Large-scale Atmospheric State and Cloud/Precipitation Characteristics During MC3E

M. Jensen¹, P. Kollias², S. E. Giangrande¹, S. Collis³, W. Petersen⁴, S. Xie⁵, H. Kalesse², T. Toto¹
¹BNL, ²McGill U., ³ANL, ⁴NASA WFF, ⁵LLNL

MC3E April 22 – June 6
ARM Southern Great Plains Central Facility

Represents a collaborative effort between the DOE ASR Program and the NASA Global Precipitation Measurement (GPM) mission

Overarching Science:
A complete characterization of convective cloud systems in order to:

1) Advance the understanding of the different components of convective parameterization
2) Improve the fidelity of satellite estimates of precipitation over land.

MC3E Surface – Based Instrument Network

MC3E Disdrometer Facility
- 16 Parsivel disdrometers
- 5 3rd generation 2D video Disdrometers
- 20 Rain gauges

MC3E Radiosonde Array
- Six launch sites
  - Pratt, KS (S1);
  - Chanute, KS (S2);
  - Vici, OK (S3);
  - Morris, OK (S4);
  - Purcell, OK (S5);
  - Lamont, OK (C1)
- Launch Frequency 4-8x per day
- More than 1400 launches during 6-week campaign

Large-scale Atmospheric State

VARANAL (300km domain) – Vertical Velocity

VARANAL (300km domain) – Horiz. Wind Divergence

CAPE / CIN from CF radiosonde

Precipitation Characteristics

Cumulative Rainfall CF – Rain gauge

Fractional coverage 30 dBZe / 10 dBZe echo at 6 km height - CSAPR

Cloud Characteristics

Hydrometeor fraction – KAZR/MPL/CEIL

Cloud Classification – KAZR/MPL/CEIL

Summary of conditions sampled during MC3E

<table>
<thead>
<tr>
<th>Cat</th>
<th>Description</th>
<th># days sampled</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Convective Line / Cell events</td>
<td>8</td>
<td>4/22, 25; 5/11, 12, 20, 23, 24, 31</td>
</tr>
<tr>
<td>2</td>
<td>Widespread Stratiform Rain</td>
<td>3</td>
<td>4/27, 5/1, 5/10</td>
</tr>
<tr>
<td>3</td>
<td>Elevated Weak (Overnight) Convection</td>
<td>3</td>
<td>4/23, 24, 5/18</td>
</tr>
<tr>
<td>4</td>
<td>Boundary Layer Clouds</td>
<td>10</td>
<td>4/26, 5/6, 13-15, 19, 27-29, 6/1</td>
</tr>
<tr>
<td>5</td>
<td>Mid- or Upper-level Clouds</td>
<td>7</td>
<td>5/2, 3, 8, 9, 25, 26, 6/2</td>
</tr>
<tr>
<td>6</td>
<td>Clear</td>
<td>14</td>
<td></td>
</tr>
</tbody>
</table>

• Coordinated aircraft missions focused on categories 1 & 2
• Dedicated boundary layer cloud flights by UND Citation 5/27 & 5/30
• Enhanced sounding operations focused on categories 1-3

Correlations between large-scale atmospheric state and cloud/precipitation properties

- 7 distinct “events” observed by C-SAPR during MC3E
- VARANAL (300 km domain) variables (horizontal wind divergence and vertical velocity) are 6-hour averages prior to detection of 10 dBZe echo
- Fraction of areal coverage at 6 km (10dBZe/30dBZe) represents maximum per event (proxy for convective “strength”)