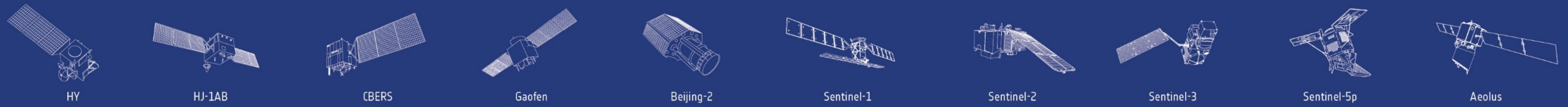


2023 DRAGON 5 SYMPOSIUM

3rd YEAR RESULTS REPORTING

11-15 SEPTEMBER 2023

[PROJECT ID. 58944]

[RETRIEVING CROP GROWTH INFORMATION FROM MULTIPLE SOURCE SATELLITE DATA TO SUPPORT SUSTAINABLE AGRICULTURE]

<WEDNESDAY & SEP 13,2023>

ID. 58944

PROJECT TITLE: RETRIEVING CROP GROWTH INFORMATION FROM MULTIPLE SOURCE SATELLITE DATA TO SUPPORT SUSTAINABLE AGRICULTURE

PRINCIPAL INVESTIGATORS:

CHINESE LI: PROF. JINLONG FAN, NATIONAL SATELLITE METEOROLOGICAL CENTER, CHINA

EUROPEAN LI: PROF. DEFOURNY PIERRE, UNIVERSITE CATHOLIQUE DE LOUVAIN, BELGIUM

CO-AUTHORS: [JINLONG FAN, DEFOURNY PIERRE**]**

PRESENTED BY: [JINLONG FAN**]**

- Inform on the project's objectives
  - Explore the crop monitoring with high resolution satellite for the diverse agricultural cultivation areas in China.
  - Extension of the crop mapping approach of Sen2Agri in China
  - Develop the fusion algorithm of optical and SAR to support the crop monitoring
  - Develop the algorithm of retrieving the biophysics parameters from optical and SAR high resolution satellite images
  - Summarize the advantage and advantage of monitoring agriculture in China with the open access high resolution satellite data

2021 Field Campaign

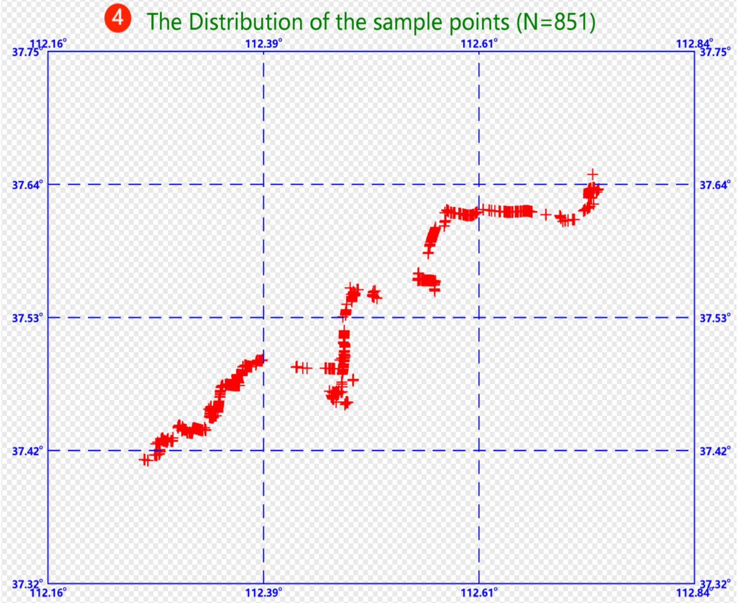
- Shannxi Site May 1-3,2021
- Jiansanjiang Site August 23-27,2021
- Shanxi Site Oct 14-15,2021
- Hunan Site Nov 1-5, 2021

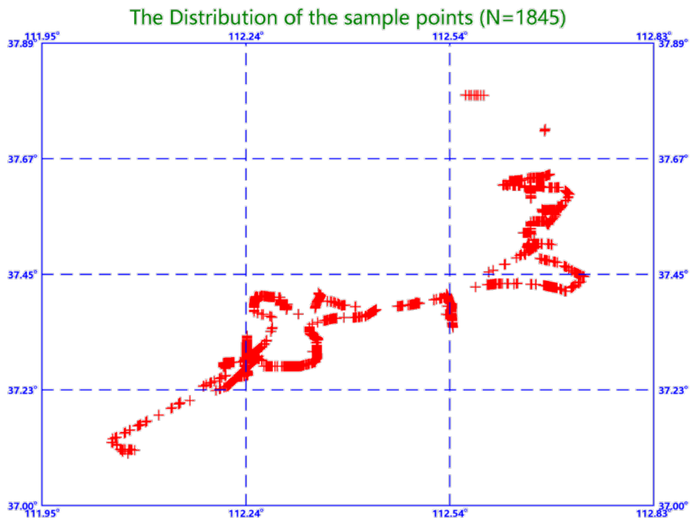
2022 Field Campaign

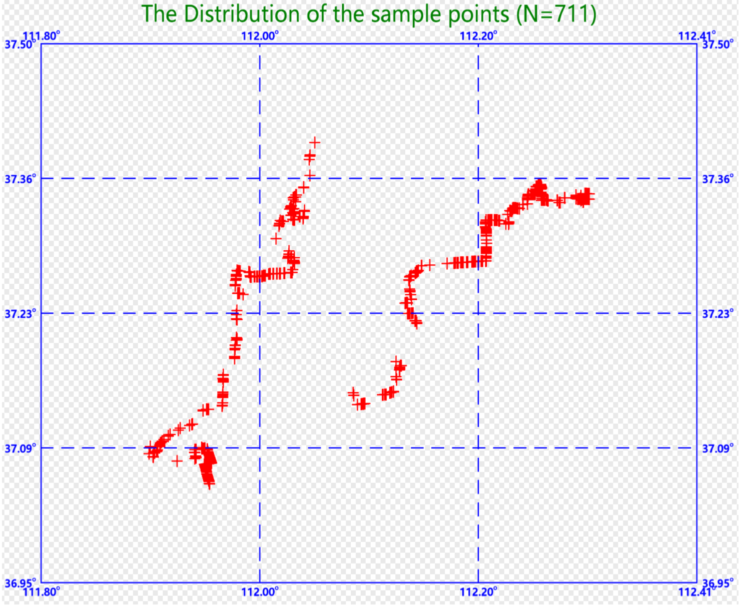
- Shanxi Site April 29-30,2022
- Jiansanjiang Site July 26-28,2022

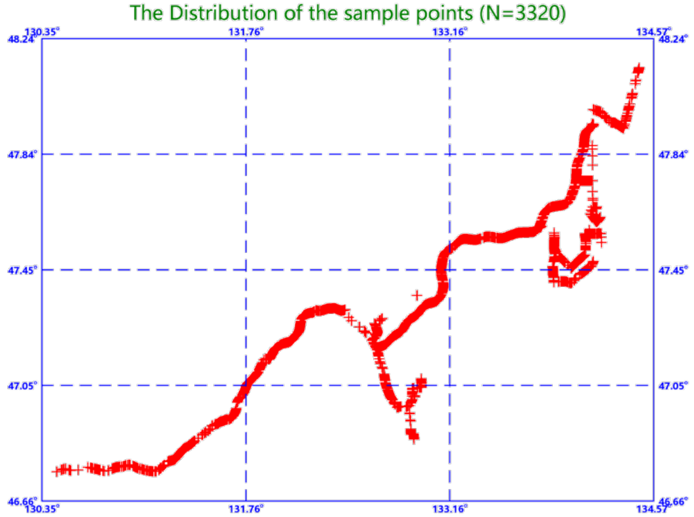
2023 Field Campaign

- Shanxi Site Feb 24-26,2023; May 28-29,2023; July 17-19, 2023;Aug 16-17,2023; Aug 23-24, 2023; Aug 31-Sep 1, 2023; Sep 6-7, 2023









EO Data Delivery

Data access (list all missions and issues if any). NB. in the tables please insert cumulative figures (since July 2020) for no. of scenes of high bit rate data (e.g. S1 100 scenes). If data delivery is low bit rate by ftp, insert "ftp"

ESA Missions	No. Scenes
1. Sentinel-1 A/B	**50**
2. Sentinel-2 A/B	**200**
3.	
4.	
5.	
6.	
Total:	
Issues:	

ESA Third Party Missions	No. Scenes
1. Landsat 8/9	**60**
2.	
3.	
4.	
5.	
6.	
Total:	
Issues:	

Chinese EO data	No. Scenes
1. GF-1	**40**
2. CBERS04	**20**
3. FY-3D MERSI	**200**
4. FY-3C VIRR	**200**
5. GF-3 SAR	**50**
6.	
Total:	
Issues:	

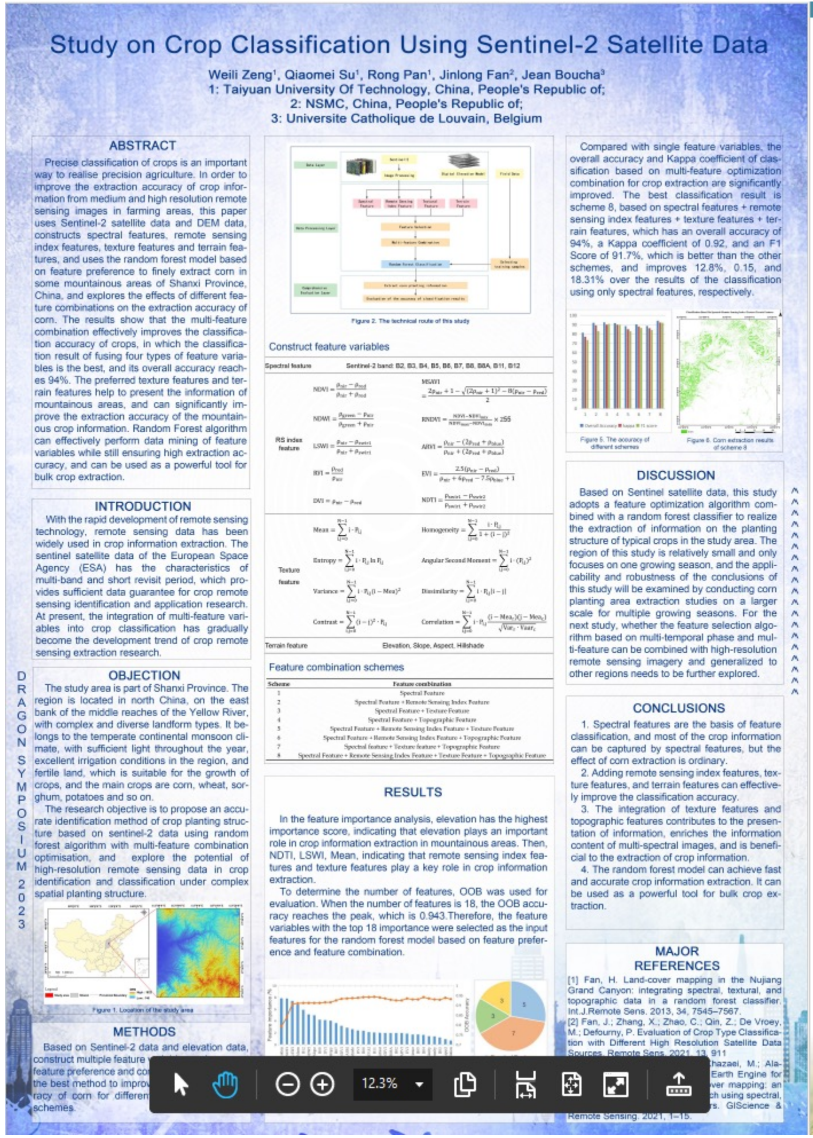
European Young scientists contributions in Dragon 5

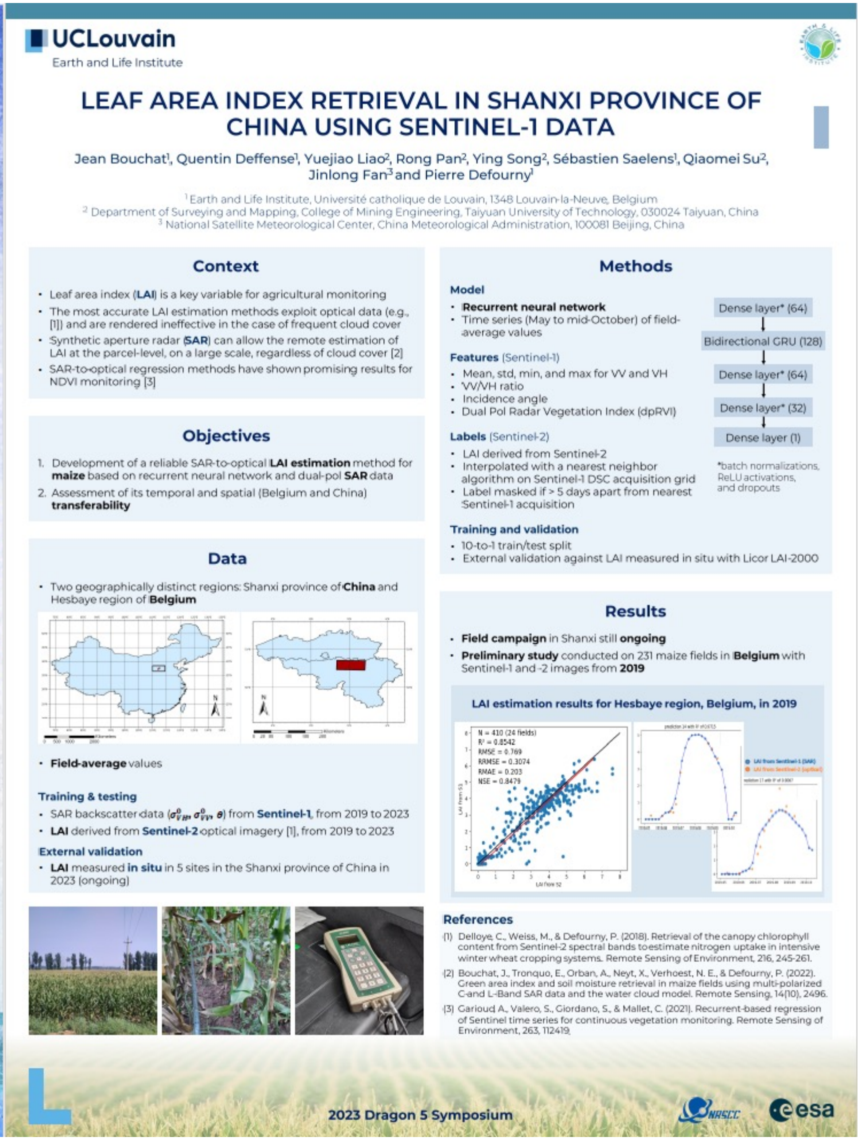
Name	Institution	Poster title	Contribution including period of research
Jean Bouchat	Universite Catholique de Louvain	Leaf Area Index Retrieval in Shanxi Province of China Using Sentinel-1 Data	Development of a reliable SAR-to-Optical LAI estimation method for Maize based on recurrent neural network and dual-pol SAR data; Assessment of its temporal and spatial transferability
Sebastien Saelens	Universite Catholique de Louvain	Leaf Area Index Retrieval in Shanxi Province of China Using Sentinel-1 Data	Development of a reliable SAR-to-Optical LAI estimation method for Maize based on recurrent neural network and dual-pol SAR data; Assessment of its temporal and spatial transferability

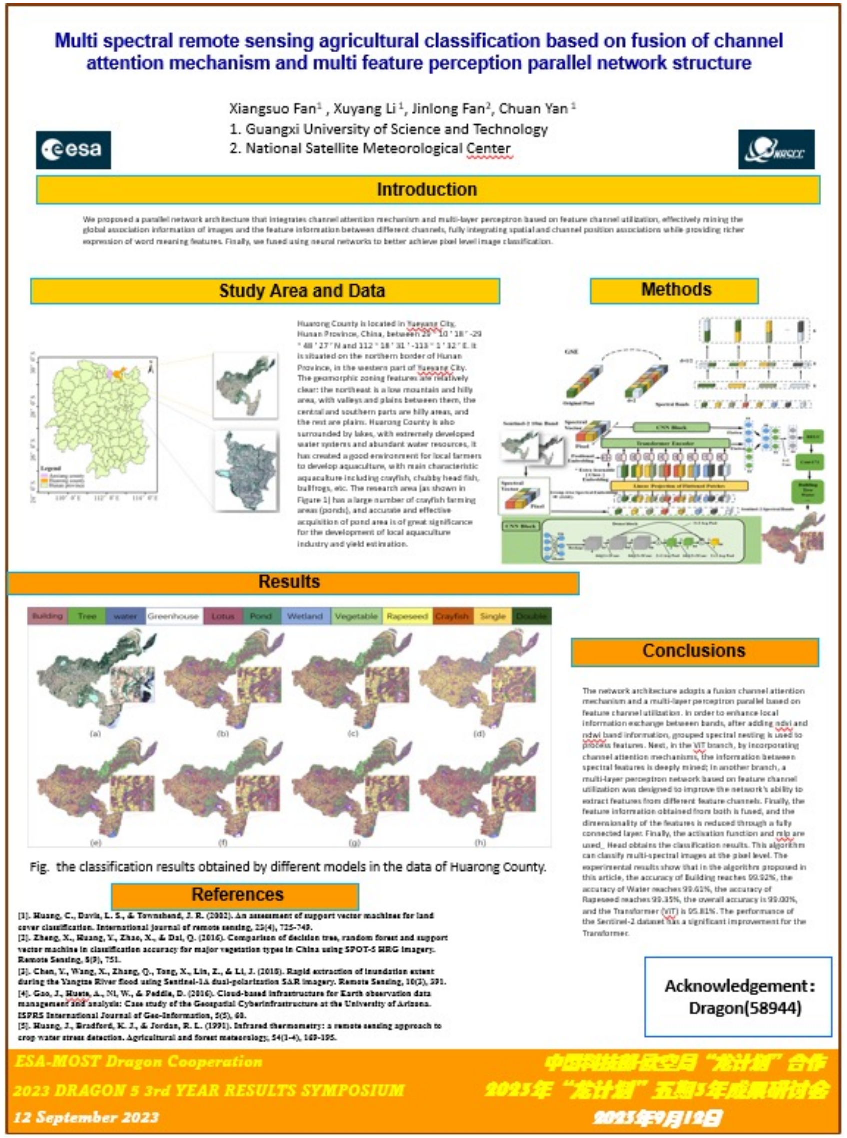
Chinese Young scientists contributions in Dragon 5

Name	Institution	Poster title	Contribution including period of research
Xiangsuo Fan (Ph. D, Ass. Prof.)	1. Guangxi University of Science and Technology	Multi spectral remote sensing agricultural classification based on fusion of channel attention mechanism and multi feature perception parallel network structure	Proposed a parallel network architecture integrating channel attention mechanism and multi-layer perceptron to provide richer expression of word meaning features.
Zeng Weili (Master)	1. Taiyuan University of Technology 2. National Satellite Meteorological Center	Study on Crop Classification Using Sentinel-2 Satellite Data	explores the effects of different feature combinations on the extraction accuracy of corn, using the random forest in the mountainous areas of Shanxi Province, China
Liao Yuejiao (Master)	1. Taiyuan University of Technology 2. National Satellite Meteorological Center	Study on Crop Classification Using Sentinel-2 Satellite Data	explores the effects of different feature combinations on the extraction accuracy of corn, using the random forest in the mountainous areas of Shanxi Province, China

