

an earth systems perspective on climate migration

Climate Change and Human Migration
National Academies
March 18, 2024

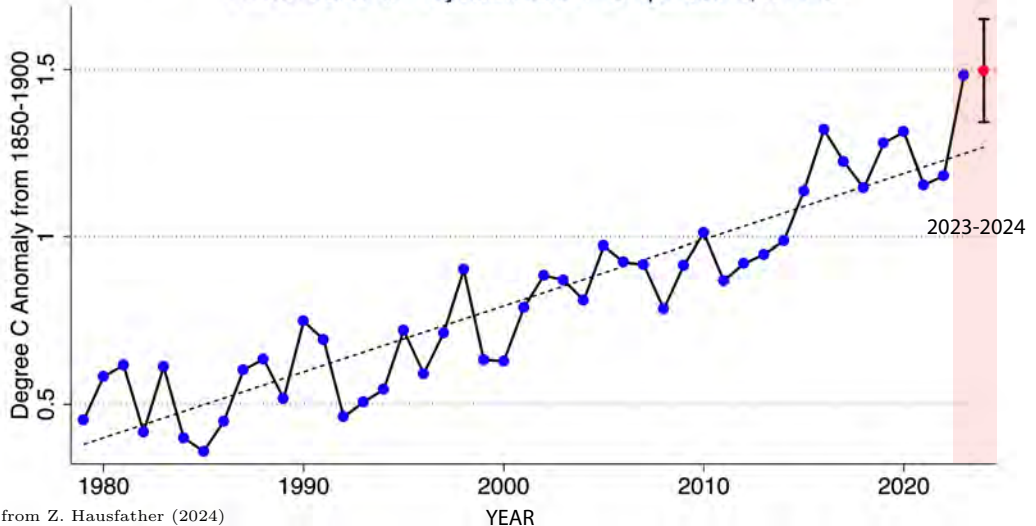
Justin Mankin
mankin@dartmouth.edu



I want to set some context for climate
migration

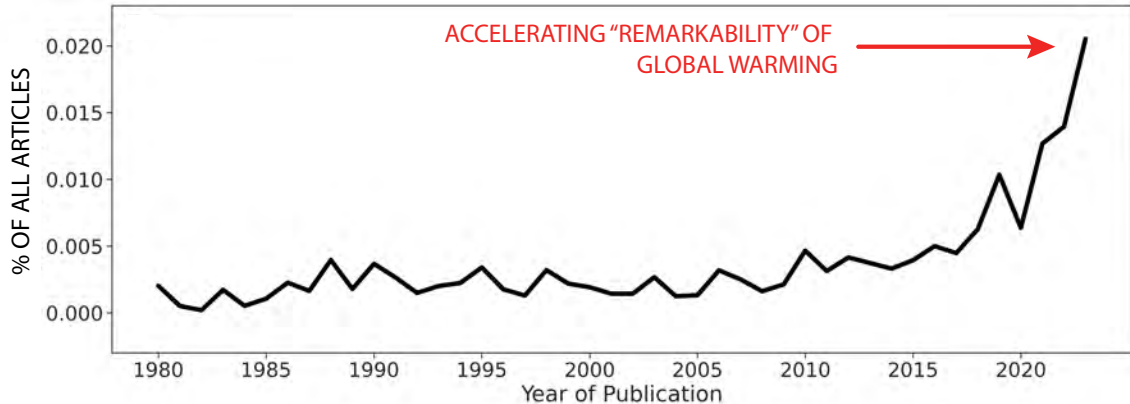
WARMING IS ON THE MARCH

Historical and Projected 2024 Temperature, ERA5



