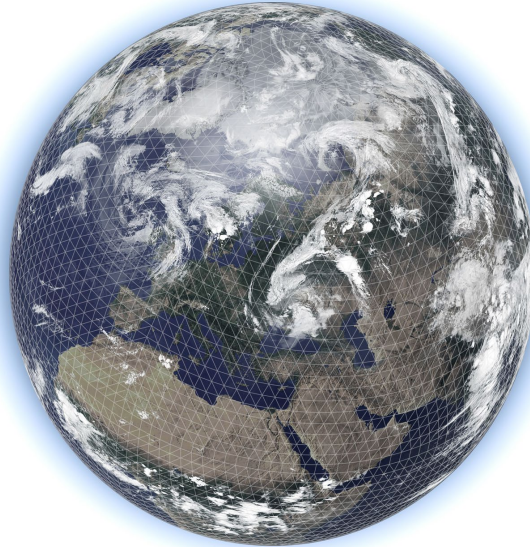




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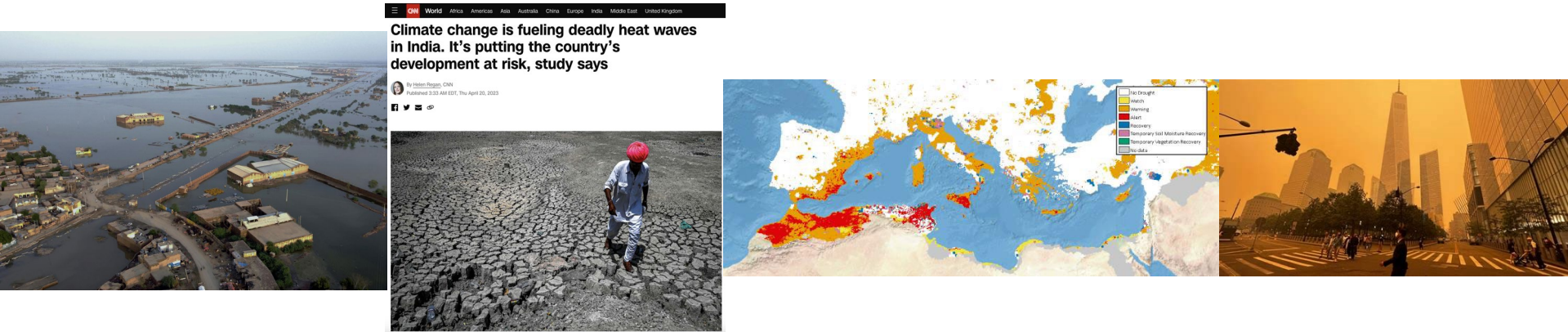
Interdependencies between migration and climate: a need for a transdisciplinary Earth System approach



Pierre Gentine
Columbia Engineering & Climate School
Director, LEAP Center



Climate Adaptation is Needed



But adaptation requires:

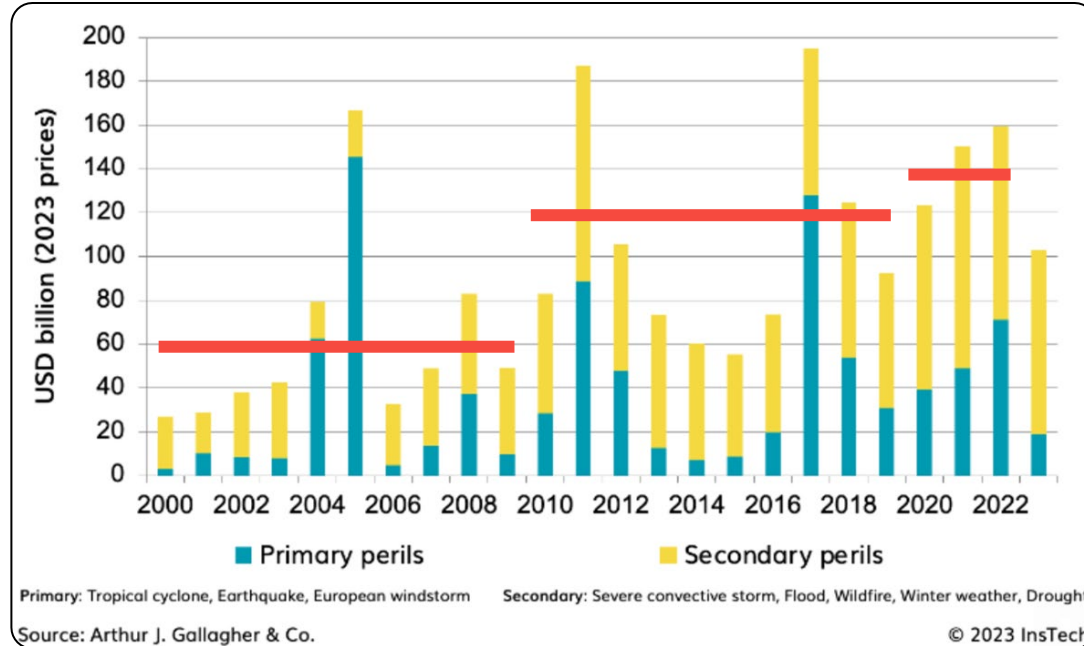
- 1) *Accurate* information (projection) about the future using climate models
- 2) Broadly and easily accessible climate projection *information*
- 3) *Capacity* to adapt (especially in the context of migration/relocation)





