Review of PLOWS microphysical measurements

David Plummer, Greg McFarquhar, Bob Rauber and Brian Jewett
University of Illinois, Urbana, IL
Data processing status

- Processing OAP data with U. Illinois codes to derive size distributions, cross-sectional area & other bulk parameters (codes include corrections of hollow particles & rejection of shattered particles)
- Processed 2D-P, 2D-C (25 μm) data for RF-01, RF-04, RF-05; partly completed for RF-02, RF-03.
- Processing of 2D-C (10 μm) underway
Measurements from RF-05

• Review of this case, examples of the data available and the products we’re creating to analyze each flight
Dropsonde track H

One single and two stacked measurements through precipitation bands

Three vertically-stacked measurements through precipitation bands
Composite radar and flight track
Three stacked legs through main precipitation band
Leg A, ~4600m, -17°C

2D-P images (green), 25 μm 2D-C (blue)

10 μm 2D-C (purple)
<table>
<thead>
<tr>
<th>Time</th>
<th>TAS</th>
<th>Overload</th>
<th>nParticles</th>
<th>Elapsed Time</th>
<th>timeBarTotal</th>
<th>sv Act</th>
<th>sv Used</th>
<th>Area 3.82mm²</th>
<th>Conc 29.203N/L</th>
<th>Lw 4.601g/M3</th>
<th>z 41.184db</th>
</tr>
</thead>
<tbody>
<tr>
<td>19:15:04.535</td>
<td>128.9</td>
<td>0.000</td>
<td>44</td>
<td>0.116</td>
<td>0.114</td>
<td>1.46L</td>
<td>0.000L</td>
<td>3.82mm²</td>
<td>29.203N/L</td>
<td>4.601g/M3</td>
<td>41.184db</td>
</tr>
<tr>
<td>19:15:04.205</td>
<td>125.0</td>
<td>0.000</td>
<td>166</td>
<td>0.247</td>
<td>0.112</td>
<td>46.35L</td>
<td>0.515L</td>
<td>28.84mm²</td>
<td>7.647N/L</td>
<td>2.295g/M3</td>
<td>42.149db</td>
</tr>
<tr>
<td>19:15:04.322</td>
<td>125.0</td>
<td>0.025</td>
<td>164</td>
<td>0.117</td>
<td>0.113</td>
<td>19.21L</td>
<td>0.592L</td>
<td>30.56mm²</td>
<td>6.646N/L</td>
<td>1.843g/M3</td>
<td>37.681db</td>
</tr>
<tr>
<td>19:15:04.600</td>
<td>133.8</td>
<td>0.000</td>
<td>24</td>
<td>0.065</td>
<td>0.113</td>
<td>0.85L</td>
<td>1520.96L</td>
<td>0.87mm²</td>
<td>0.001N/L</td>
<td>0.000g/M3</td>
<td>-25.565db</td>
</tr>
<tr>
<td>19:15:04.646</td>
<td>128.9</td>
<td>0.000</td>
<td>35</td>
<td>0.046</td>
<td>0.108</td>
<td>0.58L</td>
<td>1939.50L</td>
<td>3.59mm²</td>
<td>0.001N/L</td>
<td>0.000g/M3</td>
<td>-4.977db</td>
</tr>
<tr>
<td>19:15:04.739</td>
<td>128.9</td>
<td>0.000</td>
<td>38</td>
<td>0.093</td>
<td>0.090</td>
<td>1.17L</td>
<td>0.073L</td>
<td>3.02mm²</td>
<td>32.726N/L</td>
<td>4.843g/M3</td>
<td>41.730db</td>
</tr>
<tr>
<td>19:15:04.799</td>
<td>128.9</td>
<td>0.000</td>
<td>36</td>
<td>0.060</td>
<td>0.059</td>
<td>0.75L</td>
<td>0.038L</td>
<td>3.11mm²</td>
<td>56.899N/L</td>
<td>9.894g/M3</td>
<td>-45.176db</td>
</tr>
<tr>
<td>Time</td>
<td>Locus</td>
<td>TAS</td>
<td>overload</td>
<td>nParticles</td>
<td>elapsed time</td>
<td>timeBarTotal</td>
<td>sv: act</td>
<td>used</td>
<td>area</td>
<td>conc</td>
<td>lw</td>
</tr>
<tr>
<td>--------------</td>
<td>-------</td>
<td>------</td>
<td>----------</td>
<td>------------</td>
<td>--------------</td>
<td>--------------</td>
<td>---------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>--------</td>
</tr>
<tr>
<td>18:23:08.856</td>
<td>Leg B</td>
<td>125.0</td>
<td>0.000</td>
<td>98</td>
<td>1.539</td>
<td>0.945</td>
<td>320.93L</td>
<td>5.565L</td>
<td>83.08mm²</td>
<td>0.479N/L</td>
<td>1.270g/m³</td>
</tr>
<tr>
<td>18:23:09.064</td>
<td>Leg B</td>
<td>133.8</td>
<td>0.000</td>
<td>8</td>
<td>0.367</td>
<td>0.287</td>
<td>4.79L</td>
<td>0.239L</td>
<td>1.00mm²</td>
<td>1.057N/L</td>
<td>0.845g/m³</td>
</tr>
<tr>
<td>18:23:09.080</td>
<td>Leg B</td>
<td>128.9</td>
<td>0.000</td>
<td>33</td>
<td>0.016</td>
<td>0.345</td>
<td>0.20L</td>
<td>1939.73L</td>
<td>6.53mm²</td>
<td>0.001N/L</td>
<td>0.000g/m³</td>
</tr>
<tr>
<td>18:23:09.577</td>
<td>Leg B</td>
<td>133.8</td>
<td>0.000</td>
<td>13</td>
<td>0.497</td>
<td>0.502</td>
<td>6.49L</td>
<td>1521.083L</td>
<td>1.44mm²</td>
<td>0.000N/L</td>
<td>0.000g/m³</td>
</tr>
<tr>
<td>18:23:09.583</td>
<td>Leg B</td>
<td>128.9</td>
<td>0.000</td>
<td>39</td>
<td>0.006</td>
<td>0.466</td>
<td>0.08L</td>
<td>1939.684L</td>
<td>5.14mm²</td>
<td>0.001N/L</td>
<td>0.000g/m³</td>
</tr>
<tr>
<td>18:23:09.740</td>
<td>Leg B</td>
<td>128.9</td>
<td>0.000</td>
<td>7</td>
<td>0.157</td>
<td>0.111</td>
<td>1.98L</td>
<td>0.117L</td>
<td>5.29mm²</td>
<td>2.150N/L</td>
<td>0.433g/m³</td>
</tr>
<tr>
<td>18:23:09.678</td>
<td>Leg B</td>
<td>125.0</td>
<td>0.000</td>
<td>94</td>
<td>0.822</td>
<td>0.804</td>
<td>171.63L</td>
<td>4.184L</td>
<td>85.64mm²</td>
<td>0.571N/L</td>
<td>1.955g/m³</td>
</tr>
</tbody>
</table>
Leg B, ~4000m, -13°C

