

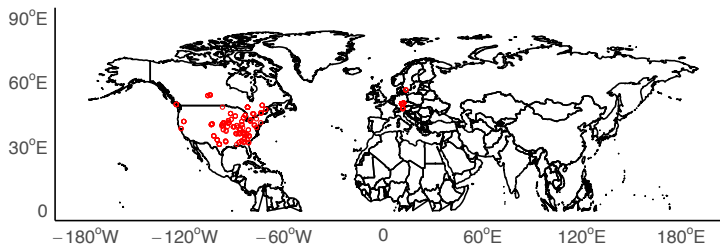
How much more carbon can be sorbed to soil?

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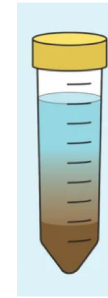
Background

- Need way to estimate potential C that can be added to stable, mineral-protected pools
- DOC sorption is one mechanism that leads to mineral-associated C
- How much more DOC can be sorbed to soils?

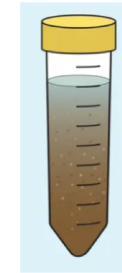


- N=400 sorption experiments
- 133 soil profiles
- 6 soil orders

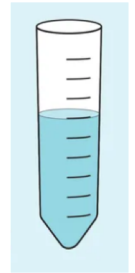
Add DOC to soil



Shake

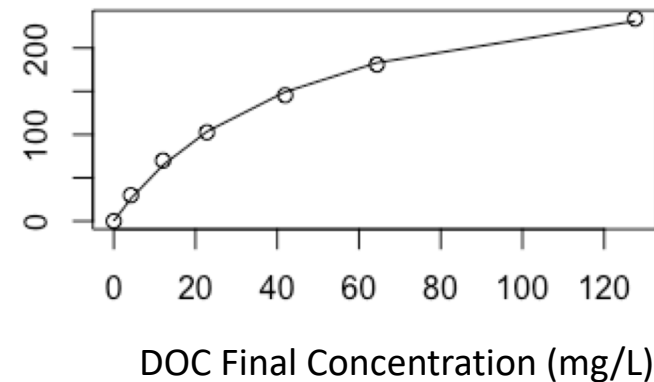


Filter



Analyze filtrate

Q (DOC Adsorbed; mg/kg)



$$Q = \frac{Q_{sp} k \cdot DOC}{1 + k \cdot DOC}$$

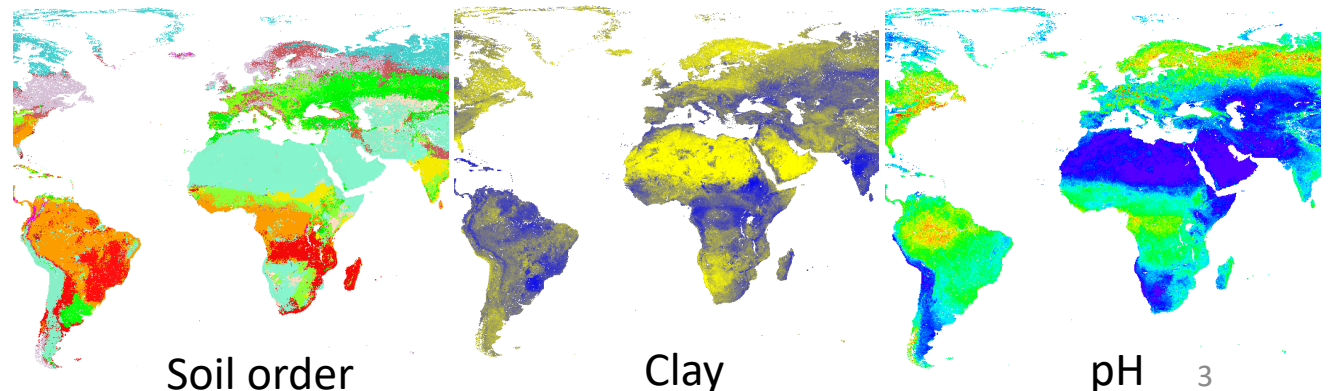
Methods

A. Created Random Forest model of Q_{sp} using reported (1) soil order, reported and imputed (2) %clay and (3) pH, (4) MAT and (5) MAP from WorldClim

