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BACHELOR GRADUATION WORK

Variability of atmospheric electricity characteristics in Saint-Petersburg

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At last time special attention is devoted to studying factors affecting variability of the atmosphere electric field parameters. It's closely related with the meteorological and geophysical analyzing which shows that atmospheric electricity can be connecting-link between variability of solar activity and troposphere climatic characteristics. Moreover, as we can see from research result, atmosphere electricity is one of the atmospheric factors which affects to the biosphere and humans organism.

The goal of my bachelor graduation work is studying meteorological atmosphere regime on the atmosphere electricity parameters.

For accomplishment assigned tasks meteorological observed date and atmosphere electricity observed date were analyzed. All observations were obtained in the Central Geophysical Observatory named by A.I.Voeiykov. The synoptic information was used for data result analyzing.

Atmosphere electricity parameters variability are investigated in the present work during 1999-2003 years. More detail researching was made by measurement results in 1999 year.

My bachelor graduation work consists of following chapters:

1. Ionization state of atmosphere
2. Atmospheric electric field
3. Atmospheric electric field variability researching
 - 3.1. Time variability of atmospheric electric field.
 - 3.2. Meteorological regime influence on the atmospheric electric field

The results of meteorological observations and atmospheric electric field observations allowed to compare statistical database of following parameters:

1. meteorological parameters: T, RH, P, precipitation and wind data
2. atmospheric electric field strength
3. positive and negative conductivity
4. solar activity parameter (Wolf's number)



Statistical adaptation allowed to get following statistical values:

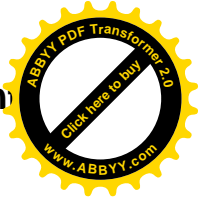
1. Average mean for every day
2. Median
3. Values extremums during the day
4. Amplitude of value daily variability
5. Value of standard deviation

Example of this data base you can see on the picture (1)

Picture 1 – Example of the statistical date base

1 Date	2 Valid N	3 Mean	4 Median	5 Minimum	6 Maximum	7 Range	8 Variance	9 Std.Dev.
1-Jan-99	24,00	92,58	95,00	3,00	166,00	163,00	1293,30	35,96
2-Jan-99	24,00	93,96	63,00	12,00	216,00	204,00	4133,87	64,30
3-Jan-99	24,00	106,17	104,00	54,00	194,00	140,00	922,14	30,37
4-Jan-99	24,00	57,96	58,00	-4,00	129,00	133,00	1579,78	39,75
9-Jan-99	24,00	260,38	233,00	171,00	435,00	264,00	5138,07	71,68
10-Jan-99	24,00	243,96	236,00	159,00	354,00	195,00	2210,91	47,02
11-Jan-99	22,00	304,00	273,00	120,00	669,00	549,00	14532,00	120,55
12-Jan-99	24,00	172,25	128,00	77,00	502,00	425,00	10947,59	104,63
13-Jan-99	24,00	121,96	120,00	57,00	211,00	154,00	1299,95	36,05
14-Jan-99	24,00	177,33	164,00	76,00	329,00	253,00	5742,32	75,78
15-Jan-99	24,00	142,67	134,00	101,00	226,00	125,00	840,41	28,99
16-Jan-99	24,00	182,96	167,00	74,00	291,00	217,00	3446,56	58,71
17-Jan-99	24,00	46,37	47,00	-122,00	194,00	316,00	7841,29	88,55
18-Jan-99	24,00	-70,33	-71,00	-558,00	223,00	781,00	62060,23	249,12
19-Jan-99	24,00	156,17	161,00	34,00	281,00	247,00	4696,75	68,53
20-Jan-99	24,00	-67,71	-68,00	-314,00	122,00	436,00	18263,43	135,14
21-Jan-99	24,00	-25,21	-41,00	-236,00	175,00	411,00	10311,30	101,54
22-Jan-99	24,00	-31,50	-46,00	-366,00	146,00	512,00	17546,61	132,46
23-Jan-99	24,00	113,87	92,00	21,00	224,00	203,00	3251,42	57,02
24-Jan-99	24,00	157,21	113,00	37,00	660,00	623,00	23819,13	154,33
25-Jan-99	24,00	567,88	453,00	38,00	1559,00	1521,00	223179,16	472,42
26-Jan-99	24,00	903,71	236,00	86,00	2756,00	2670,00	954055,52	976,76
27-Jan-99	24,00	111,08	114,00	65,00	164,00	99,00	971,12	31,16
28-Jan-99	24,00	196,71	185,00	75,00	355,00	280,00	7656,22	87,50

For information analyze were used standardized meanings of studying characteristics.