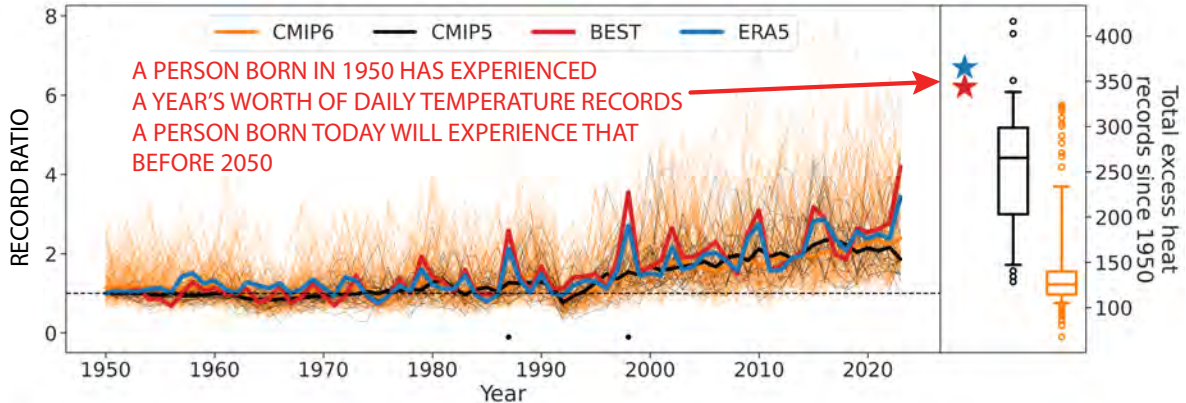
CLIMATE IMPACTS ABOUND

NEWS ARTICLES ABOUT RECORD-BREAKING HEAT

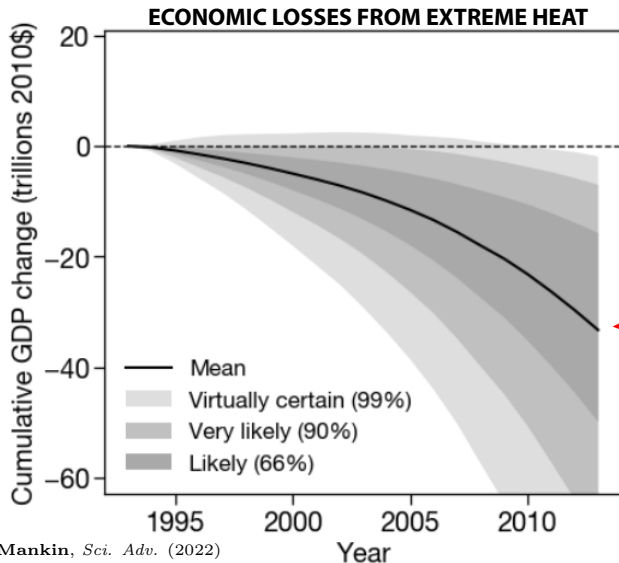


CLIMATE IMPACTS ABOUND

POPULATION-WEIGHTED GLOBAL DAILY TEMPERATURE RECORDS

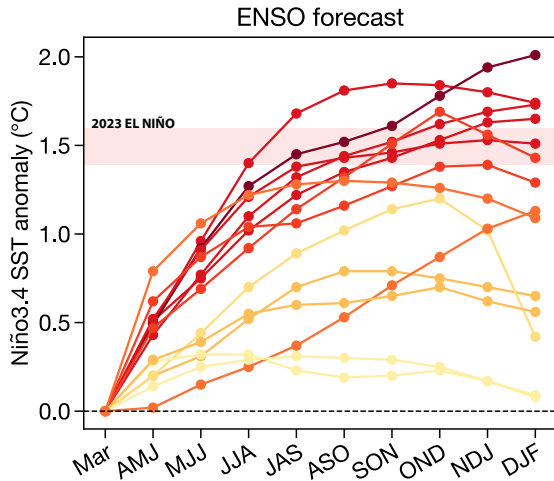


WE ARE JUST LEARNING THEIR COSTS

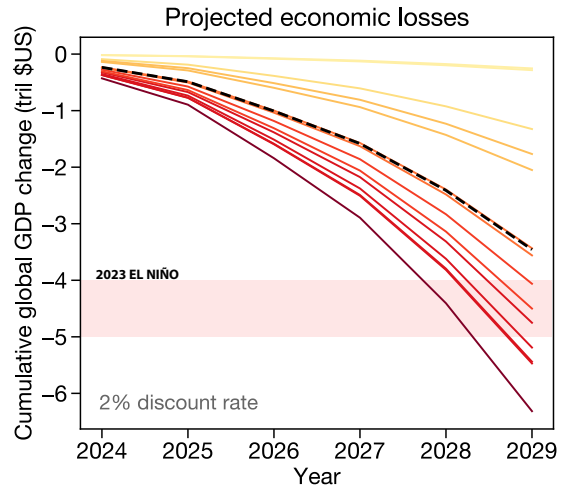
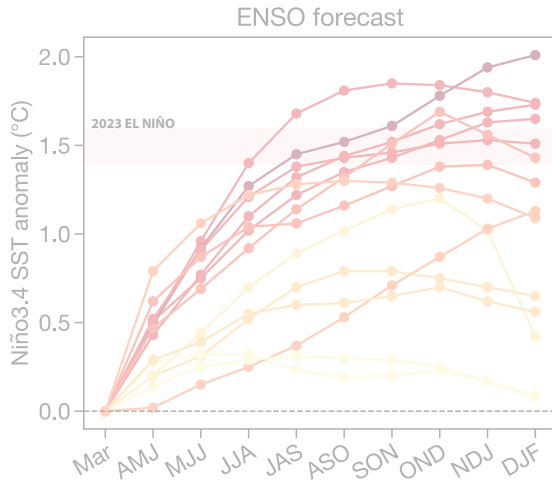


