Status of Ishioka Geodetic Observing Station

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Summary

- The position and velocity of Ishioka station were given in ITRF2020.
- Experiments were conducted to investigate how to participate in both S/X and VGOS sessions without changing receivers.
- DBBC3 and Flexbuffs are installed and being set up.
- Local-tie surveys are regularly conducted. The results for 2021 and 2022 show relatively larger difference from the value calculated from ITRF2020 than those for 2018-2020. The local-tie continues to be monitored.

Introduction

The Ishioka 13-m telescope at the Ishioka Geodetic Observing Station (hereafter Ishioka station), operated by the Geospatial Information Authority of Japan, has participated in the IVS sessions since 2015. One of the goals of Ishioka station is to participate in international observations to contribute to the development and maintenance of the ITRF and ICRF as well as Japanese national datum. To achieve these goals, we have been involved in the following topics recently:

・polarization conversion
・installation of new recording systems
・local-tie surveys

In this poster, we report these topics.

Management of polarization

Currently, the Ishioka station is involved in VGOS observations for several months a year and in legacy S/X observations for the rest of the year by switching their respective receivers (Fig. 1). This causes two problems: observations must be interrupted while switching the receivers, and the receiver change requires a lot of manpower. To improve this situation, we are now exploring the way in which we use the broad-band receiver for both VGOS and S/X observations. Since the problem of RFI in the S-band was fixed by installing the superconducting filters in the receiver (Takagi et al. 2021), the remaining challenge is how to handle the polarization.

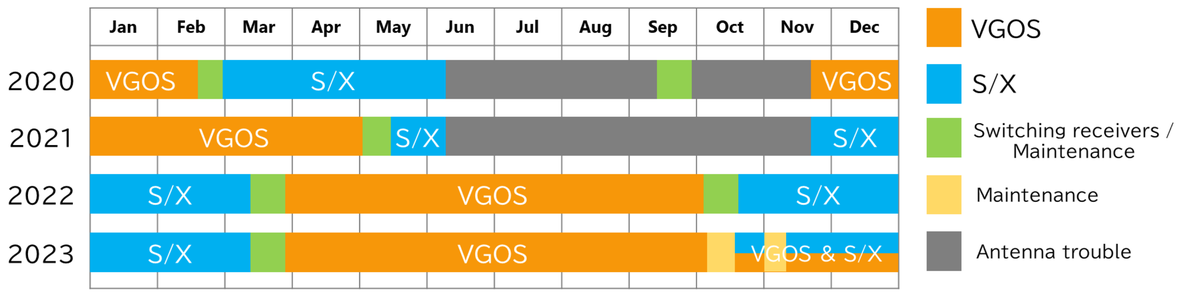

Fig. 1: Recent status of the Ishioka station.

Solution 1: Conversion at the station

We conducted an experiment in corporation with the Mizusawa station (NAOJ) to investigate the possibility of converting linear polarization to circular one. In this experiment, AOV075 and additional experimental data of the Ishioka station were converted from linear to circular polarization by shifting the phase of horizontal component by 90 degrees and combining it with the vertical component, then they were correlated the circular polarization data of the Mizusawa station.

We successfully obtained fringes (Fig. 2); however, the SNR were smaller than the expected values, which should have been 1.41 times larger than those without conversion. We need further investigation in order to improve this method.

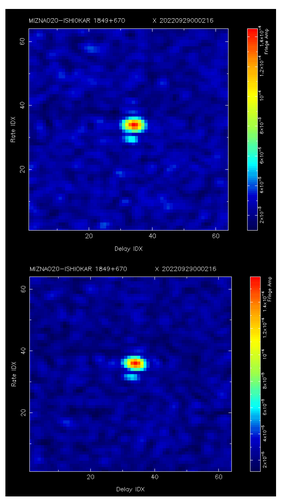

Fig. 2: Fringes detected in AOV075 (upper figure) and the additional experiment (lower figure), respectively.

Solution 2: Mixed-mode correlation by IVS correlators

The Ishioka station participated in S/X sessions R11098 and R41098 with the VGOS receiver in April 2023. IVS correlators are testing mixed-mode correlation which enable for both S/X and VGOS stations to join the same session.

In both test sessions, fringes were successfully detected (Fig. 3). We plan to have another test session before participating in mixed-mode sessions regularly.

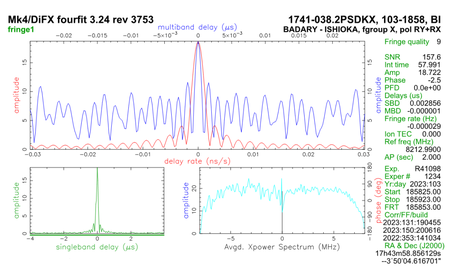

Fig. 3: Fringe detected in R41098 (provided by Sara Hardin (WASH))

New recording system

At the Ishioka station, ADS3000+ developed by NICT and JAXA is currently used for the recording system. The issue is that new servers connectable to it are no longer available.

