Studies on Bioclimate and Weather-Health Forecasting in Japan

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Abstract

In order to review the present status of bioclimate research and weather-health forecasting in Japan, development is first described briefly for the periods of the first and second halves of the 20th Century. Important topics for further development are demonstrated to be: temperature change; lifestyle changes; historical approaches used such as weather-related proverbs, old documents, etc.; and analysis of health (disease)-weather relationships. In the second part of this review, activities of the "BioClima Research Committee (BCRC)" are mentioned. The BCRC, established in 2000, has been organizing meetings and symposiums and has published several monographs or books on bioclimate. In the third part, background information used in health-weather forecasting is reviewed. Awareness of various relationships between health and weather and data pertaining to them, and their usefulness in forecasting is introduced, referring to the results of a questionnaire survey among general citizens. As a practical problem, it discusses "Expression Codes" for broadcasting information on forecasts. Also, the regional division of bioclimatic conditions in Japan is mentioned in order to consider the size of the areas covered by forecasts. For reference, information propagation by news papers is mentioned, too. In the last part, examples of influenza, myocardial infarction and heat disorder are mentioned based on the results obtained. It is concluded that such approaches to forecasting should be developed further in all countries under international cooperation.

Key words: bioclimate, biometeorology, health-weather relationship, Japan, weather-health forecasting

1. Introduction

According to a recent questionnaire survey (Aoyagi, 2006), global warming is considered to be the most important among the environmental problems facing Japan. It was indicated that 39.3% (the second largest number) of the respondents replied that the impact of global warming on human health was the most serious problem. Third ranked (36.3%) was heat islands and heat waves.

In Germany, 19.2% of people considered that health is affected strongly by weather conditions and 35.5% that health is affected by weather, according to a questionnaire survey (Hoeppe *et al.*, 2002)

These values show how important the subject of human health is in global environmental research. In the present paper, developments are first reviewed and important topics for future studies are summarized based on the review. Next, recent developments inbioclimate studies and forecasting are described. Further scientific and technical problems are summarized in the conclusion.

2. History of Description of the Human Health-Weather Relationship

2.1 From ancient times to the first half of the 20th Century

Since the ancient Greek and Arabic period, human health has been described as closely related to weather and climate. It is well-known that Hippocrates (460 B.C.? – 375 B.C.?) mentioned impacts of climate on human life in his book "Air, water and land."

In China, by 650 B.C. there were already descriptions which were included in a book "管子"(Guanzi) (completed in the Zhanguo Dynasty, 475 B.C. – 221 B.C.) which discussed seasonal changes in climate, plant development and human health, in particular, seasonal changes in points of note such as sleeping hours, mental stability, sunbathing, food and drink. Abnormal weather phenomena such as cold waves, heat waves, heavy storms and heavy rainfall were mentioned as having serious effects on human health and disease.

Similar descriptions are found in other books: "黄

帝内径" (Huangdineijing) and "左伝" (Zuochuan) in the Zhou-dynasty (Wen, 2004; Wang *et al*., 2006; Hong & Liu, 2006). Their ages of completion are not clear, but it is considered that they appeared around the 8th Century B.C. to the 5th Century B.C. Therefore, descriptions of health-weather relationships in China appeared earlier than or in almost same period as in Greece.

Through exchange of cultural missions between China and Japan starting in the 8th Century, the Chinese knowledge of relationships between weather and human health/disease was brought into Japan.

In the 17th Century, European bioclimatic knowledge came to Japan through Nagasaki, which was the only port open to the foreign countries, and spread throughout Japan. In his book entitled "Record of Genna Navigation" published in 1618, U. Ikeda wrote that "An injured person feels a pain stronger in his wound when a storm (cyclone) is approaching (Yoshino, 2007)."

In the 18th Century, the descriptions became more detailed, for example, it was noted that itchiness of the head, burning sensation in the face or ears, active fluttering of birds, active jumping of fishes, many ants coming out from nests, etc. were fore-running signs of approaching cyclones.

On the other hand, health-weather relationships have been observed by local people and maintained in the form of weather proverbs among peoples since ancient times. These have been listed up in regional geographies on a prefectural or village scale.

