Macroeconomic Impacts of Climate Change

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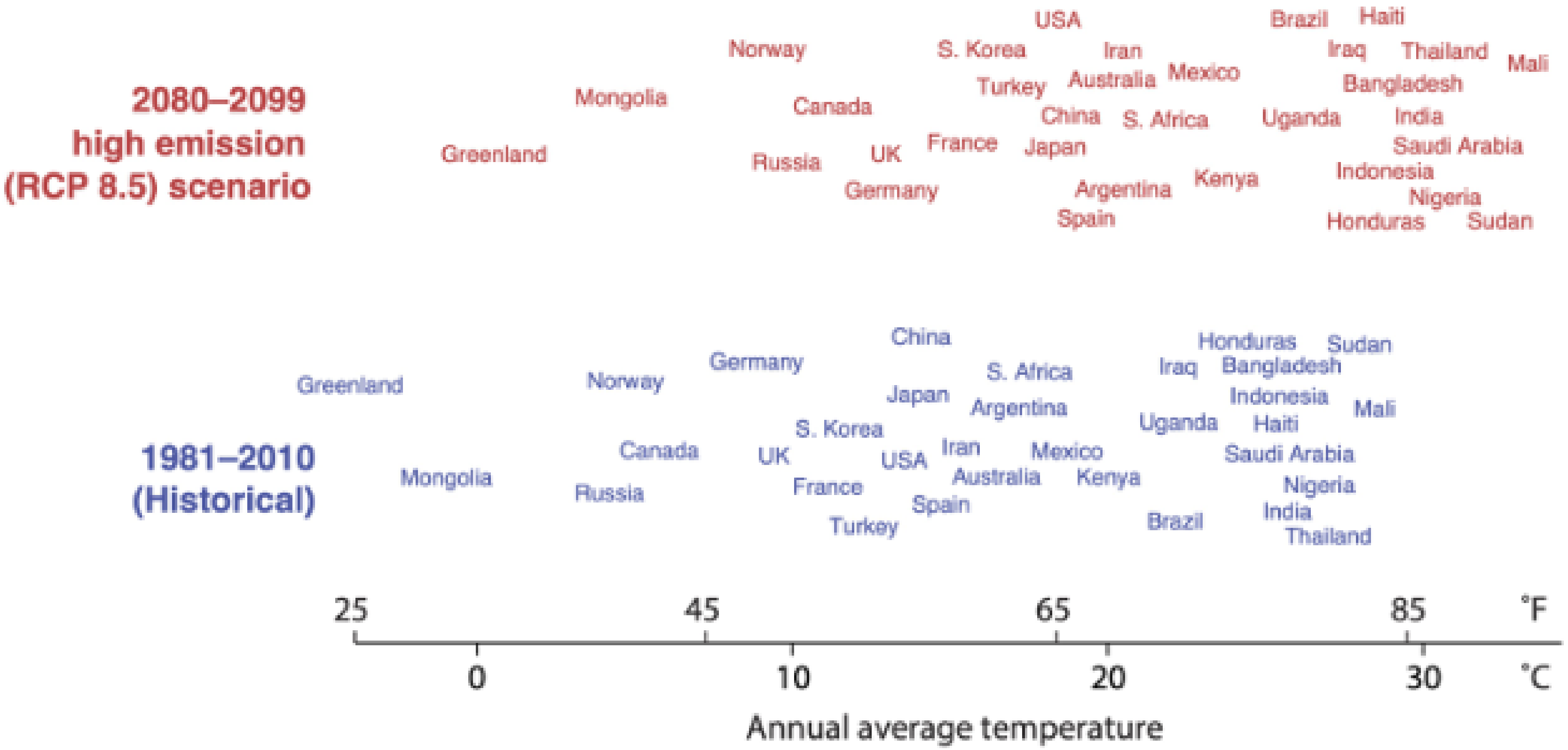
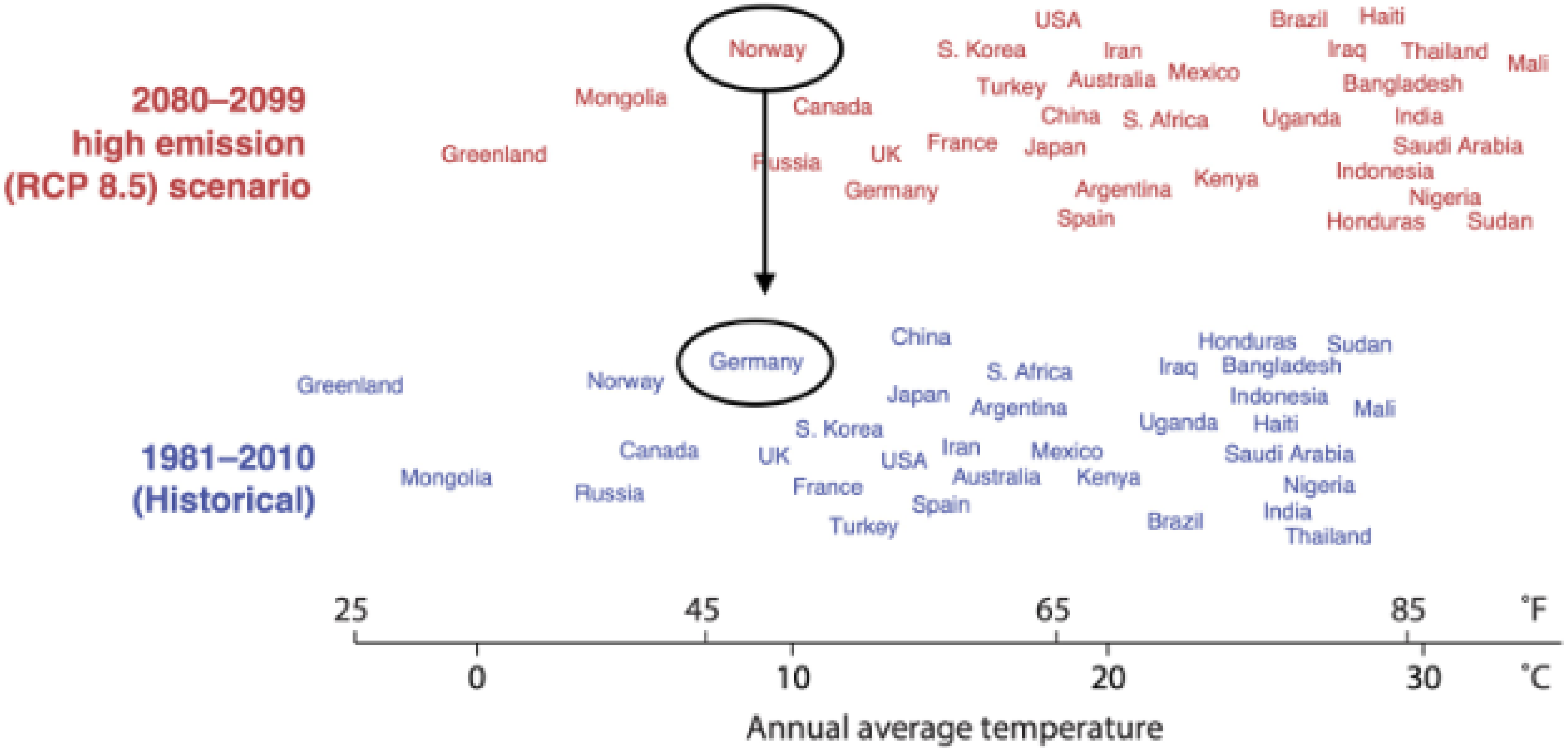
Norges Bank – October 21, 2025

How will climate change transform economies?



Hsiang & Kopp (JEP, 2018)

How will climate change transform economies?



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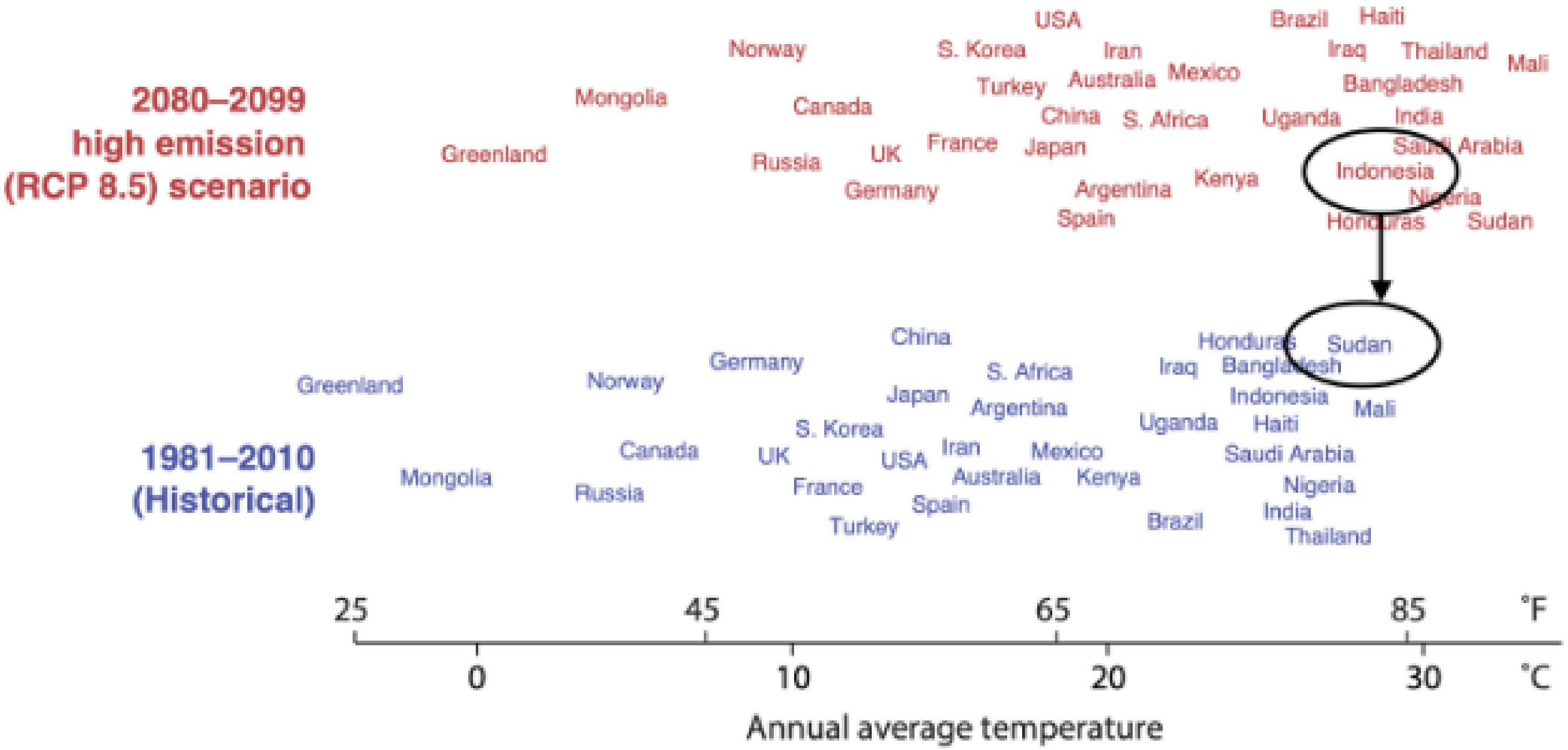
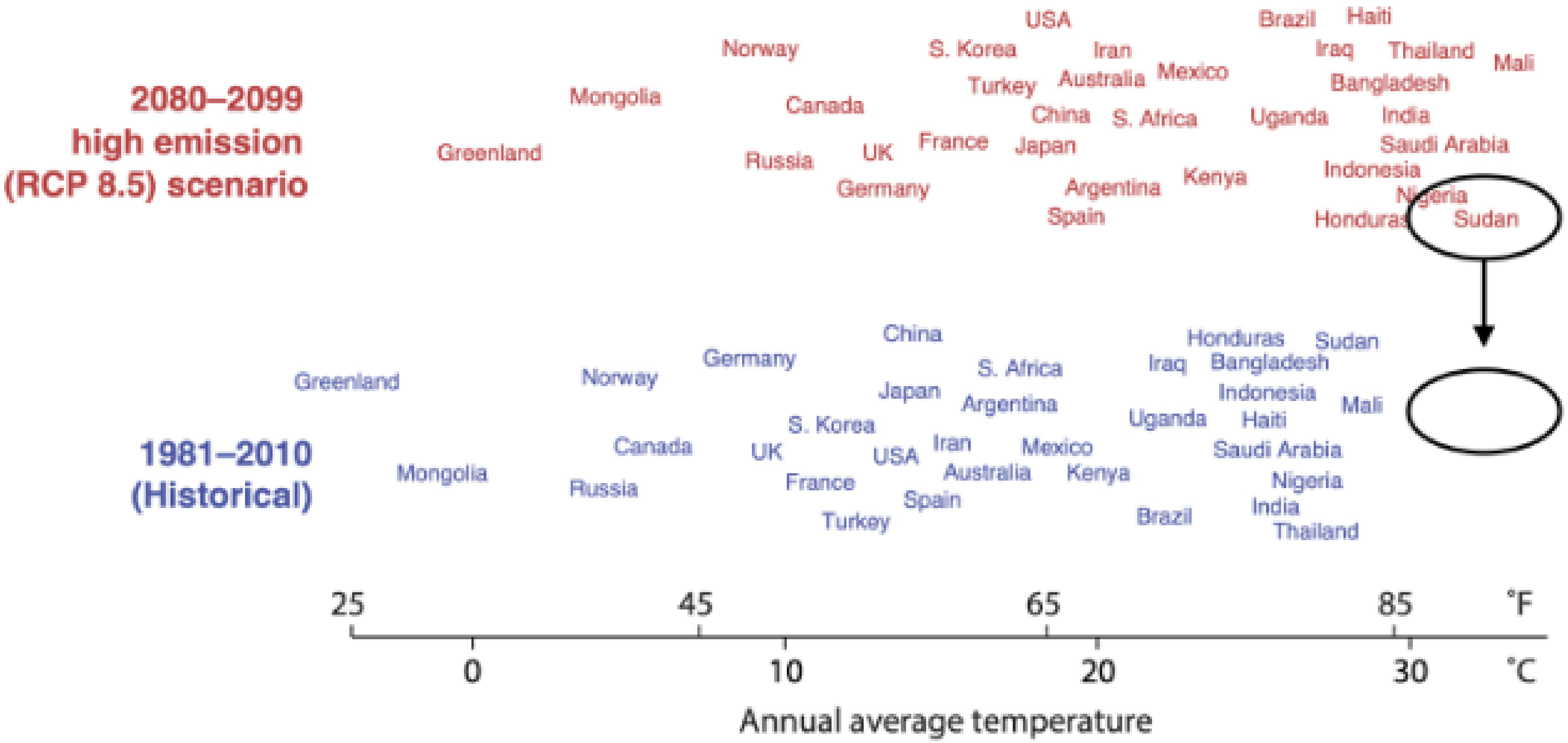
How will climate change transform economies?



Hsiang & Kopp (JEP, 2018)

How will climate change transform economies?



