# Extreme events under climate change

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# Extreme events under climate change

We investigated model output from the ISIMIP project and examined how global warming affects the Earth's land surface and population with respect to extreme events. In this exercise 6 extreme event categories were considered.

1. run impact models under the umbrella of the ISIMIP project
2. define the 6 extreme event categories
3. analyze model output driven by a preindustrial climate
4. analyze model output driven by a climate experiencing global warming
5. relate

# ISIMIP

## The Inter-Sectoral Impact Model Intercomparison Project


*"ISIMIP offers a framework for consistently projecting the impacts of climate change across affected sectors and spatial scales. An international network of climate-impact modelers contribute to a comprehensive and consistent picture of the world under different climate-change scenarios."*

`https://www.isimip.org`

# ISIMIP

The Inter-Sectoral Impact Model Intercomparison Project

collects cross-sectorally consistent climate-impacts simulations by providing

- common climate scenarios (daily, gridded data)
- common data sets describing socio-economic conditions (population, GDP, land use etc.)

strives to disseminate data and knowledge widely with low barriers to access.

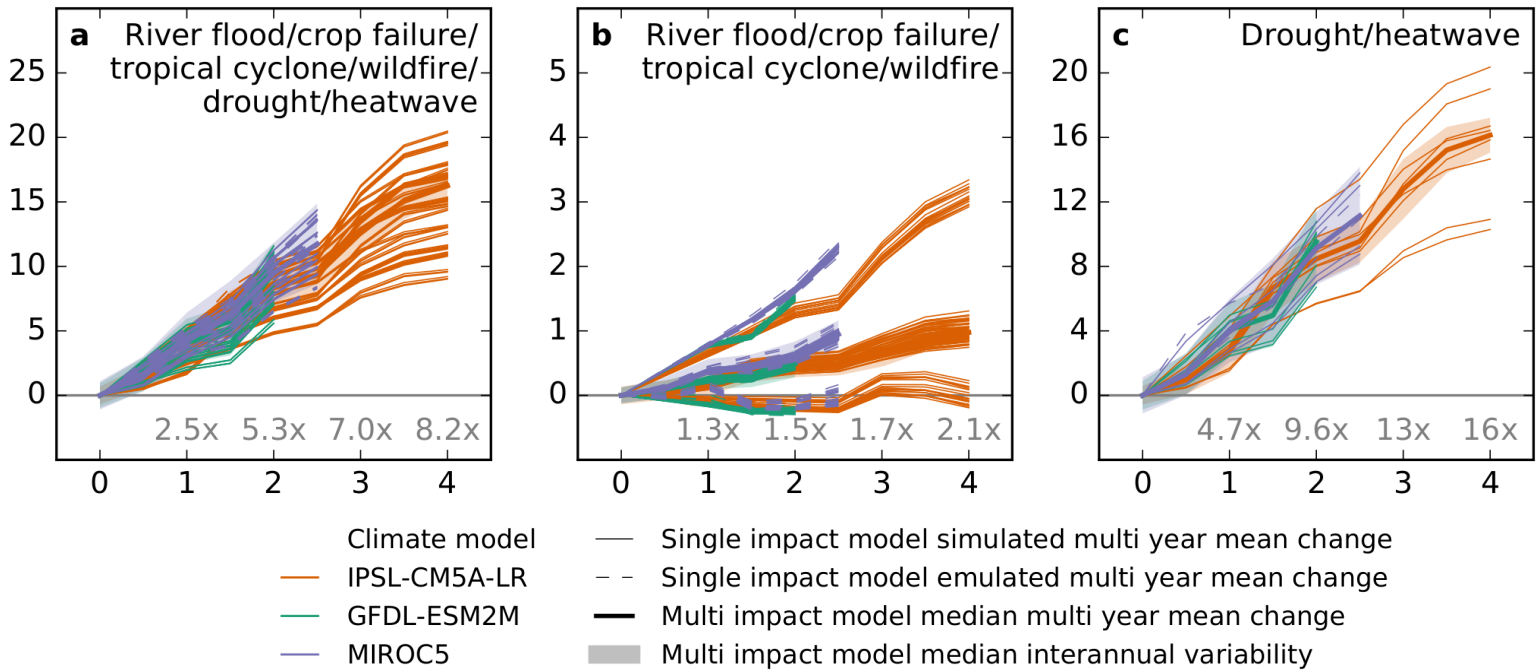
- all results receive a DOI and are eventually publicly available
  `https://esg.pik-potsdam.de`
- (almost) all ISIMIP data products are included: gridded, harmonized impacts simulations, climate data and socio-economic data