<table>
<thead>
<tr>
<th>Time</th>
<th>TAS</th>
<th>overload</th>
<th>nParticles</th>
<th>elapsed time</th>
<th>timeBarTotal</th>
<th>sv: act</th>
<th>used</th>
<th>area</th>
<th>conc</th>
<th>lw</th>
<th>z</th>
</tr>
</thead>
<tbody>
<tr>
<td>18:24:57.496</td>
<td>125.0</td>
<td>0.000</td>
<td>137</td>
<td>0.747</td>
<td>0.368</td>
<td>155.56L</td>
<td>2.155L</td>
<td>53.92mm²</td>
<td>1.712N/L</td>
<td>1.027g/m³</td>
<td>35.993db</td>
</tr>
<tr>
<td>18:24:57.858</td>
<td>127.9</td>
<td>0.000</td>
<td>30</td>
<td>0.470</td>
<td>0.406</td>
<td>5.08L</td>
<td>1925.205L</td>
<td>6.30mm²</td>
<td>0.001N/L</td>
<td>0.000g/m³</td>
<td>-0.540db</td>
</tr>
<tr>
<td>18:24:58.045</td>
<td>127.9</td>
<td>0.000</td>
<td>33</td>
<td>0.187</td>
<td>0.186</td>
<td>2.34L</td>
<td>0.123L</td>
<td>5.47mm²</td>
<td>13.859N/L</td>
<td>4.112g/m³</td>
<td>43.952db</td>
</tr>
<tr>
<td>18:24:58.000</td>
<td>133.8</td>
<td>0.000</td>
<td>20</td>
<td>0.429467</td>
<td>0.612</td>
<td>5609735.20L</td>
<td>1.04mm²</td>
<td>0.001N/L</td>
<td>0.000g/m³</td>
<td>-39.212db</td>
<td></td>
</tr>
<tr>
<td>18:24:58.309</td>
<td>127.9</td>
<td>0.000</td>
<td>30</td>
<td>0.309</td>
<td>0.259</td>
<td>3.86L</td>
<td>1925.139L</td>
<td>4.68mm²</td>
<td>0.001N/L</td>
<td>0.000g/m³</td>
<td>0.821db</td>
</tr>
<tr>
<td>18:24:58.314</td>
<td>133.8</td>
<td>0.000</td>
<td>14</td>
<td>0.005</td>
<td>0.314</td>
<td>0.07L</td>
<td>1520.696L</td>
<td>1.12mm²</td>
<td>0.000N/L</td>
<td>0.000g/m³</td>
<td>-24.187db</td>
</tr>
<tr>
<td>18:24:58.290</td>
<td>125.0</td>
<td>0.000</td>
<td>130</td>
<td>-0.794</td>
<td>0.388</td>
<td>165.79L</td>
<td>2.238L</td>
<td>58.28mm²</td>
<td>1.579N/L</td>
<td>1.231g/m³</td>
<td>39.508db</td>
</tr>
</tbody>
</table>
Leg C, ~3400m, -10ºC

