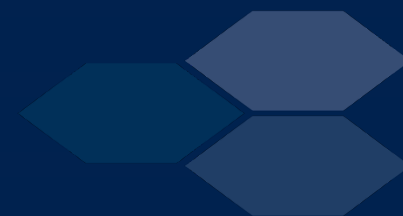




Syddjurs vandråd

25 oktober 2023

Prosjektleder / Geolog
Per Gissel Gisselø



Hvad skal vi snakke om

- SkyTEM
 - Virksomhed
 - Teknologi
- Fra geofysik til vandværk
 - Eksempel fra Varde
- Djursland
 - SkyTEM data fra 2023



SkyTEM's mission

To provide knowledge about the earth beneath our feet, supporting more sustainable solutions

At tilvejebringe informationer om Jorden under vores fødder til hjælp for bæredygtige løsninger

SkyTEM – Virksomhenden

- Geofysisk virksomhed etableret som spin-off fra Aarhus Universitet i 2004
- Specialiseret i helikopterbårne elektromagnetiske målinger
- Cirka 40% af danmarks areal er dækket med SkyTEM målinger
- Omfattende udviklingsaktiviteter



Formål

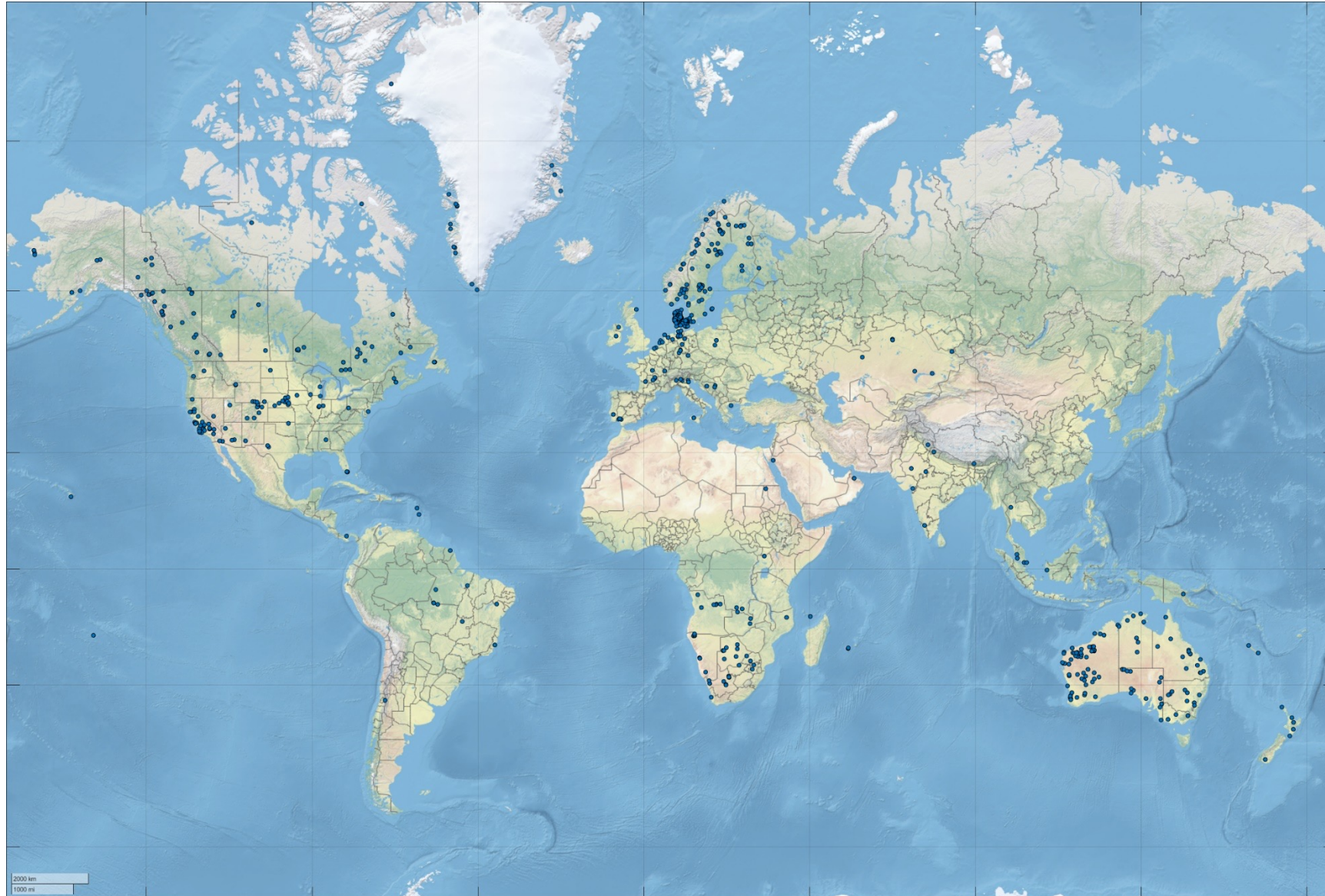
- **Hvad laver vi:** Indsamler elektromagnetiske og magnetiske data fra helikopter og i fremtiden fra droner
- **Produktet:** Høj kvalitets geofysiske data og kortprodukter til underbyggelse af arbejde med geologisk tolkning
- **Værdi:**
 - 3D kortlægning af naturlige ressourcer som grundvand og mineraler
 - Karakterisering af geologiske forhold i forbindelse med grundvandsbeskyttelse og geotekniske undersøgelser

Global tilstedeværelse

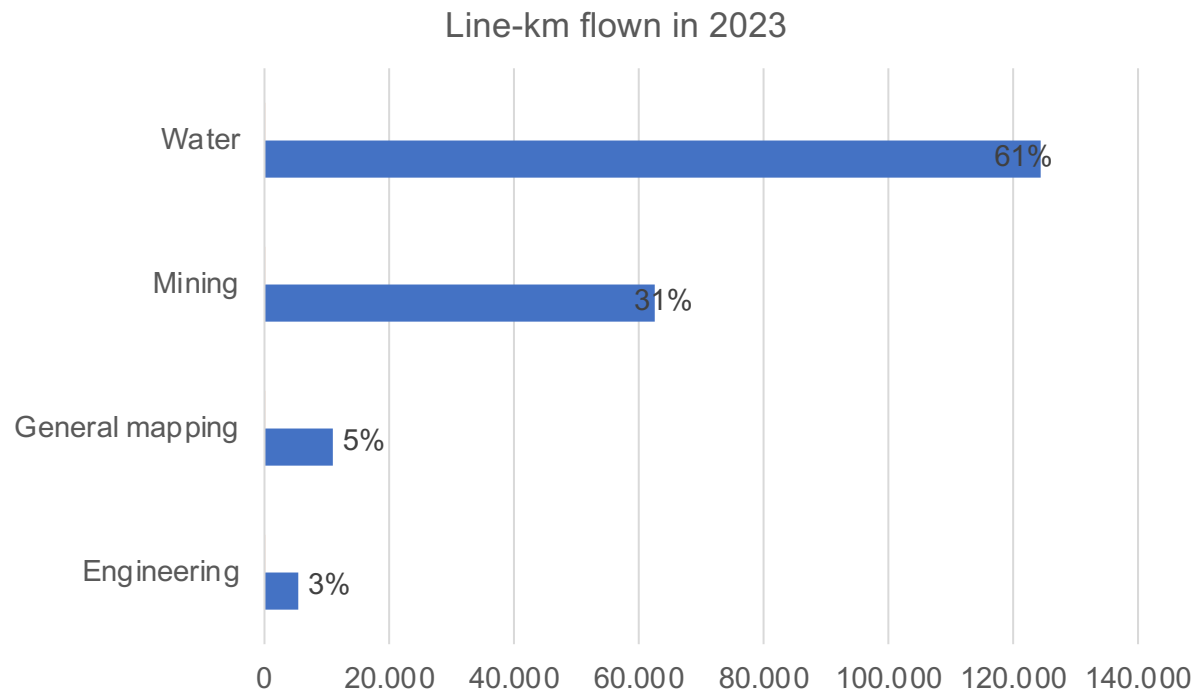
- 70+ ansatte rundt i verden
- Lokale kontorer og partnerskaber
- Vi afsøger hele tiden nye markeder



Projekter



Forretningsfordeling



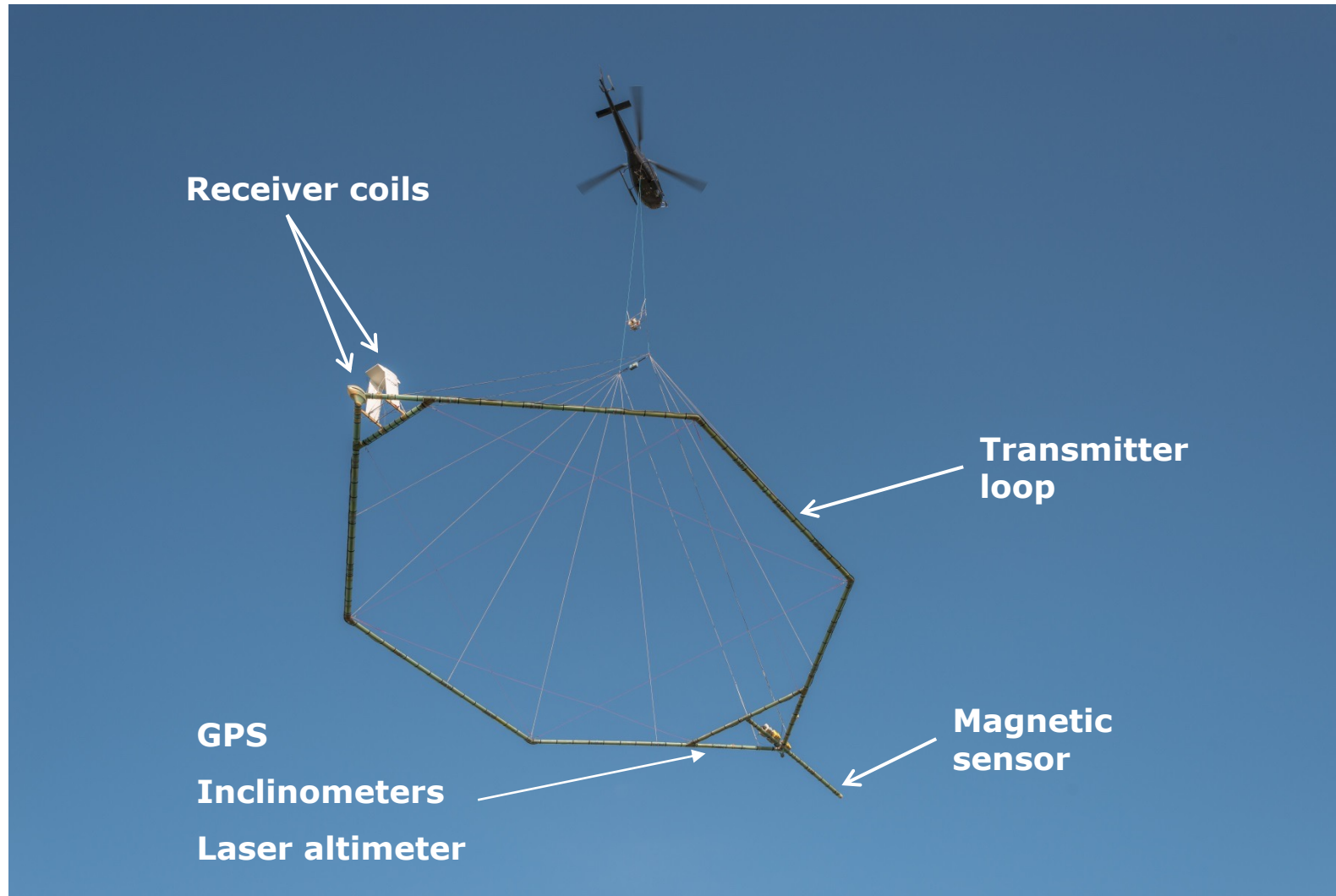
- **Engineering:**
 - Geotekniske forundersøgsler
- **General mapping:**
 - Geologisk kortlægning
- **Mining:**
 - Mineral efterforskning
- **Water:**
 - Grundvandskortlægning



Hvad skal vi snakke om

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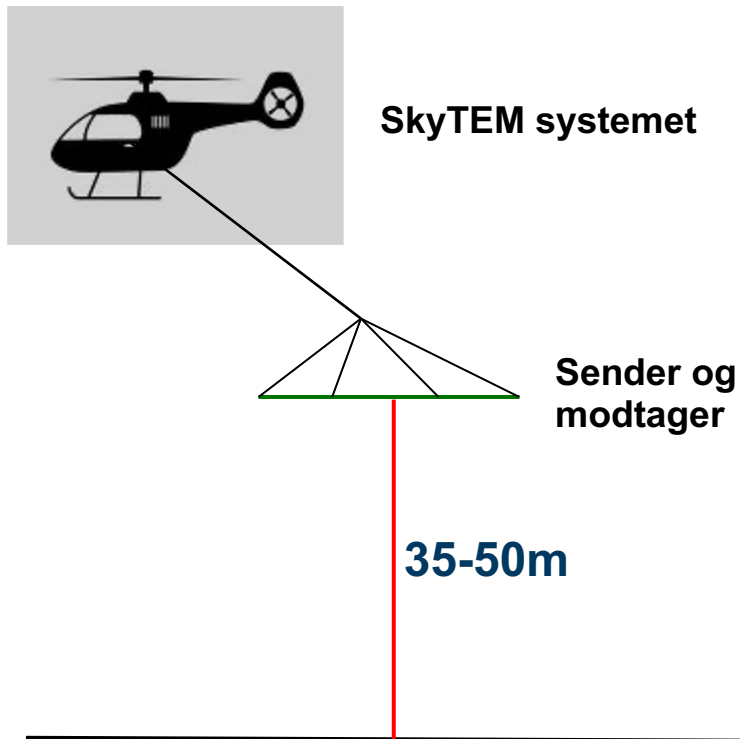
SkyTEM systemet



SkyTEM systemet



SkyTEM systemet

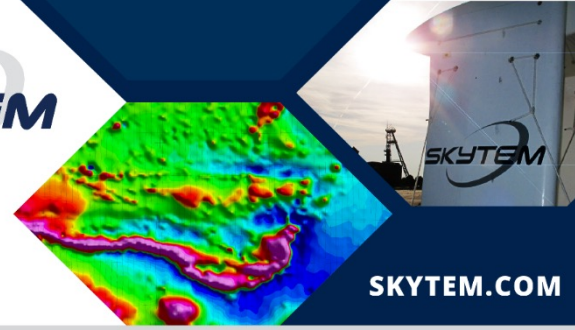


- Hastighed 60-150 km/t
- Flyvetid: 2 til 3 timer
- Kan følge terrænet
- TEM og magnetisk

SKYTEM SYSTEMS

OPTIMISED FOR YOUR
EXPLORATION TARGETING NEEDS

SKYTEM



SKYTEM.COM

SKYTEM

01

SKYTEM304

**SUPERIOR HIGH
NEAR-SURFACE EXPLORATION**
*Water, Mineral Exploration
& Geotechnical*

FEATURES

- Compact rigid frames
342 m² transmitter area
- Up to 150,000 NIA
- High Moment (HM) and Low Moment (LM) data
- Very fast Low Moment (LM) turn-off time
- High signal-to-noise ratio (SNR)
- Up to 120 kph
- Deliver accurate data from the top few metres to depths of ~200 m

BENEFITS

- Superior high near-surface resolution
- **ULTIMATE** discriminator in subtle conductivity contrasts

02

SKYTEM312

NEAR-SURFACE & DEEP EXPLORATION
*Water & Mineral Exploration
(well suited for regional mapping)*

FEATURES

- Compact rigid frames
342 m² transmitter area
- Up to 500,000 NIA
- High Moment (HM) and Low Moment (LM) data
- High signal-to-noise ratio (SNR)
- Up to 150 kph (312 FAST)
- Deliver accurate data from the top few metres to depths of ~500 m

BENEFITS

- High near-surface resolution and depth of investigation
- Improved characterisation of deeper geology
- More economical

03

HIGH POWER

SKYTEM306 HP

NEAR-SURFACE & DEEP EXPLORATION
*Water & Mineral Exploration
(well suited for regional mapping)*

FEATURES

- Compact rigid frames
342 m² transmitter area
- Up to 500,000 NIA
- High Moment (HM) and Low Moment (LM) data
- SkyTEM's breakthrough MultiMoment receiver
- High signal-to-noise ratio (SNR)
- B-field
- Up to 150 kph (306HP FAST)
- Deliver accurate data from the top few metres to depths of ~500 m

BENEFITS

- High near-surface resolution and depth of investigation
- Improved characterisation of deeper geology
- More economical

