Ozone pollution outbreaks analysed by synergism of novel IASI+GOME2 multispectral satellite observations, models and in situ measurements

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1. Abstract

This research work presents an analysis of ozone pollution combining IASI+GOME2 satellite observations, state-of-the-art chemistry transport models and in situ measurements over two key regions: East Asia and Europe. In both cases, ozone pollution outbreaks are analysed in term of their origin, their three-dimensional pathways and the impact on regional air quality. We also use pollution tracers such as CO co-located observations derived from IASI measurements and stratospheric air indicators such as potential vorticity fields derived from the ECMWF meteorological model. The analysis over East Asia focuses on the springtime of 2009 and that over Europe in July 2010. The following chemistry-transport simulations are used i) for East Asia: WRF-CHEM, WRF-CMAQ and CHASER, this last one having assimilated numerous satellite observations and ii) for Europe: CHIMERE and MOCAGE, with assimilation in this last case of IASI and surface datasets. Moreover, we study the contribution of the assimilation IASI+GOME2 observations into the MOCAGE and CHIMERE models, for better representing the 3D distribution of tropospheric ozone over Europe.

2. Lowest troposphere ozone by IASI+GOME2

IASI-GOME2 is capable of observing ozone plumes in the lowermost troposphere (below 3 km) being transported across East Asia. The structure of the plumes are consistent with that of WRF-Chem simulation for O3 at 2 km. CO satellite measurements (from LATMOS/LULB) are used for identifying pollution from anthropogenic sources during the evolution of the pollution episode. Stratospheric contributions are depicted by enhanced potential vorticity at 300 hPa (derived from ECMWF interim reanalysis).

3. Assimilation of IASI+GOME2 data into CHIMERE and MOCAGE models

The assimilation of IASI+GOME2 reduces the bias of CHIMERE below 3 km of altitude with respect to the ozone sounding measurements. Screening of IASI+GOME2 data does not change the results. The greater bias for the analyses in the middle troposphere both for CHIMERE and MOCAGE seems to be related to the choice of the assimilated column (the whole troposphere vs. the lower troposphere).

4. Summary

The multispectral IASI+GOME2 satellite approach provides a new observational characterisation of ozone pollution. Local observations of ozone plumes around 2 km of altitude, in good agreement with ozonesondes and consistency with surface observations. The synergism of IASI+GOME2 with models and in situ observations has proven to be a powerful tool for: Correcting chemistry-transport models via assimilation. Sensitivity enhancement towards the surface: AUV at the lowest troposphere (<3 km) peaks around 2 km over land.

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References:

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a) Comparison with O3 soundings over Europe

b) Comparison with surface stations over Europe

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