

Mere end struktur



*- moderne anvendelse af højopløselig
airborne geofysik i hydrologiske modeller*

Troels Vilhelmsen, AU; Pernille Marker, DTU; Nikolaj Foged, AU

Thomas Wernberg, Alectia; Anne-Sophie Høyer Christensen, GEUS

Peter Bauer-Gottwein, DTU; Steen Christensen, AU; Esben Auken, AU



Strukturel usikkerhed...

Capture zone, travel time, and solute-transport predictions using inverse modeling and different geological models

William G. Harrar · Torben Obel Sonnenborg ·
Hans Jørgen Henriksen

WATER RESOURCES RESEARCH, VOL. 48, W06503, doi:10.1029/2011WR011149, 2012

- › ministes ont été utilisés pour définir les distributions de la
- conductivité hydraulique dans deux modèles d'écoulement en régime permanent qui ont été calibrés avec des
- 1 estimations des charges et des écoulements de base faites
- 2 par des techniques inverses. Les estimations optimisées

Assessment of hydrological model predictive ability given multiple conceptual geological models

Dorte Seifert,¹ Torben O. Sonnenborg,² Jens Christian Refsgaard,² Anker L. Højberg,²
and Lars Trolldborg²

Use of alternative conceptual models to assess the impact of a buried valley on groundwater vulnerability

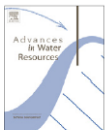
Dorte Seifert · Torben O. Sonnenborg ·
Peter Scharling · Klaus Hinsby



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Review of strategies for handling geological uncertainty in groundwater flow and transport modeling

Jens Christian Refsgaard^{a,*}, Steen Christensen^b, Torben O. Sonnenborg^a, Dorte Seifert^c,
Anker Lajer Højberg^a, Lars Trolldborg^a

^a Geological Survey of Denmark and Greenland (GEUS), Øster Voldgade 10, DK-1350 Copenhagen K, Denmark

^b Department of Earth Sciences, Aarhus University, Denmark

^c ALECTIA, Denmark

Autogenerering af hydrostratigrafiske modeller fra SkyTEM data og boringsbeskrivelser

Kan denne metode anvendes til evaluering af strukturel usikkerhed

CF-Resistivity clustering

Input

- Resistivity model
- Borehole lithology

Clay fraction

Input

- Clay fraction model
- Resistivity model

3D cluster model

Input

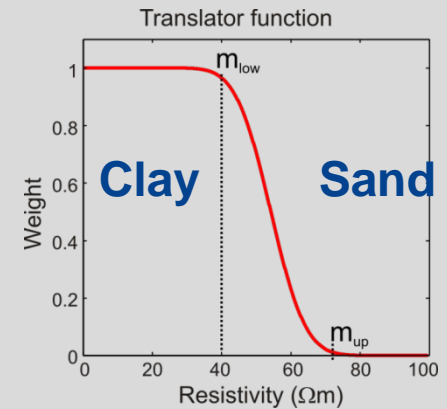
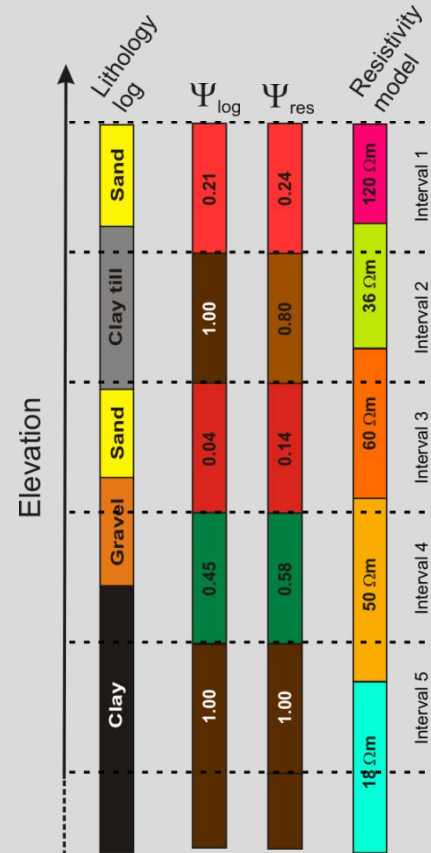
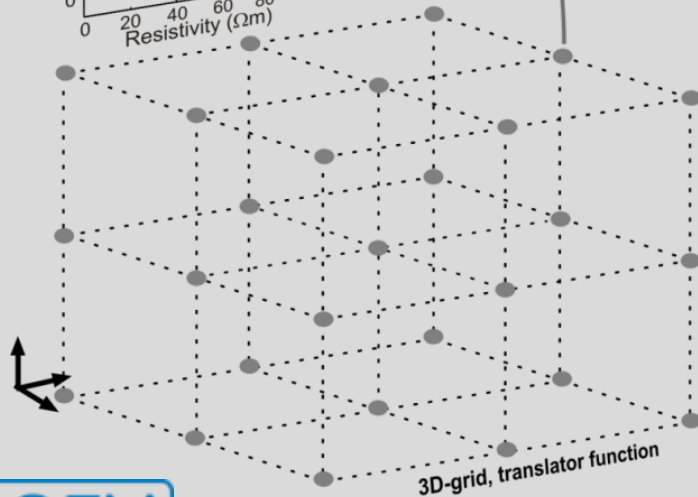
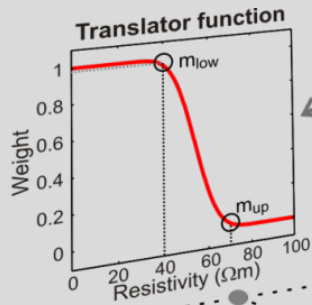
- Cluster model
- Potential head
- Stream discharge

Hydrological model calibration

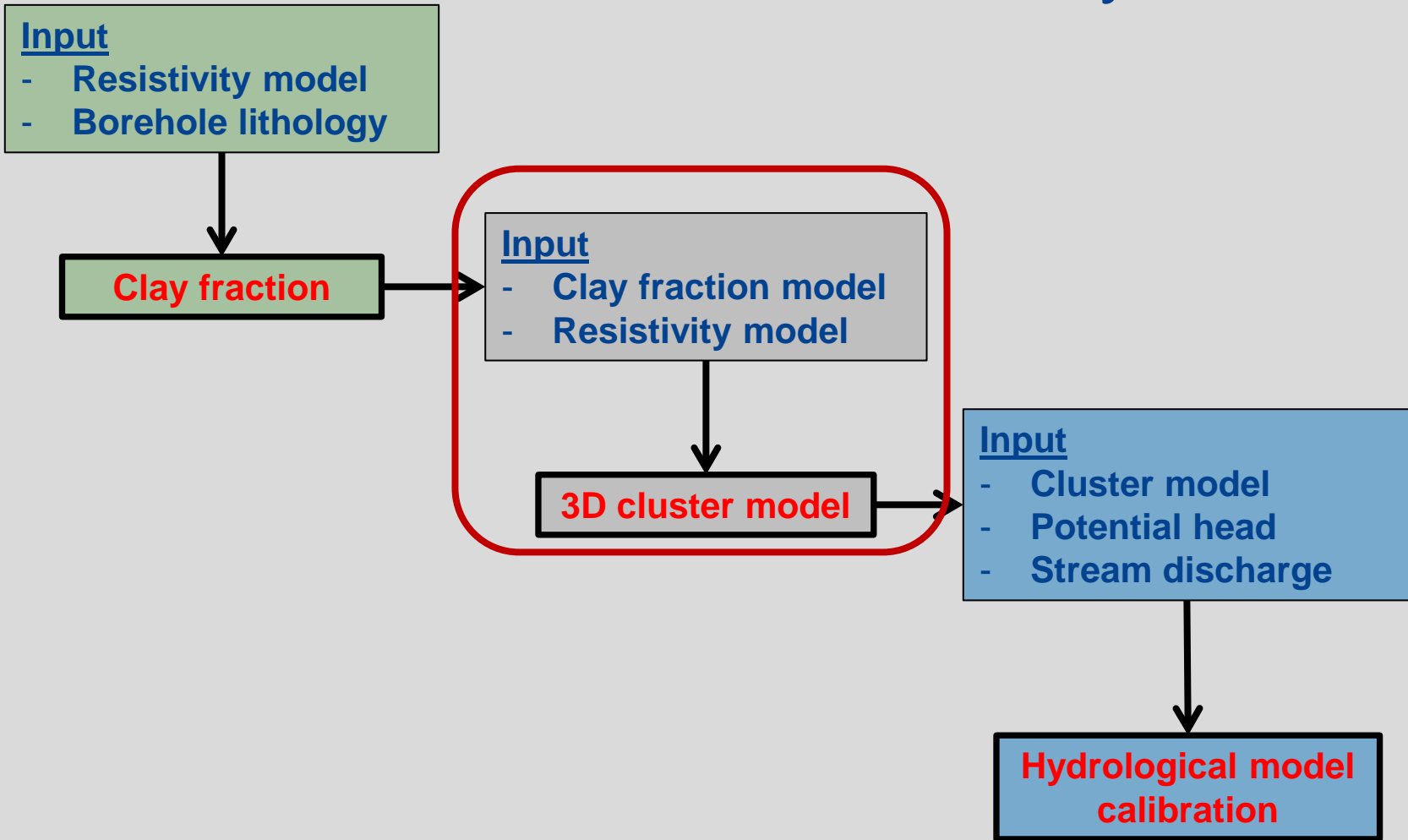


Clay fraction (CF) concept

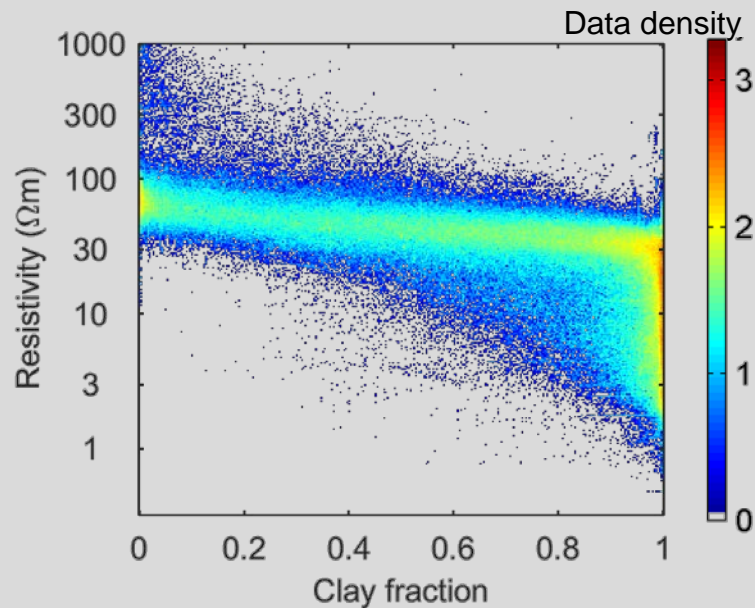
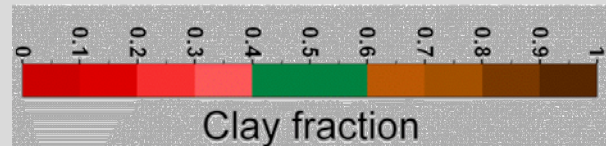
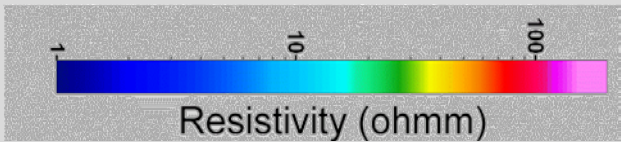
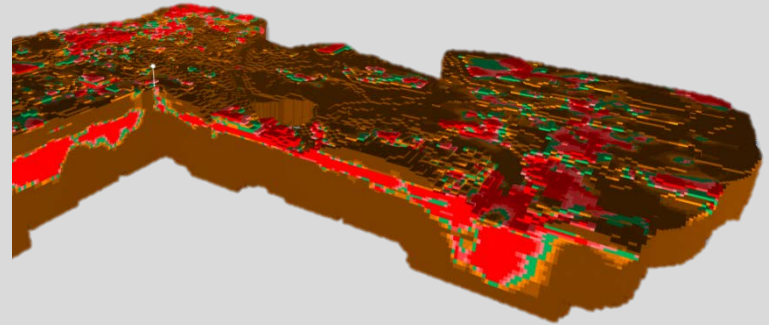
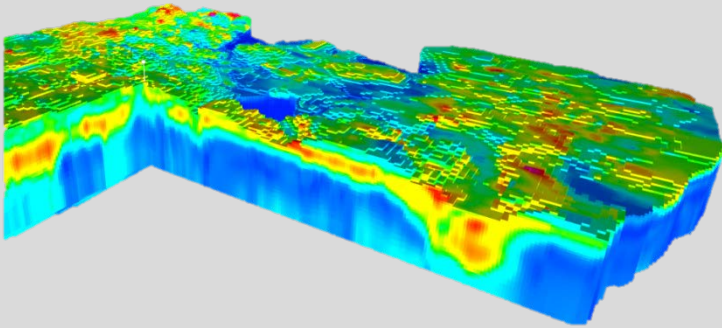
Translate resistivity to clay/sand using lithological logs



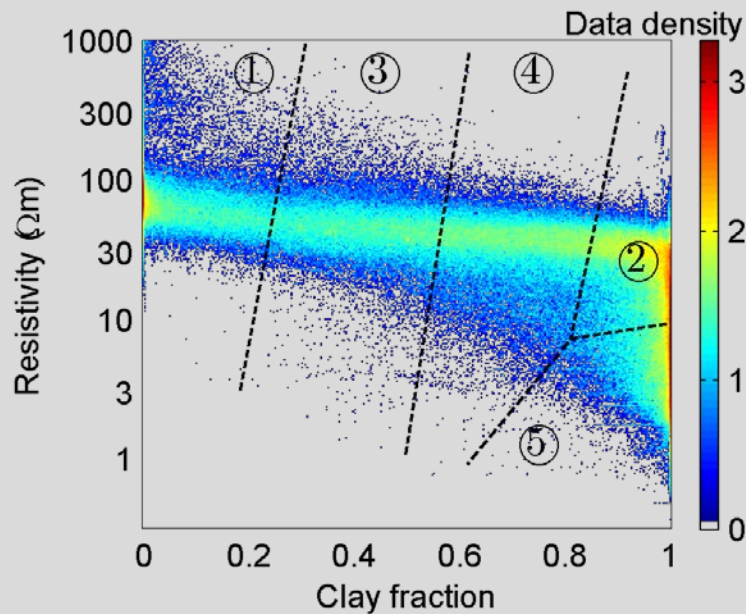
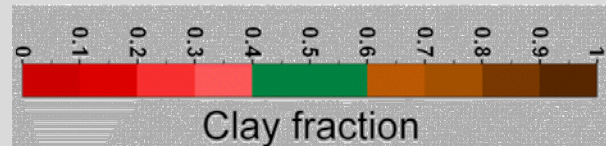
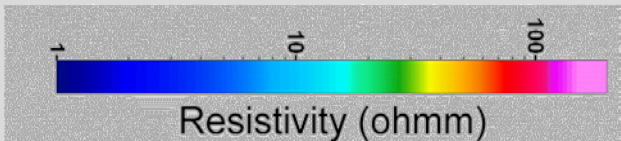
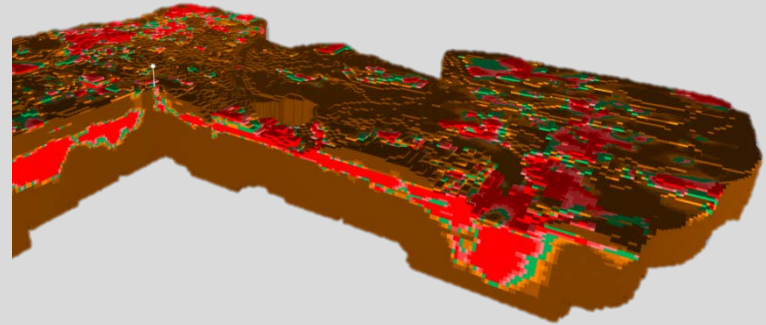
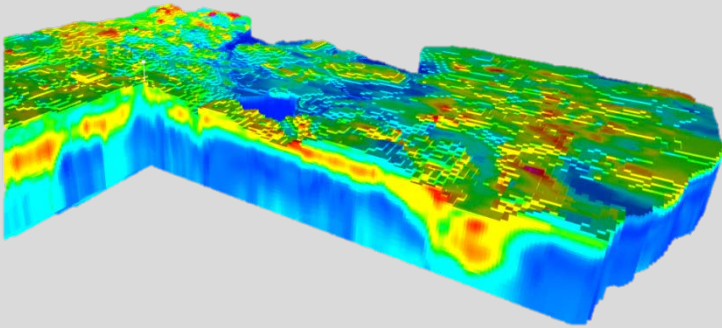
CF-Resistivity clustering



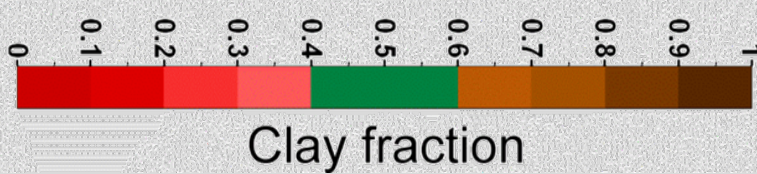
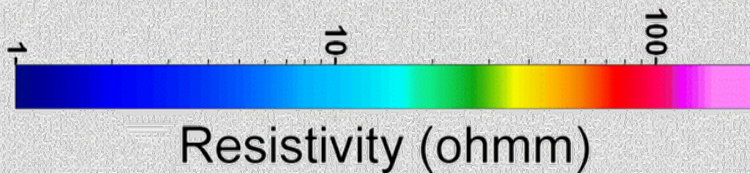
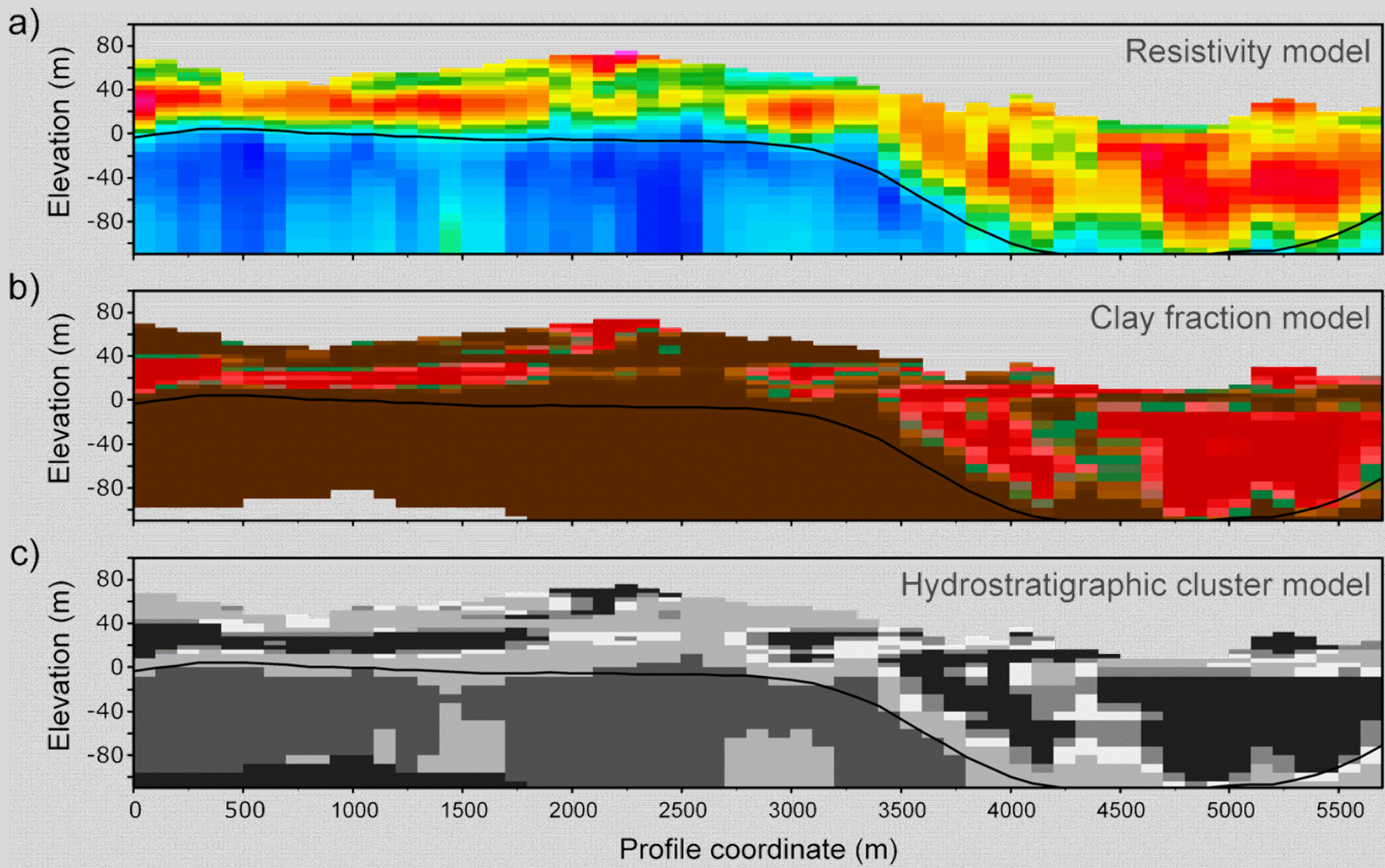
3D cluster model