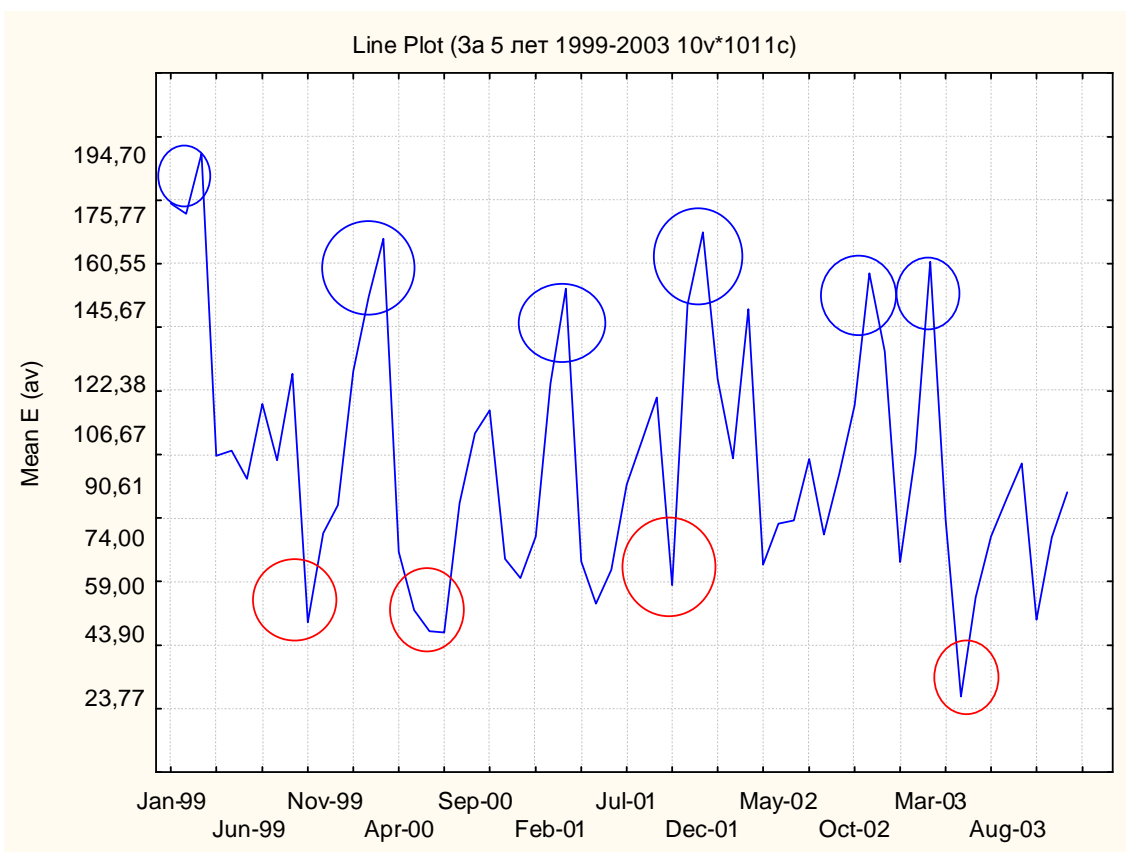


The researching of atmosphere electric field intensity in Saint Petersburg

3.1 Time variability of the atmosphere electric field intensity in Saint-Petersburg.

From atmosphere electric field intensity annual variation (pic. 3.1) follows that maximum values were observed in summer months and minimum values were observed in winter months

Picture 3.1 - atmosphere electric field intensity annual variation during 1999-2003



