Sensitivity of Florida Sea Breeze Convection to WRF Physical and Planetary Boundary Layer Parameterization Schemes

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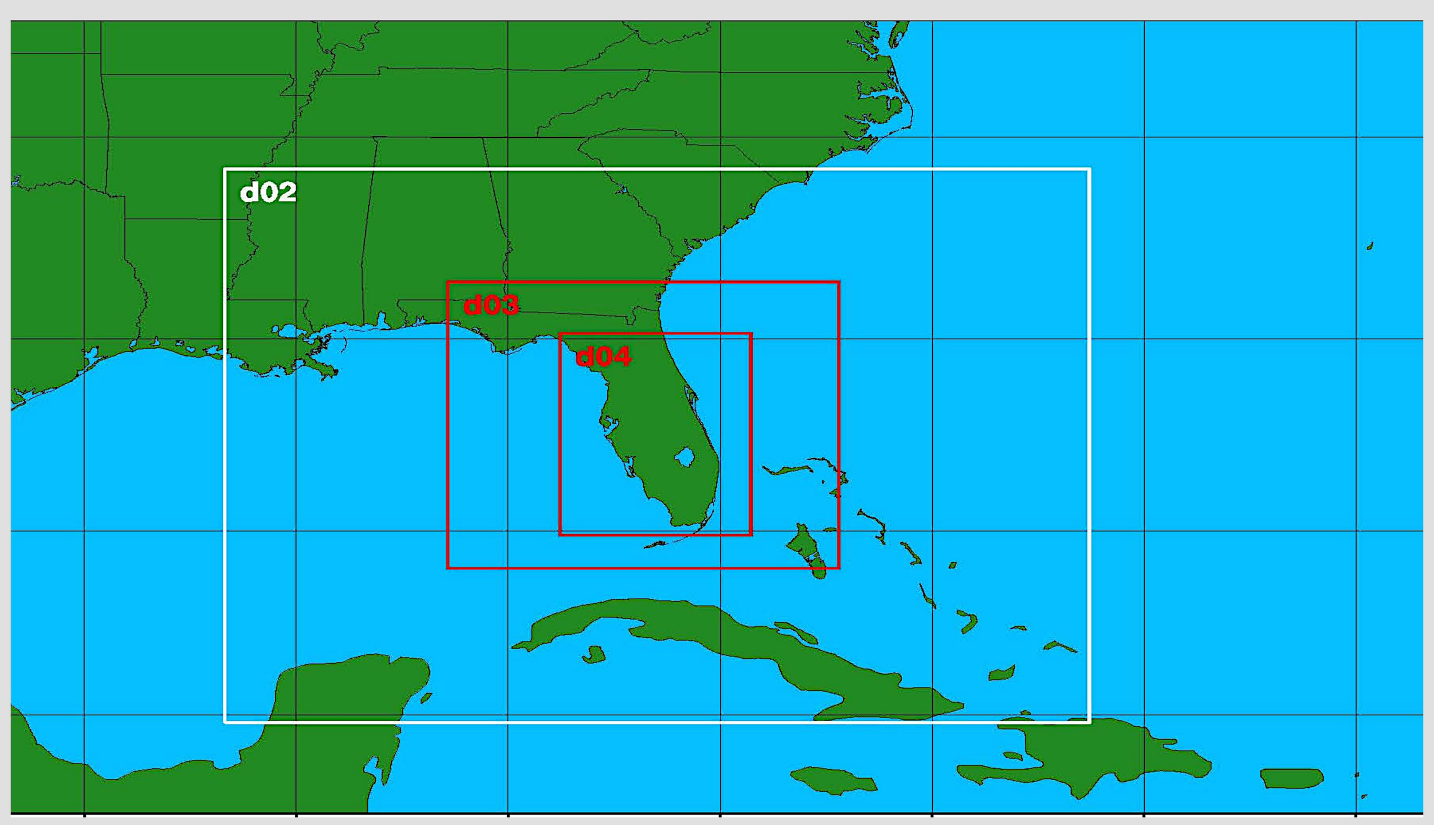
PROJECT INTRODUCTION AND MOTIVATION

The exact microphysical processes that control and affect the initiation and evolution of Florida sea breeze (FLSB) convection is not well understood. In addition, the ability of forecasters to precisely predict the timing, location, and intensity of warm season convection (to include sea breeze convection) also remains a difficulty$_1$. Challenges due to model limitations, entrainment effects, boundary layer interactions and the interactions of the sea breeze and its associated convection all induce uncertainties into forecasting SB convection

The proposed study seeks to identify specific thermodynamic and microphysical processes and variables that control FLSB convection location, timing, and intensity through high-resolution WRF numerical simulations and by testing the sensitivity to microphysics and boundary layer effects for real case studies. The limitation of the model at cloud-permitting scale in predicting FLSB convection will be assessed. Possible model improvements for accurate prediction of FLSB convection will be suggested.

