In-field Measurement of

Soil Organic Carbon, pH, Texture and more

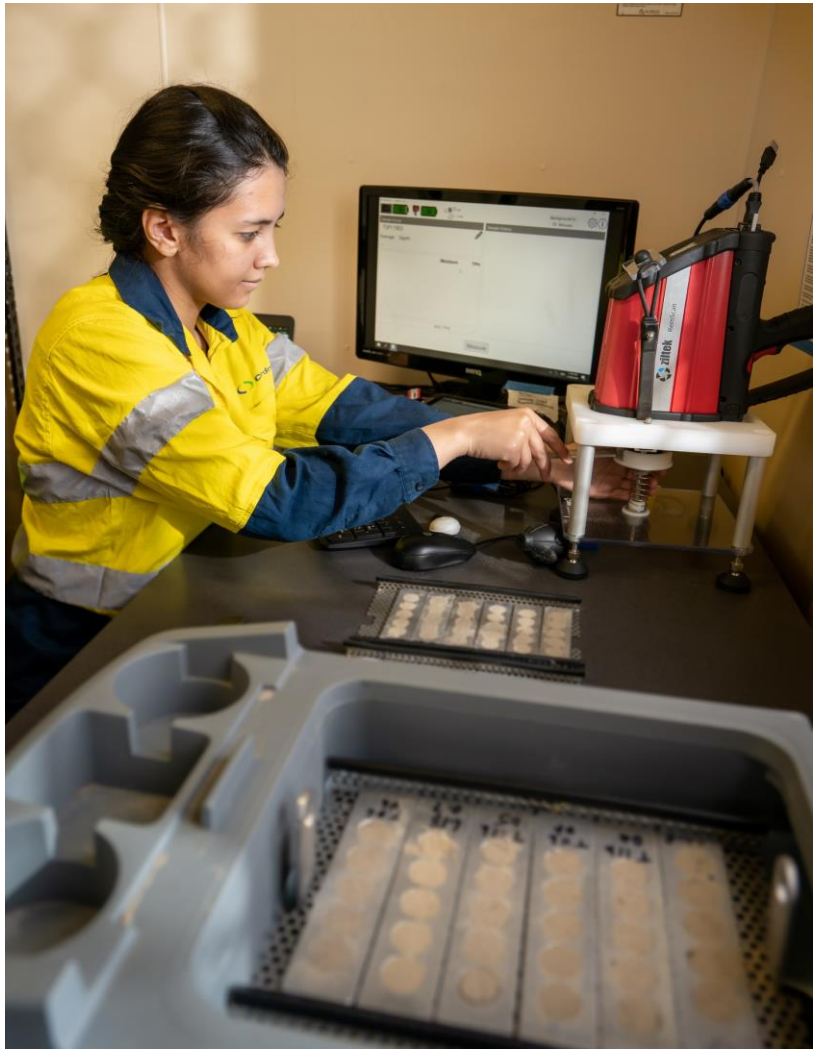
Dr. Sean Manning

Ziltek

- Ziltek founded in 2008 by Dr. Richard Stewart
- Located in Thebarton, Adelaide
- Ziltek commercialised CSIRO patented technology
- Measurement of total petroleum hydrocarbons (TPH) in soil with mid Infrared spectroscopy
- RemScan™ was developed
  - Handheld MIR spectrometer
  - Field kit
  - Calibration service
  - Training
  - Support

