Directional surveying in the Norwegian Sea

Morten Gjertsen

10. May 2012

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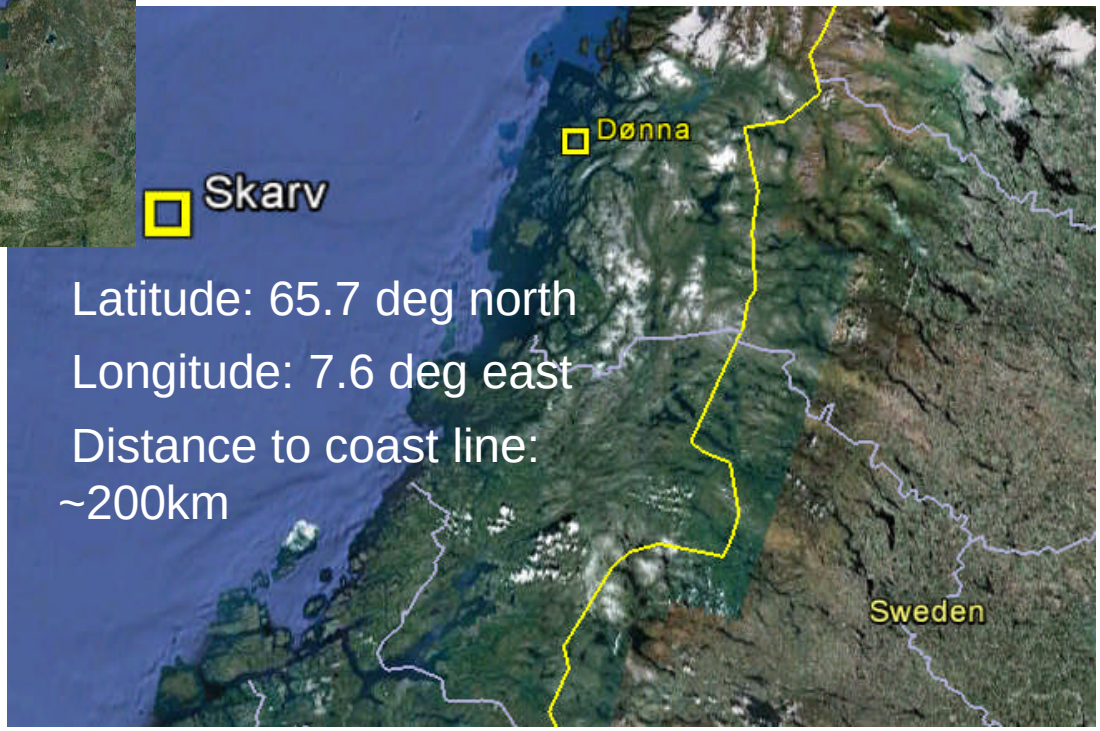
The Skarv Idun Development



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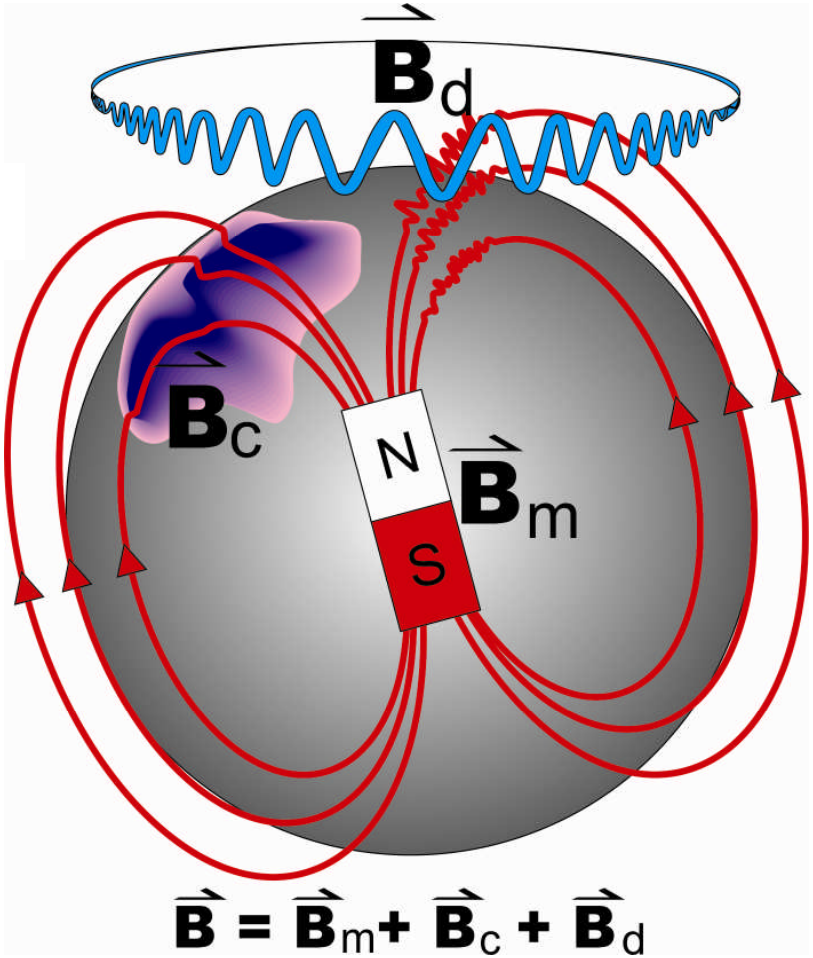
Earth's Magnetic Field - components

Local field - Crust



Disturbance field

Main field

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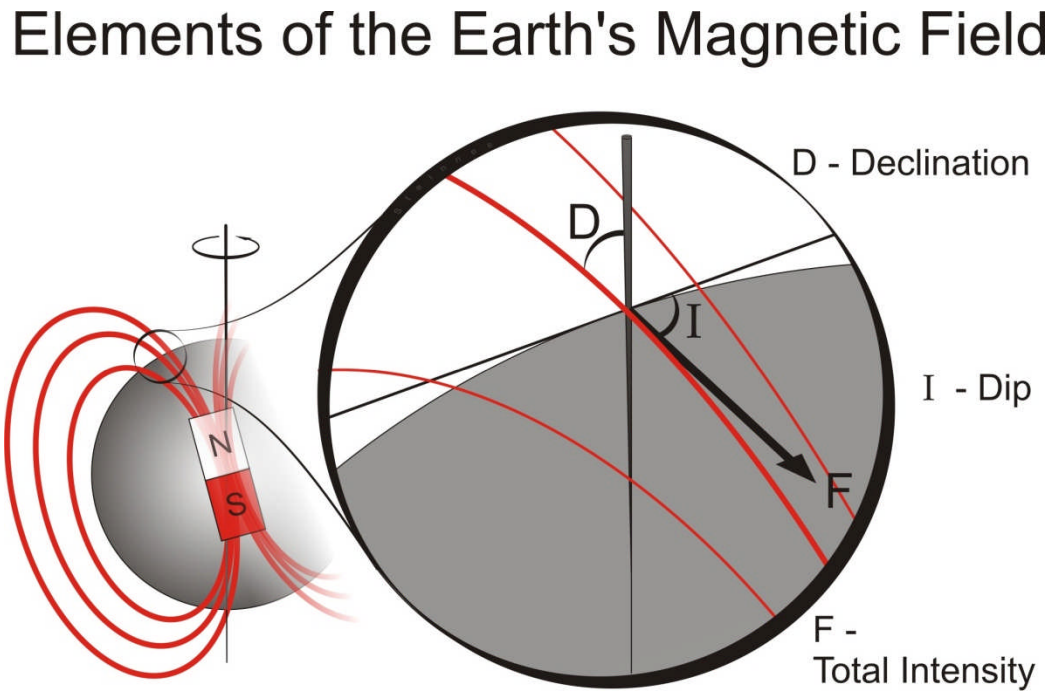
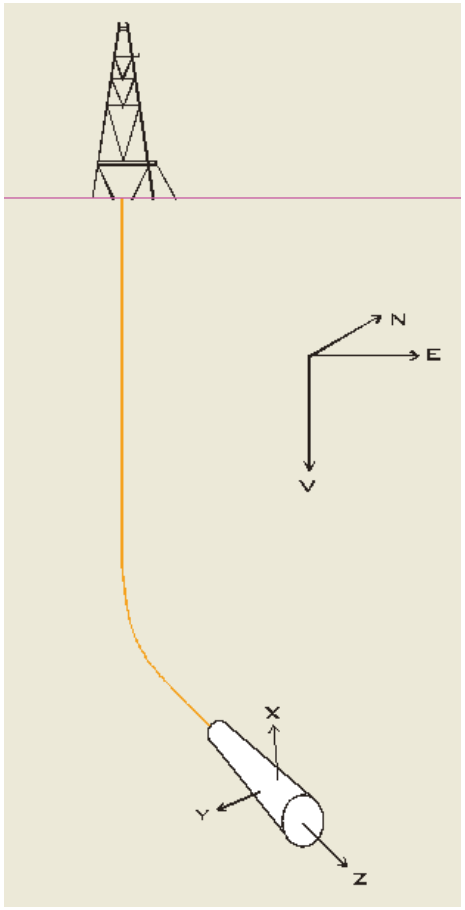
Earth's magnetic field - Main characteristics





