Preliminary Results of a U.S. Deep South Warm Season Deep Convective Initiation Modeling Experiment using NASA SPoRT Initialization Datasets for Operational National Weather Service Local Model Runs

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Objectives

Focus on two U.S. Deep South forecast challenges: the initiation of deep convection (CI) during the warm season; and heavy precipitation during the cool season.

Objectively quantify the impacts of NASA SPoRT (Short-term Prediction Research and Transition Center) datasets (LIS, SPoRT SSTs, GVF) on the summertime deep convective initiation problem.

Highlight how a NWS Operational Meteorologist-Researcher collaboration is invaluable towards addressing forecast problems, and how this approach could set a precedent for future local and/or mesoscale modeling.

Methodology

Using identical Advanced Research WRF (ARW) model settings on two separate WRF-EMS domains, the NWS Mobile and Houston offices are concurrently evaluating the impacts of the following NASA SPoRT datasets on recurring local forecast problems.

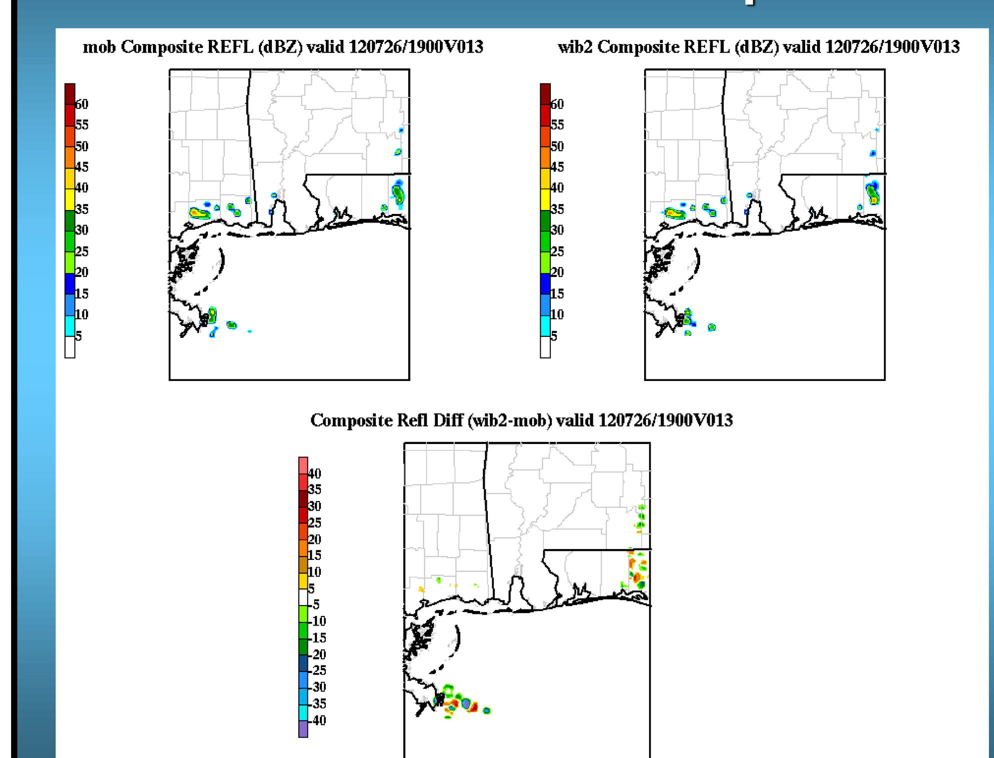
SPoRT SSTs – 2 km sea-surface temperature analysis, updated twice daily.
LIS - 3 km land information system, updated four times daily.
GVF – 1 km green vegetative fraction, updated daily.

SPoRT provides the Control run (6Z) for comparison purposes during this study.

