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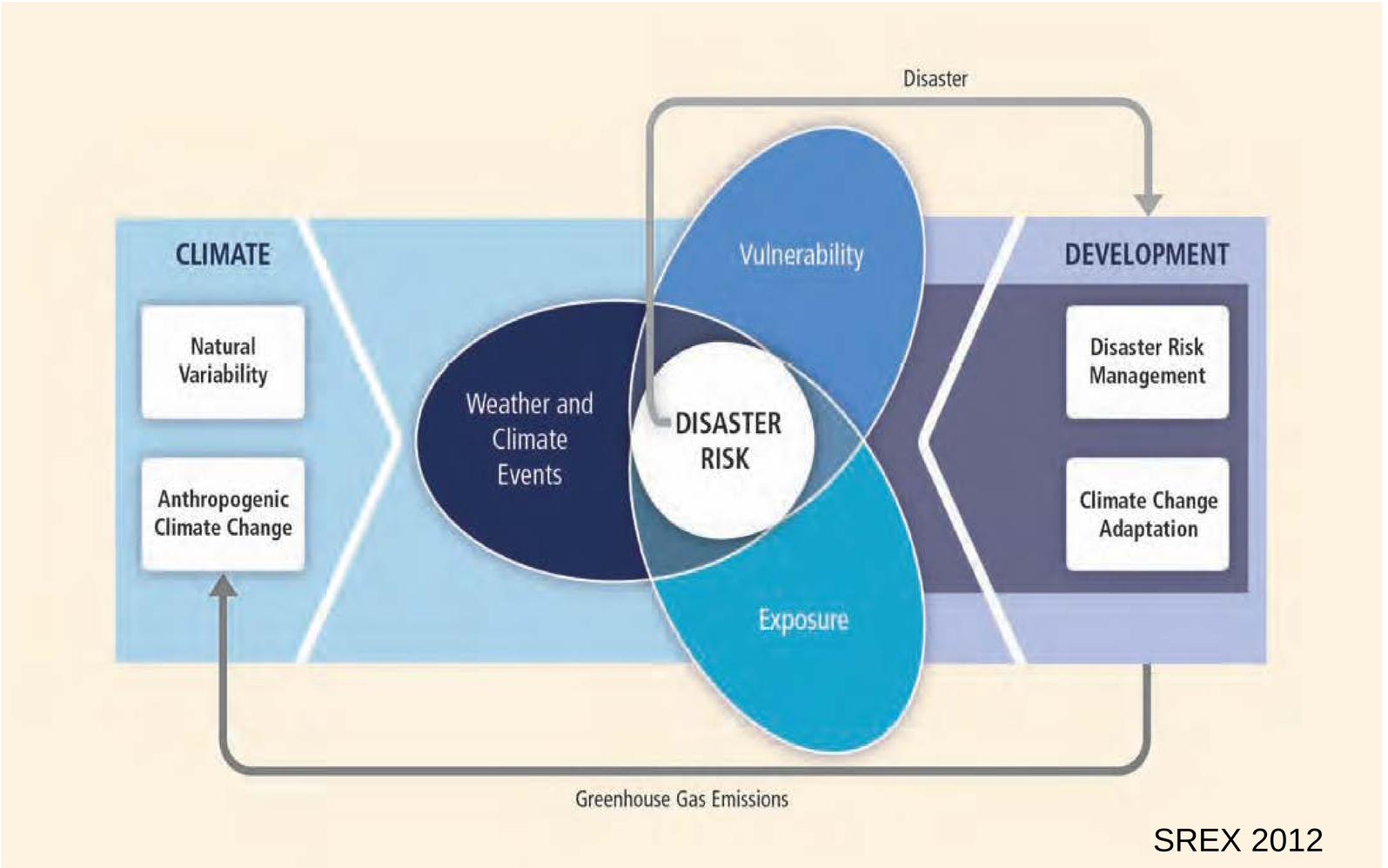
A statistical approach to estimate global heatwave risk

Jana Sillmann, Simone Russo, Sebastian Sippel, Brian O'Neill, Monika Barcikowska, Claudia Ghisetti and Marek Smid

EGU 2020, May 4th, 2020

The IPCC risk framing



SREX 2012

Risk = Probability of Events or Trends × Consequences

Technical approach to the framework

nature COMMUNICATIONS

ARTICLE

https://doi.org/10.1038/s41467-018-08070-4 OPEN

Half a degree and rapid socioeconomic development matter for heatwave risk

Simone Russo[1,2], Jana Sillmann[3], Sebastian Sippel[4], Monika J. Barcikowska[5], Claudia Ghisetti[1], Marek Smid[6] & Brian O'Neill[7]

Illustrative risk index at the global scale. At each location normalized IRI (expressed in %) is calculated as the product of the probability of occurrence of HW500Y multiplied by normalized population density and 1-HDI values:

$$\mathrm{IRI} = \left(\mathrm{HW}_{\mathrm{hazard}} \times \mathrm{Population}_{\mathrm{exposure}} \times (1 - \mathrm{HDI})_{\mathrm{vulnerability}}\right) \times 100 \qquad (1)$$

with all components of the product above normalized in [0, 1].

