



JULY 05-11, 2018, TOMSK, RUSSIA  
INTERNATIONAL CONFERENCE  
and Early Career Scientists School on Environmental Observations,  
Modeling and Information Systems

# Variability of synoptic vortex circulation over Siberia for the period of 1976-2015

Podnebesnykh N.V., Ippolitov I.I., Loginov S.V.,  
Kharyutkina E.V.



Institute of monitoring of climatic and ecological systems SB RAS  
634055, Tomsk, 10/3 Akademicheskyy ave., e-mail: [kh\\_ev@imces.ru](mailto:kh_ev@imces.ru)

An analysis of annual averaged characteristics (number and pressure in the center) of cyclones and anticyclones was carried out for the territory of Siberia ( $50^{\circ}$ - $70^{\circ}$ N,  $60^{\circ}$ - $110^{\circ}$ E) over the period of 1976-2015

# **The synoptic vortex characteristics were derived using two methods:**

1. manual processing of surface synoptic maps for the main meteorological times (00, 06, 12, 18 UTC)
2. manual processing of surface pressure maps, constructed using the NCEP/DOE AMIP II (1979-2011) and JRA-55 (2012-2015) reanalysis databases.

# Results

1. The significant contribution (28%) to anomalous increase in number of cyclones during 2012-2015 belongs to local cyclones where mean pressure in the center is 1003 hPa.

If we use reanalysis data, these cyclones could be uncounted due to its coarse grid. This fact explains less number of cyclones from reanalysis maps, in comparison with synoptic ones. And that is also the reason of overestimated values of pressure in the center of cyclones, if they are derived using synoptic maps.

2. The analysis of dynamics in number of cyclones allow us to suppose, that there is an oscillation process with the period of 20 years in its interannual variability.

# Variability of synoptic vortex circulation over Siberia for the period of 1976-2015

Podnebesnykh N.V., Ippolitov I.I., Loginov S.V., Kharyutkina E.V.

Institute of monitoring of climatic and ecological systems SB RAS, 634055, Tomsk, 10/3 Akademicheskoy ave.  
e-mail: [podnebesnykhny@inbox.ru](mailto:podnebesnykhny@inbox.ru)

An analysis of annual averaged characteristics (number and pressure in the center) of cyclones and anticyclones was carried out for the territory of Siberia (50°-70°N, 60°-110°E) over the period of 1976-2015

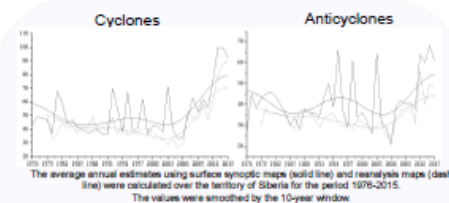
The synoptic vortex characteristics were derived using two methods:

1. manual processing of surface synoptic maps for the main meteorological times (00, 06, 12, 18 UTC)
2. manual processing of surface pressure maps, constructed using the NCEP/DOE AMIP II (1979-2011) and JRA-55 (2012-2015) reanalysis databases.

The methodology of map processing and data of surface synoptic maps over 1976-2011 were taken from (Gorbatenko V.P. et al., 2007; Podnebesnykh N.V. et al., 2017).

## Results

### Number



Interestingly, that there is a well-pronounced tendency to increase in number of both cyclones and anticyclones over 2000-2015, especially during 2012-2015.

#### Cyclones/Synoptic maps

Year	N	NW	W	SW	S	Local
2012	6	39	15	7	5	24
2013	7	25	24	9	9	26
2014	12	26	30	11	8	33
2015	6	24	17	6	7	32
	31	94	76	33	29	105

Moreover, the cyclones moving from north-western (NW) and western (W) trajectories, and also local cyclones, have the main contribution to the increase in the total number of cyclones (synoptic maps data).

The biggest contribution to the increase in number of anticyclones during 2012-2015 (surface synoptic maps), according to the Table 2, belongs to anticyclones moving from northern (north) trajectories.

#### Anticyclones/Synoptic maps

Year	N	NW	W	SW	S	Local
2012	18	9	16	15	5	5
2013	17	9	13	13	8	5
2014	14	13	14	10	17	7
2015	10	14	9	12	16	6
	60	45	52	50	46	26

Seasonal variations of number of cyclones and anticyclones during 2012-2015 are presented in the Tables 3 and 4, respectively.

