2025 DRAGON 6 SYMPOSIUM

14-18 JULY 2025

[PROJECT ID. 95531]

[RESILIENT WETLANDS AND HUMAN-WATER RELATIONSHIP IN WATERSHEDS]







JUL. 1ST, 2024-JUN. 30TH, 2028

ID. 95531

PROJECT TITLE: RESILIENT WETLANDS AND HUMAN-WATER RELATIONSHIP IN WATERSHEDS

PRINCIPAL INVESTIGATORS: HUI LIN， SABINE SAUVAGE/HAOSHENG HUANG

CO-AUTHORS:HUI LIN，SABINE SAUVAGE，XIAOLING CHEN，DANLING TANG，HONGMEI ZHAO，JIANZHONG LU，YAN SONG，ZHIGANG DENG，LI ZHANG，GUIHUA LIU，XIN XIAO，LIQIONG CHEN

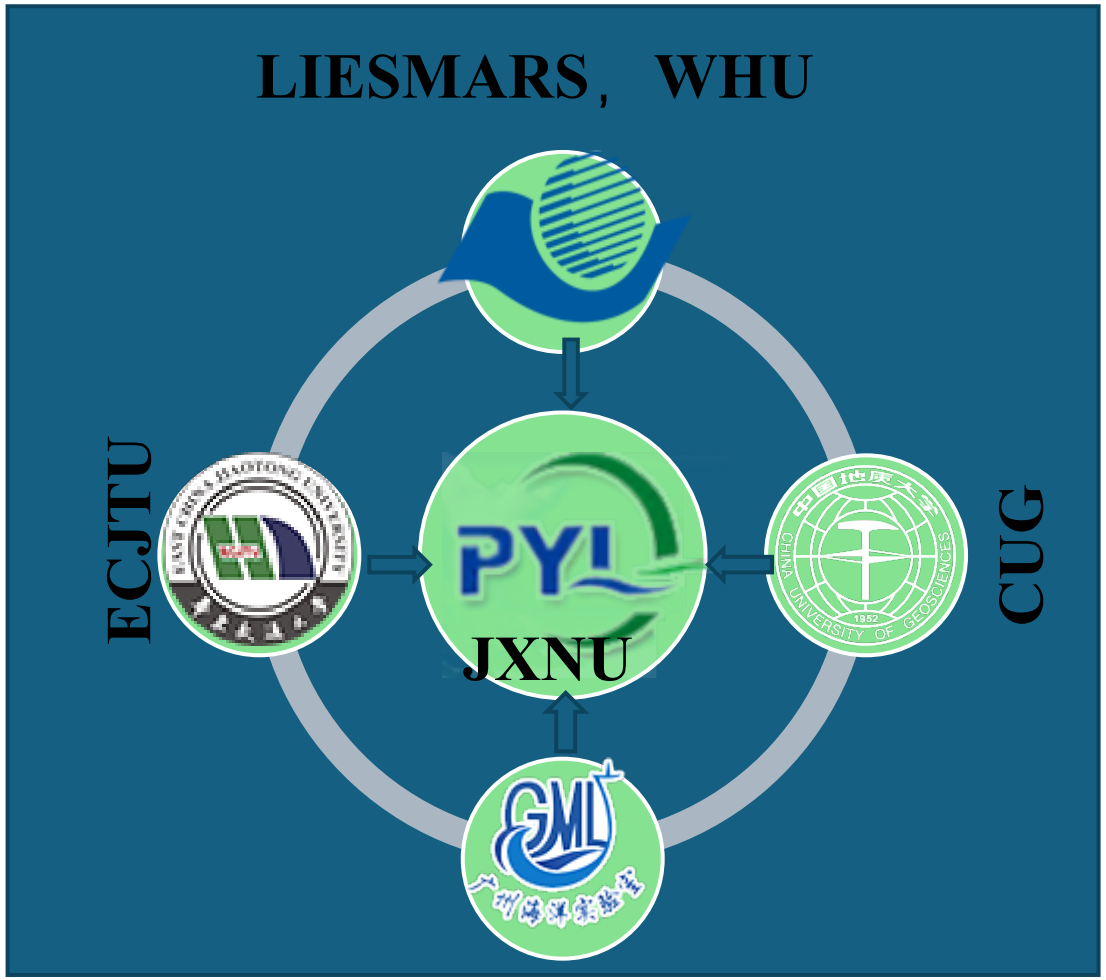
PRESENTED BY: HUI LIN

Outline

1. Partners and team members
2. Study area
3. Project Objectives
4. Data Request
5. In-Situ data measurement and requirements
6. Field data collection campaigns and periods
7. Project‘s schedule and planning
8. Overview of young scientist achievements
9. Future work

1 Partners and team members

Partners



CRBE
CENTRE DE RECHERCHE SUR LA BIODIVERSITE ET L'ENVIRONNEMENT
cnrs

French National Centre for Scientific Research –CNRS, Functional Ecology and Environment Laboratory, University Paul Sabatier - Toulouse III

~Jul. 2025

UNIVERSITEIT GENT

AI FOR GEO FOR AI

Jul. 2025~2028

1 Partners and team members ~Jul. 2025

Team members



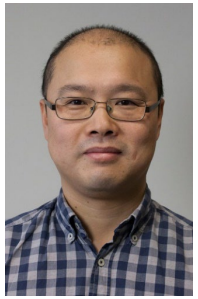


Hui Lin	Sabine Sauvage
Hongmei Zhao， Li Zhang， Guihua Liu	José Miguel Sanchez Perez
Jianzhong Lu， Liqiong Chen, Xiaoling Chen	Anthony Lecerf
Danling Tang	Jean-Luc Probst
Zhigang Deng	Anne Probst
Yan Song	

1. Partners and team members Jul. 2025~

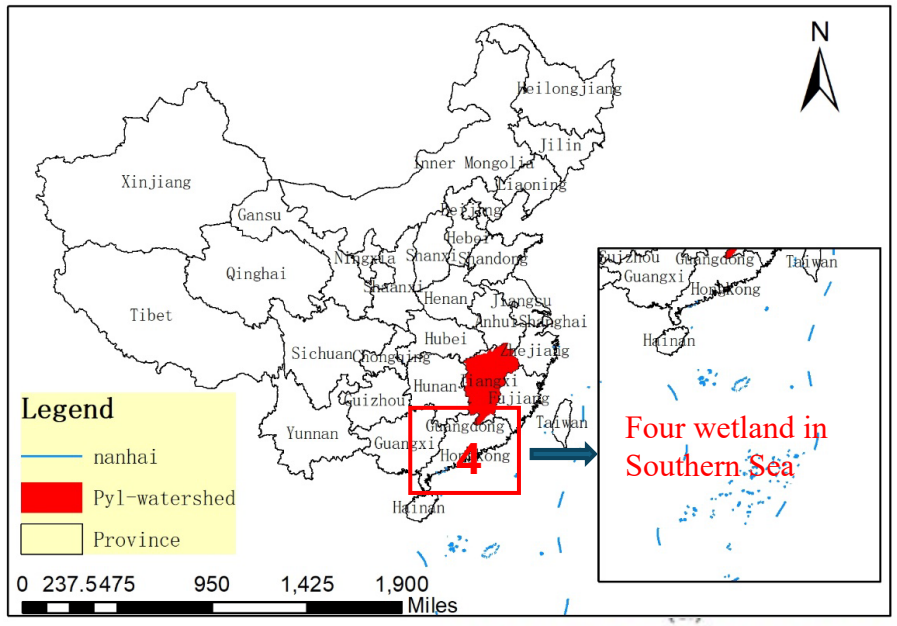
Team members

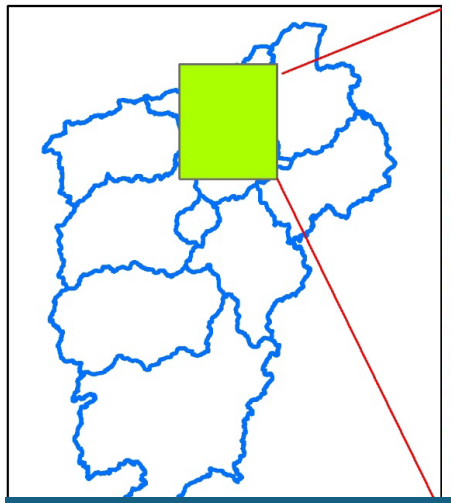


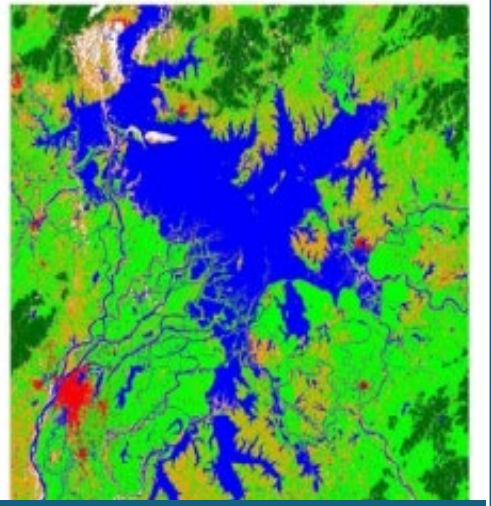


Hui Lin	Haosheng Huang
Hongmei Zhao， Li Zhang， Guihua Liu	Tim Van de Voorde
Jianzhong Lu， Liqiong Chen, Xiaoling Chen	Xiaobing Wei
Danling Tang	
Zhigang Deng	
Yan Song	

2. Study area I



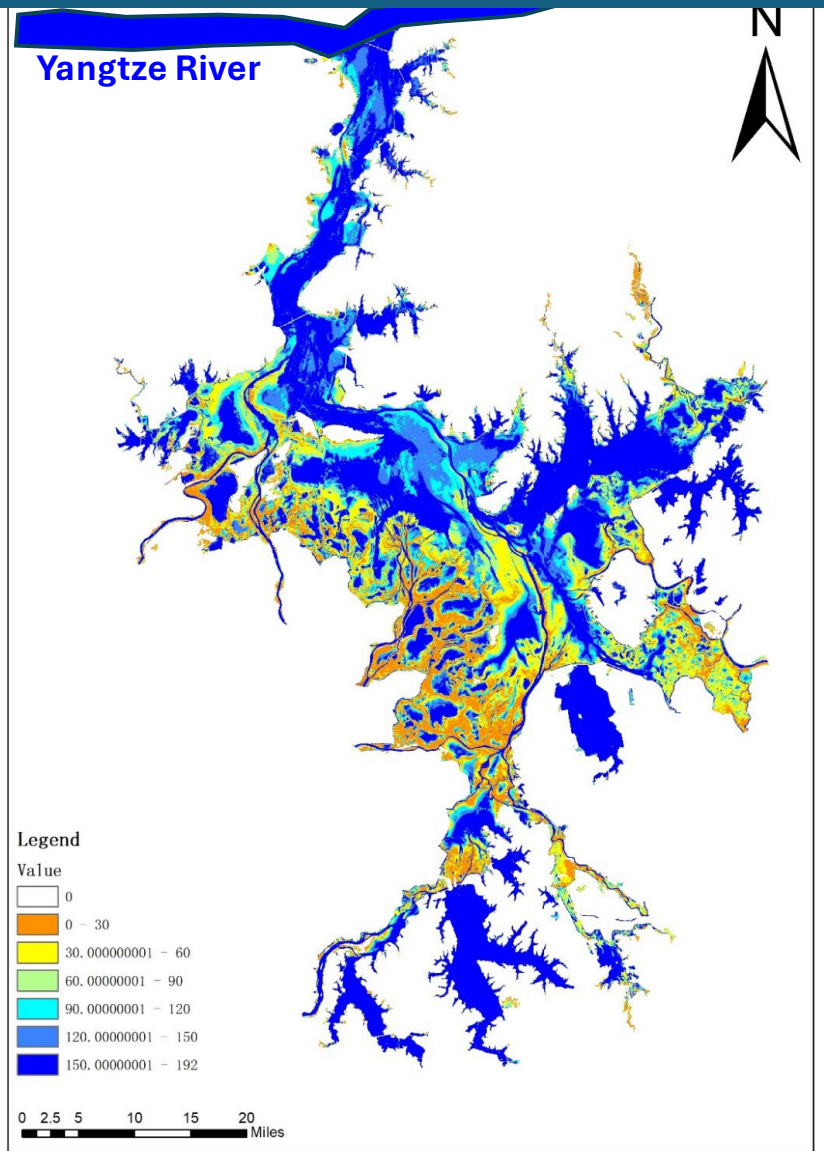




Major agricultural regions around lake

approximately 94% of Jiangxi Province, P.R. China

Key elements of Yangtze river eco-systems

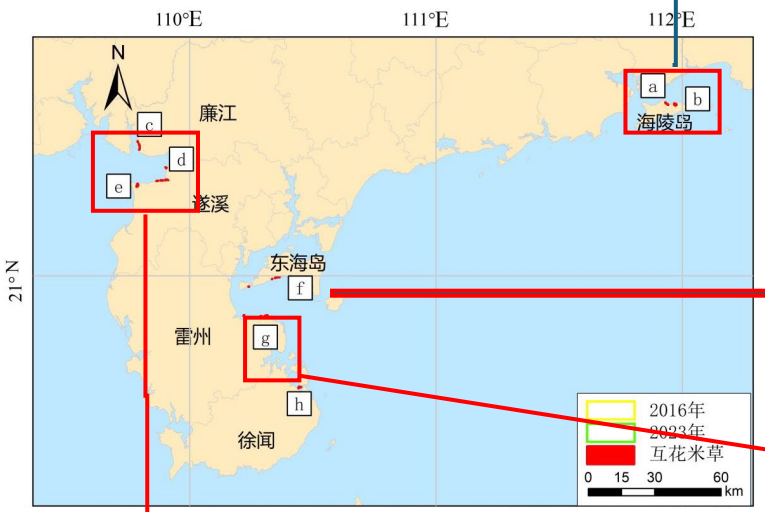


High water area variance of Poyang Lake

Flooding period: July to August ;
Normal period: April to June, September to October;
Drought period: October to April next year

Over one million migratory birds from Siberia habitat in Poyang Lake wetland

2 Study area II: Coastal Wetland of South China Sea



East China Sea Island （Oct. 2022）



Yangjiang Hailing Island （Feb. 2024）



North of Suixi （Jul. 2023）



East Coast of Leizhou (Oct. 2022)

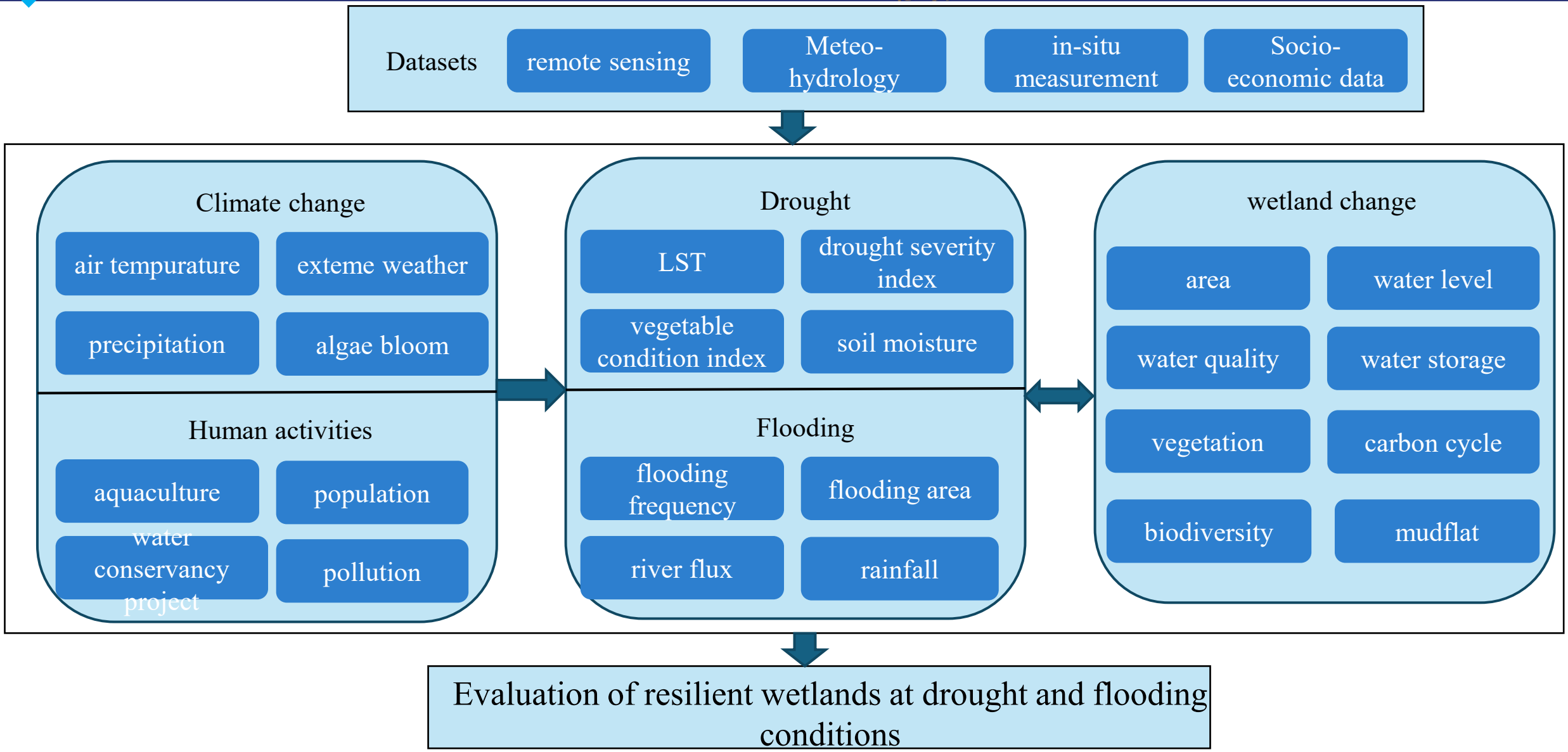


3.Project objectives

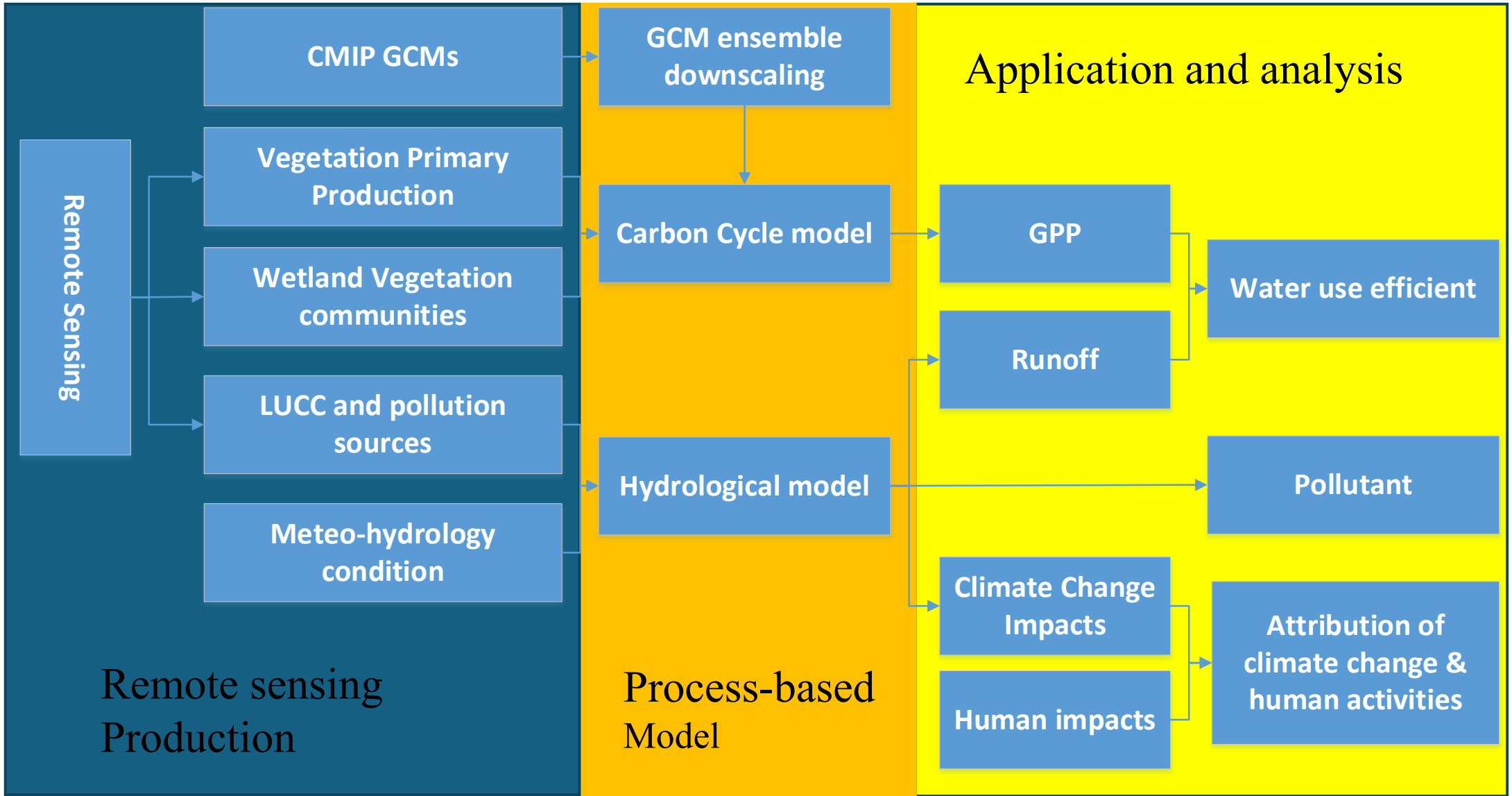


Objectives	Technicals
Resilient wetlands and Human-Water relationship	
Evaluation of resilient wetlands at drought and flooding conditions	3.1
Watershed runoff and non-point pollution modeling under impacts of human activities and climate change	3.2
Virtual and real collaborative geographic experiments for the human-water relationship	3.3