- Imputation with mice (multivariate imputation by chained equations)
- Random Forest
 - Fit model, grew 500 trees (R::randomForest)
 - K-fold cross validation, withholding 10% of training data, 99 model iterations (R::rfUtilities)
 - Partial feature contributions (R::forestFloor)

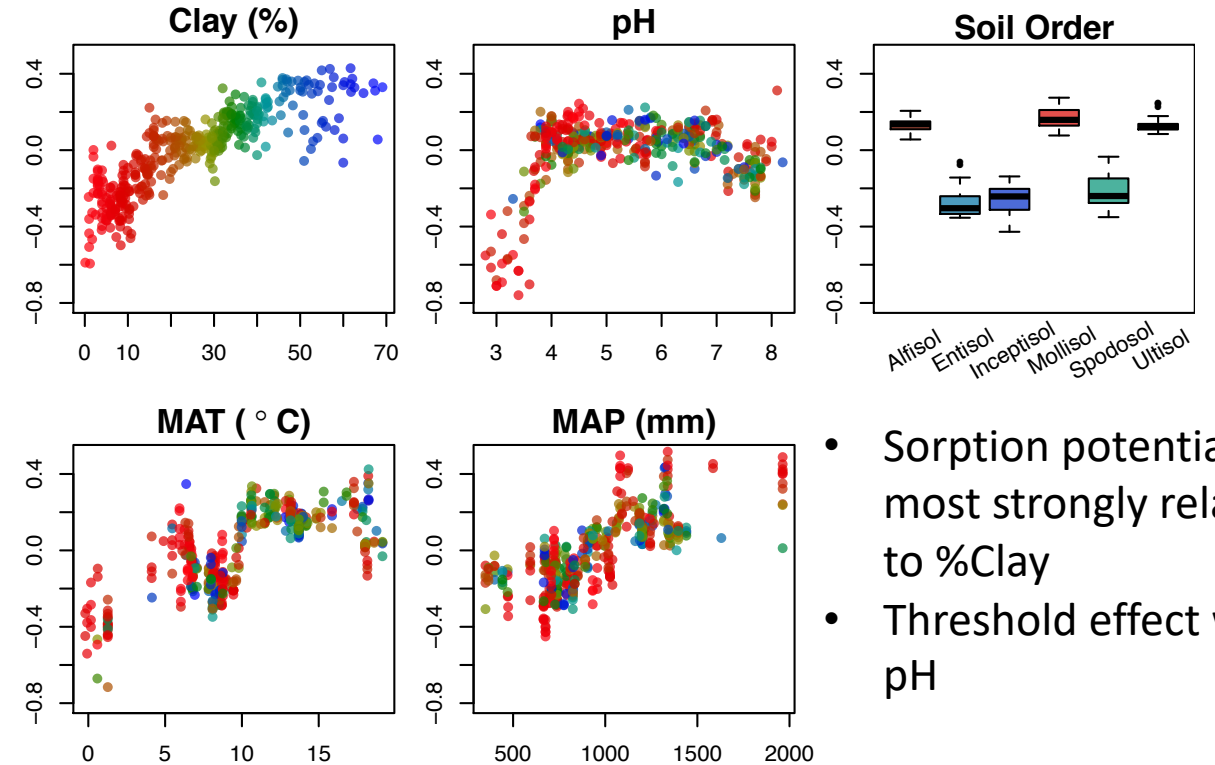
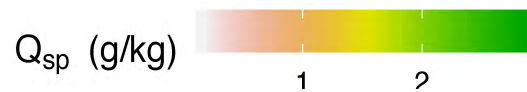
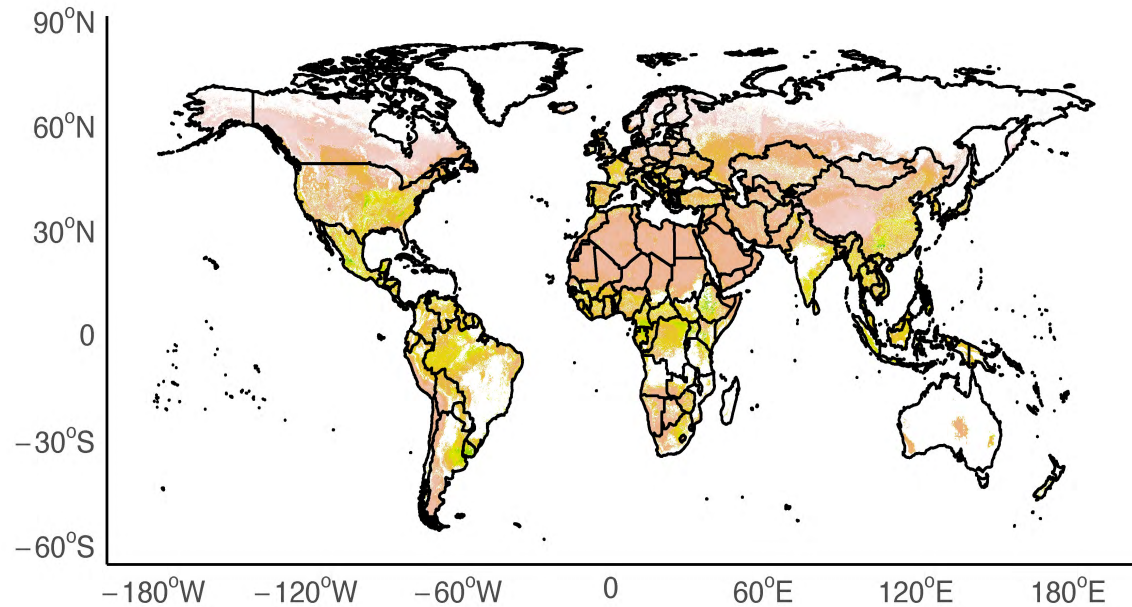
Dependent Variable	Predictor Variable	Inc. Node Purity
Q_{sp}	Clay (%)	75.55
	pH	62.70
	Soil Order	43.15
	MAT (°C)	67.91
	MAP (mm)	58.09
MSE = 0.68; R2 = 0.32		