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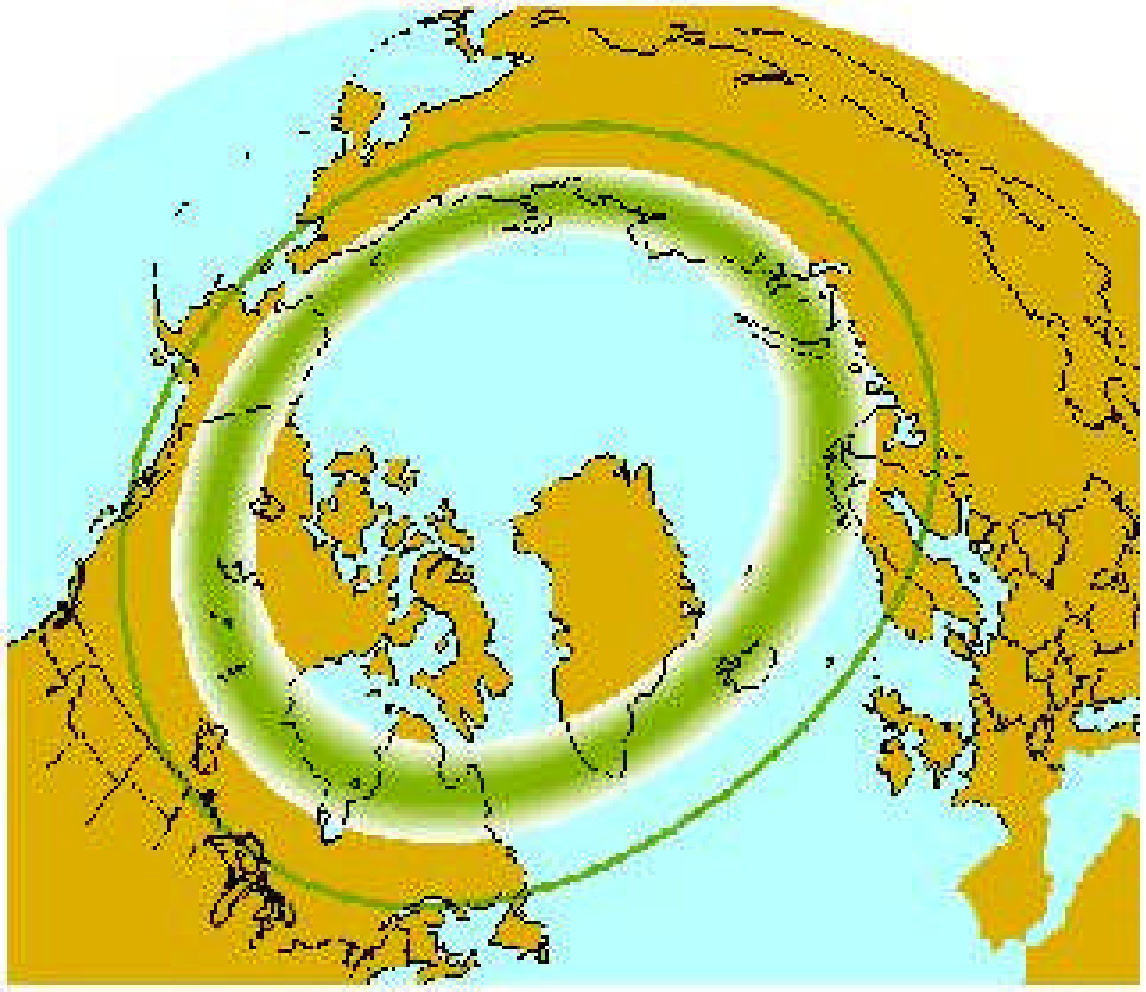
The Northern Lights zone



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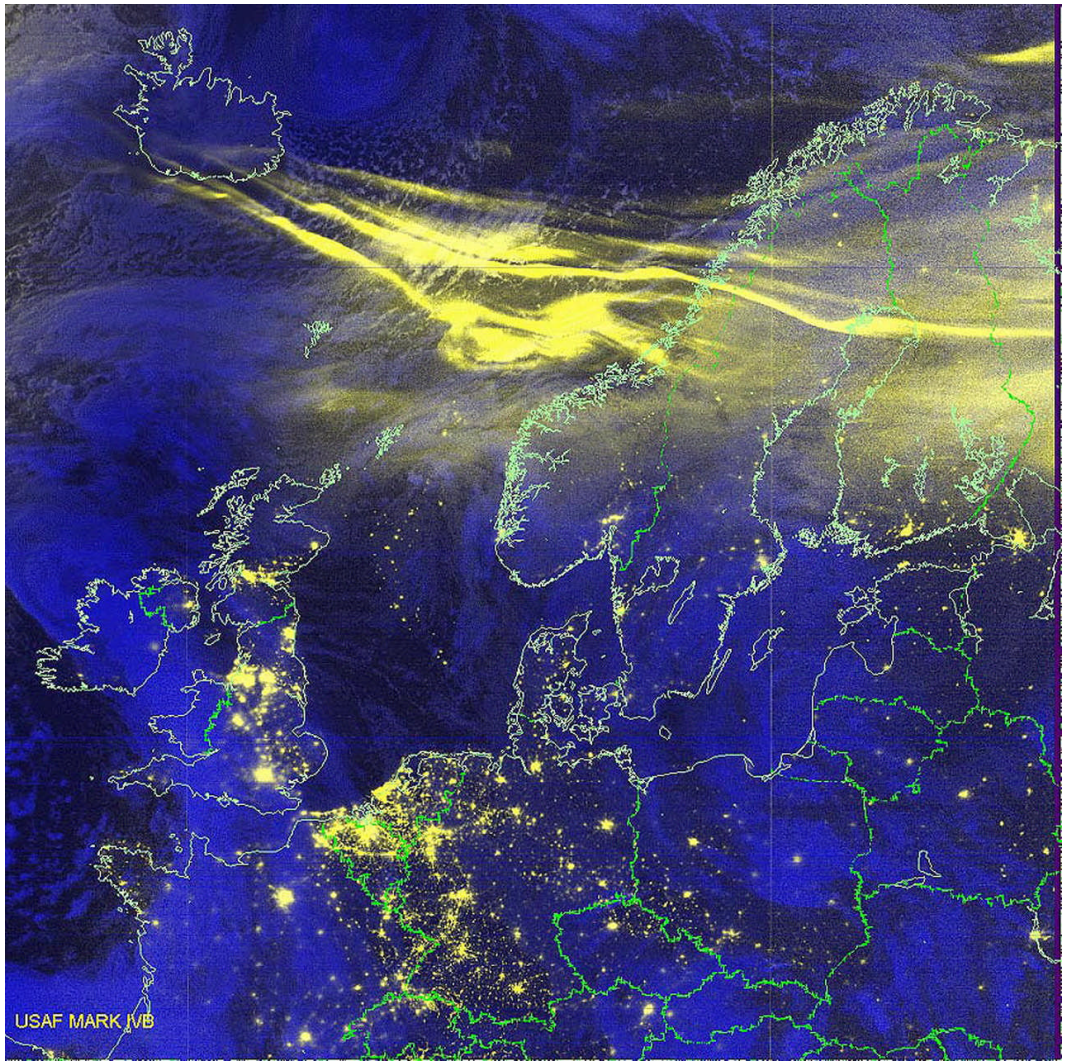
The Northern Lights oval



