6th Asia-Oceania Group on Earth Observations (AOGEO) Workshop

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The Temporally Consistent Landcover Product using Time Series of Chinese GaoFen-1/6 Satellite Data

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AO GEO
Earth Observations for Asia-Oceania

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Content

Global landcover datasets at km scale

Dataset	Resolution	Data used	System	Algorithm
IGBP-DIS	1km	AVHRR	IGBP-17	Unsupervised
UMD	1km	AVHRR	IGBP-17	Supervised decision tree
GLC2000	1km	SPOT	IGBP-22	Method set by regions
MODIS	500m	MODIS	IGBP-17	Supervised decision tree
GlobCover	300m	MERIS	IGBP-22	Unsupervised
MODIS	1km	MODIS	IGBP-17	Supervised

They have been slowly quitting!

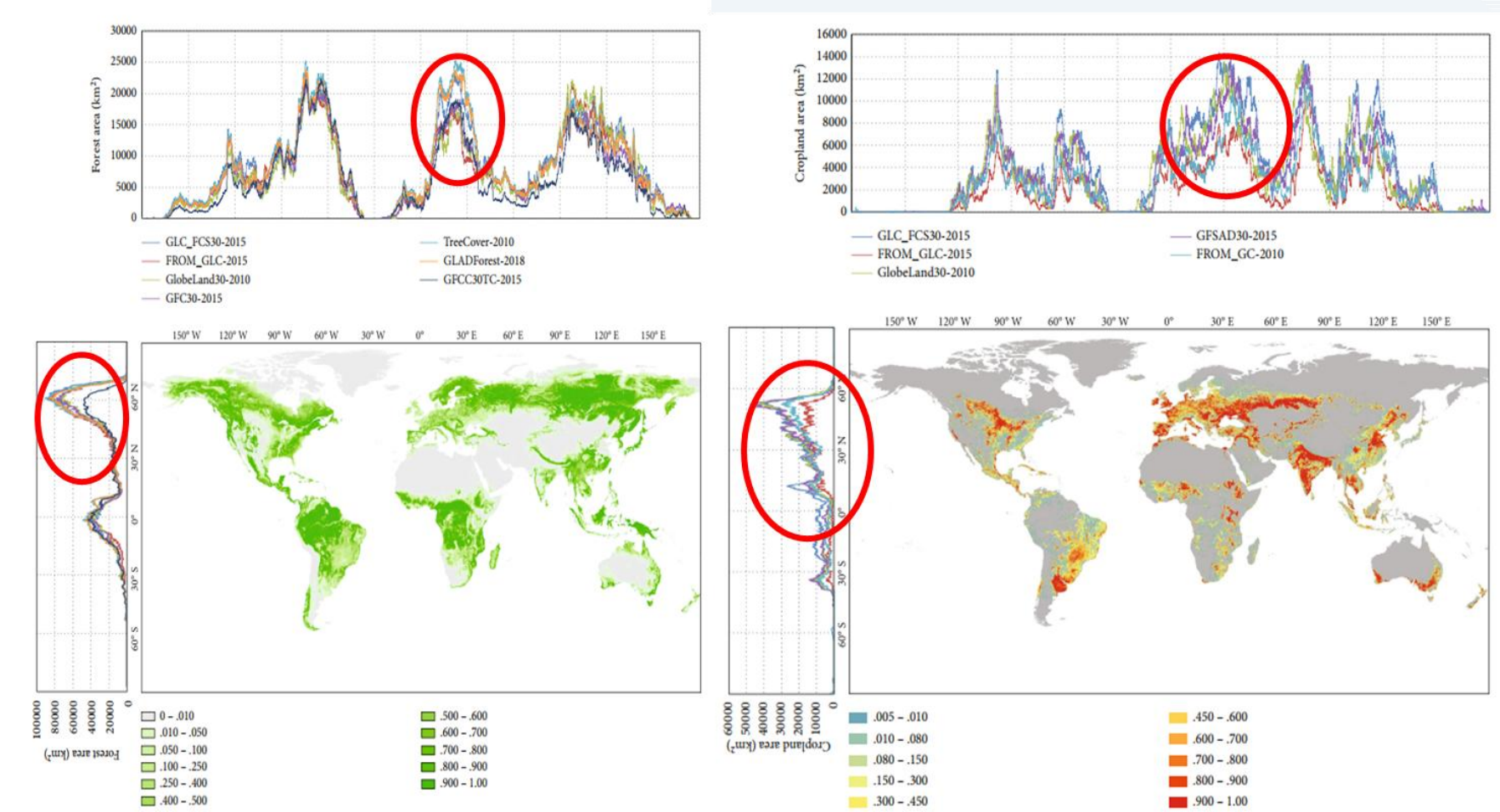
Global landcover datasets at 10m scale

Dataset	Data used	Year	Resolution （m）	Overall accuracy
GlobeLand30	Landsat TM/ETM+/OLI、HJ-1、GF-1	2000	30	-
		2010	30	83.5%
		2020	30	85.72%
FROM_GLC30	Landsat TM/ETM+/OLI	2010	30	80.6%
		2015	30	77.3%
		2017	30	72.43%
FROM_GLC10	Sentinel-2/MSI	2017	10	72.76%
GLC_FCS30	MCD43A4 Landsat TM/ETM+/OLI	2015	30	81.4%
		2020	30	-
ESA_worldcover	Sentinel-1/2	2020	10	74.4%
Esri Land Cover	Sentinel-2	2020	10	85.96%

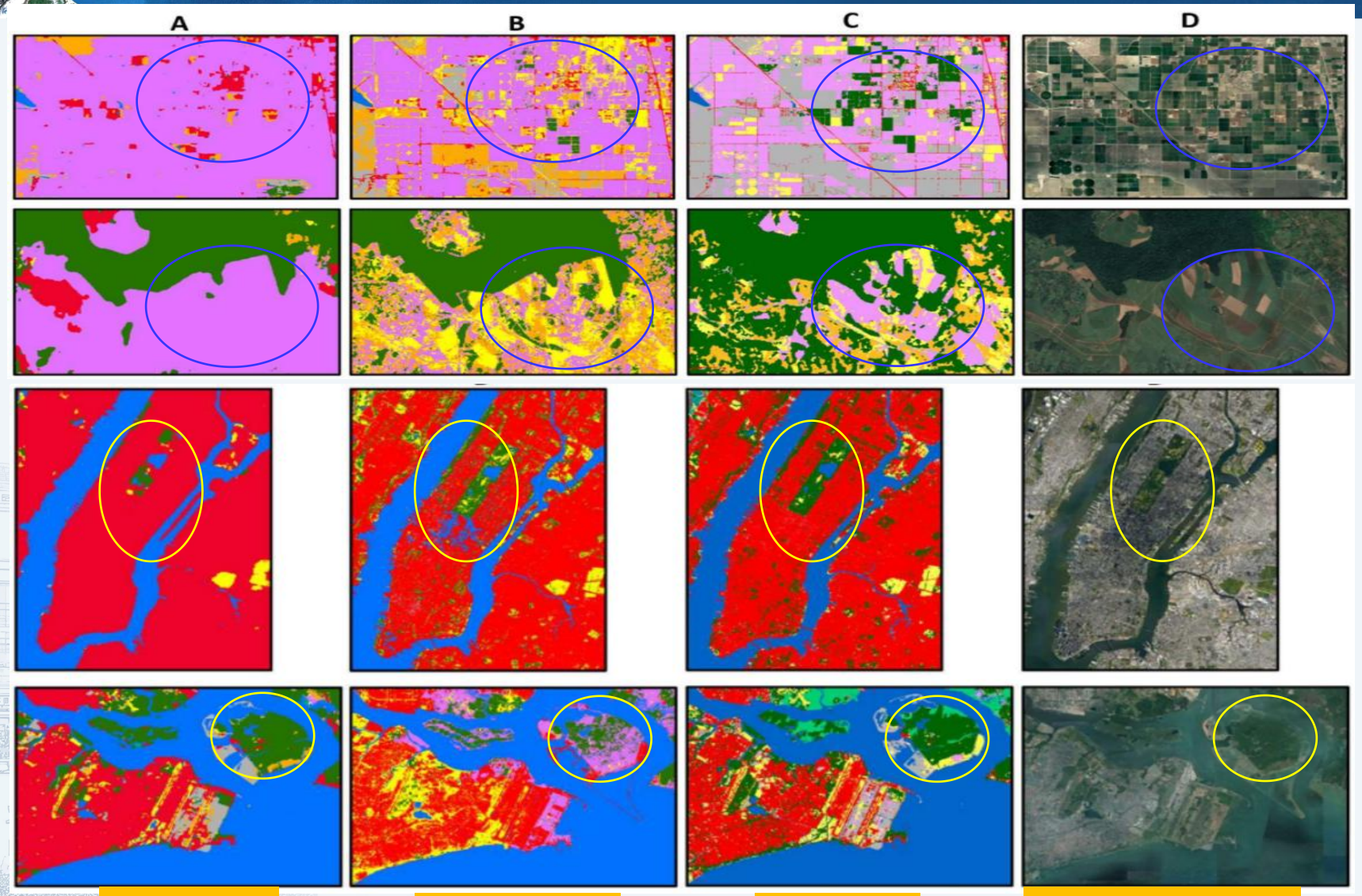
They are getting HOT!

What's the gap?

Inconsistency between different datasets spatially



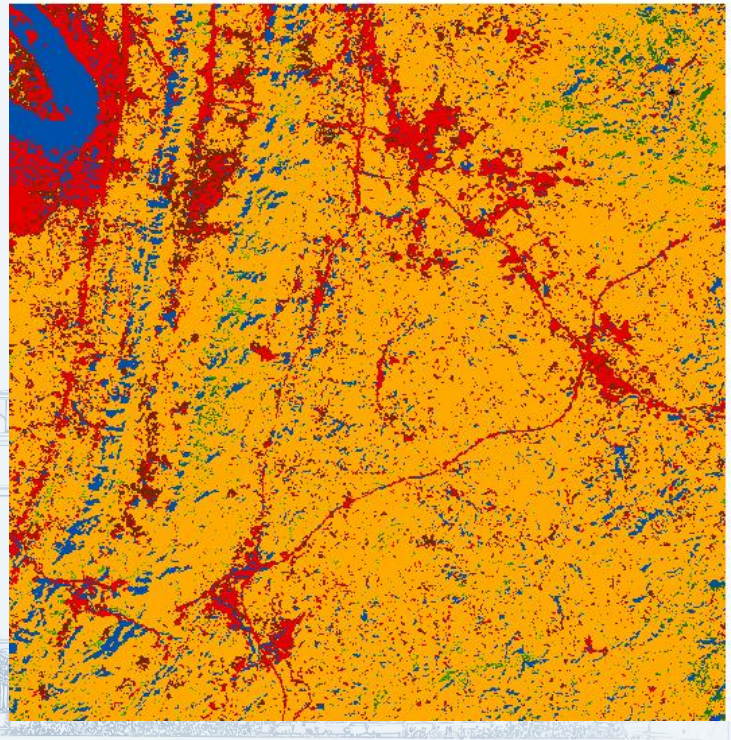
Background



Why do they leap?

