

## Accuracy improvement of reflection height and moving characteristics of frontal Es by oblique ionosonde and HF Doppler

Atsushi Ohtani<sup>1\*</sup>, Ichiro Tomizawa<sup>1</sup>

<sup>1</sup>SSRE, Univ. Electro-Comm.

The HF Doppler observation using 5006 and 8006 kHz transmitted from to the Chofu campus of UEC has been conducted at eleven stations including Sugadaira to observe of varieties ionosphere disturbances. However, it has the weak point that the wave reflection height cannot be specified by the HFD observation itself.

Fortunately, the distance between the HFD transmitting station (JG2XA) and the NICT Kokubunji ionosonde station is close to each other in only 8 km. Those Fresnel zones have an overlap area so that the two observations has the same reflection height. In this observation, we used a software defined radio receiver to receive ionosonde pulses from 7 to 9MHz around the 8006kHz HFD signal. The pulse transmission timing of ionosonde which is precisely scheduled in UTC were observed by mixing with the GPS synchronised 1sec pulse in the 1 micro-second accuracy. The propagation distance from Kokubunji to Sugadaira was measured by the arrival delay of ionosonde pulses. This method was applied to estimate the height and moving characteristics of Es. The reflection height can be determined from propagation distance and the reflection position of Es which were calculated from the movement speed and the direction angle through the HFD network. As the propagation path both to the ionosonde and the chofu HFD transmitter can be deduced by applying the method of Cornelius and Essex(1979) [1], we can deduce the same reflection height.

Around 20h JST(UT+9h) on July 28, 2012, the frontal Es with more than 200 km length passed over Sugadaira to Chofu by the speed of 60 m/s in the 182 degree from north was observed in this observation system. We obtained the accurate reflection height of the frontal Es as 115 km in matching the propagation path to the oblique ionosonde.

Acknowledgement: We are grateful to NICT for the ionosonde signal transmission.

### Reference

[1] D.W. Cornelius and E.A. Essex: Observations of mid-latitude sporadic E using the HF Doppler technique, *J. Atmos. Terr. Phys.*, vol.41, no.5, pp.481-499, 1979.

Keywords: ionosphere, ionosonde, sporadic E