# Define extreme events

| | |
|---|---|
| crop failure | Fraction of grid cell where one of the considered crops (maize, wheat, soy or rice) is grown and the corresponding crop yield falls short of the 2.5th percentile of the preindustrial reference distribution; crop-specific land area fractions affected are added up |
| river floods | Daily discharge ($0.5° \times 0.5°$ resolution) exceeds the preindustrial 100-year return level; to derive the associated land area affected per grid cell, simulated runoff is translated into inundation areas ($2.5' \times 2.5'$ resolution) by CaMaFlood |
| wildfires | Annual aggregate of monthly burned land area simulated by global vegetation models |
| tropical cyclones | Fraction of grid cell exposed to 1-minute sustained hurricane-force winds ($\geq$64 kt) at least once a year ($0.1° \times 0.1°$ resolution); information required about wind fields is derived from center location and minimum pressure/maximum wind speed |
| droughts | Entire grid cell if monthly soil moisture falls short of the 2.5th percentile of the preindustrial reference distribution for at least 7 consecutive months |
| heatwaves | Entire grid cell if both, a relative indicator based on temperature and an absolute indicator based on temperature and relaitive humidity exceed their respective threshold value |

*These are the definitions for the affected land area.*

# Change in annual global land area affected by extremes




x-axis: global warming [°C]

y-axis: absolute change of land surface affected by extreme events [%]

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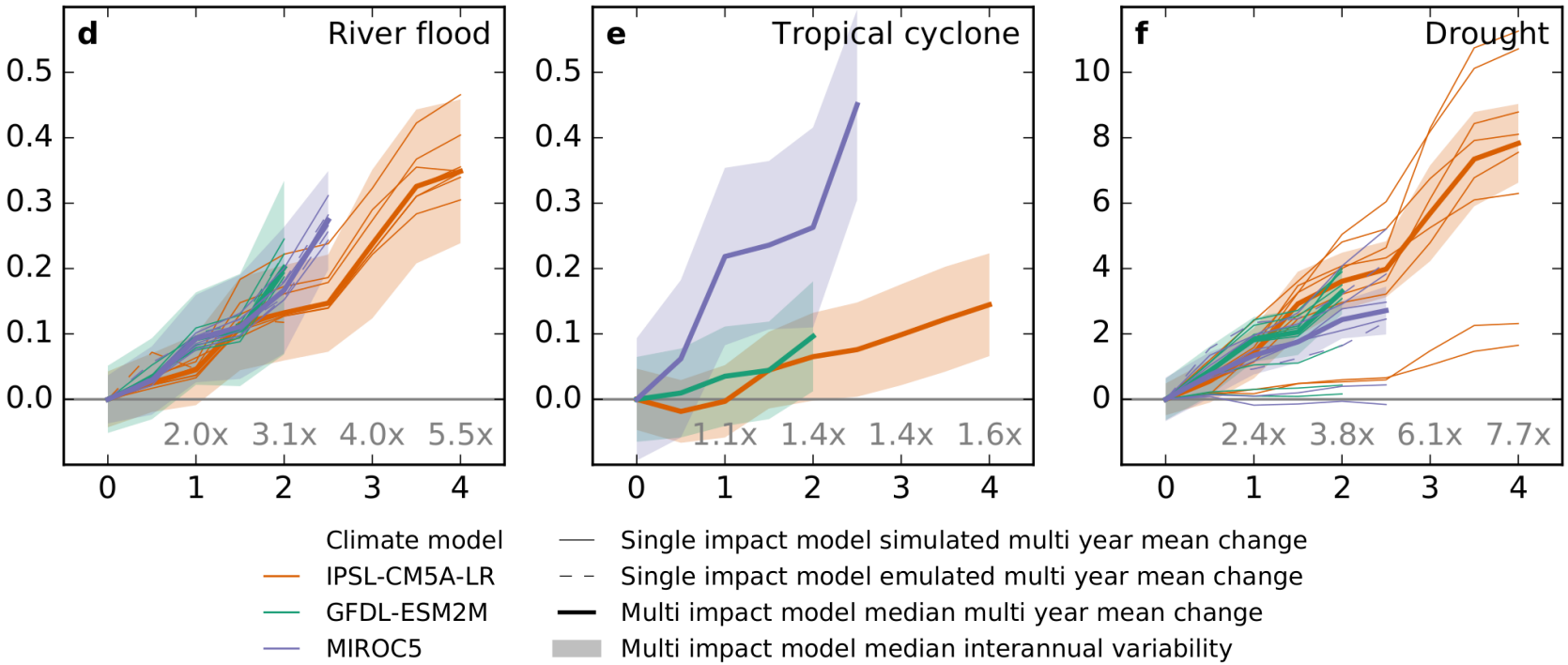


