

Variation in the Distribution of Solar Radiation Using Historical Weather Descriptions during the Tempō Famine Period

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The impact of climate change on human society has been a significant issue in historical studies and is also crucial for future adaptation to climate change. Japan has a large volume of records, including those related to daily weather conditions (e.g., “fine,” “cloudy,” “rainy”) from the 17th to 19th century. These records have been used to reconstruct data related to climate variation and events in various parts of Japan. To understand climate change and its devastating impacts on societies in the past, before the start of meteorological observations of the Japan Meteorological Agency, the spatial patterns of climate variations must be reconstructed with a higher temporal resolution than those provided by the annual data. In addition, solar radiation is a fundamental factor for not only the energy balance of the Earth but also the hydrological cycle and agricultural productivity. Therefore, this study attempted to reconstruct monthly mean solar radiation data from 1821 to 1850 based on the weather descriptions recorded in 18 historical diaries. It also discusses inter-seasonal climate disasters and their effect, focusing on the Tempō Famine in Japan in the 1830s. The method used in this study was effective for all seasons and could reconstruct solar radiation data with higher temporal resolution than other methods or proxy data used to assess historical climate variation. We examined the climate conditions in 1833, 1836, and 1838 with the spatial distribution and inter-seasonal solar radiation variations shown as the percentage of the reconstructions from the 30-year mean. In the summer of 1833, solar radiation was low in the central, eastern, and northern parts of Honshu. In contrast, in the summers of 1836 and 1838, solar radiation was low mainly in Honshu, whereas it was normal or high in northern Tohoku. This suggests that the front zone, like the Baiu front, persisted frequently in Honshu during the summer, which might have resulted in the northern part of the front being cold instead of having the normal clear summer days. Furthermore, the distribution of solar radiation and its inter-seasonal variation in 1836 were characterized by lower solar radiation in summer than in other seasons, except in northern Tohoku and southern Kyushu. In addition, the low solar radiation was prolonged from May to September, mainly in the central part of Honshu. Previous studies have stated that during the Tempō Famine period, the famine was most severe in 1836. The discussions of this study are consistent with these previous results, and the effects of famines, such as negative harvests and rising rice prices, were noted.

Key words: Solar radiation, Historical diaries, Weather description, Tempō Famine, Historical climatology, Japan
