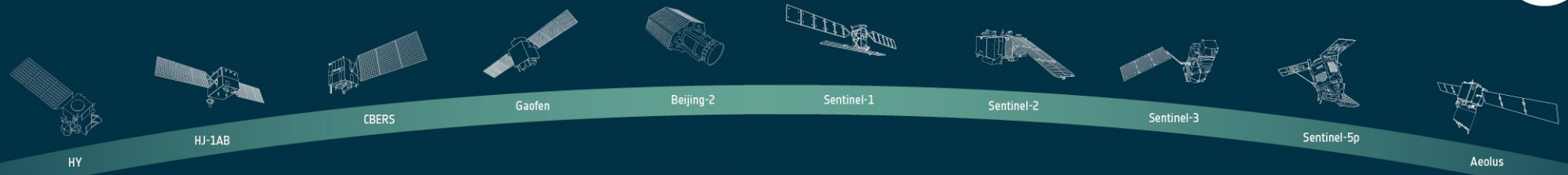


2022 DRAGON 5 SYMPOSIUM

MID-TERM RESULTS REPORTING

17-21 OCTOBER 2022

[PROJECT ID. 58944]

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

<MONDAY & OCT 17,2022>

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
  - Develop the yield estimation model to forecast the yield in time
  - Develop the nitrogen retrieval model to estimate the real nitrogen concentration and give the advice for fertilizer application
  - Summarize the advantage and advantage of monitoring agriculture in China with the open access high resolution satellite data

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	**100**
3.	
4.	
5.	
6.	
Total:	
Issues:	

ESA Third Party Missions	No. Scenes
1. Landsat 8/9	**30**
2.	
3.	
4.	
5.	
6.	
Total:	
Issues:	

Chinese EO data	No. Scenes
1. GF-1	**20**
2. CBERS04	**20**
3. FY-3D MERSI	**100**
4. FY-3C VIRR	**100**
5. GF-3 SAR	**50**
6.	
Total:	
Issues:	

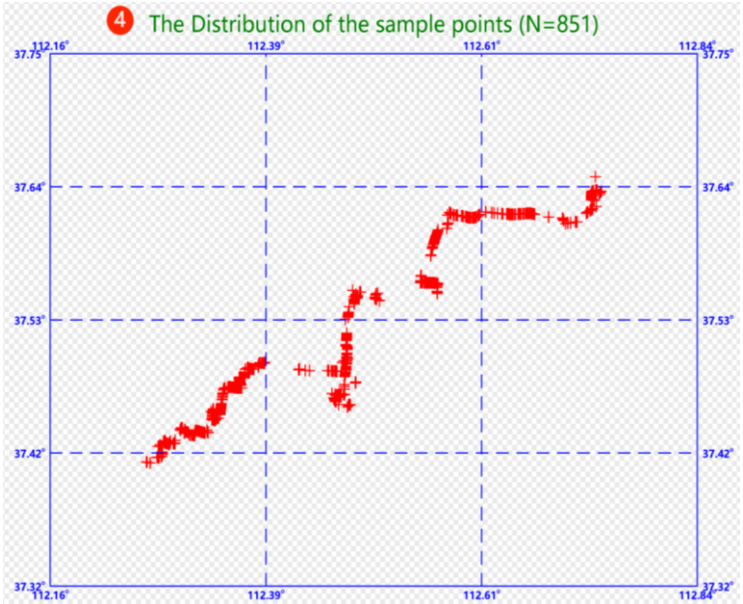
Field data collection

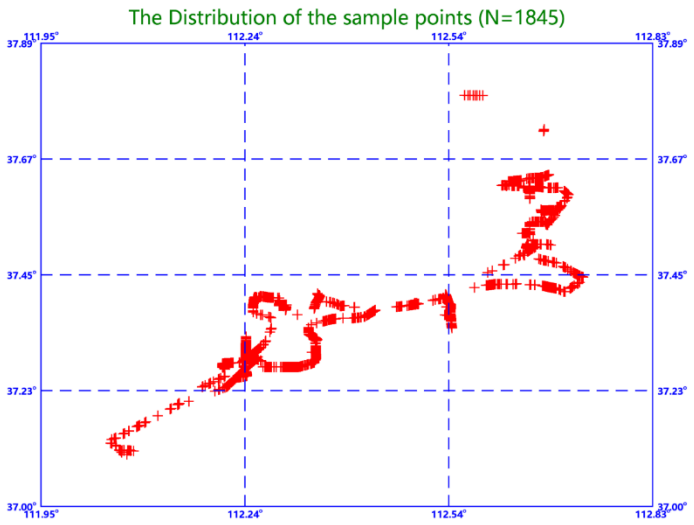
2021 Field Campaign

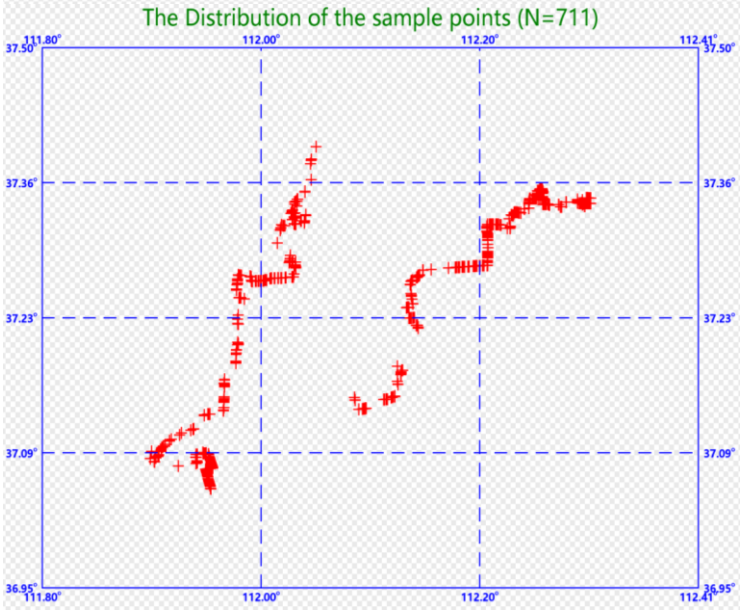
- Shannxi Site May 1-3,2021
- Jiansanjiang Site August 23-27,2021
- Shanxi Site Oct 14-15,2021
- Hunan Site Nov 1-5, 2021

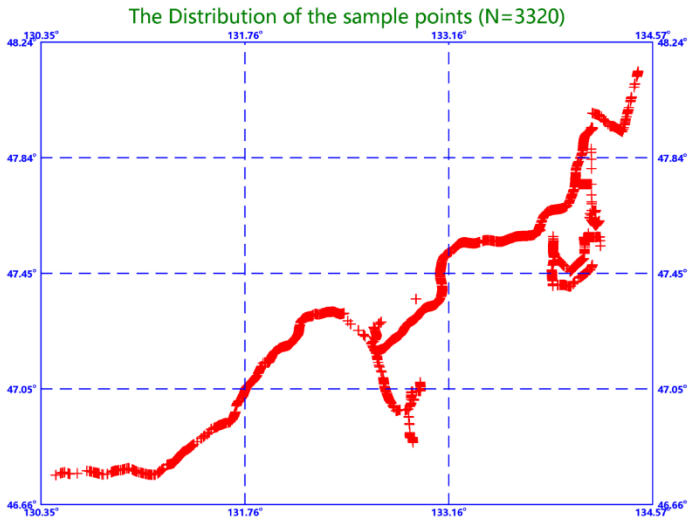
2022 Field Campaign

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









European Young scientists contributions in Dragon 5

Name	Institution	Poster title	Contribution
Emeline Gomes (Master)	Universite Catholique de Louvain	sustainable farming practices mapping with Sen2Agri	use Sen2Agri and also Sentinel-1 information to estimate LAI, crop growth and in particular bare soil period duration for the conservation agriculture

Chinese Young scientists contributions in Dragon 5

Name	Institution	Poster title	Contribution
Hao Yanan (Ph. D)	1. National Satellite Meteorological Center, 2. China Agricultural University	Study on the Identification of Rice Varieties with Remote Sensing Data	Extending a classification-based approach to identify rice varieties in support of precision rice management
Lv Jin (Master)	1. National Satellite Meteorological Center 2. China University of Geoscience	Monitoring agricultural practices in jiansanjiang farm with multiple remote sensing data	Extending a classification-based approach to monitor farming practices, in particular for field preparation
Li Yuxuan (Master)	1. National Satellite Meteorological Center, 2. Institute of Agricultural Resources and Regional Planning	Ukrainian Crop Growth Monitoring With The Chinese Meteorological Satellite Data	Explore the Chinese meteorological satellite data application for an alien country in crop growth monitoring

Dragon 5 Mid-term Results Reporting

MONITORING AGRICULTURAL PROCESS OF JIANSANJIANG FARM BASED ON MULTI-SOURCE REMOTE SENSING DATA

Jin Lv[1,2],Jinlong Fan[1],Shougeng Hu[2],Guojun Li[3],Yuxuan Li[1],Shiguang Mei[1]

1 National Satellite Meteorological Centre,China
2 China University Of Geosciences，Wuhan
3 Agricultural Bureau of Jiansanjiang Administration, Heilongjiang Province

1.Abstract

Food security is an important foundation of national security, Jiansanjiang farm has a total cultivated land area of 776000 hectares, the average annual grain output accounts for about 1/11 of Heilongjiang Province, 1/100 of the country, An important grain production base in China, in order to fully and timely understand the progress of spring ploughing in Jiansanjiang, to ensure food security, to Jiansanjiang Branch under the jurisdiction of 15 farms as the research object, based on sentinel-2 satellite April 19, April 24, Images from April 29 and images from the Landsat-8 satellite on April 28. Monitored the progress of spring preparations for paddy fields on fifteen farms. Based on the random forest algorithm and expert prior knowledge, the images of each period are divided into three categories: undisturbed, irrigated and flooded. According to the classification results, the growth rate of irrigated plots between April 19 and April 24 was faster, and the process of flooded was slower; As of April 29, the proportion of the flooded in Jiansanjiang Farm that has been the promotion of large-scale mechanization operations has increased rapidly, accounting for about 90% of the total paddy field area, and the spring preparation of paddy fields has basically ended.

2.Classification Approach

The classes were set as Undisturbed、Irrigated and Flooding.The samples used for this classification were field sampled and all sample points were randomly divided into 70% training samples and 30% validation samples when processing the samples, which were then used for classification and validation respectively. Random forest was used as the key classifier. The classification accuracy was evaluated by the error confusion matrix.

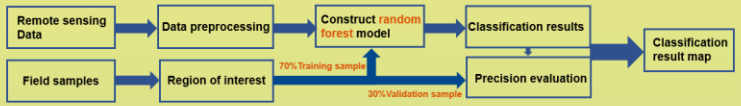
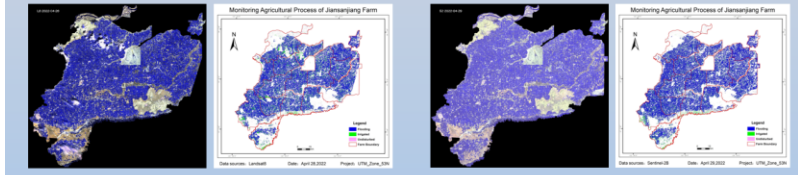


Fig. 1 Shows the logic flow for this study

3. Results



Based on the images of Landsat-8 on April 28, the final Overall Accuracy is 83.7%, Kappa is 81% and F1 Score is 81.27%

Based on the images of Sentinel-2B on April 29, the final Overall Accuracy is 90%, Kappa is 88% and F1 Score is 88.29%

4.Discussion

The landsat8 and Sentinel 2 images used in this study have not been refined, and the next step will be strict atmospheric correction and cloud removal processing.

5.Acknowledgement

Dragon(58944)

Ukrainian Crop Growth Monitoring With The Chinese Meteorological Satellite Data

Li Yuxuan[1], MeiShiguangQiliang [1,2],Lv Jin[1], SuQiaomei[2], Jinlong Fan[1]

1 National Satellite Meteorological Center, China
2 Taiyuan University of Technology, Taiyuan China

Introduction

The crop growth condition in the spring of 2022 in Ukraine was attracted the attentions from agricultural community in the world. Thanks to the global coverage of the second generation FENGYUN polar orbiting satellite, the normalized difference of vegetation index NDVI retrieved from FY3C VIRR and FY3D MERSI were used to monitor the crop growth condition in Ukraine. The NDVI difference model between the current value and the historical mean in the past few years and the time series of NDVI at present and the historical mean were used to closely monitor the changes of the crop vegetation from March to June when was the winter crop growth season in 2022.

Study Area and Data

Ukraine is located in the eastern part of Europe, within the range of longitudes 21-38 East and latitudes 44-53 North. The country is rich in agricultural resources, with 41.5 million hectares of agricultural land, accounting for 70% of the country's land area. The geographical location of Ukraine is shown in Figure 1, which is one of the images of FY-3C.

The remote sensing data in this paper use the 1km spatial resolution data from the C (referred to as FY-3C) and D (referred to as FY-3D) stars of the Wind Cloud 3 meteorological satellites, which were developed independently in China. The Fengyun-3C medium-resolution spectral imager (FY-3C/VIRR) has multi-spectral and high sensitivity features. It is especially suitable for large-scale and large-scale crop growth monitoring, and plays an important role in crop growth monitoring and crop yield

Methods

In terms of crop growth monitoring methods, this paper uses a difference model that can reflect the interannual variability of crop growth for real-time monitoring and evaluation of crop growth in Ukraine at the decadal scale.

$$\Delta NDVI(i) = (NDVI(i) - NDVI_{mean}) \times 10000 + 10000$$

In this paper, the growth condition is classified into five classes based on normal distribution: poor, poor, normal, good and good.

