Climatic Disasters in Japan

from 601 to 1200

— From Perspective on Difference of

Local Climates in Nara and Kyoto —

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Preface

Recently, extraordinary weather events are increasing rapidly and it is recognized that the increasing is related to global warming. However, climate had fluctuated worldwide any number of times and Japan also had been suffered from many disasters such as storms, heavy rains, droughts, and so on since ancient time. It is especially well-known that the climate was relatively warm from the 9th to the 12th centuries as the present and the period is called "Medieval warm period (MWP)" and a lot of descriptions of climatic disasters were remained in various historical documents, for example, "*Nihon shoki*" and the like in Japan. Elucidation of the climatic disasters in MWP is very important, however, studies concerning climatic disasters in this period still are inadequate. Moreover, studies of climatic disasters in historical times were investigated into focusing on only their secular change and little attention has been given to their locality. In addition, it was pointed out that the paleoclimate reconstructed from historical documents was influenced by local climates. Climate usually changes not only by time but also by space. Therefore it is necessary to investigate comprehensive or synthetic conditions of atmosphere including secular changes such as global warming and the spatial features as

local climate. Investigating locality is important particularly for geographical study.

However, unfortunately, geography tends to subdivide into individual specialty and to fade away identity itself. Although it was defined that climatology was separated from meteorology already in the early 20th century, geographical climatology is going to close on meteorology in geophysics and seems to depart more from an essence of geography. What is important on geographical climatology is to inquire into “locality” as “complex environment” “integratively”, “comprehensively” and “anthropocentrically” based on a concept of geography.

The purposes of this study are to clarify the features of climatic disasters from 601 to 1200 and to consider effects on “locality” of paleoclimate based on the methods of geographical climatology.

The first chapter describes the concepts of climatology in geography in accordance with the essence of geography. In the second chapter, the secular change and locality of climatic disasters from 601 to 1200 were discussed. Furthermore, the author proposed that the influence of locality on paleoclimate especially focused on droughts in Nara and floods in Kyoto. In the third chapter, water and heat balances in Nara and Kyoto from present meteorological data are analyzed due to clarify the

difference of local climates between Nara and Kyoto according to the concept of geographical climatology. Finally, as a most important factor in geography, “climates (*Kiko fudo*)” in Nara and Kyoto were compared each other and discussed the structure of climatic disasters in MWP as conclusion.

1. Stand point of “climatology in geography”

1.1 Concept of geography and problems with subdivision into specialty on geography

Before going on to the main theme, some recent problems on geography and climatology are examined briefly. Geography is constructed by various branches as Uchimura (1942) said that geography is expressed as the basis of diverse sciences. It consists of physical and human geographies having individual special branches such as climatology, hydrology, topography in physical geography and political geography, historical geography and social geography in human geography (Figure 1). Originally geography should be studied synthetically with consideration of these branches, however, some problems with subdivision have occurred in geography (Nishikawa 1985, Johnston 1991). For example, in Germany of 19th century, “*Geographisches Jahrbuch*” was apparently almost occupied by not a geography but by adjacent sciences such as geology, geodesy, geophysics, botany, zoology, statistics, ethnology, anthropology and so on because the nucleus of geography was weakening while special subdivisions of various sciences had made progress rapidly (Nishikawa 1985). Physical geography especially tends to be subdivided into individual specialties and to be

confused with geophysics.

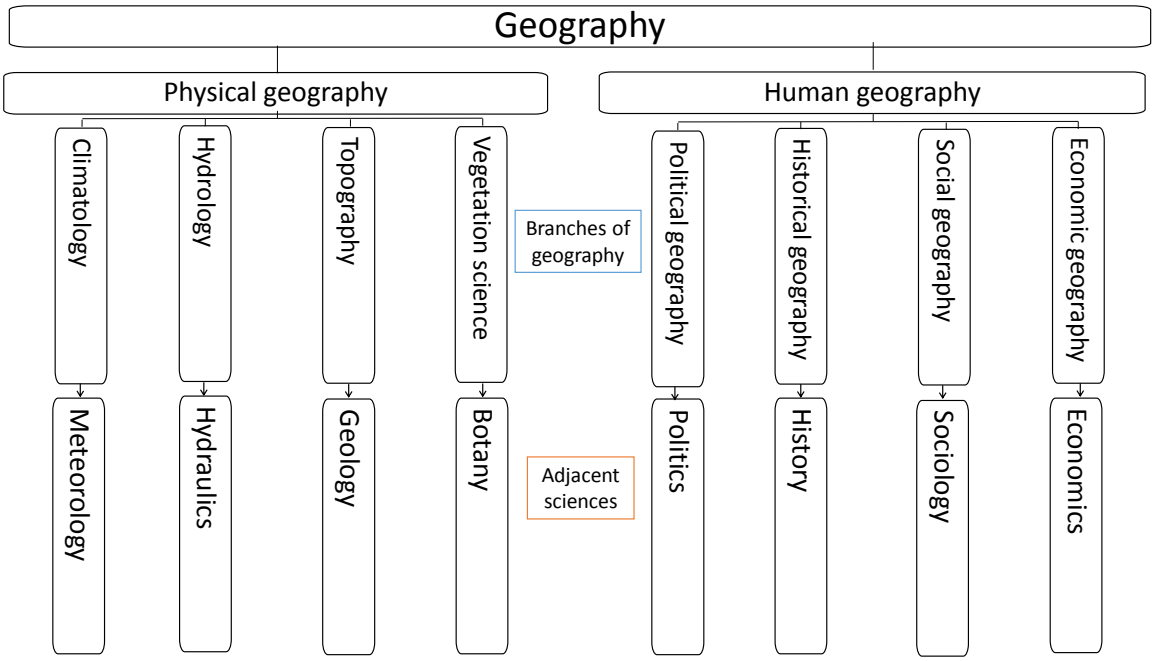

Figure 1 Formation of geography

Concerning the subdivision in geography, it is pointed out that the problem is caused by two factors. In the first, an important point of geographical studies tends to leave from locality as geographical identity (Johnstone 1991). The other is the appearance of adjacent sciences and interdisciplinary researches which are apt to be confuse with geography (Nishikawa 1985). And he also referred that geography is the study which is difficult to be understood because adjacent scientists seem to infer geography only by their viewpoints which are essentially different from geography. In other words, the problem is

caused by the reason that scientists who engage with adjacent sciences would understand geography only by their own concepts. In addition, it seems that most of geographer investigate without sufficient consideration of the concept in geography and that it causes the problem of subdivision on geography.

Geography can be characterized by anthropocentrical study focusing on locality with integrative and comprehensive concepts. Furthermore, Nishikawa (1985) stated that only explanation on distribution or factor of specific phenomena does not satisfy geographical study. Essential lines of geography are exhibited by two viewpoints such as how the features like climate or economic activities have functional relation with regional components and to what extent they have significance for characterization in each of the regions. Cholley (1951) also referred that geographical phenomena always appeared as complex and convergence phenomena even if it is most simple phenomenon. Then, he concluded that the purpose of geography is to investigate interventional role of effects together with various factors and its outcome. Therefore, integrative and comprehensive investigation focusing on locality with anthropocentric concepts is very important for geographical study.

Harvey (1969) mentioned five themes in geography as

follows; (a) the areal differentiation theme, (b) the landscape theme, (c) the man- environment theme, (d) the spatial distribution theme and (e) the geometric theme. In addition, Hartshorn (1959) argued that geography is the anthropocentric study by man himself about the earth where man lives. As stated above, a lot of great geographers emphasized that having the concept and philosophy concerning space and time is important for geographical study and that leads to protect geographical identity. However, most of these concepts and philosophy are argued only by human geographers and especially physical geographers tend to consider that these concepts and philosophy are unscientific. In these reasons, physical geographers have been given little attention and disregarded to concepts and philosophy of geography. Nonetheless, having these concepts and philosophy are very important also for physical geographers.

In Japan, the significance of existence about physical geography was discussed at the symposium in the study meeting of the association of Japanese geographers autumn 1992. In the symposium, from a viewpoint of hydrologist, Mori (1993) referred that physical geographers need a strong consciousness of genuine geographers and the evil of immoderate subdivision on physical geography probably can be corrected by that. He also noted that physical

geographers need to investigate having more the human geographical point of view than human geographers who concern about physical geography in order to proceed their geographical investigations. Moreover, as a climatologist, Fukuoka (1993) emphasized that physical geography including climatology incorporates the method of adjacent sciences but needs the philosophy of geography owning strongly human process factor in the interpretation. From these perspective, it is important to comprehend the geographical concepts and philosophy in order to understand genuinely geographical climatology.

From these insistences, whether they are physical geographers or whether they are human geographers need to examine having common concepts and philosophy based on the essence of geography as shown Figure 2. The concepts and philosophy of geography can give shape as shown in Figure 3. As stated above, geography is the study which quest for locality but it does not deal with only locality itself. The purpose of geography is investigating locality as complex environment integratively or comprehensively and antholopocentrically, namely from a viewpoint of human. Moreover, the locality ought to connect with areal structure, in other words, regional features.

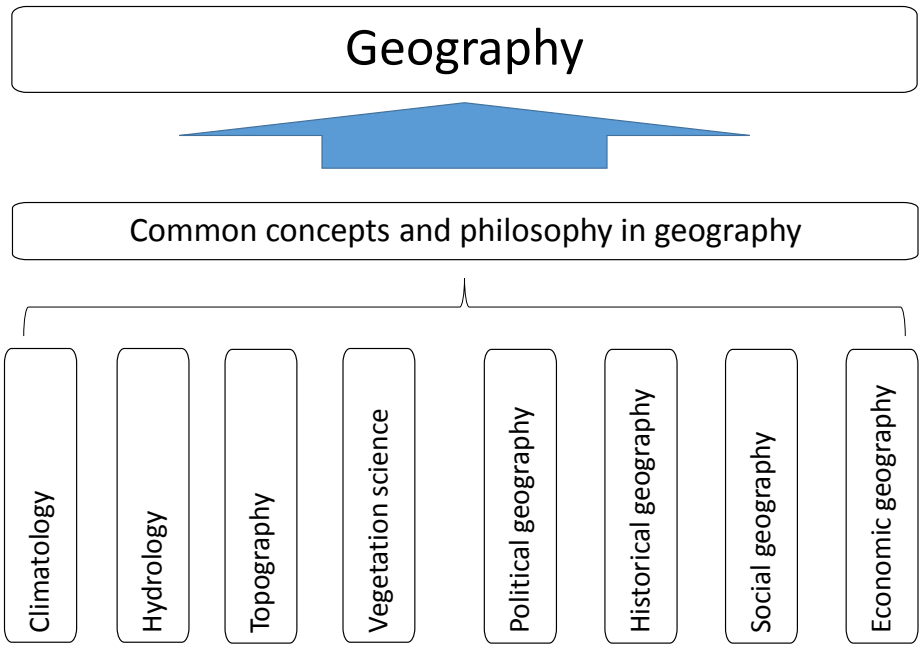

Figure 2 Viewpoint of geography

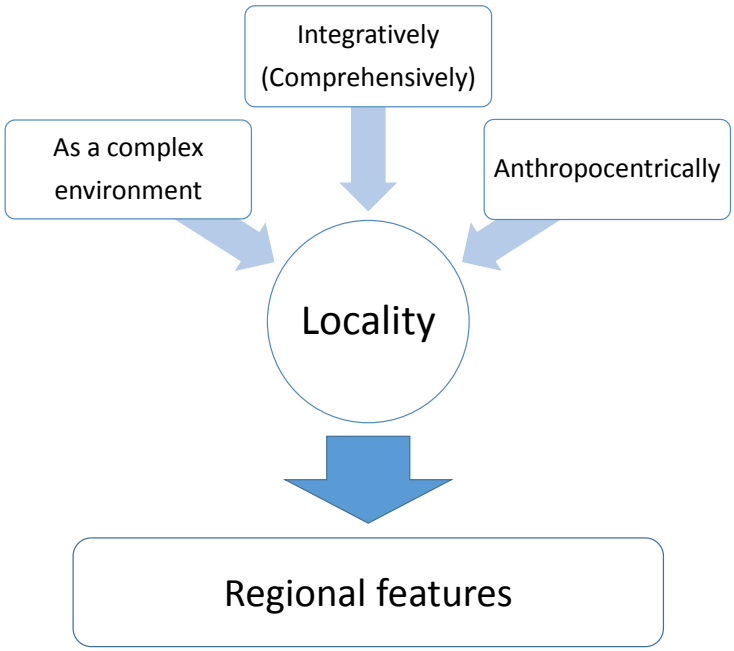

Figure 3 Concept of geography

1.2 Viewpoints of climatology

— Difference between climatology in geography and meteorology in geophysics —

The concepts and philosophy of geography were gotten in shape, that is, geography is comprehensive or integrative study related to locality and human activity as stated above. Next, the essence of climatology in geography is explained shortly.

Climatology has been studied from viewpoints of two special types. One is based on geography and another is meteorology on geophysics (Okada 1938, Fukui 1938). Hettner (1927) also argued that climatology is a branch of geography and separates from meteorology. After pointing that atmospheric sciences are divided into meteorology, climatology and weather science, Fukui (1938) defined as the purpose of meteorology that atmospheric phenomena is investigated individually mainly by method of geophysics. On the other hand, geographical climatology is studied as comprehensive conditions focusing on locality related to human activity and environment. Fukuoka (1993) succeeded Fukui to the concept and said that some parts of meteorology are studied without human activity whereas geographical climatology cannot be studied without human

activity. Moreover, he also stated that the study of geographical climatology needs to have philosophy and concepts of geographical identity with human activity. Terjung (1976) also emphasized that "geographical climatology should be of immediate relevance to geography because of its inherent interest on climate-human interrelationships". Namely, the meteorological studies deal with physical phenomena themselves while climate is treated as expression of human environment in climatological studies of geography and the conceptual thinking as philosophy also contains in geographical climatology.

Thus the differences between geographical climatology and meteorology are their own methods and viewpoints. The concepts of geographical climatology are based on the geography itself. Therefore geographical climatology needs to study based on the concepts and philosophy of geography and it connects to original geographical promotions which differ from meteorology. And then, it leads to protect for prevention of subdivision on geography.

1.3 Reconsideration of the "locality" and the definition of geographical climatology

As mentioned above, subdivision of geography is an

important problem. Therefore, geographical climatology should be investigated with considering the difference from meteorology and should be investigated after understanding the concepts and philosophy of geography itself. In order for geography to integrate, it needs to understand genuinely the concepts and philosophy of geography. Consequently geographical climatology also can be understood only after considering concepts and philosophy of geography.

And then, the author would like to explain why this study attaches importance to locality in paleoclimate. Reconstructions of paleoclimate by using historical documents have been focused on mainly its secular change and have not been enough for considering local climate. For example, Maejima and Tagami (1986) pointed out that documentary proxy data has the defect that reconstruction of paleoclimate by historical documents reflects only local climate. Therefore, it is important to reconsider “locality” of historical document in paleoclimate study. Moreover, it is necessary to understand of the concept and philosophy in geographical climatology in order to grasp the water and heat balances discussed in chapter 3. Considering “locality” relates to the essence of geographical studies and it is the most important theme in geography. As mentioned above,

although geographical climatology tends to close to meteorology in geophysics recently, the author would like to investigate this study after returning to the basis of geographical climatology and geography taking notice of “locality” and human activity. Since defining these geographical concepts is connected with defining a way to the study, in this chapter, the author put shortly geographical and climatological concepts and philosophy in order.

2. Climatic disasters in Japan from 601 to 1200

2.1 Medieval warm period (MWP) and problems on paleoclimate study in Japan

It is recognized that climatic disasters tend to increase when air temperature fluctuates remarkably. Even nowadays, social anxiety is increasing in relation between climatic disasters and existing global warming. Concerning the effects of the global warming, it is expected in Japan that the number of extremely hot day with daily maximum temperature above 35 ˚C, extraordinary rainfall and so on are going to increase (Japan Meteorological Agency 2013; IPCC and Ministry of the Environment, Government of Japan 2013).

However, climate change appeared any number of times not only in the present but also in the past. From the 9th to the 12th centuries, climate also trended toward warm and this period is called “Medieval warm period (MWP)”. Tagami (2012) concluded that the climate was relatively warm in Japan during the period, though the climate change in this period is unclear and the period should be called “Medieval climate anomaly (MCA)”. In Japan it was recognized that climate is warm as present from various analysis. For example, Maejima and Tagami (1986) clarified that from the 7th to the 9th centuries were a cool

period and the 10th to the 14th centuries were a warm period by analyzing "*Nihon kisho shiryo*". In addition, the climate reconstructed by the records of cherry blossoming was warm around the 10th century (Sekiguchi 1969; Yamamoto 1976; Aono 2013, 2014). And the temperature in the 10th century was higher than one in the present by analysis of historical documents on full-flowering dates of Japanese cherry, *Prunus jamasakura*. (Aono and Saito 2010, Aono 2014). Moreover, Yoshino (2009) argued that the warm period with various scale of fluctuations continued from the 4th to the 10th centuries. Mizukoshi (2004, 2006, 2008, 2010, 2012, 2014) collected diurnal weather records in dairies from the 11th to the 16th centuries in Japan and he concluded that the 11th and 12th centuries were relatively warm periods. According to Kitagawa and Matsumoto (1998) who analyzed carbon isotope variations in tree rings of *Yakusugi* cedars, the estimated temperature deviations from the 8th to the 12th centuries were 1.0 ˚C higher than the average during the last 2,000 years.

On the other hand, it is historically known that serious natural disasters occurred in Japan in this period. Incidentally, seismologically, the Jogan tsunami in 869 has been studied from remains, sediments and old documents by Okamura (2012) and Sangawa (2013) and so on. In the history of Japan "*Nihon sandai jitsuroku*", it is noted that

Mt. Fuji erupted in 864 and it was known as one of the three major volcanic eruptions which left in records (Nishikawa 2002). Hotate (2012) concluded that the 7th and 8th centuries can be regarded as "a peculiar period with earthquakes, climate warming and pandemics".

From the 7th to the 12th centuries, Japan also suffered from various climatic disasters such as heavy rains, droughts. Kusakabe constructed the chronology of climatic disasters from the 6th to the 19th centuries in provinces of Shikoku, Kanto, Chubu and Mie, Kinki, Chugoku and Ohu of Japan by using "*Nihon kisho shiryo*" (1969, 1973a, 1973b, 1975a, 1975b, 1975c, 1975d, 1977, 1978, 1981). By focusing on Kinki province in these results, it is shown that droughts were the major climatic disasters in the 7th and 8th centuries but floods caused by much rain increased in the 9th century. From the 10th to the 11th centuries, drought increased again while flood related to typhoon increased in the 12th century. Moreover, Nishikawa (1963) made a table of climatic disasters from the 6th to the 20th centuries based on "*Nihon saii shi*" and he concluded that the most remarkable disaster was plague and the second one was drought from the 6th to the 16th centuries.

Concerning paleoclimate study in Japan, Yamakawa (1992a, 1992b, 1993, 1997, 1999) clarified that the relation of the climatic disasters with volcanic eruptions

in “Little ice age”. In addition, reconstruction of temperature and pressure patterns from old documents particularly in the 19th century in connection with “Little ice age” by Mikami (1988) and Hirano *et al* (2012) and so on are making progress. Moreover the reconstruction of temperature from the 9th to the 12th centuries related to “Medieval warm period” by aforesaid studies are also investigating (Aono and Saito 2010, Aono 2013, 2014). On the other hand, the studies on climatic disaster in Japan, above all, in MWP, are not advancing much because of insufficient accumulation of records. Furthermore, Maejima and Tagami (1986) pointed out the problem that the paleoclimate reconstructed from historical documents reflects only local climate. Therefore, collecting as many cases of climatic disasters from historical documents as possible is an important problem for paleoclimate study and it is necessary to clarify locality of climatic disasters by detailed information. Moreover, clarification of climatic disasters from 601 to 1200 is valuable for predicting the natural and human impacts of global warming at the present.

The purposes of this study are to clarify the kinds and regions of climatic disasters from 601 to 1200 by a greater number of data and to inquire into locality of climatic disasters especially in Nara and Kyoto where a lot of the

historical documents were remained. The author will also discuss geographically that differences in the local climates in Nara and Kyoto could respectively reflect climatic disasters.

2.2 Study method

The records of climatic disasters in Japan from ancient time have been found in some historical documents, such as "*Nihon shoki*", "*Fuso ryakuk*i", and "*Sandai jitsuroku*". Furthermore, these records have been compiled in some meteorological archives, however, these materials are fragmentary. At first, the author collected the data and constructed a chronology of climatic disasters from 601 to 1200 by the following meteorological archives: (1) "*Nihon no kisho shiryo* (The Central Meteorological Observatory and The Imperial Marine Observatory 1976)", (2) "*Nihon kanbatsu rin-u shiryo* (Arakawa *et al*. 1964)", (3) "*Nihon no tensai chihen* (The Civic Section of Tokyo Metropolitan Government 1976)", (4) "N*araken kisho saigai shi* (Aoki 1956)" and (5) "*Kyoto kisho saigai nempyo* (Kyoto Local Meteorological Office 1951)". These materials include records from the prefectural histories, temples and shrines, diaries of prayers for rains and the like. Moreover, place or regional name, source and detailed content of climatic

disaster are also collected possibility.

Secondly, these data are classified according to kinds and regions of climatic disasters. As for kinds of climatic disasters, they are grouped into 9 categories as follows: (1) storm, (2) flood, (3) long rain, (4) thunder storm, (5) whirlwind, (6) drought, (7) hail storm, (8) heavy snow and (9) frost. In these climatic disasters, the cases of storm, flood, long rain and thunder storm may be difficult to distinguish from each other because storm and long rain could have been accompanied with flood. In this study, the author classified these data based on the way of "*Nihon no kisho shiryo*"[1]. In the matters of the place and regional names, the data in all Japan was classified into 6 categories and the old place names are arranged as follows:

(1) "Nara" includes its old names "*Yamato no kuni*" and "*Yamato*".

(2) "Kyoto" includes its old names "*Yamashiro no kuni*" and "*Yamashiro*".

(3) "Kinki District" includes "*Kinai*" and "*Kinki shokoku*", but excludes the cases classified as (1) or (2). However, the climatic disaster occurred in Kyoto, Nara and neighboring region simultaneously is included (3).

(4) "All provinces" include "*Shokoku*" and "*Zenkoku*".

(5) Place and regional names which do not refer to (1),

(2), (3) and (4) are classified into “others”

(6) Nameless places and regions are grouped into “Unknown”.

If the kinds, place names and dates of climatic disasters obtained from some of five archives are the same, the author counted them as one disaster.

2.3 Results

2.3.1 Features of climatic disasters from 601 to 1200

In this study, 1,220 cases on climatic disasters from 601 to 1200 were obtained. The detailed list is printed in Appendix 1. Table 1 and Figure 4-(a) represent the contents of meteorological archives made use of this study. Most of previous studies on paleoclimate using historical records analyzed only by “*Nihon kisho shiryo*” (e.g. Kusakabe 1977,Maejima and Tagami 1986). The number of the data given by “*Nihon no kisho shiryo*” from 601 to 1200 is 871. However, it is necessary that the data should be possibly collected as many as possible for the paleoclimate study. Accordingly, besides “*Nihon no kisho shiryo*”, the author probed “*Nihon kanbatsu rin-u shiryo*”, “*Nihon no tensai chihen*”, “*Naraken kisho saigai shi*” and “*Kyoto kisho saigai nempyo*” and 349 data (140%) could add the data to “*Nihon kisho shiryo*” (Table 1 and Figure 4-(a)).

From Figure 4-(b), the data in this study is more than previous studies by Kusakabe (1977) and Nishikawa (1963) who obtained 203 and 510 data respectively during the same period [2].

Table 1 Contents of meteorological archives

Name of meteorological archives	No. of data
Nihon kisho shiryo	871
Nihon no tensai chihen	204
Nihon kanbatsu rin-u shiryo	117
Naraken kisho saigai shi	26
Kyoto kisho saigai nempyo	2
Total	1,220

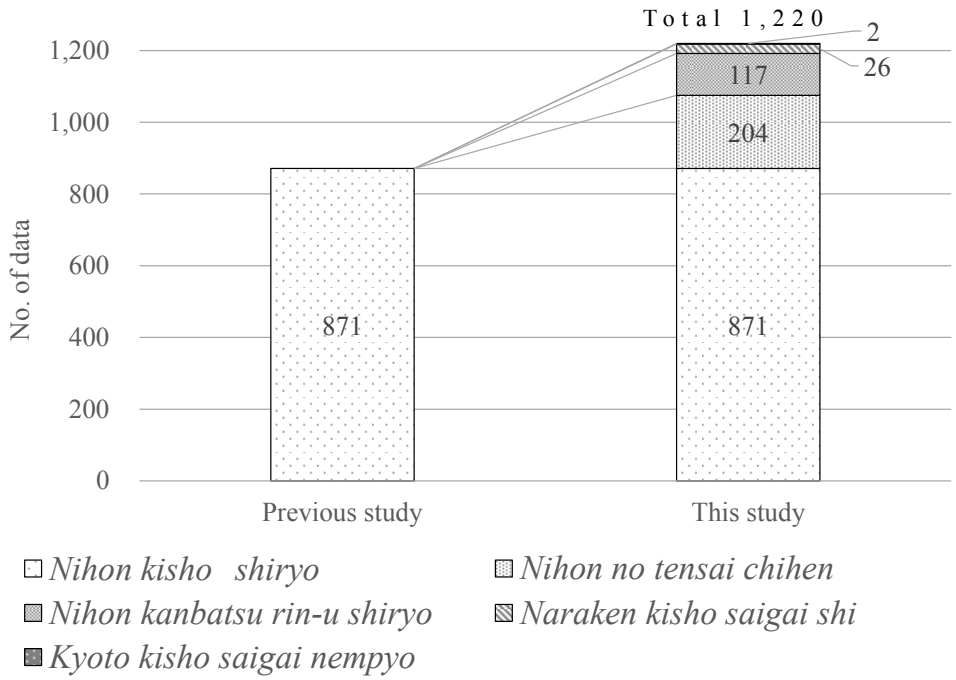

Figure 4-(a) Number of data in this study

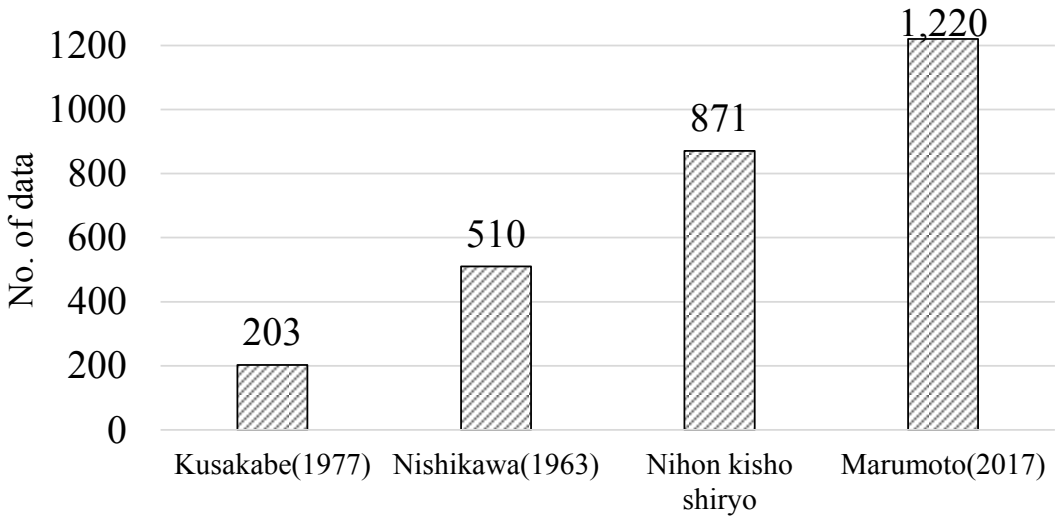

Figure 4-(b) Comparison of the number of data between this study and previous studies

Figure 5 shows the secular change of climatic disasters comparing with the estimated temperature deviations during the last 2,000 years reconstructed from tree ring analysis by Kitagawa and Matsumoto (1998) based on every decade. As shown in Figure 5, three peaks in the number of climatic disaster were found. They are the periods from the latter half of the 9th century, the first half of the 11th century and the latter half of the 12th century. It is clarified that climatic disasters tend to increase when estimated temperature deviations fluctuated remarkably from Figure 5. In the end of 9th century, it is considered that climatic disasters were increasing while the estimated temperature deviations were dropping sharply, that is, climate changed rapidly. Tagami (2012) clarified that the

climate from 880 to 910 was cool and wet in connection with the result. Around the middle of the 11th century, there was a significant decrease in number of climatic disasters while estimated temperature deviations were going up rapidly. In this respect, it is considered that the decrease of climatic disaster was not relate to climate change. Kawasumi (2004) and Takahashi (2012) stated that the level of riverbed in the Kamo-gawa River had dropped from the end of the 10th to the early period of the 12th centuries and this would keep the river from overflowing. From the database of "Historiographical Institute, the University of Tokyo", Katahira (2010) clarified that the number of floods in Kyoto was at a minimum around the latter part of the 11th century. Thus the number of climatic disaster was also effected by local circumstances. The correlation coefficient between the number of climatic disaster and the estimated temperature deviations is 0.36, which is a positive correlation at the significance level of 5%.

Figure 6 represents annual number of climatic disaster and estimated temperature of March in Kyoto reconstructed from historical documents on full-flowering dates of Japanese cherry, *Prunus jamasakura* (Aono and Saito 2010). Since the estimated temperatures are in March, there are no clear correlation between these two factors.

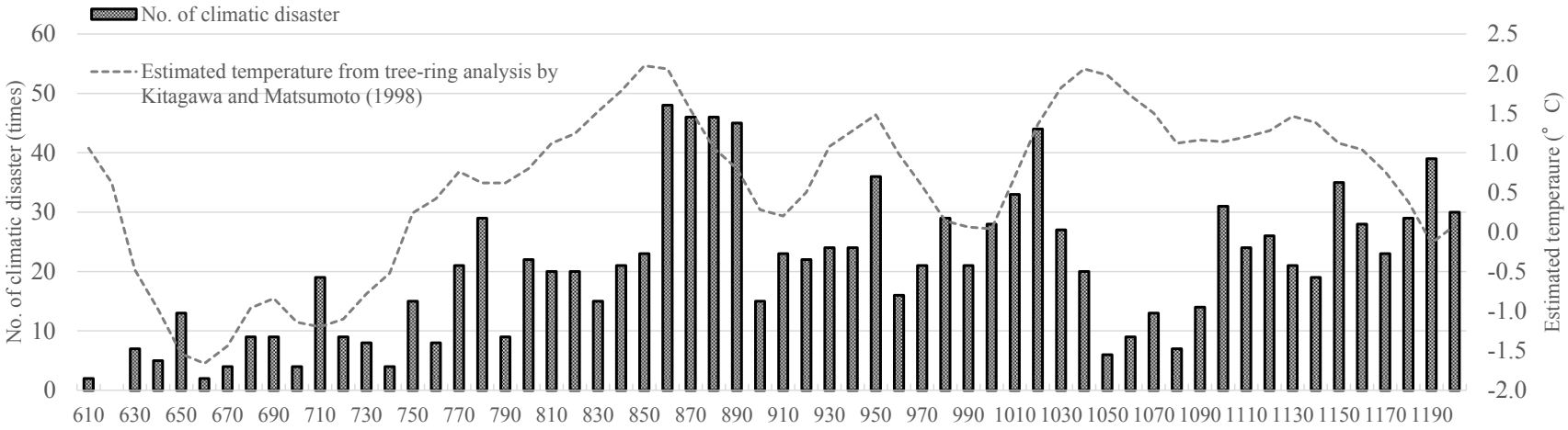

Figure 5 Secular change of the number of climatic disasters from 601 to 1200 and estimated temperature deviations by Kitagawa and Matsumoto (1998)

On these estimated temperature deviations, the author read the data from the figures on the tree-ring analysis of carbon isotope by Kitagawa and Matsumoto (1998) and calculated five decadal moving averages of the estimated temperature deviations.

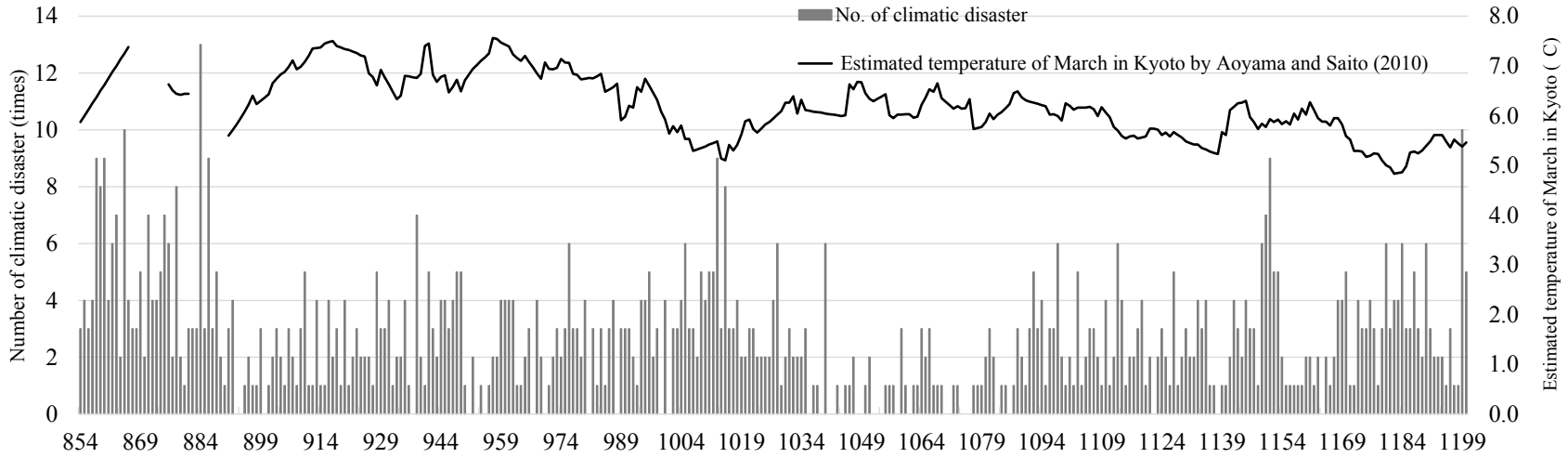

Figure 6　Secular change of the number of climatic disasters from 601 to 1200 and estimated temperature of March in Kyoto by Aono and Saito (2010)

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Table 2(a)-(c) summarize the chronology by the number of climatic disaster organized for each every decade on their kinds and percentages from 601 to 1200. In the 7th century, the number of climatic disaster is 55. Drought (30.9%) is most significant disaster and storm (18.2%) is next. In the 8th century, the records increased by 144 and drought and storm remarkably occurred in the same percentage (29.9%) respectively. In the 9th century, the records rapidly increased by 299, in which significant disasters are storm and thunder storm (19.7%) respectively. In the 10th century, records decreased by 244. In the 11th century, they dwindled a little by 204. The most remarkable disaster was storm (31.4%) and this condition continued until the 12th century.

Table 2-(a) Contents of climatic disasters from 601 to 1200 (1)

	Storm	Flood	Long-rain	Thunder storm	Whirl wind	Drought	Hail storm	Heavy-snow	Frost	Subtotal
601～610	0	1	0	0	0	1	0	0	0	2
	(0.0)	(50.0)	(0.0)	(0.0)	(0.0)	(50.0)	(0.0)	(0.0)	(0.0)	(100.0)
611～620	0	0	0	0	0	0	0	0	0	0
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
621～630	0	1	1	0	0	2	2	0	1	7
	(0.0)	(14.3)	(14.3)	(0.0)	(0.0)	(28.6)	(28.6)	(0.0)	(14.3)	(100.0)
631～640	2	1	1	0	0	1	0	0	0	5
	(40.0)	(20.0)	(20.0)	(0.0)	(0.0)	(20.0)	(0.0)	(0.0)	(0.0)	(100.0)
641～650	2	1	1	1	0	1	6	0	1	13
	(15.4)	(7.7)	(7.7)	(7.7)	(0.0)	(7.7)	(46.2)	(0.0)	(7.7)	(100.0)
651～660	0	1	0	0	0	1	0	0	0	2
	(0.0)	(50.0)	(0.0)	(0.0)	(0.0)	(50.0)	(0.0)	(0.0)	(0.0)	(100.0)
661～670	0	1	0	2	0	0	0	1	0	4
	(0.0)	(25.0)	(0.0)	(50.0)	(0.0)	(0.0)	(0.0)	(25.0)	(0.0)	(100.0)
671～680	3	1	0	0	0	4	1	0	0	9
	(33.3)	(11.1)	(0.0)	(0.0)	(0.0)	(44.4)	(11.1)	(0.0)	(0.0)	(100.0)
681～690	2	0	0	1	0	6	0	0	0	9
	(22.2)	(0.0)	(0.0)	(11.1)	(0.0)	(66.7)	(0.0)	(0.0)	(0.0)	(100.0)
691～700	1	2	0	0	0	1	0	0	0	4
	(25.0)	(50.0)	(0.0)	(0.0)	(0.0)	(25.0)	(0.0)	(0.0)	(0.0)	(100.0)
The 7th century	10	9	3	4	0	17	9	1	2	55
	(18.2)	(16.4)	(5.5)	(7.3)	(0.0)	(30.9)	(16.4)	(1.8)	(3.6)	(100.0)
701～710	7	0	3	2	0	7	0	0	0	19
	(36.8)	(0.0)	(15.8)	(10.5)	(0.0)	(36.8)	(0.0)	(0.0)	(0.0)	(100.0)
711～720	5	0	0	0	0	4	0	0	0	9
	(55.6)	(0.0)	(0.0)	(0.0)	(0.0)	(44.4)	(0.0)	(0.0)	(0.0)	(100.0)
721～730	1	2	0	3	1	1	0	0	0	8
	(12.5)	(25.0)	(0.0)	(37.5)	(12.5)	(12.5)	(0.0)	(0.0)	(0.0)	(100.0)
731～740	1	0	0	0	0	3	0	0	0	4
	(25.0)	(0.0)	(0.0)	(0.0)	(0.0)	(75.0)	(0.0)	(0.0)	(0.0)	(100.0)
741～750	3	1	1	3	0	6	1	0	0	15
	(20.0)	(6.7)	(6.7)	(20.0)	(0.0)	(40.0)	(6.7)	(0.0)	(0.0)	(100.0)
751～760	5	0	0	0	1	0	0	2	0	8
	(62.5)	(0.0)	(0.0)	(0.0)	(12.5)	(0.0)	(0.0)	(25.0)	(0.0)	(100.0)
761～770	4	4	1	1	0	10	1	0	0	21
	(19.0)	(19.0)	(4.8)	(4.8)	(0.0)	(47.6)	(4.8)	(0.0)	(0.0)	(100.0)
771～780	11	3	1	6	0	6	2	0	0	29
	(37.9)	(10.3)	(3.4)	(20.7)	(0.0)	(20.7)	(6.9)	(0.0)	(0.0)	(100.0)
781～790	2	2	0	2	0	3	0	0	0	9
	(22.2)	(22.2)	(0.0)	(22.2)	(0.0)	(33.3)	(0.0)	(0.0)	(0.0)	(100.0)
791～800	4	5	1	3	0	3	2	4	0	22
	(18.2)	(22.7)	(4.5)	(13.6)	(0.0)	(13.6)	(9.1)	(18.2)	(0.0)	(100.0)
The 8th century	43	17	7	20	2	43	6	6	0	144
	(29.9)	(11.8)	(4.9)	(13.9)	(1.4)	(29.9)	(4.2)	(4.2)	(0.0)	(100.0)

Table 2-(b) Contents of climatic disasters from 601 to 1200 (2)

	Storm	Flood	Long-rain	Thunder storm	Whirl wind	Drought	Hail storm	Heavy-snow	Frost	Subtotal
801～810	5	3	4	0	0	5	2	1	0	20
	(25.0)	(15.0)	(20.0)	(0.0)	(0.0)	(25.0)	(10.0)	(5.0)	(0.0)	(100.0)
811～820	2	2	2	1	1	7	1	4	0	20
	(10.0)	(10.0)	(10.0)	(5.0)	(5.0)	(35.0)	(5.0)	(20.0)	(0.0)	(100.0)
821～830	1	2	3	3	0	5	0	1	0	15
	(6.7)	(13.3)	(20.0)	(20.0)	(0.0)	(33.3)	(0.0)	(6.7)	(0.0)	(100.0)
831～840	7	2	1	4	1	6	0	0	0	21
	(33.3)	(9.5)	(4.8)	(19.0)	(4.8)	(28.6)	(0.0)	(0.0)	(0.0)	(100.0)
841～850	3	5	2	4	1	3	1	3	1	23
	(13.0)	(21.7)	(8.7)	(17.4)	(4.3)	(13.0)	(4.3)	(13.0)	(4.3)	(100.0)
851～860	14	11	1	10	1	3	2	3	3	48
	(29.2)	(22.9)	(2.1)	(20.8)	(2.1)	(6.3)	(4.2)	(6.3)	(6.3)	(100.0)
861～870	13	3	9	7	0	8	1	1	4	46
	(28.3)	(6.5)	(19.6)	(15.2)	(0.0)	(17.4)	(2.2)	(2.2)	(8.7)	(100.0)
871～880	5	3	7	14	3	7	1	5	1	46
	(10.9)	(6.5)	(15.2)	(30.4)	(6.5)	(15.2)	(2.2)	(10.9)	(2.2)	(100.0)
881～890	6	4	9	15	3	2	0	4	2	45
	(13.3)	(8.9)	(20.0)	(33.3)	(6.7)	(4.4)	(0.0)	(8.9)	(4.4)	(100.0)
891～900	3	4	1	1	1	3	0	2	0	15
	(20.0)	(26.7)	(6.7)	(6.7)	(6.7)	(20.0)	(0.0)	(13.3)	(0.0)	(100.0)
The 9th century	59	39	39	59	11	49	8	24	11	299
	(19.7)	(13.0)	(13.0)	(19.7)	(3.7)	(16.7)	(2.7)	(8.0)	(3.7)	(100.0)
901～910	4	3	5	4	0	7	0	0	0	23
	(17.4)	(13.0)	(21.7)	(17.4)	(0.0)	(30.4)	(0.0)	(0.0)	(0.0)	(100.0)
911～920	6	2	2	2	0	7	3	0	0	22
	(27.3)	(9.1)	(9.1)	(9.1)	(0.0)	(31.8)	(13.6)	(0.0)	(0.0)	(100.0)
921～930	5	5	2	4	1	6	0	1	0	24
	(20.8)	(20.8)	(8.3)	(16.7)	(4.2)	(25.0)	(0.0)	(4.2)	(0.0)	(100.0)
931～940	4	2	3	6	1	5	0	2	1	24
	(16.7)	(8.3)	(12.5)	(25.0)	(4.2)	(20.8)	(0.0)	(8.3)	(4.2)	(100.0)
941～950	8	3	10	4	0	8	0	2	1	36
	(22.2)	(8.3)	(27.8)	(11.1)	(0.0)	(22.2)	(0.0)	(5.6)	(2.8)	(100.0)
951～960	4	1	2	2	0	6	0	0	1	16
	(25.0)	(6.3)	(12.5)	(12.5)	(0.0)	(37.5)	(0.0)	(0.0)	(6.3)	(100.0)
961～970	4	6	5	3	0	3	0	0	0	21
	(19.0)	(28.6)	(23.8)	(14.3)	(0.0)	(14.3)	(0.0)	(0.0)	(0.0)	(100.0)
971～980	7	3	3	6	0	4	4	2	0	29
	(24.1)	(10.3)	(10.3)	(20.7)	(0.0)	(13.8)	(13.8)	(6.9)	(0.0)	(100.0)
981～990	8	1	3	2	0	6	1	0	0	21
	(38.1)	(4.8)	(14.3)	(9.5)	(0.0)	(28.6)	(4.8)	(0.0)	(0.0)	(100.0)
991～1000	6	4	3	7	0	6	1	1	0	28
	(21.4)	(14.3)	(10.7)	(25.0)	(0.0)	(21.4)	(3.6)	(3.6)	(0.0)	(100.0)
The 10th century	56	30	38	40	2	58	9	8	9	244
	(23.0)	(12.3)	(15.6)	(16.4)	(0.8)	(23.8)	(3.7)	(3.3)	(1.2)	(100.0)

Table 2-(c) Contents of climatic disasters from 601 to 1200 (3)

	Storm	Flood	Long-rain	Thunder storm	Whirl wind	Drought	Hail storm	Heavy-snow	Frost	Subtotal
1001～1010	7	2	7	12	1	4	0	0	0	33
	(21.2)	(6.1)	(21.2)	(36.4)	(3.0)	(12.1)	(0.0)	(0.0)	(0.0)	(100.0)
1011～1020	19	2	2	16	0	3	1	1	0	44
	(43.2)	(4.5)	(4.5)	(36.4)	(0.0)	(6.8)	(2.3)	(2.3)	(0.0)	(100.0)
1021～1030	11	3	2	4	0	5	1	1	0	27
	(40.7)	(11.1)	(7.4)	(14.8)	(0.0)	(18.5)	(3.7)	(3.7)	(0.0)	(100.0)
1031～1040	5	3	2	3	0	6	0	1	0	20
	(25.0)	(15.0)	(10.0)	(15.0)	(0.0)	(30.0)	(0.0)	(5.0)	(0.0)	(100.0)
1041～1050	1	2	0	0	0	3	0	0	0	6
	(16.7)	(33.3)	(0.0)	(0.0)	(0.0)	(50.0)	(0.0)	(0.0)	(0.0)	(100.0)
1051～1060	3	2	1	2	0	1	0	0	0	9
	(33.3)	(22.2)	(11.1)	(22.2)	(0.0)	(11.1)	(0.0)	(0.0)	(0.0)	(100.0)
1061～1070	3	1	1	2	0	5	1	0	0	13
	(23.1)	(7.7)	(7.7)	(15.4)	(0.0)	(38.5)	(7.7)	(0.0)	(0.0)	(100.0)
1071～1080	0	4	0	1	0	1	1	0	0	7
	(0.0)	(57.1)	(0.0)	(14.3)	(0.0)	(14.3)	(14.3)	(0.0)	(0.0)	(100.0)
1081～1090	4	2	0	3	0	5	0	0	0	14
	(28.6)	(14.3)	(0.0)	(21.4)	(0.0)	(35.7)	(0.0)	(0.0)	(0.0)	(100.0)
1091～1100	11	6	3	3	0	6	0	2	0	31
	(35.5)	(19.4)	(9.7)	(9.7)	(0.0)	(19.4)	(0.0)	(6.5)	(0.0)	(100.0)
The 11th century	64	27	18	46	1	39	4	5	0	204
	(31.4)	(13.2)	(8.8)	(22.5)	(0.5)	(19.1)	(2.0)	(2.5)	(0.0)	(100.0)
1101～1110	5	1	4	8	0	3	2	1	0	24
	(20.8)	(4.2)	(16.7)	(33.3)	(0.0)	(12.5)	(8.3)	(4.2)	(0.0)	(100.0)
1111～1120	9	4	1	5	0	4	2	0	1	26
	(34.6)	(15.4)	(3.8)	(19.2)	(0.0)	(15.4)	(7.7)	(0.0)	(3.8)	(100.0)
1121～1130	7	6	1	3	0	2	2	0	0	21
	(33.3)	(28.6)	(4.8)	(14.3)	(0.0)	(9.5)	(9.5)	(0.0)	(0.0)	(100.0)
1131～1140	6	4	2	5	0	1	1	0	0	19
	(31.6)	(21.1)	(10.5)	(26.3)	(0.0)	(5.3)	(5.3)	(0.0)	(0.0)	(100.0)
1141～1150	14	8	0	8	4	0	1	0	0	35
	(40.0)	(22.9)	(0.0)	(22.9)	(11.4)	(0.0)	(2.9)	(0.0)	(0.0)	(100.0)
1151～1160	14	4	1	5	0	4	0	0	0	28
	(50.0)	(14.3)	(3.6)	(17.9)	(0.0)	(14.3)	(0.0)	(0.0)	(0.0)	(100.0)
1161～1170	6	2	3	2	0	7	2	1	0	23
	(26.1)	(8.7)	(13.0)	(8.7)	(0.0)	(30.4)	(8.7)	(4.3)	(0.0)	(100.0)
1171～1180	7	6	0	7	4	5	0	0	0	29
	(24.1)	(20.7)	(0.0)	(24.1)	(13.8)	(17.2)	(0.0)	(0.0)	(0.0)	(100.0)
1181～1190	11	6	3	11	0	6	1	1	0	39
	(28.2)	(15.4)	(7.7)	(28.2)	(0.0)	(15.4)	(2.6)	(2.6)	(0.0)	(100.0)
1191～1200	8	6	2	8	0	4	0	2	0	30
	(26.7)	(20.0)	(6.7)	(26.7)	(0.0)	(13.3)	(0.0)	(6.7)	(0.0)	(100.0)
12th century	87	47	17	62	8	36	11	5	1	274
	(31.8)	(17.2)	(6.2)	(22.6)	(2.9)	(13.1)	(4.0)	(11.8)	(6.4)	(100.0)
Total from the 7th to the 12th centuries	319	169	122	231	24	242	47	49	17	1220
	(26.1)	(13.9)	(10.0)	(18.9)	(2.0)	(19.8)	(3.9)	(4.0)	(1.4)	(100.0)

2.3.2 Climatic disasters in each capital in Japan

In ancient Japan, successive emperors frequently changed capitals as shown in Table 3, Figures 7 and 8. Before the Fujiwara kyo, the capital was almost situated in the Asuka village, Nara Prefecture (except in 645-655; the Naniwa in Osaka Prefecture, 667-672; the Ohtsu in Shiga Prefecture). In 694, the Temmu emperor moved the capital from the Asuka kyo to the Fujiwara kyo (the Kashihawa City in Nara Prefecture at present). From 694 onward, the capitals were located in Nara Prefecture until 784 except 740-745. And then the capital was moved to Kyoto in 784. The ratio of disaster during each of the periods is shown in Figure 9. From these results, drought occupied more than 30% before the Fujiwara kyo, during the Fujiwara kyo and the Heijo kyo where these capitals were located in Nara. On the other hand, the percentages of drought during the Kuni kyo, Naniwa kyo, Nagaoka kyo and the Heian kyo were less than before the Fujiwara kyo, during the Fujiwara kyo and Heijo kyo but the percentages of flood during these periods were somewhat higher than other periods. That is to say, while the capital located in Nara, many drought disasters occurred. On the other hand, the rivers flooded frequently during there was a capital in Kyoto.

