Weather Research and Forecasting Model Sensitivity Comparisons For Warm Season Convective Initiation

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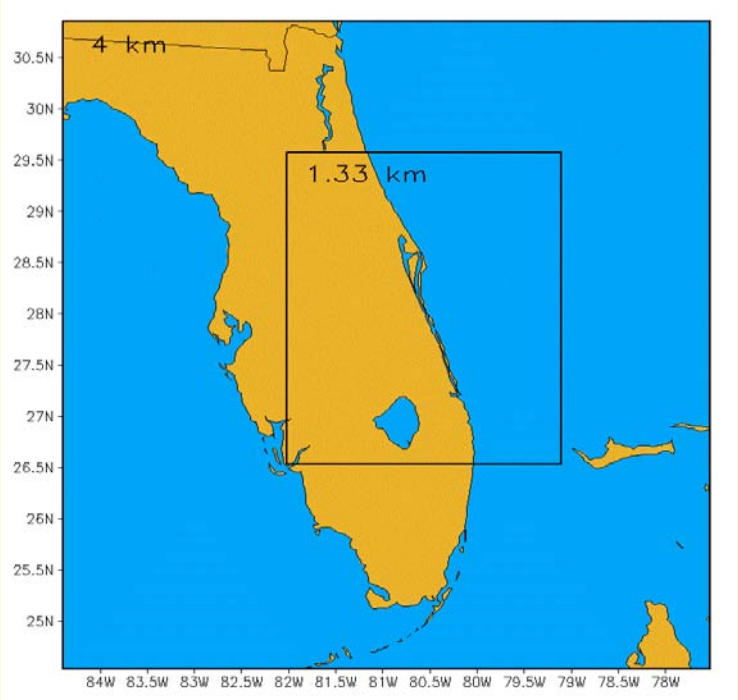
Project Objectives

- Which configuration best predicts warm season (Jun – Sep) convective initiation over east-central Florida?
- Assess different WRF model configurations:
  - Advanced Regional Prediction System (ARPS) Data Analysis System (ADAS) versus Local Analysis and Prediction System (LAPS) for the ARW and NMM model cores
  - Compare impact of high-resolution local grid with 2-way nesting, 1-way nesting, and no nesting

