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Inversion of ducted VLF transmitter signals observed in the plasmasphere

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Very low frequency (VLF) measurements by the EMFISIS instrument onboard the Van Allen Probes satellite pair regularly exhibit signals from ground-based VLF transmitters. We present the results of our measurement campaign in 2016 targeting such signals from the the Russian Alpha ground-based VLF transmitters. Based on the wave characteristics, the observed electromagnetic waves travelled in ducted mode in the plasmasphere. We carried out a monochromatic wave propagation inversion to obtain plasmaspheric electron densities.

We compare the results to independent in-situ plasma density measurements (based on the observation of upper hybrid resonances) as a reference. The two are in good agreement, validating our method as a more general tool for plasmaspheric density measurements. This also supports the validity of the same inversion procedure applied to ground detected VLF whistlers, naturally occurring VLF electromagnetic waves used for the continuous monitoring of the plasmasphere.

In addition, we observed a couple of echoed (2-hop) signals, reflected from the ionosphere at the opposite hemisphere. The wave characteristics of these also showed ducted propagation, and their inversion - having extended the procedure as necessary - is also in agreement with reference measurements, further strengthening our results.