04

HIGH POWER

SKYTEM312 HP

DEEP EXPLORATION
*New fully fledged Mineral
Exploration system*

FEATURES

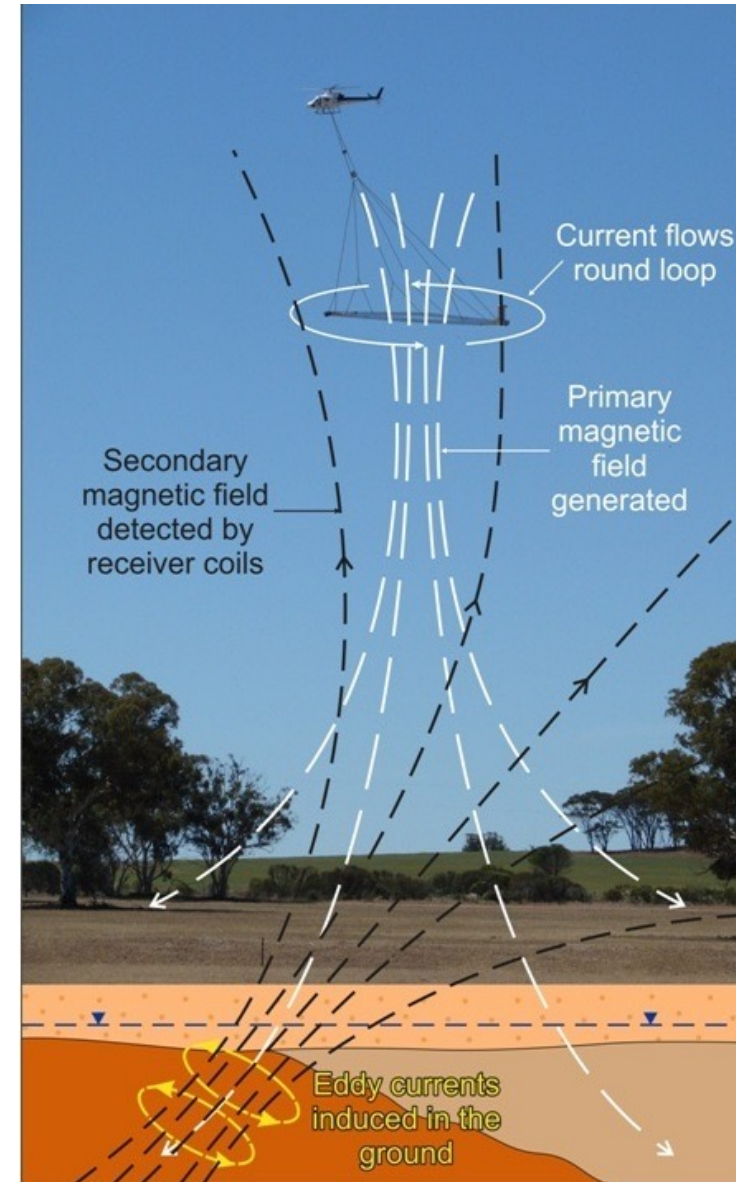
- Compact rigid frames
342 m² transmitter area
- Highly powerful, up to 1,000,000 NIA
- High Moment (HM) and Low Moment (LM) data
- SkyTEM's breakthrough MultiMoment receiver
- Low base frequency (12.5/15 Hz) to measure extended late off-time data
- Outstanding late time signal-to-noise ratio (SNR)
- B-field
- Up to 80 kph
- Verified down to depths of +700 m

BENEFITS

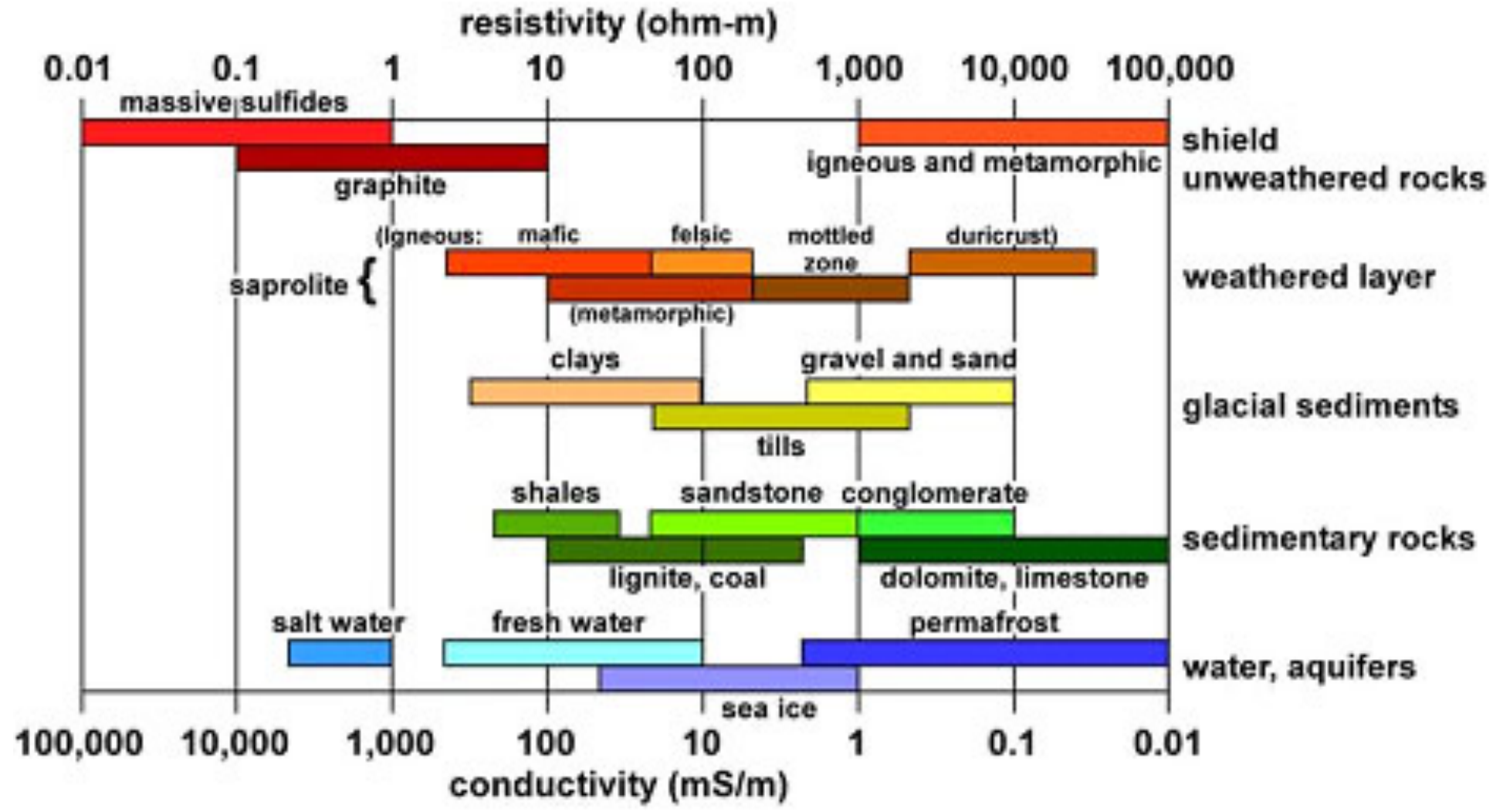
- Penetrates thicker and higher conductivity overburden
- Improved characterisation of both deeper and highly conductive geology

Electromagnetisme (EM)

- Faraday's lov for **induktion**
- Kortlægger undergrundens subsurface **electriske ledningsevne / modstand**
- Dybdeindtrægning **0-800 meter**

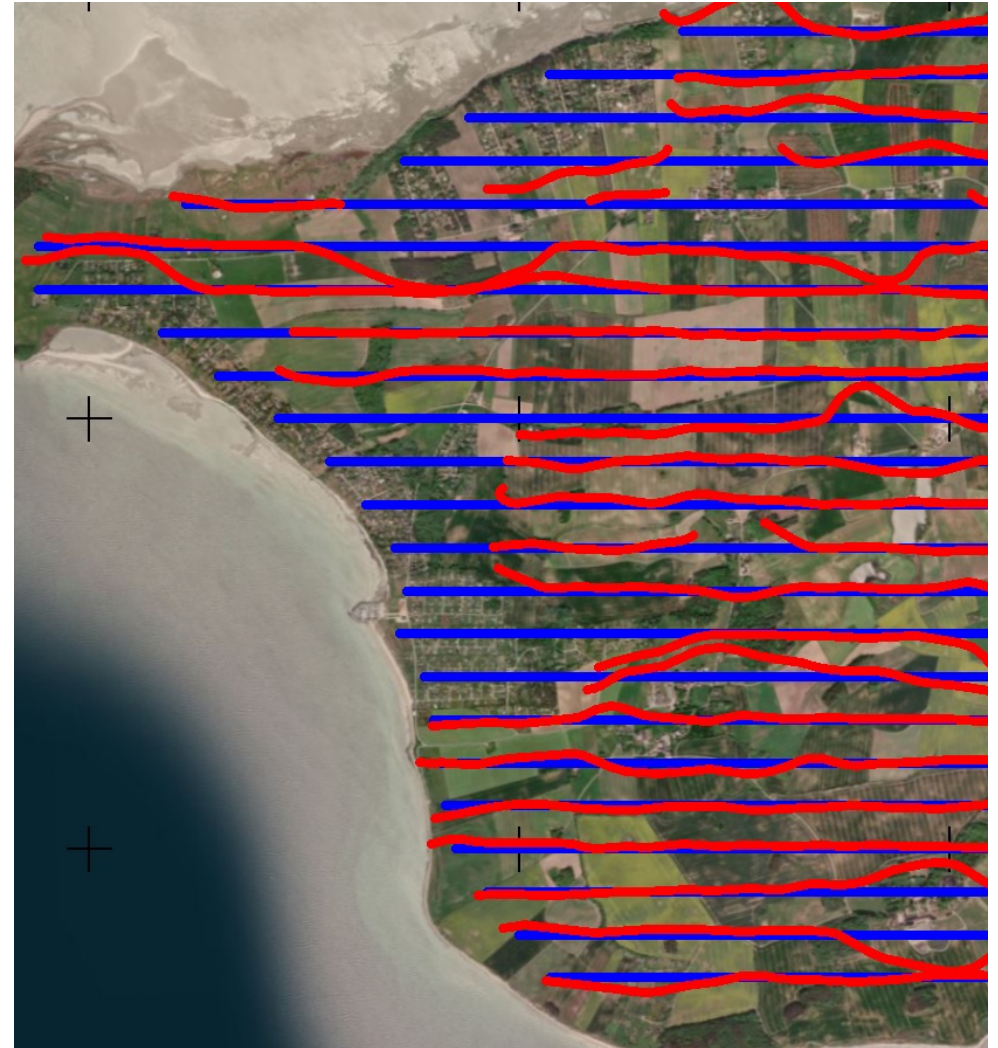


Resistivitets / konduktivitets værdier

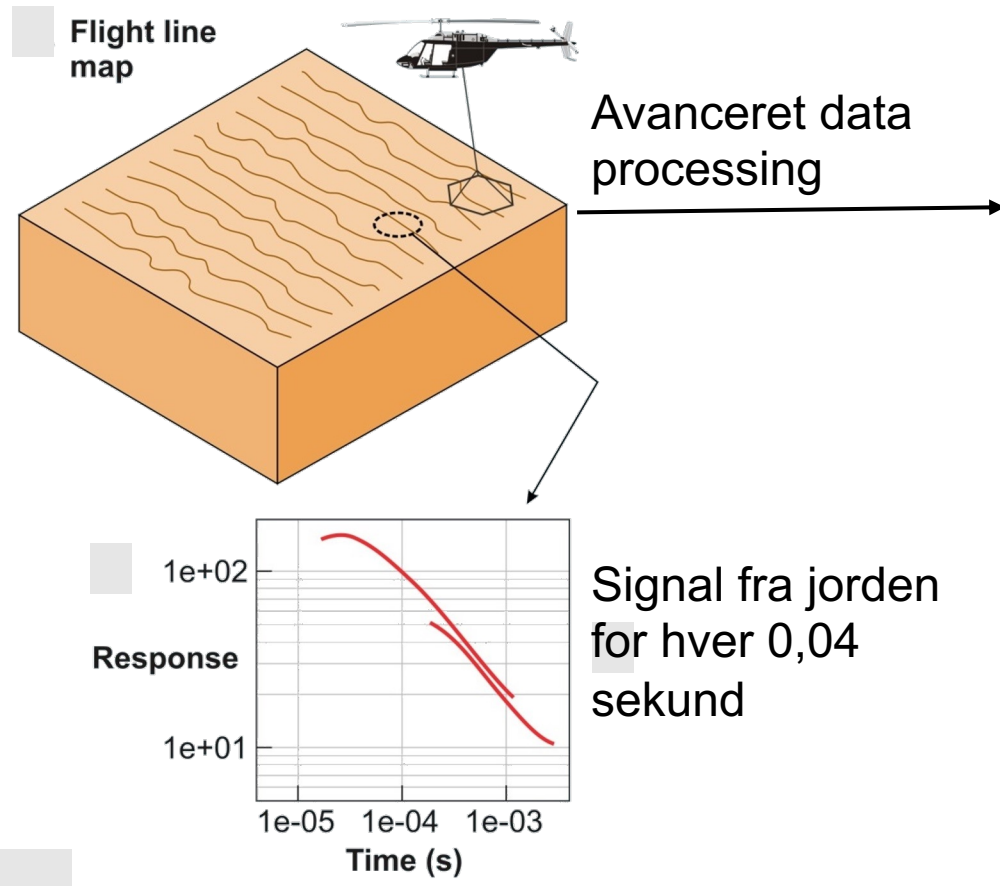


Operationelle hensyn

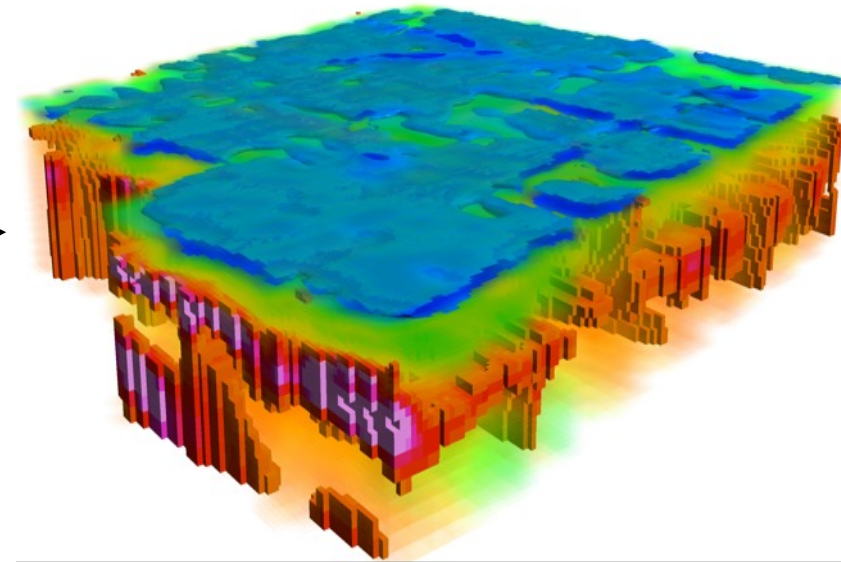
- Linieafstand mellem 100 og 250 meter
- Bebyggelse må ikke overflyves
- Ikke parallelt med højspæningsledninger – påvirker 100 til 200 meter væk
- Daglig produktion på 200 til 300 km



Data tolkning



3D modstandsmodel





Hvad skal vi snakke om

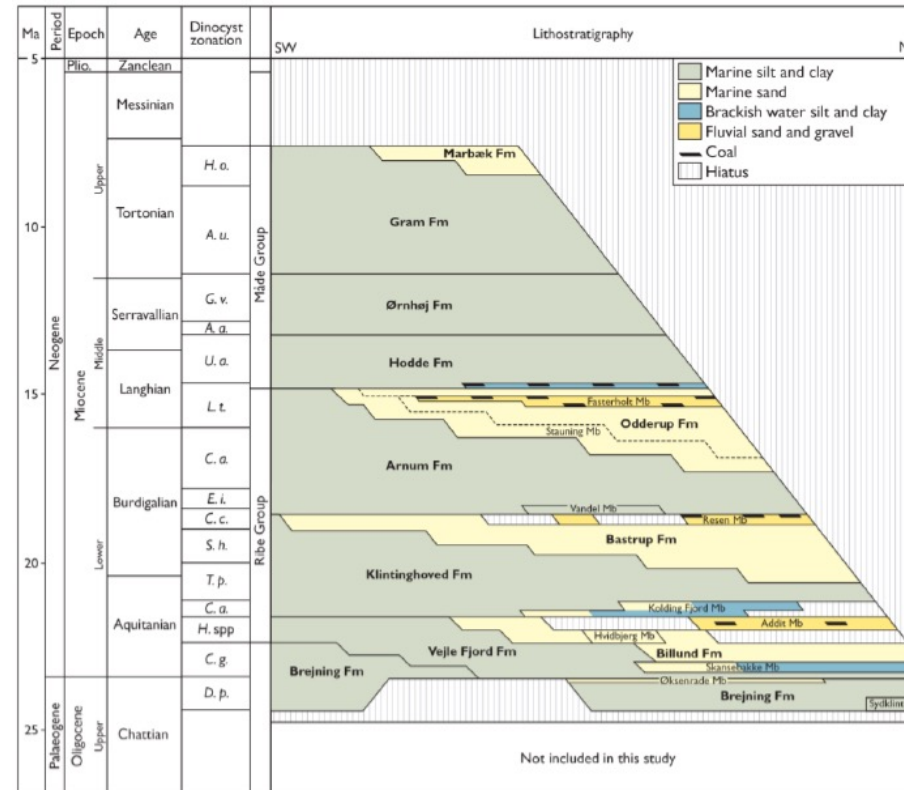
- SkyTEM
 - Virksomhed
 - Teknologi
- Fra geofysik til vandværk
 - Eksempel fra Varde
- Djursland
 - SkyTEM data fra 2023

