

Table S1 Importance of optimal bands and spectral indices for SOM estimation using single-temporal images.

Year	Date	Single band	Spectral indices	
2016	10-20	Variables	B ₇ , B ₈ , B ₁₁ , B ₄ , B ₁₂	D ₄₁₂ , D ₈₄ , D ₁₂₈ , D ₄₇ , ND ₁₁₈
		Importance	336.71, 328.24, 96.50, 74.17, 61.61	455.53, 162.44, 67.58, 54.40, 312.46
	11-16	Variables	B ₁₁ , B _{8a} , B ₅ , B ₁₂ , B ₈	D ₁₂₅ , D _{58a} , D _{88a} , D _{8a12} , D ₅₈
		Importance	476.27, 297.36, 112.38, 107.95, 33.56	551.24, 127.12, 68.86, 61.05, 27.94
2018	10-17	Variables	B ₆ , B ₇ , B ₈ , B _{8a} , B ₁₁	D ₆₁₁ , D _{8a6} , D ₆₈ , D ₇₆ , ND _{78a}
		Importance	348.58, 348.15, 283.30, 245.17, 197.24	537.17, 31.56, 28.98, 28.56, 26.63
	11-16	Variables	B ₄ , B ₁₂ , B _{8a} , B ₈ , B ₇	D ₁₂₄ , D ₄₈ , D _{78a} , R ₈₇ , ND ₇₈
		Importance	248.63, 155.23, 153.07, 150.11, 127.04	613.57, 160.87, 126.04, 123.01, 119.94
2020	10-16	Variables	B ₇ , B ₁₁ , B ₅ , B ₄ , B ₁₂	D ₁₂₄ , D ₄₁₁ , D ₇₄ , D ₁₁₁₂ , ND ₄₁₁
		Importance	386.12, 333.98, 233.06, 189.96, 119.91	558.52, 182.89, 146.22, 129.00, 121.43
	11-15	Variables	B ₈ , B ₇ , B _{8a} , B ₄ , B ₆	D _{8a4} , D ₈₄ , D ₇₄ , R ₈₆ , ND ₈₆
		Importance	478.48, 285.98, 260.81, 227.11, 181.71	581.16, 119.15, 100.02, 99.94, 93.07

Table S2. Statistical results of the three different modelling algorithms using single-temporal images based on full spectrum data and the optimum bands and spectral indices in 2016, 2018, and 2020.

Modelling strategies	Year	Period	Full Spectrum					Optimum bands and spectral indices				
			Calibration		Validation			Calibration		Validation		
			R^2_{cal}	$RMSE_{cal}$	R^2_{val}	$RMSE_{val}$	$RPIQ_{val}$	R^2_{cal}	$RMSE_{cal}$	R^2_{val}	$RMSE_{val}$	$RPIQ_{val}$
PLS	2016	10-20	0.38	3.59	0.32	3.16	2.18	0.47	2.87	0.40	2.81	2.45
		11-16	0.43	3.13	0.37	3.00	2.30	0.54	2.50	0.46	2.66	2.59
	2018	10-17	0.43	3.15	0.38	2.98	2.31	0.54	2.52	0.46	2.66	2.59
		11-16	0.38	3.4	0.34	3.07	2.24	0.48	2.72	0.43	2.73	2.52
	2020	10-16	0.39	3.31	0.36	3.02	2.28	0.49	2.65	0.44	2.65	2.60
		11-15	0.42	3.19	0.38	3.00	2.30	0.53	2.55	0.47	2.63	2.62
	2016	10-20	0.43	3.04	0.36	2.98	2.31	0.51	2.58	0.45	2.65	2.60
		11-16	0.47	2.87	0.38	2.97	2.32	0.55	2.44	0.47	2.64	2.61
	2018	10-17	0.51	2.55	0.45	2.70	2.55	0.60	2.17	0.55	2.40	2.87
		11-16	0.44	2.98	0.38	2.96	2.33	0.52	2.53	0.47	2.63	2.62
GWR	2020	10-16	0.45	2.93	0.40	2.88	2.39	0.53	2.49	0.49	2.56	2.69
		11-15	0.49	2.62	0.43	2.84	2.43	0.5	2.23	0.5	2.52	2.73

RF	2016	10-20	0.44	2.8	0.40	2.83	2.44	0.5 3	2.52	0.5 0	2.67	2.58
		11-16	0.52	2.46	0.44	2.68	2.57	0.5 8	2.21	0.5 4	2.53	2.72
	2018	10-17	0.55	2.34	0.50	2.48	2.77	0.6 2	2.11	0.6 1	2.35	2.93
		11-16	0.53	2.49	0.47	2.53	2.72	0.5 9	2.24	0.5 7	2.39	2.88
	2020	10-16	0.49	2.73	0.43	2.69	2.56	0.5 4	2.46	0.5 3	2.54	2.71
		11-15	0.54	2.38	0.48	2.51	2.74	0.6 0	2.14	0.5 8	2.37	2.91

Table S3. Analysis of variance in the $RMSE_{val}$ values of double-temporal images and regression models based on the optimal bands and spectral indices.

