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Investigating the long-term variation of atmospheric electric potential gradient at Nagycenk, Hungary, Central Europe

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The atmospheric electric potential gradient (PG, the reverse of the atmospheric vertical electric field) is commonly measured near the ground. The PG plays a pivotal role in studying the global electric circuit (GEC) which comprises all large scale quasi-static electrical processes occurring in between the Earth's surface and the lower ionosphere [1]. Therefore, long-term, coherent PG measurements are of high importance in atmospheric electricity research. Nevertheless, it is a challenging task to use PG as a reliable diagnostic tool for investigating global changes in Earth's electromagnetic environment because of its high variability.

There are few PG datasets around the globe which are long enough and have been recorded continuously for decades. One of the datasets that fulfil these requirements has been recorded in the Széchenyi István Geophysical Observatory, Nagycenk, Hungary, Central Europe (NCK, 47°38' N, 16°43' E). A necessary correction of the recorded PG time series due to the time-dependent shielding effect of nearby trees at NCK was introduced earlier [2,3]. In this study, the corrected long-term (1962-2009) variation of PG at NCK is exhibited and discussed.

In the present study, the behaviour of annual minima, maxima, means, and summer and winter means of the PG at NCK are investigated. As these PG time-series exhibited quite different characteristics, the joint analysis of these data is required. The long-term variation of these PG time series can be divided into three periods: the first period (1962-1985) is characterized by a rather steep increase and is mostly driven by the wintertime data. The increase continues with a moderate magnitude and less significantly in the second period (1986-1997) where summertime data dominate the change, whereas there is a pronounced reduction of the PG in the third period (1997-2009) with almost equal magnitude in both the winter- and summertime records. These observed trends are confirmed by independent PG observations made at other measuring sites (e.g., the Swider Observatory, Poland).

The PG at NCK is generally greater in winter than in summer, which is a well-known phenomenon at northern hemisphere continental stations [4]. The annual minima, however, do not comply with this trend in every year. The month with the lowest average PG is in late spring (May) in most years of the examined epoch at NCK but minimum values occur in autumn and winter months as well.

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