Classification criteria	Growth class
Δ NDVI < 10000	No Data
10000≤ Δ NDVI<8000	Worse
8000≤ Δ NDVI<9000	Poor
9000≤ Δ NDVI<11000	Normal
11000≤ Δ NDVI<12000	Favorable
12000≤ Δ NDVI	Good

Fig. 2 Technical flowchart

Results

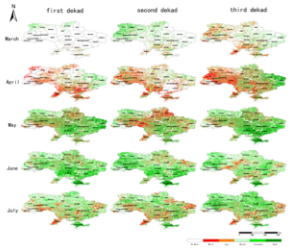


Fig 3 Crop growth monitoring map of Ukraine（FY-3C）

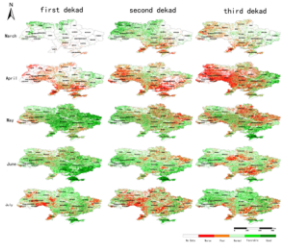


Fig 4 Crop growth monitoring map of Ukraine（FY-3D）

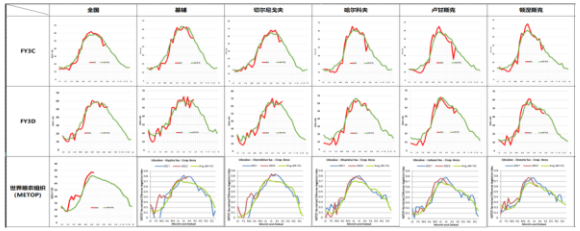


Fig. 5 FY-3D, FY-3C and METOP weather satellites Time series curve of vegetation index of agricultural crops in Ukraine affected by war

Conclusions

Using NDVI as a monitoring indicator, the NDVI difference model was constructed based on the effective use of existing domestic Fengyun-3 meteorological satellite data to conduct interannual crop growth comparison studies. The crop growth in five representative regions of northern and eastern Ukraine is not significantly different from the average of the past years, and even better than the average of the past period. Thus, it seems that the growth of winter crops in Ukraine has not been seriously affected by the war.

Acknowledgement:
Dragon(58944)

Study on the Identification of Rice Varieties with Remote Sensing Data

Yanan Hao[1]; Ruilian Li[1]; and Jinlong Fan[2]
1 College of resources and environment, China Agricultural University, China
2 National Satellite Meteorological Center, China

1.Introduction

Heilongjiang Agricultural Reclamation has abundant land resources, concentrated arable land and high degree of agricultural mechanization, which has unique advantages in the development of precision agriculture. In recent years, with the emergence of various kinds of high spatial and temporal resolution satellites, agricultural remote sensing, global navigation technology and Internet of things technology can be effectively combined, and play an important role in the fields of crop classification, accurate management, yield estimation and pest control. The Random Forest, one of the most powerful classifiers, is widely applied in the field of the land classification.

2.Study Area and Data

The Chuangye Farm is located in Heilongjiang Province in Northeast China, within the range of 132-133 longitude and 47 latitude. It is an important single-season rice producing area in China. The small red rectangle on the left in Figure 1 represents the location of the chuangye farm.

Fig.1 Study Area

Landsat 8 was launched in February 2013 and has 9 bands with a spatial resolution of 30 m, which also includes a panchromatic band with a spatial resolution of 15 m. The Landsat-8 data used in this study was downloaded from the USGS website and mainly used the image data on July 3, 2020.

Data collection started at the end of August 2020, as shown in Figure 1covering an area of about 10,000 square kilometers, including Qixing, Chuangye, Hongwei, Qianfeng, Erdaohe and other farms.

3.Classification Approach

Figure 2 shows the logical flow of this research. Rice varieties are divided into four types: Longjing, Suijing, Sanjiang and Xinnian. In addition to the collected field samples, more samples were further trained with the support of Google Earth image. Thereafter all sample points were randomly divided into 75% training samples and 25% validation samples and then used to the classification and the validation, respectively. Random Forest was used as the key classifier. The classification accuracy was evaluated by the error confusion matrix.

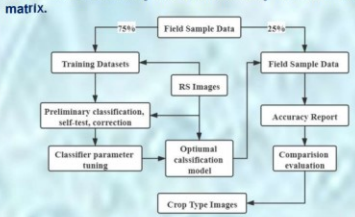


Fig.2 Flow Chart of the Classification

4.Results

Fig.3 presents the merged and classified rice area in the northeast of China. The accuracies listed in the table 1.

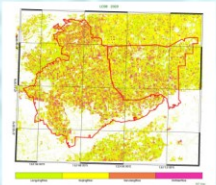


Fig.3 The classified map results from Landsat 8 in 2020

Table 1 accuracies list for classified mapping

Accuracy Matrix	Error unit %
Overall Accuracy	68.40
Kappa	56.00
F1 Score	66.40

Acknowledgement:

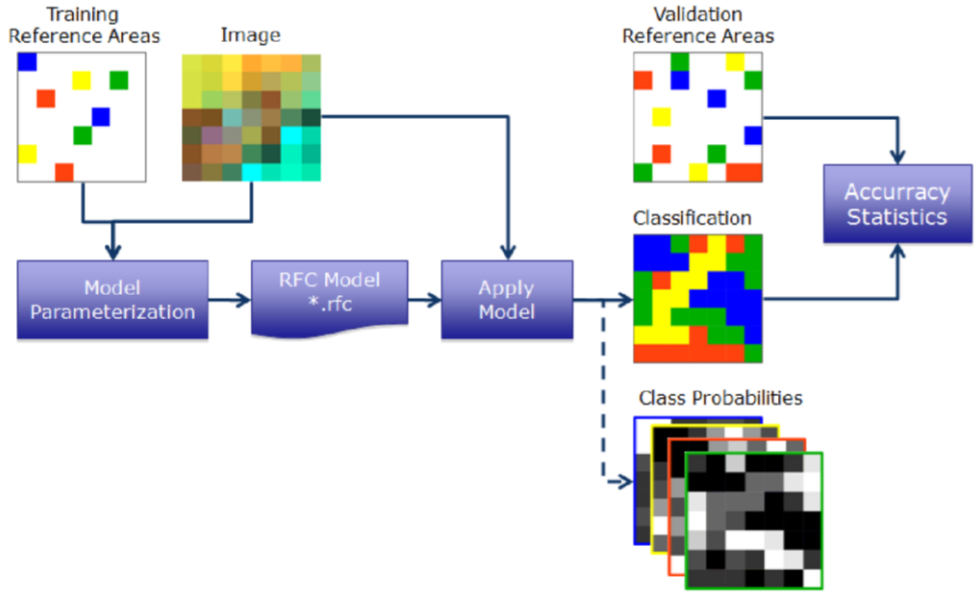
Dragon(32194,58944)

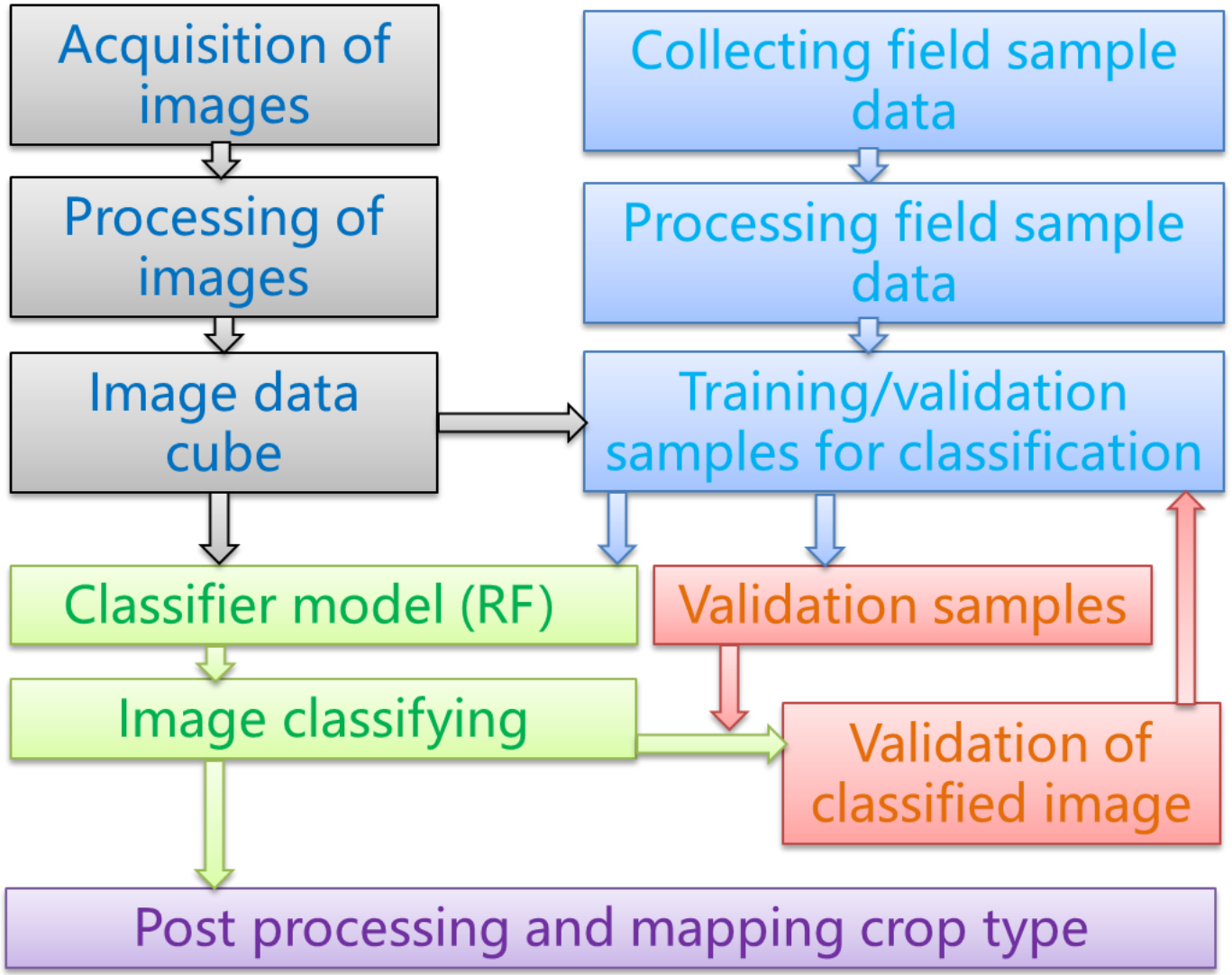
Dragon 5 Mid-term Results Reporting

- Inform on the results after 2 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

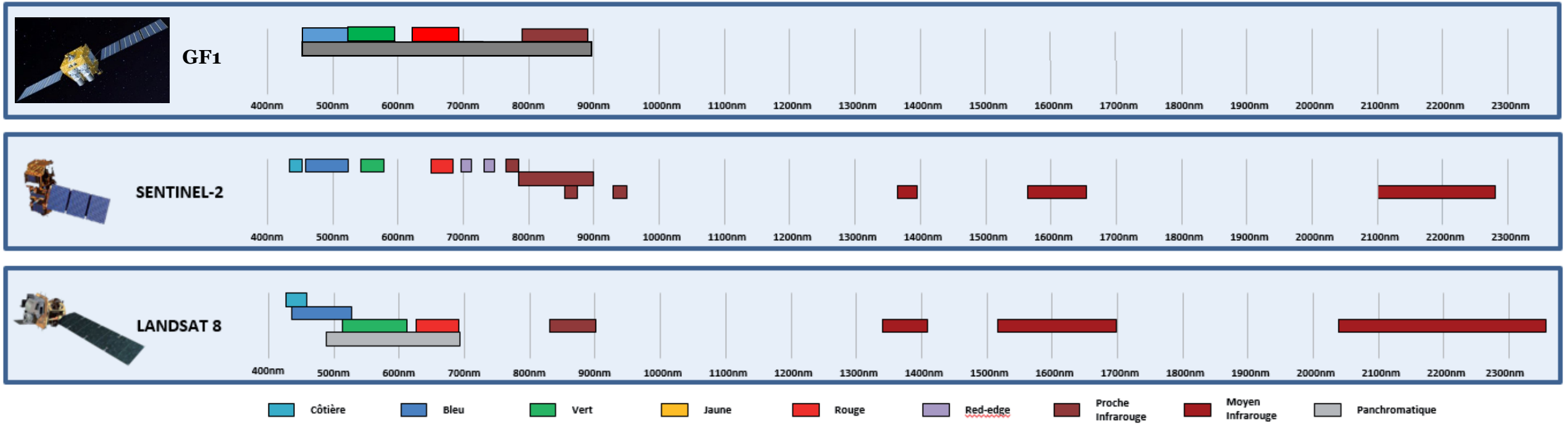
Crop Mapping Key steps

- **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

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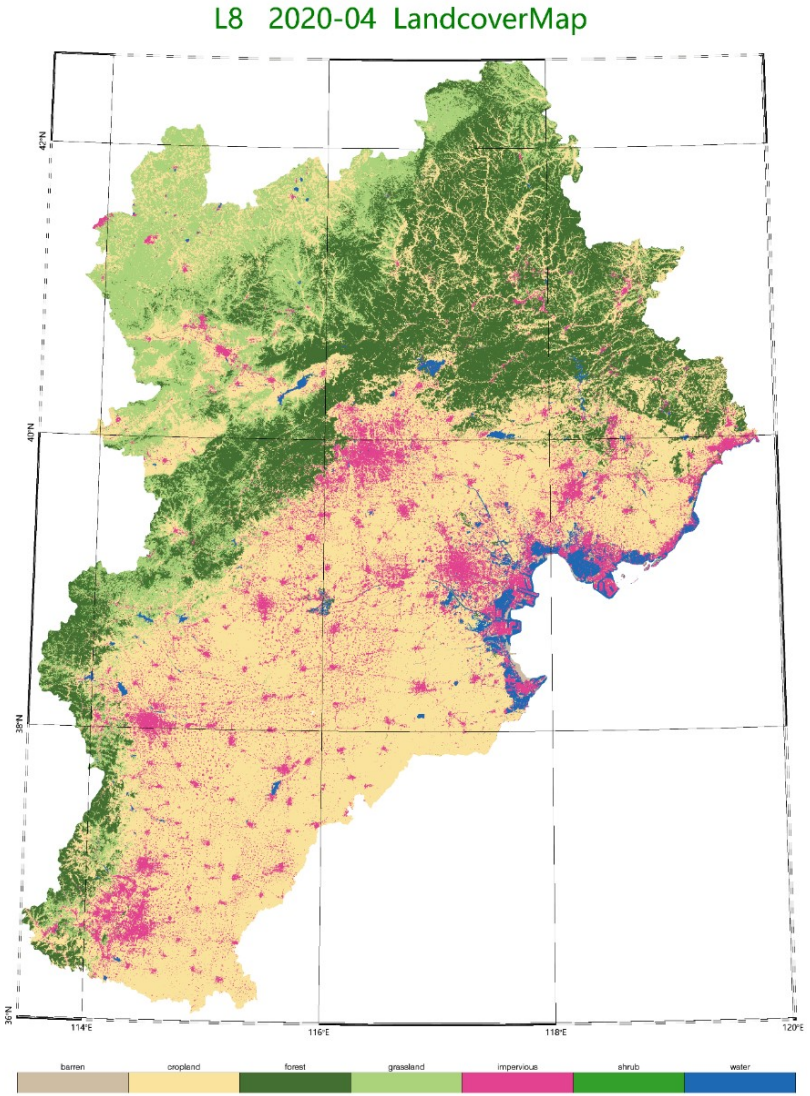
1 Crop Mapping with Chinese high resolution satellite data at provincial level

