

Mapping the Future: Updating Queensland's Phosphorus Landscape

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Queensland Government

Department of the Environment, Tourism, Science and Innovation



Project overview

MLA funded project – collaboration between Queensland Gov DPI and DETSI

Aim

Update the existing soil P map and extend into the northern regions of Queensland

Objectives

1. Review the availability of soil P data across all of Queensland
2. Identify geographical gaps in the data set and collect/analyse new samples
3. Update the previous soil mapping method with new techniques and datasets
4. Produce a soil P (0-10 cm) map of Queensland at a 30 m resolution
5. Incorporate the map into extension materials (e.g., upload to the LongPaddock website).



Soil site selection

1. Identified key variables influencing soil P variability across QLD
 - weathering index
 - radiometrics
 - elevation and slope
2. Filtered key variables to within 100 m of roads/tracks
3. Used conditioned Latin hypercube sampling (cLHS) to determine 100 sampling points per region (Cape York, Northern and Southern Gulf)
4. Used k-means clustering to give options within 10 km



Example site (**red**) within available sampling area (**green**)

Available soil P data

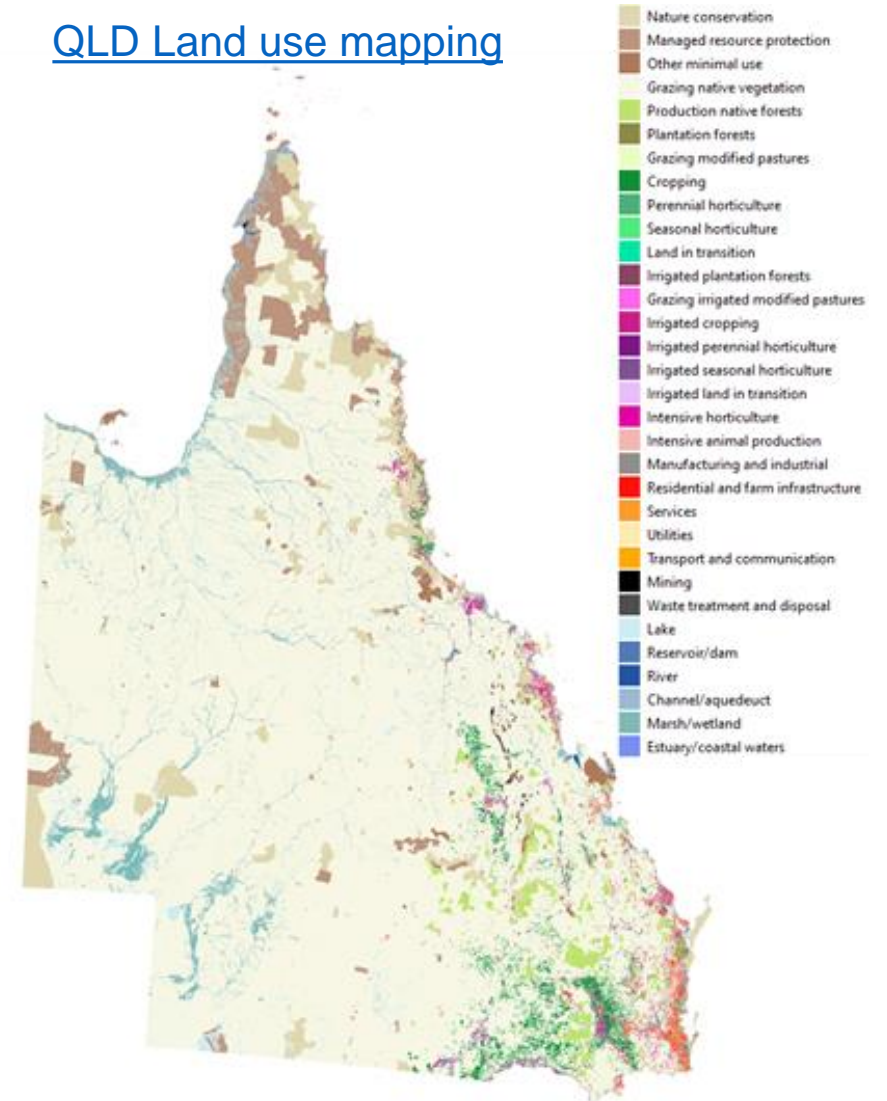
Methods:

- Bicarbonate extraction method (commonly known as Colwell-P)
- 9B1 or 9B2 (Rayment & Lyons, 2011)

