Simultaneous observations of magnetospheric ELF/VLF emissions at Canada, Finland, and Syowa Station

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Whistler mode wave emissions in the ELF/VLF range, such as chorus, hiss, and quasi-periodic (QP) emissions, accelerate relativistic electrons in the inner magnetosphere. Relativistic particles drift around the Earth in the longitudinal direction with time scales from tens of minutes to hours and interact with ELF/VLF emissions. However, global extent of ELF/VLF emissions has not been well understood. We investigate this by analyzing the data obtained at 2 longitudinally-separated stations in the northern hemisphere and 1 station in the southern hemisphere in the auroral and subauroral latitudes, i.e., Athabasca, Canada (54.7N, 113.3W, magnetic latitude (MLAT): 61.3N), Kannuslehto, Finland (67.7N, 26.3E MLAT: 64.4N) and Syowa Station, Antarctica (69.0S, 39.6E, MLAT: 70.5S). Simultaneous data at these stations are available for total 48 days during December 10-14, 2012, January 9-19 and January 29-February 5, 2013, and February 26-March 21, 2014.
As an initial analysis, we evaluated the simultaneous wave occurrence rate of ELF/VLF emissions at Athabasca and Kannuslehto, which have about 11 hour differences in MLT. The wave occurrence rate was about 4 % in all available hours of the simultaneous observations. We found that the MLT dependence of simultaneous wave occurrence was basically a superposition of wave occurrence distribution at two stations.
In order to study details of the simultaneous wave occurrence features, we report intense hiss emissions observed at three stations associated with a sudden impulse event with enhancement of solar wind dynamic pressure with northward IMF on January 18, 2013. The hiss emissions were observed at frequencies expanding from below 1 kHz to over 2.5 kHz starting at 1235 UT (1240MLT) at Syowa Station, 1236 UT (1524 MLT) at Kannuslehto, and 1240 UT (0440MLT) at Athabasca during the recovery phase of a weak geomagnetic storm. We compared the timings of wave generation and the increase of magnetic field intensity at these 3 stations. At Syowa station and Kannuslehto, there were no discernible timing differences. At Athabasca, however, the wave was generated 4 minutes after the local magnetic field enhancement.
These results suggest that 4 % of ELF/VLF emissions may have a spatial extent of more than 11 hours. The event suggests that the timing of wave generation and magnetic field variation is not necessarily coincident. In the presentation, we will report statistical results of simultaneous occurrence of ELF/VLF emissions using all three stations.

Keywords: ELF/VLF emissions, Whistler mode wave emission, simultaneous wave occurrence