Early biometeorology/bioclimatology works are found in the various fields of study in Japan. Mori (1889) wrote a textbook on hygiene for an army medical course summarizing knowledge on weather-disease relationships, and this text book was revised and enlarged as a publication by Koike and Mori (1897) in the middle of the Meiji Era. They discussed the differences between sunburn caused by insolation and heat disorders caused by high temperatures. These works appeared at almost same time, the last decade of the 19th Century, as compared with other countries of the world. For, example, in Russia, Voeikov (1893) made important contribution to the medical climatology, summarizing the climatic therapy and hygiene in 1893 (Avtsyn & Tikhomirov, 1976)

Marui (1946) studied seasonal changes in mental disorders and reported their maximum occurrence in June and July. He pointed out a similar seasonal change in frequency of suicide and crime.

In 1943, a bioclimatological study group was established in the Ministry of Welfare in Japan to overview research on bioclimate in Japanese research institutes and universities. The proceedings of the first meeting were published in 1944, but its activity ceased because of World War II.

2.2 Since the middle of the 20th Century

In the second half of the 20th Century, bioclimatology progressed. This is described in detail elsewhere (Yoshino, 2007). Concerning seasonal changes in mortality, outdoor temperatures and heating/cooling indoors affect its pattern (Momiyama, 1961; Momiyama & Kito, 1963; Sakamoto-Momiyama, 1977).

As has been pointed out by Miller (1989), Landsberg (1969), a world famous climatologist, has already written on the theme of "Weather and Health" among his many fields of bioclimatology, which include housing, air pollution, urban climates, food production, etc. Through his works, it has become clear that not only the outdoor temperatures, but also lifestyle changes, for example, air conditioning, are among the important factors.

World Meteorological Organization (WMO, 1987) published a booklet entitled "Climate and Human Health" 20 years ago. In this publication, short chapter on "Forecasts and warnings" is found: mortality rate statistics display a seasonal variation implying a link with climatic factors as well as trends over longer periods due to socio-economic or other changes. Additionally, high day-to-day variation of mortality is found in association with passage of low pressure systems, particularly in the middle latitudes regions. Further, it was written that there is clearly a good basis for considering some day-to-day weather types as biologically unfavorable for mankind and others as favorable. Accordingly weather forecasting clearly has a genuine relevance for human health.

This relevance can be increased by adding heat stress or wind chill information to forecasts of impending hot or cold weather. Special warning could be added to emphasize particular risks liable to affect those suffering from weather-dependent disease or aged. It is interesting to note that, at the status 20 years ago, it was written that "Care should be exercised to avoid causing over-reaction amongst meteorological hypo-chondriacs or those who rightly or wrongly believe themselves to be especially weather sensitive." Examples of warnings in daily forecast were heart disease, asthma or bronchitis as well as heat disorder and wind chill as mentioned above.

Impacts of extreme events caused by global warming on human health have become one of the main topics of concern, recently. Harasawa (2006) reported that heat strokes/heat stress are important particularly among aged people and the poor and needy in cities. In 2003, high temperatures continued in Europe from June and heat waves occurred in August: 37.9˚C in London on 10 August and 40.0˚C in Paris on 12 August. It was reported that 14,800 died as a result of heat waves in France (Pirard *et al*., 2005). The high temperatures of that year were an extreme case in the past 500 years (Schar *et al*., 2004).

Summarizing the historical development of descriptions and research concerning the bioclimates, especially on the relationship between climate/weather and human health/diseases (Landsberg, 1969; Yoshino, 2007), the following topics will be important for

further studies and to establish scientific forecasting.

(a) Temperature change: 1. seasonal changes; 2. day-to-day (inter-diurnal) changes; 3. long-term changes (global warming, global cooling, little ice ages, etc.): 4. extreme events (heat-stroke, cold- injury).
(b) Lifestyles: 1. long-term changes; 2. cultural differences; 3. regional differences.
(c) Historical: 1. weather proverbs; 2. old documents, regional geography or text books; 3. statistical, experimental and descriptive research; 4. forecasting.
(d) Health: 1. various diseases; 2. health conditions; 3. sports and tourism.

3. Bioclimate Study for Forecasting in Japan

3.1 The "BioClima Research Committee"

The "BioClima Research Committee (BCRC)" was established in Tokyo in 2000, chaired by M. Yoshino. The members of this Committee consist mainly of biometeorology researchers and medical doctors. The purposes of the group are: (1) to study the relationship between human health/well-being and weather/climate change/environment change; (2) to supply information to human society for the sake of disease prevention and improvement of well-being (amenity); and (3) to present a forum to researchers for exchanging information and for cooperating mutually (Yoshino & Miyashita, 2004).

