



Strong disturbance of the upper thermospheric density due to magnetic storms: CHAMP observations

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Strong enhancement of the upper thermospheric total mass density was observed by the CHAMP satellite at approximately 400 km altitude during three geomagnetic superstorms occurring on October 29-30, 2003, October 30-31, 2003, and November 20-22, 2003. The corresponding density enhancement peaked around 400%, 500%, and 800% of the quiet-time values in both noon and midnight sectors. The disturbances showed strong noon–midnight and seasonal asymmetry. In the noon sector, the average density enhancement was stronger in summer than in the winter hemisphere. In the midnight sector, however, no general conclusion can be drawn about the seasonal effect. Stronger density enhancements occurred in the summer hemisphere during the second and third storm events, while in the winter hemisphere during the first storm event. The relative intensity of the disturbance between day and night is strongly dependent on our definition of the intensity. When expressed in absolute terms (*storm* – *quiet*), the density enhancement at night was generally less than half of that at day during all three storms. When expressed in percentage terms ($\frac{\text{storm}-\text{quiet}}{\text{quiet}}$), however, the enhancement at night was comparable to or even larger than that at day. The propagation of the disturbance from high to low latitudes during the November storm was faster in summer than in the winter hemisphere on both day and night sides. In the winter hemisphere, the propagation on the dayside was found to be faster than on the nightside. These variations of the seasonal effect with local time and individual event suggest that, the many different competing processes involved in a magnetic storm may also vary dramatically with local time and from event to event. The MSIS90 model was unable to reproduce most of the observed features of these three storms.