3.1 Evaluation of resilient wetlands at drought and flooding conditions



Watershed runoff and non-point pollution modeling under impacts of human activities and climate change

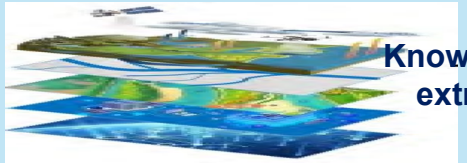


3.3 Construction of virtual and real collaborative geographical experimental environment

Data - Model – Knowledge of human-water relationship



Data Fusion



Knowledge extract

Role modeling and simulation



Permission | Role | Perception | Mind | Action | Expression

Scenery modeling and simulation

Geographic scenery management	Scenery element management	Scenery visualization
Scenery cooperative interaction	Scenery knowledge management	Scenery feedback

Situational modeling and simulation

Situational simulation management	Situational element management	Situational visualization
Situational cooperative interaction	Situational process management	Situational feedback

Evaluation of human-water relationship

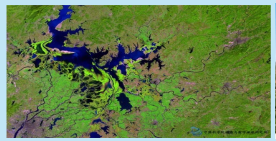
Virtual watershed System

Data extraction

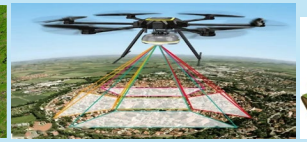
Control command

Consulting report

Synthetic perception network



Remote sensing



Drone



sensor network



Context-aware



Direct feedback control



Policy indirect feedback control

Feedback Control Network

Virtual and real interactive channel

Data receiving

Data subscription

Control command

Policy regulation



Reality watershed System

4. Data Request

Data access (list all missions and issues if any). NB. in the tables please insert cumulative figures 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 /Copernicus Missions	No. Scenes
1. S-1 Interferometric Wide Swath (IW)	20
2. S-2 MSI Level 1b	20
3. SENTINEL-3 Altimetry	60
4. SENTINEL-3 SLTSR	40
5. SENTINEL-4 (aerosol,optical,depth)	80
6. SENTINEL-5 UVNS Level-1 product	40
Total:	260

Issues:
We will use other data if Dragon 6 project cannot provide above data

ESA Third Party Missions	No. Scenes
1.Worldview_Geoeye_Quickbird_HighResOptical	20
2. RapidEye	20
3. SPOT6_7	60
4.	
5.	
6.	
Total:	100

Issues:
This project does not rely on above data completely. In other word， This project would be implemented, even if the Dragon 6 cannot provide the above data.

Chinese EO data	No. Scenes
1. FY-3A/B Visible and Infrared Radiometer (VIRR)	50
2. GF1/GF-6 WFV (Wild field Camera)	3000
3. HY-2B/C/D ALT - Radar AltimeterOperational	100
4. HJ-2F SAR S-BAND	
5.GF-5 VIMS	
6. SDGSAT-1 TIR Thermal IR Spectrometer	30
Total:	3190

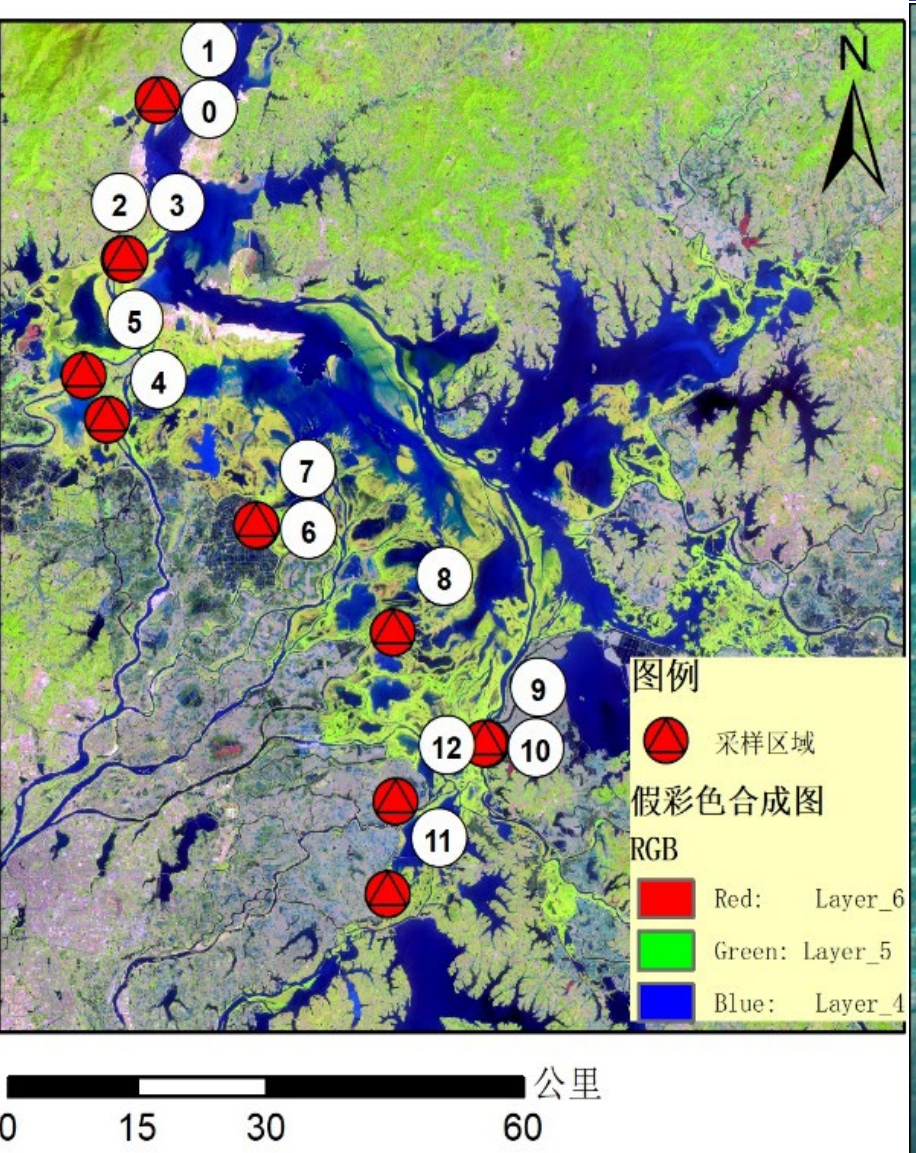
Issues:

5. In-situ data measurements and requirements

Parameters		Weather condition	Time	Annual Frequency
Vegetation	Biomass	All weather	All time	16
	Biodiversity	All weather	All time	16
	Spectrum	Sunny	9:00AM~15:30PM	4
Water	Water sample	All weather	All time	8
	Spectrum	Sunny	9:00AM~15:30PM	6
	Hydrology (11)	All weather	All time	continuously
Meteological data (17)		All weather	All time	continuously
Migratory birds (98)		All weather	All time	continuously
Land use cover type, LUCT		All weather	All time	2

In-situ data measurement would be carried out from Jan. 1, 2025 to December 30, 2026

5. In-situ data measurements and requirements







6. Field data collection campaigns and periods

Data type		Campaigns	Period		Study area	Frequency
			Month/hydrology	Year		
In-situ measurement	Vegetation	Joint	Normal Drought	2025~2026	PYL wetland	4
	Water	Joint	Flooding Normal Drought	2025~2026	PYL	6
	LUCC	Joint	Jan.-Dec.	2025~2026	PYL watershed	2
Meteoro-hydrological data		--	Jan.-Dec.	1990~2026	PYL watershed	--
Remote sensing		--	Jan.-Dec.	1990~2026		
Socio-economic data		--	Jan.-Dec.	1990~2026		

7. Project's schedule and planning

Project's schedule

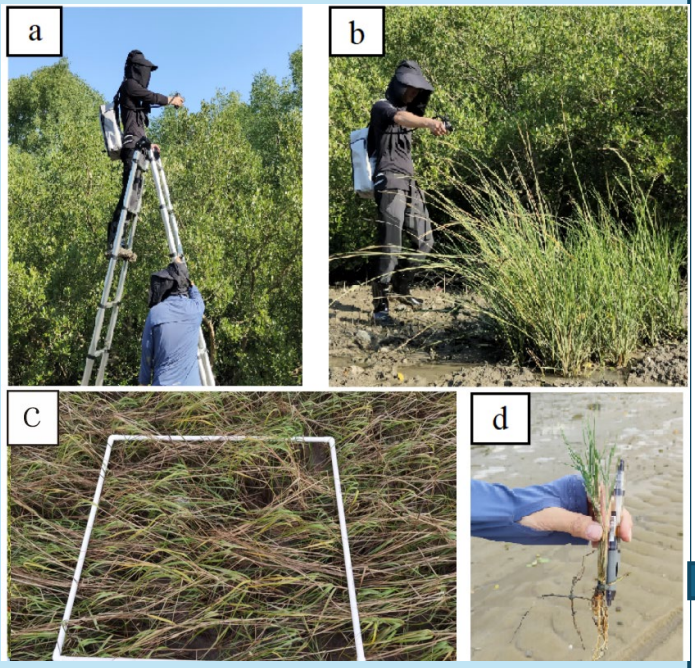
Schedule / Assignment	Jul. 1, 2024 ~Dec. 30, 2024	Jan. 1, 2025 ~ Jun. 30, 2025	Jul. 1, 2025 ~ Dec. 30, 2025	Jan. 1, 2026 ~ Jun. 30, 2026	Jul. 1 , 2026 ~ Dec. 30 , 2026	Jan. 1, 2027 ~ Jun. 30, 2027	Jul. 1, 2027 ~ Dec. 30, 2027	Jan. 1, 2028~ Jun. 30, 2028
Preparation & investigation								
Data collection & inversion								
Development								
Analysis								
Summarize & integration								
Validation								
Conclusion								

8. Overview of Young Scientist

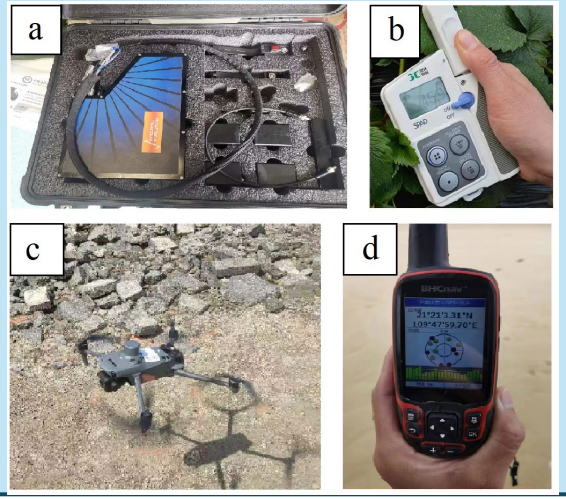
Name	Institution	Title	Source	Contribution
Xiaobing Wei	Ghent University			
Wenxian Zha	Jiangxi Normal University	A Hyperspectral Vegetation Feature Band Selection Based on Quantum Genetic Spectral Angle Mapper Algorithm (In Chinese)	Spectroscopy and Spectral Analysis	In-situ measurement
Yu Liang	Jiangxi Normal University	C-band synthetic aperture radar time-series for mapping of wetland plant communities in China's largest freshwater lake	J.Appl. Remote Sens.	Wetland Classification
Qiujie Chen	Southern Marine Science and Engineering Guangdong Laboratory	Comparing supervised classification algorithm–feature combinations for Spartina alterniflora extraction: a case study in Zhanjiang, China	Frontiers in Remote sensing	
Siyu Zheng	Jiangxi Normal University	Analysis of Water-Sand Changes and Influencing Factors in the Ganjiang River Basin from 1958-2019	Polish Journal of Environmental Studies	Human-water relationship
Yuqiong Fu	Jiangxi Normal University	Study of the Mechanisms Driving Land Use/Land Cover Change and Water Yield in the Ganjiang River Basin Based on the InVEST-PLUS Model	Agriculture-Basel	
Wenxian Zha	Jiangxi Normal University	Spatial downscaling method applicability for NPP-VIIRS-NTL of urban lakes, Yangtze River Basin (In Chinese)	National remote sensing bulletin	
Xin Xiao	Jiangxi Normal University	A preliminary study of semantic virtual geographic environment in the context of wetland monitoring (In Chinese)	National remote sensing bulletin	Virtual-visual experiment
Hao Chen	Jiangxi Normal University	Digital Twin-based Virtual Modeling of the Poyang Lake Wetland Landscapes	Environmental Modelling & Software	

Wetland Fine Classification Based on RS

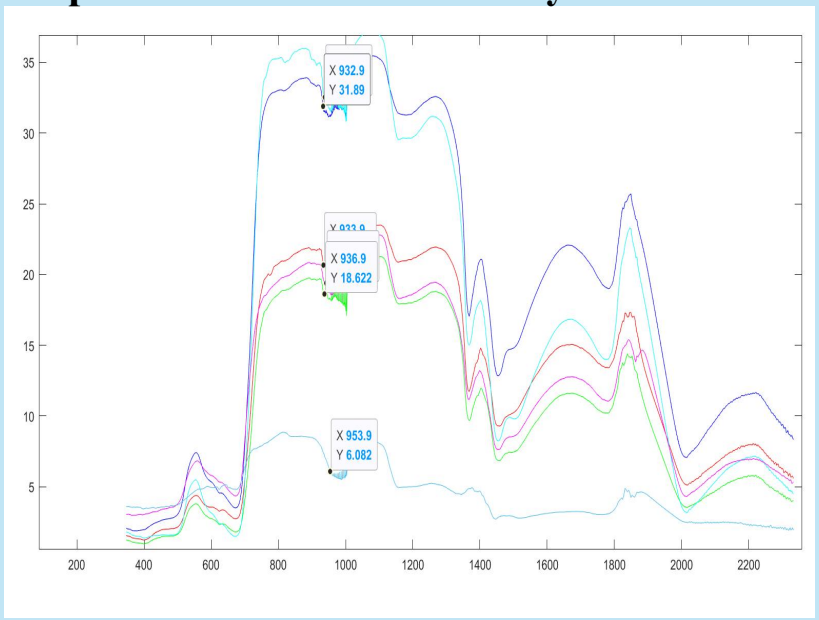
Spectrum measure and sampling

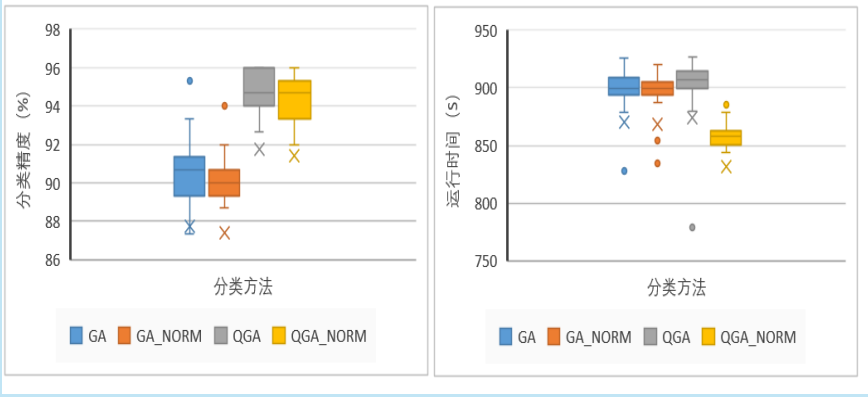


Instrument



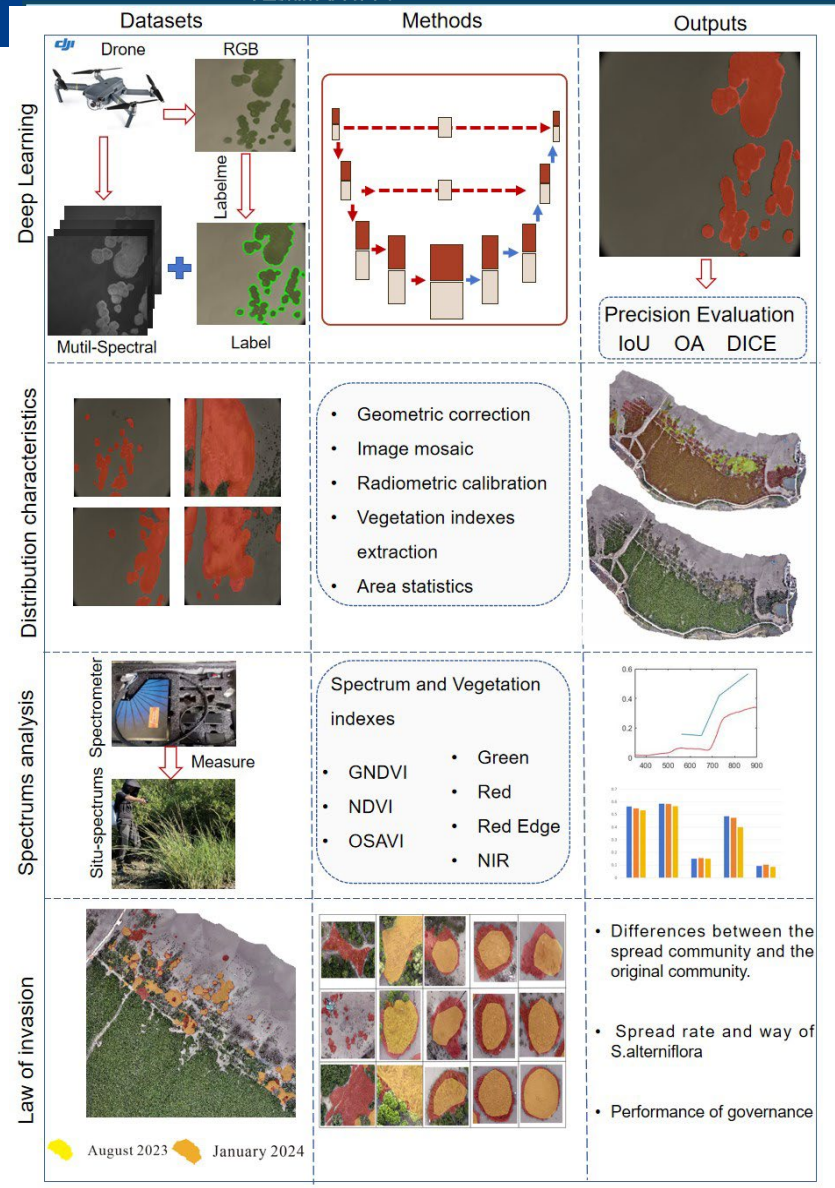
Spectral characteristic analysis





Comparison of the performance boxes for genetic spectral Angle classification based on raw spectra (QGA and GA) and normalized spectra (QGA_NORM and GA_NORM): (a) Classification accuracy; (b) Operating time

QGA-KNN-SAM

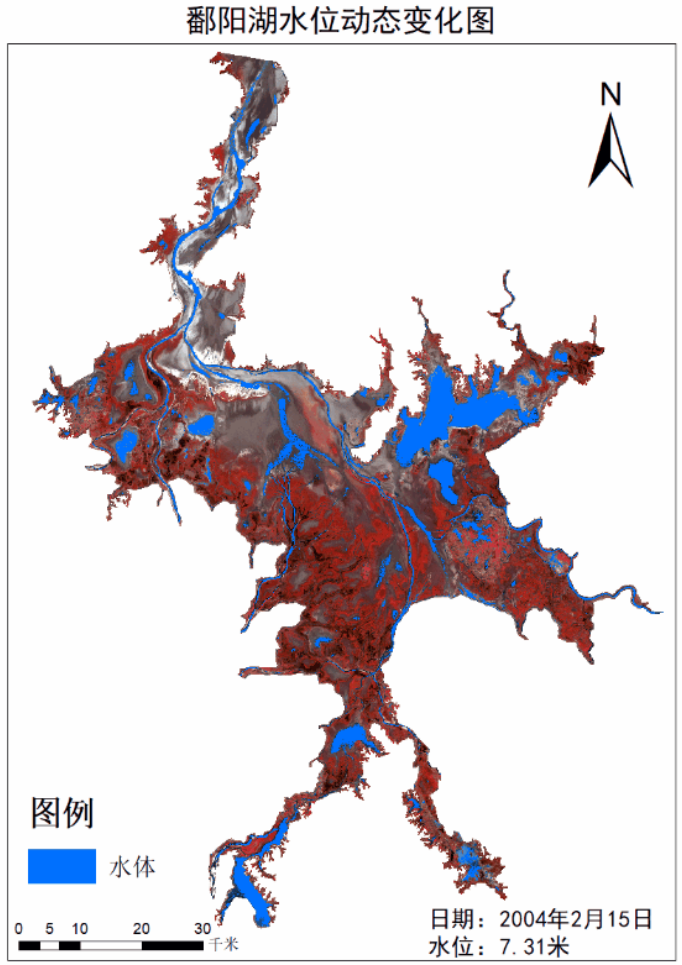


multi-channel attention mechanism-based UNet

Wetland Fine Classification Based on RS

- Hyperspectral vegetation feature band selection based on quantum genetic spectral angle mapper algorithm
  - Hyperspectral reflectance data of 10 plant species, collected by SVC spectrometer (SVC HR1024)
  - Quantum Genetic Algorithm (QGA), combined with Spectral Angle Mapper based k-Nearest Neighbors classifier (KNN-SAM) and proposed a new feature band selection algorithm, i.e., QGA-KNN-SAM, to select feature wavelength.
  - QGA-KNN-SAM generates the average classification accuracy value of 95%, which are obviously higher than achieved by GA-KNN-SAM (90%).
- Supervised classification algorithm–feature combinations for Spartina alterniflora extraction
  - Constructing a multi-channel attention mechanism-based UNet to explore Spatina alterniflora (SA);
  - SA exhibits different phenological periods in low-latitude regions of China;
  - Sexual reproduction through root systems is the main mode of diffusion after August.

