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Effect of spatial averaging on multifractal properties of meteorological time series

Holger Hoffmann (1), Piotr Baranowski (2), Jaromir Krzyszczak (2), and Monika Zubik (2)

(1) Crop Science Group, INRES, University of Bonn, Katzenburgweg 5, 53115 Bonn, DE , (2) Institute of Agrophysics, Polish Academy of Sciences, ul. Doswiadczalna 4, 20-290 Lublin, PL

Introduction

The process-based models for large-scale simulations require input of agro-meteorological quantities that are often in the form of time series of coarse spatial resolution. Therefore, the knowledge about their scaling properties is fundamental for transferring locally measured fluctuations to larger scales and vice-versa. However, the scaling analysis of these quantities is complicated due to the presence of localized trends and non-stationarities. Here we assess how spatially aggregating meteorological data to coarser resolutions affects the data's temporal scaling properties. While it is known that spatial aggregation may affect spatial data properties (Hoffmann et al., 2015), it is unknown how it affects temporal data properties. Therefore, the objective of this study was to characterize the aggregation effect (AE) with regard to both temporal and spatial input data properties considering scaling properties (i.e. statistical self-similarity) of the chosen agro-meteorological time series through multifractal detrended fluctuation analysis (MFDFA).

Materials and Methods

Time series coming from years 1982-2011 were spatially averaged from 1 to 10, 25, 50 and 100 km resolution to assess the impact of spatial aggregation. Daily minimum, mean and maximum air temperature (2 m), precipitation, global radiation, wind speed and relative humidity (Zhao et al., 2015) were used. To reveal the multifractal structure of the time series, we used the procedure described in Baranowski et al. (2015). The diversity of the studied multifractals was evaluated by the parameters of time series spectra. In order to analyse differences in multifractal properties to 1 km resolution grids, data of coarser resolutions was disaggregated to 1 km.

Results and Conclusions

Analysing the spatial averaging on multifractal properties we observed that spatial patterns of the multifractal spectrum (MS) of all meteorological variables differed from 1 km grids and MS-parameters were biased by -29.1 % (precipitation; width of MS) up to >4 % (min. Temperature, Radiation; asymmetry of MS). Also, the spatial variability of MS parameters was strongly affected at the highest aggregation (100 km). Obtained results confirm that spatial data aggregation may strongly affect temporal scaling properties. This should be taken into account when upscaling for large-scale studies.

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References

Baranowski, P., Krzyszczak, J., Sławiński, C. et al. (2015). Climate Research 65, 39-52.
Hoffman, H., G. Zhao, L.G.J. Van Bussel et al. (2015). Climate Research 65, 53-69.
Zhao, G., Siebert, S., Rezaei E. et al. (2015). Agricultural and Forest Meteorology 200, 156-171.