Autoprocessing of VIPIR ionograms based on the Spatial Attention U-Net neural network

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In this study, we proposed a method for extracting ionospheric echo signals from ionograms based on Spatial Attention U-Net (SA U-Net). The ionogram data was generated from the Vertical Incidence Pulsed Ionospheric Radar (VIPIR), which is located at Hualien (23.99°N, 131.61°E), Taiwan, and could usually produce more than 200 ionograms per day. SA U-Net is a convolutional neural network developed for the purpose of image segmentation. It has been confirmed that SA U-Net can recover the ionogram very well, making the Intersection over Union (IoU, which is the ratio of the intersection of the predicted pixel area and ground truth pixel area to their combined area) of E-layer and F2-layer signals from the autoprocessed ionograms reach 0.7. Now, we collected the quiet time data from June 1, 2022 to May 31, 2023, and used SA U-Net to process these data automatically. Finally, time and seasonal analysis are also performed on the processed ionograms.

Keywords: Ionospheric sounding; Artificial intelligence; Spatial Attention U-Net