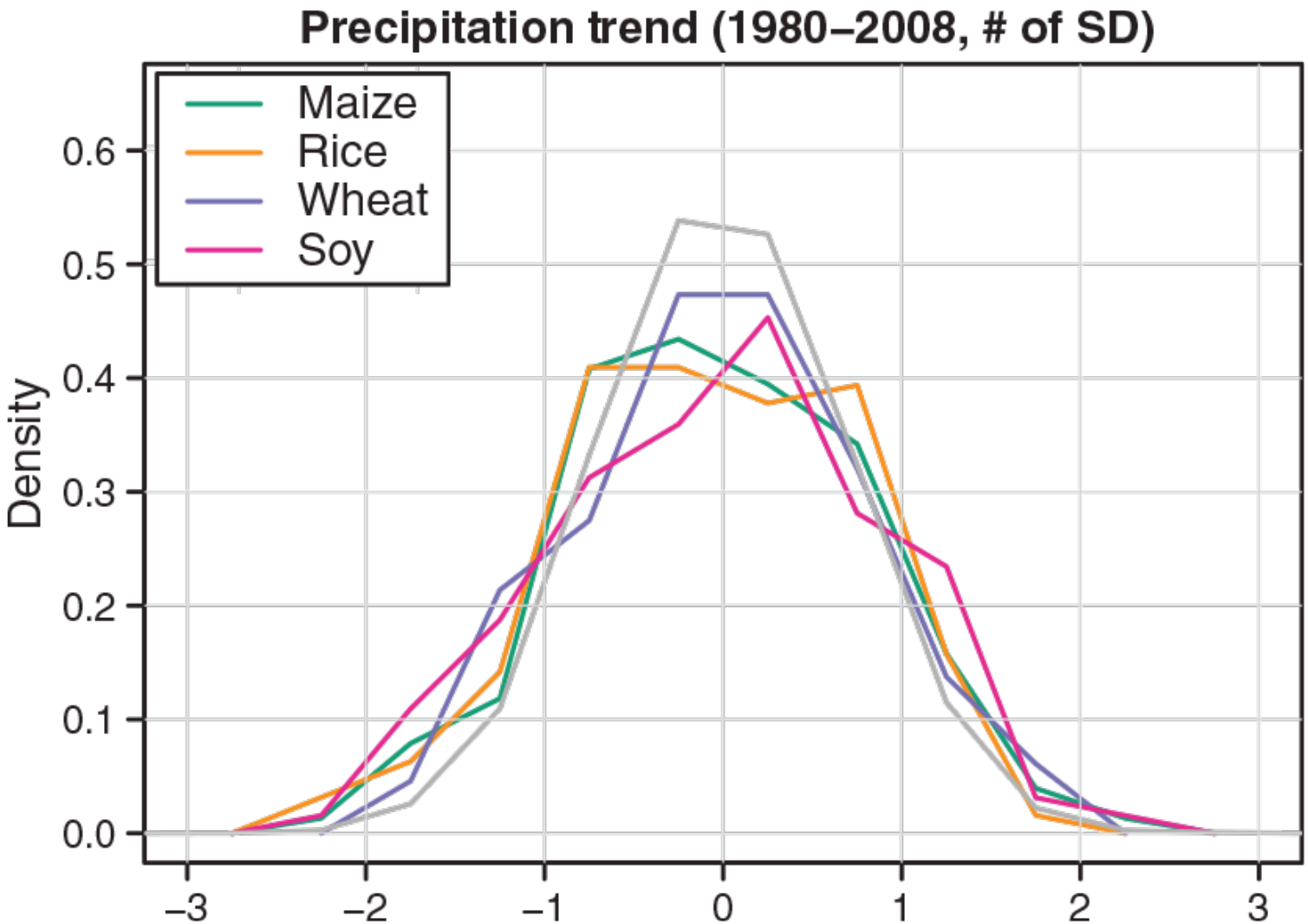

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Impact on Global Production

Crop	Global production, 1998–2002 average (millions of metric tons)	Global yield impact of temperature trends (%)	Global yield impact of precipitation trends (%)	Subtotal	Global yield impact of CO_2 trends (%)	Total
Maize	607	−3.1 (−4.9, −1.4)	−0.7 (−1.2, 0.2)	−3.8 (−5.8, −1.9)	0.0	−3.8
Rice	591	0.1 (−0.9, 1.2)	−0.2 (−1.0, 0.5)	−0.1 (−1.6, 1.4)	3.0	2.9
Wheat	586	−4.9 (−7.2, −2.8)	−0.6 (−1.3, 0.1)	−5.5 (−8.0, −3.3)	3.0	−2.5
Soybean	168	−0.8 (−3.8,1.9)	−0.9 (−1.5, −0.2)	−1.7 (−4.9, 1.2)	3.0	1.3

