Predictability of climate anomalies in the North Eurasian regions during the spring-summer months in relation to El Niño: A case study for 2023

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Possible anomalies of surface air temperature and precipitation in the Russian regions in the spring-summer months of 2023 are estimated similarly to [1–6] using long-term regional seasonal data and taking into account the La Niña phase (L-phase) at the beginning of the year. Also, the results of forecast model calculations made by May 2023 [7] were taken into account. According to ensemble model calculations, the probability of transition to the E-phase by the end of 2023 ($L \to E$ transition) is expected to be more than 90%. The corresponding probability for the neutral N-phase ($L \to N$ transition) is estimated to be less than 10%, and the probability for the L-phase ($L \to L$ transition) is even lower. It is worth to note, that according to [8], the frequency of $L \to E$ and $L \to L$ transitions has been decreasing in recent decades.

Surface temperatures δT and precipitation δP are analyzed for the European (ER) and Asian (AR) regions of Russia at mid-latitudes based on observations since 1891 [9]. To assess the effects of El Niño/La Niña, their indices were used, characterized by the sea surface temperature in the regions of Niño3 and Niño4 in the equatorial latitudes of the Pacific Ocean.

Table 1. Probability of positive and negative surface air temperature anomalies (δT) in the ER (and AR) in May-June-July for different transitions from La-Nina conditions at the beginning of the year (characterized by indices Nino3 and Nino4) from observations since 1891 (n – number of years).

δT, K		>0				≤0			
ER (AR)		> 0		> 1 K		≤ 0		< -1 K	
Nino3 n=29	**$L \to E$** n=7	0.41 (0.62)	0.57 (0.71)	0.17 (0.21)	0.29 (0.14)	0.59 (0.38)	0.43 (0.29)	0.14 (0.10)	0.29 (0.29)
	$L \to N$ n=13		0.38 (0.62)		0.15 (0.23)		0.62 (0.38)		0.15 (0.08)
	$L \to L$ n=9		0.33 (0.56)		0.11 (0.22)		0.67 (0.44)		0 (0)
Nino4 n=28	**$L \to E$** n=4	0.43 (0.54)	0.50 (0.50)	0.21 (0.25)	0.25 (0.25)	0.57 (0.46)	0.50 (0.50)	0.07 (0.07)	0 (0.25)
	$L \to N$ n=14		0.43 (0.57)		0.21 (0.29)		0.57 (0.43)		0.07 (0.07)
	$L \to L$ n=10		0.40 (0.50)		0.20 (0.20)		0.60 (0.50)		0.10 (0)

Table 1 shows estimates of the probability of temperature anomalies δT in ER and AR in May-June-July for various transitions from the L-phase at the beginning of the year using different El Niño indices. According to these estimates, for the most probable $L \to E$ transition in 2023 with the formation of the canonical El Niño, characterized by the Niño3 index, positive temperature anomalies in the ER and AR are more likely. At the same time, extreme positive temperature anomalies (> 1 K) were estimated as more probable in ER than in AR. With the development of El Niño, revealed by positive anomalies of the Niño4 index, for the $L \to E$ transition, positive and negative temperature anomalies in ER and AR in May-June-July are equally probable.

Corresponding estimates of the probability of precipitation anomalies δP in ER and AR in May-June-July for various transitions from the L-phase at the beginning of the year using various El Niño indices are presented in Table 2. According to these estimates, for the most probable $L \to E$ transition in 2023 with the formation of the canonical El Niño, characterized by the Niño index3, negative and extreme (< -20%) negative precipitation anomalies are more likely in AR and less likely in ER. With the development of El Niño, revealed by positive anomalies of the Niño index4, for the $L \to E$ transition in May-June-July, negative and positive anomalies in precipitation are equally likely for the ER, and negative anomalies are more likely for the AR. At the same time, extreme (< -20%) negative precipitation anomalies are equally likely in AR and EP.

Table 2. Probability of positive and negative surface air temperature anomalies (δ*P*) in the ER (AR) in May-June-July for different transitions from La-Nina conditions at the beginning of the year (characterized by indices Nino3 and Nino4) from observations since 1891 (n – number of years).

δ*P*, %		<0				≥0			
ER (AR)		<0		< -20%		≥0		>20%	
Nino3	***L→E*** *n*=7	0.41 (0.45)	0.43 (0.57)	0.10 (0.14)	0.14 (0.29)	0.59 (0.55)	0.57 (0.43)	0.14 (0.10)	0 (0.14)
	L→N *n*=13		0.31 (0.31)		0 (0.08)		0.69 (0.69)		0.08 (0.15)
	L→L *n*=9		0.56 (0.56)		0.22 (0.11)		0.44 (0.44)		0 (0)
Nino4	***L→E*** *n*=4	0.50 (0.46)	0.50 (0.75)	0.11 (0.14)	0.25 (0.25)	0.50 (0.54)	0.50 (0.25)	0.04 (0.04)	0 (0)
	L→N *n*=14		0.43 (0.36)		0.21 (0.29)		0.57 (0.64)		0.07 (0.07)
	L→L *n*=10		0.60 (0.50)		0.20 (0.20)		0.40 (0.50)		0 (0)

The formation of noted seasonal anomalies is facilitated by atmospheric blockings against the background of a tendency for a regional decrease in precipitation, which accompanies an increase of surface air temperature. According to ensemble model estimates under warming in the 21st century an increase in the frequency of atmospheric blockings in the regions of the Northern Hemisphere is expected [10]. In [11] the regional features of summer atmospheric blockings in the Northern Hemisphere were noted for different El Niño phase transitions, taking into account the phases of the Atlantic Multidecadal and Pacific Decadal Oscillations. According to [11], in the years beginning in the La Niña phase, an increase in the frequency of atmospheric blockings over the Russian mid-latitudinal European regions, over the Urals and Western Siberia, and also over the Far East is manifested.

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