
NRSCC
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ESA–MOST Dragon Cooperation
中国科技部-欧洲空间局“龙计划”合作
2017 DRAGON 4 SYMPOSIUM
2017年“龙计划”四期学术研讨会
Project ID – 32194: Crop Mapping with combined use of European and Chinese Satellite Data
Chinese PI: Dr. Jinlong Fan
National Satellite Meteorological Center, China
European PI: Prof. Defourny Pierre
Universite Catholique de Louvain, Belgium
26–30 June 2017 | Copenhagen, Denmark
2017年6月26-30日，丹麦 哥本哈根

Project ID – 32194: Crop Mapping with combined use of European and Chinese Satellite Data

Chinese PI: Dr. Jinlong Fan
National Satellite Meteorological Center, China
European PI: Prof. Defourny Pierre
Universite Catholique de Louvain, Belgium

outlines

- Brief Introduction of project and tasks
- Data acquisition
- Field campaigns
- Young scientist participation
- Results and ongoing work

Two Tasks

1. Crop mapping with time series of high resolution European and Chinese satellite data

Chinese PIs:
Prof. Xiaoyu Zhang
Ningxia Meteorological Science Institute
Dr. Jinlong Fan
National Satellite Meteorological Center, China

European PI:
Prof. Defourny Pierre
Universite Catholique de Louvain, Belgium
Crop type mapping with time series of Sentinel-2 and GF data in Northwest China

Teams

Chinese Teams:

Dr. Jinlong Fan
Dr. Hao Gao
National Satellite Meteorological Center

Prof. Xiaoyu Zhang
Dr. Lei Zhang
Ningxia Meteorological Science Institute

European Teams:

Prof. Defourny Pierre

Ph.D Nicolas Bellemans
Universite Catholique de Louvain, Belgium

Two Tasks

2. Assessing Crops with PROBA-V and FY-3 MERSI Data

Chinese PIs:
Dr. Jinlong Fan
National Satellite Meteorological Centre, China
Prof. Limin Wang
Institute of Agricultural Resources and Regional Planning

European PI:
Dr. Qinghan Dong
VITO, Belgium

(1)Assessing crop conditions and stress, and
(2)Mapping the crops with the time series Proba-V and FY-3 MERIS data

Teams

Chinese Teams:

Dr. Jinlong Fan
Dr. Hao Gao
Mr. Shaojie Liu, Ms. Qi Xu, Mr. Qiliang Li
National Satellite Meteorological Center

Prof. Limin Wang
Institute of Agricultural Resources and Regional Planning

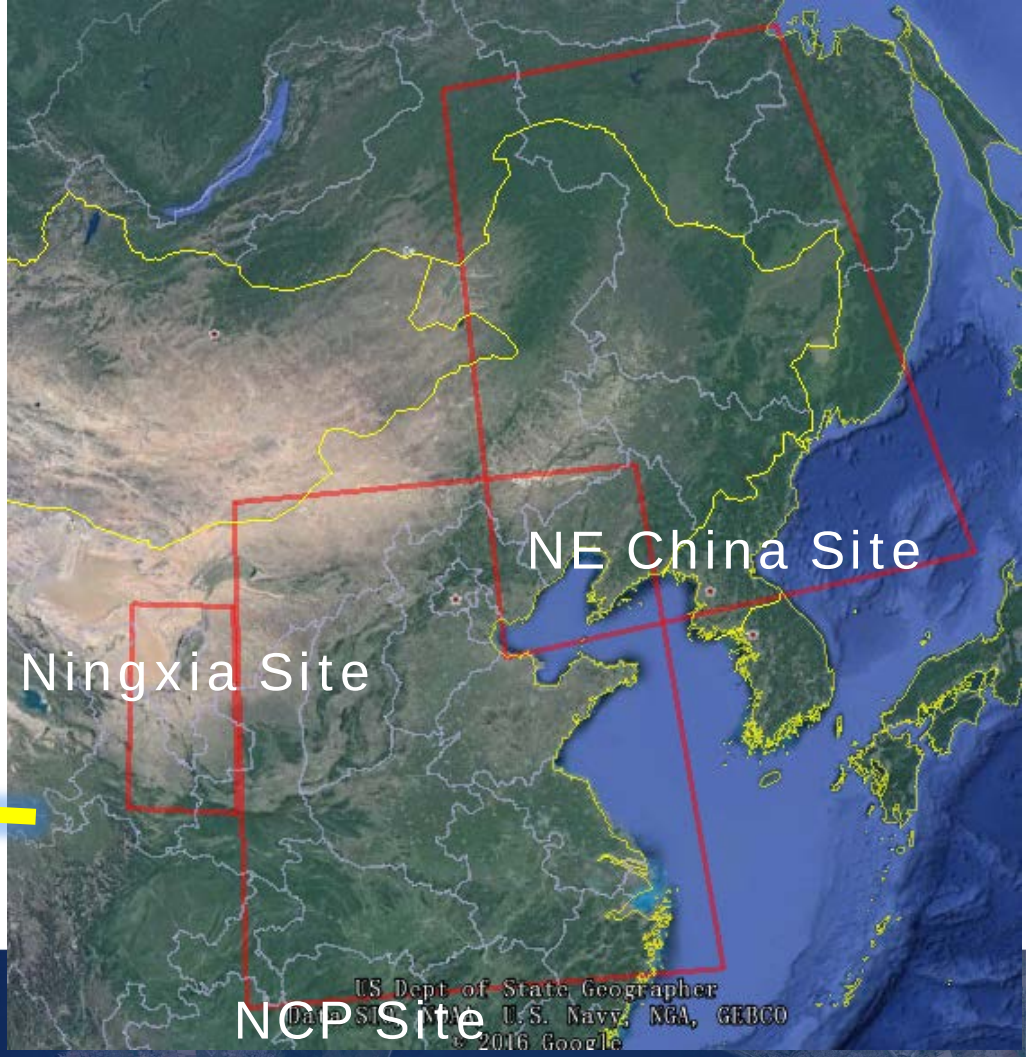
Prof. Jingfeng Xing
China Institute of Water Resources and Hydropower Research

European Teams:

Dr. Qinghan Dong
VITO, Belgium

Study Areas


寧夏回族自治區
甘肅省
Ningxia Site
US Dept of State Geographer
Image Landsat
影像拍攝日期: 1970/1/1 37° 03' 32.83" 北 10


NE China Site
Ningxia Site
NCP Site
US Dept of State Geographer
U.S. Navy, NGA, GEBCO
2016 Google

Data acquired

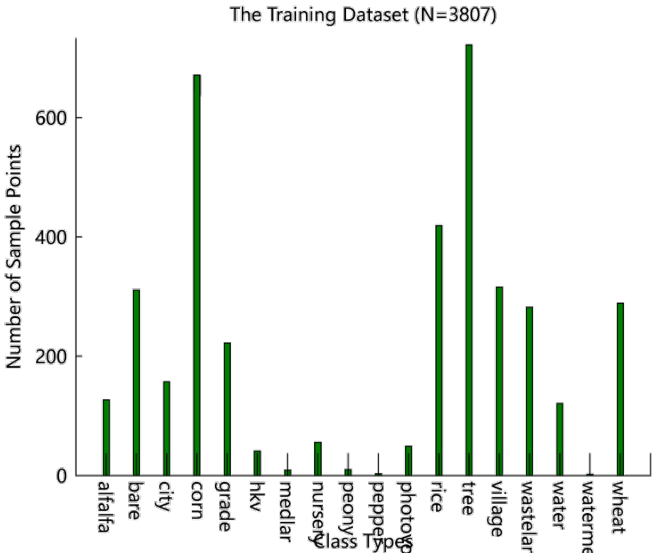
- Sentinel 2
  - Since Growing Season 2015 - 2020
- GF1/2
  - Since Growing Season 2013 /2015 - 2020

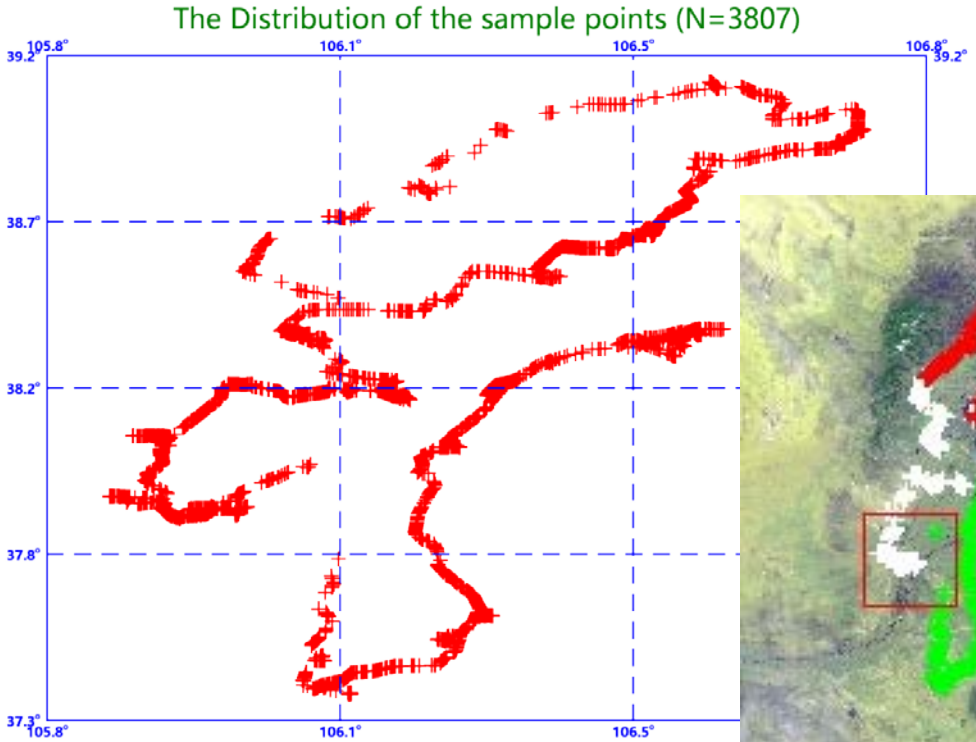
- FY3-MERSI (FY-3A/3B/3C/3D Daily)
  - Since 2009 - 2020
- PROBA-V VITO PDF
  - 2013 - 2020