Table 3　Relocations of the capitals in Japan from the Fujiwara kyo to the Heian kyo

	year	Name of the Imperial Palace	Name of the emperor	Present location	Number of disasters
①	694	Fujiwara kyo	The Temmu emperor	Kashihara City, Nara	19
②	710	Heijo kyo (1)	The Gemmei emperor	Nara City, Nara	23
③	740	Kuni kyo	The Shomu emperor	Kizu-gawa City, Kyoto	6
④	744	Naniwa kyo	The Shomu emperor	Osaka City, Osaka	2
⑤	745	Shigarakinomiya	The Shomu emperor	Koga City, Shiga	0
⑥	745	Heijokyo (2)	The Shomu emperor	Nara City, Nara	67
⑦	784	Nagaoka kyo	The Kammu emperor	Muko and Nagaokakyo Cities, Kyoto	12
⑧	794－1192[3]	Heian kyo	The Kammu emperor	Kyoto City, Kyoto	1013

The left numbers correspond to the numbers in Figure 8.

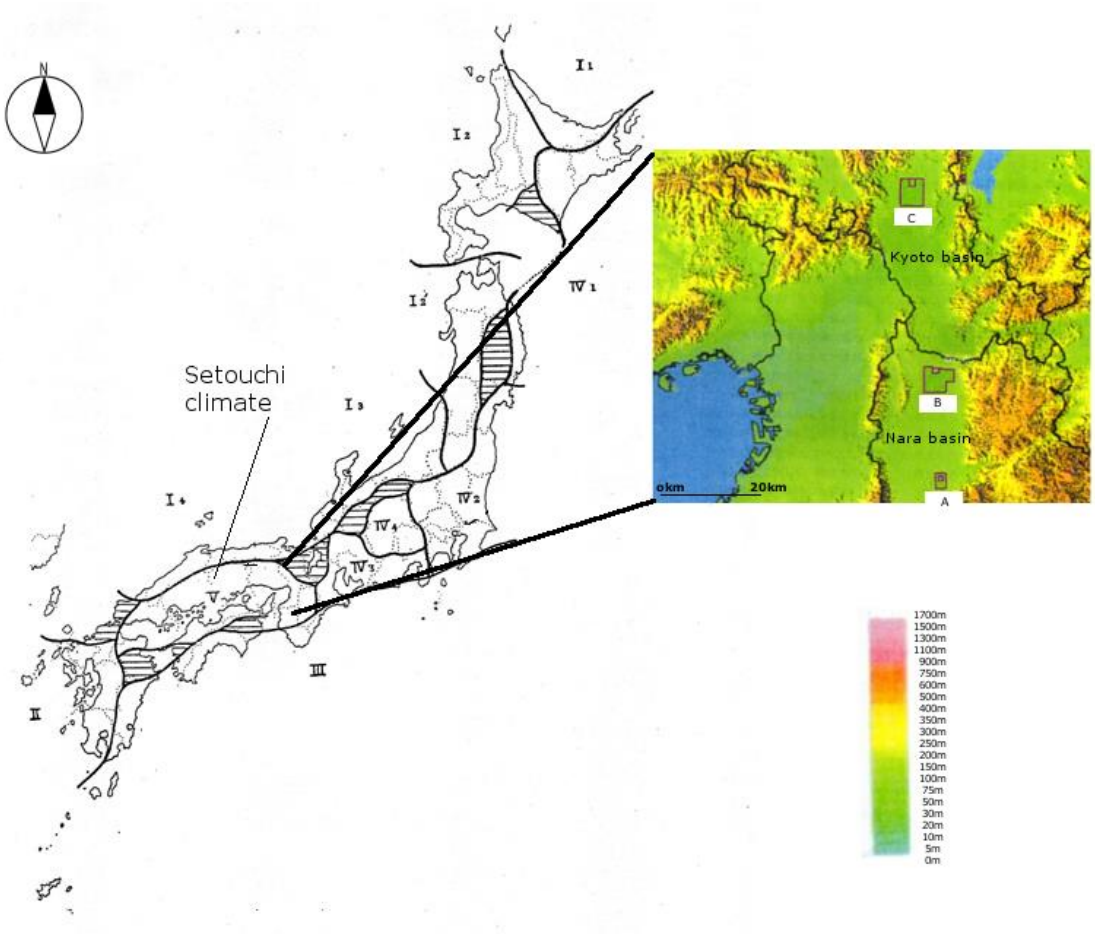


Figure 7 Climatic divisions in Japan and principal capitals of Japan in the Asuka, Nara and Heian period

A, B and C in this figure present the capitals of Asuka and Fujiwara kyo, the capital of Heijo kyo and the capital of Heian kyo respectively. This figure was recomposed from the climatic divisions by Sekiguchi (1959) and capital locations by Geospatial Information Authority of Japan (2000).

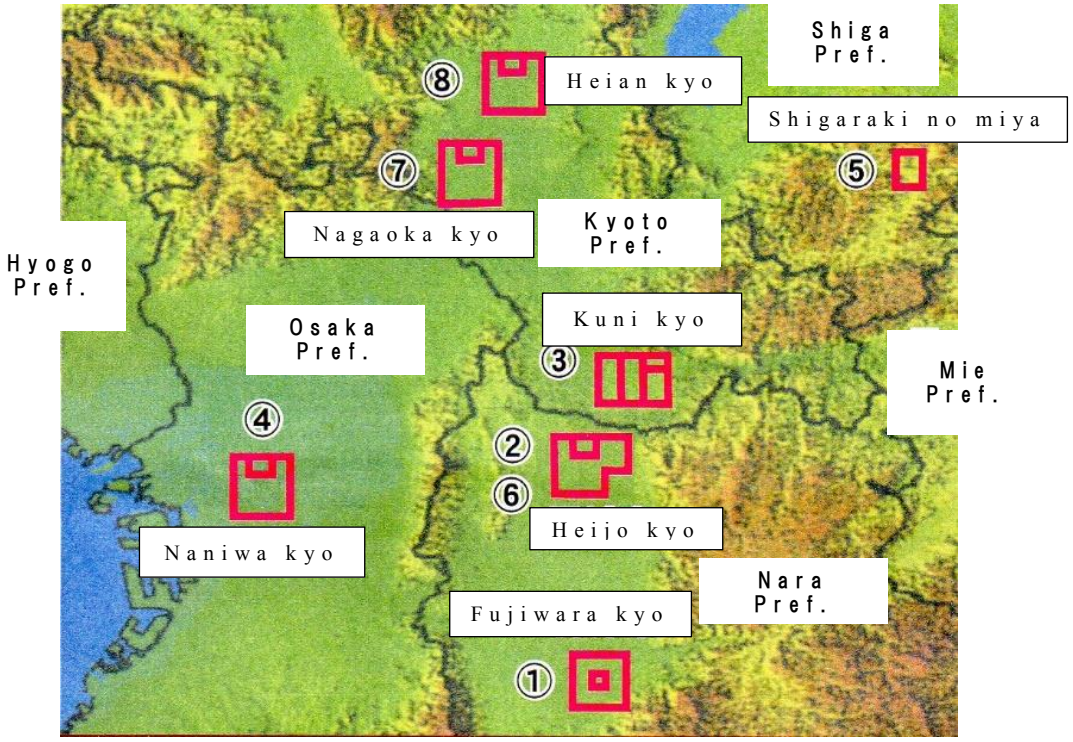


Figure 8 Locations of capitals of Japan in the Asuka, Nara and Heian period

This map was rewritten based on Geospatial Information Authority of Japan 2010.

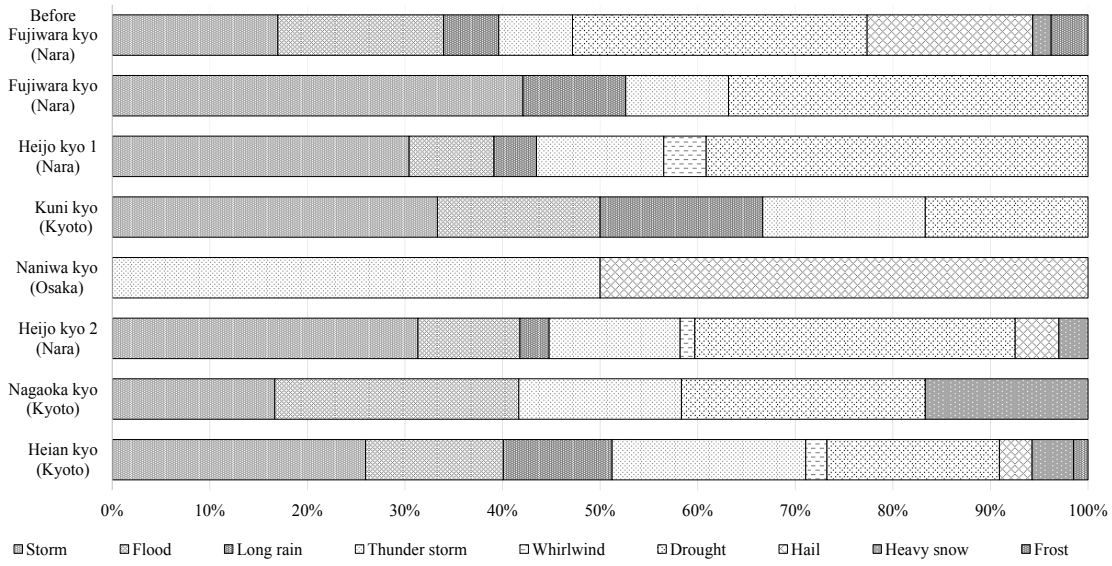


Figure 9 Percentage of climatic disaster during each capital

2.3.3 Climatic disasters in the Jogan era (859-876)

The Jogan era is the name of Japanese era corresponding the reign of the Emperor Seiwa from 859 to 876 in the early Heian period. This era is well known as the peculiar period when natural disasters including volcanic eruptions and earthquakes occurred frequently in Japan (Table 4). For instance, Mt. Fuji greatly erupted in 864 and 870 and the eruption in 864 was particularly recognized the greatest one as far as the histories of Mt. Fuji were recorded. In addition, there was a big earthquake (the Mutsu earthquake, M8.3) and a great tsunami struck in Tohoku region in 869 which are well-known as the Jogan earthquake and tsunami. Moreover, infection disasters by influenza and dysentery spread often in all over Japan, and a lot of lives were lost by these disasters. These descriptions were remained in historical records such as "*Nihon sandai jitsuroku*" and "*Ruijukokushi*".

Table 4　Major natural disasters in the Jogan era

A.D.	Disasters of eruption, earthquake and plague
860	Plague broke out in Nagato koku and many people were dead. Flood occurred in Kyoto and storm and flood struck in Kinki district
861	Dysentery spread in August and many little children were dead. Drought occurred in May and storm struck in Kyoto in July.
863	The Etchu and Echigo earthquake (M7.0) Influenza was prevalent and many people were dead. Long rain continued in Kyoto from April to June. A late frost happened in May. The imperial court held the ceremony “Goryoe” to offer prayers for placation of vengeful sprit.
864	The eruption of Mt. Fuji (VEI;3) and Mt. Aso (VEI;3) Plague broke out in Kaga and Izumo Kyoto was suffered long rain in May and the imperial court provided with rice and salt for the people in Kyoto.
867	The eruption of Mt. Tsurumidake (VEI;3) and Mt. Aso (VEI;2). Long rain continued in Kyoto from April to May. Heavy rain and flood happened in May.
868	The Harima earthquake (M7.0) The earthquake swarm was happened in Kyoto Long rain went on in Kyoto for May and August and heavy rain happened in September.
869	The Mutsu earthquake and Jogan tsunami (M8.3) The Higo earthquake, The Yamato earthquake Storm and flood tide happened in Higo. Storm caused heavy damage in Kyoto and drought occurred in August
870	The eruption of Mt. Fuji (VEI;2) Kyoto suffered from a famine by long rain in Kyoto
871	The eruption of Mt. Chokai (VEI;2). Long rain continued for March in Kyoto. Serious drought attacked all over Japan from May to June.
872	Influenza was prevalent in Kyoto and many people were dead. Heavy snow happened in Kyoto in December the previous year. Storm was suffered storm in April and August and the imperial court provided rice and salt for the people in Kyoto
874	The eruption of Mt. Kaimondake (VEI;4). Long rain happened in Kyoto in May and in unknown region in August. Kyoto was suffered the severe damage from storm.

VEI means volcanic explosivity index by Newhall and Self (1982).
The index is divided into nine levels from 0 to 8.
The VEI were utilized the data of Global Volcanism Program
by Smithsonian Institution, National Museum of Natural History http://volcano.si.edu/

The number of record corresponding climatic disaster in each name of Japanese era is shown in a bar graph of Figure 10. It is clear that the number of climatic disasters in the Jogan era is remarkable and counted 94. However, as the result, it was pointed out on the repercussion that the historical records were inhomogeneous in each era. For example, "*Rikkokushi*" is the official history book of Japan which consisted of 6 history books and the histories of Japan especially about the Imperial Court until 887 were described in them. In this reason, it is said that a lot of records left during the period of "*Rikkokushi*". It is worth mentioning that the number of climatic disasters was increasing by comparing before and after the Jogan era and that is very conspicuous from a bar graph of Figure 10, however, it has the problem that the terms of Japanese eras were varied widely respectively (the details refer to Appendix 2). The Jogan era continued for 18 years and the term is relatively longer than other eras whereas other eras like the Tempyo kanpo era lasted for only several months. Thus, it is natural that many climatic disasters happened in the Jogan era which continued for long standing. Therefore, it is necessary to compare the number of climatic disaster by its average. From line graph of Figure 10, though a

lot of climatic disasters occurred from the Tenan era to the Ninna era including the Jogan era (the average is from 4.0 to 6.0), the average of climatic disaster in the Jogan era (5.3) does not stand out from 601 to 1200. Judging from the average, a lot of climatic disasters happened in the Chowa and the Syoji eras (the averages are 7.0 and 7.5 respectively) which were rather more than the Jogan era.

The result of the climatic disaster classified by its kinds appears in Figure 11. From this figure, the most frequency of climatic disaster is thunder storm (24 times, 25.0%). The next is storm (22 times, 22.9%) and long rain is the third (15 times, 15.6%).

Next, the quality of climatic disasters in the Jogan era are examined in detail because the serious natural disaster like the Jogan earthquake and tsunami, the eruption of Mt. Fuji had happened in this period as stated above.

From the descriptions of climatic disasters in the Jogan era, the flood attracts attention as serious disasters in spite of the third. For example, in June 862 (Jogan 4) according to the lunar calendar, the long rain went on from May and the long rain brought about famine in Kyoto. And so the state provided the people who suffered the disaster with salt and rice based on official system of the state called "*Shingo*" from "*sandai jitsuroku*" (see Appendix 3).

On the other hand, in September the same year, because of heavy drought, the wells dried up in Kyoto and the well called Izumien in the Imperial Palace was opened to provide with water for people in Kyoto. In 864 (Jogan 6), famine also occurred in Kyoto in May by long rain and the people were supplied with salt and rice by "*Shingo*". Moreover, Kyoto suffered the famine caused by long rain again in May and June, 870 (Jogan 12) whereas drought happened in Kawachi (Osaka Prefecture) and it inflicted damage on the famer. And then, next year in 871 (Jogan 13), most serious food by long rain attacked Kyoto in leap August. In this case, 3,995 people who had lived in the east of the capital sustained damages and 630 houses were lost while 138 people and 35 houses in the east of the capital were damaged by the flood. As a consequence, it is said that the east of the capital suffered heavier damage than the west. According to Ishii (2002, 2016), the dwelling and population were less in the west of the capital than the east because the west of the capital is difficult to live there due to the damp area.

From Table.4, it is clarified that long rains (864, 867, 870) and volcanic eruptions like Mt. Fuji (864, 870) or Mt. Aso (864,867) happened in the same year. Yamakawa (1992a, 1997, 1999) argued the relationships between the magnitude of volcanic eruptions (DVI; dust vail Index by

Lamb 1972) and climates such as long rain and low temperature. In this study, the magnitude of eruptions were expressed as VEI (volcanic explosivity index by Newhall and Self 1982). According to Newhall and Self, the tropospheric injection is moderate in VEI 2 and that of stratospheric injection is possible in VEI 3. Yamakawa (1992b) referred that the increase in aerosol caused by large volcanic eruption is connected with increase in condensation nucleus in troposphere and it lead into much rain and short of sunshine. Although it is considered that the temperature in the Jogan era is warm from Figure 5, the eruptions might have effect on the long rains in the Jogan era.

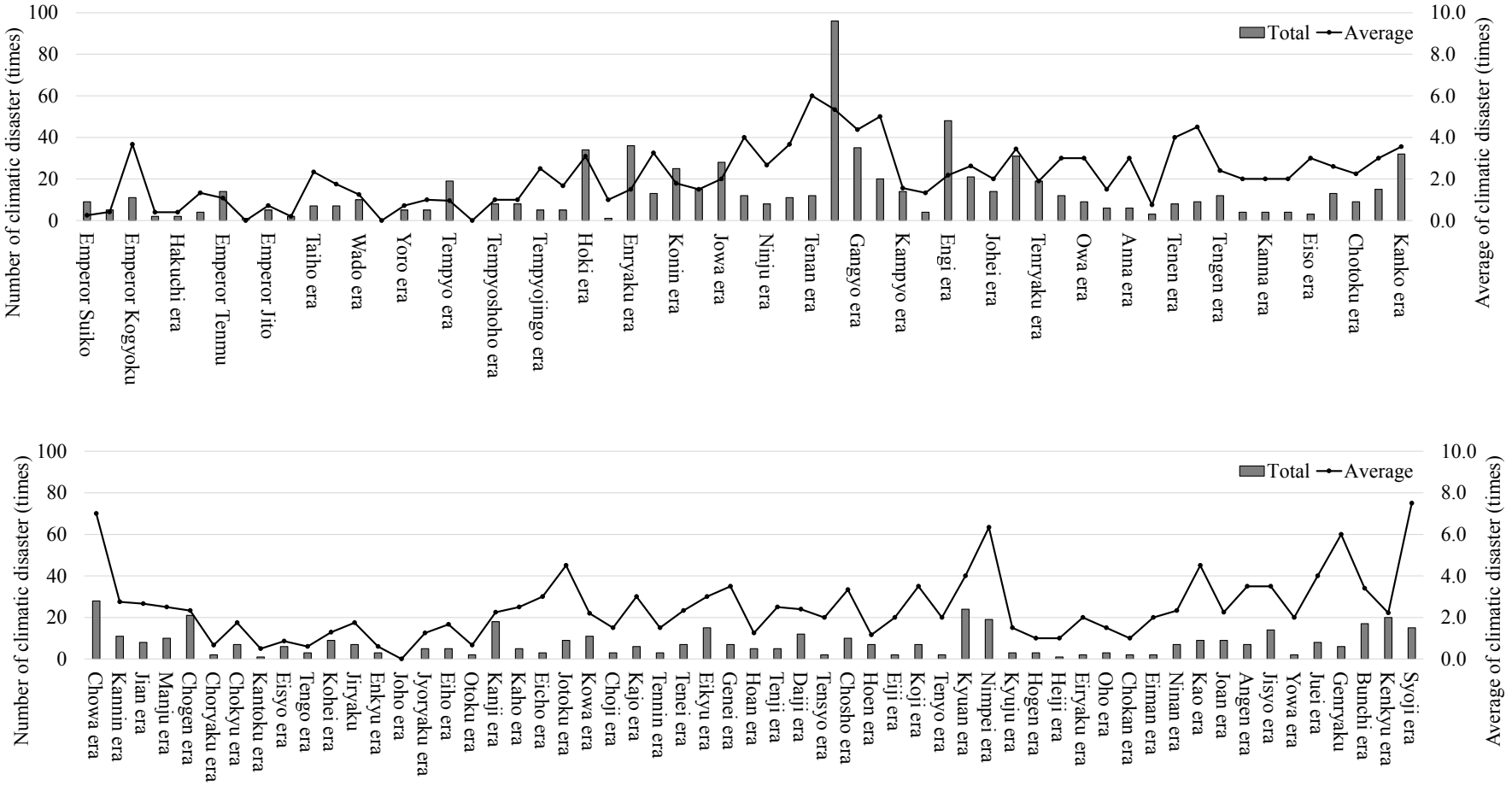


Figure 10　Number of climatic disasters and their average in each of the eras

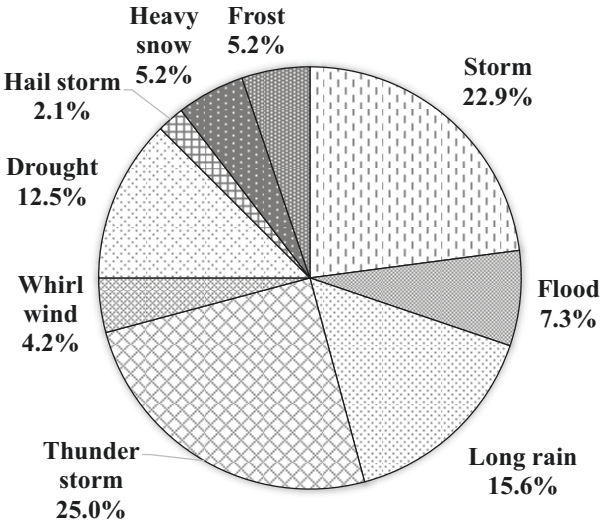


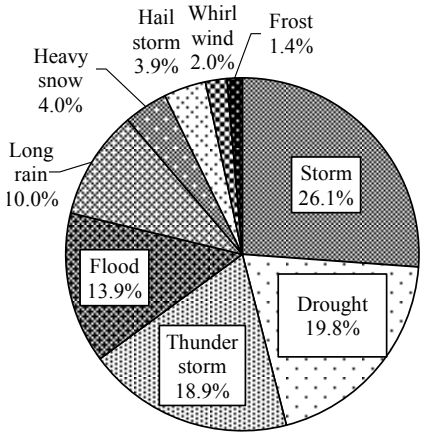
Figure 11 Kinds of climatic disasters in the Jogan era

2.3.4 Secular changes of kinds and regions in climatic disasters

Figures 12-(a) and (b) show the contents of climatic disasters organized their kinds and regions. Concerning all climatic disasters from 601 to 1200, the most common climatic disaster is the storm (26.1%), next, the drought (19.8%) and third, the thunder storm (18.9%). The disasters such as the storm, flood and long rain, occupy about half of them. On the other hand, the most common place is Kyoto making up 48.3%. The second is Nara (7.9%) and third is the Kinki District (4.1%). Some of the other

place names and its percentages are Ise (Mie Prefecture, 3.8%), Kamakura (Kanagawa Prefecture, 0.7%), Kii (Wakayama Prefecture, 0.5%), Omi (Shiga Prefecture, 0.5%), Kawachi (Osaka Prefecture, 0.5%) and Kyushu District (0.5%). From these results, it might be inferred that many records of climatic disasters had concentrated in the capital around that time.

a.



b.

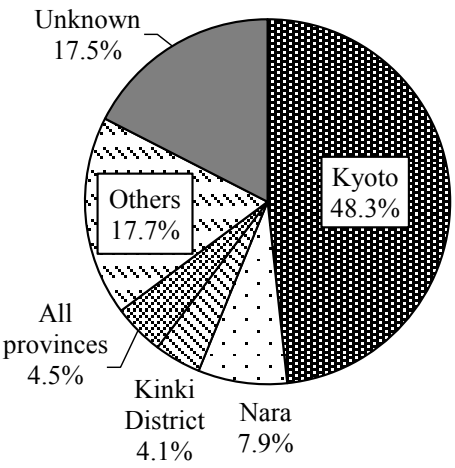


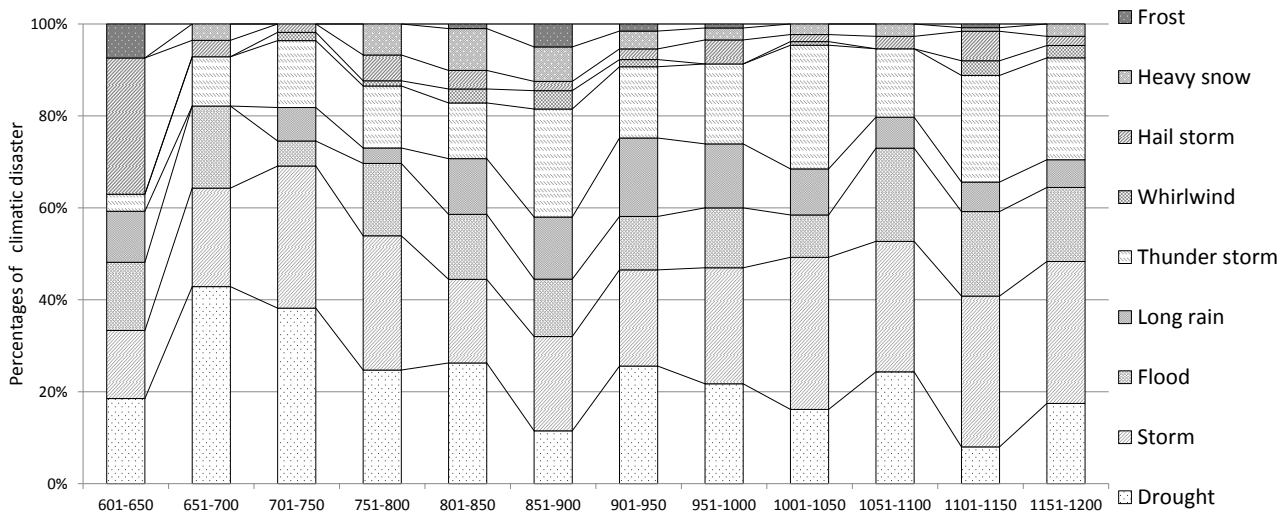
Figure 12-(a), (b) Ratio of the contents of climatic disasters (a) and place and reginal names (b) from 601 to 1200

Figure 13-(a) shows secular change of percentages (%) of climatic disasters. Drought accounts for the greatest percentage before the 8th century and from then they

decrease gradually with more or less fluctuations. Conversely, disasters caused by heavy rain represent the majority of disasters after the 9th century. Kusakabe (1977) stated that drought was more than half of climatic disasters in the 7th and the 8th centuries, in contrast to rain and flood damages in the 10th to the 12th centuries. Although secular change showed by the present study seems to a similar conclusion of this study as secular change, the author wants to draw attention to the influence of regional change of climatic disaster. As shown in Figure 13-(b), the percentage is remarkably covered by Nara until the latter part of the 8th century. On the contrary, climatic disasters recoded in historical documents in Kyoto occupy half of them, whereas the ones in Nara nearly vanished from the 9th century. The reason is that historical records tended to concentrate in the capital city of the time, that is, Nara was the capital of Japan from 593 to 784 except from 740 to 744 and Kyoto was the capital of Japan from 740 to 744, from 784 to 794 and 794 to 1192[3]. For this reason, the author can conclude that there were frequent droughts and records of climatic disasters centered in Nara before the 9th century while there were more disasters caused by much rain and records of climatic disasters concentrated in Kyoto from the 9th to the 12th centuries. Figure 14

compared the percentage of climatic disaster from 601 to 1200 in Nara with those of Kyoto. Droughts in Nara makes up 23.8%, in contrast to Kyoto which shows only 7.4%. On the other hand, concerning flood, Kyoto shows about 10% higher than Nara. Climatic disasters especially caused by rainfall are more than 70% in Kyoto.

(a)



(b)

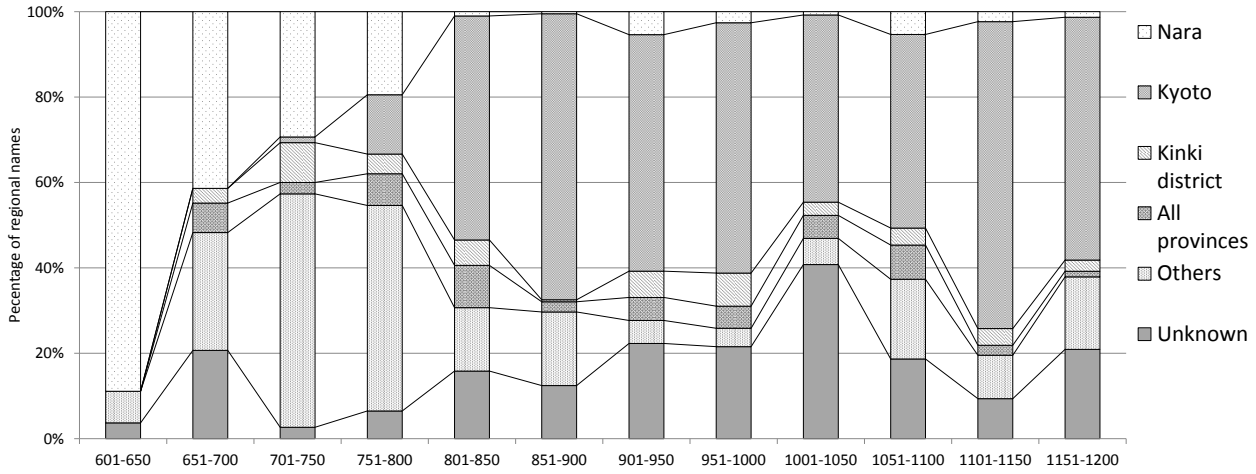


Figure 13-(a),(b) Five decadal changes of percentage on climatic disasters (a) and place and regional names of climatic disasters (b) from 601 to 1200

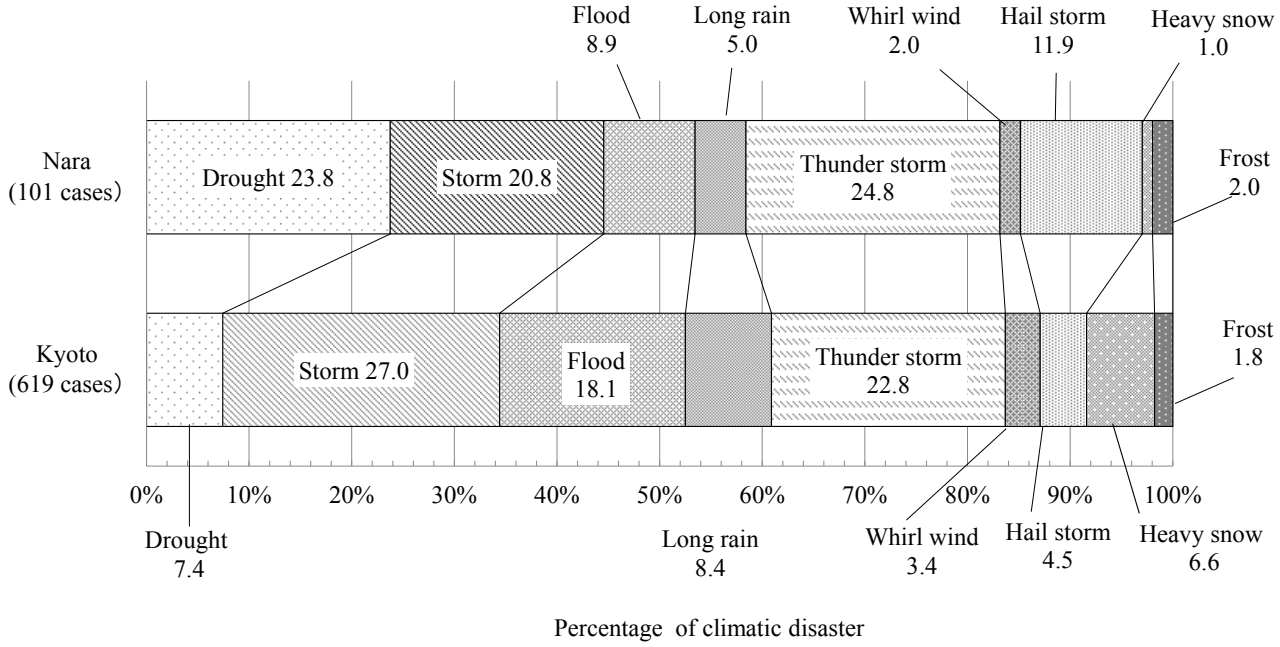


Figure 14 Percentage of climatic disaster in Nara and Kyoto

2.3.5 Changes of drought and rainy disaster

Next, the author would like to compare the secular change of disaster between drought and rainy disaster like storm, long rain and flood. Generally, it is said that rain fall tends to increase in warm period. Figure 15 shows the change of percentage on drought and rainy disaster from 601 to 1200. From this figure, both of drought and rainy disaster accounted for 40% around the 7th century but the ratio of drought was going to decrease gradually 20% or below to end of the 12th century. On the contrary, rainy disaster tended to increase around 55%. In consequence, it was clarified that the drought decreased more than 20% while rainy disaster increased 15% in the end of the Heian period, namely the end of MWP. The correlation coefficients between the number of drought, rainy disaster and temperature deviations from Kitagawa and Matsumoto (1998) were -0.18 and 0.15 respectively and they are not definitely significant. Therefore it was considered that the other factor influenced on this result.

Figure 16 represents the change of percentage on the records in Nara and Kyoto. It is clear that a lot of records left in Nara before the 8th century while the records concentrated in Kyoto from the 9th century.

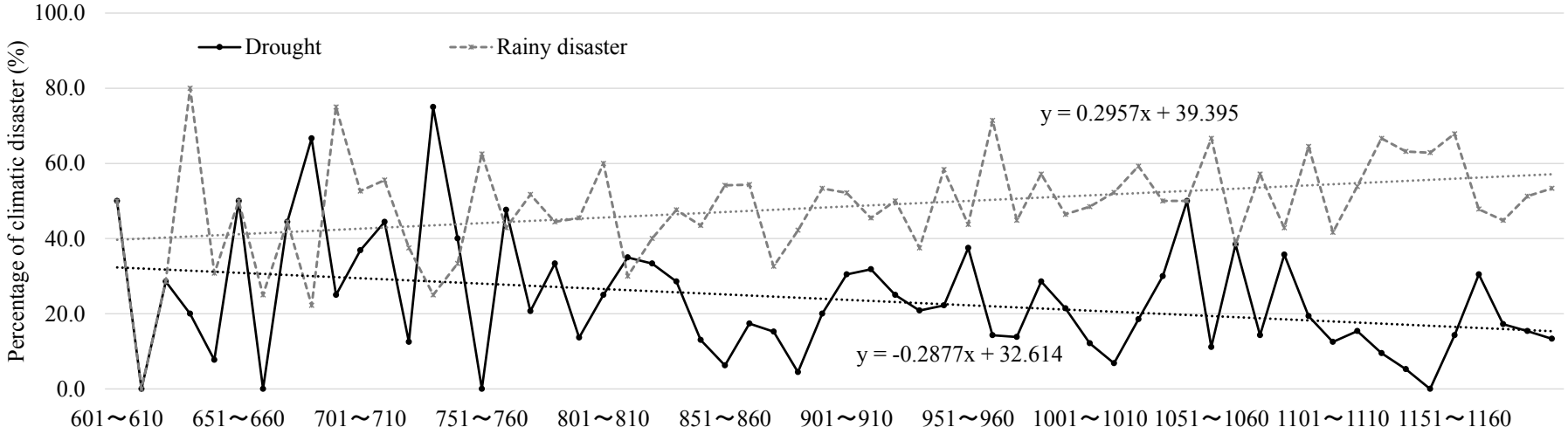


Figure 15　Change of percentage on drought and rainy disaster from 601 to 1200

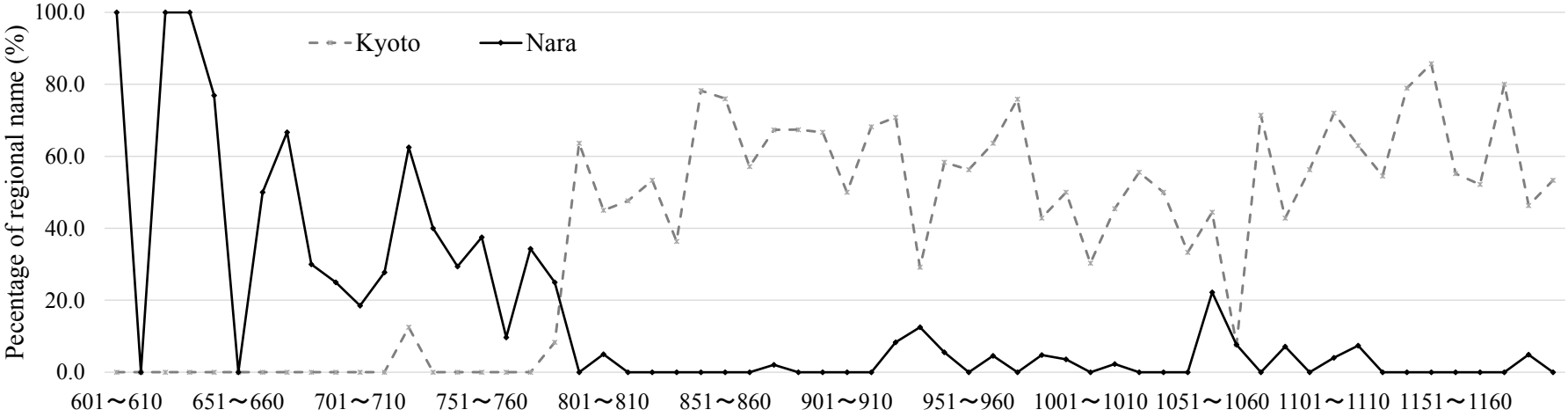


Figure 16　Change of percentage of the records in Nara and Kyoto

3. Comparative study of climatic features in Nara and Kyoto

3.1 Structure of natural disaster

As mentioned above, drought is remarkable disaster in the 7th and the 8th centuries while disaster caused by much rain occurred frequently from the 9th to the 12th centuries. However, the region of the climatic disasters shifted from Nara to Kyoto with the relocation of the capital from Nara to Kyoto in the latter part of the 8th century. Tanioka (2010) concluded that drought was the major climatic disaster in the 8th and 9th centuries whereas long rain caused principal disaster in the first part of the 9th century from the data of "*Rikkokushi*" and "*Nihon kiryaku*". He also stated that the capital relocation from Nara to Kyoto could bring about this result, but he did not refer to their local climates.

Generally, previous studies of the paleoclimate from historical documents have given attention only to climate change. However, it is important to consider that disasters are consisted of the prime, indispensable, induced and expansive factors (Sato *et al*. 1964). Especially for geographical study, it is valuable to focus on the features of indigenous climate empirically, such as landscapes and water balances in Nara and Kyoto.

Nara and Kyoto basins are located in eastern part of the Setouchi climate (Sekiguchi 1959; Kinki Regional Agricultural Administration Office 2018, Kyoto Local Meteorological Office 2018). For this reason, Nara basin had frequently suffered lack of water due to droughts until construction of Yoshino-gawa Channel in 1987. In addition, there were constructed not only a lot of irrigation ponds but also hidden wells in Nara basin in order to protect drought disaster from ancient times (Kobayashi 1940; Horiuchi 1961). On the contrary, many floods had suffered in Kyoto basin where a lot of records on floods were remained from the 9th century. Furthermore Kyoto is so-called "the metropolis of water" and grew up the cultures such as Japanese tea, Sake, dyeing and so on. Thus the differential "climates (*Kiko fudo*)" have been constructed in Nara and Kyoto relevance to human activity.

The author attempts to clarify climatic features in Nara and Kyoto basins from water and heat balances from a point of view in geographical climatology. In this chapter, difference of local climates between Nara and Kyoto will be discussed in detail.

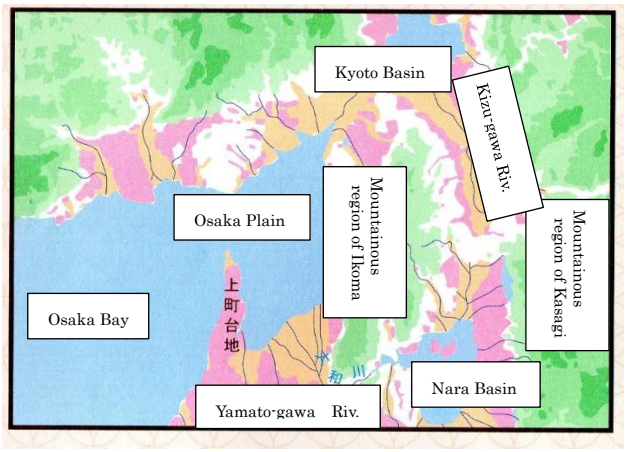
3.2 Geographical environments in Nara and Kyoto basins

The Nara and Kyoto basins are fault basins and they are located in the southwest Japan. These basins are adjoin and are separated by only the Narayama hills where sea level is about 120m. Figure 17 shows the topographical change around the Nara and Kyoto basins from the Jomon period (6,000 years BP) to the present. It is known that there were lakes instead of both basins respectively until the Jomon period. The lake in Nara was called “Ko-Nara ko” which existed in Nara basin and the lake of “Ko-Yamashiro ko” was located in Kyoto basin. These lakes faded away in the Nara period (1,300 years BP) and these areas turned into floodplain.

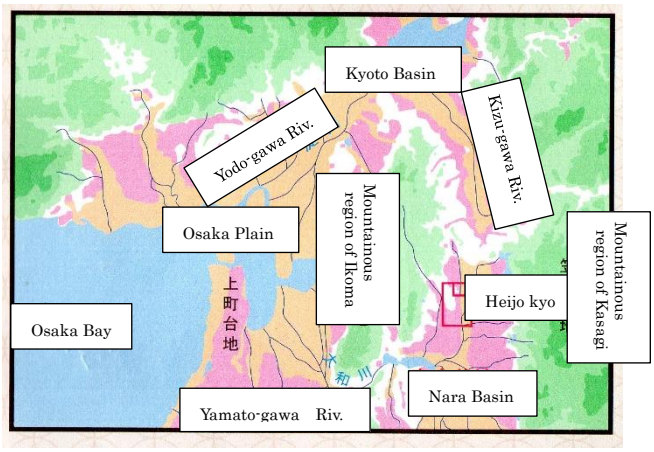
: The surface of the water such as sea,　lake or damp area

: The floodplain or the delta

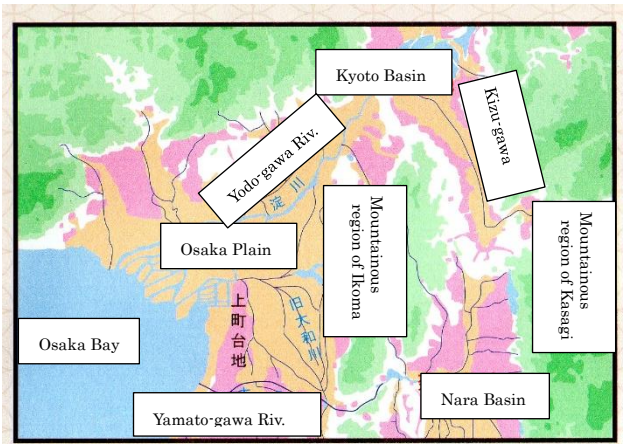
: The alluvial fan or the plateau



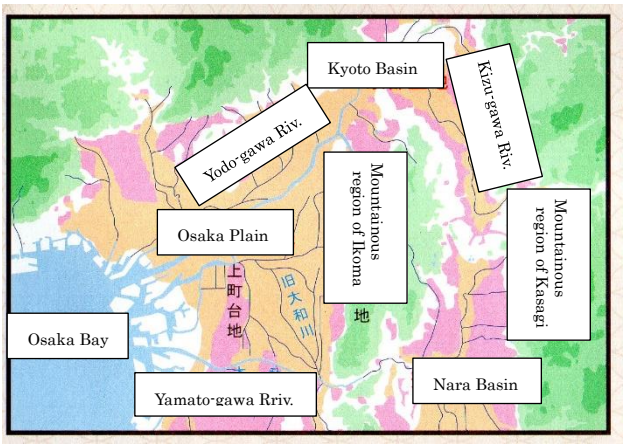
a. The Jomon period (6,000 years BP)



b. The Nara period (1,300 years BP)



c. The Edo period (400 years BP)



d. The Present

Figure 17　Topographical maps around Nara and Kyoto basins

These maps were rewritten based on Geospatial Information Authority of Japan 2010

The Nara basin is also called “Yamato basin” and it is situated in the northern part of Nara prefecture. Its length is about 30km and the breadth is 15km. The Nara basin consists of alluvium at low land, diluvial upland and hills. The bottom of basin is from 40 to 80m above sea level. There are the Yamato plateau and the mountainous region of Kasagi in the eastern edge of the basin. And the mountainous regions of Ikoma and Kongo form the western boundary of the basin. Small rivers from these mountainous regions compose raised rivers and they are gathered as the Yamato-gawa River which flows between the Ikoma and the Kongo mountainous regions and empties into Osaka Bay. According to Hall (1932), almost rivers in the Nara basin were changed artificially and they were made to flow along *Jori- sei* (the system of land division in ancient Japan). The detailed topographical condition around the Nara basin in Nara period was presented in Figure 18. The Fujiwara kyo was constructed on the alluvium fan while the Heijo kyo was located on the floodplain. However, according to Geospatial Information Authority of Japan (2010), it is clarified that the Heijo kyo was built above 50m high area which was insusceptible to flood disaster.

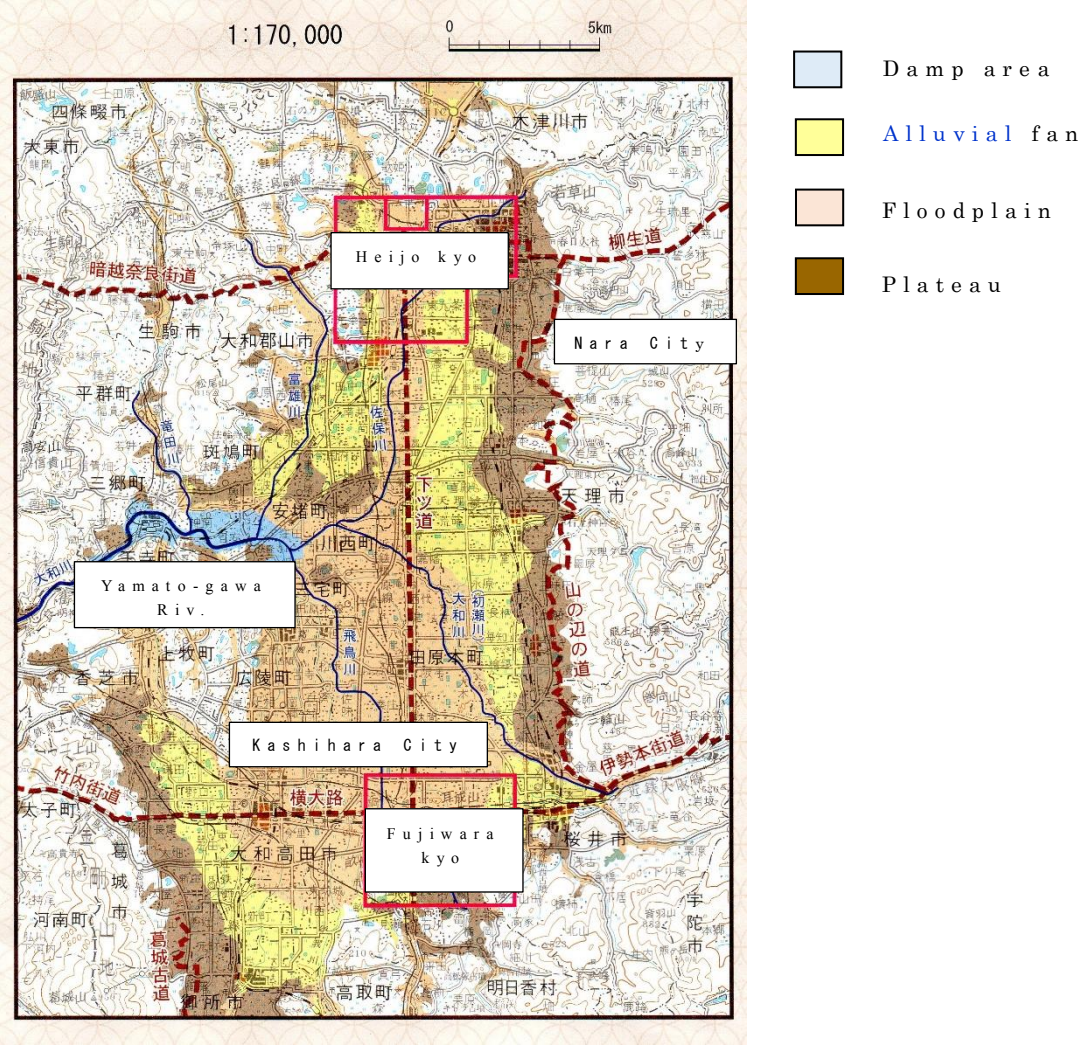


Figure 18　Topographical map of the Nara basin in the Nara Period

This map was rewritten based on Geospatial Information Authority of Japan 2010

On the other hand, the Kyoto basin is located in the south part of Kyoto Prefecture. It is considered that the Kyoto basin is a continuation of the Nara basin and the Narayama hill divides the Kyoto basin from the Nara basin

as mentioned above. The Kyoto basin extends 40km from north to south and has breadth 12km from east to west. The basin consists of three steps such as hill, platform and low land. The bottom of basin is covered with thin alluvium on the alluvial form which made by the Uji-gawa River, the Kamo-gawa River, the Katsura-gawa River and the Kizu-gawa River in Kyoto City. The mountainous region of Tamba which is the extension of the mountainous region of Chugoku lies in the north edge and Mt. Hiei is located at the eastern edge of the Kyoto basin and forms the boundary of the basin. The Uji-gawa River froms the east, the Kizu-gawa River from the south, the Katsura-gawa River and the Kamo-gawa River from the north join as the Yodo-gawa River in the lowest area of the Kyoto basin. And there were the vast pond called Ogura-ike was once formed there, however, this pond was reclaimed land due to defend from flood in 1941. Moreover, Kyoto basin abounds in grand water because of alluvial fans.