Climate Adaptation is Needed

Secondary perils are becoming primary perils



Intersection between *climate change and lack of relocation*.

Not enough incentives for now e.g. FEMA

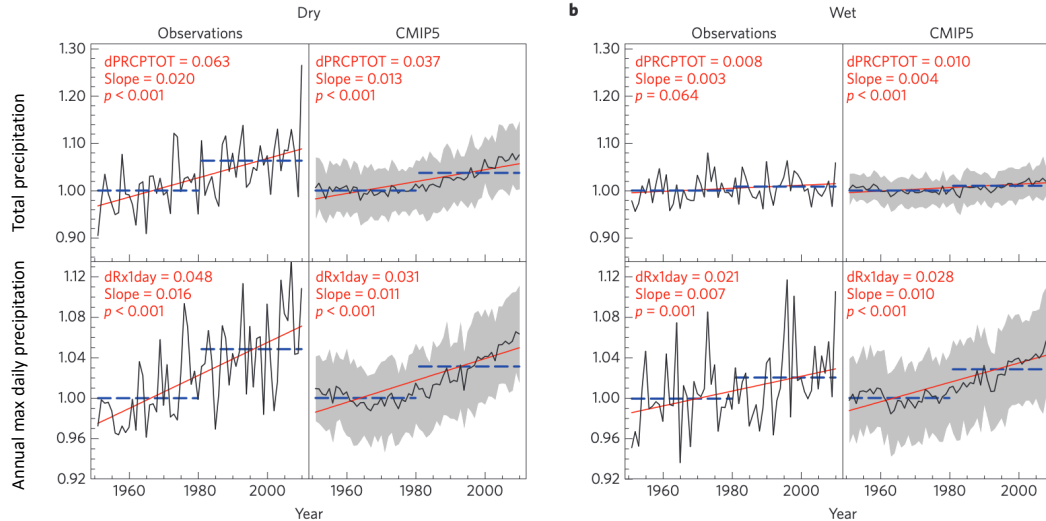
→ Potential for major and rapid migration and relocation once those incentives are lifted



Climate change is adding pressure on migrations

Beyond long-term sea level rise:

Precipitation extremes are increasing, even in regions where annual rainfall is not changing (fewer, more intense rainfall)



LETTERS
PUBLISHED ONLINE: 7 MARCH 2016 | DOI:10.1038/NCLIMATE2941

nature
climate change

More extreme precipitation in the world's dry and wet regions

Markus G. Donat^{1*}, Andrew L. Lowery¹, Lisa V. Alexander², Paul A. O'Gorman³ and Nicola Maher¹

