A-3 Development of new measurement techniques with laser radars

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This research program is divided to two projects. The first project is called "Development of a measurement technique of the laser long path absorption by using a satellite-borne retroreflector". The second one is "studies on the global atmospheric environment monitoring with satellite-borne laser radar".

The first project is for developing a new technique of the laser long path absorption between the ground and a retroreflector installed at ADEOS satellite to measure atmospheric trace gases. The ADEOS (Advanced Earth Observing Satellite) will be launched in 1996. Objectives of the first project are to find out the most suitable spectroscopic method for the laser long path absorption between the ground and the satellite and to develop a method of tracking satellite shined by the laser radiation, called as an active satellite tracking method.

The second one is for making studies of the necessity, objectives, instrument specifications and data usage of the space-borne laser radar. The studies have been performing at a working group organized by the Japanese scientists and engineers.

The following results were obtained from the research program.

1.The retroreflector in Space (RIS) with a large aperture was developed to use the laser long path absorption between the ground and the ADEOS. The RIS is a hollow type for spectroscopic measurement in wide wavelength region and is designed to correct the velocity aberration due to the relative motion of the satellite.

2.Development of the ground system with two CO_2 lasers to measure atmospheric trace gases by means of the spectroscopic method. One of the CO_2 lasers is for off-line absorption measurement and another is for on-line. The transmitter and the receiver are switched by using a rotating metal mirror and the tracking data can be used to make the spectroscopic measurement of the absorption line.

3.Data deduction method was developed to obtain the column content and the profile of the atmospheric trace gases from the absorption line spectrum.

4.The received intensity was estimated to determine the specifications of the Nd:Yag laser and the gated CCD camera for the active tracking , when the geodetic satellite and the RIS were illuminated by the radiation of the laser.

5.Light reflected from the corner cube prisms of a Japanese geodetic satellite "Ajisai" was obtained with a CCD camera with a high speed gate, which were installed on the optical tracking system with a 1.5m diameter telescope.

6.The optical tracking system was improved to make more accurate and precise tracking by making modification of the software of the telescope model.

7.Technical reviews were made space-borne laser radar and their subsystems (such as laser transmitter, receiver optics and so on), which would be utilized for measuring clouds and aerosols that are closely related to ozone layer depletion and global warming. According to the review, specifications of a laser radar for a small-sized satellite were shown as a report of the working group, which also recommended that the laser radar should be launched by a J-1 rocket near future.