Supplement of Earth Syst. Sci. Data, 17, 95–115, 2025
https://doi.org/10.5194/essd-17-95-2025-supplement

Open Access Earth System Science Data

Supplement of

High-resolution mapping of global winter-triticeae crops using a sample-free identification method

Yangyang Fu et al.

Correspondence to: Wenping Yuan (yuanwp3@mail.sysu.edu.cn)

Table S1: The sources of agricultural statistical data in all countries.

Country	Source
Afghanistan	https://invest.gov.af/
Albania	http://www.instat.gov.al/
Argentina	https://datosestimaciones.magyp.gob.ar/reportes.php?reporte=Estimaciones
Australia	https://www.agriculture.gov.au/abares
Austria	https://www.statistik.at/
Azerbaijan	https://www.stat.gov.az/source/agriculture/?lang=en
Brazil	https://www.ibge.gov.br/en/statistics/full-list-statistics.html
Belgium	https://statbel.fgov.be/de
Bulgaria	https://www.agrostat.bg/ISASPublic/Crops
China	https://www.stats.gov.cn/sj/
Croatia	https://dzs.gov.hr/
Czechia	https://www.czso.cz/csu/czso
Denmark	https://www.dst.dk/en/Statistik
Estonia	https://www.stat.ee/
Finland	www.stat.fi/index_en.html
France	https://agreste.agriculture.gouv.fr/agreste-web/accueil/
Germany	https://www.statistik-nord.de/
Greece	https://www.statistics.gr/en/home/
Hungary	https://www.ksh.hu/?lang=en
India	https://aps.dac.gov.in/APY/Public_Report1.aspx
Iran	https://irandataportal.syr.edu/socio-economic-data/statistical-yearbook
Iraq	https://cosit.gov.iq/ar/
Ireland	https://data.cso.ie/
Italy	https://www.istat.it/en/
Kyrgyzstan	http://stat.kg/en/
Latvia	https://stat.gov.lv/en
Lithuania	https://osp.stat.gov.lt/
Montenegro	www.monstat.org/eng/index.php
Morocco	https://www.hcp.ma/
Nepal	https://moald.gov.np/
Netherlands	https://www.cbs.nl/en-gb
North Macedonia	https://www.stat.gov.mk/Default_en.aspx
Norway	www.ssb.no/english/
Pakistan	https://www.pbs.gov.pk/
Poland	Statistical Office in Białystok / Publications
Portugal	www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_main
Romania	http://statistici.insse.ro:8077/tempo-online
Russia	https://rosstat.gov.ru/
Serbia	https://www.stat.gov.rs
Slovakia	https://slovak.statistics.sk/wps/portal/ext/home

Slovenia	https://www.stat.si/statweb/en/home
Spain	https://www.ine.es/en/index.htm
Sweden	www.scb.se/en/
Switzerland	https://www.bfs.admin.ch/bfs/de/home.html
Turkey	https://www.tuik.gov.tr/
Ukraine	https://statzvit.ukrstat.gov.ua/
United Kingdom	https://www.gov.uk/
United States	https://www.nass.usda.gov/
Other counties	https://www.fao.org/home/en/

Table S2: The abbreviations of countries in the study area.

Number	Abbreviation	Country
1	AFG	Afghanistan
2	ALB	Albania
3	ARG	Argentina
4	AUS	Australia
5	AUT	Austria
6	AZE	Azerbaijan
7	BEL	Belgium
8	BGD	Bangladesh
9	BGR	Bulgaria
10	BIH	Bosnia and Herzegovina
11	BLR	Belarus
12	BRA	Brazil
13	CHE	Switzerland
14	CHN	China
15	CZE	Czechia
16	DEU	Germany
17	DNK	Denmark
18	DZA	Algeria
19	EGY	Egypt
20	ESP	Spain
21	EST	Estonia
22	ETH	Ethiopia
23	FIN	Finland
24	FRA	France
25	GRC	Greece
26	HRV	Croatia
27	HUN	Hungary
28	IND	India
29	IRL	Ireland

