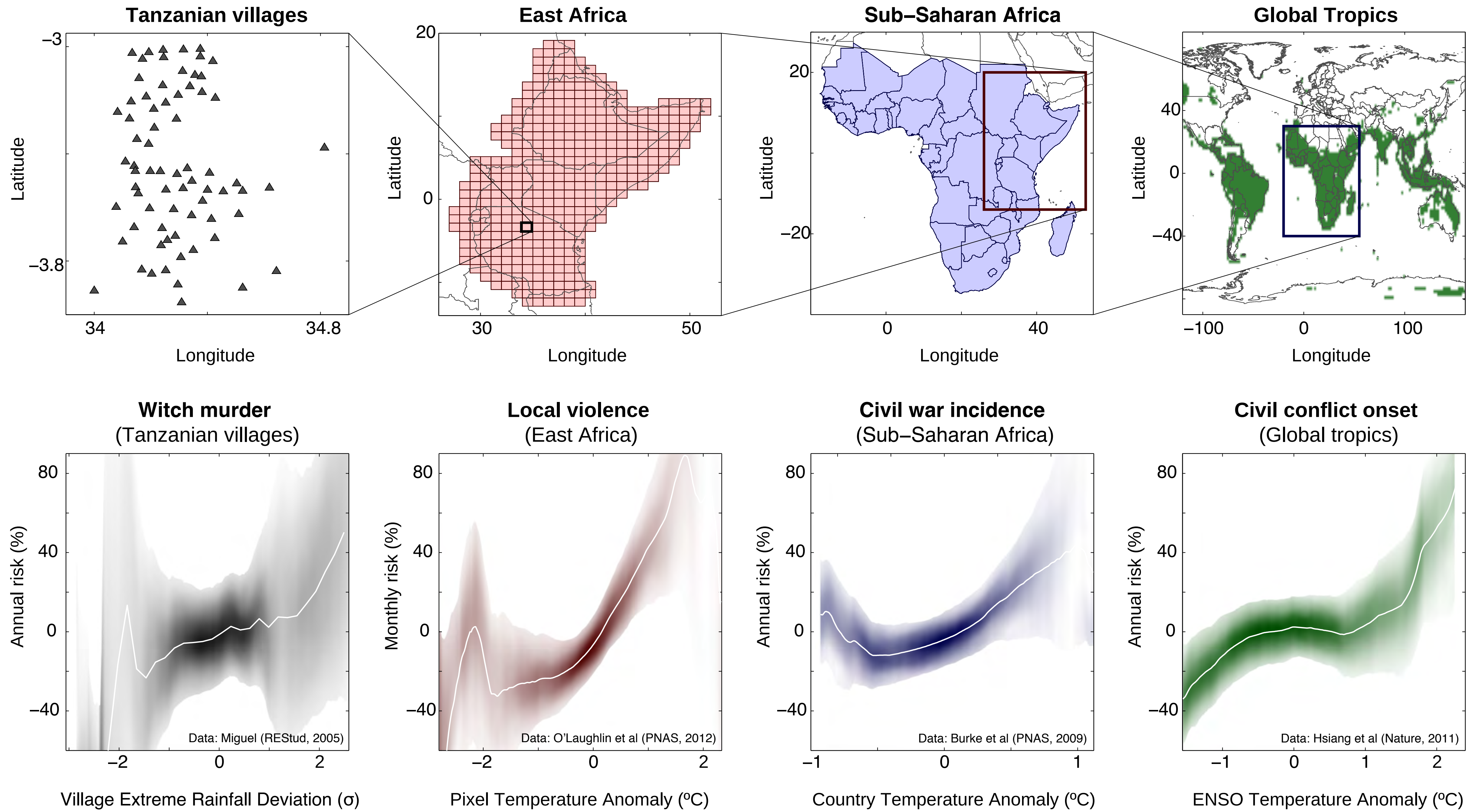
Use of data to evaluate conflict risk resulting from climate changes

Solomon Hsiang
UC Berkeley

Climate & violence across scales of social organization



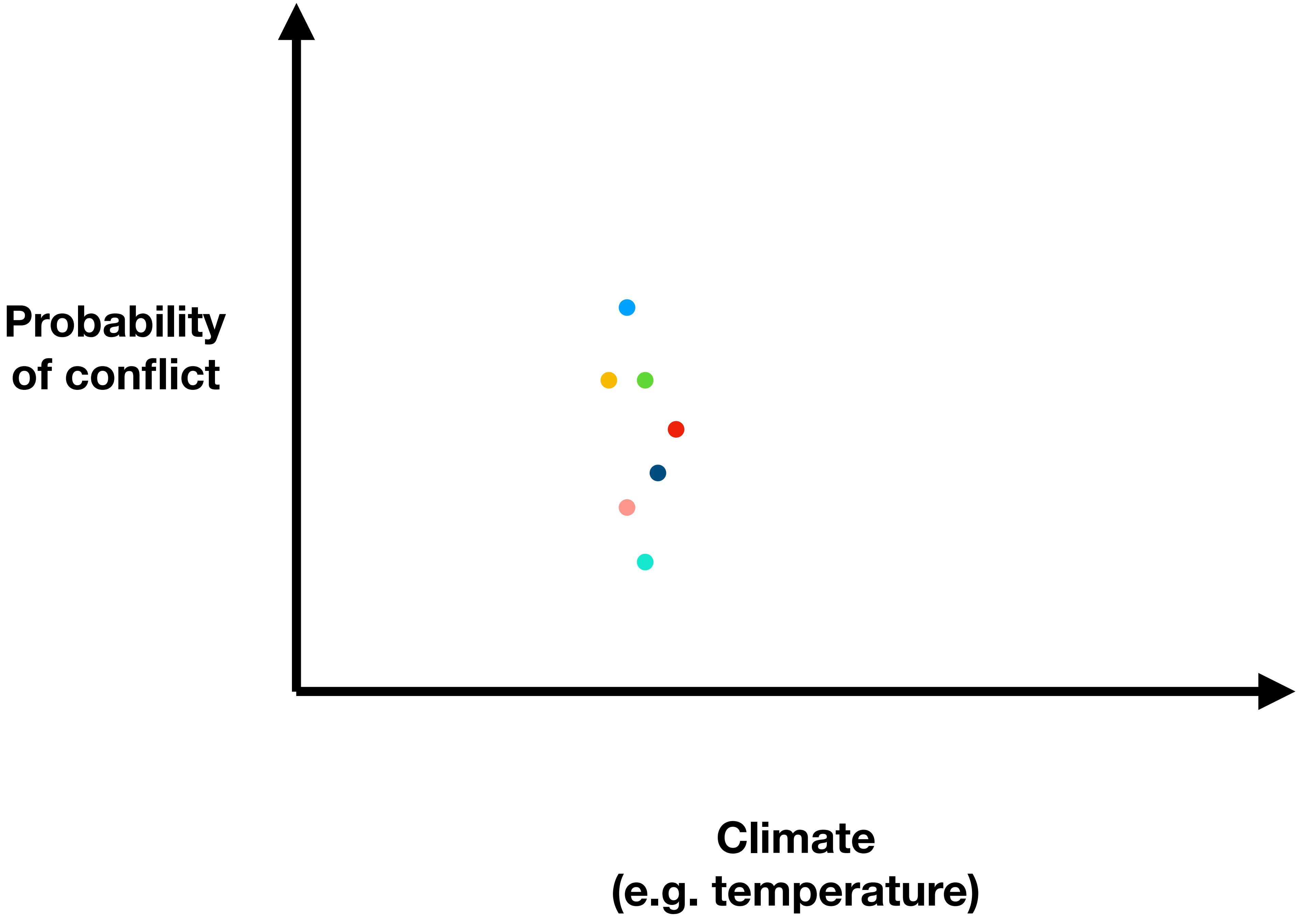
Hsiang, Burke & Miguel (Science 2013)

We now understand how to compute changes in risk

Conflict						
Burke *et al.* 2009 (*183*)	Civil conflict	Sub-Saharan Africa	1981–2002	Relative to each country's optimal annual temperature, realized temperatures increase annual incidence of war by 29.3% on average*	Between 1981 and 2006, trends in temperature increased the annual incidence of war by 11.1% on average*	Predicted climate change‡ by 2030 increases annual incidence of war by 54%
Hsiang *et al.* 2011 (*27*)	Civil conflict	Global	1950–2004	Relative to the optimal state, realized ENSO conditions had a role in 21% of all civil conflicts between 1950 and 2004		
Ranson 2014 (*136*)	Violent crime	USA	1980–2009	Relative to each county's optimal monthly temperature, realized temperatures increase crime rates by 6.1% for rape, 2.4% for murder, and 3.6% for aggravated assault on average*		Predicted climate change‡ between 2010 and 2099 increases total crime cases by 180,000 for rape, 22,000 for murder, and 2.3 million for aggravated assault

Carleton & Hsiang (*Science*, 2016)

The general idea of using econometric studies looking forward



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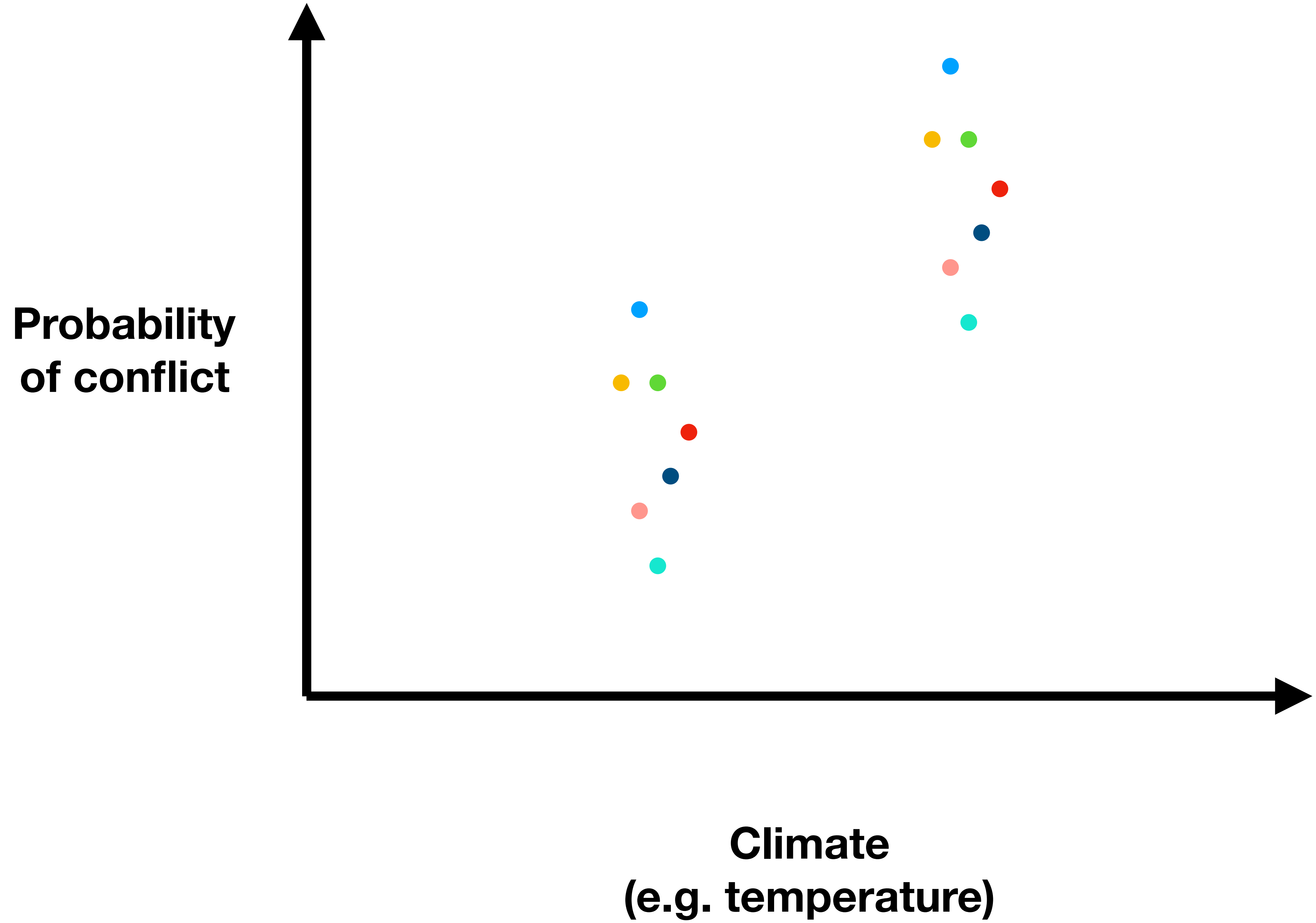