Activities in the first stage are classified into two categories: (1) basic scientific research for medical weather forecasting, and (2) establishment of bioweather services. In the Committee, two working groups, "Health" and "Amenity" were established. The activities of the "Health" working group in 2001 are shown in Table 1. The main theme at the starting point of the group was to make clear the relationships between weather and diseases, such as strokes, heat strokes, myocardial infarctions, psychotic depression, epidemic infection, cerebral blood vessel lesions, influenza, and rheumatic disease. In addition, seasonal changes in circulatory organ diseases and mortality were considered for study. Some results of the studies listed in Table 1 have been published as given in column of notes of the table.

The "Amenity" working group on concentrated intensively on themes such as green belts in urban areas, living and housing styles for persons assessed as hot or cold, comfortable air conditioning during sleep in summer, seasonal shifting of clothing conditions and forecasting for this, food customs in recent

Table 1 Study themes on human health by group members in 2001.

Name of researcher(s)	Study theme	Notes
Ando, M.	Precise forecasting of heat-strokes by weather information and human behavior.	Ando *et al*. (1998; 2004)
Inaba, Y. Hoshi, A. Xu, J	Relationship between meteorological elements and occurrence of strokes.	Xu *et al*. (2004)
Iriki, M. Komori, S.	Myocardial infarctions and meteorological conditions.	
Urashima, M. Nukariya, K.	Depression and meteorological conditions.	
Urashima, M. Okabe, N.	Modeling epidemic infectious diseases according to meteorological conditions and population movement.	
Shiozawa, Z. Iriki, M.	Relationship between occurrence of cerebrovascular disorder and climate.	
Shoji, M.	Forecasting of influenza occurrence by EXCEL.	Shoji *et al*. (2004)
Sudo, Ch.	Analysis of transport by ambulance cars in Nagoya City.	Sudo (2005)
Hoshi, A. Inaba, Y.	Analysis of heat disorder occurrence using newspaper reports.	Hoshi & Inaba (2004)
Yukiyama, Y.	Seasonal weather changes and rheumatoid arthritis.	Yukiyama (2004)

Table 2 Study themes on amenity by group members in 2001.

Name of researcher(s)	Study theme	Notes
Inoue, Y.	Reactions of self-assessed persons, whose health is affected by cold.	
Kakitsuba, T.	Comfortable cooling environment during sleep in summer.	
Tamura, T. *et al*.	Seasonal shifts in various health-weather conditions in Japan.	Tamura & Maruta (2004), Maruta & Tamura (2004) and in this volume.
Fukuoka, Y.	Seasonal shifts in various health-weather conditions.	Analysis of shifts in occurrences of discomfort, cooling degree-days, heat strokes. etc. and its application to forecasting.
Homma, K. Hashimoto, S.	Human health and environmental and social factors—sleep and biorhythms—.	
Matsubara, N. Kurazumi, Y.	Secular changes in lifestyles for escaping summer heat.	Matsubara *et al*. (2004)
Yoshino, M.	Occurrence of Asian dust storms and forecasting them.	Yoshino (2002) and Yoshino *et al*. (2002).

years, plant phenology and discomfort indices for urban areas, frontal maps of various bioclimate phenomena in Japan, and impacts of Asian dust storms on human health. The theme studied by the sub-group at the starting point in 2001 and their published results are listed in Table 2.

Figure 1 shows a Health-Weather Forecasting service image from the BCRC. From the BCRC body, this service is provided via BIOCLIMA-NET for use inlive-health calendars, health forecasting, medical forecasting, amenity forecasting, etc. It is ultimately intended for general users and professional traders.

3.2 Symposiums, conferences and working groups

The BCRC organized a session called "Scope of bioclimate in environment-human systems" at the Third International Conference on Human-Environment System (ICHES'05) on 12 Sept. 2005, held at the Bunka Women's University, Tokyo. L. Nkemdirim of the University of Calgary, Canada, presented the keynote lecture on Climate-Environments and Human Health (Nkemdirim, 2005). There were six contributions, including relationships between meteorological factors and asthma by K. Murayama and M. Tonouchi; heat strokes by Ch.-k. Liang and M. Ando; quantifying the sensation of comfort by K. Kuwabara, T. Horikoshi and T. Mochida; and landscapes by N. Koresawa, I. Tanaka and T. Horikoshi.

