Sources of geomagnetic activity at local scale. Case study - European observatories

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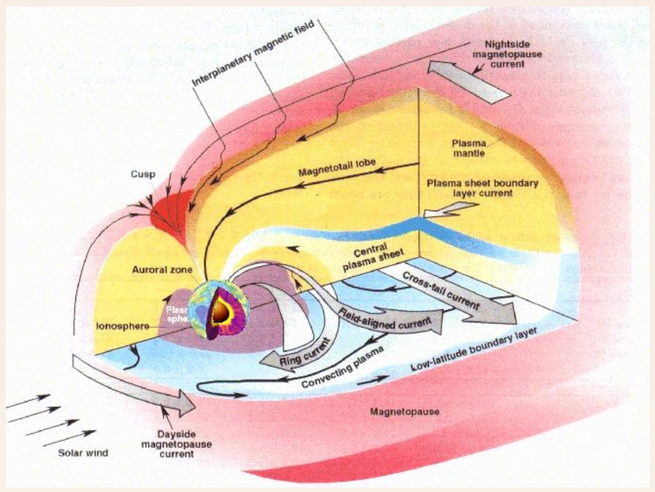
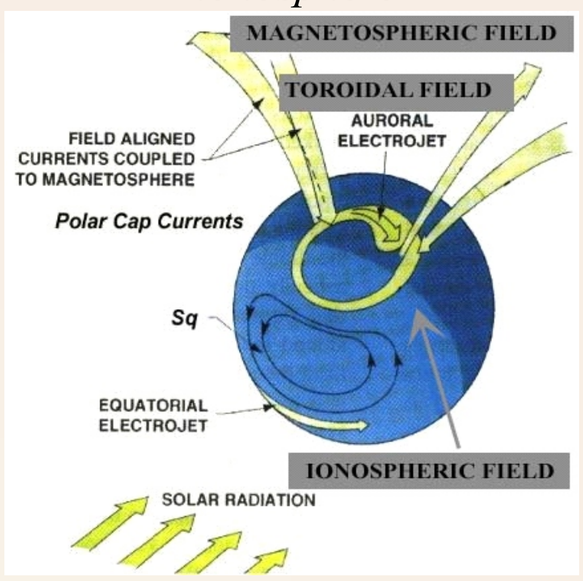
The geomagnetic activity is a result of the interaction of the magnetosphere-ionosphere system with the solar wind and with the heliospheric magnetic field. It is described by means of geomagnetic indices, specifically designed as proxies for several current systems that form in that environment, such as Dst, for the magnetospheric ring current, and AE, for the ionospheric auroral electrojet, or reflecting the general disturbed behaviour of the geomagnetic field at midlatitude (the aa index) or at planetary (Kp, Ap) scales. The present paper investigates the contribution of the ring current and auroral electrojet variabilities to the geomagnetic activity at local scale.