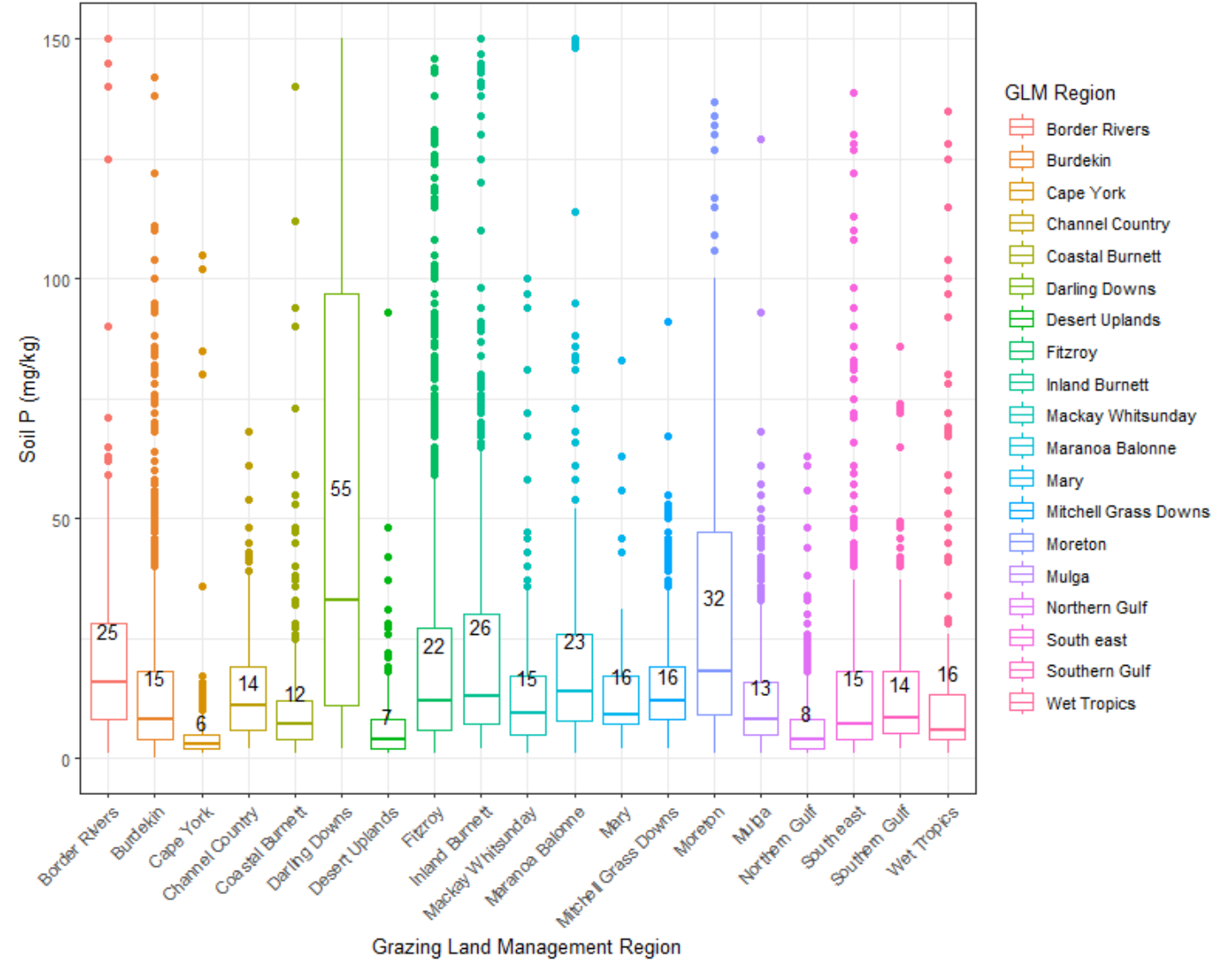
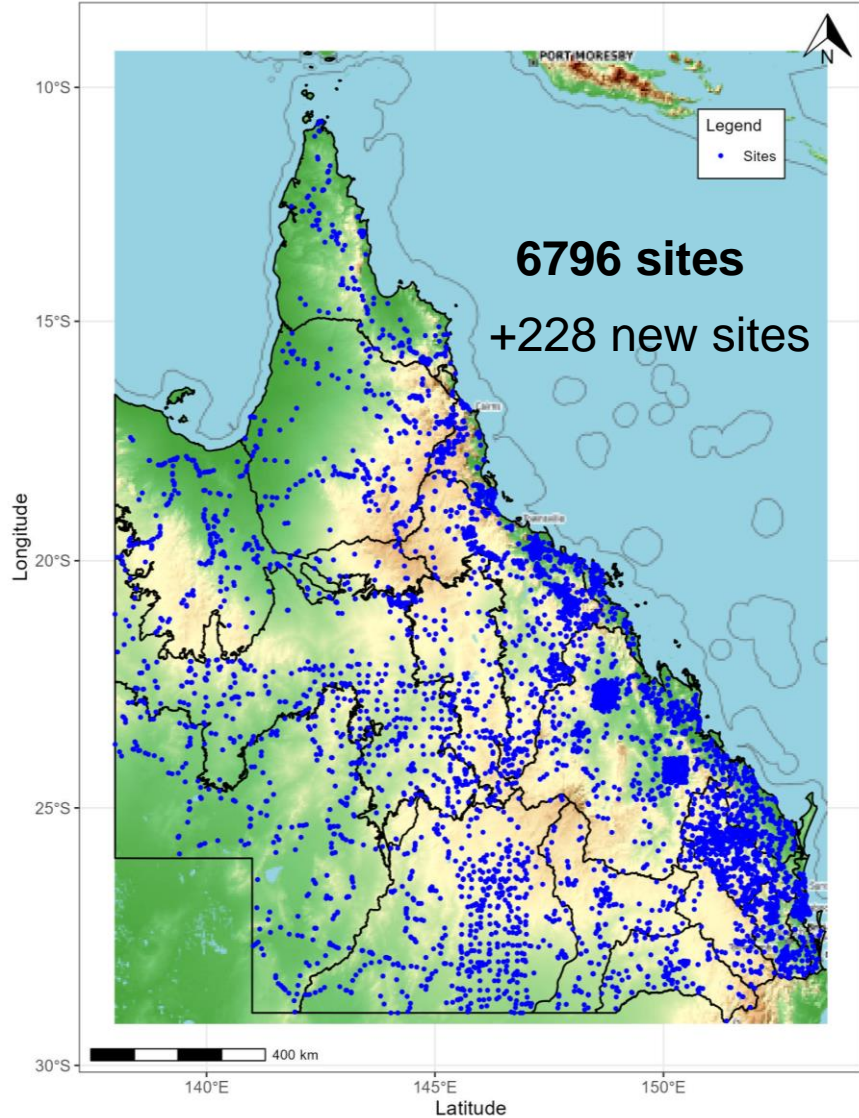
Samples were excluded if:

