



Institute of Remote Sensing and Digital Earth  
Chinese Academy of Sciences

# China Shandong JECAM Site

JECAM/GEOGLAM Science Meeting

Brussels, Belgium

16-17 November, 2015

Miao Zhang, Bingfang Wu

RADI, CAS

**JECAM**

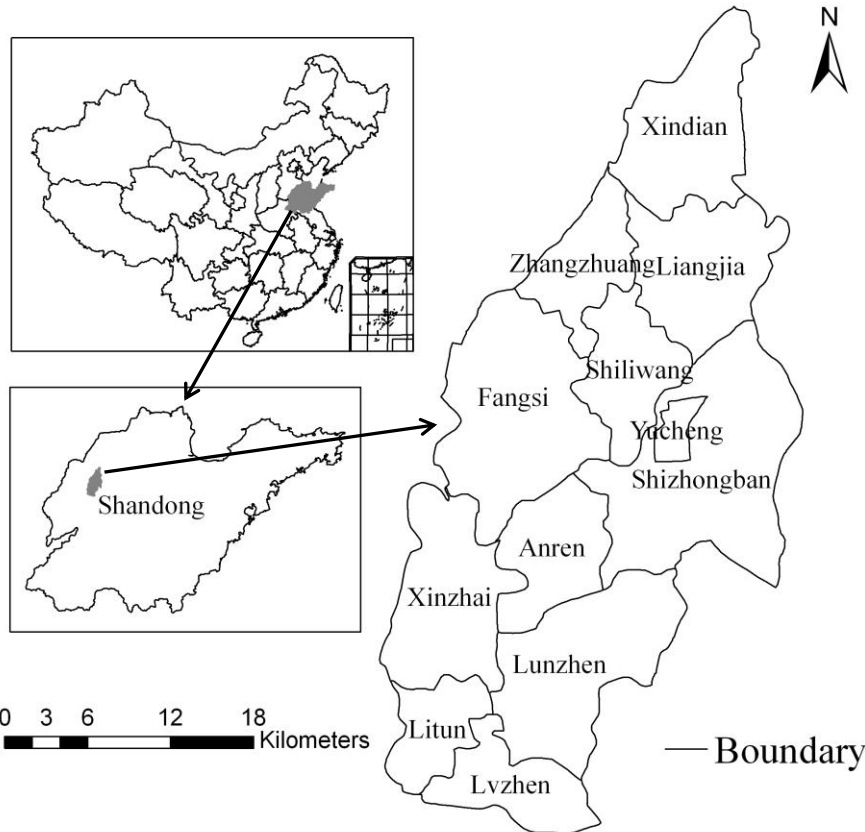
Joint Experiment for Crop Assessment and Monitoring



GROUP ON  
EARTH OBSERVATIONS

# Site description

**Yucheng** is a typical region of North China Plain where winter wheat and summer maize are widely planted.



- Temperate, semi-arid, monsoon climate
- Irrigated
- Double cropping
- No-tillage after winter wheat
- Field size < 0.5ha

# Project objective

- Crop residue cover and tillage mapping
- Crop Condition/Stress
- Yield Prediction and Forecasting
- Phenological Events
- Crop identification and Crop Area Estimation
- Estimation of Biophysical Variables (FAPAR, Biomass, etc)

# Earth Observation (EO) Data Received/Used



- Chinese satellite data (HJ-1, GF-1&2, FY-3)
- MODIS products
- Proba-V daily/10-day composite
- Radarsat-2
- Spot 5 (SPOT 5 Take 5)
- Rapideye

