Geophysical Research Abstracts
Vol. 12, EGU2010-5991, 2010
EGU General Assembly 2010

Study of the fractal dimension of the wind and its relationships with turbulent and stability parameters

Manuel Tijera (1), Gregorio Maqueda (2), José L. Cano (2), Pilar López (1), and Carlos Yagüe (3)

(1) Departamento Matemática Aplicada (Biomatemática). Universidad Complutense de Madrid, Spain. (mtijera@fis.ucm.es), (2) Departamento Física de la Tierra, Astronomía y Astrofísica (II). Universidad Complutense de Madrid, Spain. (gmaqueda@fis.ucm.es), (3) Departamento Geofísica y Meteorología. Universidad Complutense de Madrid, Spain. (carlos@fis.ucm.es)

The wind velocity series of the atmospheric turbulent flow in the planetary boundary layer (PBL), in spite of being highly erratic, present a self–similarity structure (Frisch, 1995; Peitgen et., 2004; Falkovich et., 2006). So, the wind velocity can be seen as a fractal magnitude. We calculate the fractal dimension (Komolgorov capacity or box-counting dimension) of the wind perturbation series ($u^{'} = u - <\mathrm{u}>$) in the physical spaces (namely velocity-time). It has been studied the time evolution of the fractal dimension along different days and at three levels above the ground (5.8 m, 13.5 m, 32 m). The data analysed was recorded in the experimental campaign SABLES-98 (Cuxart et al., 2000) at the Research Centre for the Lower Atmosphere (CIBA) located in Valladolid (Spain). In this work the u, v and w components of wind velocity series have been measured by sonic anemometers (20 Hz sampling rate). The fractal dimension versus the integral length scales of the mean wind series have been studied, as well as the influence of different turbulent parameters. A method for estimating these integral scales is developed using the normalized autocorrelation function and a Gaussian fit. Finally, it will be analysed the variation of the fractal dimension versus stability parameters (as Richardson number) in order to explain some of the dominant features which are likely immersed in the fractal nature of these turbulent flows.

References

- Cuxart J, Yagüe C, Morales G, Terradellas E, Orbe J, Calvo J, Fernández A, Soler MR, Infante C, Buenestado P, Espinalt A, Joergensen HE, Rees JM, Vilá J, Redondo JM, Cantalapiedra IR and Conangla L (2000) Stable atmospheric boundary-layer experiment in Spain (SABLES98): a report. Boundary- Layer Meteorol 96:337–370

- Falkovich G and Kattepalli R. Sreenivasan (2006) Lessons from Hidrodynamic Turbulence. Physics Today 59: 43-49

- Frisch U (1995) Turbulence the legacy of A.N. Kolmogorov Cambridge University Press 269pp

- Peitgen H, Jürgens H and Saupe D (2004) Chaos and Fractals Springer-Verlag 971pp