

Positioning error estimation due to snow accumulation on GNSS antenna using winter experimental data

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In research field of precise positioning using Global Navigation Satellite System (GNSS) such as GPS, it is well known that positioning error is caused by snow accumulation on GNSS antenna [1]. It is important to quantitatively evaluate the error taking account for shape of snow-cap and GPS satellite configuration, which are changing with time past. In this study, we performed two winter experiments in each winter of 2011/2012 and 2012/2013, which enabled us to quantitatively investigate reduction in receiving intensity and propagation delay due to snow accumulation on GNSS antenna. The experimental data was also able to use for positioning error estimation resulted by such effects. We installed a GPS antenna about 50 meters away from weather observational equipment, which measured pressure, temperature, humidity, wind direction and velocity, precipitation, snow depth, etc.), in observation field of Snow and Ice Research Center, National Research Institute for Earth Science and Disaster Prevention (NIED) in Nagaoka, Japan. To observe snow accumulation on GNSS antenna, a photograph of GNSS antenna was automatically took by an interval camera every 10 minutes during winter. To evaluate quantitative effects of snow accumulation on GPS signal measurement, we investigated drop events of snow-cap on GNSS antenna and analyzed gaps of rapid changes in both receiving intensity and carrier phase measurements[2]. Consequently, a snow-cap with a height of 40cm yielded reduction of several dB in receiving intensity (C/N0) and propagation delay of about 4 cm in slant range. We will show relationship between size of snow cap and positioning error based on the experimental data, including simulation analysis with range errors due to snow accumulation and satellite configuration. We will also show evaluation results to use water repellent paint on GNSS antenna radome for mitigation of snow accumulation.

References

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