Figure S1. Crop maps at 10 m resolution of ten EU countries for 2018.
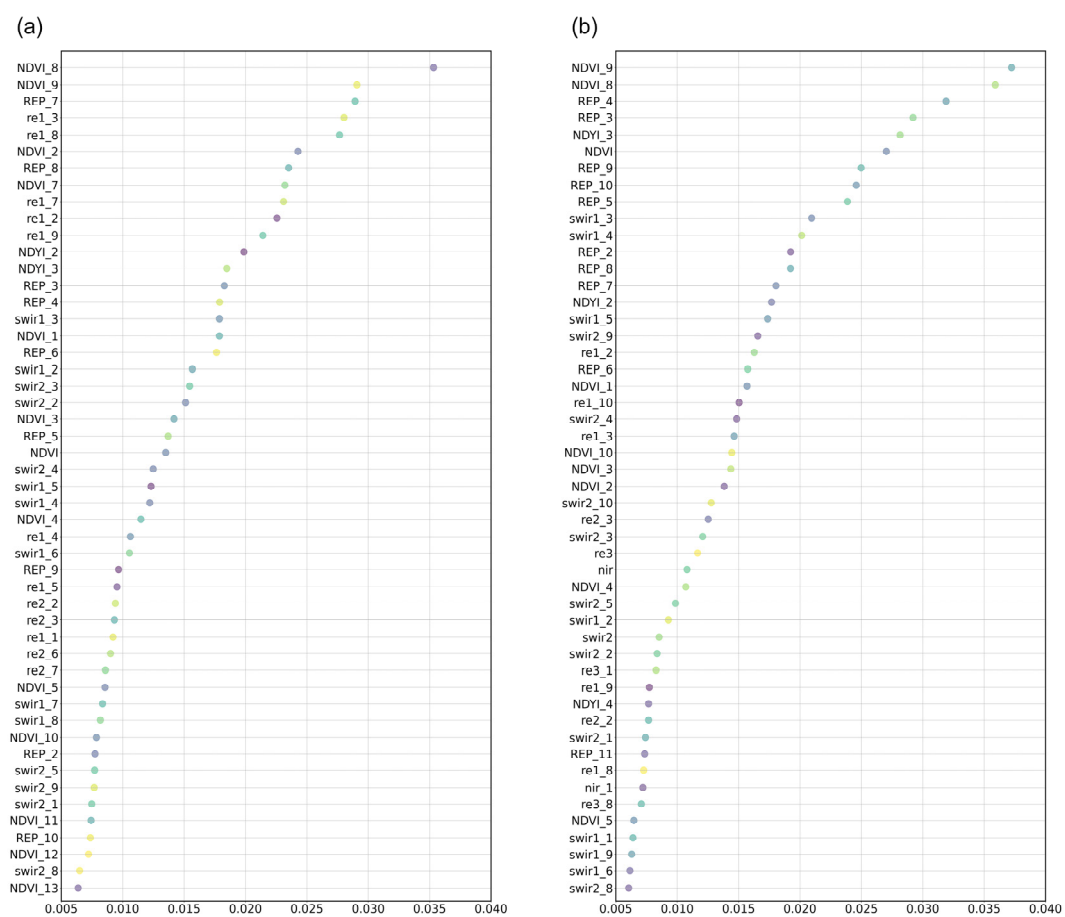
Figure S2. Feature importance values for the tope of 50 variables from random forest models in 2018 (a) and 2019 (b).
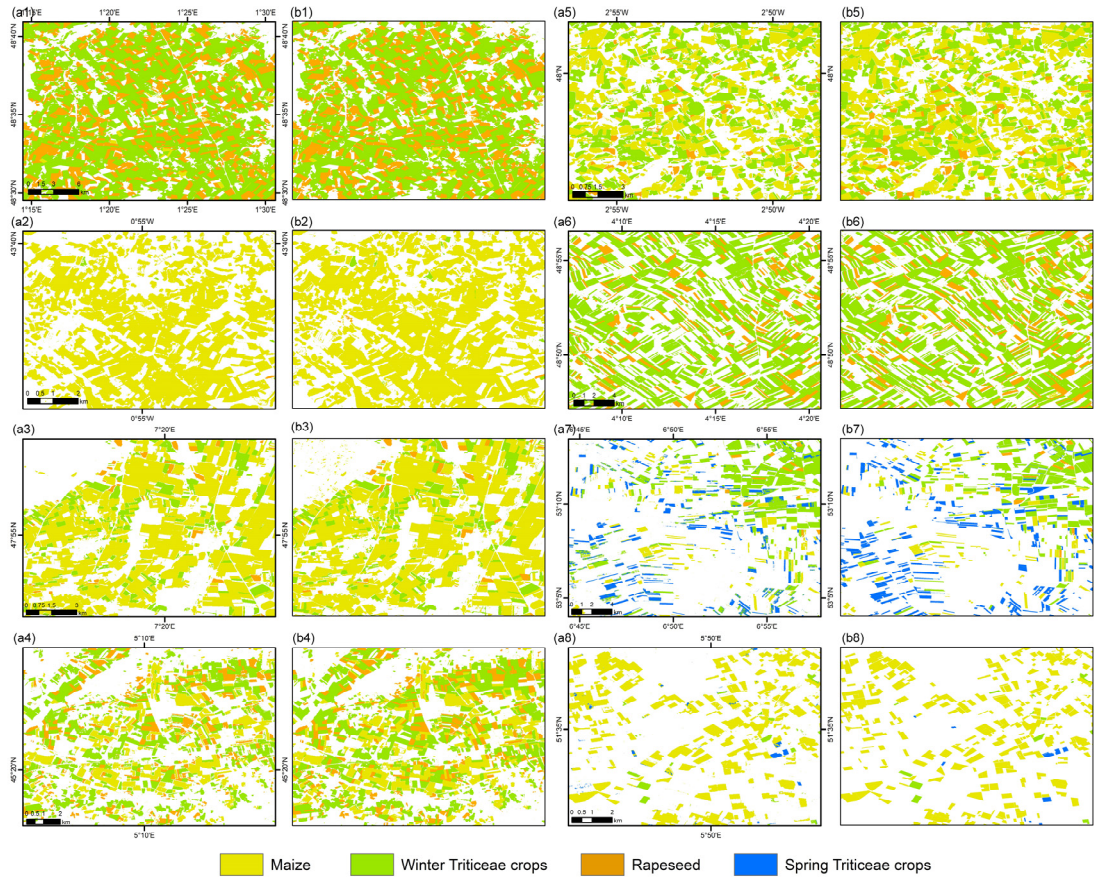