~\$30T IN GLOBAL INCOME LOSS
DUE TO GLOBAL-WARMING-CAUSED
EXTREME HEAT (1992–2013 PERIOD)

WE ARE POORLY ADAPTED



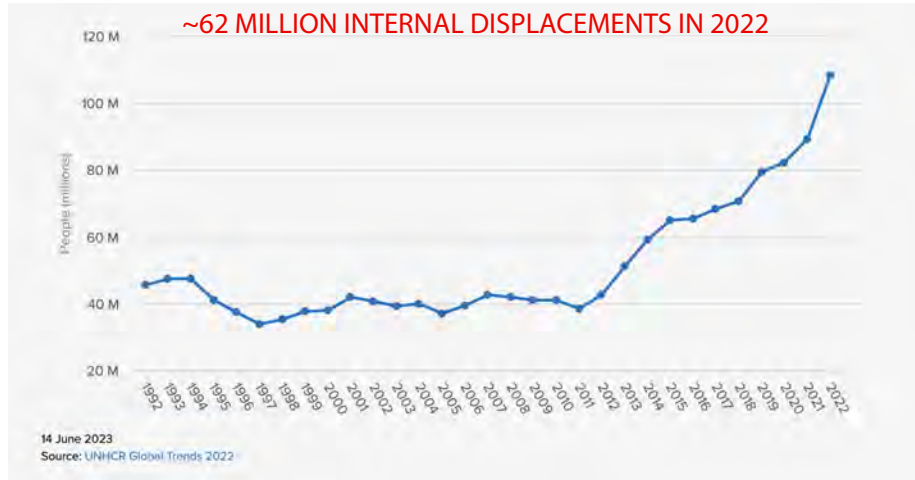
WE ARE POORLY ADAPTED



SO PEOPLE MOVE TO MANAGE STRESS

1 in 75 PEOPLE ON EARTH
HAVE FACING SOCIAL DISRUPTIONS THAT HAVE FORCED THEM TO MOVE

~62 MILLION INTERNAL DISPLACEMENTS IN 2022



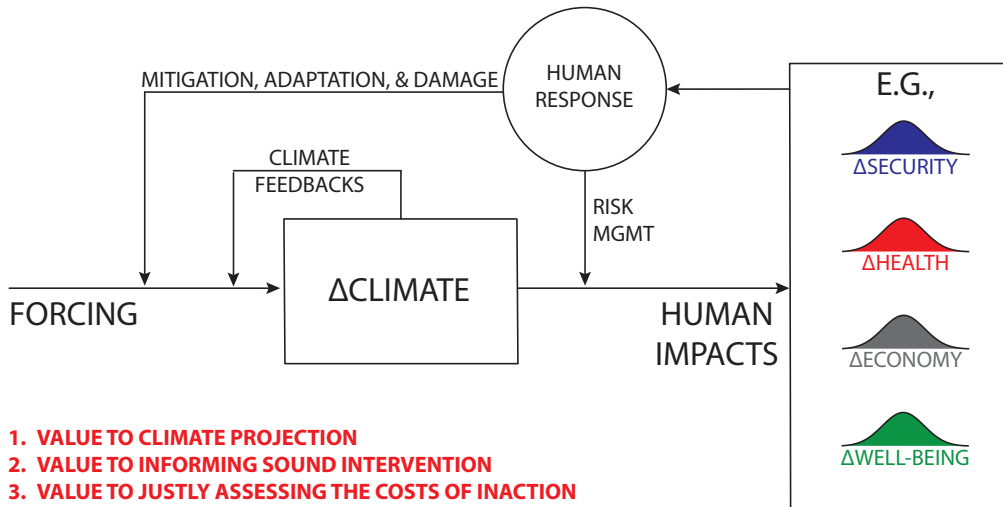
with that context, two things I want to
consider:

1. the merits to developing an Earth Systems perspective on
climate migration
2. the challenges to doing so

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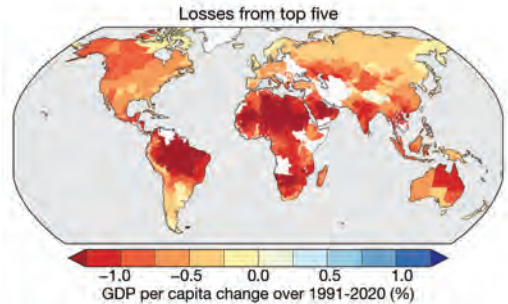
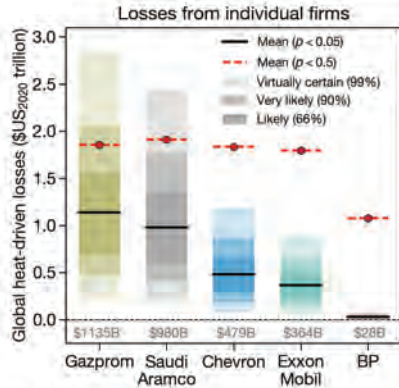
1. the merits to developing an Earth Systems perspective on
climate migration
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ENDOGENIZE PEOPLE IN MODELS OF THE CLIMATE SYSTEM