30	IRN	Iran
31	IRQ	Iraq
32	ITA	Italy
33	KGZ	Kyrgyzstan
34	LBY	Libya
35	LTU	Lithuania
36	LVA	Latvia
37	MAR	Morocco
38	MDA	Moldova
39	MEX	Mexico
40	MKD	North Macedonia
41	MNE	Montenegro
42	NLD	Netherlands
43	NOR	Norway
44	NPL	Nepal
45	PAK	Pakistan
46	POL	Poland
47	PRT	Portugal
48	PRY	Paraguay
49	ROU	Romania
50	RUS	Russia
51	SDN	Sudan
52	SRB	Serbia
53	SVK	Slovakia
54	SVN	Slovenia
55	SWE	Sweden
56	SYR	Syrian Arab Republic
57	TJK	Tajikistan
58	TKM	Turkmenistan
59	TUN	Tunisia
60	TUR	Turkey
61	UK	United Kingdom
62	UKR	Ukraine
63	URY	Uruguay
64	US	United States
65	UZB	Uzbekistan
66	ZAF	South Africa

Table S3: The abbreviations of states (provinces) in the study area.

Country	Number	Abbreviation	State (Province)
Australia	1	NSW	New South Wales
	2	QS	Queensland
	3	SA	South Australia
	4	TS	Tasmania
	5	VT	Victoria
	6	WA	Western Australia
Brazil	7	MG	Minas Gerais
	8	PR	Parana
	9	RS	Rio Grande do Sul
	10	SC	Santa Catarina
	11	SP	Sao Paulo
China	12	AH	Anhui
	13	GS	Gansu
	14	HB	Hebei
	15	HN	Henan
	16	HuB	Hubei
	17	JS	Jiangsu
	18	SAX	Shanxi
	19	SC	Sichuan
	20	SD	Shandong
	21	SX	Shanxi
	22	XJ	Xinjiang
India	23	BR	Bihar
	24	CT	Chhattisgarh
	25	GJ	Gujarat
	26	HP	Himachal Pradesh
	27	HR	Haryana
	28	JH	Jharkhand
	29	JK	Jammu and Kashmir
	30	KA	Karnataka
	31	MH	Maharashtra
	32	MP	Madhya Pradesh
	33	PB	Punjab
	34	RJ	Rajasthan
	35	UP	Uttar Pradesh
	36	UT	Uttarakhand
	37	WB	West Bengal
The United States	38	AL	Alabama
	39	AR	Arkansas
	40	CA	California
	41	CO	Colorado

42	DE	Delaware
43	GA	Georgia
44	ID	Idaho
45	IL	Illinois
46	IN	Indiana
47	KS	Kansas
48	KY	Kentucky
49	MD	Maryland
50	MI	Michigan
51	MO	Missouri
52	MS	Mississippi
53	MT	Montana
54	NC	North Carolina
55	ND	North Dakota
56	NE	Nebraska
57	NJ	New Jersey
58	NM	New Mexico
59	NY	New York
60	OH	Ohio
61	OK	Oklahoma
62	OR	Oregon
63	PA	Pennsylvania
64	SC	South Carolina
65	SD	South Dakota
66	TN	Tennessee
67	TX	Texas
68	UT	Utah
69	VA	Virginia
70	WA	Washington
71	WI	Wisconsin
72	WY	Wyoming

Table S4: The confusion matrix of the identification maps of winter-triticeae crops based on CDL dataset.

