THREE YEARS OF SCIAMACHY CARBON MONOXIDE MEASUREMENTS

Khlystova, I. G, M. Buchwitz, J. P. Burrows, H. Bovensmann

Institute of Environmental Physics (iup) / Institute of Remote Sensing (ife), University of Bremen FB1, Otto Hahn Allee 1, 28334 Bremen, Germany, E-mail: Iryna.Khlystova@iup.physik.uni-bremen.de

ABSTRACT

Carbon monoxide (CO) is an important atmospheric air pollutant and a good knowledge of its global and regional distribution is of much interest, e.g., for air quality applications. SCIAMACHY on ENVISAT is currently the only satellite instrument that can measure the vertical column of CO with high sensitivity down to the Earth surface due to its near-infrared channels and its nadir observation mode. Here we present three years (2003-2005) of SCIAMACHY CO column measurements, retrieved with the latest version of our retrieval algorithm (WFM-DOAS version 0.6). We give a short overview about the global multi-year CO data set and present some regional results focusing on south-east/eastern Asia.

1. INTRODUCTION

Carbon monoxide (CO) is an important atmospheric trace gas. It plays a critical role in determining the oxidizing capacity of the Earth's atmosphere through its reaction with the OH radical. The main sources of CO are biomass burning, fossil fuel burning and terpenoid and methane oxidation. The main sink is the oxidation by OH.

The near-infrared nadir spectra of reflected and backscattered solar radiation measured by SCIAMACHY on board ENVISAT contain information about the total column of CO, which we retrieve with our scientific algorithm WFM-DOAS version 0.6. [1]. SCIAMACHY is currently the only instrument, which measures the CO total column from space with nearly equal sensitivity to CO concentration changes at all atmospheric layers including the boundary layer. Accurate CO retrieval from SCIAMACHY is however not trivial, because the CO lines are weak and superimposed by much stronger lines of water vapor and methane, because of an ice layer that grows on the cooled detector, and because of an increasing number of bad or dead detector pixels. The WFM-DOAS retrieval algorithm copes with these problems to a large extent.

The new WFM-DOAS version 0.6 retrieval algorithm has been presented and discussed in [1, 2], including a detailed comparison with MOPITT. A first validation has been performed by comparison with ground based Fourier Transform Spectroscopy (FTS) measurements [3]. Here we give a short overview and present some regional results focusing on south-east/eastern Asia.

2. GLOBAL RESULTS

Figure 1 shows yearly averages of the SCIAMACHY WFM-DOAS version 0.6 global CO total column data set for 2003, 2004 and 2005. As can be seen, major CO source regions corresponding to elevated CO columns are clearly visible, e.g., large parts of south America, central Africa, and south-east/eastern Asia. Figure 1 also shows that the retrieved CO significantly varies from year to year.

Figure 2 shows seasonal averages for the year 2004. As can be seen, the seasonal variability of the retrieved CO columns is very high, for example, due to the seasonal variability of biomass burning in south America and Africa. Over south-east/eastern Asia CO is largest during March to May 2004.

