ERROR EVALUATION OF 5 YEAR SPACE DEBRIS OBSERVATIONS AT THE BISEI SPACEGUARD CENTER

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ABSTRACT

The Bisei spaceguard Center started its space debris observations from February, 2000. At the beginning, we used two telescopes with apertures of 25cm and 50cn to find those detectability of different artificial and natural objects. The 50cm telescope showed its ability to detect even LEO objects additionally to GEO objects. From January, 2002, the 1m telescope started its operation. Although each telescope had to stop its operation time to time, because of initial problems of the telescope itself and large format CCD camera.

Here, we will show some numbers of error evaluation during the last 2 years.

The Japan Spaceguard Association has the main target to detect near-earth asteroids in order to detect them and to present a timely precaution of possible asteroid collision to the earth. To make this work efficient, the whole sky should be surveyed as quickly as possible, and therefore telescopes with wider field were built at the Bisei Spaceguard Center. Detail descriptions are given in different papers (Isobe et al, 2000)

Three telescopes with apertures of 25cm, 50cm, and 1m have circular fields with diameters of 1.5, 2, and 3 degrees. These field sizes are also good for a survey work of space debris. At the BSGC, such works were started in 2000 under a collaboration between the JSGA and JAXA. Since our experiences of satellite and space debris observations in an optical wavelength range, we started to observe objects with well-determined orbital elements. During these test observing run, we detected some interesting objects (Isobe et al、2001). Since our telescope fields are large, we could track some objects detected under a survey mode, where we fixed telescope position during 10 minutes. This long tracking observations can produce the first order orbital elements of the detected objects, which make those identification carried our several nights later possible (Figure 1, Bisei Team, 2004).

Figures 2 and 3 are magnitude of each objects observed by 50cm and 1m telescopes, respectively. We can not see much limiting magnitude difference of both telescopes. This result is probably caused by a difference of stellar image sizes.

Usually, we make 5 exposures at one telescope position with an exposure time of 6 seconds under an interval around 2 minutes, during which most of the geosynchronous orbit objects move about several ten seconds of arc and can be used single orbital elements. Using them, we evaluate standard deviations of right ascension, O-C (dAcosD) where A and D are right ascension and declination, respectively, for each set of 5 exposures (Figure 4). Figure 5 shows same as those for declination, O-C (dD).

The standard deviations of both right ascension and declination were as large as 6 seconds of arc during time to the beginning of June, 2004. Since the telescopes were built to observe near-earth asteroid, it is not necessary to have a high accuracy of time and each observed time had been obtained in an accuracy of 1 second of time, which caused high value of the standard deviations. We changed our clock system with an accuracy down to 0.1 second of time on June 4, 2004, and then those standard deviation went down to an order of 1 second of arc. Considering our current stellar image size, these values are under a proper level, since those for asteroids are around 0.3 second of arc. If we could improve those stellar image sizes and also have clock accuracy of 0.1 second of time, much improvement of the standard deviation can be expected.

After finding these results, we started to make a systematic survey work to detect unknown space debris, additionally to regular observations of some specific satellites.