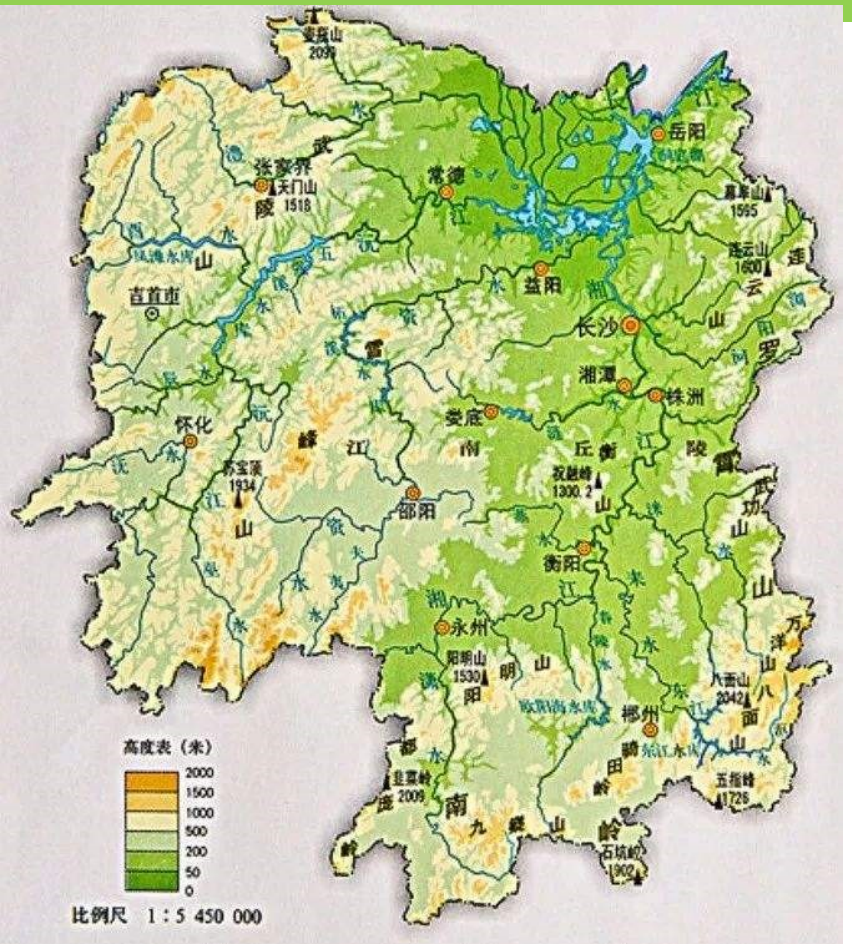
Mapping Land Cover

Beijing, Tianjin and Hebei

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



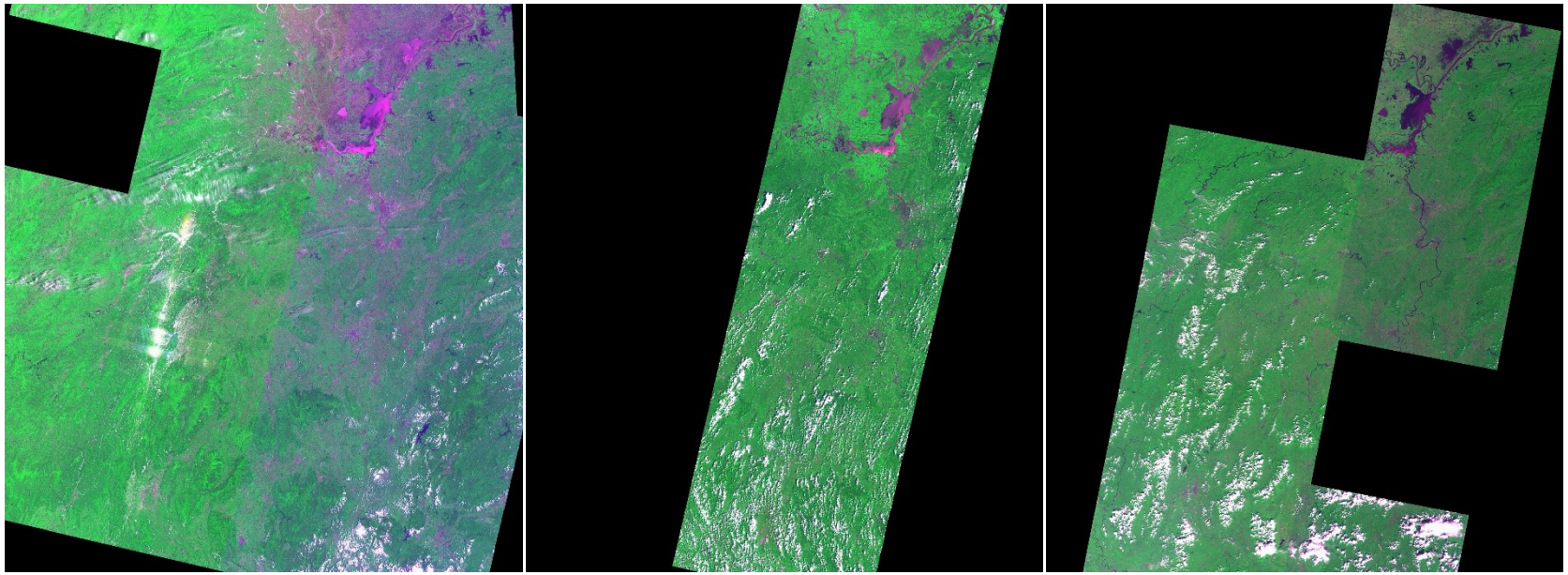
1 Crop Mapping with Chinese high resolution satellite data at provincial level



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



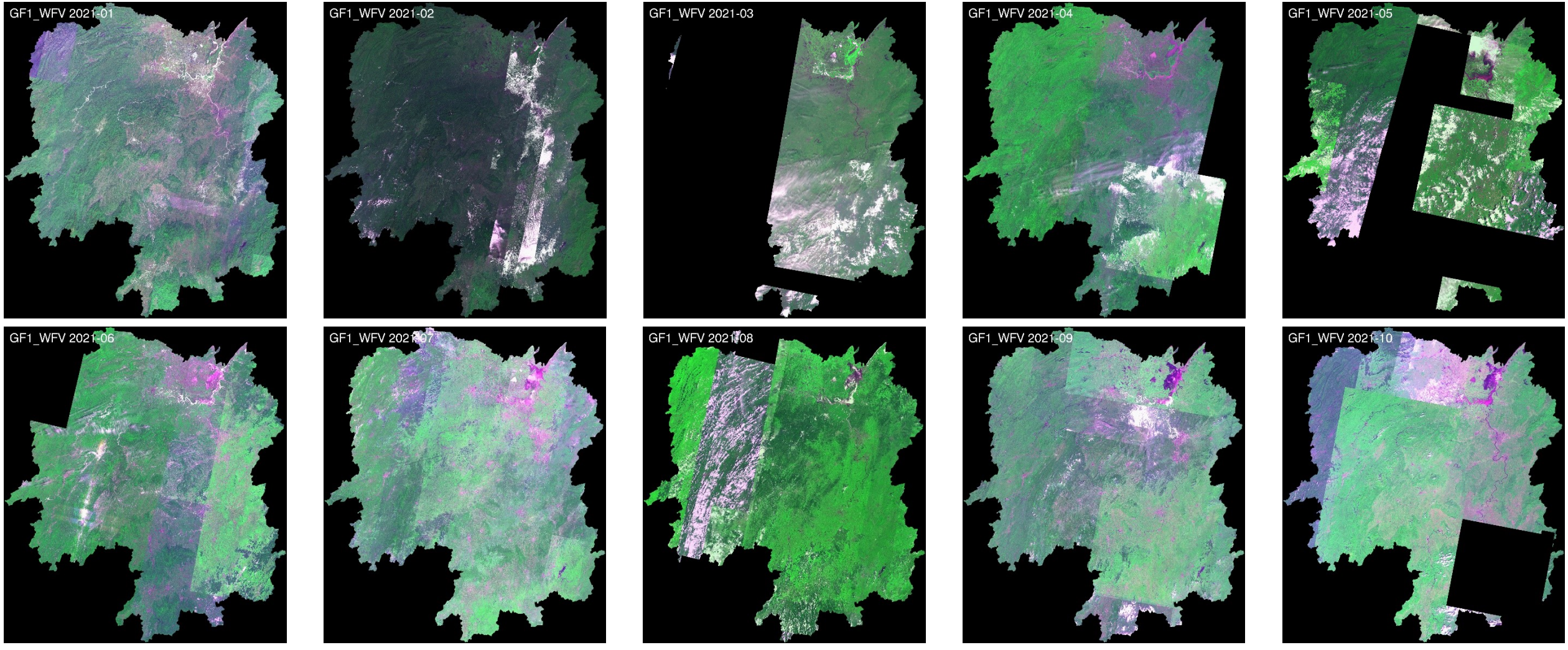
June 5 2021

August 30 2021

October 1 2021

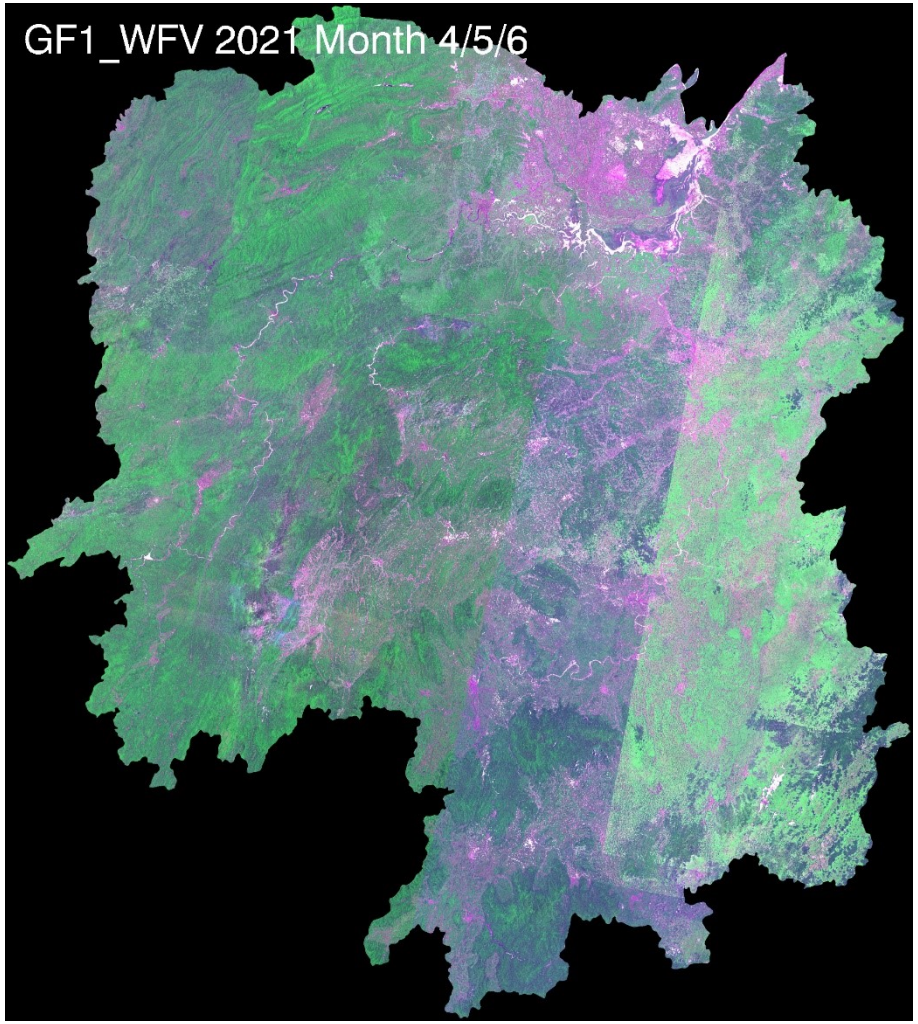
1 Crop Mapping with Chinese high resolution satellite data at provincial level

