SWOL2023
SPACE WEATHER OBSERVATIONS THROUGHOUT LATINOAMERICA

Session: Ionosphere and Upper Atmosphere

Presentation type: Oral (x) Poster( ) No preference ( )

Automatic Segmentation and Classification of Range-Time-Intensity maps of Equatorial Spread-F

Susan Palacios and Marco Milla

Pontificia Universidad Católica del Perú

In the Peruvian ionosphere, a phenomenon that can disturb the global navigation satellite systems (GNSS) and radio communication systems is called Equatorial Spread F (ESF). This nighttime phenomenon starts at the bottom of the ionospheric F-region and is related to forming plasma density-depleted areas (bubbles). ESF studies have been conducted for years using the Jicamarca ionospheric radar operating in the JULIA mode. The radar backscatter power is registered in Range-Time-Intensity (RTI) maps showing temporal vs. height occurrence. These RTI maps evidence different morphological patterns (bottom-type, bottomside, radar plumes, and others). Since the type of morphological patterns is related to the ESF evolution, identifying each pattern and analyzing its occurrences can help the models forecast the ESF. In this work, we aim to automatically segment and classify the ESF patterns in the RTI maps using machine learning and deep learning algorithms. Leveraging the RTI maps available for more than 20 years, a comparison between different techniques such as Random Forest (RF), eXtreme Gradient Boosting (XGBoost), Neural Networks, and U-Net Convolutional Neural Networks (CNN) is conducted. As a result, the U-Net architecture shows the best performance for segmenting and classifying the ESF. The features used in the segmentation and classification are the RTI maps, geospace physical parameters, and feature textures.