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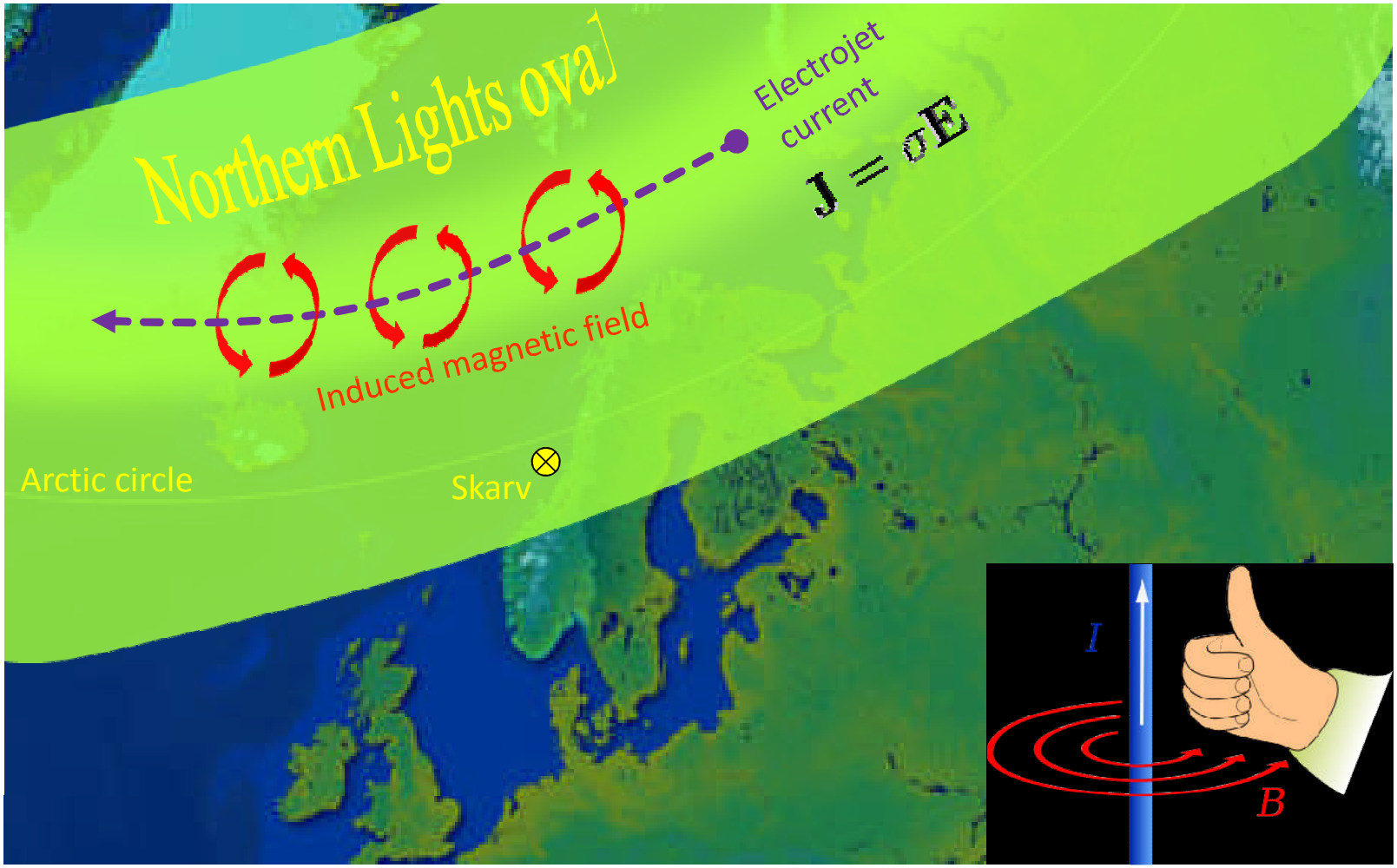
Auroral electrojet



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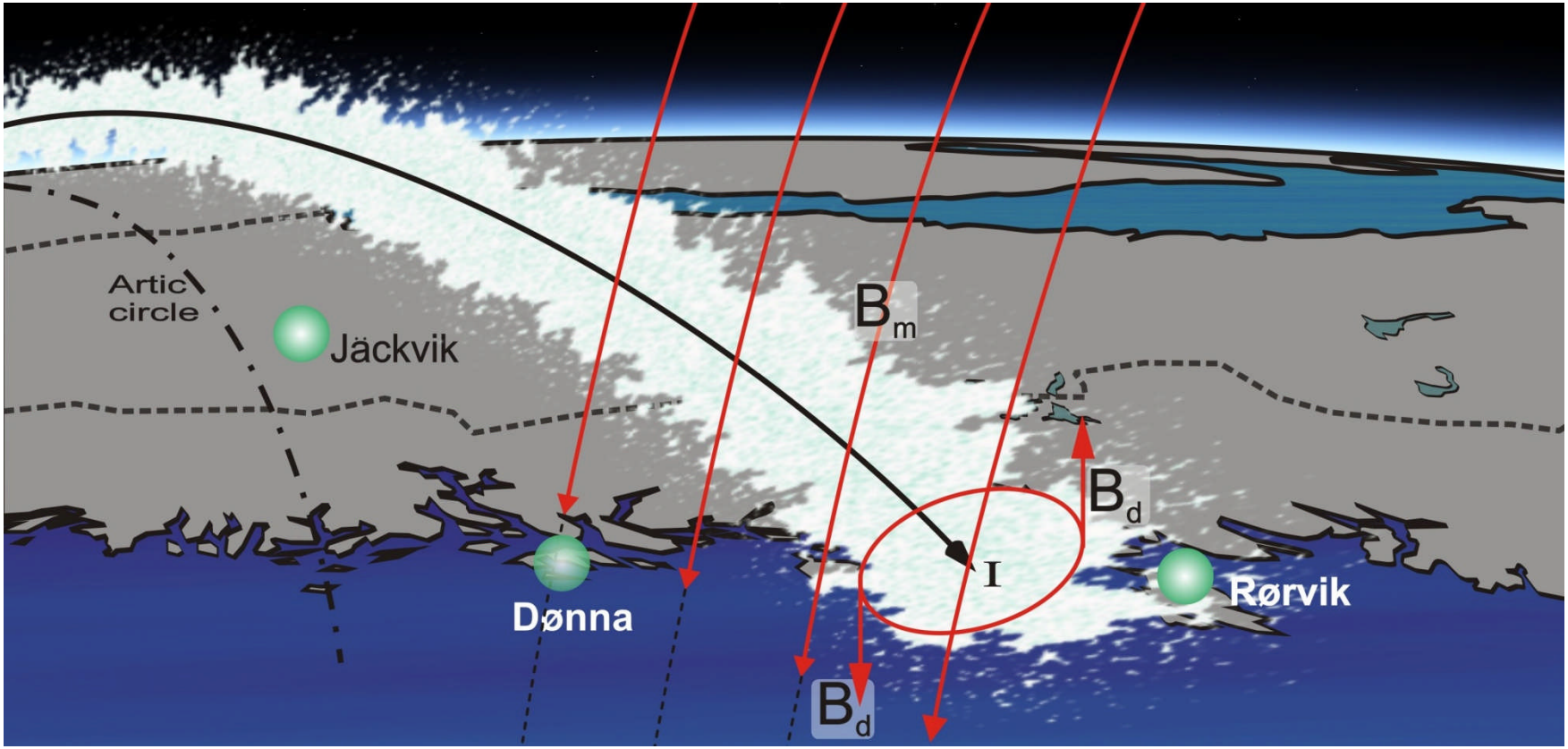
Auroral electrojet's effect on the magnetic field