Hsiang & Kopp (JEP, 2018)

Tackling the problem through research design

The Ideal Experiment

1. Take two identical planets.
2. Change the climate of one (treatment).
3. Compare to control planet.

Tackling the problem through research design

The Ideal Experiment

1. Take two identical planets.
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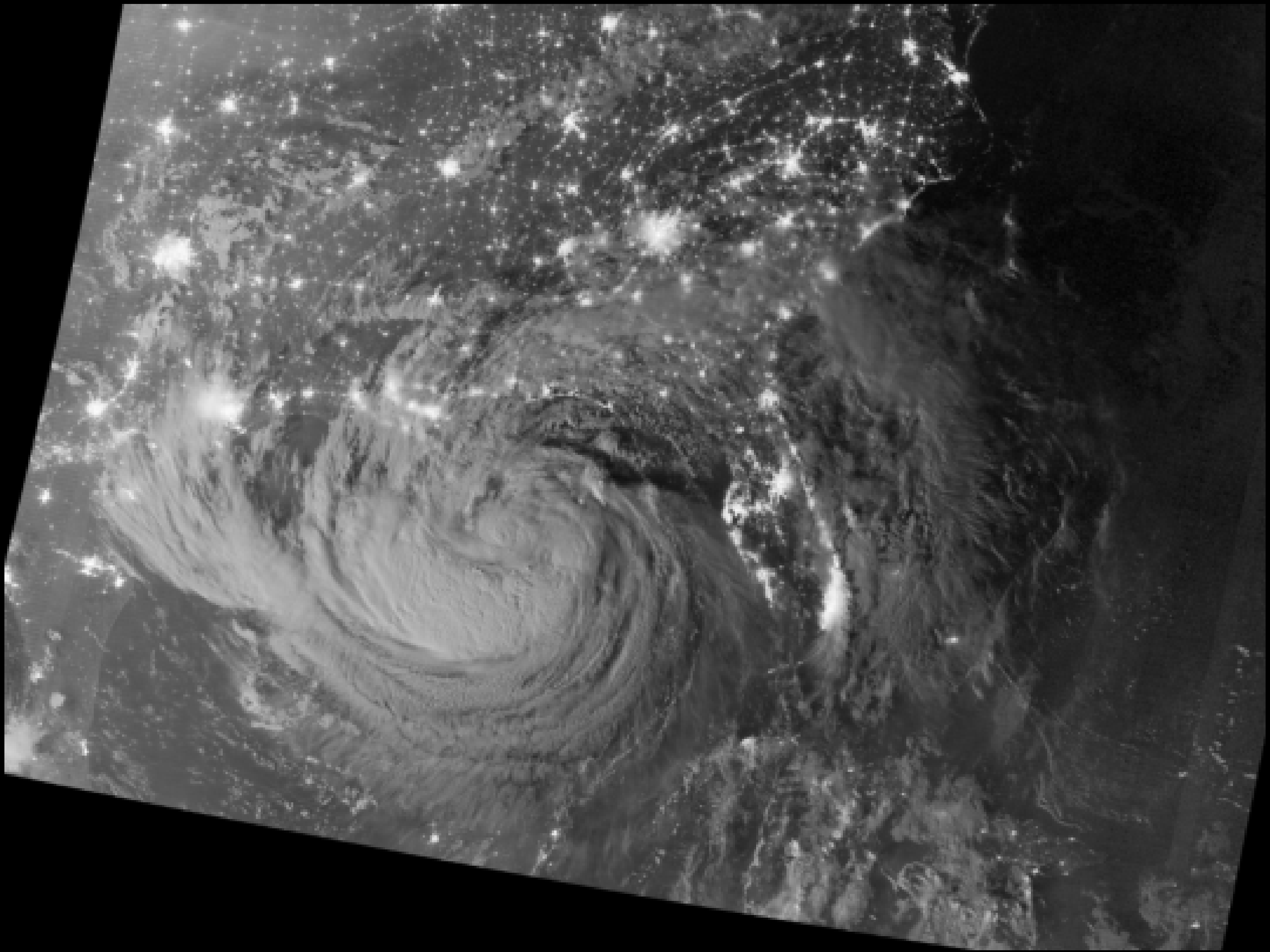
The Natural-Experiment (that we can actually do)

Step one: Reconstruct a history of each population's physical exposure to climatic conditions.

Step two: Estimate the effect of changes over time for each population:

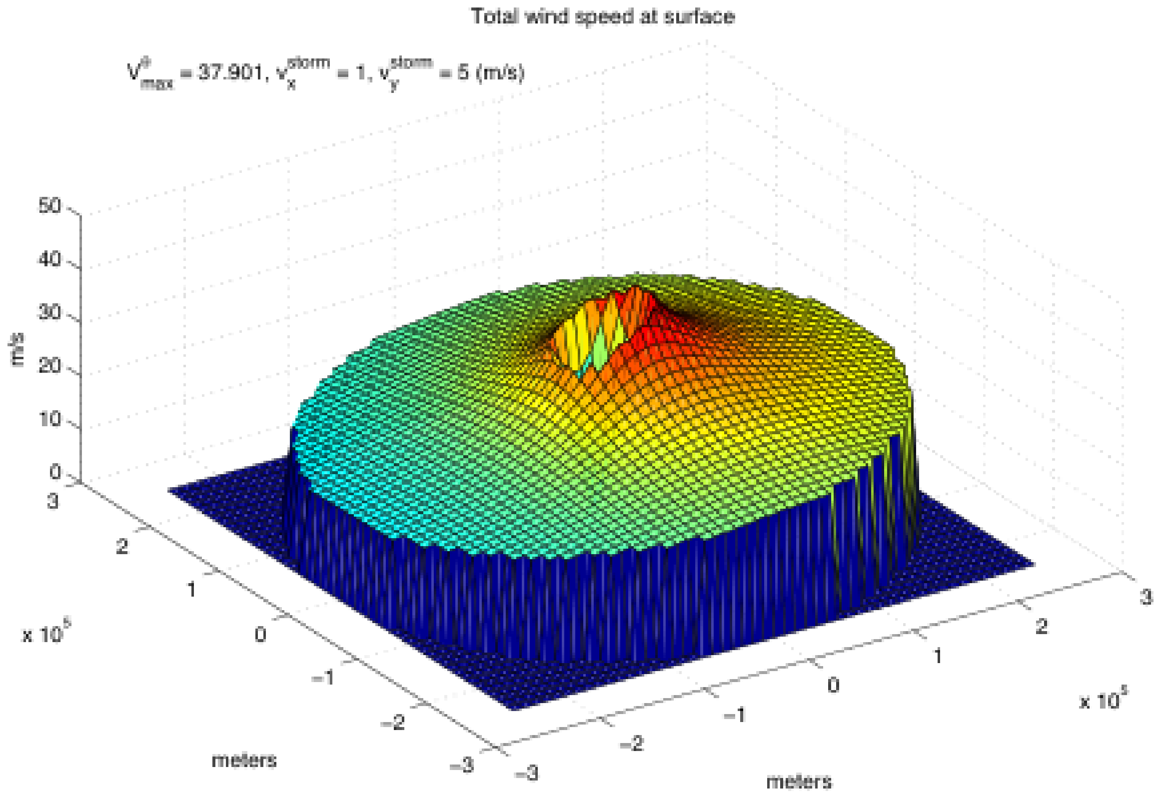
High climate exposure - "treatment"

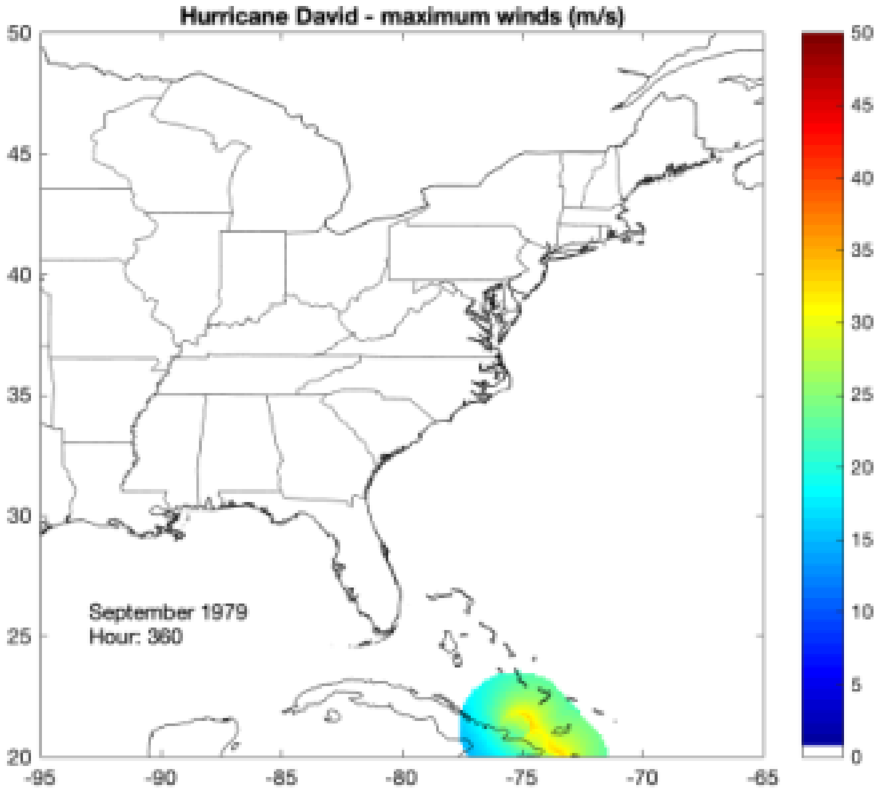
Low climate exposure - "control"



LICRICE:

Limited Information Cyclone Reconstruction and Integration for Climate and Economics





Hurricane David - maximum winds (m/s)
September 1979
Hour: 360
50
45
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-95
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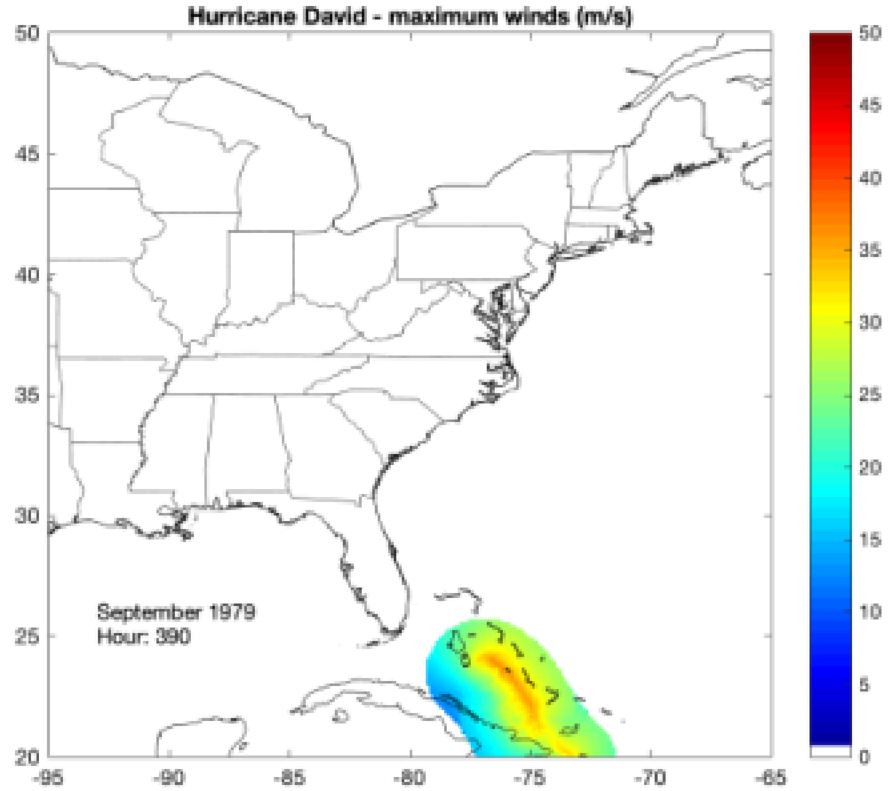

Hurricane David - maximum winds (m/s)
September 1979
Hour: 390
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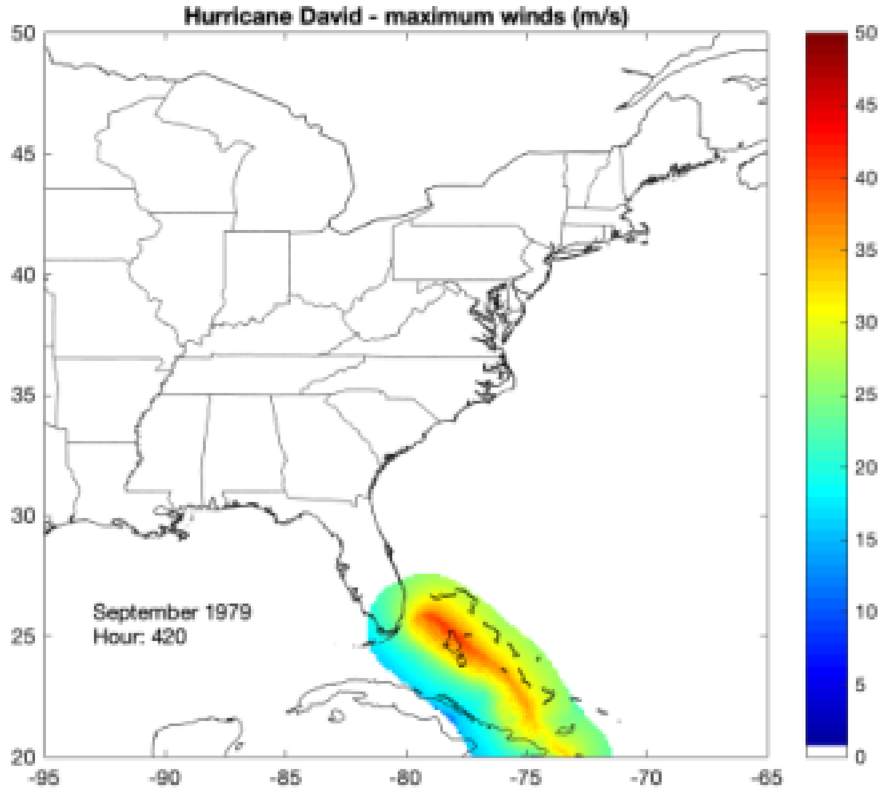