B. Estimated Q_{max} at global scales using gridded maps of predictors from SoilGrids (250m aggregated to 10km) and WorldClim



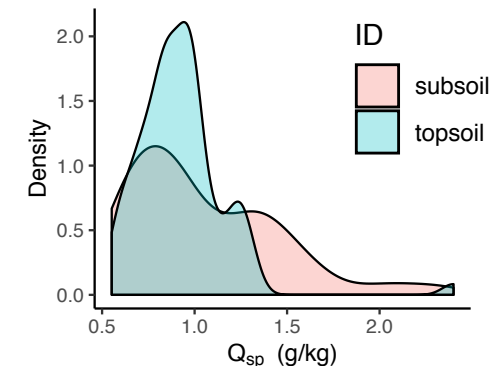
Results: DOC sorption potential/deficit (Q_{sp})

102 ± 13 Pg for 6 soil orders



- Sorption potential most strongly related to %Clay
- Threshold effect with pH

- Greater potential to add carbon to subsoil



Conclusions

- **DOC sorption potential is 102 ± 13 Pg representing a 7% increase in SOC stock**
- **C protected by sorption may be a small fraction of total mineral-associated soil C**
 - Protected C estimated from DOC sorption is not the same as “mineral-associated C” as measured by size and density fractionation
- **Mid-latitudes and subsoils have a greater capacity to sorb DOC**

