

Characterizing Threats to GBAS Services from Ionospheric Gradients and Irregularities over the Brazilian Airspace

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This paper reports on a study of the analysis of the occurrence of sharp gradients and irregularities in ionospheric total electron content (TEC) over the Brazilian airspace, using data from ground based Global Positioning System (GPS) receiver stations at a number of different locations across Brazil. GPS TEC data from 2011-2016 (corresponding to the solar cycle 24) were examined to identify the nature of potential threats to Ground Based Augmentation System (GBAS) services from ionospheric activity over Brazil. In particular, a significant portion of the data analysis was focused on an east-west chain of GPS receiver stations located along the southern crest of the equatorial ionization anomaly (EIA) where we examined the values of TEC gradients and rate-of-TEC index (ROTI). A single-station method (a.k.a. time-step method) was used for the TEC gradient calculations to circumvent the limited number of closely spaced receiver pairs in the region. Large-magnitude TEC gradients and high ROTI values over Brazil were found to be associated with the occurrence of equatorial plasma bubbles (EPBs) during the nighttime, which becomes ubiquitous on a day-to-day basis from September until March in this longitude sector. Based on the TEC data: probability distribution functions of TEC gradient magnitudes over the region from different years were constructed, numerical correlation between TEC gradient magnitudes and ROTI values was examined, and the time-of-day optimal for GBAS operation (largely free of EPB/scintillation) was also inferred.