

Simultaneous ground-based and satellite observations of MF/HF auroral radio emissions

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Ground-based and satellite observations have revealed that the Earth is a distinct radio source. The terrestrial auroral ionosphere emits electromagnetic waves in the MF/HF ranges (about 1-6 MHz) as well as well-known intense auroral kilometric radiation (AKR) and auroral hiss in the VLF/LF ranges. Terrestrial Hectometric Radiation (THR) is observed by satellite observations in a frequency range of 1-4.5 MHz at high latitudes during geomagnetic disturbances and is regarded as a counterpart of auroral roar which is one type of MF/HF auroral radio emissions observable from the ground. Both THR and auroral roar are attributed to mode conversions of upper hybrid waves favorably generated under the matching condition, $f_{UH} \sim n f_{ce}$, where previous studies confirmed $n = 2, 3, 4$ and 5 for auroral roar, and $n = 2$ for THR. However, no previous studies have tested the simultaneous appearance. In this study, we survey long-term observation data obtained by the ground-based passive receivers installed at the Husafell station, Iceland (after September 2005, latitude 64.67°N , longitude -21.03°E , 65.3° magnetic latitude) and the Kjell Henriksen Observatory (KHO), Svalbard (after August 2008, latitude 78.15°N , longitude 16.04°E , 75.2° magnetic latitude) and by the Plasma Waves and Sounder experiment (PWS) mounted on the Akebono satellite. This data set includes several simultaneous appearance events, while the frequency of auroral roar is different from that of THR observed by the Akebono satellite passing over the ground-based stations. This frequency difference supports the previously proposed idea that auroral roar and THR are generated at different altitudes near 250 km and 1000 km, respectively. There is hardly any possibility that simultaneous observations indicate the identical generation region of auroral roar and THR. We also find that auroral roar appearing during the time when the Akebono satellite passes over the ground-based stations tends to be accompanied by THR. However, when the Akebono satellite passing over the stations detects THR, auroral roar does not always appear. This tendency is explained in terms of the fact that the Akebono satellite can detect THR emissions coming from a wider region, and a considerable portion of auroral roar emissions generated in the F region is absorbed in the D/E regions.