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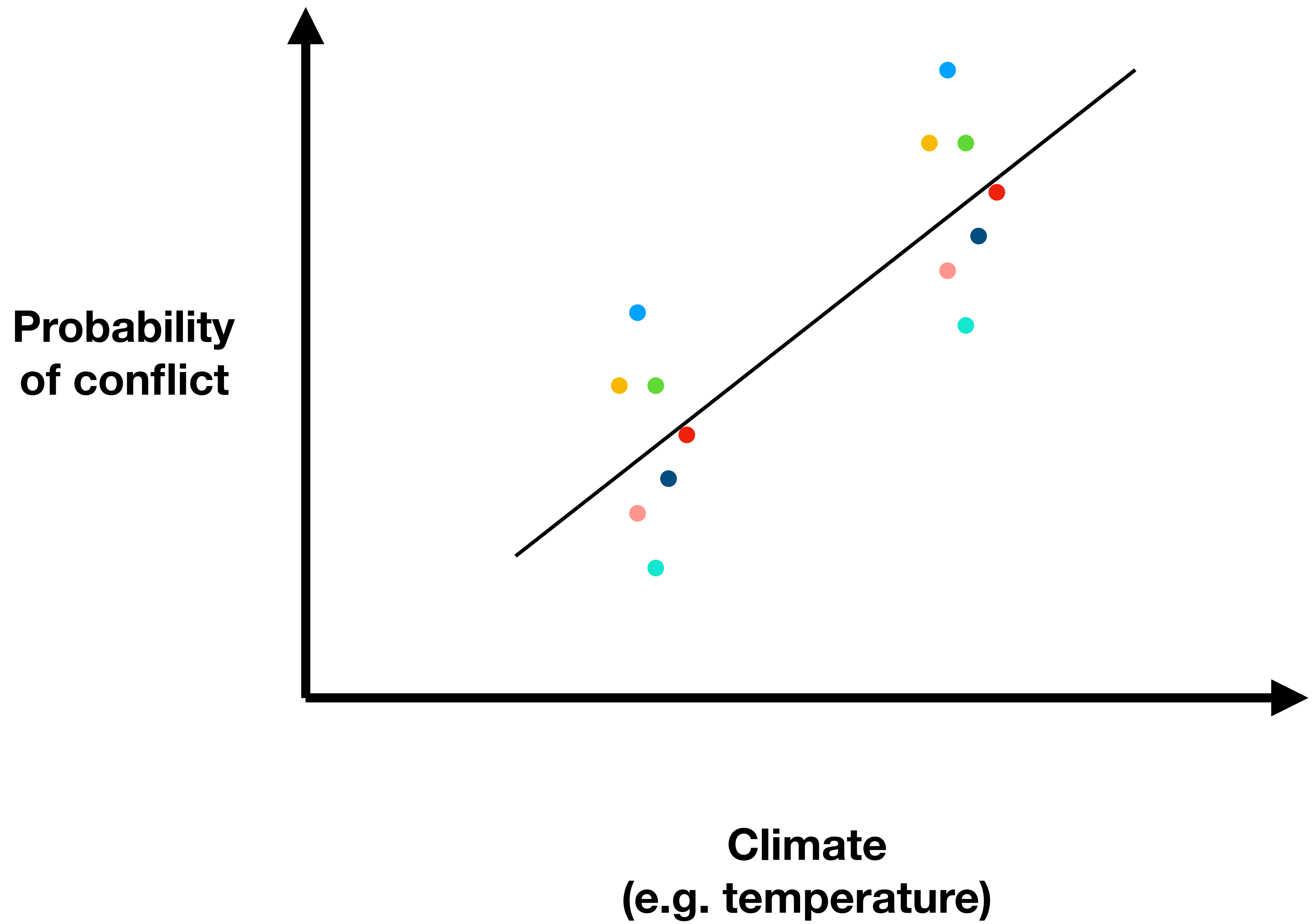

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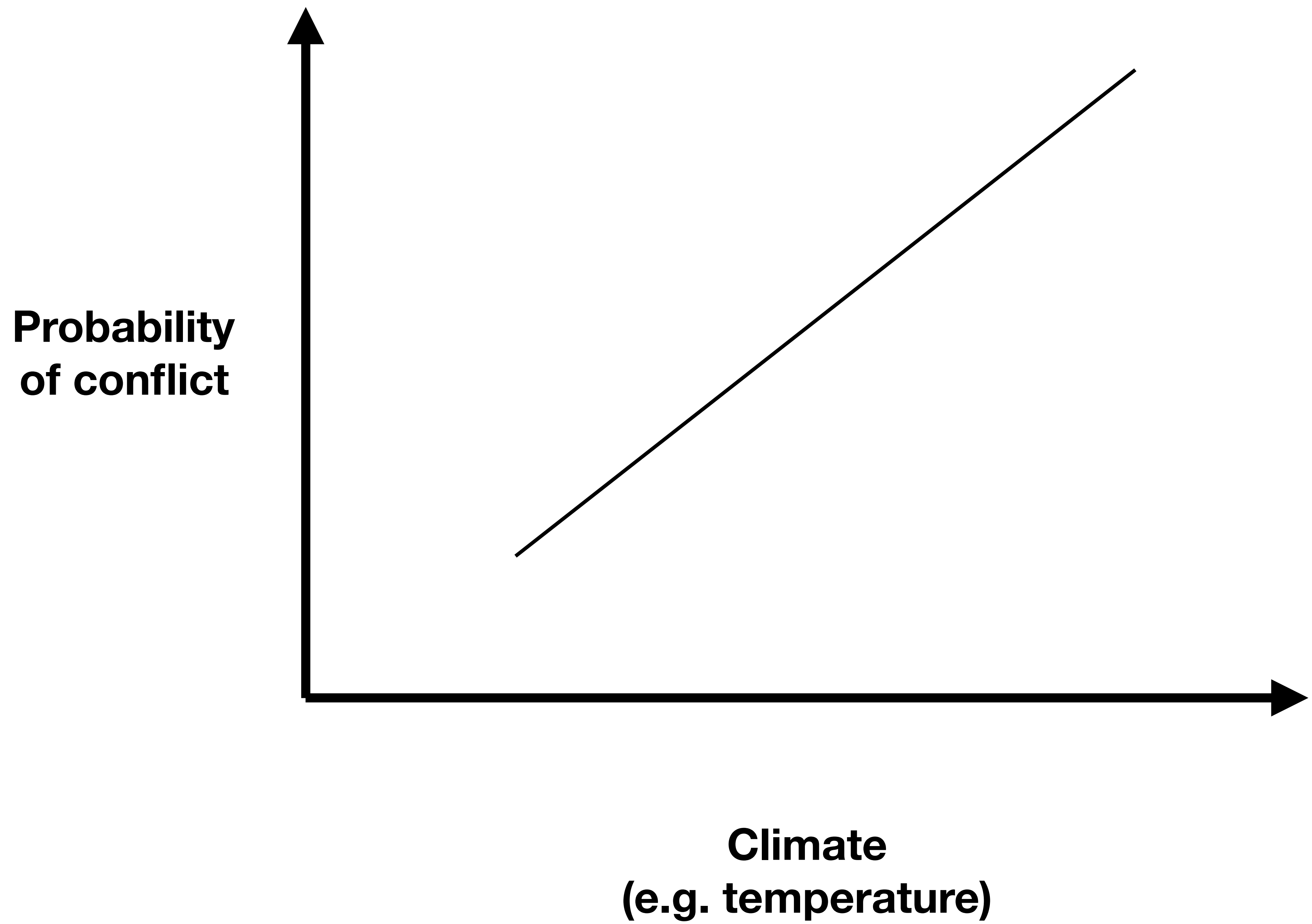

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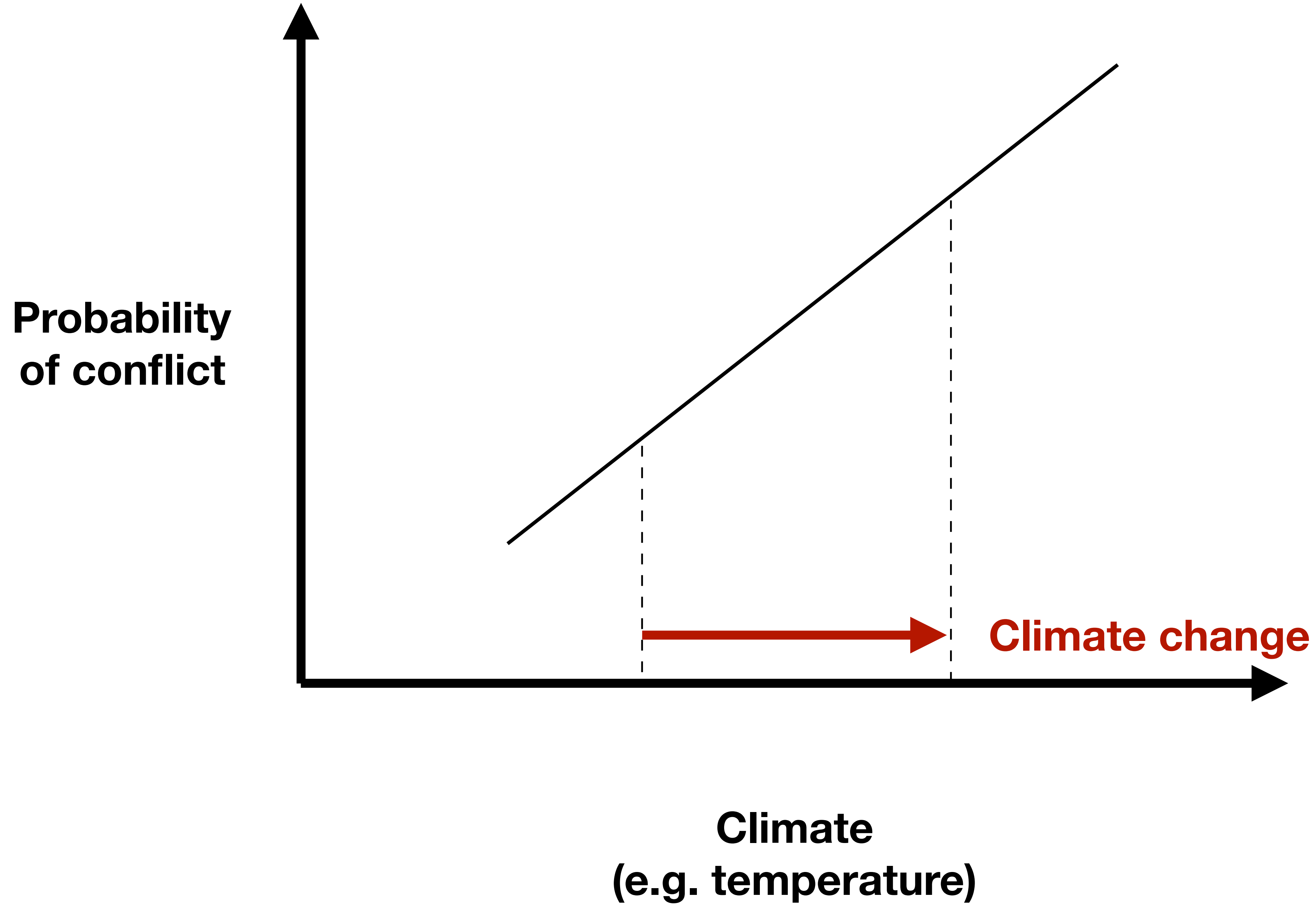