Hurricane David - maximum winds (m/s)
September 1979
Hour: 420
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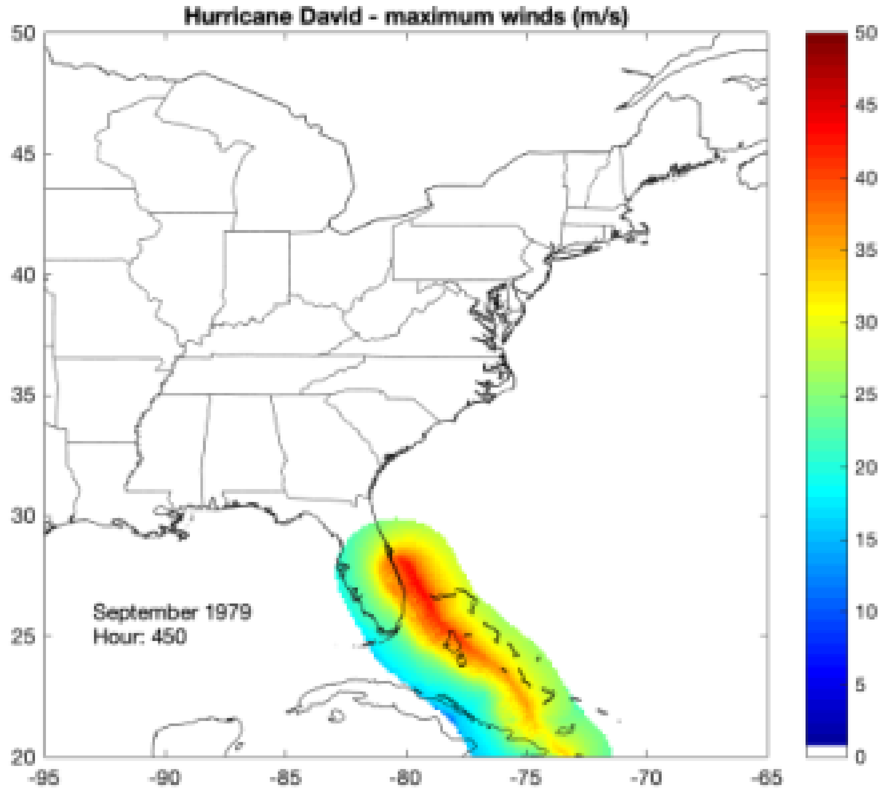
Hurricane David - maximum winds (m/s)
September 1979
Hour: 450
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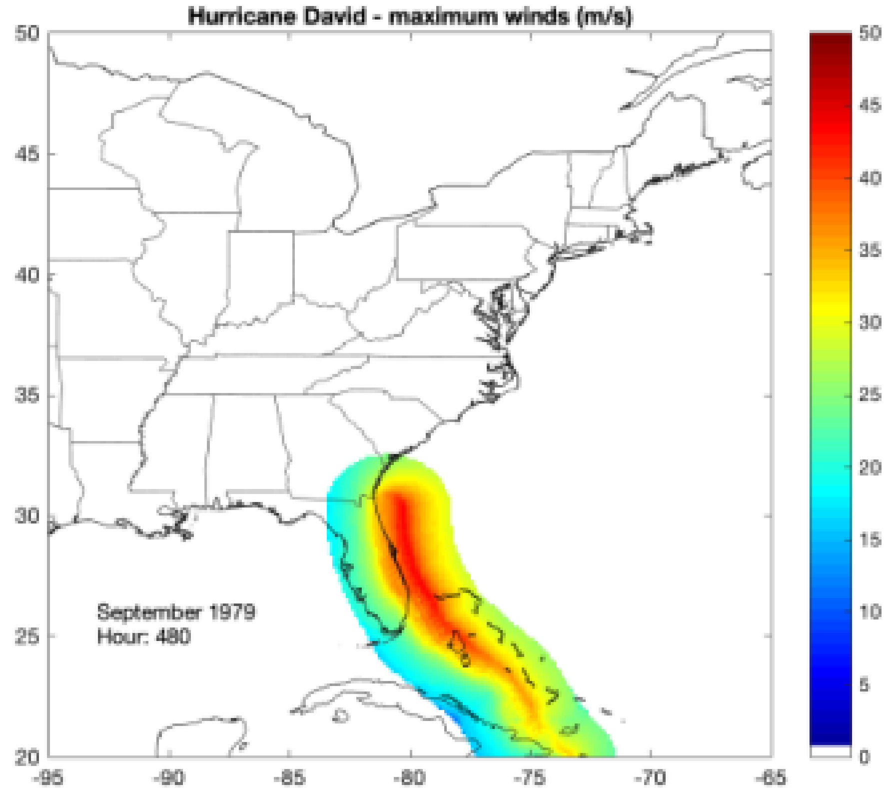
Hurricane David - maximum winds (m/s)
September 1979
Hour: 480
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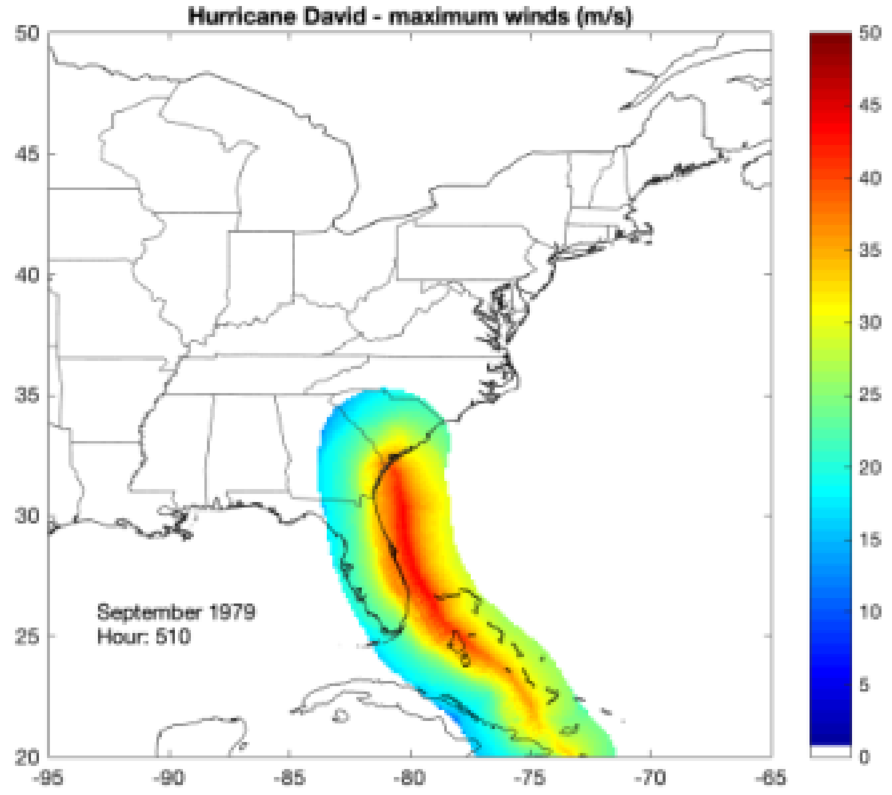
Hurricane David - maximum winds (m/s)
September 1979
Hour: 510
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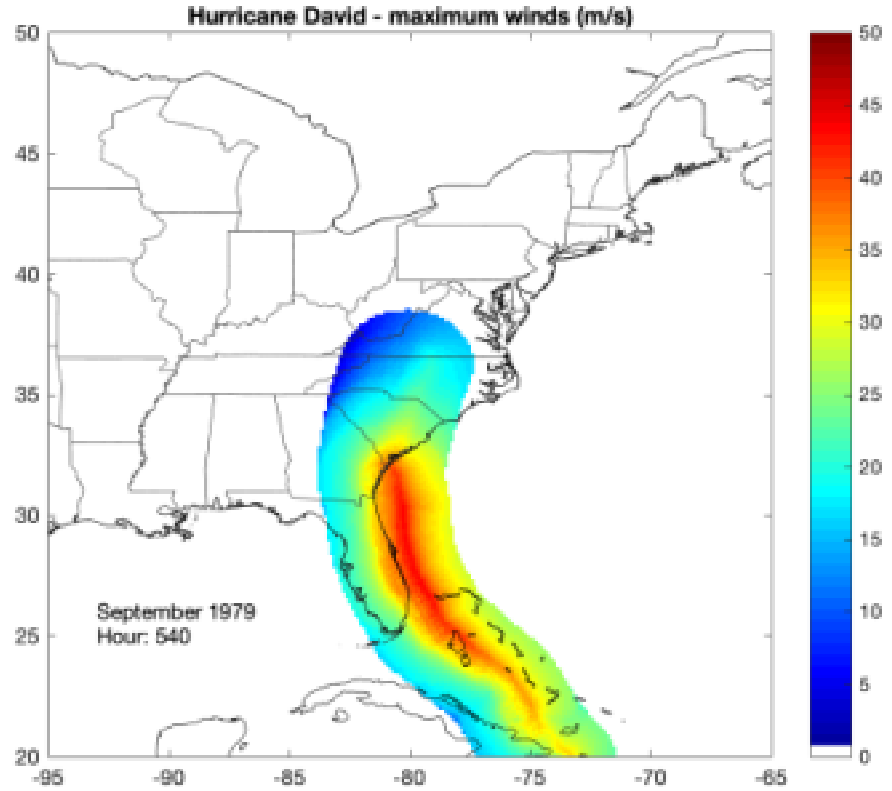

Hurricane David - maximum winds (m/s)
September 1979
Hour: 540
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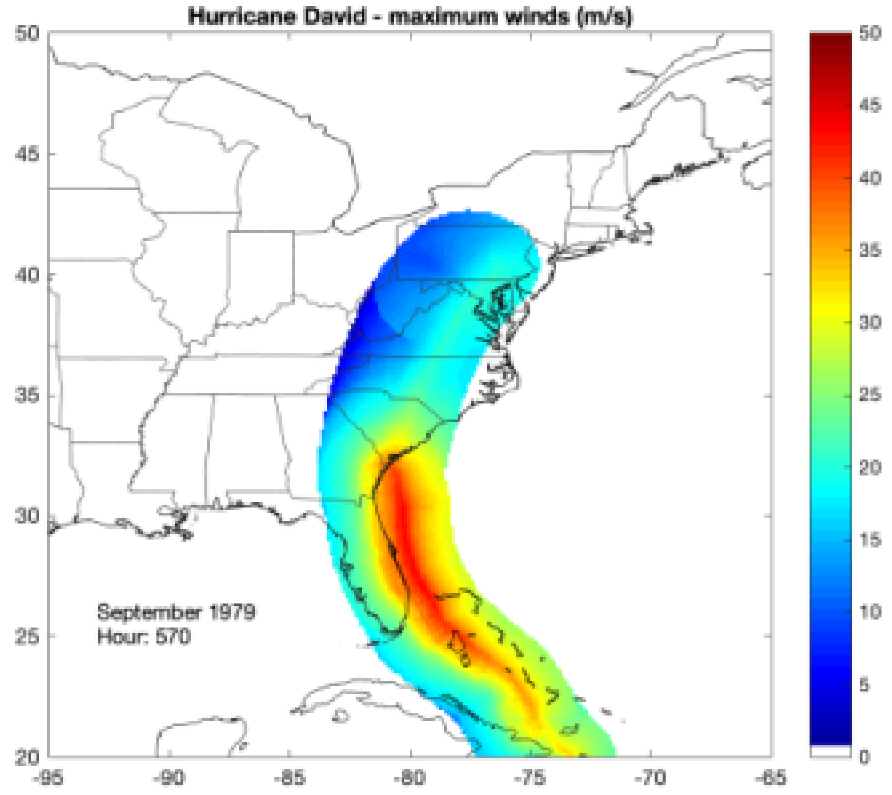

Hurricane David - maximum winds (m/s)
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September 1979
Hour: 570
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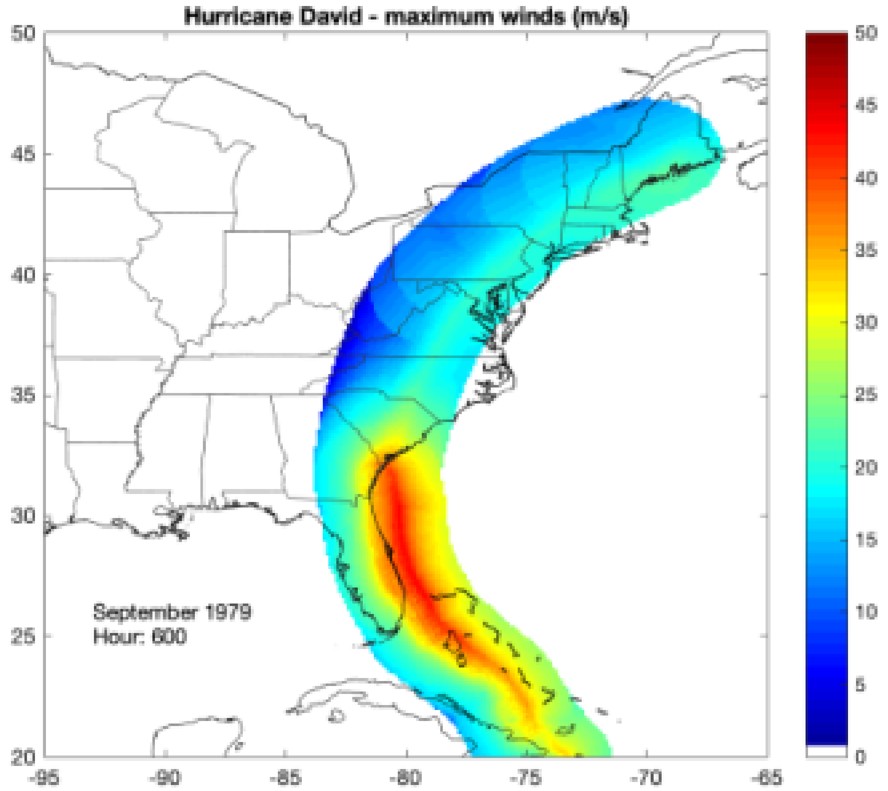
Hurricane David - maximum winds (m/s)
September 1979
Hour: 600
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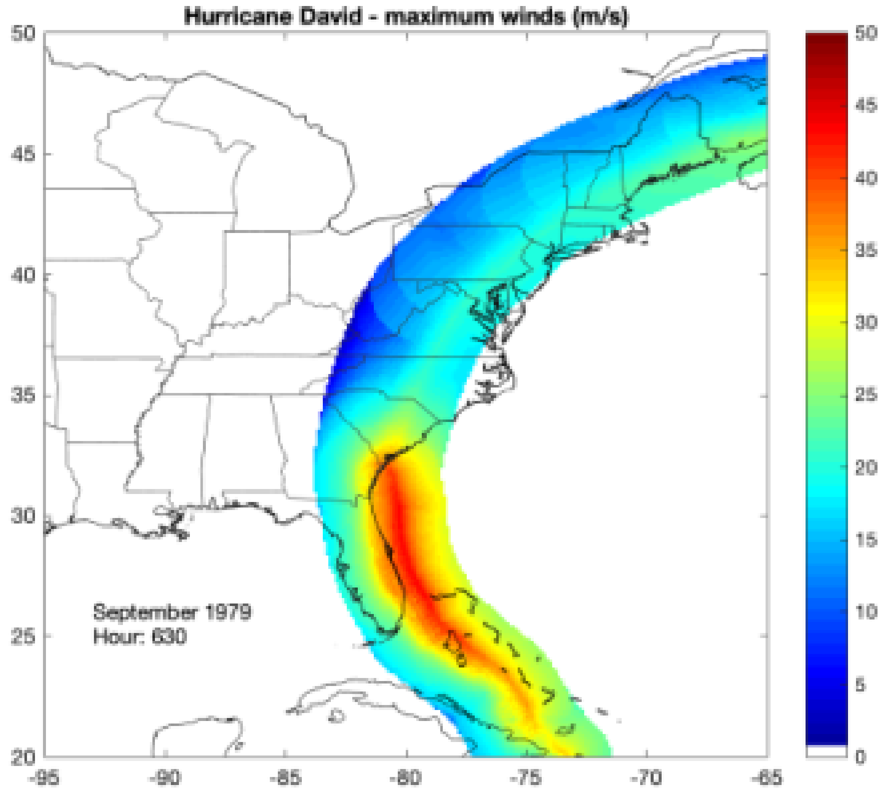

