Assessing PBL parameterization schemes performance over the Central Amazon Basin during Go Amazon 2014/5

José Antônio Mantovani Jr. [1] ; José Antônio Aravéquia[1] ; Gilberto Fisch[2] ;

[1] National Institute for Space Research (INPE) – Brazil - jamantovanijr@gmail.com / jose.aravequia@inpe.br

[2] University of Taubaté (UNITAU) – Brazil – fisch.gilberto@gmail.com

INTRODUCION

Numerical weather prediction models include the effects of vertical subgrid-scale turbulence through planetary boundary layer (PBL) parameterization schemes, which performance relies on meteorological conditions and geographical features. Although the recognized importance of PBL schemes to accurate weather forecasting, climate studies, and air quality modeling, few studies assessed its performance over the Amazon rainforest so far. This study compares eleven PBL schemes in the Weather Research and Forecasting (WRF) model for wet and dry conditions during a typical year (2014) in the central Amazon basin. Short-term forecasts were performed for both periods and the performance of PBL schemes from the 1-km resolution domain was assessed using detailed observations from the Green Ocean Amazon field campaign (GoAmazon2014/5).

METHODOLOGY

The observations were collected in site named T3 (3ºS, 60ºW, 50 m) surrounded by a native forest with about 35 m of canopy height situated nearby the intersection of Rio Negro and Solimões rivers in, Brazil. It was the most comprehensively instrumented site of the GoAmazon2014/5 campaign (Martin et al., 2016). The measurements were sampled to represent 2014 rainy and dry seasons. The numerical experiments were performed using the state-of-the-art WRF model version 4.2.2. Its domain consists of three one-way interacting nested grids with a spacing of 9 (d01), 3 (d02) and 1 km (d03), respectively (Figure 1a). All forecasts starts from 00 UTC and are integrated continuously for 72-h leading to a 60-h analysis period after spin-up time exclusion (12-h). The PBL schemes are 1D parameterization schemes developed to handle the vertical subgrid-scale fluxes in the atmospheric column. The 11 testes PBL schemes were split between local (BouLac, GBM, MYJ, MYNN2.5, MYNN3, UW) and non-local parameterizations (YSU, MRF, ACM2, SH, QNSE).

