Comparing effects of various types of geomagnetic disturbances on the winter lower atmosphere in the Northern Hemisphere

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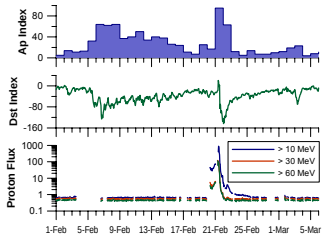
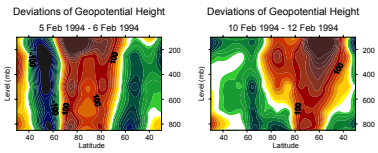
The effects of isolated geomagnetic storms and prolonged high geomagnetic activity on winter lower atmosphere in the Northern Hemisphere are compared. For this purpose geomagnetic storms with parameters Ap ≥ 60, Dst ≤ -100 nT occurring in the winter periods (January-March) 1994-2002, and geomagnetic activity course in winter period (January-March) 1982 were selected. Pressure, temperature and wind fields between geopotential heights of 1000 mb and 100 mb were investigated. Special attention was paid to analysis of maps of cross-sections along the profile Atlantic-polar region-eastern Asia.

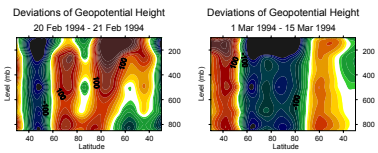
Strong isolated storms

February – March 1994

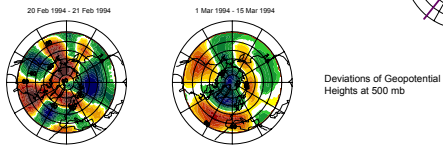
short change of atmospheric circulation after geomag. storm from 6-7 February and prolonged change after geomag. storm and enhanced Proton Flux from 20-21 Feb.



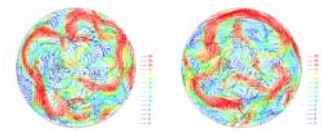




sectors of the vertical profile



Deviations of Geopotential Heights at 500 mb

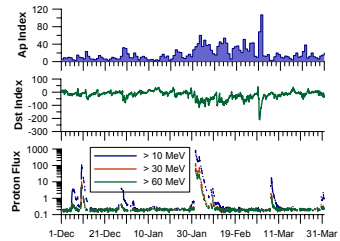


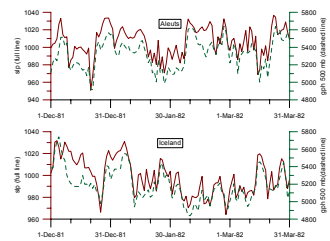
Wind field at 500 mb

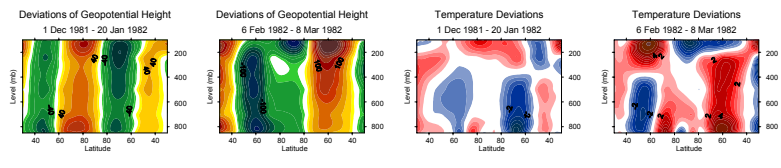
strengthening of zonal flow over Atlantic and western Europe

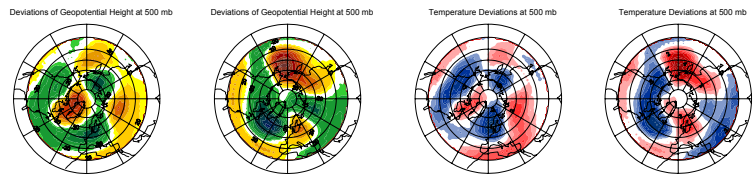
Prolonged high geomagnetic activity – Winter 1981/1982

low to medium level of geomagnetic activity in December and January was succeeded by a very high level of geomagnetic activity in February and the beginning of March







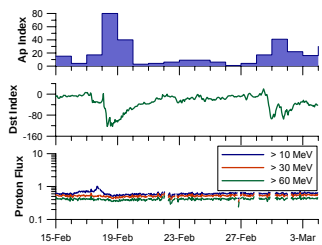


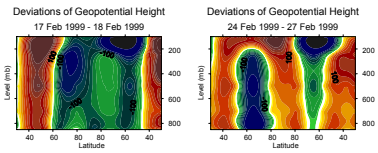
deepening of the Icelandic low

warming up in western Europe

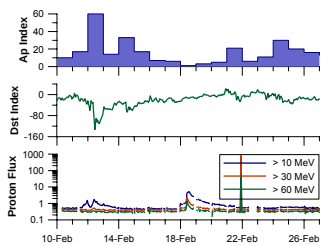
February – March 1999

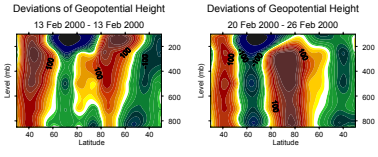
deepening of the Icelandic low





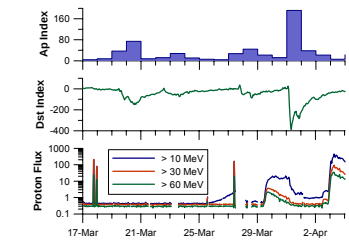
February 2000

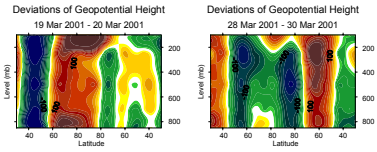


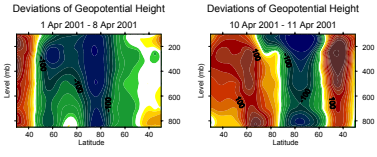


March – April 2001

low pressure in the sector 10° - 40° W from 28 March to 8 April caused by two consecutive geomagnetic storms and quick return to the initial state after 10 April.







Conclusions

Prolonged geomagnetic activity as well as isolated strong geomagnetic storms (Ap ≥ 60, Dst < -100 nT) used to be associated with tropospheric pressure and temperature field changes.

6 – 9 days after the onset of the strong geomagnetic storm or the beginning of prolonged geomagnetic activity a decrease of atmospheric pressure in the sector 10° - 40° W and the strengthening of zonal flow over Atlantic and western Europe are observed. Such changes result in advection of relatively warm and moist air.

If the geomagnetic storm or prolonged geomagnetic activity is accompanied by a strong increase of energetic proton flux (Ep > 60MeV), enhanced cyclonic activity in the sector 10° - 40° W, in agreement with Veretenenko & Thejll (JASTP 66/2004, 393-405), follows one day after this increase.

Strong increase of energetic proton flux (Ep > 60 MeV) prolongs duration of tropospheric response on geomagnetic storm about several days.

Related papers:

Bochníček, J. and Hejda, P., 2002. Association between extraterrestrial phenomena and weather changes in the Northern Hemisphere in winter. Surveys in Geophys. 23, 303 – 333.

Bochníček, J. and Hejda, P., 2005. The winter NAO pattern changes in association with solar and geomagnetic activity. J. Atmosphere. Solar-Terr. Phys. 67, 17-32.

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