Mapping Paddy Rice with Satellite Remote Sensing: A Review

Reporter: Rongkun Zhao

Organization：Southwest University

Date:2021/7/31

CONTENTS

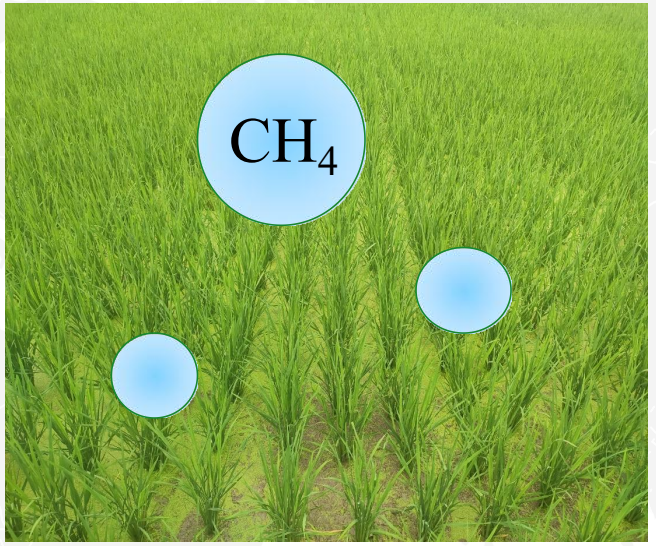
01 Introduction

Introduction

Food security

Population growth

(*Kuenzer et al. 2013*)



Climate change

Methane emissions

(*Yan et al. 2009*)

Water use

Paddy rice irrigation

(*Bouman et al. 2009*)

Human health

Avian influenza

禽流感

(*Gilbert et al. 2014*)

02 Research Situation

Research Situation

2.1 Main satellite data sources

Satellite	Sensor	Spatial Resolution	Temporal Resolution	Free or Charge	Literature Number
Landsat	MSS+TM (Landsat-5) ETM+ (Landsat-7) OLI (Landsat-8)	30 m	16 days	Free	16
Terra/Aqua	MODIS	250–1000 m	1–2 days	Free	22
HJ-1A/B	CCD1/2	30 m	2–4 days	Free	3
SPOT	HRV (SPOT1~3) VGT (SPOT-4) HRG/HRS/VGT (SPOT-5)	1 km	1 day	Charge	2
Sentinel-2	MSI	10–20 m	5 day	Free	7
Sentinel-1	SAR	5–40 m	12 days	Free	14
COSMO-SkyMed	SAR	3–15 m	16 days	Charge	1
TerraSAR-X	SAR	3–10 m	11 days	Charge	1
ENVISAT	ASAR	20–500 m	35 days	Free	2
RADARSAT-1	SAR	10–100 m	24 days	Charge	1
RADARSAT-2	SAR	3–100 m	24 days	Charge	2
ALOS-2	PALSAR-2	25 m	14 days	Charge	3

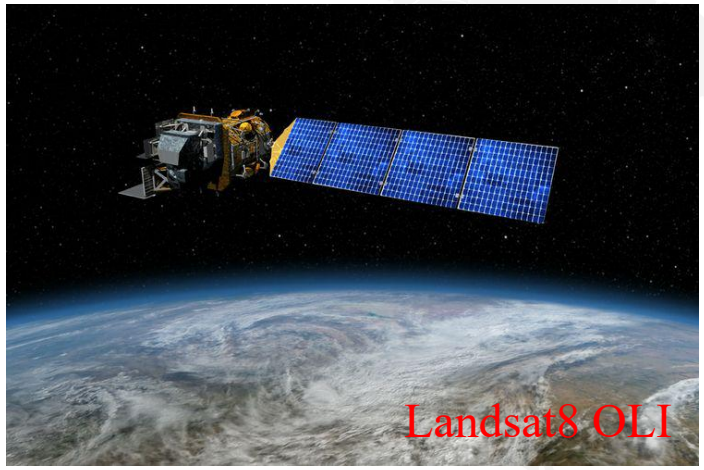
(*Zhao et al. 2020*)

