

Conflict, Climate and African Development

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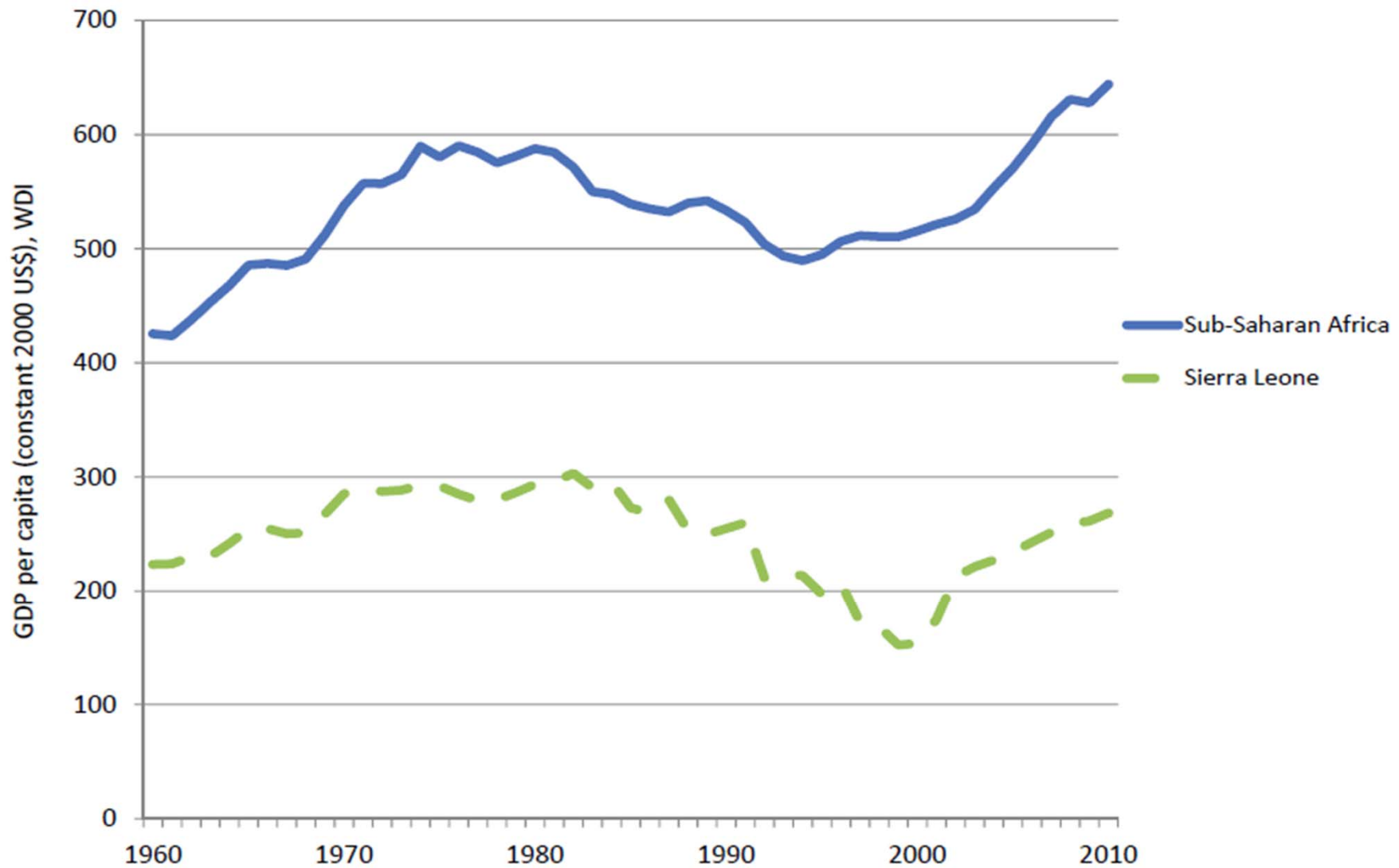
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Motivation

- It is well-known that Africa is the world's poorest region, with the slowest economic growth since 1970.
- There is less consensus on why.
- Barro (1991) notes the large negative “**Africa dummy**” in growth regressions: a measure of our ignorance.
- Economic growth has improved somewhat since 2000.

