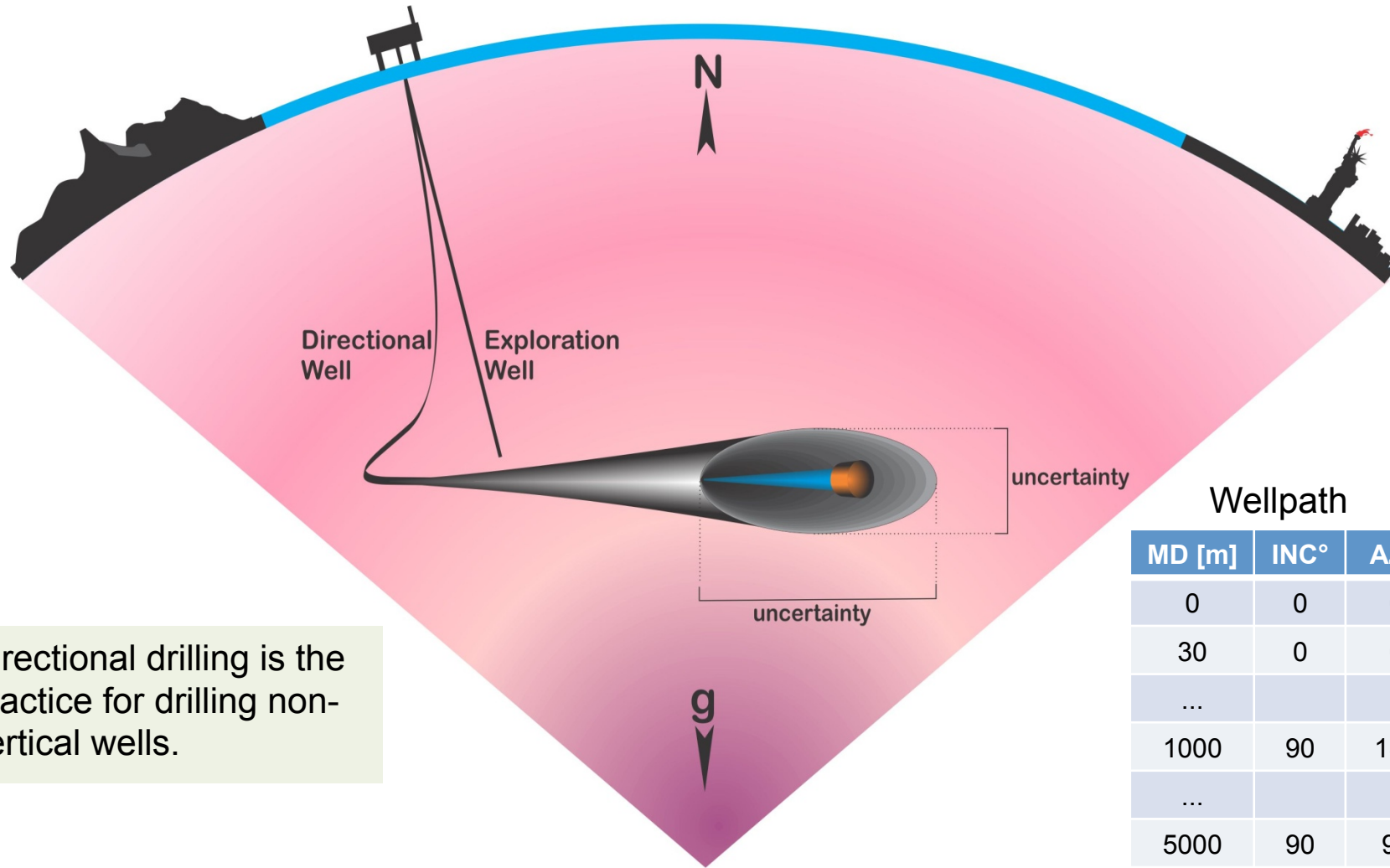


How to Deal with Geomagnetic Storms in Directional Drilling

Inge Edvardsen
PhD Candidate/Survey Management Engineer



Directional Drilling

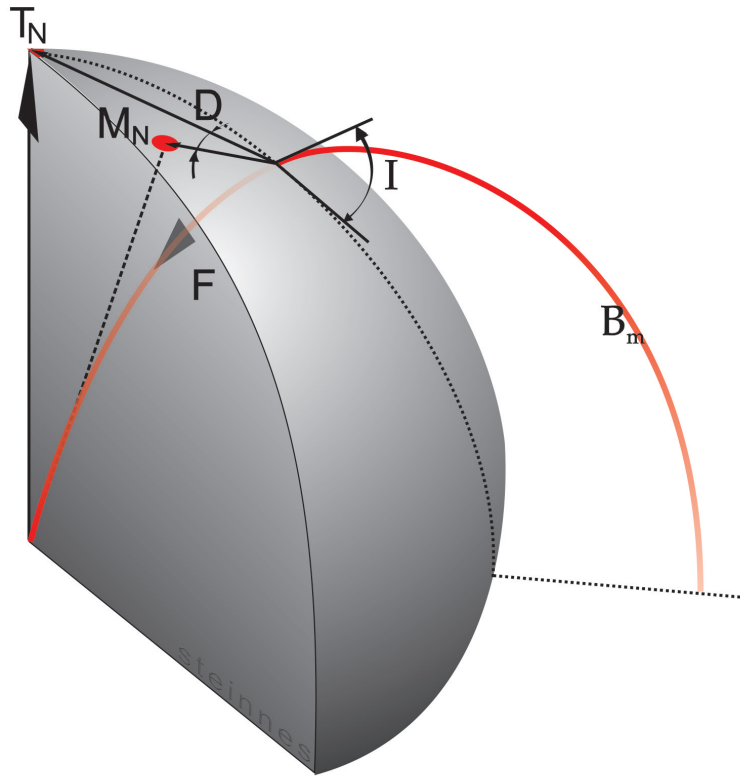


Directional drilling is the practice for drilling non-vertical wells.

Magnetic Directional Surveying

