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Supplement of

The RapeseedMap10 database: annual maps of rapeseed at a spatial resolution of 10 m based on multi-source data

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Table S1 Thresholds of different indicators in different regions

Zones	Red	Green	VH	NDYI	NRGBI	Connected components
Zone I	0.07	0.11	-11	0.05	-0.05	40
Zone II	0.07	0.11	-12	0.05	-0.05	20
Zone III	0.07	0.11	-12	0.05	-0.05	20

15 Table S2 Confusion matrix table in this study

		Class	
		Non	Rapeseed
Reference	Non	X_{11}	X_{12}
	Rapeseed	X_{21}	X_{22}

16

Table S3 The comparison of rapeseed (pixels) in Canada, USA, GBR, and France from different data sources in 2018, 2019, with rows from reference classification, while columns from our derived maps. Annual Crop Inventory (ACI), Cropland Data Layer (CDL), Crop Map of England (CROME), Land Cover Map of France (LCMF).

Existing products		Non-rapeseed	Rapeseed	Total	PA	UA	F1
ACI 2018 (Canada)	Non-rapeseed	469,895,705	434,530,41	161,133,992,1	0.71	0.96	0.82
	Rapeseed		114,144,421,6				
	Total		118,489,725,7				
CDL 2018 (USA)	Non-rapeseed	321,272,80	551,173,7	109,966,237	0.71	0.93	0.81
	Rapeseed		778,389,57				
	Total		833,506,94				
CDL 2019 (USA)	Non-rapeseed	251,284,08	619,139,3	118,636,368	0.79	0.94	0.86
	Rapeseed		935,079,60				
	Total		996,993,53				
CROME 2018 (GBR)	Non-rapeseed	180,611,43	448,424,3	893,501,89	0.80	0.94	0.86
	Rapeseed		712,890,46				
	Total		757,732,89				
LCMF 2018 (France)	Non-rapeseed	82606784	5545926	274324984	0.70	0.97	0.81
	Rapeseed		191718200				
	Total		197264126				

Table S4 Confusion matrix of rapeseed validation based on the random sampling points. Map categories are columns while reference categories are rows.

Zones	Class	Rapeseed	Non	Total	UA	PA	F1
Zone I	Rapeseed	1820	469	2289	0.89	0.80	0.84
	Non	235	2017	2252			
	Total	2055	2486				
Zone II	Rapeseed	5721	730	6541	0.95	0.88	0.91
	Non	302	6267	6569			
	Total	6023	6997				
Zone III	Rapeseed	72	9	81	0.91	0.89	0.90
	Non	7	78	85			
	Total	79	87				

