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Aurorae modulated by solar wind as proxy for historical space weather

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For studying secular variation of space weather (over centuries from the satellite to the pre-telescopic era), homogeneous time series are needed. Proxies like the Zurich sunspot number or cosmogenic isotopes like 14-C suffer from discontinuities, e.g. when the primary sunspot observer has changed, or when the industrialization leads to an enrichment of the atmosphere with 12-C (Suess effect). Observations of aurorae as solar wind proxy could provide a continuous time series overlapping with various discontinuities and eras.

For the last few centuries, we have the following two issues:
(1) While aurorae were documented all over the world for the last few centuries, a critically checked and homogeneous dataset is not available. Here, we have started new initiatives to compile such datasets (we have obtained experience with historically observed aurorae from the pre-telescopic era).

(2) It is well known that aurorae trace solar wind and, hence, are correlated to geomagnetic indices (e.g. the aa-index measured since 1868); a full understanding of the connection between auroral displays, observed from the ground by the naked eye, and, e.g., the aa-index is still missing. From radius and size of the aurora oval as measured by satellites, we have derived magnetic activity indices, namely the Kp-index, which is modulated by the solar wind.

We work on the transformation of (naked-eye) observed aurorae to modern instrumental data, and the other way around.

Currently, we derive the aurora oval size and radius from ground-based aurora observations of the last few decades (for which satellite data are available, to compare with). Next, we will extend this study to the last two centuries, the time since the Earth magnetic field is measured directly - and, if successful, then also to the time before.