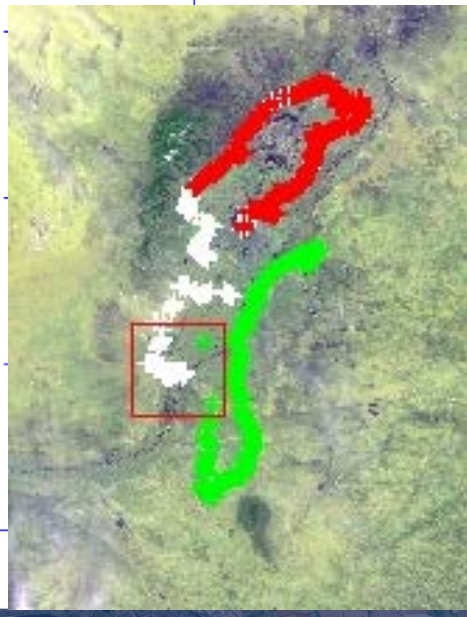
Field campaigns

- Ground truth data collection
  - Ningxia 2016-2017
  - NE 2016-2017
  - NCP 2016-2020

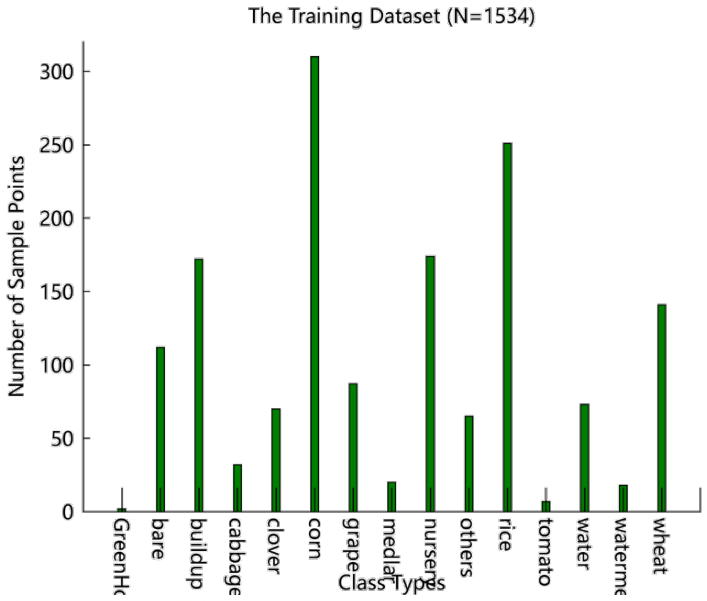
June 5,6,7, 2016
Ningxia Field Survey

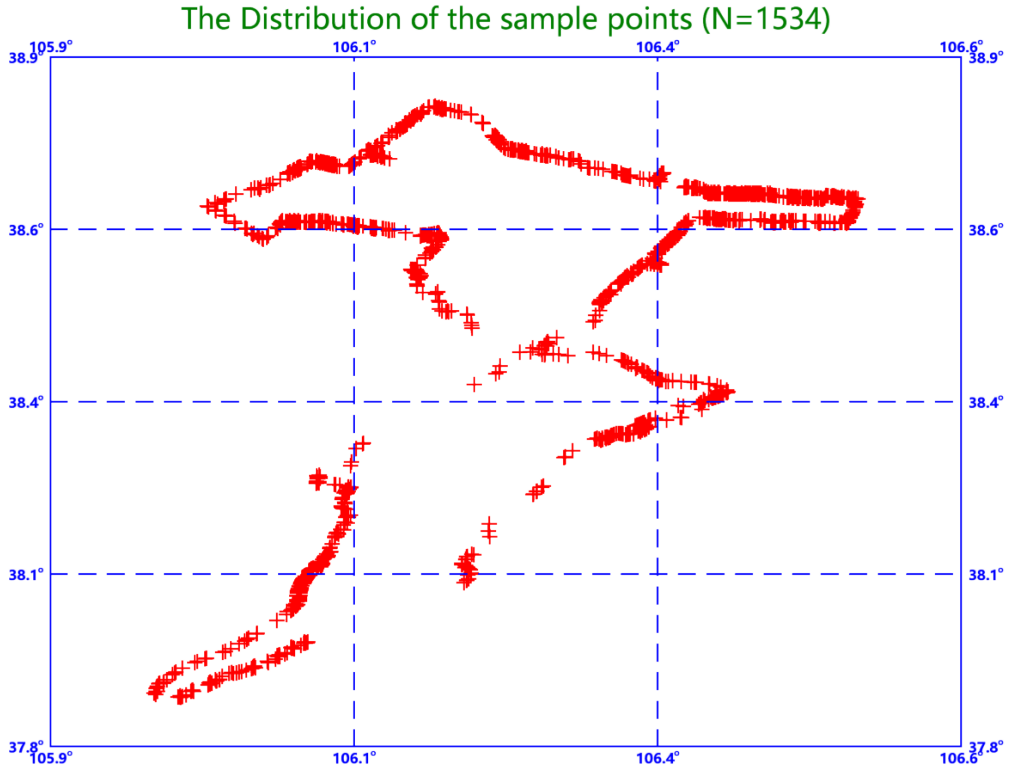




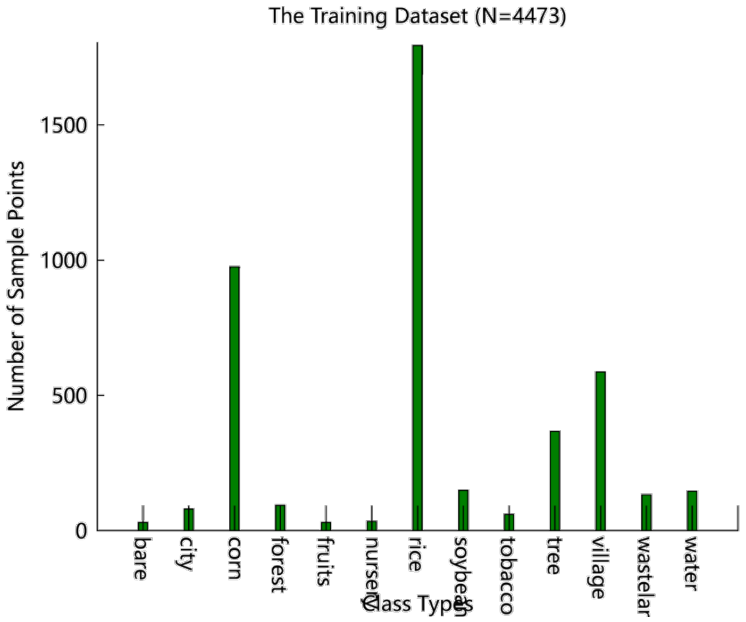


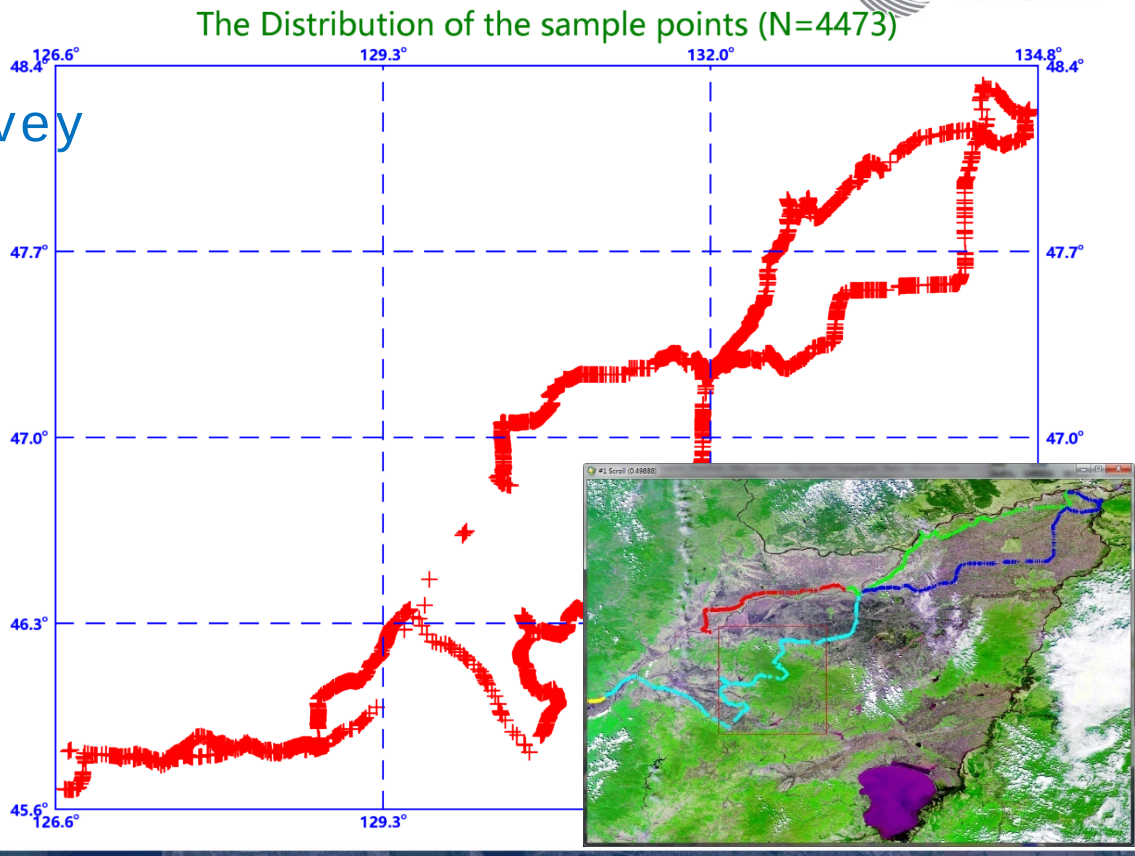
June 15,16,17, 2017
Ningxia Field Survey