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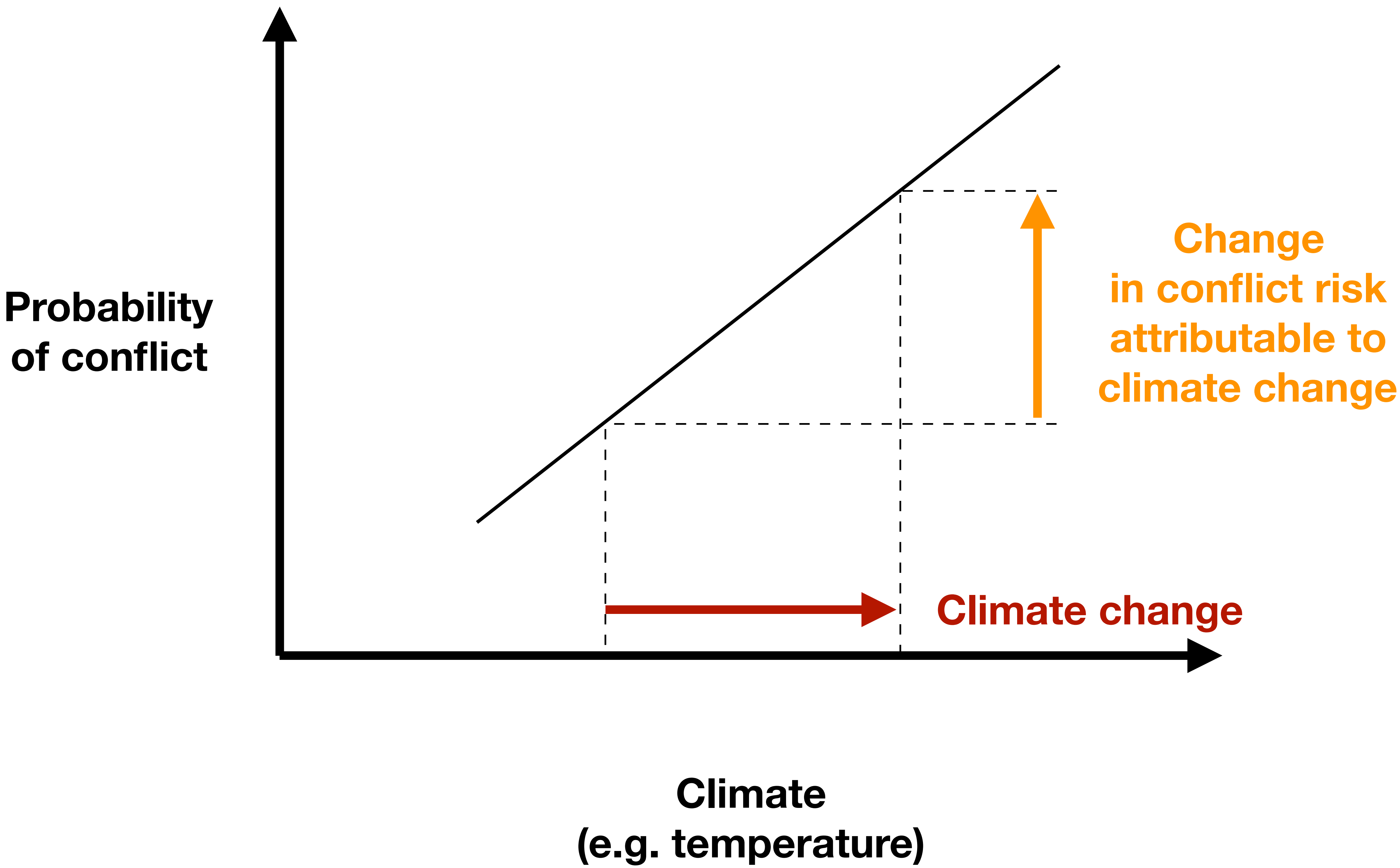

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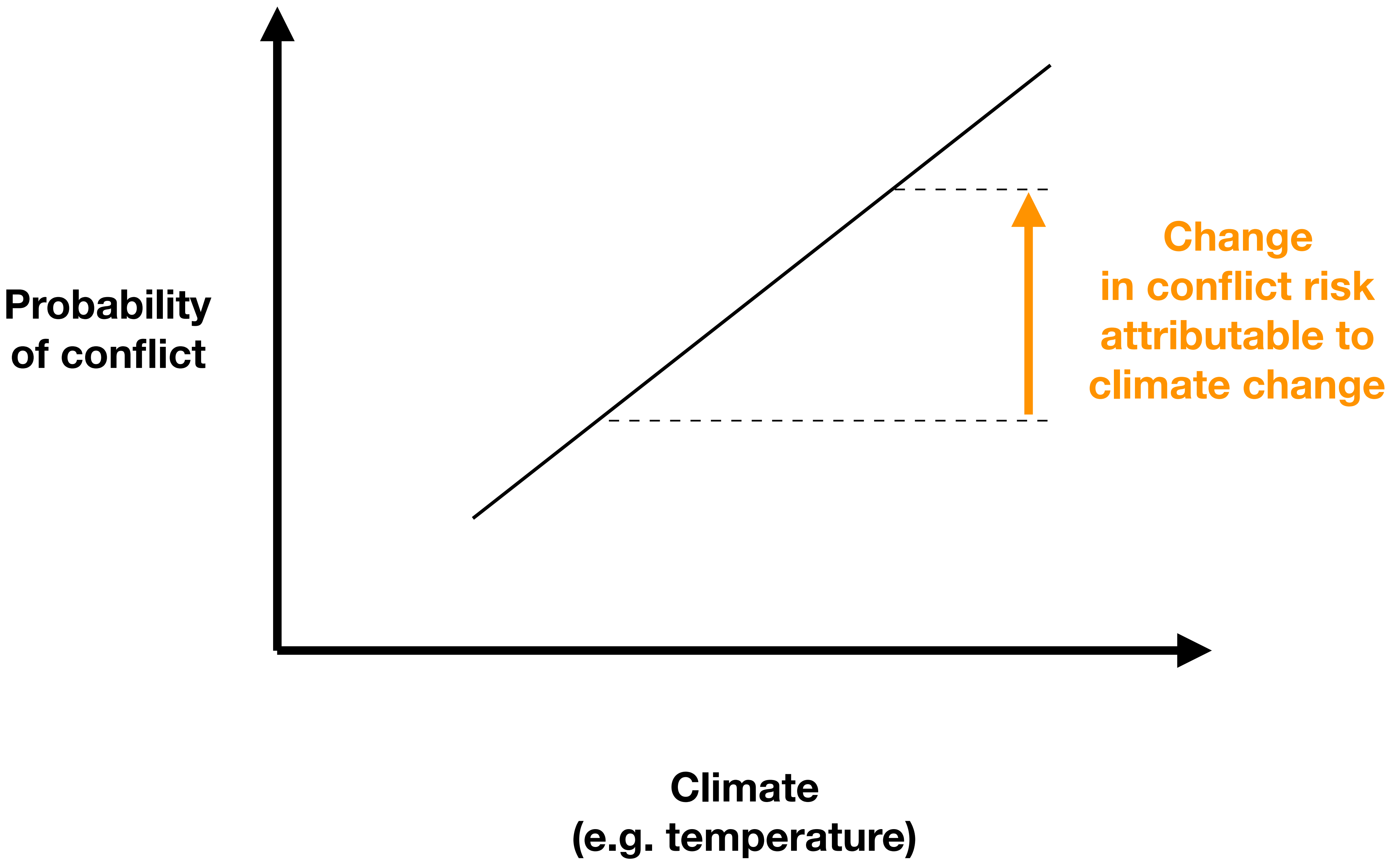

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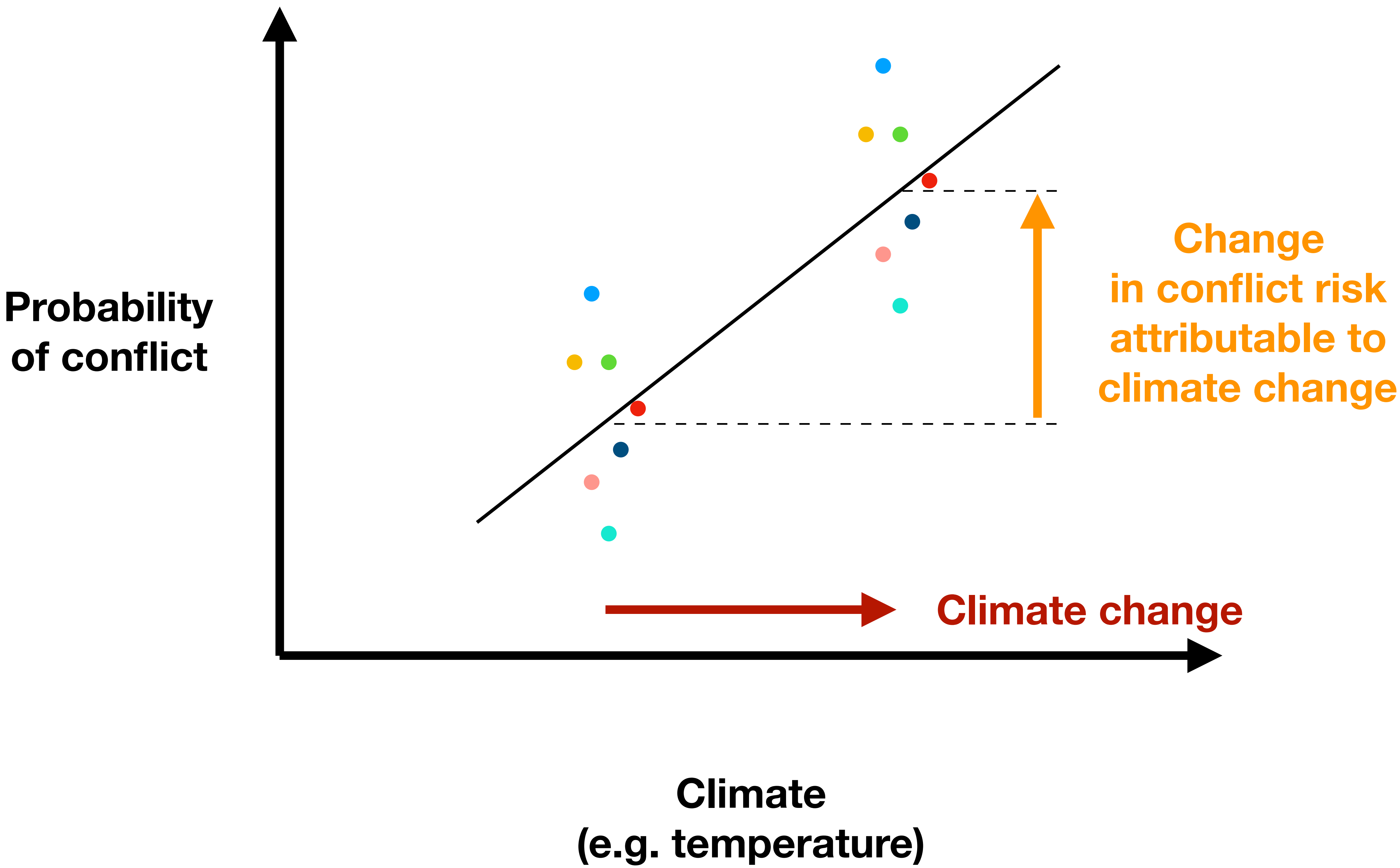

We have many public tutorials on how to combine climate data and econometric methods for social and economic impact analysis

What is the physical problem?
"An Economist's Guide to Climate Change Science"

- Hsiang & Kopp, (*J. Econ Perspectives*, 2017)

How do we look at the data for that problem?
"Using Weather Data & Climate Model Output in Economic Analyses of C.C"

- Auffhammer et al. (*Rev. of Env. Econ. & Policy*, 2013)

How does one analyze that data to learn about the problem?
"Climate Econometrics"

- Hsiang (*Annual Rev. of Env. and Resource Econ*., 2016)

What have we learned overall?
"Social and Economic Impacts of Climate"

- Carleton & Hsiang (*Science*, 2013)

What do we know about climate and conflict?
"Climate and Conflict"

- Burke, Hsiang & Miguel (*Annual Rev. of Econ*, 2015)

Do we need to understand mechanisms?

We **do not need** to understand mechanisms to infer that

“climatic changes are a cause of conflict”.

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We **<u>do not need</u>** to understand mechanisms to infer that

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e.g. pushing car accelerator or smoking

(Hsiang & Burke, *Climatic Change* 2014)

Do we need to understand mechanisms?

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“climatic changes are a cause of conflict”.

e.g. pushing car accelerator or smoking

(Hsiang & Burke, *Climatic Change* 2014)

We **do need** to understand mechanisms to

strategically design policies that interfere with the linkage.