Country	CDL samples	Map		Producer's accuracy (%)	User's accuracy (%)	Overall accuracy (%)	F1 score (%)
		Winter-triticeae crops	Non-Winter-triticeae crops				
Alabama (AL)	Winter-triticeae crops	99	38	72.26	88.39	88.54	79.52
	Non-Winter-triticeae crops	13	295	95.78	88.59		

Arkansas (AR)	Winter-triticeae crops	101	18	84.87	90.18	90.76	87.45
	Non-Winter-triticeae crops	11	184	94.36	91.09		
California (CA)	Winter-triticeae crops	34	20	62.96	79.07	75.21	70.10
	Non-Winter-triticeae crops	9	54	85.71	72.97		
Colorado (CO)	Winter-triticeae crops	204	31	86.81	90.67	93.59	88.70
	Non-Winter-triticeae crops	21	555	96.35	94.71		
Delaware (DE)	Winter-triticeae crops	308	62	83.24	90.59	90.12	86.76
	Non-Winter-triticeae crops	32	549	94.49	89.85		
Georgia (GA)	Winter-triticeae crops	64	31	67.37	84.21	81.47	74.85
	Non-Winter-triticeae crops	12	125	91.24	80.13		
Idaho (ID)	Winter-triticeae crops	174	66	72.50	80.18	82.36	76.15
	Non-Winter-triticeae crops	43	335	88.62	83.54		
Illinois (IL)	Winter-triticeae crops	247	49	83.45	92.51	91.68	87.74
	Non-Winter-triticeae crops	20	513	96.25	91.28		
Indiana (IN)	Winter-triticeae crops	287	95	75.13	96.31	89.21	84.41
	Non-Winter-triticeae crops	11	589	98.17	86.11		
Kansas (KS)	Winter-triticeae crops	344	46	88.21	93.99	93.13	91.01
	Non-Winter-	22	578	96.33	92.63		

	triticeae crops						
Kentucky (KY)	Winter-triticeae crops	130	25	83.87	90.28	90.30	86.96
	Non-Winter-triticeae crops	14	233	94.33	90.31		
Maryland (MD)	Winter-triticeae crops	216	78	73.47	85.04	87.14	78.83
	Non-Winter-triticeae crops	38	570	93.75	87.96		
Michigan (MI)	Winter-triticeae crops	345	80	81.18	97.46	91.32	88.58
	Non-Winter-triticeae crops	9	591	98.50	88.08		
Missouri (MO)	Winter-triticeae crops	148	50	74.75	85.06	88.74	79.57
	Non-Winter-triticeae crops	26	451	94.55	90.02		
Mississippi (MS)	Winter-triticeae crops	73	30	70.87	83.91	82.26	76.84
	Non-Winter-triticeae crops	14	131	90.34	81.37		
Montana (MT)	Winter-triticeae crops	122	51	70.52	81.88	84.46	75.78
	Non-Winter-triticeae crops	27	302	91.79	85.55		
North Carolina (NC)	Winter-triticeae crops	108	30	78.26	89.26	86.73	83.40
	Non-Winter-triticeae crops	13	173	93.01	85.22		
North Dakota (ND)	Winter-triticeae crops	63	45	58.33	77.78	70.42	66.67
	Non-Winter-triticeae crops	18	87	82.86	65.91		
Nebraska (NE)	Winter-triticeae crops	263	51	83.76	88.55	89.68	86.09

	Non-Winter-triticeae crops	34	476	93.33	90.32		
New Jersey (NJ)	Winter-triticeae crops	203	70	74.36	91.44	85.02	82.02
	Non-Winter-triticeae crops	19	302	94.08	81.18		
New Mexico (NM)	Winter-triticeae crops	79	32	71.17	84.95	79.46	77.45
	Non-Winter-triticeae crops	14	99	87.61	75.57		
New York (NY)	Winter-triticeae crops	167	70	70.46	84.77	77.43	76.96
	Non-Winter-triticeae crops	30	176	85.44	71.54		
Ohio (OH)	Winter-triticeae crops	315	49	86.54	94.59	92.49	90.39
	Non-Winter-triticeae crops	18	510	96.59	91.23		
Oklahoma (OK)	Winter-triticeae crops	159	27	85.48	90.34	94.24	87.85
	Non-Winter-triticeae crops	17	561	97.06	95.41		
Oregon (OR)	Winter-triticeae crops	244	36	87.14	91.73	92.67	89.38
	Non-Winter-triticeae crops	22	489	95.69	93.14		
Pennsylvania (PA)	Winter-triticeae crops	162	34	82.65	90.00	91.23	86.17
	Non-Winter-triticeae crops	18	379	95.47	91.77		
South Carolina (SC)	Winter-triticeae crops	91	28	76.47	89.22	86.17	82.35
	Non-Winter-triticeae crops	11	152	93.25	84.44		
South Dakota	Winter-triticeae	147	61	70.67	84.00	83.79	76.76