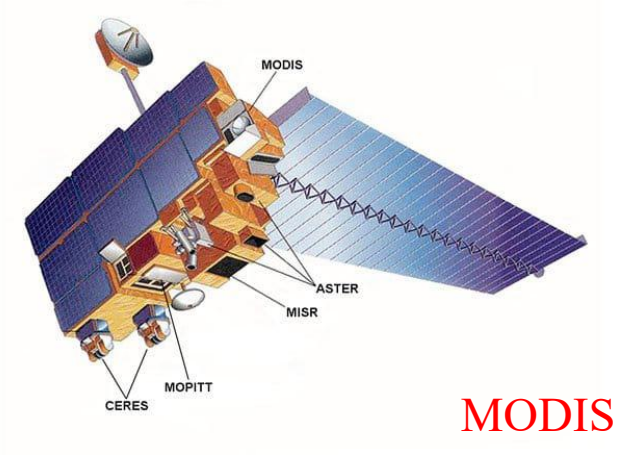
Research Situation

2.2 Integration Method Data Sources

Integrated Data Sources	Integrated Spatial Resolution	Integrated Time Resolution	Ref.
Landsat ETM+\OLI	30 m	8 days	[10]
Landsat 8 OLI MODIS	30 m	16 days	[11]
Landsat TM\ETM+\OLI	30 m	<16 days	[12]
Landsat TM\ETM+	30 m	≤16 days	[13,14]
Landsat ETM+\OLI	30 m	16 days	[15]
Sentinel-2 MODIS	10 m	16 days	[16]

(*Zhao et al. 2020*)


Landsat8 OLI



MODIS


Sentinel-2

Research Situation

2.3 Taxonomy

Optical Remote Sensing-Based Mapping Methods

01

- Machine learning
- Time series similarity method
- Vegetation index feature-based method
- Object-based image analysis

Microwave Remote Sensing-Based Mapping Methods

02

- Empirical model
- Machine learning

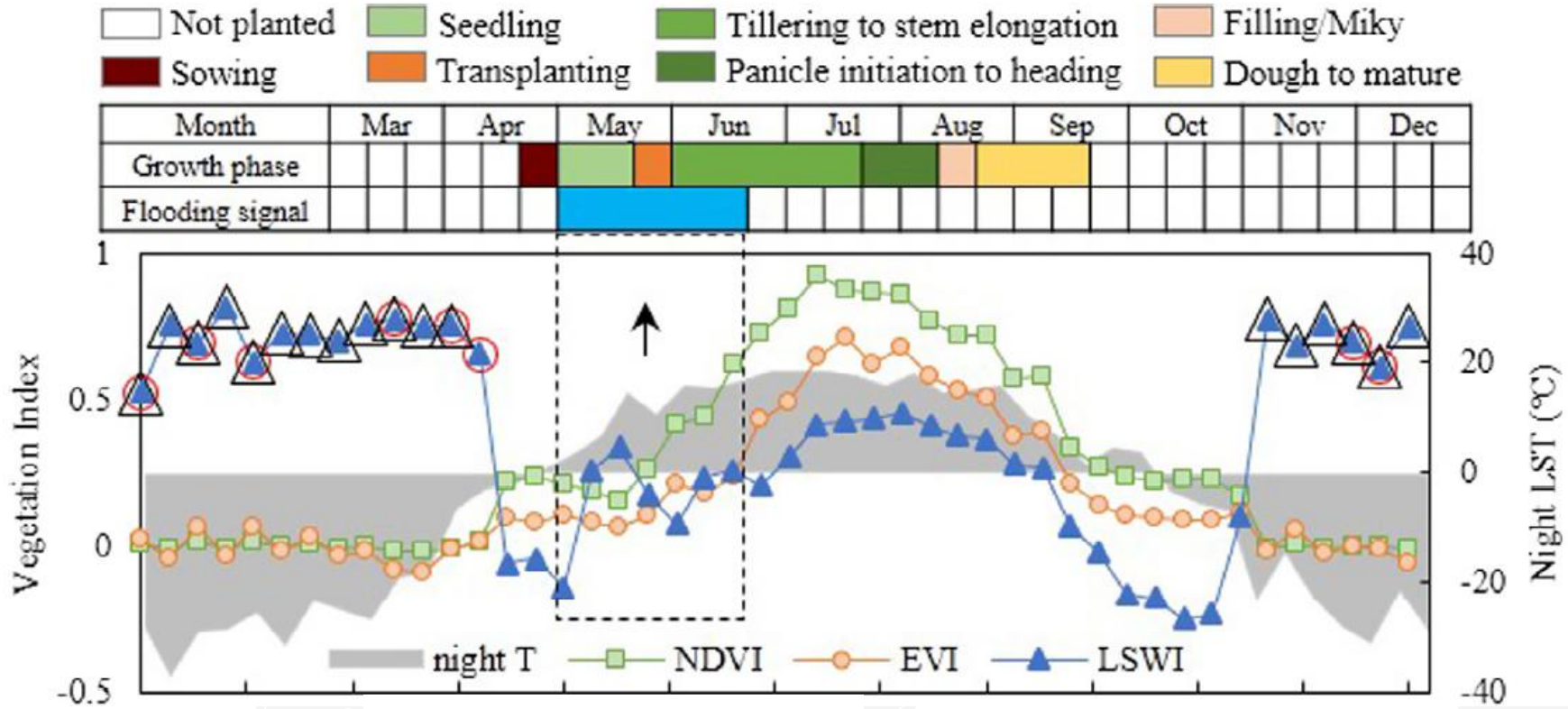
Integration of Optical and Microwave Remote Sensing-Based Mapping Methods