<table>
<thead>
<tr>
<th>Time</th>
<th>TAS</th>
<th>overload</th>
<th>nParticles</th>
<th>elapsed time</th>
<th>timeBarTotal</th>
<th>sv: act</th>
<th>used</th>
<th>area</th>
<th>conc</th>
<th>lw</th>
<th>z</th>
</tr>
</thead>
<tbody>
<tr>
<td>18:49:09:010</td>
<td>124.0</td>
<td>0.000</td>
<td>41</td>
<td>2.102</td>
<td>1.924</td>
<td>25.44L</td>
<td>0.963L</td>
<td>5.23mm²</td>
<td>2.223N/L</td>
<td>0.263g/m³</td>
<td>31.575db</td>
</tr>
<tr>
<td>18:49:10:274</td>
<td>124.0</td>
<td>0.000</td>
<td>23</td>
<td>1.264</td>
<td>1.108</td>
<td>15.30L</td>
<td>0.902L</td>
<td>6.50mm²</td>
<td>1.203N/L</td>
<td>0.257g/m³</td>
<td>30.065db</td>
</tr>
<tr>
<td>18:49:11:647</td>
<td>122.1</td>
<td>0.000</td>
<td>101</td>
<td>4.549</td>
<td>1.886</td>
<td>927.40L</td>
<td>11.367L</td>
<td>95.32mm²</td>
<td>0.270N/L</td>
<td>0.543g/m³</td>
<td>39.117db</td>
</tr>
<tr>
<td>18:49:12:326</td>
<td>124.0</td>
<td>0.000</td>
<td>33</td>
<td>2.052</td>
<td>2.052</td>
<td>24.04L</td>
<td>1.680L</td>
<td>6.75mm²</td>
<td>1.086N/L</td>
<td>0.205g/m³</td>
<td>30.190db</td>
</tr>
<tr>
<td>18:49:13:605</td>
<td>124.0</td>
<td>0.000</td>
<td>52</td>
<td>1.279</td>
<td>1.086</td>
<td>15.48L</td>
<td>0.829L</td>
<td>4.57mm²</td>
<td>3.650N/L</td>
<td>0.068g/m³</td>
<td>19.730db</td>
</tr>
<tr>
<td>18:49:14:236</td>
<td>124.0</td>
<td>0.000</td>
<td>23</td>
<td>0.631</td>
<td>0.576</td>
<td>7.64L</td>
<td>0.541L</td>
<td>4.04mm²</td>
<td>2.098N/L</td>
<td>0.387g/m³</td>
<td>32.001db</td>
</tr>
</tbody>
</table>
Rosemount ice probe & King/PVM probes indicate liquid water at this time
Leg A, ~4600 m

Leg B, ~4000 m

Leg C, ~3400 m

N(D) calculated for 2D-P (red) and 25 μm 2D-C (blue), averaged along flight legs
Total number concentration for 2D-C (red), 2D-P (blue), CDP (green), and FSSP (shrouded magenta, unshrouded black)

Supercooled water reported here in leg C
Derived ice water content (Brown & Francis 1995) from 2D-P and 25 μm 2D-C, again for leg C
Cloud Spectrometer and Impactor (CSI)

• CSI measurements of total water content (TWC) will also be used.
• Due to issues with the instrument's airspeed measurements, the TWC values will need to be rederived using the C-130's measured airspeed; The procedure to do so is expected shortly from the manufacturer.
Combined 2D-C/2D-P Measurements along entire flight path, flight legs outlined in red
PRELIMINARY RF05 N(D) (cm$^{-4}$), 10 second average

Leg B, ~4000 m
Preliminary RF05 N(D) (cm^-4), 10 second average

Leg C, ~3400 m

Maximum dimension (mm)

Time (UTC)

18:30:00 18:37:30 18:45:00 18:52:30 19:00:00
PRELIMINARY RF05 N(D) (cm⁻⁴), 10 second average

Leg A, ~4600 m