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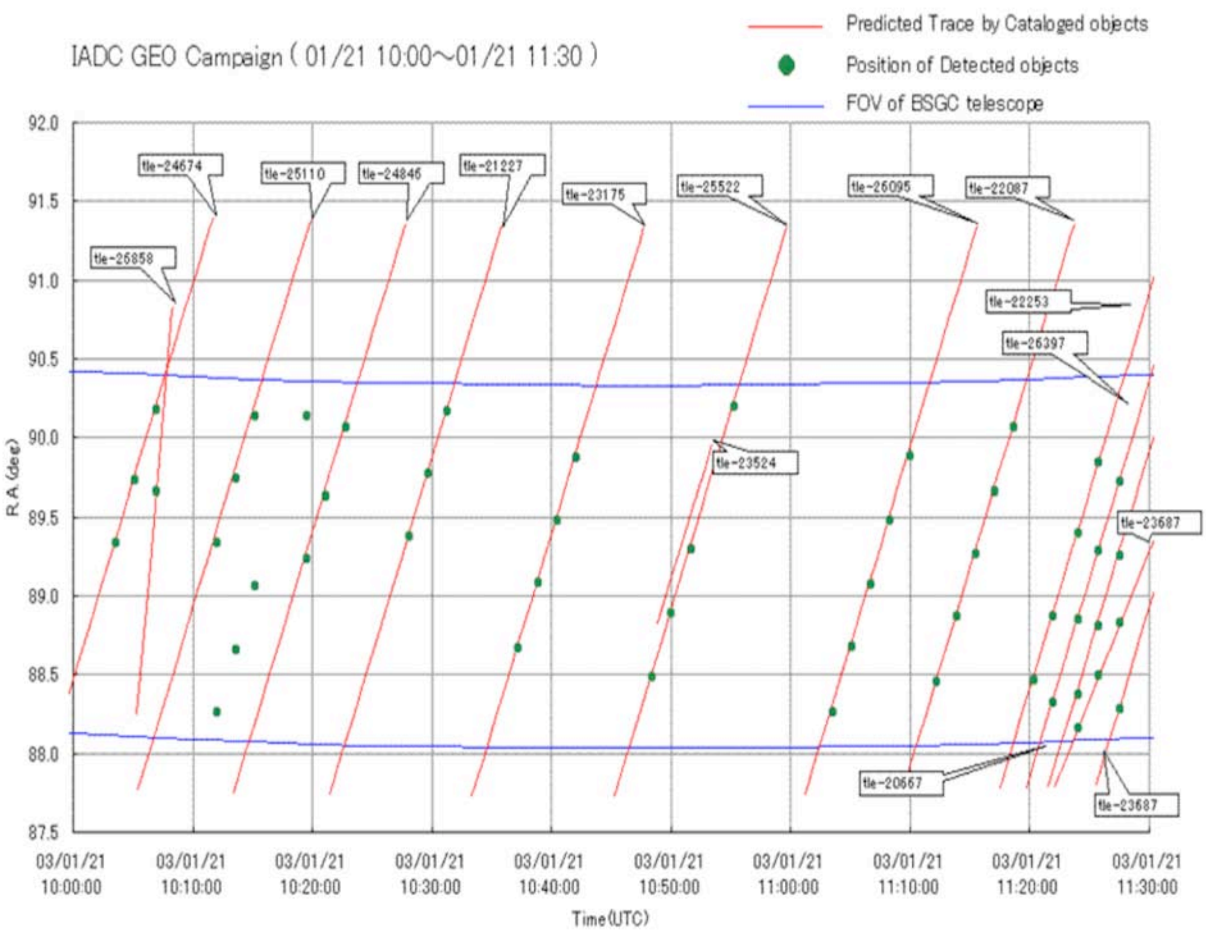

Figure 1. Observational results obtained at the BSGC during IADC campaign of "3rd Measurement Campaign in GEO".

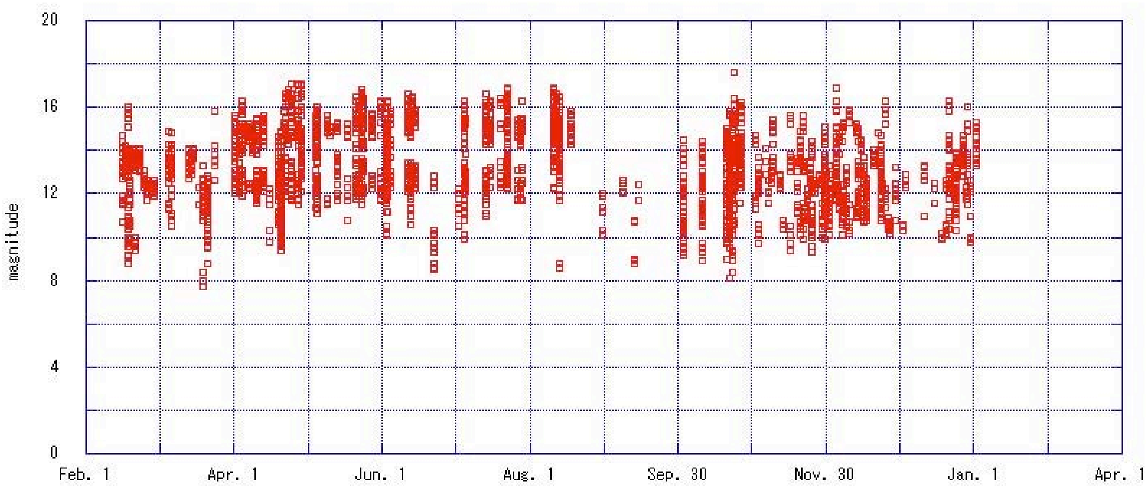

Figure 2. Magnitudes of satellites and space debris observed by 1m telescopes At the BSGC from February 1, 2004, to January 31, 2005.