- Collected outside of the 0-10 cm layer in the soil profile
- Concentration greater than 150 ppm
- Site was cultivated or highly disturbed
- Concentrations greater than 7 ppm if within 75 m of a:
 - plantation forest/modified pasture/cropping area/tree crop
 - feedlot or intensive animal farm
 - infrastructure
 - mines
 - water storage system or channel

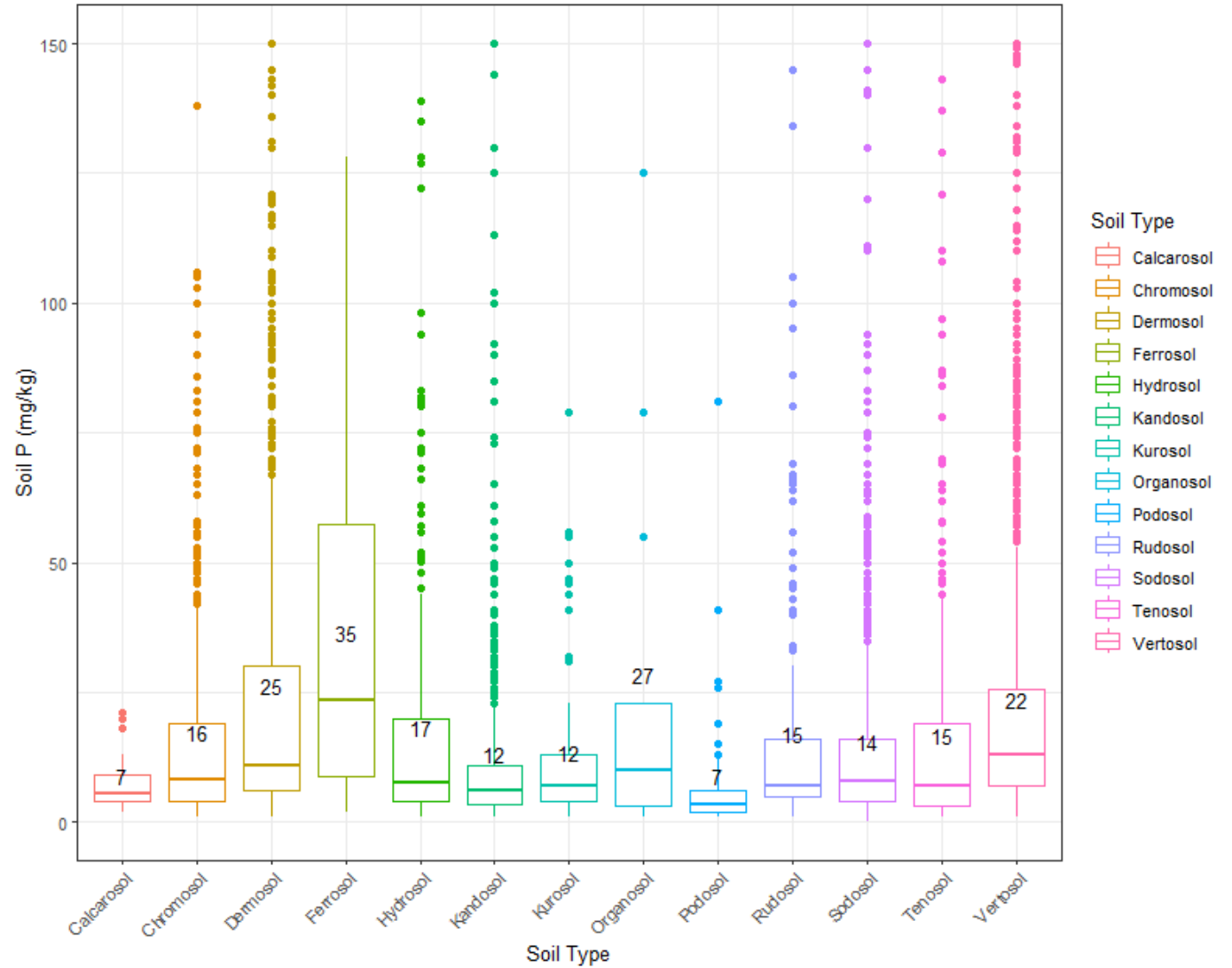
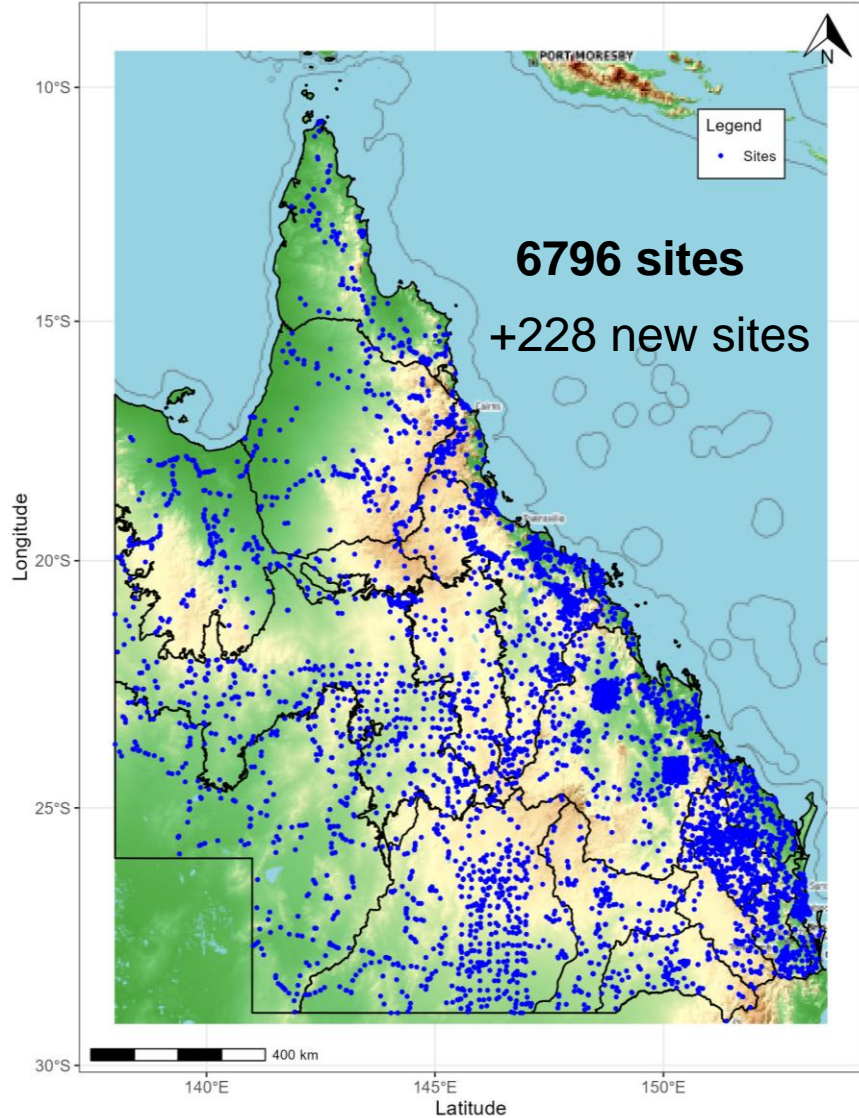
[QLD Land use mapping](#)



