KASI Combination Center Report

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Abstract

This report presents the activities of the Korea Astronomy and Space Science Institute (KASI) as an IVS Combination Center during 2012, and it sketches the intended tasks for 2013.

1. General Information

As a goverment-funded research institute, KASI is in charge of operating an IVS Combination Center. It has a wide range of research areas observing the Earth, the Sun, stars, and galaxies based on various instruments. Concerning the Earth observations, KASI operates GNSS, VLBI, and SLR. Space geodesy is one of the important research fields of KASI.

2. Component Description

KASI has prepared for regular combination analysis after it was designated as an IVS Combination Center. KASI has rich experience for GPS data processing and analysis using the Bernese GNSS Software (Bernese). Bernese, especially the subprogram ADDNEQ2, supports stacking of the normal equations and estimation of parameters [1]. We adopted Bernese to combine the sessionwise VLBI products of the IVS Analysis Centers (ACs) at the normal equation level. We altered the software, which was developed for GPS data processing and analysis, to handle IVS products appropriately. The inputs to the Bernese are the normal equation matrices and vectors from the daily SINEX files of the individual ACs (see Table 2). The outputs are daily SINEX files including combined station coordinates and Earth orientation parameters (EOPs). The missions of the KASI Combination Center are to create high quality combination products, to verify the combination solution of the BKG/DGFI Combination Center through cross-checking, to control the quality of the ACs' results, to provide feedback to the Analysis Centers, and to adhere to the IERS Conventions.

3. Staff

The staff members of the KASI Combination Center are listed below.

Table 1. Personnel of the KASI Combination Center.

Jungho Cho	+82-42-865-3234	jojh@kasi.re.kr
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Table 2. Products of individual ACs for the combination.

AC	BKG	DGFI	GSFC	IAA	OPA	USNO
Solution	bkg2010a	dgf2009a	gsf2010a	iaa2010a	opa2010c	usn2007b

4. Current Status and Activities

(1) Removing systematic variations of X and Y pole rates

In the IVS 2011 Annual Report [2], we reported that there were systematic variations of polar rates between individual and combined solutions. They looked like sine curves, so we expected that they might be caused by one of the EOPs. Most of the IVS ACs (BKG, DGFI, IAA, GSFC, and OPA) provide the SINEX format which has celestial pole offsets dX and dY as nutation parameters. The Bernese 5.0 version, however, handles nutation angles in obliquity and longitude, and thus the nutation part of the normal equations were not combined properly. Therefore, we fixed the nutation parameters of five ACs (BKG, DGFI, IAA, GSFC, and OPA) and pre-reduced the nutation parameters of USN to keep the nutation information. Finally, we could remove the systmatic variation in X-pole and Y-pole rate as shown in Figure 1.

(2) Automation using BPE

KASI uses Bernese for combining individual ACs. Bernese provides an automation tool, the Bernese Processing Engine (BPE), which is able to do routine processing. The routine processes include converting the SINEX format to the NQ0 Bernese input format, transforming the normal equations to refer to identical a priori values (reference frame and EOPs) and parameter epochs, and combining sessionwise products of ACs. Due to naming conventions of input and output files in Bernese, complete automation is restricted. Using additional scripts made BPE extensively support long-term processing, e.g. 10 years. Figure 2 shows the functions of the scripts for VLBI combination.

5. Future Plans for 2013

In 2013, we will focus on the following tasks:

- Rejecting outliers
- Weighting the individual solutions
- Combining whole period IVS products (1984-present)
- Comparing with BKG/DGFI Combination Center [3], IERS 08C04 [4], and IGS solutions [5]
- Providing IVS EOP format solutions [3] (Rapid and Quarterly)