Outline

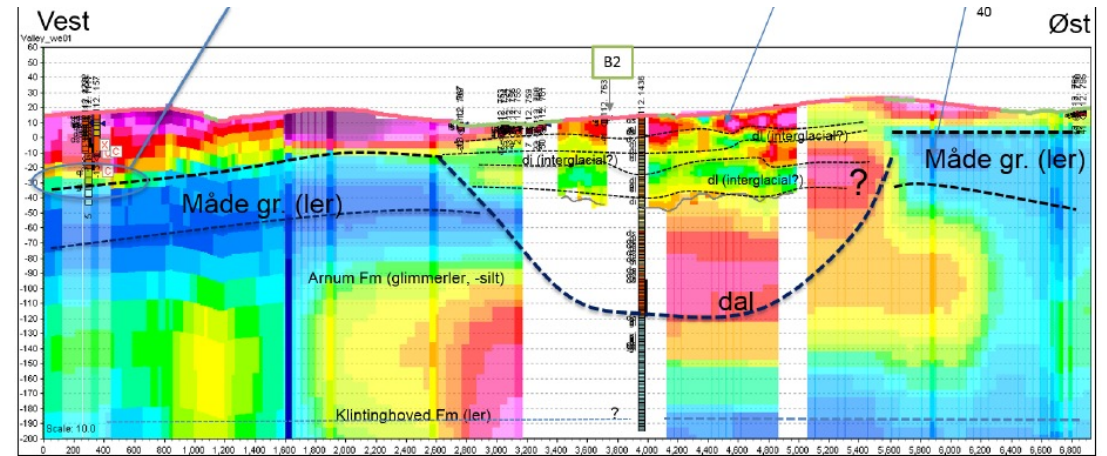
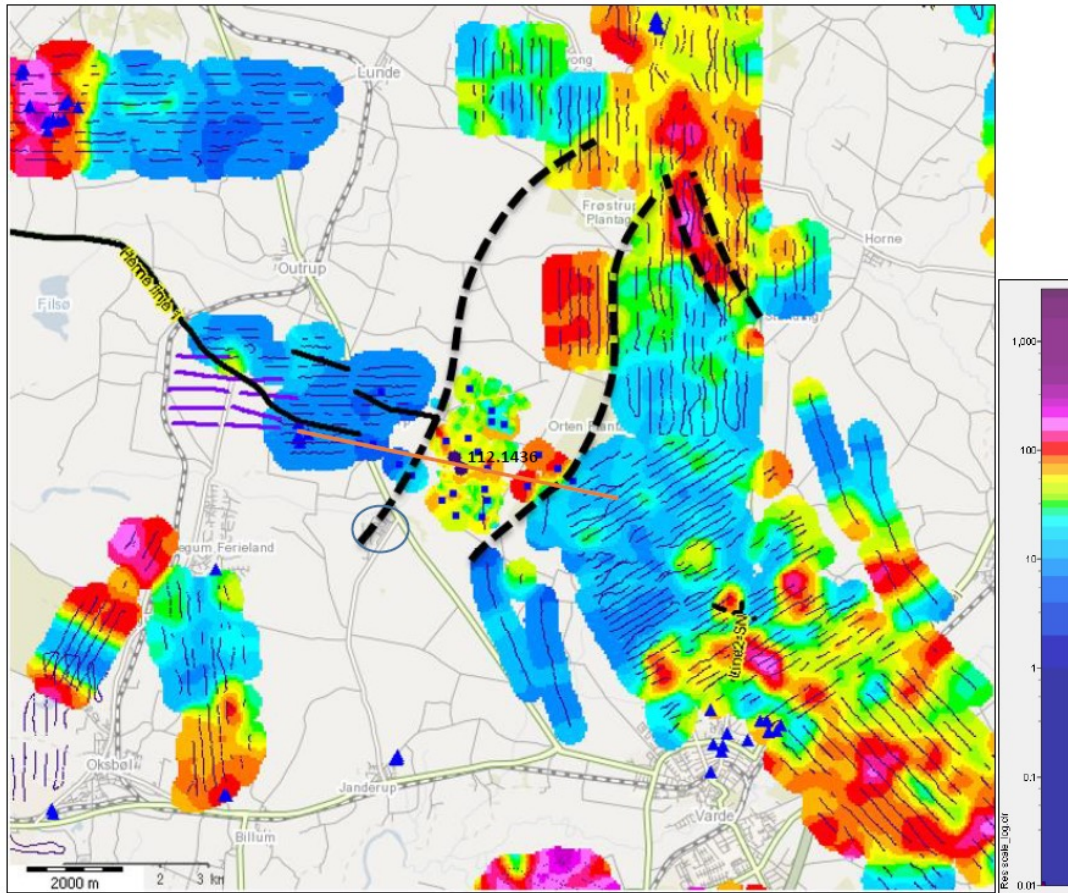
- Regional geologi
- Geofysiske data
- Grundvandsindvinding og klimascenarier
- Etablering af vandværk

Regional geologi

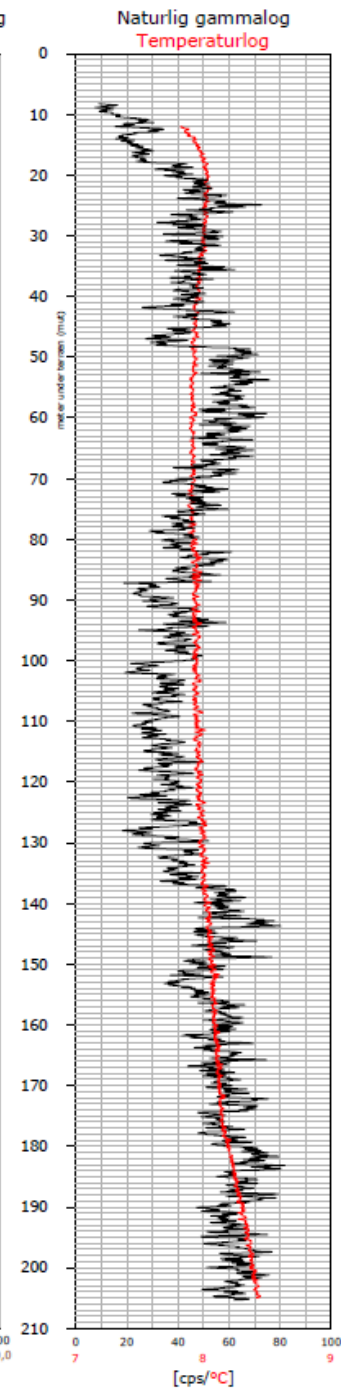
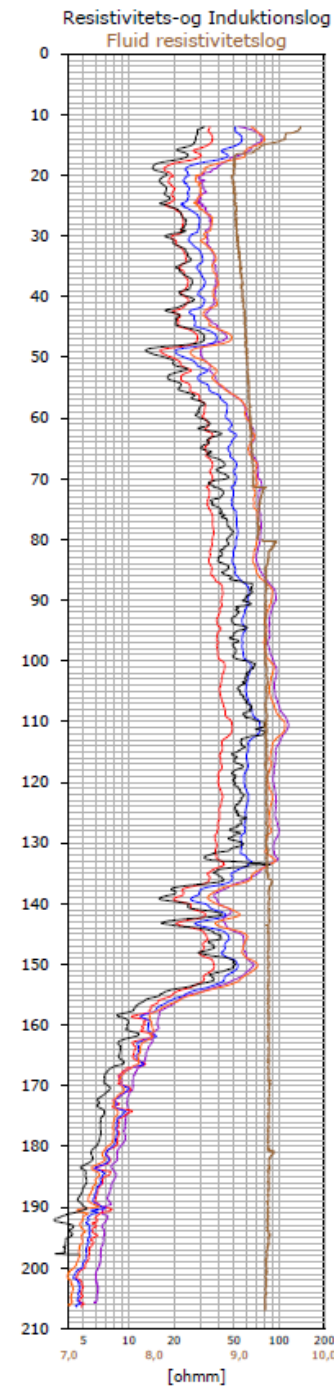
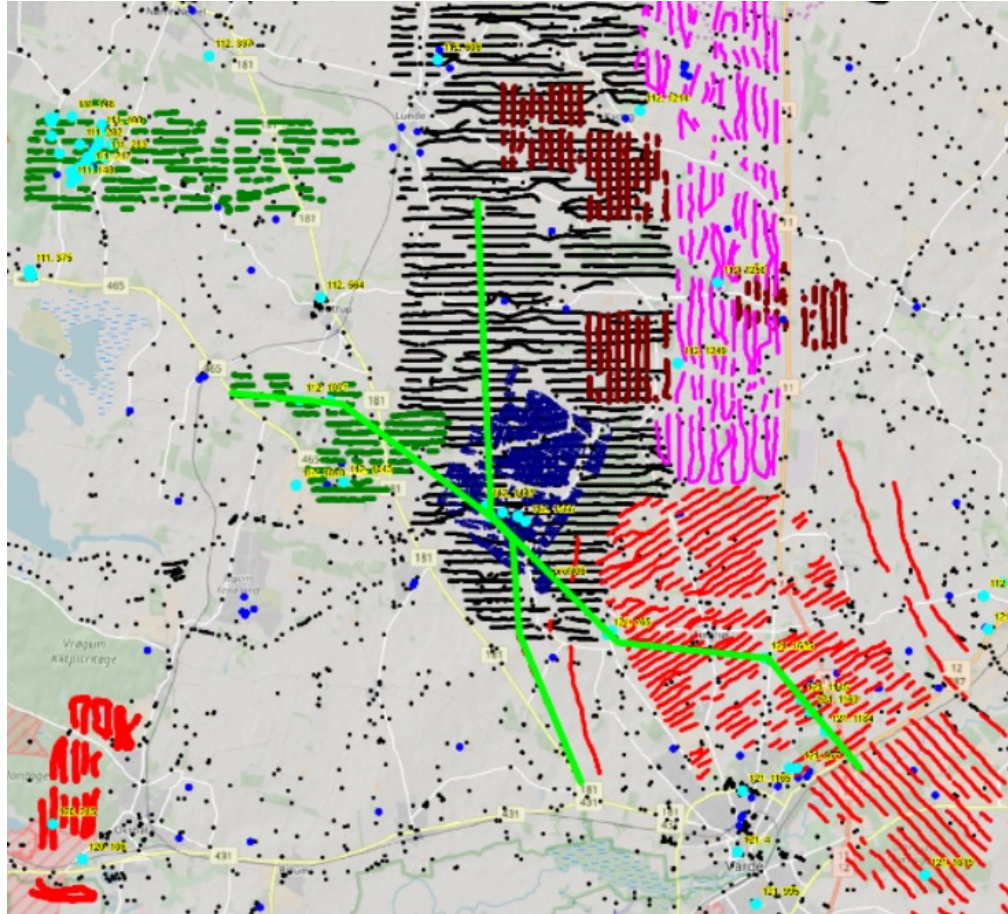
- Miocæne aflejringer
 - Ler rig Måde Gruppe
 - Ler og silt domineret Arnum Formation
- Kvartære aflejringer
 - Glaciale aflejringer
 - Glacial deformation af Miocæne aflejringer

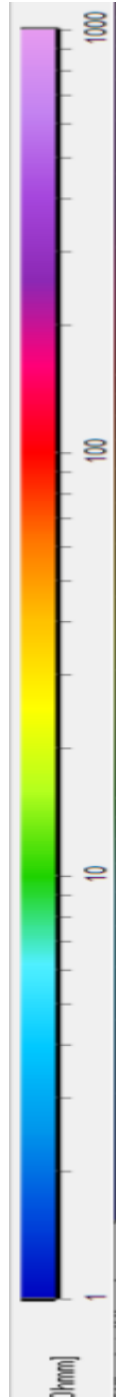
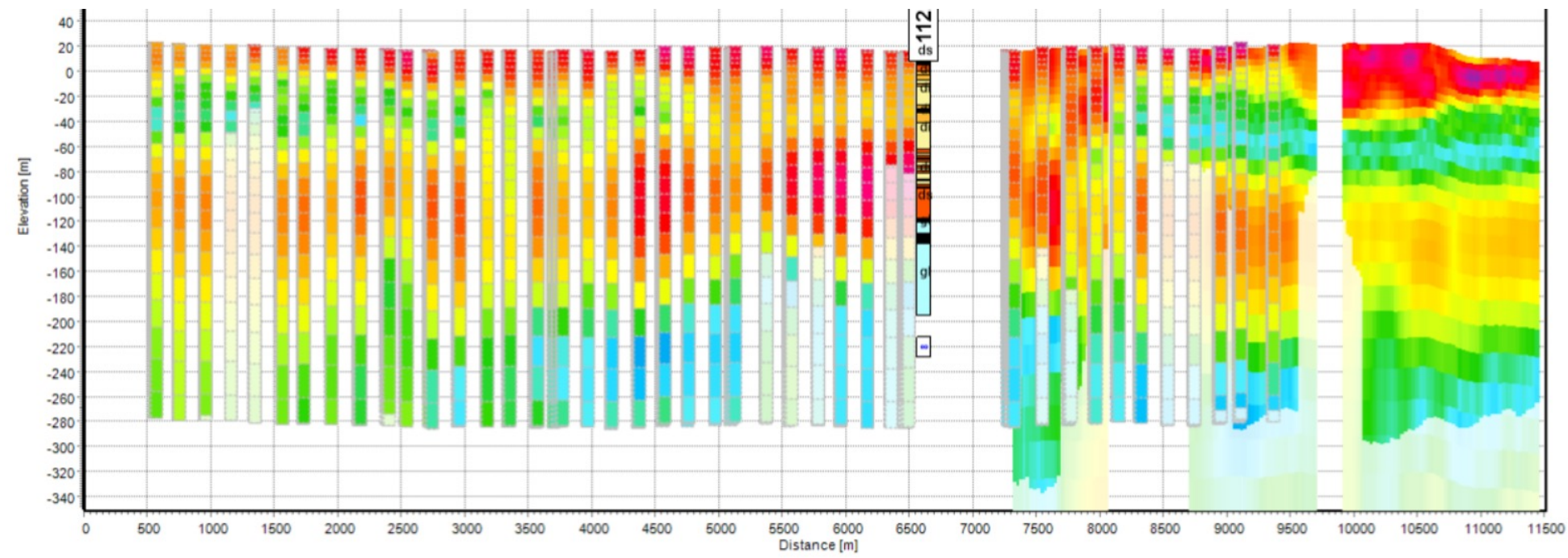
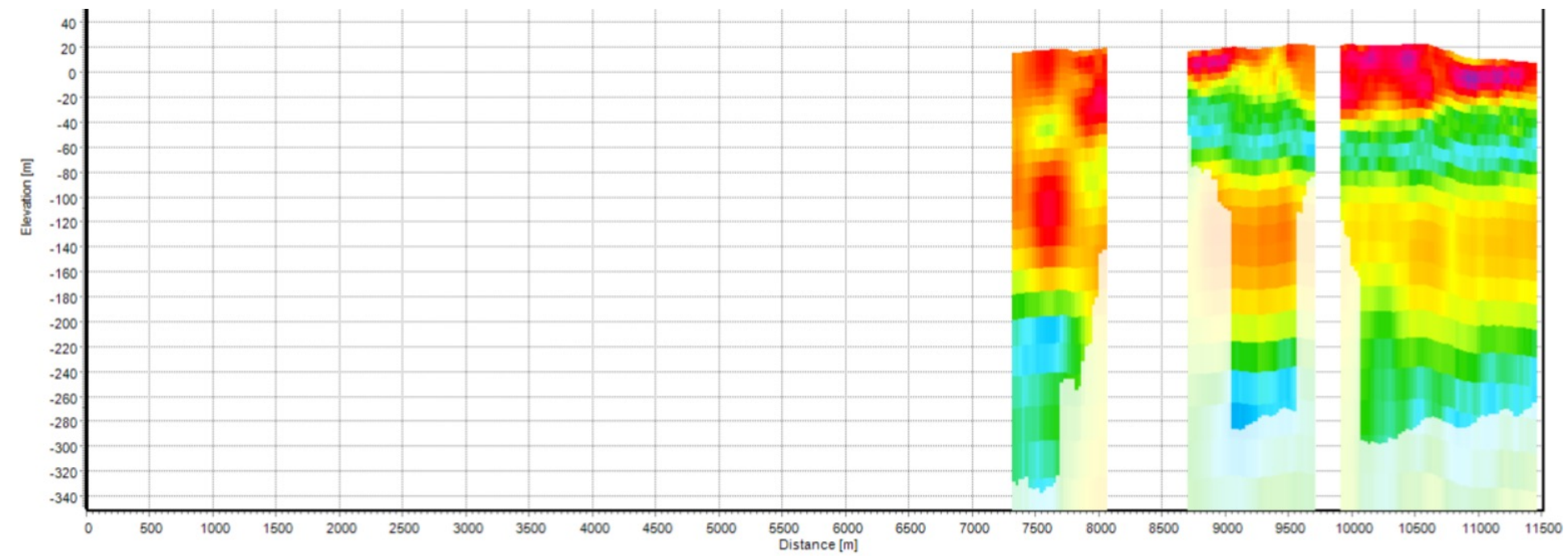


