Climatica: a software for the climatic information management

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The increasing use of climatic information for forecasting, management and planning of agroecological systems has highlighted the need of treating meteorological data easily. In order to satisfy this requirement the software CLIMATICA has been developed and is here presented together with an evaluation, performed on the climatic databases of the agrometeorological service of Veneto region.

This software owns many different procedures to explore, validate, rebuild and manage climatic data.

Particularly, the software is able to i) manage climatic databases, ii) validate dataset and rebuild missing data or outliers; iii) compute meteorological variables, statistical and climatic indexes; iv) explore the datasets even with graphing functions; v) estimate climatic parameters from which Climak weather generator can produce artificial series of meteorological variables.The input datasets to CLIMATICA are to be in a specific text format (.dct) or even in the csv format. Data are to be arranged by one dataset for each meteorological station and only one dataset is managed for each session. However, more datasets can be combined by merge and append commands or converted into a reduced dataset formed by means, sum, medians, etc. using the collapse command. Other databases utilities are available: for example it is possible to insert and modify meteorological station metadata, to handle variables (for instance, generate, drop or replace) and observations (list, sort, expand, etc.). It is also possible to convert date format and units of variables, compute new meteorological variables like, for example, wind chill temperature, solar radiation, daylength and diurnal temperature.For the validation of meteorological data CLIMATICA gives different types of checks: i) checks for dates correctness; ii) meteorological validity (univariate), based on an a priori check (ranges and time variation), on an internal consistency check (based on the distribution of the variable) and on an external one (comparison with series from other neighbouring stations); iii) climatic consistency (multivariate), that considers three checks types (a priori, based on climatic rules; internal, based on the multivariate distribution; external, by comparison with other stations data); iv) homogeneity checking to verify the discontinuities in the data series. For the evaluations based on external criteria, multiple regression, non-linear regression and neural network models are used.

Each meteorological data is classified (through a control variable) by four criteria: the origin (reconstructed or primary), the application of a checking procedure (raw data or checked), the quality (good, suspicious or invalid) and the availability (present or missing). An index is associated to every meteorological data to indicate its status regarding the above criteria. Missing data can be reconstructed with different methods, based on multiple linear regression, non-linear regression, neural networks and moving statistics (moving average, median, etc.). CLIMATICA permits to analyse meteorological data statistically, by computing some statistical indexes (average, median, standard deviation, minimum and maximum, etc.) and graphing data by using the freely available software Gnuplot, included in the package.

CLIMATICA also has many mathematical functions and random numbers generators for different pdf (uniform, normal, beta, gamma, Gumbel, Weibull, triangular, etc.).

CLIMATICA also incorporates a stochastic model of climate (Climak; Danuso, 2002). This weather generator can estimate climatic parameters from historical data and generate consistent series of daily values of rainfall, minimum and maximum air temperatures, solar radiation and reference evapotranspiration.

The software has been evaluated using various data bases differing each other by climatic region, length of climatic series, type of meteorological data and time step of data collection in order to appreciate its versatility. In particular, we used: twenty five years series of monthly rainfall and temperature in various sites in the Italian Regions;forty years series of daily data of rainfall, temperature, air humidity, radiation, wind speed measured at Legnaro station (45°12' N 11°58' E);ten years series of hourly data of rainfall measured at eight sites in Veneto hills (North - Eastern Italy).