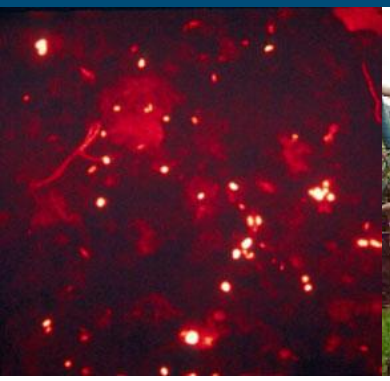
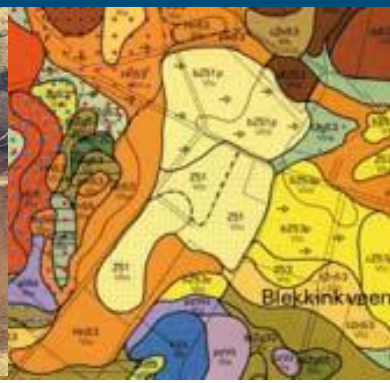
Implications of Digital Soil Mapping for Soil Information Systems

Gerard Heuvelink, Dick Brus, Folkert de Vries, Radim Vašát, Dennis Walvoort, Bas Kempen and Martin Knotters

Alterra, Wageningen

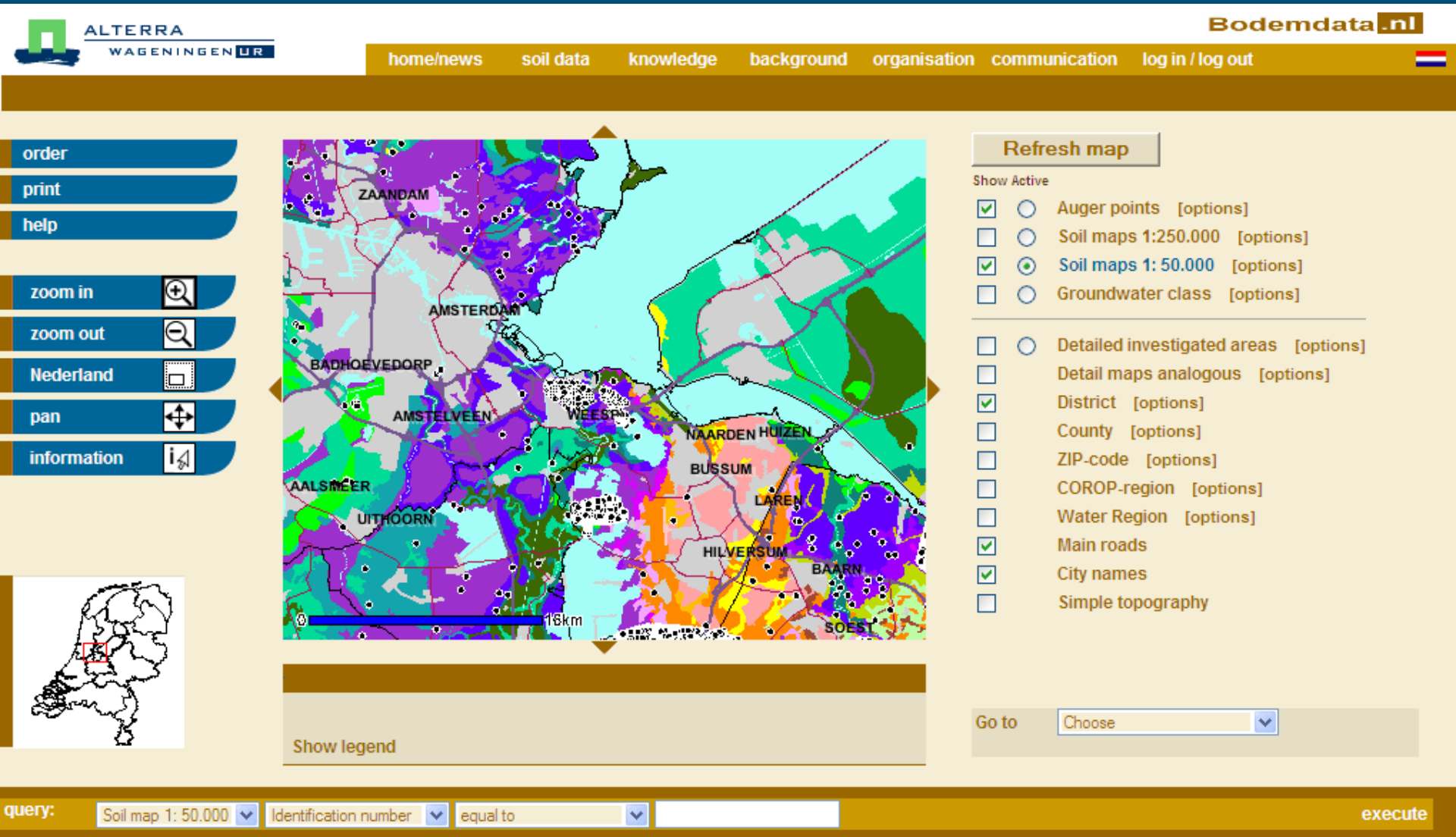






WAGENINGEN UR
For quality of life

Soil Information Systems as we know them store information about the soil as point observations and maps



In contrast, **SIS+ stores pedometric models instead of maps** (e.g. source data and kriging parameters instead of a kriged map). Advantages:

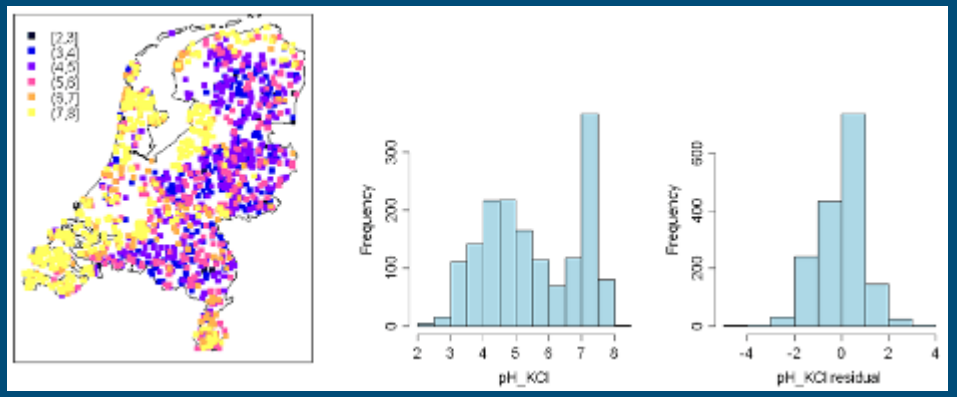
1. Flexibility with respect to: spatial and temporal extent, resolution and (lateral and vertical) support of requested map
2. Easy updating with new data
3. Automatic and detailed archiving of how maps were made
4. Saves storage capacity
5. Efficient storage of stochastic simulations of uncertain soil maps for use in Monte Carlo uncertainty propagation analyses
6. Helps solve data sharing problems when data may be used but not transferred

