FOGS AND HAZES IN A BIG CITY

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From the data of meteorological observations for 20 years (1975–1994) in St. Petersburg and Belogorka, the recurrence of fogs and hazes for day and night in all seasons is determined. It is calculated for three types of fogs and hazes, namely, heavy, moderate, and light. Contrary to the expectations, the recurrence of fogs in a big city is much smaller (up to 2–3 times) than under rural conditions. This conclusion about fogs has already been drawn in our papers. However, the conclusion about lower recurrence of hazes in St. Petersburg, as compared to the rural conditions, is formulated for the first time. The seasonal and diurnal variations of the recurrence of fogs and hazes are considered. The recurrences in the daytime and at night are close to each other. This indicates the determining factor of advection in formation of fogs and hazes. The paper presents the data on duration and probability of formation of fogs and hazes and on difference in relative humidity in St. Petersburg and Belogorka when fog or haze are formed at the second point given that they are absent at the first point. The variation of the liquid water content of fog under the effect of temperature elevation is estimated.

Fogs and hazes are the atmospheric phenomena, which have a significant effect on man's economic activity primarily because of aviation and automobile and other types of transport used for transportation of people and goods. The optical characteristics of the atmosphere change abruptly at formation of fogs.

The present paper is based on the data of meteorological observations obtained during 20 years (1975–1994) in St. Petersburg (P) – a city with a population of 5 million, highly developed industry and heating, a great number of cars and other kinds of transport – and Belogorka (B) – a small village located 80 km to the south of P. The atmospheric state in Belogorka is similar to that of the nonperturbed atmosphere.

FOGS

The data on seasonal recurrence (the number of cases) of the three types of fogs and their duration are given in Table I.

The tables below and our analysis are based on daily meteorological observations made eight times a day. The daytime observations were made at 09:00, 12:00, 15:00, and 18:00 h; the nighttime observations were made at 21:00, 00:00, 03:00, and 06:00 h.

When calculating the recurrence and duration of phenomena (fog, haze, or precipitation), the time from 06:01 to 18:00 h was referred to the daytime, whereas the time from 18:01 to 06:00 h was referred to the nighttime.

Because the observations were referred to legal Moscow time (till January 1, 1993), the day in local solar time (30°E) lasted from 08:00 till 20:00 h in summer and from 07:00 till 19:00 h in winter.

Since January 1, 1993 the meteorological observations were referred to the Greenwich time (GT). This means that the day in local time lasted from 09:00 till 21:00 h in summer and from 08:00 till 20:00 h in winter. This delay relative to 06:00 h local time, in the daytime seems to be justified, because the onset of the maximum temperature and the maxima of other meteorological parameters is delayed by 2 or 3 hours relative to the local noon (the time delay is greater in summer than in winter).

The number of fogs of all types observed in various seasons over a period of 20 years was the following:

		Spring	Summer	Fall	Winter
	Day	138	25	116	112
P.	Night	125	51	100	92
	24 hours	263	76	216	204
	Day	213	145	369	136
B.	Night	243	241	396	180
	24 hours	456	386	765	316

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TABLE I. Recurrence (the number of cases) of heavy, moderate, and light fogs and their duration in St. Petersburg (P) and Belogorka (B).

