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Climate Disasters and Climate Variation of Little Ice Age in East Asia

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In this paper, climate variation is reconstructed on the basis of the chronicles of weather disasters in Japan and China. There remain many rainstorm records in southern coast of Japan, and south-eastern coast of China. Both in Japan and China, many rainstorm disasters appeared in summer. But, they usually appeared one or two months later in Japan. The period of frequent windstorm damage occurrence in Little Ice Age differs among Japan and China, and it was caused by the change of atmospheric circulation. Cool summer period appeared around 1705, 1740, 1765, 1785, 1830, and 1845. It was generally cool before 1855, but it became warm after 1855. It corresponds with the sudden retreat of glaciers of European Alps.

Keywords: climate variation, Little Ice Age, East Asia, typhoon, gufu

Reconstruction of the Climate Change by Document Record

Climate changes of the historical times have been studied through their reconstruction from alternative data. Especially various approaches are made for the elucidation of the modern Little Ice Age. Since the climate disaster description in historical documents has sufficient time accuracy and spatial distribution, it is important for the reconstruction of the climate changes of the historical times.

The followings are the reconstruction studies of the climate change in Little Ice Age, which used the climate disaster record. Using the climate disaster record of Japan and China, Tagami (2015a) reconstructed the climate for every year and season in the 14th and 15th century, and pointed out the chill of the 1440s and the 1480s. Moreover, Tagami (2015b) pointed out the chill winter and spring, and the warm summer in the early 16th century, using climate disaster record of Japan.

In these studies, change of temperature and moisture is clarified from the distribution feature of the climate disaster of each year. In East Asia, distribution of temperature becomes contrastive between north and south in many cases, and this may be influenced by the change of the circulation system.

In order to clarify the circulation system, strong wind disaster record is most suitable. And on the basis of the record change of the circulation system in East Asia will be reconstructed. Furthermore, the factor for climate change, especially at the shifting time from Little Ice Age to the later warming period, will be clarified.

Strong Wind Disaster Record and the Name of the Strong Wind in East Asia

The climate disasters of the historical times are summarized in many chronicles, etc. in Japan. For

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example, “The Japanese weather data” (Central Meteorological Observatory and Marine Observatory, 1939[1]) is a representative one. This chronicle summarized climate disasters by their kinds, and has many records especially about rainstorm. In China, the climate disaster records from B.C. to the Qing Dynasty are gathered “China 3000-year weather record” (Zhang, 2004a, 2004b). The Qing Dynasty started from 1644 and the records in the Qing Dynasty are much more than these in the Ming Dynasty or before. In “China 3000-year weather record”, the climate disaster is summarized for every province and prefecture.

The strong wind which brings disaster is recorded by many names. The majors are “颶風” and “颱風”. The former is “gufu” in Japanese and is “jufung” (jùfēng) in Chinese. The latter is “taifu” in Japanese and is “taifung” (táifēng) in Chinese. In Japan, the tropical cyclone was called “gufu” in the 19th century (James, 1885). However, it was also described that gufu is called as “taifung” around China Sea and West Pacific Ocean. Furthermore, the name of gufu was used also in the 20th century (Hydrographical Department, 1911). At this time, gufu is described to be the same as taifung.

The strong wind was described in early stages of the European’s arrival to East Asia. In September 1555, a Portugal ship encountered a severe rainstorm. And they wrote that such strong wind was called as “tufão” in China (Gasper da Cruz, 1569). After that, it was written as “tuffon” in 1614, “tifone” in 1695, and spelled “typhoon” from the end of the 17th century (Hirth, 1880).

As for this “tufão”, Arabic “ttúffân” was considered to be the origin. “Ttôf” means overflowing or flood. In a Malaysian dictionary, “tufan” is originally a terrible storm of the Arabic language. The European called it tufão because Malaysians were concerned with the voyage (Hirth, 1880).