At the 10th annual meeting of the BCRC on 10 March, 2007, a symposium on "Heat Disorders and Their Forecasting and Prevention" was organized. Inaba (2007) reported on the activity of the Heat Disorder Working Group of the BCRC, which intends to create an index or standard for expression in forecasting and prevention.

3.3 Background for health-weather forecasting

Before starting, there was a need to consider the question of "How useful is health-weather forecasting for the public?" TERUMO Co. conducted a questionnaire survey of 1,168 individuals on their awareness of health-weather relationships (Kida, 2005). Among them, 602 were normal, healthy people, and 566 had high blood pressure, myocardial infarctions, asthma or rheumatic ailments.

As Fig. 2 indicates, 78% answered that the information service was useful (very useful or rather useful). Roughly two thirds of people are understood to be aware of health-weather relationships. Another result of the questionnaire survey was that 73% responded that they frequently or occasionally experienced effects of weather on their physical condition.

It was thought essential to consider codes for expressing health-weather forecasting, because it was the first attempt to present such information to the public. The TERUMO group summarized an "Expression Code" for health-weather forecasting according to their own standards, in addition to the code used in broadcasting, as follows:

(1) Present forecasting information based on facts which are statistically significant,
(2) Do not unnecessarily alarm TV viewers,

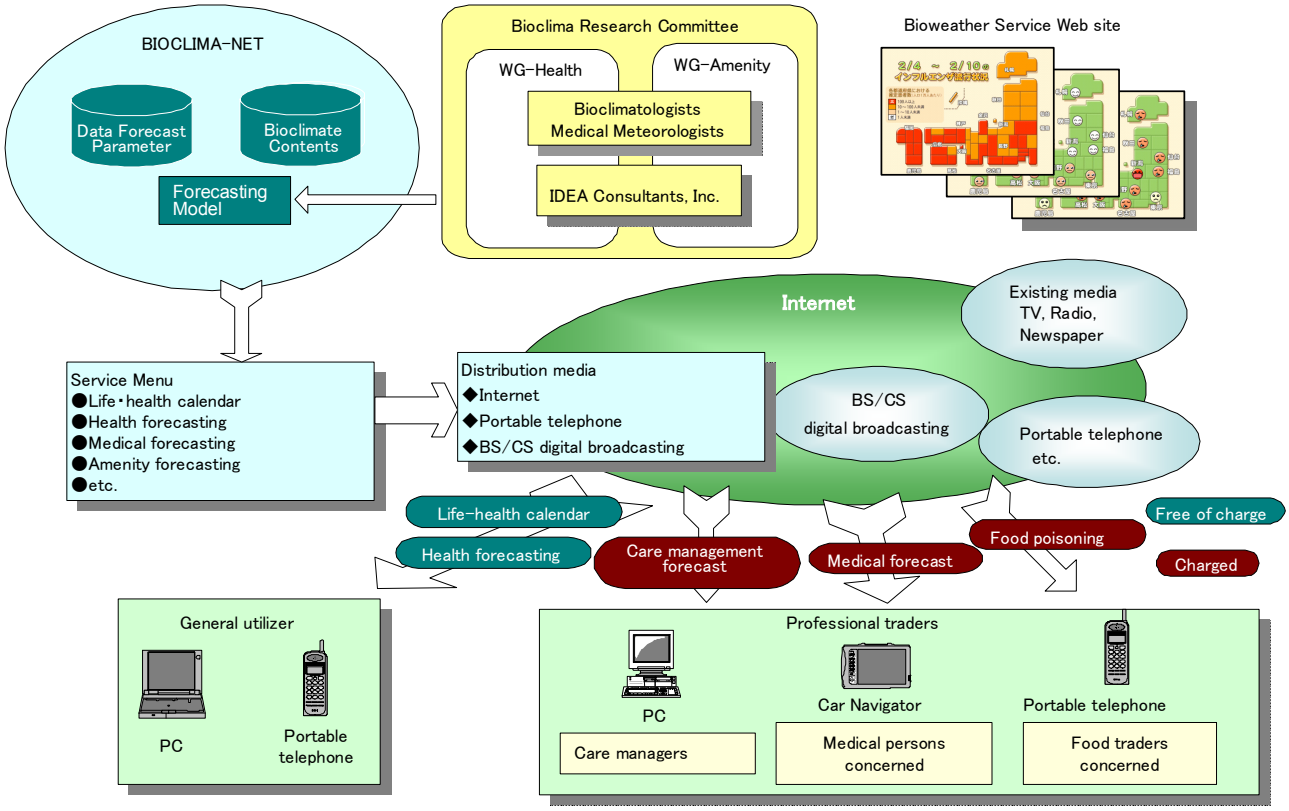

Fig. 1 Service image of medical weather forecasting by IDEA Consultants, Inc., and BCRC.

(3) Do not cause misunderstanding among TV viewers,
(4) Consider the security of TV viewers, and
(5) Inform TV viewers of countermeasures for action in as much detail as possible; for example, "wear your hat," "drink enough fluids," "avoid strenuous exercise under direct sunshine," "stay indoors, if possible," "avoid crowds," etc.

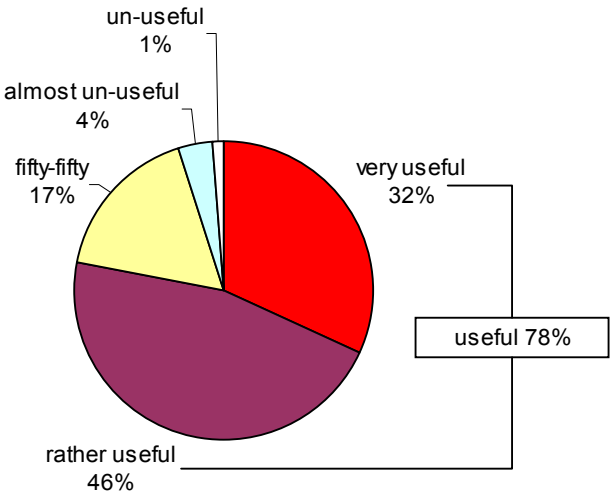

Fig. 2 Awareness of information on the relationship between health and weather and its usefulness (Kida, 2005).

