

Effects of Soil Moisture and Boundary Layer Parameterizations on Precipitation in Regional Climate Simulations over the Rocky Mountains and High Plains

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1. Introduction

Regional climate simulations are performed in June 2004 with the WRF model to study the effects of soil moisture and boundary layer parameterizations on precipitation. Convection is parameterized in simulations on 5-km resolution grid with an ensemble of closures based on varying assumptions (Grell and Devenyi 2002). Turbulence is parameterized with a 2.5 order closure (Mellor-Yamada-Janjic, Janjic, 2001, MYJ) and a bulk scheme (Yonsei University, Hong and Dudhia, 2004, YSU), and Noah (Ek et al., 2003) and RUC LSM (Smirnova et al., 2002) land surface models to calculate surface fluxes are used. Initial conditions for the atmospheric and the land surface models are obtained from the RUC analysis.

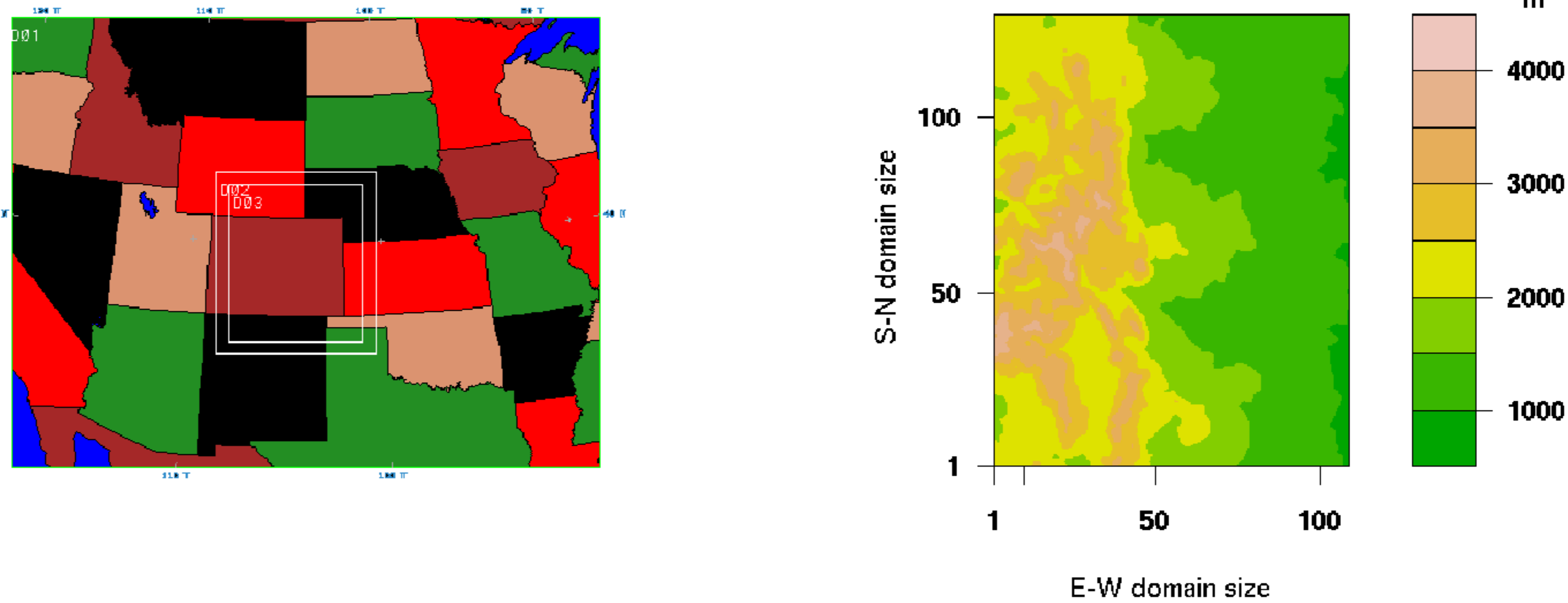


Figure 1. Simulation domains: D01 – 20-km resolution grid, D03 – 5-km resolution subgrid and its topography.