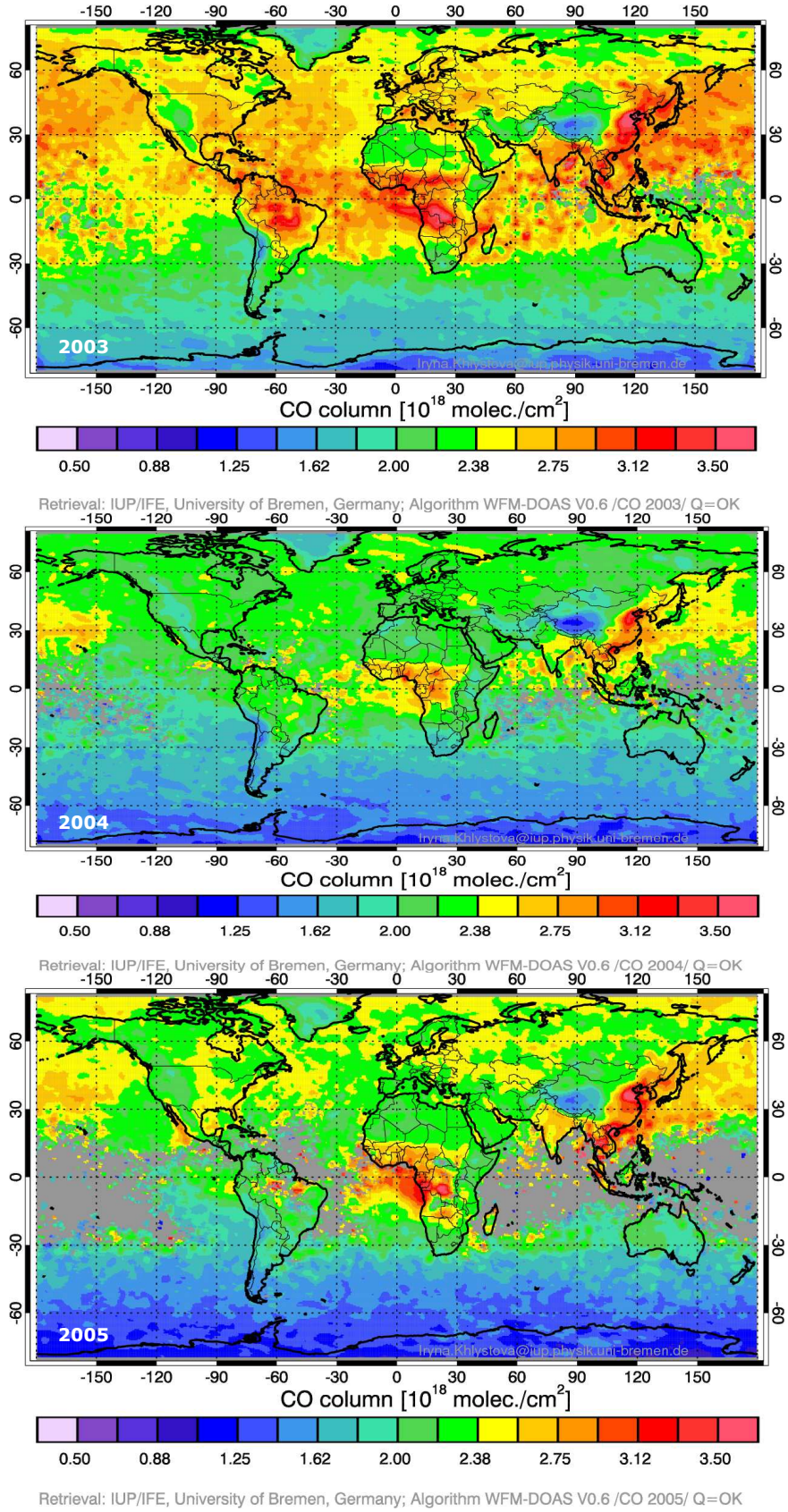

Fig. 1: Three years of SCIAMACHY WFM-DOAS version 0.6 CO columns. Top: year 2003 average, middle: year 2004 average, bottom: year 2005 average.

