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Climate change of the Sardinian hydrology: the NAO impact on the precipitation and runoff regimes

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In the last decades, climate change and human activities increased desertification process in Mediterranean regions, with dramatic consequences for agriculture and water availability. In Sardinia a dramatic reduction of water in dam reservoirs has been observed, due to the decrease of runoff.
The climate in Sardinia is typically Mediterranean maritime, characterized by a marked rainfall seasonality with wet winters and dry summers. The winter seasons play a key role for the dam water supply, and a systematic decrease of runoff during consequent years can dramatically impact on the management of the Sardinian water resources system. An analysis of the precipitation and runoff regimes for the whole Sardinia has been performed, highlighting the significant role of the coastal exposition and the orography.
We collect an innovative database of rainfall and runoff observations from 1922 to 2011, including data of more than 400 rain stations and 30 discharge stations. Hystorical trends are detected using the Mann Kendall, with a significance level of 5%, showing a decrease of the rainfall of the winter trimester (January-February-March) and, more marked, of the runoff, for the whole Sardinia generally. Interestingly, the decrease is more marked for the rain and discharge stations of the Sardinian west coast, which is exposed to the west european climate dynamics.
In this sense, several studies have shown a significant correlation between the main meteorological variables and indices related to fluctuations in global scale, for example NAO (North Atlantic Oscillation), which is a climatic phenomenon that represents the fluctuations in the difference of atmospheric pressure at sea level between the Icelandic low and the Azores high, and controls the direction and strength of westerly winds and storm tracks into Europe. A negative NAO brings to an increased storm activity and rainfall to southern Europe and North Africa. Finally, an analysis of hystorical storm tracks over the Mediterranean basin is also performed, for analysing the correlation between storm tracks and extreme events in Sardinia.
We found high negative correlations between NAO and precipitation and runoff during the winter season, and the correlations decrease with the increase of rain station longitudes. The results show a strong negative correlation at the stations and basins of the Sardinian west coast, which is due to the exposure to the mistral winds and the storm track dynamics. Instead a less negative correlation has been estimated for the east coast stations and basins due to the impact of the horography which attenuate the large scale atmospheric dynamics.