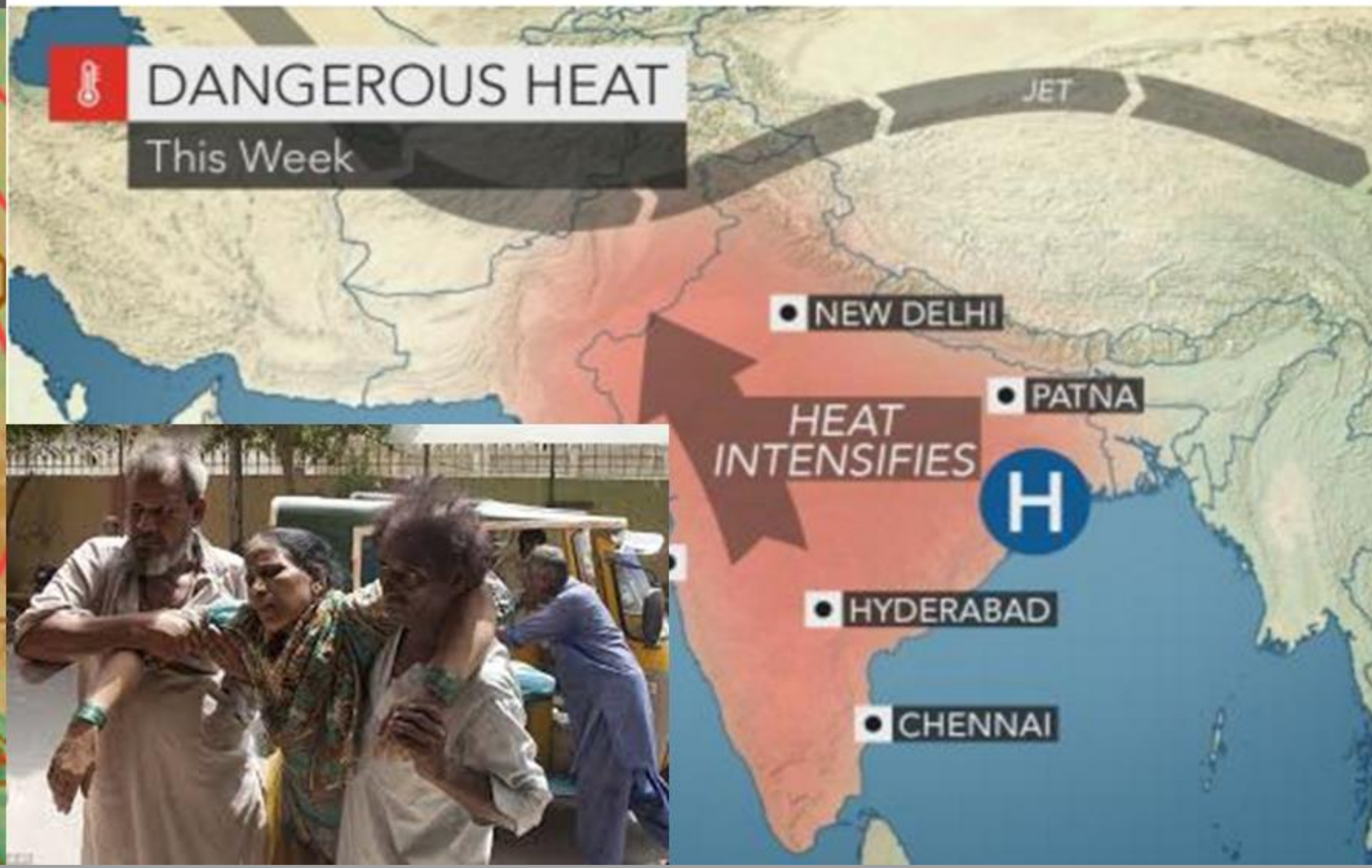


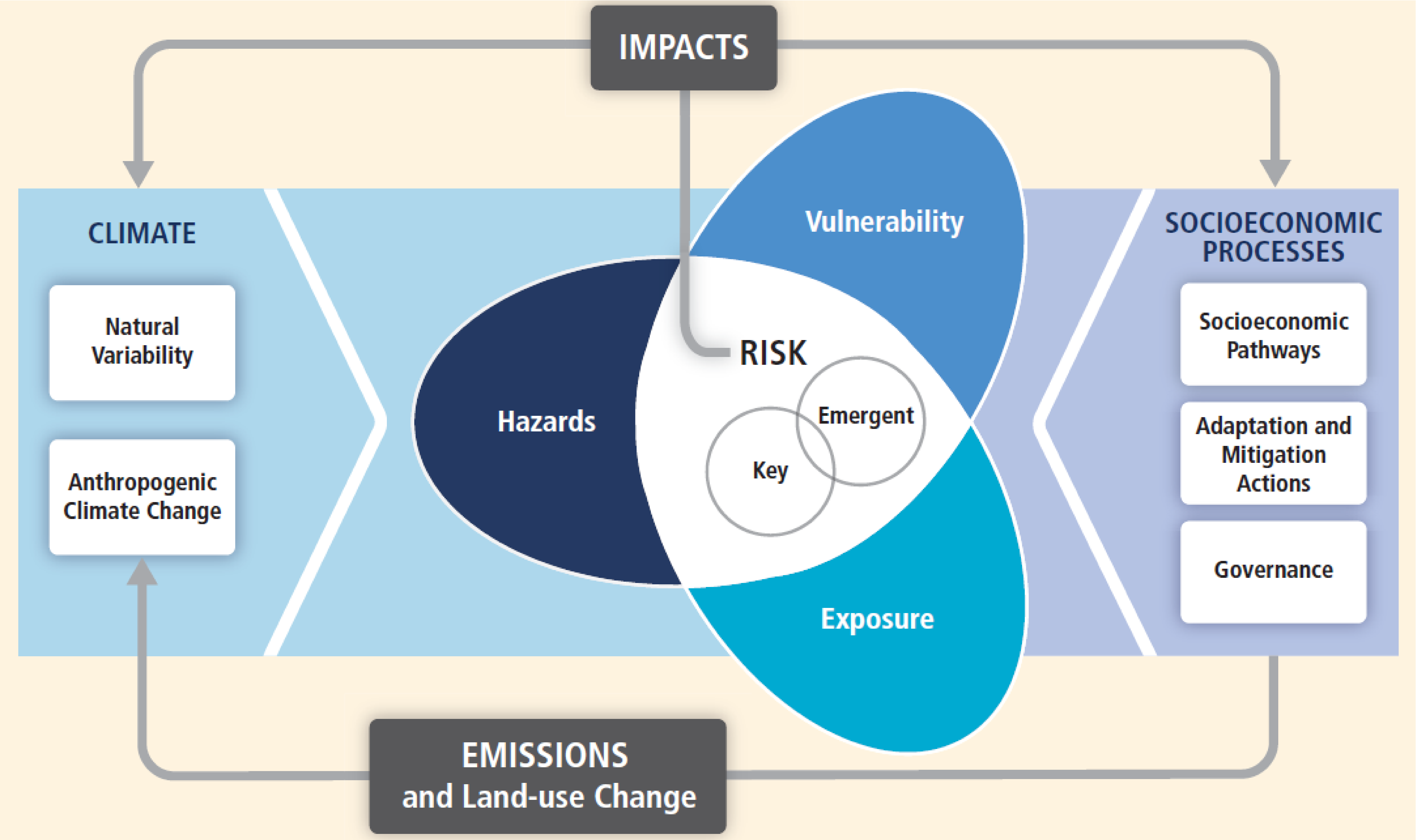
Humid heatwave events and their socio-economic implications at different warming levels

Jana Sillmann and Simone Russo

Outline

- Risk framing in IPCC AR5
- IPCC Working Group (WGI) dealing with extremes
- Importance of indices and data availability
- Example: Climate extremes and health
- Outlook