	Heavy		Moderate		Light		Duration		Heavy		Moderate		Light		Duration	
	P	B	P	B	P	B	P	B	P	B	P	B	P	B	P	B
Spring									Summer							
1975–1979																
D	1	4	15	14	34	48	147	231	0	1	1	6	1	29	21	168
N	0	7	16	13	37	48			1	7	1	12	10	53		
1980–1984																
D	0	0	6	20	31	54	68	243	0	0	2	11	6	33	5	167
N	0	0	7	43	19	47			0	0	0	22	17	42		
1985–1989																
D	0	0	6	5	18	44	64	146	0	0	0	4	8	33	21	252
N	0	0	1	10	18	42			0	0	0	8	10	60		
1990–1994																
D	0	0	10	7	17	17	239	126	0	0	3	11	4	17	30	60
N	0	0	15	16	17	28			0	1	4	9	8	27		
1975–1994																
D	1	4	37	46	100	163	518	746	0	1	6	32	19	112	77	647
N	0	7	39	82	86	154			1	8	5	51	45	182		
Fall									Winter							
1975–1979																
D	2	0	8	20	35	88	101	403	1	0	6	13	20	24	38	267
N	1	3	4	25	25	96			0	1	3	12	19	25		
1980–1984																
D	0	0	5	20	19	106	86	498	0	0	10	10	34	34	94	208
N	0	0	6	41	31	87			0	0	3	17	27	55		
1985–1989																
D	0	0	6	13	24	78	66	454	0	0	5	2	18	33	39	142
N	0	0	0	16	11	67			0	0	1	1	13	41		
1990–1994																
D	0	0	6	12	11	32	123	166	0	0	3	2	15	18	99	84
N	0	0	3	14	19	47			0	0	1	5	25	23		
1975–1994																
D	2	0	25	65	89	304	376	1521	1	0	24	27	87	109	270	701
N	1	3	13	96	86	297			0	1	8	35	84	144		

Outside the city, the recurrence of fogs in fall almost doubled in comparison with other seasons. In the city, the seasonal maximum of the recurrence is not so well defined as outside the city; however the minimum of the recurrence is well defined here, especially in the daytime in summer.

Below we present the data on the number of fogs of three types over a period of 20 years.

		Heavy	Moderate	Light	All types
	Day	4	92	295	391
P.	Night	2	65	301	368
	24 hours	6	157	596	759
	Day	5	170	688	863
B.	Night	19	264	777	1060
	24 hours	24	434	1465	1923

The average annual number of fogs is 38 in P and 96 in B. According to the data for every five years and over a period of 20 years, the recurrence of fogs in the city is much less than under rural (unperturbed) conditions.

Table II gives the values of the ratio of the number of fogs in B to that in P over the 20-year period. For all types of fogs and during all seasons this ratio is larger than unity (for heavy fogs, which are not included in Table II, this ratio equals 1.25 for day, 9.5 for night, and 4.0 for 24 hours). The maximum of the ratio is reached in summer, the minimum is observed in winter and in spring, and only in the case of moderate fogs the minimum is observed at night. Twenty eight values (of 45) given in Table II are larger than 2; 20 values are greater than 3; 13 values are greater than 4; and, 7 values are greater than 5.

Throughout the 20-year period, the number of fogs in B exceeds (based on the 24–hour data) that in P for heavy fogs by a factor of four, for moderate fogs by a factor of 2.76, for light fogs by a factor of 2.46, and for all types of fogs by a factor of 2.53.

TABLE II. Ratio of the number of fogs in B to the number of fogs in P for 1975–1994.

Season	Moderate			Light			All types		
	Day	Night	24 hours	Day	Night	24 hours	Day	Night	24 hours
Spring	1.24	2.10	1.68	1.63	1.79	1.70	1.54	1.94	1.73
Summer	5.33	10.20	7.55	5.89	4.04	4.59	5.80	4.73	5.08
Fall	2.60	7.38	4.24	3.42	3.45	3.43	3.18	3.96	3.54
Winter	1.12	4.38	1.94	1.25	1.71	1.48	1.21	1.96	1.55
Year	1.85	4.06	2.76	2.33	2.58	2.46	2.21	2.88	2.53

The data on fog duration also indicate predominance of fogs (as compared with P). According to Table I, in all seasons and five-year periods (except one season – spring – in the five-year period from 1990 to 1994) the fog duration in B is much longer than in P.

Throughout the 20-year period, the ratio of the fog duration in B to the fog duration in P is the following:

Spring	Summer	Fall	Winter	Year
1.44	8.40	4.05	2.60	2.92

In analogy with the case of the number of fogs, the ratio of fog duration is maximum in summer and minimum in spring (for moderate fogs in this season, the minimum ratio is noted).