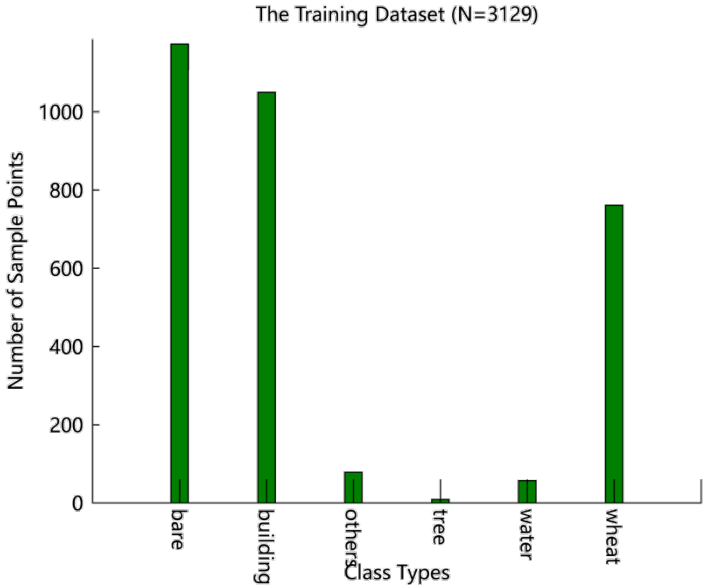


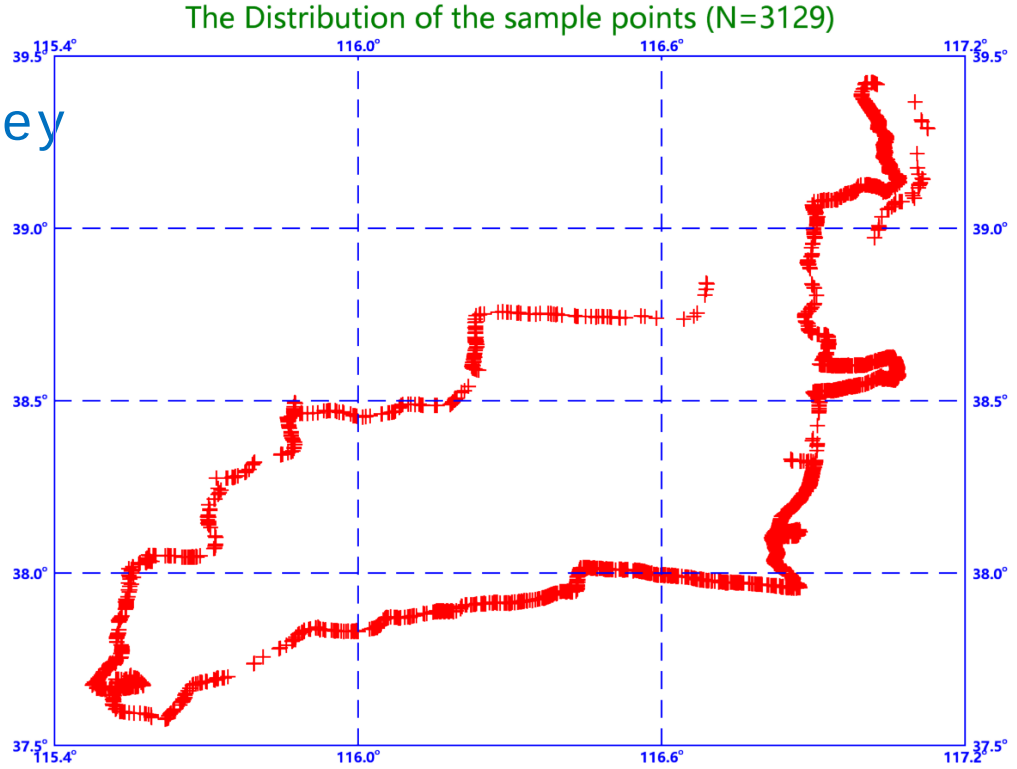
June 17-22, 2016
Northeast China Field Survey



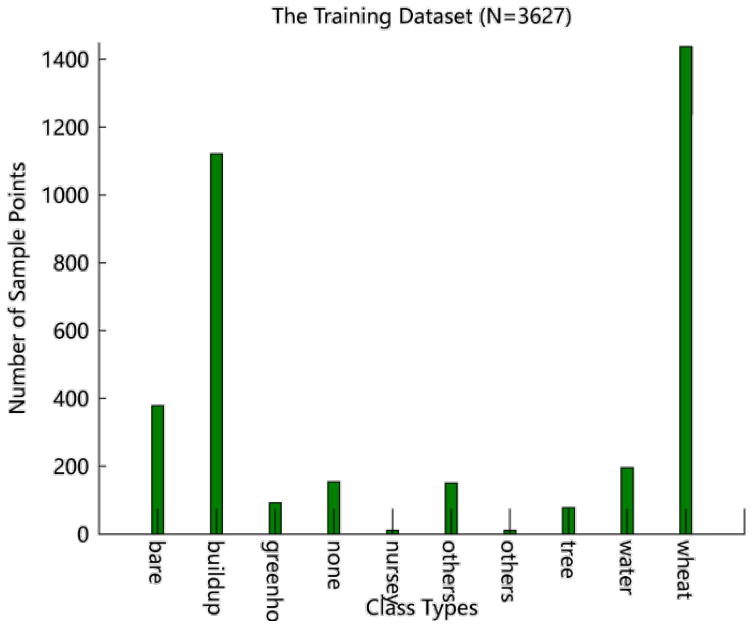


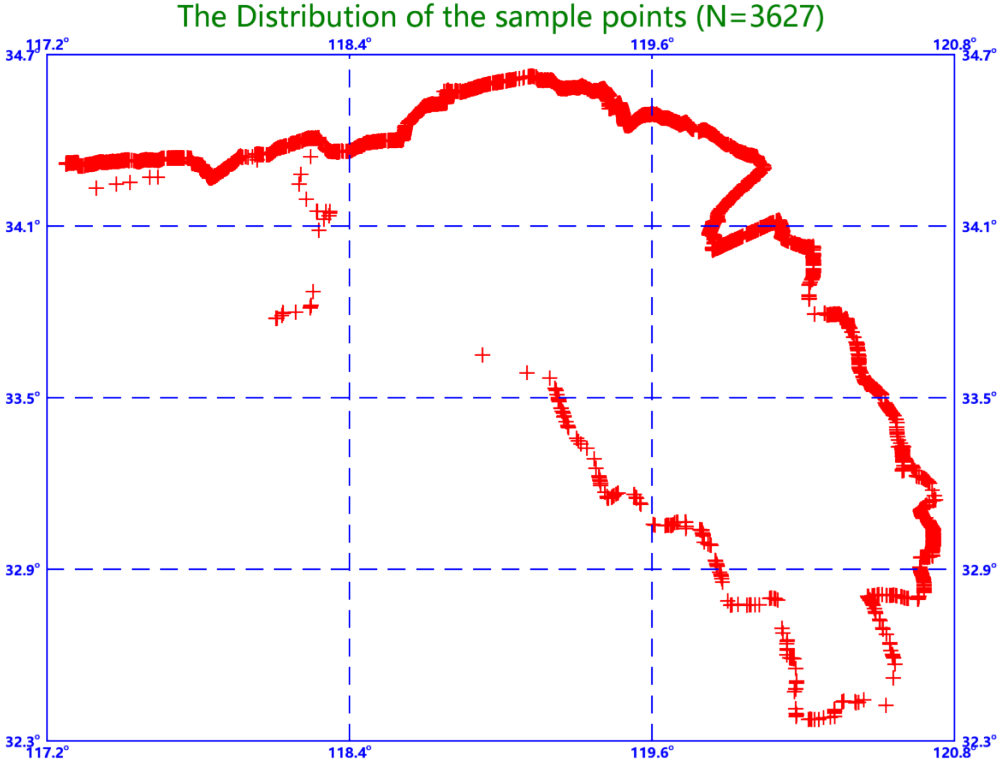
March 22,23,24,25 2017
North China Plain Field Survey





March 30,31,April,1,2 2017 Jiangsu Field Survey





Participation of Young Scientists

Chinese Team

- Gao Hao
- Shaojie Liu, Qi Xu, Qiliang Li

European Team

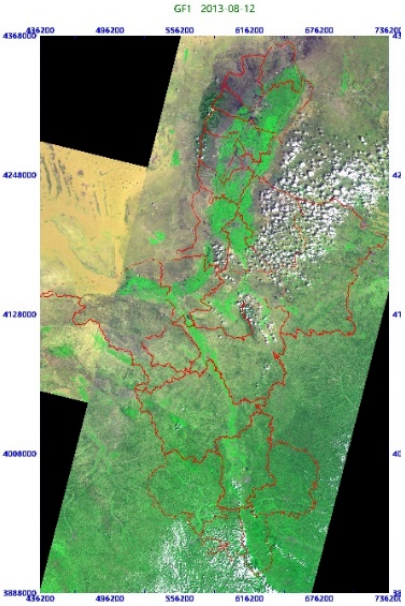
- Nicolas Bellemans

Training of young scientists

- Young Scientists will be invited to a field survey. This activity will help young scientists be familiar with and understand the ground truth of research area.
- Young scientists will be guided in processing the Sentinel series, GF series satellite data and FY-MERSI data. Thereafter, young scientists will be able to handle those data for the information retrieval.
- Young scientists will be guided for the crop mapping. This will help young scientist to handle classification methods.
- Exchange of young scientists

Results and ongoing Progress

GF-1 Satellite Data Acquisition



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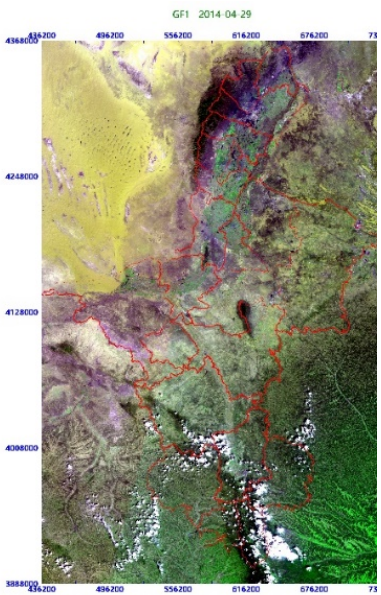
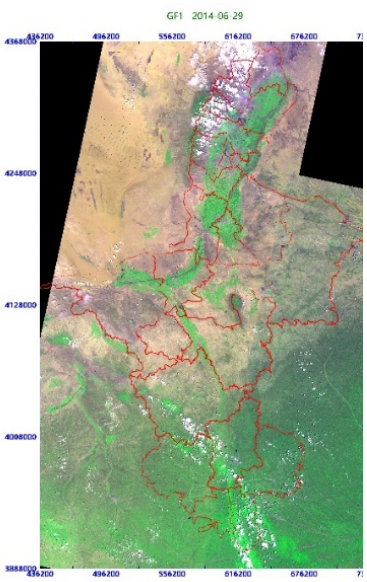
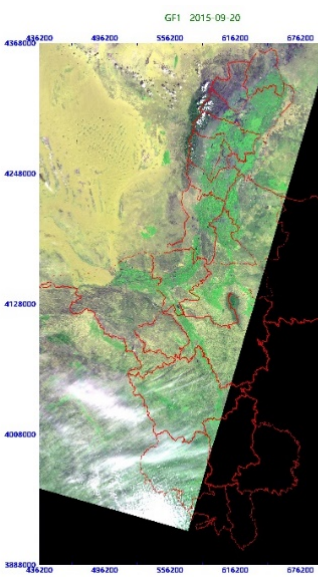