#### Cyclones/Synoptic maps

Year	N	NW	W	SW	S	Local
2012	7	21	18	6	5	32
2013	7	9	12	29	10	5
2014	6	11	34	9	18	33
2015	9	40	14	8	3	26
	31	94	76	33	29	105

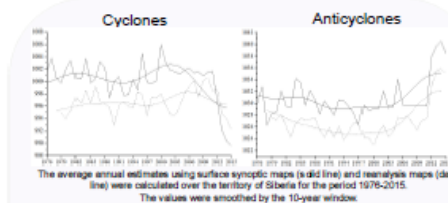
#### Anticyclones/Synoptic maps

Year	N	NW	W	SW	S	Local
2012	17	9	16	15	5	5
2013	17	9	13	13	8	5
2014	14	13	14	10	17	7
2015	10	14	9	12	16	6
	60	45	52	50	46	26

At that time local circulation prevails in winter and summer seasons.

As for annual variability of anticyclones south-west cyclones dominates in winter, and north-eastern—in summer.

### Pressure in the center



Here we can see the significant decrease/increase of pressure in the centers of cyclones/anticyclones during 2012-2015, i.e. two types of synoptic vortices became more intensive over this time interval.

#### Cyclones/Synoptic maps

Year	N	NW	W	SW	S	Local
2012	993.0	991.1	993.1	994.5	1000.2	1008.9
2013	991.0	980.4	992.0	989.9	996.0	1003.4
2014	985.0	987.3	989.6	985.4	993.0	1001.6
2015	985.3	984.3	991.0	988.9	990.1	998.1
	988.6	985.8	991.4	989.7	994.8	1003.0

Here are the values of the pressure in the centers of cyclones, moving to the territory of Siberia from different directions during 2012-2015.

It follows, that the deepest (intensive) cyclones are the north and north-western formations, and the shallowest—local cyclones.

#### Anticyclones/Synoptic maps

Year	N	NW	W	SW	S	Local
2012	1041.8	1036.8	1030.9	1036.3	1041.9	1041.9
2013	1037.6	1037.1	1037.2	1043.9	1043.4	1043.4
2014	1045.7	1035.9	1040.6	1039.5	1037.6	1037.6
2015	1036.9	1040.5	1033.2	1032.1	1047.9	1047.9
	1040.5	1037.6	1036.7	1038.3	1043.7	1043.7

Here are the values of the pressure in the centers of anticyclones, moving to the territory of Siberia during 2012-2015.

#### Cyclones/Synoptic maps

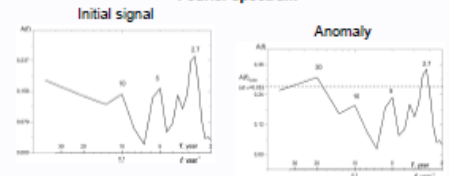
Year	N	NW	W	SW	S	Local
2012	994.6	983.9	990.7	997.8	996.9	1013.4
2013	983.0	986.6	988.8	985.2	987.0	998.5
2014	989.3	990.5	994.6	992.0	993.3	997.8
2015	988.5	987.1	991.9	985.0	990.8	1002.9
	988.9	987.1	992.0	990.0	995.8	1003.0

#### Anticyclones/Synoptic maps

Year	N	NW	W	SW	S	Local
2012	1050.0	1059.9	1059.0	1059.6	1049.7	1049.7
2013	1050.0	1056.4	1051.5	1053.0	1045.5	1045.5
2014	1051.1	1052.2	1051.8	1052.5	1052.2	1052.2
2015	1050.4	1044.7	1042.0	1042.1	1041.2	1041.2
	1050.9	1044.1	1042.1	1050.8	1040.4	1040.4

The most intensive cyclones during this period are cyclones, moving to the territory from north-western trajectories in winter and from northern in spring. The most intensive anticyclones move to Siberia in winter from western, north-western and south-western trajectories.

## Time scales of vortex circulation variability Fourier spectrum



## Summary

1. The significant contribution (28%) to anomalous increase in number of cyclones during 2012-2015 belongs to local cyclones where mean pressure in the center is 1003 hPa. If we use reanalysis data, these cyclones could be uncoupled due to its coarse grid. This fact explains less number of cyclones from reanalysis maps, in comparison with synoptic ones. And that is also the reason of overestimated values of pressure in the center of cyclones, if they are derived using synoptic maps.
2. The analysis of dynamics in number of cyclones allow us to suppose, that there is an oscillation process with the period of 20 years in its interannual variability.