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Multi-spectral retrieval of lowermost tropospheric ozone combining IASI and GOME-2 satellite observations

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Lowermost tropospheric ozone is a major factor determining air quality in densely populated megacities. During pollution events, knowledge on the 3D regional distribution of ozone in and around these urban areas is key for assessing its impact on health of population and ecosystems damages. Temporal and spatial coverage of spaceborne observations are particularly fitted for monitoring tropospheric ozone spatial distribution at the regional scale and offers a great potential for improving air quality forecasting with numerical regional models. However, current tropospheric ozone retrievals using uncoupled either UV or thermal IR spaceborne observations show limited sensitivity to lowermost troposphere ozone (up to 2 km of altitude), which is the major concern for air quality, and are mainly sensitive to ozone at the free Troposphere (the lowest relative maxima of sensitivity are around 3-4 km of altitude) or above.

In this framework, we are currently developing a new multi-spectral methodology for retrieving the lowermost tropospheric ozone concentration using the synergy of both atmospheric radiance spectra in the thermal IR observed by IASI and earth reflectance spectra in the ultraviolet measured by GOME-2. Both instruments are on-board MetOp satellite since October 2006 and their scanning capability offers each day an almost global coverage (with pixel resolution of 80 x 40 km2 for GOME-2). Our technique uses altitude-variable Tikhonov-Philips-type constraints, which optimizes sensitivity to lower troposphere ozone (formerly used for IASI retrievals [Eremenko et al., 2008, GRL; Dufour et al., 2010 ACP]). It integrates VLIDORT and KOPRA radiative transfer codes for simulating UV reflectance and thermal IR radiance, respectively. Meteorological profiles, surface properties (temperature, albedo) and correcting parameters for UV radiances (degradation, slit function, ring effect e.g. [Liu et al., 2010, ACP; Nowlan et al., 2011 JGR]) are jointly retrieved for each pixel. Numerical simulations of the present retrieval setup show a significant improvement in the sensitivity of the multi-spectral retrieval with an increase greater than 50% in the degrees of freedom for signal in the partial column 0-6 km of altitude, with respect to single band retrievals. In the current presentation, we will show our first results with real observations over Europe in July-August 2007 and the performance assessment of the methodology.