Advanced Technology Microwave Sounder (ATMS) Geolocation Analysis

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CrIS/ATMS Instrument Suite (CrIMSS)

Overview
- Used ATMS observation of shoreline crossings to determine sensor pointing accuracy (geolocation)
- Used two complimentary methods to obtain sub-pixel accuracy
- Obtained geolocation for window channels from all five ATMS bands
- Obtained best fit roll, pitch, and yaw error angles for the two bands with the largest geolocation errors
- May warrant updating the ATMS pointing parameters

ATMS Channel Definitions
- Each band has a separate geolocation
- Channels 1, 2, 3, 16 are window channels
- Channel 17 is sensitive to water vapor but under dry conditions, shorelines are visible

ATMS Channel Definitions

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Shoreline Crossing Method

Method is illustrated with CrIS data due to the complexity of overlapping ATMS FOVs
- Fit a cubic polynomial through four points in the in-track or cross-track direction
- Use the inflection point as the shore crossing point
- Use a least-squares-fit to coastlines to minimize total error for the scene

Land-Sea Fraction Method

Method is illustrated with CrIS data and CrIS/ATMS Instrument Suite (CrIMSS)
- Determine the fraction of land and sea in each ATMS footprint (ifrac)
- Use a simple linear model to calculate expected field of view (FOV) footprint brightness temperatures (TcalFOV)
  \[ T_{calFOV} = (1 - \text{ifrac})T_{land} + \text{ifrac}T_{sea} \]
- Find average brightness temperatures for land (Tland) and sea (Tsea) from the measured data
- Compare calculated brightness temperatures to observed brightness temperatures
- Shift shoreline to minimize difference between observed and calculated brightness temperatures by minimizing the following function:
  \[ x^2 = \sum_{i} (T_{calFOV_i} - T_{atmosphere})^2 \]

Geolocation Results

Land-Sea Fraction Method

Location of ATMS Geolocated Scenes

Coastlines next to dry desert areas give good brightness temperature contrasts

Geolocation Results

Tabulated Nadir Geolocation Error

<table>
<thead>
<tr>
<th>Channel</th>
<th>In-track (km)*</th>
<th>Cross-track (km)*</th>
<th>Number of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-2.8 (3.1)</td>
<td>-3.1 (2.2)</td>
<td>185</td>
</tr>
<tr>
<td>2</td>
<td>-5.8 (3.1)</td>
<td>1.6 (2.6)</td>
<td>185</td>
</tr>
<tr>
<td>3</td>
<td>-2.8 (2.2)</td>
<td>-3.1 (2.2)</td>
<td>185</td>
</tr>
<tr>
<td>16</td>
<td>-3.4 (3.8)</td>
<td>-0.6 (3.3)</td>
<td>183</td>
</tr>
<tr>
<td>17</td>
<td>1.1 (2.1)</td>
<td>0.4 (2.6)</td>
<td>84</td>
</tr>
</tbody>
</table>

*Numbers in parentheses are standard deviations

- Geolocation data plotted were binned into 10 FOV bins to reduce scatter
- Data presented uses land/sea fraction method

Test for Method Reliability

For Channel 17 only cases with a brightness temperature difference between land and sea larger than 12 K were used

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Fit for Sensor Pointing Error

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Channels 3 and 4 are V band channels that share a common feed horn. As expected, the geolocation results from the two channels are nearly identical.