Projected changes on quasi-resonant amplification by CMIP5 and CMIP6 toward the persistence in extreme summer weather events

Authors

Sullyandro Guimarães[1], *Michael Mann[2], Stefan Rahmstorf[1,3], Stefan Petri[1], Kai Kornhuber[1], Dim Coumou[1,4], Byron Steinman[5], Daniel Brouillette[6], Shannon Christiansen[2]*

Institutions

(1) Potsdam Institute for Climate Impact Research, Germany
(2) University of Pennsylvania, Philadelphia PA, USA
(3) University of Potsdam, Potsdam, Germany
(4) VU University Amsterdam, Amsterdam, Netherlands
(5) University of Minnesota Duluth, Duluth, MN, USA
(6) Pennsylvania State University, University Park, PA, USA

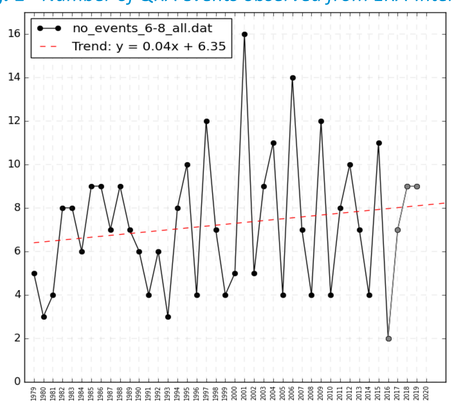
BACKGROUND AND CONCEPTS

High-amplitude quasi-stationary atmospheric Rossby waves with zonal wave numbers 6 to 8 associated with the phenomenon of ***quasi-resonant amplification (QRA)*** have been linked to persistent summer extreme weather events in the Northern Hemisphere. We project future occurrence of QRA events based on an index derived from the zonally averaged surface temperature field 25N-75N, JJA seasonal mean, comparing results from CMIP5 and CMIP6 (Coupled Models Intercomparison Projects) climate projections.

RESEARCH GOALS

Temperature anomaly signatures of observed QRA events are used to generate a composite fingerprint for model simulations, and then access outcomes of future changes in climate extreme trends.

Fig. 1 - *Number of QRA events observed from ERA-Interim*



RESULTS AND DISCUSSION

Under the scenarios analyzed, there is a general agreement among models, with most simulations projecting a substantial increase in QRA index, see **Fig. 2**. Larger increases are found among CMIP6-SSP585 (42 models, 46 realizations - **Fig. 4**) models with 85% of models displaying a positive trend, as compared with 60% of CMIP5-RCP85 (35 models, 75 realizations - **Fig. 5**), and a reduced spread among SSP585 models.

Fig. 2 – *QRA fingerprint series according to CMIP models*

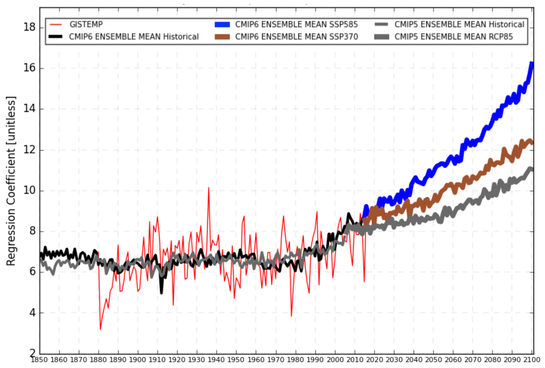
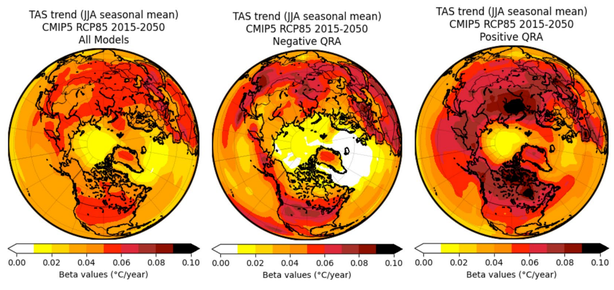


Fig. 3 – *CMIP5's mean surface temperature trend patterns (JJA mean)*



The CMIP6-SSP370 (24 models, 28 realizations) simulations display qualitatively similar behavior to SSP585, indicating a substantial increase in QRA events under business-as-usual emissions scenarios - **Fig. 2**.

