

Name of research institute or organization:

**Institute of Astrophysics and Geophysics, Université de Liège**

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Title of project:

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

Project leader and team:

Dr. Rodolphe Zander, project leader

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Observatoire Royal de Belgique: Dr. Jacques Sauval, Dr. Ronnie Blomme, Joan Vandekerckhove

Project description:

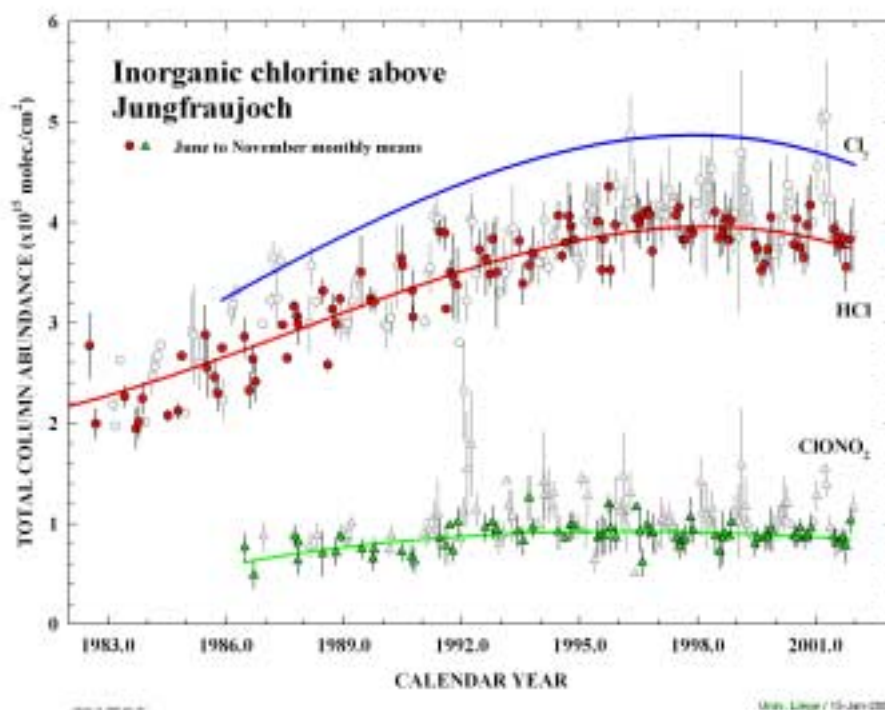
During 2001, the Liège group, together with colleagues from the Institut d'Aéronomie Spatiale de Belgique and from the Observatoire Royal de Belgique, was present at the Jungfraujoch during 275 days, among which good weather conditions enabled observations on 133 days.

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, ClONO<sub>2</sub>, HNO<sub>3</sub>, NO, NO<sub>2</sub>, HF, COF<sub>2</sub> and O<sub>3</sub>. The budget of the chlorine-containing species (see figure below) has been re-evaluated (new spectroscopic parameters for ClONO<sub>2</sub>); 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 N<sub>2</sub>O 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 N<sub>2</sub>O, CH<sub>4</sub>, CO<sub>2</sub>, SF<sub>6</sub>, CCl<sub>2</sub>F<sub>2</sub> and CHClF<sub>2</sub>.

c. - Various atmospheric constituents released at the ground, i.e. CO, C<sub>2</sub>H<sub>2</sub>, C<sub>2</sub>H<sub>6</sub>, OCS, HCN, H<sub>2</sub>CO and H<sub>2</sub>O, affecting the oxidization processes in the troposphere and the stratosphere, or appearing as important precursors in tropospheric ozone production.



*Evolution above the Jungfraujoch station of the two main chlorine reservoirs, HCl and ClONO<sub>2</sub>. The inorganic chlorine (Cl<sub>y</sub>) budget has been estimated by summing the contributions of these two gases. The Cl<sub>y</sub> curve peaks at the end of 1997.*

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 N<sub>2</sub>O.

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 ClONO<sub>2</sub> and C<sub>2</sub>H<sub>2</sub>.

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:

Anderson, J., J. M. Russell III, R. Zander, C. P. Rinsland, F. J. Murcray, J. Notholt, N. B. Jones, E. Mahieu and P. Duchatelet, A Unified Stratospheric Column HCl Climatology Constructed from HALOE and NDSC Measurements, poster presented at the NDSC 2001 Symposium, Arcachon, Sept. 24-27, 2001.

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