Supplementary Materials

Table S1: List of data sources for peat thickness, bulk density (BD), and carbon content (CC) across the globe.

Peat region	Sources	Data type	Data coverage	Thickness	Bulk Density	Carbon Content
Global	International Soil Carbon Network (Nave et al., 2022)	points	Global			x
	The World Soil Information Service (WoSIS)	points	Global		x	x
	Watmough et al. (2022)	points	Global	x		x
Northern	Deragon et al. (2022)	points	Eastern Canada	x	x	x
	GTK Finland	points*	Finland	x		
	Hugelius et al. (2020)	points	Northern peatland	x		
	Loisel et al. (2014)	points	Northern peatland	x	x	x
	Peatland ACTION (NatureScot)	points	Scotland	x		
	Rimondini et al. (2023)	map	Sweden	x		
	Sheng (2016)	points	Western Siberia	x		
	Soil Data NL (https://bodemdata.nl/downloads)	map	Netherlands	x		
	Toberman et al. (2016)	points	England	x	x	x
Tropic	Anshari et al. (2010)	points	Kalimantan, Indonesia		x	x
	Barus et al. (2021)	points	Papua, Indonesia	x		x
	Crezee et al. (2022)	points	Congo	x		
	Gani et al. (2021)	points	Papua, Indonesia	x	x	x
	Hastie et al. (2022)	points	Peru	x	x	x
	Lawson et al. (2023)	points	Peru	x		
	Ono et al. (2015)	points	Papua New Guinea	x		x
	Ruwaimana et al. (2020)	points	Southeast Asia	x		
	Sangok et al. (2020)	points	Malaysia	x	x	x
	Shimada et al. (2001)	points	Kalimantan, Indonesia	x	x	x
	The Sustainable Wetlands Adaptation and Mitigation Program (SWAMP)	points	Tropical	x	x	x
Southern	Pfeiffer et al. (2019)	points	Chile	x	x	x

*We only obtained about 2,000 out of 10,000 available points from the website.

Table S2: List of random forest hyperparameters that underwent optimization during model's training using RandomForestRegression function in Python.

Parameters	Description	Range
n_estimators	The number of trees in the forest.	400, 450, 500, 550, 600
max_features	The number of features to consider when looking for the best split.	None, 'sqrt'
max_samples	The number of samples to draw from the training dataset to train each base estimator.	0.5, 0.625, 0.75, None
min_samples_leaf	The minimum number of samples required to be at a leaf node. This may have the effect of smoothing the model, especially in regression.	3, 5, 7, 10

Table S3: Prediction accuracy of random forest models for each parameter during training. The value for each goodness metrics reflects the average accuracy of multiple models from the modelling scheme. The n is the amount of data for testing, RMSE = root mean square error (in parameter's unit), R^2 = coefficient of determinant (unitless).

