Numerical investigation of the PBL moisture content in the city of São Paulo using LES

Rafael Lima Valença, Amauri Pereira de Oliveira

Group of Micrometeorology
Department of Atmospheric Sciences, IAG/USP
e-mail: rvalenca@model.iag.usp.br

1. Introduction

The city of São Paulo, together with 38 other smaller cities, forms the Metropolitan Region of São Paulo (MRSP). This region, located about 60 km far from the Atlantic Ocean, is occupied by 20.5 millions of inhabitants and has approximately 7 million of vehicles.

The seasonal variation of moisture field in MRSP is modulated by local climate features associate to geographic position and by urban landuse. Its diurnal evolution is strongly affected by the horizontal advection caused by systematic penetration of Sea Breeze and by the diurnal evolution of urban PBL (Fig 1). In this work the role played by the diurnal evolution of the urban PBL in the moisture content of the MRSP will be investigated using LES model.

2. Numerical simulation

The LES code used in this work was originally proposed by Moeng (1984) and improved by Sullivan *et al.* (1994). The parallelized version was implemented in the cluster R900 Intel 2-quad (8 cores) 12 GB memory and 1.2 Tb HD (Bárbaro, 2010).

A numerical experiment was carried out using a 192×96^2 evenly spaced grid points, distributed over a domain of 2×5^2 km^3. The surface was considered flat and occupied by an homogeneous landuse characterized by aerodynamic roughness of 0.1 m. The simulation was externally forced by a constant geostrophic wind (U_g, V_g) = (5 m s^{-1}, 0 m s^{-1}). All the other initial and boundary conditions correspond to the typical condition observed in the city of São Paulo during winter month of June (Fig. 1).

3. Results

The simulations indicated that PBL reaches a maximum height of 1650 m during daytime and less than 100 m during nighttime (Fig. 2). The simulated diurnal evolution of the moisture flux at the surface (Fig. 3) overestimated the observed in São Paulo during the winter (120-140 Wm^{-2}). The agreement between simulation and observation is better for the profiles of specific humidity show a better (Fig. 4).

4. Acknowledgements

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5. References

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Sullivan, P., McWilliams, J.C., Moeng, C.H., 1994: A subgrid-scale model for large-eddy simulation of planetary boundary-layer flows. *Boundary-Layer Meteor.*, **71**, 247-276.

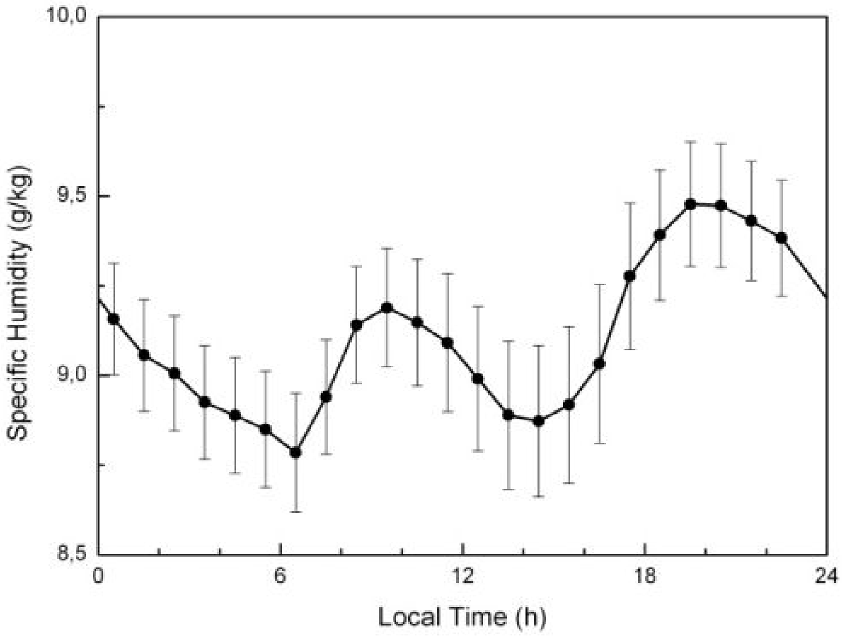

Figure 1. Diurnal evolution of specific humidity observed at the surface in the MRSP in June (2009-2011).

