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# Assessment of Extreme Geomagnetically Induced Currents in the Norwegian Power Grid

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## GIC study for the Statnett company

### Objectives:

1. Derive statistics of  $d\mathbf{B}/dt$ , electric field and GIC in Norway
2. Consider two power grid configurations: the present situation and the expected future grid in 2030
3. *Estimate the magnitude of a once in 100 years event*



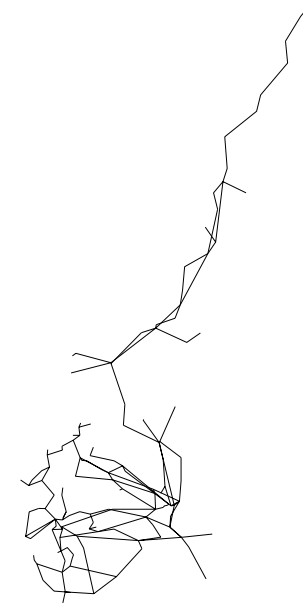
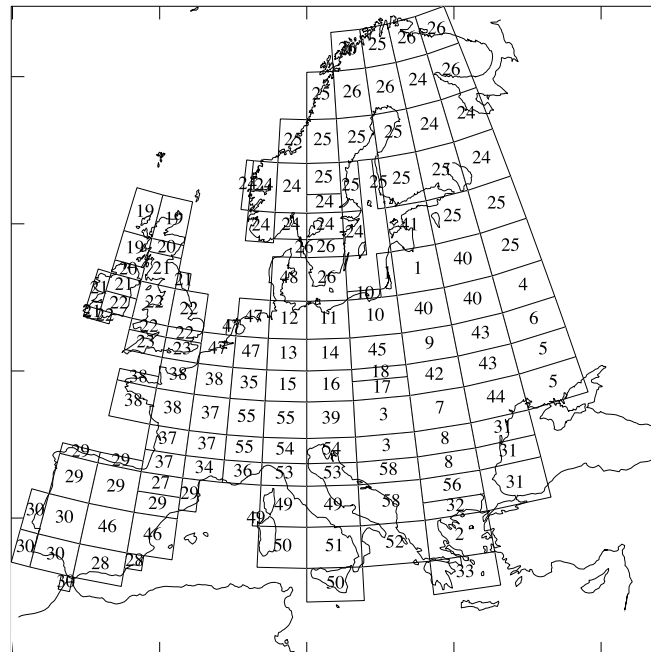
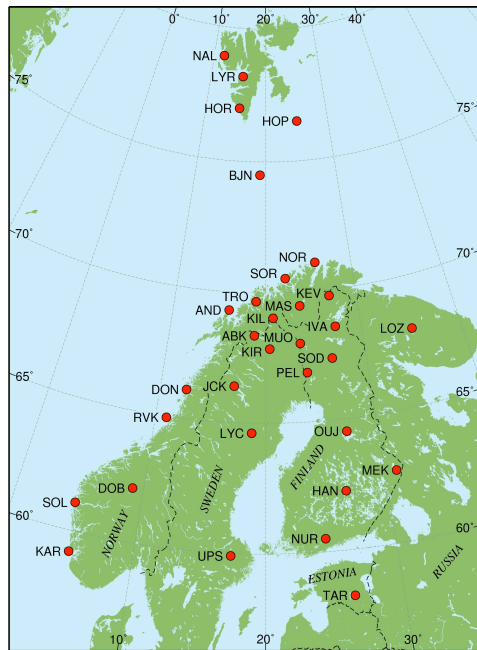
## Modelling

### Input:

10-s magnetometer data 1994-2011 (IMAGE/Norway)