Dragon 5 3rd Year Results Reporting



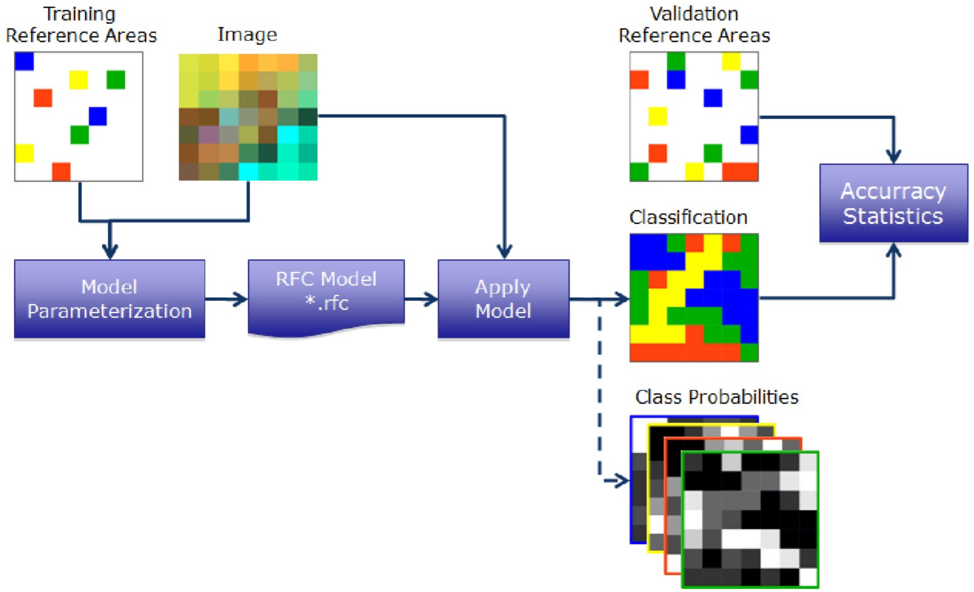


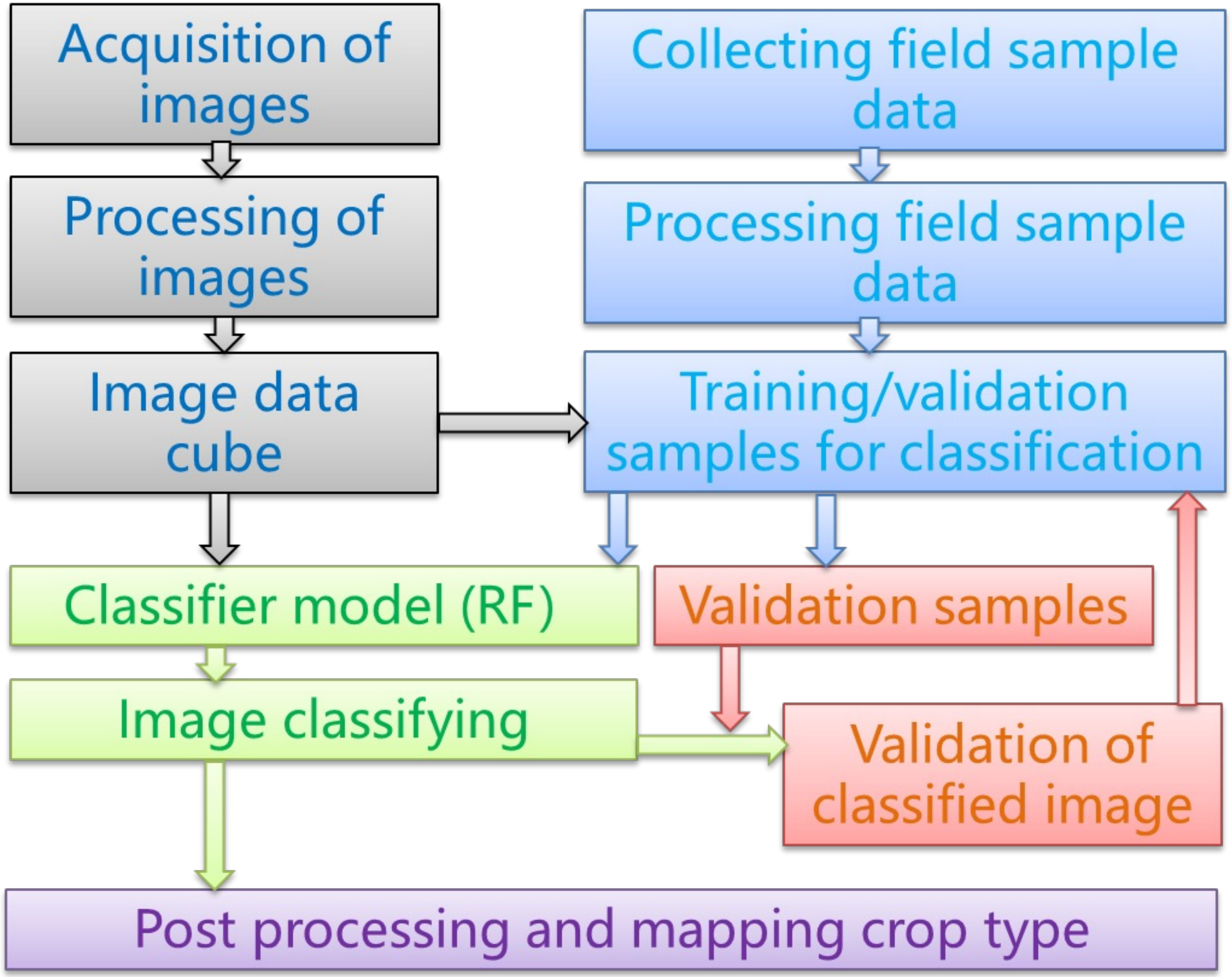


- Inform on the results after 3 years of activity
  - Crop Mapping with Chinese high resolution satellite data at provincial level
  - Mapping the flood affected crop area
  - Identifying the crop practices of conservation agriculture with Sen2Agri
  - Promoting the remote sensing application in large and modern farm

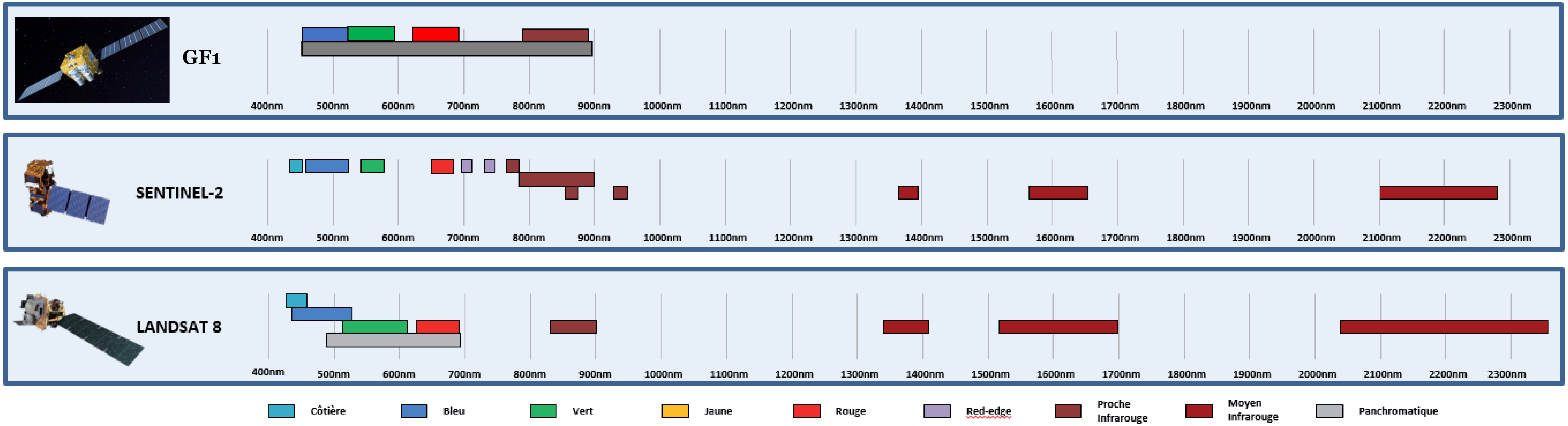
Crop Mapping Key steps

- **Remote sensing data processing**
- **Training sample collection and evaluation**
- **Classification algorithm and application**
- **Validation and feedback**
- **Post classification and noise filtering**





Spectra of high-resolution satellite data



L8 https://earthexplorer.usgs.gov

Sentinel https://scihub.copernicus.eu/

GF http://218.247.138.119:7777/DSSPlatform/index.html

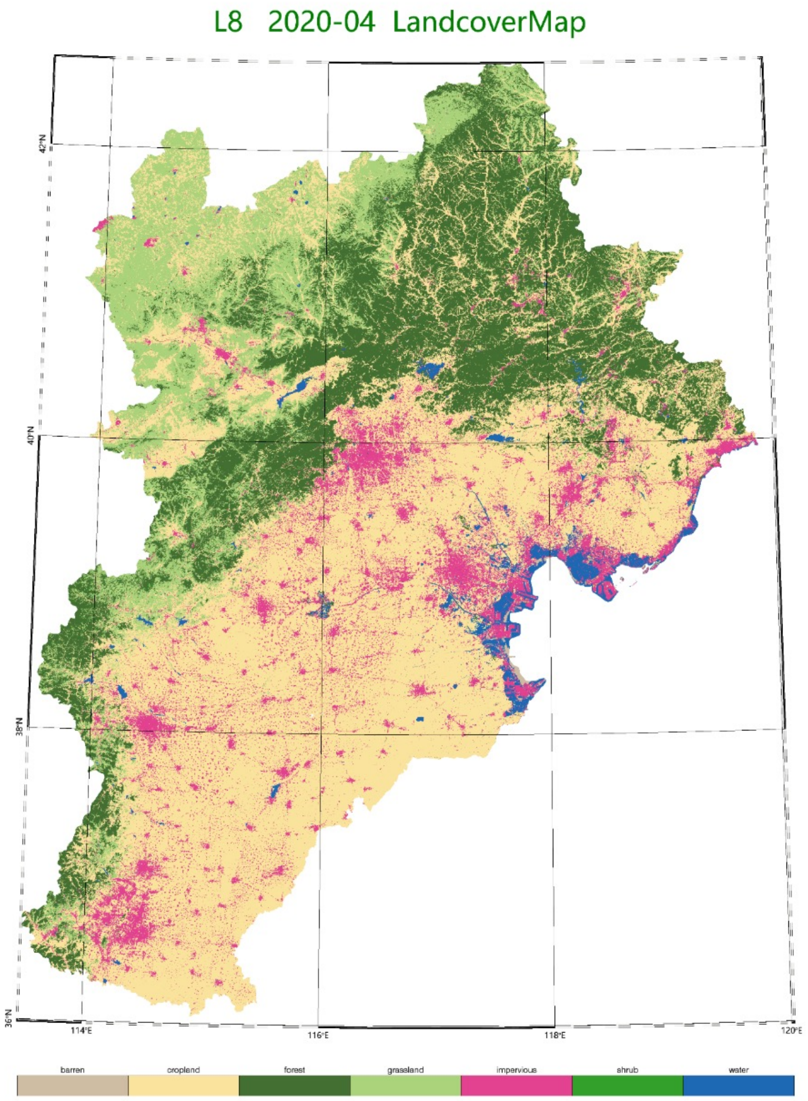
MODIFIED on @J. BRIAN

1 Crop Mapping with Chinese high resolution satellite data at provincial level

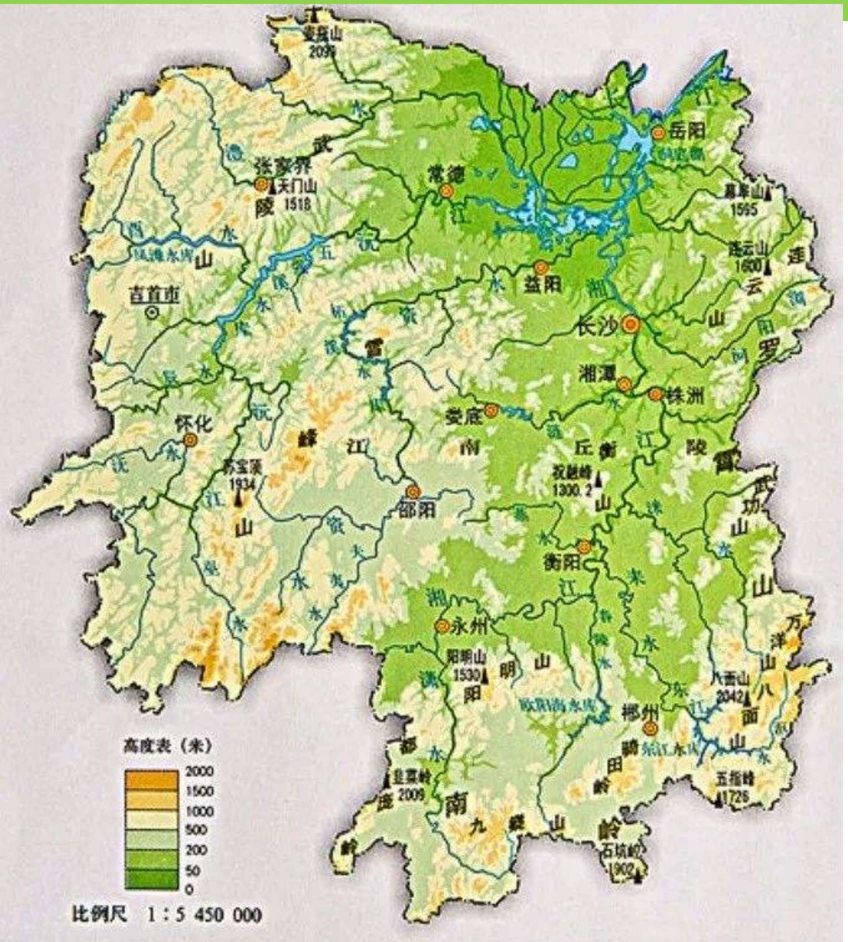
Mapping Land Cover

Beijing, Tianjin and Hebei

- Landsat 8 data
- Cloud free image by spatial Mosaic and temporal composite
- Training samples collected from published products



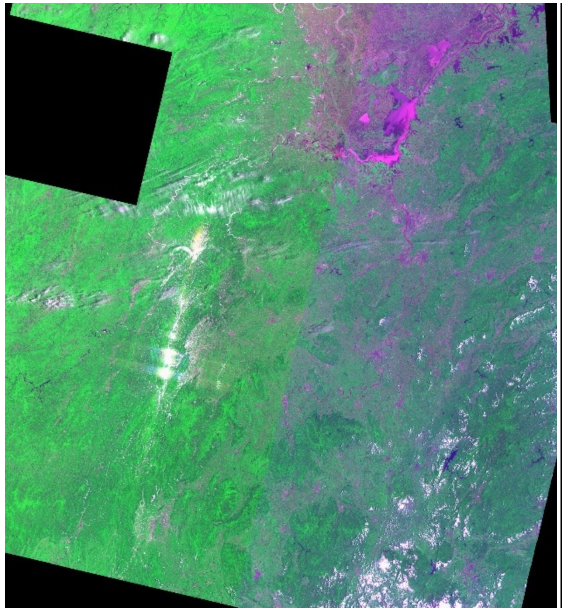
1 Crop Mapping with Chinese high resolution satellite data at provincial level



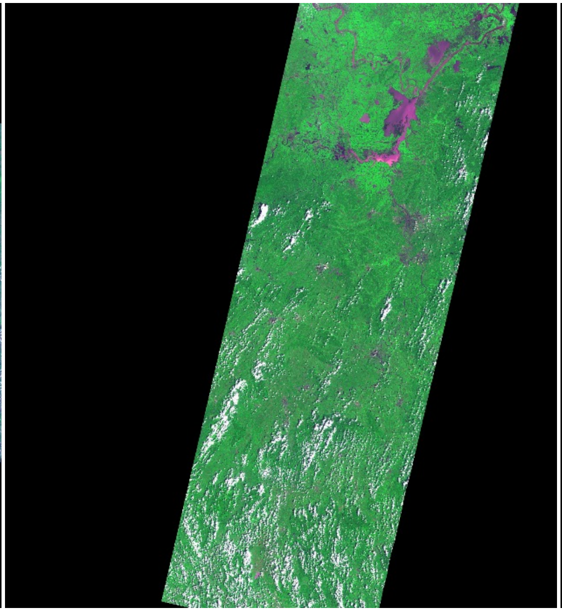
Hunan Province

- From Jan 3 to Oct 23, 2021, 341 scenes images of GF-1 in 91 of 284 days
- The best coverage was made on June 5, 2021

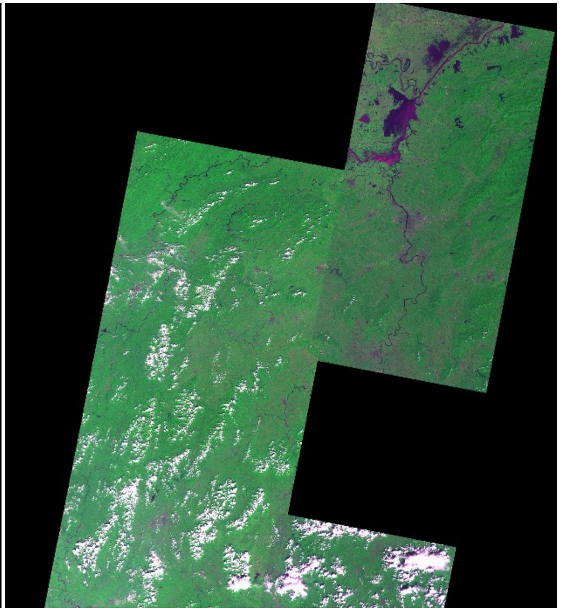
Single day mosaic of GF-1 WFV



June 5 2021



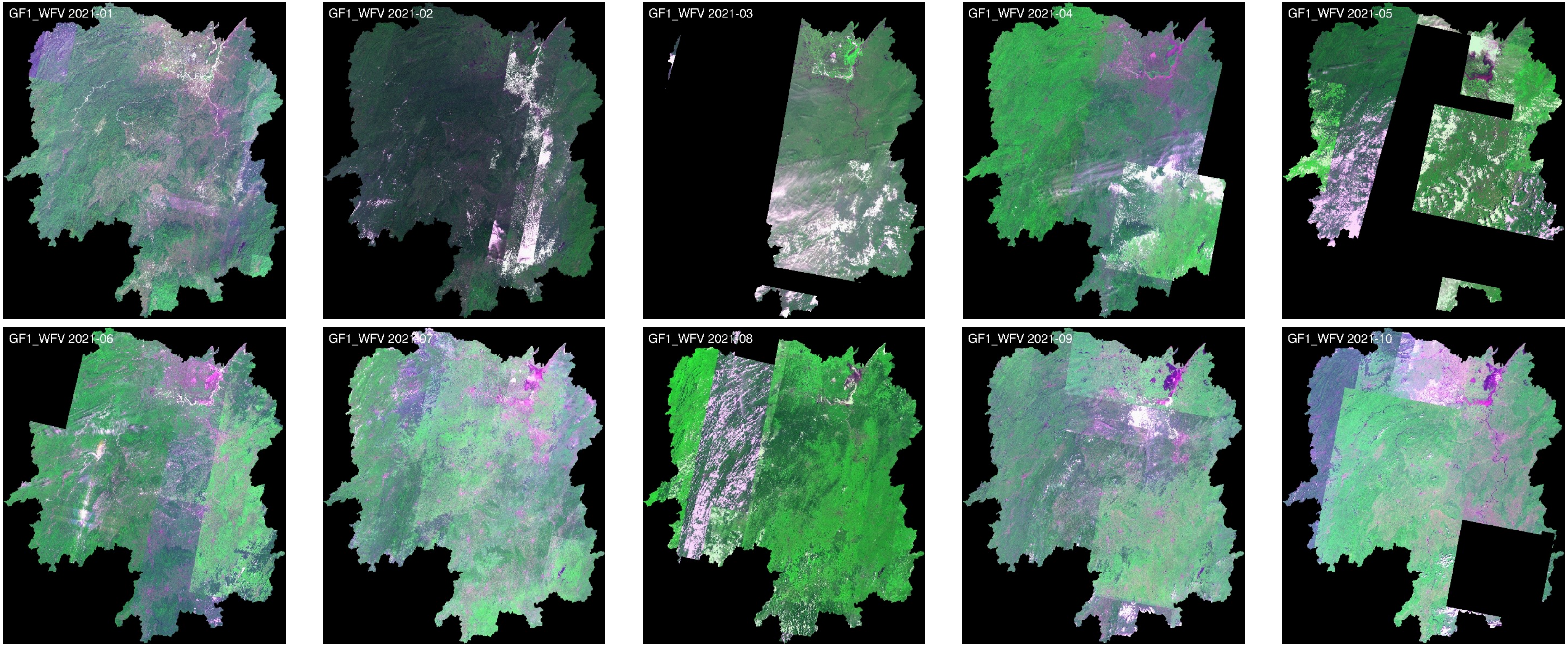
August 30 2021



October 1 2021

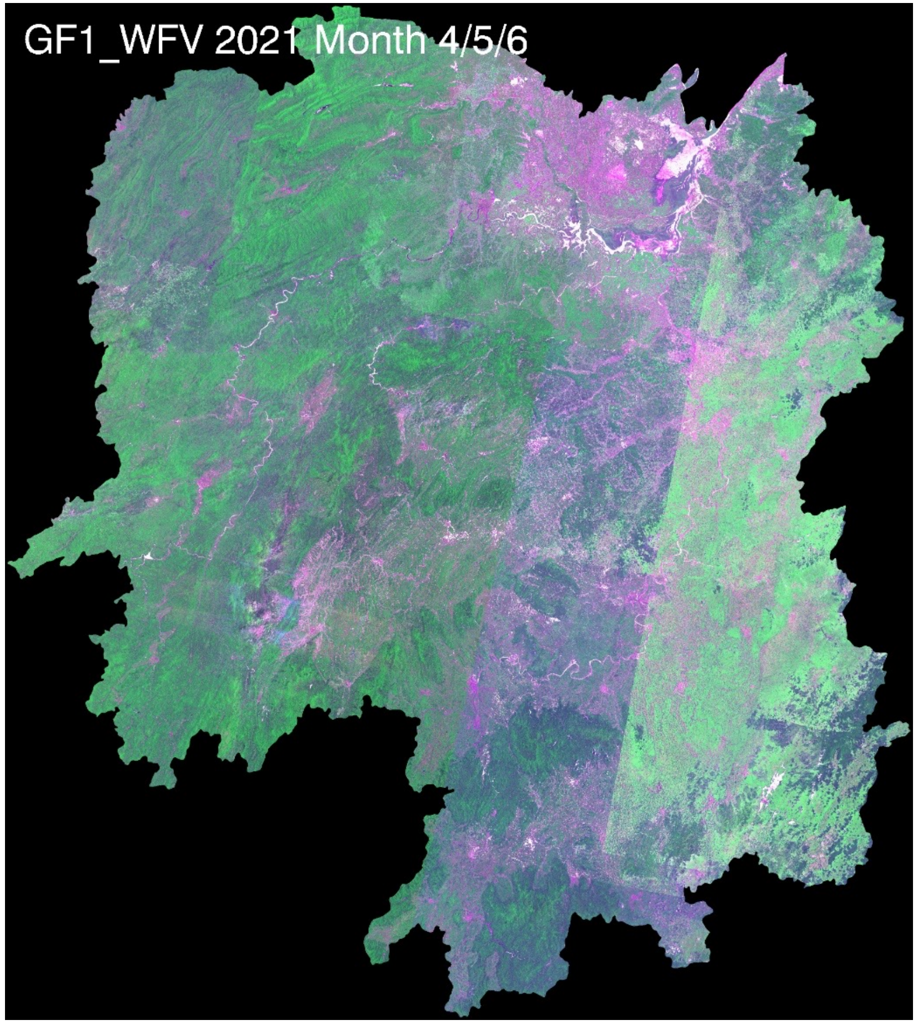
1 Crop Mapping with Chinese high resolution satellite data at provincial level

