Changes in rainfall distribution patterns over Liguria Region

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We present an analysis of precipitation data recorded during a sixty-year period at four coastal and four in-land stations in Liguria (north-west Italy). The aim of the analysis is to identify possible variations of the temporal and spatial distribution of cumulative rainfall in the region, and to attempt to relate such variations to the climate change foreseen for the Mediterranean area.

The dataset used for the analysis has been acquired from the Ligurian meteorological observational network (OMIRL). OMIRL is a network of about 200 automated meteorological stations measuring conventional meteorological parameters (wind speed and direction, rainfall, temperature, pressure, moisture) and other parameters such as river's water level and solar radiation. The network is designed and maintained according to WMO (World Meteorological Organization) standards and most of the data is transmitted via radio in near real-time to the monitoring facilities.

Climatic studies are usually influenced by the areas and timescales considered in the analysis due to the non-stationary and spatial inhomogeneity of climate phenomena. The analysis of rainfall patterns, however, is generally affected by an exceptional variability, which makes the identification of clear patterns more complex and uncertain when compared to the analysis of other climatic parameters which exhibit a clearer trend both on global and local scales (e.g. temperature, see: *ISPRA "Gli indicatori del clima in Italia nel 2019", 94/2020*). High variability of local scale precipitation often poses challenges to statistical analysis and therefore an identification of clear patterns is sometimes not possible because the synoptic, large-scale climatology heavily interacts with geography and local phenomena.

The first part of the study is a spatial analysis of the cumulative rainfall. The outcomes suggest that precipitations in the eastern part of the region are significantly higher than those in the western part.

This result is generally true for both, the total cumulative precipitation and also the number of rainy days and daily cumulative rainfall. Furthermore, the number of consecutive dry days and consecutive rainy days is respectively lower and higher in the eastern province of the region. Similarly we observed an increase from the coast towards the in-land of the region which is linked to the orographic effects.

The second part of our work has been focused to identify possible variations in the inter-annual and seasonal distribution of the rainfall of the considered sixty-year data series (from 1961 to 2019). Precipitation has been aggregated for the two different periods of the year: a first interval comprising winter, spring and summer seasons (from January to August) and a second predominantly autumnal interval (from September to December).

Results show a discernible difference between the precipitation distribution in the first 30-year period (from 1961-1990) and the distribution occurred in the second half of the considered period (from 1991-2019). In particular, it was possible to observe a noticeable decrease in the cumulative precipitation recorded during winter, spring and summer seasons and a marked increase of rainfall during autumn interval. Conversely, the overall yearly cumulative precipitation presented a less pronounced change over the considered timescales.

The work, does not highlight a variation in the total annual precipitation in most of the Ligurian territory in agreement with other researches (ARPA FG report http://www.arpa.fvg.it/export/sites/default/istituzionale/consulta/Allegati/02_Cambiamenti_climatici.pdf) while it seems instead to highlight a seasonal redistribution of the rainfall, both in intensity and in frequency.

The observed tendency to a concentration of the rainfall during the autumnal seasons (and a nearly equal drop-off of precipitation occurred during the rest of the year) seems to confirm some of the recent climatic modeling scenarios produced for the Italian territory (e.g. Piano Nazionale di Adattamento ai Cambiamenti Climatici PNACC, CMCC).

Knowledge of changes of the temporal and spatial rainfall variability could result in a useful tool for decision-makers, planners, economic sector and individuals in order to undertake proper planning and management of extreme rainfall events and landslides, to which the Ligurian territory is prone.

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