P88. Development of an Objective High Spatial Resolution Soil Moisture Index

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1. MOTIVATION

- **Flash droughts, flood and fire potential are a few of the nowcasting and hydrologic challenges for forecasters and decision makers**
- **Current soil moisture analysis products are limited by spatial resolution and/or product latency for optimal use in nowcasting environments**
- **Relative soil moisture from NASA/SPoRT's current analysis needs to be placed into a climatological context**
- **Objective: Develop a real-time, high-resolution soil moisture index product that provides climatological context to aid decision makers with the following features:**
  - sub-county spatial resolution
  - produced daily; available same day
  - displayable in forecaster decision support tools to enable overlay of other variables (e.g., forecast precipitation, lightning, etc.)

2. LAND INFORMATION SYSTEM (LIS) COUNTY CLIMATOLOGY

- **SPoRT runs the Noah Land Surface Model (LSM) in uncoupled/analysis mode to produce real-time, hourly land surface output**
- **These real-time, daily runs are then compared to a 33-year climatology (1 January 1981 to 31 December 2013)**
  - CONUS+ domain at 0.03-deg resolution (~3 km)
  - IGBP/MODIS 20-class land use, STATSGO 16-class soil
  - MODIS/FPAR 30-sec resolution monthly GVF climatology (Wang et al. 2014; Barlage, personal communication)
  - Atmospheric forcing: NARR-based NLDAS-2 hourly data
  - 30+ year spin-up (1979-2010), then re-ran for 1979-2013 (only >1980 used in climatology) to ensure deep soil equilibrium
  - Output soil fields once daily
- **Daily histograms of the 33-year climatology are created for all grid points in each county in the conterminous United States (CONUS; 21 Aug. Madison county, AL example, Fig. 1)**
- **Each percentile is assigned a proxy U.S. Drought Monitor (USDM) category using technique described in Xia et al. (2014)**

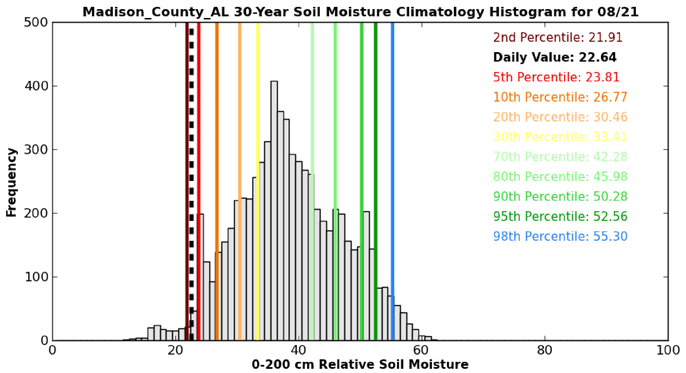

Figure 1. Histogram for Madison County, AL for 21 August. Vertical colored lines denote each USDM category (yellows/reds) and reverse categorization for flooding (greens/blues). Dashed line represented average countywide soil moisture for 21 August 2007.

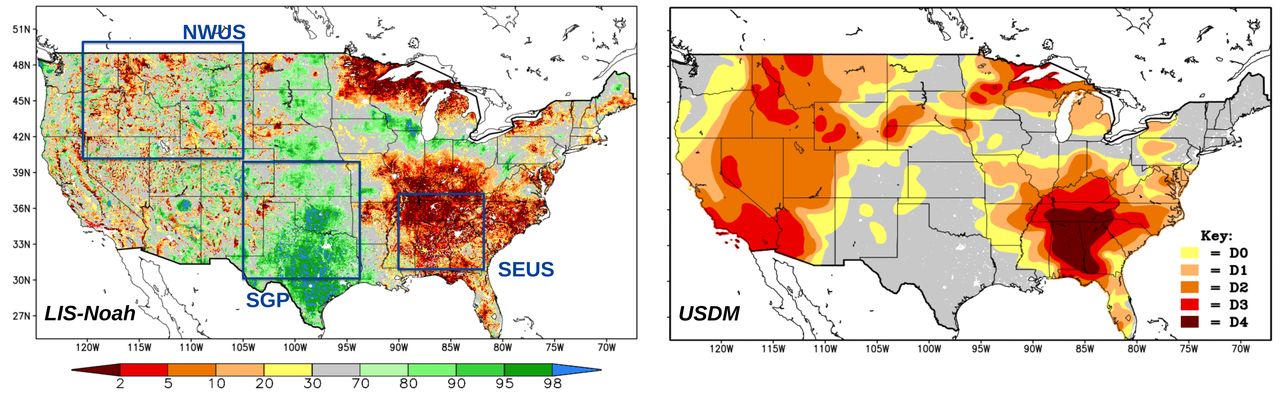

Figure 2. Qualitative comparison between LIS-Noah percentile product (left) and USDM (right) for 21 August 2007. Blue boxes denote validation regions shown in Fig. 3 and Tables 1 and 2.