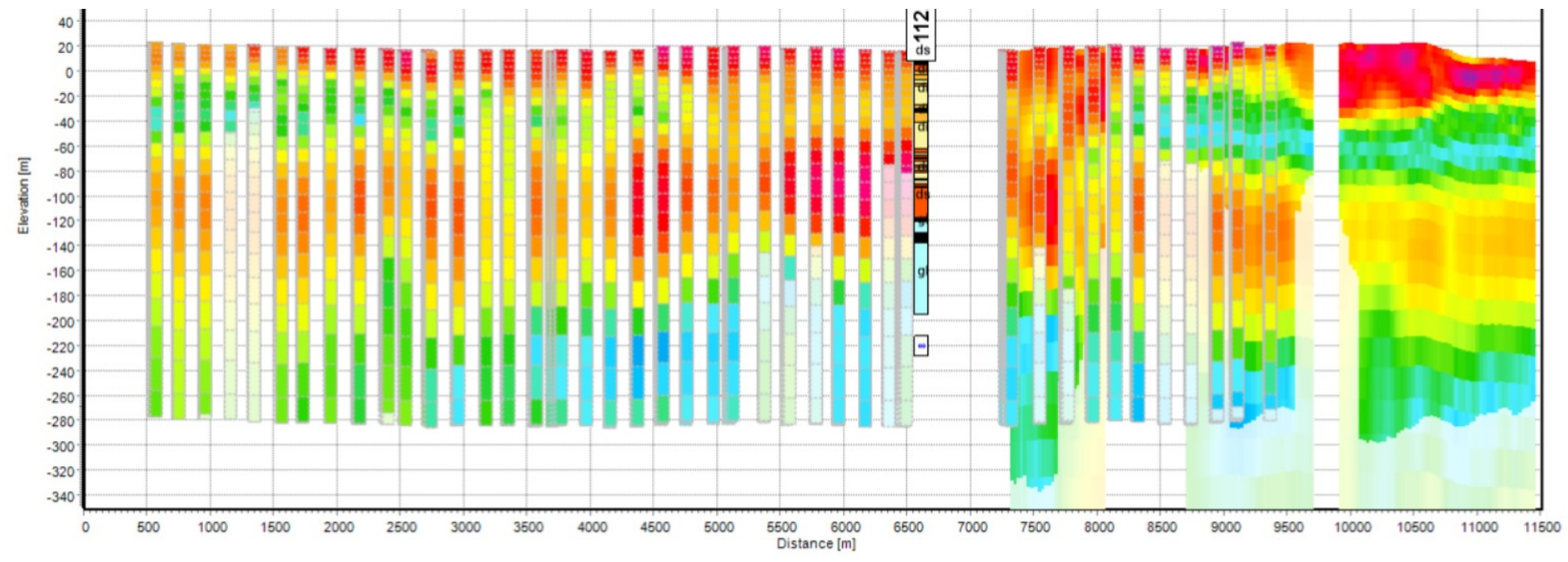
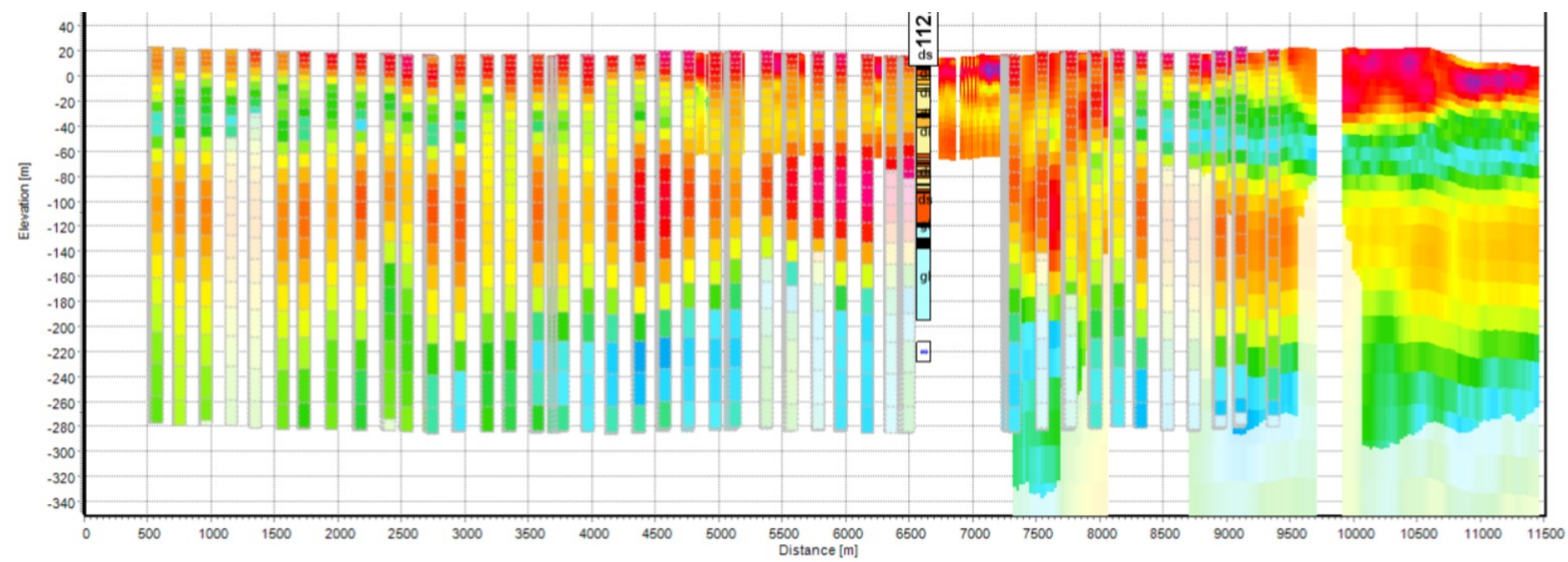
Geofysiske data

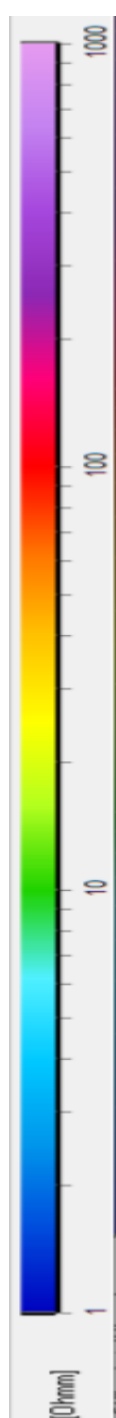
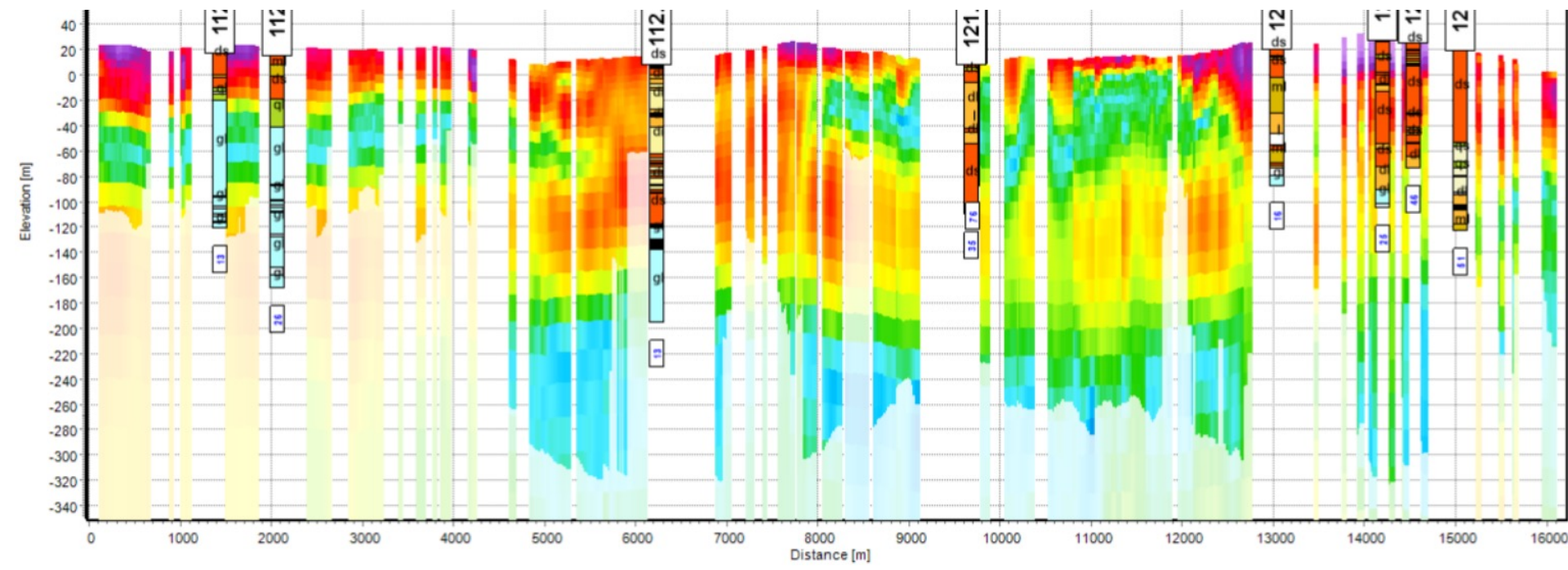
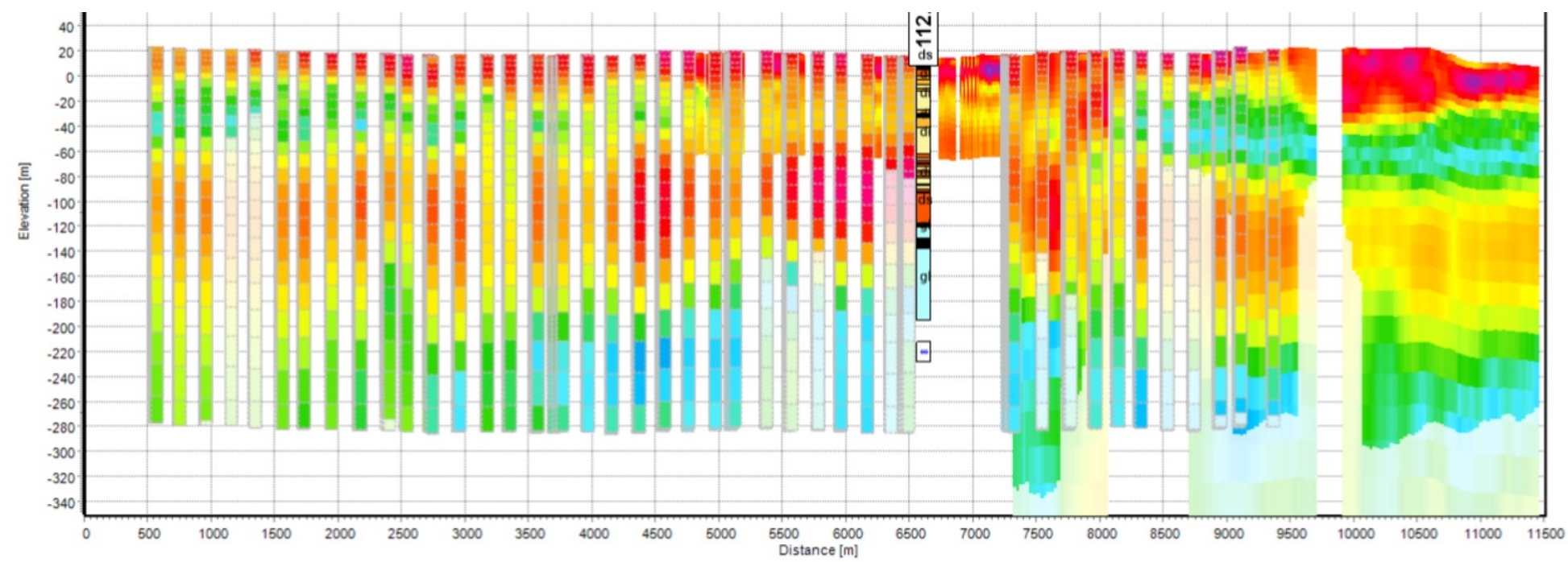


