

Measurements of ozone hole and denitrification by ILAS-II in 2003 in the Antarctica

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The Improved Limb Atmospheric Spectrometer (ILAS-II) onboard the Advanced Earth Observing Satellite-II (ADEOS-II) was successfully launched on December 14, 2002. After initial checkout has performed, ILAS-II made its routine operation since April 2, 2003, until October 24, 2003 when the ADEOS-II satellite lost its function due to solar paddle failure. However, ILAS-II succeeded to collect important data for about 7 months' period. ILAS-II is a solar-occultation sensor for measuring vertical profiles of minor constituents, such as O₃, HNO₃, NO₂, N₂O, CH₄, H₂O, ClONO₂, N₂O₅, aerosols by measuring infrared spectra by four grating spectrometers. The vertical resolution is as high as about 1 km which depends on altitudes. We used the latest Version 1.4 product for the current analysis, whose data quality have already validated by other independents measurements by large balloons, sondes, and other satellite data.

In the Antarctic and Arctic stratosphere, so-called polar stratospheric clouds (PSCs) are formed in winter where temperature becomes low due to the lack of solar illumination and the existence of polar vortex. When temperature gets lower than nitric acid trihydrate (NAT) saturation temperature, PSCs start to grow by taking gas-phase HNO₃ within them, and then start to sediment due to the gravity. In this way, irreversible loss of HNO₃ occurs in the stratospheric air mass. This is called the denitrification. The denitrification plays important role in polar ozone loss. Since ILAS-II can measure not only ozone but also other species such as HNO₃ and N₂O, which is a dynamical tracer, we can quantify the amount of ozone depletion and denitrification.

In 2003 winter, the temperature of Antarctic stratosphere stays one of the lowest after the appearance of Antarctic ozone hole in mid 1980s. Subsequently, existence of a lot of PSCs and denitrification were observed by ILAS-II measurements. Moreover, record-large ozone loss was observed by both TOMS and ILAS-II measurements. By the correlation analysis of N₂O and O₃ by ILAS-II, record-high loss rate of -0.10 ppmv/day was observed in September 2003 over the Antarctica. The cause of this large ozone loss are discussed by the comparison with the amount of denitrification and with the total sunlit time along the air mass trajectories.