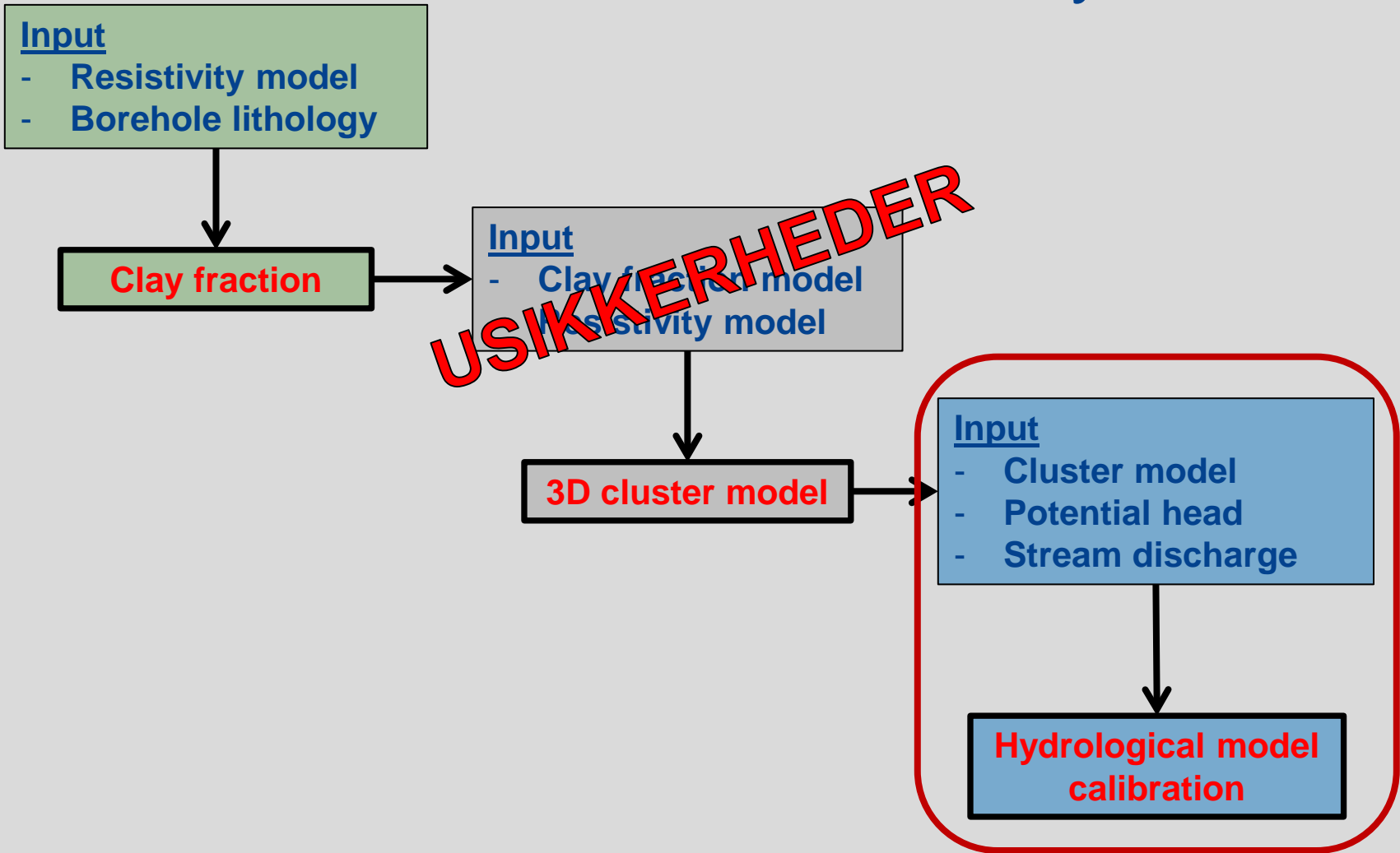
3D cluster model



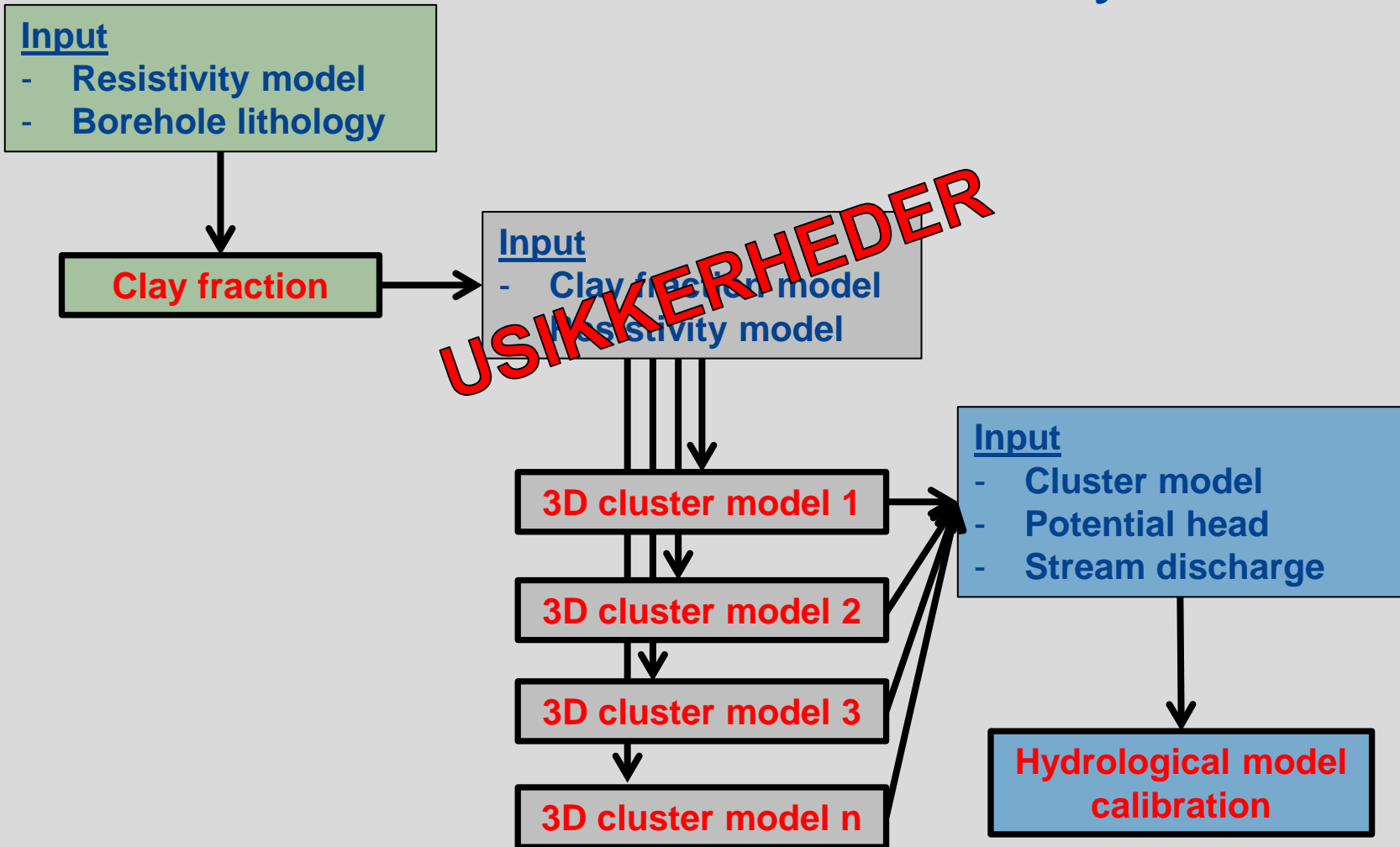
5 clusters udvalgt vha. k-means



CF-Resistivity clustering



CF-Resistivity clustering



Håndtering af usikkerheder på input

- Perturber resistivitet og CF med usikkerheder på felter

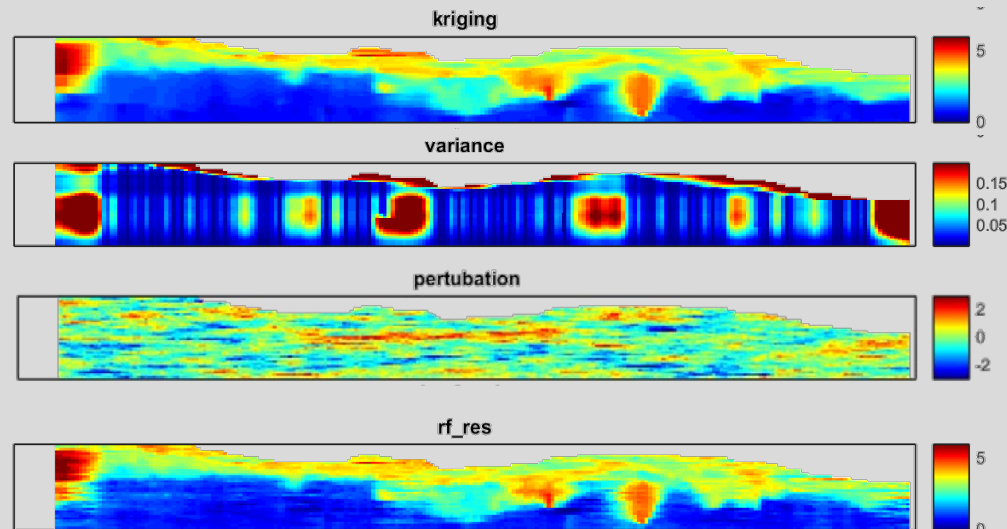
$$X(\mathbf{x}) = X'(\mathbf{x}) * \sigma(\mathbf{x}) + \mu(\mathbf{x})$$