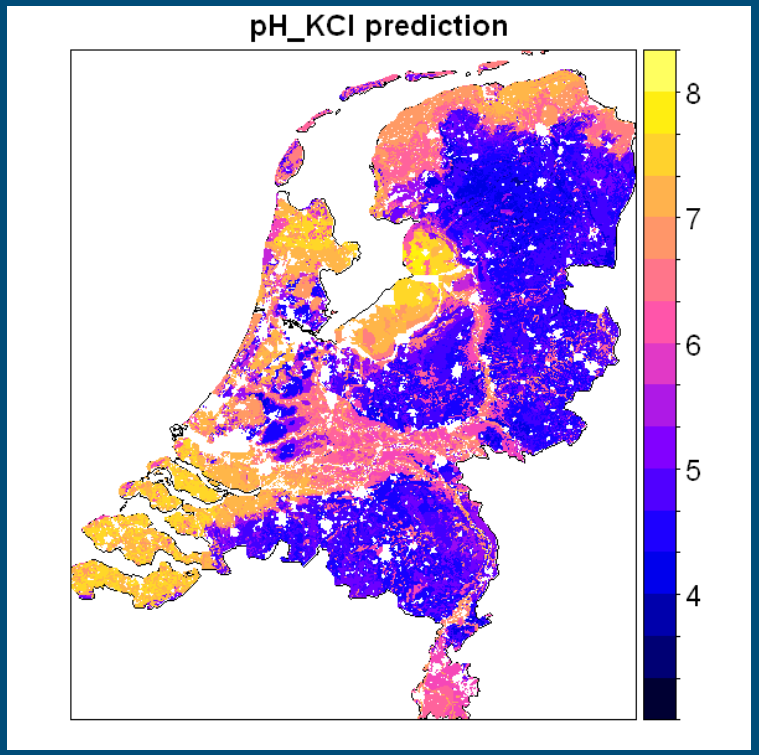
Six stages in Dutch prototype SIS+

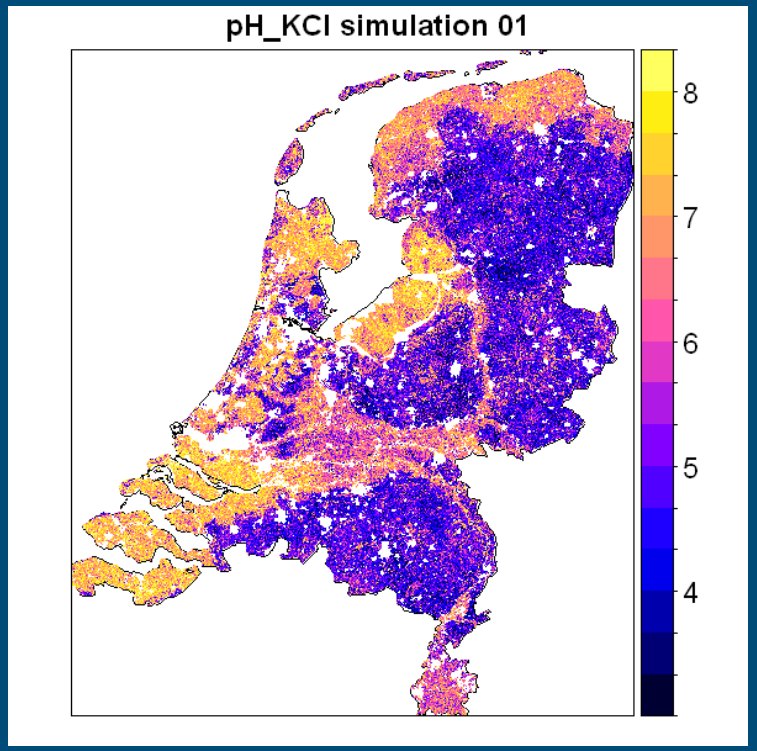
1. Importing data from the Dutch Soil Information System and other geodatabases
2. Data preprocessing (e.g. soil horizon → fixed depth interval)
3. Exploratory data analysis (e.g. skewness, outliers, anomalies)
4. Building models of spatial variation
5. Geostatistical (co)prediction and (co)simulation
6. Exporting resulting maps

```
augering$MON_DATUM <- paste(augering$MON_DATUM,"-01-01",sep="")
augering$MON_DATUM <- as.POSIXct(augering$MON_DATUM)

augering <- subset(augering,(!is.na(augering$MON_DATUM) & augering$MON_DATUM >
     from & augering$MON_DATUM < to))

# Spatial extent filtering - Augering
augering <- subset(augering,(!is.na(augering$X) & augering$X > X_MIN & augering$X < X_MAX))
augering <- subset(augering,(!is.na(augering$Y) & augering$Y > Y_MIN & augering$Y < Y_MAX))

# Horizons selection - Augering

# Exclude records with missing values
augering <- subset(x = augering, subset = (!is.na(ORGSTOF) & ORGSTOF > 0))

# Horizons selection
augering <- subset(x = augering,subset =
    (HOR_DIEPB > d1 & HOR_DIEPO < d2) |
    (HOR_DIEPB < d1 & HOR_DIEPO > d1 & HOR_DIEPO < d2) |
    (HOR_DIEPB > d1 & HOR_DIEPB < d2 & HOR_DIEPO > d2) |
    (HOR_DIEPB <= d1 & HOR_DIEPO >= d2) )

# Computing the thickness of a part of horizon which contribute to the required
# soil layer
augering$h_thick <- 0

s1 <- ((augering$HOR_DIEPB > d1) & (augering$HOR_DIEPO < d2))
augering[s1,]$h_thick <- augering[s1,]$HOR_DIEPO - augering[s1,]$HOR_DIEPB

s2 <- ((augering$HOR_DIEPB < d1) & (augering$HOR_DIEPO > d1) & (augering$HOR_DIEPO < d2))
augering[s2,]$h_thick <- augering[s2,]$HOR_DIEPO - d1

s3 <- ((augering$HOR_DIEPB > d1) & (augering$HOR_DIEPB < d2) & (augering$HOR_DIEPO > d2))
augering[s3,]$h_thick <- d2 - augering[s3,]$HOR_DIEPB

s4 <- ((augering$HOR_DIEPB <= d1) & (augering$HOR_DIEPO >= d2))
augering[s4,]$h_thick <- d2 - d1

rm(s1,s2,s3,s4)
```

