Institute of Astrophysics and Geophysics, Université de Liège

High resolution, solar infrared Fourier Transform Spectrometry. Application to the study of the Earth atmosphere

Dr. Rodolphe Zander, project leader
Prof. em. Luc Delbouille, Dr. Ginette Roland, Dr. Christian Servais, Dr. Emmanuel Mahieu, Philippe Demoulin, Pierre Duchatelet, Jacqueline Bosseloirs, Vincent Van De Weerdt, Guy Buntinx
Observatoire Royal de Belgique: Dr. Jacques Sauval, Dr. Ronnie Blomme, Joan Vандекерхове

During 2001, the Liège group, together with colleagues from the Institut d’Aéronomie Spatiale de Belgique and from the Observatoire Royal de Belgique, was present at the Jungfraujoch during 275 days, among which good weather conditions enabled observations on 133 days.

The main activity on the site was to pursue the long-term monitoring of the Earth atmosphere. The spectra recorded at the Jungfraujoch with the 2 high-performance infrared spectrometers allowed to derive total abundances of the following constituents:

a. - Those permitting to quantify the impact of human activities on the erosion of the ozone layer in the stratosphere, in particular HCl, ClONO₂, HNO₃, NO, NO₂, HF, COF₂ and O₃. The budget of the chlorine-containing species (see figure below) has been re-evaluated (new spectroscopic parameters for ClONO₂); the analysis confirms that the chlorine contents of the atmosphere is decreasing since 1998, as a result of the restrictions imposed by the Montreal Protocol and its successive amendments in the production of various chlorine-bearing source gases (in particular the CFCs). Proposed substitution species (notably HFCs and FCs) affect the fluorine budget and consequently, we don’t see any stabilization of its atmospheric contents. As the time span of the database lengthens, the evolution of the budget of nitrogen-containing species can be more accurately defined; however no trend is observed yet, in spite of the small increase of the tropospheric N₂O source gas.

b. - A series of greenhouse gases, directly affecting the radiation balance of the Earth’s atmosphere. Their tropospheric abundances are recommended to be monitored by the Kyoto protocol. Among these, a particular interest is devoted to N₂O, CH₄, CO₂, SF₆, CCl₂F₂ and CHClF₃.

c. - Various atmospheric constituents released at the ground, i.e. CO, C₂H₂, C₂H₆, OCS, HCN, H₂CO and H₂O, affecting the oxidation processes in the troposphere and the stratosphere, or appearing as important precursors in tropospheric ozone production.
Until now, the retrieved data have consisted in total abundances. However, new retrieval algorithms are currently tested and will provide some information on the distribution versus altitude for a number of the species listed above. A complete re-analysis of all archived spectra will be undertaken as soon as these retrieval tools have been tested and adopted by the NDSC.

To be able to extract the most information on the vertical distribution of the atmospheric constituents, we need to very accurately know the instrumental profile of the spectrometers; for that purpose, we have acquired 2 calibration cells, one sealed and filled with HBr gas, the other to be filled with N2O.

A new detector has also been tested and installed; its greater sensitivity in the 13 µm spectral region will allow better determination of some constituents, for example ClONO2 and C2H2.

Key words
Earth atmosphere, ozone layer, greenhouse gases, long-term monitoring, infrared spectroscopy

Collaborating partners/networks:
Main collaborations : IASB (Institut d’Aéronomie Spatiale de Belgique) / NDSC (archiving centers at NOAA [http://www.ndsc.ncep.noaa.gov/] and NILU [http://www.nilu.no/projects/nadir] ) / SOGE partners (e.g. EMPA) [http://www.nilu.no/niluweb/services/soge] / NASA Langley Research Center /
NASA JPL / University of Oslo / satellites: MOPPIT, ENVISAT and ACE validation / …

Scientific publications and public outreach 2001:


Address:
Institute of Astrophysics and Geophysics
Université de Liège
5, avenue de Cointe
B-4000 Liège (Belgique)

Contacts:

<table>
<thead>
<tr>
<th>Name</th>
<th>Phone</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Luc Delbouille</td>
<td>+32 4 342 2594</td>
<td><a href="mailto:delbouille@astro.ulg.ac.be">delbouille@astro.ulg.ac.be</a></td>
</tr>
<tr>
<td>Philippe Demoulin</td>
<td>+32 4 254 7585</td>
<td><a href="mailto:demoulin@astro.ulg.ac.be">demoulin@astro.ulg.ac.be</a></td>
</tr>
<tr>
<td>Emmanuel Mahieu</td>
<td>+32 4 254 7586</td>
<td><a href="mailto:mahieu@astro.ulg.ac.be">mahieu@astro.ulg.ac.be</a></td>
</tr>
<tr>
<td>Ginette Roland</td>
<td>+32 4 342 2594</td>
<td><a href="mailto:roland@astro.ulg.ac.be">roland@astro.ulg.ac.be</a></td>
</tr>
<tr>
<td>Christian Servais</td>
<td>+32 4 254 7584</td>
<td><a href="mailto:servais@astro.ulg.ac.be">servais@astro.ulg.ac.be</a></td>
</tr>
<tr>
<td>Rodolphe Zander</td>
<td>+32 4 254 7556</td>
<td><a href="mailto:zander@astro.ulg.ac.be">zander@astro.ulg.ac.be</a></td>
</tr>
</tbody>
</table>