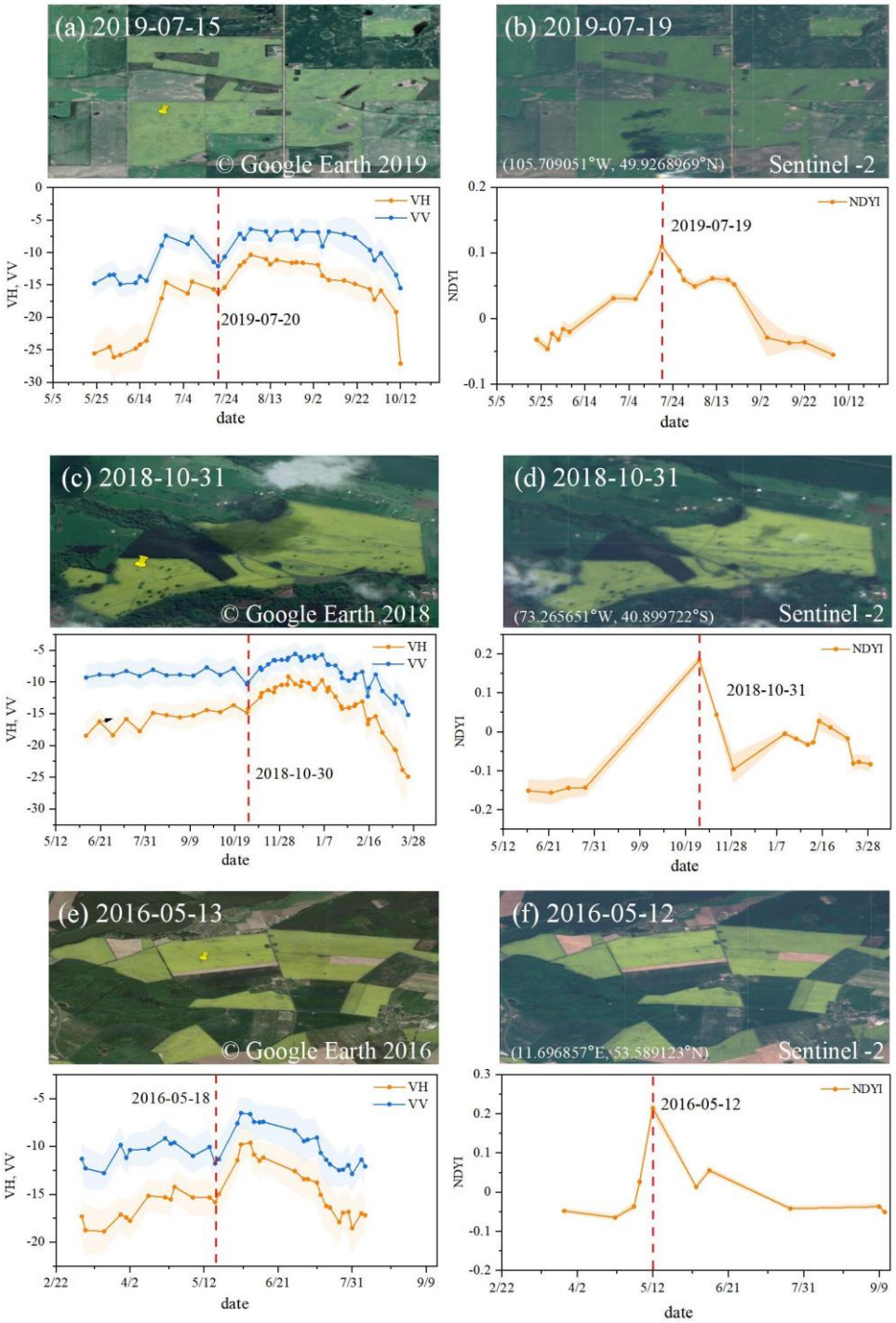

Figure S1. Sentinel-2 and Google Earth images at the flowering stage of rapeseed for visual comparison. The temporal profile of the spectral index (NDYI) and backscattering coefficient (VV, VH). The filled color areas with one positive/negative standard deviation were illustrated. We selected the rapeseed parcels in different climate types and years (a) Canada, (c) Chile, (e) Germany. For selecting the suitable images, we chose the Google Earth images according to the dates as close as possible to those of the Sentinel-2 images (images: Copernicus Sentinel-2 data).

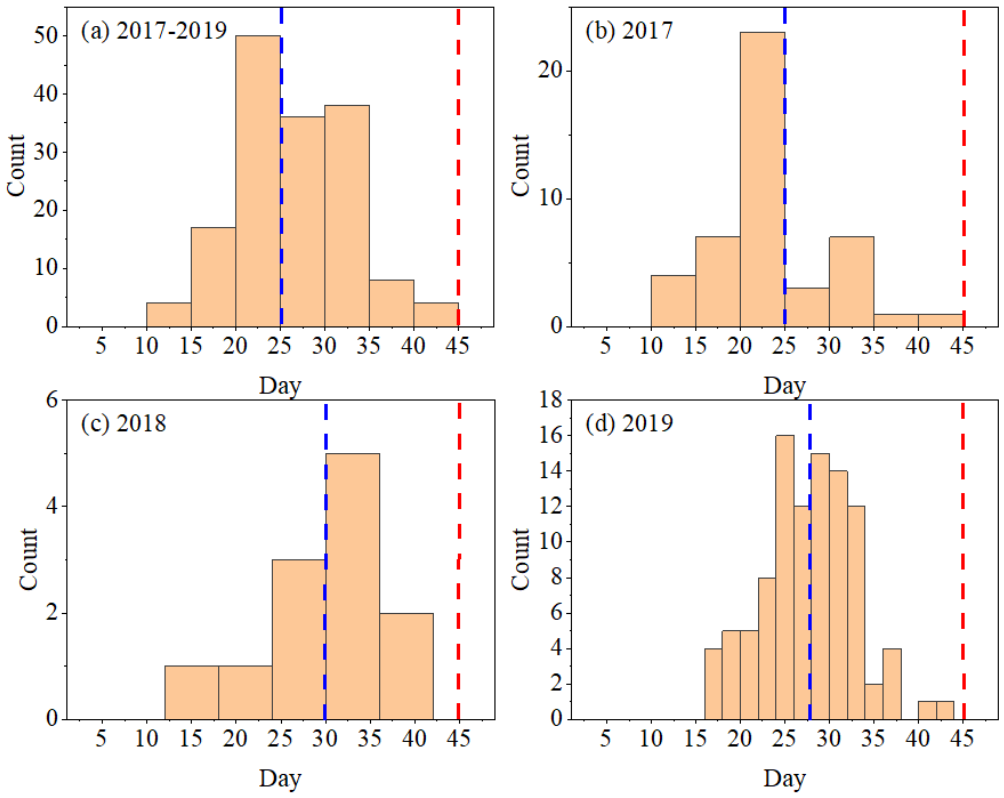

Figure S2. Histogram of the time interval between the date of the VH maximum value and the peak flowering date (the date of the local VH minimum value) of all sample blocks in different years: (a) 2017-2019, (b) 2017, (c) 2018, (d) 2019. The blue and red dotted lines are the median of days and 45 days, respectively.