Statistical modeling of heatwaves

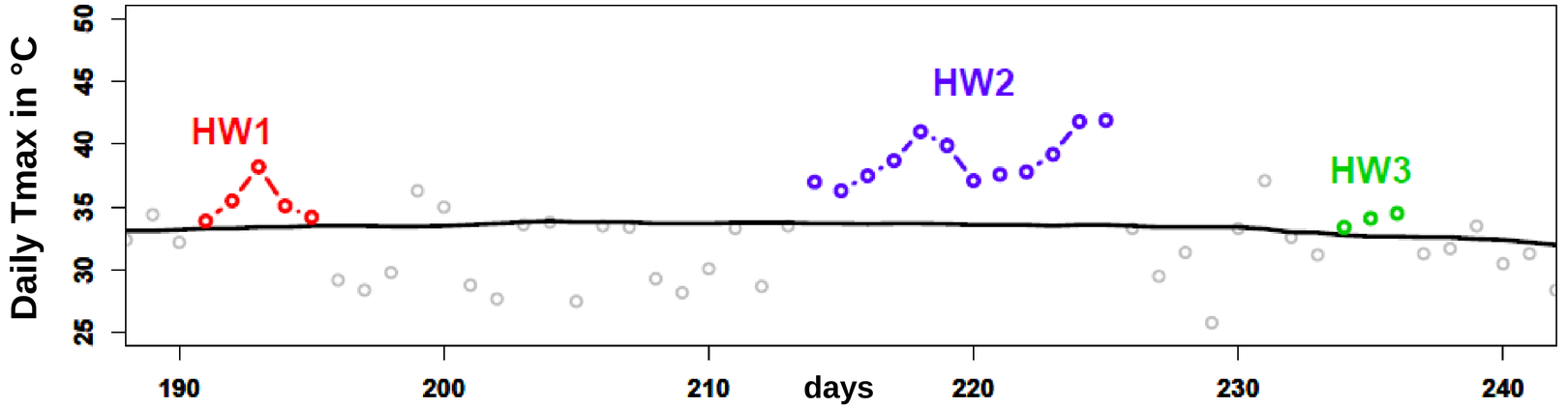
Indicator: Heat wave magnitude index (HWMId)

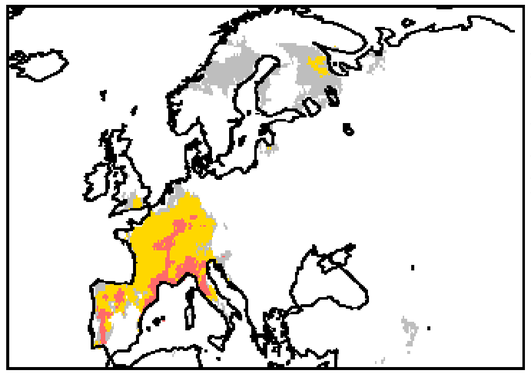
Data: Ensemble simulations from HAPPI (Half A degree additional warming, Prognosis and Projected Impacts) project

Analysis: Generalized Extreme Value (GEV) distribution
Block maxima approach

Heat wave magnitude index

Russo, Sillmann & Fischer, ERL, 2015

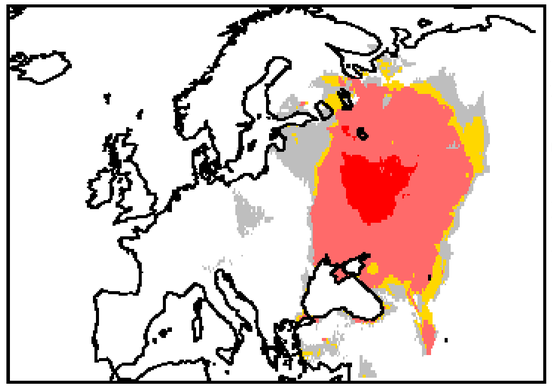




The Guardian, Aug. 29, 2003

Heat wave killed 11,000 in France

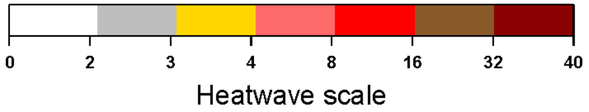
As temperatures rose to 40C (104F) in parts of the country there were massive backlogs and at hospitals many people die