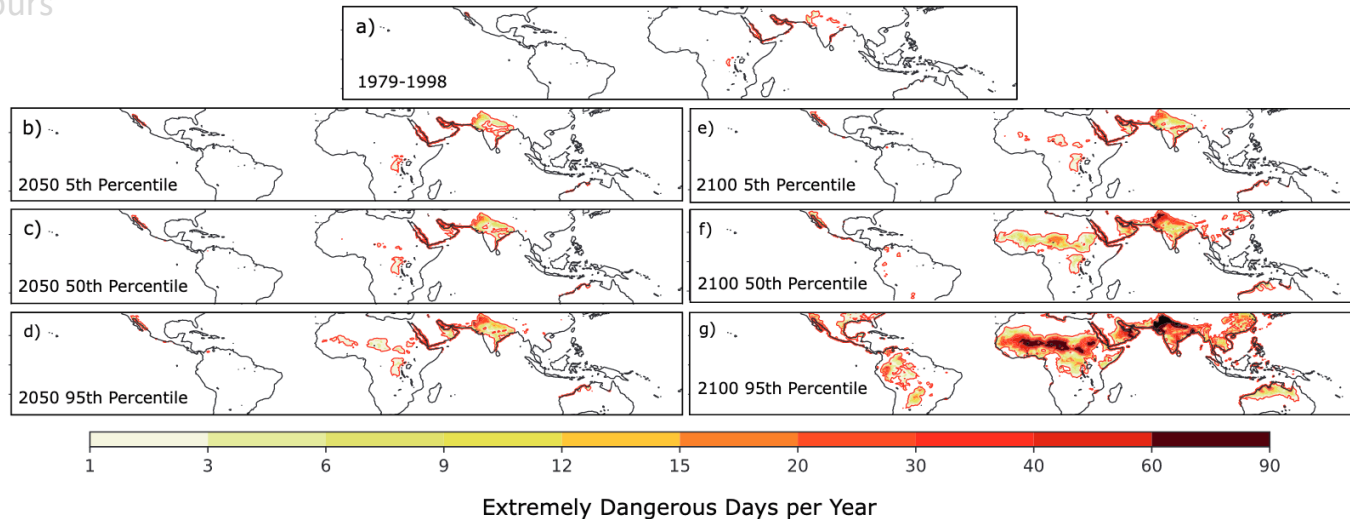
“Despite uncertainties in total precipitation changes, extreme daily precipitation averaged over both dry and wet regimes shows robust increases in both observations and climate models over the past six decades. Climate projections [...] show continued intensification of daily precipitation extremes.”



Climate change is adding pressure on migrations

Heat stress such as assessed by Heat Index or wet bulb temperature (temperature with humidity factor) is increasing and reshaping habitable regions → large-scale migration

Heat Index above 124°F is classified as “extremely dangerous” and can lead to heat stroke, and death within hours



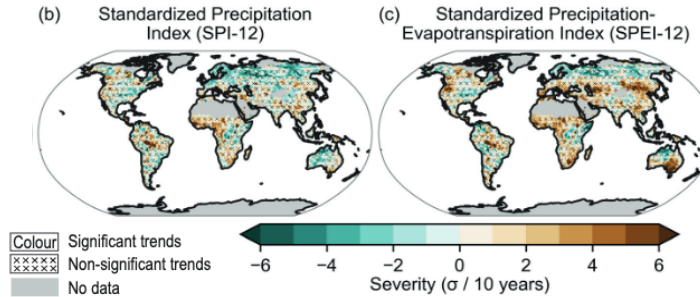
(across climate models and scenarios)

Heat is also a complex **physiological process** (e.g. acclimation)



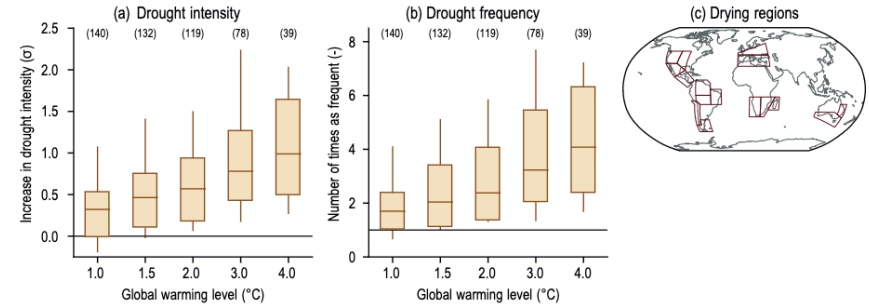
Climate change is adding pressure on migrations

Droughts have been and are increasing in *some* regions of the globe, with major environmental impacts → food productivity



