Title: The Differences in Onset Time of Conjugate Substorms

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Abstract

The auroral electrojet (AE) index, which is used to indicate the level of geomagnetic activity at the north polar region, is traditionally calculated from 13 ground magnetometer stations located around the typical northern auroral oval location. Similar coverage in the Southern Hemisphere does not exist, so the AE calculation has only been performed using Northern Hemisphere data. In the present study, we use seven southern auroral region ground magnetometers as well as their conjugate Northern Hemisphere data to calculate conjugate AE indices for 274 days covering all four seasons. With this dataset over 1200 magnetic substorm onsets have been identified in the southern auroral electrojet (SAE) index using the technique of Hsu et al. [2012]. A comparison of the SAE index with the world data center standard AE index, which has been used for the last 50 years, shows that the substorm onsets do not always occur at the same time with differences on the order of several minutes. In this study we examine the differences in the onset time and the reason for those differences using our conjugate AE indices and using pairs of conjugate ground magnetometer stations. Specifically, we used the pair of stations at West Antarctica Ice Sheet Divide and Sanikiluaq, Canada and Syowa, Antarctica and Tjörnes, Iceland. The largest differences in onset time appear to be related to the season and magnetic field line length. Differences on the order of minutes for the onset time of conjugate substorms have serious implications for substorm theories. The problem is that waves from a current disruption region in the magnetotail (~ 8 to 10 earth radii) to the mid magnetotail (15 to 20 earth radii), or flows from the mid tail to the current disruption region take the same amount of time (~2 minutes), which makes it difficult to decide where the onset disturbance is initiated, particularly when onset indicators have differences on the order of minutes.

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BIOGRAPHY

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I graduated from St Olaf in 1992 and went to the University of Calgary in Canada for graduate school. At University of Calgary I did my PhD on auroral polar arcs using the Viking auroral spacecraft where I demonstrated there are two distinct types of polar arcs. In early 1998 after graduate school, I went to Universität Bern, Switzerland, where Albert Einstein developed his Special Theory of Relativity, and did my post doctorate studies on solar wind elemental and isotopic composition. In 2001 I was invited to become a researcher the University of California, Los Angeles (UCLA). Since coming to UCLA I have worked with a number of different spacecraft teams and ground arrays on solar wind and magnetospheric research topics. I have my own research projects on space plasma turbulence, auroral ionospheric current systems, and conjugate magnetic field observations.

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