2. Observations

Accumulated precipitation in June 2004 using a .25 degree resolution CPC analysis (gauges) and STAGE4 data (radar and gauges) is presented in Figure 2.

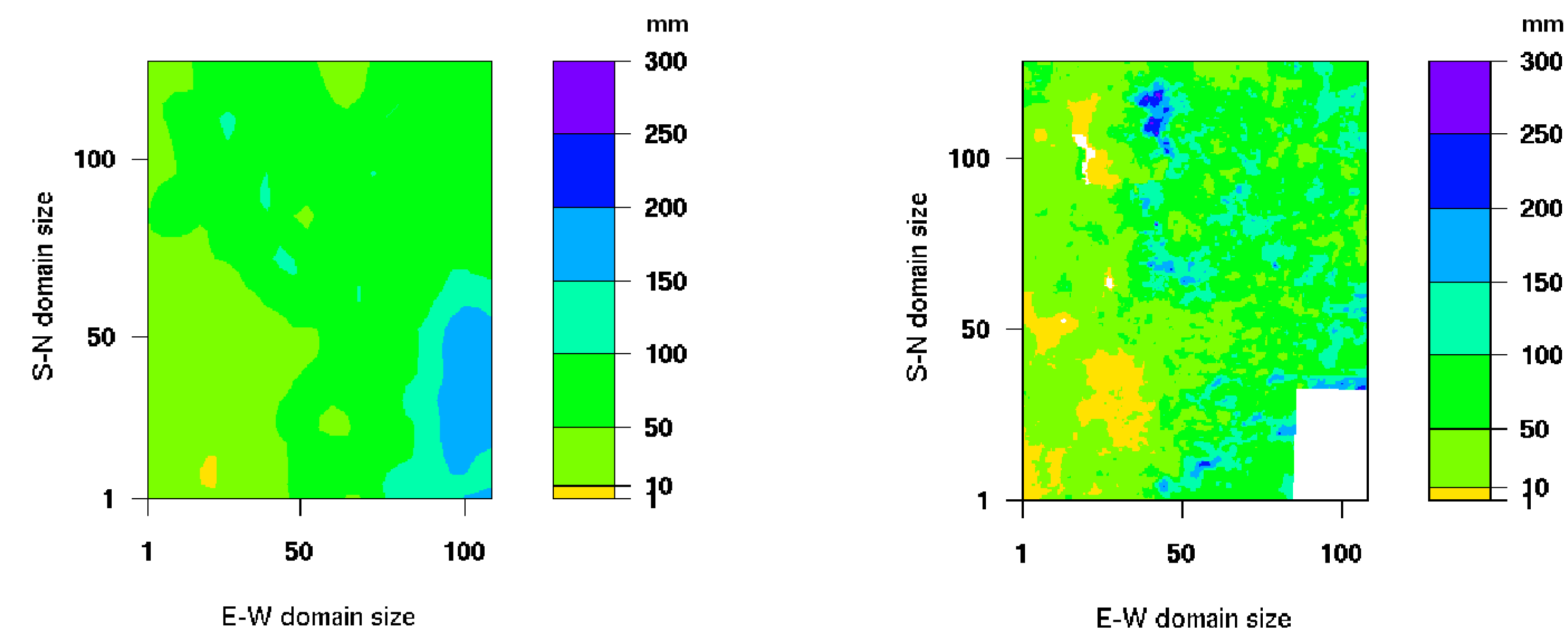


Figure 2. Observed monthly accumulated precipitation in June 2004 from the CPC and STAGE4 data

3. Sensitivity Studies

Initial soil moisture obtained from the RUC analysis does not differ significantly from the minimum values allowed for a given soil type. Sensitivity of precipitation to the initial soil moisture is studied by assigning maximum soil moisture for a given soil type.