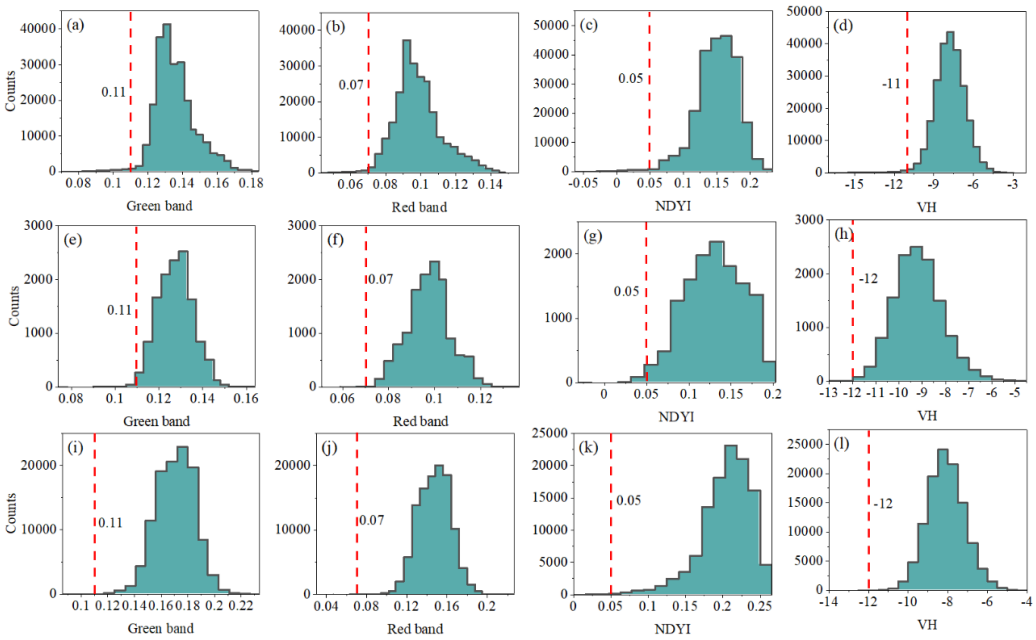

Figure S3. The histogram of green band, red band, NDYI, and VH based on sample rapeseed parcels in different regions: (a-d) zone I, (e-h) zone III, (i-l) zone II. The red dashed line indicates the threshold of the corresponding indicator.

