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Balloon-borne stratospheric BrO measurements: comparison with Envisat/SCIAMACHY BrO limb profiles

M. Dorf[1], H. Bösch[1,*], A. Butz[1], C. Camy-Peyret[2], M. P. Chipperfield[3], A. Engel[4], F. Goutail[5], K. Grunow[6], F. Hendrick[7], S. Hrechanyy[8], B. Naujokat[6], J.-P. Pommereau[5], M. Van Roozendael[7], C. Sioris[9], F. Stroh[8], F. Weidner[1], and K. Pfeilsticker[1]

[1]Institut für Umweltphysik, University of Heidelberg, Heidelberg, Germany
[2]Laboratoire de Physique Moléculaire pour l'Atmosphère et l'Astrophysique (LPMAA), Université Pierre et Marie Curie, Paris, France
[3]Institute for Atmospheric Science, School of Earth and Environment, University of Leeds, Leeds, UK
[4]Institute for Atmosphere and Environment, J. W. Goethe University Frankfurt, Frankfurt, Germany
[5]Service d'Aeronomie du CNRS, Verrières le Buisson, France
[6]Meteorologisches Institut, Freie Universität Berlin, Berlin, Germany
[7]Belgian Institute for Space Aeronomy (BIRA-IASB), Brussels, Belgium
[8]Forschungszentrum Jülich GmbH, Institut für Chemie und Dynamik der Geosphäre ICG-I: Stratosphäre, Jülich, Germany
[9]Harvard-Smithsonian Center for Astrophysics, Cambridge, USA
[*]now at: Jet Propulsion Laboratory (JPL), Pasadena, USA

Abstract. For the first time, results of four stratospheric BrO profiling instruments, are presented and compared with reference to the SLIMCAT 3-dimensional chemical transport model (3-D CTM). Model calculations are used to infer a BrO profile validation set, measured by 3 different balloon sensors, for the new Envisat/SCIAMACHY (ENVIronment SATellite/SCanning Imaging Absorption spectroMeter for Atmospheric CHartographY) satellite instrument. The balloon observations include (a) balloon-borne in situ resonance fluorescence detection of BrO (Triple), (b) balloon-borne solar occultation DOAS measurements (Differential Optical Absorption Spectroscopy) of BrO in the UV, and (c) BrO profiling from the solar occultation SAOZ (Systeme d'Analyse par Observation Zenithale) balloon instrument. Since stratospheric BrO is subject to considerable diurnal variation and none of the measurements are performed close enough in time and space for a direct comparison, all balloon observations are considered with reference to outputs from the 3-D CTM. The referencing is performed by forward and backward air mass trajectory calculations to match the balloon with the satellite observations. The diurnal variation of BrO is considered by 1-D photochemical model calculation along the trajectories. The 1-D photochemical model is initialised with output data of the 3-D model with additional constraints on the vertical transport, the total amount and photochemistry of stratospheric bromine as given by the various balloon observations. Total $[Br_y]=(20.1\pm2.5)$ pptv obtained from DOAS BrO observations at mid-latitudes in 2003, serves as an upper limit of the comparison. Most of the balloon observations agree with the photochemical model predictions within their given error estimates. First

retrieval exercises of BrO limb profiling from the SCIAMACHY satellite instrument on average agree to around 20% with the photochemically-corrected balloon observations of the remote sensing instruments (SAOZ and DOAS). An exception is the in situ Triple profile, in which the balloon and satellite data mostly does not agree within the given errors. In general, the satellite measurements show systematically higher values below 25 km than the balloon data and a change in profile shape above about 25 km.

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