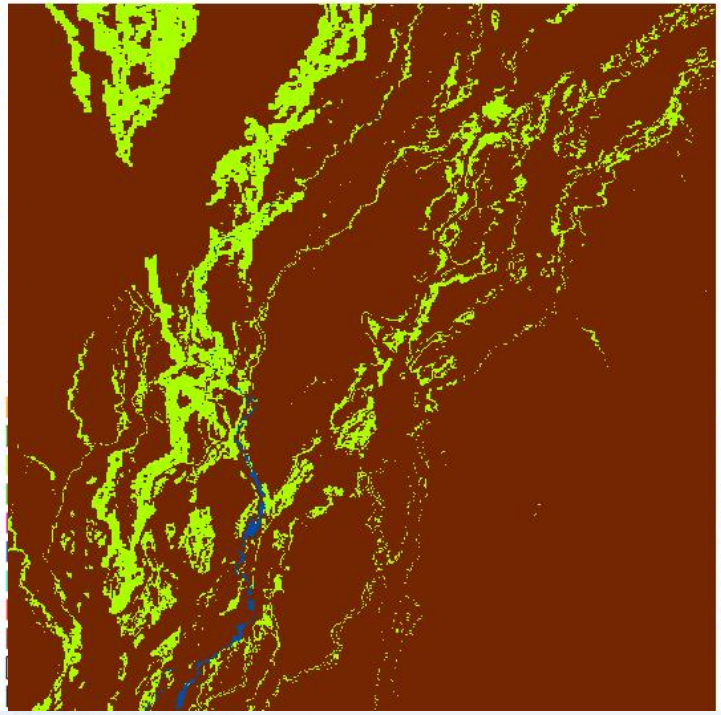
Inconsistency temporally

2010-----(106.514,29.419)



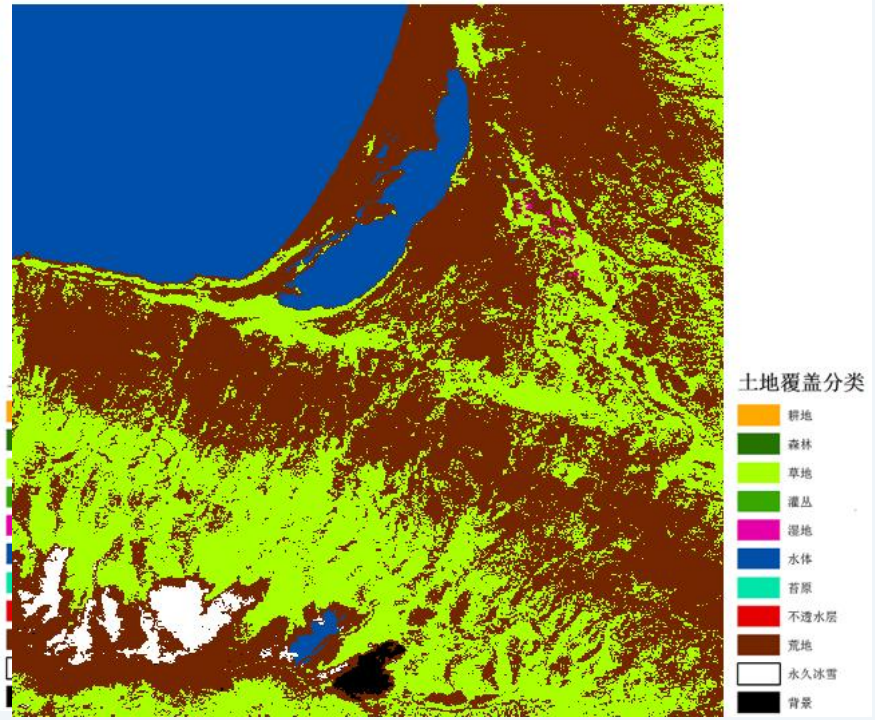
FROM-GLC30

2000-----(93.531,37.524)



GlobeLand30

2010-----(100.643,36.612)



FROM-GLC30

Background

Who we can trust?
What do we need?

- ☐Spatial resolution ⩾ 30 m
- ☐Overall accuracy ⩾ 85%
- ☐Updating frequency: 1 year
- ☐High temporal consistency

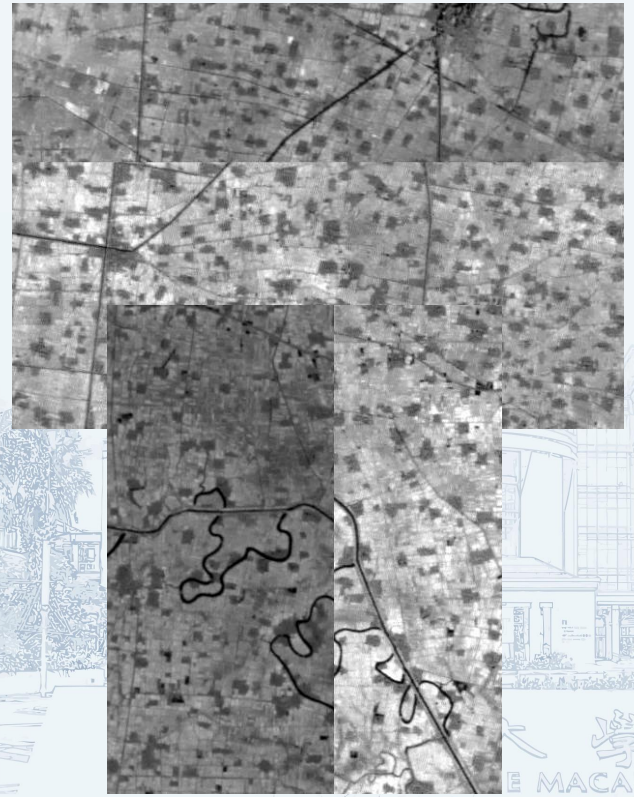
How can we do?

ARD with longer time series

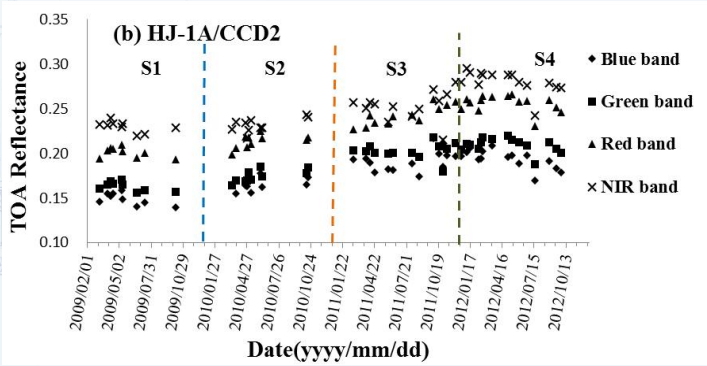
- ☐South Dakota University: L8+S2
- ☐CEOS: S2 and more
- ☐GA: Data cube
- ☐AIRCAS: Spectrum Earth
- ☐OURS: 16 m GF ARD

