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GPS positioning accuracy using the current generation of IGU near real-time observed and predicted orbits from the IGS

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We investigate the performance of the latest generation of IGU near real-time observed and predicted orbits provided by the International GNSS Service (IGS) by comparing positioning results using them with those from the rapid and final counterparts. The ultra-rapid near real-time observed orbits (first half of each two-day SP3 file) have an initial latency of about three hours and are updated four times a day while the predicted half orbits (second day of each SP3 file) are available for true real-time applications. The early IGS ultra-rapid orbits of both types, which began in late 2000, had an estimated accuracy of 5 to 10 cm. The accuracy of the ultra-rapid orbits have improved significantly and now have mean weighted RMS residuals compared to the IGS rapid orbits of about 2.5 cm (after fitting and removing a daily Helmert transformation) with mean median residuals of less than 2 cm. Rotational offsets of the GPS constellation due to EOP prediction errors, especially for UT1, are usually larger than random orbit errors, reaching up to about 3.5 mm RMS around the Z axis (equatorial at GPS altitude). The rapid and final orbits, which we use for reference here, are more accurate but have latencies of approximately 17 hours and 13 days, respectively.

To evaluate the positioning performance of the IGS near real-time and real-time orbits, GPS reference station data collected for a sample of days during the second half of 2008 from about 72 CORS sites throughout the United States have been processed using each of those orbit types as well as the IGS rapid and final products. A time series of daily position estimates for each GPS station has been determined for each of the four orbit types and the respective repeatabilities computed.

The initial results from this study are promising and show that the accuracy in computing reference station coordinates using the ultra-rapid orbits has improved significantly. There are however, slightly larger variations from the mean standard deviations of the three coordinate components for a few reference stations. One possibility for this is that some of the reference station data may be very noisy or contain gaps. However, overall accuracy improvements and reduced latency of the near real-time orbits will be an immediate benefit to many and will open up additional possibilities for a wide variety of applications.