

# A Linkage between climatic condition and market economy in the 19th century Japan

## - Analysis of solar radiation from historical documents and rice price -

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Japan has plenty of diaries in the 17th to 19th centuries, which include records of daily weather conditions ("fine", "cloudy", "rainy", etc.) It is well known that they have been used for reconstructing climate variation and events, although it provided qualitative data, not instrumental observations.

We estimate global solar radiation from weather conditions. Global solar radiation is an important factor for the energy balance of the Earth, and is also fundamental to the hydrological cycle and agricultural productivity. Our method is effective for all seasons and which could produce reconstruction with higher temporal resolution than other proxy data, for example tree rings.

Weather descriptions are classified into 3 categories and weather categories convert to solar radiation. The parameters of conversion are calculated by using JMA observations from 1995 to 1999.

We reconstructed monthly mean global solar radiation from 1821 to 1850 based on the weather records described in 11 historical diary documents. We focused on the years of Tempo Famine from 1833 to 1839.

In 1836, monthly solar radiation in summer in the east-west zone of Japan including Kanto, Kinki, and northern Kyushu was smaller than the provisional normal (average of 1821-1850). It was 10% or more smaller than the normal in July and August. However, it was not particularly small in Tohoku to the north of the zone and in southern Kyushu to the south of the zone. The characteristic of reconstruction in 1836 is that lower solar radiation prolonged from May to September in the central area of Japan. This suggests that climatic condition similar to Baiu was prolonged, and that it was cold in Tohoku. On the other hand, in 1833 and 1838, when famines also occurred, the reconstructed solar radiation was low in Tohoku.

We also checked the effect on market economy by observing the daily price of rice, the main crop at that time. For 1836, we can observe the sharp rise of the price in July. It suggests that the market had reacted to the bad climate condition before the harvest season. After this sharp rise, four times higher than usual, rice price reached a plateau then fell in September 1837.

While the rice price in 1833 and 1838 also rose up in summer, they were only two or three times higher than usual and, more importantly, they quickly bounced back.

Cross check between the reconstructed solar radiation and the rice price data support thus enables us to conclude that there existed a big difference even among the years recorded as "famine years" on the historical documents.

Keywords: documentary sources, historical climatic fluctuation, market economy, famine, global solar radiation, 19th century