For forecasting, another basic problem is the size of the area or division of area covered by the forecast. This, of course, depends on the size of the broadcast network, forecasting frequency (intervals of broadcasting times) and range (short or long, daily, weekly, monthly or seasonal) of forecasting.

For general purposes, bioclimatic divisions can be applied. Japan includes 39 bioclimate regions (Yoshino, 2003), based mainly climatic regions on the macro, meso and local scales (Yoshino, 1980). For the respective 39 regions shown in Fig. 3, the warmth-coldness index, annual precipitation and annual maximum depth of snow accumulation have been described, in addition to the complexity of biological species, atmospheric quality, land conditions, severity of natural hazards, etc. Bioclimatic conditions in the respective sub-regions are shown in Table 3. The divided regions correspond fairly well, generally, to the architectural forms, clothing customs and sensibilities of the inhabitants. These are their ways of adapting to long-term climatic conditions.

In order to clarify the applicability of bioclimatic regional divisions to forecasting and short range health-weather conditions, further studies are needed.

The BCRC studied health-weather information in newspapers. As mentioned above, bioclimates have been studied actively in Germany for the last several

The first division	The second division	Pertinent area
I	I_1	The southwest islands and others.
	I_2	Izu islands and others.
II	II_1	The southern part of Kyushu and the Pacific Ocean Coast of Shikoku.
	II_2	Pacific Ocean Coast from Kii peninsula to Boso peninsula.
III	III_1	Kyushu and the southwest of Yamaguchi Prefecture.
	III_2	The Setonaikai area.
	III_3	The Chubu and the Kanto area (the Pacific Ocean Coast and the area of the climate in the Sea of Japan side is excluded).
	III_4	The Pacific Ocean coast in Tohoku area.
	III_5	The Pacific Ocean Coast in Hokkaido.
IV	IV_1	The greater part of the Sea of Japan side in Chugoku area.
	IV_2	The side coast of the Sea of Japan in Chubu area.
	IV_3	The side of the Sea of Japan in Tohoku area and the south peninsula in Hokkaido peninsula.
V	V	Greater part of Hokkaido.

Fig. 3 Regional division of Japan by bioclimatic conditions (Yoshino, 2003).

