Current Status of VGOS Observation wtih Ishioka VLBI Station

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Abstract The Geospatial Information Authority of Japan (GSI) constructed a new VLBI facility at Ishioka in 2014 which meets the VGOS requirements. The Ishioka VLBI station is regularly involved in international VLBI observation sessions with S/X-band, is one of the leading stations of IVS after taking over the role of the Tsukuba VLBI station, and is in preparation for regular VGOS operations. From November through December 2017, IVS performed the Continuous VLBI Campaign 2017 (CONT17), which included not only 15-day conventional S/X-band observation sessions but also five-day continuous broadband observation sessions that were compatible with the VGOS frequency setup for the first time. The Ishioka VLBI station was involved in the preceding VGOS Trials and in CONT17 with five other VGOS stations as the only station with the VGOS setup in Asia-Oceania. This report summarizes the current status of the Ishioka VLBI station, especially with respect to the broadband observations in the CONT17 campaign.

Keywords Ishioka, Tsukuba, VGOS, broadband

1 Introduction

The Geospatial Information Authority of Japan (GSI) started the construction of a new geodetic VLBI station at Ishioka in 2011. Ishioka is located about 17 km northeast of Tsukuba, where the headquarters of GSI is located. The location of the new station was selected by considering some requirements such as ground stability, good sky coverage, the condition of relatively less RFI, availability of a power supply and high speed network, and accessibility to the GSI headquarters.

The VLBI station is designed for the next-generation VLBI system called VGOS. It is equipped with a fast-slewing telescope with a diameter of 13.2 m, a proper optical system, a high speed data acquisition system, and two hydrogen masers in an observing building.

In addition, the site is equipped with gravity measurement equipment and continuously operating GNSS reference stations to contribute to the Global Geodetic Observing System (GGOS) as a core observatory (Figure 1) [1].

2 Regular S/X-band Observation Sessions

GSI started the operation of the Ishioka VLBI station in February 2015 in parallel with the Tsukuba station, which had been the main VLBI station of GSI since 1998. The Ishioka station and the Tsukuba station were involved in more than 50 IVS S/X-band regular observation sessions during the overlapping operational period until the end of 2016. Figure 2 shows the baseline length between the Kokee Park station in Hawaii, USA and the two stations in Japan. Results of the Kokee-Ishioka baseline were converted to the Kokee-Tsukuba baseline by using the Tsukuba-Ishioka baseline vector derived from the parallel operation over a year and a half. One can observe a good geodetic connection between Tsukuba and Ishioka.

The UT1 Intensive series, which rapidly measures the UT1-UTC parameter, is one of the most significant services of the IVS. GSI started the weekend

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Fig. 1 The panoramic view of the new geodetic observing site at Ishioka.

Intensive sessions (INT2) in 2002 with the Tsukuba-Wettzell baseline. The whole process from data transfer to analysis is conducted by unmanned operation at GSI. Results are then submitted to the IVS and the IERS within a few minutes from the end of each session. Thus, INT2s contribute to monitoring the irregular fluctuation of UT1-UTC and improving the accuracy of the prediction value [2].

Ishioka started trial observations for UT1-UTC in October 2016 in order to take over the role of Tsukuba. The comparison of UT1-UTC estimation with respect to the IERS final solution are shown in Figure 3. The results derived from the Ishioka-Wettzell baseline are consistent with those from the Tsukuba-Wettzell baseline.

As a result, GSI terminated the operation of Tsukuba at the end of 2016, and Ishioka took over the role of Tsukuba at the beginning of 2017.

3 Broadband Experiments

The compatibility of the broadband observing system of Ishioka with overseas VGOS systems was confirmed in September 2016 through some broadband experiments [3]. The first continuous broadband observation for five days was performed in December 2017 as a part of the continuous VLBI campaign observation (CONT). Ishioka carried out this campaign observation as one of the six VGOS stations in the world (Figure 4).

In order to receive broadband data, it is necessary to replace the tri-band feed for the S/X-band system with a QRFH. Additional data storage was also prepared because the total amount of data was expected to be around 80 TB during the five-day observation. Since observation started at 8:00 a.m. every day and finished at 7:30 the next day in local time, GSI staff went to the Ishioka station at 7:00 a.m., checked the recording system and the observation status, connected new data storage, and ran a schedule file during this switching time. Thanks to these efforts, Ishioka successfully finished CONT17 without any trouble, and all data were e-transferred to MIT Haystack for correlation.