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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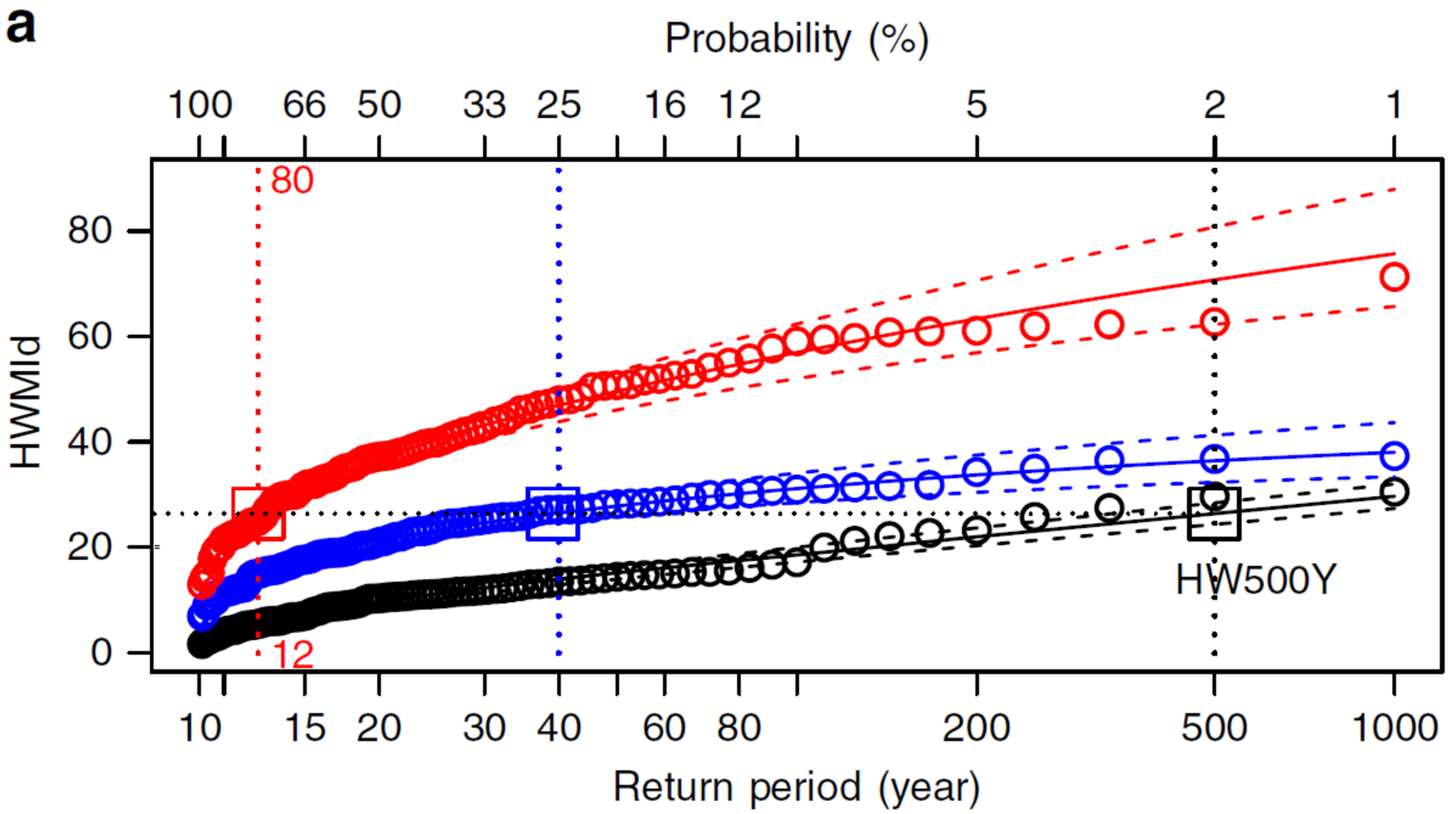
Results

Fitting decadal-maximum HWMId to a Generalized Extreme Value (GEV) distribution

Example for a location in Central Africa (18.75°E, 4.69°N)



2°C warming

1.5°C warming

Current

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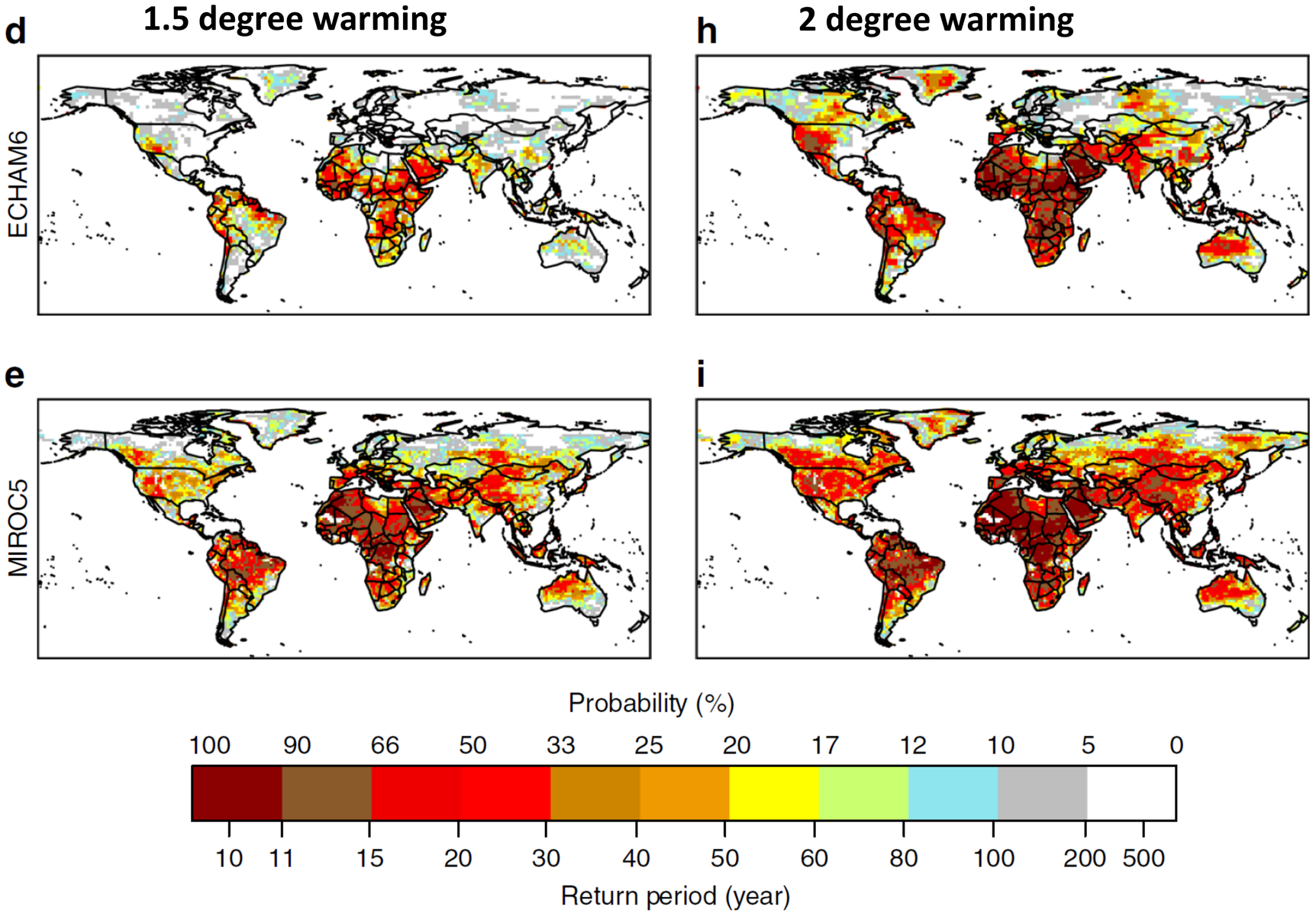
Russo, Sillmann et al. 2019, Nature Comms