μ : mean

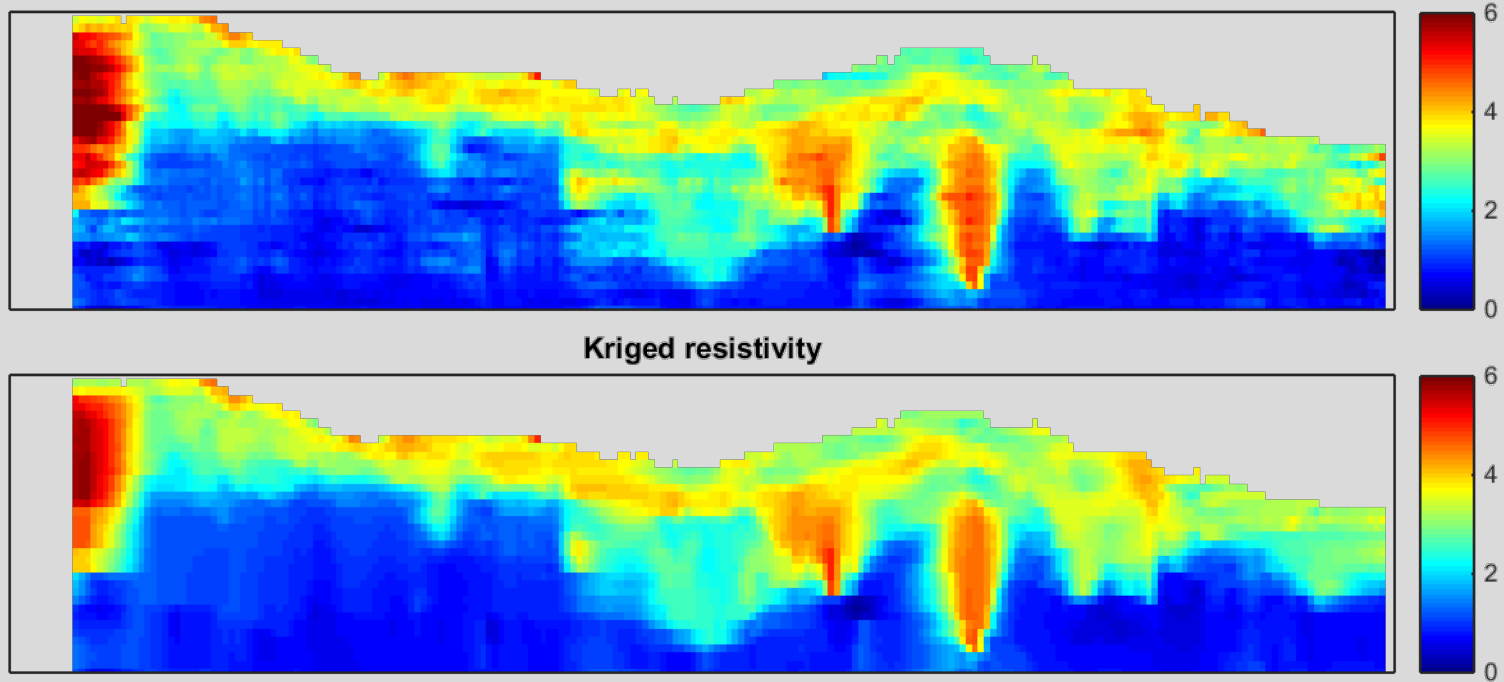
σ : standard deviation

X' : stationary random field

X : non-stationary perturbed field

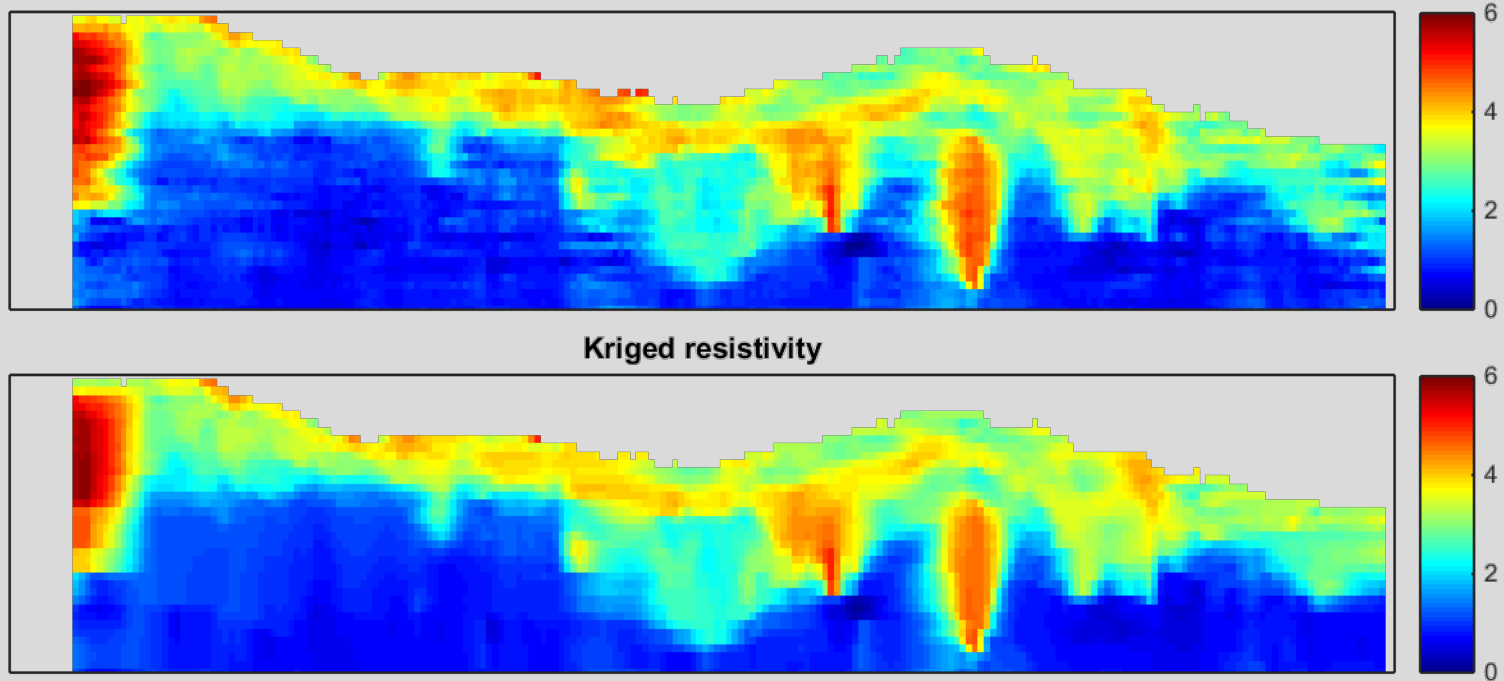


Usikkerheder i resistivitet

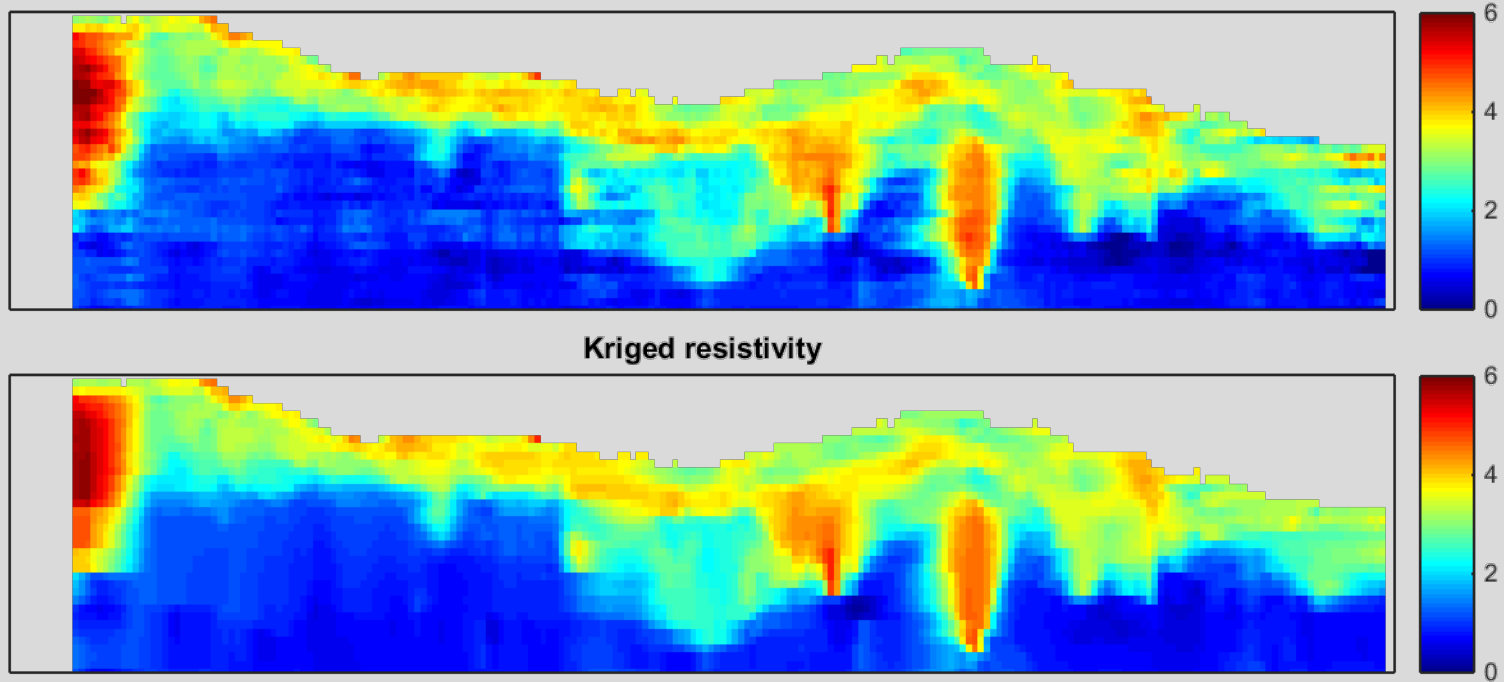


Kriged resistivity

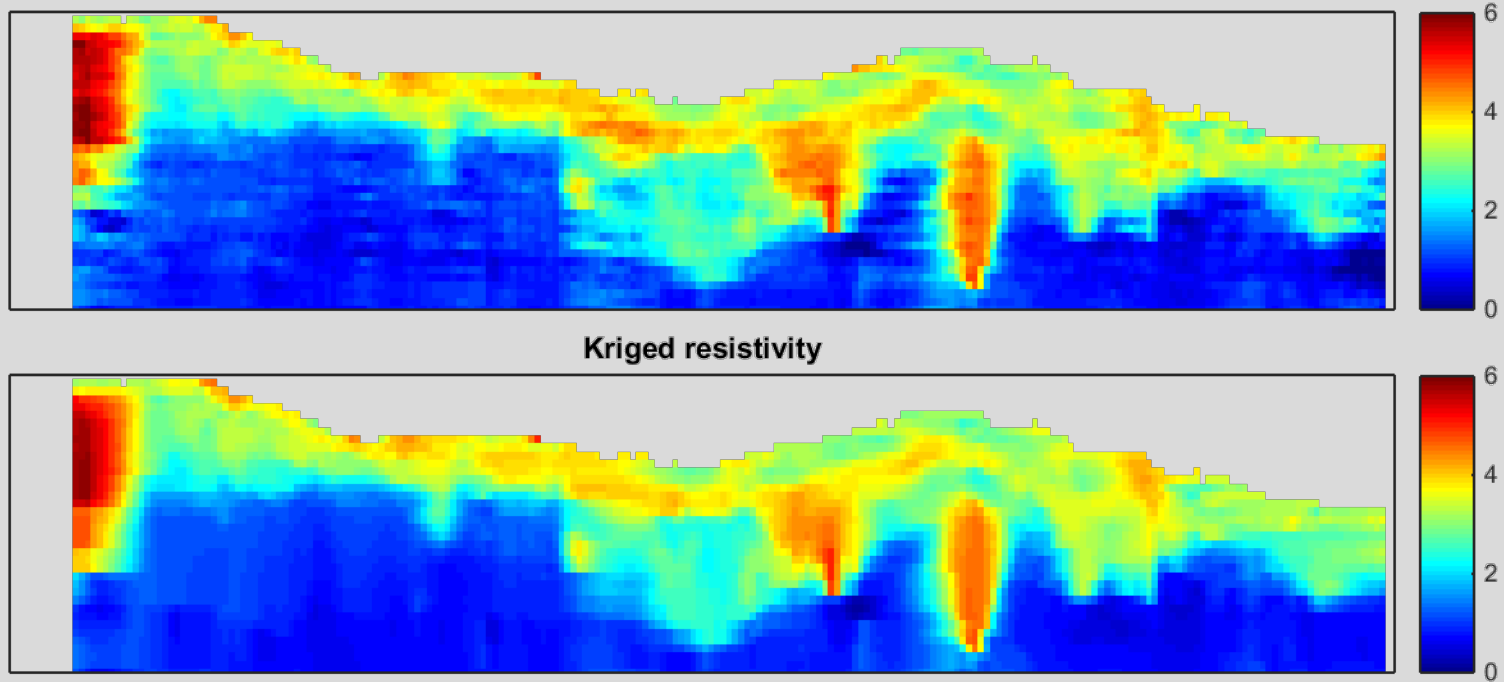
Usikkerheder i resistivitet



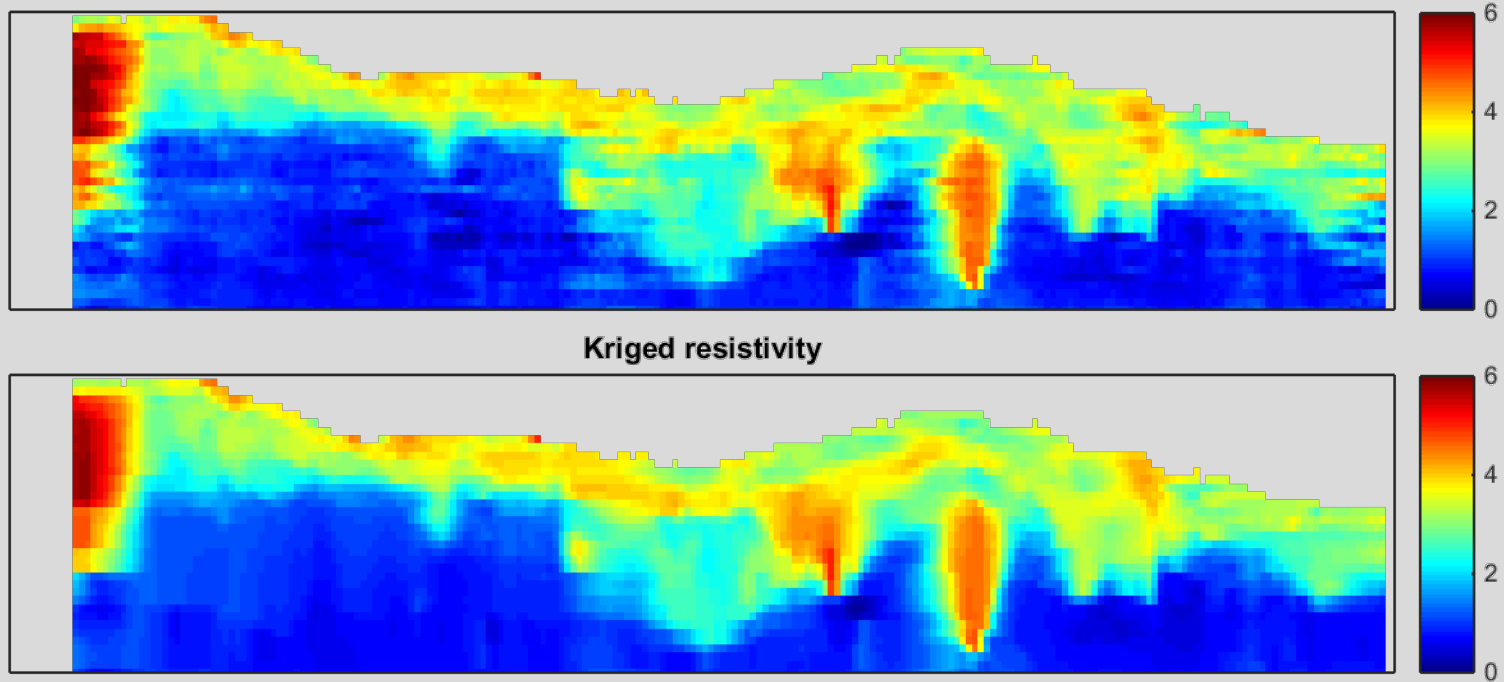
Usikkerheder i resistivitet



Usikkerheder i resistivitet

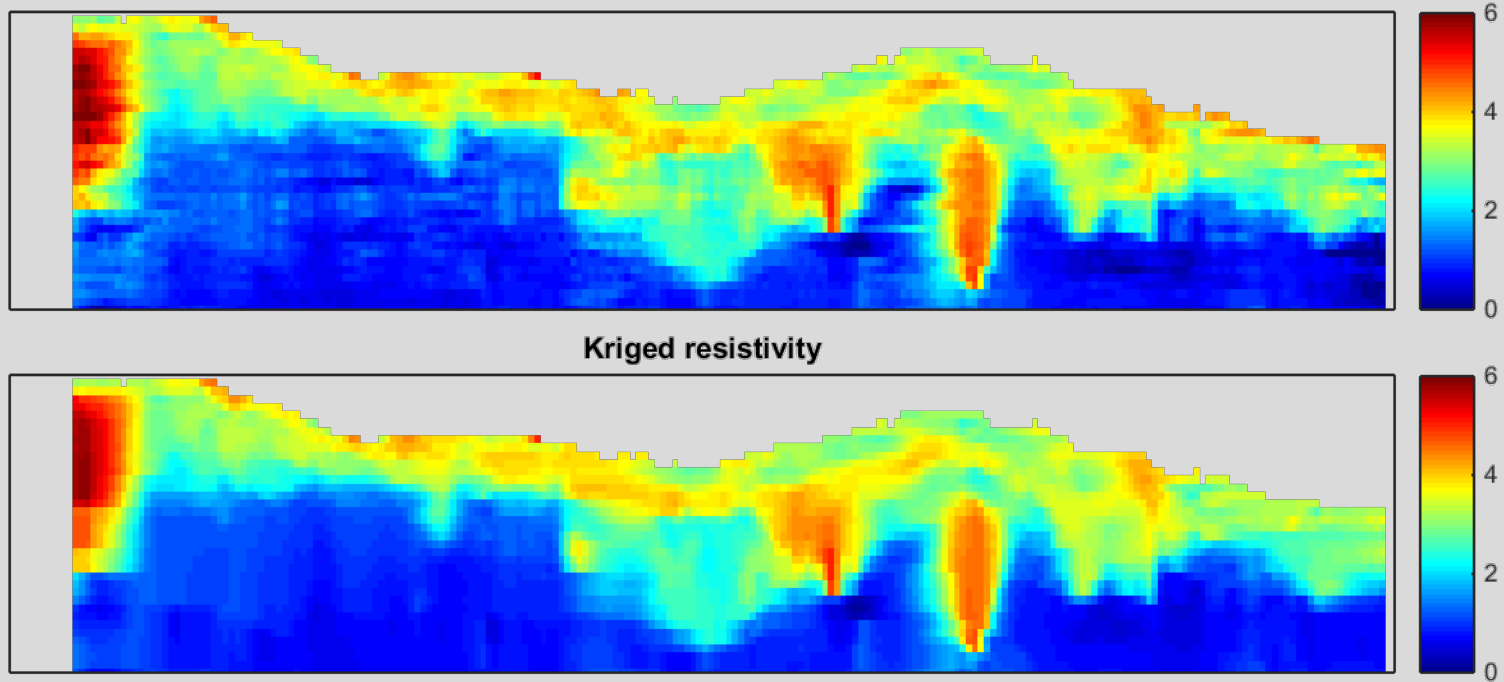


Usikkerheder i resistivitet



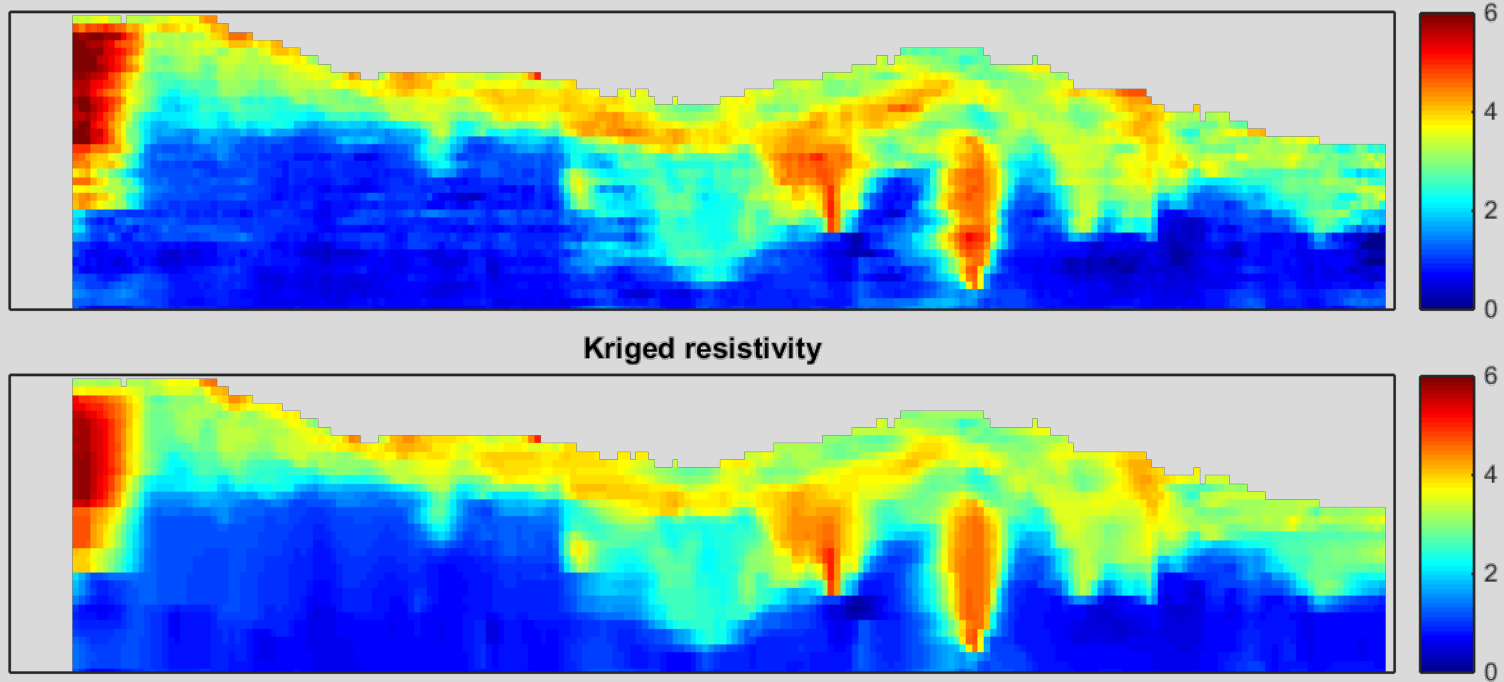
Kriged resistivity

Usikkerheder i resistivitet



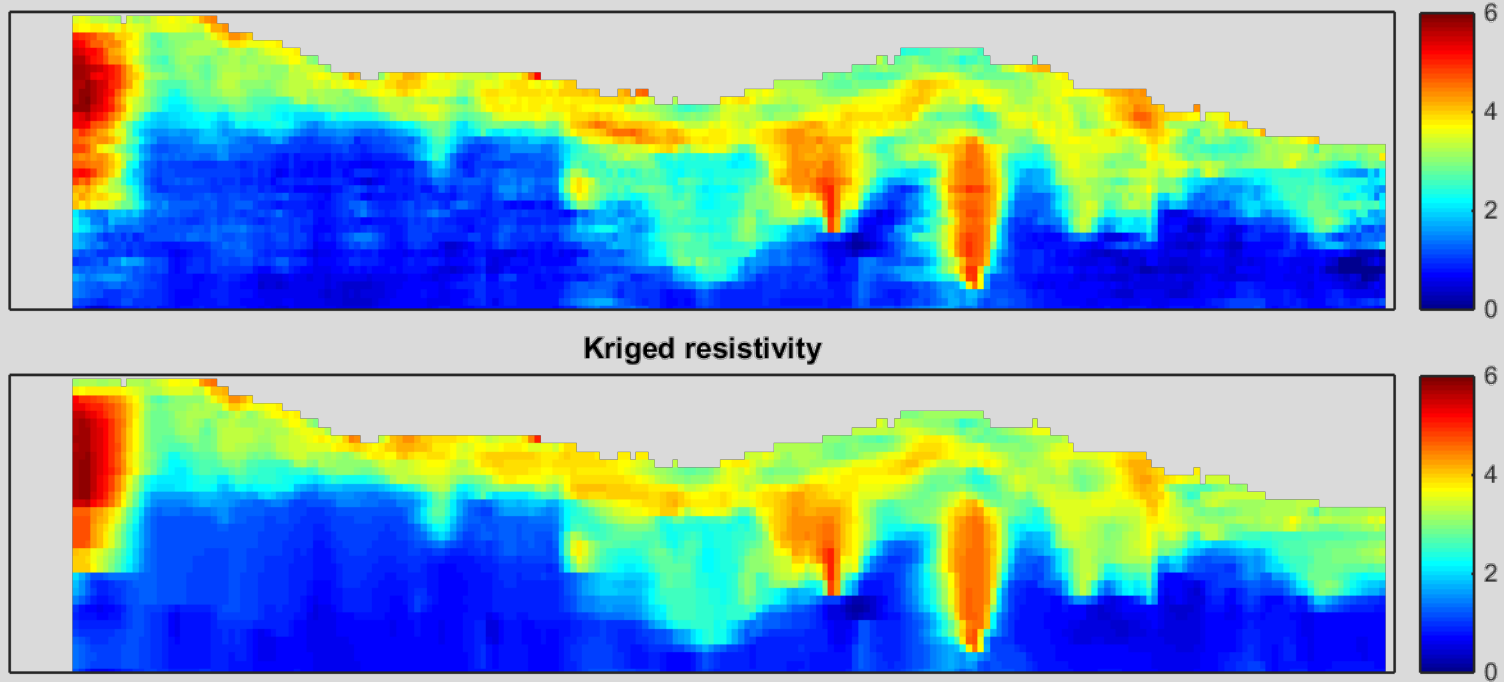
Kriged resistivity

Usikkerheder i resistivitet



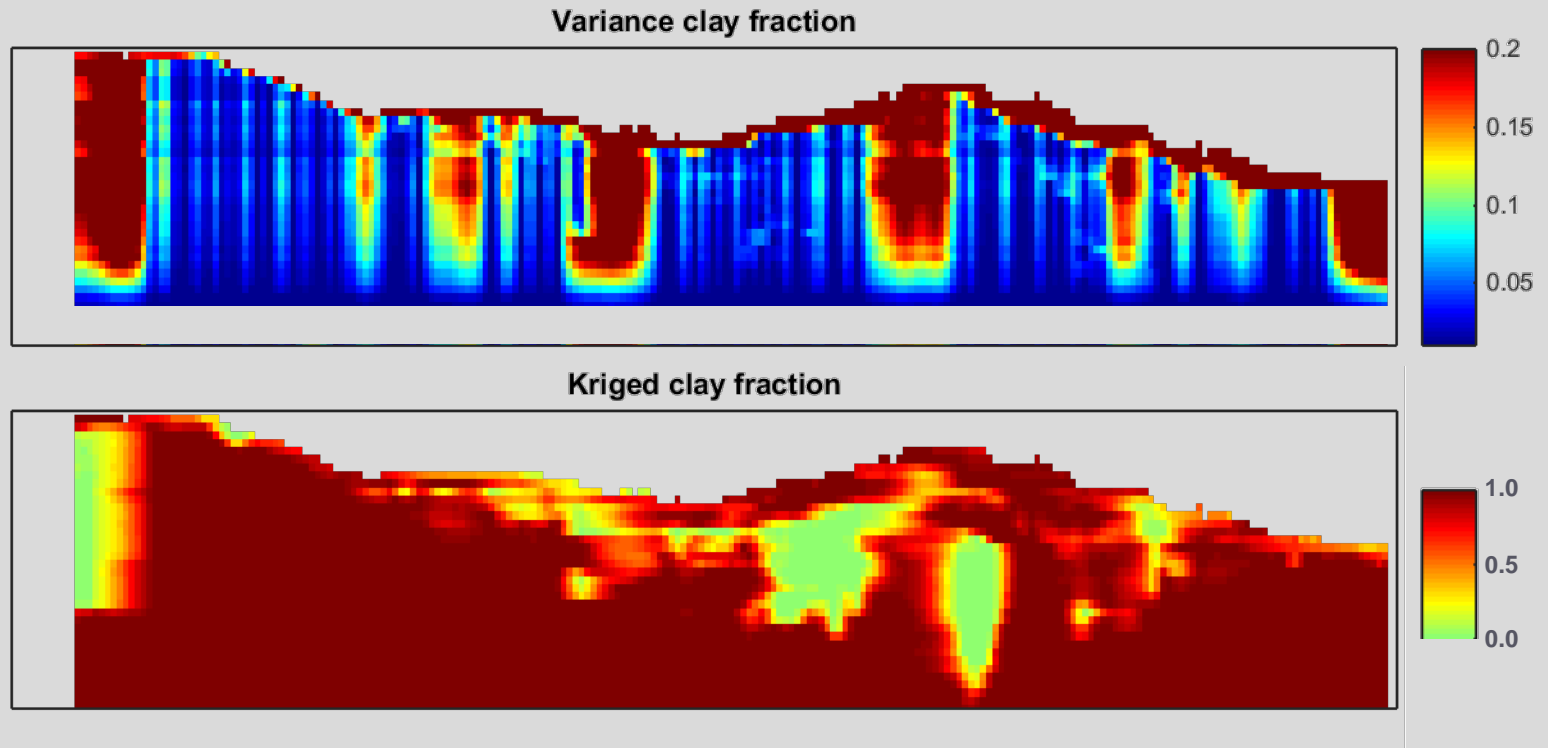
Kriged resistivity