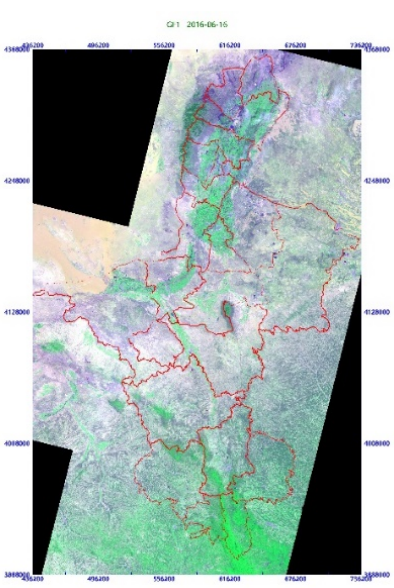
2014.4.20



2014.6.29



2015.9.20



2016.6.16

Collect Satellite data

PROBA-V TOC

2013-2020

300m

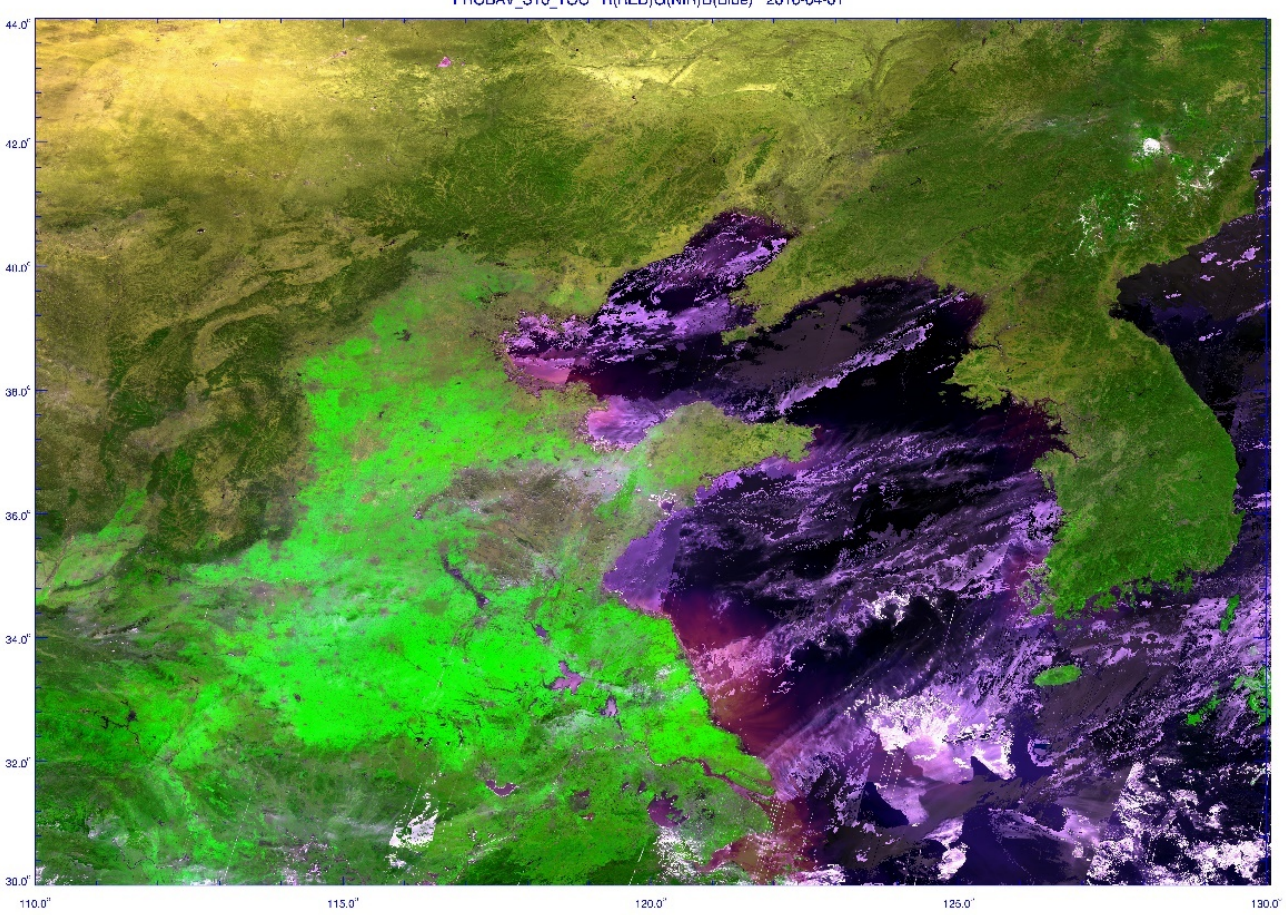
Daily

FY MERSI

2009-2020

250m

Daily



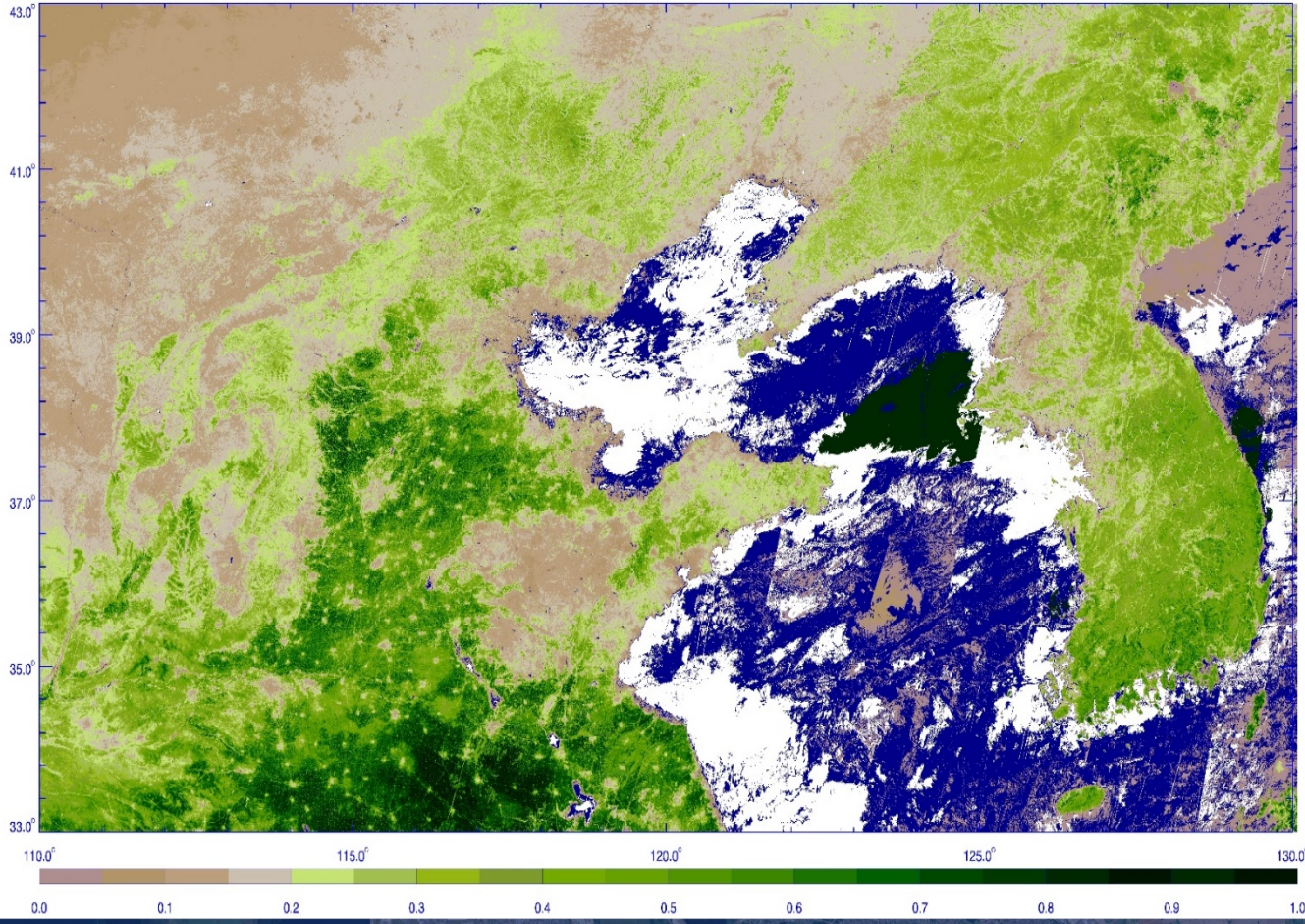
Collect Product

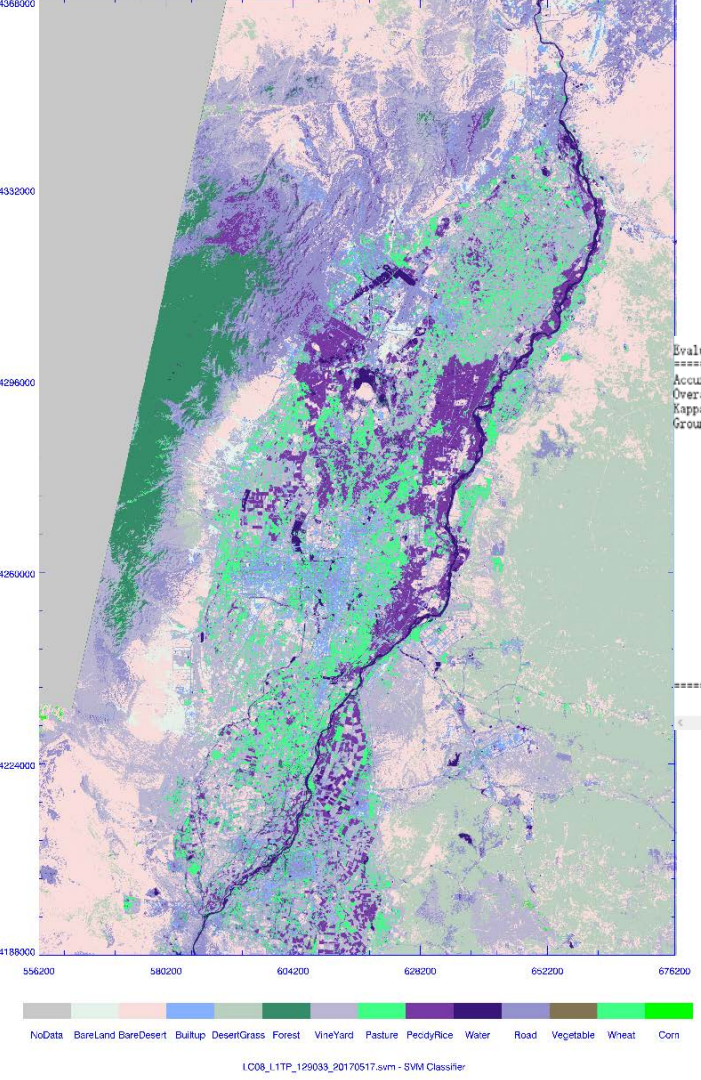
PROBA-V NDVI

2013-2020

300m

10-daily NDVI Synthesis





LC 8 2017-5-17 Classification and Validation (Support Vector Machine， SVM)