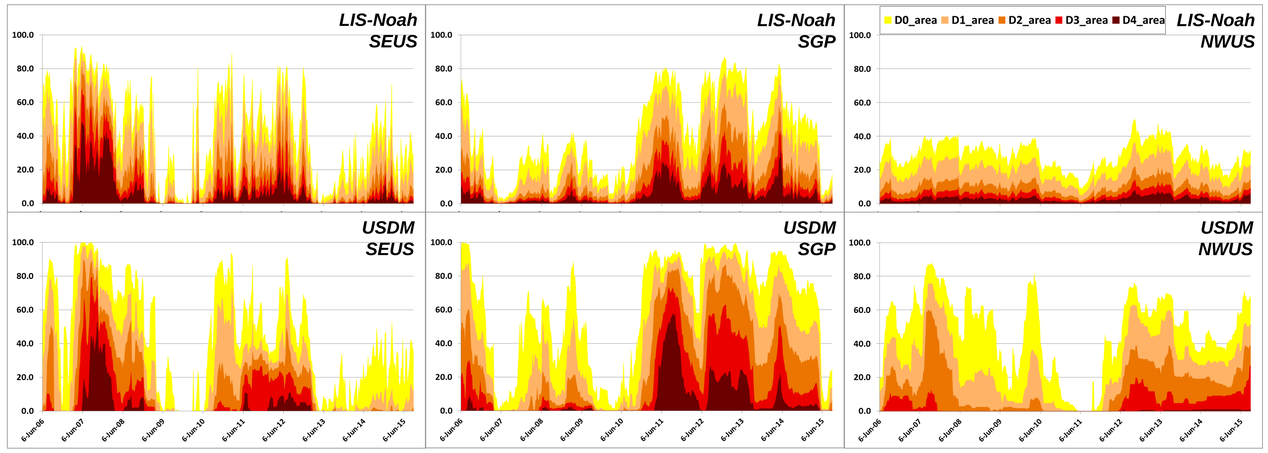

Figure 3. Time series of bulk area comparison between LIS-Noah (top row) and USDM (bottom row) for three geographical areas shown in Fig. 2 from June 2006 through September 2015.

Table 1. Difference in mean area (LIS-Noah minus USDM) for each region from Jun 2006 to Sep 2015

Bias	D0	D1	D2	D3	D4
SEUS	-4.1	2.1	0.2	0.7	2.4
SGP	-19.8	-14.0	-12.5	-6.6	-1.2
NWUS	-17.4	-8.6	-4.5	1.4	2.6

Table 2. Pearson's correlation for each region from Jun 2006 to Sep 2015

Correlation	D0	D1	D2	D3	D4
SEUS	0.89	0.87	0.85	0.83	0.72
SGP	0.90	0.90	0.88	0.83	0.70
NWUS	0.77	0.68	0.53	0.38	0.12

REFERENCES

Wang, W. and Coauthors, 2014: "WRF v3.5 User's Guide", National Centers for Atmospheric Research [Available online at: http://www2.mmm.ucar.edu/wrf/users/docs/user_guide_V3.5/contents.html]

Xia, Y., M. B. Ek, D. Mocko, C. D. Peters-Lidard, J. Sheffield, J. Dong, and E. F. Wood, 2014: Uncertainties, correlations, and optimal blends of drought indices from the NLDAS multiple land surface model ensemble. *J. Hydrometeor*, **15,** 1636–1650.

3. PERCENTILE PRODUCT

- **Each grid point in the real-time, daily LIS-Noah run is compared to its daily county histogram to create gridded percentile product**
- **Good correspondence east of Rockies; less similar in western U.S. (Fig. 2)**
- **LIS-Noah also highlights T.S. Erin 2007 impacts over Texas and Oklahoma**
- **Available in AWIPS 2 to select partner NWS WFOs**

4. COMPARISON TO USDM

- **USDM shapefiles were rasterized and mapped to the LIS-Noah grid for statistical comparison**
- **Generally captures the overall magnitude of total drought area (Fig. 3)**
- **Captures major droughts (SEUS in 2007-08; SGP in 2011-14)**
- **SEUS is noisier given the more frequent and scattered nature of precipitation**
- **Northwest not represented as well because other factors help define drought (e.g., groundwater, reservoirs and snowpack)**
- **Best overall statistics in SEUS domain**
- **Bias depicts overall under-representation of lower drought categories and slight over-representation of higher drought categories (Table 1)**
- **Correlations are highest for lower drought categories and SEUS/SGP; correlations diminish for higher drought categories and NWUS region (Table 2)**

5. FUTURE WORK

- **Formal assessment of percentile product scheduled for spring/summer with select partner NWS WFOs**
- **Investigate incorporation of snow water equivalent information into percentile calculations to improve relatively poor statistics in the west**
- **Quantitative comparison of wet categories against U.S. Geological Survey stream gauge flooding reports**