Impacts of 1.5°C warming

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IPCC Scoping Meeting

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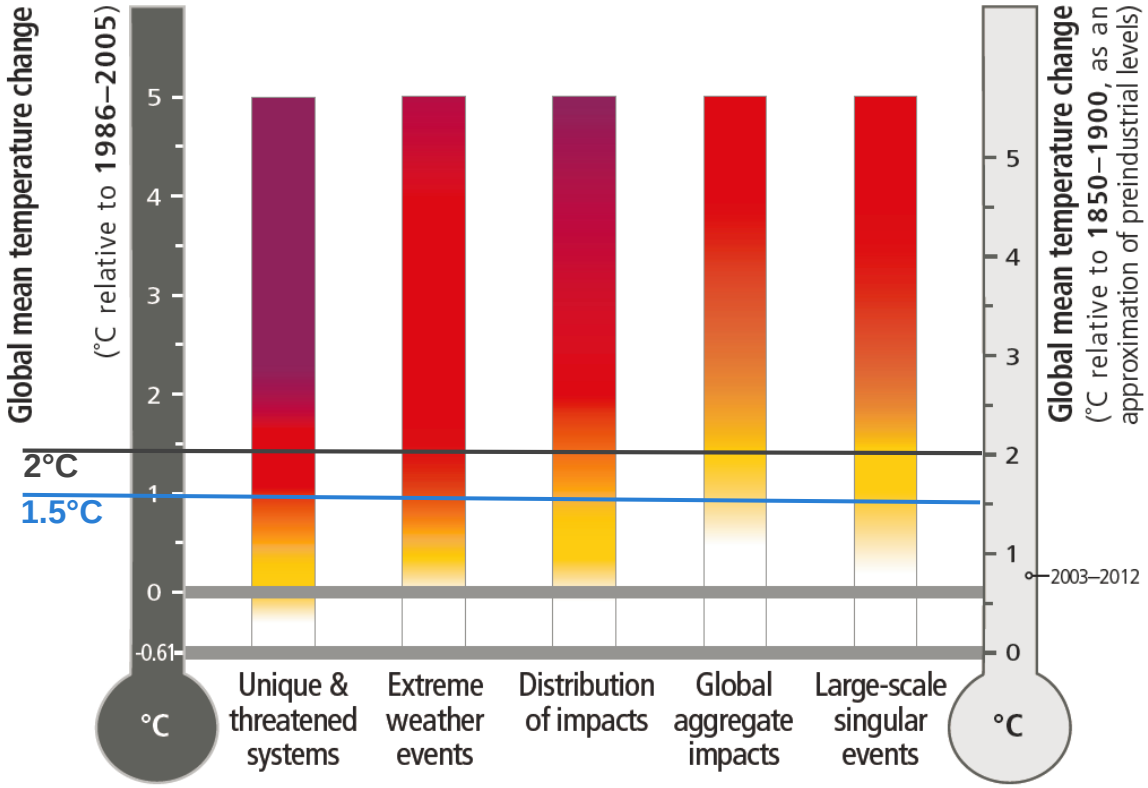
1.5°C in the IPCC AR5 and the UNFCCC Structured Expert Dialogue (SED)

- Impacts at 1.5°C have been assessed in a structured expert dialogue that was established as part of the 2013-2015 Review of the adequacy of the long-term global goal

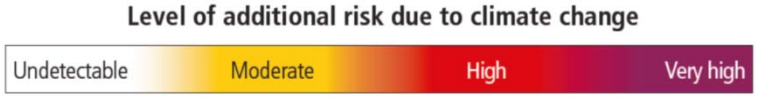
Key Outcomes:

- *"Limiting global warming to below 1.5°C would come with several advantages in terms of coming closer to a safer 'guardrail'.* ***It would avoid or reduce risks, for example, to food production or unique and threatened systems such as coral reefs or many parts of the cryosphere, including the risk of sea level rise."***
- *"The* ***science on the 1.5 °C warming limit is less robust*** *than for the 2°C warming limit or warming beyond this limit."*

