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Determination of Galactic and Solar Cosmic Ray Influences on the Earth's Atmosphere

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Cosmic rays (CRs) create the lower part of lower ionosphere and ionize significantly the middle and lower atmosphere. Some methods exist for calculating ionization by relativistic particles at low, middle and high latitudes. For the polar atmosphere are also important the solar CR and anomalous CR component. Formulas for the electron production rate q (cm-3s-1) at height h in the planetary ionosphere as a result of penetration of energetic particles are deduced in this paper. For this purpose the law of particle energy transformation by penetration through the ionosphere - atmosphere system is obtained. A model for the calculation of the cosmic ray spectrum on the basis of satellite measurements is created. This computed analytical model gives a practical possibility for investigation of experimental data from measurements of galactic cosmic rays and their anomalous component. 3D planetary modeling of the cosmic ray electron production rate q(h) (cm-3s-1) has been developed for the strato-mesosphere and lower thermosphere (altitude range 30 - 100 km) with 10 km step. Our model takes into account the isotropic penetration of the cosmic rays from the upper hemisphere and the sphericity of the Earth atmosphere by means of the Chapman function. The longitudinal effect of ionization from cosmic rays in the strato-mesosphere and lower thermosphere has been calculated. The longitudinal effect corresponds to the planetary distribution of the geomagnetic threshold rigidities RC(GV). The mathematical method for the 3D model is Gaussian quadrature with Legendre polynomials for 10 root points. The procedure uses the possibility in the Pascal algorithmic language for recursive calls of the integrand. A graphical presentation of the computational results is given for 50 and 90 km at 0°, 40°, 50° and 70° N, S and for all longitudes with a step of 30°. The results of this paper provide a basis for quantitative understanding for the influence of space weather to the Earth's weather driven by solar modulation of galactic cosmic rays.