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Parallel evaluation of spaceborne and ground-based VLF recordings: Comparative study of lightnings, spherics and whistlers in DEMETER data

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Automatic whistler detection [*Lichtenberger et al*, 2004] has been performed on burst mode VLF waveform data of the LEO DEMETER satellite along satellite passes over Central Europe. This procedure was focused on short-path fractional-hop whistlers, appearing sometimes as sharp traces with a very high occurrence rate (consecutive whistlers in less than 8 ms) on spectograms of the electric (ICE) and magnetic (IMSC) field data. Late summer period of the satellite recordings was choosen because of the typically high seasonal lightning rate. The detection on the dataset of several short (few minute) orbits, overall around one hour wideband recording yielded more than 45,000 detected whistlers. This number, as expected, much exceeds the typical volume of one-hop whistlers observable on the geomagnetic conjugate region. In the frame of this investigation the contemporal lightning data, provided by the Safir lightning detection network in Hungary [*Wantuch and Szonda*, 2005], run by the Hungarian Meteorological Service was used as reference data for possible causative lightnings in this region. The overall number of lighnings on the studied days, detected within the range of several hundred km around the country exceeded 56,000 flashes. In contrary to this high lightning activity, the number of those particular lighnings falling in the

time periods of analyzed DEMETER passes was only 520. Lightning-whistler coincidences, calculated by the accurate time delay between a supposed lightning and a consecutive whistler, referring to modelled signal propagation across the ionosphere in the satellite vicinity, resulted in 478 matching pairs. This assumes that in case of proper lower ionospheric conditions regional lightning impulses reach the LEO satellite as small dispersion whistlers with high probability. Furthermore, the vast majority of the on board detected whistlers in the same time were excited by more distant lightnings. These signals reached the subsatellite region propagated under the ionosphere, as was clearly proven by the statistical comparison of satellite dataset (whistlers) and the corresponding subset of ground based wideband VLF dataset (spherics), recorded in Tihany Observatory, Hungary. The results of this investigation showed nearly one-to-one correspondence of spheric occurrences and whistler rates even in cases of unexpectedly large (more than 1500 km) distances between subsatellite point and ground observation.

Lichtenberger, J., Ferencz, Cs., Hamar, D., Steinbach, P., and Bodnár L.,(2004) Automatic whistler detection and analyzing system, *Geophys. Res. Abs*., **6**, 01390

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