ESTIMATING OCCURRENCE PROBABILITY AND LOSS INDEX TO MANAGE THE SOCIAL RISK OF STRONG-WINDS

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***ABSTRACT*:** Recently in Japan, people concern about the uncertainty of social damage due to extreme strong-wind. There are examples such as the loss of property with collapsed houses. In order to prevent the damage from the disaster caused from extreme strong-winds, it needs to obtain the newest knowledge and empirics about the uncertainty. That is not only the hazard of extreme strong-winds that is the grade of probable damage, but also the occurrence probability of extreme strong-winds. The paper collects the past event of extreme strong-winds and the remarkable loss experienced in Japan. Using the statistics of the maximum instantaneous wind velocity at the last few decades in Japan, it estimates the occurrence probability of strong-winds exceeded more than the domestic standard level in order to resist strong-winds. It actually applies a few remarkable regions in Japan. It comments the usefulness of the model to estimate them and the managing index for the risk of extreme strong-winds.

KEYWORDS : monitoring tasumaki hazard, marginal probability indices

1. INTRODUCTION

1.1 Typhoon and "Tatsumaki" Damage in Japan

Some strong typhoons approach near Japan at September. Many of typhoons which bring about a serious disaster are landing from the middle of September towards the end of the month. A typhoon is one of the most dangerous weather in Japan, which carry out the disaster by the strong wind, heavy rain and high tide. After the world war two, there are seven cases of meteorological disasters beyond a thousand of peoples for dead and missing, where those five examples are based on the typhoon. The greatest damage was the Ise Bay typhoon, 1959. It went north from the Kii Peninsula to the Toyama Bay. In each place, 5,000 people were made victims of the typhoon.

The higher rank of the maximum instantaneous wind speed, observed in the weather government office, are included on the range from 77 to 85 meters per second. All of them are observed at the occurrence of typhoon as follows in Table1 .

Table1 Higher rank record of the maximum instantaneous wind speed

Observatory	Maximum Instantaneous Wind(m/s)	Typhoon Label (Date)
Miyakojima	85.3	2nd Miyakojima(1966.Sep.5)
Muroto	84.5	2nd Muroto(1961.Sep.16)
Miyakojima	79.8	3rd Miyakojima(1968.Sep.22)
Nase	78.9	Typhoon 9-go(1970.Aug.13)
Muroto	77.1	Typhoon 23-go (1965.Sep.10)

In connection with a typhoon, a severe storm or a tornado, which abbreviates below "tatsumaki" called in Japan, often occurs. From statistics, September has the most generating number of cases of tatsumakis. The tatsumaki generates with a progressed cumulonimbus cloud, the local strong winds bring us some damages. With a tatsumaki, it is visible at the clouds of the shape of a funnel which hangs down toward the ground from a cumulonimbus cloud. Although in English they are distinguished between the tornado land-generated and waterspout marine-generated, in Japan it is called a tatsumaki altogether. A downburst expresses the air current for which a cumulonimbus cloud is blown down explosively, and the destructive air current which this collides with surface of the earth, and blows off around.

In Japan there are many meteorological disasters due to a typhoon and local severe rain, but there is a little tatsumaki comparatively. However, 1978 February 28 the tatsumaki generated in along with Tokyo Bay. The railroad vehicle was overthrown on the iron bridge of Subway Tozai Line.

Table2 stands for tatsumakis more than Fujita-scale two after 1990, which was damage occurred.

Table2 Event of the tatsumaki generated in Japan

Tatsumaki ,Date	F-scale, Damage
Hokkaido pref., Saroma-town 2006.Nov.7	F3, death 9、injured 31、 Completely destroyed 7、 Partially destroyed 7
Miyazki pref., Nobeoka-city 2006.Sep.17	F2, death 3、injured 143、 Completely destroyed 79、 Partially destroyed 348
Aichi pref., Totohashi-city 1999.Sep.24	F3, injured 415、 Completely destroyed 40、 Partially destroyed 309
Chiba pref., Mobara-city 1990.Dec.11	F3, death 1、injured 73、 Completely destroyed 82、 Partially destroyed 161
Kagoshima pref., Makurazaki-city 1990.Feb.19	F2～F3, death 1、injured 18、 Completely destroyed 29、 Partially destroyed 88

