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Introduction/Motivation

- Accurate forecasting of convective initiation (CI) is a challenge for local-scale modeling
  - NWS WFOs: Use Weather Research and Forecasting (WRF) Environmental Modeling System (EMS)
  - SPoRT surface initialization data transitioned to EMS to help improve fields contributing to CI

- Results from Summer 2012 evaluation revealed that both Control and SPoRT-initialized forecasts exhibited a consistent under-prediction of precipitation coverage

- Motivation for this work:
  1. Determine impact of SPoRT initialization datasets in a variety of WRF model physics combinations
  2. Better understand model sensitivity to microphysics and PBL schemes to optimally configure WRF/EMS for forecasting CI with SPoRT datasets
Model Configuration

- Advanced Research WRF v3.4.1
  - 9-km/3-km, 1-way nested grids
  - 40 vertical levels, 54-s timestep
  - Initialized at 0600 UTC; 24-h forecast
  - Initial and boundary conditions from GFS personal tile (0.5-deg data)
  - Convective parameterization: Kain-Fritsch (only on outer domain)
  - SW/LW radiation: Dudhia / RRTM
  - Noah land surface model (LSM)
  - Microphysics and PBL vary for an 8 x 3 matrix of runs

- Two sets of WRF forecasts:
  - Control (CNTL; GFS IC/BC)
  - SPoRT configurations (added 3 datasets at right)

SPoRT SST Composite
- 2-km resolution
- Generated twice daily
- Provides details that allow model to account for over-ocean fluxes and seabreeze forecasting

Land Information System (LIS)
- 3-km grid spacing
- Uncoupled Noah LSM
- Atmospheric analyses and specified soil/vegetation parameters to predict soil characteristics that shape energy fluxes for weakly-forced convection

SPoRT MODIS GVF
- 1-km resolution
- Generated once daily
- Replaces coarse monthly climatology with satellite-measured vegetation health in real-time

transitioning research data to the operational weather community
Mobile Case Study: 3 July 2012

KMOB Level III Composite Reflectivity product

CI associated with a sea-breeze front occurred between 1700 and 1800 UTC across southern AL and western FL, east of Mobile Bay

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(8 MP) x (3 PBL) Matrix: 24-h precip (SPoRT runs)

In general, microphysics schemes grow in complexity to the right

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Most physics combinations do not capture the CI location, coverage, or magnitude

QNSE PBL and NSSL MP are most aggressive schemes for CI

For this case, selection of PBL and microphysics schemes is important
SPoRT data improve location & magnitude of CI for most simulations
Convection associated with sea-/bay-breezes more in-line with radar when SPoRT data are used for initialization compared to CNTL
CI by 1800 UTC in all 24 SPoRT members, an improvement over CNTL
Evaluation of Land Surface

- Differences in land surface initialization appear to have played a major role in the simulations.
- Land surface features are very smooth with the 0.5-deg GFS initialization data.
- Soil moisture (SM) from LIS & SPoRT-MODIS GVF provide greater detail of local features that affect may CI.
- GFS SM considerably more moist than LIS data, which dried out the soils by an average of 10%.
- SPoRT-MODIS GVF is slightly lower than CNTL, esp. in SW AL and SE MS.
Evaluation of 2-m Temperature

- Drier, less vegetated surface in SPoRT runs results in faster heating of land surface
- SSTs over Gulf of Mexico appear to be cooler in SPoRT runs (2-m temperature over water is on average about 1 deg C cooler than in CNTL)
- Combination of warmer land temperatures (SPoRT: 34.9 deg C; CNTL: 32.8 deg C) and cooler mean over-water temperatures (SPoRT: 27.8 deg C; CNTL: 28.9 deg C) produced stronger sea breeze and accelerated CI
Verification: 2-m Temperature

- Sample size ~46 points

- Smaller 2-m Temperature bias in SPoRT-QNSE runs before CI

- MYJ and MYNN PBL schemes have similar biases prior to CI, with the SPoRT biases smaller than CNTL (not shown)
Verification: 3-h Precipitation

- Results from QNSE PBL scheme shown
- Improved Heidke Skill Score (HSS) during forecast hours of active convection
- Similar results seen for this case with other PBL/microphysics combinations
Summary/Future Work

• Overall, SPoRT runs compare more favorably in timing, position, and intensity of CI compared to CNTL for Mobile, AL case presented

• Sea breeze likely more accurately in SPoRT-initialized run due to improved land-sea contrasts in 2-m temperature

• For case presented, use of SPoRT initialization datasets had largest impact on simulations than sensitivity to PBL and/or microphysics schemes

• Further evaluation of this case needed to determine if winds are improved with SPoRT datasets (further indication of sea-breeze improvement)

• Efforts ongoing to evaluate matrix results for 9 other cases to understand performance of different land surface initialization, microphysics, and PBL to generate cumulative statistics for more robust conclusions

• Results will be analyzed and compared to computational constraints to determine optimal configuration for NWS WFOs in CI applications
Backup Slides
• One consideration that must be taken when dealing with operational forecasts is the time constraints involved with forecast delivery
• Both HGX and MOB currently use WSM6/MYJ, which is computationally cheapest
• QNSE appears to be best PBL scheme, but is also most computationally expensive
• Each forecast office will need to determine based on their resources and time of forecast delivery which option is feasible
• Most physics combinations do not capture the CI location, coverage, or magnitude
• QNSE PBL and NSSL MP are most aggressive schemes for CI
• For this case, selection of PBL and microphysics schemes is important
SPoRT Composite Reflectivity Matrix Loop
(11-14 h forecast valid 1700-2000 UTC 3 July)

- SPoRT data improve location & magnitude of CI for most simulations
- Convection associated with sea-/bay-breezes more in-line with radar when SPoRT data are used for initialization compared to CNTL
- CI by 1800 UTC in all 24 SPoRT members, an improvement over CNTL
MOB Case Stage IV 24-h precip

max = 70.1300

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MOB Case CNTL 24-h precip

<table>
<thead>
<tr>
<th>Model</th>
<th>Precipitation Distribution</th>
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<td>WSM6</td>
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<tr>
<td>NSSL</td>
<td><img src="image" alt="NSSL Precipitation Map" /></td>
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</tbody>
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24-h Accumulated Precipitation

- 24-h forecast valid 0600 UTC 07/04/2012

**Legend**
- **Red** represents high precipitation (150 mm)
- **Blue** represents low precipitation (0 mm)

**Note:** This diagram illustrates the spatial distribution of 24-hour accumulated precipitation from different models, highlighting differences in model performance and accuracy in transitioning research data to the operational weather community.
MOB Case SPoRT 24-h precip

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