Model Settings

Domains = 9 km \ 3 km
Levels = 40
Time Step = 54 s
Run Time = 6 UTC daily out to 24 h
Initial Conditions = GFS personal tile (0.205°)
Boundary Conditions = GFS personal tile (0.205°)
Convective Parameterization = Kain-Fritsch outer 9 km grid only
Microphysics = WSM Single-Moment 6 Class
Boundary Layer Scheme = Mellor-Yamada-Janjic
Long-/Shortwave Radiation Schemes = RRTM, Dudhia

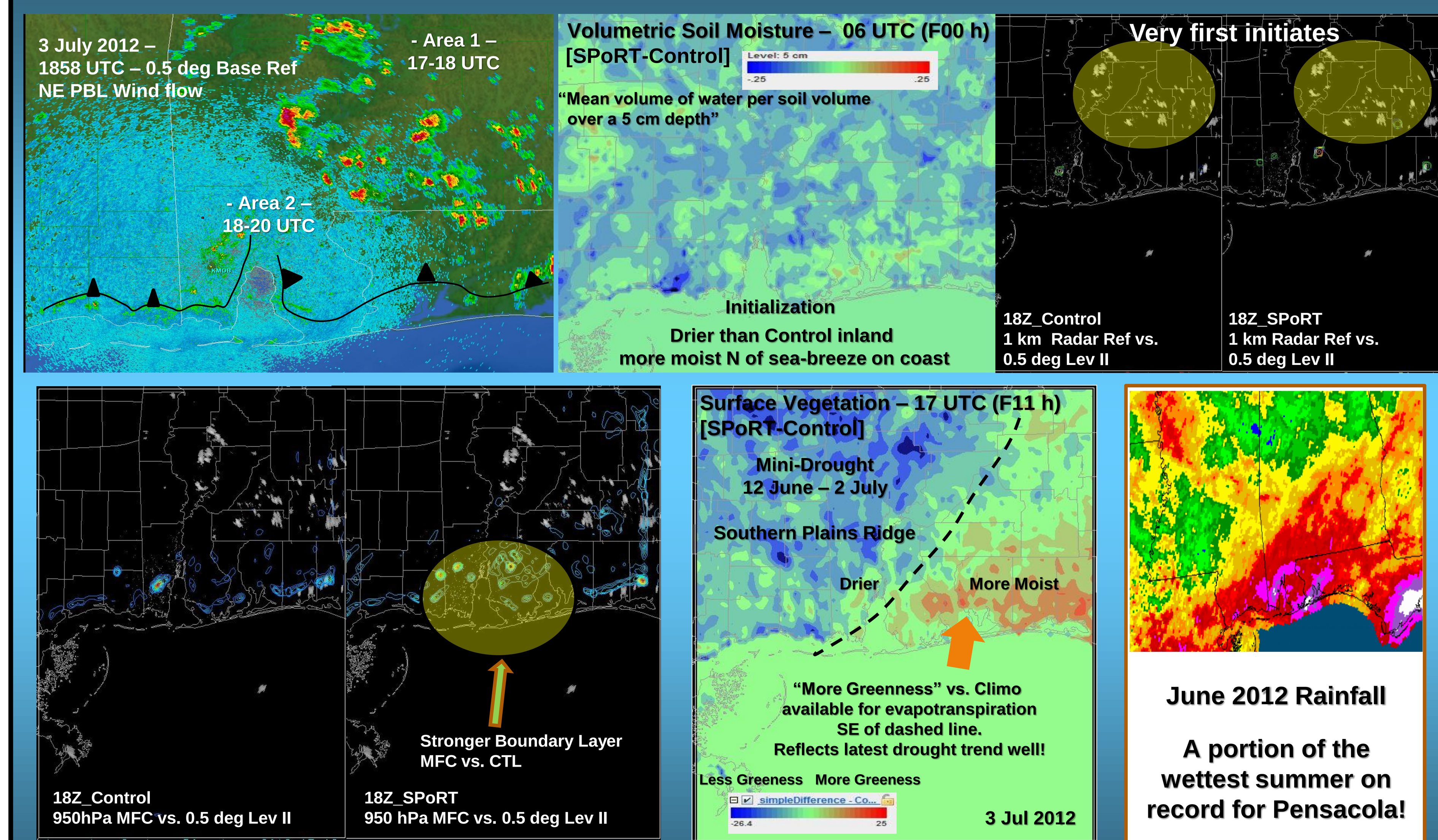
Non-Linear Variations occurring with Different Computational Platforms



Testing revealed that the different computational platforms between SPoRT and WFOs Mobile and Houston yielded slightly different forecast solutions. The differences are significant for this study, as we want to study the variances caused only by the initialization datasets.