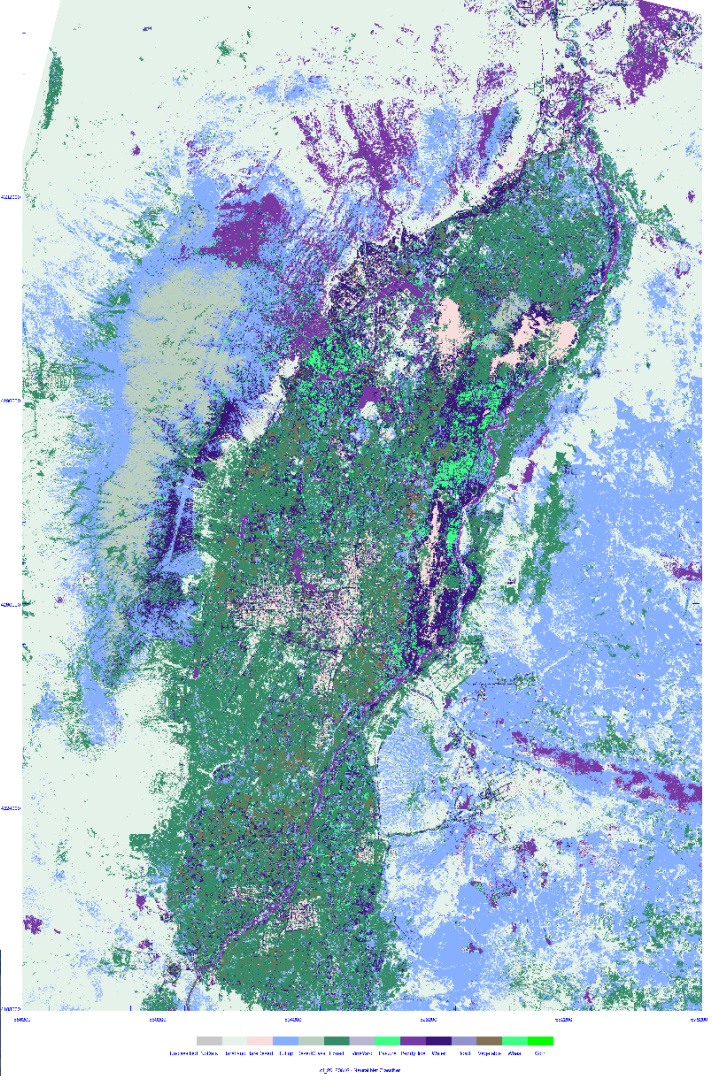
Evaluation From LC08_L1TP_129033_20170517.svm_Validation.txt

Accuracy Matrix : Error unit %
Overall Accuracy : 83.7
Kappa : 0.81

GroundTruth/Classified	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total	Producer	Omission
NoData 1	252	0	0	0	0	0	0	0	0	0	0	0	0	0	252	100.0	0.0
BareLand 2	0	270	112	24	0	0	164	0	0	0	9	0	0	0	579	46.6	53.4
BareDesert 3	0	42	3678	3	46	0	49	0	0	0	12	0	0	0	3830	96.0	4.0
Builtup 4	0	50	5	452	1	0	217	0	0	0	128	0	6	0	859	52.6	47.4
DesertGrass 5	0	0	157	0	1625	0	1	0	0	0	0	0	0	0	1783	91.1	8.9
Forest 6	0	0	0	0	0	1478	3	0	0	0	0	0	0	0	1481	99.8	0.2
Vineyard 7	0	99	169	16	0	0	1699	1	0	0	125	0	10	0	2119	80.2	19.8
Pasture 8	0	0	0	0	0	0	7	300	0	0	1	0	119	0	427	70.3	29.7
Rice 9	0	0	1	0	0	1	0	0	757	23	11	0	2	0	795	95.2	4.8
Water 10	0	0	0	0	0	2	0	0	39	1391	3	0	3	0	1438	96.7	3.3
Road 11	0	15	43	125	3	3	178	3	6	0	438	0	45	0	859	51.0	49.0
Vegetable 12	0	0	0	3	0	1	22	6	1	0	7	0	11	0	51	0.0	100.0
Wheat 13	0	0	0	2	0	5	81	25	0	0	26	0	585	0	724	80.8	19.2
Corn 14	0	2	49	11	0	0	148	0	2	0	17	0	8	0	237	0.0	100.0
Total	252	478	4214	636	1675	1490	2569	335	805	1414	777	0	789	0	15434		
User	100.0	56.5	87.3	71.1	97.0	99.2	66.1	89.6	94.0	98.4	56.4	0.0	74.1	0.0			
Commission	0.0	43.5	12.7	28.9	3.0	0.8	33.9	10.4	6.0	1.6	43.6	0.0	25.9	0.0			

Accuracy: 83.7%

Kappa: 0.81



GF-1 2016-6-16 Classification and Validation (Neural Network , NN)

Evaluation From gf_20160616_Validation.txt

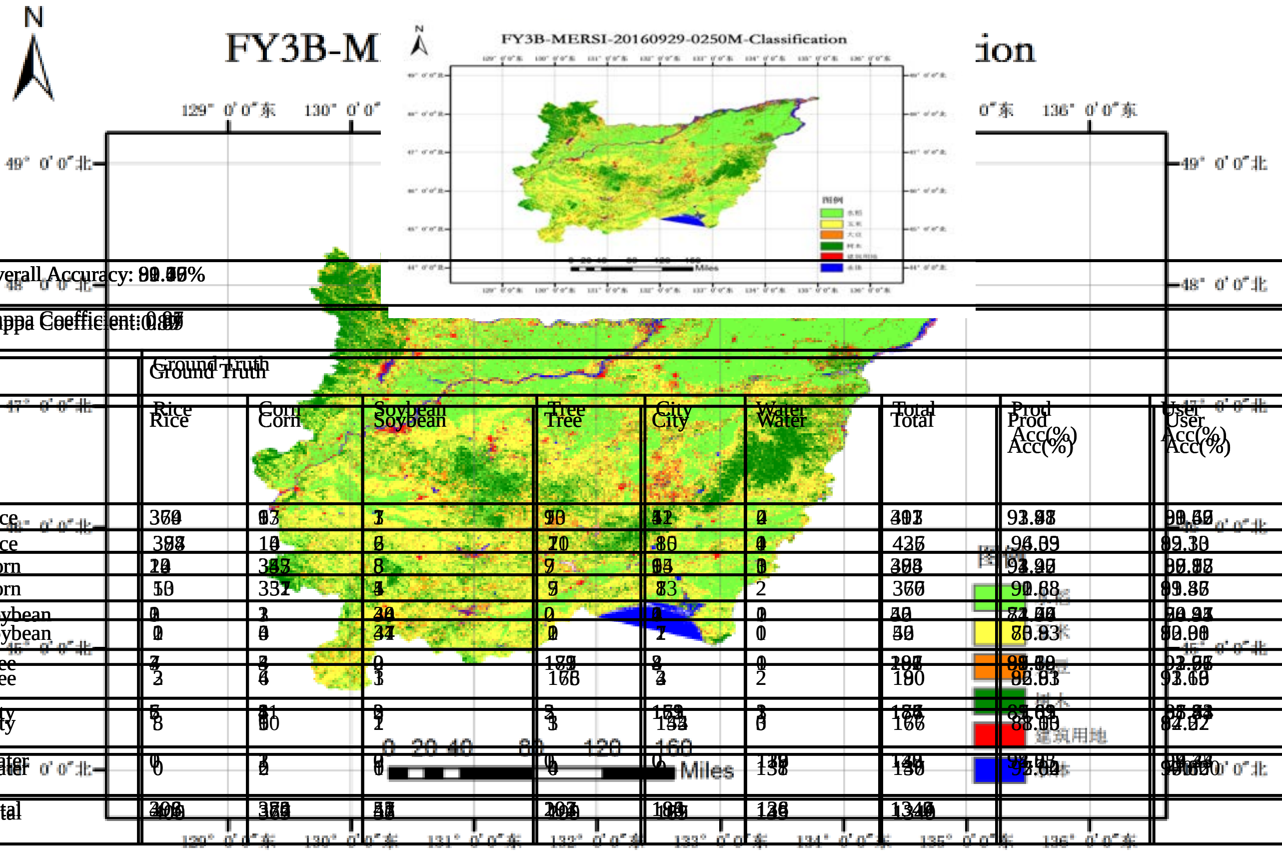
Accuracy Matrix : Error unit %
Overall Accuracy : 66.8
Kappa : 0.61