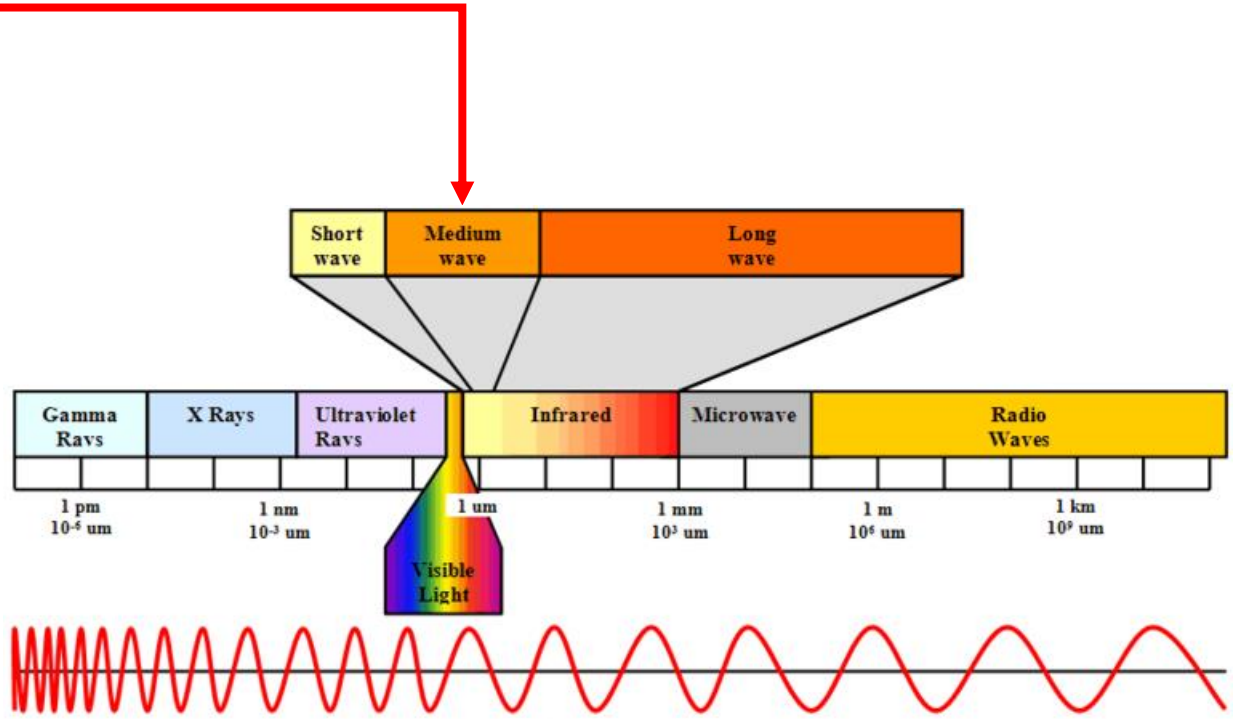
Ziltek

- Process control tool for TPH remediation
- Compliments laboratory analysis
- Many Customers
  - Oil companies: Chevron, Shell, Total, Sinopec
  - Analytical Labs: ALS
  - Mining: FMG, Alcoa, Roy Hill
  - Environmental/Waste: Cardno, Envisol, Suez, SAES, PolyEco, AECOM, DEME
  - Universities: RMIT, Melbourne Uni, Concawe, Jan Evangelista Purkyně University
  - Government: UN Italy, UN Congo, Indonesian Government
- RemScan has been use to remediate soils/sites from all over the world



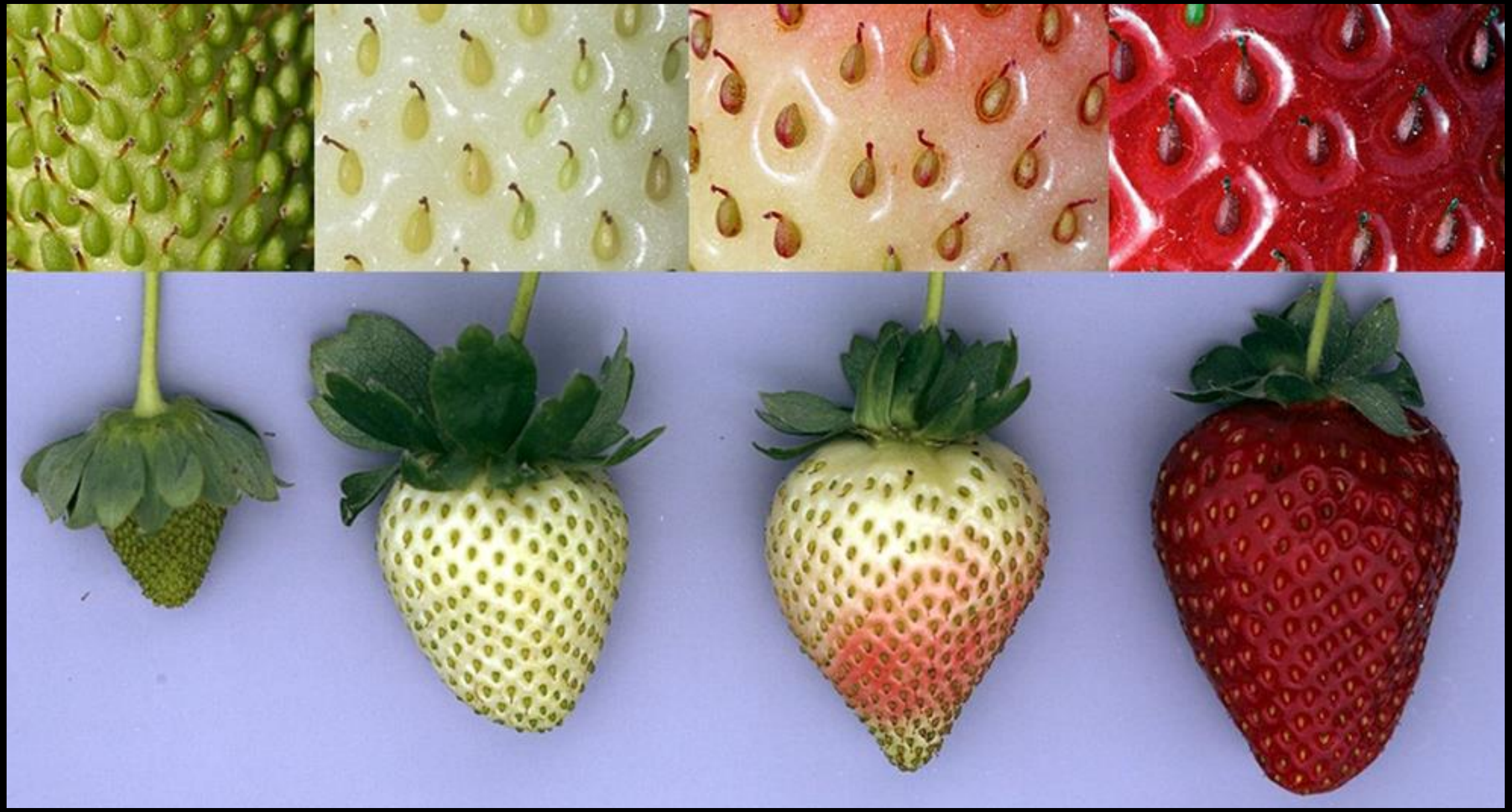
Field MIR Spectroscopy

- Mid infrared light = long wavelength light, 2-20 μm
- Causes molecular bonds to vibrate
- Reflected light from samples is missing certain colours
- Record of the reflected colours is a spectrum
- Spectra tell us what substances are in a sample
- Spectra + lab measurements can be turned into calibrations



