Sveriges lantbruksuniversitet
Swedish University of Agricultural Sciences

VÄSTRA GÖTALANDSREGIONEN
REGIONUTVECKLINGSNÄMNDEN
Interreg
Öresund-Kattegat-Skagerrak
European Regional Development Fund
EUROPEAN UNION

Digital soil data as input for spatial modelling of pesticide losses

Kristin Piikki & Mats Söderström, Swedish University of Agricultural Sciences (SLU), Sweden

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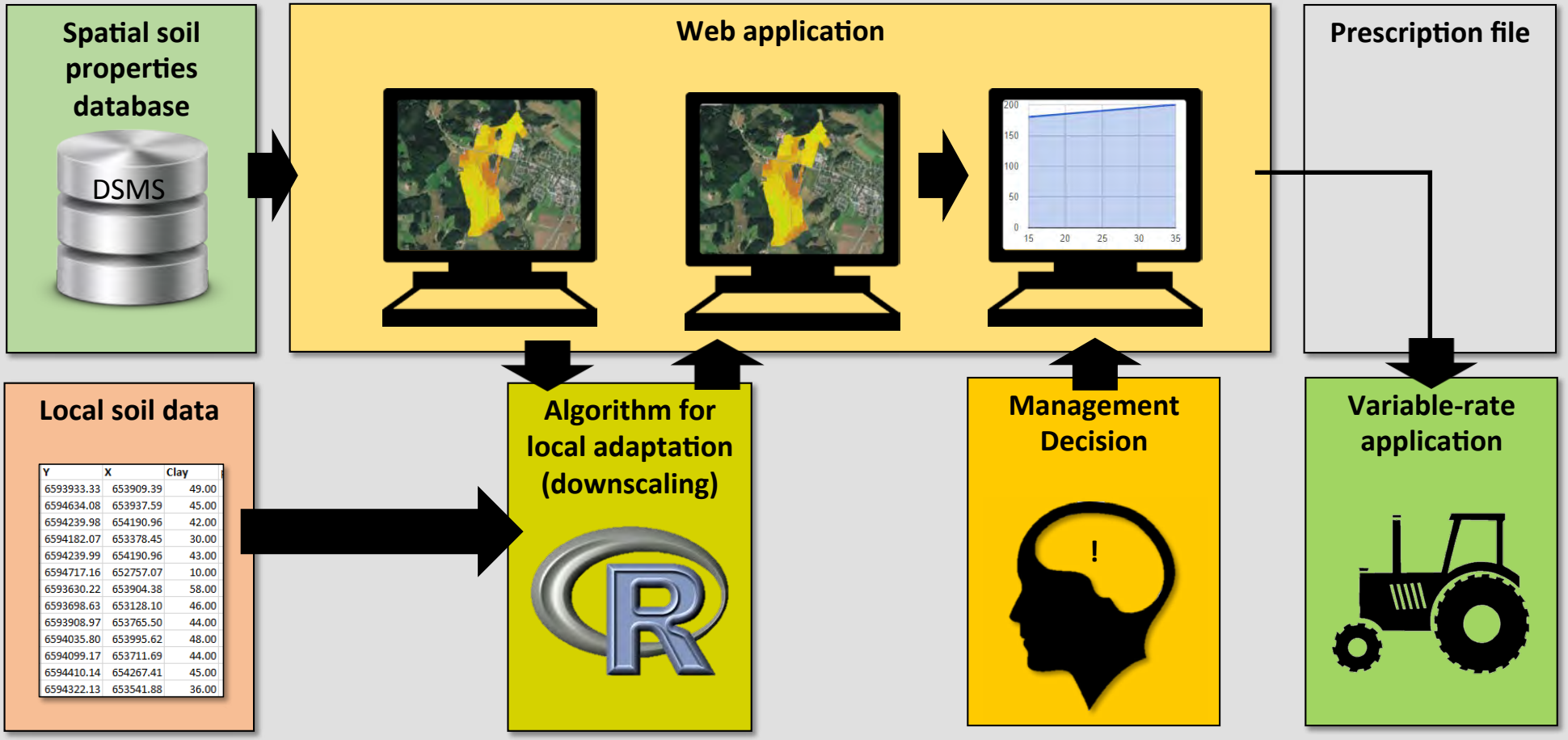
1. Markdata.se – a free web application for farmers
2. Digital soil map of Sweden (DSMS)
3. Detailed mapping by proximal soil sensors

1

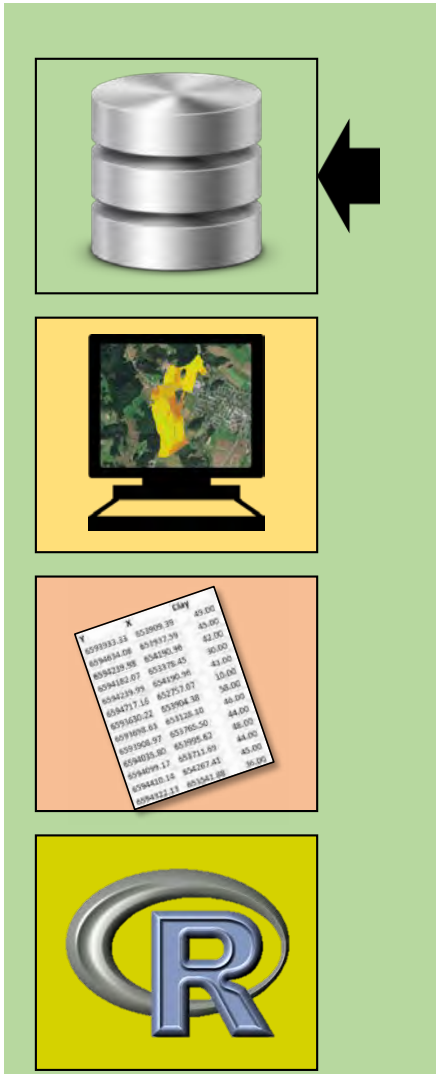
Markdata.se
A web application for practical use of soil data

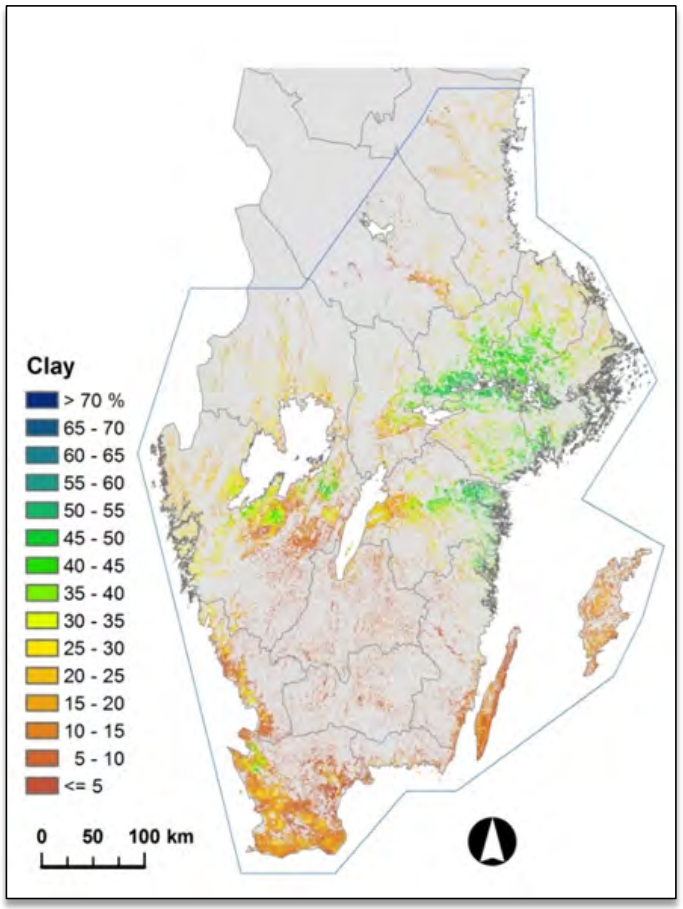
Swedish example of implemented pedometrics

for precision agriculture



Spatial Soil Properties Database: **DSMS**

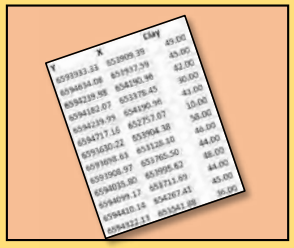




2.4 million ha of arable land

More info on DSMS later……

Free decision support application:
Markdata.se



Markdata.se

markdata.se

Sök

Markdata.se ?

Hitta block och välj markdata

1. Leta reda på det skifte du vill titta närmare på. Skriv in adressen (ex. sockennamn) i rutan uppe till vänster. Du kan också zooma in och ut med + och - tecknen eller förflytta dig genom att dra karta dit du vill.
2. Markera ett eller flera block i bakgrundskartan
3. Du kan sedan dela blocket om det innehåller flera skiften. Välj verktyget Rita delningslinje i kartan

Visa block

Föregående Nästa

Om Markdata.se

Sollebrunn, Sverige

Google

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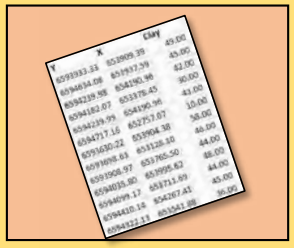