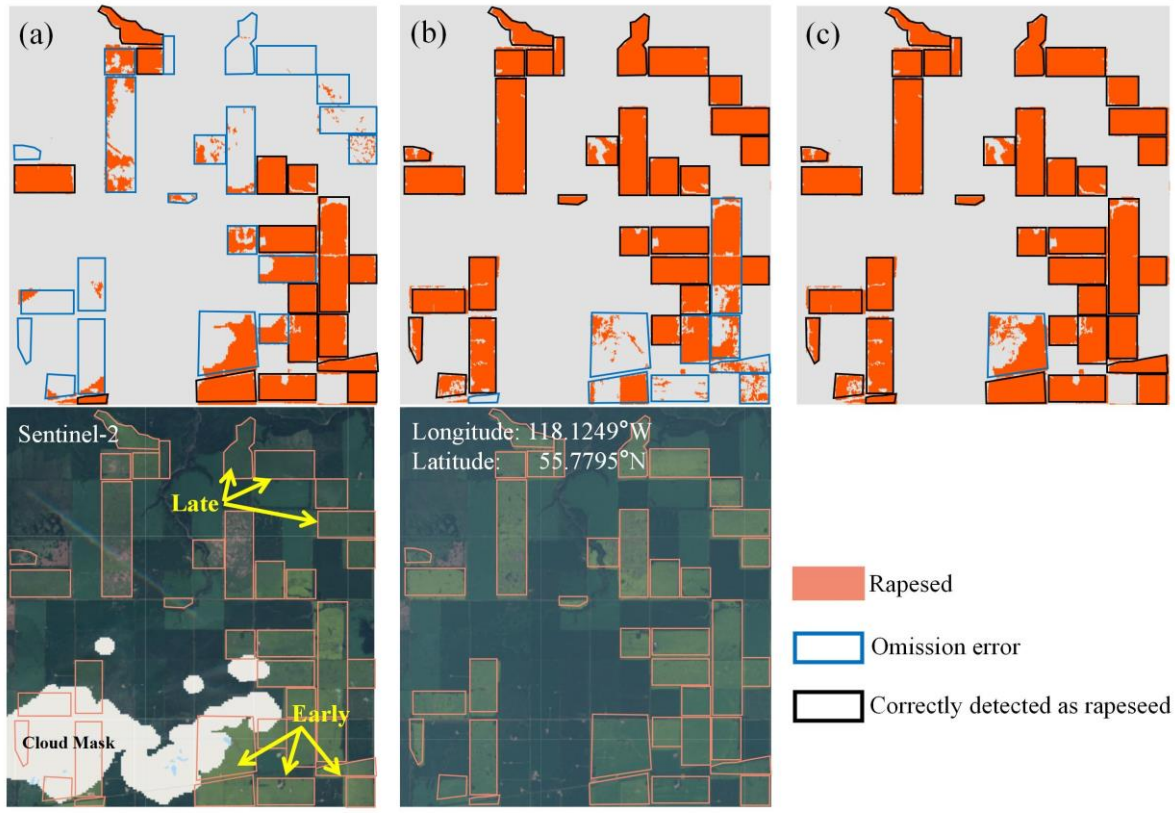

Figure S4. Rapeseed identification results based on the pixel-based algorithm on different dates. (c) is the union of (a) and (b). We found that the cumulative aggregate-based approach can reduce the misclassification from the effects of phenology and bad-quality observations (image source: Copernicus Sentinel-2 data 2018).

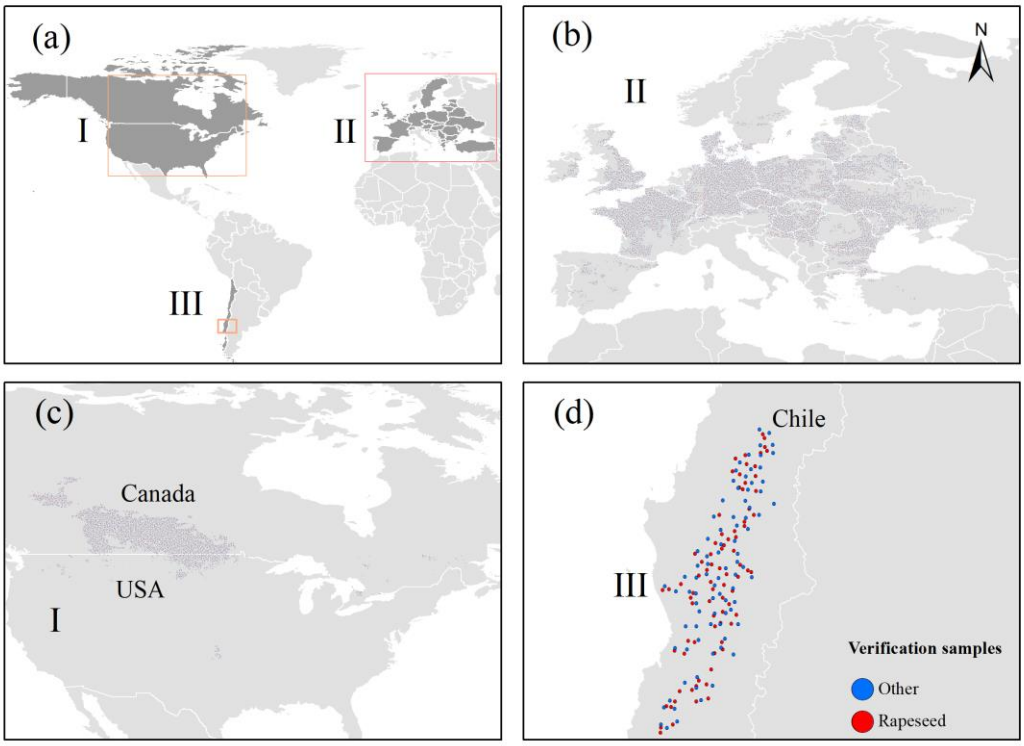

Figure S5. Geographic distribution of validation sample points at 0.2° ×0.2° grids

