Geophysical Research Abstracts
Vol. 17, EGU2015-6287, 2015
EGU General Assembly 2015

Multi-GNSS assessment of ionospheric threat model parameters for Ground Based Augmentation Systems (GBAS)

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Ground-Based Augmentation Systems (GBAS) makes aircraft precision approach and landing possible by providing differential corrections and integrity information for pseude range measurements obtained from Global Navigation Satellite System (GNSS).These information are transmited to the aviation users by means of very high frequency (VHF) or ultra high frequency (UHF) bands on the basis of GBAS local networks which support avionic receivers approximately within 20 kilometers of the airport.
GBAS is strongly affected by anomalous ionospheric gradients during high ionospheric activities which can treaten the safety of the users. Therefore anomalous ionospheric gradients must be determined to understand and mitigate ionosphere threats occurring in different geographical regions.
In this work, we assess an ionospheric anomaly threat model by analysing ionospheric gradients around Istanbul Ataturk Airport. For this, real ground-based observations from both GPS and GLONASS during high ionospheric activities since 2009 are pre-processed to extract ionospheric gradients. Afterwards ionospheric delays at each ionospheric piercing point are determined by applying different local ionospheric Total Electron Content (TEC) modeling and filtering techniques on the basis of raw carrier-phase observations. The ionospheric fronts are searched by looking at high ionospheric gradients which result from ionospheric delay differences between ionospheric piercing points. Then, the ionospheric threat parameters in terms of width, slope and velocity of the ionospheric wavefront are estimated from the extracted front occurences and gradients including velocity information of ionospheric piercing points. Finally, the estimated threat model parameters are examined and assessed by comparing the results from different techniques.