Hurricane David - maximum winds (m/s)
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September 1979
Hour: 630
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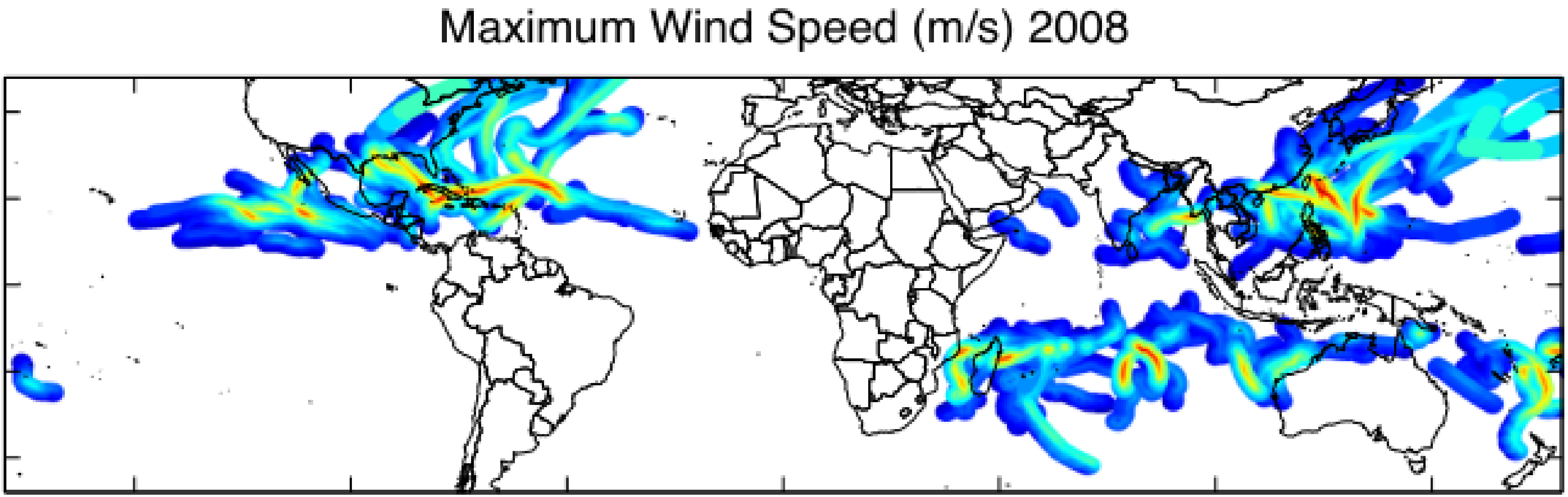
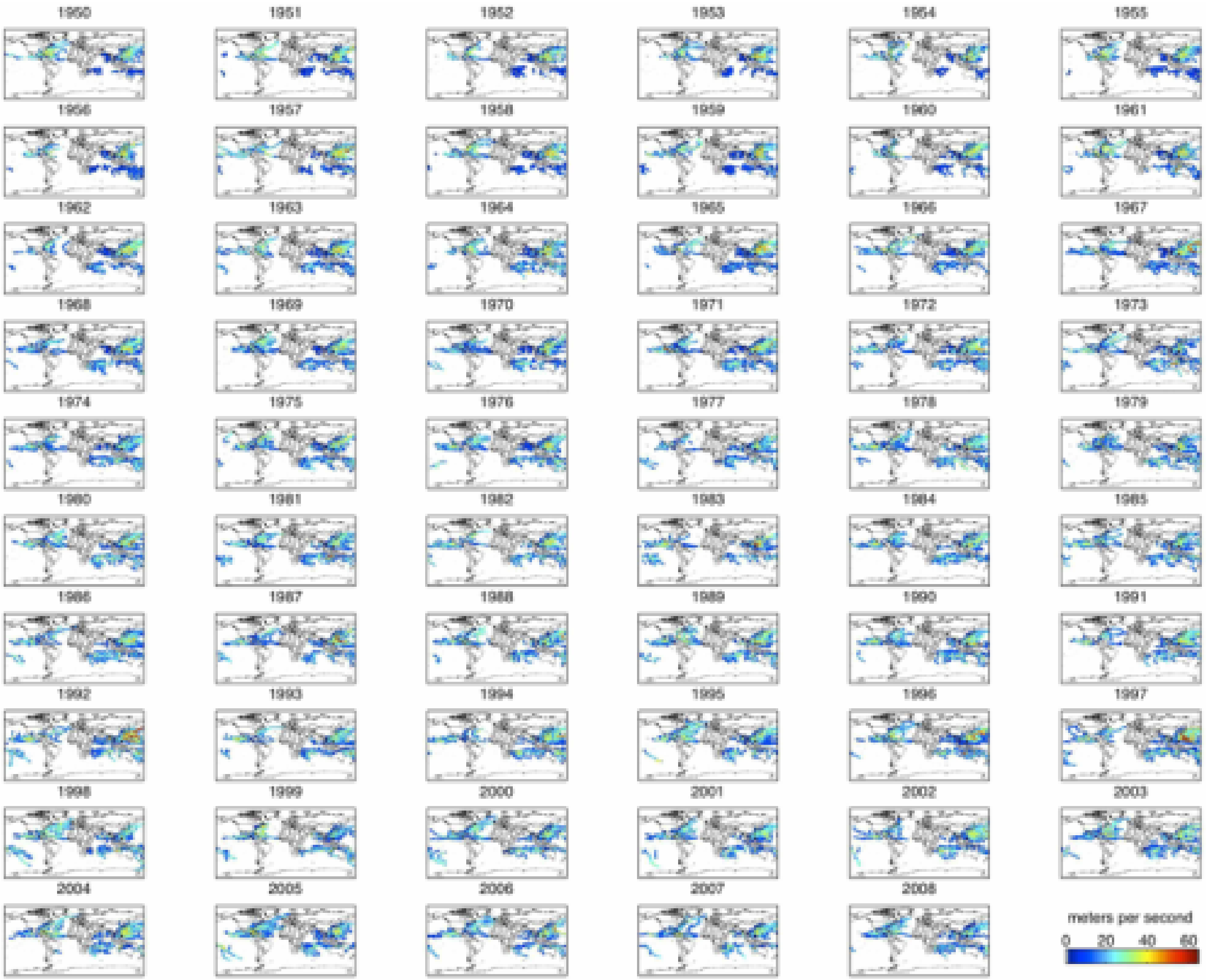
All storms within a year (LICRICE)

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meters per second
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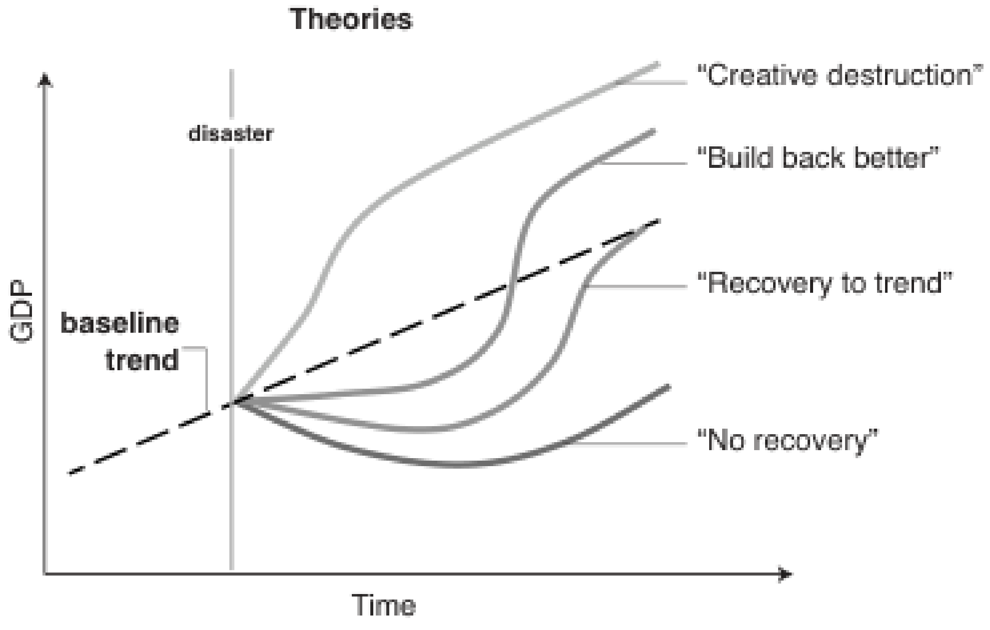
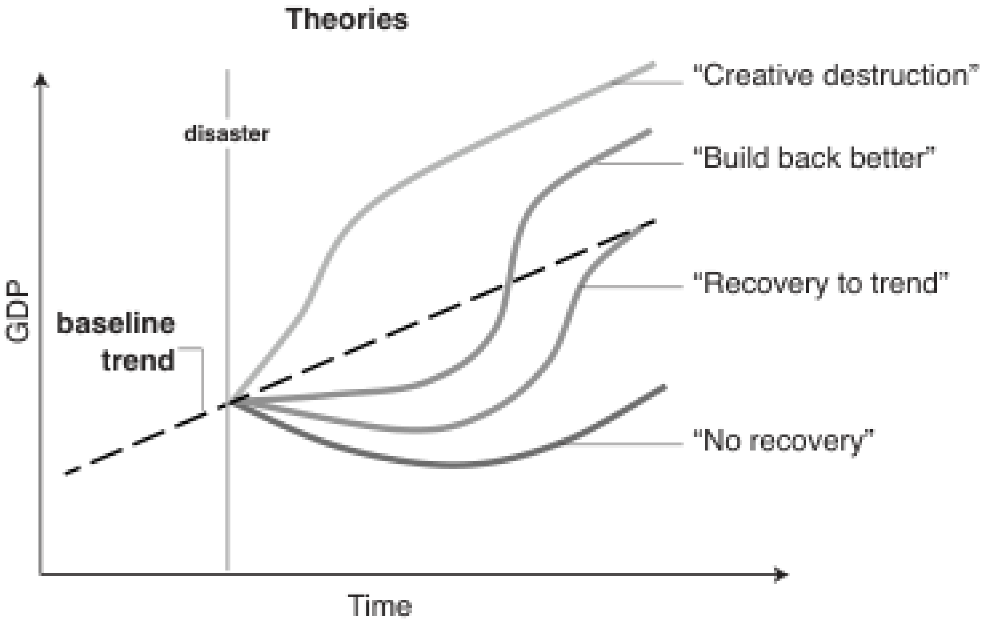
20
40
60

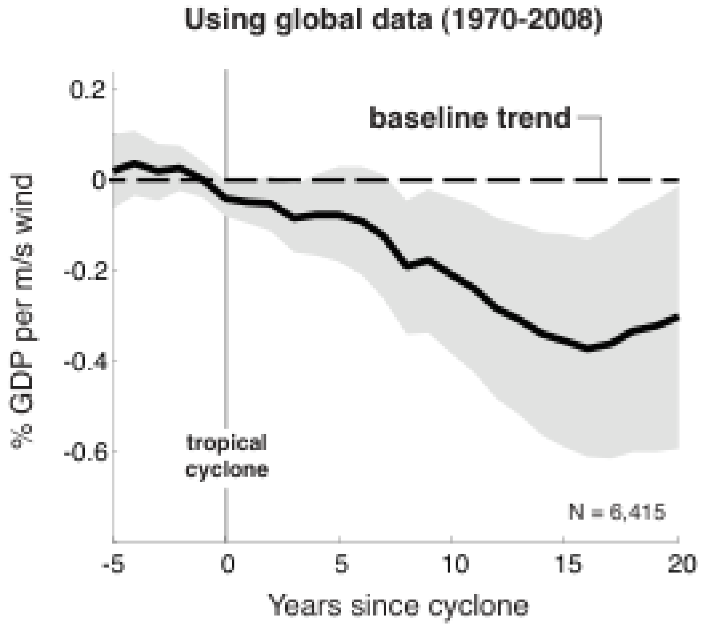
Macroeconomic impact of a cyclone: Theories vs. Evidence



Hsiang & Jina (2014)

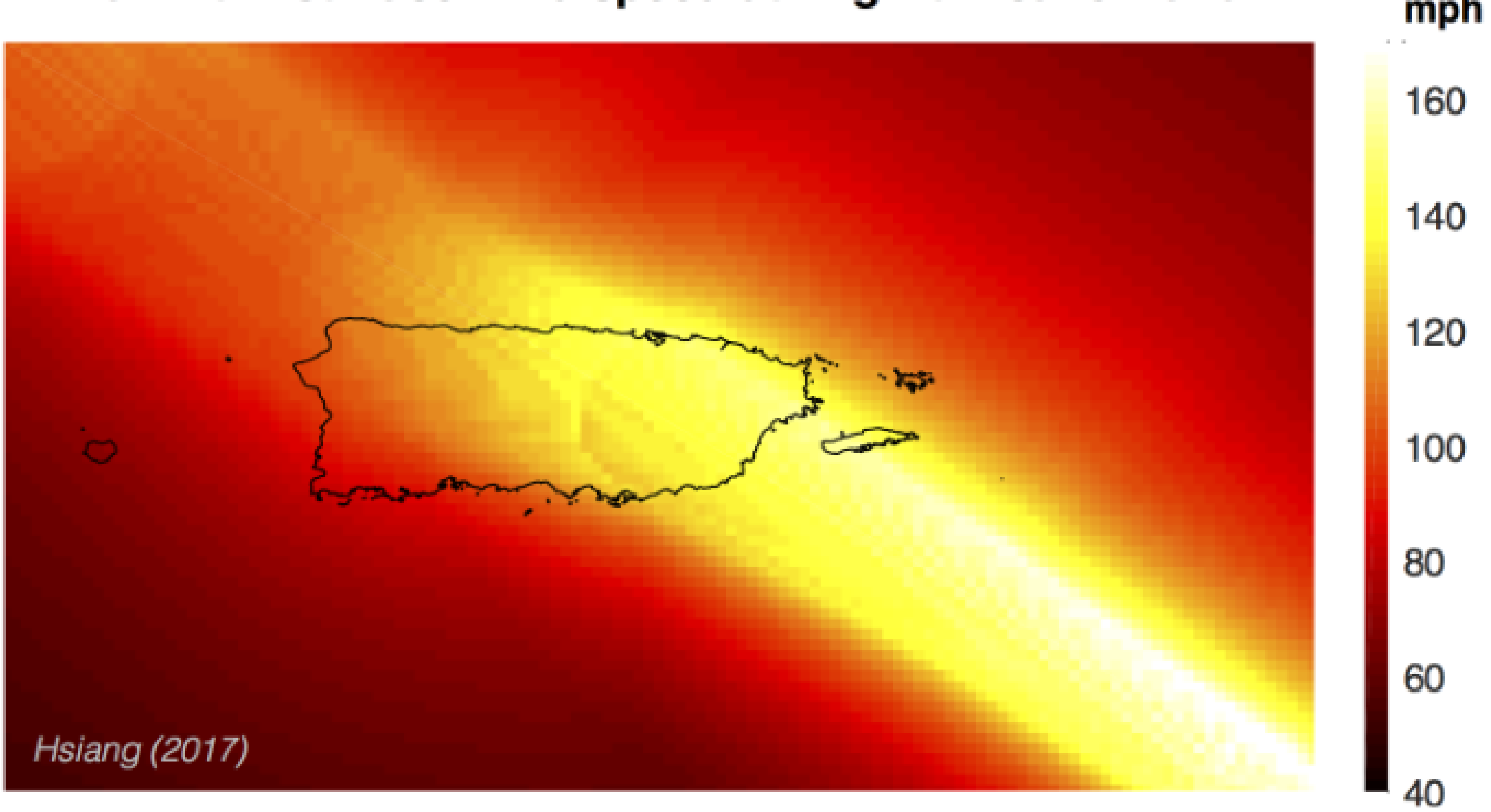
Macroeconomic impact of a cyclone: Theories vs. Evidence





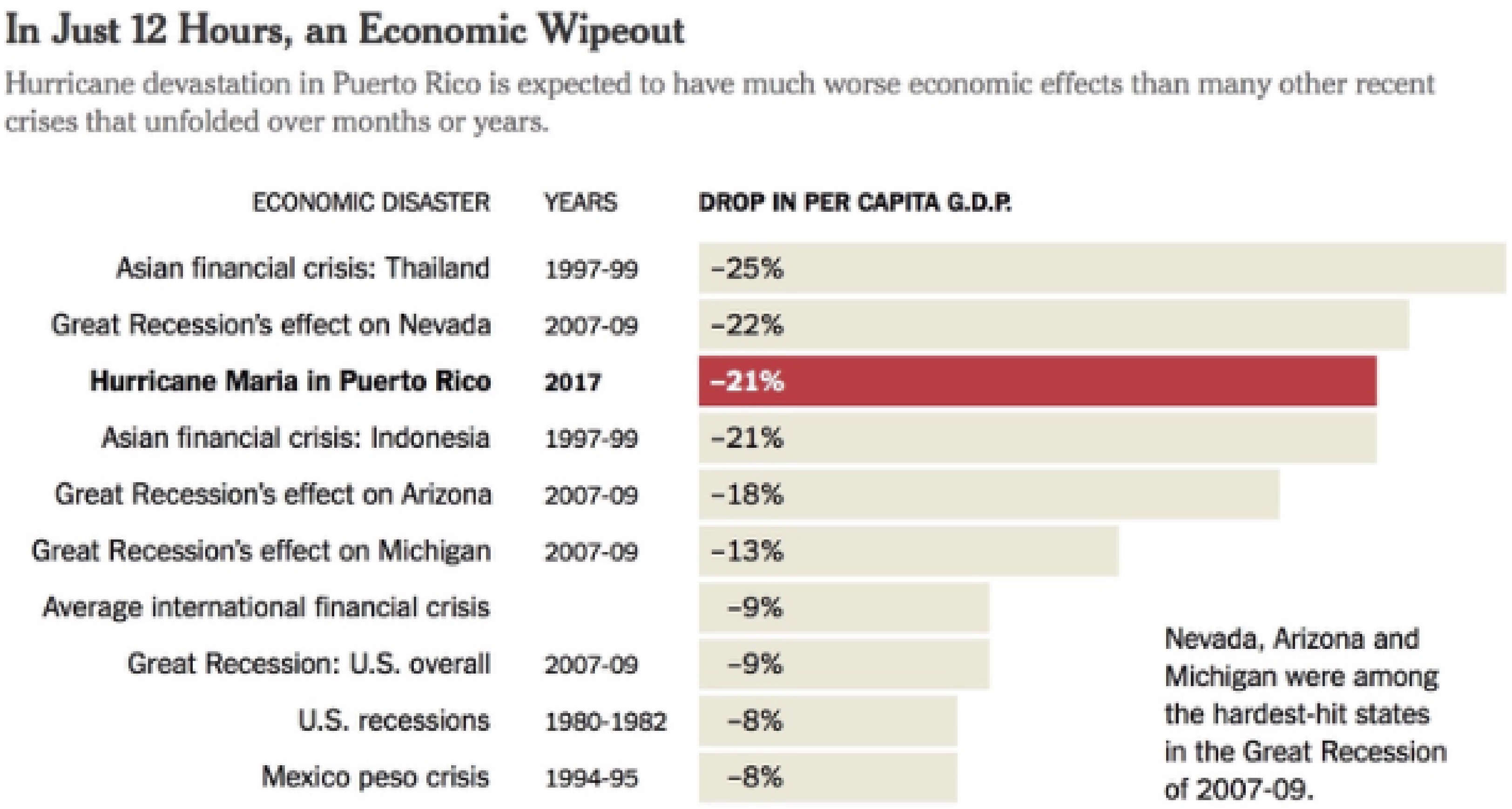
Hsiang & Jina (2014)