Usikkerheder i resistivitet



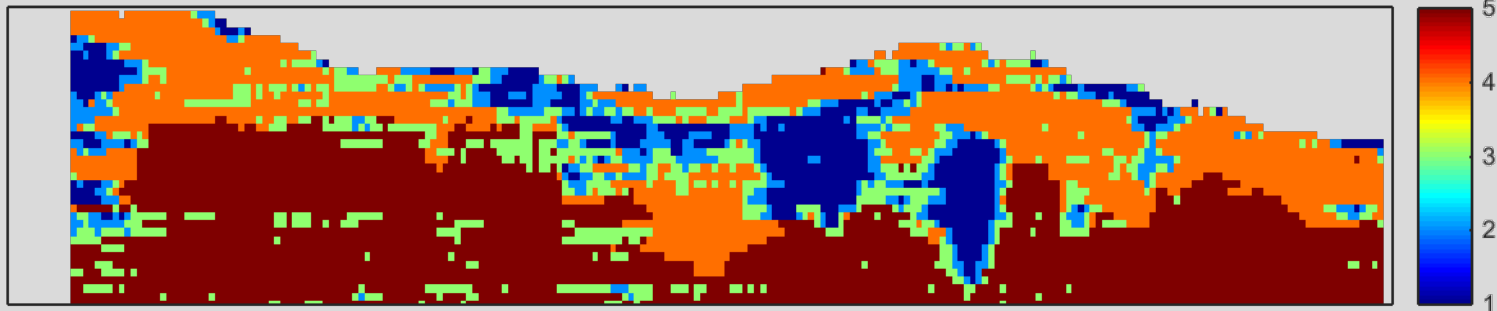
Kriged resistivity

Usikkerheder i CF

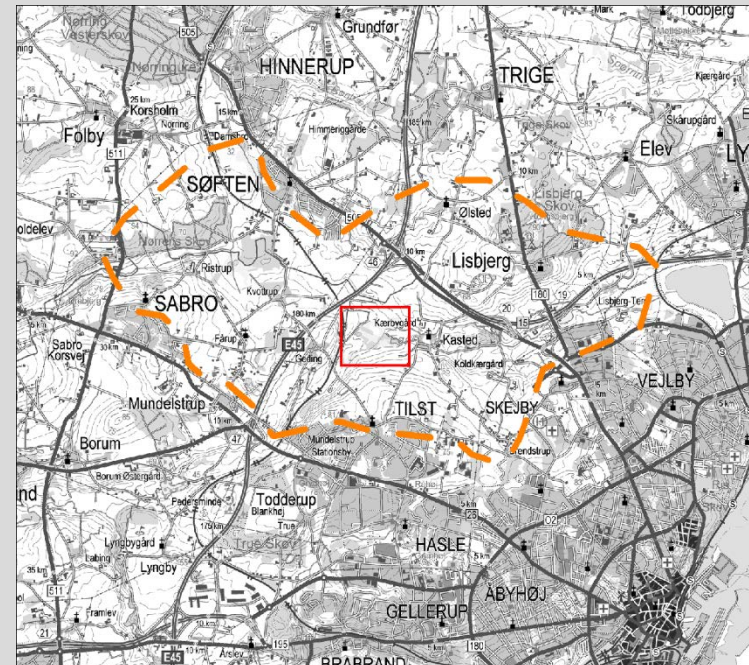
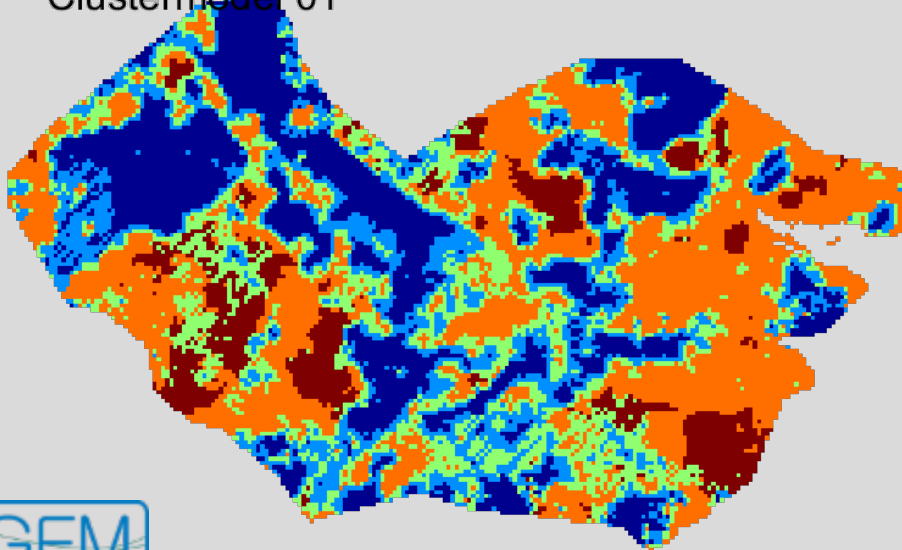


Usikkerheder i Cluster Modeller

Clustermodel 01

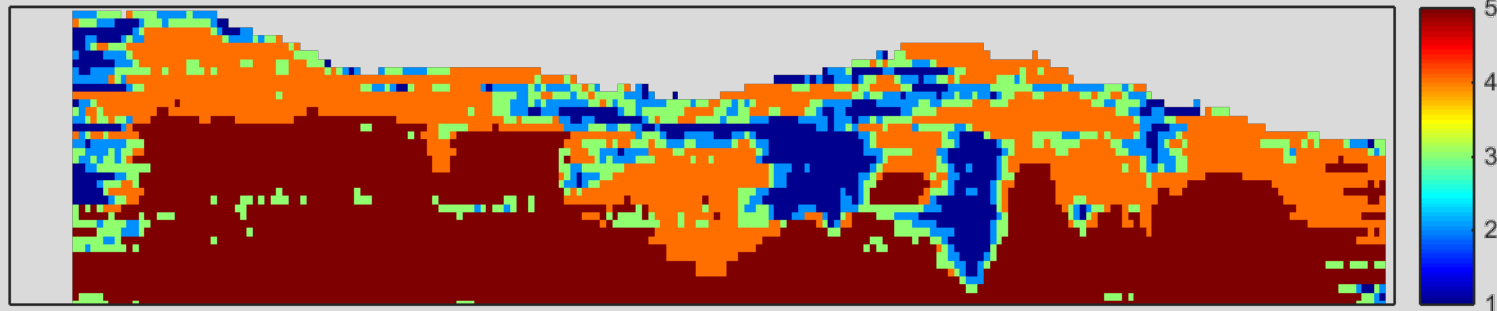


Clustermodel 01

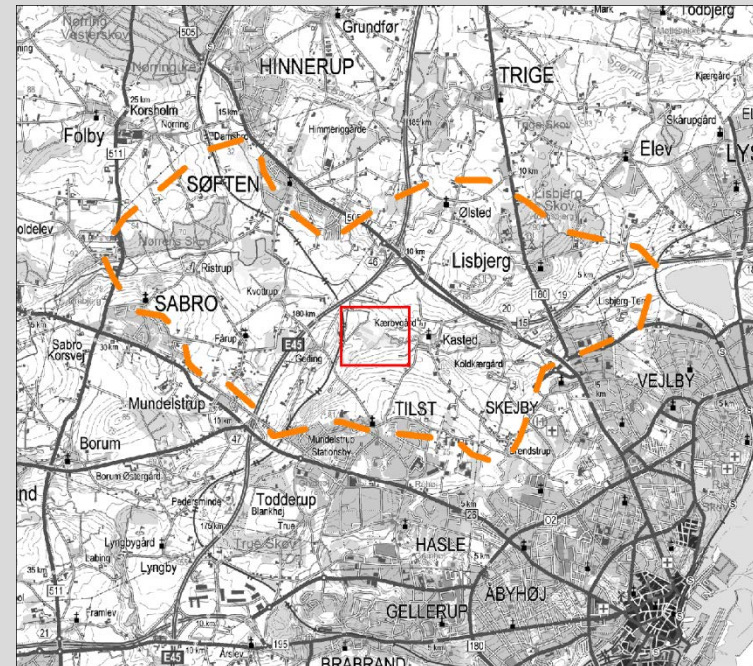
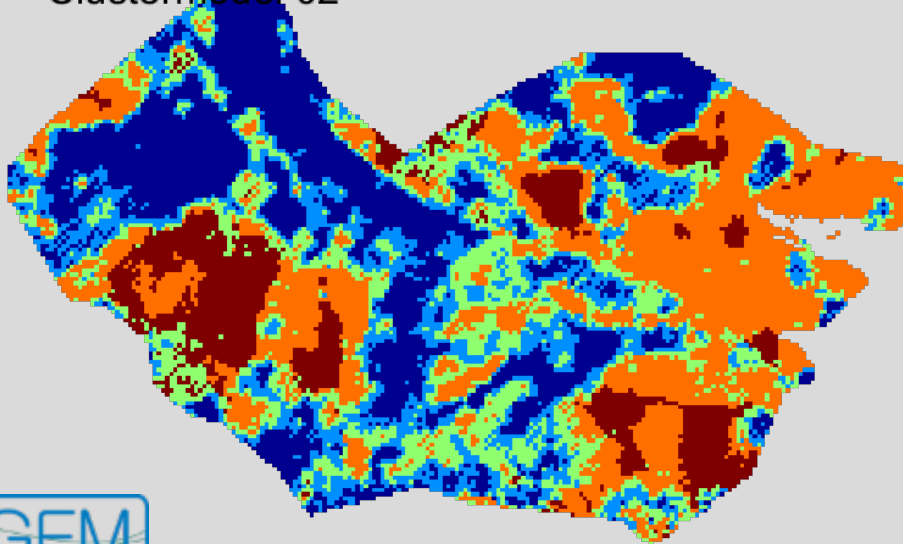


Usikkerheder i Cluster Modeller

Clustermodel 02

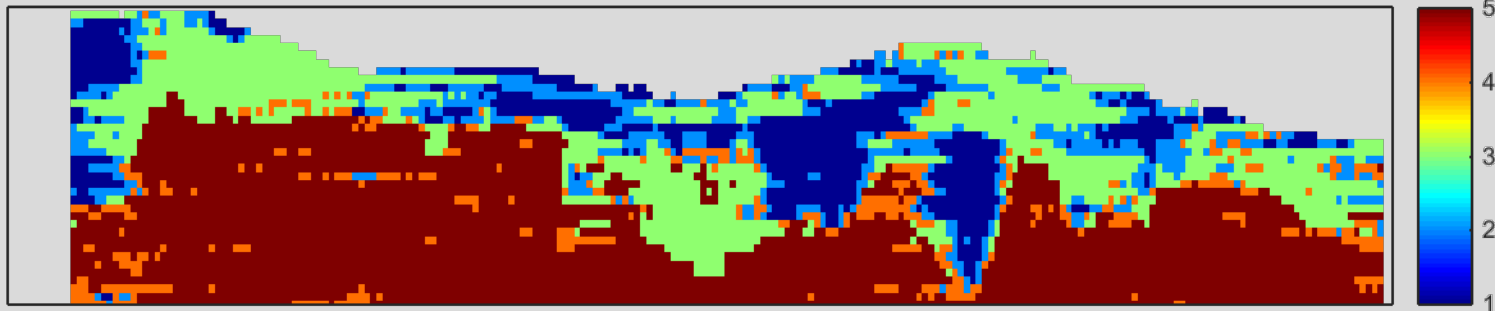


Clustermodel 02

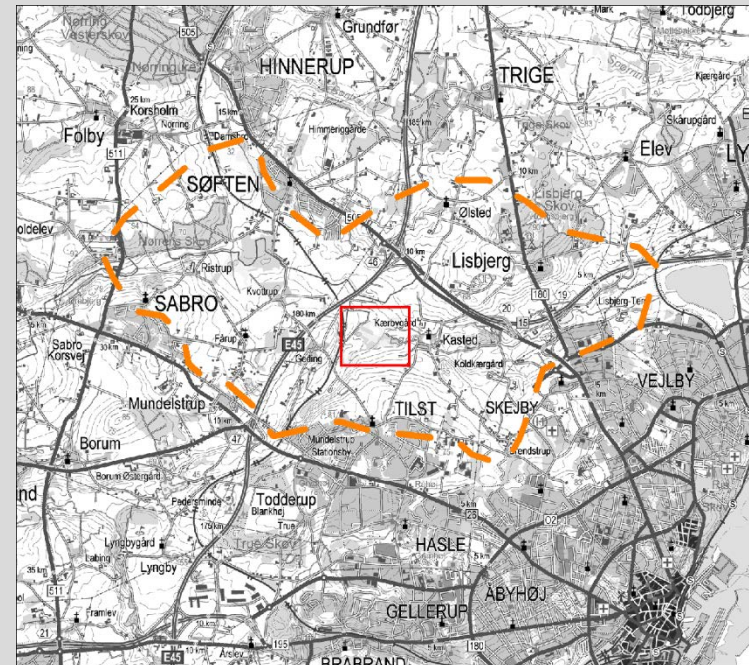
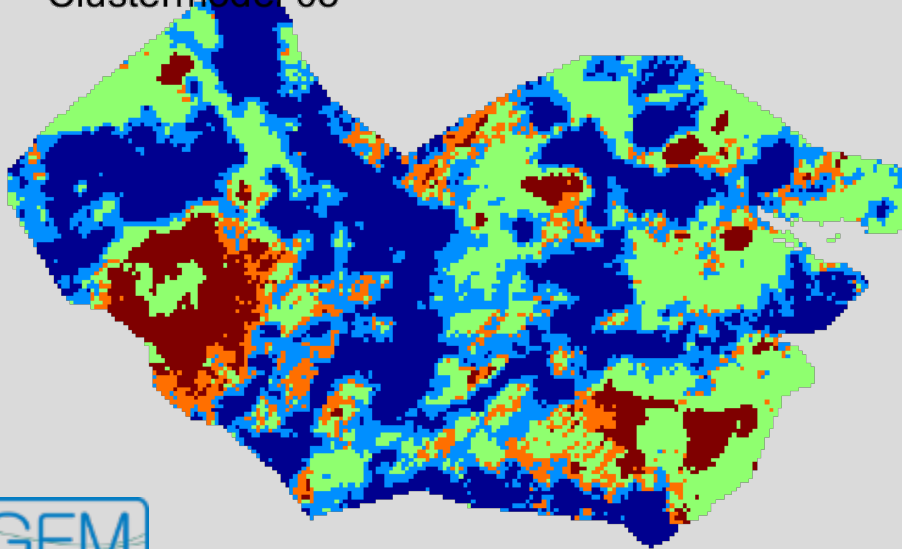


Usikkerheder i Cluster Modeller

Clustermodel 03

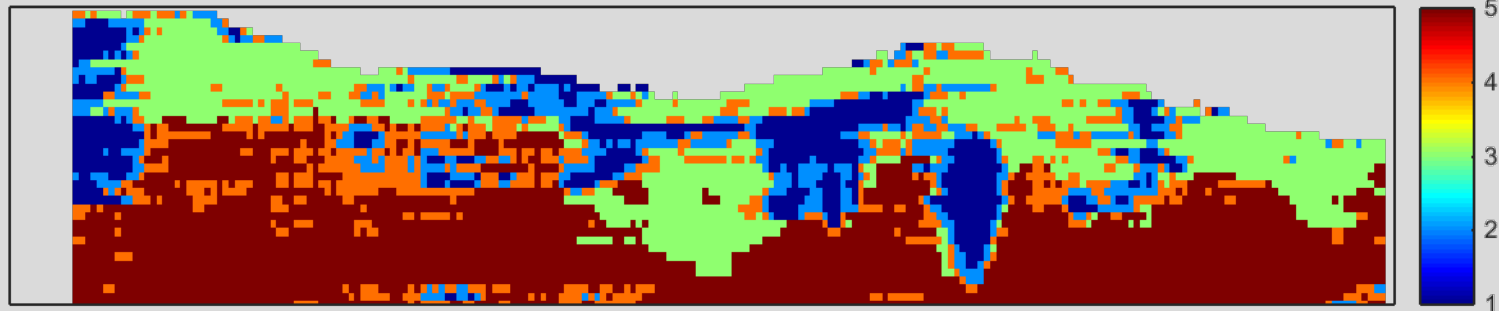


Clustermodel 03

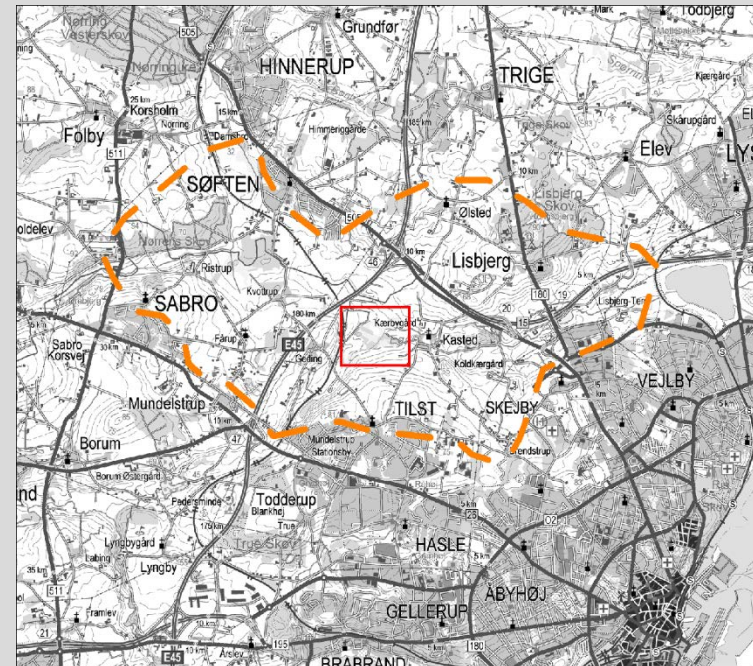
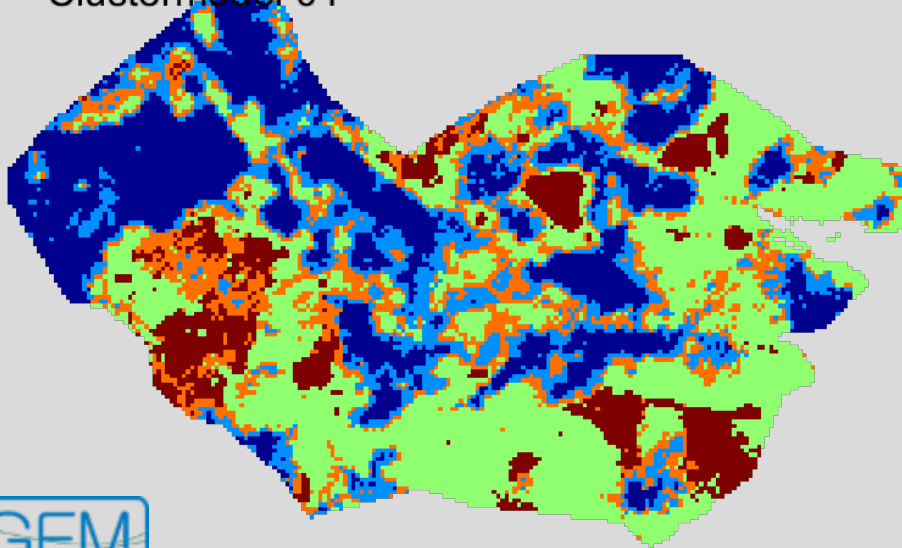