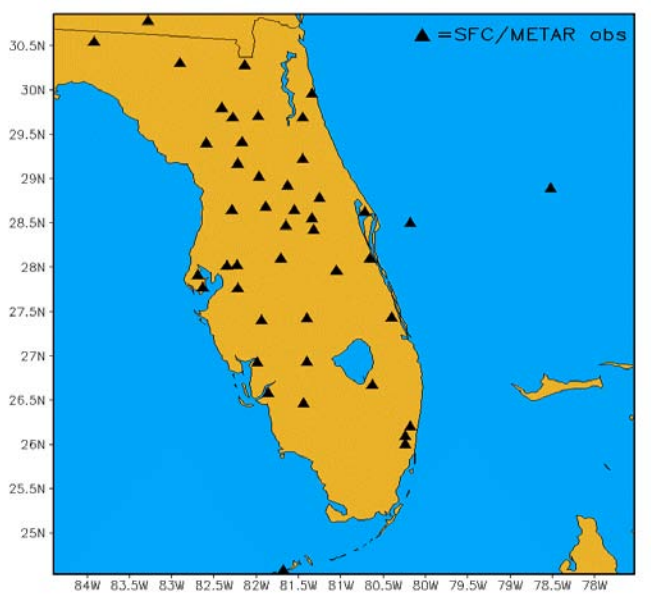
Data/Methodology

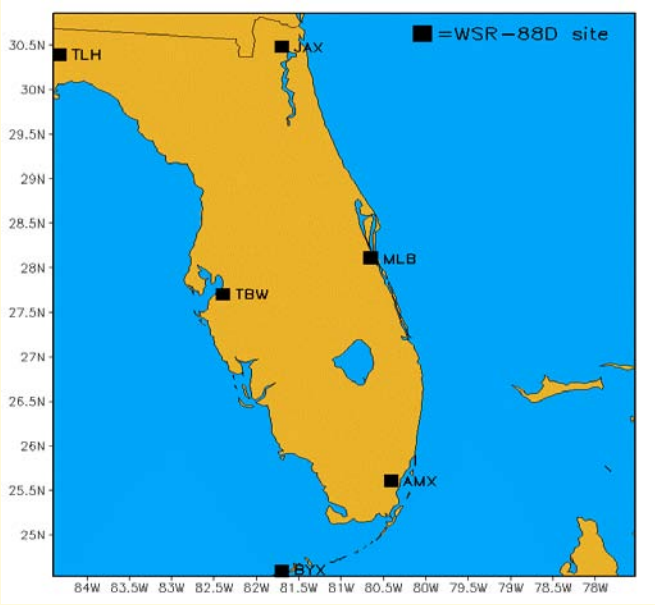
- WRF Environmental Modeling System (EMS) software
- Three combinations of WRF initializations:
  - ADAS-ARW, LAPS-ARW, LAPS-NMM
  - 4-km grid spacing over Florida peninsula and adjacent coastal waters
  - 5 convective initiation days, 2 null (non-convective) cases over 2006 convective season
  - 12-h integration, 3 runs per day at 0900, 1200, and 1500 UTC
- Three nesting configurations:
  - 2-way, 1-way, and no nesting
  - 1.33-km grid spacing covering east-central Florida



Data/Methodology

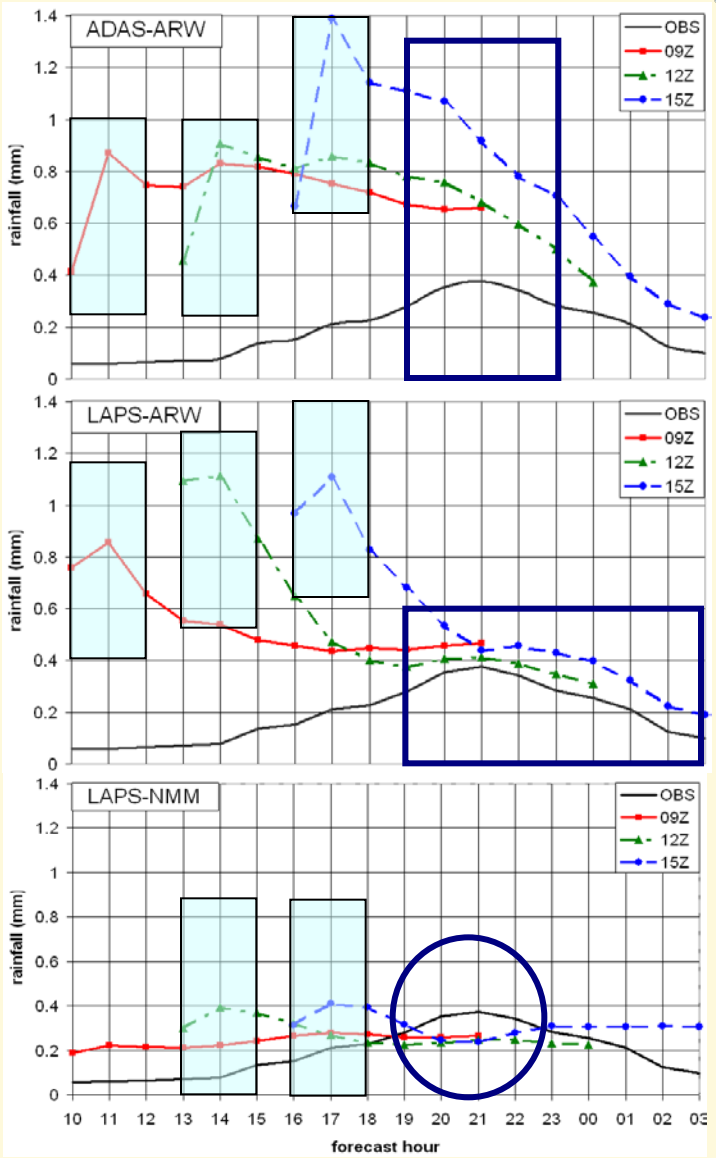
- Data ingested: Level II Weather Surveillance Radar-1988 Doppler (WSR-88D) data, GOES VIS and IR satellite imagery, surface observations
- Precipitation verification:
  - Compared forecast rainfall to NCEP stage-IV precipitation analysis
  - Forecast bias
  - Fractions Skill Score (FSS): objective precipitation verification method