Moreover, in Hainan Island and Leizhou Peninsula in China, the strong wind was called “ta-fung” or “tai-fung”. In Taiwan, the strong wind on the shore was described as “t'ai-fung” in 1694. Jufung and taifung are distinguished there. “Kü” (jufung) is a strong wind, and it blows off suddenly, stops suddenly and appears from February to May. “T'ai” (taifung) is a stronger wind, and it continues blowing day and night and appears from June to September. It blows from every direction. However, “ty” is limited to the both sides of Taiwan Strait (Hirth, 1880).

In the 19th century, the strong wind in the ocean was also called jufung in Guanzhou. It was not called taifung in Guanzhou at that time (Rui, 1966). It was called “taihong” in southern Fujian for old days. However, “颱” is the character made later.

The seasonal anniversary days of jufung are set in Taiwan (Chiang, 1985). The actual stormy disaster in Taiwan occurs about twice per year with a probability of May 1%, June 7%, July 23%, August 38%, September 22% and October 9% (Taiwan Governor’s Office, 1929). Although the day of jufung is set throughout the whole year, strong wind disaster concentrates in summer, and jufung comes to be the general term of the strong wind. Taifung is stronger but appears less than jufung. It occurs from May to August (Chiang, 1985).

Thus, many descriptions about typhoon have been kept from 16th century. Various names with similar pronunciations are due to the situation of this area of those days. Taiwan was reigned over by Netherlands from 1624, by a surviving retainer of Ming Dynasty from 1661, and by the Qing Dynasty from 1683. Typhoons are generally the serious concern for the mariners. Before 16th century, “ttúffân” of Arabia, “tufan” of Malay, “tai-fung” of southern China, etc. were related. In mainland China, the strong wind was called jufung. When

[1] Central Meteorological Observatory and Marine Observatory. (1939). The Japanese weather data. p. 770, appendix p. 103 (in Japanese).

the Qing Dynasty advanced to Taiwan, the wind which had stronger influence than a mainland one might be distinguished as “taifung”.

Strong Wind Disaster in Modern Age

In Japan, the strong wind disaster has generally been called and recorded as a “rainstorm”. In China, there are many expressions for strong wind disaster. About a thousand terms of climate disasters are extracted from “China 3000-year weather record”. Among them, about 200 kinds of expressions are about strong wind, of which the words about severe wind or severe rainstorm are the most numerous. There are also many words about jufung. In addition, there are many expressions about strong wind, unusual wind, colored wind, hot wind, etc.

In Japan, there are many records of rainstorm in the Pacific coast from Kanto to Kyushu, but a few in the Chugoku district, the Tohoku district, and Hokkaido district. In China, the disaster by jufung occupies about 15% of the whole strong wind disaster. Jufung occurs very frequently in Guangdong, and frequently in Zhejiang, Hainan, Fujian, Shanghai, etc., that is, in the shores south of Changjiang. Taifung has been described after 1850s, and is recorded 9 times in Taiwan, and even in Fujian and Liaoning province. In Taiwan, almost the same number of taifung disasters and jufung disasters are recorded.

Rainstorm of Japan and jufung of China are both tropical cyclones. In the 19th century, it was recorded 262 times in Japan, and 389 times in China. Windstorm damage occurs more in September, August, and October in Japan. On the other hand, that of jufung occurs more in September, August, and July in China. Strong wind disaster appears one to two months later in Japan than in China. In these days, the development of the Pacific high pressure influences the course of typhoon. That is, the course of tropical cyclone comes close to China in the summer when the Pacific high pressure develops, and close to Japan in the autumn when the Pacific high pressure declines. Therefore, strong wind disaster appears later in Japan than in China.

In the period covered, many strong wind disasters appeared in Japan around 1730, 1780, and 1840, but not around 1750, 1800, and 1870. In China it increased notably around 1720 and 1860, and also around 1750 and 1770, but not around 1740, 1760, 1790, 1840, and 1890.

Some Examination of the Little Ice Age of East Asia

Temperature and precipitation are major climatic elements which show atmospheric situation. They influenced natural proxy data, from which atmospheric situation are reconstructed. Furthermore, in order to investigate climatic change, it is necessary to study air circulation. Wind is most directly connected with air circulation. Historical documents have many records about strong wind, and the circulation system is able to be reconstructed by them.