Wetland Fine Classification Based on RS



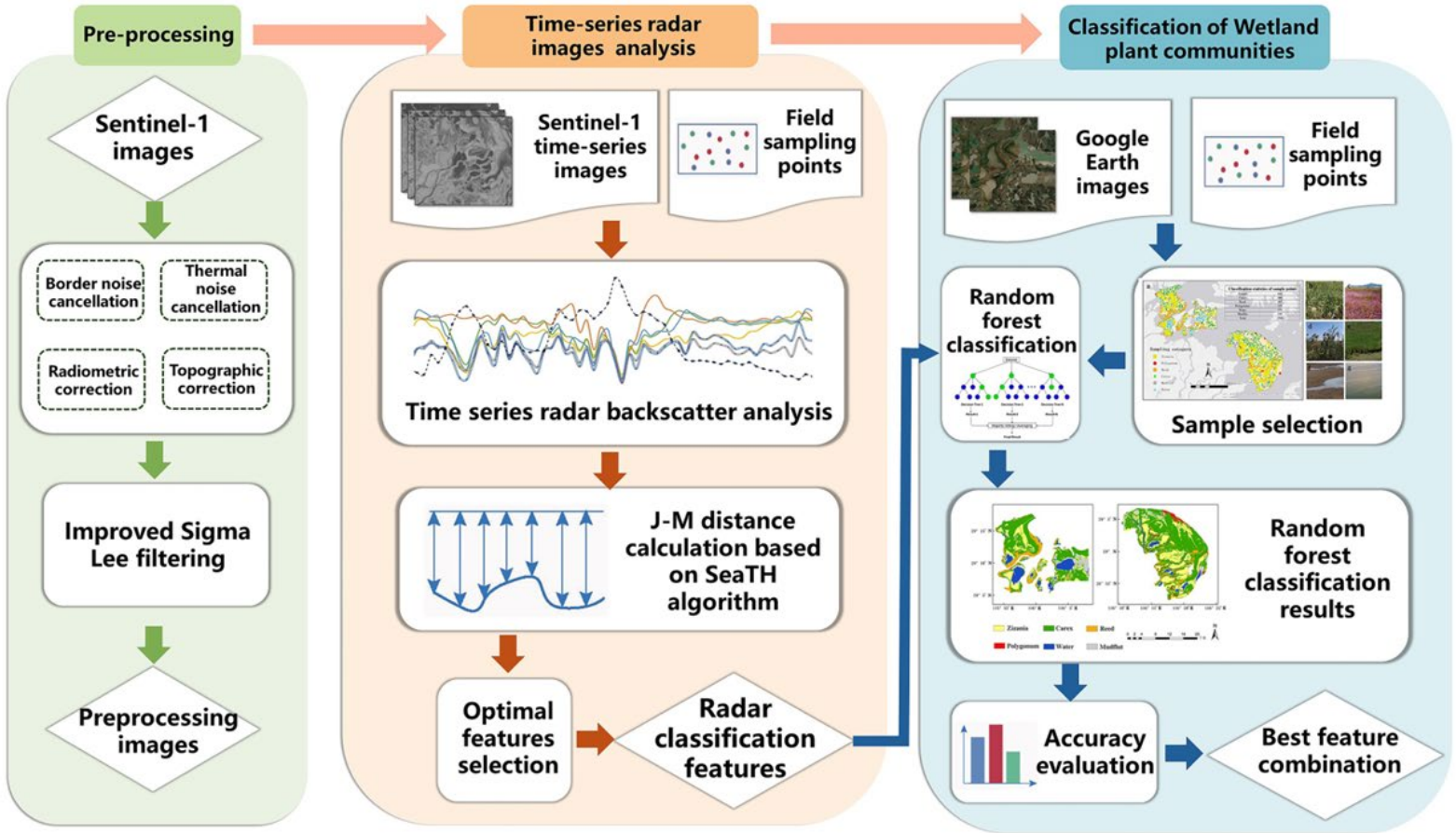
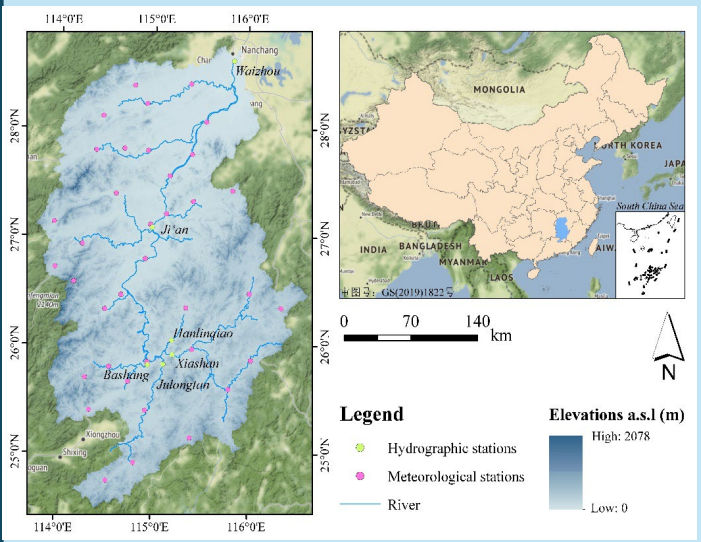


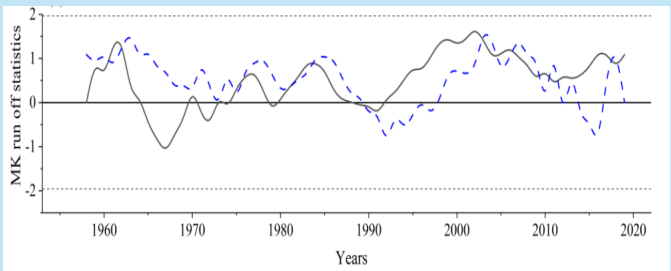
Fig. 3 Technical scheme.

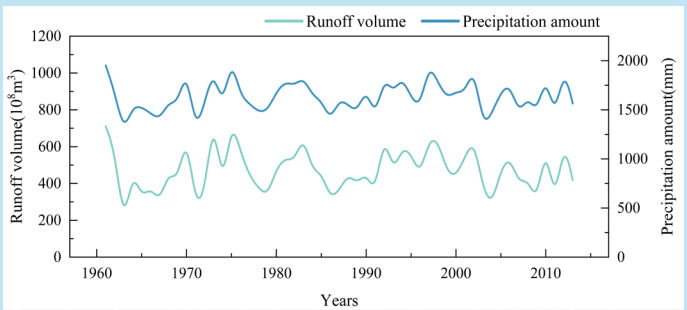
Wetland plant mapping methods for high hydro-dynamic wetlands based on C-band SAR time-series data

Water yield in the Ganjiang River Basin and its driving mechanism

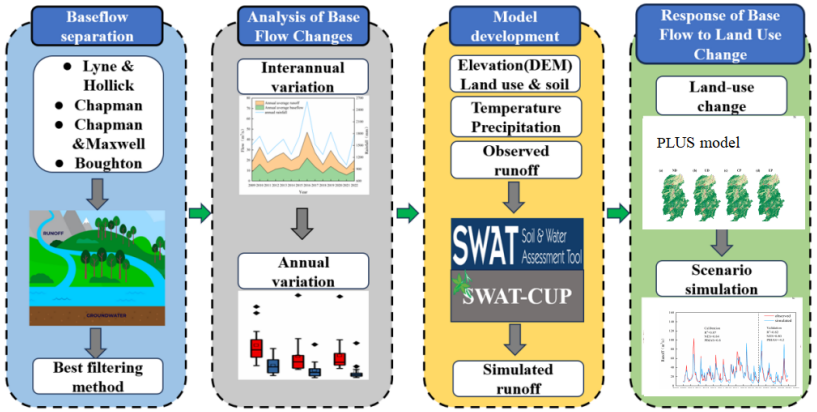
The study area and analysis of hydro-meteorological elements

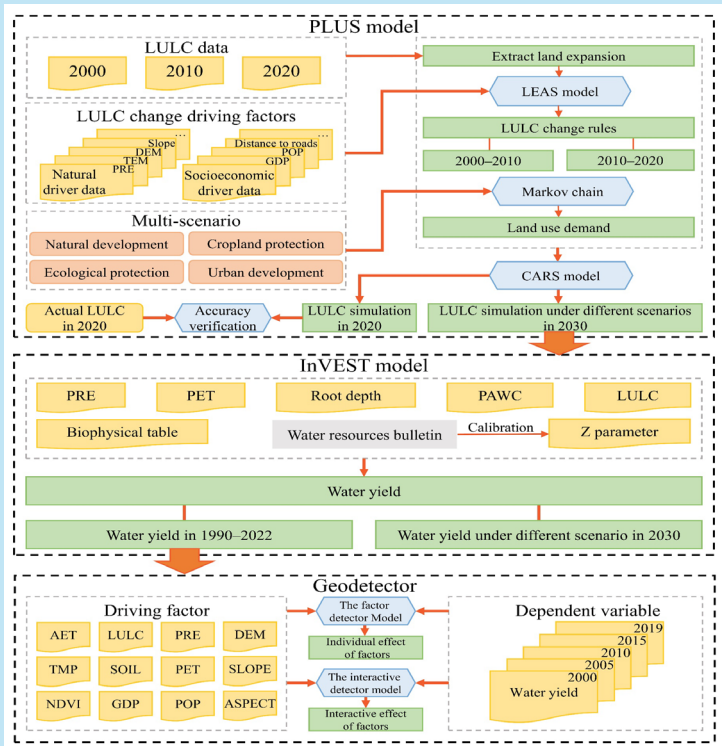




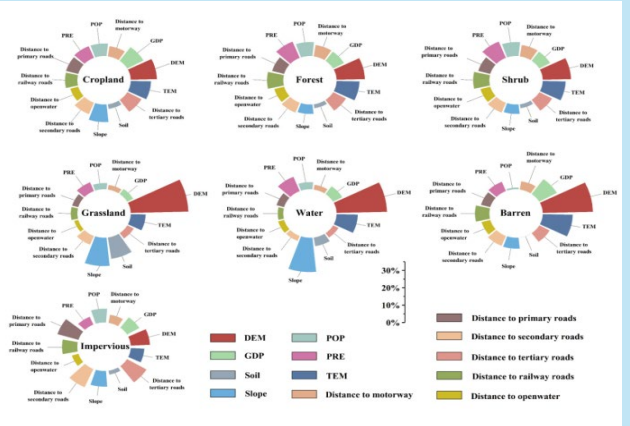


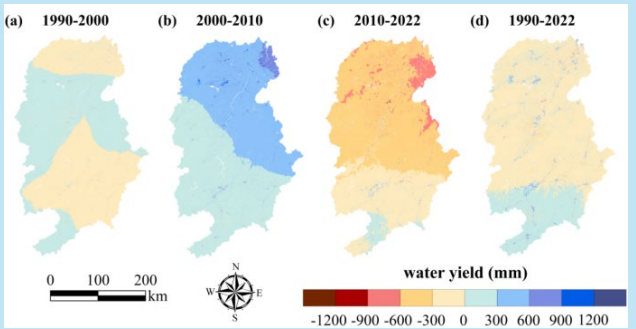
The framework of methodology

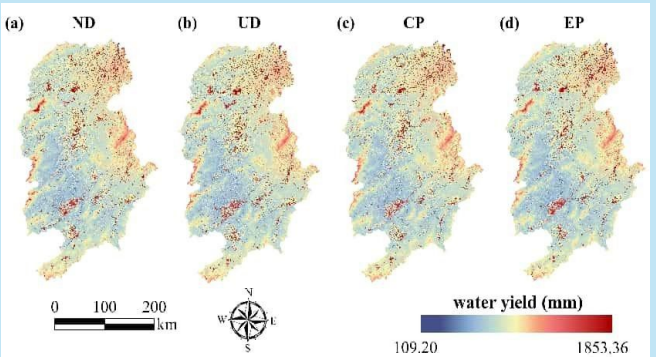




Results







Water yield in the Ganjiang River Basin and its driving mechanism

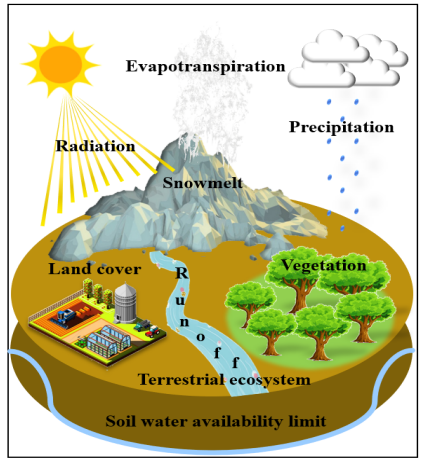
- LULC changes and their driving mechanisms in the Ganjiang River Basin from 1990 to 2022
  - From 2010 to 2020, the topography (as revealed by the DEM) emerged as the dominant factor influencing all six LULC types;
  - The distance to tertiary roads stands out as the principal driver for the expansion of impervious surfaces, accounting for 34.75% of the changes observed.
- Water yield in the Ganjiang River Basin from 1990 to 2022
  - Over the 33-year period, the water yield in the GRB initially increased, followed by a decline, stabilizing at approximately 6.50×1010 m^3 from 2017 to 2022.
  - AET, LULC, and PRE were the primary factors affecting water yield.

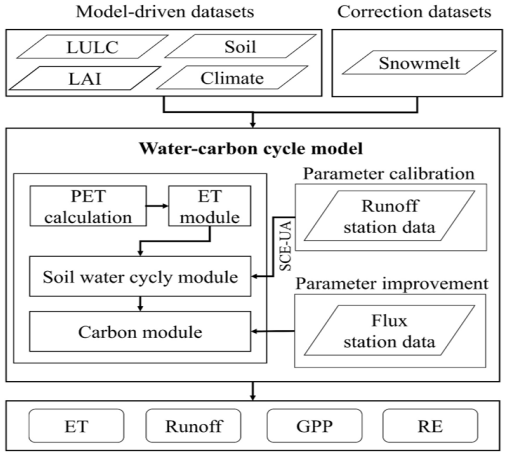
Human-water relationship in terrestrial ecosystems: Carbon and water cycle fluxes

Model **Carbon - Water Cycle Coupled Models was developed and applied in the Yangtze River Basin(YRB)**

Input

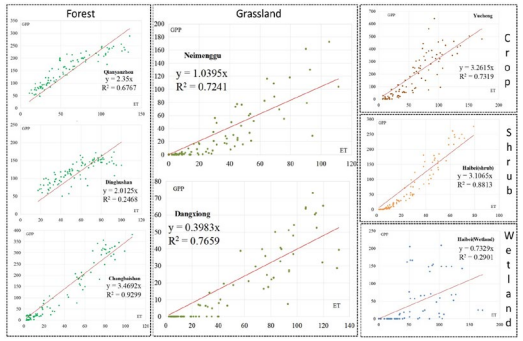
1. Climate:(precipitation, temperature)
2. Vegetation——leaf area index LAI)
3. Soil:(texture, thickness, CN value)
4. Land cover datasets
5. Coupling parameter





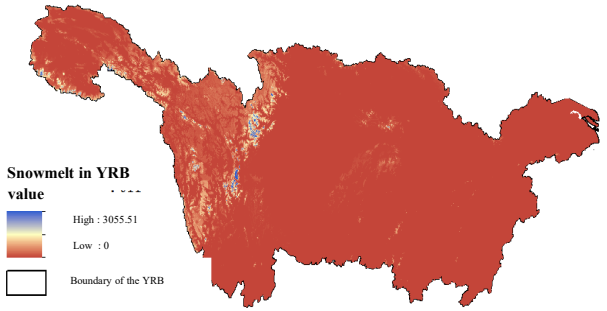
Model

Local Flux Site Data Driver



Copling Parameter Correction

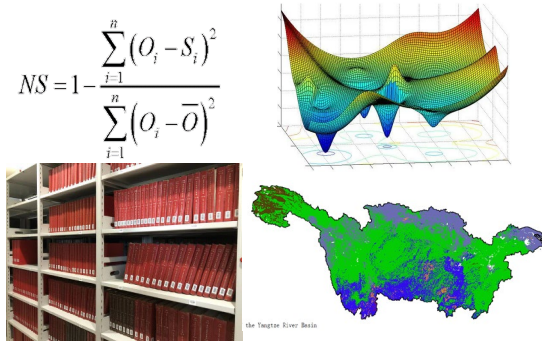
Snowmelt Water Sub-Input



Water Balance Correction

Soil water availability

$$NS = 1 - \frac{\sum_{i=1}^{n}(O_i - S_i)^2}{\sum_{i=1}^{n}(O_i - \bar{O})^2}$$



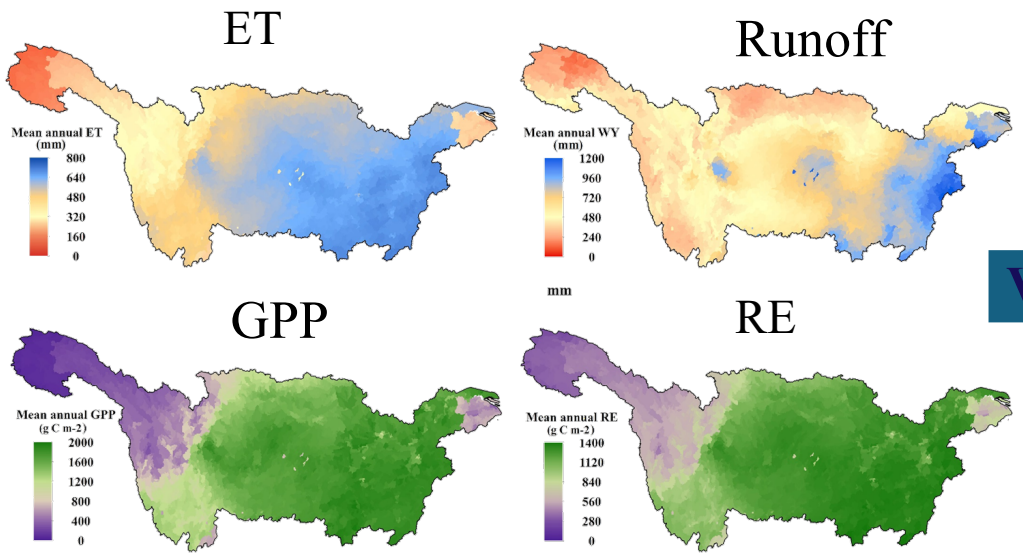
Soil parameter calibration

Human-water relationship: Carbon and water cycle fluxes in terrestrial ecosystems

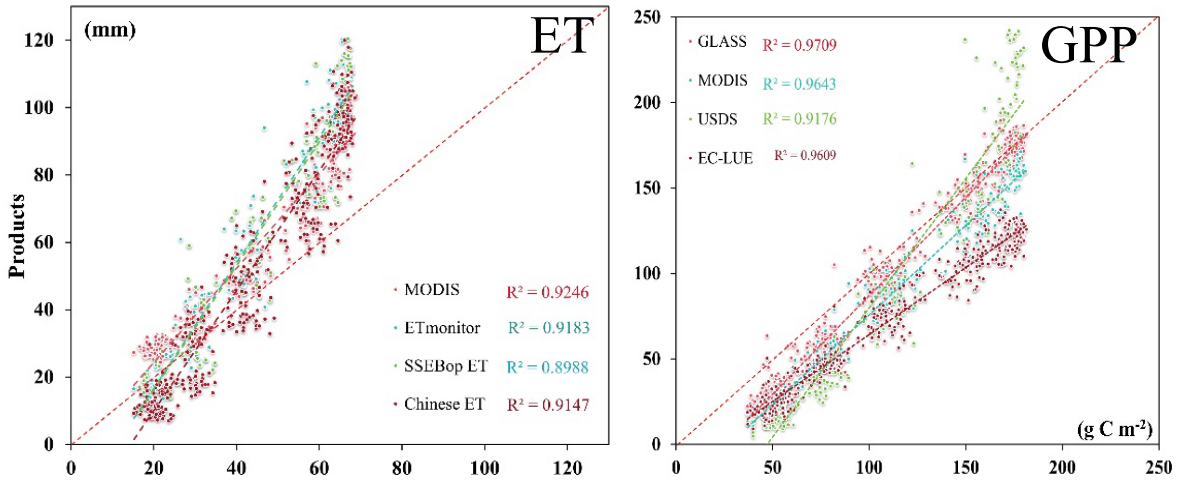
Result

Monthly water-carbon key fluxes in the Yangtze River Basin were simulated for the period 1983-2020.