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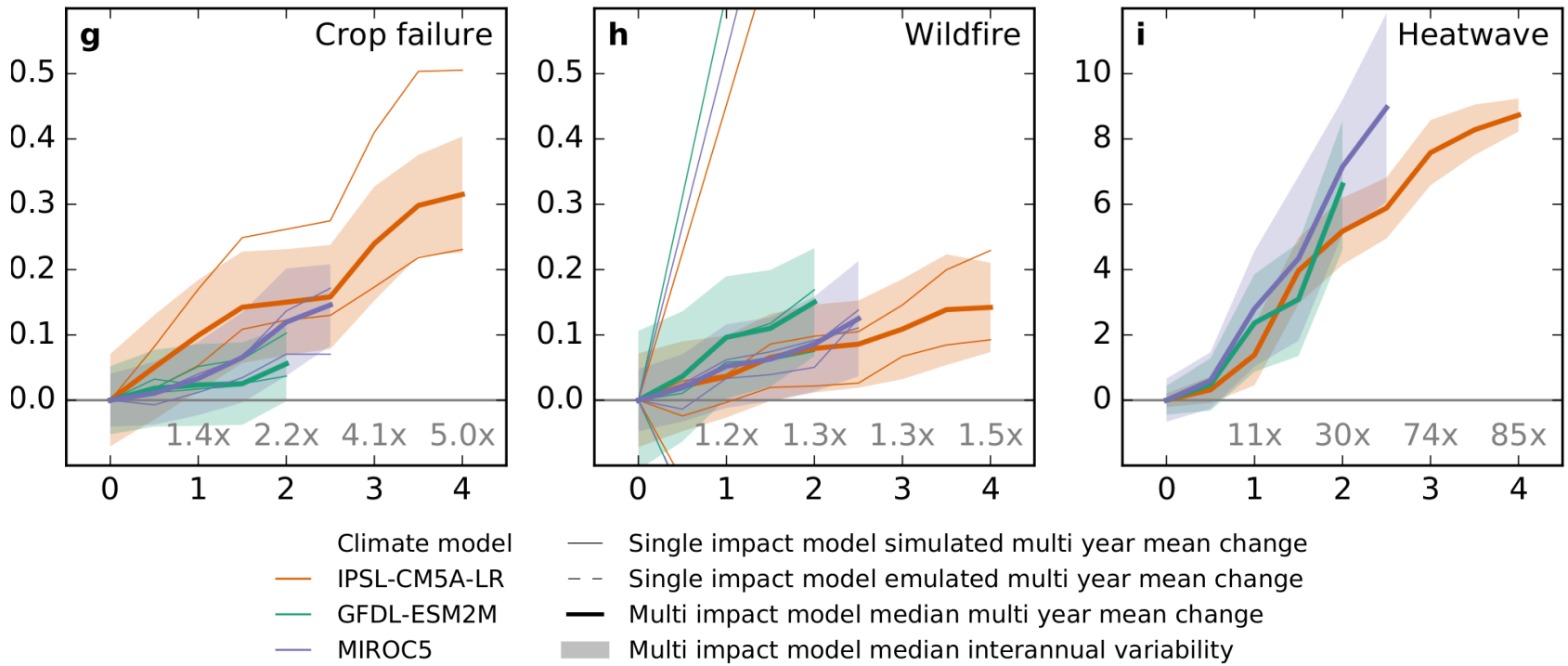


