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Analysis of temperature trends, heat and cold waves in Central Italy (1952-2008)

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Most of the recent studies on climate change agree in assessing a positive global trend of the mean temperature. However, analysis of temperature data at basin scale appears to be quite complicated because of several factors affecting measures: location, slope exposition, distance from the sea, etc., resulting in a high meteorological variability also at short distances. In this study we present an analysis of minimum and maximum daily temperature data registered in Umbria Region (Tiber Basin, Central Italy) for the period 1952-2008 in order to estimate mean trends and possible increases in the "extreme events" such us "heat waves" and "cold waves". Among the about 80 stations available for the study period, only those ones with at least 45 years of data, even not consecutive, have been retained, resulting in a data set of only 5 stations. Data have been analyzed at annual and seasonal time scale, taking into account the spatial trend due to the elevation. The spatial correlation among stations appear to be quite high, but not related to the reciprocal distances. The time trend of each temperature time series has been studied by means of classical trend tests (Mann-Kendall and t-Student test). Results are comparable for the two tests but not unique for minimum and maximum temperature. Concerning Tmax, 3 out of 5 stations present a positive trend in the last 30 years, ranging from 0.02 to 0.09 °C/y, while the remaining two stations do not present any significant trend; however, the same stations show a negative trend over the period 1960-1990. This results in a positive trend over the whole period 1952-2008 ranging from 0.02 to 0.03 °C/y. Concerning Tmin, 3 out of 5 of the study stations do not present any statistically significant trend over the last 30 years, while one station shows a negative trend (- 0.05 °C/y) and one a positive trend (+ 0.07 °C/y); moreover, 3 out of 5 stations have a significant positive trend in the period 1952-2008 (the annual temperature gradient ranging from 0.02 to 0.04 °C/y), 1 station shows a significant negative trend (- 0.02 °C/y). The spatial dishomogeneity in the signal suggests that anthropic factors could influence very much the variations of temperatures in the last 60 years, preventing from using such data, like they are, as climatic indicators.
The occurrence of "heat waves" has been analyzed considering the persistence of temperatures higher than the 90-th percentile for 5 consecutive days; analogously, the occurrence of "cold wave" has been found out considering the persistence of temperatures lower than the 10-th percentile for 5 consecutive days. Results indicate that in the last 20 years the number of heat waves has significantly increased with respect to the previous period, while an increasing of the cold waves has not been enhanced.