The Reasons for Concern in the AR5



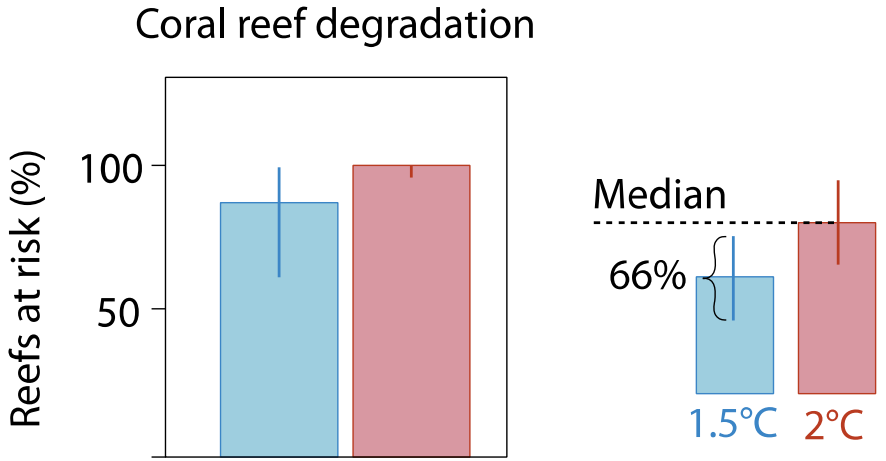
IPCC AR5 WG2 SPM



- Risks for all RFCs at least medium around 1.5°C warming
- Transition to moderate-high or high risks around or just above1.5°C
- Post-AR5 literature has assessed impacts at 1.5°C in greater detail with a particular focus on avoided impacts compared to 2°C

RFC 1 - Unique & threatened systems

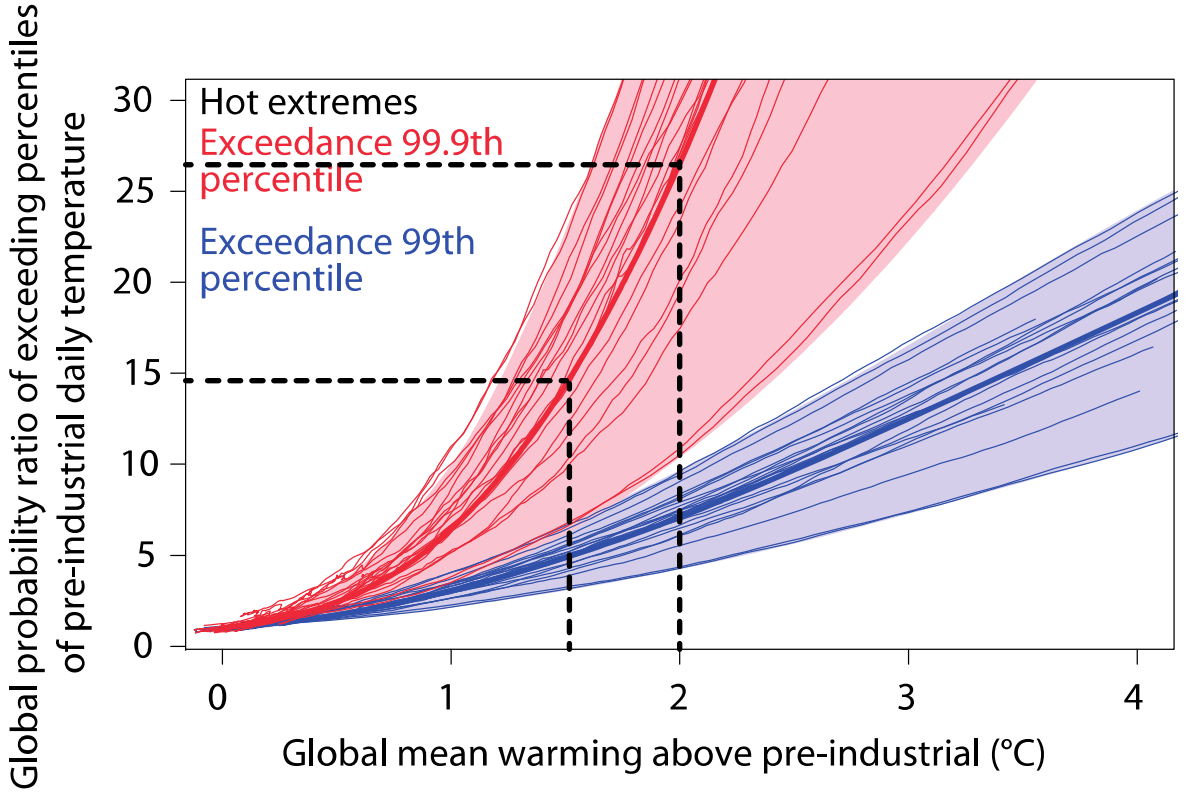
- Systems such as Arctic sea-ice and tropical coral reefs that are already substantially impacted at current levels of warming
- Loss or fundamental changes to these systems will have profound consequences for ecosystem services and livelihoods depending on them
- The vast majority of tropical coral reefs will be at risk at1.5°C, but some window for ecosystem adaptation may still exist