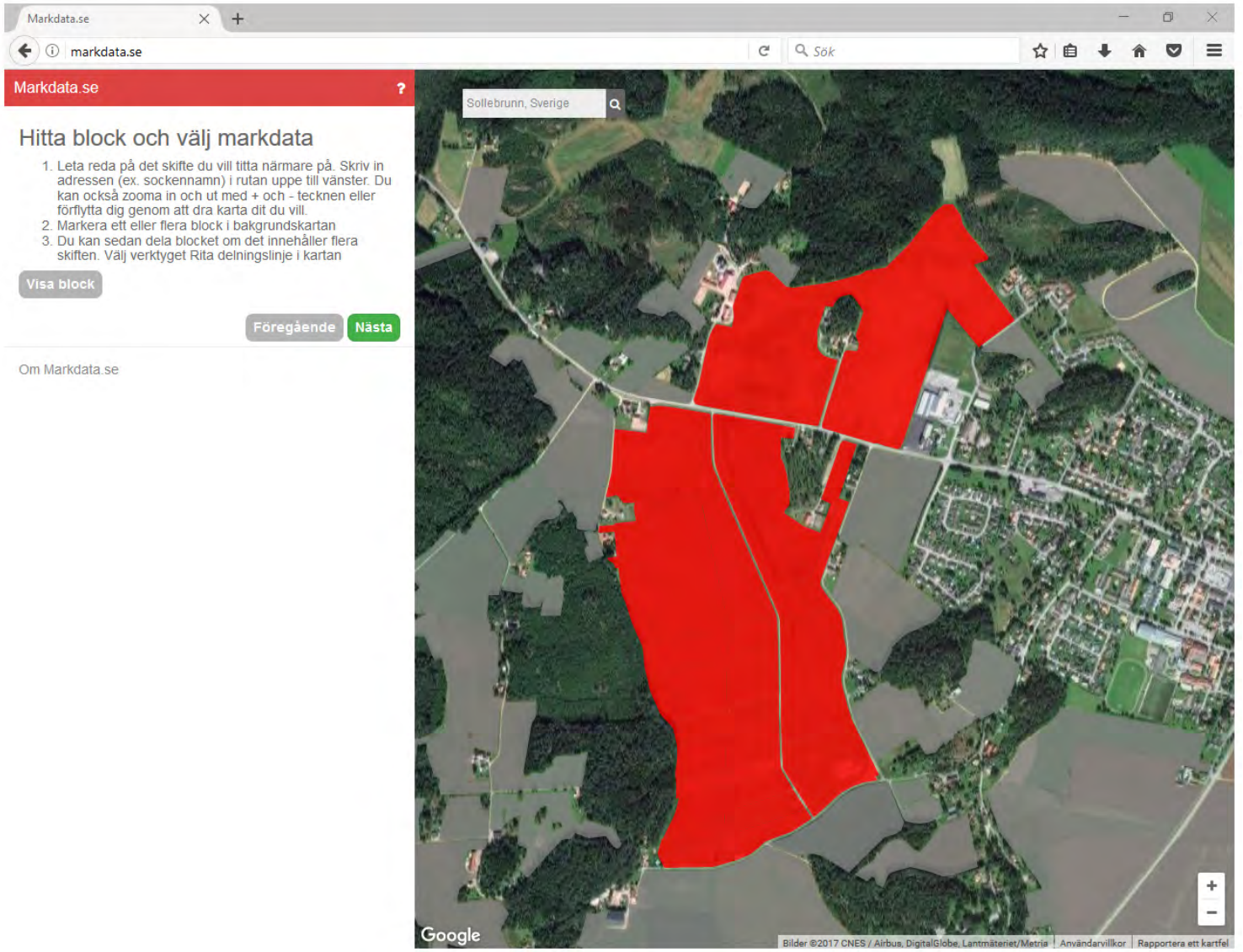
Markdata.se
markdata.se
Sök
Markdata.se
Hitta block och välj markdata
1. Leta reda på det skifte du vill titta närmare på. Skriv in adressen (ex. sockennamn) i rutan uppe till vänster. Du kan också zooma in och ut med + och - tecknen eller förflytta dig genom att dra karta dit du vill.
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Visa block
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Nästa
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Google
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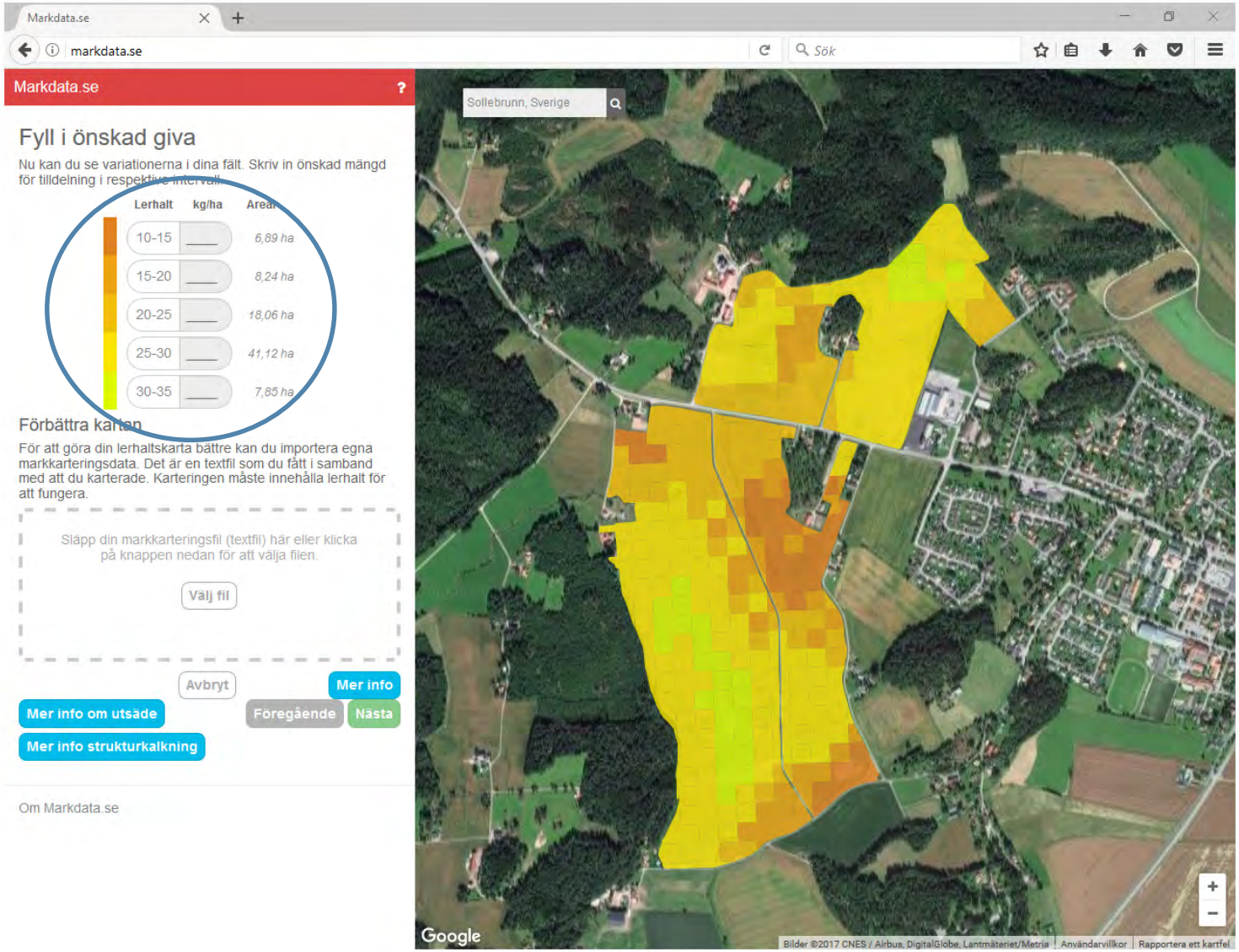
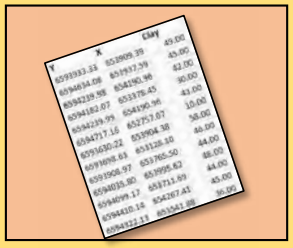
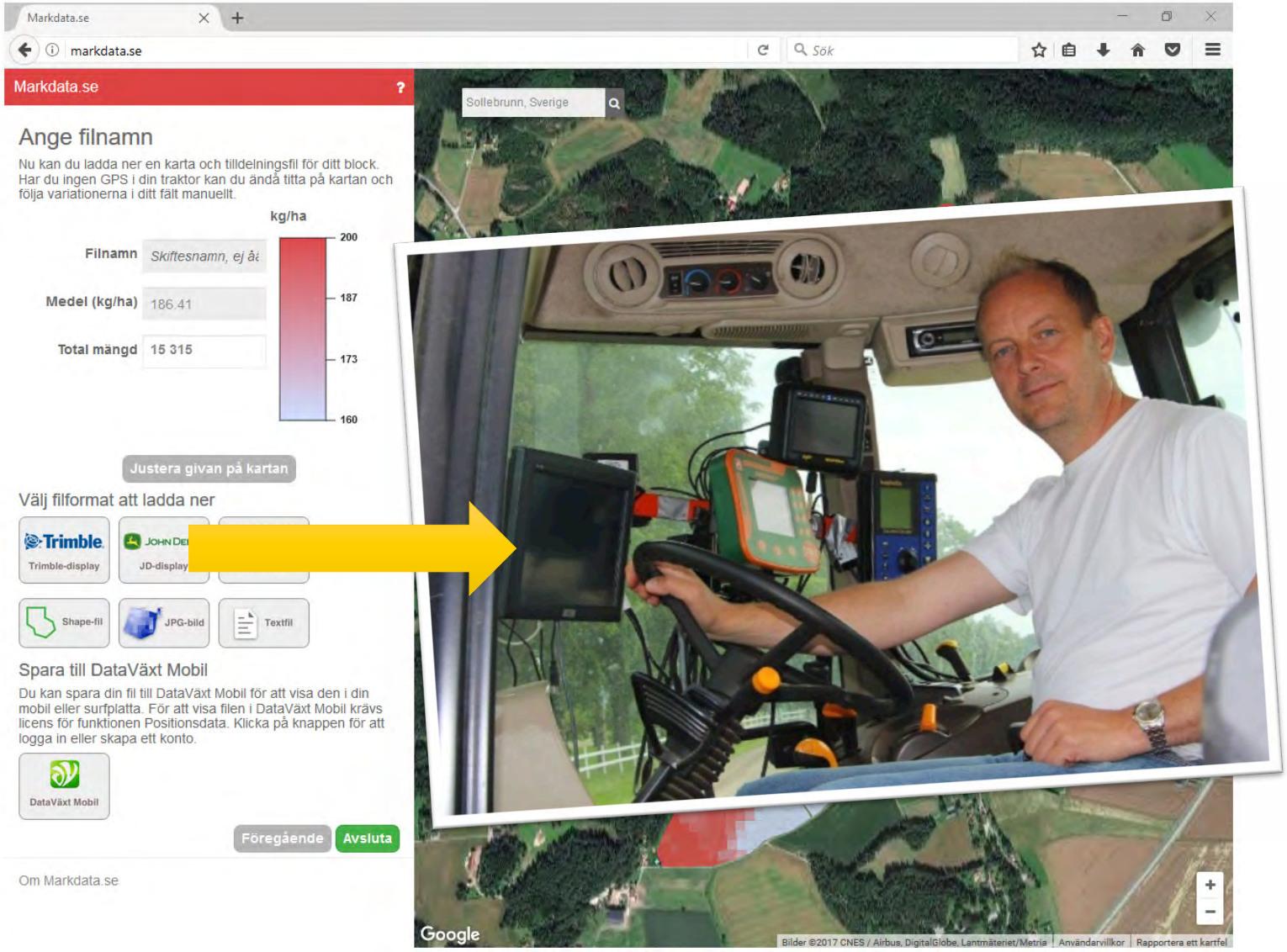
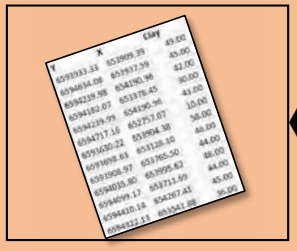
Användarvillkor
Rapportera ett kartfel

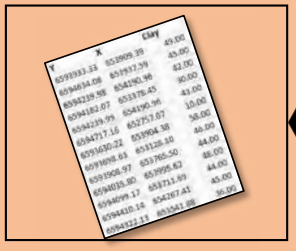

Markdata.se
markdata.se
Sök
Markdata.se
Fyll i önskad giva
Nu kan du se variationerna i dina fält. Skriv in önskad mängd för tilldelning i respektive intervall.
Lerhalt
kg/ha
Area
10-15
6,89 ha
15-20
8,24 ha
20-25
18,06 ha
25-30
41,12 ha
30-35
7,85 ha
Förbättra kartan
För att göra din lerhaltskarta bättre kan du importera egna markkarteringsdata. Det är en textfil som du fått i samband med att du karterade. Karteringen måste innehålla lerhalt för att fungera.
Släpp din markkarteringsfil (textfil) här eller klicka på knappen nedan för att välja filen.
Välj fil
Avbryt
Mer info
Mer info om utsäde
Föregående
Nästa
Mer info strukturkalkning
Om Markdata.se
Sollebrunn, Sverige
Google
Bilder ©2017 CNES / Airbus, DigitalGlobe, Lantmäteriet/Metria
Användarvillkor
Rapportera ett kartfel




Markdata.se
markdata.se
Sök
Markdata.se
Ange filnamn
Nu kan du ladda ner en karta och tilldelningsfil för ditt block. Har du ingen GPS i din traktor kan du ändå titta på kartan och följa variationerna i ditt fält manuellt.
kg/ha
Filnamn
Skiftesnamn, ej åä
Medel (kg/ha)
186.41
Total mängd
15 315
200
187
173
160
Justera givan på kartan
Välj filformat att ladda ner
Trimble
Trimble-display
JD-display
Shape-fil
JPG-bild
Textfil
Spara till DataVäxt Mobil
Du kan spara din fil till DataVäxt Mobil för att visa den i din mobil eller surfplatta. För att visa filen i DataVäxt Mobil krävs licens för funktionen Positionsdata. Klicka på knappen för att logga in eller skapa ett konto.
DataVäxt Mobil
Föregående
Avsluta
Om Markdata.se
Sollebrunn, Sverige
Google
Bilder ©2017 CNES / Airbus, DigitalGlobe, Lantmäteriet/Metria
Användarvillkor
Rapportera ett kartfel



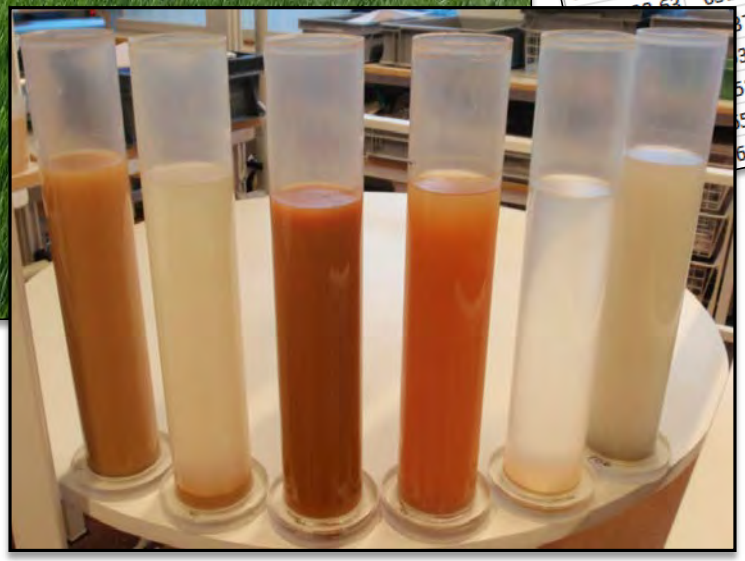
Uploading user's data: **Soil sampling**

