H51D-02

An Initial Assessment of Soil Moisture Fields Simulated by the Noah Land Surface Model

Valentine Anantharaj and Georgy V. Mostovoy

Mississippi State University, Starkville, Mississippi
E-mail: val@gri.msstate.edu

Paul R. Houser

George Mason University, Fairfax, Virginia

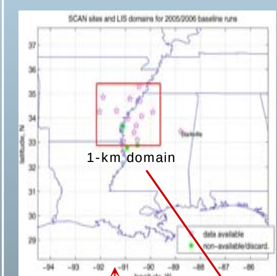
Christa D. Peters-Lidard and Bailling Li

NASA/GSFC, Hydrological Sci. Branch, Greenbelt, Maryland

Introduction

Soil moisture estimates are considered as a valuable input for various environment models including weather forecasting, water management, agriculture, and forestry applications. Generally, the network of soil moisture observations is not dense (typically only few observation points are available within each state) enough to meet the spatial resolution requirements of these applications. Therefore, several approaches were developed to generate soil moisture fields. One approach utilizes Land Surface Model (LSM) offline simulations with a prescribed atmospheric forcing to produce high-resolution surface fields. This study reports results of comparison between soil moisture fields produced by LSM simulations and point soil moisture measurements.

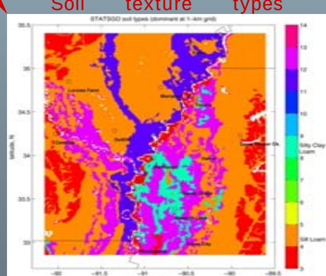
Model



Computational domain with 15 km grid spacing

The **NOAH** LSM (Ek et al., 2003) available within the state-of-the-art Land Information System (**LIS**) developed at NASA Goddard Space Flight Center (Peters-Lidard et al., 2004, Kumar et al., 2006) was configured at 0.01°x0.01° latitude-longitude resolution (approximately 1x1 km²) over a domain covering the lower part of the Mississippi Delta. Additional runs were performed over a larger area at 15 km grid spacing.

Soil texture types

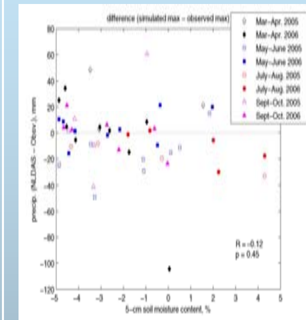


The North American Land Data Assimilation System (**NLDAS**) data (Cosgrove et al., 2003) were used to force the NOAH model. The NOAH/LIS simulations of soil moisture at the 1-km and 15-km grids were compared with point measurements.

Twelve Soil Climate Analysis Network (SCAN, 2006) sites supported by the USDA Natural Resources Conservation Service were used for verification.

Results

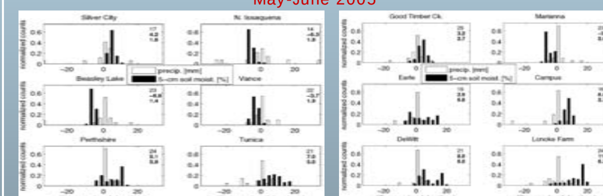
1. Sensitivity of simulated SM maximum (at 5-cm depth within 2 months) to precipitation forcing error



Error distributions of the simulated 5-cm soil moisture (SM) content and of NLDAS precipitation forcing were examined. Daily-mean values were used for examination. Histograms depicting these distributions for each of 12 SCAN sites, which are grouped into two-months periods spanning from March to October and years 2005 and 2006 were analyzed.

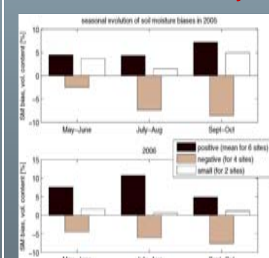
- ❑ No apparent relationship was found between precipitation and 5-cm SM bias.

May-June 2005



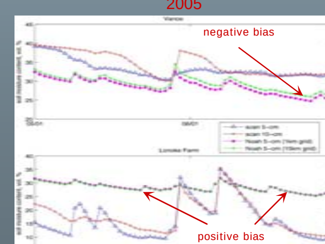
Soil moisture standard deviation – bottom number; bias error – middle.

2. SM bias seasonality and dependence on grid size



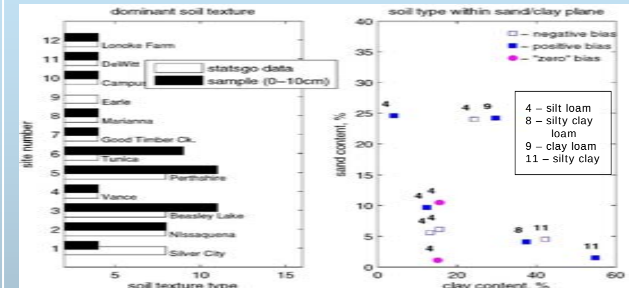
- ❑ SM fields simulated at 15 km grid agree closely with those simulated at 1 km.

2005

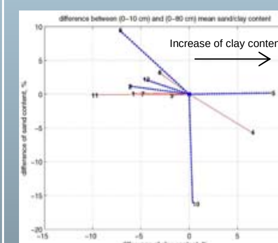


3. Influence of soil texture

Local scale variability of soil texture — Impact on 5-cm SM bias



Vertical heterogeneity of soil texture (numbers stand for scan sites)



- ❑ Because of relatively high persistence (across different years and months) of a bias sign at a particular scan site it is possible to stratify all scan sites into three category (with significant positive, negative, and small/zero bias) according to this sign.
- ❑ No association between the soil texture (and its variability with depth) and a sign of the SM was observed.

Summary

Both positive and negative significant SM biases occurred mostly during drying stages of soils' matter. This fact suggests that an accurate description/specification of other factors (such as upper/lower boundary conditions for the SM, atmospheric evaporation, etc.) in addition to precipitation forcing is critical for reduction of the SM error. This fact also implies existence of a local SM variability component (at scales of hundred meters) that cannot be resolved by the NOAH model.

Acknowledgments

The research is sponsored by the NASA-funded GeoResources Institute at Mississippi State University, Mississippi State, MS. We appreciate timely consultations provided by the LIS Helpdesk (Drs. Sujay Kumar and Yudong Tian). We acknowledge an effort of the USDA Natural Resources Conservation Service for maintaining the SCAN data webpage.

References

Cosgrove, B.A. and Coauthors, 2003: Real-time and retrospective forcing in the North American Land Data Assimilation System (NLDAS) project. *J. Geophys. Res.*,**108**, D22,12pp.

Ek, M.B., K.E., Mitchell, Y., Lin, E., Rogers, P., Grunmann, V., Koren, G., Gayno and J.D., Tarpley, 2003: Implementation of NOAH land surface model advances in the National Centers for Environmental Prediction operational mesoscale Eta model. *J. Geophys. Res.*,**108**, D22, 16pp.

Kumar, S.V. and Coauthors, 2006: Land Information System – An interoperable framework for high resolution land surface modeling. *Environmental Modelling and Software*, **21**, 1402-1415.

Peters-Lidard, C.D., S.V., Kumar, Y. Tian, J.L., Eastman, and P.R. Houser, 2004: Global Urban-Scale Land-Atmosphere Modeling with the land Information System. In Proc. 84th AMS Annual Meeting, Seattle, WA, 13 pp., 11-15 Jan., 2004.

GeoResources Institute GRI