Schleussner et al. (2016) based on Frieler et al. (2012)

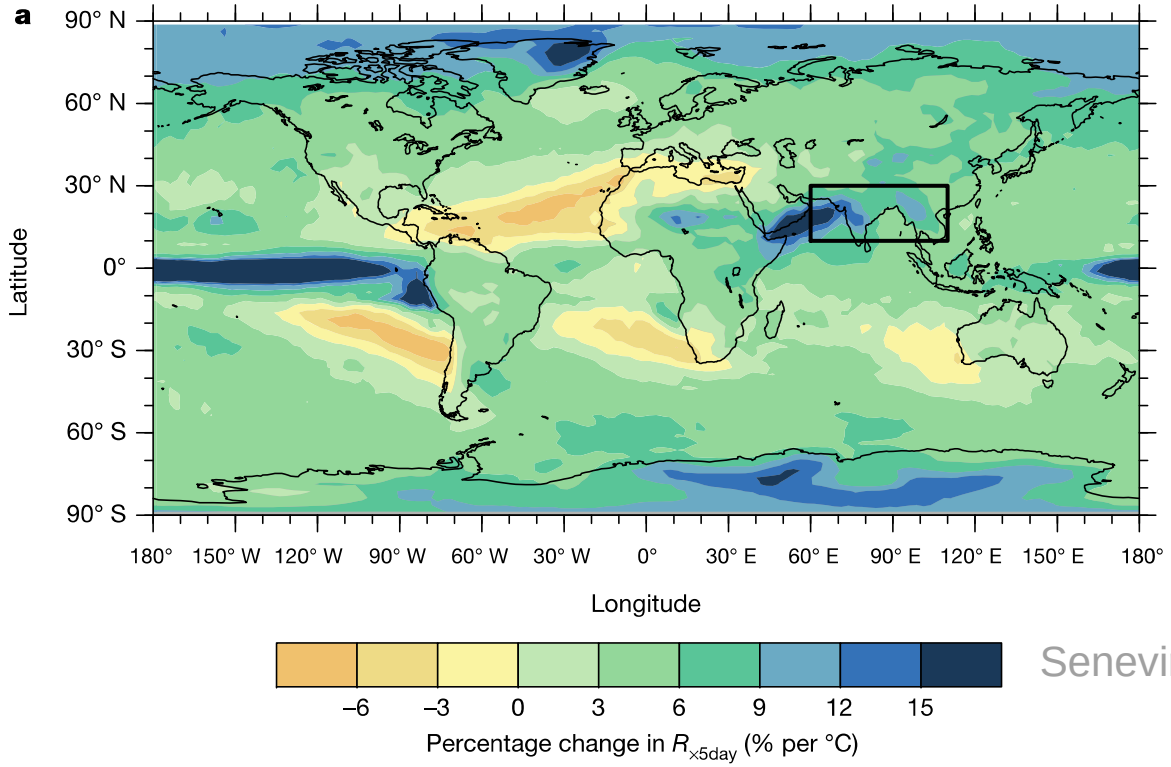
RFC 2 - Extreme Weather Events: Hot Extremes

- Threshold exceeding hot extremes will increase substantially between 1.5°C and 2°C
- Relative to natural variability, increases are particularly pronounced in tropical regions where unusual heat waves would become the new normal at 2°C (Russo et al. 2016)



Adapted from Fischer & Knutti (2015)

RFC 2 - Extreme Weather Events: Extreme Precipitation



Seneviratne et al. (2016)

- Changes in precipitation related extremes differ substantially on the regional level

