Development of down-looking GPS occultation observation using aircraft

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As a novel technique of GPS occultation observation, down-looking observation is expected to estimate tropospheric water vapor profiles below the receiving point. In this method, it is required to continuously observe Doppler-shift data in carrier phase with a negative-angle GPS satellite at the top of a high mountain.

For a further application of this technique, we aim to develop down-looking GPS occultation method using aircraft, which makes the upper limit of the observation height extend to the altitude of aircraft (i.e. typically 6 kilometers in the case of the experimental aircraft). Further, we can observe everywhere because of using the mobile receiving point. However, there are mainly two subjects to perform down-looking experiment using aircraft. The first is to estimate accurate velocity of an aircraft in processing along a flight course. Because GPS occultation method measures Doppler-shift in the carrier phase on aircraft, it is required to distinguish between the atmospheric propagation effect and the aircraft velocity from observed Doppler shift data. The second is to improve a sensitivity of GPS receiver. For this reason, Doppler-shift data from GPS occultation satellite with the minimum elevation angle specifies the lowest height of derivable water vapor profile. However, the intensity of receiving signal from GPS satellite with a low elevation angle is generally weak. Therefore, it is required to track occultation signals as continuously as possible.

To accomplish the first subject, we have developed the equipment to obtain GPS and INS (Inertial Navigation System) data. We are going to estimate accurate velocity from the both data. For the second subject, the new GPS receiver system has been developed. We have set up these equipments on the experimental aircraft of ENRI (Electro Navigation Research Institute, Japan) and performed the first experiment around the Sendai airport, which was the base airport of the experimental aircraft, on Oct. 2003. We have obtained 4 data-set to estimate water vapor profile.