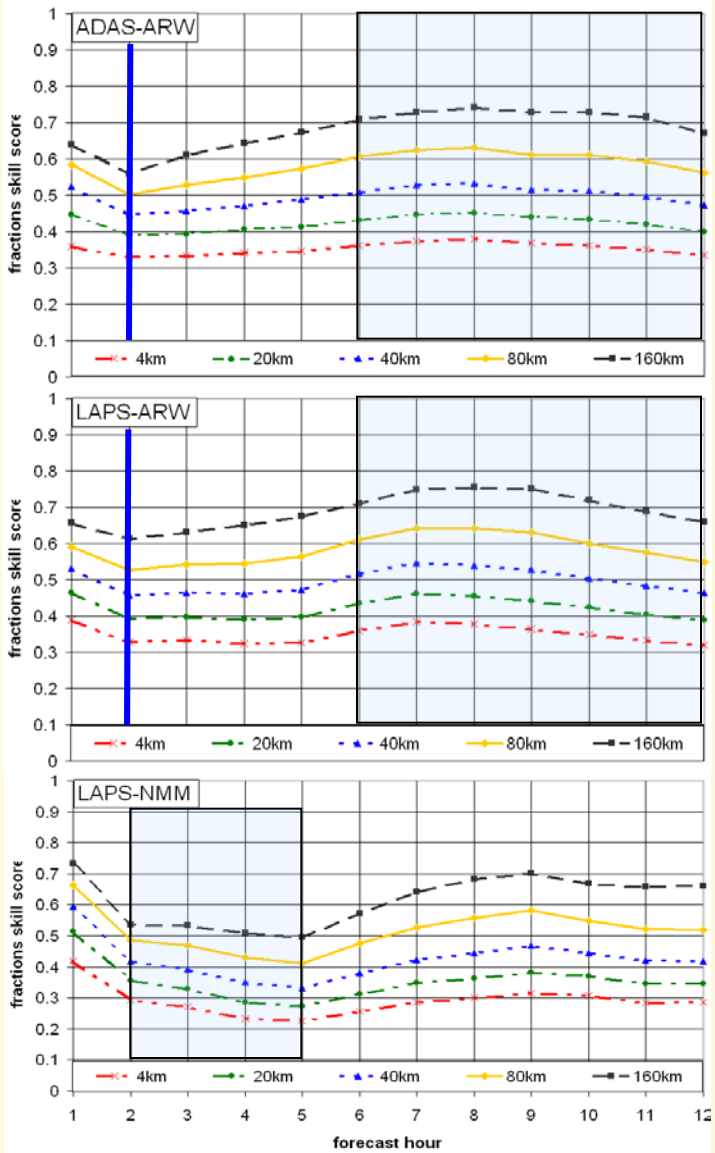
WRF Initializations: Forecast Bias

- ADAS-ARW:
  - over predicts rainfall
  - sharp increase in rainfall during first 2 hours
  - fails to capture late afternoon convective max
- LAPS-ARW:
  - over predicts rainfall
  - sharp increase in rainfall during first 2 hours
  - captures late afternoon convective max & mirrors observations
- LAPS-NMM:
  - smaller bias than other configurations
  - too much rainfall during first 2 hours (1200 UTC & 1500 UTC)
  - indicates late afternoon convective minimum (1500 UTC)



