Geophysical Research Abstracts
Vol. 20, EGU2018-14935, 2018
EGU General Assembly 2018

Use of the 1.27 μm O_2 absorption band for CO_2 and methane estimates in nadir viewing from space: Potential and application to Microcarb.

Jean-Loup Bertaux (1,4), Alain Hauchecorne (1), Franck Lefèvre (1,6), Denis Jouglet (2), Laurent Blanot (3), François-Marie Bréon (5), Pavel Akaev (4), and Pierre Lafrique (2)

(1) LATMOS/UVSQ/INSU, 11 Boulevard d'Alembert, 78280 Guyancourt, France (jean-loup.bertaux@latmos.ipsl.fr), (2) Centre National d'Etudes Spatiales, CST, 18 av.Edouard Belin, 31401 Toulouse, France, (3) ACRI-ST, 11 Boulevard d'Alembert, 78280 Guyancourt, France, (4) Laboratory for planetary and exoplanetary atmospheres, IKI/RAN, Moscow, Russia, (5) LSCE, CEA/CNRS/ UVSQ, 91191 Gif-sur-Yvette, France, (6) LATMOS/UPMC/INSU, Place Jussieu, Paris, France

Monitoring CO_2 from space is essential to characterize the spatio/temporal distribution of this major greenhouse gas, and quantify its sources and sinks. The mixing ratio of CO_2 to dry air can be derived from the CO_2/O_2 column ratio. The O_2 column is usually derived form its absorption signature on the solar reflected spectra over the O_2 A-band (OCO-2, Tanso/Gosat). As a result of atmospheric scattering, the atmospheric path length varies with the aerosols load, their vertical distribution, and their optical properties. The spectral distance between the O_2 A-band (0.76 μm) and the CO_2 absorption band (1.6 μm) results in significant uncertainties due to the varying spectral properties of the aerosols over the globe.

There is another O_2 absorption band at 1.27 μm with weaker lines than in the A-band. As the wavelength is much nearer to the CO_2 and CH4 bands, there is less uncertainty when using it as a proxy of the atmospheric path length to the CO_2 and CH4 bands. This O_2 band is used by the TCCON network implemented for the validation of space-based GHG observations. However, this absorption band is contaminated by the spontaneous emission of the excited molecule O_2*, which is produced by the photo-dissociation of O_3 molecules in the stratosphere and mesosphere. From a satellite looking nadir, this emission has a similar magnitude as the absorption signal that is used.

In the frame of the CNES Microcarb project, scientific studies have been performed in 2016-2017 to explore the problems associated to this airglow emission and methods to correct it. The intensities observed by SCIAMACHY/ENVISAT in limb viewing have been compared to a model of the emission based on the chemical-transport model Reprobus. The airglow intensities depend mostly on the Solar Zenith Angle and the agreement data/model is quite good. It was shown that, provided the spectra is acquired with a sufficient spectral resolution and SNR, the contribution of the O_2* emission at 1.27 μm to the observed spectral radiance may be disentangled from the lower atmosphere/ground absorption signature. The CO_2 mixing ratio may be retrieved with the accuracy required for quantifying the CO_2 sources (pressure level error $<$ 1 hPa, mixing ratio error $<$ 0.4 ppmv). As a result of these studies, it was decided to include such a band in the Microcarb design, although keeping the O_2 A band for reference. Some detailed results of these O_2* studies and their 2018 update will be presented. We advocate for the inclusion of such a band in other GHG monitoring future space missions, such as GOSAT-2 and EU/ESA CO_2M missions, for a better GHG retrieval.