Spatial prediction of topsoil texture in Region Centre (France) combining regression and area-to-point kriging

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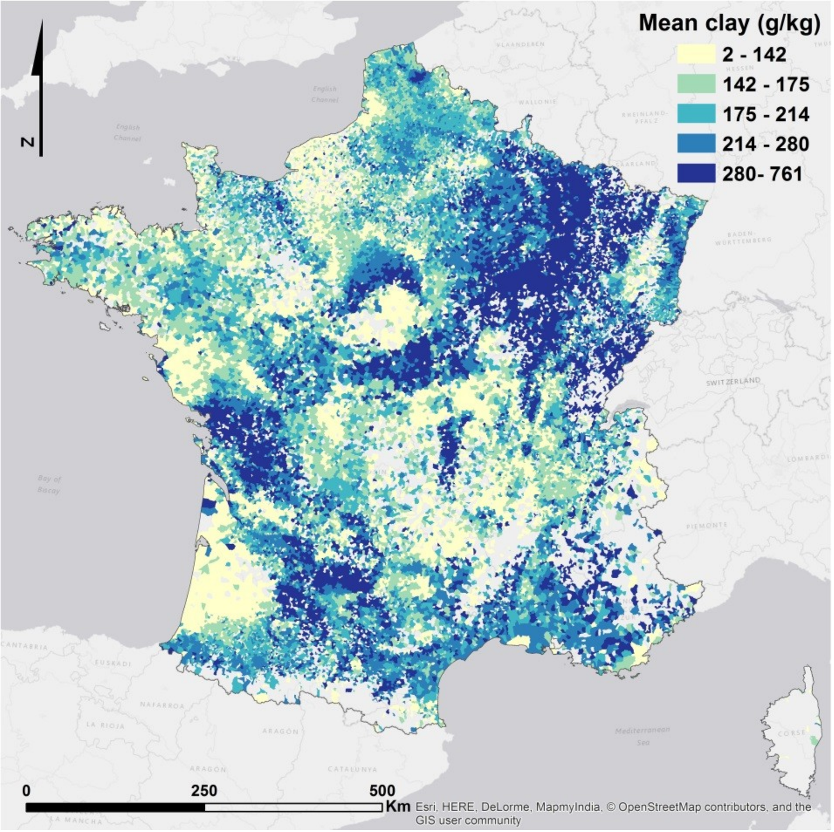
The French Soil Test Database
Base de Données d'Analyse des Terres (BDAT)



Aggregated clay content (1990 – 2009)

- The BDAT collects the results of soil analyses requested by farmers to improve management
- Physico-chemical properties of agricultural topsoils (~ 0 - 25 cm)
- Location of farms is not available due to data confidentiality, best georeference is the municipality
- > 2,000,000 samples since 1990
- Important source of information, but how can we use it?

Change of support of areal data

- Geostatistical approaches for change of support:
  - **Prediction at point support from areal data** with an estimate of prediction uncertainty **Area-to-Point kriging** (AtoP) (Kyriakidis, 2004)
  - Iterative deconvolution taking into account irregular polygon shapes (Goovaerts,2008)
  - Summary statistics approach(mean, variance, number of observations by unit) (Orton et al., 2012a, 2012b)
  - *scorpan* model + AtoP = AtoP regression kriging (Kerry et al., 2012)

Kyriakidis. 2004 *Geogr. Anal.*, 36(3):259-289

Goovaerts. 2008. *Math. Geol.*, 40(1):101-128

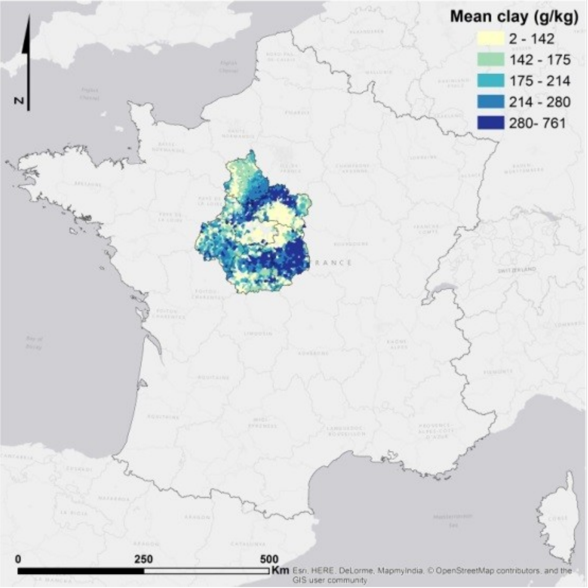
Orton et al. 2012a. *Environmetrics*, 23(2):129-147

