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An initial ULF wave index derived from two years of Swarm observations

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The ongoing Swarm satellite mission provides an opportunity to a better knowledge of the near-Earth electromagnetic environment. Herein, we use a new methodological approach for the detection and classification of ultra low frequency (ULF) wave events observed by Swarm based on an existing time-frequency analysis (TFA) tool and utilising a state-of-the-art high resolution magnetic field model and Swarm Level 2 products (i.e. the Field Aligned Currents - FAC and Ionospheric Bubble Index - IBI). We present maps of the dependence of ULF wave power with magnetic latitude and magnetic local time (MLT) as well as geographic latitude and longitude from the three satellites at their different locations in low-Earth orbit (LEO) for a period spanning two years after constellation's final configuration. We show that the inclusion of the Swarm single-spacecraft FAC product in our analysis eliminates all the wave activity at high altitudes, which is physically unrealistic. Moreover, we derive a Swarm orbit-by-orbit Pc3 wave (20–100 mHz) index for the topside ionosphere and compare its values with the corresponding variations of solar wind variables and geomagnetic activity indices. This is the first attempt, in our knowledge, to derive a ULF wave index from LEO satellite data. The technique can be potentially used to define a new Level 2 product from the mission, the Swarm ULF wave index, which would be suitable for space weather applications.