(SD)	crops						
	Non-Winter-triticeae crops	28	313	91.79	83.69		
Tennessee (TN)	Winter-triticeae crops	99	33	75.00	90.83	88.56	82.16
	Non-Winter-triticeae crops	10	234	95.90	87.64		
Texas (TX)	Winter-triticeae crops	113	24	82.48	89.68	92.64	85.93
	Non-Winter-triticeae crops	13	353	96.45	93.63		
Utah (UT)	Winter-triticeae crops	76	29	72.38	83.52	81.12	77.55
	Non-Winter-triticeae crops	15	113	88.28	79.58		
Virginia (VA)	Winter-triticeae crops	124	27	82.12	90.51	90.85	86.11
	Non-Winter-triticeae crops	13	273	95.45	91.00		
Washington (WA)	Winter-triticeae crops	275	80	77.46	84.88	86.28	81.00
	Non-Winter-triticeae crops	49	536	91.62	87.01		
Wisconsin (WI)	Winter-triticeae crops	214	64	76.98	89.54	85.71	82.79
	Non-Winter-triticeae crops	25	320	92.75	83.33		
Wyoming (WY)	Winter-triticeae crops	100	42	70.42	89.29	84.66	78.74
	Non-Winter-triticeae crops	12	198	94.29	82.50		

Table S5: The confusion matrix of the identification maps of winter-triticeae crops based on EuroCrops dataset.

Country	EuroCrops samples	Map		Producer's accuracy (%)	User's accuracy (%)	Overall accuracy (%)	F1 score (%)
		Winter-triticeae crops	Non-Winter-triticeae crops				
Austria (AUT)	Winter-triticeae crops	240	96	71.43	89.22	85.05	79.34
	Non-Winter-triticeae crops	29	471	94.20	83.07		
Belgium (BEL)	Winter-triticeae crops	139	50	73.54	76.37	86.50	74.93
	Non-Winter-triticeae crops	43	457	91.40	90.14		
Denmark (DNK)	Winter-triticeae crops	185	60	75.51	84.09	83.76	79.57
	Non-Winter-triticeae crops	35	305	89.71	83.56		
Estonia (EST)	Winter-triticeae crops	128	73	63.68	92.75	82.96	75.52
	Non-Winter-triticeae crops	10	276	96.50	79.08		
France (FRA)	Winter-triticeae crops	285	57	83.33	89.34	87.53	86.23
	Non-Winter-triticeae crops	34	354	91.24	86.13		
German (DEU)	Winter-triticeae crops	128	23	84.77	96.24	94.79	90.14
	Non-Winter-triticeae crops	5	381	98.70	94.31		
Netherlands (NLD)	Winter-triticeae crops	62	27	69.66	93.94	87.98	80.00
	Non-Winter-triticeae crops	4	165	97.63	85.94		
Slovakia (SVK)	Winter-triticeae crops	161	78	67.36	80.90	71.22	73.52

	Non-Winter-triticeae crops	38	126	76.83	61.76		
Slovenia (SVN)	Winter-triticeae crops	108	30	78.26	85.71	84.26	81.82
	Non-Winter-triticeae crops	18	149	89.22	83.24		
Sweden (SWE)	Winter-triticeae crops	45	25	64.29	71.43	74.71	67.67
	Non-Winter-triticeae crops	18	82	82.00	76.64		