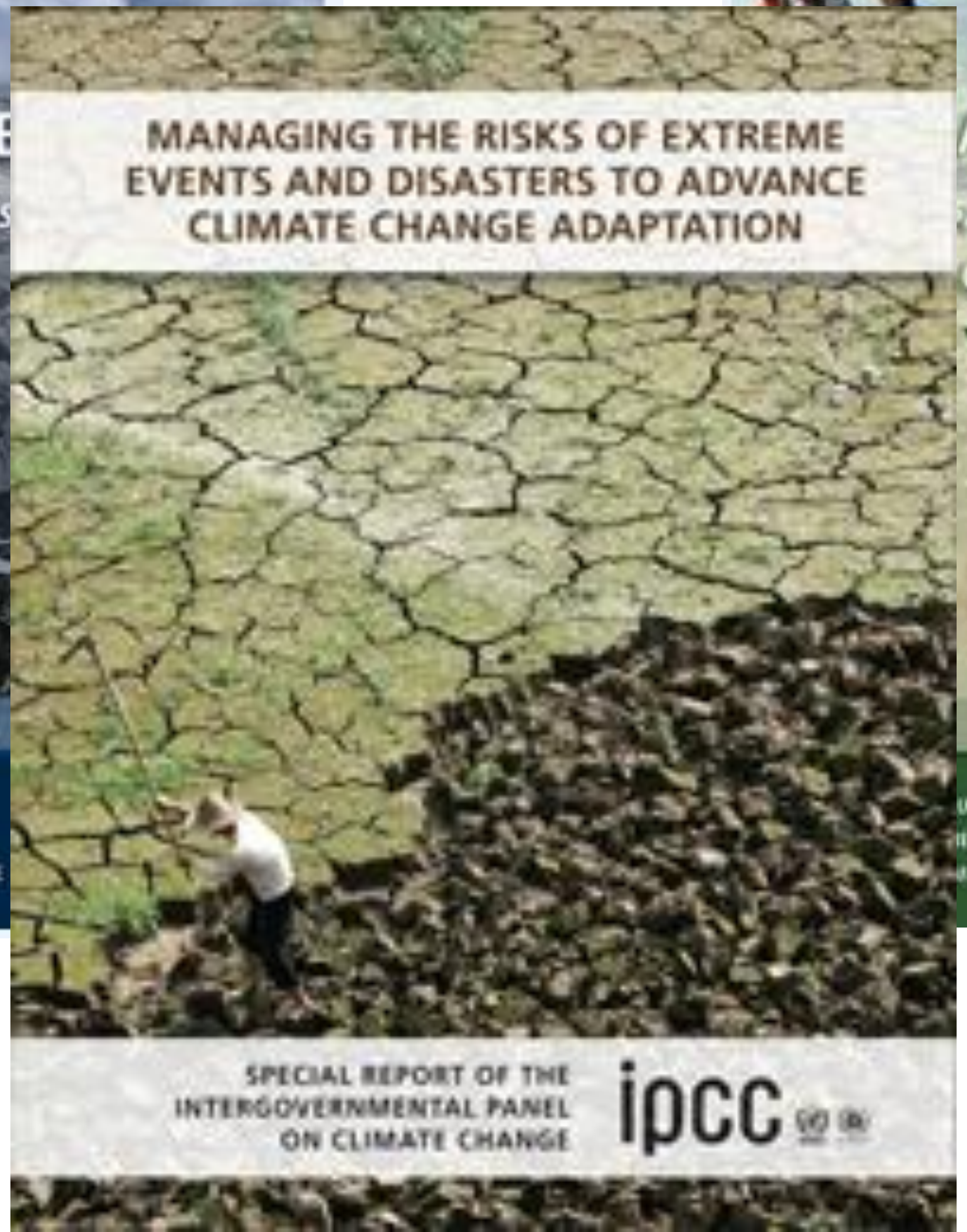
Risk framing in IPCC AR5

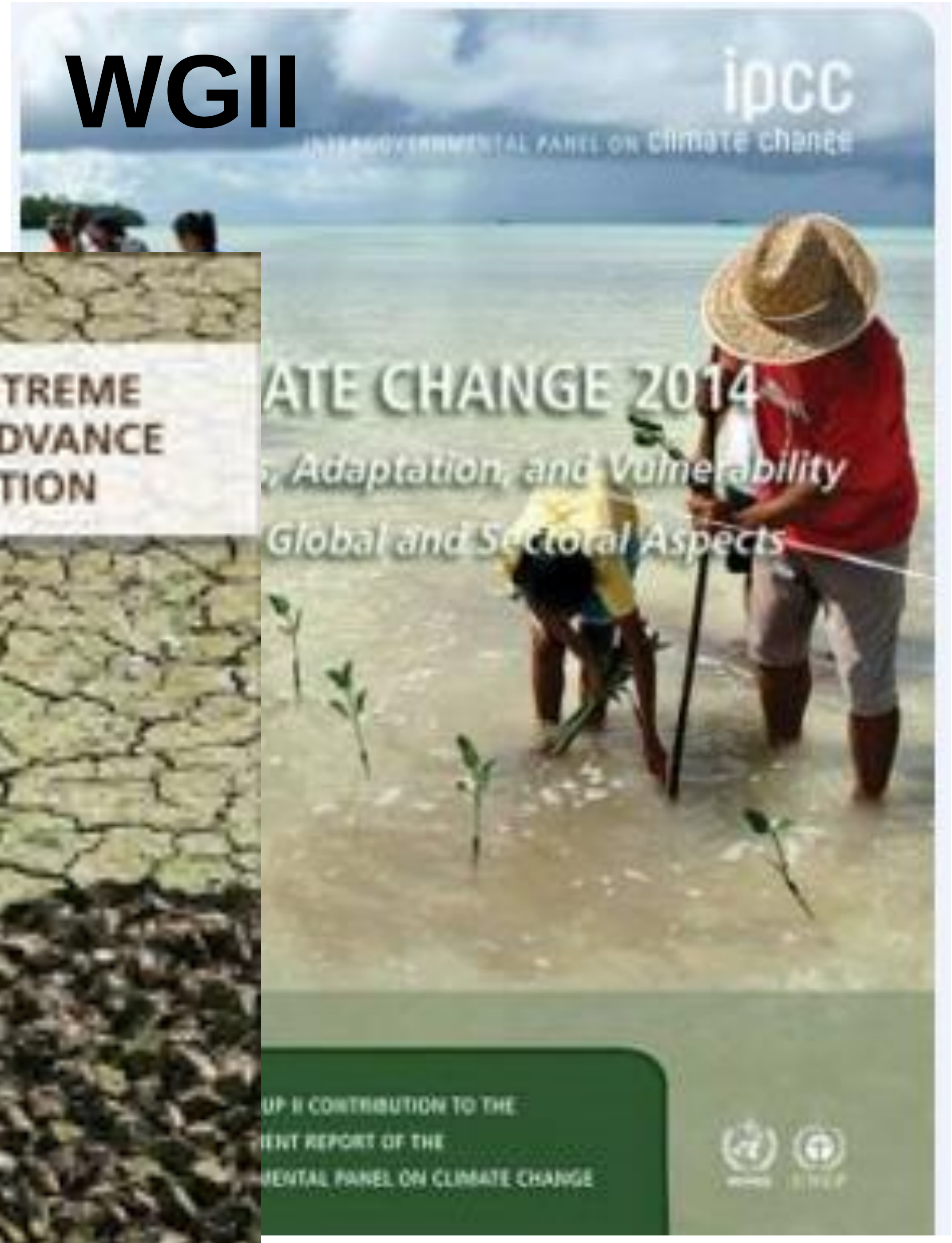


Risk framing in IPCC AR5

Climate change risk = Hazard probability × Vulnerability × Exposure

2013



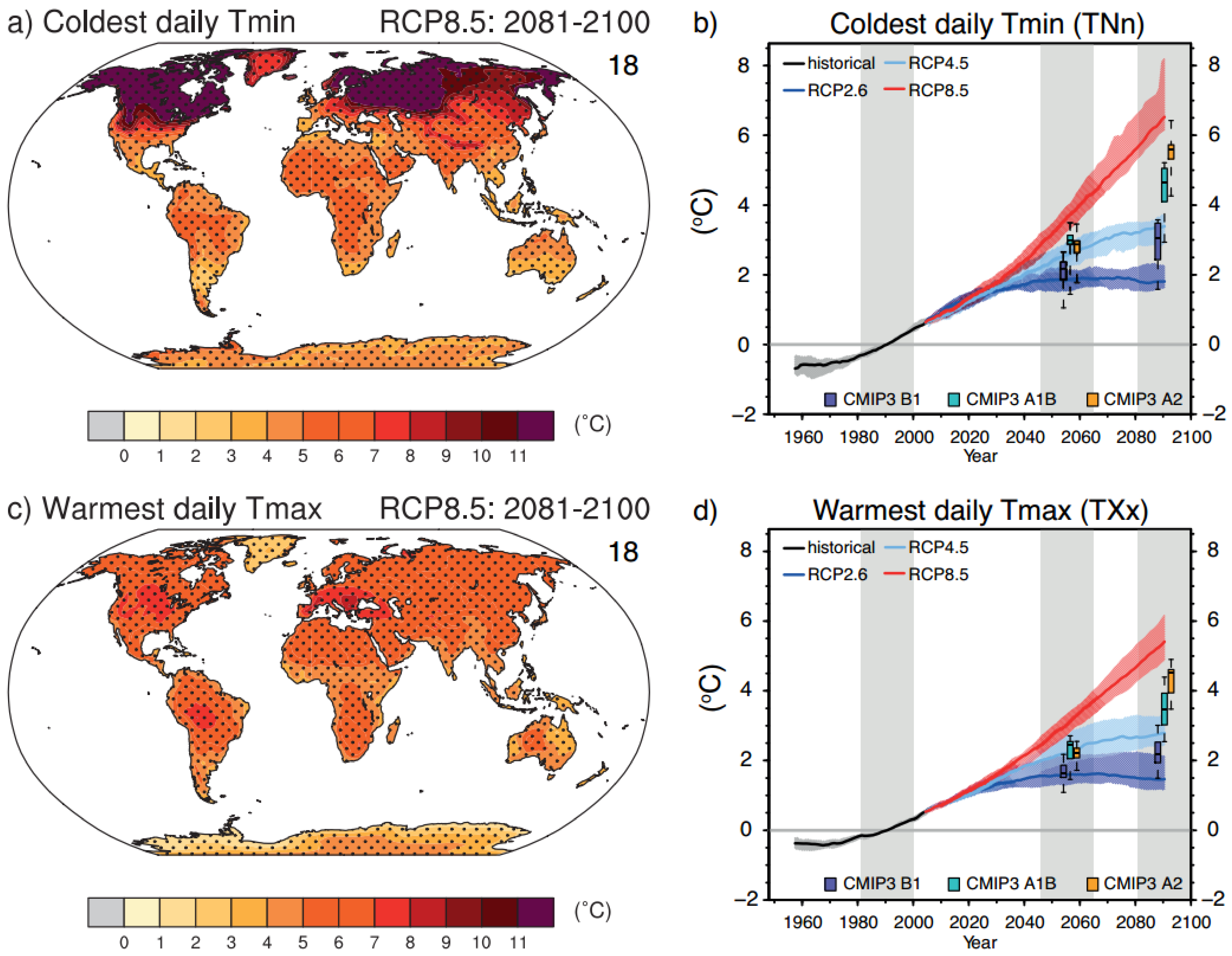


2014

2012

IPCC Working Group I – The physical basis in AR5

Long-term Climate Change: Projections, Commitments and Irreversibility　　Chapter 12



based on
Sillmann et al. 2013b

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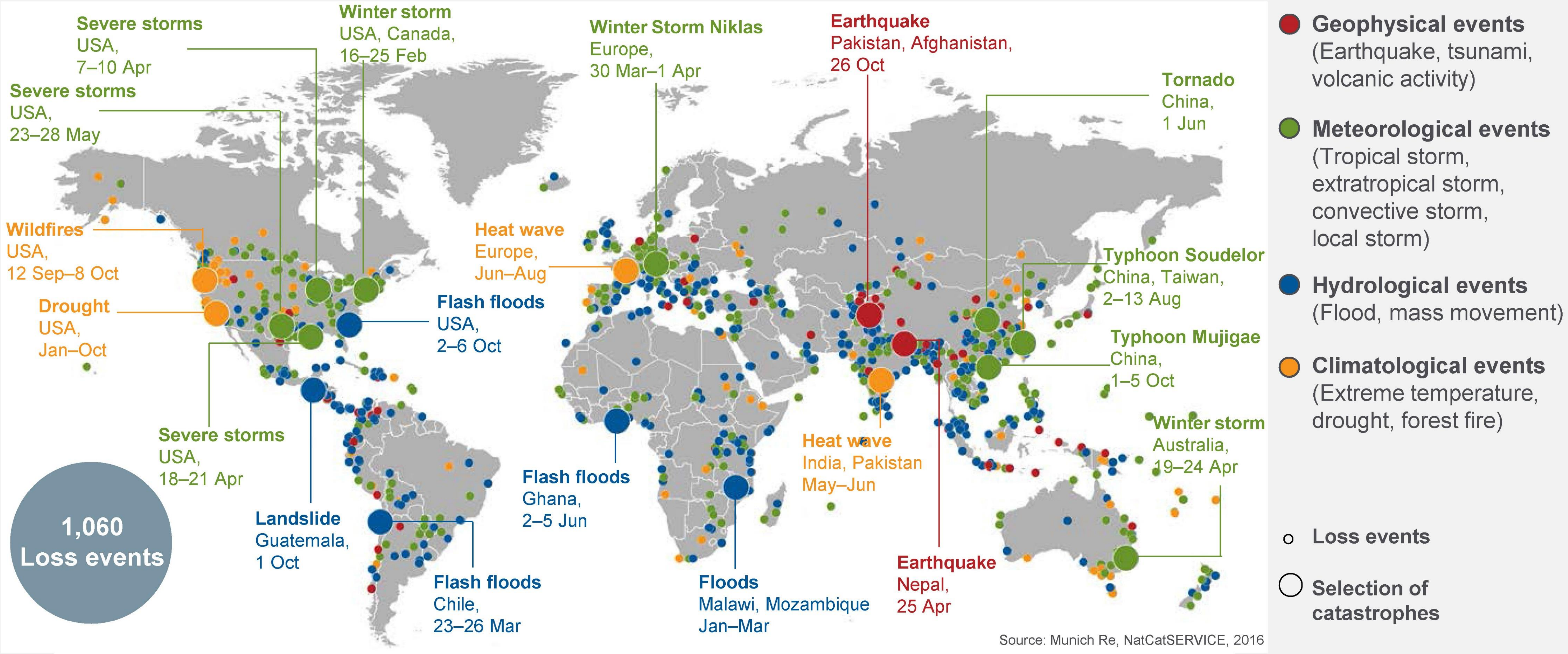
Consequences?

NatCatSERVICE

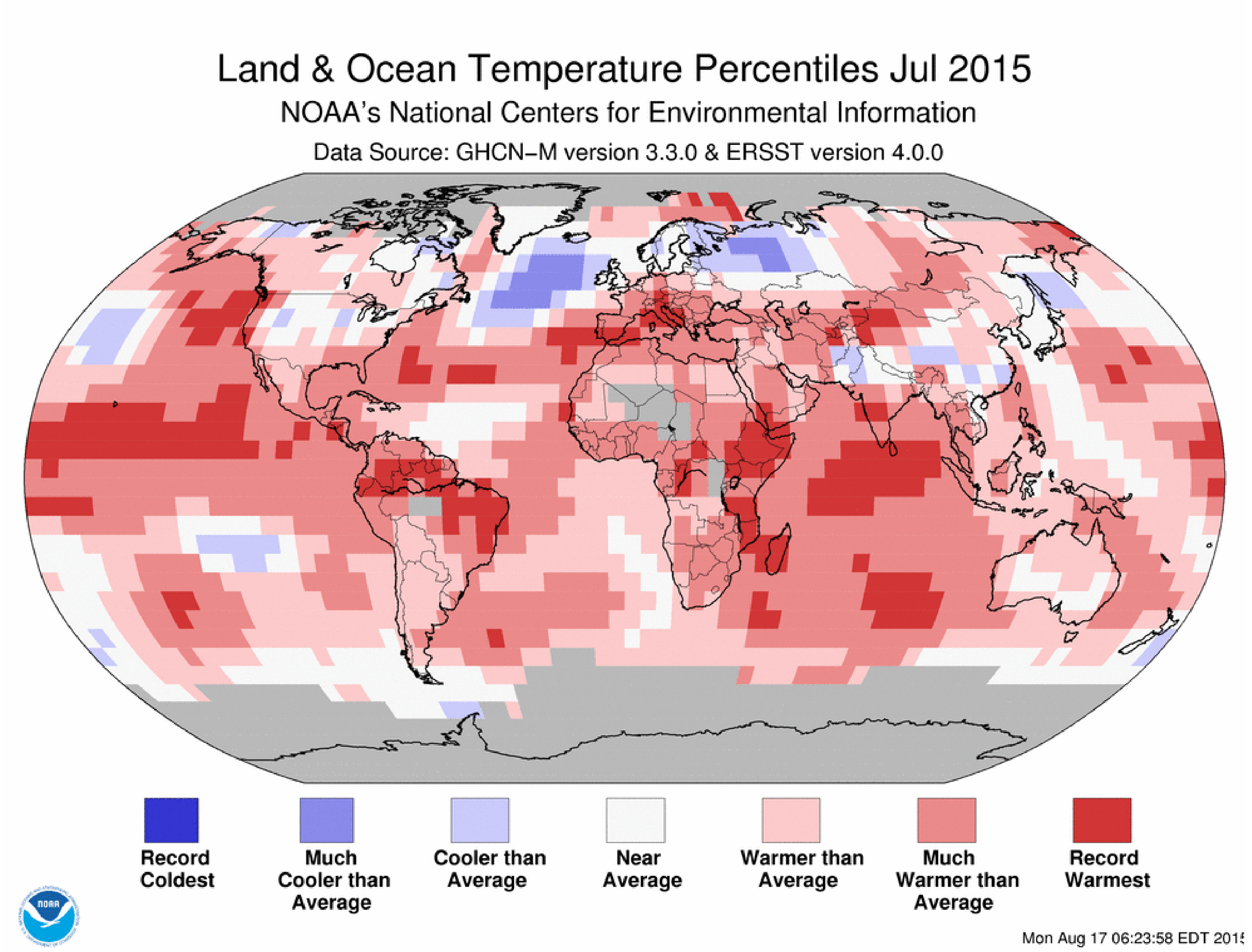
Natural loss events worldwide 2015
Geographical overview

Munich RE



Risk framing in IPCC AR5

Climate change risk = Hazard probability x Vulnerability x Exposure



In Bern ist es leichter, kühl zu bleiben

Wer in Bern lebt, sollte nicht zu laut über Hitze klagen. Denn Grünanlagen und ein «Kühlelement» namens Aare sorgen für ein sehr privilegiertes Klima.