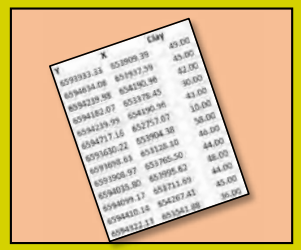


If available:

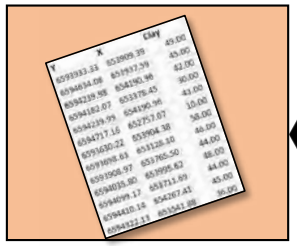
Often one sample per 3 ha

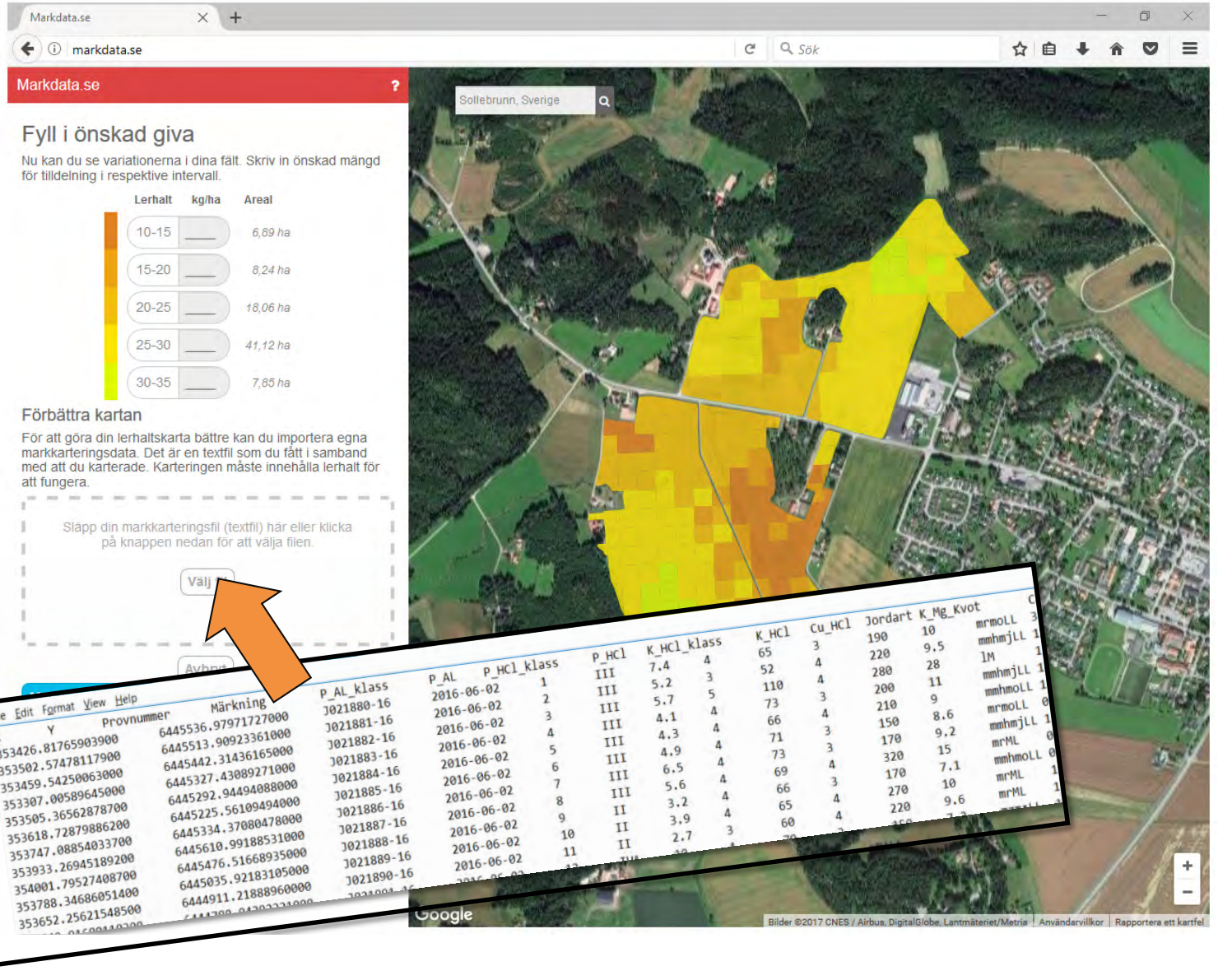
Y	X	Clay
6593933.33	653909.39	49.00
6594634.08	653937.59	45.00
6594239.98	654190.96	42.00
6594182.07	653378.45	30.00
6594239.99	654190.96	43.00
6594717.16	652757.07	10.00
6593630.22	653904.38	58.00
	653128.10	46.00
	765.50	44.00
	3995.62	48.00
	3711.69	44.00
	54267.41	45.00
	653541.88	36.00

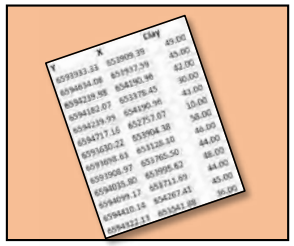




Automated algorithm : **Maps.R.Interactive**




Markdata.se
markdata.se
Sök
Markdata.se
Fyll i önskad giva
Nu kan du se variationerna i dina fält. Skriv in önskad mängd för tilldelning i respektive intervall.
Lerhalt kg/ha Areal
10-15 6,89 ha
15-20 8,24 ha
20-25 18,06 ha
25-30 41,12 ha
30-35 7,85 ha
Förbättra kartan
För att göra din lerhaltskarta bättre kan du importera egna markkarteringsdata. Det är en textfil som du fått i samband med att du karterade. Karteringen måste innehålla lerhalt för att fungera.
Släpp din markkarteringsfil (textfil) här eller klicka på knappen nedan för att välja filen.
Välj
Sollebrunn, Sverige
Google
Bilder ©2017 CNES / Airbus, DigitalGlobe, Lantmäteriet/Metria
Användarvillkor
Rapportera ett kartfel



Markdata.se

markdata.se

Sök

Markdata.se ?

Fyll i önskad giva

Nu kan du se variationerna i dina fält. Skriv in önskad mängd för tilldelning i respektive intervall.

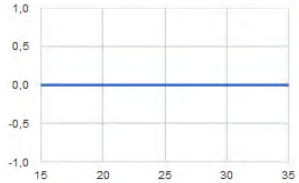
Lerhalt	kg/ha	Areal
10-15	____	9,67 ha
15-20	____	9,00 ha
20-25	____	41,71 ha
25-30	____	21,09 ha
30-35	____	0,69 ha

Förbättra kartan

För att göra din lerhaltskarta bättre kan du importera egna markkarteringsdata. Det är en textfil som du fått i samband med att du karterade. Karteringen måste innehålla lerhalt för att fungera.

Förbättra kartan

Originalkartan är uppdaterad!



Mer info om utsäde

Föregående

Nästa

Mer info strukturkalkning

Om Markdata.se

Sollebrunn, Sverige

Google

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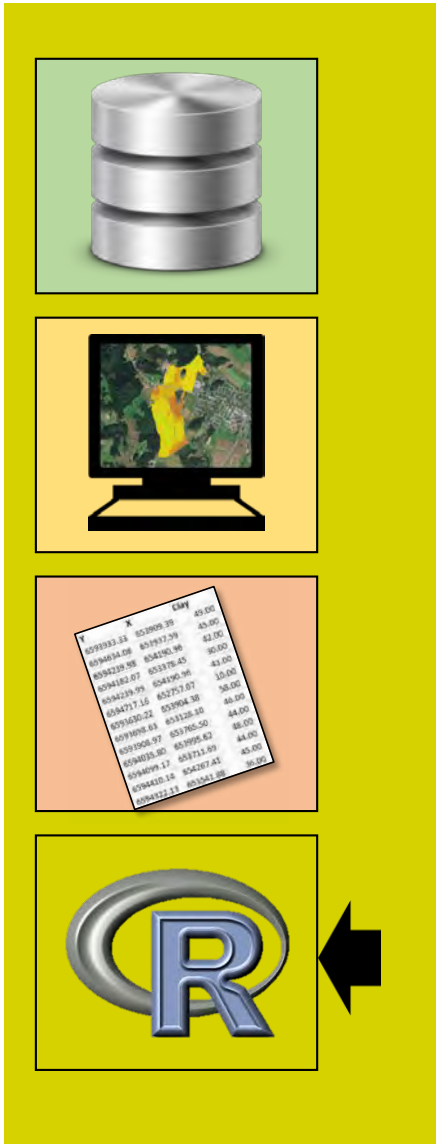


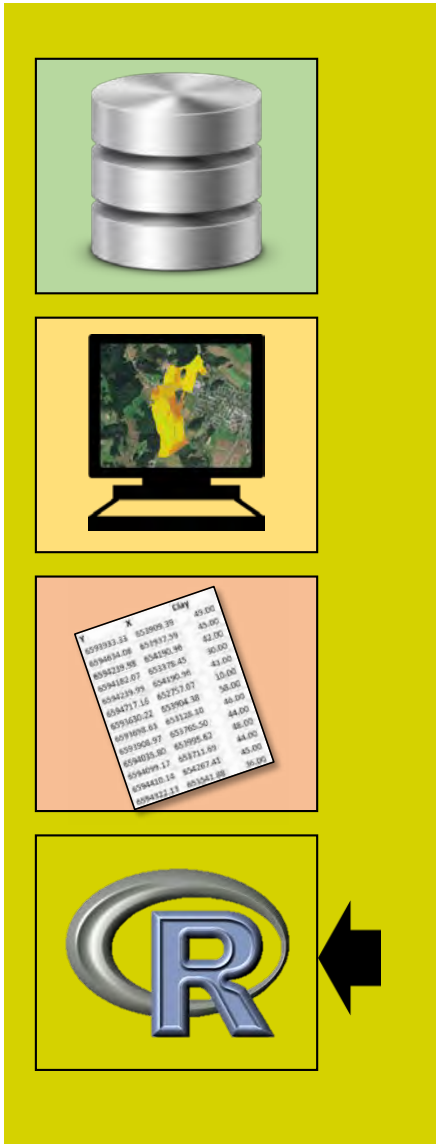
DSMS

Map based on local data only (ordinary kriging)

Adapted DSMS 1 (residual kriging)

Adapted DSMS 2 (regression kriging)

Four maps



Independent validation

DSMS

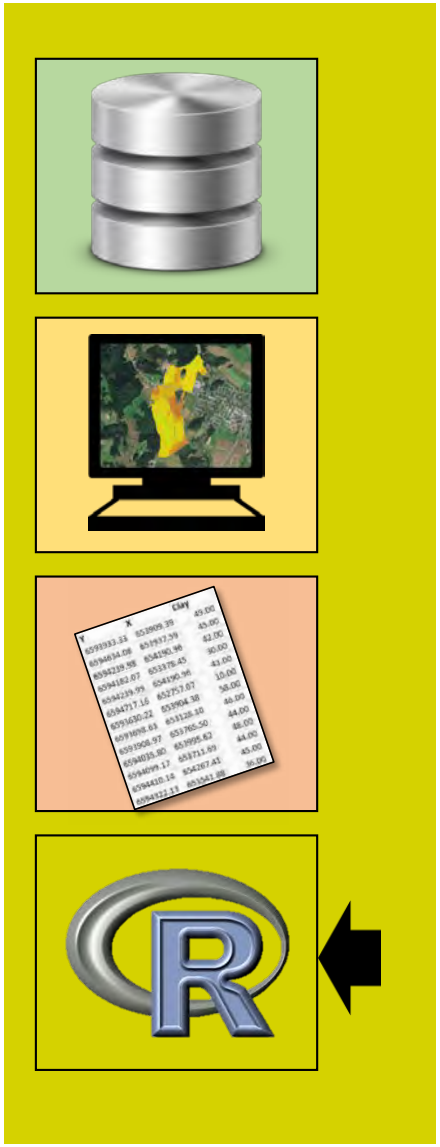
Map based on local data only (ordinary kriging)