Probability and return level of a heatwave with 500-year return period



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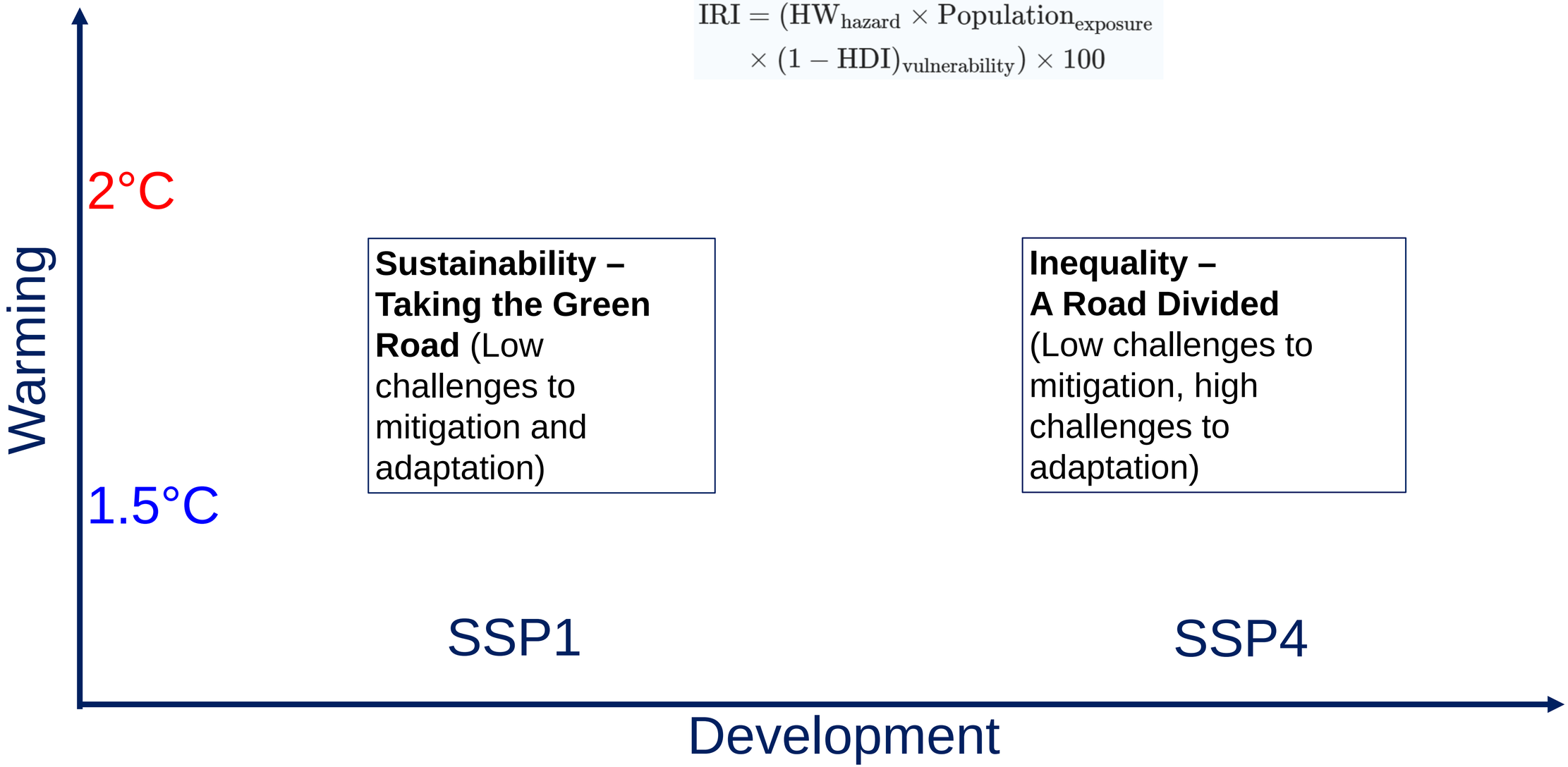
Russo, Sillmann et al. 2019, Nature Comms

