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Effects of quasi zenith satellite on the reduction of positioning error

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Signals from GPS satellites are delayed by atmosphere between GPS satellites and GPS receivers, and then cause positioning error. Then, delays are estimated by assuming linear distributions of atmospheric delays over GPS receivers, and removed from signals, to reduce positioning error. However, GPS satellites do not stay over the receivers and their paths shift in nonuniform atmosphere. Thus, there is the limit of the reduction of positioning error. On the other hand, Quasi-zenith satellite (QZS) stays over receivers, with providing the continuous data over the GPS receiver, and then it is expected to have the potential of the reduction of positioning error.

In the actual estimation of positioning error, discussion on influence of atmosphere is difficult because other factors also cause errors. Thus, delays produced from outputs of numerical models were used in estimation of positioning error so that positioning error only due to atmosphere can be discussed. In this presentation, the complicated distribution of atmosphere in mountain lee wave case event was reproduced by Non hydrostatic model (NHM) of Japan Meteorological Agency with the horizontal grid interval of 250 m, and positioning error was estimated from delays produced from outputs of NHM.

We estimated positioning error at GPS sites of 4111, 5105 and KWN. The paths from the GPS receivers were determined by a ray-tracing method, and the delays were obtained from the water vapor, temperature etc. of NHM outputs. Positioning error was estimated by the non-gradient model, linear gradient model and quadratic function model with GPS data or GPS and QZS data. When quadratic function model was used, the positioning error became small and effect of QZS data was limited. However, when the non-gradient model or gradient model was used, positioning error was large but reduced by QZS. These results show that the delay provided from QZS has the potential to reduce positioning error.

Keywords: Positioning error, Quasi zenith satellite, GPS