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Ionosphere-thermosphere global time response to geomagnetic storms

In this study, we investigate thermospheric neutral mass density

heating to 168 CME-driven geomagnetic storms in the period May 2001 to September 2011. We superpose CHAMP and GRACE density enhancements with two

different zero epoch times (ZETs): the first ZET is the CME shock impact time, and the second, the time when IMF Bz turns sharply southward. The first case is associated with SSC events (represented by SYM-H data), and the second case indicates the storm main phase onset (represented by OMNI data). We find that this approach reveals two distinct density responses: in the first ZET case, minimum SYM-H and maximum density occurrences are lagged by almost four hours, whereas in the

second case such peaks almost coincide in time. In the shock impact ZET case, density perturbations travel from the auroral zones to the

magnetic equator and magnetic poles in about 4.5 and 7.5 hours, respectively. On the other hand, in the second ZET case, such disturbances are seen in those regions in lag times of 3.0 and 6.0 hours. The equatorial response is presumably associated with direct equator-ward propagation of TADs (traveling atmospheric disturbances), while the polar response is most likely associated with a complex interplay between TADs and polar winds. We then conclude that the choice of lining up

the data according to different forcing of CME regions may affect the

thermosphere average response because in the second ZET case the storm effects are more effectively superposed in relation to the first case.