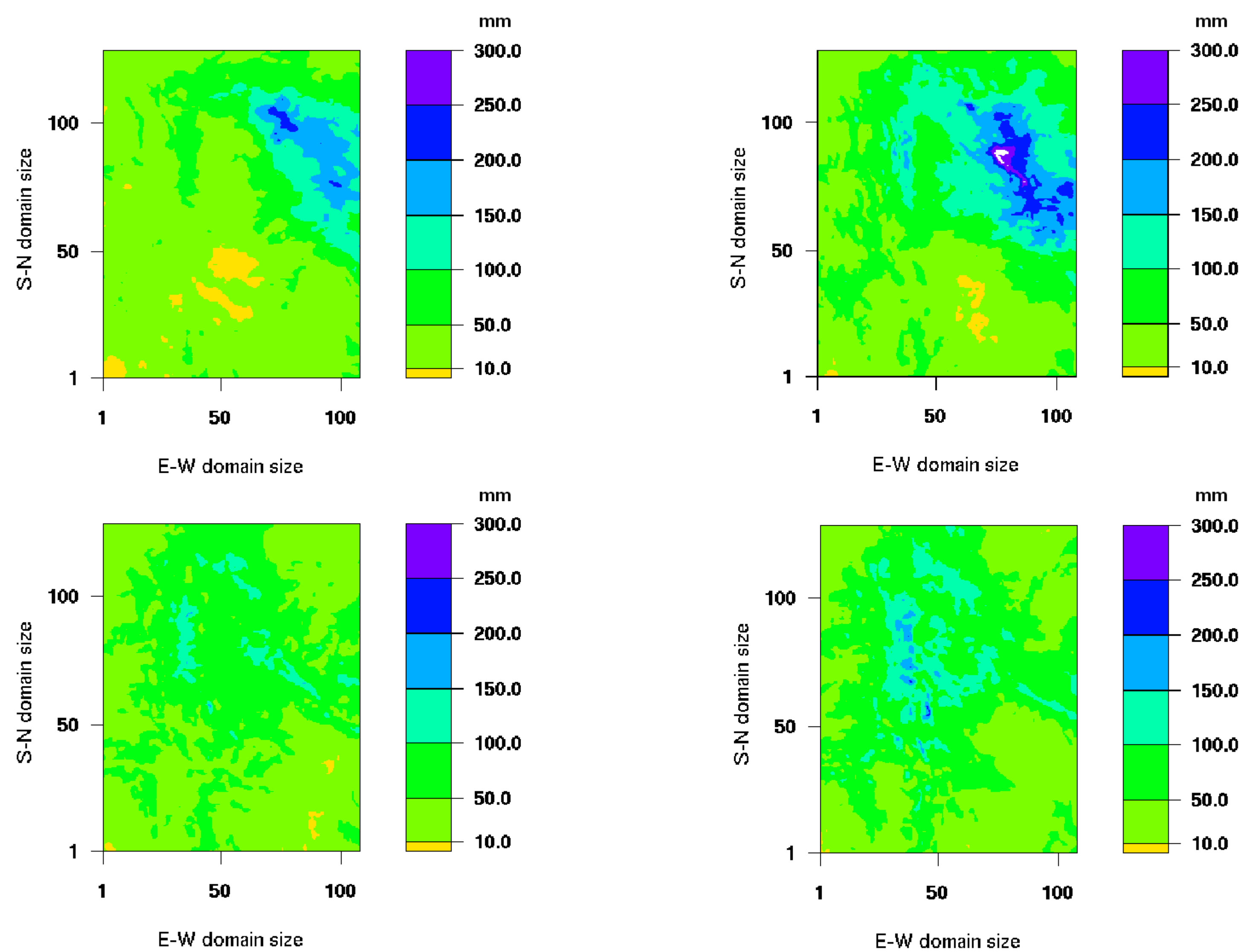


Figure 3. Sensitivity to the initial soil moisture and different surface and boundary layer parameterizations. Columns from the left: RUC derived soil moisture, maximum soil moisture. Rows from the top: YSU with RUC LSM, MYJ with Noah.