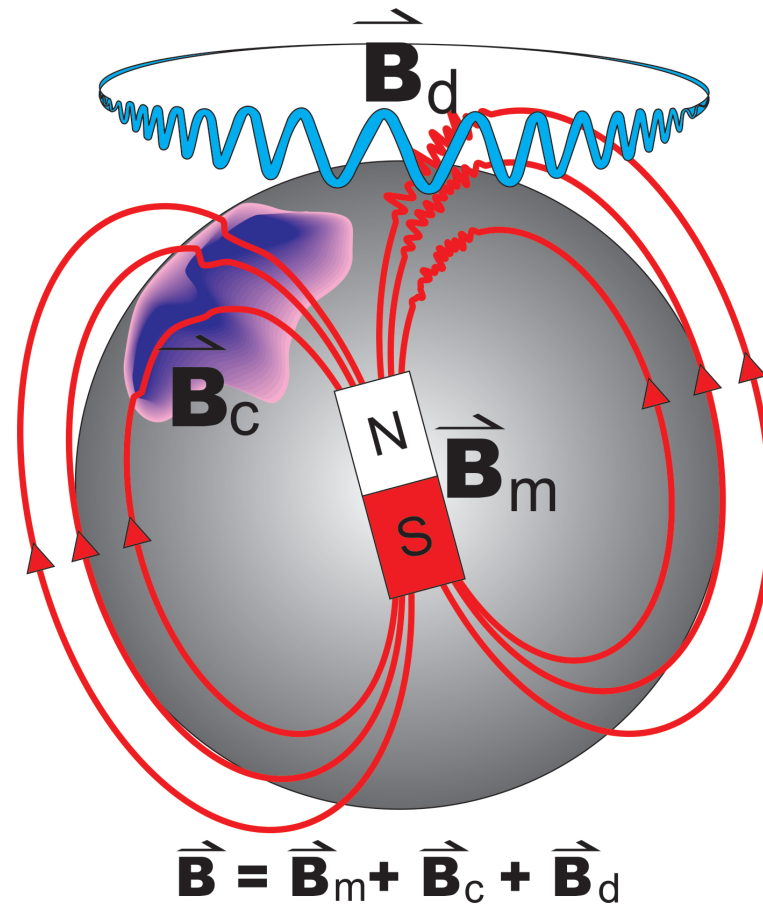
- The accuracy of magnetic azimuth decreases with increasing latitude due to:
 - Magnetic north is more difficult to resolve because of smaller signal strength.
 - Increased time dependent fluctuations in the orientation of the magnetic field, magnetic storms (The disturbance field).

