Measurements of geomagnetically induced currents in the Finnish natural gas pipeline

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Background

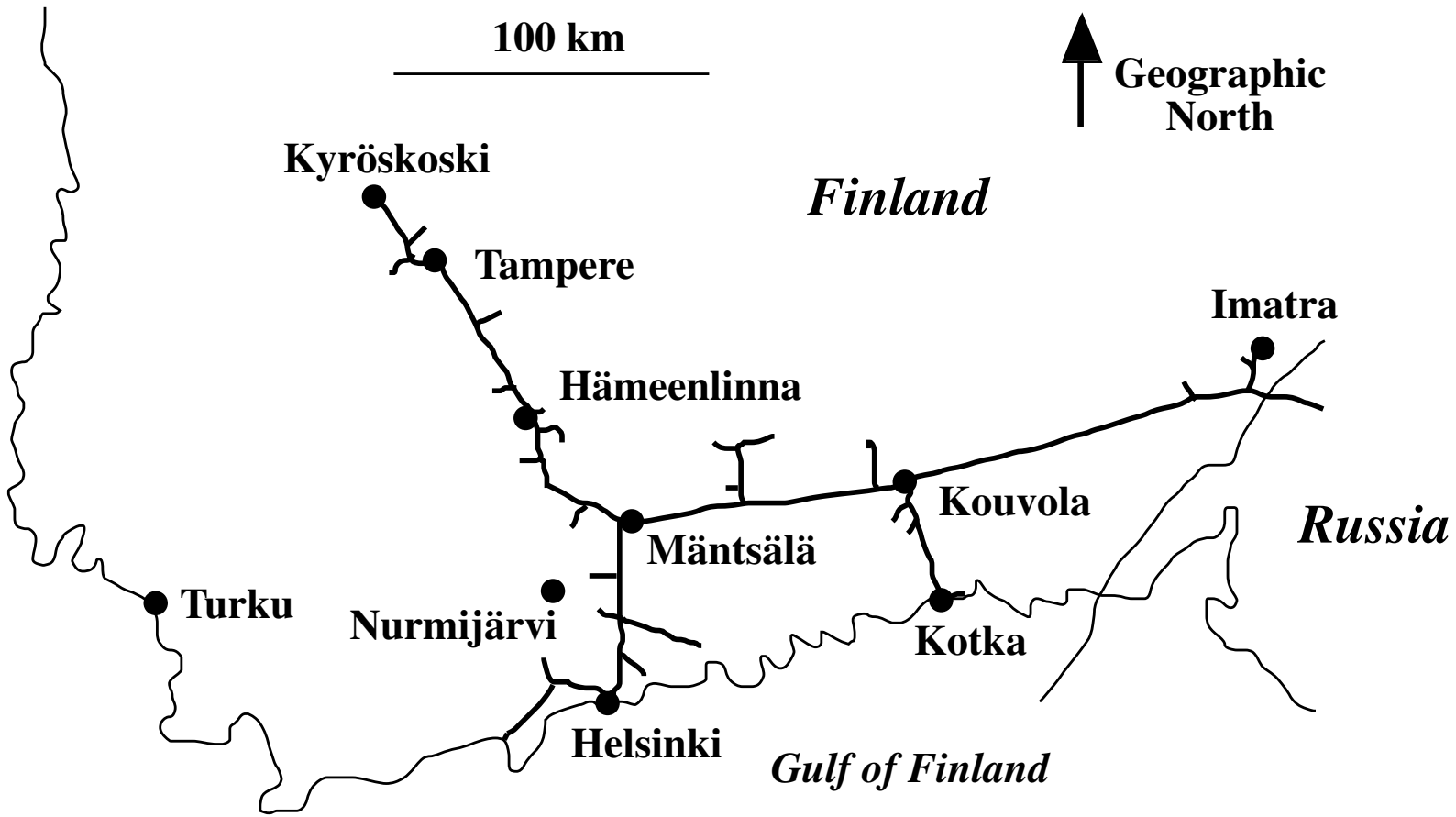
Geomagnetically induced currents (GIC) have been identified as a disturbance to the corrosion control system of the Finnish natural gas pipeline since 1970's.