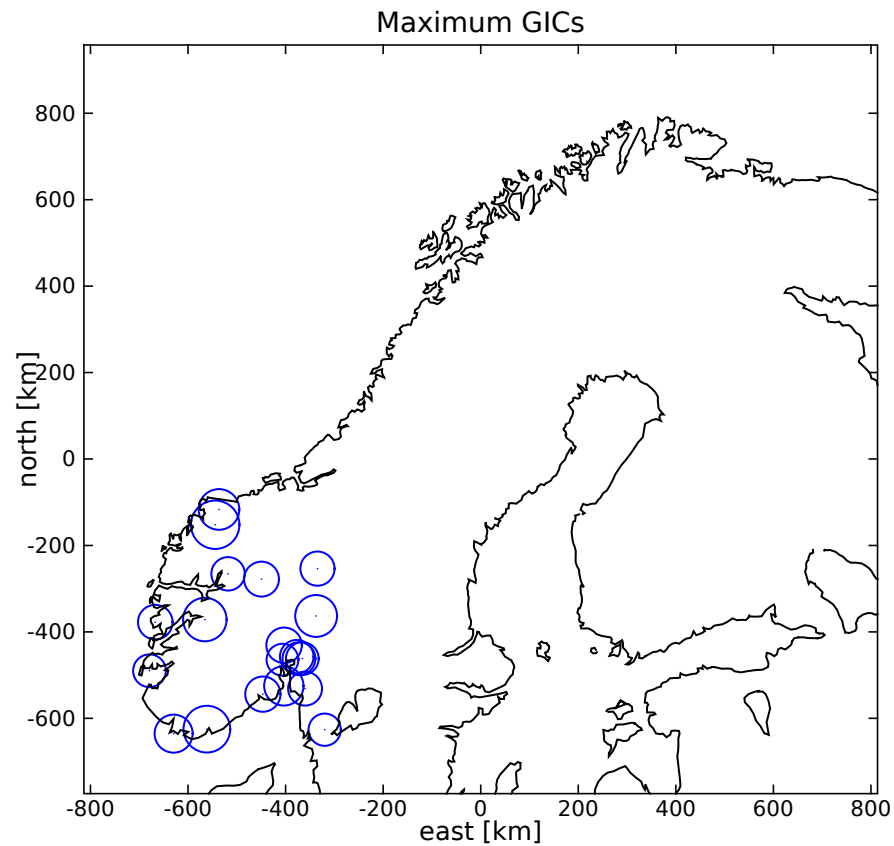
1-D ground conductivity models (EURISGIC)

Power grid model (Statnett)





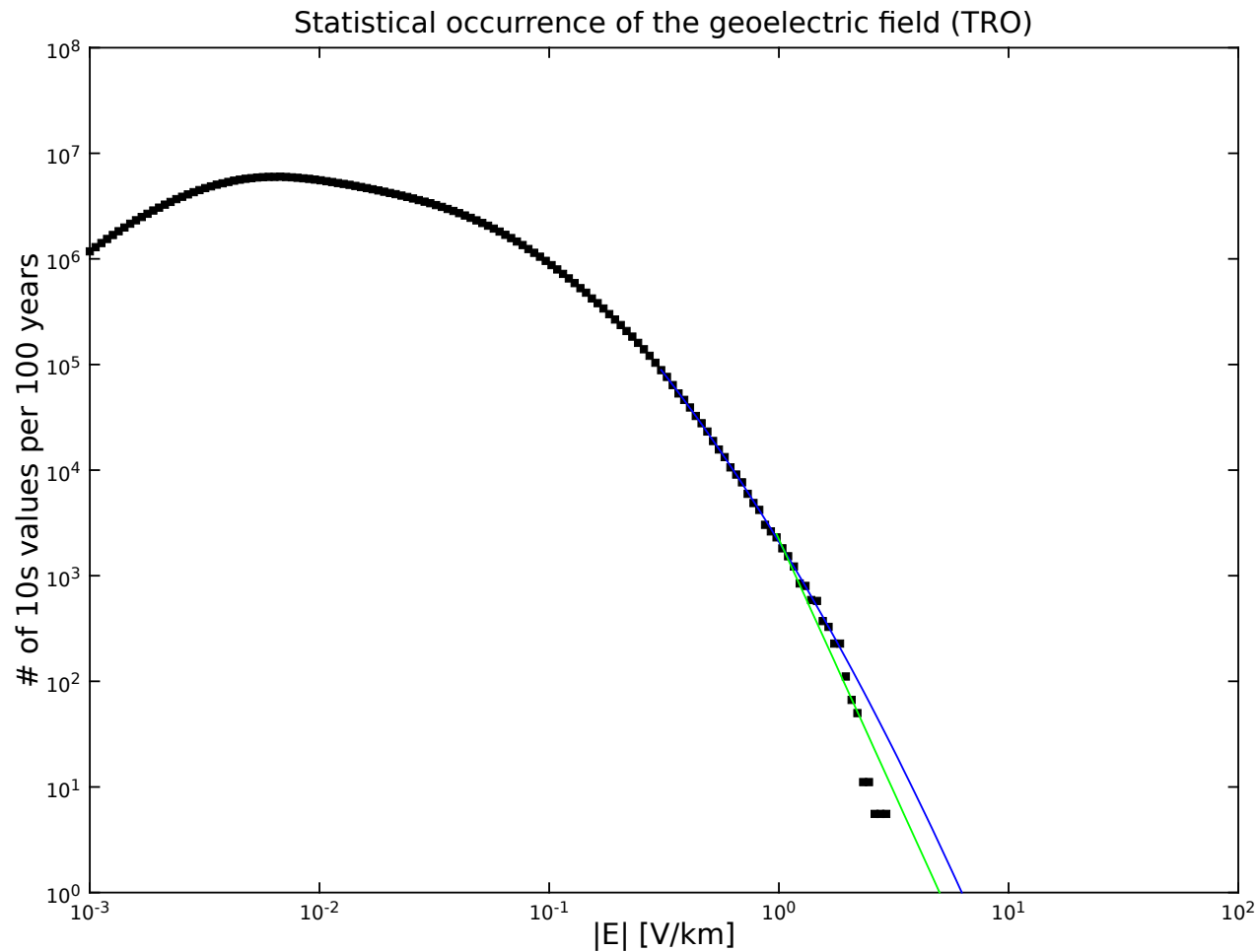
**Output:**  
Modelled 10-s horizontal electric field  
GIC at substations



