Geophysical Research Abstracts
Vol. 21, EGU2019-2399, 2019
EGU General Assembly 2019

Analysis of wind time series using network science and multifractal concept

Mohamed Laib (1,2), Fabian Guignard (1,2), Mikhail Kanevski (1,2), and Luciano Telesca (3)

(1) IDYST, Faculty of Geosciences and environment, University of Lausanne, Switzerland (mohamed.laib@unil.ch), (2) Swiss Geocomputing Centre, University of Lausanne, Switzerland, (3) CNR, Istituto di Metodologie per l'Analisi Ambientale, Tito (PZ), Italy

Complex networks are gaining popularity in describing the cooperative behaviour within a complex system involving relationships among its constituent units. A network can easily present a wind speed-monitoring system, by considering the measuring stations as nodes and the links by a linear or non-linear metric [1] [2].

This work presents two applications of using complex networks to study wind speed in Switzerland, collected from 119 measurement stations. The first one uses daily correlation network on high frequency wind speed (10-min). Then, these daily correlation networks are quantified using the connectivity density, which is studied using multifractal analysis in order to investigate the temporal evolution of the interaction between stations. The study reveals that the daily connectivity of the correlation-based network is persistent for any correlation threshold. Further, the multifractality degree is higher for larger absolute values of the correlation threshold [3].

The second application deals with the network constructed using mutual information on daily means of wind speed data. Then, the obtained network is studied using community detection method in order to understand the structure of the interaction between measurements. Two communities were detected in the constructed network. These two communities correspond, respectively, to the Alps and the Jura-Plateau geographical regions, which define the two major climatic zones of Switzerland [4].

The present research points out the importance of complex networks in visualisation and understanding of multivariate time series. Such applications could open new methodological avenues for studies devoted to the analysis of wind time series important for both environmental risks and renewable energy assessments.

References

[1] M. Newman, Networks: An Introduction, Oxford University Press, 2010

[2] Y. Zou, R. V. Donner, N. Marwan, J. F. Donges, J. Kurths, Complex network approaches to nonlinear time series analysis, Physics Reports, 2018.

[3] M. Laib, L. Telesca, M. Kanevski, Long-range fluctuations and multifractality in connectivity density time series of a wind speed monitoring network, Chaos: An Interdisciplinary Journal of Nonlinear Science, 28 (2018) pp. 033108.

[4] M. Laib, F. Guignard, M. Kanevski, L. Telesca, Community detection analysis in wind speed-monitoring systems using mutual information-based complex network, 2018. ArXiv: 1809.00511.