

Correlations of thunderstorms and magnetic records at COBS

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Due to the exposed position of the Conrad Observatory on top of Trafelberg, lightning strikes are frequently observed. Such lightning strikes cause contemporaneous peaks in our geomagnetic records, particularly visible in the live stream of the supergradiometer. These peaks/times were compared with ALDIS LLS (lightning location system) data. After down-sampling of ALDIS data to supergradiometer timestamps a good correlation between the time series was visible. This study focuses on short term effects and determination of amplitudinal calibration factors to check for systematic relations of ALDIS stroke peak currents and magnetic records at COBS.

Detection and measurement of lightnings is a discipline which is very precise in temporal terms and quite robust in spatial and amplitudinal terms. LLS, allows us to distinguish between cloud-ground(CG) and cloud-cloud(CC) lightning discharges. In Austria ALDIS is one of the main providers of such LLS data which was used in this analysis. The N-S supergradiometer system (GP20S3_NS) at COBS has a comparatively lower sampling rate (1 sample/s) at very good amplitudinal resolution. By down-sampling the ALDIS data with an exponential weighting function in time to the timestamps of GP20S3_NS (Fig. 1) one can see a good temporal correlation.

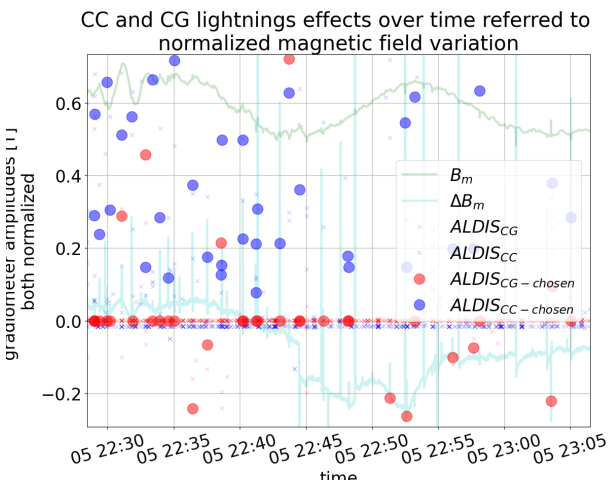


Figure 1: Small outtake of a comparison of the down-sampled ALDIS amplitudes, chosen ALDIS amplitudes and the average absolute and gradient variations of the GP20S3_NS system all normalized by their standard deviations.

The EM-fields of a lightning discharge are interpreted with a formula found in J.L. Bermudez Arboleda (2003, DOI:10.5075/epfl-thesis-2741) evaluated by Uman and

Nucci (1975 & 1995) for the three sensors of GP20S3_NS.

Heights were taken as 2km and 10km for CG strokes, depending on ALDIS amplitude sign. 6km was assumed for CC strokes. We were able to derive calibration coefficients for the strongest ALDIS “events” recorded with the GP20S3_NS sensors (Fig. 2) referred to measured field B_m and spatial gradient ΔB_m . The selection of analyzed lightning discharges was done dynamically.

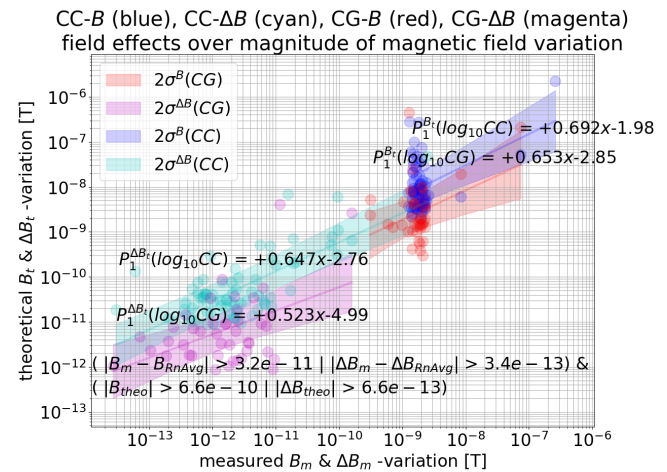


Figure 2: Calibration coefficients of the strongest peaks recorded in the N-S supergradiometer system GP20S3_NS at COBS with ALDIS amplitude effects derived by formula from Uman and Nucci (1995). The conditions met are written in lower left corner.

The polynomial fits and their confidence intervals derived in log-scale are shown in Fig. 2. The results indicate that the supergradiometer system is able to record EM effects of lightning strokes and CC discharges. Yet, ΔB_m and B_m variations are not fully supporting EMPs as solely reason but temporal correlation especially for CC events persists.

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