The trends of the wind characteristics over the territory of the Vostochny cosmodrome

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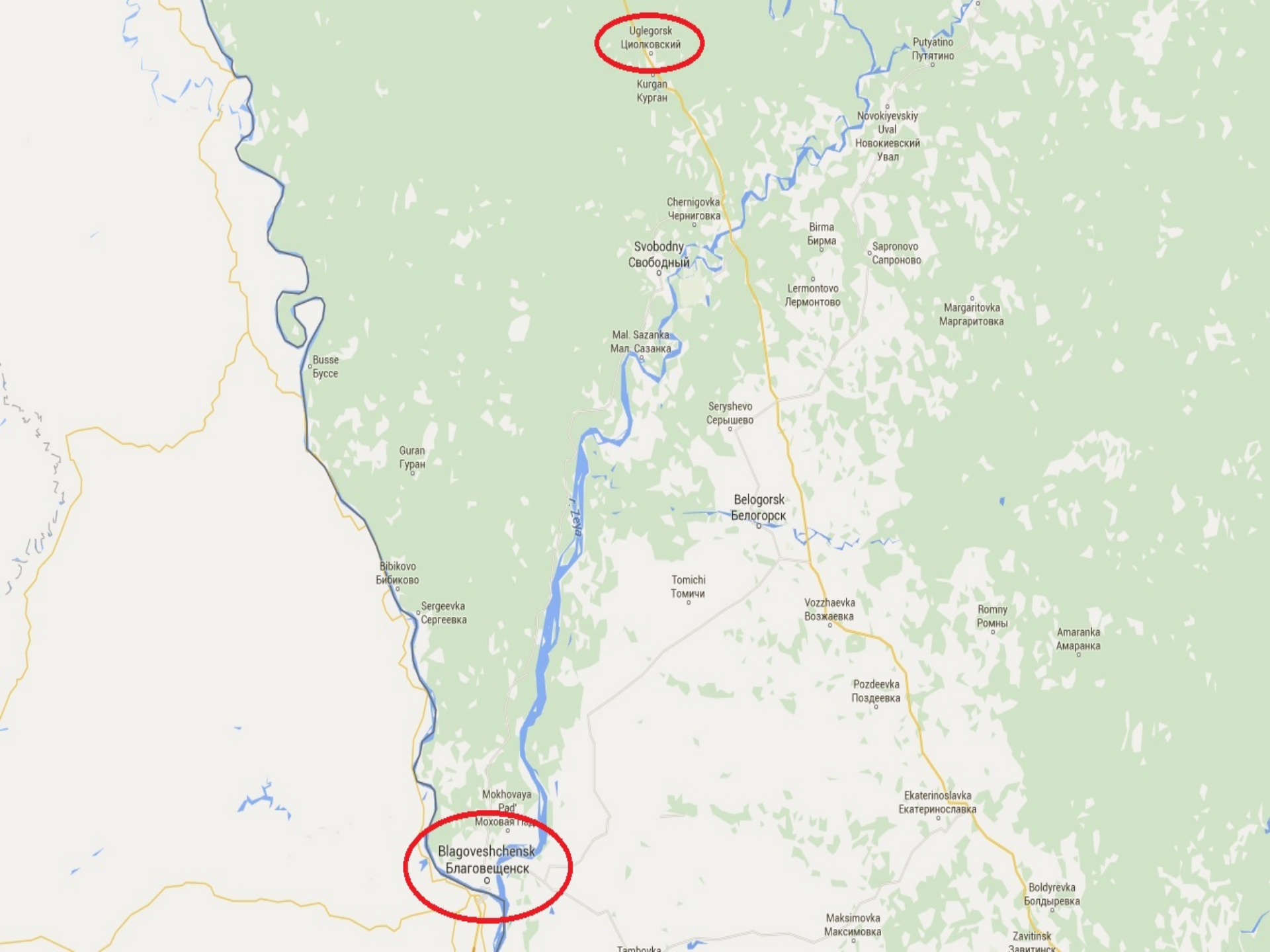
Introduction

- Prior to the full commissioning of the Vostochny cosmodrome is important to study the wind characteristics in the layer from the earth's surface up to an altitude of 25 km.
- The purpose of this report is to identify the trends in long-term series of the wind characteristics on the territory of the Vostochny cosmodrome with help the upper-air sounding data (for the period 1985–2014) and the NCEP/NCAR reanalysis (for the period 1948–2014).


