

Comparison of cloudiness and cyclonic activity changes over extratropical latitudes in Northern Hemisphere from model simulations and from satellite and reanalysis data

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Changes of cloudiness and cyclonic activity over extratropical latitudes in the Northern Hemisphere (NH) from simulations with the coupled general circulation model (CGCM) are analyzed in comparison with satellite and reanalysis data.

Results of the IPSL-CM4 (version 1) CGCM (Marti et al., 2005) simulations for 1860-2000 with the greenhouse gases concentrations in the atmosphere from observations and for 2001-2100 with the SRES-A2 scenario are used.

Model results are compared to the cyclonic activity characteristics (Bardin and Polonsky, 2005; Golitsyn et al., 2006; Golitsyn et al., 2007) on the basis of NCEP/NCAR reanalysis data (Kistler et al., 2001) during 1952-2000 and to the satellite cloudiness data (Rossow and Duenas, 2004) for 1983-2000.

Daily data for cyclonic characteristics from model simulations were obtained similar to (Bardin and Polonsky, 2005; Golitsyn et al., 2006; Golitsyn et al., 2007). Here we analyze, in particular, the part of total area covered by cyclones or density of cyclones packing (DCP) defined similar to (Mokhov et al., 1992).

Figure 1 shows changes of total cloudiness and DCP over extratropical latitudes (20-80°N) from model simulations for periods 1860-2000 (a) and 2001-2100 (b). Values on Fig.1 were normalized on their mean values for the period 1961-1990. Figure 1a does not show significant changes in total cloudiness and DCP while Fig.1b shows tendency of decrease for both variables in the 21st century. This tendency is related to a general tendency of decrease in the temperature difference between high and low latitudes with a general decrease of tropospheric baroclinic instability under global warming (Mokhov et al., 1992).

Analysis of relationship between total cloudiness by satellite monthly data and DCP by reanalysis monthly data for the NH extratropics shows significant positive correlation for the period 1983-2000 while no correlation was found by annual-mean data. Model simulations do not exhibit significant correlation for this period both by monthly-mean and annual-mean data but display positive correlation for longer periods during 1860-2100. Figure 2 shows relationship between total cloudiness and DCP for the NH extratropics from model simulations for the 21st century.

This work was supported by the CNRS/RAS Joint Agreement Program, Russian Foundation for Basic Research, Programs of the Russian Academy of Sciences and Russian President Scientific Grant.

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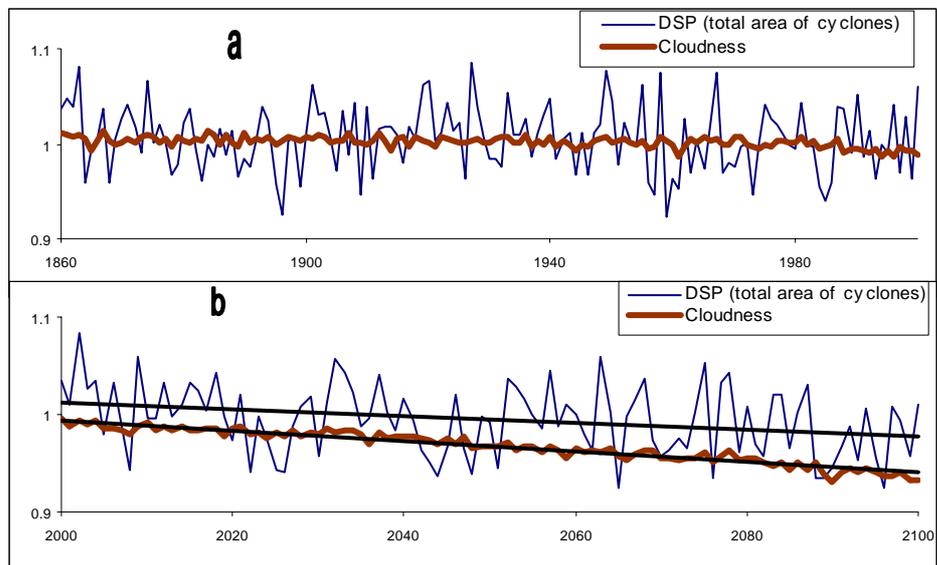


Fig. 1. Changes of normalized total cloudiness and DCP over extratropical latitudes (20-80N) from model simulations for periods 1860-2000 (a) and 2001-2100 (b).

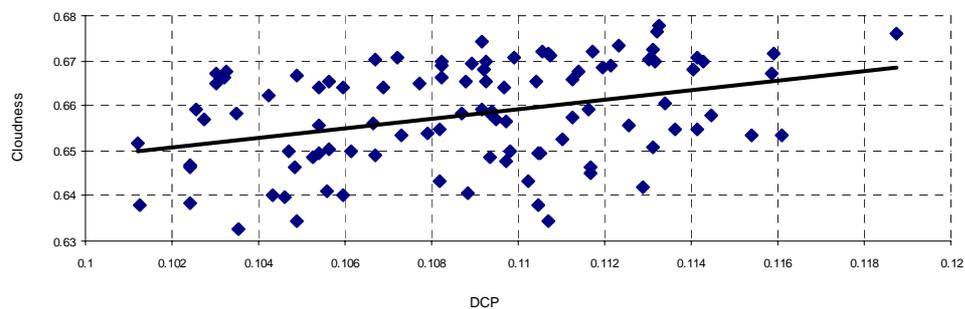


Fig. 2. Total cloudiness independence on DCP for the NH extratropics from model simulations for the 21st century.