1. VALUE TO CLIMATE PROJECTION
2. VALUE TO INFORMING SOUND INTERVENTION
3. VALUE TO JUSTLY ASSESSING THE COSTS OF INACTION

ENDOGENIZING THE ECONOMY IN OUR EARTH SYSTEM MODELING ALLOWS US TO QUANTIFY *PARTICULAR* HARMS ATTRIBUTABLE TO *PARTICULAR* CORPORATE ACTORS

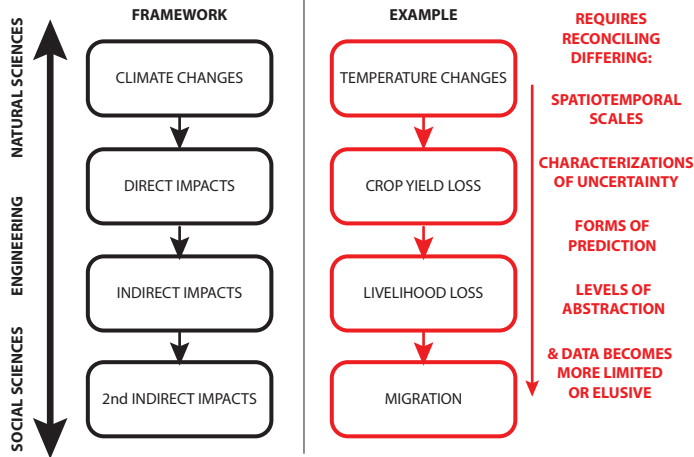


**\$9T IN LOSSES OVER 1991-2020
FROM EXTREME HEAT ATTRIBUTABLE
THE FIVE FIRMS SHOWN AT LEFT**

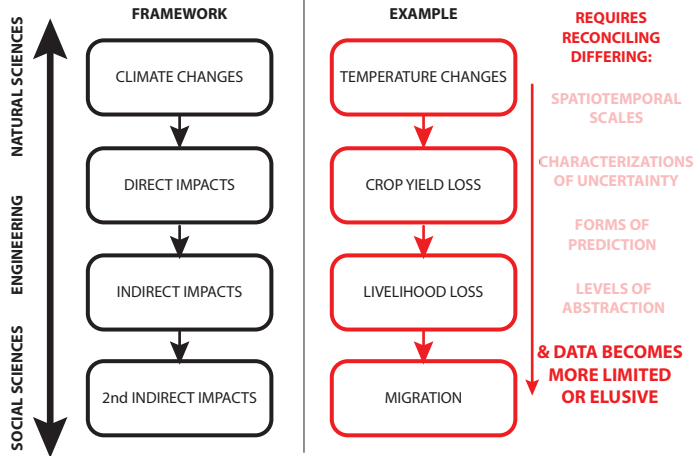
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INTEGRATION ACROSS DISCIPLINES IS HARD



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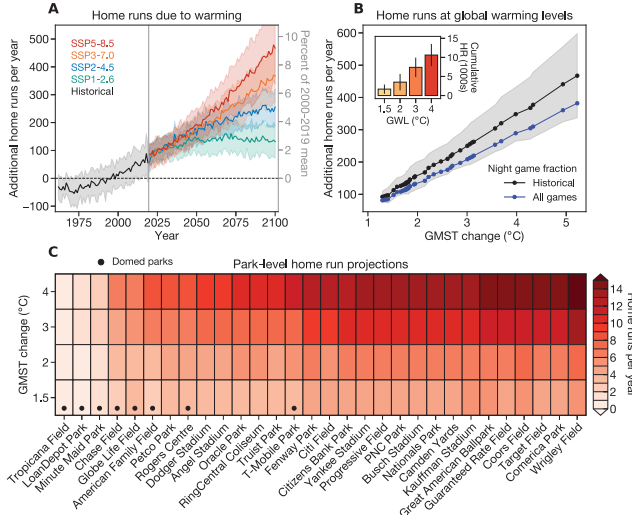


we want to know the social impacts of
climate change

to make such assessments, we need data, which is often
unavailable or interpolated

data gaps map to most vulnerable and exposed, implying that
we are systematically underestimating the impacts (and thus
costs) of climate inaction, especially among the most vulnerable

DATA EMERGE FROM POWER & PROFIT

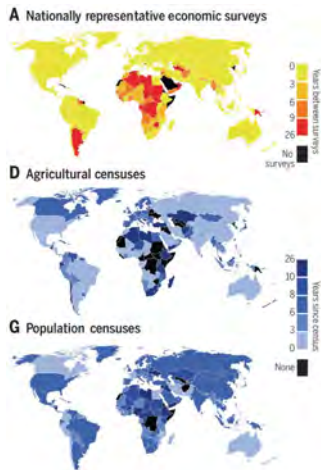


WE CAN ESTIMATE HISTORICAL AND FUTURE HOME RUNS IN MAJOR LEAGUE BASEBALL FROM GLOBAL WARMING.