Challenges

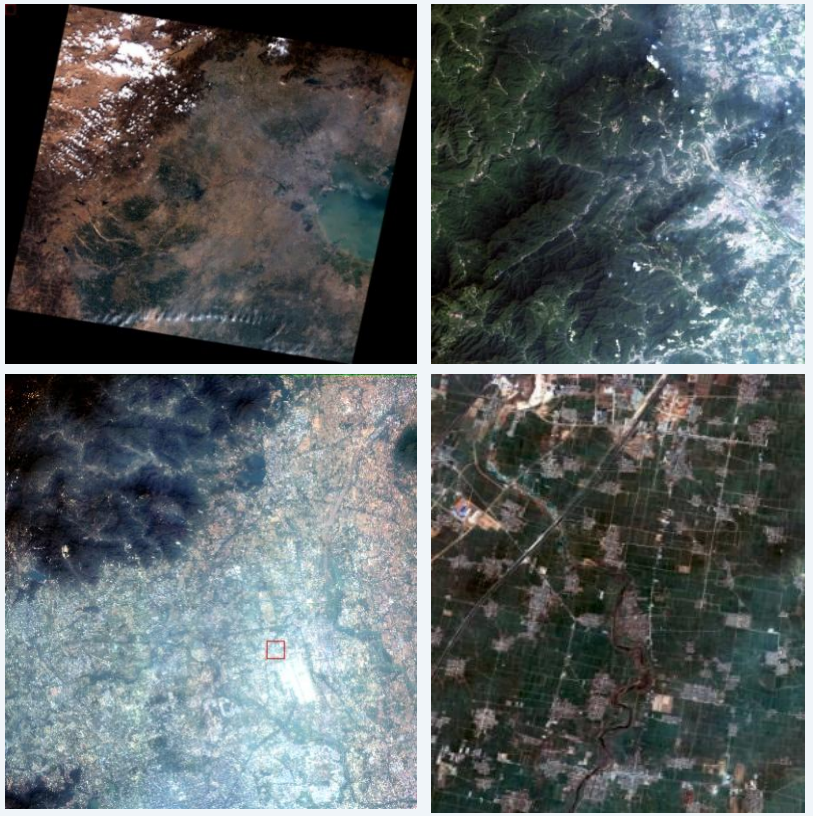
Geolocation bias



Radiometric bias



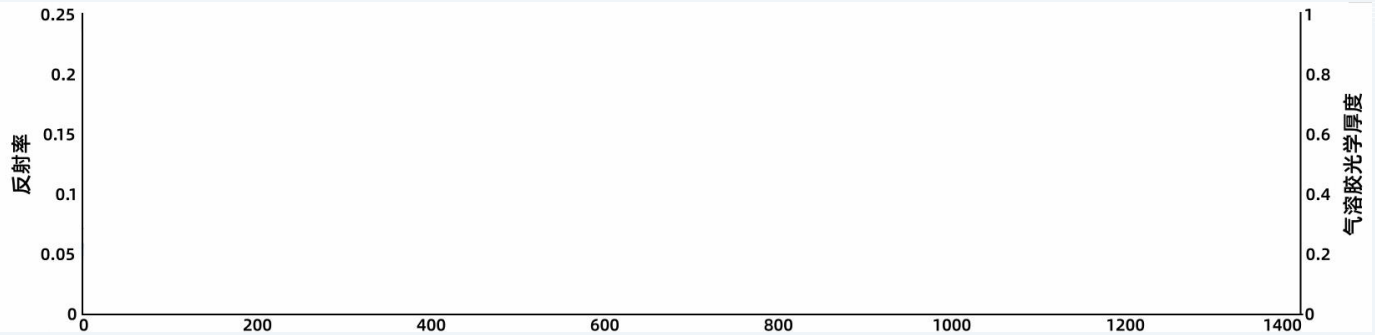
Atmospheric effect

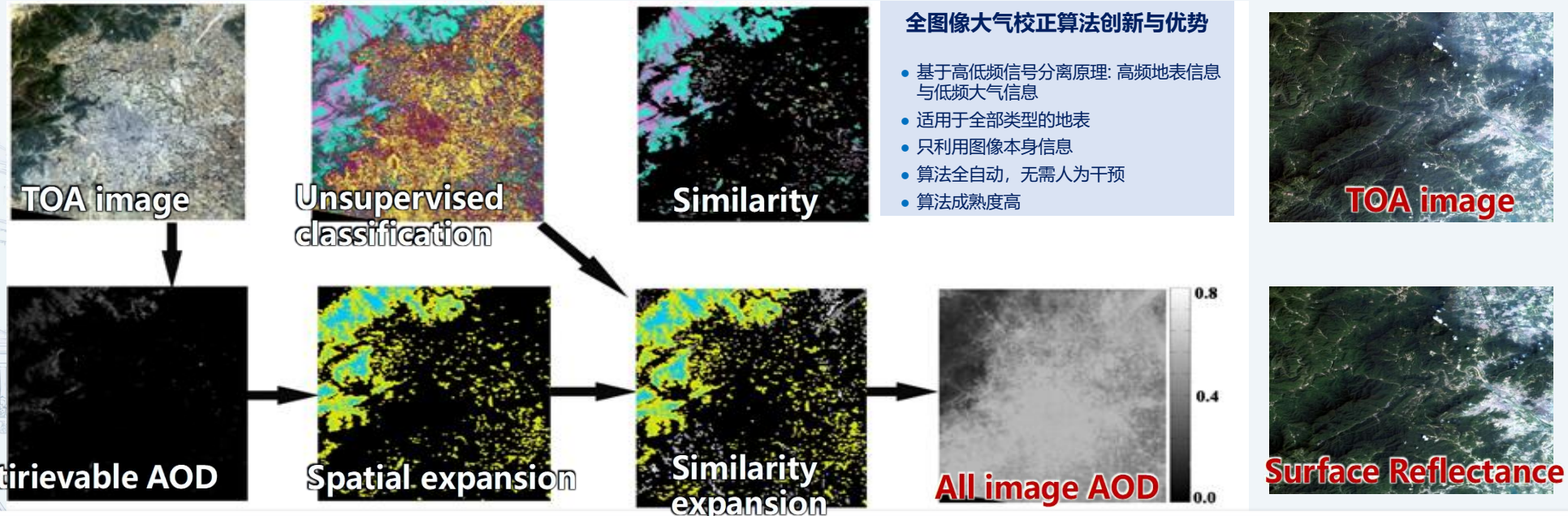


16 m GF ARD

Zhong* et al. An Improved Aerosol Optical Depth Retrieval Algorithm for Moderate to High Spatial Resolution Optical Remotely Sensed Imagery. Remote Sensing, 2017, 9(6): 555

Atmospheric correction method based on signal separation between high and low frequency at spatial dimension





All the image is atmospheric corrected with full resolution AOD!

16 m GF ARD

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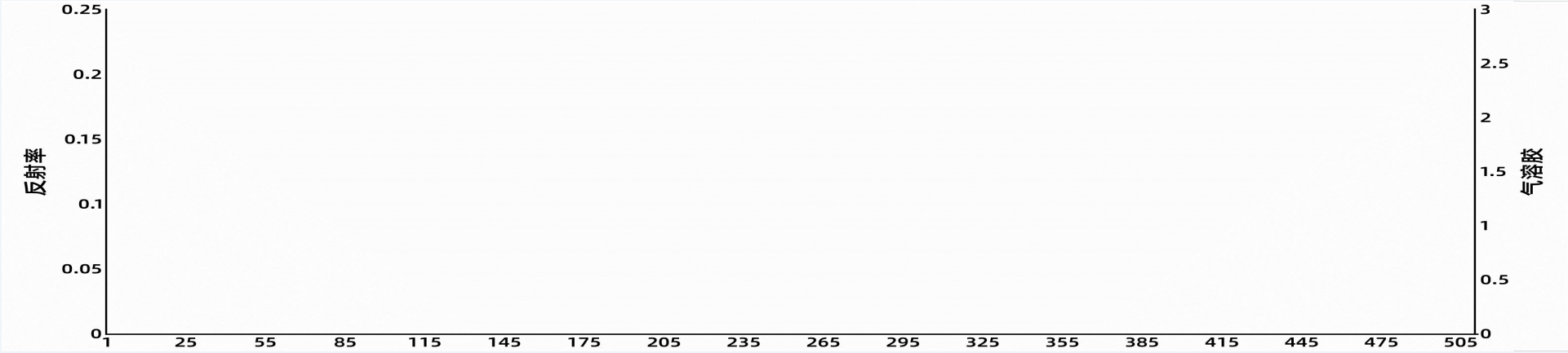
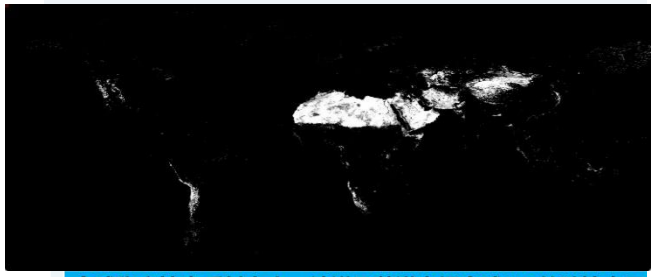
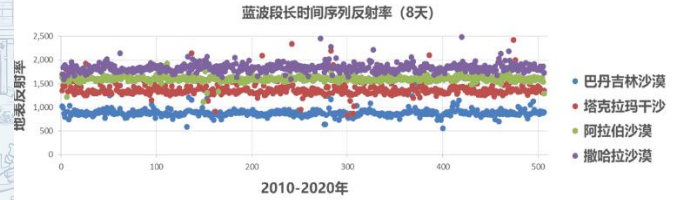
Zhong et al., Atmospheric Correction Method over Bright and Stable Surfaces for Moderate to High Spatial-Resolution Optical Remotely Sensed Imagery. Remote Sens. 2020, 12, 733.

Atmospheric correction method based on signal separation between high and low frequency at temporal dimension

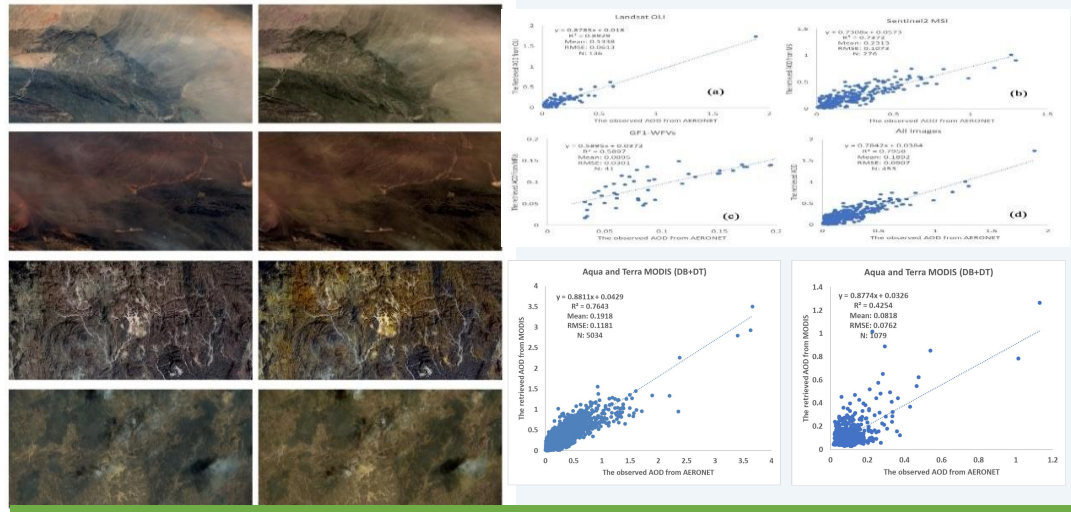




全球稳定地表反射率库—沙漠及荒漠占据全球1/3的陆地表面



沙漠地区地表反射率时间序列—稳定地表



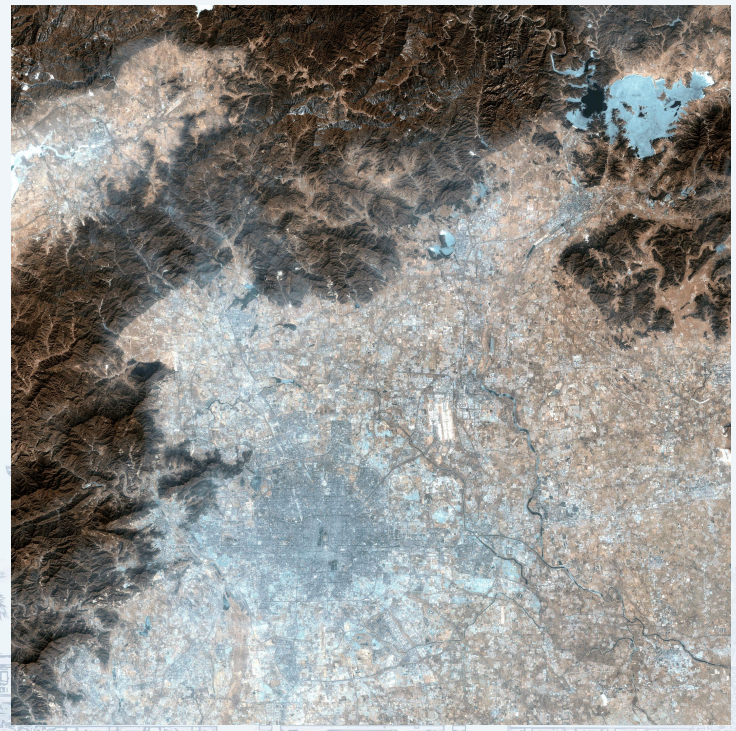
Ours

MODIS

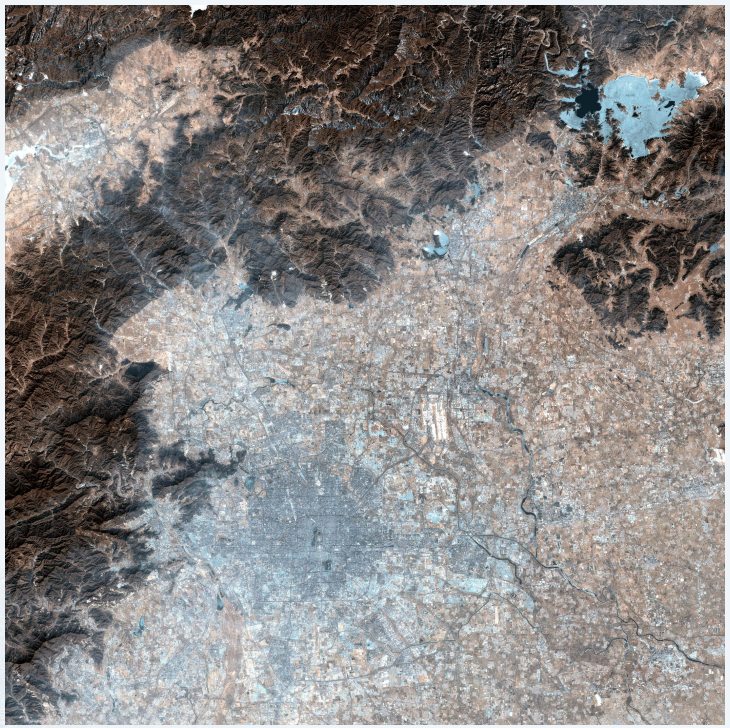
Higher resolution, higher AOD accuracy

Images with bright surface are atmospheric corrected with full resolution AOD!