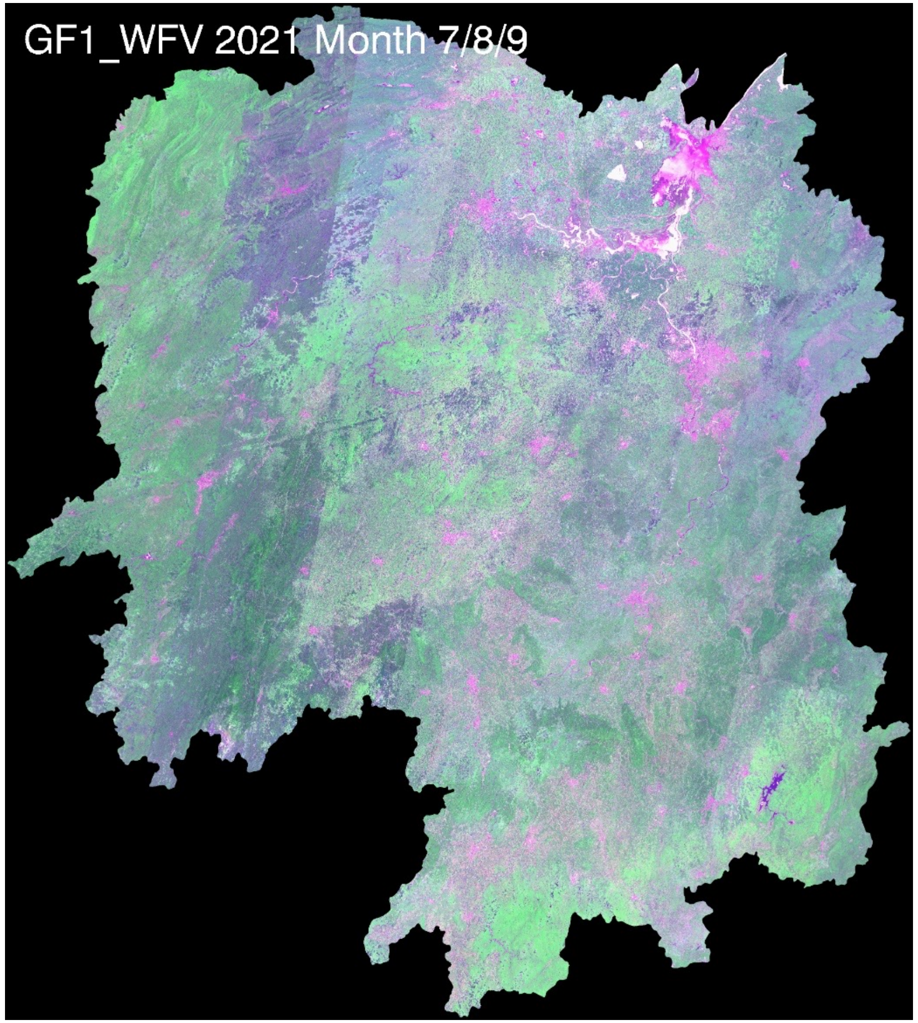
Monthly mosaic of GF-1 WFV



1 Crop Mapping with Chinese high resolution satellite data at provincial level

Seasonally mosaic of GF-1 WFV





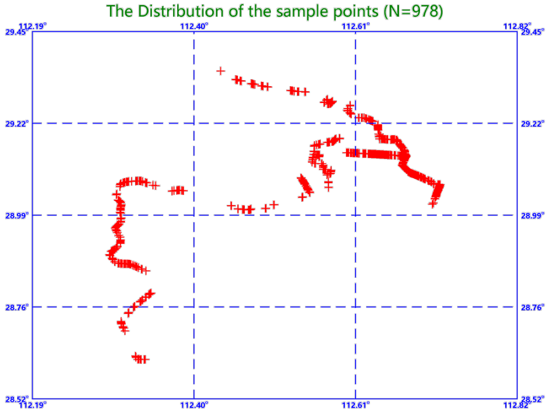
Dragon 5 3rd Year Results Reporting

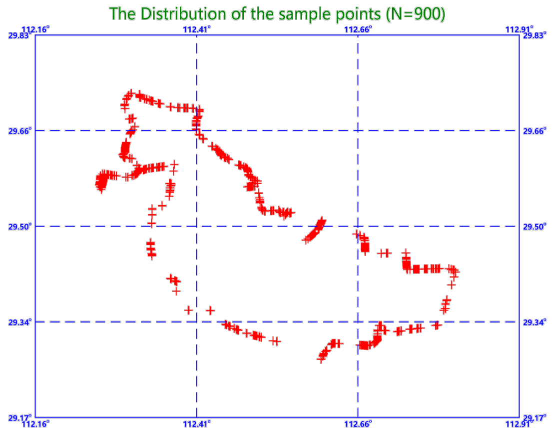
1 Crop Mapping with Chinese high resolution satellite data at provincial level

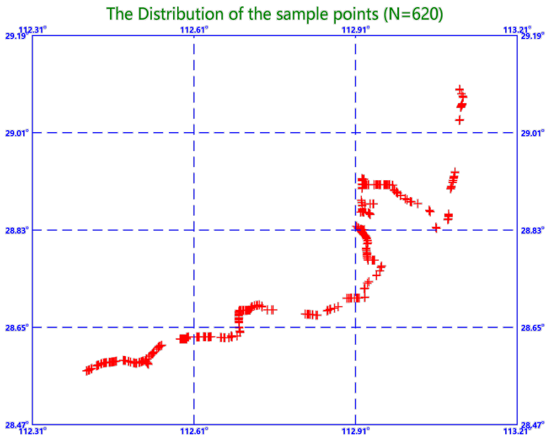
Field Survey

In early Nov. 2021， 3 students visited the Dongting lake area in Huanan province

- Collected +2500 photo samples with GPS location
- Understand the summer crop and autumn crop practices





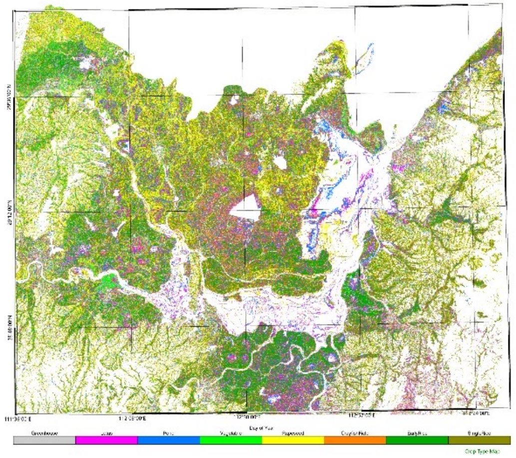


1 Crop Mapping with Chinese high resolution satellite data at provincial level

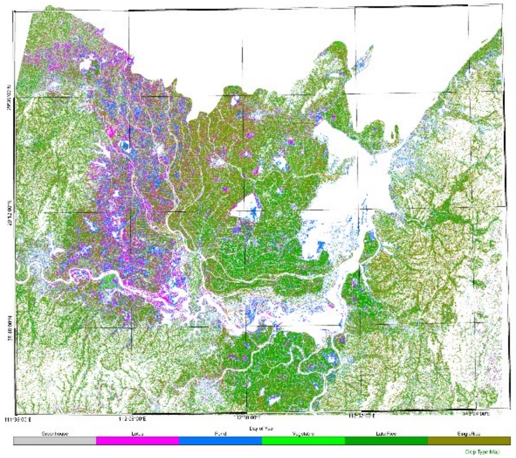
Training sample pixel counts

Classes	Summer Crop	Autumn Crop
Built-up	2363	2257
Shrub and Tree	7650	7767
Water Body	11942	12099
GreenHouse	1481	1729
Lotus	1081	1289
Fish Pond	3092	2955
Wetland	5492	5724
Vegetable	510	529
Rapeseeds	1110	
Shrimp Field	2331	
Early/Later Rice	1577	2032
Single Rice	2136	4492
Total	40765	40873