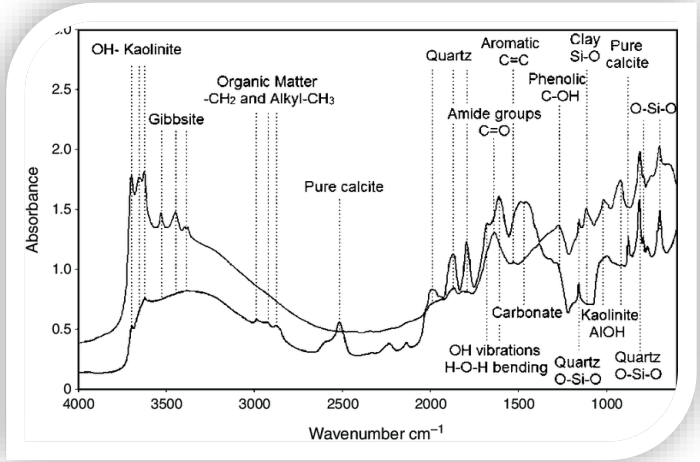

RemScan®


RemScan®



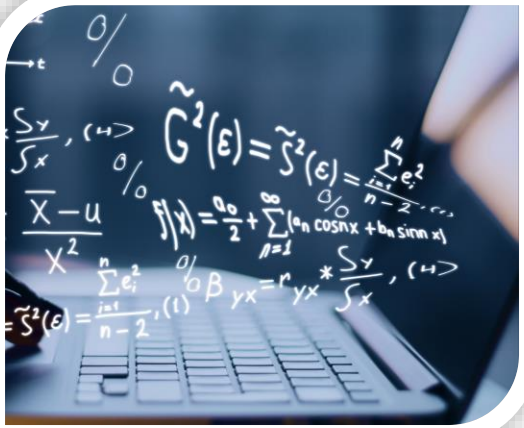
MIR Scanning

Identification

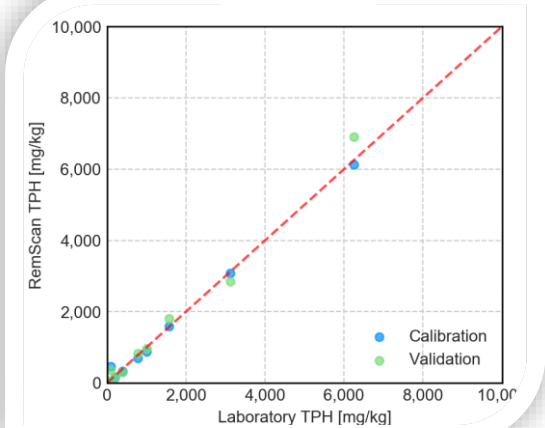


Laboratory Assay

Mathematics



Calibration



Benefits of RemScan

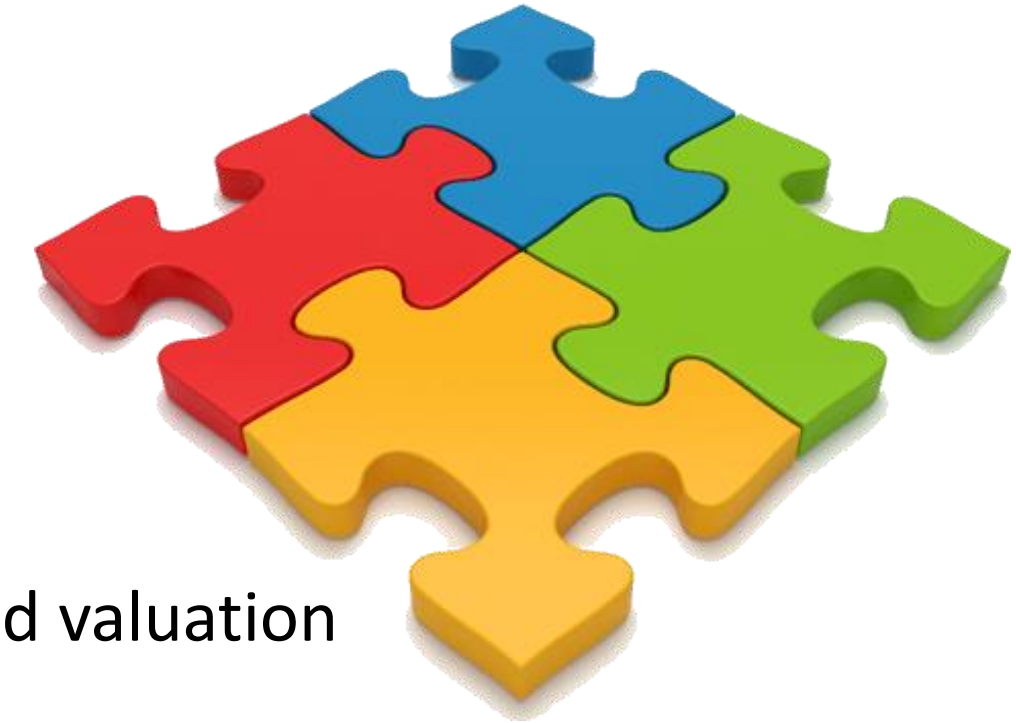
- On the spot results in under 20s
  - Make decisions in real time
- Measure multiple parameters at once
  - Spectra are information rich
- Nil incremental cost of measurement
  - Make more measurements → increase confidence
- Non destructive
  - Retain sample for lab analysis / rescan
- Correlated to metadata
  - GPS location
  - Time/date
  - Operator
  - Method
- Secure and auditable
- Indelible record of sample
  - Re-evaluate at any time using latest methods