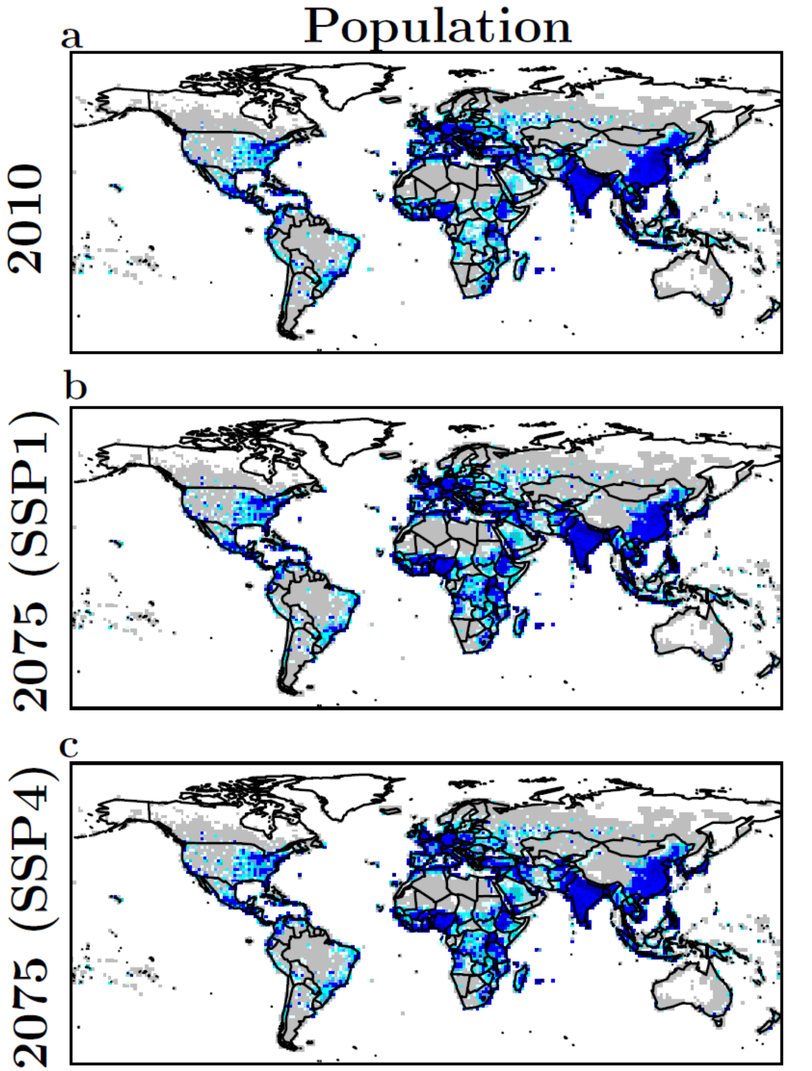
Heatwave Risk using the Illustrative Risk Index (IRI)

$$\mathrm{IRI} = (\mathrm{HW}_{\mathrm{hazard}} \times \mathrm{Population}_{\mathrm{exposure}} \times (1 - \mathrm{HDI})_{\mathrm{vulnerability}}) \times 100$$