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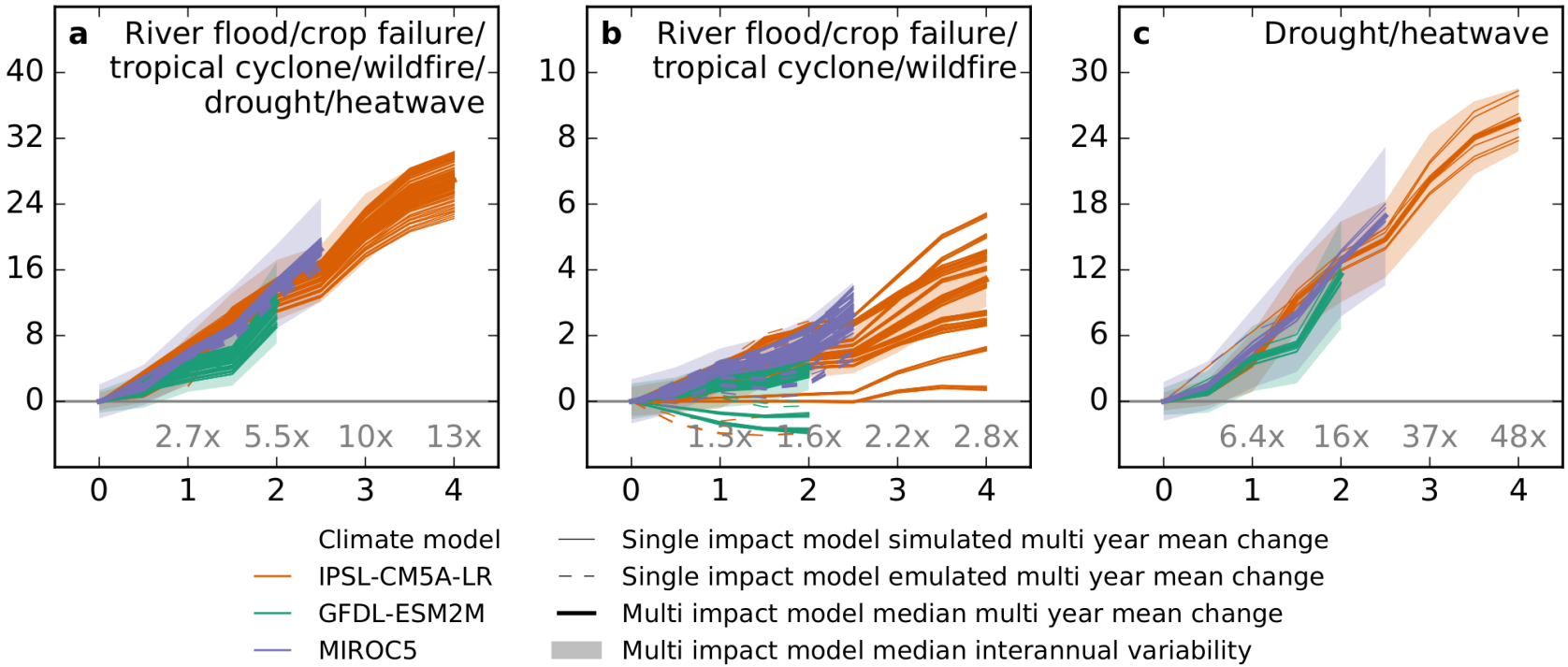
# Change in global population exposed to extreme events




x-axis: global warming [°C]

y-axis: absolute change of global population fraction annually exposed to extreme events [%]