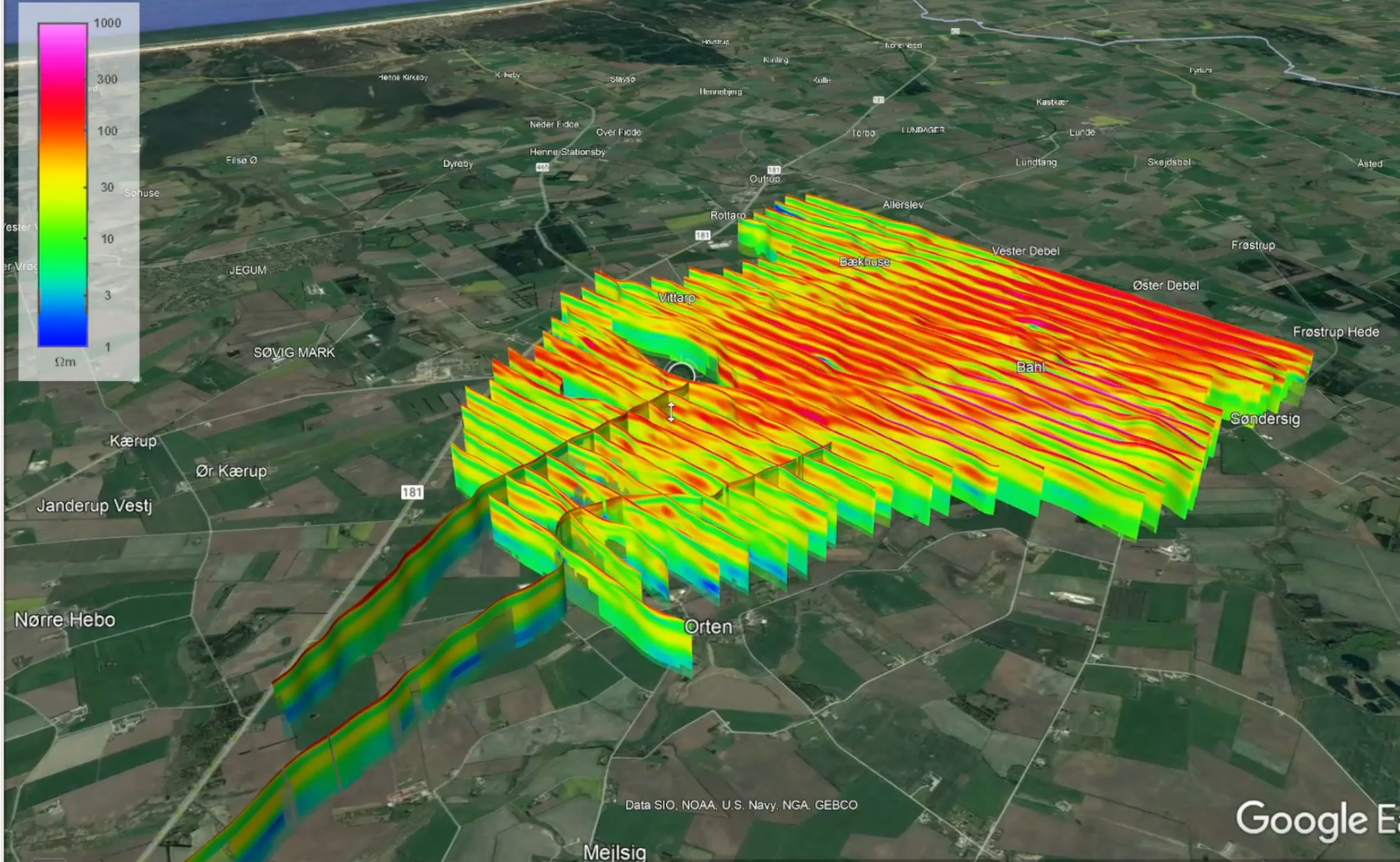
Geofysiske data





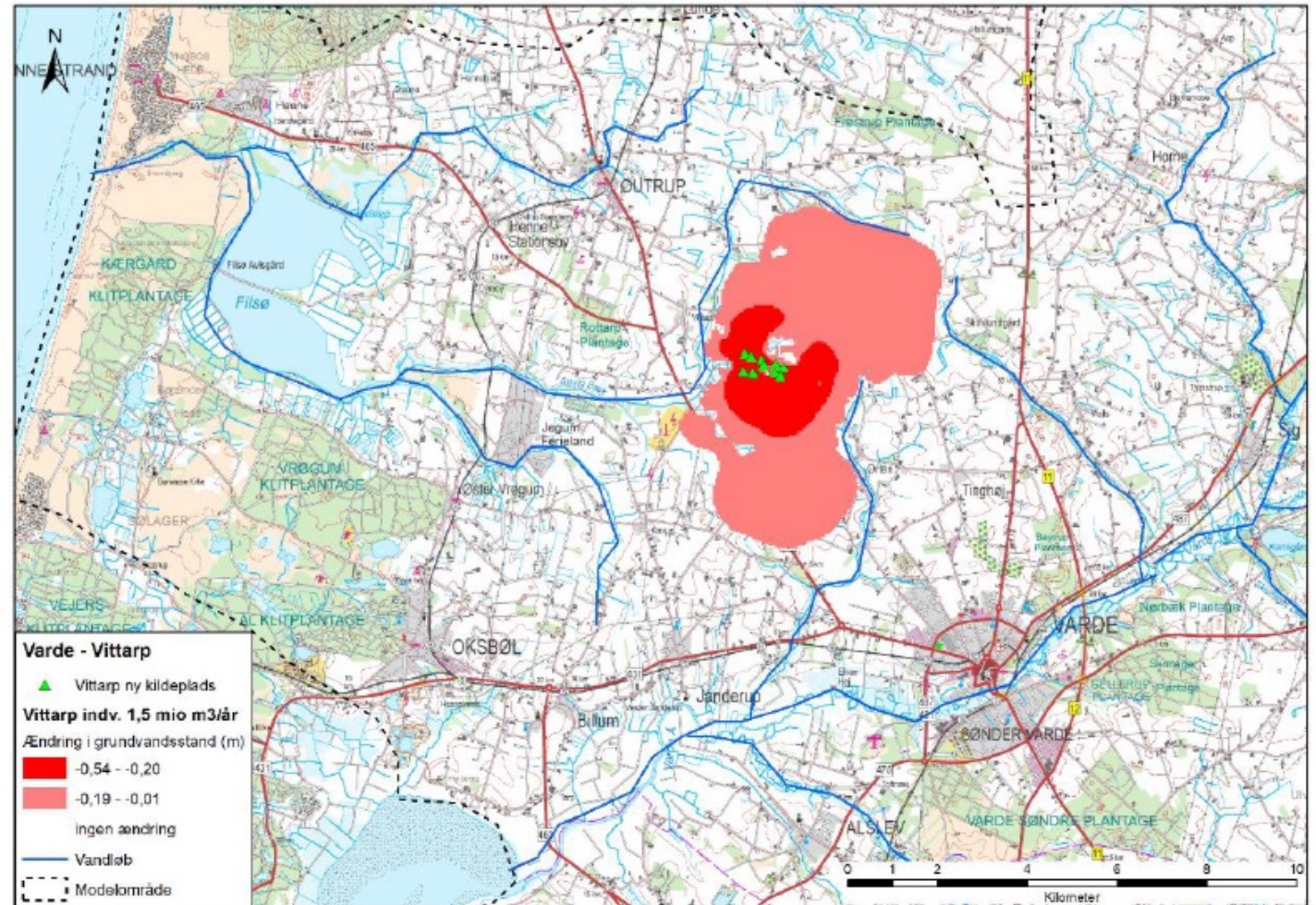






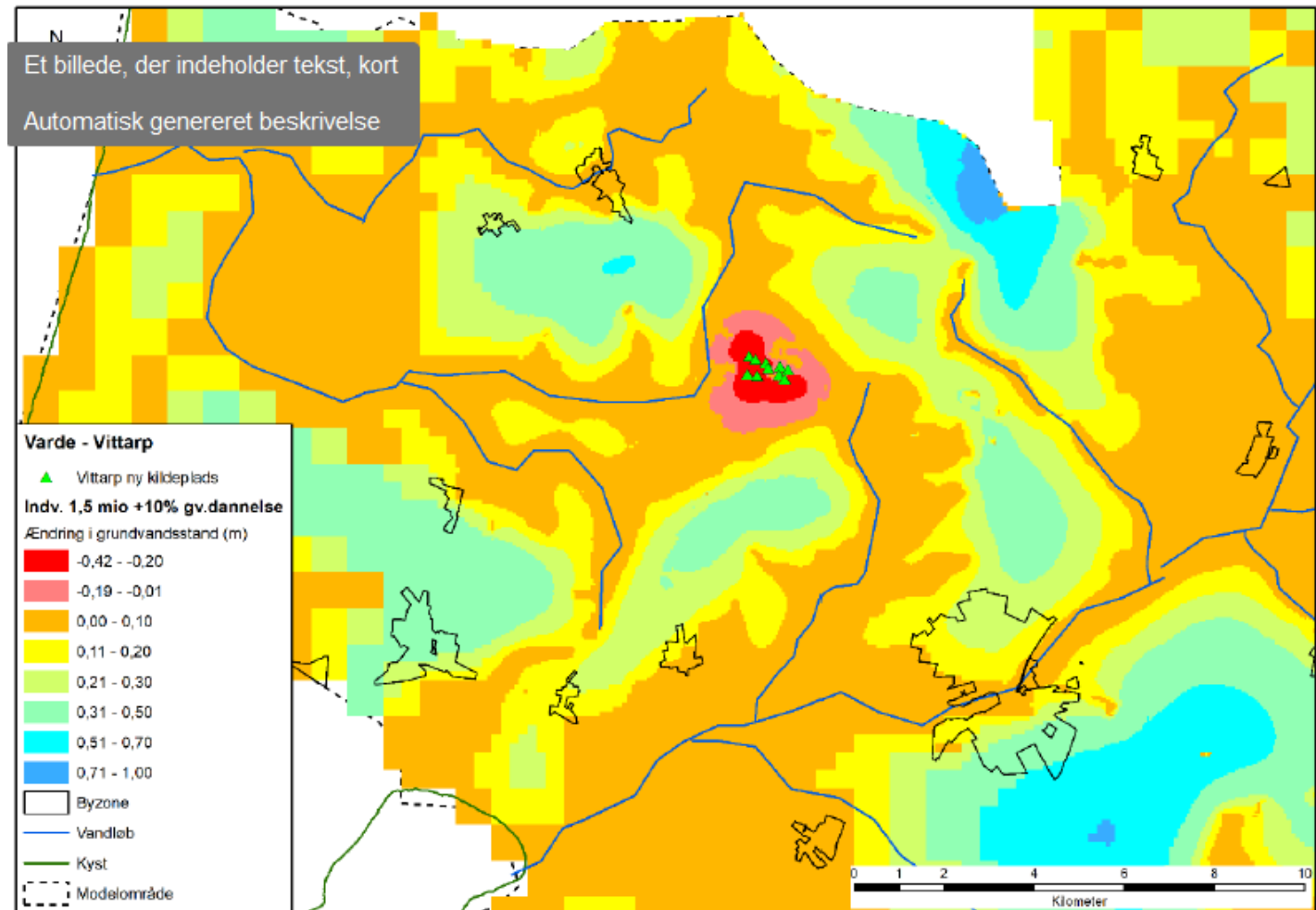
Grundvandsindvinding og klimascenarier

- Indvinding af 1.5 Mio. m³ grundvand pr. år.
- Indvinding fra 100 m under terræn
- Sænkning af grundvandsniveau er mindre end 55 cm



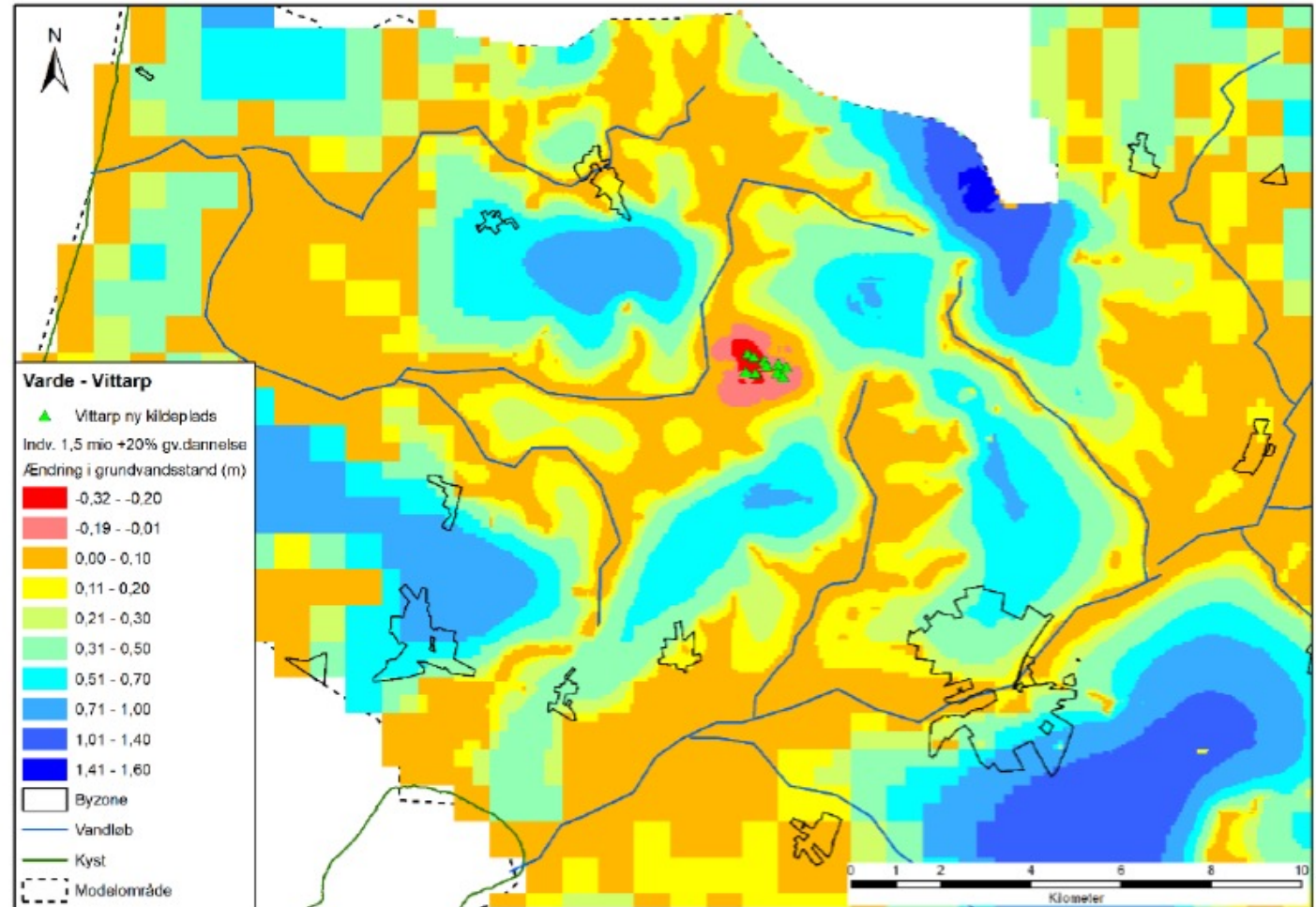
Grundvandsindvinding og klimascenarier

- Indvinding af 1.5 Mio. m³ grundvand pr. år.
- Indvinding fra 100 m under terræn
- 10 % øget grundvandsdannelse på grund af øget regnfald
- Sænkning af grundvandsniveau er mindre end 40 cm

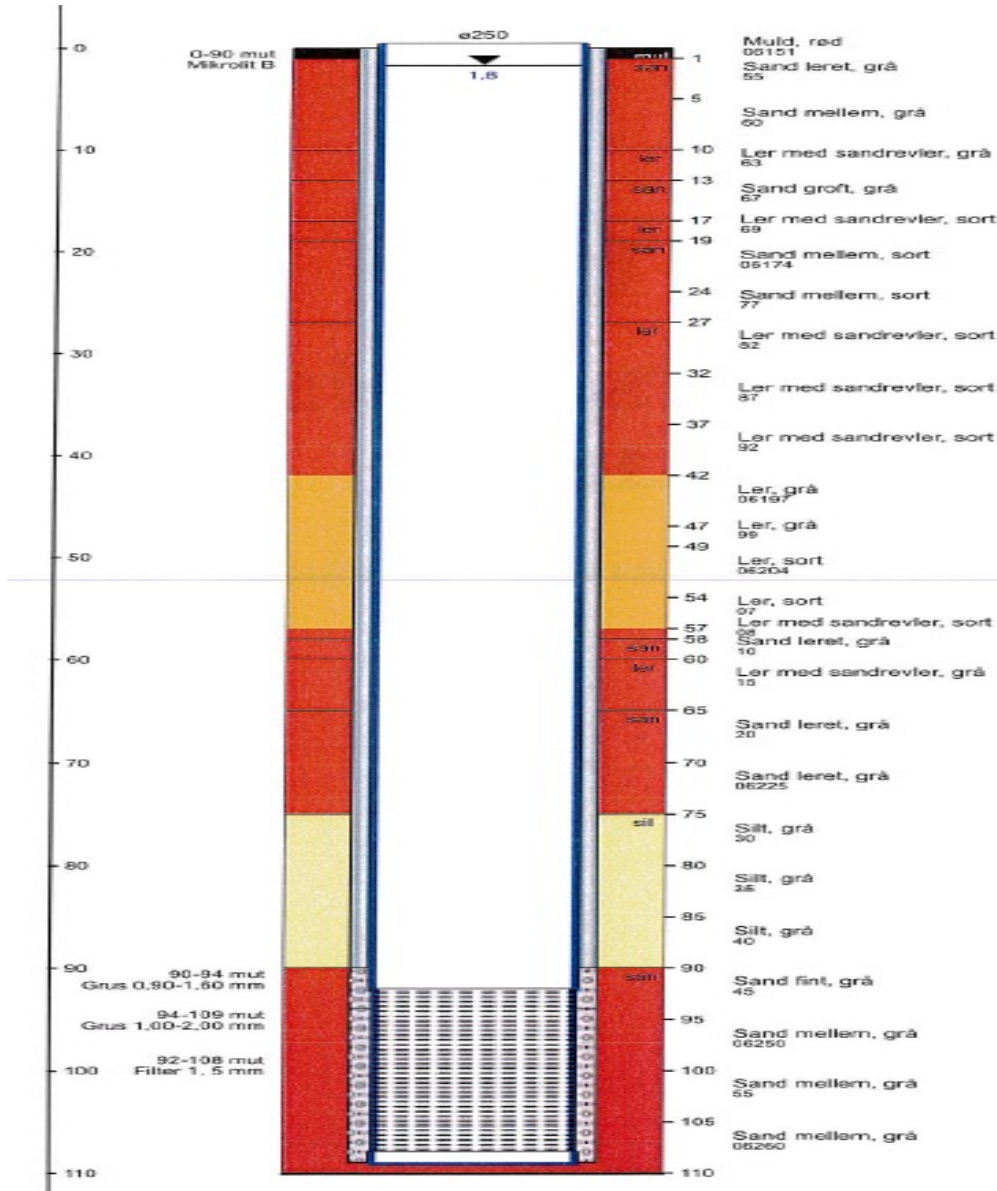


Grundvandsindvinding og klimascenarier

- Indvinding af 1.5 Mio. m³ grundvand pr. år.
- Indvinding fra 100 m under terræn
- 20 % øget grundvandsdannelse på grund af øget regnfald
- Sænkning af grundvandsniveau er mindre end 30 cm



Etablering af udvindingsboring

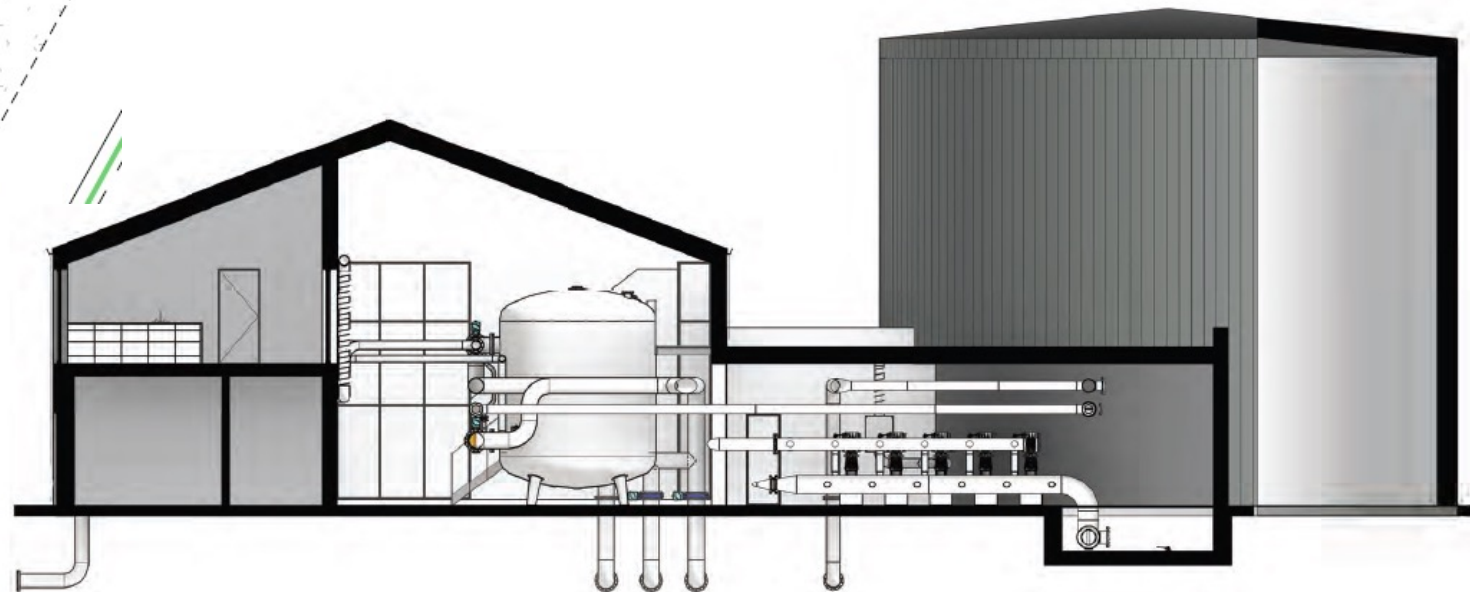
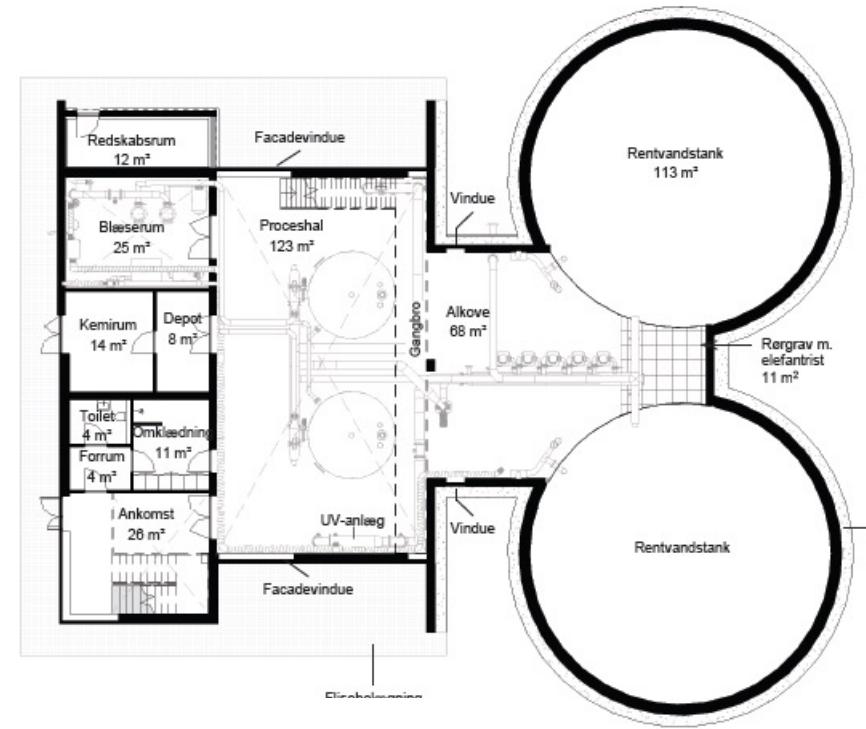
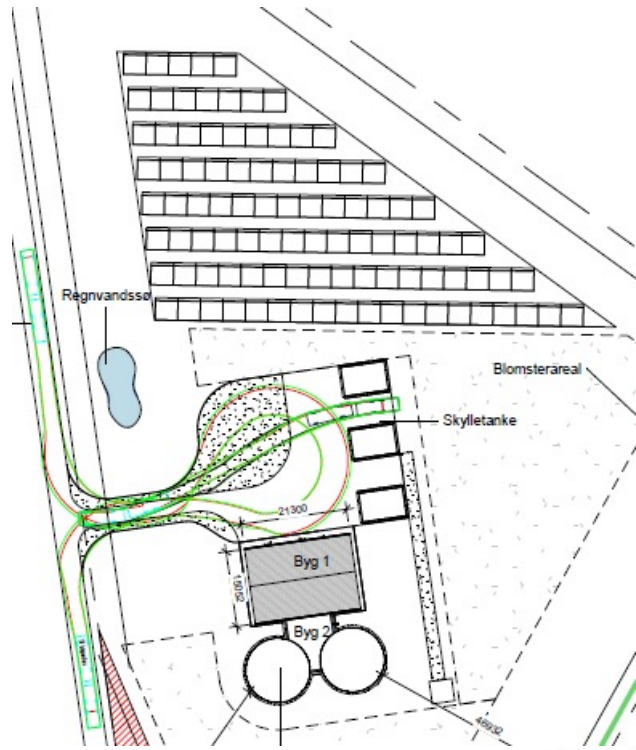