Available soil P data – GLM region



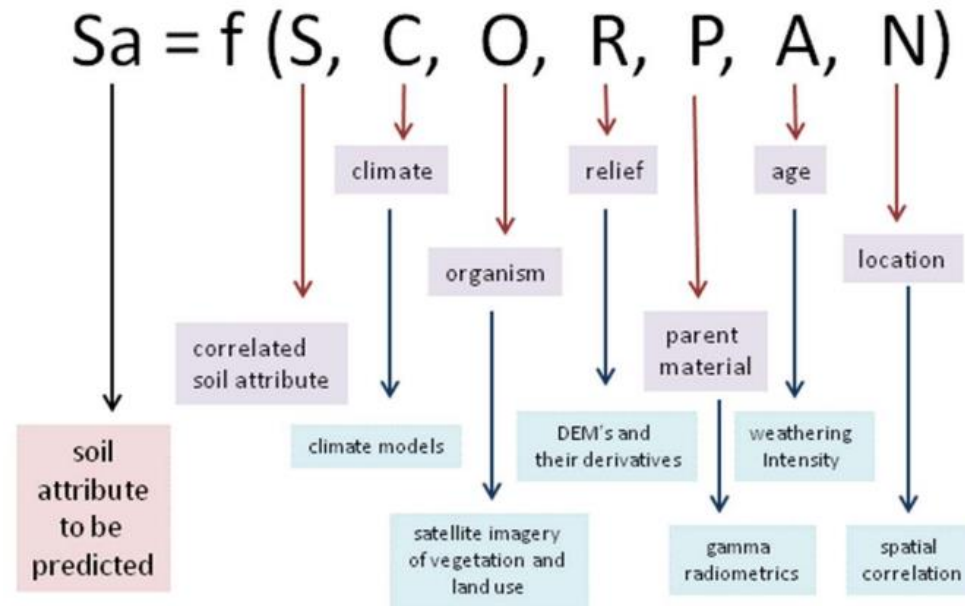
Available soil P data – Soil type



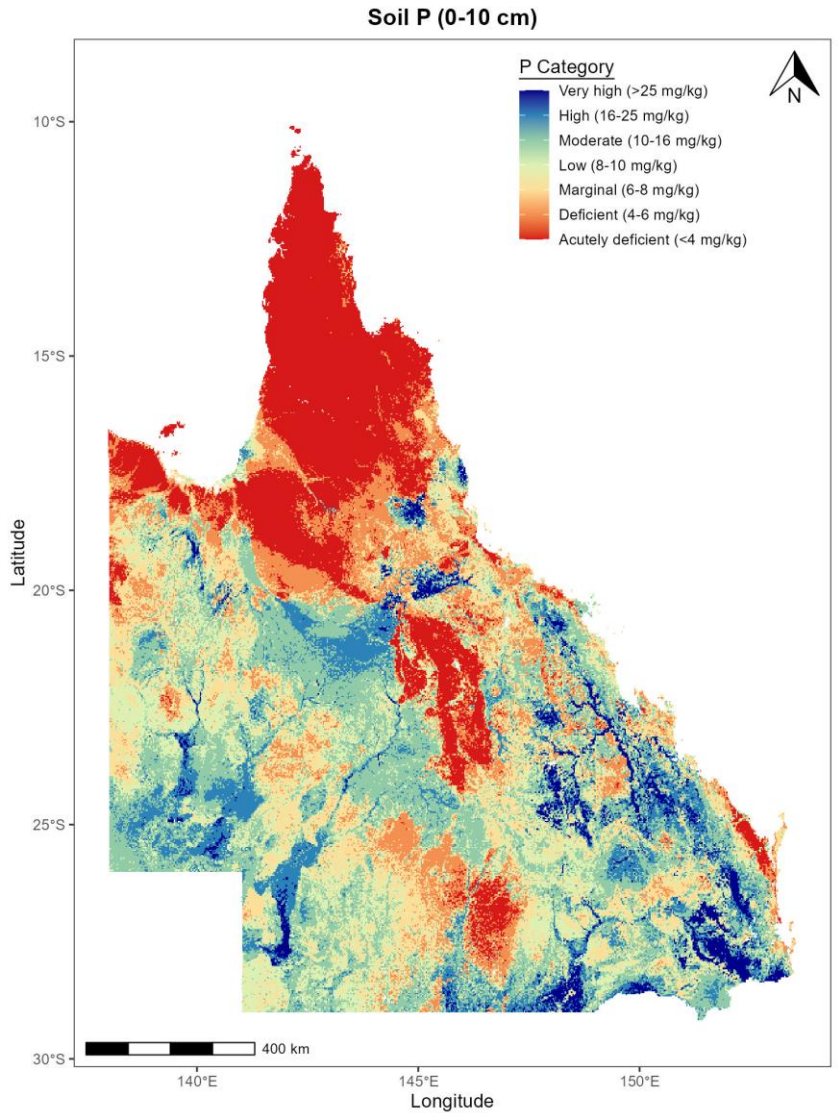