Niino et al (1997) arranged the feature of tatsmaki from 1961 to 1993 in Japan. Here the annual number of generating is the maximum 42, the minimum 10 and the average 20.5. It comes out the average of the length of the damage distance by a tatsumaki 3.2 kilometers, the longest case was 1978 February 28 in Tokyo, 41.2 kilometers. It comes out the width of damage distance from 16 meters to 51 meters more than a half, and the largest one is 1,500 meters 1990 at Mobara-city, pref. Chiba. Almost tatsumaki has the temporal duration from 5 to 16 minutes, the average temporal duration is 12 minutes. The 85 percent of tatsumaki has a counterclockwise rotation. The 20 percent of tatsumaki relate to a typhoon, and the 50 percent of tastumaki generates with a low atmospheric pressure.

The Meteorological Agency opens to public the gust data, such as a tatsumaki, downburst and so forth as follows Figure1.

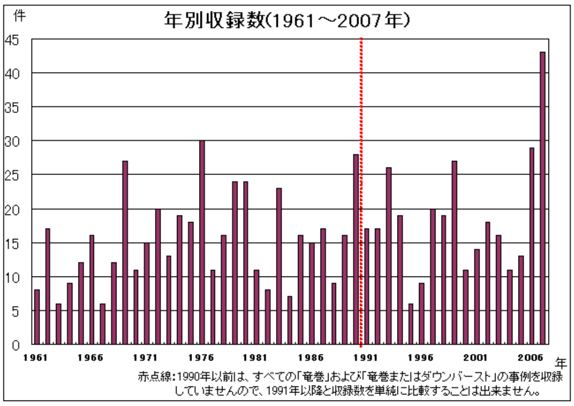

Figure1 Yearly number of tatsumaki (1961-200)

They generate mostly in summer and autumn, there are many generating of February and October as follows Figure2.

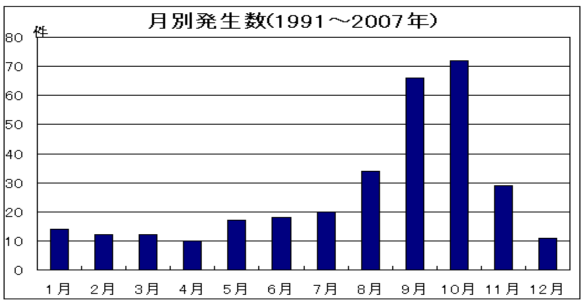

Figure2 Monthly number of tatsumaki (1991-2007)

A generating place reaches every place, and comparing to the Sea of Japan side, there are many generating of the Pacific Ocean and they concentrate in the area along the shore at Figure3.

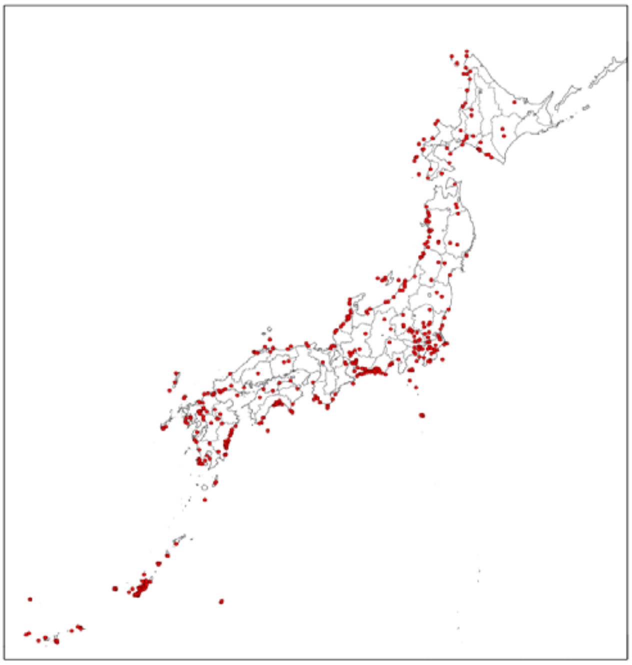

Figure3 The tatsumaki generating position in Japan from 1961 to 2007.

Weather conditions in case a tatsumaki occurs are a trough and the cold front, the cold air and warm air, typhoon and the atmospheric pressure of the Sea of Japan, it shows to Figure4.

