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ISHII, Sayaka / SATO, Norihito

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Secular Change of Fog Frequency in Some Japanese Cities

Sayaka ISHII and Norihito SATO*

[*Department of Geography, Hosei Univ.]

Key words : fog, seasonal variations, secular change,
relative humidity, urbanization.

Abstract

This paper deals with statistical analyses to clarify the frequency of fog occurrence in some cities in Japan (Fig.1). In this work, the data of Japan Meteorological Agency were used to analyze at about 80 points in Japan (Tab.1) between 1951 to 2000.

The main results of this study were summarized as follows.

1. It is tendency in fog occurrence to present the regional and seasonal characteristics during recent 50 years (Fig.2, 3 & 4).

2. Judging from the regional and seasonal characteristics in occurrence frequency of fog in Japan, the main causes of fog are advection type as well as radiation one (Fig.4).

3. The secular change of annual number days with fog at each station tends to decrease gradually in many points, especially in inland or basin stations (Fig.5).

4. In spite of above mention, the annual number days with fog have slightly increased at the stations along the coast of Pacific in Northeastern Japan.

5. It will be able to point out that the factors of decreasing of number days with fog in secular change are equal to lower the value of relative humidity or to rise the extreme value of daily minimum temperature (Fig.6).

Tab.1 Observatories and its population (2000)

O b.	P o.	O b.	P o.
Wakkanai	43, 775	Nagoya	2, 171, 557
Rumoi	28, 325	Iida	107, 381
Asahikawa	359, 536	Kofu	196, 154
Abashiri	43, 395	Tsu	163, 246
Sapporo	1, 822, 368	Hamamatsu	582, 095
Iwamisawa	85, 029	Omaezaki	11, 569
Obihiro	173, 030	Shizuoka	469, 695
Kushiro	191, 739	Tokyo*	8, 134, 688
Nemuro	33, 150	Owase	23, 683
Muroran	103, 278	Yokohama	3, 426, 651
Urakawa	16, 634	Katsuura	23, 235
Esashi	10, 959	Matsue	152, 616
Hakodate	287, 637	Toyooka	47, 308
Kutsuchan	16, 184	Hamada	47, 187
Fukaura	8, 954	Kyoto	1, 467, 785
Aomori	297, 859	Hikone	107, 860
Hachinohe	241, 920	Shimonoseki	252, 389
Akita	317, 625	Kobe	1, 493, 398
Morioka	288, 843	Wakayama	386, 551
Miyako	54, 638	Shionomisaki	15, 687
Yamagata	255, 369	Fukuoka	1, 341, 470
Sendai	1, 008, 130	Saga	167, 955
Fukushima	291, 121	Oita	436, 470
Onahama	360, 138	Nagasaki	423, 167
Wajima	26, 381	Kumamoto	662, 012
Aikawa	9, 669	Kagoshima	552, 098
Niigata	501, 431	Miyazaki	305, 755
Kanazawa	456, 438	Matsuyama	473, 379
Toyama	325, 700	Takamatsu	332, 865
Nagano	360, 112	Uwajima	62, 126
Takada	134, 751	Kochi	330, 654
Utsunomiya	443, 808	Tokushima	268, 218
Fukui	252, 274	Murotomisaki	19, 472
Takayama	66, 430	Aizuwakamatsu	118, 118
Matsumoto	208, 970	Tsuyama	90, 156
Maebashi	284, 155	Hiroshima	1, 126, 239
Kumagaya	156, 216	Okayama	626, 642
Mito	246, 739	Osaka	2, 598, 774
Tsuruga	68, 145	Nara	366, 185
Gifu	402, 751	Hitoyoshi	38, 814

* Population of Tokyo indicates the total in 23 wards

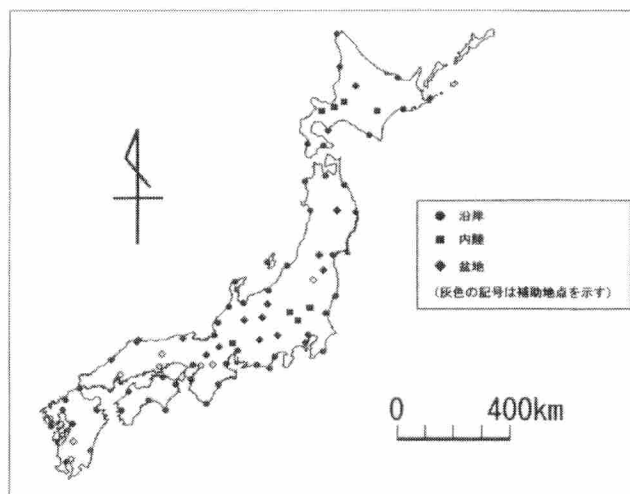


Fig.1 Location map of meteorological stations in this study.