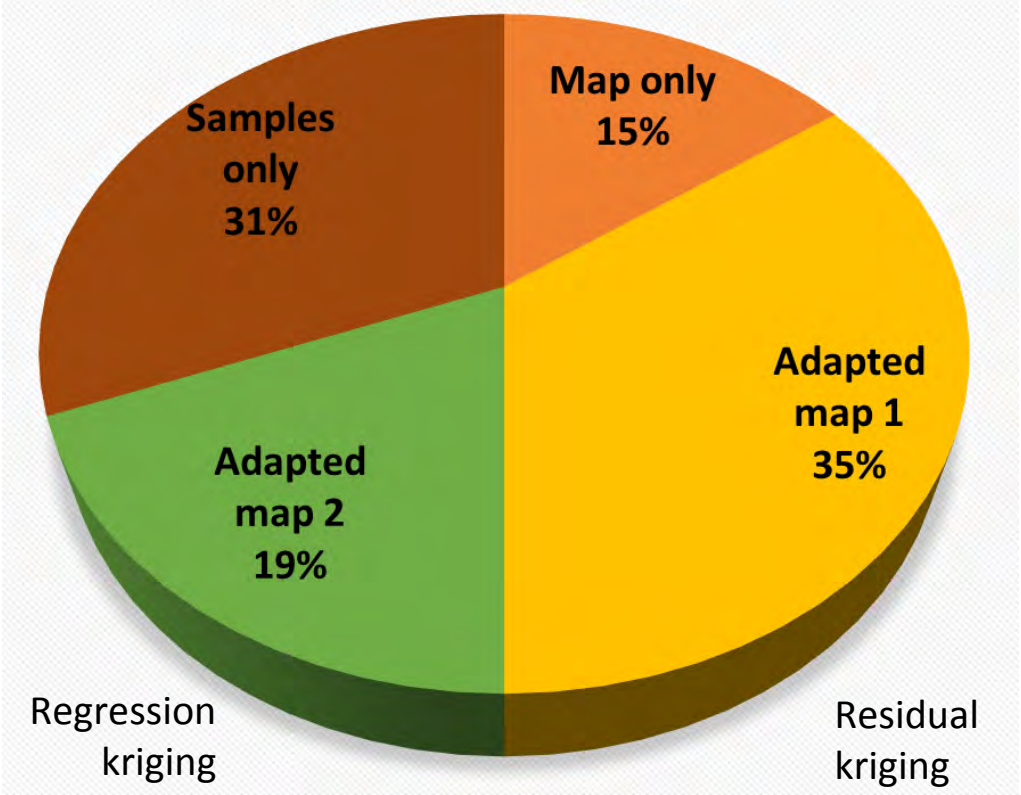
Adapted DSMS 1 (residual kriging)

Adapted DSMS 2 (regression kriging)

Leave-one-sample-out cross-validation

Validation

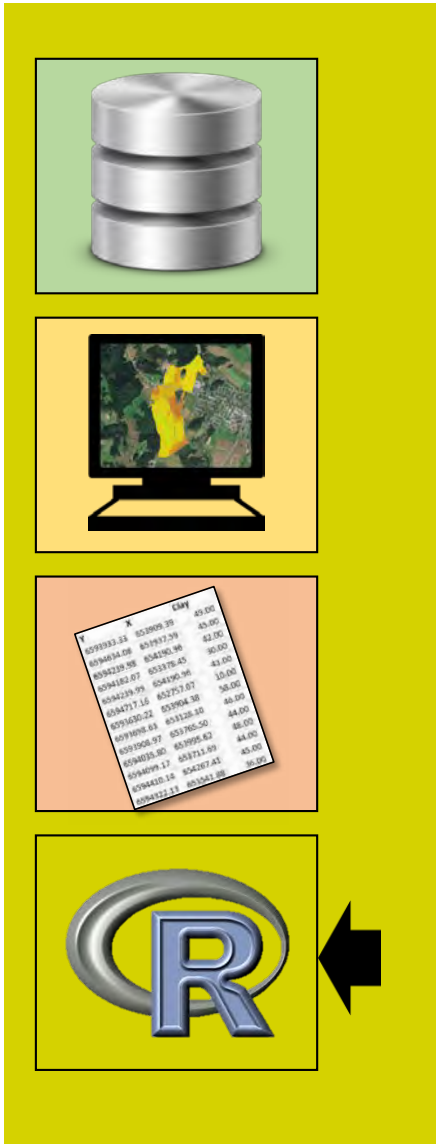


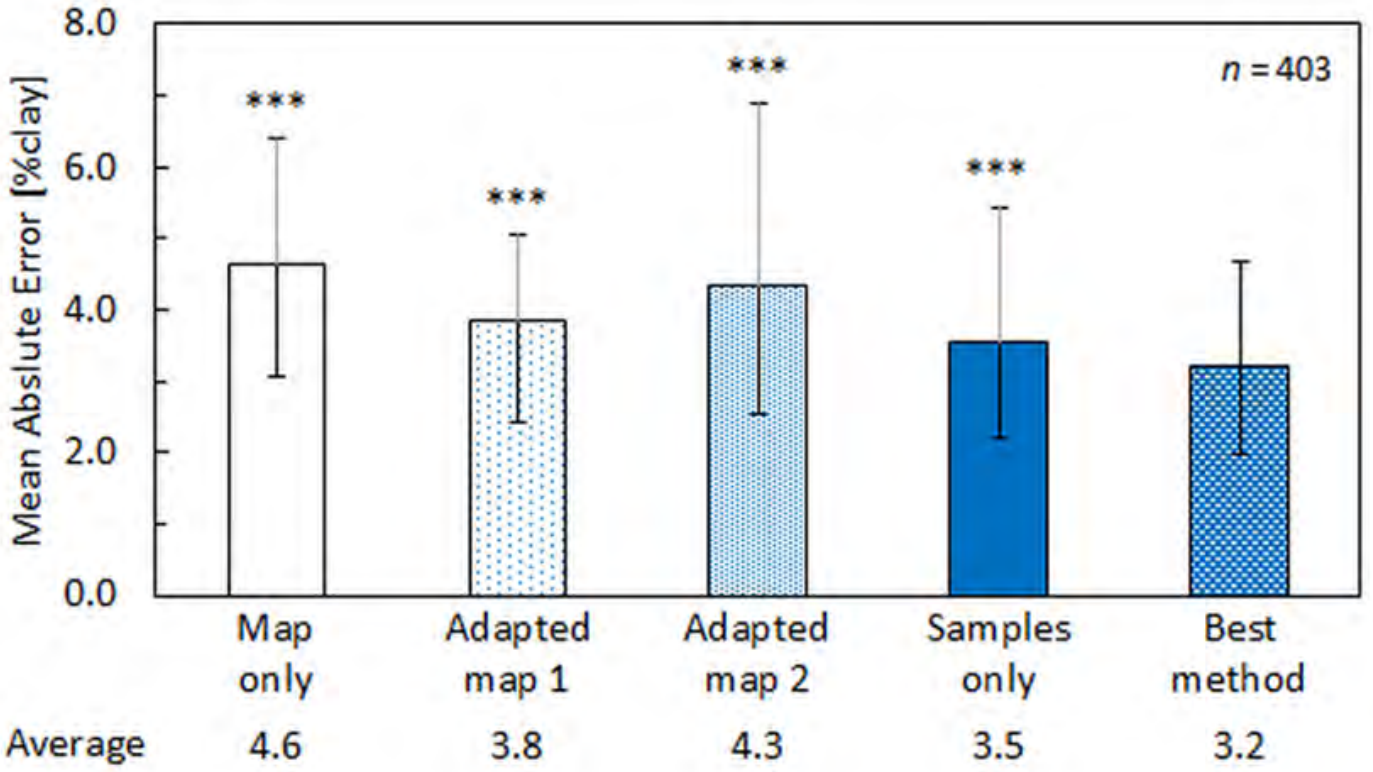


Percent of 403 farms, where the map had the lowest MAE

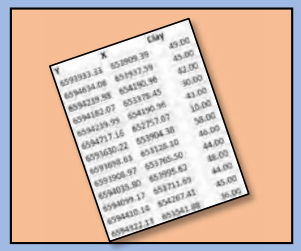
MAE = Mean Absolute Error

Validation

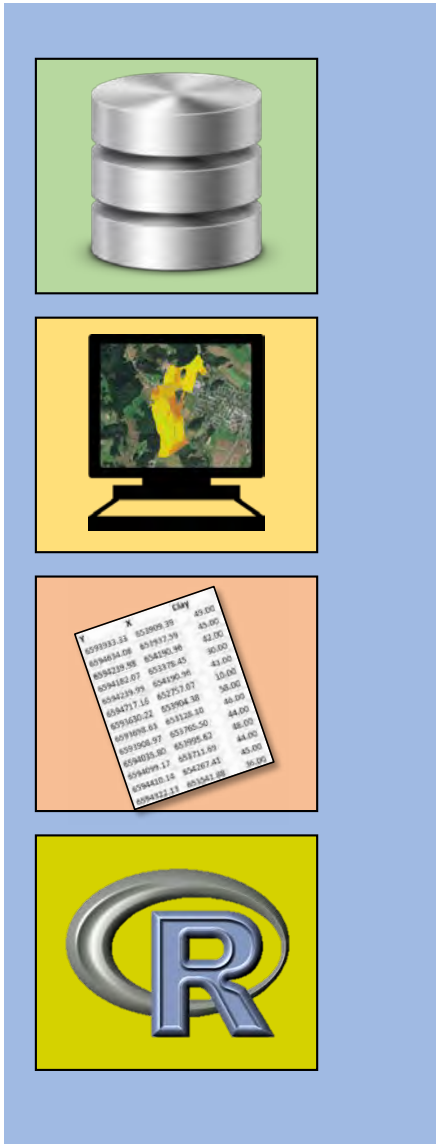




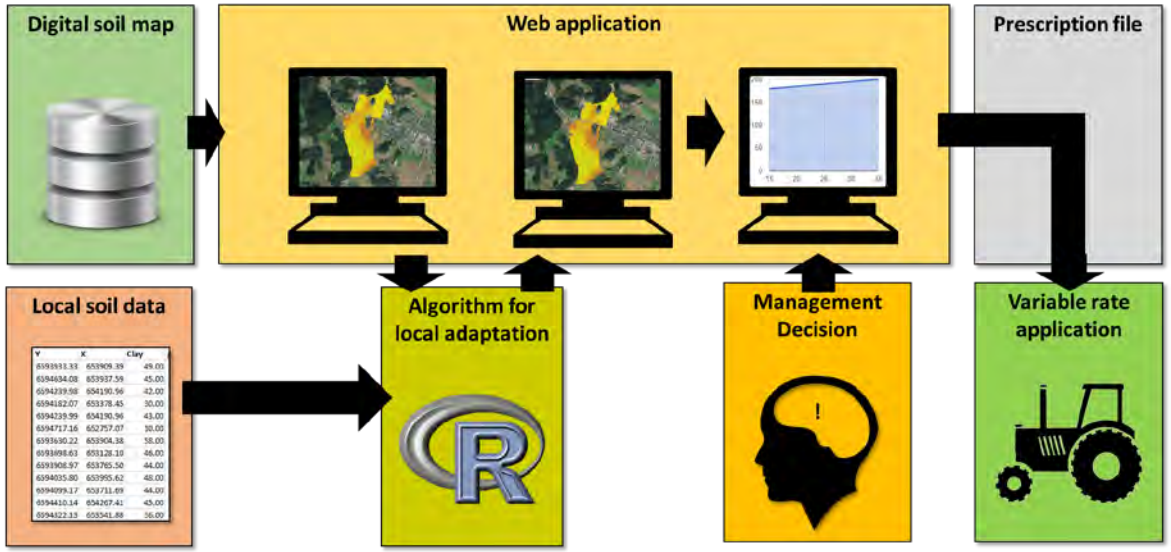
Use the locally best map



Summary



- An algorithm was developed for local adaptation (downscaling) of a national digital soil map.
- Implemented in a free web-based decision support application for precision agriculture (markdata.se).



2

What is DSMS (the digital soil map of Sweden)?