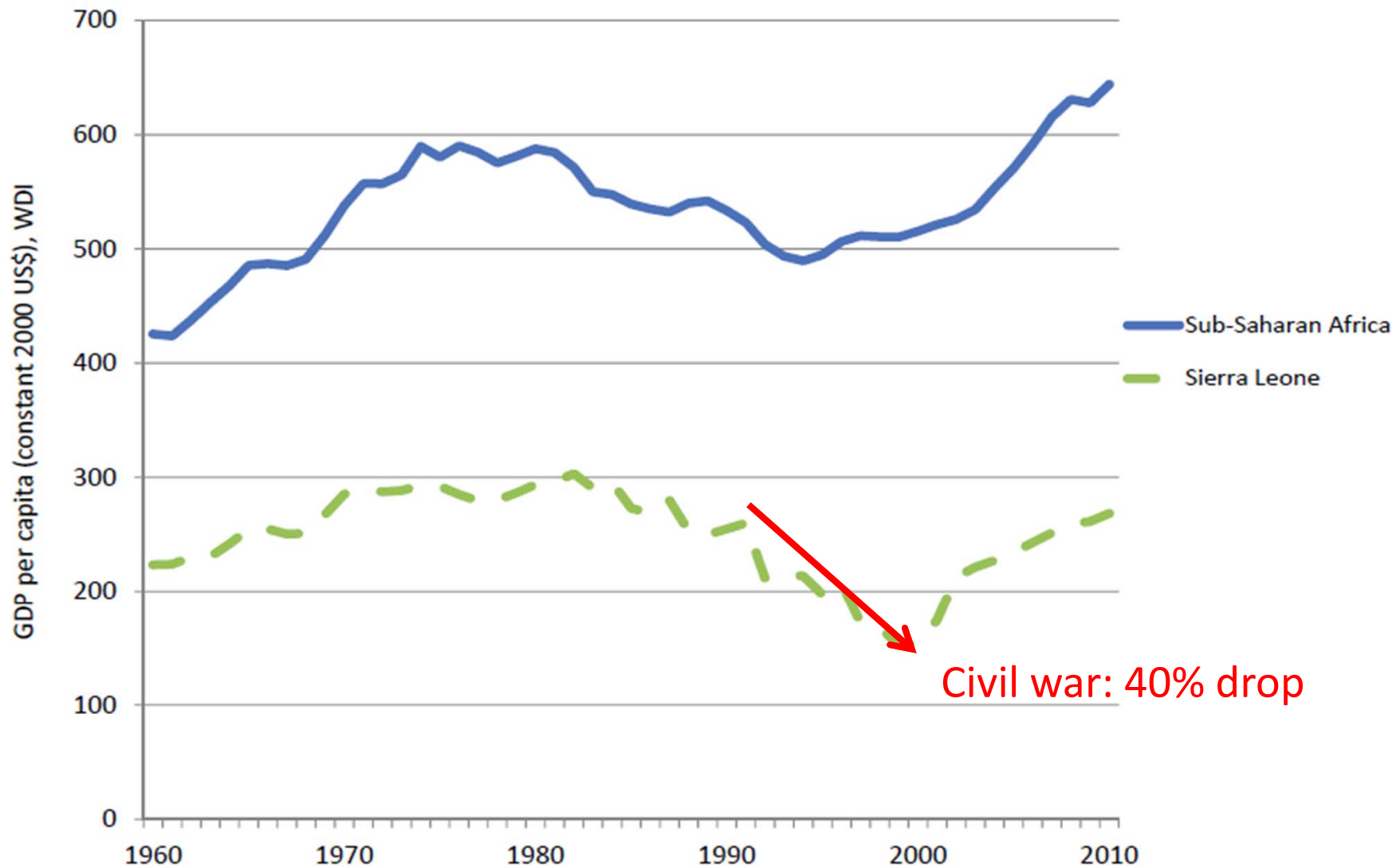
African per capita income, 1960-2010



Motivation

- Many scholars emphasize the role of political conflict and violence in Africa's poor economic performance
- E.g., Easterly and Levine (1997), Collier and Hoeffler (1998), Bates (2001), Fearon and Laitin (2003).
- Over 70% of African countries have experienced civil conflict since 1970, with adverse consequences, e.g.:
 - 1) Per capita income **fell 40%** in Sierra Leone, 1991-2002.
 - 2) Millions of civilian deaths in DR Congo since 1997
- Understanding the underlying causes of violence is critical for Africa's future economic prospects.

African per capita income, 1960-2010



This talk: Climate and conflict in Africa

- Based on a new paper with **Sol Hsiang** (Princeton) and **Marshall Burke** (Berkeley)
- We survey existing research, and analyze (and re-analyze) multiple datasets, to estimate the impact of climatic conditions on political conflict and violence in Africa, other societies, and throughout history.
- Main conclusion: a striking degree of agreement that higher temperatures are associated with more violence.

This talk: Climate and conflict in Africa

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 - 1) Models predict that temperature increases will be large for Africa by 2050, at 2° C (3-4° F) on average

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- Climatic change may be particularly important for Africa
 - 1) Models predict that temperature increases will be large for Africa by 2050, at 2° C (3-4° F) on average
 - 2) **African economies are sensitive to climate:**
 - Africa's slow growth in the 1980s and 1990s linked to historically low precipitation (Barrios et al 2010)
 - Rainfall and temperature linked to annual economic growth (Miguel et al 2004, Burke et al 2009)
- Will climate-induced violence derail incipient Africa's economic revival?

The literature on climate and violence

- Existing research spans multiple academic disciplines (economics, political science, criminology, history, archeology, climate science), timeframes, datasets, statistical methods, and conceptual frameworks.
- **No comprehensive synthesis or meta-analysis exists** to make sense of this growing literature, with its important implications for understanding climate change impacts, and policy priorities, in Africa and elsewhere

The literature on climate and violence

- The **four main goals** of our paper are to:
 - (1) Comprehensively survey this growing literature, using broad inclusion criteria (violence ranging from crime, land grabs, riots, irregular political leader exit, to civil war);
 - (2) Obtain data, replicate, and reanalyze data using a common, rigorous statistical approach (where possible), i.e., use location and time fixed effects;
 - (3) Highlight patterns in the findings and broad areas of agreement across studies;
 - (4) Identify gaps in the literature, and research approaches that will shed more light on the underlying mechanisms. E.g., economic vs. psychological factors (i.e., aggression).

The literature on climate and violence

- **50 studies** (published, unpublished), using 37 datasets.
- The field is expanding rapidly: the median study year is 2010, and since writing we have found >6 new studies.
- New analysis: we obtained 16 different datasets, and **re-analyzed data from 11 papers and reinterpreted results from 6 others**, sometimes with divergent results and conclusions than the original article.
- Many existing studies do not include year or location fixed effects; include outcomes (i.e., income) as “controls”; do not jointly estimate the impact of climate variables.

The literature on climate and violence

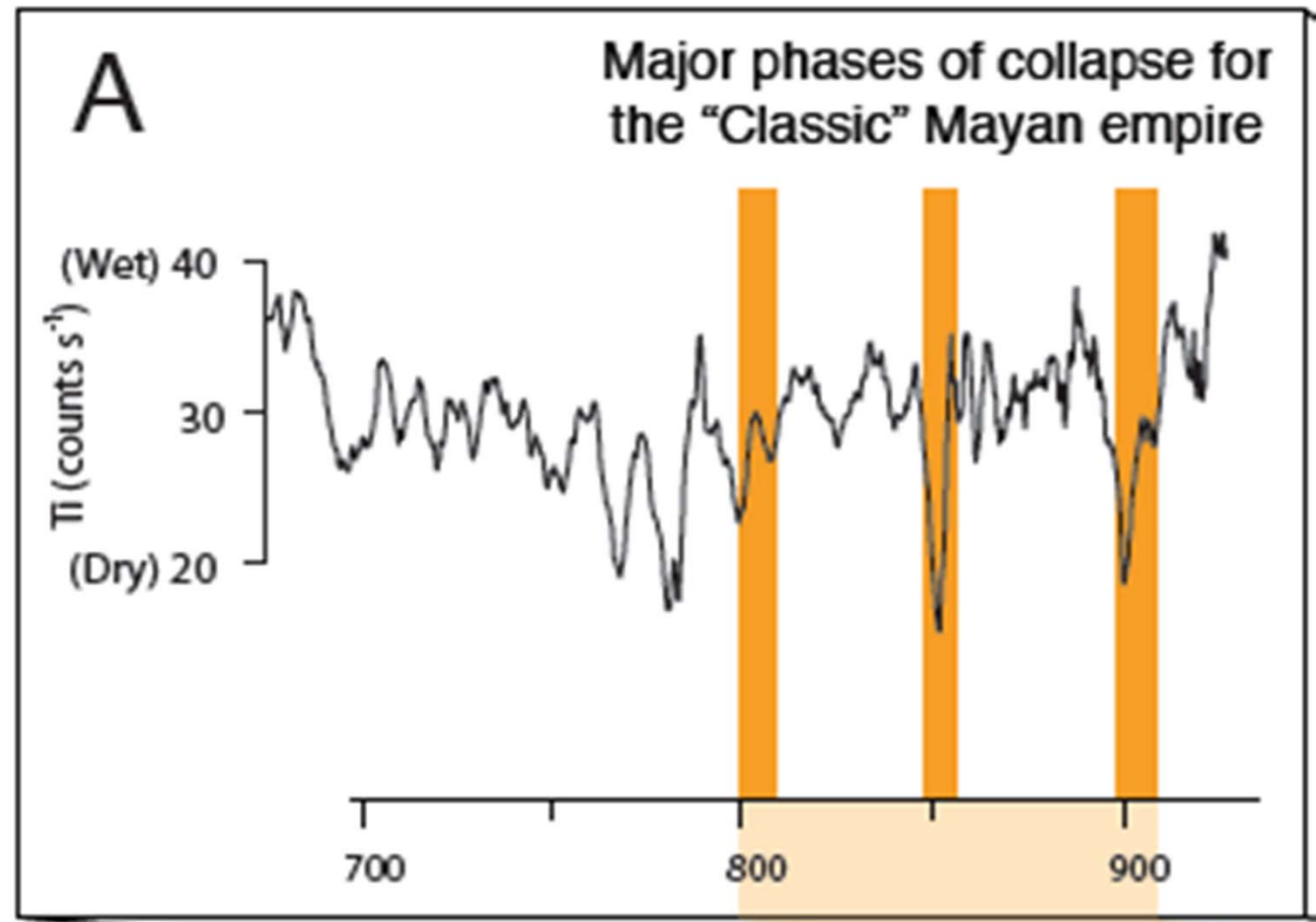
- Three main types of studies:
 - (1) Observational studies using panel data (N=38)**
 - Mainly economics, political science, criminology
 - E.g., is armed conflict more common in Africa in high temperature and/or low rainfall years?
 - (2) Experimental psychology studies (N=2)**
 - Are lab subjects more aggressive at high temperatures?
 - (3) Historical climatology and paleoclimatology (N=10)**
 - Did key episodes in Chinese history (dynasty collapse) occur during climatic anomalies, using “tree ring” data?

