

COMPARISON OF MAS STRATOSPHERIC ClO MEASUREMENTS WITH SPACEBORNE, AIRBORNE, AND GROUND-BASED EXPERIMENTS

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Fig. 1 MAS (easily identified by the large parabolic reflector) in the cargo bay of the Space Shuttle

Abstract

Daytime profiles of stratospheric chlorine monoxide (ClO) were measured by the Millimeter-wave Atmospheric Sounder (MAS) by limb-sounding at 204 GHz from the Space Shuttle. Measurements taken during the three ATLAS missions from 1992 to 1994 were compared to coincident measurements performed by UARS-MLS, airborne submillimeter observations at 649 GHz, and data from a ground-based instrument at 278 GHz on Mauna Kea, Hawaii. The MAS data do agree well with the results from all the other instruments.

For the retrieval of MAS data from ATLAS 1 and 2, day-night subtractions had to be performed. Systematic differences in the order of 0.1–0.3 ppbv between MAS and MLS ClO results may be partly explained by the effects of these subtractions and systematic biases of the MLS data by HNO₃ at low altitudes.

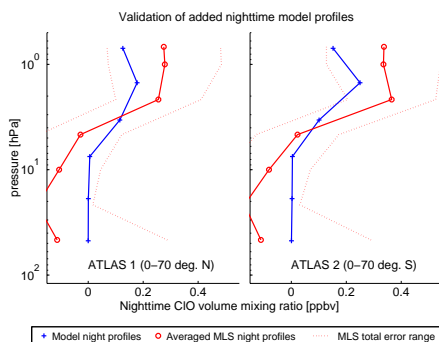


Fig. 3 Validation of model night profiles used for ATLAS 1 (24 March – 2 April 1992) and ATLAS 2 (8–17 April 1993) with nighttime Version 3 profiles (scaled by 0.92) measured by MLS. To compensate for the effects of the day–night subtraction used for ATLAS 1 and 2, model night profiles were added to the MAS data. The MLS data are zonal means over 0–70° N, averaged from 14 to 23 March 1992, and 0–70° S, averaged from 6 to 15 April 1993. The model night profiles underestimate the measured profiles by 0.1 to 0.15 ppbv below pressures of 5 hPa, while a bias in the MLS profiles, probably caused by HNO₃, can be seen at higher pressures. This behaviour could explain some of the discrepancies seen in Figure 4.

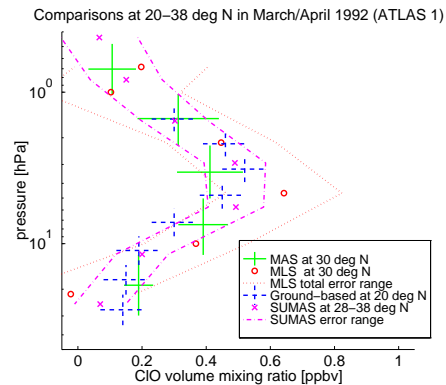


Fig. 2 Correlative daytime ClO measurements taken in 1992 by MAS (15–25° N, 24 March–2 Apr), MLS (15–25° N, 14–23 March), the airborne submillimeter radiometer SUMAS at 650 GHz (28–38° N, 29 March) and ground-based measurements at 278 GHz from Mauna Kea, Hawaii (20° N, 21–31 March). Error bars are 1 σ , including systematic errors.

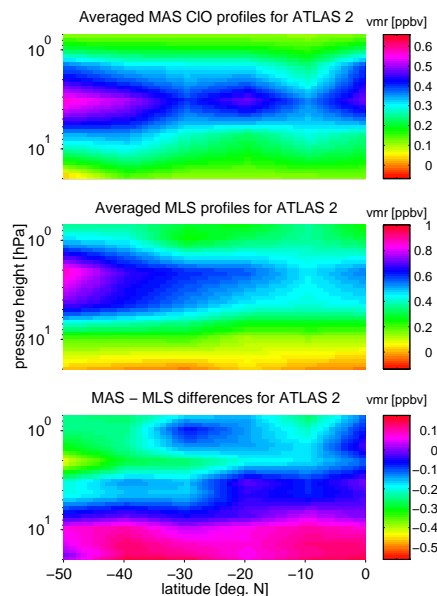


Fig. 4 Systematic differences found in MAS and MLS ClO profiles measured from 6–17 April 1993. MAS values are systematically higher by 0.1–0.2 ppbv from 10 to 20 hPa at all latitudes. This could be explained by a systematic bias of the MLS values due to HNO₃ that would not show up in the MAS results because of the day–night subtractions. The lower MAS values at pressures below 5 hPa could partly be explained by discrepancies between model nighttime ClO profiles added to the MAS profiles and nighttime profiles measured by MLS (see Fig. 3).