Source of Variation	Sum of the squares	Degrees of freedom	Mean square	F -value	p -Value
Double-temporal images	0.097	2	0.049	5.445	0.012
Statistical models	0.052	2	0.026	1.597	0.045

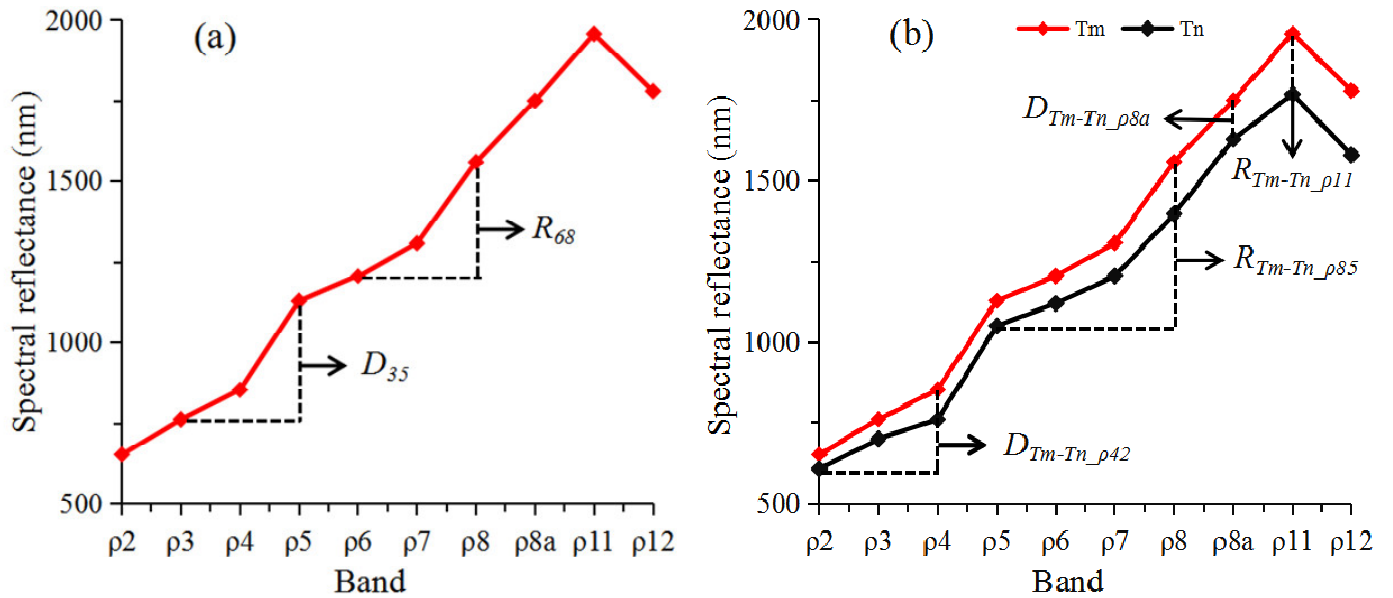


Figure S1. Illustration of the spectral indices constructed by (a) single-temporal images and (b) multitemporal images.

Notes: The spectral reflectance is the value after the original spectral reflectance is expanded by a factor of 10,000. D_{35} is the difference in spectral reflectance between band 3 and band 5. R_{68} is the spectral reflectance ratio between band 6 and band 8. T_m and T_n indicate the date of image acquisition. $D_{T_m-T_n_{\rho 7}}$ is the difference of band 7 in different periods. $D_{T_m-T_n_{\rho 42}}$ is the difference between band 4 of T_m and band 2 of T_n . $R_{T_m-T_n_{\rho 11}}$ is the ratio of band 11 in different periods. $R_{T_m-T_n_{\rho 85}}$ is the ratio of band 8 of T_m to band 5 of T_n .

