



Ionospheric scintillation prediction using gradient boosting algorithm

Xiukuan Zhao

Institute of Geology and Geophysics, Chinese Academy of Sciences,

Ionospheric scintillation is the rapid fluctuation of radio signals traversing through ionospheric irregularities. Severe scintillation can cause loss of lock for the systems using Global Navigation Satellite System (GNSS) signals. The dependences of scintillation on seasonal, solar and geomagnetic activities have been widely studied, but its day-to-day variability and prediction still remain a challenge. The relationship between scintillation occurrences and a variety of factors is complex. The machine learning algorithm could handle nonlinear problems and thus uncover the implicit correlations between multiple factors. Using the long-term ground-based GNSS receiver and ionosonde data collected in the Brazilian longitude sector during 2012-2020, an ionospheric strong scintillation prediction model based on the gradient boosting algorithms XGBoost, LightGBM and CatBoost is created and tested. The relative importance of different parameters affecting EPB/scintillation occurrence for building the prediction model is examined. A comparison of daily scintillation occurrence from the modeled and observed results during 2014 (solar maximum) and 2020 (solar minimum) shows that the gradient boosting algorithms are effective for predicting strong scintillations over low latitude, with a prediction accuracy of ~85%. The results suggest that the trained model with input of total electron content, equatorial F layer peak height and critical frequency before sunset could be well employed to predict the occurrence/nonoccurrence of intense scintillations over low latitude after sunset on a daily basis.