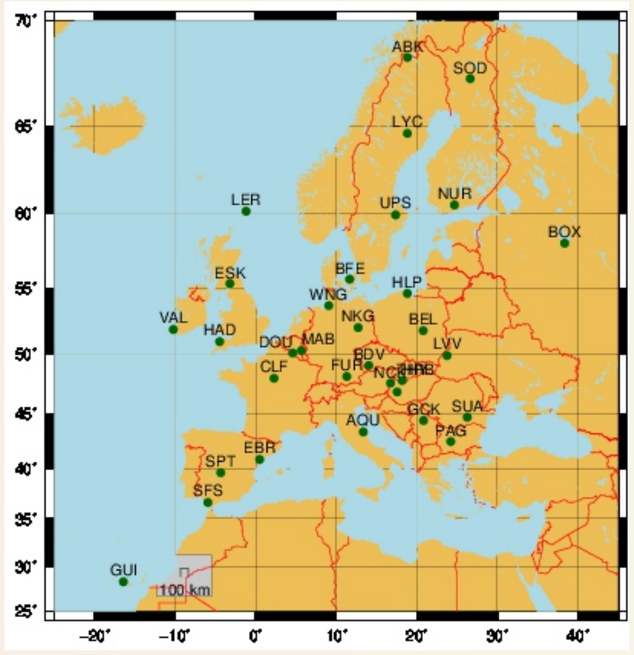
Current systems

magnetosphere



ionosphere





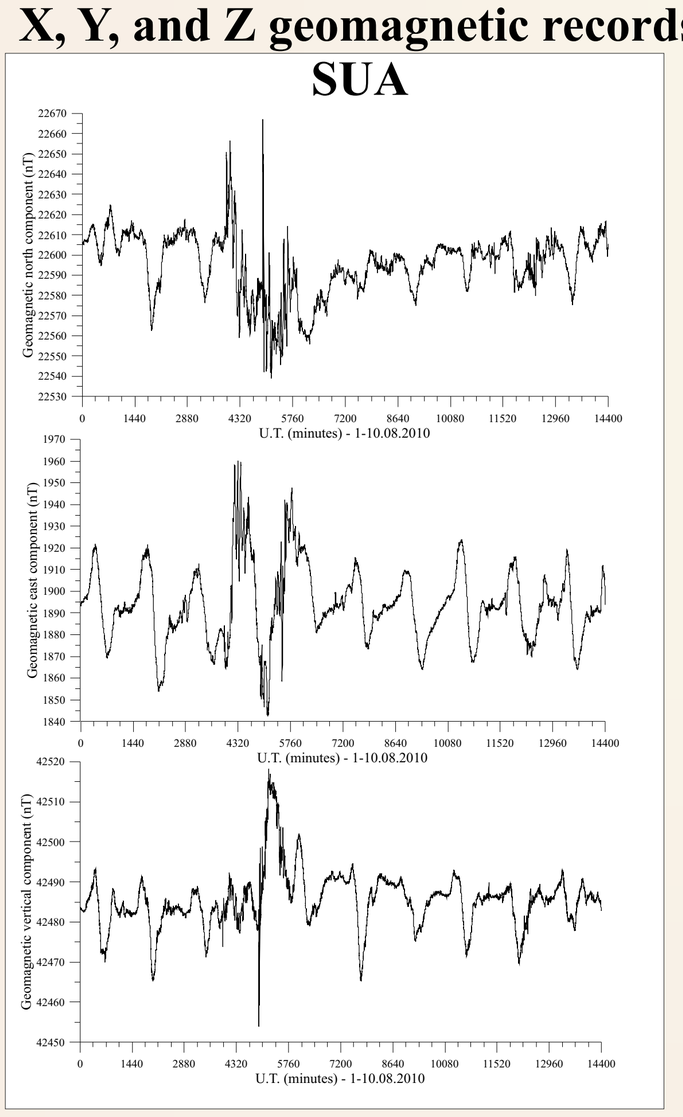
Data and method

- one-minute averages of geomagnetic elements from 31 observatories in Europe (30 - 70°N), in the time interval August 1-10, 2010
- a moderate geomagnetic storm (Dst min = - 70 nT) occured on August 3-4, with its recovery phase spanning to the 10th of August
- data were processed to show the disturbed variation by substracting a mean diurnal solar quiet variation, inferred from the recordings in the five quietest days of the month
- the disturbed variation was correlated with a linear combination of Dst and AE geomagnetic indices for the same time interval

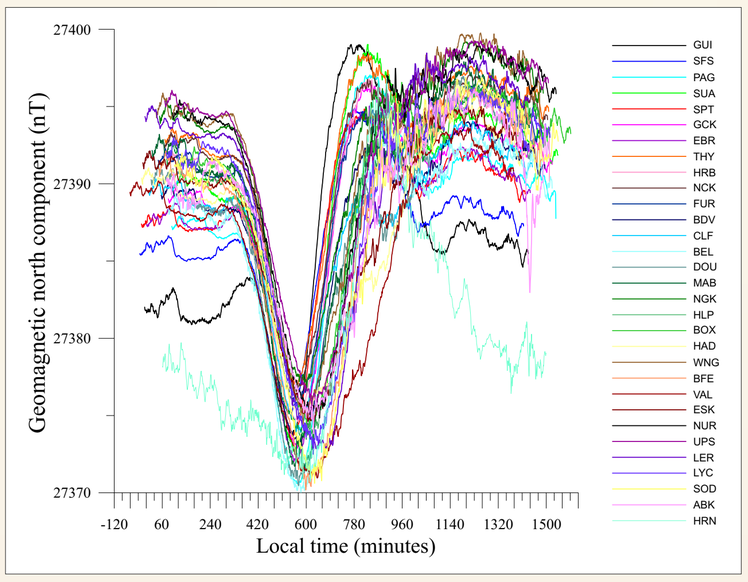
$$S_D(t) = \alpha AE(t) + \beta Dst(t)$$

S_D – all disturbances of the geomagnetic field caused by solar particle radiation ~ K index

