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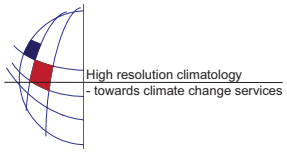

Evaluation of trends in some temperature series at some Italian stations and their modelling by means of spectral methods: first results in the Latium coastal area

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The investigation of the presence of signals indicating possible climatic changes in progress during the second half of the last century in the coastal area of the central Tyrrhenian sea has been carried out within the context of a research programme promoted by the Italian Science Academy (alias “the Academy of the XL”) and financed by the Presidential Bureau.
Our goal has been a better understanding of the behaviour of the minimum and maximum temperature variations in the period 1951-1999 and the modelling of their stochastic residuals through spectral analysis and the optimized construction of suitable autoregressive one-parameter processes.
The meteorological data source for this research was the Italian “Agrometeorological National DataBase” (BDAN) of the Agrometeorological Informatics National System (SIAN). The spectral and stochastic analysis of meteorological data usually require full data sets without gaps, but, in BDAN, numerous data sets taken at stations located in the investigated area were incomplete. Thus,
after the selection of an adequate number of stations, both representative of the region under study and characterized by a low number of data gaps, the first step was to fill all the gaps in the daily series using specific statistical techniques. After this preliminary treatment, we were left with seven temperature series that showed enough good characteristics in order to carry out an efficient modelling.
Spectral analysis of minimum and maximum temperature series permitted to identify an auto-regressive one-parameter model well representing the stochastic residual of each series.
With the aid of the complete model, consisting of a deterministic component (a linear trend plus two seasonal oscillations) and a stochastic residual, one can satisfactorily reconstruct the data in the past (climatic historical analysis) and to try a prediction of future values (forecasting). Thus the proposed model appears to represent a valid method to evaluate the whole variability of each climatic series in a multi-decadal time scale.
As for the deterministic component, the Fourier analysis of minimum and maximum temperatures series showed for each station the existence, beside the secular linear trend, of a first oscillation (annual), and a secondary oscillation (half-yearly), each characterized by an amplitude and a phase. On the other hand, the stochastic residual can always be regarded as the superposition of an AR(1) process and a residual white noise. The lower half-yearly seasonal component, although small, can produce an amplitude attenuation or enhancement, and a phase advance or delay, among the climatic expected values and the standard meteorological sequences.
The results of the stochastic analysis showed the presence during the period 1951-1999 of a discrete variability in the minimum and maximum temperature series along the Tyrrhenian coastal area, more intense for minimum temperatures. This behaviour can have direct and indirect consequences on natural vegetation and on the planning of agricultural activity, in particular for what concerns the evaluation of the quantity of the “available energy” for plant development and the assessment of “production sustainability” for the agricultural crops in terms of quantity, cost and quality of the agro products.