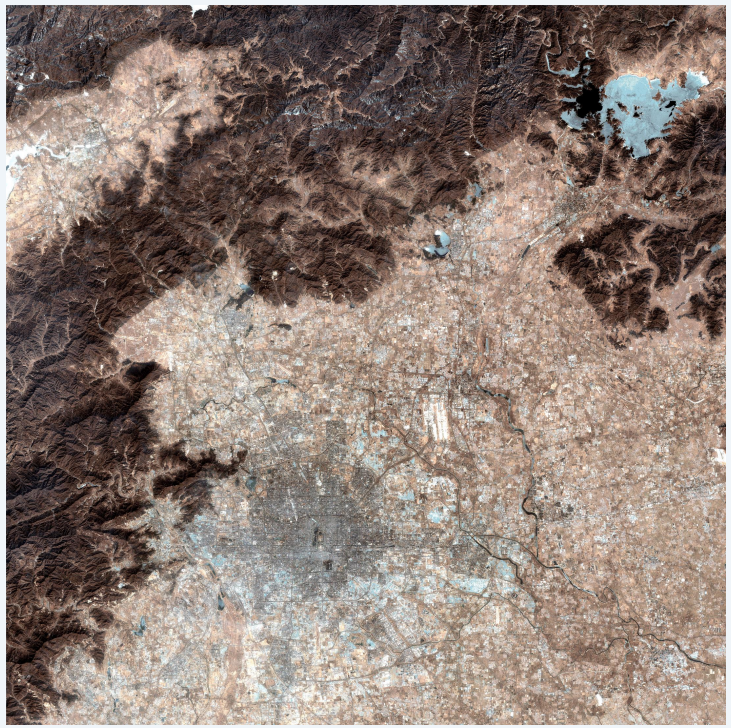
16 m GF ARD



TOA reflectance

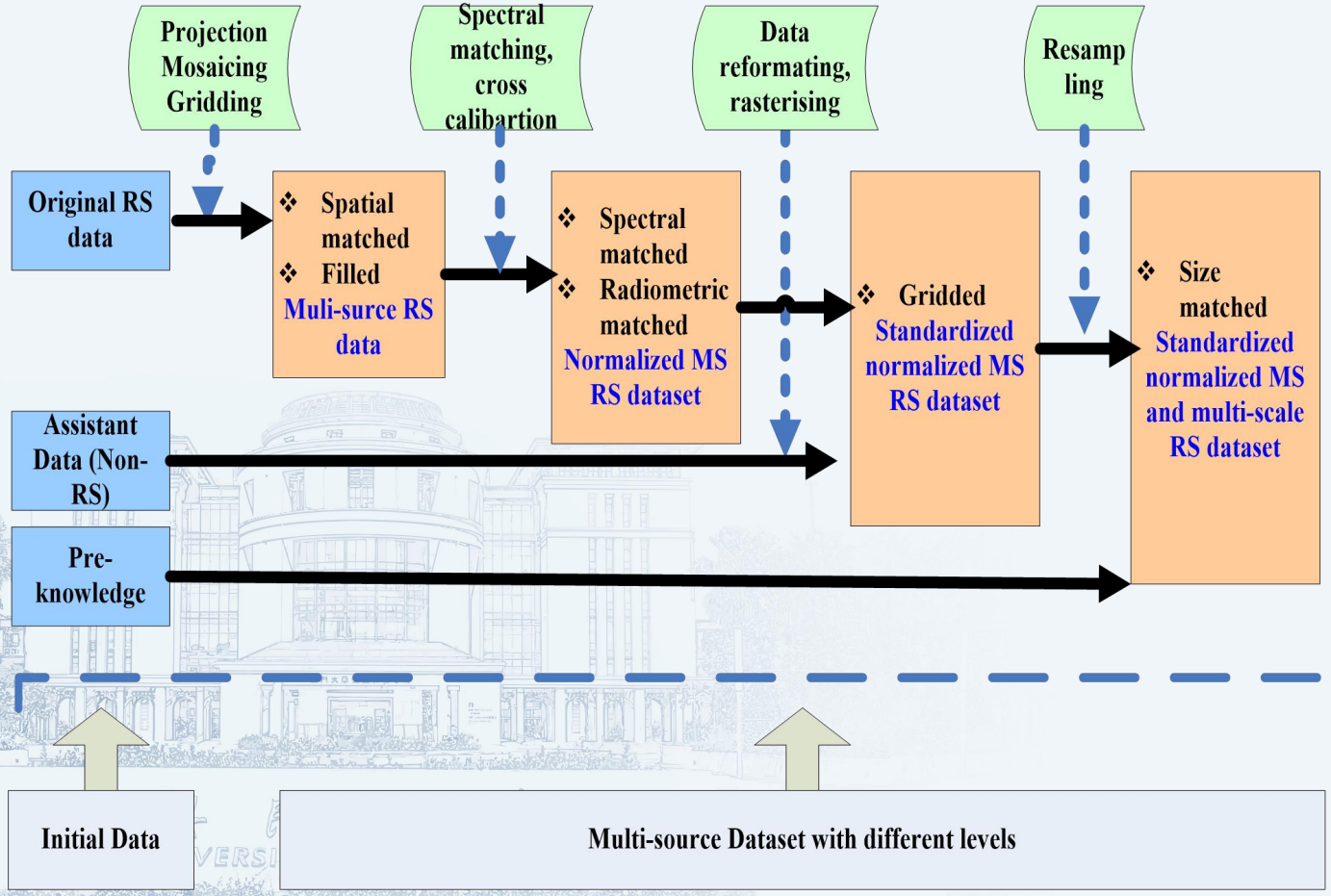


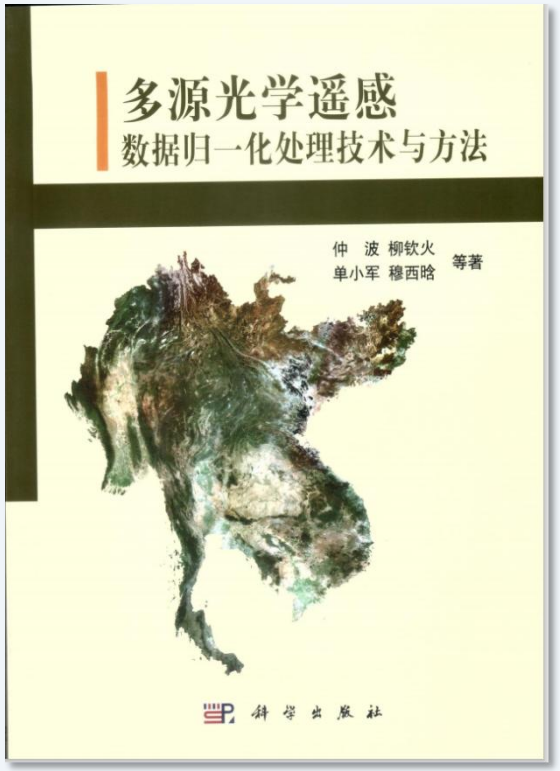
Sentinel 2 ARD



GF ARD

The procedures for producing the GF 16 m ARD

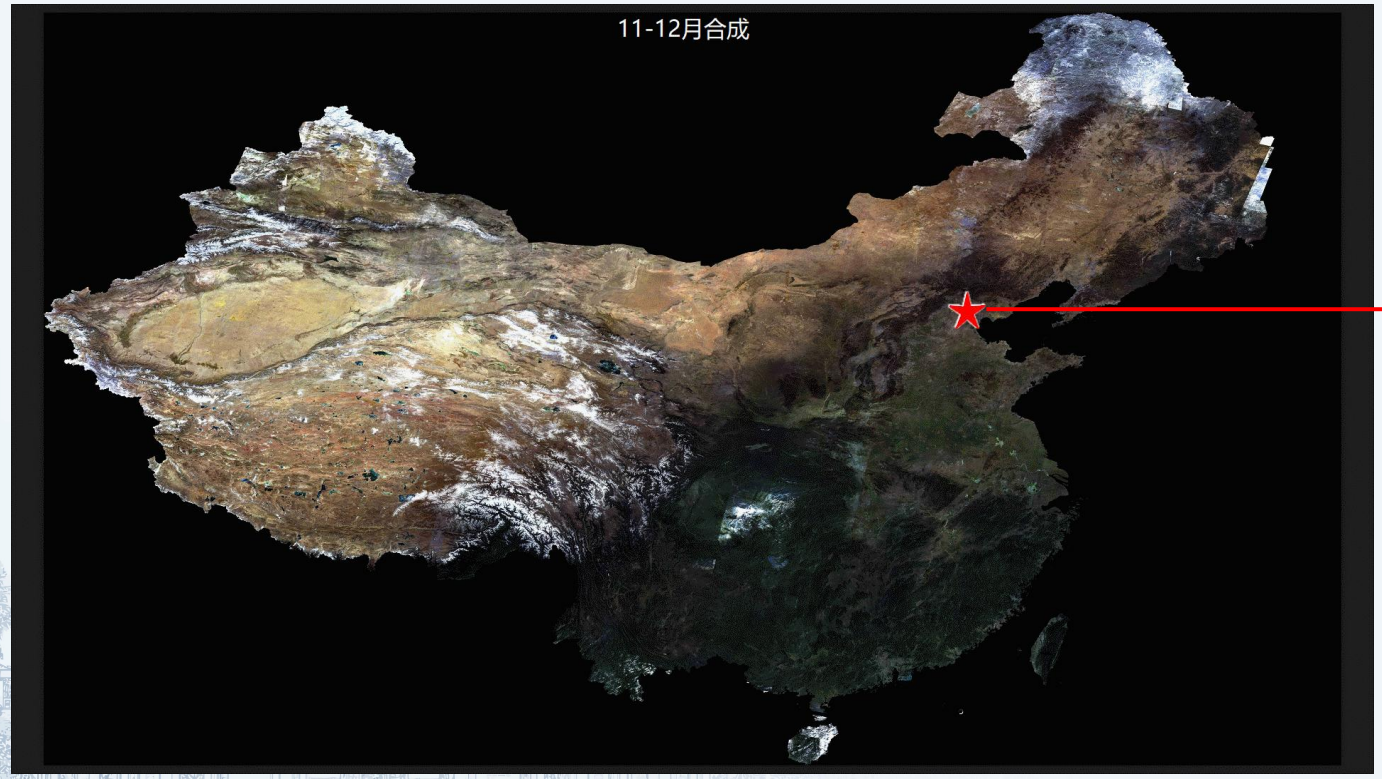


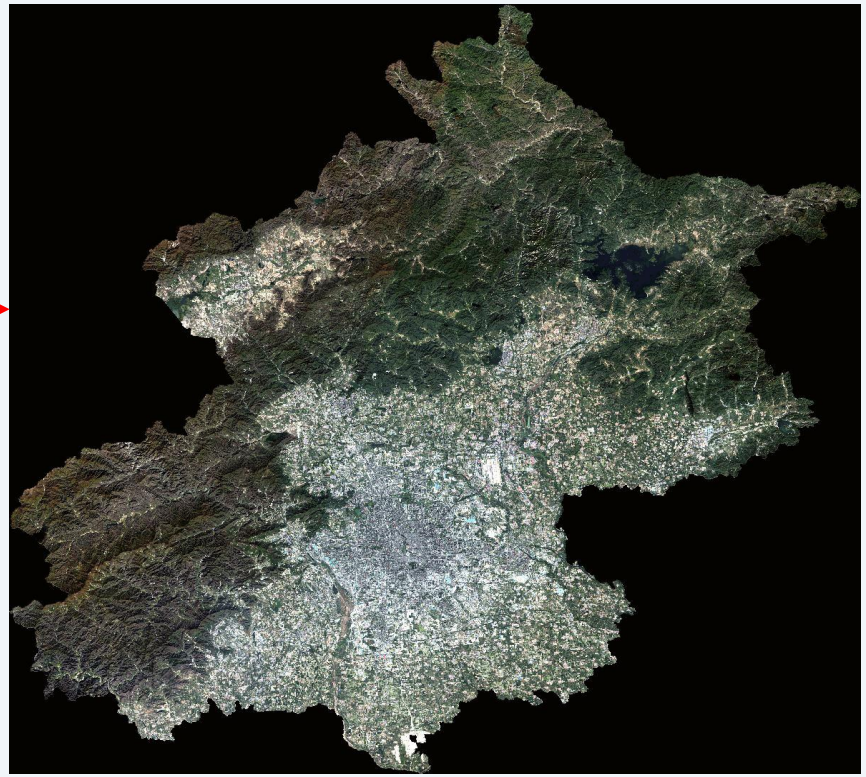


The first ARD paper for Chiese GF data

16 m GF ARD

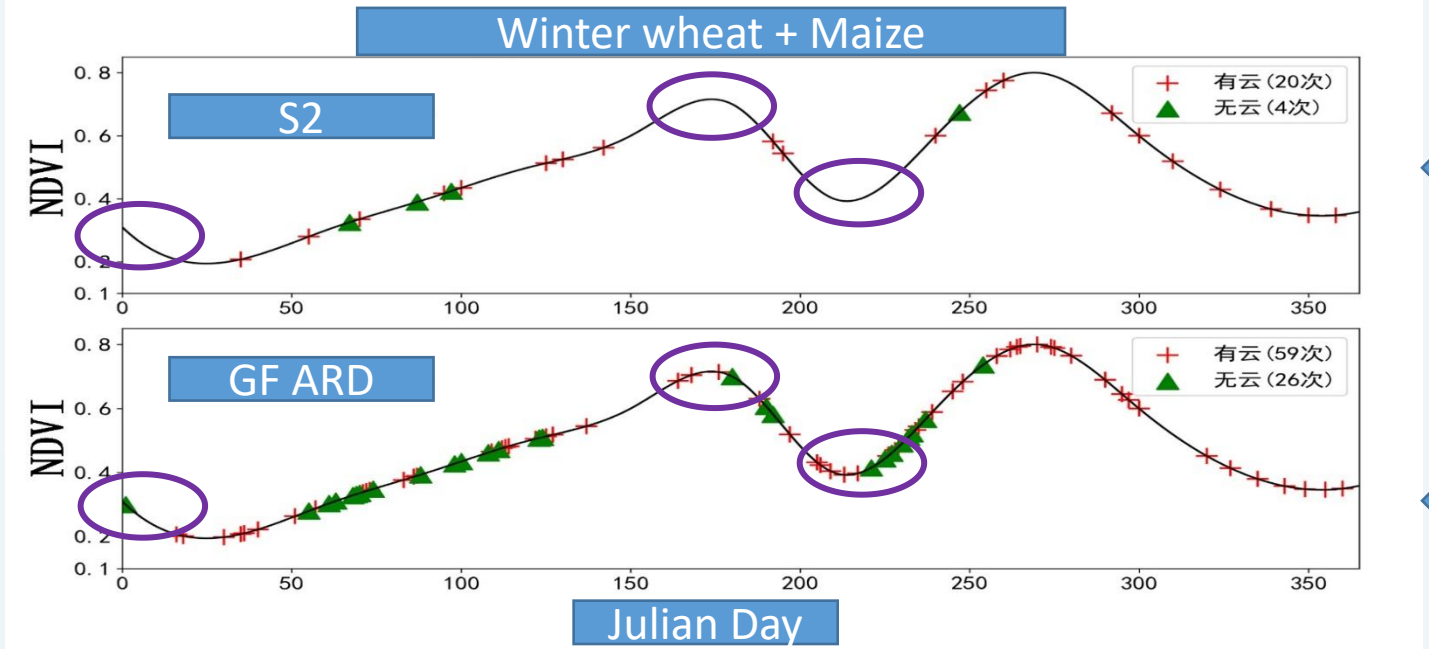
GF 16 m ARD of China from 2013~2022





Advantages: √ 16m; √ excellent spatial coverage; √ radiometric consistency; √ excellent atmospheric correction; √ higher temporal frequency

16 m GF ARD



