

Revisiting the Total Electron Content Anomaly Over Mid-North America

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We report here on an anomaly that appears in GPS total electron content (TEC) maps at approximately the same location intermittently over several years. This anomaly in TEC is observed between 35 and 45 degrees N latitude and between 100 and 105 degrees W. longitude, although this position shifts as a function of time of day. At approximately 8 or 9 am local time, this anomaly can be seen at its furthest west position at approximately 105 degrees W longitude, and whereas at approximately 19:00 local time, this anomaly appears at 100 W longitude. This anomaly is seen primarily in March and, in 2008, a relatively quiet period in the sun's solar cycle, the anomaly was as large as 5 TEC units higher than the surrounding TEC values. Multiple GPS processing techniques observe this phenomenon, although this does not preclude issues with the GPS receiver bias determination. GPS coverage is particularly good over the continental US, thereby strengthening the TEC estimation over the US. Recently, Zhang et al., [2011] have reported on a pronounced east-west difference in the TEC observed over the continental US. They attribute this difference in TEC to the changing direction of the geomagnetic declination over the US. The zero magnetic declination over the US occurs at approximately 92-95 degrees W. longitude, slightly to the east of where the hot spot is observed.

We report here on the observed hourly, day-to-day, and seasonal characteristics of this anomaly and discuss possible mechanisms for its production. We compare COSMIC TEC observations with our ground-based TEC observations. We suspect that the orientation of the Earth's magnetic field, combined with thermal winds, account for the TEC anomaly that is observed. However, another explanation involves the GPS receiver bias determination and this issue will also be addressed.