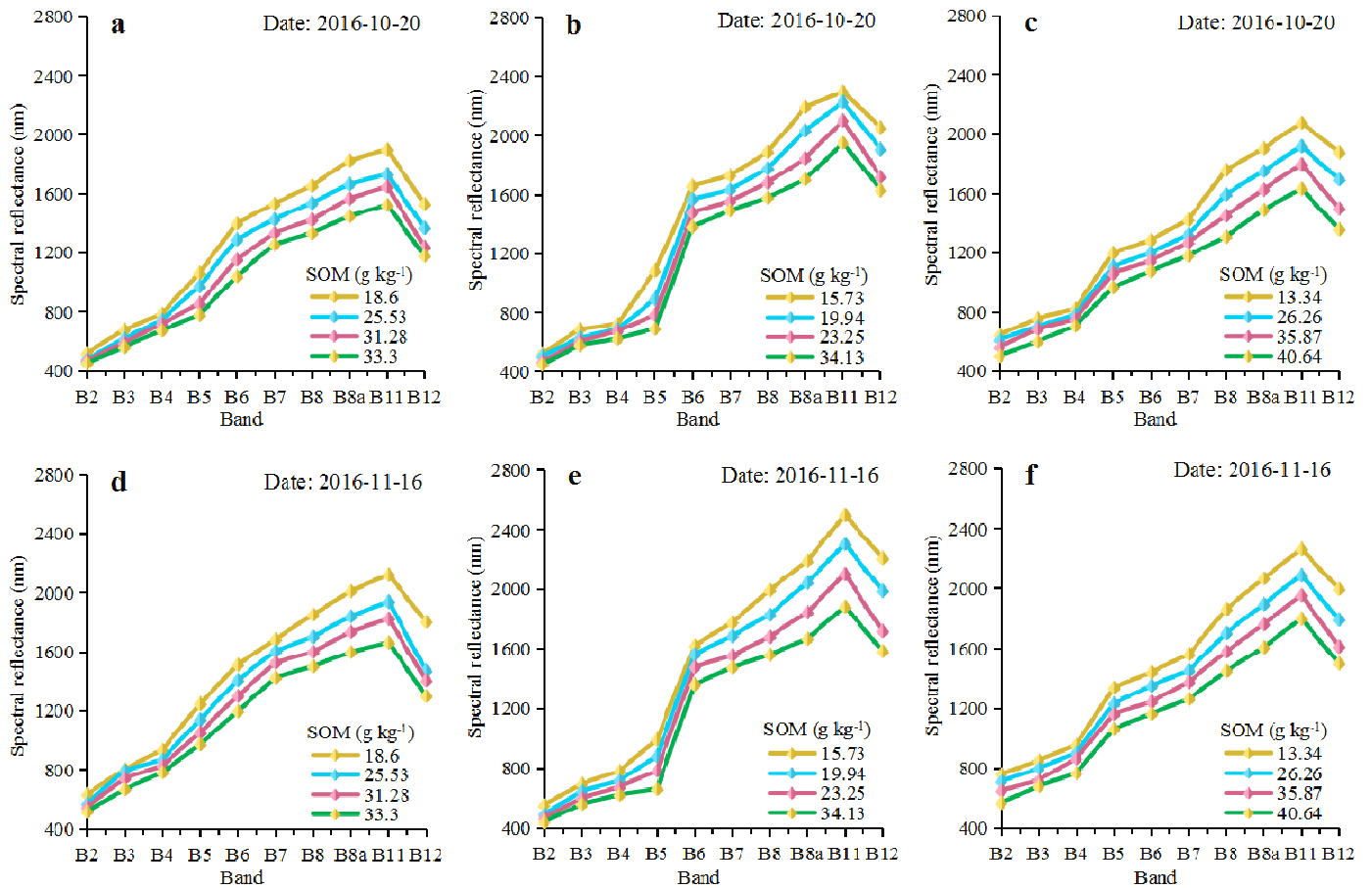


Figure S2. Spectral reflectance data for different soil types with different SOM contents in the same period in 2016: (a) and (d) fluvo-aquic soils; (b) and (e) yellow-brown earths; (c) and (f) paddy soils.