Usikkerheder i Cluster Modeller

Clustermodel 04

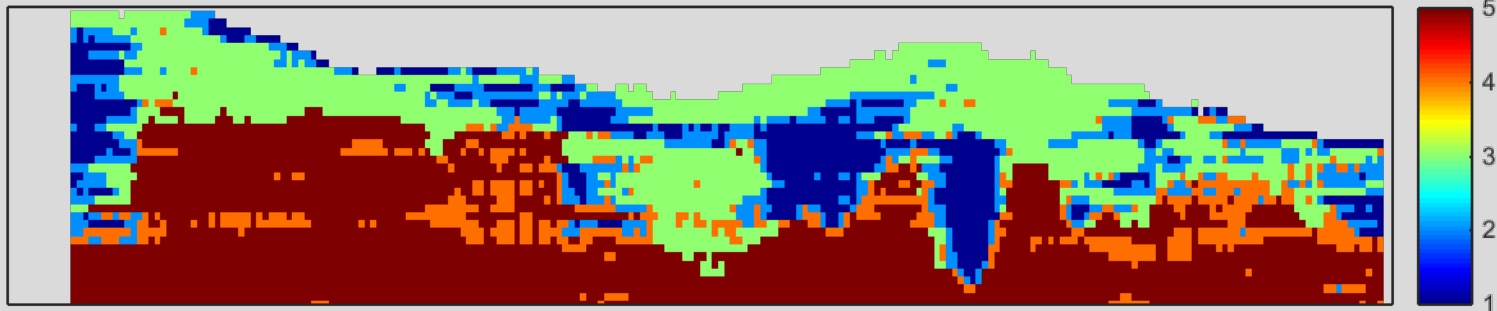


Clustermodel 04

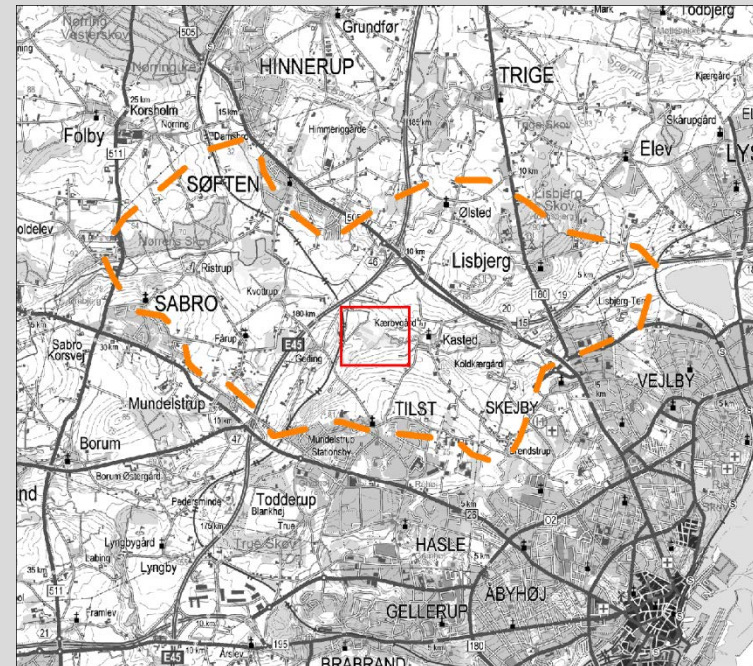
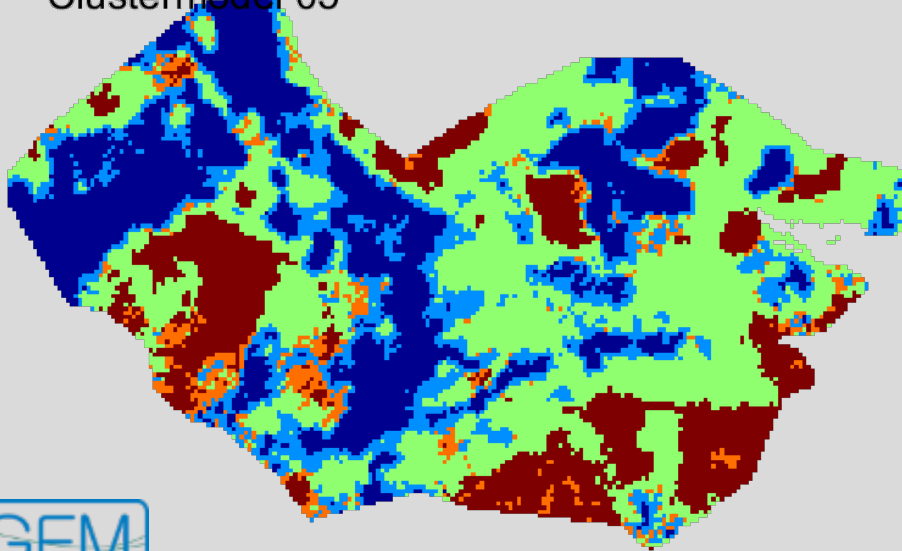


Usikkerheder i Cluster Modeller

Clustermodel 05

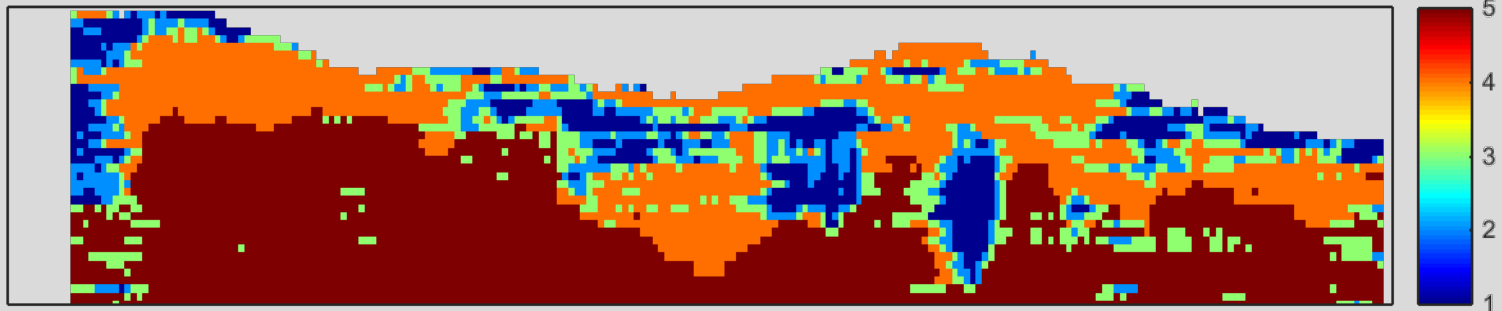


Clustermodel 05

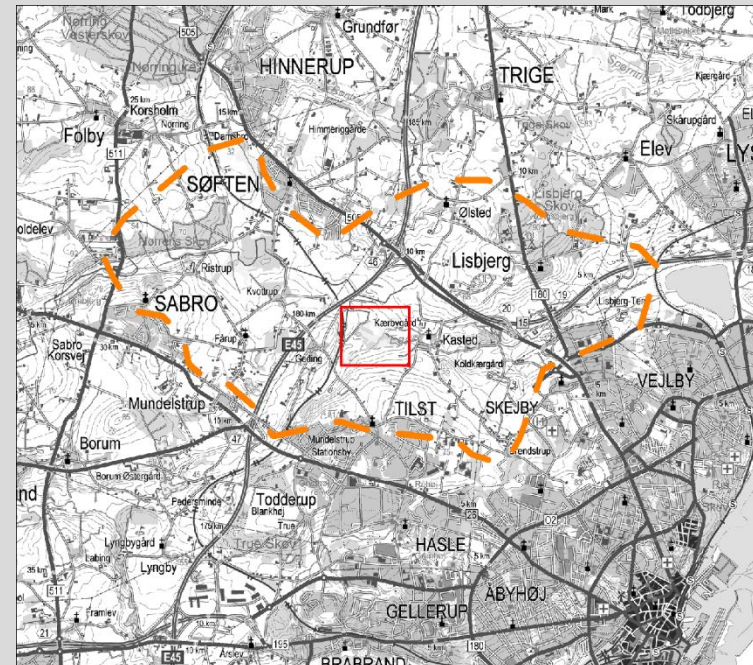
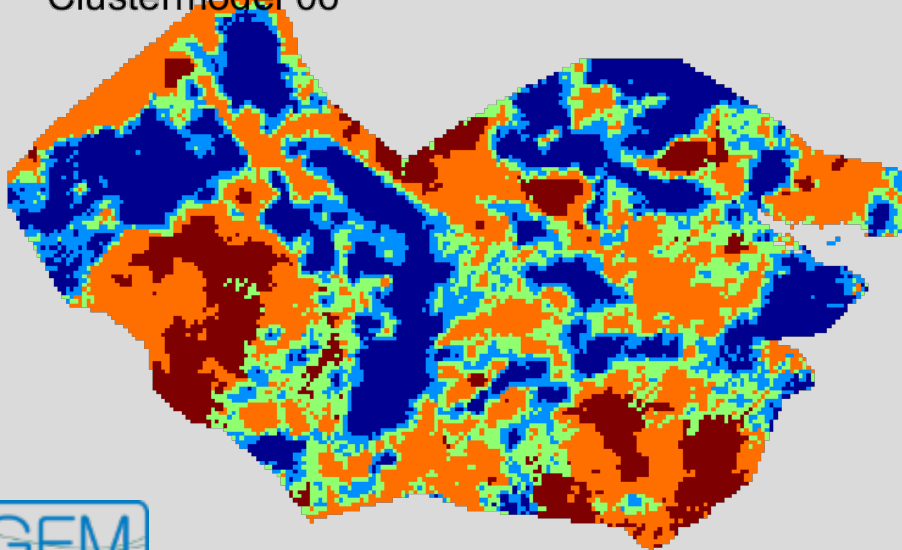


Usikkerheder i Cluster Modeller

Clustermodel 06

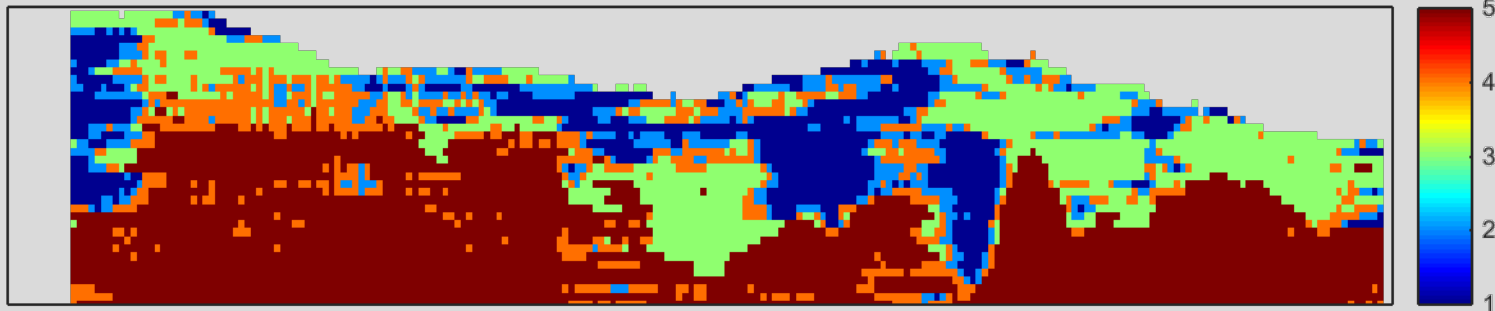


Clustermodel 06

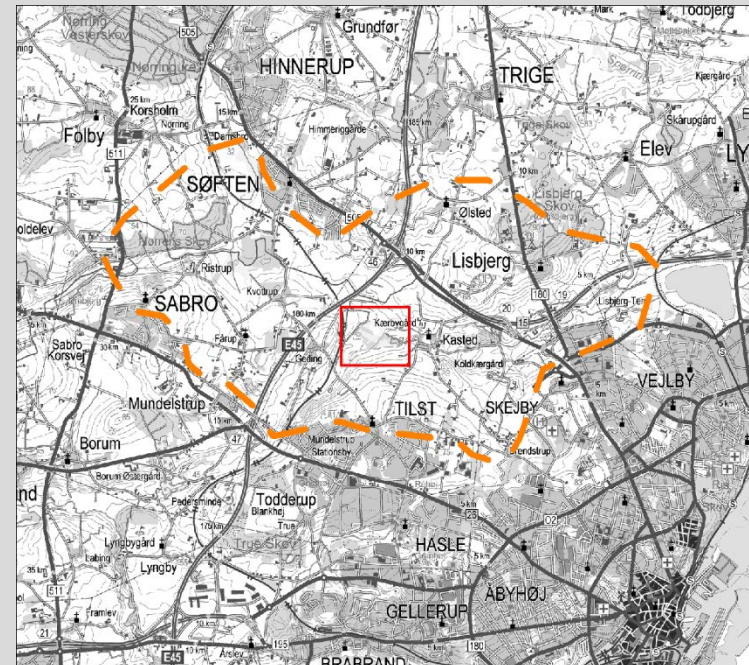
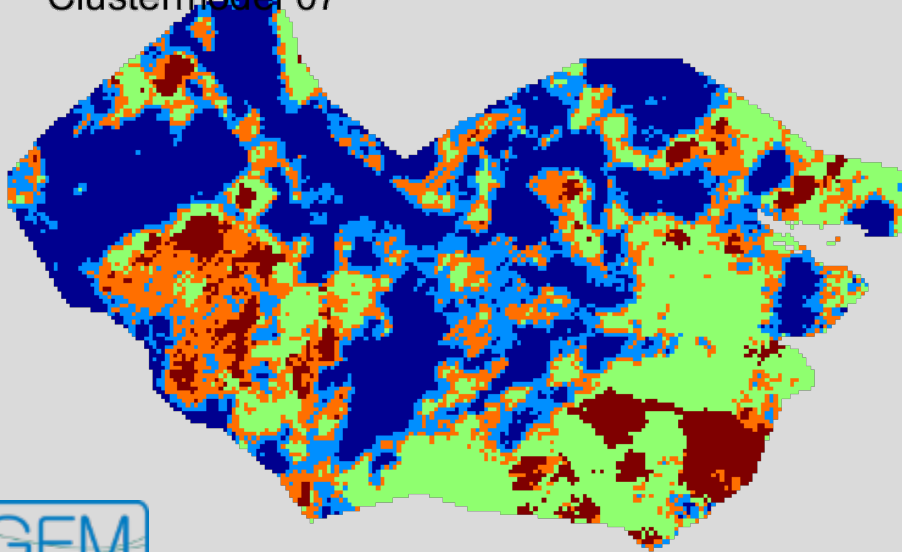


Usikkerheder i Cluster Modeller

Clustermodel 07

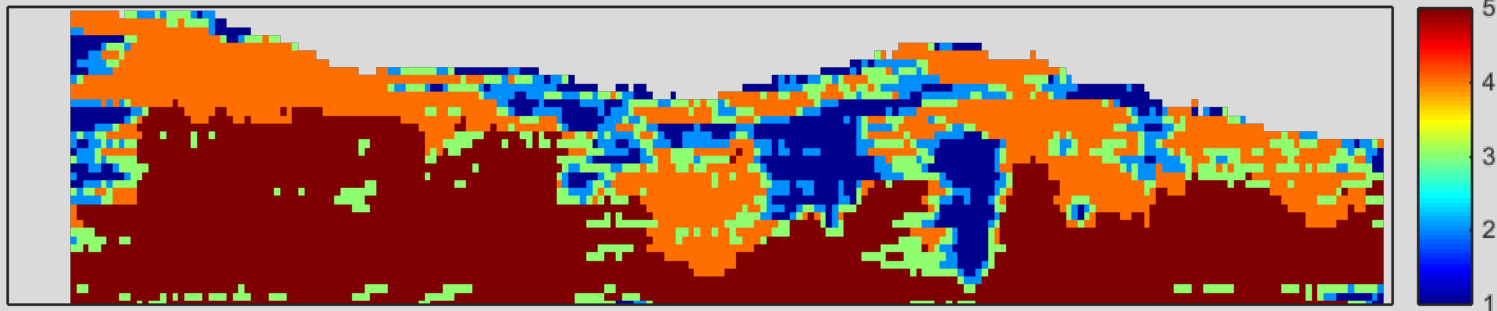


Clustermodel 07

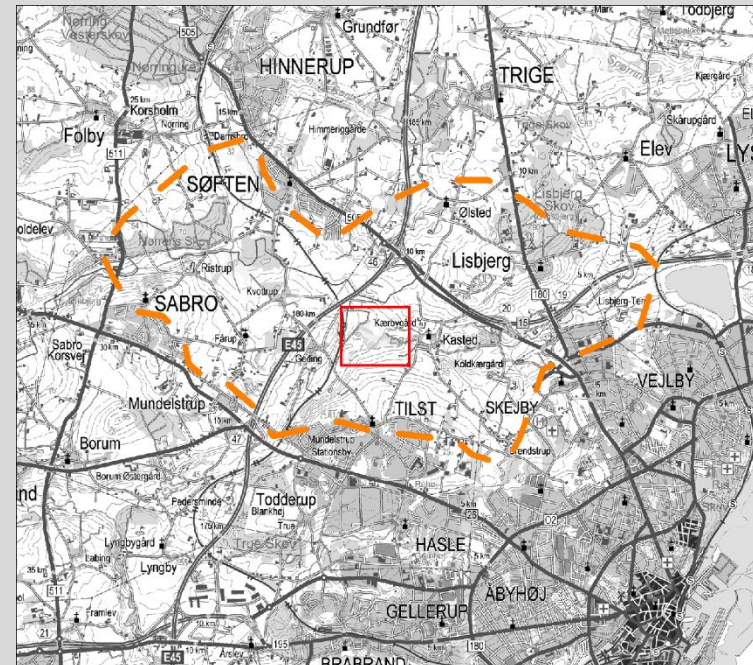
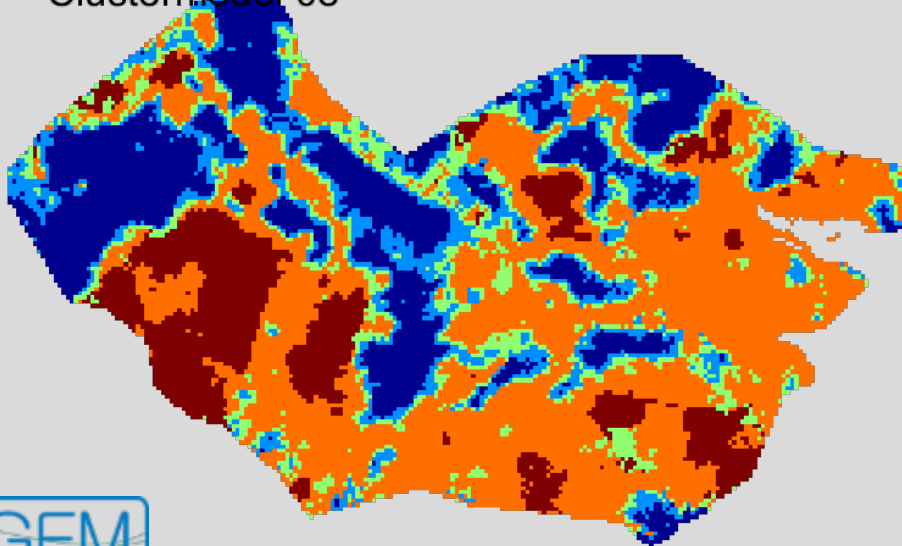


Usikkerheder i Cluster Modeller

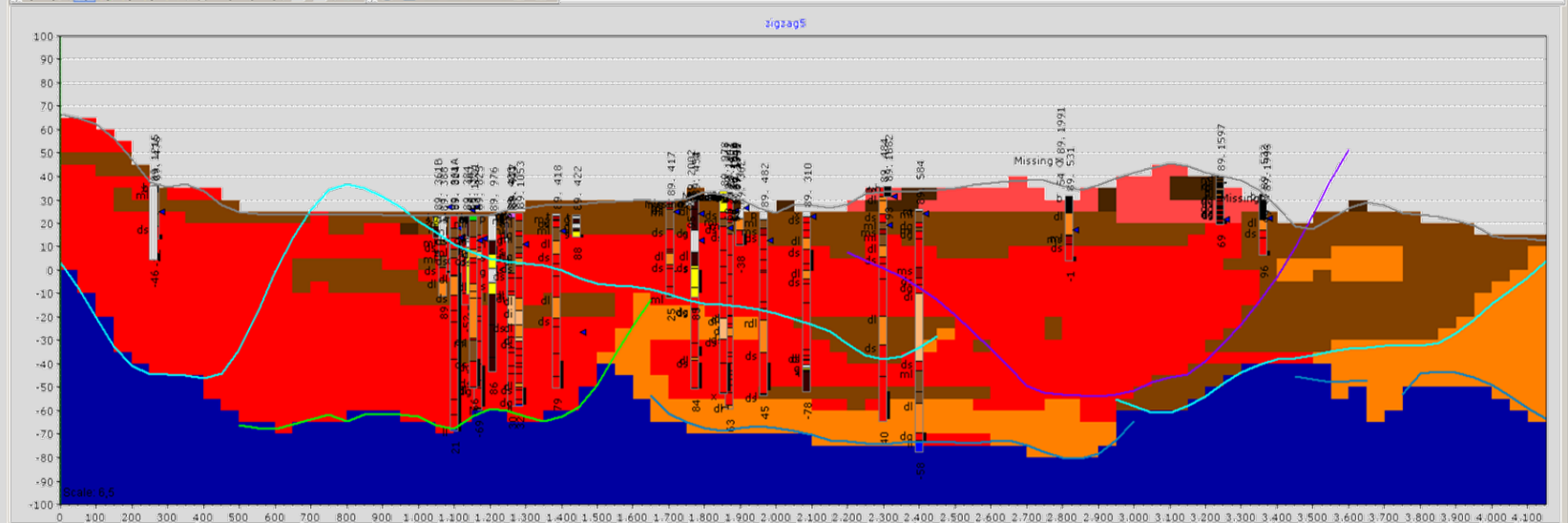
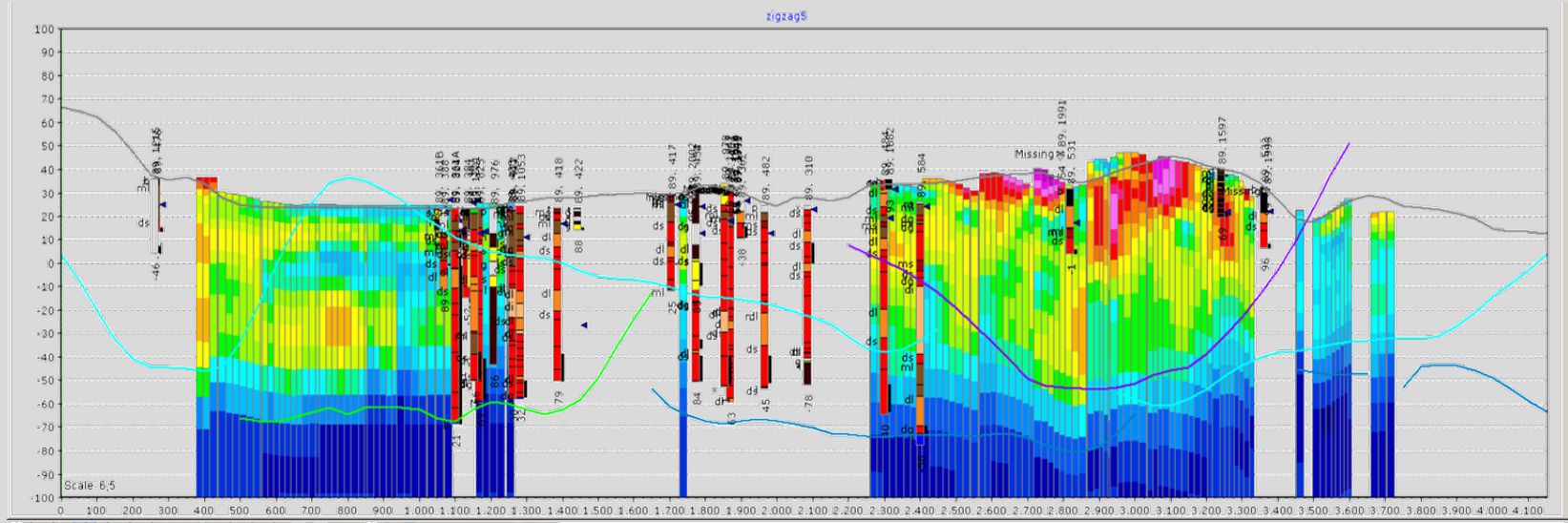
Clustermodel 08