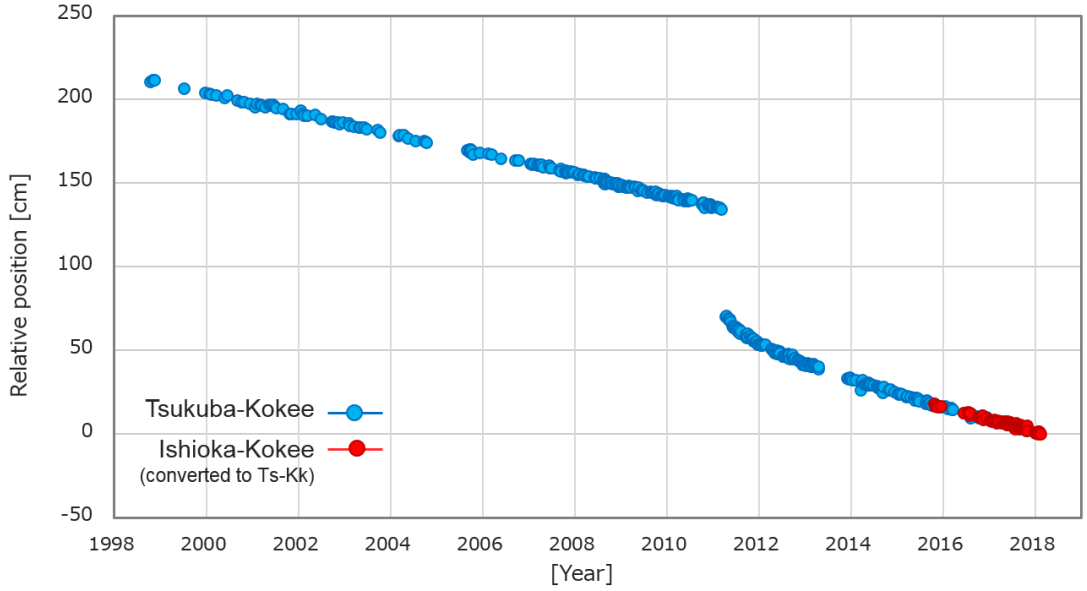

Fig. 2 The baseline length between Tsukuba-Kokee and Ishioka-Kokee obtained from S/X-band observation sessions. The length of Ishioka-Kokee was converted to the Tsukuba-Kokee baseline by using the Tsukuba-Ishioka baseline vector derived from 2015 through the end of 2016.

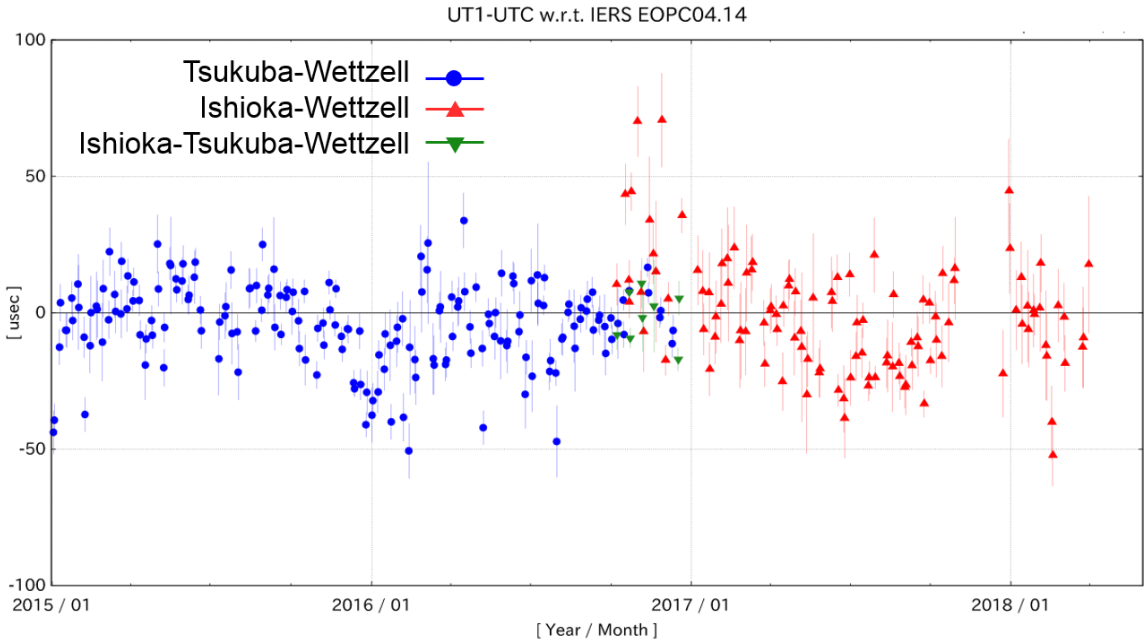

Fig. 3 The estimated UT1-UTC with the Tsukuba-Wettzell baseline and the Ishioka-Wettzell baseline, with respect to the IERS final solution.