The geographical environment of the Heian kyo is indicated in the Figure 19. The Heian kyo was planned as the city based on feng shui. The Kamo-gawa River flows in the eastern part of the city and the Katsura-gawa River flows in the west. Suzuki (2010) said that the Heian kyo has three points on the hydrological features. The first point is “the divines of water in Japan enshrined in Kyoto”,

the second is “cannels were constructed systematically in Heian kyo” and the third is “plenty water fostered the cultures in Kyoto”. As shown in Figure 19, the Heian kyo was divided by Suzaku Street and the western part of the city was called Ukyo and the eastern part was called Sakyo. Moreover, 8 small rivers were channeled in the Sakyo and 4 small rivers were channeled in the Ukyo in the early Heain period. However, these small rivers were utilized as domestic water and canal (Suzuki 2003, 2010).

About the grand water in Kyoto basin, it is said that 21.1 billion tons water were stored below the Kyoto basin and that it is equivalent to Biwa Lake (27.5 billion tons). Their quality of the water was clear around the banks of the Kamo-gawa River and the Katsura-gawa River whereas the waters in the south and west of the Kyoto City (the area corresponds to “Ukyo” in the Heian period) were poor quality.

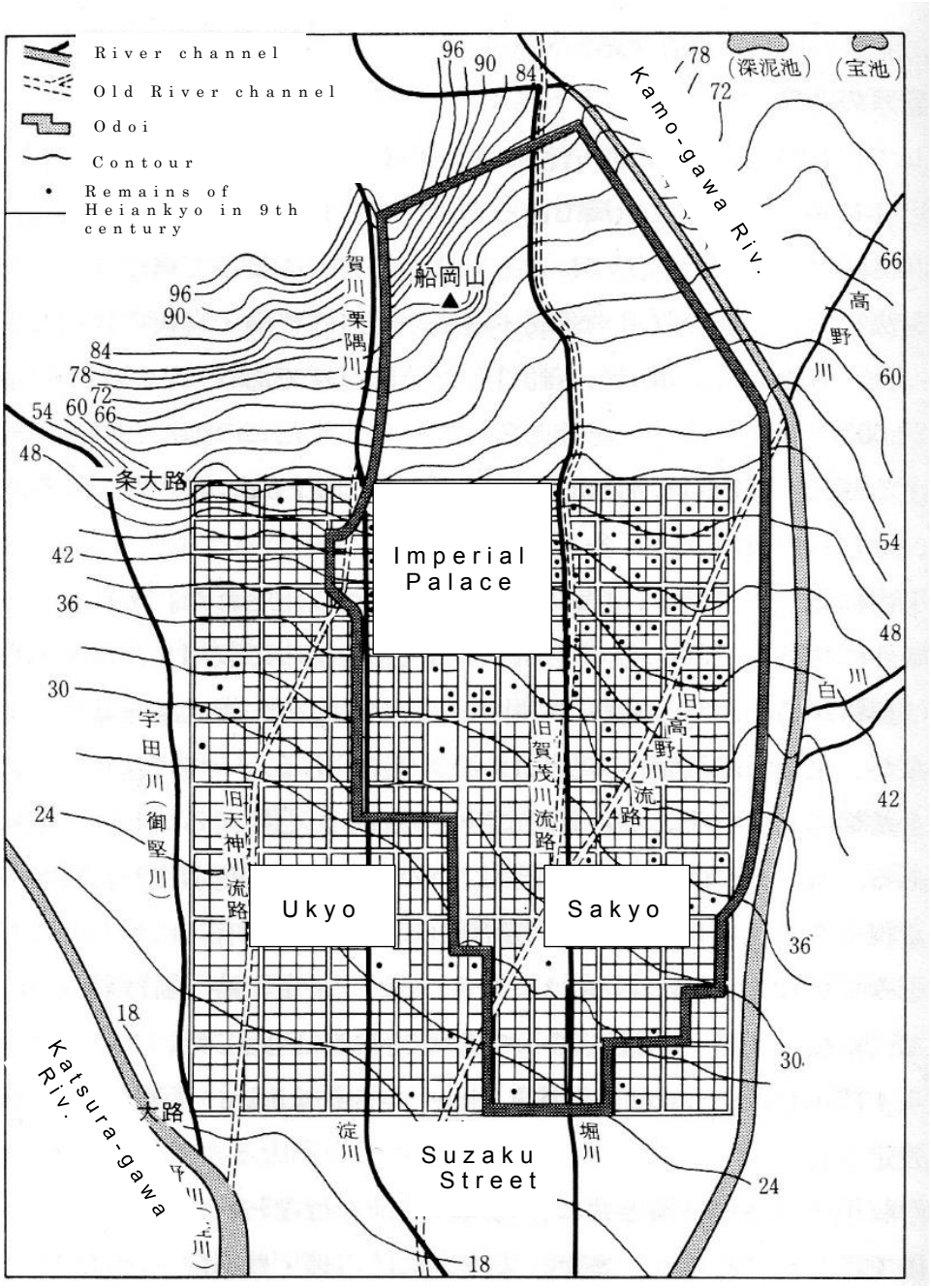


Figure 19 Geographical environment in the Heian kyo

This map was rewritten based on Yoshikoshi (1987)

3.3 Climates and water environments surrounding Nara and Kyoto basins

According to climatic divisions in Japan, the Nara and Kyoto basins are located in the east end of the Setouchi climate, and have relatively less rain in Japan (Fukui 1957, Sekiguchi 1959) as mentioned above. In Nara, more than ten thousand irrigation ponds were made due to frequently occurred droughts since ancient times. In "*Nihon shoki*", some of the irrigation ponds in Nara were made already in 607 and 613 (Uchida 2003). Moreover, a number of hidden wells were constructed in rice fields in addition to irrigation ponds (Aoki 1961; Nara Local Meteorological Office 1997; Nara Prefecture 2018). Hall (1932) stated that there were 10,056 irrigation ponds in the first half of the 20th century in the Nara basin where 70.9% of the basin was irrigated by ponds, rivers and wells (72.4%, 25.6%, and 1.6%, respectively). However, most of these ponds were made after the 17th century (the Edo period) and only 5% of them were made before the Edo period from the research in 1953 (Kimata 1985). Farris (1985) concluded that there are 2 types of these ponds. The first type is called "Tani-ike" which is small pond and was built in order to store run-off for the whole year. On the other hand, the second type is called "Sara-ike" which was constructed

for keeping away from water deficit in rice paddies for only the growing season. The former type was constructed before 18th century and most of them were used in the Nara and the Heian periods. The latter type was adopted recently. Meanwhile, some significant proverbs meaning that Nara had been distressed by lack of water remain such as "*Yamato Hideri* (weather in Nara tends to be dry)", "*Yamato Honen Komekuwazu*" which means that it rains properly to fruitful harvest in Nara while poor harvest in other regions is caused by much rain. In modern times, large irrigation ponds called Shirakawa-tameike, Ikaruga-tameike, Kurahashi-tameike and Takayama-tameike constructed in 1931, 1947, 1957 and 1963 respectively due to protect for drought. It is also said that drought has been fateful events in Nara since the dawn of history (Tsujita 1961) and it has brought about a civilization of poor water for the people in Nara.

On the contrary, Kyoto was abundant in water as mentioned above and also called "the metropolis of water" which means that the abundance of water has given rise cultures such as Japanese tea, Sake, Tofu, dyeing (Suzuki 2003, 2010). Whereas the Kyoto basin had been frequently tormented with floods by heavy rains from ancient time in spite of belonging to the Setouchi climate. As a matter of fact, the people of Kyoto have suffered the Kamo-gawa

River floods frequently since ancient time (Katahira 2012). For this reason, the protecting system from floods that was called the "*Bokashi*" was stationed in 824 (Yoshikoshi 1987). In addition, although there was a huge pond called Ogura-ike in Kyoto basin, yet it was reclaimed land in 1939 because of protection from floods. From these circumstances, Kyoto has been blessed with abundant water while it was confronted with flood disasters.

Thus climates (*kiko fudo*) are different between Nara and Kyoto basins and their adaptations are also vary in each area.

3.4 Study method

3.4.1 Concept of water balance in geographical climatology

Various climate classifications and indices using climatic elements such as temperature and precipitation were made by Köppen, de Martonne, Lang, Kira and others in order to express complex structure of climate in geographical climatology (Fukui 1938, Kawamura 1973, Yoshino 1978). And these climatic classifications and indices are valuable why they interact with distributions of culture, agriculture, soil, vegetation and so on. Furthermore, Thornthwaite (1948) emphasized that

evaporation is important as climate elements such as temperature, precipitation, humidity and he proposed that the water balance is suited for expressing as the climatic features. Water balance is helpful index to express dry or wet condition of local climate. Also, droughts and floods are closely relate to run-off, i.e. water deficit and water surplus (Hidore 2010, Kusakabe 1957). As Arai (1980) said that the climate is the mother of the waters, run-off signifies effective precipitation which is the water for the plants and animals on surface, flow to rivers, storage into lakes and ponds and source of soil erosions and floods. And Kusakabe (1966) also said that from the view-point of the protection of drought damage, it is essential to study the water balance, namely it needs to investigate not only the amount of precipitation but also the rate of evapotranspiration and soil moisture storage, water surplus and water deficit.

3.4.2 Climatic years

Usually, the average of climatic factor is used for expression of climatic feature. However, it is said that the average could not represent precisely climatic features. Sekiguchi (1951) said that the climate should be analyzed not by average but by annual frequency and that is

appropriate for expression of climate. It is called climatic year by Russell (1934). For example, the climatic division of Köppen in Penghu Island (澎湖島) in Taiwan is Cfa by the average from 1897 to 1944, but Cfa has never appeared in these period in annual analysis and 89% of all the years appeared as Cwa (Fukui 1962). Aoyama (1986) referred that the method of climatic year is suitable to analyze water balance, because amount of precipitation particularly in Japan varies year by year. For these reasons, the author analyzes the water balances in Kyoto and Nara including the concept of climatic year in this study. The run-off by Thornthwaite's method are utilized in order to clarify water surplus and water deficit in Nara and Kyoto.

3.4.3 Method of analysis on water balance

Climatological water balance is expressed by the equation as follows.

$R_f = P - E$ (1)

where R_f: run-off (mm), P: precipitation(mm),

E: evaporation (mm)

The evaporation had been observed by 20cm pan evaporimeter at each of the local meteorological observatories in Japan, however, the observation of evaporation was discontinued because the data were

inaccurate due to be influenced greatly by the inner wall of the pan (Kawamura 1973, Japanese Association of Meteorological Instrument Engineering 2001). Therefore, the author used potential evapo-transpiration (P.E.) proposed by Thornthwaite's method (1948) instead of E in this study. *P.E.* can be computed using monthly mean temperature as follows.

$$P.E. = 1.6\left(\frac{10T_i}{I}\right)^a \qquad (2)$$

$$a = (0.675I^3 - 77.1I^2 + 17920I + 492390) \times 10^{-6}$$

$$I = \sum\left(\frac{t_i}{5}\right)^{1.514}$$

T_i: monthly mean air temperature (˚C), a: constant,

I: the heat index

when monthly mean air temperature is over 26.5 ˚C, *P.E.* is given the decided values separately as a shown note 4. Furthermore, the *P.E.* obtained by above equation were made revision by coefficient at 35˚ N for effects of day length.

Water balance is calculated using *P*, *P.E.* and soil moisture (*S*) by Thornhwaite method. Therefore, eq (1) can be redefined as follows.

$$R_f = P - P.E. \pm S \qquad (3)$$

R_f: run-off (mm), P: precipitation (mm), *P.E.*: potential evapo-transpiration (mm), S: soil moisture (mm)

Based on Thornthwaite's method, the initial value of the soil moisture is set in 100.0mm and reset them in every January in this study because Arai (1976) argued that the soil moisture in Japan is applicable to 100.0mm in the Thornthwaite's method.

3.4.4 Method of analysis on heat balance

Thornthwaite (1931, 1949) originally proposed water balance for new climatic classification as mentioned above. And Sekiguchi (1950) and Hartshorn (1959) said that water balance is the one of climate index as complex environment. Because climate consists of the complex phenomena such as temperature, precipitation, wind and these complex phenomena effected to the human environment. Namely, water balance on geographical study is not the object physical quantity of water budget itself. And heat balance has also similar concept in geographical study. The aim of heat balance on geography is not only making a table of heat budget itself but understanding the nature through the heat balance (Arai 1984). Therefore, this study is based on those concepts of water and heat balances. The ratios of sensible and latent heats fluxes, in particular, tend to change according to dry and wet conditions of the local climate (Budyko 1956). In accordance with the concept,

the author analyzed heat balances in order to compare the net radiation (R_n), sensible heat flux (H) and latent heat flux (lE) in Nara and Kyoto.

Net radiation energy (R_n) is distributed to sensible heat flux (H), latent heat flux (lE) and heat exchange in soil (G) as follows.

$$R_n = H + lE + G \qquad (4)$$

(1). Net radiation

Net radiation is the difference between short wave radiation (I) as the incoming energy from the sun and long radiation (F) as the outgoing energy from the surface of the earth. The author used a value of the short wave radiation in the cloudless day $(Q+q)_0$ at 35°N[5] and made revisions in the following equation by the degree of cloudiness in order to calculate incoming short wave radiation $(Q+q)$.

$$(\mathrm{Q}+\mathrm{q}) = (Q+q)_0\{1-(1-k)n\} \qquad (5)$$

k: coefficient is 0.32 at 35°N,

n: the degree of cloudiness is 0.0-1.0

And then, $(Q+q)$ is reflected at surface and is revised by Albedo (α) as follows.

$$I = (Q + q)(1 - a) \qquad (6)$$

where the author used 0.2 as α at grass.

On the other hand, long wave radiation on a fine day (F_0) was computed by the surface temperature as follows.

$$F_0 = \varepsilon \sigma T_s^4 \qquad (7)$$

ε: emissivity is 1.0,

σ: Stefan Boltzumann constant is 5.67×10^{-8} $Wm^{-2}k^{-4}$,

T_s: surface temperature (K),

And then, F_0 is revised F by the degree of the cloudiness (Arai 2004).

$$F = \varepsilon \sigma T_a^4 \left(1 - a - b\sqrt{e_a}\right)(1 - cn^m) \qquad (8)$$

T_a: air temperature at 1.2m (K), a, b: constants are 0.51 and 0.066 respectively in Japan, e_a: vapor pressure at 1.2m height (hPa), c: constant is 0.65, m: constant is 2,

n: the degree of cloudiness (0.0-1.0).

Consequently, net radiation (R_n) is represented as follows:

$$R_n = I - F \qquad (9)$$

(2). Sensible heat flux and latent heat flux

Sensible heat flux (H) and latent heat flux (lE) are expressed by the following equations.

$H = C_P \rho_a C_D u(T_s - T_a)$ (10)

$lE = \mathrm{L}\rho_a C_D u(q_s - q_a)$ (11)

C_P: specific heat at constant pressure ($\mathrm{Jkg^{-1}K^{-1}}$),

ρ_a: density of air ($\mathrm{kgm^{-3}}$), C_D: bulk coefficient,

u: wind speed, T_s: surface temperature (K),

T_a: air temperature (K),

L: the latent heat of vaporization ($\mathrm{Jkg^{-1}}$),

q_s: specific humidity at surface ($\mathrm{kgkg^{-1}}$),

q_a: specific humidity at 1.2m height ($\mathrm{kgkg^{-1}}$)

The calculation can be converted to the following equations using heat conductive coefficient (h) with wind speed in geographical climatology (Arai 2004).

$H = h(T_s - T_a)$ (12)

$lE = 1.5h(e_s - e_a)$ (13)

h: heat conductive coefficient

$= (0.96 + 0.72u) \times 10^{-4}$ $\mathrm{cal \cdot cm^{-2} \cdot sec^{-1} \cdot {}^\circ C^{-1}}$

u: wind speed ($\mathrm{ms^{-1}}$), e_s: surface vapor pressure (hPa)[6]

e_a: vapor pressure at 1.2m height (hPa)

From the above mentioned equations, monthly water and heat balances were computed[7].

3.4.5 Climatological data

Data of mean temperature, amount of precipitation, mean surface temperature, mean wind velocity and mean

humidity for each of the month from 1897 to 1952 at the local meteorological offices in Yagi (Nara) and Kyoto are used for calculation of water and heat balances. The author used the data of this period, because the surface temperature, which needs to calculate the heat budget, and it used to observe until 1970 but its observation is remain obsolete at the present. Moreover, Nara local meteorological office started as the meteorological observation in Yagi (Kashihara city at present) from1897 and moved to Nara city in 1953 and the meteorological data cannot be regarded to continue from Yagi to Nara. For this reason, the author used the meteorological data from 1897 to 1952 in Yagi as data of Nara. The data were collected from “Meteorological Report of Nara” (Yagi local meteorological Office 1930), “Meteorological Report of Kyoto” (Kyoto local meteorological office 1952) and “Monthly Report of the Central Meteorological Observatory of Japan” (The central meteorological observatory from January in 1897 to December in 1952) because almost the data were not digitalized.

3.5 Result

3.5.1 Features of annual water balances in Kyoto and Yagi

Annual precipitation, P.E. and run-off from 1897 to 1952

in Yagi and Kyoto are represented in Figure 20, 21 and 22. The histogram of the differences on annual precipitation, P.E. and run-off between Kyoto and Yagi are shown in Figure 23.

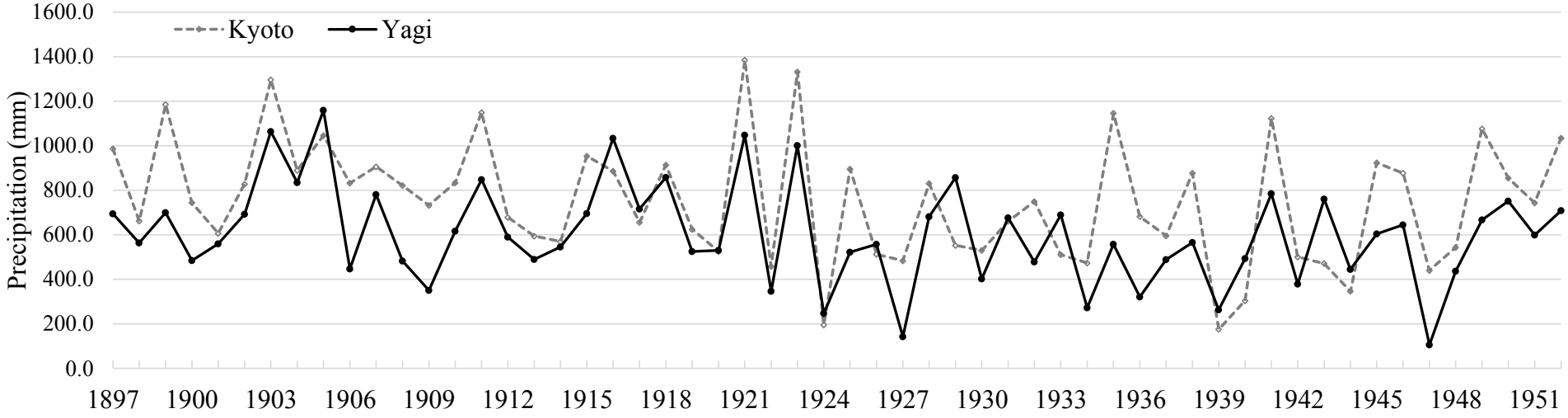


Figure 20 Annual precipitation in Kyoto and Yagi form 1897 to 1952

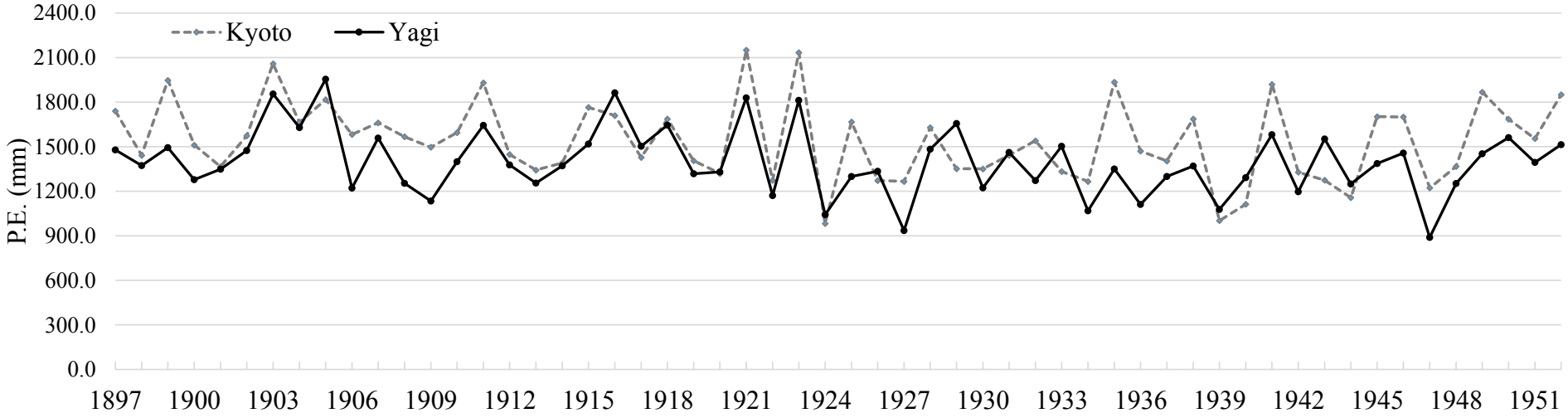


Figure 21 Annual *P.E.* in Kyoto and Yagi form 1897 to 1952

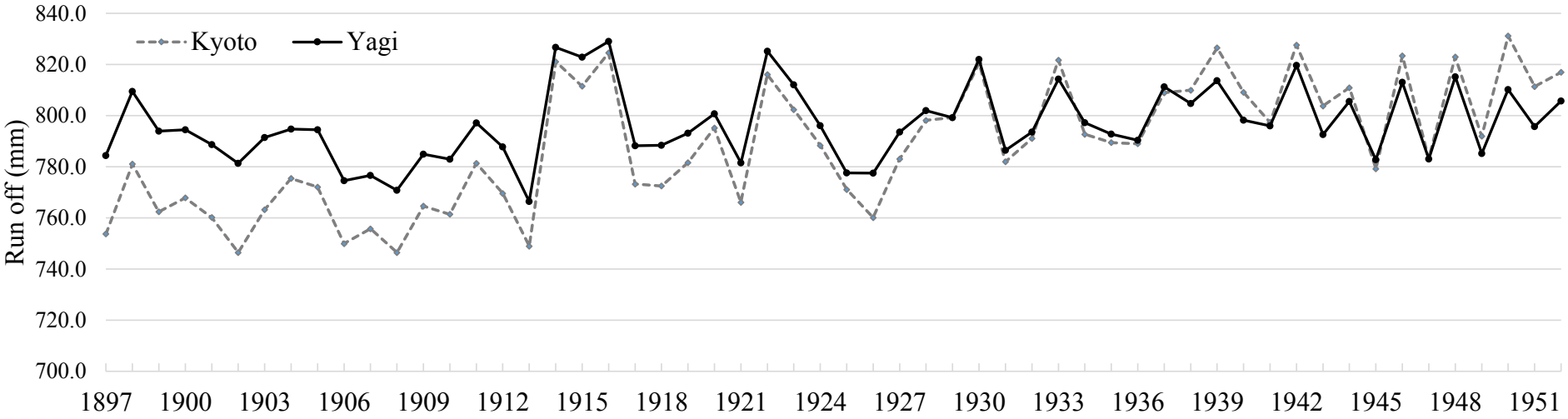


Figure 22 Annual run-off in Kyoto and Yagi from1897 to 1952

(1) Precipitation

At first, the difference of annual precipitation between Yagi and Kyoto are examined. From Figure 20, it is clear that Kyoto almost exceeds Yagi and its frequency is 43 in 56 years. The average in Yagi is 1399.4mm while one in Kyoto is 1542.3mm. In Yagi, the maximum is 1954.3mm in 1905 and the minimum is 888.9mm in 1947. On the other hand in Kyoto, the maximum is 2150.6mm in 1921 and the minimum is 983.5mm in 1924. These differences between maximum and minimum are larger than 1,000.0mm and annual precipitations are varies in both points. The standard deviations in Yagi and Kyoto are 226.3mm and 269.6mm respectively and the value in Kyoto is somewhat larger than Yagi. From Figure 23-(a), the frequency which Kyoto is over 300mm than Yagi is the highest and the largest difference between Kyoto and Yagi is 585.22mm in 1935.

(2) *P.E.*

Next, the differences of P.E. between Nara and Kyoto are compared. *P.E.* in Yagi and Kyoto are illustrated in Figure 21. There is no clear difference of *P.E.* between Kyoto and Yagi from the figure. The averages are 788.7mm

in Kyoto, 796.7mm in Yagi respectively and Yagi is slightly larger than Kyoto before 1930 whereas Yagi is less than Kyoto after 1930. The most difference between Kyoto and Yagi is 34.9mm (1902) and it is concluded that there is no great difference between Kyoto and Yagi as can be seen also in Figure 23-(b).

(3) Run-off

Since run-off is presented by the difference between precipitation and *P.E.* as equation (3), the fluctuations of run-off indicate similarly to one of precipitation (Figure 22) due to show no great difference of P.E. in Yagi and Kyoto as mentioned above. Accordingly, run-off in Kyoto exceeds ones in Yagi and most difference is 588.5mm (1935). The averages of run-off are 753.7mm in Kyoto, 602.8mm in Yagi respectively. These values changed from 157.3mm in 1939 to 1384.5mm in 1921 in Kyoto while ones fluctuated from 105.9mm in 1947 to 115.9mm in 1905 in Yagi as shown in Figure 22. These annual values of both points vary widely and their standard deviations are 275.9mm in Kyoto and 225.7mm in Yagi. From Figure 23-(c), it is clear that the difference over 300.0mm is the most frequency. From viewpoint of climatic year, run-off shows the positive in Kyoto and Yagi through the all years.

That is, judging annual analysis, Kyoto and Yagi indicate water surplus. However, water deficit occurred in midsummer in some years. Therefore, it needs to analyze the seasonal changes of water balance.

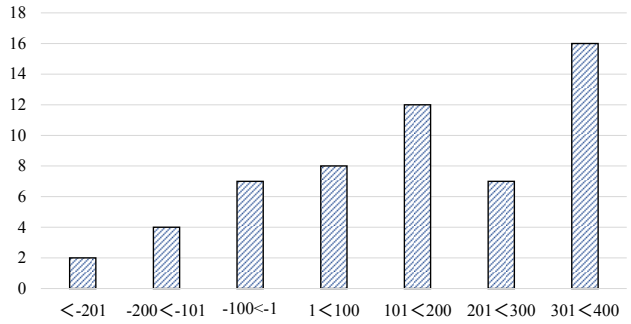


Figure 23-(a). Differences of Precipitations between Kyoto and Yagi

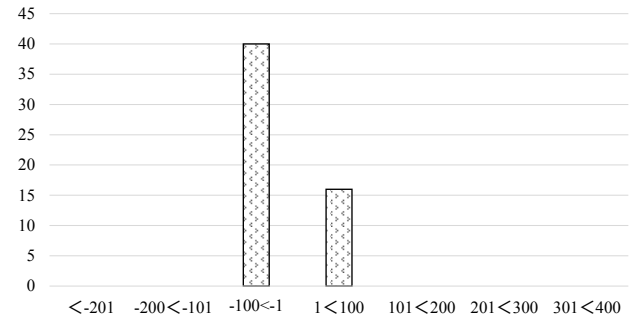


Figure 23-(b) Differences of P.E. between Kyoto and Yagi

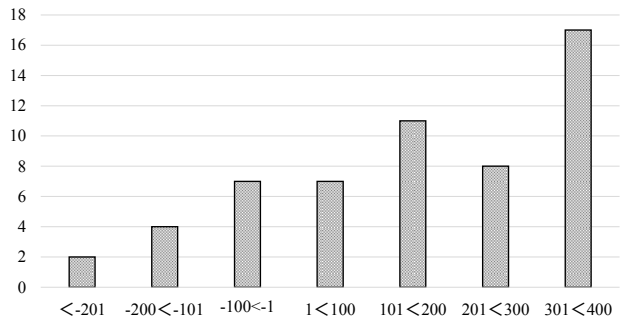


Figure 23-(c) Differences of run-off between Kyoto and Yagi

3.5.2 Seasonal changes of water balances

Next, seasonal changes of water balances in Kyoto and Yagi are examined. Figure 24 shows monthly water

balances in Kyoto and Yagi in average. It is recognized that the monthly precipitation is the most in June, the second in September and the third in July both in Kyoto and Yagi. The precipitations in Kyoto exceed than ones in Yagi from January to September and the difference gets to be larger especially in May and June. Whereas the precipitations in Yagi is slightly more than one in Kyoto from October to December. As for monthly *P.E.*, there are no precise differences in Kyoto and Yagi through the year. The peaks appear in July and August in both points and they are reflected in run-off significantly. Accordingly, run-off in Kyoto exceeds Yagi from January to September while Yagi is less than Kyoto from October to December. Although the maximum of run-off in Kyoto appears in June (112.8mm), and then, it falls to 59.1mm in July. On the contrary, the maximum in Yagi can be seen in March (77.3mm) and the run-off goes on to decrease to May (33.2mm). The run-off in May in Yagi is almost half of them in Kyoto (62.6mm) and the run-off in Yagi once increases in June to 74.4mm because of Baiu season but it is also less than one in Kyoto. The run-off is the least in August in Yagi and Kyoto. This shows clearly that the feature of Setouchi climate appeared conspicuously. Since most of precipitations are consumed by *P.E.*, Kyoto has water surplus nearly 0, besides, water deficit occurs in

Yagi in August. The run-off increases again in September due to typhoon or autumn rain front.

Table 5 summarizes the averages, maxima, minima and standard deviations of run-offs in Kyoto and Yagi. The standard deviations in Kyoto tend to be larger than Yagi from June to September.

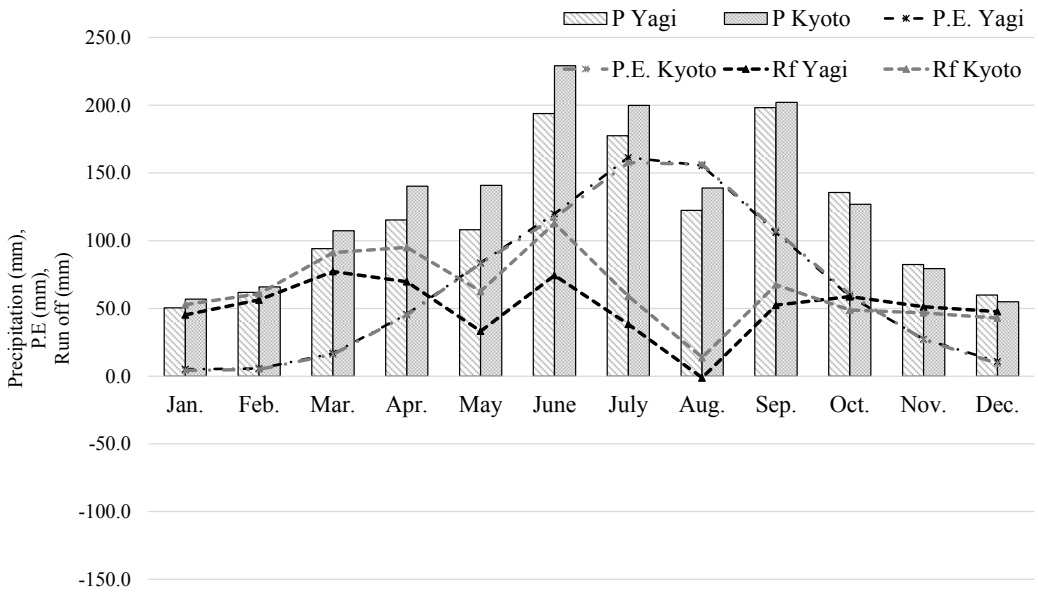


Figure 24 Average of water balances in Kyoto and Yagi

Table 5　Statistics of monthly run-off in Kyoto and Yagi　(mm)

	Jan.		Feb.		Mar.		Apr.		May		Jun.	
	Kyoto	Yagi	Kyoto	Yagi	Kyoto	Yagi	Kyoto	Yagi	Kyoto	Yagi	Kyoto	Yagi
Ave.	52.8	45.2	60.9	56.3	91.2	77.3	95.1	69.7	62.6	33.2	112.8	74.4
Max	159.4	129.1	160.8	135.8	167.8	143.3	279.3	194.2	205.0	178.2	432.0	414.8
Min	2.9	0.7	1.1	12.8	11.5	26.7	10.4	4.1	0.0	0.0	0.0	0.0
S.D.	34.3	27.4	32.6	28.3	39.7	28.9	55.3	41.7	57.9	39.7	104.6	85.2
	Jul.		Aug.		Sep.		Oct.		Nov.		Dec.	
	Kyoto	Yagi	Kyoto	Yagi	Kyoto	Yagi	Kyoto	Yagi	Kyoto	Yagi	Kyoto	Yagi
Ave.	59.1	38.4	13.8	-1.3	67.5	52.4	48.8	58.7	46.8	51.2	42.9	47.7
Max	490.6	350.0	210.8	155.8	344.0	292.1	268.7	281.5	141.9	172.2	112.0	127.7
Min	-82.6	-74.9	-102.0	-90.6	-62.9	-32.2	0.0	0.0	0.0	0.0	0.0	0.0
S.D.	101.8	84.7	57.3	47.2	90.0	80.6	56.5	64.5	34.5	39.0	27.2	29.7

Histograms of monthly run-off in Kyoto and Yagi from January to December are represented in Figure 25 From this figure, it is clear that the little surpluses of run-offs in Kyoto and Yagi occurred in January, February, November and December, that is, in winter season. However, these results are out of the question because of not agricultural season. The important question is the run-offs in warm season, namely agricultural season. In Japan, particularly, rainy season like Baiu and autumn rain appeared in warm seasons. The frequency of the run-off over 100.0mm in March counts 26 in Kyoto but one in Yagi counts only 11 in 56 years. On the other hand, the water surplus in Kyoto becomes over 200.0mm from April. The run off equals 0 which means no water surplus appears in May and their frequencies are 9 in Kyoto, 19 in Yagi respectively. In June, the amount of water surplus shows the increase as mentioned above and there are great variations in water surplus from 0.0 above 400.0mm. However, the frequency of above 200.0mm in Kyoto is larger than one of Yagi. The water deficit appears in July in Kyoto and Yagi. There are definite difference between Yagi and Kyoto around run-off equal 0. The emergences count 32 in Yagi while ones of them count 21 in Kyoto. Most appearances of water deficit are observed in August. The number of water deficits in Yagi is 21 whereas one in Kyoto is 17.

Table 6 represents the frequency how often P.E. exceeds precipitation in Yagi and Kyoto, namely, the frequency how often rain-fall is not enough for evaporation and transpiration. Water deficit does not occur in May as shown in Figure 24 because of sufficient soil moisture, but, the condition which precipitation is less for evaporation and transpiration begins in May. The frequency in Yagi is more than Kyoto through the period and the difference is largest especially in May

Table 6 Frequency of *P.E.*(mm) exceeds precipitation in Yagi and Kyoto from May to August (time)

May		June		July		August	
Yagi	Kyoto	Yagi	Kyoto	Yagi	Kyoto	Yagi	Kyoto
19	9	12	9	28	20	43	35

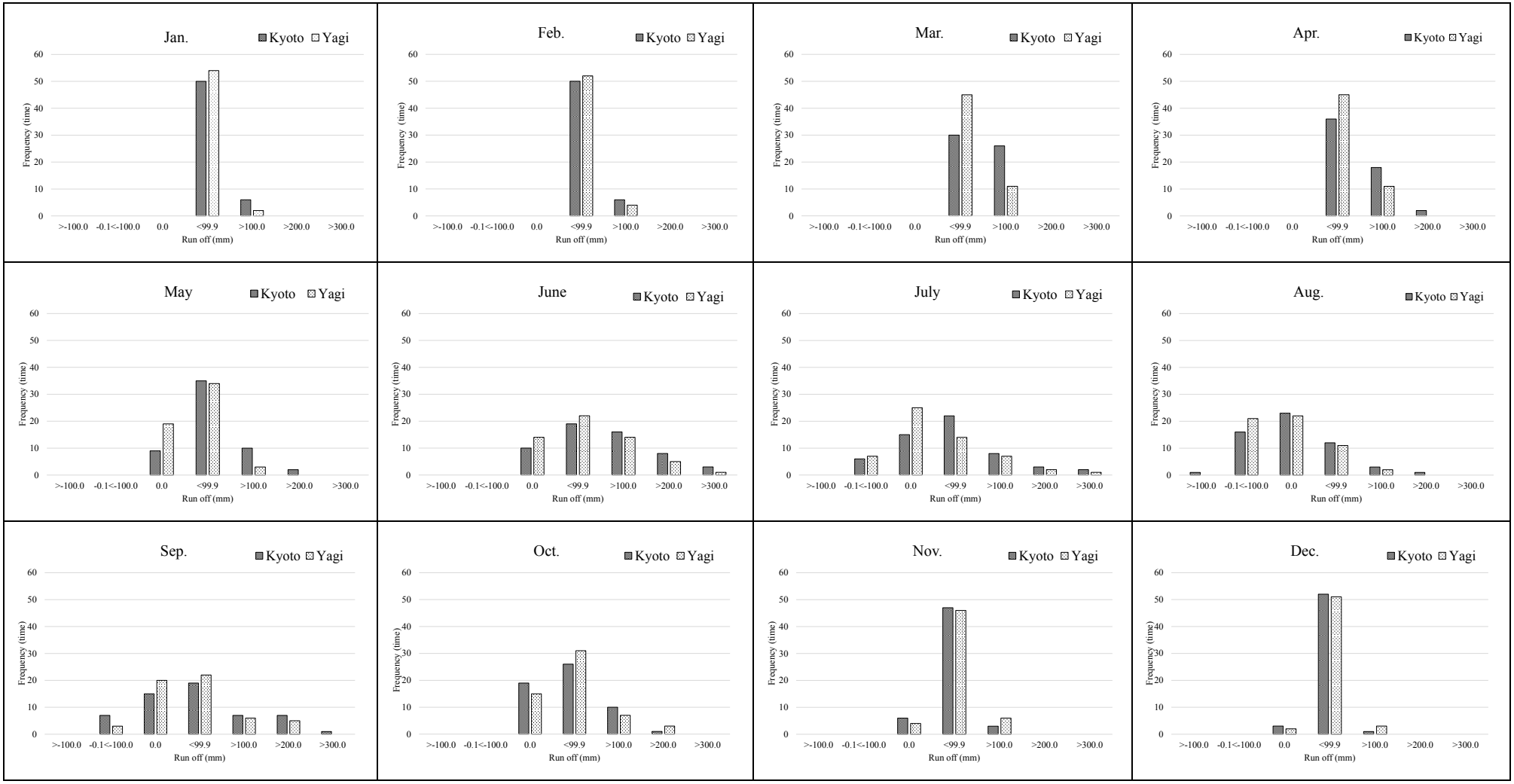


Figure 25 Histograms of monthly run-off in Kyoto and Yagi

3.5.3 Water balances in drought and rainy years

(1) Drought year

Monthly water balances in Kyoto and Yagi are compared in order to clarify the changes of drought year and rainy year. The case in 1947 is selected for drought year, that is, the least case in all years from Figure 22. Figure 26 shows seasonal change of water balance in 1947. From this figure, P.E. in Yagi and Kyoto changed almost equally, however, precipitations in Yagi are only 60.2mm in June and 72.3mm also in July. The difference between Yagi and Kyoto reaches nearly 100.0mm. The precipitations in Yagi come up only 31.0% in June and 40.7% in July respectively for each of the averages and they are well below the half of average. For this reason, P.E. in July and August exceeds precipitation in Yagi where water shortage occurs. According to "Chronology of climatic disasters in Japan" (The Central Meteorological Observatory of Japan 1949), severe droughts spread in Nara during this summer in 77% of rice paddy field where suffered water shortage and agricultural production was estimated a decrease from 5% to 20%. In addition, Aoki (1956) referred that the precipitation is rather less during Baiu season and that the lack of water led to cause of severe drought in August. On the other hand, a little water deficit occurred in Kyoto but

the drought disaster was not confirmed. Drought in Nara could occurr not only in midsummer when Pacific high pressure prevails but also in Baiu season caused by less precipitation unexpectedly. The drought in 1947 appropriated the instance of drought from Baiu season to midsummer.

(2) Rainy year

The case in 1921 is selected as rainy year, because, water surplus is largest as shown in Figure 22. Figure 27 indicates seasonal change of water balance in 1921. P.E. in Yagi is almost equal to one in Kyoto and also they are no different in averages. However, monthly precipitations exceed over 300mm in June, July and September in Kyoto and monthly precipitations over 300.0mm in Yagi continued from June to July. However, there are no definite differences of the P.E. between rainy year and average. Therefore the run-offs are from 2.4 to 6.8 times comparing with average in these periods. According to The Central Meteorological Observatory of Japan (1949), much rain of September in Kyoto was caused by typhoon. Although typhoon passed through Nara and Kyoto Prefectures (Figure 28) and the grave flood occurred in Kyoto, serious damage did not occur in the northern part of Nara basin

(Aoki 1961). And he referred that Nara basin is hard to influence by low pressure and disturbance because Nara basin is close to Kyoto basin topographically. On the other hand, the damp air is brought from the western part of Kyoto basin because Kyoto basin opens for Osaka Bay along the Yodo-gawa River. Baba et al. (2012) said that the convergence is apt to occur due to meeting with the sea breezes from Osaka Bay, Wakasa Bay and the lake breeze from Lake Biwa in Kyoto basin.

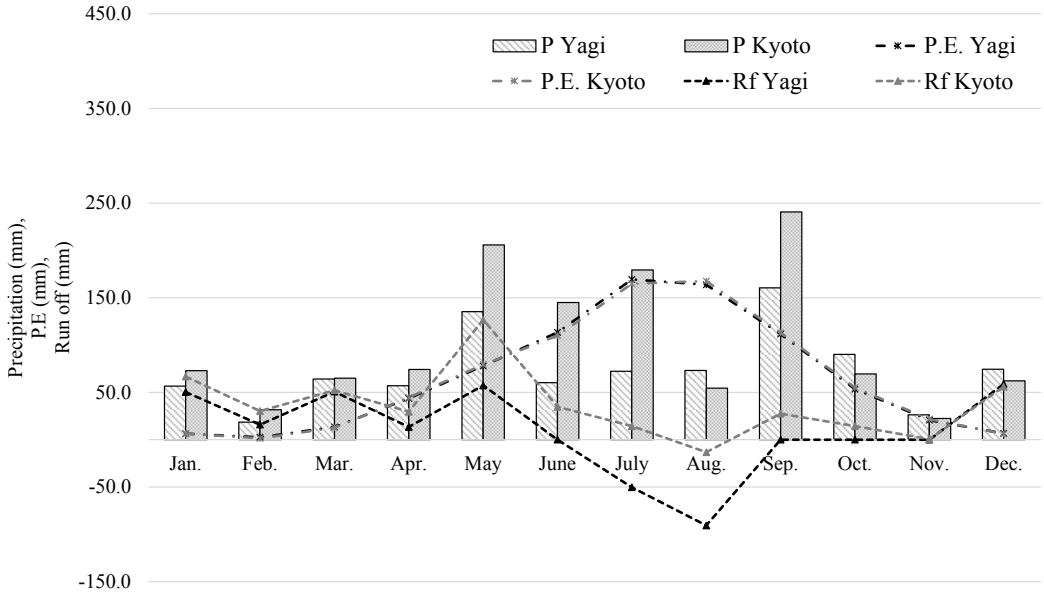


Figure 26 Monthly water balance in drought year (1947)

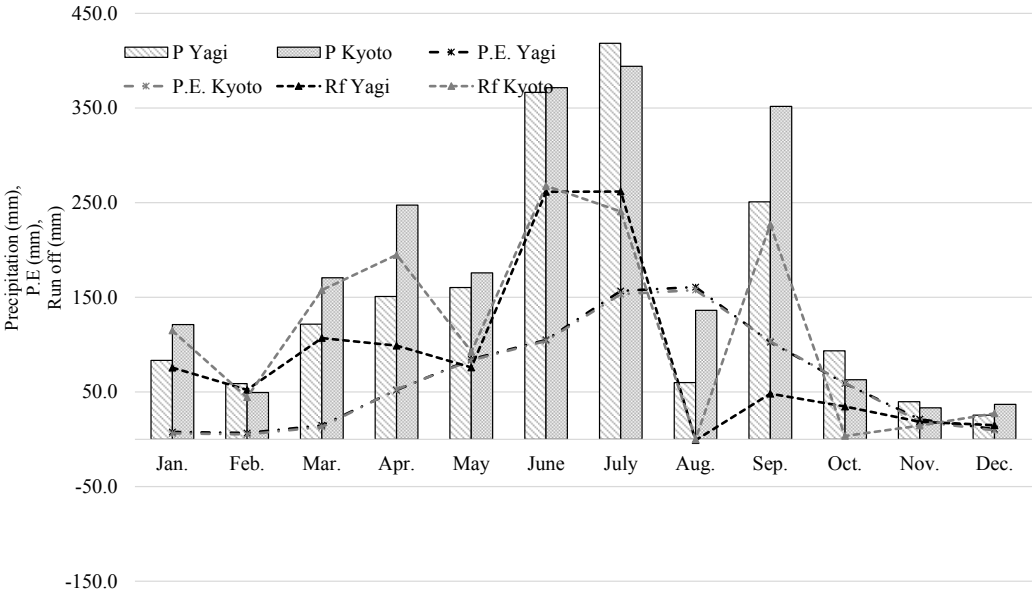


Figure 27 Monthly water balance in rainy year (1921)

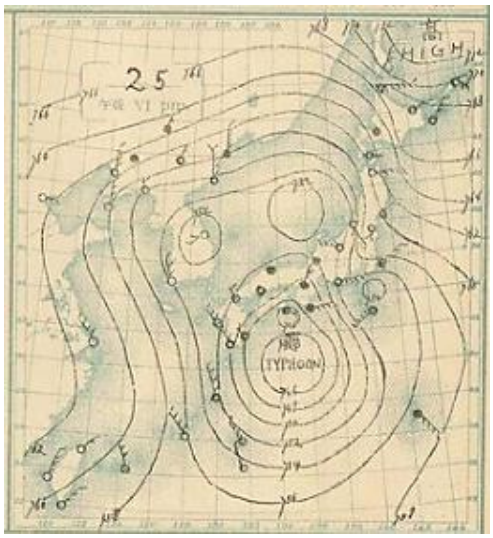


Figure 28　Weather map at 18:00, 25th, September 1921

The original map from Japan Meteorological Agency and the manufacture from “digital typhoon” National Institute of Informatics (2018)

From these results, P.E. is approximately equal between Yagi and Kyoto. Consequently, difference of run-off closely relates to difference of precipitation between Yagi and Kyoto. And then, precipitation and run-off in Yagi are almost less than ones in Kyoto from spring to autumn. These result could bring about drought in Yagi potentially. On the other hand, while precipitation and run-off are larger enough to occur flood in Kyoto, ones in Yagi are less than in Kyoto.

3.5.4 Climatic years in Yagi and Kyoto

Next, the author tried to consider climatic year using the method of the climatic classification by Thorntwaite (1948). Thornthwaite's classification has 4 steps. At first, climates are divided by a moisture index (I_m) which is calculated as follows.

$I_m = I_h - 0.6 \times I_a$

I_h: humidity index, $I_h = 100\frac{s}{n}$

I_a: aridity index, $I_a = 100\frac{d}{n}$

n: annual amount of $P.E.$(mm), s: annual amount of water surplus(mm), d: annual amount of water deficit (mm)

I_m calculated by above equation is divided the following climatic types.

Climatic type		I_m
A	Perhumid	100 and above
B4	Humid	80 to 100
B3	Humid	60 to 80
B2	Humid	40 to 60
B1	Humid	20 to 40
C2	Moist subhumid	0 to 20
C1	Dry subhumid	-20 to 0
D	Semiarid	-40 to -20
E	Arid	-60 to -40

Figure 29 shows the frequency of annual I_m in Yagi and Kyoto. From this figure, the climate of A (Perhumid) appeared 48.2 % in Kyoto while the most occurrence of climate in Yagi is B_3 (Humid; 37.5%). Accordingly, it is

recognized that the climate in Kyoto is more moisture the 2 level than one in Yagi.

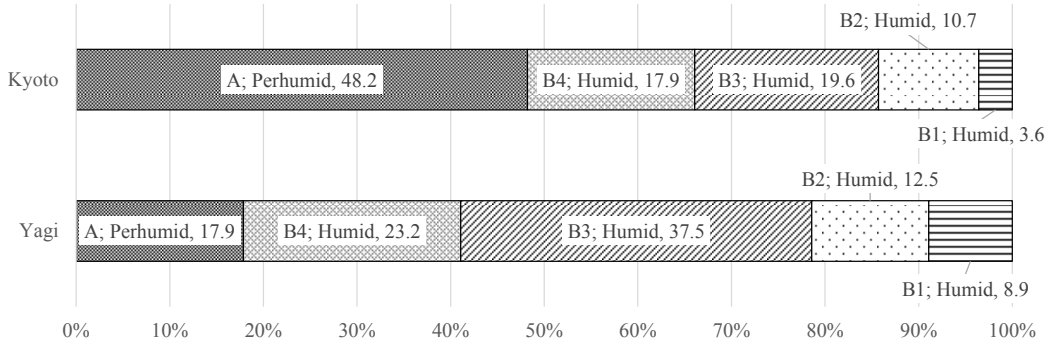


Figure 29 Frequency of annual I_m in Yagi and Kyoto

Index of thermal efficiency means annual amount *P.E.* and it is represent *n* and it is divided as following table. The climate is determined by combination of I_m, index of thermal efficiency, humidity or aridity indices and summer concentration type. These methods of calculations are described as follows.

