Idealized Modeling of the Role of Stability and Shear on Mesoscale Gravity Wave Evolution

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**What is a Mesoscale Gravity Wave (MGW)**
- Correlated pressure wind perturbations often found behind a Mesoscale Convective System (MCS)
- MGWs can cause damaging winds and intense precipitation
- MGWs can be very long lived and travel several hundred kilometers

**Modeling MGWs**
- Using WRF version 3.2.1 and NCSA/LEAD workflow broker system
- Evaporative cooling is simulated using an imposed cold thermal
- Model domain is (x*y*z)=(83*83*7km)
- In the model example images
  - Cold thermal is falling at 5min
  - Wave is at max activity at 25min

**Goals**
- Explore the relationship between the following variables
  - Lapse rate within the stable layer
  - Temperature of the imposed cooling aloft
  - Vertical U-wind speed shear
- To the following characteristics of MGW intensity
  - High and positive correlation between U-wind perturbation (U') and pressure perturbation (P')
  - Increased temperature immediately following lower pressure
- Strength of surface winds in vicinity of large pressure changes

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**Summary of Current and Future Work**
- Current Work
  - 500 runs completed
  - Analysis code written to process data and results from each WRF simulation
  - What we know now about variable dependence for strong MGW cases
  - 1.0°C thermal combined with larger H1 and γ, and smaller H2 and γ, and δ
  - Results in larger negative U' and P'
  - Thermal appears to be the most important, followed by the lapse rate and heights

<table>
<thead>
<tr>
<th>MGW</th>
<th>Thermal</th>
<th>H1</th>
<th>H2</th>
<th>H3</th>
<th>r</th>
<th>min u'</th>
<th>min P'</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strong</td>
<td>-10</td>
<td>1250</td>
<td>5150</td>
<td>7250</td>
<td>6</td>
<td>0.89</td>
<td>-4.086</td>
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<tr>
<td>Weak</td>
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<td>250</td>
<td>6</td>
<td>3750</td>
<td>8</td>
<td>0.94</td>
<td>-0.839</td>
</tr>
</tbody>
</table>

- Future Work
  - Complete all runs
  - Create Regime Diagrams to relate shear, stability, and cooling with MGW activity
  - Substitute a constant cold source for the cold thermal
  - Examine MGW response for the thermal versus a constant cold source