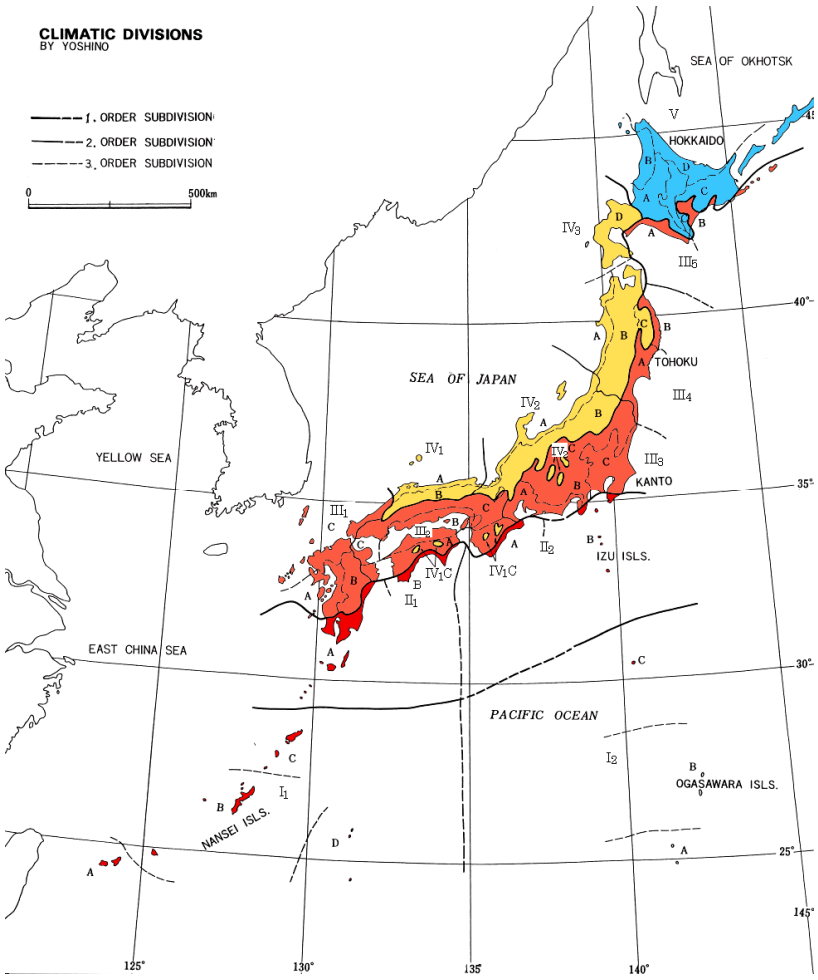

Table 3 Bioclimatic conditions in the respective sub-regions of Japan, given in Fig. 3.

		Stimulation by coldness			
		Rarely	Occasionally	Frequently	Most frequently
Difficulty or lesion caused by heat	Most frequently	I_1, I_2, II_1, II_2, III_1A.	III_1C, III_3C	---	---
	Frequently	III_1B, III_2A, III_3A.	III_4A.	III_3B, III_4B	---
	Occasionally	---	III_2B, III_2C.	IV_1A, IV_2A	IV_2B, IV_3B
	Rarely	---	---	IV_1B, IV_1C, IV_3A	III_5, IV_2C, IV_3C, IV_3D, V

decades. It was thought, therefore, that for health-weather forecasting in the media including TV in Japan, the treatment of this topic in the newspapers in Germany would be relevant. We therefore chose the "Frankfurther Allgemeine," one of the representative newspapers in Germany, as an example (Yoshino, 2006). In the newspaper, the weather information occupies a space of 19.7 cm × 37.0 cm, including a weather map (weather and air temperature) of Germany and weather maps (pressure patterns, weather, and air temperature distribution) of three global regions: Europe, North America and Asia (SE-Asia and E-Asia). Forecasting is given for that day, the next day and three days later, and it includes bioclimate conditions and pollen. Also, travel advisories are issued in another part. The contents of the "Bioweather" information given in seven lines are as follows:

(1) Regional conditions from north to south in Germany,
(2) Trends in warmth or coldness,
(3) Sleeping conditions at night and sensible temperatures in the daytime,
(4) Warnings with regard to some diseases, such as high blood pressure, and
(5) Weather and winds on the coasts and mountains for sports, leisure and travel.