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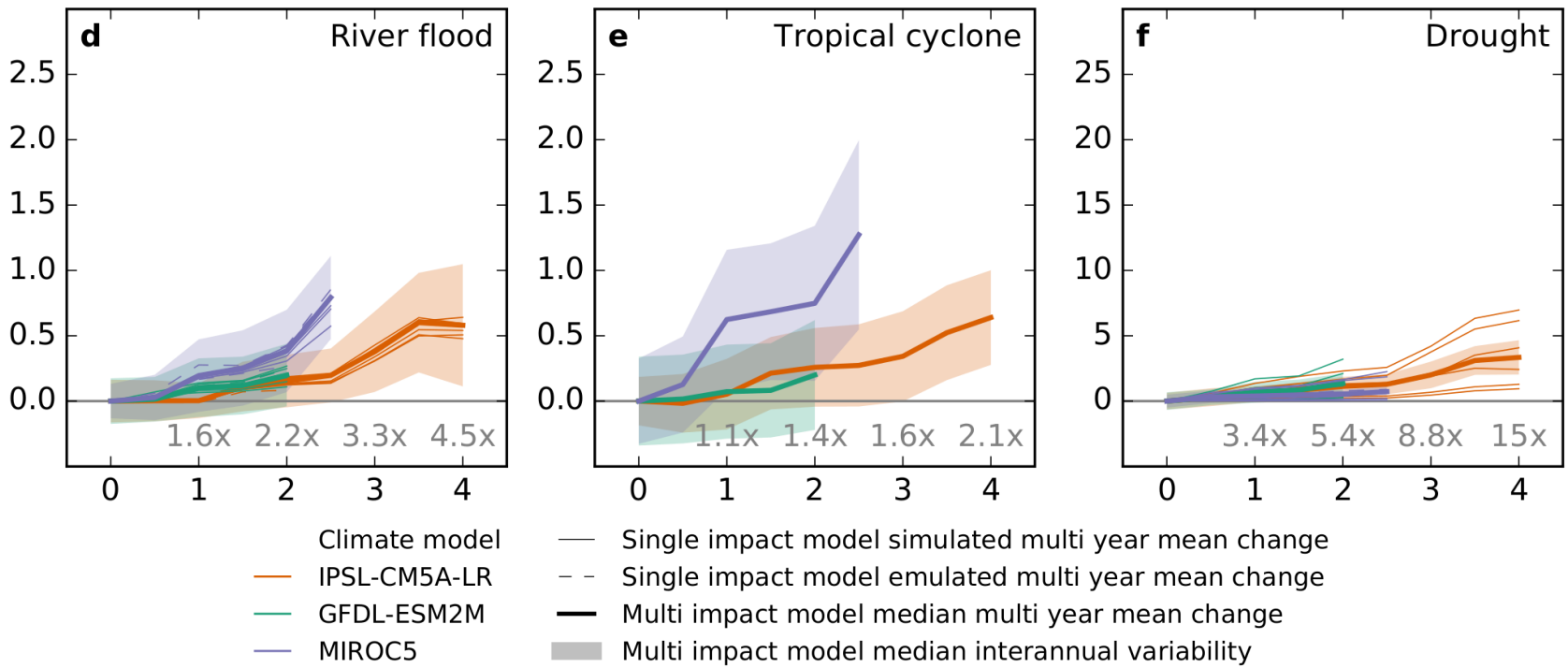


x-axis: global warming [°C]

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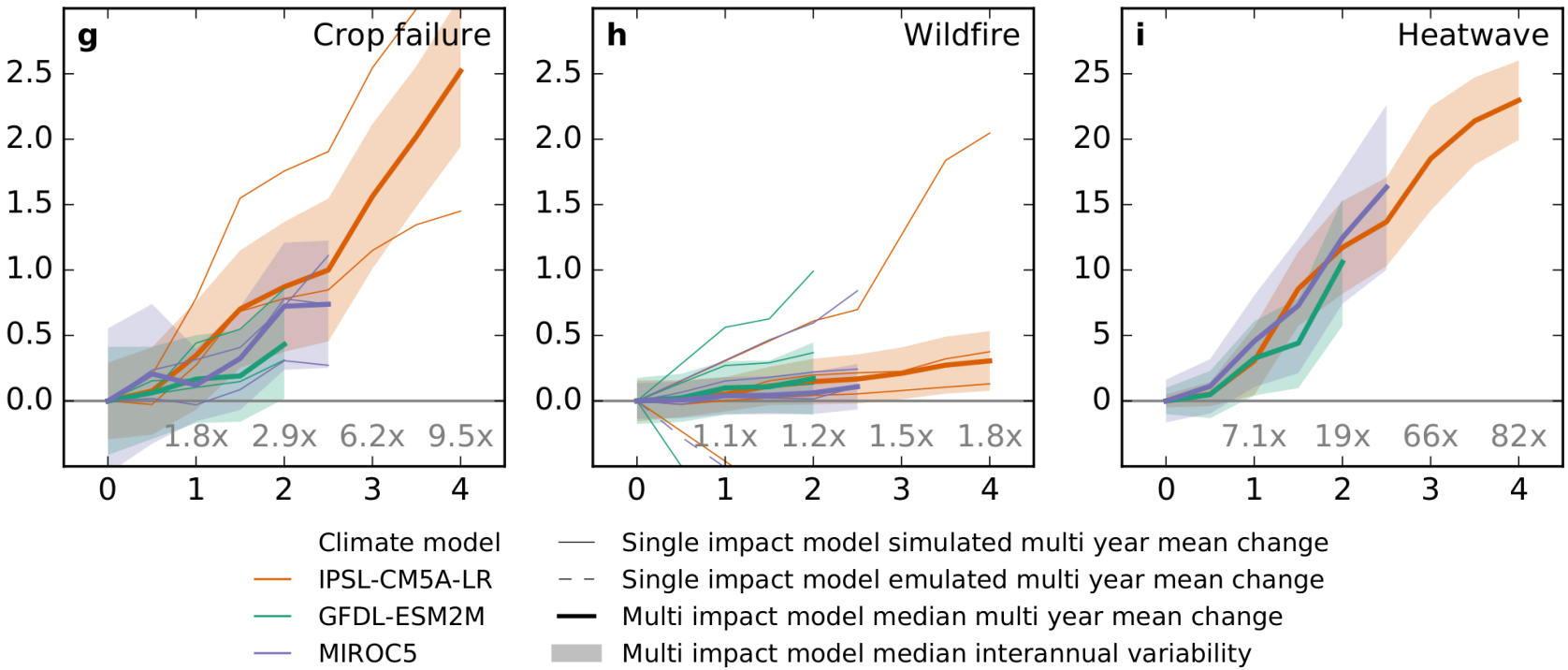