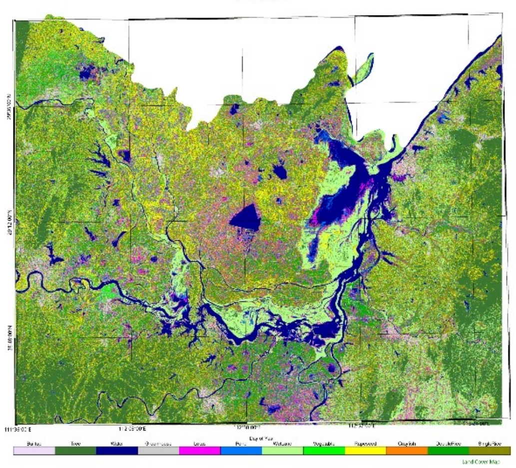
Crop Type Map in Spring for Dongting



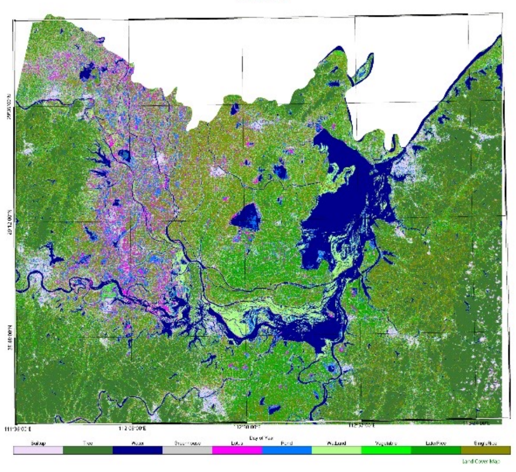
Crop Type Map in Autumn for Dongting



Landcover Map in Spring for Dongting

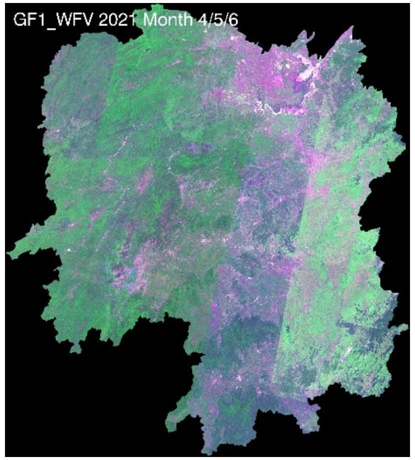


Landcover Map in Autumn for Dongting

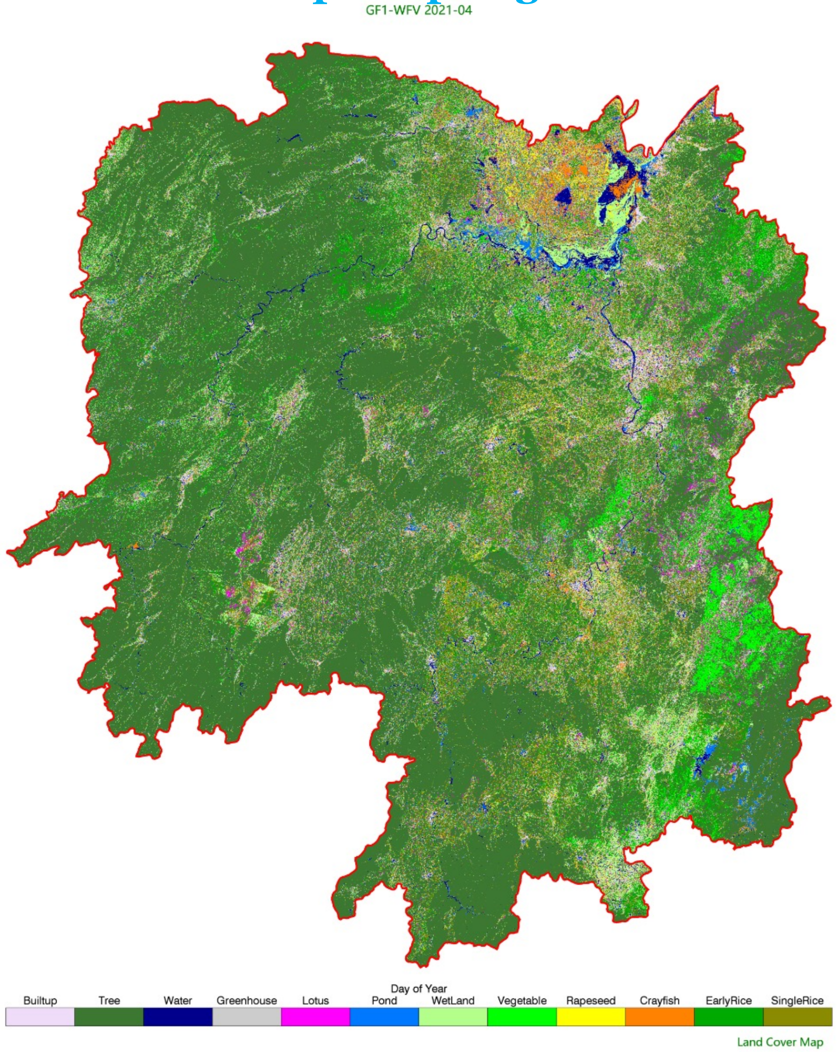


1 Crop Mapping with Chinese high resolution satellite data at provincial level

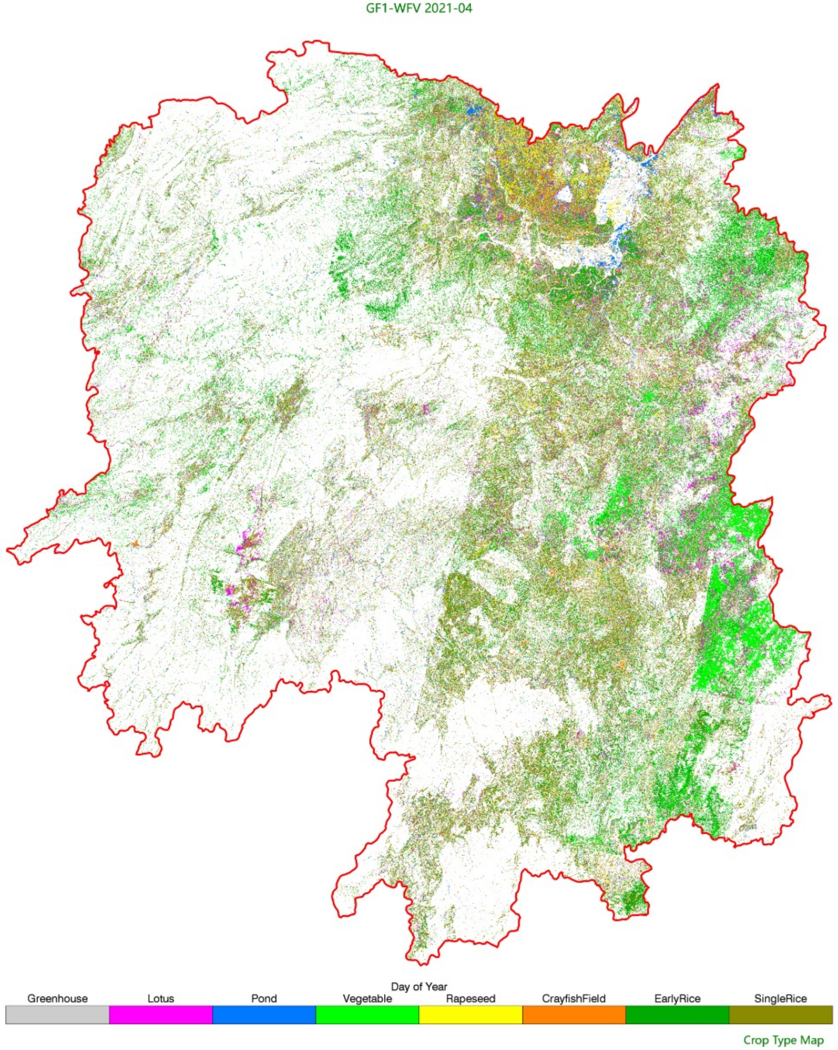
Input Image



Landcover Map in Spring for Hunan

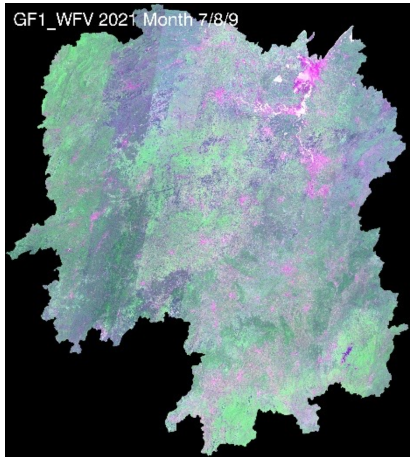


Crop Type Map in Spring for Hunan

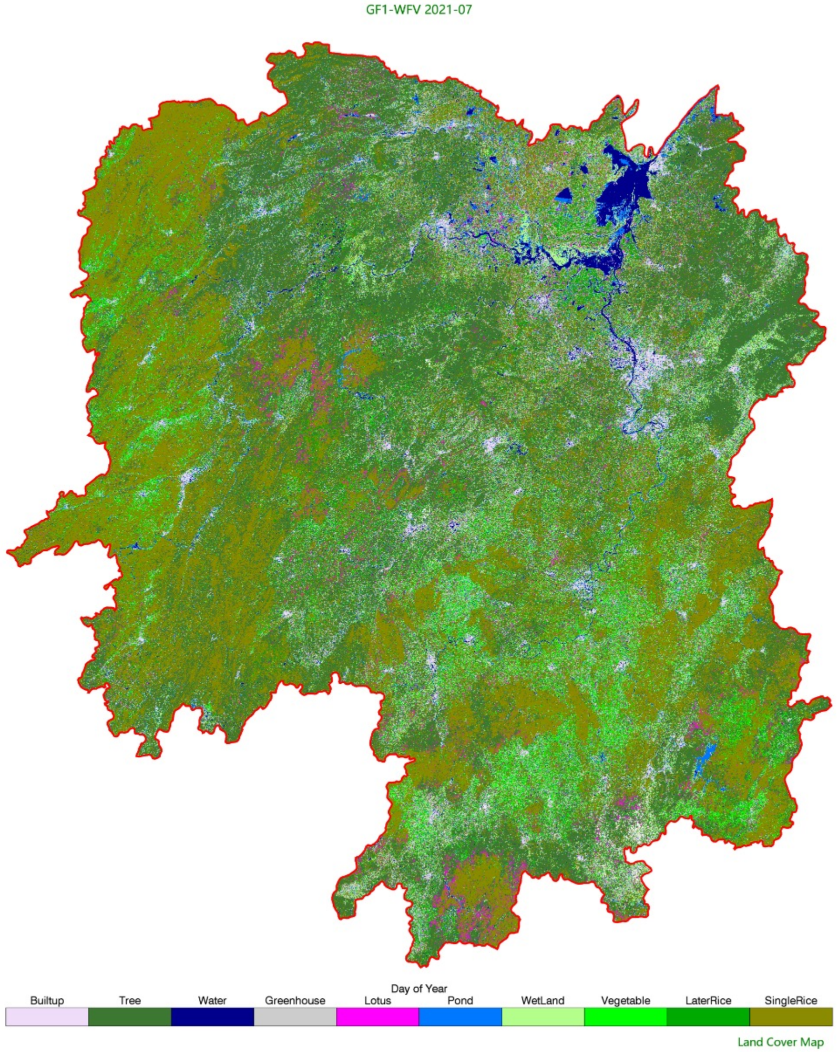


1 Crop Mapping with Chinese high resolution satellite data at provincial level

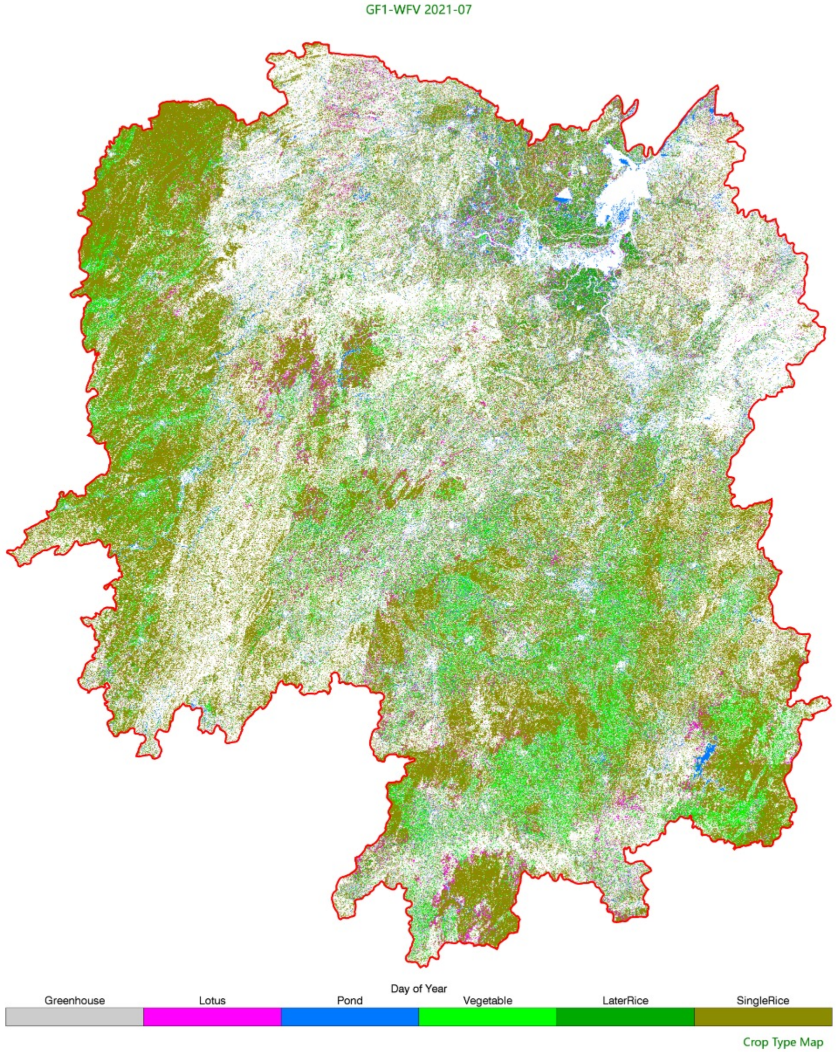
Input Image



Landcover Map in Autumn for Hunan



Crop Type Map in Autumn for Hunan

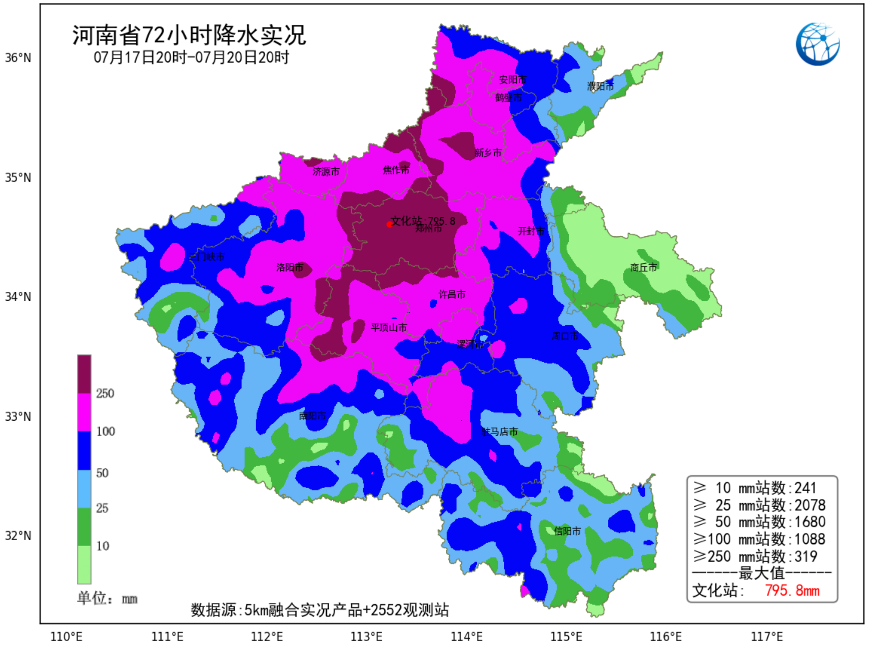


2 Mapping the flood affected crop area

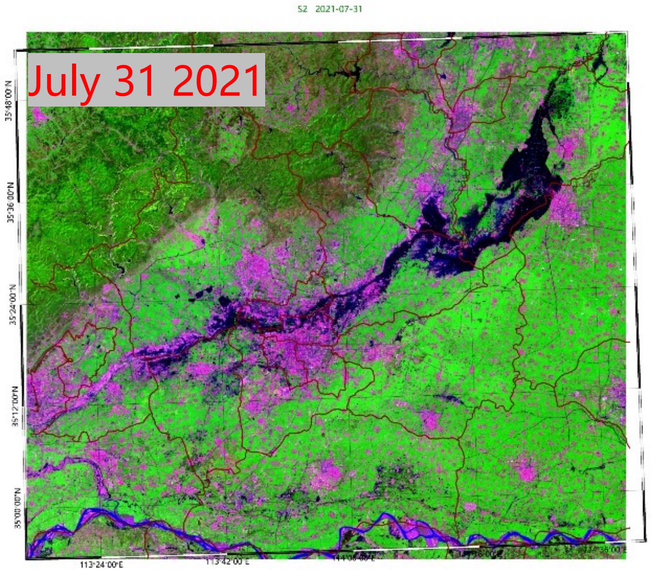
Henan 7.21 Flood 2021

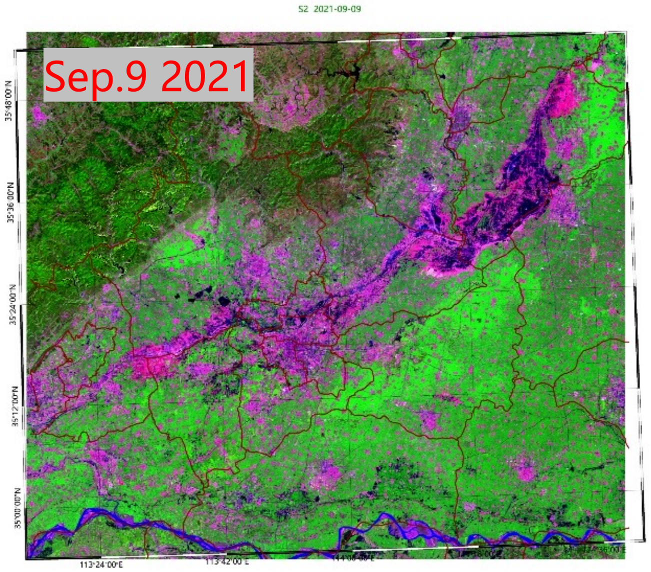
July 17-22, 2021

- 696.9 mm per day on July 20 in Zhengzhou & 640 mm annual

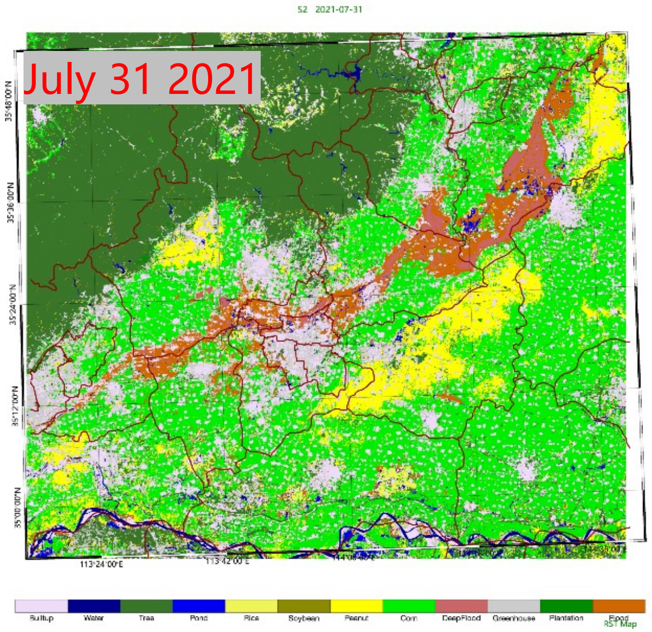


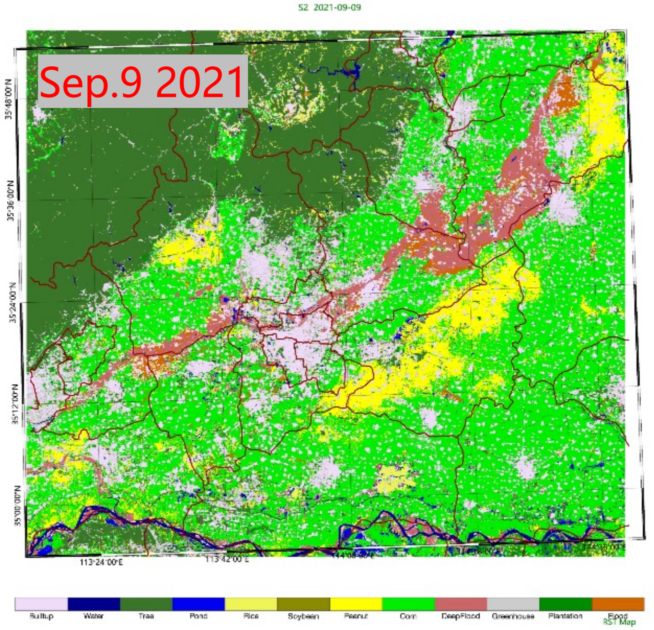
Satellite Images





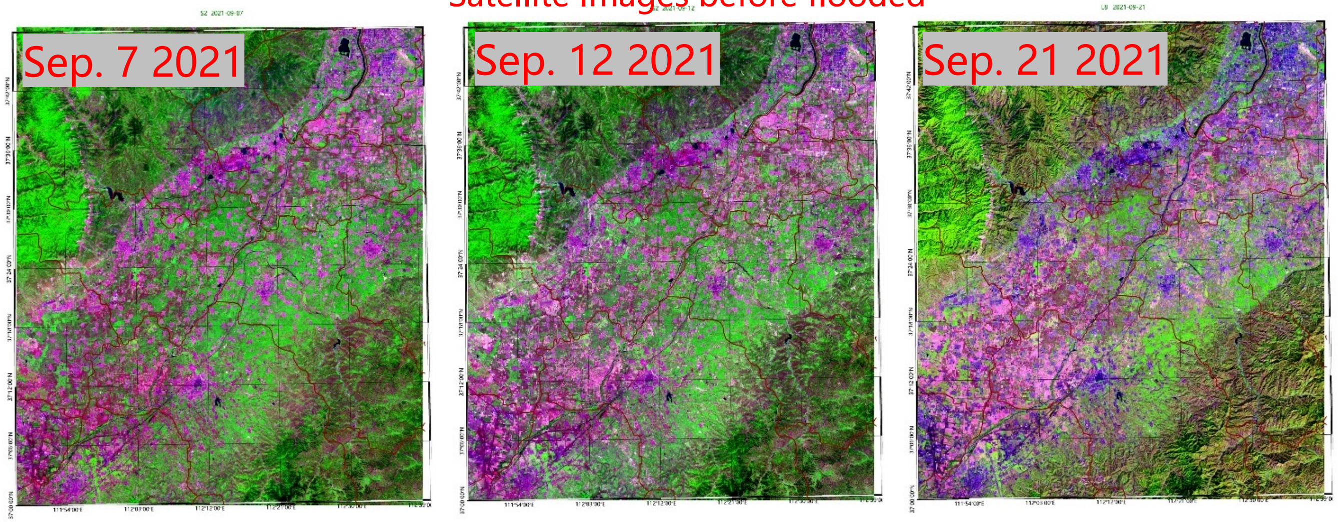
Flood situation Map



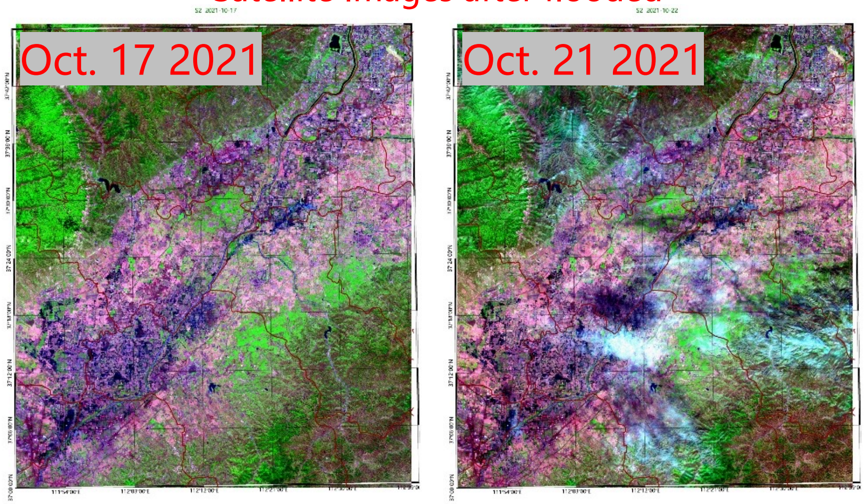


2 Mapping the flood affected crop area

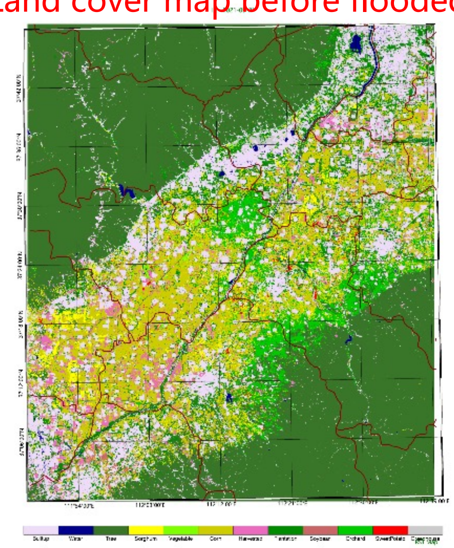
Satellite Images before flooded



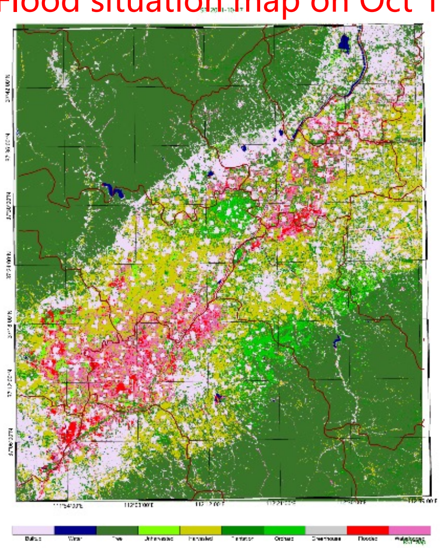
Satellite Images after flooded



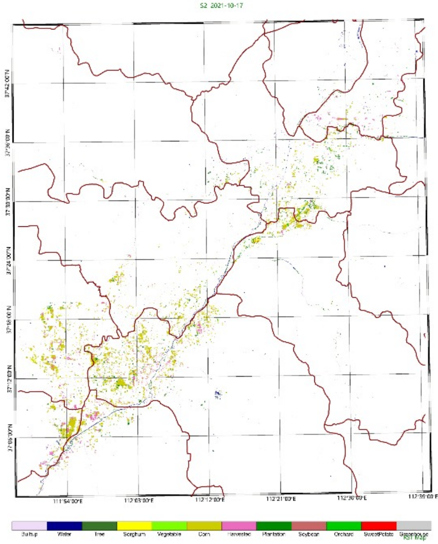
Land cover map before flooded



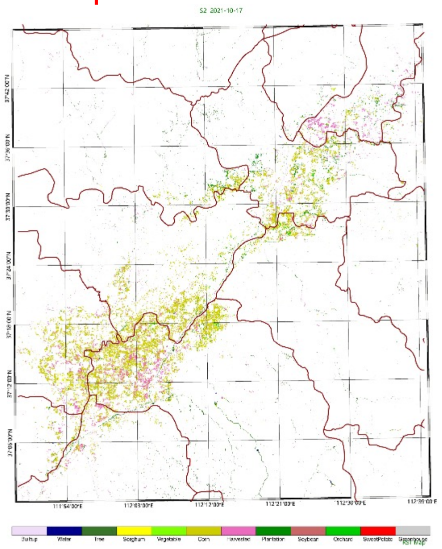
Flood situation map on Oct 17



Crops in deep water



Crops in shallow water



Shanxi Fall Flood, 2021

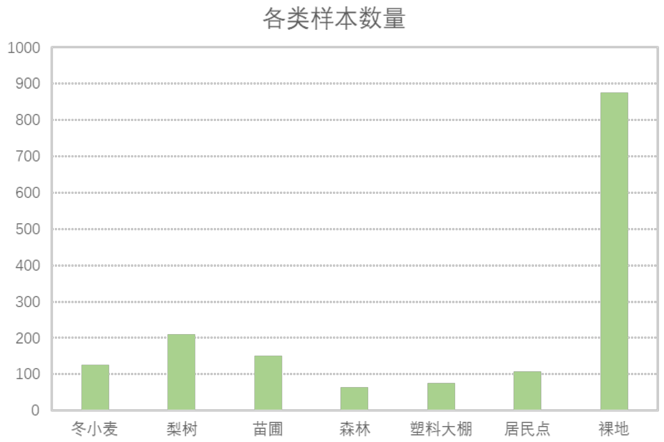
Oct 2-7, 2021

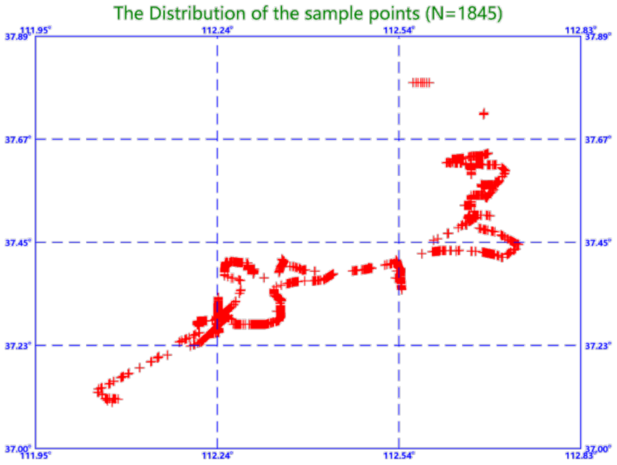
- 100-250 mm

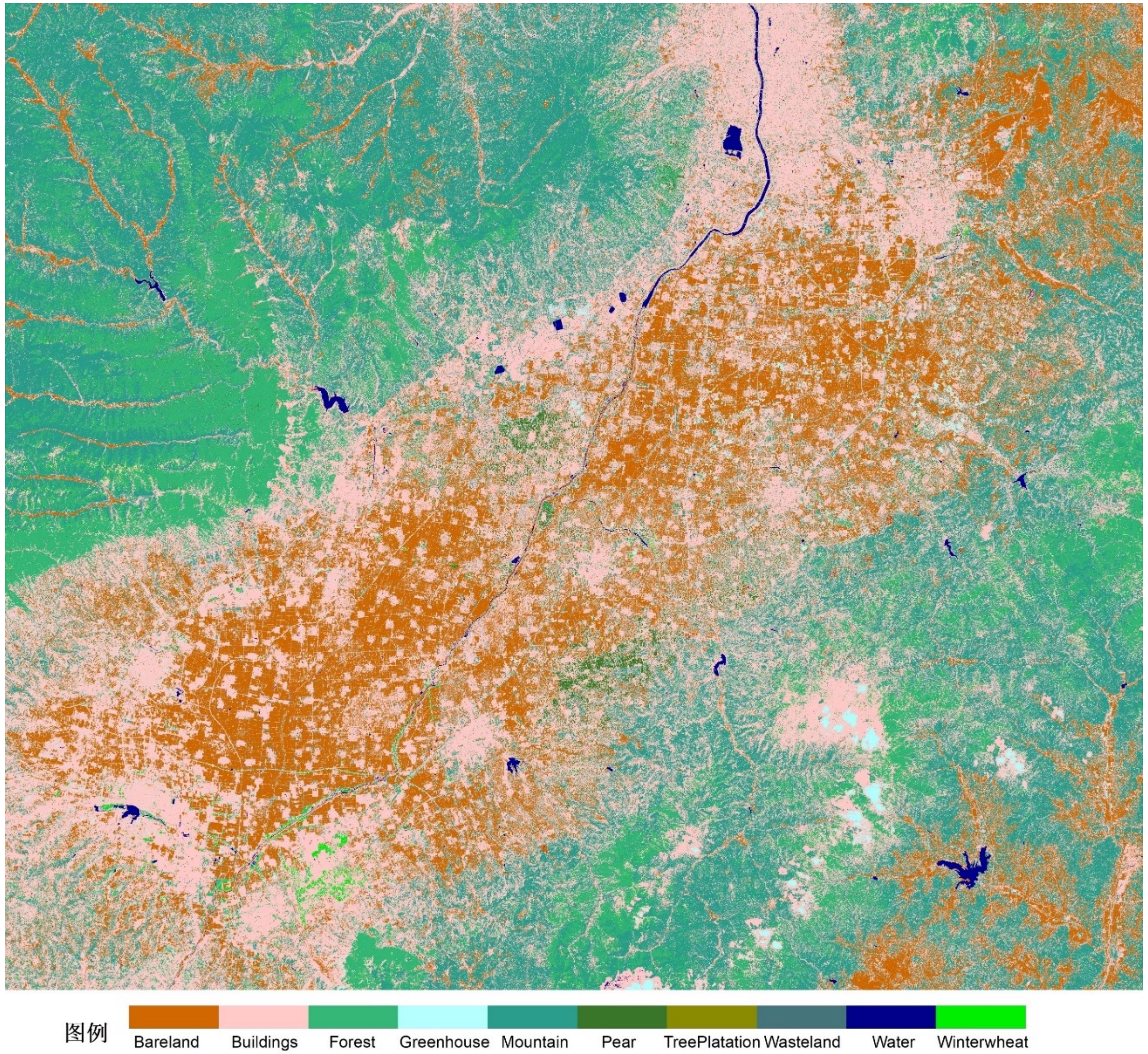
3 Identifying the crop practices of conservation agriculture