Along with the absolute values of the fog duration presented for different seasons in Table I and equal to 1241 hours in P and 3615 hours in B over the 20-year period, we estimated the probability of fog occurrence, i.e., the ratio of the fog duration to the observation period (season, year).

For all types of fogs these probabilities (%) are the following:

	Spring	Summer	Fall	Winter	Year
P	1.173	0.174	0.861	0.623	0.708
B	1.689	1.465	3.482	1.618	2.062

Although the number of fogs, especially outside the city, is considerable (on average, the annual number is 96 in B and 38 in P), the probability of fog occurrence, even in such a moist region as the northwest of European part of Russia, is low, namely, varies from 1.4 to 3.5% in the rural locality and from 0.17 and 1.2% in the large city. This probability is very low as compared to the other phenomenon caused by the same water vapor condensation, i.e., clouds, whose number in the same region exceeds 50%.

Below we present the data on the average (over 20 years) lifetime (in hours) of one fog.

	Spring	Summer	Fall	Winter	Year
P	1.97	1.01	1.74	1.32	1.64
B	1.64	1.68	1.99	2.22	1.88

At site B, the fog is observed for the longest time, on average, in winter, while at site P – in spring. The shortest duration of fog is observed in spring in B and in summer in P.

Most fogs are light. Below we present the ratio of the number of light fogs to the number of moderate fogs (24-hour data).

	Spring	Summer	Fall	Winter	Year
P	2.45	5.82	4.61	5.34	3.80
B	2.48	3.54	3.73	4.08	3.38

As to heavy fogs (for the meteorological visibility less than 200 m), their recurrence for the 20-year period is very low. All the fogs (6 in P and 23 in B), except only one, were observed in the first five years.

Let us consider the conditions of fog formation at different times. According to Table I, the number of moderate and light fogs for five years was larger at night than in the daytime during 36 seasons, less at night than in the daytime during 24 seasons, and the same during 4 seasons. Only in summer the recurrence of fogs over the 20-year period is about 1.5 times larger at night than in the daytime (for all types of fogs in B and only for light fogs in P). In other seasons, the numbers of fogs observed in the daytime and at night differ only slightly. In spring and fall, the recurrence of light fogs (over 20-year period) in B and P at night is less than in the daytime. This is true for the recurrence of moderate fogs in P during all seasons (in spring their number is practically the same). Only in B, the recurrence of moderate fogs throughout the year is much larger at night than in the daytime.

The data obtained enable us to evaluate the contribution of different factors to formation of fogs. The opinion is widespread (even in textbooks) that the radiation is important (decisive) for formation of fogs at night. Radiation fogs predominate over the others (at least, at night). Our data do not favor this opinion.

Really, in the daytime radiation fogs cannot be formed, because the radiation balance in all seasons (including winter) is positive in the daytime. Thus, in the daytime fogs occur only under the effect of advective and turbulent influxes of heat and moisture. Since the advection is equally probable by day and at night, the number of the advection fogs at night is the same as in the daytime. In B, as follows from our data, 863 advective fogs have been formed at night throughout the 20-year period (the same number of fogs have been formed in the daytime). Thus, the number of radiation fogs in B is 197 (1060 − 863 = 197), i.e., the radiation fogs in our region comprise only 10% of the number (1923) of fogs.

For different seasons the radiation fogs in B comprise 6.6% in spring, 24.9% in summer, 3.5% in fall, and 13.9% in winter. In B the radiation is decisive for formation of moderate fogs in 21.7% of cases and in only 6.1% of cases for light fogs. As to P, only in summer the radiation is important: the number of radiation fogs is 26 (51 − 25 = 26), i.e., 34.2% of the number of summer fogs. In other seasons, all fogs in P are advective (because the number of fogs in the daytime is larger than at night).

EXPERIMENTAL DATA DISCUSSION

The influence of the temperature rise in the city on the fog occurrence was briefly considered in Refs. 1 and 2.