○ — winter monthes

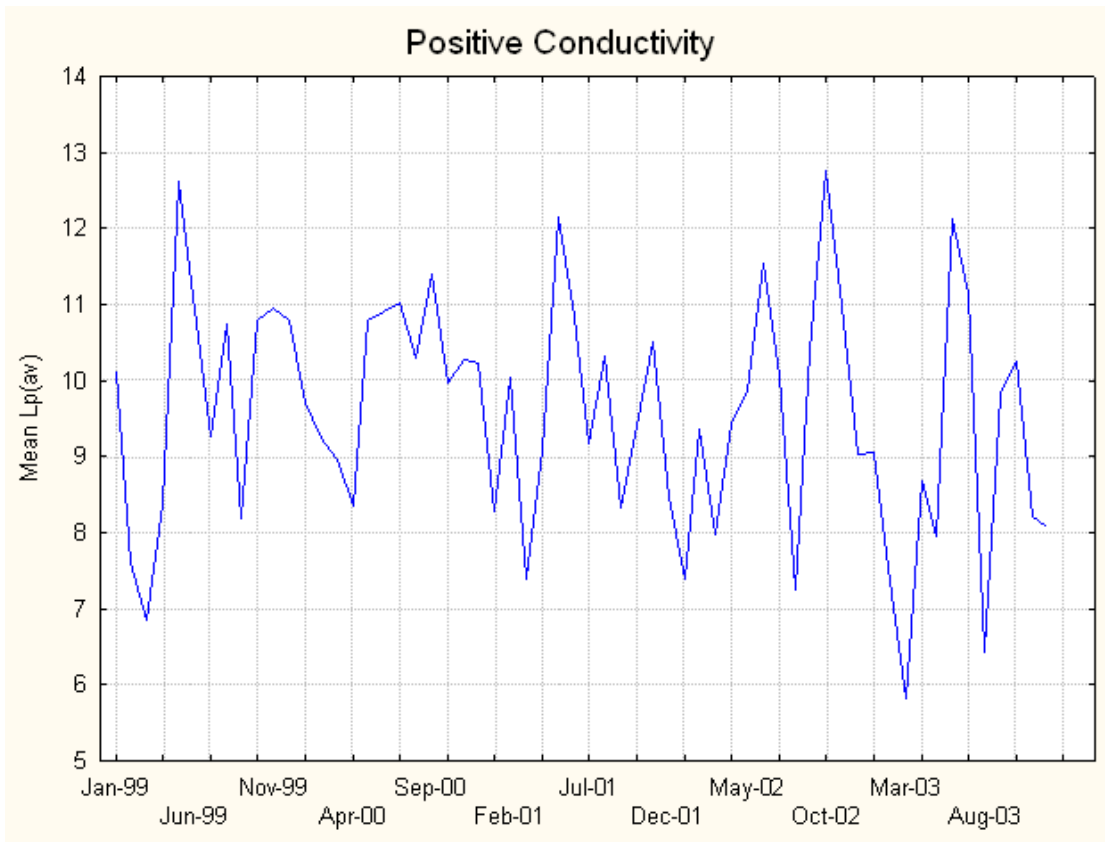
○ — summer monthes



In this work was visual demonstration that there is correlation dependence between meteorological parameters variation and atmospheric electricity parameters variation. There wasn't goal to find numerical correlation of values variation in assigned task, but there was a goal to show availability of this correlation.