Etablering af vandværk

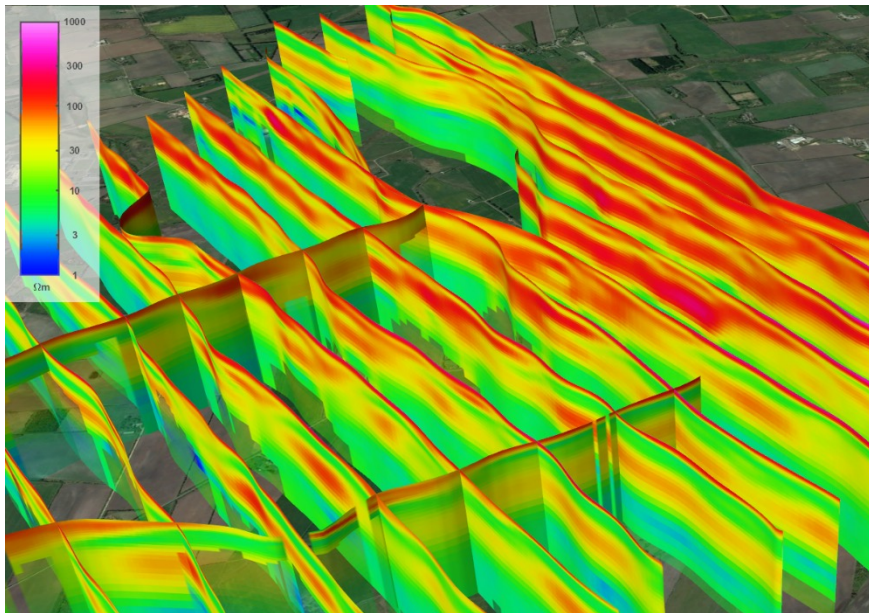
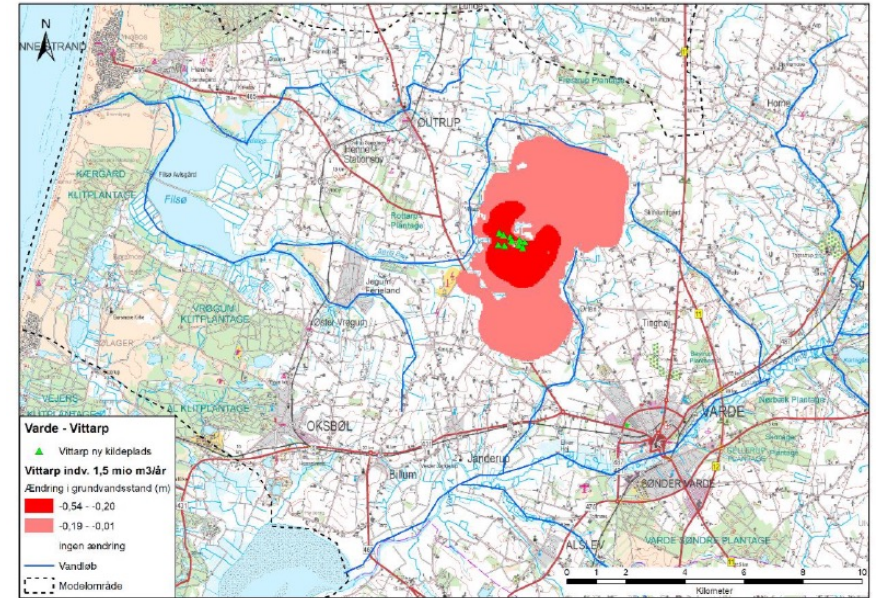
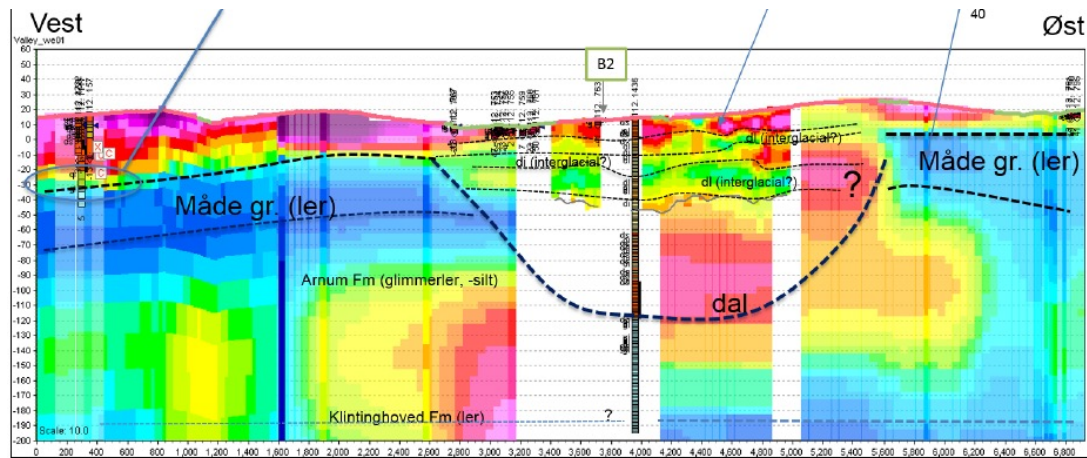
- Vandværket er designet efter nedenstående principper
 - Beskyttelse af grundvand
 - Intet affald
 - Fossilfri værdikæde
 - Flexibelt brug



Etablering af vandværk



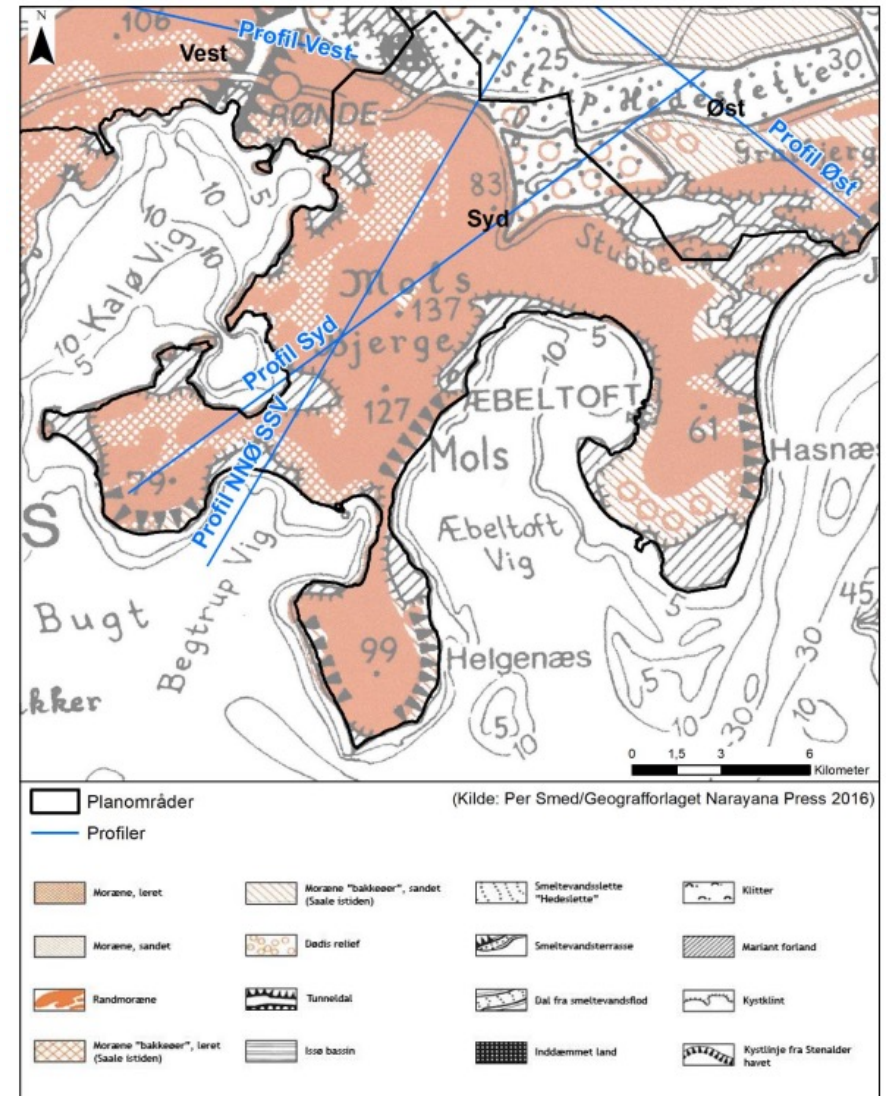
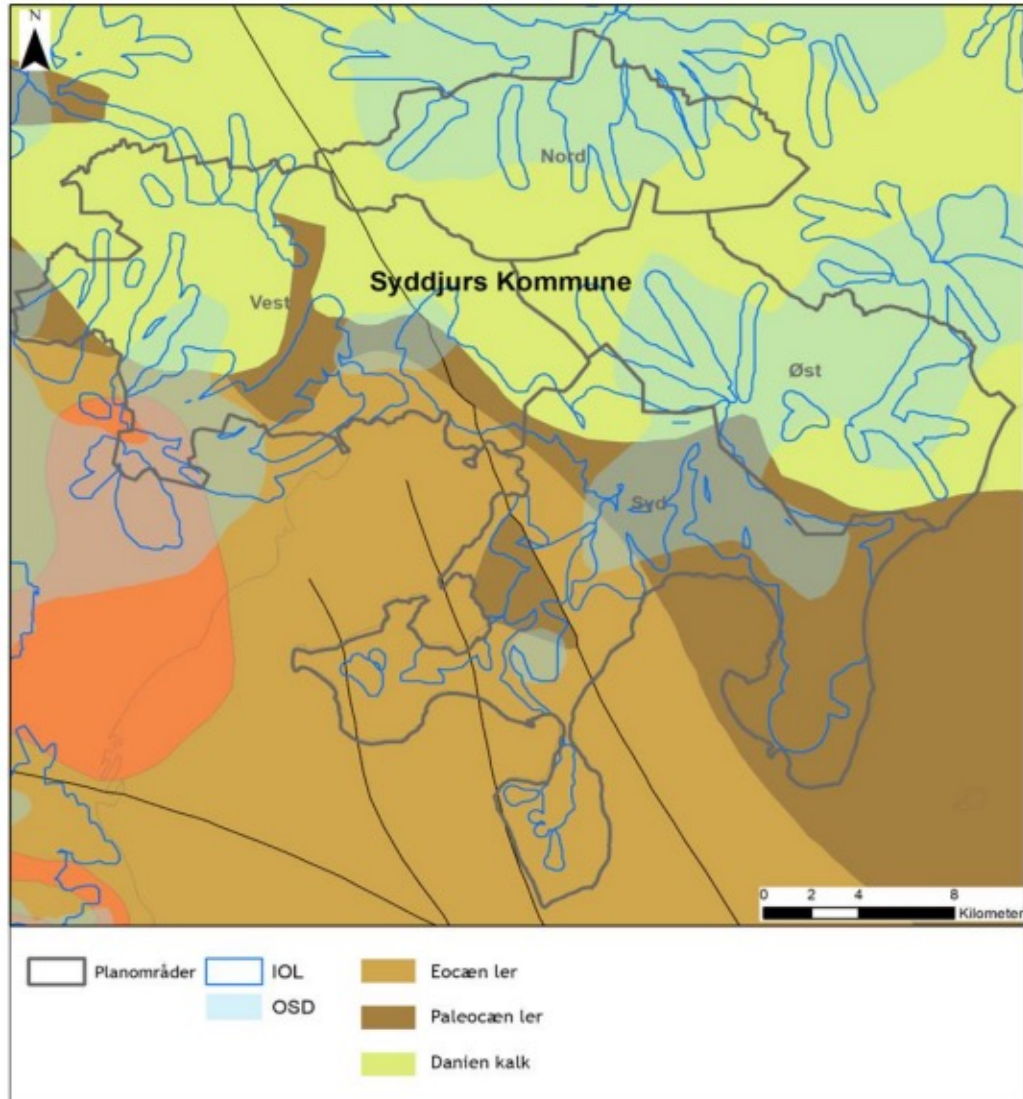
Konklusion



