Climatology of the Traffic Accident in Japan on the Expressway with Dense Fog and a Case Study

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1. Introduction

Fog limits visibility, and it can often be a cause of the traffic accidents. Especially, it may be a cause of the major accidents on the expressway in which many automobiles run at high speed. It is necessary to examine features of the fog with the traffic accident in order to prevent such disaster. Climatological features were examined, and a detailed meteorological analysis was carried out on the one case.

2. Some climatological features of the traffic accident in Japan on the expressway with Dense Fog

Major traffic accidents with dense fog occurred on the expressway in Japan is shown at Table 1 (Yamamoto, 2000; 2001). The serious accidents often occurred with the dense fog in various places. There is no decreasing aspect, even if it is in 1990's. The time in which the accident occurs is concentrated in the cooling season. Meteorological situation at the incidence time is various. That is, with low extratropical cyclone, anticyclone, front. Such climatological features not always agree with general features of the fog in Japan. It seems to be characteristic of the fog that is easy to connect with the accident. Detailed study is necessary on individual case.

3. A case study of the accident on the Ban'estu expressway on December 1, 1998

Sufficient meteorological data are not often obtained in the follow-up investigation. In this paper, the result of an analysis on the accident, which occurred at 5:50AM December 1, 1998 (JST: Japan Standard Time) is presented (Yamamoto and Oyamada, 2000). In this case, meteorological features were caught to some extent by hearings at fieldwork and collection of extensive meteorological data, etc.

Table 1. Major traffic accidents on the expressway with dense fog in Japan.

Incidence date and time.	Place	Accident situation	Human damage	Meteorological situation
February 1, 1972 1055AM	Shizuoka Pref. Tomei Exp. way	29 cars multiple collision, 6 cars burnt	2 killed, 23 injured	"Two eyes" low pressure
December 5, 1972 morning	Kyoto Pref. Meishin Exp. way	Connected accident	1 killed, 36 injured	Migratory anticyclone.
March 8, 1987 0645AM	Saitama Pref. Tohoku Exp. way	53 cars multiple collision	1 killed, 27 injured	Migratory anticyclone.
December 6, 1991 09AM	Yamaguchi Pref. Chugoku Exp. way	7 cars multiple collision	22 injured	Migratory anticyclone.
June 23, 1993 0020PM	Gunma Pref. Kan'etsu Exp. way	58 cars multiple collision	18 injured	Stationary front
February 14, 1996 09AM	Osaka Pref. Hanshin Exp. way	8 continuous collisions 25 cars related	11 injured	Stationary front
December 1 1998 0550AM	Fukushima Pref. Ban'etsu Exp. way	16 cars multiple collision	2 killed, 30 injured	"Two eyes" low pressure

There were two low pressures, which are referred as "two eyes", south and north of Japan. The pressure gradient was small near an accident site and the surface wind was quite weak (Figure 1).

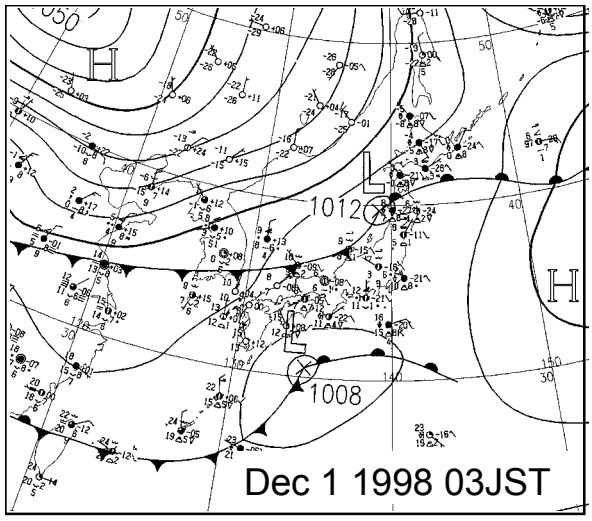

Figure 1. Surface synoptic weather map.

Table. 2. Standards of the warnings for low visibility.

