Dynamic map for engineering use of GNSS positioning

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1. Introduction

We have obtained the RINEX data of the electronic reference points of the Geospatial Information Authority of Japan every day from 2008, and automatically process it using GAMIT/GLOBK software and accumulate the coordinate data of day value and week value (Shimada et al., 2014; 2015). We used ITRF 2005 from April 2008 to October 2011, ITRF 2008 from October 2011 to May 2017, and ITRF 2014 from May 2017 onwards so that the reference coordinate system of that analysis conforms to the latest coordinate system as much as possible. In the processing, observation data of 30 IGS points around Japan is used as reference points for constraining to the ITRF coordinate system, and it is solved together with electronic reference point data in Japan. In addition, we processed using Bernese Ver. 5.2 under the same conditions, and checked whether or not there is no difference in the results depending on processing software.

2. Application to dynamic map (4 dimensional map) management for engineering use

By using the above data, as the Japanese Information System of Land Deformation (JISLaD), changes in the position of the electronic reference point and the baseline length have already been disclosed. We also plan to announce the results of monitoring the fluctuation of area distortion etc.
Furthermore, we plan to calculate the fluctuation speed of an arbitrary point from the fluctuation at the GEONET point. Specifically, we are considering application to dynamic map management which is a 4-dimensional map.

As one of the items of the Cross-ministerial Strategic Innovation Promotion Program (SIP), an automatic driving system is mentioned in both the first and second phases. Automatic traveling system is a system to combine various technologies, but high-precision digital map is an important item among them. For self-location estimation for automatic driving, it is important to recognize self-position using satellite positioning information etc. However, if there is no map corresponding to it, it is meaningless only by self-position recognition.

Needless to say, the crustal deformation in Japan is intense. Therefore, once you have made a precise digital map you cannot use the map forever.

The idea of crustal deformation in Japan's map is based on semi-dynamic system. In other words, the idea is to decide the initial stage and to take the correspondence with the map by returning the latest position coordinates measured at the present time to the value of the coordinates of the original period, based on the observation of the crustal deformation.

Although this system is suitable for use such as the registration of land, it is not suitable for the automatic traveling system which corresponds the position and the map of the car every moment in the Japanese

islands where the crustal deformation is intense. Therefore, we consider the dynamic map which makes the coordinates of the map itself new every day considering the change accompanying the crustal deformation, considering application of JISLaD data to dynamic map management. In the Tohoku region, the postseismic movements exceed 10 cm per year continues still after the 2011 Tohoku Earthquake. We believe that an accuracy of about 10 cm is necessary as a basic map used for automatic driving, which means that even if crustal deformation due to a new earthquake does not occur, update the map at least once a year is necessary in the Tohoku region.

This way of thinking is not limited to cars with both roads and autonomous driving, it is important for all engineering applications where acquisition of precise coordinates is considered to be effective, especially for aircraft using electronic navigation and airport. It is a very important thing for checking the positional relationship etc.

Keywords: dynamic map, 4 dimensional coordinate management, precise GNSS positioning

