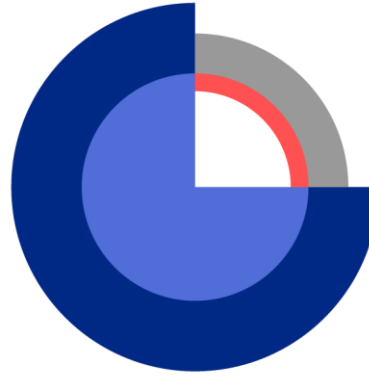




G E U S

Geostatistisk modellering med geologiske elementer

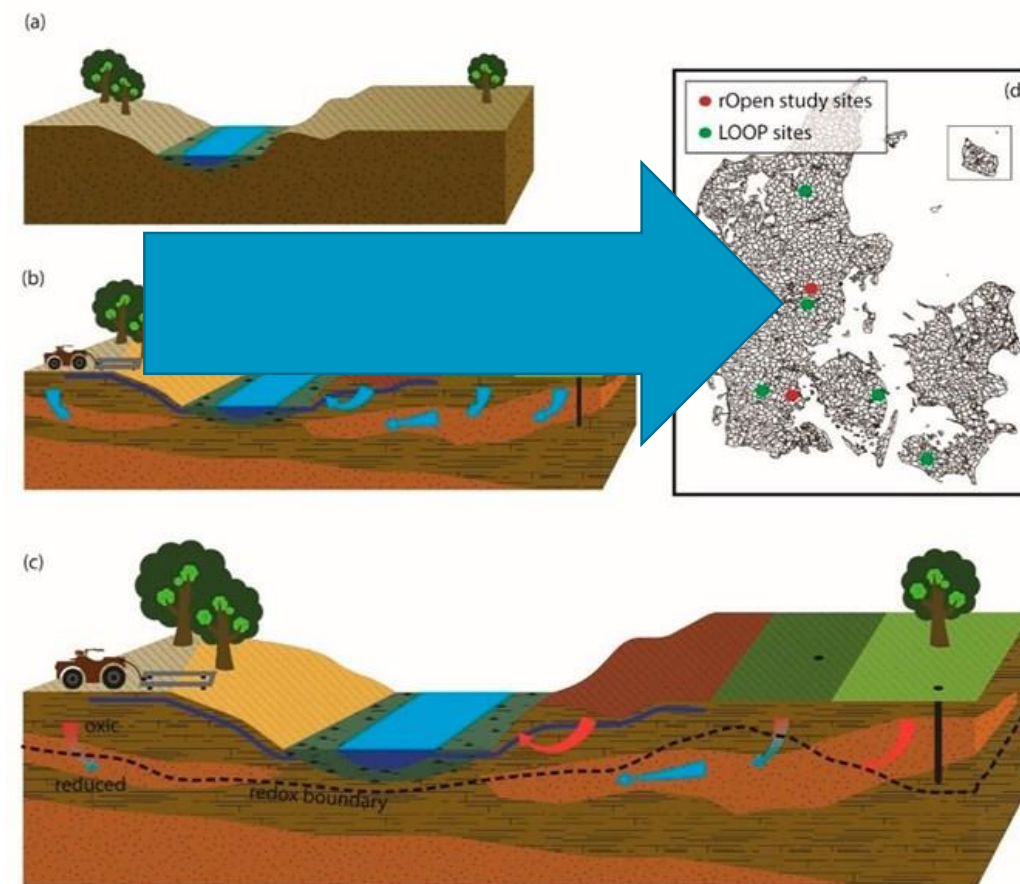
af Rasmus Bødker Madsen, forsker



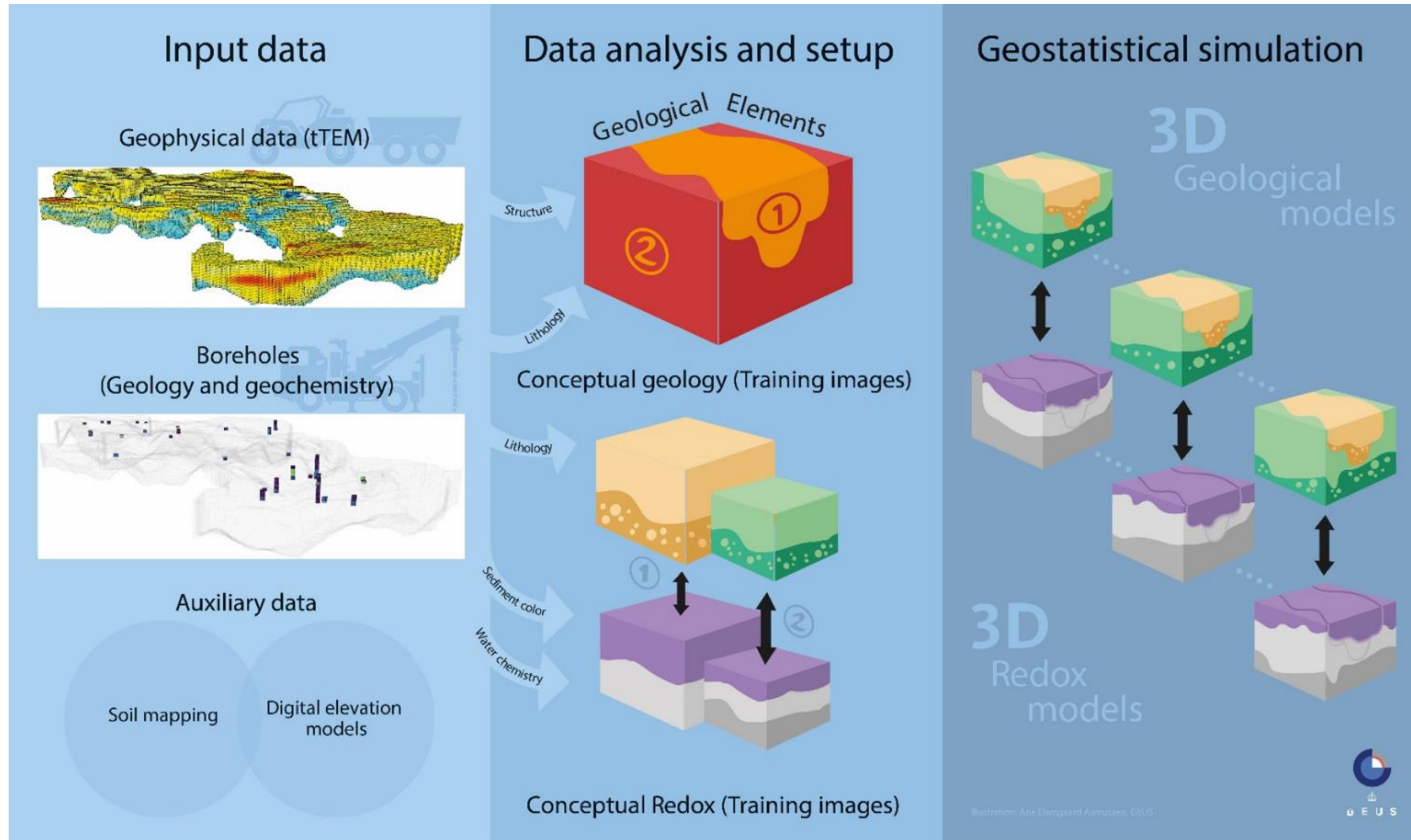
G E U S

Motivation

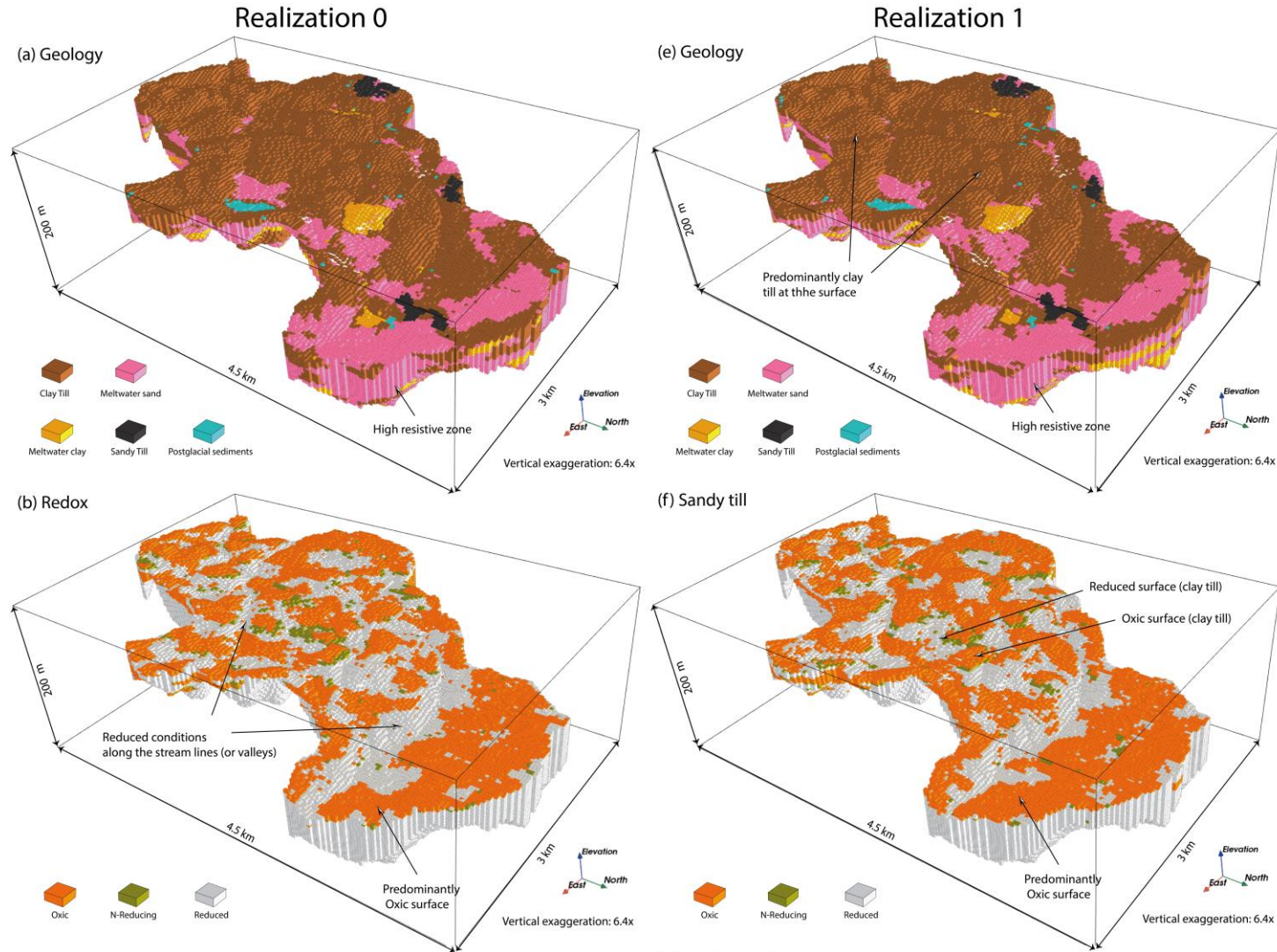
- Forskning udført i Innovation Fund Denmark projektet “Mapfield”
 - Hovedmål er at udvikle teknikker og koncepter til målrettet N-regulering i dansk landbrug til beskyttelse af grundvands- og overfladevandresourcer.
- Problem? Nitrat kontaminerer gennem udvaskning fra overfladen.
- Hvad skal vi kende?
 - Redoxforhold: Bestemmer faser og koncentrationer af nitrat
 - Geologiske arkitektur: Styrer strømninger og transport af nitrat i undergrunden
- Løsning: Detaljeret kortlægning af redox og geologi i 3D
 - Tage hånd om rumlige usikkerheder i kortlægning gennem ensemble af mulige løsninger ved geostatistisk simulering
- Mål: Muliggøre målrettet N-regulering



