Conjugate dayside responses to sudden solar wind pressure increases at high-latitude polar regions with the 40° magnetometer chain

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The near-Earth space environment is strongly affected by solar activity. As a result, the Earth's magnetosphere and ionosphere have a variety of responses to different solar activities. At the present time, it is unclear whether the responses in the two polar regions are symmetric and whether the degree of symmetry has a seasonal dependence. This is largely attributed to the limited availability of high quality Antarctic observations during the past. In recent years, the magnetosphere-ionosphere science team (MIST) at Virginia Tech has deployed a series of Autonomous Adaptive Low-Power Instrument Platforms (AAL-PIP) in the Antarctic, in an effort to improve our understanding of interhemispheric conjugacy. Each platform carries a high quality fluxgate magnetometer and searchcoil magnetometer. This new magnetometer chain is located along 40° magnetic meridian and is conjugate to the west coast Greenland magnetometer chain in the north hemisphere. Thus as shown in the Figure 1, these two chains when combined with SuperDARN radars overlooking the station locations provide a unique opportunity to examine the conjugate magnetosphere and ionosphere responses to solar wind transients simultaneously at the northern and southern conjugate points.

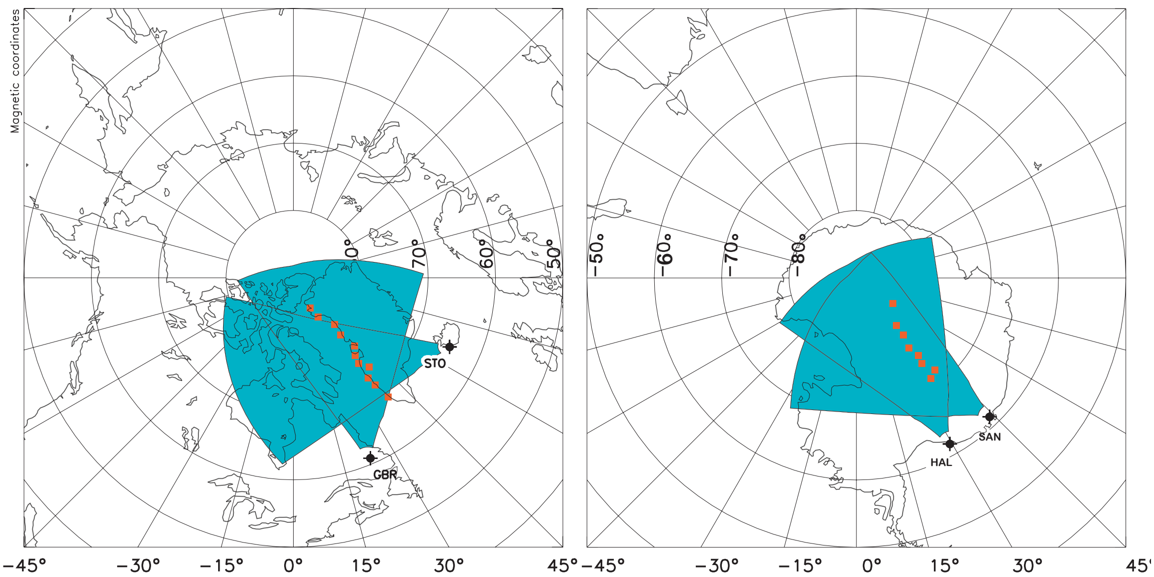

Figure 1: Distribution of 40° magnetometer chain and SuperDARN FOV in the northern hemisphere (left panel) and southern hemisphere (right panel). The magnetometers are represented as red rectangles and radar FOVs are shaded in blue. The radar names are given as three letters only. The perspective is as viewed from the top of the Earth. The numbers on the bottom show the magnetic longitude. The circles in each panel are magnetic latitudes plotted every 10°.

In this research, we investigate the conjugate magnetosphere and ionosphere responses to sudden solar wind pressure increases at high latitude using magnetometers along the 40° magnetic meridian chain. Sudden solar wind pressure events are identified using solar wind measurements obtained from the ACE satellite located at the L1 point between the Sun and the Earth. Our criteria are: 1) the solar wind dynamic pressure increases by at least 5 nPa in less than 5 minutes, and 2) the solar wind pressure is quasi-steady 45 minutes before and 15 minutes after the increase. The solar wind pressure increases are identified automatically by a computer algorithm and then checked manually by eye. From 1998 to 2009, we have identified 139 sudden solar wind pressure increases. During each event, the ground magnetic disturbance in the two hemispheres is carefully examined in terms of magnitude and polarization using conjugate pairs of magnetometers. The equivalent ionospheric convection patterns are also generated for comparison with that inferred from SuperDARN measurements. We concentrate on answering the following questions: 1) Are the magnetic disturbance patterns observed in the two hemispheres different, and if so, is there a dependence on local time and season? 2) Are the ionospheric convection patterns derived from magnetometers and radar measurements different, and if so, is there a dependence on local time and season? The answers to these questions will shed a new light on whether or not there is interhemisphere symmetry in solar wind-magnetosphere-ionosphere coupling at high-latitude polar regions.