Where to now?

- Ziltek are world leaders in in-field TPH measurement of soil
- Looking to expand the capabilities of RemScan / enter new markets
- Precision agriculture and soil carbon sequestration show potential
  - Scientific literature
  - Climate change
  - Food security
  - Water usage
  - Increased investment

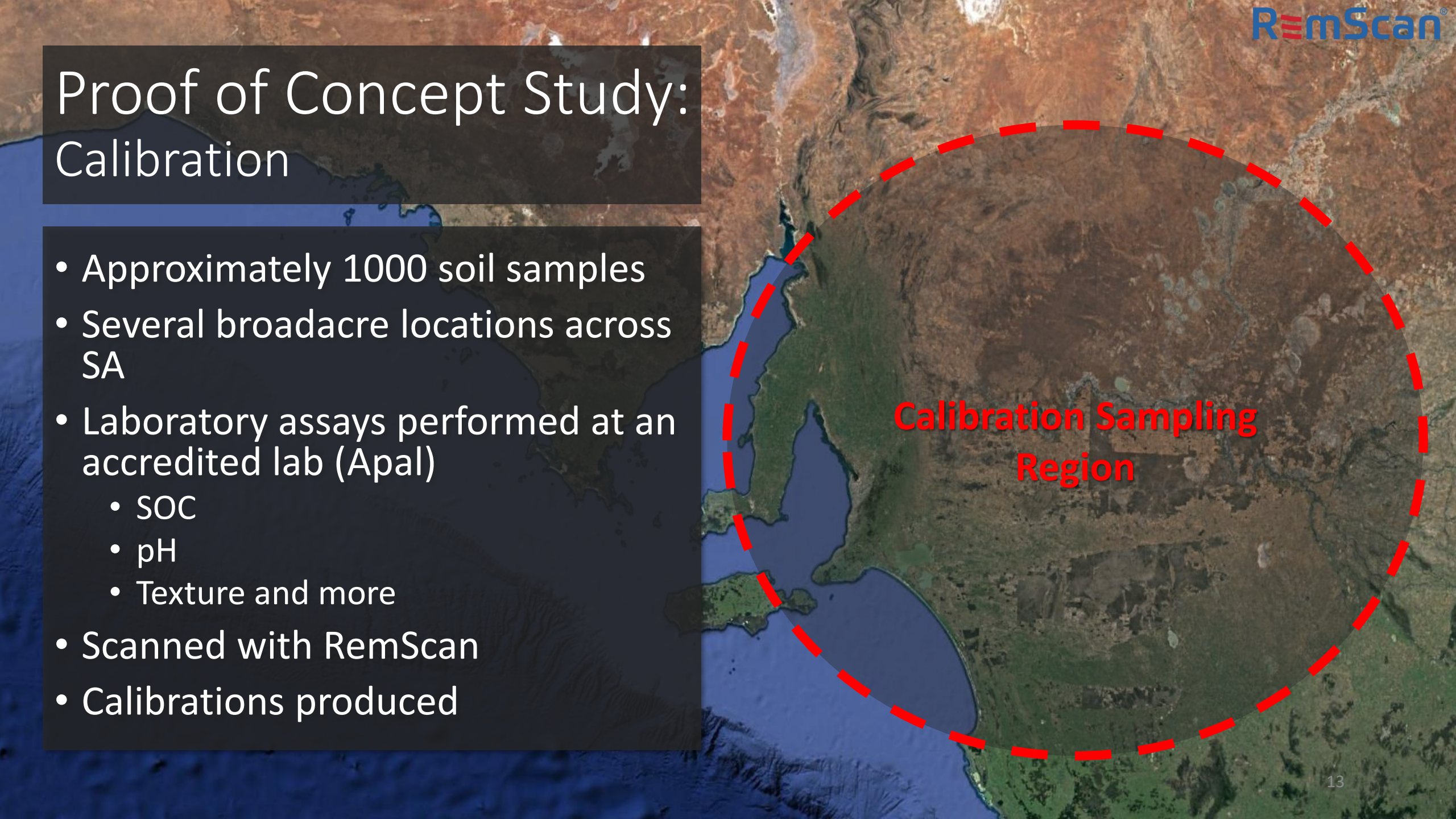
