Separation of slant tropospheric delay from phase residuals in precise point positioning analyses for GEONET

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We study methods to retrieve slant tropospheric delay using phase residuals in precise positioning analyses with phase center variation (PCV) model for antenna which does not account elevation dependencies of the PCV. We estimate elevation dependencies of the phase residuals by fitting polynomials for those during one month in February, 1999, in the individual site. The pattern of curves depends on the antenna monument types. The magnitude of the biases exceed 30 mm. We show that elevation-dependent biases free residuals show real atmosoheric condition by comparing the residuals and the ZTD gradient computed by ZTD distributions in each site in the cases of the weather front passages in summer.

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The number of site used in the analysis is 952 and the analysis period is from January 1 to December 31, 1999. The LC (Ionosphere-free) wave, JPL default antenna phase center variation (PCV) model, Niell's mapping function (1996), JPL precise satellite orbit and clock information, and coefficients for coordinate change by oceanic tidal loading by Sengoku and Sato are used. The zenith tropospheric delay (ZTD) is estimated every five minutes and thus LC phase residuals are also obtained every five minutes.

We estimate elevation dependencies of the phase residuals by fitting polynomials for the residuals during one month in February, 1999, in the individual site. The pattern of curves depends on the antenna monument types and the magnitude of the biases exceed 30 mm. They are similar to L3 phase plot in GEONET sites shown by Hatanaka et al. (2001). The facts suggest that they show the PCV elevation dependence pattern of GEONET that cannot be explained in the JPL PCV model. The facts also imply that the atmospheric gradient parameter contains some biases according to uniformity distribution of the GPS satellite for north-south axis.

On the other hand, some sites show biases of about 5 mm which depended on the elevation angle though they use same antenna-monument types. The fact suggests that the modeling elevation-dependent phase residual for individual site is effective to remove site-dependent PCV errors.

We show that the elevation-dependent biases free residuals show real atmosoheric condition by comparing the phase residual and ZTD gradient computed from ZTD distributions in each site in the cases of the weather front passages in summer. The azimuth-dependent biases in PCV and/or multipath error will be also estimated.