e.g. fixing a car engine or medical treatment for smoking

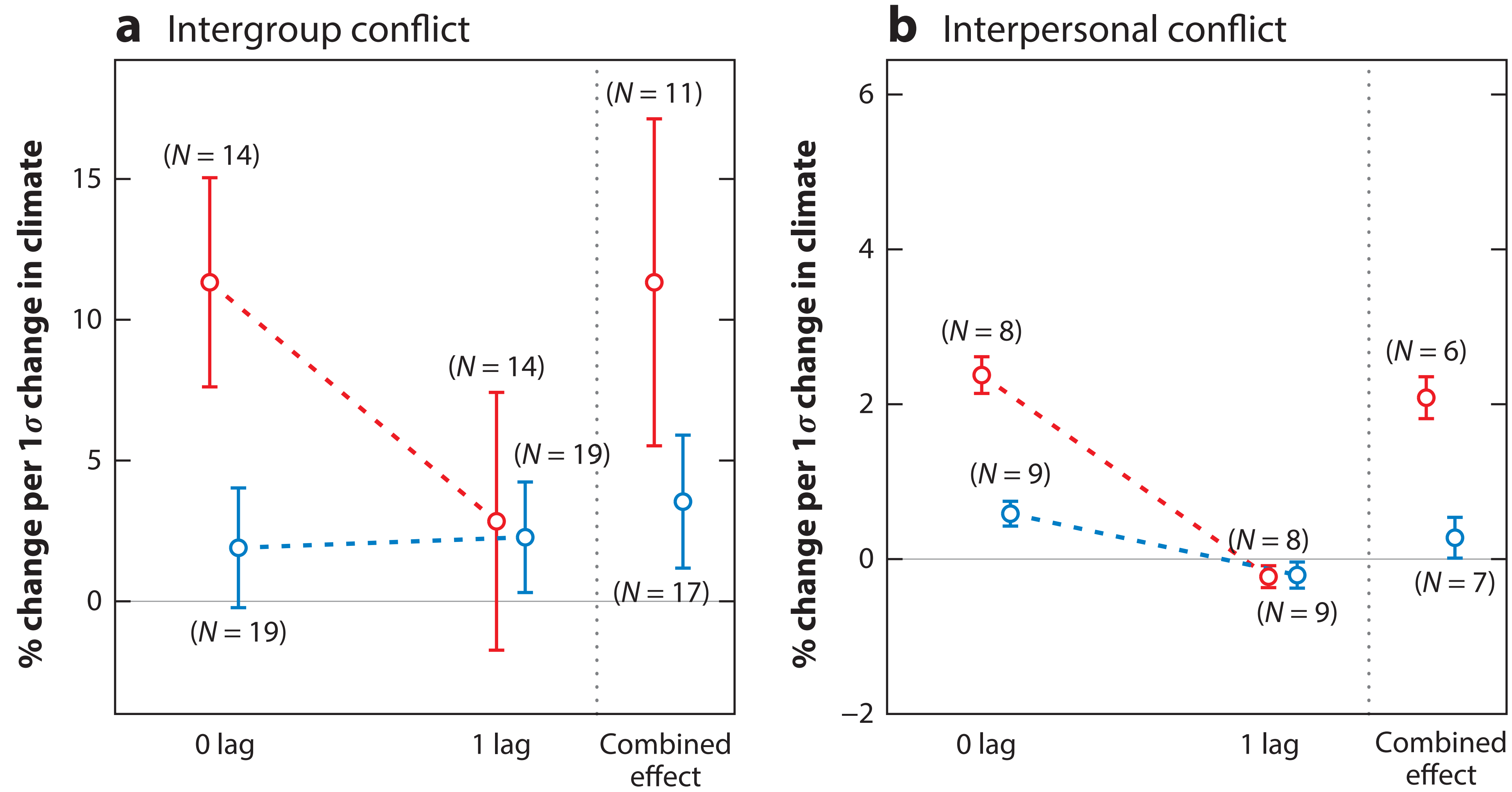
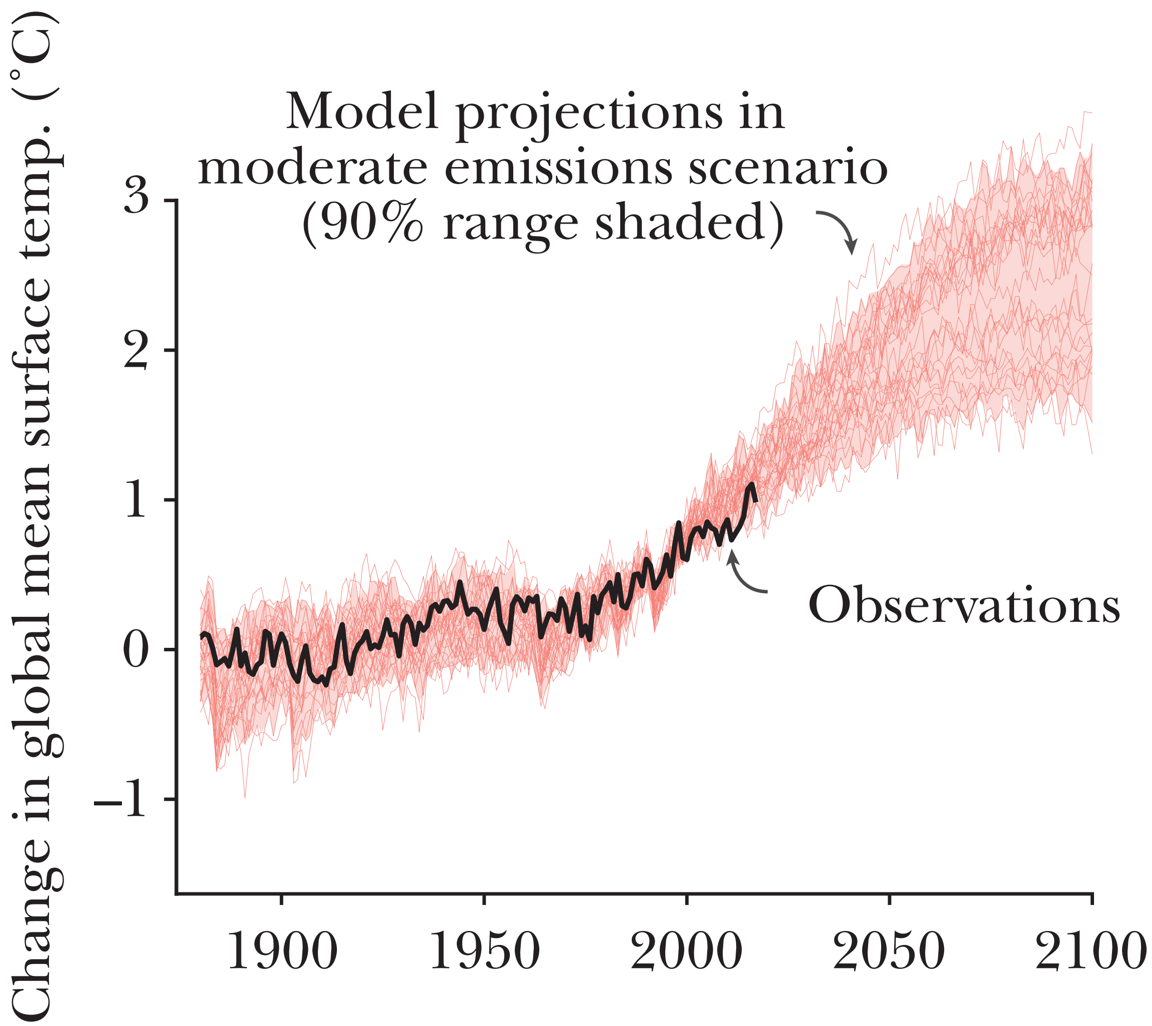


Figure 4

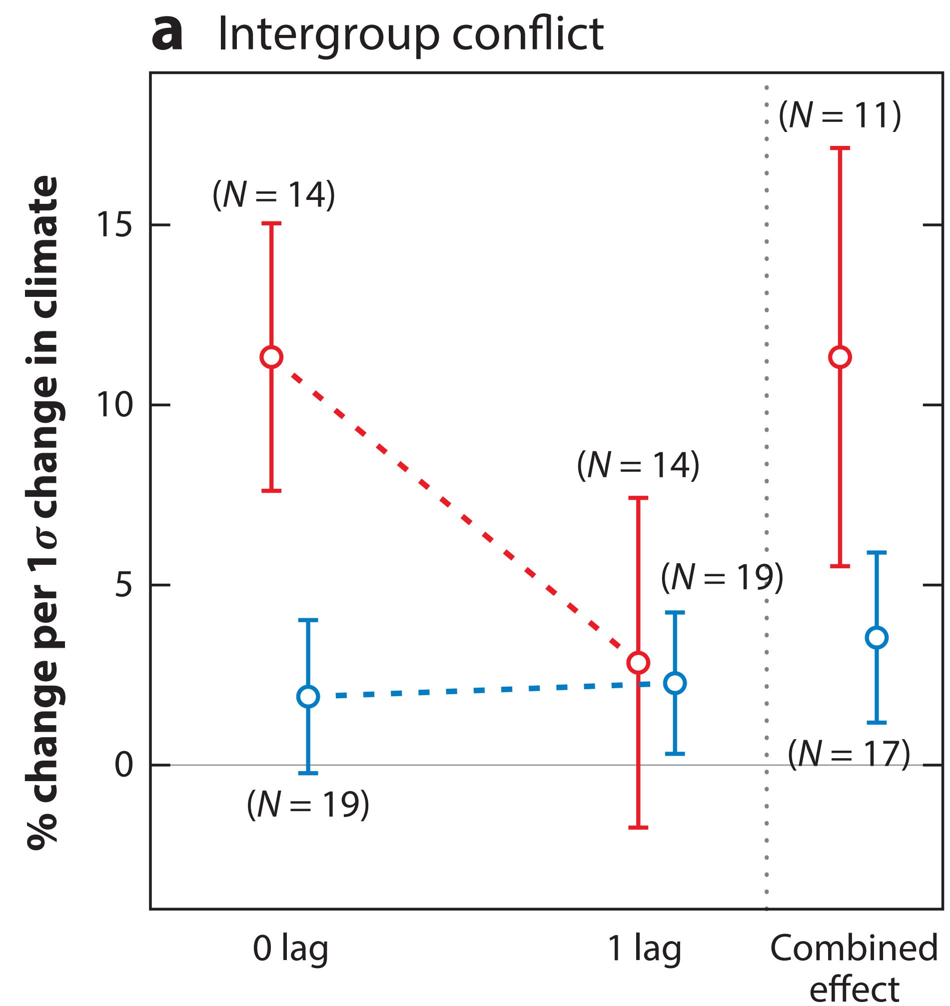
Summary of meta-analysis for studies reanalyzed with distributed-lag structure, showing estimated precision-weighted mean effects and 95% confidence intervals for (*a*) intergroup and (*b*) interpersonal conflict, for both contemporaneous (zero lag) and one-period lagged temperature (*red*, left offset) and precipitation (*blue*, right offset). Combined effects equal the sum of the contemporaneous and one-period lagged effects for studies for which the calculation was possible. The number of studies contributing to each estimate is given in parentheses.

Burke, Hsiang, Miguel (*Annual Review of Economics*, 2015)

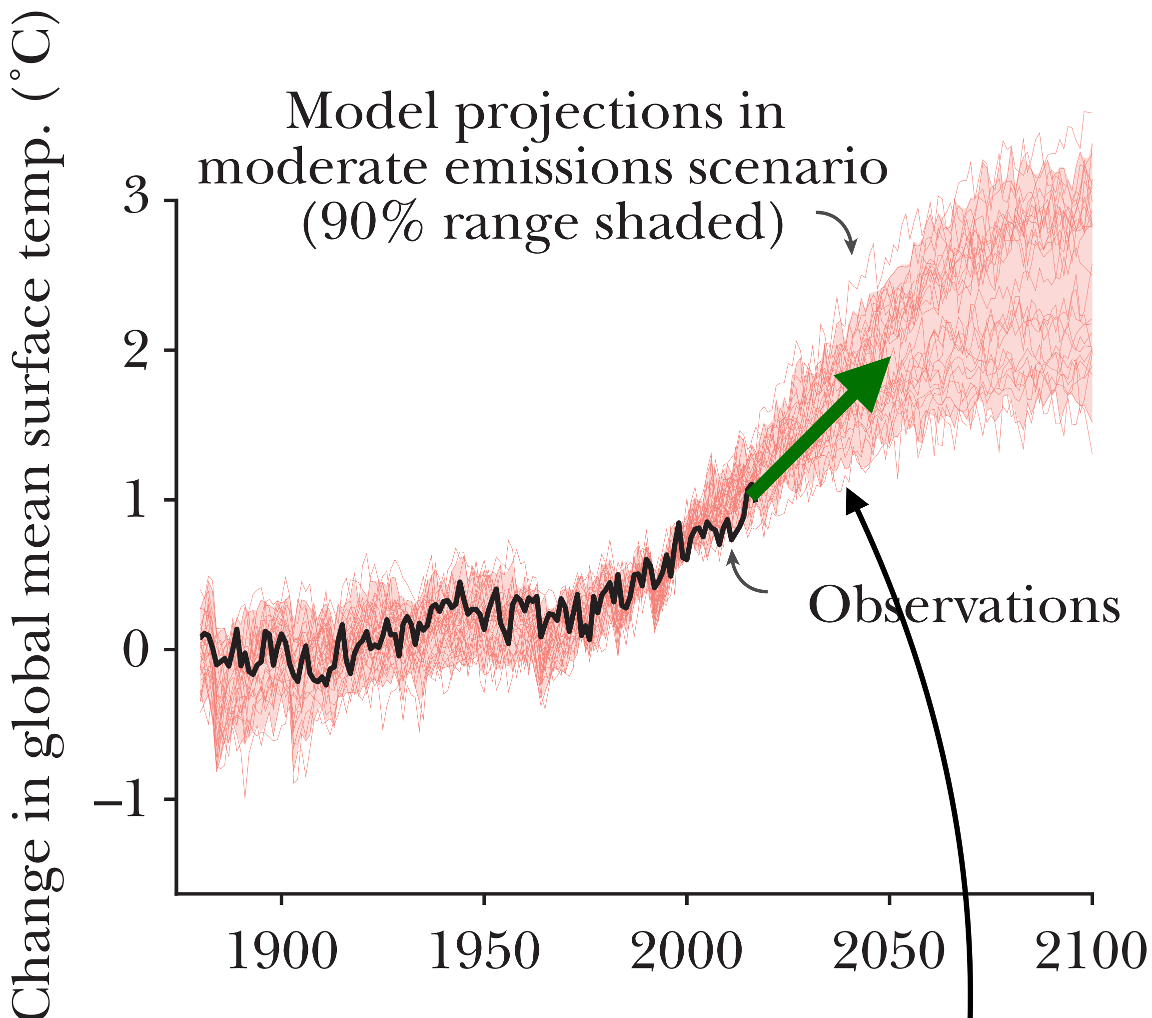
Intergroup conflict
temp: 11.3% per +s.d.
precip: 3.54% per + s.d.



