Table S1 Nadir BRDF-adjusted reflectance (NBAR) bands, indices, and multi-temporal metrics derived from the 10-day Sentinel-2 analysis-ready data. Metric names are shown in brackets. Two sets of metrics of basic statistics, average values, standard deviation, and amplitude were calculated from 1) 10-day time-series observations ranked by individual NBAR band or index and 2) 10-day time-series observations ranked by NDVI values.

NBAR bands and indices	Blue, Green, Red, Red-Edge1, Red-Edge2, Red-Edge3, NNIR, NIR, SWIR1, SWIR2, NDVI, SWSW
Basic statistics	second maximum (smax)
	second minimum (smin)
	median (p50)
	10th, 25th, 75th, 90th percentiles (p10, p25, p75, p90)
Average between	p90 and smax (av90smax)
	p75 and smax (av75smax)
	p50 and smax (av50smax)
	p25 and p75 (av2575)
	smin and p90 (avsmin90)
	smin and p25 (avsmin25)
	smin and p10 (avsmin10)
Standard Deviation between	p90 and smax (std90smax)
	p75 and smax (std75smax)
	p50 and smax (std50smax)
	p25 and p75 (std2575)
	smin and p90 (stdsmin90)
	smin and p25 (stdsmin25)
	smin and p10 (stdsmin10)
Amplitude between	smax and smin (ampsmaxamin)
	p75 and p25 (amp7525)
	smax and p50 (ampsmax50)
	p50 and smin (amp50smin)
	smax and p75 (ampsmax75)
	p25 and smin (amp25smin)

Table S2 Maize and soybean stratification for field survey, from 2019 to 2022. PSU: primary sampling unit; SSU: secondary sampling unit; H: high stratum; M: medium stratum; L: low stratum; T: total.

Year	Stratum	Maize/soy pixel coverage	Number of blocks	Number of PSUs	Number of SSUs	PSU size	SSU size
2019	High	50%	1,301	30	20 * 30	20 km × 20 km	30 m × 30 m
	Medium	40%	2,378	30	20 * 30		
	Low	9.9%	3,680	30	20 * 30		
	Total	99.9%	7,359	90	1,800		
2020	High	50%	1,321	30	20 * 30	20 km × 20 km	30 m × 30 m
	Medium	40%	2,388	30	20 * 30		
	Low	9.9%	3,709	30	20 * 30		
	Total	99.9%	7,418	90	1,800		
2021	High	50%	1,395	35	20 * 35	20 km × 20 km	30 m × 30 m
	Medium	40%	2,592	40	20 * 40		
	Low	9.9%	3,715	25	20 * 25		
	Total	99.9%	7,702	100	2,000		
2022	High	50%	1,407	35	20 * 35	20 km × 20 km	10 m × 10 m
	Medium	40%	2,592	37	20 * 37		
	Low	9.9%	3,722	25	20 * 25		
	Total	99.9%	7,721	92	1,840		