Climatic type		Index of thermal efficiency (mm)
A'	Megathermal	1140 and above
B'_4	Mesothermal	997 to 1140
B'_3		855 to 997
B'_2		712 to 855
B'_1		570 to 712
C'_2	Microthermal	427 to 570
C'_1		285 to 427
D	Tundra	142 to 285
E	Frost	142 and below

On the humidity or aridity indices, if I_m is divided as

$A, B_{1,2,3,4}$ or C_2, the climate subdivided by I_a whereas if I_m is divided as C_1, D or E, by I_h. Since I_m in Yagi and Kyoto are belong to the former from Figure 29, the climate is subdivided by I_a as follows.

Moist climates (A, B, C_2)		Aridity Index (I_a)
r	Little or no water deficiency	0-16.7
s	Moderate summer water deficiency	16.7-33.3
w	Moderate winter water deficiency	16.7-33.3
s2	Large summer water deficiency	33.3+
w2	Large water winter deficiency	33.3+
Dry Climates(C_1, D, E)		Humidity Index (I_h)
d	Little or no water surplus	0-10
s	Moderate winter water surplus	10-20
w	Moderate summer water surplus	10-20
s2	Large winter water surplus	20+
w2	Large summer water surplus	20+

Finally, climate is subdivided by the summer concentration of *P.E.*. Summer concentration means a percentage of amount of P.E. from June to August to annual *P.E.*.

Summer concentration type (mm)	
a'	48 and above
b'_4	48 to 51.9
b'_3	51.9 to 56.3
b'_2	56.3 to 61.6
b'_1	61.6 to 68.0
c'_2	68.0 to 76.3
c'_1	76.3 to 68.0
d	88 and below

The climatic years obtained foregoing method is represented in Table 7. There is a clear difference of I_m between Yagi and Kyoto, however, there is not clear difference subdivision of index of thermal efficiency, aridity index and summer concentration type between Yagi and Kyoto. The similar result concerning the difference on water balances and climatic years between Nara and Kyoto could obtain by the analysis based on the climatological data from 1954 to 2012 (Marumoto 2014).

Table 7　Climatic years by Thornthwaite's climatic classification in Yagi and Kyoto

	Climatic divisions			Climatic divisions	
	Yagi	Kyoto		Yagi	Kyoto
1897	$B_4B'_2rb'_3$	$AB_2'rb_3'$	1936	$B_2B_2'rb_3'$	$B_4B_2'rb_3'$
1898	$B_3B_2'rb_3'$	$B_4B_2'rb_3'$	1937	$B_3B_2'rb_3'$	$B_3B_2'rb_3'$
1899	$B_4B_2'rb_3'$	$AB_2'rb_3'$	1938	$B_3B_2'rb_3'$	$AB_2'rb_3'$
1900	$B_3B_2'rb_3'$	$B_4B_2'rb_3'$	1939	$B_1B_2'rb_3'$	$B_1B_2'rb_3'$
1901	$B_3B_2'rB_3'$	$B_4B_2'rb_3'$	1940	$B_3B_2'rb_3'$	$B_2B_2'rb_3'$
1902	$B_4B_2'rb_4'$	$AB_2'rb_4'$	1941	$B_4B_2'rb_3'$	$AB_2'rb_3'$
1903	$AB_2'rb_3'$	$AB_2'rb_4'$	1942	$B_2B_2'rb_2'$	$B_3B_2'rb_2'$
1904	$AB_2'rb_3'$	$AB_2'rb_3'$	1943	$B_4B_2'rb_3'$	$B_2B_2'rb_3'$
1905	$AB_2'rb_3'$	$AB_2'rb_3'$	1944	$B_3B_2'rb_3'$	$B_2B_2'rb_3'$
1906	$B_2B_2'rb_3'$	$AB_2'rb_3'$	1945	$B_3B_2'rb_3'$	$AB_2'rb_3'$
1907	$AB_2'rb_3'$	$AB_2'rb_3'$	1946	$B_3B_2'rb_3'$	$AB_2'rb_3'$
1908	$B_3B_2'rb_3'$	$AB_2'rb_3'$	1947	$B_1B_2'sb_2'$	$B_2B_2'rb_2'$
1909	$B_2B_2'rb3'$	$AB_2'rb_3'$	1948	$B_2B_2'rb_3'$	$B_3B_2'rb_3'$
1910	$B_3B_2'rb_3'$	$AB_2'rb_3'$	1949	$B_4B_2'rb_3'$	$AB_2'rb_3'$
1911	$AB_2'rb_3'$	$AB_2'rb_3'$	1950	$B_4B_2'rb_3'$	$AB_2'rb_3'$
1912	$B_3B_2'rb_3'$	$B_4B_2'rb_3'$	1951	$B_3B2'rb_3'$	$B_4B_2'rb_3'$
1913	$B_3B_2'rb_3'$	$B_4B_2'rb_3'$	1952	$B_4B_2'rb_3'$	$AB_2'rb_3'$
1914	$B_3B_2'rb_3'$	$B_3B_2'rb_3'$			
1915	$B_4B_2'rb_3'$	$AB_2'rb_3'$			
1916	$AB_2'rb_3'$	$AB_2'rb_3'$			
1917	$B_4B_2'rb_3'$	$B_4B_2'rb_3'$			
1918	$AB_2'rb_3'$	$AB_2'rb_3'$			
1919	$B_3B_2'rb_3'$	$B_3B_2'rb_3'$			
1920	$B_3B_2'rb_3'$	$B_3B_2'rb_3'$			
1921	$AB_2'rb_3'$	$AB_2'rb_3'$			
1922	$B_2B_2'rb_3'$	$B_2B_2'rb_3'$			
1923	$AB_2'rb_3'$	$AB_2'rb_3'$			
1924	$B_1B_2'sb_2'$	$B_1B_2'sb_2'$			
1925	$B_3B_2'rB_3'$	$AB_2'rb_3'$			
1926	$B_3B_2'rb_3'$	$B_3B_2'rb_3'$			
1927	$B_1B_2'rb_3'$	$B_3B_2'rb_3'$			
1928	$B_4B_2'rB_3'$	$AB_2'rb_3'$			
1929	$AB_2'rb_2'$	$B_3B_2'rb_2'$			
1930	$B_2B_2'rb_2'$	$B_3B_2'rb_3'$			
1931	$B_4B_2'rb_3'$	$B_4B_2'rb_3'$			
1932	$B_3B_2'rb_3'$	$B_4B_2'rb_3'$			
1933	$B_4B_2'rb_3'$	$B_3B_2'rb_2'$			
1934	$B_1B_2'rb_2'$	$B_2B_2'rb_2'$			
1935	$B_3B_2'rb_3'$	$AB_2'rb_3'$			

3.5.5 Heat balances in average, drought and rainy years

Finally, basing on the analysis of water balances, the author discusses the heat balances in Yagi and Kyoto. Heat balance has connection with water balance because energy of evaporation is considered to connect solar radiation and evaporation relating to latent heat flux (Arai 2004). Hence in this study, net radiation (R_n), sensible heat flux (H), latent heat flux (lE) and Bowen ratio are compared between Yagi and Kyoto. Figures 30, 31 and 32 represent monthly R_n, H and lE in Yagi and Kyoto about average, drought year (1947) and rainy year (1921) respectively. As for R_n, there is no definite difference between Yagi and Kyoto. H of the all cases in Yagi are larger than ones in Kyoto. In the case of drought year, the differences of H between Yagi and Kyoto is largest in all cases especially in August. On the contrary, lE in Kyoto exceeds one in Yagi in almost cases except July and August in rainy year. Concerning the Bowen ratios which mean the ratio of H to lE, the ratios in Yagi are higher than ones in Kyoto in all cases except in November of rainy year from Figure 33 (a), (b) and (c). And the Bowen ratio in Yagi is higher than those of Kyoto almost all years. When Bowen ratio is higher, the climate tends to dry. Therefore, it is substantiated that Yagi has drier weather than Kyoto by analysis of water balance.

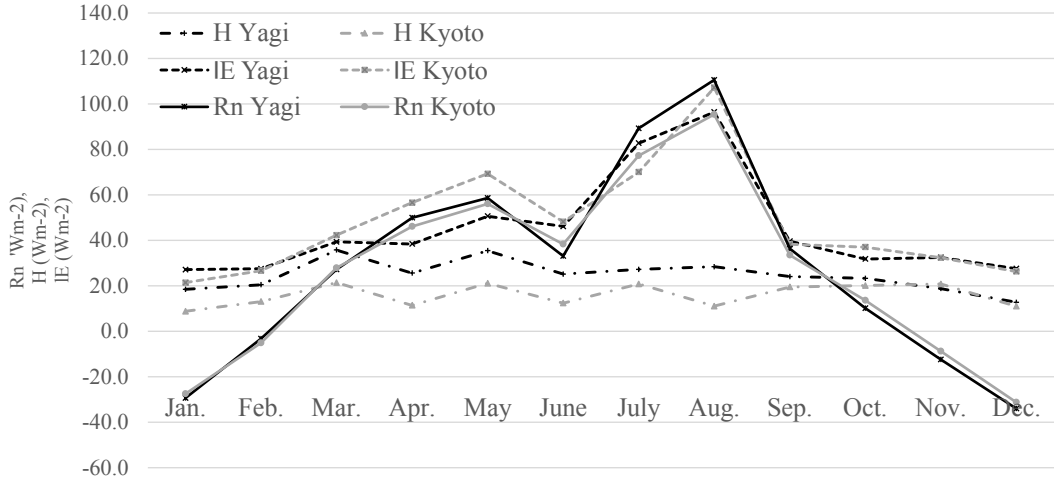


Figure 30 Monthly heat balance in average

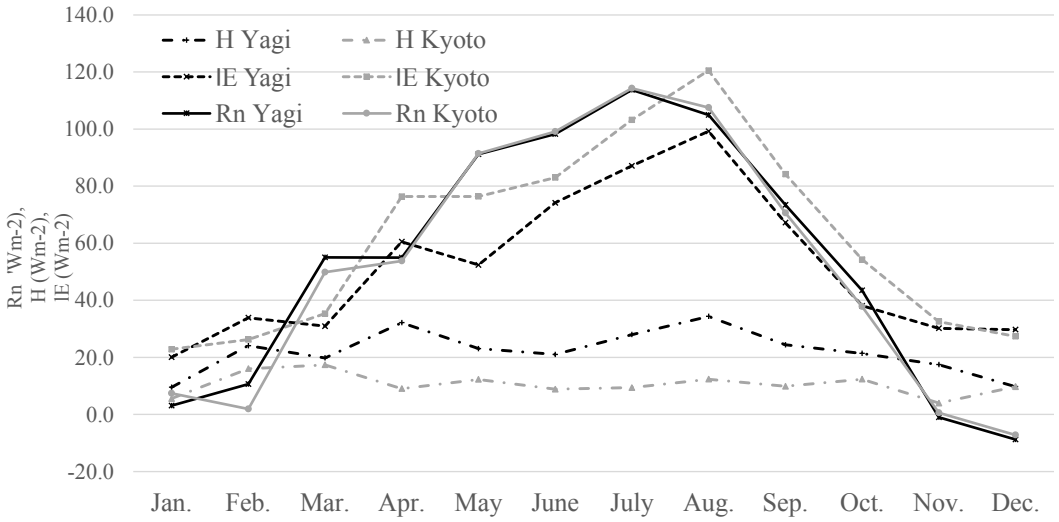


Figure 31 Monthly heat balance in drought year (1947)

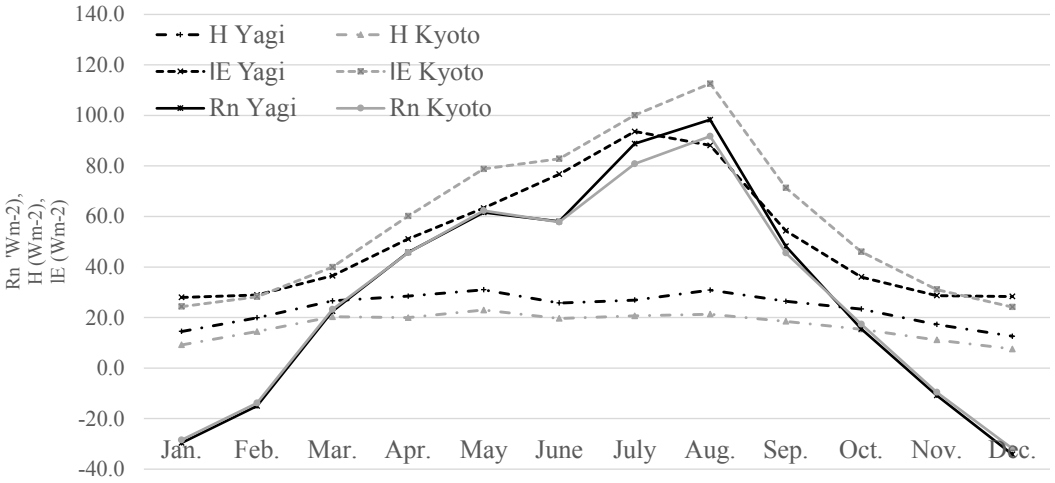


Figure 32 Monthly heat balance in rainy year (1921)

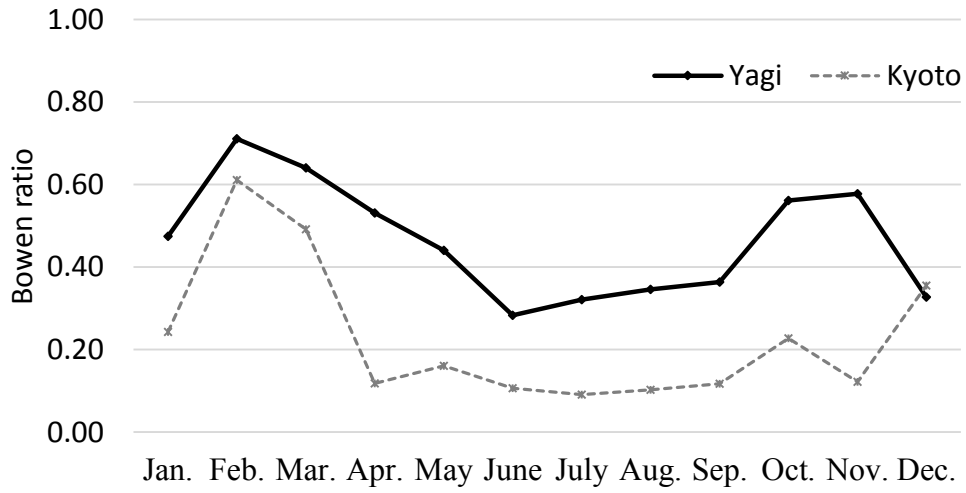


Figure 33-(a) Bowen ratios in Average

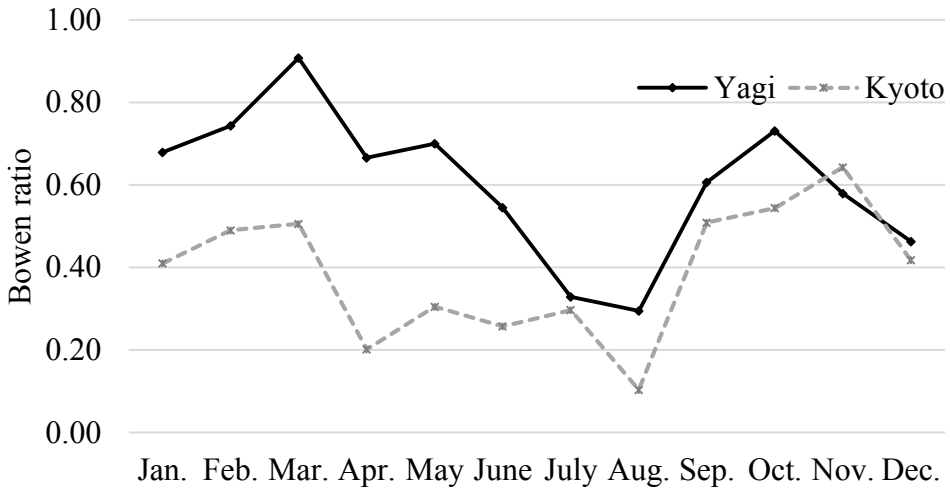


Figure 33-(b) Bowen ratios in drought year (1947)

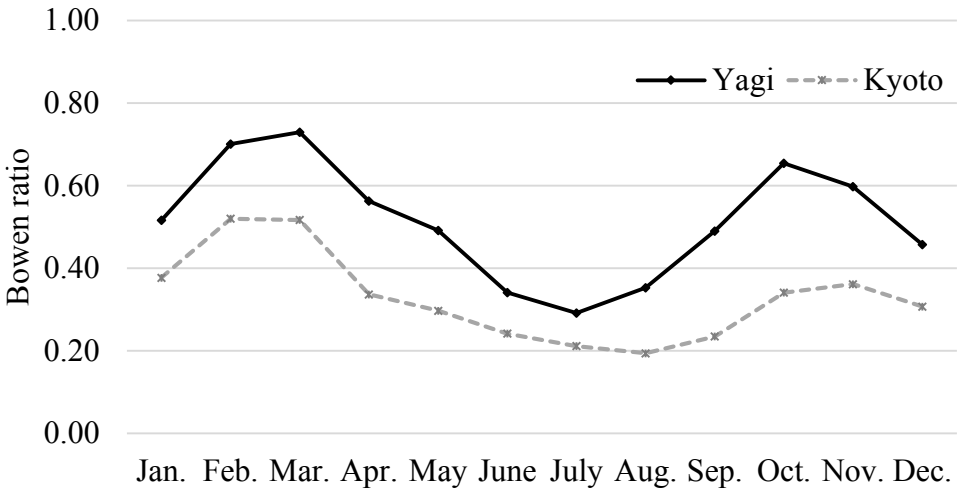


Figure 33-(c) Bowen ratios in rainy year (1921)

4. Conclusion

In this study, climatic disasters from the 601 to 1200 were examined based on the concept of geographical climatology.

The database of climatic disasters consisted of 1,220 cases were constructed and analyzed especially their kinds and regions. Climatic disasters in Japan from 601 to 1200 are characterized as follows. The number of climatic disasters has three peaks, that is, in the latter half of the 9th century, the first half of the 11th century and the latter half of the 12th century. There are 94 records of climatic disasters especially in the Jogan era when a lot of natural disasters like eruptions, earthquakes and so on. The climatic disasters in the Jogan period recorded 94 and that the number is the most through all the periods from 601 to 1200. However, the average is not so remarkable. Droughts were the major climatic disaster before the 9th century while disasters caused by too much rains prevailed from the 9th century. On the other hand, the regions on climatic disasters clearly changed from Nara to Kyoto at the end of the 8th century because of the relocation of the capital. Therefore, the author proposed that there are differences of local climate influenced on the climatic disasters in Nara and Kyoto. Consequently, it is important to take

notice of geographical factors such as indigenous local climate and landscape for elucidating climatic disasters in the historical period and a more holistic viewpoint is needed. Since geography is the study of integrative and interactive study, it is necessary to consider not only climate change but also various geographical factors in order to elucidate the environment in any historical period.

As for analysis of water and heat balances, the following results were obtained. On secular changes of water balance, water deficit of Yagi (Nara) is larger than one in Kyoto while water surplus in Kyoto exceeds one in Yagi. $P.E.$ is approximately equal between Yagi and Kyoto on the seasonal change of water balance, but precipitation and run-off in Yagi are almost less than ones in Kyoto from spring to autumn. As for heat balances, R_n in Yagi and Kyoto are almost same in average, but, H of almost cases in Yagi are larger than ones in Kyoto. In the case of drought year, the difference of H between Yagi and Kyoto is largest especially in August. The Bowen ratio in Yagi is higher than one in Kyoto. From these results, it seems that Yagi has drier weather than Kyoto and these results lead to the vulnerability of potential occurrences of climatic disasters. Water deficit means the lack of water and water surplus represents the plentiful amount of water flowing into soil, ground water and river. That is, Nara shows more

remarkable influence of the Setouchi climate than Kyoto. Water deficit in Nara and water surplus in Kyoto could potentially influence their disasters.

Figure 34 shows the concept of complex factors on climatic disasters. According to Sato et al. (1964), some factors for example, prime factor, inducement factor, indispensable factor and the expansible factor are closely connected with natural disasters. Concretely, as shown in Figure 34, only occurrence of weather events such as lack of water or surplus water could not bring about climatic disaster. It needs that the regional vulnerability as inducement factor and the human existence as indispensable factor are required for occurrence of disaster. Moreover, disasters could expand into enormous disasters when expansible factors such as concentration of population or climate change accompanied with these factors. That is, climatic disasters relate not only to natural factors but also to social factors.

On the basis of Figure 34, complex environments of climatic disasters in Nara and Kyoto from 601 to 1200 are explained in Figure 35. Climatic disaster is not caused directly merely from an occurrence of prime factor like lack of water or surplus of water. As stated above, it needs inducement and indispensable factors to occurrence of climatic disaster. In this case, there was indispensable

factor as human existence in Nara and Kyoto in which justly people lived long before. And the difference of local climates in Nara and Kyoto has an effect on climatic disaster. That is, tendencies to lack of water in Nara and to surplus of water in Kyoto were connected with vulnerability to disaster such as drought in Nara and flood in Kyoto. In addition, it is supposed that pressure patterns from 601 to 1200 were changeable like today because the temperature was increasing from the 7th century and high temperature kept up until 12th century. Moreover, people were concentrated in Nara the 7th and the 8th centuries and in Kyoto from 9th to 12th centuries because capitals of Japan were located in Nara during the 7th and 8th centuries and in Kyoto from the 9th to the 12th centuries respectively. And these causes of natural factor and social factor could trigger enormous disaster.

On the other hand, different civilizations have been fostered in Nara and Kyoto by the different local climates between them. Nara tends to be water deficit and so a lot of irrigation ponds and hidden wells were constructed in order to adapt for drought. While Kyoto tends to be water surplus and so organized "*Bokashi*" for protecting from flood. Furthermore, plenty water brought about cultures such as Japanese tea, Sake, Tofu, dyeing in Kyoto.

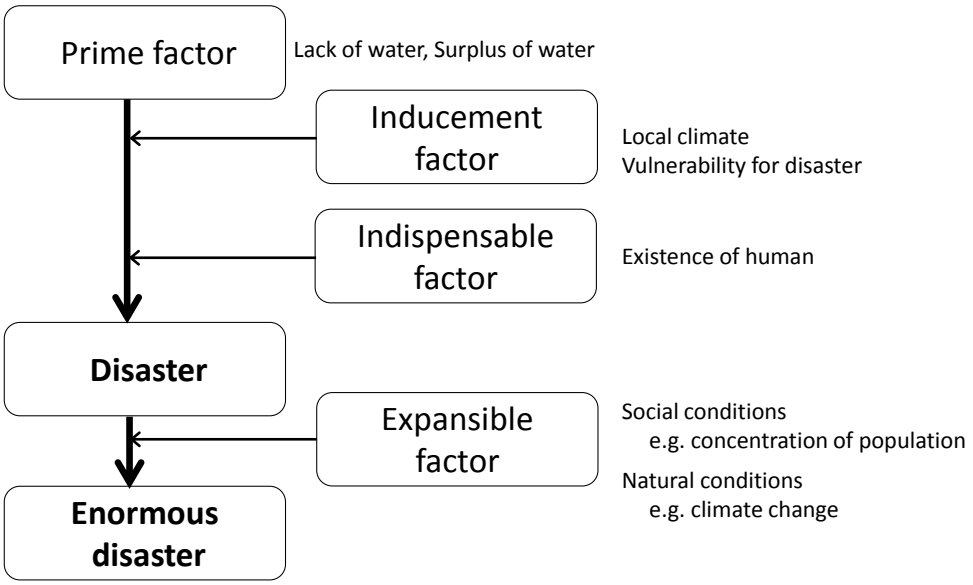


Figure 34 Complex factors for climatic disasters

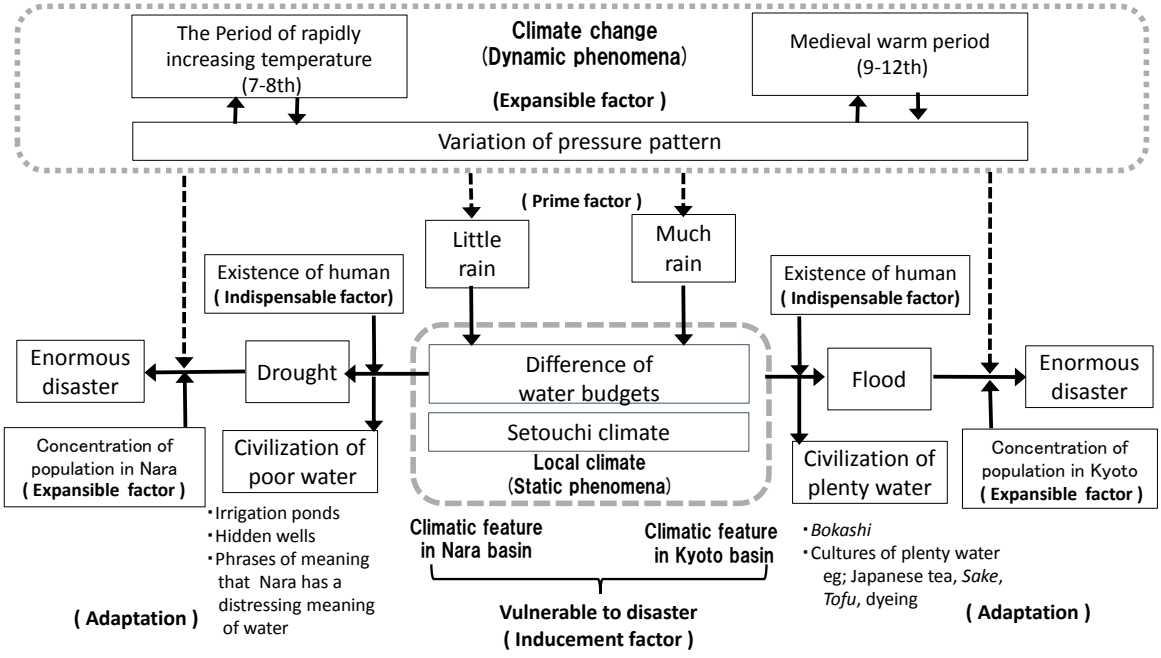


Figure 35 Complex environment of climatic disasters in Nara and Kyoto from 601 to 1200

Needless to say, it could be considered that climatic disasters were caused by other geographical factors such as the concentration of rivers like the Kamo-gawa River, the Katsura-gawa River and others in the case of floods in Kyoto. The difference of the vulnerabilities between drought in Nara and flood in Kyoto leads to the difference of the cultures between poor water in Nara and plenty water in Kyoto. In other words, adaption for climatic disasters in each of the regions product different cultures. That is, as Arai (1980) said that climate is the mother of the waters, it is considered that the difference of climatic features in Nara and Kyoto influences their local components.

The tendency of drought in Nara had been held of late. Nara got rid of drought from constructing of large irrigation ponds in 1957 and Yoshino-gawa Channel in 1987. On the other hand, in Kyoto, the huge pond called Ogura-ike was reclaimed for protecting from flood in 1939 that was opposite to Nara and Kyoto is still suffering from flood.

Climate usually changes in time and in space, and represents the synthetic condition of atmosphere. Yamakawa (1993) states that a synthetic approach will be needed to reconstruct the paleoclimate. Consequently, it is necessary to give attention not only to climate change but

also to various factors such as local climate in order to examine climatic disasters. Moreover, geography is an integrative and anthropocentric study and it is identity of geography. The connection between climatic features and human environment has been studied from early stage in geography (Ratzel 1921; Fevre 1922; Derrick *et al* 1968 and so on). Terjung (1976) referred to importance of human relevance as decision-making in geographical study and put a highest level of physical - human process – response systems in methods of geographical climatology. The human environment is very complex. Therefore, it is important that geographical climatology is approach not as simple phenomena but as complex phenomena with relevance of human activity.

Note

1 According to The Central Meteorological Observatory and The Imperial Marine Observatory (1976), the storm means heavy rain with gale. In addition, in case of simply gale occurred in one district while heavy rain with flood observed in other district, this record is adopted the storm. However, thunder storm and whirlwind are excluded. The flood represents some damages from both heavy rain and long rain without gale. Furthermore flood caused by storm or thunder storm is excluded to avoid duplication. The thunder storm consists of lightning, hailstone, gale or heavy rain which are able to bring about disaster. However, thunder storm with whirlwind is classified as the whirlwind. The whirlwind contains mainly tornado and includes the episode of dragon, serpent or "*Mizuchi*"(imaginary animal like dragon or serpent) because these animals were considered that they were related to tornado in the past. Moreover, singular wind as "*Shofu*" or "*Ichimokuren*" (such as blast) is also classified into the whirlwind. On the other hand, drought means that no rainfall continued from one to several months and a few records of prayers for rain are also counted to the drought. Rainfall that goes on as

long as a month or more is added to the long rain if they caused disaster. However, the long rain that obviously caused flood is classified into the flood to keep out duplication. The heavy snow involves the case of the snowfall more than 1 *shaku* (about 30.3cm) around Kinki and Kanto districts. In case of hail storm which caused disaster, the case is classified mainly into the hail storm. But the hail storm with thunder is classified into the thunder storm.

2 Kusakabe (1977) counted only climatic disasters that occurred in two or more regions from "*Nihon no kisho shiryo*". Nishikawa (1963) used just "*Nihon sai i shi*" for counting climatic disasters. For these reasons, their disaster's datum are less than this study. These datum were excluded epidemic, famine, volcanic eruption and tsunami from their original data.

3 The period when Kyoto was capital is estimated until 1192or 1185. In this study, the author took 1192 as the end of the period.

4 If monthly mean temperature is above 26.5 ˚C, the P.E. of the month is given the following value by Thornthwaite (1948).

T °C	P.E.
26.5	13.50
27.0	13.95
27.5	14.37
28.0	14.78
28.5	15.17
29.0	15.54
29.5	15.89
30.0	16.21
30.5	16.52
31.0	16.80
31.5	16.80
32.0	17.31
32.5	17.53

5 $(Q + q)_0$ was obtained by Budyko (1956).

6 Vapor presser can be calculated by Tetens

$$e_s(T) = 6.1078 \times 10^{7.5T_a/(237.3+T_a)}$$

7 On the calculation of water and heat balances, it is considered that urban climate influences the temperature especially in Kyoto. Because Kyoto has a population of about 280,000 in 1889 and it has been over a million since 1932. The population in 1952 was about 1,140,000 by the Kyoto statistical portal site (2018). On the other hand, the population of Kashihara City (the old Yagi) is only 38,000 and population

increased little to 47,000 in 1957.

Fukuoka (1983) clarified the relationship between urban temperature and human population in Japan. And he mentioned that urban temperatures rise rapidly under the condition of human populations above 300,000. From the study, it is estimated that the effect of urban climate to temperature is from 2.0 to 5.0 °C in Kyoto, however, the water budget was calculated without the effect of urban temperature in this study because it is difficult to clarify monthly urban climate effect in each year. If the effect of urban climate in Kyoto is excluded, the P.E. in Kyoto will be less than the result and the run-off in Kyoto will be more than the result.

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Appendix 1. Chronological table of climatic disaster in Japan from 601 to 1200.

NO.	Kind of disaster	The Gregorian calendar			The old calendar				Area	Descliption of disaster in Japanese	Historical record	Source 1	Source 2	Source 3	Source 4
		A.D.	Month	Day	The name of Japanese era	Year	Month	Day							
1	Flood	601	Jun.		The Emperor Suiko	9	May		Yamato	大雨,洪水	Nihon shoki	A	B		
2	Drought	607			The Emperor Suiko	15			Yamato	旱魃	Nihon shoki	D			
3	Flood	623			The Emperor Suiko	31			Yamato	霖雨,洪水	Nihon shoki, Nihon kiryaku	A	D	C	B
4	Drought	625			The Emperor Suiko	33			Yamato	大旱	Genkoshakusho, Fuso ryakuki, Ichidaiyoki	A	D	C	
5	Frost	626	Apr.		The Emperor Suiko	34	Mar.		Yamato	晩霜	Nihon shoki	A			
6	Long rain	626	From Apr. to Aug.		The Emperor Suiko	34	From Mar. to Jul.		Yamato	霖雨,飢饉	Nihon shoki	A	D	C	B
7	Hail	628	May	18	The Emperor Suiko	36	Apr.	7	Yamato	降雹	Nihon shoki	A	B		
8	Hail	628	May	22	The Emperor Suiko	36	Apr.	11	Yamato	降雹	Nihon shoki	A			
9	Drought	628	Spring and summer		The Emperor Suiko	36	Spring and summer		Yamato	旱魃,飢饉	Nihon shoki	A	D	C	B
10	Flood	636	Jun.		The Emperor Jomei	8	May		Yamato	霖雨,大水	Nihon shoki	A	D	C	B
11	Drought	636			The Emperor Jomei	8			Yamato	大旱,飢饉	Nihon shoki	A	D	C	B
12	Storm	638	Sep.	5	The Emperor Jomei	10	Jul.	19	Yamato	大風	Nihon shoki, Nihon kiryaku	A	D	B	
13	Long rain	638	October		The Emperor Jomei	10	Sep.		Yamato	霖雨	Nihon shoki	A	D	C	
14	Storm	639	Mar.	5	The Emperor Jomei	11	Jan.	22	Yamato	大風雨	Nihon shoki, Nihon kiryaku	A	D		
15	Long rain	642	Apr. and May		The Emperor Kogyoku	1	Mar. and Apr.		Yamato	霖雨	Nihon shoki	A	D	C	
16	Drought	642	From Jul. to Sep.		The Emperor Kogyoku	1	From Jun to Aug.		Yamato	大旱	Nihon shoki	A	D	C	
17	Storm	643	Feb.	7	The Emperor Kogyoku	2	Jan.	10	Yamato	大風	Nihon shoki, Nihon kiryaku	A	D		
18	Thunder storm	643	Mar.		The Emperor Kogyoku	2	Feb.		Yamato	風雷,降雹	Nihon shoki, Nihon kiryaku	A			
19	Hail	643	Mar.	23	The Emperor Kogyoku	2	Feb.	25	Yamato	降雹	Nihon shoki	A	D		
20	Frost	643	Apr.	22	The Emperor Kogyoku	2	Mar.	25	Yamato	霜害	Nihon shoki	A			
21	Storm	643	May	3	The Emperor Kogyoku	2	Apr.	7	Yamato	大風雨	Nihon shoki, Nihon kiryaku	A	D		
22	Hail	643	May	4	The Emperor Kogyoku	2	Apr.	8	Yamato	天寒,雹風	Nihon shoki, Nihon kiryaku	D			
23	Hail	643	May	16	The Emperor Kogyoku	2	Apr.	20	Yamato	降雹	Nihon shoki	A	D		
24	Hail	643	May	21	The Emperor Kogyoku	2	Apr.	25	Omi	降雹	Nihon shoki	A			
25	Hail	643	Nov.	8	The Emperor Kogyoku	2	Sep.	19	Yamato	大雨,降雹	Nihon shoki	A	D		
26	Hail	645	Oct.		The Taika era	1	Sep.		Unknown	大雨雹	Nihon shoki	B			
27	Flood	649	Aug.		The Taika era	5	Jul.		Mino	洪水	Gifuken suigai yoroku	A			
28	Flood	652	Jun.	5	The Hakuchi era	3	Apr.	20	Settsu	連雨,洪水,雹	Nihon shoki, Nihon kiryaku, Dai-nihonshi	A	C	B	
29	Drought	653	From May to Aug.		The Hakuchi era	4	From Apr. to Jul.		Kii	不雨	Kumanoshi	A			
30	Heavy snow	663	Apr.		The Emperor Tenji	2	Mar.		Kumano	大雪7尺余	Kumanoshi	D			
31	Flood	666	Aug.		The Emperor Tenji	5	Jul.		Yamato	大水	Nihon shoki	A	D	B	
32	Thunder storm	669	Sep.		The Emperor Tenji	8	Aug.		Yamato	落雷	Fuso ryakuki, Nihon kiryaku	D	A		
33	Thunder storm	670	May	27	The Emperor Tenji	9	Apr.	30	Kinki district	雷震	Nihon shoki, Nihon kiryaku, Dai-nihonshi	A			
34	Storm	674	Sep.	30	The Emperor Tenmu	3	Aug.	22	Yamato	大風	Nihon shoki	A	D	B	
35	Drought	675	Jul.		The Emperor Tenmu	4	Jun.		Yamato	旱魃,飢饉	Nihon shoki	A	D	C	B
36	Storm	675	Sep.	15	The Emperor Tenmu	4	Aug.	18	Kii	大風雨	Kumanoshi	A	D		

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NO.	Kind of disaster	The Gregorian calendar			The old calendar				Area	Descliption of disaster in Japanese	Historical record	Source 1	Source 2	Source 3	Source 4
		A.D.	Month	Day	The name of Japanese era	Year	Month	Day							
37	Drought	676	Jul.		The Emperor Tenmu	5	May		Yamato	旱魃,飢饉	Nihon shoki, Shodokanmon	A	D	C	B
38	Hail	678	Jun.	28	The Emperor Tenmu	7	Jun.	1	Yamato	降雹	Nihon shoki, Nihon kiryaku	A	D	B	
39	Drought	678	Aug.		The Emperor Tenmu	7	Jul.		Unknown	旱	Nihon shoki	B			
40	Flood	679	Sep.	18	The Emperor Tenmu	8	Aug.	5	Yamato	大水	Nihon shoki	A			
41	Storm	679	Sep.	27	The Emperor Tenmu	8	Aug.	14	Yamato	大風	Nihon shoki, Nihon kiryaku	A	D	B	
42	Drought	679	Aug.		The Emperor Tenmu	8	Jul.		Unknown	旱	Nihon shoki	B			
43	Drought	680	Jul.		The Emperor Tenmu	9	Jun.		Unknown	旱	Nihon shoki	B			
44	Storm	681	Aug.	19	The Emperor Tenmu	10	Jul.	27	Shinano, Kibi	大風,降霜	Nihon shoki	A	B		
45	Drought	682	Aug. and Sep.		The Emperor Tenmu	11	Jul. and Aug.		Yamato	旱魃	Nihon shoki	A	D	C	B
46	Storm	682	Oct.	11	The Emperor Tenmu	11	Sep.	2	Yamato	大風	Nihon shoki, Nihon kiryaku	A	D		
47	Drought	683	Jul.		The Emperor Tenmu	12	Jun.		Unknown	雨乞い	Nihon shoki	B			
48	Thunder storm	686	Aug.	7		1	Jul.	10	Yamato	雷火か？	Nihon kiryaku	A			
49	Drought	687	From Jun. to Aug.		The Emperor Jito	1	From Apr. to Jun.		Echigo	不雨	Niigataken kitakanbaragunshi	A	D		
50	Drought	688	Aug.		The Emperor Jito	2	Jul.		Unknown	旱	Nihon shoki	C	B		
51	Drought	690	May		The Emperor Jito	4	Apr.		Unknown	祈雨	Nihon shoki	B			
52	Flood	691	From May to Jul.		The Emperor Jito	5	From Apr. to Jun.		All provinces	霖雨,洪水,降雹	Nihon shoki, Nihon kiryaku	A	D	C	B
53	Flood	692	Jun.	25	The Emperor Jito	6	leap May	3	Yamato	大水	Nihon shoki, Nihon kiryaku	A	B		
54	Drought	698	From Jun. to Aug.		The Emperor Mommu	2	From Apr. to Jun.		All provinces	旱魃	Shoku-Nihongi	D	C	B	
55	Storm	698	Oct.	19	The Emperor Mommu	2	Sep.	7	Shimousa	大風	Shoku-Nihongi	A	B		
56	Drought	701	From May to Jul.	3	The Taiho era	1	From Apr. to Jun.		Yamato	旱魃	Shoku-Nihongi	A	C	B	
57	Storm	701	Sep.	24	The Taiho era	1	Aug.	14	Harima, Awaji, Kii	大風,高潮	Shoku-Nihongi, Nihon kiryaku	A	B		
58	Storm	701	Oct.	1	The Taiho era	1	Aug.	21	Suruga, Totoumi, Sagami, Shinano, Echizen, Sado, Tajima, Hoki, Izumo, Bizen, Aki, Suo, Nagato, Kii, Sanuki, Iyo	大風	Shoku-Nihongi, Nihon kiryaku	A				
59	Thunder storm	702	Jul.	31	The Taiho era	2	Jun.	28	Yamato	落雷	Shoku-Nihongi	A			
60	Storm	702	Sep.	5	The Taiho era	2	Aug.	5		大風	Shoku-Nihongi	A	B		
61	Thunder storm	702	Sep.	8	The Taiho era	2	Aug.	8	Ise	落雷	Shoku-Nihongi	A			

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NO.	Kind of disaster	The Gregorian calendar			The old calendar				Area	Descliption of disaster in Japanese	Historical record	Source 1	Source 2	Source 3	Source 4
		A.D.	Month	Day	The name of Japanese era	Year	Month	Day							
62	Drought	703	Sep.	6	The Taiho era	3	Jul.	17	Omi	旱	Shoku-Nihongi	C			
63	Storm	704	Oct.	5	The Kyoun era	1	Aug.	28	Suo, Kyushu district	大風	Shoku-Nihongi, Nihon kiryaku	A			
64	Drought	704	From summer to Nov.		The Kyoun era	1	From Summer to October		Yamato	祈雨	Shoku-Nihongi, Ruijukokushi	D	C	B	
65	Storm	705	Aug.	26	The Kyoun era	2	Jul.	29	Yamato	大風	Shoku-Nihongi, Nihon kiryaku	A			
66	Drought	705	Sep.	7	The Kyoun era	2	Aug.	11	Yamato	旱魃,飢饉	Shoku-Nihongi, Nihon kiryaku	A	C	D	B
67	Drought	706	Jul.	22	The Kyoun era	3	Jun.	4	All provinces	旱飢饉	Shoku-Nihongi	C	B		
68	Storm	706	Sep.	13	The Kyoun era	3	Jul.	28	Kyushu district	大風	Shoku-Nihongi	A			
69	Long rain	707	Jun.	29	The Kyoun era	4	May	21	Kinki district	霖雨,賑給	Shoku-Nihongi	A	C	B	
70	Storm	708	Aug.	8	The Wado era	1	Jul.	14	Sanuki	大風,霖雨	Shoku-Nihongi	A	C	B	
71	Long rain	709	Jul.	5	The Wado era	2	May	20	Kawachi, Settsu, Yamashiro, Izu, Kai	霖雨	Shoku-Nihongi	A	C	B	
72	Drought	709	Jul.		The Wado era	2	Jun.		Kinki district	旱	Shoku-Nihongi	B			
73	Drought	710	May	28	The Wado era	3	Apr.	22	Unknown	旱	Shoku-Nihongi	C			
74	Long rain	710	Jul.	24	The Wado era	3	Jun.	20	Unknown	霖雨	Shoku-Nihongi	C			
75	Drought	711	Jul.	15	The Wado era	4	Jun.	21	Yamato	大旱	Shoku-Nihongi	A	D	C	
76	Storm	713	Sep.	22	The Wado era	6	Aug.	24	Yamato	大風	Shoku-Nihongi, Nihon kiryaku	A	D	B	
77	Storm	713	Nov.	27	The Wado era	6	Nov.	1	Iga, Ise, Owari, Suruga, Dewa	大風	Shoku-Nihongi	A	B		
78	Drought	714	Aug.	11	The Wado era	7	Jun.	23	Yamato	旱魃	Shoku-Nihongi, Nihon kiryaku	A	D	C	
79	Storm	714	Nov.	16	The Wado era	7	Oct.	1	Mino, Musashi, Shimotsuke, Harima, Iyo	大風	Shoku-Nihongi	A	B		
80	Drought	717	From Jun. to Aug.		The Yoro era	1	From Apr. to Jun.		Yamato	不雨祈雨	Shoku-Nihongi	A	C		
81	Storm	717	Sep.	29	The Yoro era	1	Aug.	16	Ise	大風,雨水	Daijingu shozojiki	A			
82	Storm	719	Jan.	29	The Yoro era	3	Jan.	1	Yamato	大風	Shoku-Nihongi	A			
83	Drought	719	Nov.		The Yoro era	3	Sep.		All provinces	大旱魃,飢饉	Nihon kanbatsu shi	D	C	B	
84	Drought	722	Fro Jul. to Sep.		The Yoro era	6	From May to Jul.		Yamato	旱魃	Shoku-Nihongi	A	C	B	
85	Flood	727	Jan.		The Jinki era	3	Dec.		Totomi	水害	Shoku-Nihongi	A	B		
86	Thunder storm	727	Mar.		The Jinki era	4	Feb.		Kyoto	雷雨,大風	Shoku-Nihongi	B			
87	whirlwind	727	Jun.	17	The Jinki era	4	May	20	Yamato	飄風	Shoku-Nihongi	A			
88	Storm	727	Nov.	23	The Jinki era	4	Oct.	2	Awa	大風	Shoku-Nihongi	A	B		
89	Flood	728	Jul.	1	The Jinki era	5	May	16	Yamato	大水	Shoku-Nihongi	A	B		
90	Thunder storm	730	Jul.	22	The Tempyo era	2	Jun.	29	Yamato	大雷雨	Shoku-Nihongi	A			

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		A.D.	Month	Day	The name of Japanese era	Year	Month	Day							
91	Thunder storm	730	Dec.	24	The Tempyo era	2	Nov.	7	Yamato	大雷雨	Shoku-Nihongi	A	B		
92	Drought	732	Summer		The Tempyo era	4	Summer		Kinki district	大旱	Shoku-Nihongi	A	C	B	
93	Storm	732	Sep.	24	The Tempyo era	4	Aug.	27	Yamato	大風雨	Shoku-Nihongi	A	B		
94	Drought	733	Mar.	1	The Tempyo era	5	Feb.	7	Kinki district, Shikoku	旱損	Shoku-Nihongi	A	C		
95	Drought	737	Jun.	25	The Tempyo era	9	May	19	Yamato	旱魃	Shoku-Nihongi, Nihon kiryaku	A	C		
96	Long rain	741	From Aug. to Oct.		The Tempyo era	13	From Jun. to Aug.		Sado-island	霖雨,免租	Shoku-Nihongi	A	C	B	
97	Flood	742	Jun.	13	The Tempyo era	14	May	3	Kinki district	水損	Shoku-Nihongi	A			
98	Storm	742	Oct.	18	The Tempyo era	14	Sep.	12	Yamato	大風雨	Shoku-Nihongi	A	B		
99	Drought	743	From Apr. to Jun.		The Tempyo era	15	From Mar. to May		Kinki district	不雨	Shoku-Nihongi, Dai-nihonshi	A	C	B	
100	Thunder storm	743	Aug.	3	The Tempyo era	15	Jul.	5	Izumo	大雷雨	Shoku-Nihongi	A	B		
101	Storm	743	Aug.		The Tempyo era	15	Jul.		Kazusa	大風雨	Shoku-Nihongi	A	B		
102	Thunder storm	744	Jul.	6	The Tempyo era	16	May	18	Higo	大雷雨,地震	Shoku-Nihongi, Nihon kiryaku	A	B		
103	Hail	744	Aug.	7	The Tempyo era	16	Jun.	21	Yamato	降雹	Shoku-Nihongi, Dai-nihonshi	A			
104	Drought	745	Jun.	16	The Tempyo era	17	May	8	Settsu	不雨	Shoku-Nihongi	A	C	B	
106	Drought	746	Aug.		The Tempyo era	18	Jul.		Yamato	大旱	Shoku-Nihongi	A	C	B	
105	Storm	746	Nov.	26	The Tempyo era	18	Oct.	5	Hyuga	大風雨	Shoku-Nihongi, Dai-nihonshi	A	B		
107	Drought	747	May	31	The Tempyo era	19	Apr.	14	Yamato, Kii	旱魃	Shoku-Nihongi	A	C		
108	Drought	747	Aug.	21	The Tempyo era	19	Jul.	7	Yamato, Kii	旱魃	Shoku-Nihongi	A	C	B	
109	Drought	749	Mar.	2	The Tempyoshoho era	1	Feb.	5	Shimousa	旱魃	Shoku-Nihongi	A	C	B	
110	Thunder storm	750	Jul.	6	The Tempyoshoho era	2	May	24	Kinki district	雷火	Shoku-Nihongi	A	B		
111	Heavy snow	751	Feb.	6	The Tempyoshoho era	3	Jan.	2	Echu	積雪四尺	Manyosyu	A			
112	Heavy snow	753	Feb.	22	The Tempyoshoho era	5	Jan.	11	Yamato	大雪一尺二寸	Manyosyu	A			
113	whirlwind	753	May	10	The Tempyoshoho era	5	Mar.	29	Yamato	飄風	Shoku-Nihongi	A			
114	Storm	753	Oct.	9	The Tempyoshoho era	5	Sep.	5	Settsu	大風,高潮	Shoku-Nihongi	A	B		
115	Storm	754	Sep.		The Tempyoshoho era	6	Aug.		All provinces	風水	Shoku-Nihongi, Ruijukokushi	A	B		
116	Storm	755			The Tempyoshoho era	7			All provinces	雨水	Shoku-Nihongi	B			
117	Storm	759	Sep.	28	The Tempyohoji era	3	Aug.	29	Kyushu district	大南風	Shoku-Nihongi	A	B		
118	Storm	759	Nov.		The Tempyohoji era	3	Oct.		Yamato	大風	Shoku-Nihongi	A			
119	Flood	762	Oct.	10	The Tempyohoji era	6	Sep.	15	Ise	洪水	Daijingu shozojiki, Shoku-Nihongi	A	C		
120	Drought	762	Apr. and May		The Tempyohoji era	6	Mar. and Apr.		Tokaido district	大旱	Shoku-Nihongi	A	C	B	
121	Drought	762	Jun. and Jul.		The Tempyohoji era	6	May and Jun.		All provinces	大旱	Shoku-Nihongi	C			
122	Drought	763	Sep.	16	The Tempyohoji era	7	Aug.	1	Yamato, Sanyo, Nankaido	大旱,飢饉	Shoku-Nihongi, Dai-nihonshi	A	C	B	
123	Drought	764	Apr.	28	The Tempyohoji era	8	Mar.	19	Awaji, Sanyo, Nankaido	旱疫	Shoku-Nihongi	A	C	B	

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124	Drought	764	Sep.	23	The Tempyohoji era	8	Aug.	19	Awaji, Sanyo, Nankaido	旱疫	Shoku-Nihongi	A	C	B	
125	Drought	765	Apr.	2	The Tempyojingo era	1	Mar.	4	All provinces	大旱	Shoku-Nihongi	A	C	B	
126	Drought	766	Jun.		The Tempyojingo era	2	May		Unknown	祈雨	Shoku-Nihongi	B			
127	Storm	766	Jul.	18	The Tempyojingo era	2	Jun.	3	Hyuga, Osumi, Satsuma	大風	Shoku-Nihongi	A	B		
128	Storm	766	Oct.	17	The Tempyojingo era	2	Sep.	5	Ise, Mino	大風	Shoku-Nihongi	A			
129	Thunder storm	767	Feb.	5	The Tempyojingo era	2	Dec.	28	Yamato	落雷	Shoku-Nihongi	A			
130	Drought	767	Mar.	19	The Jingokeiun era	1	Feb.	11	Awaji, Mino	大旱	Shoku-Nihongi	A	C	B	
131	Drought	768	Jan.	14	The Jingokeiun era	1	Dec.	16	All provinces	大旱	Shoku-Nihongi	A	B		
132	Hail	768	Apr.	9	The Jingokeiun era	2	Mar.	14	Yamato	降雹	Shoku-Nihongi	A			
133	Drought	768	Jun.		The Jingokeiun era	2	May		Kinki district	旱	Shoku-Nihongi	B			
134	Flood	769	Sep.	17	The Jingokeiun era	3	Aug.	9	Owari	大水	Shoku-Nihongi	A	B		
135	Storm	770	Feb.	25	The Hoki era	1	Jan.	21	Kyushu district	大風	Shoku-Nihongi	A	B		
136	Storm	770	Jul.	9	The Hoki era	1	Jun.	8	Shima	大風	Shoku-Nihongi	A	B		
137	Long rain	770	Jul.	15	The Hoki era	1	Jun.	14	Mino	霖雨,賑給	Shoku-Nihongi	A	C		
138	Flood	770	Aug.	27	The Hoki era	1	Jul.	28	Dewa	大水	Shoku-Nihongi, Dai-nihonshi	A			
139	Flood	770	Autumn		The Hoki era	1	Autumn		Izumo	出水	Shoku-Nihongi	B			
140	Thunder storm	771	Feb.		The Hoki era	2	Jan.		Yamato	落雷	Kofukuji ryakunendaiki	A			
141	Drought	771	Aug.		The Hoki era	2	Jun.		Unknown	旱	Shoku-Nihongi	B			
142	Storm	771	Nov.	7	The Hoki era	2	Sep.	22	Ise	大風,洪水	Daijingu shozojiki	A			
143	Thunder storm	772	May	15	The Hoki era	3	Apr.	5	Yamato	落雷	Shoku-Nihongi	A			
144	Drought	772	Jul.		The Hoki era	3	Jun.		Unknown	旱	Shoku-Nihongi	B			
145	Storm	772	Sep.	11	The Hoki era	3	Aug.	6	Yamato, Kawachi	大風雨	Shoku-Nihongi	A	B		
146	Storm	773	Apr.	5	The Hoki era	4	Mar.	5	Omi, Hida, Dewa	大風	Shoku-Nihongi, Dai-nihonshi	A	B		
147	Storm	773	Apr.	17	The Hoki era	4	Mar.	17	Suruga	大風	Shoku-Nihongi	B			
148	Drought	773	May and Jun.		The Hoki era	4	Apr. and May		Unknown	旱	Shoku-Nihongi	B			
149	Drought	774	Jul.		The Hoki era	5	Jun.		Unknown	旱	Shoku-Nihongi	B			
150	Hail	775	Aug.	23	The Hoki era	6	Jul.	19	Yamato	降雹	Shoku-Nihongi, Nihon kiryaku	A	B		
151	Storm	775	From Sep. to Nov.		The Hoki era	6	From Aug. to Oct.		All provinces	大風	Shoku-Nihongi	B			
152	Storm	775	Sep.	25	The Hoki era	6	Aug.	22	Ise, Owari, Mino	大風雨	Shoku-Nihongi	A			
153	Storm	775	Dec.	8	The Hoki era	6	Nov.	7	Huga, Satsuma	大風雨	Shoku-Nihongi	A			
154	Drought	776	Jul.		The Hoki era	7	Jun.		Unknown	旱	Shoku-Nihongi	B			
155	Thunder storm	776	Aug.	11	The Hoki era	7	Jul.	19	Yamato	落雷	Shoku-Nihongi	A			
156	Storm	776	Sep.	4	The Hoki era	7	Aug.	13	Yamato	大風	Shoku-Nihongi	A			
157	Storm	776	Oct.	19	The Hoki era	7	leap Aug.	28	Iki island	大風	Shoku-Nihongi	A	B		
158	Hail	777	May	20	The Hoki era	8	Apr.	5	Yamato	降雹	Shoku-Nihongi	A			

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Appendix 1. Chronological table of climatic disaster in Japan from 601 to 1200.

