Supplementary Information for

Global patterns and drivers of phosphorus pools in natural soils

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Table S1. Gridded data

Group	Variables	Brief description	Original resolution	Data source
Climate	Mean annual temperature	30-yr (1981 to 2010) annual average temperature	1 km	http://worldclim.org/bioclim
	Mean annual precipitation	30-yr (1981 to 2010) annual average precipitation	1 km	http://worldclim.org/bioclim
	Biomes	Potential Biomes	1 km	https://sedac.ciesin.columbia.edu
Soil	Total soil phosphorus	Total soil phosphorus concentration	50 km	https://doi.org/10.6084/m9.figshare.14583375
	Soil organic carbon	Soil organic carbon concentration	250 m	https://openlandmap.org
	Soil pH	Soil pH	250 m	https://openlandmap.org
	Soil clay	Soil clay content	250 m	https://openlandmap.org
	Soil sand	Soil sand content	250 m	https://openlandmap.org
	Soil order	Taxonomy soil order class	250 m	https://openlandmap.org
	Soil depth	Soil depth	10 km	http://globalchange.bnu.edu.cn/research/data
Topography	Elevation	Land surface elevation	250 m	https://openlandmap.org

Table S2. Representativeness of the soil P pool concentrations database.

	Global distribution	Our database
Soil orders		
Alfisols	9.90%	11.74%
Andisols	0.70%	3.07%
Aridisols	11.10%	4.63%
Entisols	15.60%	10.07%
Gelisols	18.40%	0.75%
Histosols	1.40%	3.77%
Inceptisols	16.30%	26.33%
Mollisols	7.40%	5.71%
Oxisols	5.80%	12.06%
Spodosols	4.90%	7.32%
Ultisols	6.60%	9.21%
Vertisols	2.00%	5.33%
Biomes		
Boreal forest	22.00%	4.82%
Desert	5.19%	3.04%
Grassland	22.32%	10.41%
Savanna	12.10%	10.51%
Temperate forest	17.62%	53.39%
Tropical forest	10.09%	10.14%
Tundra	10.67%	7.70%

Global data: USDA for soils order, and Hengl et al.'s potential biomes (2012) for biome. Global data were recalculated for a sum of 100%.

Table S3 Area-weighted average P pool concentrations and proportions in soils of different weathering stages. Results based on the global estimates for depths of 0-30 cm.

Weathering stage	Labile Pi	Labile Po	Moderately labile Pi	Moderately labile Po	Primary P	Occluded P
Concentration (mg kg^{-1})						
Slight	40.0	39.5	70.4	167.3	116.6	228.3
Intermediate	29.1	24.9	42.6	88.1	123.7	197.9
Strong	28.5	31.3	47.7	103.3	54.8	198.0
Proportion of total P (%)						
Slight	6.0	5.9	10.2	23.3	18.2	36.4
Intermediate	5.7	4.9	8.4	17.0	24.0	39.9
Strong	6.1	6.7	10.3	21.2	11.4	44.4

Table S4 Area-weighted average P pool concentrations and proportions in different biomes. Results based on the global estimates at depths of 0-30 cm.

Biome	Labile Pi	Labile Po	Moderately labile Pi	Moderately labile Po	Primary P	Occluded P
Concentration (mg kg^{-1})						
Tundra	54.9	54.9	102.1	251.5	141.5	260.2
Boreal forest	53.6	55.2	98.6	256.2	102.7	251.0
Temperate forest	33.8	32.4	53.2	116.7	87.9	211.1
Tropical forest	25.0	27.2	40.0	83.7	63.5	204.3
Savanna	24.5	22.2	38.9	74.9	88.1	189.2
Grassland	27.4	20.0	34.5	70.3	165.3	185.7
Desert	27.7	22.5	31.6	58.5	214.7	171.3
Proportion of total P (%)						
Tundra	6.3	6.3	11.8	29.1	16.4	30.1
Boreal forest	6.6	6.8	12.1	31.3	12.6	30.7
Temperate forest	6.3	6.5	9.3	20.9	21.7	35.4
Tropical forest	5.6	6.1	9.0	18.9	14.3	46.0
Savanna	5.6	5.1	8.9	17.1	20.1	43.2
Grassland	5.4	4.0	6.9	14.0	32.8	36.9
Desert	5.3	4.3	6.0	11.1	40.8	32.5

Table S5. Comparison of P pool concentrations between our estimates and estimates by Yang *et al*. (2013).

	Labile Pi	Organic P	Moderately labile Pi	Primary P	Occluded P
Median					
He	29.9	157.6	46.1	95.6	215.8
Yang	27.9	69.4	26.8	89.1	104.0
Mean					
He	34.4	195.2	62.9	111.2	213.3
Yang	33.5	85.4	30.6	117.5	115.6

Figure S1. Comparison of site-level Hedley P pool measurement distributions between our database and Yang et al.'s (2013). Our database (A) contains 1838 observations, while Yang et al. (2013) (B) contains 178.