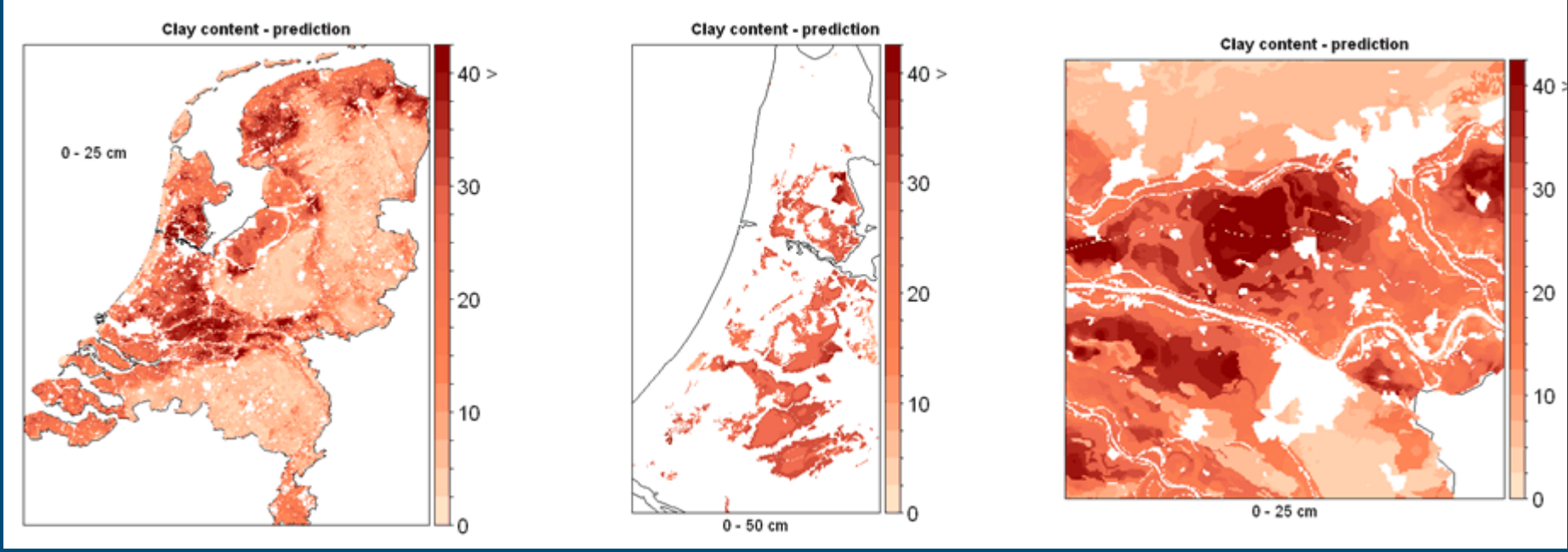
Example 1: topsoil pH (using soil map as covariate and producing stochastic simulations)



