

## Image analysis of sunspot drawings in Dalton minimum(the early 1800s) and reproduction of magnetograms from sunspot drawings by using machine learning.

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Solar activity varies periodically in 11 years. Because the solar activity is one of the main origins of the variability of the solar-terrestrial environment, it is important to predict the solar activity especially in the category of space weather study. It is known that the polar magnetic field at the solar minimum is closely correlated with the solar activity at the next solar activity. This correlation was confirmed by observing the current sun precisely. On the other hand, it is not clear whether there was a similar correlation in the past sun. Therefore, the aim of this study is to analyze the past sunspot drawing images to verify whether the polar field value at the solar minimum is also good correlation with the next solar activity. Especially, we focused on the Dalton minimum when sunspots were little in the early 1800s. We extracted latitude and longitude of sunspot from drawings in the early 1800 's. Furthermore, we generated magnetograms from sunspot drawings by using cGAN(Conditional Generative Adversarial Nets), one of the popular machine learning methods, and will discuss the validity of these magnetograms. In future, we will calculate the polar magnetic field in the Dalton minimum from these generated magnetograms by surface magnetic flux transport model and compare it with the correlation.

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