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Review on Practical Use of Weather Forecasting for Health in Japan and Germany

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Abstract

This paper reviews recent status of health-weather forecasting developed in Japan as well as in Germany. First, brief history of biometeorology in Japan was described with special reference to health-weather forecasting, based mainly on the previous studies by M. Yoshino and R. Miyashita in 2007 and 2008. In Japan, health-weather forecasting in TVs, Radios, Newspapers etc. has become popular since several years ago, but it has longer than 30 years' history in Germany. Secondly, recent activities by the Bioclima-Research-Committee (BCRC) on health-weather forecasting services were introduced, showing the flow chart. Importance of the size in space scale and the regional division or climatic division for the forecasting areas was discussed, according to the scale division by M. Yoshino.

Thirdly, delivery methods and frequencies of health-weather forecasting were dealt with. Fourthly, examples were given for (1) short-term UV conditions and adjusting for skin constitution and (2) heat disorder and its forecasting system at Kumagaya City. In the last part, examples appeared in the Newspapers and TVs in Germany were introduced. German methods have been used at 74 cities in the world in 2008, according to a report by J. N. Petit. It provides health-weather forecasting for the coming five days, updated every twelve hours at approximately 1200Z and 2300Z. Forecasts are categorized into one of the eight weather phases.

Key words: biometeorological history, health-weather relationship, Japan and Germany, med-weather forecasting

1. Introduction

Global warming and the urban heat-island phenomenon have recently brought about heat disorders, photochemical smog and other problems. Therefore, every weather company is making efforts to develop methods of weather forecasting for health or to prevent diseases such as heat disorders in collaboration with biometeorologists at universities or institutes.

In this paper, the author reviews some examples of weather forecasts for diseases or health, which are broadcast by mass media like TV, the Internet, mobile phone services, etc. in Japan, comparing them with weather forecasting in Germany. Some bio-weather forecasting systems incorporate not only meteorological elements but also personal physiological information such as gender, age, blood pressure, lifestyle, and so forth, especially in the cases of heat disorders and dry skin.

2. Historical Reviews of Biometeorology in Japan from the Viewpoint of Weather Forecasting

2.1 Short history of biometeorological forecasting in Japan

The author introduces a short history of biometeorological forecasting in Japan which was presented by Yoshino and Miyashita (2008) at Luncheon Seminar 1 at ICB2008 in Tokyo, September 2008.

It may be summarized as follows:

5th Century --- Knowledge related to biometeorology came to Japan gradually or sporadically from China and the countries in Korean Peninsula.

8th Century --- Cultural exchange missions between China (Tang Dynasty) and Japan brought biometeorological knowledge of the relationship between human health/disease and weather to Japan (Yoshino, 2007).

17th Century --- U. Ikeda described that "an injured

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person feels pain more strongly in his wounds when a storm (cyclone) is approaching."

18th Century --- Descriptions became more detailed, *e.g.*, itchiness of scalp, burning sensation in the face or ears, many ants emerging from nests, active movement of birds, active jumping of fishes, etc., as fore-running signs of approaching cyclones. Proverbs on the relationship between health/disease and weather have been passed down by local peoples since ancient times. These have been listed up by regional geographers on a prefectural or village scale.

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. Kuno (1949) studied perspiration and seasonal temperature.

In the 1960s and 1970s, M. Momiyama studied seasonal variations in mortality in relation to outdoor temperatures and indoor temperatures with heating/cooling, including lifestyle changes. She presented a seasonal disease calendar (Momiyama, 1961; Sakamoto-Momiyama, 1977).

In the paper "Med-Weather: A New Approach to Weather/Health Science and Weather Awareness," Petit *et al.*, 2008 state that efforts to quantify and express the health effects of weather will be enhanced by new Med-Weather forecasts on the Internet (http://www.med-weather.com). Derived from studies of the Deutscher Wetterdienst (German Weather Service), the University of Miami and others, those forecasts indicate how severely sufferers of arthritis, asthma, cardiovascular, and migraine symptoms may be affected. In addition, attention span and reaction time forecasts show how weather may affect the general population. To promote further research in this field, the Med-Weather web-based presentation will use responses from the site's visitors to validate its forecasts.