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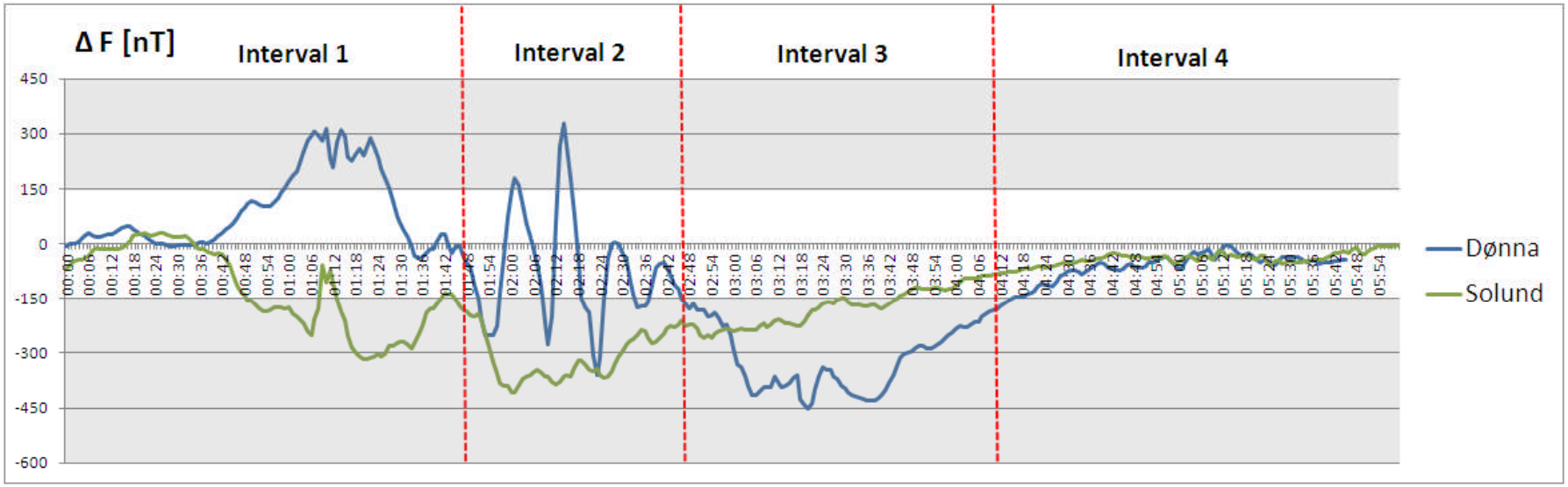
Auroral electrojet's effect on the magnetic field

Magnetic storm on 6th August 2011



Station	Geomagnetic Latitude	Geomagnetic Longitude
Dønna	63.4	95.8
Solund	58.5	86.1

Error model disturbance limits (3σ) at Dønna		
D	I	F
0.45	0.18	147

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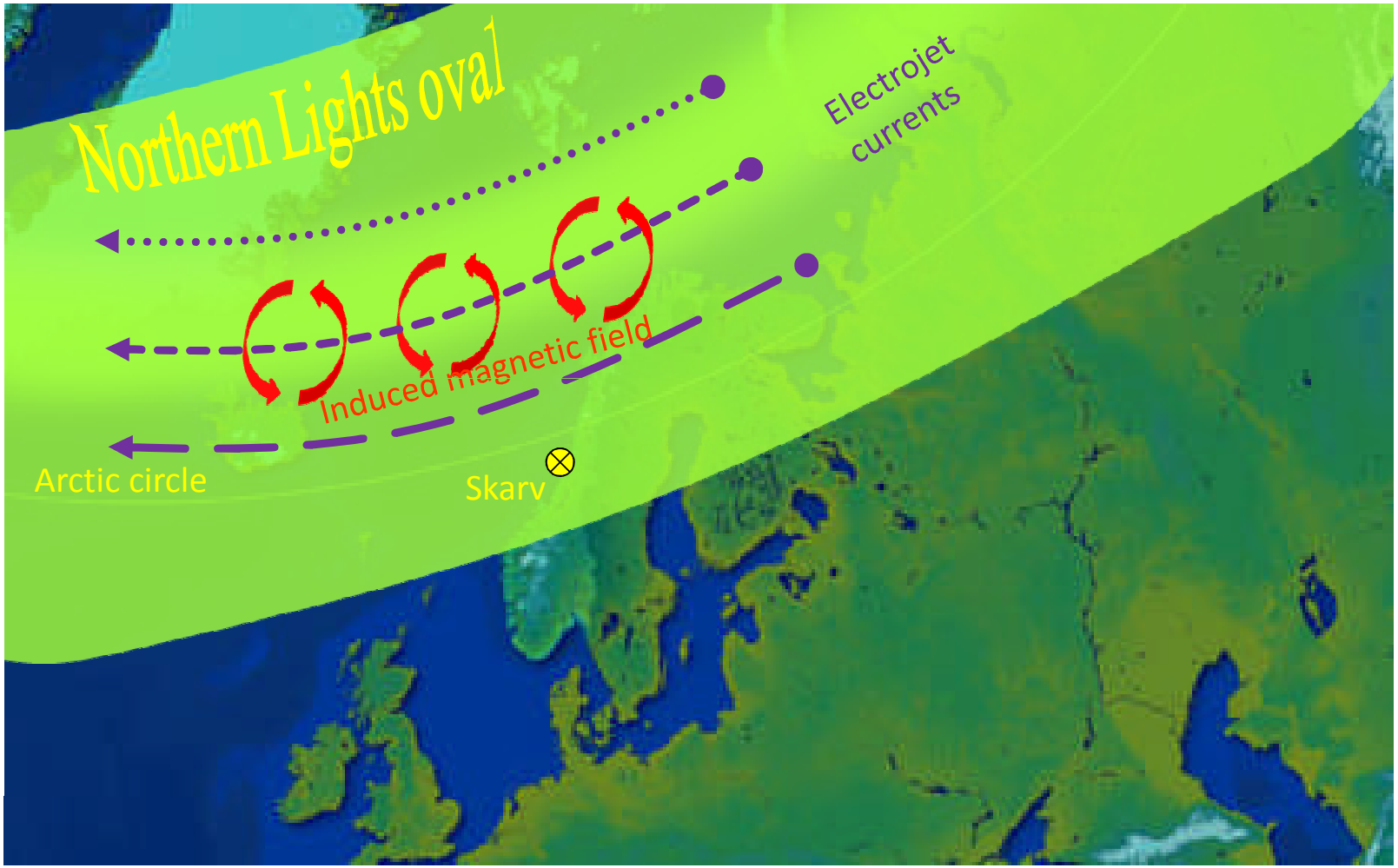
Magnetic field behaviour- Hypothesis



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The Magnetic field at drill site

We assume the disturbance is the same onshore and offshore:

$$\Delta \mathbf{B}_1 \sim \Delta \mathbf{B}_S$$

and get: $\mathbf{B}_S = \mathbf{Q}_S + \Delta \mathbf{B}_1$

Offshore:

$B_S = Q_S + \Delta B_S$

Q_S : the undisturbed part
ΔB_S : the disturbance part

The undisturbed part

Q_S = Global model + Crust

Foto: Dolphin Drilling

Onshore variometer:

$\mathbf{B}_1 = \mathbf{Q}_1 + \Delta \mathbf{B}_1$

$\mathbf{B}_1$: Variometer output

$\mathbf{Q}_1$: Corresponds to the offshore Q_s (ideally)

$\Delta \mathbf{B}_1 = \mathbf{Q}_1 - \mathbf{B}_1$

(long term drift and Secular Variations accounted for)