Bare soil period duration

- conservation agriculture
- Soil wind erosion

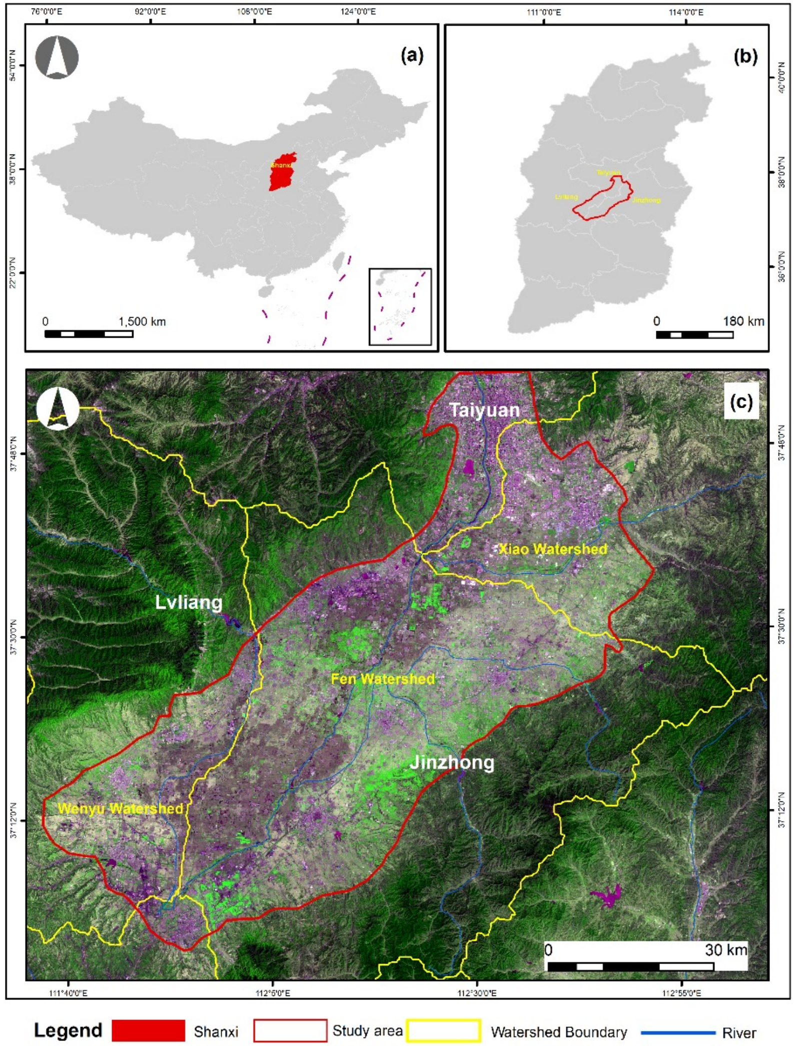




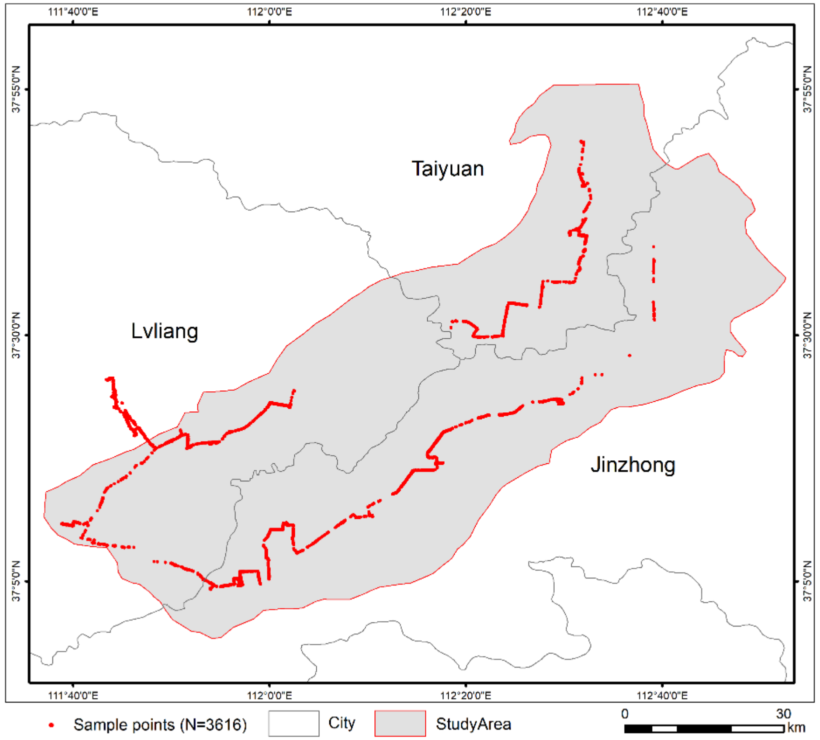


Source: Sentinel-2 April 25, 2022

3 Identifying the crop practices of conservation agriculture



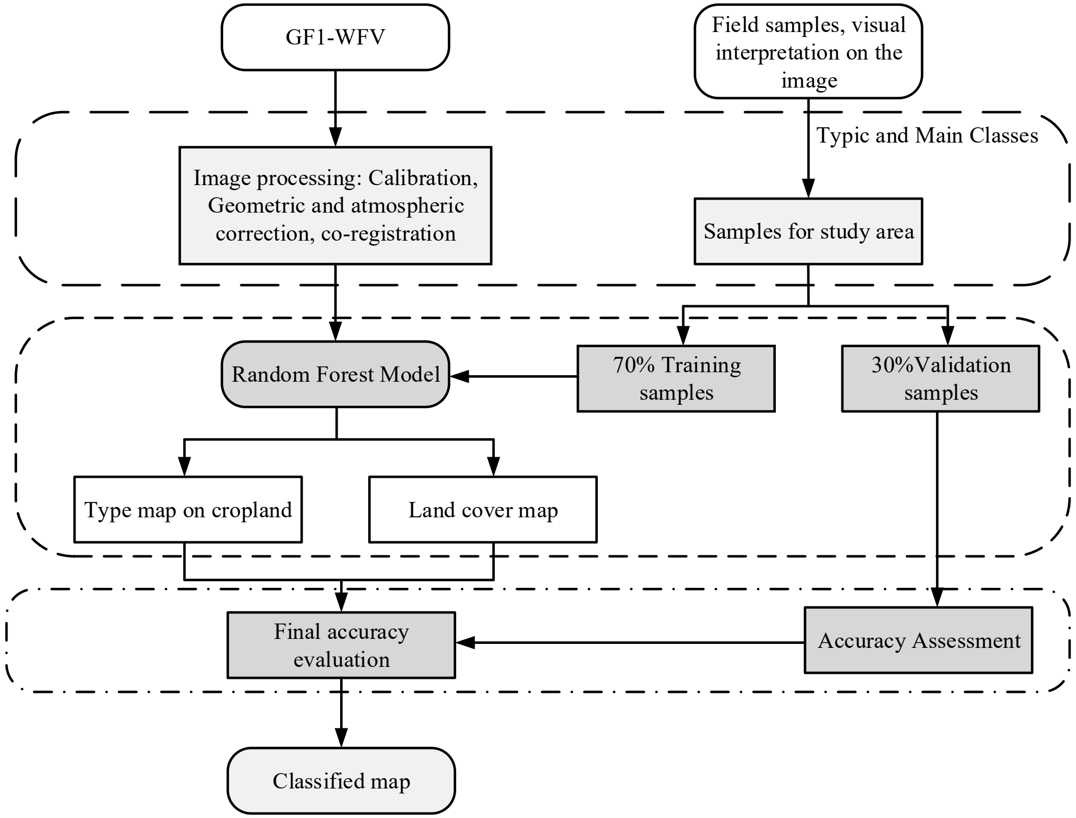
Identifying the Farm Fields Irrigated out of season with GF-1 Satellite Images



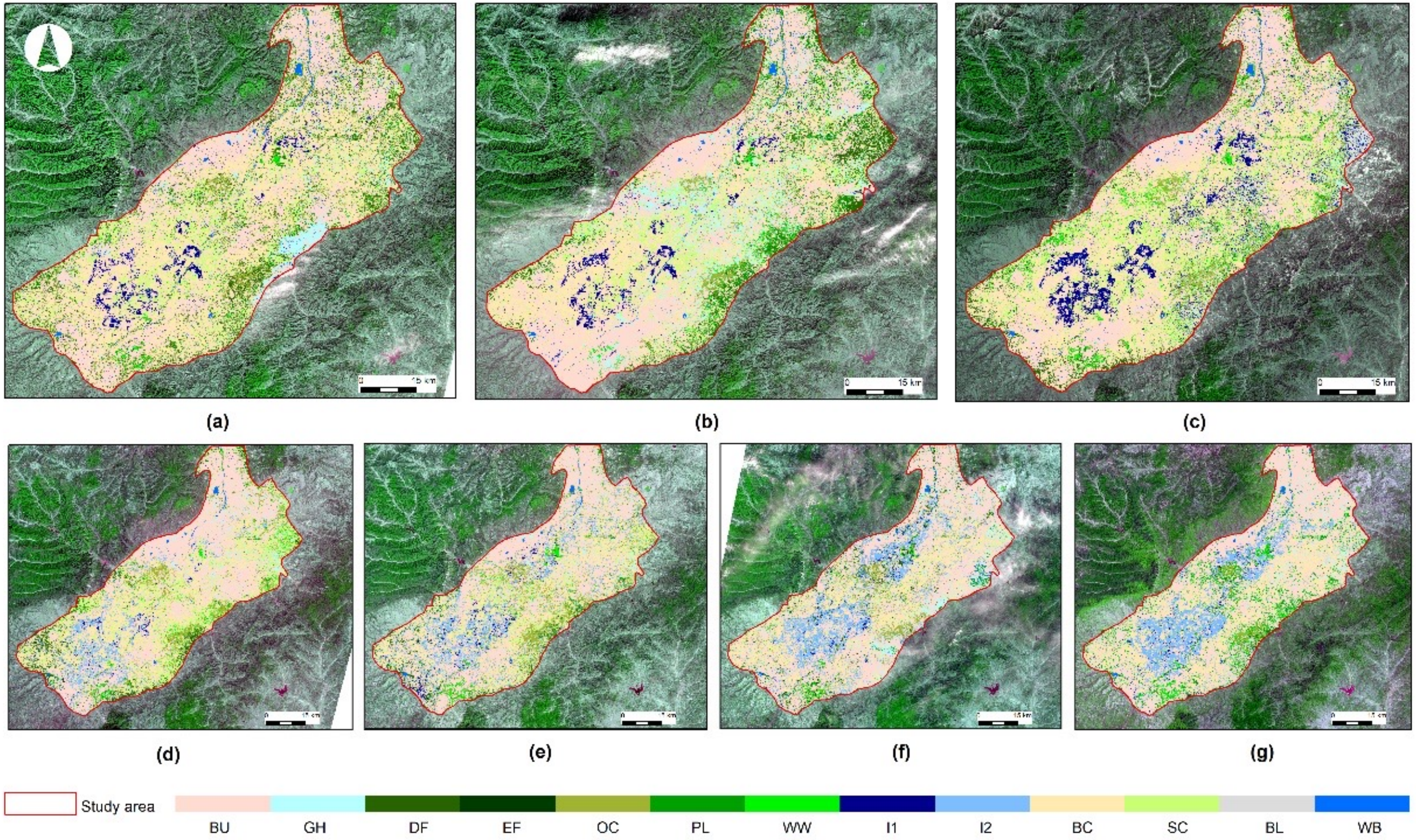
GF-1 Satellite Images

No.	Date
1	2022/12/27
2	2023/01/04
3	2023/01/25
4	2023/03/03
5	2023/03/27
6	2023/04/08
7	2023/04/29

Dragon 5 3rd Year Results Reporting



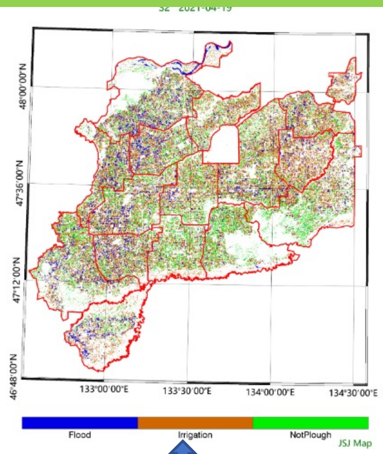
	Class	Acronym	Description
Cropland	Irrigation 1	I1	Waterlogged or Frozen field after irrigation
	Irrigation 2	I2	Field with high soil moisture after irrigation
	Winter Wheat	WW	Winter wheat field
	Straw Covered Cropland	SC	Cropland covered by the straw or other residues out of season
	Bare Cropland	BC	Bare and no covered cropland out of season
	Greenhouse	GH	Greenhouse for vegetable or other cash crops
	Orchards	OC	Fruit trees plantation
	Plantation	PL	Cropland planted with wood or shrub trees
Non Cropland	Built-up	BU	Artificial area including building, road, and factory
	Barren Land	BL	No vegetation covered area in rock mountain
	Deciduous Forest	DF	Deciduous tree and shrub
	Evergreen Forest	EF	Coniferous tree and shrub
	Water Body	WB	Lake, River, Dam, and other Water body


(a)
(b)
(c)
(d)
(e)
(f)
(g)
Study area
BU
GH
DF
EF
OC
PL
WW
I1
I2
BC
SC
BL
WB

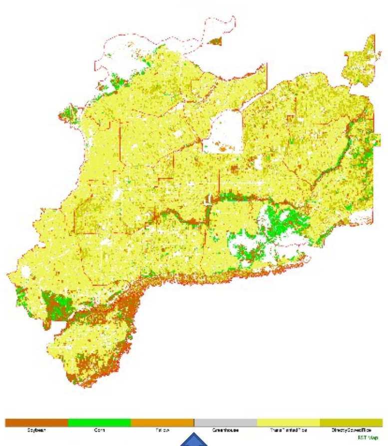
		Fen River		Wenyu River		Xiao River	
Date	sum	I1	I2	I1	I2	I1	I2
2022/12/27	98.6	65.8	-	22.9	-	9.9	-
2023/01/04	166.9	115.1	-	33.9	-	17.9	-
2023/01/25	208.0	143.1	-	37.6	-	27.3	-
2023/03/03	292.8	10.2	166.1	3.4	98.5	1.1	13.5
2023/03/27	538.0	6.2	306.4	1.3	166.0	0.3	57.8
2023/04/08	623.1	9.4	436.2	0.7	107.2	0.3	69.3
2023/04/29	653.8	5.8	453.1	1.1	120.5	0.9	72.4

Dragon 5 3rd Year Results Reporting

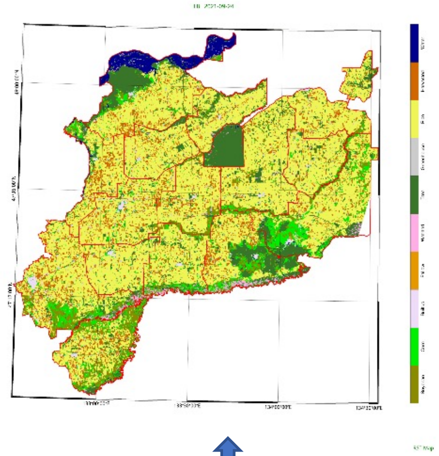
4 Promoting the remote sensing application in large and modern farm



Multiple images of field preparation



Crop type map



Harvest and plough maps

Middle April to Middle May – **Field Preparation**

Middle June to Middle July – **Crop Type Maping**

Middle Sep. to end Oct. – **Harvest and plough**

农场	平地泡田	灌水未整地	未耕作
	4/19 S2A		
创业农场	22%	59%	19%
大兴农场	24%	60%	16%
红卫农场	11%	53%	36%
洪河农场	13%	59%	27%
浓江农场	23%	56%	20%
七星农场	19%	54%	26%
前锋农场	16%	62%	22%
前进农场	20%	56%	24%
前哨农场	16%	68%	16%
胜利农场	10%	48%	42%
八五九农场	12%	52%	36%
二道河农场	18%	70%	12%
勤得利农场	29%	49%	22%
青龙山农场	22%	58%	20%
鸭绿河农场	11%	65%	24%

Statistics for every farm

2021年建三江各农场农作物遥感面积

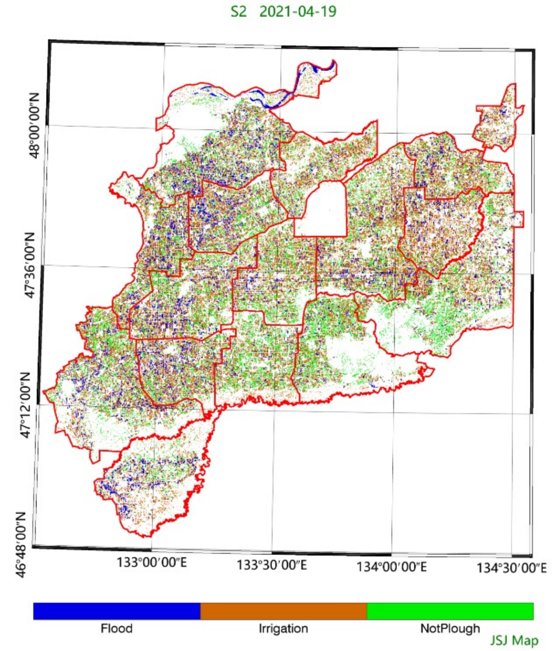
水稻种植方式遥感监测结果				
插秧稻（万亩）	直播稻（万亩）	水稻（万亩）	大豆（万亩）	玉米（万亩）
53.9	3.0	56.9	6.6	13.3
48.7	8.6	57.2	4.7	3.3
89.5	24.8	114.3	8.1	3.1
58.6	9.6	68.2	7.5	1.3
57.7	3.4	61.2	2.1	1.9
81.5	14.2	95.7	5.1	6.0
59.1	4.7	63.9	0.1	0.0
44.5	6.8	51.3	2.7	0.2
72.5	17.5	90.0	1.7	0.4
55.3	5.2	60.5	0.3	0.2
105.7	3.2	108.9	14.9	13.1
51.6	2.8	54.4	24.7	13.2
74.0	29.3	103.2	15.9	26.9
47.5	11.4	58.8	2.5	2.9
46.2	30.0	76.2	3.0	1.0
946.4	174.5	1120.8	99.9	86.7

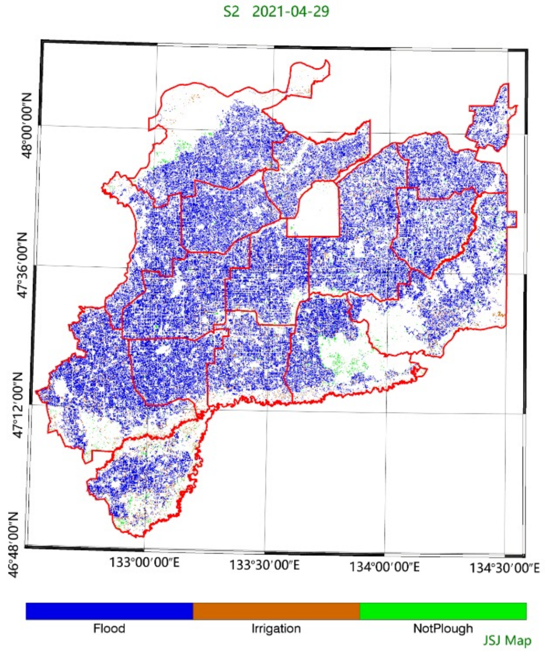
Cultivated acreages for paddy rice and dryland crops

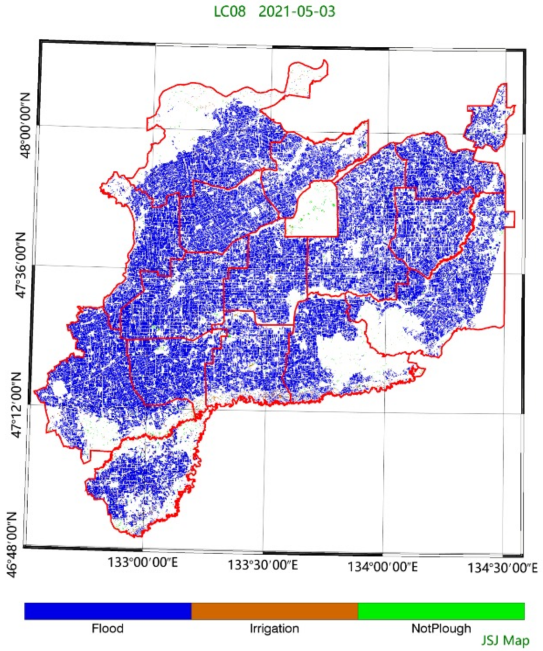
农场	水稻收获占比(9.24)
胜利	20.4%
红卫	8.8%
前锋	4.6%
洪河	12.7%
青龙山	19.4%
勤得利	14.8%
浓江	12.3%
鸭绿河	5.5%
前进	16.9%
创业	10.8%
七星	19.4%
大兴	18.7%
八五九	8.5%
二道河	6.3%
前哨	9.5%
平均	12.6%

