Atmospheric drag effects on the KOMPSAT-1 during geomagnetic storms

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A satellite traveling through the atmosphere experiences a drag force in the opposite direction of its orbital motion. The local atmospheric total mass density over the path traveled by a satellite is an important parameter for the drag force. It is well known that the atmospheric density is strongly driven by space weather effects from solar EUV radiation (i.e., solar radiation activity) and from local atmospheric heating associated with local geomagnetic current enhancements (i.e., geomagnetic activity). However, it has been rarely examined which activity plays a dominant role in atmospheric drag on a satellite under extreme geomagnetic conditions. In order to examine the relationship between satellite drag and solar radiation/geomagnetic activity, we used the daily drag data acquired by the Korea Multipurpose Satellite-1 (KOMPSAT-1) during a 3-month (October-December) period in 2003. This 3-month interval includes the October 29-30 and November 20 superstorms caused by Earthward coronal mass ejections (CMEs) as well as weak to moderate storms caused by high-speed streams and/or CMEs. We find that the daily KOMPSAT-1 drag rate transiently increases whenever magnetic storms occur. That is, the drag increase is well correlated with a main phase of geomagnetic storms. The drag increase depends on strength of geomagnetic storm characterized by Dst index. We also find that the solar index (F10.7) variations were not reflected in satellite drag variations during the superstorms. From these observations, we suggest that geomagnetic activity is more important parameter than solar radiation activity for daily drag effects during the period of strong geomagnetic storms and that large geomagnetic storms can cause large orbital perturbations.