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Processing of the Data of Syowa VLBI Experiment by Copying Between the Different Recording Systems and the Result of the Analysis

Yoshihiro Fukuzaki [1], *Kazuo Shibuya* [2], *Koichiro Doi* [2], *Takaaki Jike* [3], *David L. Jauncey* [4], *George D. Nicolson* [5]

[1)] *Geographical Survey Institute*
[2)] *National Institute of Polar Research*
[3)] *National Astronomical Observatory of Japan*
[4)] *Hartebeesthoek Radio Astronomy observatory*
[5)] *Australia Telescope National Facility, CSIRO*

Contact author: Yoshihiro Fukuzaki, e-mail: fukuzaki@gsi.go.jp

Abstract

At the Syowa Station on Antarctica, regular VLBI experiments have been undertaken since 1998. In this experiment different recording systems were employed. Development of copy system, however, enabled us to process the data. Meanwhile, since 1992, the O'Higgins Station on Antarctic Peninsula has participated in VLBI experiment with most of the VLBI stations in the southern hemisphere. The Syowa station has been taking part in this experiment since 1999 by developing another copy system. This is the first VLBI observation of the intra-Antarctic plate baseline.

1. Introduction

The Japanese Antarctic Research Expedition (JARE), which is coordinated by the National Institute of Polar Research (NIPR), started regular VLBI experiments at the Syowa station in 1998. The Syowa station is located at 69.0 deg S and 39.6 deg E on East Ongul Island, Antarctica, and has 11-m antenna. This experiment is called "Syowa VLBI experiment" or "SYW session." Three stations in the southern hemisphere, Syowa, Hobart and HartRAO, have participated in SYW sessions. In addition, the Syowa Station has been taking part in CORE-OHIG experiment, which is the largest network in the southern hemisphere, since 1999. But there was a serious problem concerning the data-recording format. The Syowa station has only K4 recorder, but there is no other station that has K4 recorder in the southern hemisphere. To solve this problem two types of copy system were developed. By using the copy systems, we have processed the data of SYW and CORE-OHIG sessions including Syowa station. In this article, I will report on the copy systems and results of the analysis, and the results of the first-ever observation of the baseline in Antarctic plate undertaken in collaboration with the O'Higgins station.

2. Copy System

In SYW session, the Syowa station has only K4 recording system, and Hobart and HartRAO adopted S2 recording system. In order to process the data of this session, we developed the copy system from the S2 data into K4. A conversion device from the S2 format into the K4 was already

developed by the Mitaka Correlator of the National Astronomical Observatory of Japan (NAOJ) for the VLBI Space Observatory Programme. On the assumption that this device converts the format, the Hobart and the HartRAO stations adopted the S2 format in the SYW session. Nevertheless, we were faced by the challenge that the time stamps recorded at a normal geodetic session were not embedded on the data copied by the conversion device, since it was designed for the correlation of astronomical observation data.

In order to overcome this issue, Jike et al. (2000) [1] developed software to obtain the geodetic solution from the SYW session data processed by the Mitaka Correlator (FX Correlator). At the same time, Fukuzaki et al. (2001) [2] developed a method to embed the time stamps on data converted from the S2 into the K4 format so that an ordinary correlator for geodetic session could be used for processing. For embedding the time stamps on the data, a time stamp generator developed by the NAOJ was utilized. The S2 playback recorder reproduces and reads out the time stamps written on the observation tape every second. Concurrently a pulse (1PPS) synchronized to the time stamp is also generated. Entry of this 1PPS into the time stamp generator, which synchronizes with the time stamp, enabled us to process the data as if the time stamps were embedded at the time of observation. The flow of data is shown in Fig. 1. This method allowed the correlators owned by the Geographical Survey Institute (GSI) or the Communications Research Laboratory to process data in the SYW session.

On the other hand, the CORE-OHIG session adopted the Mark III format, interfering with the participation of the Syowa Station that employed nothing other than the K4 format. The GSI, nonetheless, completed the development of a copy system for converting the K4 data into the Mark III format by 1999, which opened the door for the Syowa station to join the CORE-OHIG session. The correlation process for this session is performed at the Bonn Correlator.

