High Resolution Radiometer Measurements of Chlorine Monoxide and Ozone in the Polar Stratosphere

G. Hochschild, H. Berg, G. Kopp, R. Krupa, M. Kuntz
Forschungszentrum Karlsruhe GmbH, Institut für Meteorologie und Klimaforschung, Postfach 3640, D-76021 Karlsruhe, Germany

During March 1997 millimeter wave observations of stratospheric trace gases have been carried out at the NDSC station Ny-Ålesund (78.9°N, 11.9°E). The radiometric measurements have been focused on Chlorine Monoxide (ClO), which was the objective of the international intercomparison campaign [1], during which 5 different instruments have been installed at the same site. Our radiometer has been operated continuously from 12 March to 31 March. During this timespan a few days of coincident measurements in parallel with 1 or 2 of the other ClO radiometers present at Ny-Ålesund could be achieved, allowing a direct comparison of the measurement and retrieval results in the next future.

The radiometer used for these measurements was the improved version of the MIRA2 radiometer, which was previously used during winter 1996 at Kiruna [2]. This instrument uses a cryogenic cooled Schottky mixer leading to a moderate noise temperature of 1100 K. The quality of the resulting spectra originates merely from the advanced balanced calibration method [3], based on the internal adjustable reference, and from the associated optimized measurement procedures. With this instrument spectral data with high time resolution have been measured continuously over 19 days, except for 2 days because of unfavorable weather.

The processing of the whole dataset measured with this radiometer during the March'97 campaign has been completed in the meantime. The spectra, which include the 278,6 GHz signature of ClO and a few neighboring O_3 lines, have been integrated over typically 3-4 hours to suppress excessive noise contributions. Thus an almost continuous sequence of 100 individual spectra has been achieved, all being suitable for inversion.

Using the advanced inversion technique [4], which includes an efficient standing wave correction method, both ClO and O_3 profiles have been retrieved simultaneously. The direct inversion of spectra, which contain overlapping signatures of different constituents, allows the separate processing for any individual timeframe. Thus, the achievable time resolution is only restricted by the noise temperature of the radiometer.

From the measurements a series of 100 separate volume mixing ratio profiles has been retrieved, which provides an unique synopsis of the ClO and O_3 variations over the entire period. As obvious from Fig. 1, the O_3 maximum altitude remains at 30 - 35 km, whereas the decay of the values after 20 March indicates an essential amount of O_3 loss. The ClO profiles represent both diurnal and long-term variations, which are interesting for further interpretation.

Up to 8 individual profiles per day have been inverted. This high time-resolution allows the visualization of the diurnal profile variations, exemplified here for March 17, showing in particular the strong variation of the volume mixing ratio within the lower ClO layer in contrast to the weak dependence of the upper ClO and the O_3 layer (Fig. 2).