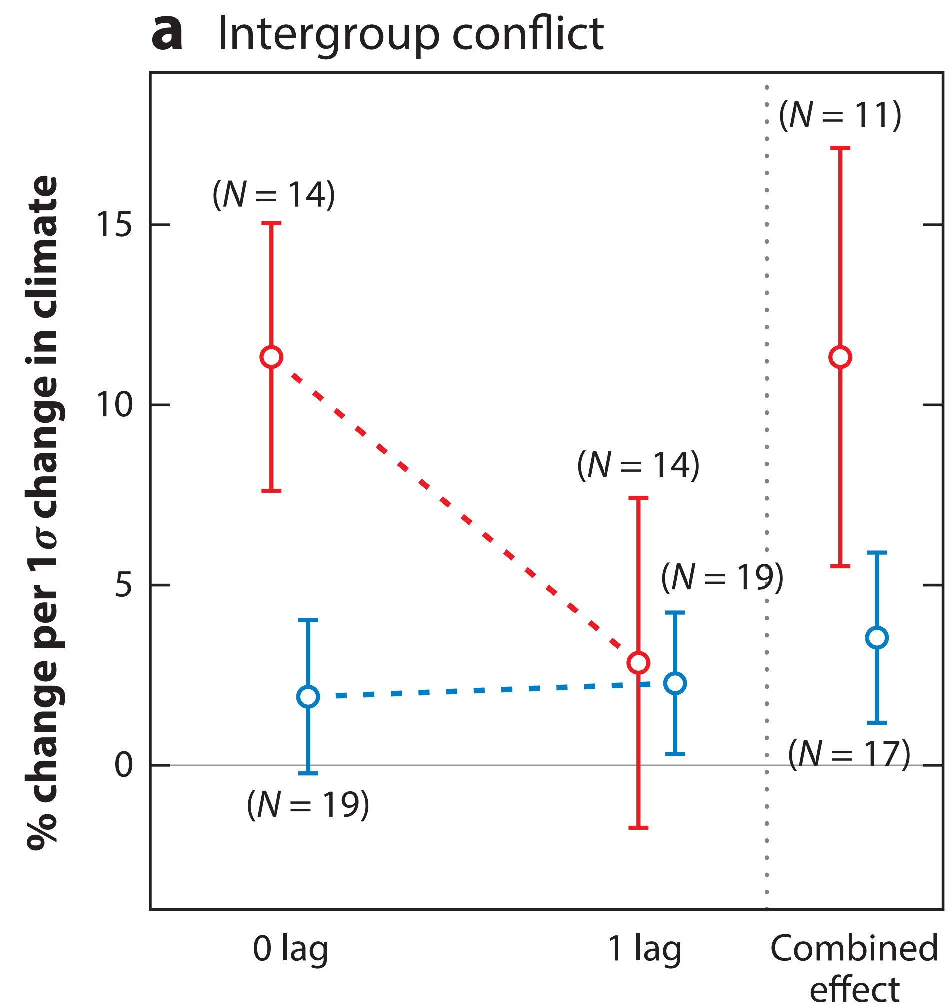
Hsiang & Kopp (*J. Econ Perspectives*, 2018)



Burke, Hsiang, Miguel (*Annual Review of Economics*, 2015)

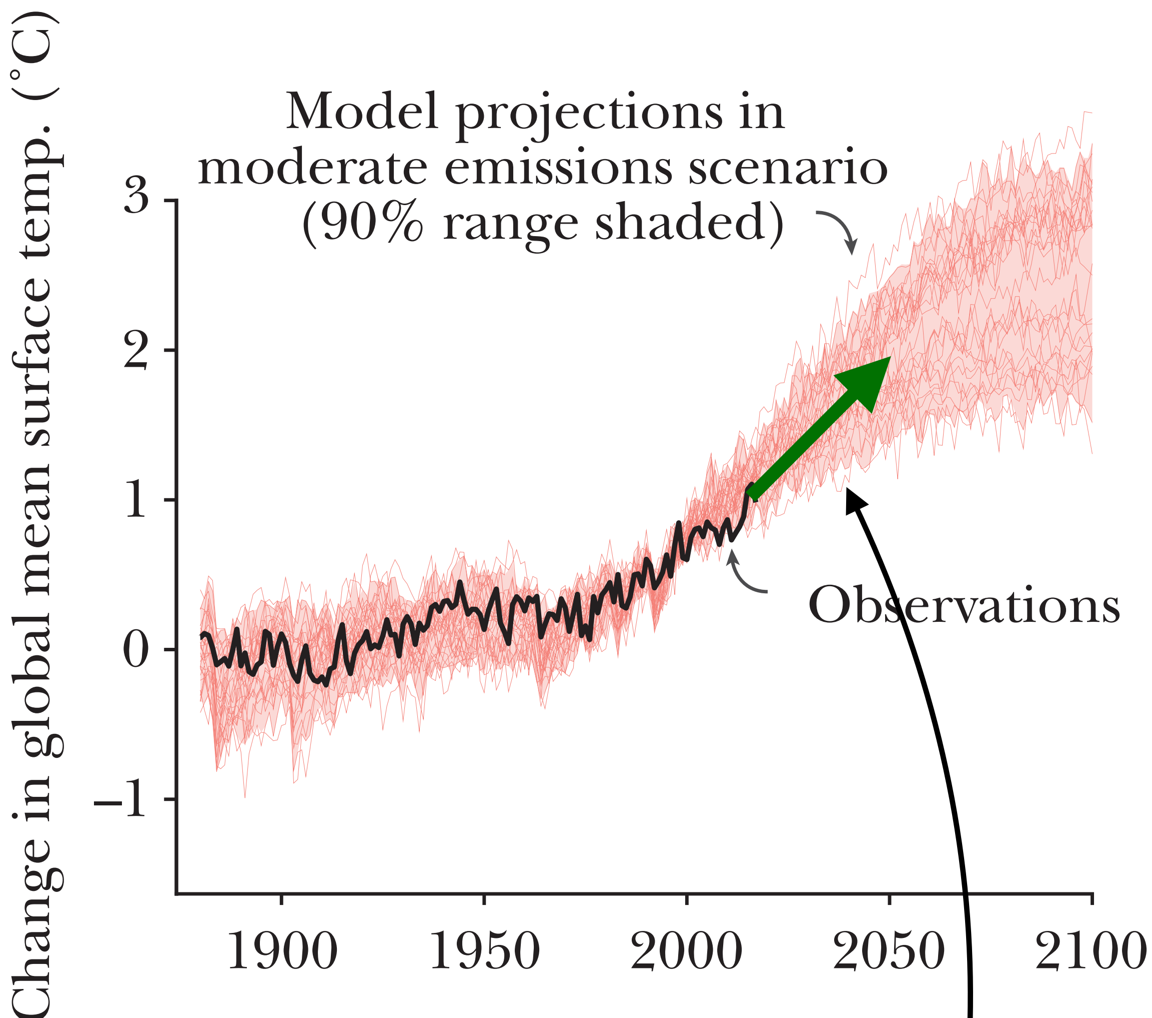


Hsiang & Kopp (*J. Econ Perspectives*, 2018)



Burke, Hsiang, Miguel (*Annual Review of Economics*, 2015)

Warming (RCP 4.5): 1C over 30 years



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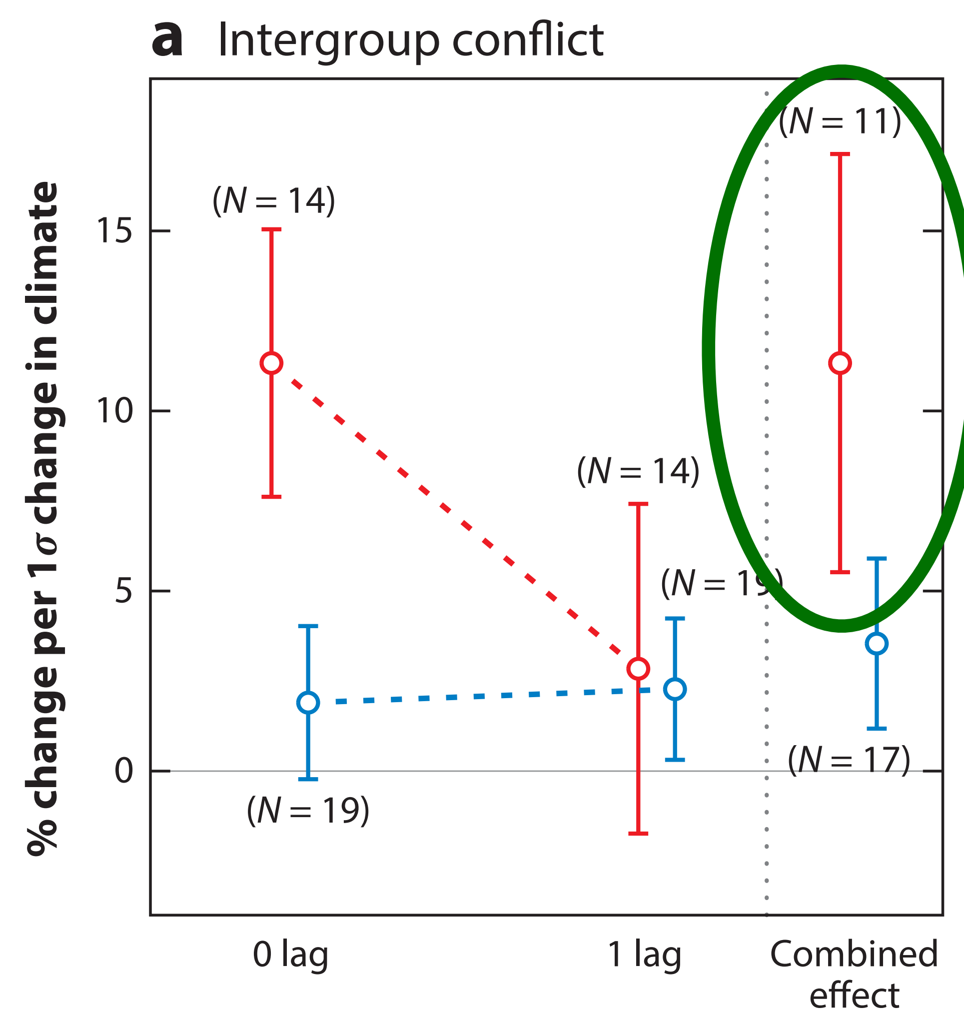

Burke, Hsiang, Miguel (*Annual Review of Economics*, 2015)

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Temp effect: 11.3% per +s.d.

s.d. = 0.4C for avg country

Temp effect
= 28.25% / 1C for avg country

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(0.033 C / yr) x (28.25% / 1C) = **+0.93% increase in risk / yr**