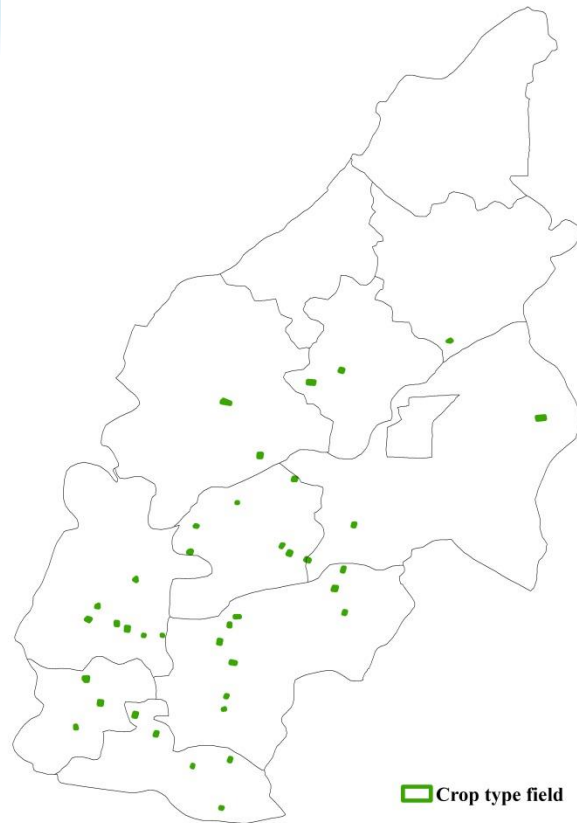
# In situ data

- Field campaigns are carried out every month from April to September
- Biophysical variables & crop type field

<b>Main variables</b>	<b>Instruments or processing method</b>
<b>Spectral reflectance</b>	HR-768 portable spectroradiometer
<b>Above ground dry biomass</b>	Oven dried and weight
<b>Yield</b>	Oven dried and weight
<b>Harvest index</b>	Calculated by yield and AGB
<b>Density/canopy height</b>	Tape measured
<b>Crop type field boundary</b>	GPS record using GIS system

# In situ data

- Crop type field using the standard crop type classes (mindataset)



Croptype2015_ChinaShandong						
FID	Shape *	Id	landcover	cropgroup	cropclass	subclass
0	Polygon	0	Annual cropland	Cereals	Wheat	Winter crop
1	Polygon	0	Annual cropland	Cereals	Wheat	Winter crop
2	Polygon	0	Annual cropland	Cereals	Wheat	Winter crop
3	Polygon	0	Annual cropland	Cereals	Wheat	Winter crop
4	Polygon	0	Annual cropland	Cereals	Wheat	Winter crop
5	Polygon	0	Annual cropland	Cereals	Wheat	Winter crop
6	Polygon	0	Annual cropland	Cereals	Wheat	Winter crop
7	Polygon	0	Annual cropland	Cereals	Wheat	Winter crop
8	Polygon	0	Annual cropland	Cereals	Wheat	Winter crop
9	Polygon	0	Annual cropland	Cereals	Wheat	Winter crop
▶ 10	Polygon	0	Annual cropland	Cereals	Wheat	Winter crop
11	Polygon	0	Annual cropland	Cereals	Wheat	Winter crop
12	Polygon	0	Annual cropland	Cereals	Wheat	Winter crop
13	Polygon	0	Annual cropland	Cereals	Wheat	Winter crop
14	Polygon	0	Annual cropland	Cereals	Wheat	Winter crop
15	Polygon	0	Annual cropland	Cereals	Wheat	Winter crop
16	Polygon	0	Annual cropland	Cereals	Wheat	Winter crop
17	Polygon	0	Annual cropland	Cereals	Wheat	Winter crop
18	Polygon	0	Annual cropland	Cereals	Wheat	Winter crop
19	Polygon	0	Annual cropland	Cereals	Wheat	Winter crop
20	Polygon	0	Annual cropland	Cereals	Wheat	Winter crop
21	Polygon	0	Annual cropland	Cereals	Wheat	Winter crop
22	Polygon	0	Annual cropland	Cereals	Wheat	Winter crop
23	Polygon	0	Annual cropland	Cereals	Wheat	Winter crop
24	Polygon	0	Annual cropland	Cereals	Wheat	Winter crop
25	Polygon	0	Annual cropland	Cereals	Wheat	Winter crop
26	Polygon	0	Annual cropland	Cereals	Wheat	Winter crop
27	Polygon	0	Annual cropland	Cereals	Wheat	Winter crop
28	Polygon	0	Annual cropland	Cereals	Wheat	Winter crop
29	Polygon	0	Annual cropland	Cereals	Wheat	Winter crop
30	Polygon	0	Annual cropland	Cereals	Wheat	Winter crop
31	Polygon	0	Annual cropland	Cereals	Wheat	Winter crop
32	Polygon	0	Annual cropland	Cereals	Wheat	Winter crop
33	Polygon	0	Annual cropland	Cereals	Wheat	Winter crop
34	Polygon	0	Annual cropland	Cereals	Wheat	Winter crop
35	Polygon	0	Annual cropland	Cereals	Wheat	Winter crop
36	Polygon	0	Annual cropland	Cereals	Wheat	Winter crop
37	Polygon	0	Annual cropland	Other crops	Cotton	Spring crop

