

Evaluation of inter-system biases of geodetic GNSS receivers in double differences

Tomoaki Furuya¹, Hiromi Yamao¹, Yuki Kamakari¹, and Hiromichi Tsuji¹

¹*Geodetic Observation Center, Geospatial Information Authority of Japan, Japan,
gsi-qzss@ml.mlit.go.jp*

The Geospatial Information Authority of Japan (GSI) is developing new precise positioning techniques combining multiple GNSS constellations in order to promote efficient GNSS surveys at places where GPS-only solutions are degraded due to poor satellite visibility. We examined Inter-System Biases (ISB) of GNSS receivers in double differences between GPS and other GNSSs, i.e. QZSS, GLONASS, Galileo and BeiDou. The ISBs originate from the signal processing hardware of a GNSS receiver when signals from different satellite systems are observed. We estimated relative ISBs of several models of geodetic GNSS receivers using zero baseline observation data under the following observation scenarios: change of antennas, reboot of receivers, change of receiver's firmware, and change of temperature. In the observations, two receivers are connected to the same GNSS antenna with a signal distributor. The results are as follows:

- 1) ISBs between the same model of receivers are almost constant for all the scenarios.
- 2) ISBs of GPS-QZSS and GPS-Galileo are stable even for different models of receivers. Note that ISB of GPS-QZSS is nearly zero.
- 3) ISBs of GPS-GLONASS and GPS-BeiDou are not stable for different models of receivers. They irregularly change at every time receivers are rebooted.

Therefore, correction of ISBs is mandatory for multi GNSS surveys with different models of receivers. One possible solution to correct the ISBs of GPS-QZSS and GPS-Galileo is to use a table of the estimated ISBs in advance. However, there is no simple solution to correct ISBs of GPS-GLONASS and GPS-BeiDou.

From several examinations including the ISB, the GSI developed new analysis software named GSILIB (GNSS Surveying Implementation Library) based on RTKLIB developed by Mr. T.Takasu. The GSILIB supports to estimate and/or correct several biases which occur in GNSS receivers: L2C quarter-cycle bias, Inter Frequency Bias and ISB. It is an open source software package for GNSS positioning, whose source codes and documents were released on the GSI's web site at <http://datahouse1.gsi.go.jp/gsilib/gsilib.html>.

Keywords: multiple GNSS, ISB, GSILIB