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Equatorial total column of nitrous oxide as measured by IASI on MetOp-A: implications for transport processes

P. Ricaud[1], J.-L. Attié[1,2], H. Teyssèdre[2], L. El Amraoui[2], V.-H. Peuch[2], M. Matricardi[3], and P. Schluessel[4]

[1]Université de Toulouse, Laboratoire d'Aérologie, CNRS UMR 5560, Toulouse, France
[2]CNRM-GAME, Météo-France and CNRS URA 1357, Toulouse, France
[3]ECMWF, Shinfield Park, Reading, Berkshire, RG2 9AX, UK
[4]Department of Programme Development, EUMETSAT, Am Kavalleriesand 31, 64295 Darmstadt, Germany

Abstract. In this paper we use the total columns of nitrous oxide (N_2O) as retrieved from the radiance spectra as measured by the Infrared Atmospheric Sounding Interferometer (IASI) instrument aboard the MetOp-A platform and distributed by the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) during the March – May (MAM) 2008 period. Since the total column of N_2O reflects concentrations in the middle troposphere, cloud-free columnar N_2O measurements are used to assess transport processes in the equatorial band (10 ° S – 10 ° N). We compare the measured data set with the outputs produced by the 3-D chemical-transport model MOCAGE during the period MAM 2002 – 2004. To reflect MAM 2008 concentrations, MOCAGE results have been scaled by a factor 1.0125 in order to represent the change in concentration of N_2O since 2004. IASI N_2O equatorial measurements show a maximum over Africa (4.96×10^{-3} kg m^{-2}) and a minimum over South America (4.86×10^{-3} kg m^{-2}) in reasonable agreement with the outputs from MOCAGE despite the fact that emissions of N_2O are more intense over America than over Africa. The amplitude of the longitudinal variation of total column N_2O along the equatorial band is twice as intense in the measurements (~1.6%) than as in the model calculations (~0.8%), and much greater than the IASI mean random error (0.16 – 0.33%). A difference between the two data sets is observed above the Western Pacific (110 ° E – 150 ° E) with a marked minimum in IASI compared to MOCAGE. Recent theoretical studies (Ricaud et al., 2007 and 2009) have shown the potentially important effect of the Walker and the Hadley cells on the tropospheric distribution of N_2O in producing a local maximum in N_2O above Africa. Based on equatorial total columns of N_2O retrieved from IASI, our results are consistent with the fact that Africa is a zone of convergence of airmasses coming from different convective regions whilst Western Pacific behaves more like a divergence zone.

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