Behavior of $ClONO_2$ at high latitudes observed with ILAS: inter-hemispheric contrast during the recovery phase of polar ozone depletions

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The newest retrieval algorithm (version 6.0) of the Improved Limb Atmospheric Spectrometer (ILAS) succeeded to derive chlorine nitrate ($ClONO_2$) profiles, giving continuous and comprehensive dataset from November 1996 through June 1997 for both hemispheres. The combined analysis with other chemical species observed with ILAS and Halogen Occultation Experiment (HALOE) indicates reasonable change in the $ClONO_2$ mixing ratios during the recovery period of polar ozone depletion events.

Heterogeneous reactions on Polar Stratospheric Clouds (PSCs) convert chlorine reservoir species into active chlorines that destroy ozone. The active chlorines produce predominantly $ClONO_2$ rather than HCl upon deactivation when a sufficient abundance of O_3 is available. The $ClONO_2$ data in the Arctic lower stratosphere indicated outstanding enhancement in late February and in March 1997. Though the ozone mixing ratio was apparently lower inside the vortex, still it was left about 3 ppmv inside the vortex even after February. This sufficient amount of ozone would have produced $ClONO_2$ rather than HCl.

On the other hand, HCl is preferably formed under ozone-depleted conditions because of the shift of Cl/ClO and NO/NO_2 ratios toward Cl and NO when ozone is low, resulting in suppression of $ClONO_2$ formation through $ClO + NO_2$ and enhancement of HCl formation through the reaction of Cl and CH_4. Indeed, the behavior of $ClONO_2$ in the recovery phase of the Antarctic ozone hole in 1996 was quite different from that of the Arctic in 1997. The $ClONO_2$ mixing ratio data were extremely low, corresponding to very low ozone of less than 1 ppmv in November 1996 in the Antarctic polar vortex. At the boundary region, $ClONO_2$ mixing ratio was much higher, corresponding to higher ozone mixing ratio (2.5-3.5 ppmv).

The subsequent ILAS-II that was launched in December 2002 will also provide useful dataset for understanding chlorine partitioning, and will improve quantitative ozone loss estimate in the future.