EMS Annual Meeting Abstracts
Vol. 10, EMS2013-31, 2013
13th EMS / 11th ECAM

Attribution of trends in daily rainfall statistics to the global mean temperature

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The question about trends in extreme precipitation and their causes has been elusive because of climate models' limited precision and the fact that extremes are both rare and occur at irregular intervals. Here a newly discovered empirical relationship between the wet-day mean μ and quantiles in 24-hr precipitation amounts was used to show that trends in the wet-day 95th percentiles q_{95} - world-wide - have been influenced by the global mean temperature, consistent with an accelerated hydrological cycle caused by a global warming.

It can be shown that most of the marginal distribution for 24-hr precipitation records, sampled from more than 30,000 rain gauges, can be specified from only four parameter: wet-day mean μ, wet-day frequency f_w, distance from the coast d and altitude z. Most of the temporal variations and trends in the upper quantiles, however, can be captured through μ, which provides a more robust estimate of the upper tail of the distribution than small samples of extremes suffering from substantial statistical fluctuation.

A multiple regression analysis was used as a basis for the attribution analysis by matching temporal variability in precipitation statistics with the global mean temperature and some of the dominant modes of internal variability. The regression was applied to both μ and f_w respectively, using general linear models and a logit link for the latter.