Recalculation of Altitudes of GPS-based Control Stations

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Geographical Survey Institute (GSI) remodeled GPS-based control stations in 2002 and modified the analysis system in order to improve GPS Observation Network (GEONET) system in 2003. Remodeling GPS stations was following; replacing previous antennas with choke ring antennas (TRM29659.00), unifying height of antenna supports depending on pillar types, and installation of radomes to Type 93 pillars. Analysis strategies of GEONET were also modified. The biggest modification was improved network configuration. We abolished previous network configuration that were divided into three sub-networks depending on types of receivers and antennas, and adopted a large hierarchized network covering whole Japan. We also adapted new phase maps specific for antenna-monument types. These maps were newly created with the remodeling of GPS stations. ITRF 2000 was adapted as reference frame, instead of ITRF 97.

Resultant coordinates of GEONET analysis showed significant changes with these remodeling and modifications. Coordinates calculated after the remodeling and modifications might represent more accurate values than previous ones, because several biases might be eliminated by these changes. Therefore, we recalculated altitudes of GPS stations based on the coordinates resulted from the new analysis.

We used resultant coordinates of F2 analysis, the most accurate and precise analysis among new analysis strategies in GEONET system, in order to calculate altitudes with higher accuracy and precision.

The coordinates calculated after the remodeling and modifications have to be used in order to avoid influences of gaps of coordinates time series. We also have to used coordinates before Tokachi earthquake occurred in September 27, 2003 in order to avoid the influence. Coordinates of reference points have been calculated based on epoch 1997.0, so the altitude also have to go back to epoch 1997.0.

Here is the procedure to recalculate the altitudes.
1. Calculation of coordinates in September 1, 2003
2. Calculation of velocities of the stations with coordinates from 1998 to 1999
3. Calculation of coordinates in epoch 1997.0
4. Transformation of coordinate system from ITRF 2000 to ITRF 1997
5. Collocation with VLBI
6. Calculation of coordinates of exceptional stations

The altitudes were combined with latitudes and longitudes that had been already presented to the public, and we adopted the combined coordinates as a result of the recalculation.

We calculated error of closure using observation data from reference point surveying in order to evaluate accuracy of the coordinates.