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# Large-extent digital soil mapping approaches for total soil depth

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## General information

Total soil depth ( $SD_t$ ) plays a key role in supporting various ecosystem services and properties, including plant growth, water availability and carbon stocks. Therefore, predictive mapping of  $SD_t$  has been included as one of the deliverables within the GlobalSoilMap (GSM) project. In this work  $SD_t$  was predicted for France using 2 different methods 1) Data mining, including a bias correction + kriging of residuals (DM) and 2) Multi-Resolution Kriging for large datasets (MrK).

## Methods

**Deterministic trend**

**Interpolation residuals**

**Prediction uncertainty**

### DM + Kriging of residuals

Data mining (R package GBM)  
Bias correction

Ordinary kriging

Calculation of prediction intervals by ordinary kriging of error

### Multi-resolution kriging

Linear regression model

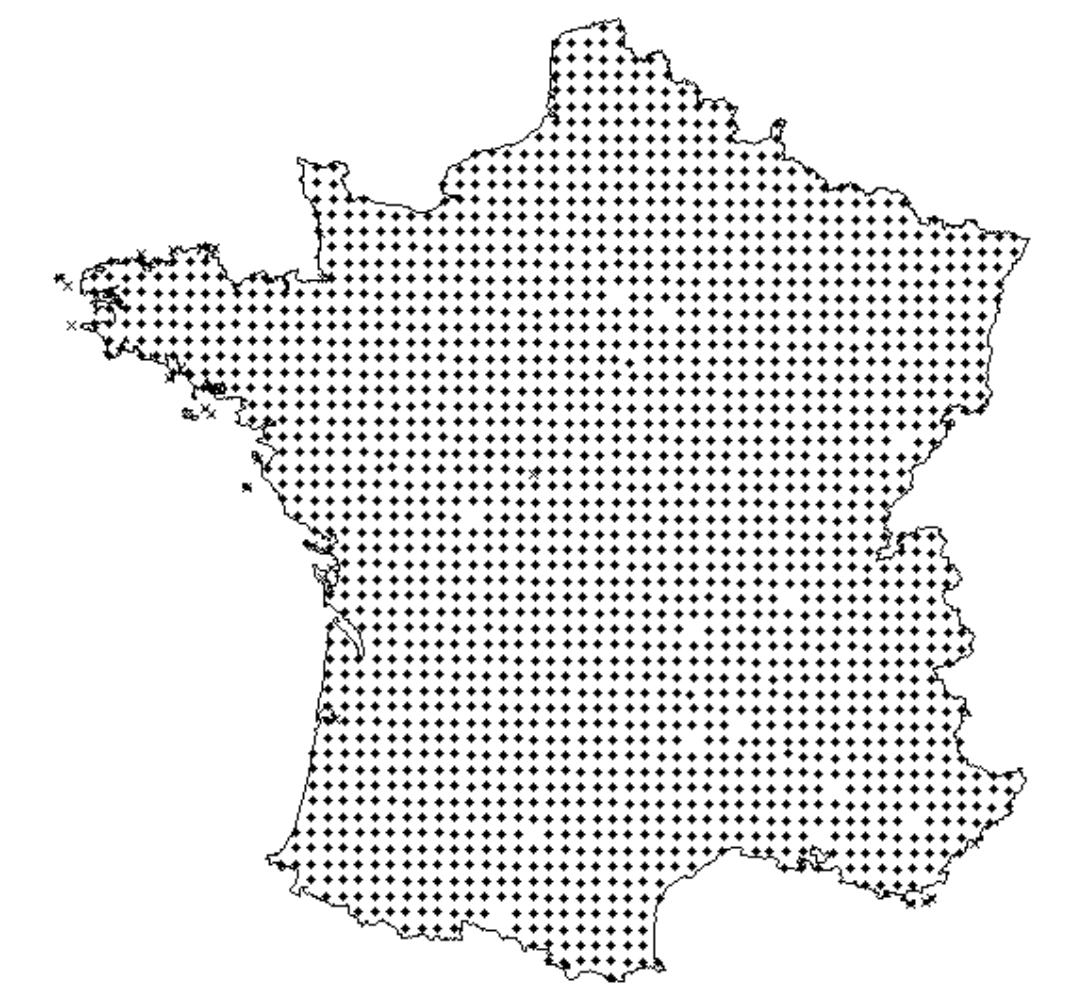
Multi-resolution kriging using spatial basis function for estimating the covariance matrix