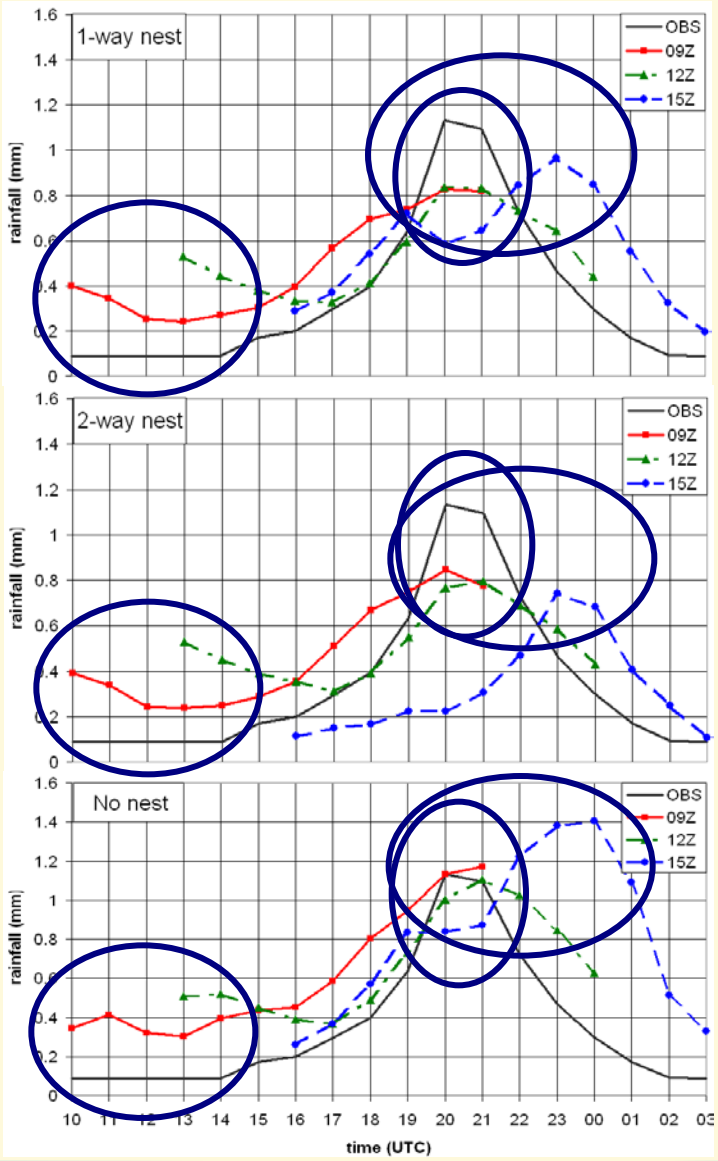
WRF Initializations: Fractions Skill Score

- ADAS-ARW & LAPS-ARW:
  - least skill 2 hours after initialization, consistent with forecast bias
  - some skill at predicting warm season convection in the 6 – 12 hour range
  - skill forecasting rainfall distribution increases with spatial scale
- LAPS-NMM:
  - little skill in 2 – 5 hour range
  - least skill overall
  - skill in forecasting the distribution of rainfall increases with spatial scale