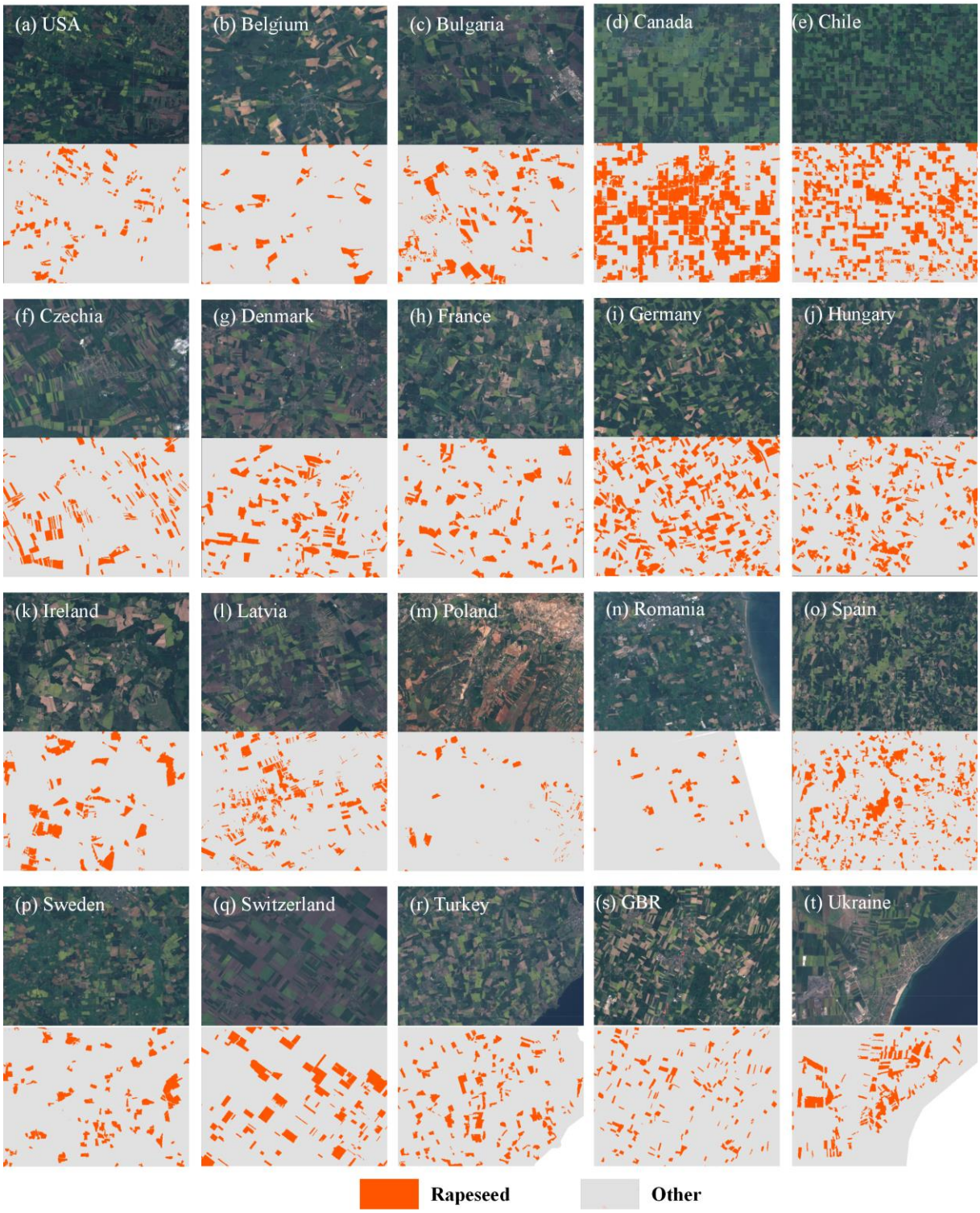

Figure S6. Spatially details of rapeseed maps in 20 countries with diverse crop structures in 2018. The base maps were RGB images composite using bands from the red, green, and blue bands of the Sentinel-2 images with good-quality observations in the flowering period of rapeseed (image source: Copernicus Sentinel-2 data).