Type	Standard
Fog warning (Meteorological Observatory)	Visibility 100m
Passage regulation for expressway (Freeway Traffic Police)	visibility 50m（shut） visibility 100m（50km/h speed control）

There was no meteorologically observed amount of visibility in the accident place, but it is estimated that it was about 10m based on the interview with rescue squad and general drivers.

It seemed that the fog was formed at narrow region of about 2 km by 2 km. Though a visibility meter exists at distance of about 1.5km from the accident site, observed visibility was considerably large, above 100 meters. When visibility will be limited by dense fog, meteorological observatory issues the fog warning, and when dense fog appears, the police carry out the passage regulation for expressway. Visibility in the day seemed to have reached these standard (Table 2), however, these warning and caution were not taken.

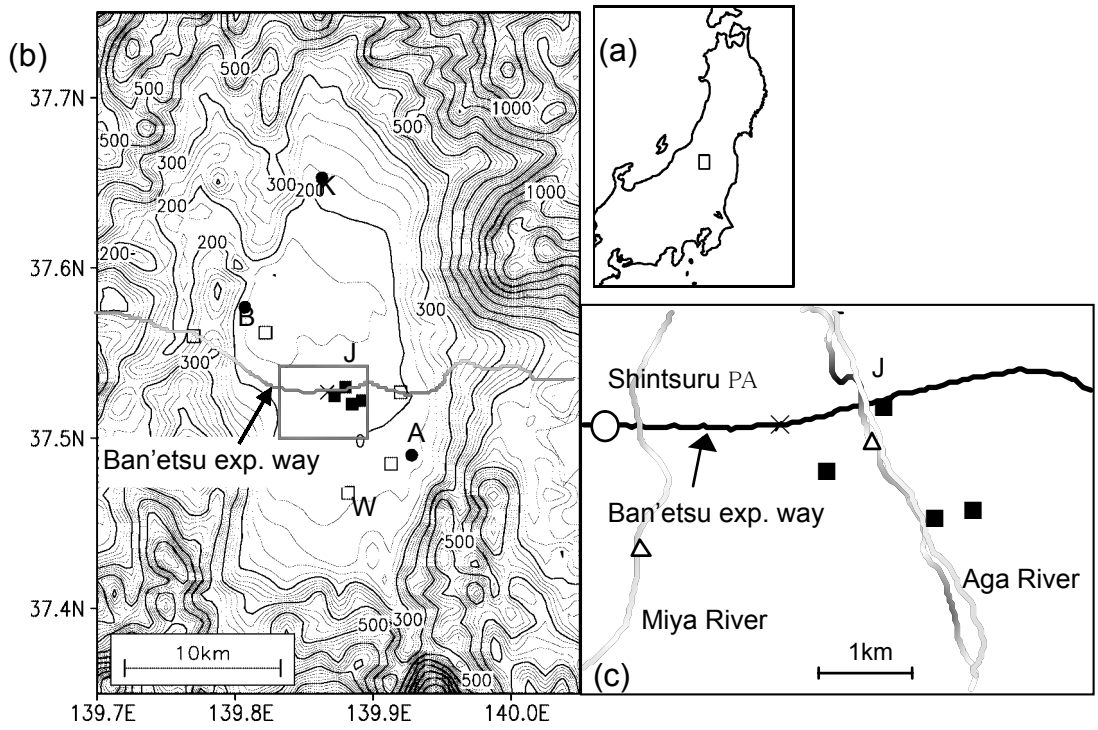

Figure 2. Map of Aizu Basin (a) positon of the basin (b)topography (contour every 20 meters) (c)map around accident site ×: position of the accident. ■: the points where fog was observed. □; fog not observed. K, B, J, A, W: meteorological stations.