WEATHER RESEARCH AND FORECASTING MODEL SPECIFICATION

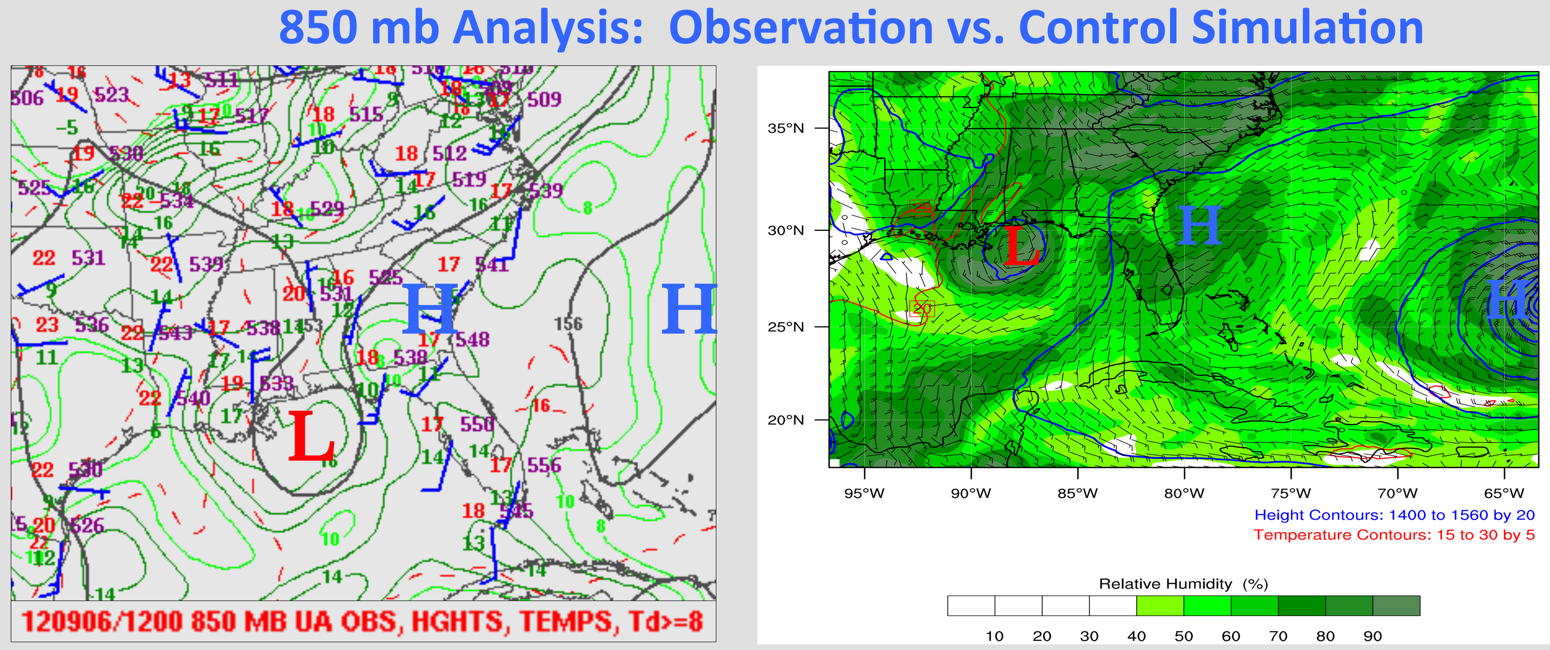
- Utilized the Advanced Research WRF (ARW) Model v3.7.1$_2$
- Configured with four, one-way nested domains
  - Horizontal resolution for nested domains: 27km, 9km, 3km, and 1km
- Initial and boundary conditions derived from NCEP NAM for a 36-h model forecast



FLSB CASE STUDY AND CONTROL SIMULATION DESCRIPTION

- Case Study: 6 Sep 2012 enhanced west coast sea breeze
  - Classified as Type III Florida sea breeze event with slight synoptic influence$_3$
- Control Simulation: Thompson microphysics, RRTM LW radiation physics, MM5 (Dudhia) SW radiation physics, YSU PBL physics, New Kain-Fritsch cumulus physics (d01/02 only), one-way feedback.

850 mb Analysis: Observation vs. Control Simulation



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PARAMETERIZATION SCHEME EXPERIMENTS

- Test 1: Lin microphysics
- Test 2: Two-way feedback
- Test 3: Grell 3D Cumulus physics
- Test 4: Kain-Fritsch Cumulus physics
- Test 5: MYNN3 PBL physics
- Test 6: GBM PBL physics
- Test 7: ACM2 PBL physics
- Test 8: RRTMG SW physics, GD Cumulus physics