2.2 Some recent significant purposes of biometeorological studies

(1) Basic scientific research for application to medical weather forecasting.

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 in live-health calendars, health forecasting, medical forecasting, comfort forecasting, etc. It is ultimately intended for general and professional users.

(2) Background for health-weather forecasting: "How useful is health-weather forecasting to 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.

In response to the questionnaire survey, more than 70% of the persons answered that they thought there was a close relationship between weather and health, and most of them had had experiences such as "I get stiff shoulders when it becomes cold," "I become depressed when bad weather continues," "Dry weather brings about itchiness all over, "Old wounds start to hurt when bad weather continues," and so on (Kida, 2005; Fukuoka *et al.*, 2007).

The TERUMO group summarized an "Expression Code" for health-weather forecasting according to their own standards, for use in addition to the standard code used in broadcasting, as follows:

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

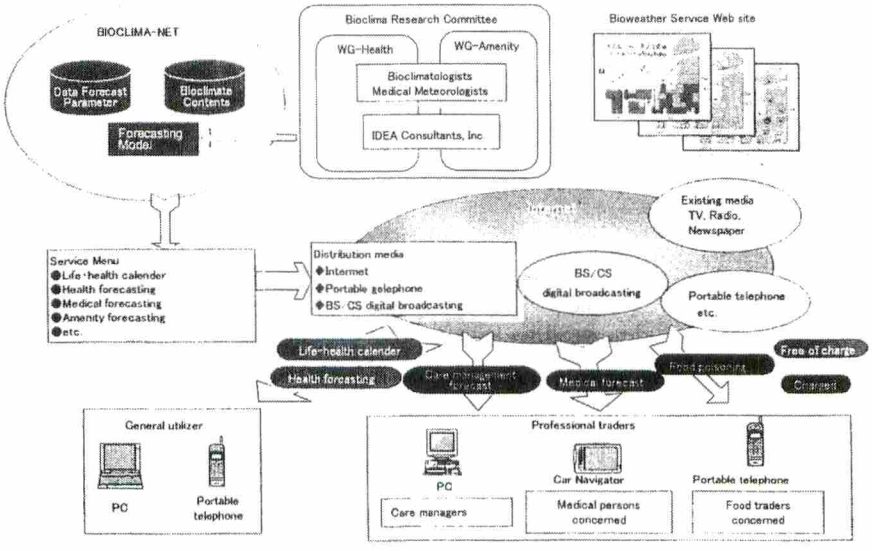

Fig. 1 Health-Weather Forecasting service image by IDEA Co.

hat," "drink plenty of fluids," "avoid strenuous exercise under direct sunshine," "stay indoors, if possible," "avoid crowds," etc.

2.3 Size of area and division of area for forecasting

For general purposes (broadcasting time intervals, networks, ranges--short or long, daily, weekly, monthly, or seasonal), Japan has been subdivided into 39 regions. These regions correspond fairly well, generally, to different architectural forms, clothing customs and sensibilities of the inhabitants, which have been their ways of adapting to long-term climatic conditions.

2.4 For whom is forecasting to be made?

Delivery methods and frequencies depend upon the scales of space as shown in Tables 1 and 2 presented by Yoshino and Miyashita (2007).

3. An Example of Weather-health Forecasting

3.1 In the case of short-term UV conditions

(1) Seasonal variation --- Maximum in August and secondary maximum in May in Japan (because of the rainy season in June and July).

(2) Impacts stronger in April than September (important point is the period after winter or after summer).

(3) Fine, cloudy or rainy weather for the day (important point is daytime weather). An example of information (forecasts) on UV in Japan is given in Fig. 2, from the Japan Meteorological Agency (http://www.jma.go.jp/jp/uv/).