x-axis: global warming [°C]

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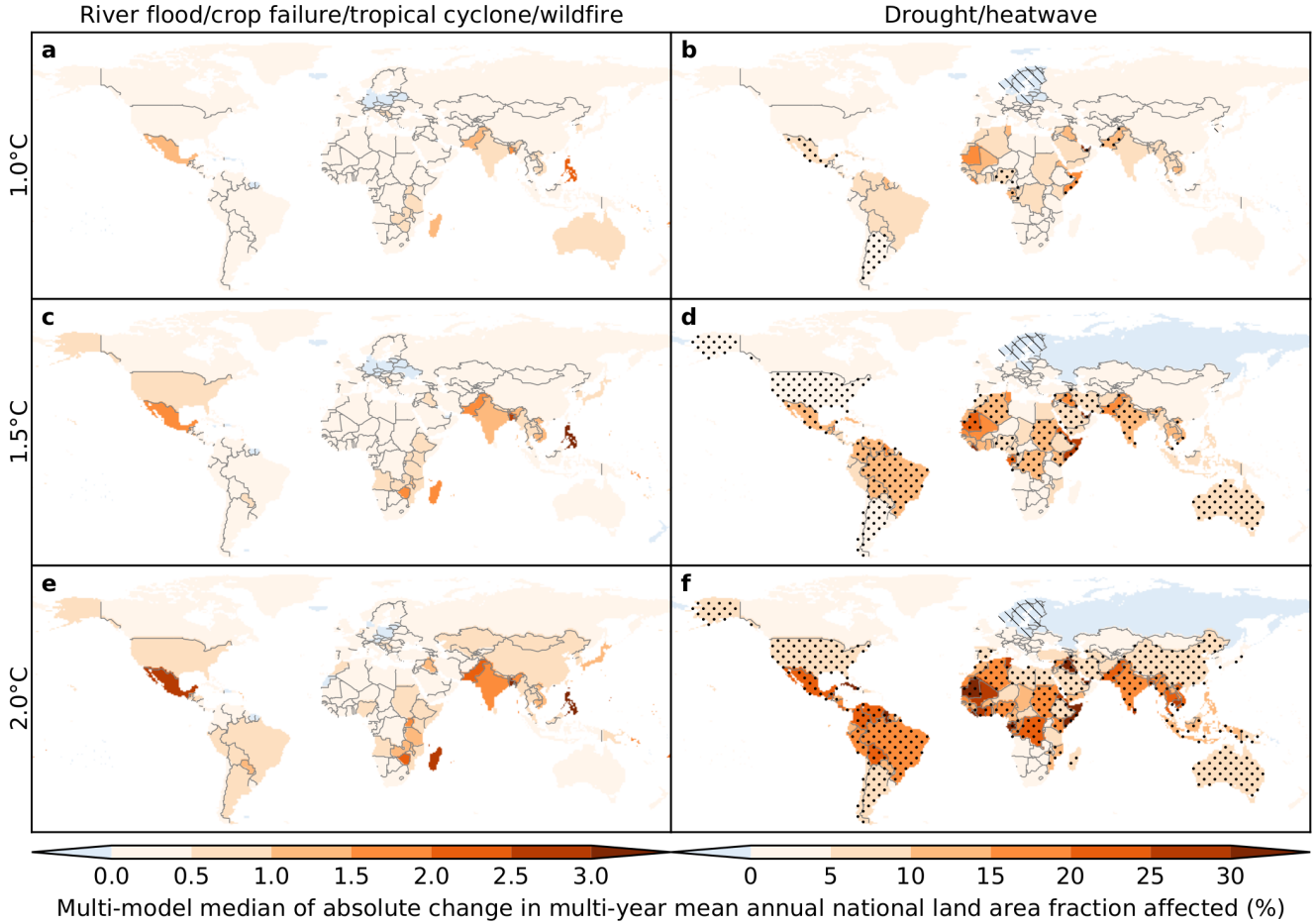


