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Ground-based measurements of O_3, NO_2, OClO, and BrO during the 1987 Antarctic ozone depletion event

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Near-ultraviolet absorption spectroscopy in the wavelength range from 330-370 nm was used to measure O_3, NO_2, OClO, and BrO at McMurdo Station (78S) during 1987. Visible absorption measurements of O_3, NO_2, and OClO were also obtained using the wavelength range from about 403-453 nm. These data are described and compared to observations obtained in 1986. It is shown that comparisons of observations in the two wavelength ranges provide a sensitive measure of the altitude where the bulk of atmospheric absorption takes place. The measurements indicate that the bulk of the NO_2 column abundance is located near 30 km, while those of OClO and O_3 are near 20 km. The measurements of NO_2 display a systematic increase during the month of September, probably reflecting the release of odd nitrogen from reservoirs formed earlier in the winter season. The measurements of OClO display a strong diurnal variation, with considerably higher values being obtained in the evening than those measured in the morning. The evening twilight OClO column abundances obtained in 1987 were notably larger than those in 1986, perhaps because stratospheric temperatures were colder, and associated heterogeneous chemistry may have been more intense. These observations provide important constraints on the coupled nitrogen-halogen chemistry of antarctic spring and its influence on the springtime antarctic ozone depletion. Observations of the evening twilight BrO abundance over McMurdo Station, Antarctica during austral spring, 1987 are described. The observed variation of the slant column abundance with increasing solar zenith angles suggests that most of the BrO is located near 15 km. The total vertical column abundance observed during one week of measurements yielded an average value of 2.5×10^{13} cm^{-2} assuming the room temperature absorption cross sections measured by Cox et al. [1]. These values are consistent with BrO mixing ratios of about 5-15 pptv distributed from 150 to 20 mb.

[1] Cox, R. A., D. W. Sheppard and M. P. Stevens, J. Photochem., *19*, 201, 1982.