Sensitivity analysis of the different land surface

Parametrizations available in the WRF model

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Introduction

Land-atmosphere feedbacks are very important in order to understand local and regional scale climate variability and meteorology. In general, the skill of limited-area models depend on their ability to represent the main physical processes involved in land-atmosphere interaction.

In this work we evaluate the skill of the WRF model with different land surface schemes simulating the skin and air temperature in the Aburrá Valley (located in the Colombia`s Andes) and nearby regions.

Data and Simulation methodology

Experimental Setup:

Climatological limited-area runs varying land surface parameterizations (NOAH, Thermal diffusion, Pleim and Xiu and Rapid Update Cycle schemes)

Boundary conditions:
Nine-year average of NCAR FNL.

Land Surface Scheme, Analysis

Boundary conditions:
Nine-year average of NCAR FNL.

27sigma levels and 6 hour time interval

Land-use modification. 18 km resolution

2 km resolution

MODIS Coverage
WRF Domain configuration
Automatic Weather Stations

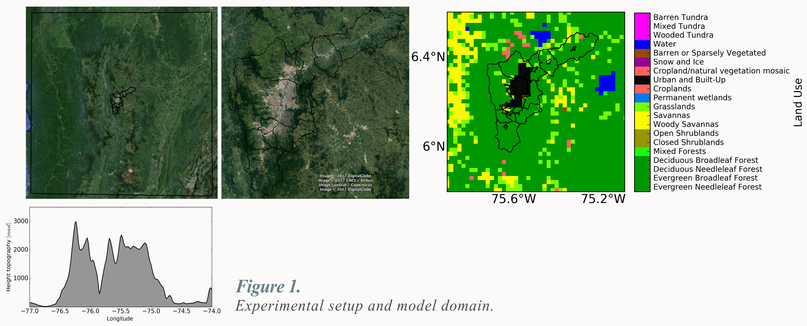

Figure 1.
Experimental setup and model domain.

MODIS Skin-Temperature Diurnal Cycle

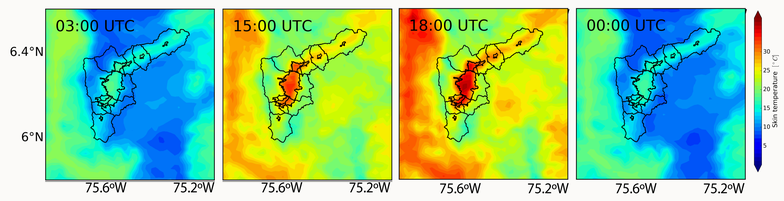

Figure 2. MODIS
Skin Temperature Diurnal Cycle

Results: SkinTemperature Differences

Skin temperature **differences** ($TSK_{MODIS} - TSK_{par}$)

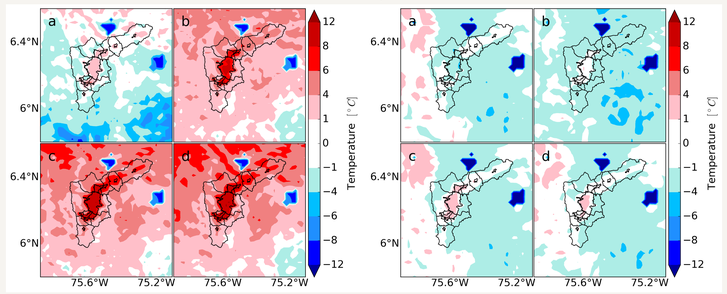

Figure 3.
a: NOAHLSM, b: Thermal diffusion, c: Pleim and Xiu and d: Rapid Update Cycle

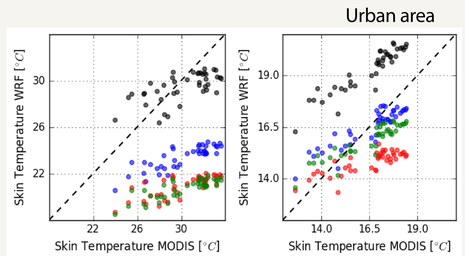

Figure 4.
Skin Temperature validation for all urban pixes and for Land Surface Schemes: NOAH, Thermal diffusion, Pleim and Xiu and Rapid Update Cycle

