Neutral and plasma density perturbations in the top-/bottom-side ionosphere associated with MSTIDs

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Medium-scale traveling ionospheric disturbances (MSTIDs) are a well-known wavy structure in the F-region ionosphere. They typically have a horizontal wavelength of several hundred kilometers and a periodicity of about one hour. Although, the MSTIDs were considered to be caused by atmospheric gravity waves, recent studies have suggested that the generation of the MSTID in nighttime is highly associated with coupling processes between the E- and F-region electrodynamics. To confirm the different processes in the MSTID generation in daytime and nighttime, CHAMP satellite measurements would be greatly helpful; CHAMP plasma and neutral density data obtained in the day- and night-side sector can monitor the phase relations between the neutral (i.e., atmospheric gravity wave) and ionospheric plasma perturbations simultaneously at the top-side F-region (approximately 400 km).

As the first step in the abovementioned research, we compared the MSTID signatures between the CHAMP and ground-based 630-nm airglow measurements to validate the MSTID detection by CHAMP. Airglow imaging is a quite useful technique to investigate two-dimensional characteristics of the nighttime MSTIDs. Horizontal parameters of the MSTIDs (such as wavelengths, motions, and their spatial extent) can be estimated directly with a high spatial and temporal resolutions through the 630-nm airglow emission in the bottom-side F-region. Previous study by Park et al. [2009, JGR] made an investigation of spatial signatures regarding one MSTID event using airglow images along the CHAMP orbit. The Institute for Space-Earth Environmental Research, Nagoya University, have operated airglow imaging network, as the OMTI system, around the world since 2000; this network gives much more chance to make coordinated measurements with CHAMP.

In this presentation, we will report the statistics of conjugate MSTID measurements at mid-latitude Japanese stations (Rikubetsu: 44N, 144E, Shigaraki: 35N, 136E, and Sata: 31N, 131E) with CHAMP and the ground-based optical network in 2005-2008.