A new methodology for regional trends in sub-daily rainfall annual maxima by using the Meta-statistical Extreme Value Distribution

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Abstract

The literature generally agrees that extreme precipitation is changing due to global warming and understanding these changes could improve our ability to predict their dynamics under future conditions. Trends emerging from the study of observed annual maximum time series (AM) are found to be highly variable in space and uncertain, partially because of the large stochastic uncertainty of rainfall maxima. We adopt a novel unified framework combining the Meta-statistical Extreme Value (MEV) Distribution and a Regional Kendall test, with the aims of (a) analyzing trends in extremes and (b) linking them to specific changes in the local precipitation regime. The MEV ability to separate storm intensity and yearly occurrence allows to understand the statistical processes underlying extremes, while its reduced uncertainty and the possibility of yearly estimations are clear advantages for trend studies. We analyzed the case of the eastern Italian Alps, where subdaily and daily AM showed relevant changes. We computed the parameters describing the yearly intensity distribution of events at durations from 15 min to 24 hr, their yearly number, and some return levels. The regional trend test is applied to these values. The model well reproduces the observed trends and the extremes show more marked trends for < 1 hr durations. This is mostly explained by the increase in the tail heaviness of the intensity distribution, linked to the increasing proportion of summery convective storms.

Keywords: trend, extreme value, rainfall, MEV, rainfall extremes

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