The Validation with other products indicating that the results have high reliability.



Validation

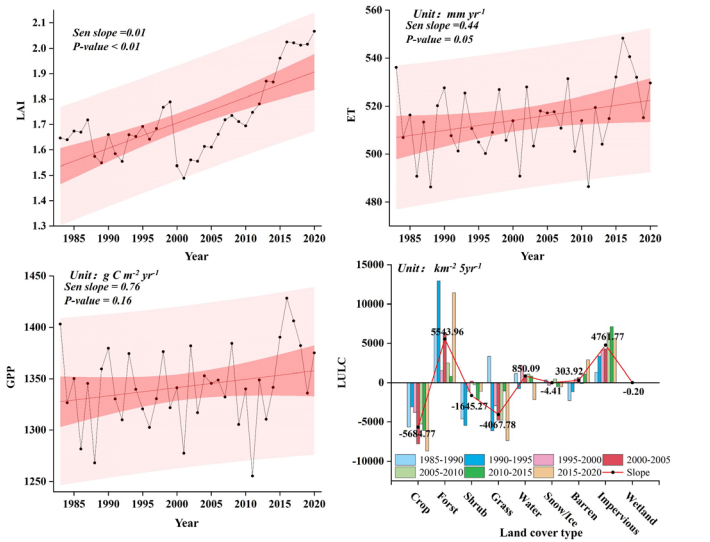


Simulation results: The annual mean ± standard deviation of ET, Runoff, GPP, RE are 515±15 mm yr^{-1}, 573±59 mm yr^{-1}, 1343±39 g C m^{-2} yr^{-1}, 1036±21 g C m^{-2}.

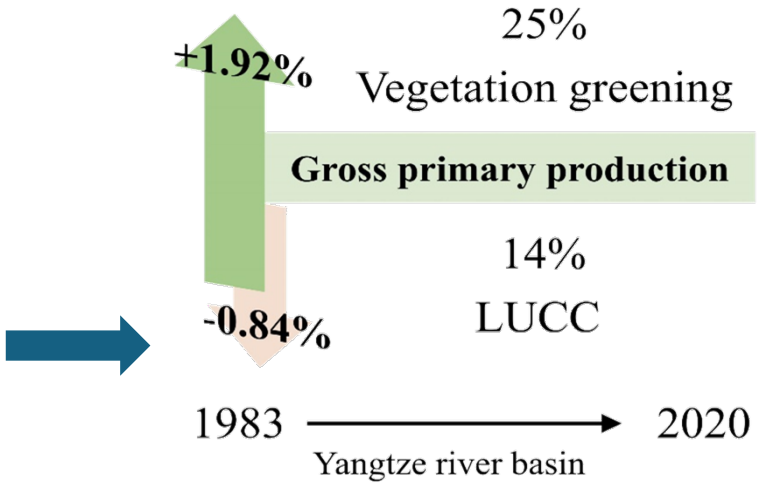
Validation results: The R^2 values for MODIS, ETmonitor, SSEBop, ETa, and Chinese Eta in ET products were 0.925, 0.918, 0.939, 0.915. The corresponding RMSE values were 16.89, 24.89, 18.01, and 18.77 (mm $month^{-1}$).

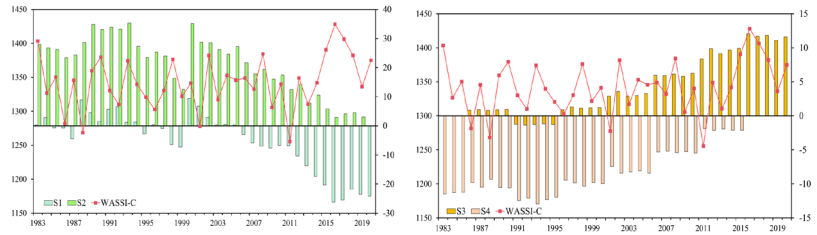
Human-water relationship: Carbon and water cycle fluxes in terrestrial ecosystems

Analysis To reveal the spatial and temporal trends of watershed fluxes of carbon and water with coupled environmental elements and their correlations through statistical analysis and scenario modeling.



Time-series analysis of key elements





Scenario simulation results

Conclusions:

① Vegetation greenness compensated for the effects of anthropogenic LUCC on terrestrial ecosystem GPP and dominated past GPP growth in the YRB.

② Temperature, precipitation, ET, GPP, vegetation greenness show an increasing trend

➢ Twin Poyang Lake: A Human Water Relationship Experimental Platfo

中国科学技术交流中心 China Science and Technology Exchange Center

esa → THE EUROPEAN SPACE AGENCY

Realistic wetland landscape



Wetland migratory bird



Wetland landscape vegetation



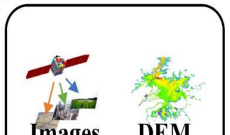
Typical wetland landscape scene

Modeling process of wetland virtual landscape

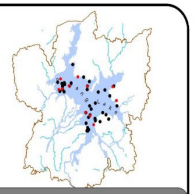
Data acquisition For Digital twin

Wetland virtual element modeling and scenario integration

Browser deployment and Cloud Render



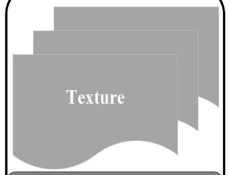
Images and DEM



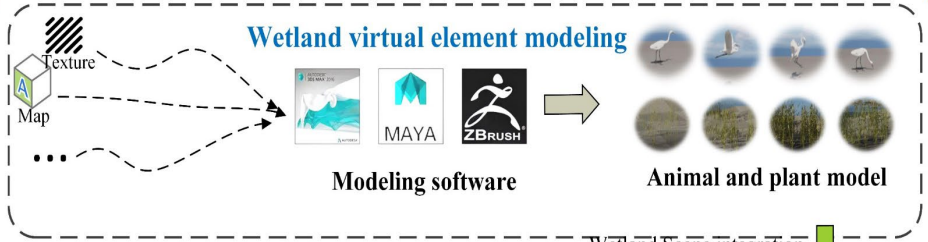
Shpfiles

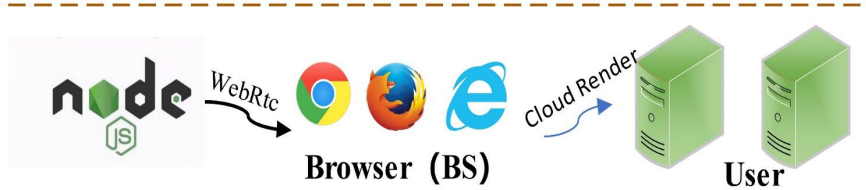


UAV and 3D scanning



Texture and map data

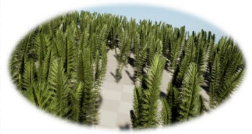




Virtual wetland landscape



Wetland migratory bird model



Wetland landscape vegetation model



Typical wetland landscape virtual scenarios

The Digital Twin of Poyang Lake uses UAV imagery, DEMs, and 3D scanning to build a detailed wetland model. Virtual birds and vegetation are created with MAYA for ecological realism. Unreal Engine and Cesium enable interactive simulation. Cloud rendering and browser access support real-time use and ecological monitoring.

PART I
EVALUATION OF RESILIENT WETLANDS AT DROUGHT AND FLOODING CONDITIONS

PRESENTED BY: DANLING TANG

南方海洋科学与工程广东省实验室（广州）
SOUTHERN MARINE SCIENCE AND ENGINEERING GUANGDONG LABORATORY (GUANGZHOU)

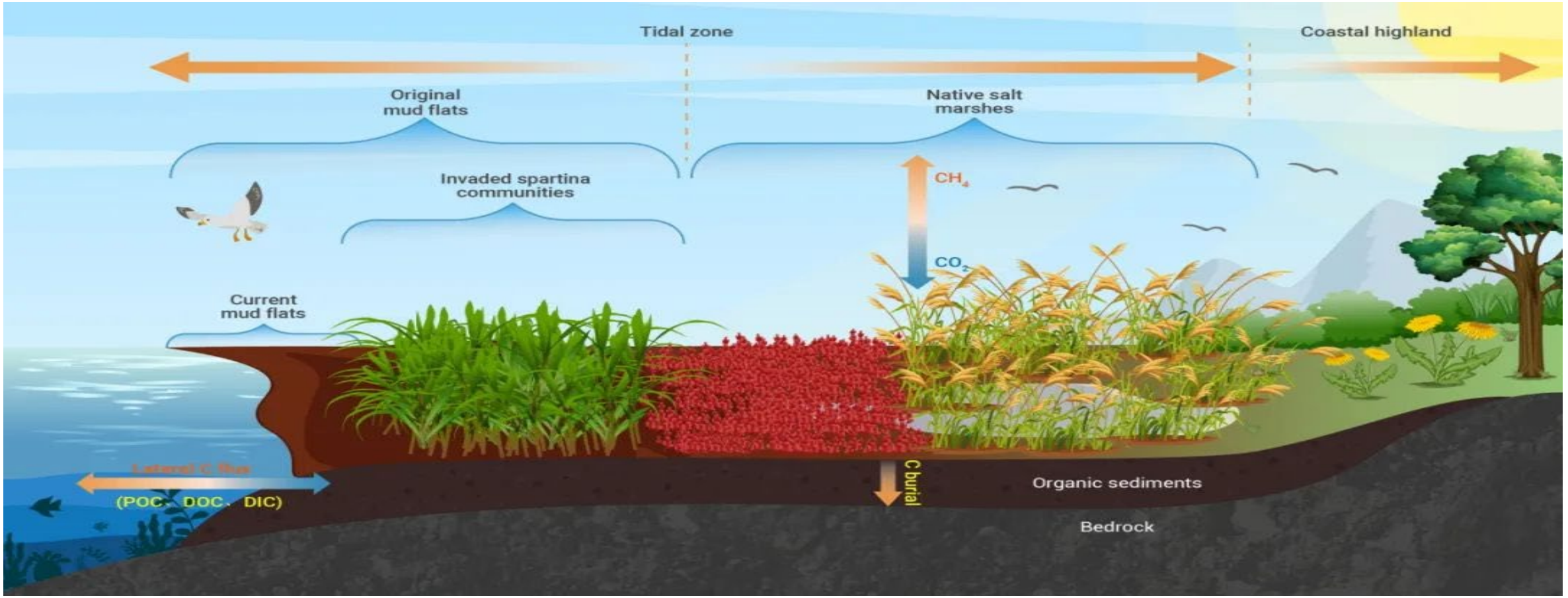
- Wetland fine classification based on RS
  - Comparing supervised classification algorithm–feature combinations for Spartina alterniflora extraction
  - A Hyperspectral Vegetation Feature Band Selection Based on Quantum Genetic Spectral Angle Mapper Algorithm (In Chinese)
  - Mapping of wetland plant communities based on time-series C-band synthetic aperture radar data
- The Influence of Wetland Hydrological Condition on Human Life environment

Wetland Fine Classification Based on RS (1)

Comparing supervised classification algorithm–feature combinations for Spartina alterniflora extraction: a case study in Zhanjiang, China



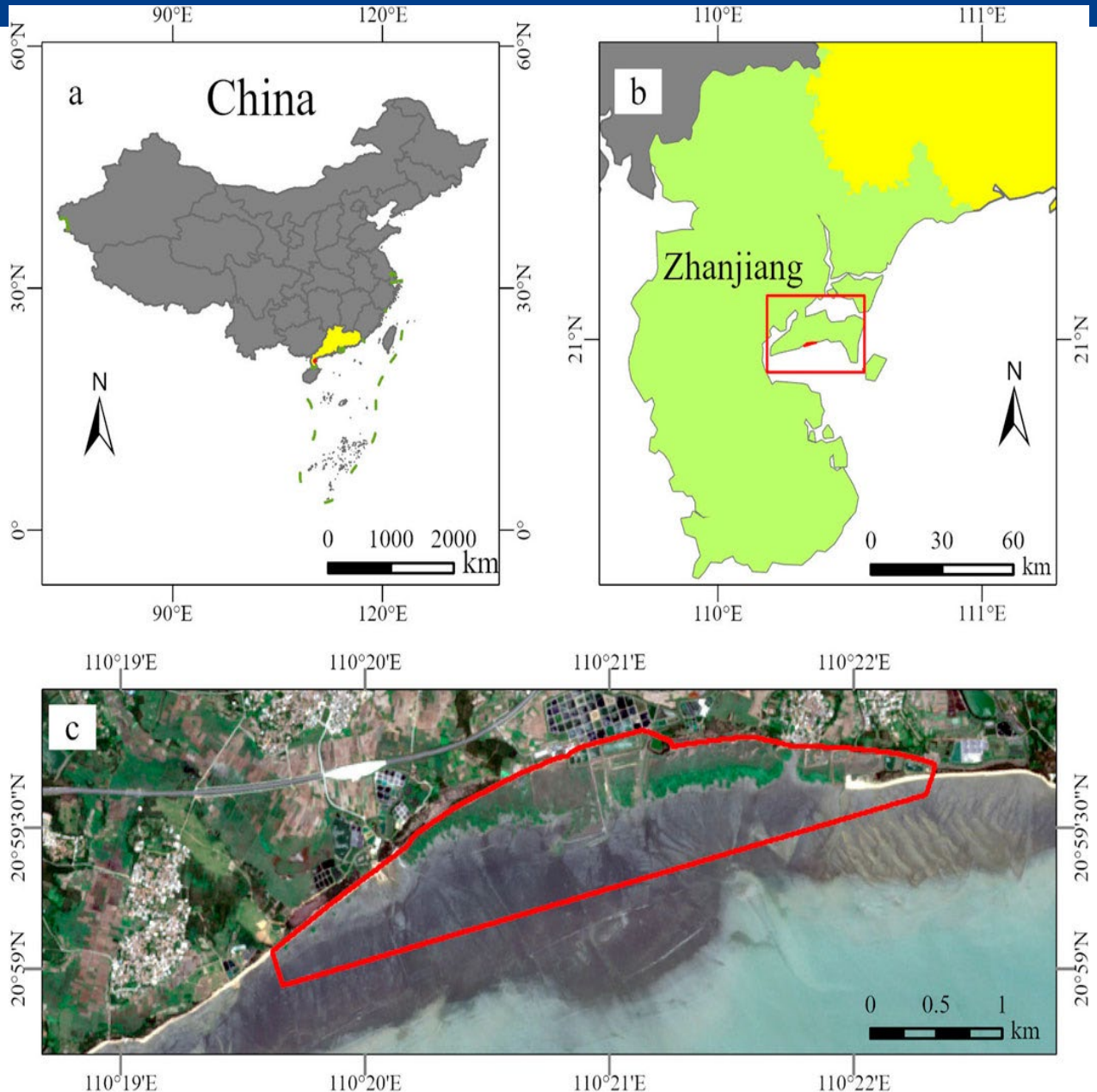
Wetland Fine Classification Based on RS (1)



Mangrove forests are vital blue carbon ecosystems whose security is increasingly threatened by the non-native species Spartina alterniflora.

Accurate remote sensing-based identification and monitoring are crucial for invasive species management;

Wetland Fine Classification Based on RS (1)

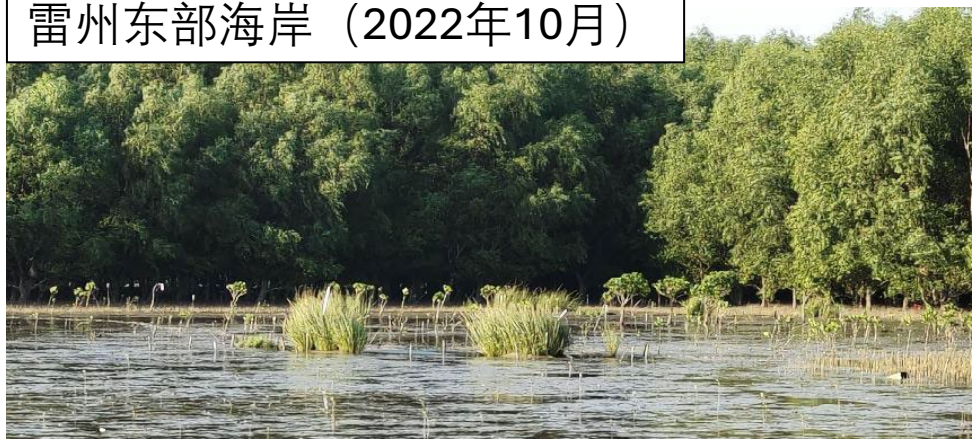


Maps of the study area: (a) yellow area shows Guangdong; (b) red box shows Donghai Island; (c) red line represents the target study area.