Earth's Magnetic Field - Main Characteristics



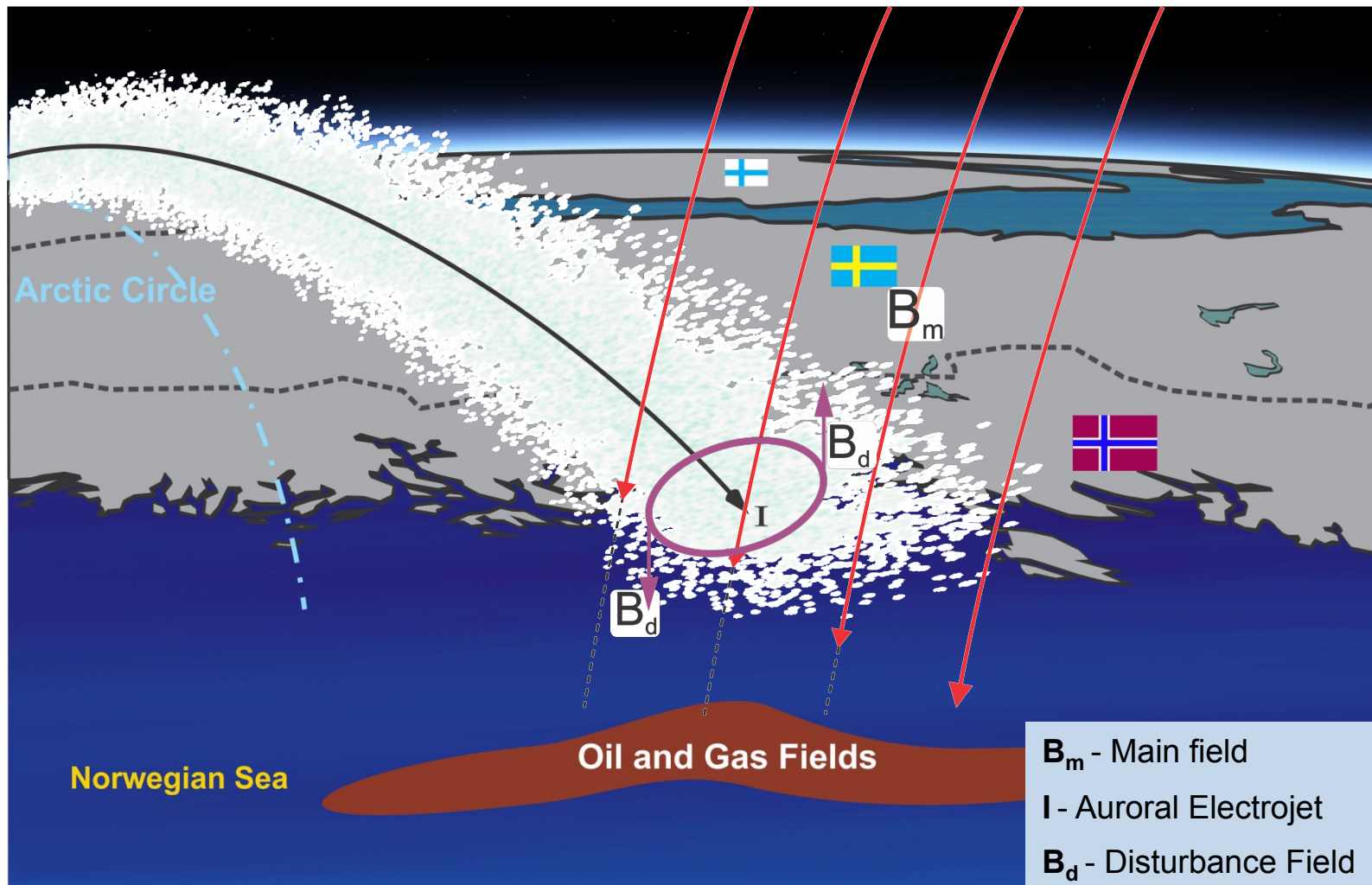
D - Declination [deg] **I** - Dip [deg] **F** - Total Intensity [nT]
T_N - True North **M_N** - Magnetic North **B_m** - Main Field