Tipps: Luftige Kle… Skinny Jeans

Leiden Sie unter der Hitz… Co-Chefarzt im City-Not… sich bei diesen Tempera… verhält:

- Regelmässig Wasser … Dabei ist es wichtig, e… nicht in zu grossen Mengen zu konsumieren, da dies zu Kopf- oder Magenschmerzen führen kann. Ideal ist es, Durst gar nicht erst aufkommen zu lassen, indem man immer wieder Wasser zu sich nimmt. «Notfälle in

Der Bund

Indian rickshaw pullers sleep in their rickshaws on a hot summer day in New Delhi

Picture: AP/Manish Swarup

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Importance of indices and data availability

Climate change risk = Hazard probability x Vulnerability x Exposure

Hazard probability	Vulnerability	Exposure
Heat	Age	Population density
Air Pollution	Gender	
	Income	

Importance of indices and data availability

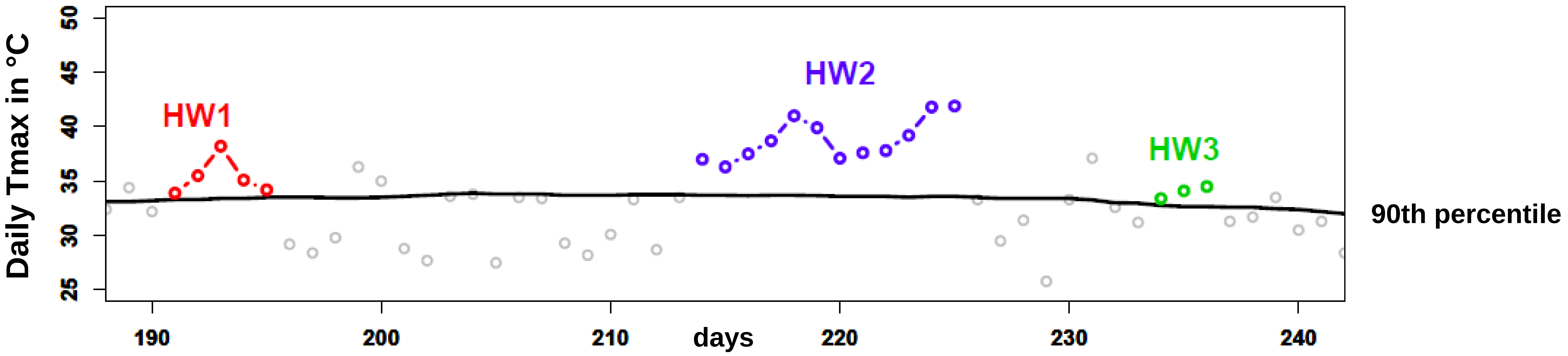
Climate change risk = Hazard probability × Vulnerability × Exposure

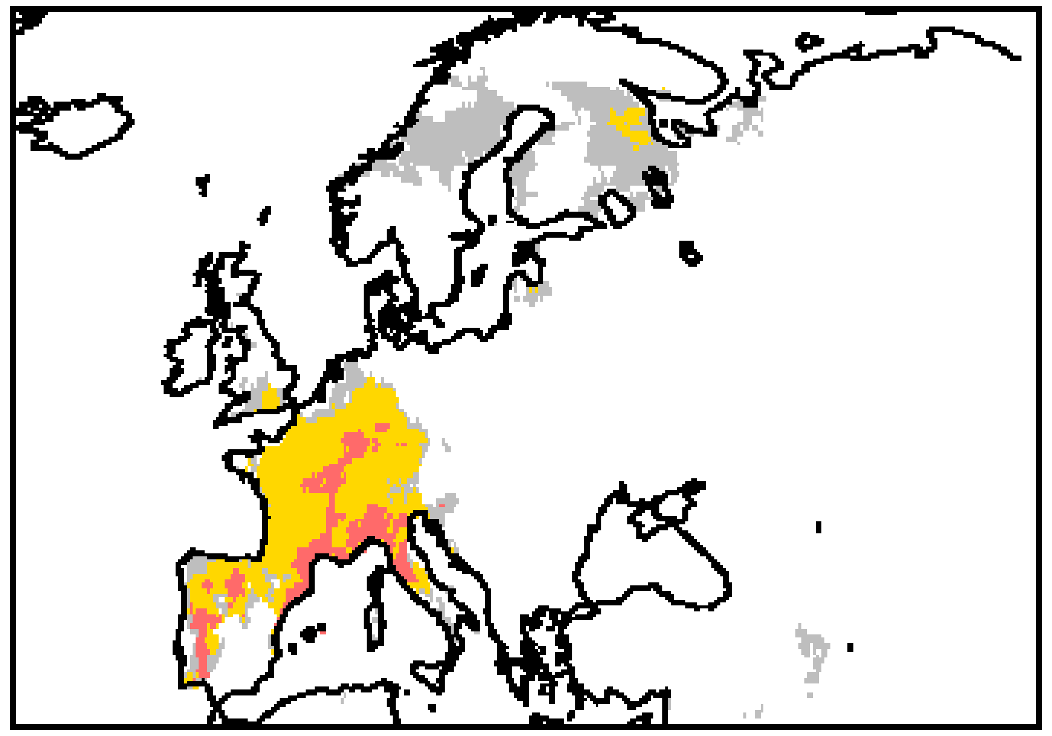
Heat

- Warmest daily Tmax (TXx)
- Warm Spell Duration Index (WSDI)
- Heat Wave Magnitude Index (HWMId)
- Humid Heat Wave Magnitude Index (AWMI)
- Wet Bulb Global Temperature (WBGT)
- Etc.

Heat wave magnitude index

Russo, Sillmann & Fischer, ERL, 2015

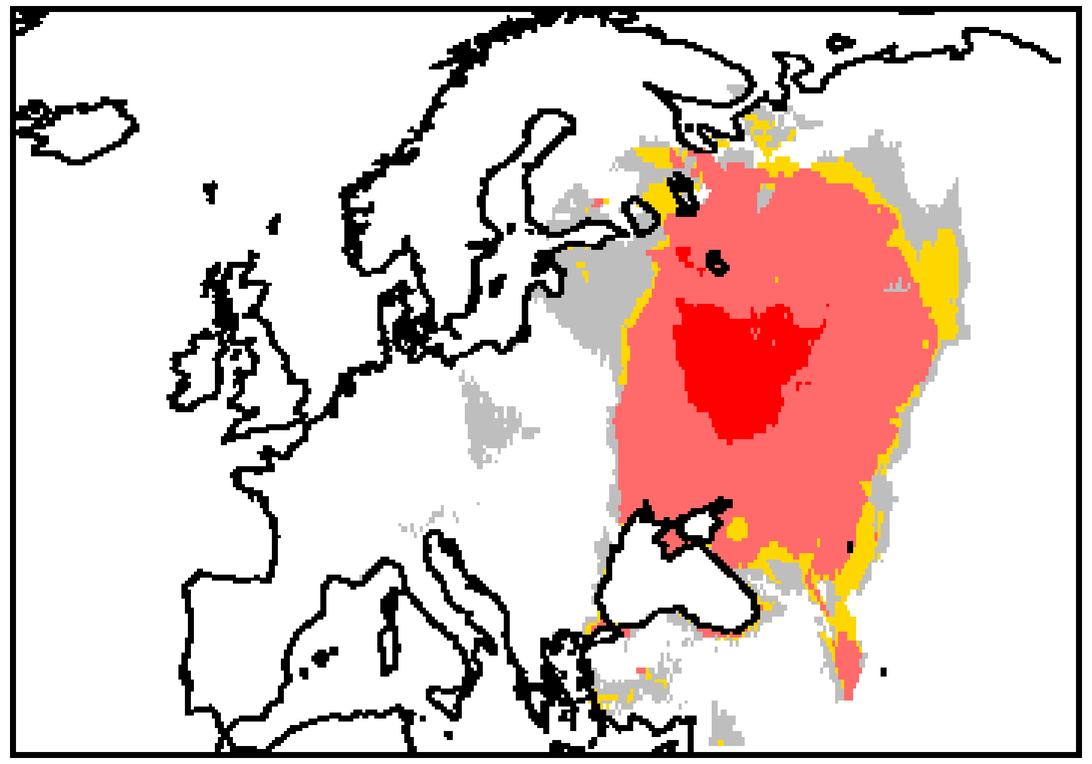




The Guardian, Aug. 29, 2003

Heat wave killed 11,000 in France

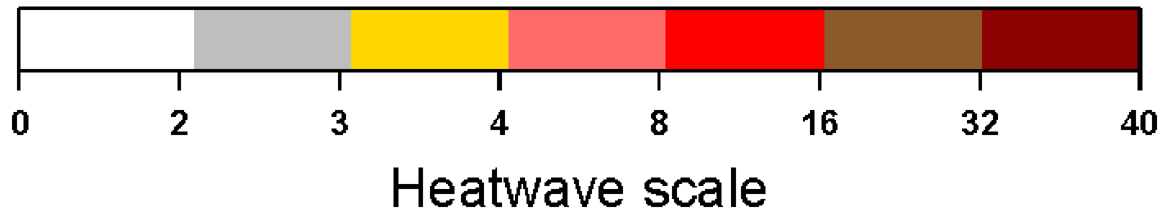
As temperatures rose to 40C (104F) in parts of the country there were massive backlogs and at hospitals many people die



The New York Times, July 19, 2010

Russians and Their Crops Wilt Under Heat Wave

The heat has been besting decades-old records here. At 92.5 F, Friday was the hottest July 16 ever in Moscow.



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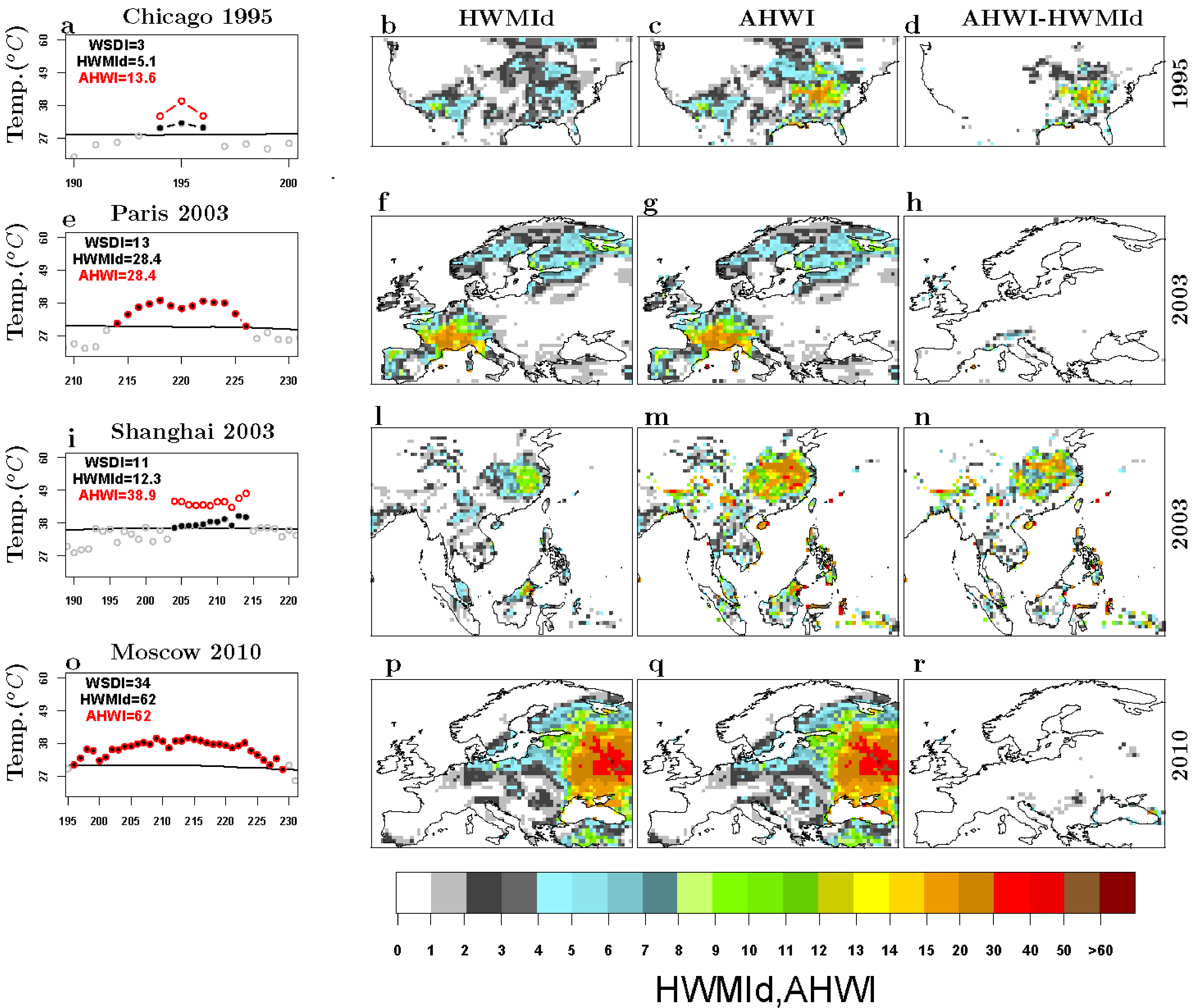
Humid heat wave index

