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A new method for studying the extratropical response to tropical precipitation anomalies and its role in improving projections of Northern Hemisphere climate variability

Natasha Senior[1], Manoj Joshi[1], Adrian Matthews[2], and Pranab Deb[1,3]
[1]Climatic Research Unit, School of Environmental Sciences, University of East Anglia, Norwich, United Kingdom (n.senior@uea.ac.uk)
[2]Centre for Ocean and Atmospheric Sciences, School of Environmental Sciences and School of Mathematics, University of East Anglia, Norwich, United Kingdom
[3]Centre for Oceans, Rivers, Atmosphere and Land Science (CORAL), Indian Institute of Technology, Kharagpur, India

Intensification of extreme precipitation and weather events are some of the projections under a 2°C average global temperature increase scenario. Rossby wave trains may be triggered by anomalous tropical precipitation through the interaction of the associated upper level divergent wind and the vorticity gradients of the subtropical jet streams. In this way, anomalous tropical precipitation can influence weather patterns in the Northern Hemisphere. Owing to the quasi-linearity of this teleconnection pattern, it may be studied statistically as a series of signal-response functions. Here the anomalous precipitation events are treated as input forcings and the resulting geopotential height anomalies are the output signals. Through calculating the response functions we are able to realistically capture the 250 hPa geopotential height response to a step-like change in precipitation over the Maritime Continent or the eastern Indian Ocean during the boreal winter. When examining these responses using the same forcing for a selection of CMIP5 models, we find that there is a large inter-model spread, owing to differences in the model basic state. Since these teleconnection patterns are not faithfully represented in climate models, this can obscure our ability to develop realistic projections of atmospheric circulation and extreme weather. We discuss the potential of the linear response theory method to provide improved projections for Northern Hemisphere climate variability.