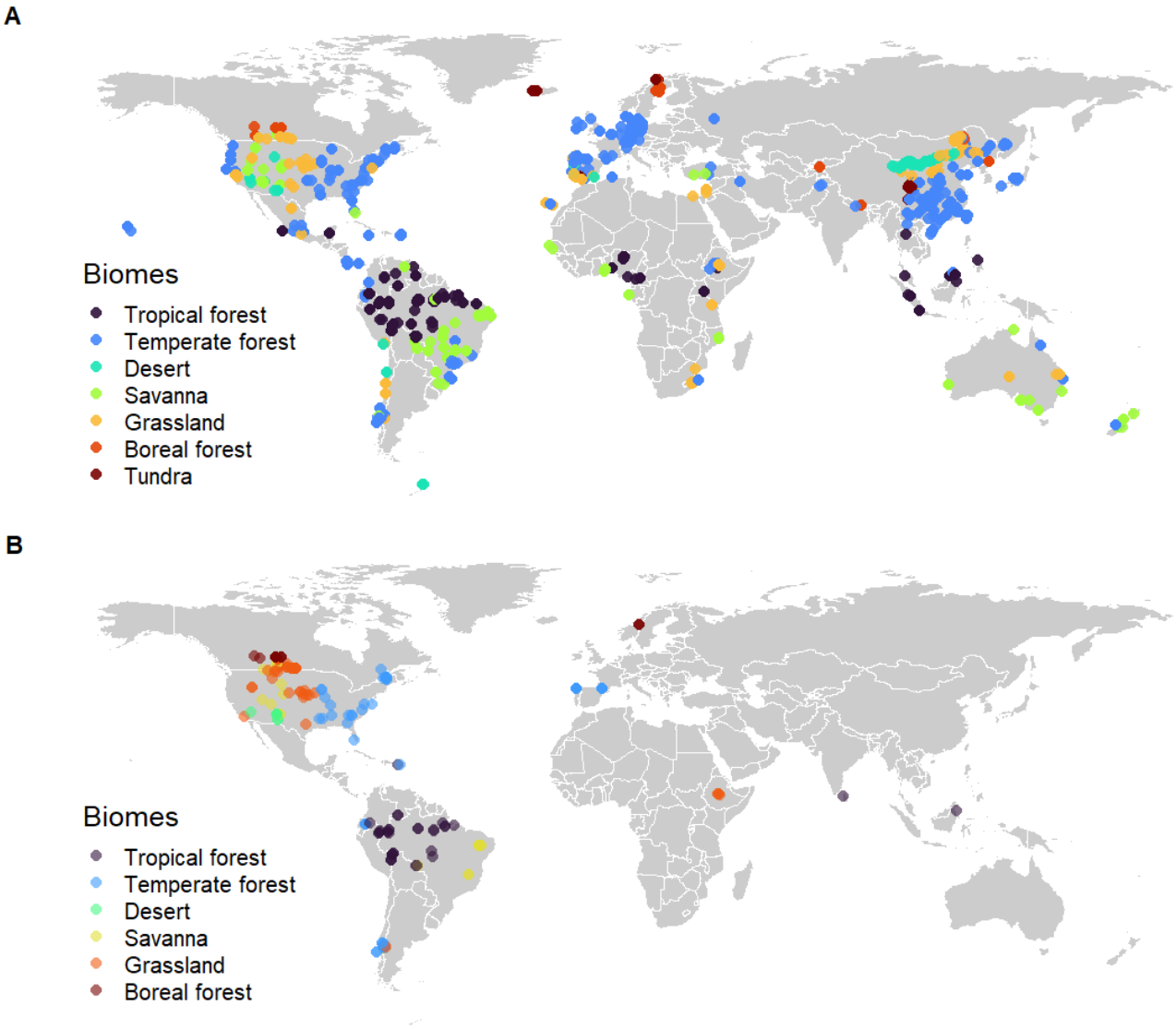

Figure S2. PRISMA flow diagram showing the procedure used for selection of studies for synthesis.