NO.	Kind of disaster	The Gregorian calendar			The old calendar				Area	Descliption of disaster in Japanese	Historical record	Source 1	Source 2	Source 3	Source 4
		A.D.	Month	Day	The name of Japanese era	Year	Month	Day							
159	Thunder storm	777	May	28	The Hoki era	8	Apr.	13	Yamato	落雷	Shoku-Nihongi	A			
160	Long rain	777	From Jun. to Sep.		The Hoki era	8	From May to Aug.		Yamato	霖雨	Shoku-Nihongi	C	B		
161	Thunder storm	777	Aug.	25	The Hoki era	8	Jul.	14	Tajima kokubun	落雷	Shoku-Nihongi	A			
162	Storm	777	Aug.		The Hoki era	8	Jul.	一	Tosa	大風雨	Shoku-Nihongi	A	B		
163	Drought	777	Winter		The Hoki era	8	Winter		Yamato	不雨	Shoku-Nihongi, Kofukuji ryakunendaiki	A	C	B	
164	Flood	778	Sep.		The Hoki era	9	Aug.		Kii	大水	Kumanoshi	A			
165	Storm	779	May	13	The Hoki era	10	Apr.	19	Yamato	暴風雨	Shoku-Nihongi	A	B		
166	Flood	779	Aug.	19	The Hoki era	10	Jun.	29	Imba	暴雨	Shoku-Nihongi, Nihon kiryaku	A	B		
167	Flood	779	Sep.	2	The Hoki era	10	Jul.	14	Suruga	大雨,洪水	Shoku-Nihongi, Nihon kiryaku	A	B		
168	Thunder storm	780	Feb.	28	The Hoki era	11	Jan.	14	Yamato	落雷數所	Shoku-Nihongi	A	B		
169	Drought	781	Aug.	3	The Ten-o era	1	Jul.	5	Yamato	大旱	Shoku-Nihongi	A	C		
170	Thunder storm	782	Aug.	20	The Enryaku era	1	Jul.	3	Yamato	大雷雨	Shoku-Nihongi	A	B		
171	Flood	784	Sep.	27	The Enryaku era	3	Sep.	5	Yamato	大雨水	Shoku-Nihongi	A	B		
172	Storm	785	From Aug. to Sep.		The Enryaku era	4	Jul. and Aug.		Totomi	大風	Shoku-Nihongi	A	B		
173	Flood	785	Oct.	21	The Enryaku era	4	Sep.	10	Kawachi	洪水	Shoku-Nihongi	A	B		
174	Storm	785	Oct.		The Enryaku era	4	Sep.		Ise	大洪水	Daijingu shozojiki	A			
175	Drought	788	May		The Enryaku era	7	Apr.		Kinki district	大旱	Shoku-Nihongi	A	C	B	
176	Thunder storm	788	Nov.	8	The Enryaku era	7	Oct.	2	Yamashiro	大雷雨	Shoku-Nihongi	A	B		
177	Drought	790	Fro Jul. to Dec.		The Enryaku era	9	From May to Nov.		Kinki district	大旱,旱疫	Shoku-Nihongi	A	C	B	
178	Drought	791	From Jun.		The Enryaku era	10	From May		All provinces	旱	Shoku-Nihongi	C	B		
179	Thunder storm	792	Jul.	19	The Enryaku era	11	Jun.	22	Yamashiro	大雷雨	Nihon kiryaku	A			
180	Flood	792	Sep.	3	The Enryaku era	11	Aug.	9	Yamashiro	大雨,洪水	Nihon kiryaku	A			
181	Heavy snow	792	Dec.	16	The Enryaku era	11	Nov.	24	Yamashiro	大雪	Ruijukokushi	A			
182	Heavy snow	793	Dec.	23	The Enryaku era	12	Nov.	12	Yamashiro	大雪	Ruijukokushi	A			
183	Thunder storm	794	Aug.	13	The Enryaku era	13	Jul.	10	Yamashiro	落雷數所	Nihon kiryaku	A			
184	Heavy snow	795	Feb.	11	The Enryaku era	14	Jan.	13	Kyoto	大雪	Ruijukokushi	A			
185	Storm	795	Sep.	2	The Enryaku era	14	leap Jul.	11	Yamashiro	大風	Nihon kiryaku	A			
186	Hail	796	May	30	The Enryaku era	15	Apr.	15	Kyoto	降雹	Nihon kiryaku	A			
187	Flood	796	Jun.	25	The Enryaku era	15	May	12	Yamashiro	大雨,洪水	Nihon kiryaku	A			
188	Flood	796	Sep.	15-17	The Enryaku era	15	Aug.	6-8	Kinki district	霖雨,水損	Nihonkoki	A	C	B	
189	Storm	797	Sep.	13	The Enryaku era	16	Aug.	14	Kyoto	大風	Ruijukokushi	A			
190	Long rain	797	Jul. and Aug.		The Enryaku era	16	Jun. and Jul.		Unknown	霖雨	Nihon tsushi	B			
191	Heavy snow	798	Jan.	9	The Enryaku era	16	Dec.	14	Kyoto	大雪	Ruijukokushi	A			
192	Drought	798	Jul.	17-25	The Enryaku era	17	From 25th Leap May to 4th Jun.		All provinces	旱魃	Nihon kiryaku, Ruijukokushi	C	B		
193	Storm	798	Sep.	27	The Enryaku era	17	Aug.	9	Kyoto	大風	Nihon kiryaku, Ruijukokushi	A	B		
194	Thunder storm	799	Apr.	14	The Enryaku era	18	Mar.	1	Kyoto	落雷	Nihonkoki	A			
195	Flood	799	May	22	The Enryaku era	18	Apr.	9	Kinki district	水損,霖雨	Nihonkoki	A	C		
196	Drought	799	Aug.		The Enryaku era	18	Jul.		Bichu	旱災	Nihonkoki	B			
197	Storm	799	Oct.	14	The Enryaku era	18	Sep.	7	Kyoto	暴風	Nihonkoki	A			
198	Flood	799	Dec.		The Enryaku era	18	Nov.		Awaji	滂(おおなみ)洪水？	Nihon tsushi	B			
199	Hail	800	May	24	The Enryaku era	19	Apr.	23	Izumi	降雹	Nihon kiryaku	A			
200	Long rain	803	Jul.		The Enryaku era	22	Jun.		Unknown	霖雨	Nihon tsushi	B			
201	Drought	804	Apr.		The Enryaku era	23	Feb.		Yamato	旱災	Nihonkoki	B			
202	Long rain	804	May	3	The Enryaku era	23	Mar.	16	Kyoto	霖雨	Nihonkoki	A	C	B	
203	Storm	804	Sep.	21	The Enryaku era	23	Aug.	10	All provinces	暴風雨	Nihonkoki	A	B		

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Appendix 1. Chronological table of climatic disaster in Japan from 601 to 1200.

NO.	Kind of disaster	The Gregorian calendar			The old calendar				Area	Descliption of disaster in Japanese	Historical record	Source 1	Source 2	Source 3	Source 4
		A.D.	Month	Day	The name of Japanese era	Year	Month	Day							
204	Flood	804			The Enryaku era	23			Settsu	水害	Nihonkoki	A			
205	Drought	805			The Enryaku era	24			Kinki district	祈雨	Nihon tsushi	B			
206	Flood	806	Sep.	23	The Daido era	1	Aug.	4	All provinces	水害	Nihonkoki	A	C	B	
207	Drought	806	Dec.	23	The Daido era	1	Nov.	6	Kyushu district	旱魃	Ruijukokushi	C			
208	Flood	807	Feb.	27	The Daido era	2	Jan.	12	Tango	水害	Nihon tsushi	B			
209	Hail	807	Jun.	14	The Daido era	2	May	1	Kyoto	降雹	Nihon kiryaku	A			
210	Hail	807	Jul.	27	The Daido era	2	Jun.	15	Kyoto	降雹	Nihon kiryaku	A			
211	Drought	808	Jun.	22	The Daido era	3	May	21	Unknown	旱祈雨	Nihonkoki	C	B		
212	Heavy snow	808	Dec.	31	The Daido era	3	Dec.	7	Kyoto	大雪	Nihonkoki	A			
213	Long rain	809	Jul.		The Daido era	4	May		Kyoto	霖雨,賑給	Nihon kiryaku	A	C	B	
214	Drought	809	From Aug. to Sep.		The Daido era	4	Jun. and Jul.		Kyoto	大旱,祈雨	Nihon kiryaku	A	C	B	
215	Storm	809	Sep.	6	The Daido era	4	Jul.	19	Kyoto	大風	Nihon kiryaku	A	B		
216	Storm	809	Sep.	21	The Daido era	4	Aug.	5	Kyoto	大風	Nihon kiryaku	A	B		
217	Storm	809	Oct.	12	The Daido era	4	Aug.	26	Ise	風雨,洪水	Ujiyamadashishi	A			
218	Storm	809	Oct.	21	The Daido era	4	Sep.	5	Kyoto	暴風	Nihon kiryaku	A	B		
219	Long rain	810	Jun.		The Konin era	1	May		Unknown	霖雨	Nihon tsushi	B			
220	Storm	811	Oct.	6	The Konin era	2	Sep.	12	Kyoto	大風	Nihonkoki	A	B		
221	Hail	812	May	16	The Konin era	3	Mar.	28	Kyoto	降雹	Nihonkoki	A			
222	Drought	812	Jul. and Aug.		The Konin era	3	Jun. and Jul.		Unknown	旱	Nihonkoki	C	B		
223	Flood	813	Jul.	7	The Konin era	4	Jun.	2	Iwami, Aki	大水	Nihon tsushi	B			
224	Drought	814	Aug.	18	The Konin era	5	Jul.	25	Kinki district	旱害	Nihonkoki	C	B		
225	Heavy snow	814	Nov.	23	The Konin era	5	Oct.	4	Kyoto	大雪	Nihonkoki	A			
226	Heavy snow	815	Jan.	19	The Konin era	5	Dec.	2	Kyoto	大雪	Nihonkoki	A			
227	Flood	815	Jul.	29	The Konin era	6	Jun.	16	Kinki district	水害	Nihonkoki	A	C	B	
228	Thunder storm	815	Aug.	6	The Konin era	6	Jun.	24	Yamashiro	大雷風	Nihonkoki	A			
229	Long rain	815	From Jun. to Oct.		The Konin era	6	From May to Sep.		All provinces	霖雨	Nihonkoki	C	B		
230	Storm	816	Sep.	15	The Konin era	7	Aug.	16	Kinki district	大風	Nihon kiryaku	A			
231	Drought	816			The Konin era	7			Kyoto	大旱	Konendairyakuki	A	C		
232	Drought	817	Aug.		The Konin era	8	Jun.		All provinces	旱,祈雨	Nihon kiryaku, Nihon tsushi	C	B		
233	Heavy snow	818	Jan.	9	The Konin era	8	Nov.	25	Kyoto	大雪	Nihon kiryaku	A			
234	Heavy snow	818	Jan.	27	The Konin era	8	Dec.	14	Kyoto	大雪	Nihon kiryaku	A			
235	Drought	818	May		The Konin era	9	Apr.		Kyoto	旱災,祈雨	Nihon kiryaku	A	C	B	
236	whirlwind	819	Aug.	18	The Konin era	10	Jul.	20	Kyoto	大風雨	Nihon kiryaku	A	B		
237	Drought	819	From Jun. to Aug.		The Konin era	10	From May to Jul.		All provinces	大旱	Nihon kiryaku	A	C	B	
238	Long rain	819	Sep.		The Konin era	10	Aug.		Unknown	霖雨	Nihon tsushi	B			
239	Drought	820	From Jul. to Sep.		The Konin era	11	From May to Jul.		All provinces	旱	Nihon kiryaku	A	C	B	
240	Long rain	821	Jul.		The Konin era	12	Jun.		Unknown	祈霽雨	Nihon tsushi	B			
241	Drought	822	Jul.	30	The Konin era	13	Jul.	5	Kyoto	大旱	Nihon kiryaku, Dai-nihonshi	A	C		
242	Long rain	823	Jun.		The Konin era	14	May		All provinces	旱害,祈霽雨	Nihon tsushi	B			
243	Heavy snow	824	Jan.	14	The Konin era	14	Dec.	6	Kyoto	大雪	Ruijukokushi, Nihon kiryaku	A			
244	Drought	824	Mar. and Apr.		The Tencho era	1	Feb. and Mar.		All provinces	大旱	Ichidaiyoki, Kojidan, Ranshosho, Genkoshakusho, Tojichojabunin, Dai-nihonshi	A	C		

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Appendix 1. Chronological table of climatic disaster in Japan from 601 to 1200.

NO.	Kind of disaster	The Gregorian calendar			The old calendar				Area	Descliption of disaster in Japanese	Historical record	Source 1	Source 2	Source 3	Source 4
		A.D.	Month	Day	The name of Japanese era	Year	Month	Day							
245	Thunder storm	825	Jun.	25	The Tencho era	2	Jun.	2	Kyoto	落雷	Nihon kiryaku, Nihon tsushi	A	B		
246	Flood	826	Oct.	6	The Tencho era	3	Aug.	27	Kyoto	水害	Nihon tsushi	B			
247	Drought	827	Jun.		The Tencho era	4	May		Unknown	祈雨	Nihon tsushi	B			
248	Storm	827	Sep.	19	The Tencho era	4	Aug.	21	Kyoto	大風	Nihon kiryaku	A			
249	Flood	828	Jul. and Aug.		The Tencho era	5	May and Jun.		Kyoto	大雨,洪水	Nihon kiryaku, Nihon tsushi	A	B		
250	Thunder storm	828	Aug.	11	The Tencho era	5	Jun.	23	Kyoto	大雷雨	Nihon kiryaku	A			
251	Drought	829	Mar.		The Tencho era	6	Feb.		Unknown	旱	Nihon tsushi	B			
252	Long rain	829	Sep.		The Tencho era	6	Aug.		Unknown	霖雨,祈霽雨	Nihon tsushi	B			
253	Drought	830	Jul.	29	The Tencho era	7	Jul.	2	Nagato	旱損	Ruijukokushi, Nihon tsushi	A	C	B	
254	Thunder storm	830	Aug.	12	The Tencho era	7	Jul.	16	Kyoto	落雷	Nihon kiryaku	A			
255	Storm	831	Sep.		The Tencho era	8	Aug.		Unknown	風雨災	Nihon tsushi	B			
256	Drought	832	Jun.		The Tencho era	9	May		Kinki district	旱	Nihon kiryaku, Ruijukokushi	C			
257	Storm	832	Sep.	21	The Tencho era	9	Aug.	20	Kawachi, Settsu	大風雨,洪水	Nihon kiryaku, Konendai shiki, Nihon tsushi	A	B		
258	Long rain	833	Sep.		The Tencho era	10	leap Jul.		Unknown	祈霽雨	Shoku-Nihonkoki	B			
259	Drought	834	Jul. and Aug.		The Jowa era	1	Jun. and Jul.		All provinces	旱魃	Shoku-Nihonkoki	C			
260	Flood	834	Aug.	24	The Jowa era	1	Jul.	12	Kyoto	雨水	Shoku-Nihonkoki	A	B		
261	Storm	834	Oct.	1	The Jowa era	1	Aug.	21	Kyoto	暴風雨	Shoku-Nihonkoki	A	B		
262	Drought	836	Jan.	15	The Jowa era	2	Dec.	20	Noto	旱疫	Shoku-Nihonkoki	A	C	B	
263	Storm	836	Jun.	9	The Jowa era	3	May	18	Kyoto	大風雨	Shoku-Nihonkoki, Kobeshi-shi	A	B		
264	whirlwind	836	Jul.	5	The Jowa era	3	leap May	14	Kyoto	颱風	Shoku-Nihonkoki	A			
265	Drought	836	Aug.		The Jowa era	3	Jun.		Noto	旱	Shoku-Nihonkoki	C			
266	Thunder storm	836	Sep.	9	The Jowa era	3	Jul.	21	Kyoto	大雷雨,落雷	Shoku-Nihonkoki, Nihon kiryaku	A			
267	Storm	836	Oct.	7	The Jowa era	3	Aug.	19	Settsu	暴風雨,洪水	Nishinarigun-shi	A			
268	Thunder storm	837	Jan.	19	The Jowa era	3	Dec.	6	Settsu	落雷	Shoku-Nihonkoki	A			
269	Flood	837	Apr.		The Jowa era	4	Mar.		Owari	洪水	Shoku-Nihonkoki	B			
270	Storm	838	Jan.	14	The Jowa era	4	Dec.	11	Kyoto	大風	Shoku-Nihonkoki	A	B		
271	Thunder storm	838	Sep.	10	The Jowa era	5	Aug.	14	Kyoto	落雷	Shoku-Nihonkoki	A			
272	Storm	838	Sep.	16	The Jowa era	5	Aug.	20	Kyoto	暴風雨	Shoku-Nihonkoki	A			
273	Drought	839	Jun.	10	The Jowa era	6	Apr.	21	Unknown	旱	Shoku-Nihonkoki	C	B		
274	Thunder storm	839	Oct.	14	The Jowa era	6	Aug.	29	Dewa	雷電十餘日	Shoku-Nihonkoki, Wakansansaizue	A			
275	Drought	840	From May to Jul.		The Jowa era	7	From Apr. to Jun.		All provinces	旱魃	Shoku-Nihonkoki	C	B		
276	Drought	841	May and Jun.		The Jowa era	8	Apr. and May		Unknown	旱	Shoku-Nihonkoki	C			
277	Thunder storm	841	Aug.	9	The Jowa era	8	Jul.	15	Kyoto	落雷,降雹	Shoku-Nihonkoki	A			
278	Flood	841	Sep.	22	The Jowa era	8	Aug.	30	Kyoto	大雨,洪水	Shoku-Nihonkoki	A	B		
279	Drought	842	Jul. and Aug.		The Jowa era	9	Jun. and Jul.		Unknown	旱	Shoku-Nihonkoki	C	B		
280	Heavy snow	844	Jan.	27	The Jowa era	11	Jan.	1	Kyoto	大雪	Shoku-Nihonkoki	A			
281	Heavy snow	845	Feb.	14	The Jowa era	12	Jan.	1	Kyoto	大雪	Shoku-Nihonkoki	A			
282	Drought	845	May		The Jowa era	12	Apr.		Unknown	旱祈雨	Shoku-Nihonkoki	B			
283	Storm	845	Oct.	29	The Jowa era	12	Sep.	21	Kyoto	大風雨	Nihon kiryaku, Shoku-Nihongi	A	B		
284	Heavy snow	847	Jan.	25	The Jowa era	14	Jan.	1	Kyoto	大雪	Shoku-Nihonkoki	A			

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		A.D.	Month	Day	The name of Japanese era	Year	Month	Day							
285	Long rain	847	Jul.		The Jowa era	14	May		Kyoto	祈止雨	Shoku-Nihonkoki	B			
286	Storm	847	Jul.	22	The Jowa era	14	Jun.	3	Kyoto	大風雨	Shoku-Nihonkoki	A	B		
287	Flood	848	From Jul. to Sep.		The Kasyo era	1	From Jun. to Aug.		Unknown	連雨,水害	Shoku-Nihonkoki	B			
288	whirlwind	848	Aug.	13	The Kasyo era	1	Jul.	7	Kyoto	颶風	Shoku-Nihonkoki	A			
289	Thunder storm	848	Sep.	4	The Kasyo era	1	Jul.	29	Kyoto	落雷凡十一所	Shoku-Nihonkoki	A			
290	Flood	848	Sep.	9	The Kasyo era	1	Aug.	5	Kyoto	大雨,洪水	Shoku-Nihonkoki	A			
291	Frost	849	May	9	The Kasyo era	2	Apr.	10	Kyoto	晩霜	Shoku-Nihonkoki	A			
292	Long rain	849	Jun.	28	The Kasyo era	2	Jun.	1	Kinki district	霖雨,飢饉	Shoku-Nihonkoki	A	C		
293	Thunder storm	850	May	16	The Kasyo era	3	Mar.	27	Kyoto	大雷雨	Montokujitsuroku	A			
294	Storm	850	Jun.	19	The Kasyo era	3	May	2	Kyoto	大風	Montokujitsuroku	A			
295	Flood	850	Jun.	28	The Kasyo era	3	May	11	Kyoto	雨水	Nihon kiryaku	A			
296	Hail	850	Jul.	13	The Kasyo era	3	May	26	Kyoto	降雹	Montokujitsuroku	A			
297	Thunder storm	850	Jul.	19	The Kasyo era	3	Jun.	3	Kyoto	落雷	Montokujitsuroku	A			
298	Flood	850	Sep.	7	The Kasyo era	3	Jul.	24	Kyoto	大雨,洪水	Montokujitsuroku	A	B		
299	Flood	851	Jun.	14	The Ninju era	1	May	8	Kyoto	雨水	Montokujitsuroku	A	B		
300	Flood	851	Jul.	9	The Ninju era	1	Jun.	3	Kyoto	雨水	Montokujitsuroku	A	B		
301	Storm	851	Sep.	5	The Ninju era	1	Aug.	3	Ise	大風雨,洪水	Daijingu shozojiki	A			
302	Flood	851	Sep.	12	The Ninju era	1	Aug.	10	Kyoto	大雨,洪水	Nihon kiryaku	A			
303	Storm	852	Aug.	21	The Ninju era	2	Jul.	28	Kyoto	暴風雨	Montokujitsuroku	A			
304	Storm	852	Oct.	2	The Ninju era	2	leap Aug.	12	Kyoto	大風	Montokujitsuroku	A			
305	Storm	853	Oct.	8	The Ninju era	3	Aug.	28	Ise	大風雨	Daijingu shozojiki, Kanchuki	A			
306	Storm	853	Oct.	10	The Ninju era	3	Sep.	1	Kyoto	大風	Montokujitsuroku	A	B		
307	Flood	854	Mar.		The Saiko era	1	Feb.		Unknown	洪水	Montokujitsuroku	B			
308	Frost	854	Apr.		The Saiko era	1	Mar.		Kyoto	晩霜	Montokujitsuroku	A			
309	Storm	854	Aug.	28	The Saiko era	1	Jul.	27	Kyoto, Mino	大風雨,洪水	Montokujitsuroku, Gifuken suigai yoroku	A	B		
310	Storm	855	Apr.	11	The Saiko era	2	Mar.	17	Kyoto	大風雨	Montokujitsuroku	A			
311	Flood	855	Jun.	7	The Saiko era	2	leap Apr.	15	Kyoto	大雨水	Montokujitsuroku	A			
312	Frost	855	May		The Saiko era	2	Apr.		Kyoto	晩霜	Montokujitsuroku	A			
313	Thunder storm	855	Jul.	27	The Saiko era	2	Jun.	6	Kyoto	落雷	Montokujitsuroku	A			
314	Hail	856	Apr.	15	The Saiko era	3	Mar.	3	Kyoto	降雹	Montokujitsuroku	A	B		
315	Flood	856	Jul.	7	The Saiko era	3	May	28	Kyoto	雨水	Montokujitsuroku	A			
316	Drought	856	Aug.		The Saiko era	3	Jul.		Ecchu, Wakasa	大旱	Montokujitsuroku	A	C		
317	Heavy snow	857	Jan.	7	The Saiko era	3	Dec.	4	Kyoto	大雪	Montokujitsuroku	A			
318	Thunder storm	857	Jun.	19	The Tenan era	1	May	20	Kyoto	雷雨	Montokujitsuroku	D	C		
319	Flood	857	Jun.	28	The Tenan era	1	May	29	Kyoto	霖雨,洪水	Montokujitsuroku	A	C	B	
320	Drought	857	Sep.	23	The Tenan era	1	Aug.	28	Kyoto	旱魃	Montokujitsuroku	A	C	B	
321	Storm	858	Feb.	19	The Tenan era	2	Jan.	28	Kyoto	暴風雨	Montokujitsuroku	A	B		
322	Heavy snow	858	Mar.	4	The Tenan era	2	Feb.	11	Kyoto	大雪	Montokujitsuroku	A			
323	Hail	858	Apr.	4	The Tenan era	2	leap Feb.	13	Kyoto	降雹	Montokujitsuroku	A			
324	Thunder storm	858	May	26	The Tenan era	2	Apr.	6	Kyoto	雷雨,降雹	Montokujitsuroku	A			
325	Storm	858	Jun.	19	The Tenan era	2	May	1	Kyushu district	大風雨	Montokujitsuroku	A	B		
326	Flood	858	Jul.	10	The Tenan era	2	May	22	Kyoto	大雨,洪水	Montokujitsuroku	A	C	B	
327	Thunder storm	858	Jul.	24	The Tenan era	2	Jun.	7	Izumi	落雷	Montokujitsuroku	A			
328	Storm	858	Aug.	7	The Tenan era	2	Jun.	21	Kyoto	大風	Montokujitsuroku	A			
329	Drought	858	Aug.	28	The Tenan era	2	Jul.	12	Unknown	旱	Montokujitsuroku	C			
330	Thunder storm	859	May	10	The Jogan era	1	Apr.	1	Kyoto	落雷	Nihon sandai jitsuroku, Nihon kiryaku	A			

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Appendix 1. Chronological table of climatic disaster in Japan from 601 to 1200.

NO.	Kind of disaster	The Gregorian calendar			The old calendar				Area	Descliption of disaster in Japanese	Historical record	Source 1	Source 2	Source 3	Source 4
		A.D.	Month	Day	The name of Japanese era	Year	Month	Day							
331	Thunder storm	859	Jun.	25	The Jogan era	1	May	17	Kyoto	雷電,降雹	Nihon sandai jitsuroku	A			
332	Flood	859	Jul.	8	The Jogan era	1	Jun.	1	Kyoto	大雨,洪水	Nihon sandai jitsuroku	A	B		
333	Thunder storm	859	Jul.	29	The Jogan era	1	Jun.	22	Kyoto	大雷雨	Nihon sandai jitsuroku	A	B		
334	Thunder storm	859	Aug.	24	The Jogan era	1	Jul.	19	Kyoto	落雷	Nihon sandai jitsuroku	A			
335	Storm	859	Sep.	16	The Jogan era	1	Aug.	12	Kyoto	大風雨	Nihon sandai jitsuroku	A	B		
336	Storm	859	Oct.	12	The Jogan era	1	Sep.	9	Kyoto	大風雨	Nihon sandai jitsuroku	A	B		
337	Heavy snow	859	Dec.	24	The Jogan era	1	Nov.	23	Kyoto	大雪	Ruijukokushi	A			
338	Long rain	860	Mar.		The Jogan era	2	Feb.		Unknown	雷風,暴風,霖雨	Nihon sandai jitsuroku	B			
339	Frost	860	May	4	The Jogan era	2	Apr.	6	Kyoto	霜害	Nihon sandai jitsuroku	B			
340	whirlwind	860	May	9	The Jogan era	2	Apr.	11	Kyoto	廻飄	Nihon sandai jitsuroku	A			
341	Thunder storm	860	Jun.	1	The Jogan era	2	May	5	Kyoto	雷電,降雹	Nihon sandai jitsuroku	A			
342	Thunder storm	860	Jun.	14	The Jogan era	2	May	18	Kyoto	雷電,降雹	Nihon sandai jitsuroku	A			
343	Flood	860	Jun.	29	The Jogan era	2	Jun.	3	Kyoto	大水	Nihon sandai jitsuroku	A			
344	Storm	860	Aug.	15	The Jogan era	2	Jul.	21	Kyoto	大風雨	Nihon sandai jitsuroku	A			
345	Flood	860	Sep.	22	The Jogan era	2	Aug.	30	Kyoto	大水	Nihon sandai jitsuroku	A			
346	Storm	860	Oct.	6	The Jogan era	2	Sep.	14	Kinki district	大風雨,洪水,高潮	Nihon sandai jitsuroku	A			
347	Storm	861	Jan.	6	The Jogan era	2	Nov.	17	Kyoto	大風	Nihon kiryaku	A			
348	Frost	861	May		The Jogan era	3	Mar.		Izumo	霜頻	Nihon sandai jitsuroku	B			
349	Drought	861	Jun.		The Jogan era	3	May		Unknown	旱魃	Nihon sandai jitsuroku	B			
350	Storm	861	Aug.	24	The Jogan era	3	Jul.	11	Kyoto	大風雨	Nihon sandai jitsuroku	A	B		
351	Hail	862	Apr.	25	The Jogan era	4	Mar.	19	Kyoto	降雹	Nihon sandai jitsuroku	A			
352	Flood	862	May	8	The Jogan era	4	Apr.	2	Kyoto	大雨,大水	Nihon sandai jitsuroku	A	B		
353	Thunder storm	862	Jul.	1	The Jogan era	4	May	27	Kyoto	雷電,大雨	Nihon sandai jitsuroku	C			
354	Long rain	862	Jul.	22	The Jogan era	4	Jun.	18	Kyoto	霖雨,飢饉	Nihon sandai jitsuroku	A	C		
355	Drought	862	Aug.	5	The Jogan era	4	Jul.	2	Hitachi	旱疫	Nihon sandai jitsuroku	B			
356	Drought	862	Oct.		The Jogan era	4	Sep.		Kyoto	大旱	Konendairyakuki, Nihon sandai jitsuroku	A	C	B	
357	Thunder storm	863	Jan.	23	The Jogan era	4	Dec.	26	Unknown	雷雨	Nihon sandai jitsuroku	B			
358	Storm	863	Mar.	11	The Jogan era	5	Feb.	14	Kyoto	大風	Nihon sandai jitsuroku	A	B		
359	Long rain	863	From May to Jul.		The Jogan era	5	From Apr. to Jun.		Kyoto	霖雨	Nihon sandai jitsuroku	A	C	B	
360	Storm	863	May	6	The Jogan era	5	Apr.	11	Kyoto	大風	Nihon sandai jitsuroku	A			
361	Frost	863	Jun.	1	The Jogan era	5	May	7	Kyoto	霜頻	Nihon sandai jitsuroku	B			
362	Storm	863	Sep.	11	The Jogan era	5	Jul.	21	Kyoto	大風	Nihon sandai jitsuroku	A	B		
363	Thunder storm	863	Dec.		The Jogan era	5	Oct.		Unknown	大風,雷雨	Nihon sandai jitsuroku	B			
364	Heavy snow	864	Feb.	15	The Jogan era	6	Jan.	1	Kyoto	大雪	Nihon sandai jitsuroku	A			
365	Long rain	864	Jul.	6	The Jogan era	6	May	25	Kyoto	霖雨,賑給	Nihon sandai jitsuroku	A	C	B	
367	Frost	865	May	5	The Jogan era	7	Apr.	3	Kyoto	霜頻,晩霜	Nihon sandai jitsuroku	B	A		
366	Thunder storm	865	May	19	The Jogan era	7	Apr.	17	Unknown	雷雨,霖雨	Nihon sandai jitsuroku	B			
368	Thunder storm	865	Jun.	3	The Jogan era	7	May	2	Unknown	雷雨,霖雨	Nihon sandai jitsuroku	B			
369	Thunder storm	865	Jun.	30	The Jogan era	7	May	29	Unknown	雷雨,霖雨	Nihon sandai jitsuroku	B			
370	Storm	865	Jul.	16	The Jogan era	7	Jun.	16	Kyoto	大風雨	Nihon sandai jitsuroku	A			
371	Storm	865	Aug.	16	The Jogan era	7	Jul.	17	Kyoto	大風雨	Nihon sandai jitsuroku	A	B		
372	Flood	865	Aug.	30	The Jogan era	7	Aug.	2	Kyoto	雨水	Nihon sandai jitsuroku	A	B		
373	Drought	865	Sep.		The Jogan era	7	Aug.		Bingo	旱疫	Nihon sandai jitsuroku	B			
374	Drought	865			The Jogan era	7			Musashi	旱	Nihon sandai jitsuroku	B			
375	Frost	865			The Jogan era	7			Musashi	霜	Nihon sandai jitsuroku	B			

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Appendix 1. Chronological table of climatic disaster in Japan from 601 to 1200.

NO.	Kind of disaster	The Gregorian calendar			The old calendar				Area	Descliption of disaster in Japanese	Historical record	Source 1	Source 2	Source 3	Source 4
		A.D.	Month	Day	The name of Japanese era	Year	Month	Day							
376	Long rain	866	Jun. and Jul.		The Jogan era	8	Apr. and May		Kyoto	霖雨	Nihon sandai jitsuroku, Nihon kiryaku	A	C	B	
377	Drought	866	From Jul. to Sep.		The Jogan era	8	From May to Jul.		All provinces	旱疫,飢饉	Nihon sandai jitsuroku	A	C	B	
378	Storm	866	Oct.	9	The Jogan era	8	Aug.	23	Kyoto	暴風,雷雨	Nihon sandai jitsuroku	B			
379	Storm	866			The Jogan era	8			Owari, Awa	風波,飢饉	Nihon sandai jitsuroku	B			
380	Flood	867	Jun.	13	The Jogan era	9	May	4	Kyoto	大雨,洪水	Nihon sandai jitsuroku	A	C	B	
381	Long rain	867	May and Jun.		The Jogan era	9	Apr. and May		Kyoto	霖雨	Nihon sandai jitsuroku	C	B		
382	Storm	867	Oct.	19	The Jogan era	9	Sep.	14	Kyoto	大風雨	Nihon sandai jitsuroku	A	B		
383	Long rain	868	Jun.		The Jogan era	10	May		Kyoto	霖雨	Nihon kiryaku	A	C	B	
384	Long rain	868	Sep.		The Jogan era	10	Aug.		Kyoto	霖雨	Nihon kiryaku	A	C		
385	Storm	868	Oct.	7	The Jogan era	10	Sep.	14	Unknown	大風雨	Nihon sandai jitsuroku	B			
386	Long rain	869	Apr.		The Jogan era	11	Feb.		Kyoto	霖雨	Nihon sandai jitsuroku	A	C	B	
387	Thunder storm	869	Aug.	28	The Jogan era	11	Jul.	13	Kyoto	落雷	Nihon sandai jitsuroku	A			
388	Storm	869	Aug.	29	The Jogan era	11	Jul.	14	Higo	大風雨,高潮	Nihon sandai jitsuroku	A	B		
389	Storm	869	Oct.	9	The Jogan era	11	Aug.	26	Kyoto	大風雨	Nihon sandai jitsuroku, Nihon kiryaku	A	B		
390	Drought	869	From Aug. to Jan.		The Jogan era	11	From Jun. to December		Yamashiro, Aki, Kawachi	旱魃	Nihon sandai jitsuroku	A	C	B	
391	Long rain	870	Jun. and Jul.		The Jogan era	12	May and Jun.		Kyoto	霖雨,飢饉	Nihon sandai jitsuroku	A	C	B	
392	Drought	870			The Jogan era	12			Kawachi	旱	Nihon sandai jitsuroku	C			
393	whirlwind	871	Jan.	29	The Jogan era	13	Jan.	1	Kyoto	颷風	Nihon sandai jitsuroku	A			
394	Heavy snow	871	Feb.	21	The Jogan era	13	Jan.	24	Kyoto	大雪	Nihon sandai jitsuroku	A			
395	Long rain	871	Apr.		The Jogan era	13	Mar.		Kyoto	霖雨	Nihon kiryaku	A	C	B	
396	Drought	871	Jun. and Jul.		The Jogan era	13	May and Jun.		All provinces	大旱	Nihon sandai jitsuroku	C	B		
397	Thunder storm	871	Sep.	3	The Jogan era	13	Aug.	11	Kyoto	大雷雨	Nihon sandai jitsuroku	A	B		
398	Thunder storm	871	Sep.	28	The Jogan era	13	leap Aug.	7	Kyoto	雷雨,洪水	Nihon sandai jitsuroku	A	C		
399	Flood	871	Oct.	2	The Jogan era	13	leap Aug.	11	Kyoto	霖雨,洪水	Nihon sandai jitsuroku	A	C		
400	Heavy snow	872	Feb.	4	The Jogan era	13	Dec.	18	Kyoto	大雪	Nihon sandai jitsuroku	A			
401	Storm	872	Apr.	25	The Jogan era	14	Mar.	10	Kyoto	大風雨	Nihon sandai jitsuroku	A	B		
402	Storm	872	Sep.	14	The Jogan era	14	Aug.	4	Kyoto	大風雨	Nihon kiryaku, Nihon sandai jitsuroku	A	B		
403	Drought	872	Aug.		The Jogan era	14	Jul.		Yamato, Imba	旱魃	Nihon sandai jitsuroku	D	C	B	
404	whirlwind	873	Feb.	6	The Jogan era	15	Jan.	1	Kyoto	颷風,雷鳴	Nihon sandai jitsuroku	A			
405	Thunder storm	873	May	31	The Jogan era	15	Apr.	27	Kyoto	雷電,降雹	Nihon sandai jitsuroku	A	B		
406	Thunder storm	873	Jun.	5	The Jogan era	15	May	3	Kyoto	雷電,降雹	Nihon sandai jitsuroku	A	B		
407	Storm	873	Sep.	12	The Jogan era	15	Aug.	13	Ise	大風雨,洪水	Daijingu shozojiki, Nihon saiishi	A			
408	Thunder storm	874	Mar.	29	The Jogan era	16	Mar.	4	Kyushu district	雷霆,降沙	Nihon sandai jitsuroku	A			
409	Long rain	874	Jul.		The Jogan era	16	May		Kyoto	霖雨,雷雨	Nihon kiryaku, Nihon sandai jitsuroku	A	C	B	
410	Thunder storm	874	Aug.	3	The Jogan era	16	Jun.	14	Kyoto	落雷	Nihon sandai jitsuroku	A			
411	Long rain	874	Oct.		The Jogan era	16	Aug.		Unknown	霖雨,祈霽	Nihon sandai jitsuroku	B			
412	Storm	874	Oct.	12	The Jogan era	16	Aug.	24	Kyoto	大風雨,洪水	Nihon sandai jitsuroku, Dai-nihonshi	A	B		
413	Heavy snow	875	Feb.	2	The Jogan era	16	Dec.	19	Kyoto	大雪	Nihon sandai jitsuroku	A			
414	Thunder storm	875	May	25	The Jogan era	17	Apr.	13	Unknown	雷雨	Nihon sandai jitsuroku	B			
415	Thunder storm	875	May	30	The Jogan era	17	Apr.	18	Unknown	雷雨	Nihon sandai jitsuroku	B			

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NO.	Kind of disaster	The Gregorian calendar			The old calendar				Area	Descliption of disaster in Japanese	Historical record	Source 1	Source 2	Source 3	Source 4
		A.D.	Month	Day	The name of Japanese era	Year	Month	Day							
416	Drought	875	Jul. and Aug.		The Jogan era	17	Jun. and Jul.		Kyoto	大旱	Konendairyakuki, Kodaiki	A	C	B	
417	Thunder storm	875	Aug.	18	The Jogan era	17	Jul.	10	Kyoto	大雷雨	Nihon sandai jitsuroku, Nihon kiryaku, Nihon sandai jitsuroku	A	B		
418	Thunder storm	875	Aug.	20	The Jogan era	17	Jul.	12	Unknown	雷雨	Nihon sandai jitsuroku	B			
419	Long rain	875	Sep.	3	The Jogan era	17	Jul.	26	Kyoto	霖雨,祈霽	Nihon sandai jitsuroku	C	B		
420	Long rain	876	Apr.	23	The Jogan era	18	Mar.	21	Kyoto	霖雨,賑給	Nihon sandai jitsuroku	A	C	B	
421	whirlwind	876	Jun.	11	The Jogan era	18	May	12	Kyoto	颱風	Nihon sandai jitsuroku	A			
422	Long rain	876	Jun. and Jul.		The Jogan era	18	May and Jun.		Kyoto	霖雨,賑給,霧	Nihon sandai jitsuroku	A	C	B	
423	Hail	876	Jul.	16	The Jogan era	18	Jun.	18	Kyoto	降雹	Nihon sandai jitsuroku	A			
424	Drought	876	Aug.	20	The Jogan era	18	Jul.	23	Tango	旱,凶荒	Nihon sandai jitsuroku	C	B		
425	Thunder storm	876	Dec.	29	The Jogan era	18	Dec.	6	Kyoto	雷電,降雹	Nihon sandai jitsuroku, Nihon kiryaku, Dai-nihonshi	A			
426	Drought	877	Aug.		The Gangyo era	1	Jun.		All provinces	大旱,飢饉	Nihon kiryaku, Fuso ryakuki, Nihon sandai jitsuroku	A	C	B	
427	Heavy snow	877	Dec.	21	The Gangyo era	1	Nov.	9	Kyoto	大雪	Nihon sandai jitsuroku	A			
428	Frost	878	May	18	The Gangyo era	2	Apr.	9	Kyoto	晩霜	Nihon sandai jitsuroku	A			
429	Drought	878	Jul.		The Gangyo era	2	Jun.		Yamashiro, Kawachi, Settsu	旱魃	Nihon kiryaku, Nihon sandai jitsuroku	A	C	B	
430	Thunder storm	878	Jul.	23	The Gangyo era	2	Jun.	16	Kyoto	大雷雨,洪水	Nihon sandai jitsuroku	A			
431	Thunder storm	878	Aug.	6	The Gangyo era	2	Jul.	1	Kyoto	落雷	Nihon sandai jitsuroku, Dai-nihonshi	A			
432	Storm	878	Sep.	22	The Gangyo era	2	Aug.	18	Kyoto	大風雨,洪水	Nihon sandai jitsuroku	A	B		
433	Flood	878	Oct.	24	The Gangyo era	2	Sep.	21	Kyoto	雨水	Nihon sandai jitsuroku	A	C		
434	Thunder storm	878	Oct.	29	The Gangyo era	2	Sep.	26	Kii	大雷雨,落雷數十處	Nihon sandai jitsuroku	A	B		
435	Long rain	878	Oc.		The Gangyo era	2	Sep.		Unknown	霖雨	Nihon sandai jitsuroku	B			
436	Heavy snow	879	Feb.	8	The Gangyo era	3	Jan.	10	Kyoto	大雪	Nihon sandai jitsuroku	A			
437	Flood	879	Jul.	15	The Gangyo era	3	Jun.	18	Kyoto	大雨,洪水	Nihon kiryaku, Nihon sandai jitsuroku	A	B		
438	Drought	880	Jul.		The Gangyo era	4	Jun.		Unknown	旱	Nihon sandai jitsuroku	C			
439	Heavy snow	881	Mar.	5-6	The Gangyo era	5	Jan.	27-28	Kyoto	大雪	Nihon sandai jitsuroku	A	B		
440	Thunder storm	881	Jul.	11	The Gangyo era	5	Jun.	8	Kyoto	落雷	Nihon sandai jitsuroku	A			
441	Long rain	881	Jul.	4-17	The Gangyo era	5	Jun.	1-14	Kyoto	霖雨,賑給	Nihon sandai jitsuroku	A	C	B	
442	Heavy snow	882	Jan.	27-28	The Gangyo era	6	Jan.	1－2	Kyoto	大雪二尺	Nihon sandai jitsuroku	A	B		
443	Long rain	882	Jun.		The Gangyo era	6	May		Kyoto	霖雨,賑給	Nihon sandai jitsuroku	A	C	B	
444	whirlwind	882	Dec.	13	The Gangyo era	6	Oct.	25	Noto	激雷,廻飄	Nihon sandai jitsuroku	A			
445	Storm	883	May	11	The Gangyo era	7	Mar.	27	Kyoto	大風,雨水	Nihon sandai jitsuroku	A	B		
446	Long rain	883	Jul.		The Gangyo era	7	Jun.		Kyoto	霖雨	Nihon kiryaku, Nihon sandai jitsuroku	A	C	B	
447	Long rain	883	Oct.		The Gangyo era	7	Sep.		Kyoto	霖雨	Nihon kiryaku, Nihon sandai jitsuroku	A	C	B	
448	Heavy snow	884	Feb.	6	The Gangyo era	8	Jan.	2	Kyoto	大雪	Nihon sandai jitsuroku	A			
449	Thunder storm	884	Feb.	8	The Gangyo era	8	Jan.	4	Kyoto	雷風,降雹	Nihon sandai jitsuroku	A			
450	whirlwind	884	Apr.	7	The Gangyo era	8	Mar.	4	Kyoto	廻飄	Nihon sandai jitsuroku	A			
451	Thunder storm	884	Apr.	8	The Gangyo era	8	Mar.	5	Unknown	大雷雨	Nihon sandai jitsuroku	B			
452	Thunder storm	884	Apr.	18	The Gangyo era	8	Mar.	15	Jojuji	雷火	Nihon sandai jitsuroku	A			

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Appendix 1. Chronological table of climatic disaster in Japan from 601 to 1200.