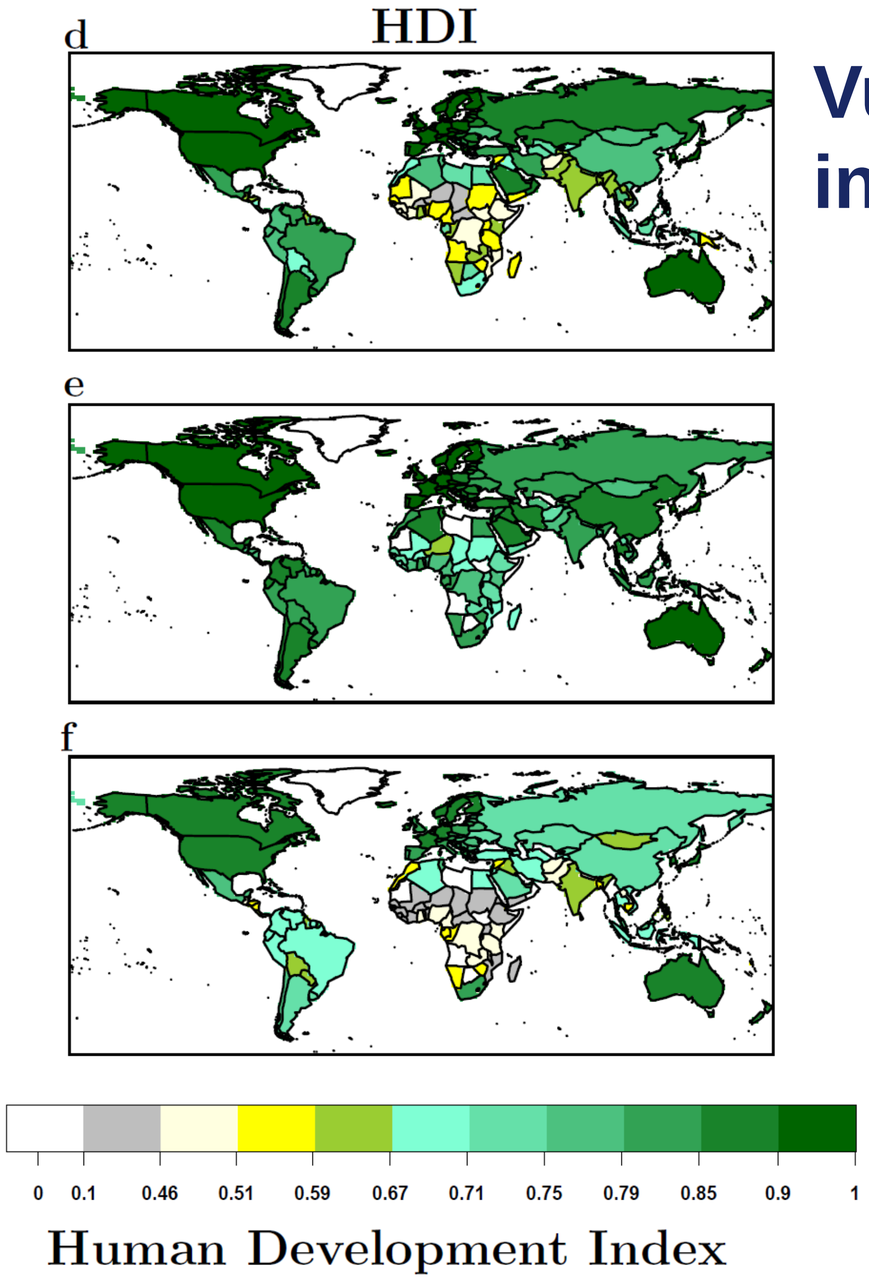


SSP = Shared Socioeconomic Pathways

Exposure index



Vulnerability index



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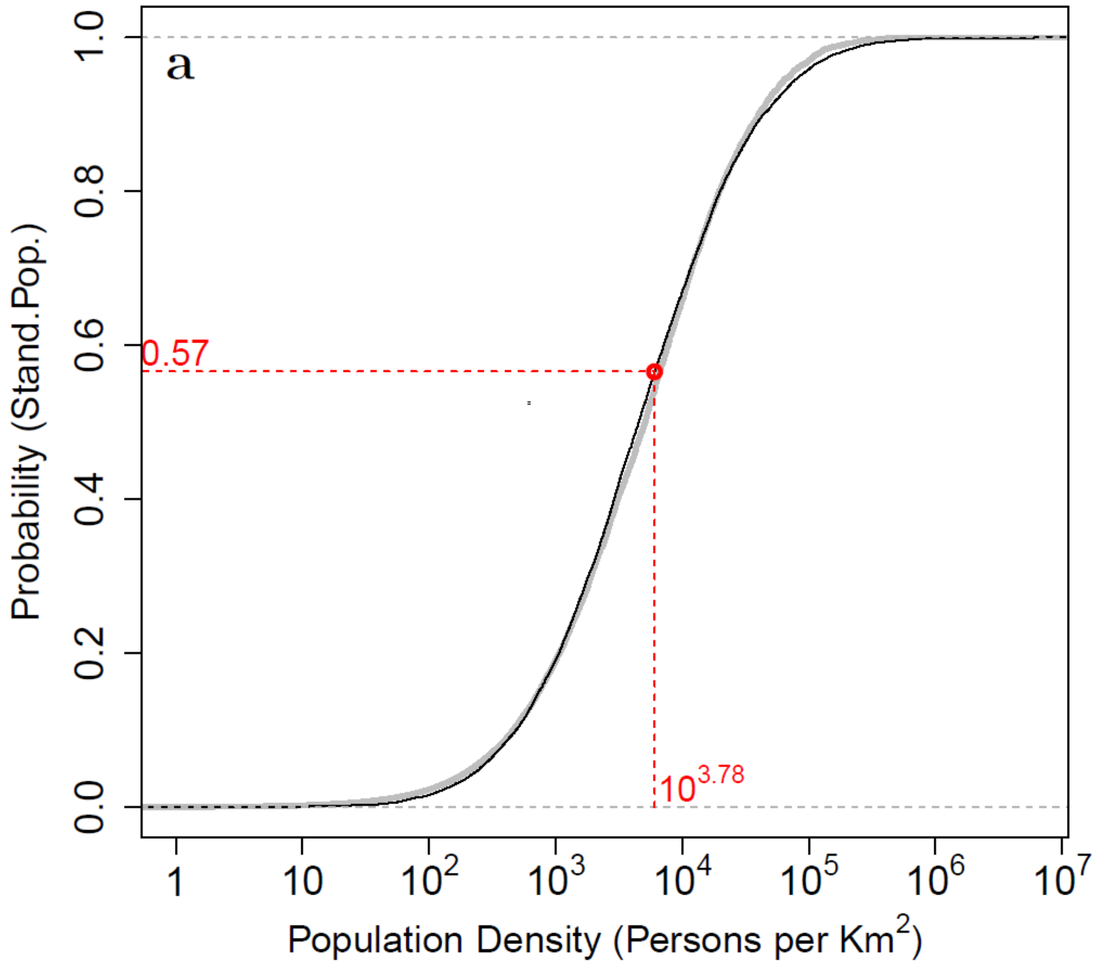
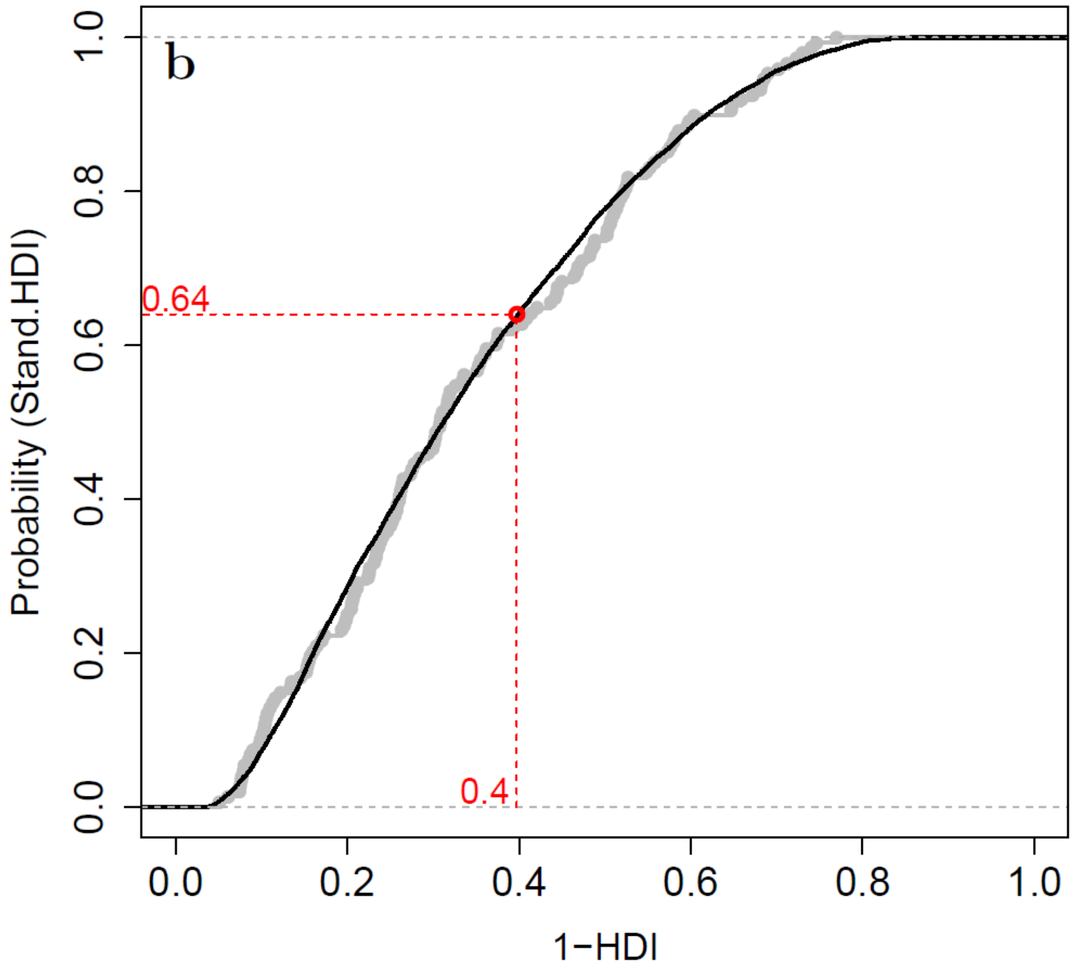
Russo, Sillmann et al. 2019, Nature Comms