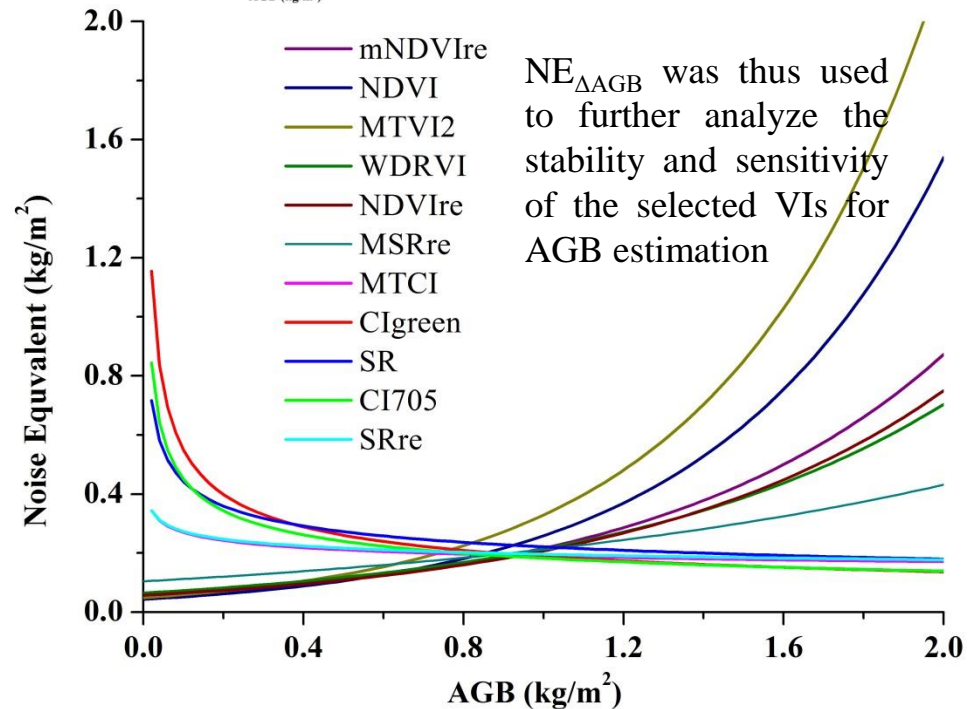
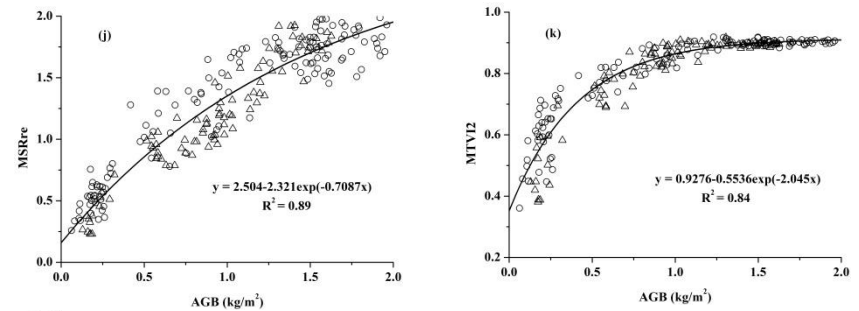
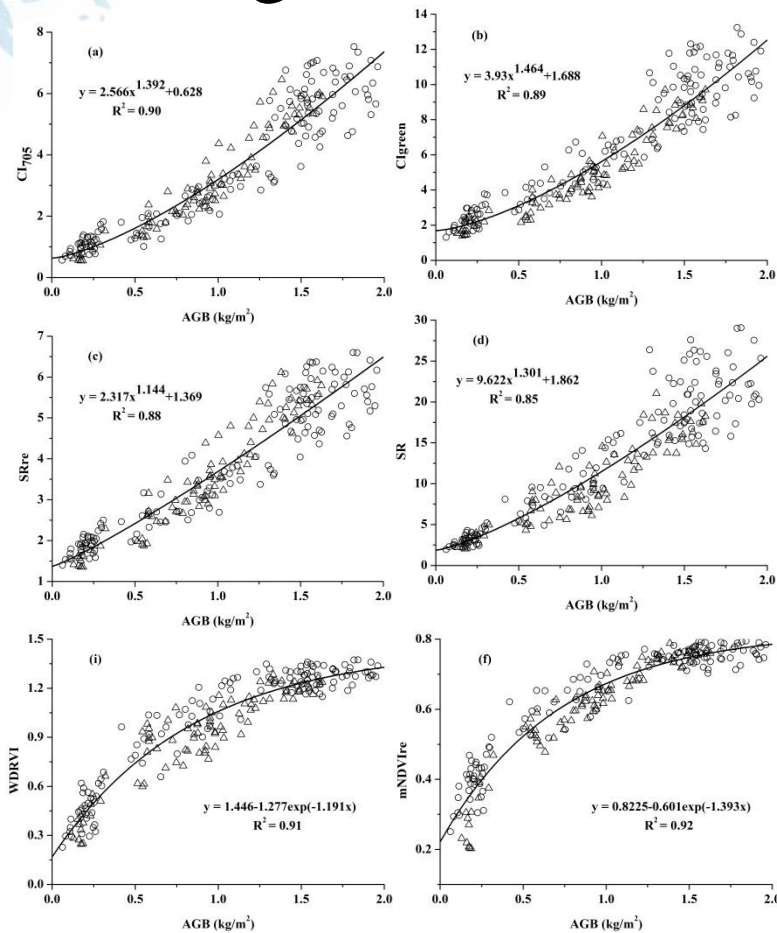
# Results