NO.	Kind of disaster	The Gregorian calendar			The old calendar				Area	Descliption of disaster in Japanese	Historical record	Source 1	Source 2	Source 3	Source 4
		A.D.	Month	Day	The name of Japanese era	Year	Month	Day							
453	Frost	884	Apr.	29	The Gangyo era	8	Mar.	26	Kyoto	晩霜	Nihon sandai jitsuroku	A			
454	Thunder storm	884	May	7	The Gangyo era	8	Apr.	5	Kyoto	雷電,降雹	Nihon sandai jitsuroku	A	B		
455	Storm	884	May	16	The Gangyo era	8	Apr.	14	Kyoto	大風雨	Nihon sandai jitsuroku	A			
456	Frost	884	May	19	The Gangyo era	8	Apr.	17	Kyoto	晩霜	Nihon sandai jitsuroku	A			
457	Long rain	884	Spring and summer		The Gangyo era	8	Spring and summer		Kyushu	連雨	Nihon sandai jitsuroku	C	B		
458	Thunder storm	884	Jul.	26	The Gangyo era	8	Jun.	26	Dewa	大雷雨	Nihon sandai jitsuroku, Wakansansaizue	A			
459	Thunder storm	884	Aug.	25	The Gangyo era	8	Jul.	27	Yamashiro	大雷雨,落雷	Nihon sandai jitsuroku	A			
460	Thunder storm	884	Oct.	14	The Gangyo era	8	Sep.	18	Kyoto	雷電,降雹	Nihon sandai jitsuroku	A			
461	Storm	885	May	12	The Nina era	1	leap Mar.	20	Kyoto	大風雨	Nihon sandai jitsuroku	A			
462	Long rain	885	Jul.		The Nina era	1	May		Kyoto	霖雨,飢饉	Nihon sandai jitsuroku	A	C	B	
463	Drought	885			The Nina era	1			Hizen, Satsuma	旱	Nihon sandai jitsuroku	C	B		
464	Heavy snow	886	Jan.	26	The Nina era	1	Dec.	14	Kyoto	大雪	Ruijukokushi	A			
465	Thunder storm	886	Apr.	19	The Nina era	2	Mar.	8	Unknown	大風,雷雨	Nihon sandai jitsuroku	B			
466	Thunder storm	886	Apr.	24	The Nina era	2	Mar.	13	Kyoto	大雷雨,東寺塔雷火,大風	Nihon sandai jitsuroku, Dai-nihonshiryo	A			
467	Thunder storm	886	May	31	The Nina era	2	Apr.	20	Kyoto	大雷雨,落雷	Nihon sandai jitsuroku	A			
468	Flood	886	Jun.	19	The Nina era	2	May	10	Kyoto	大雨,洪水	Nihon sandai jitsuroku	A			
469	Thunder storm	886	Jul.	3	The Nina era	2	May	24	Awa	雷電,粉石粉土降ル	Nihon sandai jitsuroku	A			
470	Long rain	886	Jun. and Jul.		The Nina era	2	May and Jun.		Kyoto	霖雨,飢饉	Nihon sandai jitsuroku	A	C	B	
471	Storm	886	Sep.	12	The Nina era	2	Aug.	7	Kyoto	大風雨,洪水	Nihon sandai jitsuroku	A	B		
472	Thunder storm	886	Oct.	8	The Nina era	2	Sep.	4	Kyoto	大雷雨,雷震	Nihon sandai jitsuroku	A			
473	Long rain	887	Jun. and Jul.		The Nina era	3	May and Jun.		Kyoto	霖雨,飢饉	Nihon sandai jitsuroku	A	C	B	
474	Thunder storm	887	Jul.	25	The Nina era	3	Jun.(Jul.?)	27	Kyoto	雷電,降雹	Nihon sandai jitsuroku	A	B		
475	Storm	887	Sep.	15	The Nina era	3	Aug.	20	All provinces	大風雨,洪水	Nihon sandai jitsuroku, Ruijusaidaikyaku	A	B		
476	whirlwind	888	Mar.	9	The Nina era	4	Jan.	18	Kyoto	飄風	Nihon kiryaku	A			
477	Storm	888	May	1	The Nina era	4	Mar.	13	Unknown	暴風雨	Toboki	B			
478	Drought	888	Jun.		The Nina era	4	Apr.		Sanuki	大旱	Udatenno jitsuroku, Kanke bunso	A	C	B	
479	Flood	888	Jun.	24	The Nina era	4	May	8	Shinano	大水	Nihon kiryaku, Ruijusaidaikyaku	A	B		
480	Long rain	888	Aug.		The Nina era	4	Jul.		Unknown	祈止雨	Nihon kiryaku, Ruijusaidaikyaku	C	B		
481	Thunder storm	889	May	17	The Kampyo Era	1	Apr.	10	Kyoto	雷雨,降雹,風雨	Nihon kiryaku	A	B		
482	Flood	889	Jul. and Aug.		The Kampyo era	1	Jun. and Jul.		Kyoto	霖雨,洪水,餓死	Udatenno jitsuroku, Nihon kiryaku	A	C	B	
483	Flood	890	Aug.		The Kampyo era	2	Jul.		Unknown	霖雨,洪水	Nihon kiryaku	B			
484	Storm	891	Apr.	18	The Kampyo era	3	Mar.	2	Nagato	大風雨	Nihon kiryaku	A	C	B	
485	Drought	891	Jun.		The Kampyo era	3	May		Kyoto	旱魃	Nihon kiryaku	A	C	B	
486	Thunder storm	891	Jul.	27	The Kampyo era	3	Jun.	14	Ise	落雷	Daijingu shozojiki, Isekugyochokushi zorei	A			
487	Heavy snow	892	Jan.	23	The Kampyo era	3	Dec.	16	Kyoto	大雪二尺	Nihon kiryaku	A			
489	Flood	892	Jul.		The Kampyo era	4	Jun.		Ise	大水	Dai-nihonshi	A			
488	Drought	892	Aug. and Sep.		The Kampyo era	4	Jul. and Aug.		Unknown	旱魃	Nihon kiryaku	C	B		
490	Heavy snow	892			The Kampyo era	4			Kyoto	大雪三尺	Nihon kiryaku	A			
491	Flood	895	Aug.	7	The Kampyo era	7	Jul.	9	Kyoto	洪水	Nihon kiryaku	A	B		
492	Flood	896	Jun.	27	The Kampyo era	8	May	9	Kyoto	洪水	Nihon kiryaku	A	C	B	
493	Long rain	896	Oct.	5	The Kampyo era	8	Aug.	21	Kyoto	霖雨	Nihon kiryaku	C	B		

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Appendix 1. Chronological table of climatic disaster in Japan from 601 to 1200.

NO.	Kind of disaster	The Gregorian calendar			The old calendar				Area	Descliption of disaster in Japanese	Historical record	Source 1	Source 2	Source 3	Source 4
		A.D.	Month	Day	The name of Japanese era	Year	Month	Day							
494	Flood	897	Jul. and Aug.		The Kampyo era	9	Jun. and Jul.		Kyoto	霖雨,洪水	Nihon saiishi	A			
495	Drought	898	Jun.		The Syotai era	1	May		All provinces	旱魃	Kofukuji kiuki, Fuso ryakuki	D	C	B	
496	whirlwind	899	Jul.	7	The Syotai era	2	May	22	Kyoto	飄風,大風	Nihon kiryaku	A	B		
497	Storm	899	Jul.	30	The Syotai era	2	Jun.	15	Kyoto	大風雨	Nihon kiryaku	A	B		
498	Storm	899	Oct.	20	The Syotai era	2	Sep.	8	Kyoto	大風	Nihon kiryaku	A	B		
499	Thunder storm	901	Sep.		The Engi era	1	Jul.		Kyoto	強雷	Zoku honchotsugan	A			
500	Drought	902	Jul.		The Engi era	2	Jun.		Unknown	旱	Nihon kiryaku, Fuso ryakuki	C	B		
501	Long rain	902	Sep.	23-26	The Engi era	2	Aug.	14－17	Kyoto	霖雨	Fuso ryakuki	C	B		
502	Drought	903	Aug.		The Engi era	3	Jul.		Unknown	炎旱,祈雨	Fuso ryakuki	B			
503	Long rain	903	Aug.		The Engi era	3	Jul.		Unknown	祈止雨	Nihon kiryaku	B			
504	Long rain	903	Oct.		The Engi era	3	Sep.		Unknown	祈止雨	Nihon kiryaku	B			
505	Drought	904	From Aug. to Oct.		The Engi era	4	From Jun. to Aug.		Unknown	旱	Nihon kiryaku	C	B		
506	Long rain	904	Oct.	9	The Engi era	4	Aug.	23	Unknown	霖雨	Nihon kiryaku	C			
507	Drought	905	Aug.	26	The Engi era	5	Jul.	18	Unknown	旱魃,炎旱	Nihon kiryaku	C	B		
508	Thunder storm	906	May		The Engi era	6	Apr.		Kyoto	雷雨,降雹	Nihon kiryaku, Zoku honchotsugan	A	B		
509	Drought	906	Jun.	27	The Engi era	6	May	28	Unknown	旱	Fuso ryakuki	C	B		
510	Storm	906	Aug.	10	The Engi era	6	Jul.	13	Sauki, Oki	大風	Nihon kiryaku	A	B		
511	Flood	907			The Engi era	7			Kyoto	洪水	Nihon saiishi, Honchonendaiki	A	B		
512	Thunder storm	907			The Engi era	7			Kyoto	落雷	Wakan gozu bassui	A			
513	Drought	908	From Jul. to Sep.		The Engi era	8	From Jun. to Aug.		All provinces	旱魃	Nihon kiryaku, Fuso ryakuki	A	C	B	
514	Flood	909	Jun.	14	The Engi era	9	May	19	Kyoto	洪水	Nihon kiryaku	A	C	B	
515	Flood	909	Jun.	30	The Engi era	9	Jun.	5	Kyoto	大雨,洪水	Fuso ryakuki	A	C		
516	Long rain	909	Jul. and Sep.		The Engi era	9	Jun. and Aug.		Kyoto	霖雨	Fuso ryakuki, Nihon kiryaku	C	B		
517	Storm	910	Jun.	7	The Engi era	10	Apr.	22	Kyoto	大風雨	Nihon kiryaku	A	B		
518	Thunder storm	910	Jun.	28	The Engi era	10	May	14	Kyoto	落雷	Nihon kiryaku, Dai-nihonshi	A			
519	Drought	910	From Jul. to Oct.		The Engi era	10	From Jun. to Sep.		All provinces	大旱	Nihon kiryaku, Fuso ryakuki	A	C	B	
520	Storm	910	Aug.	30	The Engi era	10	Jul.	18	Kyoto	大風雨	Nihon kiryaku	A	B		
521	Storm	910	Sep.	12	The Engi era	10	Aug.	1	Kyoto	大風	Nihon kiryaku	A	B		
522	Flood	911	Jul.		The Engi era	11	Jun.		Kyoto	霖雨,洪水	Nihon kiryaku	A	C	B	
523	Drought	912	From May to Sep.		The Engi era	12	From Apr. to Jul.		Unknown	旱	Nihon kiryaku, Teishinkoukisho	C	B		
524	Thunder storm	913	Aug.	1	The Engi era	13	Jun.	21	Kyoto	落雷	Teishinkoukisho	A			
525	Storm	913	Sep.	8	The Engi era	13	Aug.	1	Kyoto	大風	Teishinkoukisho, Nihon kiryaku, Fuso ryakuki, Kakaisho	A	B		
527	Drought	913	Summer		The Engi era	13	Summer		All provinces	旱魃	Fuso ryakuki, Nihon kosodenyomonsho	A	C	B	
526	Storm	913	Dec.	12	The Engi era	13	Nov.	7	Kyoto	大風	Nihon kiryaku, Fuso ryakuki, Dai-nihonshi	A	B		

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Appendix 1. Chronological table of climatic disaster in Japan from 601 to 1200.

NO.	Kind of disaster	The Gregorian calendar			The old calendar				Area	Descliption of disaster in Japanese	Historical record	Source 1	Source 2	Source 3	Source 4
		A.D.	Month	Day	The name of Japanese era	Year	Month	Day							
528	Flood	914	Jul.	15	The Engi era	14	Jun.	15	Kyoto	洪水	Nihon kiryaku, Wakan goun shisho zu	A	B		
529	Drought	915	From Jul. to Oct.		The Engi era	15	From May to Sep.		All provinces	旱損	Fuso ryakuki, Nihon kiryaku	A	C	B	
530	Hail	916	Jun.	11	The Engi era	16	May	3	Kyoto	降雹	Nihon kiryaku, Zoku honchotsugan	A			
531	Hail	916	Jun.	30	The Engi era	16	May	22	Kyoto	降雹,烈風	Nihon kiryaku, Zoku honchotsugan	A	B		
532	Drought	916	Jul. and Aug.		The Engi era	16	Jun. and Jul.		Unknown	旱,飢渇	Fuso ryakuki, Seikyuki	C	B		
533	Storm	916			The Engi era	16			Kyoto	大風雨	Seikyuki, Honchotsuki, Nihon saiishi, Nihon shisaikyokinko	A			
534	Hail	917	Apr.	22	The Engi era	17	Mar.	23	Kyoto	降雹	Fuso ryakuki, Dai-nihonshi	A			
535	Drought	917	From Aug. to Feb.		The Engi era	17	From Jul. to December		All provinces	旱魃,飢渇	Nihon kiryaku, Seikyuki	A	D	C	B
536	Thunder storm	918	Aug.	8	The Engi era	18	Jun.	24	Kyoto	落雷	Fuso ryakuki, Dai-nihonshi	A			
537	Long rain	918	Aug. and Sep.		The Engi era	18	Jul. and Aug.		Kyoto	霖雨	Teishinkoukisho, Fuso ryakuki	C	B		
538	Storm	918	Sep.	28	The Engi era	18	Aug.	16	Kyoto	大風雨,洪水	Fuso ryakuki, Nihon kiryaku	A	B		
539	Drought	919	Jul. and Aug.		The Engi era	19	Jun. and Jul.		All provinces	旱魃	Fuso ryakuki, Tojichojabunin	D	C		
540	Storm	920	Spring and summer		The Engi era	20	Spring and Summer			風水	Nihon kiryaku	B			
541	Drought	920	From Apr. to Sep.	30	The Engi era	20	From Mar. to Jul.		Kyoto	旱魃	Teishinkoukisho, Nihon kiryaku	A	C	B	
542	Long rain	920	Sep.	9-11	The Engi era	20	Aug.	20－22	Kyoto	霖雨	Teishinkoukisho, Fuso ryakuki	C			
543	Storm	920			The Engi era	20			Kyoto	風水	Nihon kiryaku	A			
544	Storm	921	Jul.	13	The Engi era	21	Jun.	1	Unknown	大雨	Nihon kiryaku	B			
545	Drought	922	From Jun. to Oct.		The Engi era	22	From May to Sep.		Kyoto	大旱	Fuso ryakuki, Nihon kiryaku, Honchotsuki	A	C	B	
546	Flood	922	Jul.	23	The Engi era	22	Jun.	21	Kyoto	洪水	Daijingu shozojiki	B			
547	Thunder storm	923	Apr.		The Encho era	1	Mar.		Kyoto	大雷	Jinnosyotoroku	A			
548	Flood	923	Jun.	13	The Encho era	1	leap Apr.	21	Kyoto	洪水	Toji odaiki	A			
549	Long rain	923	Oct.	17	The Encho era	1	Aug.	30	Unknown	霖雨	Nihon kiryaku	B			
550	Flood	924	Jun.	16	The Encho era	2	May	7	Kyoto	大雨,洪水	Teishinkoukisho, Fuso ryakuki	A	C	B	
551	Storm	924	Sep.	10	The Encho era	2	Aug.	4	Kyoto	風雨	Fuso ryakuki	A	B		
552	Heavy snow	925	Feb.	14	The Encho era	3	Jan.	14	Kyoto	大雪七寸	Seikyuki, Dai-nihonshi	A	B		
553	Drought	925	From Jun. to Aug.		The Encho era	3	From May to Jul.		Kinki district	大旱	Nihon kiryaku, Fuso ryakuki, Nihon kosodenyomonsho	A	D	B	
554	Storm	926	Sep.	3	The Encho era	4	Jul.	19	Kinki district	大風	Teishinkoukisho, Nihon kiryaku	A	B		

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		A.D.	Month	Day	The name of Japanese era	Year	Month	Day							
555	Long rain	926	Sep.		The Encho era	4	Aug.		Kyoto	霖雨	Teishinkoukisho	C			
556	Drought	927	From Jun. to Aug.		The Encho era	5	From May to Jul.		Kinki district	旱	Teishinkoukisho, Kiuki	C	B		
557	Storm	928	Jan.	31	The Encho era	6	Jan.	1	Kyoto	大風	Fuso ryakuki	A			
558	Thunder storm	928	Jun.	24	The Encho era	6	May	29	Kyoto	落雷	Fuso ryakuki	A			
559	Thunder storm	928	Aug.	4	The Encho era	6	Jul.	11	Yamato	雷火	Fuso ryakuki	A			
560	Flood	928	Aug.	5	The Encho era	6	Jul.	12	Yamato	長谷川洪水	Fuso ryakuki	A	B	D	
561	Drought	928	Sep.	22	The Encho era	6	leap Aug.	1	Kyoto	旱	Fuso ryakuki	C	B		
562	Drought	929	Aug.	20	The Encho era	7	Jul.	8	Kyoto	旱請雨	Kiu nikki	C	B		
563	Storm	929	Sep.	7	The Encho era	7	Jul.	26	Kyoto	大風雨,洪水	Fuso ryakuki, Jinnosyotoroku	A	B		
564	Flood	929	Sep.	25	The Encho era	7	Aug.	15	Kyoto	大雨,洪水	Nihon kiryaku, Fuso ryakuki	A	C	B	
565	Drought	930	Jun. and Jul.		The Encho era	8	May and Jun.		Kyoto	不雨	Nihon kiryaku, Kacho yoryaku, Zoku-Honchotsuki	A	C	B	
566	Thunder storm	930	Jul.	29	The Encho era	8	Jun.	26	Kyoto	落雷	Nihon kiryaku, Fuso ryakuki, Kujodono ikai, Taigensho	A			
567	whirlwind	930	Aug.	21	The Encho era	8	Jul.	20	Kyoto	雷鳴,風雨	Fuso ryakuki, Kokonchomonju	A			
570	Thunder storm	931	Mar.	9	The Johei era	1	Feb.	13	Kyoto	落雷,降雹	Nihon kiryaku, Fuso ryakuki, Teishinkoukisho, Shingishiki	A			
568	Drought	931	Jun. and Jul.		The Johei era	1	May and Jun.		Unknown	旱	Teishinkoukisho	C			
569	Long rain	931	Jul.		The Johei era	1	Leap May		Yamato	霖雨	Teishinkoukisho, Fuso ryakuki, Nihon kiryaku	D	B		
571	Heavy snow	931			The Johei era	1			Mino	積雪八尺	Taisetsushi	A			
572	Drought	932	Jul.	27	The Johei era	2	Jun.	16	Unknown	旱祈雨	Teishinkoukisho	C	B		
573	whirlwind	933	Aug.	11	The Johei era	3	Jul.	13	Kyoto	颶風	Fuso ryakuki	A	B		
574	Thunder storm	933	Nov.	14	The Johei era	3	Oct.	19		落雷	Ichidaiyoki	A			
575	Thunder storm	934	Mar.	8	The Johei era	4	leap Jan.	15	Mutsu	雷火	Nihon kiryaku	A			
576	Thunder storm	934	Dec.	3	The Johei era	4	Oct.	19	Yamato	落雷	Nihon kiryaku, Fuso ryakuki Todaijibettoshidai, Ichidaiyoki	A			
577	Thunder storm	935	Apr.	16	The Johei era	5	Mar.	6	Omi	震火	Koyahennnensyunjusyuroku	A			
578	Frost	935	May	14	The Johei era	5	Apr.	4	Kyoto	晩霜	Fuso ryakuki	A			
579	Drought	935	May and Jun.		The Johei era	5	Apr. and May		Unknown	旱	Fuso ryakuki, Nihon kiryaku	C	B		
580	Storm	935	Oct.	19	The Johei era	5	Sep.	14	Ise	風雨,洪水	Ujiyamadashishi	A			
581	Long rain	936	Sep.		The Johei era	6	Aug.		Unknown	霖雨	Hokuzansho	C	B		
582	Flood	938	Jul.	1	The Tengyo era	1	May	26	Kyoto	大雨,洪水	Nihon kiryaku, Honchoseiki	A	B		

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		A.D.	Month	Day	The name of Japanese era	Year	Month	Day							
583	Storm	938	Jul.	24	The Tengyo era	1	Jun.	20	Kyoto	大風雨,洪水	Teishinkoukisho, Nihon kiryaku	A	B		
584	Thunder storm	938	Jul.		The Tengyo era	1	Jun.		Kinki district	雷震十餘日	Shinkokushiitsubunko	A			
585	Storm	938	Aug.	14	The Tengyo era	1	Jul.	11	Unknown	大風	Honchoseiki	B			
586	Drought	938	Aug.	30	The Tengyo era	1	Jul.	27	Unknown	旱	Nihon kiryaku	C			
587	Flood	938	Sep.	28	The Tengyo era	1	Aug.	27	Unknown	洪水	Honchoseiki	B			
589	Long rain	938			The Tengyo era	1			Kyoto	霖雨	Kinpisho	C			
588	Heavy snow	939	Jan.	4	The Tengyo era	1	Dec.	6	Unknown	大雪	Honchoseiki, Nihon kiryaku, Jinnosyotoroku, Honchotsuki, Dai-nihonshi	A	B		
590	Drought	939	Jul. and Aug.		The Tengyo era	2	Jun. and Jul.		Kinki district	大旱,祈雨	Honchoseiki, Fuso ryakuki	A	D	C	B
591	Storm	940	Sep.		The Tengyo era	3	Aug.	—	Kyoto	風雨,飢饉	Fuso ryakuki	A	B		
592	Heavy snow	941	Jan.	12	The Tengyo era	3	Dec.	7	Kyoto	積雪三尺	Nihon kiryaku	A			
593	Heavy snow	941	Feb.		The Tengyo era	4	Jan.		Izumo	氷塊漂着	Kokonchomonju	A			
594	Long rain	941	Oct.	4	The Tengyo era	4	Sep.	6	Unknown	祈止雨	Honchoseiki	B			
595	Drought	941	Aug. and Sep.		The Tengyo era	4	Jul. and Aug.		Unknown	旱	Honchoseiki, Hokuzansho	C	B		
596	Long rain	941	Sep.		The Tengyo era	4	Aug.		Kyoto	霖雨	Honchoseiki	C			
597	Drought	942	Jun.	28	The Tengyo era	5	May	7	Unknown	旱	Honchoseiki	C			
598	Thunder storm	942	Aug.	22	The Tengyo era	5	Jul.	3	Kyoto	雷火	Washukumederaruki	A			
599	Storm	942	Sep.	28	The Tengyo era	5	Aug.	11	Kyoto	大風雨	Nihon kiryaku, Gogumaiki	A	B		
600	Thunder storm	943	Mar.	20	The Tengyo era	6	Feb.	7	Unknown	烈風,雷雨	Nihon kiryaku	B			
601	Drought	943	From May to Aug.		The Tengyo era	6	From Apr. to Jul.		Kinki district	旱	Tojichojabunin, Nihon kiryaku	C	B		
602	Thunder storm	944	Feb.	10	The Tengyo era	7	Jan.	9	Yamato	雷火	Toji odaiki, Nihon kiryaku	A			
603	Storm	944	Sep.	26	The Tengyo era	7	Sep.	2	All provinces	大風雨	Nihon kiryaku, Fuso ryakuki, Gogumaiki, Hokuzansho	A	B		
604	Flood	944	Oct.	5	The Tengyo era	7	Sep.	11	Kyoto	大雨,洪水	Nihon kiryaku	A	B		
605	Long rain	944	Oct.		The Tengyo era	7	Sep.			霖雨	Hokuzansho	C			
606	Long rain	945	Jun.		The Tengyo era	8	May		Kyoto	霖雨	Nihon kiryaku, Seikyuki	A	C	B	
608	Storm	945	Sep.	11	The Tengyo era	8	Jul.	27	Kyoto	大風雨	Honchoseiki, Seikyuki	A	B		
609	Drought	945	Aug.		The Tengyo era	8	Jul.		Kyoto	旱	Teishinkoukisho, Goshidai	C			
607	Long rain	945	Sep. and Oct.		The Tengyo era	8	Aug. and Sep.		Kyoto	霖雨	Honchoseiki	C			
610	Storm	946	Apr.	4	The Tengyo era	9	Feb.	25	Kyoto	大風	Nihon kiryaku	A	B		
611	Drought	946	Jun.	21	The Tengyo era	9	May	15	Unknown	旱	Teishinkoukisho	C			
612	Long rain	946	Aug.		The Tengyo era	9	Jul.		Unknown	霖雨	Teishinkoukisho	C			
613	Frost	947	May	19	The Tenryaku era	1	Apr.	21	Kyoto	晩霜	Nihon kiryaku	A			
614	Long rain	947	Jul.	12	The Tenryaku era	1	Jun.	17	Kyoto	霖雨	Nihon kiryaku	A	C	B	
615	Storm	947	Jul.	28	The Tenryaku era	1	Jul.	3	Kyoto	大風雨,洪水	Teishinkoukisho, Nihon kiryaku	A	B		

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Appendix 1. Chronological table of climatic disaster in Japan from 601 to 1200.

NO.	Kind of disaster	The Gregorian calendar			The old calendar				Area	Descliption of disaster in Japanese	Historical record	Source 1	Source 2	Source 3	Source 4
		A.D.	Month	Day	The name of Japanese era	Year	Month	Day							
616	Storm	947	Sep.	11	The Tenryaku era	1	leap Jul.	19	Kyoto	大風	Nihon kiryaku	A	B		
617	Drought	948	From May to Jul.		The Tenryaku era	2	From Apr. to Jun.		Kyoto	旱魃	Teishinkoukisho, Nihon kiryaku, Shinkokushiitsubunko, Honchotsuki	A	C	B	
618	Storm	948	Aug.	27	The Tenryaku era	2	Jul.	15	Kyoto	大風雨	Nihon kiryaku, Gifuken chisui nempyo	A	B		
619	Storm	948	Sep.	8	The Tenryaku era	2	Jul.	27	Kyoto	大風雨	Teishinkoukisho, Nihon kiryaku	A	B		
620	Flood	948	Sep.	23	The Tenryaku era	2	Aug.	13	Unknown	洪水	Nihon kiryaku	B			
621	Long rain	948	Sep. and Oct.		The Tenryaku era	2	Aug. and Sep.		Kinki district	霖雨	Nihon kiryaku, Seikyuki	C	B		
622	Long rain	949	May		The Tenryaku era	3	Apr.		Kyoto	霖雨	Nihon kiryaku	C	B		
623	Drought	949	Jul. and Aug.		The Tenryaku era	3	Jun. and Jul.		Kyoto	旱魃	Nihon kiryaku	A	C		
624	Long rain	949	Sep.		The Tenryaku era	3	Aug.		Kyoto	霖雨	Nihon kiryaku	C	B		
625	Flood	949	Sep.	1	The Tenryaku era	3	Aug.	1	Kyoto	洪水	Nihon kiryaku	B			
626	Thunder storm	949	Dec.	7	The Tenryaku era	3	Nov.	10	Yamato	雷火	Nihon kiryaku, Fuso ryakuki	A			
627	Long rain	950	May		The Tenryaku era	4	Apr.		Unknown	霖雨	Nihon kiryaku	B			
629	Drought	952	May		The Tenryaku era	6	Apr.		Unknown	旱	Seikyuki	C	B		
628	Thunder storm	952	Jul.	25	The Tenryaku era	6	Jun.	26	Kinki district	雷火	Koyahennnensyunjusyuroku	A			
630	Drought	954	May and Jun.		The Tenryaku era	8	Apr. and May		Kinki district	旱魃	Kiu nikki	D	C	B	
631	Drought	956	From Jun. to Aug.		The Tenryaku era	10	From Apr. to Jul.		Kyoto	大旱	Hokuzansho, Dai-nihonshi, Seikyuki	A	D	C	B
632	Drought	957	From Apr. to Sep.		The Tentoku era	1	From Mar. to Aug.		Kinki district	旱魃,飢饉	Nihon kiryaku, Hokuzansho, Todaijibettoshidai	D	C	B	
633	Storm	957	Jul.	29	The Tentoku era	1	Jun.	25	Kyoto	大風雨	Nihon kiryaku	A	B		
634	Storm	958	Jan.	17	The Tentoku era	1	Dec.	20	Kyoto	大風雨	Nihon kiryaku	A	B		
635	Long rain	958	Jul.		The Tentoku era	2	Jun.		Unknown	霖雨	Nihon kiryaku	C	B		
636	Flood	959	Jun.	29	The Tentoku era	3	May	16	Kyoto	霖雨,洪水	Nihon kiryaku	A	C	B	
637	Long rain	959	Jul.		The Tentoku era	3	Jun.		Kyoto	霖雨	Nihon kiryaku	C			
638	Drought	959	Aug.	16	The Tentoku era	3	Jul.	5	Unknown	旱	Nihon kiryaku	C	B		
639	Storm	959	Sep.	18	The Tentoku era	3	Aug.	8	Kyoto	大風	Nihon kiryaku	A	B		
640	Thunder storm	960	Mar.	22	The Tentoku era	4	Feb.	17	Kyoto	落雷	Nihon kiryaku	A			
641	Frost	960	Jun.	9	The Tentoku era	4	May	8	Kyoto	降霜	Fuso ryakuki	A			
643	Drought	960	From Jun. to Aug.		The Tentoku era	4	From May toJul.		All provinces	旱魃	Nihon kiryaku, Kiu nikki, Fuso ryakuki	D	C	B	
642	Storm	960	Sep.	16	The Tentoku era	4	Aug.	18	Kyoto	大風	Fuso ryakuki	A	B		
644	Thunder storm	961	Jul.	12	The Owa era	1	May	22	Kyoto	大雷	Fuso ryakuki	A			
645	Drought	961	Aug.		The Owa era	1	Jun.		All provinces	旱魃	Nihon kiryaku, Fuso ryakuki	A	C	B	
646	Storm	961	Aug.	19	The Owa era	1	Jul.	1	Kinki district	大風	Nihon kiryaku	A			
647	Long rain	961	Sep. and Oct.		The Owa era	1	Jul. and Aug.		Kyoto	霖雨	Nihon kiryaku, Kiuki	C	B		
648	Flood	962	Jul.	8	The Owa era	2	May	29	Kyoto	霖雨,洪水	Nihon kiryaku	A	C	B	
649	Long rain	962	Jun. ad Jul.		The Owa era	2	May and Jun.		Kyoto	霖雨	Nihon kiryaku, Kimpimisho	C	B		

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Appendix 1. Chronological table of climatic disaster in Japan from 601 to 1200.

NO.	Kind of disaster	The Gregorian calendar			The old calendar				Area	Descliption of disaster in Japanese	Historical record	Source 1	Source 2	Source 3	Source 4
		A.D.	Month	Day	The name of Japanese era	Year	Month	Day							
650	Thunder storm	962	Jul.	28	The Owa era	2	Jun.	19	Kyoto	落雷	Nihon kiryaku	A			
651	Storm	962	Oct.	6	The Owa era	2	Aug.	30	Yamato	大風雨	Nihon kiryaku, Todaijibettoshidai, Gogumaiki	A	B		
652	Drought	963	From May to Aug.		The Owa era	3	From Apr. to Jul.		Kinki district	早魃	Nihon kiryaku, Choyagunsai, Sandaigyoki, Kofukuji nendaiki	A	C	B	
653	Flood	964	Jun.	24	The Koho era	1	May	7	Kyoto	大雨,洪水	Nihon kiryaku	A			
654	Storm	965	Sep.	30	The Koho era	2	Aug.	28	Kyoto	大風雨,洪水	Nihon kiryaku, Kimpisho	A	B		
655	Long rain	965			The Koho era	2			Kinki district	霖雨	Nijunisha chushiki, Kimpisho	C			
656	Flood	966	Sep.	10	The Koho era	3	Aug.	18	Kyoto	洪水	Fuso ryakuki	A	B		
657	Long rain	966	Sep.		The Koho era	3	Aug.		Kyoto	霖雨	Nihon kiryaku	C			
658	Flood	966	Oct.	10	The Koho era	3	leap Aug.	19	Kyoto	霖雨,洪水	Nihon kiryaku, Nijunisha chushiki	A	C		
659	Thunder storm	968	Mar.	10	The Anna era	1	Feb.	4	Unknown	大風雷	Nihon kiryaku	B			
660	Flood	968	Jun.	23	The Anna era	1	May	20	Kyoto	雨水	Nihon kiryaku	A	C	B	
661	Flood	968	Jun.	29	The Anna era	1	May	26	Kyoto	洪水	Nihon kiryaku	B			
662	Long rain	968	Aug.		The Anna era	1	Jul.		Kyoto	霖雨	Nihon kiryaku	C	B		
663	Drought	969	Aug. and Sep.		The Anna era	2	Jun. and Jul.		Kinki district	旱	Nihon kiryaku	C	B		
664	Storm	969	Sep.	11	The Anna era	2	Jul.	22	Kyoto	大風雨	Nihon kiryaku	A	B		
665	Drought	971	Sep.	21	The Tenroku era	2	Jun.	21	Kinki district	旱	Nihon kiryaku	C	B		
666	Drought	972	From Sep. to Oct.		The Tenroku era	3	From Jun. to Sep.		All provinces	旱	Nihon kiryaku	C	B		
667	Storm	972	Oct.		The Tenroku era	3	Sep.	—	Kyoto	大風	Nihon saiishi, Wakan goun shisho zu	A	B		
668	Hail	973	Apr.	17	The Tenen era	1	Mar.	7	Kyoto	降雹	Nihon kiryaku, Yasutomiki	A			
669	Storm	973	Jun.	25	The Tenen era	1	May	17	Kyoto	大風雨	Nihon kiryaku, Zoku honchotsugan	A	B		
670	Long rain	973	Oct.		The Tenen era	1	Sep.		Unknown	霖雨	Nihon kiryaku	C			
671	Thunder storm	974	Aug.	1	The Tenen era	2	Jul.	6	Kyoto	落雷	Tenenninenki	A			
672	Long rain	974	Sep. and Oct.		The Tenen era	2	Aug. and Sep.		Kyoto	霖雨	Tenenninenki, Kageronikki	A	C	B	
673	Hail	975	May	23	The Tenen era	3	Apr.	5	Kyoto	降雹	Nihon kiryaku, Dai-nihonshi	A			
674	Long rain	975	Jul.		The Tenen era	3	Jun.		Unknown	霖雨	Nihon kiryaku	C	B		
675	Storm	975	Sep.	12	The Tenen era	3	Jul.	29	Kanto district	大風	Nihon kiryaku, Nyozein nendaiki, Nihon unjo roku	A	B		
676	Storm	976	Mar.	20	The Jogen era	1	Feb.	12	Kyoto	風雨	Nihon kiryaku	A	B		
677	Storm	976	Jul.	15	The Jogen era	1	Jun.	11	Kyoto	大風	Nihon kiryaku	A	B		
678	Thunder storm	976	Jul.	30	The Jogen era	1	Jun.	26	Kyoto	雷雨	Nihon kiryaku	A	B		
679	Thunder storm	976	Sep.		The Jogen era	1	Aug.		Kii	風雨,電光	Kumanoshi	A			
680	Storm	976	Oct.	5	The Jogen era	1	Sep.	5	Kyoto	大風	Nihon kiryaku	A	B		
681	Heavy snow	976	Dec.	2	The Jogen era	1	Nov.	4	Kyoto	積雪尺餘	Nihon kiryaku	A			
682	Heavy snow	977	Jan.	26	The Jogen era	1	Dec.	29	Kyoto	積雪尺餘	Nihon kiryaku	A			
683	Long rain	977	Sep.		The Jogen era	2	leap Jul.		Unknown	霖雨	Nihon kiryaku	C	B		
684	Drought	977			The Jogen era	2			Kyoto	早魃	Ryusenji nendaiki	A	C		

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Appendix 1. Chronological table of climatic disaster in Japan from 601 to 1200.

NO.	Kind of disaster	The Gregorian calendar			The old calendar				Area	Descliption of disaster in Japanese	Historical record	Source 1	Source 2	Source 3	Source 4
		A.D.	Month	Day	The name of Japanese era	Year	Month	Day							
685	Thunder storm	978	Jun.	2	The Tengen era	1	Apr.	19	Kyoto	雷鳴,降雹	Nihon kiryaku, Shiryo soran	A			
686	Thunder storm	978	Sep.	3	The Tengen era	1	Jul.	23	Kyoto	落雷	Hyakurensho, Nihon kiryaku	A			
687	Thunder storm	978	Sep.	4	The Tengen era	1	Jul.	24	Kyoto	落雷	Hyakurensho, Nihon kiryaku	A			
688	Hail	979	May	11	The Tengen era	2	Apr.	8	Kyoto	降雹	Nihon kiryaku, Dai-nihonshi	A			
689	Flood	979	Jul.	9	The Tengen era	2	Jun.	8	Kyoto	雨水	Nihon saiishi, Nihon kiryaku	A	B		
690	Hail	980	Apr.	4	The Tengen era	3	Mar.	12	Kyoto	降雹	Nihon kiryaku	A			
691	Storm	980	Aug.	27	The Tengen era	3	Jul.	9	Kyoto	大風雨	Nihon kiryaku, Fuso ryakuki	A	B		
692	Flood	980	Sep.	2	The Tengen era	3	Jul.	15	Kyoto	大雨,洪水	Nihon kiryaku, Hyakurensho	A	B		
693	Flood	980	Sep.	17	The Tengen era	3	Aug.	1	Kyoto	洪水	Fuso ryakuki, Dai-nihonshi	A	B		
694	Long rain	982	Jun.		The Tengen era	5	May		Kyoto	霖雨	Shoyuki, Zoku honchotsugan	A	C	B	
695	Drought	982	Aug.	12	The Tengen era	5	Jul.	16	Kyoto	旱魃,飢饉	Nihon kiryaku, Zoku honchotsugan	A	C	B	
696	Storm	982	Sep.	15	The Tengen era	5	Aug.	20	Kyoto	大風	Nihon kiryaku, Hyakurensho	A	B		
697	Drought	983	Aug.		The Eikan era	1	Jun.		Unknown	災旱,祈雨	Nihon kiryaku	B			
698	Drought	984	Jul.	4	The Eikan era	2	May	28	Kinki district	旱	Nihon kiryaku, Honcho monzui	C			
699	Storm	984	Sep.		The Eikan era	2	Aug.	一	Kyoto	大風	Ryusenji nendaiki	A			
700	Long rain	984	Dec.	7	The Eikan era	2	Nov.	7	Unknown	霖雨	Shoyuki	B			
701	Drought	985	From Jul. to Sep.		The Kanna era	1	From Jun. to Aug.		All provinces	旱	Nihon kiryaku, Shoyuki	C	B		
702	Hail	986	Jun.	13	The Kanna era	2	Apr.	28	Kyoto	降雹	Honchoseiki	A			
703	Long rain	986	Jul.		The Kanna era	2	Jun.		Kyoto	霖雨	Nihon kiryaku, Honchoseiki	C	B		
704	Drought	986	Aug.	16	The Kanna era	2	Jul.	4	Unknown	旱	Nihon kiryaku, Fuso ryakuki	C			
705	Thunder storm	987	Jul.	2	The Eien era	1	May	29	Yamato	落雷	Todaijibettoshidai	A			
707	Drought	987	From Jun. to Aug.		The Eien era	1	From May to Jul.		Kinki district	大旱	Nihon kiryaku, Fuso ryakuki, Kiu nikki	A	C	B	
706	Storm	987	Jul.	6	The Eien era	1	Jun.	3	Unknown	大雨	Nihon kiryaku	B			
708	Storm	987	Aug.	31	The Eien era	1	Jul.	29	Kyoto	大風雨	Nihon kiryaku	A	B		
709	Storm	989	Mar.	9	The Eiso era	1	Jan.	24	Unknown	暴風雨	Shoyuki	B			
710	Flood	989	Jul.	23	The Eiso era	1	Jun.	13	Unknown	大風,洪水	Fuso ryakuki	B			
711	Storm	989	Sep.	20	The Eiso era	1	Aug.	13	All provinces	大風雨,洪水,高潮	Nihon kiryaku, Fuso ryakuki, Teio hennen ki, Nyozein nendaiki, Ryusenji nendaiki, Konjaku monogatari, Nihon saiishi	A	B		

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		A.D.	Month	Day	The name of Japanese era	Year	Month	Day							
712	Storm	990	Mar.	7	The Shoryaku era	1	Feb.	3	Unknown	大風	Honchonendaiki	B			
713	Thunder storm	990	Sep.	8	The Shoryaku era	1	Aug.	12	Kyoto	大雷雨,雹,豊樂殿雷火	Shoyuki, Honchoseiki, Dai-nihonshi	A			
714	Storm	990	Sep.	24	The Shoryaku era	1	Aug.	28	Kyoto	大風雨,洪水	Shoyuki, Honchoseiki	A	B		
715	Storm	991	Feb.	25	The Shoryaku era	2	Feb.	3	Yamato	大風	Hasedera reigen ki	A			
716	Drought	991	From Jun. to Sep.		The Shoryaku era	2	From Apr. to Jul.		All provinces	旱魃	Kiuho ki, Kiu nikki, Fuso ryakuki, Nihon kiryaku, Hyakurensho	A	C	B	
717	Long rain	991	Sep.		The Shoryaku era	2	Aug.		Unknown	霖雨	Nihon kiryaku	B			
718	Flood	992	Jul.	4	The Shoryaku era	3	May	26	Kyoto	洪水	Nihon kiryaku	A	B		
719	Thunder storm	992	Jul.	8	The Shoryaku era	3	Jun.	1	Kyoto	雷鳴,洪水	Nihon kiryaku	A	B		
720	Thunder storm	993	Aug.	15	The Shoryaku era	4	Jul.	20	Kyoto	落雷	Shoyuki, Honchoseiki	A			
721	Drought	994	Jul.		The Shoryaku era	5	Jun.		Unknown	旱	Honchoseiki	C			
722	Thunder storm	994	Aug.	20	The Shoryaku era	5	Jul.	6	Omi	雷火	Koyasan monjo, Koyahennnensyunjusyuroku, Kofukuji ryakunenndaiki, Shiryo soran	A			
723	Storm	994	Sep.	3	The Shoryaku era	5	Jul.	20	Kyoto	大風	Nihon kiryaku	A	B		
724	Storm	994	Nov.	7	The Shoryaku era	5	Sep.	26	Unknown	大風	Ruiju fusensho	B			
725	Thunder storm	995	May	25	The Chotoku era	1	Apr.	18	Kyoto	雷鳴,降雹	Nihon kiryaku	A	B		
726	Long rain	995	Oct.		The Chotoku era	1	Sep.		Unknown	霖雨	Nihon kiryaku	C			
727	Thunder storm	995	Nov.	15	The Chotoku era	1	Oct.	15	Unknown	雷雨	Gonki	B			
728	Thunder storm	995	Dec.	24	The Chotoku era	1	Nov.	25	Unknown	雷鳴	Nihon kiryaku	B			
729	Storm	996	Mar.	6	The Chotoku era	2	Feb.	8	Kyoto	大風	Nihon kiryaku	A	B		
730	Drought	996	Jun. and Jul.		The Chotoku era	2	May and Jun.		Unknown	旱	Nihon kiryaku, Gonki	C			
731	Hail	996	Jul.	20	The Chotoku era	2	Jun.	27	Kyoto	降雹	Nihon kiryaku	A	B		
732	Flood	996	Aug.	31	The Chotoku era	2	leap Jul.	10	Kyoto	洪水	Nihon kiryaku	A	B		
733	Storm	996	Sep.	11	The Chotoku era	2	leap Jul.	21	Kyoto	大風	Nihon kiryaku	A	B		
734	Drought	997	Mar.		The Choho era	3	Feb.		Unknown	旱	Nihon kiryaku, Gonki	C			
735	Long rain	997	Oct. and Nov.		The Choho era	3	Sep. and Oct.		Unknown	霖雨	Gonki	C			
736	Drought	998	Jul.		The Choho era	4	Jun.		Unknown	旱	Nihon kiryaku, Ruiju fusensho	C			
737	Storm	998	Sep.	18	The Choho era	4	Aug.	20	Kyoto	大風	Nihon kiryaku, Shodokanmon	A	B		
738	Flood	998	Sep.	29	The Choho era	4	Sep.	1	Kyoto	霖雨,洪水	Fushiminomiya kiroku	C			
739	Heavy snow	1000	Feb.	21	The Choho era	2	Jan.	9	Kyoto	積雪二尺	Nihon kiryaku, Mido kanpaku ki	A	B		
740	Thunder storm	1000	May	19	The Choho era	2	Apr.	7	Kyoto	雷火	Nihon kiryaku, Fuso ryakuki	A			
741	Drought	1000	Jun.	14	The Choho era	2	May	4	Unknown	祈雨	Nihon kiryaku	B			
742	Flood	1000	Sep.	22	The Choho era	2	Aug.	16	Kyoto	大雨,洪水	Gonki	A	C	B	
743	Thunder storm	1002	May	2	The Choho era	4	Mar.	11	Kyoto	雷電,降雹	Nihon kiryaku, Fuso ryakuki	A	B		

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Appendix 1. Chronological table of climatic disaster in Japan from 601 to 1200.