Calculation of confidence intervals by Gaussian simulation of the kriging model

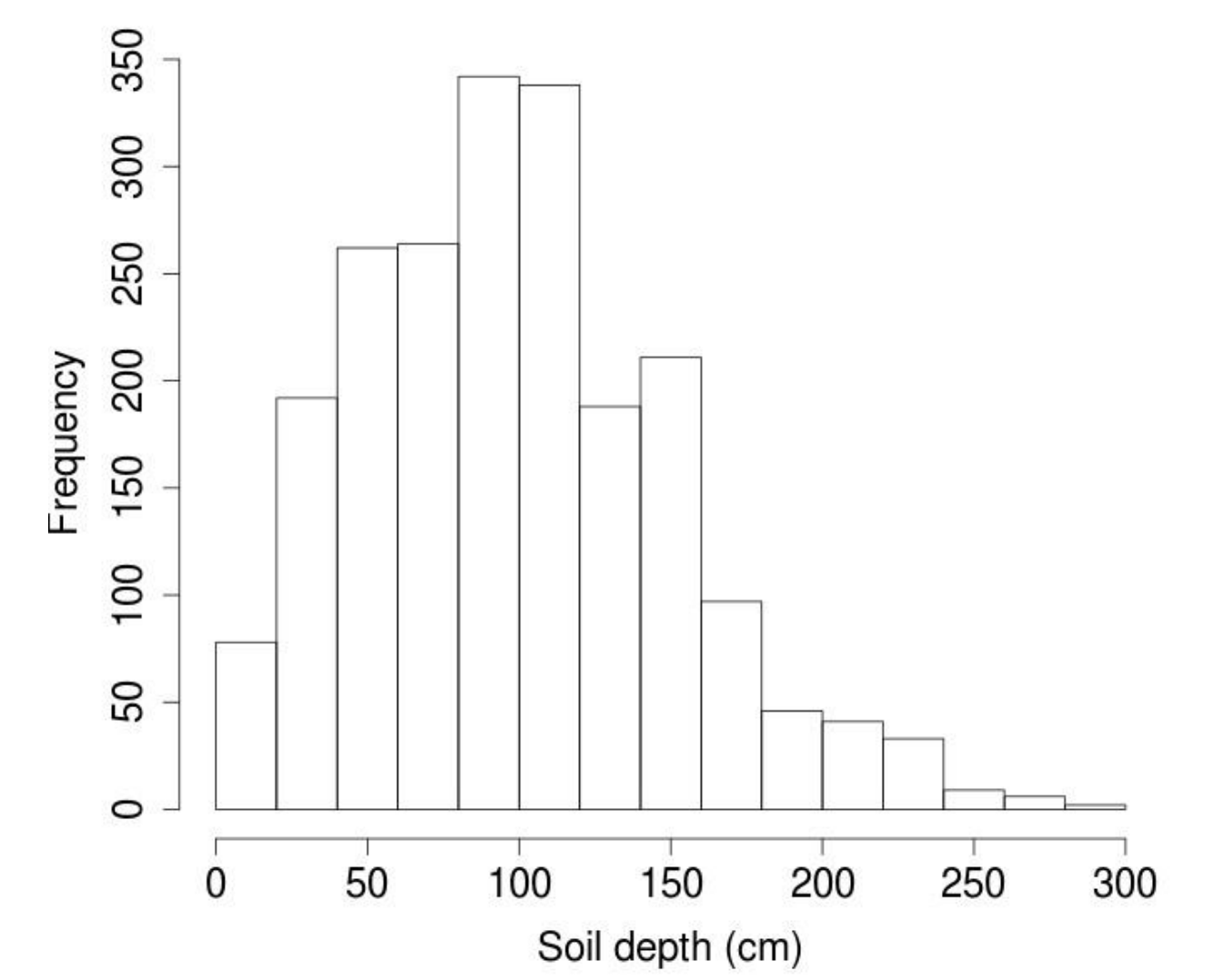
## Data

### Soil samples

The  $SD_t$  was determined for 2116 sites, originating from the French Soil Monitoring network (RMQS). This dataset encompasses a broad spectrum of climatic, soil and agricultural parameters and covers the entire metropolitan France, based on a regular, 16km x 16km grid. Soil depth ranged from 0 to 300 cm, with a mean value of 102 cm.



500 km Sample locations



### Environmental data

#### Topography

Elevation  
Slope  
Aspect  
CTI  
Roughness  
Exposition  
Curvature  
Scale position