Normalization of population density and Human Development Index





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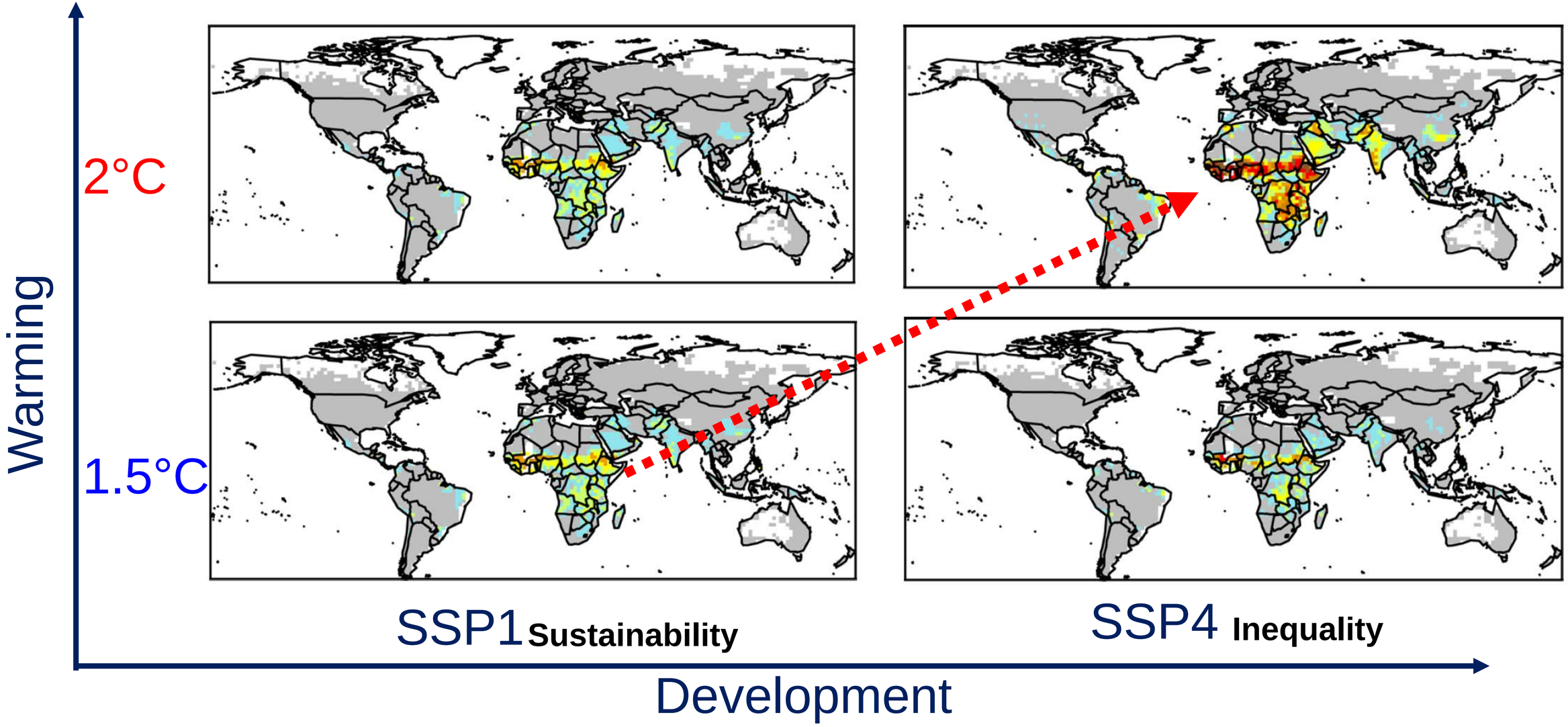
Russo, Sillmann et al. 2019, Nature Comms