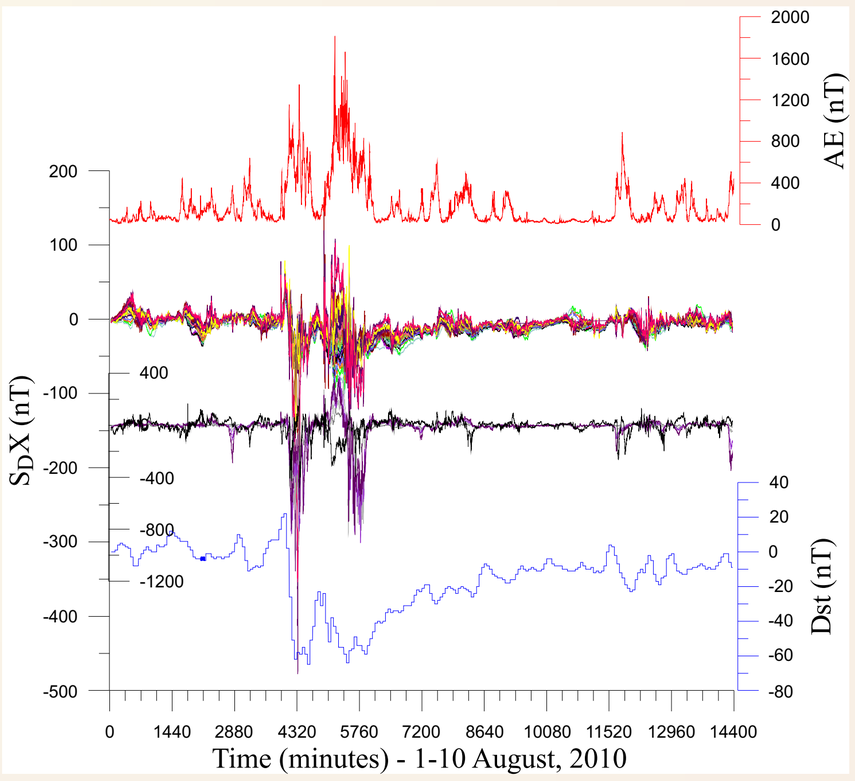
X, Y, and Z geomagnetic records



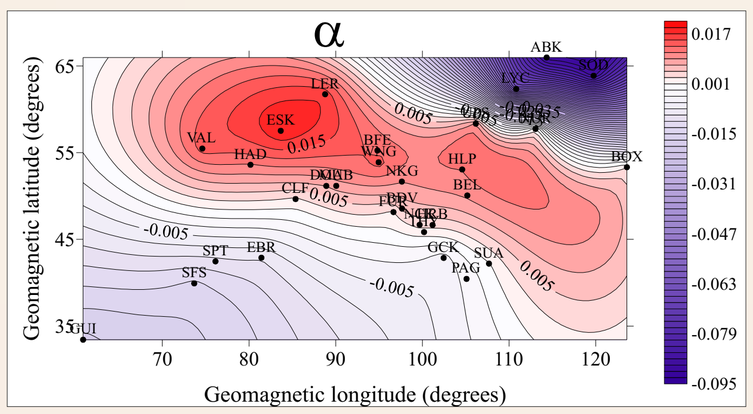
Diurnal variation of the geomagnetic field

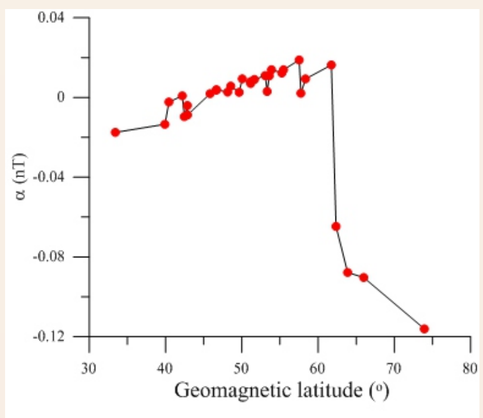


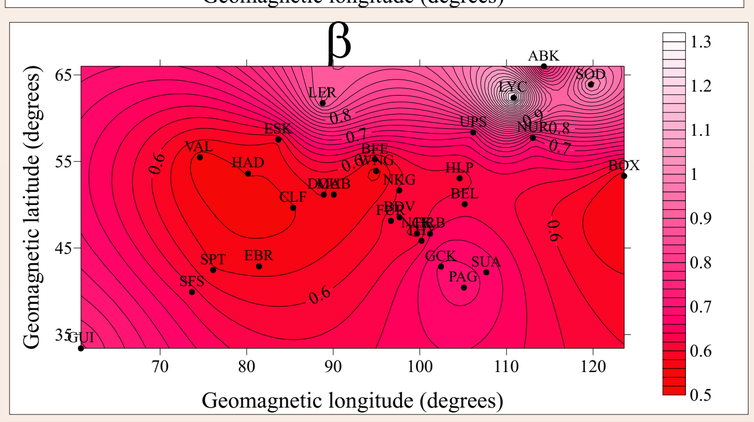
Disturbed geomagnetic field

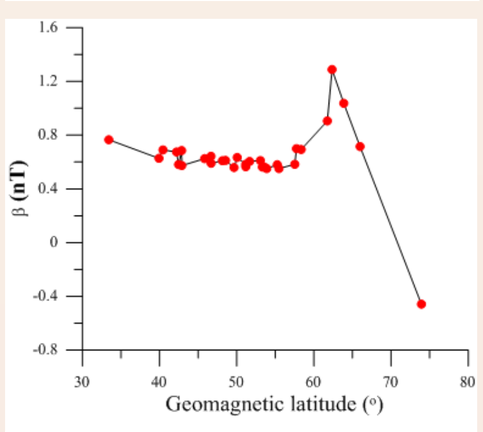


Quantitative approach









CONCLUSIONS

- coherency of the variation at the European scale, indicating the common source, and also amplitude and phase differences from place to place because of the underground electric and magnetic structure differences. In the study interval a geomagnetic storm occurred, disturbing the regular daily variation;
- the results show, as one might expect from the geometry of the two current systems, the decreasing influence of the ring current and of the increasing influence of the auroral electrojet from low to high latitudes. Complex behaviour for observatories beyond 60 N;

Future work: employing the SqZ and S_DZ to infer information on the underground electric structure.

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