Soil Carbon Sequestration

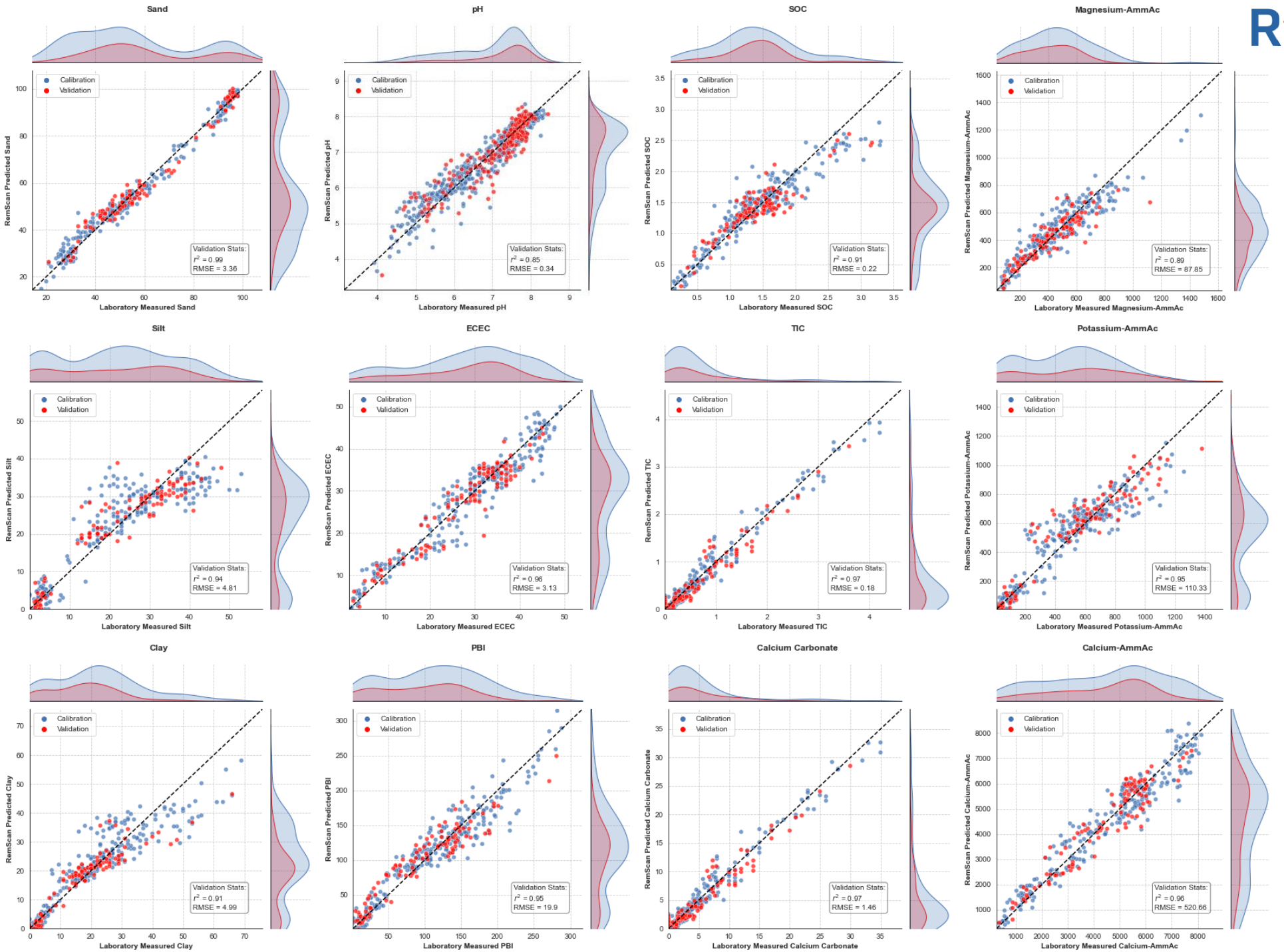
1. Monetise carbon
   - Cap and Trade
   - Carbon Tax
   - etc.
2. Increase carbon in agricultural soils
   - Changes in land management practises
3. Quantify SOC increase for monitoring and valuation
   - Inexpensive
   - Reliable
   - Data rich → Statistical confidence