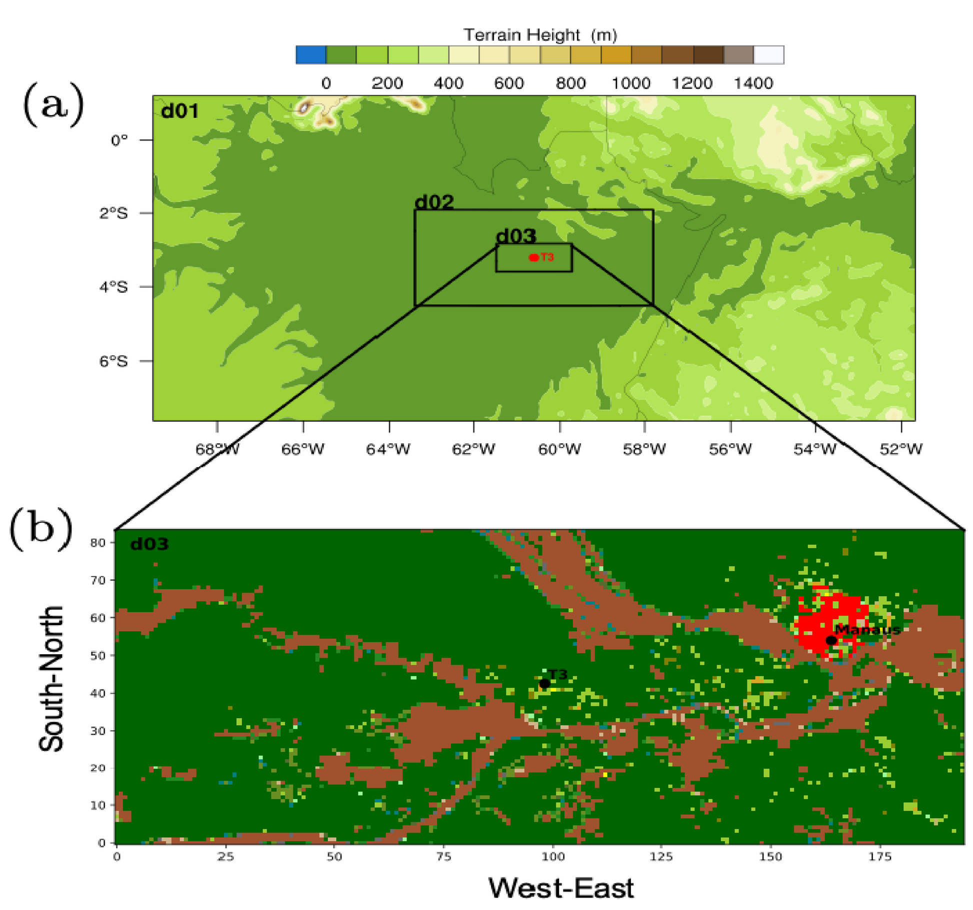

Figure 1: The model configuration topography for domain (d01) in (a) and land-use categories for the inner domain (d03) according to MODIS data in (b).

RESULTS

The main results are shown in the next Figures. Figure 2 shows the time series of the heights of PBL. The Figure 3 shows the profiles of the thermodynamics and windspeed. The Figure 4 shows some of the statistics computed (Taylor diagram) and Figure 5 shows the spatial field of the PBL heights. All graphics are for wet (left) and dry (right) periods.