03

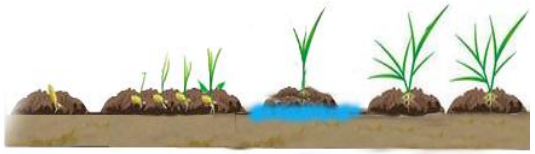
- Complementary method
- Comparison class method

Research Situation

2.3.1 Optical Remote Sensing-Based Mapping Methods



(*Dong et al. 2016*)



Research Situation

2.3.1 Optical Remote Sensing-Based Mapping Methods

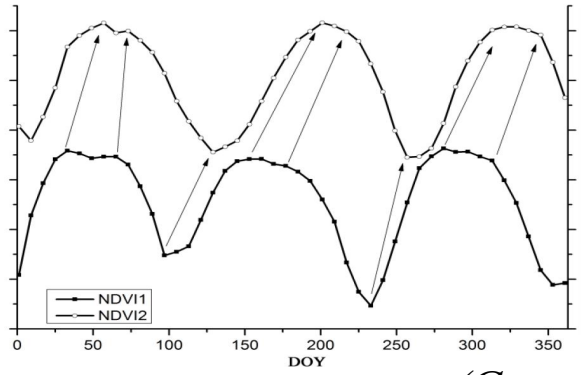
Machine learning

ISODATA、

DT、RF、

SVM、CNN

Time series similarity method

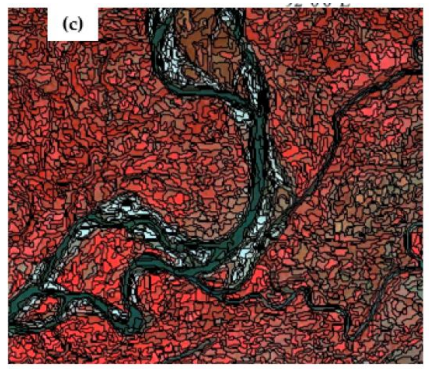


(Guan et al. 2016)

$$V_{\text{mean}} - (nS) < x < V_{\text{mean}} + (nS)$$

(Nuarsa et al. 2012)