Some observations at key date are **missed**

The observations are enough to cover all key dates

S2 without clouds (4)

GF ARD without clouds (26)

GF 16 m ARD with more observations without clouds

Landcover mapping

- Simple method
- Large amount of automatically selected samples
- Training in tile by tile, not all tiles
- Not just tile, but tile and its neighbors

Data

GF 16 m ARD
Only GF-1/WFV data

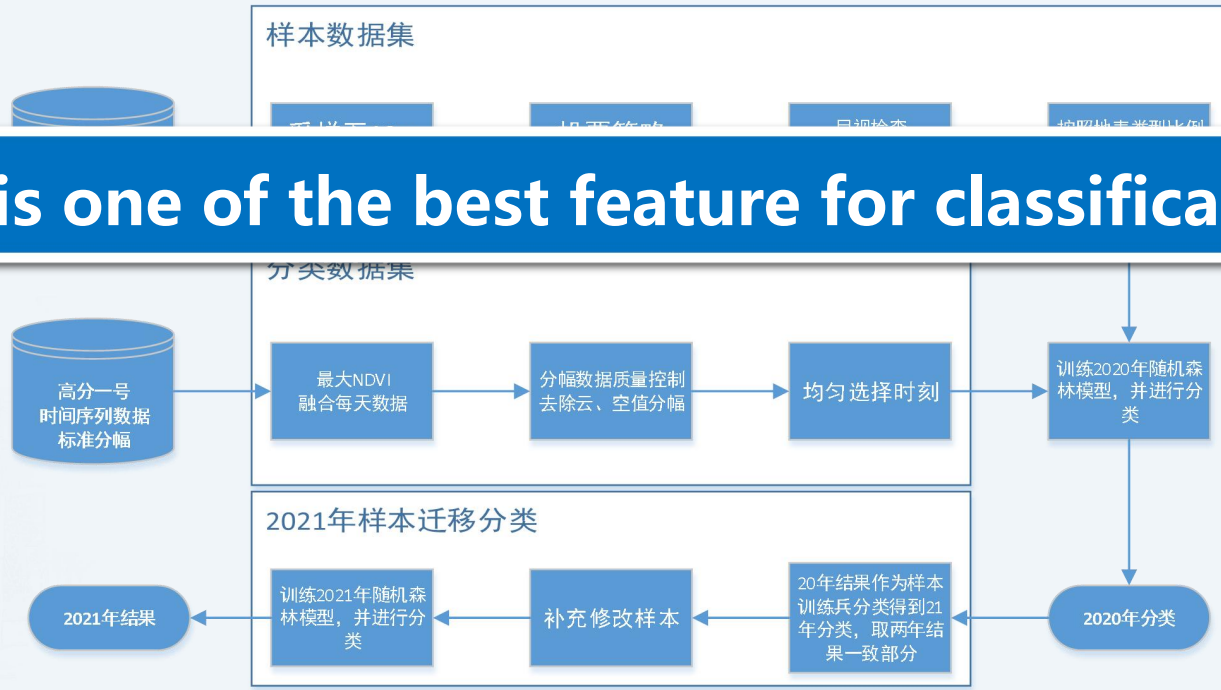
Samples

- GlobleLand30(2020)

Method

- **Model**： Radom Forest
- **Features**： time series data, spectra, DEM
- **QA**： possible clouds and saturated data
- **Platform**： HPC