Historical

Changes in 10-year soil moisture drought in drying regions

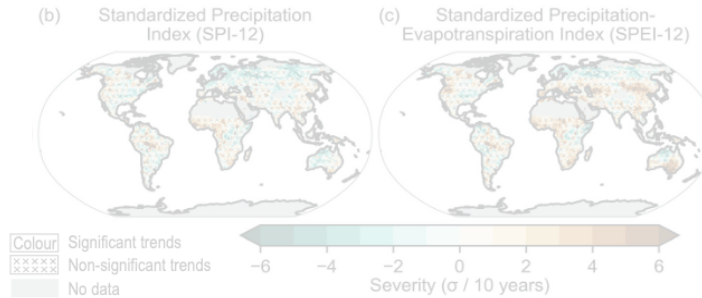


Projected

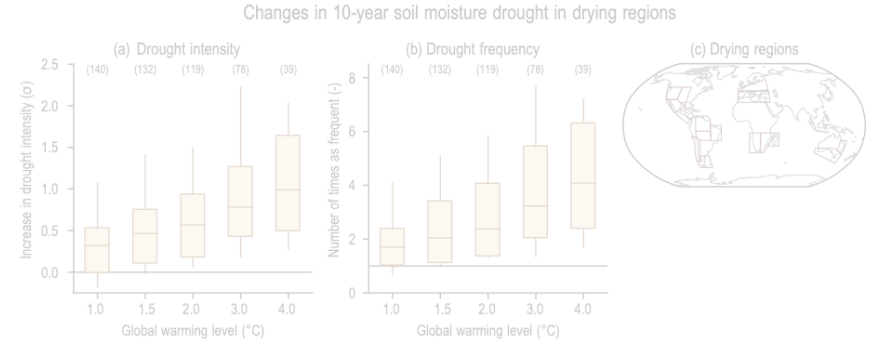


Climate change is adding pressure on migrations

Droughts have been increasing in some regions of the globe, with major environmental impacts → food productivity



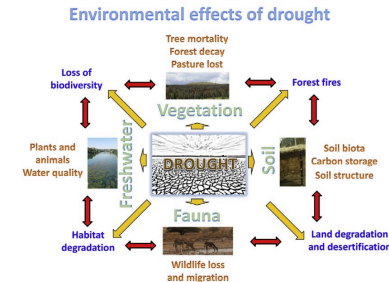
Historical



Projected

Certain regions are experiencing more droughts and are expected to increase

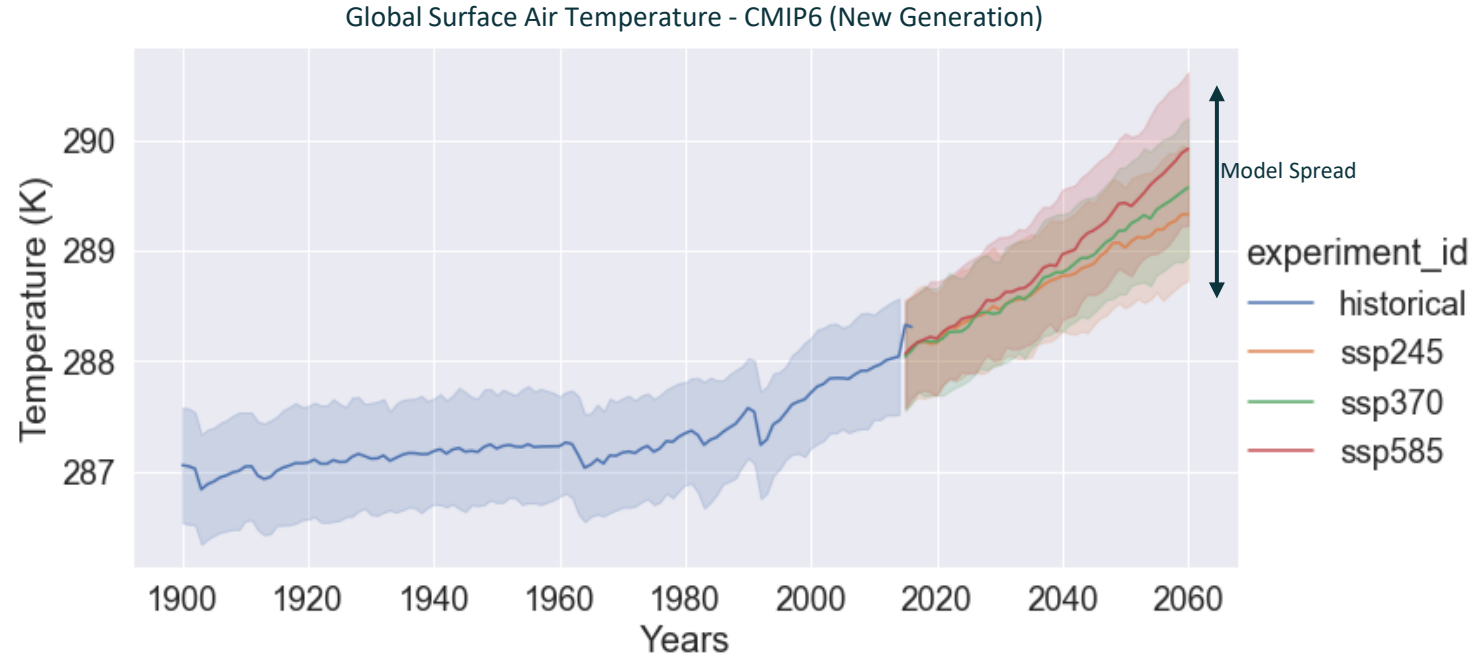
Droughts are **multifactorial** → many definitions
Require strongly interdisciplinary teams/knowledge





