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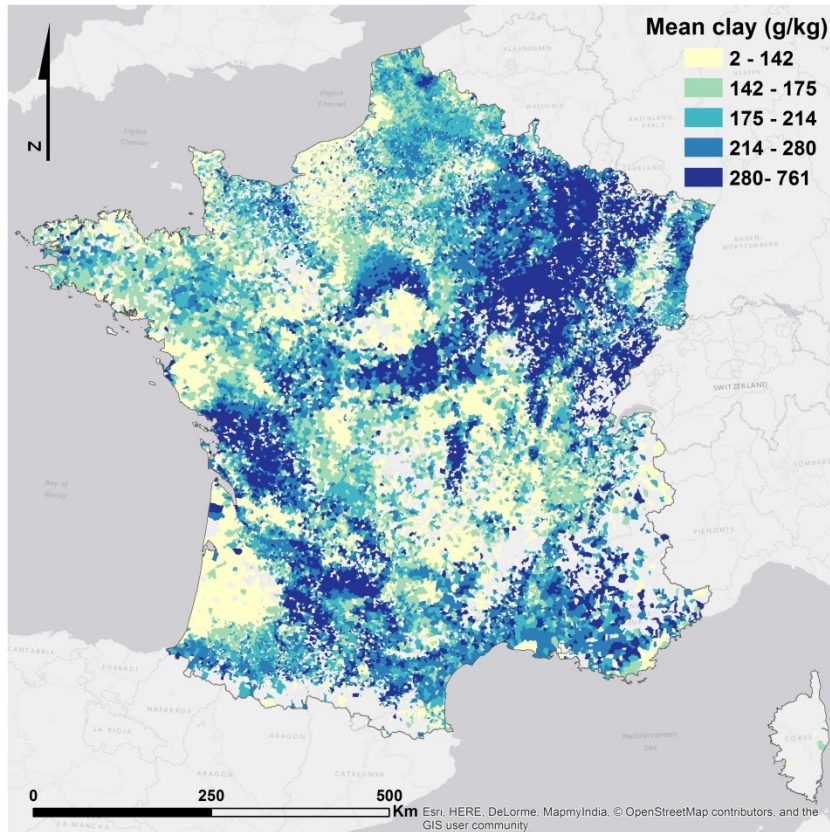
Spatial prediction of topsoil texture in Region Centre (France) combining regression and area-to-point kriging



Mercedes ROMAN DOBARCO, Tom G. ORTON, Nicolas P. A. SABY,
V. L. (Titia) MULDER, Sébastien DRUFIN, Blandine LEMERCIER, Dominique ARROUAYS

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

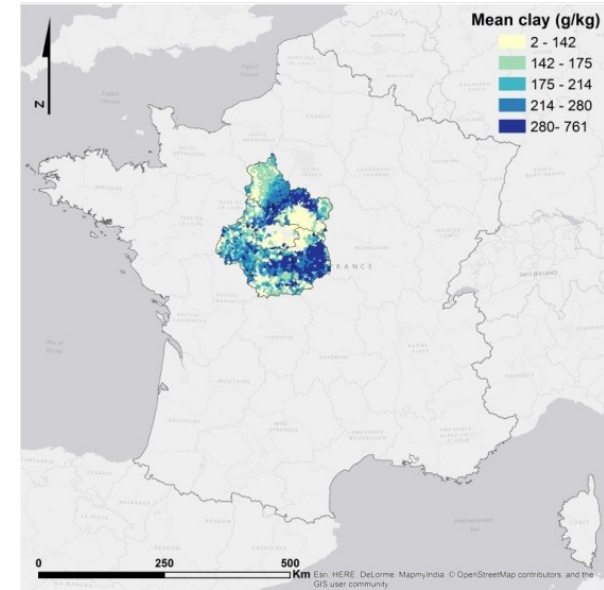
Orton et al. 2012a. *Environmetrics*, 23(2):129-147

