Use of a Weather Generator for analysis of projections of future daily temperature and its validation with climate change indices

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Abstract

High temporal resolution climate change scenarios are required in the evaluation of the impacts of climate change on agricultural management, energy production, and water management. In this work, a Weather Generator technique was used for downscaling climate change scenarios for temperature. An R package - RMAWGEN - was developed aiming to generate synthetic daily weather conditions by using the theory of vectorial autoregressive models (see details in RMAWGEN documentation). Here, an application is presented that uses a dataset with daily temperature time series recorded at 41 different sites of the Alpine Trentino region (Italy) for the period 1958-2010. Temperature time series were pre-processed to fill missing values and to remove inhomogeneities. Several climatic indices, selected from the list recommended by the World Meteorological Organization Commission for Climatology (WMO-CCL), were taken into account and their time trends within the time series were analyzed. Each index was applied to both observed data and to synthetic time series produced by the Weather Generator, over the thirty year reference period 1981-2010, in order to validate the model. Climate projections were statistically downscaled for a selection of the two 30-year periods 2021-2050 and 2071-2099 of the European project Ensembles multi-model output (scenario A1B).

Pre-processing data

RMAWGEN application - Validation

Validation procedure:
- period: 1981-2010,
- 30 time series generated by RMAWGEN procedure with different values of $p$,
- comparison of index series distribution (generated vs. observed, 1981-2010) by Kolmogorov-Smirnov and Wilcoxon-Mann-Whitney statistic tests.

Results

Climate index distribution of series generated with RMAWGEN: 30-year periods 1981-2010 (climatology from instrumental series), 2021-2050 and 2071-2099 (climate projections)

Conclusion and Future developments

- Good results for GSL, TX90p and WSDI indices with autoregression order $p = 1$,
- Good results for DTR index with autoregression order $p = 10$ for K-S test;
- RMAWGEN is a good tool for the assessment of climate change for future projections by use of these climate change indices.

References

San Michele all’Adige, Italy, 2011. RMAWGEN (R Multi-site Autoregressive Weather GENerator): a package to generate daily time series from monthly mean values. http://CRAN.R-project.org/package=RMAWGEN

Acknowledgements: Envirochange, ACESAP, CLITRE50 projects.