A-3 Studies on remote sensing techniques using satellites for measuring atmospheric trace gases related to ozone depletion (Final Report)

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In the signal processing of data obtained by the infrared spectrometer of the Improved Limb Atmospheric Spectrometer (ILAS), the authors proposed an analytical method, examined its feasibility by conducting simulations, and applied it to actual data, to correct aerosol/PSCs effects in the signals. When applied to actual ILAS data, this proposed method could not work well due to the existence of offset component. A realistic method was proposed to express non-gaseous components by linear interpolation. In addition, gaseous and non-gaseous components were estimated simultaneously by expressing non-gaseous components by linear combination of absorption spectra originating from aerosols/PSCs and offset components. In both of these cases, reasonable corrections could be made.

Earth-satellite-earth laser long-path absorption method for measuring atmospheric trace species was demonstrated with the Retroreflector in Space (RIS) on the ADEOS launched on August 17, 1996. Optical characteristics of the RIS was evaluated and it was confirmed that the RIS worked properly in orbit. The atmospheric spectrum was measured with two TEA CO2 lasers based on the method using the Doppler shift caused by the satellite movement. Ozone column contents was derived from the spectrum and was validated by the simultaneous measurement with a laser heterodyne spectrometer. Based on measurement error analysis, the transmitter system and the satellite tracking system were improved and characteristists of errors were also studied by comparing with the errors in the measurements with a corner-cube retroreflector installed on a tower 4 km away from the ground station.

SLR observation to ADEOS started at Simosato Hydrographic Observatory in October 1996. Modeling of geometrically complex shape of ADEOS was made using box-wing representation. Experiments on the orbit prediction using ADEOS tracking data showed that the box-wing model and center of mass correction improved significantly accuracy of the predicted orbit of ADEOS. Long preriod data analyses show that the accuracy of prediction by our scheme is several hundreds of meters after about a week in the along-track component.

A precise prediction of the ADEOS satellite orbit by using data obtained by the satellite laser ranging (SLR) network was developed and the RIS tracking experiments have been conducted. In orbit prediction, we demonstrate repeatability of predicted satellite position of 10 meters by three days, and 50 meters by one week after epoch. Through this experiment, we have also developed a prototype of advanced orbit determination system, including advanced tracking system, algorithm and data collection/delivery system. The uncorelated variations of the light returned from the RIS experiments were calculated. According to papers that described experiments of the pulse pair correlation, uncorelated variations of the light returned from RIS were reasonable. It was showed that the laser long path absorption of the RIS installed on the ADEOS satellite was very useful for the measurement of the atmospheric trace gases.