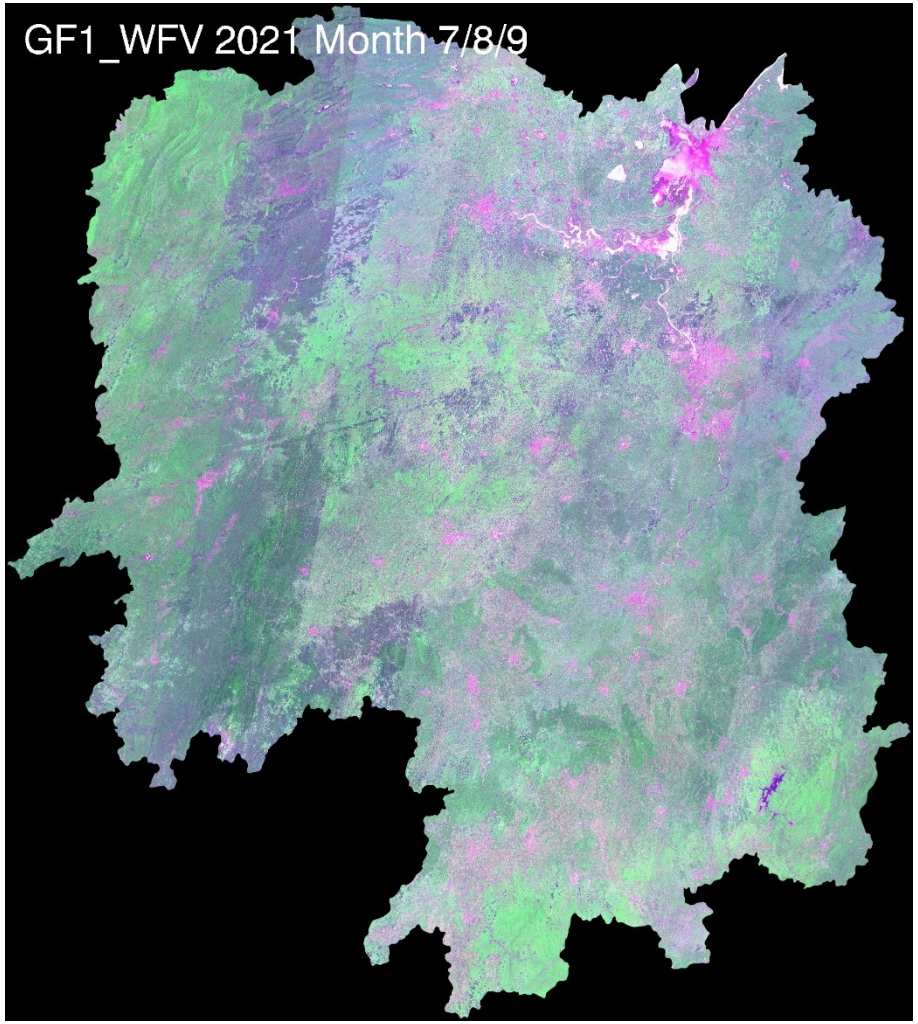
Monthly mosaic of GF-1 WFV



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

Seasonally mosaic of GF-1 WFV



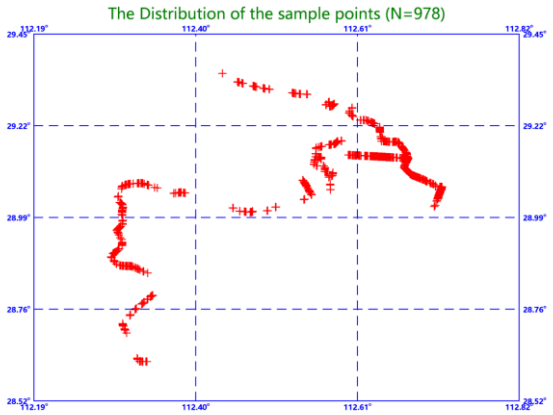


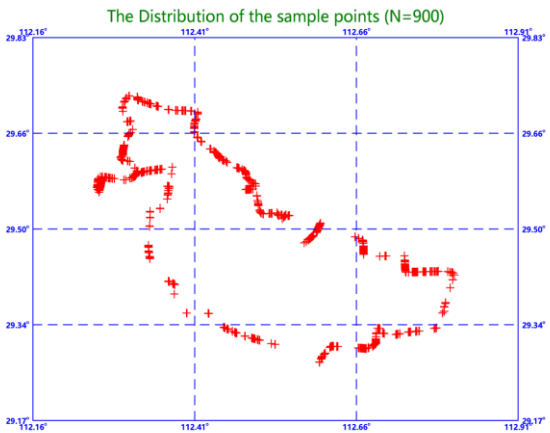
1 Crop Mapping with Chinese high resolution satellite data at provincial level

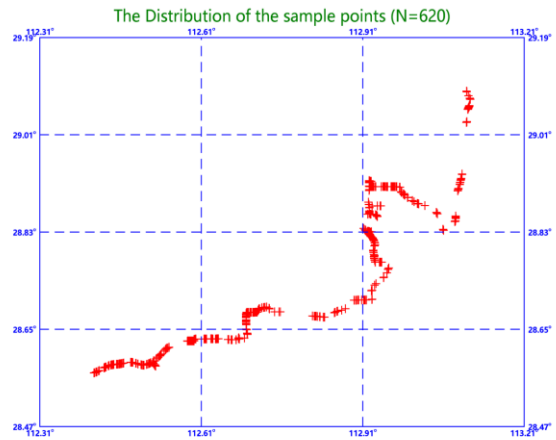
Field Survey

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







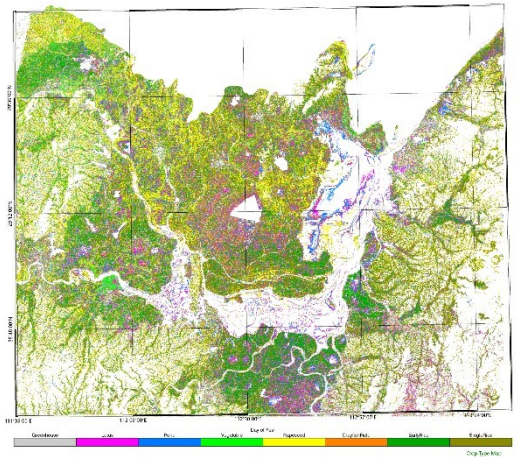
Dragon 5 Mid-term Results Reporting

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

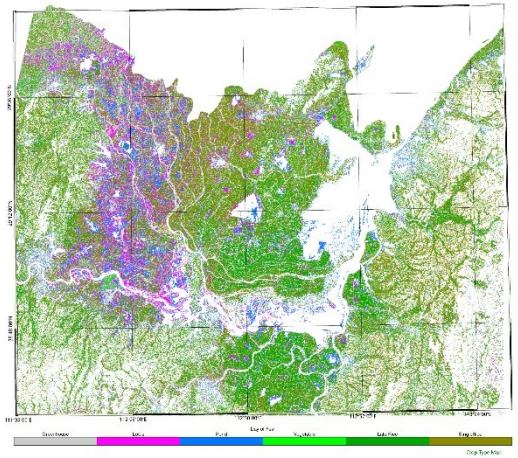
Training sample pixel counts

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

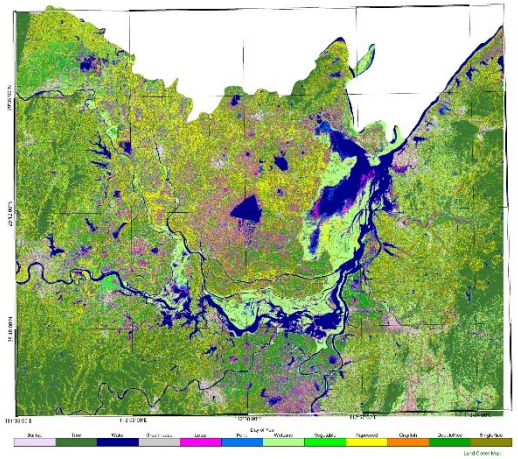
Crop Type Map in Spring for Dongting



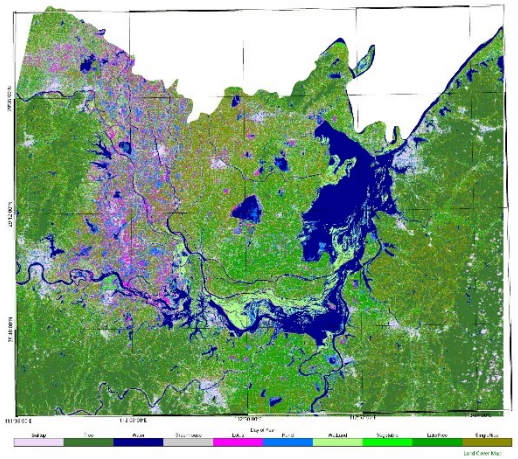
Crop Type Map in Autumn for Dongting



Landcover Map in Spring for Dongting



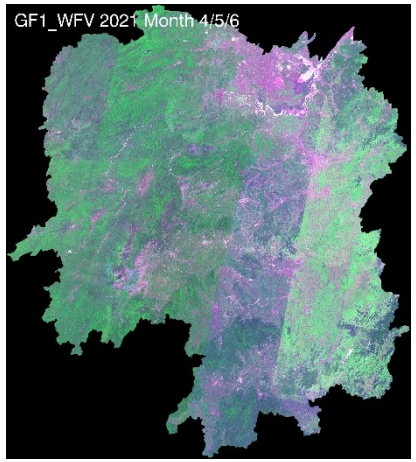
Landcover Map in Autumn for Dongting



Dragon 5 Mid-term Results Reporting

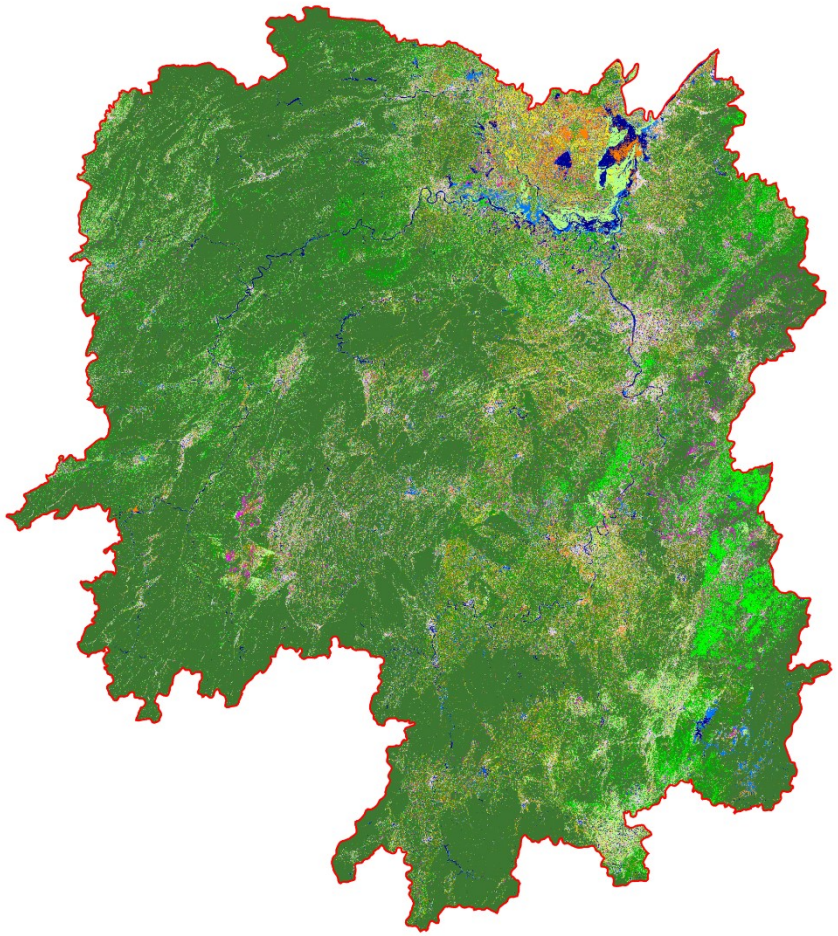
1 Crop Mapping with Chinese high resolution satellite data at provincial level