- Biophysical variables retrieval
- Field collected canopy reflectance data
- Various VIs are simulated

Vegetation indices	Formula	Reference
Green Chlorophyll Index (CIgreen)	$\rho_{NIR}/\rho_{green} - 1$	Gitelson et al. (2005)
Red-edge chlorophyll index (CI <sub>705</sub> )	$\rho_{NIR}/\rho_{red-edge} - 1$	Gitelson et al. (2005)
Red-edge chlorophyll index (CI <sub>750</sub> )	$\rho_{NIR}/\rho_{red-edge} - 1$	Schlemmer et al. (2013)
Enhanced Vegetation Index (EVI)	$2.5 * [(\rho_{NIR} - \rho_{red}) / (\rho_{NIR} + 6\rho_{red} - 7.5\rho_{blue})]$	Huete et al. (2002)
Modified Triangular Vegetation Index 2 (MTVI2)	$1.5 * [1.2 * (\rho_{800} - \rho_{550}) - 2.5 * (\rho_{670} - \rho_{550})] / \sqrt{(2\rho_{800} + 1)^2 - (6\rho_{800} - 5\sqrt{\rho_{670}} - 0.5)}$	Haboudane et al. (2004)
Enhanced Vegetation Index 2 (EVI2)	$(\rho_{NIR} - \rho_{red}) / (1 + \rho_{NIR} + 2.4 * \rho_{red})$	Jiang et al. (2008)
modified NDVI (mNDVI)	$(\rho_{800} - \rho_{680}) / (\rho_{800} + \rho_{680} - 2\rho_{445})$	D. A. Sims et al. (2002)
modified red-edge NDVI (mNDVIRE)	$(\rho_{750} - \rho_{705}) / (\rho_{750} + \rho_{705} - 2\rho_{445})$	D. A. Sims et al. (2002)
Modified Simple Ratio (MSR)	$(\rho_{800}/\rho_{670} - 1) / \sqrt{\rho_{800}/\rho_{670} + 1}$	Chen (1996)
Modified red-edge Simple Ratio (MSRre)	$(\rho_{750}/\rho_{705} - 1) / \sqrt{\rho_{750}/\rho_{705} + 1}$	Wu et al. (2008)
MERIS Terrestrial Chlorophyll Index (MTCI)	$(\rho_{NIR} - \rho_{red-edge}) / (\rho_{red-edge} - \rho_{red})$	J. Dash (2004)
Normalized Difference Vegetation Index (NDVI)	$(\rho_{NIR} - \rho_{red}) / (\rho_{NIR} + \rho_{red})$	Rouse et al. (1974)
Red-edge NDVI (NDVIRE)	$(\rho_{NIR} - \rho_{red-edge}) / (\rho_{NIR} + \rho_{red-edge})$	Gitelson et al. (1997)
Simple Ratio (SR)	$\rho_{NIR}/\rho_{red}$	Jordan (1969)
Red-edge Simple Ratio (SRre)	$\rho_{750}/\rho_{705}$	D. A. Sims et al. (2002)
Wide Dynamic Range Vegetation Index (WDRVI)	$\frac{\alpha * \rho_{NIR} - \rho_{red} + 1 - \alpha}{\alpha * \rho_{NIR} + \rho_{red} + 1 + \alpha}$ ( $\alpha = 0.2$ )	Gitelson et al. (2004)
Red-edge triangular vegetation index (RTVI)	$(100(\rho_{750} - \rho_{730}) - 10(\rho_{750} - \rho_{550})) * \text{SQRT}(\frac{\rho_{700}}{\rho_{670}})$	Chen et al. (2010)

