Progress on GOSAT validation using data from Eureka and Toronto

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1. Introduction
It is always important to compare data from a new source against that of older, well-characterized sources. The launch of the satellite GOSAT in 2009 by JAXA has given cause for comparison between its data products and other data sets. This poster will describe:
- Measurement techniques associated with the systems used at TAO and PEARL, and on board the satellites SCISAT-1 and GOSAT
- Comparisons of data recorded by these measurement systems with the data recorded by the TANSO-FTS instrument on GOSAT
- Progress made on GOSAT validation and future analysis efforts

2. Instrumentation and data analysis

Table 1. Summary of measurement systems in Toronto, Eureka, on SCISAT-1, and on GOSAT.

<table>
<thead>
<tr>
<th>Location</th>
<th>Instrument &amp; Specifications</th>
<th>Data Products</th>
<th>Measurement Methods</th>
<th>Acronyms</th>
</tr>
</thead>
<tbody>
<tr>
<td>downtown toronto, ontario, canada</td>
<td>NDACC (<a href="http://www.ndacc.org">www.ndacc.org</a>)</td>
<td>Solar absorption spectra</td>
<td>Heliosat tracks the sun, directing sunlight into the laboratory</td>
<td>ACE: Atmospheric Chemistry Experiment</td>
</tr>
<tr>
<td>nunavut, canada (80N, 86W)</td>
<td>PEARL site</td>
<td>Total and partial columns for trace gases– CH4, CO2 among others</td>
<td>Mirrors reflect and focus beam, which passes through one of 6 standard NDACC filters before entering the spectrometer</td>
<td>CAI: Cloud and Imager</td>
</tr>
<tr>
<td>DOWNTOWN TROONTO, TORONTO, ONTARIO</td>
<td>SCISAT-1</td>
<td>Vertical profiles for temperature, pressure, and volume mixing ratios are obtained from slant columns</td>
<td>.Capable of measuring atmospheric properties from the ground to about 100 km</td>
<td>CANDAC: Canadian Network for the Detection of Atmospheric Change</td>
</tr>
<tr>
<td>TROONTO, ONTARIO</td>
<td>GOSAT</td>
<td>Vertical profiles of CO2 and CH4</td>
<td>Uses solar occultation (see Fig. 1, right) to record spectra during sunrise and sunset</td>
<td>FTS: Fourier Transform Spectrometer</td>
</tr>
</tbody>
</table>

3. Column comparisons with TAO
- Total column abundances of CH4 measured by TAO and GOSAT plotted against one another to examine their relationship
- Ideal relationship: all points lie along a 45° line
- Note improvement from versions 01.xx to 02.00, particularly in vertical scattering
- Coincidence criteria:
  - +10° latitude/longitude
  - +12 hours

Figure 1. In solar occultation, a series of measurements made looking through the atmosphere at different tangent heights are compared to an unattenuated one made through the exoatmosphere.

4. Profile comparisons with ACE-FTS
- Column abundances of CO2 and CH4 | TIR: Thermal And Near infrared Sensor for carbon Observation
- Vertical profiles of CO2 and CH4 | TAO: University of Toronto Atmospheric Observatory
- Clear-sky confidence levels

Table 2. Mean % differences VFM for Eureka and Toronto (groups 1 and 2) at a range of pressures.

<table>
<thead>
<tr>
<th>Pressure (hPa)</th>
<th>Eureka Mean % Diff.</th>
<th>Toronto Mean % Diff.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>300</td>
<td>-0.022</td>
<td>-0.074</td>
</tr>
<tr>
<td>100</td>
<td>-0.074</td>
<td>-0.033</td>
</tr>
<tr>
<td>50</td>
<td>-0.047</td>
<td>-0.112</td>
</tr>
<tr>
<td>10</td>
<td>0.059</td>
<td>-0.088</td>
</tr>
<tr>
<td>Group 2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. Conclusions & future work
- Contributions to GOSAT validation have involved comparisons with measurements made by various instruments and techniques at Toronto, Eureka, and on SCISAT-1
- Improvements in GOSAT CH4 column abundances between JAXA versions 01.xx and 02.00 are seen
- Profile comparisons between ACE-FTS and GOSAT will be expanded in the future to cover locations across the globe. TIR data has only recently been released; this is work in progress.
- Many thanks to CGCS for contributing to summer internship funding, and to Dr. Kim Strong for her supervision and guidance this summer.

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JAXA datasets on Earth observation: National Space Development Agency of Japan (NASDA)
JAXA is operated by the Japanese Space Agency (JAXA) for the Ministry of Education, Culture, Sports, Science and Technology
The Centre for Global Change Science
The Centre for Global Change Science
The Centre for Global Change Science
www.gosat.nies.go.jp/index_e.html

References

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Figure 2. Measurement sites at Eureka and Toronto.

Figure 3. Coincident TAO and GOSAT (data version 02.00) CH4 column abundances. Version 02.00 covers 2009/06/03 to 2010/07/31

Figure 4. Correlation between CH4 total column amounts measured in the SWIR band over Toronto. GOSAT data versions 01.10, 01.20, 01.30, 01.40, and 01.50 were compared to a single TAO data set.

Figure 5. Correlation between CH4 total column amounts measured in the SWIR band over Toronto. GOSAT data version 02.00 was compared to the same TAO data set as versions v01.xx.

Figure 6. Time series comparison between PEARL and GOSAT CH4 column abundances. Figure courtesy of [1].

Figure 7. Profile comparison between Fig. 1, right). Conversion of CH4 profiles measured in the TIR band over Eureka. 3 GOSAT profiles were coincident with one ACE profile.

Figure 8. Profile comparison between Fig. 1, right). Comparison of CH4 profiles measured in the TIR band over Eureka. 3 GOSAT profiles were coincident with one ACE profile.

Figure 9. Profile comparison between Fig. 1, right). Comparison of CH4 profiles measured in the TIR band over Eureka. 3 GOSAT profiles were coincident with one ACE profile.