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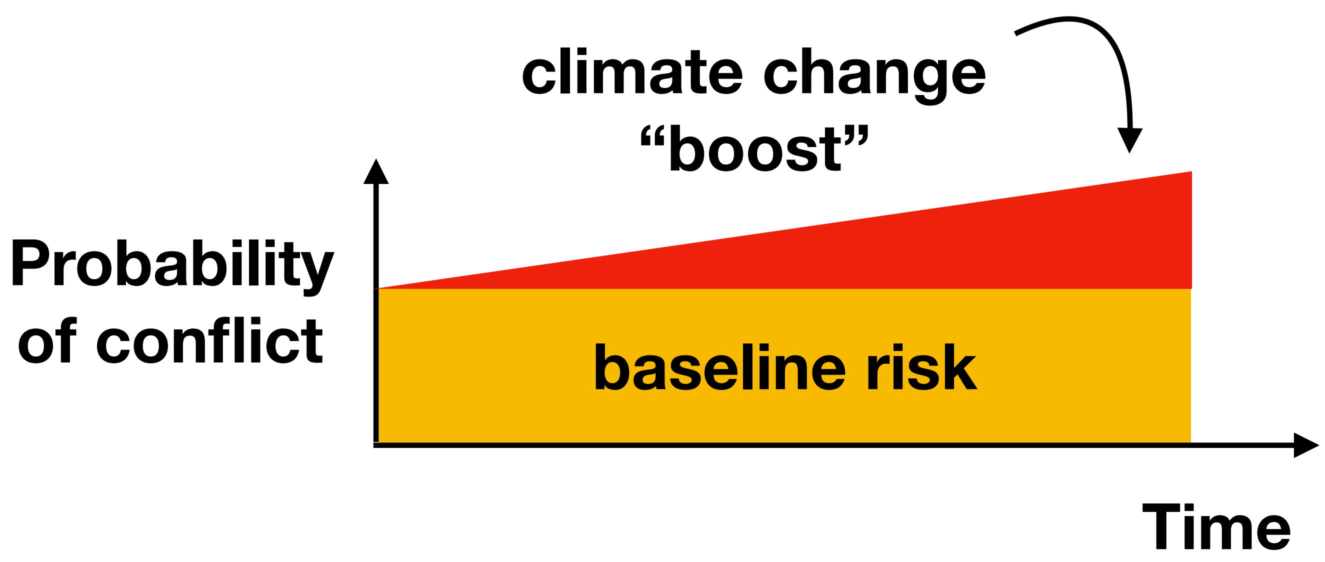
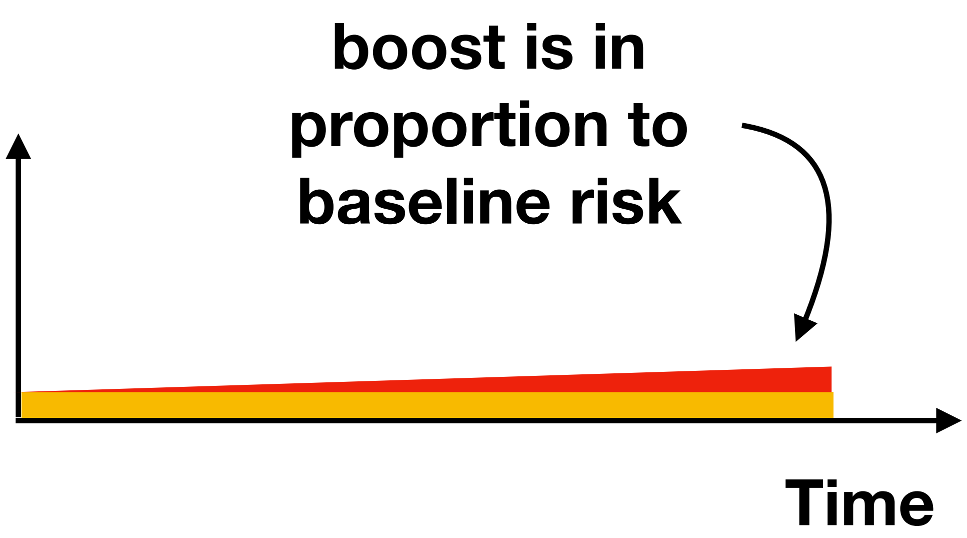
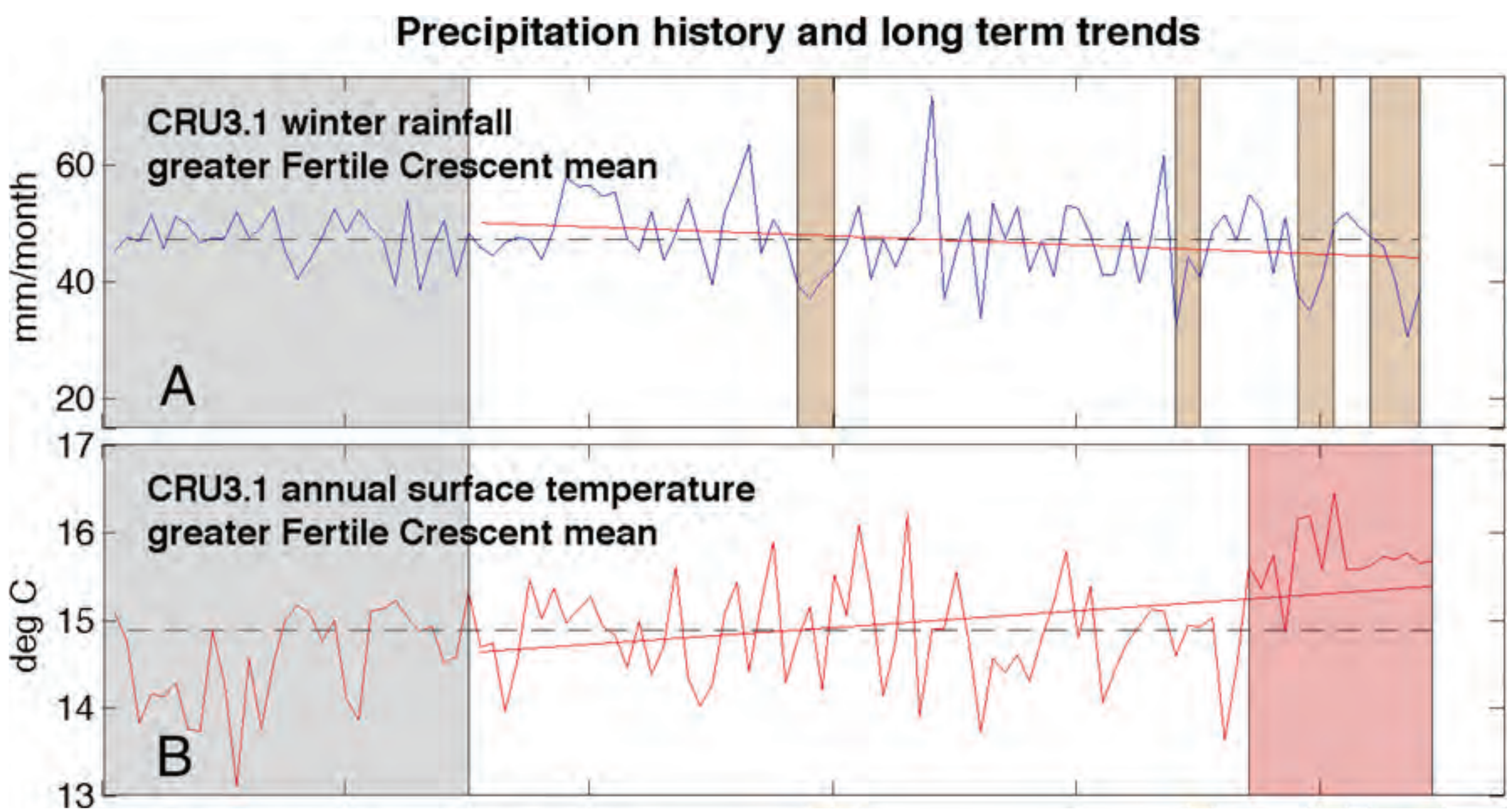




Example: Syria

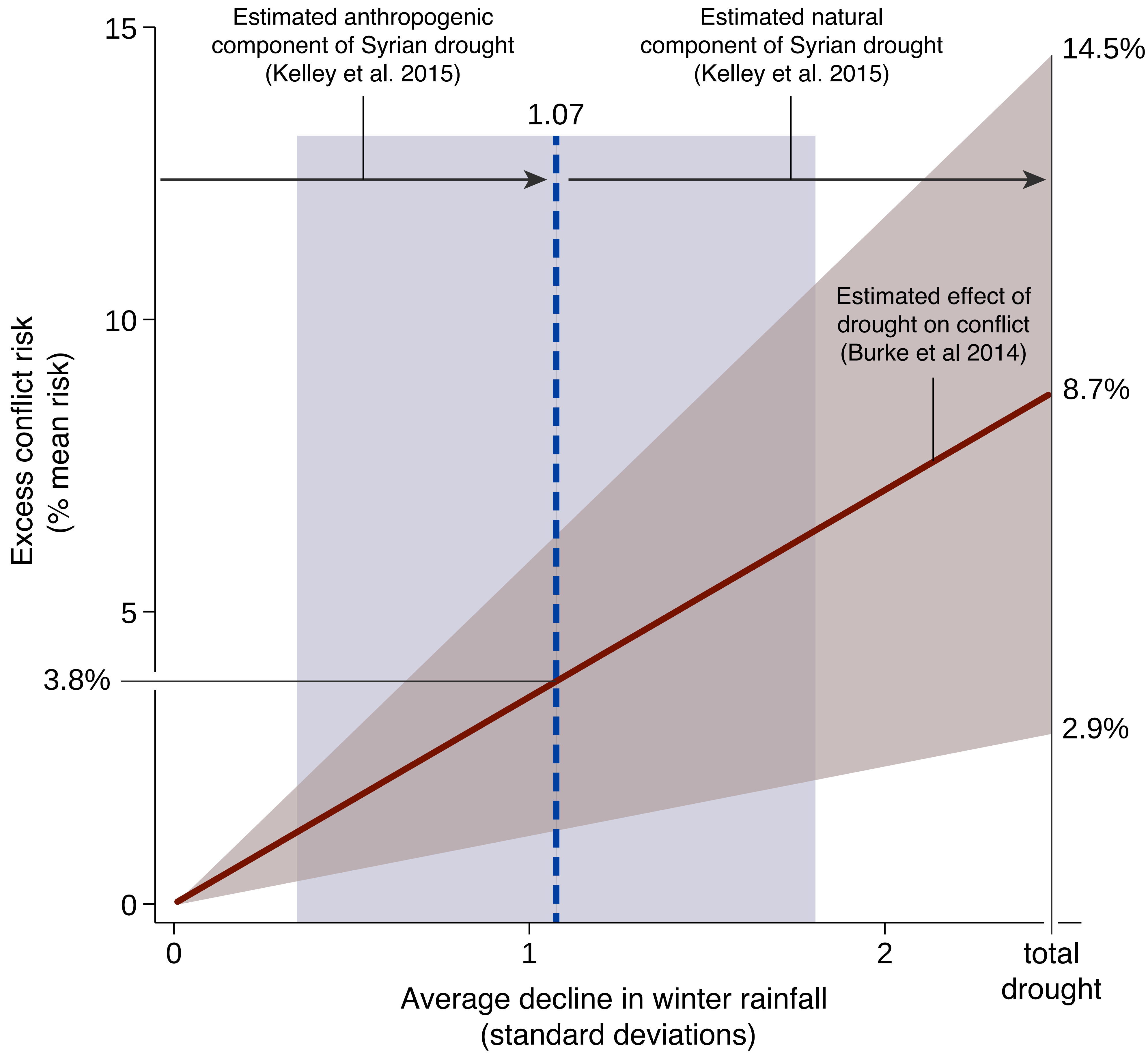
"Between 2007 and 2010, the greater Fertile Crescent experienced the worst drought in the instrumental record. Crop yields plummeted, nutrition-related disease rates rose, and school enrollment fell; the number of drought-induced internally displaced people is estimated to be 1.5 million" (Kelly et al., 2014)



Kelley et al (PNAS, 2014)

March 2011 marked the beginning of the ongoing Syrian civil war.

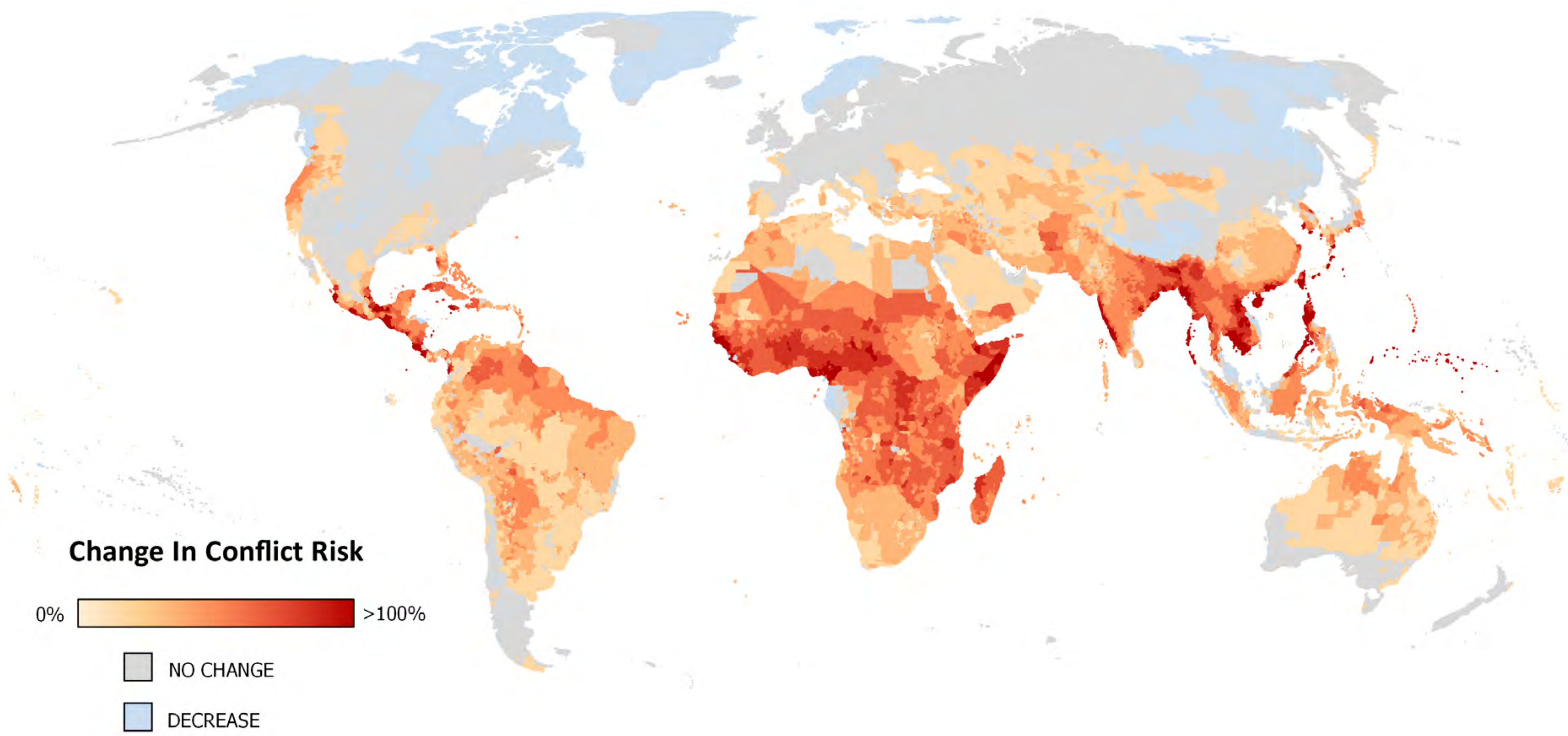
How would we have assessed the risk of conflict in Syria if we were writing a report in January of 2011?



