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Challenges in the modeling ionospheric scintillation during extreme solar events at Antarctica

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South Pole has dark winter months, which make researchers capable of studying changes in scintillation patterns in the background ionosphere. We have used observed scintillation data throughout the solar active year of 2013. Using two B-spline basis functions of degree 4 and the ionospheric scintillation data from a Global Positioning Satellite System (GPS) scintillation receiver at South Pole, we reproduced ionospheric scintillation indices for the periods of the six X-class solar flares in 2013. These reproduced indices have filled the data gaps, and they are serving as a smooth replica of the real observations. In either event, these modeled scintillation indices are minimizing the geometrical effects between GPS satellite and the receiver. Six X-class solar flares have been studied during the summer and winter months, using the produced
scintillation indices based on the observations from the GPS receiver at South Pole and the in situ plasma measurement from the associated passing of Defense Meteorological Satellite Program. Our results show that the solar flare peak suppresses the scintillation level and builds time-independent scintillation patterns; however, after a certain time from the solar flare peak, complicated scintillation patterns develop at high-latitude ionosphere and spread toward the polar cap boundary region. Substantial consistency has been found between moderate proton fluxes and scintillation enhancement.