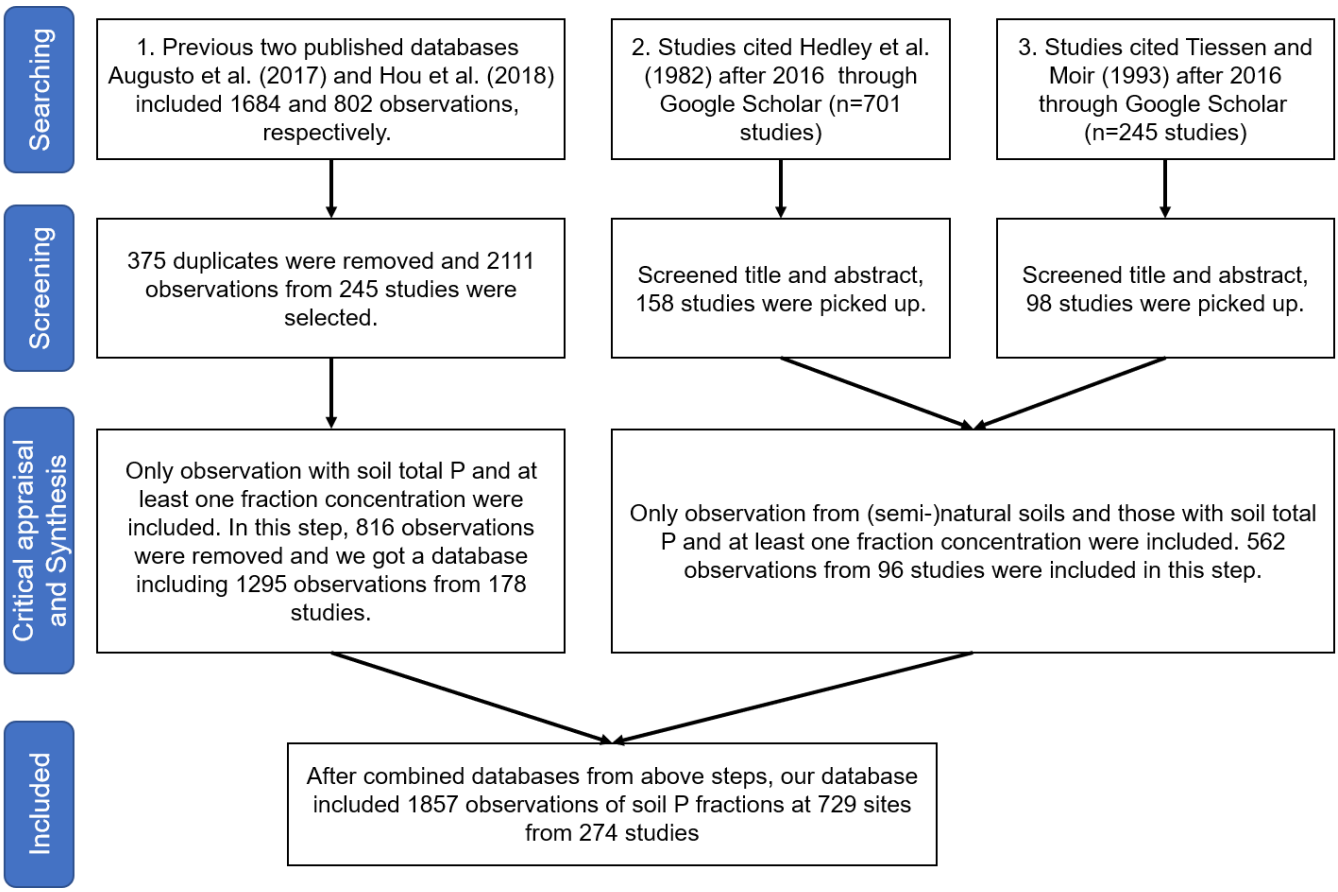

Figure S3. Flow chart of soil P fractionation. The flow chart follows the procedures outlined by Hedley et al. (1982) and Tiessen and Moir (1993). Redrawn according to Hou et al. (2018).