#### Vegetation

Land use  
Forest type

#### Soil/Geology

Parent material  
Bare rock areas  
Soil waterlogging indices

#### Climate

Precipitation  
Temperature  
Climate type

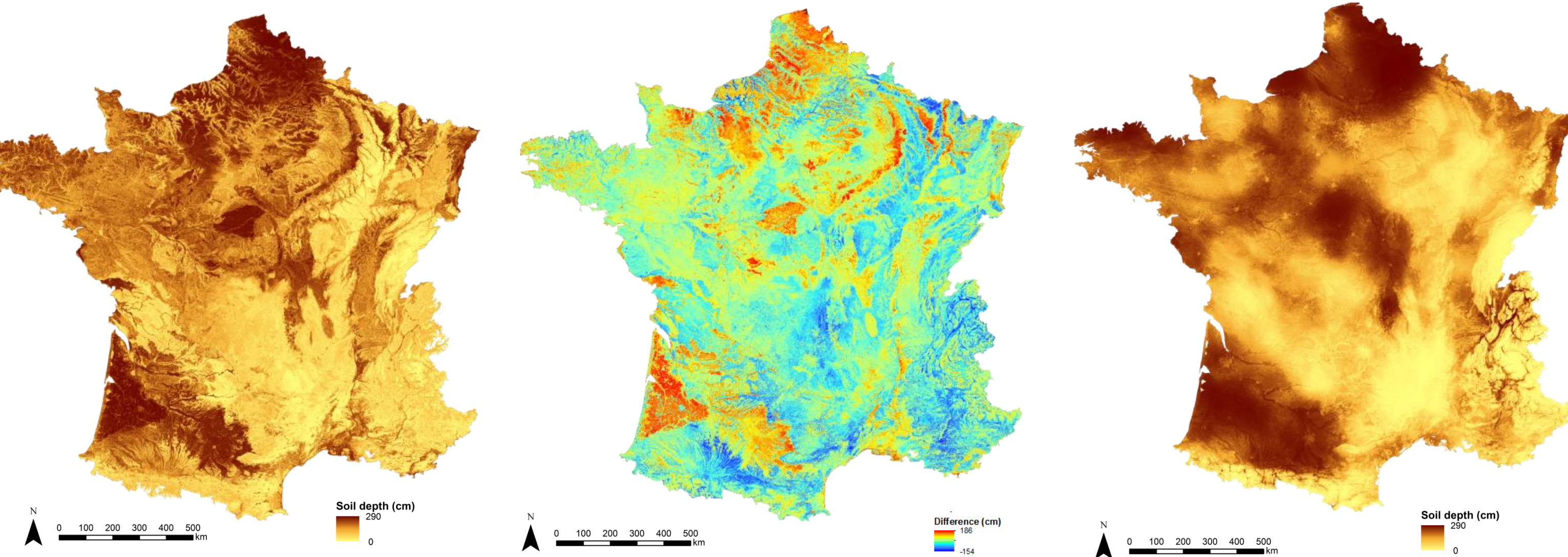
