#108 Received 01/20/2015

Altshuler, Eric[1]; Shallberg, Karl[2]; Potter, BJ[3]
1. Sequoia Research Corporation
2. Zeta Associates
3. FAA, Mike Monroney Aeronautical Center

Scintillation Characterization for WAAS during Solar Maximum

Abstract:
The IOC and FLP development phases of WAAS took place from 1996 through 2008, coincident with solar cycle 23 which peaked in 2002, subsided in the 2005/2006 time frame. During that period, WAAS algorithms were under development and then tuned to account for several different ionospheric issues. The ionosphere related issues affecting WAAS performance include extreme storms (such as the Halloween storm of 2003) as well as extreme gradients (as was seen on November 21st, 2003). Those ionospheric threats, as along with others, were extensively researched and the WAAS ionosphere related algorithms developed to mitigate such events. As solar cycle 23 subsided, WAAS ionospheric algorithms supported very good coverage performance during the remainder of solar cycle.

As solar cycle 24 activity increased during the 2009/2010 time frame, the WAAS ionospheric focus turned from the more extreme ionospheric phenomena seen previously to scintillation. While scintillation was certainly a phenomena WAAS considered with its ionospheric research, the installation of new reference stations in far northern Alaska and Canada as well as in Mexico made it clear that scintillation was occurring on a regular basis and affecting WAAS performance. Phase scintillation is most prominent at northern latitudes with amplitude scintillation prevalent in the equatorial region. While individual scintillation events were noted and studied, no overarching study has been undertaken to examine the effects that scintillation has had on WAAS over a considerable time period.

This paper presents a detailed characterization of scintillation as seen by WAAS during the majority of the present solar cycle 24 (2011 to 2014). The paper examines the frequency of occurrence scintillation events, noting the size, duration and geographic location. Of particular interest are events during which scintillation effects were widespread and multiple stations were affected simultaneously. Detailed analysis for select widespread events is presented. Tracking performance with respect to both L1 and L2 was also performed, specifically instances where carrier lock on one frequency was maintained while lock on the other was lost. The results are compiled over the four year time period.

Finally, the WAAS program has just installed the next generation reference receiver to select sites. This receiver provides adaptive phase lock loop tracking intended to improve performance in high dynamic conditions such as scintillation. The receiver provides L2C and L5 tracking independent of the L1 and this data will be investigated to demonstrate the differences in performance with the current L2 P(Y) semi-codeless technique.