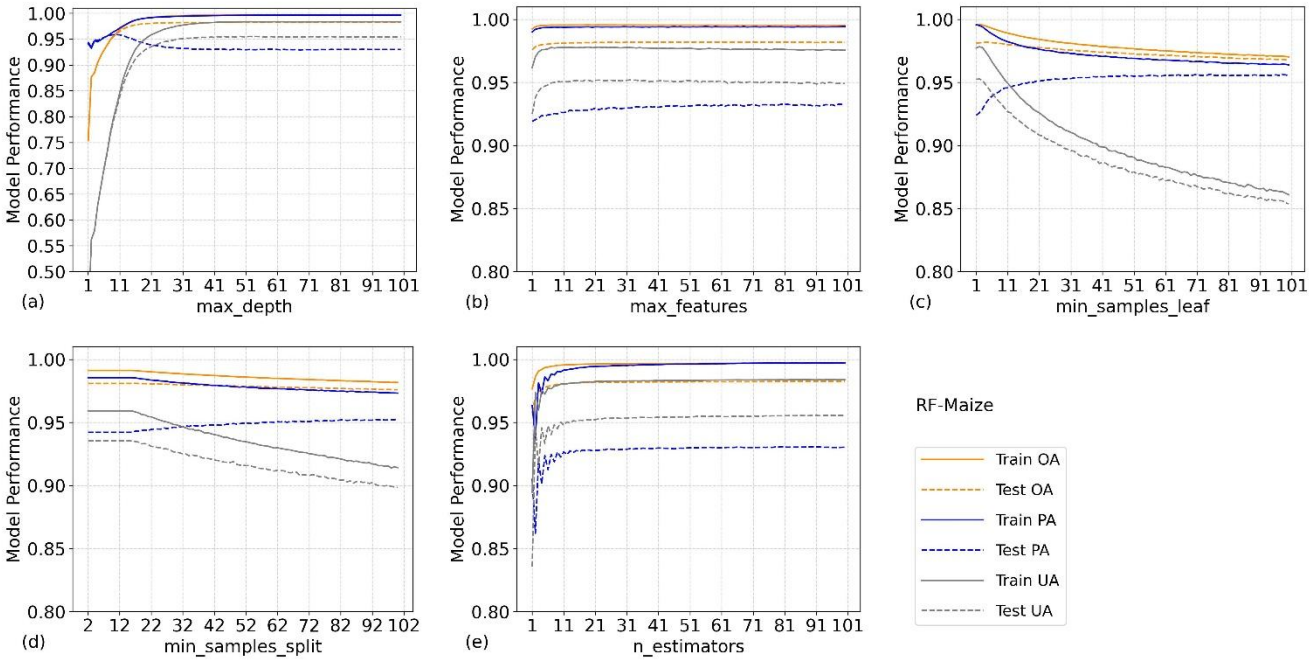

Figure S1 Hyper-parameters fine-tuning for RF-Maize. (a) max_depth: the maximum depth of a tree; (b) max_features: the number of features to consider when looking for the best split; (c) min_samples_leaf: the minimum number of samples required to be at a leaf node; (d) min_samples_split: the minimum number of samples required to split an internal node; (e) n_estimators: the number of trees in a forest. OA: Overall Accuracy; PA: Producers' Accuracy; UA: Users' Accuracy.

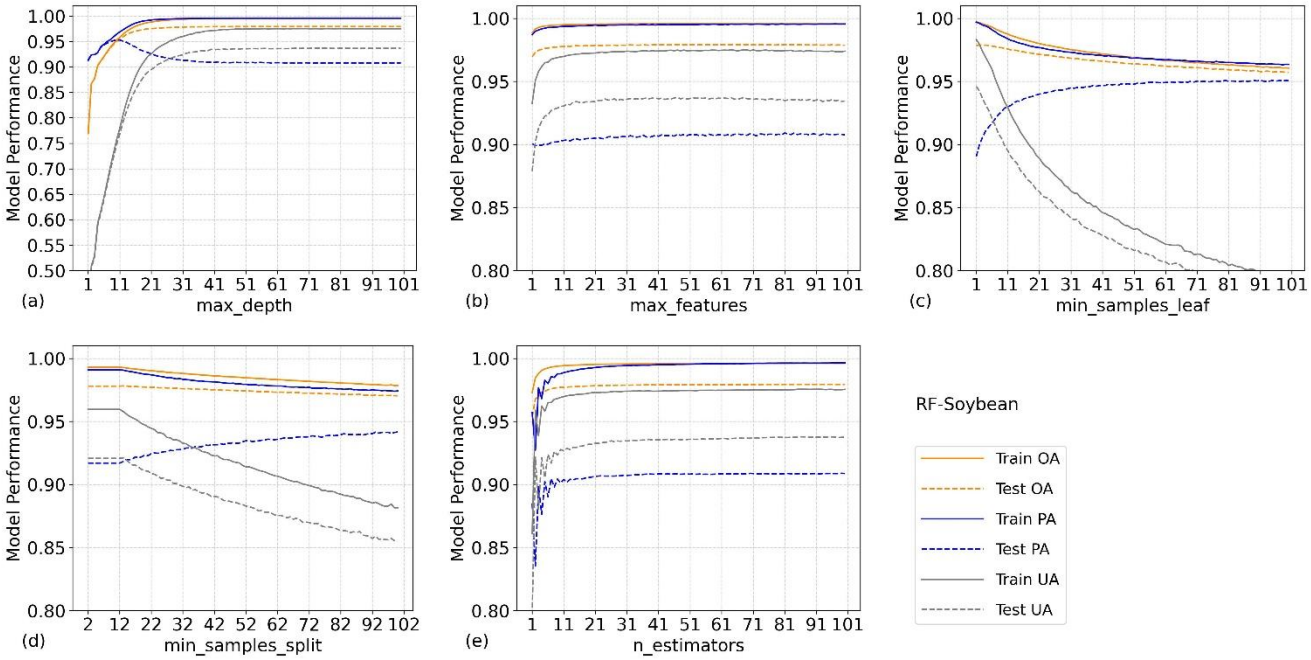

Figure S2: Hyper-parameters fine-tuning for RF-Soybean. (a) max_depth: the maximum depth of a tree; (b) max_features: the number of features to consider when looking for the best split; (c) min_samples_leaf: the minimum number of samples required to be at a leaf node; (d) min_samples_split: the minimum number of samples required to split an internal node; (e) n_estimators: the number of trees in a forest. OA: Overall Accuracy; PA: Producers' Accuracy; UA: Users' Accuracy.

Table S3 Fine-tuned hyper-parameters for RF-Maize and RF-Soybean models.

