Summer climate anomalies in the Northern Eurasia during intra-annual transitions from El Niño to La Niña

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Summer seasons during the transition from El Niño (E) in the beginning of the year to La Niña (L) at the end of the year (hereinafter $E \rightarrow L$) are characterized by a high risk of extremely high surface air temperature and drought conditions in the European part of Russia (ETR) [1]. According to the ensemble of model forecasts (CPC/IRI official probabilistic ENSO forecasts) there is a high probability (over 70% in April 2016) for the transition to the phase of La Niña by the end of 2016. In this case there is a high risk of extremely high temperature and drought conditions at the ETR in spring and summer months during the $E \rightarrow L$ transition in 2016, that began in the phase of El Niño. This paper presents the analysis of the spatial distribution of the summer temperatures anomalies in the Northern Eurasia during transitions $E \rightarrow L$.

Temperature anomalies were determined from the ERA-Interim reanalysis data [2] for the period 1979-2015. El Niño phenomena were characterized by the sea surface temperature anomalies in the Niño-3 region (http://www.esrl.noaa.gov/psd/gcos_wgsp/).

There were four $E \rightarrow L$ transitions during 1979-2015 (in 1988, 1998, 2007 and 2010). (Such transitions occur about once in a decade.) The ETR surface air temperature in May-July was extremely high with drought conditions for all four cases noted. In three of four cases extreme drought conditions were achieved [1]. According to the data from [3], the average total duration of atmospheric blockings in the Euro-Atlantic region (60W-60E) in the Northern Hemisphere was more than 2.5 weeks for all 4 cases (and more than a month for 1988 and 2010).

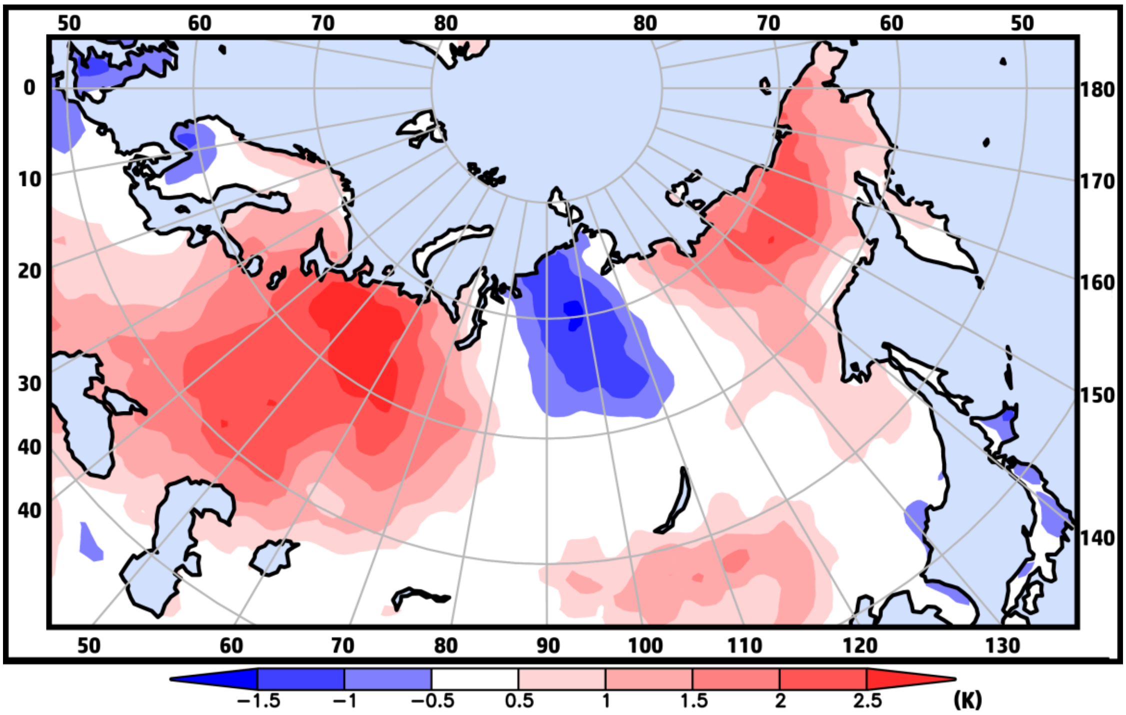

Figure 1. Mean anomalies of the surface air temperature in July during $E \rightarrow L$ transitions (for 4 transitions in 1988, 1998, 2007 and 2010).

Figure 1 shows the distribution of composite (mean) anomalies for surface air temperature in July during $E \rightarrow L$ transitions (for 4 transitions in 1988, 1998, 2007 and 2010). This distribution is characterized by positive anomalies in Eastern Europe with the highest values for the ETR as well as for the north-eastern part of Asia. The central part of Siberia is characterized by negative anomalies of surface air temperatures. This spatial distribution with the characteristic wave structure (with establishment of the stationary Rossby wave) is especially clear for 2010.

The ability of modern climate models to reproduce the noted regional features for the transition $E \rightarrow L$ has been assessed. Ensemble CMIP5 simulations for the 150-year period with the piControl scenario (Pre-Industrial coupled atmosphere / ocean control run) [4] with 21 models have been analyzed. Some models are able to qualitatively reproduce the spatial structure of the surface temperature anomalies in summer, noted from reanalysis data and the characteristic frequency of transitions $E \rightarrow L$, but in general the results vary considerably for different models. The frequency of transitions $E \rightarrow L$ from ensemble model simulations varies from one in half a century up to one in four years. For some models the spatial distribution of temperature anomalies with characteristic wave structure similar to the one noted from reanalysis data is reproduced with a longitudinal shift.

For the analysis we also used our simulations with a coupled atmosphere-ocean general circulation model (GCM). In particular, we analyzed the control-run simulations for the 150-year period with the coupled ECHAM5 atmospheric GCM [5] and MOM5 oceanic GCM [6]. Atmospheric GCM (T31L39) and oceanic GCM (with resolution 1.125x1.125°) were combined with the use of the OASIS coupling system [7]. Simulations with this model show reasonable reproduction of current distributions for climate characteristics (including surface temperature, sea level pressure and others). From our model simulations we obtained an adequate number (15) of the $E \rightarrow L$ transitions. Spatial distribution of temperature anomalies with characteristic wave structure is similar to that obtained from reanalysis data, but with a shift in longitude (as estimated for a number of models within CMIP5).

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