Russo, Sillmann & Sterl, 2017



AHWI → Replacing daily Tmax with Apparent Temperature AT, when AT > T

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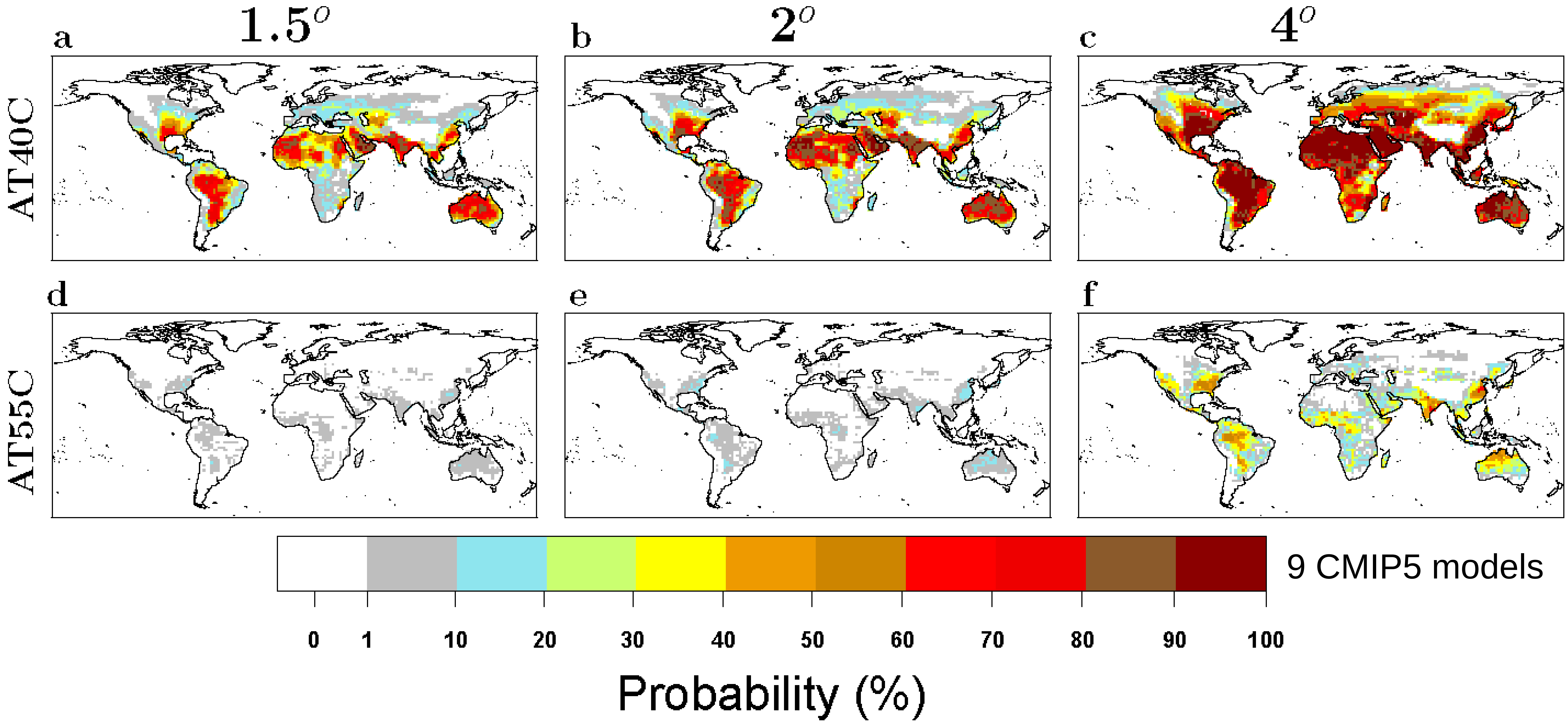
Humid heat waves in the future

Risk of heat cramps and exhaustion

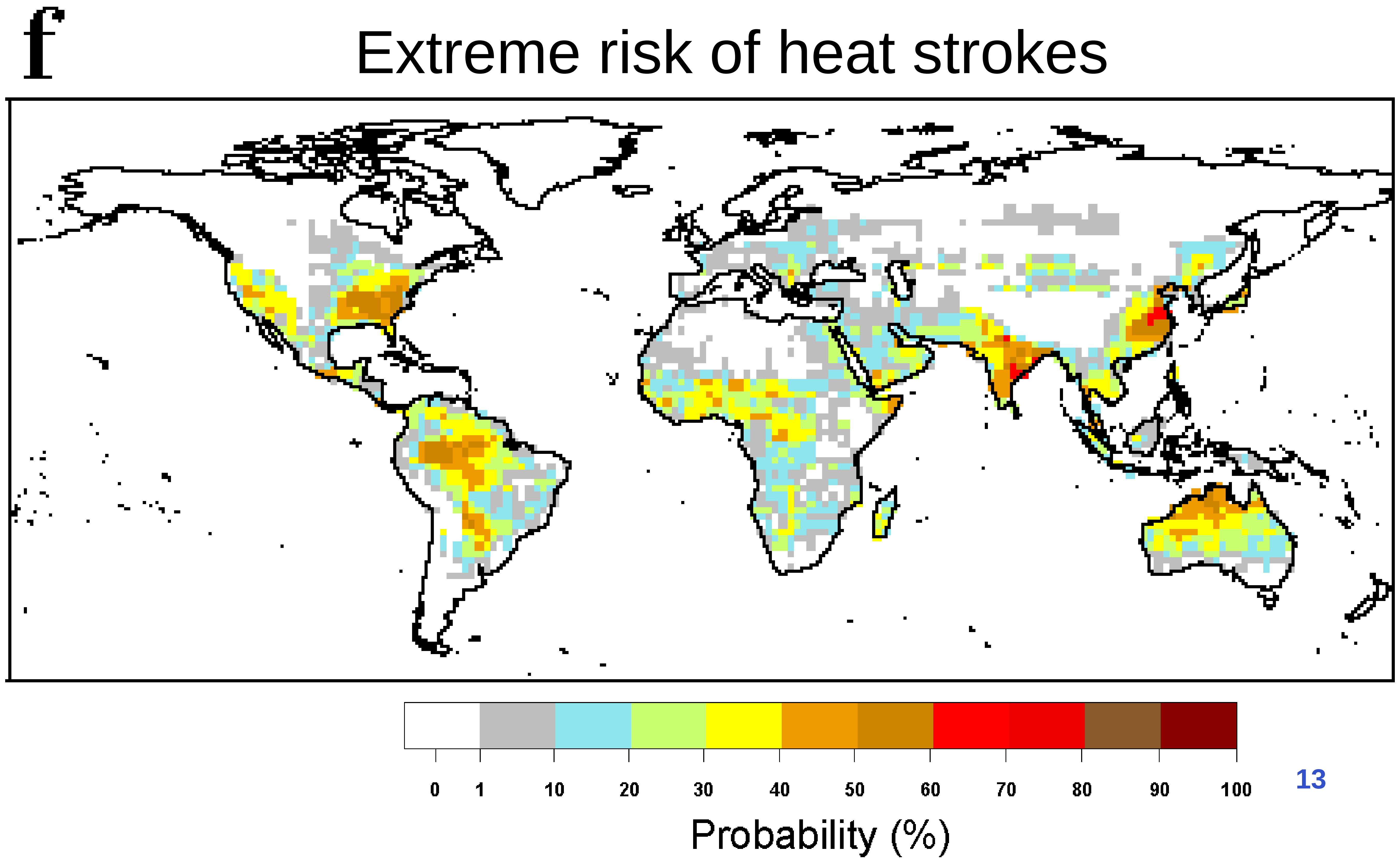
Extreme risk of heat strokes



Russo, Sillmann & Sterl, 2017

Humid heat waves in the future

Under 4°C warming some regions of the world become **uninhabitable!**



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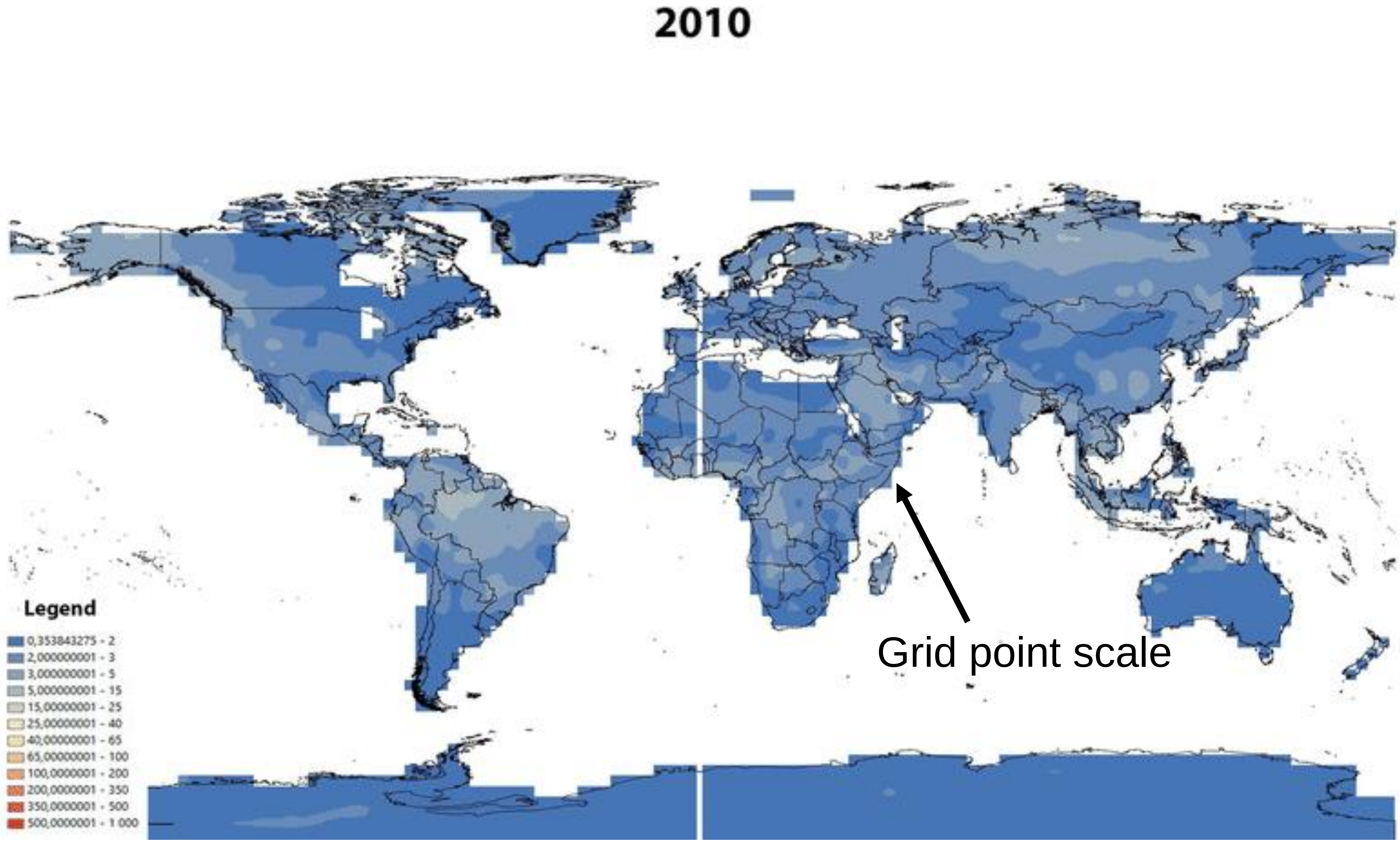
Example: Climate Extremes and Health

Climate change risk = Hazard probability × Vulnerability × Exposure

Heat	**Age**	**Population**
HWMId from 50 ensemble members of CanESM2	UN ESA* (<4 and >65 years)	NCAR SSP2 scenario (Jones &O'Neill 2016)

* United Nations, Department of Economic and Social Affairs, Population Division (2015). *World Population Prospects: The 2015 Revision, Methodology of the United Nations Population Estimates and Projections,* Working Paper No. ESA/P/WP.242.

Hazards: Heat waves (HWMId from CanESM2)



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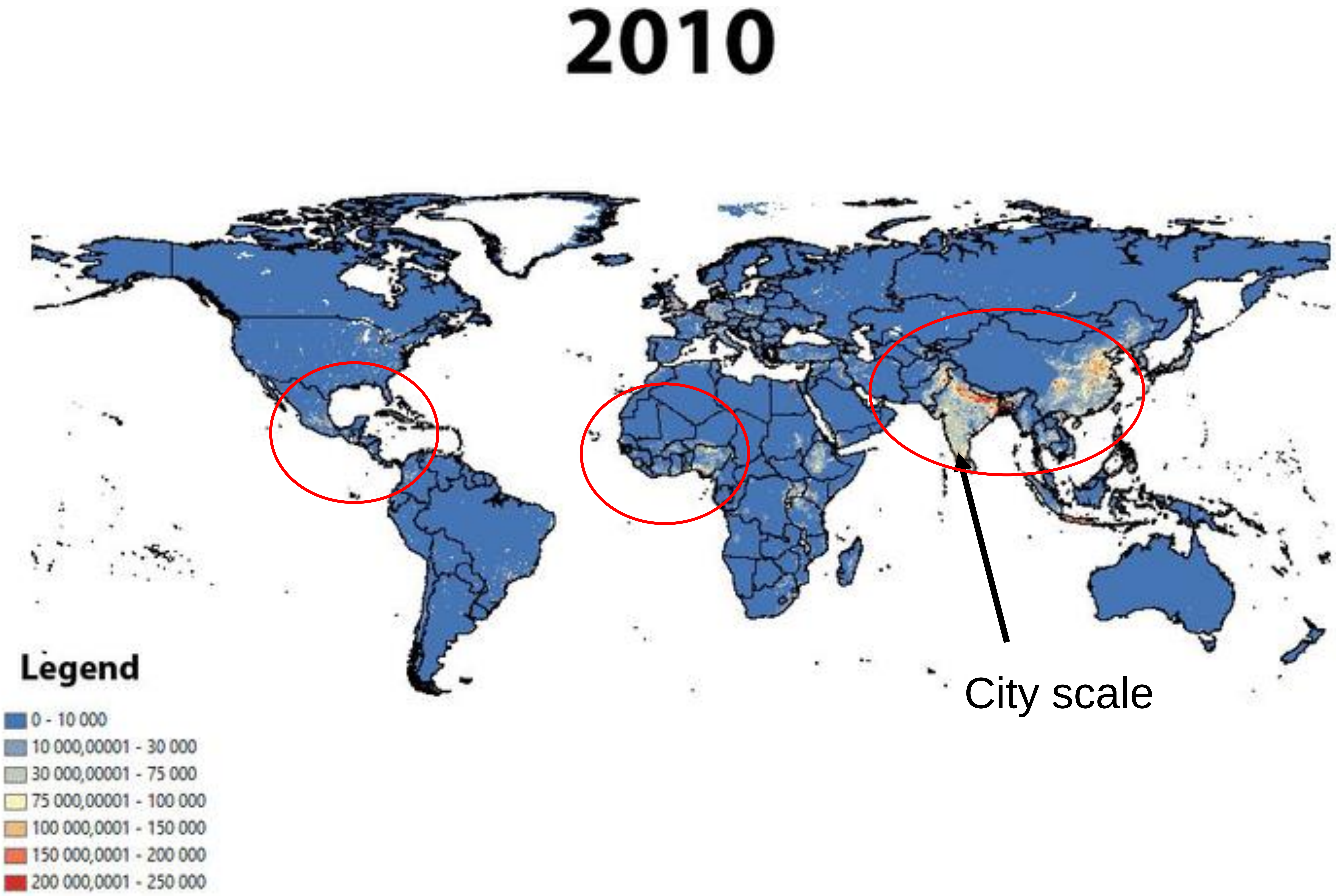
Exposure: Population SSP2 scenario (Jones & O'Neill 2016)