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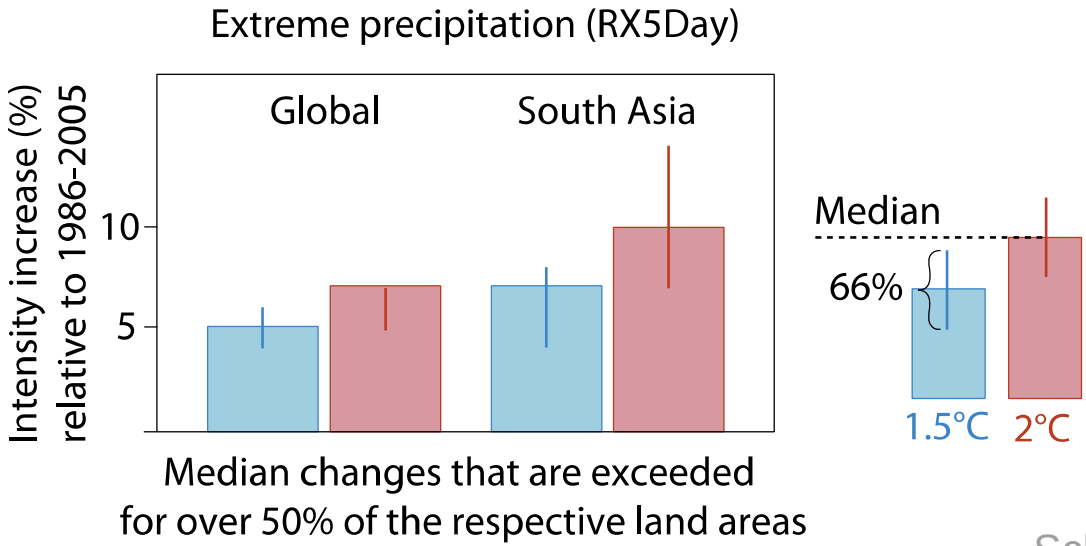
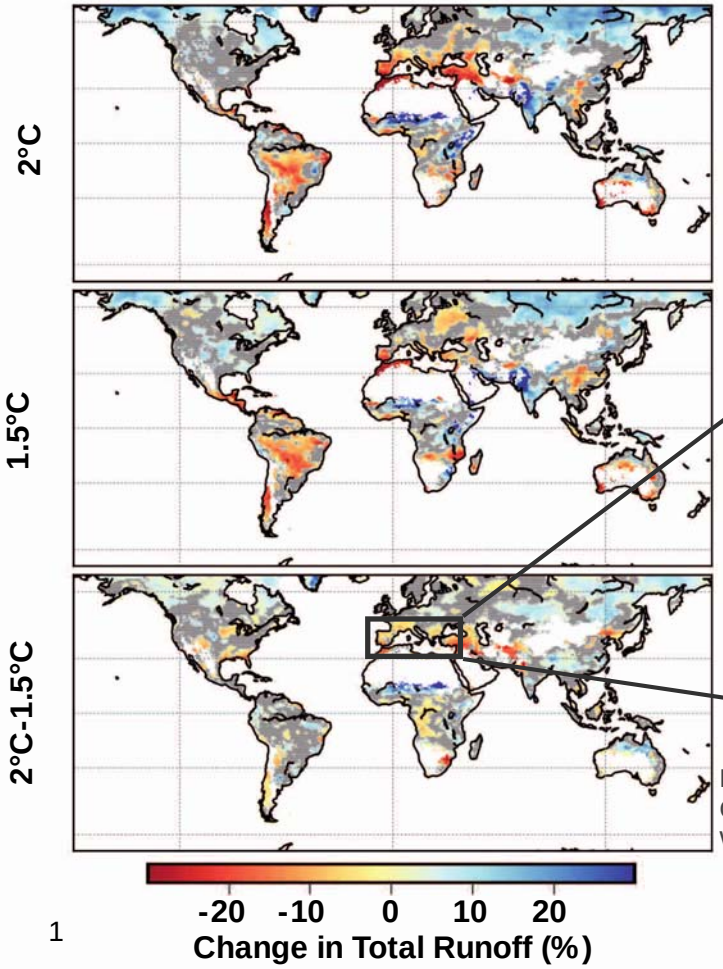