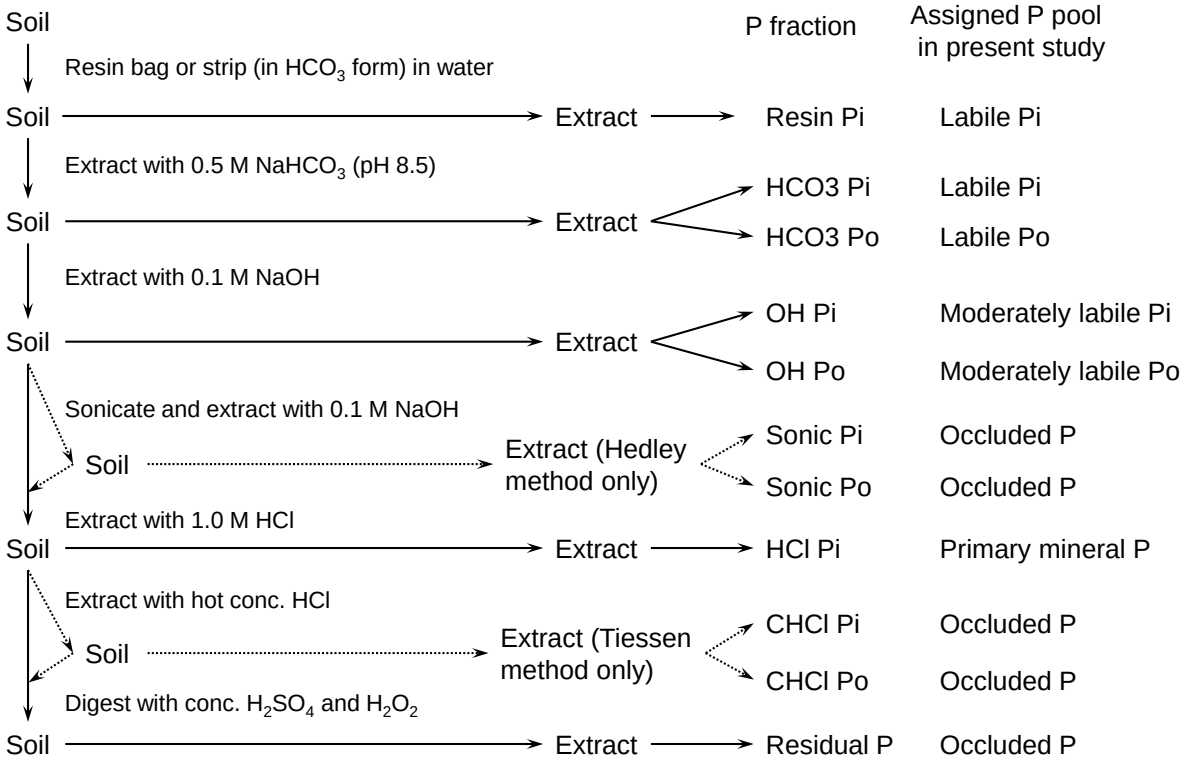

Figure S4. Average P pool concentrations and proportions of total P concentration across weathering stage and biome. Labile Po and moderately labile Po are combined into the organic pool. Results based on 1857 observations.

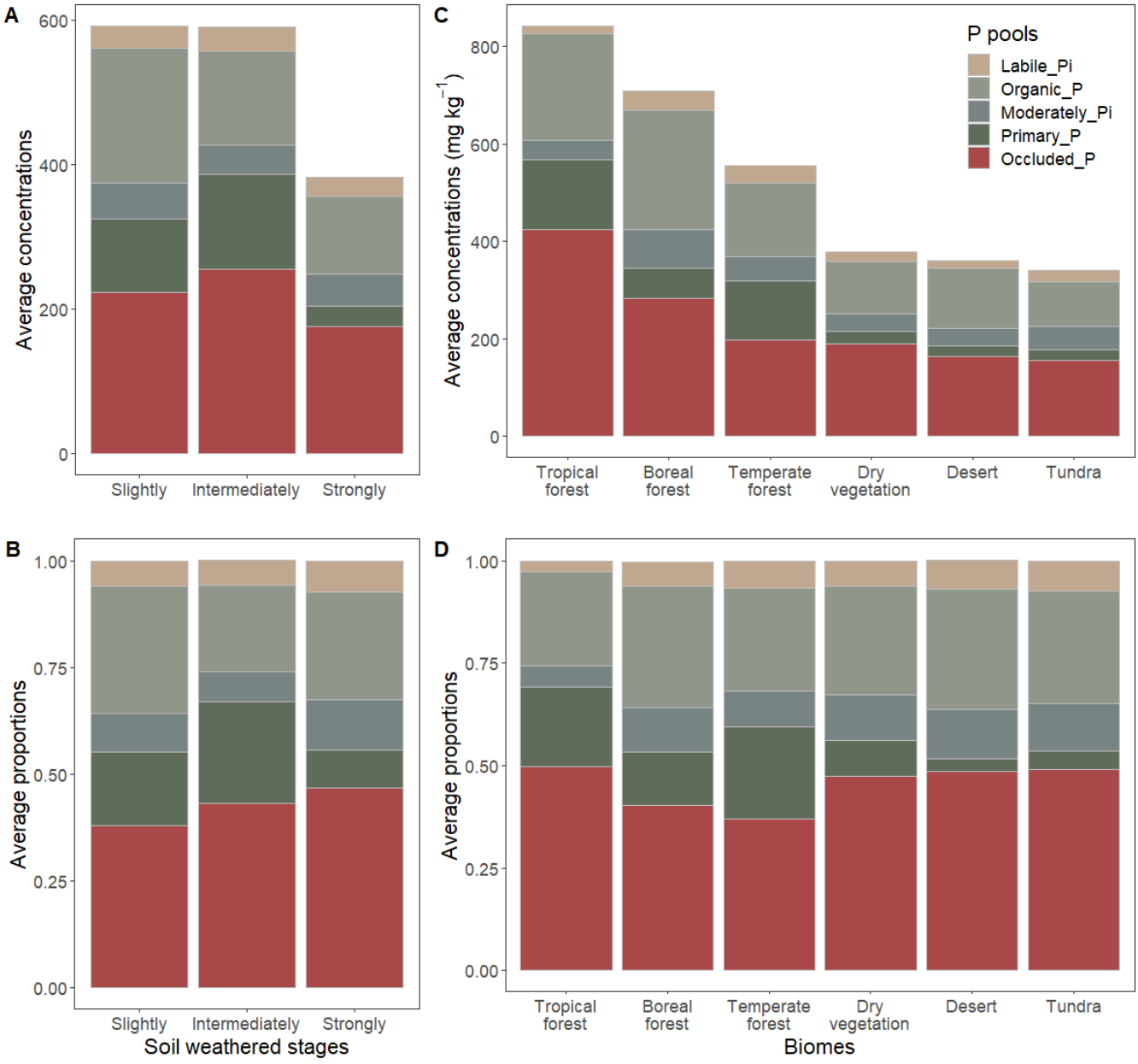

Figure S5. Histogram plots of different P pool concentrations. We only included values falling in the interval between 1% and 99% in these plots.