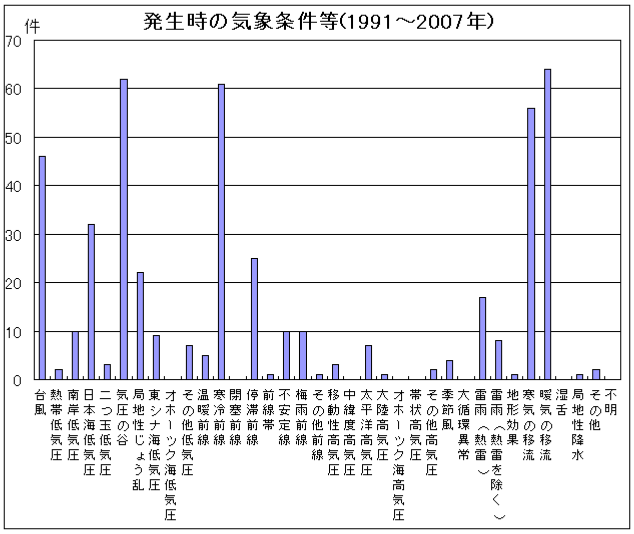

Figure4 The generating factors of a tatsumaki

According to prefectural area, it is higher rank with many tatsumaki or down burst, Okinawa 56, Hokkaido 42, Kochi 24, Miyazaki 18, Kagoshima 15, Aichi 15, Niigata 14, Wakayama 9 and so forth. Thus, the strong wind is the one which brings about serious damage in Japan, heavy rain and the typhoon accompanied by high tide, and the others that follow on a cumulonimbus cloud, tatsumaki and downburst.

It is important to manage the risk of the strong wind, and windproof society should be realized. For windproof policy, it needs to monitor the strength of the wind which may happen regionally, and it also needs the index which quantifies the grade of damage. People want to the systematic structure for the future windproof society to learn the disaster history of a strong wind, occurrence probability of strong wind and the amount of damage from them.

This paper proposes the method to estimate the occurrence probability of the strong wind using the wind velocity statistics. It also supposes the management indices of the risk for the strong wind to be useful for the windproof social life.

Regional monitoring strong wind

○Survey the history and the strong wind generating damage quantity happened at the region

○Estimation of occurrence probability, such as a gust and a downburst at the region

○Strong wind hazard index based on seasons and periods at the region

Windproof regional policy against strong wind

○Windproof design and reinforcement of a house and public institution

○Wind damage education, consciousness of gust risk for each community

○Gust forecast as quick as reception, behavior to be windproof

Figure5 Regional monitoring the strong wind toward the windproof policy

2 . MODELING STRONG WIND

2.1 Method to estimate occurrence probability of excess strong wind

It formulates the method to estimate the probability which carry out the strong winds exceeded the standard of an area, such as a tatsumaki and a downburst, indicated as Figure6.

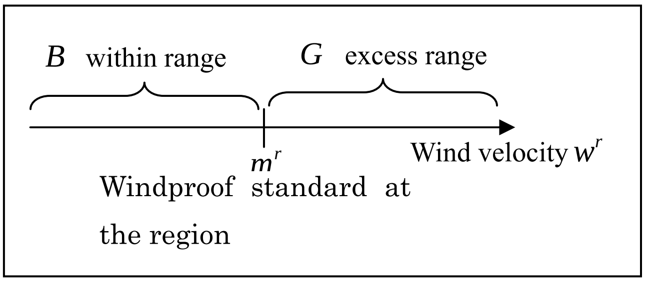

Figure6 An occurrence probability of the strong wind exceeded over the regional standard

Suppose that wind velocity is observed at the region r . The wind velocity blown at time j is denoted by w_t^r $(j = 1,...,N)$. The wind velocity level used as the windproof standard of the past in an area is expressed by m^r . Due to notational convenience, it omits the subscripts of an area r . For modeling, the wind velocity is the integer part. Inside of a past windproof standard, the wind is included at the Breeze range (abbreviate B range), it is expressed as follows.

$$B \text{ if } w \in \{0,1,2,...,m-1\} \quad (1)$$

The Gust or Gale range (abbreviate G range) that is the strong wind exceeded the standard (abbreviate excess wind), it is denoted as follows.

$$G \text{ if } w \in \{m, m+1, m+2, ...\} \quad (2)$$

Since wind velocity is contained to one of ranges, the next equation is realized.

$$\Pr(G) = 1 - \Pr(B) \quad (3)$$

In order to make the risk of excess wind the index, it needs to estimate the occurrence probability of excess wind $\Pr(G)$.