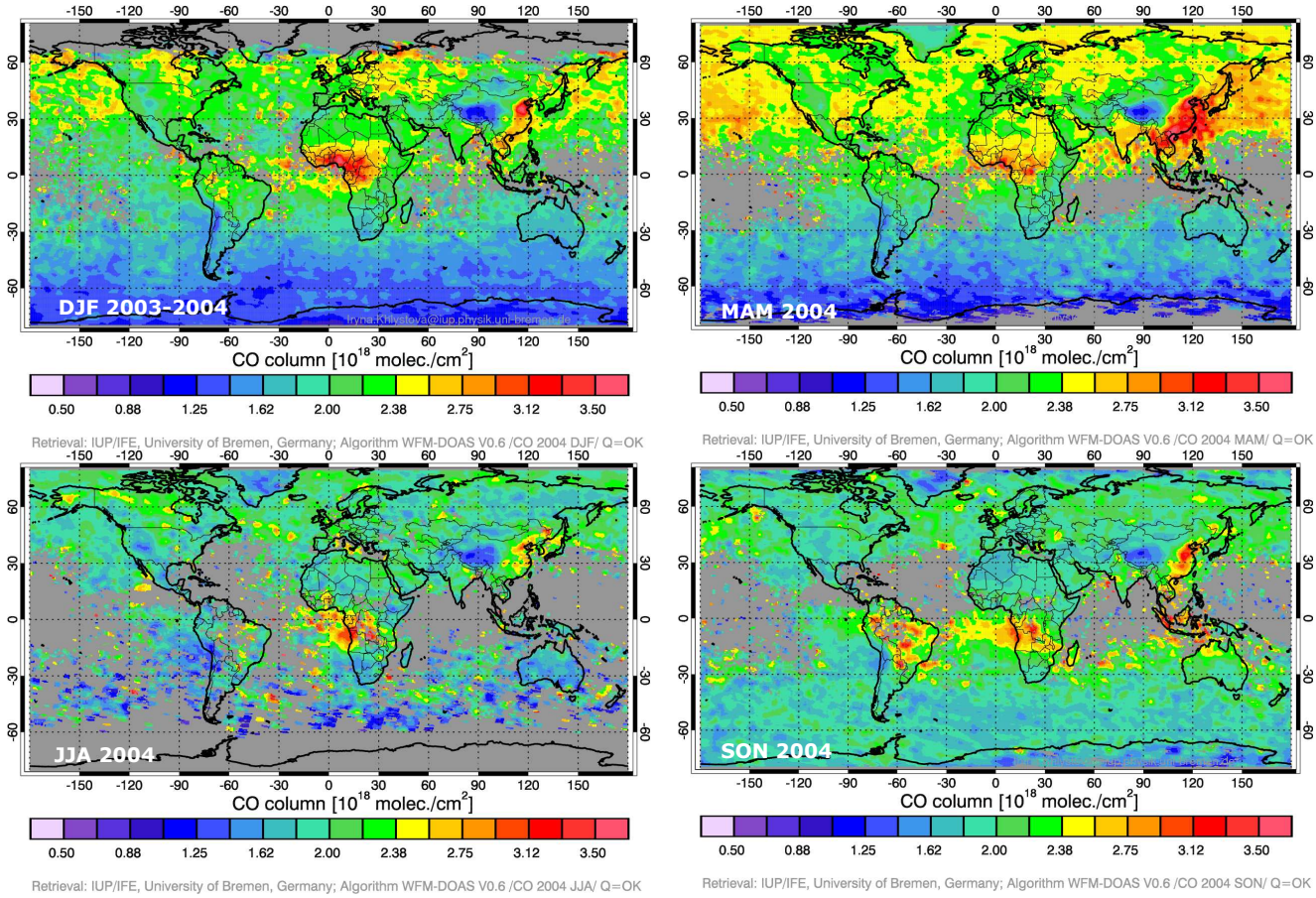

Fig. 2: Year 2004 seasonal averages of SCIAMACHY/WFM-DOAS version 0.6 CO columns. The DJF average corresponds to the average from December 2003 to February 2004.

3. REGIONAL CASE STUDY: SOUTH-EAST AND EASTERN ASIA

The SCIAMACHY satellite instruments onboard ENVISAT can measure several important atmospheric trace gases, such as CO, HCHO [4], and NO_2 [5], simultaneously. Information on fires are available from the AATSR instrument on board ENVISAT in terms of fire counts. Used together, these simultaneous measurements provide the opportunity to get information on the various sources of CO.

Figure 3 shows first results of these simultaneous measurements focussing on south-east/eastern Asia including China, which is a major source region for CO as shown in Figs. 1 and 2.

As can be seen from Fig. 3, regions of elevated CO over the highly populated eastern part of China correlate well with enhanced NO_2 during each season in 2004. However over south-east Asia, especially in spring (MAM), CO is high but NO_2 is low. Here the high CO is correlated with high HCHO. This is probably due to fires as can be concluded from the large number of AATSR fire counts in this area.