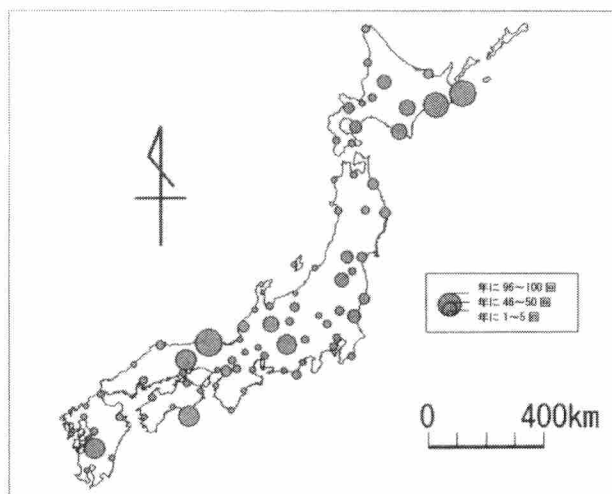


Fig.2 Distribution map of frequency of number days with fog using annual mean value (1951~2000).

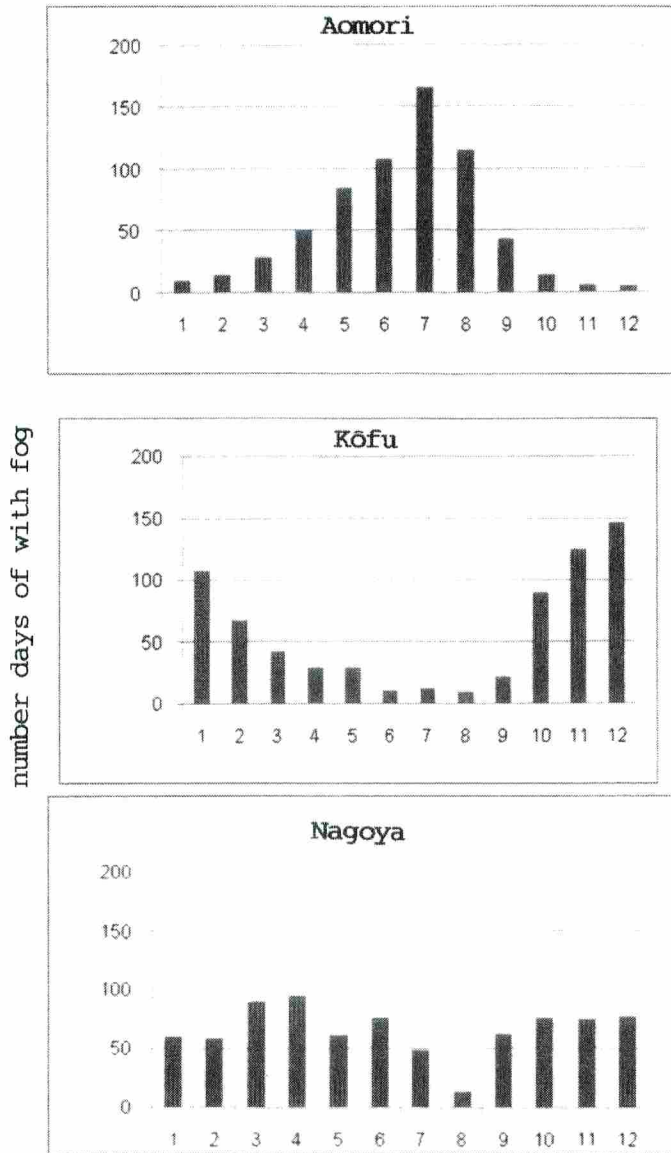


Fig. 3 Annual variation of number days with fog using monthly mean value at Aomori, Kofu and Nagoya (1951~2000).