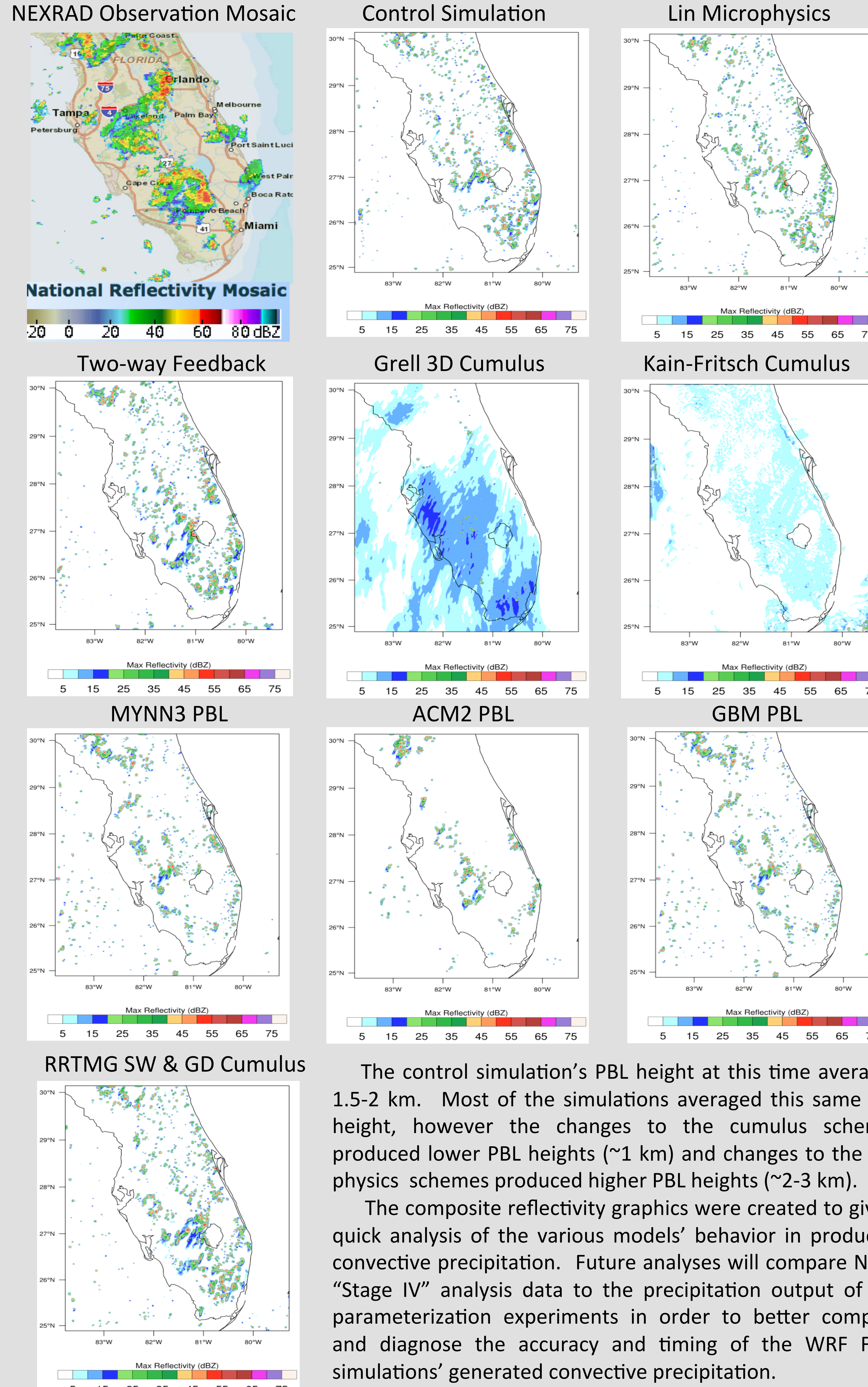
MIAMI, FLORIDA 07/00Z SOUNDING COMPARISONS

PARAMETERIZATION SENSITIVITY DISCUSSION

- All simulations successfully produced the FLSB convection for our case study.
- Preliminary results show a sensitivity of the high-resolution numerical simulations of FLSB convection to the various parameterization schemes.
  - Parameterization experiments show significant differences in timing, intensity, spatial coverage, and duration of the FLSB convection.
- Biggest differences in the convection produced by the WRF models were most likely caused by **updrafts being too weak** to generate strong initial convection, as well as **too dry of a mid-troposphere** (400-550 mb) inhibiting the generation of the secondary convection.
- Additional sensitivity studies of various WRF parameterization schemes need to be completed. Model performance also needs to be evaluated with additional case studies (enhanced east and east/west FLSB cases).

SENSITIVITY STUDIES OF SIMULATED FLSB CONVECTION

Composite Reflectivity at 19:30 UTC



The control simulation's PBL height at this time averaged 1.5-2 km. Most of the simulations averaged this same PBL height, however the changes to the cumulus schemes produced lower PBL heights (~1 km) and changes to the PBL physics schemes produced higher PBL heights (~2-3 km).

The composite reflectivity graphics were created to give a quick analysis of the various models' behavior in producing convective precipitation. Future analyses will compare NCEP "Stage IV" analysis data to the precipitation output of the parameterization experiments in order to better compare and diagnose the accuracy and timing of the WRF FLSB simulations' generated convective precipitation.

REFERENCES

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