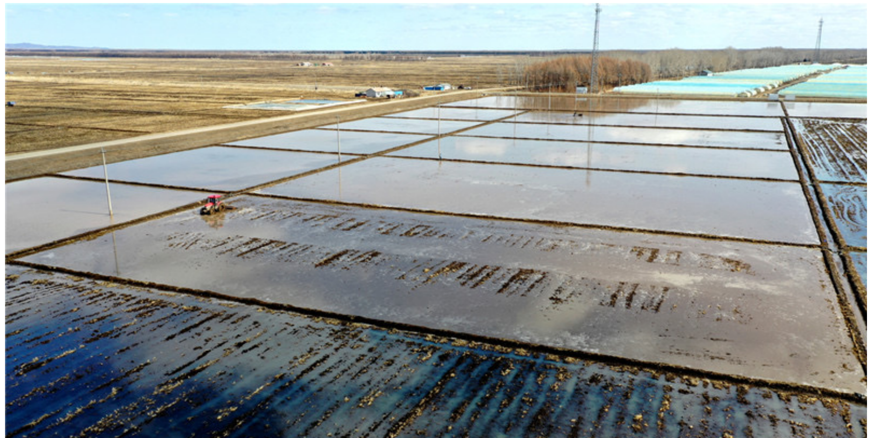
Statistics for Harvest and plough in fall

Re



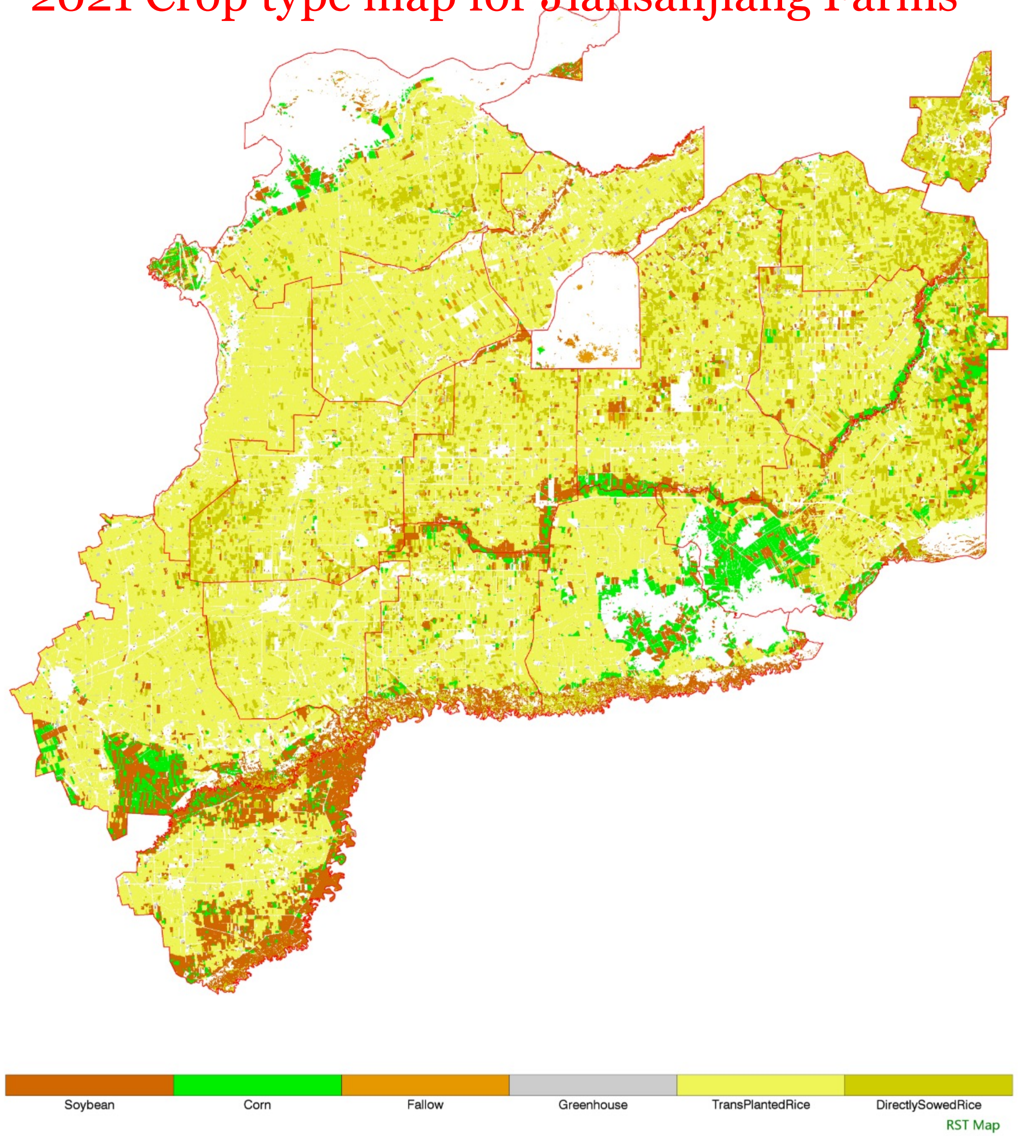




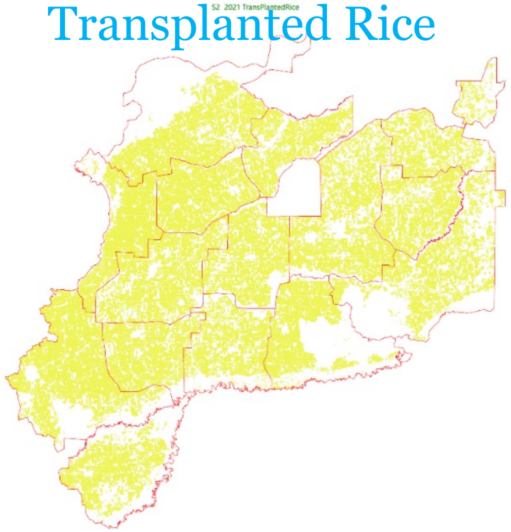


	4/19 S2A			4/29 S21C			5/3 L8		
农场	平地泡田	灌水未整地	未耕作	平地泡田	灌水未整地	未耕作	平地泡田	灌水未整地	未耕作
创业农场	22%	59%	19%	96%	3%	1%	97%	2%	1%
大兴农场	24%	60%	16%	75%	18%	7%	90%	7%	3%
红卫农场	11%	53%	36%	88%	10%	2%	95%	4%	1%
洪河农场	13%	59%	27%	94%	4%	2%	99%	1%	0%
浓江农场	23%	56%	20%	96%	3%	1%	99%	1%	0%
七星农场	19%	54%	26%	89%	10%	2%	96%	3%	1%
前锋农场	16%	62%	22%	92%	5%	3%	98%	1%	1%
前进农场	20%	56%	24%	93%	5%	1%	97%	2%	1%
前哨农场	16%	68%	16%	97%	2%	1%	97%	2%	1%
胜利农场	10%	48%	42%	83%	8%	9%	95%	3%	1%
八五九农场	12%	52%	36%	87%	9%	5%	97%	2%	2%
二道河农场	18%	70%	12%	93%	3%	3%	97%	2%	1%
勤得利农场	29%	49%	22%	93%	3%	3%	97%	2%	1%
青龙山农场	22%	58%	20%	97%	2%	1%	99%	1%	0%
鸭绿河农场	11%	65%	24%	90%	8%	2%	95%	4%	1%

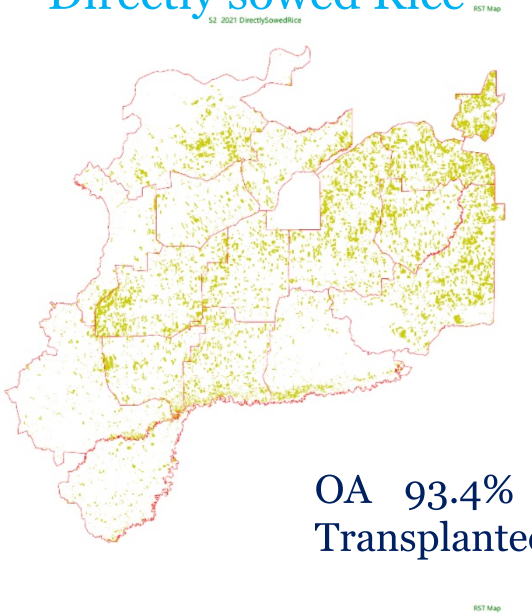
2021 Crop type map for Jiansanjiang Farms



Transplanted Rice



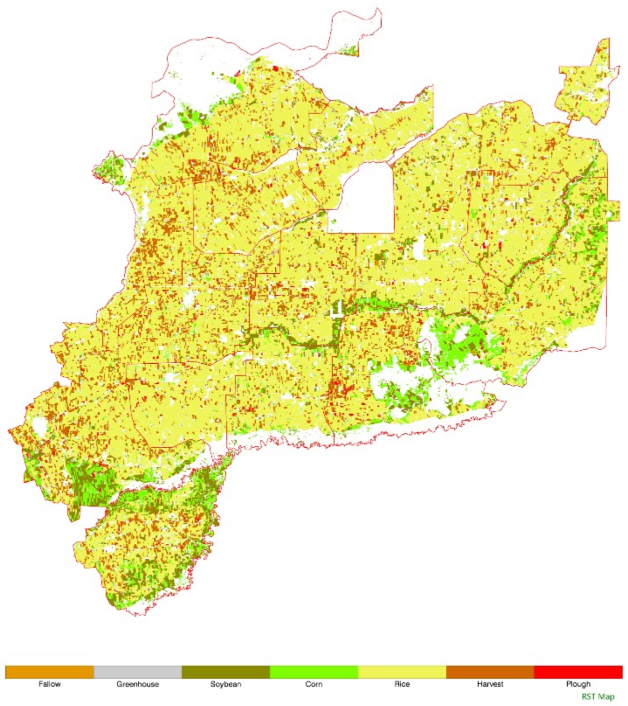
Directly sowed Rice



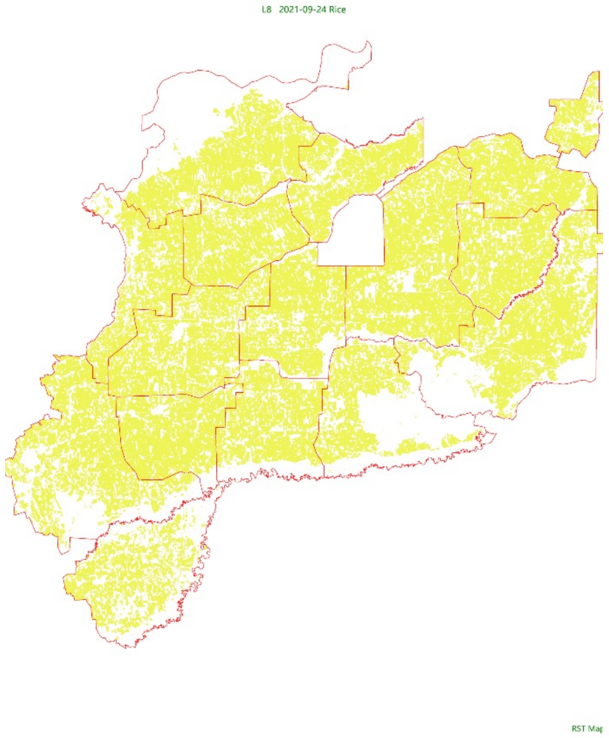
Source: Sentinel 2 images obtained on May 14, June 8,June 23, July 13, July 18, August 17, September1 and September 6, 2021

OA 93.4% , Soybean F1 97.8% , Maize F1 99.2% , Transplanted Rice F1 93.8%, Directly Sowed Rice F1 87.7%

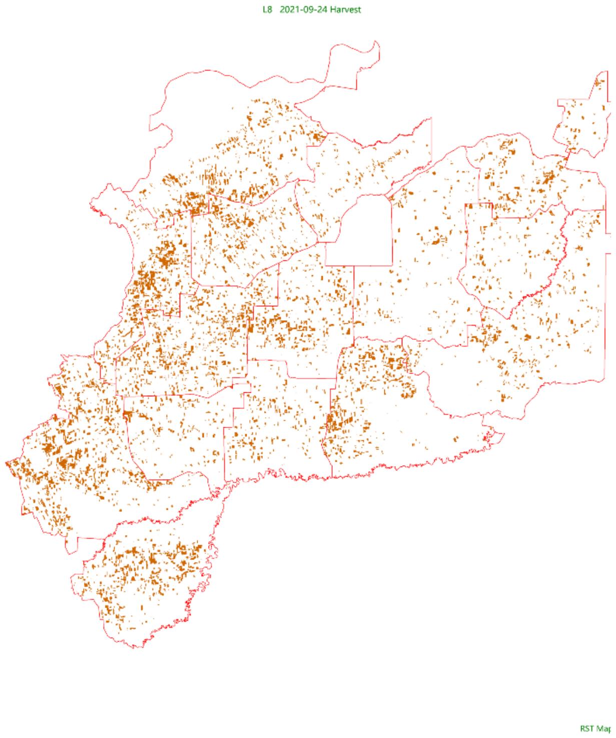
Field situation of farms in Jiansanjiang as of Sep.24, 2021



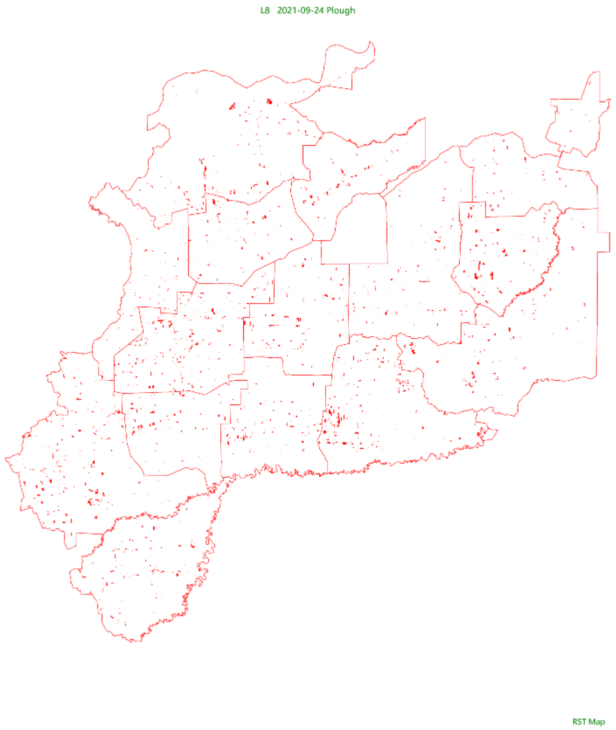
Not yet harvested rice



Harvested



Ploughed



Source: L8 Sep. 24, 2021

OA 96.6%, Soybean F1 91.2%, Maize F1 87.6%, not yet harvested Rice F1 99.4%, Harvested Rice F1 93.3%, Ploughed F1 91.3%

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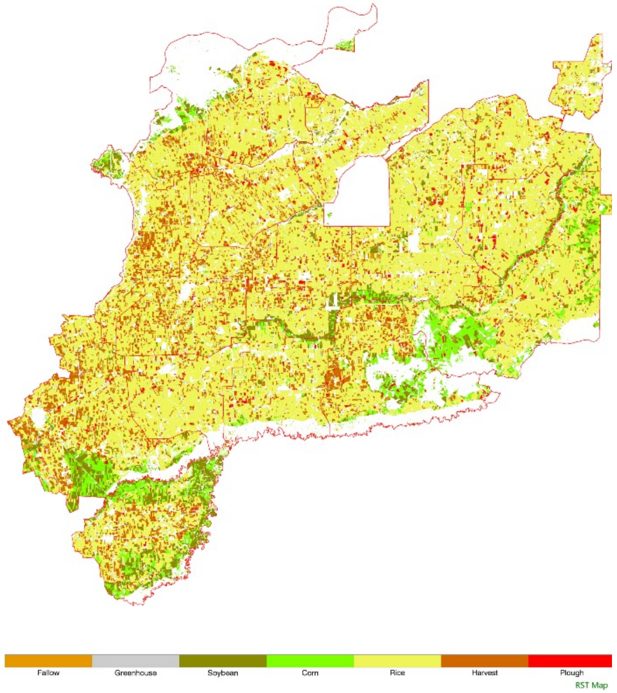
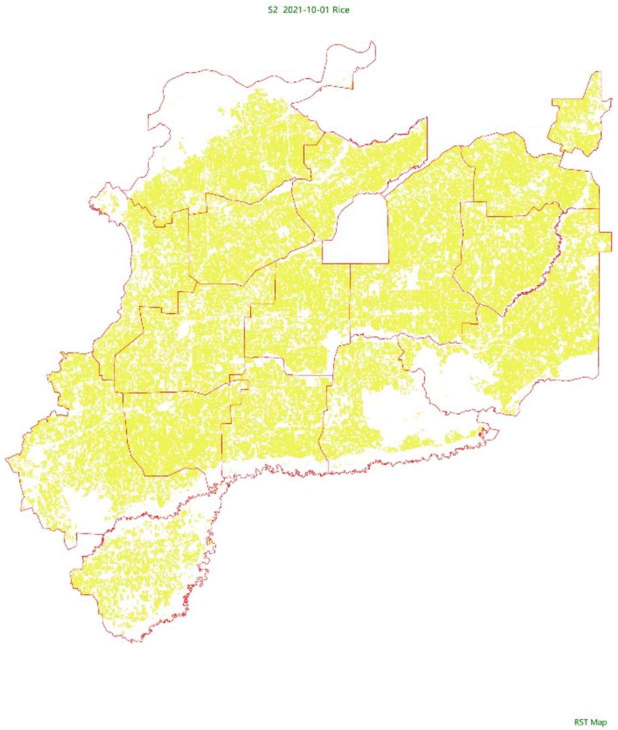
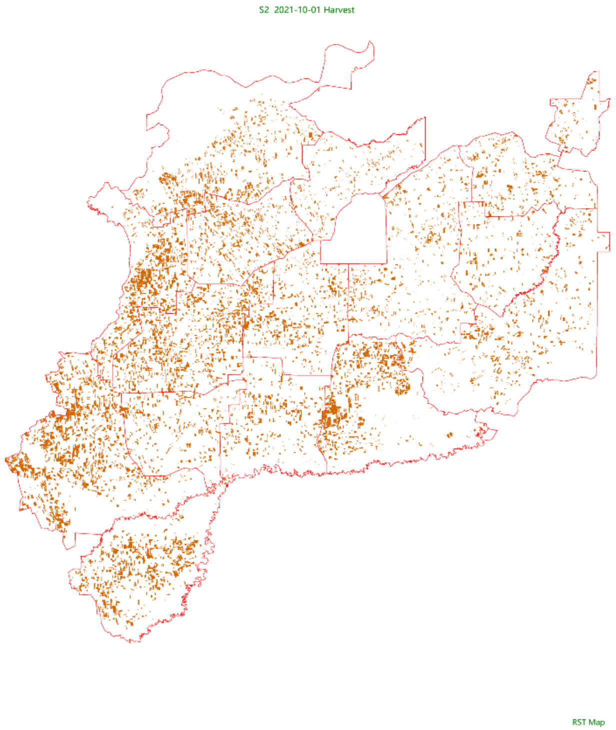
Field situation of farms in Jiansanjiang as of Oct.1, 2021



