

GIC Now!

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Background

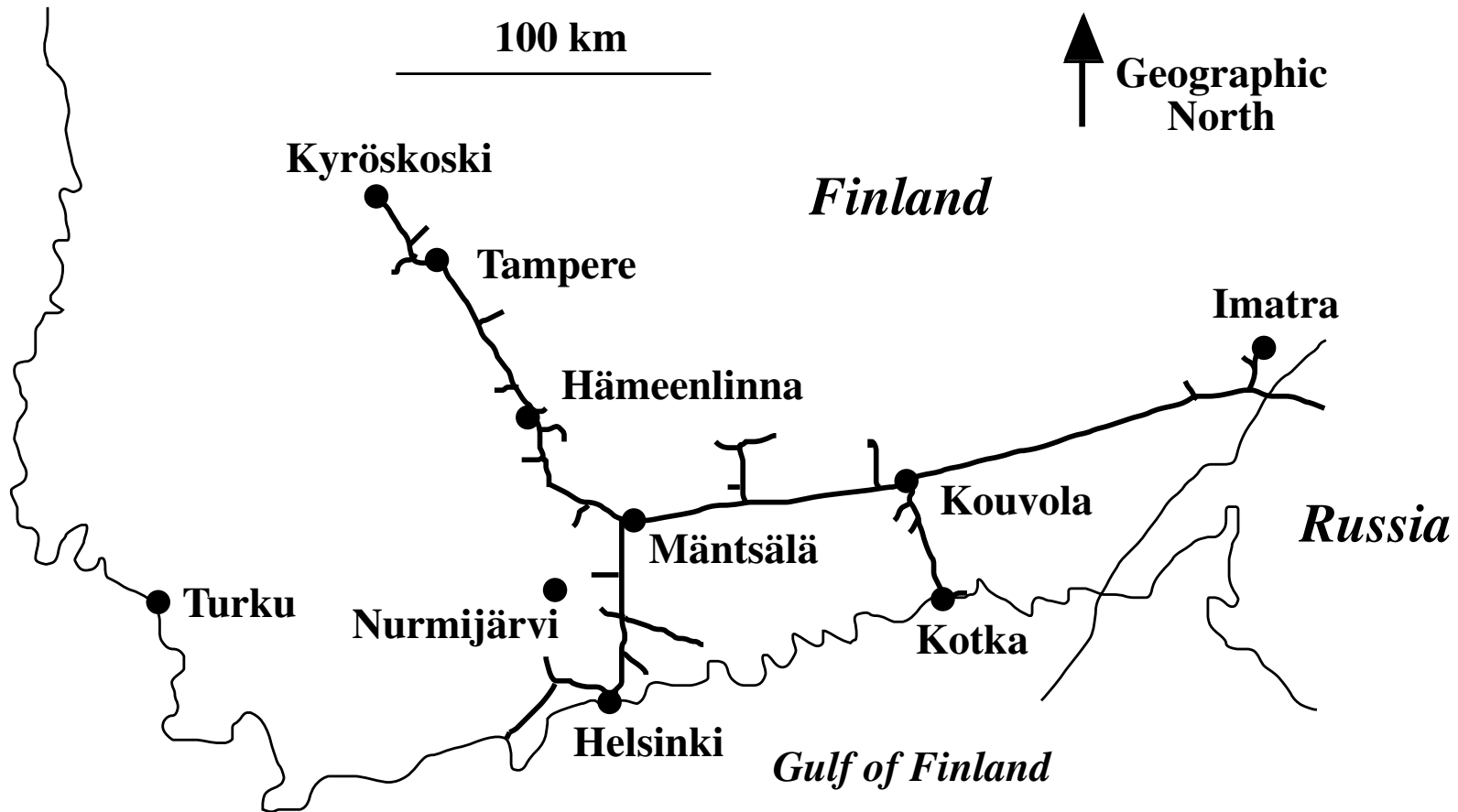
Geomagnetically induced currents (GIC) have been identified as a disturbance to the corrosion control system of the Finnish natural gas pipeline since 1970's.

Theoretical studies on GIC made in co-operation between Gasum and FMI since the early 1980's.

