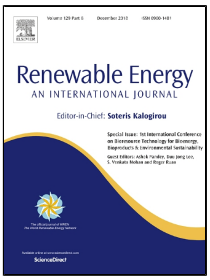
Accepted Manuscript



Prediction of the wind speed probabilities in the atmospheric surface layer

G.C. Efthimiou, P. Kumar, S.G. Giannissi, A.A. Feiz, S. Andronopoulos

PII:	S0960-1481(18)31008-5
DOI:	10.1016/j.renene.2018.08.060
Reference:	RENE 10487
To appear in:	*Renewable Energy*
Received Date:	16 May 2018
Accepted Date:	15 August 2018

Please cite this article as: G.C. Efthimiou, P. Kumar, S.G. Giannissi, A.A. Feiz, S. Andronopoulos, Prediction of the wind speed probabilities in the atmospheric surface layer, *Renewable Energy* (2018), doi: 10.1016/j.renene.2018.08.060

Prediction of the wind speed probabilities in the atmospheric surface layer

G. C. Efthimiou[1a], P. Kumar[b], S. G. Giannissi[a], A. A. Feiz[b], S. Andronopoulos[a]

[a]Environmental Research Laboratory, INRASTES, NCSR Demokritos, Patriarchou Grigoriou & Neapoleos Str., 15310, Aghia Paraskevi, Greece.

[b]LMEE, Université d'Evry Val-d'Essonne, 40 Rue du Pelvoux 91080 Courcouronnes, France.

Abstract

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

Keywords

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

1. Introduction

[1]Corresponding author. Tel: +30 2106503405. E-mail address: gefthimiou@ipta.demokritos.gr (G. C. Efthimiou).