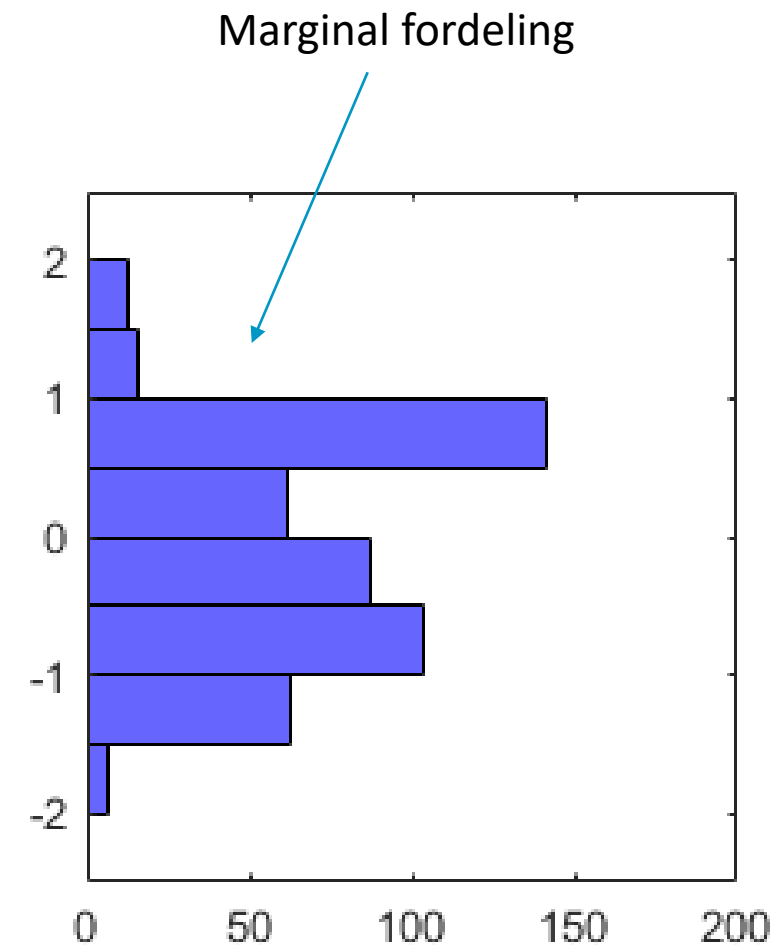
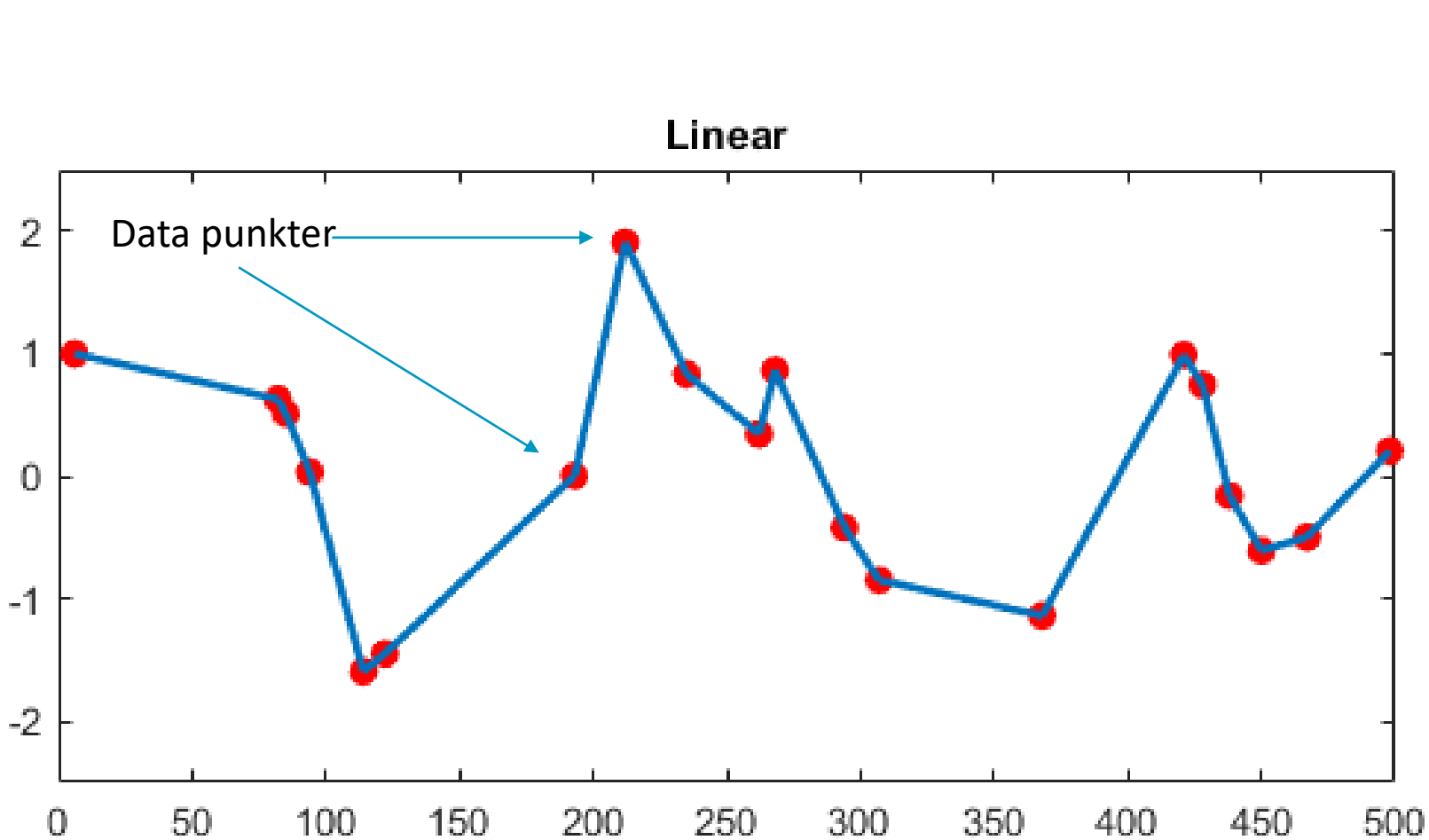
Geologisk/geofysisk/geokemisk modellering



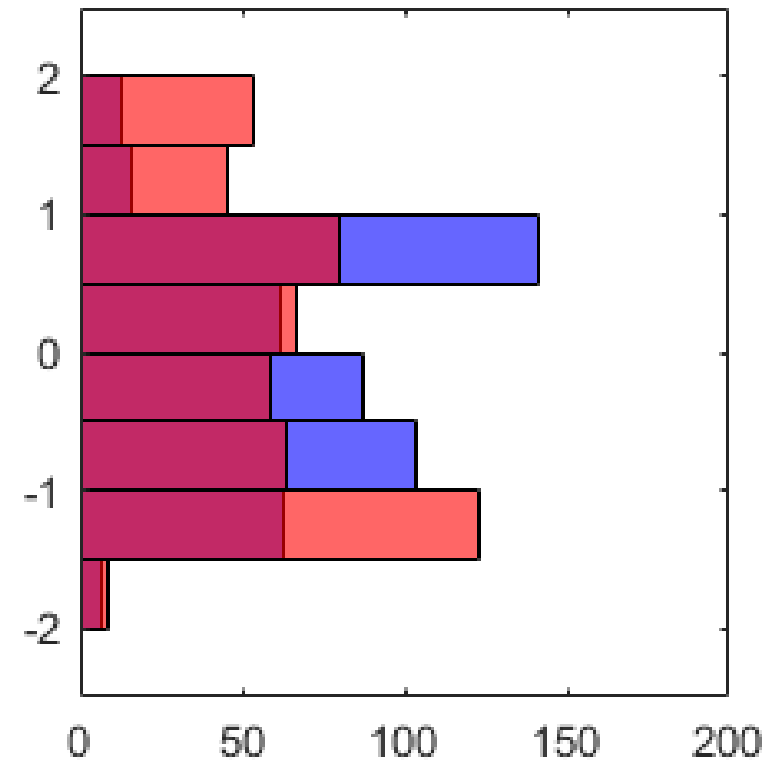
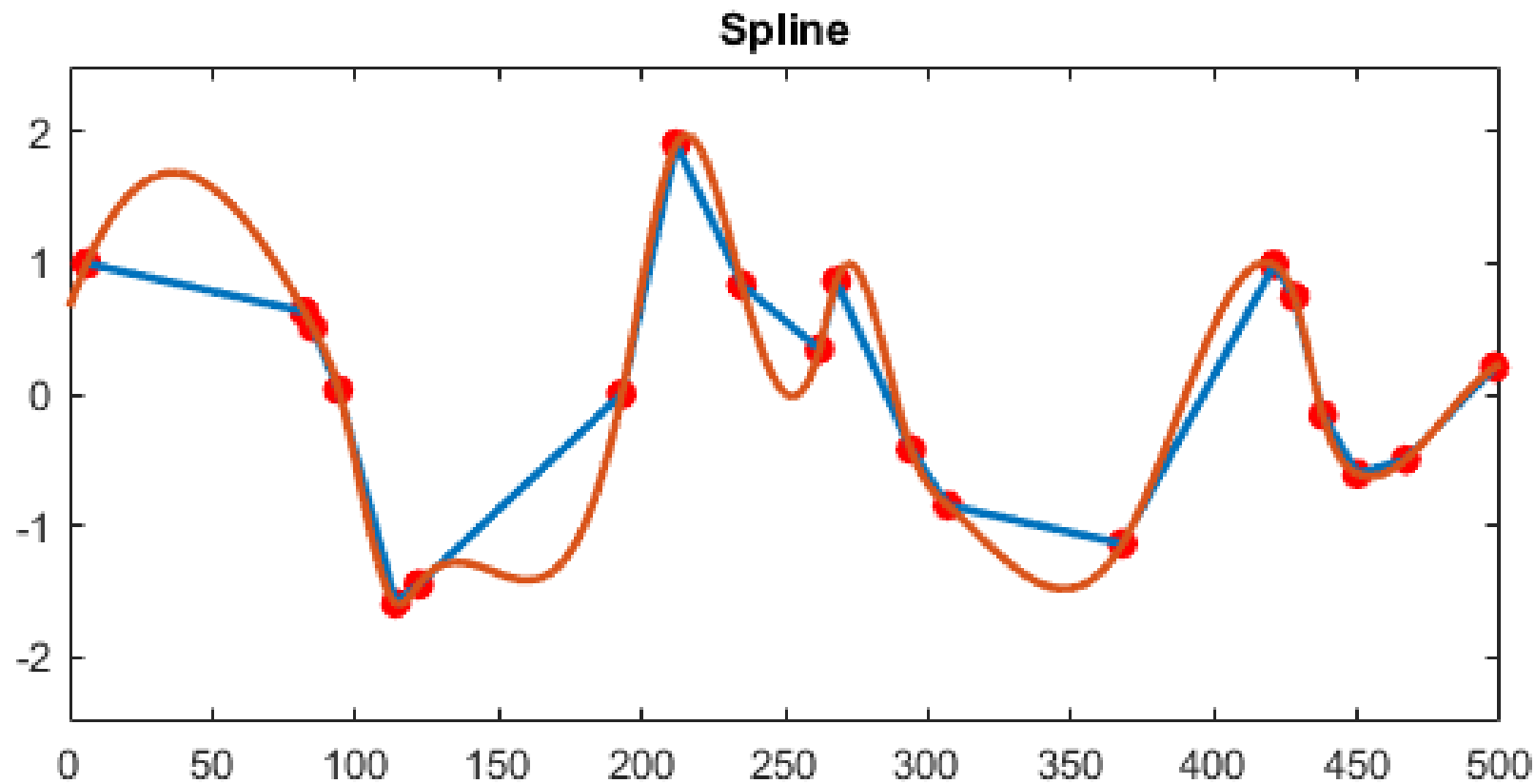
Løsninger fra geostatistisk MPS simulering



