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A model study of the January 2006 low total ozone episode over Western Europe and comparison with ozone sonde data

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Total column and stratospheric ozone levels at mid-latitudes often reveal strong fluctuations on short-term time scales such as days which can lead to a distinct reduction of the total ozone column. Such events are often referred to as ozone miniholes. Mainly two mechanisms have been proposed to be responsible for their development: (a) advection of ozone-poor or ozone-depleted air masses and (b) isentropic lifting of air masses, causing net divergence of ozone-rich air out of the column in the mid to lower stratosphere. In the context of ozone miniholes chemical ozone depletion is usually assumed to be negligible.

Here, an extreme low total ozone event around 19 January 2006 over Western Europe is investigated. On that day, the measured total ozone column over Uccle, Belgium, measured by a Brewer spectrophotometer, reached a daily minimum of 200 DU, the lowest value ever measured at this site (the long-year mean is 330 DU). Similar low values were measured at other sites in Western Europe, too. In order to investigate the mechanisms leading to that minihole event, this study uses data from (i) a run of the Chemical Lagrangian Model of the Stratosphere (CLaMS) for the whole January 2006, (ii) a multi-year run (1972-2006) of the 3-D CTM KArslruhe SImulation model of the Middle Atmosphere (KASIMA), (iii) a five-year run of the climate-chemistry model MESSy (Modular Earth Submodel System), (iv) ECMWF meteorological fields and (v) seven ozone sonde stations, spread over Western and Middle Europe.

The models reproduce the low ozone episode in January 2006 very well and modelled and measured ozone profiles compare well. First results indicate that in the mid-stratosphere, the ozone-poor polar vortex was moving over Western Europe, and in the UTLS region tropical ozone-poor air masses were advected in combination with isentropic lifting of air masses. However, the data set allows also for characterising the influence of chemical ozone depletion on that event. We will quantify the ozone depletion at different height levels and assign it to the different depletion mechanisms. E.g., the ozone column in the UTLS measured by an ozone sonde at 19 January over Uccle is around 8 DU against 23 DU for the long-year mean and for the mid-stratosphere the values are 86 against 178 DU, respectively.