3.2 Heat-disorder forecasting based on weather

There is a quite excellent forecasting system for heat disorders developed by LBW Co., which is adopted during the summer season. In order to get med-weather forecasts by means of this system, we have to input some personal physiological data such as age, gender, blood pressure, perspiration, body type, lifestyle (outdoor or indoor type), and so on, as shown in the picture (Fig. 3). After input of such personal data, detailed forecast information is produced as in Fig. 3, where

Table 1 Space scale and objects of weather-health forecasting. (Yoshino & Miyashita, 2008)

Space scale	Objects of presentation
Micro-scale	Individuals, Families, Groups, Enterprises, Schools, Hospitals, Communities, Local(town, village level) administration, Clinics, Health care centers, etc.
Local scale	Local (Prefecture, city, town, village level) administration, Enterprises, Schools, Hospitals, Local communities, Clinics, Health care centers, etc.
Meso-scale	National government, Prefectural government, etc.
Macro-scale	World organizations (WHO, WMO, UN, etc.), Regional Communities (EU, ASEAN, etc.)

Table 2 Delivery methods and frequencies of weather-health forecasting. (Yoshino & Miyashita, 2008)

Space scale	TV		Radio		News paper		Internet		Mobile telephone	Frequency (more than)
	Nat.	Reg.	Nat.	Reg.	Nat.	Reg.	Nat.	Reg.		
Micro-scale	×	○	×	○	×	×	×	○	○	5-6 times/day
Local scale	×	○	×	○	×	×	×	○	○	4 times/day
Meso-scale	○	○	○	○	○	○	○	○	×	1 times/day
Macro-scale	○	○	○	○	○	○	○	○	×	1 times/day

Note: Nat.=national scale; Reg.=regional scale.
○: possible; ×: impossible

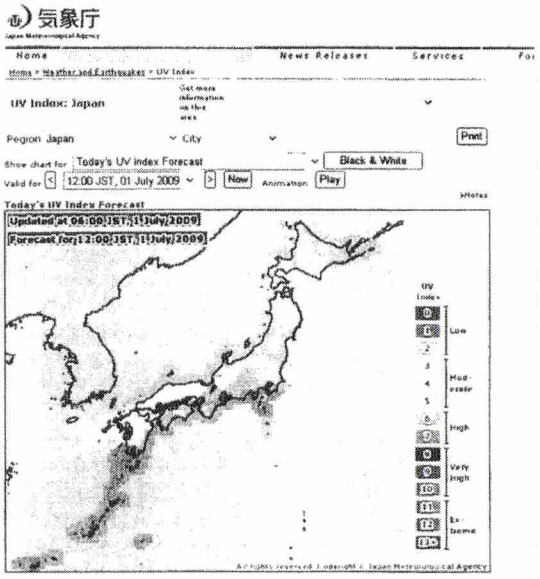

Fig. 2 An example of "Today's UV Index Forecast" (After Japan Met. Agency).

Table 3 An example of weather-health forecasting in the case of heat disorders. (Yoshino & Miyashita, 2008)

Factors	Items to be considered	Possibility of forecasting
Environmental factors	1. Temperature, humidity (air conditioning, indoor temperature and outdoor temperature).	○
	2. Wind velocity, sunshine.	(○), ×
Medical-Biological factors	1. Babies, infants, aged peoples, obese body, intake of alcohol.	○
	2. Abnormal conditions of body (e.g. fever, dehydration).	(○), ×
	3. Drag dependents, persons who cannot care themselves.	×

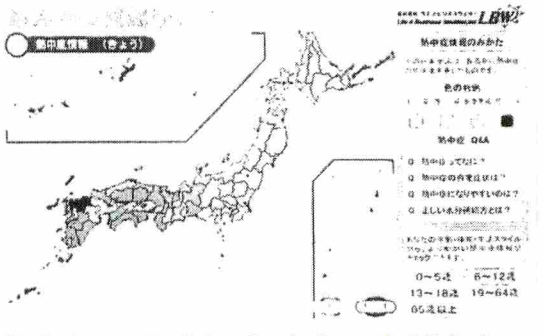

Fig. 3 An example of a heat disorder forecast by Life Business Weather, Inc.

eight grades of heat disorders are presented by eight colors and detailed comments are written adding information on precautions and treatment. Incidentally, the eight grades in this system originated from the guidelines proposed by the Committee on Heat Disorders of the Japanese Society of Biometeorology 2008.

