Soil diffuse reflectance spectroscopy: a tool for digital soil mapping

Raphael VISCARRA ROSSEL
& Alex. McBRATNEY

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[1]Australian Centre for Precision Agriculture
Faculty of Agriculture, Food & Natural Resources
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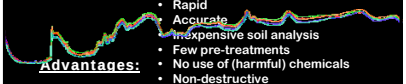
Visible (Vis), Near Infrared (NIR) and Mid Infrared (MIR) Diffuse Reflectance Spectroscopy (DRS)



Advantages:

- Rapid
- Accurate
- Inexpensive soil analysis
- Few pre-treatments
- No use of (harmful) chemicals
- Non-destructive
- Multivariate calibration
- Single spectrum = lots of information
- May be adapted for field use

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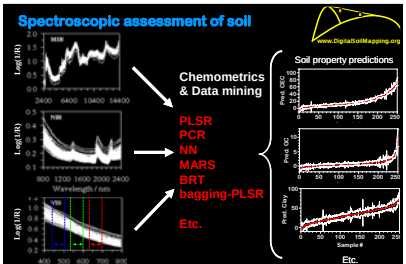
Spectroscopic assessment of soil



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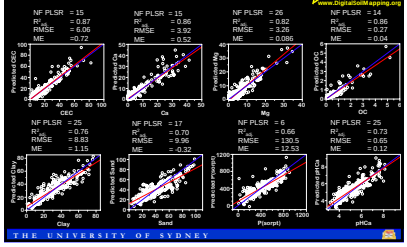
Predictions of soil properties by MIR DRS



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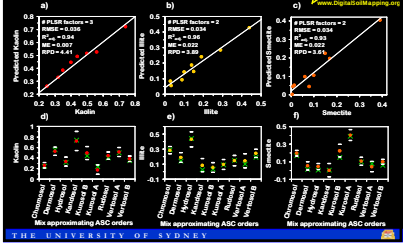
Predicting soil minerals using DRS



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Predictions of soil properties using DRS – Review 1986 - 2004

	vis	vis-NIR	NIR	MIR
V. Good R^2 > 0.81		C(inorg.); C(total); C:N; Ca; N(total); P; Heavy metals	C(inorg.); C(total); N(total);	C(inorg.); C(total); OC; Ca; Carbonate; LR; N(total); Heavy metals; Sand; Water
Good R^2 0.61 - 0.8		Acid.; CEC; Ca; Fe; Mg; NO_3-N; pH; Clay; Sand; Water; OC; Resp. Rate; Heavy metal	Acid; Al; Carbonate; LR; pH; Clay; Sand; SSA; Water; OC; Biomass	CEC; Mg; pH; Heavy metal content; Clay; Silt; Biomass; Enzyme activity
Fair R^2 0.41 – 0.6	OC; Clay; Sand	K; Heavy metal content; Silt; Biomass	CEC; Ca; Fe; K; Mg; Silt; Enzyme activity	Acid; Al; Fe
Poor R^2 < 0.4	Al; CEC; Ca; EC; K; LR; P; pH	EC; Na;	NO_3-N; P	EC; K; NO_3-N; Na; P;

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Which spectral region to use?

The choice of which spectral region to use will depend on:

(i) the application,

(ii) the soil property and the required accuracy,

(iii) the robustness of the technology,

(iv) its cost

(~U$ 50 - 70K for NIR-MIR and ~U$ 3 – 60K for portable vis-NIR)

(v) the amount of sample preparation required, etc…

e.g. although DRS in the MIR generally produce better results than vis-NIR, the technology is more complex and expensive, sample preparation is more involved than for vis-NIR analysis and portable instruments are not yet robust enough.

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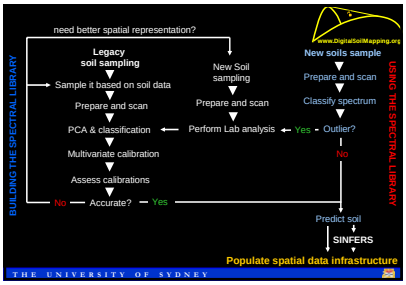
How could we use DRS for DSM and population of sparse soil spatial data infrastructures?



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What may be needed?

Collaboration between institutes, agencies, etc. to prepare legacy soil sample and scan it

Collaboration between existing labs for spectral standardization and calibration transfer

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Conclusions

DRS can be used to populate sparse soil spatial data infrastructures cheaply and with good quality, high-resolution soil information.

DRS is a useful and powerful tool for DSM and SPEC-SINFERS even more so!!!