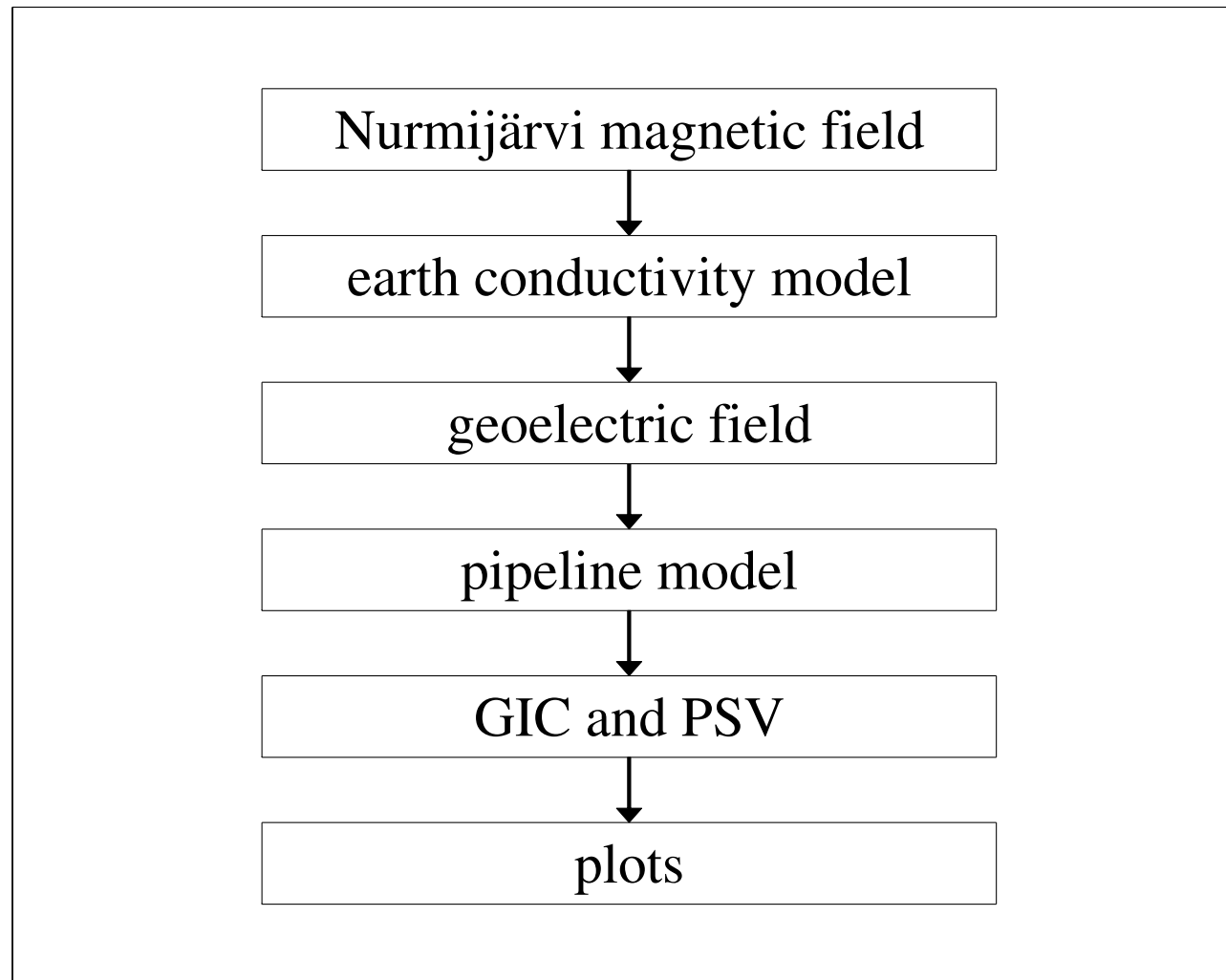
FMI started GIC recordings at the Mäntsälä compressor station in November 1998. See another poster for details.

GIC Now! started in June 2003. In addition to the existing GIC measurement, a nowcasting service was developed.

Finnish natural gas pipeline network



Principle of calculation



The magnetic field measured at Nurmijärvi is the key input quantity.