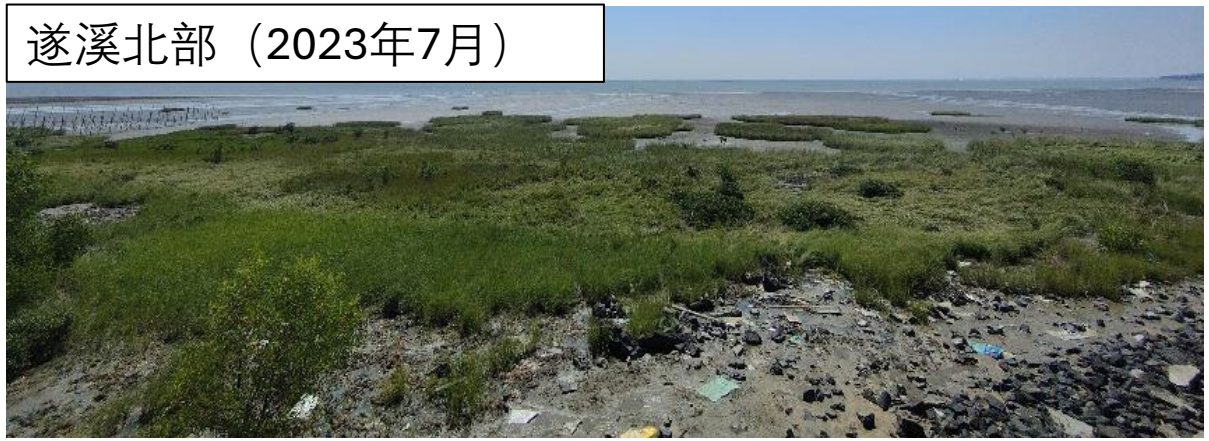
Wetland Fine Classification Based on RS （1）

Multispectral Datasets for Spartina alterniflora and Benchmark

雷州东部海岸（2022年10月）



遂溪北部（2023年7月）



东海岛（2022年10月）



阳江海陵岛（2024年2月）



Wetland Fine Classification Based on RS (1)









广东省海洋生态环境遥感中心

Guangdong Remote Sensing Center for Marine Ecology and Environment (GDRS)

Wetland Fine Classification Based on RS (1)

- **Constructing a multi-channel attention mechanism-based UNet to explore Spatina alterniflora (SA);**
- **SA exhibits different phenological periods in low-latitude regions of China;**
- **Sexual reproduction through root systems is the main mode of diffusion after August.**

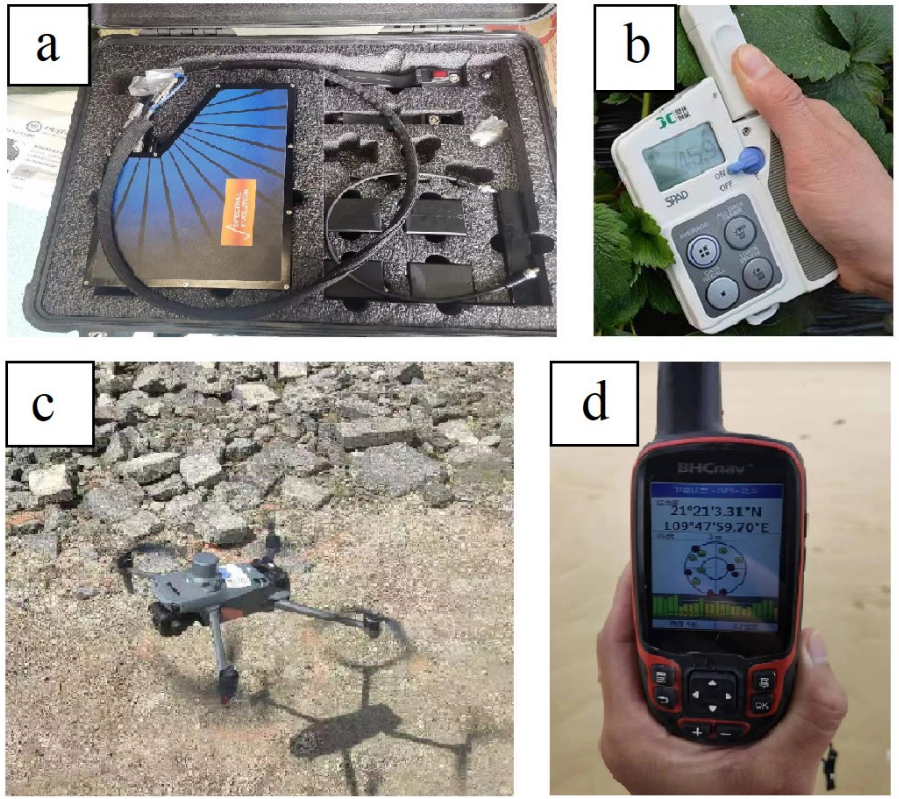


The photo of spatinel alterflora taken on Hailing island in August 2023;

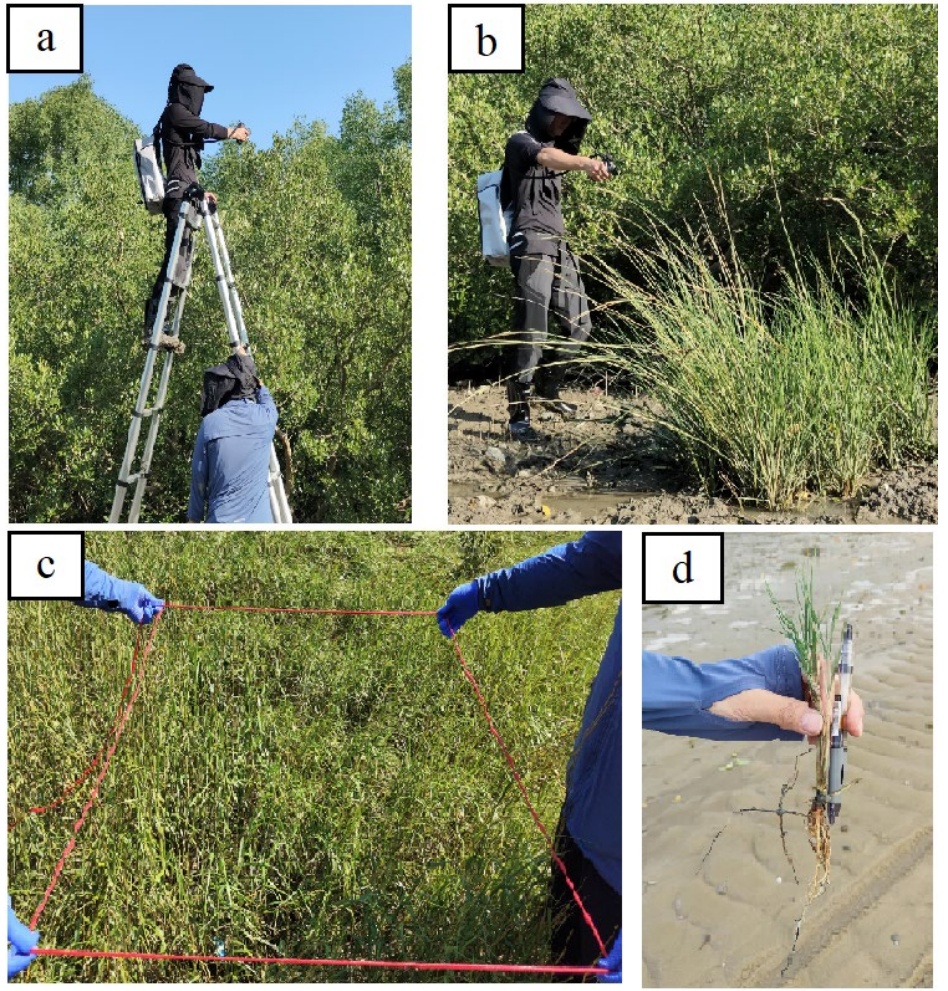


The photo of spatinel alterflora taken by UAV.

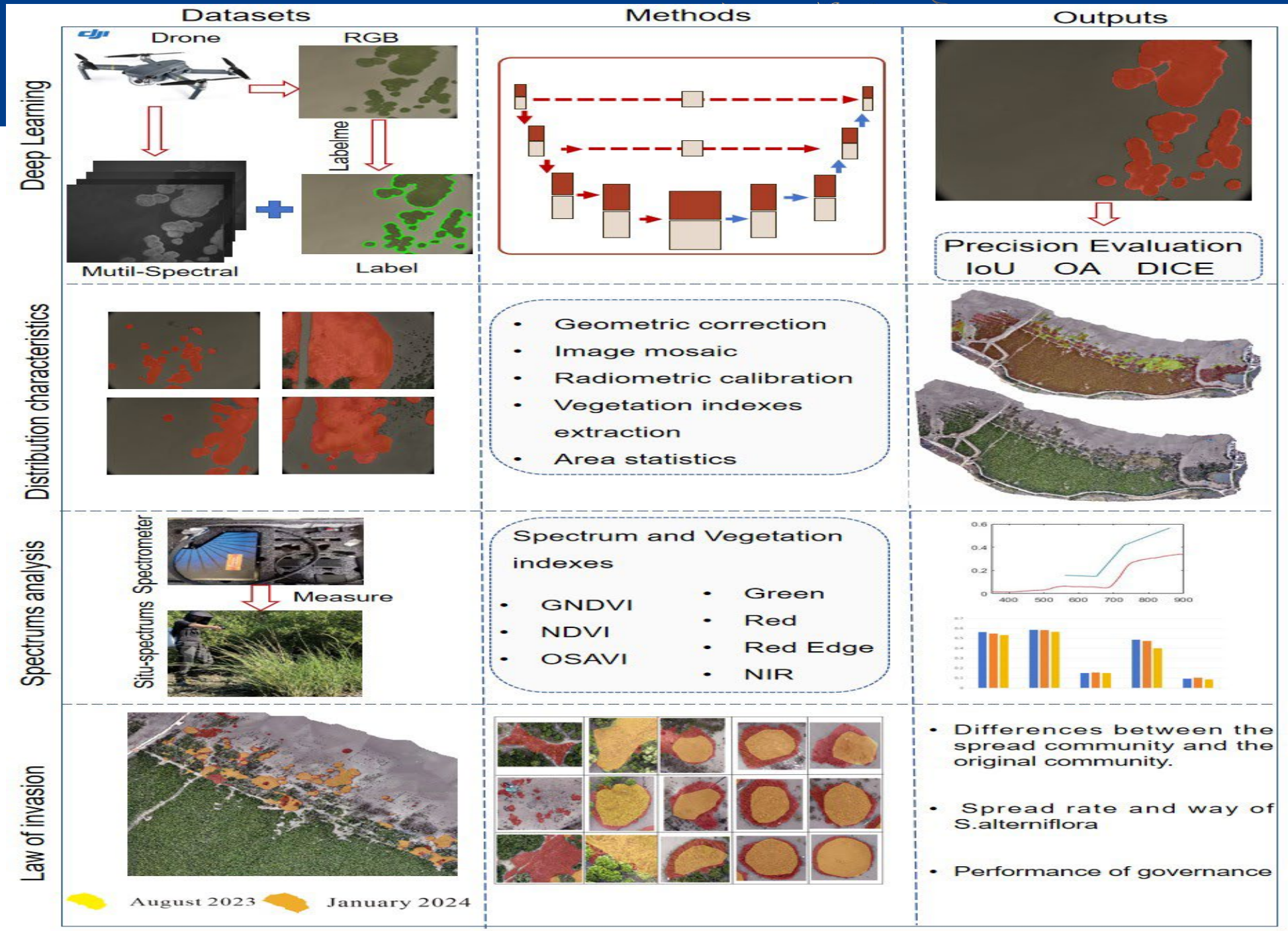
Wetland Fine Classification Based on RS-Data (1) Collection



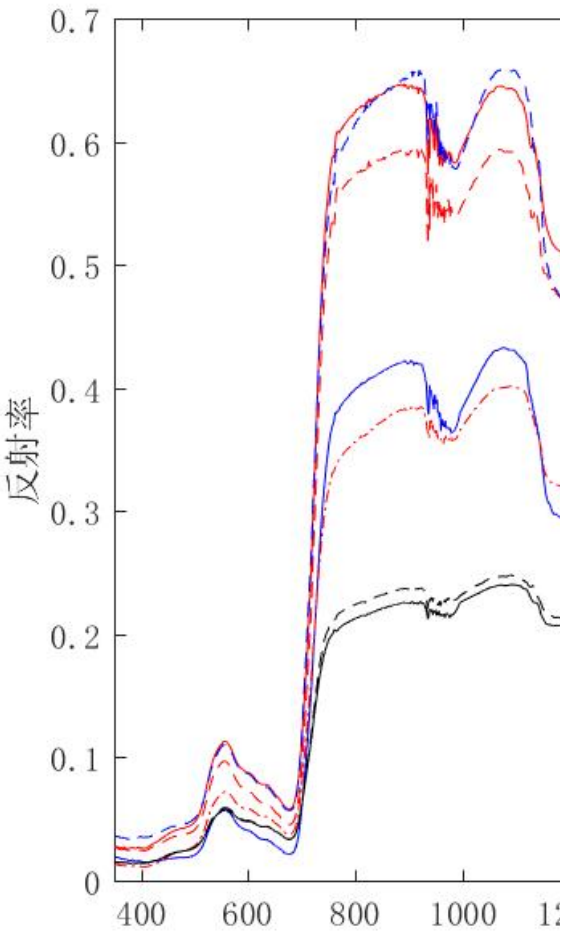
Instrument: (a) PSR; (b) SPAD; (c) UAV; (d) Beidou Positioning



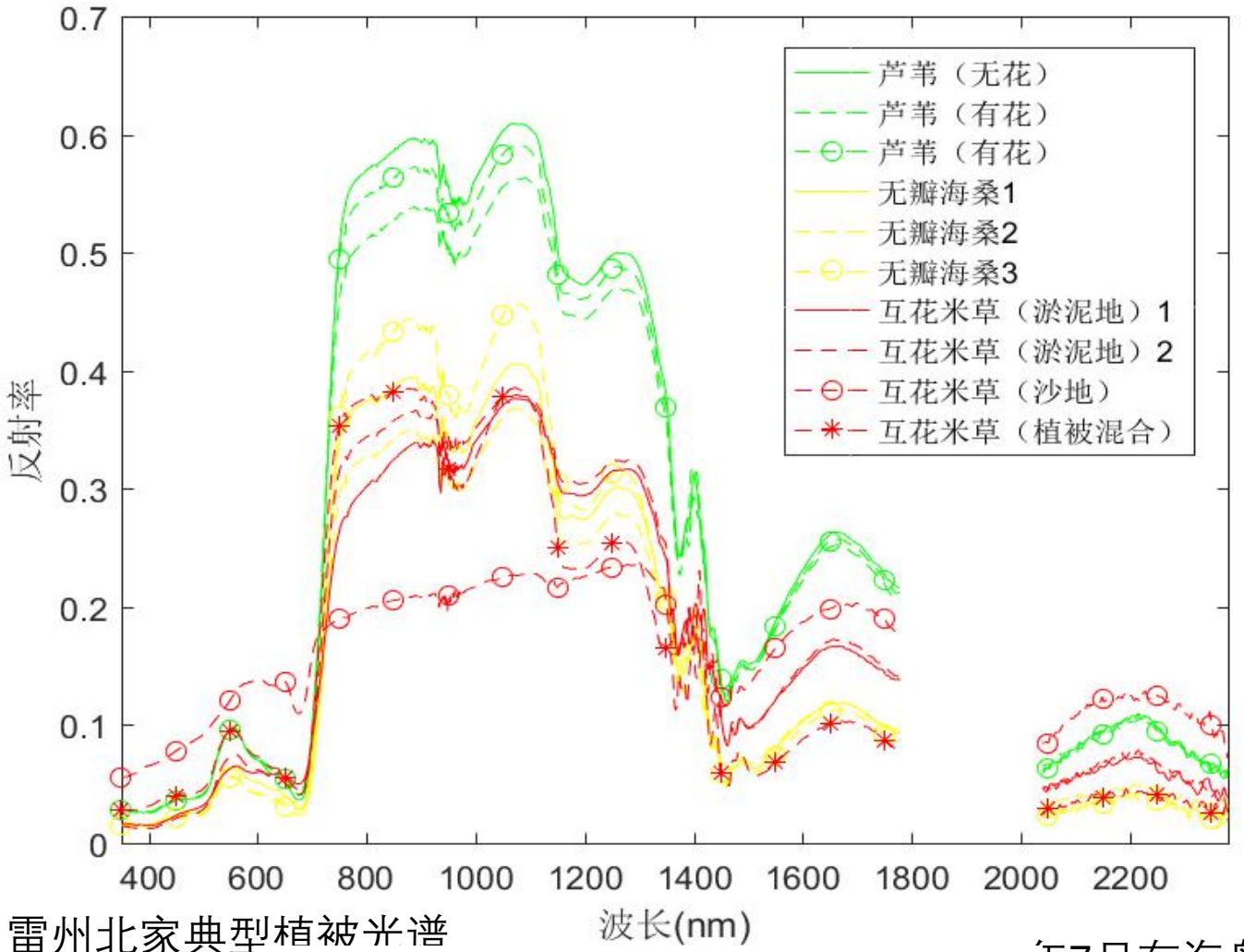
In-situ spectral measurement: (a) mangrove; (b) Spartina alterniflora; (c) sample collection; (d) Sampling


Datasets
Methods
Outputs
Deep Learning
Drone
RGB
Labelme
Mutil-Spectral
Label
Precision Evaluation
IoU OA DICE
Distribution characteristics
Geometric correction
Image mosaic
Radiometric calibration
Vegetation indexes extraction
Area statistics
Spectrums analysis
Spectrometer
Measure
Situ-spectrums
Spectrum and Vegetation indexes
GNDVI
NDVI
OSAVI
Green
Red
Red Edge
NIR
Law of invasion
August 2023
January 2024
Differences between the spread community and the original community.
Spread rate and way of S.alterniflora
Performance of governance

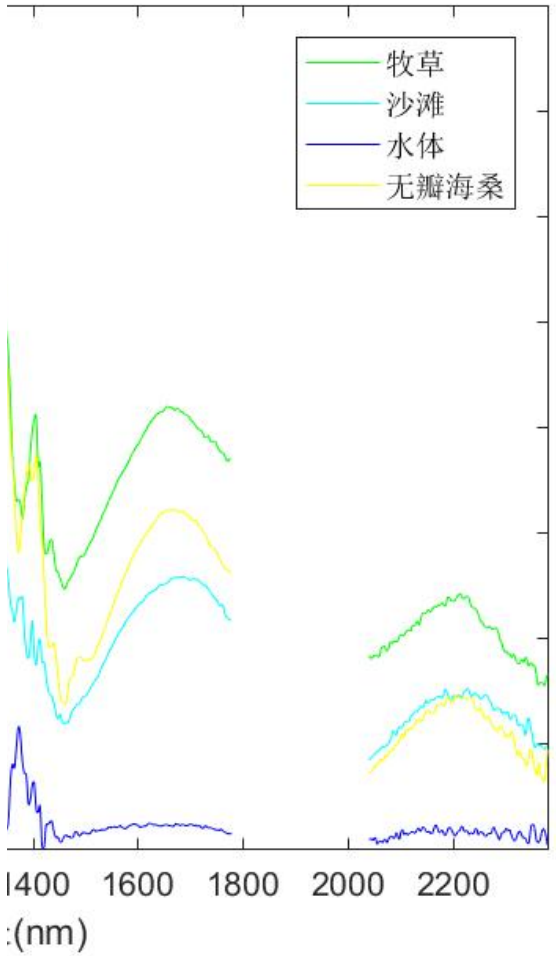
Data Collection



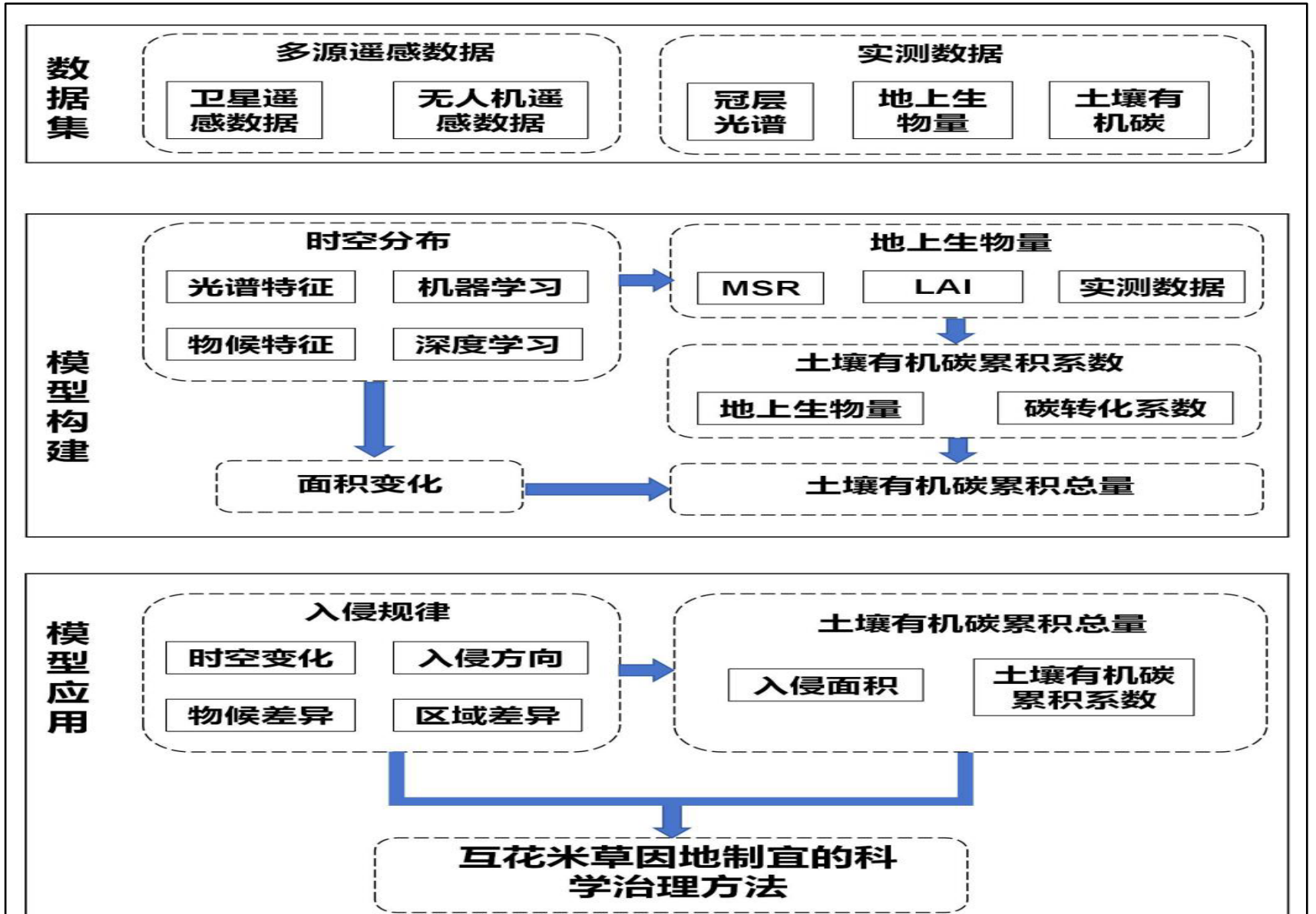
2022年10月雷州北家典型植被光谱



互花米草与其他典型地物光谱差异

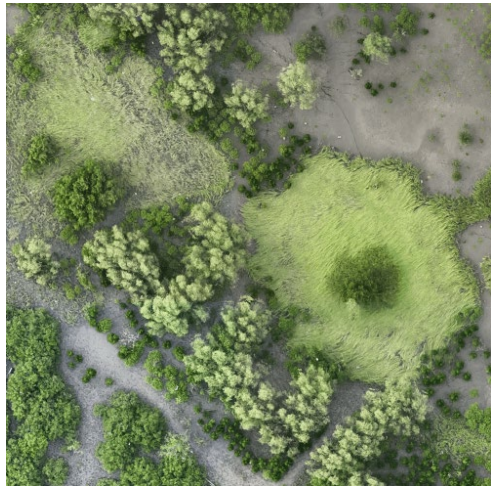


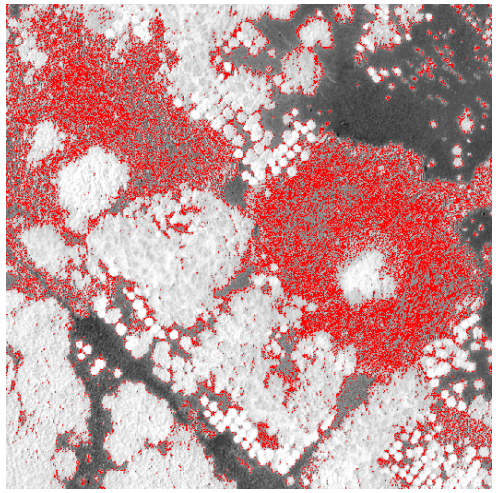
年7月东海岛典型地物光谱


数据集
多源遥感数据
卫星遥感数据
无人机遥感数据
实测数据
冠层光谱
地上生物量
土壤有机碳
模型构建
时空分布
光谱特征
机器学习
物候特征
深度学习
面积变化
地上生物量
MSR
LAI
实测数据
土壤有机碳累积系数
地上生物量
碳转化系数
土壤有机碳累积总量
模型应用
入侵规律
时空变化
入侵方向
物候差异
区域差异
土壤有机碳累积总量
入侵面积
土壤有机碳累积系数
互花米草因地制宜的科学治理方法

