Key Stone Project VLBI Stations (Kashima, Koganei, and Tateyama)

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Abstract

The Key Stone Project VLBI Network used to consist of four VLBI stations at Kashima, Koganei, Miura, and Tateyama, but the 11-m antenna and other VLBI facilities at Miura station were transported to Tomakomai Experimental Forest of the Hokkaido University in the begining of 2001. As a consequence, only the other three stations were used for regular VLBI sessions in the year 2001. The regular VLBI observations with the three stations continued until November 30, 2001, when the regular operations of the Key Stone Project VLBI Network were formally completed. The facilities at Tateyama site were transported to Gifu University and are currently waiting to be assembled in the campus of the University. The facilities at Kashima and at Koganei will be maintained and these systems along with the new sites at Tomakomai and Gifu will be used for the purposes of technical development and various observations in the future.

1. Introduction

The Key Stone Project (KSP) is a challenging research and development project of the Communications Research Laboratory to establish four space geodetic collocation sites around Tokyo. The locations of the four sites were chosen to surround Tokyo Metropolitan Area to regularly monitor the precise positions of these sites and their changes using VLBI, SLR, and GPS techniques (Figure 1). Therefore, the primary objective of the KSP VLBI system was to determine precise site positions of the VLBI stations as frequently and fast as possible. To realize this objective, various new technical advancements were attempted and achieved. By automating all of the process from the observations to the data analyses and by developing the real-time VLBI system using the high speed digital communication links, unattended continuous VLBI operations were made possible. Daily continuous VLBI observations without human operations were actually demonstrated and the results of data analyses were made available to the public users immediately after each VLBI session. Improvements in the measurement accuracies were also accomplished by utilizing fast slewing antennas and by developing higher data rate VLBI systems operating at 256 Mbps.

The construction of the KSP VLBI Network started in 1994 and the frequent regular VLBI sessions began in January 1995 with a single baseline between Kashima and Koganei VLBI stations. Since then, the other two stations at Miura and Tateyama were constructed and the six-baseline correlator system was developed. Miura and Tateyama stations began regular observations in December 1995 and in September 1996, respectively. The duration of each session was extended from about 5.5 hours to about 23.5 hours in July 1997 and the observation method was changed from tape-base VLBI to real-time VLBI at the same time. From that time until November 2001, the regular sessions were basically performed once every two days with a few exceptions when daily and almost continuous sessions were performed such as from Feb 28, 1999 until April 1, 1999 and from July 23, 2000 until November 11, 2000.

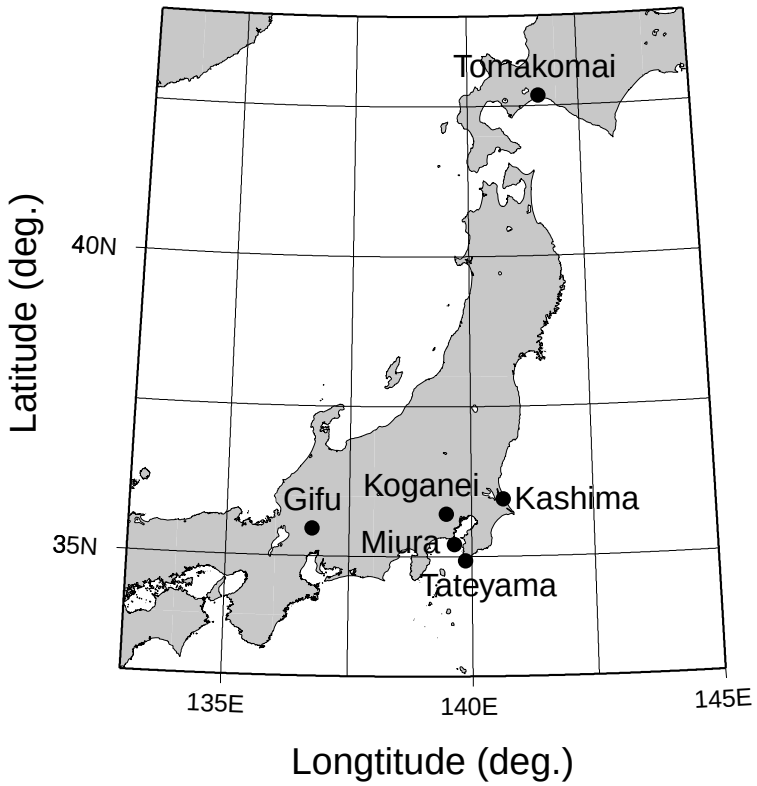

Figure 1. Geographic locations of four Key Stone Project network sites and two new sites at Tomakomai and Gifu. 11-m antenna and other VLBI facilities at Miura and Tateyama have been transported to Tomakomai and Gifu, respectively. The Tomakomai station is already operational and the Gifu station will become operational in early 2002.