Uglegorsk
Циолковский
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Новокиевский Увал
Chernigovka
Черниговка
Svobodny
Свободный
Birma
Бирма
Sapronovo
Сапроново
Lermontovo
Лермонтово
Margaritovka
Маргаритовка
Mal. Sazanka
Мал. Сазанка
Busse
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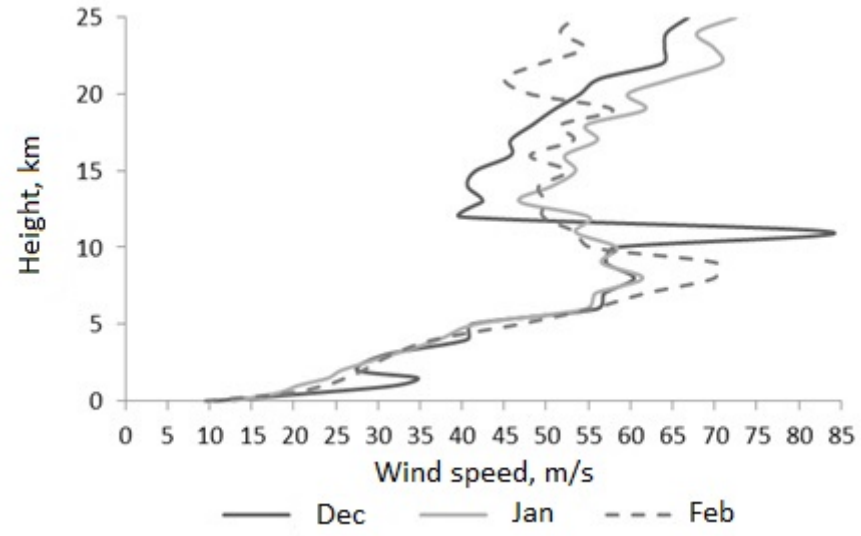
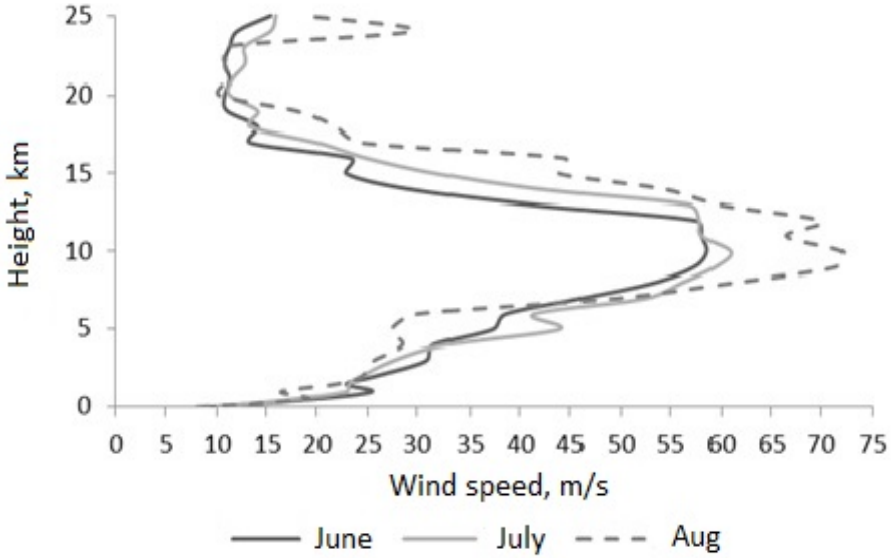