Vegetation index feature-based method

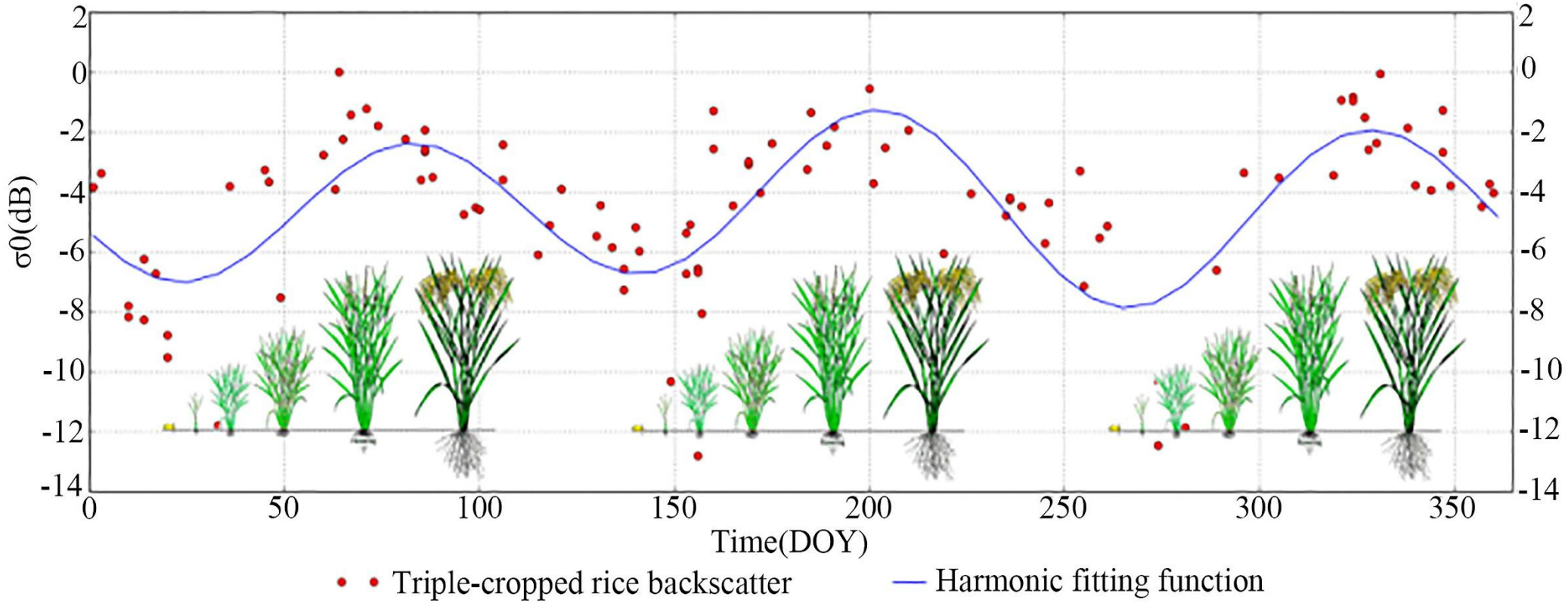


(Singha et al. 2016)

Object-based image analysis

Research Situation

2.3.2 Microwave Remote Sensing-Based Mapping Methods



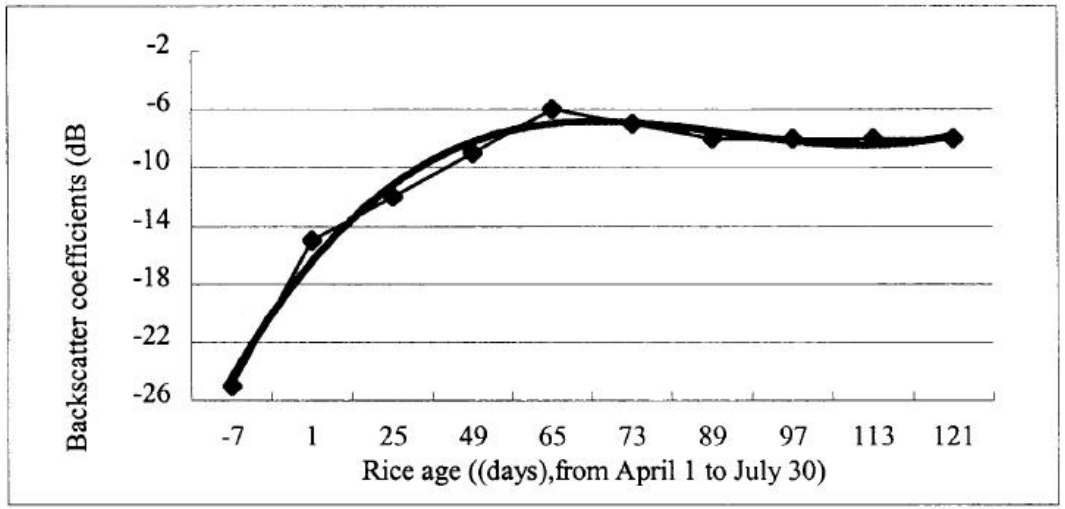
(Nguyen et al. 2015)

