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Collective significance of climatic trends over Europe

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A common way of assessing long-term trends in climate elements at individual sites (stations or gridpoints) is to conduct separate local significance tests at each site, without any attempt to evaluate whether the number of individual local tests that are found significant could (or could not) occur by chance at a given significance level. That is, the issue of collective (global, field) significance in the context of testing for climatic trends has been overlooked and ignored almost completely.

In order to avoid this gap, we developed and evaluated several tests for field significance on synthetic datasets, generated by multi-site stochastic generator SPAGETTA (SPatial GEneraTor for Trend Analysis). These tests are based on: (i) counts of locally significant tests, (ii) lowest p-value of all local tests (Walker test), (iii) false discovery rate (generalization of the Walker test); (iv) generalized Mann-Kendall test; and (v) counts of positive and negative trends regardless their local significance.

The tests are applied to temperature trends in real datasets over Europe, both station (ECA&D) and gridded (E-OBS). The sensitivity of results of statistical testing to the length of the series and to the proportion between autocorrelation distance and the density of the station network / grid is assessed. We demonstrate that the tests of collective significance confirm that temperature trends were indeed positive over Europe in the second half of the 20th century.