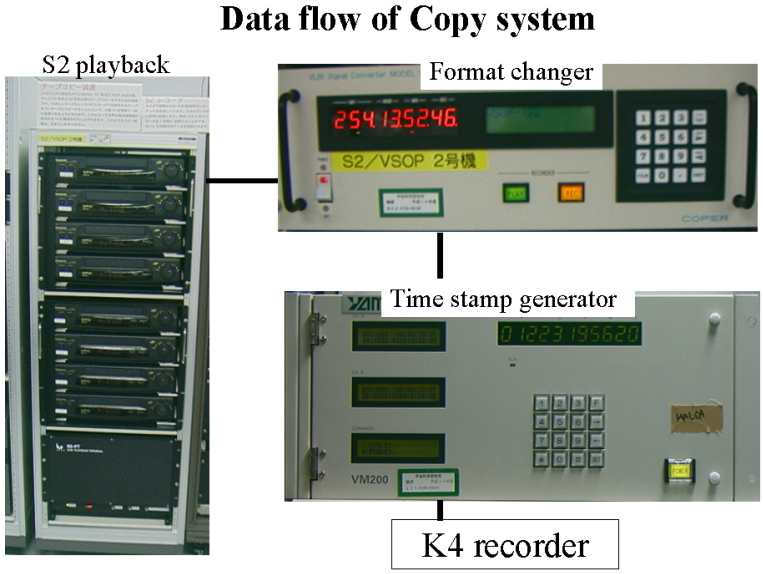

Figure 1. Data Flow of Copy System

3. Result of the Analysis

The analysis has so far been completed of the data of the SYW and the CORE-OHIG sessions conducted in 1999 and 2000. Since the SYW and the CORE-OHIG sessions use different copy systems and correlators, comparison of the results of the analysis provides a tool to verify the proper operation of the systems. Tables 1 and 2 show the Syowa-Hobart and Syowa-HartRAO baseline lengths, respectively. A comparison of the sessions recorded on approximately the same date revealed that they agreed with each other within the acceptable margin of error, confirming that this method could determine the baseline solution as intended. The baseline lengths in the time series are shown in Figs. 2 (between Syowa and Hobart) and 3 (between Syowa and HartRAO). The trends of the change of baseline length approximately agree in both cases with the geophysical plate kinematic model, NNR-Nuvel1A.

The CORE-OHIG session marked the first VLBI experiment of the intra-Antarctic plate baseline (between Syowa and O'Higgins). Table 3 lists its analyses, each of which was determined with a precision of about 10 mm. These were analysed by Dr. Leonid Petrov of GSFC/NASA. The time series data are shown in Fig. 4. Although having too few samples to produce a clear idea regarding change in the baseline length between Syowa and O'Higgins, this multinational session is expected to offer crucial information as to whether or not the plate motion in east Antarctica is different from that in west Antarctica.

Table 1. Baseline Length of Syowa-Hobart

CODE	Date	Baseline Length (mm)	Sigma (mm)
SYW995	99/Sep/09	6035892342.49	12.54
SYW996	99/Oct/07	6035892345.31	9.45
COHIG7	99/Nov/08	6035892355.70	10.55
COHIG8	99/Nov/10	6035892333.17	12.20
COHIG9	99/Nov/11	6035892336.18	11.41
SYW997	99/Nov/18	6035892340.52	10.35
SYW008	00/Feb/02	6035892371.66	11.33
COHG12	00/Feb/10	6035892360.42	10.52
SYW015	00/Dec/07	6035892419.63	19.52

4. Summary

At the Syowa station, regular VLBI experiment has been undertaken with Hobart and HartRAO since 1998. In this SYW session different recording systems were employed. Development of copy system, however, enabled us to process the data of SYW session. The goal of SYW session is to strengthen the reference frame in the southern hemisphere and to detect the motion of Antarctic plate.

Meanwhile, the Syowa station has been taking part in CORE-OHIG sessions since 1999 by developing another copy system for converting from the K4 data into the Mark III format. This is the first VLBI experiment of the intra-Antarctic plate baseline, so the results obtained by future

Table 2. Baseline Length of Syowa-HartRAO

CODE	Date	Baseline Length (mm)	Sigma (mm)
SYW995	99/Sep/09	4741786031.16	10.24
SYW996	99/Oct/07	4741786037.32	11.91
COHIG7	99/Nov/08	4741786026.64	7.55
COHIG8	99/Nov/10	4741786056.07	6.80
COHIG9	99/Nov/11	4741786030.17	7.67
SYW997	99/Nov/18	4741786008.05	12.46
SYW008	00/Feb/02	4741786032.37	16.76
COHG12	00/Feb/10	4741786024.55	9.75
SYW015	00/Dec/07	4741786044.69	9.56