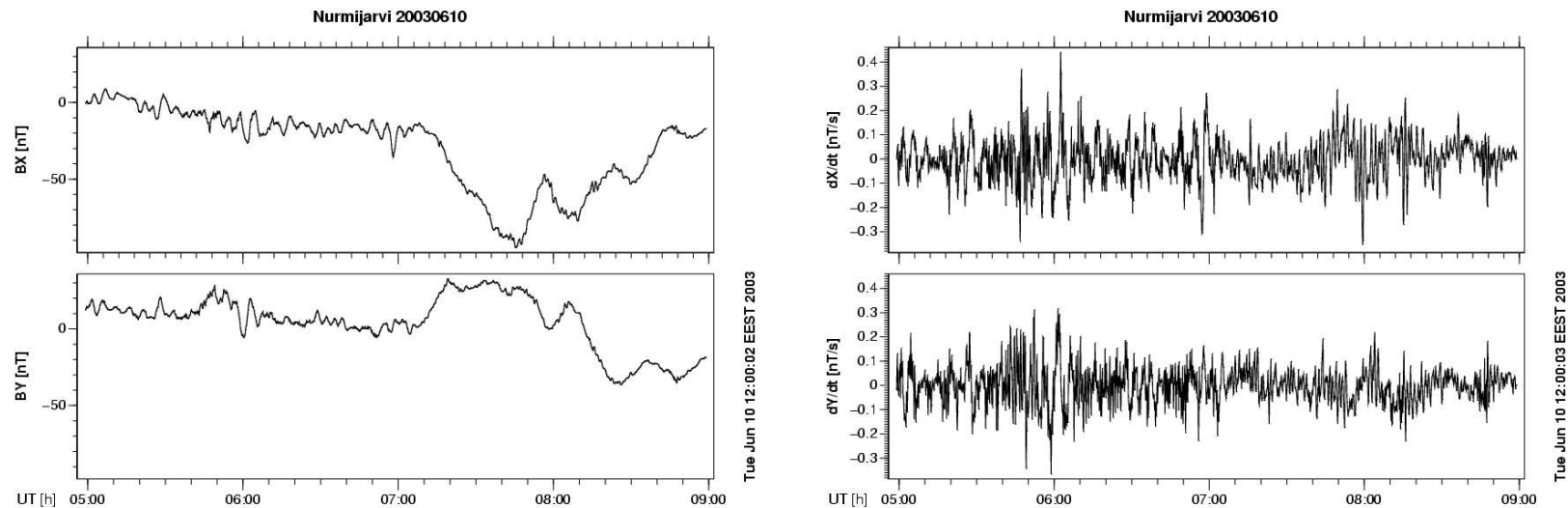


Figure 1: GIC Now! screen views of the real-time horizontal magnetic field and its time derivative.

As indicated by Faraday's law, $d\mathbf{B}/dt$ is closely related to the electric field and GIC.

Assuming a layered earth model and a plane wave field, the geoelectric field has an especially simple relation to the magnetic field by the surface impedance.

