Assessing recent trends in co-occurring hot, dry and wet events under climate change

Bianca Biess[1], Lukas Gudmundsson[1], Sonia I. Seneviratne[1]
[1]Institute for Atmospheric and Climate Science, ETH Zurich, Zurich, Switzerland

1 Introduction

The spring-to-summer seasons in recent years were characterized by co-occurring hot, dry, and wet extremes around the globe[1,2] leading to questions about the contribution of human-induced global warming to the changing likelihood of such extreme years.

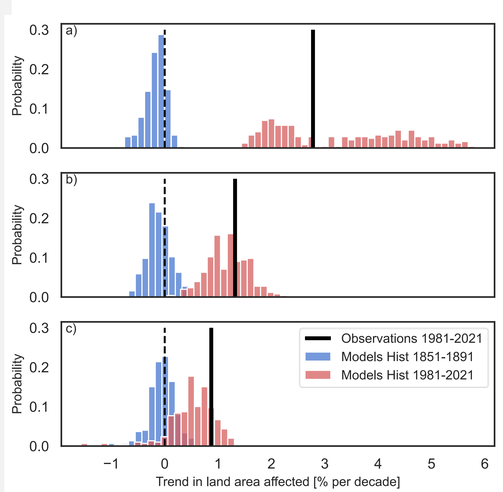
2 Method Overview

- Recent trends (1981-2021) in the fraction of global and regional land-area that is affected by hot days (TX90p), wet days (RX1day) and dry months (P-E10p) during the summer season are calculated using ERA5-reanalysis products.
- Observed trends are put into context of CMIP6 simulations accounting for present day and pre-industrial climate conditions in a trend detection and attribution (D&A) setting.

Detection Statement	The observed trend is not consistent with trends under pre-industrial climate conditions.
Attribution Statement	(I) The observed trend is consistent with trends under current climate conditions. (II) The simulated trends under current climate conditions are significantly different from the simulated trends under pre-industrial climate conditions.

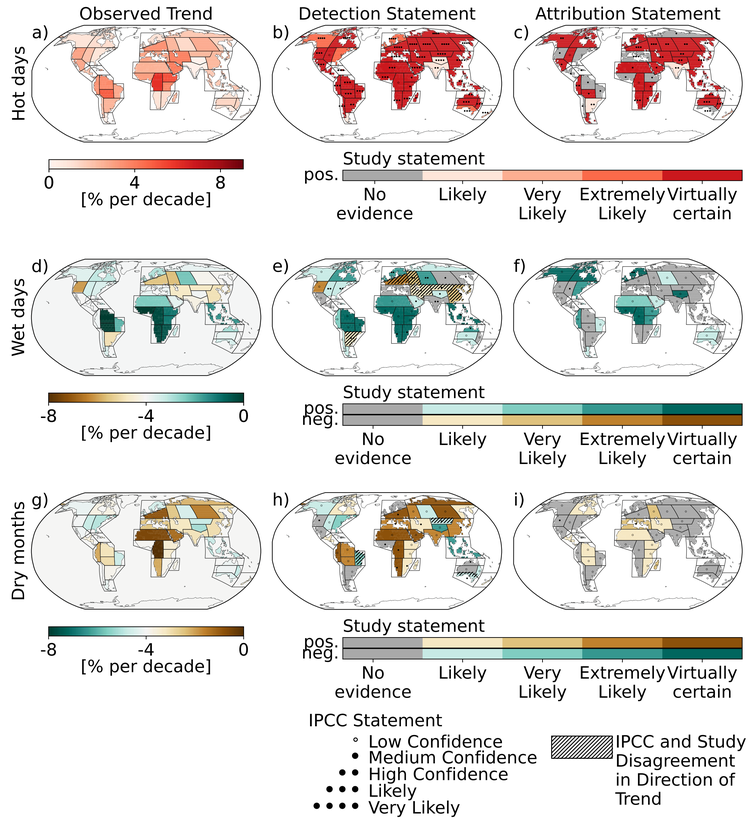
3 Results

- Observed trends in global hot day, wet day and dry month area are *virtually certain** (p>0.99) larger than the simulated trends under pre-industrial climate conditions.
- Conversely the observed trends in global hot day, wet day (dry month) area can be *virtually certain* (*extremely likely (p>0.95)*) explained using simulated trends under current climate conditions.



- More than 75% of the regions show a positive and detectable trend in hot day area which is *virtually certain* only explainable when the forcing accounting for anthropogenic emissions is taken into account.
- Positive and negative trends in concurrent wet day (dry month) area are detected. Around 50% (30%) of the regions show a positive trend in wet day (dry month) area which is at least *likely (p>0.66)* attributable to human induced climate change.

*according to the IPCC calibrated language of uncertainties[3]



4 Conclusion

- The contribution of human-induced climate change to the increase in global concurrent hot day, wet day, and dry month area can be stated with great certainty.
- For many regions, new insights were gained in the contribution of human-induced climate change to the increase in land area affected by hot days wet days and dry months.
- This further advances the knowledgebase on the human contribution to hot wet and dry climate extremes compared to the recently published IPCC AR6 report[4].

Partner/Sponsor:

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 956396

References

1. NOAA. (2021). Monthly Global Climate Report for Annual 2021. published online. Retrieved from https://www.ncei.noaa.gov/access/monitoring/
2. WMO. (2022). State of the global climate 2021. published online. Retrieved from https://library.wmo.int/doc num.php?explnum id=11178 (WMO No. 1290)
3. Chen, D., et al. (2021). Framing, context, and methods. In *Climate change 2021: The physical science basis. contribution of working group into the sixth assessment report of the intergovernmental panel on climate change*. [Masson-Delmotte, V., P. et al. (eds.)].Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 147–286.
4. Seneviratne, S. I., X. Zhang, et al. (2021). Weather and climate extreme events in a changing climate. In: [Masson-Delmotte, V., et al. (eds.)]. Cambridge University Press, Cambridge, *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* United Kingdom and New York, NY, USA, pp. 1513–1766..