The items mentioned above change according to weather conditions, treating some subjects in more detail.

4. Some Examples

4.1 Influenza

The Infectious Disease Surveillance Center, National Institute of Infectious Diseases in Japan, reports on the occurrence of influenza on a weekly basis. An example from the 49th week, 5-11 December, in 2005, which was somewhat colder than normal, provided the following information (Nihon-Iji-Nippo, 2006).

"The number of reports (4,289) increased to more than twice that of last week. This number is the third ranking among the last eleven seasons (years). The largest number of reports occurred in 1995-1996 and the second largest, in 1996-1997. Since the 1999-2000 season, this week has already reached a record high. Levels of alert higher than "warning" have been issued in the five prefectures. Since the 36th week, there have been 103 reports on different types of viruses; 31 were type AH1 and 72 were Type AH3, with no Type B. These will be prevalent throughout the country soon. More caution is necessary, based on the occurrence tendency."

Shoji (1999) pointed out that influenza occurs every winter when temperatures and absolute humidity are lowest. He pointed out differences in conditions among five regions in Japan. He showed that epidemics occured below 5 g/m^3 of absolute humidity in Hokkaido and Miyagi Prefecture, below 7 g/m^3 in Kagoshima Prefecture, and below 10 g/m^3 in Tokyo and Okinawa Prefecture. Making use of this information, weekly forecasting of the occurrence of influenza epidemics has been conducted for eight regions in Japan since July 2003 (Shoji, 2003). Currently, however, there is a three-week lag in the input of newly obtained data for forecasting. Shoji *et al*. (2004) re-examined the basis for forecasting in the season of 2003-2004, considering the boundary condition of "below 11 g/m^3 of absolute humidity in Japan." Other reports are as follows: According to the statistics from the seasons of 1990-1991, 1991-1992, 1992-1993 and 1994-1995, the occurrence of influenza started with conditions of absolute humidity below 11 g/m^3 in Japan. Forecasting presented for the current day, that the prevailing period will be 14 weeks, will not necessarily come about in actuality. In 83% of the prefectures, influenza continued for 9-14 weeks. Particularly, important will be the case of weaker occurrences under the influence of warmer winters. For more developed forecasting, the results of the 2004-2005 and 2005-2006 seasons were examined during the 10th Meeting of the BCRC held on 3 March 2007. A reduced frequency of occurrence of the so-called "tropical type" in June and July has been reported, probably under the influence of air conditioning, in addition to the winter maximum.

4.2 Myocardial infarctions

Matsumura (2003) summarized disease warning related to weather conditions season to season, using the data from Hiroshima City, West Japan, based mainly on his studies. He proposed that, for increasing accuracy level of forecast on weather-health conditions, cooperation studies by medical doctors in many hospitals, local government, local weather services, fire stations, medias etc. are necessary. It is considered that these cooperation is effective and relatively easier

in the medium size cities, because of the size of area, numbers of population, budget and man power. Hiroshima city (area is 905 km^2 and population is 1,155,000 in 2005) is one of the good examples.

The Hiroshima Medical Association has been forecasting myocardial infractions on its home page since 20 December 2003, based on an analysis of the relationships between the occurrence of 3,755 cases and the prevailing meteorological conditions (Matsumura, 2004). The effects of air temperature and pressure on the occurrence of acute myocardial infarction are clear (Wang *et al*., 2006). The highest risk was found on the days with low temperature and low air pressure. "Warning days" in the forecast indicate conditions of daily mean air pressure lower than 1,005 hPa, daily mean air temperature lower than 10°C and synoptic weather patterns with cold fronts passing. In contrast, "Caution days" indicate conditions of daily mean air pressure above 1,012 hPa, daily mean air temperature lower than 10°C and synoptic weather patterns with zonal anticyclones.

Figure 4 shows rates of occurrences of myocardial infarction of more than two cases per day in Hiroshima for the respective pressure patterns over Japan (Matsumura, 2004). The rates were obtained from data on transportation by ambulance cars in Hiroshima City. In 2002, there were a total of 419 myocardial infarction patients. If we sum up the winter weather patterns; that is, troughs passing (before and after) and typical winter-type pressure patterns (west-high/east-low), in addition to the passage of cold fronts, 55% of myocardial infarctions occur under such winter conditions. Therefore, in forecasting particular attention should be paid to synoptic weather patterns.

