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Drought spatial and temporal variability in Southern Italy (1821-2004): analysis of temperature and rainfall monthly data

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Southern Italy has been hit by dramatic and frequent droughts in the last 25 years. The last one involved the period between 1999 and summer 2002. The prolonged unavailability of water resources or a significant water resources deficit was the reason inhabitants were short of water, and there were dramatic economic losses for industry and agriculture was in difficulties.

This study attempts to offer answers to questions concerning the causes of these droughts, in terms of the modification of the hydrological cycle in time and space domains, focusing on the natural availability of water resources, independent of the human ability to tap and to manage these resources. It is based on monthly data of rainfall, temperature and rainy days, also allowing estimates of actual or real evapotranspiration, net rainfall and average precipitation intensity.

Data from 1821 to 2004 of 126 rain gauges located in four regions of Southern Italy (Apulia, Campania, Calabria and Basilicata, around 60,000 km^2), and the correspondent temperature records, where available, were analyzed. Regular data are available from 1921 to 2001. Many analysis methods are used: principal component analysis, to divide the study area in homogenous portions; trend analysis, considering the Mann-Kendall, t-Student and Craddock tests, autocorrelation and crosscorrelation analyses; seasonal, annual and moving average variables were considered, applying the spatial analysis to each variable with a GIS approach.

A widespread decreasing trend of annual rainfall is observed from 1921 to 2001 over 97% of the whole area. The decreasing trend of rainfall worsens or decreases as mean annual rainfall increases; the spatial mean of trend ranges from -0.8 mm/year in Apulia

to -2.9 mm/year in Calabria. The decrease in rainfall is notable after 1980: the recent droughts of 1988-92 and 1999-2001 appear to be exceptional. On a seasonal basis, the decreasing trend is concentrated in winter; a slight positive trend is observed in summer, the arid season in which the increase is useless as it is transformed in actual evapotranspiration. The temperature trend is not everywhere significant and homogeneous also if the temperature increase seems to prevail, especially from about 1980. Net rainfall, calculated as a function of monthly rainfall and temperature, shows a huge and generalized negative trend.