➢ 无人机航飞影像解译

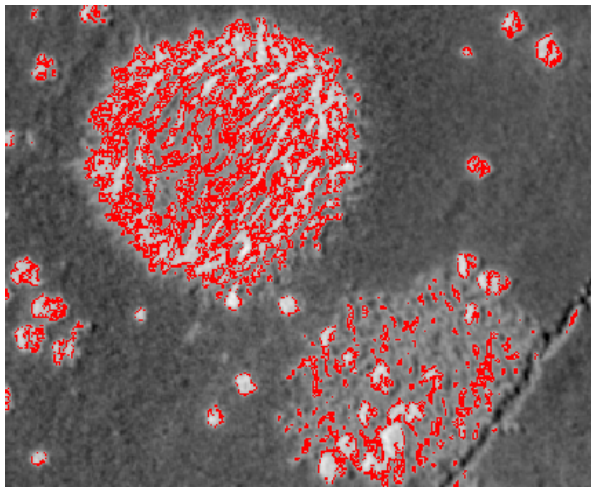
（1）与红树林混杂区域





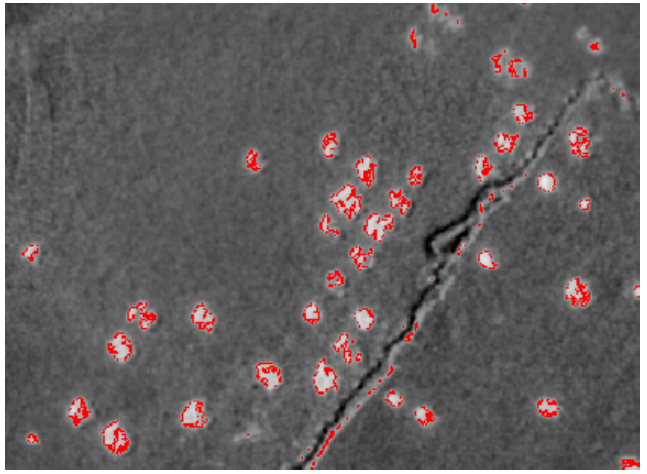
（2）片状分布群落





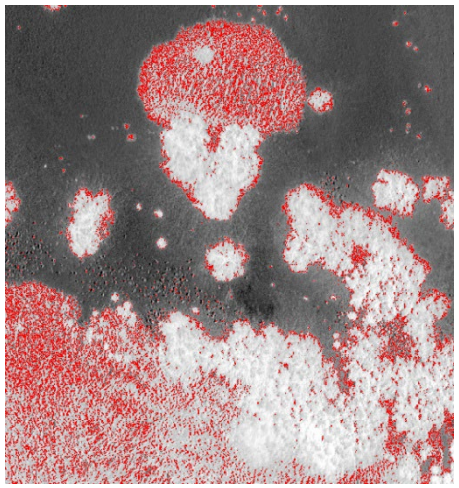
（3）零星状分布群落



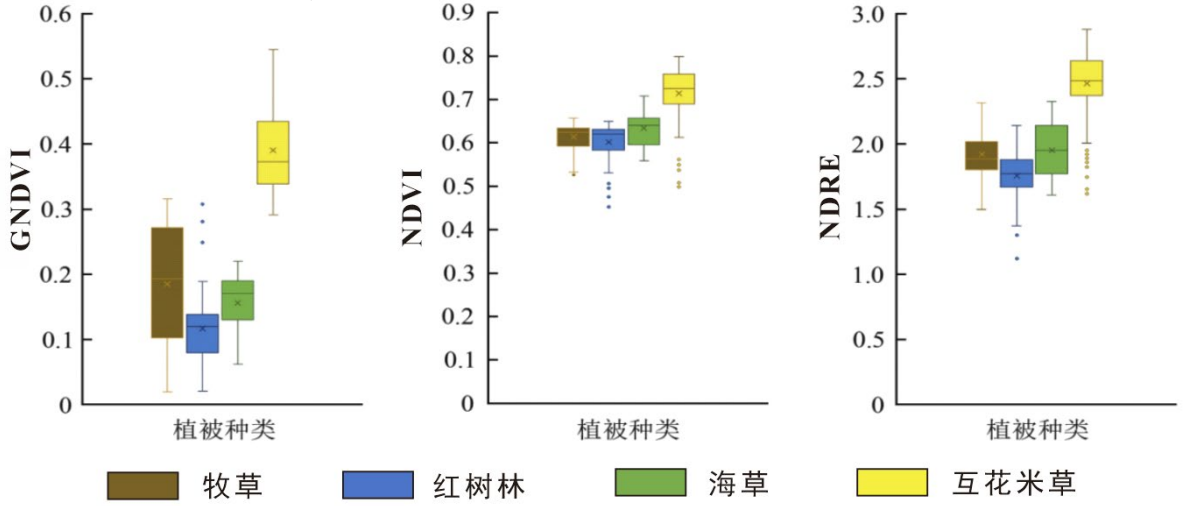


（4）包围红树林



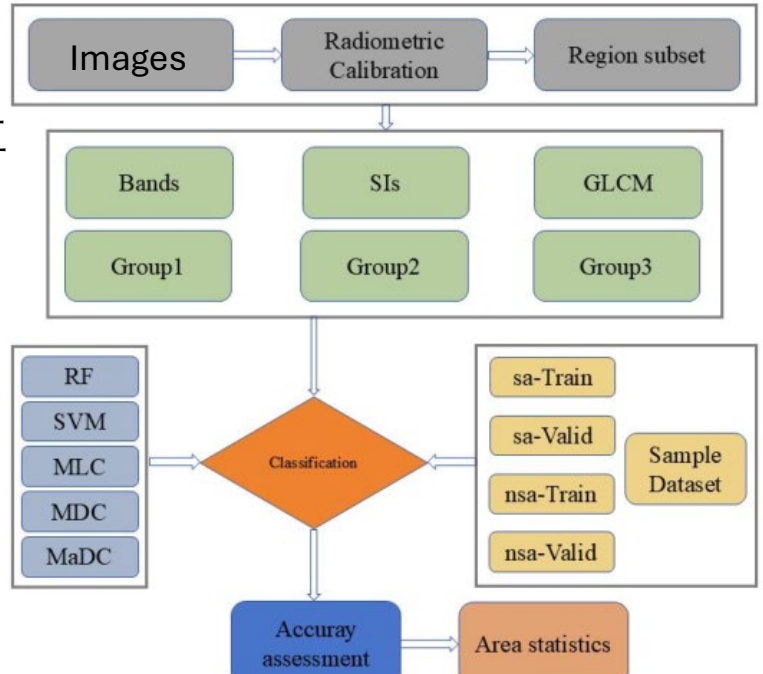


- 植被指数差异：目视解译，建立标签

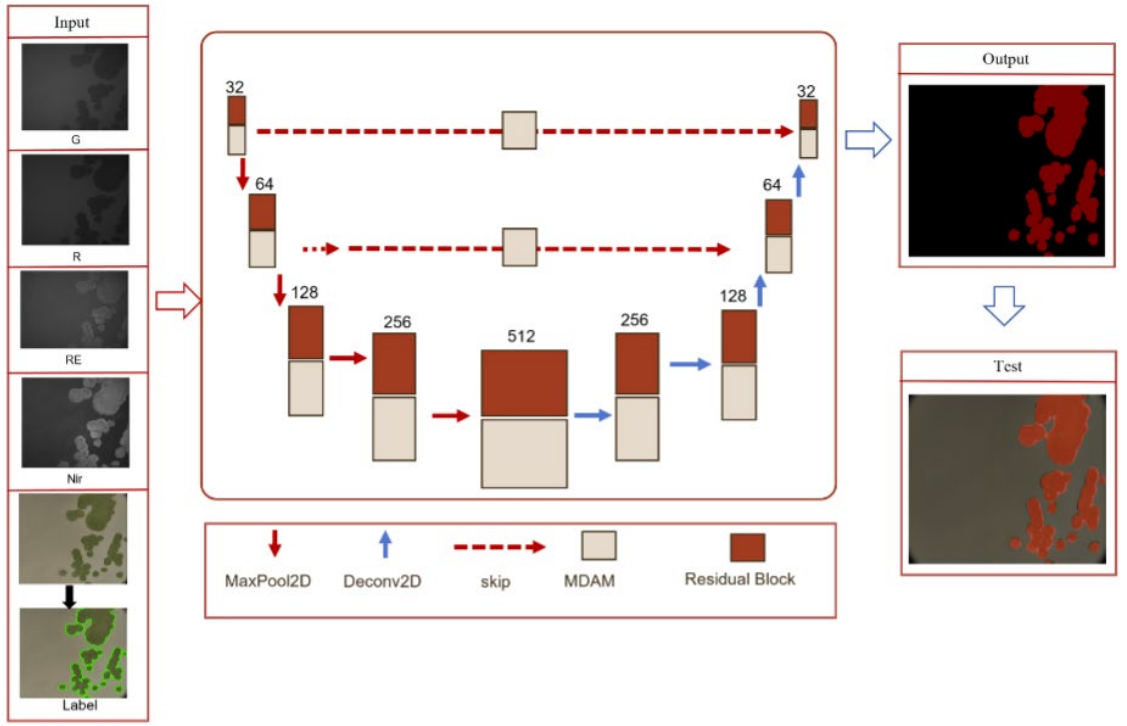


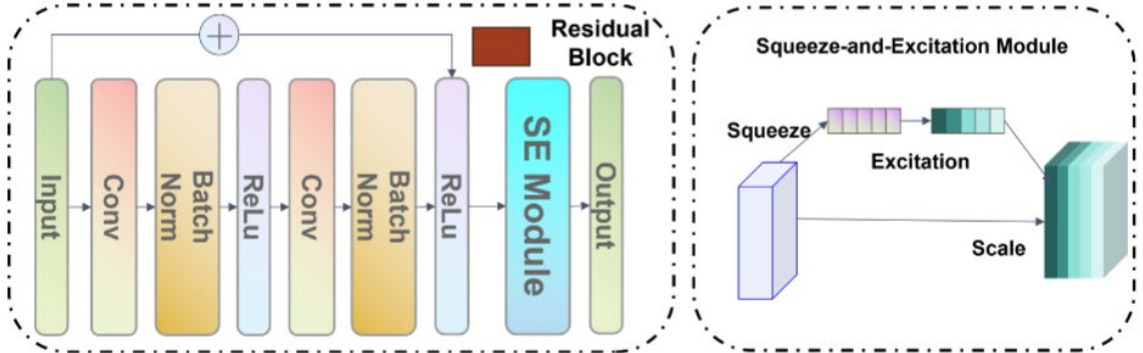
- 机器学习：

提取卫星影像互花米草信息



- 深度学习：基于多通道注意力机制的无人机影像互花米草识别方法





Wetland Fine Classification Based on RS (1)

Spartina alterniflora (SA) is a major invasive species in China's coastal wetlands.

We constructed a multi-channel attention mechanism-based UNet (MCAUNet) model to automatically identify the spatial distribution of SA in drone imagery and to explore its spatiotemporal changes and invasion trends.

By analyzing the area and vegetation index differences of SA on Hailing Island during two phenological periods on August 8, 2023, and January 29, 2024, we demonstrate that SA exhibits different phenological periods in low-latitude regions of China, and sexual reproduction through root systems is the main mode of diffusion after August. We also applied for a patent on the MCAUNet model，and the patent is pending.

Wetland Fine Classification Based on RS (1)

- We propose a S. alterniflora UAV image dataset including RGB images and multispectral images with 4 bands (green, red, red edge, NIR), and a novol UNet based on MCAUnet, **a multi-channel attention mechanism**-based Unet, which precisely identifies the distribution of S. alterniflora communities by texture, spatial, and spectral informations from UAV remote sensing images.
- Extensive experimental results on UAV images with different background information demonstrate that MCAUNet achieves state-of-the-art performance at the level of mainstream remote sensing segmentation algorithms and maintains a better advantage in terms of model overhead, particularly in identifying S. alterniflora communities mixed with mangroves.
- We believe our novel dataset will pave the way for developing better algorithms and exploring new research directions for wetland vegetation species identification.

Wetland Fine Classification Based on RS (1)

基于卫星遥感的粤西地区互花米草长时序扩散/演化研究”



国家知识产权局

518052

深圳市南山区粤海街道高新区社区高新南七道 20 号深圳国家工程实验室大楼 A503 深圳市君胜知识产权代理事务所（普通合伙）
庄敏芳(0755-26406581)

发文日：
2025 年 03 月 11 日

申请号：202510281094.2　　发文序号：202503110128286O

专利申请受理通知书

根据专利法第 28 条及其实施细则第 43 条、第 44 条的规定，申请人提出的专利申请已由国家知识产权局受理。现将确定的申请号、申请日等信息通知如下：

申请号：2025102810942
申请日：2025 年 03 月 11 日
申请人：南方海洋科学与工程广东省实验室（广州）
发明人：于岩,唐丹玲,黄畅,严卫聪
发明创造名称：一种基于无人机遥感数据的互花米草信息提取方法及系统
经核实，国家知识产权局确认收到文件如下：
权利要求书 1 份 3 页,权利要求项数 ： 10 项
说明书 1 份 17 页
说明书附图 1 份 3 页
说明书摘要 1 份 1 页
专利代理委托书 1 份 2 页
发明专利请求书 1 份 5 页
实质审查请求书 文件份数：1 份
申请方案卷号：250610-PI-101

提示：

1.申请人收到专利申请受理通知书之后，认为其记载的内容与申请人所提交的相应内容不一致时，可以向国家知识产权局请求更正。

2.申请人收到专利申请受理通知书之后，再向国家知识产权局办理各种手续时，均应当准确、清晰地写明申请号。

国家知识产权局 专利申请业务章

审 查 员：自动受理
联系电话：010-62356655

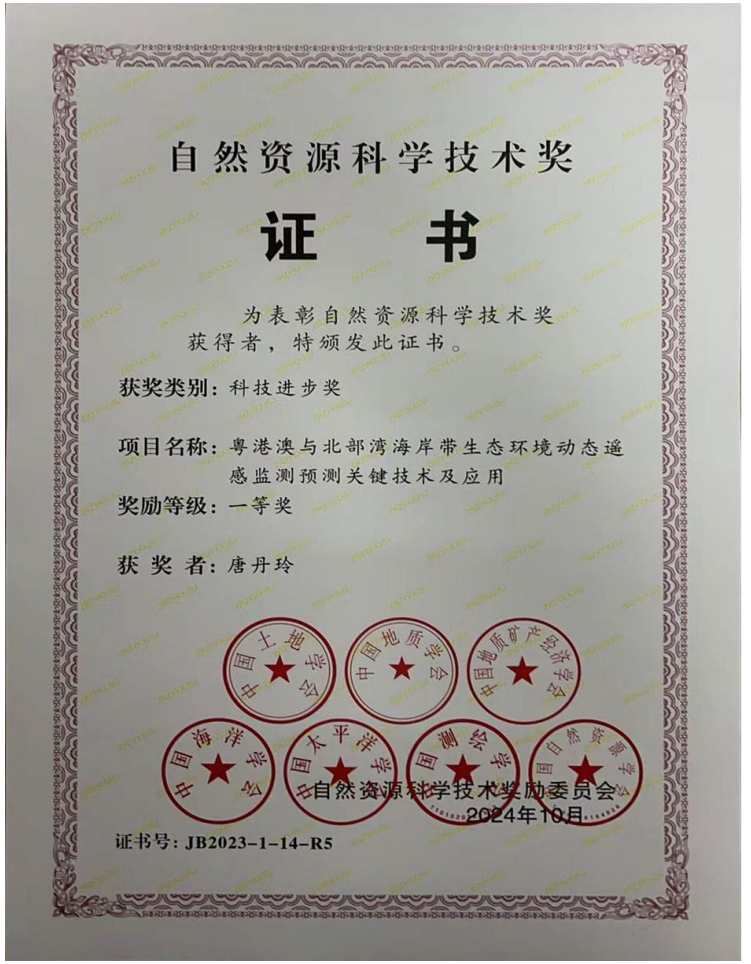
审查部门：初审及流程管理部

200101
2023.03

纸件申请，回函请寄：100088 北京市海淀区蓟门桥西土城路 6 号 国家知识产权局专利局受理处收
电子申请，应当通过专利业务办理系统以电子文件形式提交相关文件。除另有规定外，以纸件等其他形式提交的文件视为未提交。

