

Ionospheric Effects on Near Equatorial Space Based Augmentation Systems (SBAS)

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The ionosphere is a highly dynamic physical phenomenon that presents a variable source of error for Global Positioning System (GPS) signals and GPS based operational systems. The Federal Aviation Administration's (FAA) Wide-Area Augmentation System (WAAS) was designed to enhance the GPS standard positioning service by providing additional accuracy, availability and integrity that is sufficient for use in commercial aviation. It is the first of a number of planned regional Satellite Based Augmentation Systems (SBAS) that include the European EGNOS system, the MSAS system in Japan, the GRAS system in Australia, the GAGAN system in India and the CSTB system in South America.

The WAAS system reached Initial Operational Capability (IOC) in 2003, meeting all performance requirements for Precision Approach (PA) with vertical guidance at many airports located throughout the CONTiguous United States (CONUS). Much of the WAAS ionospheric research and development focused on defining and mitigating ionospheric challenges characteristic of the mid-latitude regions, where the ionosphere is well studied and mostly quiescent. The EGNOS and MSAS systems will primarily operate under a similarly quiescent mid-latitude ionosphere. SBAS system development in South America, India and other low-latitude regions, however, will have to contend with much more extreme conditions. These conditions include strong spatial and temporal gradients, plasma depletions and scintillation. All of these conditions have a potential to limit SBAS performance in the low latitude regions.

In this presentation, we will define the ionospheric phenomena that may challenge SBAS operation and performance in the low latitude regions. This will feature case studies and statistical summaries of plasma depletion activity recorded during the current solar cycle by a chain of dual-frequency GPS receivers extending from ~20 degrees South to ~16 degrees North Magnetic Latitude along the west coast of South America. Finally, it will illustrate efforts to estimate the ionospheric effects on PA SBAS service capability in the low latitude region.