# Results

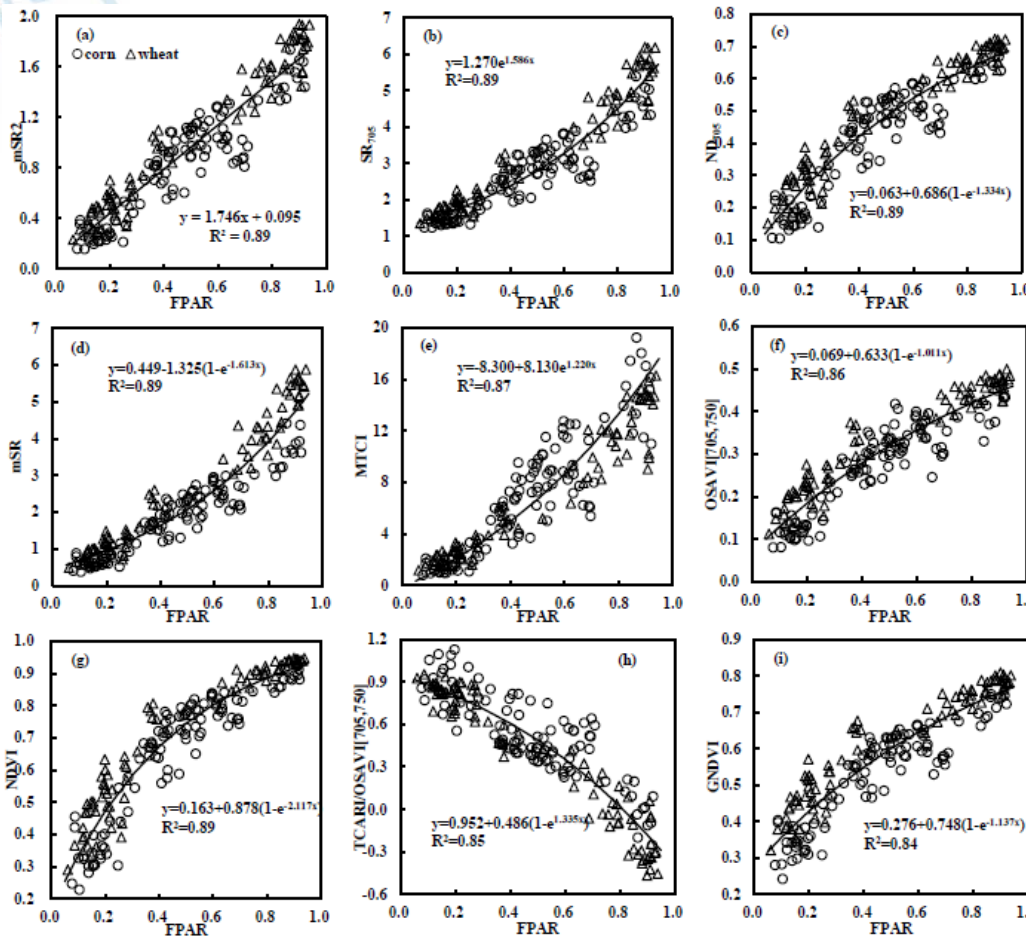
## ➤ Regression between AGB and VIs



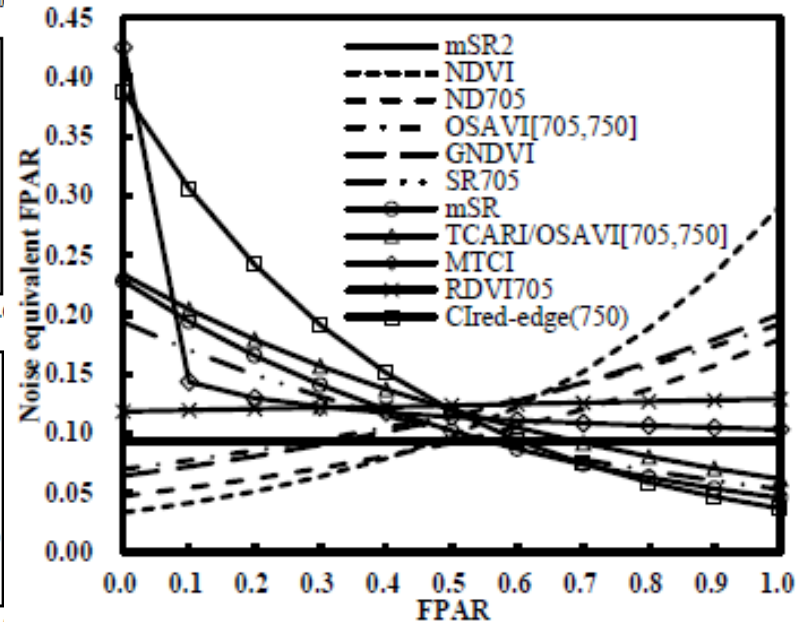


# Results

## ➤ FAPAR retrieval



$NE_{\Delta FAPAR}$  was used to further analyze the stability and sensitivity of the selected VIs for FAPAR retrieval