fluxgate

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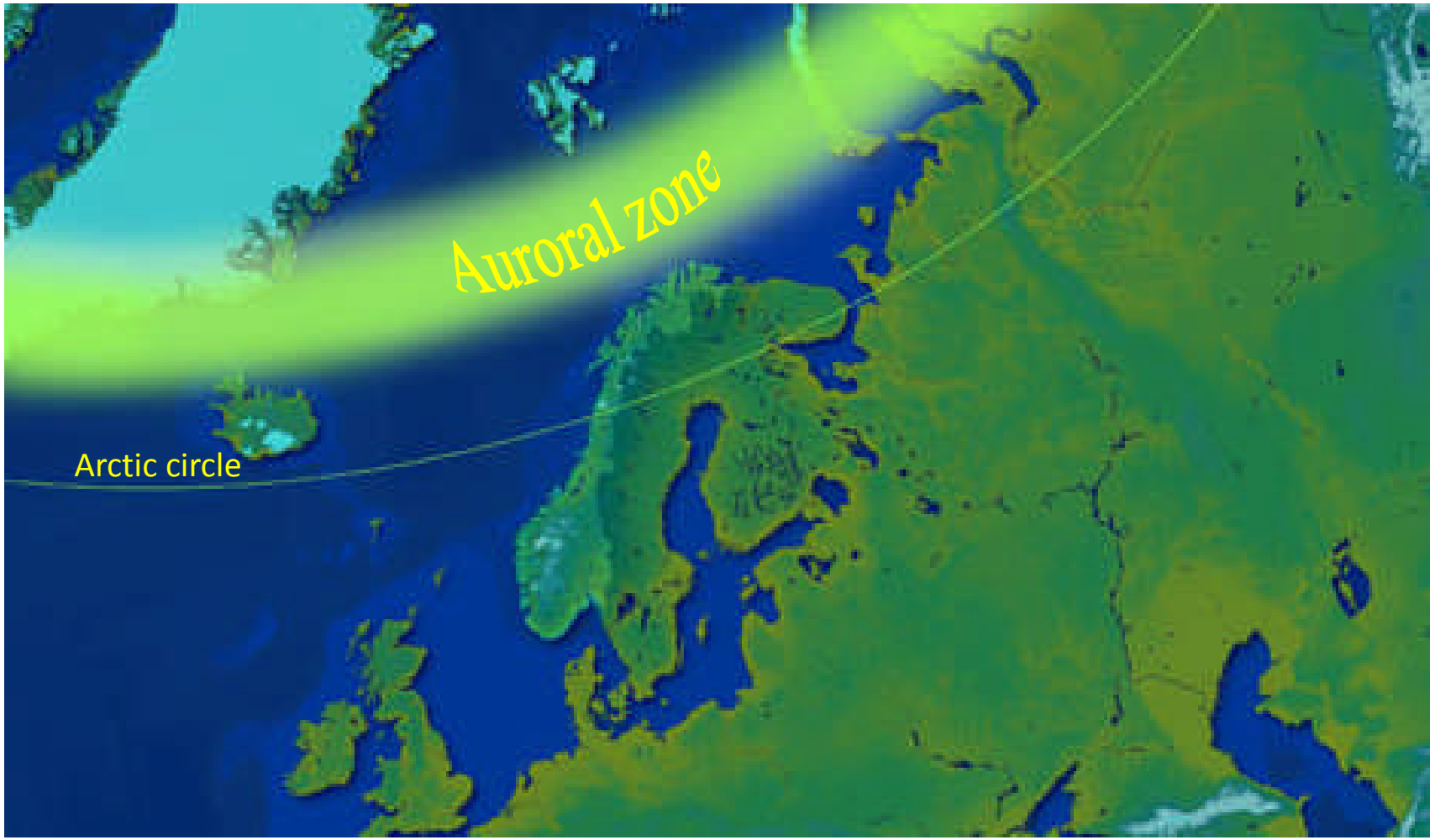
Testing the Hypothesis



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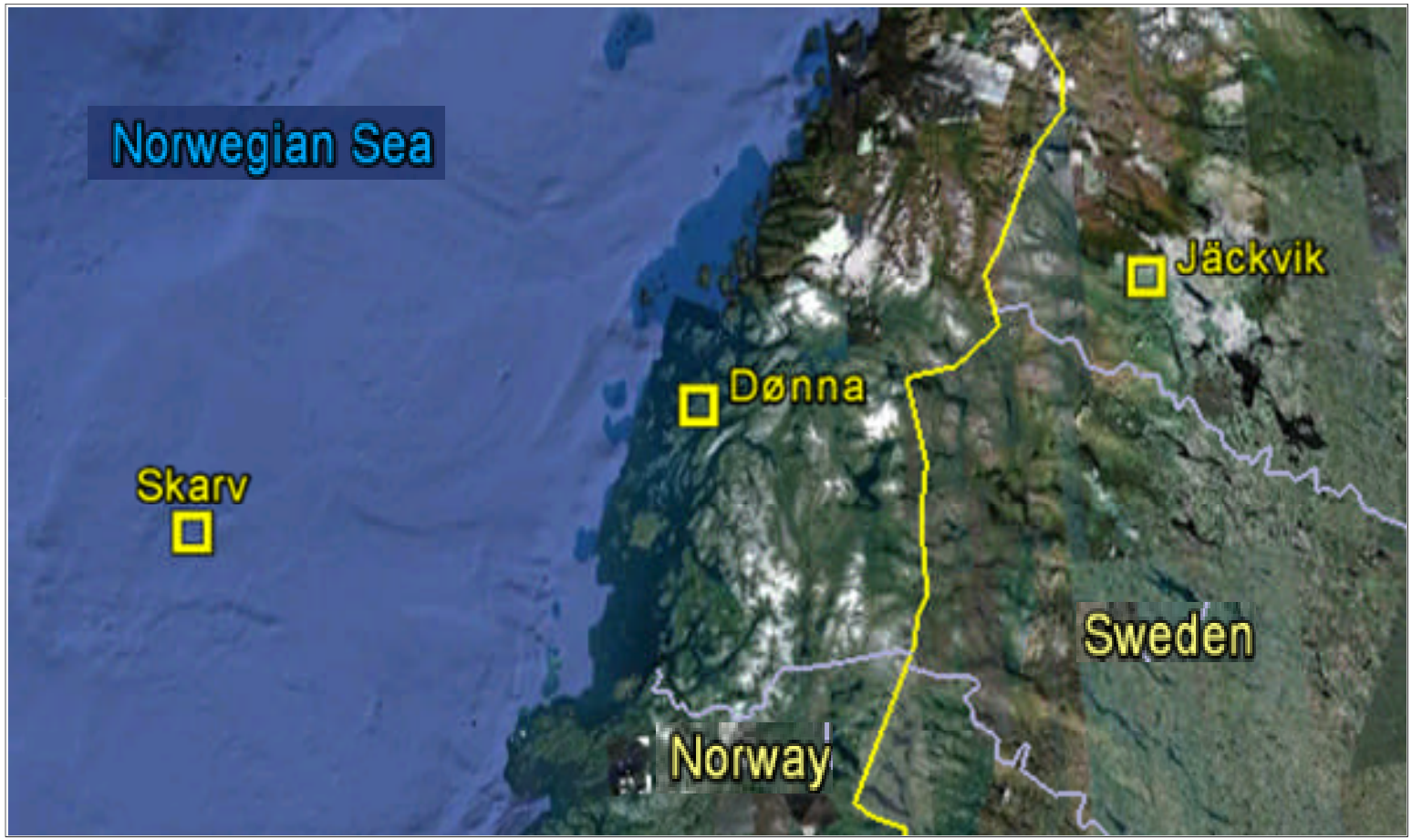
Monitoring sites



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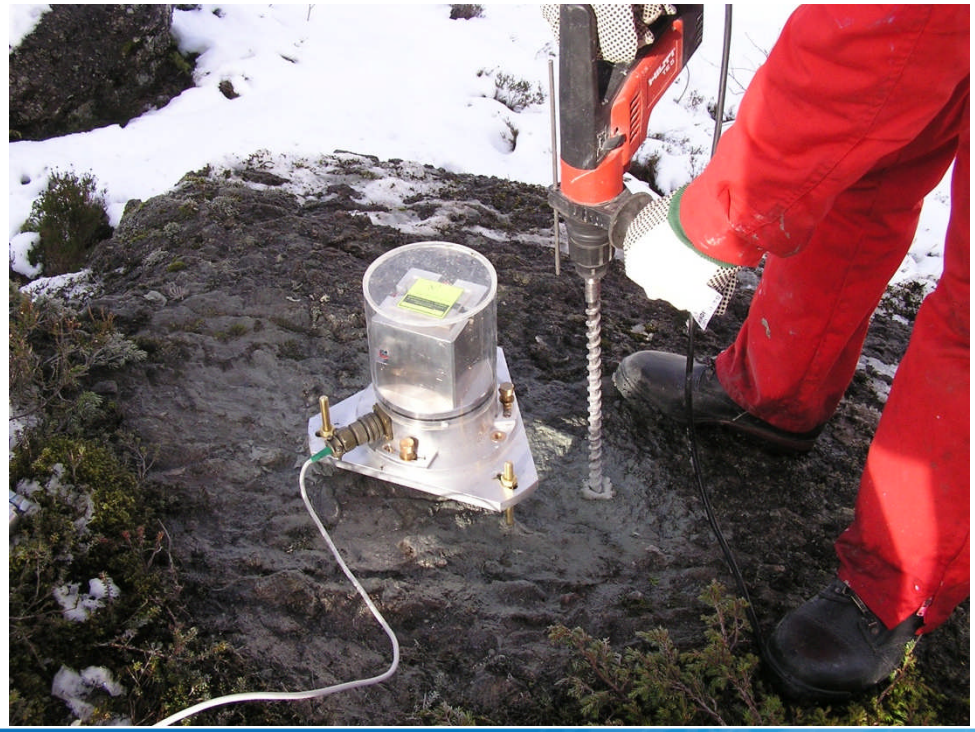
The Magnetometer stations

- Standard 3-axes fluxgate
- Mounted on magnetically undisturbed site
- Electronics, data logger and communication equipment in nearby house
- Good short-time stability. Long term drift acceptable
- Data every few minutes are transmitted to TGO in Tromsø



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The Magnetometer stations

The locals.....