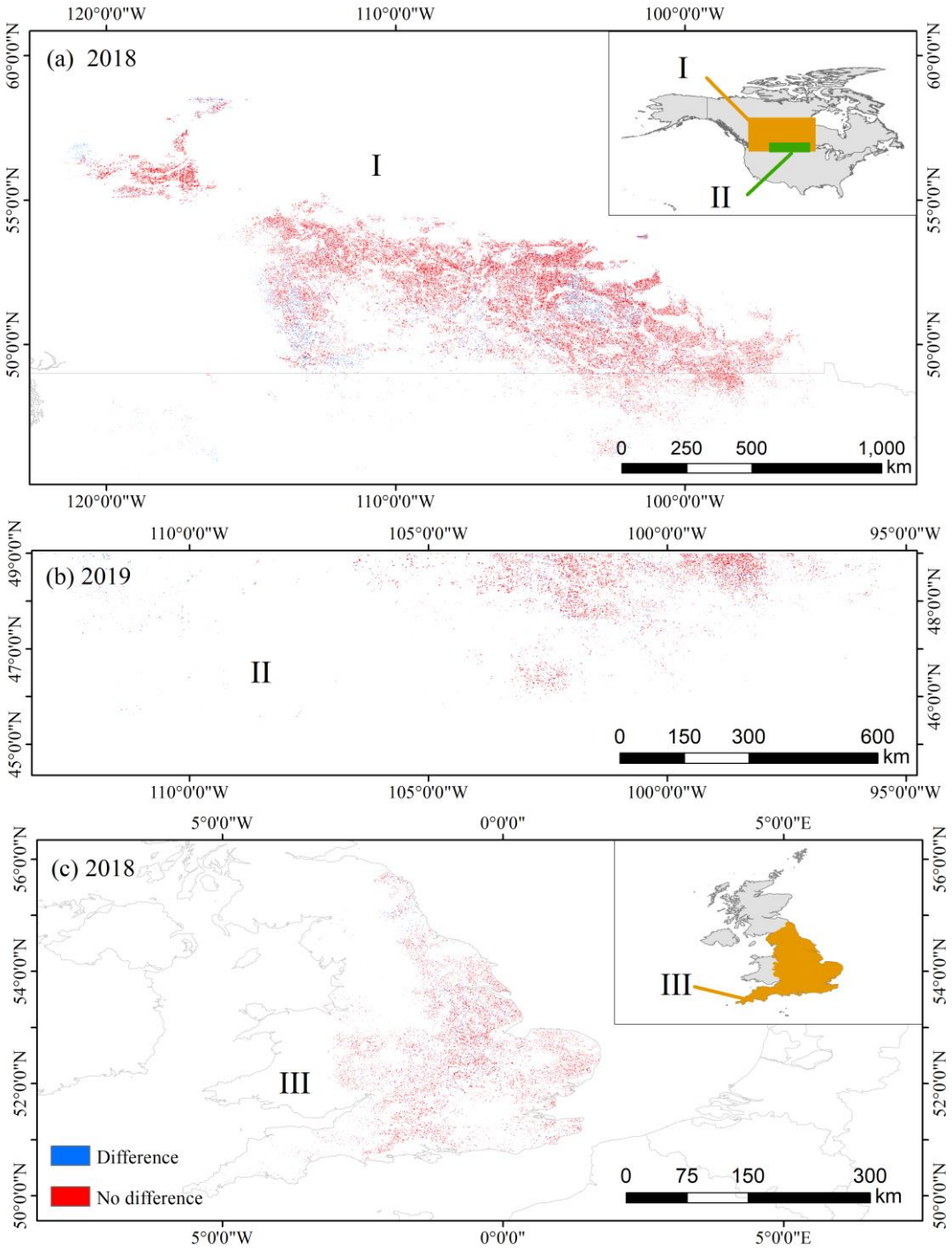

Figure S7. Spatial comparison between rapeseed classifications obtained by our pixel- and phenology-based method and other crop products in Canada (ACI, 2018), USA (CDL, 2019), and GBR (CROME, 2018).

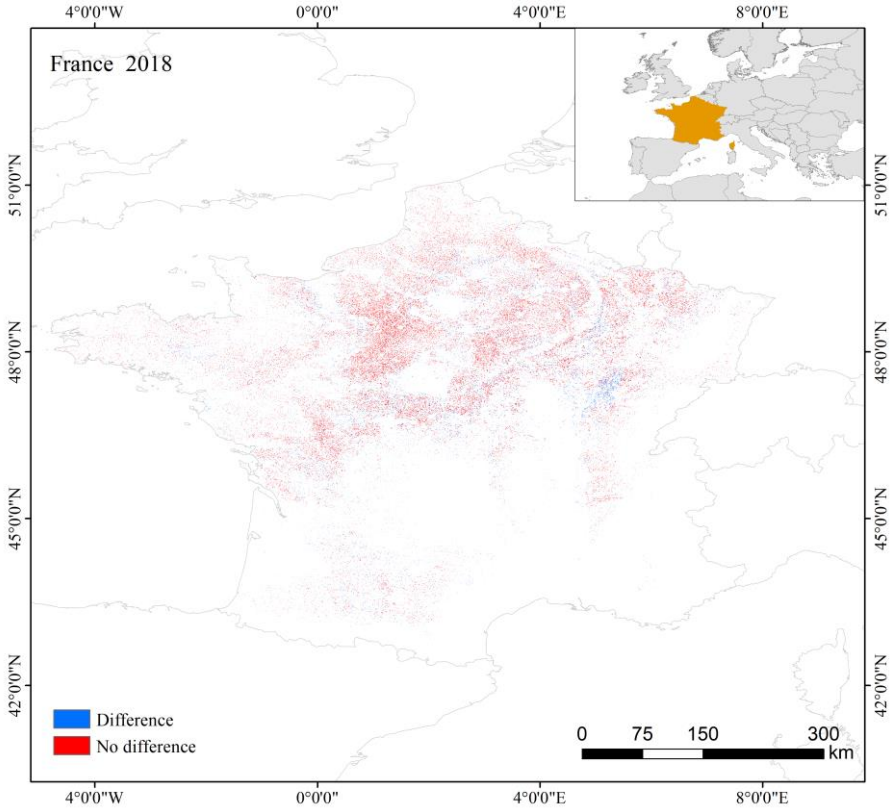

Figure S8. Spatial comparison between rapeseed classifications obtained by our pixel- and phenology-based method and land cover map of France in 2018.

