1. Introduction

- A case study on the 15 July 2015 nocturnal MCS (Fig.1) is used here to explore the possible nocturnal MCS maintenance in a low-shear environment.
- A robust hydrometeor recirculation (Siegel and Van den Heever 2013) process favors MCS maintenance by strengthening the mid-level updraft.
- Pre-MCS low-level moisture distribution is also important.

2. Methodology

- Pre-MCS environment sampling: High-frequency rawinsonde launches, surface observation and AERIoe thermodynamic profile retrieval data (Turner 2016) at FP5 (MCsO) and MP2 (MCsC), University of Wyoming King Air measurements.
- Dual-polarization level-II data from Goodland, Kansas and NOXPR mobile radar data → Non-meteorological signal filtering (Thresholds: $q_v>0.8$, SW (Spectrum Width)<8.0)
- QC is performed with SOLO interactive editor (Oye et al. 1995). Processed data are plotted with the open-source Py-ART package (Helmus and Collis 2016).

3. Pre-MCS environment

3.1 Evolution of environmental instability

- MCAPE-MCIN evolution in pre-MCs, TLSRs, pre-MCs, MCs updraft, and pre-MCs, environment (green) derived from sounding data. Numbers represent the approximate rainsonde launch time. (b) Temperature-Dewpoint profile in pre-MCs and pre-MCs environment.

3.2 Difference in low-level moisture vertical distribution

- Doppler depression profile of pre-MCs, TLSRs, pre-MCs, environment (blue) Wyoming King Air (UWKA) flight track at the edge of MCs, and (c) Flight Data. The variables plotted are: Flight Level Altitude, $q_v$, pressure, vertical wind speed, relative humidity and eddy dissipation rate.

4. Microphysical structure

- NE-SW cross section (Fig.4a,b) through MCsO shows strong inflow layer lifting. Rear inflow of MCS, is strong and relatively deep, reaching ~30 m/s near MCS freezing level.
- ZDR column at the edge of strong convective cells (Fig.4b) is also indicative of a strong updraft.
- E-W cross section (Fig.5a,b) through MCsC illustrates a lack of strong inflow layer lifting, weaker rear inflow, weaker and shallower reflectivity core.

5. WRF simulation results

5.1 Experimental Design

- Two simulations are performed to test the microphysical sensitivity:
  - FULL (No change applied to 2M NSSL scheme)
  - GHSS (For graupel class, set mass-weighted fall speed (Eq.1a) for $N_{s_{max}}$)

5.2 MCS structural comparison

- E-W cross section (Fig.6a,b) through MCsO shows strong inflow layer lifting. Rear inflow of MCS, is strong and relatively deep, reaching ~30 m/s near MCS freezing level.
- ZDR column at the edge of strong convective cells (Fig.6b) is also indicative of a strong updraft.

5.3 CFAD Analysis

- NE-SW cross section (Fig.7a,b) through MCsC shows strong inflow layer lifting. Rear inflow of MCS, is strong and relatively deep, reaching ~30 m/s near MCS freezing level.

6. Take-home

- Strong rear inflow → Enhanced mid-level updraft → Favorable for long-lived MCS
- 2M simulations indicate a sensitivity of recirculation process to size-sorting
- Subtle changes in low-level moisture availability can be consequential

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