Warm and cold winters in the North Eurasian regions:
Assessment of El-Niño effects

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The probability of warm and cold winters, in particular extremely warm and very cold winters, in the regions of Northern Eurasia is estimated for different phases of El-Nino. Monthly-mean data for surface temperature anomalies (SAT) δT in January and February for the period 1936-2014 from [1] for different regions are used. In particular, the ratio of δT for January and February to the standard deviation σT for the period 1961-1990 (index $\alpha = \delta T/\sigma T$) was used for different regions. Winters range from extremely warm (EWW) and extremely cold (ECW) to considerably warm (CWW) and considerably cold (CCW), as well as moderately warm (MWW) and moderately cold (MCW) winters.

Table 1 (a, b, c) presents the number and probability estimates of warm and cold winters for ETR (a), Baikal and Transbaikalia (b) and Amur and Primorye (c) south of 60°N during the onset of various El-Nino phases, characterized by Nino3 and Nino4 indices. The largest total number of cold and warm winters is characteristic for neutral (*N*) phases of El-Niño for all considered regions. This is due to the fact that the total number of years in the *N*-phase is greater than the total number of years in the El-Nino (*E*) and La-Nina (*L*) phases. Estimates of the probability of an abnormal winter for the expected *E*-phase or *L*-phase can be significantly higher than the corresponding estimates for the *N*-phase. For example, the probability of a warm winter for ETR is estimated to be the highest in the *E*-phase (more than 2/3), and the probability of a cold winter is estimated as the highest in the *L*-phase.

Table 1a.

1936-2014		(a) European region							
		Warm Winters				Cold Winters			
		EWW	*CWW*	*MWW*	∑	*ECW*	*CCW*	*MCW*	∑
Nino3	*N* $n_{\Sigma}=44$	4 (0.09)	10 (0.23)	11 (0.25)	25 (0.57)	5 (0.11)	6 (0.14)	8 (0.18)	19 (0.43)
	L $n_{\Sigma}=19$	3 (0.16)	4 (0.21)	2 (0.11)	9 (0.47)	3 (0.16)	4 (0.21)	3 (0.16)	10 (0.53)
	E $n_{\Sigma}=16$	1 (0.06)	4 (0.25)	6 (0.38)	11 (0.69)	0 (0)	1 (0.06)	4 (0.25)	5 (0.31)
Nino4	*N* $n_{\Sigma}=40$	3 (0.08)	10 (0.25)	8 (0.20)	21 (0.53)	3 (0.08)	6 (0.15)	10 (0.25)	19 (0.48)
	L $n_{\Sigma}=18$	3 (0.17)	4 (0.22)	2 (0.11)	9 (0.50)	3 (0.17)	4 (0.22)	2 (0.11)	9 (0.50)
	E $n_{\Sigma}=21$	2 (0.10)	4 (0.19)	9 (0.43)	15 (0.71)	2 (0.10)	1 (0.05)	3 (0.14)	6 (0.29)

The greatest probability of warm winters for ETR in years starting in the *E*-phase is mainly associated with MWW. Estimates of the MWW probabilities for ETR in the *E*-phase are up to two or more times greater than in other phases. At the same time the estimates of the number and probability of cold winters for ETR are minimal in the *E*-phase, and the number and probability estimates of warm winters are in the *L*-phase. The lowest values of the cold winter probability for ETR are estimated for the *E*-phase. The probability of warm winters for ETR is estimated to be maximum in the E-phase and this is mainly due to MWW.

Table1b.

1936-2014		(b) Baikal Lake region							
		Warm Winters				Cold Winters			
		EWW	*CWW*	*MWW*	∑	*ECW*	*CCW*	*MCW*	∑
Nino3	*N* n_Σ=44	4 (0.09)	13 (0.30)	5 (0.11)	22 (0.50)	5 (0.11)	6 (0.14)	11 (0.25)	22 (0.50)
	L n_Σ=19	4 (0.21)	4 (0.21)	3 (0.16)	11 (0.58)	0 (0)	0 (0)	8 (0.42)	8 (0.42)
	E n_Σ=16	0 (0)	1 (0.06)	3 (0.19)	4 (0.25)	3 (0.19)	5 (0.31)	4 (0.25)	12 (0.75)
Nino4	*N* n_Σ=40	3 (0.08)	10 (0.25)	3 (0.08)	16 (0.40)	7 (0.18)	5 (0.13)	11 (0.28)	23 (0.58)
	L n_Σ=18	3 (0.17)	5 (0.28)	4 (0.22)	12 (0.67)	0 (0)	0 (0)	6 (0.33)	6 (0.33)
	E n_Σ=21	2 (0.10)	3 (0.14)	4 (0.19)	9 (0.43)	1 (0.05)	6 (0.29)	6 (0.29)	13 (0.62)

The probability of warm winters for Pribaikalye and Transbaikalia is usually higher in the *L*-phase, and the probability of cold winters is estimated as the highest in the *E*-phase (up to ¾). The number and probability estimates of cold winters in the Baikal and Transbaikalia regions are minimal in the *L*-phase, and the number of warm winters in the *E*-phase. It should be noted that in 24 years with ECW and CCW such winters were never observed in this region in the *L*-phase.

Table 1c.

1936-2014		(c) Amur River region							
		Warm Winters				Cold Winters			
		EWW	*CWW*	*MWW*	∑	*ECW*	*CCW*	*MCW*	∑
Nino3	*N* n_Σ=44	5 (0.11)	8 (0.18)	9 (0.20)	22 (0.50)	4 (0.09)	7 (0.16)	11 (0.25)	22 (0.50)
	L n_Σ=19	2 (0.11)	8 (0.42)	1 (0.05)	11 (0.58)	1 (0.05)	2 (0.11)	5 (0.26)	8 (0.42)
	E n_Σ=16	1 (0.06)	2 (0.13)	4 (0.25)	7 (0.44)	3 (0.19)	2 (0.13)	4 (0.25)	9 (0.56)
Nino4	*N* n_Σ=40	3 (0.08)	7 (0.18)	7 (0.18)	17 (0.43)	2 (0.05)	8 (0.20)	13 (0.33)	23 (0.58)
	L n_Σ=18	2 (0.11)	7 (0.39)	2 (0.11)	11 (0.61)	2 (0.11)	1 (0.06)	4 (0.22)	7 (0.39)
	E n_Σ=21	3 (0.14)	4 (0.19)	5 (0.24)	12 (0.57)	4 (0.19)	2 (0.10)	3 (0.14)	9 (0.43)

It is worth to note, that the probability of a warm winter in the Amur Region and Primorye at El Niño with positive anomalies of equatorial SST in the central Pacific Ocean is estimated to be 30% higher than with positive anomalies in the eastern Pacific Ocean, and the corresponding probability of a cold winter - on the contrary - by 30% less.

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References

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