Input Image



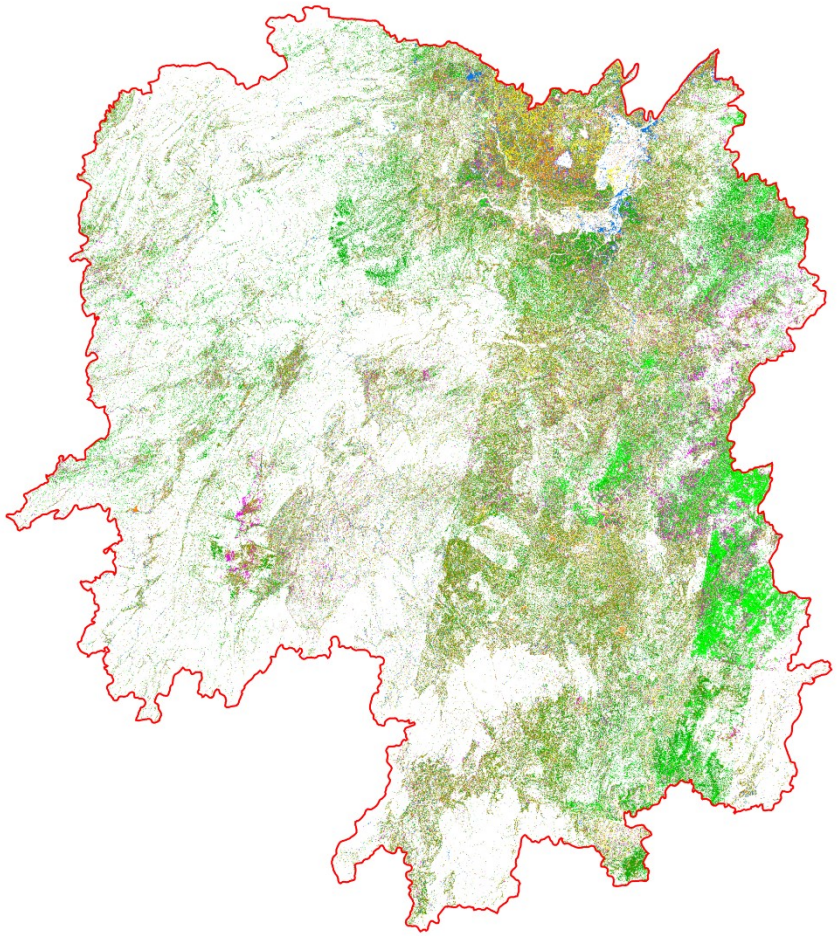
Landcover Map in Spring for Hunan

GF1-WFV 2021-04



Crop Type Map in Spring for Hunan

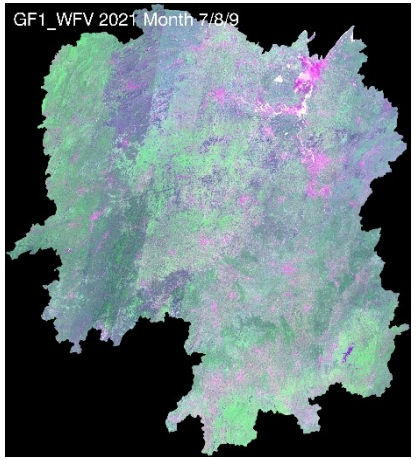
GF1-WFV 2021-04



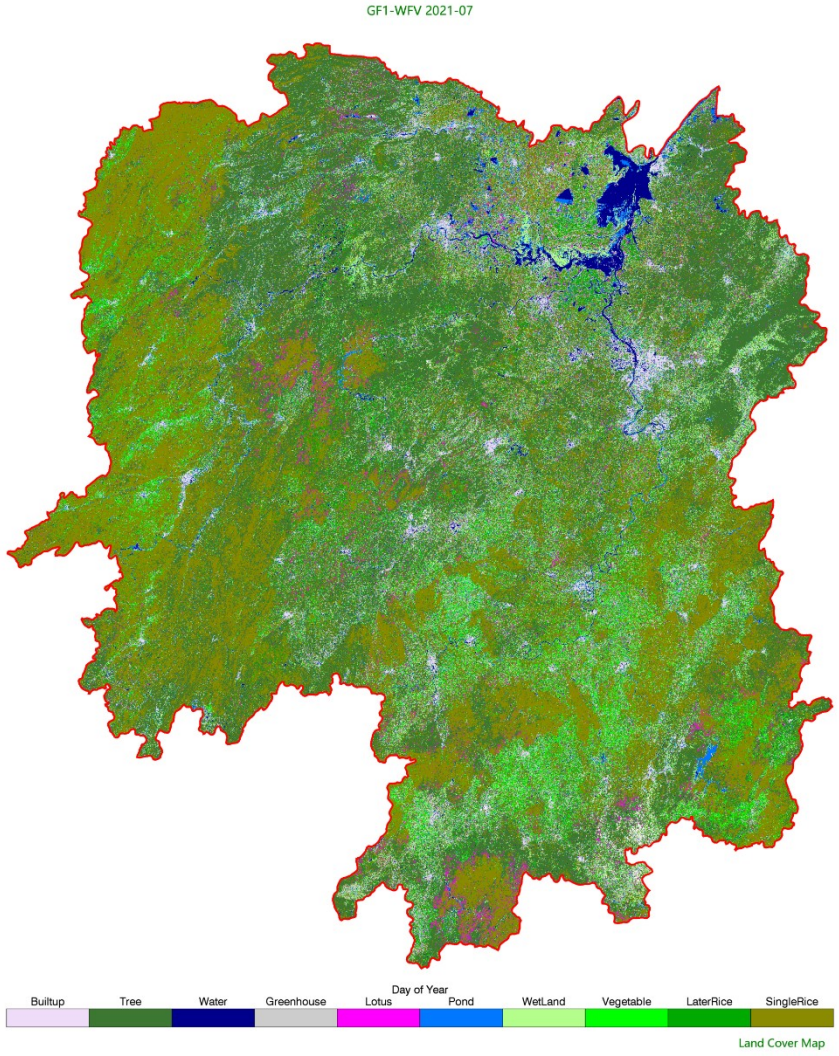
Dragon 5 Mid-term Results Reporting

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

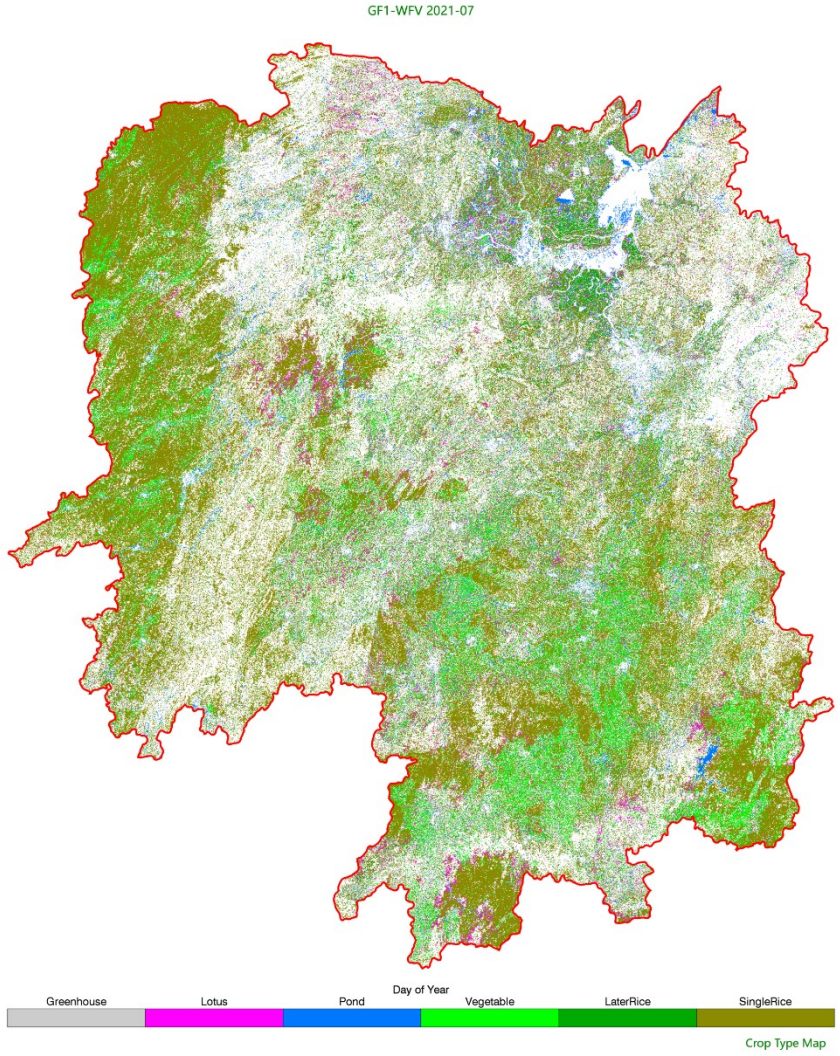
Input Image



Landcover Map in Autumn for Hunan



Crop Type Map in Autumn for Hunan

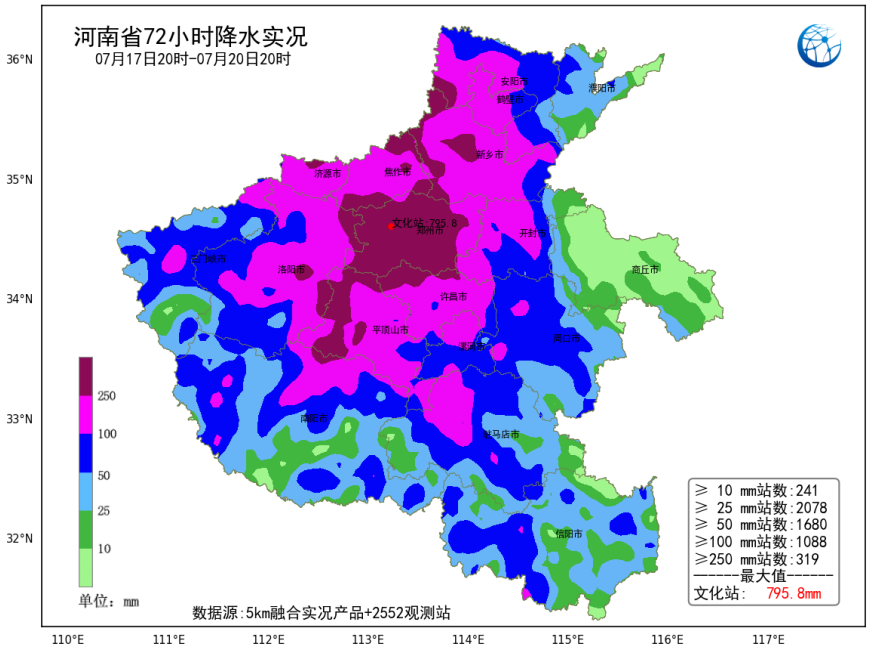


2 Mapping the flood affected crop area

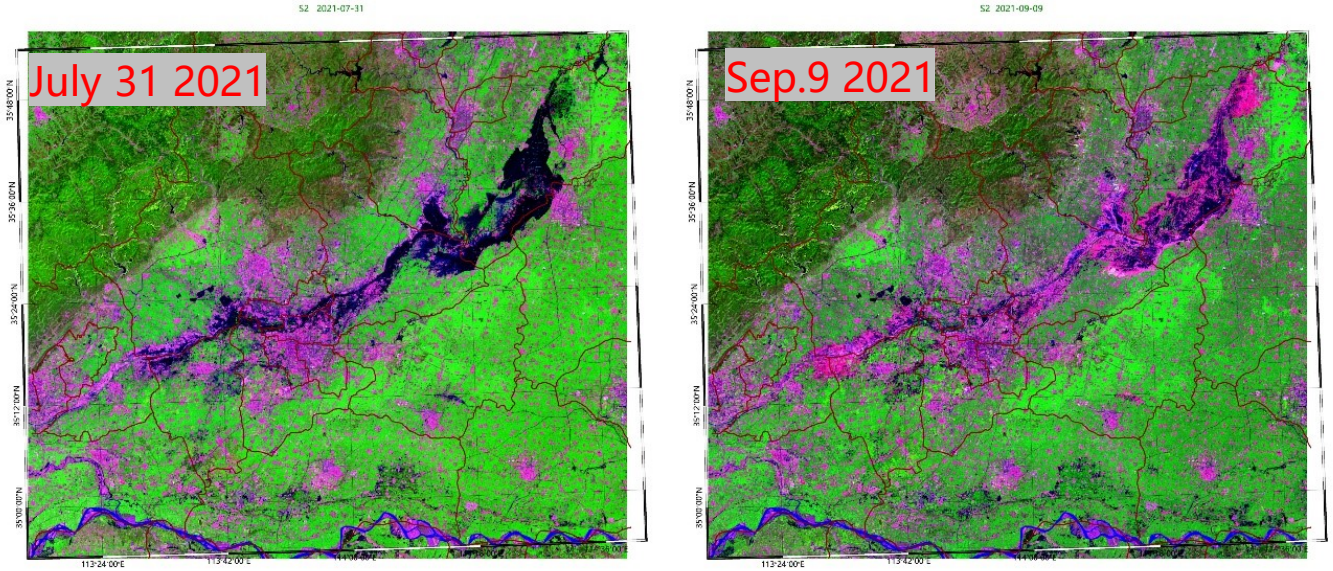
Henan 7.21 Flood 2021

July 17-22, 2021

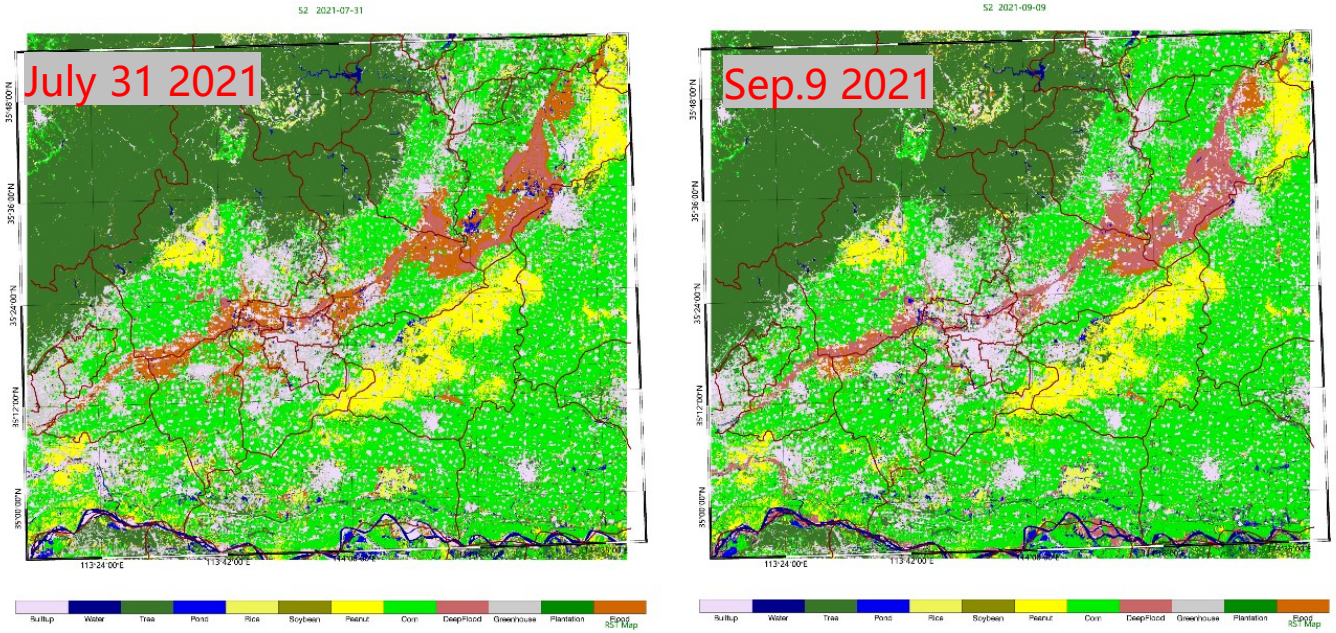
- 696.9 mm per day on July 20 in Zhengzhou & 640 mm annual