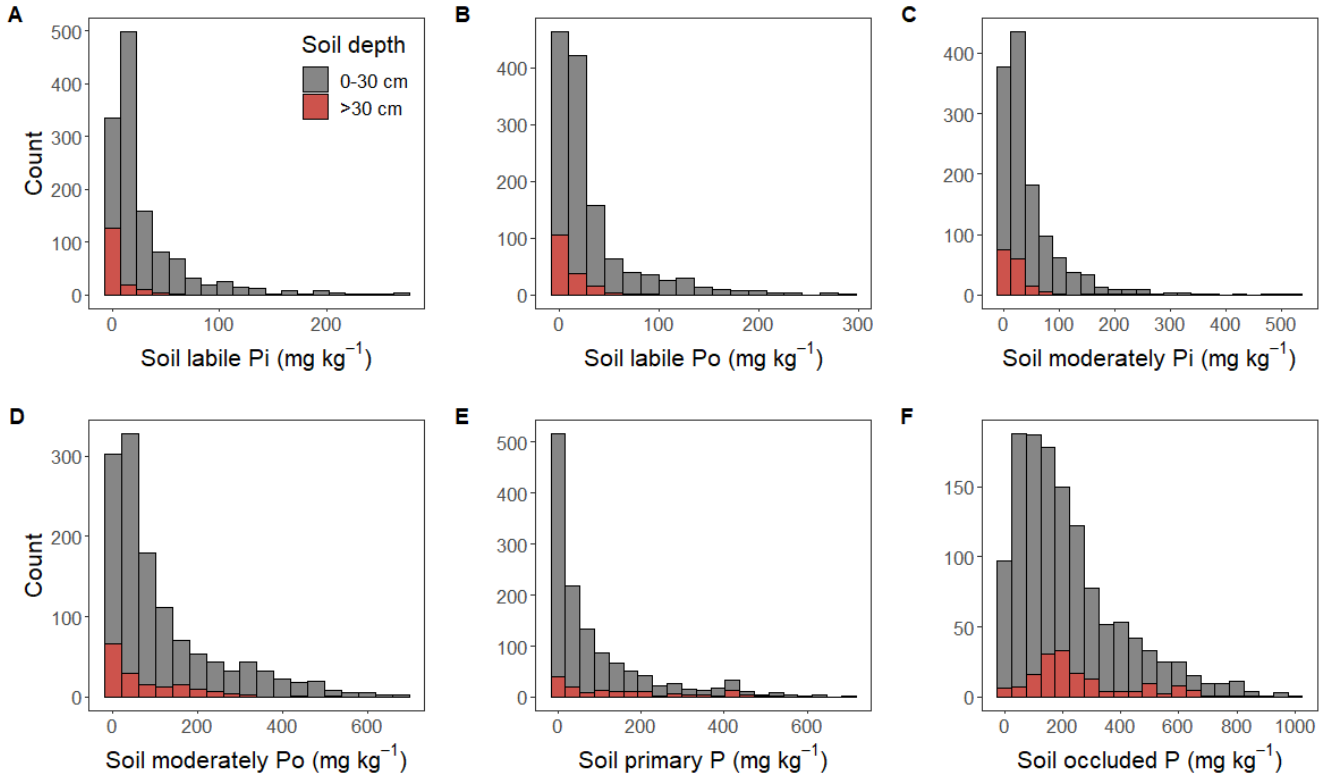

Figure S6. Histogram plots of different P pool proportions. We only included values falling in the interval between 1% and 99% in these plots.

