Atmospheric Chemistry and Physics
An Interactive Open Access Journal of the European Geosciences Union

Atmos. Chem. Phys., 8, 6169-6187, 2008
www.atmos-chem-phys.net/8/6169/2008/

4D-Var assimilation of MIPAS chemical observations: ozone and nitrogen dioxide analyses

Q. Errera[1], F. Daerden[1], S. Chabrillat[1], J. C. Lambert[1], W. A. Lahoz[2], S. Viscardy[1], S. Bonjean[1,*], and D. Fonteyn[1,**]
[1]Insitut d'Aéronomie Spatiale de Belgique, BIRA-IASB, Belgium
[2]Norsk Institutt for Luftforskning, NILU, Norway
[*]now at: Sputnik Web, Belgium
[**]now at: Belgian Federal Science Office, Belgium

Abstract. This paper discusses the global analyses of stratospheric ozone (O_3) and nitrogen dioxide (NO_2) obtained by the Belgian Assimilation System for Chemical Observations from Envisat (BASCOE). Based on a chemistry transport model (CTM) and the 4-dimensional variational (4D-Var) method, BASCOE has assimilated chemical observations of O_3, NO_2, HNO_3, N_2O, CH_4 and H_2O, made between July 2002 and March 2004 by the Michelson Interferometer for Passive Atmospheric Sounding (MIPAS) onboard the European Space Agency (ESA) Environment Satellite (ENVISAT). This corresponds to the entire period during which MIPAS was operating at its nominal resolution.

Our analyses are evaluated against assimilated MIPAS data and independent HALOE (HALogen Occultation Experiment) and POAM-III (Polar Ozone and Aerosol Measurement) satellite data. A good agreement is generally found between the analyses and these datasets, in both cases within the estimated error bars of the observations. The benefit of data assimilation is also evaluated by comparing a BASCOE free model run with MIPAS observations. For O_3, the gain from the assimilation is significant during ozone hole conditions, and in the lower stratosphere. Elsewhere, the assimilation does not provide significant improvement. For NO_2, the gain from the assimilation is realized through most of the stratosphere. Using the BASCOE analyses, we estimate the differences between MIPAS data and independent data from HALOE and POAM-III, and find results close to those obtained by classical validation methods involving only direct measurement-to-measurement comparisons. Our results extend and reinforce previous MIPAS data validation efforts by taking into account a much larger variety of atmospheric states and measurement conditions.