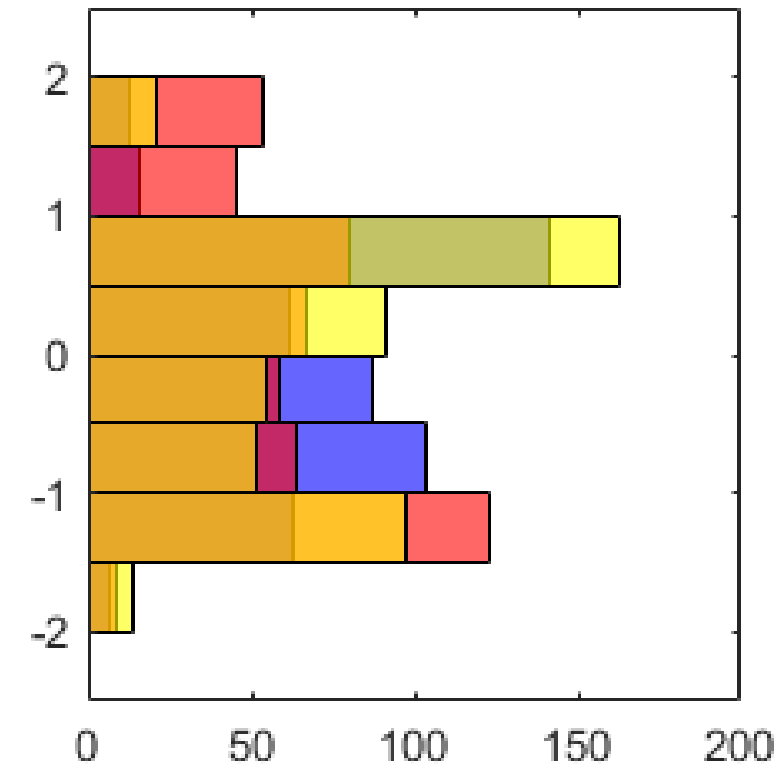
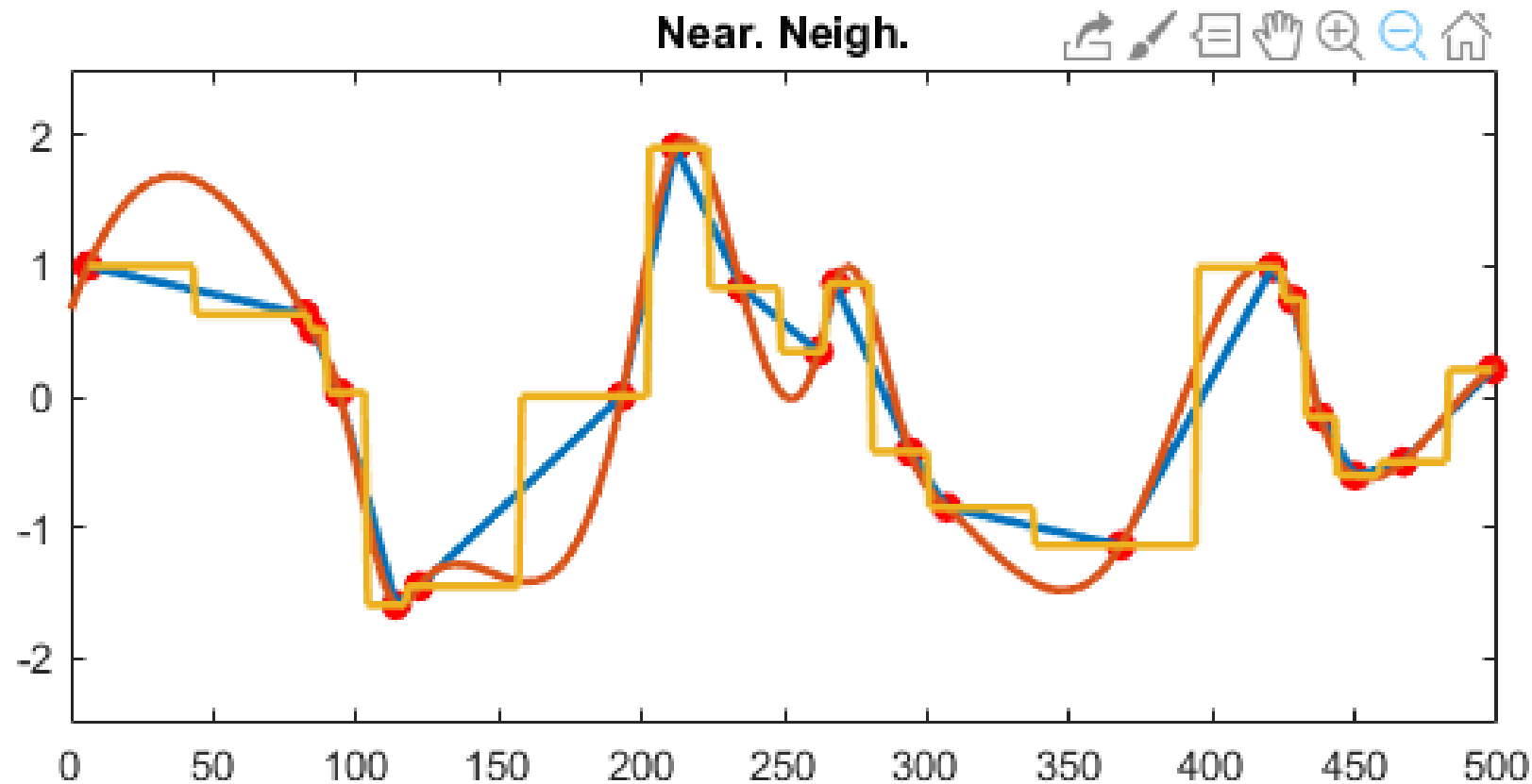
Et fælles ståsted – interpolation i 1D



Et fælles ståsted – interpolation i 1D

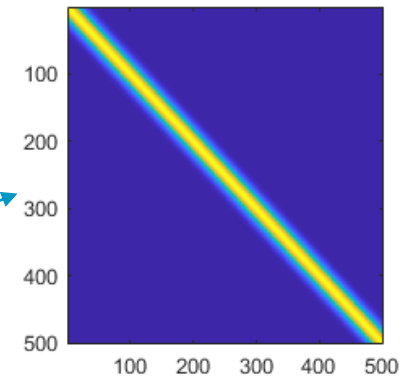


Et fælles ståsted – interpolation i 1D

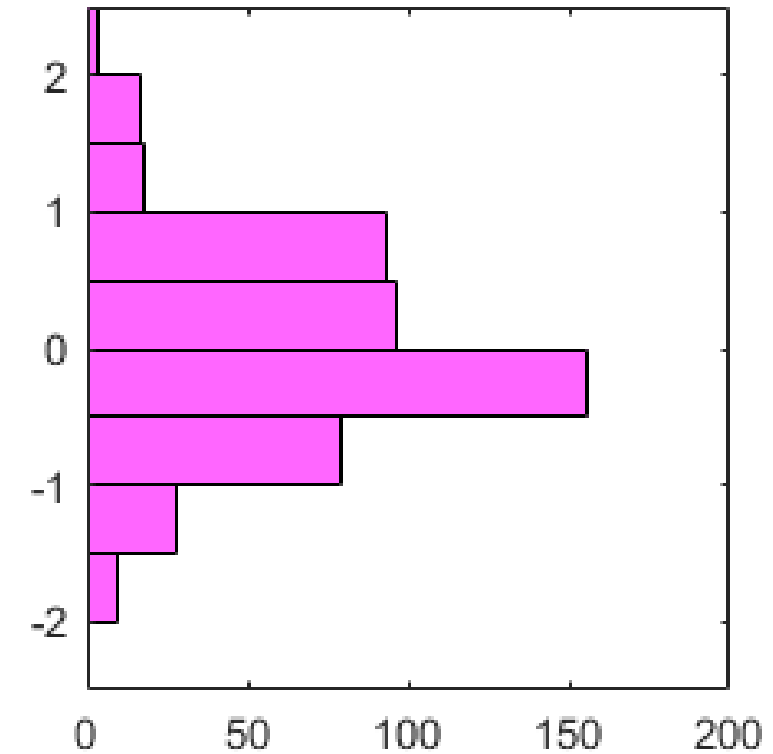
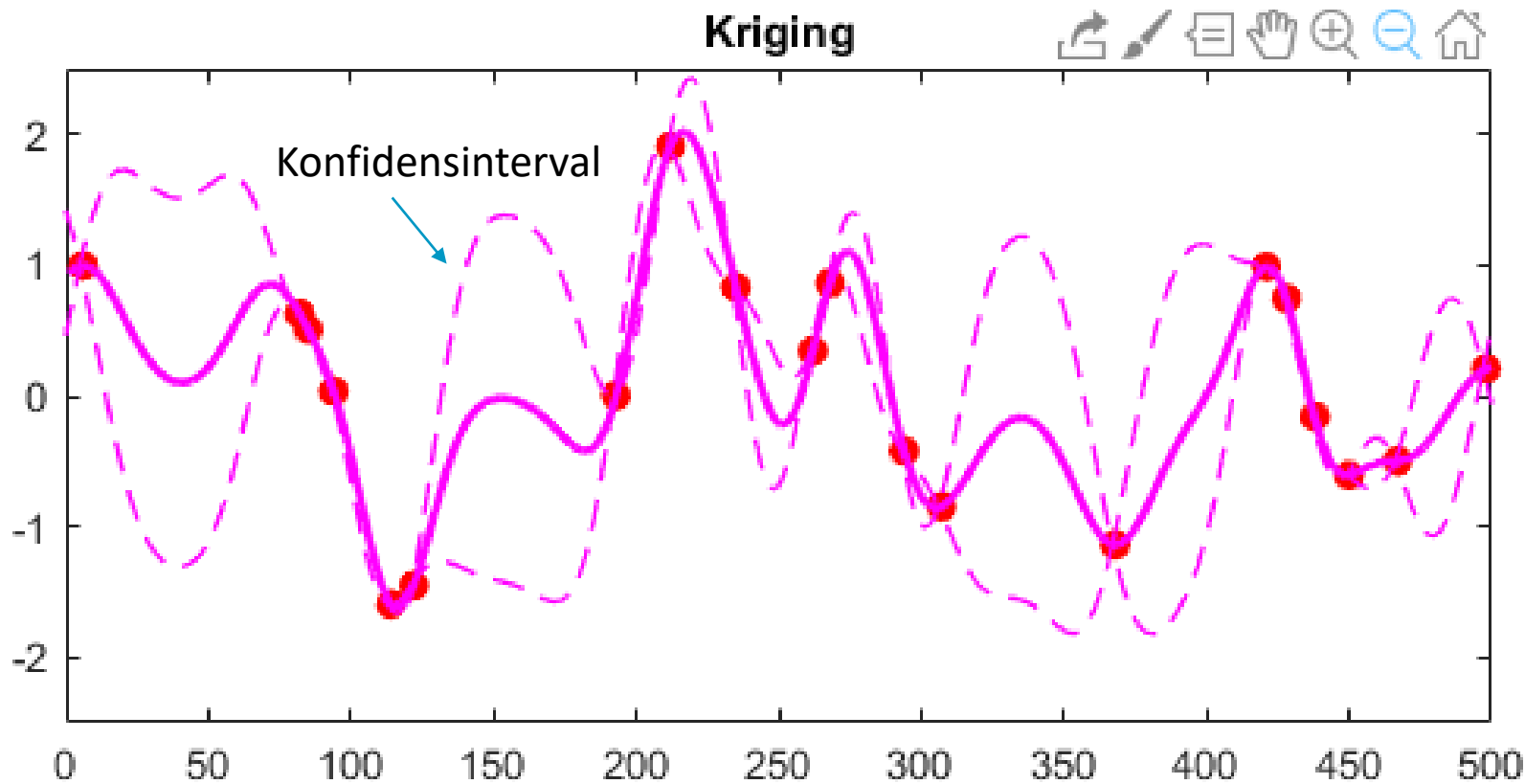