Hyper-parameter	RF-Maize	RF-Soybean
Max_depth	30	50
Max_features	28	34
Min_samples_leaf	8	6
Min_samples_split	10	10
N_estimators	50	50

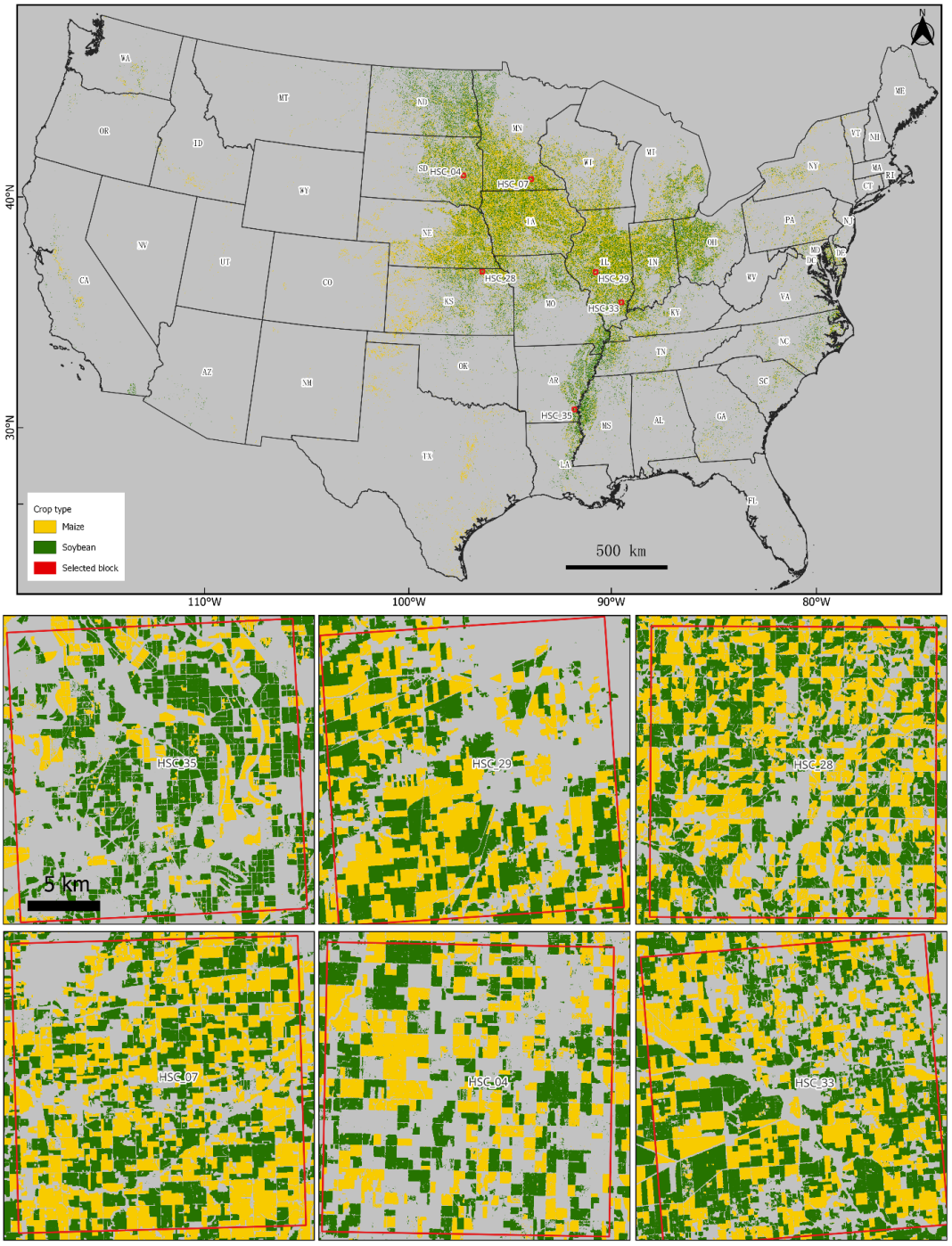

Figure S3: The selected 20 km × 20 km primary sampling units (PSU) blocks used to derive NDVI and multi-temporal metrics for maize and soybean pixels. The maize and soybean map for 2022 is shown. The PSU blocks HSC_35, HSC_29, HSC_28, HSC_07, and HSC_04 are used to derive single-year data for 2022. The PSU block HSC_33 is used to derive four-year data from 2019 to 2022.

Table S4 The selected 20 km × 20 km primary sampling units (PSU) blocks used to derive NDVI for maize and soybean pixels. The PSU blocks HSC_35, HSC_29, HSC_28, HSC_07, and HSC_04 are used to derive single-year data for 2022. The PSU block HSC_33 is used to derive four-year data from 2019 to 2022.

PSU ID	Stratum	Location	Center coordinates	Maize pixels	Soybean pixels
HSC_35	High	Arkansas	(91.374° W, 33.570° N)	390,039	1,229,816
HSC_29	High	Illinois	(89.725° W, 39.690° N)	12,73,135	1,218,699
HSC_28	High	Kansas	(96.449° W, 39.870° N)	1,395,915	1,397,590
HSC_07	High	Minnesota	(93.406° W, 44.010° N)	1,704,091	1,409,508
HSC_04	High	South Dakota	(97.679° W, 44.190° N)	1,045,399	1,134,050
HSC_33	High	Illinois	(88.350° W, 38.250° N)	390,039	1,229,816