(3) Historical climatology and paleoclimatology

- Evidence from a variety of civilizations (Maya, Angkor Wat, Chinese dynasties, Akkadian empire) that exceptionally dry and/or hot periods are associated with political collapse
- E.g., **the Maya civilization** experienced three extended multi-year droughts in the 9th century AD that are thought to have precipitated its collapse (Haug et al. 2003, *Science*)
- Collapse of the 9th century Chinese Tang dynasty linked to the same extended drying (Yancheva et al. 2007, *Nature*)
- Relevance: had incomes similar to poor countries today, i.e., historical Maya (~\$400), China (~\$600)
- Caveat: looking for “keys under the lamppost”? These studies do not test hypotheses on the universe of societies.

Historical climatology examples

Mexico



(2) Experimental psychology studies

- Laboratory studies find impacts of ambient temperature on subject aggression.
- Vrij et al. (1994): **Dutch police in a training exercise** were more likely to shoot at a simulated intruder when randomly placed in a high temperature room (27° C / 80° F) than at lower temperature (21° C / 70° F).
- Also perceived the intruder as more dangerous in surveys.
- Does aggression lead to “escalation” of potential conflicts?
- Kenrick et al. (1986): high temperatures are linked to more horn honking in a field experiment, when experimenters deliberately stood still when lights turned green

(1) Observational studies using panel data

- The largest number of studies estimate impacts of climate on national-scale violence, often on armed civil conflict
- **Miguel, Satyanath and Sergenti (2004)** find that civil conflict is more likely following large drops in rainfall across African countries during 1981-1999. Rainfall correlates with GDP growth (IV first stage)
- Many recent studies regress outcome y on temperature deviation (rather than changes), precipitation deviation, and country and time fixed effects:

$$y_{it} = \alpha + \beta_1 Temp_{it} + \beta_2 Precip_{it} + \eta_i + \delta_t + \varepsilon_{it}$$