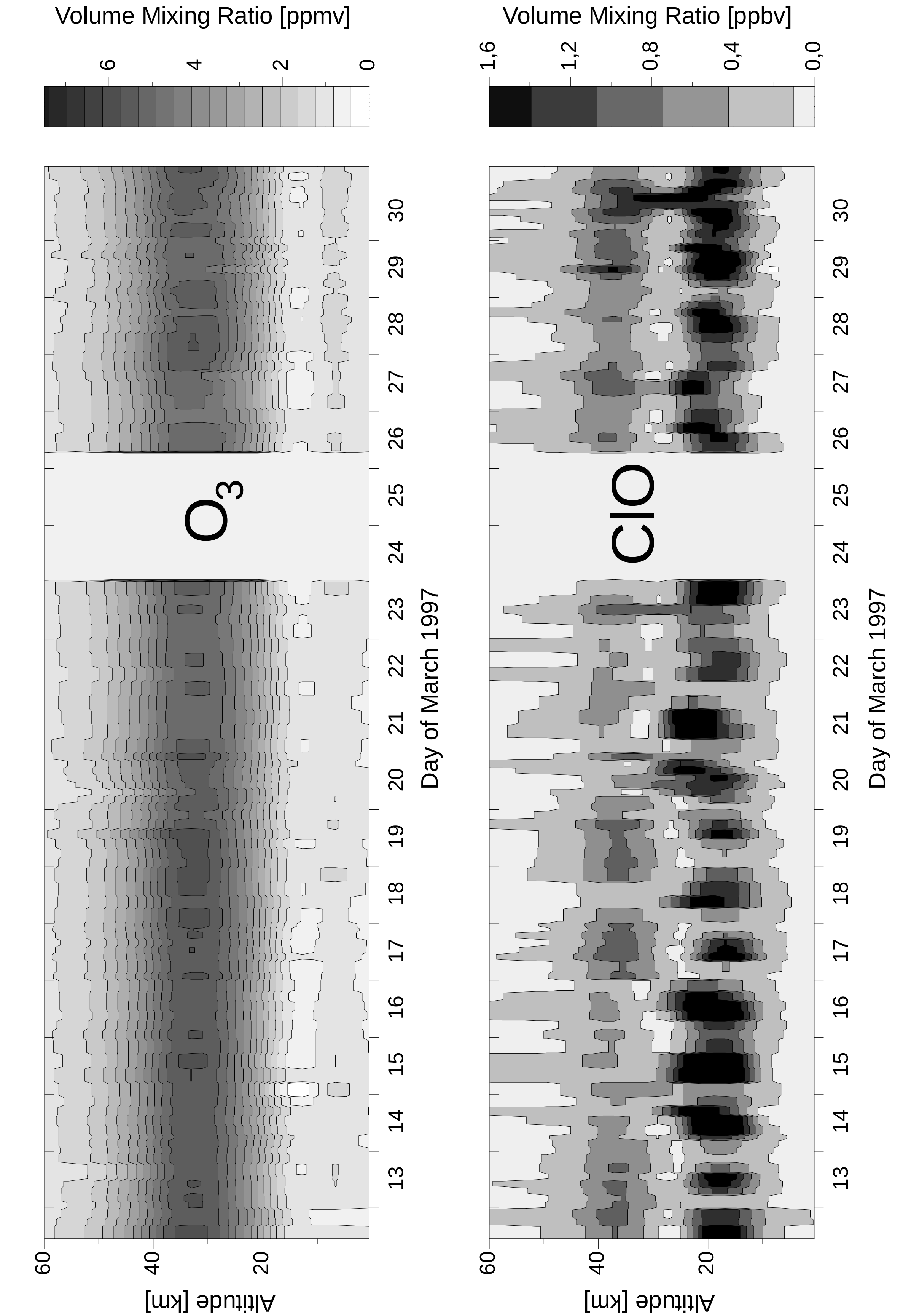

Fig. 1: Contour plots of a series of volume mixing ratio profiles. 100 profiles of O_3 (left) and ClO (right) has been retrieved respectively during 19 days (due to unfavorable weather no measurements could be taken on March 24 and 25).

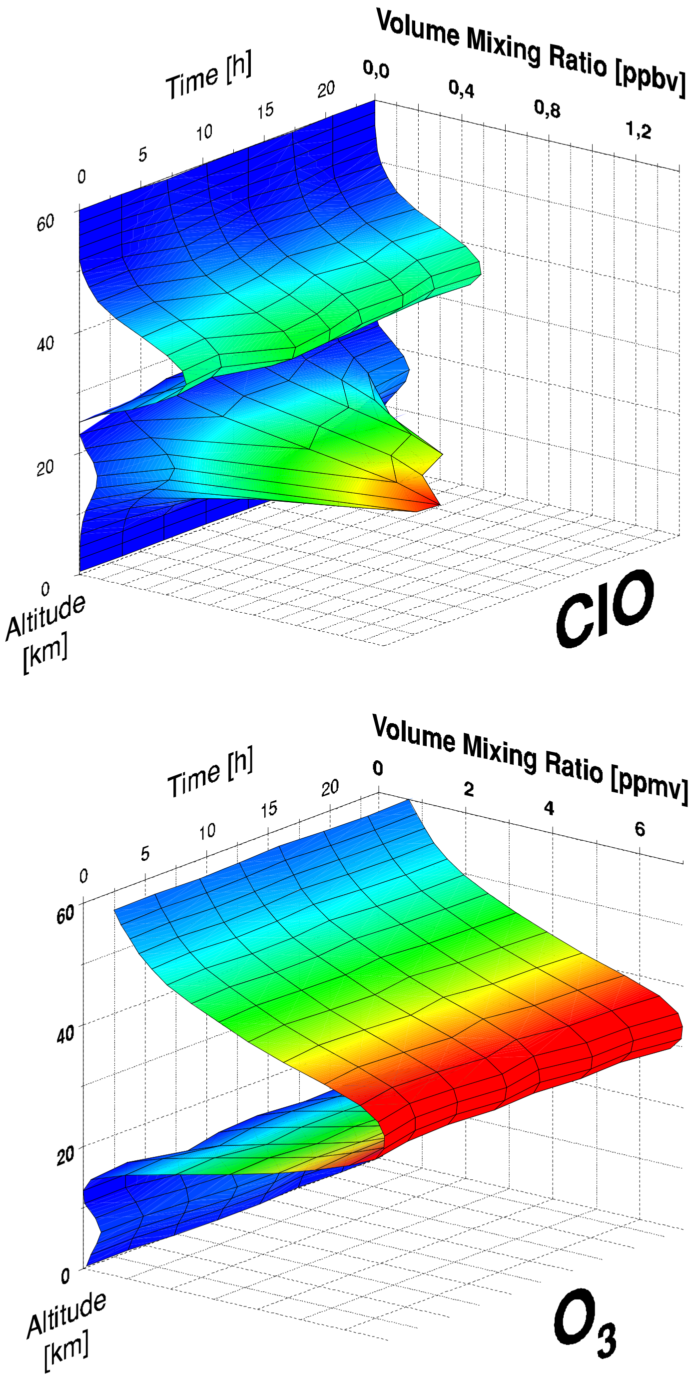

Fig. 2: Diurnal variation of ClO and O_3 profiles on March 17.

High quality color figures will be made available by the authors on request.

REFERENCES

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[4] Kuntz M. et al.; *Simultaneous Retrieval of Chlorine Monoxide and Ozone Profiles from High Resolution Millimeter Wave Spectra*; this issue