DSMS properties

Format: Raster

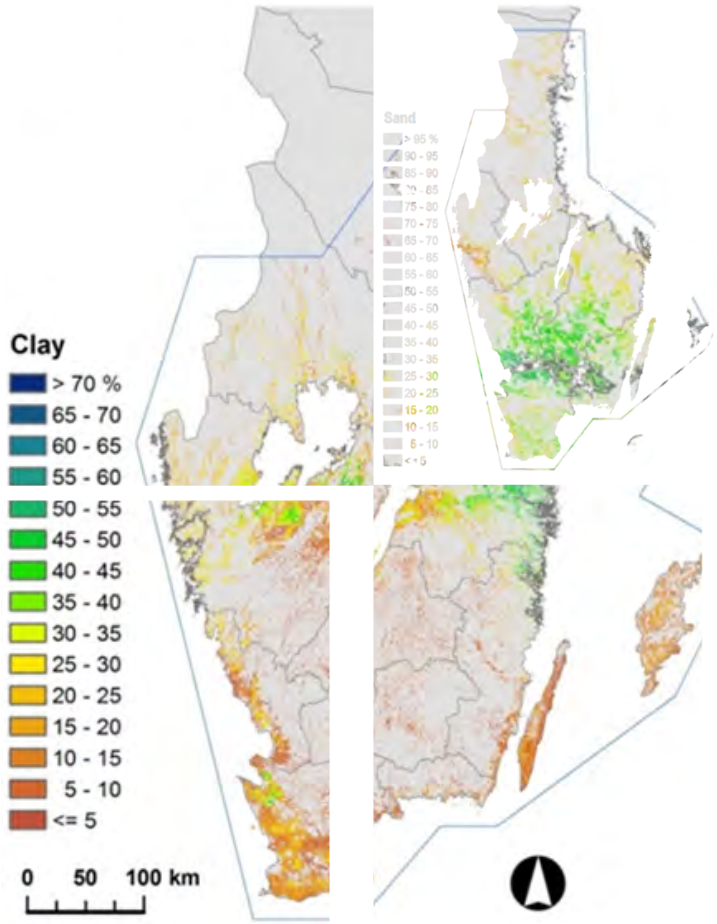
Cell size: 50 m × 50 m

Extent: 2.4 million ha
>90% of the arable land
! Except organic soils

Attributes: Topsoil clay content
Topsoil sand content
Topsoil silt content
Topsoil FAO texture class

License: CC-BY

Download site: http://bit.ly/DSMS_download

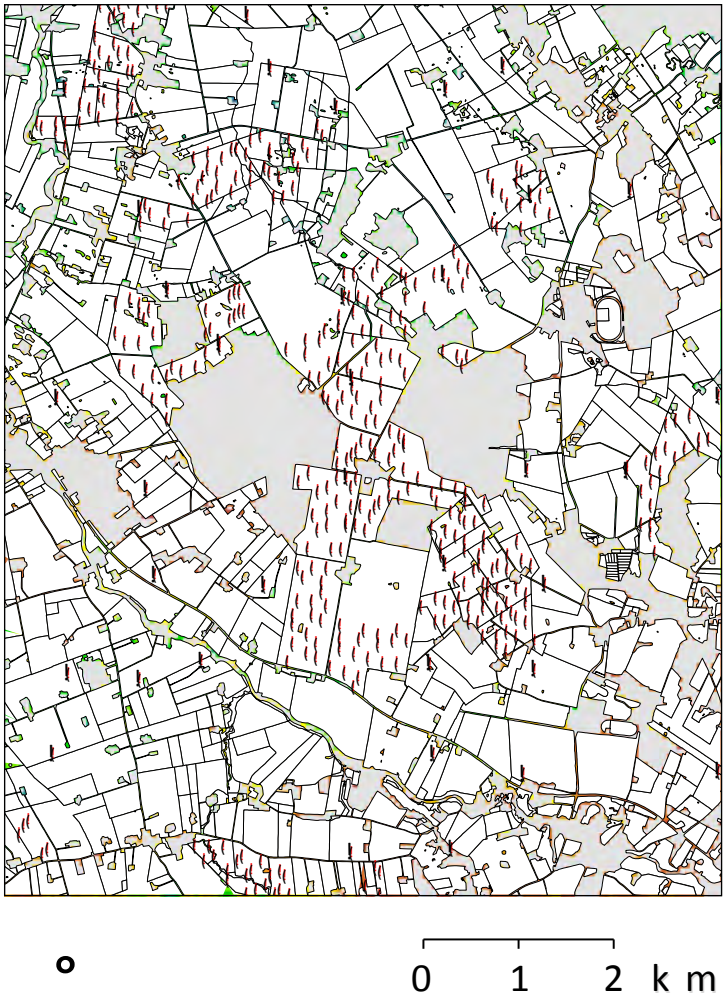


Data

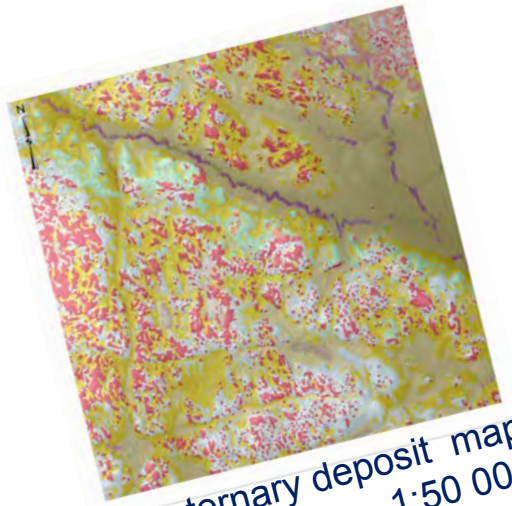
Lattice point location data:
Texture and organic matter (OM) content in 13,600 soil samples taken in a ~1 km^2 square grid

Clustered point location data:
Texture and OM content in 24,000 soil samples at 544 farms: 1 sample / 3 ha

Polygon data
Field boundaries and field classifications



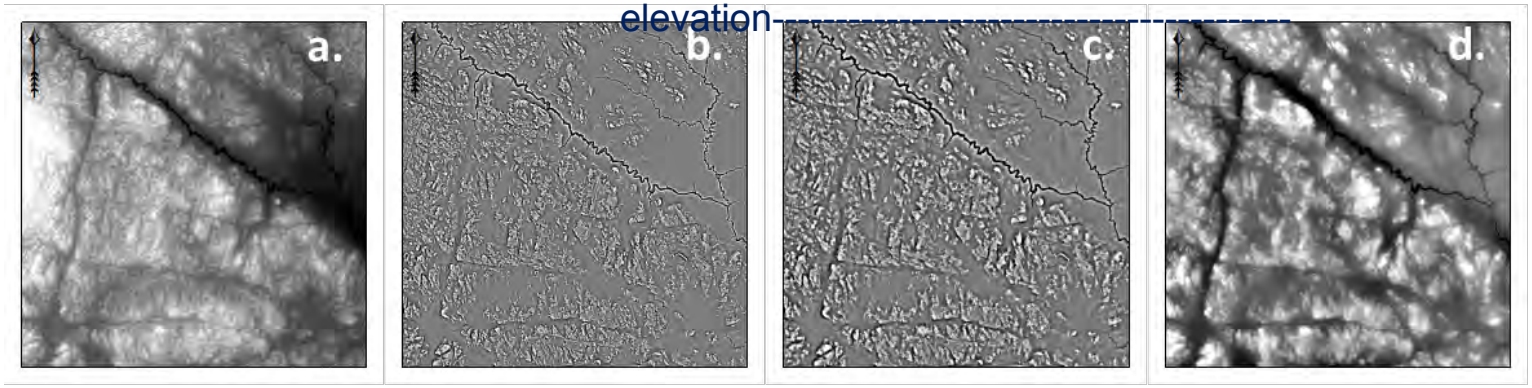
Covariates



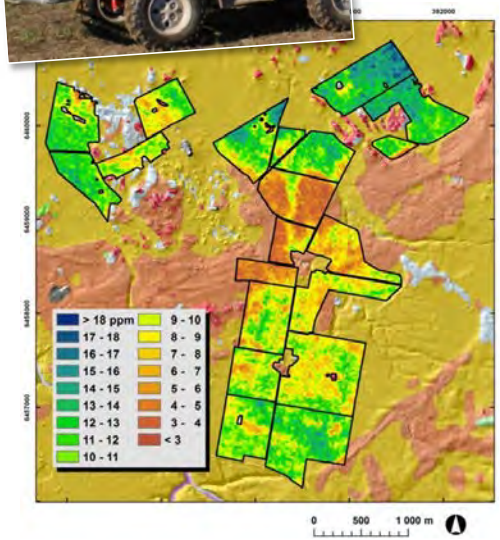
Quaternary deposit map 1:50 000

Gamma radiation scannings

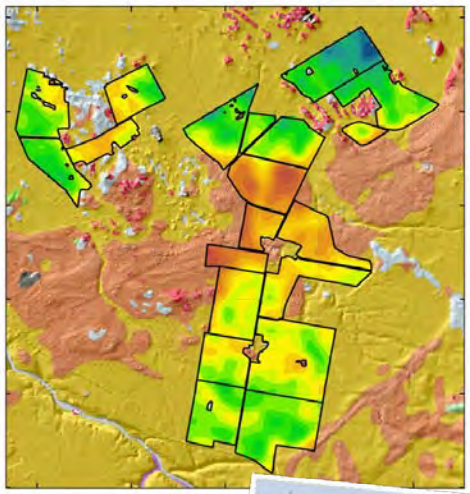
Elevation ----------Relative elevation----------



