Impact of Changes in CO$_2$ Concentration on the Rate of Extreme Precipitation Events in the Planet Simulator

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Motivation

- Primary impacts of climate on society result from extreme events
- Context of global rise of CO_2 concentration: Does the number of **extreme precipitation events** increase?

- PlaSim simulations: PI-185/280/560ppm, LGM-185/280/560ppm
- Constant PI orbital parameters

Two dead and 24 missing after floods in France and Italy

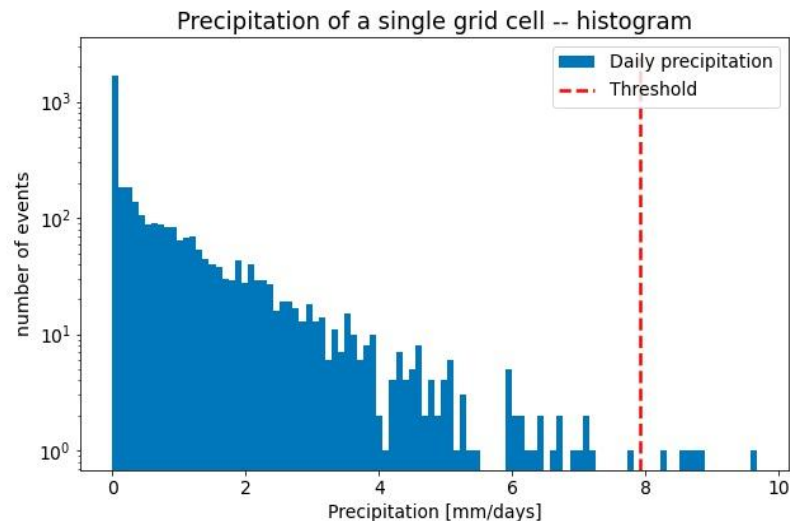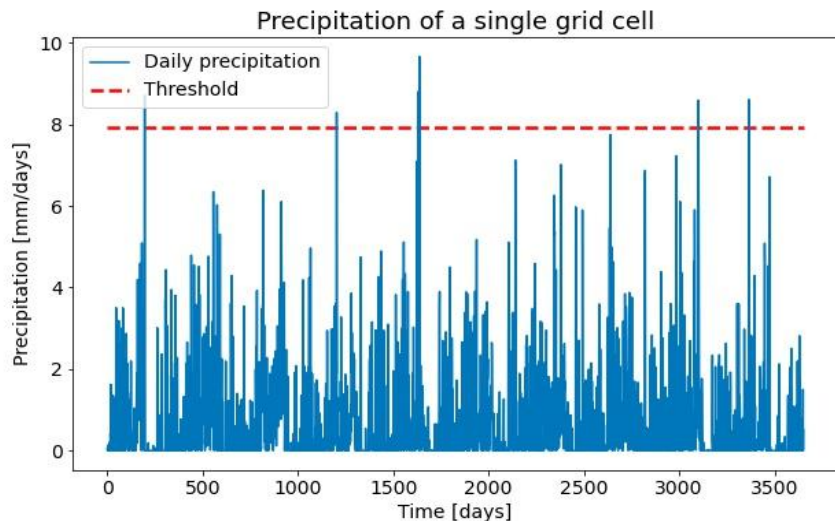**Record rain in mountainous region destroys bridges, blocks roads and cuts off communities**

▲ Damage after heavy rains in Cuneo, Italy. Photograph: Tino Romano/EPA

https://www.theguardian.com/world/2020/oct/03/floods-france-italy-record-rain
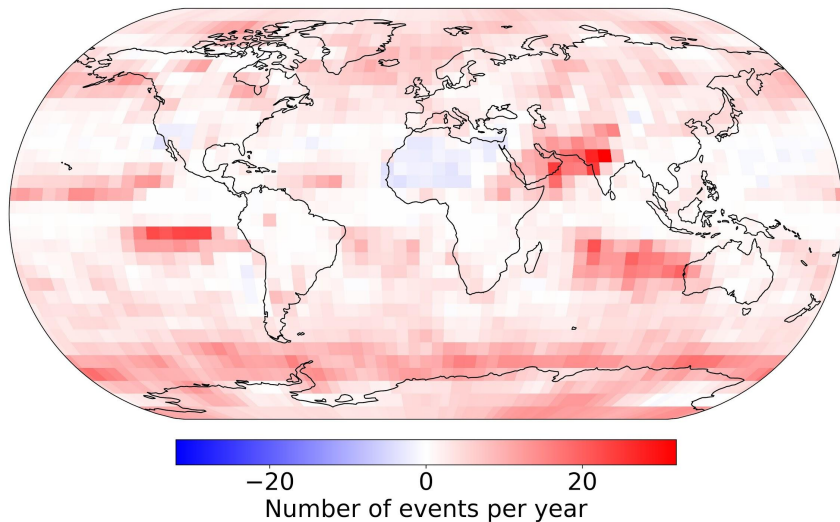
Methods

→ What do we consider an extreme precipitation event?