Figure S3. Visual comparison between our final crop maps (a1-a8) and existing reference datasets in 2018 for France (b1-b6) and Netherlands (b7-b8). For France, winter and spring Triticeae crops was concluded as a single category (green color).
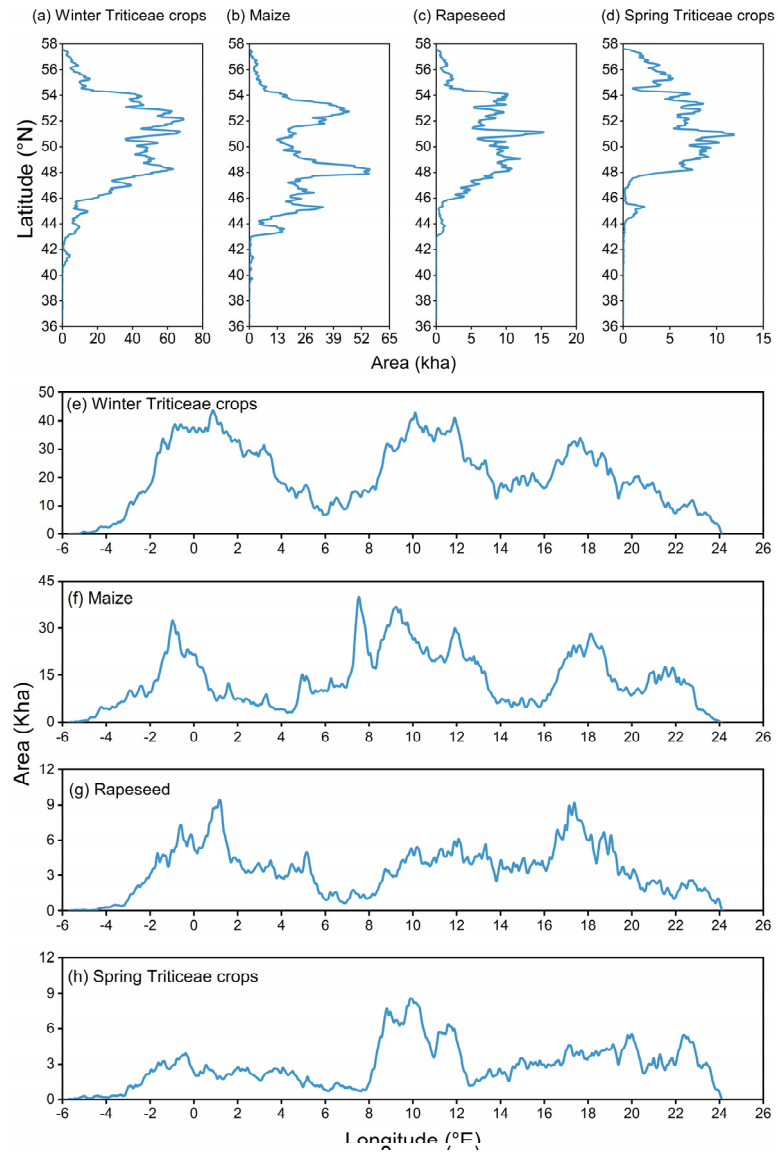