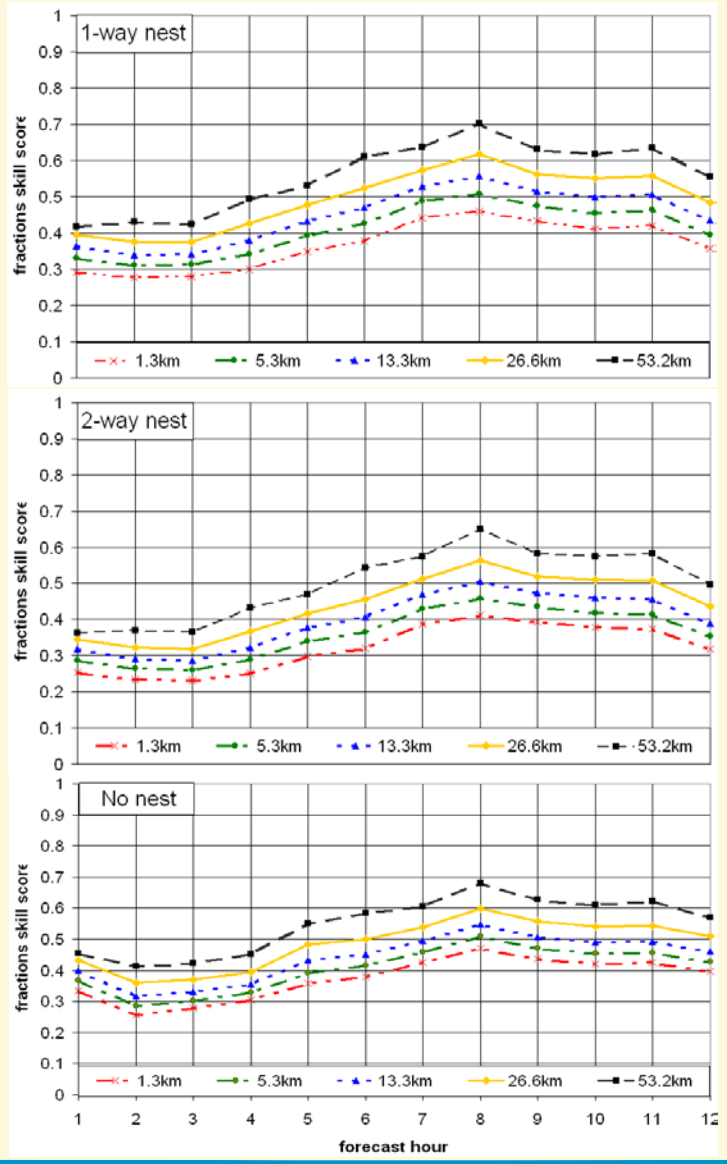
Nesting Configurations: Forecast Bias

- 0900 & 1200 UTC forecasts over predict precipitation during initial stages of forecast
- 0900 & 1200 UTC forecasts capture timing of late afternoon convective max:
  - 1-way and 2-way nesting under predict rainfall
  - No nesting captures timing and amount of rainfall
- 15Z forecasts: late afternoon convective max delay



