Cyclonic activity and its total action over extratropical latitudes in Northern Hemisphere from model simulations

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Changes of cyclonic activity over extratropical latitudes in the Northern Hemisphere (20-80^{o}N) from simulations with the coupled general circulation model (CGCM) are analyzed. Results of the IPSL-CM4 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. Cyclonic characteristics (for each 6 hours) were obtained similar to (Akperov et al., 2007; Golitsyn et al., 2007) from model simulations for sea level pressure.

We analyzed probability distributions for extratropical cyclones in dependence on their intensity, size and duration for different seasons. Analysis has been performed also for the atmospheric cyclones action S as an integral characteristic of their effect. Similar analysis was done by Mokhov (2006a,b) for total action of atmospheric blockings. This value S has a dimension [energy]x[time]. Action S of individual climate structure, in particular for cyclonic or anticyclonic vortex, can be defined as follows $S \sim \int E(t)dt$, where integration on time t is performed from 0 to τ, τ – vortex life time, E – vortex energy. Kinetic energy of extratropical (geostrophical) vortex can be expressed via $(\Delta P)^2$, where ΔP is a pressure difference between centre and periphery of the vortex. Integral action S_Σ for ensemble of vortices is defined by the sum of values of action for individual vortices.

Figure 1 shows distributions of the cyclone-days (x4) number as a function of ΔP (hPa) from model simulations for the second half of the 20th century and also for the first and second half of the 21st century. According to Fig. 1 we can expect increase in the number of very strong cyclones.

Analysis of total action for extratropical cyclones from model simulations shows its general decrease in the 21st century under global warming. Changes in seasonal values of S display large interannual and interdecadal variability. Substantial general decrease in the total action of cyclones was noted in winter, while in summer changes in S are not statistically significant.

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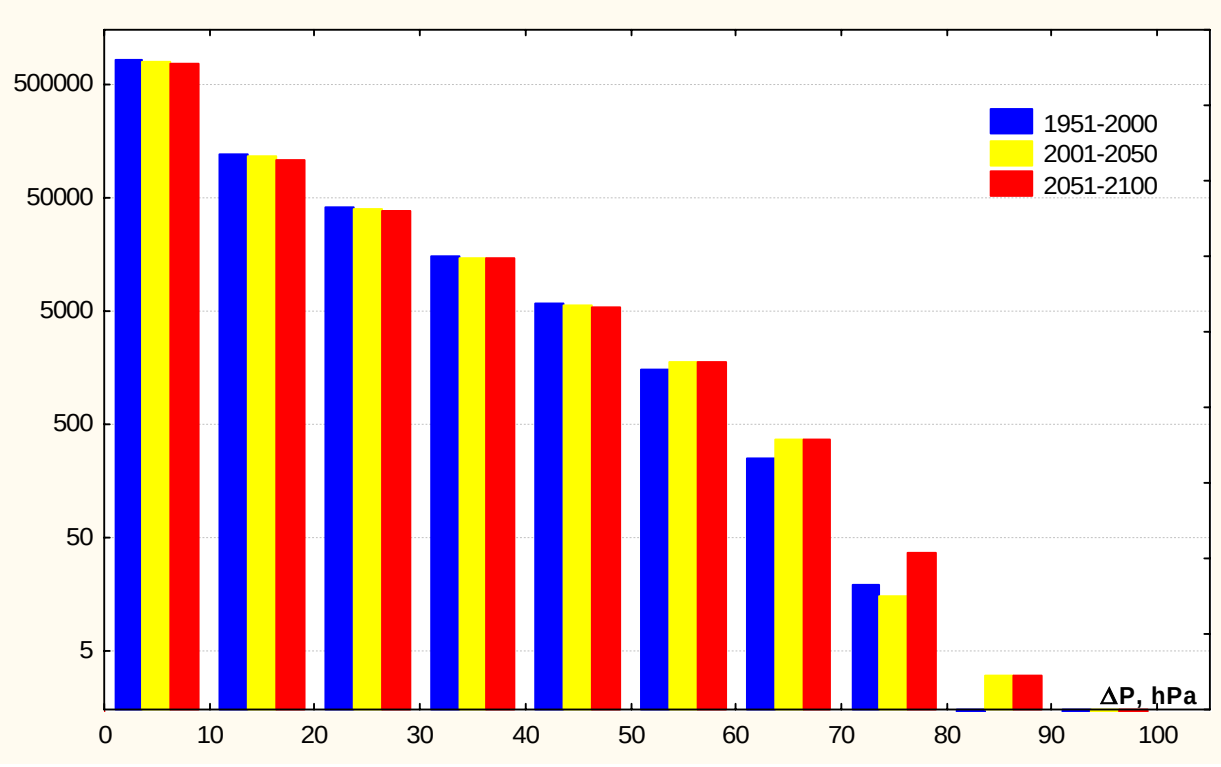

Fig. 1. Distributions of the cyclones number as a function of ΔP (hPa) from model simulations for the second half of the 20th century and also for the first and second half of the 21st century.