Dependence of the High-Latitude Thermospheric Density on the Interplanetary Magnetic Field

Young-Sil Kwak[1], Arthur D. Richmond[2], Yue Deng[2], Jeffrey M. Forbes[3], Khan-Hyuk Kim[1], and Kyung-Suk Cho[1]

[1]*Division of Space Science, Korea Astronomy and Space Science Institute, Daejeon, Korea*
[2]*High Altitude Observatory, National Center for Atmospheric Research, Boulder, CO, USA*
[3]*University of Colorado, Boulder, CO, USA*

The direction and strength of the interplanetary magnetic field (IMF) have a strong influence on the high-latitude ionospheric plasma convection and current, so it is generally believed that they influence the high-latitude thermospheric wind and forcing on the wind. From the relationship between the IMF and thermospheric wind, we can expect that thermospheric density driven by the high-latitude forcing is strongly modulated by the IMF variation. In this study, the high-latitude thermospheric total mass density around 400 km altitude, derived from the high-accuracy accelerometer on board the Challenging Minisatellite Payload (CHAMP) spacecraft in November 2001 through February 2002, is statistically analyzed in magnetic coordinates as a function of the direction and strength of the IMF for southern hemisphere. Moreover, a comparison of the observed CHAMP density with the simulated density by the National Center for Atmospheric Research Thermosphere Ionosphere Electrodynamics General Circulation Model (NCAR-TIEGCM) coupled with a new quantitative empirical model of the high-latitude forcing on the thermosphere, is also performed. This numerical experiment using model simulations can provide insight into sources responsible for driving the thermospheric density. From a comparison of the model and observation, we suggest that the IMF conditions play an important role in the high-latitude thermospheric density variations, which are strongly determined by thermospheric winds. We also find that the density variations are also influenced by the local heating associated with ionospheric current or auroral particle precipitation, or by the local cooling, which varies with IMF conditions.