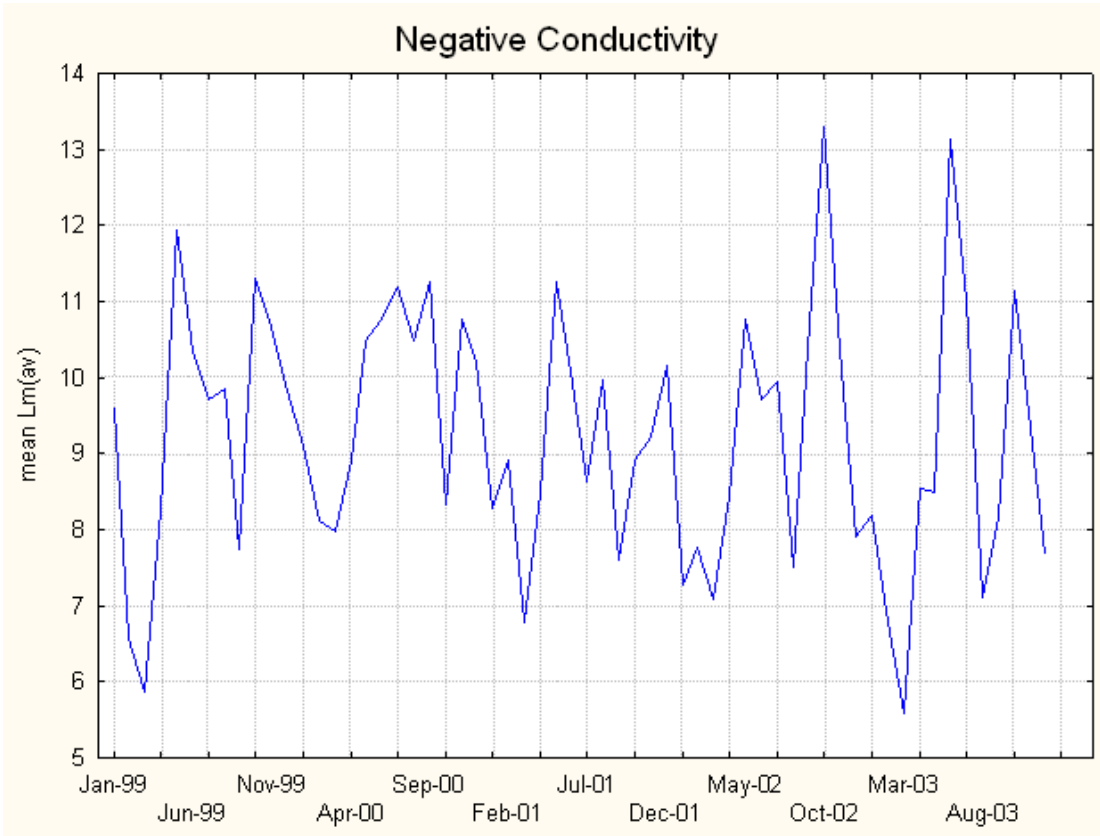
On the next graphs (3.2 and 3.3) we can see annual variations of positive and negative conductivities during 1999-2005.