Research Situation

2.3.2 Microwave Remote Sensing-Based Mapping Methods

➢ **Empirical model**

The principle of this method is to establish a mathematical formula based on the change in the backscattering coefficient during the paddy rice growth cycle, determine the threshold, coefficient and other parameters, and extract and map the paddy rice according to the parameters.



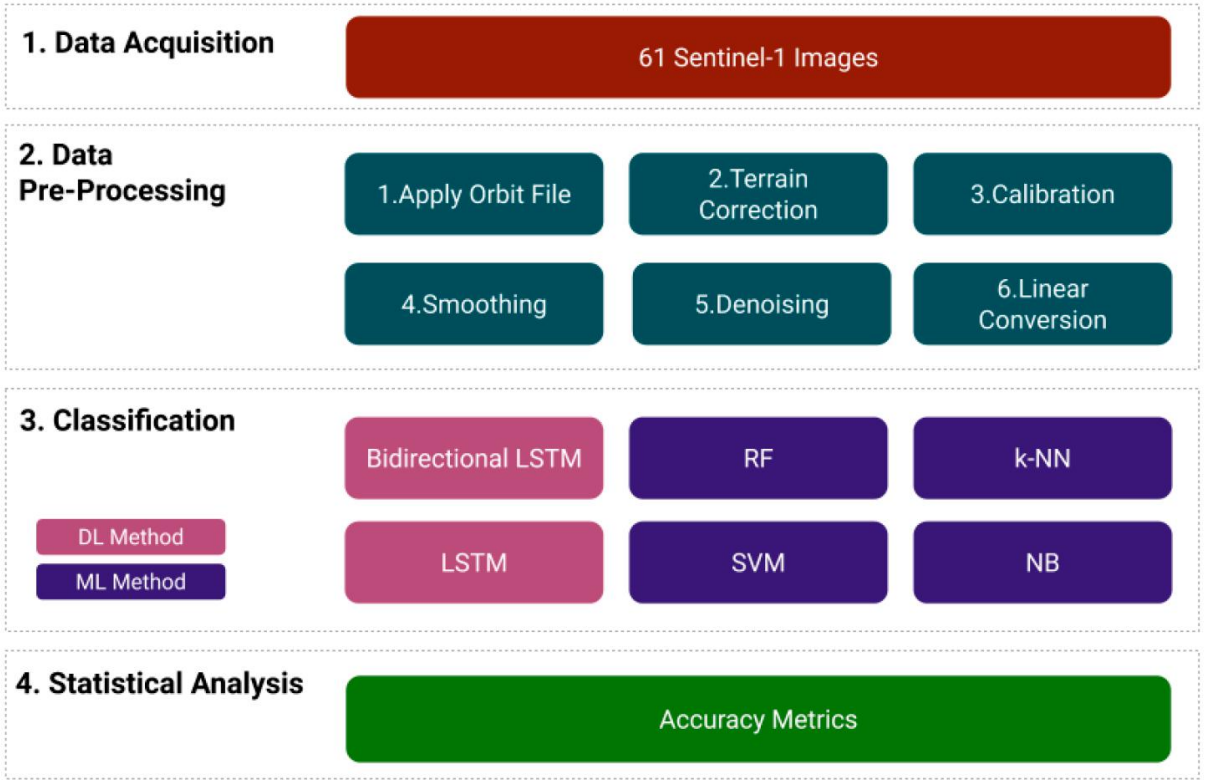
(Shao et al. 2011)