Maximum surface wind speed during Hurricane Maria

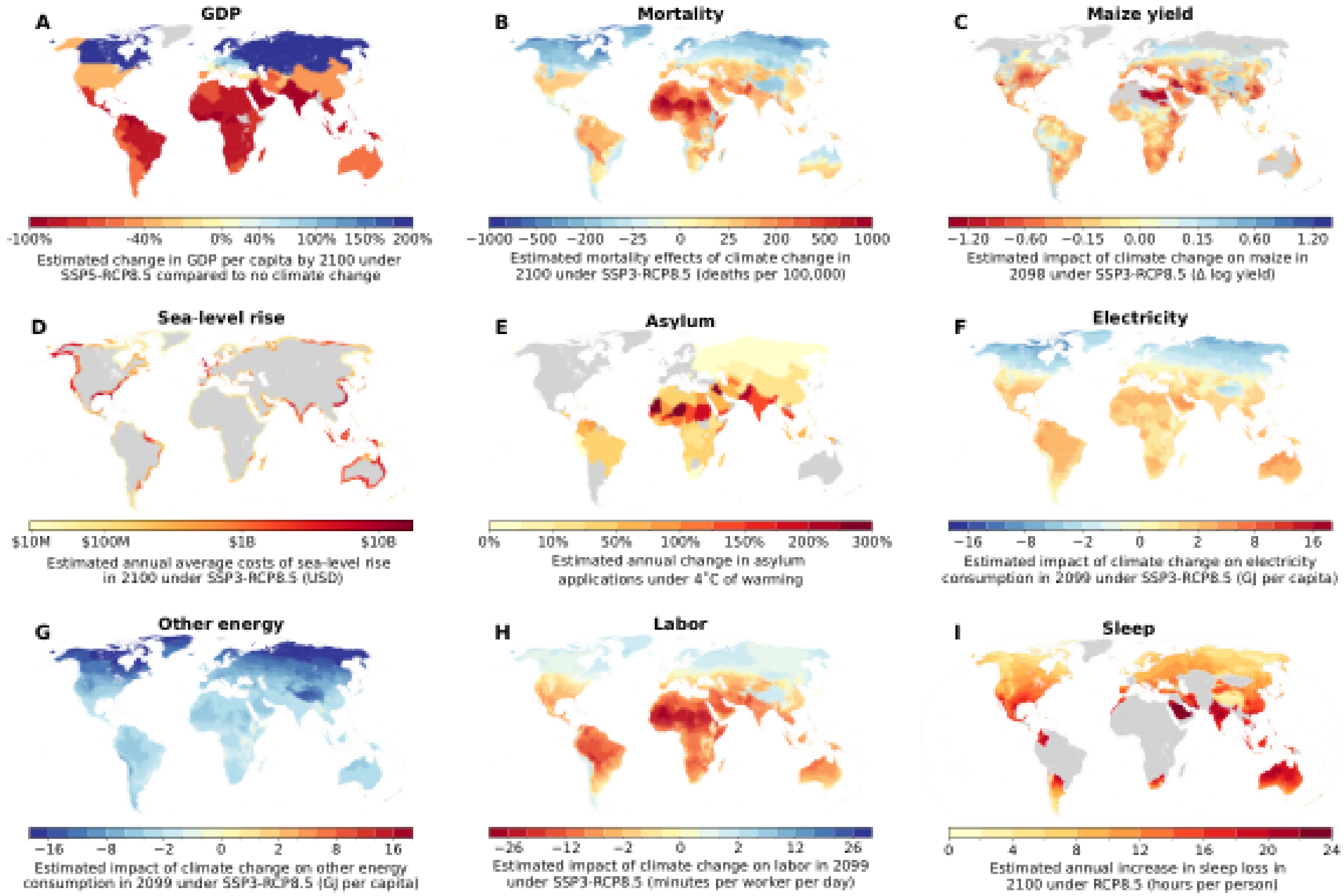


S. Hsiang | Stanford

Undoing 26 years of Puerto Rican growth in 12 hours



Hsiang & Houser (New York Times, 2017)



Hsiang (Annual Rev. Econ., *in press*)

Why might temperature matter for the macro-economy?

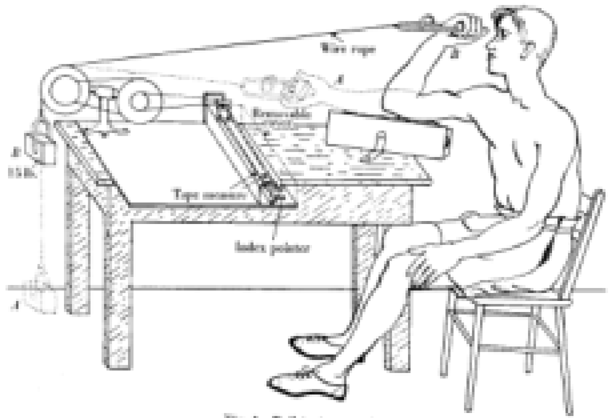
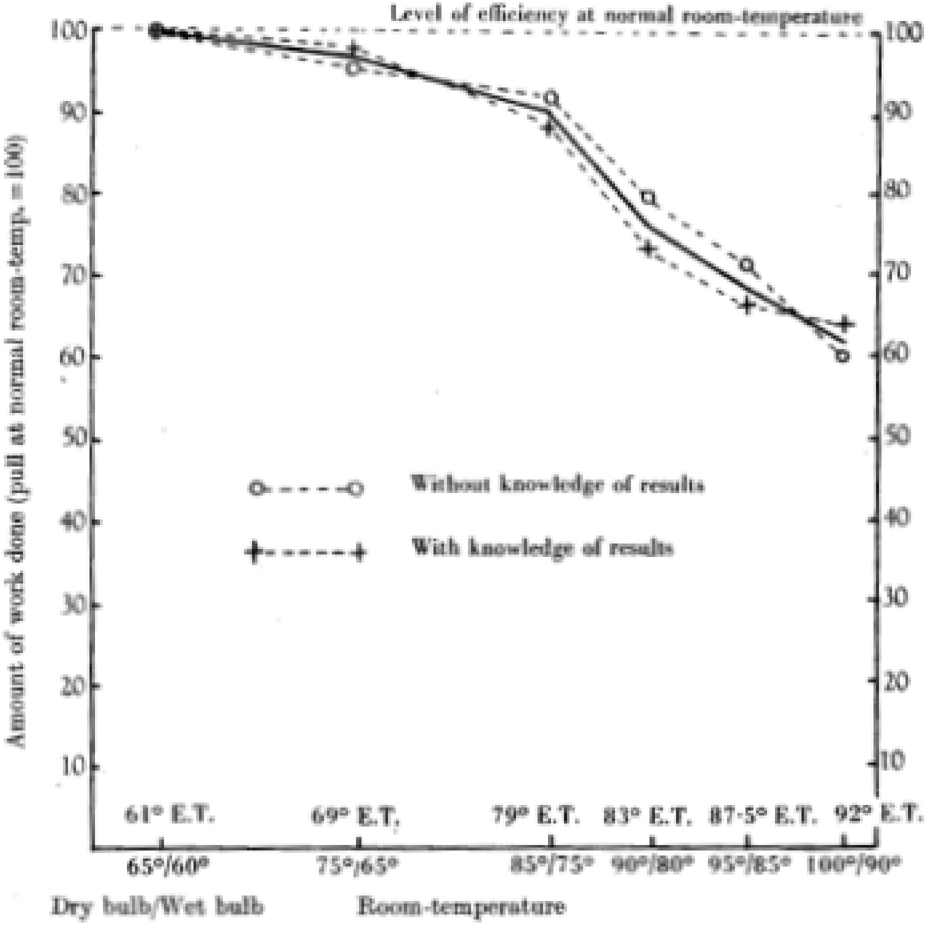
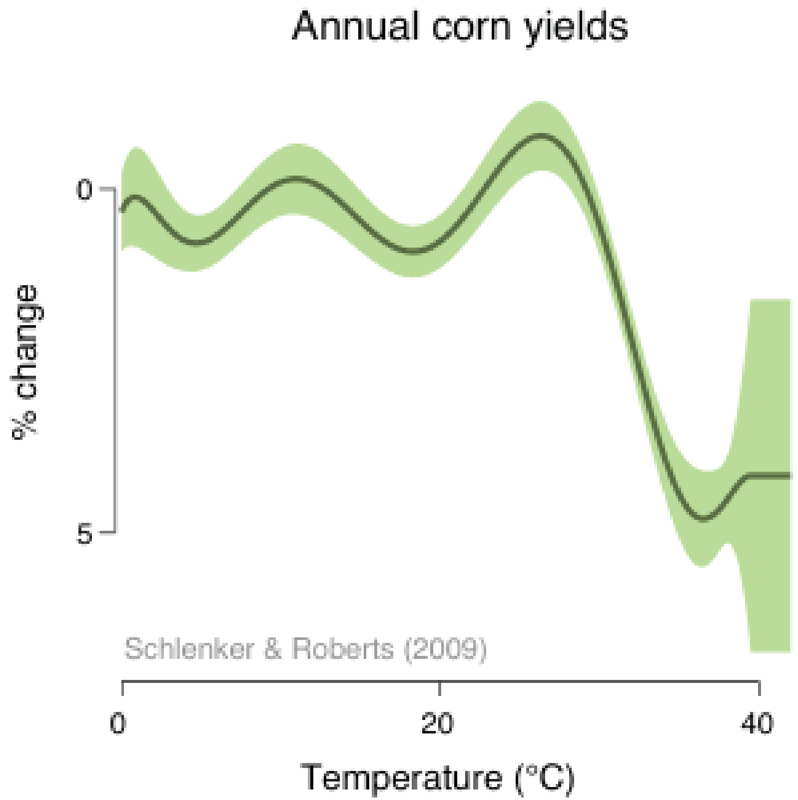


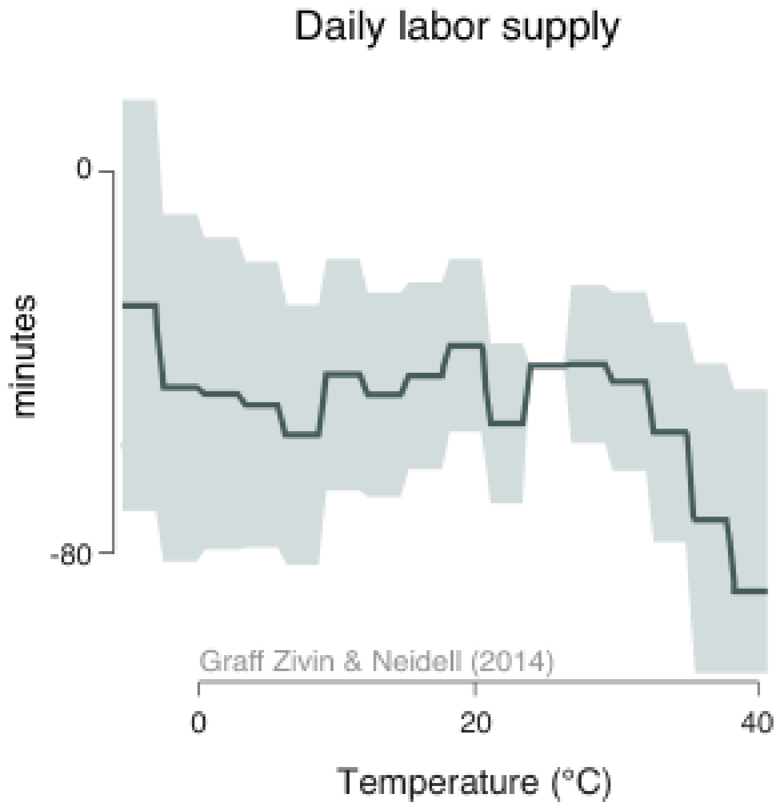
Fig. 1. Pull test apparatus.

British Naval Experiments
C. Mackworth (1947)
British Journal of Psychology



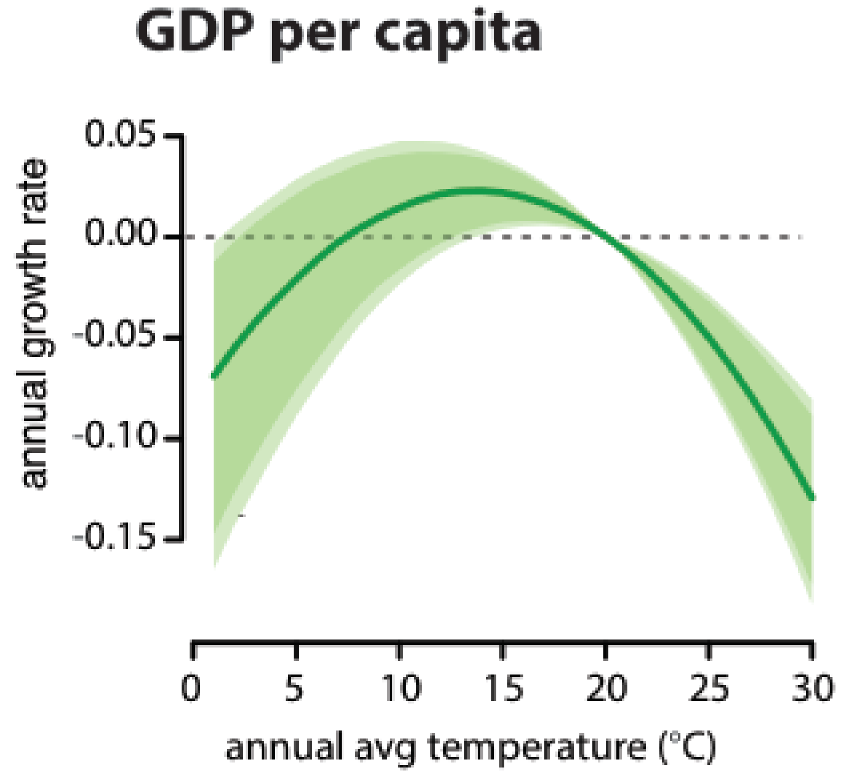
Temperature affects productivity of labor & capital





