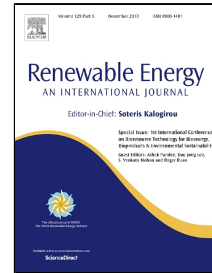


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Prediction of the wind speed probabilities in the atmospheric surface layer

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# 1 Prediction of the wind speed probabilities in the atmospheric surface layer

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## 7 Abstract

8 Accurate prediction of the wind speed probabilities in the atmospheric surface layer is very  
9 important for wind energy assessment studies and many other practical applications such as  
10 the design and operation of wind turbines and human exposure to wind extremes. In a recent  
11 study, an optimized beta distribution was developed for the prediction of the wind speed  
12 probabilities in the atmospheric surface layer. Various uncertainties arise in real scenarios  
13 due to the composite atmospheric variability, the topography of the terrain, nearby obstacles,  
14 orographical features, and other synoptic conditions. Thus, in the first part of this study, the  
15 beta distribution is validated further with the wind speed database of the FUSION Field Trial  
16 2007 (FFT-07) tracer field experiment for various atmospheric stability conditions. The  
17 model is applied without any change in its constants and a high degree of agreement with the  
18 field experiment is achieved. One main advantage of the proposed beta distribution is that it  
19 can be incorporated in computational models that are able to predict the mean, the variance  
20 and the integral time scale of the wind speed. The second part of the paper includes the  
21 incorporation of the beta distribution in the Reynolds Averaged Navier Stokes (RANS)  
22 methodology. Initially, the "RANS-beta" model is validated against wind speed  
23 measurements performed in a wind tunnel over a rough ground. The wind speed 25<sup>th</sup>, 50<sup>th</sup> and  
24 75<sup>th</sup> percentiles were found to be highly dependent on the height and the model gave  
25 comparable results with the experiment. Then, the wind speed database of the field  
26 experiment JU2003 is used to examine the "RANS-beta" model's performance. The 25<sup>th</sup>,  
27 50<sup>th</sup>, 75<sup>th</sup> and 95<sup>th</sup> model percentiles at 20 sensors located inside the complex urban area were  
28 found to be in good agreement with the experimental ones (FAC2=0.8).

29

## 30 Keywords

31 beta distribution; wind speed; RANS; atmospheric surface layer.

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## 33 1. Introduction

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