

Paper ID	125
Author(s)	Junpei Hirano, Naoko Hasegawa and Takehiko Mikami
Title	Long-term variations of snowfall ratio in the Sea of Japan side area of Tohoku region since the late 17th century
Abstract	
<p>We analyzed long-term variations of snowfall ratio during winter/early spring season in the Sea of Japan side area of north-eastern Japan since 1665. We used two long term historical daily weather documents and instrumental meteorological data for this analysis. We reconstructed time series of snowfall ratio from 1665 to 2005. We revealed that multi-decadal scale variations prevailed from the 17th to the early 20th century. In particular, the 1780s and the 1830s are characterized by high snowfall ratio, which coincides with periods of prolonged famines and unusual cool climate in summer. Abrupt decreases of snowfall ratio were observed in the mid-1940s and the mid-1980s. These abrupt decreases are unprecedented in our study period. We revealed that these abrupt decreases were due to recent rapid warming of surface air temperature.</p>	
Keywords	snowfall ratio, climate reconstruction, winter/early spring season, Long-term variations

Paper ID	178
Author(s)	Yasuo Takatsuki, Mika Ichino, Kooiti Masuda and Takehiko Mikami
Title	Abnormal climate and its Impact on market economy: the relationship between reconstructed solar radiation and rice price during the 1830s famine in Japan
Abstract	
<p>How do societies respond to varying climates? This question not only arouses academic curiosity but also offers insights into how our society can adapt to ongoing climate change. To explore this, we focused on early modern Japan (1603-1867), particularly the Tempō Famine of the 1830s. By reconstructing solar radiation from 18 historical diaries, we adopted a novel approach to analyzing climatic anomalies' impacts on agricultural production and the market economy. The results showed that lower solar radiation, indicative of poor weather conditions, was associated with higher rice prices, particularly during the summer of 1836. Applying principal component analysis to the reconstructed solar radiation data revealed spatiotemporal patterns that elucidated the link between climatic anomalies and their impacts on agricultural production and market prices during the Tempō Famine. This demonstrates the sensitivity of market prices and economic stability to climate fluctuations. We also examined the effects on other crops, such as wheat and soybeans, to highlight broader economic impacts of climate variations. By utilizing high-resolution data, this study reveals more detailed connections between climate, agriculture, and economic fluctuations than previously available. Our findings provide valuable historical perspectives and have significant implications for contemporary climate adaptation strategies and policy-making. Additionally, this study suggests further directions for research and encourages continued exploration into the relationship between climate change, agriculture, and economic fluctuations, inspiring future studies in this field.</p>	
Keywords	climatic impact, economic fluctuation, Tempō Famine, solar radiation, Japan, rice

Paper ID	104
Author(s)	Mika Ichino, Satomi Kurosu and Kooiti Masuda
Title	Climate Change and Severe Famines: Exploring the Relationship between Solar Radiation and

	the Dynamics of Historical Migration
Abstract	
<p>Understanding the effects of past climate change on human societies and their adaptations is vital for both historical studies and modern resilience strategies. Our previous study examined the impacts of seasonal solar radiation variations, reconstructed from diary weather records across 18 locations in Japan, on rice prices and migration during the Tenpō famine (1833–1839). We found that severe weather, reflected in these solar radiation estimates, led to high rice prices in Osaka. Consequently, higher temporal resolution data, compared to annual or limited-season data, can be more effective in studying the impacts of climate change on society.</p> <p>This study further explores how climate change affected food and economics and how stresses like famine and grain price fluctuations impacted migration, using historical weather descriptions, rice prices, and migration data. The migration data were calculated based on individual-level panel data from local population registers of four communities (current Fukushima prefecture) from 1708 to 1870. The rice price series in the local market of Aizu in the same prefecture was used to measure the annual fluctuations in local agricultural output. Monthly solar radiation was reconstructed from historical weather descriptions for three locations in the target area of Moriama, one to the north (Yamagata) and two to the south (Nikko). A comparison of the migration data with the reconstructed monthly solar radiation indicated that an increase in migration, abscondence, and death after summer solar radiation decreased significantly in the Tenmei (1782-1788) and Tenpo famines.</p>	
Keywords	Climate Change, Severe Famines, Migration, Solar radiation, Crop prices

Paper ID	251
Author(s)	Kooiti Masuda, Mika Ichino and Takehiko Mikami
Title	Spatial patterns of solar radiation related to poor rice harvest in Japan in early modern and modern times
Abstract	
<p>We investigate into the spatial patterns of cool summer which often led to poor rice harvest and famines in early modern Japan.</p> <p>We reconstructed monthly mean solar radiation (SR) in 1821-1850 at 18 locations in Japan from daily weather records in diaries. We made principal component (PC) analysis of SR for June, July, August and September, respectively. The eigenvectors of PC 1 for all of these months had negative values in a broad zone between 32 and 37 deg. N, but nearly zero values to the north of 38 deg. N. Among the known years of poor harvest in the 1830s, The score of PC 1 was high in all the four months of 1836, and high in July and August of 1838, but near zero in July and August of 1833.</p> <p>Instrumental observation of sunshine duration (SD) started around the end of the 19th century. We made PC analysis of SD for July and August in 1901-2021 at 45 locations. The eigenvectors of PC 1 were similar to that of the reconstructed SR. Those of PC 2 were negative in the northeastern Japan and positive in western Japan. In the known years of poor harvest, the score of either PC 1 (1902, 1905, 1980 and 1993) or PC 2 (1913, 1934) were high.</p> <p>It is likely that the situation of 1836 and 1838 was nation-wide cool summer similar to 1980 and 1993, and that of 1833 was cool summer in the northeastern Japan similar to 1913.</p>	
Keywords	Air, Disasters, Foods, Sunshine, Rice

Paper ID	221
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Author(s)	ATM SHAKHAWAT HOSSAIN and Toru Terao
Title	Emerging Challenges & Issues of Climate, Threatened Sustainability & Humanitarian Crisis in the Ukhiya, Teknaf Hills, Bangladesh
Abstract	
<p>Bangladesh is a South Asian tropical monsoonal country and used to struggle with various types of water-related hydro-meteorological hazards & disasters mainly during monsoon. The recent change of climate in the southeastern folded part has severely affected the rural households, income & livelihood of the poor people of the Ukhiya area and threatening sustainability. Water level fluctuations during dry and wet seasons and short-term monsoonal rainfall influences the stability and liquefaction potentiality of the hills. Attempts have been made to identify risk prone areas and tried to establish an alarm based early warning system for landslide hazards to raise awareness among communities and to reduce loss and risks during disasters and to enhance sustainability. A motivation campaign and training program to educate disaster victims, preparing and distributing risk maps and applying some ground improvement techniques helping community people to save lives and improve the livelihood of the common people of the investigated area. The impact of climate related hazards on livelihood were also assessed.</p>	
Keywords	Climate, Monsoon, rainfall & warning