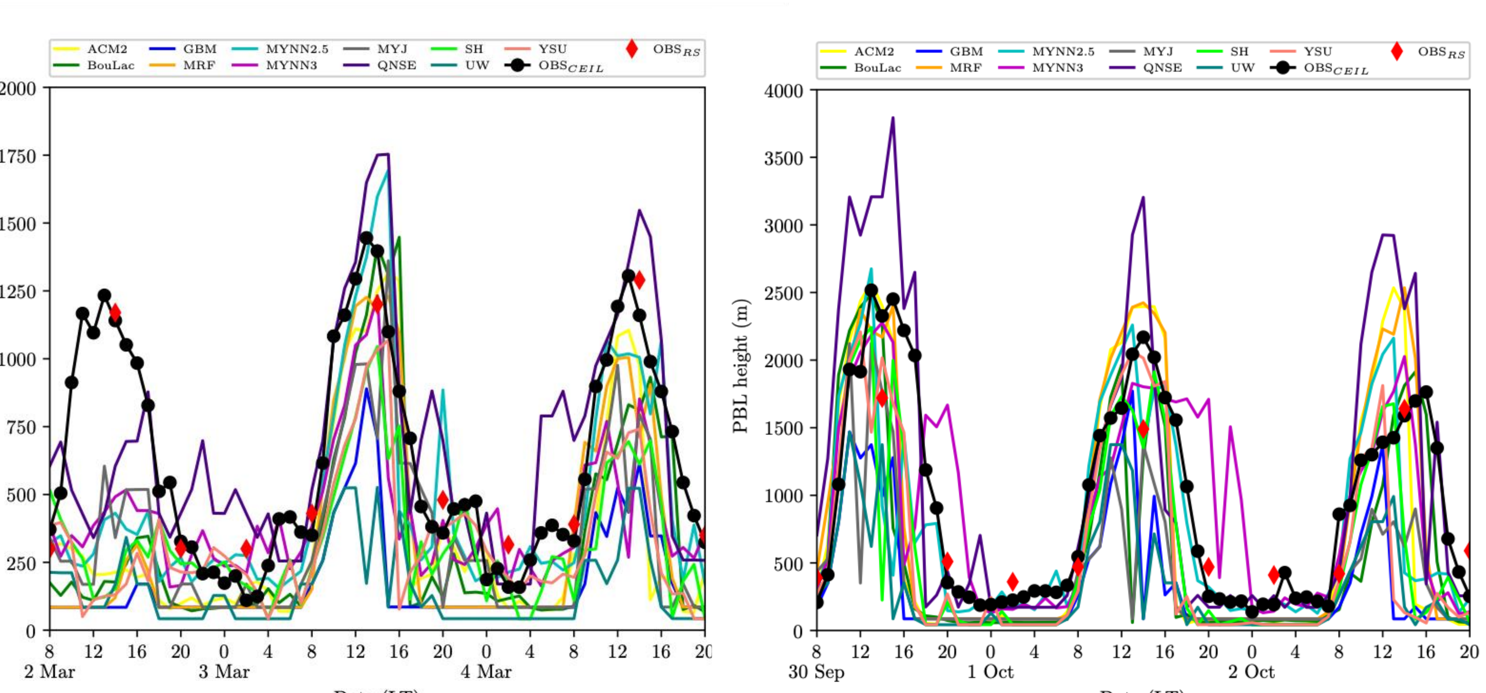

Figure 2: Time Series of the height of PBL (observations and 11 PBL schemes) for wet (a) and dry (b) period.

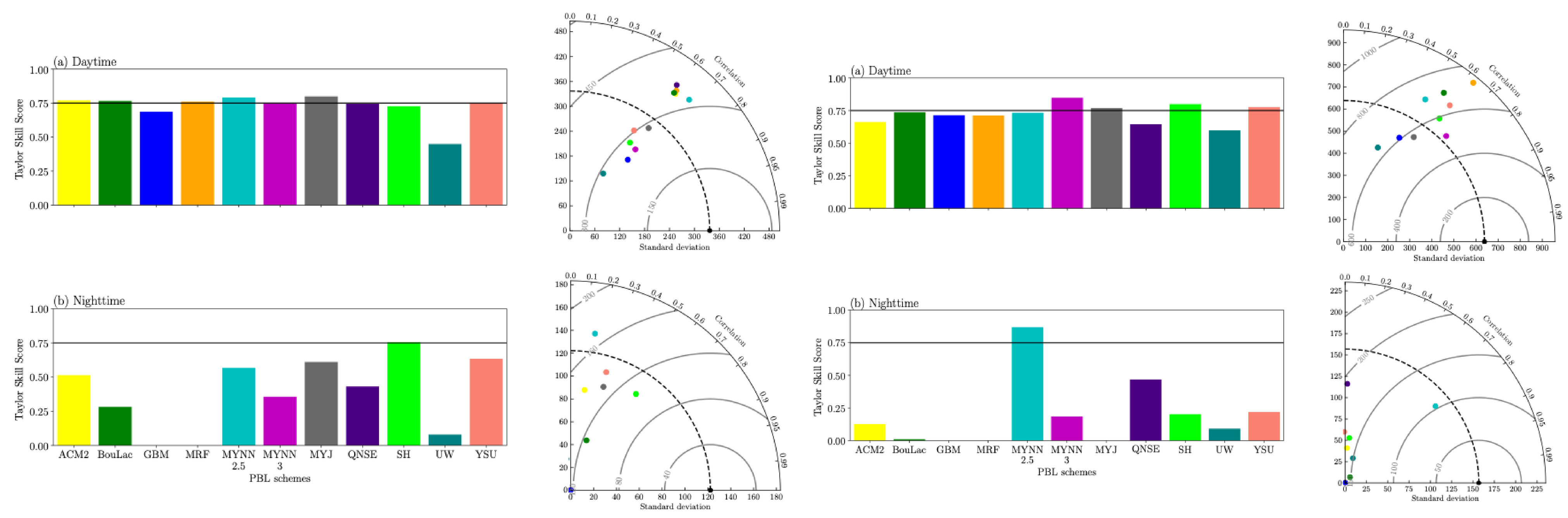

Figure 3: Metrics computed for all 11 PBL schemes for wet (a) and dry (b) periods.

