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Simulation on requirements and observational plan for aircraft GPS down-looking experiments in 2003

T. Yoshihara, N. Fujii, K. Hoshinoo, K. Matsunaga, S. Saitoh

Electronic Navigation Research Institute (ENRI), Japan

T. Tsuda, Y. Aoyama

Radio Science Center for Space and Atmosphere (RASC), Japan

Abstract

GPS occultation observation, which can provide atmospheric refractivity index profile, is a powerful and useful application of GPS for monitoring the Earth's atmosphere. As a novel technique of this, down-looking occultation method is expected to estimate lower tropospheric water vapor profiles below the receiving point with aid of temperature profiles. In this method, it is required to continuously observe Doppler shift in carrier phase of an occultation GPS satellite from view angle of depression using GPS receiver set up on the top of high mountains and operated with a high sampling rate. Here, we aim to further apply this novel technique to observation using receiver set up on aircraft (aircraft down-looking observation). It makes the upper limit of estimation height extend to the altitude of aircraft. Using this technique, it is expected that we can observe water vapor profiles everywhere because of using a mobile receiving point. In autumn, 2003, we will perform experimental flights in Japan using two purpose-built equipments, which are a new GPS receiving system designed for aircraft down-looking observation and a united system combining GPS kinematic data with Inertial Navigation System (GPS/INS), which includes ring laser gyros (for measuring angular velocity of p, q, r, components) and accelerometer (for measuring accelerate of x, y, z components). The new GPS receiver system, which consists of exclusive antenna for observing occultation satellite signal, will be designed to track occultation signals as weaker as possible. In generally, it is difficult to determine aircraft velocity using only GPS kinematic data with the accuracy of 5mm/s, which is necessary to estimate water vapor profile with a good accuracy. Therefore, we are going to measure accurate aircraft velocity by GPS/INS system including 1-Hz-sampling stations of GPS Earth Observation Network (GEONET) as ground reference stations. For flight experiments, we are going to simulate optimum conditions, which are satellite configuration, flight course such as minimizing observational error and so on, in consideration of error originated in observational equipments.