The water vapor condensation and fog formation start in the atmosphere when the air relative humidity $f = e/E(T)$ approaches 100% (here, e is the water vapor pressure, $E(T)$ is the pressure of saturated vapor increasing with the temperature T). According to this equation, variations of the air temperature and water vapor pressure affect the formation and subsequent evolution of fog.

The differences $\Delta T = T_P - T_B$ and $\Delta e = e_P - e_B$ in air temperatures and water vapor pressures in P and B were discussed in detail in Ref. 3. The differences ΔT and Δe affect the difference $\Delta f = f_P - f_B$ oppositely: the increase of ΔT causes the decrease of Δf, while the increase of Δe results in the increase of Δf. For the period of 1975–1979 the mean values of the difference Δf were the following: −5.3% in summer (−7.4% at night and −3.2% by day), −2% in winter (−2.2% at night and −1.8% by day).

Negative values of Δf (i.e., $f_P < f_B$) favorable for the decrease of the number of fogs in the city are observed in 74% of cases in summer (84% at night and 64% in the daytime) and in 47% of cases in winter (at night and by day).

The above data characterize the general conditions mainly in the absence of fogs and hazes (their lifetimes do not exceed several per cent). To determine the relation between Δf and formation of fogs and hazes, the values of ΔT, Δe, and Δf were calculated for the cases when fog or haze was observed in B, while they were absent in P. Based on the data of 84 such cases in summer, the difference $\Delta T \geq 0$ (83%), and $\Delta e \geq 0$ (60%).

The distribution function F of the difference Δf has the following form:

$\Delta f \leq$	−16	−14	−12	−10	−8	−6	−4	−2	0	2	4	10
F, %	8	13	18	24	38	55	67	80	89	93	95	100

Thus, the difference $\Delta f \leq 0$ in 89% of cases, and the relative humidity in the city is lower than outside it.

Based on the data of another sample including 24 cases (fall) under the same conditions (fog or haze occurs in B, and there is neither fog nor haze in P) the values of $\Delta T \geq 0$ and $\Delta e \geq 0$ were observed in 96% and 75% of cases, respectively, and the difference $\Delta f \leq 0$ in 93% of cases.

The data presented here strongly suggest that when the meteorological conditions result in formation of haze or fog outside the city, in most cases the relative humidity in the city turns out lower than outside it. In its turn, this prevents formation of haze and fog in the city or favors the decrease of their intensity.

We should focus our attention on the important peculiarity of fogs (as well as clouds), namely, they are very sensitive to the temperature variation. Table III gives the values of the coefficient b in the equation $\Delta\delta = -b\Delta T$, connecting the decrease ($\Delta\delta$) of the volume liquid water content δ of fog with the increase (ΔT) of temperature T in different ranges. It is seen from Table III that when the temperature is higher than −5°C, its increase by only 0.5°C results in the decrease of the liquid water content by 0.18 to 0.55 g/m^3. Since the liquid water content of fog under rural conditions, as a rule, does not exceed the above values, it follows that the air temperature rise in the city by even 0.3–0.5°C results in the fog dispersion (vanishing).

TABLE III. Values of the coefficient b, in g/(m^3·°C), *for the formula* $\Delta\delta = -b\,\Delta T$.

Temperature range, °C				
from −25 to −15	from 15 to −5	from −5 to 5	from 5 to 15	from 15 to 25
0.087	0.184	0.363	0.661	1.119

For the same values of ΔT, the higher is the temperature itself, the larger is the decrease of the liquid water content of fog. That is why in summer the number of fogs decreases especially sharply, although the difference ΔT in the daytime in summer is much less than in other seasons.

HAZES

The data on the seasonal recurrence (the number of cases) of three types of hazes and their overall duration are given in Table IV.

It is widely believed (in the scientific literature[4,5] and textbooks) that the recurrence of hazes in a city is much higher than in a rural locality. It is motivated by the fact that the atmosphere in the city is more polluted with different pollutants. However, the data of Table IV do not confirm the popular opinion and also lead to the opposite conclusion, namely, the number of hazes in P is much less than in B.

