On the road to MTG IRS retrieval of CO using interferograms – case of IASI

Nejla Ećo [(1)], Sébastien Payan [(1)], Laurence Croizé [(2)]

[(1)] LATMOS, Sorbonne Univeristé
4 Pl. Jussieu, 75005, Paris, France
EMail: nejla.eco@latmos.ipsl.fr, sebastien.payan@latmos.ipsl.fr

[(2)] DOTA, ONERA, Université Paris Saclay
6 Chemin De la Vauve aux Granges, 91120, Palaiseau, France
EMail: laurence.croize@onera.fr

ABSTRACT

On board of MetOp satellite series is Infrared Atmospheric Sounding Interferometer (IASI), a Fourier Transform, Michelson-based spectrometer which aims to provide a high-resolution atmospheric emission spectrum to derive temperature and humidity profiles with high spectral resolution. We will use IASI archive to test the retrieval approach in the interferogram domain which we expect to be well suited for NRT analysis of large sets of spectra to be recorded by next generation spatial tropospheric sounder such as MTG-IRS. The partially scanned interferograms (PSI) method applied to the retrieval of trace gases from the Infrared Atmospheric Sounding Interferometer was rarely used. However, there exist works that indicate the potential of this methodology for the specific cases of CO, CO_2, CH_4 and N_2O that should allow us to retrieve trace gases column densities at an unprecedented accuracy and at the level of only one IASI footprint. Since IASI interferograms are not available, we choose to transform the IASI spectra back to the interferogram domain and identify regions (optical path differences) sensitive to the carbon monoxide species. The retrieval is performed using a Least Squares estimation. The expected advantage compared to the usual methods is an efficient use of the information contained in all IASI channels that are available in the absorption bands of a specific gas species.

We will present the first step of our study, the interferogram retrieval approach of CO from IASI simulations. These first results are based on the set of simulations of IASI interferograms that are noised and then used for CO retrievals. The study which aims to compare the performance of the interferogram retrieval approach compared to the classical one (i.e. from the spectral domain) will also be presented. Simulation of IASI spectra, was performed using LATMOS Atmospheric Retrieval Algorithm (LARA), a robust and affirmed radiative transfer model [Segonne at al., 2021]. LARA was conjoined with the TIGR, a climatological library of atmospheric situations representing the Earth's atmosphere called the Thermodynamic Initial Guess Retrieval (TIGR) [Chédin et al., 1985; Chevallier et al., 1998]. Each atmospheric situation is described by values of temperature, water vapor and ozone concentrations for a given pressure grid, from the ground surface to the TOA (top of the atmosphere). This case study includes all 2311 TIGR profiles available. Furthermore, the study considers carbon monoxide, a trace gas crucial for understanding both the air quality and climate forcing. Carbon monoxide typically appears in the range of 2050 to 2350 cm^{-1} wavenumber, with its characteristic "comb" shaped absorption signature [Serio et al.,2012]. Simulations are performed for surface temperatures ranging from -15 to 15 K in steps of 5 K from the base surface temperature, to explore the impact of thermal contrast [Baudin et al., 2016]. Finally, we investigate the potential of inferring the interferogram dependency on surface temperature and H2O content, which would allow for a more accurate prediction of CO columns. Using interferogram points sensitive to surface temperature and H_2O content, we classify all the interferograms predicting the surface temperature and the abundance of H_2O for each. Approach is also compelling for its potential immersion in the machine learning algorithms granting a fast retrieval of gases.