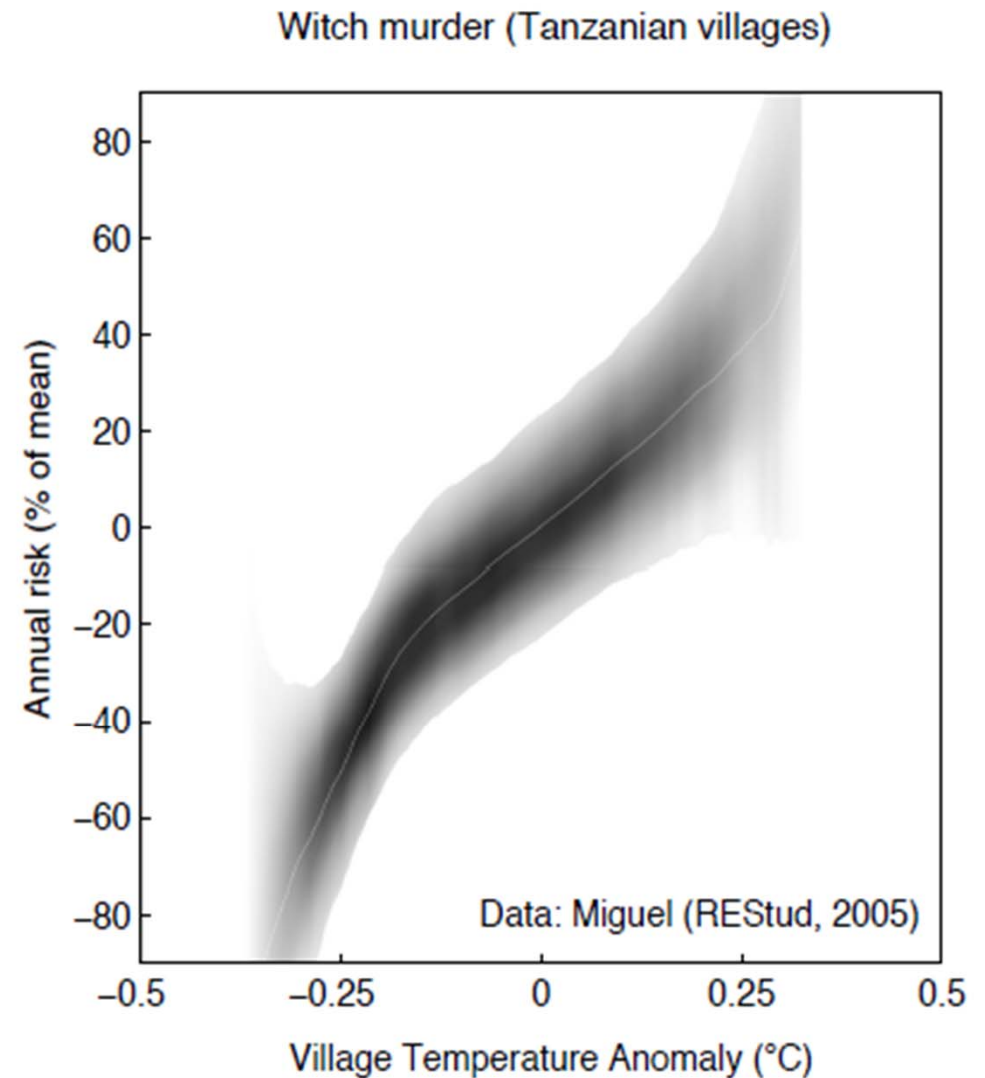
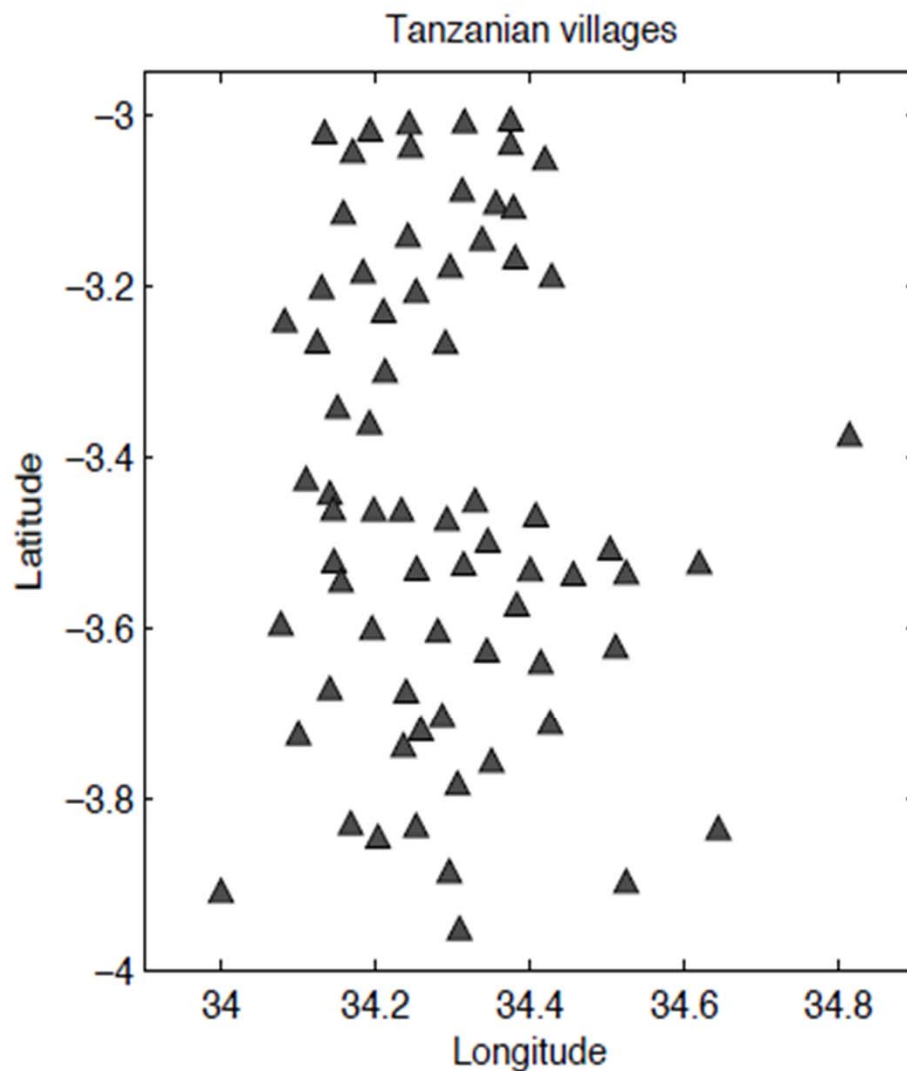
(1) Observational studies using panel data

- The results are remarkably consistent: **all 21 empirical studies** that focus on temperature estimate a positive association between higher temperatures and violence. This pattern is extremely unlikely to happen by chance, maybe 1 in 2 million ($p < 0.000001$).
- 14 of 16 rainfall studies have a consistent sign ($p < 0.01$)
- The pattern emerges at scales ranging from the village, to region, to country and even global scale, using a common econometric specification.

Temperature and violence in Africa, across scales

- Four studies illustrate the relationship across scales:
- **Village level:** we re-confirm the link between climate and witch killing in Miguel (2005, *REStud*), using temperature instead of extreme rainfall.

