Significance of Precise and Broadcast ephemerides for coordinate estimation

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IGS (International GNSS services) publishes precise orbits for GPS satellites better than 2.5cms and clock better than 75ps in 12-18days timeframe (1). In this paper a study is carried out by collecting GNSS data across different IGS stations widely spread on Indian land mass for multiple days, different targeted accuracy and the selection of the precise or broad cast ephemeris accordingly. The effect of Indianionosphere region and the usage of precise ephemeris and broadcast ephemeris are brought out.It is observed that only broadcast ephemeris may not be sufficient to estimate the coordinates for Indian regions due to large ionosphere distribution. Also it is observed that the usage of precise and broadcast ephemerides is dependent on the accuracy requirement of the user.

In total, six baselines are studied, ranging from 5kms to 1500kms. Precise ephemerides are expected to give a result better than broadcast or real-time ephemerides. The RMS horizontal error can be calculated as:

$$Horizontal\ error = \sqrt{((\sigma X)^2 + (\sigma Y)^2)} \quad (1)$$

Vertical error is approximately double than the horizontal error and this is entirely due to GDOP and nothing to do with the processing.

The first baseline set yielded following outputs in horizontal and vertical directions:

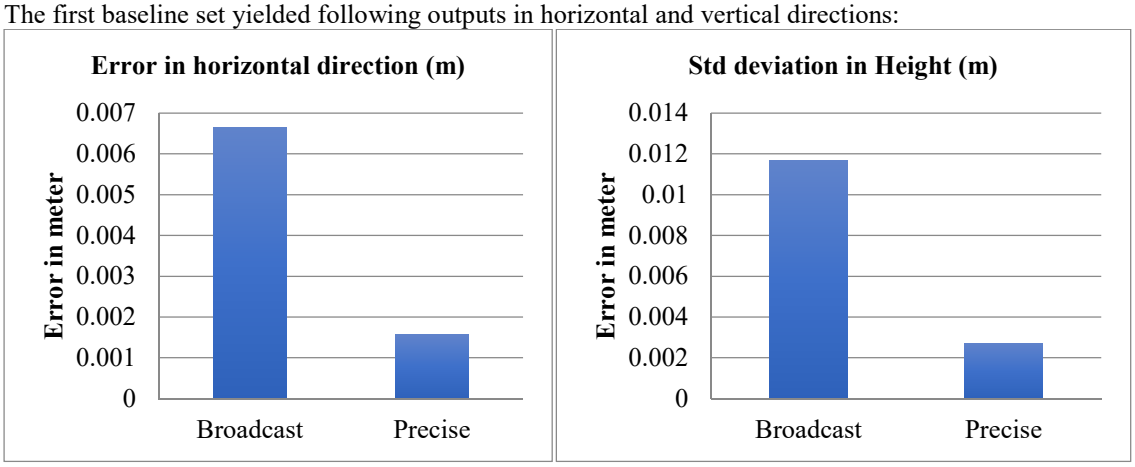

Figure-1 and 2: The data of rover site was post processed with respect to IISC IGS station using broadcast and precise ephemerides. The RMS error in horizontal direction and standard deviation in height is plotted on above graphs.

In horizontal direction, the RMS error was computed 0.0066m in case of usage of broadcast ephemerides whereas it was only 0.0015m, when precise ephemerides were used. The vertical error component was estimated 0.0117m and 0.0027m for broadcast and precise ephemerides respectively. The data, which was post processed, was multi frequency and multi constellation data of 24 hours. Before feeding data to post processing software, RINEX data quality check was performed. This study also included variable duration of data (from 6hrs samples to 24hrs) and results were compared. India, being in near-equator belt, the signal-in-space is more prone to ionospheric scintillation. It is observed that coordinate computation results achieved on a normal day (means with minimum ionosphere irregularities) is found to be different from the achieved accuracy on an equinox day.

References

[1] https://www.igs.org
[2] Pratap Mishra and Per Enge, “Global Positioning Systems” second edition