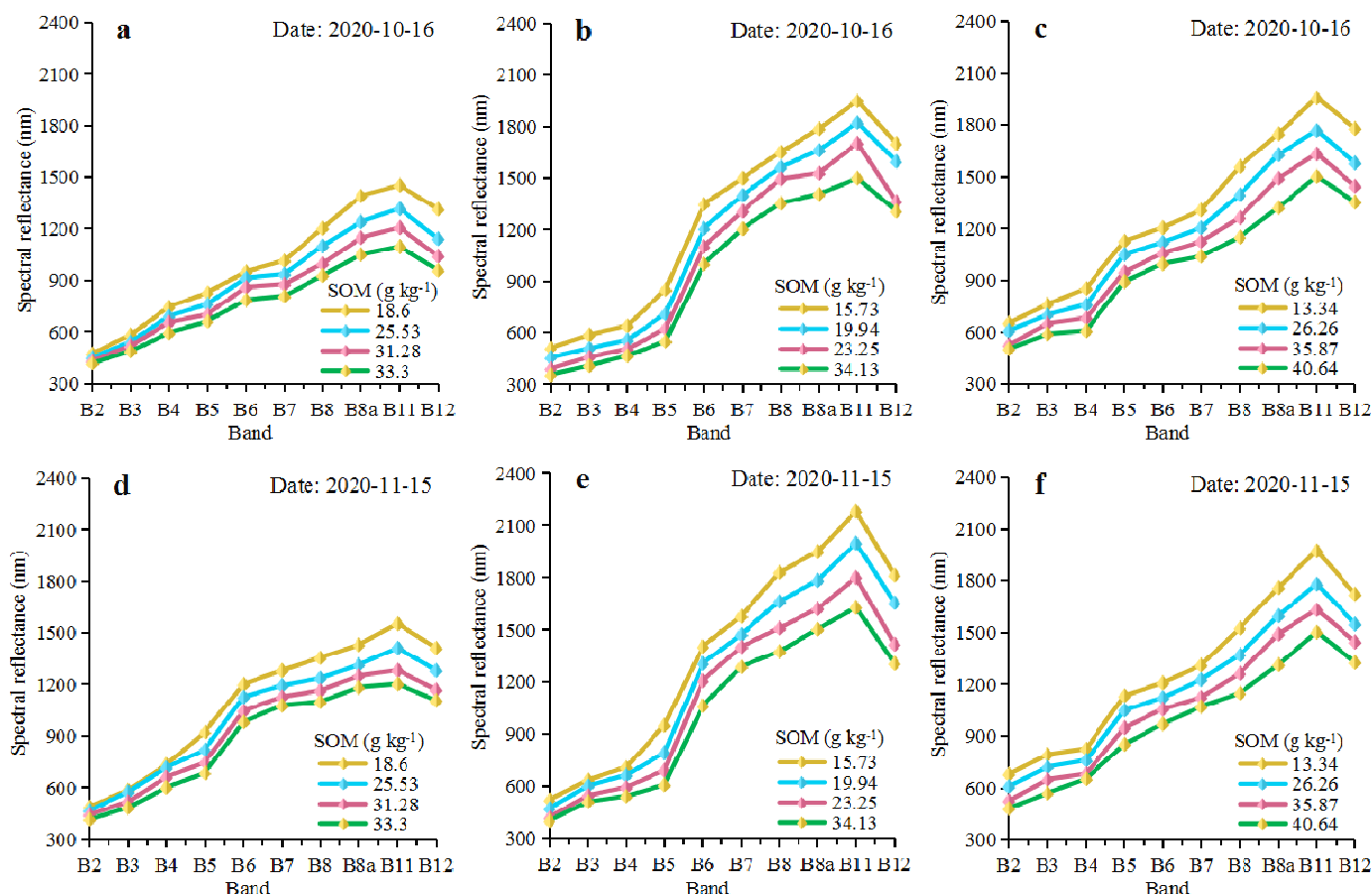


Figure S3. Spectral reflectance data for different soil types with different SOM contents in the same period in 2020: (a) and (d) fluvo-aquic soils; (b) and (e) yellow-brown earths; (c) and (f) paddy soils.