Earth's Magnetic Field - Components

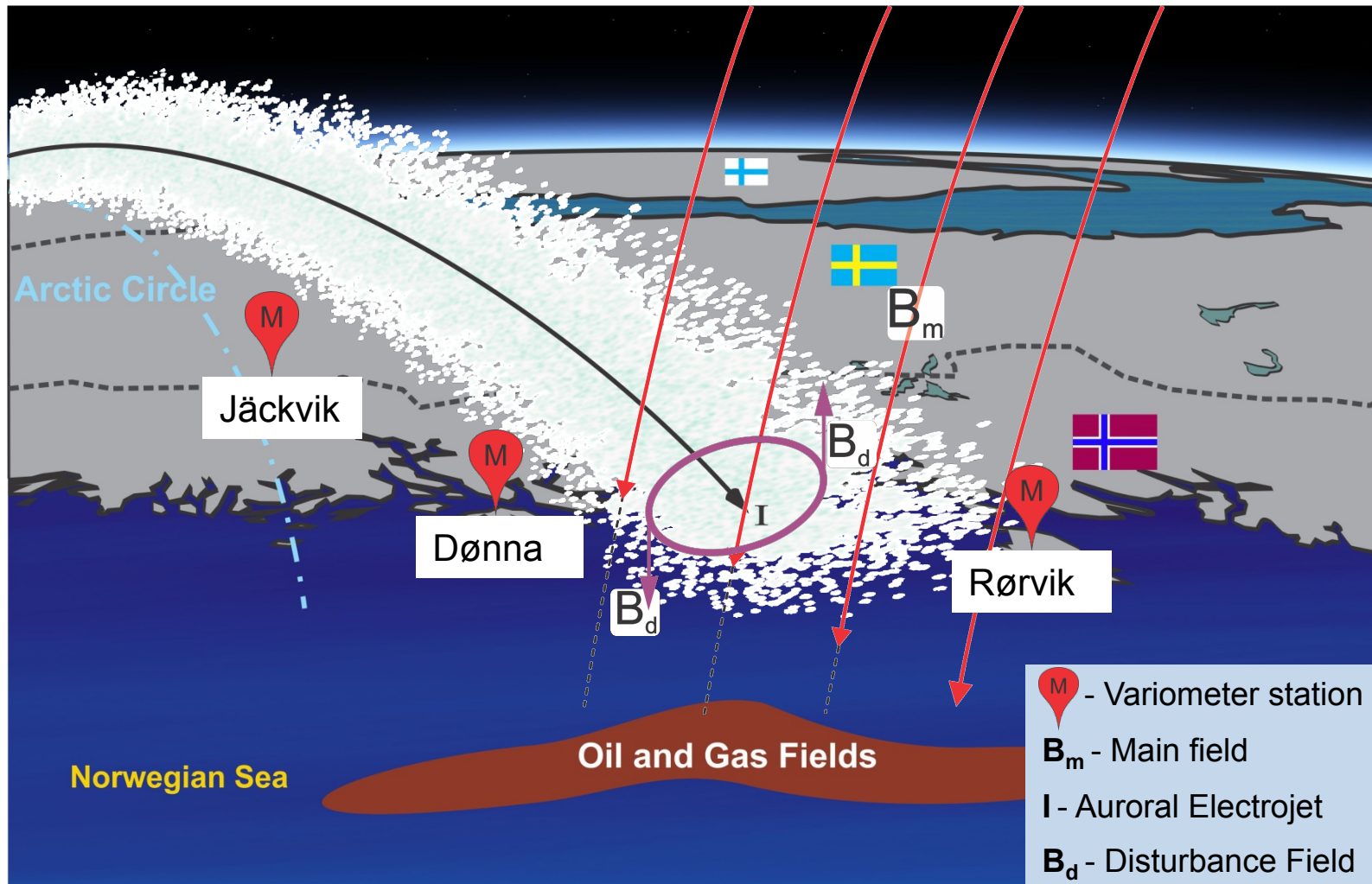


B_m - Main field
 B_c - Crustal field
 B_d - Disturbance field

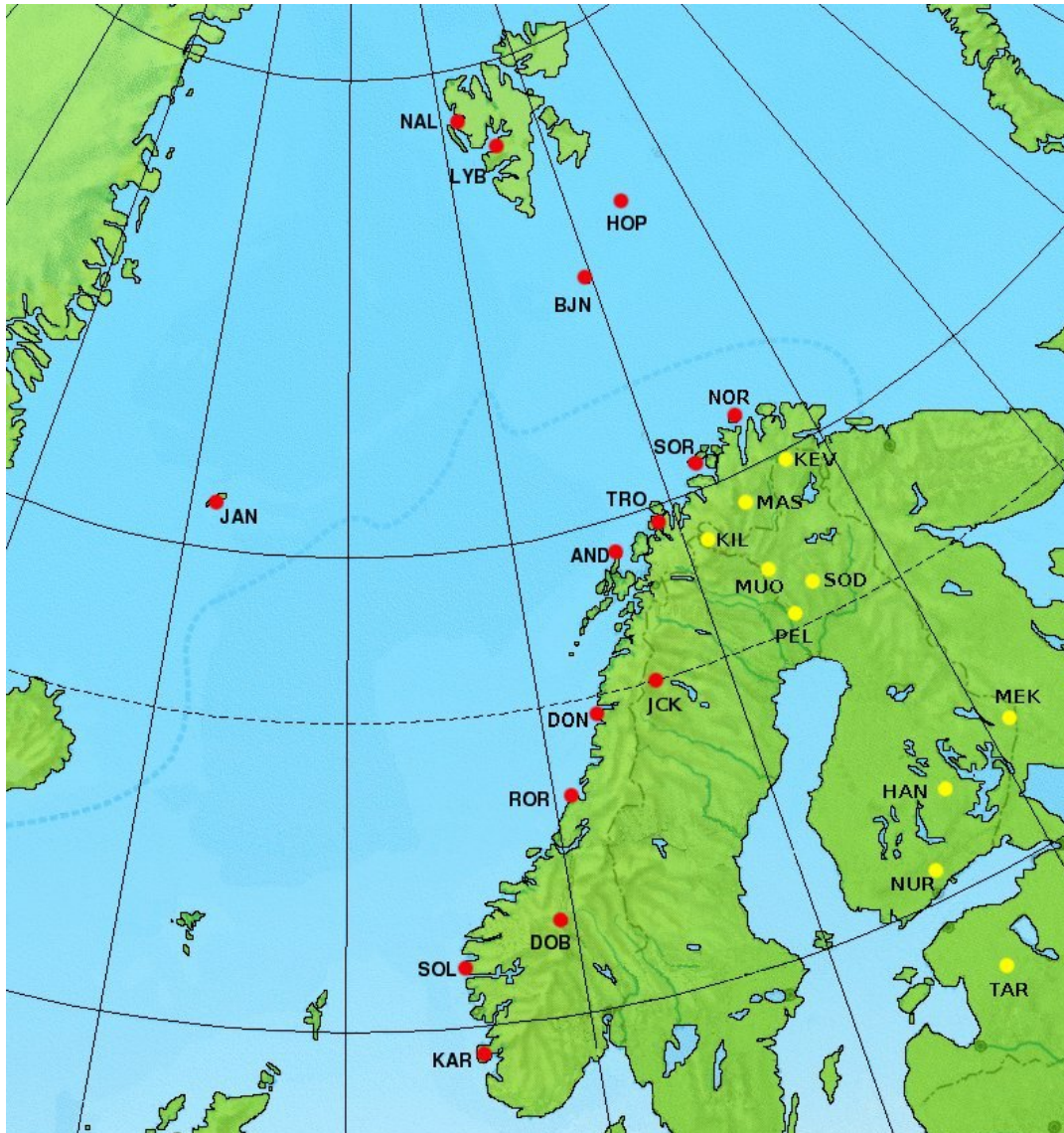
The Disturbance Field – The Auroral Electrojet



