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Computation of ionization effect due to cosmic rays in polar middle atmosphere during GLE 70 on 13 December 2006

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At recent one of the modern topics in solar-terrestrial physics is the study of the possible effect of solar variability, respectively cosmic ray (CR) variations on atmospheric physics and chemistry. An important feature in most of the proposed mechanisms and models is the key role of the induced by cosmic rays ion production in the atmosphere. Since recently is observed an apparent effect on minor constituents and aerosols over polar regions during major solar proton events, the ground level enhancement 70 on 13 December 2006 deserves a special attention. In this work we compute the ion production rate profiles on 13 December 2006 on the basis on a previously applied model based on detailed Monte Carlo simulations of cosmic ray induced atmospheric cascade. The ion production rate during the event is considered as superposition of cosmic rays with galactic and solar origin. The time evolution of ion production is computed in a realistic manner. The spectral and angular characteristics of the solar protons are explicitly considered throughout the event as well their time evolution. The ionization effect during the event is computed at several altitudes above the sea level in a region with geomagnetic cut-off rigidity Rc ≤ 1 GV. The 24 hour ionization effect is estimated in the region of the Pfotzer maximum.
The present study is part of a larger research project on impact of galactic and solar cosmic rays on the atmosphere during 23-rd solar cycle. During the solar cycle 23, sixteen GLE events were observed with intensities ranging ˜ 3 –277%. The first event occurred on 6 November 1997 (GLE 55) and the last event occurred on 13 December 2006 (GLE 70). There was a slight increase in the number of GLE events as one progressed from the rise (4 GLEs) to the maximum (5 GLEs) and to the declining phases (7 GLEs). It should be noted that the last two GLE events of 23-rd solar cycle were the most powerful - GLE 69 reached CR intensity increase 277.3 % and GLE 70 reached increase ˜ 92.3 %. In this respect the considered by us GLE 70 represents great interest for the solar-terrestrial and space physics.

Collaboration

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