The remarkable strong wind in East Asia is brought about by tropical cyclones. The damage by tropical cyclone is large, and the season is limited. Therefore, the disaster records caused by tropical cyclone are clearly distinguished from other disaster records. Before modern times, tropical cyclone was called as “taifung” only around Taiwan. In the southward of Changjiang, it also was called jufung.

The appearance season of the strong wind disaster by tropical cyclone is later in Japan, and earlier in China. In summer when the Pacific high pressure is at its peak, typhoon goes west to China. However, in autumn when the Pacific high pressure is declining, it goes east to Japan. Strong wind disaster appearance in the 18th to 19th centuries differs between China and Japan. Increase of the strong wind disaster in China means strengthening of the Pacific high pressure, and that in Japan means weakening of the Pacific high pressure.

Change of rainstorm appearance and change of flood appearance are well alike in Japan. However, change of rainstorm and change of a drought are opposite. In Japan, when there are many rainstorms, the weather is cool and humid, and when there are less rainstorms, it is hot and dry. In Japan, there were the Kanei famine in the 17th century, the Kyoho famine and the Tenmei famine in the 18th century, and the Tenpo famine in the 19th century. The windstorm damage with the cool summer damage produced the great famines.

Change of atmospheric circulation, i.e., development of the Pacific high pressure, is concerned. When the Pacific high pressure is weaker or is located east, it is cool in summer and windstorm damage increases. When the Pacific high pressure is stronger, or is located west, it is hot in summer and there are less windstorm damages. If the windstorm damage and atmospheric general circulation becomes clear, the climate of Little Ice Age is understood deeply. In Little Ice Age of East Asia, low-temperature periods are estimated to appear around 1705, 1740, 1765, 1785, 1830, and 1845. Relatively warm periods were supposed to be there between those low periods, and it is estimated to have been especially warm around 1870.

Furthermore, near Taiwan, many marine accidents were recorded after the Qing Dynasty first stage (Ino, 1965). Many of them occurred from June to September of the China calendar, so probably they were caused by typhoon. Athough there were not so many marine accidents from the 17th century to the first half of the 19th century, they increased rapidly in the second half of the 19th century. As was shown in the change of rainstorm, Pacific high pressure become stronger in the second half of the 19th century, and it may be considered that the number of typhoons which took the western course increased.

Thus, Changes of strong wind disaster, circulation system, and flood or drought are related. Contrast between the cool state around 1845 and the warm state around 1870 is remarkable, and the climate was very different before and after the border year, 1855. Therefore, the circulation system seems to have changed around that time, and it is concluded that the cool state of Little Ice Age had ended and it was moving to the warming period.

Change of the Circulation System of East Asia, and the End of Little Ice Age

Since the 16th century, the tropical cyclone had been described by the arriving Europeans like “tufão”, “tuffon”, and “tifone”. Before that, among the mariners of South Asia or East Asia, tropical cyclone was called “ttúffân”, “tufan”, “tai-fung”, etc.

Tropical cyclone came to be spelled “typhoon” at the end of the 17th century, when Qing advanced to Taiwan and named tropical cyclone “t'ai-fung”, and it is thought that it influenced the change of spelling.

There are many disasters affected by tropical cyclones in the Pacific coast from Kanto to Kyushu of Japan. Similarly, in China, there are many of them on the East China Sea coast, south of Changjiang. Although they appear mostly in summer mostly, it is one to two months later in Japan than in China. As for the change of disasters caused by tropical cyclone in the 18th and the 19th centuries, those of Japan and China are in clear conflict. Pacific high pressure developed and disaster increased in China; Pacific high pressure declined and disaster increased in Japan.

The formative period of Pacific high pressure is high in temperature, and the decline period is low in it. Low-temperature periods may be around 1705, 1740, 1765, 1785, 1830, and 1845. The cool situation around 1845 differs greatly from the high temperature situation around 1870. A big change of circulation system may have occurred around 1855.

Also in Europe, the glacier in the Alps began to retreat quickly around the middle of the 19th century, when the Little Ice Age was finished, and the warming period has continued after that. That is similar in East Asia.

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