Horizontal shapes of mid-latitude sporadic-E observed with GPS-TEC

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The horizontal shapes of sporadic-E (Es) have remained uncovered due to the lack of effective observation methods. We use a dense array of Global Positioning System (GPS) receivers in Japan to map horizontal shapes of mid-latitude sporadic-E layers and explore their diversity. The spatial and temporal resolutions of the GPS array are \textasciitilde25 km (in horizontal) and 30 s, respectively, which is ideal for studying the horizontal shape and movement of sporadic-E. Sporadic-E can be identified as positive anomalies of total electron content (TEC) along the line of sight between a satellite and a ground-based GPS station.

The results of GPS-TEC observation, i.e., mapping of positive TEC anomaly caused by mid-latitude sporadic E are presented in this presentation with a special emphasis on latitudinal and temporal variations of horizontal shapes of Es-layers. We analyzed \textasciitilde100 Es events in 2010-2013 to examine the latitudinal dependence of Es frontal structures with three study areas at different latitudes near ionosondes, namely Sarobetsu (geographical latitude: 45.16 N), Kokubunji (35.71 N) and Yamagwa (31.20 N).

As a result, strong Es shares the large-scale frontal structure as a common shape regardless of the occurrence latitude and time (e.g., morning, afternoon, and the evening). The horizontal structures of large-scale fronts are typically elongated in east-west (E-W) with the length and width of \textasciitilde300 km and \textasciitilde30 km, respectively. However, lengths vary from 30 to 300 km by occasion. The alignment of frontal structures prefers E-W, ENE-WSW and NE-SW alignment with some exception of NW-SE and NNW-SSE aligned structures.

We will also discuss the possible mechanisms for formation, development, and movement of mid-latitude sporadic-E based on the results of our observations and proposed theories.

Keywords: Sporadic-E, GPS, TEC