Monitoring the Disturbance Field



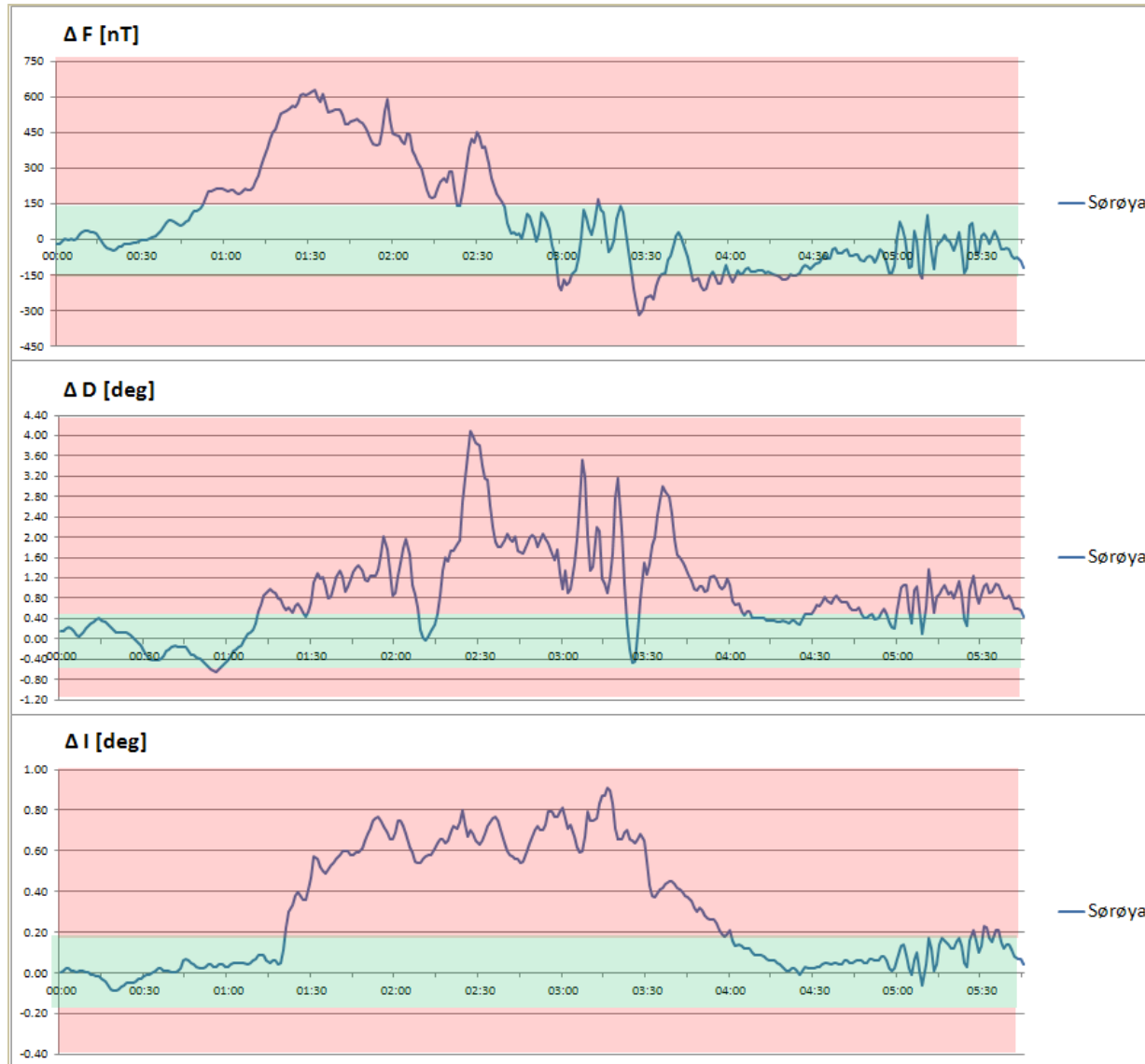
Monitoring the Disturbance Field



● Finnish geomagnetic observatories and stations

● Norwegian geomagnetic observatories and stations

The Disturbance Field – Magnetic Storm



Magnetic storm at Sørøya
6th August 2011

The green area indicates the MWD
error model disturbance limits.

