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Quasi-Stationary Global Auroral Ionospheric Model: E-layer

Vera Nikolaeva (1,2), Evgeny Gordeev (1,2), Andrey Kotikov (2,3), Ludmila Makarova (1), and Aleksander Shirochkov (1)

(1) Arctic and Antarctic Research Institute, St. Petersburg, Russia , (2) St. Petersburg State University, St. Petersburg, Russia, (3) Pushkov Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation of the Russian Academy of Science St. Petersburg Branch, St. Petersburg, Russia

E-layer Auroral Ionospheric Model (E-AIM) is developed to provide temporal and spatial density distribution of the main ionosphere neutral species *(NO,* $N(^4S)$, $N(^2D)$), and ions (N_2^+, NO^+, O_2^+, O^+) in the altitude range from 90 to 150 km. NRLMSISE-00 model [Picone et al., JGR 2003] is used for neutral atmosphere content and temperature determination, that is the input for the E-AIM model. The E-AIM model based on chemical equilibrium state in E-layer that reaches in chemical reactions between ionospheric species considering solar radiation ionization source, superposed with sporadic precipitation of magnetospheric electrons. The chemical equilibrium state in each location under specific solar and geomagnetic activity conditions reaches during numerical solution of the continuity equations for the neutrals and ions using the high-performance Gear method [Gear, 1971] for ordinary differential equation (ODE) systems. Applying the Gear method for solving stiff ODE system strongly reduce the computation time and machine resources comparing to widely used methods and provide an opportunity to calculate the global spatial E-layer ion content distribution.

In contrast to the mid-latitude ionosphere, structure and dynamics of the auroral zone ionosphere ($\phi \approx$ 60-75° MLat) associated not only with shortwave solar radiation. Precipitating magnetospheric particle flux is the most important ionization source and is the main cause of E-layer disturbances. Precipitated electrons with initial energies of 1 - 30 keV influence the auroral ionosphere E-layer. E-AIM model can estimate ionization rate corresponds to auroral electron precipitation in two different ways: 1. with direct electron flux satellite data; 2. with differential energy spectrum reconstructed from OVATION-Prime empirical model [Newell, JGR 2009] average values, that allows to estimate ionosphere ion content for any time and location in the auroral zone.

Comparison of E-AIM results with direct ionospheric observations (ionosonde, incoherent scatter radar) show good agreement of electron concentration vertical distribution values.