TABLE IV. Recurrence (the number of cases) of heavy, moderate, and light hazes and their duration (h) *in St. Petersburg (P) and Belogorka (B).*

	Heavy		Moderate		Light		Duration		Heavy		Moderate		Light		Duration	
	P	B	P	B	P	B	P	B	P	B	P	B	P	B	P	B
	Spring								Summer							
	1975–1979															
D	0	0	35	59	114	199	481	1066	0	0	1	46	21	132	117	868
N	0	0	30	66	90	216			0	0	6	47	55	262		
	1980–1984															
D	0	0	52	93	205	344	859	1529	0	0	11	56	62	240	263	1203
N	0	0	38	70	177	290			0	0	9	59	72	290		
	1985–1989															
D	0	2	79	57	124	202	900	983	0	1	34	37	121	157	801	863
N	0	1	92	46	157	144			0	0	61	46	162	182		
	1990–1994															
D	1	0	51	35	49	172	497	964	0	1	9	13	12	29	99	180
N	1	1	66	39	68	194			0	1	21	21	34	36		
	1975–1994															
D	1	2	217	244	492	917	2737	4538	0	2	55	152	216	558	1280	3114
N	1	2	225	221	392	844			0	1	97	173	323	770		
	Fall								Winter							
	1975–1979															
D	0	1	48	132	174	466	822	2097	0	0	27	149	127	215	530	1355
N	0	0	44	90	182	384			0	1	21	161	112	198		
	1980–1984															
D	0	0	33	144	352	452	1477	1847	0	0	64	99	288	218	1536	1304
N	0	1	55	77	282	233			0	0	33	80	263	196		
	1985–1989															
D	0	0	123	87	202	246	1450	1108	0	0	99	62	245	219	1574	979
N	0	0	118	58	174	173			0	0	70	37	248	113		
	1990–1994															
D	0	1	53	77	73	316	657	1636	0	1	47	62	60	236	631	1138
N	0	0	62	68	87	263			0	0	47	52	62	156		
	1975–1994															
D	0	2	257	440	801	1480	4406	6688	0	1	237	372	720	688	4271	4776
N	0	1	279	293	725	1053			0	1	171	330	685	663		

For the 20-year period, according to Table IV, only 4 values (of 45) of the ratio of the number of hazes in B and P are close to unity. All other values are much larger than unity (including 9 values larger than two). As in the case of fogs (Table II), the maximum values of this ratio were observed in summer, the minimum values were observed for light hazes in summer and for all types of hazes in winter and for moderate hazes in spring.

Let us write down the number of hazes of all types observed in different seasons for the 20-year period:

		Spring	Summer	Fall	Winter
P.	Day	710	271	1058	957
	Night	618	420	1004	856
	24 hours	1328	691	2062	1813
B.	Day	1163	712	1922	1061
	Night	1067	883	1347	994
	24 hours	2230	1595	3269	2055

The maximum recurrence of hazes in P and B, especially well defined in the rural locality (B), is observed in the fall; the minimum recurrence, especially well defined in P, is observed in summer.

Below we also present the data on the number of hazes of three types observed for the 20-year period.

		Heavy	Moderate	Light	All types
P.	Day	1	766	2229	2996
	Night	1	772	2125	2898
	24 hours	2	1538	4354	5894
B.	Day	7	1208	3643	4858
	Night	5	1017	3269	4291
	24 hours	12	2225	6912	9149

On average for 20 years, observed during one year were 295 hazes in P and 457 hazes in B. The number of hazes in separate seasons and during the year, in the daytime and at night, is less in P than in B. However, since the conditions of haze formation in the city are affected by not only the temperature-humidity regime (as in the case of fogs), but also atmospheric pollution with anthropogenic pollutants, the number of hazes in the city decreased (as compared to B) not so markedly as in the case of fogs. Whereas the average annual number of fogs in P is 2.53 times less than in B (see Table II), the number of hazes is 1.55 times less (see Table IV).

