

EGU22-11061

<https://doi.org/10.5194/egusphere-egu22-11061>

EGU General Assembly 2022

© Author(s) 2022. This work is distributed under the Creative Commons Attribution 4.0 License.



Performance of two planetary boundary layer parameterizations in the NCAR-CAM5 climate model over different climatic zones within Indian land

Prabhakar Namdev, Maithili Sharan, and Saroj Kanta Mishra

Centre for Atmospheric Sciences, Indian Institute of Technology Delhi, New Delhi, India

In the present study, an effort has been made to investigate the performance of two planetary boundary layer (PBL) schemes available in the NCAR-CAM5 climate model. The available schemes are the Holtslag and Boville (HB) scheme and the University of Washington (UW) scheme. The HB scheme considers surface heating because of incoming solar radiation to be the origin of turbulent motion in the PBL. However, the UW scheme is a 1.5-order local TKE (turbulent kinetic energy) closure scheme. It considers the increased turbulent activity region associated with the buoyancy perturbations because of the cloud-top entrainment instability and longwave cooling present at the stratocumulus-topped PBLs.

The evaluation was carried out by conducting two simulations with the NCAR-CAM5 climate model over six years using HB and UW PBL schemes with a horizontal resolution of 1° . The last five years of the simulation are used in the analysis, discarding the first year as spin-up. The study evaluates the performance of two PBL schemes during the DJF (December–January), MAM (March–May), JJA (June–August), and SON (September–November) seasons over different climatic zones that exist within Indian land. The study reveals that the spatial distribution of sensible and latent heat fluxes, 2-m temperature, wind speed at 925 hPa and 200 hPa, and precipitation produced by both the schemes are consistent with ERA-interim reanalysis data. The UW scheme, when compared to the HB scheme, shows significant heating over the South Indian region during all seasons except DJF. It significantly reduced the cold bias present over the South Indian region. The UW scheme is favorable for simulating precipitation over central and north-east India, mostly during JJA. However, it significantly increased the positive bias over the western ghats and the north and south Indian regions during JJA. It also increased the positive bias over south India during SON. Both the schemes performed almost similar for precipitation during DJF and MAM. In case of sensible and latent heat fluxes, both the schemes have a more or less similar distribution of biases in all the seasons, with a slight difference in magnitude. As far as wind is concerned, both the schemes use a reasonable approach to the positioning of jets and observed monsoon flow with a slight difference. The UW scheme significantly reduced the existing negative bias in the HB scheme for wind speed at 925 hPa during JJA. Further, recommendations have been made for the performance of two PBL schemes over different climatic zones within Indian land.

References:

- Holtslag, A. A. M., and B. A. Boville, Local versus nonlocal boundary-layer diffusion in a global climate model, *J. Climate*, 6, 1825–1842, 1993.
- Bretherton, C. S., and S. Park, A new moist turbulence parameterization in the community atmosphere model, *J. Climate*, 22, 3422–3448, 2009.

Keywords: PBL parameterization, Climate model, surface turbulent fluxes, precipitation