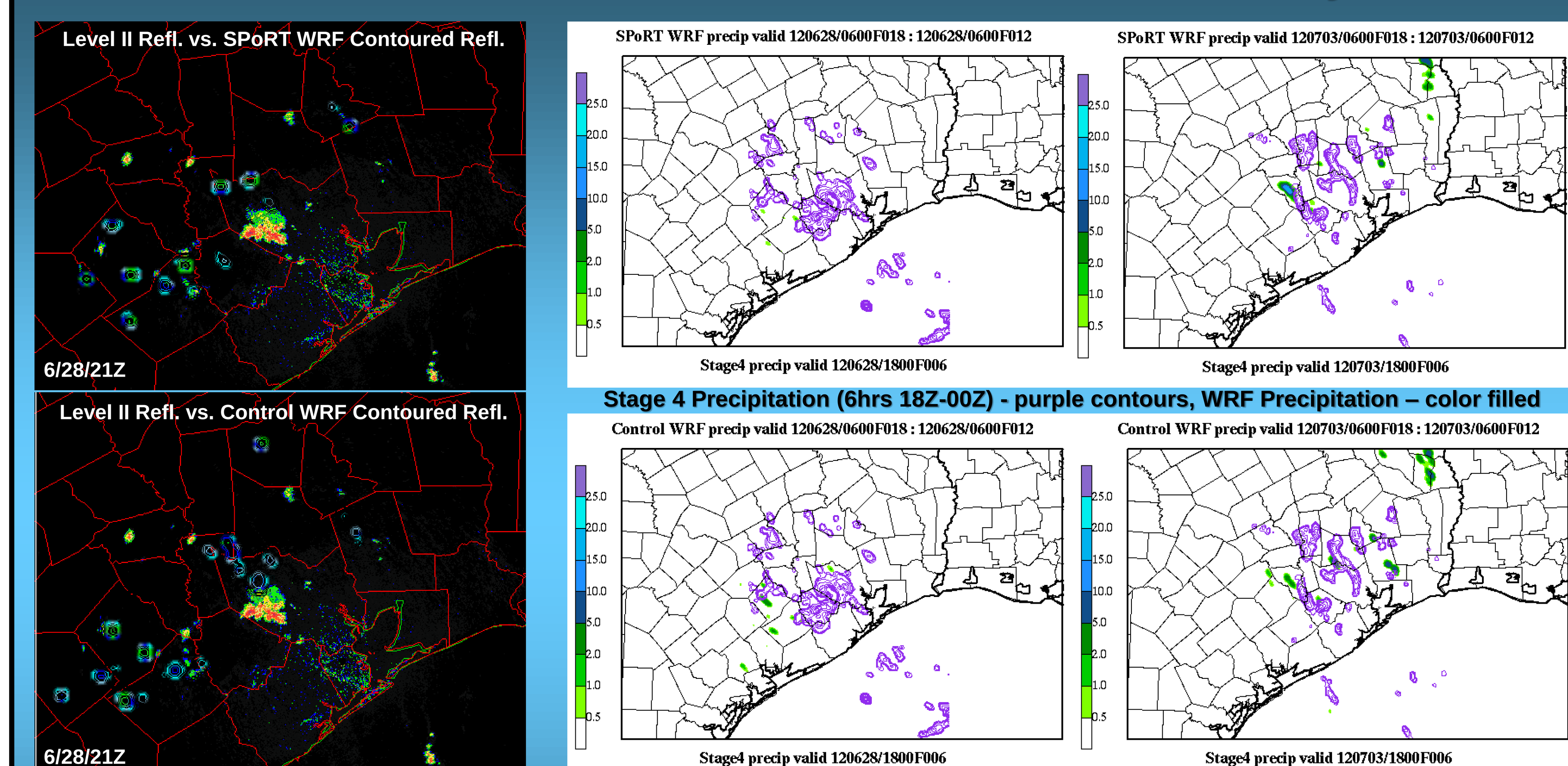
To remove this issue, SPoRT performed re-runs of our operational WRF-EMS for good candidate (no synoptic forcing) warm season CI days. These cases can then be compared to the Control runs, which were run on the same platform by SPoRT.

Convective Initiation Case - Mobile - July 3rd 2012



This case provides a good opportunity to examine some of the variables that we are evaluating when assessing the value of the SPoRT datasets with respect to convective initiation.

Convective Initiation Cases - Houston - June 28th and July 3rd 2012



In both of these Houston area convective cases, the SPoRT and Control runs underestimated precipitation coverage, with the Control runs having better verification scores for 3 and 6 hour precipitation than the SPoRT WRF.

