Impact of Atmospheric Delay Reduction using KARAT on GPS/PPP Analysis

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We have been developing a state-of-art tool to obtain the delays by ray-tracing through the meso-scale analysis (MANAL data) data for numerical weather prediction developed by Japan Meteorological Agency (JMA). The tool, which we have named **'KAshima RAytracing Tools (KARAT)'**, is capable of calculating total slant delays and ray-bending angles considering real atmospheric phenomena. According to Hobiger et al. [2008a], the KARAT solutions are better than the solutions using the Global Mapping Function (GMF) with gradient during a period of 4 months. We also compared PPP processed position solution using KARAT with that using the GMF for the data sets of GEONET (GPS Earth Observation Network System) operated by Geographical Survey Institute (GSI). In our comparison about 1360 stations of GEONET data during July 1st - August 31st of 2007 were processed. The averaged repeatabilitiy differences of height component indicate the KARAT solution is worse than the GMF with gradient solution. The largest repeatabilities more than 10 mm, which occur in Kyushu and Shikoku islands which are located in the west of Japan. During the whole processed period southwest Japan has undergone severe heavy rain fall event due to the Baiu front and the typhoon 'MAN-YI' passing and cumulative precipitation amounts ranging 500 - 1100 mm. Under the extreme atmospheric condition such as the concerned period, our results imply that the performance of KARAT is almost equal to the solution using the GMF with gradient.

The KARAT can estimate atmospheric slant delays by three different calculation scheme. These are (1) a piece-wise linear propagation, (2) an analytical 2-D ray-propagation model by Thayer [1967], and (3) a 3-D Eikonal equation [Hobiger et al., 2008b]. Though the third scheme gives the most accurate solution, it has a significant disadvantage due to a computational load. So far, we have not yet applied the Eikonal equation method for reducing the atmospheric delays from GPS data sets. According to our preliminary computation, slant delay differences between the Eikonal calculation and Thayer model are up to 5 millimeters at the elevation of 5 degrees. In addition, the Eikonal calculation can predict small scale perturbations which are not retrieved using both Thayer and linear models. These result suggest that the higer order variations of slant delays can be reduced from the GPS data using JMA/MANAL data. We are now performing KARAT calculation using Eikonal model for longer duration of GPS data sets and we will present these results.