Et fælles ståsted – kriging i 1D

Kovariansmatrice

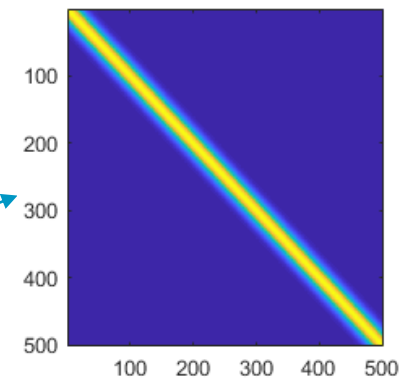


Kriging

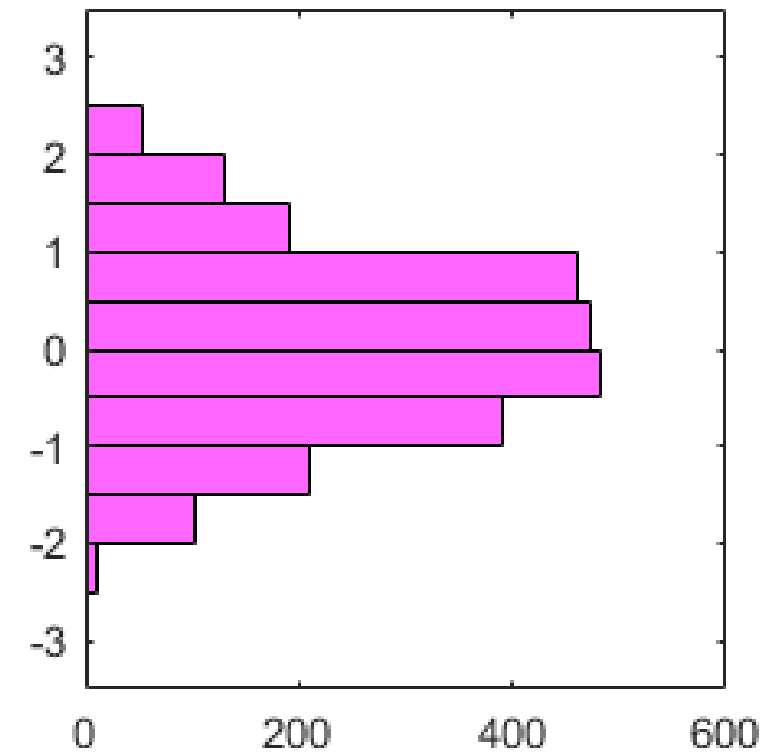
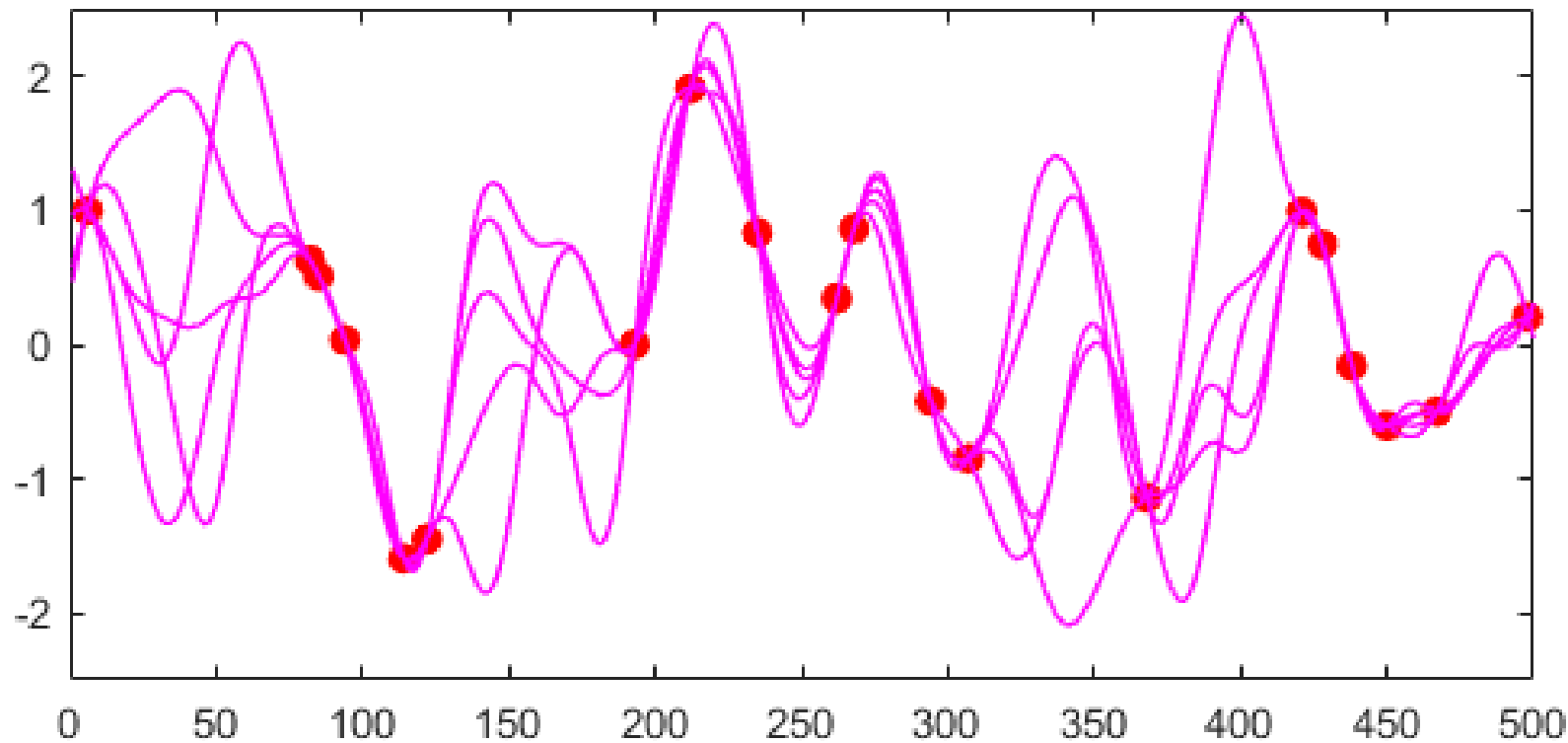


