

Direction-finding measurements of auroral roar emissions

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Auroral roar is a band-limited auroral radio emission observable from the ground in the MF/HF ranges. It is believed to be generated through mode conversion of upper hybrid waves excited by auroral electrons at points in the auroral F region ionosphere where upper hybrid frequency (f_{UH}) matches electron cyclotron harmonics (nf_{ce}). Direction-finding measurement is a powerful method to verify the occurrence factor of auroral roar [e.g., Hughes and LaBelle, 2001; Hughes et al., 2002]. We installed a new instrument referred to as Auroral Radio Spectrograph (ARS) in Longyearbyen, Svalbard (CGM latitude 75.2 deg). The ARS consists of two types of receivers: ARS-S and ARS-WF. The ARS-S is designed for the spectrum measurement in a frequency range below 6 MHz. The ARS-WF is designed to obtain waveform data for the estimation of the direction of arrival (DOA) of incoming radio waves. The ARS has observed several auroral roar events since the operation started in August, 2008. This is the first report of direction-finding measurement to evaluate the correlation of auroral roar with optical aurora and absorption event observed by imaging riometer (IRIS) installed in Longyearbyen. In the event on December 17, 2008, $2f_{ce}$ auroral roar appears near 2.75 MHz during 1649-1708 UT. The FMI all-sky camera located at the same place shows that there is a faint aurora in the equatorial edge of the field of view before the auroral roar onset, which coincides with the start of the poleward motion of auroral arcs. The estimated DOA shows that the $2f_{ce}$ auroral roar comes from the vicinity of the most poleward auroral arc. The IRIS data shows the $2f_{ce}$ auroral roar is not associated with any absorption event. It is likely that the auroral roar is associated with low energy auroral electrons (< keV), which do not cause the ionization in the ionospheric D and E regions. The temporal change of the DOA corresponds well to a slight equatorward motion of the auroral arc. This observation provides evidence suggesting that the $2f_{ce}$ auroral roar is generated in the bottomside of the ionospheric F region along the most poleward auroral arc.

Keywords: auroral roar, auroral ionosphere, radio propagation, plasma instability, ionospheric absorption