GroundTruth/Classified	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total	Producer	Omission
NoData 1	72	0	157	7	0	0	16	0	0	0	0	0	0	0	252	28.6	71.4
BareLand 2	0	27	209	9	6	0	278	0	0	0	40	0	6	4	579	4.7	95.3
BareDesert 3	0	0	3259	0	300	0	52	0	0	0	219	0	0	0	3830	85.1	14.9
Builtup 4	0	0	176	333	0	0	305	0	9	0	36	0	0	0	859	38.8	61.2
DesertGrass 5	0	0	154	0	1589	0	36	0	0	4	0	0	0	0	1783	89.1	10.9
Forest 6	0	0	0	0	114	1339	18	0	2	0	8	0	0	0	1481	90.4	9.6
Vineyard 7	0	0	160	9	105	19	1633	0	3	0	185	0	5	0	2119	77.1	22.9
Pasture 8	0	0	2	3	0	0	338	0	0	0	9	0	75	0	427	0.0	100.0
Rice 9	0	0	1	5	43	11	94	0	371	15	228	0	26	1	795	46.7	53.3
Water 10	0	0	100	4	40	0	33	0	8	1241	12	0	0	0	1438	86.3	13.7
Road 11	0	6	70	127	73	8	293	0	25	0	241	0	16	0	859	28.1	71.9
Vegetable 12	0	0	1	0	11	1	26	0	0	1	9	0	2	0	51	0.0	100.0
Wheat 13	0	0	9	15	10	21	293	0	26	3	135	0	212	0	724	29.3	70.7
Corn 14	0	0	5	5	31	5	143	0	3	1	33	0	11	0	237	0.0	100.0
Total	72	33	4303	517	2322	1404	3558	0	447	1265	1155	0	353	5	15434		
User	100.0	81.8	75.7	64.4	68.4	95.4	45.9	0.0	83.0	98.1	20.9	0.0	60.1	0.0			
Commission	0.0	18.2	24.3	35.6	31.6	4.6	54.1	0.0	17.0	1.9	79.1	0.0	39.9	100.0			

Accuracy: 66.8%

Kappa: 0.61

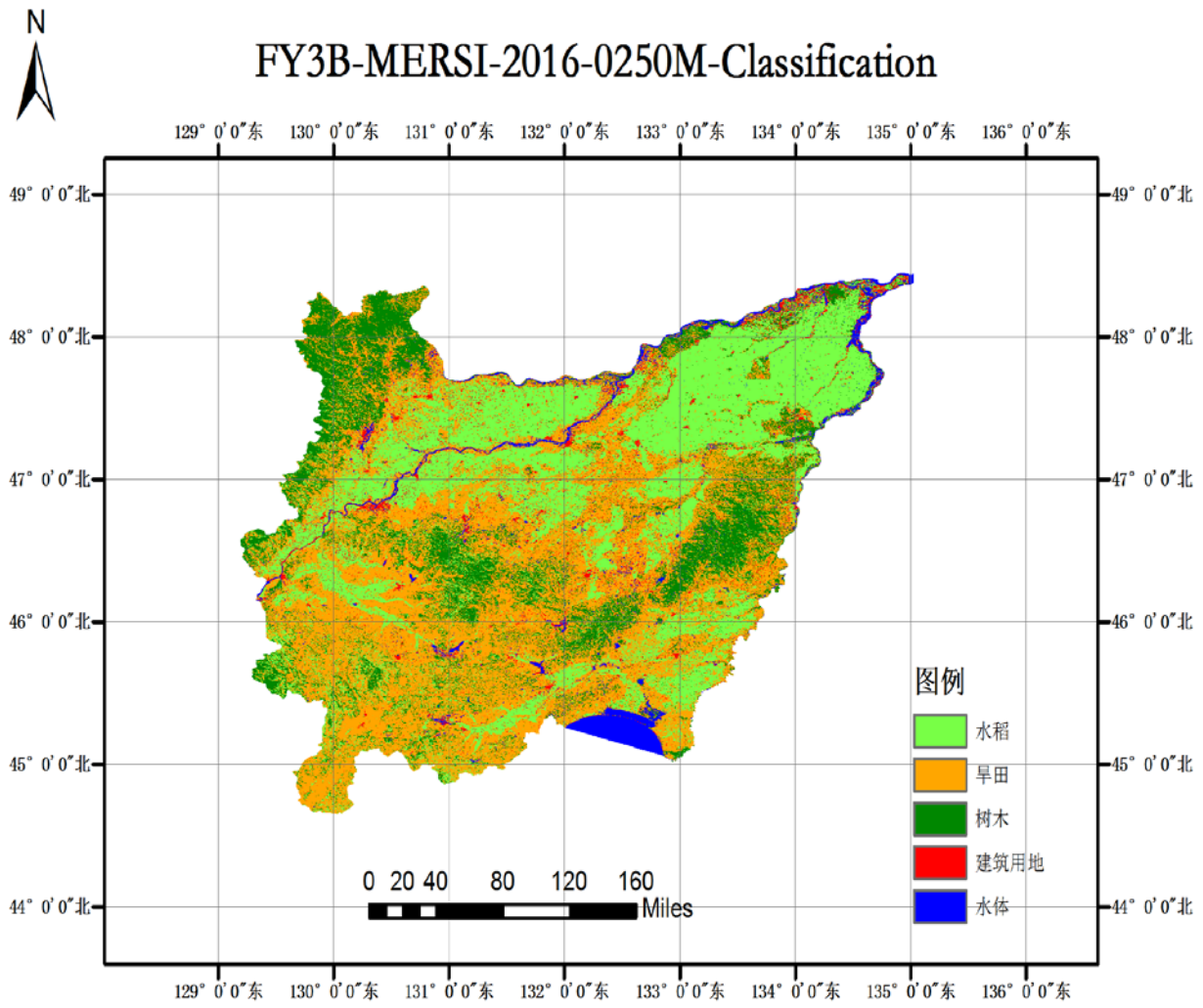
FY3B MERSI 2016 Sanjiang Plain NE China Classification(Random Forest, RF)



Overall Accuracy: 9[illegible]%

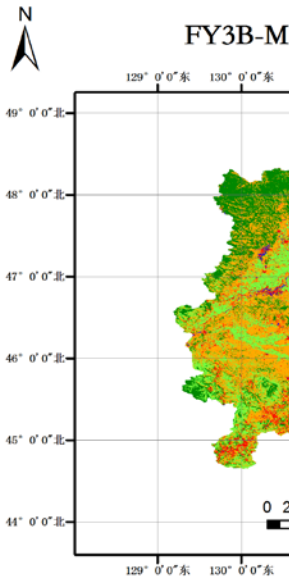
Kappa Coefficient: 0.[illegible]

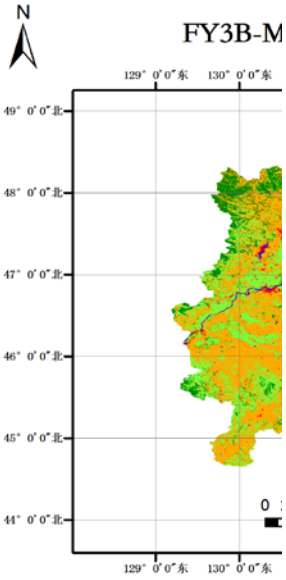
	Ground Truth								
	Rice	Corn	Soybean	Tree	City	Water	Total	Prod Acc(%)	User Acc(%)
Rice	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	9[illegible]	9[illegible]
Rice	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Corn	[illegible]	[illegible]	8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Corn	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2	[illegible]	[illegible]	[illegible]
Soybean	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Soybean	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]	[illegible]
Tree	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Tree	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2	[illegible]	[illegible]	[illegible]
City	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
City	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Water	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Water	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		

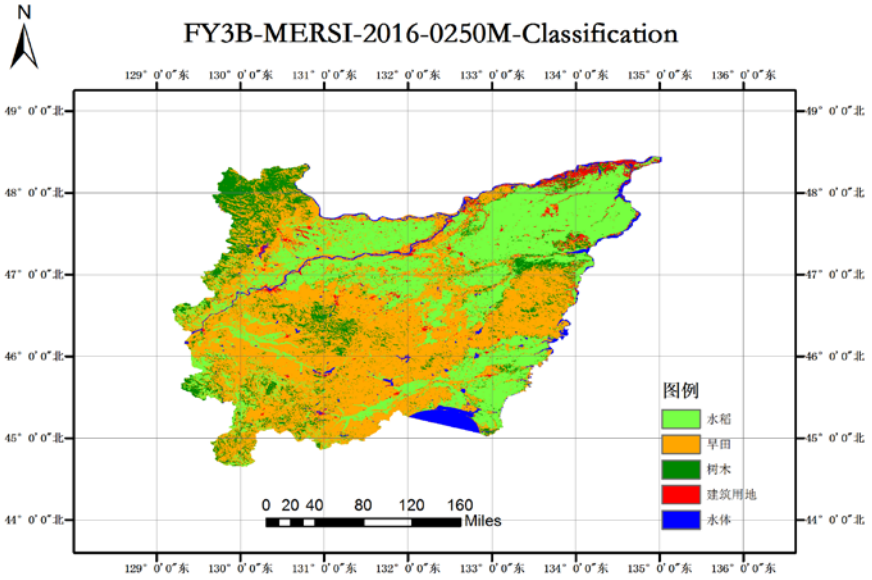


FY3B MERSI 2016 Classification (Random Forest, RF)