Jäckvik - Sweden

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Observation and analysis - 2011

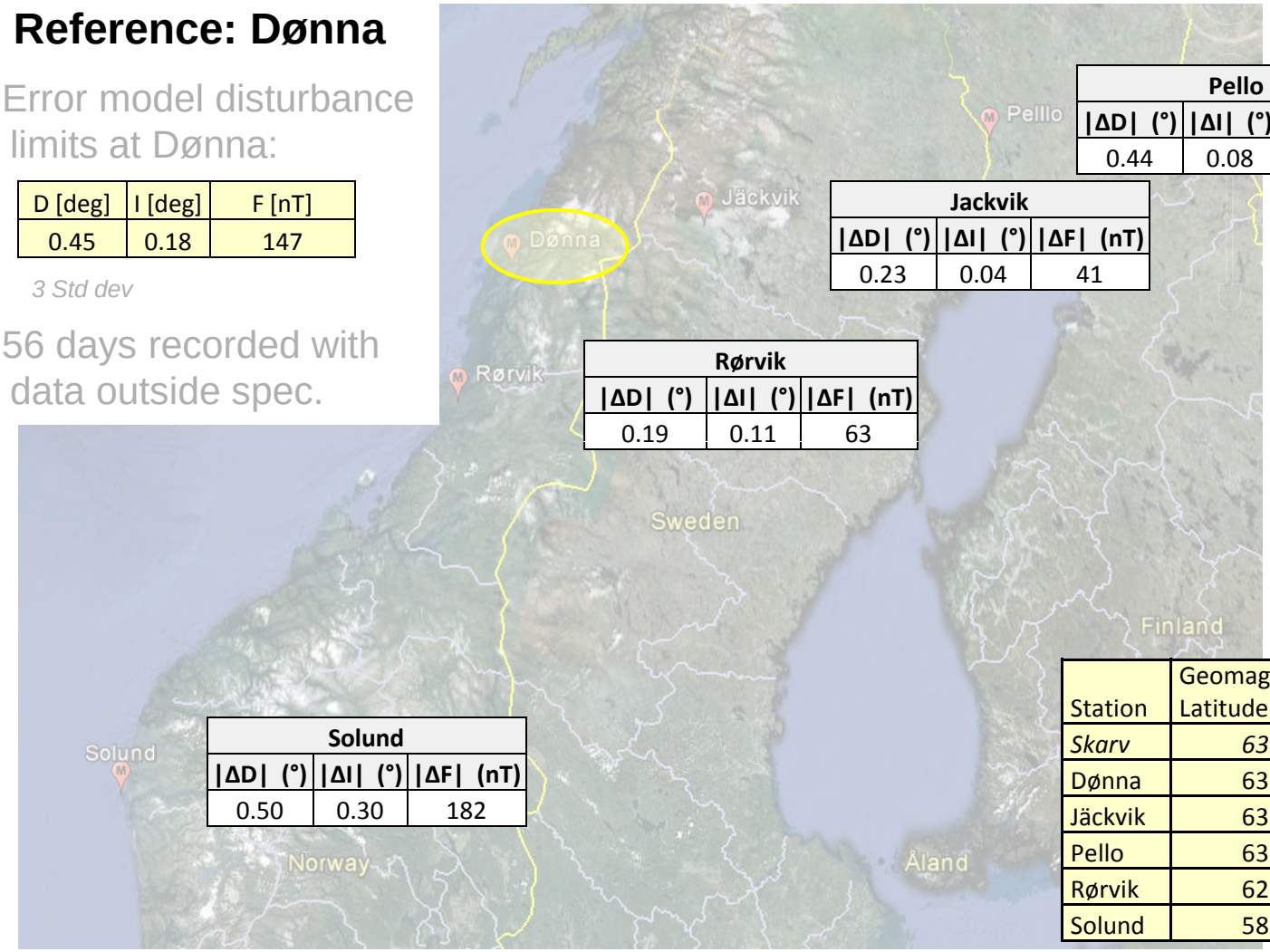
Reference: Dønna

- Error model disturbance limits at Dønna:

D [deg]	I [deg]	F [nT]
0.45	0.18	147

3 Std dev

- 56 days recorded with data outside spec.



Pello		
|ΔD| (°)	|ΔI| (°)	|ΔF| (nT)
0.44	0.08	84

Jackvik		
|ΔD| (°)	|ΔI| (°)	|ΔF| (nT)
0.23	0.04	41

Rørvik		
|ΔD| (°)	|ΔI| (°)	|ΔF| (nT)
0.19	0.11	63

Solund		
|ΔD| (°)	|ΔI| (°)	|ΔF| (nT)
0.50	0.30	182

Note!
Absolute average difference

Station	Geomagnetic Latitude	Geomagnetic Longitude
Skarv	*63.3*	*91.7*
Dønna	63.4	95.8
Jäckvik	63.5	99.5
Pello	63.6	105.4
Rørvik	62.2	93.2
Solund	58.5	86.1

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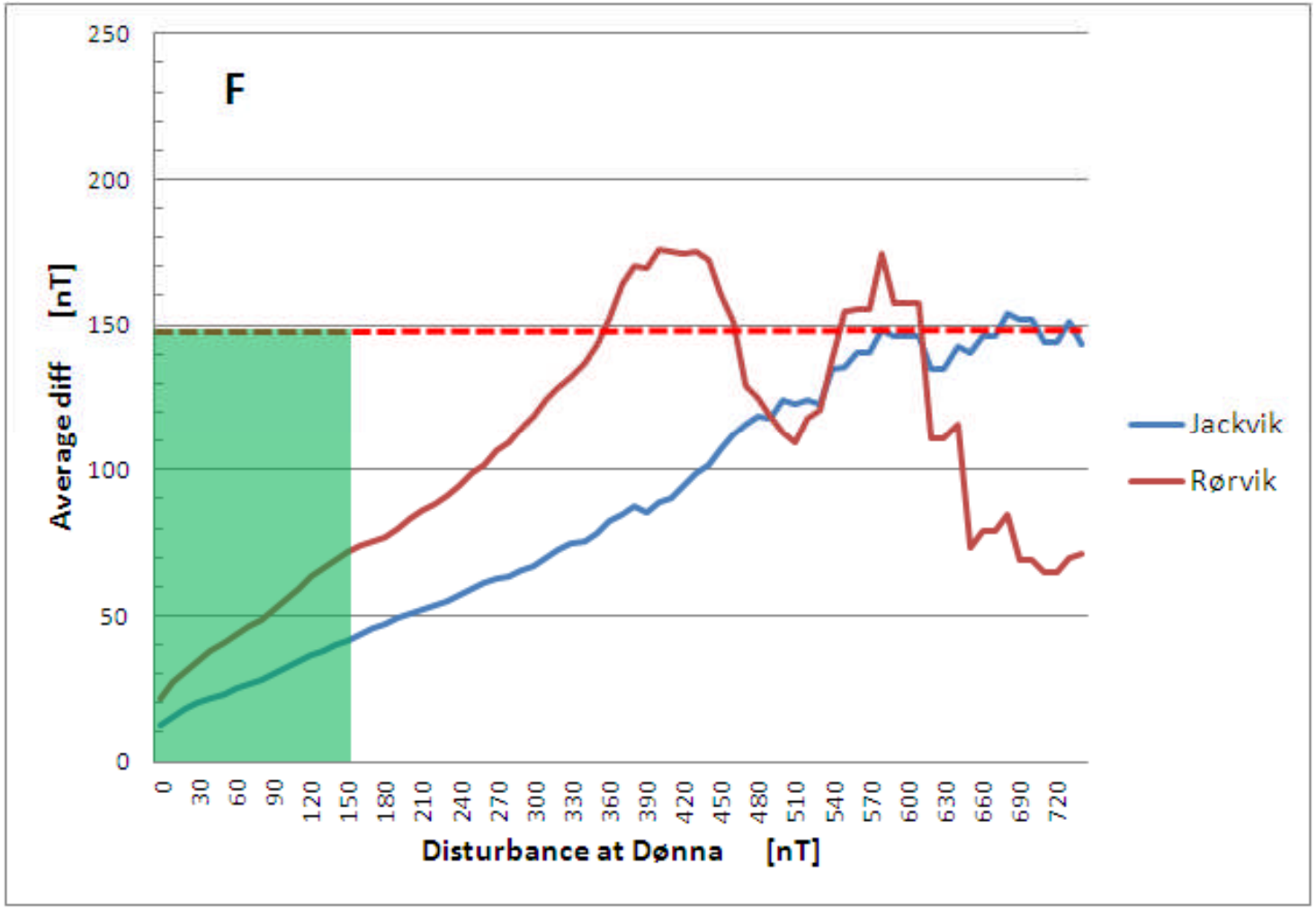
Observation and analysis - 2011