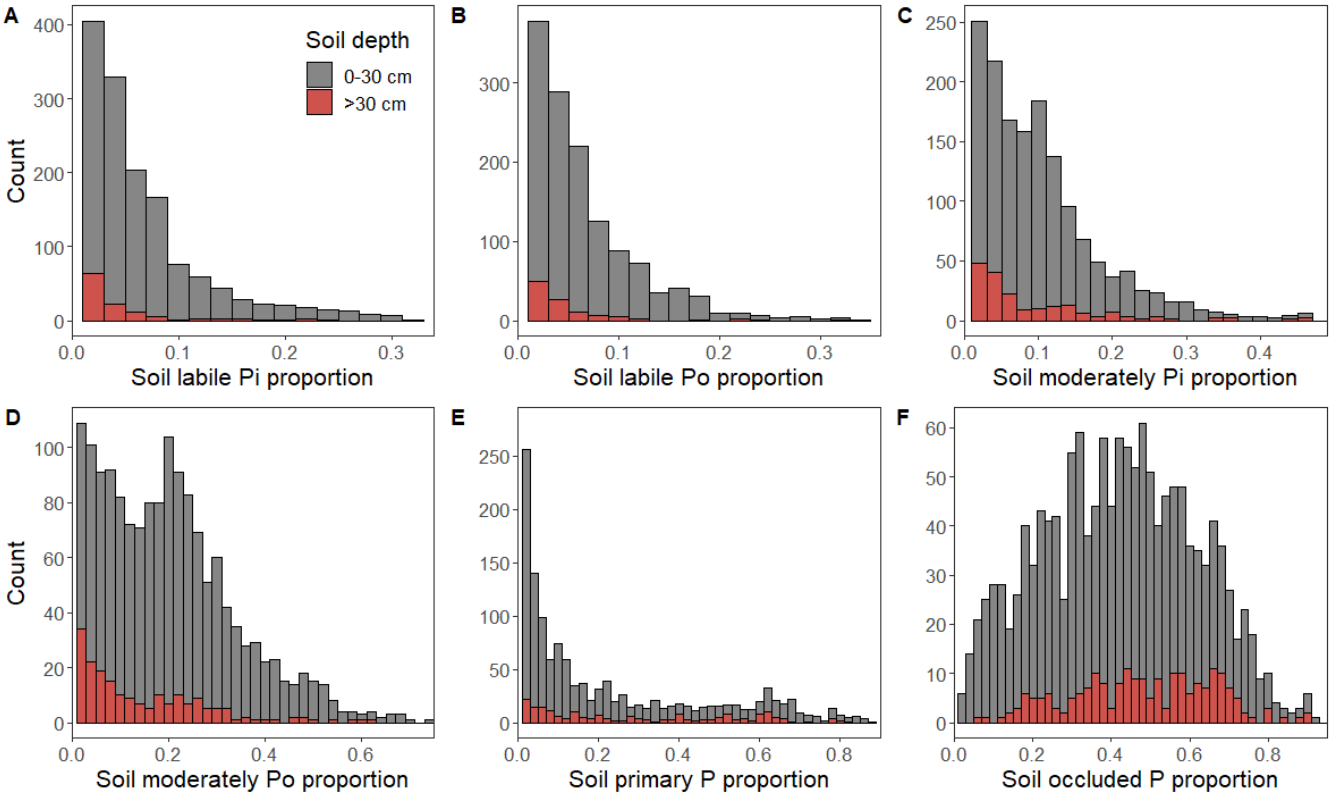

Figure S7. Correlations between proportions predicted by random forest models and those calculated by predicted concentration divided by total P concentration.