WHAT OF ALL THE IMPACTS WE CANNOT ASSESS OWING TO DATA LIMITATIONS?

DATA COLLECTION IS A FUNCTION OF THE PRIVILEGE, PRIORITIES, AND VALUES OF THE DATA COLLECTOR

DATA POVERTY ON THE SOCIAL SIDE

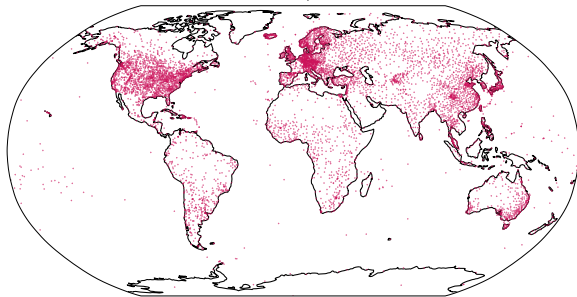


REPRESENTATIVE DATA
ON KEY DEVELOPMENT &
WELL-BEING INDICATORS
ARE SPORADIC (AT BEST)
IN THE LOW-INCOME WORLD

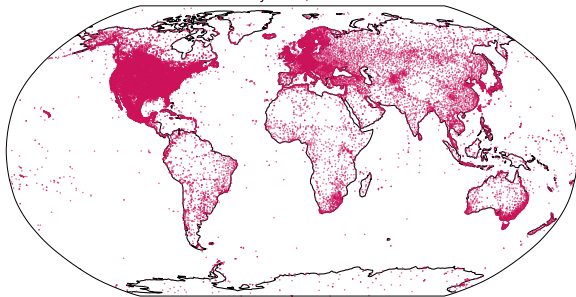
DATA POVERTY ON THE PHYSICAL SIDE

OUR WEATHER MEASUREMENTS HAVE SYSTEMATIC GAPS

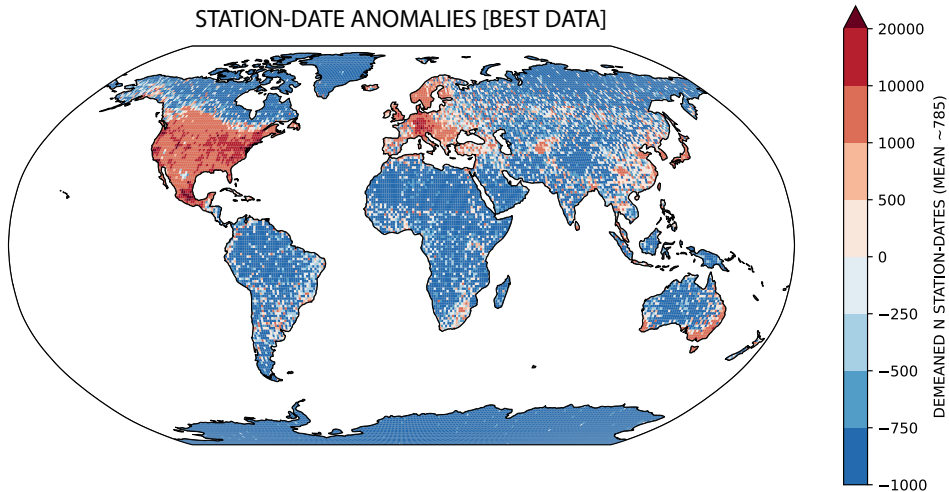
CRUTEMP 4.6, n=7599



Berkeley Earth, n=50522

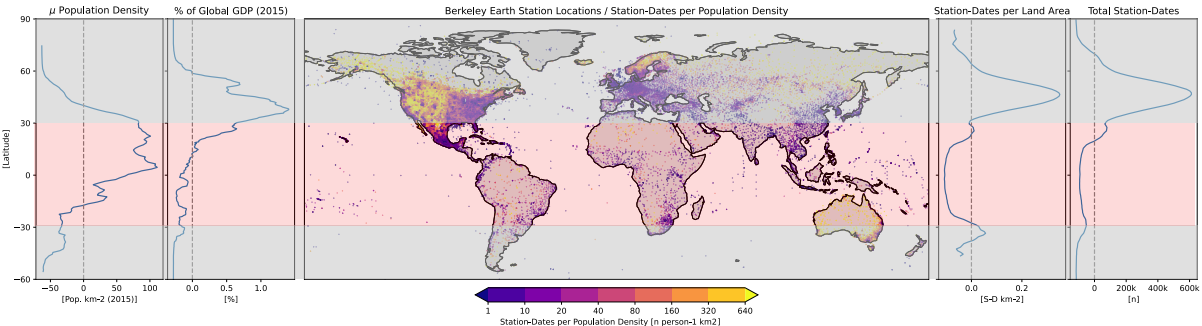


DATA POVERTY ON THE PHYSICAL SIDE



& THEY REFLECT UNDERLYING INEQUITIES

Global Climate Data Disparities, version 3.1 (ZONAL MEANS ANOMALIZED & ROLLING)