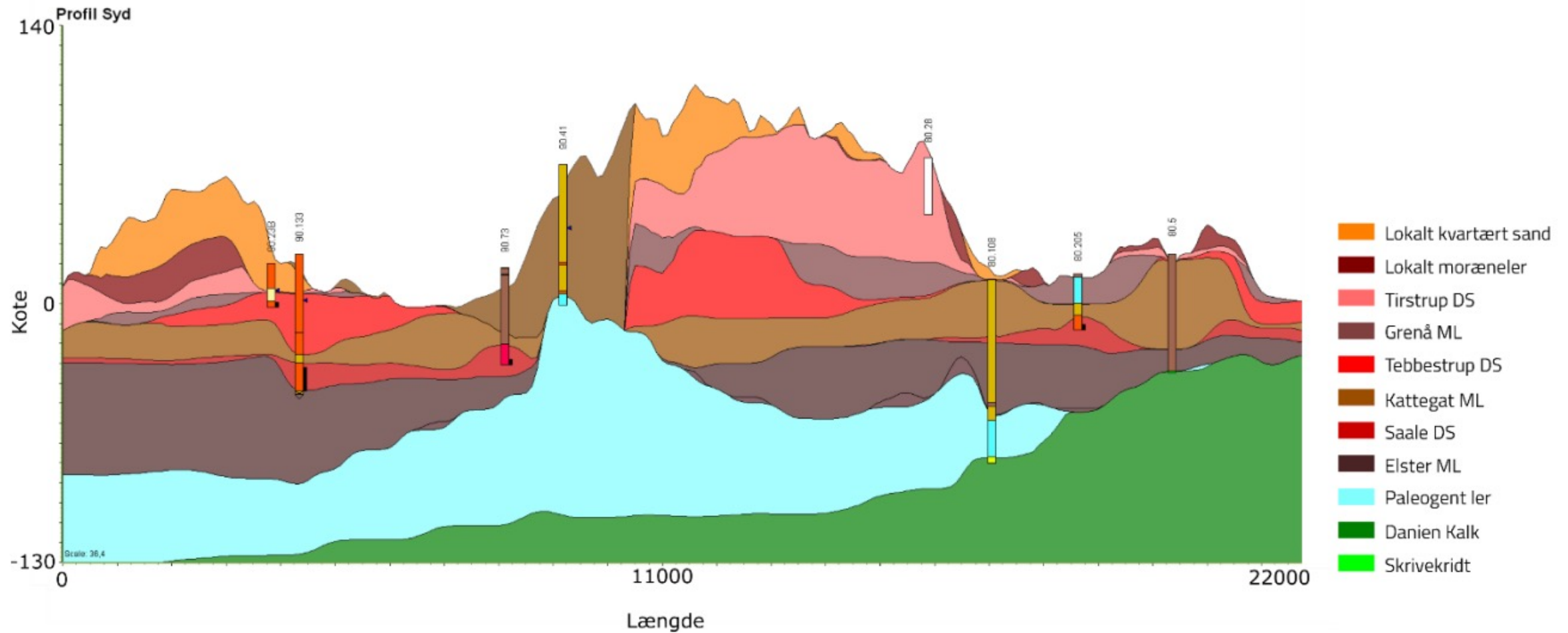
Hvad skal vi snakke om

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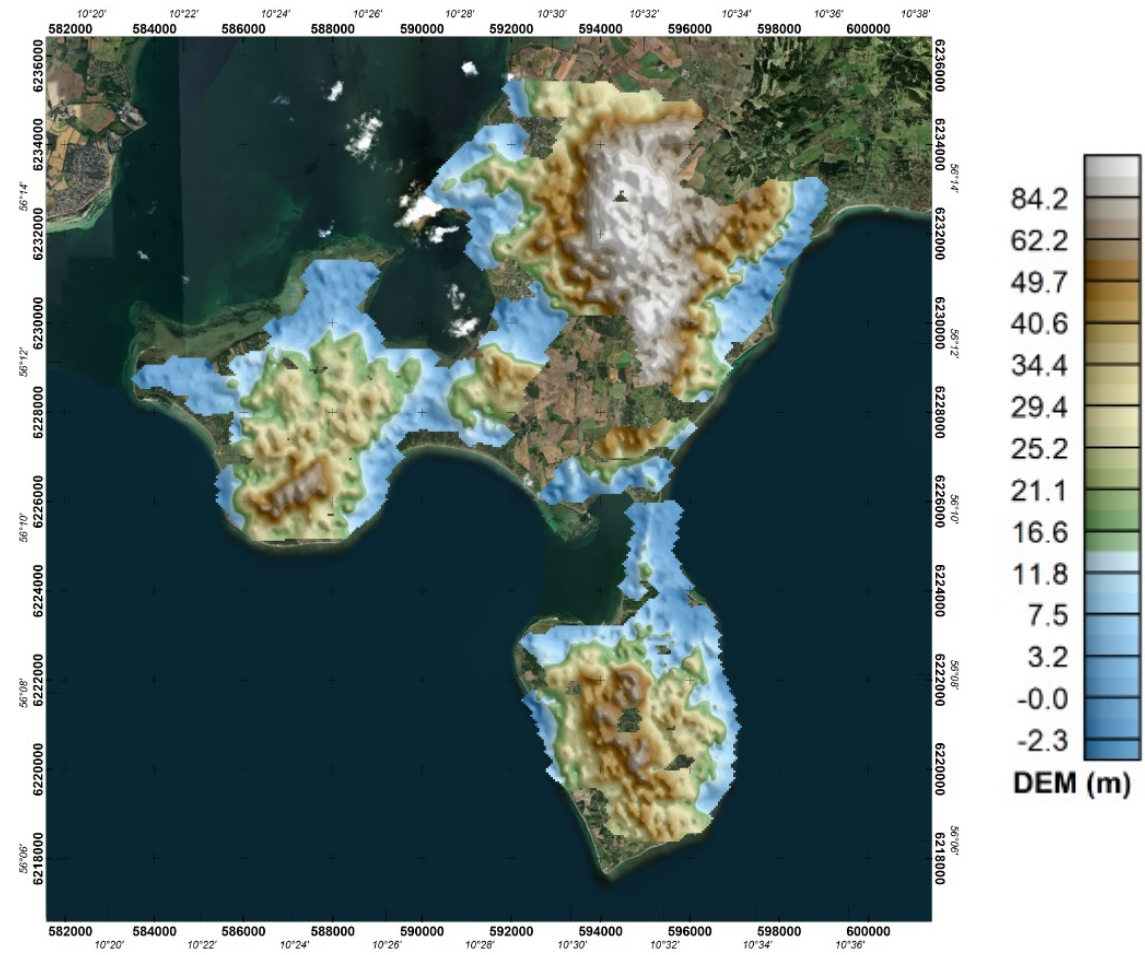
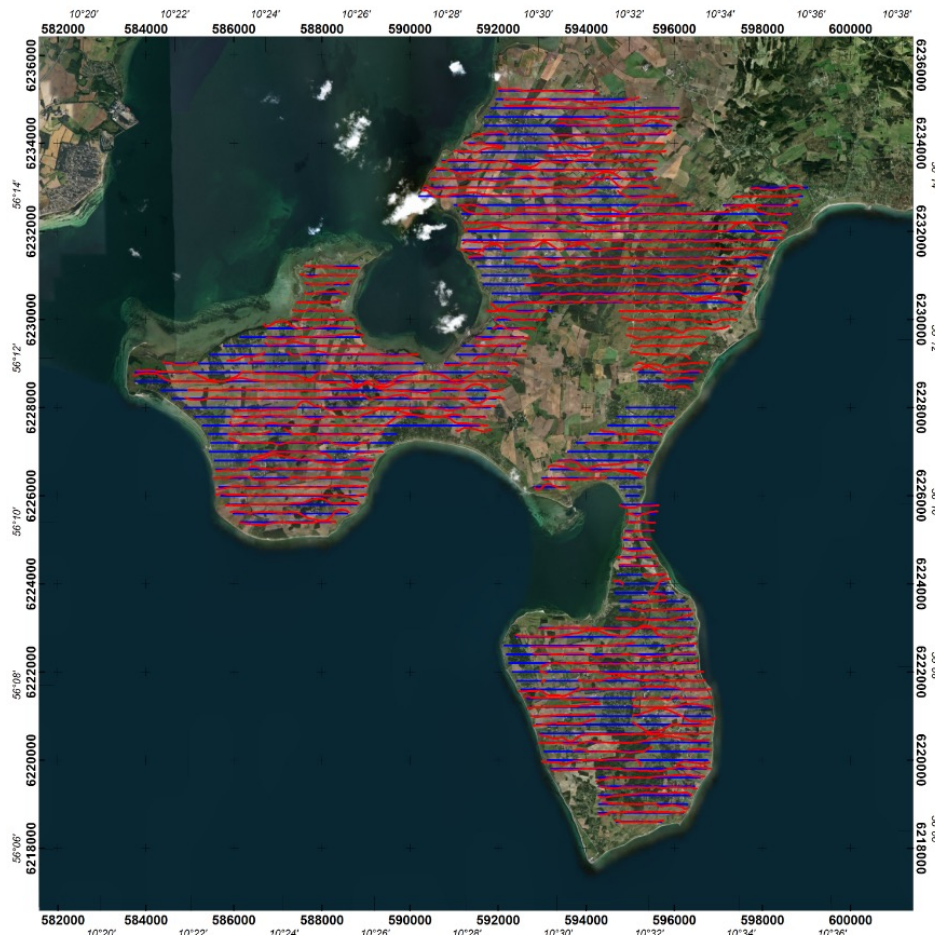
Regional geologi



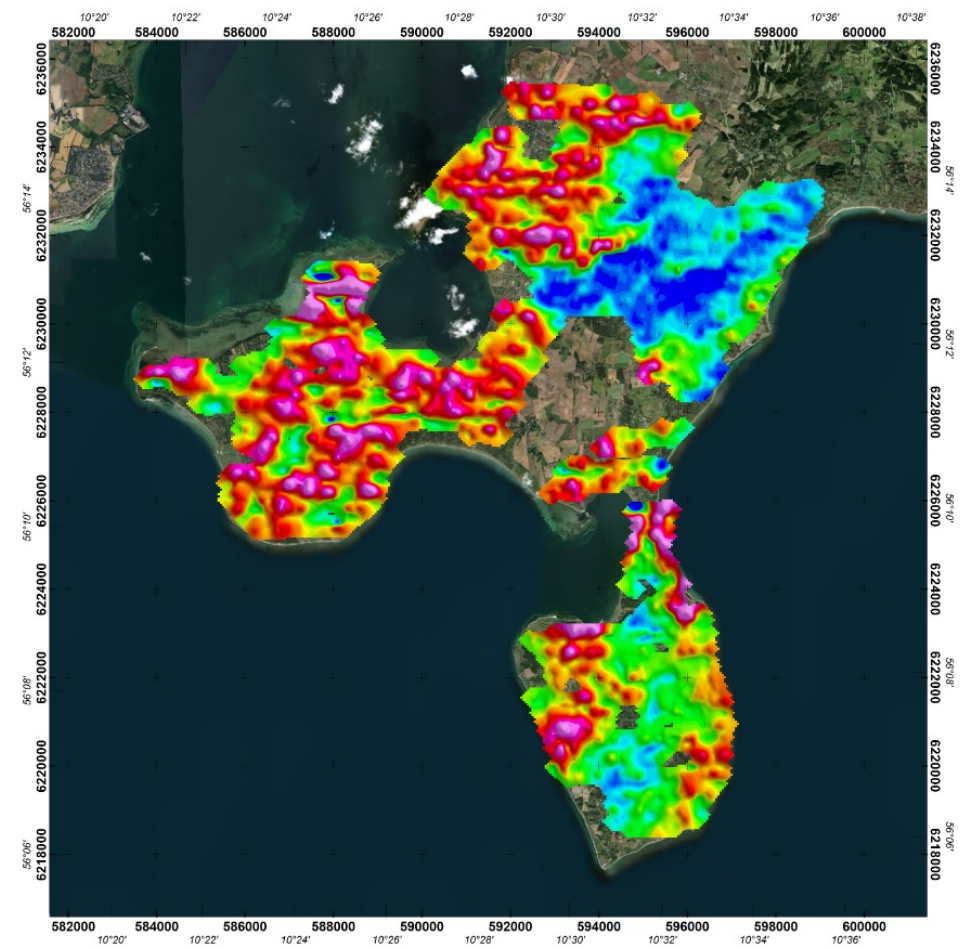
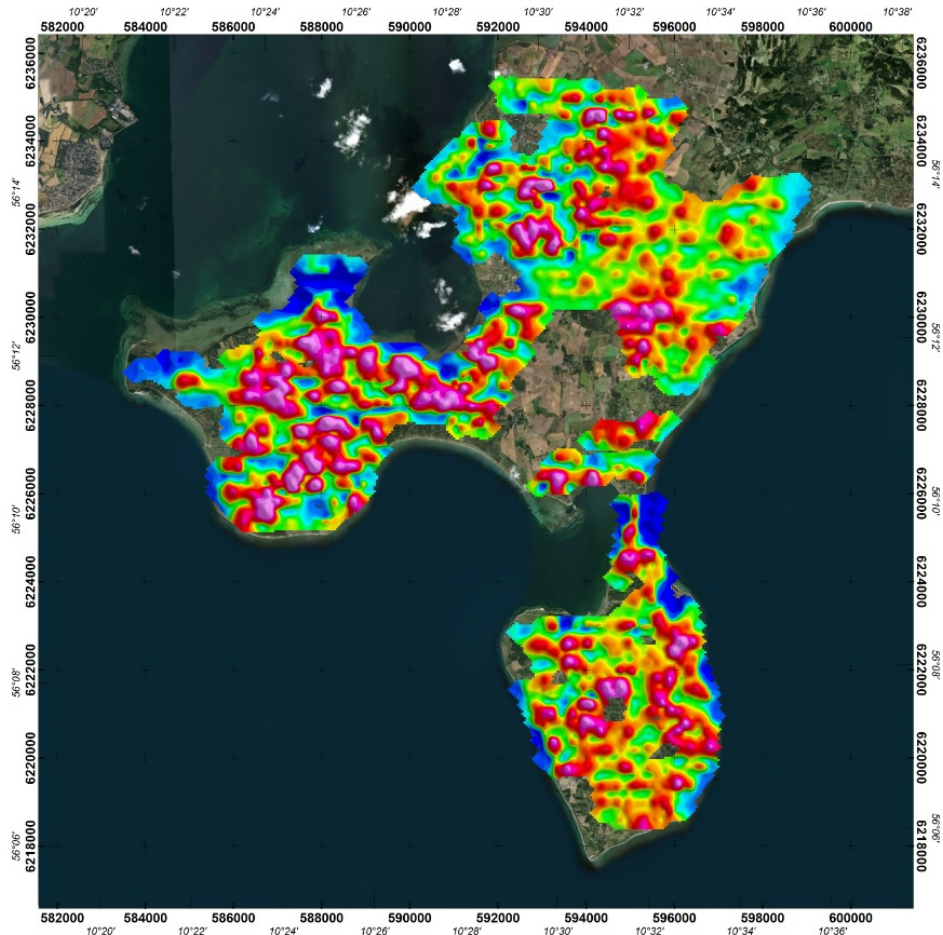
Regional geologi



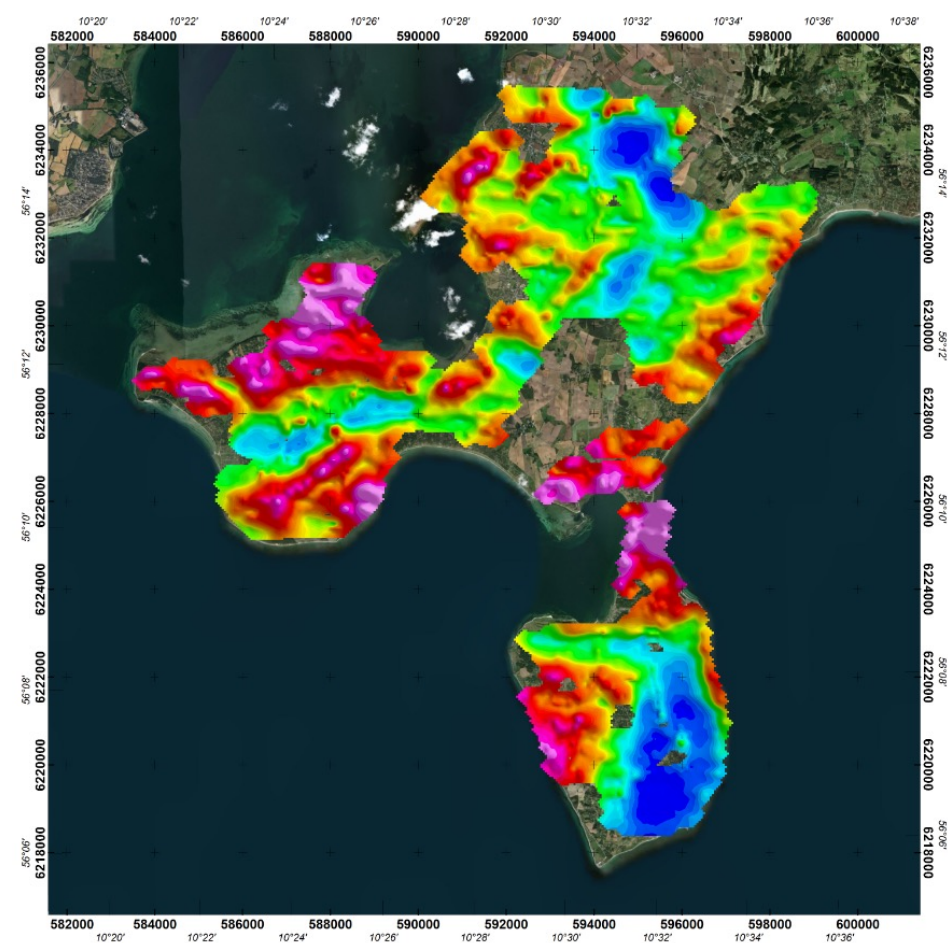
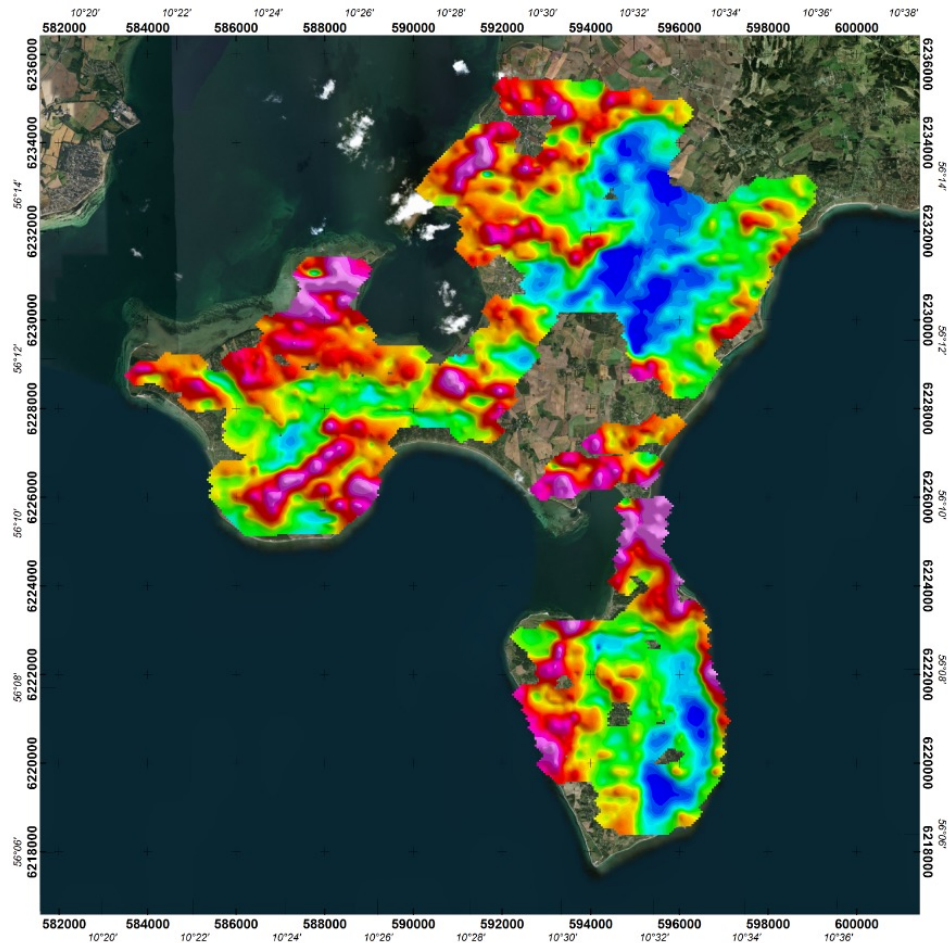
Fløjne linjer og terrænmodel