Research Situation

2.3.2 Microwave Remote Sensing-Based Mapping Methods

➢ **Machine learning**

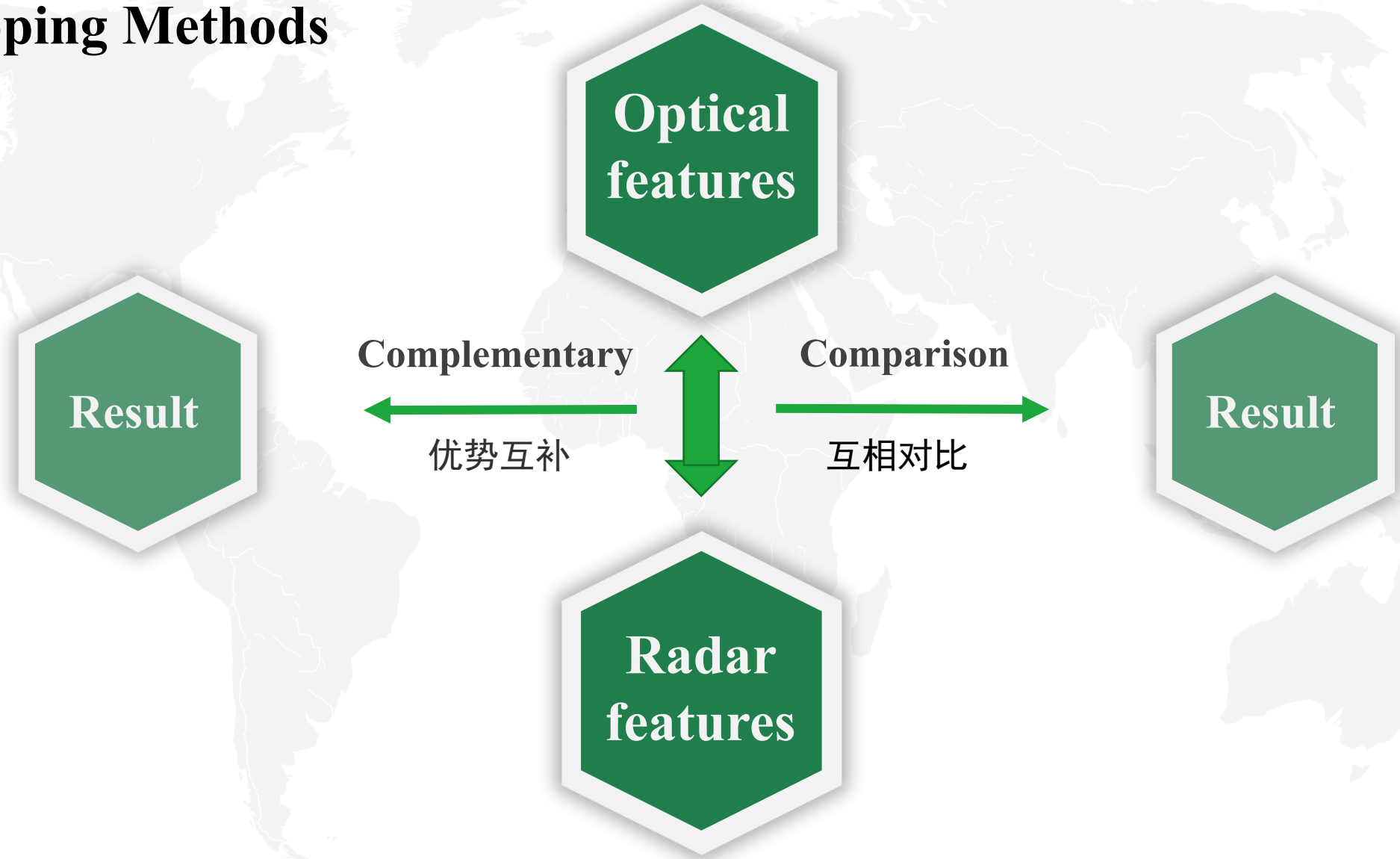
Classification models mainly include traditional machine learning models (DT, SVM, RF) and deep learning models such as CNN and recurrent neural network (RNN).