to summarize:

an Earth Systems perspective on climate migration has merits,
but it must first help articulate and rectify data gaps, lest it
reinforce overly reductive and deterministic models of human
tragedy

CMIG SUPPORT FROM



U.S. DEPARTMENT OF
ENERGY

Office of
Science



MAPP

Modeling, Analysis,
Predictions, and Projections

with thanks to Neukom, the Wright Center, and the
Rockefeller Center

collaborators C. Callahan, A. Gottlieb, M. O'Shea, F.
Perlmutter

extra slides

UNDERESTIMATING COSTS: PREDICTOR

DATA GAPS CAN MEAN ENDOGENEITY PROBLEMS

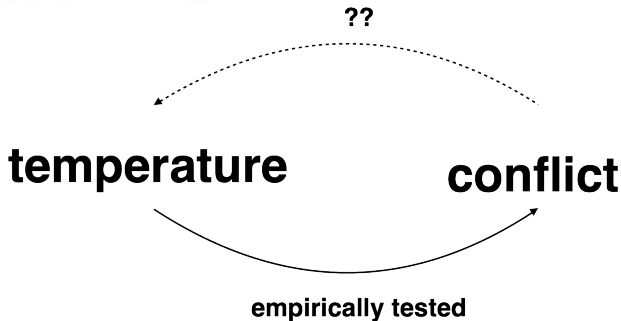


A woman in the Central African Republic waves her flag. Years of fighting have left the country's already crumbling infrastructure in shambles. (AP Photo/Steve Delaney)

By Kenneth Schultz and Justin Mankin

April 22, 2019 at 8:05 a.m. EDT

When the Central African Republic erupted in civil war in December 2012, nine of the country's weather stations participating in the Global Climate Observing System stopped reporting within months. When we reached out to the country's national meteorological service to find out what happened, the response was striking: "destroyed by war," "personnel forced to leave."



UNDERESTIMATING COSTS: PREDICTOR

DATA GAPS CAN MEAN ENDOGENEITY PROBLEMS

The Washington Post

Monkey Cage • Analysis

The weather stations that monitor climate change are at risk. This is why.

Civil war and other conflicts are costing us valuable data.

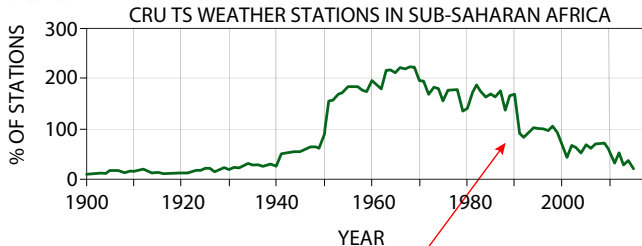


A woman in the Central African Republic waves country flags. Years of fighting have left the country's already underdeveloped climate change infrastructure in shambles. (Associated Press)

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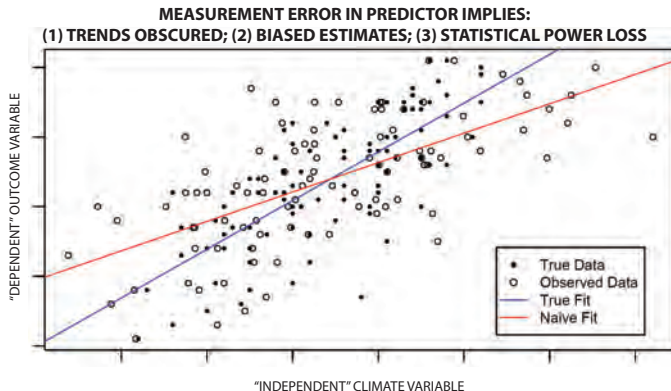
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MEASUREMENT ERROR CAUSES BIASES IN CRU DATA, WHICH BIASES CLIMATE-CONFLICT ESTIMATES

