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Global increasing trends in annual maximum daily precipitation

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This study investigates the presence of trends in annual maximum daily precipitation timeseries in a global dataset of 8326 high quality land-based observing stations with more than 30 years of record over the period from 1900 to 2009. Two complementary statistical techniques were adopted to evaluate the possible non-stationary behaviour of this precipitation data. The first was a Mann-Kendall non-parametric trend test, and was used to evaluate the existence of monotonic trends. The second was a non-stationary generalised extreme value analysis, and was used to determine the strength of association between the precipitation extremes and globally averaged near-surface temperature.

The outcomes are that statistically significant increasing trends can be detected at the global scale, with close to two-thirds of stations showing increases. Furthermore, there is a statistically significant association with globally averaged near-surface temperature, with the median intensity of extreme precipitation changing in proportion with changes in global mean temperature at a rate of between 5.9% and 7.7% per degree, depending on the method of analysis. This ratio was robust irrespective of record length or time period considered, and was not strongly biased by the uneven global coverage of precipitation data. Finally, there is a distinct meridional variation, with the greatest sensitivity occurring in the tropics and higher latitudes, and minima around 13°S and 11°N. The greatest uncertainty is near the equator due to the limited number of sufficiently long precipitation records, and there remains an urgent need to improve data collection in this region to better constrain future changes in tropical precipitation.