Proof of Concept Study:
Calibration

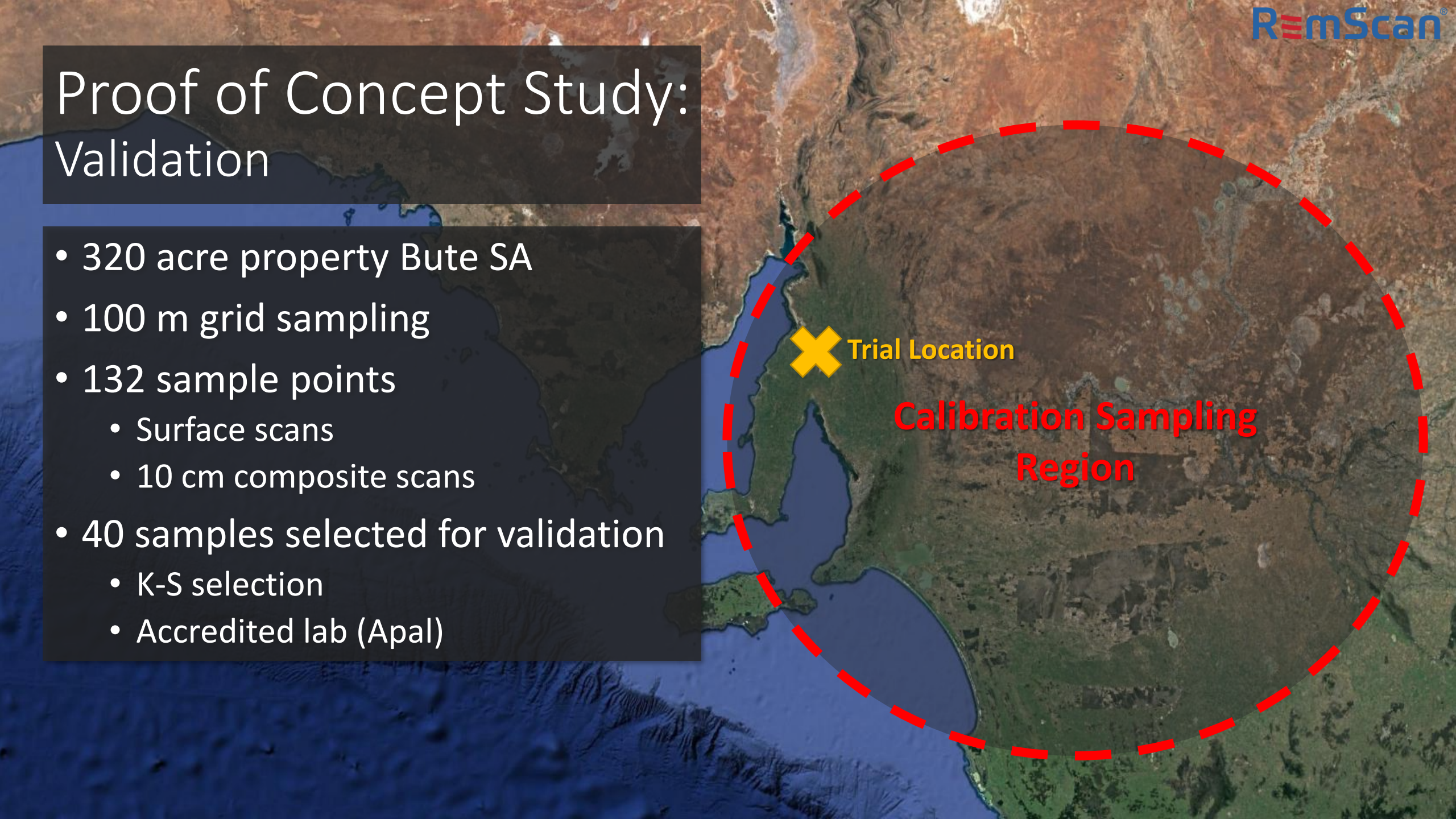
- Approximately 1000 soil samples
- Several broadacre locations across SA
- Laboratory assays performed at an accredited lab (Apal)
  - SOC
  - pH
  - Texture and more
- Scanned with RemScan
- Calibrations produced




Sand
Calibration
Validation
RemScan Predicted Sand
Laboratory Measured Sand
Validation Stats:
r^2 = 0.99
RMSE = 3.36
pH
RemScan Predicted pH
Laboratory Measured pH
r^2 = 0.85
RMSE = 0.34
SOC
RemScan Predicted SOC
Laboratory Measured SOC
r^2 = 0.91
RMSE = 0.22
Magnesium-AmmAc
RemScan Predicted Magnesium-AmmAc
Laboratory Measured Magnesium-AmmAc
r^2 = 0.89
RMSE = 87.85
Silt
RemScan Predicted Silt
Laboratory Measured Silt
r^2 = 0.94
RMSE = 4.81
ECEC
RemScan Predicted ECEC
Laboratory Measured ECEC
r^2 = 0.96
RMSE = 3.13
TIC
RemScan Predicted TIC
Laboratory Measured TIC
r^2 = 0.97
RMSE = 0.18
Potassium-AmmAc
RemScan Predicted Potassium-AmmAc
Laboratory Measured Potassium-AmmAc
r^2 = 0.95
RMSE = 110.33
Clay
RemScan Predicted Clay
Laboratory Measured Clay
r^2 = 0.91
RMSE = 4.99
PBI
RemScan Predicted PBI
Laboratory Measured PBI
r^2 = 0.95
RMSE = 19.9
Calcium Carbonate
RemScan Predicted Calcium Carbonate
Laboratory Measured Calcium Carbonate
r^2 = 0.97
RMSE = 1.46
Calcium-AmmAc
RemScan Predicted Calcium-AmmAc
Laboratory Measured Calcium-AmmAc
r^2 = 0.96
RMSE = 520.66