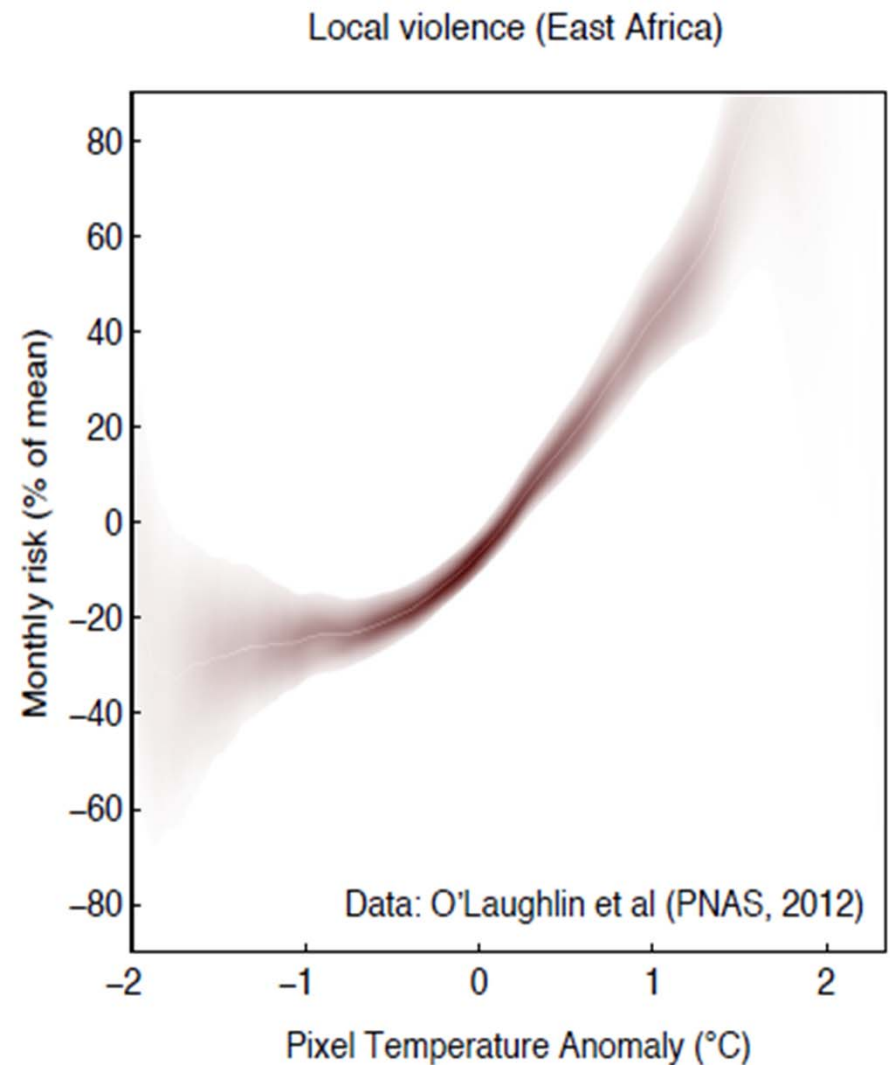
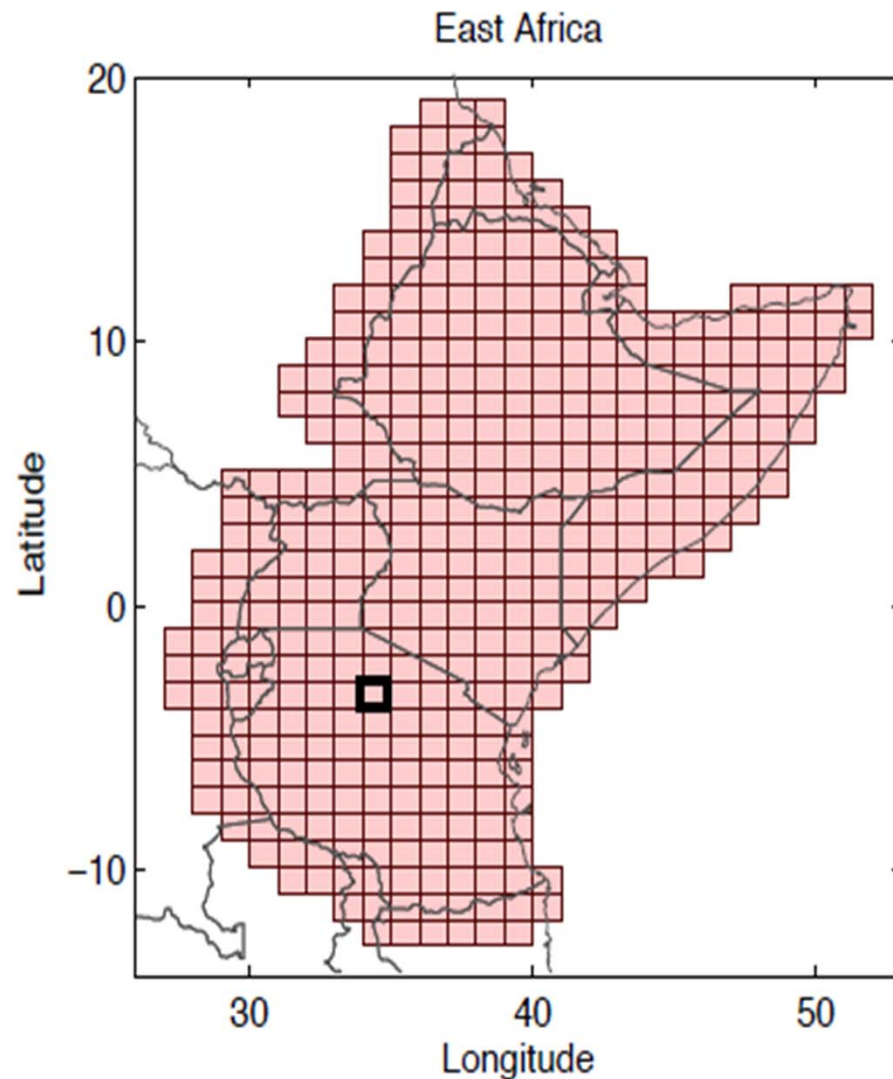
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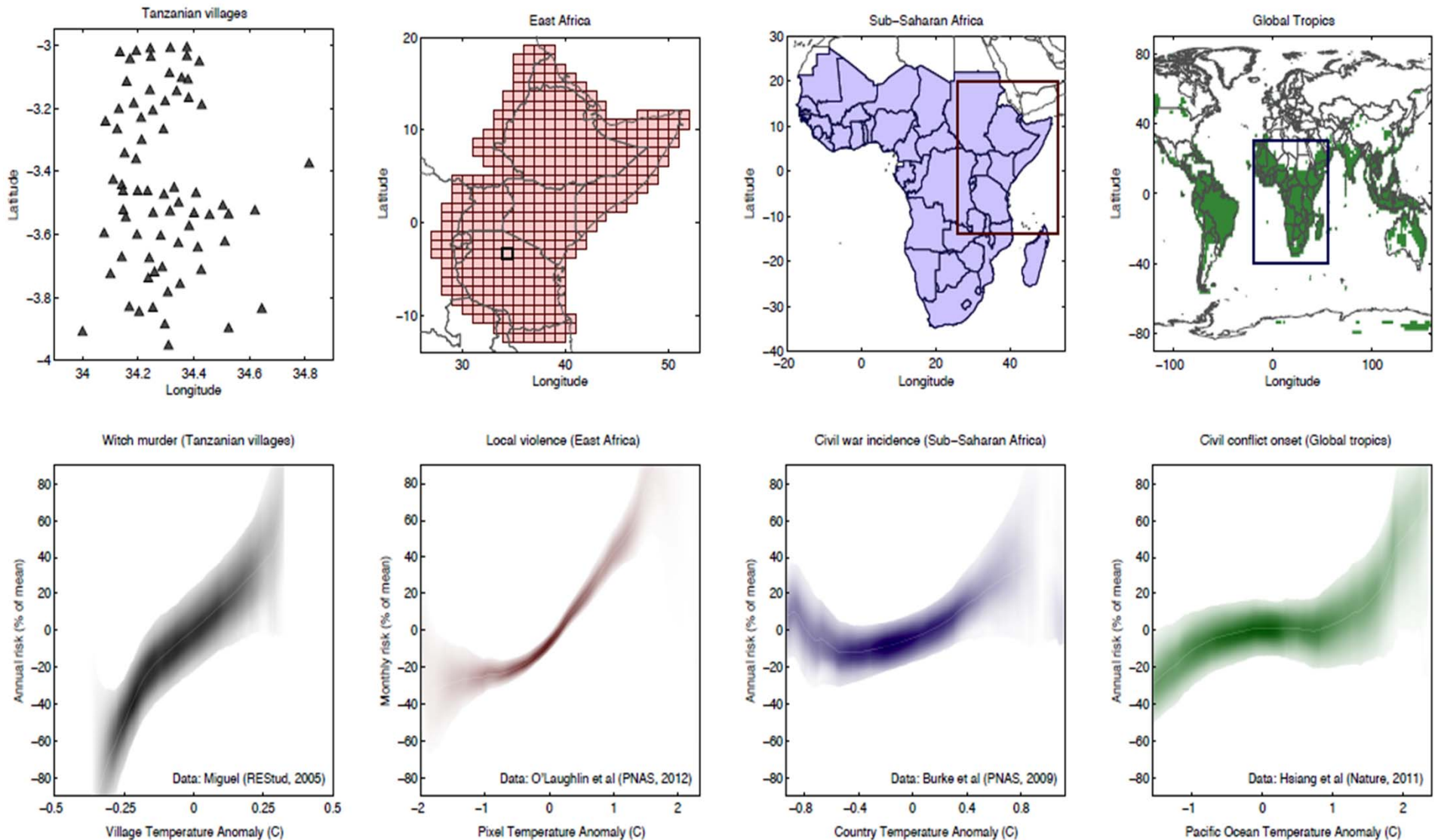
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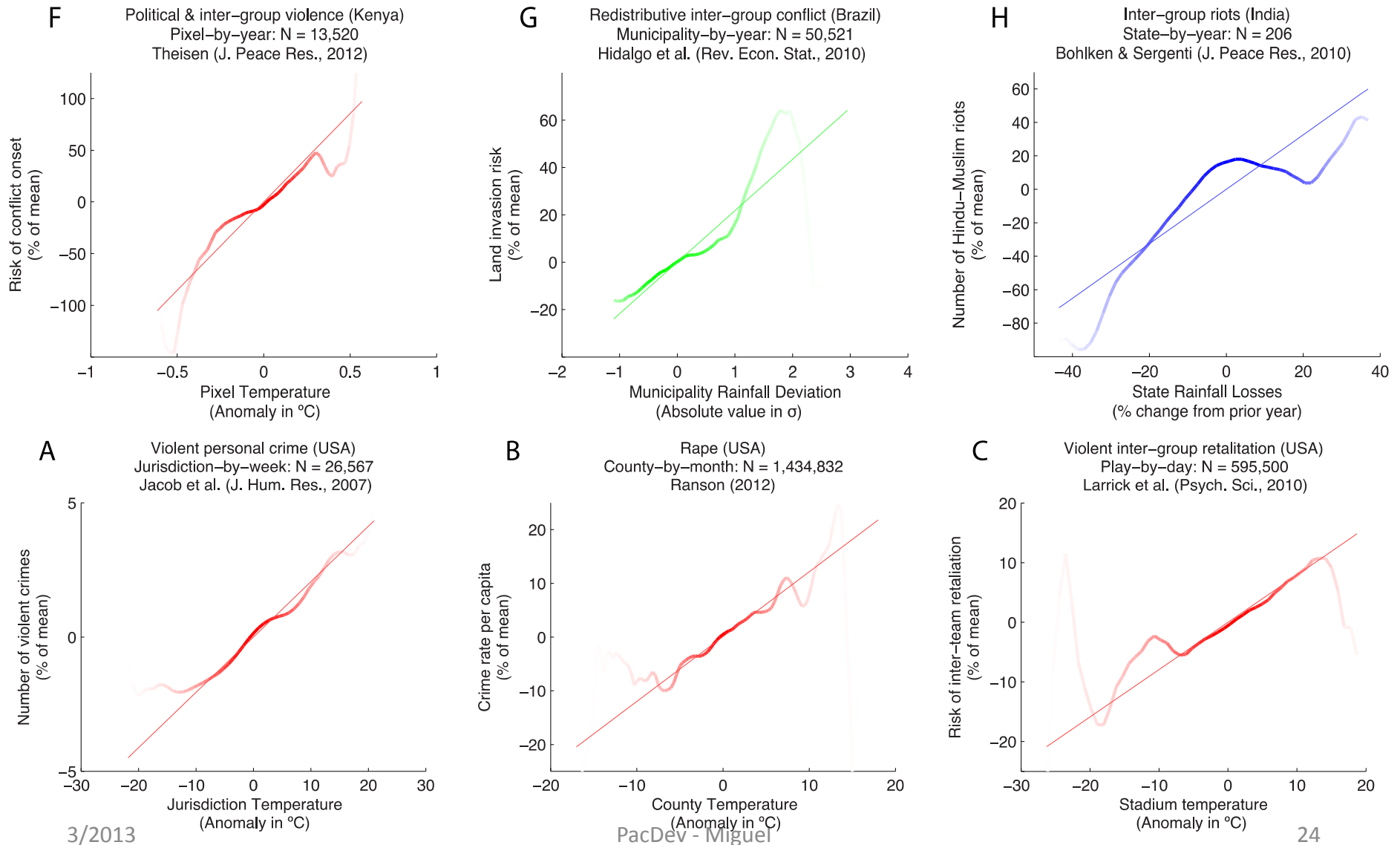
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- **Country level:** higher temperature increases civil war risk in Sub-Saharan Africa (Burke et al. 2009, *PNAS*).
- **Global level:** higher temperature is associated with more civil conflict in the tropics, exploiting climatic variation induced by El Niño (ENSO) (Hsiang et al 2011, *Nature*).