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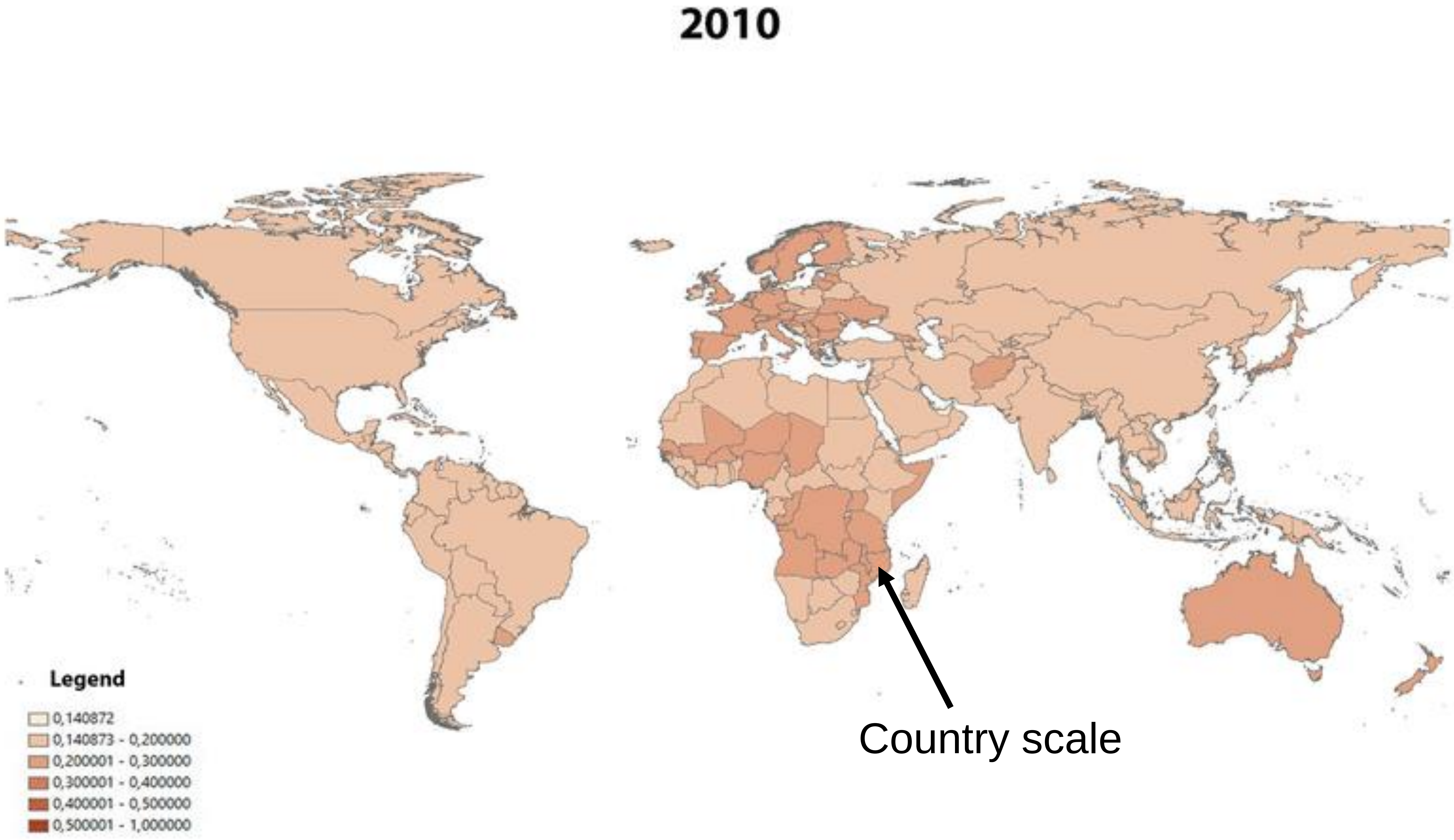
Vulnerability: Age distribution from UN ESA



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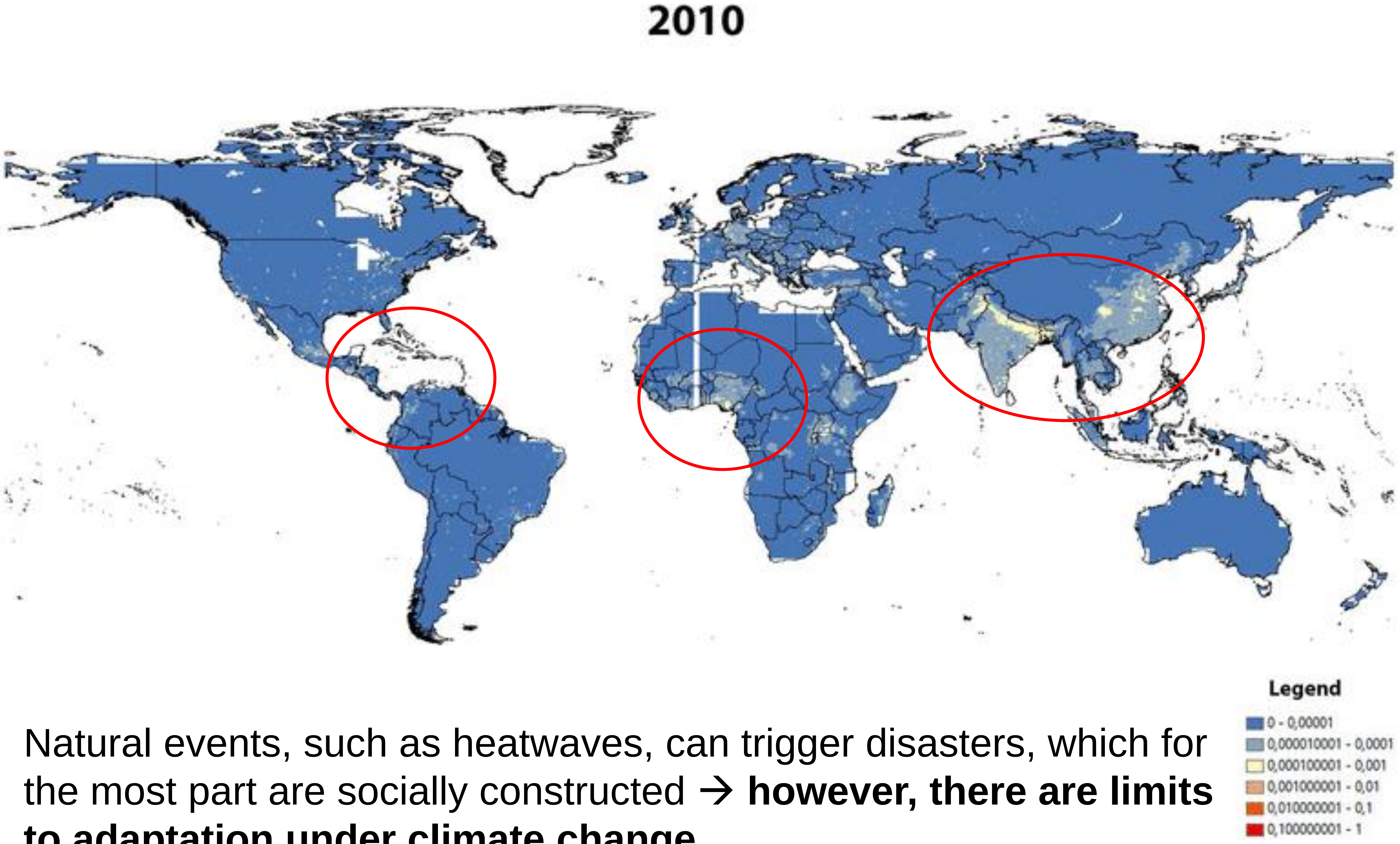
Climate change risk = Heat x Population x Age



Natural events, such as heatwaves, can trigger disasters, which for the most part are socially constructed → **however, there are limits to adaptation under climate change**

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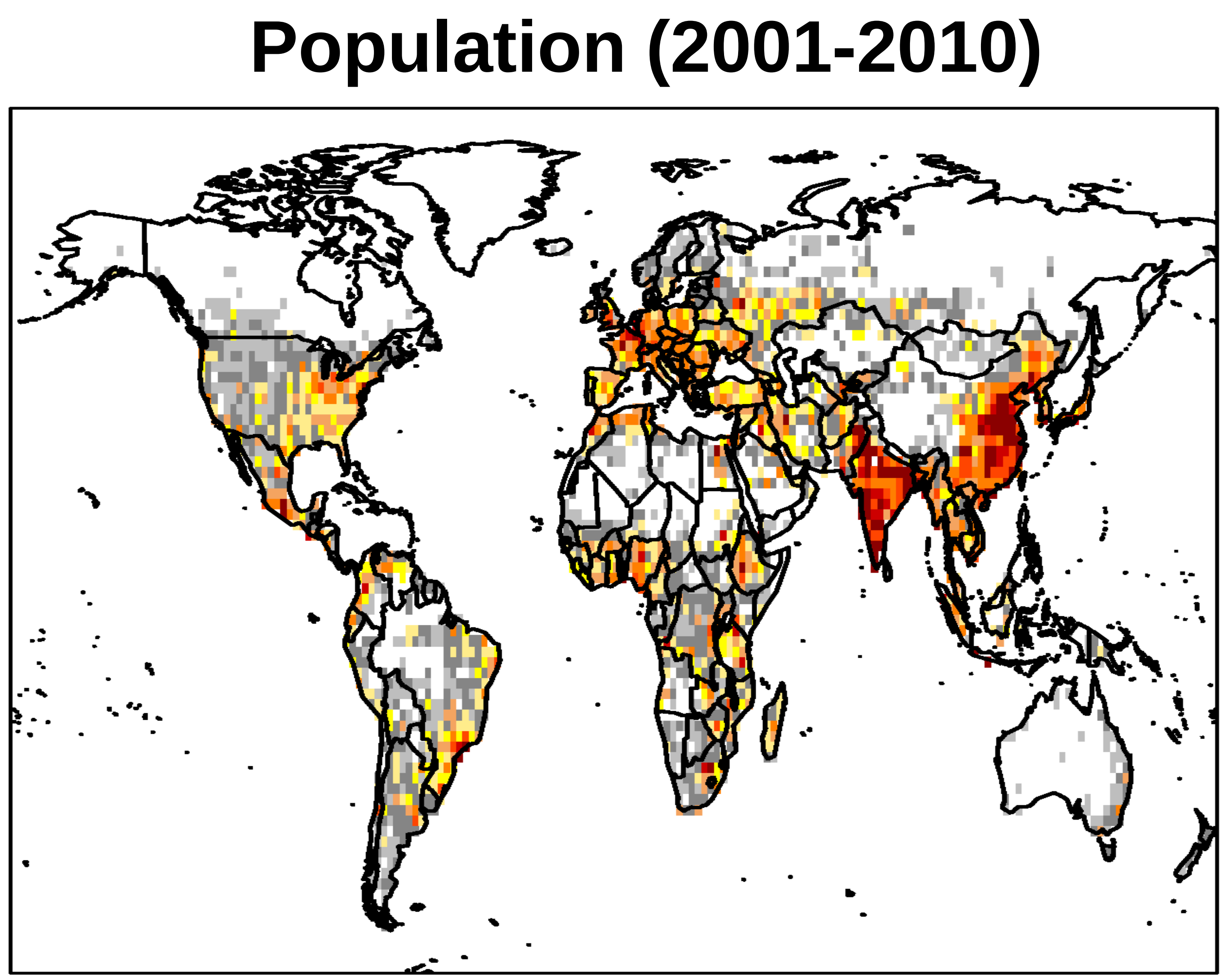
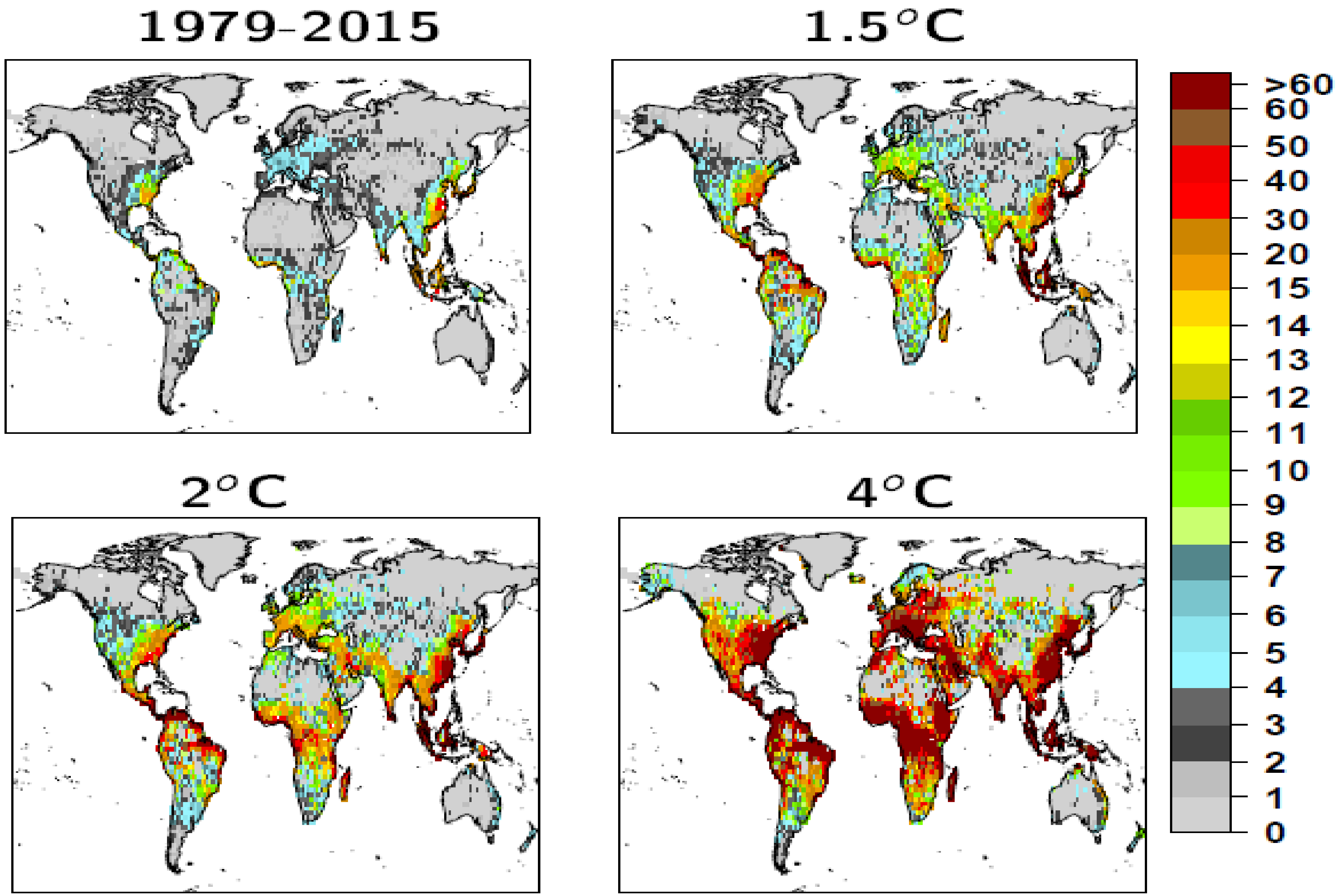
Heatwaves scaled by Population x GDP

For present day conditions (2001-2010) of population and GDP (Harrington et al. 2016, ERL)





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Conclusion

Challenges with following IPCC risk framework to identify social «hot spots»

- Data availability, open-access and compatibility
- Temporal and spatial resolution of datasets
- Empirical data combined with model development
- Up-scaling of case studies → learning from climate services

Close collaboration needed between Climate Change and IRDR community!