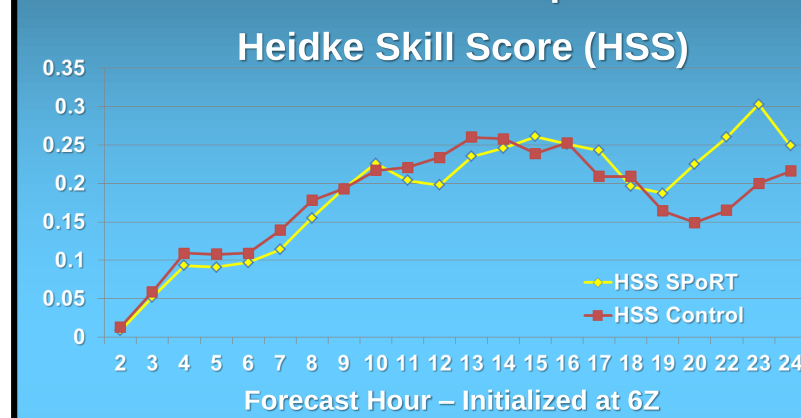
When comparing hourly reflectivity snapshots, this trend was not apparent. It appears that convective cells are not sustained for a long enough time period in either WRF run, and this needs to be investigated further.

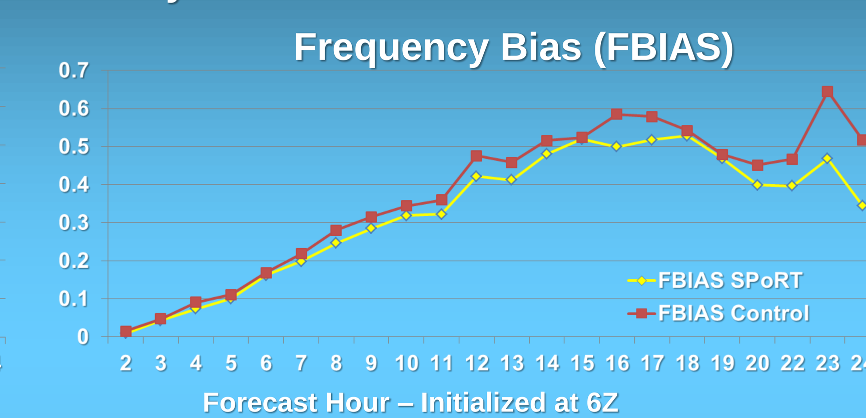
We are currently looking at how to best objectively verify convective initiation using the Model Evaluation Tools package. Some preliminary statistics are shown above, to the right.

Statistics from Model Evaluation Tools

All Warm Season Convective Cases (41 days) - no Synoptic Forcing

1 Hour Accumulated Precipitation Verification - by forecast hour - WFO Mobile domain





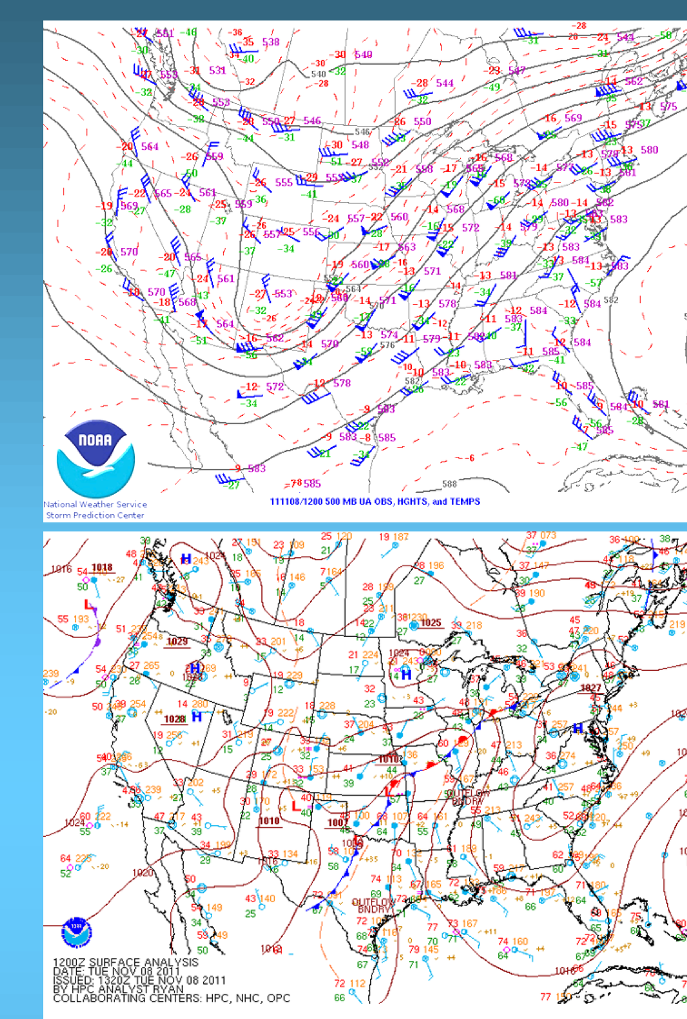
The table (right) shows precipitation verification statistics for the two Houston cases (6/28 and 7/3). Time period is 6 hour accumulation from 18Z to 00Z, or F12-F18 from the 6Z model runs. Based on a 24 km grid box for the neighborhood, and a precipitation threshold of 1 mm.

