Anti-correlation between sunspot number and spectral resonance structures of ELF magnetic variations at Kawatabi, Japan

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Spectral resonance structures in a frequency range 0.5 –8 Hz were found in the ELF magnetic field data obtained at Kawatabi, Osaki, Miyagi prefecture Japan (magnetic latitude N30) during the period from December 11, 1997, to June 2, 2016. The data were obtained by an induction magnetometer placed in North-South direction at a sampling frequency of 128 Hz. The data were Fourier transformed every 8 second and averaged for 2 minutes to be displayed in the form of dynamic spectra [1]. Figure 1 shows an example. We can see structured enhancements approximately at 1 Hz, 2 Hz, 2.5 Hz, 3.5 Hz, 4.5 Hz. They are thought to be spectral resonance structures (SRS) generated by ionospheric Alfvén resonator which is an ionospheric cavity with the minimum Alfvén velocity bounded by E layer and a steep gradient of the Alfvén velocity above the maximum of F layer [2]. In accordance with previous literatures, the occurrence of the spectral resonance structure in Kawatabi was restricted within the nighttime from17 LT to 06 LT. The frequency rose from the evening toward the midnight. They were detected in rather quiet periods of geomagnetic activity. Although the data coverage was limited as low as 51%, nearly two decades of observations show a clear anticorrelation between the occurrence of the spectral resonance structures and the sunspot number, consistently with the scenario of ionospheric cavity with minimum Alfvén velocity.

[1] https://www.ice.tohtech.ac.jp/nakagawa/elfdata/index.html.
[2] M. Nosé, et al.(2017), *J. Geophys. Res., Space,* **122**, pp.7240-7255, doi:10.1002/2017JA024204.

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