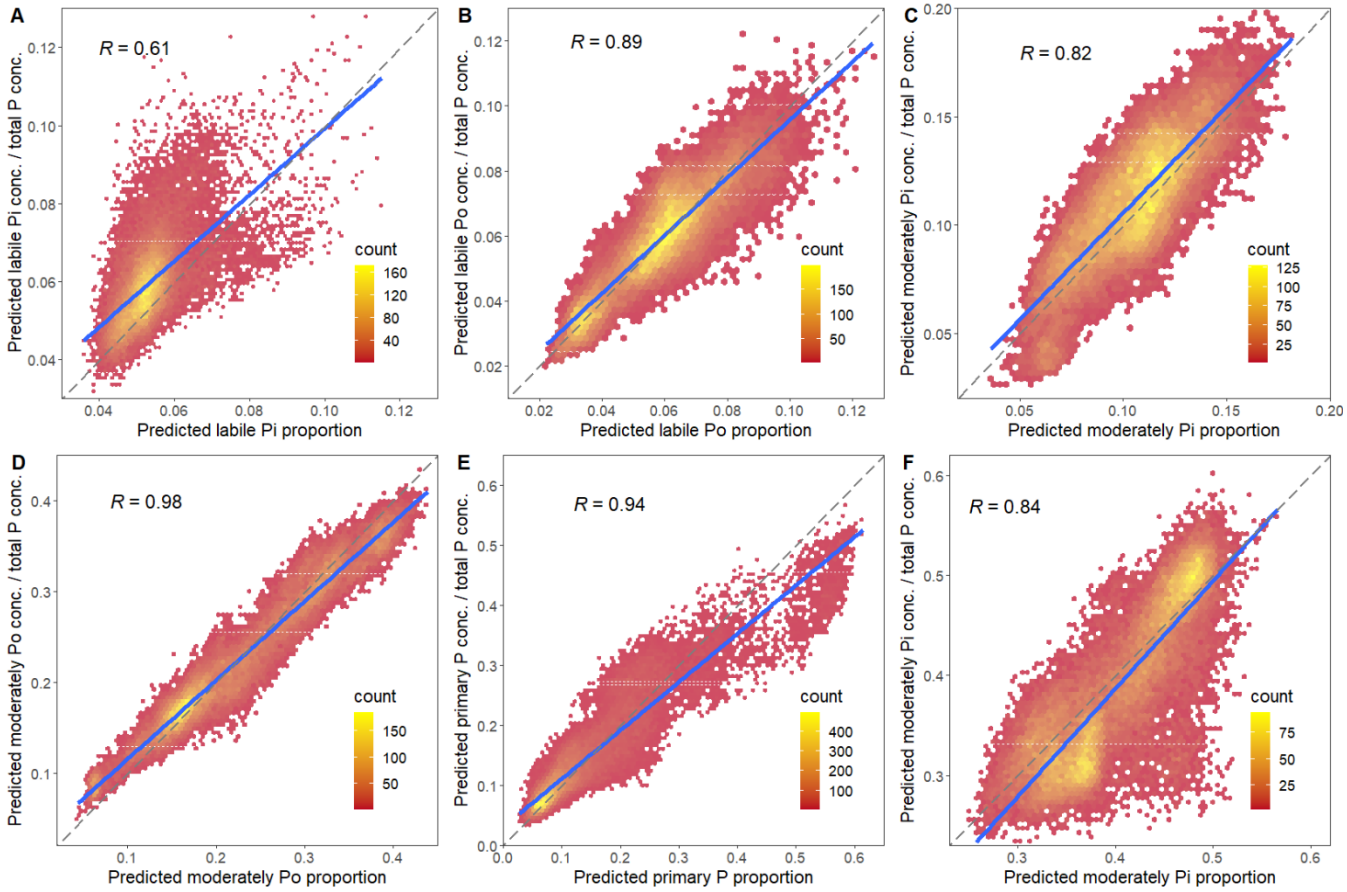

Figure S8. Yang et al. (2013)'s predictions of different P pool concentrations.