It formulates below the phenomenon included in either of two group of the B range within the standard or the G range without the level. Concretely, using the Two-Grouped Poisson model (abbreviate 2GP model), it proposes the method to estimate the strong wind occurrence probability exceeded a standard level.

Now, at time j a wind velocity w_j generates to the B range within a standard, characterized by the period or the area x_j , it is the following formula as.

$$p_j^B(x_j) = \Pr(w_j \in B \mid x_j) = \sum_{w_j \in B} f(w_j \mid x_j) \quad (4)$$

Assume that the wind velocity is independently and identically Poisson distributed as next formula.

$$f(k \mid x_j) = \frac{\exp(-\lambda_j)(\lambda_j)^k}{k!} \quad k = 0,1,2,... \quad (5)$$

Here, considering the characteristic of the period or the region, it specifies the mean as follows.

$$\lambda_j = \exp(x_j'\alpha) \quad (6)$$

Where it stands for $x_j' = (x_{j1},...,x_{jK})$: K -attribute vector of the wind velocity, $\alpha' = (\alpha_1,...,\alpha_K)$: K -characteristic parameter vector. Therefore the likelihood function of 2GP model can be formulated as next equation.

$$L^{2GP} = \prod_{j=1}^{N} p_j^B(x_j)^{d_B} \left[1 - p_j^B(x_j)\right]^{(1-d_B)} \quad (7)$$

Here, d_B denotes the membership function contained in the B range. If the wind velocity is contained in the B range, it takes $d_B = 1$, elsewhere it takes $d_B = 0$. The logarithmic likelihood function is derived as next formula.

$$\log L^{2GP} = \sum_{j=1}^{N} d_B \log p_j^B(x_j) + \sum_{j=1}^{N} (1-d_B) \log\left[1 - p_j^B(x_j)\right] \quad (8)$$

Here a probability term of Breeze range stands for the following equation.

$$p_j^B(x_j) = \sum_{k=0}^{m-1} \frac{\exp(-\lambda_j)(\lambda_j)^k}{k!} \quad (9)$$

In order to maximize the logarithmic likelihood, it gets an optimum characteristic parameter using a numerical computation such as quasi Newton method. Using these parameters, the occurrence probability of excess wind can be predicted as follows.

$$p_j^G(x_j;\alpha_1,...,\alpha_K)=\Pr(w_j\in G\mid x_j)$$
$$=1-p_j^B(x_j;\alpha_1,...,\alpha_K) \qquad (10)$$

2.2 Periodic, seasonal change, Marginal indices

The excess wind is possible to be heterogeneous with the period and the season happened. We know that El Nino is influenced on some period, and that a strong wind relatively more generates at the season of autumn. Therefore the Poisson mean equation (6) specifies below.

$$\lambda_j^D=\exp(\lambda_0+D'_{j,period}\pi+D'_{j,season}\theta) \qquad (11)$$

Here, λ_0 is the constant parameter of the first period from 1961 to 1970, $\pi'=(\pi_1,...,\pi_4)$ is the periodic parameter vector, $\theta'=(\theta_1,...,\theta_4)$ is the seasonal parameter vector. Each period is classified by 10 years interval, it sets up with the dummy variable of the period characteristic, it defines as follows.

$$D'_{j,period}=(d_j^{71-80},d_j^{81-90},d_j^{91-2000},d_j^{2001-2007}) \qquad (12)$$

Here, d_j^{71-80} is defined that if the observed wind velocity w_j is contained from 1971 to 1980 then it takes $d_j^{71-80}=1$, elsewhere $d_j^{71-80}=0$ .The remaining periods are also the same. The seasonal division has three months interval, it sets up with the dummy variable of seasonal characteristic, it specifies below.

$$D'_{j,season}=(d_j^{3-5},d_j^{6-8},d_j^{9-11},d_j^{12-2}) \qquad (13)$$

Here, d_j^{3-5} is defined that if observed wind velocity w_j is contained in spring such as March, April and May, it takes $d_j^{3-5}=1$, elsewhere $d_j^{3-5}=0$. The other season are the same such as d_j^{6-8} : the summer dummy variable contained in June, July and August, d_j^{9-11} : the autumn dummy variable contained in September, October and November, d_j^{12-2} : the winter dummy variable contained in December, January and February.