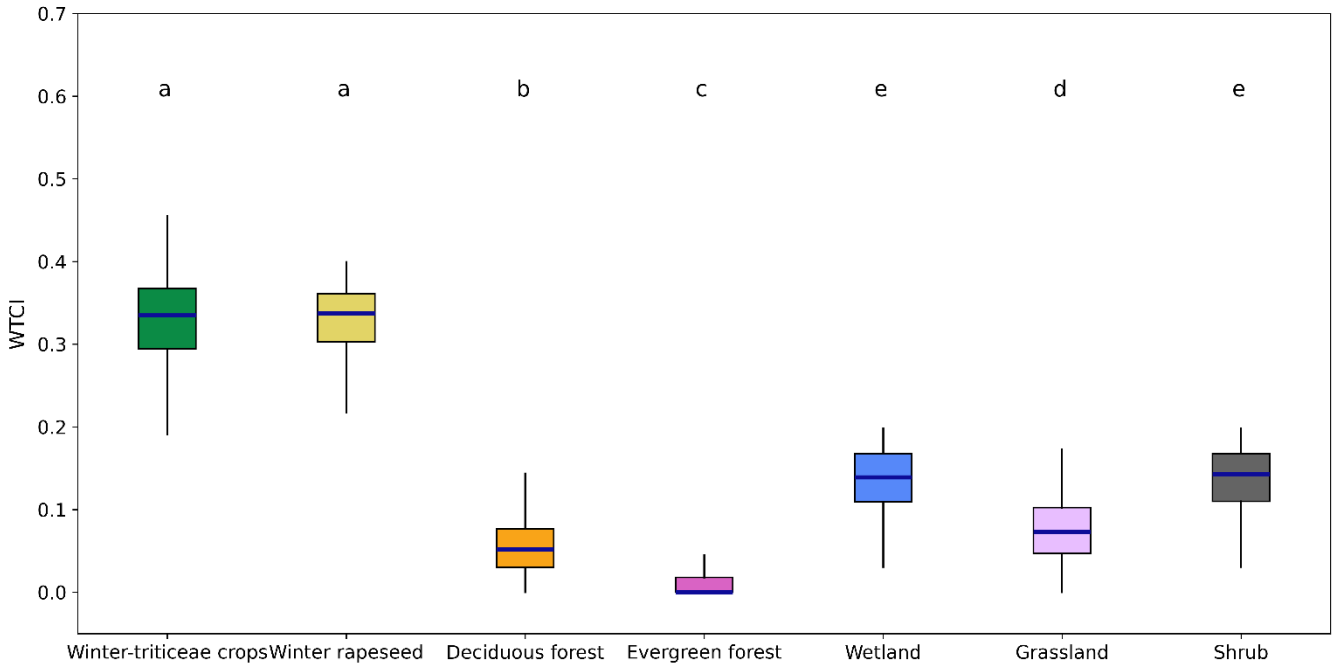

Figure S1: WTCI values of different land cover types. Letters represent statistically significant differences in WTCI values for different land cover types (Tukey's Test, $P < 0.05$).