Parameters	Unit	Peatland region	n	RMSE	R^2
Thickness	m	A—North America	1,425	1.10	0.65
		B—Europe and Russia	13,245	0.54	0.79
		C—Latin America	1,499	0.35	0.83
		D—Africa	122	0.57	0.86
		E—South and Southeast Asia	1,245	1.05	0.86
		F—Australia and New Zealand	577	0.52	0.89
		peat layers (cm depth)			
Bulk density	Mg m⁻³	0 - 15	9,544	0.05	0.84
		15 - 30	12,484	0.07	0.93
		30 - 60	9,460	0.06	0.87
		60 - 100	7,105	0.02	0.87
		100 - 200	6,698	0.02	0.84
Carbon content	g g⁻¹	0 - 15	5,198	0.05	0.90
		15 - 30	4,941	0.06	0.87
		30 - 60	2,727	0.08	0.75
		60 - 100	574	0.05	0.77
		100 - 200	393	0.06	0.75
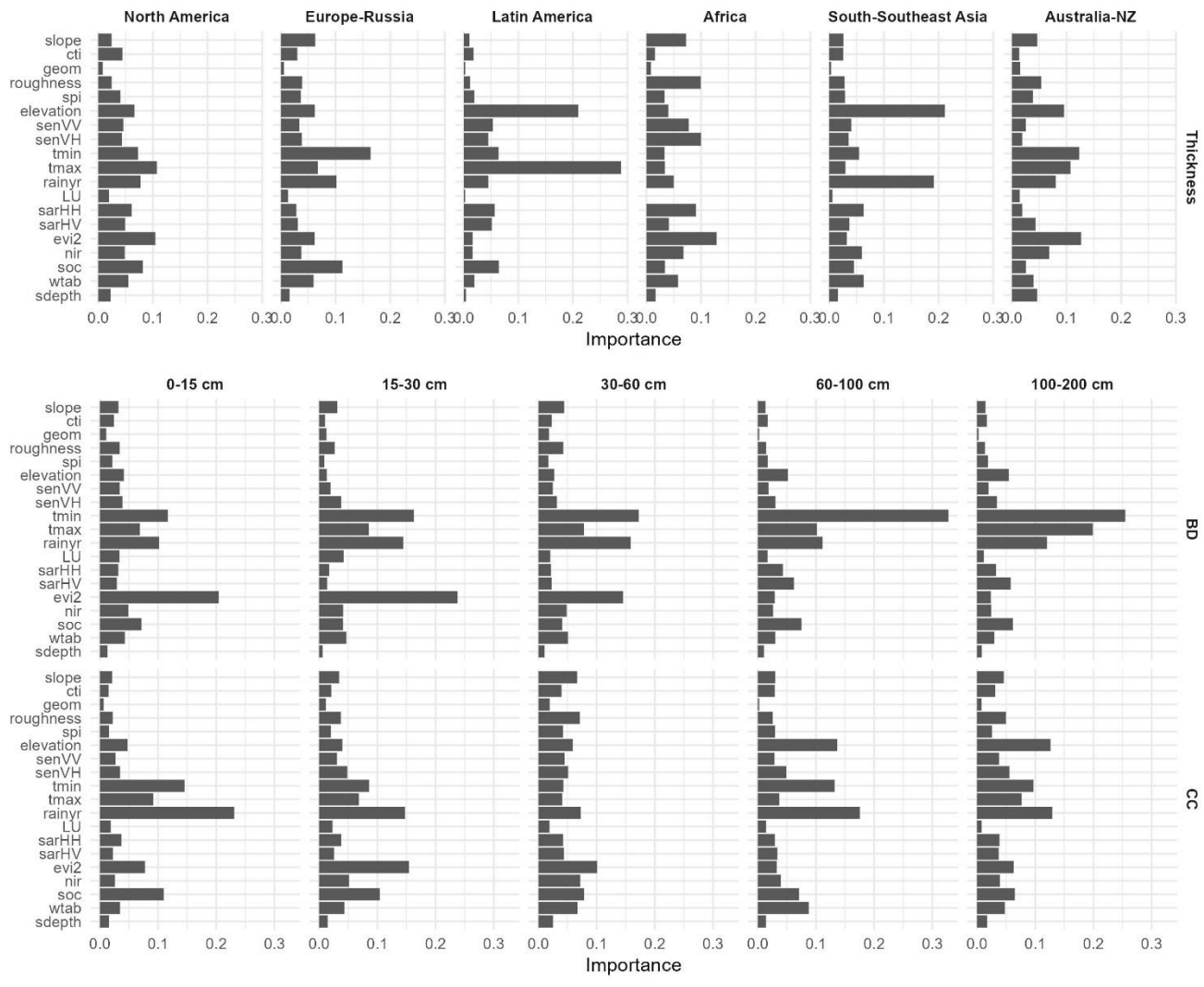
Figure S1: Variable importance of input features used in random forest models for each parameter in this work. Features in Y axis follow the bands order in Table 1. BD = Bulk Density, CC = Carbon Content.

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