

The experiment of the detection of an artificial slow event by the application of kinematic GPS

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1. INTRODUCTION

An anomalous vertical deformation preceding the 1944 Tonankai Earthquake was detected by leveling survey performed near Kakegawa, Japan, about 300 km away from its epicenter [Mogi (1982)]. It is hard to detect such an anomalous deformation with conventional surveys, because they cover a narrow area and cannot be frequently made. GPS has overcome these drawbacks of conventional surveys. It is important to develop a method to detect such a deformation with GPS. Now, in the Japanese Islands, the GPS observing stations are built at an interval of about 20 km over the whole region. At present, daily solutions are obtained by static analysis of GEONET data. Therefore we cannot observe deformation with a time constant shorter than 1 day like that in 1944. We must adopt a kinematic GPS positioning.

2. A SEARCH FOR THE ERROR FACTOR OF THE KINEMATIC GPS

We pursued the error factor in the kinematic GPS positioning to obtain the same precision as that for the static GPS positioning. The factors which we evaluated are as follows.

The first is the influence of the number of tracked satellite which depends on the elevation mask. The second is the influence of the receiver clock without the external frequency standard. The third is the influence of the accuracy of the satellite orbits.

As for the first, dispersion in the up-down component could be suppressed by tracking more satellites. As for the second, because we could enhance precision of receiver clock by using external frequency standard, we could determine an accurate position coordinates without a systematic bias error. As for the third, a big difference wasn't seen between the analyses using the precise ephemeris and the rapid orbit. But, there was a problem in the analysis using the broadcast ephemeris to determine some coordinates precisely.

3. THE EXPERIMENT TO DETECT A VIRTUAL SLOW EVENT GENERATED BY A SLIDER

First, we made a slider which virtually create slow events. We adopted the mechanism of the drum-type seismograph, and improved a gear ratio and so on. A GPS antenna can be held on the screw that moves at three constant speeds, such as 0.4 mm/min., 0.2 mm/min., and 0.1 mm/min. We installed voltage-type displacement gauge on this slider, and measured the position of the GPS antenna. Then, we compared the position of the GPS antenna by the kinematic GPS analysis and the displacement measured by the gauge. We verified whether we could exactly detect the slow slip which was the phenomenon with long time constant by the kinematic GPS.

We presumed an actual GEONET observation network, and did an analysis in the experiment by using the short base line of 10-20 km. We verified the effect of the control of the receiver clock by the external frequency standard at the reference point at the same time. This experiment is scheduled several times in a year. We will see an influence due to the seasonal variation, an influence by the difference in terms of weather, and so on through the year. We will model it so that it can apply it to the actual phenomenon. We report it about the preparation process of this slider and the first result of an experiment at this presentation.