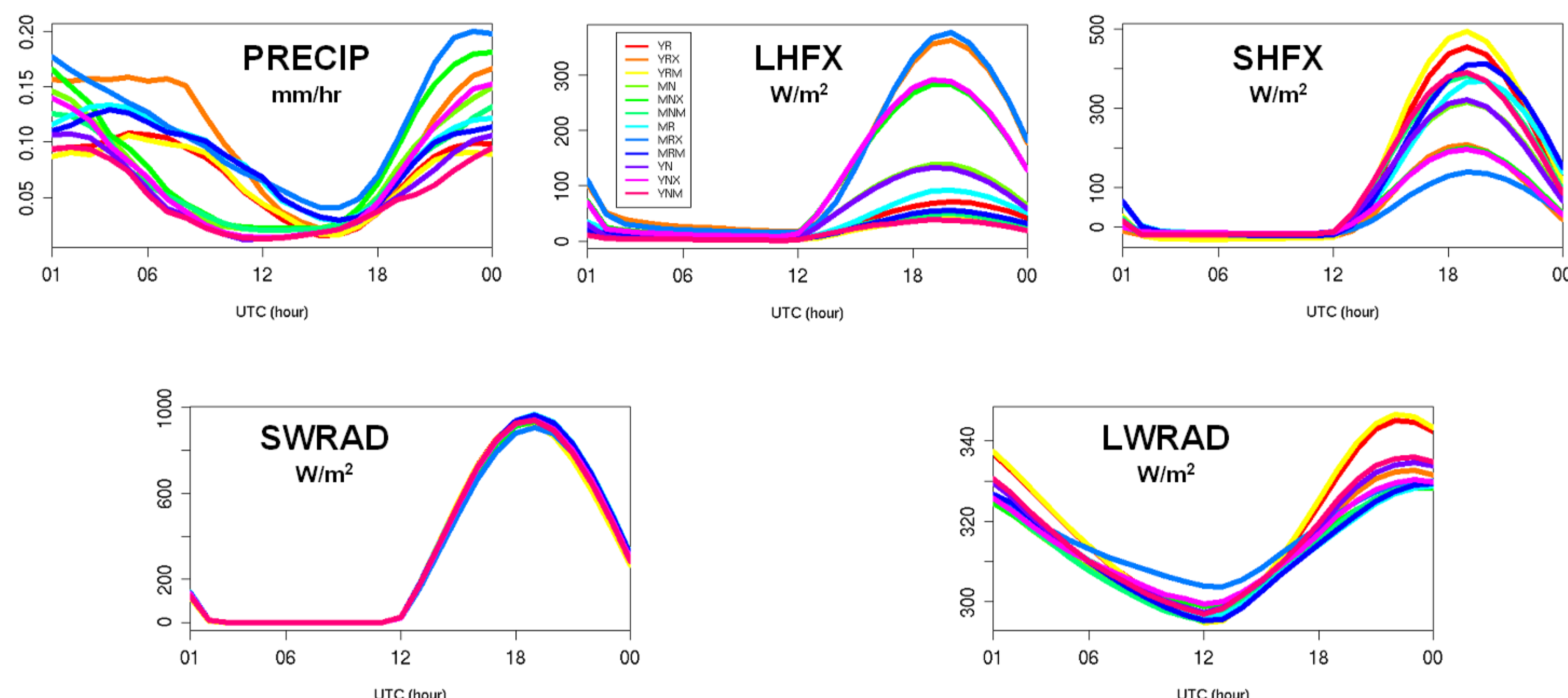


Figure 4. Diurnal variation of domain averaged precipitation, latent heat flux, sensible heat flux, shortwave and longwave radiation at the surface.