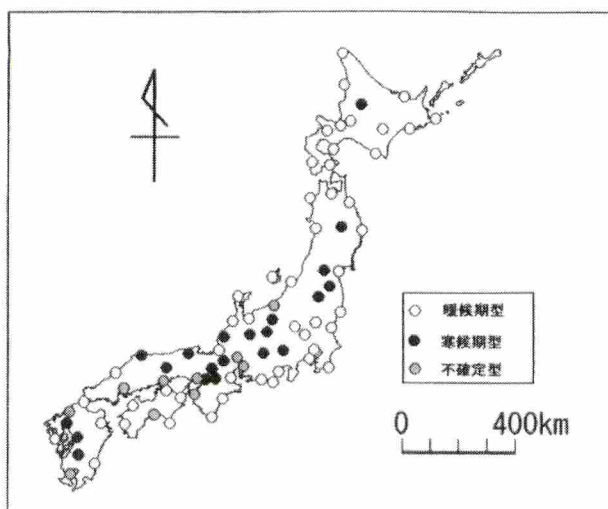
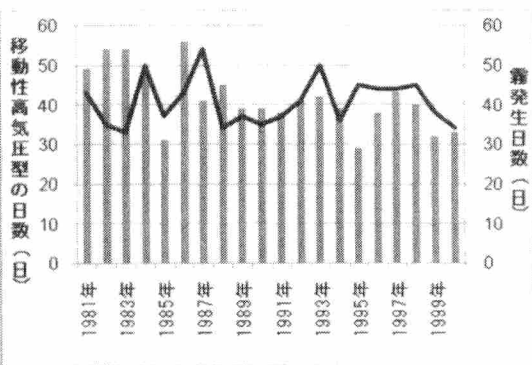
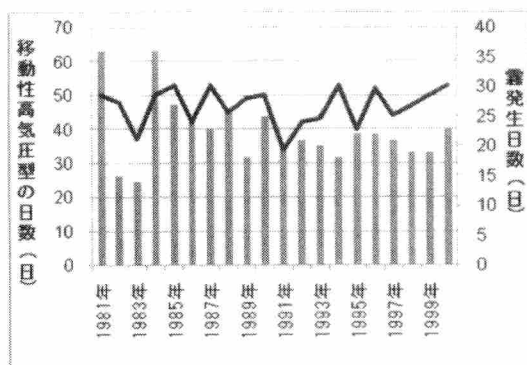


Fig. 4 Distribution map of three types in annual variation of number days with fog using monthly value.
 (○ : maximum peak in summer half year/outlined circle)
 (● : its peak in winter half year/black circle)
 (● : its peak unsettled/gray circle)

number days of travelling anticyclone pressure pattern



number days of with fog

Fig. 6 Secular change of seasonal number days of with fog and that of travelling anticyclone pressure pattern at Toyooka in basin, Hyogo Pref.
 (left : spring season, right : autumn season.
 black line : number days of travelling anticyclone pressure pattern. vertical bar : number days with fog)

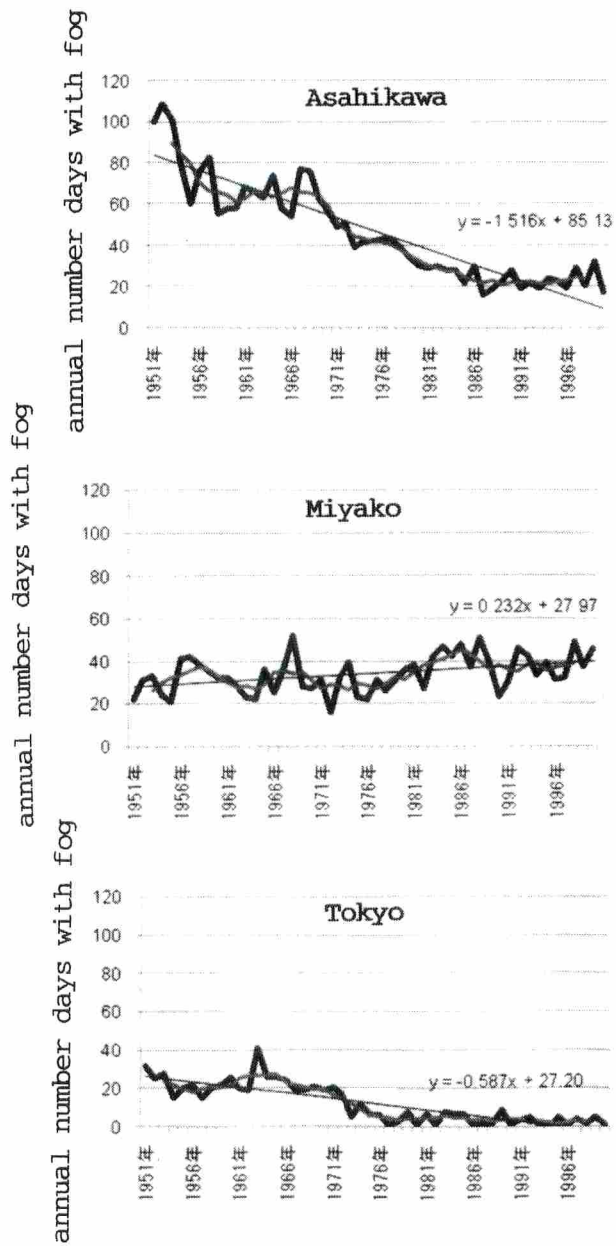


Fig. 5 Secular change of annual number days with fog at Asahikawa, Miyako and Tokyo (1951~2000). (gray line : 5-year running means)

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