Orton et al. 2012b. *Environmetrics*, 23(2):148-161

Kerry et al. 2012. *Geoderma*, 170:347-358

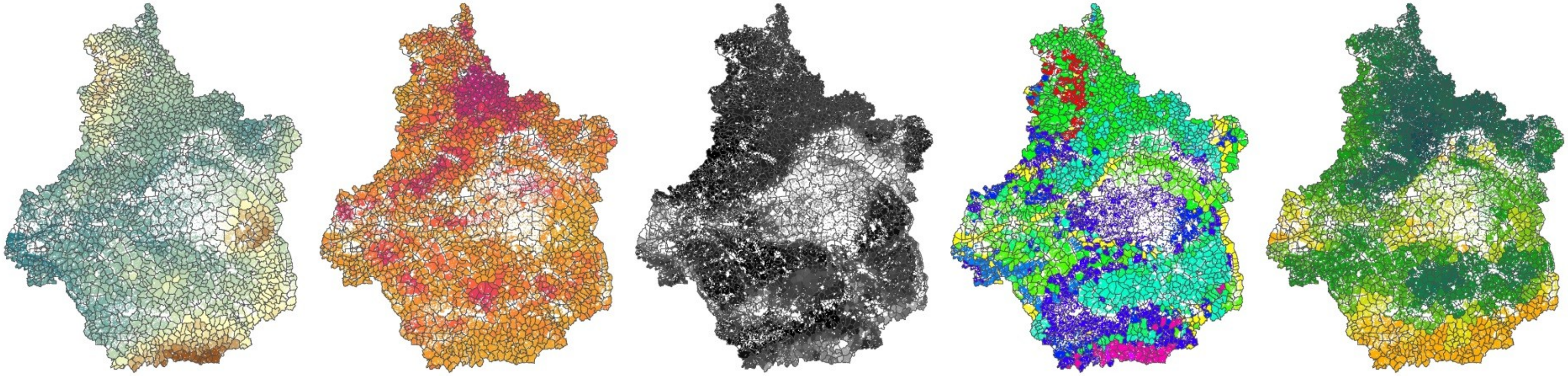
Objectives

- Compare 4 approaches for mapping soil texture in Region Centre using BDAT data:
  - Average BDAT data aggregated by municipality (BDAT reference)
  - *scorpan* model
  - AtoP cokriging
  - AtoP regression cokriging