Temperature and violence in Africa, across scales



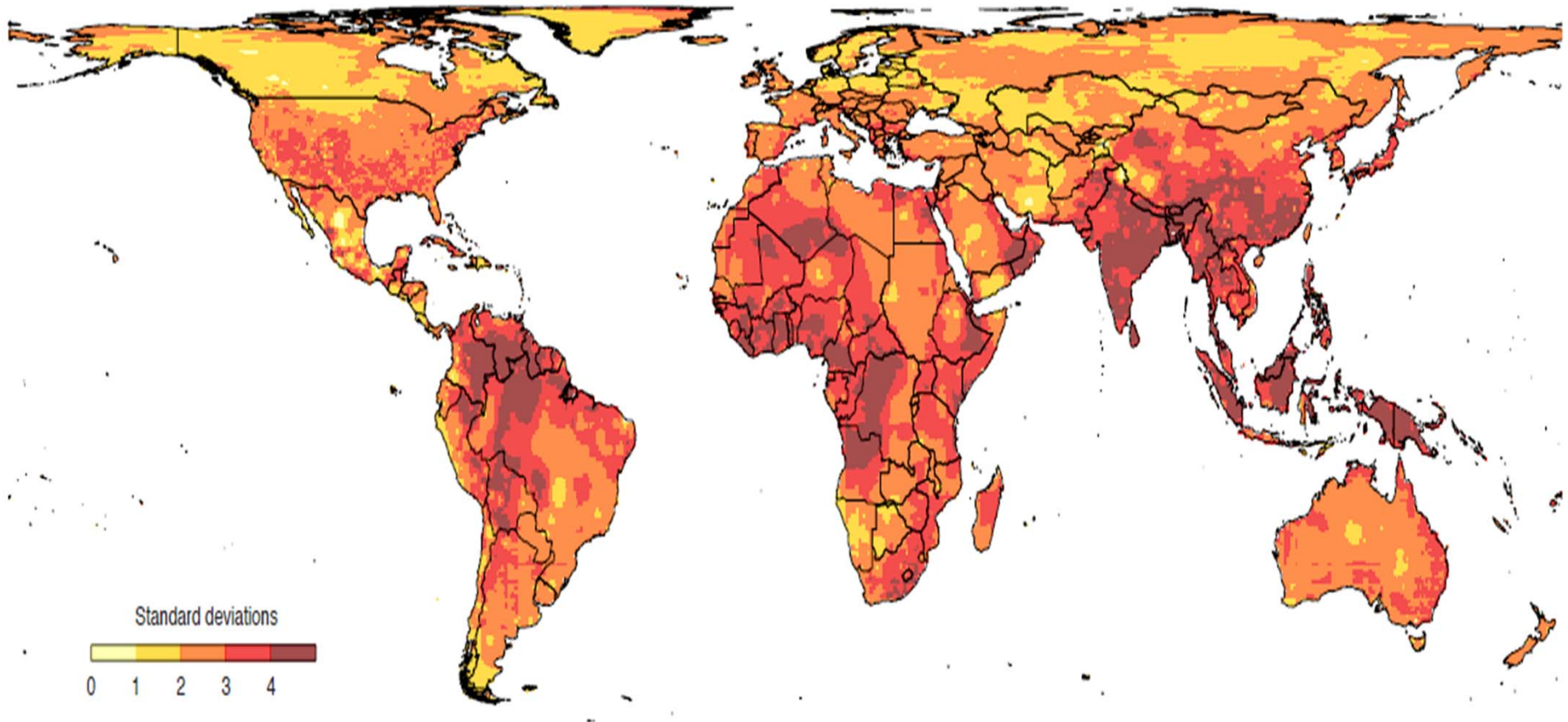
Climatic impacts on intergroup violence, crime



Magnitude of the effects

- Are effects “large”? Rule of thumb: 1 s.d. change in climate is associated with a **+11% increase** in intergroup conflict.
- Most of Sub-Saharan Africa is projected to experience average warming of at least 3 s.d. by 2050, implying that the risk of violent conflict will rise considerably (>30%).
- Beyond average changes, **weather variability is likely to increase**, potentially exacerbating effects
- For interpersonal violence (e.g., crime), the median standardized effect is smaller, at +4% per 1 s.d. change, although note that these are mainly non-African data.