It differentiates the occurrence probability of excess wind (10) with the l th-periodic variable $(l=1,2,3,4)$, it is derived as the next equation.

$$\frac{\partial p_j^G}{\partial d_j^{l(period)}}$$

$$=(-1)\sum_{k=0}^{m-1}\left\{\frac{\exp(-\lambda_j^D)(\lambda_j^D)^k}{k!}(k-\lambda_j^D)\right\}\cdot\pi_{l(period)}$$

$$l(period)\in\{1(71-80),2(81-90),3(91-2000),4(2001-2007)\} \qquad (14)$$

Moreover, it differentiates the occurrence probability of excess wind (10) with the h th-seasonal variable $(h=1,2,3,4)$, it is derived as follows.

$$\frac{\partial p_j^G}{\partial d_j^{h(season)}}$$

$$=(-1)\sum_{k=0}^{m-1}\left\{\frac{\exp(-\lambda_j^D)(\lambda_j^D)^k}{k!}(k-\lambda_j^D)\right\}\cdot\theta_{h(season)}$$

$$h(season)\in\{1(3-5),2(6-8),3(9-11),4(12-2)\} \qquad (15)$$

The sign of these marginal change (14)(15) is not uniquely determined. It is possible to predict the change of excess wind probability according to the sign calculated by estimated parameters.

3 . Applied results

3.1 Case study region

2006 November 7, the tatsumaki occurred at Saroma-town, Hokkaido prefecture in Japan. Reported later by the Tatsumaki disaster investigation special committees, it was estimated as the greatest ever scale in Japan, Fujita scale 3, the maximum wind speed is 92 meter per second. Disaster concentrates the belt-like range with the length one kilometer and the maximum breadth 300 meters. The amount of total loss is estimated as 5.7 hundred million yen.

Below, in the circumference of Saroma-town it tests whether the occurrence probability of excess wind was increasing or not. In Saroma-town it has just been begun from 2008 March to observe the maximum instantaneous wind speed. After 2008, there are some of the highest observations of maximum instantaneous wind speed such as 2008 April 24, south-southwest wind 21.7 meter per second, 2008 November 20, southwest wind 19.8

meter per second and 2008 May 20, south wind 19.8 meter per second. There are comparatively many southwest strong winds from the Saroma Lake.

Figure7 The locations of Saroma-town and Abashiri observatory

Figure7 shows the point of observatory by the Abashiri branch office of the Meteorological Agency. Saroma-town is located in the center of the Abashiri branch. There is no point at the inland which observes the maximum instantaneous wind speed. The Abashiri 409 point has ground observed from 1967 in 40 years long at the annual maximum instantaneous wind speed. This point can play the role of the antenna point which catches the strong wind of direction of the southwest in Saroma-town.

Below it uses the statistics data in the Abashiri meteorological station of 14,610 day unit from 1967 to 2006 up to 40 years, the maximum instantaneous wind velocity began to be observed from the database according to ground observation (by the Weather operating support center). The division of a period is from 1967 by 10 years interval. The windproof standard which the country sets in the Abashiri area is 32 meter per second.

The one hypothesis to test is whether at the autumn season the occurrence probability of excess wind is high through four seasons. Another hypothesis to test is the occurrence probability of excess wind has being increasing at the latest period from 1997 to 2006.

3.2 Estimated results

3.2.1 Parameter estimations

Figure8 indicates the histogram of the maximum instantaneous wind velocity at the Abashiri meteorological station. It is the form sharpened and distorted on left-hand side centering on the value of 10 meter per second. Some cases are seen slightly near the maximum instantaneous wind speed occurs over the windproof standard at Abashiri.

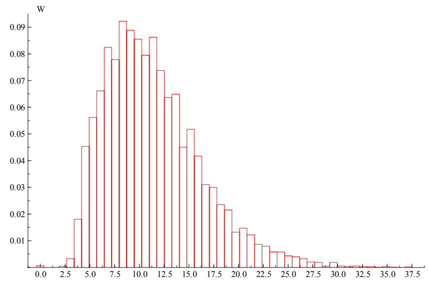

Figure8 Histogram of the maximum instantaneous wind speed of the Abashiri 409 (1967-2006)

Table10 shows the basic statistics of the maximum instantaneous wind speed of the Abashiri meteorological station. The maximum on the past 40 years is 37.5 meter per seconds, it was recorded exceeding over the windproof standard at the region. The average value is 11.3 meter per seconds, the standard deviation is 4.8 meter per seconds. The first quartile is 7.8 meter per seconds, the median is 10.6 and the third quartile is 14.2 meter per seconds.