Majority of Voting for Data Fusion



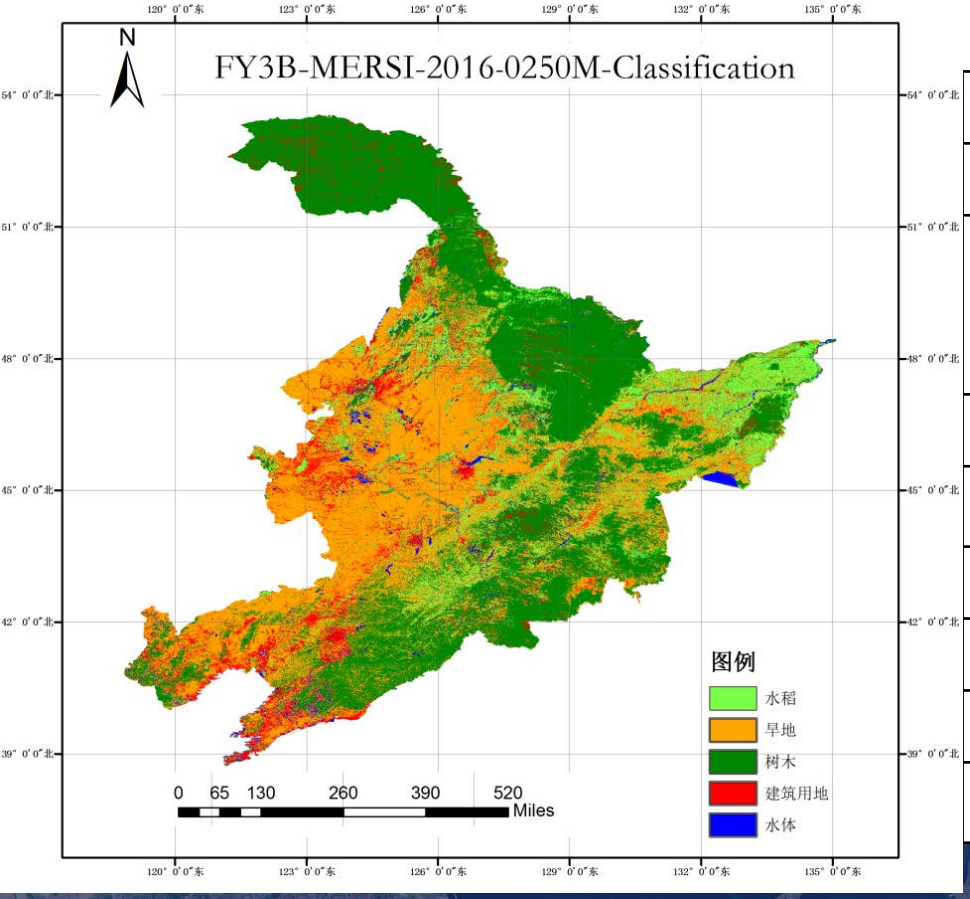




Method Comparison

	OA	KC	Rice	Cropland	Forest	Urban	Water
Random Forest (RF)	92.87	0.90	93.92	95.07	89.67	85.42	96.41
Decision Tree (DT)	85.70	0.81	90.45	88.63	80.39	77.72	89.68
Neural Network (NN)	81.83	0.78	84.83	79.32	76.61	76.10	85.87
Support Vector Machine (SVM)	82.14	0.78	85.66	83.73	70.51	78.81	86.24

FY3B MERSI 2016 Northeastern China Classification Fusion

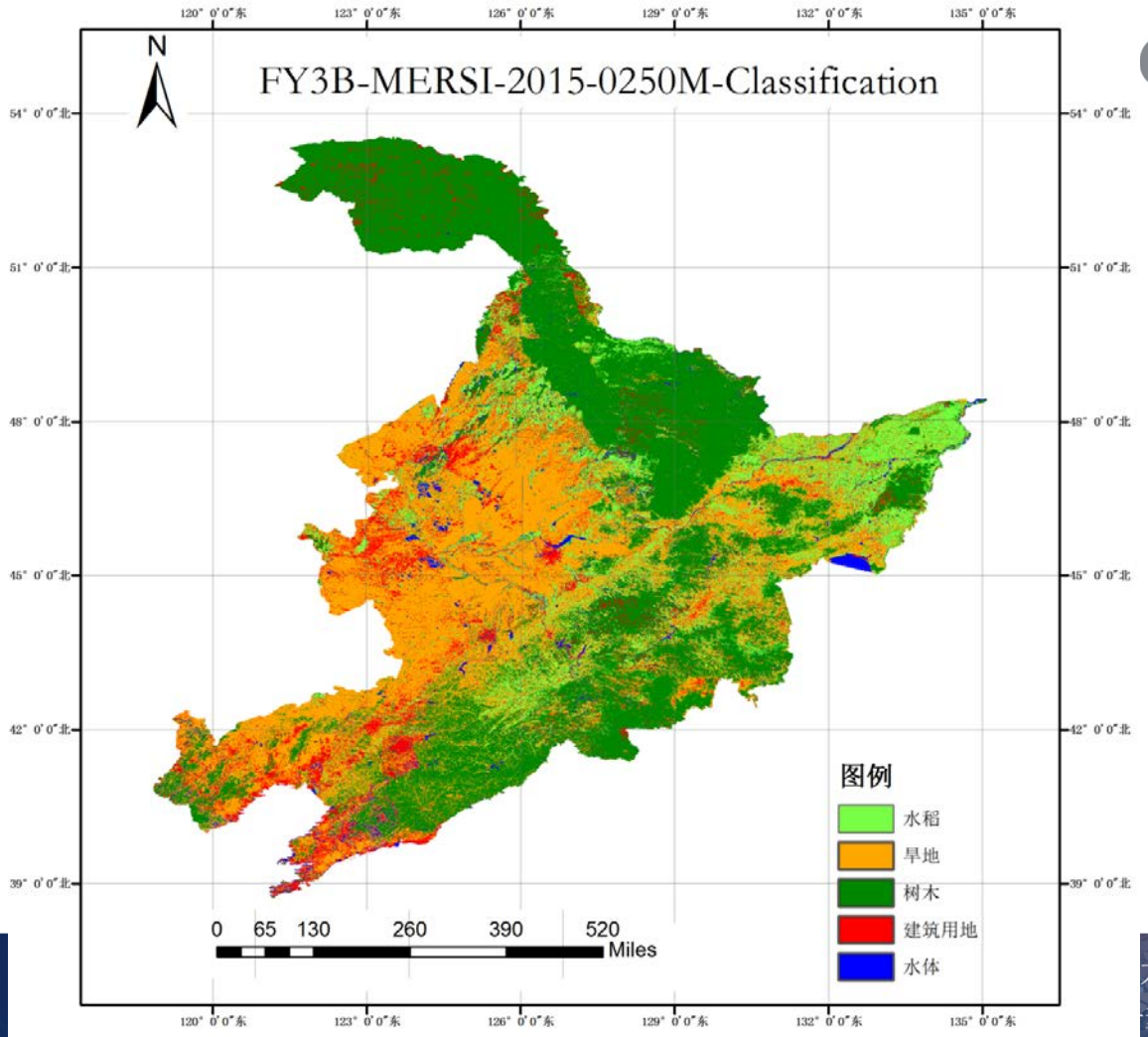


Overall Accuracy: 89.21%

Kappa Coefficient: 0.85

	Ground Truth							
	Rice	**Corn**	**Tree**	**City**	**Water**	**Total**	**Prod Acc(%)**	**User Acc(%)**
Rice	**105**	**13**	**2**	**2**	**1**	**123**	**90.52**	**85.37**
Corn	**9**	**230**	**6**	**11**	**2**	**258**	**93.12**	**89.15**
Tree	**0**	**1**	**82**	**1**	**4**	**88**	**90.11**	**93.18**
City	**1**	**3**	**0**	**51**	**0**	**55**	**80.12**	**92.73**
Water	**1**	**0**	**1**	**0**	**28**	**30**	**80.00**	**93.33**
Total	**116**	**247**	**91**	**67**	**35**	**556**		

2009-2015
Northeastern China
Mapping
FY3B MERSI 2016

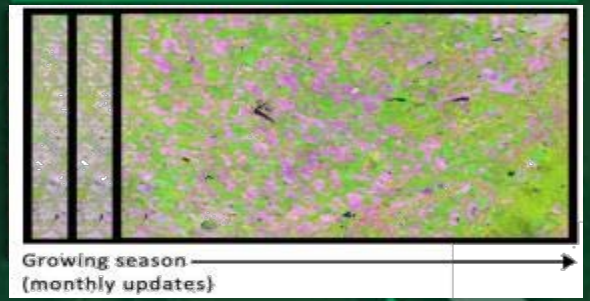


A system to automatically deliver 4 Sen2-Agri products

in line with the GEOGLAM core products

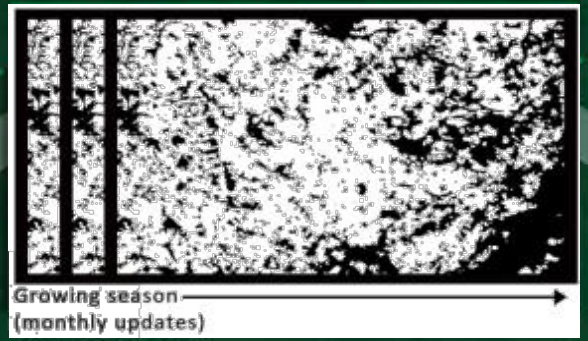
Monthly cloud free surface reflectance composite at 10-20 m

CLOUD FREE SURFACE REFLECTANCE COMPOSITES



Vegetation status map at 20 m delivered every week (NDVI, LAI, pheno index)

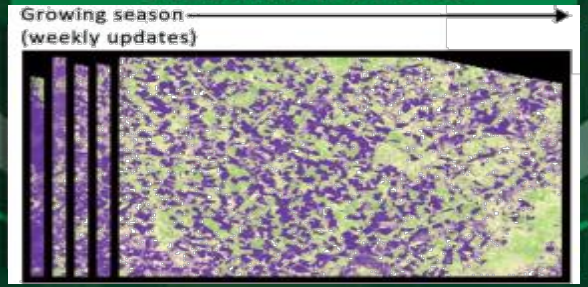
DYNAMIC CROPLAND MASK



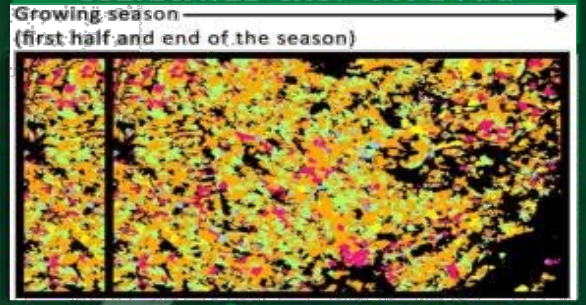
Binary map identifying annually cultivated land at 10m updated every month