Burke & Hsiang (*2014*)

Seasonal **intergroup conflict** forecast

Excess risk attributable to temperature and rainfall



[PRELIMINARY]

Climate Impact Lab (*in progress*)

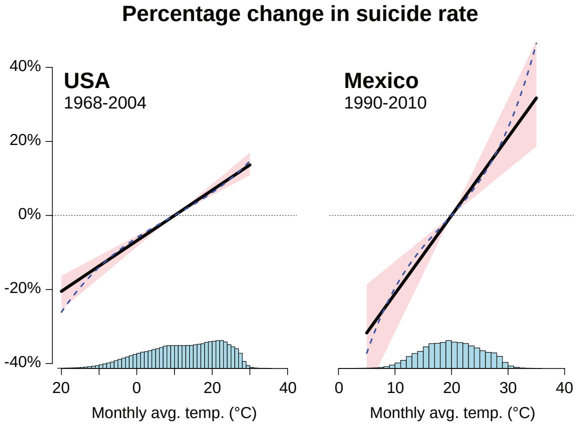
What explains these patterns?

Hypothesis 1: **External economic factors**
$\rightarrow$ e.g. deteriorating agricultural labor markets

Hypothesis 2: **External logistical factors**
$\rightarrow$ e.g. individuals come into contact outdoors during summer

Hypothesis 3: **Internal psychological factors**
$\rightarrow$ e.g. mechanics of decision-making changes

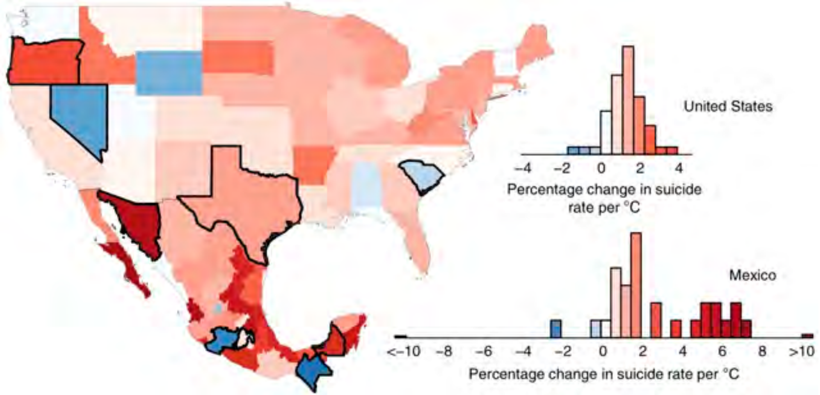
North American self-harm suggests psychological pathway



Burke et al. (Nature Climate Change, 2018)

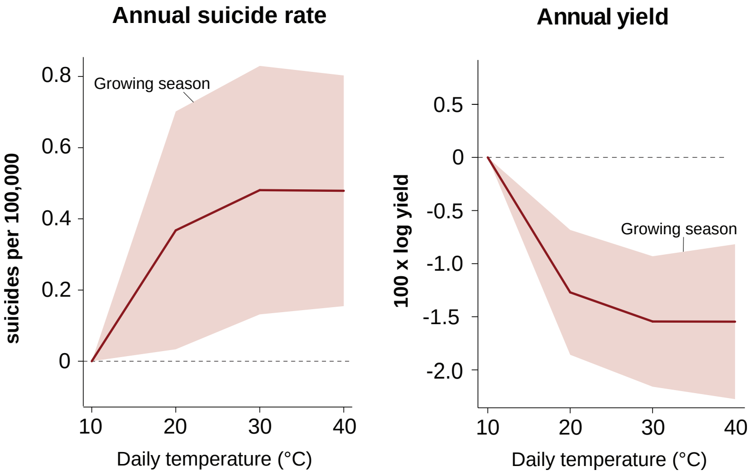
<u>Note:</u> Self-harm causes more deaths globally than all forms of interpersonal + intergroup violence combined. In top 5 causes of death in USA, ages 10-54.

North American self-harm suggests psychological pathway



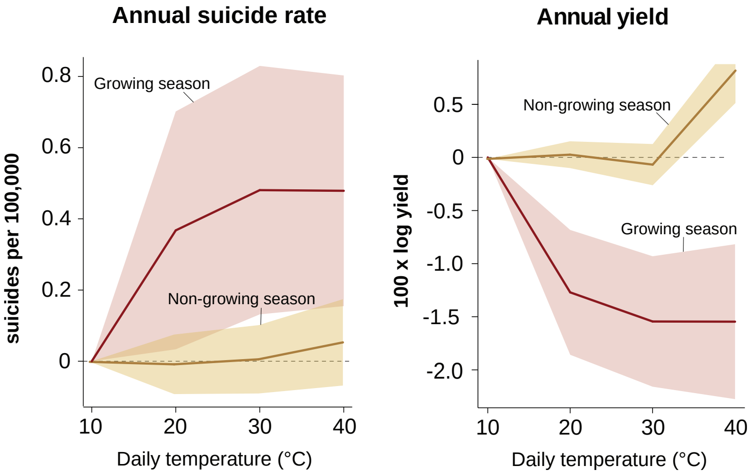
Burke et al. (Nature Climate Change, 2018)

Self-harm in India implicated economic factors



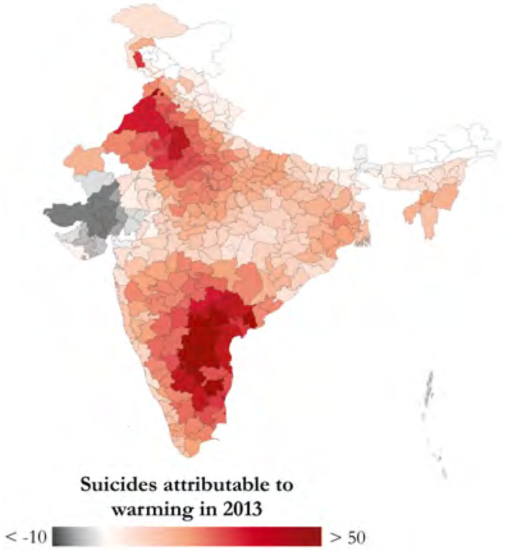
Carleton (PNAS, 2017)

Self-harm in India implicated economic factors



Carleton (PNAS, 2017)

60k suicides attributable to warming that already occurred



Carleton (PNAS, 2017)

Scrutinizing decision-making mechanics w/ lab experiments

- We ran two parallel large-scale behavioral experiments in Berkeley, USA (N = 903) and Nairobi, Kenya (N = 1015).
- Randomly assign subjects to Hot (30°C / 86°F) or Control (22°C/ 71°F) environments.
- Deployed a battery of 14 standard tests to understand if / how temperature affected social / economic decision-making

  → e.g. charitableness, patience, trust, "joy of destruction"

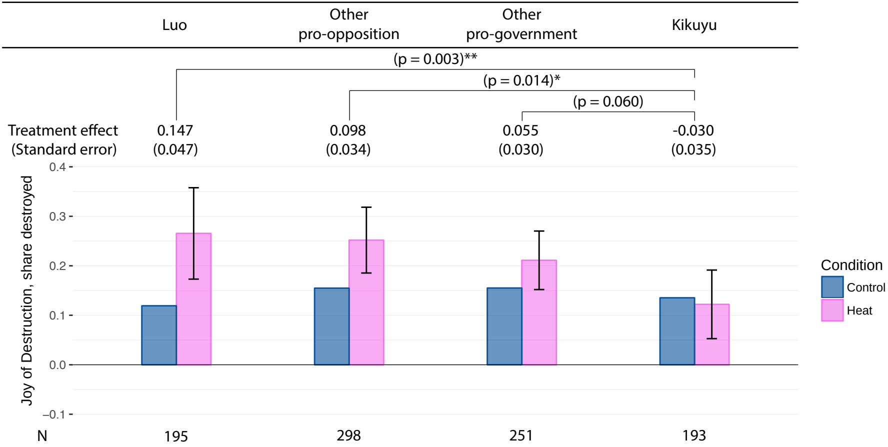
Kenyan presidential election is “stolen” during experiment

This was not planned.

Almas et al (in review)

Unexpected findings of experiment × political context

Luo - felt election was stolen; **Kikuyu** - won election



Note: No effect in Berkeley. We interpret this cautiously.

Almas et al (in review)

Climatic Change
December 2014, Volume 127, Issue 3–4, pp 399–405 | Cite as

Reconciling climate-conflict meta-analyses: reply to Buhaug et al.

Authors Authors and affiliations

Solomon M. Hsiang, Marshall Burke, Edward Miguel

Response
First Online: 28 October 2014

Abstract

A comment by Buhaug et al. attributes disagreement between our recent analyses and their review articles to biased decisions in our meta-analysis and a difference of opinion regarding statistical approaches. The claim is false. Buhaug et al.'s alteration of our meta-analysis misrepresents findings in the literature, makes statistical errors, misclassifies multiple studies, makes coding errors, and suppresses the display of results that are consistent with our original analysis. We correct these mistakes and obtain findings in line with our original results, even when we use the study selection criteria proposed by Buhaug et al. We conclude that there is no evidence in the data supporting the claims raised in Buhaug et al.

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One effect to rule them all? A comment on climate and conflict