Patent

“粤港澳与北部湾海岸带生态环境动态遥感监测预测关键技术及应用”获**2023年度自然资源科技进步奖一等奖**。



自然资源科学技术奖

证　书

为表彰自然资源科学技术奖获得者，特颁发此证书。

获奖类别：科技进步奖

项目名称：粤港澳与北部湾海岸带生态环境动态遥感监测预测关键技术及应用

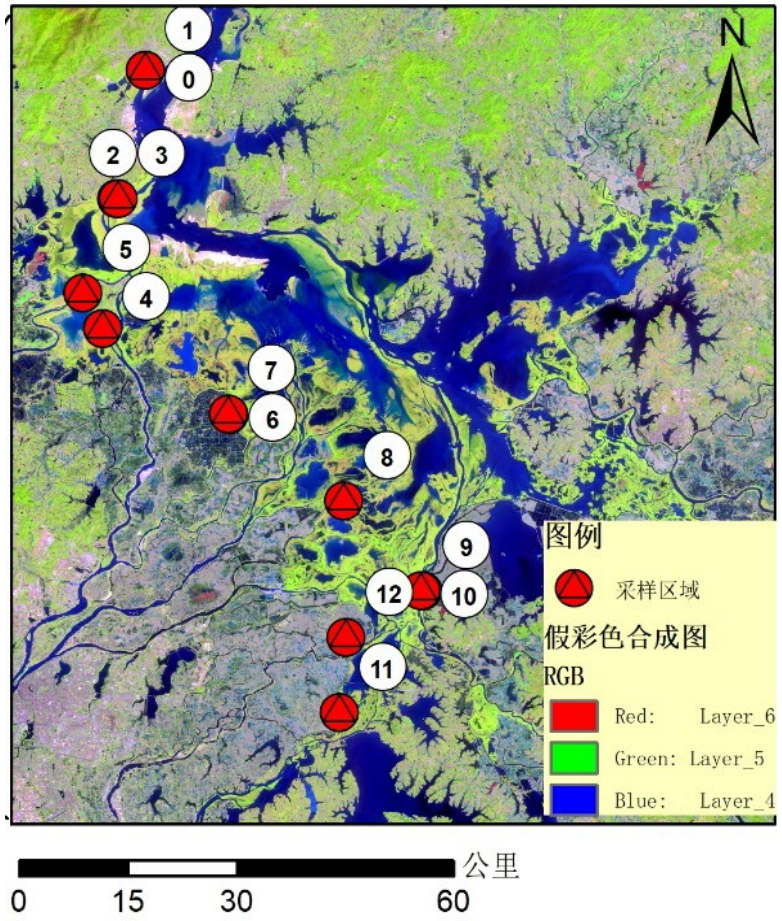
奖励等级：一等奖

获 奖 者：唐丹玲

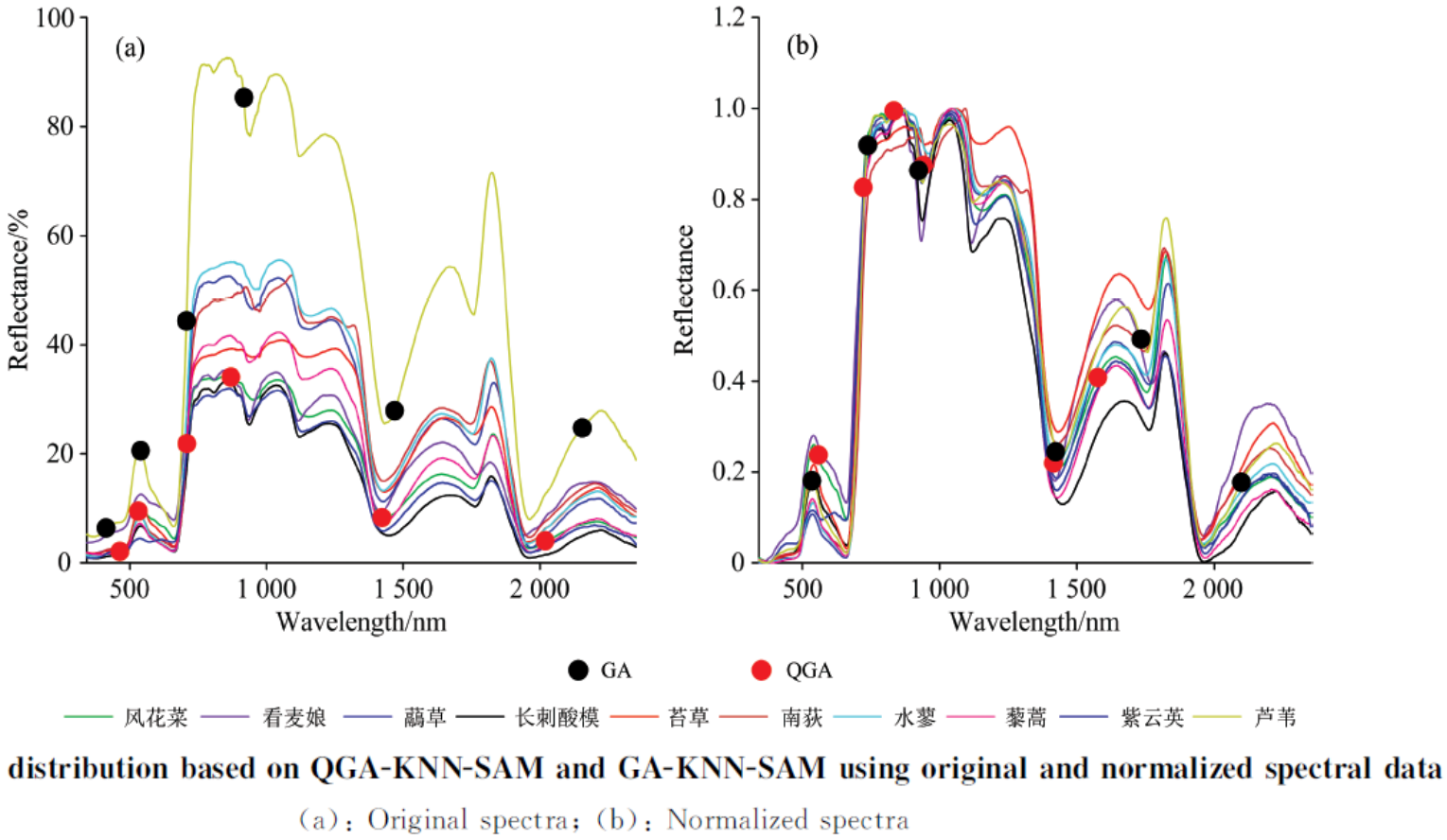
自然资源科学技术奖励委员会
2024年10月

证书号：JB2023-1-14-R5

Wetland Fine Classification Based on RS (2)



Experiments Sites- Poyang Lake wetland



Centroid distribution based on QGA-KNN-SAM and GA-KNN-SAM using original and normalized spectral data

(a): Original spectra; (b): Normalized spectra

Spectral Curve of 10 Wetland Plant Species in Poyang Lake Wetland

Hyper-Spectral of 10 wetland plant species is collected by SVC-1024

Wetland Fine Classification Based on RS (2)

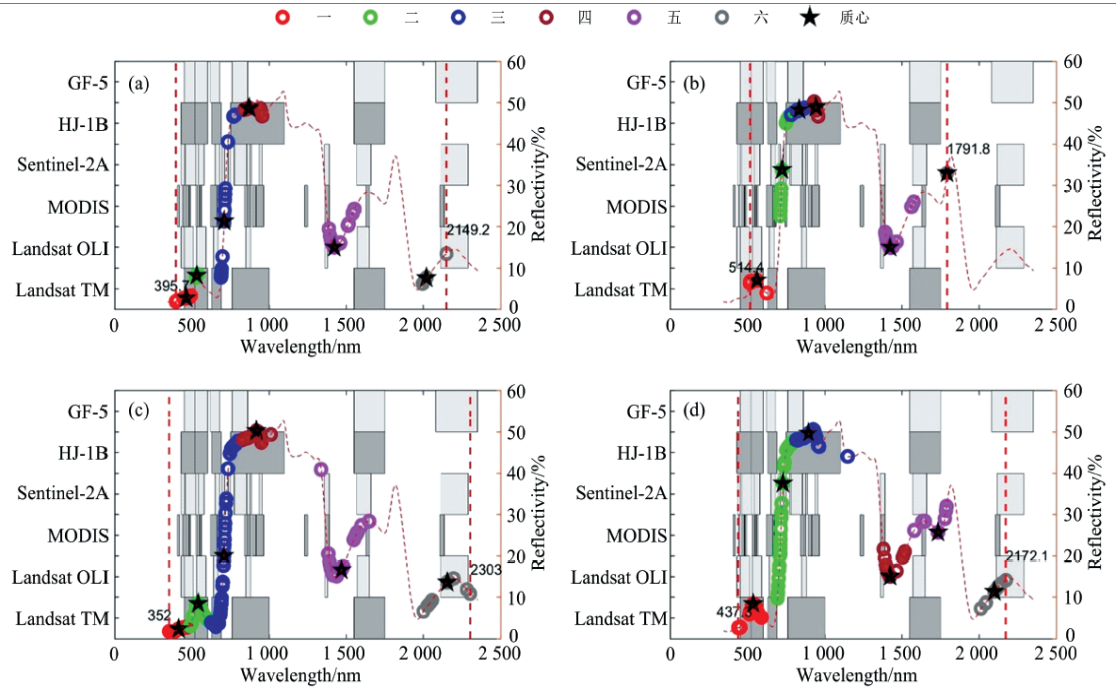
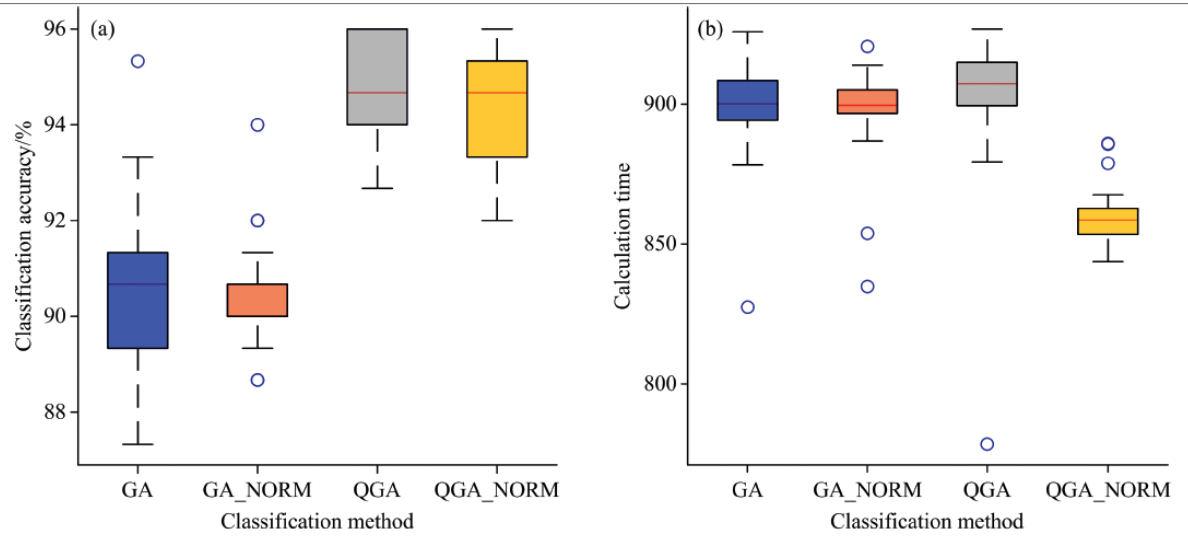


Fig. 5 Band distribution of multi-source satellite images (grey box and white box) and feature wavelength gene clustering results of wetland vegetation

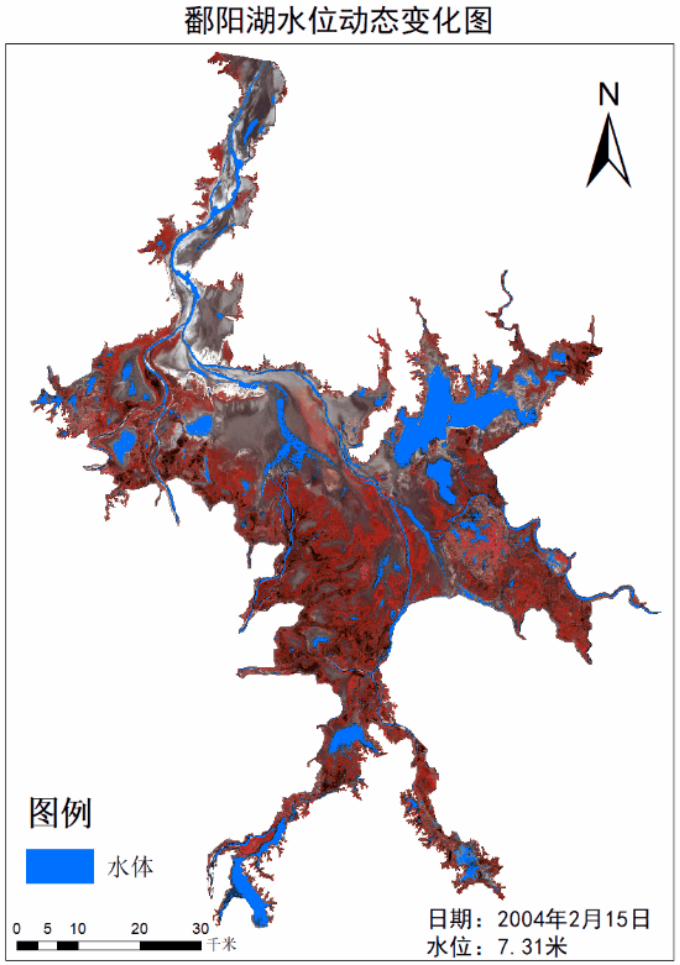
(a): QGA; (b): QGA_NORM; (c): GA; (d): GA_NORM

- QGA-KNN-SAM is proposed to select feature wavelength.
- The feature wavelengths selected by QGA-KNN-SAM is relative more concentrated



- QGA-KNN-SAM generates the average classification accuracy value of 95%, which are obviously higher than achieved by GA-KNN-SAM (90%)
- QGA-KNN-SAM algorithm selects feature bands with better directionality and interpretability.

Wetland Fine Classification Based on RS（3）



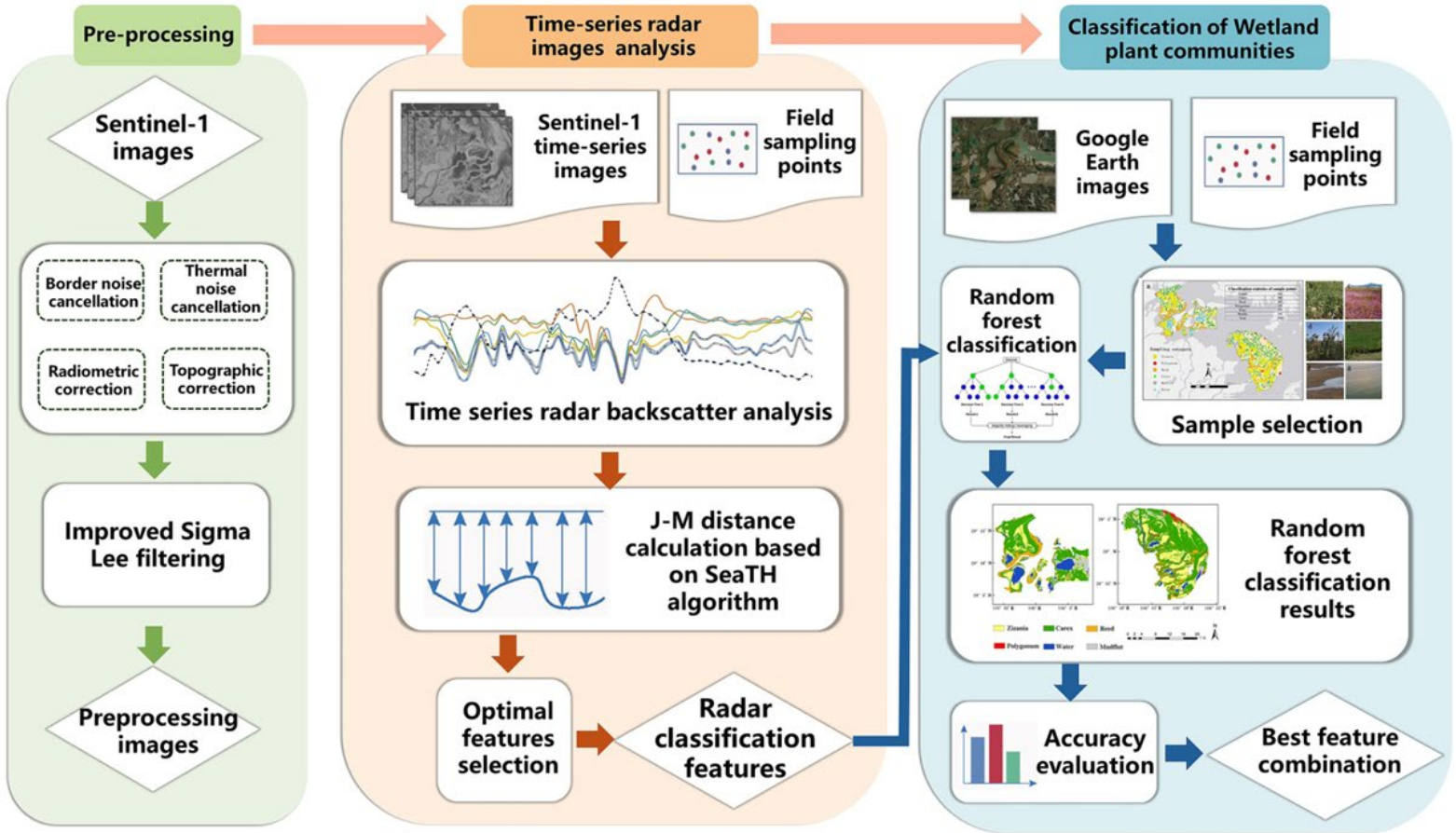
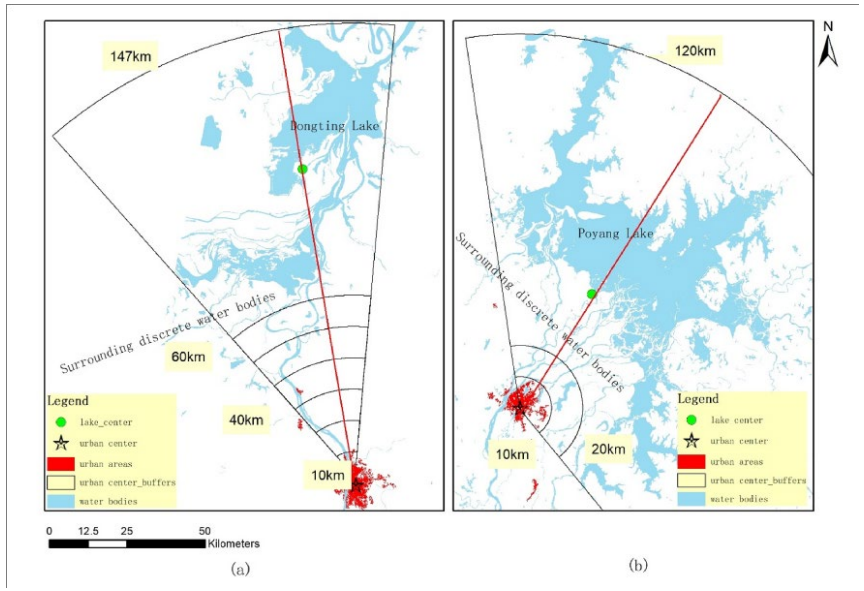
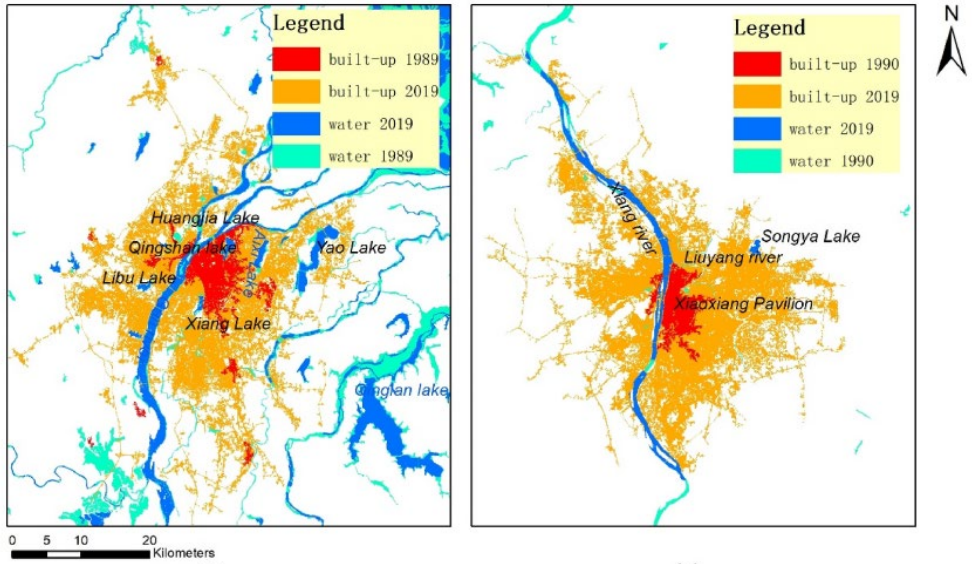


Fig. 3 Technical scheme.