Open source toolbox
Capacity building and training

VEGETATION STATUS

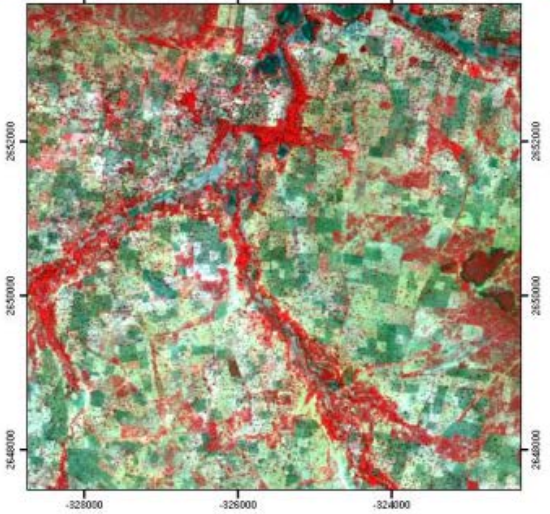


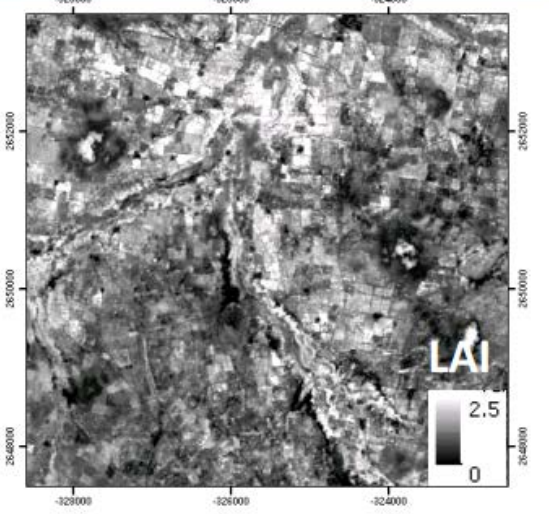
CULTIVATED CROP TYPE MAP

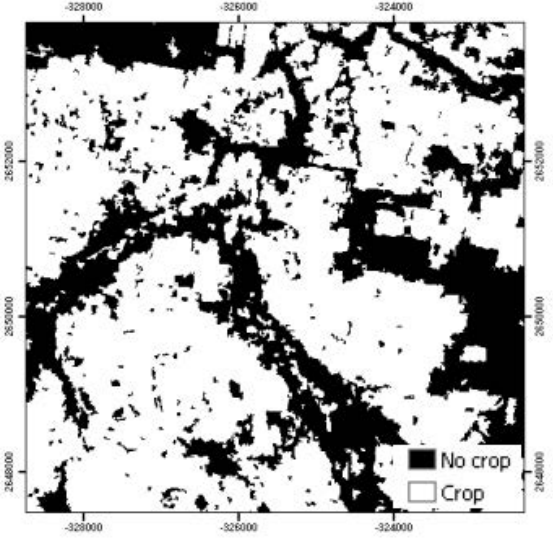


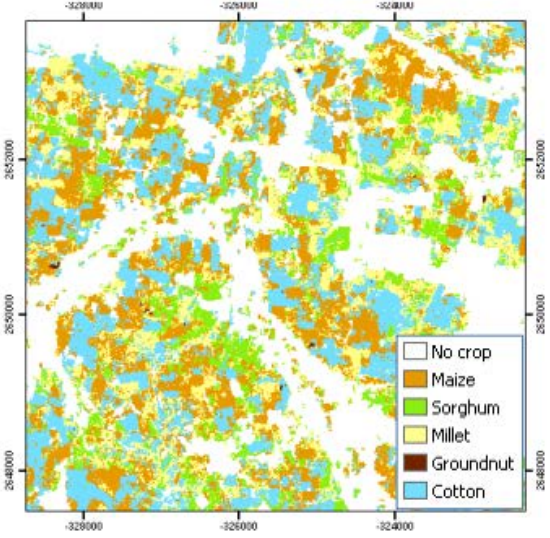
Crop type map at 10 m for the main regional crops including irrigated/rainfed discrimination

Example of products over Mali









Sen2-Agri System ready for demonstration

Algorithm Development 2014

Prototypes of EO products 2015

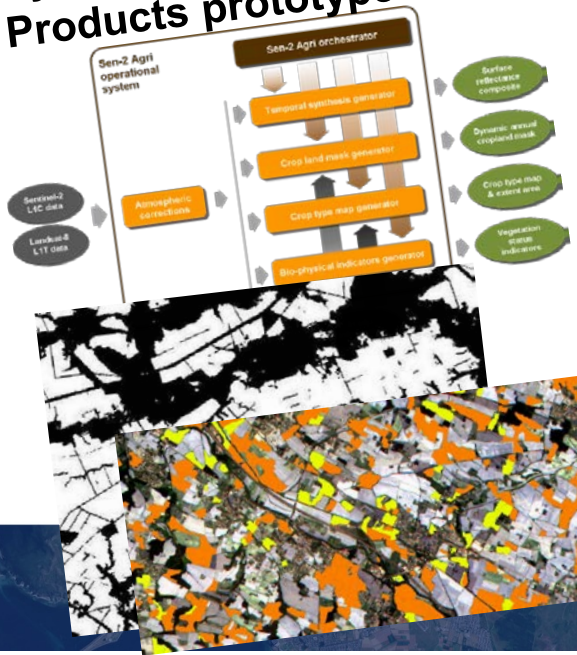
Demonstration & Validation 2016-2017

Users Products specifications

Benchmarked Methods (4 pub.)

System ready in April 2016

Products prototype SPOT5-T5



3 National use cases

7 Local use cases

Capacity building

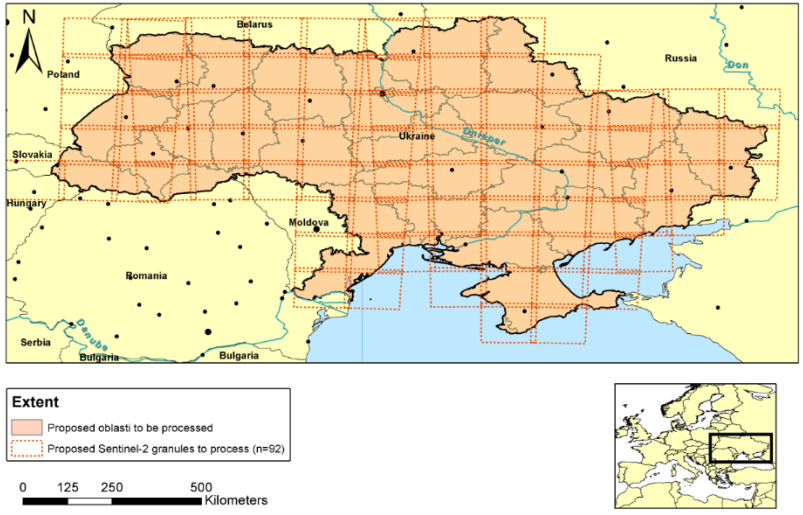
Training activities

Fitness-to-use assessment

Demonstration phase : 3 National Cases

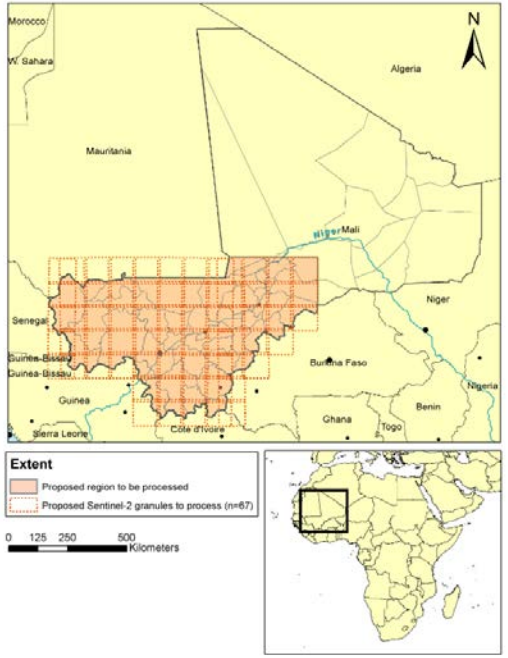
To demonstrate the Sen2-Agri system producing NRT products using Sentinel-2a & Landsat 8 at national scale with *in situ* system implementation :

Ukraine (SRI)



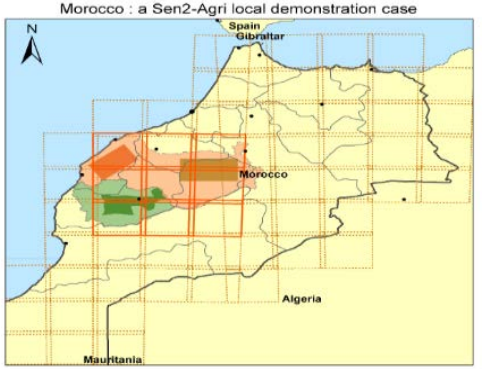
South Africa (ARC)

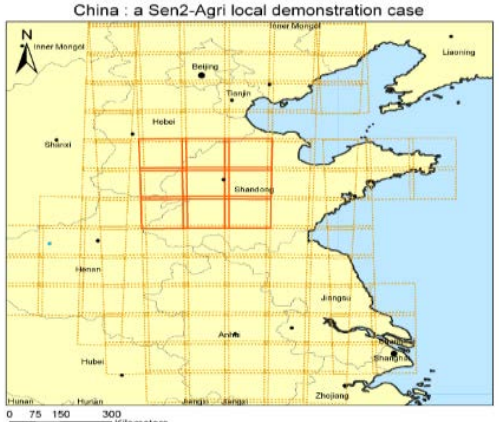
Mali (ICRISAT & IER)

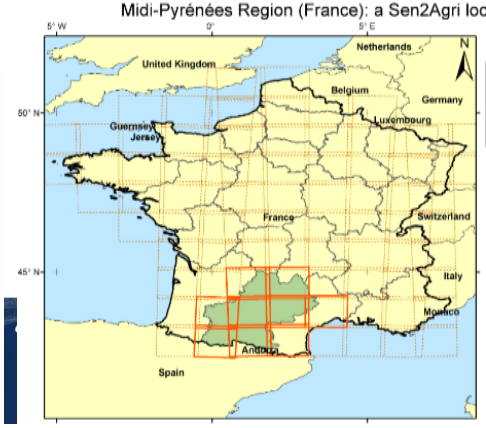


To demonstrate NRT products using Sentinel-2 & Landsat 8 **at local scale** (~ 300 x 300 km) :

Site ID	Site name and localization
Sen2-Agri supported sites	
1	France, Midi-Pyrénées
2	Morocco, Tensift
3	China, Shandong
4	Madagascar, Antsirabe
5	Sudan, White Nile /South-Sudan
Additional demonstration sites	
6	Czech sites , Czech (CCN2)
7	Belgium, Belgium







Thank you very much for your attention!

Dr. Jinlong Fan
fanjl@cma.gov.cn

Under Dragon Framework, this Dragon 4 project is really supported by the following projects:
- Dragon 4 ESA