NO.	Kind of disaster	The Gregorian calendar			The old calendar				Area	Descliption of disaster in Japanese	Historical record	Source 1	Source 2	Source 3	Source 4
		A.D.	Month	Day	The name of Japanese era	Year	Month	Day							
744	Drought	1002	Aug.		The Choho era	4	Jun.		Unknown	旱	Ruiju fusensho	B			
745	Long rain	1002	Sep.		The Choho era	4	Aug.		Unknown	霖雨	Nihon kiryaku, Honchoseiki	C			
746	Flood	1003	Jun.	27	The Choho era	5	May	19	Kyoto	大雨,洪水	Honchoseiki, Nihon kiryaku	A	B		
747	Storm	1003	Oct.	2	The Choho era	5	Aug.	28	Ise	大風	Ruiju fusensho	A			
748	Storm	1003	Dec.	15	The Choho era	5	Nov.	13	Unknown	大風,暴雨,雷,雪	Nihon kiryaku	B			
749	Thunder storm	1004	Feb.	18	The Kanko era	1	Jan.	19	Unknown	大雨,雷電	Nihon kiryaku	B			
750	Storm	1004	Feb.	26	The Kanko era	1	Jan.	27	Unknown	飄風	Gonki	B			
751	whirlwind	1004	May	24	The Kanko era	1	Apr.	27	Kyoto	旋風	Shiryo soran	A			
752	Drought	1004	From Jul. to Sep.		The Kanko era	1	From Jun. to Aug.		All provinces	旱魃	Ryusenji nendaiki, Nihon kiryaku, Hyakurensho	A	C	B	
753	Thunder storm	1005	May	19	The Kanko era	2	Apr.	3	Unknown	大風,雷雨	Nihon kiryaku, Shoyuki	B			
754	Storm	1005	Jun.	30	The Kanko era	2	May	15	Unknown	大風雨	Nihon kiryaku, Shoyuki	B			
755	Flood	1005	Jul.	2	The Kanko era	2	May	17	Kyoto	雨水	Shoyuki	A			
756	Thunder storm	1005	Jul.	8	The Kanko era	2	May	23	Kyoto	落雷	Shoyuki, Nihon kiryaku	A			
757	Long rain	1005	Sep.		The Kanko era	2	Aug.		Unknown	霖雨,祈止雨	Nihon kiryaku, Mido kanpaku ki	C	B		
758	Thunder storm	1005	Dec.	11	The Kanko era	2	Nov.	2	Kyoto	大雷,降雹	Shoyuki, Nihon kiryaku, Hojoji sesho ki, Nihon kiryaku	A	B		
759	Long rain	1006	Sep.		The Kanko era	3	Aug.		Unknown	霖雨	Mido kanpaku ki	C			
760	Thunder storm	1006	Sep.	23	The Kanko era	3	Aug.	22	Unknown	雷鳴	Hojoji sesho ki	B			
761	Drought	1006	Oct.	4	The Kanko era	3	Sep.	4	Unknown	旱	Nihon kiryaku	C			
762	Drought	1007	Aug. and Sep.		The Kanko era	4	Jun. and Jul.		Unknown	旱	Nihon kiryaku, Gonki	C	B		
763	Thunder storm	1007	Aug.	22	The Kanko era	4	Jul.	1	Unknown	雷雨	Hojoji sesho ki	B			
764	Long rain	1007	Oct.		The Kanko era	4	Aug.		Unknown	霖雨	Nihon kiryaku	C	B		
765	Thunder storm	1008	May	3	The Kanko era	5	Mar.	19	Unknown	雷雨	Hojoji sesho ki	B			
766	Long rain	1008	Sep.		The Kanko era	5	Aug.		Unknown	霖雨	Nihon kiryaku, Mido kanpaku ki	C	B		
767	Thunder storm	1009	Apr.	25	The Kanko era	6	Mar.	22	Kyoto	雷電,降雹	Nihon kiryaku, Dai-nihonshi	A	B		
768	Thunder storm	1009	Aug.	26	The Kanko era	6	Jul.	27	Unknown	雷雨	Nihon kiryaku	B			
769	Long rain	1009	Sep.	8	The Kanko era	6	Aug.	11	Unknown	霖雨	Mido kanpaku ki	C			
770	Thunder storm	1009	Oct.	30	The Kanko era	6	Oct.	4	Unknown	雷雨	Nihon kiryaku	B			
771	Thunder storm	1009	Dec.	29	The Kanko era	6	Dec.	5	Unknown	雷鳴	Nihon kiryaku	B			
772	Storm	1010	Feb.	13	The Kanko era	7	Jan.	21	Kyoto	大風	Nihon kiryaku	A	B		
773	Storm	1010		3), 25-26	The Kanko era	7	26th Feb., From first to second lea		Kyoto	大風雨	Nihon kiryaku, Gonki	A	B		
774	Storm	1010	Aug.	24-26	The Kanko era	7	Jul.	6-8	Kyoto	風雨,洪水	Nihon kiryaku, Mido kanpaku ki	A	B		
775	Long rain	1010	Oct. and Nov.		The Kanko era	7	Aug. and Sep.		Kinki district	霖雨	Nihon kiryaku, Mido kanpaku ki, Kitanoin omuro hinamiki	A	D	B	

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		A.D.	Month	Day	The name of Japanese era	Year	Month	Day							
776	Thunder storm	1011	Feb.	16	The Kanko era	8	Jan.	5	Unknown	雷電	Nihon kiryaku, Hyakurensho	B			
777	Thunder storm	1011	Apr.	5	The Kanko era	8	Feb.	23	Kyoto	雷雨,降雹	Nihon kiryaku, Hyakurensho	A	B		
778	Thunder storm	1011	Jun.	15	The Kanko era	8	May	5	Unknown	雷電	Nihon kiryaku, Hyakurensho	B			
779	Thunder storm	1011	Oct.	11	The Kanko era	8	Sep.	6	Unknown	雷雨	Nihon kiryaku, Hyakurensho	B			
780	Storm	1011	Nov.	27	The Kanko era	8	Oct.	24	Kyoto	大風,洪水	Nihon saiishi, Nihon shisaikyokinko	A	B		
781	Thunder storm	1012	Mar.	11	The Chowa era	1	Feb.	10	Unknown	雷電,風雨	Nihon kiryaku	B			
782	Storm	1012	May	26	The Chowa era	1	Apr.	27	Unknown	大雨	Nihon kiryaku	B			
783	Thunder storm	1012	Jul.	10	The Chowa era	1	Jun.	13	Unknown	雷雨	Shoyuki	B			
784	Thunder storm	1012	Jul.	25	The Chowa era	1	Jun.	28	Kyoto	落雷	Shoyuki, Nihon kiryaku	A	B		
785	Thunder storm	1012	Aug.	1	The Chowa era	1	Jul.	5	Unknown	大雨,雷鳴	Shoyuki	B			
786	Storm	1013	Mar.	3	The Chowa era	2	Jan.	13	Unknown	大風雨	Shoyuki	B			
787	Storm	1013	Mar.	2 or 17	The Chowa era	2	Jan.	22 or 27	Unknown	大雨	Shoyuki	B			
788	Storm	1013	Apr.	26	The Chowa era	2	Mar.	8	Unknown	大雨	Shoyuki	B			
789	Storm	1013	May	3	The Chowa era	2	Mar.	15	Unknown	大雨	Shoyuki	B			
790	Thunder storm	1013	May	17	The Chowa era	2	Mar.	29	Kyoto	大雷,降雹	Mido kanpaku ki, Shoyuki	A	B		
791	Thunder storm	1013	May	26	The Chowa era	2	Apr.	8	Unknown	雷雨	Shoyuki	B			
792	Thunder storm	1013	Jul.	30	The Chowa era	2	Jun.	14	Kyoto	大雷,降雹	Shoyuki, Nihon kiryaku, Honchoseiki	A	B		
793	Thunder storm	1013	Sep.	3	The Chowa era	2	Jul.	19	Unknown	雷雨	Shoyuki	B			
794	Long rain	1013	Sep.		The Chowa era	2	Aug.		Kyoto	霖雨,祈止雨	Mido kanpaku ki, Shoyuki	C	B		
795	Long rain	1014	Aug.		The Chowa era	3	Jul.		Unknown	霖雨	Shoyuki mokuroku	C			
796	Storm	1014	Sep.	23	The Chowa era	3	Aug.	21	Kyoto	大風	Nihon kiryaku, Hanawa shiryo	A	B		
797	Storm	1014	Dec.	24	The Chowa era	3	Nov.	24	Unknown	大風	Nihon kiryaku, Shoyuki	B			
798	Storm	1015	May	19	The Chowa era	4	Apr.	23	Unknown	大雨	Nihon kiryaku	B			
799	Storm	1015	Jun.	17	The Chowa era	4	May	22	Kyoto	風雨	Mido kanpaku ki, Shoyuki	A	B		
800	Storm	1015	Jun.	28	The Chowa era	4	Jun.	4	Unknown	大雨	Nihon kiryaku	B			
801	Storm	1015	Jul.	6	The Chowa era	4	Jun.	12	Unknown	大雨	Nihon kiryaku	B			
802	Thunder storm	1015	Sep.	6	The Chowa era	4	Jul.	15	Kyoto	雷雨,洪水	Shoyuki	A	B		
803	Storm	1015	Sep.	30	The Chowa era	4	Aug.	9	Kyoto	大風	Nihon kiryaku	A			
804	Storm	1015	Nov.	10	The Chowa era	4	Sep.	20	Unknown	大雨	Nihon kiryaku	B			
805	Storm	1015	Nov.	25	The Chowa era	4	Oct.	5	Kyoto	風雨	Mido kanpaku ki	A			
806	Drought	1016	Jun. and Jul.		The Chowa era	5	May and Jun.		All provinces	大旱	Mido kanpaku ki, Shoyuki	C	B		
807	Storm	1016	Sep.	20	The Chowa era	5	Aug.	11	Kyoto	大風	Nihon kiryaku, Mido kanpaku ki	A	B		
808	Flood	1016	Oct.	11	The Chowa era	5	Sep.	2	Harima	洪水	Hyogoken Innamigun shi	A			

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		A.D.	Month	Day	The name of Japanese era	Year	Month	Day							
809	Thunder storm	1017	Jul.	24	The Kannin era	1	Jun.	22	Yamato	雷火	Sogobuninsyoshutu, Nihon kiryaku, Kofukuji ryakunenndaiki	A			
810	Flood	1017	Aug.	1	The Kannin era	1	Jul.	1	Kyoto	霖雨,洪水	Sakeiki, Nihon kiryaku	A	C	B	
811	Thunder storm	1017	Aug.	7	The Kannin era	1	Jul.	7	Kyoto	落雷	Mido kanpaku ki	A			
812	Heavy snow	1018	From the last of Feb. to the first of Mar.		The Kannin era	2	From the last of Jan. to the first o		Kyoto	多雪	Sakeiki	A			
813	Hail	1018	Jun.	15	The Kannin era	2	leap Apr.	23	Kyoto	降雹,大風	Nihon kiryaku, Dai-nihonshi	A	B		
814	Thunder storm	1018	Aug.	19	The Kannin era	2	Jun.	29	Kyoto	落雷數所,暴雨	Sakeiki, Shoyuki	A	B		
815	Drought	1018	From the middle of May to the first of Aug.		The Kannin era	2	From the last of May to the first of Jun.			旱損,大旱	Shoyuki, Mido kanpaku ki	A	C	B	
816	Storm	1019	Apr.	7	The Kannin era	3	Feb.	23	Kyoto	大風	Nihon kiryaku, Mido kanpaku ki	A			
817	Drought	1019	Around the first of Jul.		The Kannin era	3	Around the first of May.		Unknown	祈雨	Nihon kiryaku	B			
818	Storm	1020	Aug.	19	The Kannin era	4	Jul.	22	Kyoto	大風	Nihon kiryaku	A	B		
819	Storm	1020	Sep.	18	The Kannin era	4	Aug.	22	Kyoto	大風雨	Fuso ryakuki, Nihon kiryaku	A	B		
822	Drought	1021	From the last of May to the middle of Oct.		The Jian era	1	From Apr. to the first of Sep.		Kyoto	旱魃,飢饉	Ichidaiyoki, Nihon kiryaku	A	C	B	
820	Thunder storm	1021	Sep.	10-11	The Jian era	1	Jul.	25－26	Unknown	風雨,雷鳴	Nihon kiryaku	B			
821	Long rain	1021	Aug. and Sep.		The Jian era	1	Jul. and Aug.		Kyoto	霖雨,大風,飢饉	Nihon kiryaku	D			
823	Long rain	1022	Aug. and Sep.		The Jian era	2	Jul. and Aug.		Kyoto	霖雨,飢饉	Ryusenji nendaiki	A	C	B	
824	Storm	1022			The Jian era	2			All provinces	大風	Ryusenji nendaiki	A			
825	Thunder storm	1022	Dec.	3	The Jian era	2	Nov.	1	Omi	雷火	Sakeiki	A			
826	Drought	1023	Jun.		The Jian era	3	May		Unknown	旱魃	Shoyuki	B			
827	Storm	1023	Jul.	30	The Jian era	3	Jul.	4	Unknown	大風雨	Nihon kiryaku	B			
828	Drought	1024	May	27	The Manju era	1	Apr.	11	Unknown	祈雨	Shoyuki	B			
829	Hail	1024	Aug.	28	The Manju era	1	Jul.	16	Osumi	降雹	Nyozein nendaiki	A			
830	Storm	1025	Aug.	2	The Manju era	2	Jun.	30	Totomi	大雨	Shoyuki	B			
831	Drought	1025	Jul. and Aug.		The Manju era	2	Jun. and Jul.		All provinces	大旱	Shoyuki, Sakeiki, Nihon kiryaku	A	C	B	
832	Storm	1026	Jan.	10	The Manju era	2	Dec.	13	Kyoto	暴風	Shoyuki	B			
833	Storm	1026	Oct.	6	The Manju era	3	Aug.	17	Kyoto	大風雨	Sakeiki, Nihon kiryaku	A	B		
834	Heavy snow	1027	May		The Manju era	4	Apr.		Unknown	大雪	Honchonendaiki	B			
835	Storm	1027	Jun.	26	The Manju era	4	May	14	Kyoto	大風	Nihon kiryaku	A	B		
836	Thunder storm	1027	Jul.	6	The Manju era	4	May	24	Kyoto	落雷,洪水	Nihon kiryaku, Fuso ryakuki	A	B		
837	Storm	1027	Oct.	21	The Manju era	4	Sep.	13	Kyoto	大風	Nihon kiryaku	A	B		
838	Drought	1028	From Jun. to Aug.		The Chogen era	1	From May to Jul.		Kyoto	大旱	Nihon kiryaku	A	C		
839	Storm	1028	Jun.	9	The Chogen era	1	May	8	Kyoto	風雨	Sakeiki	A	B		
840	Thunder storm	1028	Sep.	1	The Chogen era	1	Aug.	4	Kyoto	大雷	Sakeiki	A			
841	Storm	1028	Sep.	6	The Chogen era	1	Aug.	9	Kyoto	大風	Sakeiki, Zoku honchotsugan, Dai-nihonshi, Nihon saiishi	A			

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		A.D.	Month	Day	The name of Japanese era	Year	Month	Day							
842	Flood	1028	Sep.	20	The Chogen era	1	Aug.	23	Unknown	水害	Sakeiki	B			
843	Storm	1028	Sep.	28	The Chogen era	1	Sep.	2	Kinki district	大風雨,洪水	Sakeiki, Nihon kiryaku	A	B		
844	Flood	1029	Jun.	11	The Chogen era	2	Apr.	21	Kyoto	大雨,洪水	Nihon kiryaku	A	B		
845	Storm	1030	Sep.	15	The Chogen era	3	Aug.	9	Kyoto	大風	Heihanki, Nihon saiishi	A	B		
846	Flood	1030	Sep.		The Chogen era	3	Aug.		Kyoto	霖雨,洪水	Nihon kiryaku	C	B		
847	Thunder storm	1031	Aug.	21	The Chogen era	4	Jul.	25	Kyoto	落雷	Shoyuki, Dai-nihonshi	A			
848	Drought	1031	Aug.		The Chogen era	4	Jul.		Mimasaka	旱魃	Shoyuki	A	C	B	
849	Long rain	1031	Sep. and Oct.		The Chogen era	4	Aug. and Sep.		Kyoto	霖雨,洪水	Sakeiki, Nihon kiryaku	A	C	B	
850	Drought	1032	From Apr. to Aug.		The Chogen era	5	From Feb. to Jun.		Kinki district	旱魃,豊作	Nihon kiryaku, Hyakurensho	A	C	B	
851	Storm	1032	Jun.	8	The Chogen era	5	Apr.	22	Buzen	大風	Nihon kiryaku	A	B		
852	Long rain	1033	From Feb. to Aug.		The Chogen era	6	From Jan. to Jul.		Unknown	雨多く	Hyakurensho, Sakeiki	B			
853	Drought	1033	Summer		The Chogen era	6	Summer		Unknown	旱魃	Nihon kiryaku	B			
855	Flood	1034	Sep.		The Chogen era	7	Jul.		Kyoto	霖雨,洪水	Sakeiki	A	C		
854	Storm	1034	Sep.	30	The Chogen era	7	Aug.	9	Kyoto	大風雨	Sakeiki, Nihon kiryaku, Fuso ryakuki	A	B		
856	Thunder storm	1035	May	22	The Chogen era	8	Apr.	7	Kyoto	雷雨,降雹	Sakeiki	A			
857	Drought	1035	Jun.		The Chogen era	8	May		Unknown	旱魃	Sakeiki	B			
858	Flood	1035	zOct.	20	The Chogen era	8	Sep.	11	Unknown	洪水	Daijingu shozojiki	B			
859	Thunder storm	1037	May	31	The Choryaku era	1	leap Apr.	8	Kyoto	雷鳴,降雹	Fuso ryakuki, Hyakurensho, Heiki	A			
860	Drought	1038	Jul.		The Choryaku era	2	Jun.		Unknown	旱魃	Kiu nikki	C	B		
861	Flood	1040	Jul.	15	The Chokyu era	1	May	27	Kyoto	大雨,大水	Shunki, Hyakurensho	A	B		
862	Drought	1040	Aug.		The Chokyu era	1	Jun.		Unknown	炎旱,祈雨	Shunki	B			
863	Storm	1040	Aug.	6	The Chokyu era	1	Jun.	20	Kyoto	大風	Shiryo soran, Shunki	A	B		
864	Storm	1040	Sep.	11	The Chokyu era	1	Jul.	26	Kinki district	大風雨,洪水	Daijingu shozojiki, Shunki, Kanchuki, Hyakurensho, Dai-nihonshi, Kojidan	A	B		
865	Storm	1040	Oct.		The Chokyu era	1	Sep.		Kyoto	大風	Nihon saiishi	A			
866	Heavy snow	1040	Dec.	23	The Chokyu era	1	Nov.	11	Kyoto	積雪一尺三寸	Shunki	A			
867	Drought	1043	From Mar. to Jul.		The Chokyu era	4	From Jan. to May		All provinces	大旱	Kiu nikki, Fuso ryakuki	A	C	B	
868	Drought	1045	Aug. and Sep.		The Kantoku era	2	Jun. and Jul.		Unknown	大旱	Tojichojabunin	B			
869	Flood	1046	Jul.	9	The Eisyo era	1	May	27	Kyoto	洪水	Fuso ryakuki	A	B		
870	Drought	1047	Jul. and Aug.		The Eisyo era	2	Jun. and Jul.		All provinces	旱魃	Fuso ryakuki	A	C	B	
871	Storm	1047	Oct.	5	The Eisyo era	2	Sep.	8	Kyoto	大風	Fuso ryakuki	A	B		
872	Flood	1050	Oct.	19	The Eisyo era	5	Sep.	25	Ise	大雨,洪水	Daijingu shozojiki	A			
873	Storm	1051	Aug.	21	The Eisyo era	6	Jul.	7	Kyoto	大風	Hyakurensho	A	B		

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874	Storm	1051	Oct.	27	The Eisyo era	6	Sep.	14	Ise	大風,洪水	Daijingu shozojiki	A			
875	Thunder storm	1055	Sep.	20	The Tenki era	3	Aug.	21	Yamato	雷火	Fuso ryakuki, Sogobunin, Hyakurensho, Koyahennnensyunjusyuroku	A			
876	Flood	1056	Nov.		The Tenki era	4	Sep.	—	Ise	大雨,洪水	Daijingu shozojiki	A			
877	Thunder storm	1057	Aug.	22	The Tenki era	5	Jul.	14	Yamato	落雷	Todaijibettoshidai	A			
878	Long rain	1059	Jan.	8	The Kohei era	1	Dec.	16	Shinano	霖雨	Fuso ryakuki	A	C	B	
879	Flood	1059	Jun.	20	The Kohei era	2	May	2	Kyoto	大雨,洪水	Fuso ryakuki	A	B		
880	Storm	1059	Aug.	28	The Kohei era	2	Jul.	12	Kyoto	大風	Hyakurensho	A	B		
881	Drought	1060	Jul.	28	The Kohei era	3	Jun.	22	Kyoto	大旱	Fuso ryakuki	A	C	B	
882	Long rain	1062	Sep.		The Kohei era	5	Aug.		Mutsu	霖雨	Mutsu waki	C			
883	Drought	1063	Summer		The Kohei era	6	Summer		Unknown	旱	Hyakurensho	C	B		
884	Storm	1064	Apr.		The Kohei era	7	Mar.		Chikuzen	大風	Fuso ryakuki	A	B		
885	Thunder storm	1064	May	14	The Kohei era	7	Apr.	19	Kyoto	雷雨,降雹	Fuso ryakuki	A			
886	Drought	1064	Summer		The Kohei era	7	Summer		Unknown	旱	Bunrui honchonendaiki	C	B		
887	Drought	1065	Jun. and Jul.		The Jiryaku era	1	May and Jun.		All provinces	旱魃	Fuso ryakuki, Kofukuji betto shidai, Rekidai koki	A	C	B	
888	Hail	1065	Aug.	4	The Jiryaku era	1	Jun.	24	Yamato	降雹	Fuso ryakuki	A			
889	Thunder storm	1066	Jun.	14	The Jiryaku era	2	May	13	Ise	雷電,降雹	Daijingu shozojiki, Fuso ryakuki	A			
890	Drought	1066	Aug.		The Jiryaku era	2	Jul.		Unknown	旱魃		B			
891	Flood	1066	Sep.	22	The Jiryaku era	2	Aug.	24	Ise	大雨,洪水	Daijingu shozojiki	A			
892	Drought	1067	Aug.	3	The Jiryaku era	3	Jun.	15	Unknown	災旱	Chushi sho	B			
893	Storm	1068	Feb.	14	The Jiryaku era	4	Jan.	3	Ise	大風	Daijingu shozojiki	A			
894	Storm	1069	Sep.	30	The Enkyu era	1	Sep.	7	Kinki district	大風雨	Toyo ki, Fuso ryakuki, Rekidai koki	A	D	B	
895	Hail	1072	May	15	The Enkyu era	4	Apr.	19	Kyoto	降雹	Nyozein nendaiki	A			
896	Flood	1073	Jun.		The Enkyu era	5	May		Kyoto	洪水	Hyakurensho	A	B		
897	Drought	1077	From Jul. to Sep.		The Jyoryaku era	1	From Jun. to Aug.		Kyoto	大旱	Suisaki	A	C	B	
898	Flood	1078	Jun.	23	The Jyoryaku era	2	May	5	Kyoto	大雨,洪水	Fuso ryakuki	A	B		
899	Flood	1079	Aug.	3	The Jyoryaku era	3	Jun.	27	Ise	洪水	Fuso ryakuki	A	B		
900	Flood	1080	Jul.	13	The Jyoryaku era	4	Jun.	18	Kyoto	大雨,洪水	Fuso ryakuki, Suisaki	A	B		
901	Thunder storm	1080	Sep.	24	The Jyoryaku era	4	leap Aug.	3	Ise	落雷	Suisaki	A			
902	Thunder storm	1081			The Eiho era	1			Yamato	雷火	Horyuji betto shidai	D			
903	Flood	1081	Jun.	1	The Eiho era	1	Apr.	15	Kyoto	大雨,洪水	Sochi ki, Fuso ryakuki	A			
904	Flood	1081	Jun.	21	The Eiho era	1	May	6	Kyoto	大雨,洪水	Sochi ki	A			
905	Storm	1082	Feb.	13	The Eiho era	2	Jan.	7	Unknown	雨大	Kiu nikki	B			
906	Drought	1082	Feom May to Aug.		The Eiho era	2	From Apr. to Jul.		All provinces	旱魃,飢饉	Fuso ryakuki, Hyakurensho	A	D	C	B
907	Storm	1084	Sep.	30	The Otoku era	1	Aug.	22	Kyoto	大風	Gyorogusho, Jimoku taisei sho, Dai-nihonshi	A			
908	Storm	1085	Sep.	23	The Otoku era	2	Aug.	26	Kyoto	大風	Tendai zasu ki, Honchotsuki	A	B		

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Appendix 1. Chronological table of climatic disaster in Japan from 601 to 1200.

NO.	Kind of disaster	The Gregorian calendar			The old calendar				Area	Descliption of disaster in Japanese	Historical record	Source 1	Source 2	Source 3	Source 4
		A.D.	Month	Day	The name of Japanese era	Year	Month	Day							
909	Drought	1087	Aug.		The Kanji era	1	Jul.		Unknown	旱	Chuyuki, Gukansho	B			
910	Storm	1088	Jan.	31	The Kanji era	1	Dec.	29	Unknown	大風	Chuyuki	B			
912	Drought	1088	Jul. and Aug.		The Kanji era	2	Jun. and Jul.		All provinces	大旱	Ryusenji nendaiki, Choyagunsai	A	C	B	
911	Thunder storm	1088	Aug.	4	The Kanji era	2	Jul.	9	Kyoto	大雷電	Ryusenji nendaiki	A	B		
913	Drought	1089	Jul.		The Kanji era	3	May		Kinki district	旱魃	Chuyuki	D	B		
914	Thunder storm	1089	Sep.	2	The Kanji era	3	Jul.	19	Kyoto	雷震	Kiu nikki	A			
915	Drought	1090	Jun.		The Kanji era	4	May		Unknown	旱	Chuyuki	C	B		
916	Storm	1091	Feb.	9	The Kanji era	5	Jan.	12	Kinki district	大風雨	Chuyuki, Fuso ryakuki	A	B		
917	Storm	1091	Mar.	15−16	The Kanji era	5	Feb.	17−18	Unknown	大風	Chuyuki	B			
918	Storm	1091	Oct.	1	The Kanji era	5	Aug.	10	Kyoto	大風	Shiryo soran, Chuyuki	A	B		
919	Storm	1092	Sep.	13	The Kanji era	6	Aug.	3	All provinces	大風,高潮	Fuso ryakuki, Kanchuki, Jusandai yoryaku	A	B		
920	Flood	1092	Sep.	19	The Kanji era	6	Aug.	9	Kyoto	大雨,水損	Chuyuki	A			
921	Storm	1092	Oct.	10	The Kanji era	6	Sep.	1	Kyoto	大風雨	Go Nijo moromichi ki	A			
922	Drought	1092			The Kanji era	6			Izumi, Kii	旱魃	Shiryo soran, Go Nijo moromichi ki	A	C	B	
923	Long rain	1092			The Kanji era	6			Kanto district	霖雨	Go Nijo moromichi ki	A	C		
924	Storm	1093	May	22	The Kanji era	7	Apr.	19	Kyoto	大雨	Chuyuki	B			
925	Storm	1093	Aug.	26	The Kanji era	7	Jul.	26	Unknown	大雨	Chuyuki	B			
926	Flood	1093	Sep.	17	The Kanji era	7	Aug.	18	Kyoto	大雨,洪水	Fuso ryakuki, Go Nijo moromichi ki	A	B		
927	Heavy snow	1094	Feb.		The Kaho era	1	Jan.		All provinces	大雪	Chuyuki, Fuso ryakuki	A			
928	Drought	1094	May, Jul and Aug.		The Kaho era	1	leap Mar., Jun. and Jul.		Kyoto	旱魃	Chuyuki	D	B		
930	Long rain	1094	Sep. and Oct.		The Kaho era	1	Jul. and Aug.		Kyoto	霖雨	Chuyuki	A	D	C	
929	Storm	1094	Sep.	28	The Kaho era	1	Aug.	10	Ise	大風	Kanchuki, Chuyuki	A			
931	Heavy snow	1095	Dec.	31	The Kaho era	2	Nov.	26	Kyoto	積雪尺餘	Chuyuki	A			
932	Thunder storm	1096	Jun.	8	The Eicho era	1	May	9	Kyoto	雷雨,降雹	Chuyuki, Nyozein nendaiki	A	B		
933	Drought	1096	Jun. and Jul.	29	The Eicho era	1	May and Jun.		Kyoto	大旱	Chuyuki	A	C	B	
934	Storm	1096	Sep.	27	The Eicho era	1	Sep.	3	Kyoto	風雨		E			
935	Flood	1097	Apr.	30	The Jotoku era	1	Mar.	10	Kyoto	大雨,洪水	Chuyuki	A			
936	Drought	1097	Aug.		The Jotoku era	1	Jun.		Unknown	炎旱	Chuyuki	B			
937	Storm	1097	Sep.	19	The Jotoku era	1	Aug.	5	All provinces	大風,洪水	Chuyuki, Iwashimizu hachimangu kiroku , Choyagunsai, Dai-nihonshi, Nihon saiishi, Ryusenji nendaiki	A	D	B	
938	Storm	1098	Jan.	23	The Jotoku era	1	Dec.	12	Kyoto	大風雨,光耀有り	Chuyuki	A			
939	Flood	1098	Jun.	17	The Jotoku era	2	May	10	Kyoto	霖雨,洪水	Chuyuki	A	C		
940	Flood	1098	Jul.	9	The Jotoku era	2	Jun.	2	Kyoto	霖雨,洪水	Chuyuki	A	C	B	
941	Thunder storm	1098	Aug.	8	The Jotoku era	2	Jul.	3	Kyoto	大雷	Chuyuki	A	B		
942	Thunder storm	1098	Aug.	30	The Jotoku era	2	Jul.	25	Unknown	大雷雨	Chuyuki	B			

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		A.D.	Month	Day	The name of Japanese era	Year	Month	Day							
943	Flood	1098	Sep.	11,16	The Jotoku era	2	Aug.	8、13	Kyoto	洪水	Jinnosyotoroku, Chuyuki	A	B		
944	Drought	1099	Mar. and Apr.		The Kowa era	1	Feb. and Mar.		Kyoto	不雨	Honchoseiki	A	C	B	
945	Drought	1099	Sep.		The Kowa era	1	Aug.		Unknown	旱魃		D			
946	Long rain	1100	Sep.		The Kowa era	2	Aug.		Unknown	霖雨		D			
947	Thunder storm	1101	Apr.	20	The Kowa era	3	Mar.	13	Kyoto	雷降雹	Chuyuki	A			
948	Long rain	1101			The Kowa era	3			Kyoto	霖雨	Ryusenji nendaiki, Chuyuki	A	C	B	
949	Storm	1102	Sep.	18	The Kowa era	4	Jul.	27	Kyoto	大風	Iwashimizu monjo, Chuyuki	A			
950	Storm	1103	Feb.	14	The Kowa era	4	Dec.	29	Kyoto	大風	Chuyuki	A	B		
951	Storm	1103	Mar.	8	The Kowa era	5	Jan.	21	Kyoto	大風	Honchoseiki	A	B		
952	Hail	1103	May	28	The Kowa era	5	Apr.	14	Kyoto	降雹	Nyozein nendaiki	A			
953	Thunder storm	1103	Jul.	8	The Kowa era	5	May	25	Kyoto	落雷	Honchoseiki, Chuyuki	A			
954	Long rain	1103	From Sep. to Dec.		The Kowa era	5	Frm Aug. to Nov.		Unknown	長雨	Geki nikki, Denryaku	D	B		
955	Drought	1104	Jul.		The Choji era	1	Jun.		Kyoto	旱	Chuyuki	A	C		
956	Flood	1105	Jul.	4	The Choji era	2	May	14	Kyoto	霖雨,洪水	Chuyuki	A	C	B	
957	Long rain	1105	Sep.	25	The Choji era	2	Aug.	9	Unknown	霖雨	Chuyuki	B			
958	Thunder storm	1106	Jun.	2	The Kasho era	1	Apr.	22	Kyoto	雷雨,降雹	Shiryo soran, Eishoki, Chuyuki	A			
959	Thunder storm	1106	Jul.	18	The Kasho era	1	Jun.	9	Yamato	落雷	Chuyuki	A			
960	Drought	1106	Jul. and Aug.		The Kasho era	1	Jun. and Jul.		Kyoto	旱魃	Chuyuki, Eishoki	D	B		
961	Thunder storm	1107	Jul.	20	The Kasho era	2	Jun.	21	Kyoto	落雷數十所	Chuyuki, Jusandai yoryaku	A			
962	Thunder storm	1107	Jul.	29	The Kasho era	2	Jul.	1	Kyoto	落雷	Chuyuki	A			
963	Drought	1107	From Aug. to Nov.		The Kasho era	2	From Jul. to October		Kyoto	旱魃	Chuyuki	D	C	B	
964	Thunder storm	1108	Jul.	31	The Tennin era	1	Jun.	14		落雷,降雹	Chuyuki	A			
965	Hail	1108	Aug.	12	The Tennin era	1	Jun.	26		降雹	Chuyuki	A			
966	Thunder storm	1109	Jul.	29	The Tennin era	2	Jun.	23	Kyoto	落雷	Shiryo soran	A			
967	Heavy snow	1110	Apr.	1	The Tenei era	1	Mar.	4	Kyoto	積雪尺餘	Eishoki, Hyakurensho, Dai-nihonshi	A			
968	Storm	1110	Apr.	8	The Tenei era	1	Mar.	11	Kyoto	大雨水	Hyakurensho	B			
969	Storm	1110	Jul.	16	The Tenei era	1	Jun.	21	Kyoto	大風雨	Shiryo soran, Zoku honchotsugan, Sankaiki	A	B		
970	Long rain	1110	Jul.		The Tenei era	1	Jun.		Unknown	霖雨,洪水	Hyakurensho	B			
971	Storm	1111	May	25	The Tenei era	2	Apr.	9	Kinki district	大風雨	Chuyuki	A	D	B	
972	Hail	1112	Jul.	1	The Tenei era	3	May	28	Kyoto	降雹	Jinnosyotoroku	A	B		
973	Drought	1112	Aug.		The Tenei era	3	Jul.		Unknown	旱魃	Denryaku, Chuyuki	B			
974	Hail	1113	Jul.	19	The Eikyu era	1	May	28	Unknown	降雹	Honcho nendaiki	B			
975	Thunder storm	1113	Aug.	7	The Eikyu era	1	Jun.	17	Kyoto	落雷	Shiryo soran	A			
976	Storm	1113	Aug.	15	The Eikyu era	1	Jun.	25	Kinki district	風水害	Honcho nendaiki	B			
977	Storm	1113	Sep.	22	The Eikyu era	1	Aug.	4	Ise	大風雨	Choshuki	A	B		
978	Flood	1113	Sep.	26	The Eikyu era	1	Aug.	8	Kyoto	洪水	Honcho nendaiki	B			

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		A.D.	Month	Day	The name of Japanese era	Year	Month	Day							
979	Storm	1113	Oct.	8,9	The Eikyu era	1	Aug.	20,21	Kyoto	大風雨,洪水	Denryaku, Choshuki	A	B		
980	Storm	1114	Mar.	18	The Eikyu era	2	Feb.	3	Kinki district	大風雨,洪水	Denryaku, Chuyuki	A	B		
981	Flood	1114	May	29	The Eikyu era	2	Apr.	16	Kyoto	大雨,洪水	Hyakurensho	B			
982	Storm	1114	Sep.	8	The Eikyu era	2	Aug.	1	Kyoto	大風雨	Ujiyamadashishi, Denryaku, Chuyuki	A	B		
983	Drought	1114	Autumn		The Eikyu era	2	Autumn		Kyoto	旱	Chuyuki, Kofukuji betto shidai	A	C	B	
984	Flood	1115			The Eikyu era	3	—	—	All provinces	大洪水	Kofukuji betto shidai	A	B		
985	Thunder storm	1116	Aug.	16	The Eikyu era	4	Jun.	29	Yamato	落雷	Shiryo soran	A			
986	Storm	1116	Aug.	23	The Eikyu era	4	Jul.	7	Yamato	大風雨	Denryaku	B			
987	Drought	1117	Jun. and Jul.		The Eikyu era	5	May and Jun.		Kyoto	旱魃	Kojiruien, Nijunisha chushiki	A	C	B	
988	Storm	1117	Oct.	5	The Eikyu era	5	Sep.	1	Kyoto	大風雨	Denryaku	A	B		
989	Frost	1118	May	8	The Genei era	1	Apr.	9	Kyoto	晩霜	Chuyuki	A			
990	Flood	1118	Jul.		The Genei era	1	Jun.	—	Kyoto	霖雨,洪水	Hyakurensho, Chuyuki	A	C	B	
991	Thunder storm	1118	Aug.	18	The Genei era	1	Jul.	23	Kyoto	大雷雨	Chuyuki	B			
992	Thunder storm	1119	Sep.	12	The Genei era	2	Jul.	29	Kyoto	落雷	Chuyuki	A			
993	Drought	1119	Summer		The Genei era	2	Summer		Kyoto	旱	Chuyuki	C	B		
994	Long rain	1119	Aug. and Sep.		The Genei era	2	Jul. and Aug.		Kyoto	霖雨	Chuyuki, Dai-nihonshi	A	C	B	
995	Storm	1119	Dec.	12	The Genei era	2	Nov.	2	Kyoto	大風雨,光有り	Chuyuki	A	B		
996	Thunder storm	1120	Jul.	31	The Hoan era	1	Jun.	27	Kyoto	落雷數所	Chuyuki	A			
997	Storm	1121	Jan.	17	The Hoan era	1	Dec.	20	Kyoto	大風雨,光有り	Chuyuki	A	B		
998	Flood	1121	Oct.	15	The Hoan era	2	Aug.	25	Ise	洪水	Jingu zoreishu, Kanchuki	A	B		
999	Drought	1123	Jul.		The Hoan era	4	Jun.		Unknown	旱	Hyakurensho	B			
1000	Storm	1123	Sep.	20	The Hoan era	4	Aug.	22	Ise	大風雨,洪水	Jingu zoreishu	A	B		
1001	Hail	1124	May	17	The Tenji era	1	Mar.	25	Kyoto	降雹	Chuyuki	A			
1002	Flood	1124	Oct.	10	The Tenji era	1	Aug.	24	Ise	洪水	Chuyuki	A			
1003	Flood	1124	Nov.	28	The Tenji era	1	Oct.	14	Ise	洪水	Chuyuki	A	B		
1004	Storm	1125	Aug.	14	The Tenji era	2	Jul.	7	Unknown	大風雨	Chuyuki	B			
1005	Flood	1125	Sep. and Oct.		The Tenji era	2	Aug. and Sep.	—	All provinces	洪水霖雨	Chuyuki mokuroku	A	C	B	
1006	Thunder storm	1126	Jul.	17	The Daiji era	1	Jun.	18	Kyoto	落雷	Chuyuki	A			
1007	Thunder storm	1127	May	29	The Daiji era	2	Apr.	10	Kyoto	雷鳴,比叡山降雹	Chuyuki	A			
1008	Flood	1127	Jun.	22	The Daiji era	2	May	4	Kyoto	雨水	Chuyuki	A			
1009	Storm	1127	Aug.	23	The Daiji era	2	Jul.	7	Kyoto	大風雨	Chuyuki	A			
1010	Storm	1127	Sep.	4	The Daiji era	2	Jul.	19	Kyoto	大風雨	Chuyuki	A			
1011	Long rain	1127	Oct.		The Daiji era	2	Sep.		All provinces	霖雨	Chuyuki, Dai-nihonshi	A	C		
1012	Storm	1128	Sep.	5	The Daiji era	3	Aug.	2	Kyoto	大風雨	Hyakurensho, Chuyuki	A	B		
1013	Hail	1129	May	28	The Daiji era	4	May	2	Kyoto	降雹	Daigo zojiki	A			
1014	Flood	1129	Sep.	4	The Daiji era	4	leap Jul.	12	Kyoto	霖雨,大水	Chuyuki	A	C	B	
1015	Drought	1130	Jul.		The Daiji era	5	Jun.		Unknown	旱祈雨	Chuyuki	B			
1016	Thunder storm	1130	Aug.	25	The Daiji era	5	Jul.	13	Kyoto	雷雨	Daigo zojiki	A			

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		A.D.	Month	Day	The name of Japanese era	Year	Month	Day							
1017	Storm	1130	Oct.	22	The Daiji era	5	Sep.	12	Kyoto	大風	Kawachinokuni shoushouji engi, Hyakurensho	A	B		
1018	Storm	1131	Aug.	4	The Tensyo era	1	Jul.	3	Kyoto	大風	Choshuki, Hyakurensho	A	B		
1019	Storm	1131	Sep.	25	The Tensyo era	1	Aug.	25	Kyoto	大風	Choshuki	A			
1020	Flood	1132	Jun.	28	The Chosho era	1	May	7	Kyoto	大雨水	Choshuki, Chuyuki	A			
1021	Thunder storm	1132	Jul.	10	The Chosho era	1	May	19	Kyoto	落雷	Chuyuki	A			
1022	Drought	1133	Apr.		The Chosho era	2	Mar.		Kyoto	旱	Chuyuki	C			
1023	Thunder storm	1133	Jul.	25	The Chosho era	2	Jun.	15	Kyoto	落雷數所	Chuyuki	A			
1024	Thunder storm	1133	Aug.	23	The Chosho era	2	Jul.	14	Kyoto	落雷	Chuyuki	A			
1025	Long rain	1133	Oct.	1	The Chosho era	2	Aug.	24	Kyoto	霖雨	Hyakurensho, Chuyuki, Dai-nihonshi	A	C	B	
1026	Flood	1134	Jun.	18	The Chosho era	3	May	17	Kinki district	霖雨,洪水	Chuyuki, Hyakurensho	A	C		
1027	Storm	1134	Jul.	14	The Chosho era	3	Jun.	14	Kyoto	大風雨	Choshuki	A			
1028	Storm	1134	Oct.	8	The Chosho era	3	Sep.	12	Kyoto	大風雨	Chuyuki, Hyakurensho	A			
1029	Flood	1135	Jan.		The Chosho era	3	Dec.		Unknown	洪水	Chuyuki, Kofukuji nendaiki	B			
1030	Long rain	1135	Jun.		The Hoen era	1	Apr.		Unknown	霖雨	Chuyuki	B			
1031	Thunder storm	1135	Aug.	28	The Hoen era	1	Jul.	11	Kyoto	落雷數所	Chuyuki	A			
1032	Hail	1135	Sep.	17	The Hoen era	1	Aug.	1	Kyoto	降雹	Chuyuki	A			
1033	Storm	1136	Sep.	9	The Hoen era	2	Aug.	5	Kyoto	大風	Chuyuki	B			
1034	Storm	1137	Mar.	27	The Hoen era	3	Feb.	27	Kawachi	大風	Kawachinokuni Shoushouji engi	B			
1035	Flood	1139	Aug.		The Hoen era	5	Jul.	—	Kyoto	洪水	Nyozein nendaiki, Wakangofu	A	B		
1036	Thunder storm	1140	Jul.	9	The Hoen era	6	leap May	16	Kyoto	落雷	Jusandai yoryaku, Hyakurensho, Sogobunin, Kojiruien	A			
1037	Flood	1141	Sep.	28	The Eiji era	1	Aug.	20	Kyoto	大雨,洪水	Hyakurensho, Taiki	A	B		
1038	Storm	1141	Oct.	10	The Eiji era	1	Sep.	2	Kyoto	大風	Dainihon fuken shi	A			
1039	Hail	1142	May	3	The Koji era	1	Mar.	29	Kyoto	降雹	Taiki	A			
1040	Thunder storm	1142	Jun.	30	The Koji era	1	May	28	Kyoto	雷電,降雹	Taiki, Honchoseiki	A			
1041	Flood	1142	Jul.	2	The Koji era	1	Jun.	1	Kyoto	雨水,大雨,洪水	Taiki	A	B		
1042	Storm	1142	Sep.	29	The Koji era	1	Sep.	2	Kyoto	大風雨,洪水	Taiki, Honchoseiki	A	B		
1043	Storm	1143	Feb.	26	The Koji era	2	Feb.	3	Kyoto	大風	Honchoseiki	A	B		
1044	Thunder storm	1143	May	14	The Koji era	2	Mar.	21	Kyoto	雷雨,降雹	Honchoseiki	A			
1045	Flood	1143	Jun.	26	The Koji era	2	May	5	Kyoto	洪水	Hyakurensho, Honchoseiki	A	B		
1046	whirlwind	1144	Jul.	5	The Tenyo era	1	May	26	Kyoto	颱風,雷雨	Taiki, Zoku honchotsugan	A			
1047	Storm	1144	Aug.	14	The Tenyo era	1	Jul.	7	Kyoto	大風	Taiki, Honchoseiki	A	B		
1048	Storm	1145	Feb.	5	The Kyuan era	1	Jan.	5	Kyoto	風雨	Taiki	A			

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Appendix 1. Chronological table of climatic disaster in Japan from 601 to 1200.

NO.	Kind of disaster	The Gregorian calendar			The old calendar				Area	Descliption of disaster in Japanese	Historical record	Source 1	Source 2	Source 3	Source 4
		A.D.	Month	Day	The name of Japanese era	Year	Month	Day							
1049	Flood	1145	Jun.	30	The Kyuan era	1	Jun.	2	Kyoto	洪水	Taiki	A	B		
1050	Storm	1145	Sep.	9	The Kyuan era	1	Aug.	14	Kyoto	大風雨	Taiki	A	B		
1051	Storm	1145	Oct.	2	The Kyuan era	1	Sep.	7	Kyoto	大風雨	Honchoseiki, Taiki	A	B		
1052	Thunder storm	1146	Apr.	28	The Kyuan era	2	Mar.	9	Kyoto	落雷	Honchoseiki, Hyakurensho	A			
1053	Flood	1146	Jun.	29	The Kyuan era	2	May	12	Kinki district	大雨,洪水	Kofukuji ryakunenndaiki, Hyakurensho, Taiki	A	B		
1054	Thunder storm	1146	Dec.	28	The Kyuan era	2	Nov.	16	Unknown	大雷雨	Honchoseiki	B			
1055	whirlwind	1147	Aug.	5	The Kyuan era	3	Jun.	30	Kyoto	龍昇天(竜巻？),大風雨	Taiki, Honchoseiki	A	B		
1056	whirlwind	1147	Aug.	26	The Kyuan era	3	Jul.	21	Kyoto	龍巻,雷雨	Zoku honchotsugan, Taiki	A			
1057	Storm	1147	Oct.	14	The Kyuan era	3	Sep.	11	Kyoto	大風雨	Taiki	A			
1058	Storm	1148	Apr.	26	The Kyuan era	4	Mar.	29	Kyoto	大風	Honchoseiki	A			
1059	Thunder storm	1149	Jun.	26	The Kyuan era	5	May	12	Omi	雷火	Koyasan morjo, Honchoseiki, Sogobunin	A			
1060	Thunder storm	1149	Jul.	17	The Kyuan era	5	Jun.	4	Kyoto	大雷	Honchoseiki	A			
1061	Thunder storm	1149	Aug.	3	The Kyuan era	5	Jun.	21	Kyoto	大雷	Honchoseiki	A			
1062	Storm	1149	Aug.	5,9	The Kyuan era	5	Jun.	23、27	Ise	大風雨	Kanchuki	A			
1063	Flood	1149	Sep.	19,20	The Kyuan era	5	Aug.	9,10	Kyoto	大雨,流損	Honchoseiki	A	B		
1064	whirlwind	1149	Nov.	6	The Kyuan era	5	Sep.	27	Kyoto	雷風,暴風	Honchoseiki	A	B		
1065	Thunder storm	1150	Feb.	12	The Kyuan era	6	Jan.	6	Kyoto	雷電,降雹	Taiki	A			
1066	Flood	1150	Apr.	6	The Kyuan era	6	Feb.	30	Kyoto	大雨,洪水	Taiki	A			
1067	Storm	1150	Jul.	24	The Kyuan era	6	Jun.	21	Kyoto	大風雨	Taiki	A			
1068	Storm	1150	Sep.	3	The Kyuan era	6	Aug.	4	Kyoto	大風雨	Honchoseiki, Hyakurensho, Taiki	A	B		
1069	Storm	1150	Sep.	19	The Kyuan era	6	Aug.	20	Kyoto	大風雨	Taiki	A			
1070	Flood	1150	Sep.	27	The Kyuan era	6	Aug.	28	Kyoto	大雨,洪水	Honchoseiki, Taiki	A	B		
1071	Storm	1150	Oct.	18	The Kyuan era	6	Sep.	19	Unknown	大雨	Taiki	B			
1072	Thunder storm	1151	Mar.	17	The Nimpei era	1	Feb.	21	Kyoto	落雷,降雪	Taiki, Honchoseiki	A			
1073	Flood	1151	Apr.	1	The Nimpei era	1	Mar.	6	Kyoto	大雨,水氾濫	Honchoseiki	B			
1074	Storm	1151	Apr.	15	The Nimpei era	1	Mar.	20	Ise	大風雨	Dainihon fuken shi, Honchoseiki	A	B		
1075	Storm	1151	Apr.	24	The Nimpei era	1	Mar.	29	Unknown	暴風雨,降雹,雷鳴	Honchoseiki, Taiki	A	B		
1076	Storm	1151	Aug.	15	The Nimpei era	1	Jun.	24	Ise	大風雨	Dainihon fuken shi, Honchoseiki	A	B		
1077	Storm	1151	Aug.	27,28	The Nimpei era	1	Jul.	7－8	Kyoto	風雨,洪水	Honchoseiki, Hyakurensho	A	B		
1078	Storm	1151	Sep.	17	The Nimpei era	1	Jul.	28	Ise	大雨,山崩れ	Honchoseiki	B			
1079	Storm	1151	Oct.		The Nimpei era	1	Aug.		Kii	大風	Kumanoshi	A			
1080	Storm	1151	Nov.	16	The Nimpei era	1	Sep.	29	Kyoto	大風	Honchoseiki	A			
1081	Storm	1152	Apr.	11	The Nimpei era	2	Feb.	28	Ise	暴風,雷雨	Honchoseiki, Heihanki	B			

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		A.D.	Month	Day	The name of Japanese era	Year	Month	Day							
1082	Thunder storm	1152	Jul.	1	The Nimpei era	2	May	20	Kyoto	落雷數所,暴風,雷雨	Honchoseiki, Sankaiki	A	B		
1083	Drought	1152	Jul.		The Nimpei era	2	Jun.		Unknown	大旱	Honchoseiki	B			
1084	Storm	1152	Aug.	31	The Nimpei era	2	Jul.	22	Unknown	大雨	Honchoseiki, Heihanki	B			
1085	Storm	1152	Sep.	23	The Nimpei era	2	Aug.	16	Kyoto	風雨	Honchoseiki, Sankaiki, Heihanki	A			
1086	Flood	1153	Jun.	25	The Nimpei era	3	May	25	Kyoto	大雨,洪水	Honchoseiki, Taiki	A	B		
1088	Drought	1153	Jul. and Aug.		The Nimpei era	3	Jun. and Jul.		Kyoto	旱魃	Honchoseiki, Taiki	A	C		
1087	Thunder storm	1153	Aug.	4	The Nimpei era	3	Jul.	6	Kyoto	落雷虹	Honchoseiki, Taiki	A	B		
1089	Storm	1153	Oct.	16	The Nimpei era	3	Sep.	20	Kyoto	大風雨	Honchoseiki, Hyakurensho, Taiki	A	B		
1090	Storm	1153	Nov.	4	The Nimpei era	3	Oct.	10	Unknown	大風雨,雷鳴	Honchoseiki, Taiki	B			
1091	Thunder storm	1154	Aug.	12	The Kyuju era	1	Jun.	24	Kyoto	落雷	Taiki	A			
1092	Flood	1154	Sep.	19	The Kyuju era	1	Aug.	3	Kyoto	大雨,洪水	Taiki	A	B		
1093	Long rain	1155	Dec.	28	The Kyuju era	2	Nov.	25	Unknown	霖雨,暴風	Taiki	B			
1094	Thunder storm	1156	Jul.	27	The Hogen era	1	Jul.	2	Kyoto	落雷	Iwashimizu hachimangu shi	A			
1095	Drought	1157	Aug.	29	The Hogen era	2	Jul.	16	Kyoto	祈雨	Heihanki	B			
1096	Drought	1158	Jul.	27	The Hogen era	3	Jun.	23	Unknown	祈雨	Heihanki	B			
1097	Storm	1159	Aug.		The Heiji era	1	Jun.	—	Kyoto	大風,洪水	Entairyaku	A	B		
1098	Flood	1160	Aug.	2,3	The Eiryaku era	1	Jun.	21,22	Kyoto	洪水	Hyakurensho	A	B		
1099	Storm	1160	Oct.	21	The Eiryaku era	1	Sep.	13	Unknown	大風	Sankaiki	B			
1101	Drought	1161	Jul. and Aug.		The Oho era	1	Jun. and Jul.		Kyoto	旱,祈雨	Sankaiki, Tojichojabunin	C	B		
1100	Flood	1161	Aug.	4	The Oho era	1	Jul.	4	Kyoto	洪水	Sankaiki	A	B		
1102	Drought	1162	Summer		The Oho era	2	Summer		Kyoto	大旱	Honchotsuki	A	C		
1103	Hail	1163	Jun.	6	The Chokan era	1	Apr.	26	Kyoto	降雹	Dainihon fuken shi	A			
1104	Storm	1163	Sep.		The Chokan era	1	Aug.	—	Kyoto	大風,祈止雨	Honcho tsuki, Iwashimizu hachimangu kiroku	A	B		
1105	Long rain	1165	May and Jun.		The Eiman era	1	Mar. and Apr.		Unknown	霖雨,祈止雨	Sankaiki	B			
1106	Storm	1165	Sep.	14	The Eiman era	1	Aug.	1	Kyoto	大風	Hyakurensho	A	B		
1107	Drought	1166	Jul. and Aug.		The Ninan era	1	Jun. and Jul.		Unknown	旱魃,祈雨	Daigoji zojiki	B			
1108	Long rain	1167	Jun.	16	The Ninan era	2	May	20	Unknown	霖雨,祈止雨	Akihiro oki	B			
1109	Drought	1167	Aug.	10	The Ninan era	2	Jul.	17	Unknown	炎旱	Heihanki	B			
1110	Heavy snow	1168	Feb.	24	The Ninan era	3	Jan.	7	Kyoto	積雪尺餘	Heihanki	A			
1111	Drought	1168	Jul.		The Ninan era	3	Jun.		Unknown	旱	Heihanki	B			
1112	Hail	1168	Jul.		The Ninan era	3	Jun.		Iwashiro	降氷力	Aizu kyuji soko	A			
1113	Thunder storm	1168	Aug.	28	The Ninan era	3	Jul.	17	Kyoto	落雷	Hyakurensho, Jinnosyotoroku	A			
1114	Storm	1169	Mar.	16	The Kao era	1	Feb.	9	Kyoto	大風	Hyakurensho, Dai-nihonshi	A	B		
1115	Drought	1169	Jul.		The Kao era	1	Jun.		Unknown	炎旱	Heihanki	B			
1116	Long rain	1169	Oct.	24	The Kao era	1	Sep.	25	Unknown	霖雨,祈止雨	Heihanki	B			
1117	Thunder storm	1169	Dec.	9	The Kao era	1	Nov.	12	Kyoto	落雷	Hyakurensho	A			

