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Verification of SBAS ionospheric correction by using a 3-D ionospheric tomography

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SBAS (Satellite-Based Augmentation System) is one of the GNSS (global navigation satellite system) augmentation systems, and is designed to support aircraft navigation in a wide area. The SBAS systems that are currently deployed are all based on the single-frequency (SF) GNSS. In the SF-SBAS, ionospheric delay on GNSS signals are corrected by sending ionospheric delay estimates at ionospheric grid points (IGPs). The IGP ionospheric delays are estimated by using GNSS observations at SBAS monitoring stations. Thy are estimated at every 5x5 degrees in the latitude and longitude except in high latitude regions and broadcast from geostationary satellites. Since the number of SBAS monitoring stations are limited, there is uncertainty in the IGP ionospheric delay estimates, and the potential errors in the IGP ionospheric delay estimates are the major part of total error bounds. Therefore, it is important to estimate the ionospheric delays and their errors as accurately as possible. Since it is very difficult to know the truth of the ionospheric delay, however, the error bounds had to be estimated indirectly. If the truth can be obtained by other methods, the error bounds could be estimated more accurately and be tightened.

In Japan, a 3-D ionospheric tomography over Japan based on GEONET (GNSS Earth Observation Network) data has been operated by the Electronic Navigation Research Institute since 2016. Since the 3-D tomography methods are different from the method of ionospheric delay estimation in SBAS and the GNSS stations are different, it could provide independent estimation of the ionospheric delay as a reference. We used broadcast SBAS IGP ionospheric delay estimates and compared with the vertically integrated ionospheric density at the same IGPs. As a first step, we selected several periods of an year in ionospheric quiet and disturbed conditions and compared to see the general characteristics. We will also apply the comparison for the past several years including low and high solar activity periods.