Yet, current projections are still too uncertain

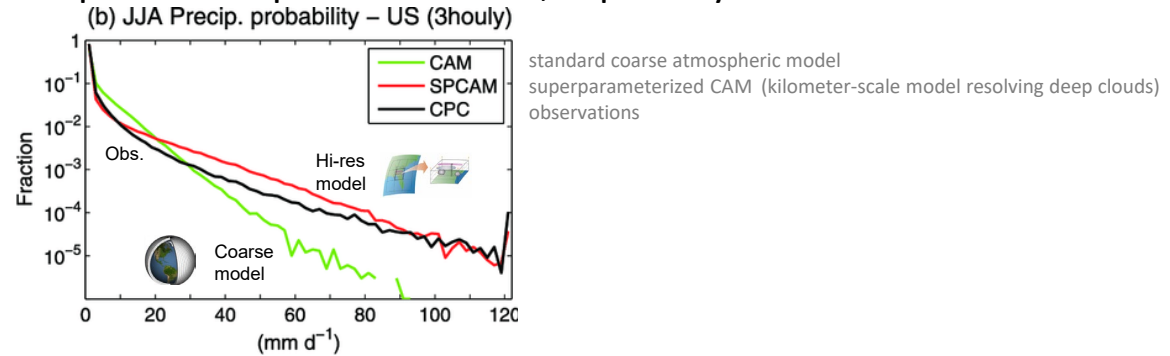
Even for (simple) global metrics such as surface temperature





Regional climate and carbon cycles are even more uncertain

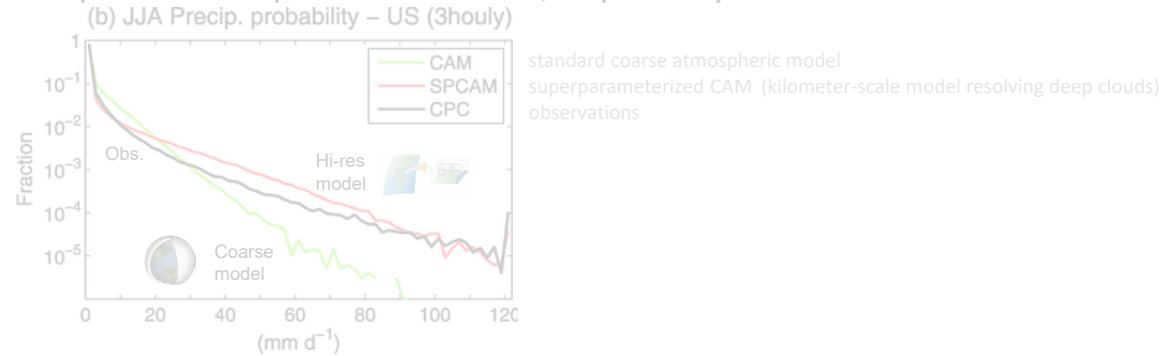
- Regional precipitation is quite inaccurate, especially for extremes