Figure S4. Distribution of crop area along latitude gradients (a)-(d) and longitude gradients (e-h).
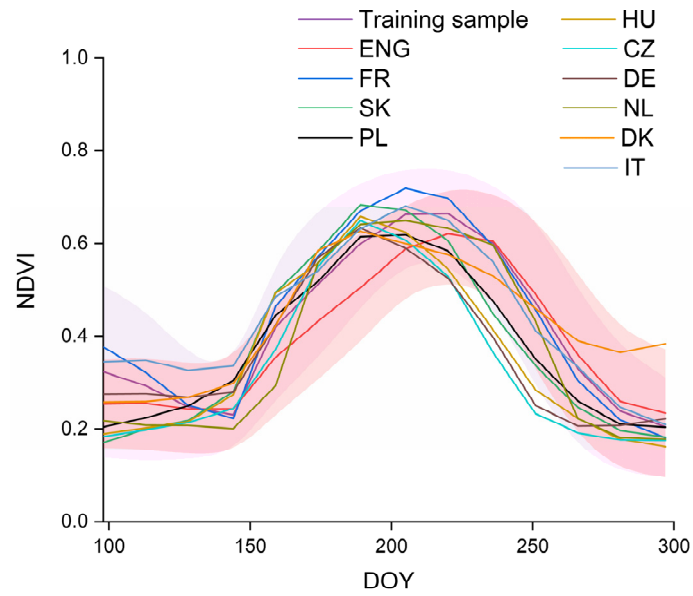
Figure S5. Temporal profiles of NDVI for maize of different countries. Lines depicts the mean values. Shaded area depicts error bars with one positive/negative standard deviation of maize.

