R011-P06
ポスター 1 ：11/24　PM1/PM2 （13:15-18:15）

#古川 瑠晟 [1)], 藤本 晶子 [1)]
([1] 九州工業大学

A generation model of two dimensional aurora image based-on Conditional GAN considering substorm process

#Ryusei Furukawa[1)], Akiko Fujimoto[1)]
([1]Kyushu Institute of Technology

We propose a deep learning model for generating aurora images, focusing on the substorm process. Aurora all-sky image analysis is important in understanding the substorm time evolution caused by the interaction of the solar wind with the Earth's magnetosphere. Machine learning-based two dimensional aurora image classification research has increased over the last decade. Many studies have only classified aurora images into several types by mechanically learning the features of aurora shape and texture in the image, and have not yet taken into account the substorm development process. Aurora shapes such as arcs and aurora illumination intensity in two dimensional aurora images correspond to substorm phases and precipitation particles. Substorm time development processes can be estimated from these aurora property information in two dimensional aurora images. The reconstruction of two dimensional aurora time-series development processes will provide consequent insights into solar wind and magnetospheric physics, such as magnetic reconnection and particle acceleration.

Our proposed model for generating two dimensional aurora images is based on Conditional GAN (Mirza and Osindero, 2014), which is an Adversarial Generative Network model. GAN models are generative models that can learn features from prepared data, such as images, using two different types of learners, Generator and Discriminator, to generate artificial images. To generate aurora images considering substorm time development processes, 2-hour time-series data of solar wind data (velocity, density, IMF Bz, and Electric Field) and ground-based geomagnetic field are given as condition vectors to the generators and discriminators in our conditional GAN model.

As a dataset, we use aurora all-sky images, in which the aurora can be clearly observed, without the influence of moonlight or weather. As a result, a total of 67,409 aurora all-sky images are obtained for the period 2015-2019. The training time for our two dimensional aurora image generation model was approximately 8 hours.

The performance of the generated models was assessed by qualitative and quantitative evaluation. The results showed that auroras with simple shapes and a slow temporal variation were reproduced well, with an average accuracy of 0.725. On the other hand, auroras with complex shapes and auroras with a rapid change in time had a low reproducibility, with an average accuracy of 0.362. These results demonstrate the potential of using a two dimensional aurora image generation model based on a conditional GAN model in understanding substorm development processes through deep learning.