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Reparametrization of the OVATION Prime (2010) model: Introducing PC-index as input parameter and testing model predictive ability

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The development of an advanced auroral ionospheric models, providing estimates of polar ionosphere parameters, requires information about background and sporadic electron fluxes which actively interact high-latitudes under disturbed magnetospheric conditions. Precipitating magnetospheric electrons with initial energies of 1-30 keV significantly change ionization rate at altitude range from 90 to 150 km and actively participate in chemical reactions between recombination and solar radiation ionization processes. To account for the effects of the corpuscular ionization source we use OVATION Prime (2010) model as the most advanced model which is based on spectral measurements of different auroral particle species onboard DMSP spacecraft. The advantage of this model is that it is parameterized by the Solar Wind driving using well-known Newell's coupling function predicting auroral power. However, SW measured far ahead of dayside magnetopause at ACE spacecraft location (Lagrange point, L1) in some cases does not impact the magnetosphere (or contact it partially) and aurora predicted by the model is not consistent with reality. The PC-index as a quantitative characteristic of the substorm activity level and a measure of SW energy that directly penetrate to the magnetosphere can essentially improve timing within substorm cycle and reduce model inconsistency caused by errors of solar wind parameters conversion from L1 to the magnetopause. In this paper we introduce PC-index (and its derivatives) as OVATION Prime (2010) input parameter and quantitatively test modified model predictions using Polar UVI auroral data. Test results have shown that: (1) accuracy of modified model version higher than original one ($r \approx 0.72$, $r^2 \approx 0.52\%$ versus $r \approx 0.67$, $r^2 \approx 0.45\%$); (2) the modified model describes substorm auroral dynamics at 1-min time scales significantly better (case study); (3) the modified model predictions have a lead of 2-5 minutes comparing to the Polar UVI optical observations.