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

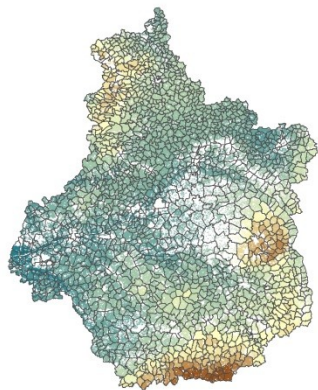


Photos: Jean Weber ©

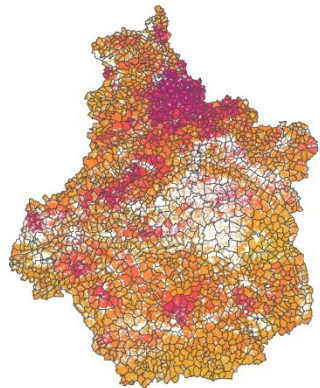
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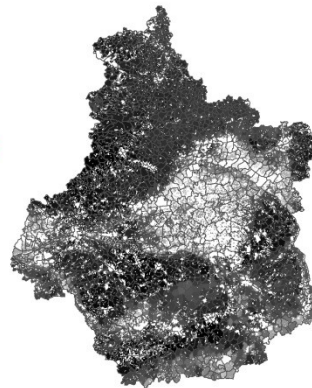
Methods



Relief derivatives



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

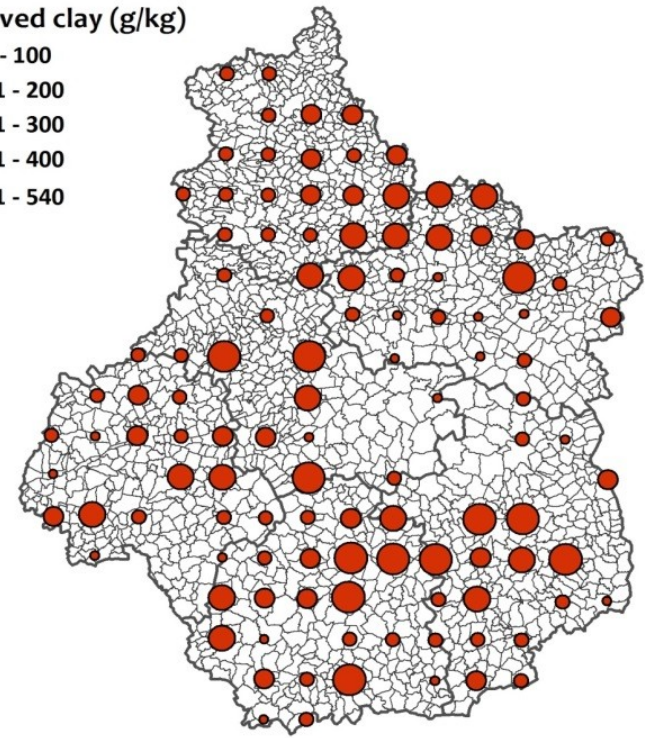
Methods

❖ Independent validation

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

Observed clay (g/kg)