Satellite Images



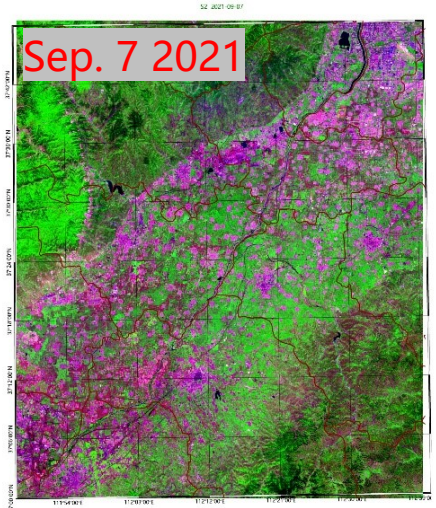
Flood situation Map

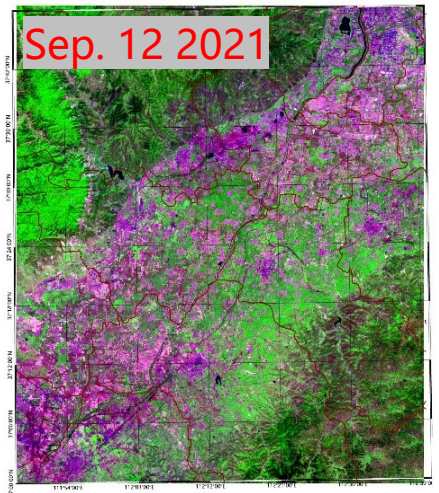


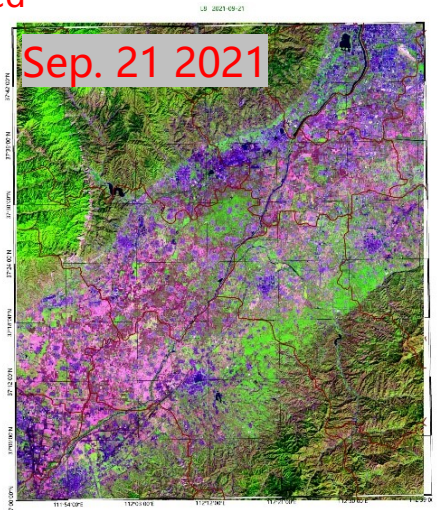
Dragon 5 Mid-term Results Reporting

2 Mapping the flood affected crop area

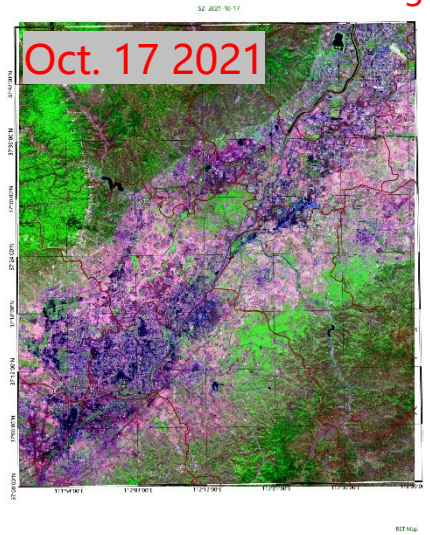
Satellite Images before flooded

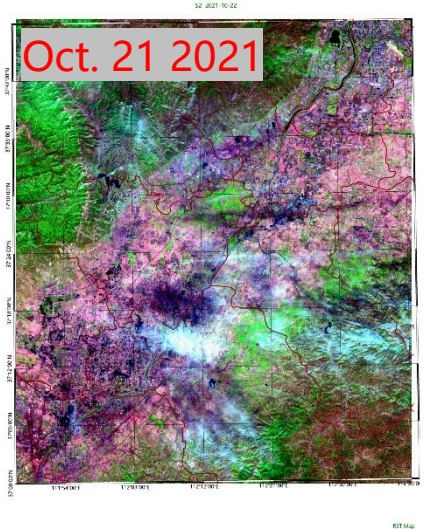




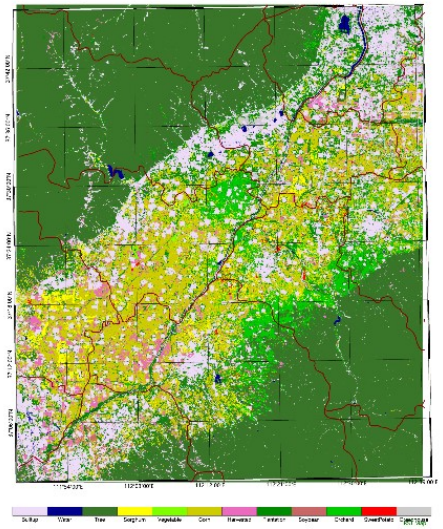


Satellite Images after flooded

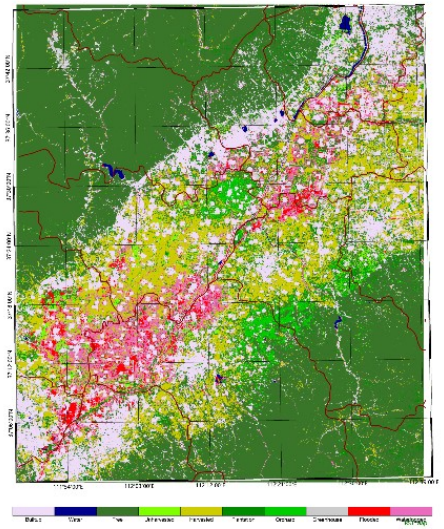




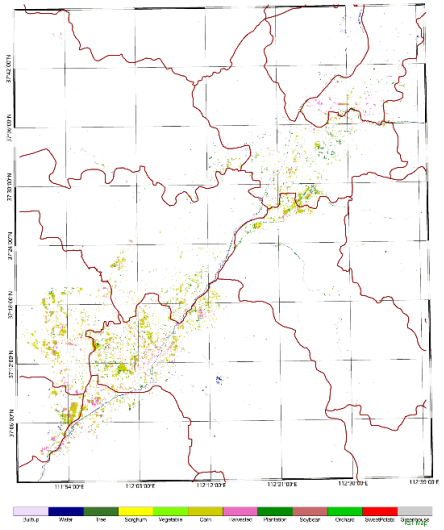
Land cover map before flooded



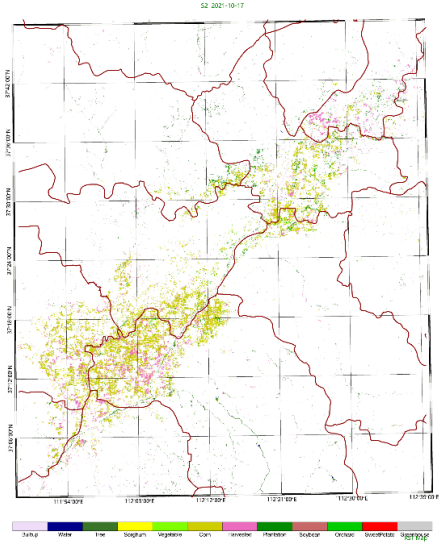
Flood situation map on Oct 17



Crops in deep water



Crops in shallow water



Shanxi Fall Flood, 2021

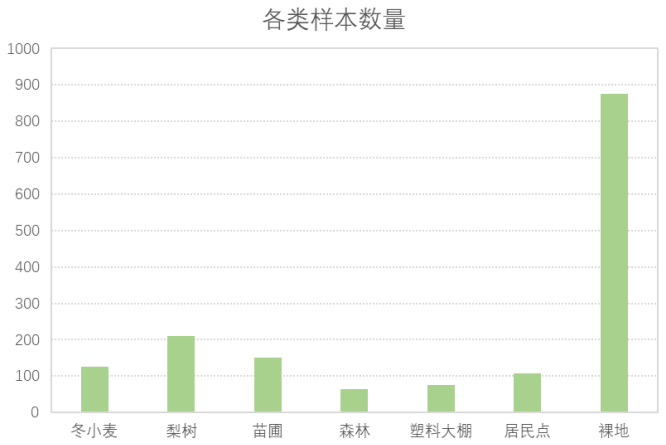
Oct 2-7, 2021

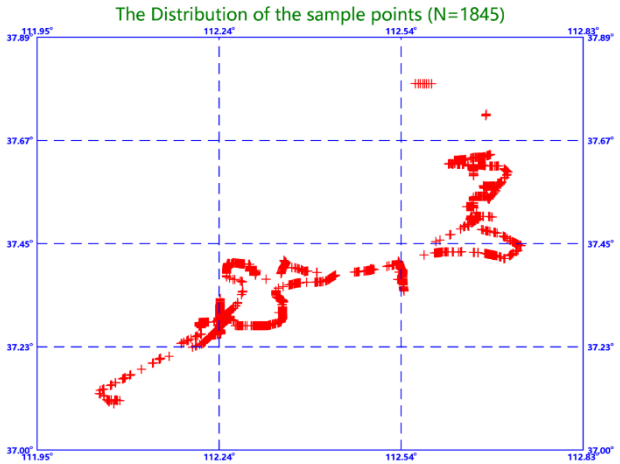
- 100-250 mm

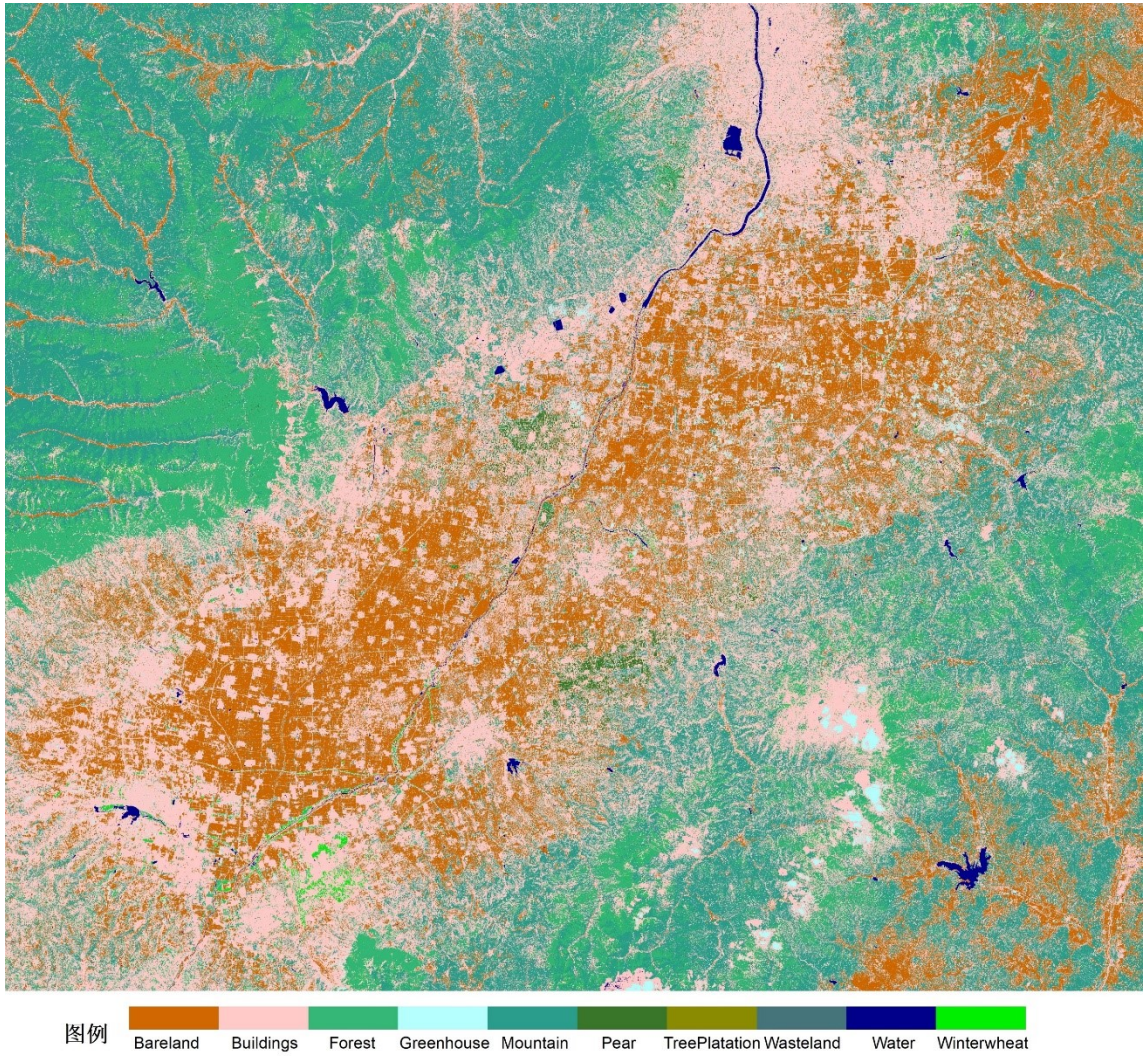
3 Identifying the crop practices of conservation agriculture with Sen2Agri

Bare soil period duration

- conservation agriculture
- Soil wind erosion



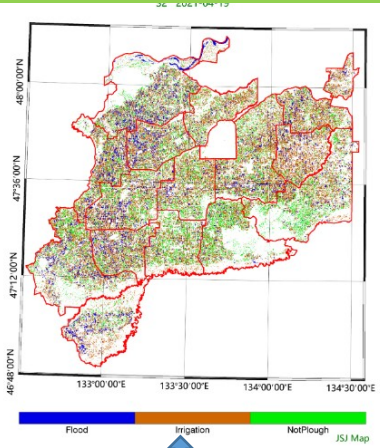




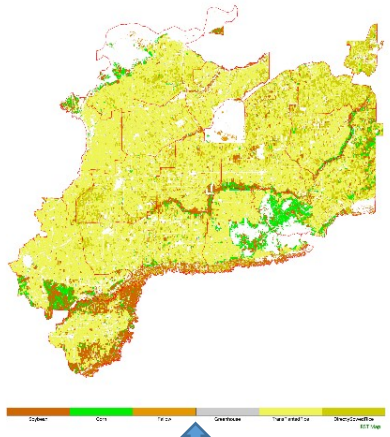
Source: Sentinel-2 April 25, 2022

Dragon 5 Mid-term Results Reporting

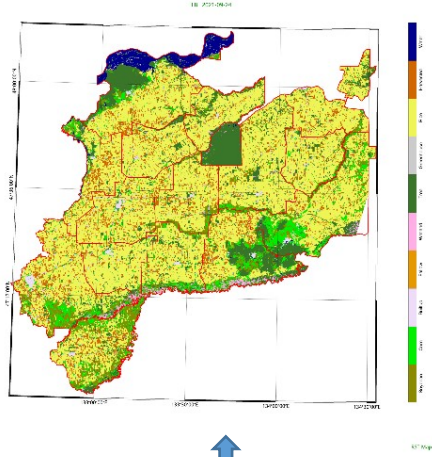
4 Promoting the remote sensing application in large and modern farm



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

	4/19 S2A		
农场	平地泡田	灌水未整地	未耕作
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