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 (magnetic latitude about 57).

GIC Now! started in June 2003. See another poster for the description of this service.

Finnish natural gas pipeline network



Measurement technique

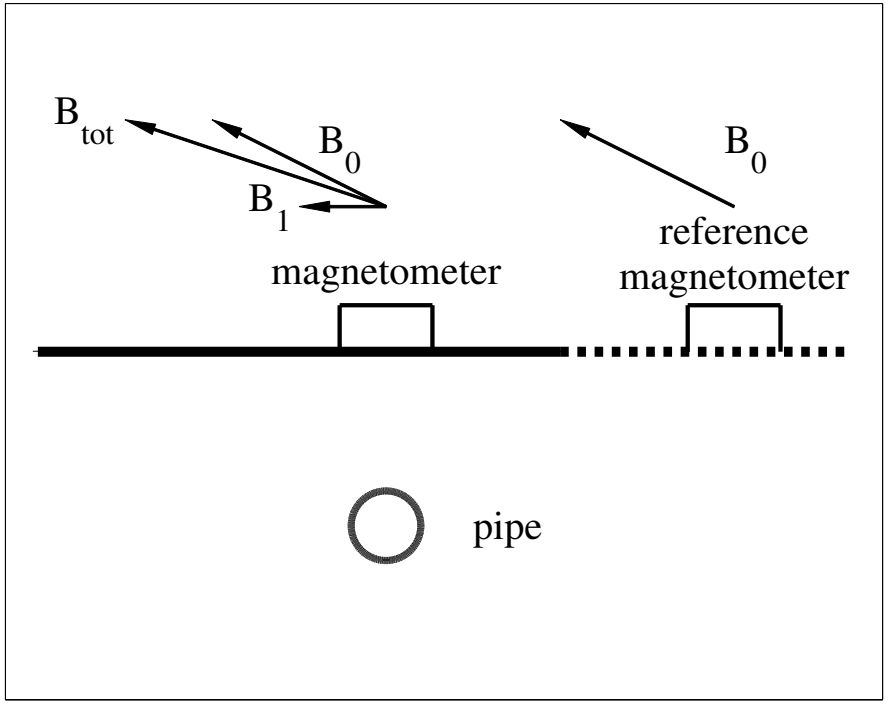
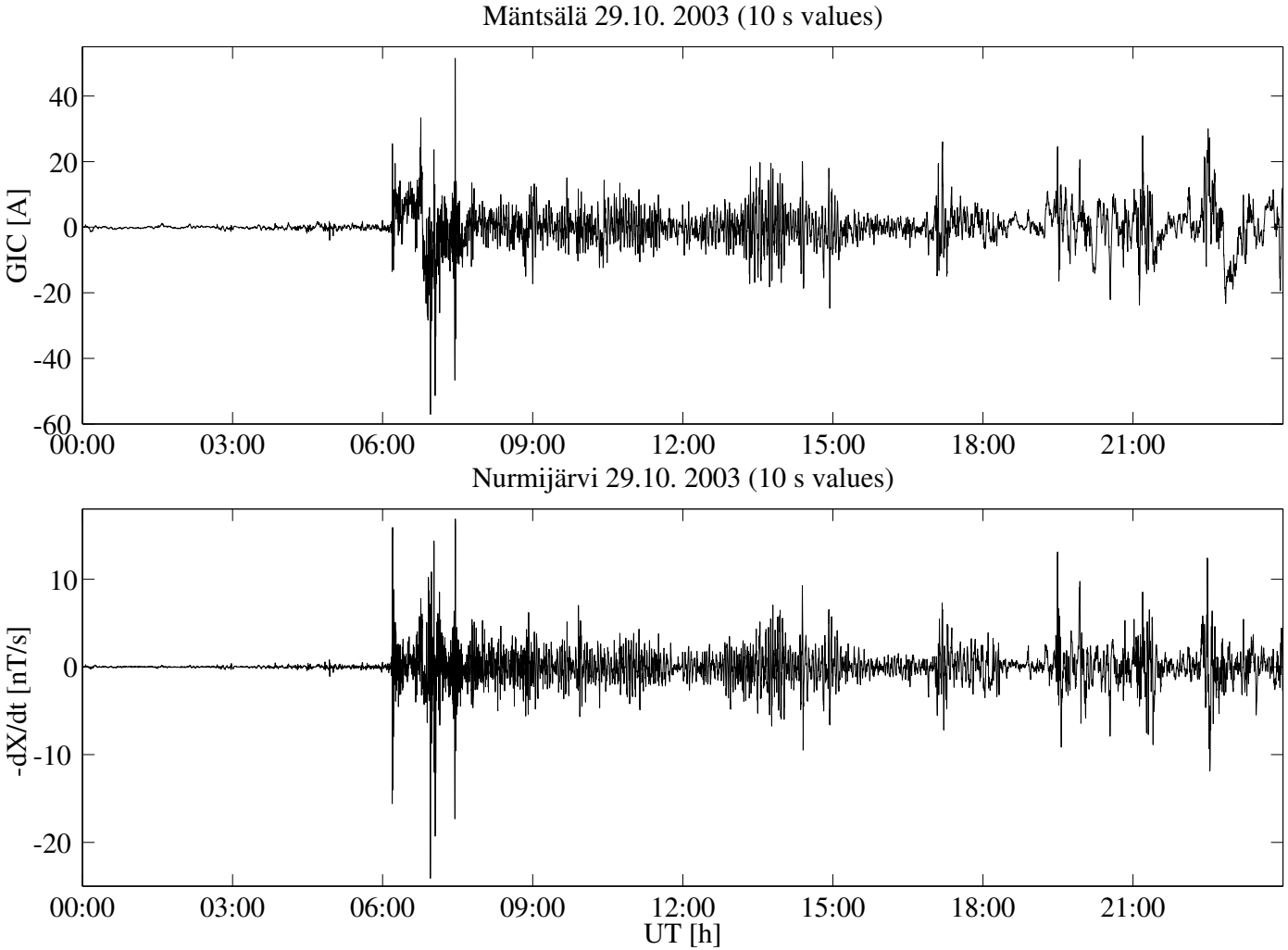