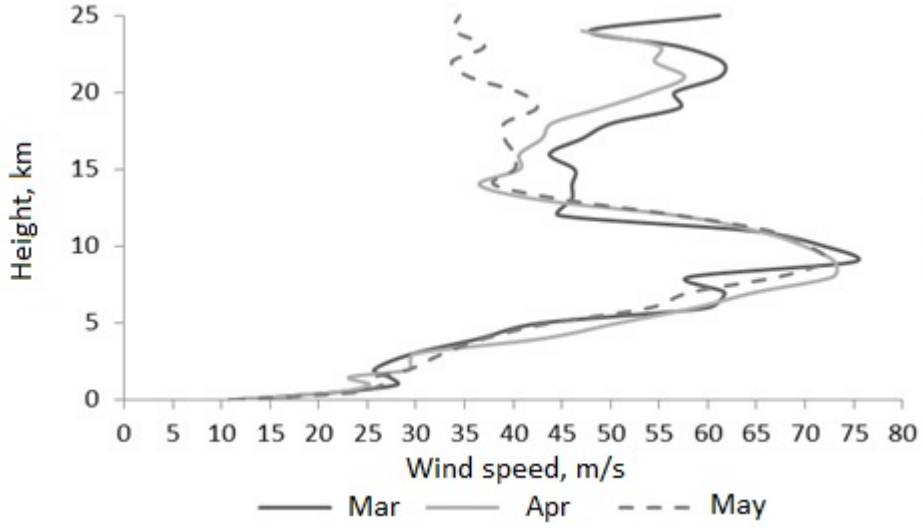
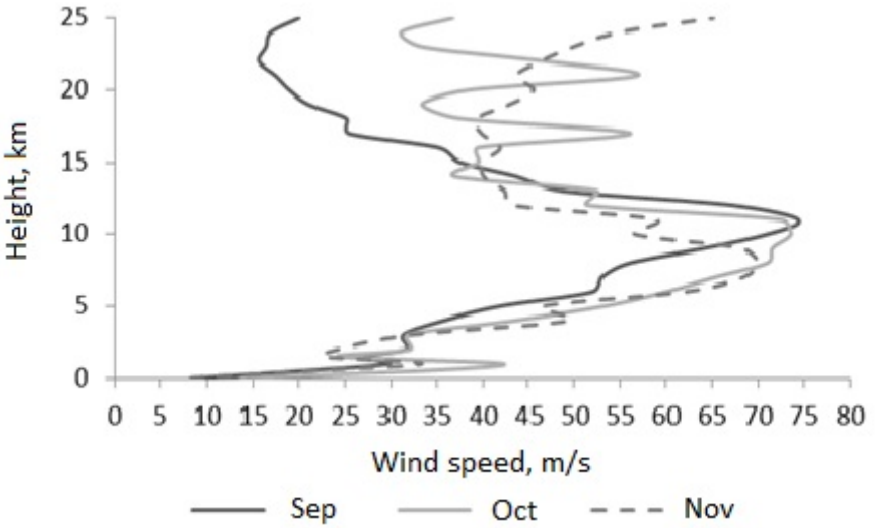
Seryshevo
Серышево
Guran
Гуран
Belogorsk
Белогорск
Bibikovo
Бибиково
Sergeevka
Сергеевка
Tomichi
Томичи
Vozzhaevka
Возжаевка
Romny
Ромны
Amaranka
Амаранка
Pozdeevka
Поздеевка
Mokhovaya Pad'
Моховая Падь
Blagoveshchensk
Благовещенск
Ekaterinoslavka
Екатеринославка
Boldyrevka
Болдыревка
Maksimovka
Максимовка
Zavitinsk
Завитинск