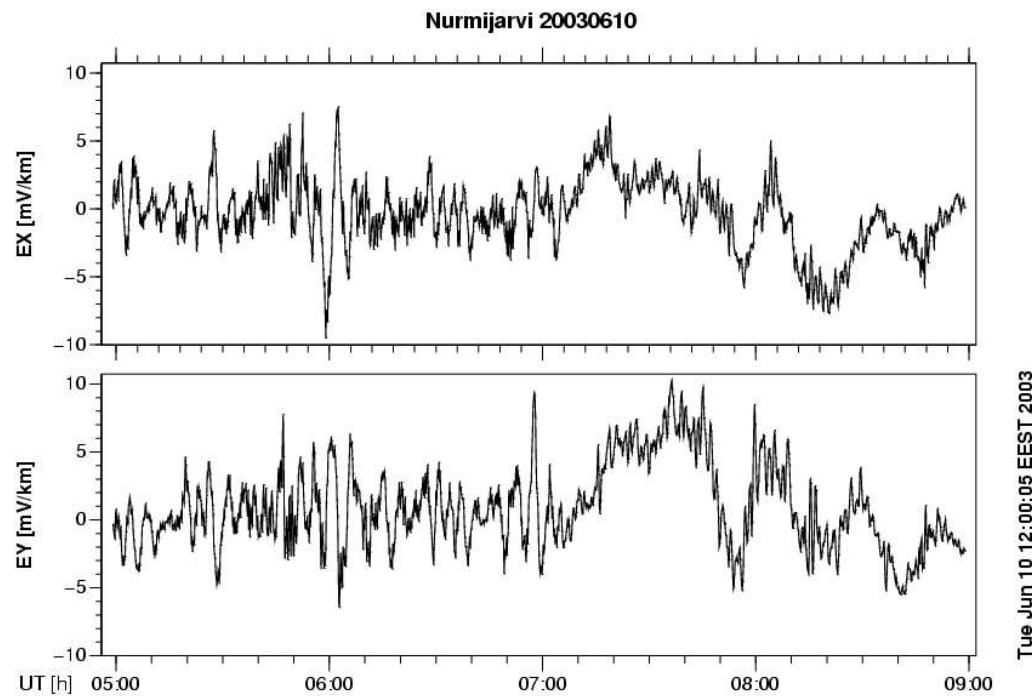
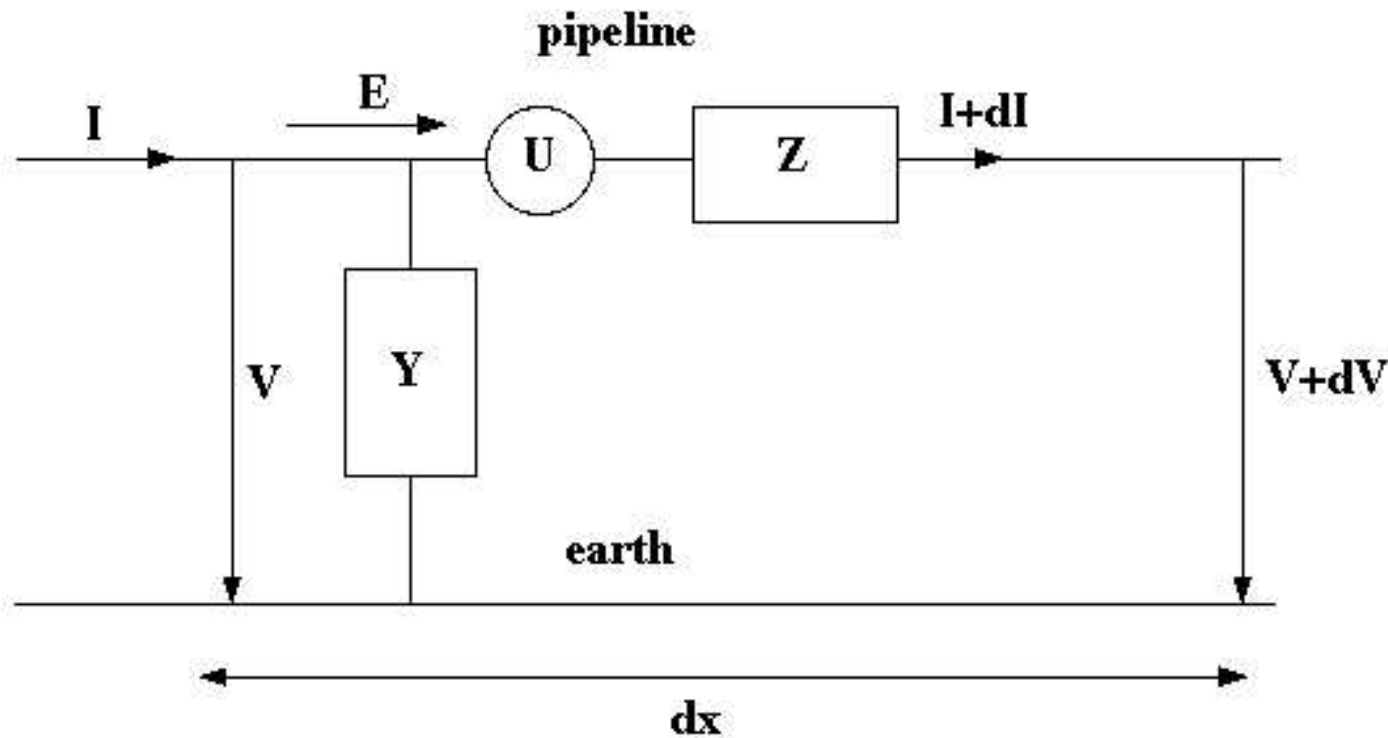


