Development of aerosol altitude retrieval from GOSAT observations of the oxygen A-band

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Introduction and Motivation

Aerosols are an important element of global climate. Their effect on the atmospheric radiation budget shows large regional differences. The Japanese satellite GOSAT is the first dedicated satellite to measure the greenhouse gases CO2 and CH4, and for an accurate determination of their total column, the light path is a critical parameter. Even in the case of cloud-free scenes, the horizontal distribution of aerosols cannot be determined in this way. From DAK, for each wavelength \( \chi^2 \approx 1400 \) points, the fit looks good in the frequency domain. However, when the same fit is viewed in the absorption optical thickness domain, it does not look as perfect, and a systematic deviation can be detected.

What is GOSAT?
The Greenhouse Gases Observing Satellite "IBUYUK" (GOSAT) is the world’s first spacecraft designed to specially measure the concentrations of carbon dioxide and methane, the two major greenhouse gases, from space.

### CAI IMAGER

<table>
<thead>
<tr>
<th>Spectral coverage (µm)</th>
<th>Band 1</th>
<th>Band 2</th>
<th>Band 3</th>
<th>Band 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(0.380)</td>
<td>(0.390)</td>
<td>(0.870)</td>
<td>(1.600)</td>
</tr>
</tbody>
</table>

Targeted substances: Cloud and aerosol.

### Spectral resolution at nadir (km)

- 0.5
- 0.5
- 0.5
- 1.5

CAI images and cloud mask

CAI images allow us to see if there are clear aerosol plumes. This image was taken the 15th of April 2010, when the Eyjafjallajökull volcano erupted. The other two lower images are a display of the CAI cloud mask product. Image on the left is cloudy, while the image on the right is cloud-free. The cloud mask does not have aerosol information.

### TANSO-FTS SPECIMETROMETER

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<tr>
<td></td>
<td>(0.755)</td>
<td>(0.870)</td>
<td>(1.568)</td>
<td>(1.720)</td>
</tr>
</tbody>
</table>

Targeted gases: CO2, CH4, H2O.

### Spatial resolution at nadir (km)

- 0.5
- 0.5
- 0.5
- 1.5

### Spectral resolution (cm⁻¹)

- 0.27 (0.1 nm)
- 0.27 (5.5 nm)

TANSO-FTS is a Fourier-Transform Spectrometer, with a resolution of 0.27 cm⁻¹. It measures at four spectral windows or bands.

### Observation of the O2-A band with GOSAT

Non-cloudy scene 15 April 2010

Typical spectra obtained with TANSO FTs.

Two distinct orthogonal polarization directions are measured (P and S). However, the given polarization state is the polarization inside the instrument, not at the top of the atmosphere. To transform the polarization state, a Mueller matrix transformation is necessary.

CAI images allow us to see if there are clear aerosol plumes. This image was taken the 15th of April 2010, when the Eyjafjallajökull volcano erupted.

Comparing to different ways of observing the match between observation and calculation. The \( \chi^2 \) value is the same in both cases.