Et fælles ståsted– simulation i 1D

Kovariansmatrice:
Beskriver rumlig
variabilitet

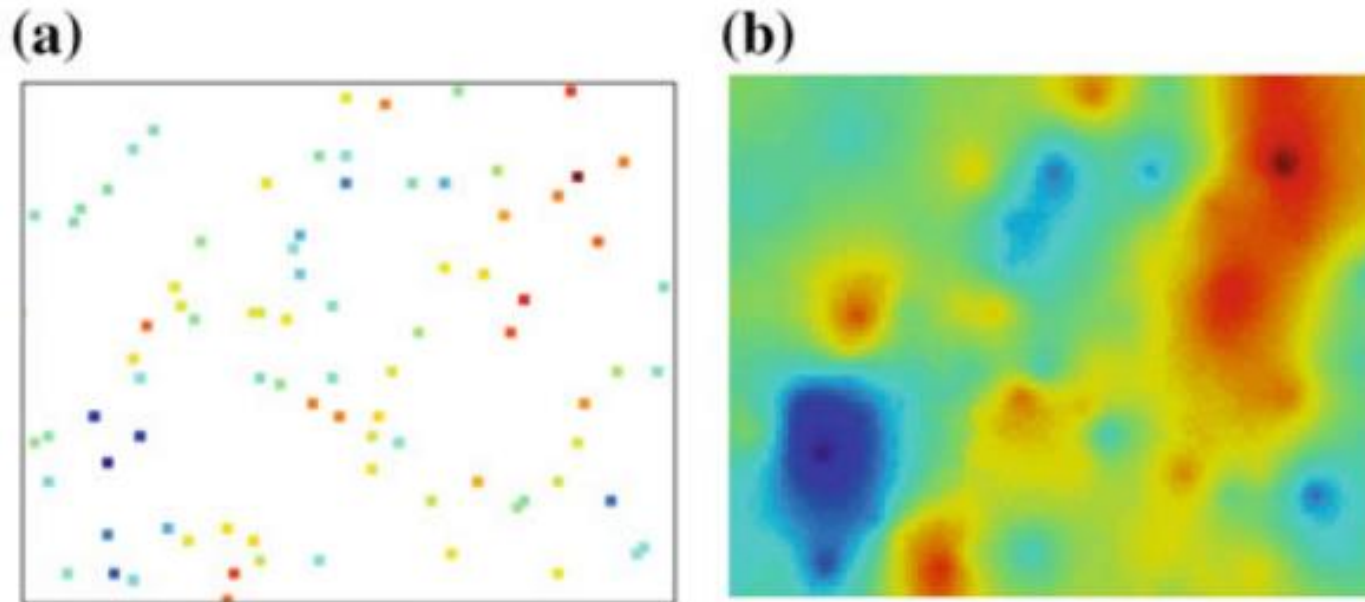


Simulation

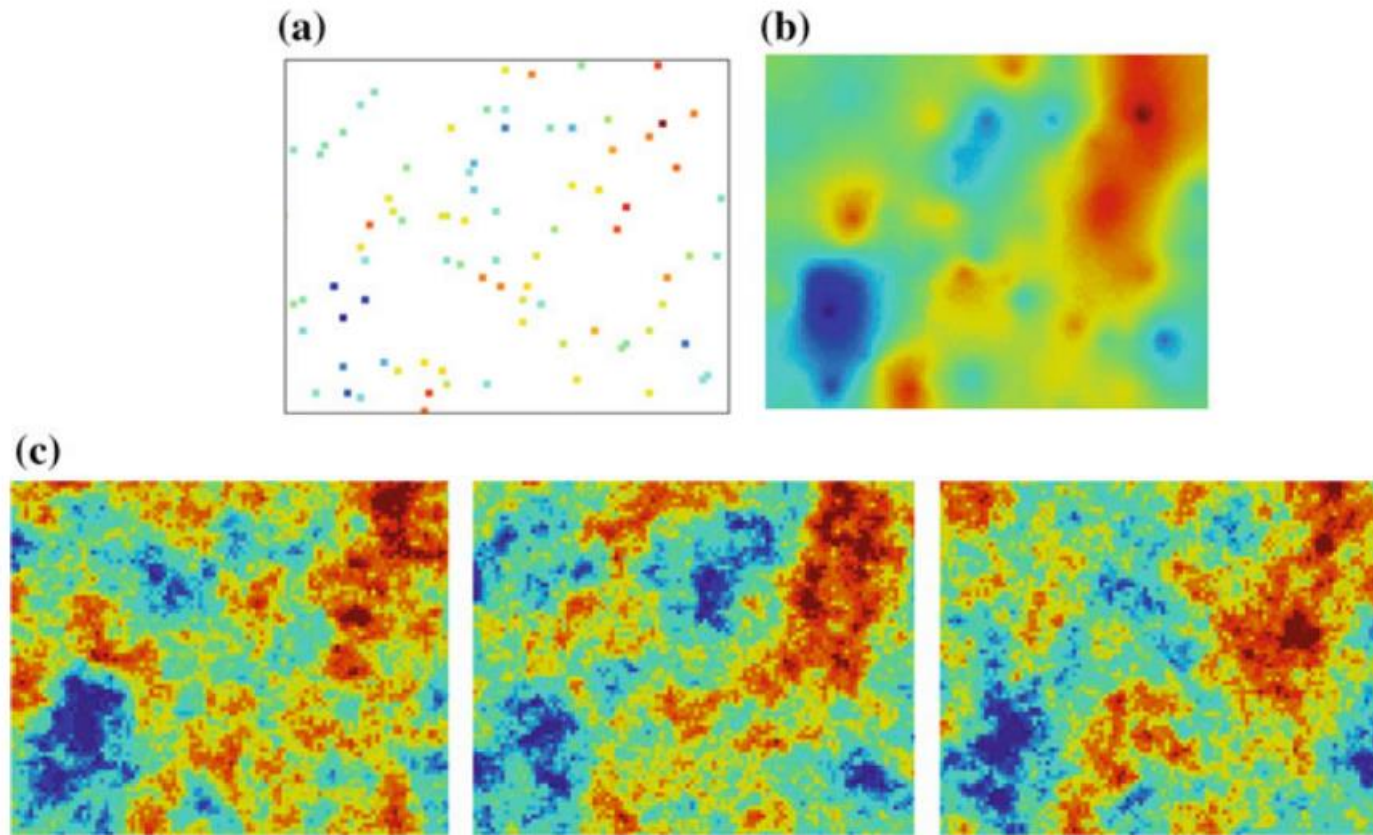


Et fælles ståsted - kriging

2D kriging

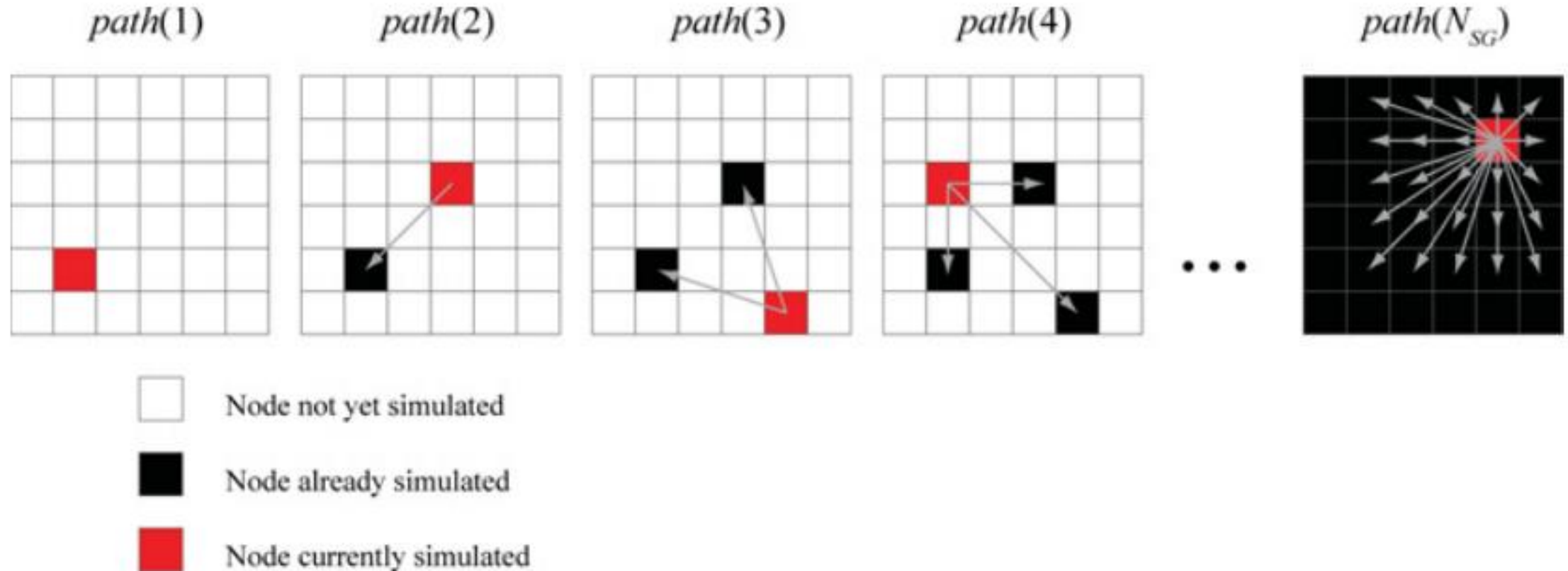


Geostatistisk simulering

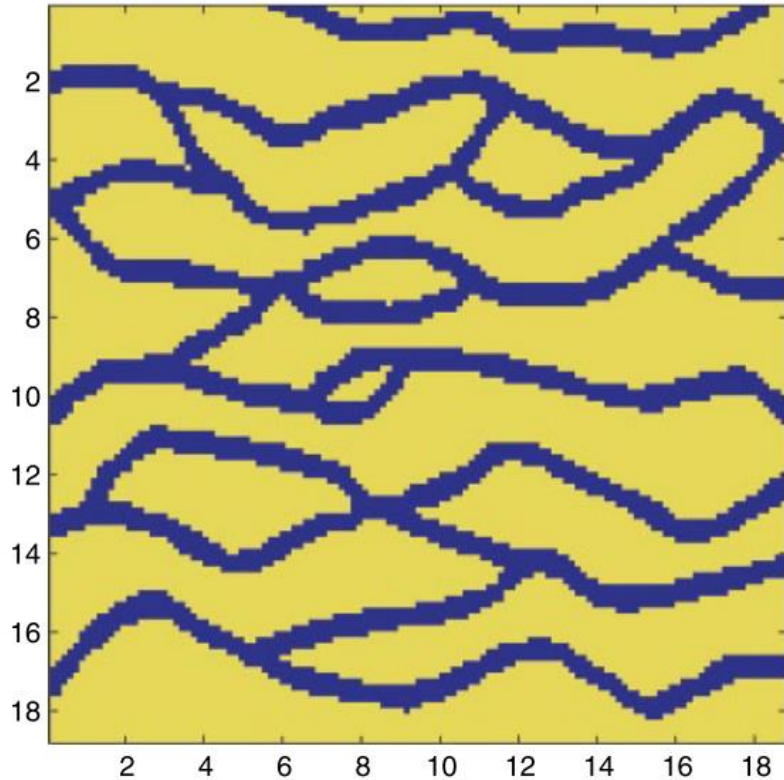


Realisationer fra simulering:
Udtryk for den rumlige
variabilitet

Geostatistisk simulering: Sekventiel simulering



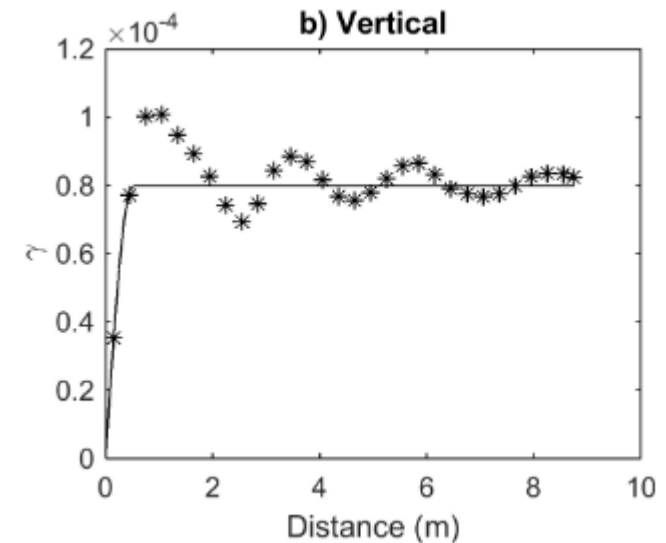
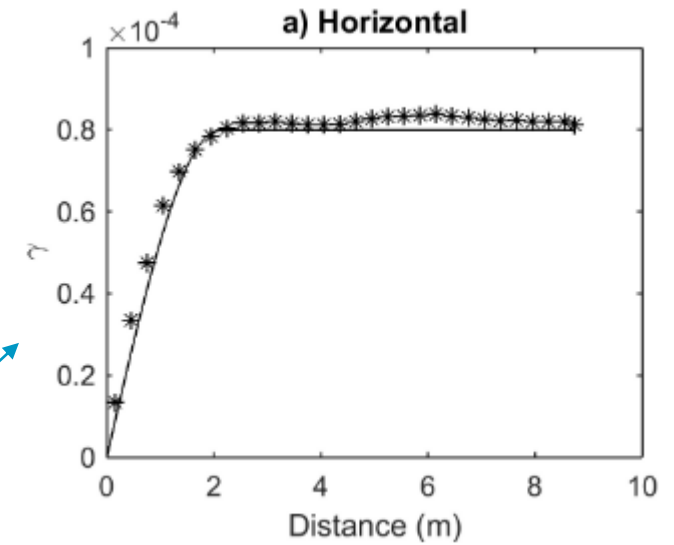
Geostatistisk simulering:



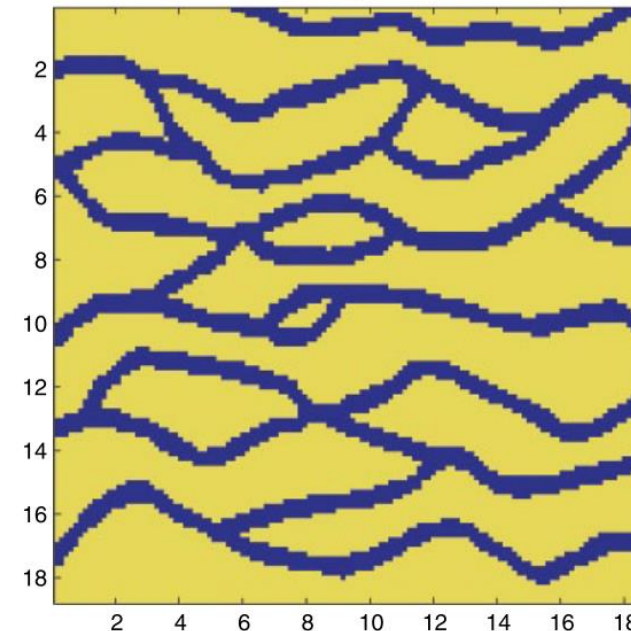
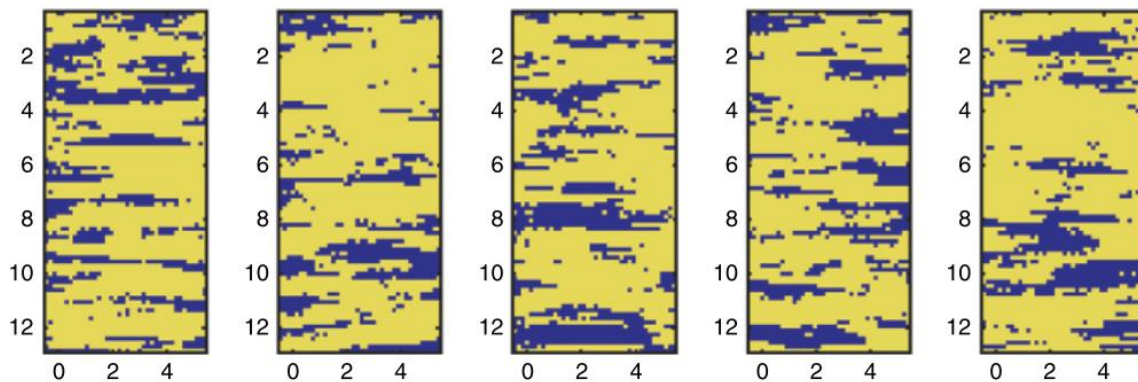
Rumlig variabilitet:

Variogrammer (Kovarians)

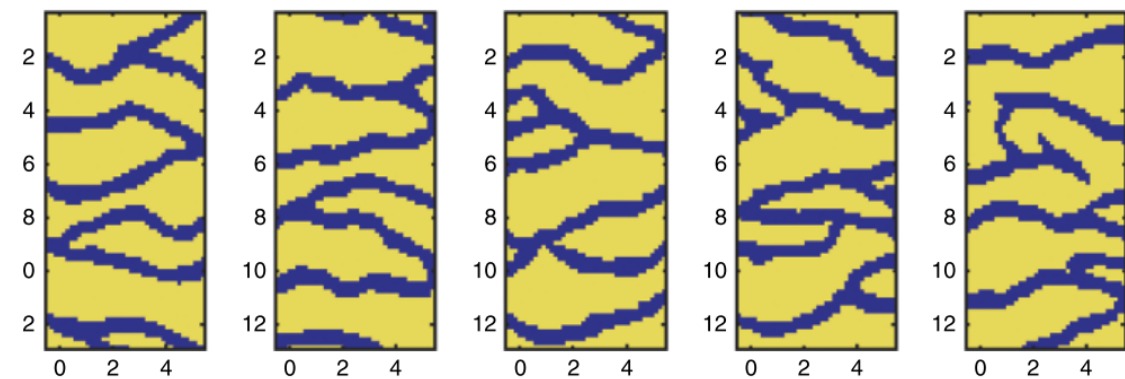
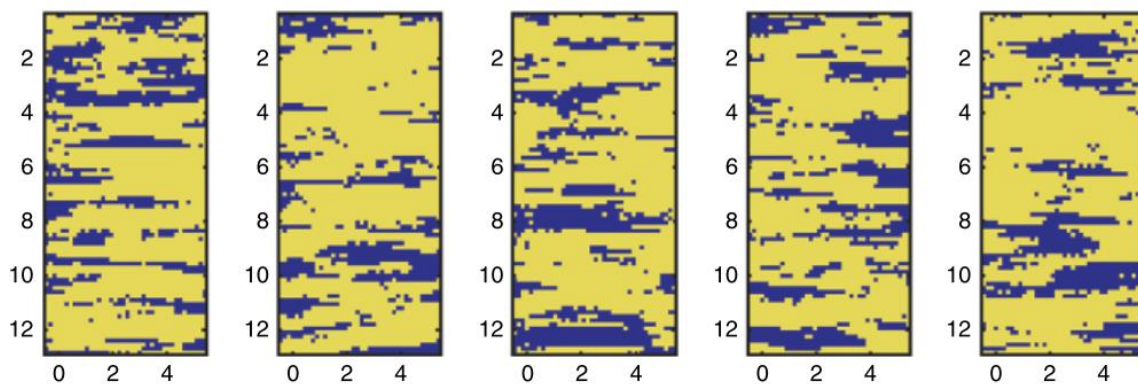
Topunkts-statistik.



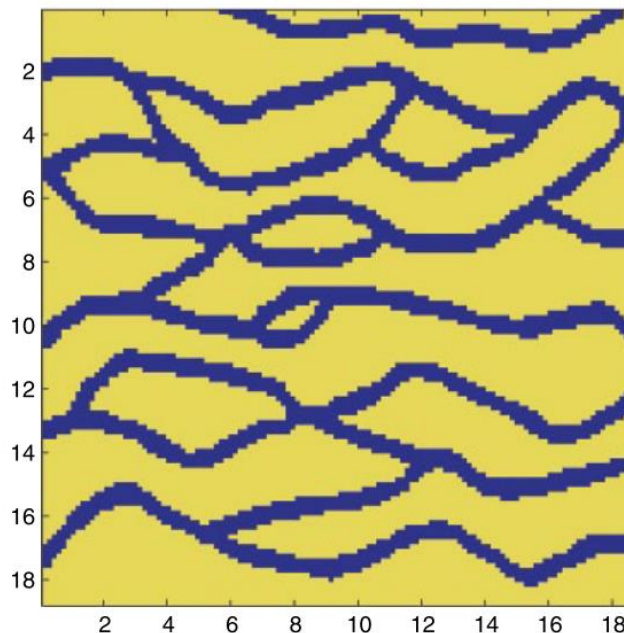
Geostatistisk simulering: - Gaussisk (kriging)



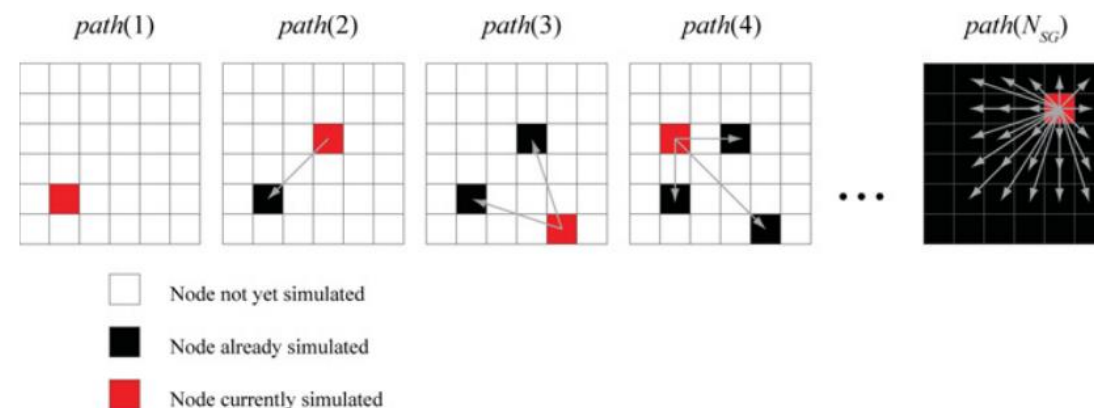
Geostatistisk simulering: - Flerpunkts-statistik (MPS)