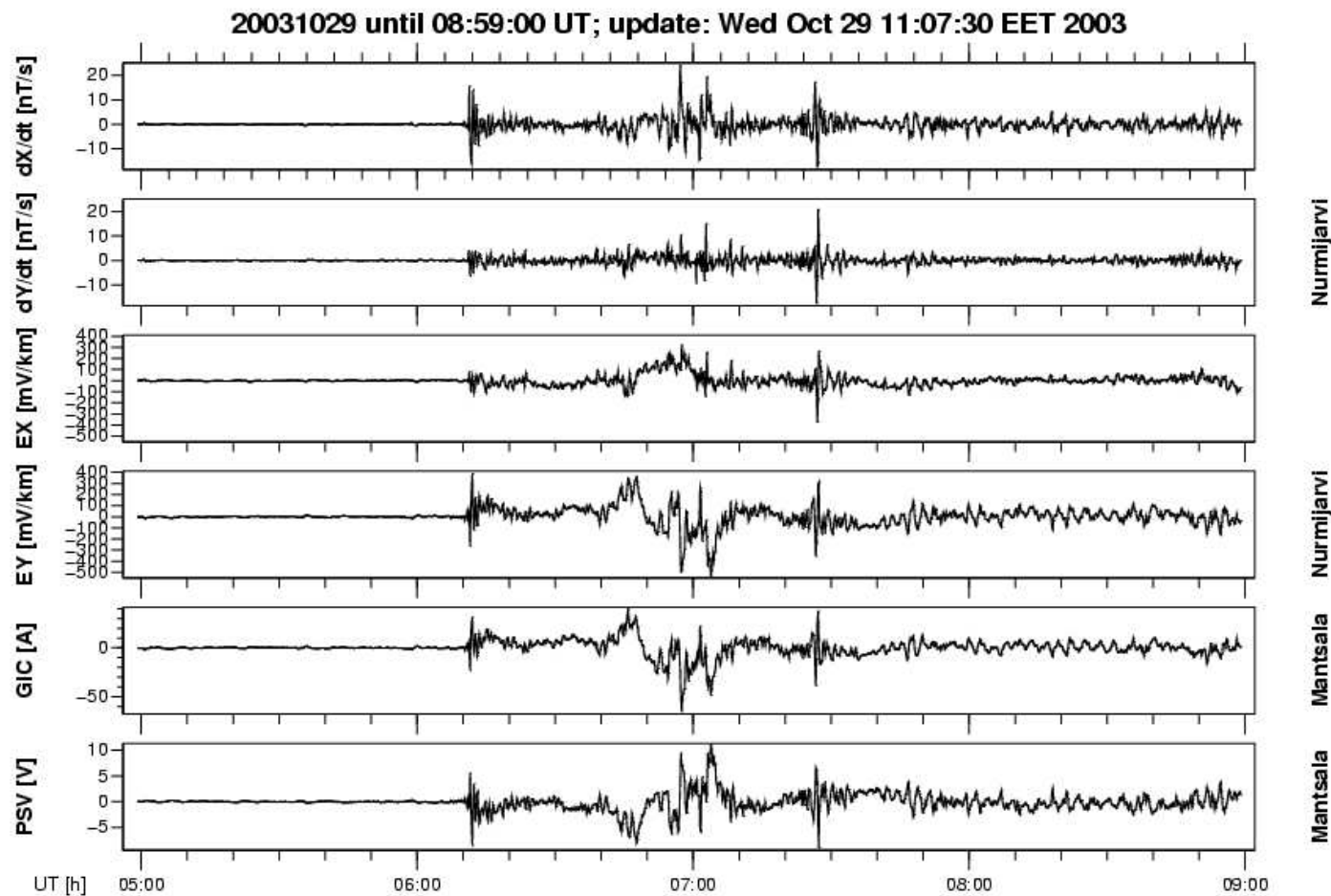
Figure 2: Computed electric field.

The pipeline is modelled using the distributed source transmission line theory. Given DC parameters of the system and the geoelectric field, we can calculate GIC and pipe-to-soil voltages at any location.