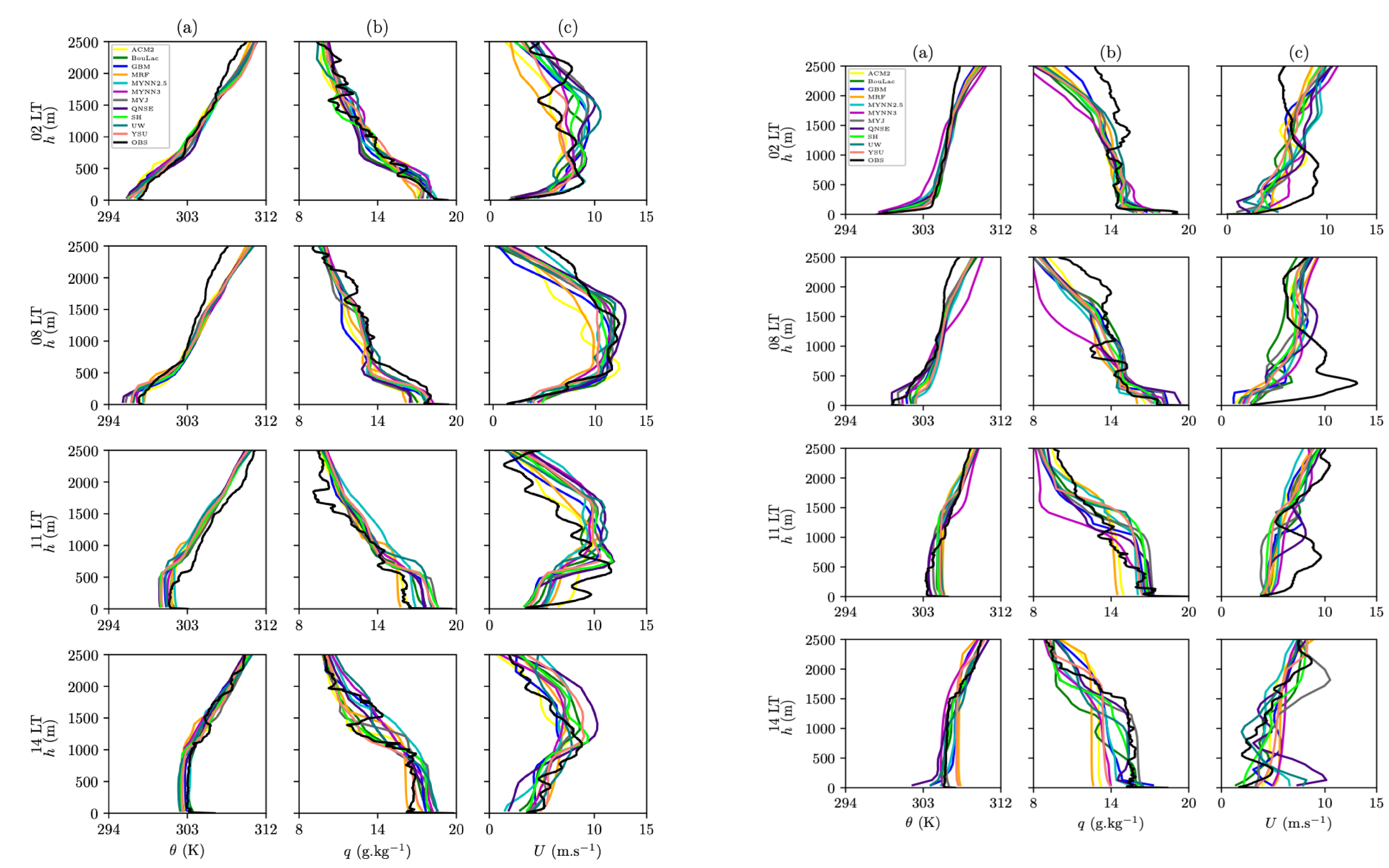

Figure 4: Profiles of potential temperature, specific humidity and windspeed for wet (a) and dry (b) periods.