The frequency of excess wind over the standard level is 0.103 percent on the past 40 years.

Table10 Basic statistics of maximum instantaneous wind speed of the Abashiri observatory

unit : (m/s)

Maximum	Mean	Std Dev	Frequency under 32(m/s)
37.5	11.3	4.8	0.99897
1st Quantile	Median	3rd Quantile	
7.8	10.6	14.2	

Table11 The estimated parameters (m=32)

Explanately Variables	Estimator	p-value
Constant	475.581	[.000***]
Periodic Dummy(1997-2006)	0.513461	[.007***]
Seasonal Dummy(Sep.-Nov.)	0.267955	[.152]
Atomospheric pressure at spot(mean)	-51.8239	[.000***]
Rainfall per day	0.181275	[.019**]
Iterations to Convergence	175	
Number of Observation	14610	
Log likelihood	-69.3989	

***: $p<0.01$(1% significant), **: $p<0.05$(5%), *: $p<0.10$(10%) .
Atomospheric pressure and rainfall per day are logarithmic value.

Table11 indicates the estimated parameters of excess probability which standard threshold is 32 meter per second. Here, the four variables are used such as the first periodic dummy variable of whether to be contained in the recent period from 1997 to 2006, the second autumn dummy variable of whether to be contained in the autumn by September, October and November, the third variable of the average value of local atmospheric pressure per day (logarithm value) and the fourth variable of the amount of rainfall per day (logarithm value). The constant parameter is significant by one percent. The periodic dummy parameter is positive value and also is significant by one percent. It can be interpreted that the excess wind over the windproof standard occurred relatively at the period from 1997 to 2006, comparing other periods.

On the other hand, although the autumn dummy parameter is not ten percent significant, but it can not ignored at the level of 15.2 percent, which is merely close to ten percent. It can not deny that in autumn relatively there is much maximum instantaneous wind speed which exceeds a windproof standard through each year. The average local atmospheric pressure is negative value and is also significant at one percent. It can be interpreted that the low pressure of a spot tends to bring about the strong wind which exceeds a windproof standard. The logarithmic value of precipitation per day is positive value and also is significant at 5 percent. It can be interpreted that it is easy to blow the strong wind which exceeds a windproof standard.

3.2.2 Indices of Marginal change

Figure9 shows the excess probability over 32 meters per second the windproof standard of Abashiri region, using the parameter estimated. On the past 40 years, with the inside of the year 1972 and the year 2006 the predicted value of the probability which exceeds a standard is increasing. Especially, 2006 October 8 the excess standard probability is the most increasing in front of one month at the day tatsumaki occurred at Saroma-town.

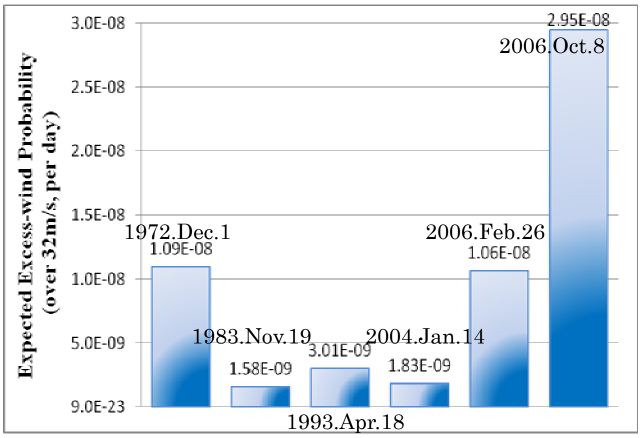

Figure9 Occurrence probability of the excess wind of Abashiri region

Table12 indicates the maximum instantaneous wind velocity per day exceeded the standard windproof, the local average atmospheric pressure, and the rainfall per day. 2006 October 8 in the Abashiri observatory, it was recording that the maximum instantaneous wind velocity is 34 meters per second, the local atmospheric pressure is 987 hectopascal, and precipitation is 70 mm. Of course, the Abashiri observatory is far from Saroma-town, where the strong wind can not be predicted correctly. It is said to be an interesting result that it was able to predict the greatest excess probability over the standard from the annual observation near the town in the past

40 years before one month the tasumaki occurred.

