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Air quality monitoring with current (IASI/Metop) and future (IASI-NG/Metop-SG, IRS/MTG) space-borne thermal infrared sounders

Anne Boynard (1,2), Cathy Clerbaux (1,3), Sophie Bauduin (3), Pascal Prunet (2), Olivier Lezeaux (2), and Bernard Tournier (2)

(1) LATMOS/IPSL, Sorbonne Université, UVSQ, CNRS, Paris, France, (2) SPASCIA, Toulouse, France, (3) Spectroscopie de l'Atmosphère, Service de Chimie Quantique et Photophysique, Université Libre de Bruxelles (ULB), Brussels, Belgium

Current nadir-looking thermal infrared (TIR) sounders, such as the Infrared Atmospheric Sounding Interferometer (IASI) launched onboard the Metop polar-orbiting platforms, are now playing an important role for probing pollutants in the troposphere and in the boundary layer (e.g., carbon monoxide – CO, ozone – O_3, ammonia – NH3, sulfur dioxide – SO_2). Vertical profiles can be obtained for the main absorbers, with varying vertical resolution and accuracy, depending on geophysical parameters and instrumental specifications.

Two future missions using TIR instruments (IRS on Sentinel 4/MTG geostationary-orbiting platform and IASI-NG on Sentinel 5/Metop-SG polar-orbiting platform) are planned to be launched by EUMETSAT within 5 years. Both instruments are nadir looking Fourier transform spectrometers like IASI but with different radiometric and spectral characteristics, which both have an impact on vertical resolution. Compared to IASI, IASI-NG will have an improved radiometric noise and spectral resolution (factor of 2), while IRS will have a degraded radiometric noise and spectral resolution, but a better spatial and temporal resolution.

In this study, we assess the potential of IASI-NG and IRS relative to IASI to monitor CO and O_3 in the lowermost troposphere. Using radiative transfer (RT) simulations, we quantify the impact of the instrumental specifications along with geophysical conditions (such as the thermal contrast, which is a key parameter for detecting species near the surface) on the vertical resolution and sensitivity. In a first part, RT simulations are performed using representative CO and O_3 profiles and a various range of thermal contrasts. In a second part, the study is performed using realistic atmospheres over Europe and China (based on CAMS simulations).