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# Modeling the Weibull shape parameter to improve estimates of the annual wind energy potential in Sweden

Wind energy is one of the fastest growing renewable energies in Sweden. To support this growth, it is essential to give stakeholders, such as investors, municipalities and policy planers, access to high accuracy and high-resolution wind speed data.

Essential components for an accurate wind energy potential prediction are the average long-term wind speed and the probability of occurrence of wind speeds. The probability is usually modeled either by the Weibull probability density function (PDF) or the Rayleigh PDF. For the case of Sweden, the average wind speed and Weibull shape parameters, as the main components of the Weibull PDF were available. However, the accuracy of the shape parameter was unknown.

This study evaluated whether there is a considerable difference between using the Weibull PDF or the Rayleigh PDF for assessing the annual wind energy potential at sites in Sweden. Due to the unknown accuracy of the shape parameter, a new model approach to model the shape parameter was proposed. A generalized additive model (GAM) was built out of the tested relationship between shape values at known locations and other geographical variables. It was tested if the modeled shape values resulted in a considerably more accurate energy prediction than the Rayleigh PDF. The results showed that the accuracy of the Rayleigh PDF was considerable lower than the one from the Weibull PDF and the GAM model PDF. The study also showed that the Rayleigh PDF is probably only a good representation for the wind conditions in the southern third of Sweden and it underestimated the potentials in the northern parts considerably. The GAM model seemed to perform well, had a high accuracy and it's predicted values were in line with literature. It proved to be a good alternative to model the Weibull shape parameter and to use it for wind energy potential predictions.

Keywords: Physical Geography and Ecosystem analysis, wind energy potential, Weibull PDF, GAM, Rayleigh PDF, wind, Sweden

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