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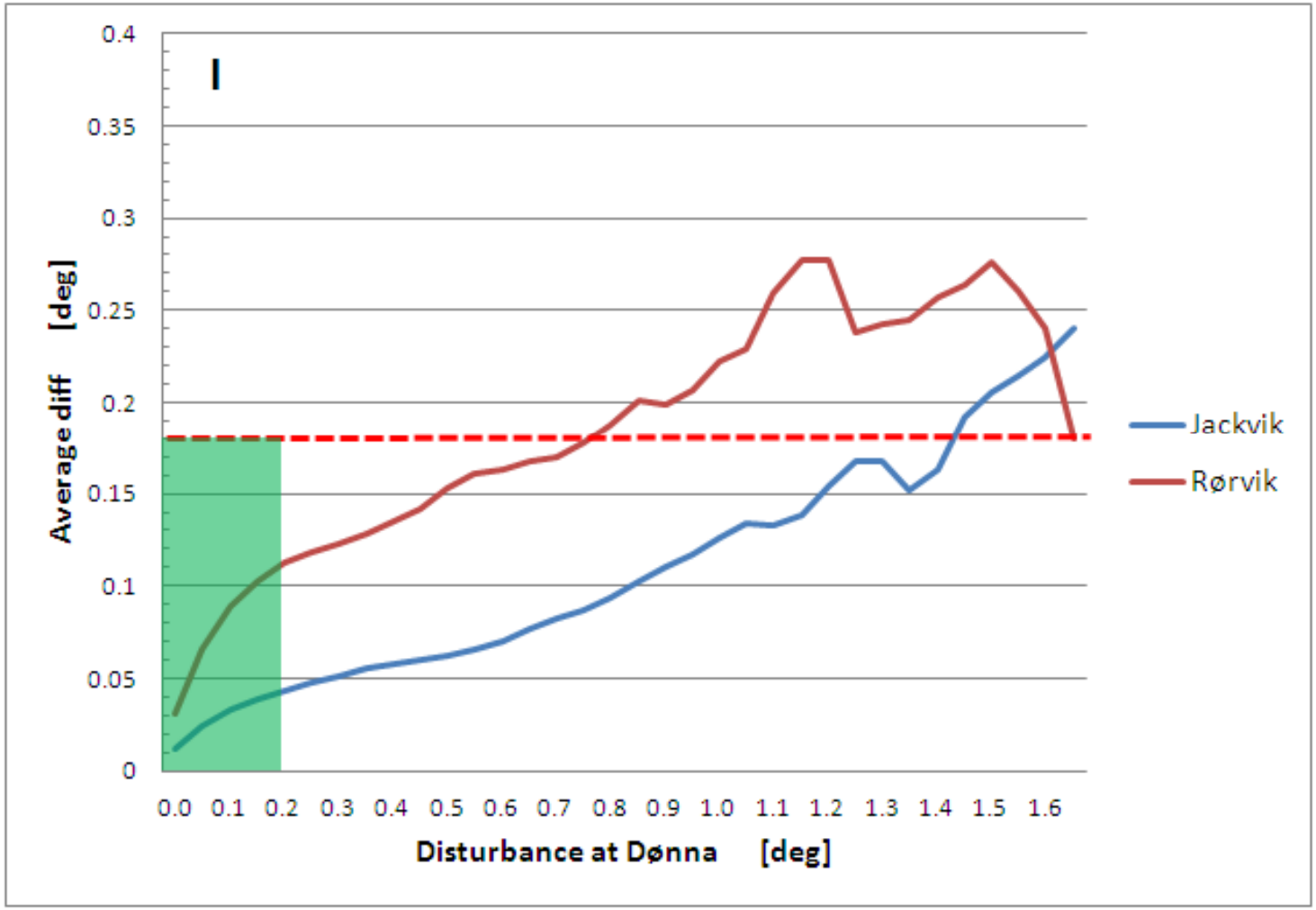
Observation and analysis - 2011



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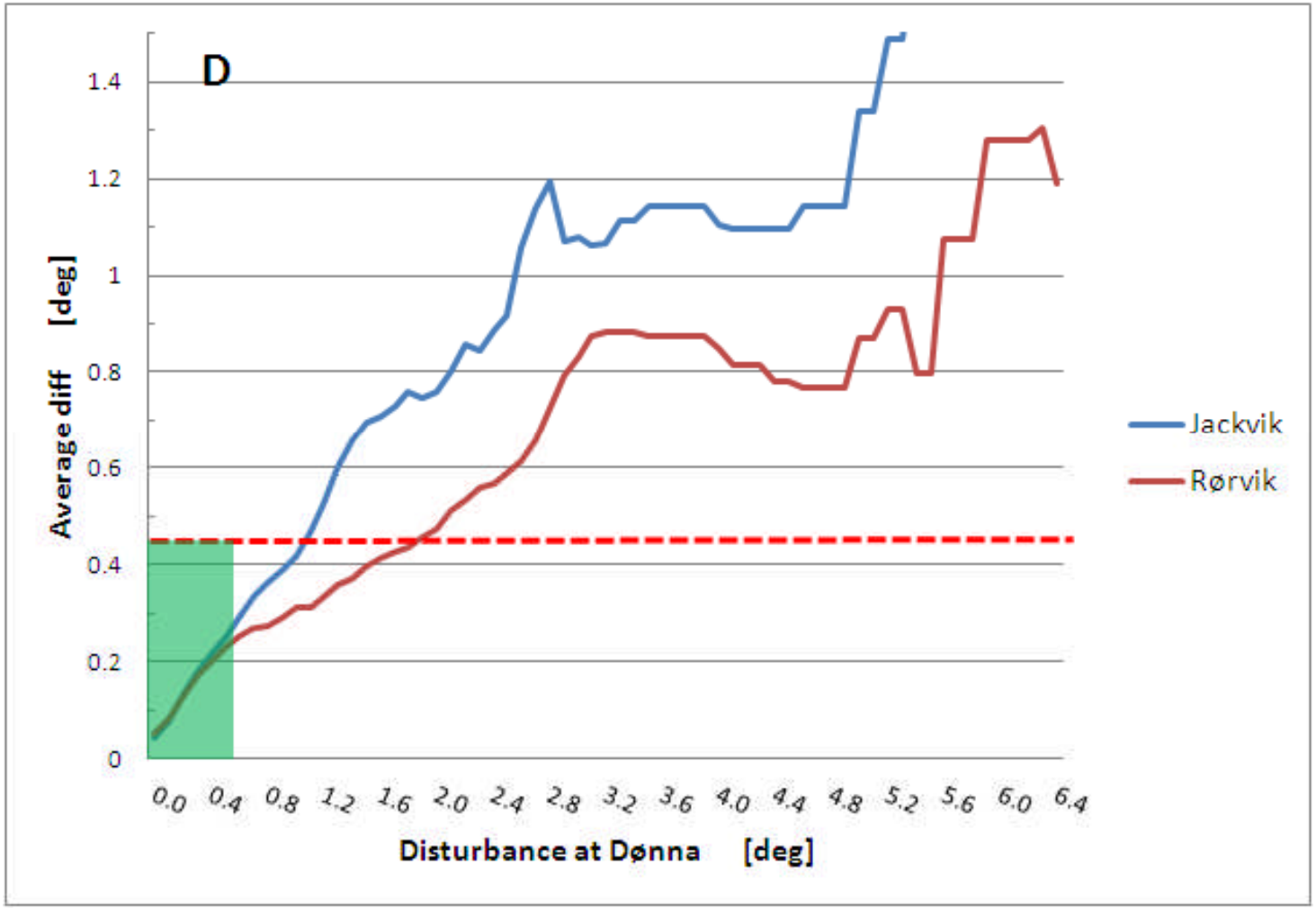
Observation and analysis - 2011