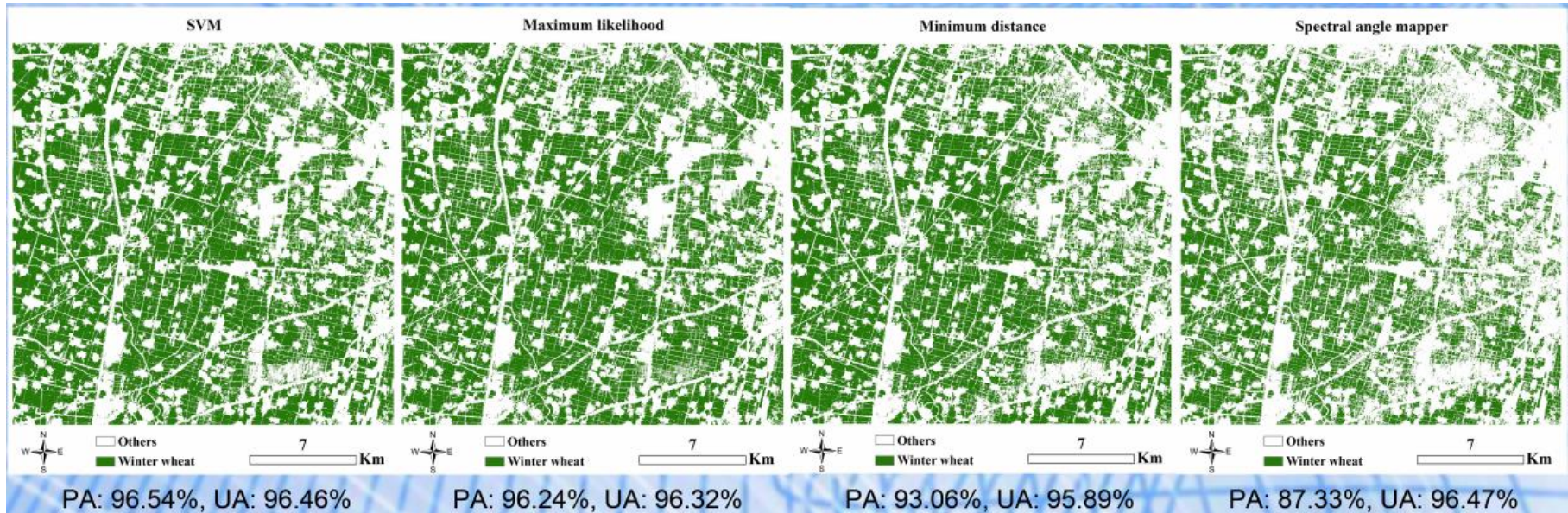


# Results

- Biophysical variables retrieval
  - NDVI is the best at early growing stage (low biomass/leaf area stage)
  - VIs using red-edge band perform much better than other indices
  - Use crop calendar / phenology data
  - Use different VIs for different growing stage

