Cold winters in the North Eurasian regions:
Risk assessment of El Niño effects

I.I. Mokhov[1,2]

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

The impacts of the El Niño phenomena are significant on a global scale, including North Eurasian regions (Mokhov, Timazhev, 2015; Mokhov, Timazhev, 2016). Here the risk of cold winters, in particular extremely cold winters, in North Eurasian regions is assessed for different El Niño phases. The monthly-mean data for surface air temperature (SAT) anomalies δT in January and February for the period 1936-2014 from (Meshcherskaya and Golod, 2015) for different regions are used. In particular, the ratio of SAT anomalies for January and February to the standard deviation σT for the period 1961-1990 (index $\alpha = \delta T/\sigma T$) was used for different Russian regions. Winters are ranged for each region as extremely cold winters (ECW), considerably cold winters (CCW) and moderately cold winters (MCW).

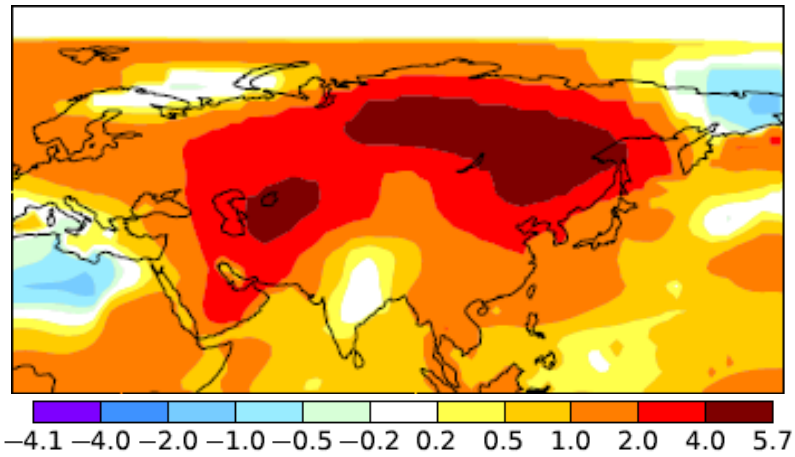

Figure 1. Regional SAT anomalies (K) in January 2019 from GISS data.

Figure 1 shows significant positive SAT anomalies in North Eurasian regions during the El Nino in January 2019 (relative to the period 1951-1980) from GISS data (https://data.giss.nasa.gov/gistemp/).

Table 1. Probability of different El Nino phases (characterized by indices Nino3 and Nino4) during 1936-2014.

1936-2014	***N*** n_N / n_Σ	***E*** n_E / n_Σ	***L*** n_L / n_Σ
Nino3	**44/79 (0.56)**	**16/79 (0.20)**	**19/79 (0.24)**
Nino4	**40/79 (0.51)**	**21/79 (0.27)**	**18/79 (0.23)**

Table 1 presents estimates for probabilities (n_E/n_Σ , n_N/n_Σ , n_L/n_Σ) of years starting with El Niño (*E*, n_E), La Niña (L, n_L) or neutral (*N*, n_N) phase of ENSO processes detected with the use different indices (Nino3 and Nino4) for the period 1936-2014 (n_Σ=79 years).

Table 2. Pobability of extremely cold winters (ECW), considerably cold winters (CCW) and moderately cold winters (MCW) in three North Eurasian regions to the south from 60ºN in different phases of El Nino, characterized by indices Nino3 and Nino4.

1936-2014		**European region**			**Baikal Lake region**			**Amur River region**		
		ECW	***CCW***	***MCW***	***ECW***	***CCW***	***MCW***	***ECW***	***CCW***	***MCW***
Nino3	***N***	**5/8 (0.63)**	6/11 (0.55)	8/15 (0.53)	**5/8 (0.63)**	6/11 (0.55)	11/23 (0.48)	4/8 (0.50)	**7/11 (0.64)**	11/20 (0.55)
	L	**3/8 (0.38)**	**4/11 (0.36)**	3/15 (0.20)	0/8 (0)	0/11 (0)	**8/23 (0.35)**	1/8 (0.13)	2/11 (0.18)	**5/20 (0.25)**
	E	0/8 (0)	1/11 (0.09)	**4/15 (0.27)**	**3/8 (0.38)**	**5/11 (0.45)**	4/23 (0.17)	**3/8 (0.38)**	2/11 (0.18)	4/20 (0.20)
Nino4	***N***	3/8 (0.38)	**6/11 (0.55)**	**10/15 (0.67)**	**7/8 (0.88)**	**5/11 (0.55)**	11/23 (0.48)	2/8 (0.25)	**8/11 (0.73)**	**13/20 (0.65)**
	L	**3/8 (0.38)**	**4/11 (0.36)**	2/15 (0.13)	0/8 (0)	0/11 (0)	**6/23 (0.26)**	**2/8 (0.25)**	1/11 (0.09)	4/20 (0.20)
	E	2/8 (0.25)	1/11 (0.09)	3/15 (0.20)	1/8 (0.13)	**6/11 (0.55)**	6/23 (0.26)	**4/8 (0.50)**	2/11 (0.18)	3/20 (0.15)

Table 2 shows estimates for probabilities of extremely cold winters (ECW), considerably cold winters (CCW) and moderately cold winters (MCW) in three North Eurasian regions to the south from 60ºN in different phases El Nino, characterized by indices Nino3 and Nino4. Probability larger than probability of corresponding El Nino phase are noted in bold. According to Table 2 there is a small probability of ECW and CCW in years starting in *L*-phase in the Baikal Lake region and in *E*-phase in the European region. Quite different risks of cold winters are estimated for the Amur River basin on Far East. The ECW probability for this region in the *E*-phase is quite high. In the European region the probability of ECW and CCW is quite high in the *L*-phase.

This work was supported by the RSF (project No. 19-17-00240). The results obtained in the framework of the RAS Presidium program "Climate change: causes, risks, consequences, problems of adaptation and regulation" and RFBR (projects No. 17-05-01097 and No. 17-29-05098) were used.

References

Mescherskaya A.V., Golod M.P. Catalogs of abnormal winters over the Russian territory. Proc. MGO, 2015, **579**, 130−162. (in Russian)

Mokhov I.I., Timazhev A.V. Drought risk in the North Eurasian regions: Assessment of El-Nino effects. *Res. Activ. Atmos. Ocean. Model.* 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. Model*. E. Astakhova (ed.). WCRP Rep. No.15/2016, 2016, 6.9–6.10.