

Temporal increases of horizontal speed of frontal Es observed by HFD

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In the yearly analysis of the horizontal speed of frontal Es by using the HFD observation data of the year 2012, we found some events which showed temporal increase and then decrease within the time scale from 40 to 270 minutes. The rate of the temporal speed enhancements were only 2.4 % in all frontal Es events in 2012, and the enhances were mainly observed around 21h JST in summer. The rate of the speed enhancement were less than 30 %, but some peak speeds increased up to more than 200 m/s. The duration times varied from 40 to 300 min, but most of the events terminated within 150 min. The average leading and trailing times were 35 and 50 min, respectively, so the trailing part took long time. The cause of temporal speed variation can be related to time variation of horizontal electric field or of horizontal wind speed of neutral atmosphere in the E layer. The former should show coincidence over the wide area but the latter would show some time difference. Analyzing pair data over 100 km separation, we obtained time delay less than 20 min. It is therefore interpreted that the temporal speed increase is caused by the change of the horizontal wind speed. Because the distance between successive Es front shows the minimum of less than 50 km around the speed peak, and increases upto 200 km both to the start and to the end, it can be attributed to the inequally spaced Es front. Combining all separation distances for each event, we get the outer size of the temporal variation as 400 km for 65 %, and as the maximum of 1400 km. On the otherhand, it can be related to a non-isotropic structure because the peak speed did show different values for the separate stations. Based on those observational results, it is concluded that the temporal speed increase may be introduced by a spiral-like, instead of linear, structure.

Keywords: frontal Es, horizontal speed, temporal increase, HF Doppler observation