Fig. 4 – QRA fingerprint of CMIP6 SSP585 2015-2050 mean

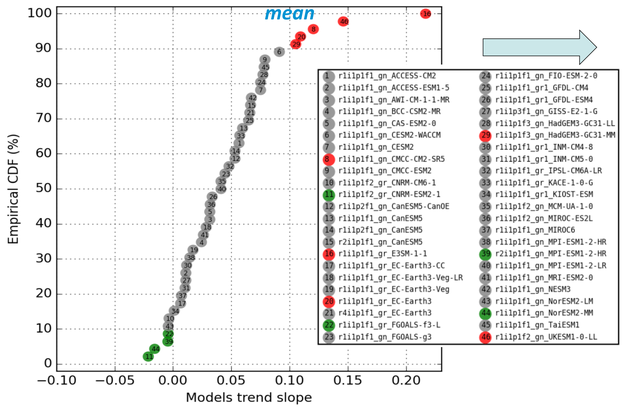
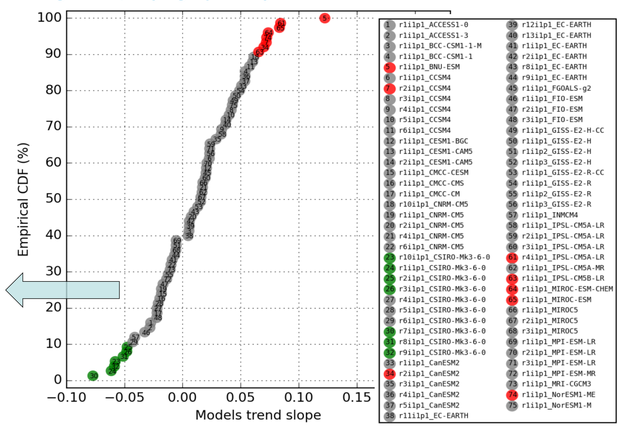


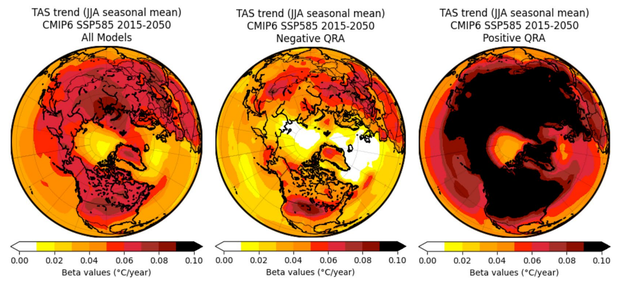
Fig. 5 – QRA fingerprint of CMIP5 RCP85 2015-2050 mean



CONCLUSIONS

Our analysis suggests that anthropogenic warming will likely lead to an even more substantial increase in QRA events (and associated summer weather extremes) for CMIP6 than our previous analysis of CMIP5 simulations.

Fig. 6 – *CMIP6's mean surface temperature trend patterns (JJA mean)*



ACKNOWLEDGMENTS

This work was supported by the Potsdam institute for climate impact research (PIK) under the Project Atmo-POEM funded by H&M Foundation. University of Potsdam contributed for the work by the first author's association as a PhD candidate.

REFERENCES

Mann, M., Rahmstorf, S., Kornhuber, K., Steinman, BA., Miller, SK., Petri, S., Coumou D. **Projected changes in persistent extreme summer weather events: The role of quasi-resonant amplification**. Science Advances, 2018.

Mann, M., Rahmstorf, S., Kornhuber, K. et al. **Influence of Anthropogenic Climate Change on Planetary Wave Resonance and Extreme Weather Events**. Scientific Reports, 2017.

Kornhuber, K., Petoukhov, V., Petri, S., Rahmstorf, S., Coumou, D. **Evidence for wave resonance as a key mechanism for generating high-amplitude quasi-stationary waves in boreal summer**. Climate Dynamics, 2017.

Contact Sullyandro Guimarães
Telegrafenberg A62| D-14412 Potsdam
sullyandro@pik-potsdam.de

Contact Press and Public Relations
Telegrafenberg A31 | D-14473 Potsdam
www.pik-potsdam.de

Sponsors

Universität Potsdam

H&M FOUNDATION

EGU23-15986