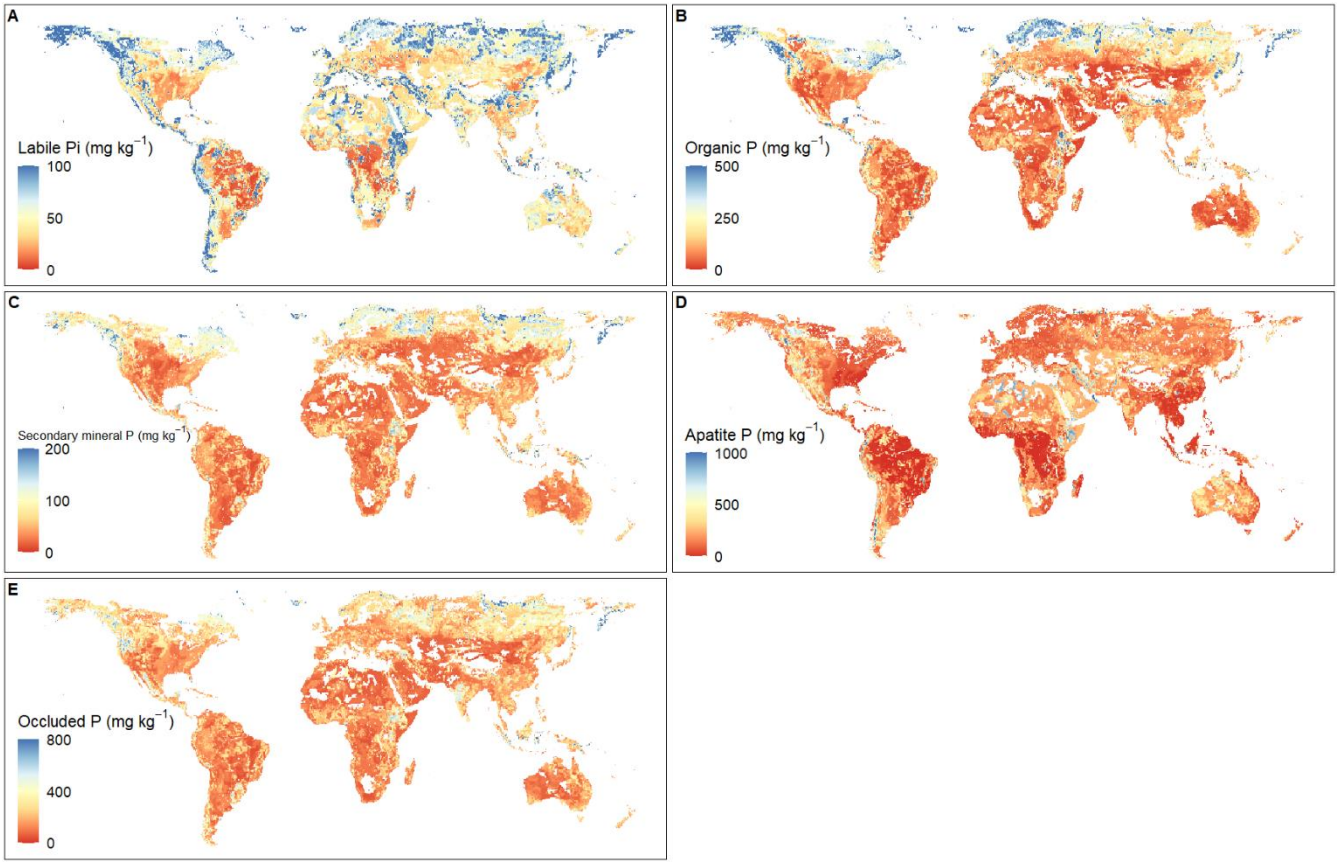

Figure S9. Relationship between our predicted P fraction concentrations and Yang et al.'s predictions. Panels A, B, C, D, E, and F depict correlations between both sets of predictions for soil labile Pi, organic P, primary mineral P, moderately labile Pi, and occluded P, respectively. Dashed lines indicate the 1:1 line; blue lines indicate the regression line.

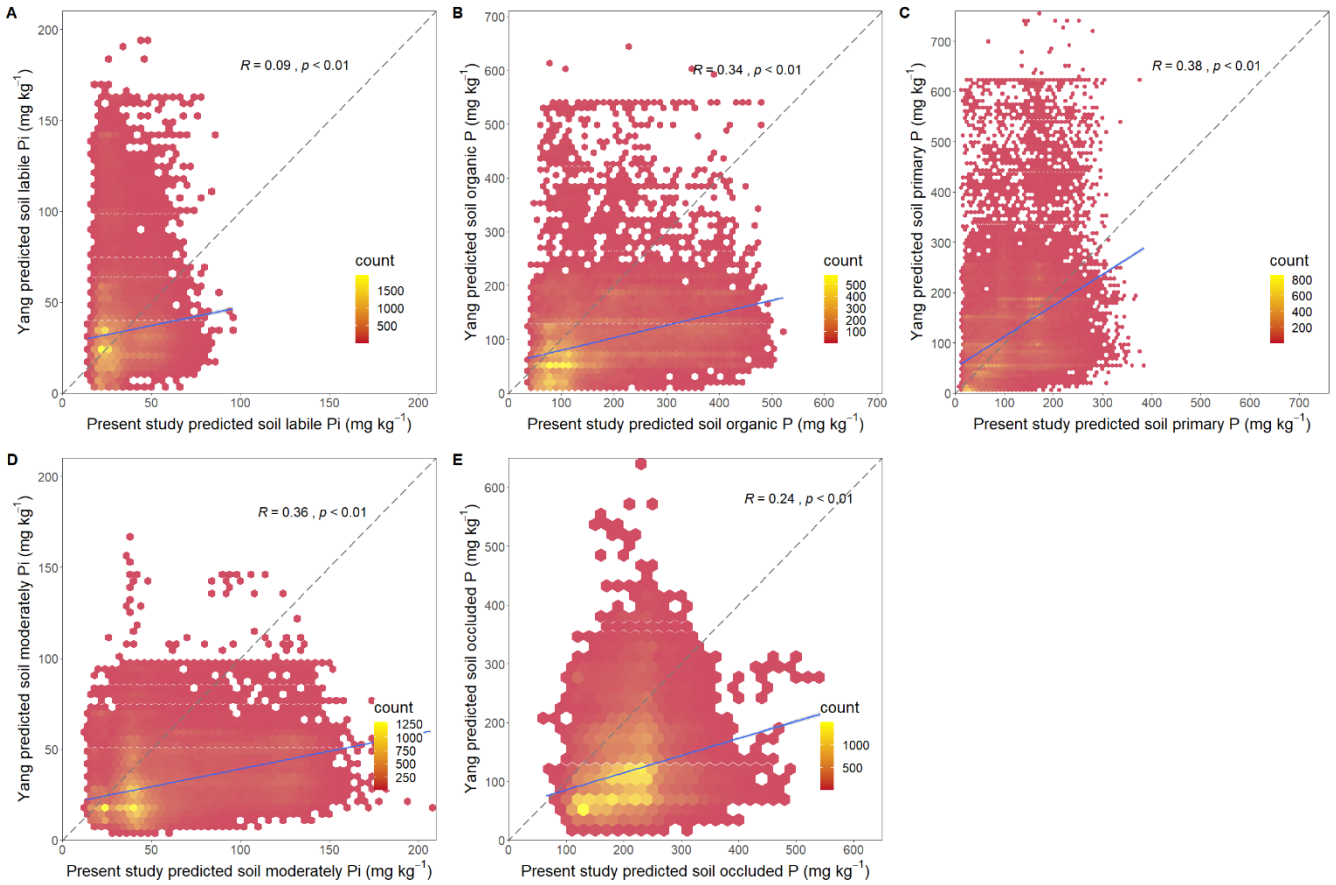

Figure S10. Standard error of predicted different P pool concentrations. Panels A, B, C, D, E, F indicate the standard error of the soil labile Pi, labile Po, moderately labile Pi, moderately labile Po, primary mineral P, and occluded P pools, respectively.