F [nT]	D [deg]	I [deg]
+/- 147	+/- 0.45	+/- 0.18

UIT Warning System

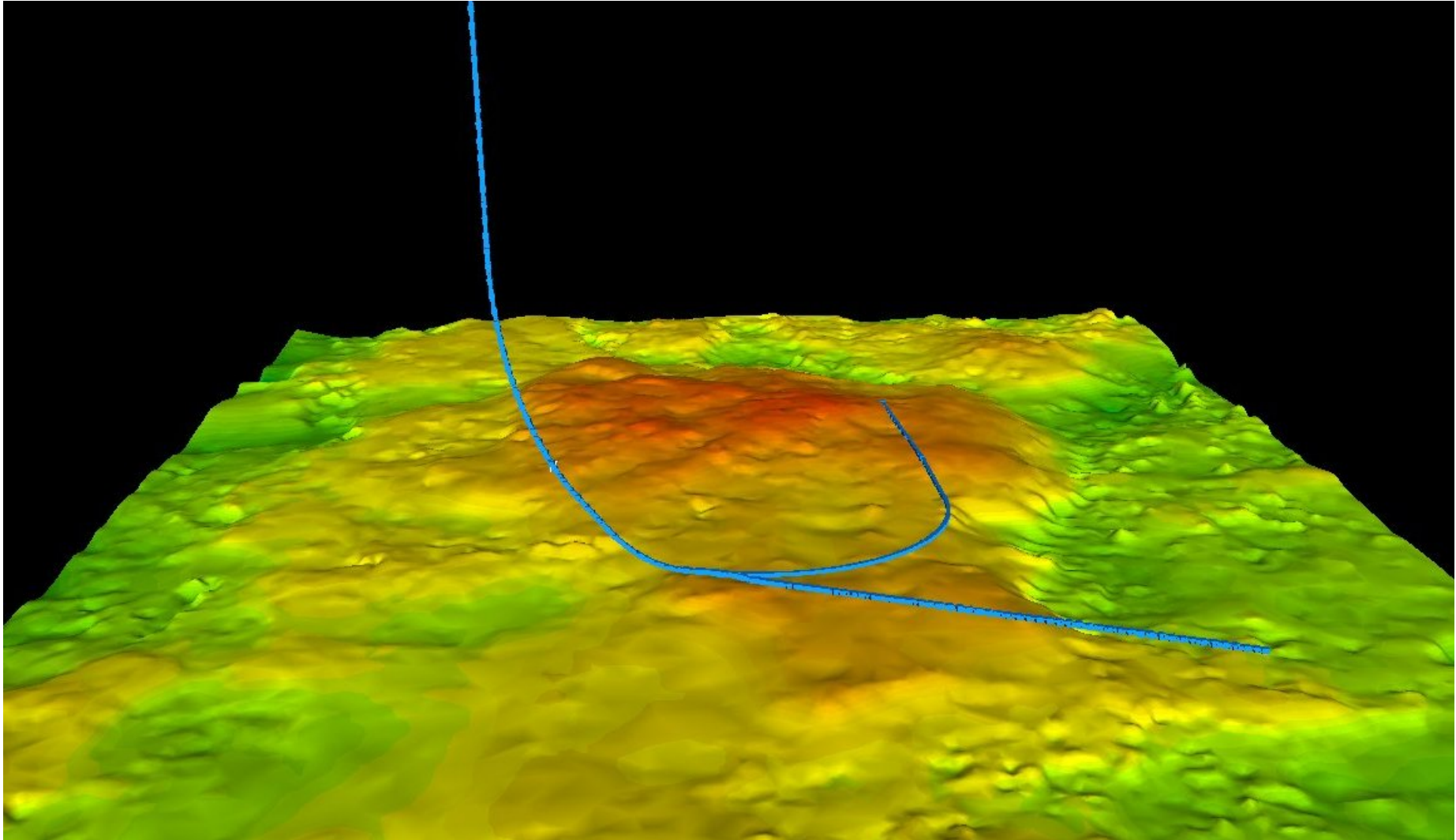
- When any of the error model disturbance limits are exceeded:
 - A sms and an e-mail is transmitted to service companies.
 - The Survey Management engineer evaluates the situation og gives recommendations to the offshore rig sites.



