D124-013 **Room: 302** **Time: May 17 13:45-14:00**

Hypothesis of the Earth Tide, Explaining the GPS Annual Crustal Deformation

Yoshinori Sugimoto[1]; Kaoru Miyashita[2]; Jun Kawahara[2]

[1] Grad. School of Science and Engineering, Ibaraki Univ.; [2] Faculty of Science, Ibaraki Univ.

1. Introduction

It has been widely recognized that the GPS time-series data obtained from GSI/GEONET (Geographical Survey Institute/GPS Earth Observation NETwork) includes an annual variation of the crustal deformation. It has been controversial whether the variation indicates a real crustal deformation or not. In the present study, we reexamine the GPS time-series data, using the wavelet transform analysis. Then, we propose the mechanism associated with the earth tide, which could explain such an annual variation of the crustal deformation.

2. Annual crustal deformation by wavelet analysis

The north-south (NS), east-west (EW) and up-down (UD) components of the GPS time-series data were assumed to be mutually independent. We decomposed each of these components up to the 8th level by using the Daubechies wavelet family. Concretely, we decomposed the original time-series data to the approximation part, A1, and the detail part, D1. Following this procedure, we decomposed A1 to A2 and D2. We could continue such procedures as above up to some desired level. We could recognize a seasonal variation clearly in the D8 part of the GPS time-series data from April, 1996 to May, 2002. We estimated both amplitudes and phases of the annual crustal movements at 208 GPS sites in central Japan.

The average amplitude of the horizontal components of the annual crustal movements was estimated to be 3.0 mm, and their maximum 11.7 mm. The average of the UD components was estimated to be 17.7 mm, and their maximum 78.4 mm. The phases of the horizontal components varied depending on the locations of GPS observation sites. Especially, the directions of the horizontal displacement vectors in the Pacific coastal area were shown to be opposite to those in the Japan Sea coastal area. This means that the vectors in the coastal areas are turned toward the seaside direction in summer and toward the inland direction in winter. On the other hand, the phases of the UD components were indicated to be nearly the same for all of the GPS sites. This means that the UD components take the minimum values in the wintertime (March) and the maximum ones in the summertime (September).

3. Earth Tide

We estimated the annual tidal variations at 60 tidal observatories in Japan. As a result, we could recognize that they take the minimum values around March and the maximum ones around September, and that their phases were nearly the same at all of the stations. However, the amplitudes of the variations varied depending on the site locations, and amounted to 300 mm or more at the observatories at the seaside of Japan Sea in southwestern Japan. The phases of the annual tidal variations nearly coincided with those of the GPS annual crustal vertical movement, although their amplitude ratio of GPS/Tide was very small to be 0.069.

By using the computer program of Global Oceanic Tidal Correction 2 (GOTIC2) (Matsumoto et al., 2001), we estimated the amounts of the crustal deformations associated with the solid earth tide and the sea loading tide, respectively. The annual crustal vertical deformation due to the solid earth tide was found to be similar to the GPS annual crustal vertical movement, although their phases differed by 0.5*pi (Fig.1). On the Pacific Ocean side, the annual crustal horizontal deformation due to the sea loading tide was found to be nearly the same as the GPS horizontal movement (Fig.2).

4. Conclusion

We proposed the mechanism model associated with the solid earth tide and the sea loading tide in order to explain the GPS annual crustal deformation, which was verified by the wavelet analysis of the GPS time-series data. We interpreted that its vertical component should be caused by the process of the solid earth tide, and its horizontal component by the process of the sea loading tide. However, it is necessary to improve the method of calculation of the crustal deformation due to the earth tide in order to discuss the present model in more detail.

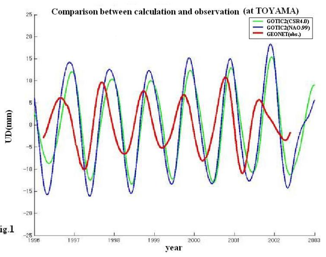

Fig.1

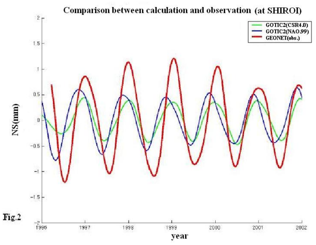

Fig.2