Bedre reproduktion af komplekse rumlige mønstre og
sammenhængende klasser

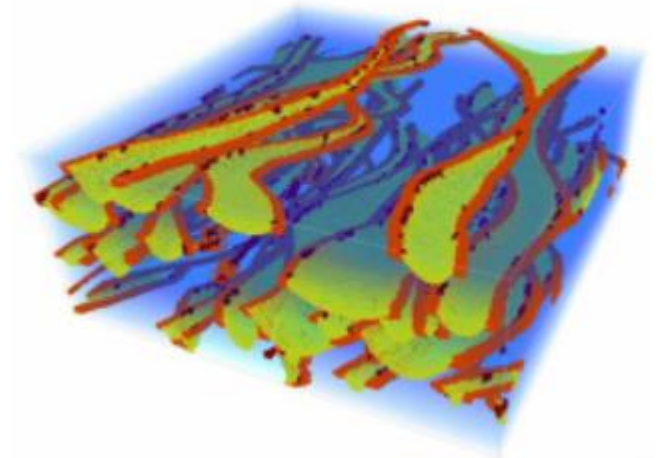
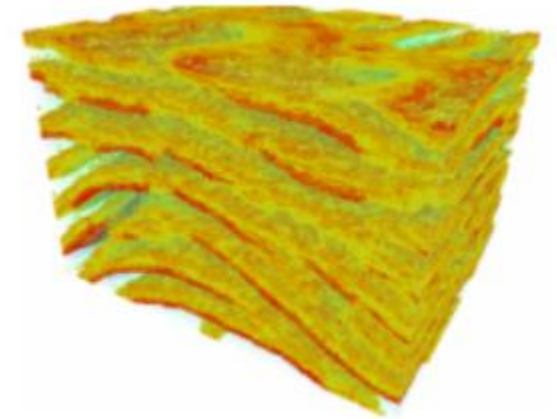
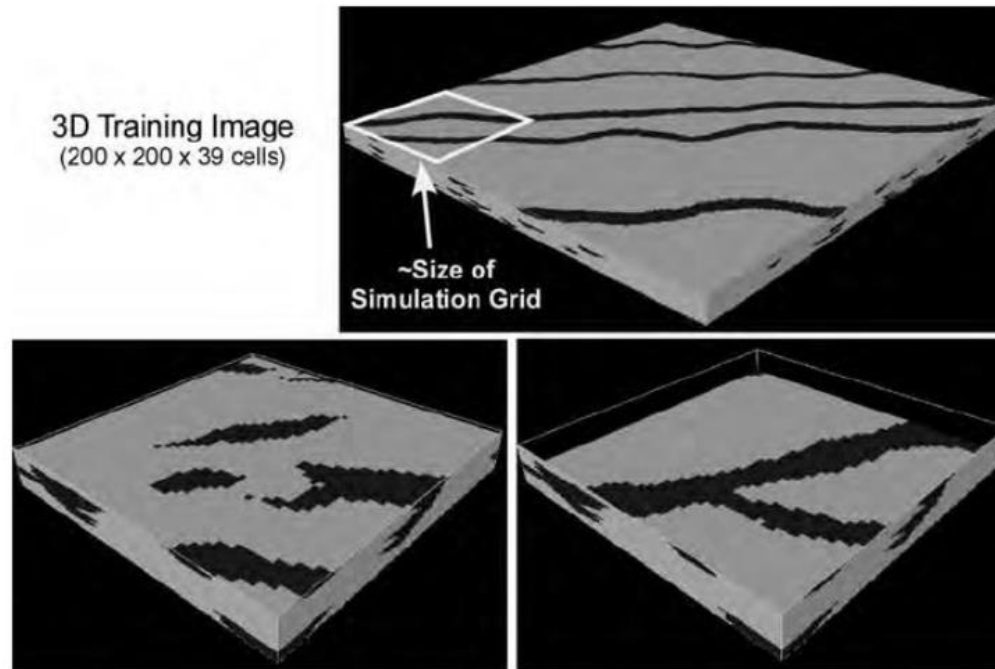


Træningsbillede



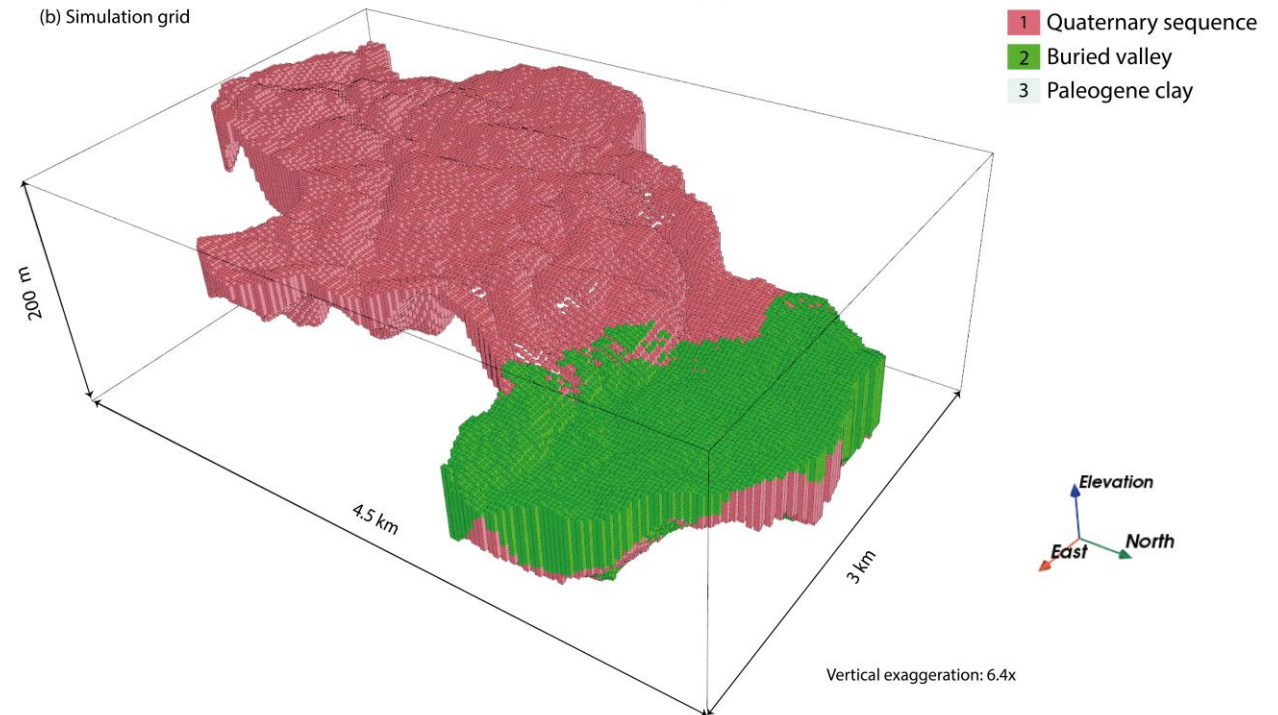
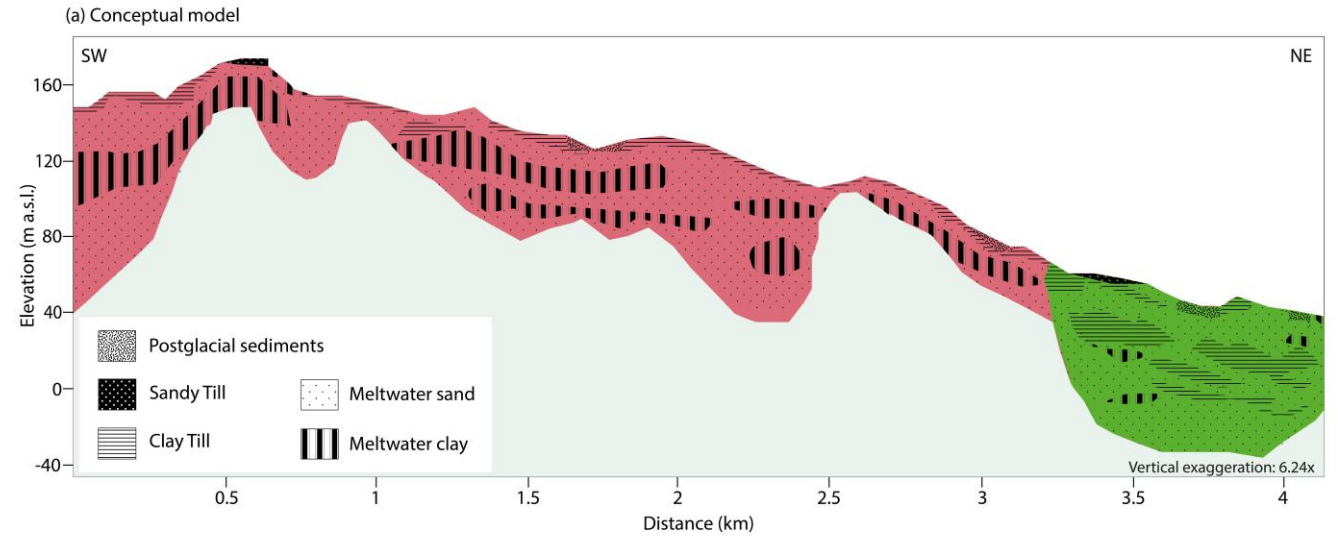
MPS

- Træningsbilleder: Beskriver den rumlige variation
- MPS algoritme: Simulere realisationer gennem en sandsynlighedstæthedsfunktion fra træningsbilledet



