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Banded VLF emissions occurring in the frequency range 16 - 39 kHz observed on the ground

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Analysis of Very Low Frequency (VLF) radio waves provides us with an outstanding possibility of investigating the response of both the lower ionosphere and magnetosphere to a diversity of transient and long-term physical phenomena originating on Earth (e.g. atmospheric waves) and outside Earth (e.g. solar flares). Usually, natural VLF emissions have been reported in broadband for frequencies below 16 kHz. Thus, in this study, VLF measurements obtained by the Kannuslehto radio receiver (in northern Finland) during the campaigns 2006 - 2018, are used to look for new natural VLF emissions observed in the frequency range 16 - 39 kHz. We found banded emissions observed either in high frequency ranges (16 – 39 kHz) or spanning from low to high frequency ranges (0.2 – 39 kHz). These emissions occur between 16:00 and 24:00 UT (18:00 – 02:00 LT), lasting from 5 to 80 min. We verified that the banded emissions are not associated to either geomagnetic quiet or disturbed conditions. Moreover, we found that the events have stronger left-handed polarization than right-handed polarization. The frequency band separation of these emissions is less than 2 kHz, with a maximum probability around 0.4 kHz. Furthermore, the frequency drift distribution is maximum between 5 and 10 Hz/s. Our results indicate that these banded emissions might be related to lightning emissions and their propagation in the Earth-ionosphere waveguide.