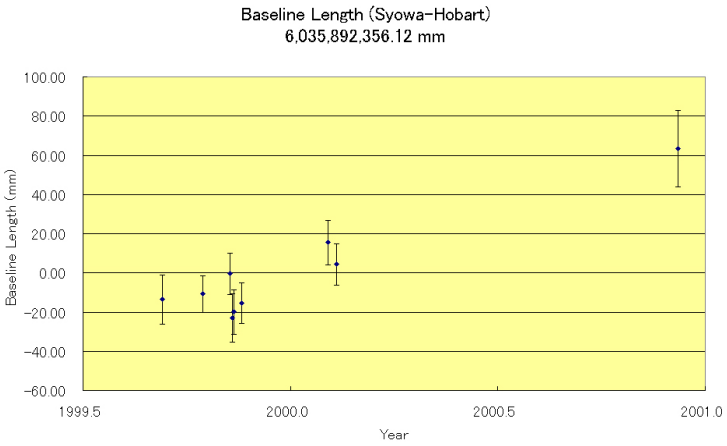

Figure 2. Baseline Length of Syowa-Hobart

Table 3. Baseline Length of Syowa-O'Higgins

CODE	Date	Baseline Length (mm)	Sigma (mm)
COHIG7	99/Nov/08	3908686827.72	9.03
COHIG8	99/Nov/10	3908686803.40	10.77
COHIG9	99/Nov/11	3908686814.17	8.66
COHG12	00/Feb/10	3908686813.38	10.87

sessions should provide data that can greatly contribute to the investigation of the motion of Antarctic plate.

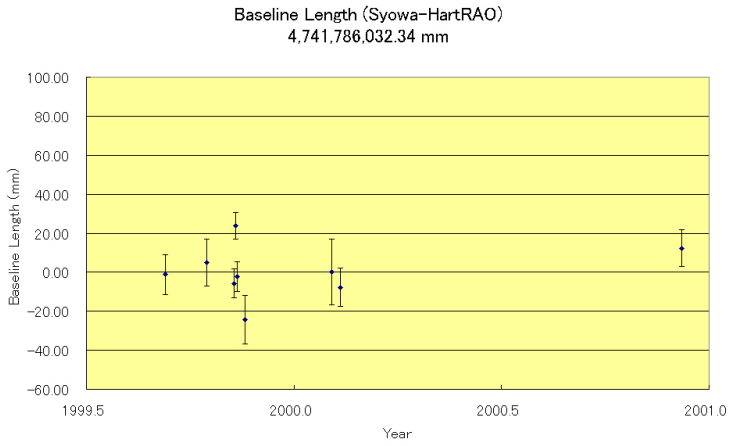

Figure 3. Baseline Length of Syowa-HartRAO

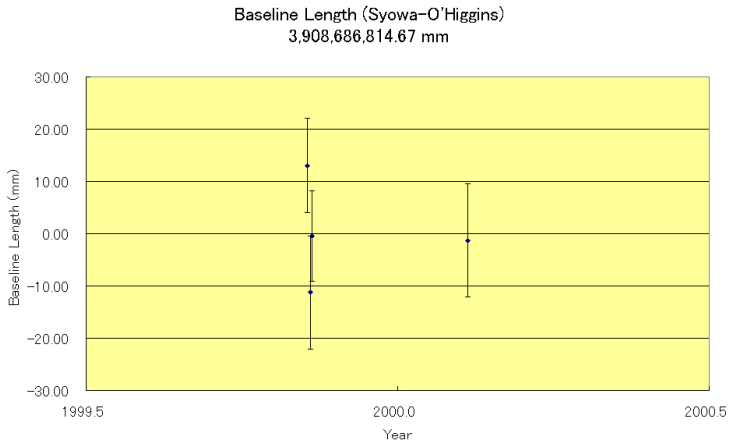

Figure 4. Baseline Length of Syowa-O'Higgins

References

[1] Jike, T., S. Manabe, Y. Tamura, and K. Shibuya (2000): Development of geodetic analysis software for FX Correlator and its application to the Antarctic VLBI experiments, presented at the 20th Symposium on Antarctic Geosciences 12-13 October 2000, Program and Abstracts, p155.

[2] Fukuzaki, Y., K. Shibuya, K. Doi, and T. Jike (2001): Processing of the data of Syowa VLBI experiment by dubbing S2 into K4, presented at the 21st Symposium on Antarctic Geosciences 18-19 October 2001, Program and Abstracts, p109.