Key: longer time series of ARD is one of the best feature for classification

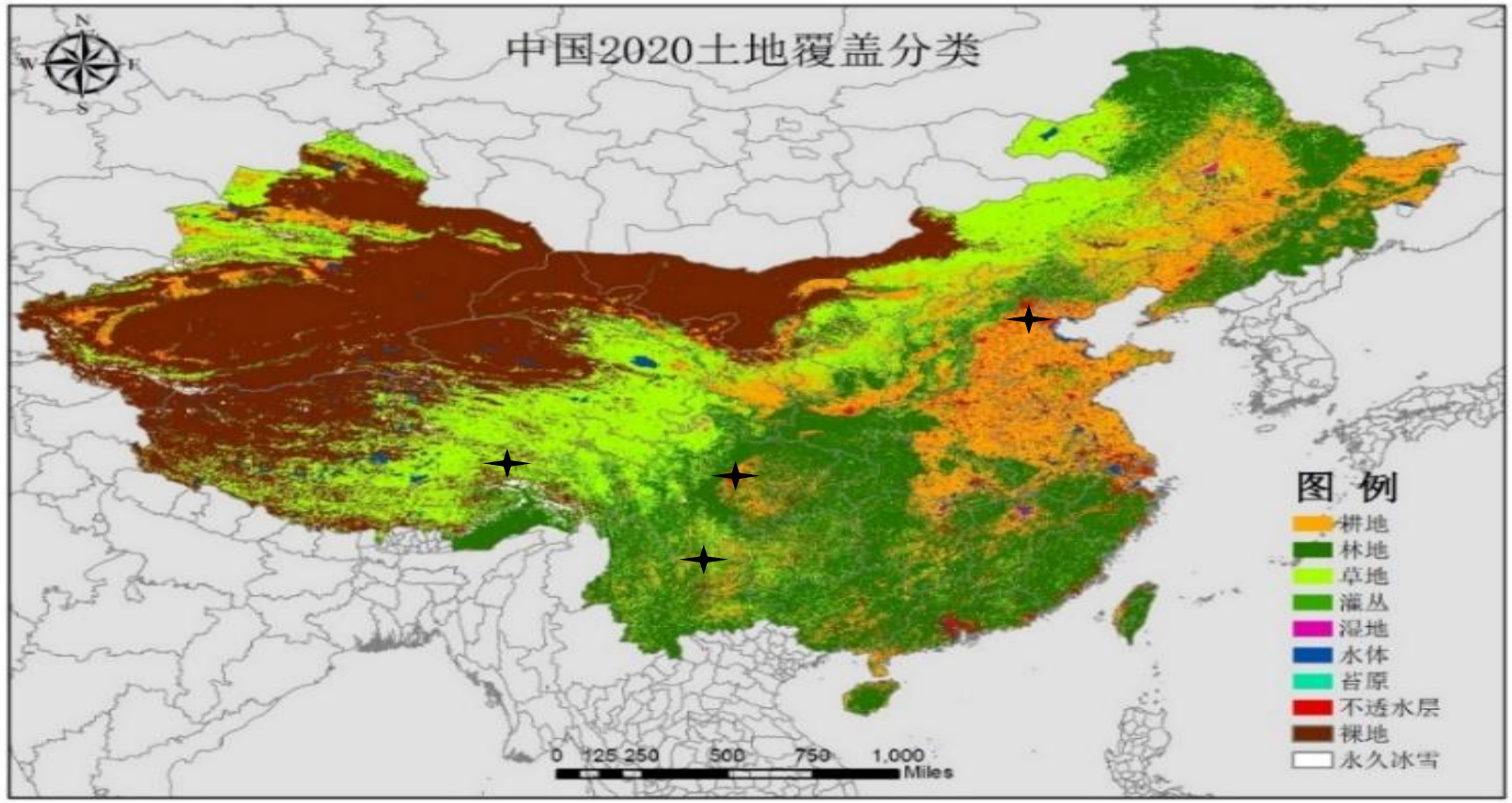


Landcover mapping procedure

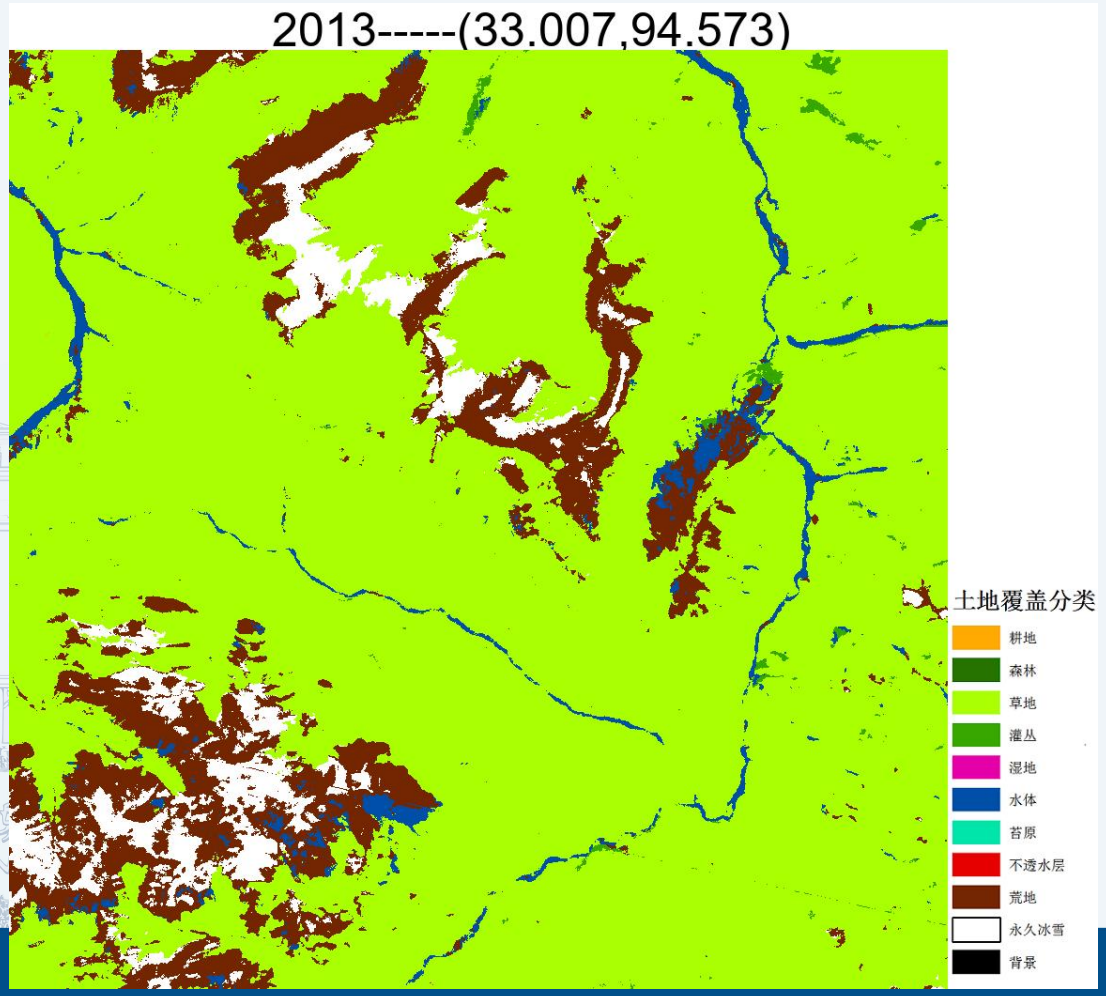
Data statistics for mapping the yearly landcover from 2013~2022

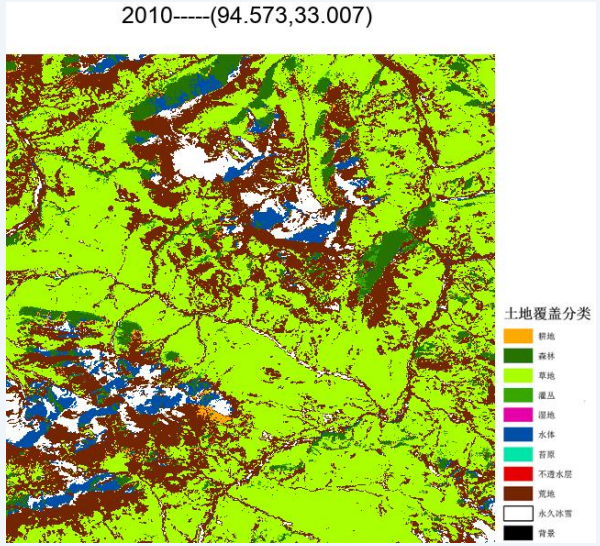
Year	GF-1/WFV (Scene)	Size (TB)	GF-1 ARD (tile)	Size (TB)
2013	13075	8.9	129367	24
2014	22707	15.4	209306	39
2015	18184	12.3	188487	35
2016	18231	12.4	179564	33
2017	16558	11.2	160637	30
2018	16445	11.1	180162	38
2019	17987	12.1	203822	38
2020	18707	12.7	201465	38
2021	19603	13.3	207979	29
2022	20959	14.2	222366	31
Total	182456	123.6	1883155	335

