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Inter-hemispheric comparisons of the ground magnetic responses during the 2013 and 2015 St. Patrick's Day geomagnetic storms

Zhonghua Xu (1), Michael Hartinger (1), Robert Clauer (1), Taikara Peek (1), and Rico Behlke (2)
(1) Virginia Tech, Blacksburg, United States (mdhartin@vt.edu), (2) DTU Space, Kongens Lyngby, Denmark

Inter-hemispheric differences in the magnetosphere-ionosphere system depend on a range of parameters that may vary simultaneously, including solar wind driving conditions and ionospheric conductivity in each hemisphere. It is difficult to assess how each of these parameters contribute to inter-hemispheric differences during geomagnetic storms and extreme driving conditions; these events occur less frequently providing fewer opportunities to isolate one parameter or another. The 17 March 2013 and 17 March 2015 geomagnetic storms driven by coronal mass ejections (CME) provide one such opportunity. The two events occur during the same solar illumination conditions. In particular, both occur near equinox on the same day of the year leading to similar ionospheric conductivity profiles. Moreover, both CMEs arrive at the same time of day leading to similar observing conditions (i.e. ground stations at similar magnetic local time in both events). We examine the ground magnetic response to each CME at high-latitudes in both the Northern and Southern Hemispheres, including the West Greenland chain and the newly deployed AAL-PIP magnetometer chain in Antarctica, remote sensing magnetospheric and ionospheric current systems. There are dramatic differences between the intensity, onset time and occurrence, duration, and spatial structure of the current systems in each case. For example, differing solar wind driving conditions lead to interhemispheric asymmetries in the high-latitude ground magnetic response during the 2015 storm, while these asymmetries are not obviously present in the 2013 storm. We discuss possible explanations for these asymmetries and implications for other storm events.