UNDERESTIMATING COSTS: PREDICTOR



WE WANT TO ESTIMATE:

$$Y = B_0 + B_x X + \varepsilon$$

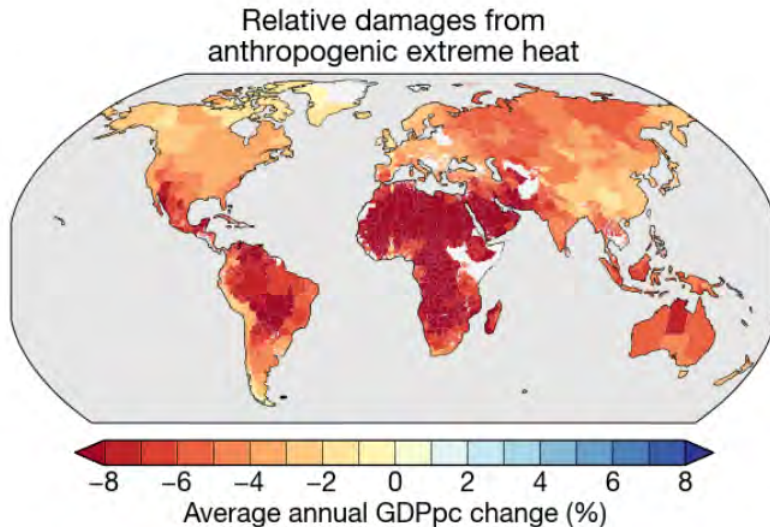
For example, if 25% of the variance of W comes from measurement error, then your reliability ratio will be 0.75, so $\beta_W = 0.75\beta_X$.

BUT INSTEAD WE ARE ESTIMATING:

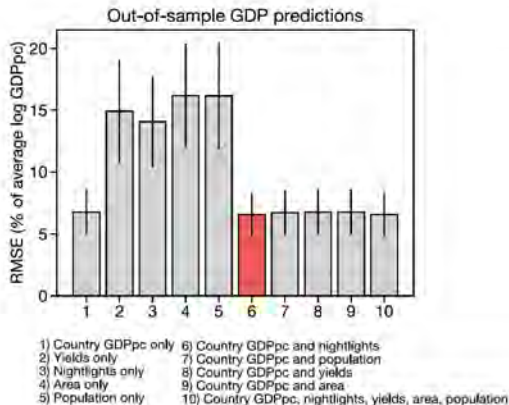
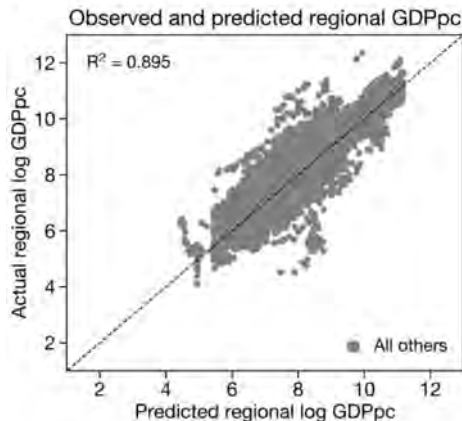
$$Y = B_0 + B_x W + \varepsilon$$