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		A.D.	Month	Day	The name of Japanese era	Year	Month	Day							
1118	Storm	1170	Feb.	8	The Kao era	2	Jan.	14	Unknown	霖雨,洪水	Gumaiki	B			
1119	Drought	1170	Jul.	20	The Kao era	2	May	28	Unknown	祈雨	Gyokuyo, Heihanki	B			
1120	Storm	1170	Jul.	21	The Kao era	2	May	29	Unknown	大雨	Gumaiki	B			
1121	Flood	1170	Jul.	23,24	The Kao era	2	Jun.	1-2	Kyoto	大雨,洪水,霖雨	Gyokuyo, Gumaiki	A	B		
1122	Storm	1170	Sep.	26	The Kao era	2	Aug.	8	Kyoto	大風,大雷雨	Hyakurensho, Gyokuyo	A	B		
1123	Flood	1171	Jun.		The Syoan era	1	May	—	Kii	洪水	Shiryosoran, Koyasan monjo	A	B		
1124	Flood	1172	Jun.	20	The Syoan era	2	May	20	Kyoto	霖雨,洪水	Gyokuyo, Hyakurensho	A	C	B	
1125	Thunder storm	1173	May	18	The Syoan era	3	Mar.	28	Kyoto	雷鳴,降雹	Gyokuyo	A			
1126	Flood	1173	Jun.	27	The Syoan era	3	May	9	Kyoto	大雨,洪水	Gyokuyo	A	B		
1127	Drought	1173	Aug.	17	The Syoan era	3	Jun.	30	Unknown	炎旱	Gyokuyo	B			
1128	Storm	1173	Oct.	26	The Syoan era	3	Sep.	11	Kyoto	風雨	Gyokuyo	A	B		
1129	Thunder storm	1174	Jul.	29	The Syoan era	4	Jun.	22	Kyoto	落雷	Akihiro oki, Gyokuyo	A			
1130	Drought	1174	Jun. and Jul.		The Syoan era	4	From May to Jul.		Kyoto	大旱	Zoku honchotsugan, Gyokuyo, Hyakurensho, Kojidan	A	C	B	
1131	Thunder storm	1174	Aug.	26	The Syoan era	4	Jul.	20	Kyoto	落雷	Hyakurensho	A			
1132	Flood	1175	Jul.	3	The Angen era	1	Jun.	7	Kyoto	霖雨,洪水	Gyokuyo	A	C	B	
1133	Storm	1175	Sep.	25	The Angen era	1	Sep.	2	Kyoto	大風雨,光氣アリ	Sankaiki, Gyokuyo	A			
1134	Storm	1175	Oct.	5	The Angen era	1	Sep.	12	Kyoto	大風	Gyokuyo, Sankaiki, Hyakurensho	A	B		
1135	Thunder storm	1176	Apr.	18	The Angen era	2	Mar.	1	Kyoto	落雷	Akihiro oki, Gyokuyo, Hyakurensho	A			
1136	Thunder storm	1176	Aug.	6	The Angen era	2	Jun.	23	Kyoto	大雷雨	Rekidaikoki, Hyakurensho, Gyokuyo, Akihiro oki	A	B		
1137	Drought	1176	Jul.		The Angen era	2	Jun.		Unknown	祈雨	Akihiro oki	B			
1138	Storm	1176	Aug.	18	The Angen era	2	Jul.	5	Kyoto	大風雨	Gyokuyo	A	B		
1139	whirlwind	1177	May	24	The Jisyo era	1	Apr.	18	Kyoto	辻風	Akihiro oki, Hyakurensho, Gyokuyo	A	B		
1140	Storm	1177	Jul.	27	The Jisyo era	1	Jun.	23	Unknown	大風雨	Rekidaikoki	B			
1141	Flood	1177	Aug.		The Jisyo era	1	Jul.	—	Kyoto	大雨,洪水,大風	Nakasuke oki	A	B		
1142	Drought	1178	Aug.		The Jisyo era	2	leap Jun.		Unknown	祈雨	Sankaiki	B			
1143	Storm	1179	Jun.	25	The Jisyo era	3	May	12	Kyoto	大風	Honchotsuki, Zoku honchotsugan	A	B		
1144	whirlwind	1179	Jul.	27	The Jisyo era	3	Jun.	14	Kyoto	旋風	Genpei seisui ki	A			
1145	Flood	1179	Oct.	2,7	The Jisyo era	3	Aug.	23、28	Kyoto	洪水	Gyokuyo	A	B		
1146	whirlwind	1180	Mar.	22	The Jisyo era	4	Feb.	18	Kyoto	廻風	Sankaiki, Hyakurensho	A	B		

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		A.D.	Month	Day	The name of Japanese era	Year	Month	Day							
1147	whirlwind	1180	Jun.	1	The Jisyo era	4	Apr.	29	Kyoto	大旋風,雷鳴,降雹	Gyokuyo, Sankaiki, Meigetsuki, Hyakurensho	A	B		
1148	Drought	1180	From Jun. to Aug.		The Jisyo era	4	From May to Jul.		Kyoto	旱魃	Hyakurensho, Sankaiki	A	C	B	
1149	Thunder storm	1180	Aug.	7	The Jisyo era	4	Jul.	8	Kyoto	雷雹		E			
1150	Storm	1180	Sep.	24	The Jisyo era	4	Aug.	26	Kyoto	風雨	Sankaiki, Azuma kagami	A	B		
1151	Thunder storm	1180	Nov.	25	The Jisyo era	4	Oct.	29	Kyoto	雷雨,降雹	Sankaiki, Gyokuyo, Kikki	A			
1152	Thunder storm	1181	Jan.	22	The Jisyo era	4	Dec.	28	Kyoto	雷火	Nyozein nendaiki	A			
1153	Flood	1181	Jul.	3	The Yowa era	1	May	13	Kyoto	甚雨,洪水	Gyokuyo	A			
1154	Drought	1181	Aug. and Nov.		The Yowa era	1	Jun. and October		Kyoto	大旱,祈雨	Kikki, Hojoki	C	B		
1155	Storm	1182	Apr.	7	The Juei era	1	Feb.	25	Ise	大風	Kanchuki, Gyokuyo	A			
1156	Flood	1182	Jul.	11	The Juei era	1	Jun.	2	Kyoto	大雨,洪水	Gyokuyo	A	B		
1157	Thunder storm	1182	Aug.	1	The Juei era	1	Jun.	23	Kyoto	落雷	Gyokuyo, Kikki	A			
1158	Thunder storm	1182	Aug.	16	The Juei era	1	Jul.	9	Kyoto	落雷	Gyokuyo, Kikki	A			
1159	Hail	1183	Apr.	24	The Juei era	2	Mar.	23	Kyoto	暴雨,降雹	Gyokuyo	A			
1160	Drought	1183	Jun.		The Juei era	2	May		Unknown	旱,祈雨	Hyakurensho	B			
1161	Long rain	1183	Jul.		The Juei era	2	Jun.		Kyoto	降雨多し	Kikki	B			
1162	Thunder storm	1183	Aug.	20	The Juei era	2	Jul.	24	Kyoto	落雷	Hyakurensho, Kikki	A			
1163	Thunder storm	1184	Feb.	21	The Genryaku era	1	Jan.	1	Ise	雷雨	Gyokuyo	A	B		
1164	Flood	1184	May	29	The Genryaku era	1	Apr.	11	Kyoto	大雨,洪水	Gyokuyo	A			
1165	Drought	1184	Aug.	24	The Genryaku era	1	Jul.	10	Unknown	祈雨	Gyokuyo	B			
1166	Storm	1184	Aug.	29	The Genryaku era	1	Jul.	15	Kyoto	風雨	Sankaiki, Gyokuyo	A			
1168	Drought	1184	Aug.		The Genryaku era	1	Jul.		Kinki district	大旱	Gyokuyo	A	C		
1167	Storm	1184	Sep.	30	The Genryaku era	1	Aug.	17	Kyoto	風雨	Sankaiki, Gyokuyo	A			
1169	Storm	1185	Mar.	28	The Bunji era	1	Feb.	18	Setouchi	大風	Horyakukan ki, Zoku honchotsugan	A			
1170	Drought	1185	Spring and Summer		The Bunji era	1	Spring and Summer		All provinces	大旱	Dai-nihonshi, Genpei seisui ki	A	B		
1171	Flood	1185	Autumn and Winter		The Bunji era	1	Autumn and Winter		Kyoto	洪水	Dai-nihonshi, Genpei seisui ki	A	B		
1172	Heavy snow	1186	Jan.	25	The Bunji era	1	Dec.	26	Kyoto	積雪尺餘	Gyokuyo	A			
1173	Storm	1186	Oct.	14	The Bunji era	2	Aug.	23	Yamato	大風雨,洪水	Gyokuyo, Nakatomino hiroshige ki	A			
1174	Flood	1186	Dec.	30	The Bunji era	2	Nov.	11	Kyoto	洪水	Ryusenji nendaiki	A	B		
1175	Thunder storm	1187	May	1	The Bunji era	3	Mar.	14	Kyoto	雷鳴,降雹	Gyokuyo	A	B		
1176	Thunder storm	1187	May	30	The Bunji era	3	Apr.	14	Kamakura	落雷,雨雷	Azuma kagami	A	B		
1177	Storm	1187	Aug.	25	The Bunji era	3	Jul.	13	Kyoto	大風雨	Kanchuki, Gyokuyo	A			

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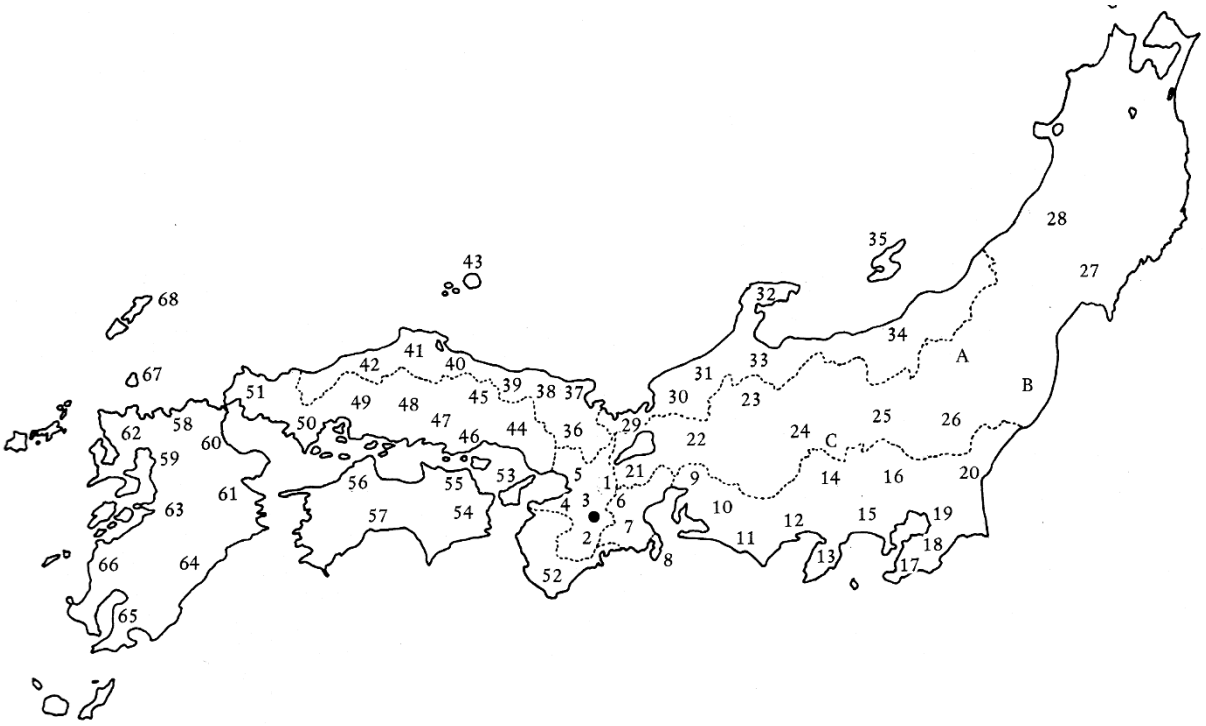
		A.D.	Month	Day	The name of Japanese era	Year	Month	Day							
1178	Flood	1187	Oct.	6	The Bunji era	3	Aug.	26	Kamakura	洪水	Buke nendaiki	A	B		
1179	Thunder storm	1187	Dec.	27	The Bunji era	3	Nov.	19	Unknown	大雷鳴,暴雨	Gyokuyo	B			
1180	Storm	1188	Mar.	20	The Bunji era	4	Feb.	14	Kamakura	風雨	Azuma kagami	A			
1181	Storm	1188	Apr.	23	The Bunji era	4	Mar.	18	Yamato	大風	Gyokuyo	A	B		
1182	Thunder storm	1188	Jul.	7	The Bunji era	4	Jun.	5	Kamakura	雷雨,洪水	Azuma kagami	A	B		
1183	Long rain	1189	Feb. and Mar.		The Bunji era	5	Jan. and Feb.		Unknown	霖雨	Gyokuyo	B			
1184	Storm	1189	Oct.	8	The Bunji era	5	Aug.	20	Kyoto	大風雨	Gyokuyo, Nakasuke oki, Azuma kagami	A	B		
1185	Storm	1190	Jan.	8	The Bunji era	5	Nov.	23	Kamakura	烈風	Azuma kagami	B			
1186	Thunder storm	1190	Jun.	26	The Kenkyu era	1	May	15	Kamakura	雷雨,山崩れ	Azuma kagami	A	B		
1187	Thunder storm	1190	Aug.	14	The Kenkyu era	1	Jul.	5	Kyoto	落雷	Hyakurensho	A	B		
1188	Storm	1190	Sep.	25	The Kenkyu era	1	Aug.	17	Kinki district	大風雨,洪水	Gyokuyo, Azuma kagami , Zoku honchotsugan, Nyozein nendaiki, Kofukuji ryakunenndaiki,	A	B		
1189	Drought	1190	From Oct. to Dec.		The Kenkyu era	1	From Sep. to Nov.		All provinces	旱	Azuma kagami	C	B		
1190	Long rain	1190			The Kenkyu era	1			Unknown	霖雨	Moromori ki	C			
1191	Storm	1191	Mar.	19	The Kenkyu era	2	Feb.	15	Kanto district	大風	Dainihon fuken shi	A			
1192	Drought	1191	Jun.		The Kenkyu era	2	May		Kyoto	小旱魃,祈雨	Gyokuyo, Kiu nikki in the Kenkyuera 2, Kanotoi	D	C	B	
1193	Flood	1191	Sep.	23	The Kenkyu era	2	Aug.	26	Kyoto	洪水	Nyozein nendaiki	A	B		
1194	Heavy snow	1192	Feb.	13	The Kenkyu era	2	leap December	21	Kyoto	積雪尺餘	Gyokuyo	A			
1195	Flood	1192	Oct.	13	The Kenkyu era	3	Aug.	28	Kyoto	大雨,洪水		A			
1196	Long rain	1193	Jul.		The Kenkyu era	4	Jun.		Unknown	霖雨	Gyokuyo	B			
1197	Drought	1193	Jul.	27	The Kenkyu era	4	Jun.	20	Unknown	炎旱,祈雨	Azuma kagami	B			
1198	Drought	1194	May		The Kenkyu era	5	Apr.		Kyoto	旱	Gyokuyo	C			
1199	Thunder storm	1194	Oct.	31	The Kenkyu era	5	Sep.	9	Kyoto	落雷數所	Hyakurensho	A			
1200	Storm	1195	Oct.	17	The Kenkyu era	6	Sep.	6	Kinki district	大風	Gyokuyo, Shiryo soran	A	B		
1201	Thunder storm	1196	Aug.	10	The Kenkyu era	7	Jul.	8	Kyoto	落雷	Hyakurensho, Iwashimizu hachimangu kiroku , Genko shakusho	A	B		
1202	Thunder storm	1196	Aug.	22	The Kenkyu era	7	Jul.	20	Kyoto	落雷	Hyakurensho, Iwashimizu hachimangu kiroku , Genko shakusho	A			
1203	Thunder storm	1196	Sep.	18	The Kenkyu era	7	Aug.	17	Kyoto	雷火	Hyakurensho, Shiryo soran	A	B		
1204	Thunder storm	1197	Aug.	17	The Kenkyu era	8	leap Jun.	25	Kyoto	大雷雨	Hyakurensho, Shiryo soran	A	B		
1205	Thunder storm	1198	Apr.	6	The Kenkyu era	9	Feb.	21	Unknown	大雨,雷鳴	Meigetsuki	B			
1206	Thunder storm	1199	Jun.	10	The Syoji era	1	May	8	Kyoto	落雷,降雹	Meigetsuki, Inokuma kanpaku ki	A			
1207	Flood	1199	Jun.	12	The Syoji era	1	May	10	Kyoto	大雨,洪水	Meigetsuki	A			
1208	Flood	1199	Jun.	28	The Syoji era	1	May	26	Kyoto	大雨,洪水	Meigetsuki	A			
1209	Thunder storm	1199	Jul.	7	The Syoji era	1	Jun.	6	Kyoto	落雷,降雹	Meigetsuki, Inokuma kanpaku ki	A			

A:Nihon kisho shiryo,
B: Nihon no tensai・chihen
C: Nihon rin-u kanbatsu shiryo
D: Naraken kishosaigai shi
E: Kyoto kishosaigai nempyo

Appendix 1. Chronological table of climatic disaster in Japan from 601 to 1200.

NO.	Kind of disaster	The Gregorian calendar			The old calendar				Area	Descliption of disaster in Japanese	Historical record	Source 1	Source 2	Source 3	Source 4
		A.D.	Month	Day	The name of Japanese era	Year	Month	Day							
1210	Storm	1199	Jul.	27	The Syoji era	1	Jun.	26	Unknown	甚雨	Meigetsuki	B			
1211	Drought	1199	Aug.		The Syoji era	1	Jul.		Kyoto	旱魃	Meigetsuki	D			
1212	Flood	1199	Sep.	18	The Syoji era	1	Aug.	19	Echigo	洪水	Meigetsuki, Narusuke oki	A			
1213	Storm	1199	Sep.	28	The Syoji era	1	Aug.	29	Unknown	甚雨	Meigetsuki	B			
1214	Storm	1199	Oct.	22	The Syoji era	1	Sep.	24	Ise	大風	Ruiju daibunin	A			
1215	Long rain	1199	Oct.		The Syoji era	1	Sep.		Kinki district	霖雨	Meigetsuki, Narusuke oki	D	C	B	
1216	Heavy snow	1200	Feb.	6	The Syoji era	2	Jan.	13	Kamakura	積雪尺餘		A			
1217	Storm	1200	Feb.	7,8	The Syoji era	2	Jan.	14－15	Unknown	大風	Gyokuyo	B			
1218	Storm	1200	Apr.	24	The Syoji era	2	Mar.	3	Kamakura	大風雨	Azuma kagami	A			
1219	Flood	1200	Sep.	25	The Syoji era	2	Aug.	9	Kyoto	大雨,洪水	Meigetsuki	A	B		
1220	Storm	1200	Sep.	27	The Syoji era	2	Aug.	11	Izu	大風	Sotozan jogeshodo meyasu	A			

A:Nihon kisho shiryo,
B: Nihon no tensai・chihen
C: Nihon rin-u kanbatsu shiryo
D: Naraken kishosaigai shi
E: Kyoto kishosaigai nempyo



1.Yamashiro
2.Yamato
3.Kawachi
4.Izumi
5.Settsu
6.Iga
7.Ise
8.Shima
9.Owari
10.Mikawa
11.Totomi
12.Suruga
13.Izu
14.Kai
15.Sagami
16.Musashi
17.Awa
18.Kazusa
19.Shimosa
20.Hitachi
21.Omi
22.Mino
23.Hida
24.Shinano
25.Kozuke
26.Shimotsuke
27.Mutsu
28.Dewa
29.Wakasa
30.Kaga
32.Noto
33.Etchu
34.Echigo
35.Sado
36.Tamba
37.Tango
38.Tajima
39.Inaba
40.Hoki
41.Izumo
42.Iwami
43.Oki
44.Harima
45.Mimasaka
46.Bizen
47.Bitchu
48.Bingo
49.Aki
50.Suo
51.Nagato
52.Kii
53.Awaji
54.Awa
55.Sanuki
56.Iyo
57.Tosa
58.Chikuzen
59.Chikugo
60.Buzen
61.Bungo
62.Hizen
63.Higo
64.Hyuga
65.Osumi
66.Satsuma
67.Iki
68.Tsushima

Provinces of early Japan

This Figure is quoted from Farris (1985)

Appendix 2. Terms of Japanese era (a)

The name of Japanese era		A.D.	Term	The number of climatic disaster	Climatic disaster per year
Emperor Suiko	推古天皇	592-628	36	9	0.3
Emperor Jomei	舒明天皇	629-641	12	5	0.4
Emperor Kogyoku	皇極天皇	655-661	3	11	3.7
Taika era	大化	645-650	5	2	0.4
Hakuchi era	白雉	650-654	5	2	0.4
Emperor Tenji	天智天皇	668-671	3	4	1.3
Emperor Tenmu	天武天皇	673-686	13	14	1.1
Shucho era	朱鳥	686-686	0	1	-
Emperor Jito	持統天皇	690-697	7	5	0.7
Emperor Mommu	文武天皇	697-701	10	2	0.2
Taiho era	大寶	701-704	3	7	2.3
Kyoun era	慶雲	704-708	4	7	1.8
Wado era	和銅	708-715	8	10	1.3
Reiki era	霊亀	715-717	2	0	0.0
Yoro era	養老	717-724	7	5	0.7
Jinki era	神龜	724-729	5	5	1.0
Tempyo era	天平	729-749	20	19	1.0
Tempyokanpo era	天平感宝	749-749	0	0	0.0
Tempyoshoho era	天平勝寶	749-757	8	8	1.0
Tempyohoji era	天平寶字	757-765	8	8	1.0
Tempyojingo era	天平神護	765-767	2	5	2.5
Jingokeiun era	神護景雲	767-770	3	5	1.7

Appendix 2. Terms of Japanese era (b)

The name of Japanese era		A.D.	Term	The number of climatic disaster	Climatic disaster per year
Hoki era	寶龜	770-781	11	34	3.1
Ten-o era	天應	781-782	1	1	1.0
Enryaku era	延暦	782-806	24	36	1.5
Daido era	大同	806-810	4	13	3.3
konin era	弘仁	810-824	14	25	1.8
Tencho era	天長	824-834	10	15	1.5
Jowa era	承和	834-848	14	28	2.0
Kasyo era	嘉祥	848-851	3	12	4.0
Ninju era	仁壽	851-854	3	8	2.7
Saiko era	齊衡	854-857	3	11	3.7
Tenan era	天安	857-859	2	12	6.0
Jogan era	貞観	859-877	18	96	5.3
Gangyo era	元慶	877-885	8	35	4.4
Nina era	仁和	885-889	4	20	5.0
Kampyo era	寛平	889-898	9	14	1.6
Syotai era	昌泰	898-901	3	4	1.3
Engi era	延喜	901-923	22	48	2.2
Encho era	延長	923-931	8	21	2.6
Johei era	承平	931-938	7	14	2.0
Tengyo era	天慶	938-947	9	31	3.4
Tenryaku era	天暦	947-957	10	19	1.9
Tentoku era	天徳	957-961	4	12	3.0

Appendix 2. Terms of Japanese era (c)

The name of Japanese era		A.D.	Term	The number of climatic disaster	Climatic disaster per year
Owa era	應和	961-964	3	9	3.0
Koho era	康保	964-968	4	6	1.5
Anna era	安和	968-970	2	6	3.0
Tenroku era	天祿	970-974	4	3	0.8
Tenen era	天延	974-976	2	8	4.0
Jogen era	貞元	974-978	2	9	4.5
Tengen era	天元	978-983	5	12	2.4
Eikan era	永觀	983-985	2	4	2.0
Kanna era	寬和	985-987	2	4	2.0
Eien era	永延	987-989	2	4	2.0
Eiso era	永祚	989-990	1	3	3.0
Shoryaku era	正暦	990-995	5	13	2.6
Chotoku era	長徳	995-999	4	9	2.3
Choho era	長保	999-1004	5	15	3.0
Kanko era	寬弘	1004-1013	9	32	3.6
Chowa era	長和	1013-1017	4	28	7.0
Kannin era	寬仁	1017-1021	4	11	2.8
Jian era	治安	1021-1024	3	8	2.7
Manju era	萬壽	1024-1028	4	10	2.5
Chogen era	長元	1028-1037	9	21	2.3
Choryaku era	長歷	1037-1040	3	2	0.7
Chokyu era	長久	1040-1044	4	7	1.8

Appendix 2. Terms of Japanese era (d)

The name of Japanese era		A.D.	Term	The number of climatic disaster	Climatic disaster per year
Kantoku era	寛徳	1044-1046	2	1	0.5
Eisyo era	永承	1046-1053	7	6	0.9
Tengi era	天喜	1053-1058	5	3	0.6
Kohei era	康平	1058-1065	7	9	1.3
Jiryaku era	治暦	1065-1069	4	7	1.8
Enkyu era	延久	1069-1074	5	3	0.6
Joho era	承保	1074-1077	3		0.0
Jyoryaku era	承暦	1077-1081	4	5	1.3
Eiho era	永保	1081-1084	3	5	1.7
Otoku era	應徳	1084-1087	3	2	0.7
Kanji era	寛治	1087-1095	8	18	2.3
Kaho era	嘉保	1095-1097	2	5	2.5
Eicho era	永長	1097-1097	1	3	3.0
Jotoku era	承徳	1097-1099	2	9	4.5
Kowa era	康和	1099-1104	5	11	2.2
Choji era	長治	1104-1106	2	3	1.5
Kajo era	嘉承	1106-1108	2	6	3.0
Tennin era	天仁	1108-1110	2	3	1.5
Tenei era	天永	1110-1113	3	7	2.3
Eikyu era	永久	1113-1118	5	15	3.0
Genei era	元永	1118-1120	2	7	3.5
Hoan era	保安	1120-1124	4	5	1.3

Appendix 2. Terms of Japanese era (e)

The name of Japanese era		A.D.	Term	The number of climatic disaster	Climatic disaster per year
Tenji era	天治	1124-1126	2	5	2.5
Daiji era	大治	1126-1131	5	12	2.4
Tensyo era	天承	1131-1132	1	2	2.0
Chosho era	長承	1132-1135	3	10	3.3
Hoen era	保延	1135-1141	6	7	1.2
Eiji era	永治	1141-1142	1	2	2.0
Koji era	康治	1142-1144	2	7	3.5
Tenyo era	天養	1144-1145	1	2	2.0
Kyuan era	久安	1145-1151	6	24	4.0
Nimpei era	仁平	1151-1154	3	19	6.3
Kyuju Era	久壽	1154-1156	2	3	1.5
Hogen era	保元	1156-1159	3	3	1.0
Heiji era	平治	1159-1160	1	1	1.0
Eiryaku era	永暦	1160-1161	1	2	2.0
Oho era	應保	1161-1163	2	3	1.5
Chokan era	長寬	1163-1165	2	2	1.0
Eiman era	永萬	1165-1166	1	2	2.0
Ninan era	仁安	1166-1169	3	7	2.3
Kao era	嘉應	1169-1171	2	9	4.5
Joan era	承安	1171-1175	4	9	2.3
Angen era	安元	1175-1177	2	7	3.5
Jisyo era	治承	1177-1181	4	14	3.5

Appendix 2. Terms of Japanese era (f)

The name of Japanese era		A.D.	Term	The number of climatic disaster	Climatic disaster per year
Yowa era	養和	1181-1182	1	2	2.0
Juei era	壽永	1182-1184	2	8	4.0
Genryaku era	元暦	1184-1185	1	6	6.0
Bunchi era	文治	1185-1190	5	17	3.4
Kenkyu era	建久	1190-1199	9	20	2.2
Syoji era	正治	1199-1201	2	15	7.5

Appendix 3. Climatic disasters in the Jogan era

NO.	Kind of disaster	The Gregorian calendar			The old calendar				Area	Records of weather ①	Records of weather ②	Records of weather ③	Records of weather ④	Details (In Japanese)	Historical record
		A.D.	Month	Day	The name of Japanese era	Year	Month	Day							
1	Thunder storm	859	May	10	The Jogan era	1	Apr.	1	Kyoto	落雷				雷雨 震京民居二家(日本三代實録)、雷雨 震東京民居二百家(百、此恐非。日本紀略)	Nihon sandai jitsuroku, Nihon kiryaku
2	Thunder storm	859	Jun.	25	The Jogan era	1	May	17	Kyoto	雷電	降雹			雷電 雨雹	Nihon sandai jitsuroku
3	Flood	859	Jul.	8	The Jogan era	1	Jun.	1	Kyoto	大雨	洪水			五月二十九日 大雨 六月朔 霖雨 大水 四日 霖雨未霽 賑京邑飢乏者 八月九日 自五月至今月霖雨 祈止雨	Nihon sandai jitsuroku
4	Thunder storm	859	Jul.	29	The Jogan era	1	Jun.	22	Kyoto	大雷雨				雷雨大嵐 折木發屋	Nihon sandai jitsuroku
5	Thunder storm	859	Aug.	24	The Jogan era	1	Jul.	19	Kyoto	落雷				雷雨 震内教坊柿樹	Nihon sandai jitsuroku
6	Storm	859	Sep.	16	The Jogan era	1	Aug.	12	Kyoto	大風雨				大風雨交接 京師人居火風壊者多	Nihon sandai jitsuroku
7	Storm	859	Oct.	12	The Jogan era	1	Sep.	9	Kyoto	大風雨				此日 大風暴雨 發屋折木	Nihon sandai jitsuroku
8	Heavy snow	859	Dec.	24	The Jogan era	1	Nov.	23	Kyoto	大雪				二十三日 大雨雪 廿九日 雪未止	Ruijukokushi
9	Long rain	860	Mar.		The Jogan era	2	Feb.		Unknown	雷風	暴風	霖雨		是年二月より雷風暴風霖雨の害續く	Nihon sandai jitsuroku
10	Frost	860	May	4	The Jogan era	2	Apr.	6	Unknown	霜害				殞霜 殺草(四月六日霜害草苗に及ぶ;日本の天災地変)	Nihon sandai jitsuroku
11	whirlwind	860	May	9	The Jogan era	2	Apr.	11	Kyoto	廻飄				廻飄起外記候廳前 旋轉西行 小虫無萬數 飛散其中	Nihon sandai jitsuroku
12	Thunder storm	860	Jun.	1	The Jogan era	2	May	5	Kyoto	雷電	降雹			五日 雷電 雨雹	Nihon sandai jitsuroku
13	Thunder storm	860	Jun.	14	The Jogan era	2	May	18	Kyoto	雷電	降雹			十八日 雷 雨雹	Nihon sandai jitsuroku
14	Flood	860	Jun.	29	The Jogan era	2	Jun.	3	Kyoto	大水				六月三日 自五月霖雨 至是大水	Nihon sandai jitsuroku
15	Storm	860	Aug.	15	The Jogan era	2	Jul.	21	Kyoto	大風雨				大風暴雨	Nihon sandai jitsuroku
16	Flood	860	Sep.	22	The Jogan era	2	Aug.	30	Kyoto	大水				雨水	Nihon sandai jitsuroku
17	Storm	860	Oct.	6	The Jogan era	2	Sep.	14	Kinki district	大風雨洪水	高潮			大風 折樹發屋 京師百姓廬舍破損者甚多 十五日 風雨未止 都城東西兩河洪水 人馬不通 諸國濱海之地 潮水漲溢 人畜被害	Nihon sandai jitsuroku
18	Storm	861	Jan.	6	The Jogan era	2	Nov.	17	Kyoto	大風				十六日 是日烈風雷雨 十七日 風不止 多壊人舍	Nihon kiryaku
19	Frost	861	May		The Jogan era	3	Mar.		Unknown	霜頻				出雲国風水霜害あり	Nihon sandai jitsuroku
20	Drought	861	Jun.		The Jogan era	3	May		Unknown	旱魃				五月旱魃	Nihon sandai jitsuroku
21	Storm	861	Aug.	24	The Jogan era	3	Jul.	11	Kyoto	大風雨				大風雨	Nihon sandai jitsuroku
22	Hail	862	Apr.	25	The Jogan era	4	Mar.	19	Kyoto	降雹				雨雹	Nihon sandai jitsuroku
23	Flood	862	May	8	The Jogan era	4	Apr.	2	Kyoto	大雨	大水			大雨 河水流溢 行路難通	Nihon sandai jitsuroku
24	Thunder storm	862	Jul.	1	The Jogan era	4	May	27	Kyoto	雷電大雨					Nihon sandai jitsuroku
25	Long rain	862	Jul.	22	The Jogan era	4	Jun.	18	Kyoto	霖雨	飢饉			六月十八日 自去五月霖雨 京邑飢饉 頒遣使者賑給之	Nihon sandai jitsuroku
26	Drought	862	Aug.	5	The Jogan era	4	Jul.	2	Hitachi	旱疫				常陸国 旱疫に復二年を給ふ	Nihon sandai jitsuroku
27	Drought	862	Oct.		The Jogan era	4	Sep.		Kyoto	大旱				京師大旱 井泉竭枯(皇年代略記)、京市井旱甚し 皇宮の和泉園を開き給ふ(三代實録)	Konendairyakuki, Nihon sandai jitsuroku
28	Thunder storm	863	Jan.	23	The Jogan era	4	Dec.	26	Unknown	雷雨				雷雨甚し	Nihon sandai jitsuroku
29	Storm	863	Mar.	11	The Jogan era	5	Feb.	14	Kyoto	大風				大風 壊民廬舍	Nihon sandai jitsuroku
30	Long rain	863	From May to Jul.		The Jogan era	5	From Apr. to Jun.		Kyoto	霖雨				四月廿九日 是月霖雨 六月 霖雨	Nihon sandai jitsuroku
31	Storm	863	May	6	The Jogan era	5	Apr.	11	Kyoto	大風				天寒大風	Nihon sandai jitsuroku
32	Frost	863	Jun.	1	The Jogan era	5	May	7	Unknown	霜頻				天寒殞霜	Nihon sandai jitsuroku
33	Storm	863	Sep.	11	The Jogan era	5	Jul.	21	Kyoto	大風				大風 折樹發屋	Nihon sandai jitsuroku
34	Thunder storm	863	Dec.		The Jogan era	5	Oct.		Unknown	大風	雷雨			十月 大風、雷雨	Nihon sandai jitsuroku
35	Heavy snow	864	Feb.	15	The Jogan era	6	Jan.	1	Kyoto	大雪				大雨雪	Nihon sandai jitsuroku
36	Long rain	864	Jul.	6	The Jogan era	6	May	25	Kyoto	霖雨	賑給			五月二十五日 霖雨 京師隠居飢病者 特加賑恤	Nihon sandai jitsuroku
38	Frost	865	May	5	The Jogan era	7	Apr.	3	Kyoto	霜頻	晩霜			三日 殞霜 殺草 四日 殞霜不止 七日殞霜 八日殞霜 十四日殞霜	Nihon sandai jitsuroku
37	Thunder storm	865	May	19	The Jogan era	7	Apr.	17	Unknown	雷雨	霖雨			四月十七日 雷雨且つ霖雨不止	Nihon sandai jitsuroku
39	Thunder storm	865	Jun.	3	The Jogan era	7	May	2	Unknown	雷雨	霖雨			五月二日 雷雨且つ霖雨不止	Nihon sandai jitsuroku
40	Thunder storm	865	Jun.	30	The Jogan era	7	May	29	Unknown	雷雨	霖雨			五月廿九日 雷雨且つ霖雨不止	Nihon sandai jitsuroku
41	Storm	865	Jul.	16	The Jogan era	7	Jun.	16	Kyoto	大風雨				大風暴雨 壊廬舍折樹木 建禮門扉二枚仆	Nihon sandai jitsuroku
42	Storm	865	Aug.	16	The Jogan era	7	Jul.	17	Kyoto	大風雨				大風雨 折樹發屋	Nihon sandai jitsuroku
43	Flood	865	Aug.	30	The Jogan era	7	Aug.	2	Kyoto	雨水				雨水	Nihon sandai jitsuroku
44	Drought	865	Sep.		The Jogan era	7	Aug.		Bingo	旱疫				八月十七日備後國旱疫に復あり	Nihon sandai jitsuroku
45	Drought	865			The Jogan era	7			Musashi	旱				十二月九日武蔵國旱霜につき復一年を賜ふ	Nihon sandai jitsuroku
46	Frost	865			The Jogan era	7			Musashi	霜				十二月九日武蔵國旱霜につき復一年を賜ふ	Nihon sandai jitsuroku
47	Long rain	866	Jun. and Jul.		The Jogan era	8	Apr. and May		Kyoto	霖雨				四月二十七日 是月自朔至今 霖雨未止 五月 是日 淫霖(日、恐當作月、日本三代實録)、五月 是月 淫霖(日本紀略)	Nihon sandai jitsuroku, Nihon kiryaku

Appendix 3. Climatic disasters in the Jogan era

NO.	Kind of disaster	The Gregorian calendar			The old calendar				Area	Records of weather ①	Records of weather ②	Records of weather ③	Records of weather ④	Details (In Japanese)	Historical record
		A.D.	Month	Day	The name of Japanese era	Year	Month	Day							
48	Drought	866	From Jul. to Sep.		The Jogan era	8	From May to Jul.		All provinces	旱疫	飢饉			五月二十七日 備前國 旱疫 六月十三日 武蔵國 去年風雨 今年飢旱 賑給之 是月 天下大旱 民多飢餓	Nihon sandai jitsuroku
49	Storm	866	Oct.	9	The Jogan era	8	Aug.	23	Unknown	暴風	雷雨			八月廿三日 暴風雷雨	Nihon sandai jitsuroku
50	Storm	866			The Jogan era	8			Owari	風波	飢饉			尾張、阿波、両國風波の爲飢饉	Nihon sandai jitsuroku
51	Flood	867	Jun.	13	The Jogan era	9	May	4	Kyoto	大雨	洪水			四日 大雨洪水 往還難通 晦 自去月迄此月霖雨 人頗苦之	Nihon sandai jitsuroku
52	Long rain	867	May and Jun.		The Jogan era	9	Apr. and May		Kyoto	霖雨				五月晦 自去月迄此月霖雨 人頗苦之	Nihon sandai jitsuroku
53	Storm	867	Oct.	19	The Jogan era	9	Sep.	14	Kyoto	大風雨				大風雨 抜樹發屋	Nihon sandai jitsuroku
54	Long rain	868	Jun.		The Jogan era	10	May		Kyoto	霖雨				五月 是月 霖雨	Nihon kiryaku
55	Long rain	868	Sep.		The Jogan era	10	Aug.		Kyoto	霖雨				八月 霖雨	Nihon kiryaku
56	Storm	868	Oct.	7	The Jogan era	10	Sep.	14	Unknown	大雨				九月一日 大雨	Nihon sandai jitsuroku
57	Long rain	869	Apr.		The Jogan era	11	Feb.		Kyoto	霖雨				二月廿九日 是月霖雨 至今未霽	Nihon sandai jitsuroku
58	Thunder storm	869	Aug.	28	The Jogan era	11	Jul.	13	Kyoto	落雷				雷雨 震武徳殿前松樹	Nihon sandai jitsuroku
59	Storm	869	Aug.	29	The Jogan era	11	Jul.	14	Higo	大風雨	高潮			風雨 是日肥後國大風雨 飛瓦抜樹 官舍民居顚倒者多 人畜厭死不可勝計 潮水漲溢 漂沒六郡 水退之後捜漉官物 十失五六焉 自海至山 是間田園數百里陥而爲海 （漉、恐掘字之誤）	Nihon sandai jitsuroku
60	Storm	869	Oct.	9	The Jogan era	11	Aug.	26	Kyoto	大風雨				夜 大風暴雨 抜樹發屋 城京*邑損傷甚多 （日本三代實録：城京→此間恐有脱字、日本紀略：城京邑ヲ宮城京邑トセリ）	Nihon sandai jitsuroku, Nihon kiryaku
61	Drought	869	From Aug. to Jan.		The Jogan era	11	From Jun. to December		Yamashiro	旱魃				十一月廿一日 安藝國 旱 詔免當年田租五分 十二月二日 山城國 旱 免當年田租五分	Nihon sandai jitsuroku
62	Long rain	870	Jun. and Jul.		The Jogan era	12	May and Jun.		Kyoto	霖雨	飢饉			六月十日 自五月霖雨 至此未止 奉幣祈止雨 十七日 頻月淫霖 京師飢饉 賑給之	Nihon sandai jitsuroku
63	Drought	870			The Jogan era	12			Kawachi	旱				貞観十三年三月廿六日 河内國昨年水旱 農民失業	Nihon sandai jitsuroku
64	whirlwind	871	Jan.	29	The Jogan era	13	Jan.	1	Kyoto	颷風				是日有衝颷 入自日花門 吹倒内豎傅點籌木（籌木：紀略作高案）	Nihon sandai jitsuroku
65	Heavy snow	871	Feb.	21	The Jogan era	13	Jan.	24	Kyoto	大雪				大雨雪	Nihon sandai jitsuroku
66	Long rain	871	Apr.		The Jogan era	13	Mar.		Kyoto	霖雨				三月 是月 霖雨	Nihon kiryaku
67	Drought	871	Jun. and Jul.		The Jogan era	13	May and Jun.		All provinces	大旱				五月十九日 遣使於丹生川上雨師神社奉幣、祈雨也、廿二日 勅控秀良親王家池水涘城南百姓田、旱也、六月十日 自朔不雨、至是、班幣諸神社、祈雨也、六月十三日 勅東海、東山、北陸、山陰、山陽、南海道諸国、班幣境内名山大沢諸神、幷転読大般若金剛般若等経、祈甘雨也、十五日 延六十僧於大極殿	Nihon sandai jitsuroku
68	Thunder storm	871	Sep.	3	The Jogan era	13	Aug.	11	Kyoto	大雷雨				、限以三日、転読大般若経、苦請澍雨、十七日 更延講経三箇日、縁不快雨也	Nihon sandai jitsuroku
69	Thunder storm	871	Sep.	28	The Jogan era	13	leap Aug.	7	Kyoto	雷雨	洪水			雷 大雨 諸衛陣於殿前 河水暴溢れ 京師道橋流損者衆 壊人廬舍不知其數	Nihon sandai jitsuroku
70	Flood	871	Oct.	2	The Jogan era	13	leap Aug.	11	Kyoto	霖雨	洪水			七日 雷 大雨 十一日 霖雨未止 東京居人遭水損者 三十五家百三十八人 西京六百三十家 三千九百九十五人 賜穀鹽 各有差	Nihon sandai jitsuroku
71	Heavy snow	872	Feb.	4	The Jogan era	13	Dec.	18	Kyoto	大雪				大雨雪	Nihon sandai jitsuroku
72	Storm	872	Apr.	25	The Jogan era	14	Mar.	10	Kyoto	大風雨				大風雨 賑給京師絶之者	Nihon sandai jitsuroku
73	Storm	872	Sep.	14	The Jogan era	14	Aug.	4	Kyoto	大風雨				日本紀略：大風雨 多壊民人廬舍，三代實録：十月十七日（中略）大和因幡兩國 當年田租不収四待 六段 以夏旱魃秋風水 苗稼連損也（待、一本之内本作得）	Nihon kiryaku, Nihon sandai jitsuroku
74	Drought	872	Aug.		The Jogan era	14	Jul.		Nara	旱魃				十一月十七日 詔大和國因幡國當年田租収らず、夏旱、秋風水苗稼連損す	Nihon sandai jitsuroku
75	whirlwind	873	Feb.	6	The Jogan era	15	Jan.	1	Kyoto	颷風	雷鳴			是日 申時 飄風暴雨 雷二聲	Nihon sandai jitsuroku
76	Thunder storm	873	May	31	The Jogan era	15	Apr.	27	Kyoto	雷電	降雹			四月二十七日 雷電 雨雹	Nihon sandai jitsuroku
77	Thunder storm	873	Jun.	5	The Jogan era	15	May	3	Kyoto	雷電	降雹			五月三日 雷電 雨雹 其大如雞子 或如梅實	Nihon sandai jitsuroku
78	Storm	873	Sep.	12	The Jogan era	15	Aug.	13	Ise	大風雨	洪水			太神宮諸雜事記：大風洪水間 豊受宮重々御垣流失 件水正殿之許一丈不寄志天 地底流入 甚奇異也 件河東西人家牛馬多流失了，日本災異志：伊勢大風洪水 豊受大神社層門倒 中外院殿舍及倉庫流失皇継年序	Daijingu shozojiki, Nihon saiishi
79	Thunder storm	874	Mar.	29	The Jogan era	16	Mar.	4	Kyushu	雷霆	降沙			七月二十九日 大宰府言 去三月四日夜 雷霆發響 通宵震動 遲明天氣陰蒙 晝暗如夜 干時雨沙 色如聚墨終日不止 積地之厚 或處可一寸餘 此及昏暮沙變成雨 禾稼得之皆致枯損 河水和沙 更爲虚濁 魚鱉死者無數	Nihon sandai jitsuroku
80	Long rain	874	Jul.		The Jogan era	16	May		Kyoto	霖雨	雷雨			五月 是月霖雨（日本紀略）、五月 霖雨雷雨頻繁につづく（日本三代實録）、参考→貞観十七年 但馬國 去年水損 貸借正税 免四分之一	Nihon kiryaku, Nihon sandai jitsuroku
81	Thunder storm	874	Aug.	3	The Jogan era	16	Jun.	14	Kyoto	落雷				是日 雷雨 東京牛震死	Nihon sandai jitsuroku
82	Long rain	874	Oct.		The Jogan era	16	Aug.		Unknown	霖雨	祈霽			七月廿六日 霖雨祈霽	Nihon sandai jitsuroku

Appendix 3. Climatic disasters in the Jogan era

NO.	Kind of disaster	The Gregorian calendar			The old calendar				Area	Records of weather ①	Records of weather ②	Records of weather ③	Records of weather ④	Details (In Japanese)	Historical record
		A.D.	Month	Day	The name of Japanese era	Year	Month	Day							
83	Storm	874	Oct.	12	The Jogan era	16	Aug.	24	Kyoto	大風雨	洪水			大風雨 折樹發屋 柴宸殿前櫻 東宮紅梅 侍従局大梨等樹木有名皆吹倒 内外官舎 人民居廬舎 罕有全者 京邑衆水爆長七八尺 水流迅激 直衝城下 大小橋梁無有子遺 朱雀大路 豊財坊門倒覆 抱闘兵士圧妻子四壓死 東西河溢蕩々百姓及牛馬殆溺 死者不知基數 興度渡口四邊三十餘家 山埼橋南四十餘家流土人居屋中随流蕩去者甚多 一婦人提携兩兒 在小倉中排扉随河水而流下 擧手招呼岸上人云 來救我 人々號哭百万相計 水勢奔湧 遂不能授手 至觸橋柱倉壊人没 權律師法橋上人位宗叡豫造御願寺 在山城國愛宕郡栗栖野 堂舎顚覆 佛像元在 北山高岑寺 貞観十三年 大雨水 自然以大巌石 寒甚道路 行人不通 去高岑寺 移立於栗栖野 又去年京師大雨雹 時人皆日此三度灾被像而發焉 是日 班幣畿内諸神祈風雨 時論或云 今年洪水 増於嘉祥元年六尺有餘 九月七日 東西京被風水損尤甚者 三千百五十九家 開倉庫賑給之 （長、恐作漲云 據一本内本補 我、同上補 授、朝本作援） 十一月二十七日 參河因幡両國秋風水 免當年租五分（日本三代實録） 是歳 但馬水 伊勢風水（大日本史）	Nihon sandai jitsuroku, Dai-nihonshi
84	Heavy snow	875	Feb.	2	The Jogan era	16	Dec.	19	Kyoto	大雪				大雨雪	Nihon sandai jitsuroku
85	Thunder storm	875	May	25	The Jogan era	17	Apr.	13	Unknown	雷雨				四月十三日 雷雨	Nihon sandai jitsuroku
86	Thunder storm	875	May	30	The Jogan era	17	Apr.	18	Unknown	雷雨				四月十八日 雷雨	Nihon sandai jitsuroku
87	Drought	875	Jul. and Aug.		The Jogan era	17	Jun. and Jul.		Kyoto	大旱				大旱（皇年代略記）、大炎旱（皇代記）	Konendairyakuki, Kodaiki
88	Thunder storm	875	Aug.	18	The Jogan era	17	Jul.	10	Kyoto	大雷雨				雷電風雨 抜樹木 壊廬舎（三代實録）、風雨 抜樹木 壊舎（日本紀略）	Nihon sandai jitsuroku, Nihon kiryaku, Nihon sandai jitsuroku
89	Thunder storm	875	Aug.	20	The Jogan era	17	Jul.	12	Unknown	雷雨				七月十二日 雷雨	Nihon sandai jitsuroku
90	Long rain	875	Sep.	3	The Jogan era	17	Jul.	26	Kyoto	霖雨	祈霽			七月廿六日 霖雨不止、遣使大和國丹生川上神社、奉幣白馬、祈止雨也、	Nihon sandai jitsuroku
91	Long rain	876	Apr.	23	The Jogan era	18	Mar.	21	Kyoto	霖雨	賑給			三月二十一日 霖雨 京城人飢 賑給之 二十九日 是月霖雨至今未止	Nihon sandai jitsuroku
92	whirlwind	876	Jun.	11	The Jogan era	18	May	12	Kyoto	颮風				颮風起紫宸殿前 轉出修明門	Nihon sandai jitsuroku
93	Long rain	876	Jun. and Jul.		The Jogan era	18	May and Jun.		Kyoto	霖雨	賑給	霧	雹	五月 是月霖雨	Nihon sandai jitsuroku
94	Hail	876	Jul.	16	The Jogan era	18	Jun.	18	Kyoto	降雹				是旦霧降 申時雨雹	Nihon sandai jitsuroku
95	Drought	876	Aug.	20	The Jogan era	18	Jul.	23	Tango	旱	凶荒			七月廿三日 丹後国此年水旱、百姓飢饉	Nihon sandai jitsuroku
96	Thunder storm	876	Dec.	29	The Jogan era	18	Dec.	6	Kyoto	雷電	降雹			雷電 雨雪（雪、諸本作雹 恐是、日本三代實録）、雷電 雨雹之（雹、三代實録作雪 諸本與此同 實録恐誤、日本紀略）、雷 雨雹（大日本史）	Nihon sandai jitsuroku, Nihon kiryaku, Dai-nihonshi