Uncertainty in Random Forests

What does it mean in a spatial context?

Jens Klump | OCE Science Leader Earth Science Informatics
Francky Fouedjio | OCE Postdoctoral Research Fellow

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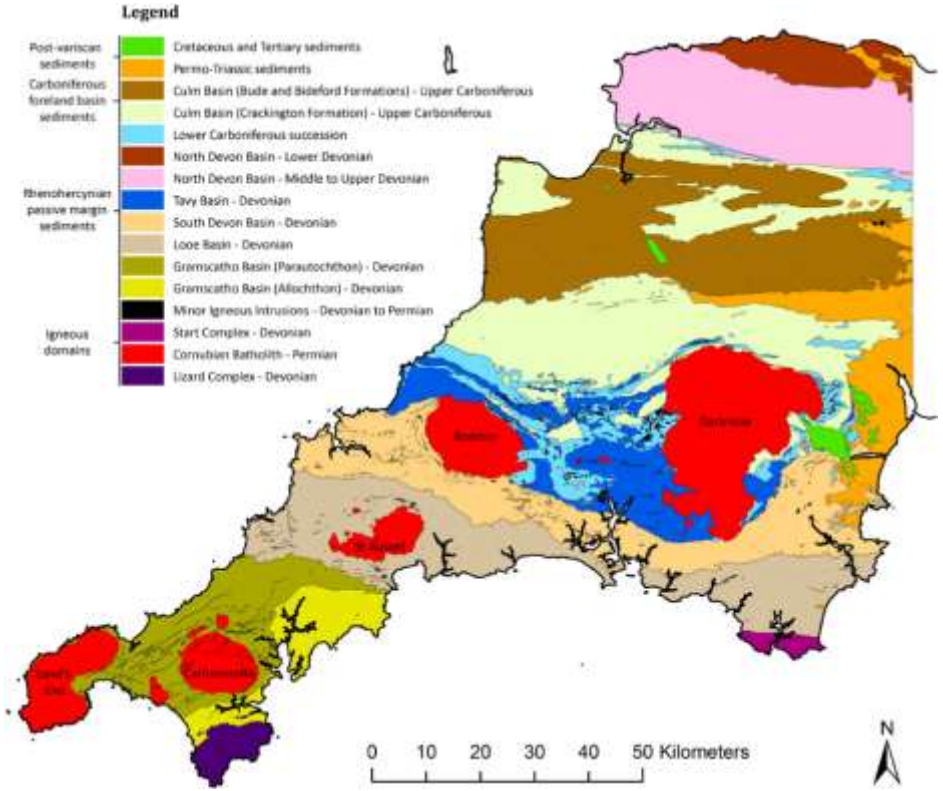
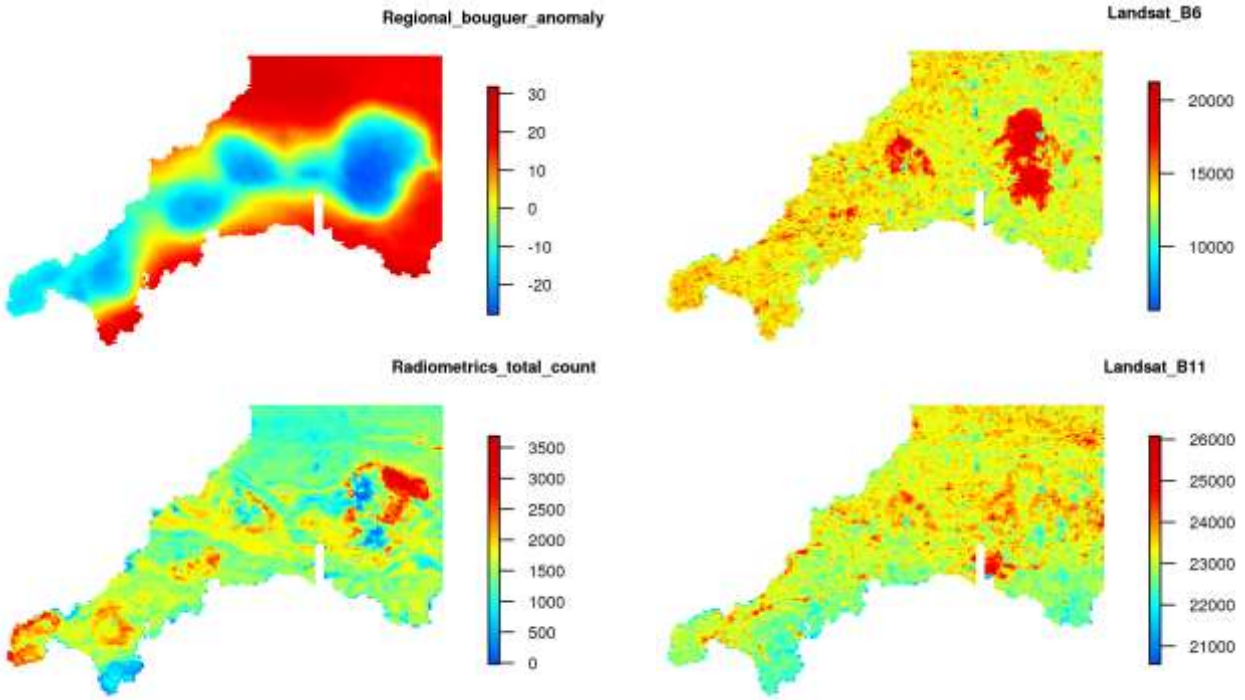
Case Study: Soil Geochemistry

