

The treatment of the ionosphere within EGNOS: from simulation to validation

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The EGNOS AOC system is an augmentation to GPS and GLONASS that will largely meet the positioning, velocity and timing requirements of the land, maritime and aeronautical modes of transport in the European Region. From the different GPS position error contributions, the ionosphere is probably the most critical one: the ionosphere is a highly variable and hardly predictable environment. Phenomena of different geographical and time characteristics may affect the performances of ionospheric monitoring methods based on real time GPS measurements data GPS signals have to cross the complete ionosphere on their path from satellites to users. The user measurements are affected by this crossing of the ionosphere in a number of ways:

- Scintillation: leading to increased noise in the signal and possibly to signal loss.
- Code delay: the pseudorange measurements are increased due to the delay experienced by the signals during the travel through the ionospheric layers
- Phase advance: the measurement of the phase carrier is affected by a seemingly phase advance due to the travel of the signal through the ionosphere

This paper will address at length the problem of ionosphere estimation and modeling in the context of the EGNOS project. This complex problem will be analyzed from the following complementary perspectives:

- **IONO physical behavior**: discussion and determination of representative worst case iono for the integrity, availability and continuity performance evaluation of the EGNOS system;
- **IONO SW modeling**: debate on existing IONO models and identifications of their assets and limitations. Presentation of the NEQUICK model;
- **Processing algorithms** for the IONO corrections computation and IONO integrity bounds determination;
- **System considerations**: dimensioning of the EGNOS system with respect to IONO considerations, identification of intrinsic to EGNOS limitations, EGNOS system performance, MOPS limitations, etc.

This paper is co-authored by complementary experts in line with above list of issues including: system experts, Ionospheric experts (part of the European Space Agency created Ionospheric Expert Team) and algorithm experts working for the EGNOS Central Processing Facility (CPF).