3.3 The case of UV forecasting, adjusting for skin constitution

UV forecasting is carried out to suit skin constitution. It takes into account not only weather elements but also the physiological condition of the skin. As a meteorological element, this forecasting system uses an international ultra-violet index consisting of 14 grades (0~13).

This index was deduced through experiments on the relationship between the UV index and skin type: white, standard and black. The UV index is based on the time interval required for the skin's color to change to red, that is, sunburn occurs differently in the three types of skin.

In Fig. 4 the red symbol indicates extremely strong UV; orange, very strong; yellow, strong; green, medium; and blue, weak

3.4 Heat-disorder forecast practices of local governments

In Japan, the record maximum air temperature was reestablished from its historical high of 40.8°C in Yamagata City in 1933 to 40.9°C in Kumagaya

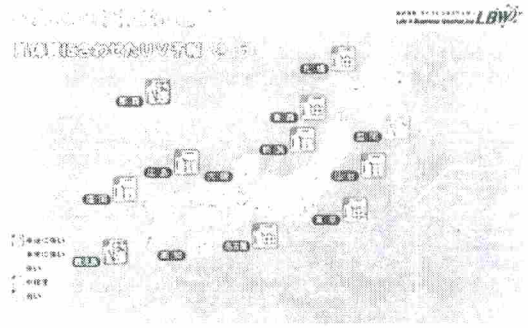

Fig. 4 An example of a UV forecast by Life Business Weather, Inc. The marks in this figure are as follows: red—extremely strong UV, orange—very strong, yellow —strong, green—medium and blue—weak.

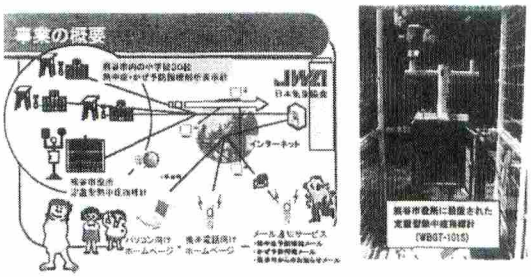

Fig. 5 Heat-disorder forecasting system of Kumagaya City.

(Saitama Pref.) and Tajimi (Gifu Pref.) in 2007. Therefore, local governments such as Kumagaya City and Kusatsu City are trying to mitigate physiological damage due to heat disorders by using new facilities or special systems based on WBGT observations locally.

In the case of Kumagaya City, 30 air temperature and relative humidity observation stations have been established in order to compute WGBT by using WBGT at the city center and meteorogical data from the JMA (Japanese Meteorological Agency), The estimated WGBT figures can be obtained by any citizen with a mobile phone at any time, under a system established on July 1, 2008 as shown in Fig. 5.

The web-based presentation of the Kumagaya local government's heat-disorder forecast will use responses from the site's visitors to validate the forecasts.

4. Introduction of German Health-weather Forecasting as a Forerunner

In Germany, health-weather forecasting has been carried by daily news paper (Fig. 6) as well as TV (Fig. 7) from a few decades ago. It includes more than 20 items comprising not only diseases themselves but also mental disorders like irritation, insomnia, etc. The scientific basis of the newspapers' *biowetter* or TV stations' health-weather forecasts has not been made public, which means that the author has no data on the original papers dealing with the relationship between diseases and weather in Germany.

Nonetheless, the author thinks it useful as a "Forewarned, forearmed" strategy tool ("*Korobanusaki no tsue*" in Japanese).

Recent studies of German med-weather forecasts were presented at ICB2008 in Tokyo, one of which the

Fig. 6 An example of a health-weather forecast in a newspaper (*Biowetter* in German) as shown on the bottom left, where *Kopfschmerzen* (headaches) and other health concerns are predicted.