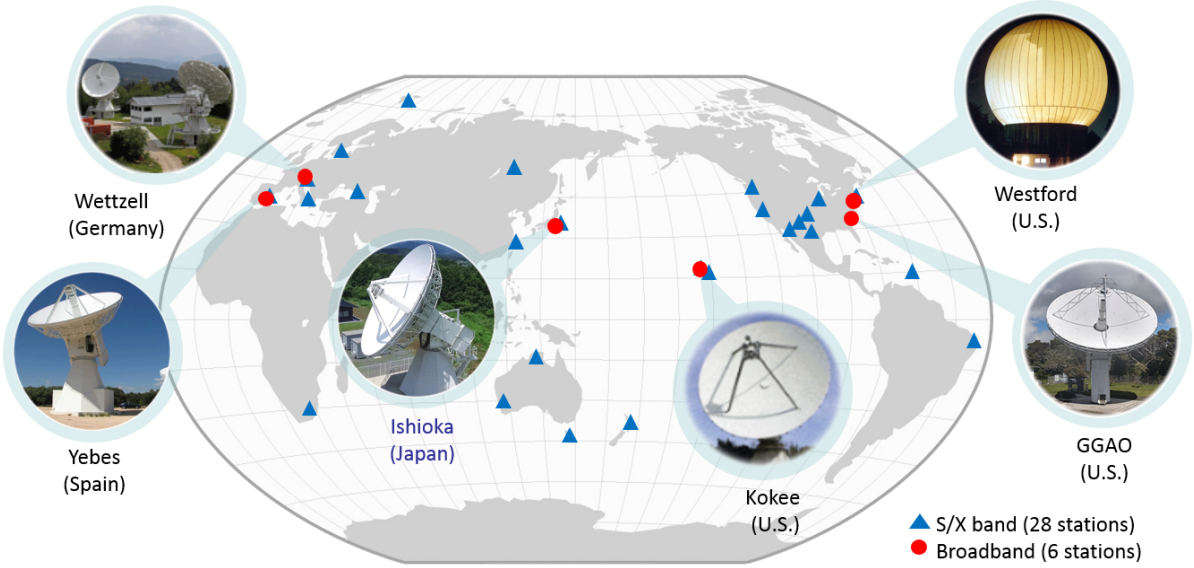

Fig. 4 Six VGOS stations involved in CONT17.

GSI has interest in VGOS not only as an observing station but also as a correlator. We tested the correlation of the Ishioka-Yebes baseline with the K5 correlation software, which was developed by NICT, with the cooperation of the Spanish IGN for provision of Yebes data. Fringes were successfully detected on each channel, and it is confirmed that the K5 software is applicable to VDIF format data.

4 Future Perspective

Ishioka will continue legacy S/X-band observation sessions for a while in order to establish relative positions with existing stations in the world. On the other hand, the development and the operation of the broadband system are very significant challenges. Ishioka is involved in VGOS experiments from June to mid-September 2018. Then the station will gradually transit to VGOS observations while keeping pace with overseas stations.

GSI will also continue test correlation of VGOS data and its validation and will investigate feasibility as a future VGOS correlator.

5 Conclusions

GSI constructed a new geodetic VLBI station at Ishioka in 2014 and started its operation in 2015 in parallel with Tsukuba. Through the overlapping operations until the end of 2016, a reliable geodetic connection between Tsukuba and Ishioka was established. Accompanying the termination of operations and demolishment of Tsukuba, Ishioka took over the roles of Tsukuba, such as the IVS Intensive sessions for the rapid estimation of UT1-UTC.

Ishioka succeeded in carrying out the first continuous broadband observation of CONT17 as one of the six VGOS stations in December 2017. In addition, GSI started VGOS correlation testing with K5 correlation software. We continue to move VGOS forward through these contributions.

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