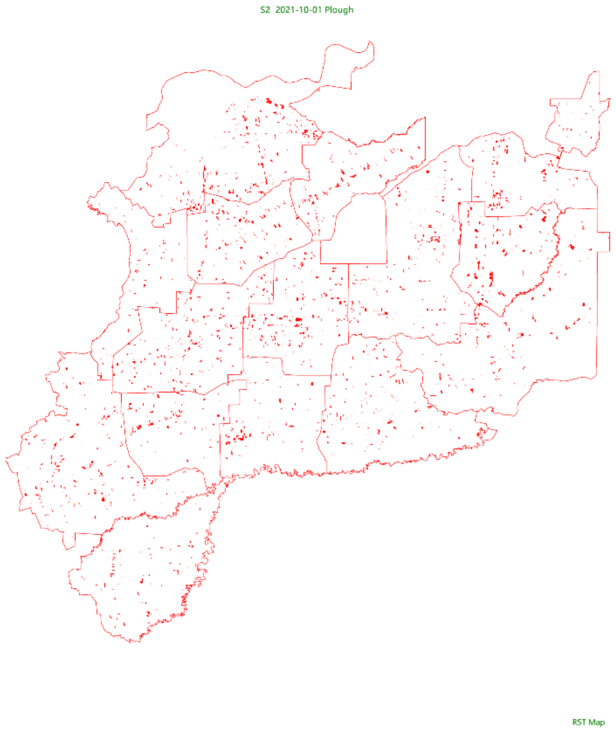
Not yet harvested rice



Harvested

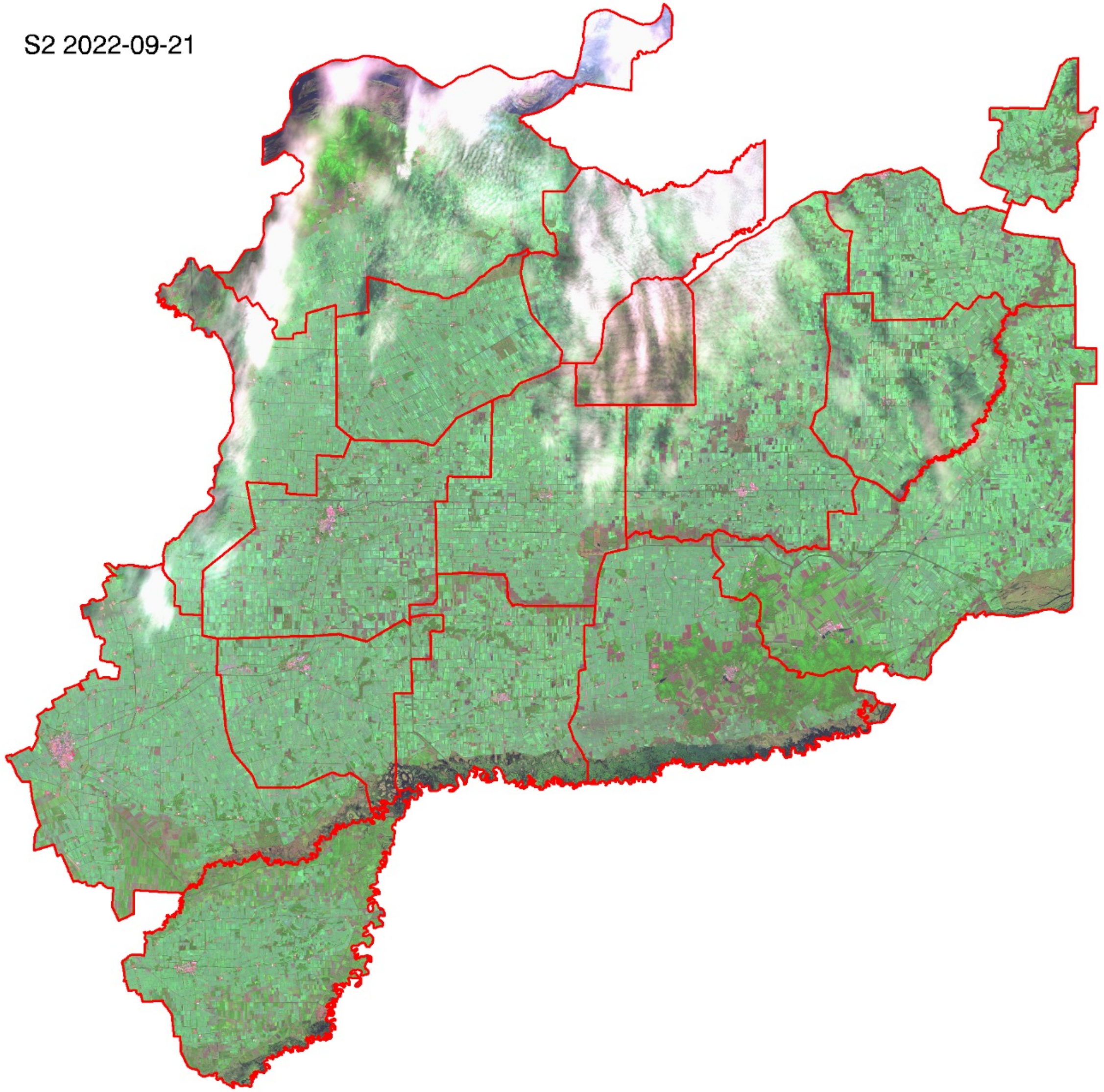


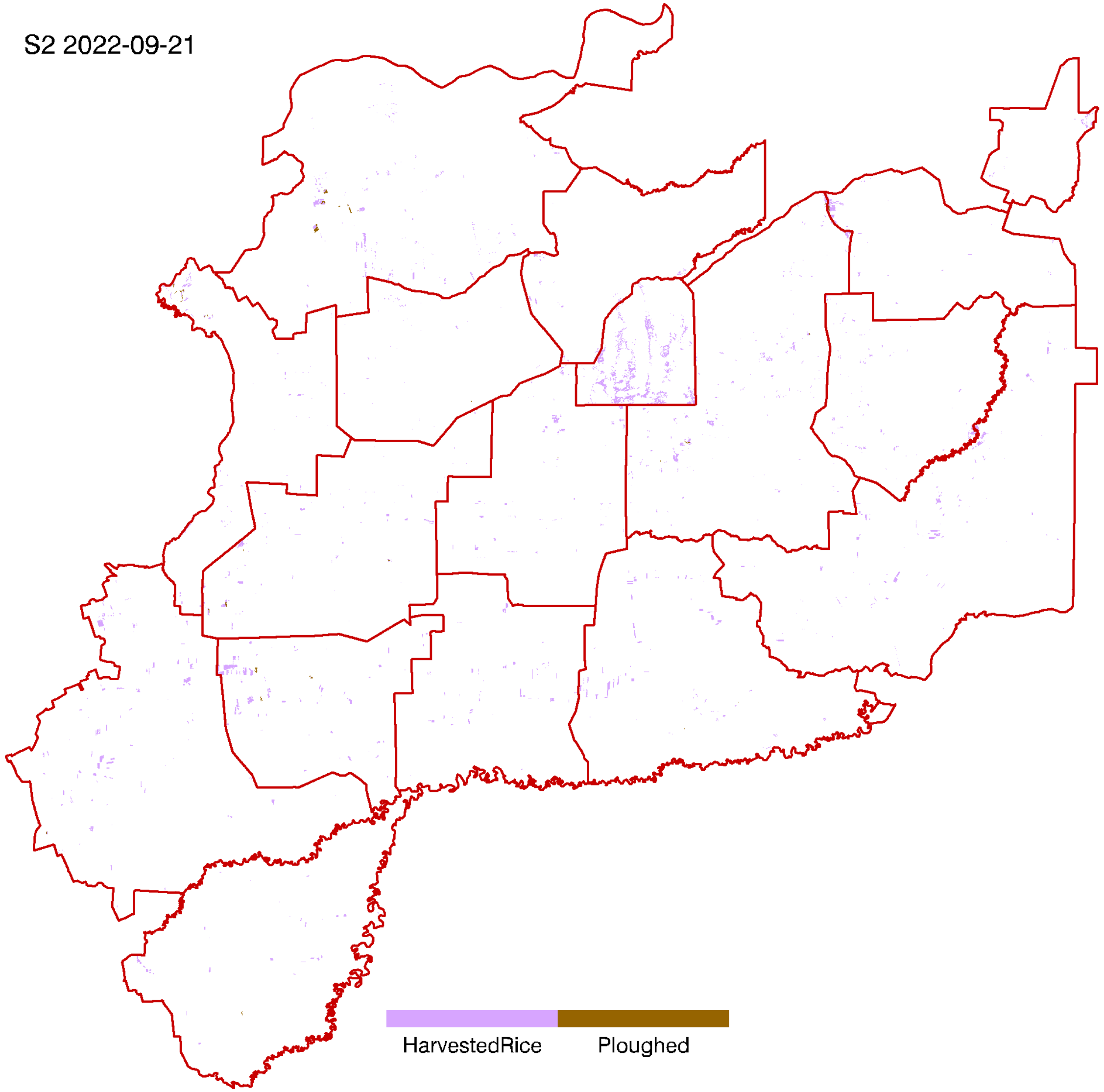
Ploughed

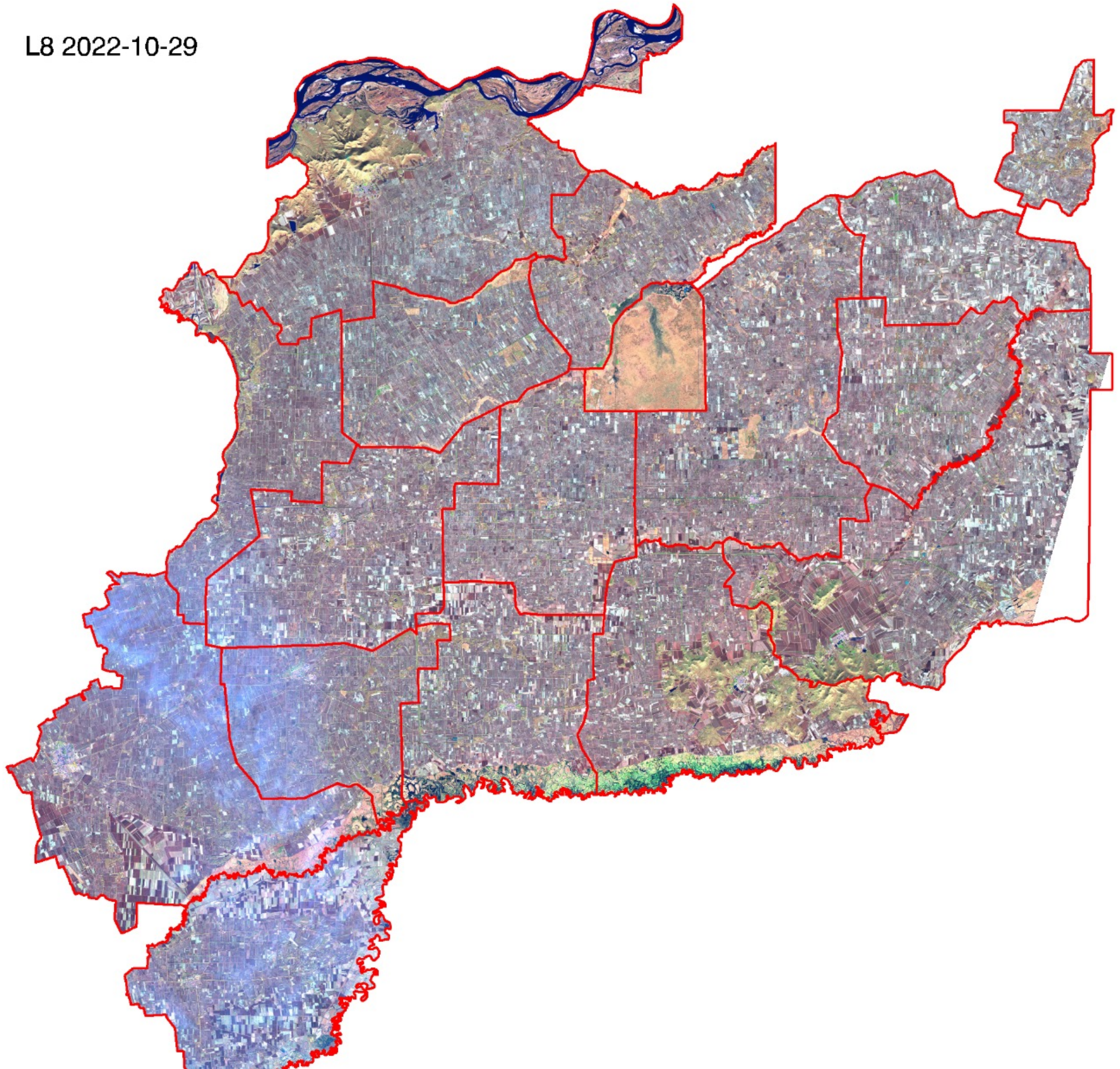


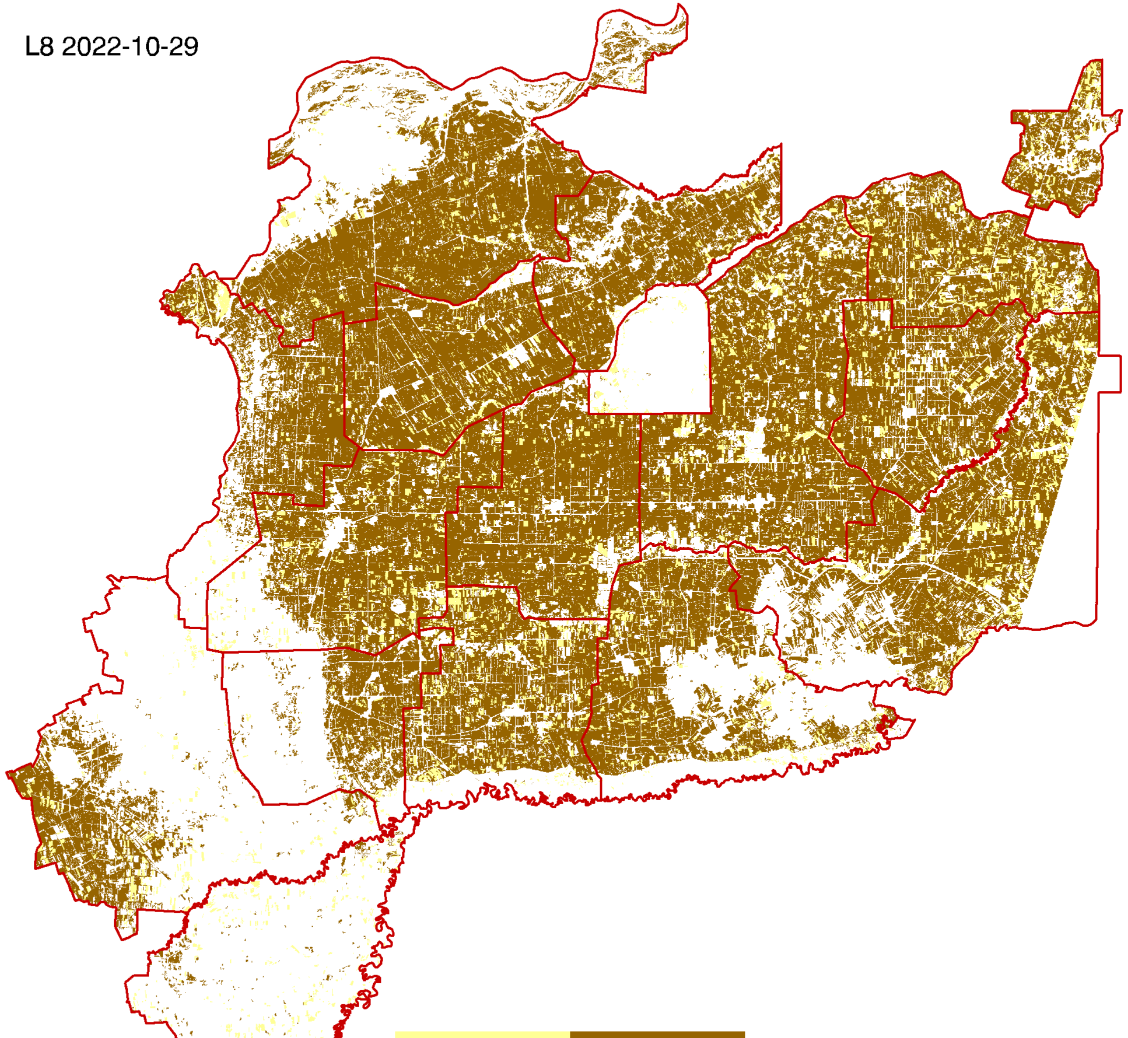
Source: S2 Oct. 1, 2021

OA 96.7%, Soybean F1 92.2%, Maize F1 91.3%, not yet harvested Rice F1 99.4%, Harvested Rice F1 85.4%, Ploughed F1 92.4%


S2 2022-09-21


S2 2022-09-21
HarvestedRice
Ploughed


L8 2022-10-29


L8 2022-10-29

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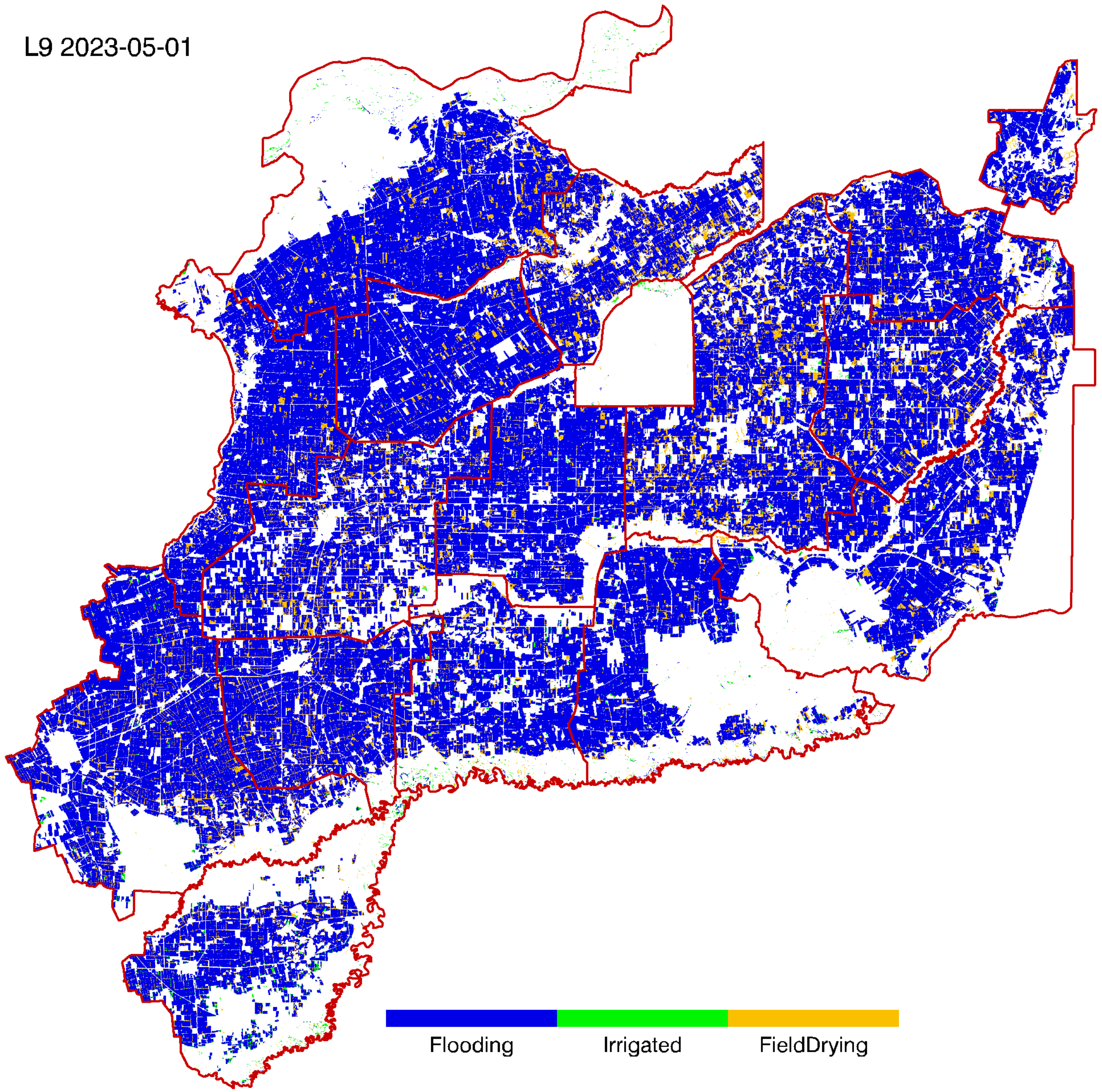