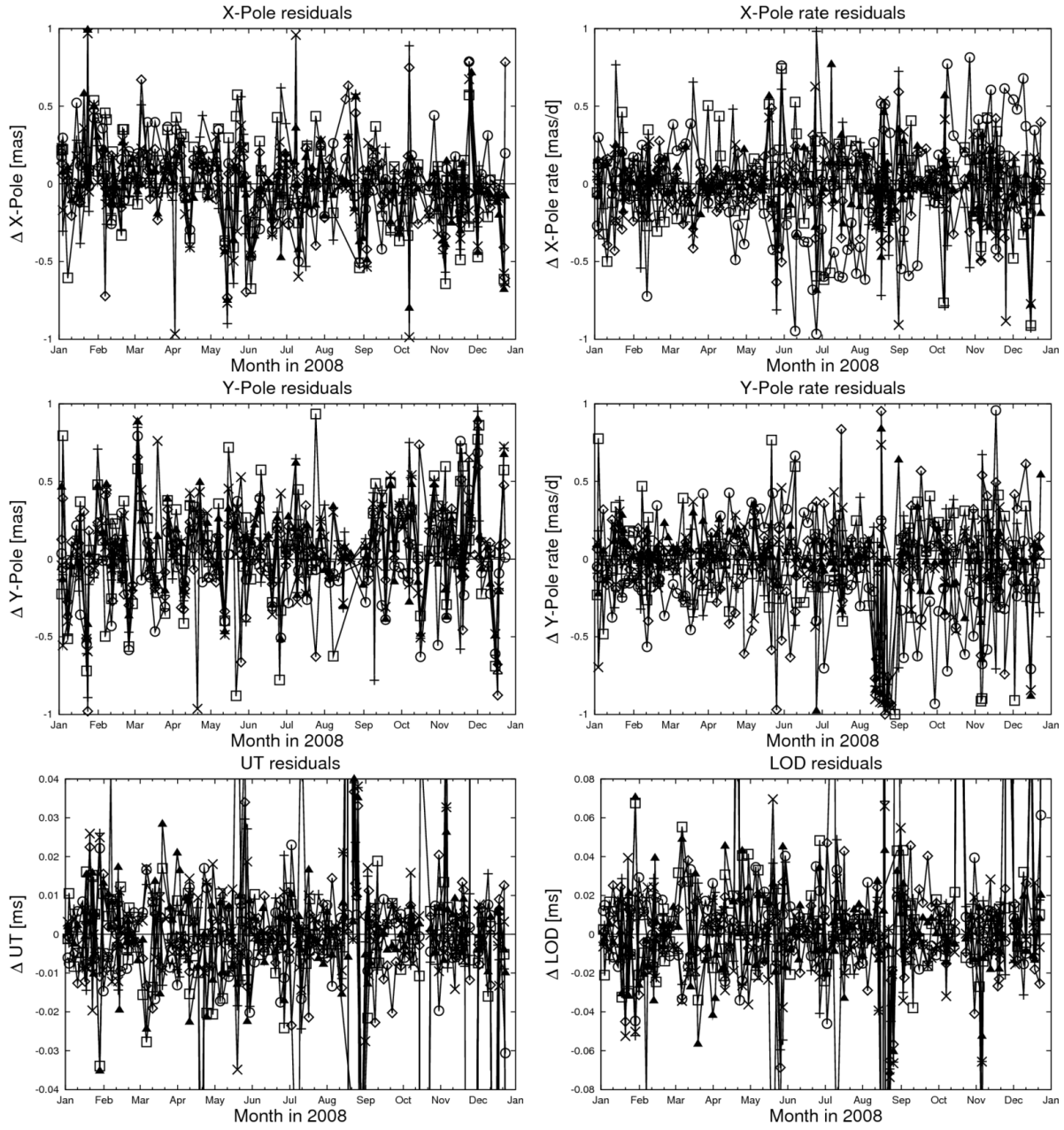

Figure 1. Internal comparison between individual solutions and the KASI combination solution (Individual solutions - Combined solution). + : BKG, ◊ : DGFI, × : GSFC, □ : IAA, ▲ : OPA, ○ : USNO.

References

[1] Dach, R., Hugentobler, U., Fridez, P., and Meindl, M. (eds.), Bernese GPS Software Version 5.0 User manual, Astronomical Institute, University of Bern, 2007.

[2] Kwak, Y., Cho, J., KASI Combination Center Report, in International VLBI Service for Geodesy and Astrometry 2011 Annual Report, edited by K. D. Baver and D. Behrend, NASA/TP-2012-217505, 2012.

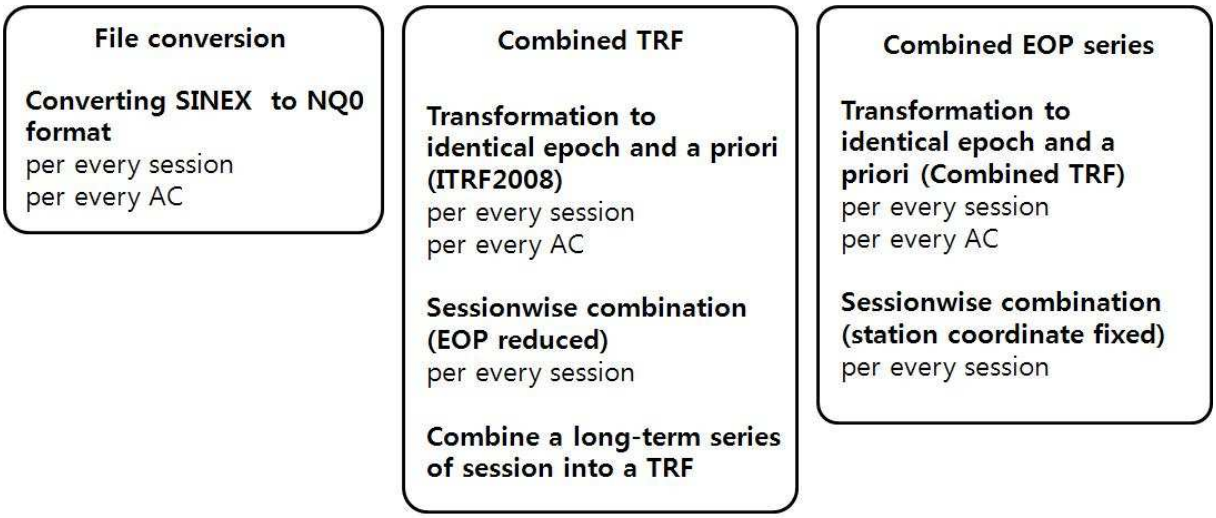

Figure 2. The scripts for KASI combination analysis.

[3] http://ccivs.bkg.bund.de
BKG/DGFI Combination Center Web page.

[4] http://hpiers.obspm.fr/eop-pc
IERS Earth Orientation Center Web page.

[5] http://igscb.jpl.nasa.gov/components/prods.html
IGS Products Table.