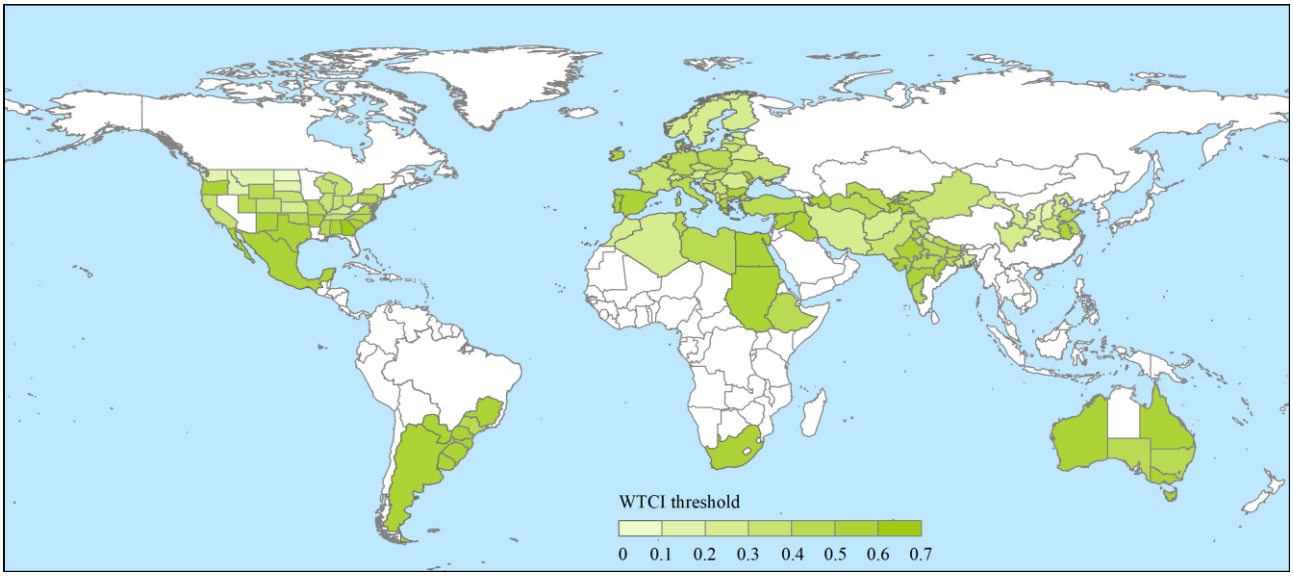

Figure S2: The spatial distribution of WTCI thresholds in all identification units in 2020.