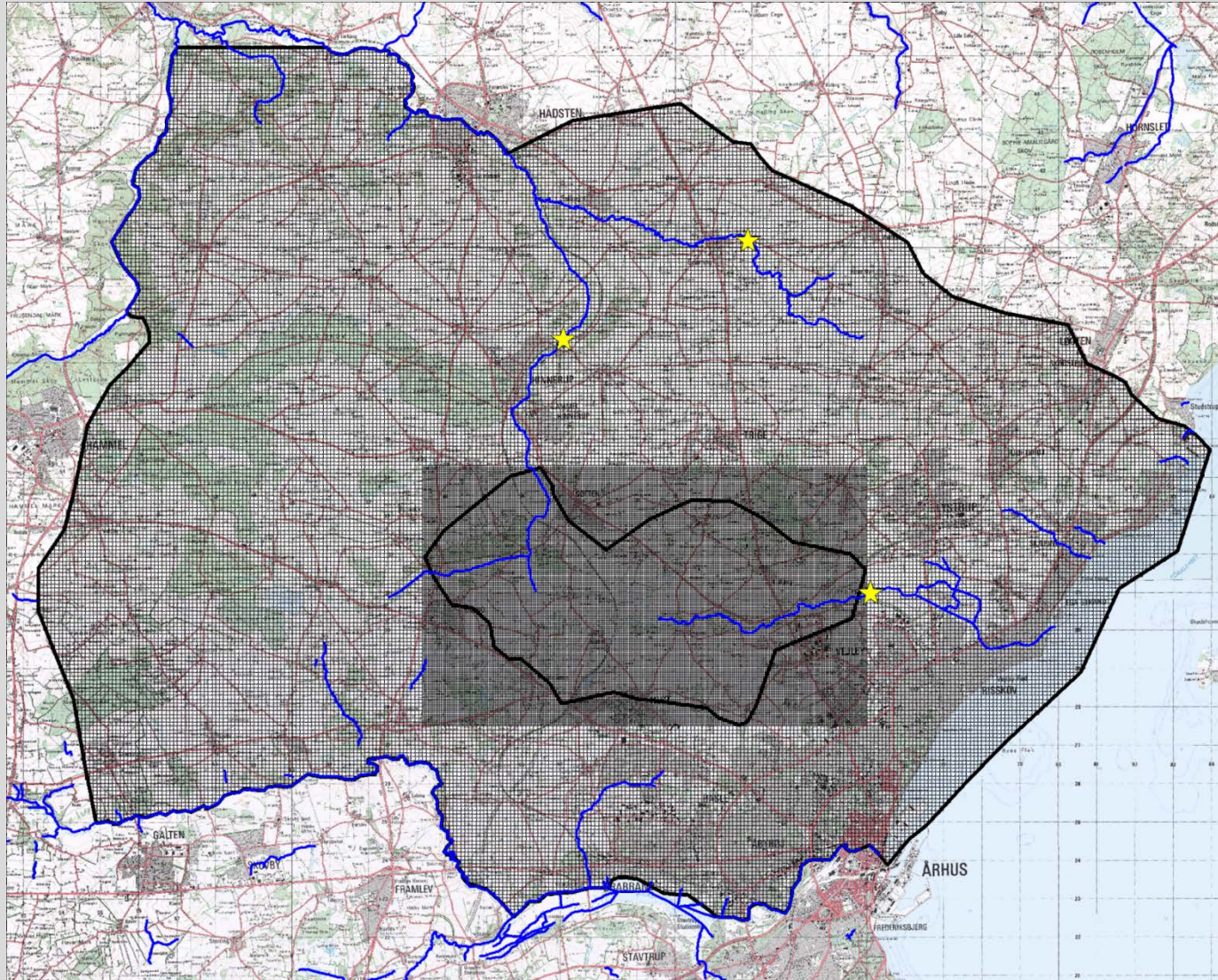
Clustermodel 08



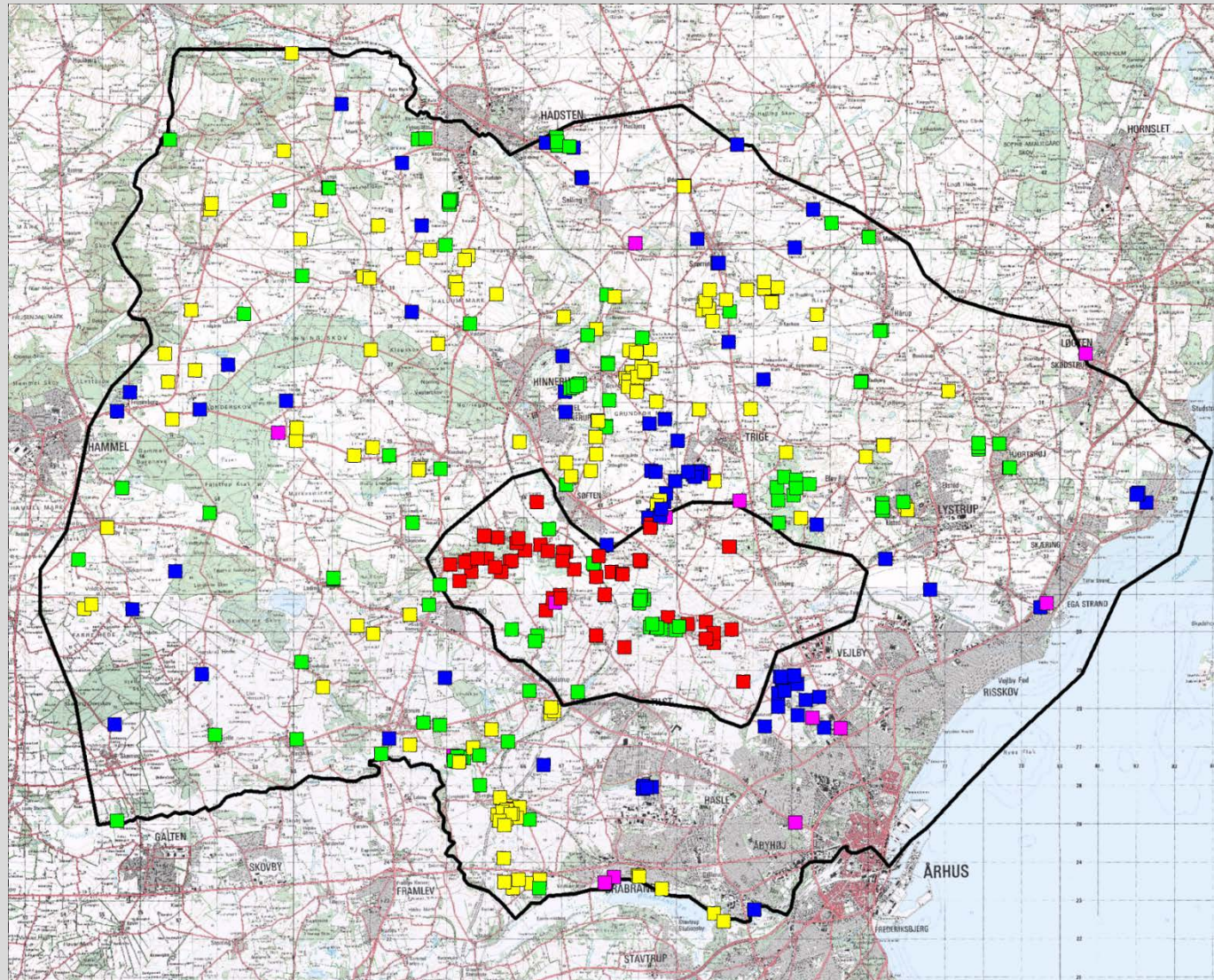
Reference geologisk model



Model og hydrologiske data

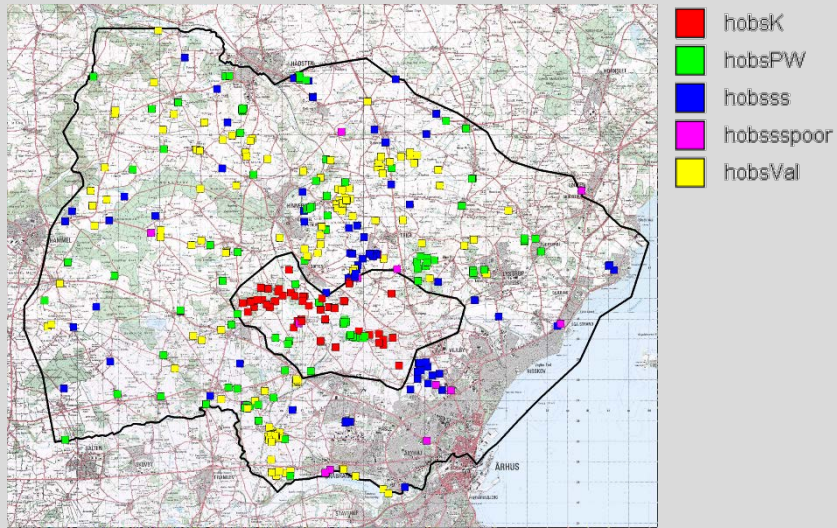


Model og hydrologiske data

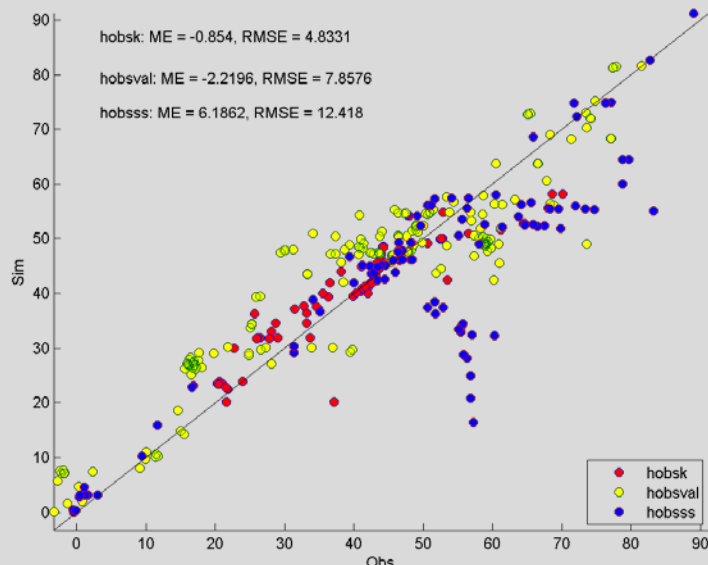


- hobsK
- hobsPW
- hobss
- hobsspoor
- hobsVal

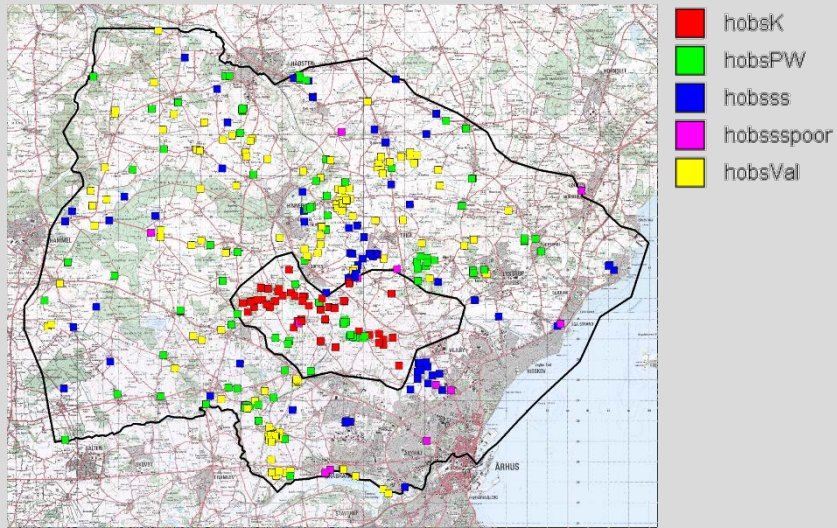
Model og hydrologiske data



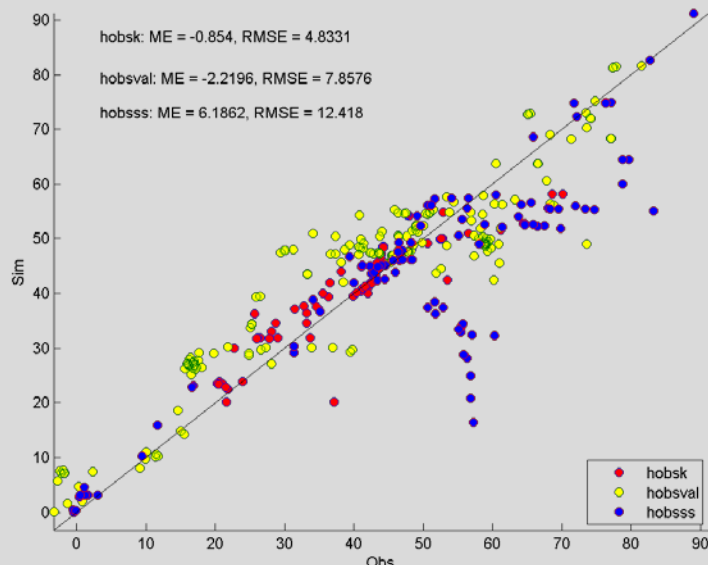
Reference model



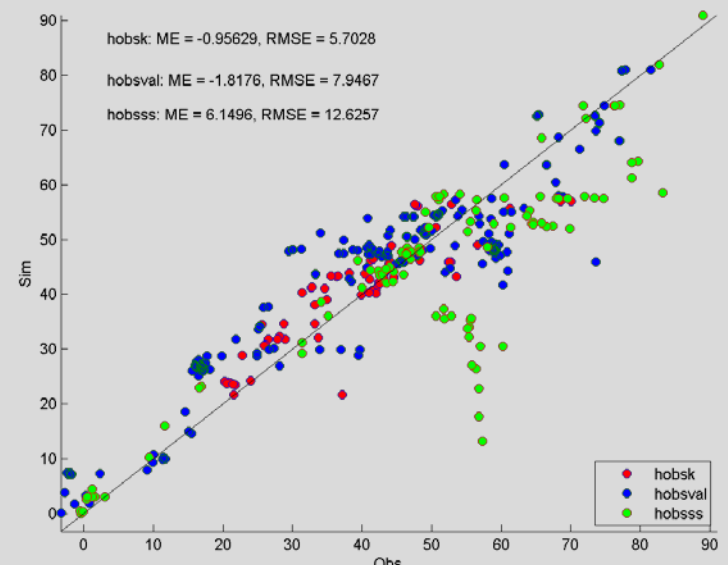
Model og hydrologiske data



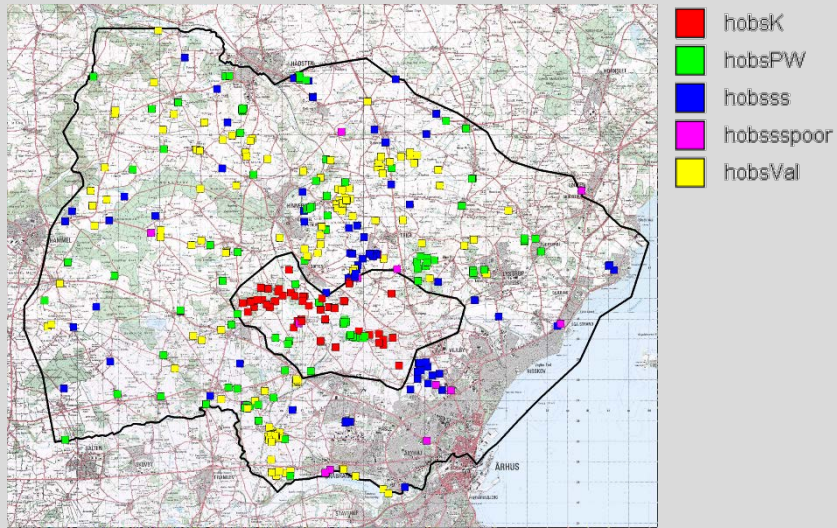
Reference model



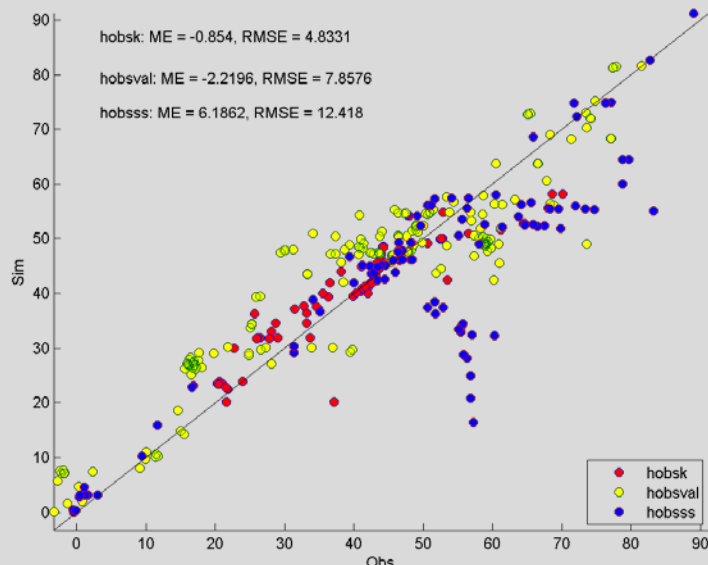
Cluster model 1



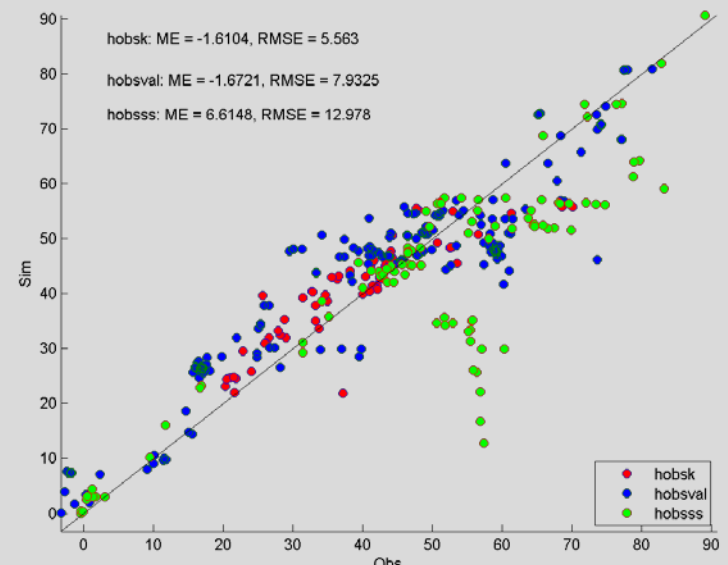
Model og hydrologiske data



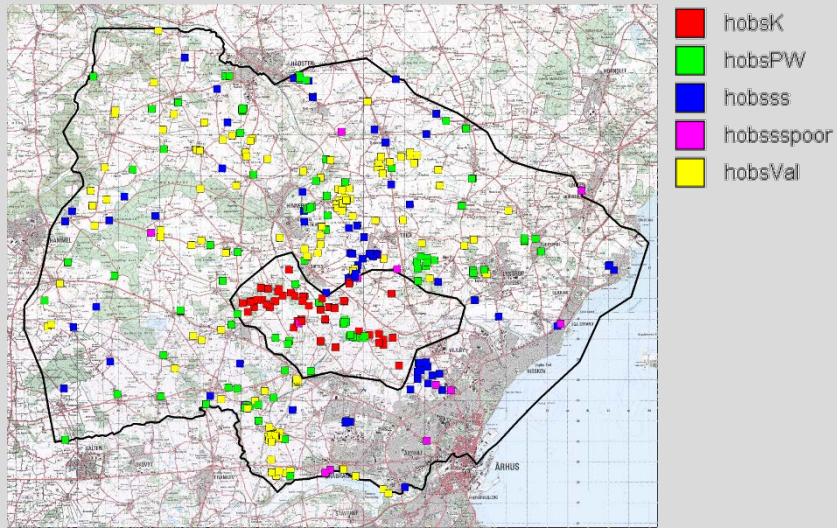
Reference model



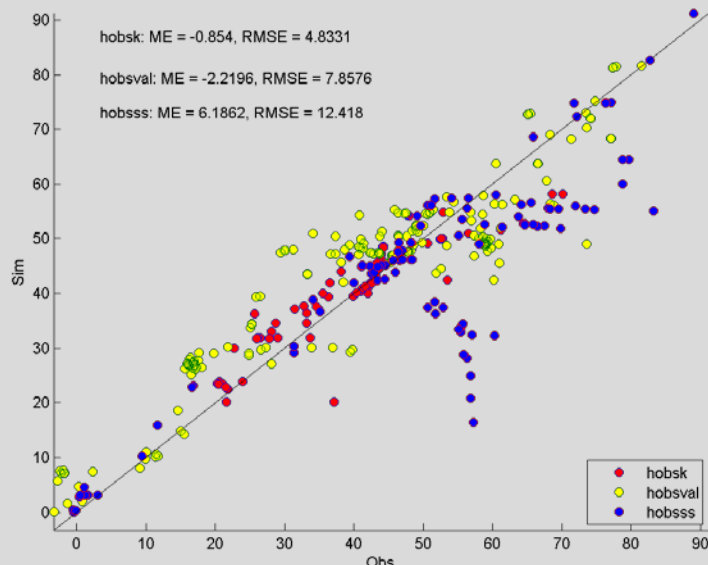
Cluster model 2



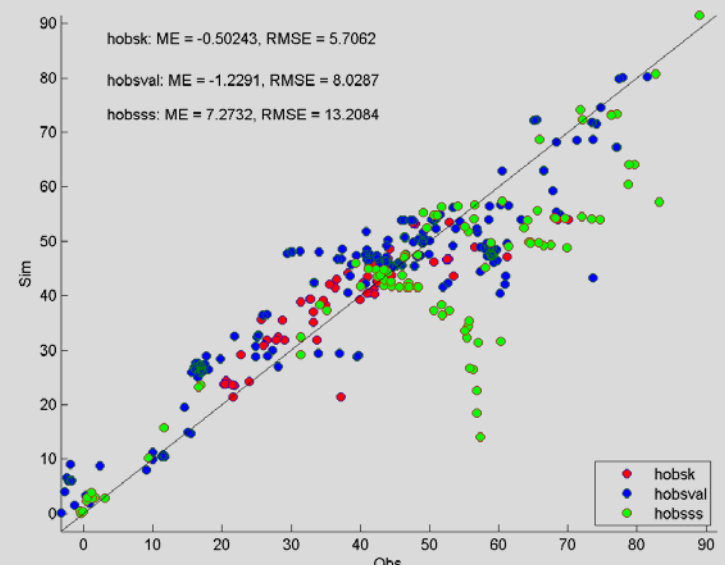
Model og hydrologiske data



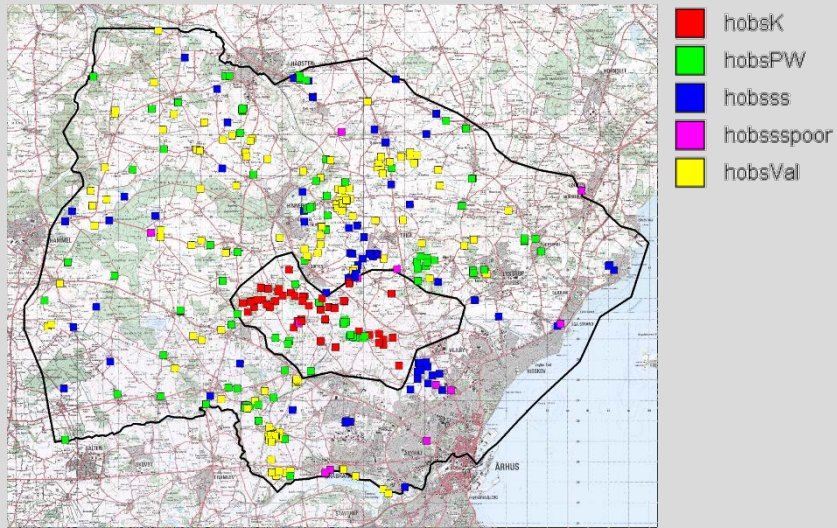
Reference model



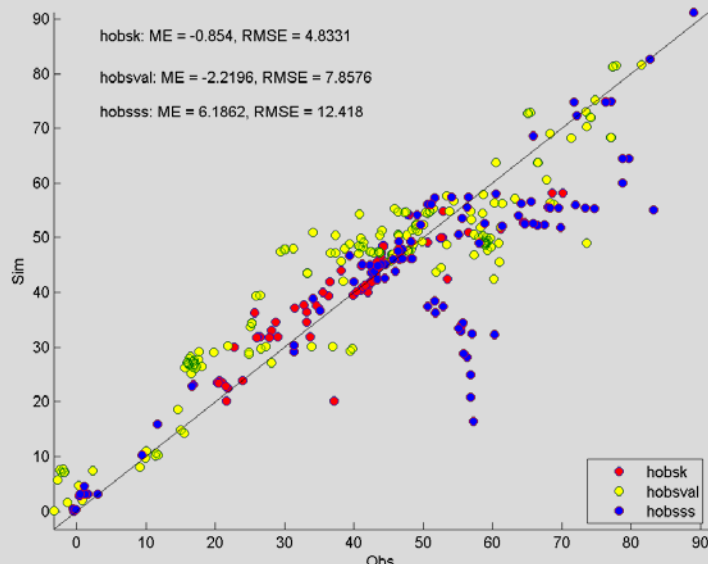