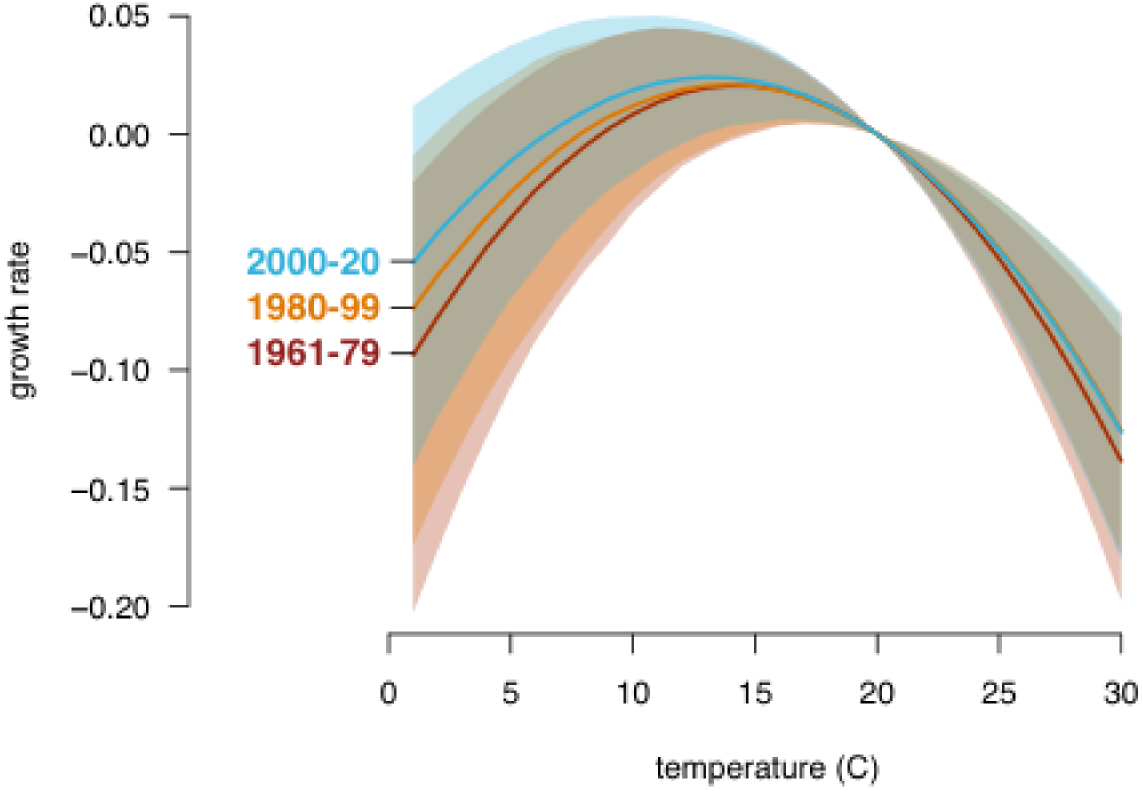
Carleton & Hsiang (Science 2016)

Global non-linear response of growth to temperature



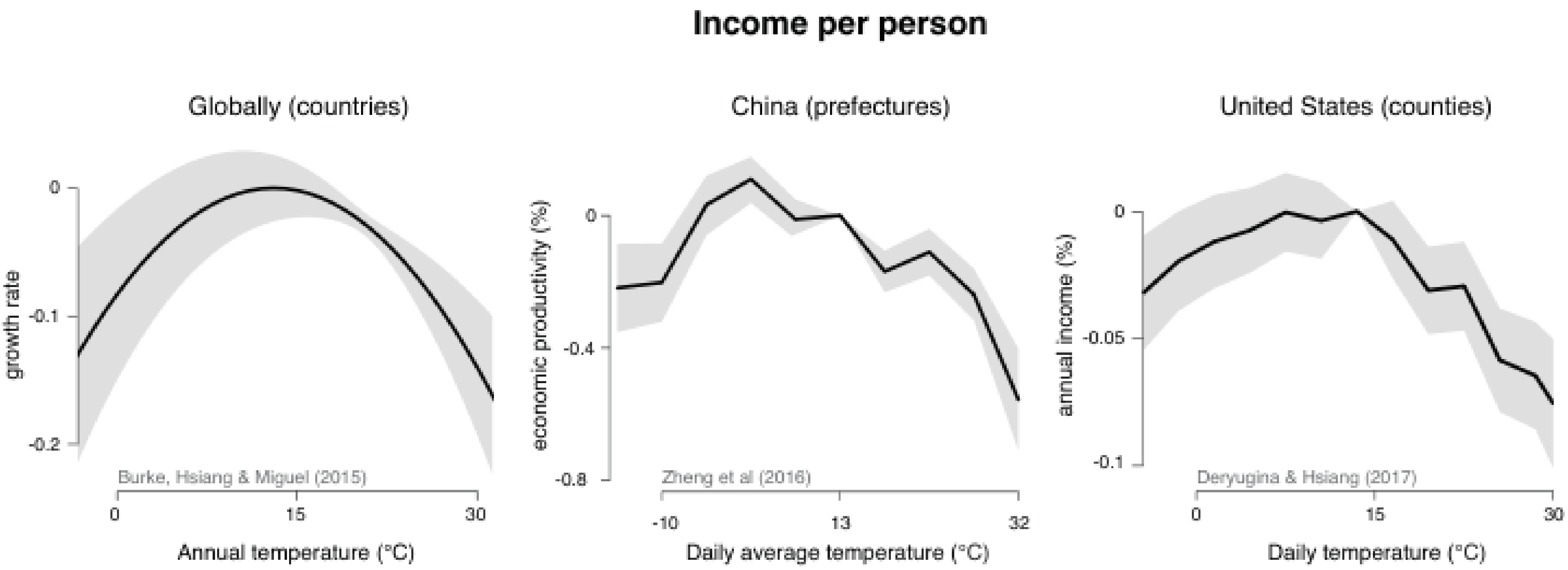
Burke, Hsiang, Miguel (Nature, 2015); Burke, Zahid, Diffenbaugh, Hsiang (Nature, in press)

Is the world adapting? Nope.



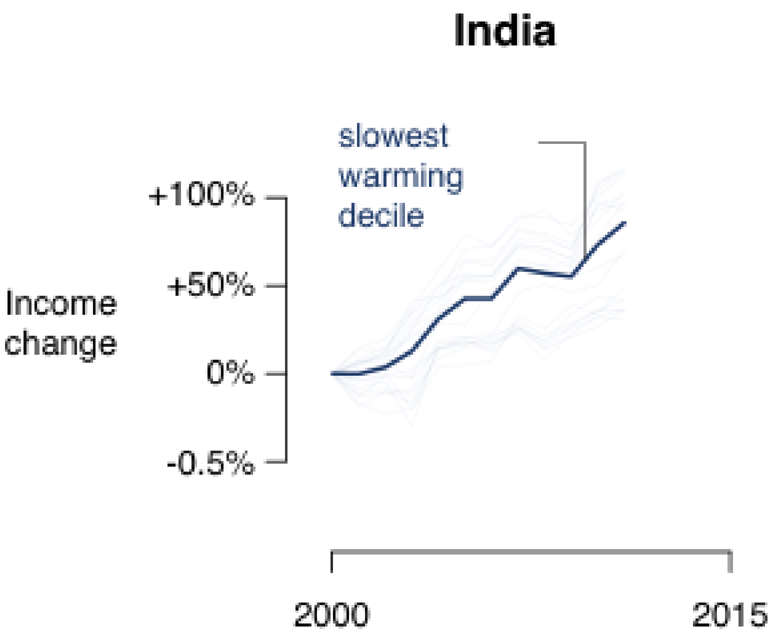
Burke, Zahid, Hsiang (2025)

Global replication: "The Marginal Product of Climate"



Also: Brazil, Indonesia, Europe, India, 962 World Bank HH surveys, etc.

Climate change is already slowing growth



Burke & Tanutama (2019)

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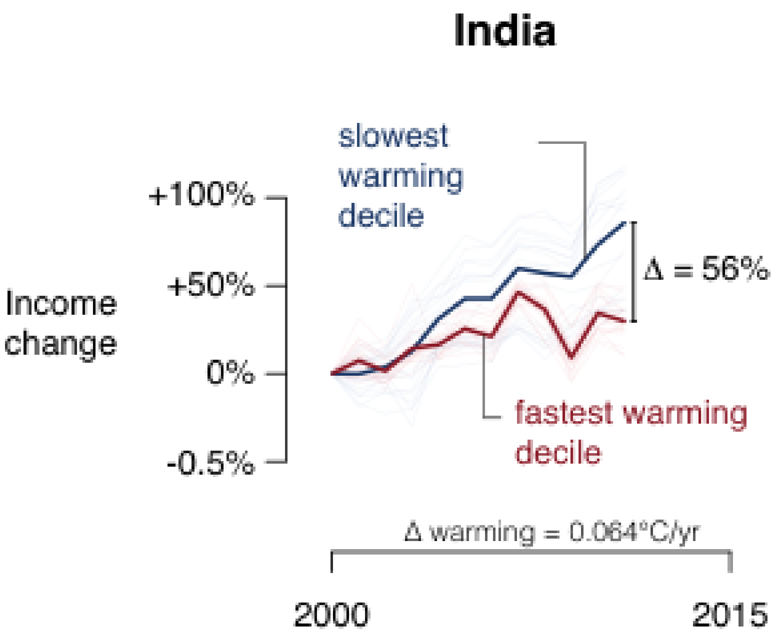

Burke & Tanutama (2019)

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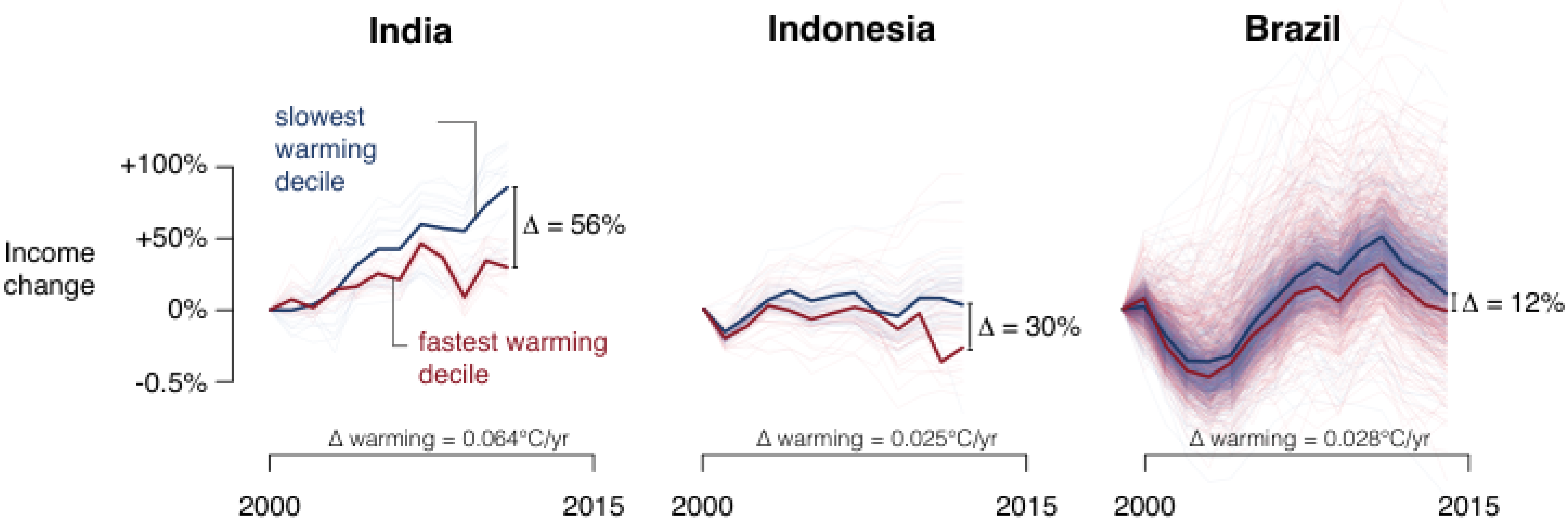
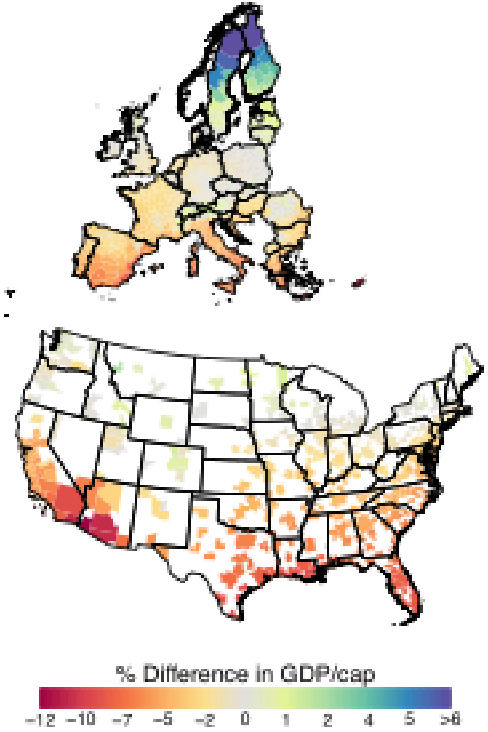
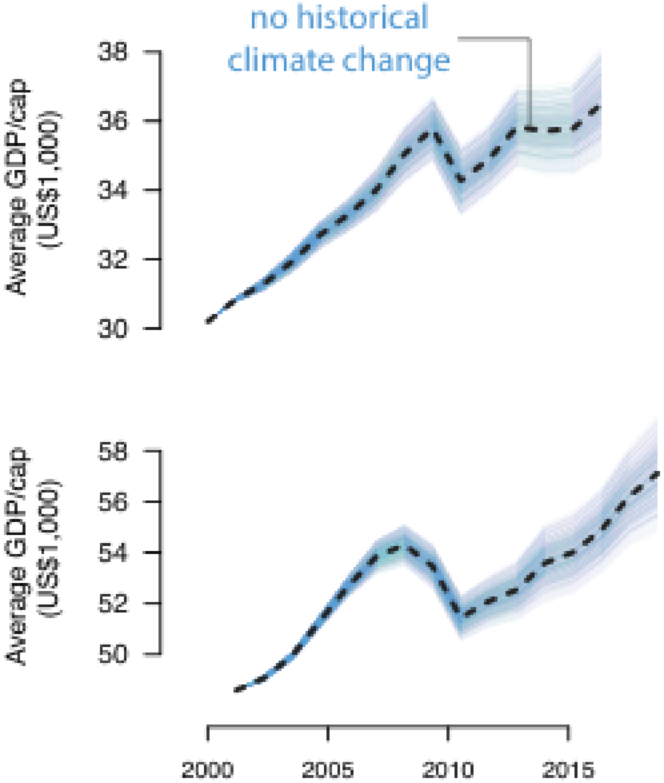


Burke & Tanutama (2019)

Computing income already lost due to past warming





Burke & Tanutama (2019)