# Results

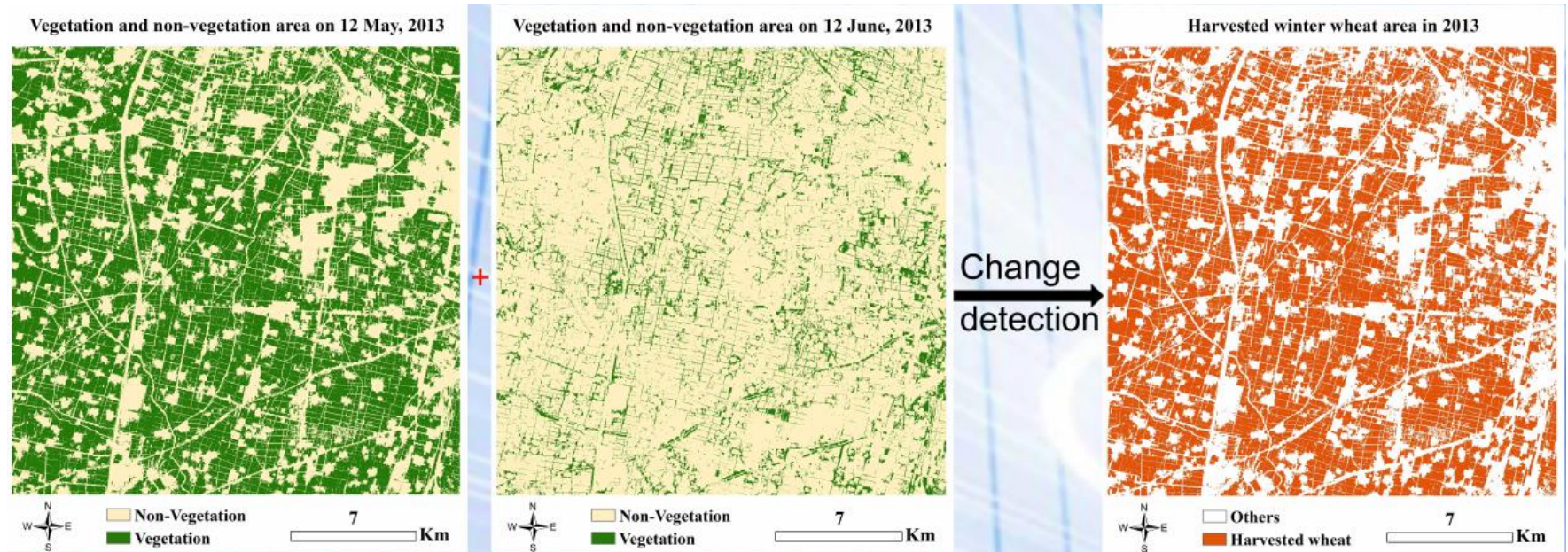
- Planting area and harvest area estimation
- Multi-temporal crop classification



