EMS Annual Meeting Abstracts
Vol. 12, EMS2015-240, 2015
15th EMS / 12th ECAM
© Author(s) 2015. CC Attribution 3.0 License.

The turbulent fluxes and TKE budget in Amazonia using LES PALM model

Gilberto Fisch (1), Theomar Neves (2), and Sigfried Raasch (3)

(1) Aeronautic and Space Institute, Atmospheric Science Division, São José dos Campos, Brazil (fisch.gilberto@gmail.com), (2) National Institute of Space Research, Sao José dos Campos, Brazil (theomar.neves@cptec.inpe.br), (3) Leibniz Universität Hannover, Hannover, Germany (raasch@muk.uni-hannover.de)

The knowledge of turbulent fluxes and turbulent kinetic energy budget (TKE) is very important for a better understanding of the processes for atmosphere convection, especially in a region strongly influenced by convective systems like Amazonia. Although there are many measurements made during the last 2-3 decades (for instance the LBA Programm), the vertical structure of the turbulent fluxes and TKE are not well measured or know yet. A LES model (named PALM) was used in order to analyse these information over a pasture and forest site in the southwest Amazonia. The simulations were carried out using cyclic lateral boundaries, and Monin–Obukhov similarity theory applied between the surface and the first computational grid level. At the beginning of each simulation, a random generator was used to create small perturbations of the velocity field to initiate or create the turbulence. The simulations were performed with data collected during the Rondonia Boundary Layer Experiment (Aug 15, 1994), starting at 8 Local Time, when the turbulent fluxes are positive and the unstable conditions is the dominant source of turbulence (free convection). This is the period of the dry season. A validation procedure of the LES outputs was made using radiosondes launched throughout the day (12, 18 and 21 UTC) and the results (profiles of potential temperature and specific humidity) showed that the simulations performed reasonable well. The computed surface sensible heat flux in pasture is always higher than forest (usually around 50 W.m-2) and thus producing a stronger and deeper mixture in the atmosphere. This higher flux will produce more convection and rain, if there is sufficient moisture in the atmosphere. For the vertical simulations, the sensible heat flux has a negative peak (-61.3 W.m-2) at 1400 m height at around 14 LT over the forest and at 2000 m (-87.0 W.m-2) for pasture. At this time both places are completely well mixed due to the eddies originated from the surface due to the solar heating. Assuming that the height of the Convective Boundary Layer (CBL) can be estimated as the height of minimum sensible heat flux, these values (1400 m for forest and 2000 m for pasture) agreed well with previous determination of the CBL using radiosondes. These negative fluxes can be associated with the entrainment flux at the top of the CBL (which is very seldom measured in the field experiments) and it is more pronounced over forest than pasture. This is caused by a combination of surface heating (buoyancy), surface roughness (estimated by u*) and windshear at the top of CBL. The components of the TKE (the thermal (TP) and mechanical (MP) production, turbulent transport (TT) and dissipation (D)) were computed from the outputs of the LES model and they have been normalized against u* and height of the boundary layer. For both sites, the TP variable has its maximum at the surface and decrease up to the height of the boundary layer. The MP shows a strong increase between the surface and top of the boundary layer .The TT energy was distributed inside de boundary layer: close to the surface, it is negative and opposite at the top of CBL. The D shows a maximum near the surface (especially during windy conditions), decreasing with the height until reach null value above the top of CBL. These values are similar in magnitude with TT. This paper is a contribution of the Brazilian National Institute of Science and Technology (INCT) for Climate Change funded by CNPq Grant Number 573797/2008-0 e FAPESP Grant Number 2008/57719-9.