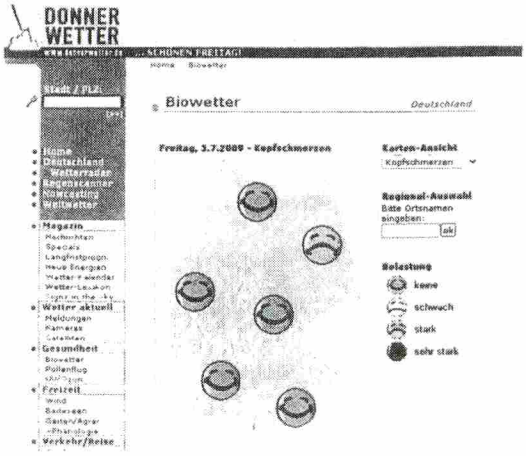

Fig. 7 An example of a health-weather forecast on TV (*Biowetter* on DONNER WETTER), where four levels of bronchitis are shown for six regions.

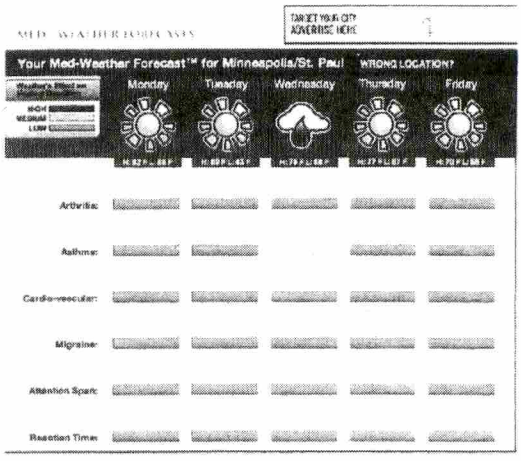

Fig. 8 Example of weekly forecasts four basic groups' diseases, attention span and reaction time at St. Paul. (after Petit *et al.*, 2008)

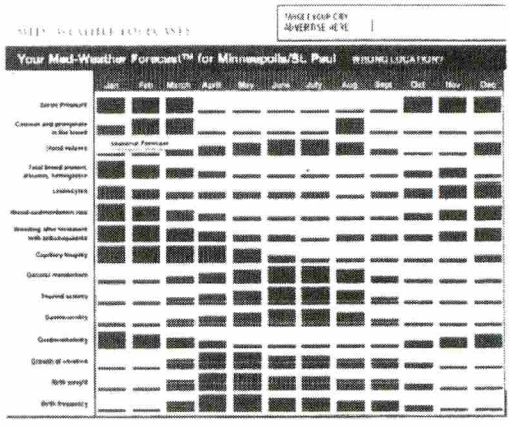

Fig. 9 Example of seasonal forecasts of Med-Weather at St. Paul. (after Petit *et al.*, 2008)

author summarizes as follows.

At present 74 cities around the world provide local health-effect forecasts for the coming five days, updated every twelve hours at approximately 1,200 Z and 2,300 Z. This allows the forecasts to be most relevant to users who may need information on how they may be affected in the next 12 to 24 hours.

Forecasts are then categorized into one of eight weather phases as defined by the original studies of the Deutcher Wetterdienst. These forecast phases are based on changes in the weather patterns in terms of cloudiness, temperature, precipitation, barometric pressure and winds:

Phase 1: Moderately good weather
Phase 2: Improving weather
Phase 3A: Good weather
Phase 3F: Exceptional weather
Phase 4: Forthcoming precipitation
Phase 5: Precipitation beginning
Phase 6: Clearing, calm weather
Phase 6Z: Completed precipitation

Though the general health effects of weather were analyzed for 40 different diseases (*e.g.*, asthma, migraines, rheumatic arthritis, etc.) they simplified these to four basic groups of diseases at the beginning of their studies: arthritis, asthma, cardio-vascular and migraines. There are also some studies indicating effects on attention span and reaction time (Figs. 8 & 9).

The study concludes that this site can be used for collecting data on wellness and can help build an understanding of the weather-disease connection and promote the science of biometeorology.

5. Conclusions

In this review paper, the author points out that the med-weather forecasting is not so popular in Japan even on TV, while in Germany they are prominent in newspapers as well as on TV, every day nationwide. This difference is thought to be rather similar to differences in the way of thinking on environmental problems, that is, a difference in awareness and sense of crisis before problems happen.

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