Yearly 16 m landcover map of China from 2013~2022

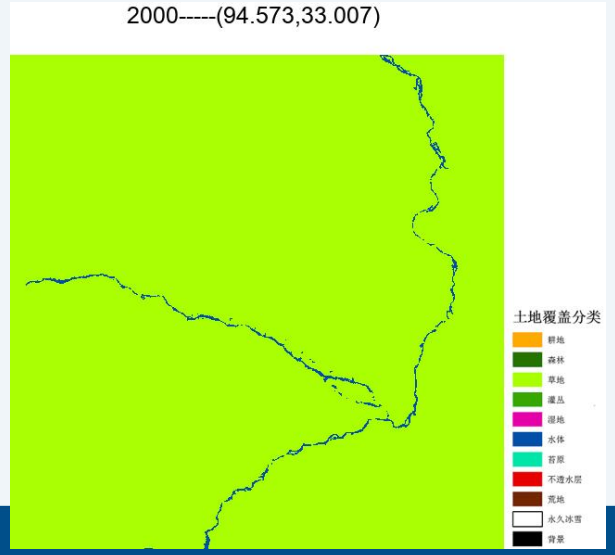


Case 1: The grassland deterioration with the glacier vanishing



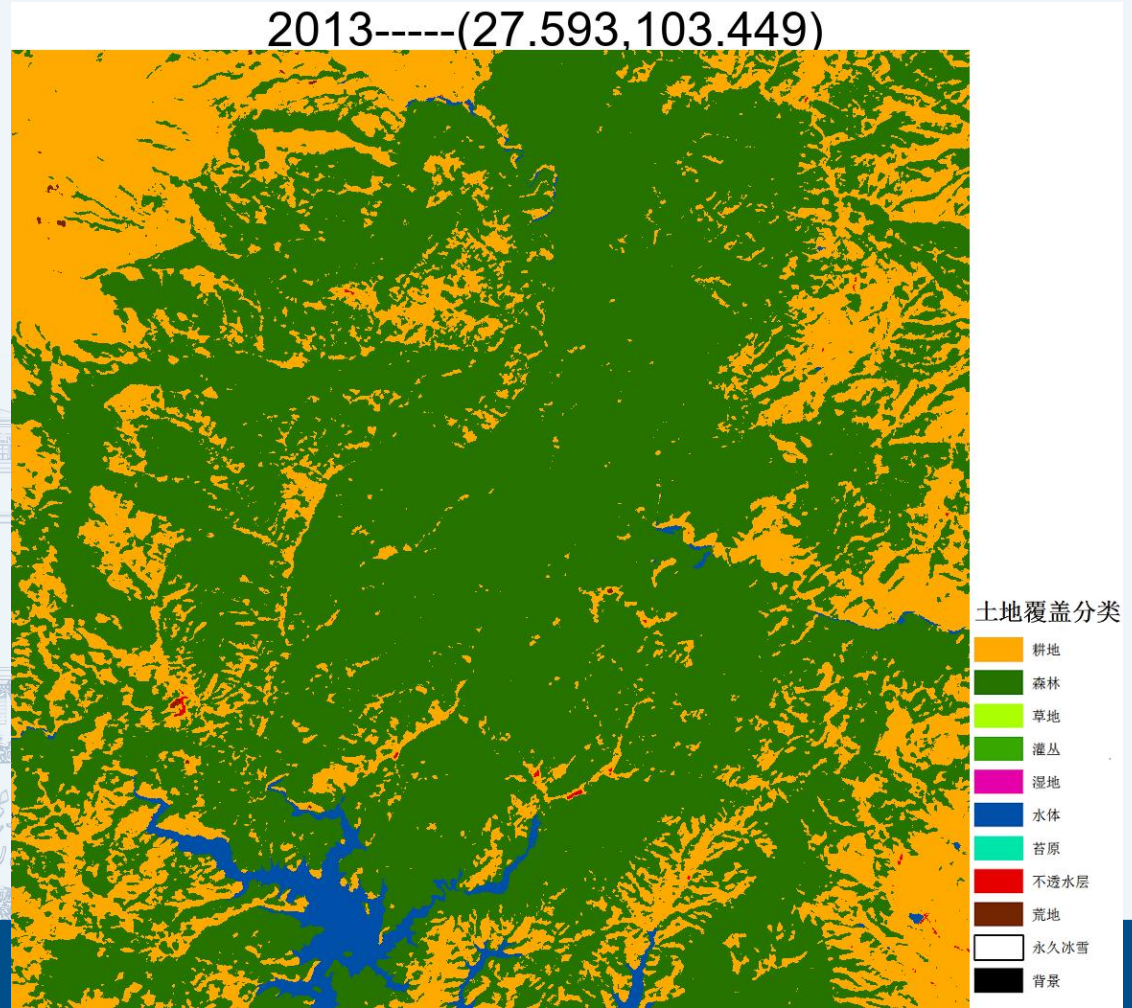


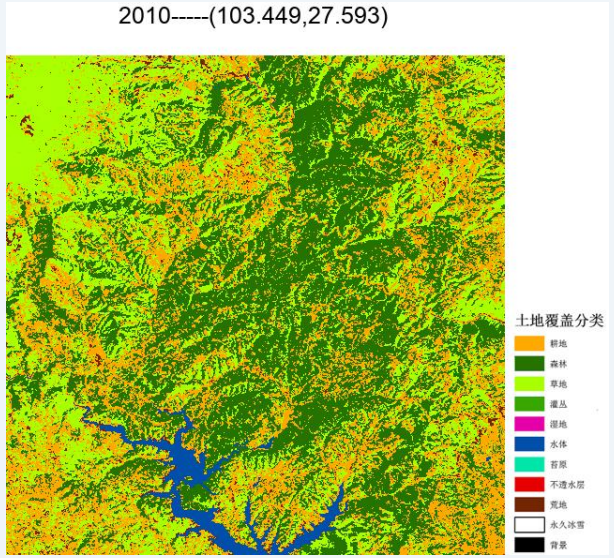
FROM-GLC30



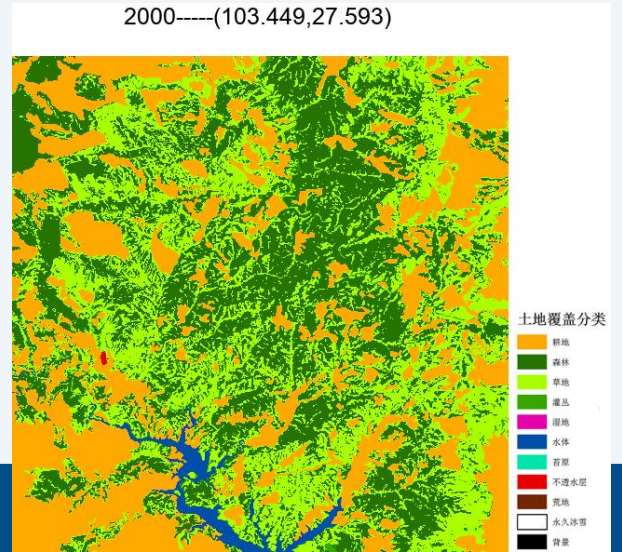
GlobeLand30

Case 2: The yearly monitoring of big construction



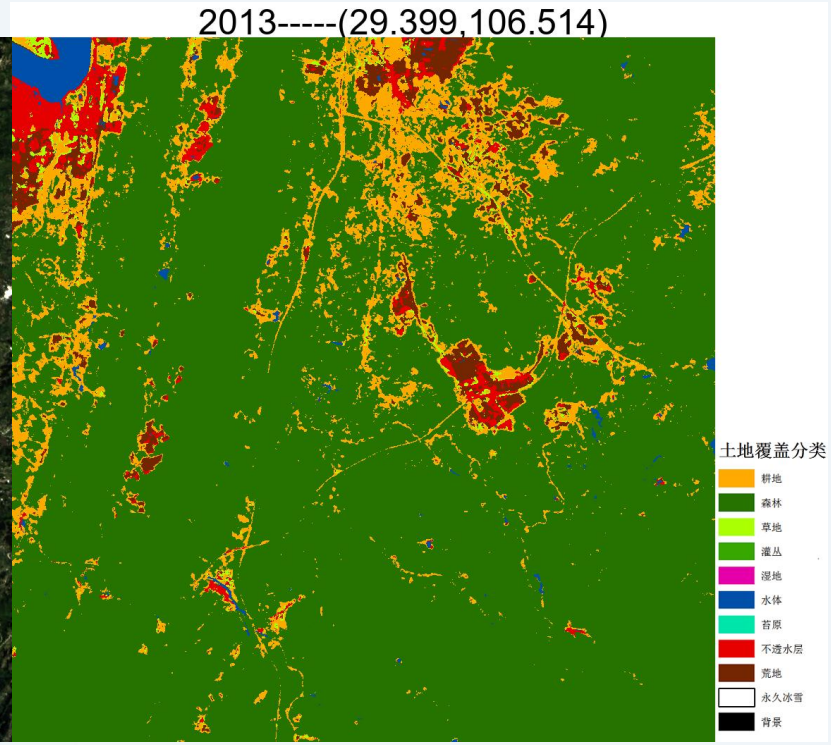


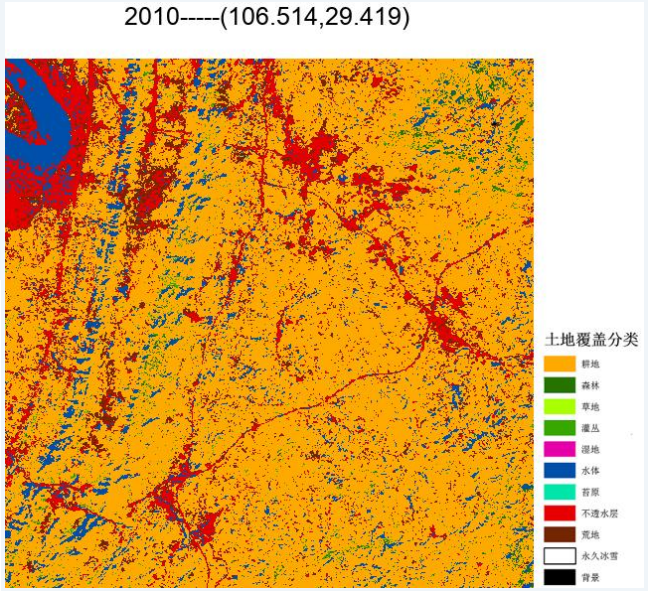
FROM-GLC30



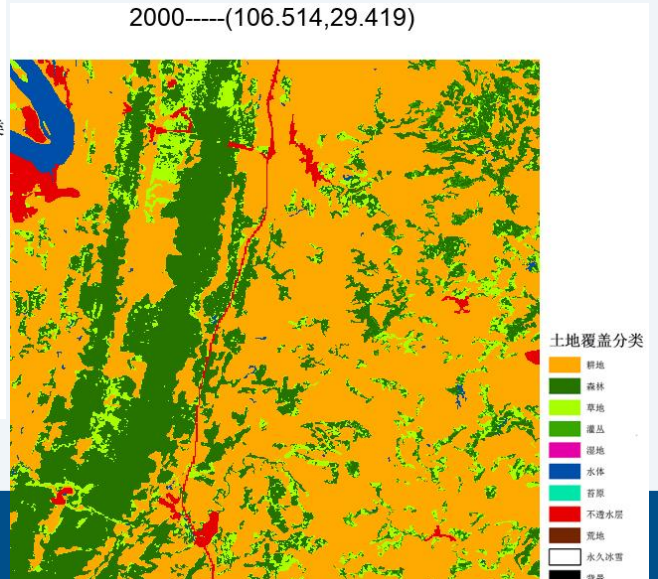
GlobeLand30

Case 3: The yearly monitoring of urbanization -- the policy of China's Western developing