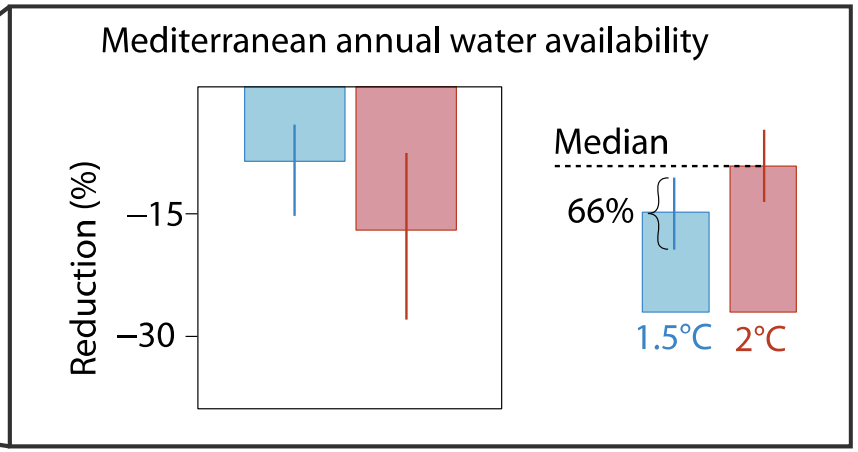
Schleussner et al. (2016)

- Changes in precipitation related extremes differ substantially on the regional level

RFC 3 - Distribution of impacts: Water availability



- Changes in water availability at 1.5°C assessed based on the ISIMIP modelling intercomparison framework
- Mediterranean 'hot-spot' of change

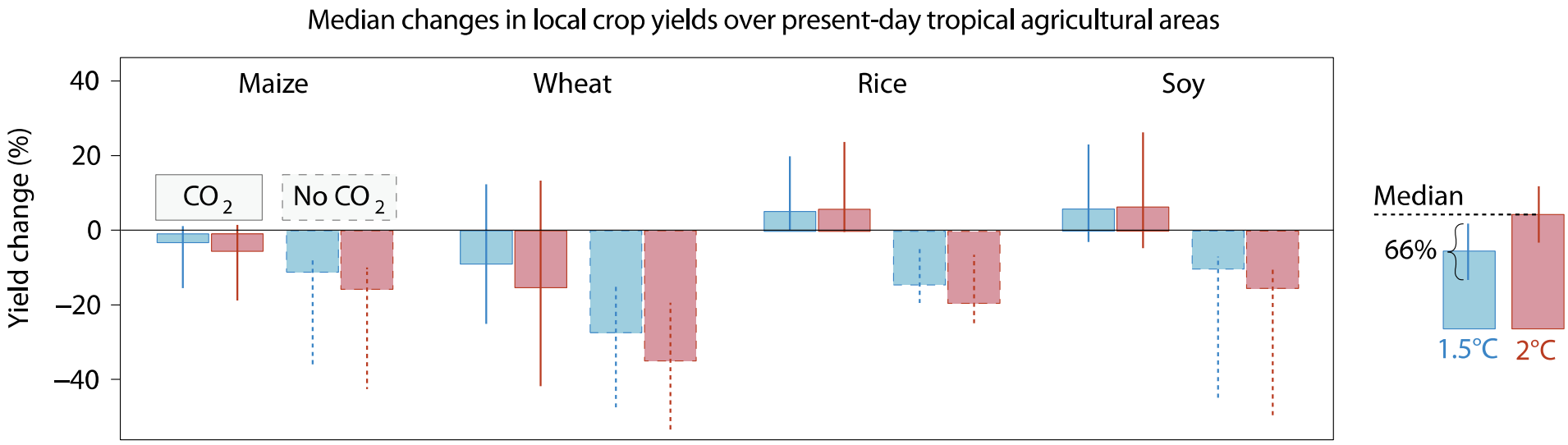


Relative changes in total runoff relative to 1986-2005
Grey: less than 66 % of all ISIMIP GCM-GHM pairs agree with the median sign of change
White: annual mean runoff of less than 0.05 mm/day

Schleussner et al. (2016 a,b)