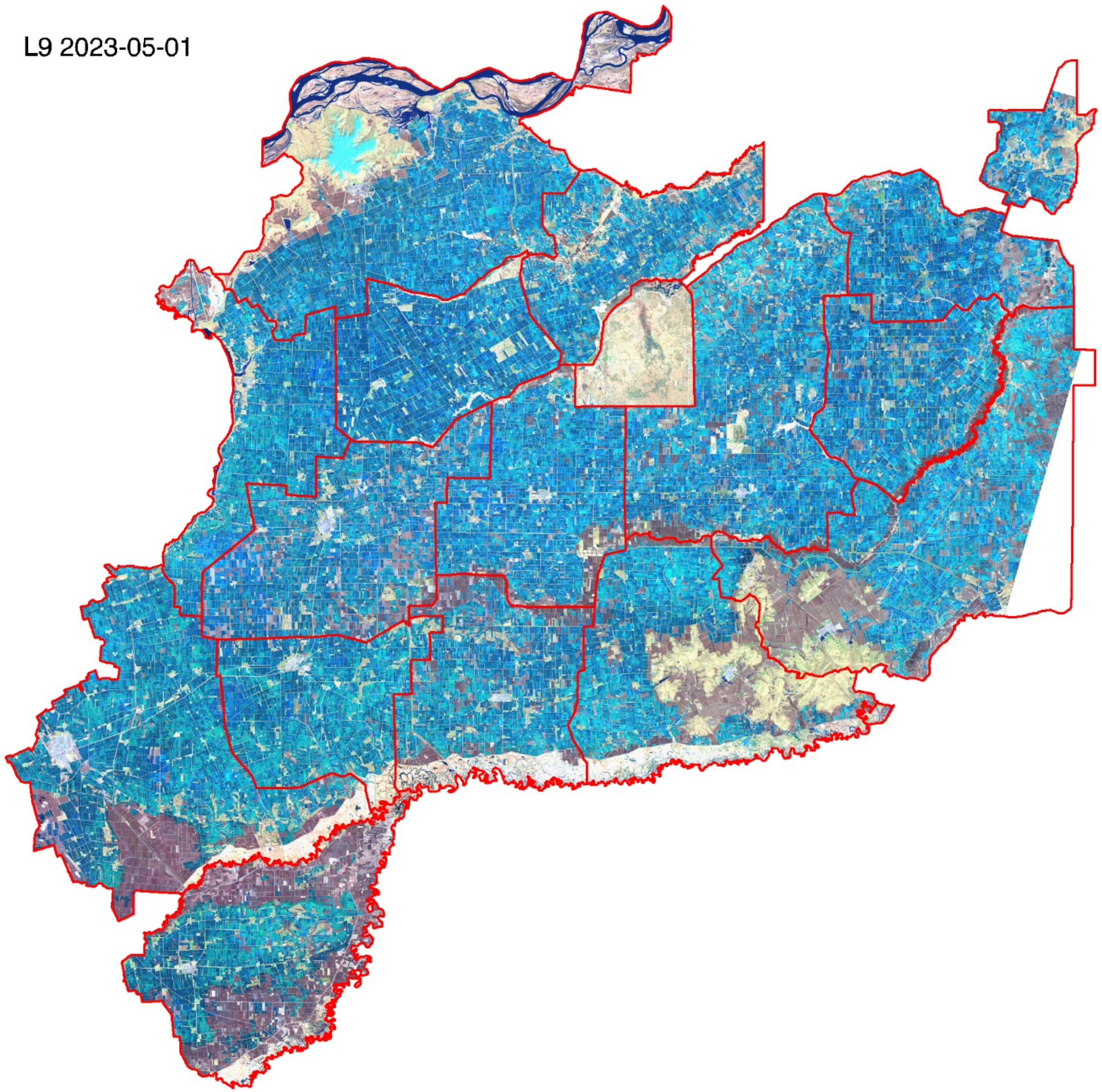

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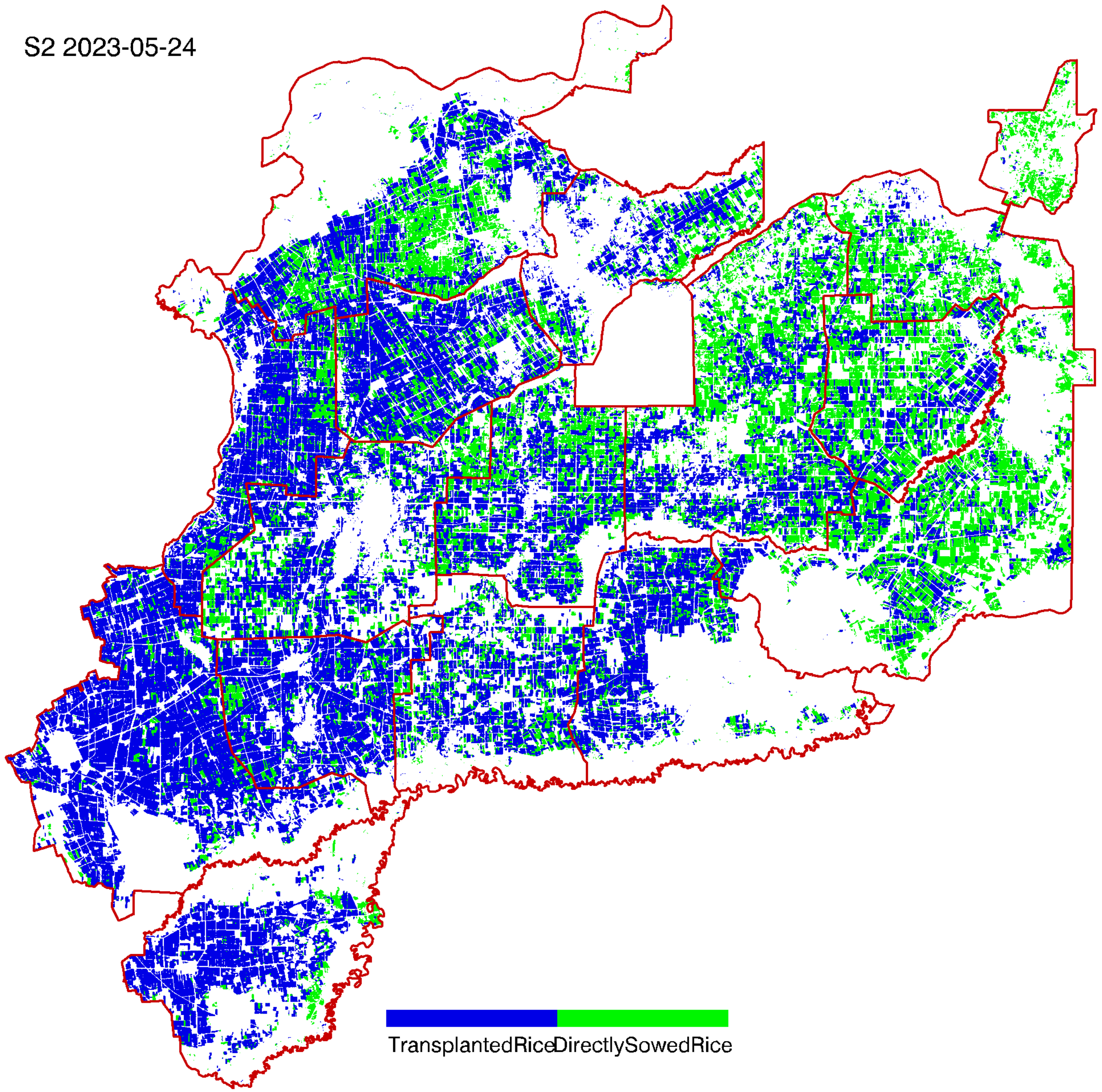
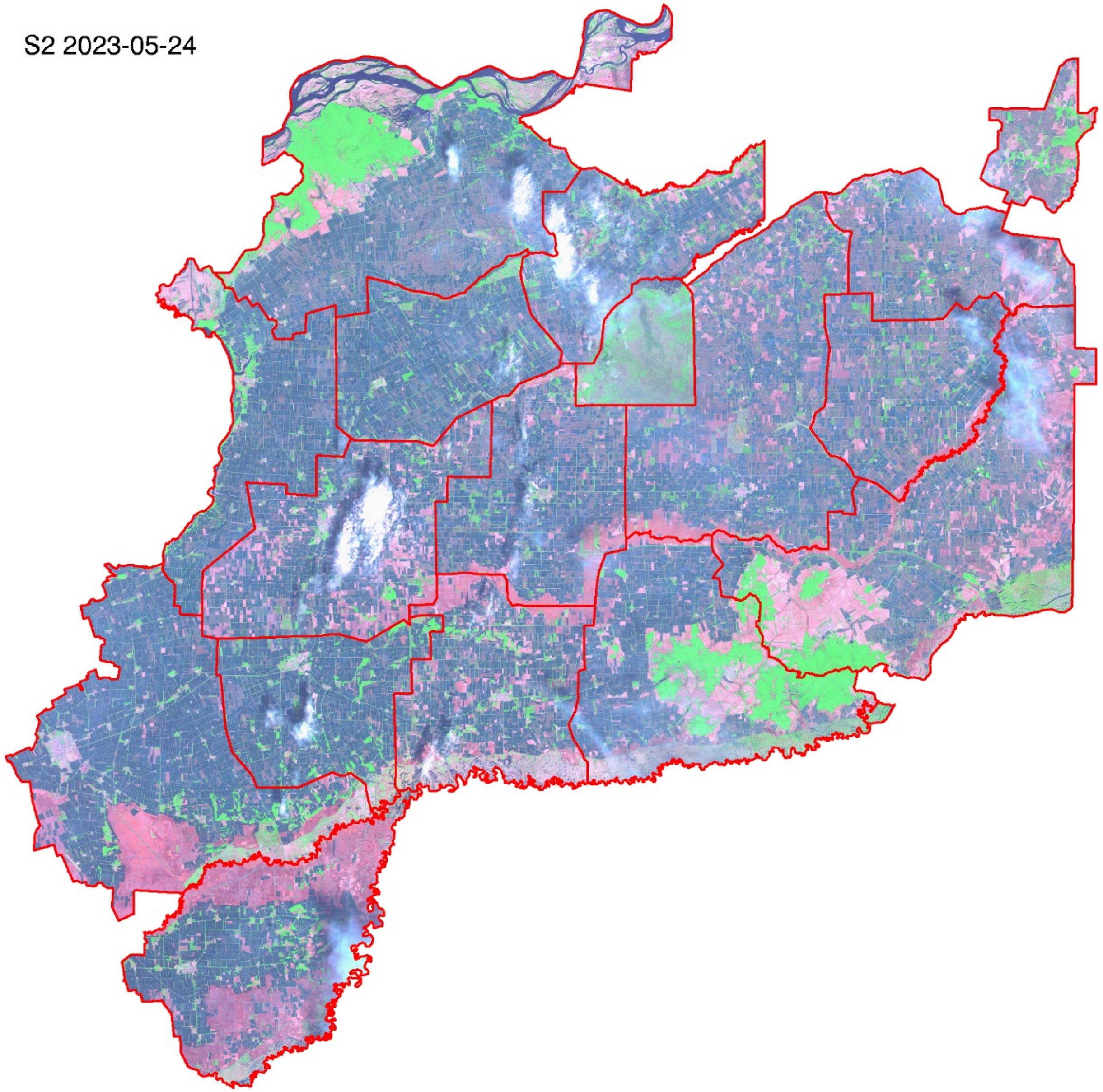
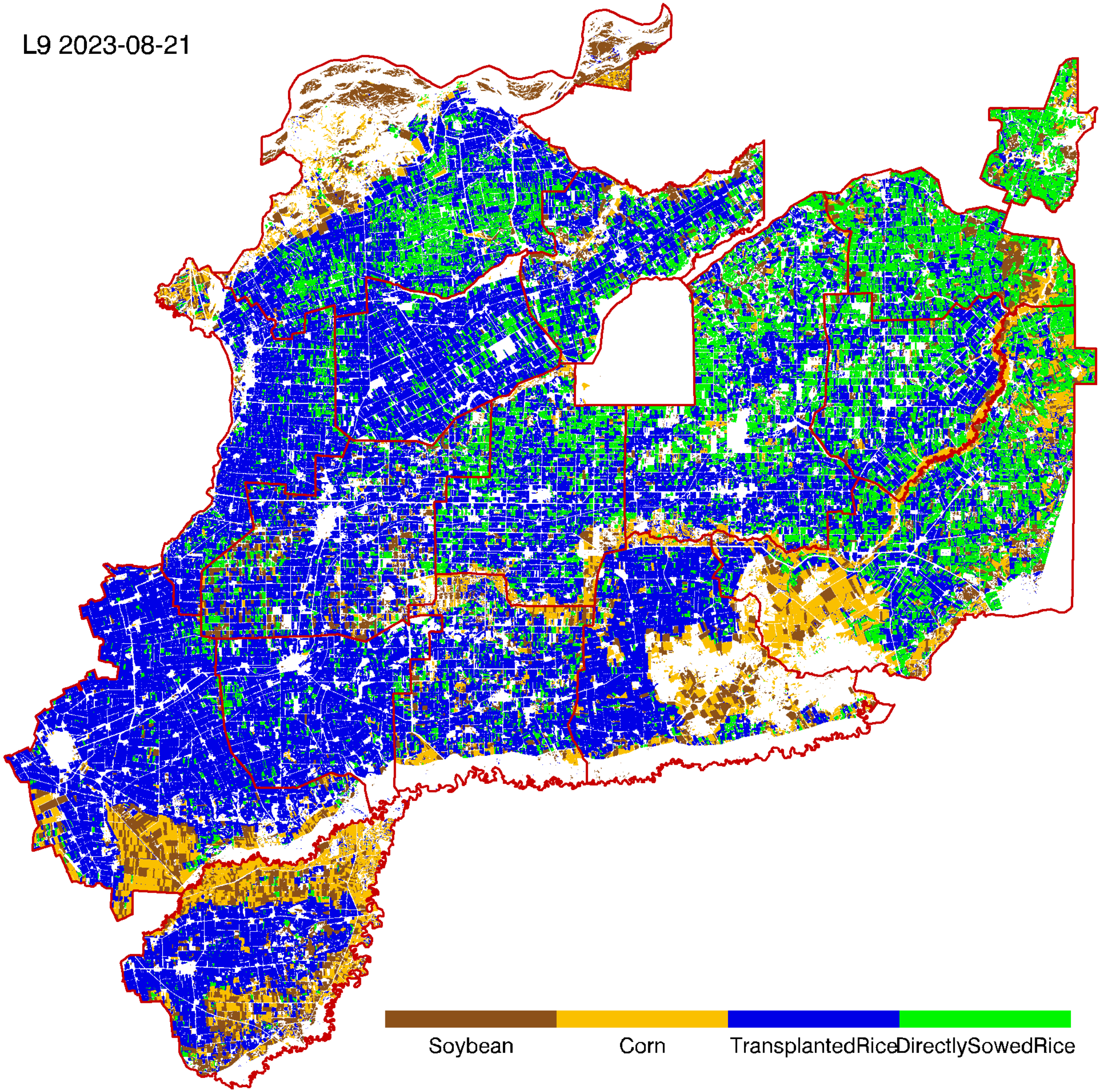
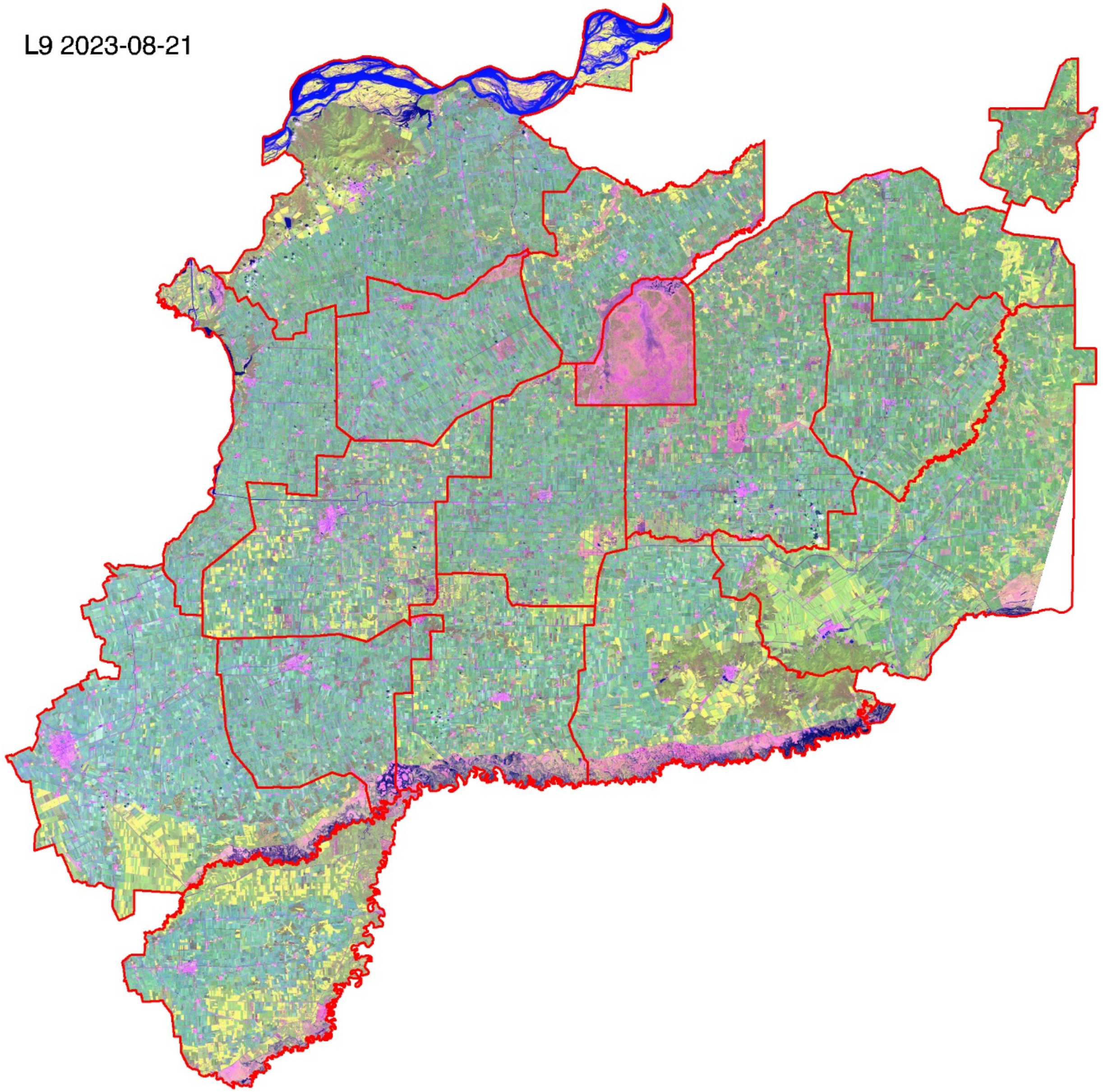
S2 2023-05-24



S2 2023-05-24




L9 2023-08-21
Soybean
Corn
TransplantedRice
DirectlySowedRice


L9 2023-08-21

- Lists of the project's output

  - Fan, X.; Li, X.; Yan, C.; Fan, J.; Chen, L.; Wang, N. Converging Channel Attention Mechanisms with Multilayer Perceptron Parallel Networks for Land Cover Classification. Remote Sens. 2023, 15(16), 3924; https://doi.org/10.3390/rs15163924.
  - Fan, X.; Li, X.; Yan, C.; Fan, J.; Yu, L.; Wang, N.; Chen, L. MARC-Net: Terrain Classification in Parallel Network Architectures Containing Multiple Attention Mechanisms and Multi-Scale Residual Cascades. Forests 2023, 14(5), 1060; https://doi.org/10.3390/f14051060.
  - Yan, C.; Fan, X.; Fan, J.; Yu, L.; Wang, N.; Chen, L.; Li, X. HyFormer: Hybrid Transformer and CNN for Pixel-Level Multispectral Image Land Cover Classification. Int. J. Environ. Res. Public Health 2023, 20(4), 3059; https://doi.org/10.3390/ijerph20043059.
  - Yan, C.; Fan, X.; Fan, J.; Wang, N. Improved U-Net Remote Sensing Classification Algorithm Based on Multi-Feature Fusion Perception. Remote Sens. 2022, 14(5), 1118; https://doi.org/10.3390/rs14051118.
  - Wang, N.; Fan, X.; Fan, J.; Yan, C. Random Forest Winter Wheat Extraction Algorithm Based on Spatial Features of Neighborhood Samples. Mathematics 2022, 10(13), 2206; https://doi.org/10.3390/math10132206.
  - Fan, X.; Yan, C.; Fan, J.; Wang, N. Improved U-Net Remote Sensing Classification Algorithm Fusing Attention and Multiscale Features. Remote Sens. 2022, 14(15), 3591; https://doi.org/10.3390/rs14153591.
  - Fan J, Defourny P, Zhang X, Dong Q, Wang L, Qin Z, De Vroey M, Zhao C. Crop Mapping with Combined Use of European and Chinese Satellite Data. Remote Sensing. 2021; 13(22):4641. https://doi.org/10.3390/rs13224641
  - Fan, J.; Zhang, X.; Zhao, C.; Qin, Z.; De Vroey, M.; Defourny, P. Evaluation of Crop Type Classification with Different High Resolution Satellite Data Sources. Remote Sens. 2021, 13(5), 911; https://doi.org/10.3390/rs13050911.
  - Fan, J.; Defourny, P.; Dong, Q.; Zhang, X.; De Vroey, M.; Belleman, N.; Xu, Q.; Li, Q.; Zhang, L.; Gao, H. Sent2Agri System Based Crop Type Mapping in Yellow River Irrigation Area. J. Geod. Geoinf. Sci. 2020, 3, 110–117.

- Inform on the project's schedule, planning & contribution of the partners for the following year

European Team

- Crop type mapping with Sent2agri system
- Algorithm of crop biophysics parameter retrieved from high resolution SAR satellite
- Joint field survey

Chinese Team

- Project coordination and management
- Site manager, Field survey and data collection in study sites
- Crop type mapping with Chinese high resolution satellite data
- Algorithm of crop biophysics parameter retrieved from high resolution satellite
- Crop monitoring with high resolution satellite data

- Report on the level and training of young scientists on the project achievements, including plans for academic exchanges

- 1. Young Scientists will be invited to join the field survey. This activity will help young scientists be familiar with and well understand the ground truth of research area.
- 2. Young scientists will be guided in processing the Sentinel series and GF series satellite data. Thereafter, young scientists will be able to handle those data for the information retrieval.
- 3. Young scientists will be guided for the crop mapping. Thereafter young scientists will be able to run the code to make a crop map.
- 4. Young scientists will be guided for the crop biophysics parameter retrieval. Thereafter young scientists will be able to run the code to produce the product.
- 5. Young scientists will also be engaged in manuscript writing that will enhance their academic experience.

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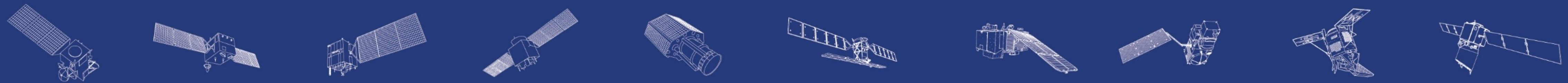

Thank you very much for your attentions!