Heatwave Risk using the Illustrative Risk Index (IRI)



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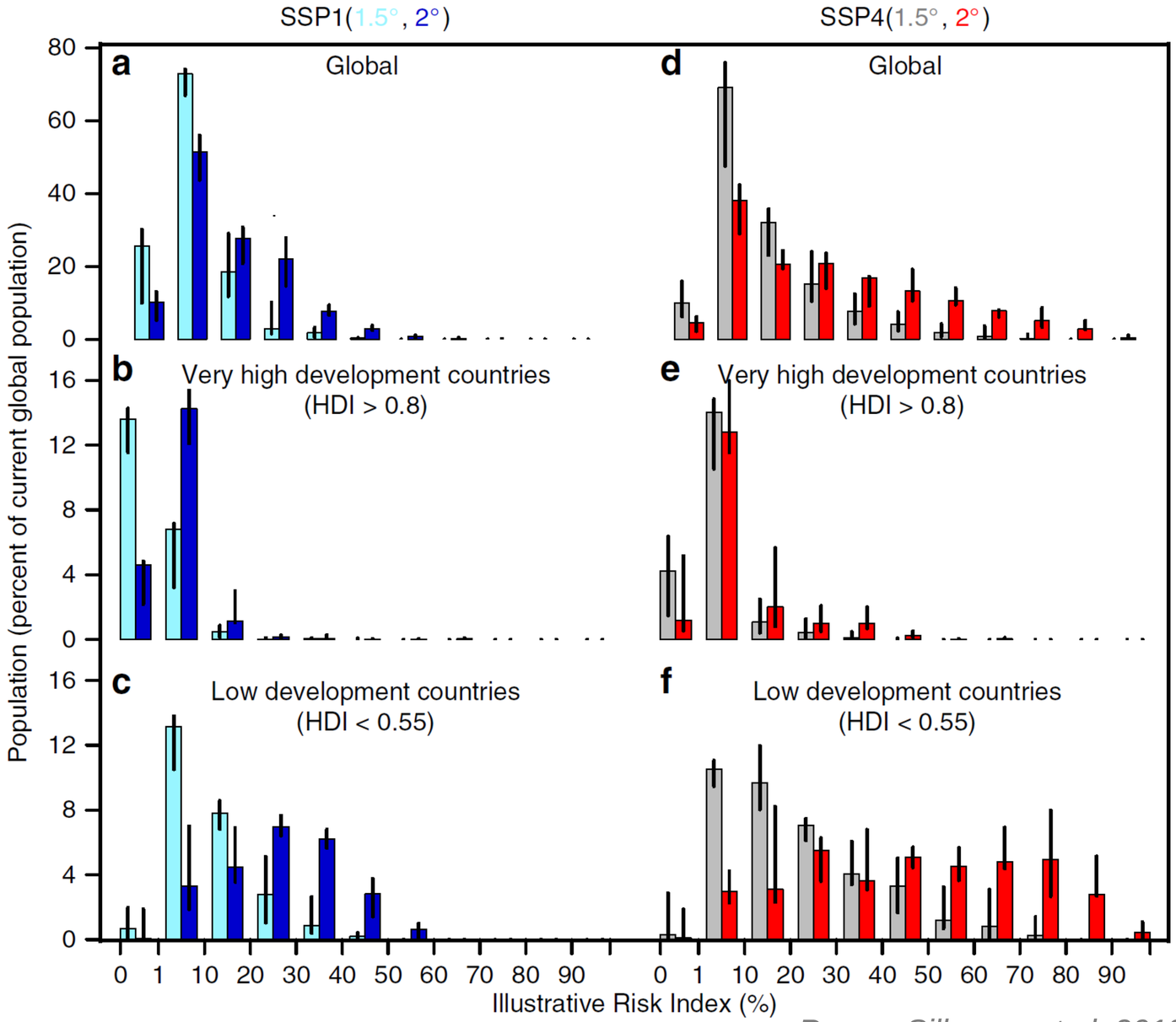
Russo, Sillmann et al. 2019, Nature Comms

Heatwave Risk



Russo, Sillmann et al. 2019, Nature Comms

Summary and Implications

- Keeping global mean temperature below 1.5 °C warming reduces heatwave exposure, particularly in tropical and subtropical regions
- Socio-economic development reduces risks of heatwaves, with greatest effect in low developed countries
- Climate and sustainable development goals have to be seen in conjunction
- Presented approach is for estimating relative risk on global scale, but given caveats put limits on this approach for use in local/regional decision making

Follow more research in our current project:

Exposure to heat and air pollution in EUrope – cardio-pulmonary impacts and benefits of mitigation and adap-tation (EXHAUSTION)

https://www.exhaustion.eu/

European Commission

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