

Cosmic ray induced ionization in the atmosphere: An improved model

I.G. Usoskin (1), G.A. Kovaltsov (2)

(1) Sodankylä Geophysical Observatory (Oulu unit), University of Oulu, Finland
(Ilya.Usoskin@oulu.fi);

(2) Ioffe Physical-Technical Institute, St.Petersburg, Russia

We present a full quantitative physical model to calculate cosmic ray induced ionization in the atmosphere. The model is based on the Monte-Carlo CORSIKA tool, which simulates the full development of an electromagnetic-muon-nucleonic cascade in the atmosphere, with the FLUKA package used for low energy interactions. The model is applicable to the entire atmosphere, from the ground up to the stratosphere. A comparison to direct measurements of the ionization in the atmosphere confirms the validity of the model in the whole range of geographical latitudes and altitudes. This provides a new tool for a quantitative study of the space weather influence upon the Earth's environment. We apply the model to study the cosmic ray induced ionization on different time scales. In particular, variations of the induced ionization are calculated for the last centuries and show a great variability, about 50% between the modern period and the Maunder minimum.