max  $\approx$  400 A



## Extrapolation of statistics

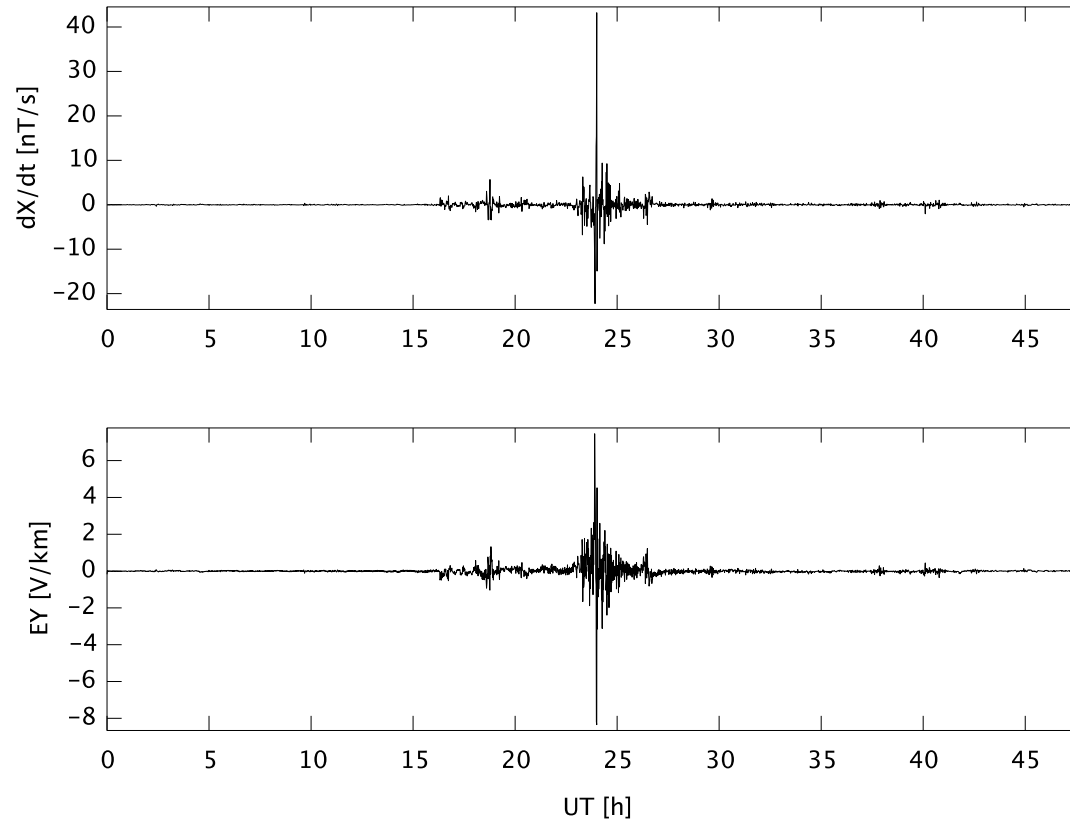


Once per 100 year event:  $\max|\mathbf{E}| = (1.5 - 2) \times \max|\mathbf{E}|_{1994-2011}$



## Magnetic storm on 13-14 Jul 1982

LOV, starting day 19820713



Maximum electric fields reach or slightly exceed the estimated 100-year maximum at some locations.



## Conclusions

- Geometry of the Norwegian grid favours the existence of large GIC in the southern parts of the country
- $d\mathbf{B}/dt$  reaches comparable maximum values everywhere in the country
- Small ground conductivity in the south increases the electric field there
- Due to these three factors, the largest GIC occur in South Norway
- Extrapolation of statistics in 1994-2011: once per 100 year event is 1.5-2 times larger
- 13-14 July 1982 might have been such an extreme event

**To be done:** Apply a more sophisticated extrapolation method



**Acknowledgements.** We thank the Statnett company, especially Øyvind August Rui and Trond Magne Ohnstad, for supporting this study. We acknowledge the University of Tromsø for the possibility to use their long-term geomagnetic data series.

This research exploited the software developed within the EURISGIC project funded from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement no 260330.