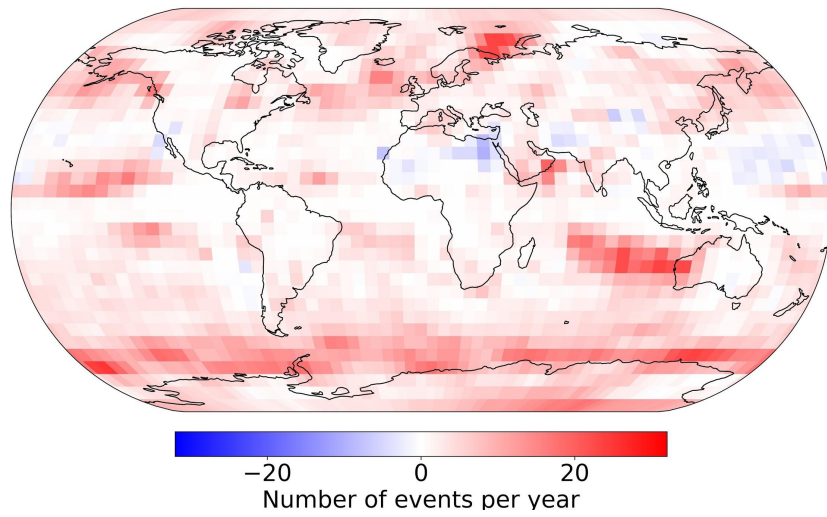**Threshold = Local mean + 5 * Std$_{PI,185}$**

Results

- Overall increase in extreme events with CO_2
- Local structure (slight decrease or stronger increase in some regions)
- PI-LGM differences where the LGM ice sheet is located in Northern Europe, but also elsewhere
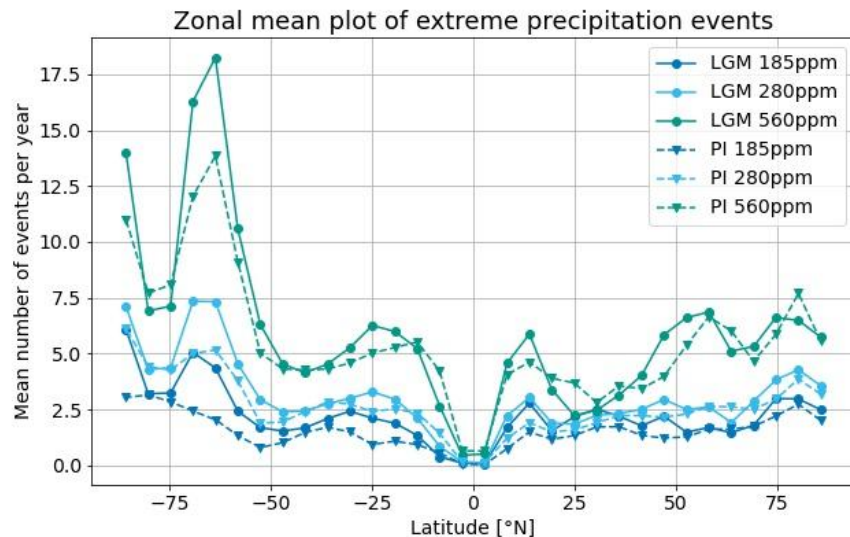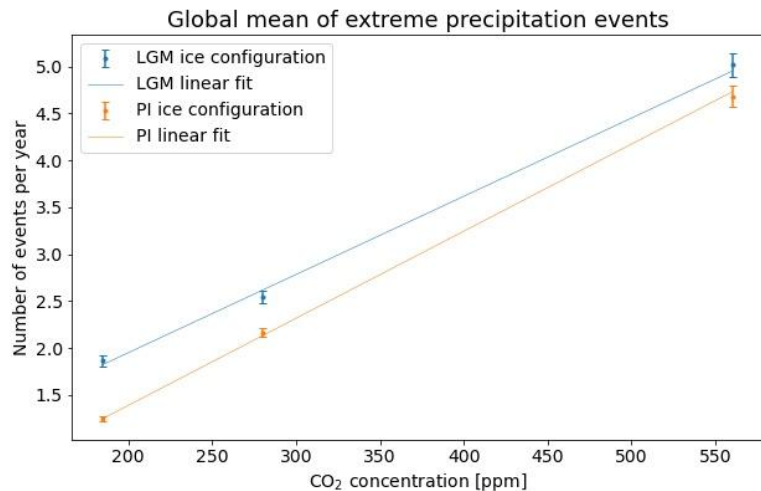
Difference in events per year (PI, CO2_560-CO2_185)

Difference in events per year (LGM, CO2_560-CO2_185)

Results

- Global mean increase: (0.83 ± 0.05) and (0.93 ± 0.03) additional events per 100ppm in LGM and PI respectively
- Stronger effect in Southern Hemisphere

Global mean of extreme precipitation events

Zonal mean plot of extreme precipitation events

Discussion & Conclusions

- Increase in CO_2 $\rightarrow$ Increase of extreme precipitation events
- CO_2 more important than ice sheet configuration

- Few events around the equator: High precipitation mean and variability creates a very high threshold
- Influence of glaciers/sea ice on changes in precipitation? But also across oceans and elsewhere $\rightarrow$ influence on global climate?

- Correlation between precipitation, standard deviation and extreme event rate seems reasonable $\rightarrow$ choice of threshold decides about research object
- Threshold definition via dangerous amounts of rain (floods, crop damage, etc.)