(Hugo et al. 2020)

Research Situation

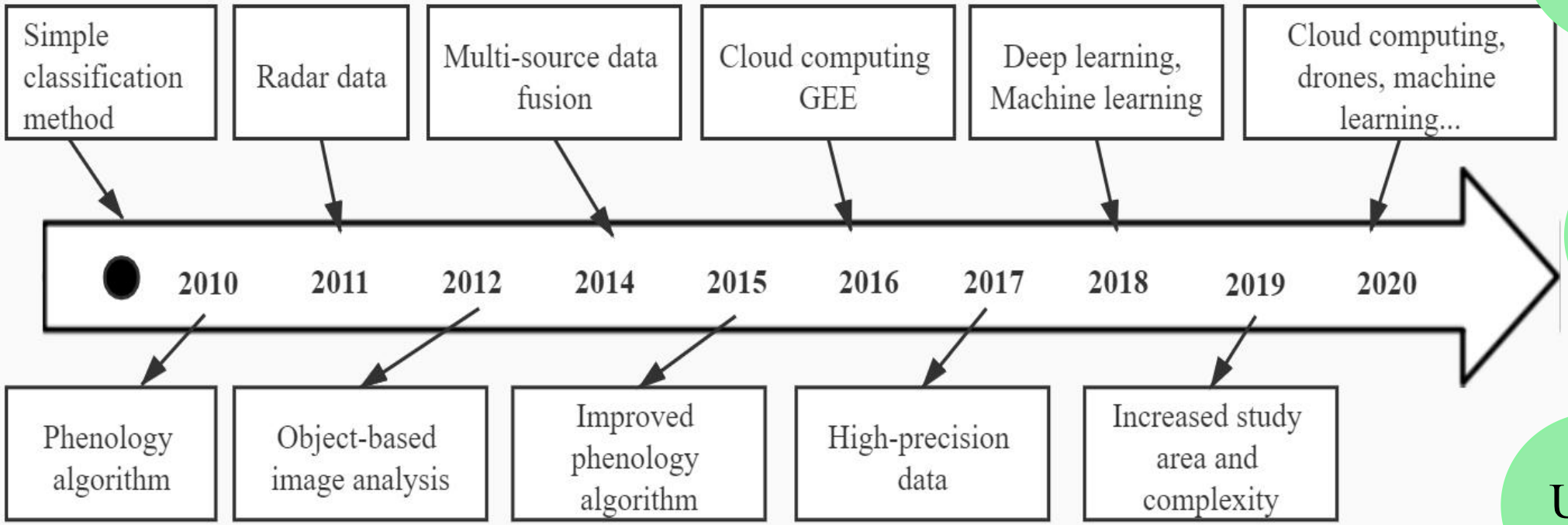
2.3.3 Integration of Optical and Microwave Remote Sensing-Based Mapping Methods



03 Discussion & Conclusion

Discussion & Conclusion

3.1 Method Evolution Trend



Cubsat

GF

HLS

Deep learning

UAV

(*Zhao et al. 2020*)

Discussion & Conclusion

3.2 Research Challenges

Cloud cover

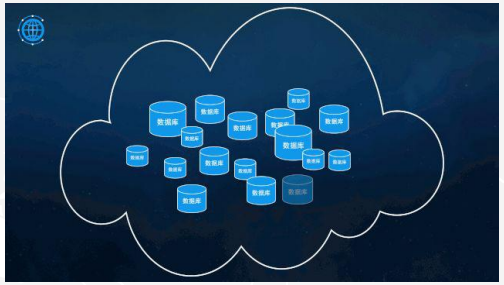
Data verification

Versatility of the method

Discussion & Conclusion

3.3 Conclusion

- **Integrated system**



- **Different planting systems**

- **Global change and the ecological environment**

Thanks for your listening!

Reporter: Rongkun Zhao

Organization：Southwest University

Date:2021/7/31