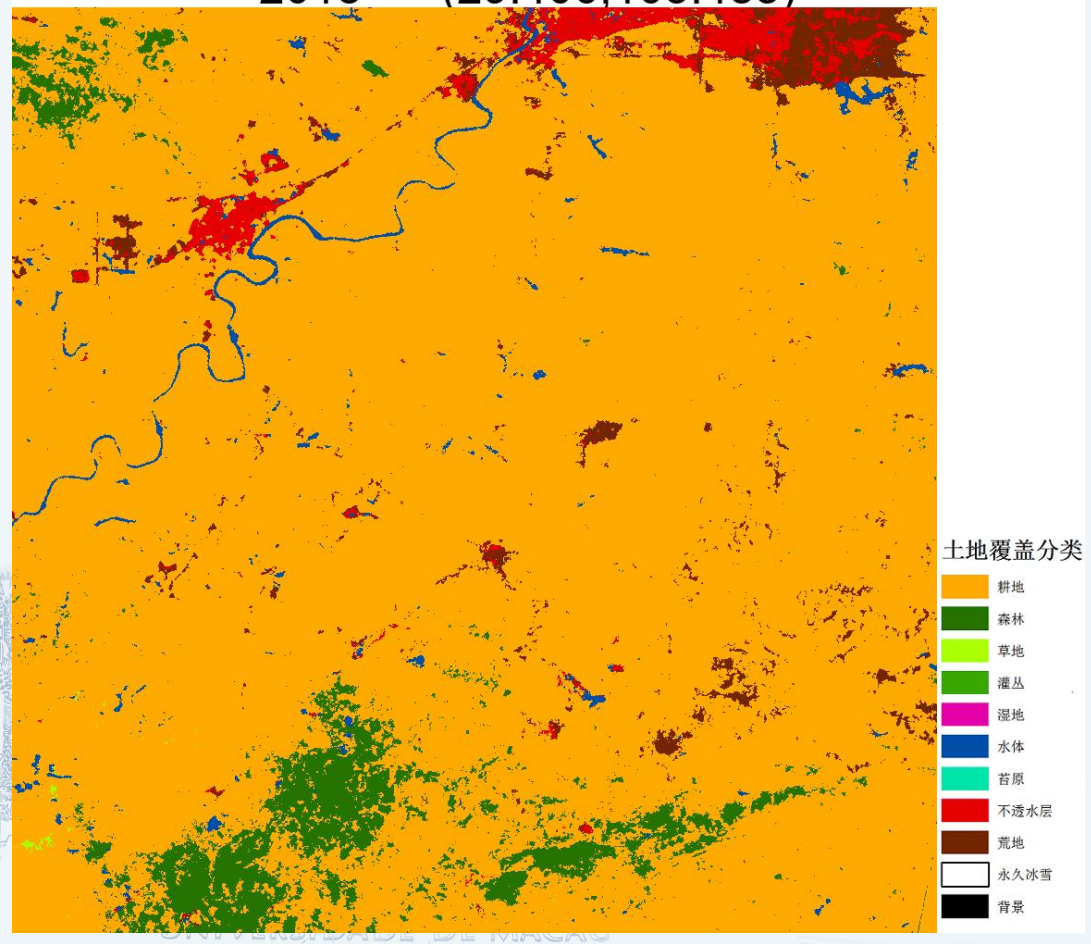
FROM-GLC30



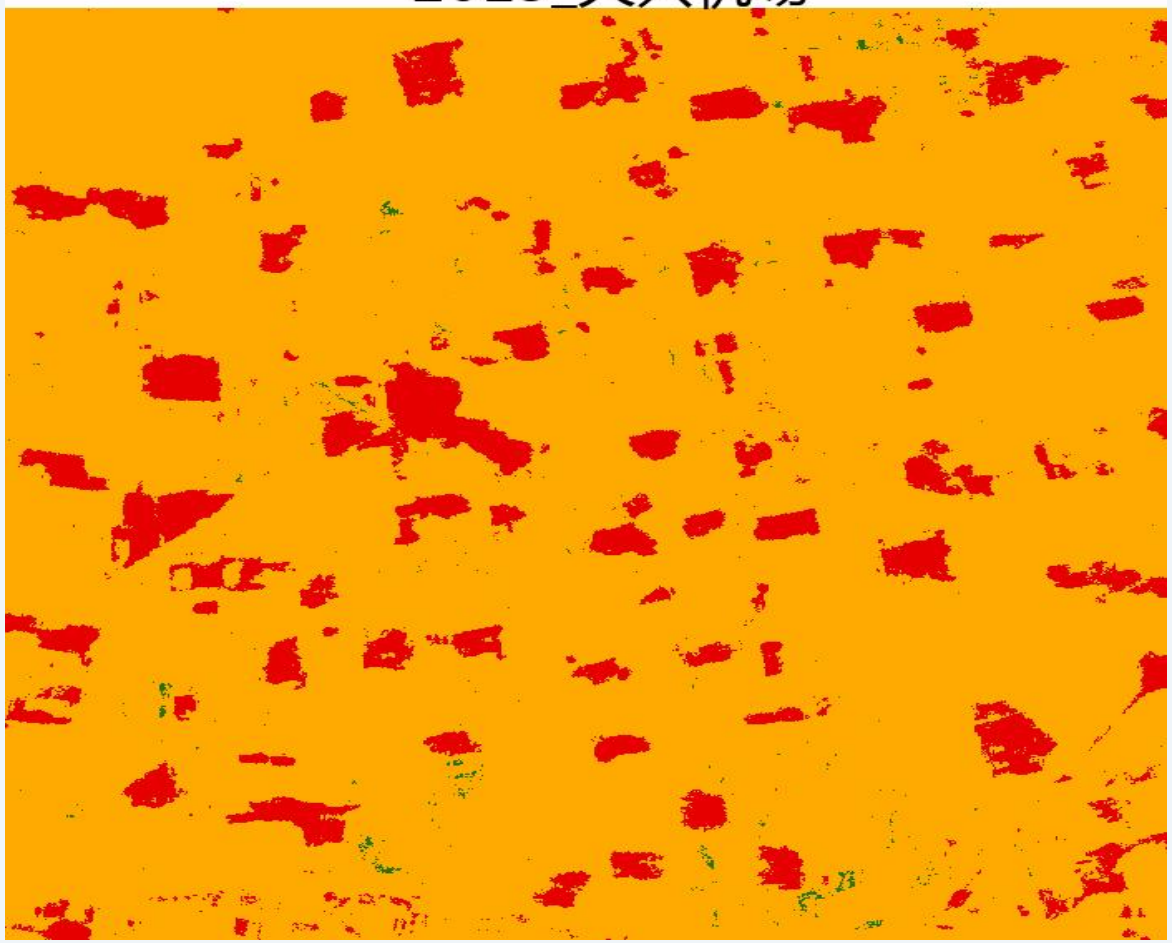
GlobeLand30

Chongqing is one of the most cloudy cities in China

2013-----(29.406,105.483)

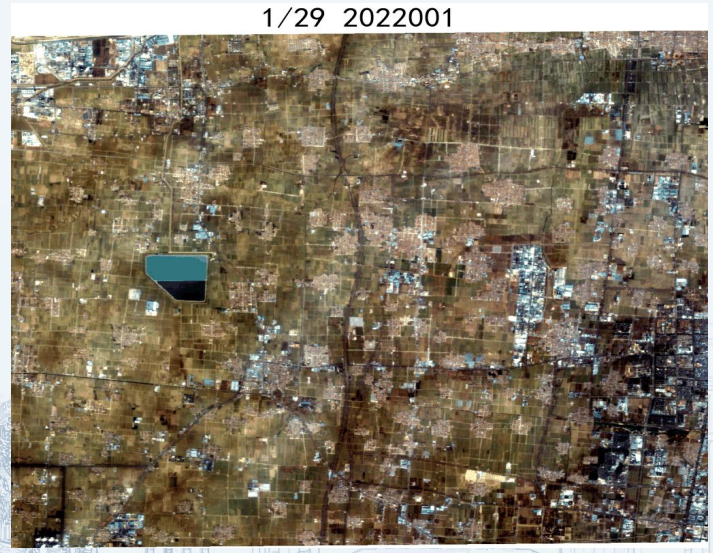


2013_大兴机场



Crop type mapping

29 observations
Very long series of ARD

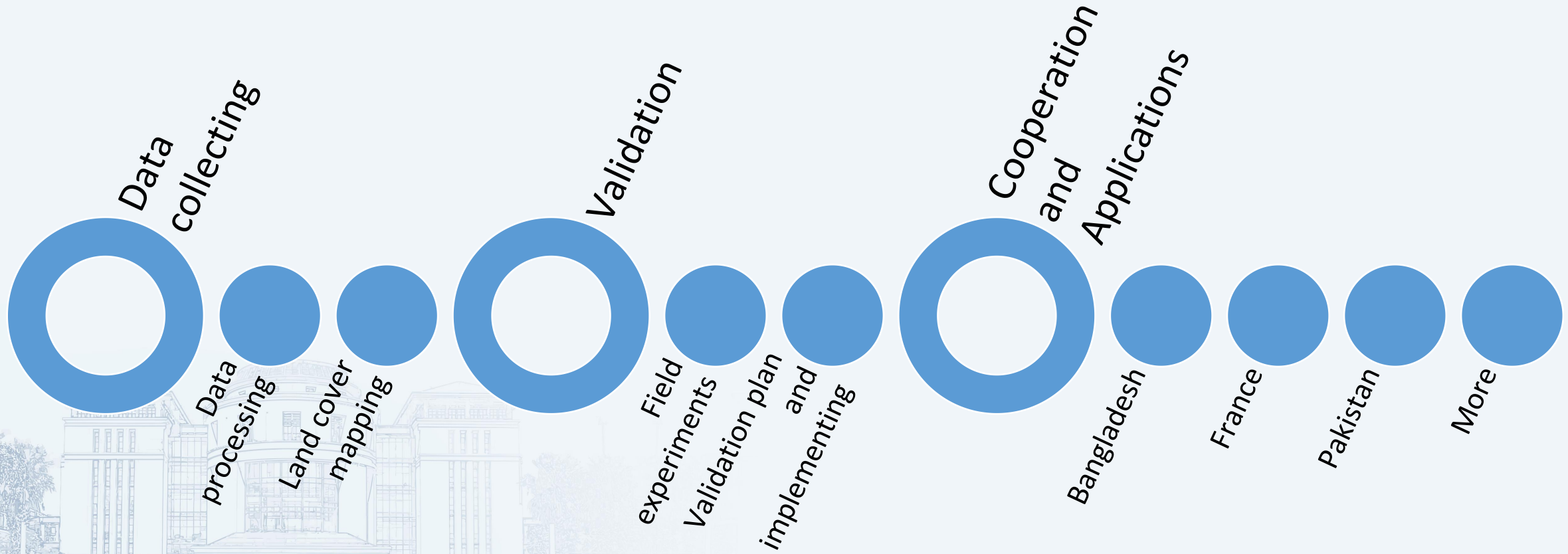


Crop type in May

Crop type in August

Compared with the field data from Sinochem Agricultrual company， the OA reaches 95%

Next to do



Funded by MODT, China under GEO speicified Project

International services and collaborative applications of global remote sensing data and products for typical land covers at 10 m scale using domestic satellite data

Data collected for mapping the global landcover from 2020~2022

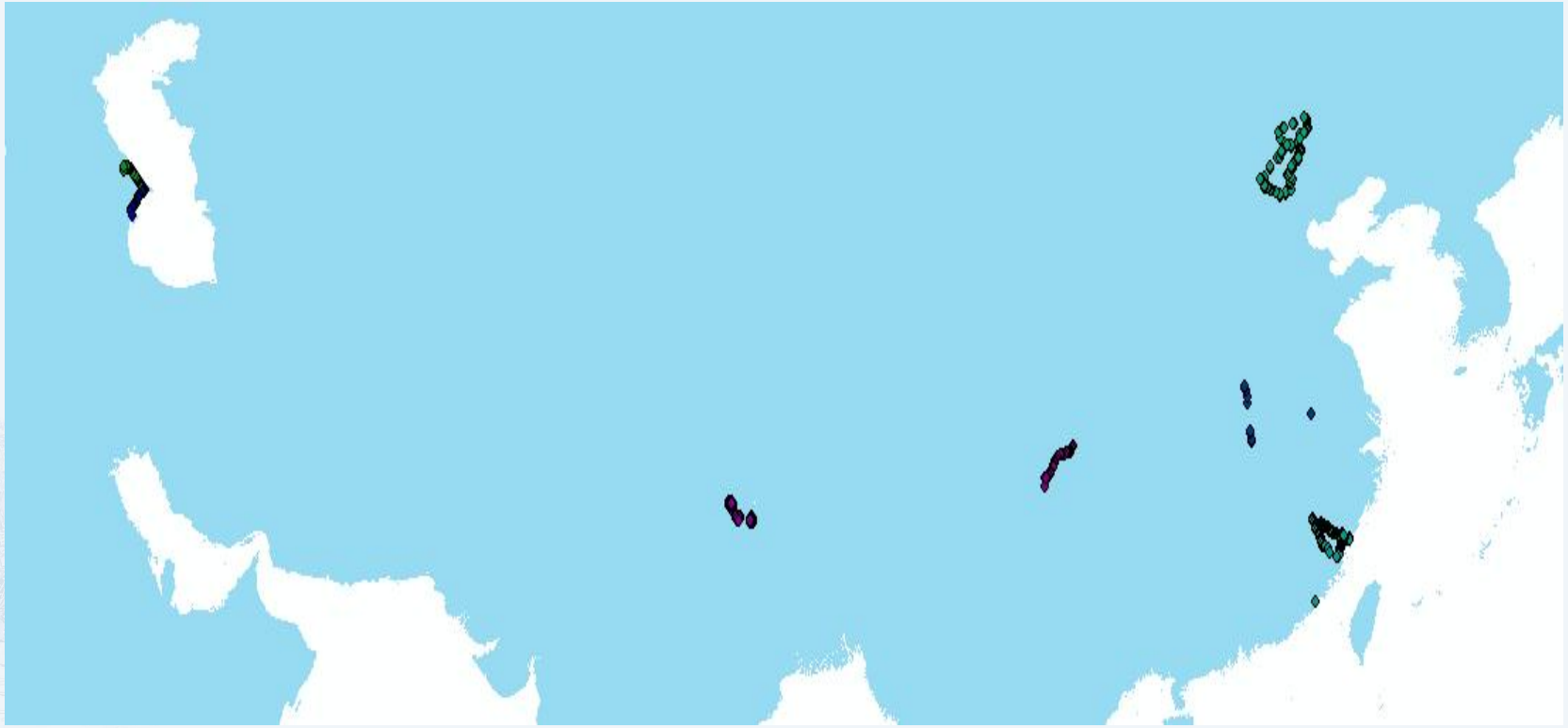
Sat	Sensor	Year	Scene	Size	Region collected	Total sences required	Rate of progress
GF6	WFV	2020	3072	30TB	USA/Brazail	29633	10%
GF6	WFV	2021	19049	154TB	Globe	35009	54.4%
GF6	WFV	2022	102	1TB	France	30172	1%
GF1	WFV	2020	18707	12.7TB	China	51382	36.4%
GF1	WFV	2021	53123	36TB	Globe	54091	98%
GF1	WFV	2022	56978	38TB	Globe	56978	100%
Total			151031	271.7TB	/	257265	58.7%

Next to do

Field experiments for sample verification: for better samples and for validation

Sampled patches

- ☐ Azerbaijan： 131
- ☐ Kenya： 1065
- ☐ Sichuan, China： 68
- ☐ Hubei, China： 22
- ☐ Fujian, China： 306
- ☐ Beijing-Hebei-Inner Mongolia, China： 392



Conclusions

- ARD does help to improve the landcover mapping accuracy
- Longer time series of ARD are better for temporal consistency
- Yearly landcover can captures the subtle variations for knowledge discovering

Discussions

- Complementary validation required
- Samples and validation for easy confused land covers from end users are encouraged and better to be collected by a public platform

5th Asia- Oceania Group on Earth Observations (AOGEO) Workshop

https://aogeo-workshop-2022.casconf.cn/

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