Latitudinal Dependence of Diurnal and Seasonal Variations in the Tropospheric Zenith Delay Observed from GPS Measurements

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Ground based GPS finds potential applications in many atmospheric studies such as the spatial distribution of columnar water vapor as well as tidal oscillations in the atmosphere. As the zenith tropospheric delay (ZTD) derived from GPS data is a function of atmospheric pressure, temperature and watervapor, the effect of atmospheric oscillations could reflect more prominently in its temporal variations. The GPS data with very high temporal resolution (5 min.) from thirteen IGS stations in the longitudinal sector of 50_0-130_0E are used to establish its potential for studying the atmospheric tidal, intra-seasonal and planetary oscillations. Very prominent tidal (diurnal and semi-diurnal) oscillations observed at all these stations, with amplitude of the diurnal variation as ~0.5-12+0.5 mm and that of the semi-diurnal variation in the range ~0.1-5+0.2 mm. Although 90% of the delay is contributed by the dry atmospheric pressure (which shows prominent semi-diurnal oscillations) the tidal oscillations in the ZTD is dominated by the diurnal component. This effect could be attributed to the temporal variations of atmospheric water vapor in a diurnal scale. The amplitude of these variations in general is largest near the equator and decreases with increase in latitude. Interestingly, this latitudinal trend matches very well with the latitude variation of the precipitable water vapor (as well as the actual precipitation) in this longitudinal region. Though the values of ZTD at stations very close to equator stations do not show any prominent seasonal variation, as the latitude increases the annual variation in ZTD becomes more distinct. A prominent peak in ZTD is observed during the July-August period, which matches well with the annual variation of atmospheric water vapor. This shows that the diurnal and seasonal variation of ZTD is mainly governed by the corresponding variations in atmospheric water vapor, even though its contribution to the total delay is around 10%.

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