## Results

### Predicted soil depth

#### Data mining

#### Difference

#### MrK

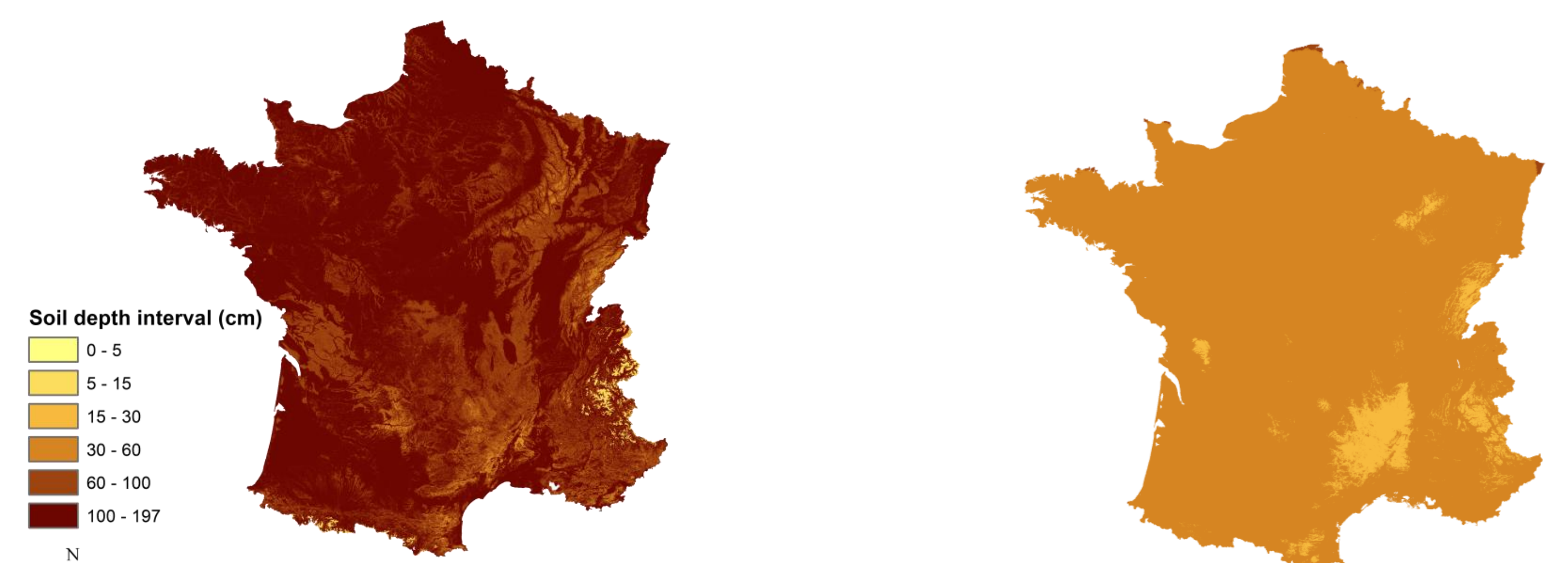


	Min	Q1	Mean	Median	Q3	Max	sd
Data Mining	0	66	99	97	125	288	45
MrK	4	78	95	96	112	193	25