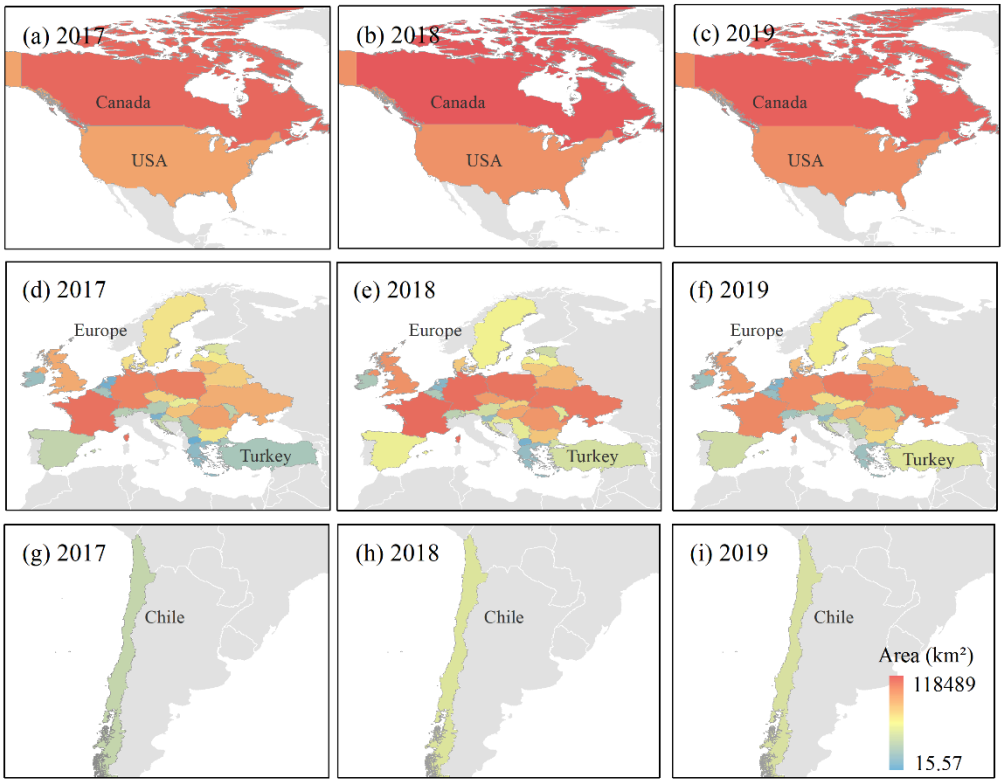

Figure S9. The normalized rapeseed planting areas are derived from rapeseed maps in each country.