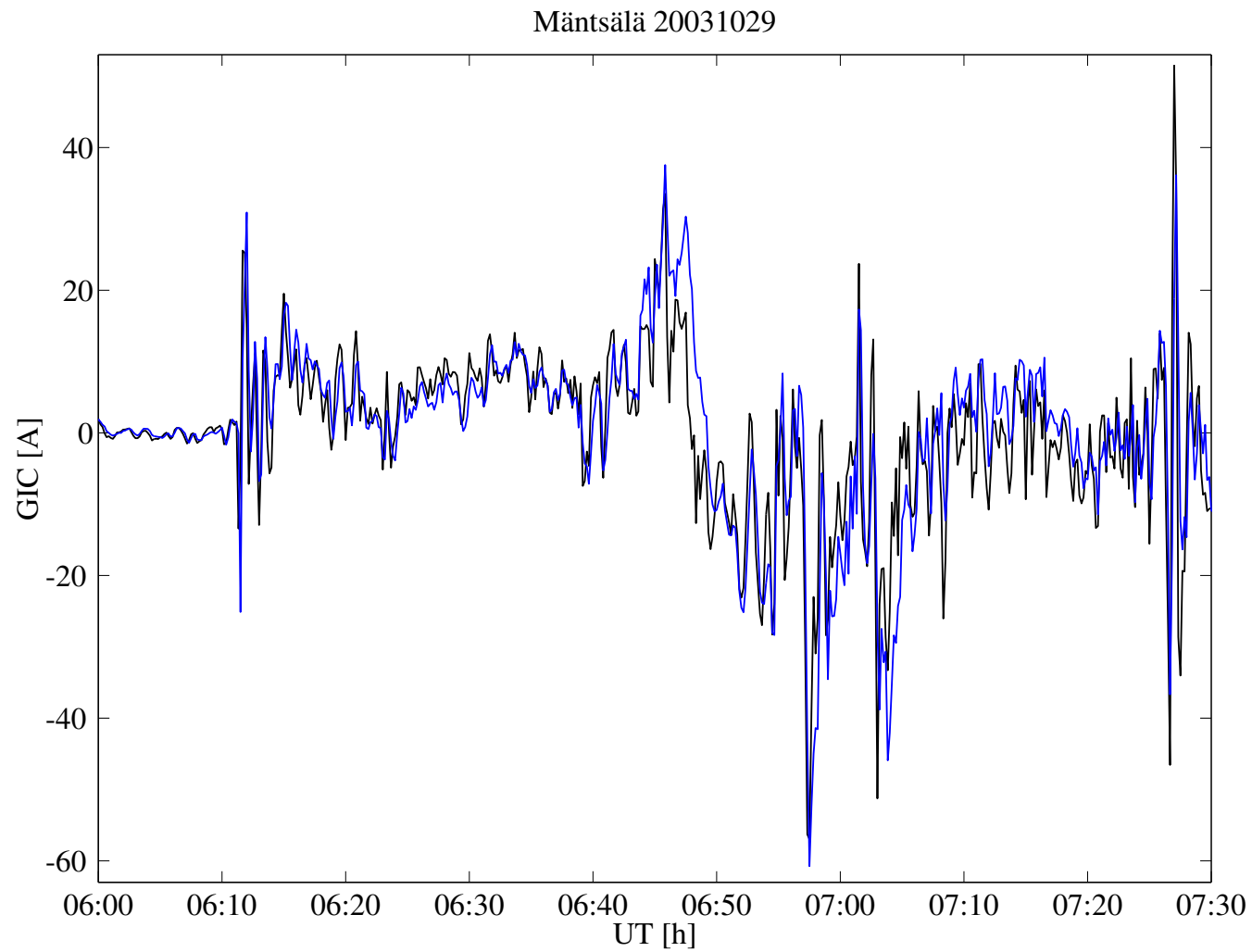


A complicated pipeline system can be constructed of linear sections.