4.3 Others

In this special issue of the "Global Environmental Research," other health concerns such as heat disorders, pollen allergies, acute or chronic rheumatic ailments and asthma are being discussed separately in detail, so they are omitted here.

Among others, the Ministry of the Environment's approach to heat disorders is representative. On its web site, the Ministry has a "Heat disorder prevention information" page, on which it presents a "*High-Temperature Index,*" which is obtained from data on the current and following day, updated every three hours, for every prefecture in Japan. "*High-Temperature Index*" is divided into five levels as follows: Greater than 31°C (Wet Bulb Globe Temperature (WBGT)): Outdoor exercise is prohibited in principle.

31°C-28°C: Strict warning.

28°C-25°C: Warning.

25°C-21°C: Caution.

Lower than 21°C: Almost safe.

The Ministry of the Environment also reports briefly on the *"High-Temperature Index*" observed at five city stations, Tokyo, Niigata, Nagoya, Osaka and Fukuoka.

Ohshige *et al*. (2006) studied the influence of weather on emergency transport events coded as stroke. The events caused brain stroke increased under the conditions of lower air temperature and lower air humidity. In addition, it was found that they occurred more frquently at the daytime before noon (Ohshige, 2007).

Clothing is considered a mobile climatic environment for human beings. Tamura and Maruta (2004) analyzed it by laboratory measurement and Maruta and Tamura (2004) provided the outdoor observation

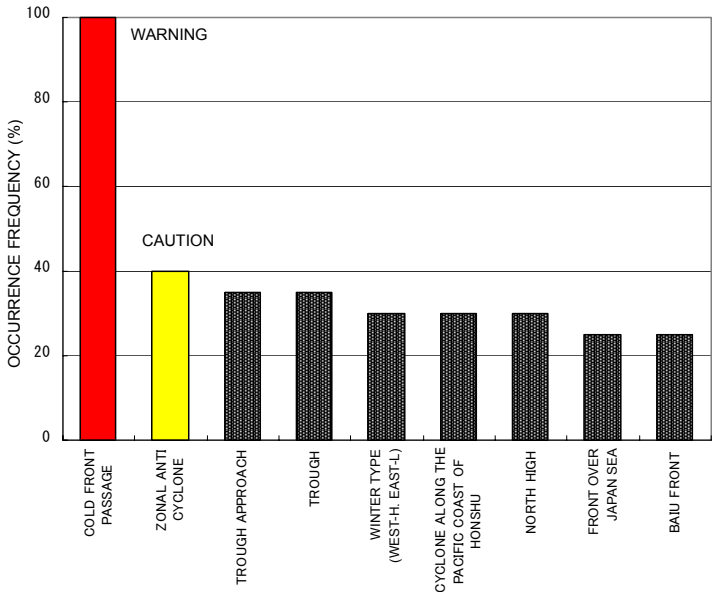

Fig. 4 Rates of occurrence of myocardial infarction of more than two cases per day in Hiroshima City for different synoptic weather patterns in 2002 (Matsumura, 2004).

mentioned above. Tamura (2005) recommends based on these works that such types of studies should be developed further in the regions at the high and low latitudes and also in areas with high elevations, where people are living with different cultural backgrounds in addition to the various bioclimatic environments.

In addition to the short-range forecasting dealt with in the present paper, there will be problems of long-range prediction such as monthly and seasonal forecasting or further longer time periods. For example, epidemic malaria warnings in Africa based on the seasonal climate forecasts have been studied recently (Thomson *et al.*, 2006). Technical problems and aims for long-range prediction can be different from the short-range forecasting, but we should study similar problems in the future.

5. Summary and Conclusion

This review paper points out firstly that the following topics are considered important for further study. (1) Seasonal, inter-diurnal, long-term and short-term temperature change and extreme values. (2) Lifestyle changes over long periods, various cultural backgrounds and their regional differences. (3) A historical overview for researches including weather proverbs, old documents, statistics, and experimental or descriptive research. (4) Health conditions, various diseases, sports and tourism.

The BCRC has been active in reserach since 2000. Some of its results are described separately in this special issue. There still remain, however, many themes to be studied. In particular, techniques of forecasting for various diseases, outdoor sports, clothing, travel etc. and expression of the results are main points to be considered in the future.

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