Photos: Jean Weber © INRA

Methods



Relief derivates

Gamma-ray, geology, soil

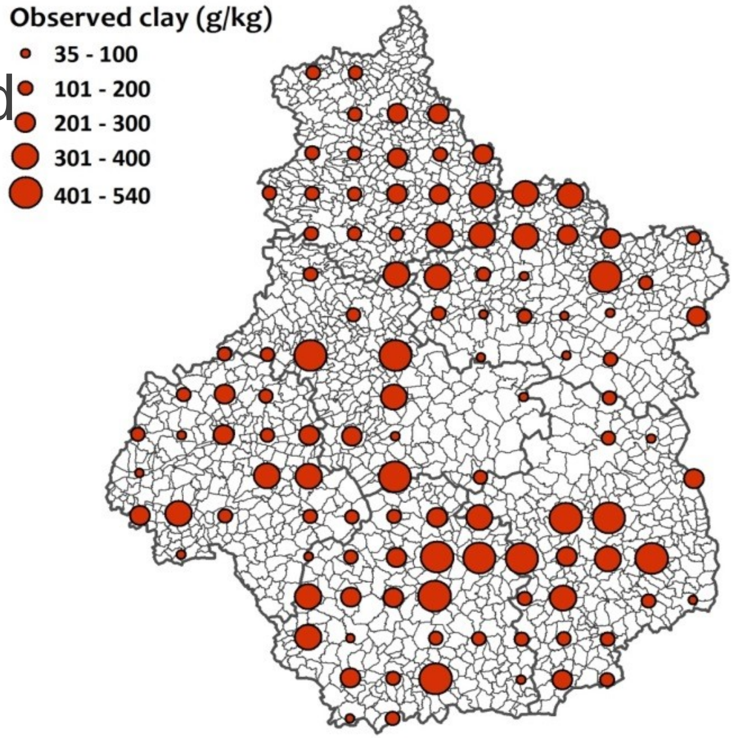
% crop types

Methods

- AtoP cokriging approach with summary statistics data (AtoP CK)
- AtoP regression cokriging (AtoP RCK)
  - BRT predictions = auxiliary variable (fixed effect of LMM)
  - Variance of predicted variables - but we assume the covariates do not vary within municipalities

Methods

- **Independent validation**
  - 100 sites from the French National Soil Monitoring Network (RMQS)
  - 16-km systematic random grid
  - RMSE, R2, MPE
  - Uncertainty assessment:



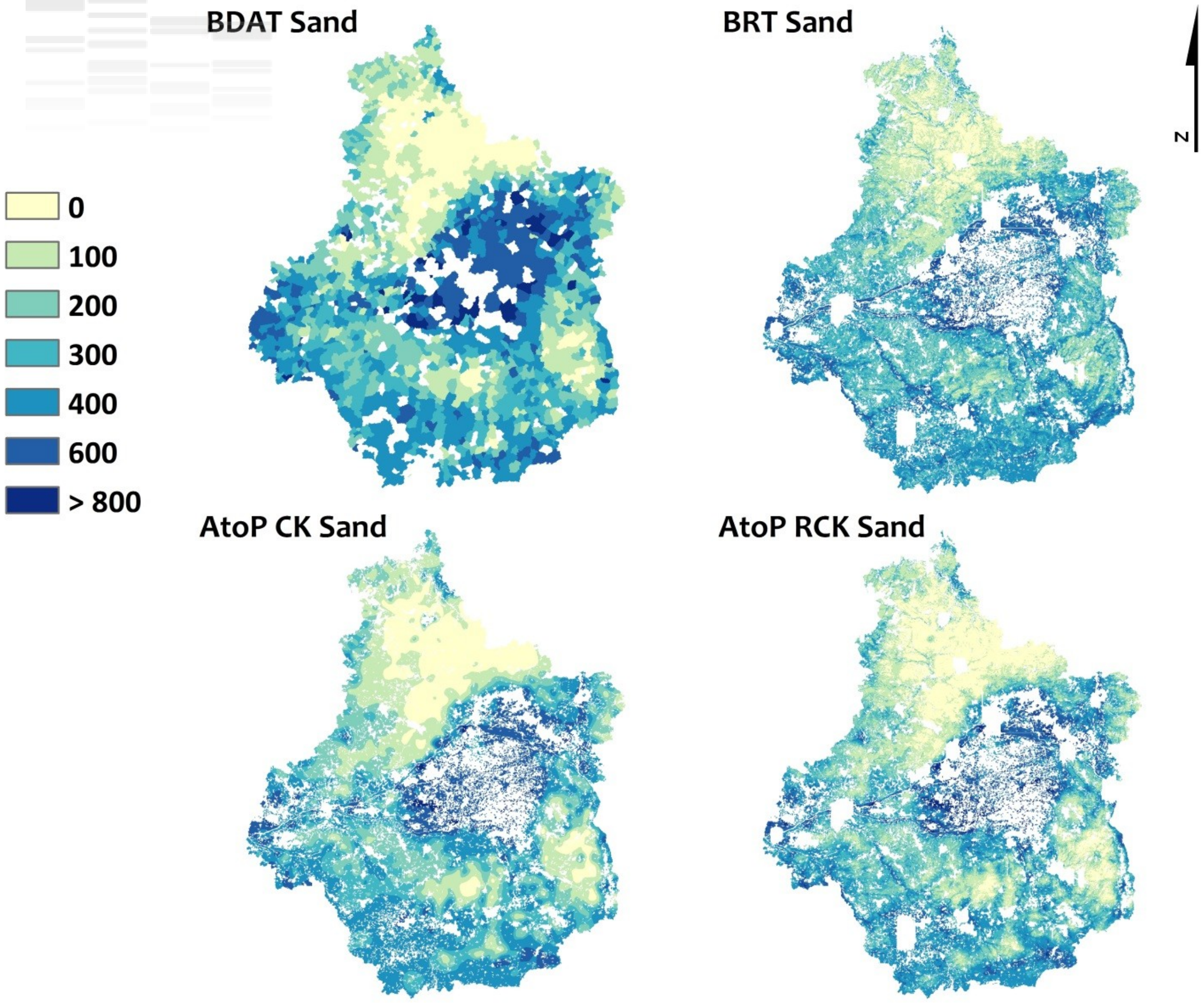
Results

Prediction accuracy – Independent validation

Particle size fraction	Model	RMSE	R2	MPE
Clay	BDAT reference	96.9	0.32	-8.6
Clay	BRT	**81.6**	**0.50**	-20.0
Clay	AToP CK	86.7	0.44	-5.9
Clay	AToP RCK	85.2	0.46	**-1.8**
Sand	BDAT reference	153.7	0.59	-2.7
Sand	BRT	125.2	0.73	-4.7
Sand	AToP CK	130.5	0.71	**2.3**
Sand	AToP RCK	**120.8**	**0.75**	-4.5
Silt	BDAT reference	123.0	0.64	10.5
Silt	BRT	100.0	0.77	24.7
Silt	AToP CK	111.7	0.71	**3.6**
Silt	AToP RCK	**97.9**	**0.78**	6.3

Results
Uncertainty assessment – Independent validation

Results



BDAT Sand
BRT Sand
N
0
100
200
300
400
600
> 800
AtoP CK Sand
AtoP RCK Sand

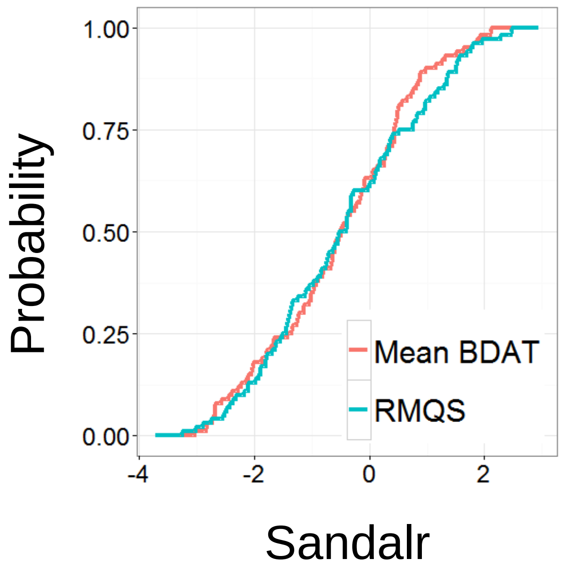
Discussion and conclusions

- Aggregated BDAT data provided a good first idea of the spatial distribution of soil texture
- BRT model had similar performance to BRT models calibrated with a point-support dataset (Ciampalini et al., 2014)
- Prediction accuracy: AtoP RCK > AToP CK
- Uncertainty assessment: AtoP CK > AToP RCK

Ciampalini et al. 2014. *GlobalSoilMap*, pp 121-126

Discussion and conclusions

- AToP CK and AToP RCK are powerful methods for disaggregating and mapping areal data
- Improving *scorpan* model predictions with other covariates? e.g.,LANDSAT indices
- Further applications of disaggregated maps of BDAT data
  - Model ensemble
  - French scale products



- Always difficult to estimate the bias of the BDAT

Acknowledgements

Région Centre

Inventaire, gestion
et conservation
des sols

Sol