Projected temperature increase (s.d.), to 2050



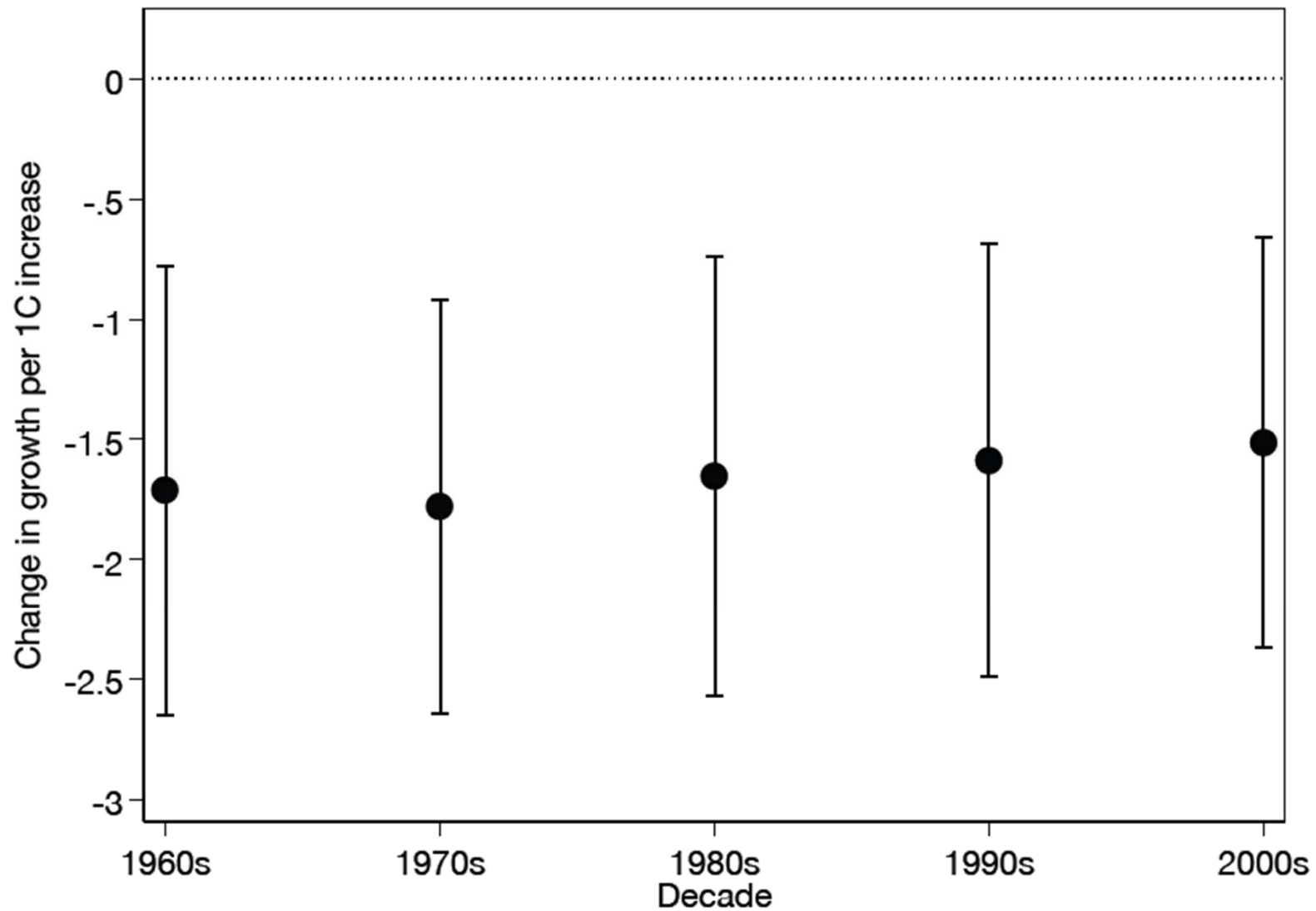
The role of economic factors in Africa

- Economic channels seem to be important.
 - 1) There is a strong relationship between climatic factors and agricultural production (Lobell et al 2008)
 - 2) In the witch killing data, growing season temperature has a much larger effect than non-growing season temperature
 - 3) Harari and La Ferrara (2012) show that **growing season weather shocks** are key determinants of local conflict, and argue agricultural output is the mechanism
 - 4) Labor productivity falls at high temperatures (Graff-Zivin and Neidell 2013, Hsiang 2010)
- But the link between temperature and violent crime means aggression is also likely to be a contributing factor.

How likely is adaptation to climate change?

- A key unresolved question is the extent to which societies can adapt to future warming to limit adverse impacts.
- Unfortunately, the existing evidence suggests that **any adaptation is likely to be partial**.
 - 1) Even with declining reliance on agriculture, African economic growth rates have not become less sensitive to high temperature over time: -1.5% growth per 1^o C increase

Temperature and growth in Africa, 1960-2010



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- Unfortunately, the existing evidence suggests that **any adaptation is likely to be partial**.
 - 1) Even with declining reliance on agriculture, African economic growth rates have not become less sensitive to high temperature over time: -1.5% growth per 1° C increase
 - 2) Minimal adaptation (~15%) of Indian agriculture to monsoon intensity over decades (Taraz 2013)
 - 3) Even in the U.S., the sensitivity of agricultural production and crime to temperature is nearly unchanged over time (Burke and Emerick 2012; Ranson 2012)

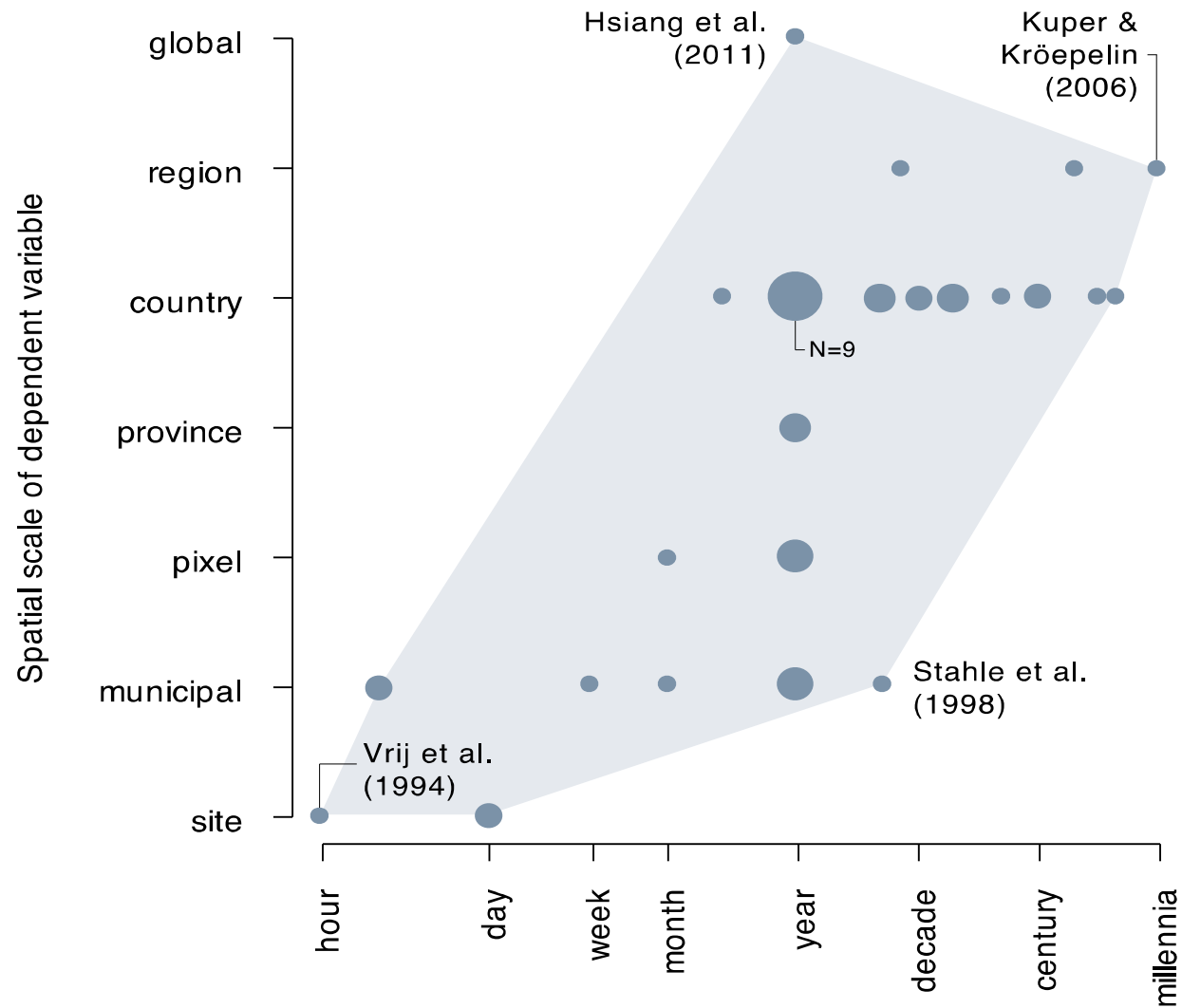
Climate and conflict in Africa: looking forward

- The bottom line of the Hsiang, Burke and Miguel (2013) article: there is a remarkably consistent relationship between adverse weather and human violence across time and space, including for Africa.

→ Major implications for the impact of climate change on African political stability and economic development.

EXTRA SLIDES

Recent research at multiple time, spatial scales



Climate and conflict in Africa: looking forward

- With global mitigation (pollution control) efforts currently stalled politically, **an adaptation agenda for Africa** is desperately needed
- E.g., the development of new crop varieties, weather insurance schemes, “rapid” targeted foreign aid, and peace-building programs that will reduce sensitivity to future climate change.

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