- 35 - 100
- 101 - 200
- 201 - 300
- 301 - 400
- 401 - 540



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

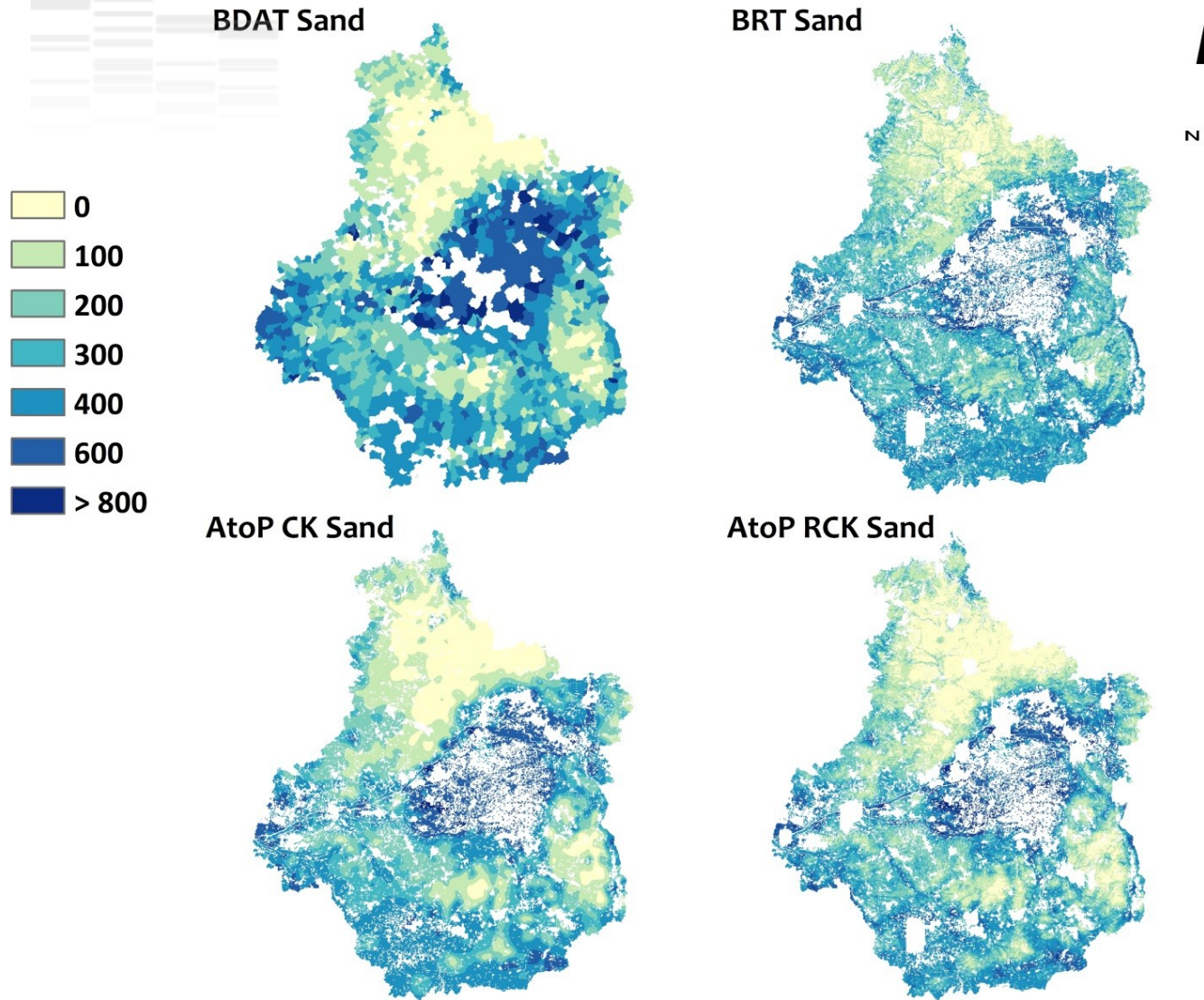
100

Results

Uncertainty assessment – Independent validation



Results



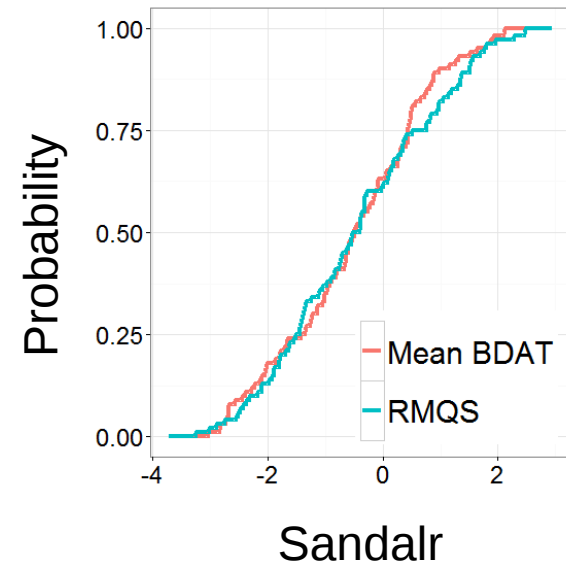
Discussion and conclusions

- ❖ 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

