



## **The dependence on elevation of extreme rainfall in Northern Italy**

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Precipitation is often believed to increase with elevation, due to the presence of an orographic effect that forces wet air masses to rise above land reliefs. This effect is responsible, for example, of the increase with elevation of the annual precipitation amounts measured at the ground level.

Variability with elevation of heavy rainfall of short duration, on the contrary, is poorly known and investigated in hydrology, despite the importance of short duration events in hydrological applications. In our work we analyze a database of 567 time series of annual maximum sub-daily rainfall in northern Italy. We find the intensity of rainfall to decrease with elevation for very short durations (i.e., 1 to 3 hours), while the negative slope of the intensity-elevation regression lines tends to decrease when considering events of longer duration (i.e., 12 to 24 hours). This tendency also appears to have a geographic drift from the western to the eastern Alps.

A possible reason behind the decrease of extreme rainfall with elevation is gauge undercatch at high-elevation sites. As an alternative, more convincing, explanation these phenomena may be the result of the reduction with altitude of the effective condensation rate of an air mass when subjected to orographic uplift.

To practically account for our empirical results, in this study we propose a combined use of kriging and regression techniques to consider the effect of elevation and longitude in the spatial interpolation of sub-daily rainfalls. This simple statistical tool proves to be very effective for the estimation of a design rainfall at an ungauged site, or in ungauged areas.