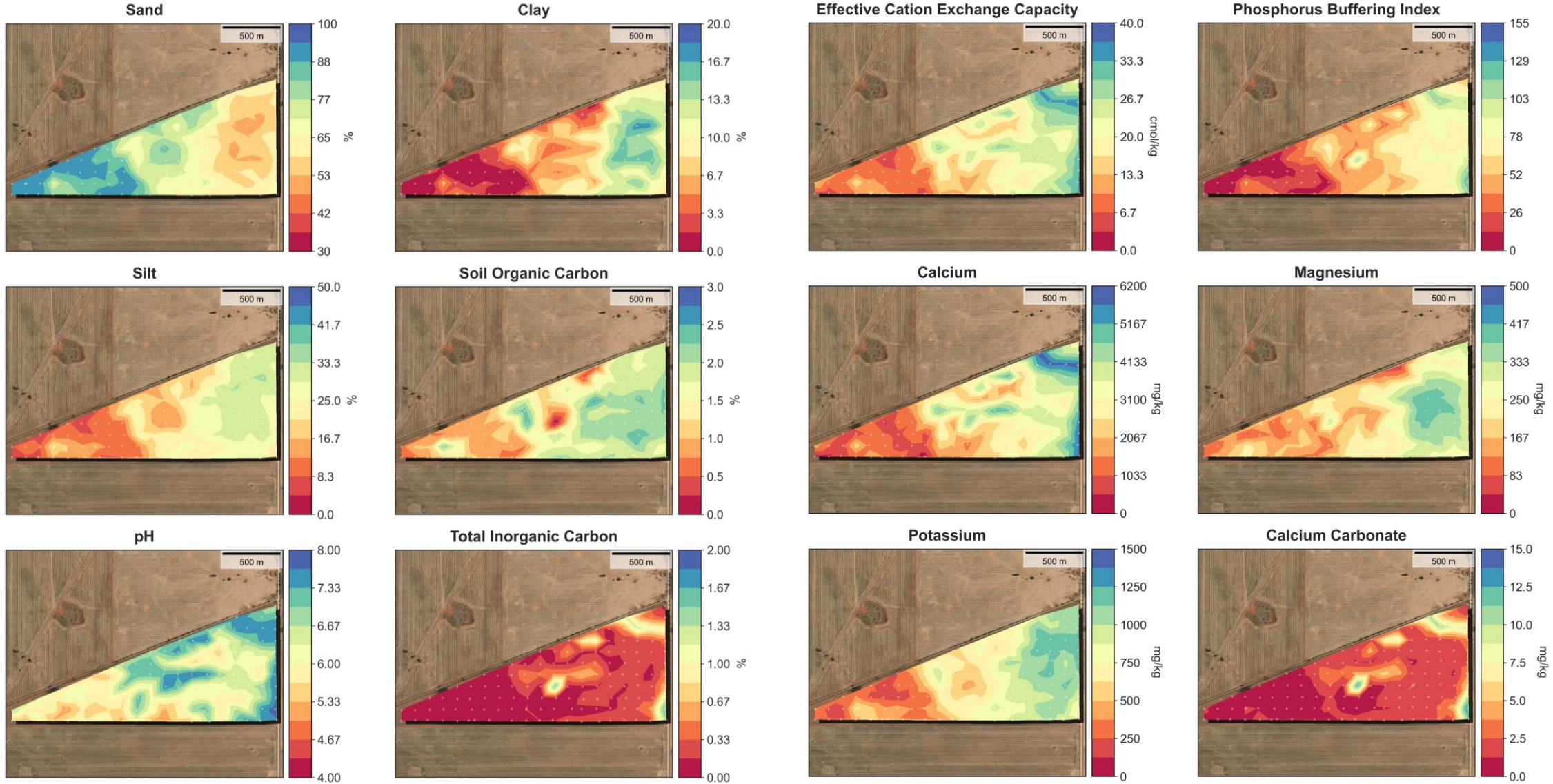
Proof of Concept Study:
Validation

- 320 acre property Bute SA
- 100 m grid sampling
- 132 sample points
  - Surface scans
  - 10 cm composite scans
- 40 samples selected for validation
  - K-S selection
  - Accredited lab (Apal)

