Simulations of the atmospheric boundary layer parameters using one dimensional PBL model and its comparison with observations

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This paper presents the numerical simulations of Atmospheric Boundary Layer [ABL] parameters over Gadanki using 1 D time dependent ABL model. The Oregon state university (OSU) one-dimensional Coupled Atmospheric plant –Soil (CAPS) model used in the present study take into account the interactions of the atmospheric boundary layer, vegetation and soil. The model simulated values of atmospheric boundary layer parameters viz, height, horizontal wind components, potential temperature and specific humidity are compared with the Radiosonde, GPS sonde, Tethersonde and LAWP observations over Gadanki. As a method for quantifying the comparison of model simulations with the observed data, RMS (root mean square) errors have been computed from mean profiles, for each simulation. Sensitivity studies are carried out to check the effect of change in Albedo, roughness length and the effect of subsidence in the performance of ABL simulations. Sensitivity studies show that the Albedo and roughness length for momentum, heat and moisture appear to be sensitive parameters for the accurate prediction of latent and sensible heat fluxes. This is particularly important because a change in fluxes can influence the ABL height. It is seen that the variations in Albedo greatly influence the model-simulated values of fluxes, temperature, ABL height and profiles of various parameters. The changes in roughness length of momentum, heat and moisture also influence the exchange coefficients and hence the fluxes especially in the day time boundary layer. Along with the boundary conditions at the surface, the external forcing at the top of the boundary layer, such as subsidence seems to influence the ABL height very much. The ABL simulations showed good agreement with the observations made using wind profiler and the tethersonde. RMS difference seems very reasonable. The sensible heat flux estimated using vertical wind variance and those predicted by the model also show good agreement. The difference between the model results and the observation can be attributed to the modifications in the air mass during integration period. The difference between the simulated and observed wind velocity profiles can be attributed to the omission of the several physical factors such as mesoscale advection and the variation of synoptic changes during integration period.