**stippling:** at least 80% of all model combinations agree on an increase or decrease that is larger than 2 standard deviations of the preindustrial interannual variability **hatching:** least 80% of all model combinations agree that the change is smaller than 1 standard deviation of the preindustrial interannual variability

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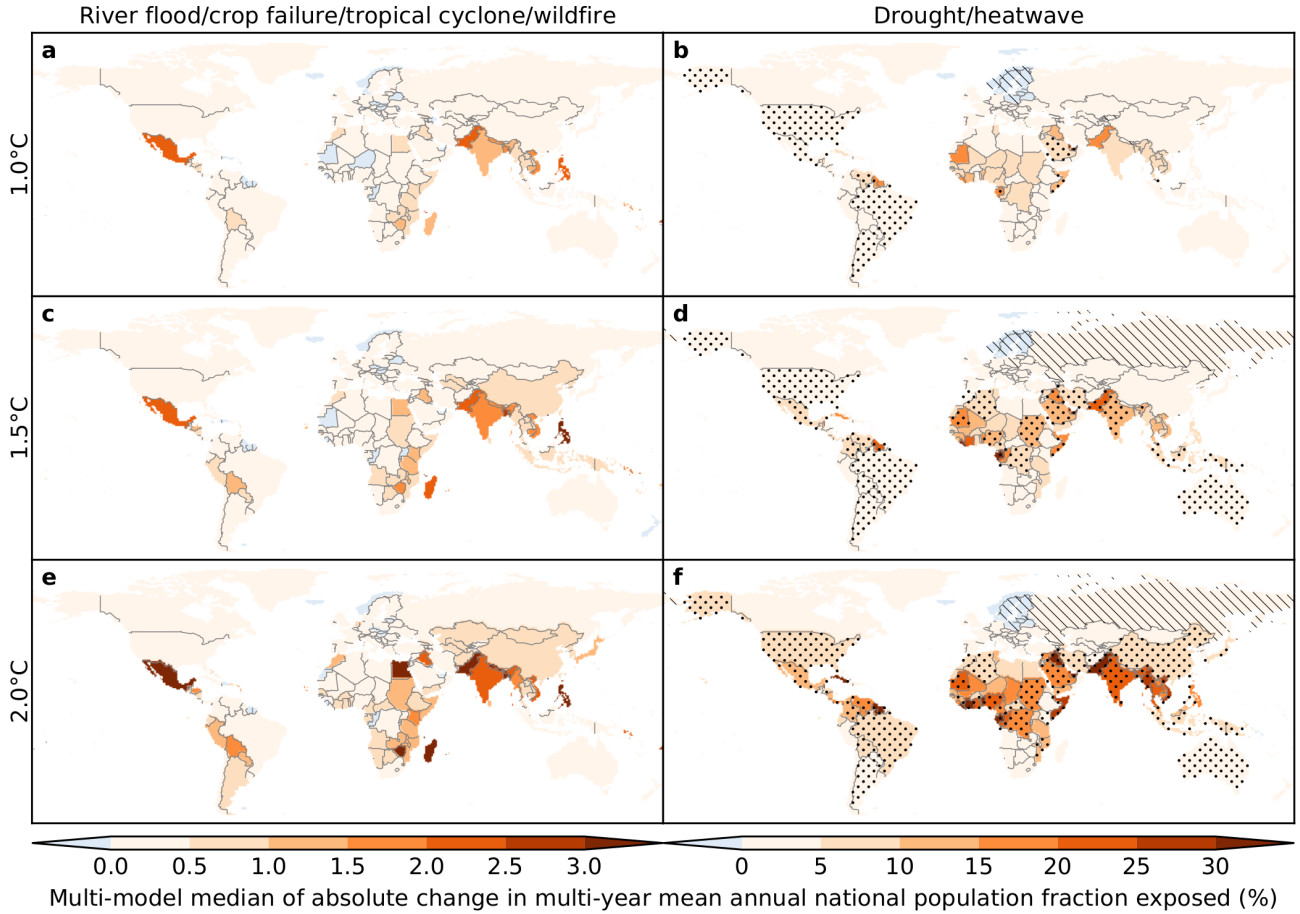