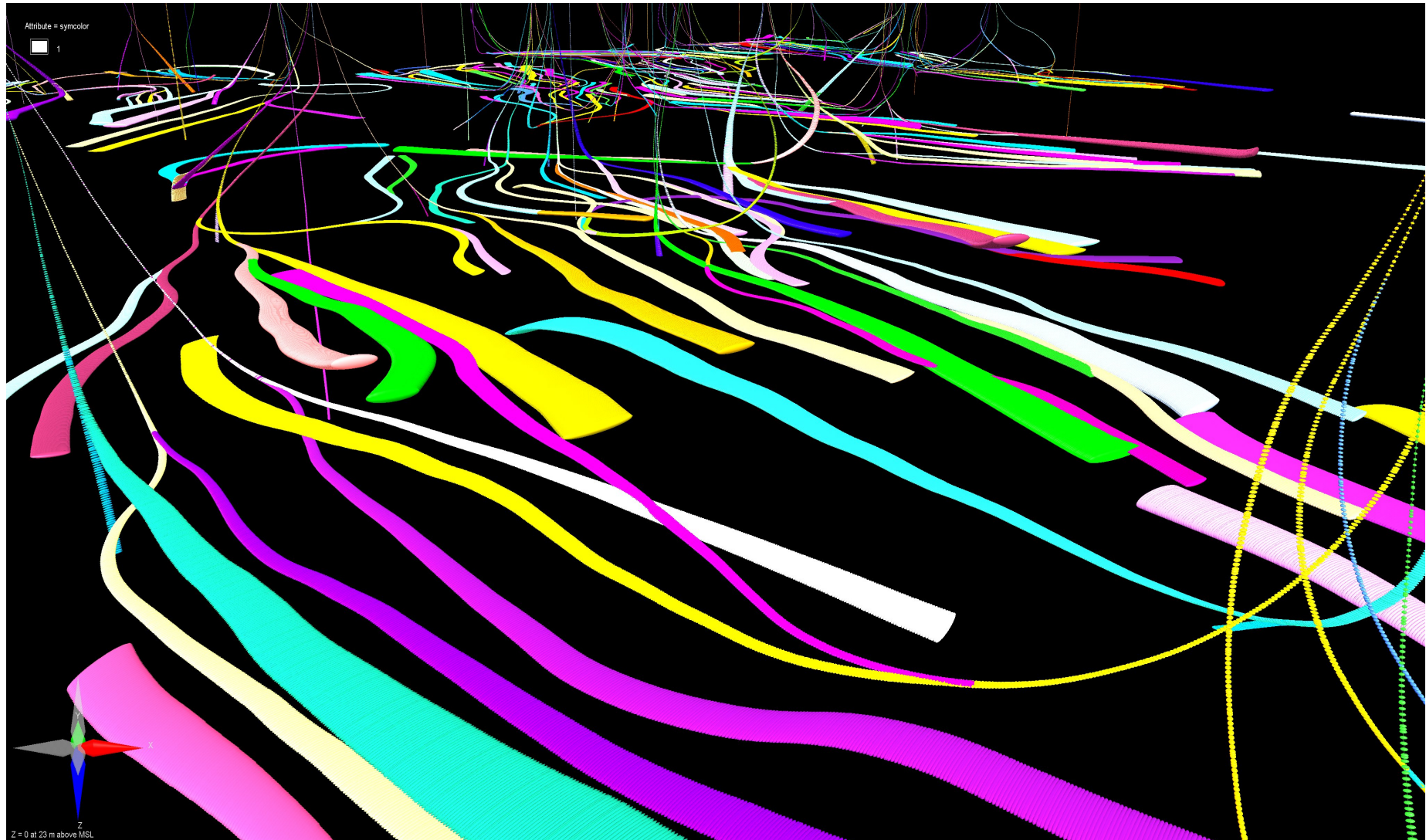
Why Deal with the Disturbance Field

- It is necessary to manage such disturbances to have directional control while drilling.
 - Hit the geological target and maximize the recovery
 - Avoid other wells
- Survey QC tests may identify an out of spec condition, and monitoring of the field can differentiate between tool failure and field disturbance.
 - Avoid unnecessary pull outs
- Accurate monitoring may allow correction for disturbance effects.