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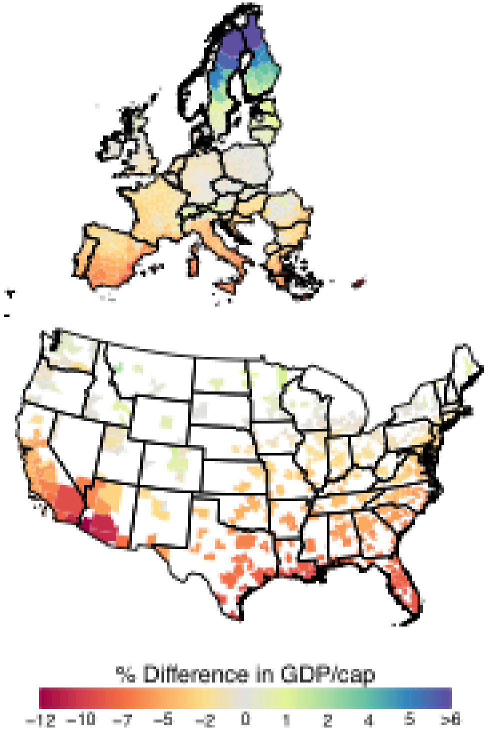
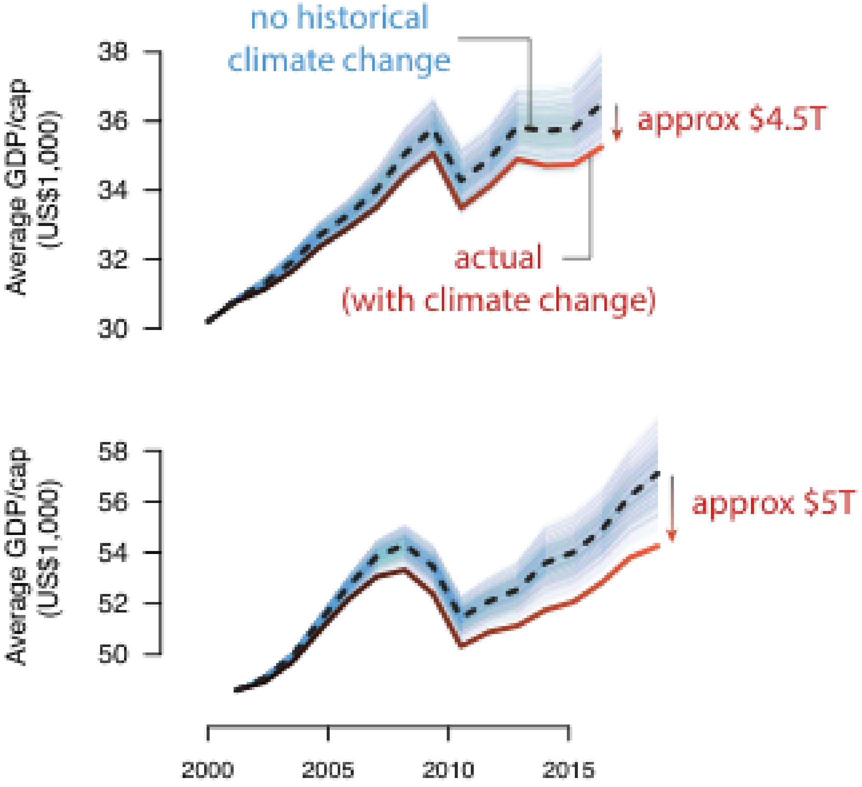
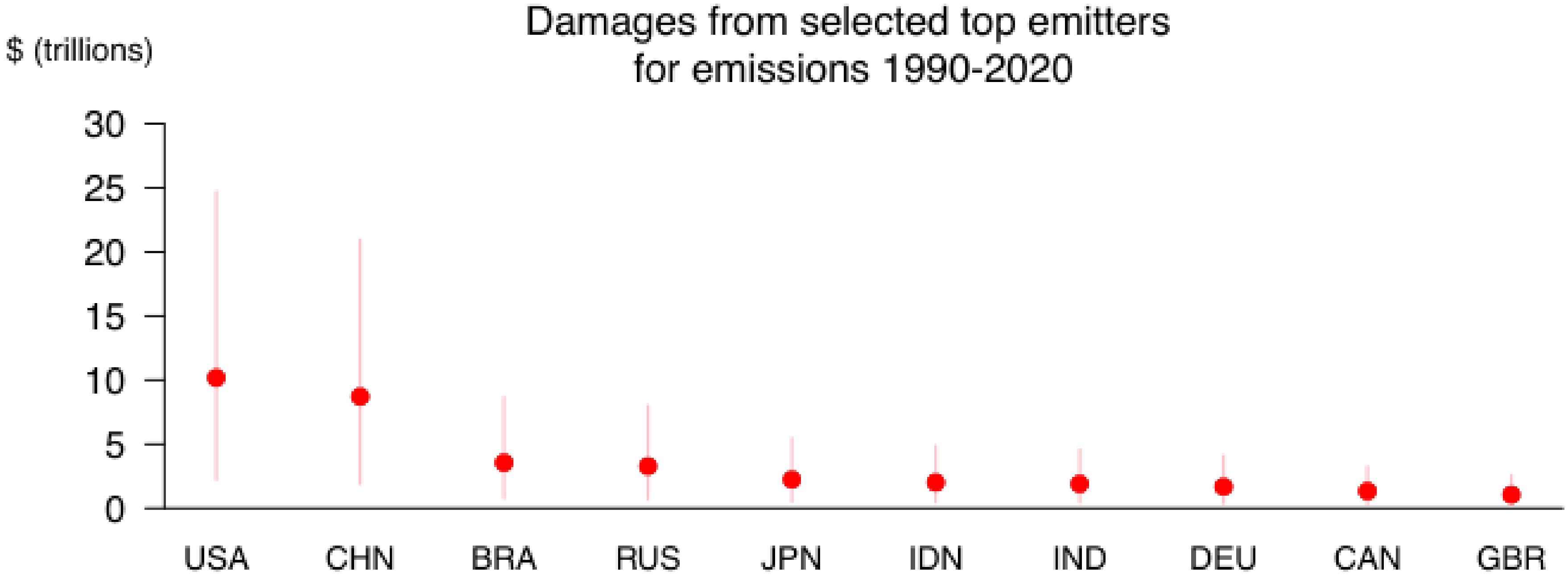




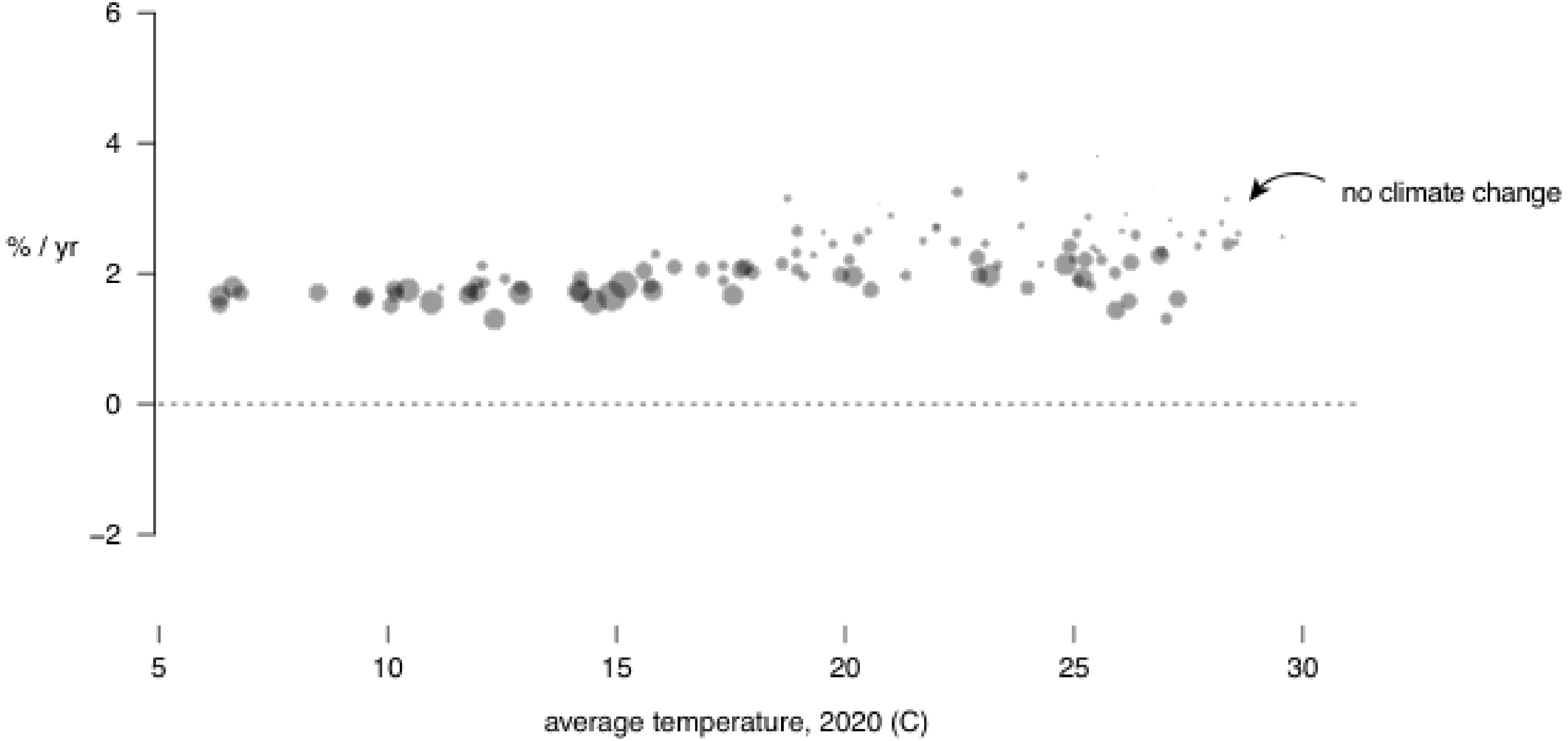
Burke & Tanutama (2019)

Historical responsibility for historical damages



Burke, Zahid, Diffenbaugh, Hsiang (Nature, *in press*)

Projected annual growth rates in 50 years



Burke, Zahid, Hsiang (2025)

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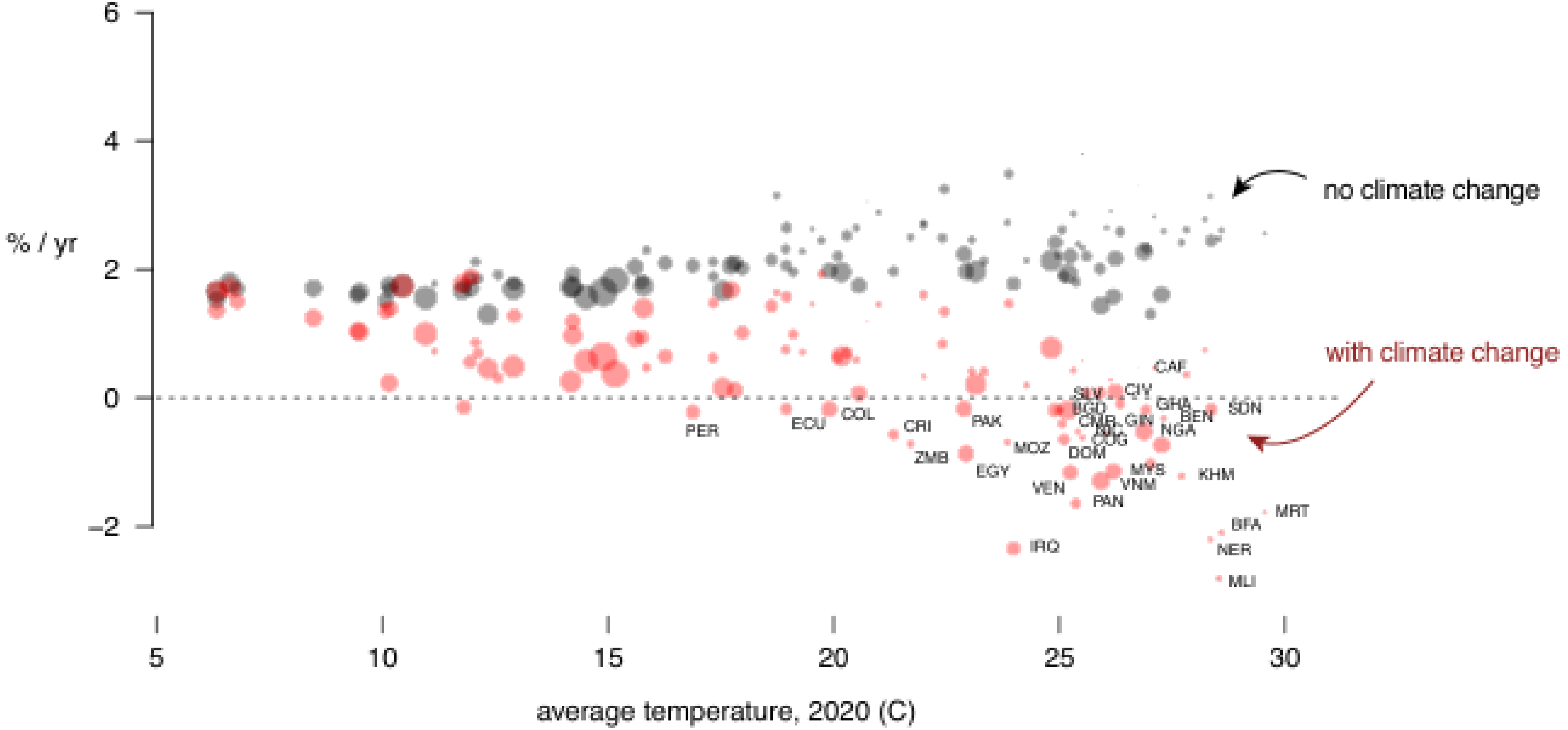
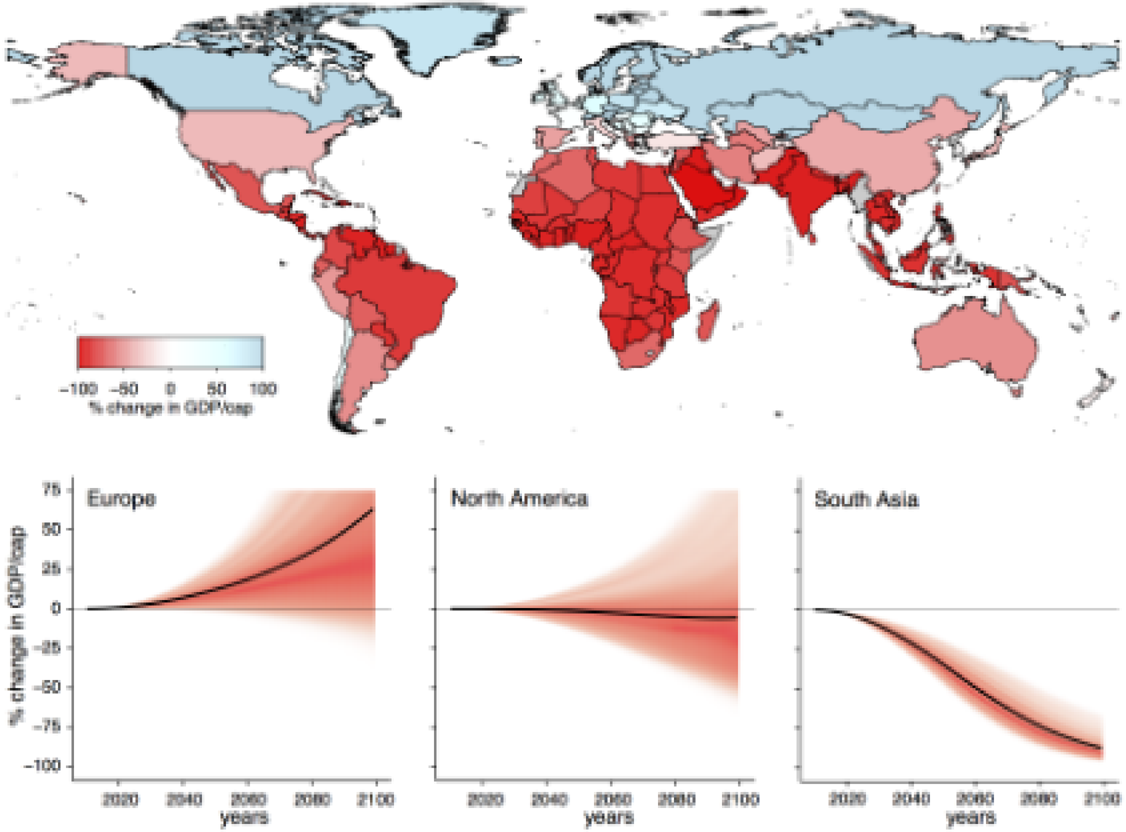