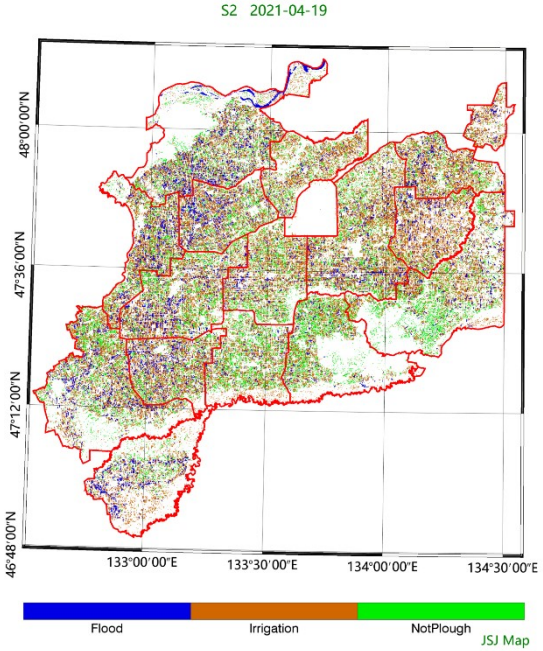
Cultivated acreages for paddy rice and dryland crops

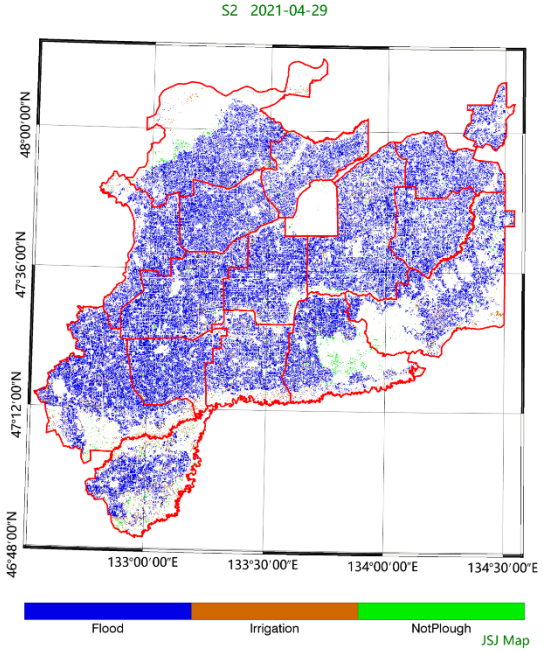
农场	水稻收获占比(9.24)
胜利	20.4%
红卫	8.8%
前锋	4.6%
洪河	12.7%
青龙山	19.4%
勤得利	14.8%
浓江	12.3%
鸭绿河	5.5%
前进	16.9%
创业	10.8%
七星	19.4%
大兴	18.7%
八五九	8.5%
二道河	6.3%
前哨	9.5%
平均	12.6%

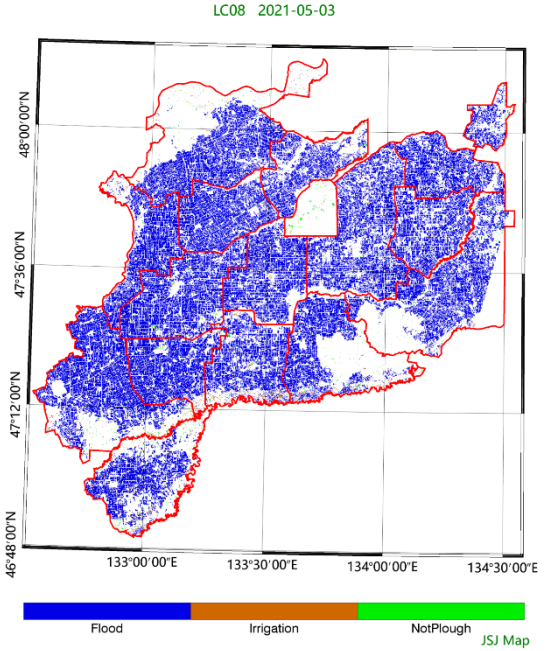
Statistics for Harvest and plough in fall


May 14
Field Prepared for Rice

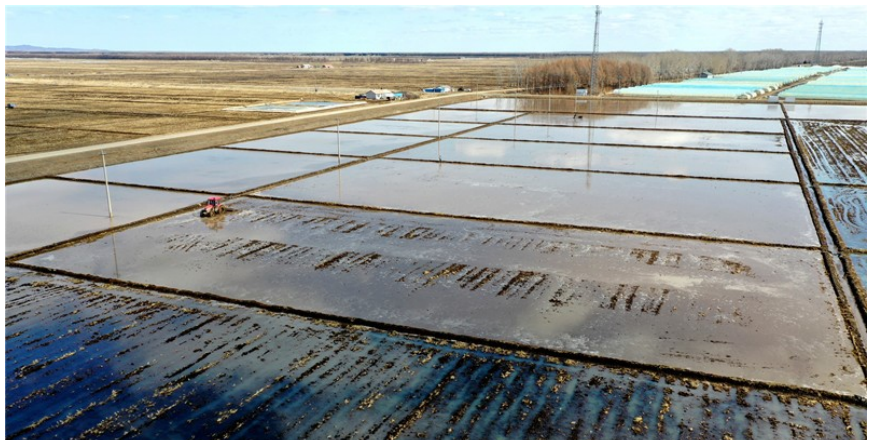

June 8
No Rice transplanted





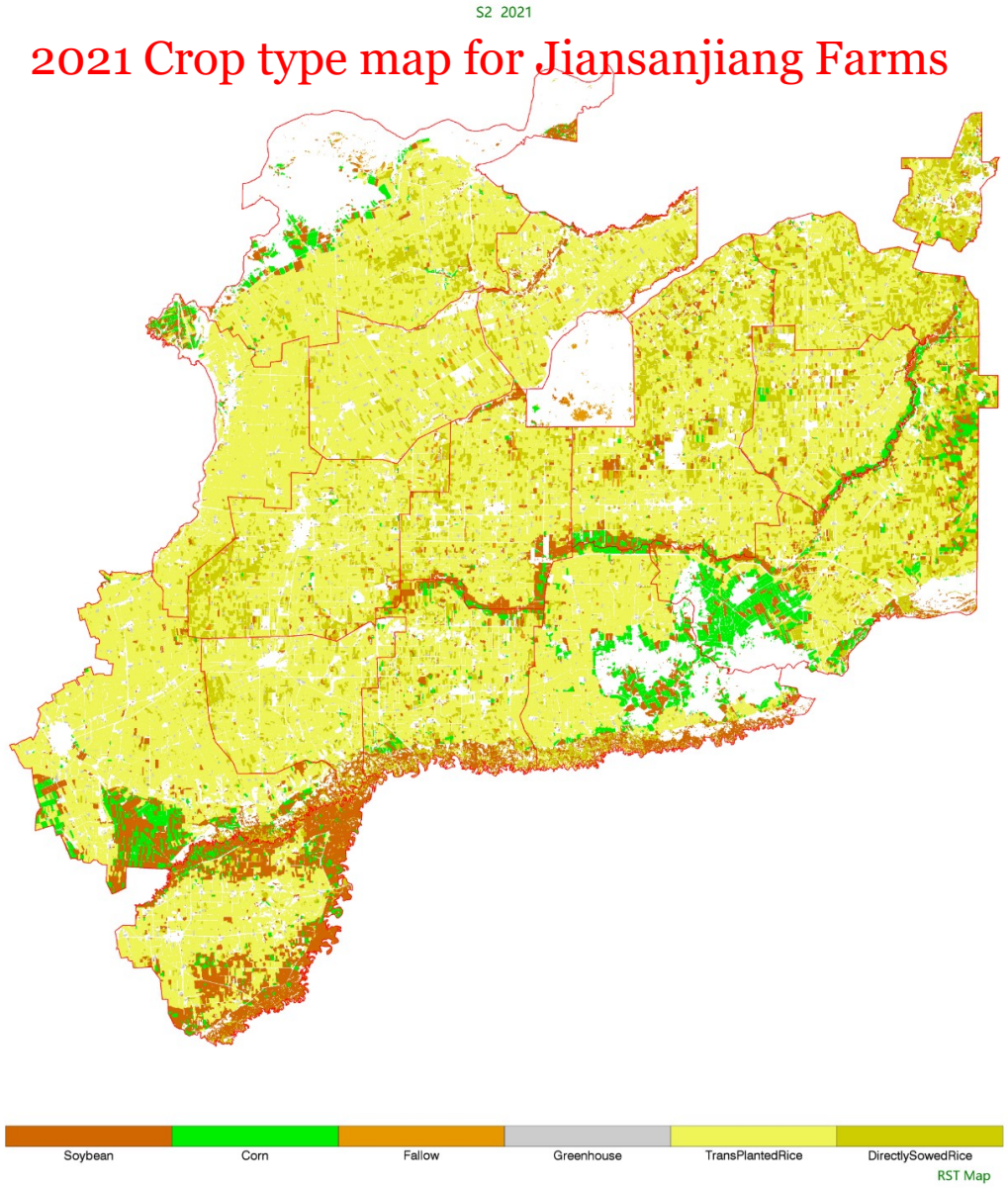


	4/19 S2A			4/29 S21C			5/3 L8		
农场	平地泡田	灌水未整地	未耕作	平地泡田	灌水未整地	未耕作	平地泡田	灌水未整地	未耕作
创业农场	22%	59%	19%	96%	3%	1%	97%	2%	1%
大兴农场	24%	60%	16%	75%	18%	7%	90%	7%	3%
红卫农场	11%	53%	36%	88%	10%	2%	95%	4%	1%
洪河农场	13%	59%	27%	94%	4%	2%	99%	1%	0%
浓江农场	23%	56%	20%	96%	3%	1%	99%	1%	0%
七星农场	19%	54%	26%	89%	10%	2%	96%	3%	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%

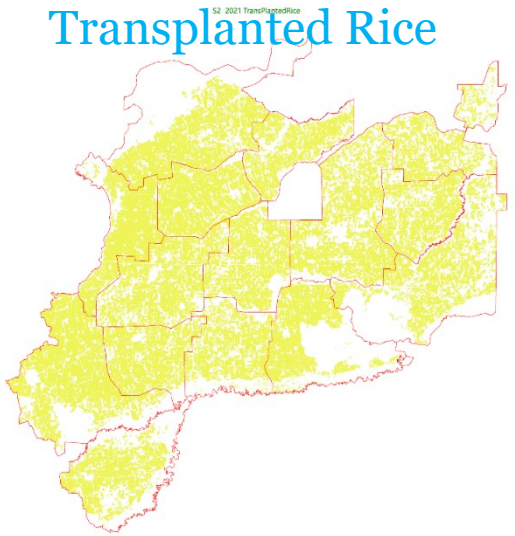


Dragon 5 Mid-term Results Reporting

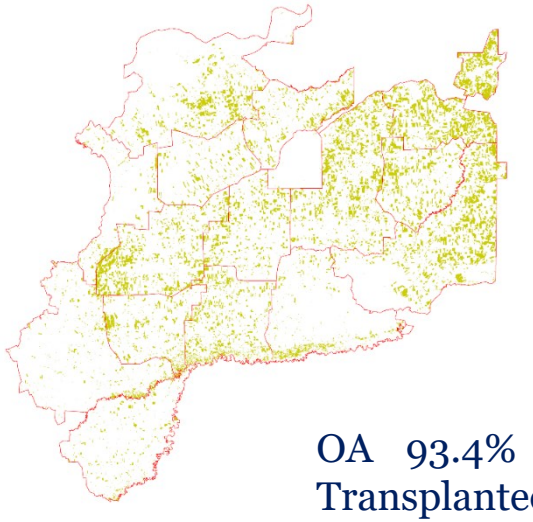
2021 Crop type map for Jiansanjiang Farms



Transplanted Rice



Directly sowed Rice

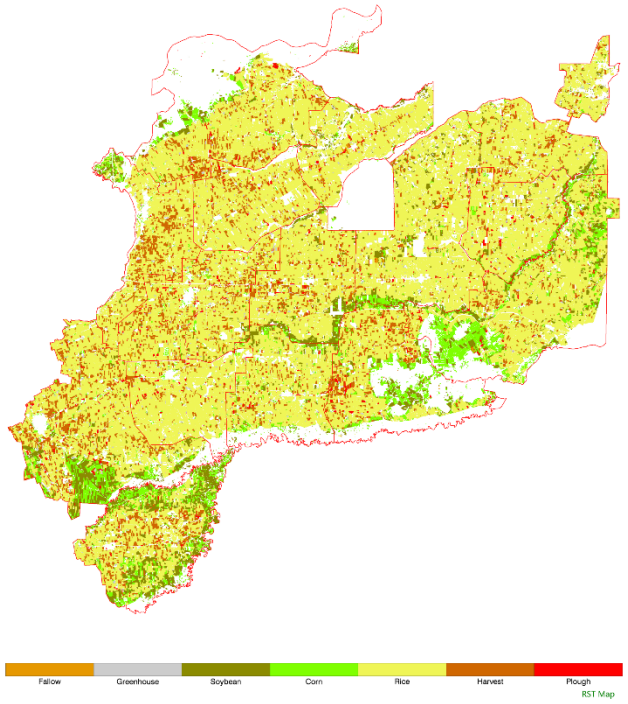


Source: Sentinel 2 images obtained on May 14, June 8,June 23, July 13, July 18, August 17, September1 and September 6, 2021

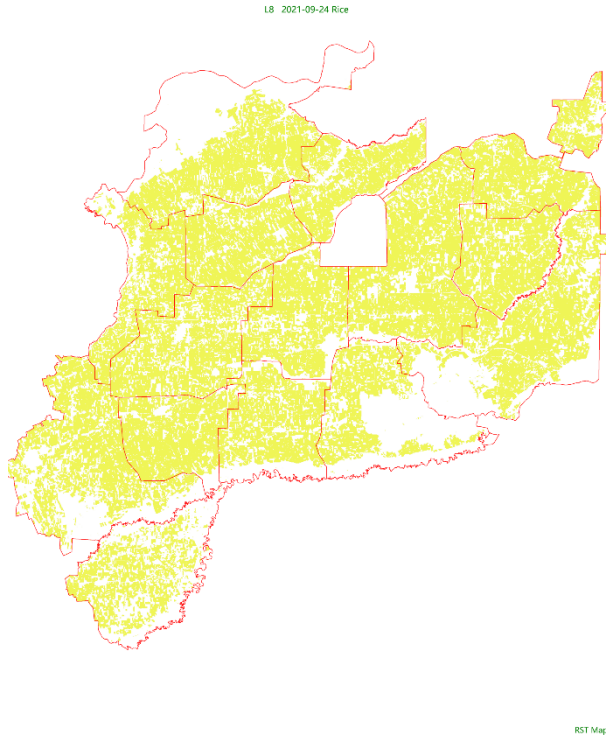
OA 93.4% , Soybean F1 97.8% , Maize F1 99.2% , Transplanted Rice F1 93.8%, Directly Sowed Rice F1 87.7%