Picture 3.2 – Annual variations of positive conductivity





Picture 3.3 – Annual variations of negative conductivity

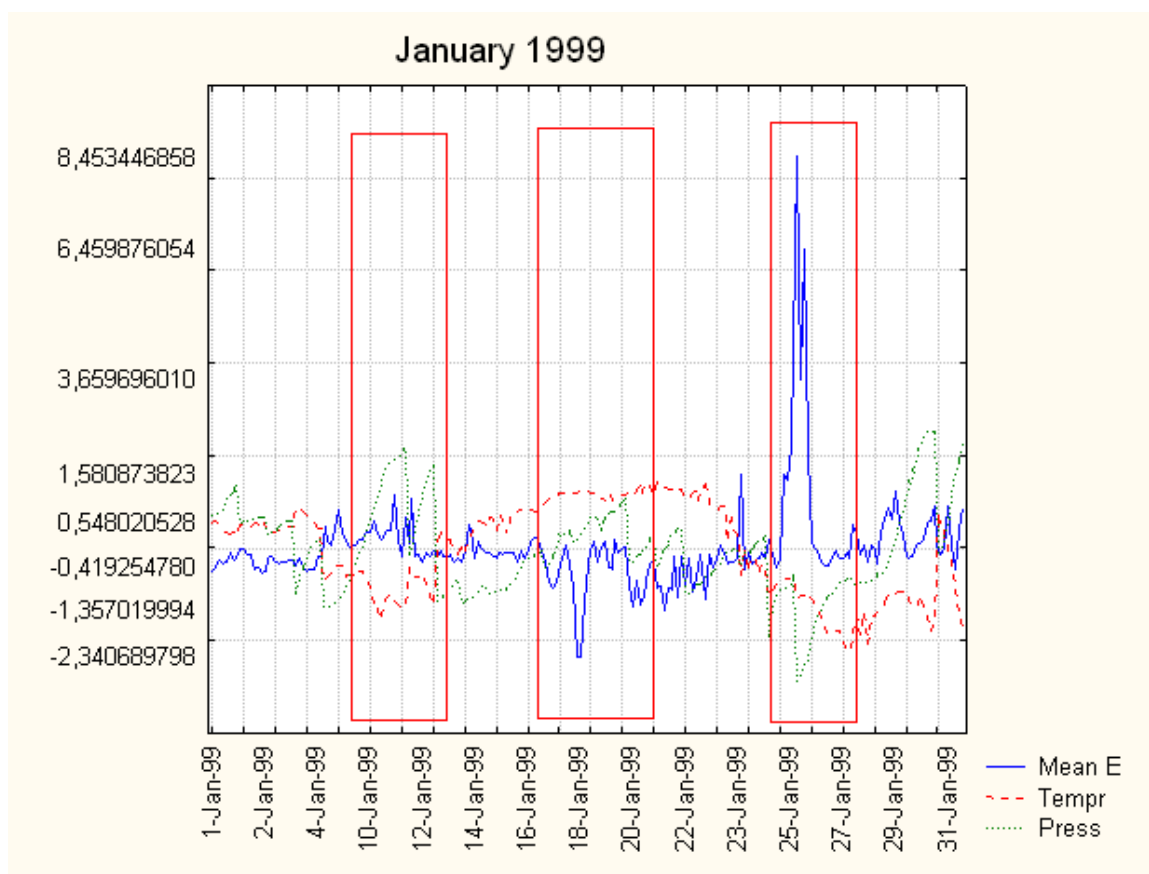


From these we can see that our meanings of maximums and minimums will repeat each other. So can say that annual variations of positive and negative variations will be always going with one amplitude and they can't be in antiphase.

3.2. The meteorological events influence on the atmosphere electric field intensity.

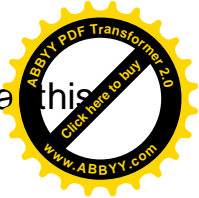
As we say before there are many different atmosphere events which can make influence on the atmospheric electric field intensity in Saint-Petersburg. For more detail studying I studied only one year – 1999. For better understanding the dependence of the intensity on the meteorological parameters I plot graphs not by their absolute values but by their standardized values.

Picture 3.4 – Meteorological events influence on the atmosphere electric field intensity in January 1999



On graph (3.4) I analyzed next periods of this month:

