Climate anomalies in the North Eurasian regions: predictability for different El-Nino conditions

I.I. Mokhov[1,2] and A.V. Timazhev[1]

[1]A.M. Obukhov Institute of Atmospheric Physics RAS
[2]Lomonosov Moscow State University
mokhov@ifaran.ru

The impact of the El-Niño/La-Niña events is significant on a global scale, including North Eurasian regions [2]. In [3] estimates of possible anomalies in Russian regions in 2016 in May-July are obtained, taking into account the beginning of the year in the El-Niño phase and the forecasts of its transformation by the end of the year. Here we present similar estimations for 2020 with the beginning in the neutral phase of canonical El-Nino characterized by Nino3 index (Eastern Pacific El-Nino). At the same time the beginning of this year was in the El-Nino phase of El-Nino characterized by Nino4 index (Central Pacific El-Nino). The El-Niño (*E*), La-Niña (*L*) and neutral (*N*) phases are defined similar to [2].

According to model predictive estimates (https://www.cpc.ncep.noaa.gov/) obtained by the beginning of May 2020 using the Nino 3.4 index, during 2020 the probability of the continuation of the neutral phase decreases, the La Niña phase increases and the probability of the El Nino phase remains low (about 10%). At the same time, by the end of 2020, the probabilities of the *N*-phase and *L*-phase are comparable (more than 40%), and by the beginning of 2021, the probability of the *L*-phase is slightly higher than the *N*-phase.

We analyzed the spring-summer (May-June-July) anomalies of surface air temperature (SAT) δT for European (ER) and Asian (AR) parts of Russia in mid-latitudes from observations since 1891 [1] (see also [3]). Tables 1a,b show the estimates for probability of spring–summer SAT anomalies δT in May-June-July for ER and AR (in brackets) for different transitions from the *N* and *E* phases at the beginning of the year with the use Nino 3 (a) and Nino 4 (b) indices from observations since 1891.

Table 1a. Probability of positive and negative surface air temperature anomalies (δT) in the ER (and AR) in May-July for different ENSO phase transitions (characterized by the Niño3 index) from observations since 1891 for ER and AR (in brackets).

***δT*, K**		***Nino 3***					
		N→E *n*=18	***N→L*** *n=11*	***N→N*** *n=39*	***E→E*** *n*=4	***E→L*** *n*=9	***E→N*** *n*=15
>0	>0	0.44 (0.50)	0.64 (0.45)	0.62 (0.62)	0.75 (0.50)	0.89 (0.44)	0.40 (0.40)
	>1K	0.17 (0.22)	0.18 (0.09)	0.31 (0.31)	0.25 (0.50)	0.56 (0.11)	0.13 (0.27)
≤0	≤0	0.56 (0.50)	0.36 (0.55)	0.38 (0.38)	0.25 (0.50)	0.11 (0.56)	0.60 (0.60)
	≤-1K	0.22 (0.06)	0.18 (0)	0.13 (0.10)	0 (0.25)	0 (0.22)	0.33 (0.27)

According to the values of the Nino3 index, 2020 began in the neutral phase. At the most probable phase transitions *N→L* and *N→N*, the probability of a positive temperature anomaly for EP in May-July is noticeably (more than one and a half times) greater than negative. For AR, the probabilities of positive and negative anomalies differ significantly for the *N→L* and *N→N* phase transitions. The highest probability of extreme temperature anomalies was estimated for the *N→N* transition with a probability for positive temperature anomalies in EP and AR (more than 30%) more than twice those for the negative ones.

Table 1b. Probability of positive and negative surface air temperature anomalies (δ*T*) in the ER (and AR) in May-July for different ENSO phase transitions (characterized by the Niño4 index) from observations since 1891 for ER and AR (in brackets).

***δT*, K**		***Nino 4***					
		N→E *n*=18	***N→L*** *n=9*	***N→N*** *n=41*	***E→E*** *n*=8	***E→L*** *n*=8	***E→N*** *n*=13
>0	>0	0.44 (0.44)	0.56 (0.44)	0.63 (0.61)	0.38 (**0.75**)	**0.88** (0.63)	0.54 (0.38)
	>1K	0.17 (0.22)	0.22 (0.11)	0.22 (0.22)	0.25 (**0.75**)	**0.50** (0.13)	0.31 (0.15)
≤0	≤0	0.56 (0.56)	0.44 (0.56)	0.37 (0.39)	**0.63** (0.25)	0.13 (0.38)	0.46 (**0.62**)
	≤-1K	0.17 (0.17)	0.11 (0)	0.17 (0.12)	**0.38** (1/8)	0 (0.13)	0.31 (0.23)

According to the Nino 4 index, the year 2020 began in the *E*-phase. At the most probable phase transitions *E→L* and *E→N*, the probability of a positive temperature anomaly for EP in May-July, as with the Nino3 index, is greater than negative. With 8 analyzed most probable phase transitions *E→L*, positive cases were observed in 7 cases, and extreme positive temperature anomalies in 4 cases in May-July for EP. For AR, the probabilities of positive and negative anomalies differ significantly for the phase transitions *E→L* and *E→N*.

This work was supported by the RSF (project No. 19-17-00240). Analysis for North Asia regions was carried out in the framework of the RFBR project (17–29–05098).

References

Meshcherskaya A.V., Mirvis V.M., Golod M.P. The drought in 2010 against the background of multiannual changes in aridity in the major grain-producing regions of the European part of Russia. *Tr. MGO,* 2011, **563**, 94–121 (in Russian)

Mokhov I.I., Timazhev A.V. Drought risk in the North Eurasian regions: Assessment of El-Nino effects. *Res. Activ. Atmos. Ocean. Modell.* E. Astakhova (ed.). WCRP Rep. No.12/2015, 2015, 2.6–2.7.

Mokhov I.I., Timazhev A.V. Weather-climate anomalies in Russian regions: El Niño-associated predictability. *Res. Activ. Atmos. Ocean. Modell*. E. Astakhova (ed.). WCRP Rep. No.15/2016, 2016, 6.9–6.10.