Source: Lobell, Schlenker, and Costa-Roberts *Science* (2011)

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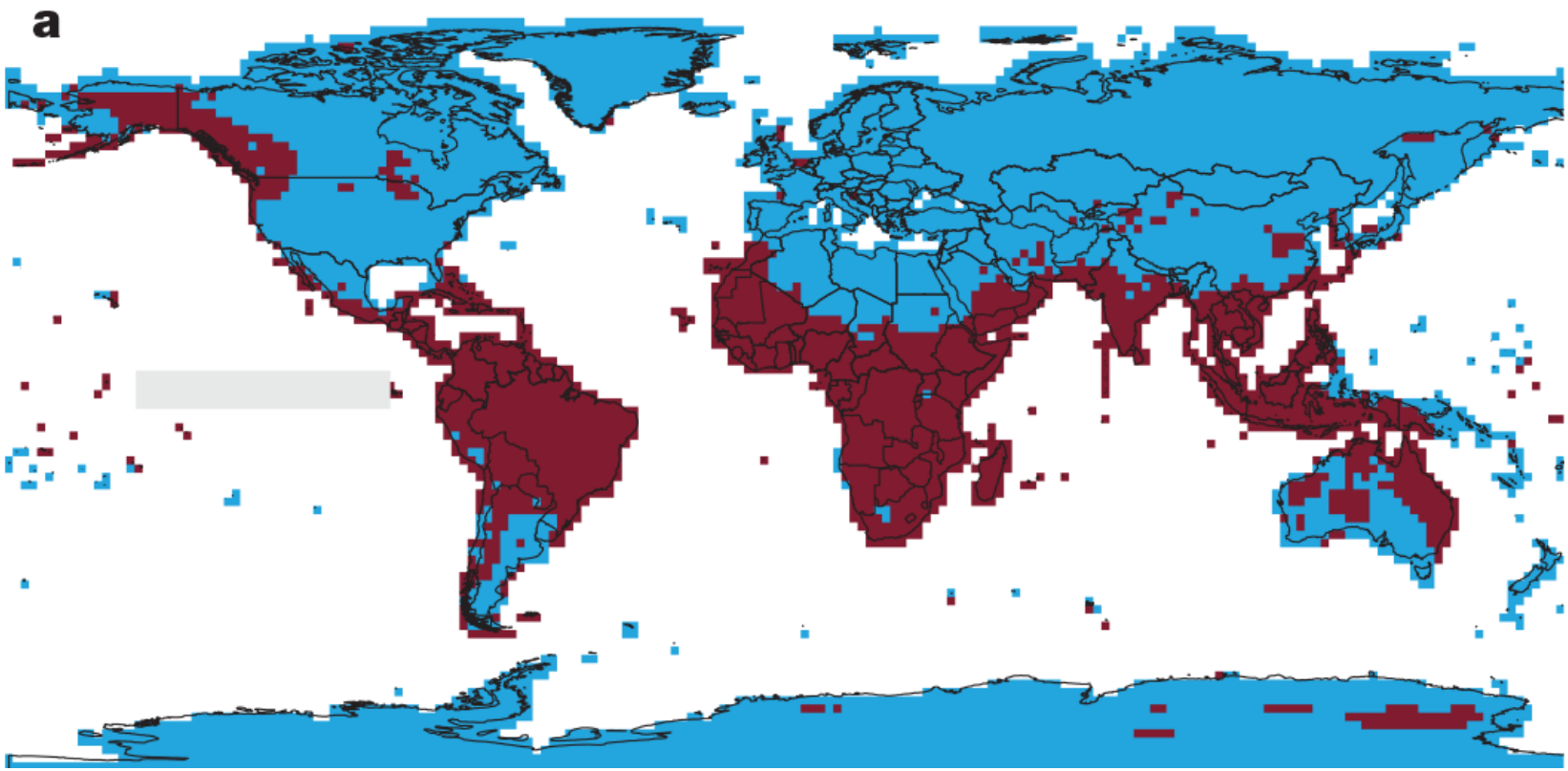
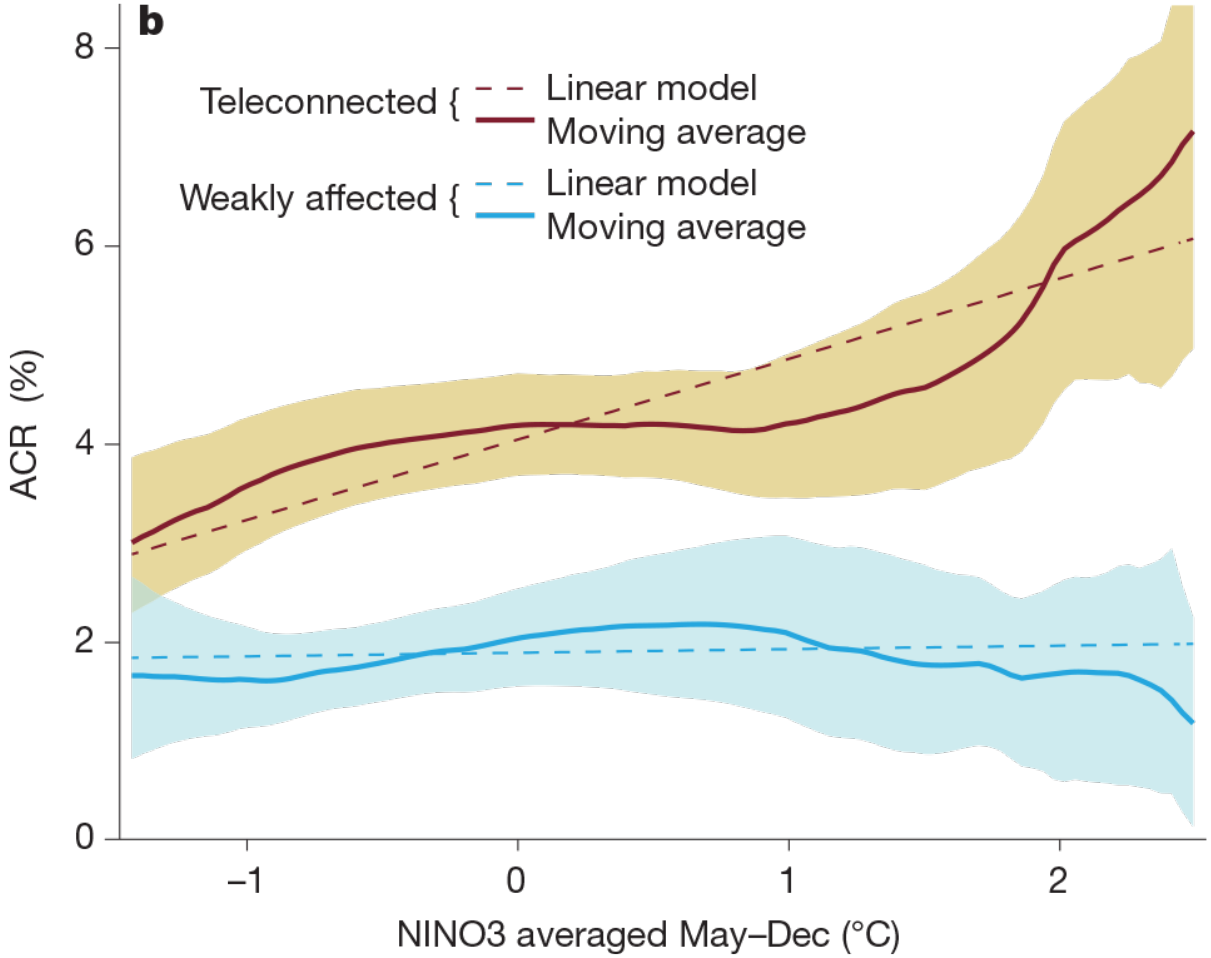
Countries Influenced by El Nino



Source: Hsiang, Meng, and Cane *Nature* (2011)

Effect of El Nino on Civil Conflict

El Nino had a role in 21% of conflicts (1950-2004)



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Looking Forward

- Heat predicted to increase with climate change
- Regional projects
  - For example: increase forests (Abiodun this morning)
- Global projects
  - Restore funding to crop research
    - Large positive spill-overs
    - Private firms don't have right incentive to innovate
  - Trade can mitigate effects
    - Commitment against export bans
    - Shift in growing areas