

Summer Blockings in Euro-Atlantic Region from Model Simulations

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The Russian heat wave in summer 2010 was associated with an anomalous blocking situation (with total duration about two months) over the European part of Russia. Frequency of atmospheric blockings in the Euro-Atlantic region in summer season has a maximum near 30°E over Eastern Europe (Wiedenmann et al., 2002). Estimates based on observations and model simulations (Lupo et al., 1997; Mokhov and Petukhov, 1997) display a tendency of increase of blockings duration under general warming.

Similar to (Mokhov et al., 2011) we analyzed possible changes of atmospheric blockings activity in the Northern Hemisphere (NH) from different climate model simulations for the 21st century with various scenarios. In particular, the CMIP3 simulations with global climate models (GCMs) were used. Special attention was paid to the analysis of summer blockings in the Euro-Atlantic region (60°W-60°E) with an assessment of risk and potential predictability for extreme total duration of blockings.

According to results of analysis of simulations the most comprehensive global climate models have an ability to reproduce extreme blocking situations in the atmosphere. At the same time results are sensitive to the choice of criteria for blockings as well to the scenarios (initial conditions) used.

Figure 1 shows an example of interannual variations for total blockings duration over Euro-Atlantic region (60°W-60°E) in summer from the IPSL-CM4 GCM simulations for 1960-2100 with anthropogenic scenarios SRES-A1B and SRES-A2 for the 21st century and with various criteria for blockings (see also (Mokhov et al., 2009)). In particular, modified Lejenas-Okland criteria were used similar to (Wiedenmann et al., 2002) with stronger (version I) or weaker (version II) conditions for longitudinal size of blockings.

Analysis of possible changes in the extratropical cyclonic and anticyclonic activity displays large variability in the 21st century from different model simulations with anthropogenic forcing (Mokhov et al., 2009). Blocking anticyclones also display remarkable interannual and interdecadal variability.

It can be expected according to Fig. 1 an extreme total duration of blocking situation in summer for the NH Euro-Atlantic region up to about 60 days and even longer. The anomalous total duration of blocking situation about 60 days in Euro-Atlantic region was obtained for summer 2010 in the considered model simulations with the SRES-A1B scenario and with one of applied criteria for blockings (I). This model estimate is close to real duration of blocking situation for European part of Russia in summer 2010. Model simulations show possibility of other summer blockings in the Euro-Atlantic region with duration about two months in the 21st century, in particular in 2020 and 2022 for the SRES-A1B scenario or in 2043 and 2081 for the SRES-A2 scenario. The largest total duration of summer blockings over the Euro-Atlantic region before 2010 was detected from model simulations (since 1960) in 1973.

With a weaker conditions for longitudinal size of blockings (II) the total duration of blocking situation was detected even longer (about 10 weeks) for Euro-Atlantic region in summer 2010.

Blockings characteristics display nonlinear changes in dependence on climate changes.

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References

Lupo A.R., R.J. Oglesby and I.I. Mokhov, 1997: Climatological features of blocking anticyclones: A study of Northern Hemisphere CCM1 model blocking events in present-day and double CO₂ concentration atmospheres. *Climate Dyn.*, **13**, 181–195.

Mokhov I.I., 2011: Specific features of the 2010 summer heat formation in the European territory of Russia in the context of general climate changes and climate anomalies. *Izvestiya, Atmos. Oceanic Phys.*, **47**(6), 653-660.

Mokhov I.I., M.G. Akperov, J.-L. Dufresne and H. Le Treut, 2009: Cyclonic activity and its total action over extratropical latitudes in Northern Hemisphere from model simulations. *Research Activities in Atmospheric and Oceanic Modelling*, J. Cote (ed.), Rep.39(7), 9-10.

Mokhov I.I., M.G. Akperov and A.A. Vetrova, 2011: Russian heat wave and blockings activity changes. *Research Activities in Atmospheric and Oceanic Modelling*, A. Zadra (ed.), Rep.41(7), 13-14.

Mokhov I.I. and V.K. Petukhov, 1997: Blockings and their tendencies of change. *Doklady Earth Sci.*, **357**, 687-689.

Wiedenmann J.M., A.R. Lupo, I.I. Mokhov and E.A. Tikhonova, 2002: The climatology of blocking anticyclones for the Northern and Southern Hemispheres: Block intensity as a diagnostic. *J. Climate*, **15**(23), 3459–3473.

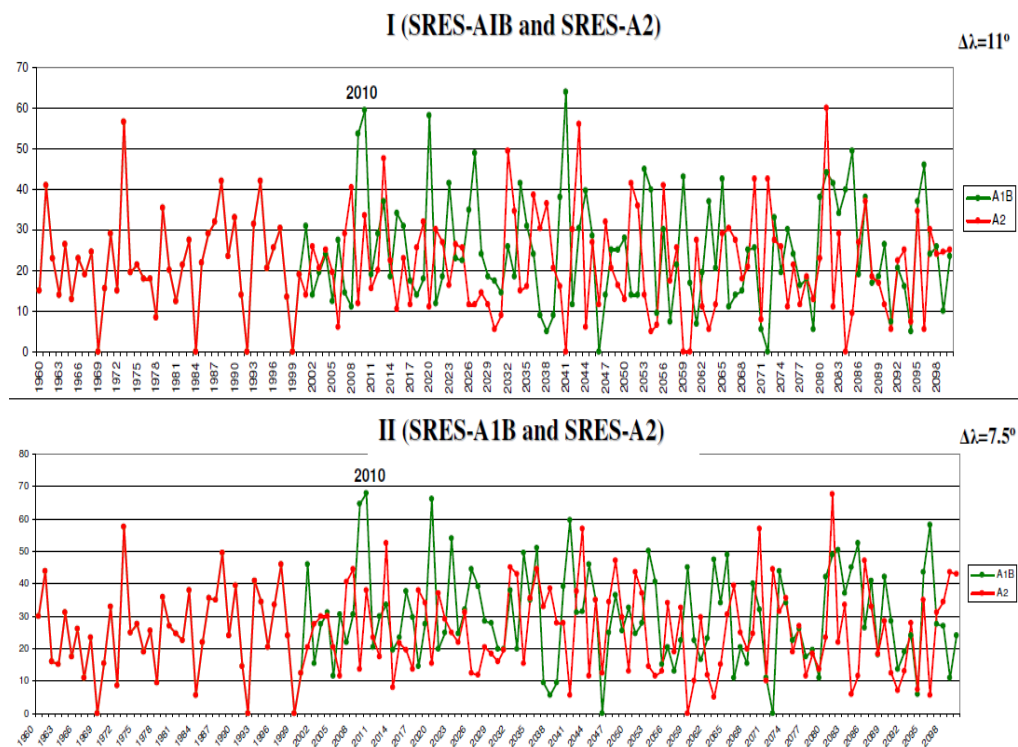


Figure 1. Interannual variations of total blockings duration over Euro-Atlantic region (60°W-60°E) in summer from model simulations with different SRES (A1B and A2) scenarios and with various criteria for blockings (I and II).