Winter wheat planting area using four Rapideye images by four classifier

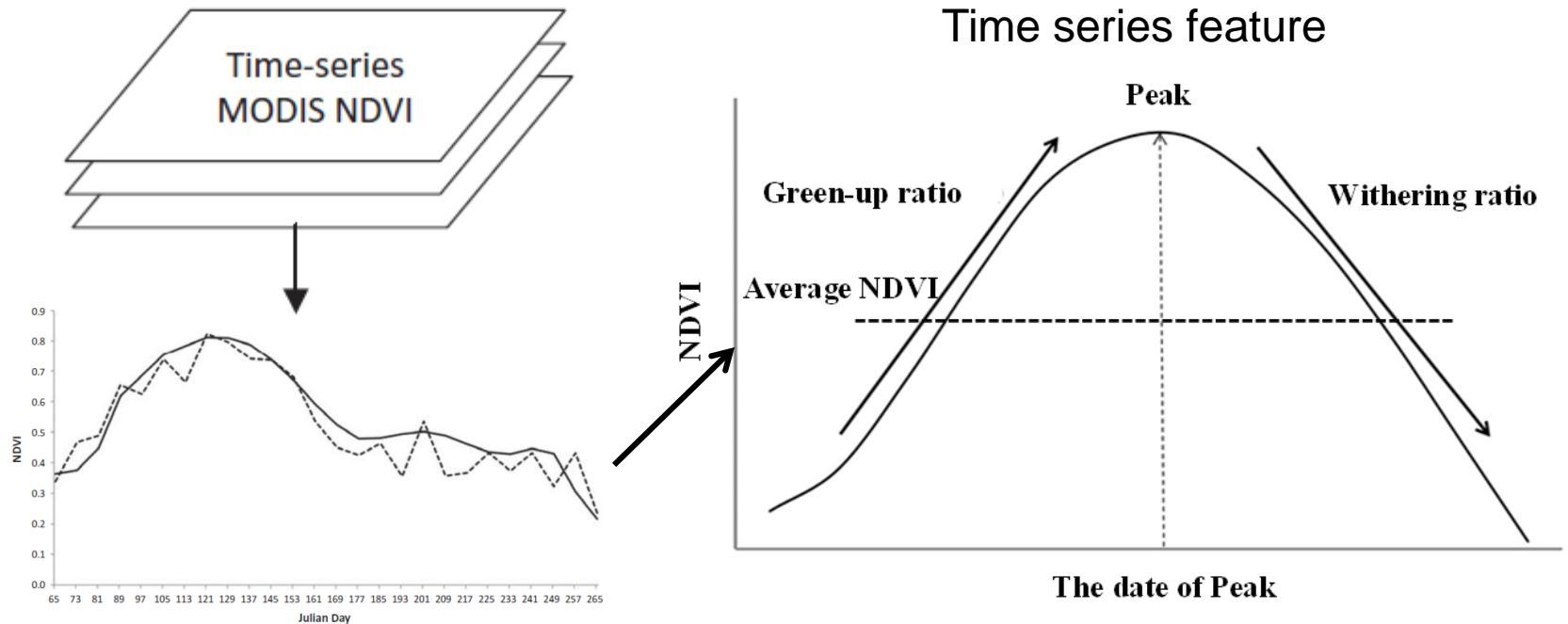
# Results

- Planting area and harvest area estimation
  - Harvest wheat area extraction using decision tree and change detection



# Results

- Annual Cropland Mapping
- Decision Tree classification applied for 5 JECAM sites using MODIS data



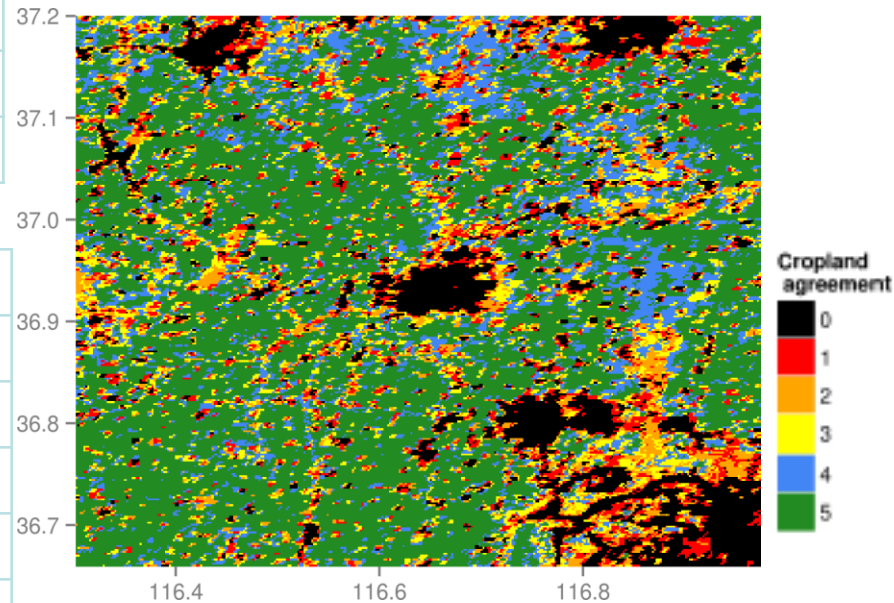
# Results

## ➤ Annual Cropland Mapping – inter-comparison

Site	method	OA(%)
SaoPaulo_Brazil	DT	84.5
SRIA_Russia	DT	94.5
Kyiv_Ukraine	DT	95.9
Shangdong_China	DT	90.6
SanAntonio_Argentina	DT	90.5

Site	method	OA(%)
Shangdong_China	LSAM	90.6
Shangdong_China	TSAEC	91.2
Shangdong_China	DT	90.6
Shangdong_China	NNE	90.6
Shangdong_China	KBC	91.2

Cropland agreement map using 5 different methods

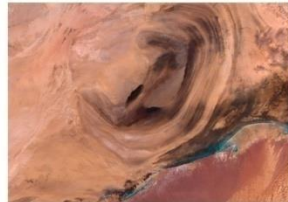
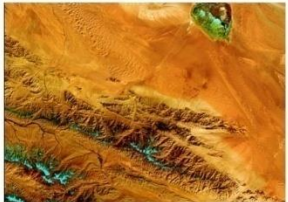


# Research Plans for Next Growing Season



- New crop classification using time series data and investigate the robustness and consistency of the method over multiple years and different regions
- Pixel based biomass and yield mapping
- Crop classification by integration of optical (SPOT5) and SAR (Radarsat2) data
- Collaboration on yield estimation between sites

# Thanks!



**Institute of Remote Sensing and Digital Earth  
Chinese Academy of Sciences**

Add: No.9 Dengzhuang South Road,Haidian District,Beijing 100094,China

Tel: 86-10-82178008 Fax: 86-10-82178009

E-mail: [office@radi.ac.cn](mailto:office@radi.ac.cn)

Web: [www.radi.cas.cn](http://www.radi.cas.cn)