2. Activities in 2001

The KSP had a predetermined term of five years at the time of its beginning and various challenging technical developments were necessary to realize its primary objective within the limited term. Since satisfactory accomplishments had been achieved, the project was planned to be completed by the end of September 2000. However, unusual site motions were detected for Tateyama and Miura stations from the end of June 2000 and it appeared that the data obtained with the KSP VLBI sessions were very useful to investigate the phenomena. Therefore, a lot of effort was made to continue the regular VLBI session with the KSP VLBI Network. Consequently, the operation of the Miura station was extended for about three months until the begining of January 2001, and the operation of the Tateyama station was extended about one year until the end of November 2001. The site motions are currently considered as the consequences of the crustal deformation around Izu Islands associated with the volcanic and seismic activities at Miyakejima Island and Kozushima Island [1]. The data obtained with the KSP VLBI Network became the first experience for geodetic VLBI to continuously monitor in-situ dynamic crustal motion. It can be said that this event clearly demonstrated the capability and advantages of the automated VLBI system realized by the KSP VLBI Network.

The last VLBI session with the Miura station was carried out on January 4, 2001. The 11-m antenna and the observation facilities of the Miura station were transported to the Tomakomai Experimental Forest of the Hokkaido University after that. The antenna was reconstructed at the new site (Figure 2) and the first successful VLBI observations were performed in November 2001. The 11-m antenna and the observation facilities of the Tateyama station were transported to the campus of Gifu University after the final regular KSP VLBI session on November 30, 2001. The antenna components are now waiting to be reconstructed and the new station is expected to become operational by April 2002.

Figure 2. 11-m VLBI antenna at Tomakomai Experimental Forest of the Hokkaido University. The antenna and the VLBI observation facilities were transported from Miura KSP VLBI station in early 2001.

In addition to the regular VLBI sessions under the KSP, the KSP VLBI stations were used as a testbed for technology developments. In December 2001, observations with a VSI sampler unit and two 1 Gbps data recorders at Kashima and Koganei were successfully performed at the data rate of 2 Gbps. The data were correlated with a VSI Gigabit Correlator and fringes were detected (Figure 3). The success was achieved with the newly developed VSI Gigabit VLBI system and the system is expected to dramatically enhance the sensitivity of VLBI observations. The high speed digital network links between KSP stations were also used to connect the 34-m station and Kashima and the 64-m station at the Usuda Deep Space Center of the Institute of Space and Astronomical Sciences. Realtime VLBI observations at 1 Gbps data rate were achieved in October 2001 by using the Gigabit Correlator at Kashima.

One GPS station at Kashima (KSMV) and two GPS stations at Koganei (KGNI and KGN0) were added to the IGS network on October 8, 2001. These stations are all equiped with an Ashtec Z12 receiver and a choke ring antenna. The two stations KSMV and KGNI are the KSP GPS sites and are located very close to the VLBI antennas at Kashima and at Koganei.

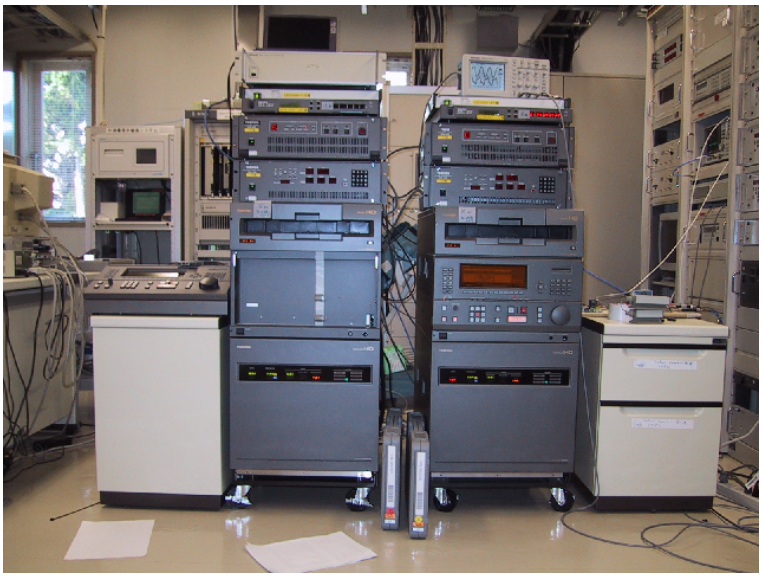

Figure 3. A VSI Gigabit sampler unit and two VSI Gigabit data recorders used to record the observed data at the data rate of 2 Gbps. The picture was taken at the KSP Kashima VLBI station on December 12, 2001. Fringes were successfully detected from the observations with the Kashima-Koganei baseline.

3. Future Plans

The regular VLBI sessions with the KSP VLBI Network finished with the last session performed on November 30, 2001. The 11-m antenna and related facilities at Miura and at Tateyama were already transported to Tomakomai and Gifu sites, respectively. On the other hand, the facilities at Kashima and at Koganei will be maintained and these systems along with the new sites at Tomakomai and Gifu will be used for the purposes of technical developments and various observations in the future.

References

[1] Yasuhiro Koyama, Ryuichi Ichikawa, Mamoru Sekido, Tetsuro Kondo, Hitoshi Kiuchi, Jun Amagai, and Taizoh Yoshino: Site position displacements due to the seismic and volcanic activities in the area of Izu islands detected by the KSP VLBI Network, CRL IVS Technology Development Center News, No. 17, pp.8-10, November 2000.