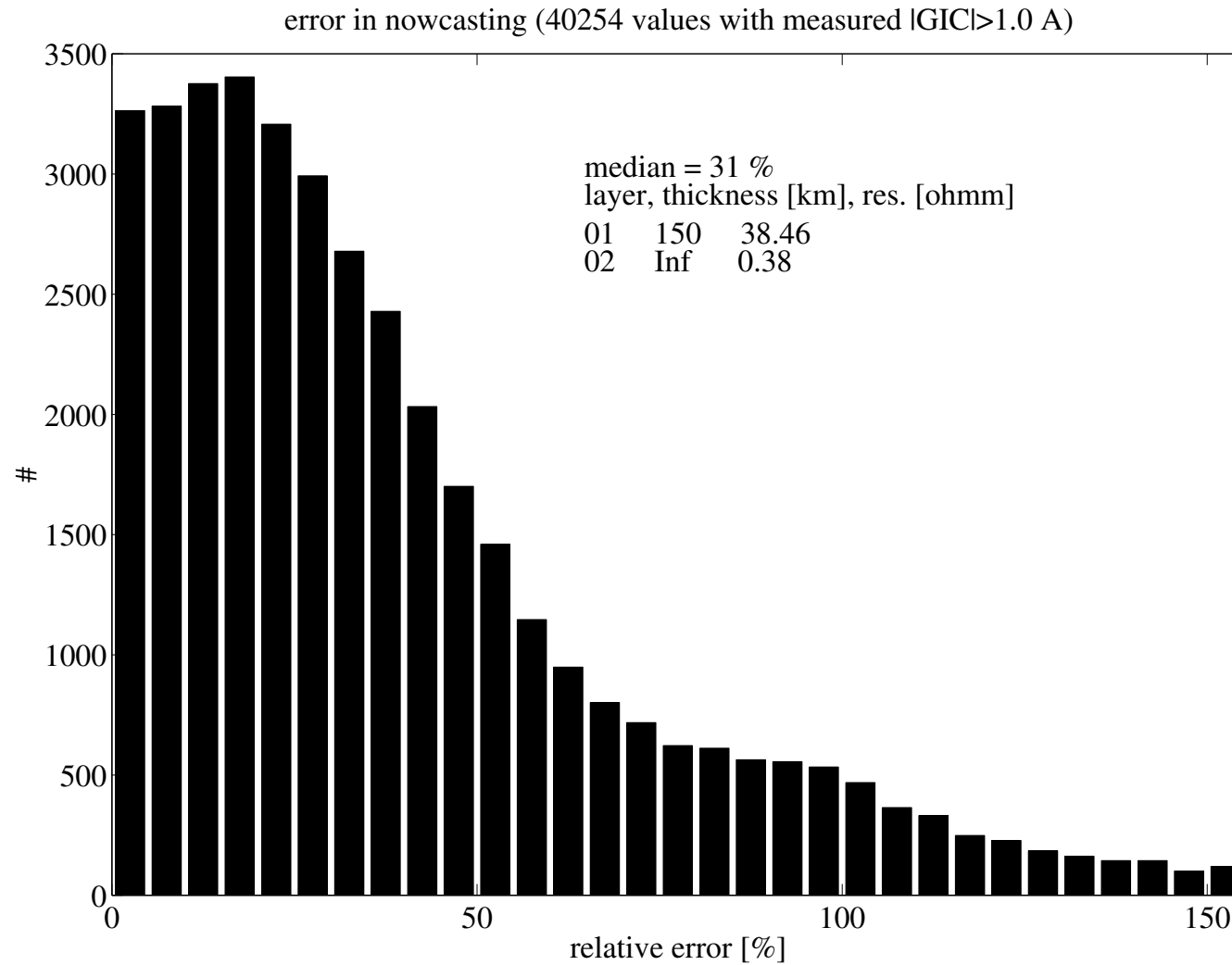
We were lucky to follow the October 2003 storm during working hours.



Nowcasted GIC follows quite well the **measured value**.



We obtain a good accuracy in nowcasting the GIC activity.



User feedback

- Knowledge of GIC helps to identify possible sources of disturbances detected by the pipeline control system.
- A near-real-time identification of GIC saves time, since then other reasons for fluctuations can be excluded.
- A large cumulative GIC risk at some parts of the pipeline system may lead to a need to shorten the interval between control surveys there.
- Information about GIC is one of the elements that may affect decision making regarding preventive maintenance.

GIC Now! will continue its operation.

WWW site: http://aurora.fmi.fi/gic_service/

Acknowledgements

We wish to thank the Gasum company for the long-term interest in GIC studies.

Several members of FMI staff and of Space Systems Finland and CDQ Solutions have had an invaluable contribution to the development of the server.

GIC Now! is a service development activity within the ESA Space Weather Applications Pilot Project (ESTEC Contract 16984/03/NL/LvH).