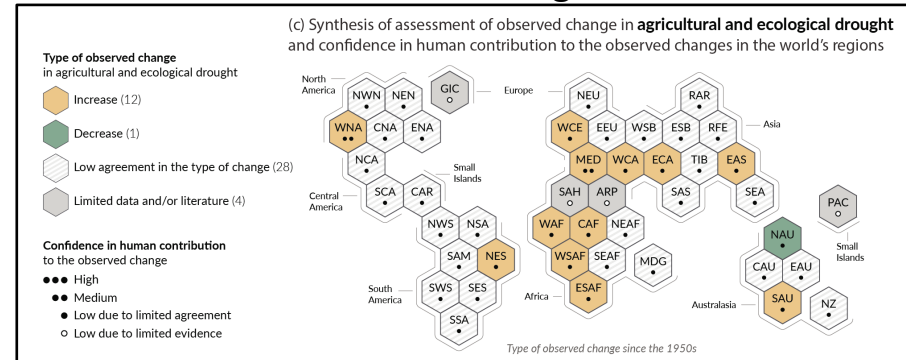


Regional climate and carbon cycles are even more uncertain

- Regional precipitation is quite inaccurate, especially for extremes



- Past and future droughts are *uncertain*



“The future occurrence of low-likelihood, high-impact events linked to climate extremes is generally associated with low confidence, but cannot be excluded.”

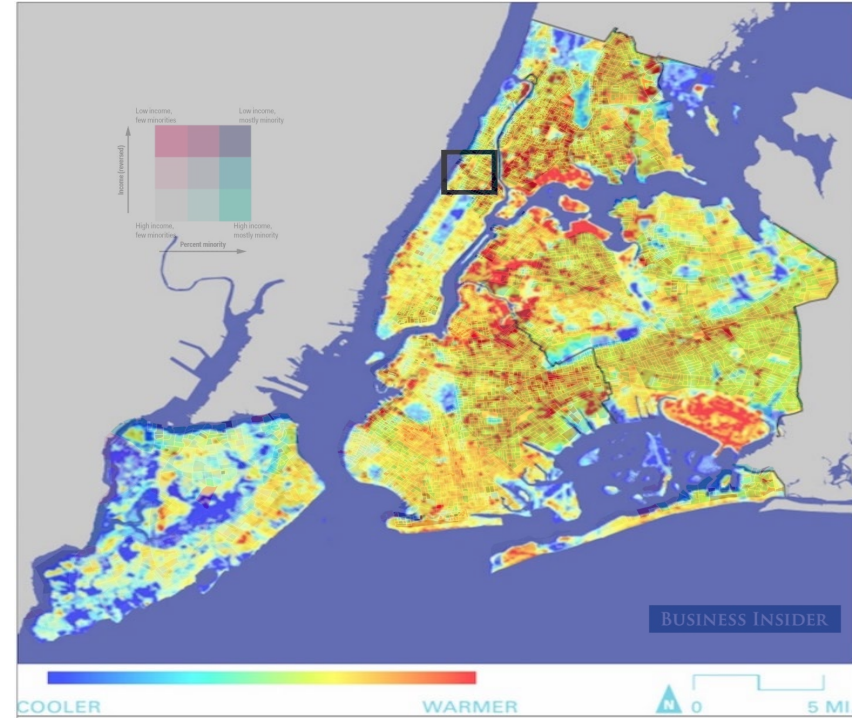
[IPCC, ES, Ch. 11]

But regional change is what impacts people



Impact of climate change can be very local

- Not just regional or Global North vs Global South
But within same country, same state or even city
 - Example of *redlining* – here for heat
 - Many similar examples for flooding
- Relocation/regional migration, if people can afford





Conclusions

Extremes are increasing,
especially in the Global South
(precipitation extremes, heat stress, drought frequency/intensity)
in addition to long-term changes (e.g. sea-level rise)

Those extremes have or will have significant impact on:

- Livability
- Food productivity
- Relocation/Migration

→ *Added stress*, especially to already underserved communities



Conclusions

Still issues to adapt locally (beyond migration):

- Difficulty in accurately predicting/projecting the future, locally
- Underserved communities might not be able to bear the cost

→ Difficulty in being prepared, being more resilient and limiting the impact as a whole

1) *Earth system modeling* research is still critical to address and support this issue
(local impact)

2) *Data* is needed in underserved communities
(data poverty in underserved community)



Conclusions

Understanding the impacts of climate change on migration/relocation is inherently *transdisciplinary*

(climate, health, biology, ecology, sociology, economics)

Challenges:

- Vocabulary
- Training
- Limited resources
(funding, workforce)
- Assessment/evaluation