Maximum wind speed (the upper-air sounding data, 1985-2014)









The percentage of the number of wind speed values for the wind speed bands

Height, km	The wind speed bands, m/s														
	30-39	40-49	50-59	60-69	more 70	30-39	40-49	50-59	60-69	more 70	30-39	40-49	50-59	60-69	more 70
	December					January					February				
7	13	5	0,6	–	–	9	4	0,7	0,2	–	14	8	1,8	0,2	–
8	14	7	1,3	0,2	–	14	5	0,8	0,3	–	14	7	2,7	0,3	–
9	13	5	1,3	–	–	12	3	1,2	–	–	15	5	3	0,7	–
10	10	3	0,7	0,5	0,2	10	3	0,2	0,1	–	12	2	0,5	–	0,3
11	9	2	0,5	–	0,3	10	0,9	0,2	–	–	14	3	0,2	–	0,4
12	8	1	0,4	–	–	13	0,5	0,1	–	–	12	2	0,2	–	0,2
13	8	1	0,5	–	–	12	1,8	0,2	–	–	12	2	0,2	–	0,2
14	9	1	0,5	–	–	19	3	0,2	–	0,2	13	2	0,3	–	0,2
	March					April					May				
7	12	5	2	0,5	–	11	6	1	0,5	–	11	4	1	0,2	–
8	13	6	2	0,5	–	14	9	3	1	0,2	14	9	3	0,5	–
9	12	4	2	0,7	–	12	10	4	2	0,2	13	9	2	0,5	–
10	13	5	1	0,8	0,2	12	8	4	2	–	12	7	3	0,7	–
11	12	2	0,3	–	–	11	6	2	0,5	0,2	8	6	2	0,3	–
12	10	1	–	–	–	6	2	1	–	–	7	2	1	0,2	–
13	9	1	–	–	–	5	1	0,5	–	–	5	1	–	–	–
14	8	1	–	–	–	4	0,5	–	–	–	3	0,5	–	–	–
	June					July					August				
7	4	1	–	–	–	3	0,5	0,3	–	–	3	1	0,2	–	–
8	5	2	0,5	–	–	5	2	0,3	0,1	–	8	2	1	0,2	–
9	6	3	0,5	0,2	–	6	4	0,4	0,2	–	10	5	1	0,2	–
10	6	5	0,5	–	–	8	6	1	0,4	–	10	7	3	0,2	–
11	6	3	0,4	–	–	10	5	2	–	–	12	8	3	0,4	–
12	4	1	0,2	–	–	10	3	1	–	–	12	7	3	0,2	–
13	0,5	0,2	–	–	–	4	1	–	–	–	9	5	1	–	–
14	0,3	–	–	–	–	3	0,5	–	–	–	8	3	0,5	–	–
	September					October					November				
7	9	2	0,3	–	–	12	4	1	0,5	–	15	8	1,5	0,8	–
8	17	5	2	–	–	18	9	2,5	1	0,1	18	11	2	0,8	0,2
9	15	7	2	0,3	–	16	9	3	1	0,2	18	7	3	0,7	0,2
10	16	6	3	0,5	0,1	17	9	3	1	0,2	17	6	3	0,4	0,2
11	15	5	1,5	0,6	0,2	14	5	1	–	–	13	3	1	0,2	–
12	12	4	1,2	0,4	–	12	3	0,5	–	–	11	2	1	–	–
13	10	2	0,5	–	–	9	1	0,5	–	–	8	1	0,5	–	–
14	8	1	–	–	–	9	0,5	–	–	–	10	0,5	–	–	–

The upper-air sounding data, 1985-2014

Height layer, km	Average wind speed, m/s												
	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Year
7-10	20±11	20±11	22±11	21±12	22±13	22±13	15±10	14±10	17±11	21±12	24±12	24±12	20±12
10-14	19±8	20±9	21±9	19±9	19±10	17±13	13±8	16±10	20±12	21±10	22±10	22±9	19±10

The NCEP/NCAR reanalysis, 1985-2014

Height layer, km	Average wind speed, m/s												
	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Year
7-10	21±4	19±4	20±4	20±3	22±4	21±4	15±3	15±4	18±4	19±4	23±4	24±4	20±4
10-14	20±4	19±4	20±4	20±4	20±5	19±4	14±3	17±4	22±5	21±4	23±4	24±4	20±4

The NCEP/NCAR reanalysis, 1948-2014

Height layer, km	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Year
	Trends of wind speed, m/s per decade												
7-10	0.2	0.2	**0.7**	**0.4**	-0.2	**-0.4**	0.2	0.0	-0.2	**0.6**	0.2	0.2	0.1
10-14	0.0	0.1	**0.8**	0.3	-0.4	**-0.6**	-0.1	-0.2	-0.3	**0.5**	0.1	0.0	0.0
	Predominant wind directions and their trends, ‰ per decade												
7-10	NWW -0.09	NWW -0.06	NWW 0.07	NWW -0.02	W **-0.19**	W **-0.28**	W **-0.11**	SWW **-0.23**	SWW **-0.22**	W -0.01	W -0.06	W -0.08	W **-0.11**
10-14	NWW 0.00	NWW -0.07	NWW **0.25**	NWW -0.01	W **-0.22**	W **-0.23**	NWW **-0.14**	W **-0.19**	SWW -0.12	W -0.01	W -0.04	W -0.06	W **-0.08**

Summary

- The largest average wind speeds are observed in autumn (October, November), the lowest in the summer in line with the position of the high-altitude frontal zone.
- Long-term trends in annual average wind speed in the upper troposphere over the territory of the Vostochny cosmodrome have not been identified.
- The most statistically significant increase in the wind velocity observed in February and September that offset by a decrease in velocity in May and July.
- Spring and summer long-term decrease in the wind speed in the upper troposphere is due to the weakening of the zonal component.
- The winter wind rate increase is accompanied by increased north meridional component in the upper troposphere. The western wind transfer virtually unchanged in the autumn.
- In the layer of the lower stratosphere (14-20 km) is seen intensification of the zonal component of the wind speed.


Thanks for your attention!