Carl-Friedrich Schleussner, 15 August 2016

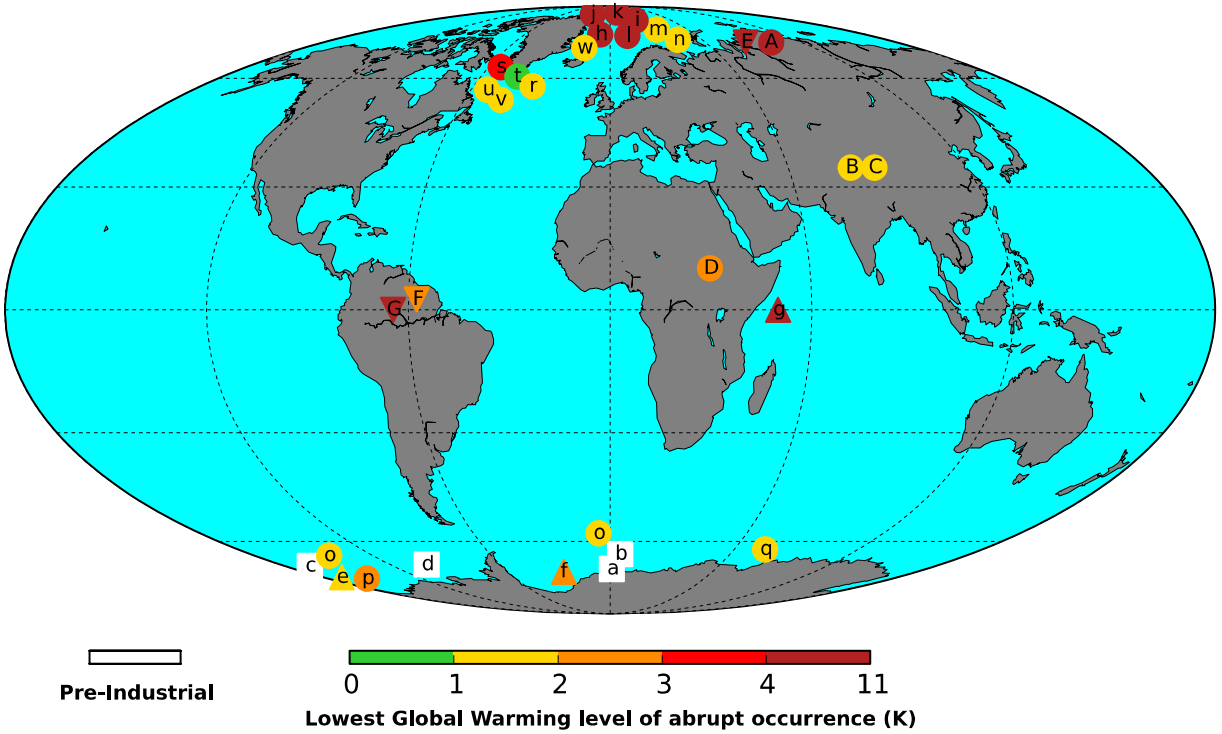
RFC 3 - Distribution of impacts: Local crop yields



- Median changes that are exceeded for over 50% of the tropical agricultural land areas based on ISIMIP projections relative to 1986-2005
- Projections excluding effects for CO_2 fertilization are singled out for intercomparison

Schleussner et al. (2016)

RFC 5 - Singular events: Abrupt shifts in CMIP5 models



- 37 abrupt shifts in climate system identified in CMIP5 models for a warming exceeding 10°C
- Including biome changes, permafrost loss, ocean circulation changes, sea-ice snow and glacier loss

Drijfhout et al. (2015)