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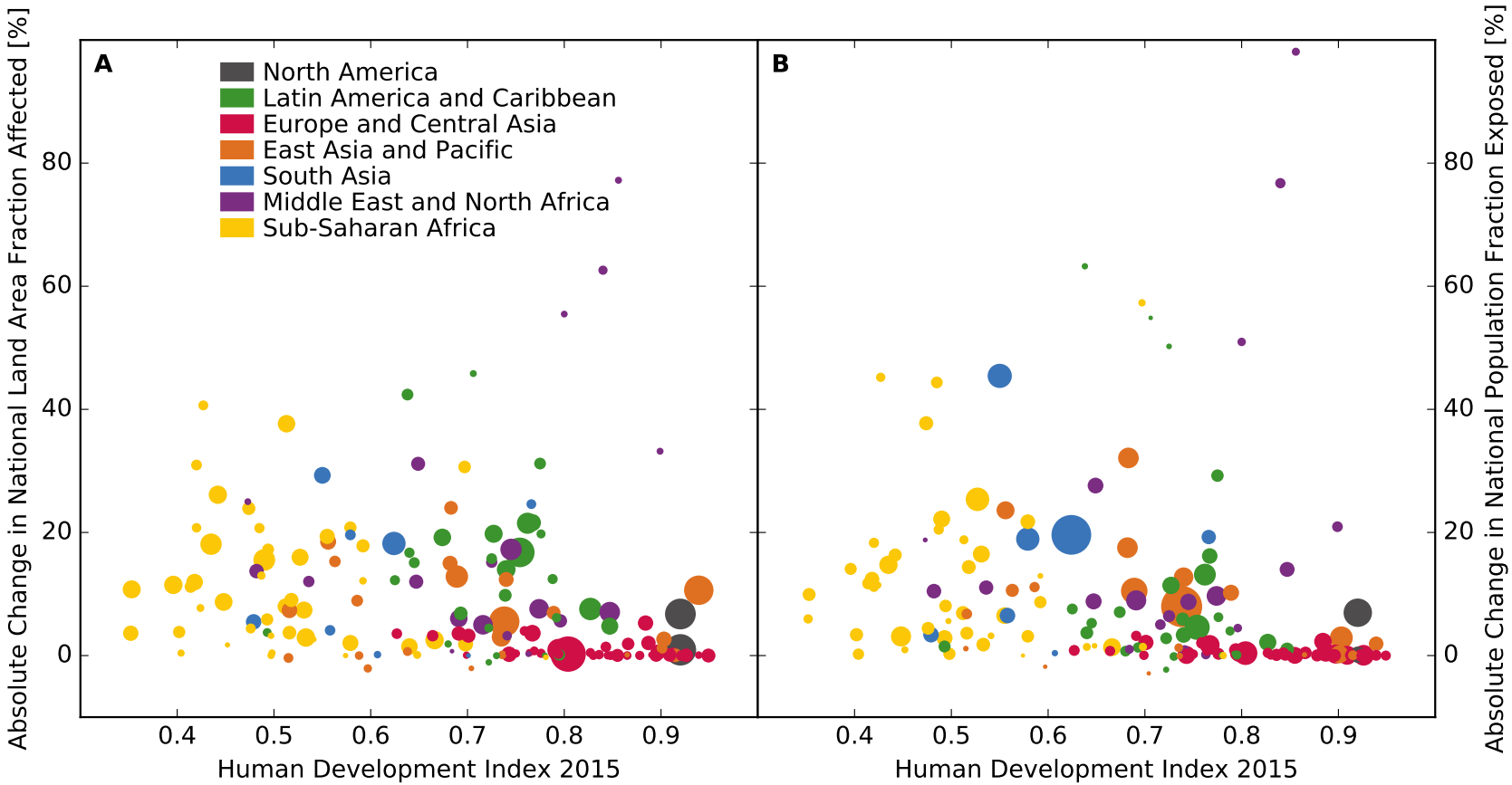
# Extreme events vs. HDI at 2 °C global warming on the country level




the dot size corresponds to the countries' land surface size (left pane) resp. population size (right pane)