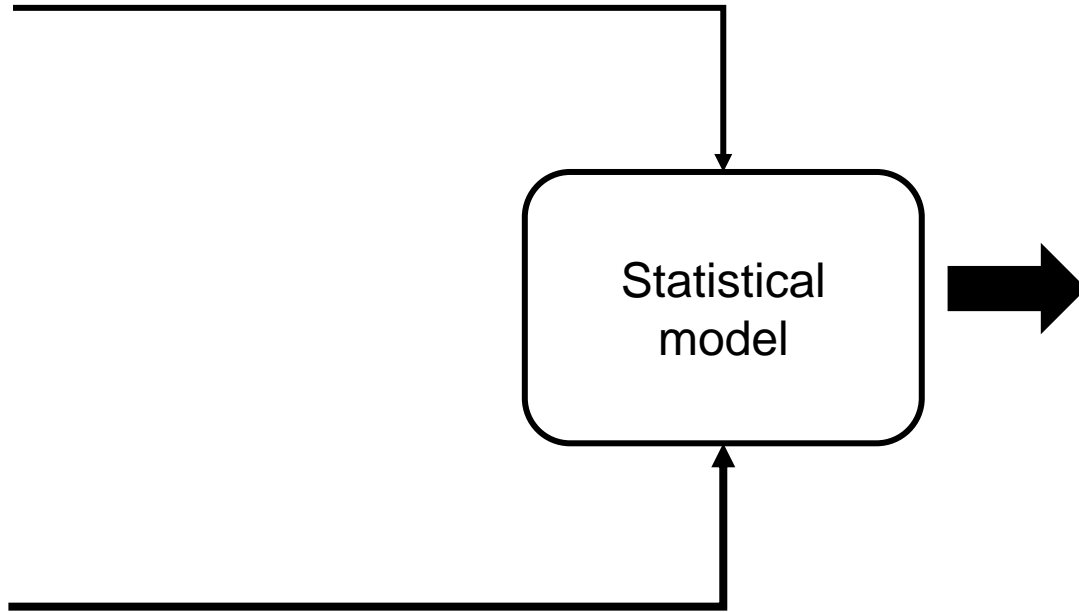
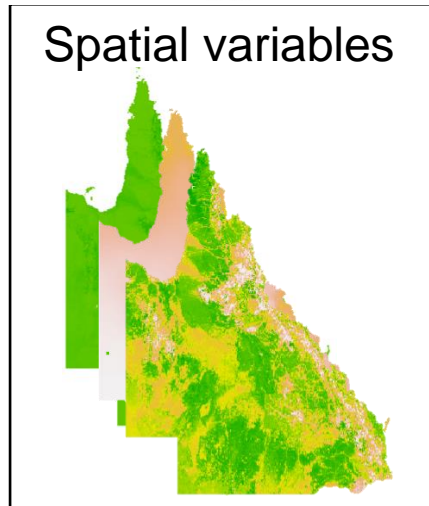
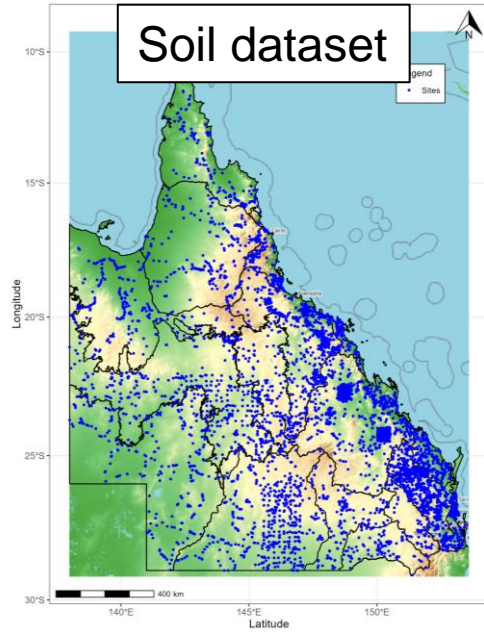
Soil mapping methods