Table S1. The number of Sentinel-2 images processed in this study for each country in 2018 and 2019.

Country	2019	2018
England	5839	5859
France	14024	13904
Netherlands	2272	2299
Germany	12154	12098
Denmark	3014	3009
Poland	9368	9393
Czechia	3774	3738
Slovakia	2570	2578
Hungary	3399	3395
Italy	11248	11346

Table S2. Confusion matrix of the point-based validation for England in 2019.

	Others	Winter Triticeae crops	Maize	Rapeseed	Spring Triticeae crops	Total	UA	F1
Others	3619	32	13	12	10	3686	0.98	0.98
Winter Triticeae crops	55	728	0	3	4	790	0.92	0.93
Maize	8	0	61	0	1	70	0.87	0.84
Rapeseed	9	3	0	181	2	195	0.93	0.92
Spring Triticeae crops	20	6	1	0	200	227	0.88	0.90
Total	3711	769	75	196	217			
PA	0.98	0.95	0.81	0.92	0.92			
OA								0.97

Table S3. Confusion matrix of the point-based validation for England in 2018.

	Others	Winter Triticeae crops	Maize	Rapeseed	Spring Triticeae crops	Total	UA	F1
Others	3523	40	23	15	48	3649	0.97	0.97
Winter Triticeae crops	57	676	0	2	4	739	0.91	0.92
Maize	4	0	62	0	0	66	0.94	0.82
Rapeseed	8	4	0	181	0	193	0.94	0.92
Spring Triticeae crops	26	4	0	1	275	306	0.90	0.87
Total	3618	724	85	199	327			
PA	0.97	0.93	0.73	0.91	0.84			
OA								0.95

Table S4. Confusion matrix of the point-based validation for Netherlands in 2019.

	Others	Winter Triticeae crops	Maize	Rapeseed	Spring Triticeae crops	Total	UA	F1
Others	1725	4	15	2	12	1758	0.98	0.98
Winter Triticeae crops	17	243	0	0	3	263	0.92	0.93
Maize	9	0	393	0	1	403	0.98	0.97
Rapeseed	3	0	0	22	0	25	0.88	0.88
Spring Triticeae crops	15	15	0	1	154	185	0.83	0.87
Total	1769	262	408	25	170			
PA	0.98	0.93	0.96	0.88	0.91			
OA								0.96

Table S5. Confusion matrix of the point-based validation for Netherlands in 2018.

	Others	Winter Triticeae crops	Maize	Rapeseed	Spring Triticeae crops	Total	UA	F1
Others	1707	5	28	2	9	1751	0.97	0.98
Winter Triticeae crops	10	216	0	0	14	240	0.90	0.89
Maize	11	0	405	0	0	416	0.97	0.94
Rapeseed	2	0	0	22	0	24	0.92	0.90
Spring Triticeae crops	14	24	12	1	138	189	0.73	0.79
Total	1744	245	445	25	161			
PA	0.98	0.88	0.91	0.88	0.86			
OA								0.95

Table S6. Confusion matrix of the point-based validation for France in 2019.

	Others	Triticeae crops	Maize	Rapeseed	Total	UA	F1
Others	3207	93	83	28	3411	0.94	0.95
Triticeae crops	89	908	2	14	1013	0.90	0.89
Maize	9	0	293	1	303	0.97	0.86
Rapeseed	8	21	1	227	257	0.88	0.86
Total	3313	1022	379	270			
PA	0.97	0.89	0.77	0.84			
OA							0.93

Table S7. Confusion matrix of the point-based validation for France in 2018.

	Others	Triticeae crops	Maize	Rapeseed	Total	UA	F1
Others	3311	86	79	21	3497	0.95	0.96
Triticeae crops	56	866	5	8	935	0.93	0.91
Maize	12	1	295	0	308	0.96	0.86
Rapeseed	8	15	0	228	251	0.91	0.90
Total	3387	968	379	257			
PA	0.98	0.89	0.78	0.89			
OA							0.94

Table S8. Confusion matrix of the point-based validation for the whole study area using LUCAS data in 2018.

	Others	Triticeae crops	Maize	Rapeseed	Total	UA	F1
Others	19702	1583	304	134	21723	0.91	0.93
Triticeae crops	659	4141	63	91	4954	0.84	0.77
Maize	124	24	1273	3	1424	0.89	0.83
Rapeseed	99	26	2	654	781	0.84	0.79
Total	20584	5774	1642	882			
PA	0.96	0.72	0.78	0.74			
OA							0.89