Development of a Data Analysis System for GPS Occultation Measurements

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GPS (Global Positioning System) occultation is useful to monitor the global distribution of humidity, temperature and electron density perturbations. This technique is based on the principle of satellite-to-satellite limb sounding. By receiving GPS radio wave which passes through the atmosphere with a receiver onboard a low Earth orbiting (LEO) satellite, refractivity profile can be obtained. With objective of the dense observations in the equatorial region, RISH (Research Institute for Sustainable Humanosphere) plans to perform GPS occultation experiment on the Brazilian LEO satellite named EQUARS (Equatorial Atmospheric Research Satellite) to be launched in 2007. The data obtained from EQUARS can be applied into the operational numerical weather prediction (NWP) in Japanese Meteorological Agency. For this application the real-time processing is required.

In this study, we have developed the data analysis system for retrieving the atmospheric parameters from GPS occultation data obtained by LEO satellites. The system consists of data collection and reduction part, positioning and orbit determination part, excess phase delay calibration part, and retrieval part. Data needed for the analysis are acquired in data collection and reduction part. The position and velocity vectors of GPS and LEO satellite are derived in positioning and orbit determination part. In excess phase delay calibration part, phase delay due to the atmosphere is obtained. In retrieval part bending angle of the ray path is calculated, and atmospheric parameters such as refractive index, temperature, and pressure are derived at the end.

We also improved the atmospheric retrieval procedure. To solve the problems of the bending angle collection method which was previously used, we developed the improved collection method, and verify its effect by comparing with other data. Moreover, we estimated the total analysis time of the data analysis system and evaluated the possibility of operational application of EQUARS data to NWP.
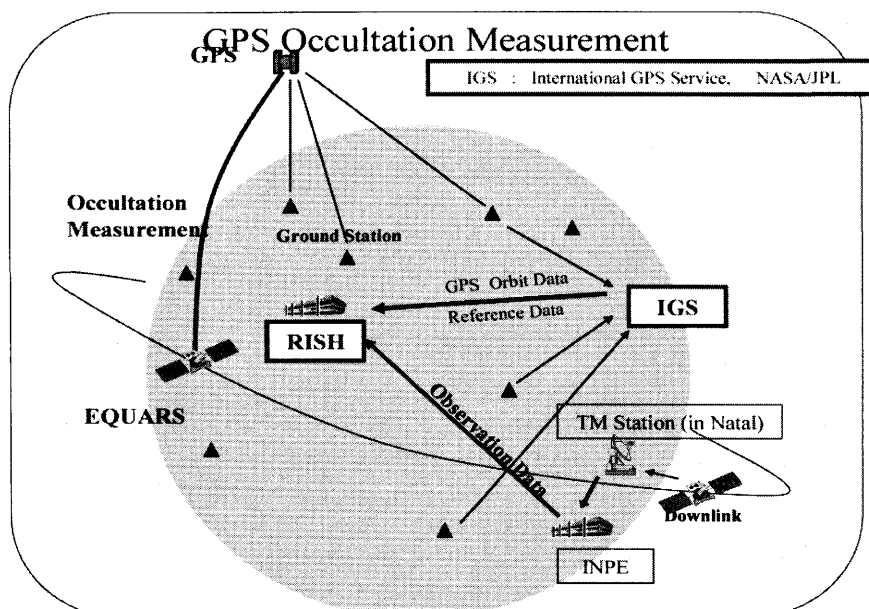

Fig. 1. Schematic diagram showing the communication of GPS occultation and ground reference data.