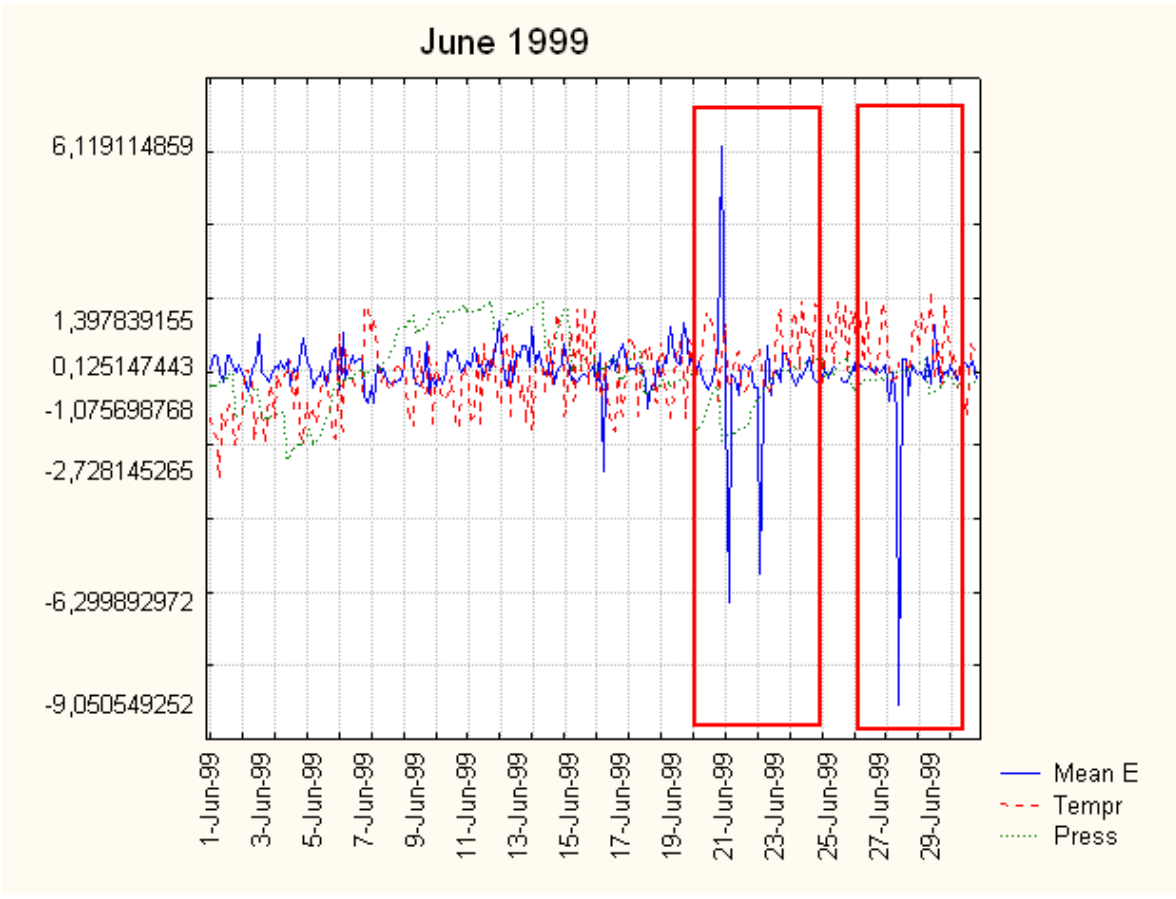
- 11 January – Cold front was in Saint-Petersburg. So as the result we can see the temperature decreasing and pressure increasing. And the



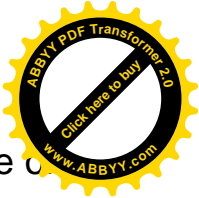
variability of the atmospheric electric field intensity was also observed at this moment

- 18 January – The situation like 11 January but in this case we can see warm front with according atmosphere electric field intensity variability
- 25 and 26 January – In this case the maximum of atmosphere intensity was observed in the periods when all day long there were fogs or ice fogs

Picture 3.5 – Meteorological events influence on the atmosphere electric field intensity in June 1999



Now we will make the same researching but with summer month. At both cases were observed rains all day long. And as we can see it was the reason of sign inversion.



Conclusions.

In this work I try to show the meteorological phenomena influence on the variability of atmosphere electric field intensity. Annual variation of atmospheric electric field and meteorological values characteristics shows the connection between atmospheric pressure variations and atmospheric electric strength variation in the boundary layer. As for conductivity as well as for electric field strength pronounced year period variations, at that they are take place in antiphase.

Atmospheric electric field strength variations and atmosphere pressure comparison shows resemblance of their year variations (time variability). Pressure variation amplitude in examined period changes slightly. At the same time conductivity variation amplitude and atmosphere electric field strength variation amplitude changes more fundamentally.

Polar conductivity depends on day time only particularly repeat atmosphere electric field strength course and have very small correlation between each other. Those conductivity behaviors connected with daily variations of aerosol parts, governed on the atmosphere electric field strength, concentration and their size.

Atmosphere and meteorological characteristics variations showed at the same time. On the individual time intervals correlation coefficient between atmospheric electric field and atmospheric events (air temperature and humidity, atmospheric pressure, fog, ice fog) can reach 0,7-0,8. Well known that boundary atmosphere parameters are modulated by external factor. One of those factors is cloudiness which is influence on the variability not only atmosphere electric field parameter but also on the atmosphere electric field strength sign insertion.

Research result shows us that atmospheric electric field characteristics depend on solar activity. Comparing of Wolfs Number(solar activity parameter) annual variation and atmosphere electric field strength showed synchronism of this parameters variability.