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Impact of Strong Geomagnetic Storms and Forbush Decreases of Cosmic Ray Flux on the Ozone Layer at Higher Middle Latitudes

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Impact of strong geomagnetic storms and Forbush decreases of cosmic ray flux on the ozone layer at higher middle latitudesJ. Lastovicka, P. KrizanInstitute of Atmospheric Physics, Bocni II, 14131 Prague 4, Czech Republic; jla@ufa. cas. czIn a recent publication Lastovicka and Krizan (JASTP 67, 119, 2005) showed that large and statistically significant effects of strong geomagnetic storms and Forbush decreases of cosmic rays on total ozone at northern middle latitudes occurred only in the winter part of the year, under high solar activity and the E-phase of the QBO (E-max) conditions. At northern higher midlatitudes, a significant and repeatable in all individual events effect occurred along the 50oN latitudinal circle, not at 40oN (probably too low latitude) or 60oN (different events display different response pattern). Around the 50oN latitudinal circle a redistribution of ozone was observed with substantial diminishing of strong winter longitudinal variation, which resulted in a large increase of total ozone in North Atlantic-European sector. Here we test these results with several geomagnetic super-storms from non-favorable periods (not winter, E-max conditions) from the current solar cycle but observed various conditions. All these events had Dst around or lower than –200 nT. Satellite data along latitudinal circles 40o, 50o and 60oN are analyzed. Some events do not display any observable effect, others exhibit some changes in ozone distribution, but rather random changes of meteorological origin, not those observed under the E-max conditions (diminishing of longitudinal variation, ozone enhancement in the Euro-Atlantic sector). Therefore we may conclude that atmospheric preconditioning, given by the winter E-max conditions, is more important than the strength of geomagnetic storms for the occurrence of systematic and large enough effects of storms on the total ozone at northern higher middle latitudes. This supports our explanation of the observed effects of strong geomagnetic storms on ozone as an indirect effect, response to storm-related changes in circulation, caused rather by storm-related Forbush decreases of cosmic rays.