Thus, we decided to install a DBBC3 and Flexbuffs. New Flexbuffs and a DBBC3 were delivered in March and April, 2023, respectively. Now, they are being installed and tested.

Fig. 4: (Left) Front view of the DBBC3 newly installed at the Ishioka station. (Right) Top-down view.

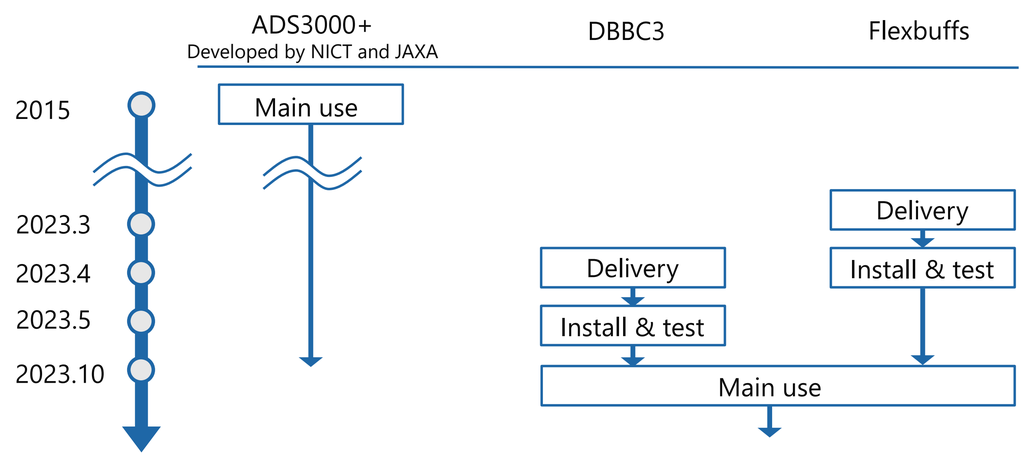

Fig. 5: Upcoming schedule of installation & test of new instruments in Ishioka.

VLBI-GNSS Local-tie survey

We carry out local-tie surveys regularly to estimate the local-tie vector between the reference points of the telescopes and the IGS GNSS station operated at the Ishioka station. We have adopted 'inside method' (Matsumoto et al. 2022) to conduct the surveys efficiently. The results of the 2018 and 2020 surveys were submitted to the IERS to contribute to the construction of ITRF2020. The surveys were also conducted in 2021 and 2022.

Fig. 6: (Left) Measuring the positions of the mirror installed in the AZ cabin from the pillar using the TS. (Middle) GNSS station called ISHI, which is registered as an IGS station. (Right) VLBI-GNSS local-tie vector.

The results for local surveys were compared with the calculated value based on ITRF2020 (Fig. 7). The value obtained by the surveys are consistent with the calculated value from 2018 to 2022. On the other hand, the deviation becomes larger in 2021 and 2022.

It is possibly because the ITRF2020 does not reproduce the velocity of the Ishioka station after 2021. The ITRF2020 uses only a linear function to represent the position of the Ishioka station although it has experienced large post-seismic deformation caused by the 2011 off the Pacific coast of Tohoku Earthquake.

Further monitoring of the velocity is necessary by regular local-tie survey for revealing what causes this deviation.

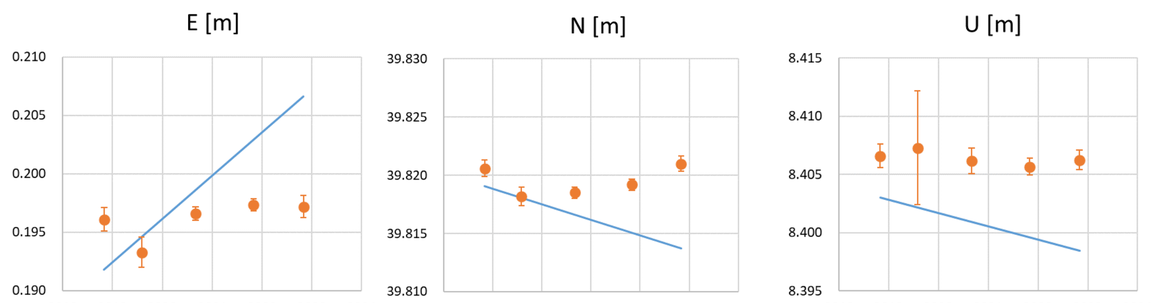

Fig. 7: Results for local-tie surveys (orange circle) are compared to the calculated values based on ITRF2020 (blue line). Left, middle, and right panels represent the east-west, north-south and up-down components, respectively.

Acknowledgment

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References

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