Figure 1: Assume the same natural variation field $\mathbf{B}_0$ above the pipe (Mäntsälä) and at the reference magnetometer (Nurmijärvi). Then $\mathbf{B}_1 = \mathbf{B}_{tot} - \mathbf{B}_0$ gives GIC along the pipe according to the Biot and Savart law.

Data processing

October 2003: largest GIC event



Diurnal occurrence of large GIC values at Mäntsälä

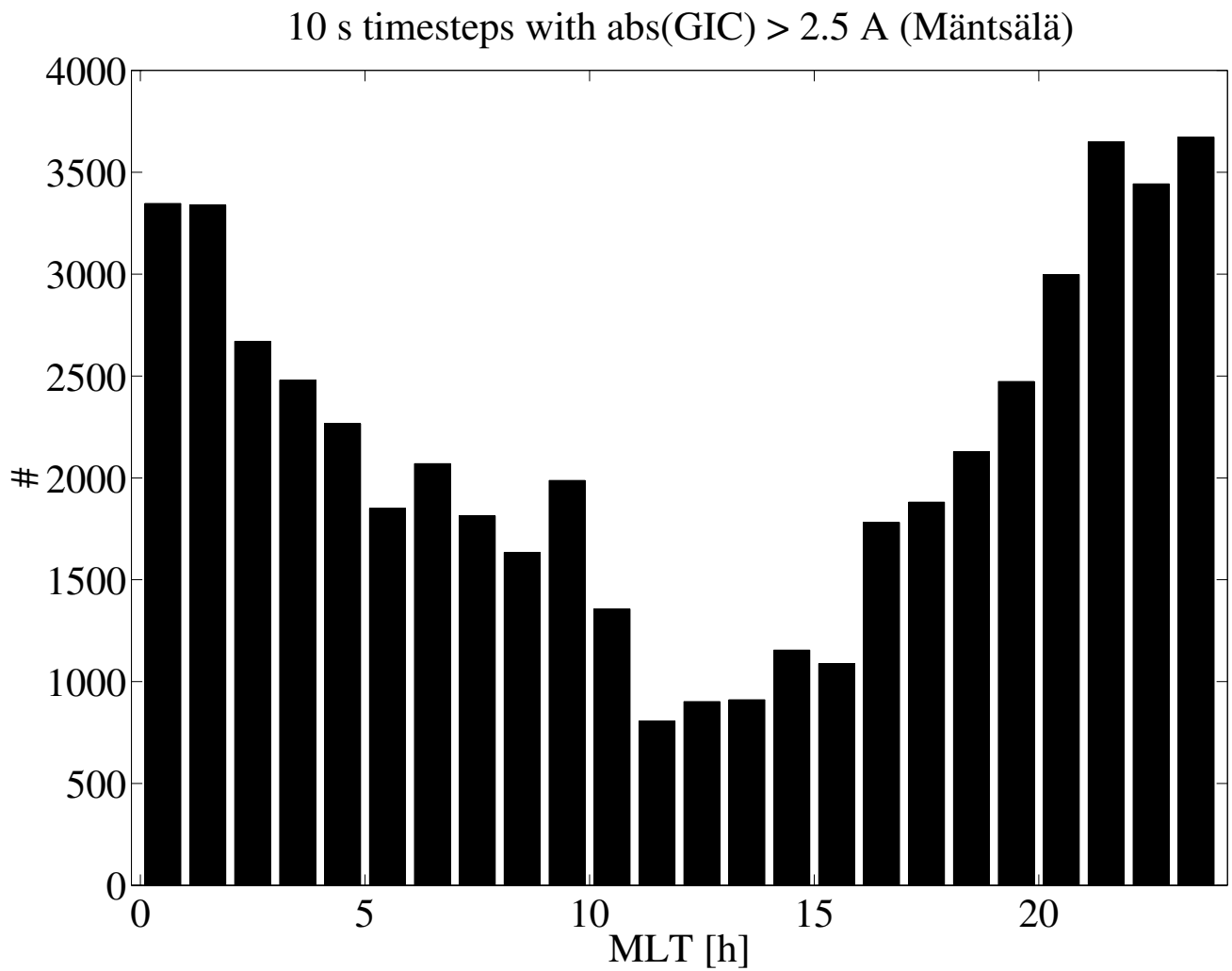


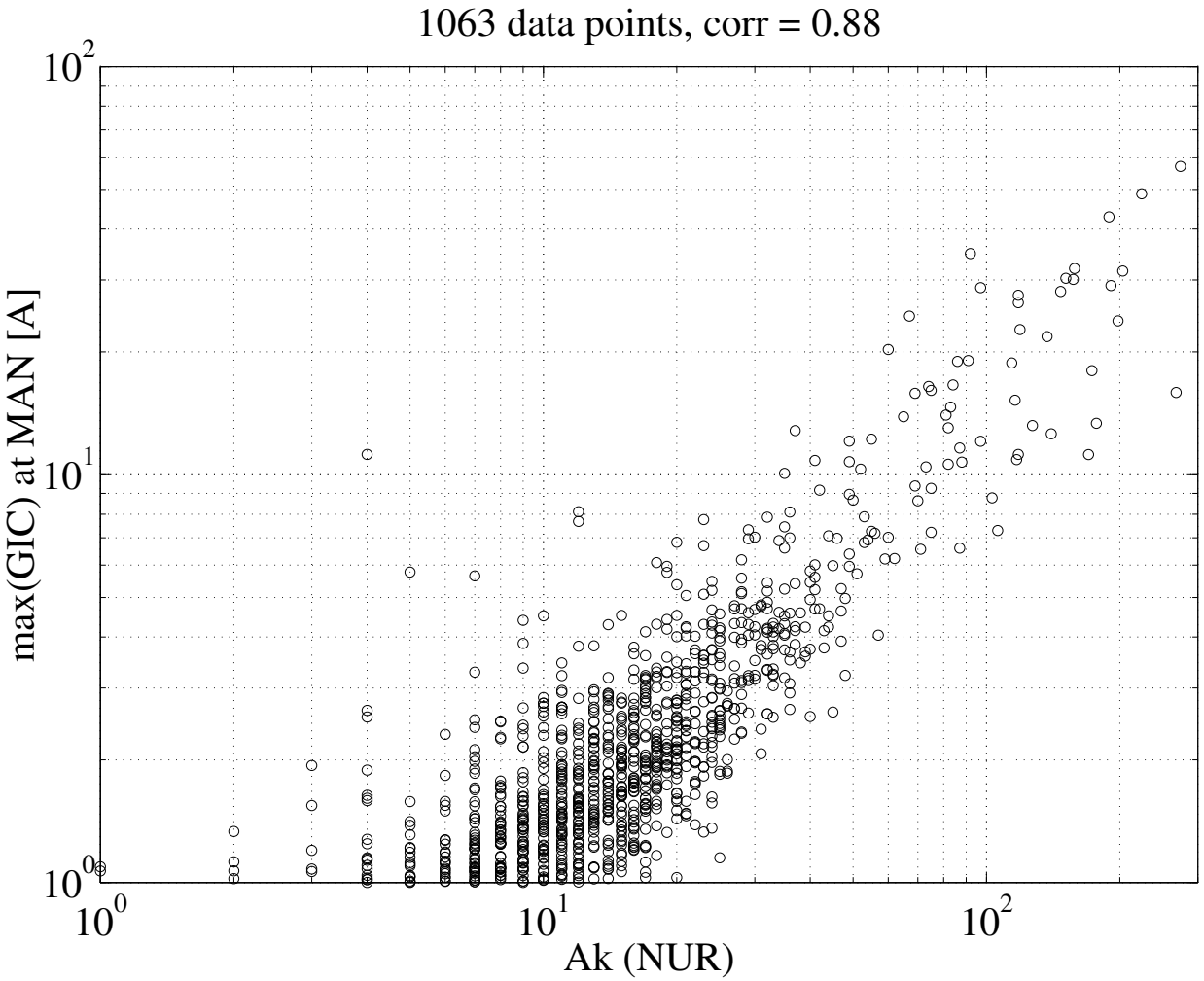
Table 1: Top10 daily maxima of GIC [A] at Mäntsälä (10 s values), A_k and K indices at Nurmijärvi and $\#(|d\mathbf{H}/dt| > 1.0$ nT/s) (1998-2005)

01.	20031029	57.0	274	9	4094
02.	20031030	48.8	224	9	2039
03.	20041109	42.8	189	9	946
04.	20041107	34.8	92	9	412
05.	20011124	32.0	158	8	1326
06.	20011106	31.6	203	9	1045
07.	20031031	30.3	151	9	2337
08.	20000715	30.1	157	9	1195
09.	20041108	29.1	191	9	1631
10.	20031014	28.7	97	9	124

Table 2: Top10 daily number of abs(GIC)>5.0 A at Mäntsälä (10 s values), A_k at Nurmijärvi and $\#(|d\mathbf{H}/dt| > 1.0$ nT/s) (1998-2005)

01.	20031029	1934	274	4094
02.	20031030	878	224	2039
03.	20041108	833	191	1631
04.	20031031	829	151	2337
05.	20031120	667	198	1142
06.	20011106	579	203	1045
07.	20000715	549	157	1195
08.	20011124	515	158	1326
09.	20041109	450	189	946
10.	20010331	399	268	1545

max(GIC) at Mäntsälä vs. A_k at Nurmijärvi



Conclusions

- GIC recording already covers one solar maximum
- $d\mathbf{H}/dt$ is a good indicator of the GIC activity
- Large GIC values and large values of local geomagnetic indices have also a good statistical correlation
- Large GIC values occur most probably around the local midnight (at least at MLAT ≈ 57)
- Measurements will continue as a part of GIC Now!

WWW pages

Quick-look plots: http://space.fmi.fi/gic/
GIC Now!: http://aurora.fmi.fi/gic_service/

Acknowledgements

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