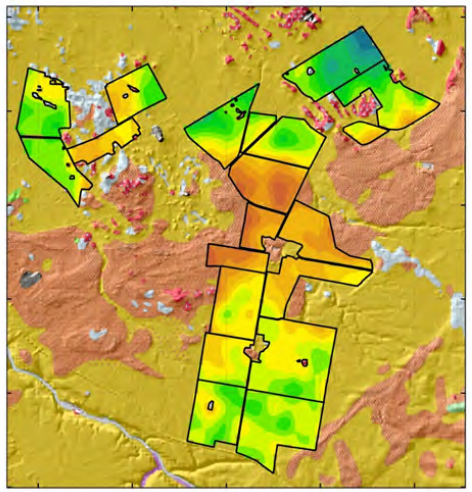
Gamma radiation data



Th, proximal
0.2 m height
24 m spacing

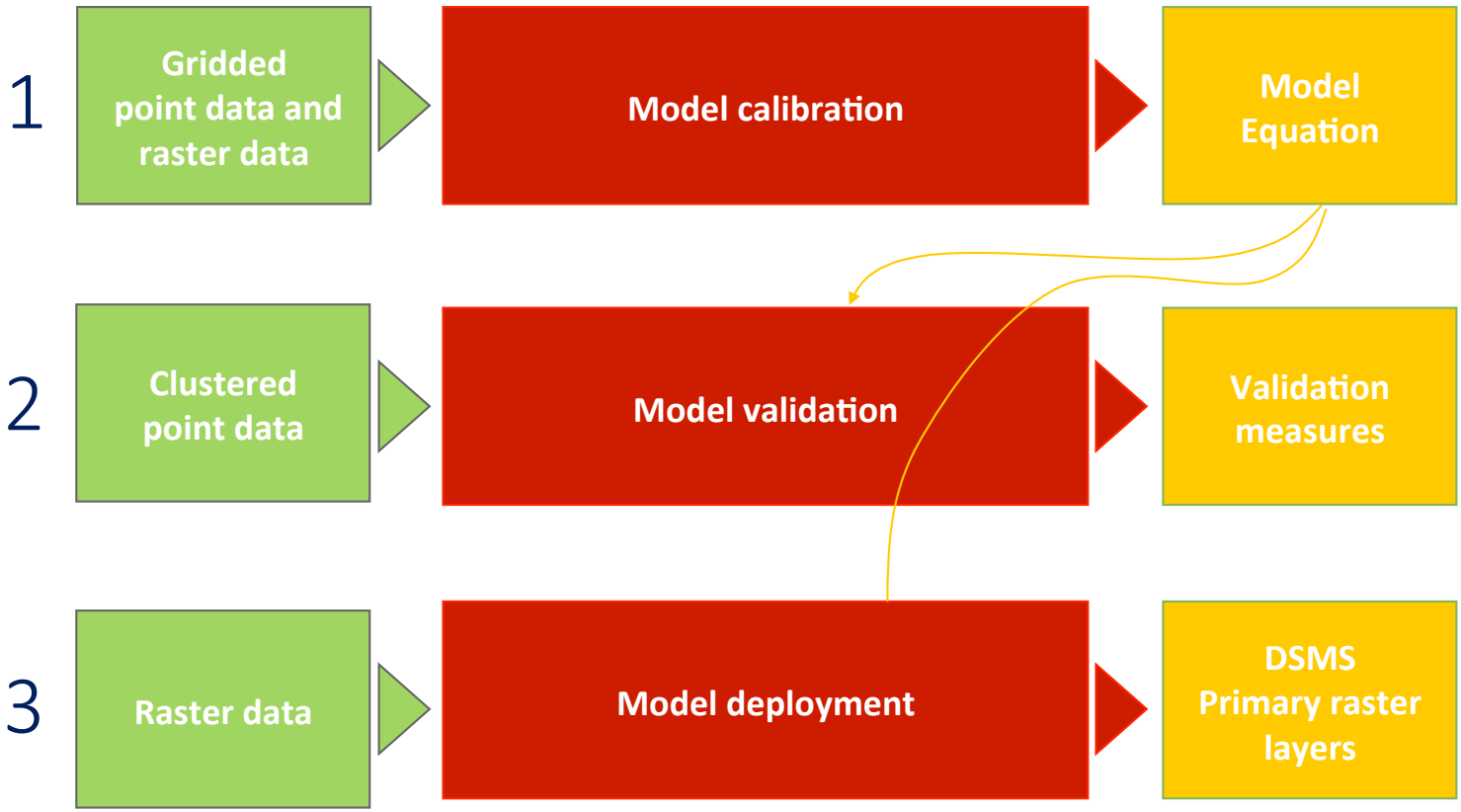


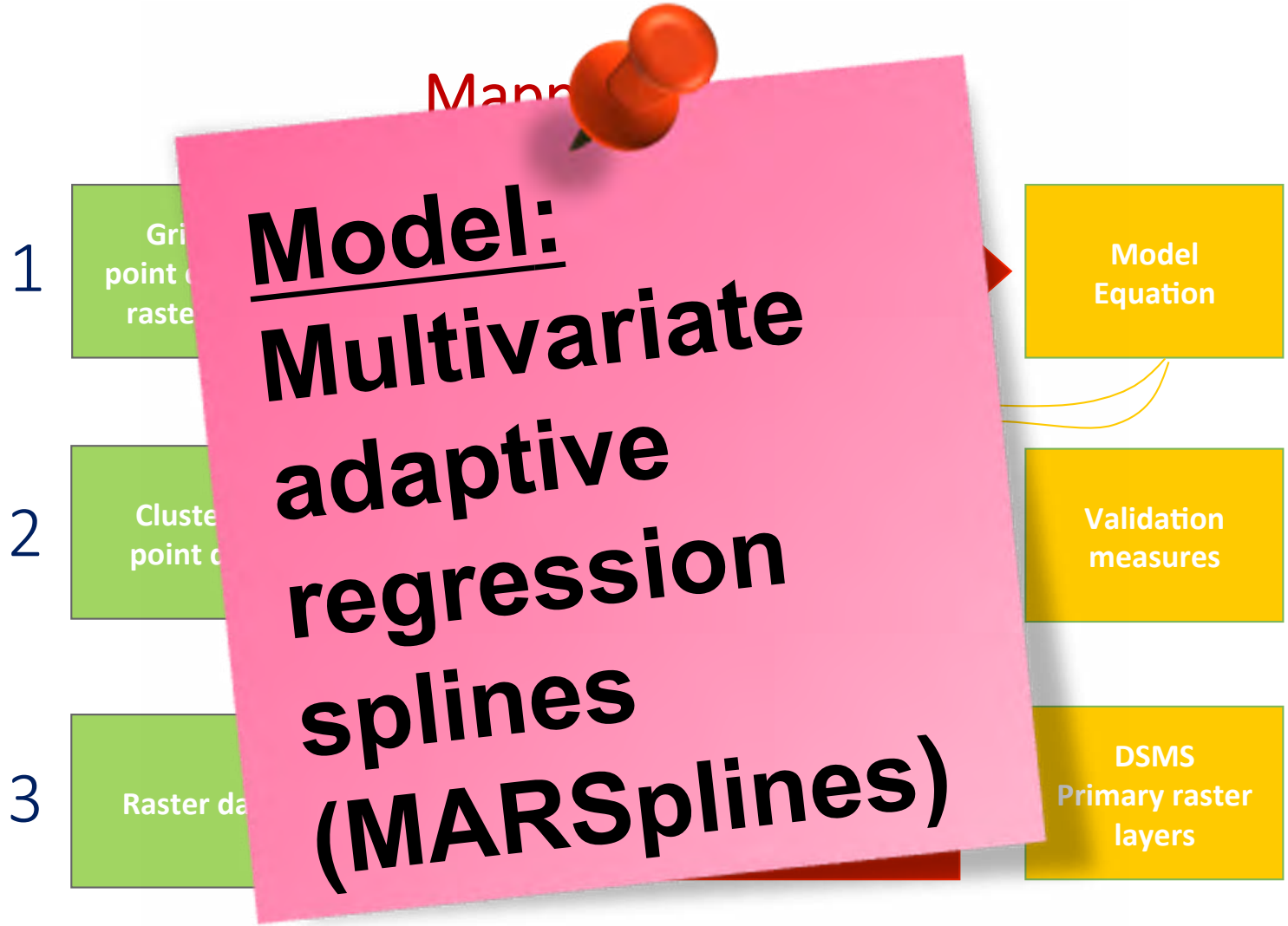
Th, airborne
30 m height
100 m spacing



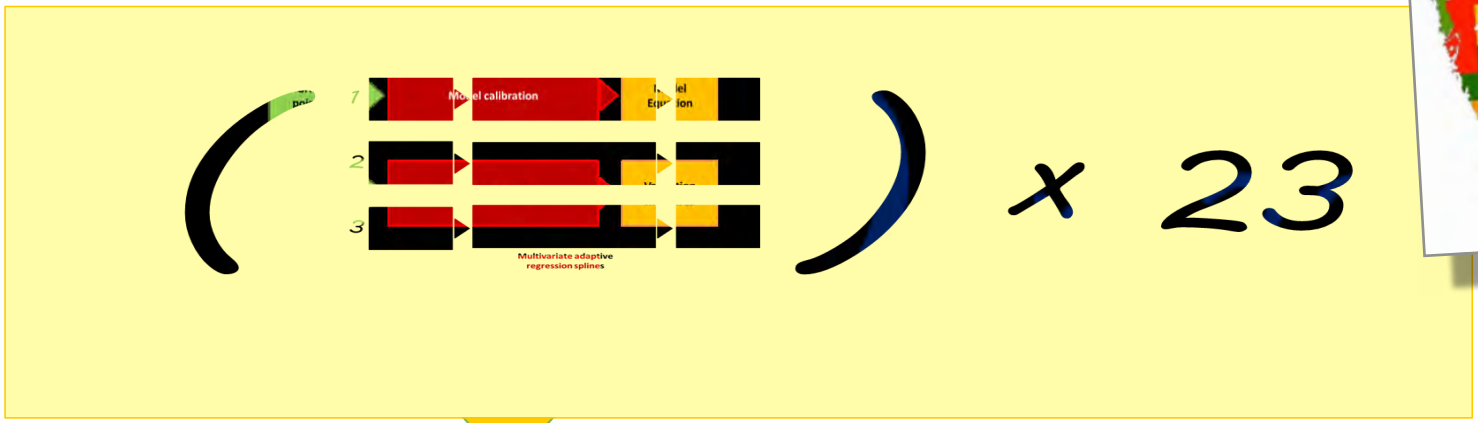
Th, airborne
60 m height
200 m spacing

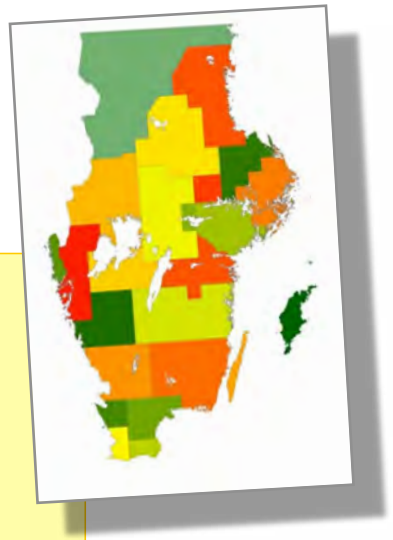
Mapping strategy




Mapp
1
Gri
point
raste
2
Cluste
point
3
Raster da
Model:
Multivariate adaptive regression splines (MARSplines)
Model Equation
Validation measures
DSMS Primary raster layers

Mapping strategy





4 Applying pedotransfer functions → DSMS Secondary raster layers

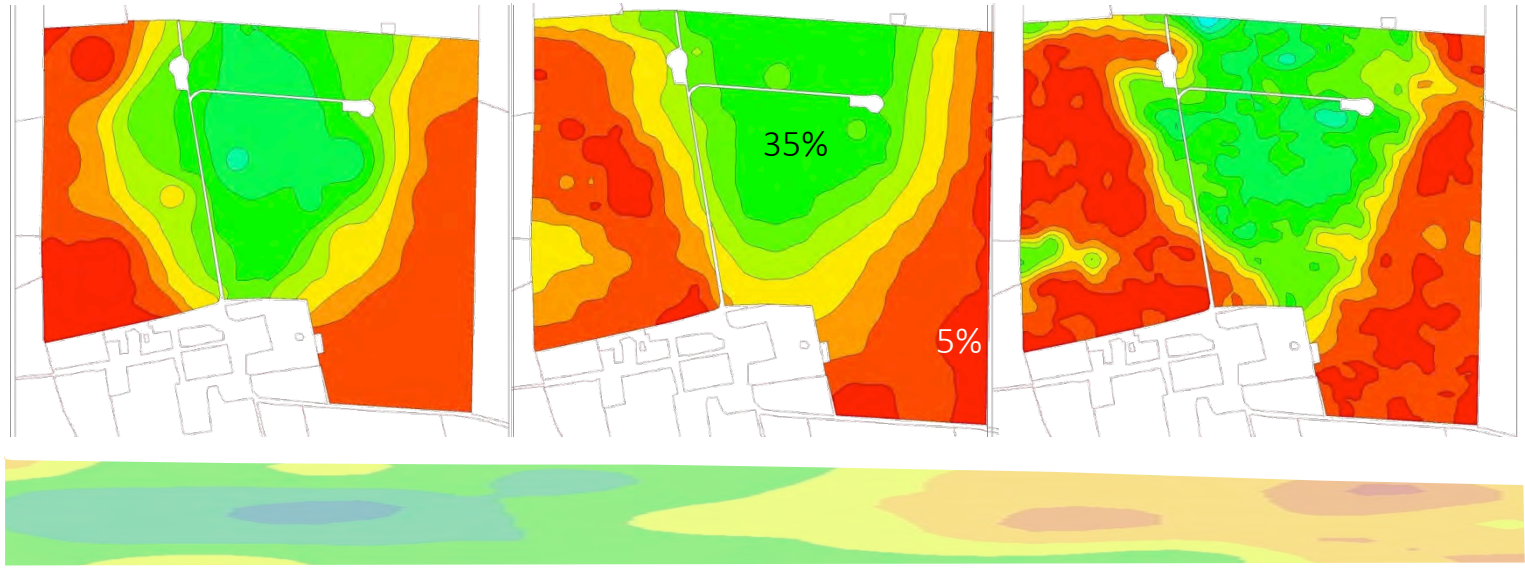
-Buffering capacity
-Target pH
etc….

Clay content at one 55 ha farm…

Soil samples only
1 sample/3 ha

DSMS

Proximal sensing
”the truth”

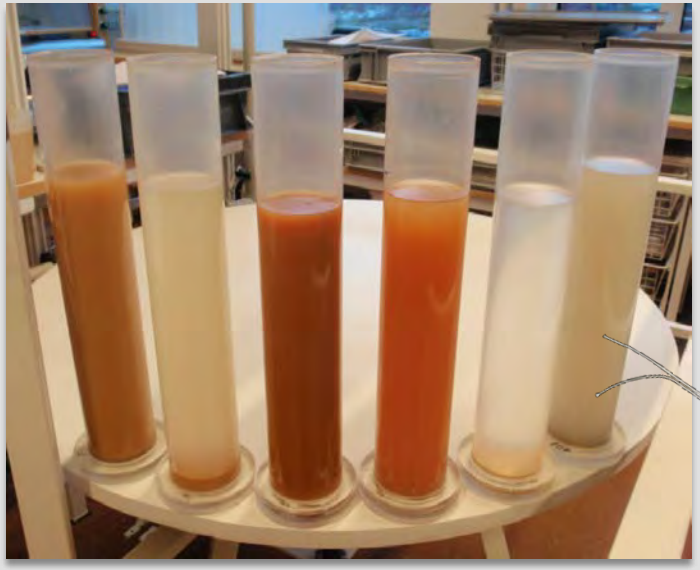


3

Detailed local soil maps derived by proximal sensing

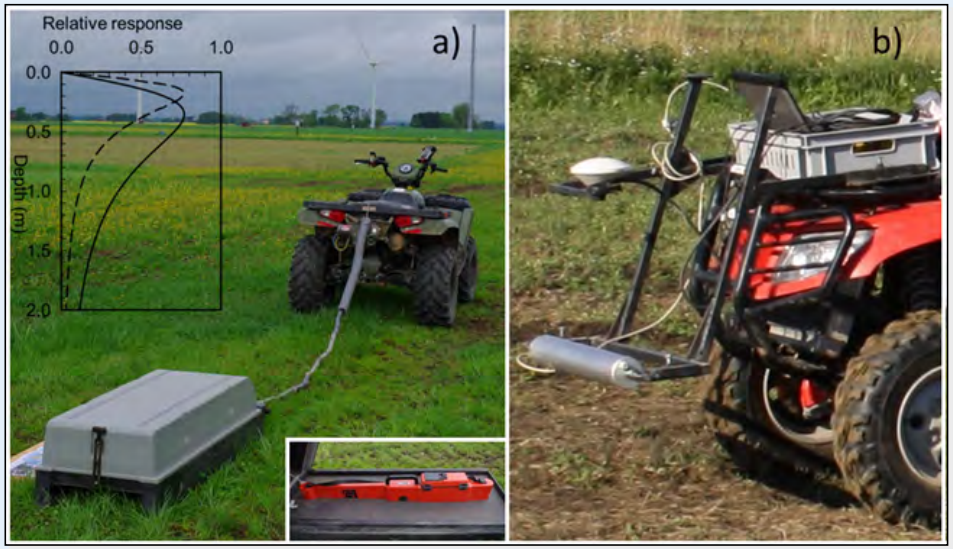
Lab analyses are:

- More expensive
- Less uncertain



640 :- /st

Foto: Christina Öhman, SLU



Proximal sensor measurements *in situ* are:

- Less expensive
- More uncertain

Gamma spectrometry

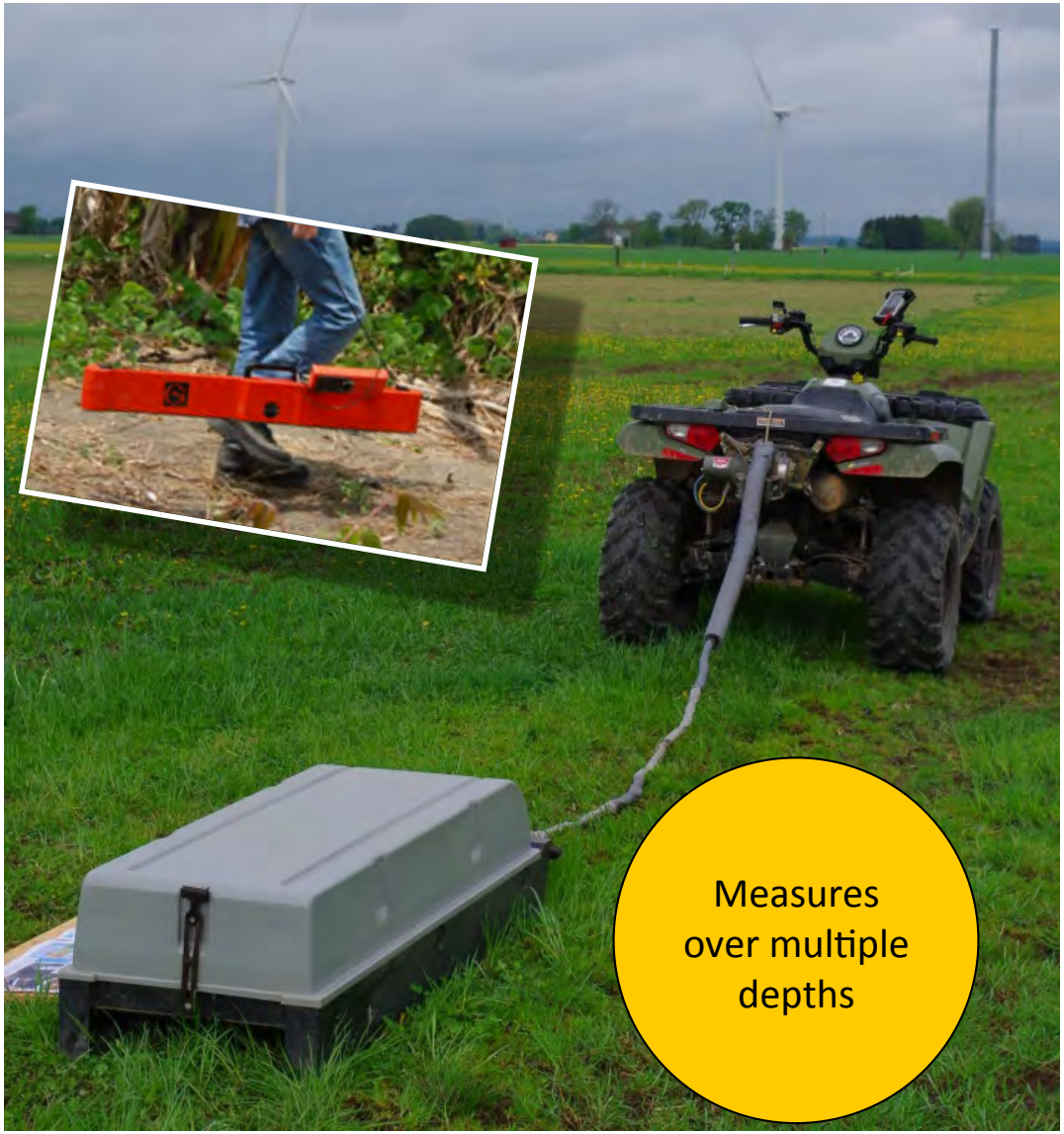
Registers:

- Natural gamma radiation of ^{40}K, ^{238}U och ^{232}Th in the topsoil

Can be related to:

- Soil parent material
- Soil texture
- Cadmium content in some areas

Excellent for topsoil clay content



Electromagnetic induction sensor

Registers:

- Apparent electrical conductivity and magnetic susceptibiliy over multiple depth

Can e.g. be related to:

- Soil texture
- Moisture content
- Salinity
- Organic matter content

Any relationships are site-specific

Hydraulic probe

Registers depth profiles!

Registers :

- Apparent electrical conductivity
- Insertion force
- visNIR reflectance spectra

Can be related to:

- Soil texture
- Moisture content
- Salinity
- Organic matter content

Vis-NIR/MIR spectroscopy

Suitable for small plots

Registers :

- visNIR reflectance spectra

Can be related to:

- Soil texture
- Moisture content
- Organic matter content
- Other properties…..(?)

PXRF

Direct measure-ments

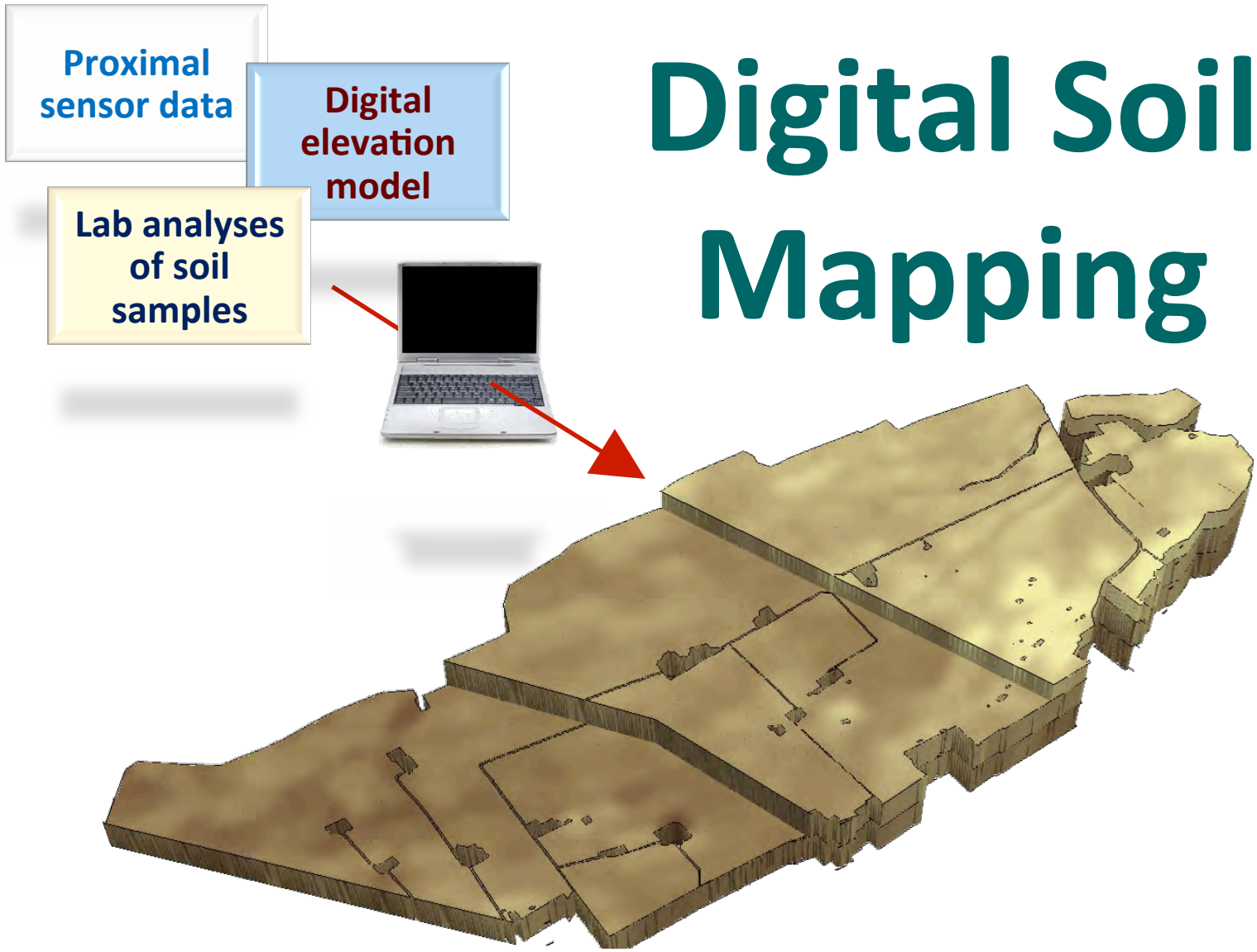
Registers :

- X-ray fluorescence of elements from Mg →

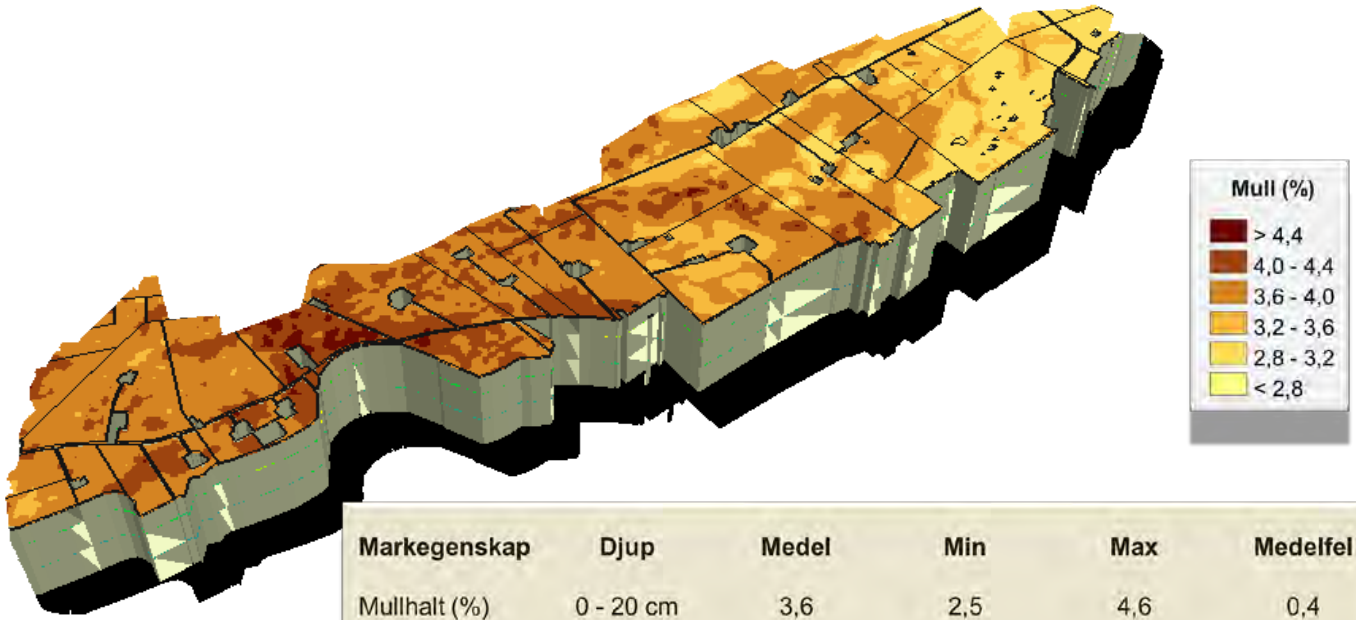
Can be related to:

