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Nonlinear Processes in Geophysics
Discussions

Interactive comment on "Toward enhanced understanding and projections of climate extremes using physics-guided data mining techniques" *by* A. R. Ganguly et al.

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General comments

The perspective by Ganguly et al. discusses an important and timely topic in the data-driven research community. It uncovers current shortcomings in purely data-driven approaches in the detection and future prediction of climate extremes and makes suggestions how to improve those approaches. The paper is well written and research gaps are well illustrated and often confronted with constructive suggestions for improvement. It seems, however, that most approaches suggested to improve current activities in climate extreme research stem from papers by the authors or associated groups. Hence, an inclusion of a broader range of other groups working in the same area could greatly improve the impact of this perspective. I have mentioned a couple

of such papers for specific sections below.

Specific comments

Labels for the subfigures would make it much easier to follow the description of the figures.

p 55, l 11: A discussion similar to the drought example given here exists for temperature extremes. Studies showed an increase (Hansen et al. 2012) and no increase (Huntingford et al. 2013) in global temperature variability over the last decades. The reason for that is also here a different choice of metrics. Alexander and Perkins (2013) give a good overview over the debate. Maybe this is worth mentioning.

p 60, l 19: mention (Fischer et al. 2013, Fischer and Knutti 2014)

p 63, l 7: Impacts of climate extremes are mentioned a couple of times in the paper, but little of recent quantitative research in that area is mentioned (see e.g. Reichstein et al. (2013), Zscheischler et al. (2013), Zscheischler et al. (2014) for impacts of climate extremes on terrestrial ecosystems).

p 65, l 14: Lloyd-Hughes (2012) also presented a very simple approach to detect large-scale droughts in the spatiotemporal domain which is computationally extremely fast and easily extendable to the multivariate domain.

p 69, l 20: in this context, also mention Diffenbaugh et al. (2013)

p 71, l 22: mention Runge et al. (2014), who provide a much better approach to detect causality in climate variables.

p 72, l 5: mention Fischer et al. (2013), who present a robust projection of climate extremes into the future and discuss limitations intrinsic to the structure of GCMs.

Technical corrections

p 67, l 24: where is (b) in the figure?

Alexander, L. and S. Perkins. 2013. Debate heating up over changes in climate variability. Environmental Research Letters 8.

Diffenbaugh, N. S., M. Scherer, and R. J. Trapp. 2013. Robust increases in severe thunderstorm environments in response to greenhouse forcing. Proc Natl Acad Sci U S A 110:16361-16366.

Fischer, E., U. Beyerle, and R. Knutti. 2013. Robust spatially aggregated projections of climate extremes. Nature Climate Change 3:1033-1038.

Fischer, E. and R. Knutti. 2014. Detection of spatially aggregated changes in temperature and precipitation extremes. Geophysical Research Letters.

Hansen, J., M. Sato, and R. Ruedy. 2012. Perception of climate change. Proc Natl Acad Sci USA 109:E2415-E2423.

Huntingford, C., P. D. Jones, V. N. Livina, T. M. Lenton, and P. M. Cox. 2013. No increase in global temperature variability despite changing regional patterns. Nature 500:327-330.

Lloyd-Hughes, B. 2012. A spatio-temporal structure-based approach to drought characterisation. International Journal of Climatology 32:406-418.

Reichstein, M., M. Bahn, P. Ciais, D. Frank, M. D. Mahecha, S. I. Seneviratne, J. Zscheischler, C. Beer, N. Buchmann, D. C. Frank, D. Papale, A. Rammig, P. Smith, K. Thonicke, M. van der Velde, S. Vicca, A. Walz, and M. Wattenbach. 2013. Climate extremes and the carbon cycle. Nature 500:287-295.

Runge, J., V. Petoukhov, and J. Kurths. 2014. Quantifying the Strength and Delay of Climatic Interactions: The Ambiguities of Cross Correlation and a Novel Measure Based on Graphical Models. Journal of Climate 27.

Zscheischler, J., M. D. Mahecha, S. Harmeling, A. Rammig, E. Tomelleri, and M. Reichstein. 2014. Extreme events in gross primary production: a characterization across

continents. Biogeosciences Discuss. 11:1869-1907.

Zscheischler, J., M. D. Mahecha, S. Harmeling, and M. Reichstein. 2013. Detection and attribution of large spatiotemporal extreme events in Earth observation data. Ecological Informatics 15:66-73.

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