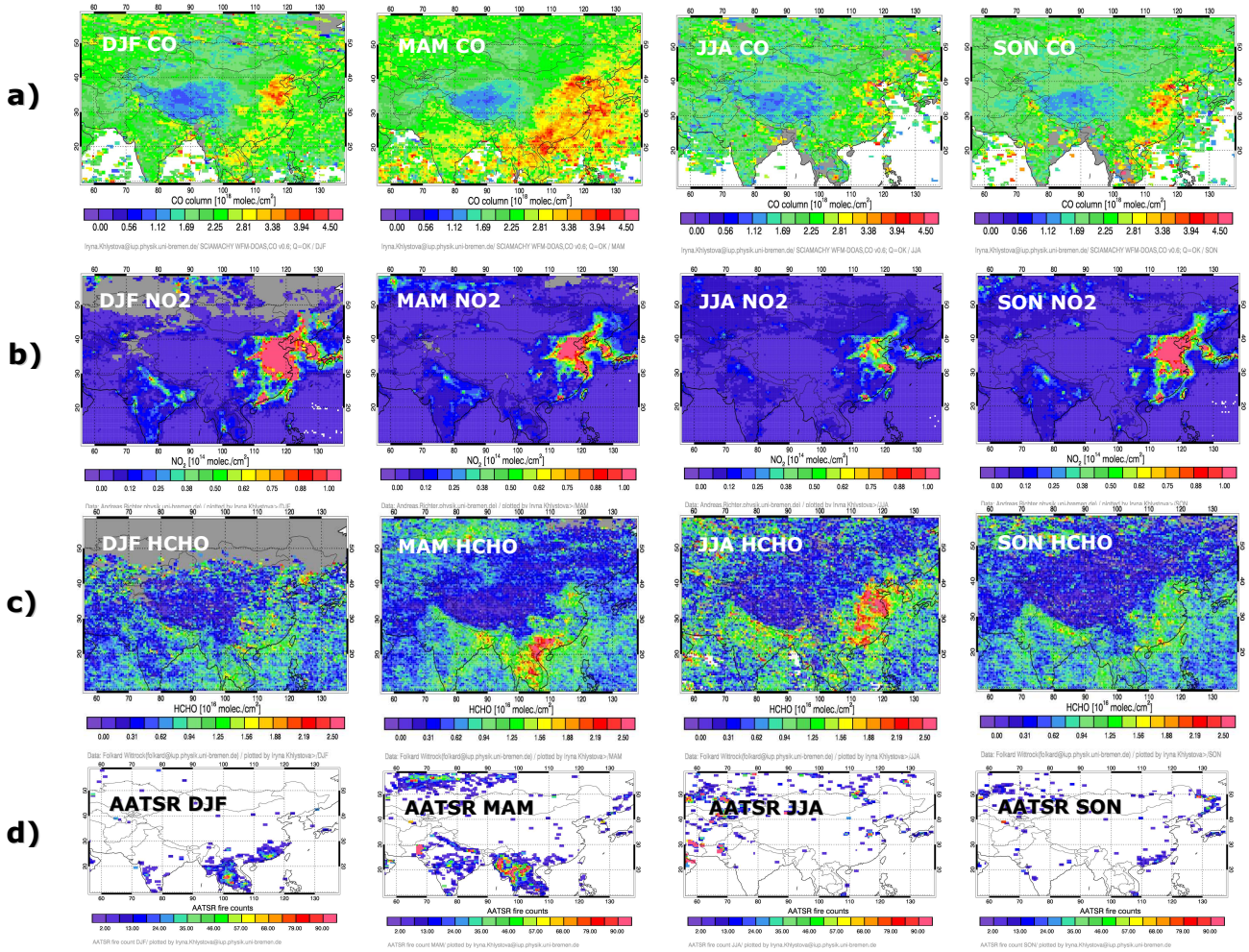

Fig 3. Seasonal averages of a) CO total columns, b) NO_2 tropospheric columns, c) HCHO tropospheric columns, and d) AATSR fire counts over south-east Asia during 2004. All maps have a spatial resolution of 0.5x0.5 degrees. The four seasons are: DJF: December 2003 - February 2004; MAM: March-May 2004; JJA: June-August 2004; and SON: September-November 2004.

4. SUMMARY AND OUTLOOK

We have presented and discussed three years of SCIAMACHY CO total column measurements and have shown first results focussing on south-east/eastern Asia. Our future work will focus on further analysing the presented data, for example, by performing a detailed comparison with model simulations using the latest emission data bases. Information about the latest status is given on our SCIAMACHY/WFM-DOAS web page: http://www.iup.uni-bremen.de/sciamachy/NIR_NADIR_WFM_DOAS/index.html .

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