Digital soil mapping

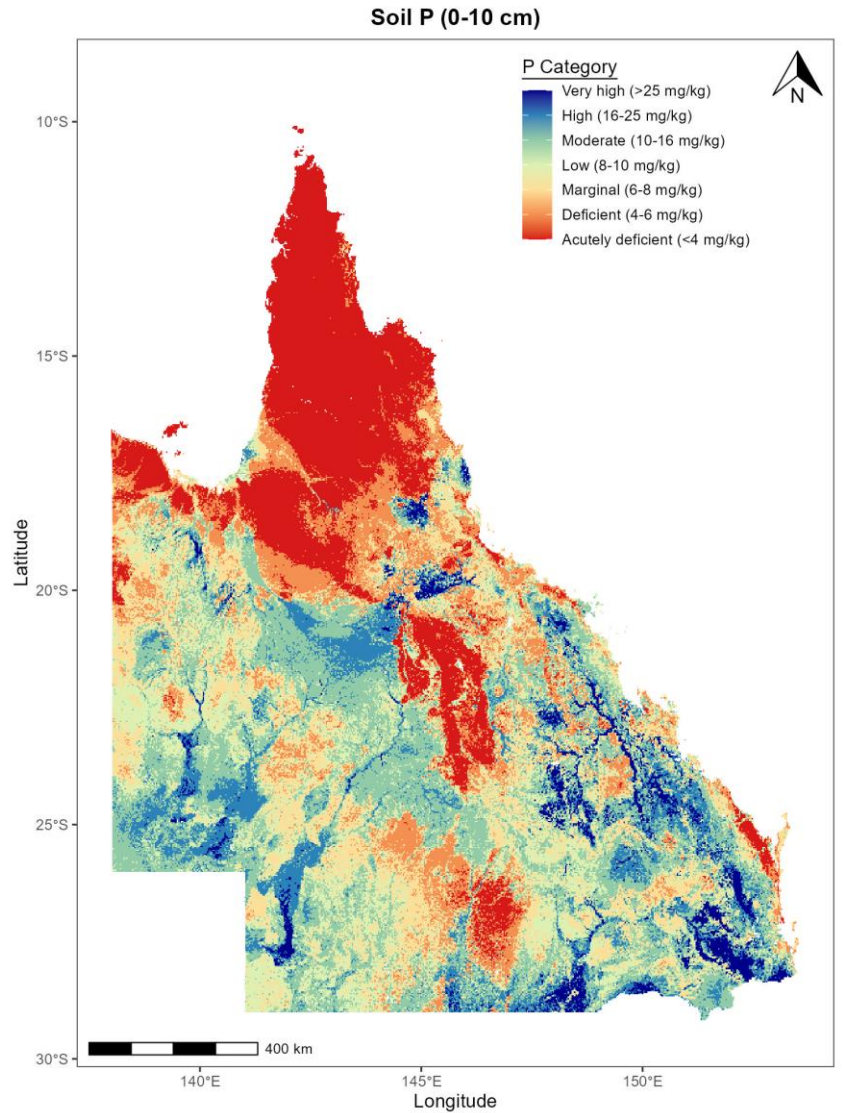
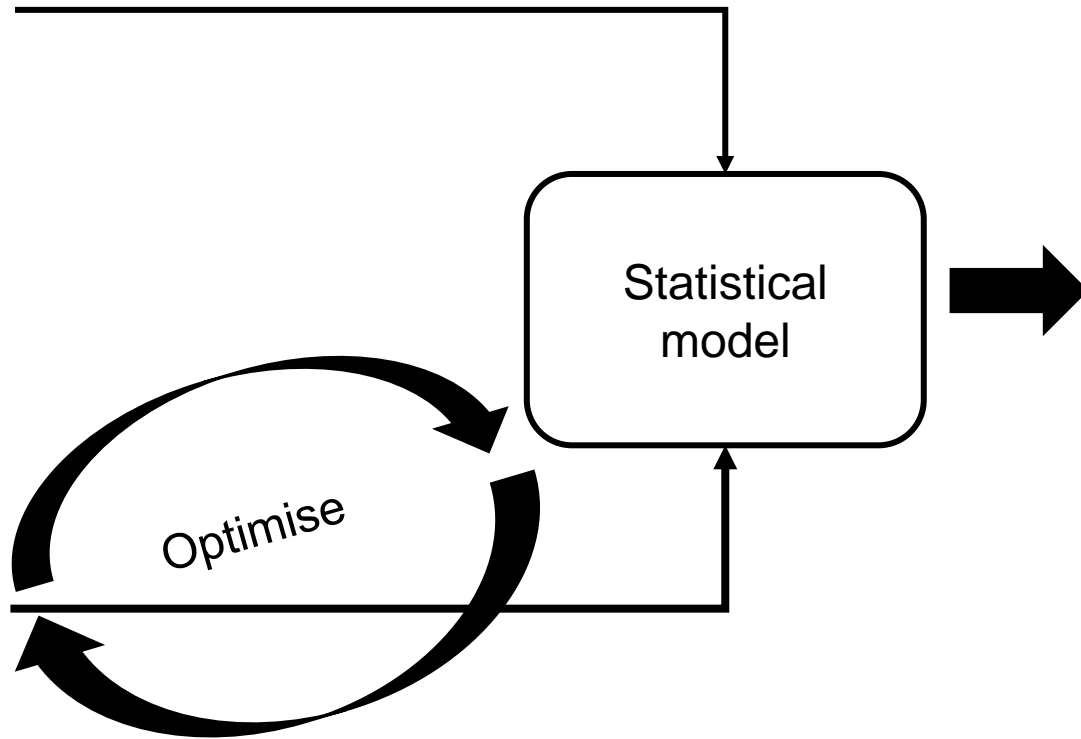
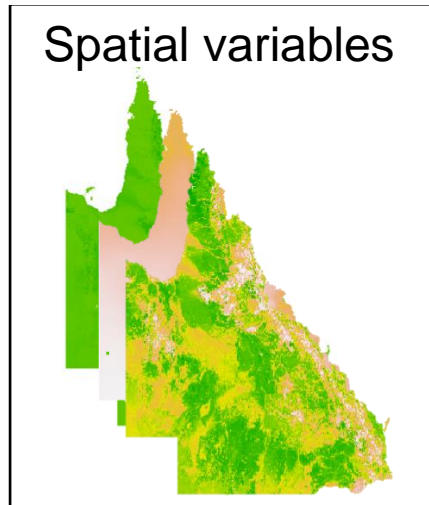
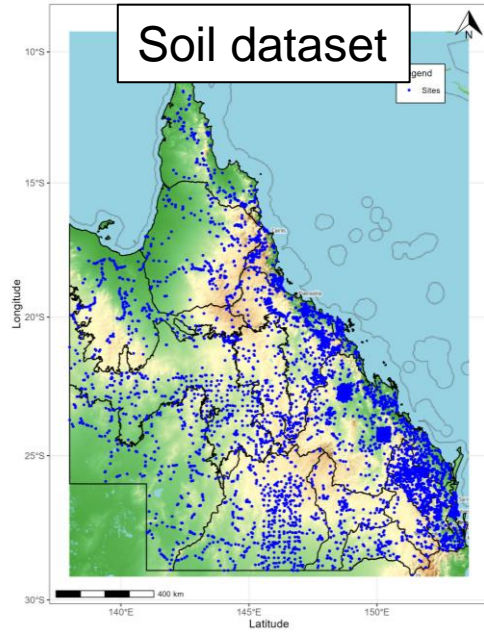
- Build relationships between observed soil data and related variables - **SCORPAN**
- Produces a continuous prediction layer rather than polygons/mapping units
- Can also generate uncertainty estimates and easy to update with new data



