Sensitivity of Simulated Great Salt Lake Effect Precipitation to the Parameterization of Microphysical Processes

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Introduction
- Great Salt Lake Effect (GSLE) snow is a significant forecast challenge for forecasters and NWP during the cool season.
- Aciot and Steenburgh (2013) showed via simulation the GSLE event of 27 October 2010 required synergistic interaction of orography and land-surface contrasts to produce precipitation comparable to observations.
- GSLE precipitation is sensitive to moisture flux from the lake and moisture in the incident airmass as shown by Otten and Steenburgh (2003).
- We found GSLE precipitation distribution and amount was also sensitive to the choice of microphysics parameterization (MP) in the Weather Research and Forecasting (WRF) Advanced Research WRF (ARW) system.

Methods
- We simulated the 27 Oct 2010 GSLE event with the WRF ARW V3.4.
- The GSLE event occurred following the passage of a precipitation band associated with a baroclinic trough.
- Our control simulation (THOM) used the Thompson MP scheme and produced a similar precipitation distribution and amount as that derived from NEXRAD observations.
- Additional simulations used the same configuration as THOM except for the choice of Goddard (GDDN), Morrison (MORR), and WRF double moment six-class (WDM6) MP schemes.
- All simulations generated similar moisture fields after a few hours of model run time, indicating consistent synoptic situations.
- Consistency of synoptic conditions imply that GSLE precipitation distribution and amount differences between simulations were primarily caused by the choice of MP scheme.

Results
- The THOM, MORR, and WDM6 simulations all produced more mean precipitation and larger areal distributions of precipitation than the THOM simulation.

<table>
<thead>
<tr>
<th></th>
<th>Max Precipitation (mm)</th>
<th>Mean Precipitation (mm)</th>
<th>Rainfall Type</th>
<th>Precipitation Type</th>
<th>Area-avg Precipitation (mm)</th>
<th>Area-avg Precipitation (mm)</th>
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<tbody>
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<td>CTL</td>
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<td>1.23</td>
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<td>9.45</td>
<td>10.3</td>
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<td>13</td>
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<tr>
<td>MORR</td>
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<td>1.32</td>
<td>6.94</td>
<td>9.55</td>
<td>52</td>
<td>220</td>
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<tr>
<td>WDM6</td>
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<td>1.58</td>
<td>22.25</td>
<td>465</td>
<td>655</td>
<td>191</td>
</tr>
</tbody>
</table>

- The choice of MP scheme causes differences in GSLE precipitation distribution and amount in two ways:
  1. differing amounts of graupel production
  2. displacement of the convergence zone due to pre-GSLE event precipitation.

Graupel Production
- WDM6 produced far more graupel and the maximum graupel mixing ratio was lower in altitude by roughly 1 km than THOM.
- Above 1.8 km MSL THOM produced slightly more rain, but below 1.8 km MSL WDM6 produced much more rain.
- The rain mixing ratio is important to consider because of its role in producing graupel.

Conclusions
- GSLE precipitation distribution and amount is sensitive to the choice of MP scheme.
- MP scheme choice affects GSLE precipitation distribution and amount by:
  1. differing amounts of graupel production
  2. displacement of the convergence zone due to pre-GSLE precipitation.