Dragon 5 Mid-term Results Reporting

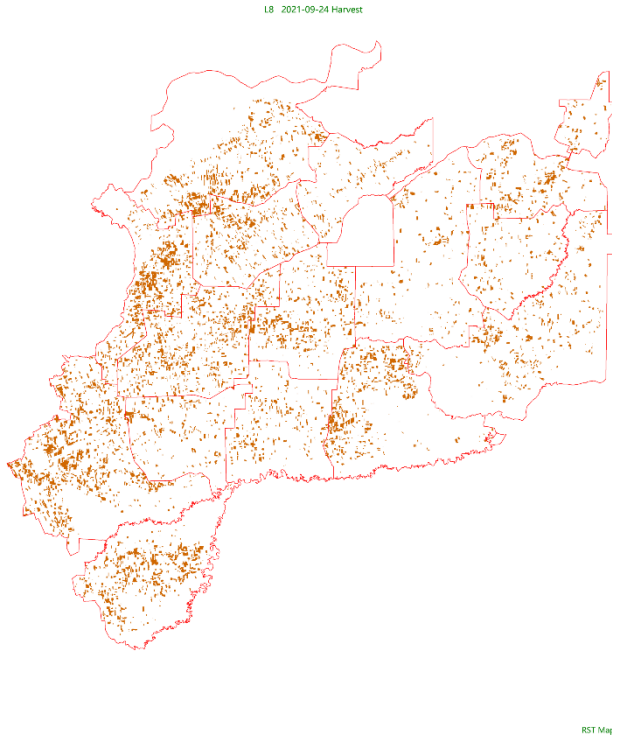
Field situation of farms in Jiansanjiang as of Sep.24, 2021



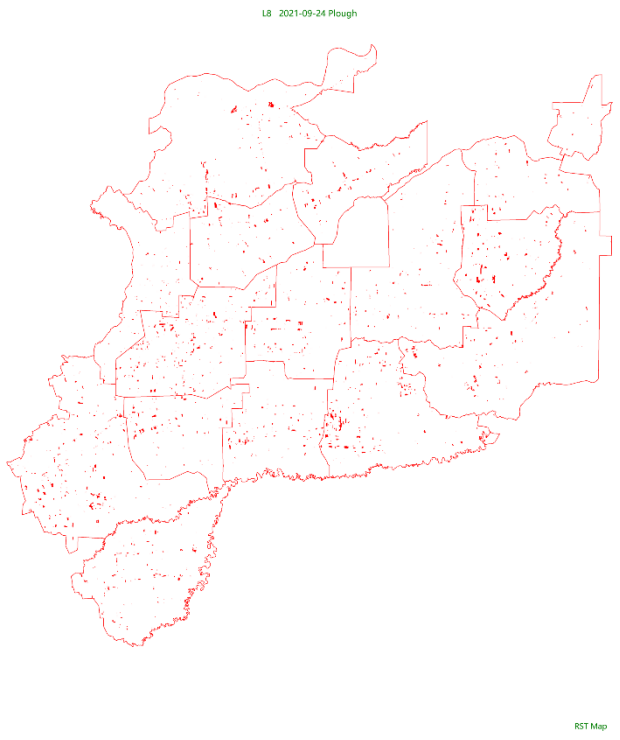
Not yet harvested rice



Harvested



Ploughed

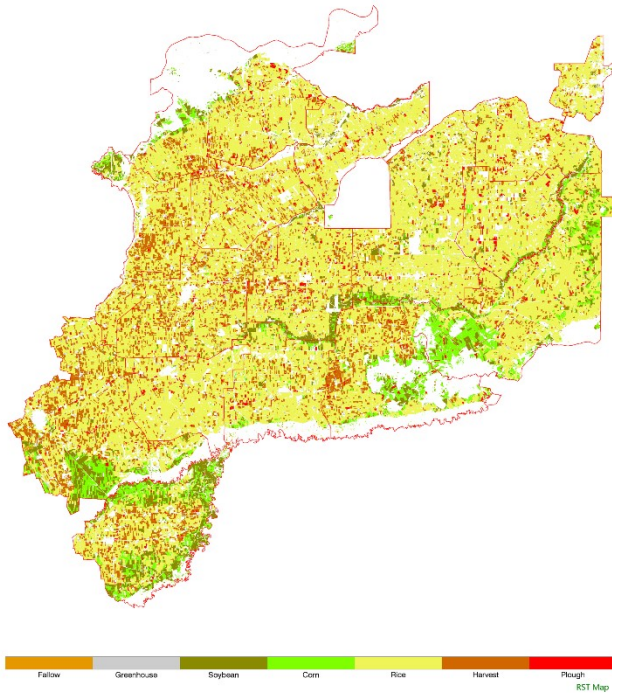


Source: L8 Sep. 24, 2021

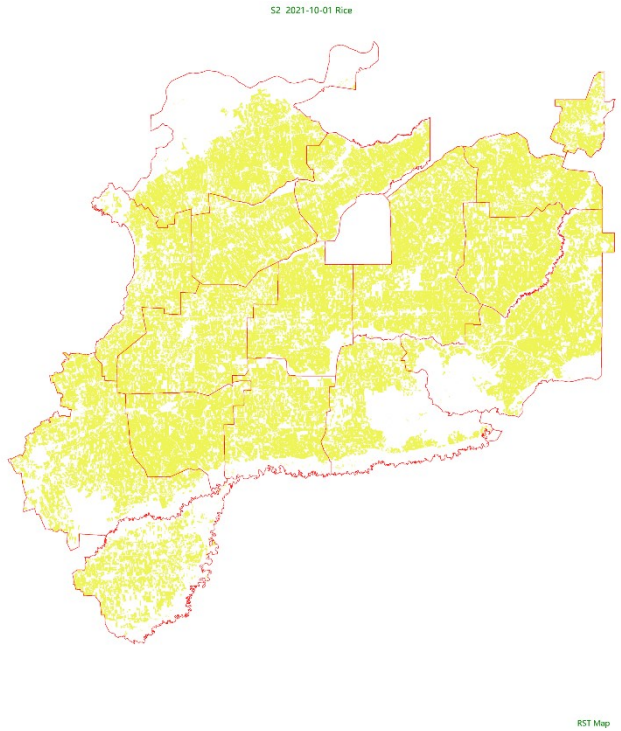
OA 96.6%, Soybean F1 91.2%, Maize F1 87.6%, not yet harvested Rice F1 99.4%, Harvested Rice F1 93.3%, Ploughed F1 91.3%

Dragon 5 Mid-term Results Reporting

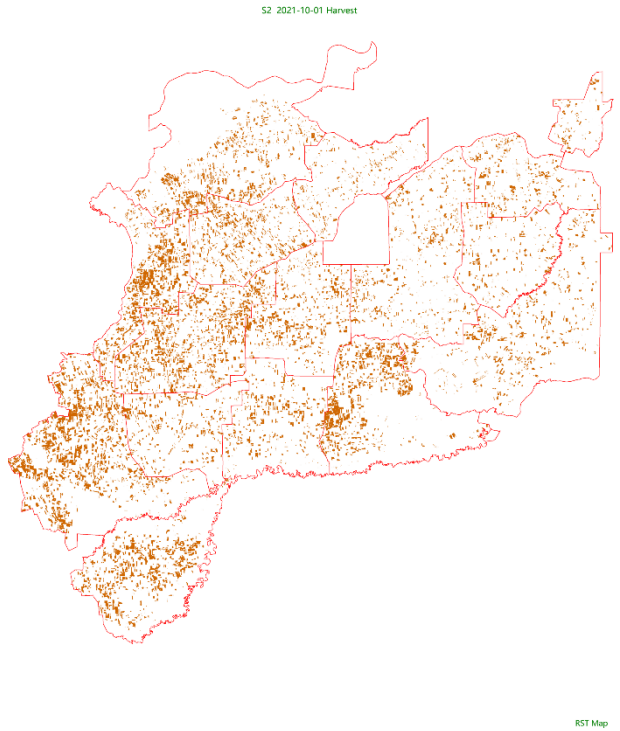
Field situation of farms in Jiansanjiang as of Oct.1, 2021



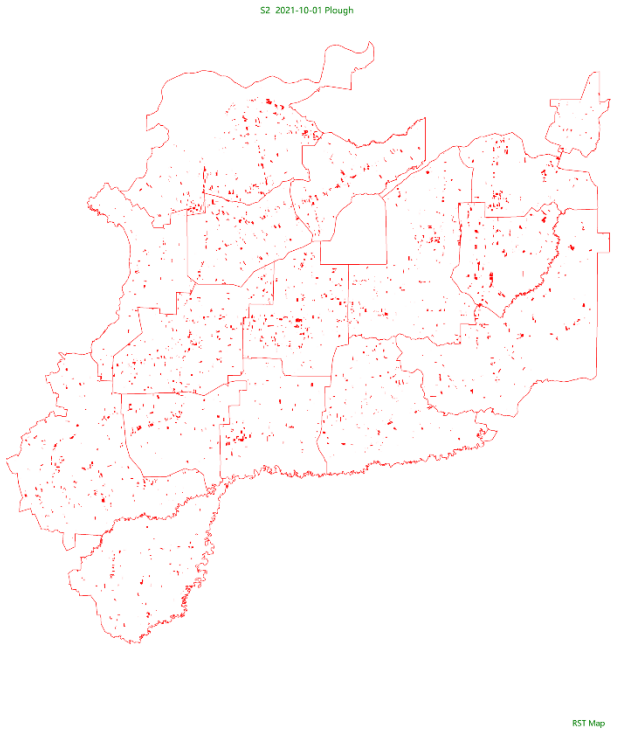
Not yet harvested rice



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%

Dragon 5 Mid-term Results Reporting

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

European Team

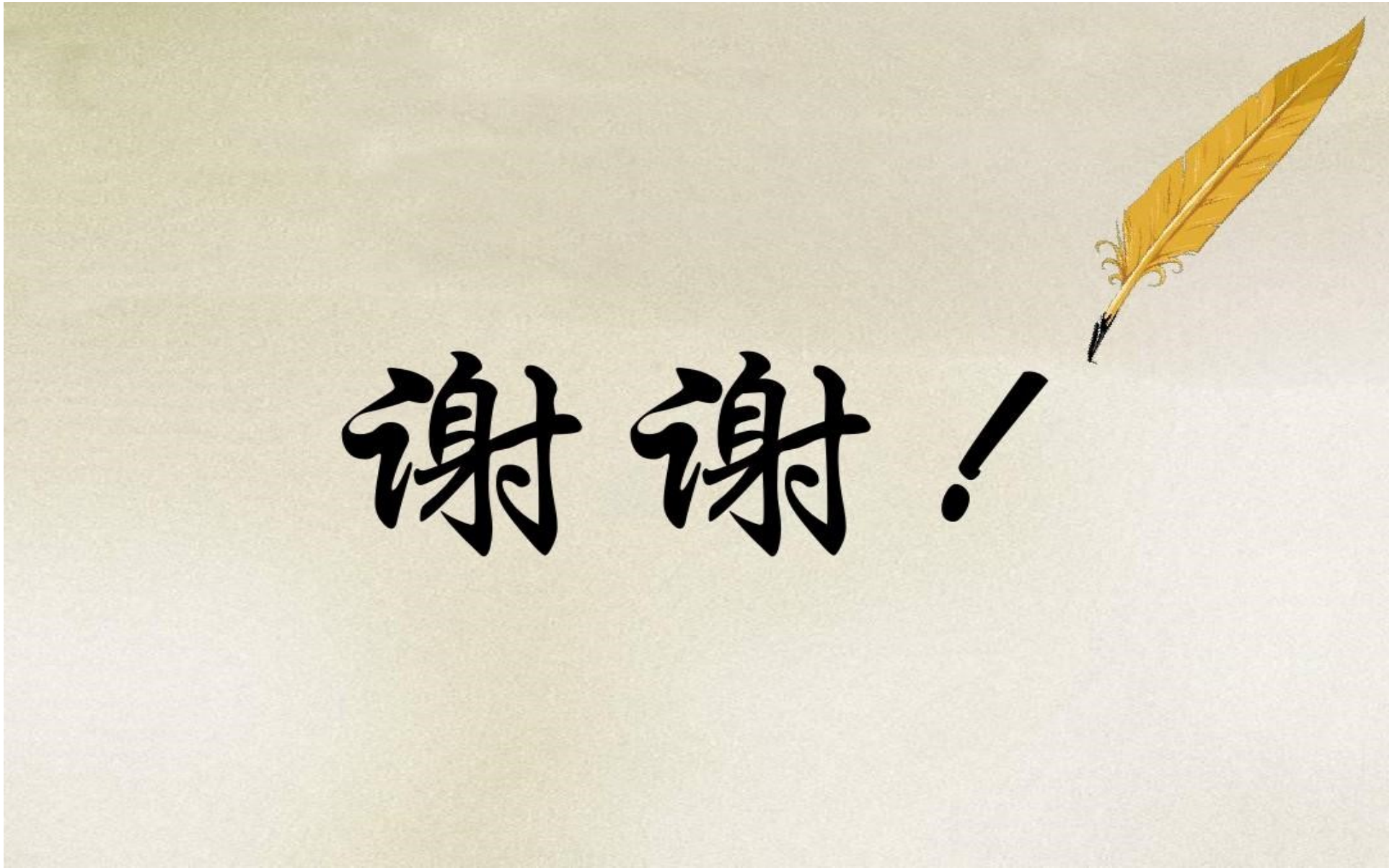
- Crop type mapping with Sent2agri system
- Algorithm of crop biophysics parameter retrieved from high resolution satellite
- Nutrition retrieval algorithm form high resolution satellite data
- Crop yield estimation from high resolution satellite data
- Joint field survey

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.


谢谢！