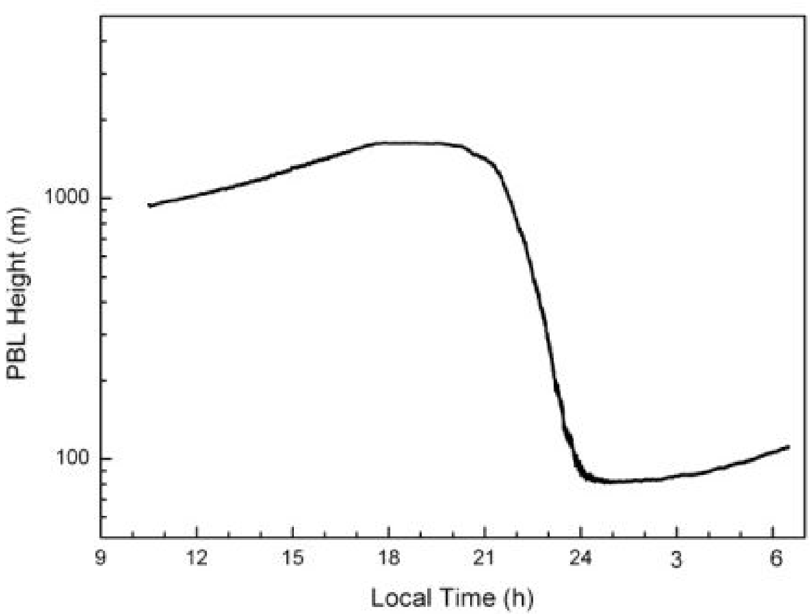

Figure 2. Diurnal evolution of the PBL height simulated by LES Model.

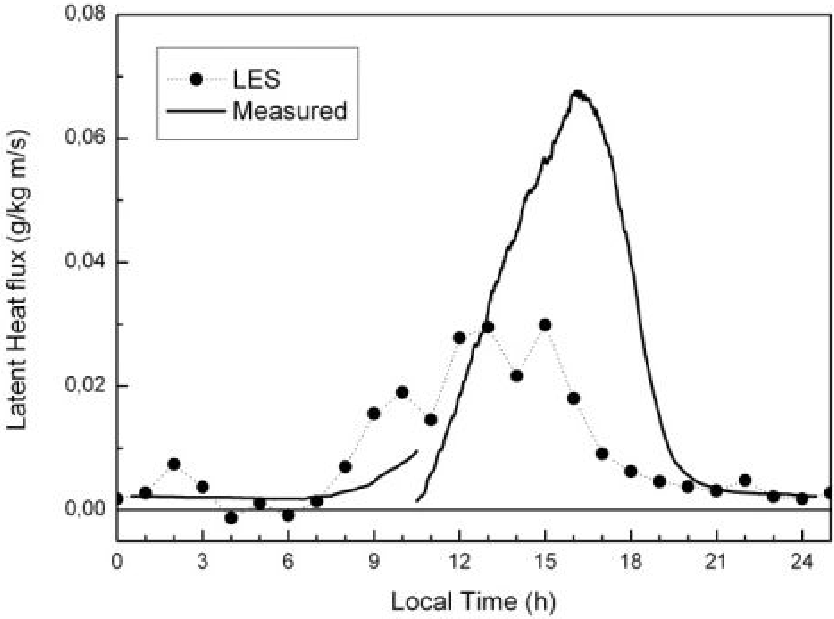

Figure 3. Time evolution of moisture flux at the surface simulated by LES model.

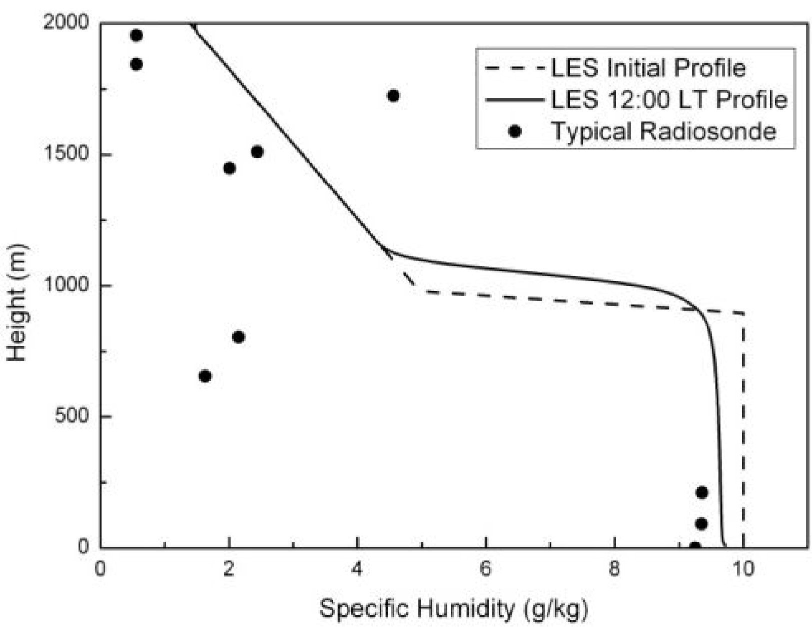

Figure 4. Evolution of vertical profile of specific humidity simulated by LES model. Typical radiosonde was carried out on 06/01/2011 12GMT (Campo de Marte, SP).