

DEVELOPMENT OF A STATISTIC ALGORITHM APPLIED TO LES MODEL

Eduardo Wilde Bárbaro¹, Amauri Pereira de Oliveira², Jacyra Soares³, Edson P. Marques Filho⁴

^{1,2,3}Institute of Astronomy, Geophysics and Atmospheric Sciences – University of São Paulo

⁴Institute of Geosciences – Federal University of Rio de Janeiro

ABSTRACT

The main objective of this work is to develop a statistical algorithm to process all the data generated by the Large-Eddy-Simulation model (LES) in real time. The simulation analyzed here was based on the day-time convective period. Mainly the temperature, specific humidity and velocity components were analyzed. The new statistical algorithm generates all the first and second order statistic moments for “u,v,w,θ,q”, and the components of TKE equation. All these parameters were developed to the resolved and sub-grid scale. The preliminary results indicate a good agreement with the expected vertical and temporal profiles.

Key-Words: LES, Convective Planetary Boundary Layer, Statistical Algorithm.

INTRODUCTION

A model which explicitly simulates the large eddies and parameterize the small is called a LES model, (Moeng, 1984). Using this kind of model is possible understand the PBL most important behaviors like momentum, temperature and humidity turbulent fluxes. The LES code used in this work was proposed by Moeng (1984) and improved by Sullivan (1994) mainly in the sub grid scheme. Understanding this kind of model is possible to simulate several conditions of the planetary boundary layer (PBL) over a stable, neutral or convective situation. The particulates, momentum, temperature and humidity fields, develop a critical role in the environment and can be simulated using LES; see Marques Filho, 2004 and Lu, 2005. These features become the LES an excellent choice to simulate the PBL phenomena.

The main objective of this work is to use the LES model to characterize the proprieties of the Convective PBL, over a horizontally homogeneous domain; moreover a real time statistical algorithm will be implemented to eliminate any kind of post-processing.

¹ BSc.Met (Sponsored by FAPESP.), Rua do Matão, 1226 Tel:(55-11)3091-4702, eduardo.barbaro@usp.br

² PhD, Rua do Matão, 1226, Tel:(55-11)3091-4701, apdolive@usp.br

³ PhD, Rua do Matão, 1226, Tel:(55-11)3091-4711, jacyra@usp.br

⁴ Dr, Av. Athos da Silveira Ramos 274, Tel:(55-21) 2598-9405, emarques@acd.ufrj.br

METHODOLOGY

The simulation presented in this work was generated for a convective PBL, over a spatial domain of 10x10x2Km using 96 grid points, \approx 105m horizontally and 21m vertically. This work simulates 8 hours of convective PBL, (1s time step), and the computer processing time is about 12 hours using a DELL-R900 Intel 2-quad (8 cores total) 12Gb RAM and 1.2 Tb HD. Some improvements were added to LES code, like a real time momentum, humidity and temperature horizontal fluxes calculation; the time evolutions either were improved. An especial overview will be give to the humidity and temperature.

RESULTS

The simulation results is displayed in the figure 1(a,b). The figure 1a shows the main temperature and humidity vertical profiles. The figure 1b shows the humidity and temperature turbulent vertical fluxes.

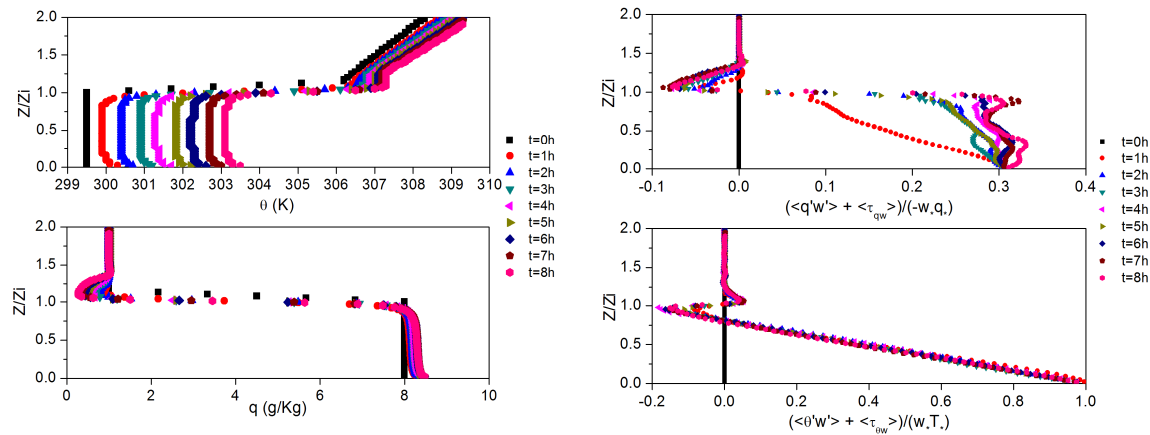


Figure 1: a-) Temperature and humidity vertical profile; b-) Turbulent vertical fluxes of humidity and temperature, (normalized by the characteristic scales). The results are displayed hourly.

The figure 1(a,b) presents the temperature, humidity and vertical turbulent flows expected profiles for a convective PBL during all the day-time period. These results indicate that the statistic algorithm perform satisfactorily in the preliminary simulations.

BIBLIOGRAPHY

- MOENG, C.H. A Large Eddy Simulation Model for the Study of Planetary Boundary Layer Turbulence. *Journal of the Atmos. Sci.* **41**-13: 2052-2062, 1984.
- SULLIVAN, P.P. McWILLIAMS, J.C., MOENG, C.H. A Subgrid-Scale Model For Large-Eddy Simulation of PBL Flows, *Boundary Layer Meteorology* **71** 247-276, 1994.
- MARQUES FILHO, E.P. Dr. Thesis IAG-USP: Investigaç o da CLP convectiva com modelo LES aplicado   dispersao de poluentes, 2004.
- LU, M.L. PhD Thesis CALTECH: Large-Eddy Simulations of Marine Cumulus, Stratocumulus and Study of Humidity Halos and Aerosol Indirect Radiative Effects, 2005.