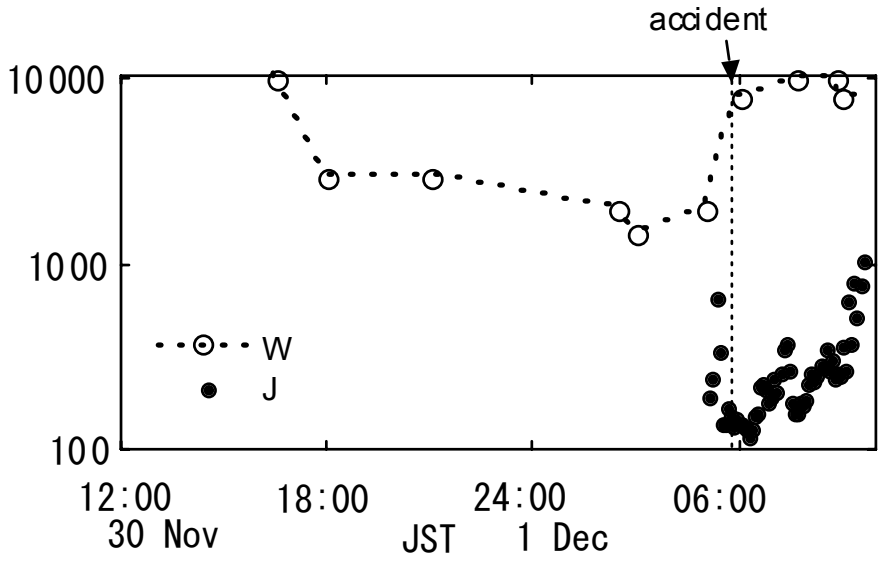

Figure 3. Visibility at station J (visibilisy meter) and W (Human eye).

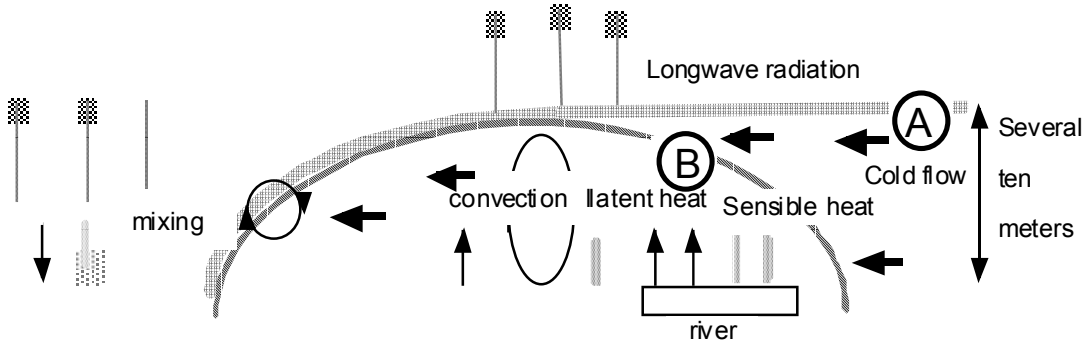

Figure 4. Conceptual model of the local dense fog. In almost saturated layer with a thin fog(shaded), cold flow (which upper surface is showed as A and flow of the inside is showed as thick arrows) which is almost more saturated is intruded, and it mixes of the circumference with the air. The numerous water droplets formed (surrounded in the curve of B) by supplies of latent heat and sensible heat from relatively high-temperature ground surface (Upward short arrows. They are downward outside cold flow), longwave radiation from the upper surface of the fog layer and unstabilization of fog layer, and convective mixing in it.

The time change of visibility is shown in the Figure 3. Visibility near the accident site rapidly decreased from before about 20 minutes before the accident occurred. At the weather station, which left about 5 km from the accident site, visibility increased in this time reversely.

The mechanism in which such local dense fog rapidly formed could not be sufficiently clarified.

However, it is regarded that radiative cooling, and supply of sensible and latent heat from the river were effectively functioning (Figure 4). Some features of the fog, which can be a cause of an accident are that visibility is very limited with under 100m and the visibility changes suddenly with time and space (Lavdas and Achtemeier, 1995).

4. Conclusion

At present, there is no specific remedy for the reduced visibility by fog. It will be necessary to accumulate measures for preventing the disasters with dense fog in various fields. In the meteorological field, characteristic of the fog, which is connected with the accident, development of technique for fog monitoring and prediction, and development of the dissipation technology of the fog, etc. will be required.

By the way, the strengthened caution systems around there has been installed, such as the extension of the visibility meters and meteorological information boards after the accident (JH Tohoku, 1999).

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