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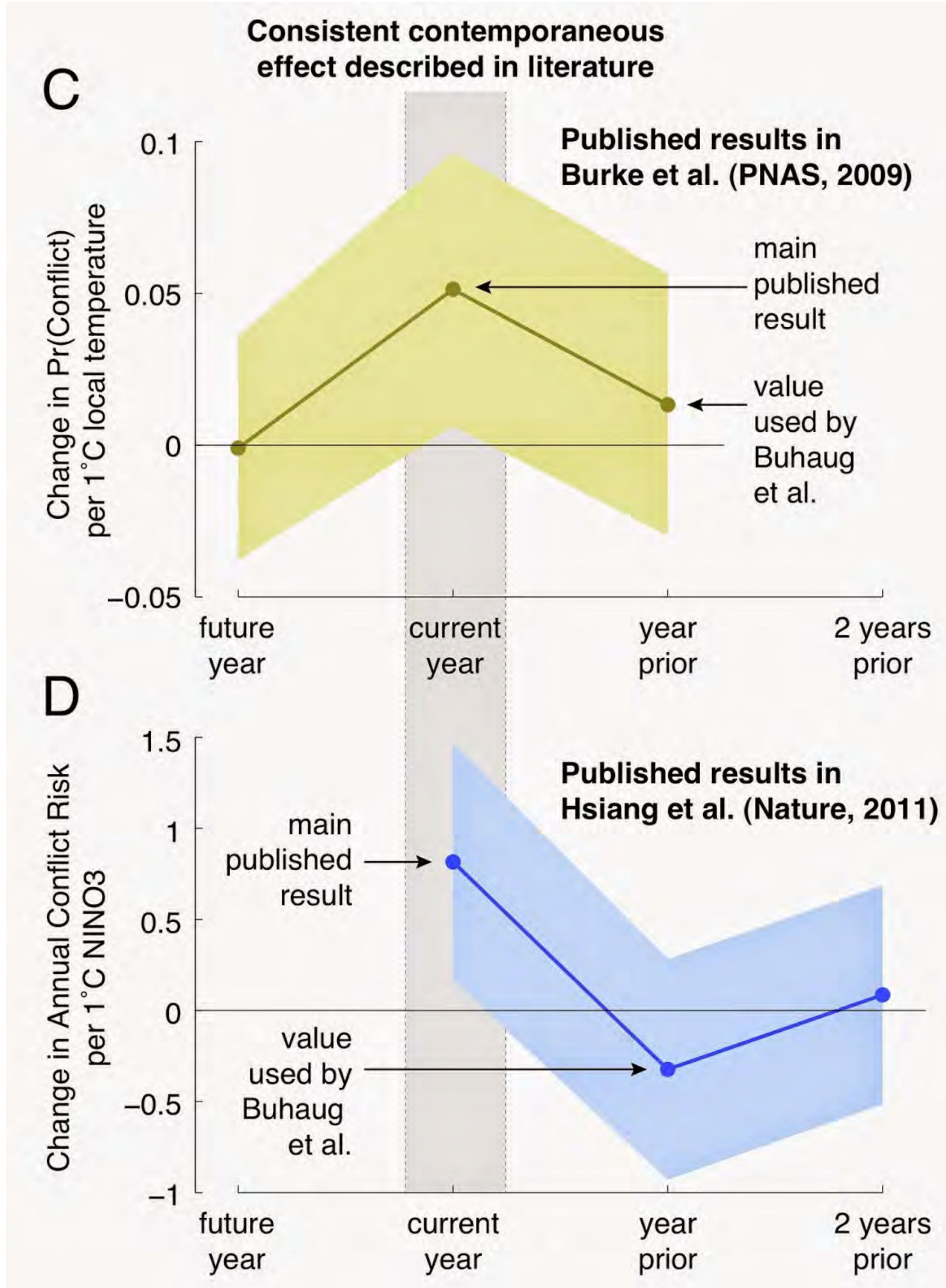
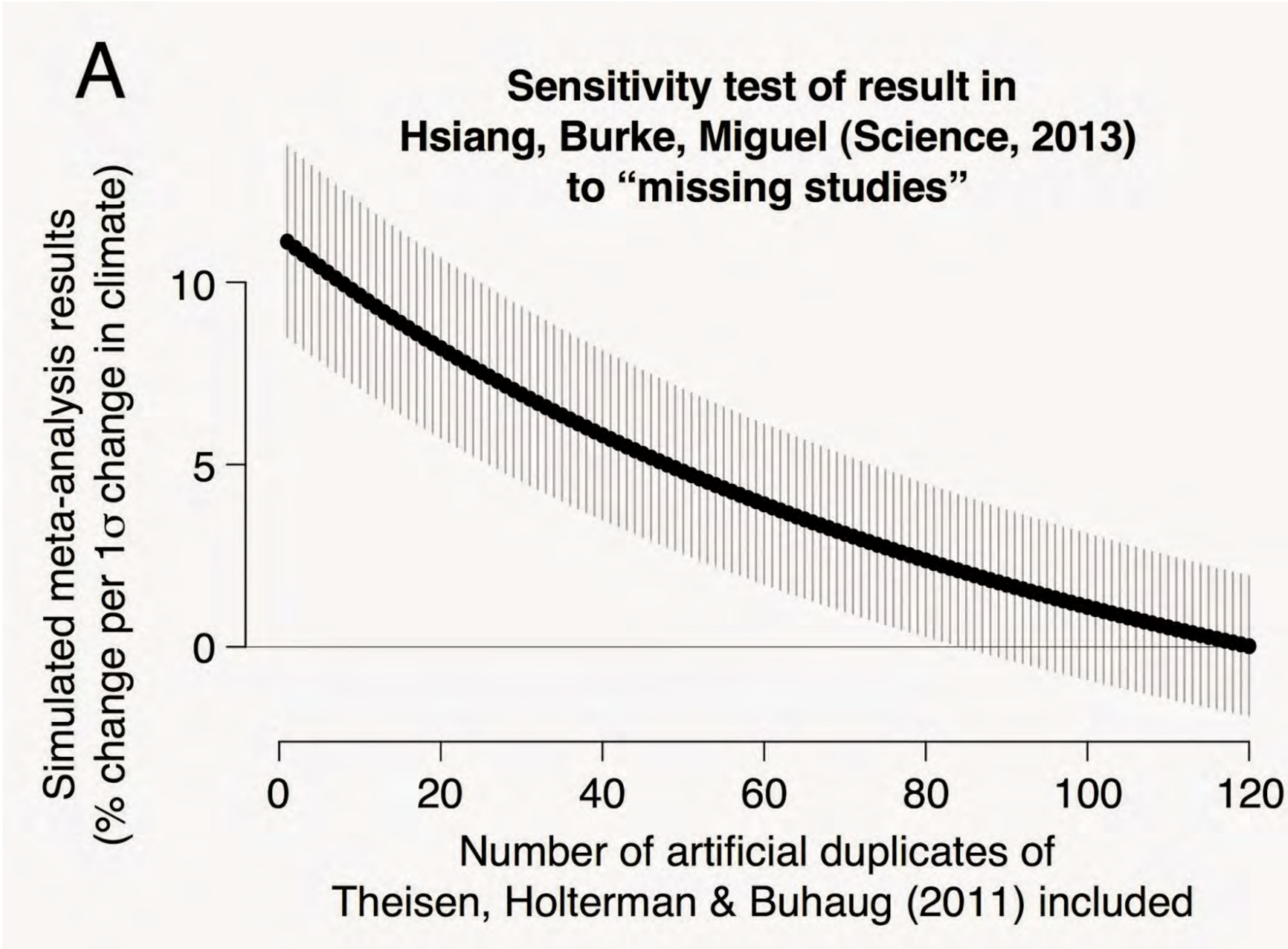


Hsiang, Burke, Miguel (*Climatic Change*, 2014)



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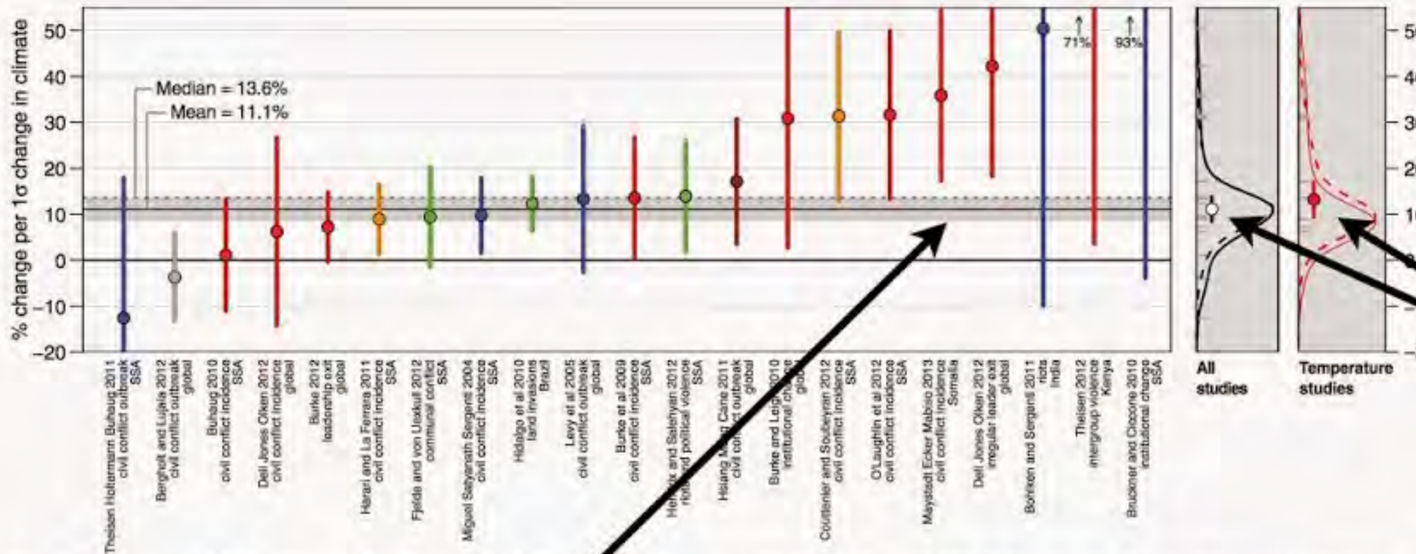
From
Hsiang, Burke, Miguel
Science (2013)

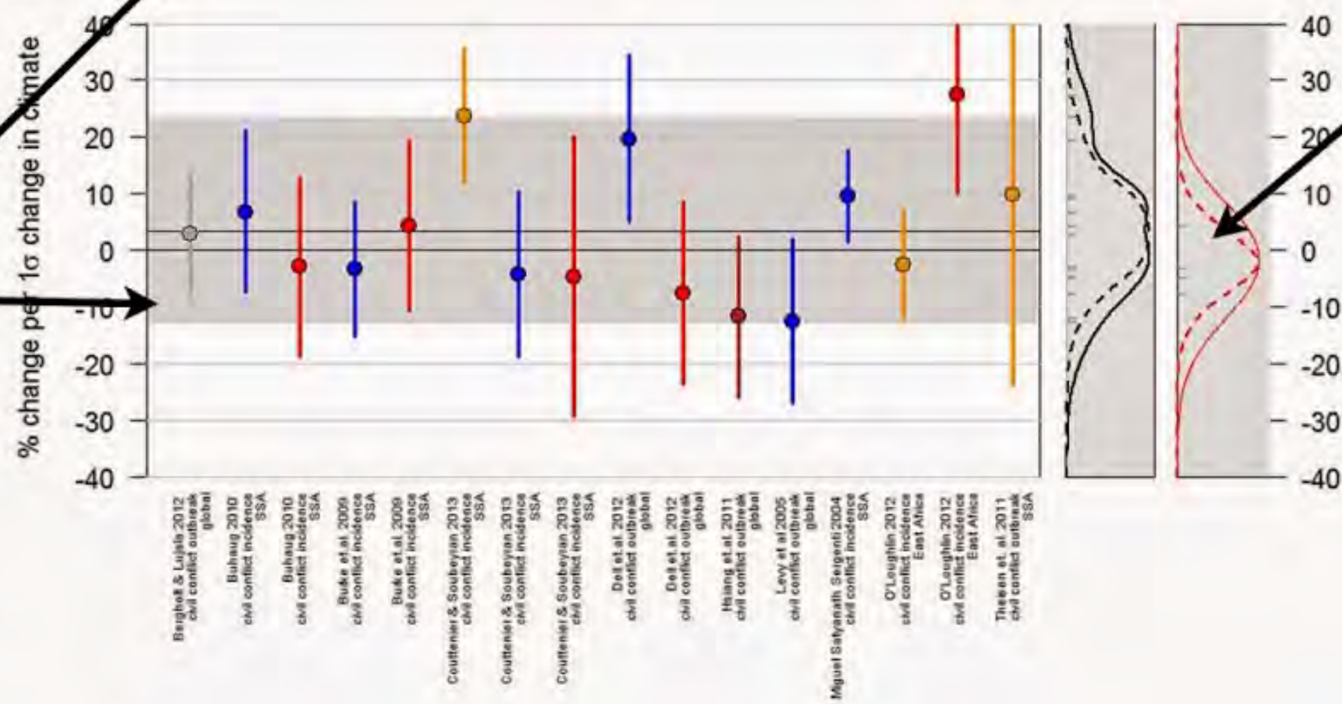


Markers and confidence intervals denoting the main conclusion of study

Fig. 5. Modern empirical estimates for the effect of climatic events on the risk of intergroup conflict. Each marker represents the estimated effect of a 1σ increase in a climate variable, expressed as a percentage change in the outcome variable relative to its mean. Whiskers represent the 95% CI on this point estimate. Colors indicate the forcing climate variable: A coefficient is positive if conflict increases with higher temperature (red), greater rainfall loss (blue), greater rainfall deviation from normal (green), more floods and storms (gray), more El Niño–like conditions (brown), or more drought (orange), as captured by different drought indices. The dashed line indicates the median estimate; the top solid black line denotes the precision-weighted mean, with its 95% CI shown in gray. The panels at right show the precision-weighted mean effect (circles) and the distribution of study results for all 21 results looking at intergroup conflict or for the subset of 12 results focusing on temperature effects (which includes the ENSO and drought studies). Distributions of effect sizes are either precision-weighted (solid lines) or derived from a Bayesian hierarchical model (dashed lines). See the supplementary materials for details on the individual studies and on the calculation of mean effects and their distribution.

From
Buhaug et al.
Climatic Change (2014)

Climatic Change



Markers removed in comment by Buhaug et al., which is based off of original code in Hsiang et al.

Had the marker been included, it would have indicated a statistically significant result.

Gray band in Buhaug et al. visually mimics the confidence interval in Hsiang et al, but it is not a confidence interval. It is the 2.5-97.5 centile range of the data.

An actual confidence interval would have indicated a statistically significant result.

Fig. 1 Modern empirical estimates for the effect of climate variability on civil conflict. The markers illustrate the estimated percentage change in conflict with a 1σ increase in temperature (*red*), loss of rainfall (*blue*), increase in drought (*orange*), El Niño-like conditions (*brown*) or increase in severity of climatic natural disasters (*gray*). Whiskers denote the 95 % confidence interval. The solid horizontal line indicates the median climate effect with the 95 % highest density interval in grey, based on a Bayesian hierarchical model. The panels at the right show the distribution of results from all candidate studies (*black*) or those focusing squarely on temperature effects (*red*); solid lines represent the variance-weighted distribution while dashed lines depict the Bayesian hierarchical distribution. Studies listed alphabetically