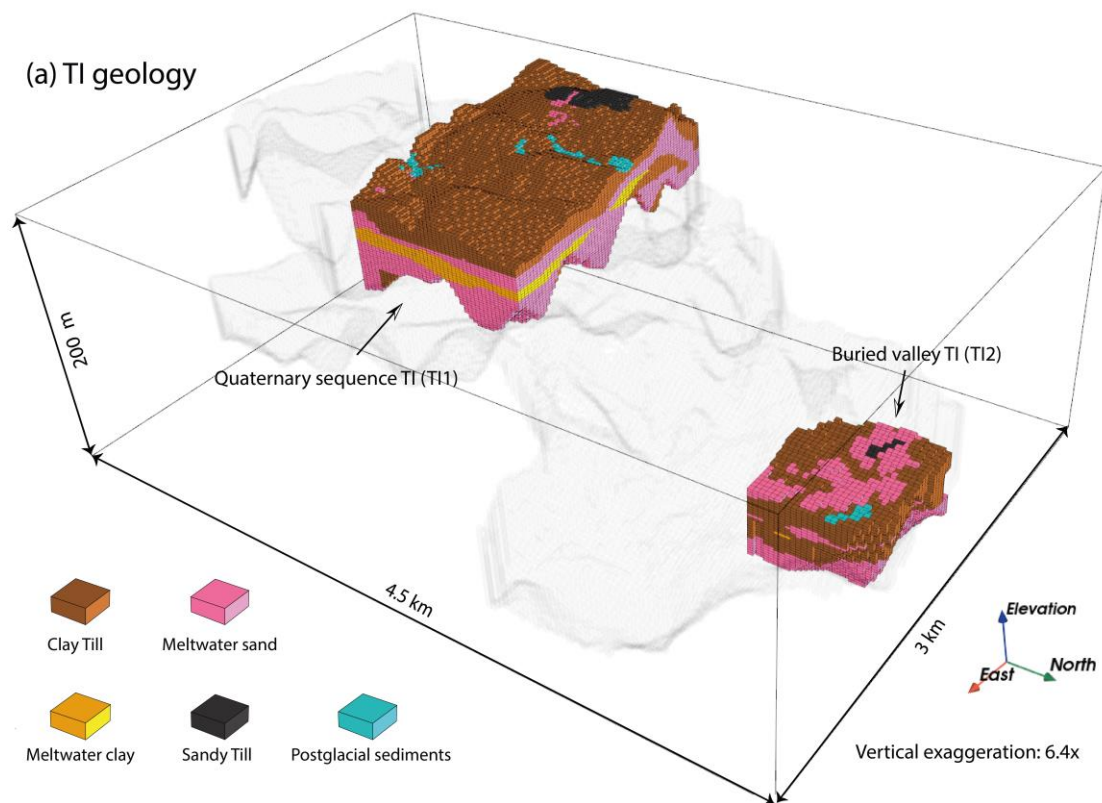
Simuleringsgrid

Geologiske elementer

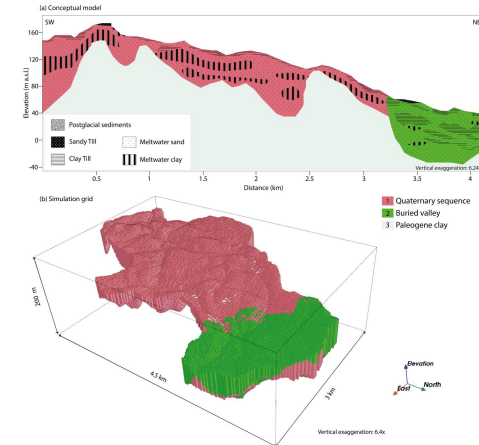
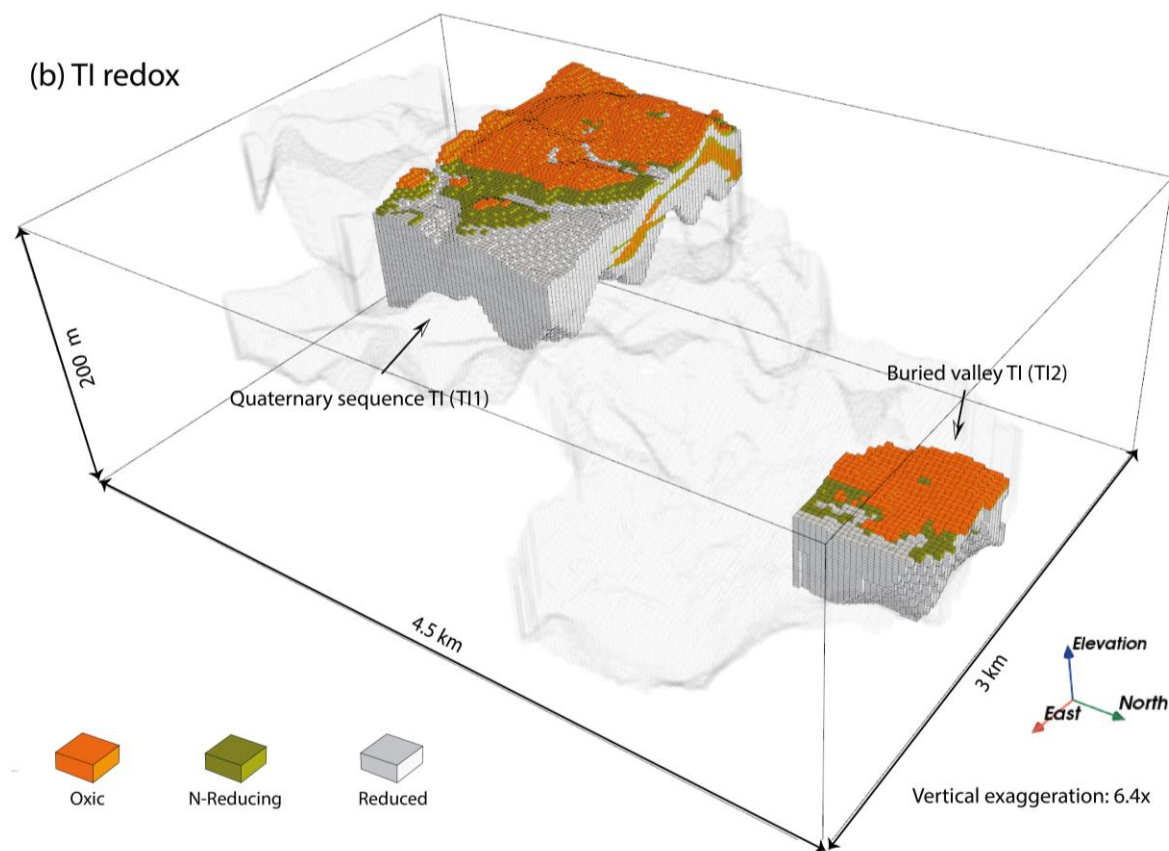


Træningsbilleder

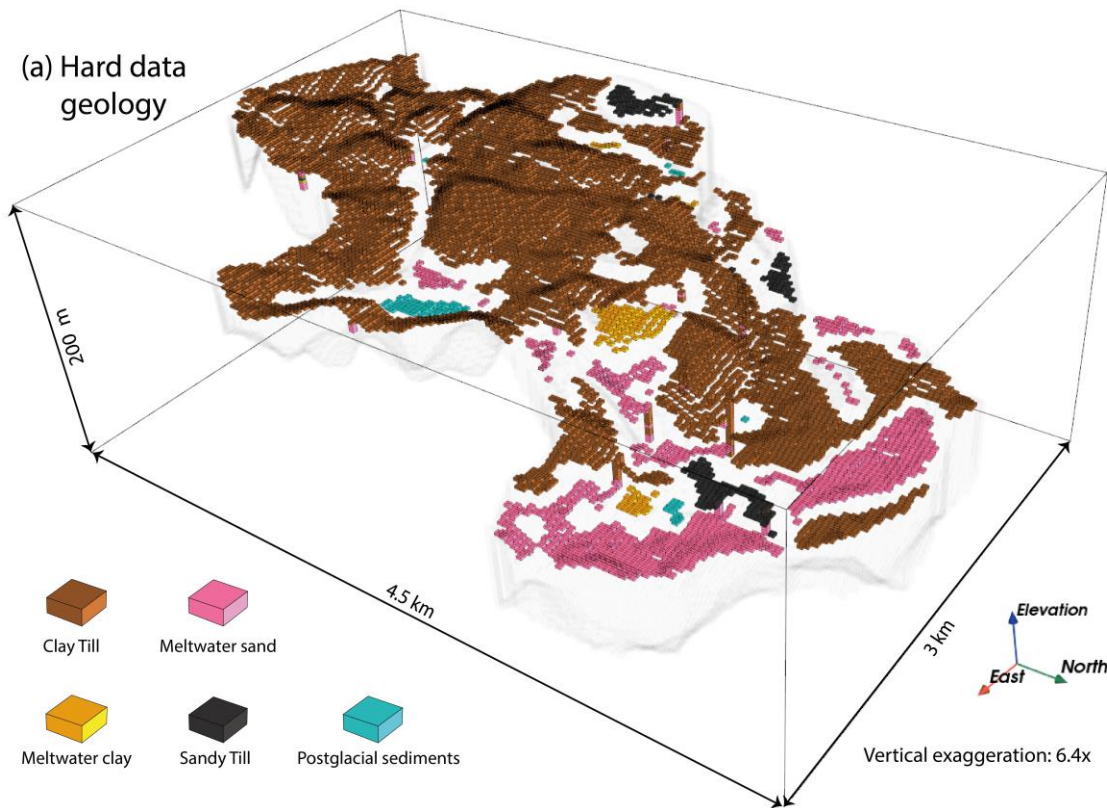
(a) TI geology



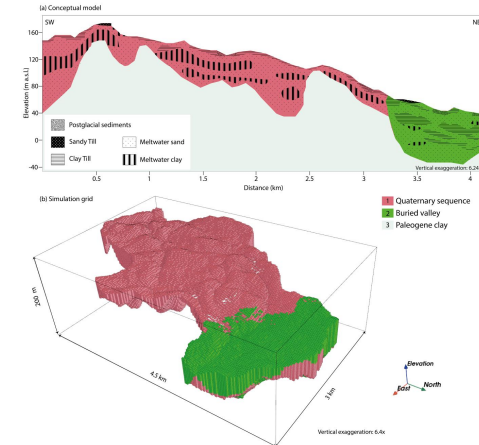
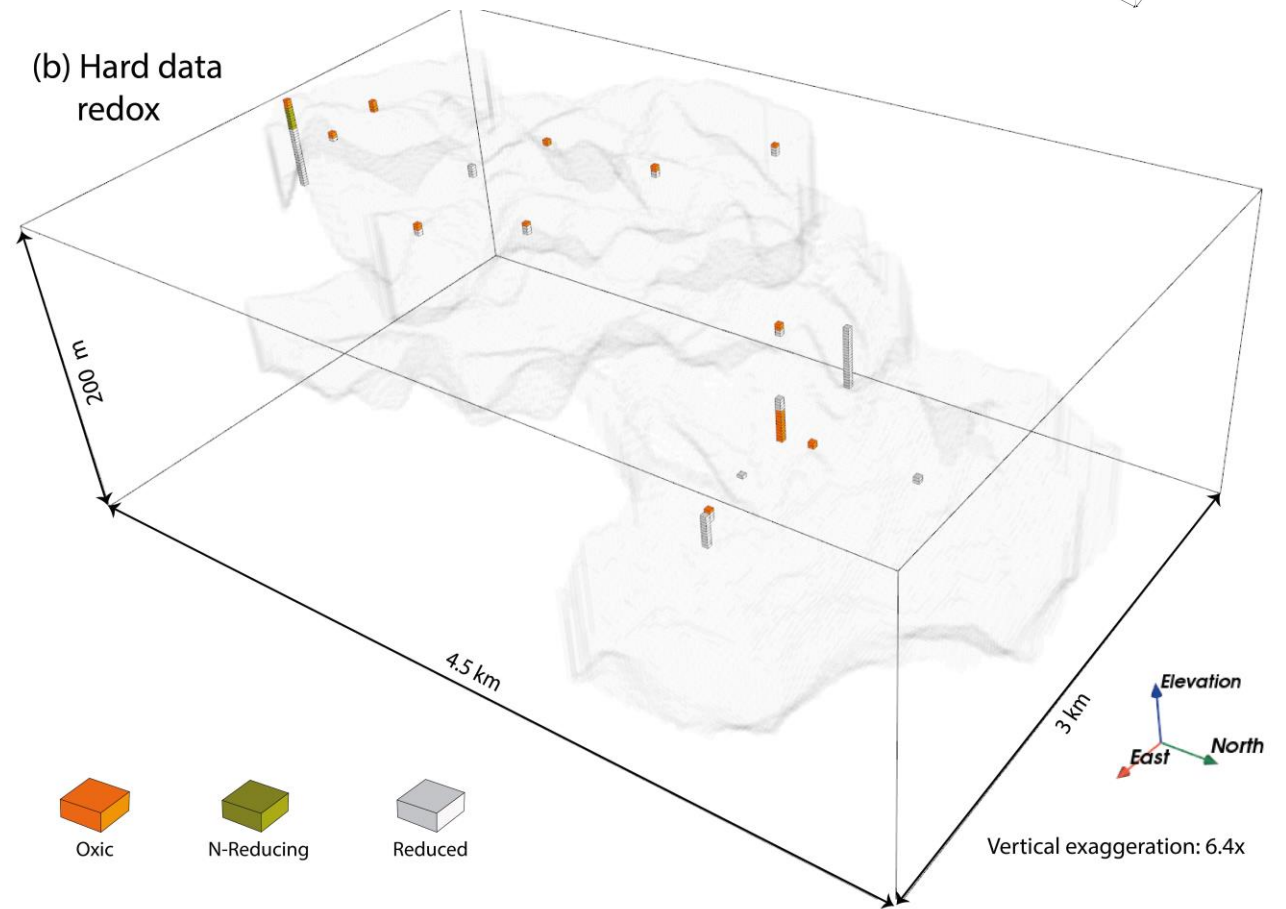
(b) TI redox



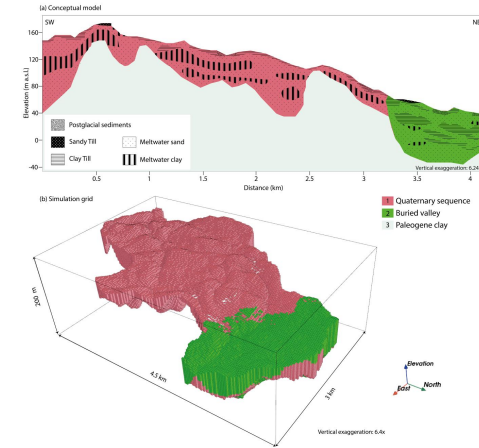
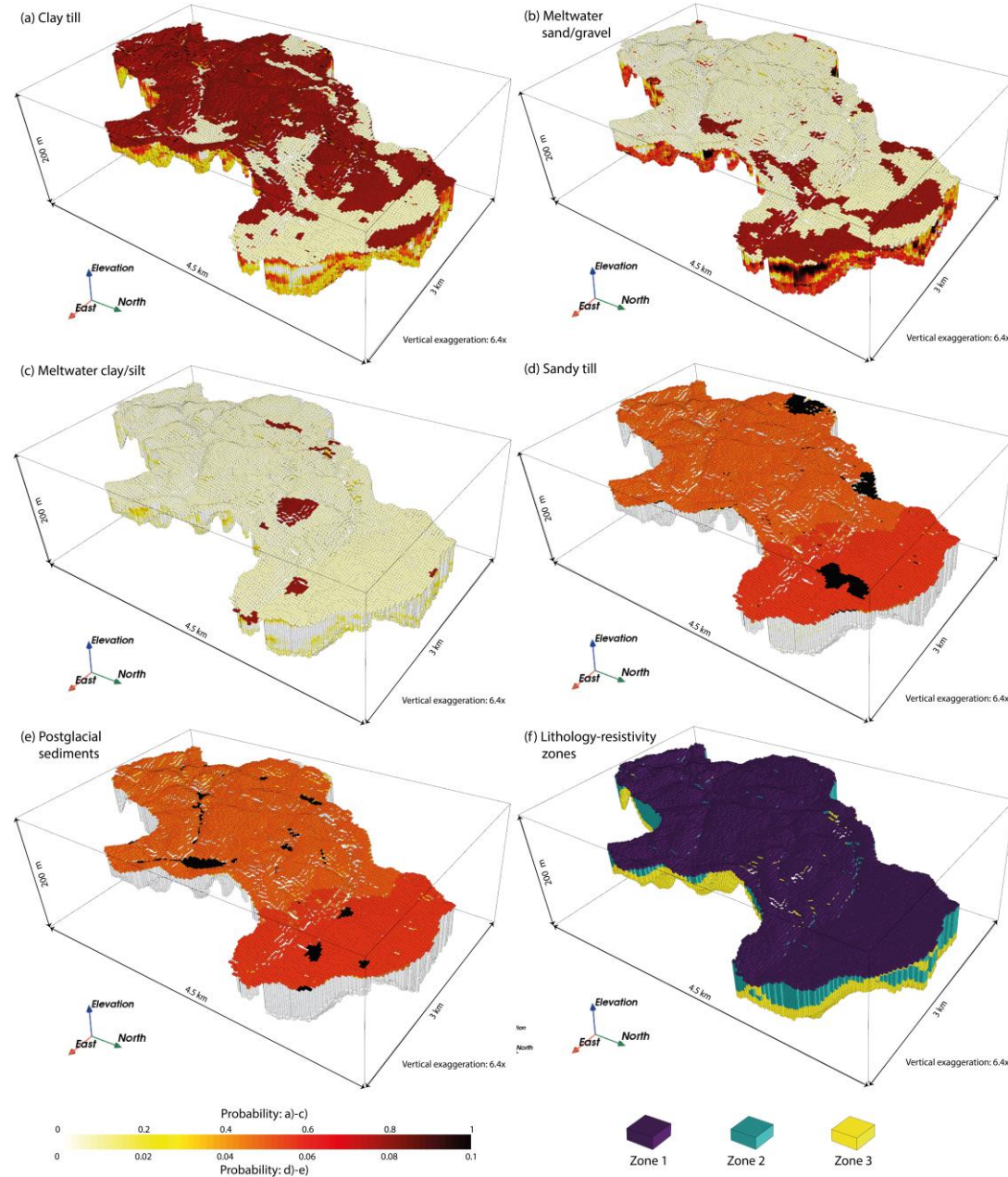
Hård data