Air Temperature diurnal Cycle

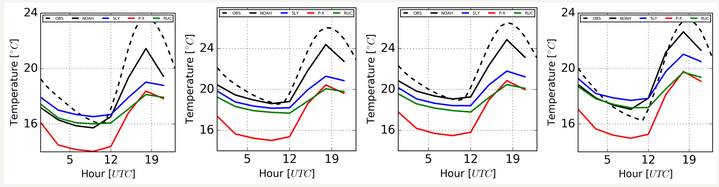

Figure 5.
Model Air Temperature (Different Land Surface Schemes) vs. Weather Stations records

Relative Humidity diurnal Cycle

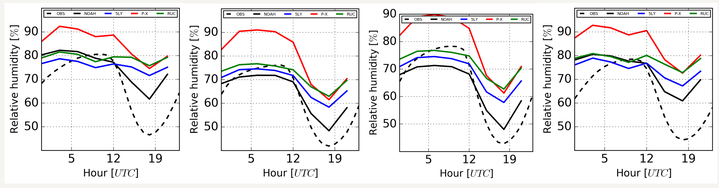

Figure 6.
Model Relative Humidity (Different Land Surface Schemes) vs. Weather Stations records

Results: Turbulent Fluxes

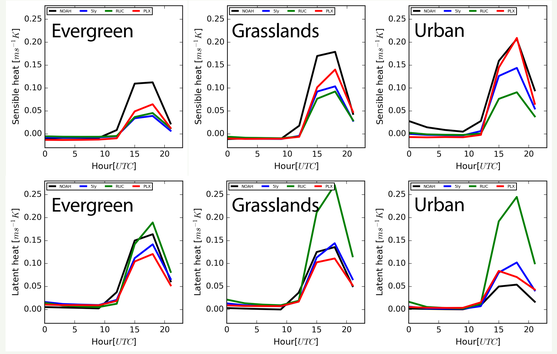

Figure 7.
Model kinematic sensible and latent heat fluxes for different land uses and different land surface schemes.

Surface Turbulent Flux Validation

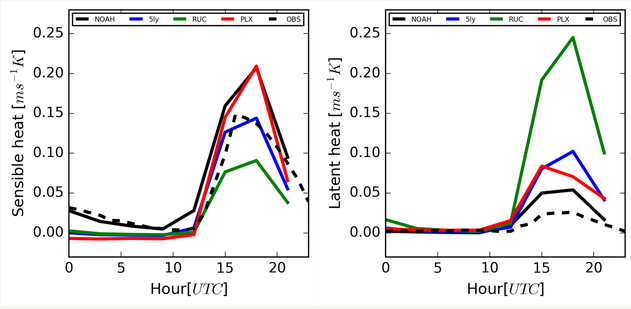

Figure 8.
Surface and latent heat flux validation for urban areas: Model simulated fluxes are compared to turbulent flux measurements at a representative urban site using a Campbell CSAT3 sonic anemometer and a Campbell KH20 higrometer

Conclusions

The relevance and influence of land -atmosphere interaction in weather forecasting applications using limited area models is often overlooked. Land surface schemes play an import role in the accurate simulation of energy, momentum and mass exchanges at the surface. In our model sensitivity experiments the choice of land surface scheme has a considerable impact on the accuracy of simulated surface temperate, relative humidity, surface turbulent fluxes and other variables.

Comparison with observations evidences differences between observed and simulated surface variables for different variables throughout the diurnal cycle. Evidence suggest that surface turbulent fluxes, and in particular latent heat fluxes, are poorly simulated by the model, affecting the simulation skill.

The experiments suggest that the best land surface scheme for our region is the NOAH

Acknowledgements

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