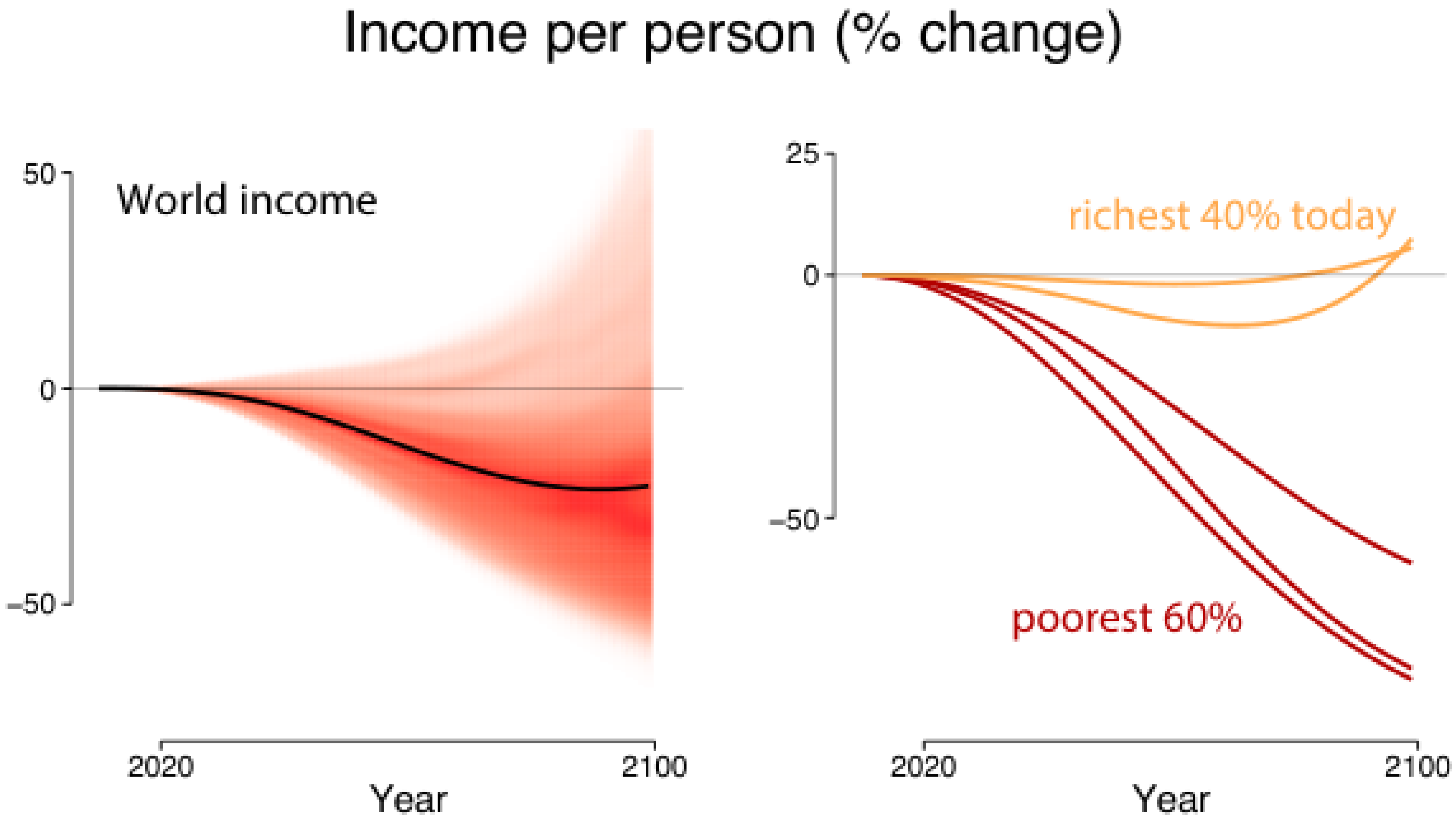
Burke, Zahid, Hsiang (2025)

Projecting forward: avg loss = 23% World GDP



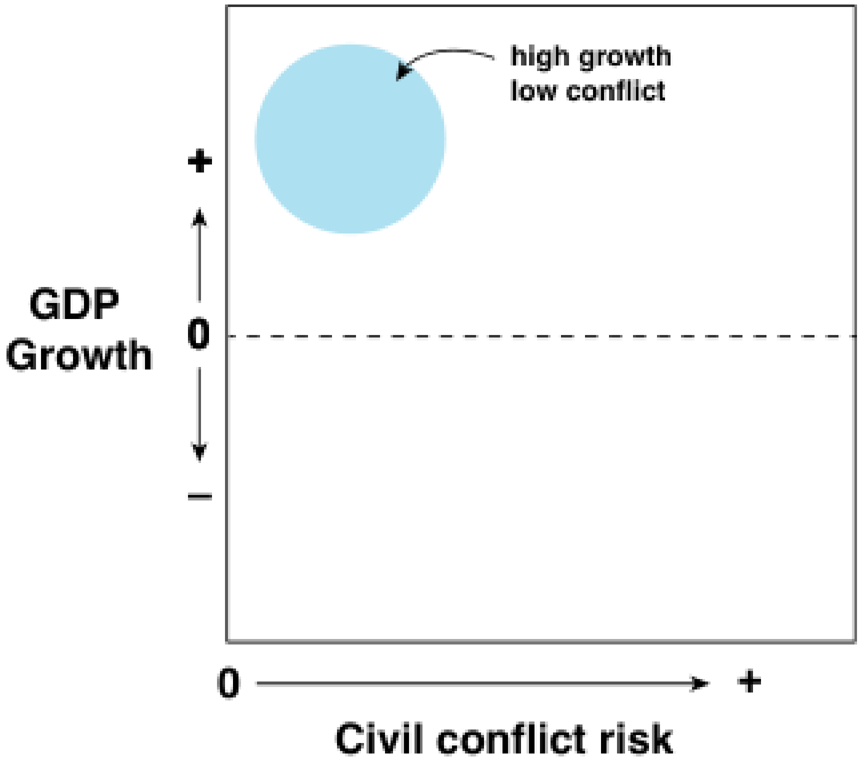
Burke, Hsiang & Miguel (Nature 2015)

A poorer, more uncertain, more unequal world



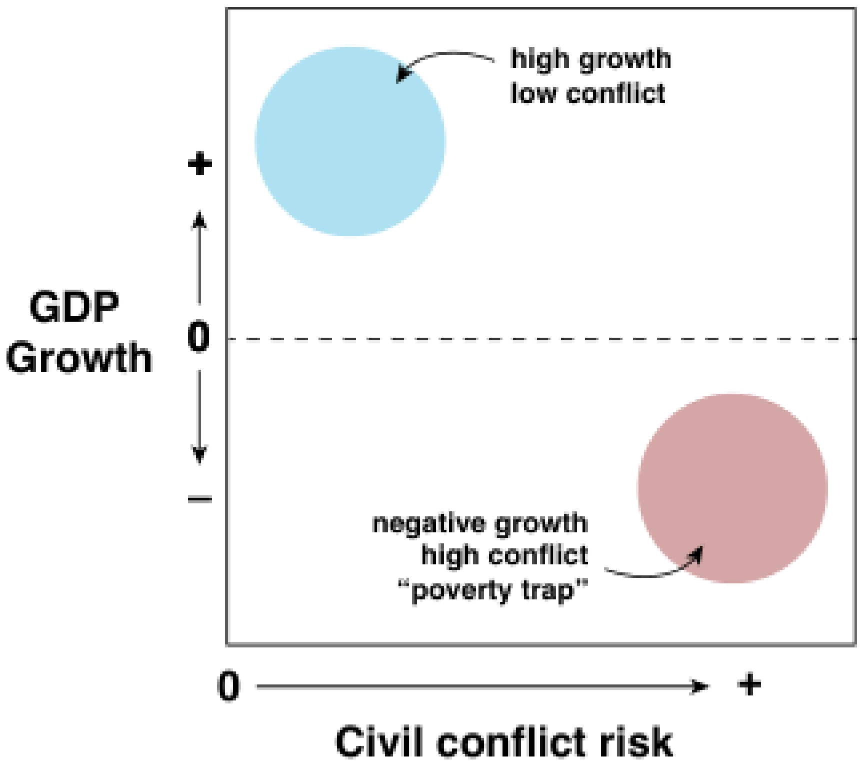
Burke, Hsiang & Miguel (Nature 2015)

Material risks of economic collapse



Ferguson, Burke, Miguel, Hsiang (PNAS, Forthcoming)

Material risks of economic collapse



Ferguson, Burke, Miguel, Hsiang (PNAS, Forthcoming)

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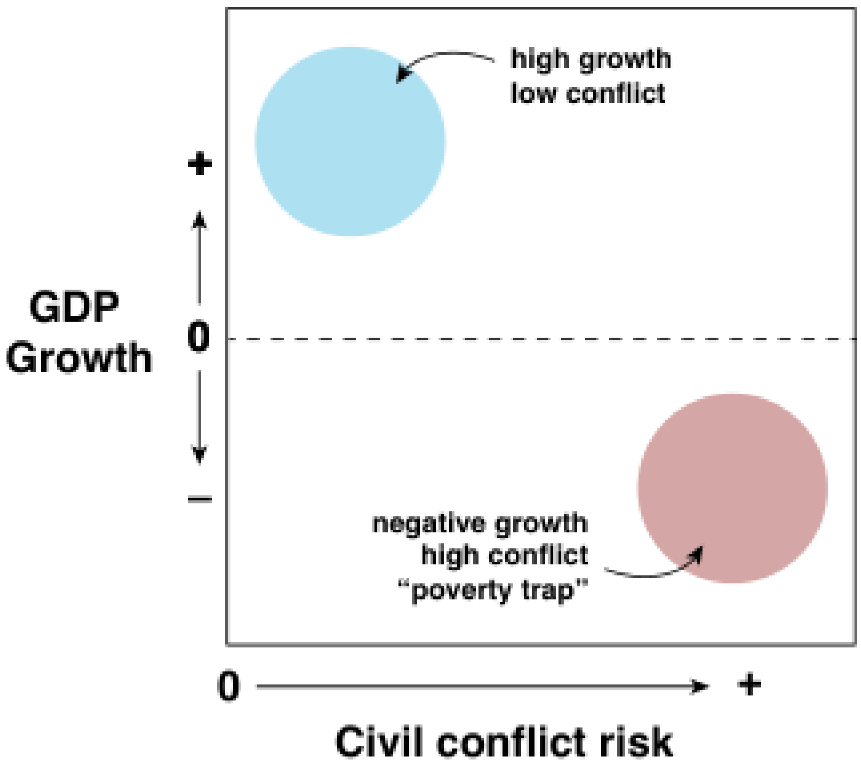

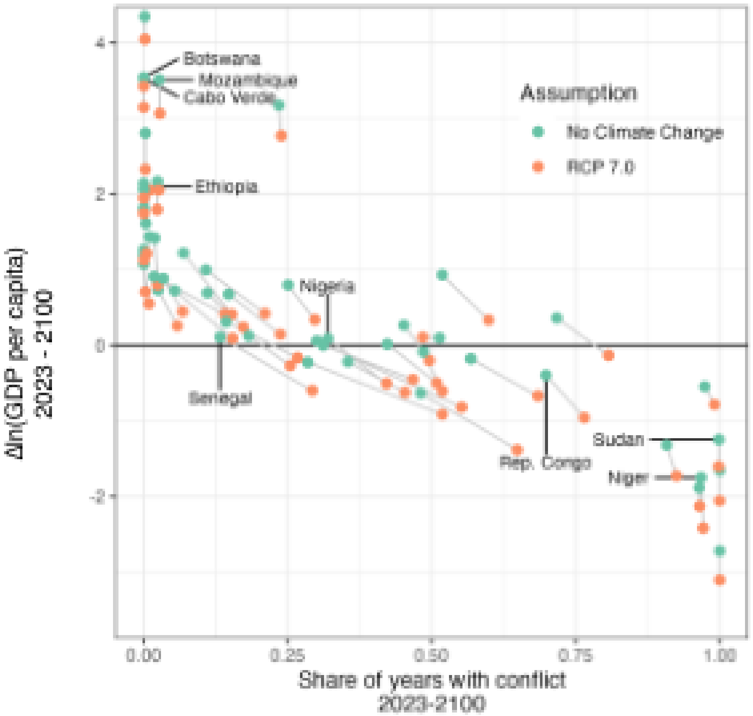

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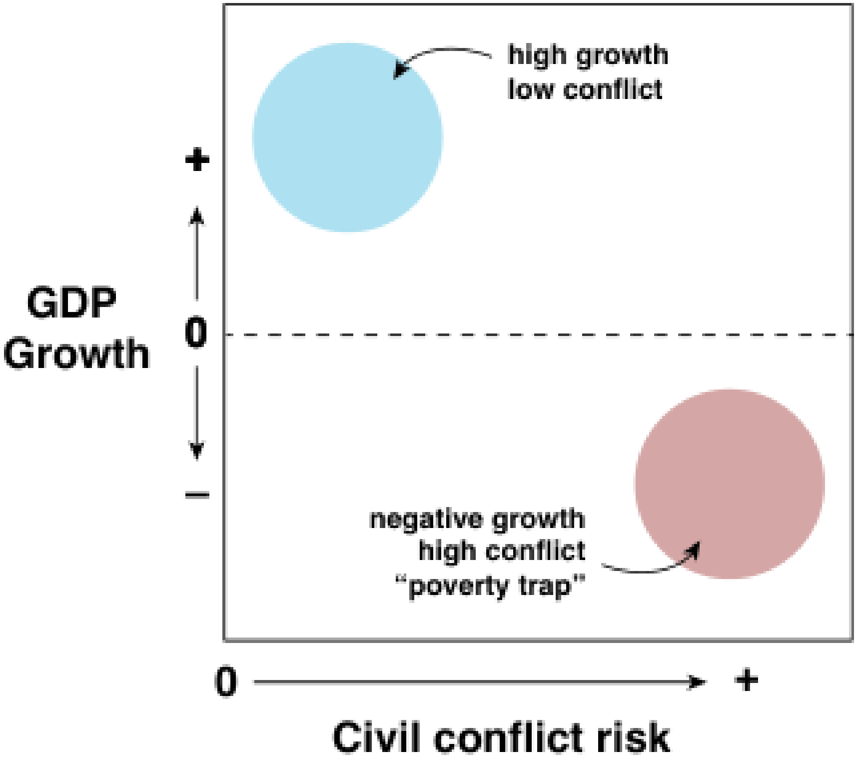
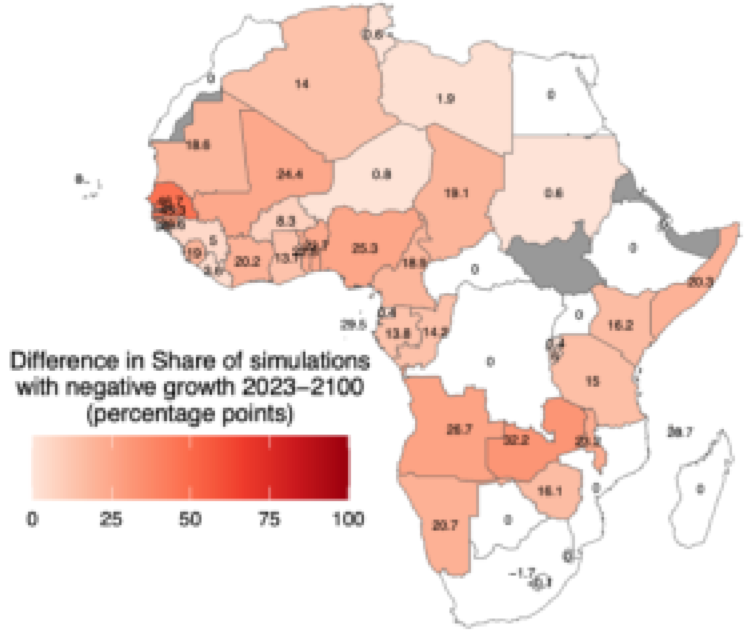
Material risks of economic collapse





Ferguson, Burke, Miguel, Hsiang (PNAS, Forthcoming)

Take home messages

Rising temperatures and tropical cyclones slow GDP growth.

Non-linear effect of temperature causes global inequality to increase.

No evidence of adaptation.

Recent warming has already likely slowed growth.

Historical global damages already approximately $50T.

Damages in 2100 are roughly 10% of world GDP per 1°C of warming.

GDP-conflict feedbacks generate a material risk of persistent economic decline in some regions.

The Social Cost of Carbon from macroeconomic impacts is $1000-2000 per ton of CO2.