Hazes, like fogs, are formed in the process of water vapor condensation on the condensation nuclei. Water vapor begins to precipitate (condense) on hygroscopic particles (nuclei) well before the attainment of the saturation state. Based on the data by G.V. Rozenberg,[6] already starting from relative humidity of 60%, the mass of water precipitated on such a particle exceeds the particle mass. With further increase of the relative humidity, this mass further increases and the particle (now already a drop) grows in size.

It is natural that first a haze occurs and then, if the relative humidity reaches the values close to 100%, formation of a fog is possible. Since the saturation state is not always achieved, the transformation of haze into fog is also not always possible. Due to this fact, the recurrence of hazes is everywhere much higher than that of fogs.

Based on the above data, the ratio of the seasonal number of hazes to the number of fogs is the following:

	Spring	Summer	Fall	Winter
P	5.1	9.1	9.6	8.9
B	4.9	4.1	4.3	6.5

The annual values of this ratio are:

		Moderate	Light	All types
	Day	8.3	7.6	7.7
P	Night	11.9	7.1	7.9
	24 hours	9.8	7.3	7.8
	Day	7.1	5.3	5.6
B	Night	3.9	4.2	4.0
	24 hours	5.1	4.7	4.8

Under rural conditions (B), the number of hazes is four to five times larger than the number of fogs. In the city (P), the number of fogs decreases (as compared with B) only under the effect of variation of the temperature-humidity conditions. The haze formation is also affected by the atmospheric pollution favoring the increase of the number of hazes as compared with that observed in the absence of pollution. As a result, the ratio of the number of hazes to the number of fogs increases in the city up to 7–9 (except for spring).

The data on the haze number agree well with the data on the haze duration given in Table IV. We notice that in 17 of 20 pairs the haze duration in B is longer than in P. Throughout the 20-year period, the ratio of the haze duration in B to that in P is as follows:

Spring	Summer	Fall	Winter	Year
1.65	2.43	1.52	1.12	1.51

These values are close to the ratios of the haze number (see Table IV). The maximum and minimum fall on the same seasons (summer and winter); the annual values are practically equal. The closeness of the ratios of the haze number and the haze duration from the 24-hour data enables us to suggest that also in the daytime and the nighttime these ratios do not differ greatly.

The duration of hazes for the 20-year period is 12 694 hours in P and 19 116 hours in B, and their number is 5894 in P and 9149 in B. Now we estimate the probability of hazes, i.e., the ratio of the haze duration to the observation time (season, year).

For all hazes these probabilities (%) are given below.

	Spring	Summer	Fall	Winter	Year
P	6.198	2.899	10.087	9.859	7.240
B	10.274	7.052	15.311	11.025	10.903

As compared to fogs, the probability of haze occurrence is higher: it varies from 3% to 10% in P and from 7% to 15% in B. The mean lifetime (hours) of one haze is given below.

	Spring	Summer	Fall	Winter	Year
P	2.061	1.852	2.137	2.356	2.154
B	2.035	1.952	2.046	2.324	2.089

The times of haze occurrence in P and B are practically the same: they differ for a given season by no more than 0.1 hour (6 min). This time is minimum in summer and maximum in winter.

A comparison with the above estimates of time of fog occurrence shows that haze occurs, on average, longer than fog. Let us present the values of the ratio of the time of haze occurrence to that for fogs:

	Spring	Summer	Fall	Winter	Year
P	5.3	16.6	11.7	15.8	10.2
B	6.1	4.8	4.4	6.8	5.3

In B, these (time) ratios are quite comparable with the above ratios of the haze number to the fog number. However, in P the first (time) ratios are much larger than the second ones (except the spring season, when both ratios are practically equal and much less than in the other seasons). This points to the fact that in P not only the number of hazes increases under the effect of pollution, but also the haze lifetime.