- Data: soil geochemistry of southwest England (source: C. Kirkwood, BGS G-BASE)
- Elements used in this study: Al, Ba, Br, Ca, Ce, Co, Cr, Cs, Fe, Ga, Ge, Hf, K, La, Mg, Mn, Mo, Na, Nb, Nd, Ni, P, Rb, Sc, Se, Si, Sm, Sr, Ta, Th, Ti, U, V, Y, Zr
- Other elements were excluded due to their hydrothermal mobility or concentrations below detection limits.
- Auxiliary data: Gravity, geomorphology, radiometrics, IR (LANDSAT)
- Geographically sparse data
- Aim: geochemical exploration (outliers)

Study Area

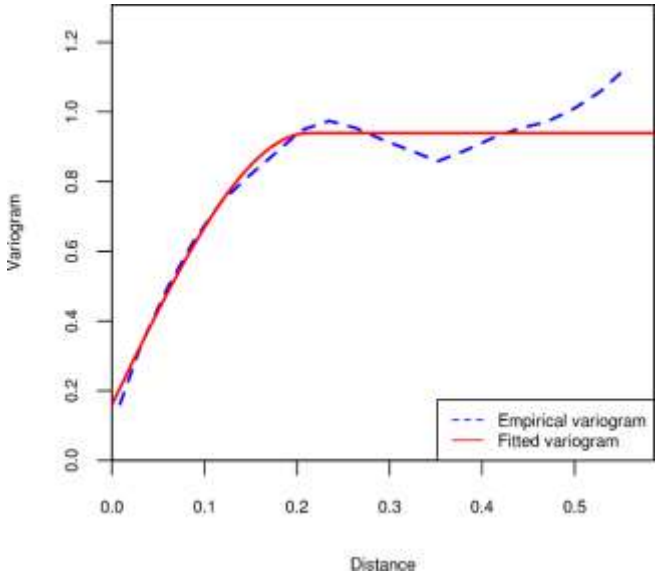


Auxiliary Variables

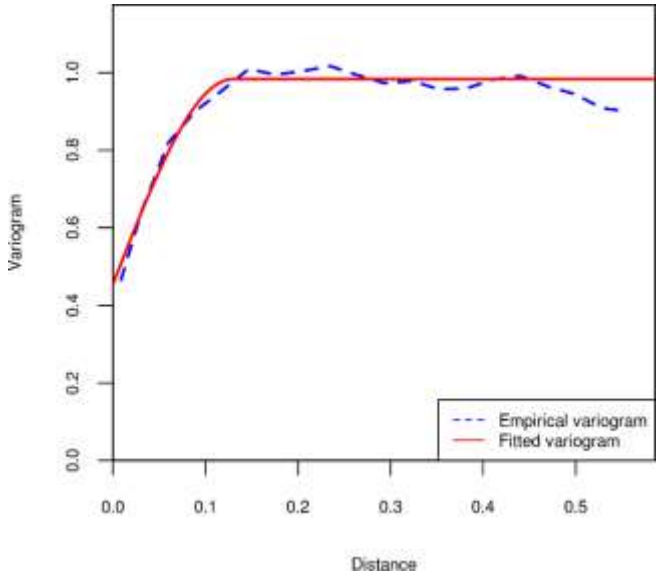


Soil Geochemistry - Kriging

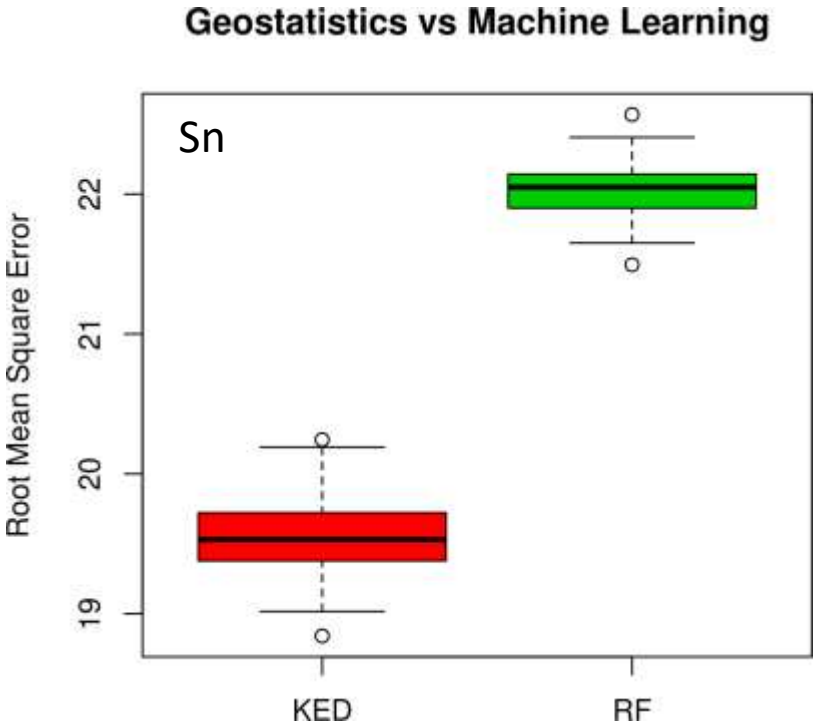
Sn (LLD = 0.5 ppm)

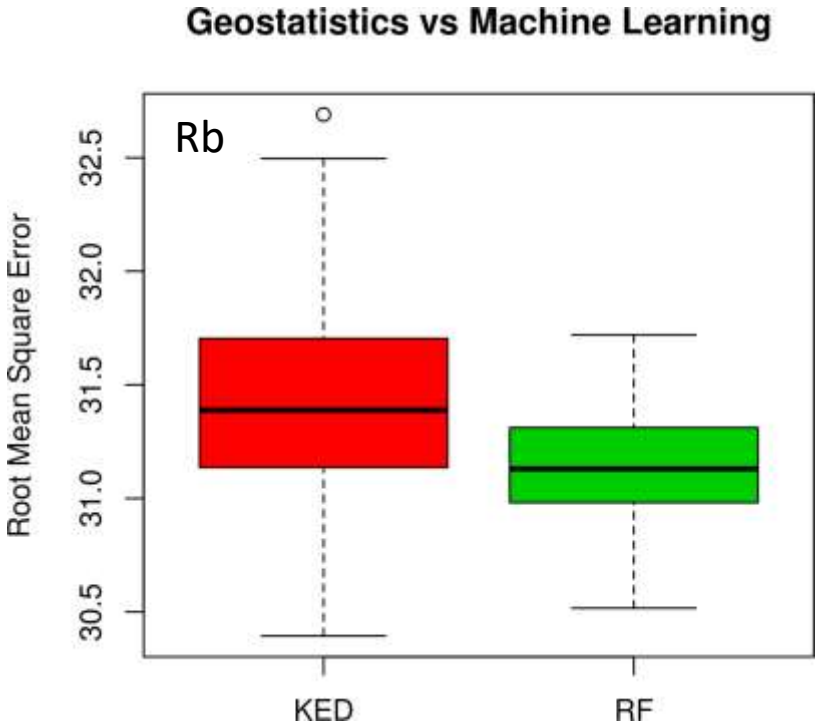


Rb (LLD = 1 ppm)