Table12 The records of excess wind over the standard at the Abashiri observatory

Day	Wind (m/s)	Atmospheric pressure(hPa)	Rainfall per day(mm)
1972.Dec.1	34.8	981.2	26.5
1983.Nov.19	32.4	999.2	12.0
1993.Apr.18	32.5	983.6	27.0
2004.Jan.14	32.8	981.3	36.5
2006.Feb.26	34.6	1014.4	1.0
2006.Oct.8	34.0	987.1	70.5

Figure10 shows the marginal effects that the change of characteristic variable brings the excess probability over the standard by sum of the past 40 years. The lower is the atmospheric pressure, the more marginal change of the excess probability becomes.

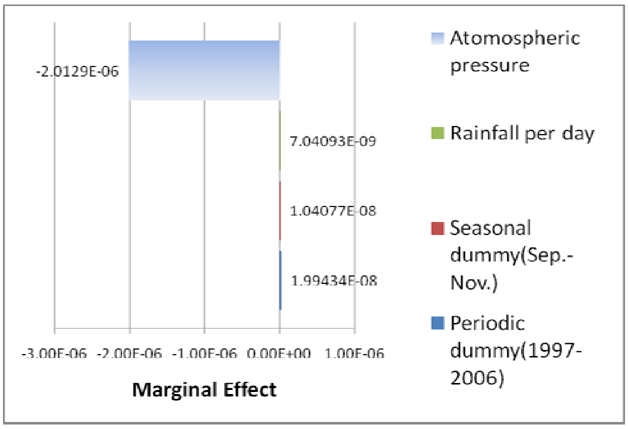

Figure10 The marginal change with characteristic variables of excess probability over the standard

Figure11 indicates the marginal change of the excess probability about the variables except the atmospheric pressure. Firstly the recent period from 1997 to 2006 has contributed to a relatively great change of the excess probability. Secondly the autumn season has brought about a middle marginal change of the excess probability. Thirdly rainfall per day has brought about a slightly marginal change of the excess probability.

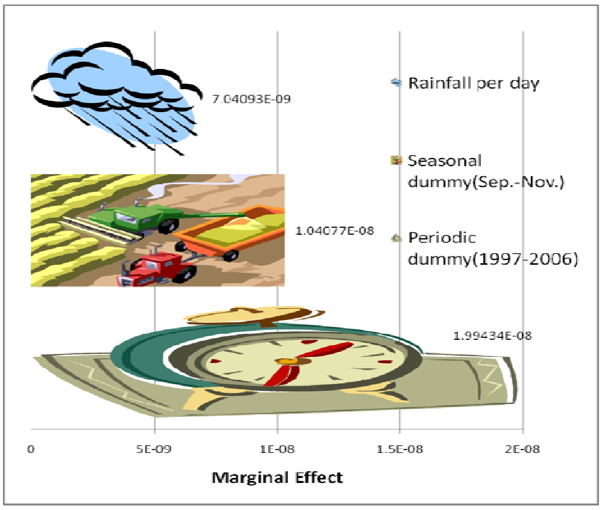

Figure11 The marginal change with three variables of excess probability except atmospheric pressure

Table13 shows the results to estimate the excess probability by 2GP model which set up several excess levels. The sign and significance at the level from 10 to 28 meters per second are the same as the case which threshold is 32 meters per second. But in the case which threshold is 5 meters per second, the local atmospheric pressure is not ten percent significant. In another case which level is a typhoon 17 meters per second, the autumn parameter (the value is 0.207) contributes relatively more change of the excess wind than the recent period parameter (the value is 0.174), it is different point from others.

Table 13 Estimated parameters of 2GP model which exceeds each level

	Excess wind threshold				
Explanately variables	m=5	m=10	m=17	m=22	m=28
Constant	41.0217 [.123]	135.692 [.000***]	287.505 [.000***]	315.493 [.000***]	391.608 [.000***]
Periodic Dummy (1997-2006)	0.172871 [.000***]	0.082548 [.000***]	0.174191 [.000***]	0.163864 [.000***]	0.240389 [.006***]
Seasonal Dummy (Sep.-Nov.)	0.203009 [.000***]	0.198872 [.000***]	0.207705 [.000***]	0.148649 [.000***]	0.105304 [.273]
Atomospheric pressure at spot(mean)	-4.2357 [.142]	-14.574 [.000***]	-31.1451 [.000***]	-34.2574 [.000***]	-42.6347 [.000***]
Rainfall per day	0.02916 [.017**]	0.031312 [.000***]	0.06892 [.000***]	0.124017 [.000***]	0.200186 [.000***]
Iterations to Convergence	11	7	8	8	11
Number of Observation	14610	14610	14610	14610	14610
Log likelihood	-750.791	-3527.04	-2851.85	-1318.83	-272.468