Cluster model 3



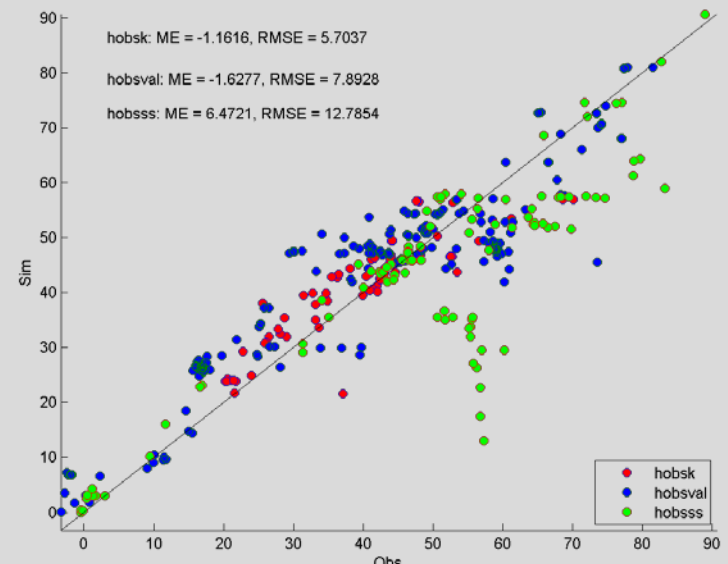
Model og hydrologiske data



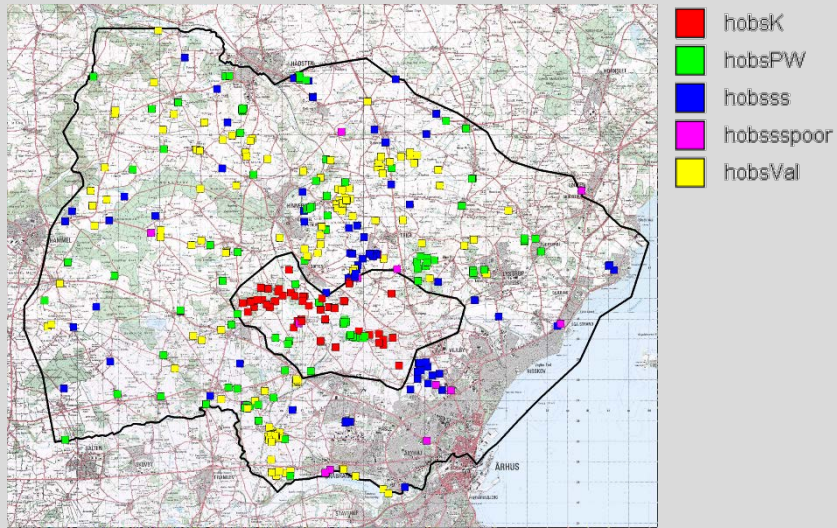
Reference model



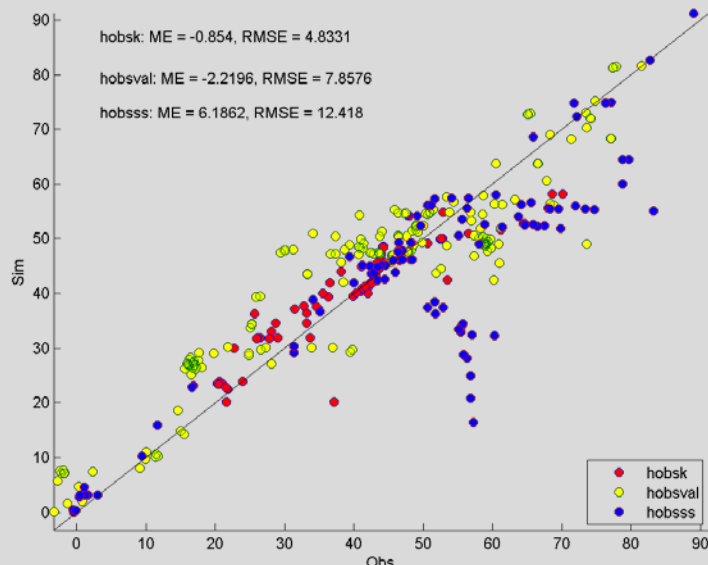
Cluster model 4



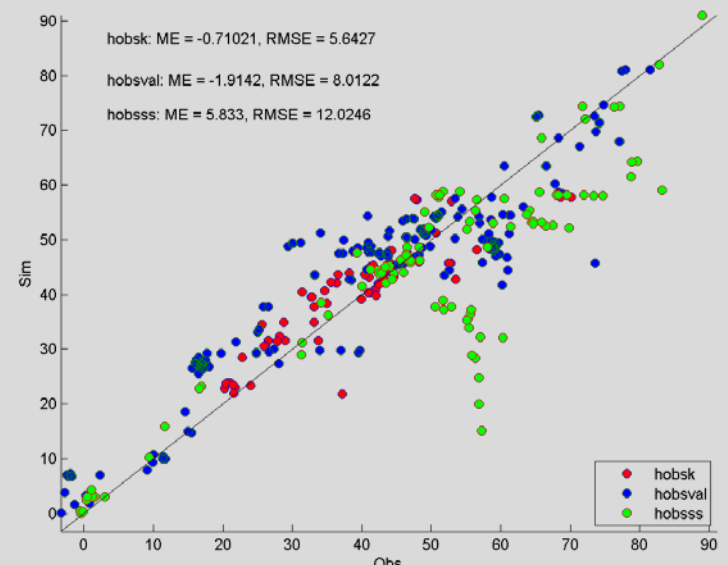
Model og hydrologiske data



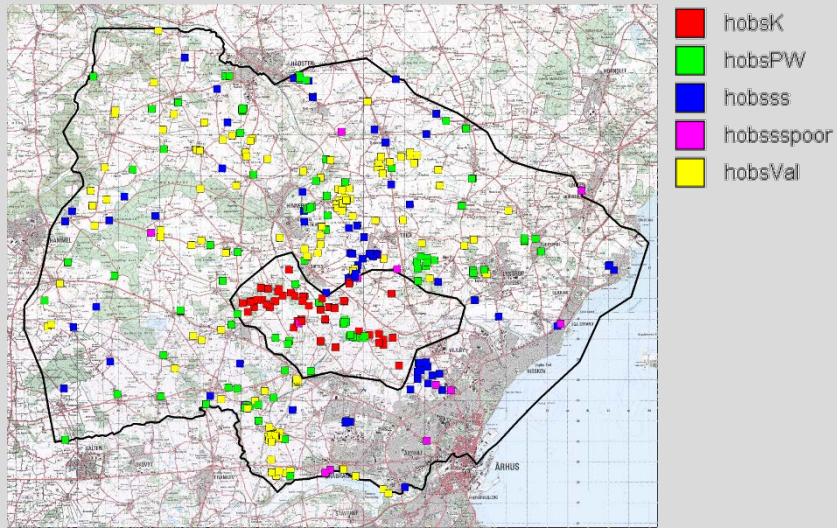
Reference model



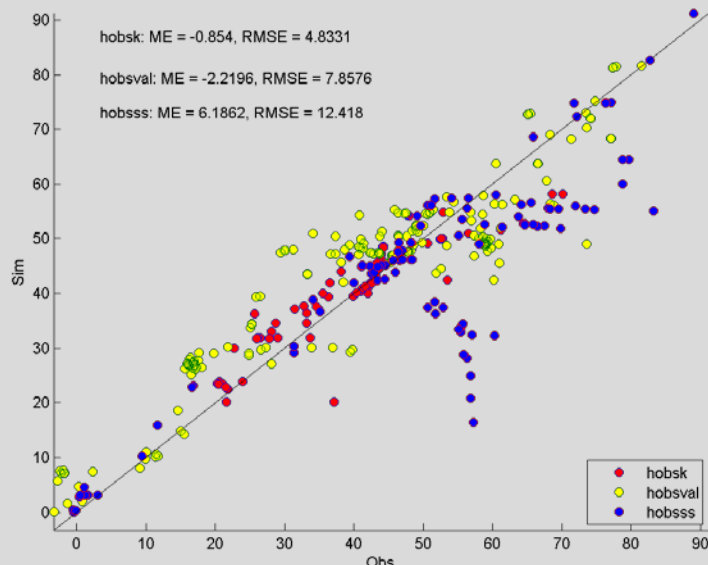
Cluster model 5



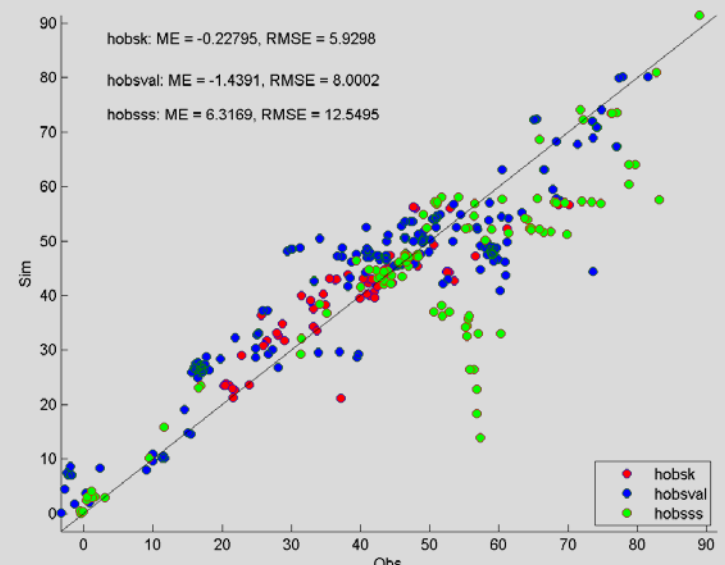
Model og hydrologiske data



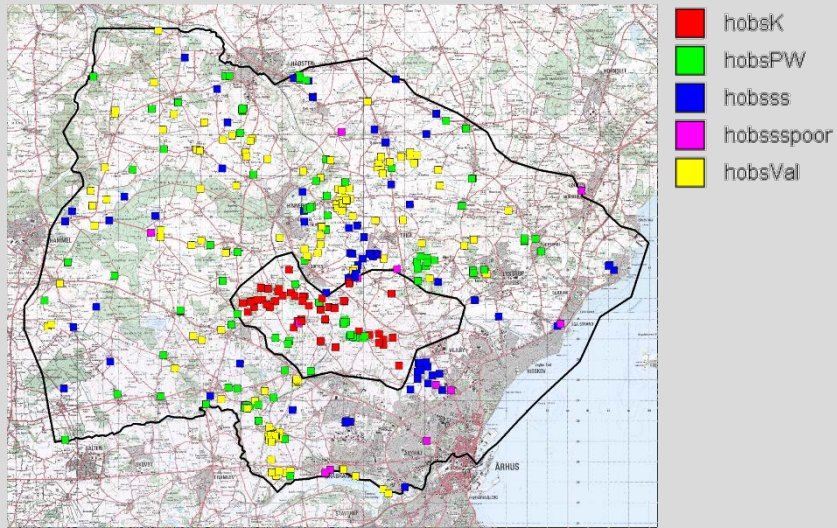
Reference model



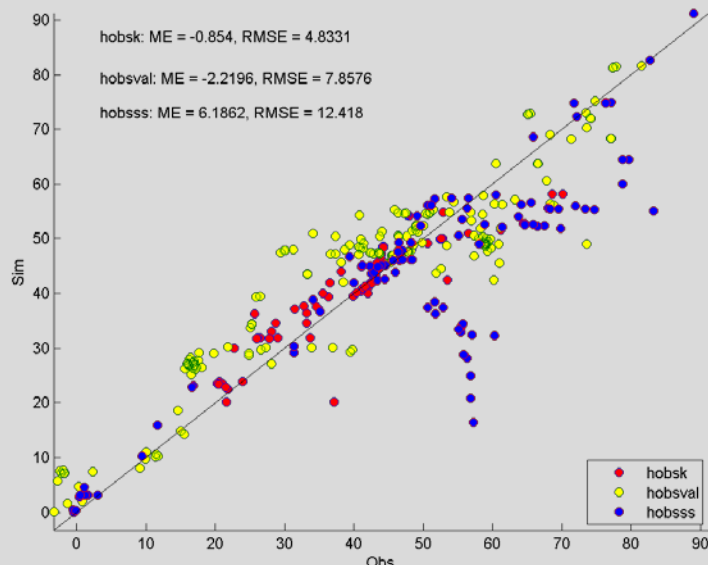
Cluster model 6



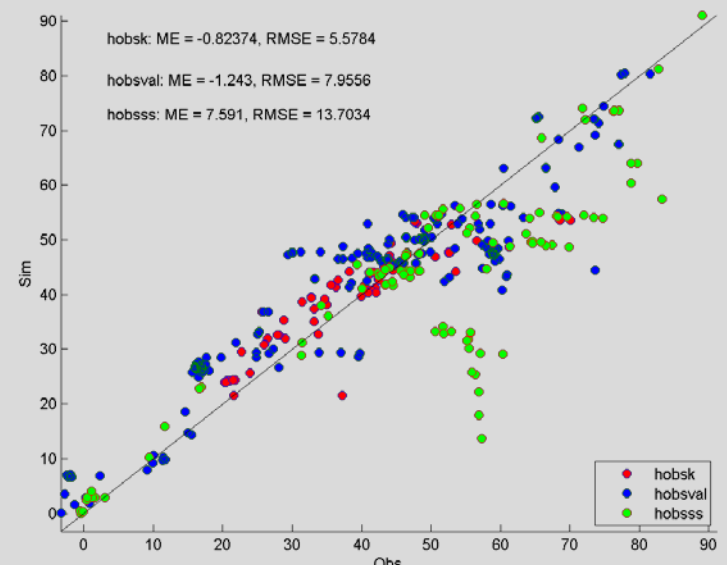
Model og hydrologiske data



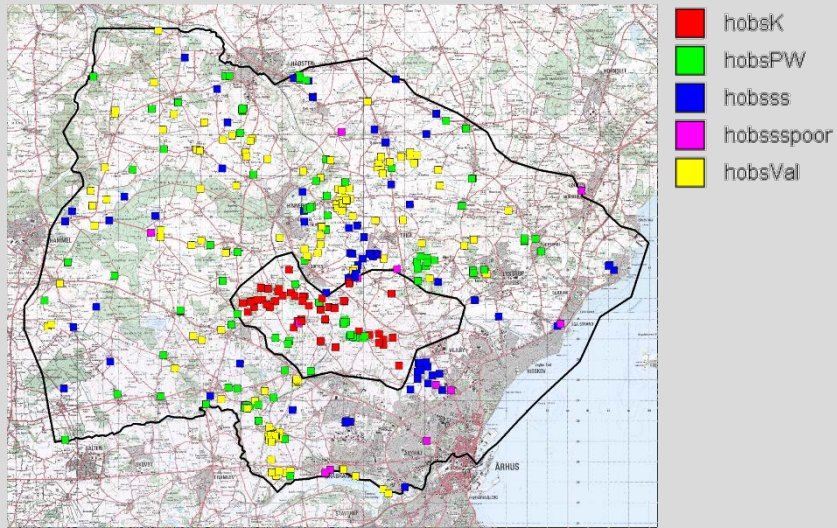
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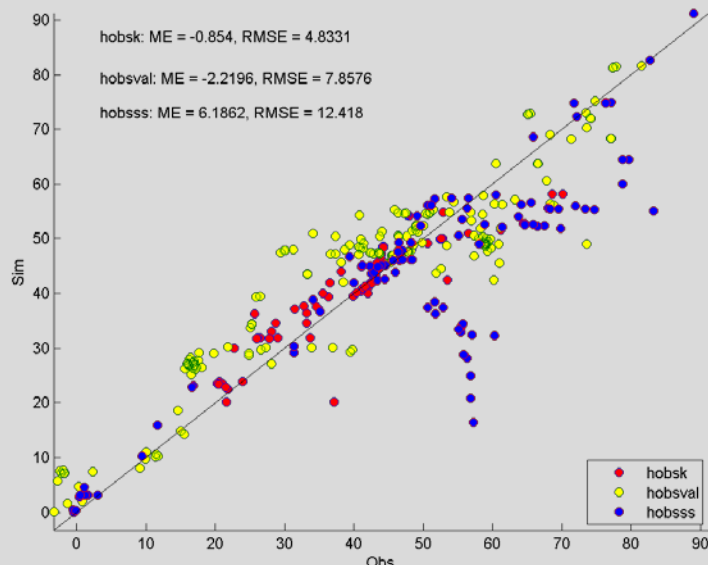
Cluster model 7



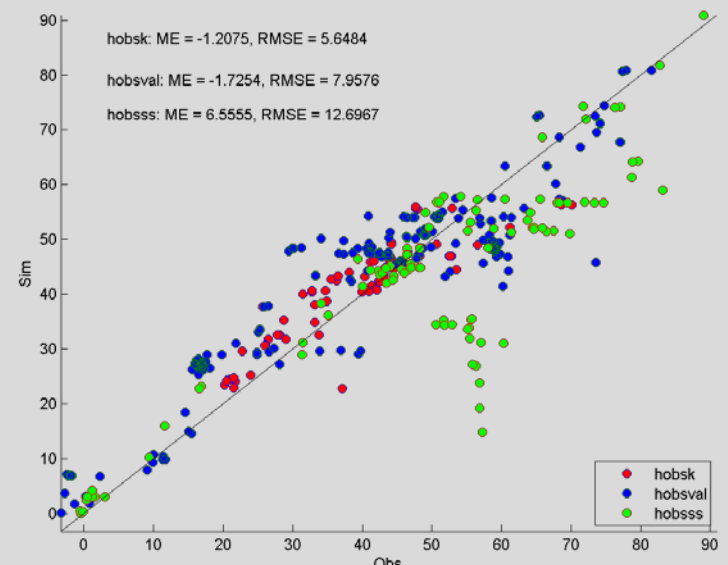
Model og hydrologiske data



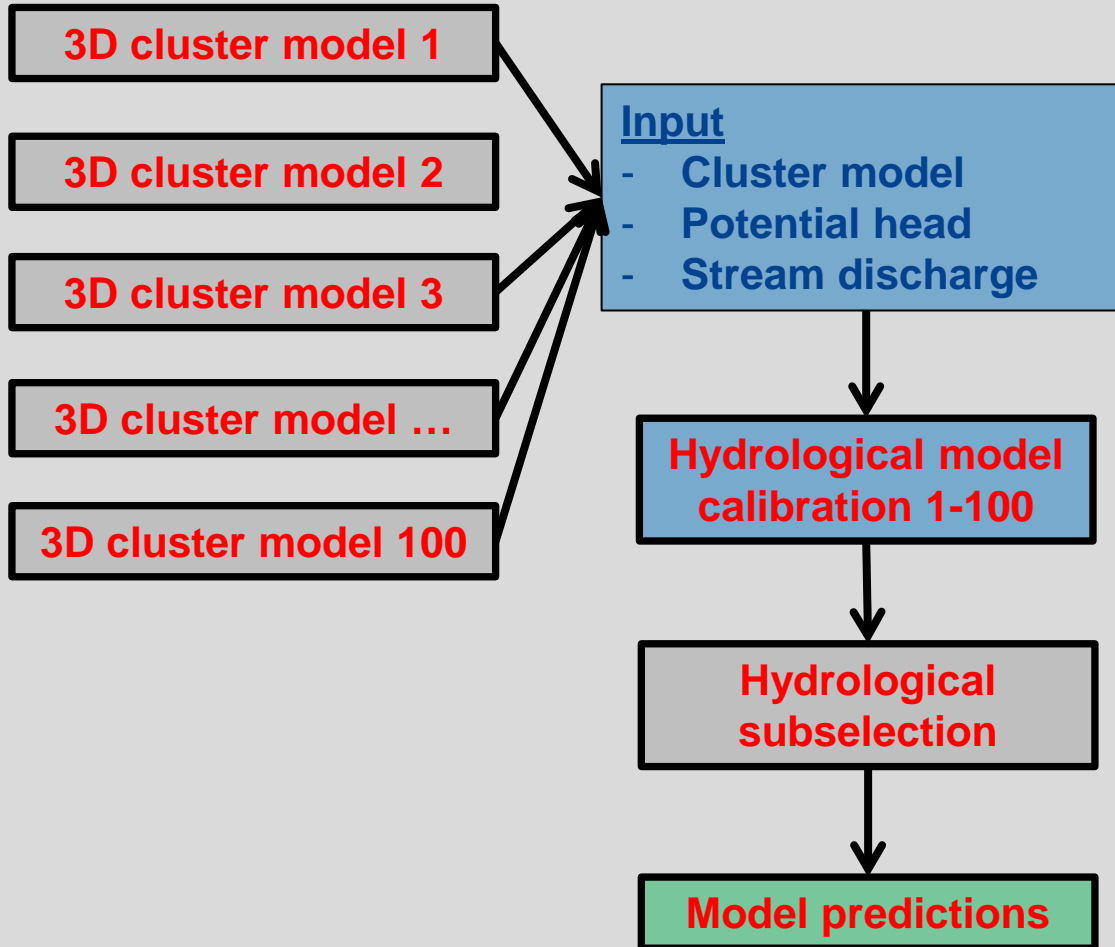
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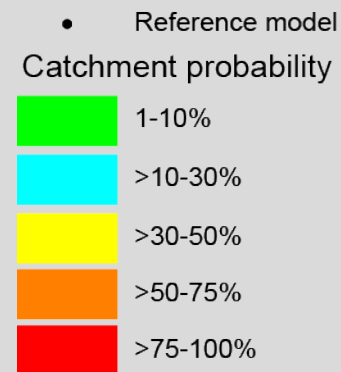
