Global-scale teleconnections of extreme rainfall revealed by complex networks

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Extreme rainfall events are often coupled across long spatial distances due to atmospheric teleconnections. Revealing such linkages is important for our understanding of extreme events and related atmospheric circulation patterns, but also for enhancing the forecast skill of such events [1]. Here, we present recent results [2] on how complex networks can be employed to discover extreme rainfall teleconnections from high-resolution satellite data. Our method allows to quantitatively distinguish regional weather systems from global-scale teleconnections coupling the individual weather systems. Several lines of evidence suggest that the most relevant mechanisms for global-scale teleconnections of extreme rainfall events are related to atmospheric Rossby waves. We exemplify our approach with a focus on extreme rainfall events in the mountain regions of South-Central Asia (including Northern Pakistan and India), and show that they are statistically significantly coupled to preceding events in Europe as well as succeeding events in eastern China. An analysis of the corresponding atmospheric circulation patterns shows that a previously revealed, quasi-stationary Rossby wave termed the 'silk road pattern' [3] is responsible for this instance of long-range coupling between extreme rainfall events. Overall, our findings give new insights into the connections between atmospheric Rossby waves and extreme rainfall events, and thus into the potential predictability of related natural hazards. Moreover, they give promising clues in how to constrain state-of-the-art climate models with respect to their simulation of extreme rainfall.