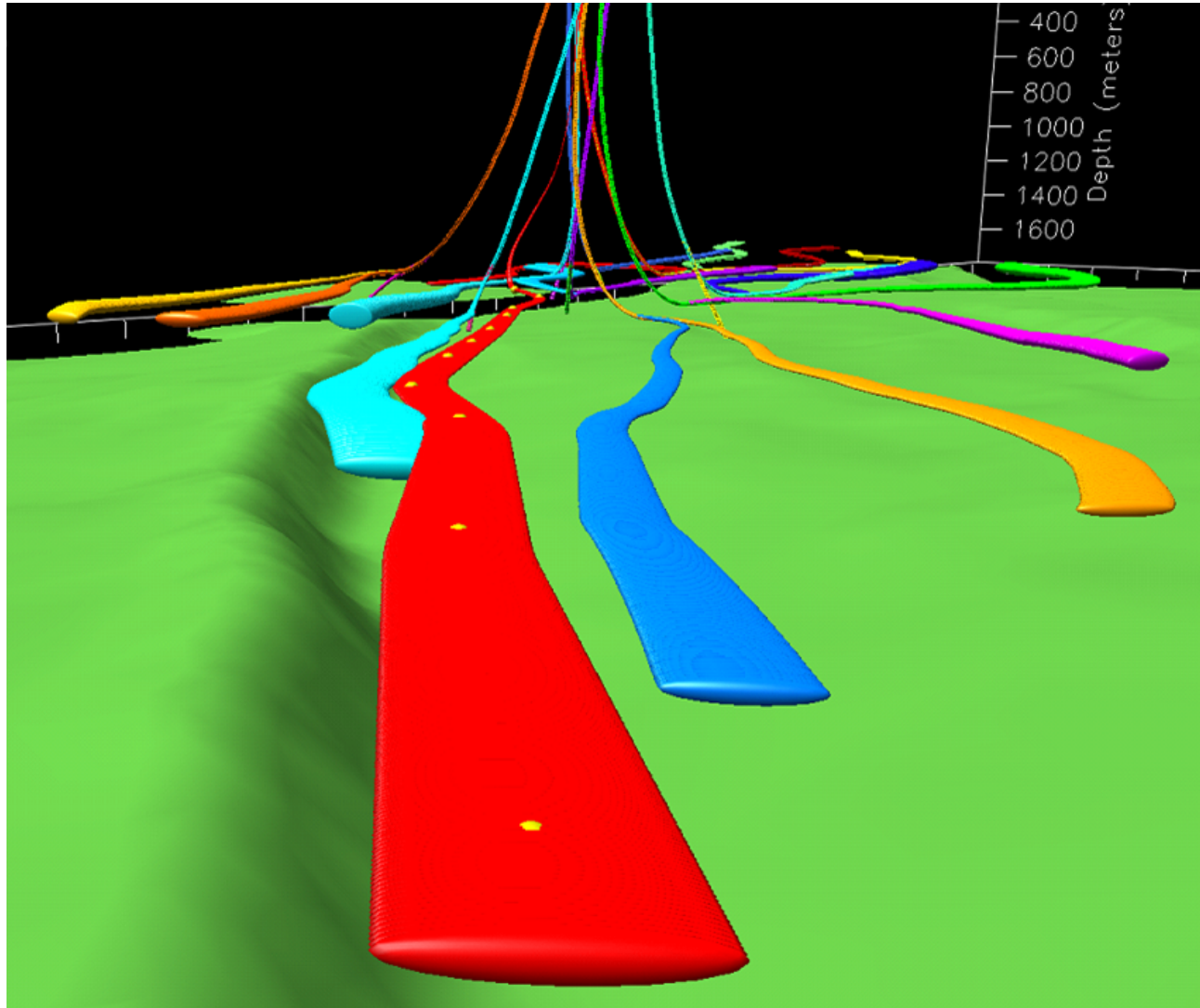
Hit the Geological Target



Avoid Other Wells




Maximize the Recovery



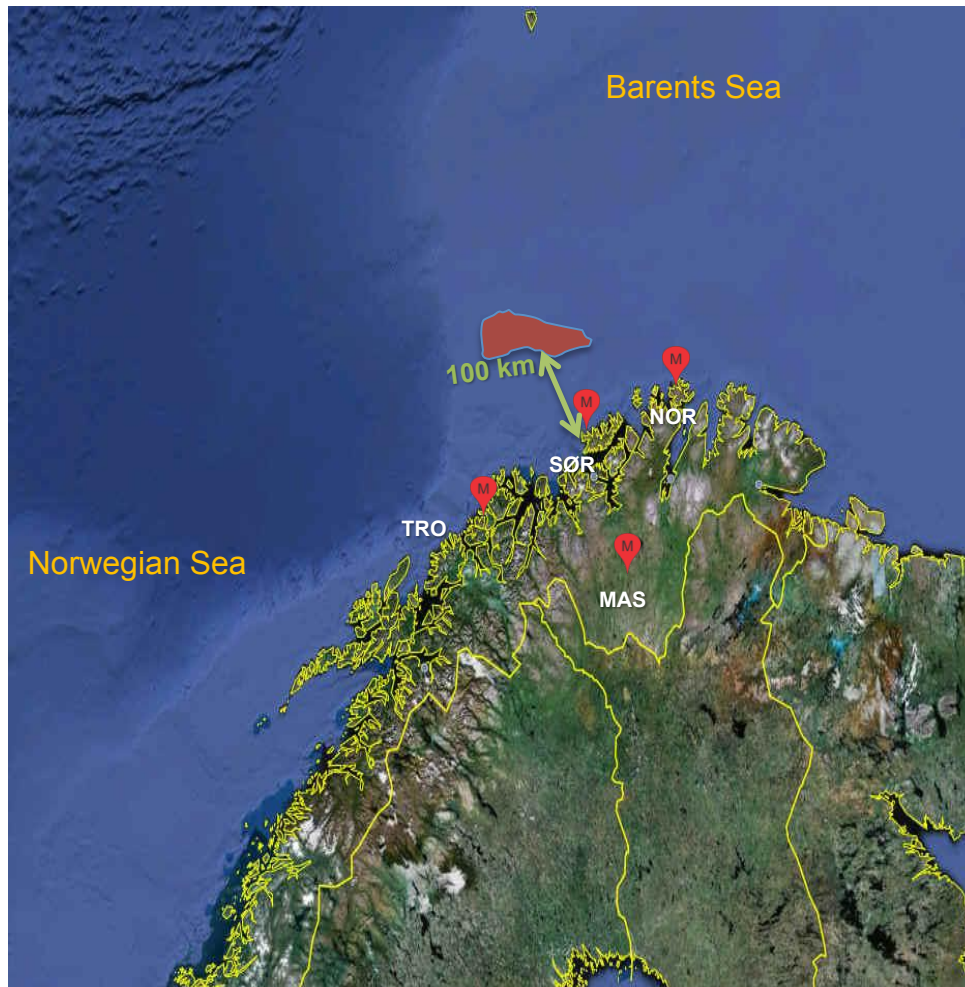
Monitoring in the Norwegian Sea



 - Monitoring Station (Variometer)

 - Oil & Gas Fields

Monitoring in the Barents Sea



- Monitoring Station (Variometer)

- Oil & Gas Fields

Conclusions

- To have directional control while drilling is important for several reasons:
 - Hit the geological target
 - Maximize the recovery
 - Avoid other wells
 - Avoid unnecessary pull outs
- Monitoring the external magnetic field is vital for achieving this.

Thank You for Listening

