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Cosmic Ray Induced Ionization of the Atmosphere: Improved Modeling

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Recently, a physical model have been developed [Usoskin et al., JASTP, 66, 1791, 2004] to calculate the cosmic ray induced ionization (CRII) in the troposphere. The model was based on the CORSIKA Monte-Carlo simulation tool including the full development of electromagnetic-nucleonic cascade in the atmosphere. This basic model had some shortcomings: it was static, neglecting direct ionization by energetic primaries, and therefore valid only for the troposphere. Here we present the improved model which is based on the updated version of CORSIKA code, including FLUKA package to simulate low energy interactions, and takes into account also the direct ionization by primary cosmic rays. The improved model covers the entire atmosphere. A comparison with fragmentary direct ionization measurements in the atmosphere confirms the validity of the model in the whole range of geographical latitudes and altitudes. The results of the full Monte-Carlo simulation are tabulated to present the basic ionization yield function. These tables are presented together with a piece of code to allow a user easily computing CRII for given location, altitude and the spectrum of cosmic rays. This provides a new tool for quantitative study of the space weather influence upon the Earth's environment.