→ New WCRP-IRDR-Future Earth initiative on Knowledge-Action-Network (KAN) on Extreme Events and Disaster Risk Reduction / Emergent Risks

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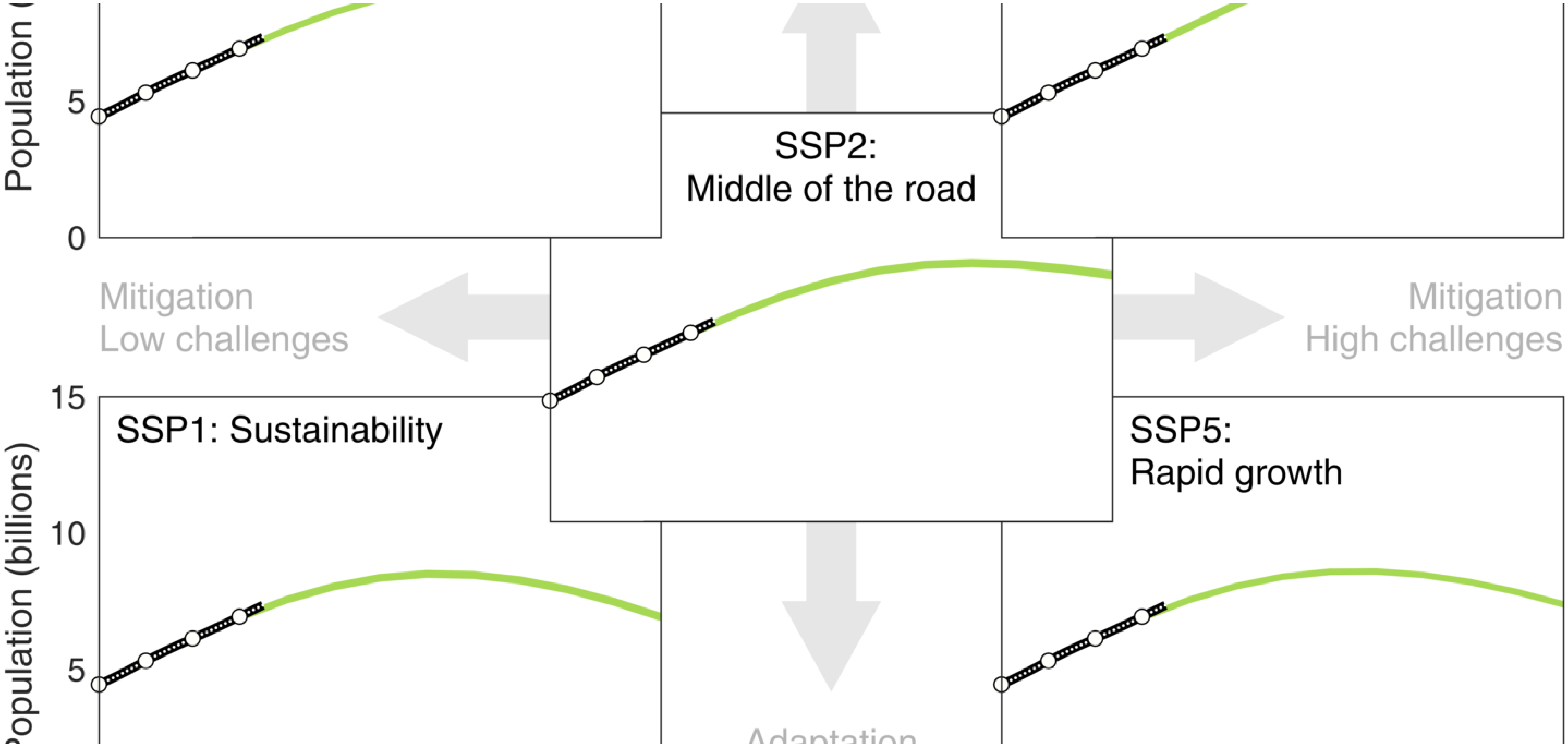
SSP Quantification: Population

Each SSP has a different population, but climate change does not feedback onto population growth



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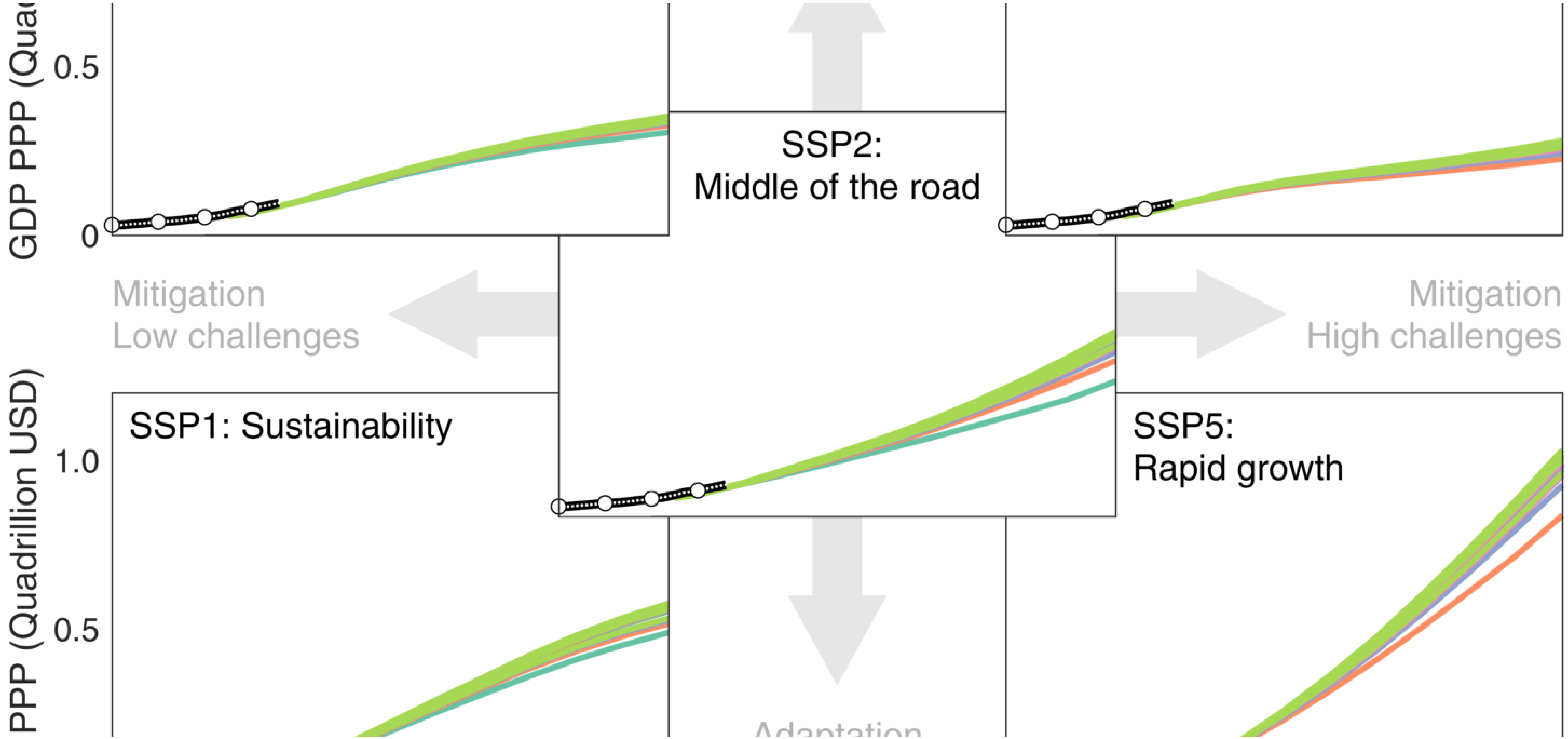
Source: [Riahi et al (2017)](), [Global Carbon Budget 2016]()

SSP Quantification: GDP

Each SSP and IAM has a different GDP, and mitigation leads to reduce GDP growth
The cost of climate impacts is not included (and IPCC has shied from this)



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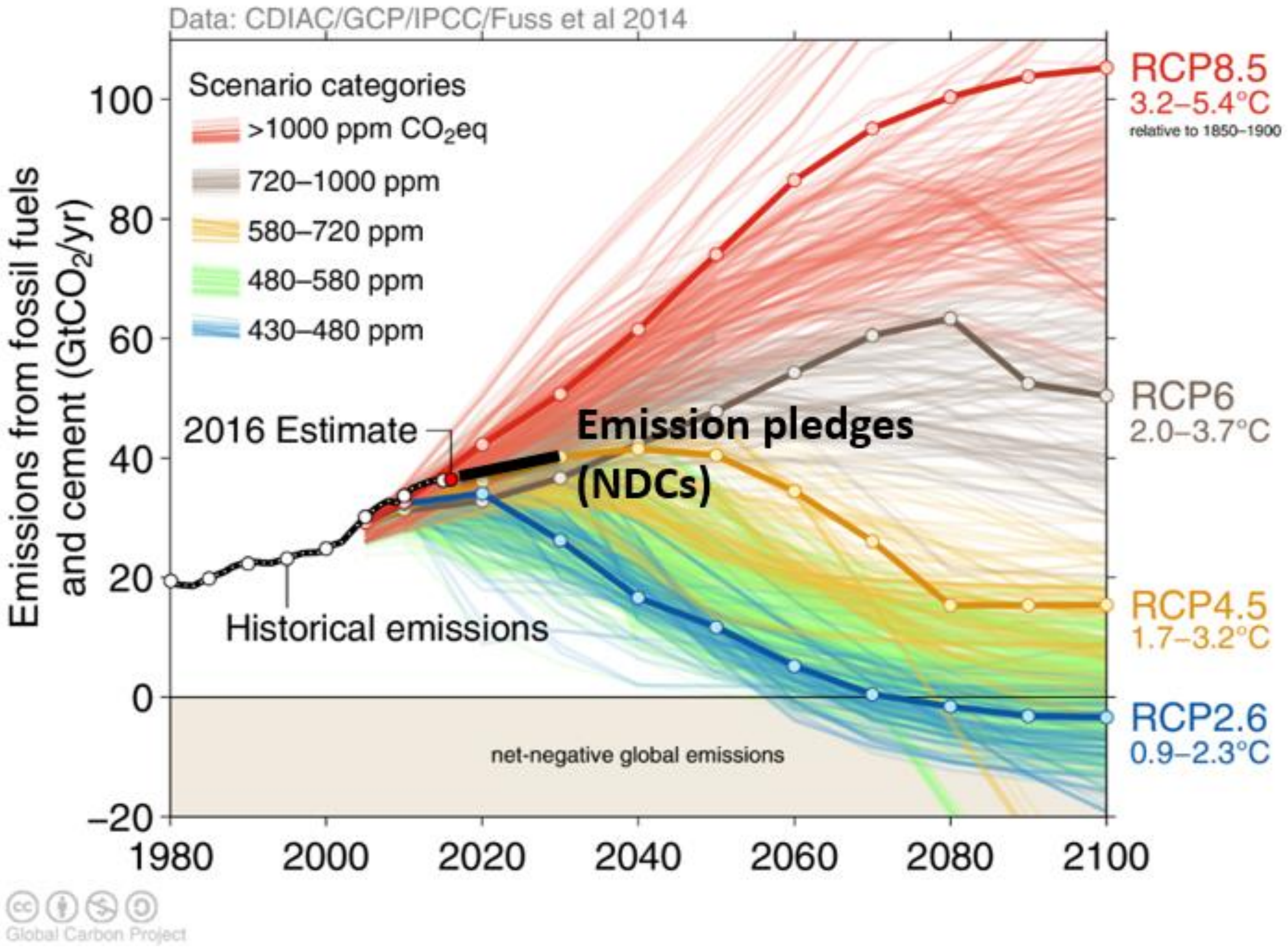
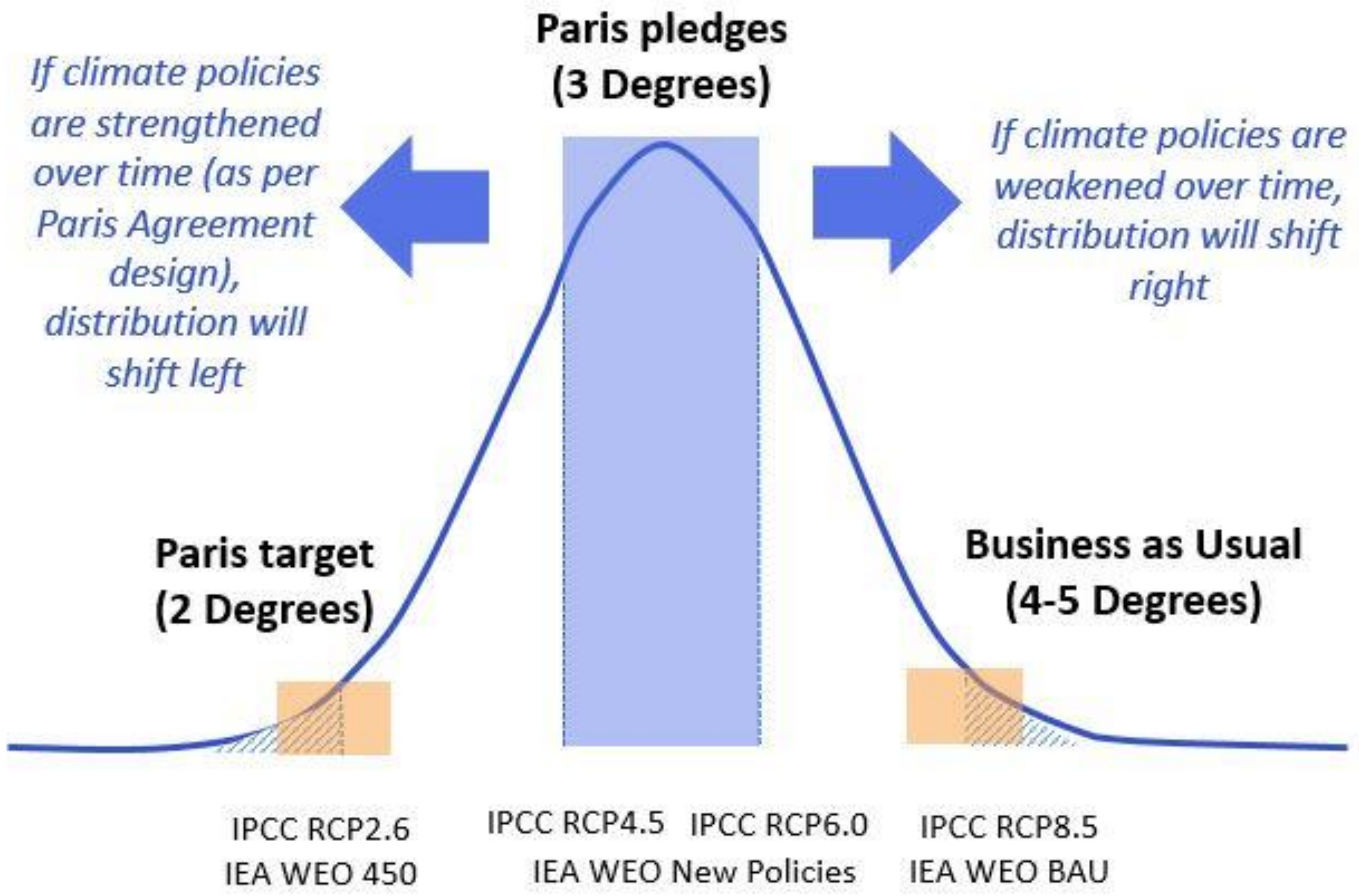
Source: Riahi et al (2017), Global Carbon Budget 2016