### Spatial uncertainties

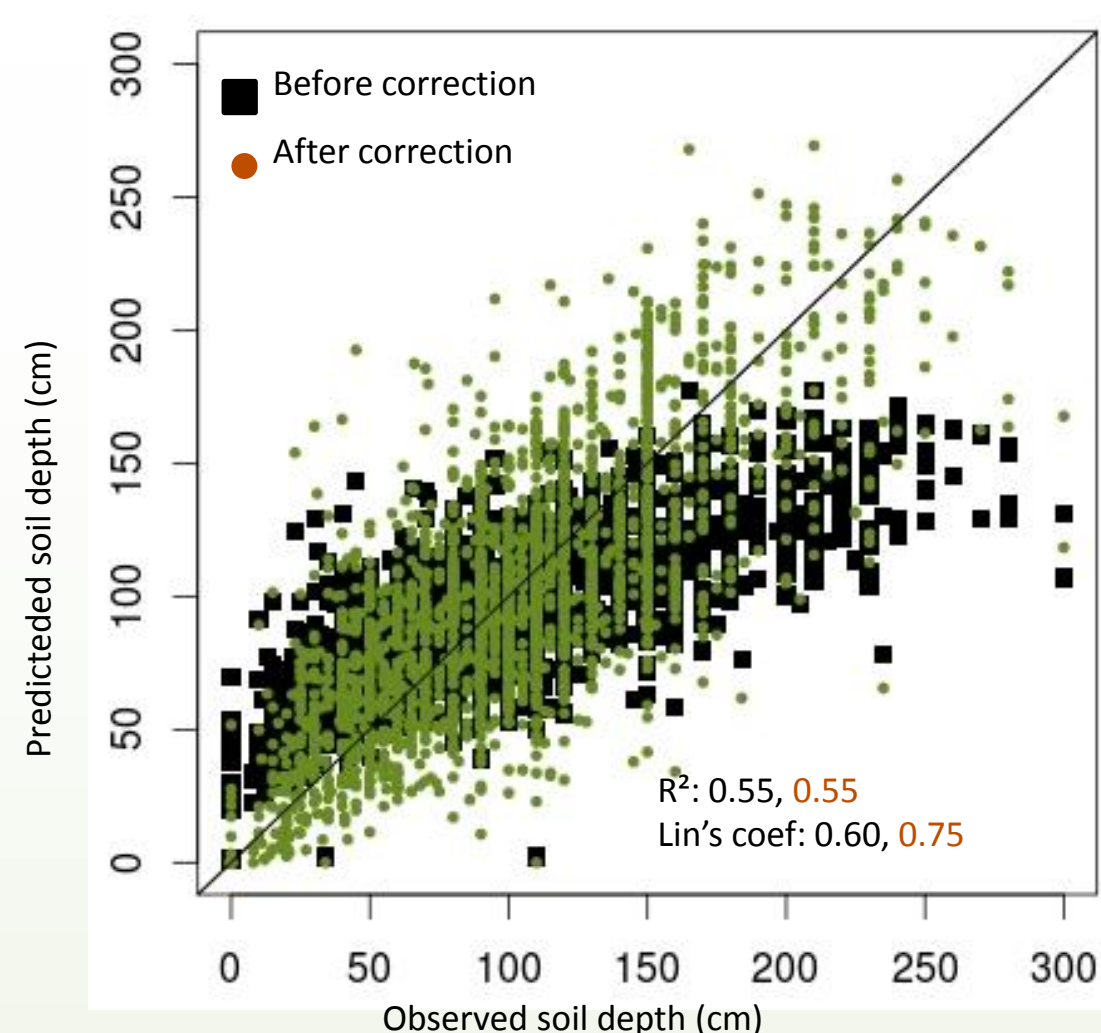
#### Data mining: prediction interval

#### MrK: confidence interval



	Min	Q1	Mean	Median	Q3	Max	sd
Data Mining	0	97	111	113	127	197	25
MrK	13	35	38	38	42	72	6

### Bias correction



Empirical adjustment (bias correction) of the distribution of variables using quantile mapping"

2 steps correction method:

- 1) Identifying the distribution parameters of a population (RMQS data)
- 2) Apply these parameters to the predictive data to correct its distribution

	Min	Q1	Mean	Median	Q3	Max	sd
Observed	0	60	102	100	130	300	52
Before	1	79	96	97	113	178	27
After	0	68	102	98	130	269	49

## Major findings

### Data mining

### MrK

#### Predictive map of soil depth

Consistent spatial pattern  
Good prediction of the mean values

- Prediction of extremes values (bias correction)
- No extremes values**

**Prediction interval**

Different meaning, direct comparison not possible

**Confidence interval**

#### Implementation

- Deterministic trend: flexible model choice, flexible for large datasets, high resolution
- Estimation of uncertainties: no direct of and not flexible for large datasets**
- Deterministic trend: limited to a linear model**
- Straight forward modelling approach
- Flexible in delivering spatial explicit uncertainty measures

#### Outlook

- Promising prediction of soil depth class instead
- Potential for modelling beyond the country level, at high resolution