P2B.7 Initializing the Land Surface* with the NASA Land Information System to Improve WRF Predictions of Summertime Convection

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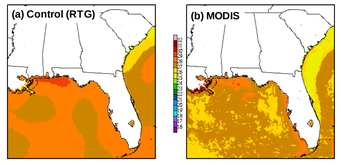
Hypothesis and Objectives

- **Hypothesis:** ***High-resolution land and water datasets from NASA utilities can lead to improvements in simulated summertime pulse-type convection over the S.E. U.S.***
- **Experiment objectives**
  - Use NASA Land Information System (LIS) to provide high-resolution land surface initializations
  - Incorporate SPoRT MODIS composites for detailed representation of sea surface temperatures (SSTs)
  - Demonstrate proof of concept in using these datasets in local model applications with the Weather Research and Forecasting (WRF) model
  - Quantify possible improvements to WRF simulations

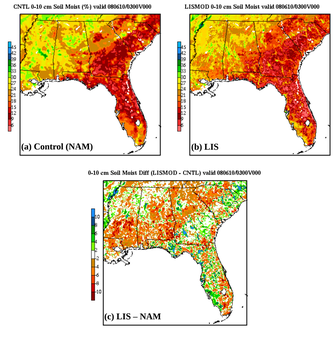
*NASA/SPoRT MODIS SST Initialization

- ***Moderate Resolution Imaging Spectroradiometer (MODIS) SSTs provide superior resolution***
- ***Ocean surface initialized with SPoRT/MODIS SSTs***
- ***Quality check with the latency product***
- ***Current weakness is high latency in areas with persistent cloud cover***
- ***JPL collaboration to improve product with AMSR-E***



SST Comparison: 10 June 2008

Soil Moisture Comparison: 10 June 2008

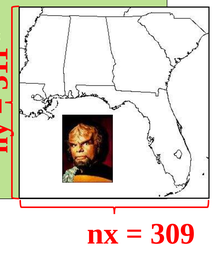


Methodology and Data

- ***LIS/Noah 4-km LSM run: 1/1/2004 to 9/1/2008***
  - *Same soil and vegetation parameters as in WRF*
  - *Atmospheric forcing from GDAS + Stage IV analyses*
  - *Run long enough for soil to reach equilibrium state*
  - *Output GRIB files initialize WRF land surface variables*
- ***Bring LIS data into WRF initial conditions***
  - *Modifications to WRF Preprocessing System (WPS):*
    - *Created Vtable.LIS ; added LIS fields into METGRID.TBL file*
    - *Soil moisture/temp, skin temp, snow-water, land-sea mask*
  - *LIS data over-write NAM land surface data*
  - *MODIS SSTs over-write NAM / RTG SSTs in WPS*
- ***Run parallel WRF simulations***
  - *Once daily 27-h simulations, initialized at 0300 UTC*
    - *81 total forecasts (Jun – Aug 2008)*
    - *11 missing dates due to missing/corrupted MODIS SSTs*
  - ***Control**: ICs/BCs from NCEP 12-km NAM model*
  - ***LISMOD**: Same as Control, except:*
    - *Replace land surface data with LIS output fields*
    - *Replace SSTs with SPoRT MODIS composites*
- ***Evaluation and Verification***
  - *Graphical and subjective comparisons*
  - *Meteorological Evaluation Tools (MET) package*
    - *Standard point / grid verification statistics*
    - *Method for Object-Based Diagnostic Evaluation (MODE): object-oriented, non-traditional verification method*

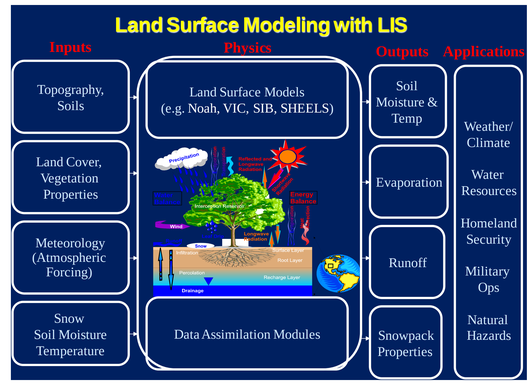
WRF Model Configuration

- ***Model domain over Southeastern U.S.***
  - *Advanced Research WRF v3.0.1.1*
  - *4-km horizontal grid spacing*
  - *39 sigma-p levels from surface to 50 mb*
    - *Min. spacing near surface of 0.004 sigma*
    - *Max. spacing of 0.034 sigma*
  - *Positive definite advection of scalars*
  - *Model physics options*
    - *Radiation: Dudhia SW and RRTM LW*
    - *Microphysics: WSM6*
    - *Land Surface: Noah LSM (same as LIS)*
    - *PBL: MYJ scheme*
    - *Cumulus parameterization: None*



