A review of “Fractal-based numerical simulation of multivariate typhoon wind speeds utilizing Weierstrass Mandelbrot function” submitted for publication to Wind Energy Science.

This paper proposes a “fractal-based” technique for the analysis and simulation of typhoon wind velocities. At first sight, this could be seen as a potential contribution to the advancement of state-of-the-art wind energy analysis and simulation techniques, which too often rely on quasi-normal assumptions. However, the typhoon wind velocities could be easily out of the range of the exploitable wind velocities by turbines. Surprisingly, the authors do not discuss this possible limitation at all and more generally how their results could be used in the wind energy framework.

Unfortunately, a more radical limitation is the use of the stochastic Weierstrass-Mandelbrot function as the stochastic model of wind velocities that is extremely outdated. It is ironic that Richardson (1926) used the Weierstrass function (as presented by Klein, 1902) as a pedagogic example of the non-differentiability of wind and was cautious enough to state he was not suggesting that it has anything to do with real wind. On the contrary, the present authors rely on Mandelbrot’s assertion that one parameter of the function is “the” fractal dimension to limit their investigations to how best to estimate this single dimension, whereas, since the early 1980s, wind intermittency has been considered to result from an infinite hierarchy of embedded fractal supports, and, hence a similar hierarchy of fractal dimensions. See, for instance, Calif and Schmitt (2014) and Fitton et al. (2014) for applications to wind energy, Lazarev et al. (1994) and Lee et al. (2020) for typhoons, as well as references herein. This hierarchy corresponds to the physical fact that increasing wind fluctuations are concentrated on smaller and smaller fraction of space-time. It is hard to understand how the authors missed this fundamental methodological point in their state of the art.

Fractal analyses, as carried out by the authors, have therefore been abandoned in favour of multifractal analyses. In the present case, the authors estimate the fractal dimension using only the second order structure function, whereas it has become quite common to estimate the dimension hierarchy using the structure functions of all positive orders. It is worth noting that the underlying stochastic model is quite different from the Weierstrass-Mandelbrot function and gives a different meaning to the scaling exponents and associated dimensions, including for the second order.

Overall, the current manuscript is not so well suited to the scope of Wind Energy Science, but, among Copernicus Press journals, better to that of Nonlinear Processes in Geophysics. However, to be successful, a fundament methodological update should be carried out before transferring this paper.

References

Calif, R. and F.G. Schmitt (2014) ‘Multiscaling and joint multiscaling description of the atmospheric wind speed and the aggregate power output from a wind farm’. *Nonlin. Processes Geophys.*, **21**, 379–392 doi:10.5194/npg-21-379-2014.

Klein, F. (1902) *Anwendung de Differential und Integralrechnung auf Geometrie*, Leipzig, B. G. Teubner.

Lee, J. et al. (2020) ‘Multifractal analysis of rainfall-rate datasets obtained by radar and numerical model: The case study of typhoon bolaven (2012)’, Journal of Applied Meteorology and Climatology, 59(5), pp. 819–840. doi: 10.1175/JAMC-D-18-0209.1.

Lazarev, A. *et al.* (1994) ‘Unified multifractal atmospheric dynamics tested in the tropics: part II, vertical scaling and Generalized Scale Invariance’, *Nonlin. Processes Geophys.* **1**, 115–123. doi: 10.5194/npg-1-115-1994.

Mandelbrot, B. (1983) *The Fractal Geometry of Nature,* W. H. Freeman, NY.

Richardson, L.F. (1926) ‘Atmospheric Diffusion Shown on a Distance-Neighbour Graph’, *Proceedings of the Royal Society of London. Series A*,**110** (756),709-737.