***: p<0.01(1% significant), **: p<0.05(5%), *: p<0.10(10%) .
Atomospheric pressure and rainfall per day are each logarithmic value.

Figure12 shows on the past 40 years, the predicted value of the excess probability of the strong wind in each level is calculated, and the result of maximum plotted. At the level of a typhoon17 meters per second, the occurrence probability of the excess wind is 0.023. At the level more than 22 meters per second, the occurrence probability of the excess wind is the range from ten to the minus fifth power to ten to the minus eighth power.

Even if a loss from an excess-wind damage is one hundred million yen, the risk of strong wind multiplied by the loss and the probability is evaluated from ten thousand yen to a hundred thousand yen.

Thus, the risk of the excess strong wind in the Abashiri observatory becomes slight. It is a reason why this has the very small occurrence probability of a excess strong wind comparing to the scale of loss for strong wind. Although the strong wind which exceeds a windproof standard in the Abashiri observatory has rarely happened, once it generates, surely there is a destructive damage.

As mentioned above, it is useful for risk monitoring index of a strong wind by predicting marginal change of the excess probability which the occurrence probability and characteristic change bring about using the method.

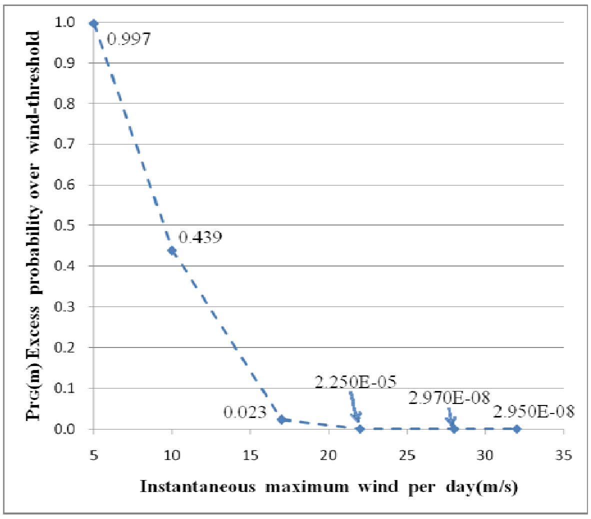

Figure12 Excess probability of the strong wind at each level

4. Concluding remark

This paper proposed the method to acquire the newest knowledge about the occurrence probability to cope with the risk of the strong wind of a region which may excess over the windproof standard. Concretely, using wind statistics at a region, to the boundary of a past windproof standard, it formulates the model whether it is settled within the standard range or without one. And it propose the method to estimate the occurrence probability of excess wind. Furthermore, it derives the marginal indices to predict that a unit change of a periodic or a seasonal variable bring to the excess probability over the standard. Using the method it becomes possible to monitor the risk of an excess strong wind of society being exposed to a certain period and a certain season. It applied to one of region in Japan and also comments the usefulness. At Abashiri observatory Hokkaido prefecture it is accepted tendency that at the recent period on the autumn season the excess wind probability over the windproof standard was increasing. Calculating the predicted value of the excess probability each day, it had become the predicted value of the greatest occurrence probability before one month when tatsumaki generates at Saroma-town. The model proposed in the paper is able to analyze the risk characteristics leading to a strong wind using observed wind data. Also the predicted marginal effect with a unit change of characteristic variables is able to utilize as monitoring indices.

It mentions a future developing topic, in order to review the hazard of the strong wind such as tatsumaki, downburst it needs to estimate excess probability over the windproof standard at each region in Japan. At some region before there was no risk of strong wind, it is possible to catch the tendency quickly where it is increasing recently. In order to carry out the suitable windproof policy at the society with risk of strong wind, I am pleased if it becomes some contribution to partly construct the windproof system and to quantify the occurrence probability of the excess wind which is beginning to actualize some social damage.

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