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Zoom meeting C ：11/1 PM2 (15:45-18:15)
16:30〜16:45

Automated detection of mid-latitude sporadic E using GPS-TEC ROTI and aeronautical navigation radio wave data

#Masahiro Takahi[1)],Keisuke Hosokawa[1)],Jun Sakai[1)],Susumu Saito[2)]
([1]UEC,([2]ENRI, MPAT

The sporadic E (Es) layer is a thin layer having dense electron density that appears at an altitude around 100 km. The Es layer mainly appears at mid-latitudes during the summer months. When the Es layer appears, radio waves in VHF frequencies, sometimes above 100 MHz, may be reflected by the Es layer and propagate over anomalously long distances. It may cause interference on radio systems such as FM broadcast and aeronautical navigation systems. Therefore, it is necessary to clarify the mechanism and dynamics of the Es layer. Although the vertical shear in the neutral wind has been accepted as a basic mechanism of the Es layer generation, the dynamics of the Es layer is still unclear and is still being studied by observations and numerical simulations.

Recently, two types of mapping techniques, such as Global Positioning System (GPS) Total Election Content (TEC) and Rate Of TEC Index (ROTI), have been used to detect the Es layer. Recent studies using these mapping techniques indicated that the Es layer often has a frontal structure extending roughly in the east-west direction during the daytime. More recently, measurements of aeronautical radio navigation signals have been conducted to reveal the location of the Es layer using abnormal radio propagation phenomena. Combining these observations, it is possible to visualize the spatial structure of the Es layer. However, detection of the Es events and estimation of their parameters such as front direction and velocity rely on manual processing. Therefore, it is required to establish a method to automatically detect and analyze the Es layer characteristics.

In this study, we propose a method to automatically detect the Es layer and retrieve the information on the spatial structure of the Es layer by applying the Hough transform, which can extract lines in an image to the ROTI map. This method demonstrated that the detected line segment well captured characteristics of the elongation direction of the Es layer. Furthermore, we used a map of reflection points of the VHF anomalous propagation to improve detection accuracy in the ROTI map. The reflection points of the Es layer are selected by setting minimum received powers (-110, -115, -120 dBm). We confirmed that adding the reflection points of the Es layer to the ROTI map could improve the performance of the Es layer extraction.