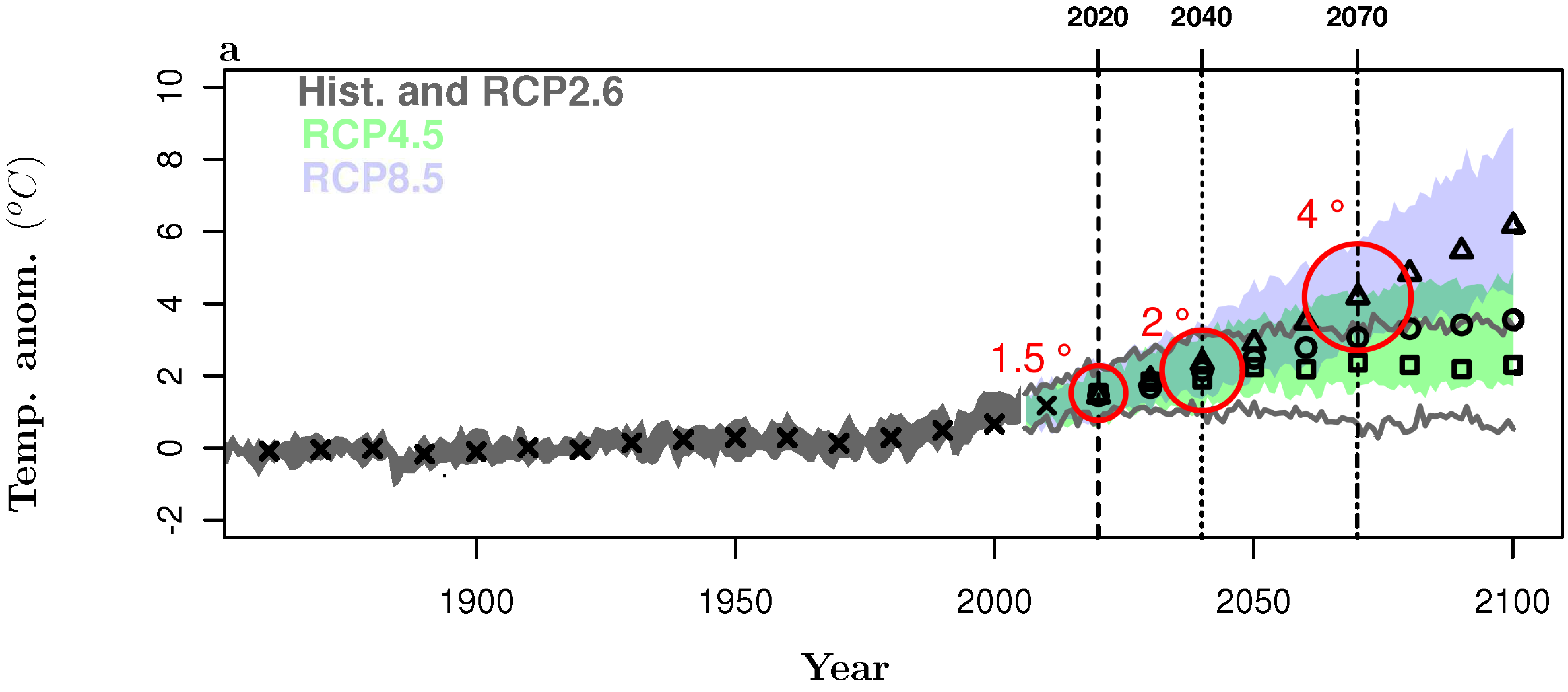
Shades of Climate Risk

Scenarios





Humid heat waves in the future



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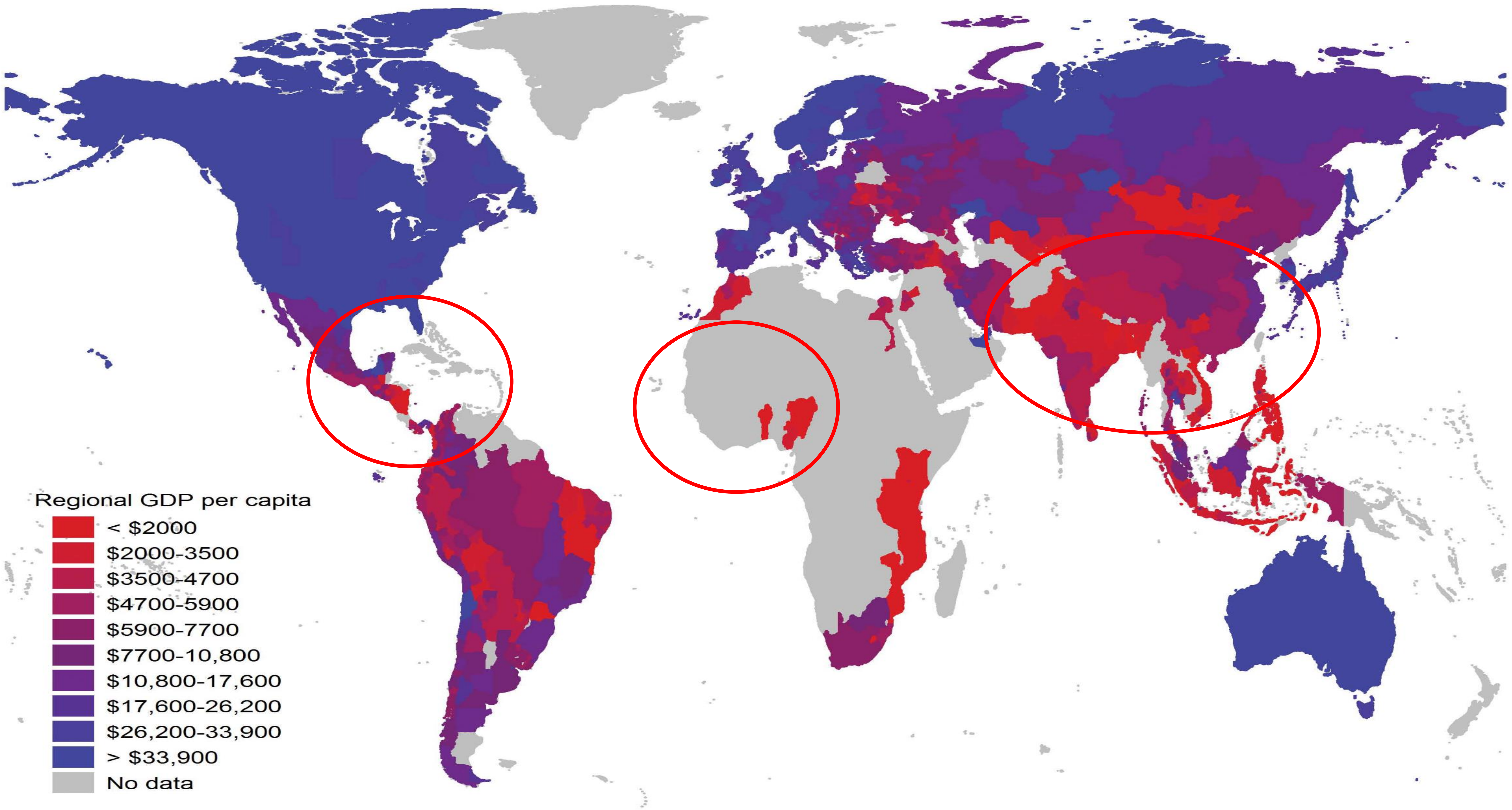
Russo, Sillmann & Sterl, 2017, submitted

Example: Climate Extremes and Wealth

Climate change risk = Hazard probability × Vulnerability × Exposure

Heat	GDP	Population
HWMId from 50 ensemble members of CanESM2		NCAR SSP2 scenario (Jones &O'Neill 2016)

Example: Climate Extremes and Wealth



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Source: Centre for Global Development, www.cgdev.org/blog/global-map-subnational-gdp

Example: Climate Extremes, Air Pollution and Health

Climate change risk = Hazard probability × Vulnerability × Exposure

"… during the European summer heat wave of 2003 […] possibly 50% of the deaths could have been associated with **ozone** exposure rather than the **heat** itself." IPCC AR5 WGII (2014)

"… **particle air pollution** [is] among the largest risk factors globally, far higher than any other environmental risk […]. IPCC AR5 WGII (2014)


Russian heat wave 2010

"The economic impact of this burden is difficult to assess as evaluation methods vary dramatically in the literature." IPCC AR5 WGII (2014)