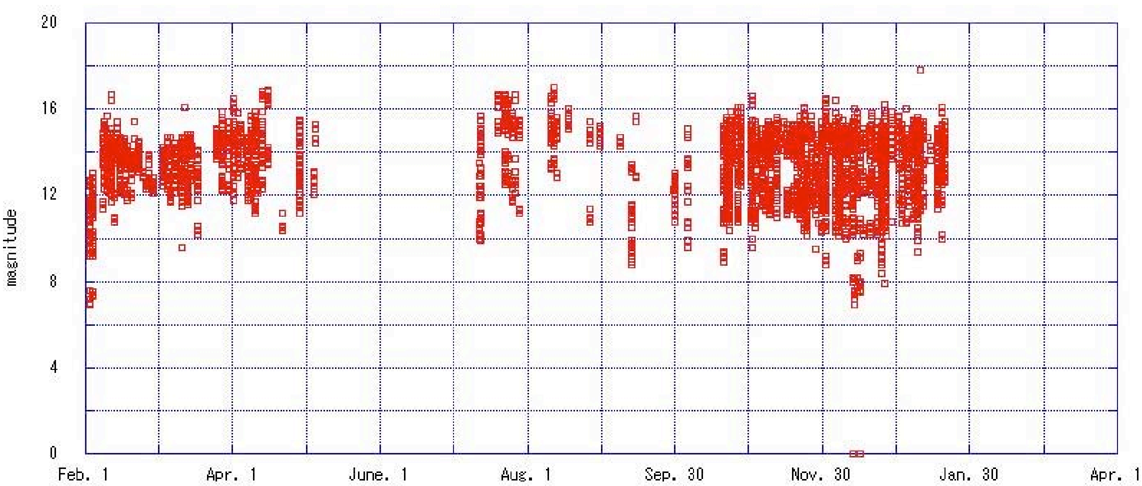

Figure 3. Same as figure 2, but only for a case for 0.5m telescope.

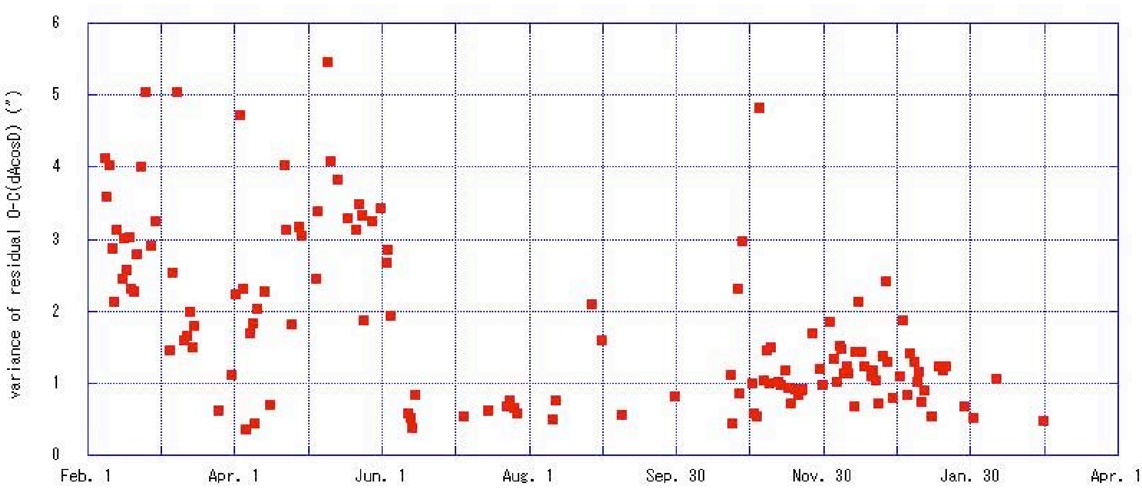

Figure 4. Standard deviation, O=C(dAcosD), for a case of GMS-5 observations, (February, 2004-January, 2005)

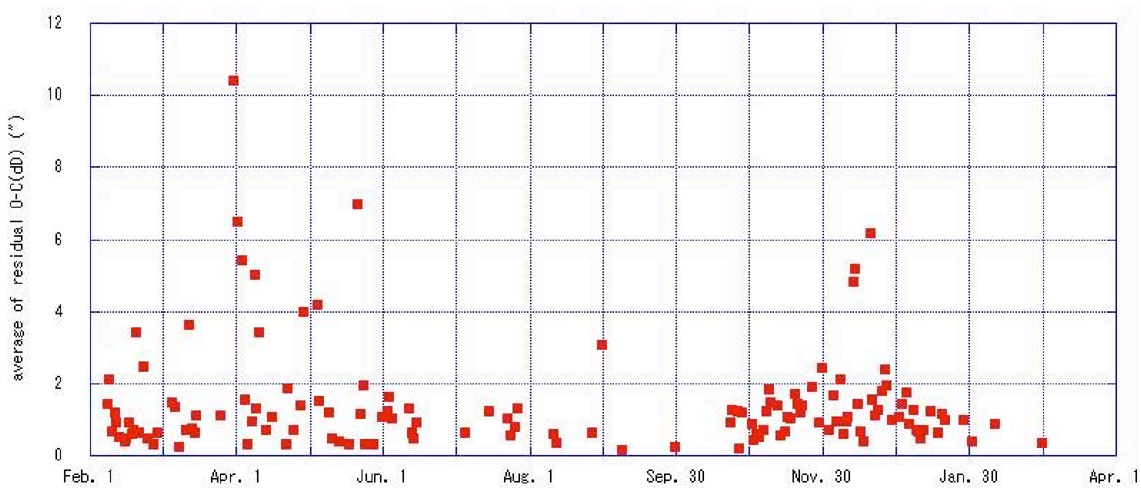

Figure 5. Same as for figure 4, but for a case of O-C(dD).