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The Role of Multipath in Antenna Height Tests at Table Mountain

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Abstract

In order to determine what effect the antenna height has on baseline horizontal and height components, data were collected on short (~5 meters) baselines at the Table Mountain Antenna Range. These data were analyzed, and height biases of 1.0 to 1.7 cm were found between baselines with high and low antenna setups when tropospheric parameters were estimated. Horizontal components did not change. When both ends of the baseline were occupied with the same height setups, no bias was seen, although the repeatabilities for low-low antenna setups were worse than for high-high setups. This paper will show that the height bias in high-low antenna baselines is the result of multipath at the low antenna being mismodeled as troposphere. First we construct a simplified model of multipath phase and amplitude error as a function of antenna height. To verify this model we compare the predicted amplitude pattern for low and high antenna setups to the signal- to-noise ratio recorded by the GPS receivers. We then show that the multipath phase error generated by a low antenna setup correlates to a tropospheric signal for large intervals of elevation. In specific, the L1 phase error for an antenna height of 24 cm shows a strong correlation to a tropospheric delay in the elevation range of 17.5 to 29.0 degrees. This range of elevation is sensitive to both multipath and tropospheric errors. We also see that multipath from near ground reflections have a long period (> 1 hour) which makes them less likely to average out over time. We then briefly discuss the possibility of modeling and/or identifying the multipath in the low antenna setup. Based on our simple multipath model and experimental results, we conclude for environments such as Table Mountain that: (1) GPS antennas should not be placed near the ground because the multipath phase error is of low frequency and can be mismodeled as a tropospheric delay, (2) The multipath from the low antenna setup can not be easily modeled or corrected, and (3) GPS antennas mounted on tripods 1.5 meters above the ground suffer from high frequency multipath that can not be modeled as a tropospheric parameter and therefore does not effect the baseline determination.

[See attached .pdf file for more.]