1 Introduction and Background

Several recent studies have shown the importance of land surface atmosphere coupling in the monsoon system of the West Africa. The African Monsoon Multidisciplinary Analysis (AMMA) has provided an opportunity to investigate model deficiencies in land surface processes by providing high resolution datasets. In participation with the AMMA Land Surface Model Inter-comparison Project Phase 2 (ALMIP2), a global land surface model is regionalized for conducting a high space-time resolution (0.05°×30 minutes) experiment over three distinct meso-scale domains in West Africa (see Fig.1).

The objective of this research is to investigate the impacts of uncertainty on the surface fluxes and hydrological responses through LSM. Specifically, we estimate the uncertainty in observed precipitation due to different interpolation methods (Lagrangian-krigged and Thiessen) and its propagation to the simulated evapotranspiration and runoff.

2 Methodology

Our approach is to investigate the propagation of precipitation uncertainty in terrestrial hydrological modeling. The propagation of precipitation uncertainty is conducted through three distinct inter-comparison phases in West Africa (Benin, Niger, and Senegal). Under the auspices of UNESCO, Tsukuba, Ibaraki, Japan, the terrestrial hydrological model MATSRO (Model of Atmospheric Transport, Surface Intermittency and Runoff) is used.

5 Propagation of Uncertainty in Forcing Data through LSM Simulation

For monthly variation, large range and relatively lower values of $\Omega_p$, $\Omega_{\Delta p}$, and $\Omega_{\Delta\text{runoff}}$ in Benin (cleared forest) indicate that evapotranspiration (and its components) is more sensitive to $\Omega_p$ compared to that in Niger (semi-arid). Inversely, Niger shows steeper slope between $\Delta p$ and $\Omega$, which means in semi-arid region, uncertainty of simulated runoff is larger compared to cleared forest. Cleared forest and semi-arid regions have opposite tendency in the uncertainty propagation for ET, $\Omega_{\Delta p}$, and runoff, $\Omega_{\Delta\text{runoff}}$ as presented in Fig. 5. Generally negative values in Benin illustrate that the uncertainty in precipitation is propagated in an amplified way. However, the generally positive values in Niger show that uncertainty translates relatively reduced in ET. Negative values of $\Omega_p$ in Benin and Niger, show that uncertainty propagation for runoff is amplified through land surface simulation.

4 Similarity of Two Interpolation Scheme

Fig 4. Simulation of evapotranspiration and runoff forced by Lagrangian-krigged and Thiessen rainfall.

Fig 3. Comparison of similarity of ensemble members ($\Omega_p$, $\Omega_{\Delta p}$, and $\Omega_{\Delta\text{runoff}}$) in Benin and Niger (monthly variation).

The high values of $\Omega_p$ in Benin (cleared forest) compared to that in Niger (semi-arid) can be explained by the higher spatial heterogeneity and its relative lower values demonstrate that simulated runoff tends to have inconsistent temporal variability.

References

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