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Global intensification in observed short-duration rainfall extremes

Hayley Fowler (1), Renaud Barbero (1), Elizabeth Lewis (1), Seth Westra (2), Geert Lenderink (3), Stephen Blenkinsop (1), Selma Guerreiro (1), and Xiao-Feng Li (1)

(1) School of Civil Engineering and Geosciences, Newcastle University, Newcastle-upon-Tyne, United-Kingdom, (2) School of Civil, Environmental and Mining Engineering, University of Adelaide, Adelaide, Australia, (3) Royal Netherlands Meteorological Institute, De Bilt, The Netherlands

Extreme rainfall events are expected to intensify with a warming climate and this is currently driving extensive research. While daily rainfall extremes are widely thought to have increased globally in recent decades, changes in rainfall extremes on shorter timescales, often associated with flash flooding, have not been documented at global scale due to surface observational limitations and the lack of a global sub-daily rainfall database. The access to and use of such data remains a challenge. For the first time, we have synthesized across multiple data sources providing gauge-based sub-daily rainfall observations across the globe over the last 6 decades. This forms part of the INTENSE project (part of the World Climate Research Programme (WCRP)'s Grand Challenge on 'Understanding and Predicting Weather and Climate Extremes' and the Global Water and Energy Exchanges (GEWEX) Hydroclimate Project cross-cut on sub-daily rainfall).

A set of global hydroclimatic indices have been produced based upon stakeholder recommendations including indices that describe maximum rainfall totals and timing, the intensity, duration and frequency of storms, frequency of storms above specific thresholds and information about the diurnal cycle. This will provide a unique global data resource on sub-daily precipitation whose derived indices will be freely available to the wider scientific community.

Because of the physical connection between global warming and the moisture budget, we also sought to infer long-term changes in sub-daily rainfall extremes contingent on global mean temperature. Whereas the potential influence of global warming is uncertain at regional scales, where natural variability dominates, aggregating surface stations across parts of the world may increase the global warming-induced signal. Changes in terms of annual maximum rainfall across various resolutions ranging from 1-h to 24-h are presented and discussed.