Study of time-spatial structure of E-region FAIs based on MU radar interferometry observations

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Plasma instabilities in the ionospheric E-region are highly field-aligned, and is called field-aligned irregularities (FAI). Quasi-periodic (QP) echoes, which were found with the middle and upper atmosphere (MU) radar, show periodicity of 2-15 minutes and sloping striations in a range-time-intensity (RTI) plot. The QP echoes are correlated with the sporadic-E (Es) layers, so that they have been considered to be generated by deeply modulated Es layer. Such Es layer behavior was, however, not observed with the rocket experiments (SEEK and SEEK2 campaign). We conducted the MU radar interferometry observations in order to reveal time-spatial structure of the QP echoes. We determined three-dimensional position of the echoes by means of the interferometry, and found that that the QP echoes moved horizontally in the southwestward direction with keeping their altitudes. In the horizontal motion the QP echoes moved from perpendicular direction to the geomagnetic field to the off-perpendicular directions. The offset from the perpendicularity reached more than two degrees. We have conducted simulations of the radar radiowave (46.5 MHz) propagation by means of the Finite Difference Time Domain (FDTD) method. Assuming a planar Es layer, diffraction of the radiowave at the lower edge of the Es layer was less than two degrees. However, the diffraction angle became as large as 2.4 degrees by changing the incidence angle of the radiowave by assuming tilted Es layers. In the presentation we show results from the MU radar interferometry observations and FDTD simulations.