Study of Ionospheric Irregularities over Japan and Indonesia with radars and other instruments

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We have been studying ionospheric irregularities in mid-latitude and low-latitude regions by using radars. The MU radar observations have elucidated wave-like structures that are specific in the mid-latitudes. One of the phenomena is quasi-periodic echoes (QP echoes) in the E-region. The other is medium-scale traveling ionospheric disturbance (MSTID) in the F-region. We also used Equatorial Atmosphere Radar (EAR) in Indonesia to study plasma bubble that is the most intense irregularity in the low-latitude ionosphere. Multi-beam and/or multi-channel capability of these radars was powerful to know spatial structures of the phenomena. Studies of these phenomena with the single radar approach, however, had limitations as these phenomena are generated by the coupling processes between neutral atmosphere and ionosphere plasma, or between E-region and F-region of the ionosphere. Multi-instrument approach, the combination of these radars and other instruments, was then necessary for further understanding. We review cases of such multi-instrument studies; two-radar experiment and sounding rocket experiment for the mid-latitude, and satellite beacon experiment in the low-latitude.

Key words: MU radar, Equatorial Atmosphere Radar, Ionospheric irregularities