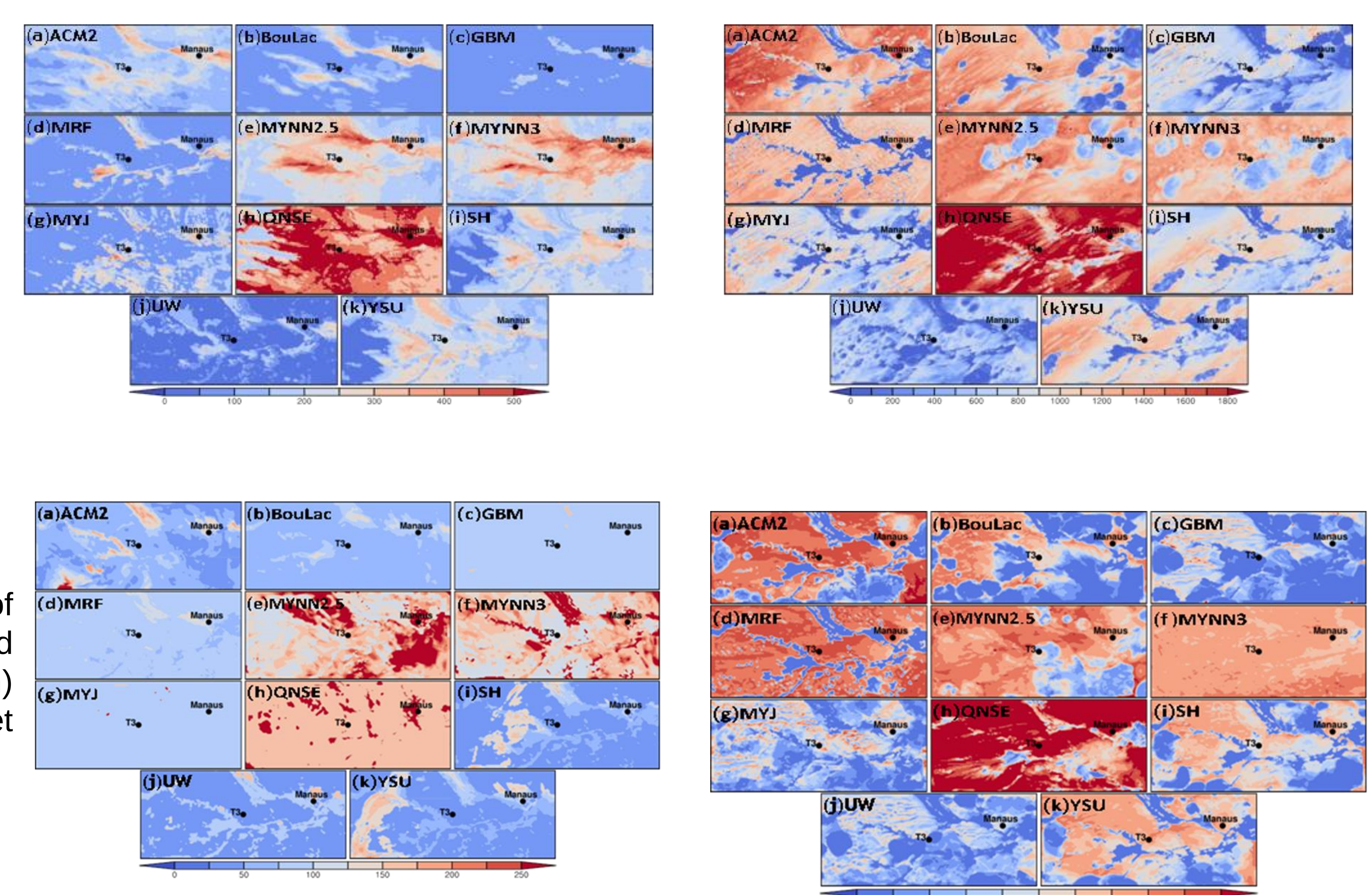

Figure 5: Spatial field of the PBL heights for nighttime/stable (02 LT) and daytime/unstable (14 LT) for wet (a) and dry periods.

FINAL REMARKS

The analysis revealed that diurnal PBLH is better predicted than nocturnal, independently of the period. We recommend SH as the preferable PBL scheme in both daytime and nighttime periods for wet period. For the dry period, altough most PBL schemes underestimated the observations, we recommend MYNN3, MYJ, SH, and YSU to predict the diurnal PBLH. For nighttime, the MYNN2.5 presented the best performance.