Name of research institute or organization:

Laboratory of Atmospheric Physics, Aristotle University of Thessaloniki, Greece

Title of project:

Validation of retrieval of atmospheric trace gases with Phaethon system using differential optical absorption spectroscopy

Project leader and team:

Prof. Alkiviadis Bais, project leader
Dr. Natalia Kouremeti

Project description:

The project aimed at validating the retrieval of atmospheric columns of trace gases (such as NO_2, O_3, HCHO, SO_2, O_4, BrO) using differential optical absorption spectroscopy (DOAS) with spectrally resolved measurements of atmospheric radiance and direct solar irradiance with the newly developed system Phaethon under an ESA funded contact. The validation was preformed against measurements of a collocated MAXDOAS system operating at Jungfraujoch by the Belgian Institute of Space Aeronomy (IASB/BIRA).

Phaethon was installed at the High Altitude Research Station Jungfraujoch at a location suitable for performing spectral sky radiance measurements from the zenith down to about 0° elevation angles, as well as spectral solar irradiance measurements by pointing directly towards the solar disk. The acquired spectra were analyzed with WINDOAS, a software platform that has been developed by IASB.

The analysis of the collected data was made almost on real time. This facilitated the assessment of Phaethon's performance and optimization of the measurements duration in order to reduce the signal of noise ratio.

The duration of the experimental campaign was 7 days. Clear sky and sun conditions were possible for almost 3 full days, allowing the opportunity to get high quality undisturbed measurements. The comparison of differential slant column densities derived for Phaethon and MAXDOAS-IASB instruments shows good agreement for the NO_2, O_3 while O_4 has higher deviation. All retrievals follow closely the same diurnal pattern.

In addition to the comparison with the IASB system, direct solar irradiance measurements were collected in order to derive the extraterrestrial solar irradiance reference spectrum using the Langley extrapolation method. This enables the retrieval of the total atmospheric optical depth, and consequently the direct estimation of the optical depth of some abundant trace gases and aerosols.

The expectation of this experimental campaign was to establish the quality of atmospheric gas retrievals with Phaethon and the associated uncertainties. It should be noted that at such high altitudes, the atmospheric column amounts of trace gases are smaller than at sea level, and consequently their absorption signals in the radiation measurements are weak. Therefore, the good agreement between Phaethon and IASB system, under such conditions, verifies the quality of the trace gases retrievals. The

zenith sky spectral measurements acquired during clear sky conditions will be used as reference spectra in future retrievals.

Key words:

Column density measurements, solar irradiance, sky radiance, trace gases, DOAS

Collaborating partners/networks:

Data collected with the IASB (Brussels, Belgium) MAXDOAS system operating regularly at the station were used for the validation.

Address:

Laboratory of Atmospheric Physics
Aristotle University of Thessaloniki
Campus Box 149
54124Thessaloniki
Greece

Contacts:

Prof. Alkiviadis Bais
Tel.: +30 2310 998184
Fax: +30 2310 998090
e-mail: abais@auth.gr
URL: http://lap.physics.auth.gr/index.asp?lang=en