Most of hazes are light: $6 < S_M \le 10$ km. Below we present the ratio of the number of light hazes to the number of moderate ones (per day):

	Spring	Summer	Fall	Winter	Year
P	2.0	3.5	2.8	3.4	2.8
B	3.8	4.1	3.5	1.9	3.1

The number of heavy hazes ($1 < S_M \le 2$ km), like heavy fogs, is small: for 20 years we observed only 2 hazes of such type in P and 12 hazes in B.

The data on hazes (see Table IV) indicate that, in contrast to the popular opinion, in the daytime hazes occur as often as at night. Moderate hazes, according to the data of Table IV, were observed during 17 seasons (of 32), and light hazes were observed during 15 seasons (of 32) at both sites more often in the daytime than at night. Most cases (14 with moderate hazes and 17 with light hazes) in which the larger number of hazes was observed at night than in the daytime took place in summer (7 for moderate hazes and 8 for light hazes).

Throughout the 20-year period, the light hazes in P and B were observed more often in the daytime than at night in all the seasons except summer; the moderate hazes were observed more often by day than at night during 3 seasons of 4 in B and during one season of 4 in P.

Since in most seasons the number of daily hazes is larger than that of night ones, the same considerations as for fogs enable us to conclude that the decisive factors in haze formation are the advective and turbulent influxes of heat and humidity. Only in summer, a certain part (20 to 40%) of night hazes is formed under the effect of radiative losses of heat by the ground and the atmosphere.

In conclusion, it also should be noted that the observations in the other regions agree with the above concept on the conditions of haze and fog formation. In recent years, the observation data obtained at the seven meteorological stations in Moscow have been summarized and briefly analyzed in Ref. 7. Based on the observations made in 1950–1989, we present the ratio of the number of fogs observed at the observatory of the K.A. Timiryazev Agricultural Academy (TAA) located 8–9 km apart from the center (to the north-north-west of the center) and the number of fogs observed at the Balchug meteorological station located at the center of the city:

Spring	Summer	Fall	Winter
1.63	3.30	1.83	1.17

Despite the fact that the observatory is located within the limits of the city (although in the region with plantations of trees and shrubs) not far from the center, fogs are observed there more often than in the city center. The above ratios of the fog number in Moscow are quite comparable with those given in Table II for St. Petersburg (although due to smaller distance between sites, the former are smaller than the latter). However, the seasonal behavior of the ratios correlates closely, with the maximum in summer and the minimum in winter. Good agreement is also observed between the data on formation and recurrence of fogs in different seasons, in the daytime and nighttime. The mean annual fog number (38) in the center of P is much larger than in the center of Moscow (23) and even slightly larger than in the TAA (36), not to mention the fact that in B (at a distance of 80 km from P) the number of fogs is much larger than in P and in Moscow.

Unfortunately, the authors of Ref. 7 were not acquainted with Refs. 1 and 2, because Ref. 7 presents the data unambiguously indicating the basic cause of the observed peculiarities of fog formation in Balchug and the TAA.

Really, the mean (over 40 years) monthly temperature in the TAA is lower than the temperature in Balchug: from 0.6°C in November to 1.1°C in June and July (note that, as compared to Nemchinovka located approximately at the same distance from the center as the TAA, but to the south-west, the mean monthly temperature in Balchug is 1.8°C higher in June and July and 1°C higher in November).

The mean monthly values of relative humidity in Balchug are 3–10% lower than in the TAA, Nemchinovka, and especially in Lenino-Dachnoe. It is natural that the temperature increase and the decrease of relative humidity favor the reduction of the fog number in the center of the city (Balchug) as compared to the sites in the outskirts of the city. Unfortunately, Ref. 7 does not present more complete data on the temperature and relative humidity in Moscow itself and at the sites located at a distance of 50–150 km from Moscow.

As to St. Petersburg and Moscow, the difference in the fog number is caused by the general circulation factors. However, special attention must be given to the fact that in the last 100 years the 1.5–2.5°C temperature increase in Moscow was observed, while in St. Petersburg the temperature increased only by 1.0–1.5°C.

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