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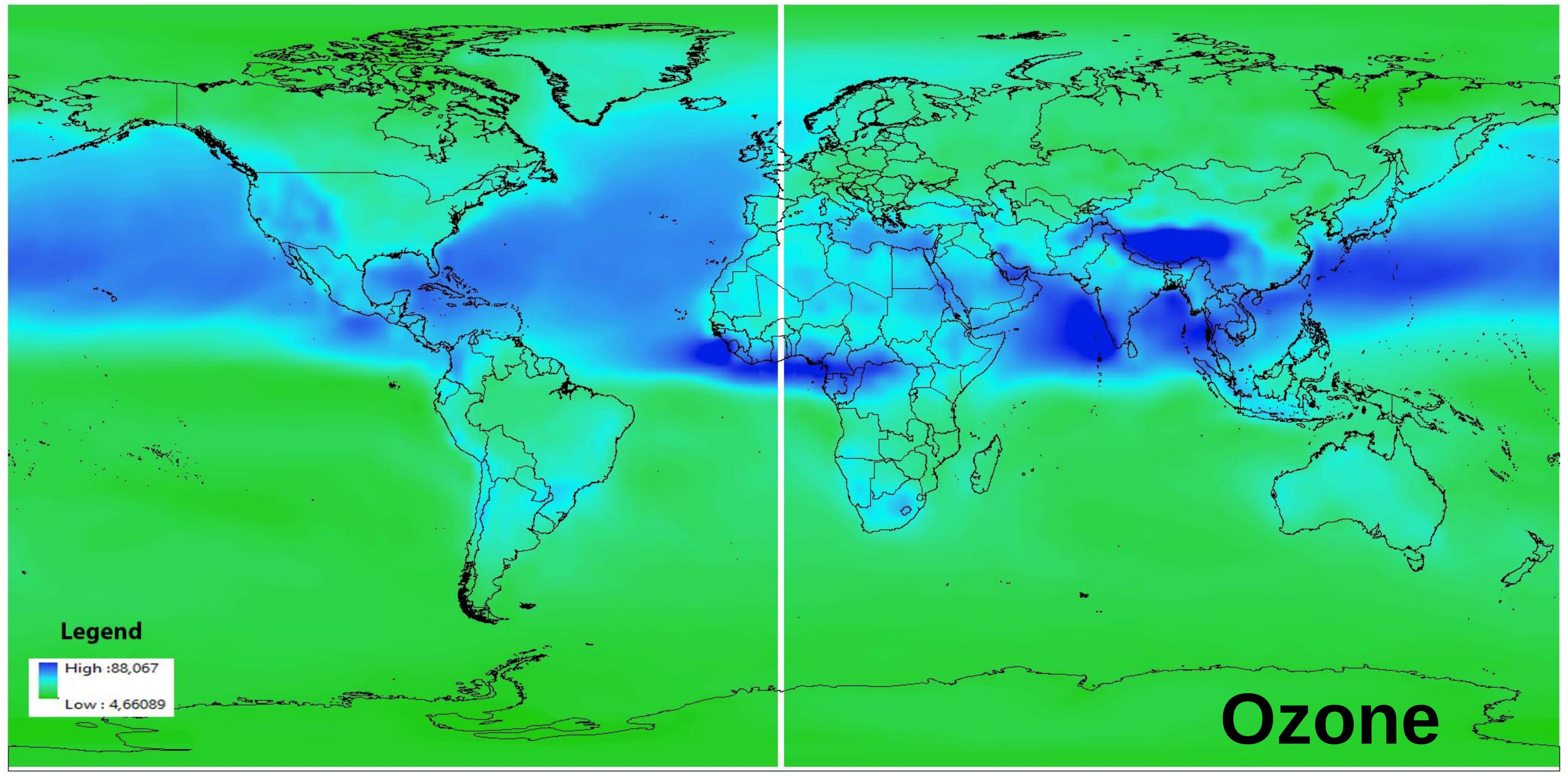
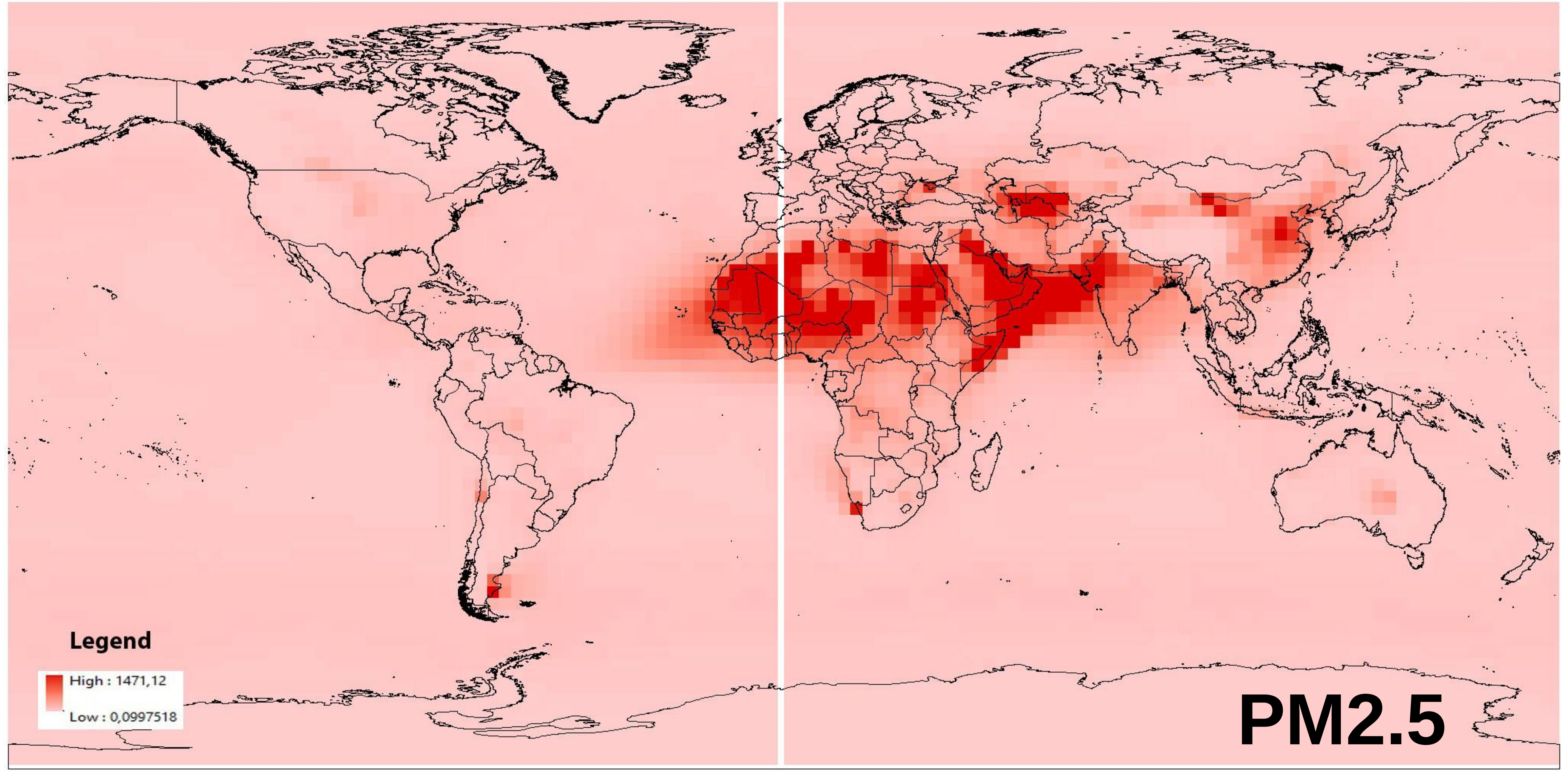
Hazards: Ozone and PM2.5 from ECLIPSE

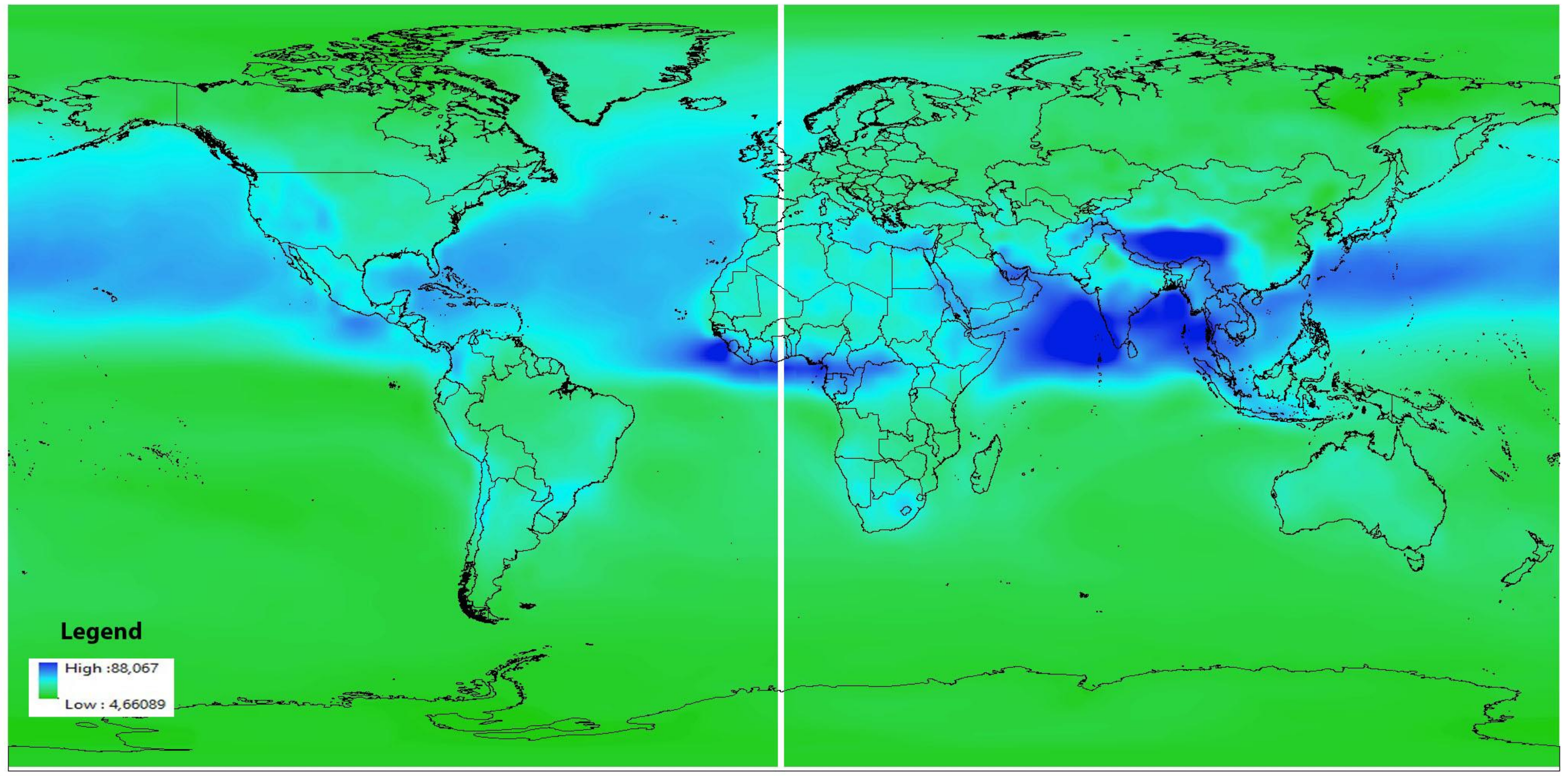
2010



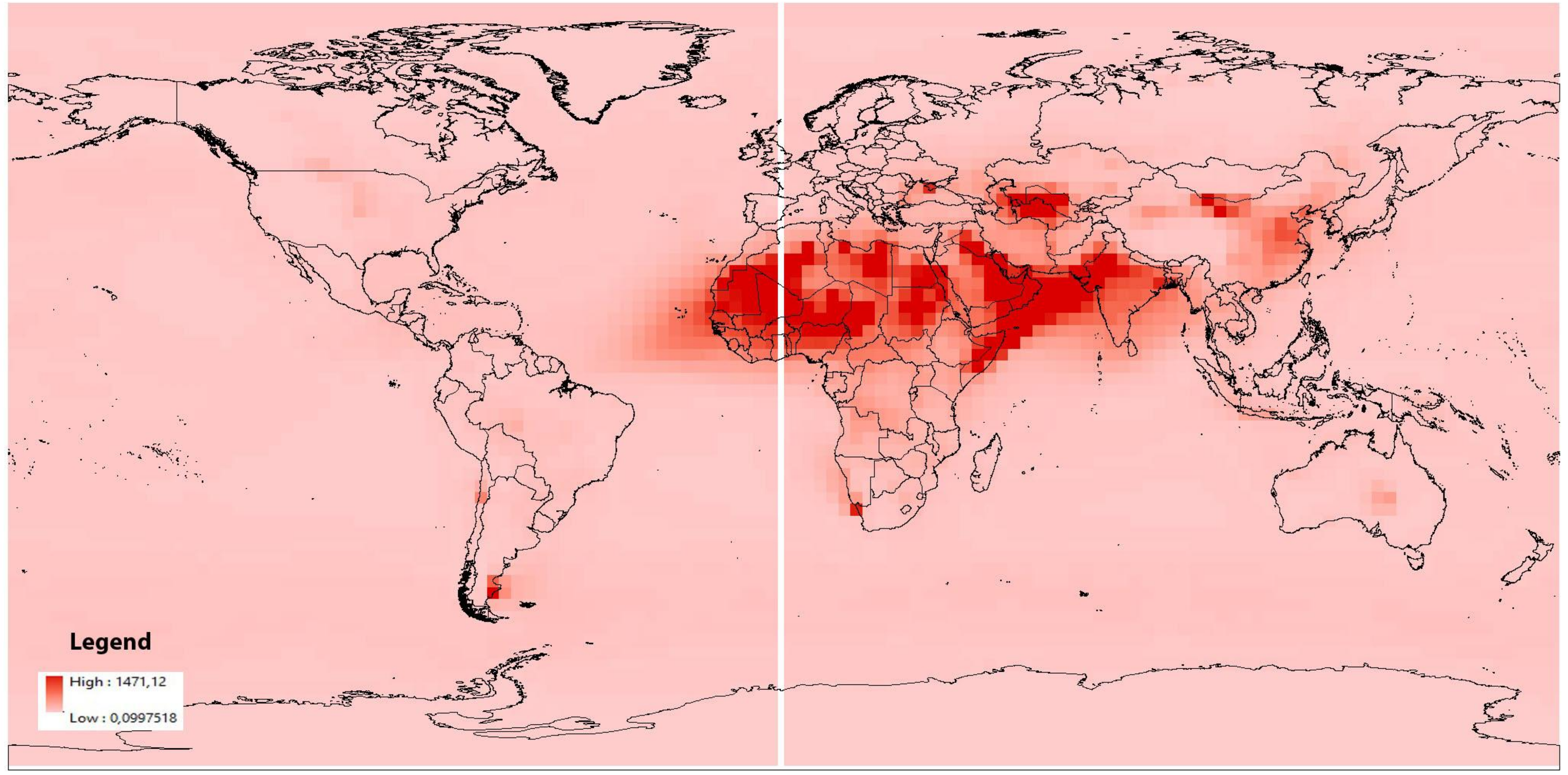
2010



2050



2050



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Example: Climate Extremes, Air Pollution and Health

Climate change risk = Hazard probability x Vulnerability x Exposure

Heat

HWMId from 50 ensemble members of CanESM2

+ or x?

Air Pollution

ECLIPSE (Stohl et al. 2015)

O_3 and PM2.5

Age

UN ESA* (<4 and >65 years)

Population

NCAR SSP2 scenario (Jones &O'Neill 2016)

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* United Nations, Department of Economic and Social Affairs, Population Division (2015). *World Population Prospects: The 2015 Revision, Methodology of the United Nations Population Estimates and Projections,* Working Paper No. ESA/P/WP.242.