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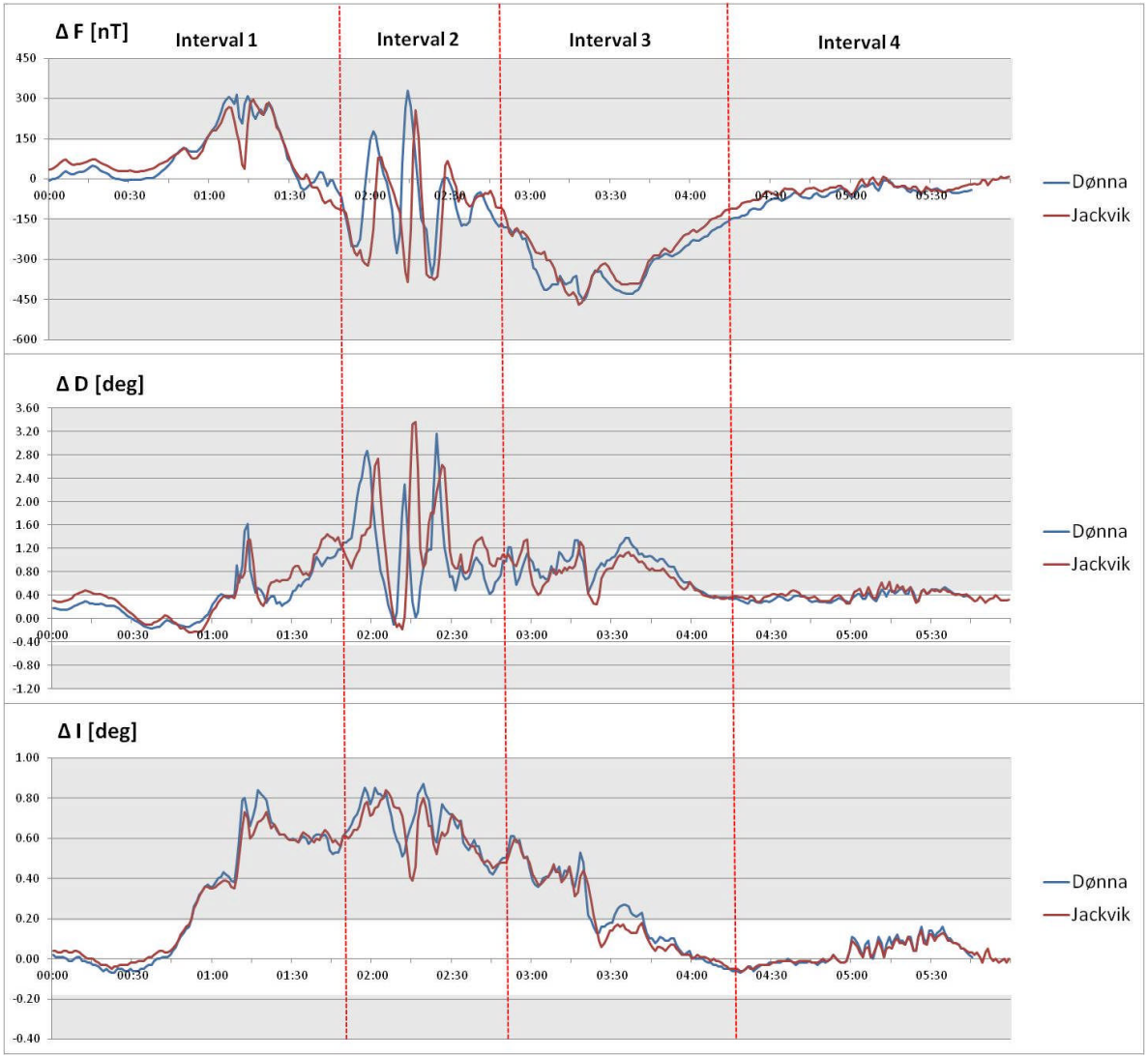
When to correct?



Correction possible:
Intervall 1 and 3.

Correction not possible:
Intervall 2
(requires evaluation)

Correction not required:
Intervall 4

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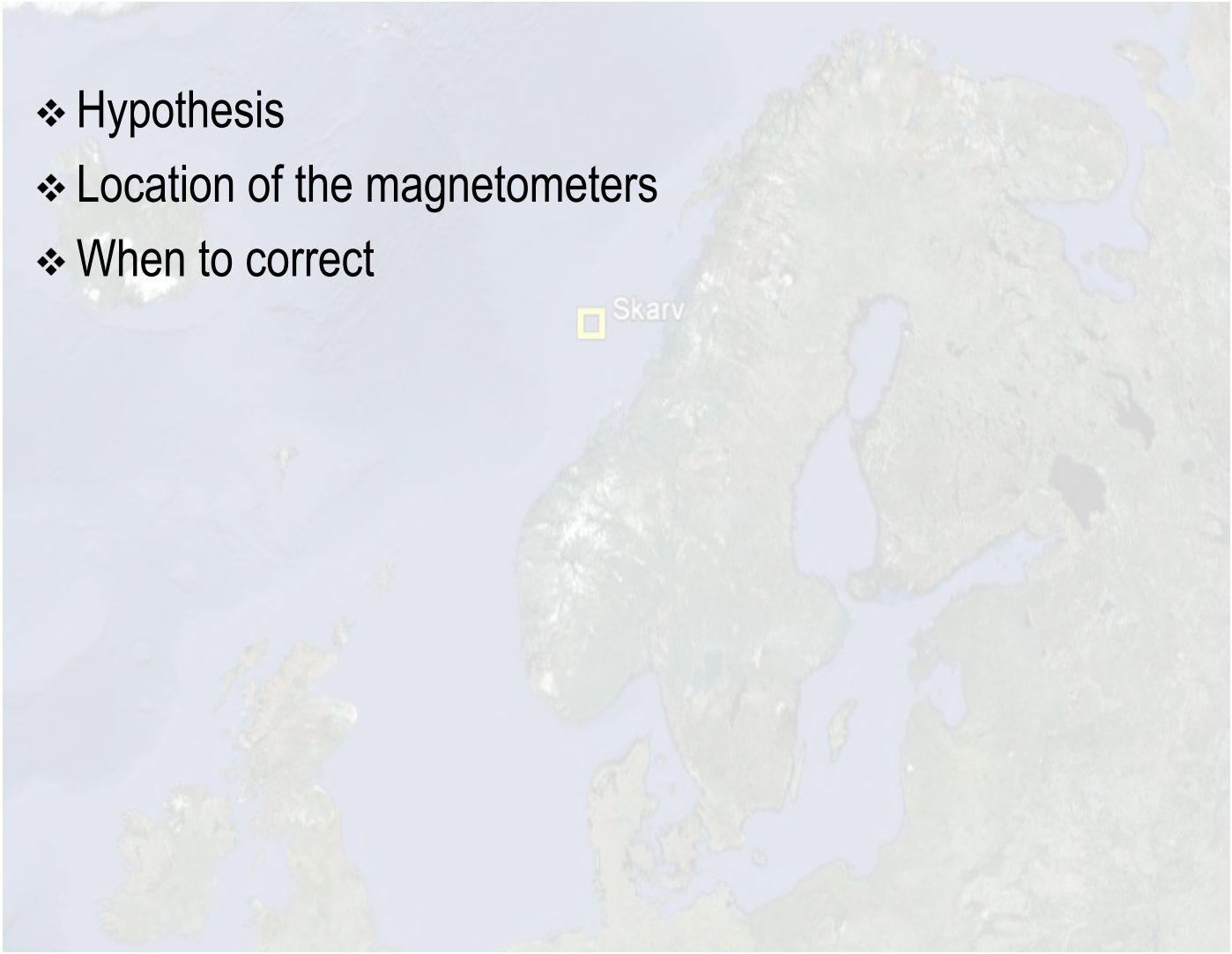
Conclusion

- Hypothesis
- Location of the magnetometers
- When to correct



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