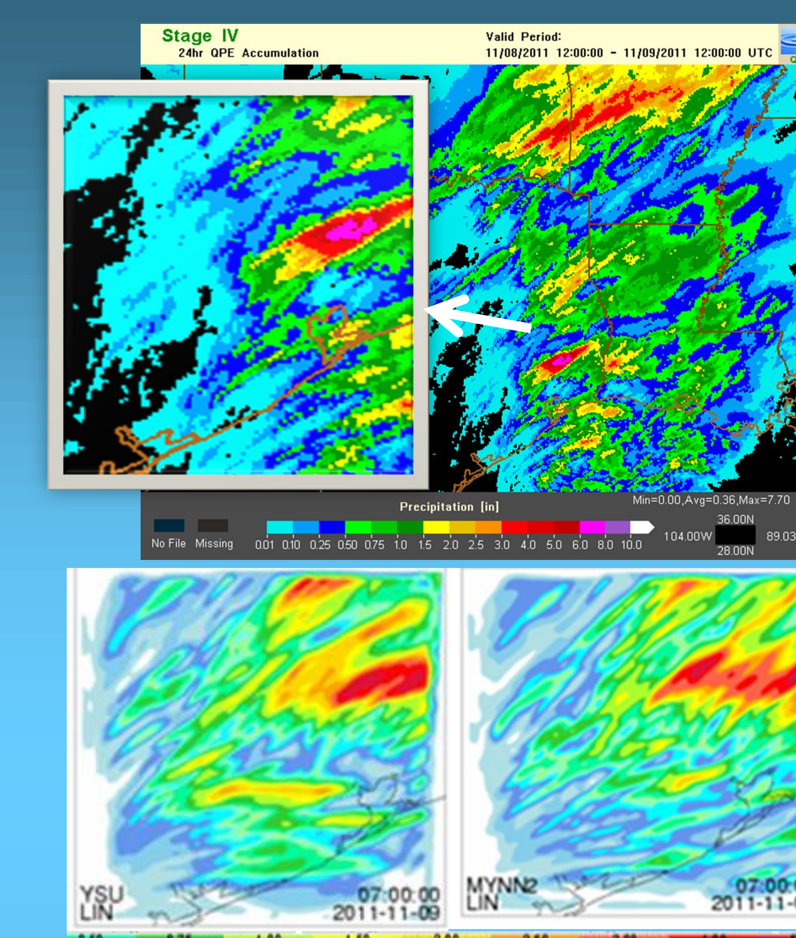
The SPoRT run is slightly less skillful than the Control in these two cases with a lower CSI, HSS, and FBIAS. Bulk stats for all convective cases will be computed hourly, as shown above for Mobile.

7/3/2012	HSS	FBIAS	CSI
SPoRT	0.11	0.27	0.13
Control	0.16	0.38	0.18

6/28/2012	HSS	FBIAS	CSI
SPoRT	0.03	0.03	0.03
Control	0.10	0.17	0.10

Cool Season Heavy Rainfall Case Southeast Texas November 8-9th 2011





Two favored combinations of PBL and microphysics for this event (above), for resolving the precipitation maximum.

- The 24-h simulation reasonably represented the passing of the cold front and development of discrete storms and supercells.
  - No specific combination of PBL or microphysics dramatically changed the storm mode or ability to initiate convection in advance of the front.
- No single microphysics scheme appeared to have a significant impact on storm characteristics.
- Some impacts on storm-total precipitation were noted based primarily upon the microphysics selection.
- PBL selection appears to have an impact on PBL height, hourly maximum up or downdraft, and mean vertical velocity.