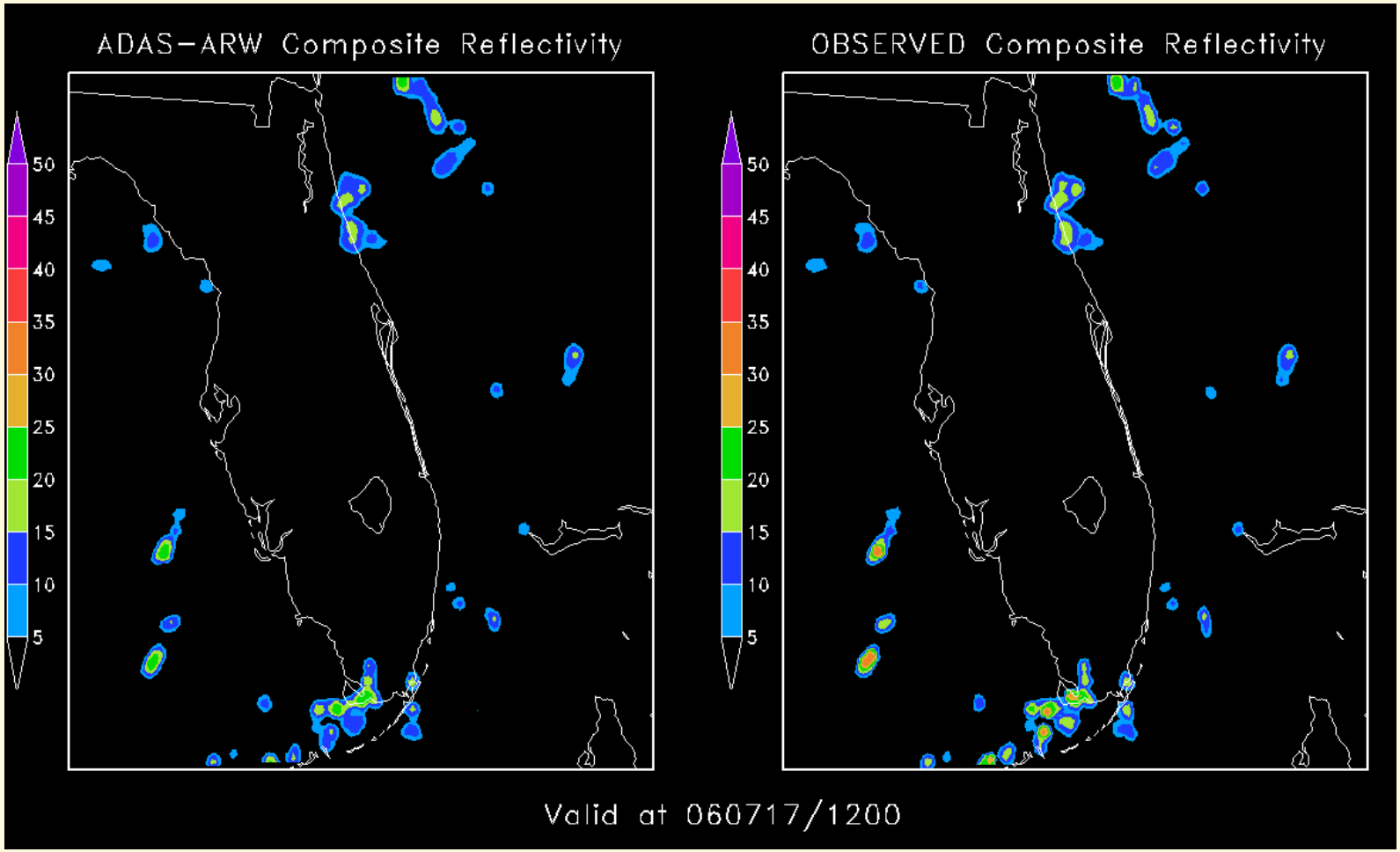
Nesting Configurations: Fractions Skill Score

- All configurations look nearly identical
- Each configuration increased in skill by ~50% from first 6 hours to last 6 hours
- The FSS for 2-way nested run is ~0.5 less than the FSS for 1-way and no nest runs



Impact of Model Spin Up

- Forecast and observed composite reflectivity for first 3 hours of forecast
- Initialized at 1200 UTC 17 July 2006, output every 30 min



Summary

- ADAS-ARW and LAPS-ARW over predict rainfall across Florida and the surrounding coastal waters throughout forecast.
- Beyond 6 hours: Rainfall bias decreases and skill increases.
- Difference in skill between ADAS-ARW and LAPS-ARW is negligible, while skill of LAPS-NMM is slightly worse.
- 1-way and 2-way nesting configurations under predict late afternoon convective maximum over east-central Florida.
- Skill for nesting configurations increased as forecast progressed.
- Difference in skill between all nesting configurations was negligible.
- **FINAL ANALYSIS**: No single model was clearly better than the rest.
- Future work:
  - Extend the FSS method to examine the temporal scale.
  - Conduct rigorous data analysis to quantify which model configuration will be most useful to SMG, NWS MLB, and 45 WS for operations.