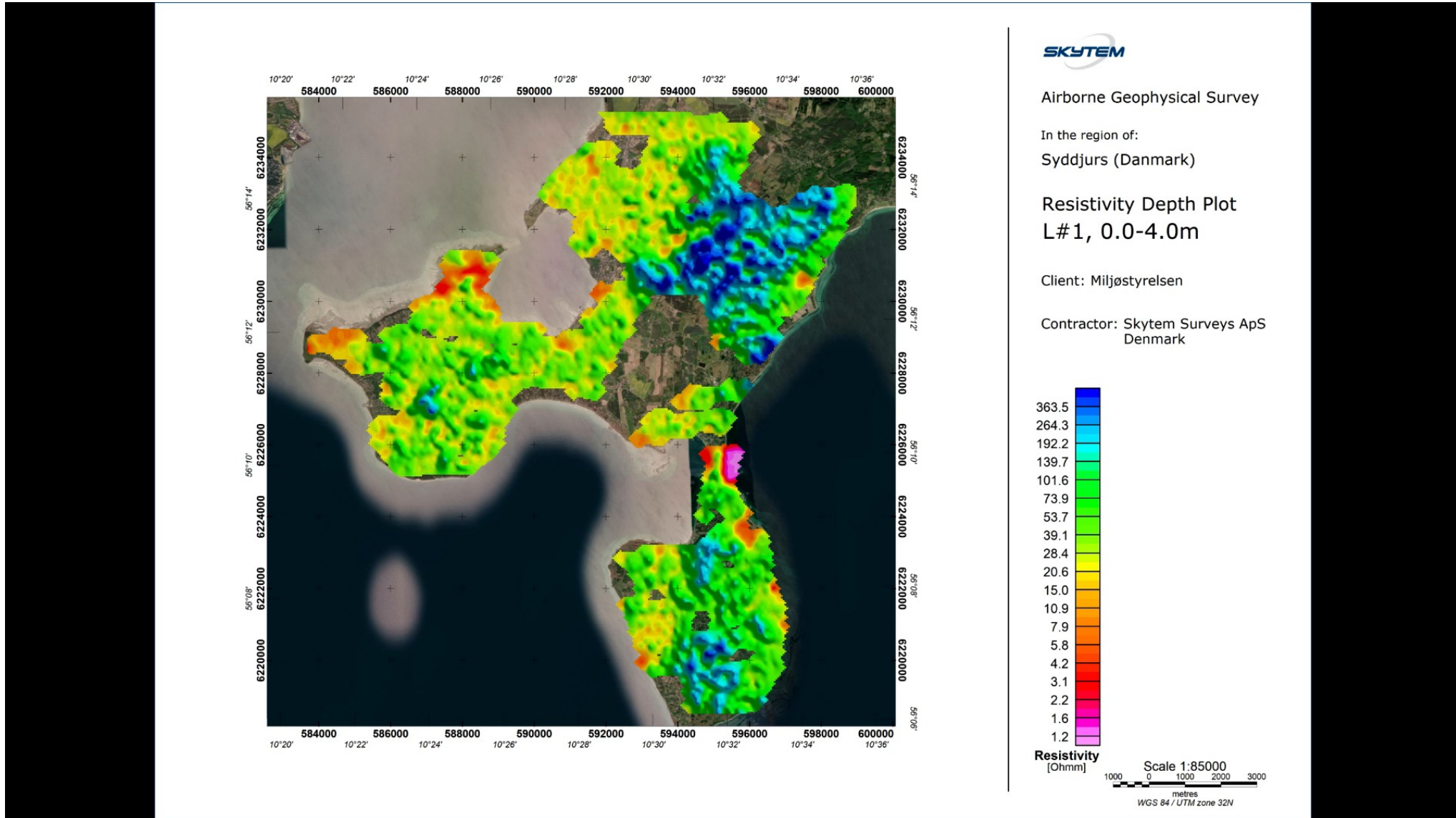
Rådata – Lavt moment - overfladenært



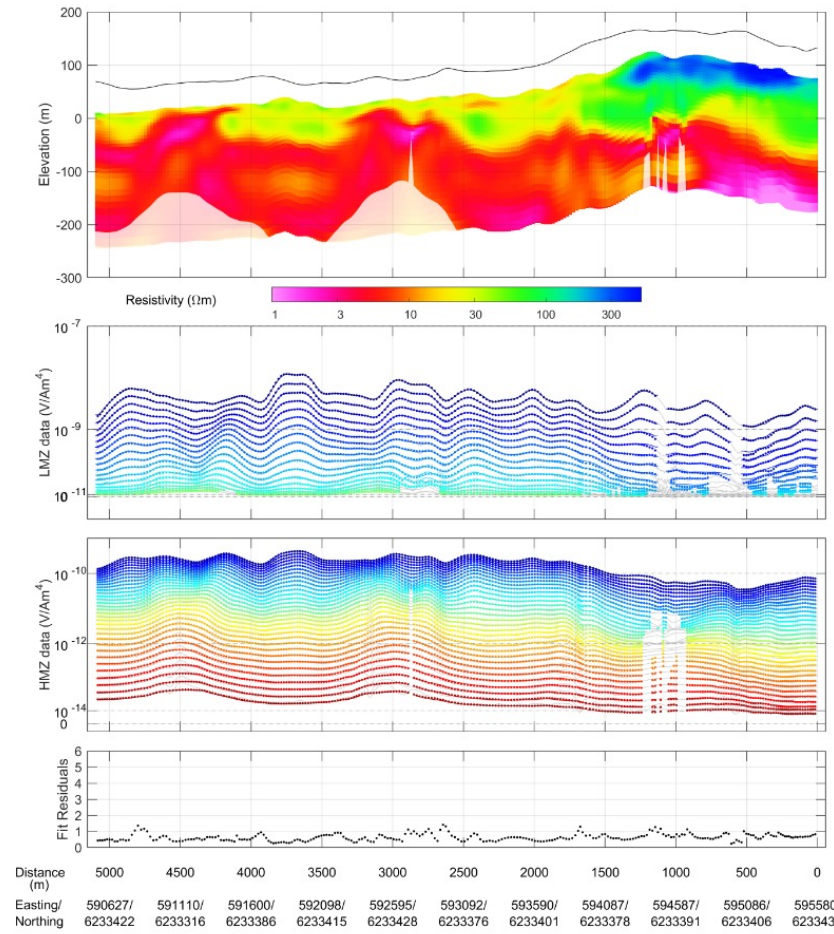
Rådata – Højt moment - dybdeindtrængning



Inversion – Dybde-modstandsmodel



Inversionsprofiler



Client:
Miljøstyrelsen

Area:
Syddjurs (DEN)

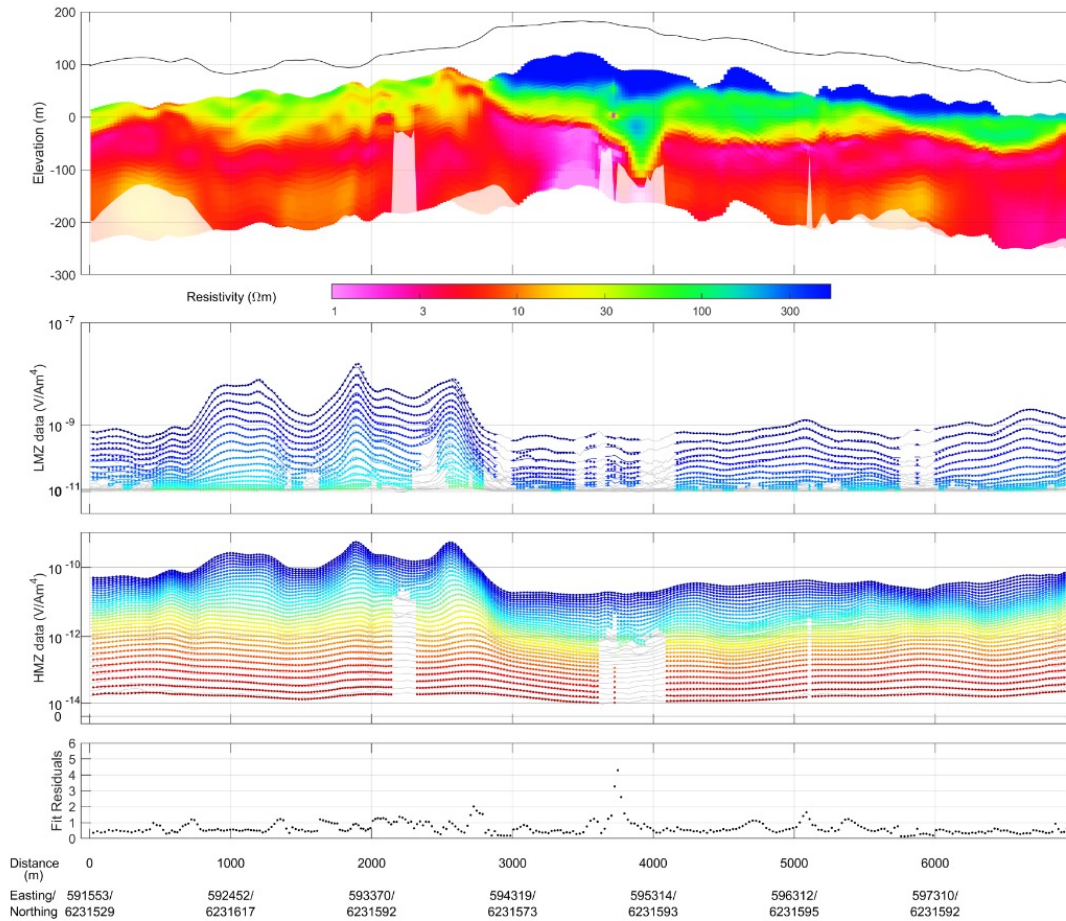
Line number:
404001

Flight:
20230208.03

Coordinate system:
WGS 84 UTM zone 32N



Inversionsprofiler



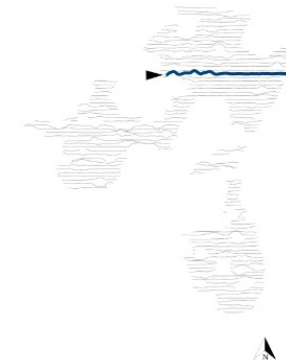
Client:
Miljøstyrelsen

Area:
Syddjurs (DEN)

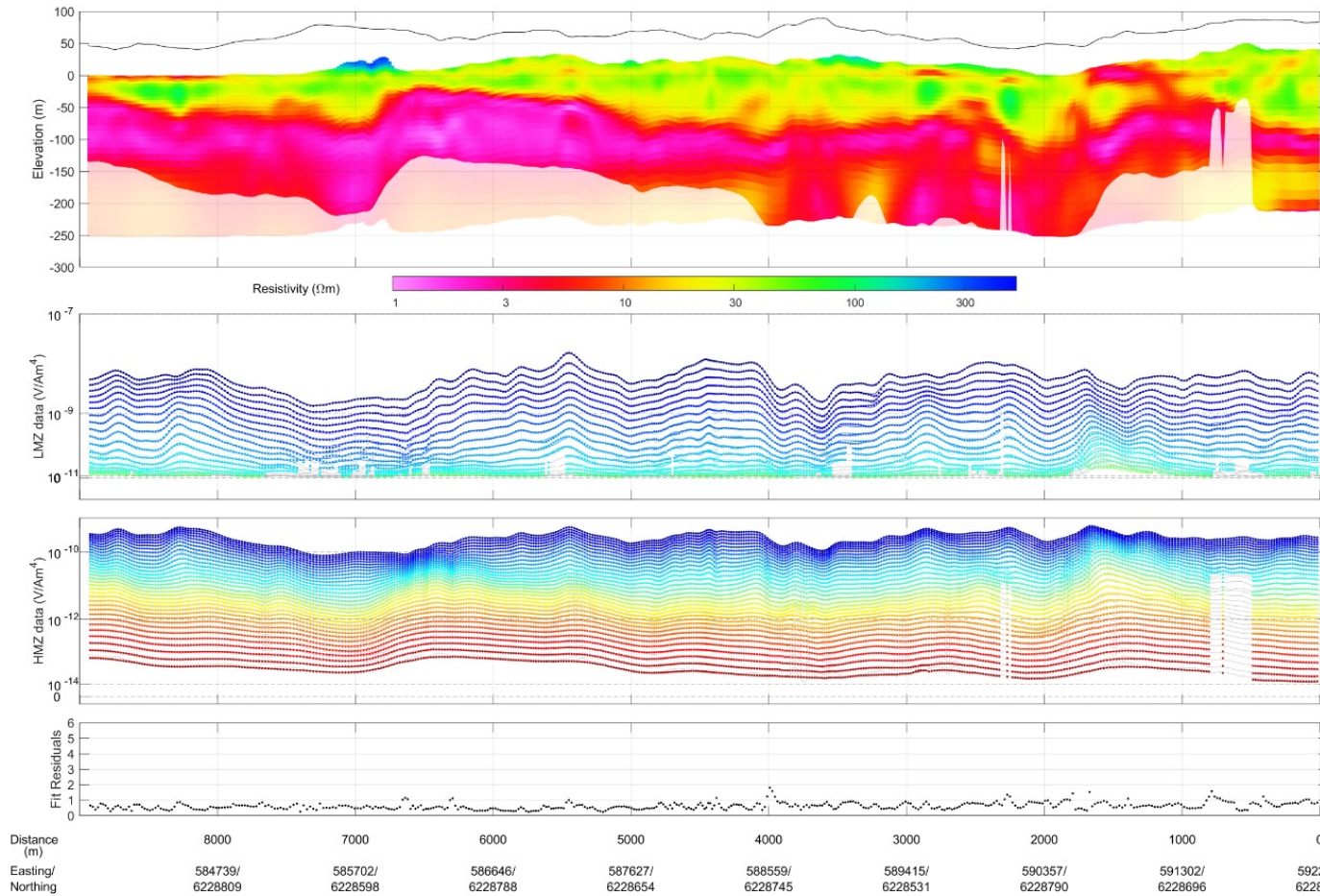
Line number:
404902

Flight:
20230209.02

Coordinate system:
WGS 84 UTM zone 32N



Inversionsprofiler



Client:
Miljøstyrelsen

Area:
Syddjurs (DEN)

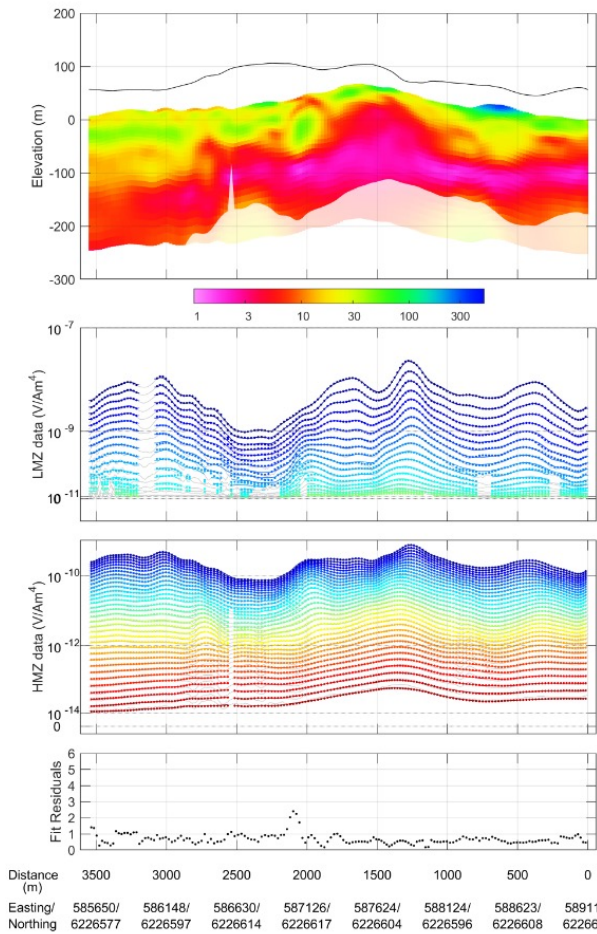
Line number:
406301

Flight:
20230209.01

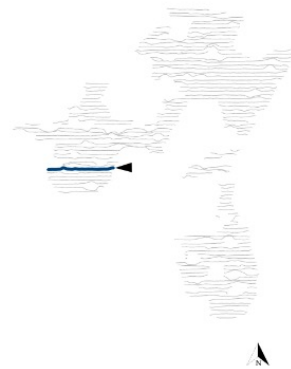
Coordinate system:
WGS 84 UTM zone 32N



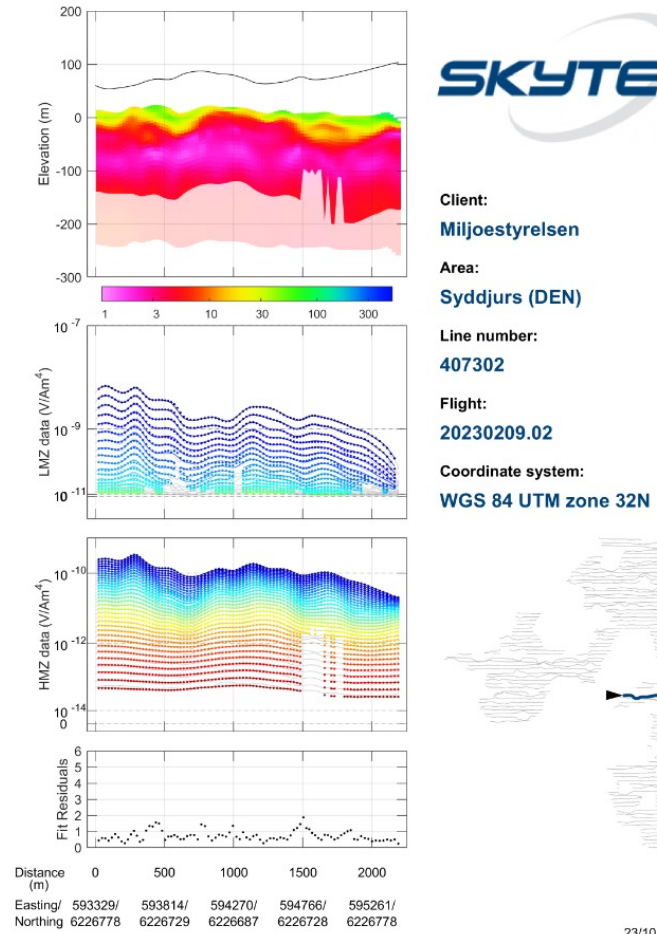
Inversionsprofiler



Client: Miljøstyrelsen
 Area: Syddjurs (DEN)
 Line number: 407401
 Flight: 20230209.02
 Coordinate system: WGS 84 UTM zone 32N



23/10 2023 - by PGG

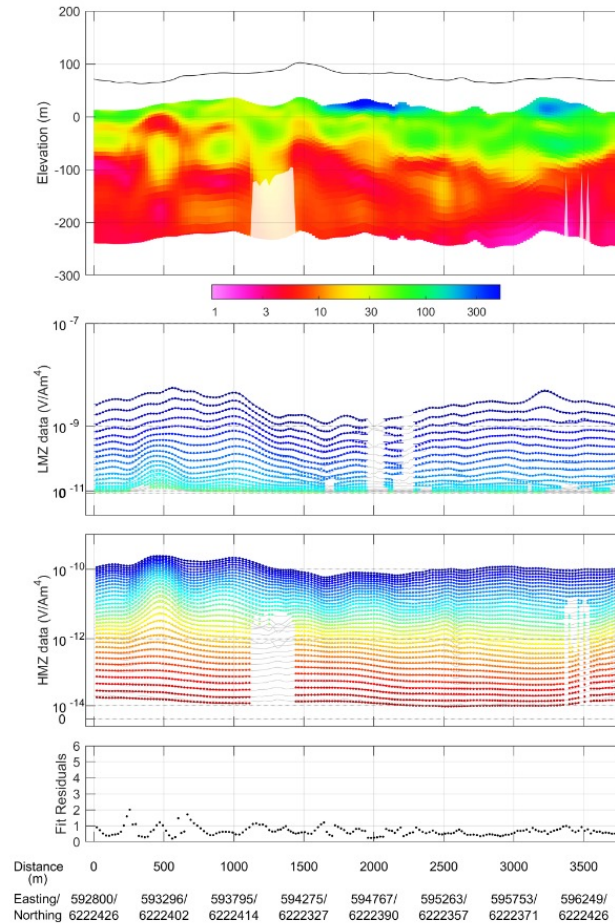


Client: Miljøstyrelsen
 Area: Syddjurs (DEN)
 Line number: 407302
 Flight: 20230209.02
 Coordinate system: WGS 84 UTM zone 32N



23/10 2023 - by PGG

Inversionsprofiler



Client:
Miljøstyrelsen

Area:
Syddjurs (DEN)

Line number:
409501

Flight:
20230209.01

Coordinate system:
WGS 84 UTM zone 32N



Tak for opmærksomheden / Spørgsmål?