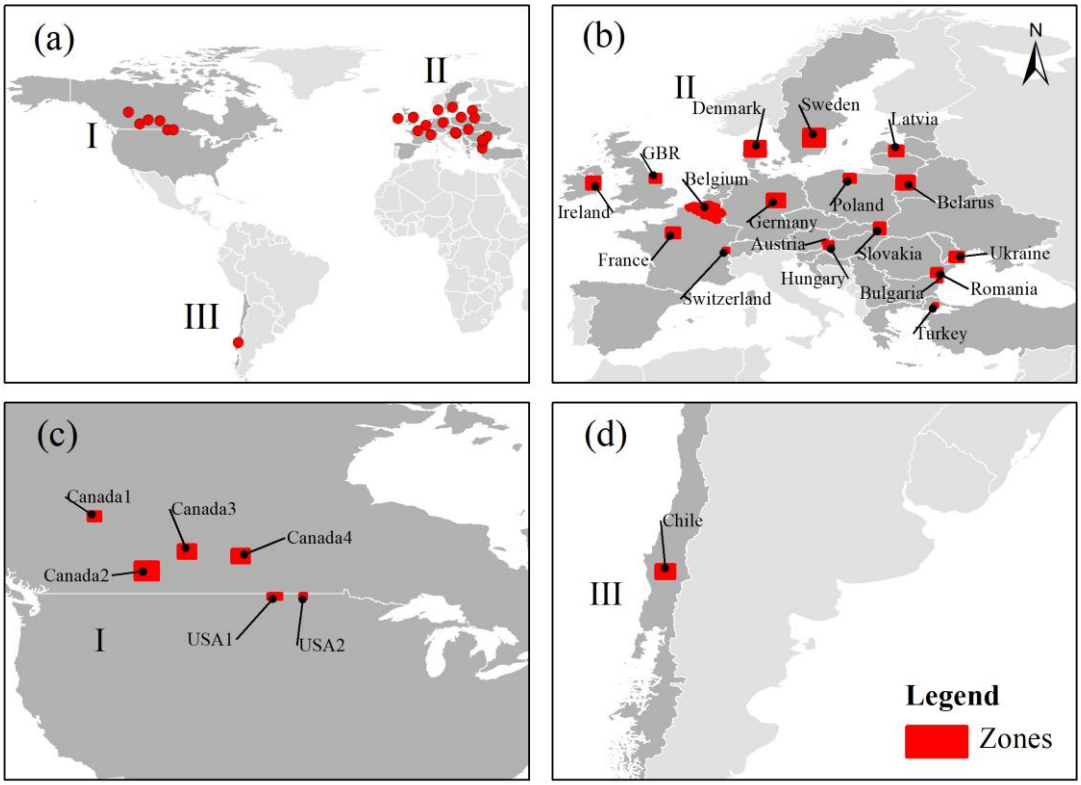

Figure S10. The 25 zones selected for investigating rotation information. The areas that met the following three criteria: high image quality, high rapeseed classification accuracy, and large extent of planted rapeseed. Rapeseed rotation in these areas was calculated based on the frequency of each rapeseed pixel

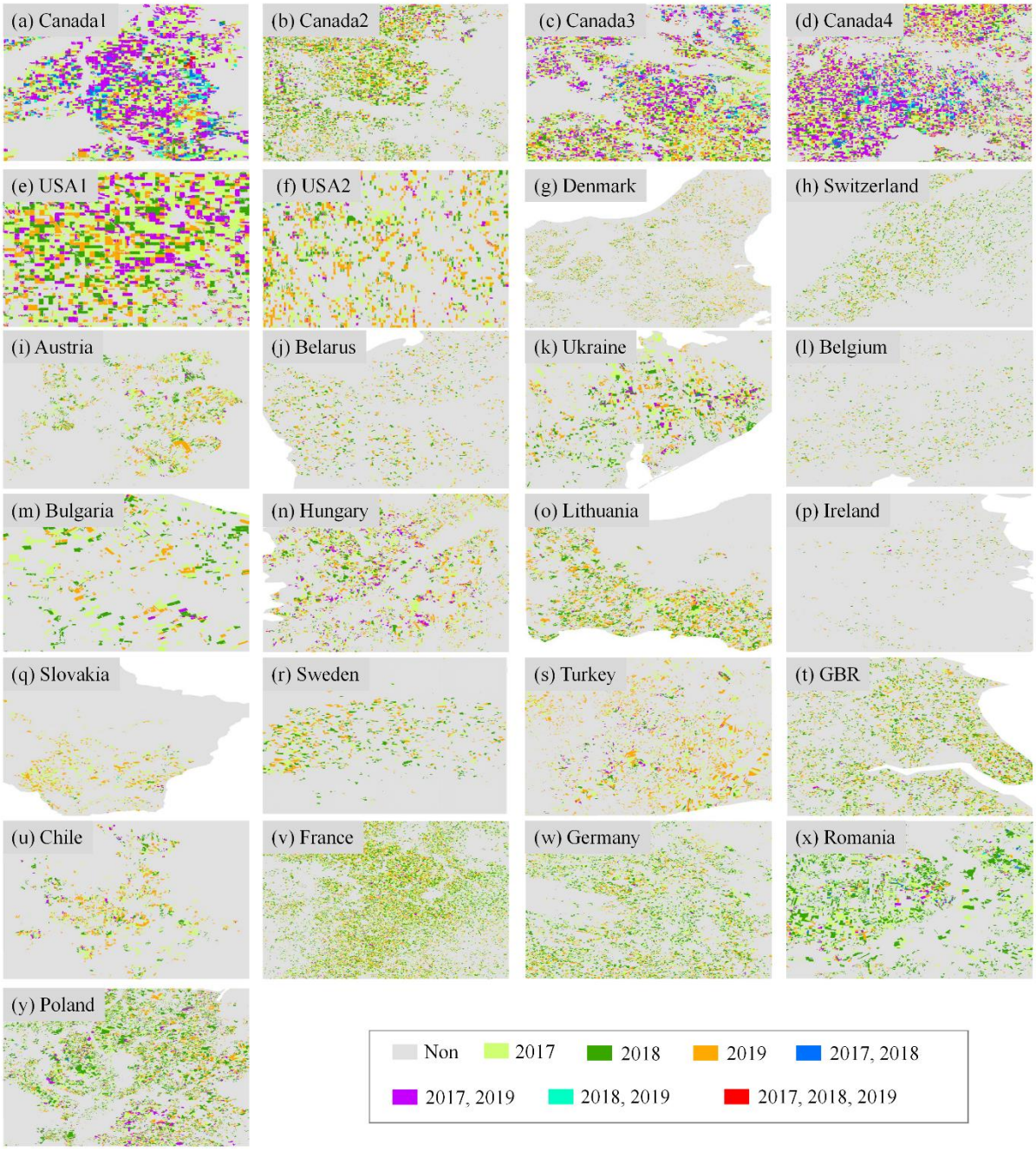

Figure S11. Spatial distribution of rapeseed rotation patterns in different areas from 2017~2019.