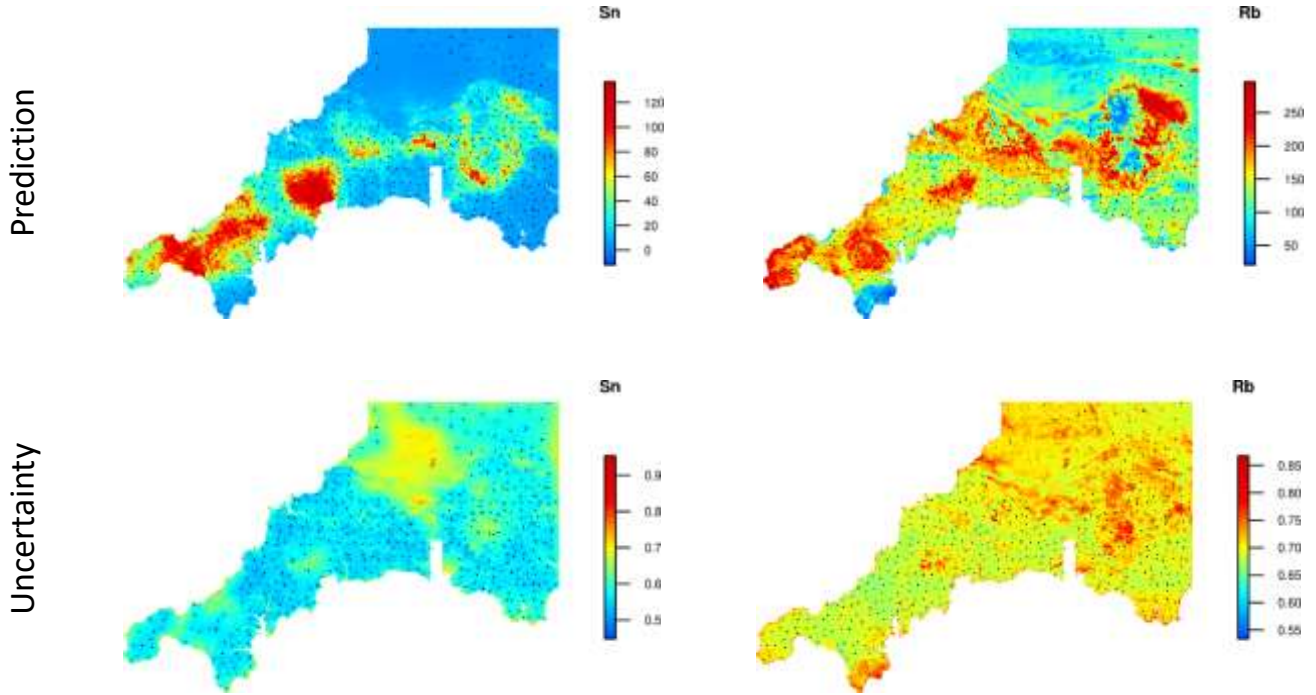


Error estimates

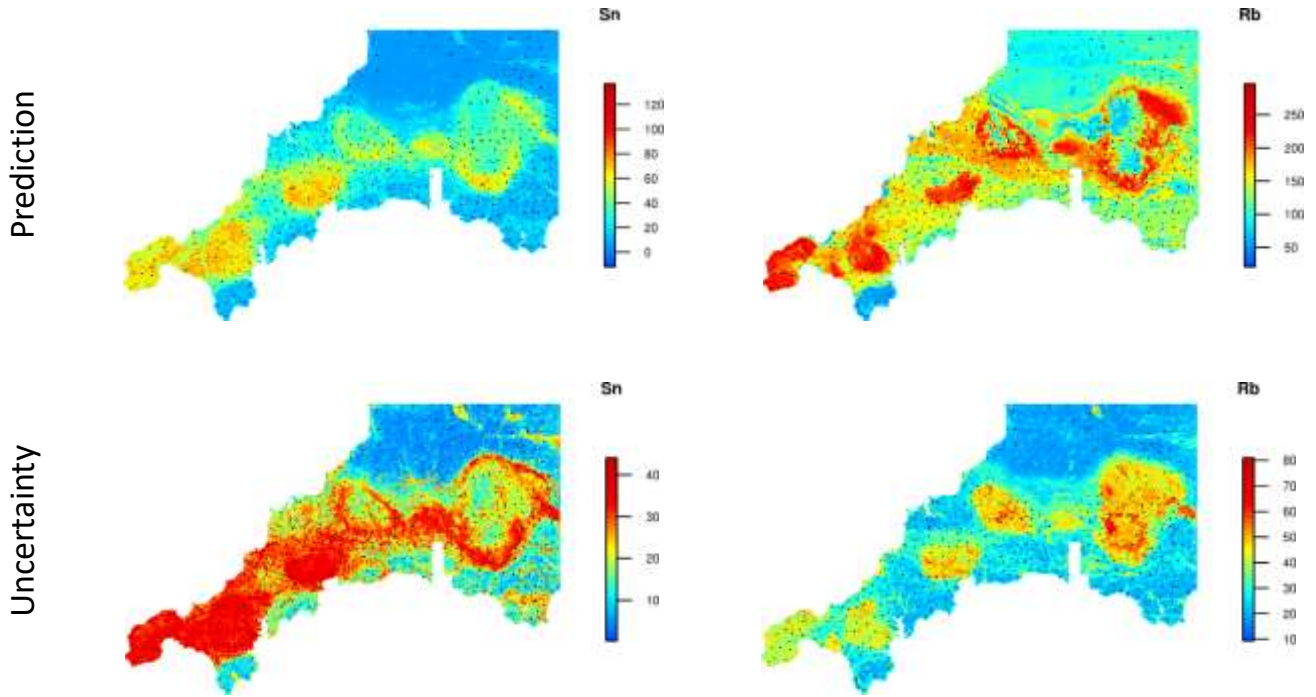




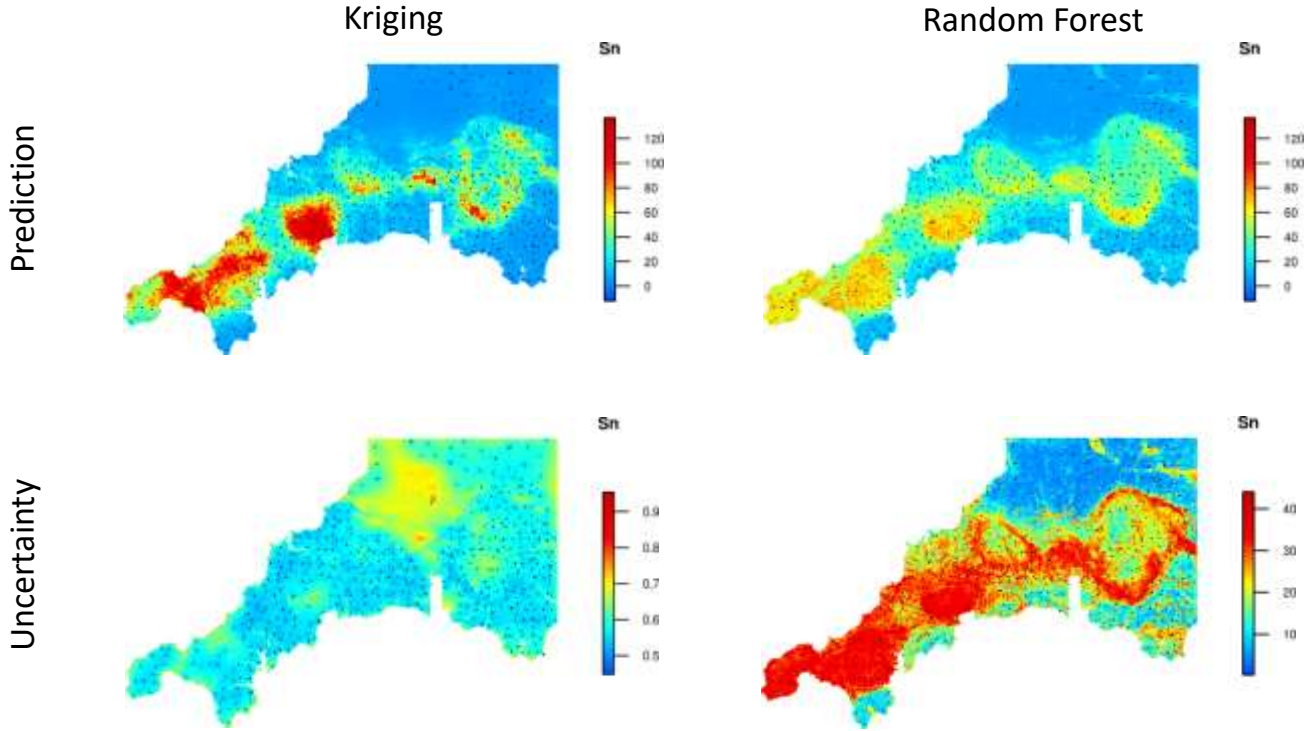
Soil Geochemistry - Kriging



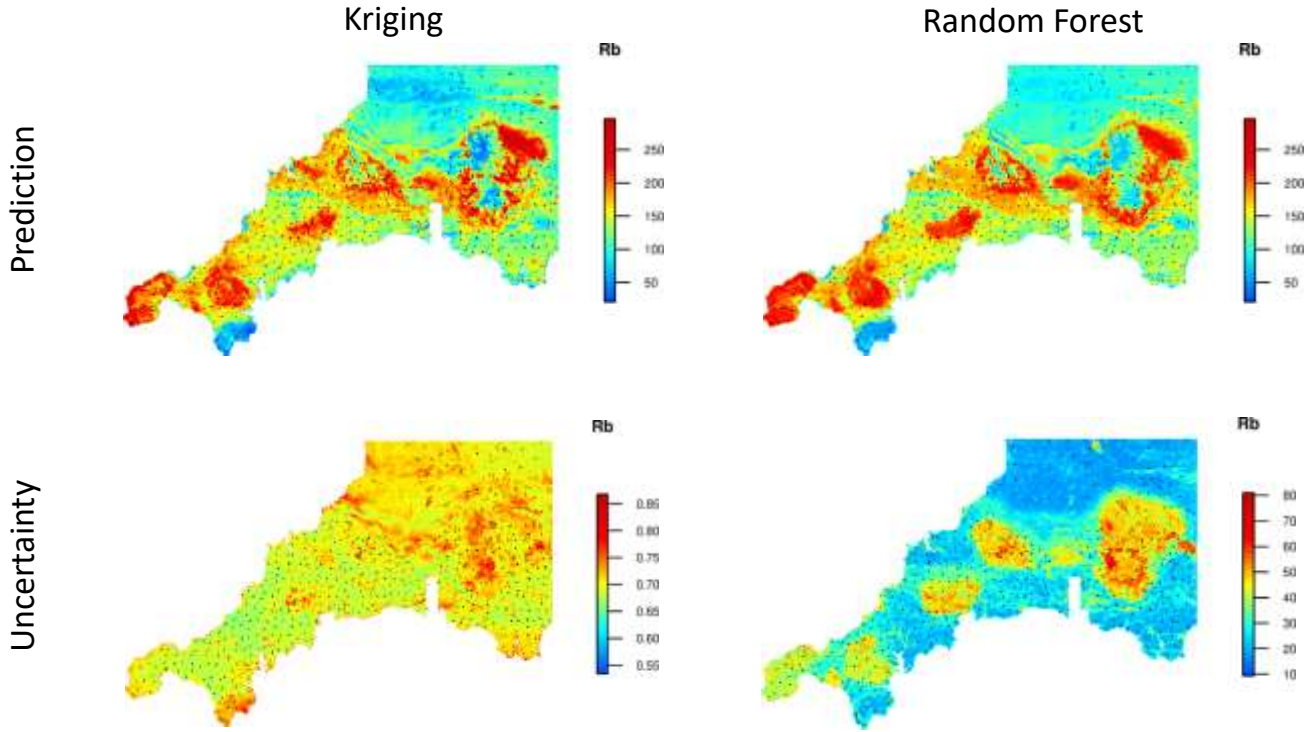
Soil Geochemistry – Random Forest



Prediction – Kriging vs. Random Forest



Prediction – Kriging vs. Random Forest



What does uncertainty mean?

- Kriging: higher uncertainty in areas of geographically sparse data.
  - A significant factor is the range of the variogram for a parameter.

- Random Forest: lower uncertainty in areas of geographically sparse data.
  - Is this a result of lower variance in point predictions for areas with no or little data?
  - Spatial dependence structures are not taken into account.

Summary

- We compared the prediction of soil geochemistry variables produced by kriging and by Random Forest based on a geochemical dataset and auxiliary variables.
- Kriging and Random Forest produced similar predictions.
- Kriging outperformed Random Forest in cases with strong spatial covariance.
- Random Forest outperformed Kriging in cases with weak spatial covariance.
- Kriging and Random Forest reported contradicting Uncertainties.

Acknowledgements

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Thank you

Mineral Resources
Jens Klump
OCE Science Leader Earth Science Informatics

t +61 8 6436 8828
e jens.klump@csiro.au
w people.csiro.au/K/J/Jens-Klump

Mineral Resources
Francky Fouedjio
OCE Postdoctoral Research Fellow

t +61 8 6436 8648
e francky.fouedjiokameni@csiro.au
w people.csiro.au/F/F/Francky-Fouedjiokameni