Geophysical Research Abstracts
Vol. 16, EGU2014-13599-1, 2014
EGU General Assembly 2014

Synergetic investigation of CO on Mars and validation using PFS and CRISM observations

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In the framework of the ESA General Studies Programme activity SIROCCO (Synergetic SWIR and IR retrievals of near-surface concentrations of CH_4 and CO for Earth and Mars) and in preparation of the ExoMars TGO mission (2016), synergies between different instruments onboard the TGO orbiter are investigated. The challenge is to better capture CO information as close as possible to the surface, in view of better addressing the understanding, quantification or monitoring of sources and sinks.

ASIMUT-ALVL, a line-by-line radiative transfer code developed at IASB-BIRA [1], is used to simulate spectra in the infrared range (0.7 – 4.5 μm) under instrumental conditions corresponding to the instruments which will be onboard ExoMars TGO 2016. Simulations were performed under various atmospheric conditions given by GEM-Mars [2] and used for a sensitivity study of the different parameters involved (absorption lines selected, CO concentration, etc).

We test synergetic approaches to combine different spectral domains and different geometries (solar occultation and nadir). This seems necessary for an optimal exploitation of near surface information from the available data. A synthetic dataset of spectra was created for various scenarios. Different parameters were chosen to get a statistical and representative set of spectra. Then retrievals were performed in non-synergetic and synergetic strategies. The results of the fitting procedure and the benefits of the synergies will be discussed in this communication.

In order to define a validation dataset, we used the results of the Planetary Fourier Spectrometer (PFS) onboard Mars Express (MEX) [3] and Compact Reconnaissance Imaging Spectrometer (CRISM) onboard Mars Reconnaissance Orbiter (MRO) [4]. Seasonal trends of the two datasets were investigated for co-located observations. The data considered in this study were collected from L_s =131, MY28 to L_s =103, MY31. CO mixing ratios from PFS will be retrieved, under synergetic and non-synergetic conditions, and then compared to the CRISM values.

[1] Vandaele et al., 2006.
[2] L. Neary and F. Daerden, Fifth International Workshop on the Mars Atmosphere: Modelling and Observations, Oxford, UK, 2014.
[3] Sindoni et al., PSS 59 (2011) 149-162.
[4] Smith et al., JGR 114 (2009) E00D03