Modelling framework

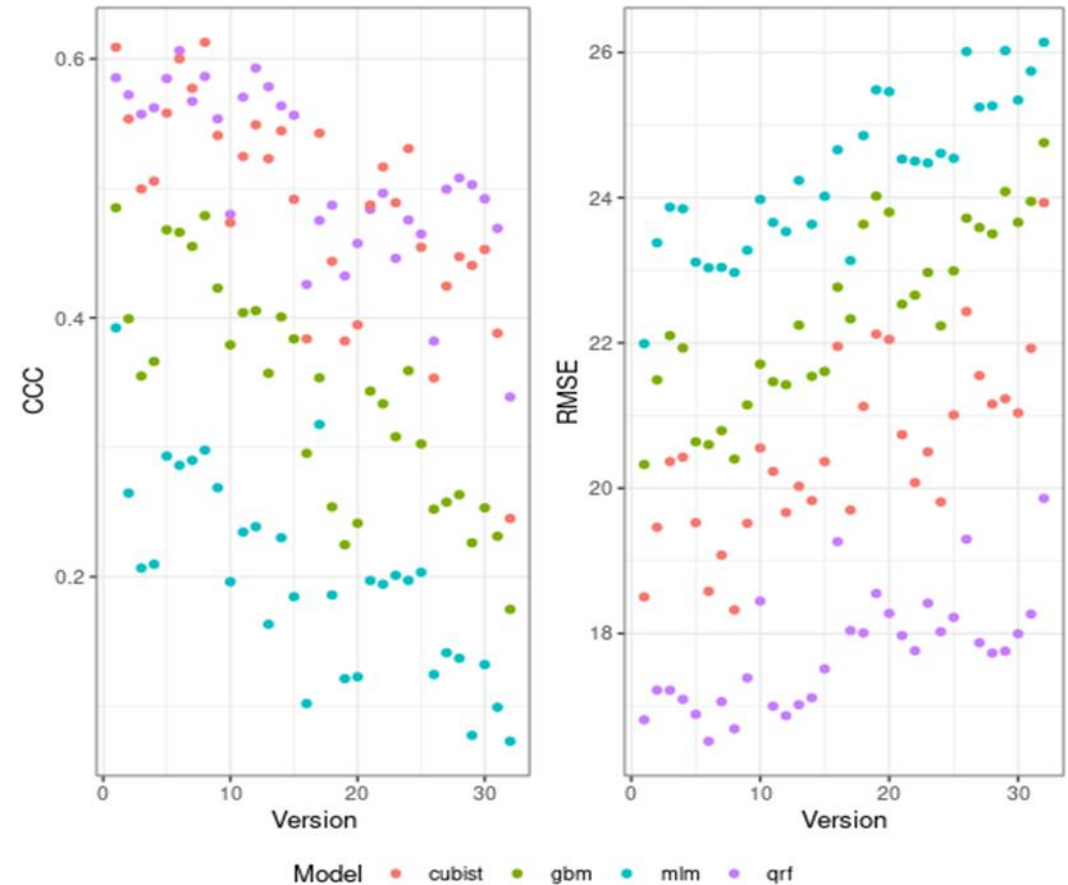


Modelling framework



Prediction accuracy

- Tested 4 different models and 32 different combinations of spatial variables
- Assessed multiple metrics
 - CCC – how accurate the data is predicted
 - RMSE – how much error
- Cubist and Quantile Random Forest performed well
- Quantile Random Forest selected
- Improved accuracy between 17 and 48% compared to 2022 map



Prediction accuracy (2022 map)

Accuracy
28%

	Acutely Deficient (<4 mg/kg)	Deficient (4-6 mg/kg)	Marginal (6-8 mg/kg)	Low (8-10 mg/kg)	Moderate (10-16 mg/kg)	High (16-25 mg/kg)	Very High (>25 mg/kg)
Acutely Deficient	289	334	240	124	129	23	0
Deficient	71	184	209	133	184	34	8
Marginal	13	111	164	131	174	54	10
Low	10	63	103	86	162	57	10
Moderate	11	69	121	149	364	135	36
High	3	23	71	97	298	159	56
Very High	1	16	41	94	329	378	433

Prediction accuracy (2024 map)

Accuracy
70%

	Acutely Deficient (<4 mg/kg)	Deficient (4-6 mg/kg)	Marginal (6-8 mg/kg)	Low (8-10 mg/kg)	Moderate (10-16 mg/kg)	High (16-25 mg/kg)	Very High (>25 mg/kg)
Acutely Deficient	637	466	33	3	0	0	0
Deficient	0	371	435	14	2	1	0
Marginal	1	2	337	311	6	0	0
Low	0	0	7	245	237	2	0
Moderate	0	1	4	9	753	118	0
High	0	0	1	9	21	614	62
Very High	0	0	1	0	10	52	1229

Prediction uncertainty

- Areas with naturally high P/large range
- Areas with low sampling density
- Map is only indicative - should be followed up with additional soil sampling