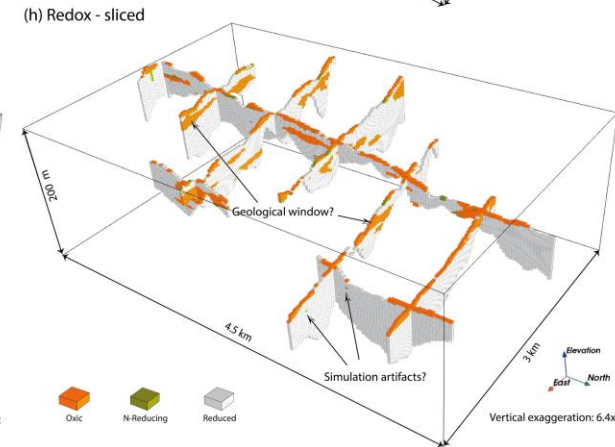
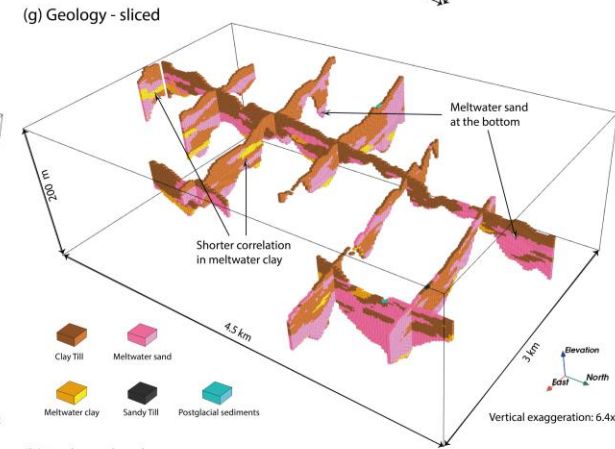
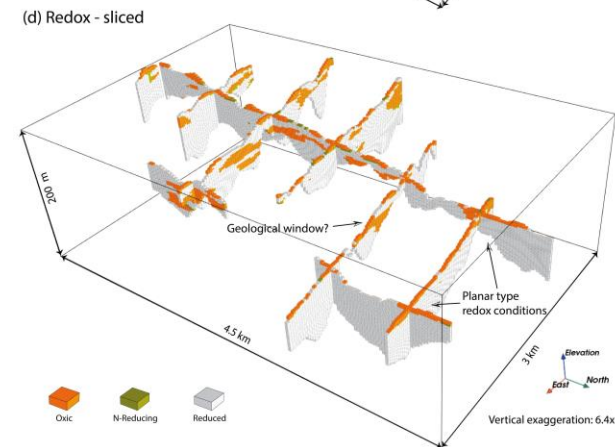
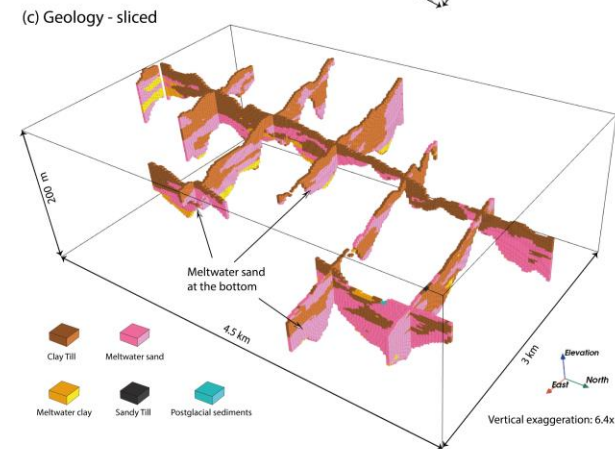
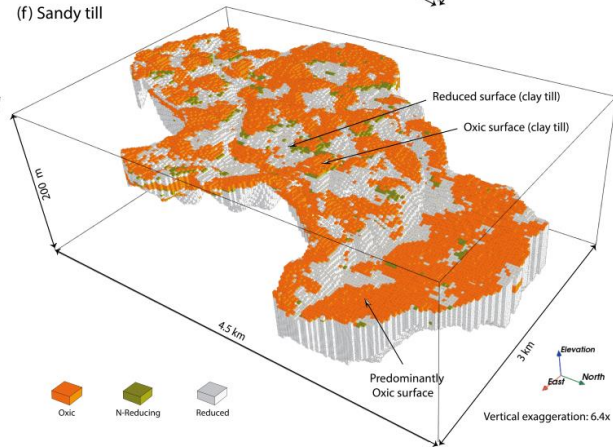
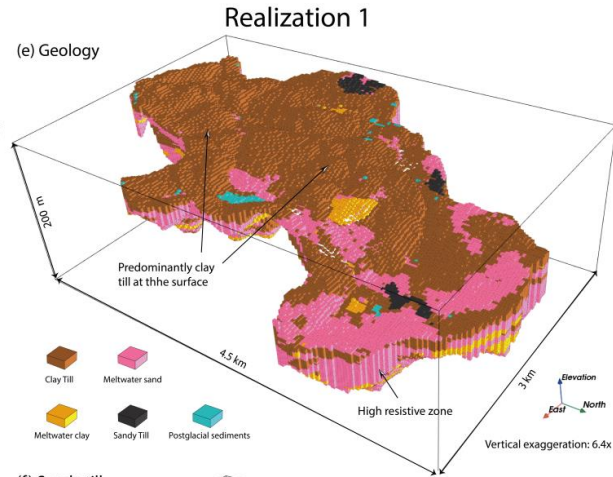
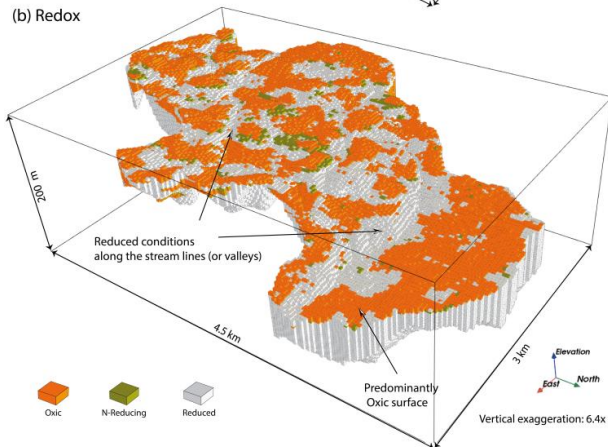
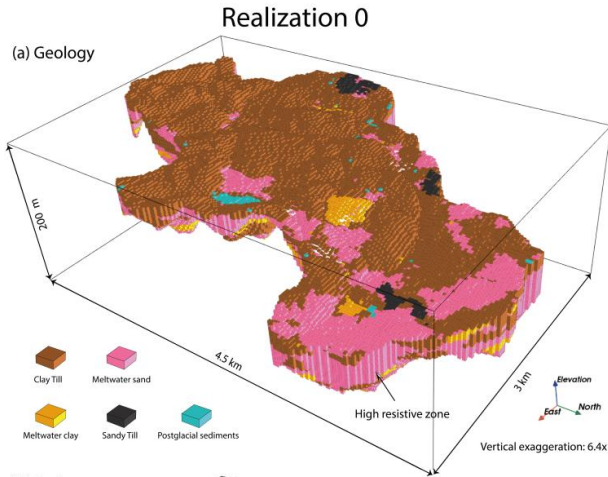
(b) Hard data redox



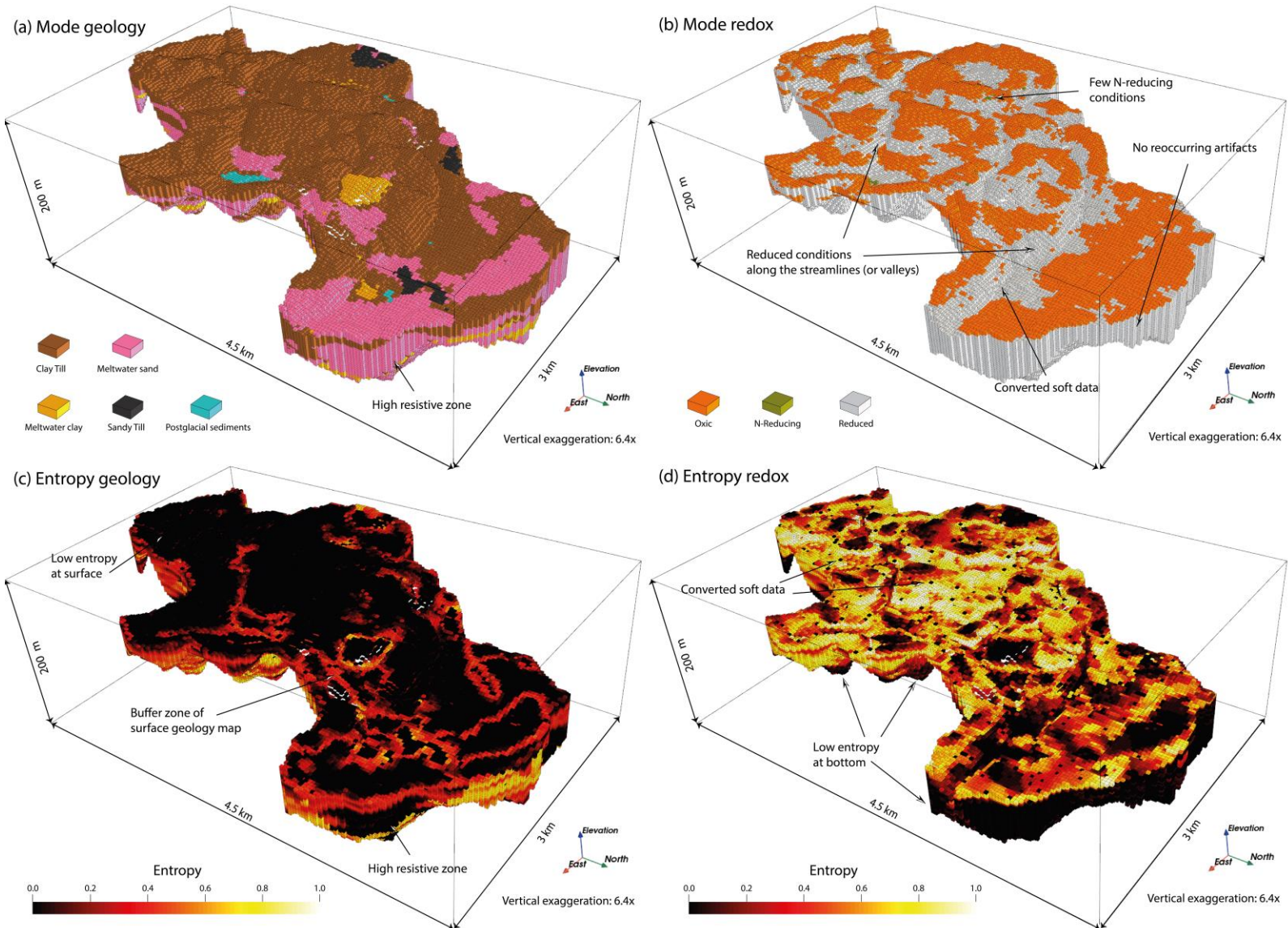
Blød data



Simuleringer



Opsummerende statistik



Spørgsmål