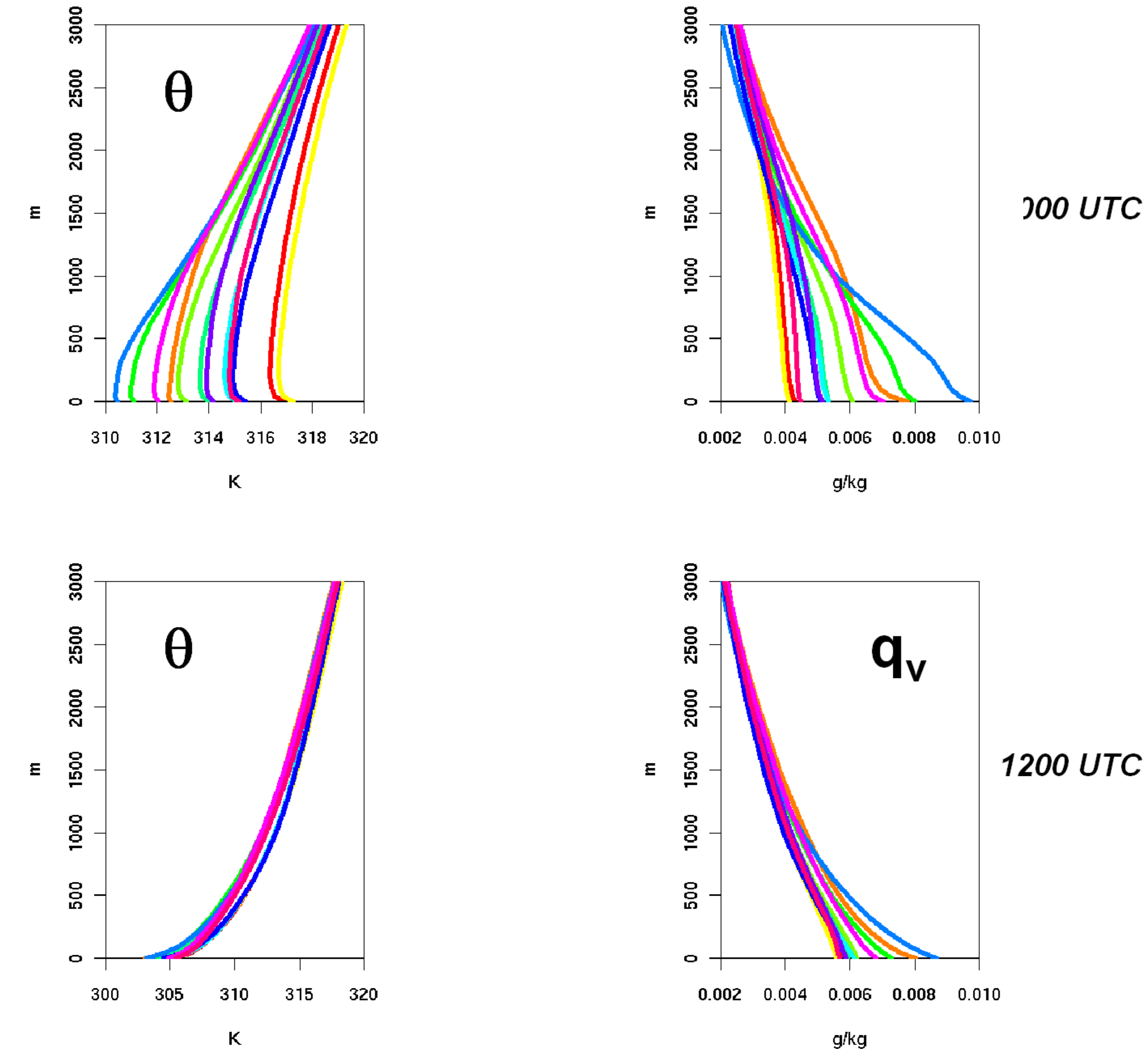


Figure 5. Domain averaged vertical profiles of potential temperature and water vapor mixing ratio at 0000 UTC and 1200 UTC.

4. References

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