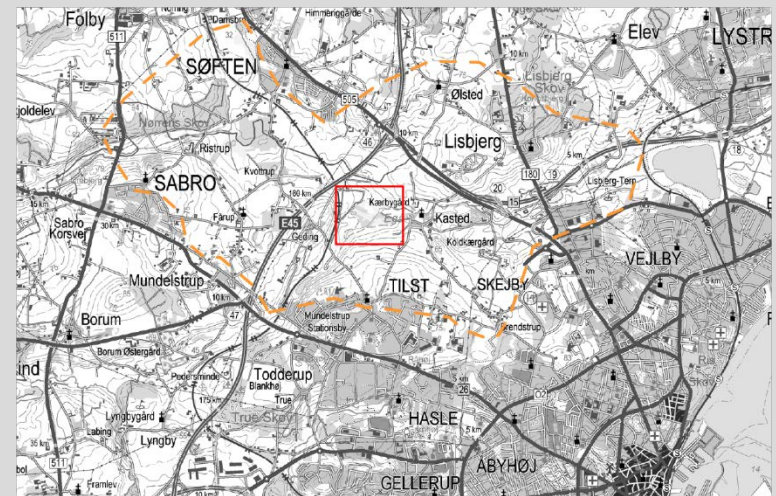
Cluster model 8



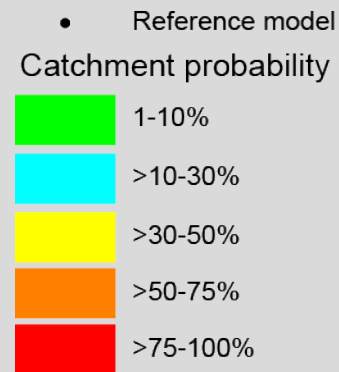
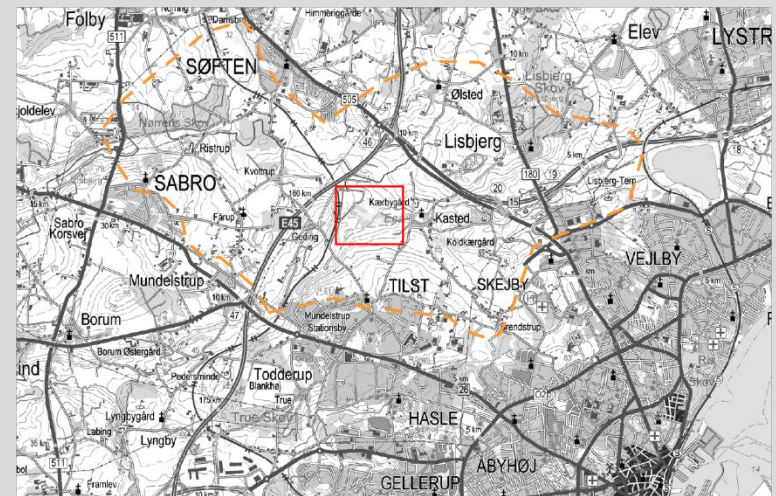
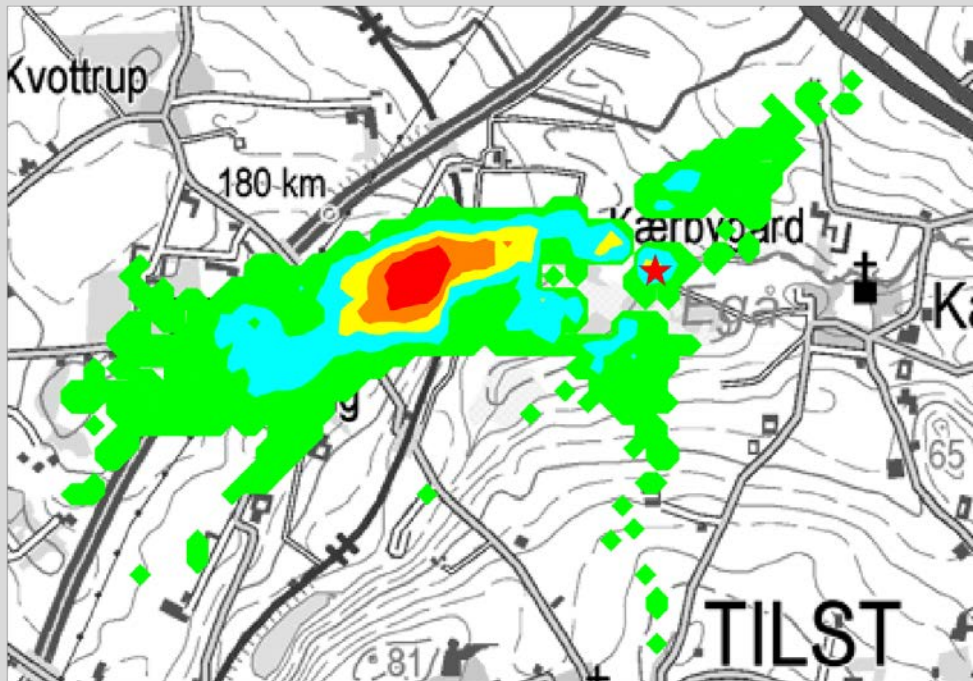
Model Uncertainty



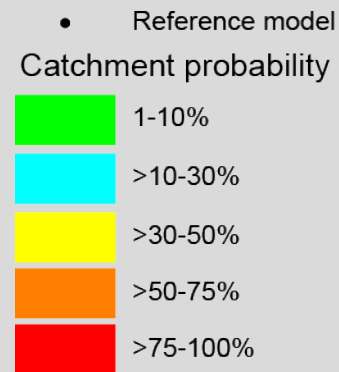
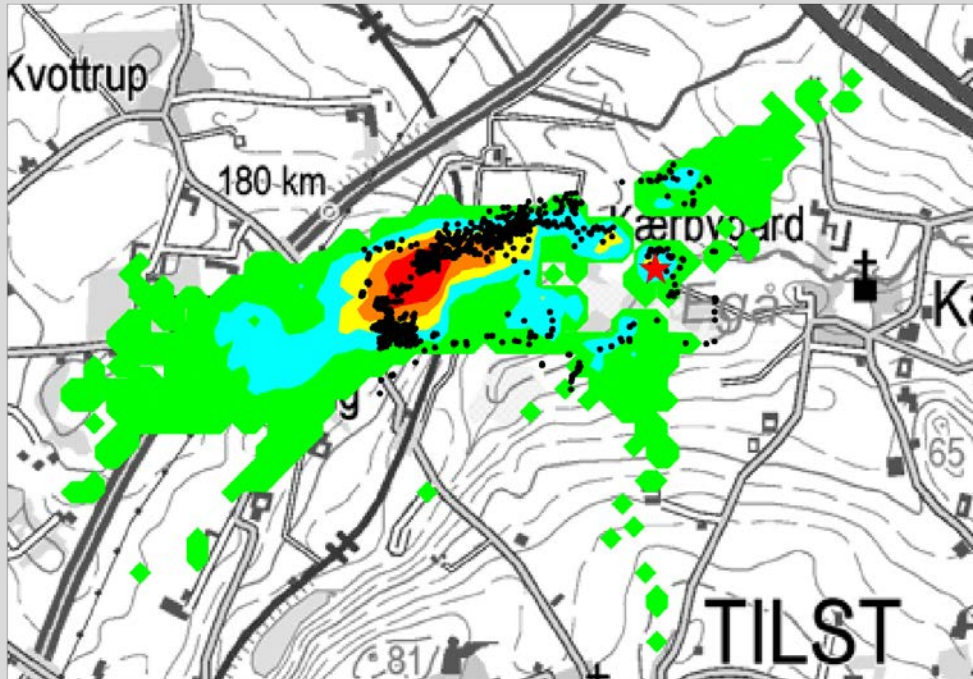
Oplandsusikkerhed



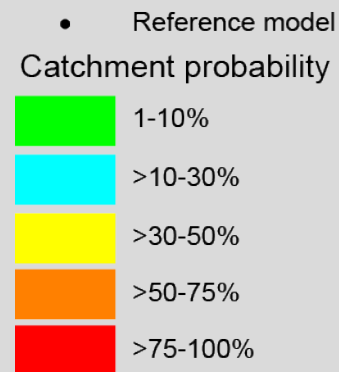
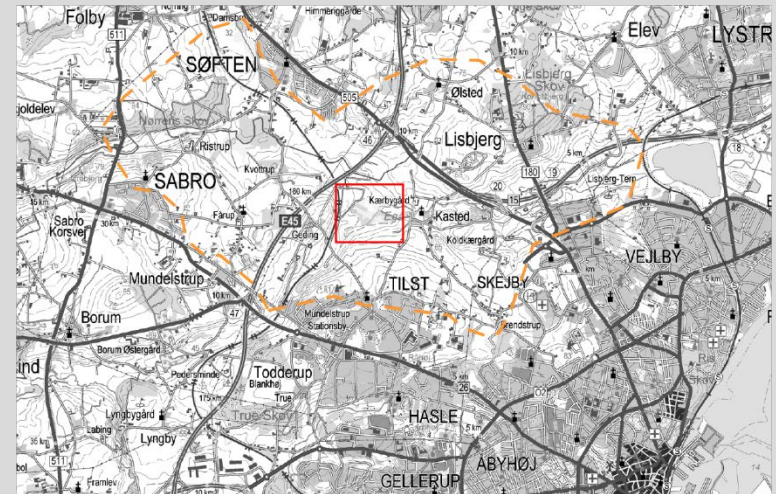
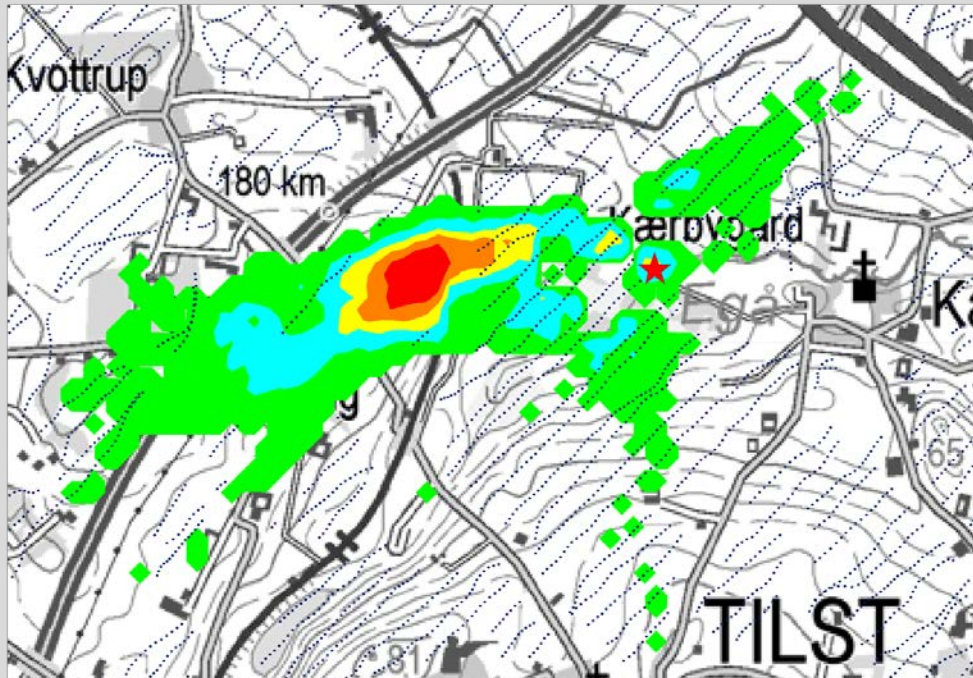
Oplandsusikkerhed



Oplandsusikkerhed



Oplandsusikkerhed



Opsummering

- **For visse prædiktioner dominerer strukturelle fejl i hydrologiske modeller, men der findes få effektive måder at kvantificerer dem på**
- **Metoden er hurtig og effektiv**
- **Metoden er objektiv og reproducerbar**
- **Vha. subsektion kan vi genererer modeller som overholder alle input data -> geologiske, geofysiske og hydrologiske**
- **Metoden er generisk i forhold til geofysisk input**
- **Vores prædiktion er i overensstemmelse med vores referencemodel**