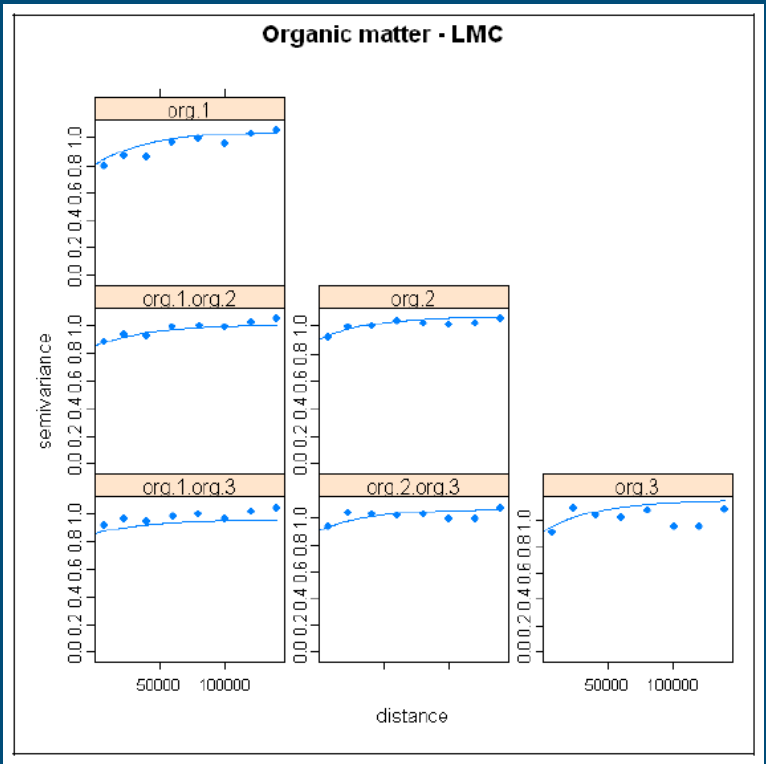


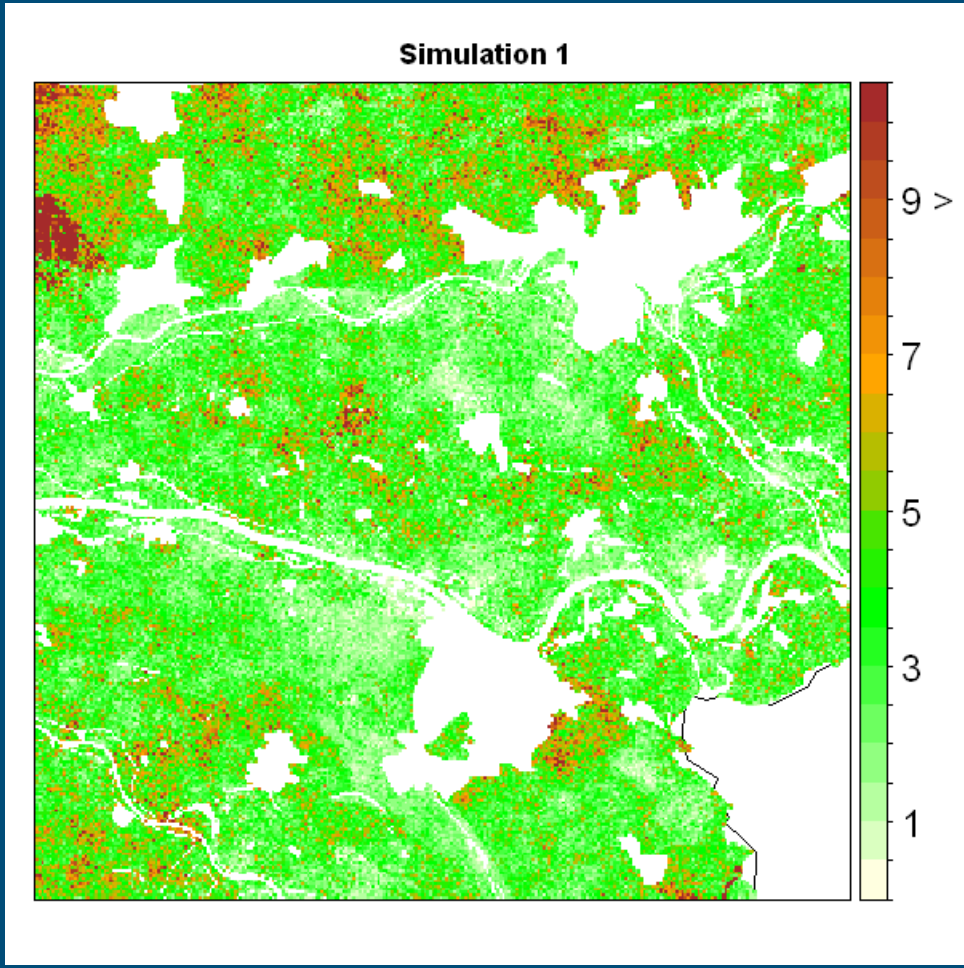


Example 2: clay content at various depths (and illustrating zooming facility with automatic adjustment of resolution)



Example 3: organic matter content (cokriging OM at multiple depth intervals to help achieve sensible vertical profiles)





Conclusions

- A SIS+ that stores pedometric models instead of maps has many advantages over conventional SIS
- SIS+ does not replace SIS but needs it for delivery of point soil data and basic soil maps; maps produced by SIS+ that have frequent use may be stored semi-permanently in the SIS
- In the long term, SIS and SIS+ may be integrated but during the development phase it is better to keep them separated
- SIS+ development can benefit from recent developments in automated mapping and web-based implementations
- Experience with development of a prototype Dutch SIS+ are very positive: already much functionality achieved and further extensions foreseen for the next few years (e.g. extension of toolbox, 3D, space-time)

Thank you