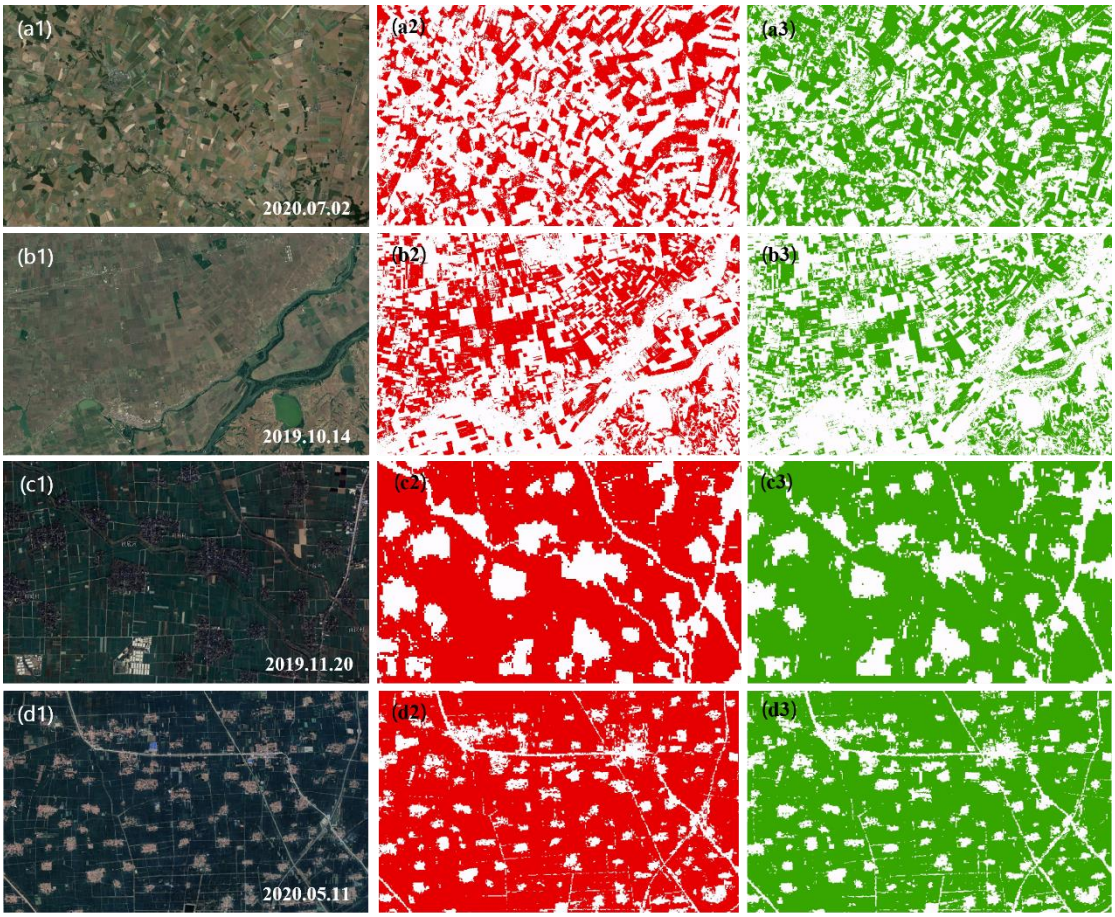

Figure S3: Comparison between the identification maps of this study and other studies. (a1-d1) represent the high-resolution images from © Google Earth in the study area; (a2-d2) represent the zoomed-in maps of the identification results based on WTCI method; (a3-d3) represent the zoomed-in maps of the identification results of other studies. Area a-d can be found in Figure 5.

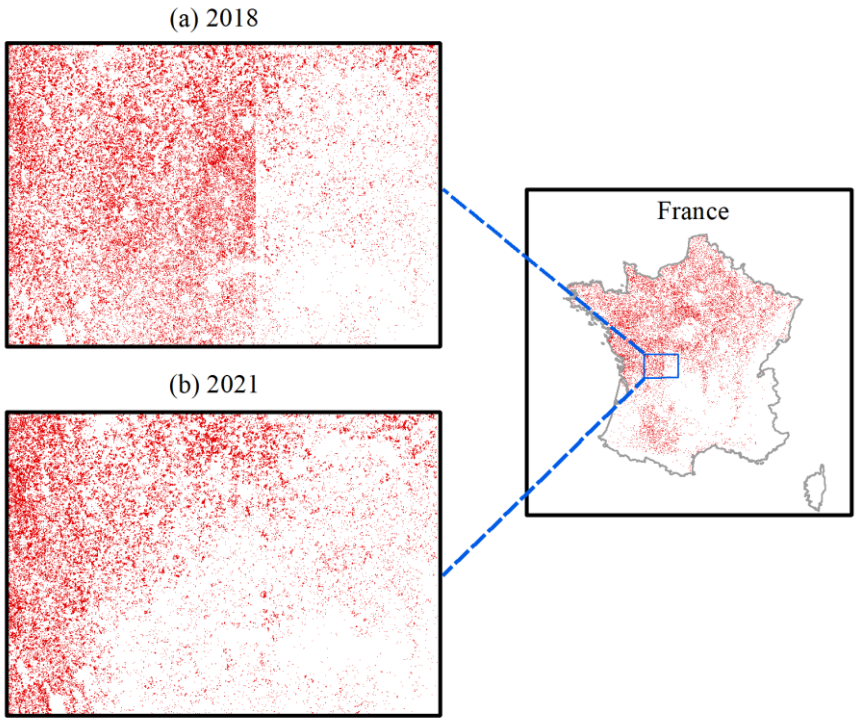

Figure S4: Comparison of distribution maps of winter-triticeae crops between different years. (a) and (b) show the zoomed-in maps of subregion in France in 2018 and 2021, respectively.