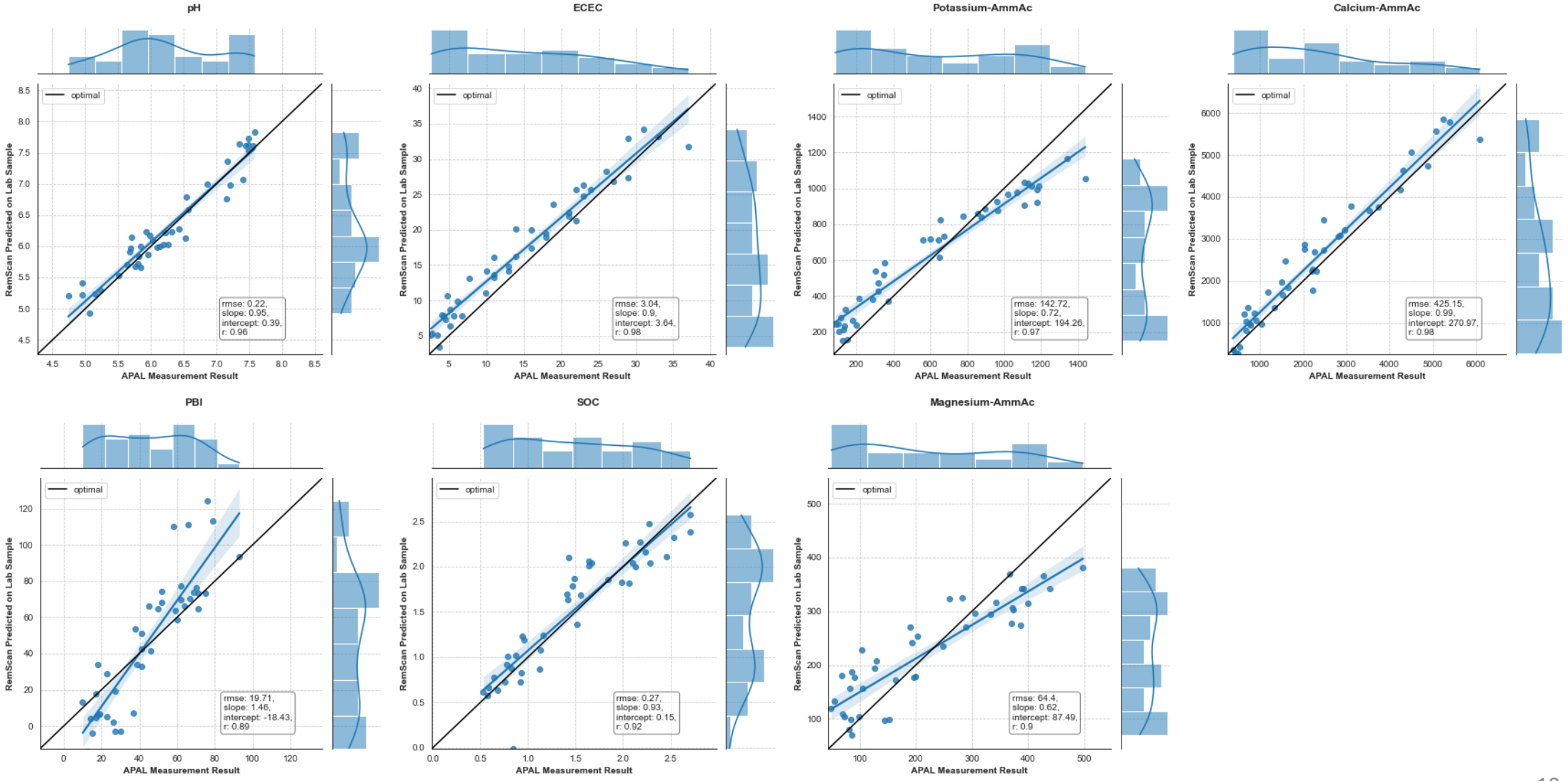



RemScan®

Bute Field Trial Results

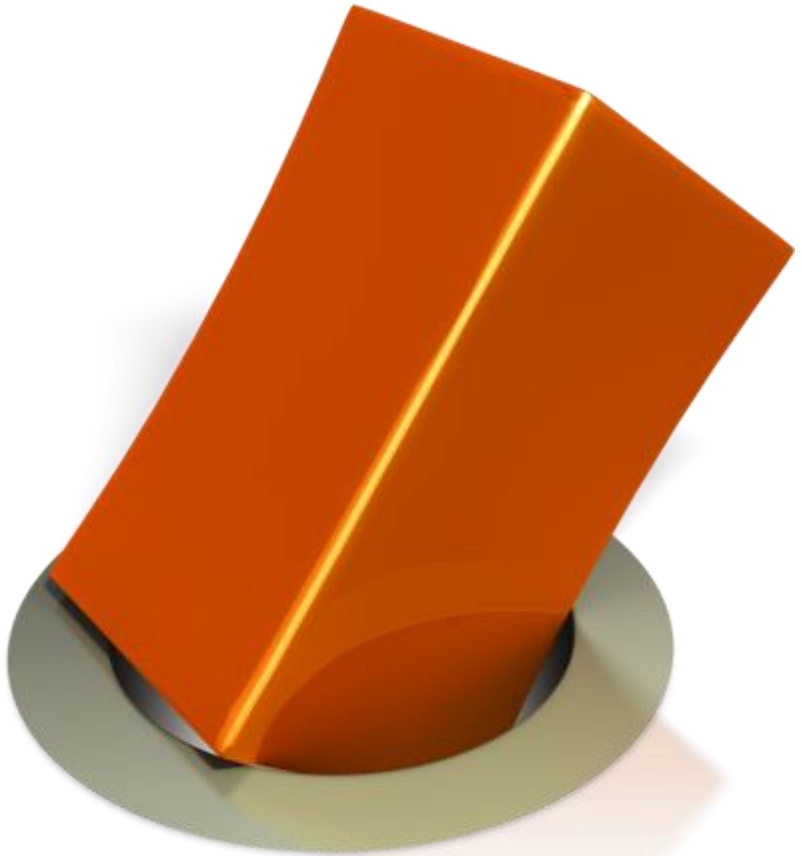


Laboratory Validation of Results



Now looking to partner with key stakeholders

- Ziltek knowhow:
  - Soil MIR spectroscopy
  - Chemometrics, machine Learning, data analysis
  - Handheld field instruments
- We are not Agronomists / Farmers
- Hence we are seeking partnerships
  - Method validation
  - Product design input
- We want to make the right tool for the right job



Thanks for listening

Questions welcome

If you’re interested in working with us please reach out

Contact→