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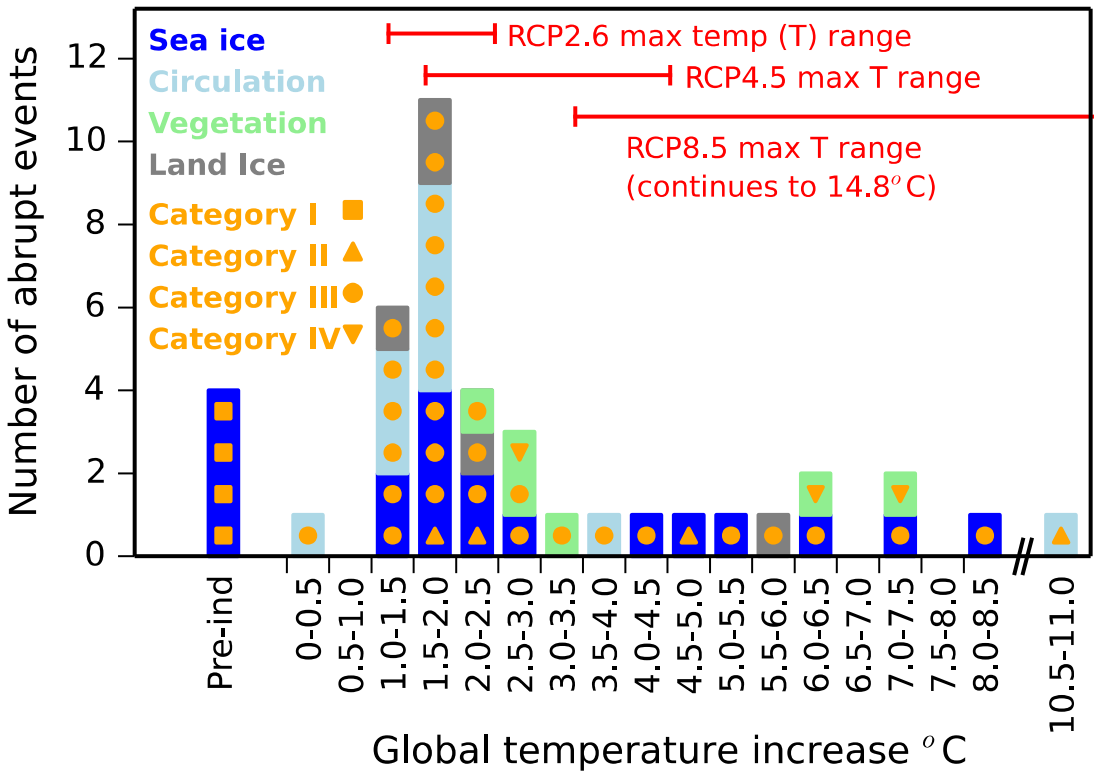
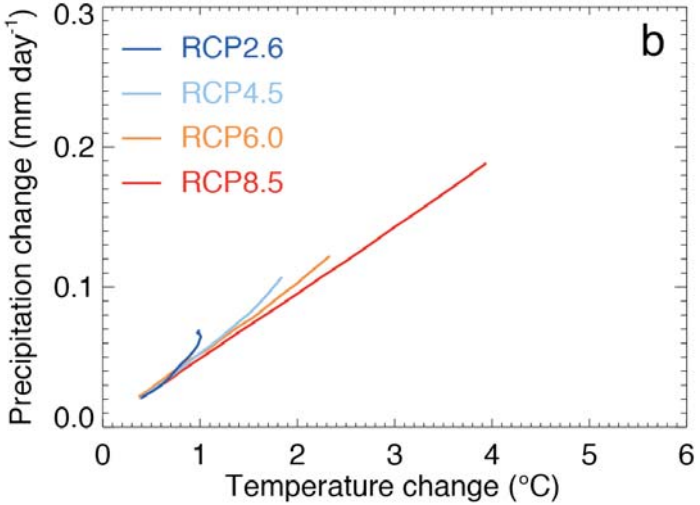


- 37 abrupt shifts in climate system identified in CMIP5 models for a warming exceeding 10°C
- Including biome changes, permafrost loss, ocean circulation changes, sea-ice snow and glacier loss
- **20% of thresholds of abrupt shifts crossed for 1.5°C compared to 50% at 2°C**

Drijfhout et al. (2015)

Limitations of available literature and research needs

- Most available studies on impacts at 1.5°C (and comparison with other warming levels) are based on transient analysis from RCPs (most often RCP8.5):
  - Limited statistics for extreme weather event analysis
  - Time-lagged and scenario dependent responses as well as changes in climate phenomena such as ENSO have not been assessed



IPCC AR5 WG1 Figure 12.6: Global mean precipitation (mm day^{-1}) versus temperature (°C) Changes relative to 1986–2005 baseline period

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  - Limited statistics for extreme weather event analysis
  - Time-lagged and scenario dependent responses as well as changes in climate phenomena such as ENSO have not been assessed
- Most available studies on 1.5°C impacts are based on global climate models, while regional differentiation calls for regional climate modelling approaches
- Reversibility of impacts and impact legacy of temperature overshoots above 1.5°C are not well understood

Thank you for your attention!

References

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