$$W = X + U$$

UNDERESTIMATING COSTS: PREDICTAND

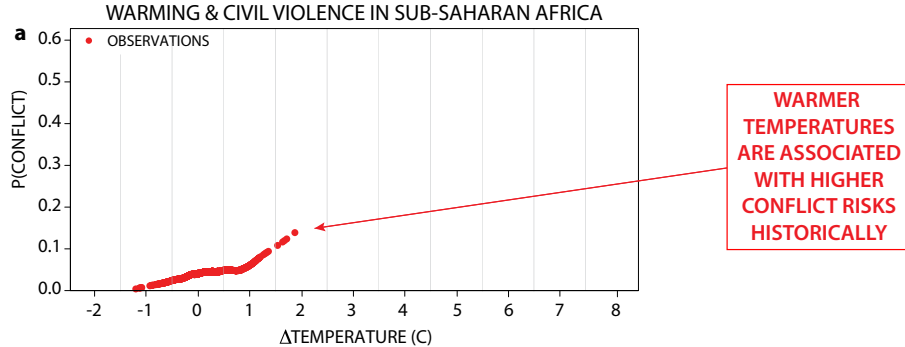


UNDERESTIMATING COSTS: PREDICTAND

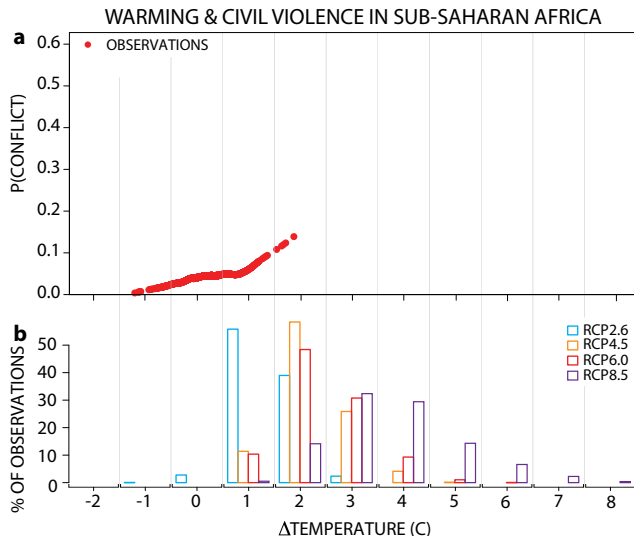


**AND GDP IS A SHALLOW MEASURE
(DOES NOT CONSIDER NONMARKET OR DISTRIBUTIONAL IMPACTS)**

FOR EXAMPLE, CLIMATE AND VIOLENCE



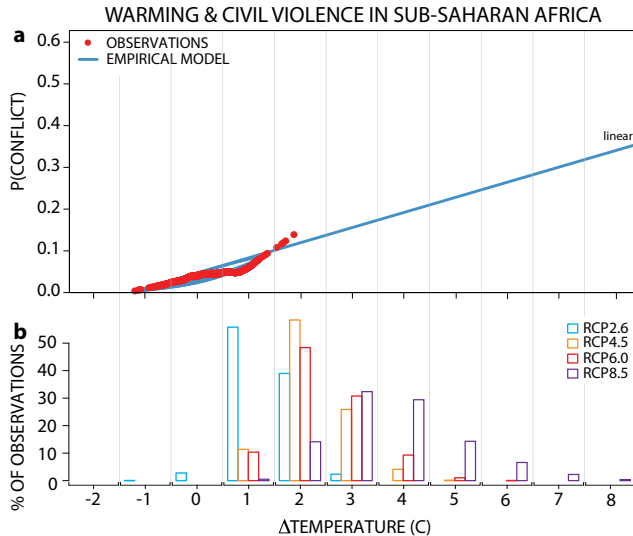
FOR EXAMPLE, CLIMATE AND VIOLENCE



HOW DO WE RESPONSIBLY
EXTRAPOLATE
THIS RELATIONSHIP?

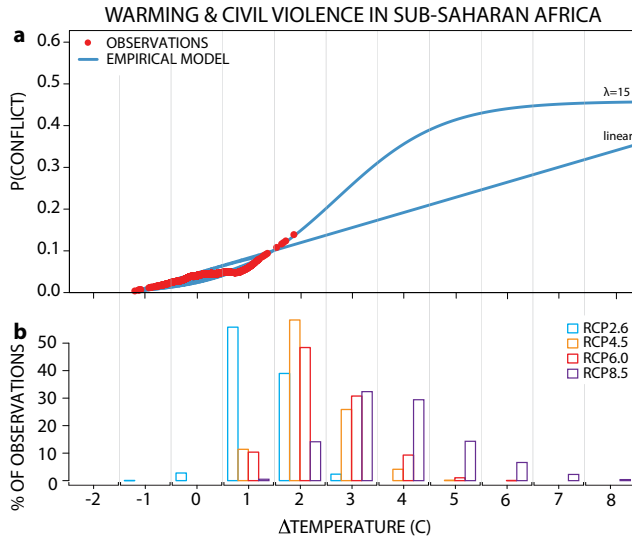
USE MODEL
PROJECTIONS
OF WARMING

FOR EXAMPLE, CLIMATE AND VIOLENCE



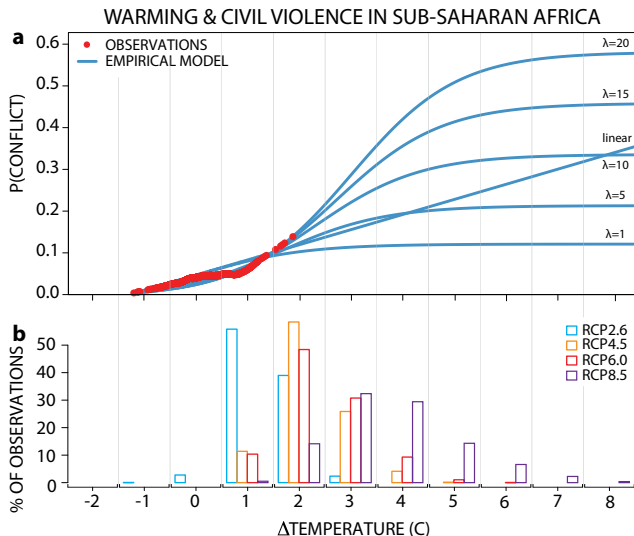
PERHAPS
THE RELATIONSHIP
IS LINEAR?

FOR EXAMPLE, CLIMATE AND VIOLENCE



OR MAYBE IT'S
NONLINEAR?

FOR EXAMPLE, CLIMATE AND VIOLENCE



WHICH OF THESE IS "RIGHT?"

IN SOCIO-PHYSICAL SYSTEMS,
THE PAST MAY NOT BE
A MEANINGFUL ANALOGUE
FOR THE FUTURE