2\textsuperscript{nd} Generation Airborne Precipitation Radar (APR-2)

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Airborne Precipitation Radar (APR-2) - Overview

- Dual-frequency operation with Ku-band (13.4 GHz) and Ka-band (35.6 GHz)
  - Geometry and frequencies chosen to simulate GPM radar
- Measures reflectivity at co- and cross-polarizations, and Doppler
- Range resolution is ~ 60 m
- Horizontal resolution at surface (DC-8 at 11 km altitude) is ~ 1 km

Image below shows 3D nature of APR-2 data; 50-degree data wedge underneath flight track
Data Collected During GRIP

- Table below shows each day that APR-2 collected science data, along with total duration and storm name, if applicable

<table>
<thead>
<tr>
<th>Date</th>
<th>Flight No.</th>
<th>Name</th>
<th>Data Vol.</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/17</td>
<td>6</td>
<td>Ex TD 5</td>
<td>2.0 hr</td>
<td>Melting layer spiral</td>
</tr>
<tr>
<td>8/24</td>
<td>7</td>
<td>-</td>
<td>4.8 hr</td>
<td>Multiple passes developing</td>
</tr>
<tr>
<td>8/29</td>
<td>9</td>
<td>Earl</td>
<td>4.4 hr</td>
<td>Cat 1 – developing eye</td>
</tr>
<tr>
<td>8/30</td>
<td>10</td>
<td>Earl</td>
<td>3.9 hr</td>
<td>Cat 4</td>
</tr>
<tr>
<td>9/1</td>
<td>12</td>
<td>Earl</td>
<td>2.5 hr</td>
<td>Cat 4</td>
</tr>
<tr>
<td>9/2</td>
<td>13</td>
<td>Earl</td>
<td>4.3 hr</td>
<td>Collapsing eyewall</td>
</tr>
<tr>
<td>9/6</td>
<td>15</td>
<td>Gaston</td>
<td>3.8 hr</td>
<td>Convective cell</td>
</tr>
<tr>
<td>9/7</td>
<td>16</td>
<td>Gaston</td>
<td>3.9 hr</td>
<td>Stratiform area</td>
</tr>
<tr>
<td>9/12</td>
<td>17</td>
<td>PGI44</td>
<td>4.8 hr</td>
<td>Non-developing Karl</td>
</tr>
<tr>
<td>9/13</td>
<td>18</td>
<td>PGI44</td>
<td>4.7 hr</td>
<td>Non-developing Karl</td>
</tr>
<tr>
<td>9/14</td>
<td>19</td>
<td>PGI44/Karl</td>
<td>2.8 hr</td>
<td>Genesis</td>
</tr>
<tr>
<td>9/16</td>
<td>20</td>
<td>Karl</td>
<td>3.8 hr</td>
<td>Emerged from Yucatan</td>
</tr>
<tr>
<td>9/17</td>
<td>21</td>
<td>Karl</td>
<td>4.4 hr</td>
<td>Landfall – orographic rain</td>
</tr>
<tr>
<td>9/21</td>
<td>23</td>
<td>Pre-Matthew</td>
<td>3.6 hr</td>
<td>A-Train underpass</td>
</tr>
<tr>
<td>9/22</td>
<td>24</td>
<td>Pre-Matthew</td>
<td>4.5 hr</td>
<td>A-Train underpass</td>
</tr>
</tbody>
</table>
Post-Experiment Processing

- The flow-chart below illustrates the processing of APR-2 data post-experiment.
- Calibrated reflectivities, Doppler have been delivered to archive 5/12.

Cal used surface at Ku and light precip at Ka; estimated accuracy +/- 1 dB.
Aircraft motion calculation includes MMS data.
Delivery to archive.
Example: Karl Genesis 9/14

Wind direction shift
Example: Hurricane Karl At Landfall 9/17
Example: August 24 – Convective Cell Time Series
Hurricane Earl – August 29 – Cat 1
Rossby Length Calculation for Hurricane Lines

- L is the length scale at which rotational effects become as important as buoyancy effects \( L = NH/f \) - related to efficiency of convective heating
  - \( f \) is modified Coriolis parameter
  \[
  f^2 = \left( f_c + \frac{2V}{r} \right) \left( f_c + \frac{V}{r} + \frac{\partial V}{\partial r} \right)
  \]
- \( NH \) was set to a constant value for the tropical atmosphere
- \( v \) is crosswind estimate \( frc \)
- To check, made same calculation from reconnaissance flight level data (at right)
- Are other storm-centered parameters of interest?
Hurricane Earl – August 30 – Cat 3
Status and Plans

- Calibrated level 1 data now archived
- Plans for selected cases –
  - Precipitation analysis/retrieval (for details, see talk by S. Tanelli)
    - Melting layer classification
    - Precipitation classification (e.g., stratiform)
    - Dual-frequency estimation of precipitation rate and particle size
  - Doppler analysis
    - Compare cross-wind measurements with NOAA/AF measurements
    - Derive products from vertical and cross-wind data (e.g., Rossby length)
- Collaborations – put our measurements in the context of other observations and models