- Total concentration of many elements

Digital Soil Mapping



Organic matter content 0-20 cm

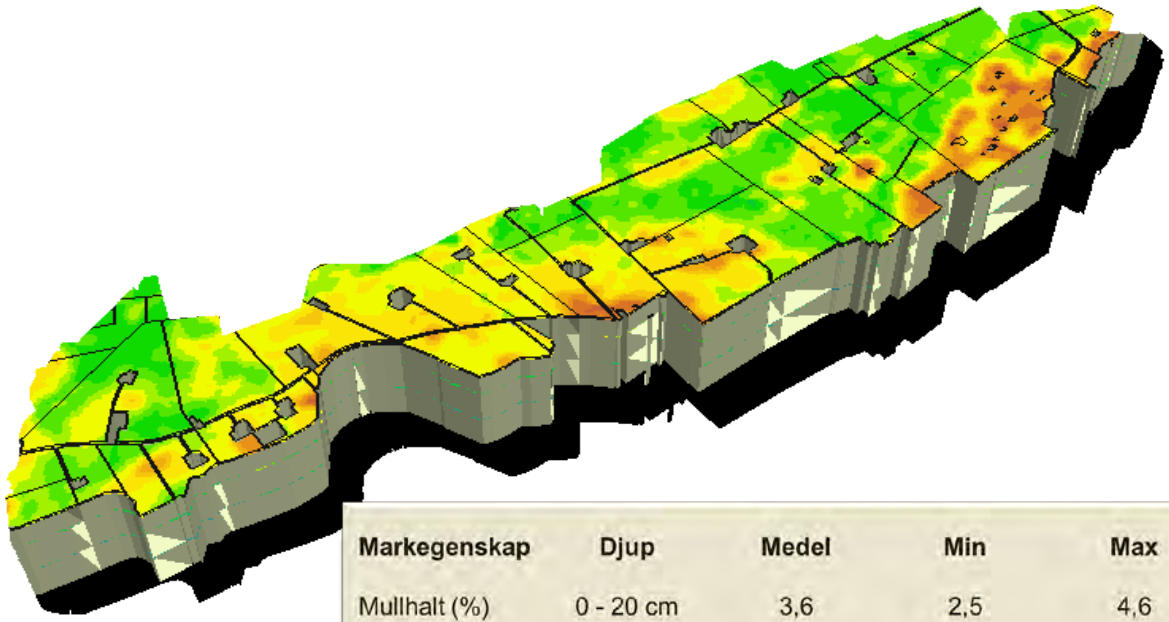


Markegenskap	Djup	Medel	Min	Max	Medelfel
Mullhalt (%)	0 - 20 cm	3,6	2,5	4,6	0,4
Lerhalt (%)	0 - 20 cm	40,4	21,5	48,7	3,5
Lerhalt (%)	20 - 50 cm	51,2	31,2	58,7	4,6
Lerhalt (%)	50 - 80 cm	55,6	44,0	60,8	3,9

Example:

- Watershed of 800 ha
- 50 soil samples * 3 depths
- 800 000 registrations of ECa and gamma radiation
- Digital elevation model from RTK-GPS
- Multivariate prediction modelling

Clay content 0-20 cm



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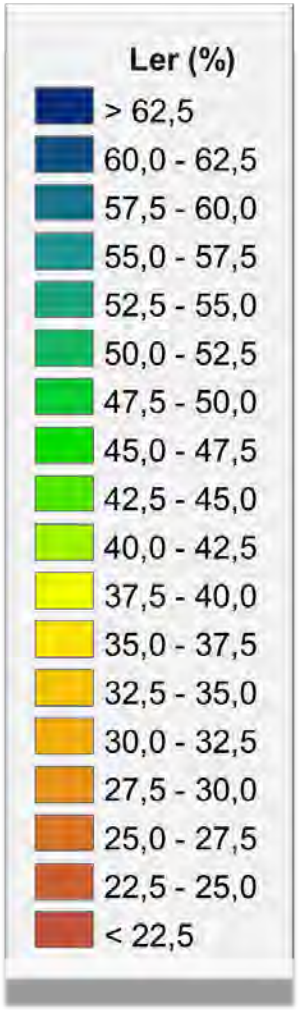
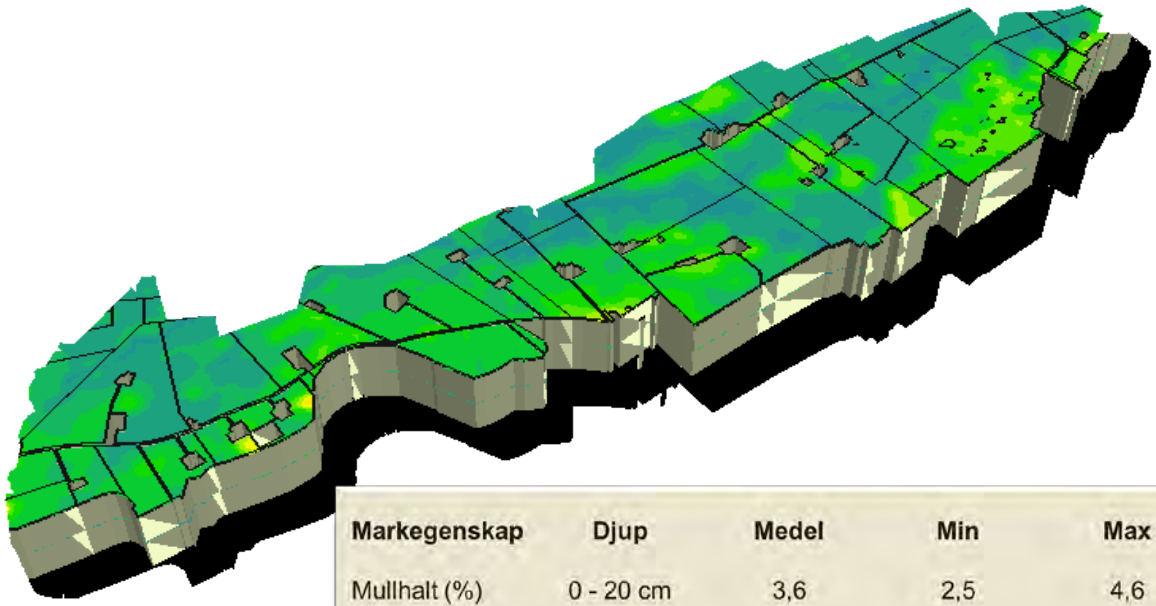
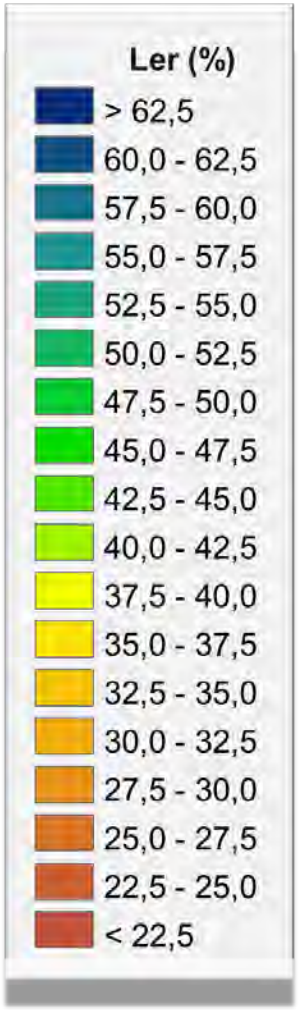


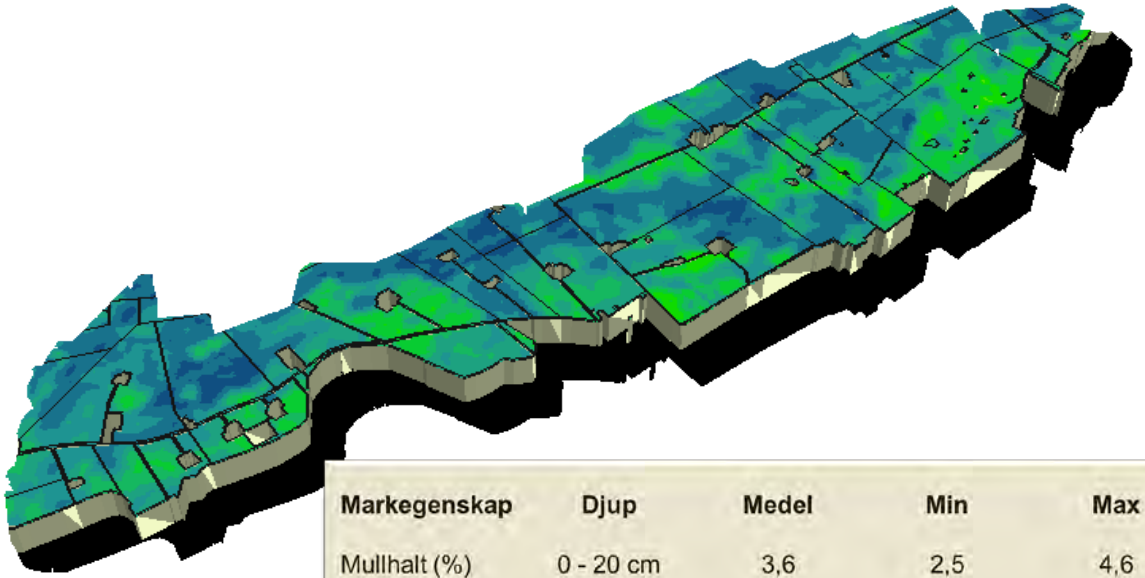
Clay content 20-50 cm



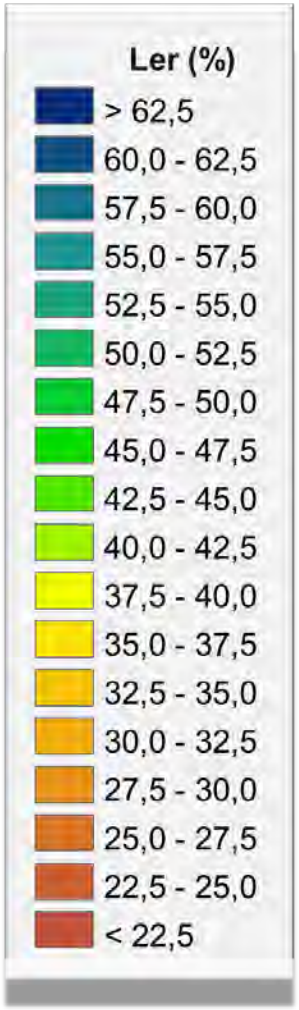
Markegenskap	Djup	Medel	Min	Max	Medelfel
Mullhalt (%)	0 - 20 cm	3,6	2,5	4,6	0,4
Lerhalt (%)	0 - 20 cm	40,4	21,5	48,7	3,5
Lerhalt (%)	20 - 50 cm	51,2	31,2	58,7	4,6
Lerhalt (%)	50 - 80 cm	55,6	44,0	60,8	3,9



Clay content 50-80 cm

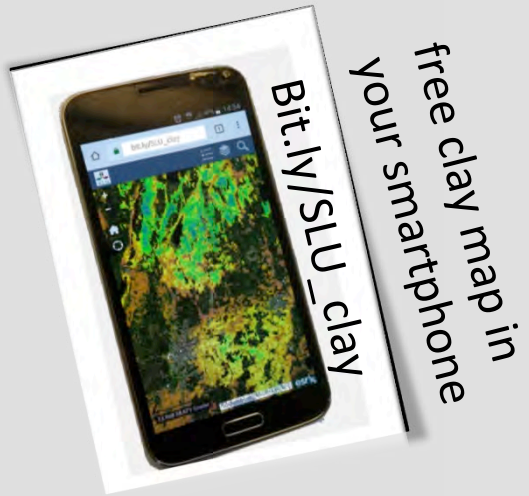


Markegenskap	Djup	Medel	Min	Max	Medelfel
Mullhalt (%)	0 - 20 cm	3,6	2,5	4,6	0,4
Lerhalt (%)	0 - 20 cm	40,4	21,5	48,7	3,5
Lerhalt (%)	20 - 50 cm	51,2	31,2	58,7	4,6
Lerhalt (%)	50 - 80 cm	55,6	44,0	60,8	3,9



Summary

- DSMS is a free map of topsoil texture with 50 x 50 m spatial resolution.
- Markdata.se is one example of an application that transfers soil data to useful information available for public use.
- More detailed spatial soil information and information on subsoil properties can be produced by proximal sensing.



More info: kristin.piikki@slu.se or mats.soderstrom@slu.se