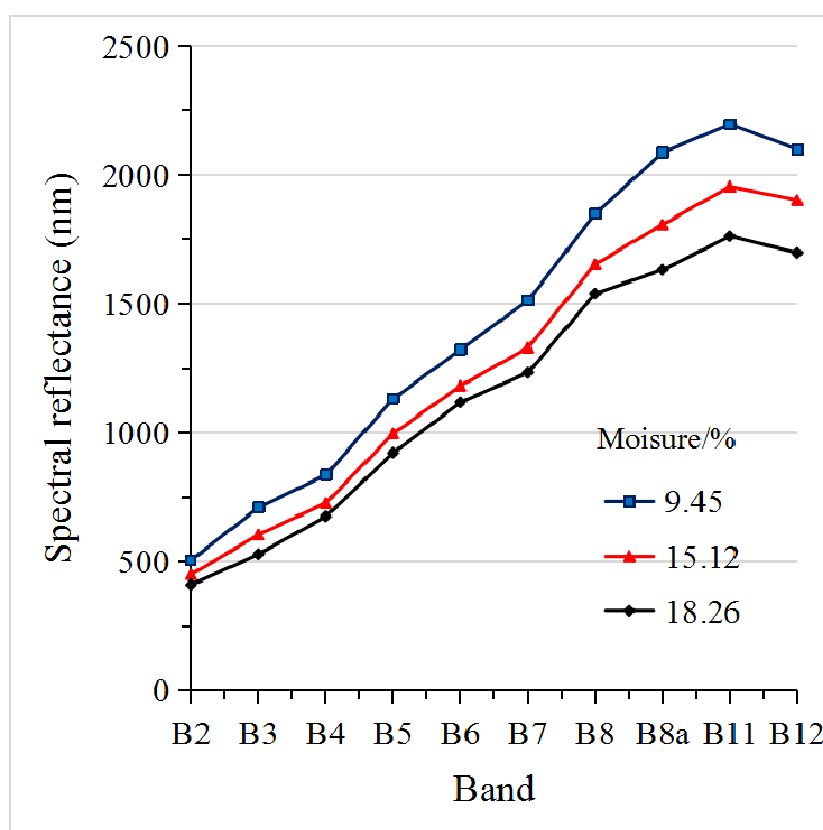


Figure S4. Soil spectral curves for the same SOM content at different moisture contents.

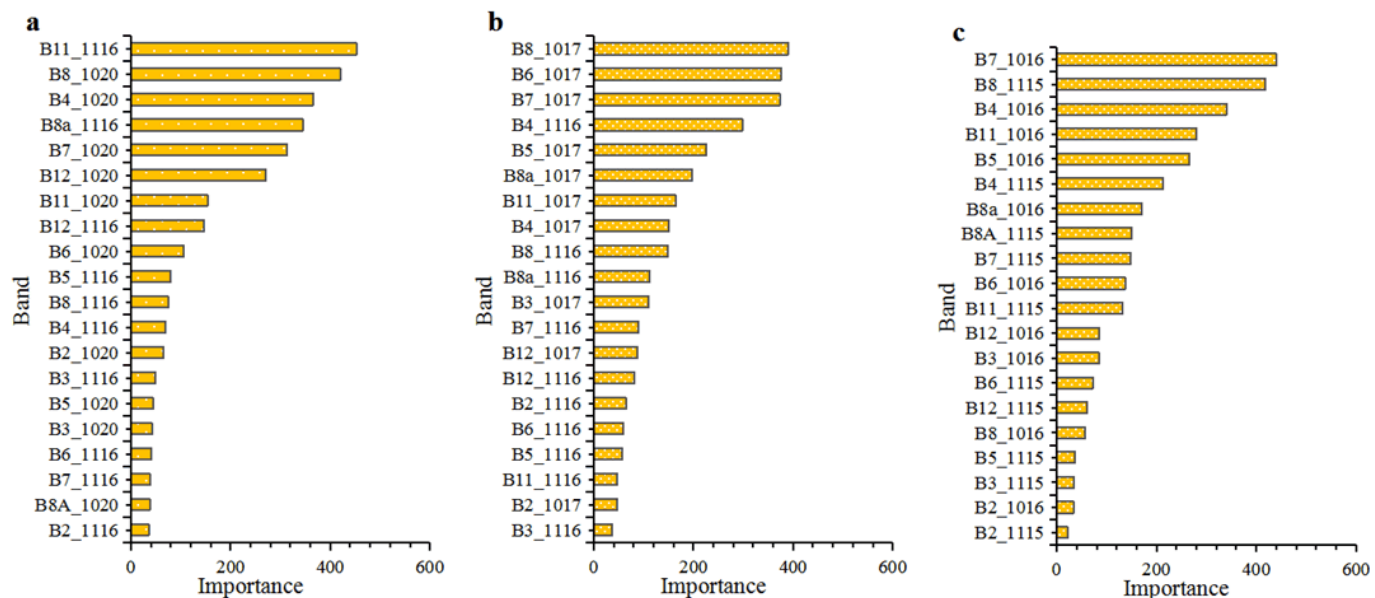


Figure S5. Importances of the bands in the SOM estimation model based on double-temporal images: (a) 2016; (b) 2018; (c) 2020.