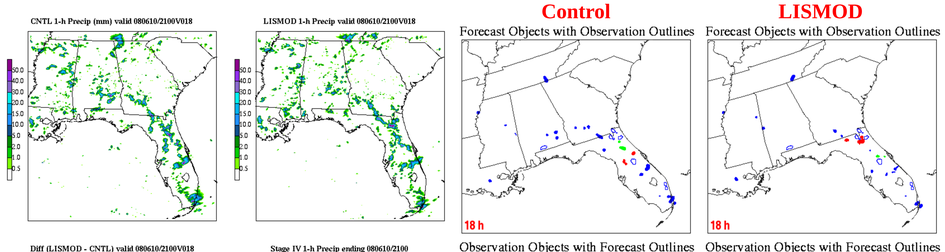
Use of MET/MODE for Precip Verification

- ***Stage IV analyses used as validation for traditional precip stats and MODE***
- ***Traditional grid point verification***
  - *Bias, Threat Score, Heidke Skill Score (HSS)*
    - *1-h / 3-h accumulation intervals*
    - *5, 10, and 25 mm thresholds*
  - *Neighborhood precipitation verification*
    - *Occurrence of precipitation threshold in a "box" surrounding a grid point*
    - *Relaxes stringency and determines model skill at distance thresholds*
- ***MODE object classification***
  - *Resolves objects through convolution thresholding:*
    - *Filter function applied to raw data using a tunable radius of influence*
    - *Filtered field thresholded (tunable parameter) to create mask field*
    - *Raw data restored to objects where mask meets/exceeds threshold*
  - *Attributes computed for "matched" objects*



10 June 2008 Example: MODE Precip Objects and Verification

10-mm (1 h)$^{-1}$ MODE Objects

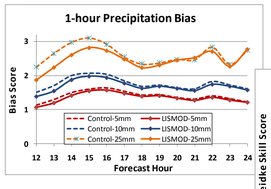


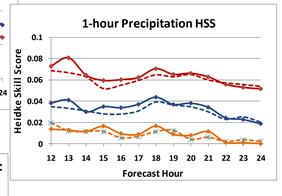
	Control		LISMOD	
Fcst hour	Grid Area Match	Grid Area Un-match	Grid Area Match	Grid Area Un-match
15	0	492	0	474
16	0	802	232	587
17	388	544	606	653
18	419	1039	470	711
19	108	1122	186	916
20	318	680	271	674
21	394	301	382	646
22	0	596	110	424
23	28	632	30	501
24	0	328	0	417

Fuzzy engine weights applied to object attributes to compute "total interest" field

Object Attribute	Weight
Centroid Distance	20%
Minimum Boundary Distance	40%
Orientation Angle Difference	10%
Ratio of Object Areas	10%
Intersection Area Ratio	20%

Traditional Verification: Summer 2008

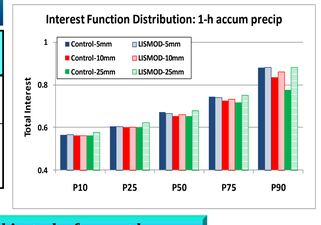




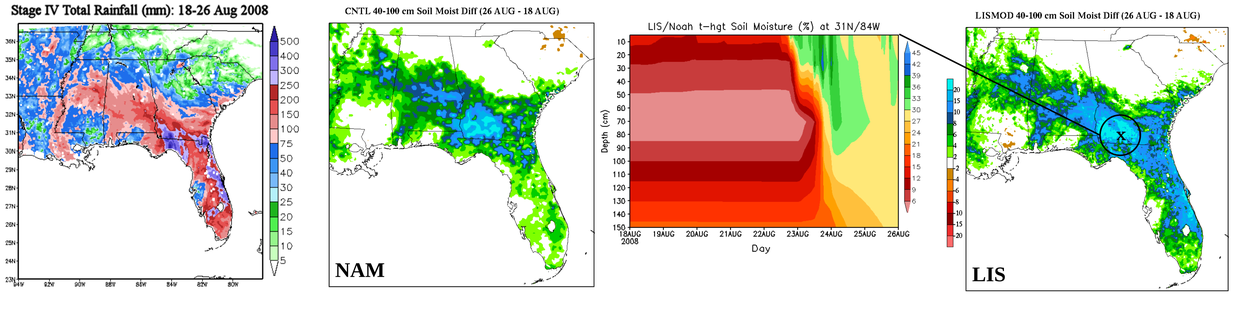
MODE Verification: Summer 2008

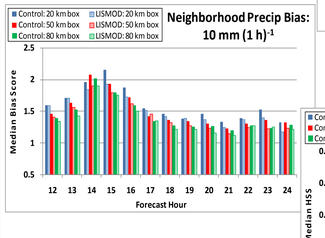
10-mm (1 h)$^{-1}$ objects, by forecast run, 12-24 h combined together

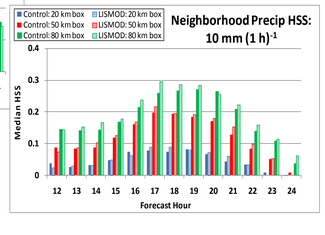
Quantity	Control	LISMOD	Difference (LISMOD – Con)	% Improved
Mean Matched (per model run)	2456	2562	106	4.3%
Mean Unmatched (per model run)	6798	6538	-260	3.8%



Tropical Storm Fay: 18-26 AUG 2008







10-mm (1 h)$^{-1}$ objects, by forecast hour