Wetland plant mapping methods for high hydro-dynamic wetlands based on C-band SAR time-series data

The Influence of Wetland Hydrological Condition on Human Life environment





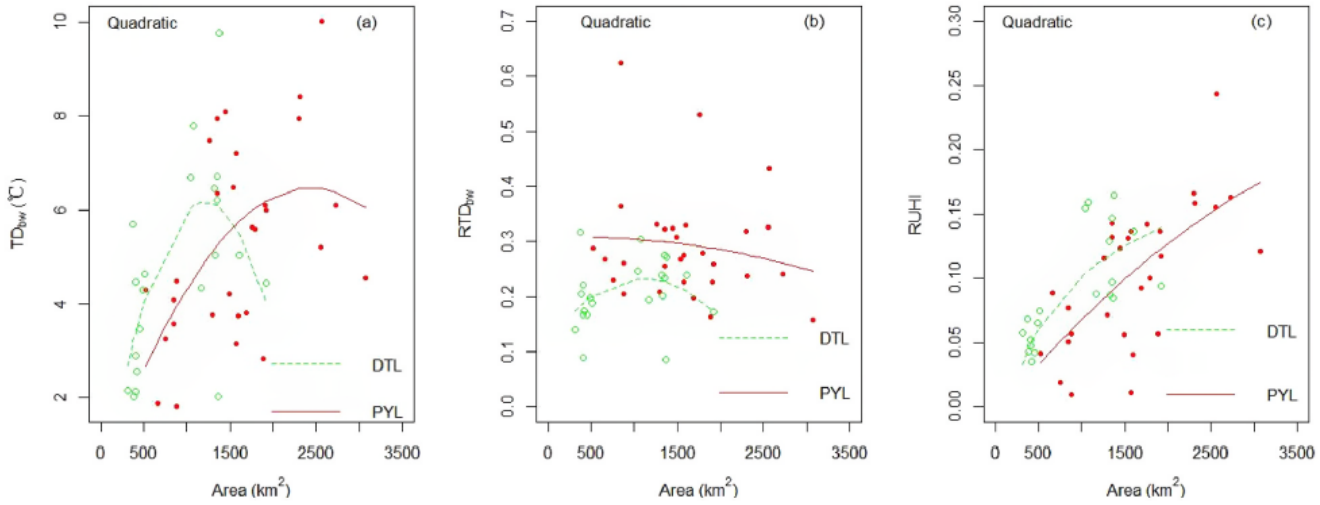


Fig. 12. Relationships between large lake acreage and the urban heat island effect: (a) Area and TD_{bw}; (b) Area and RTD_{bw}; (c) Area and RUHI.

- The long river shape, depth, orientation and fluidity is benefit to enhance their cooling effect.
- The distance of urban outside water bodies from built-up areas are positive correlated with their cooling effect
- The optimal acreage of large water bodies is >2500 square kilometers and 1111–1287.5 square kilometers for climate adaption of Poyang Lake and Dongting Lake,



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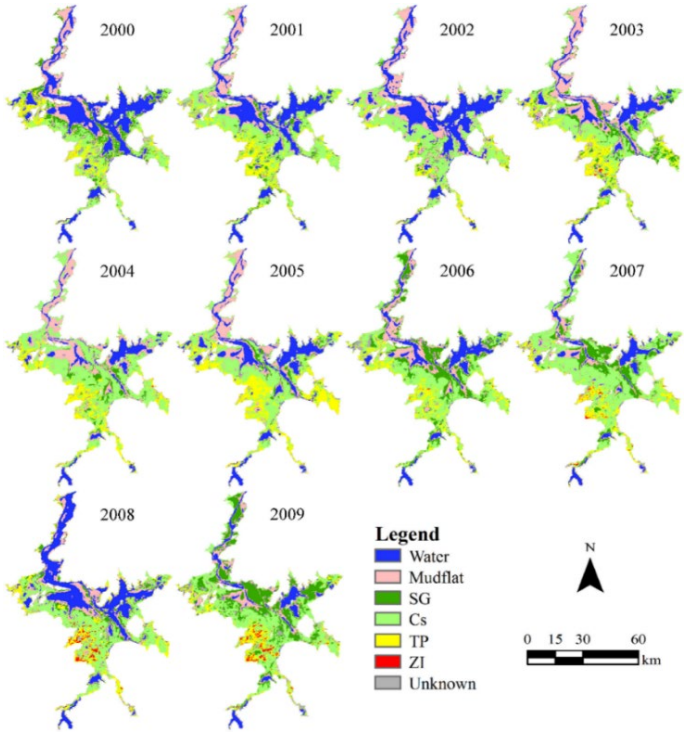
THE EUROPEAN SPACE AGENCY

PART II CARBON-WATER CYCLE MODELING IN WATERSHED

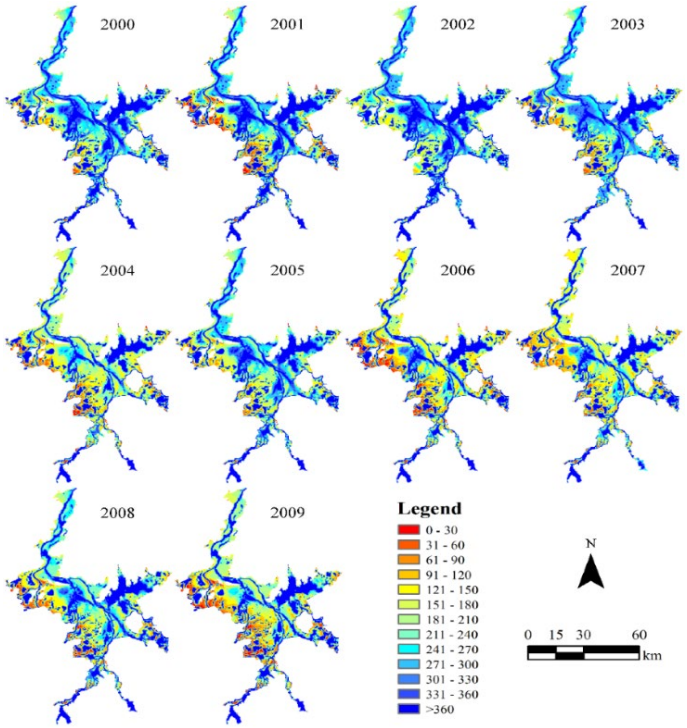
PRESENTED BY: JIANZHONG LU

Hydrological influence on the distribution and transition of wetland cover

- Response of wetland vegetational type to hydrological regime



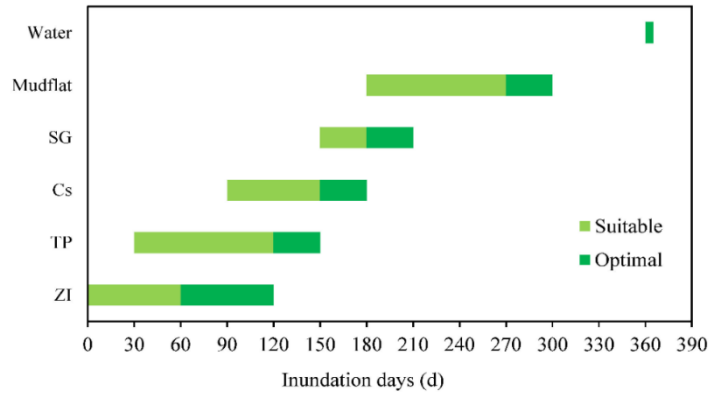
Phenology-based wetland vegetation classification from remote sensing observation



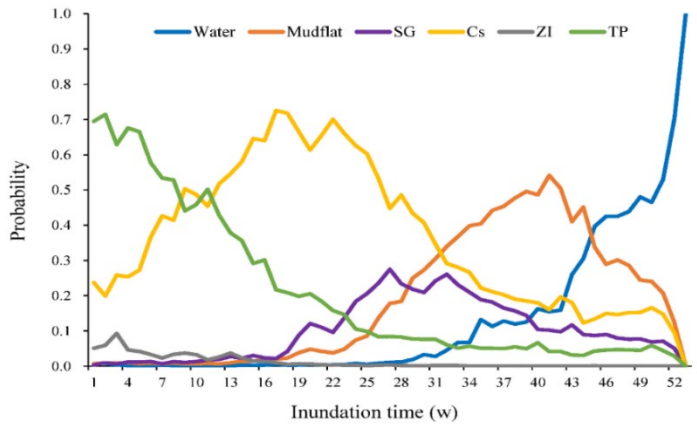
Inundation conditions of Poyang Lake during 2000-2009 by hydrodynamic model.

- Water and mudflats showed a decreasing trend, and all vegetation types showed an increasing trend in the Poyang Lake wetland.
- Inundation duration decreased significantly during 2000-2009.

- Hydrology is critical to wetland cover, but not the unique determined factor!



Optimal and suitable inundation conditions for different cover

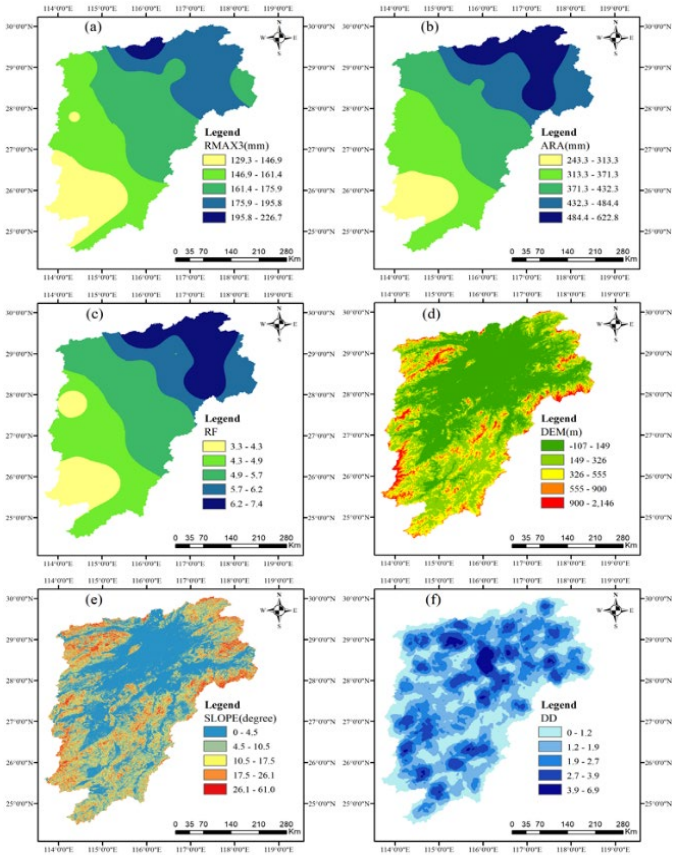


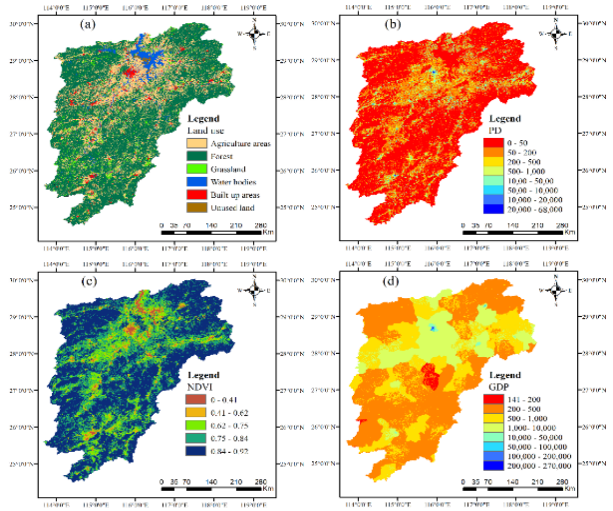
Occurrence probability of different cover types against inundation conditions

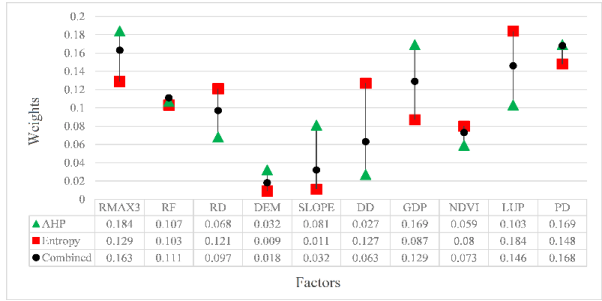
Long and short-term flood risk assessment using the multi-criteria analysis model

- Long and short-term flood risk assessment using the multi-criteria analysis model

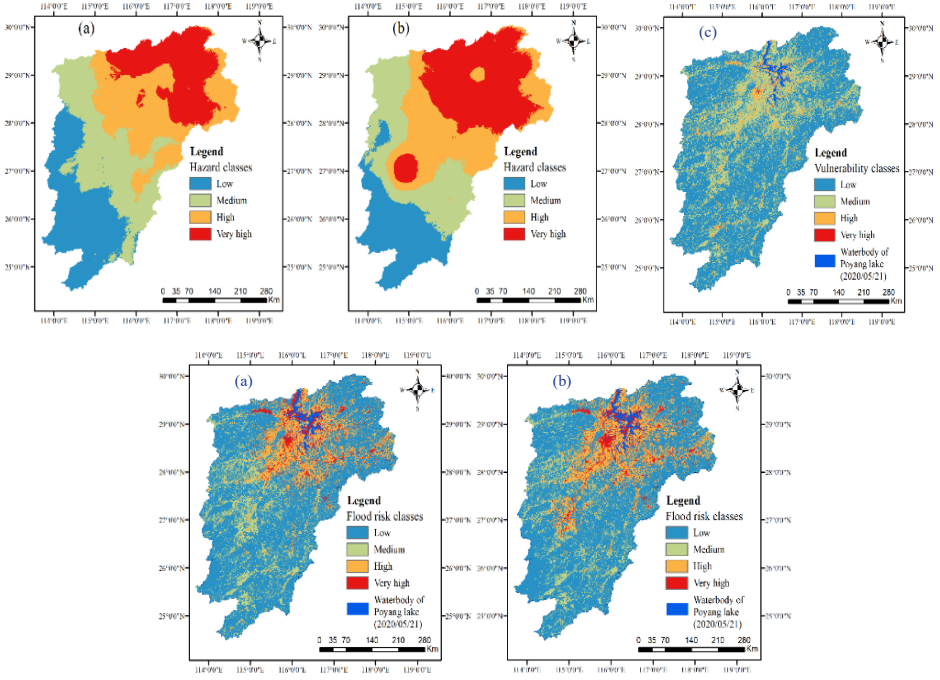
➢ The final weights for each factor were combined by the minimum relative entropy method based on AHP and entropy-derived weights.







	RMAX3	RF	RD	DEM	SLOPE	DD	GDP	NDVI	LUP	PD
AHP	0.184	0.107	0.068	0.032	0.081	0.027	0.169	0.059	0.103	0.169
Entropy	0.129	0.103	0.121	0.009	0.011	0.127	0.087	0.08	0.184	0.148
Combined	0.163	0.111	0.097	0.018	0.032	0.063	0.129	0.073	0.146	0.168



➢ The long and short-term flood risk maps show a similar spatial pattern with a correlation coefficient of 0.90.

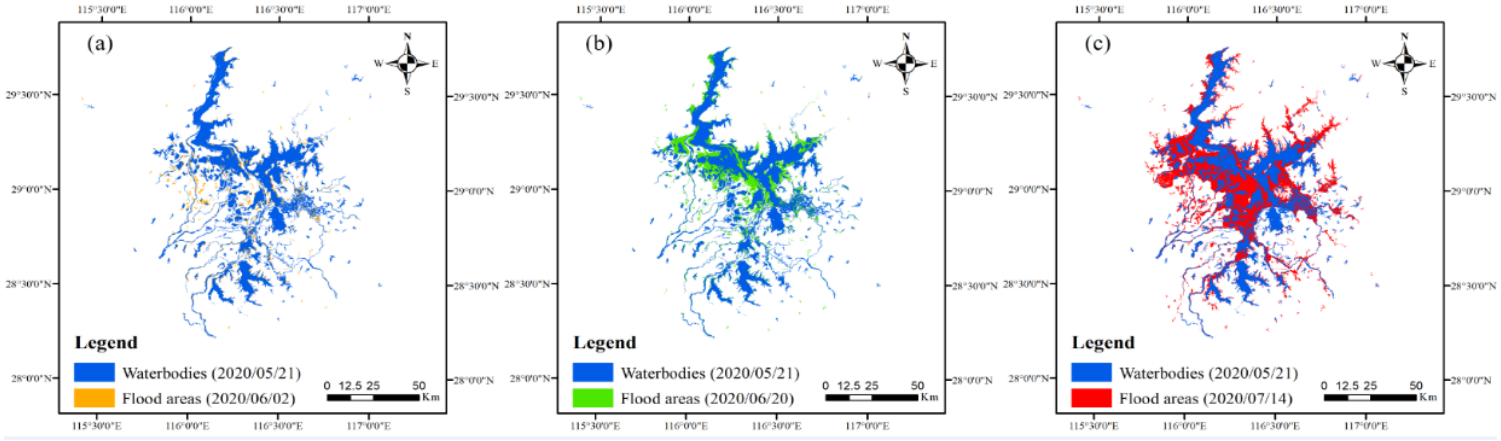
➢ The northeastern parts of the Poyang Lake basin are more prone to floods.

➢ The flood risk gradually decreases from the Poyang Lake towards the surrounding areas.

Long and short-term flood risk assessment using the multi-criteria analysis model

- Long and short-term flood risk assessment using the multi-criteria analysis model
  - The short-term flood risk was validated using the catastrophic flood during the summer of 2020 in the Poyang Lake region.
  - There was a high agreement between the flood risk assessment map and monitored floods extracted from Sentinel-1 SAR images.
  - The flood risk assessment model has an accuracy of more than 50% in very high-risk zones for floods, and more than 90% for high and very high-risk floods.

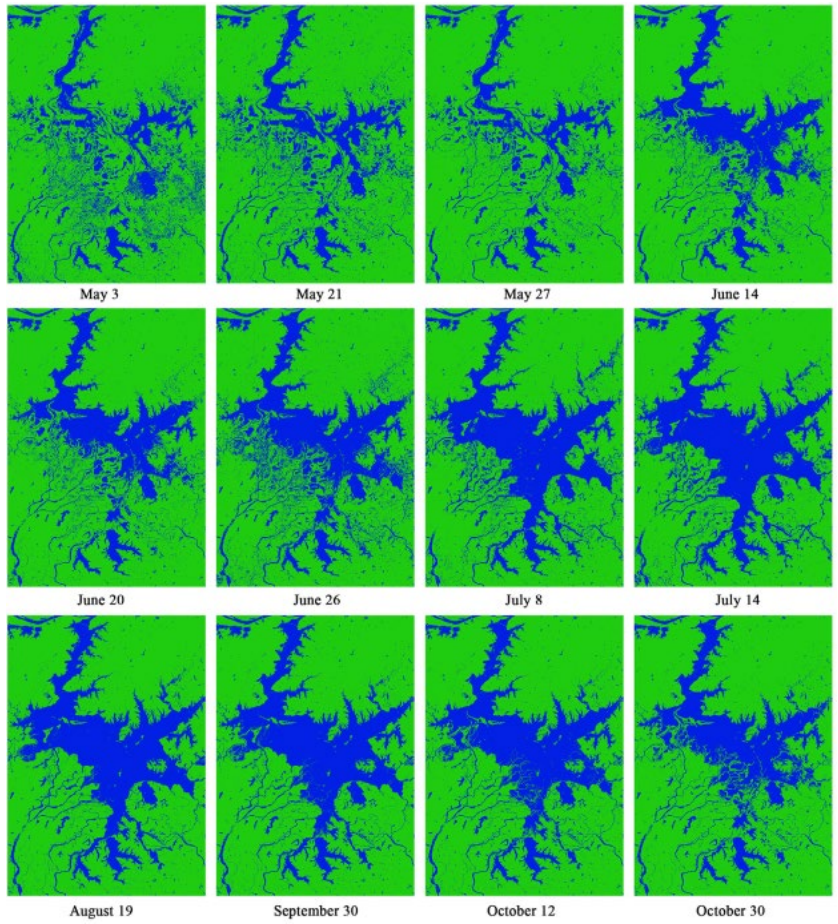
Risk classes	Area (km2) of flood risk classes	Percentage of each risk class
Low	10.40	66.43%
Medium	1.78	11.37%
High	2.85	18.18%
Very high	0.63	4.02%

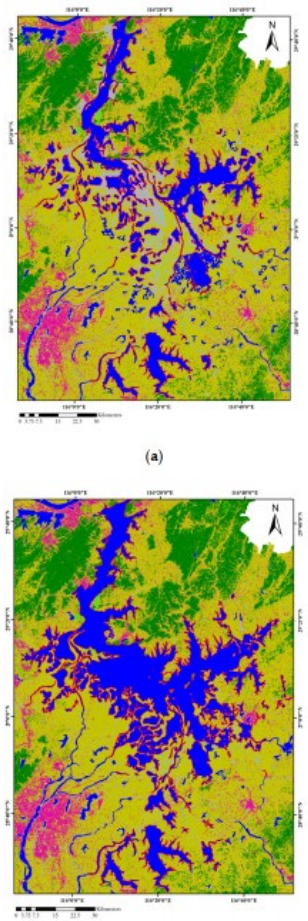


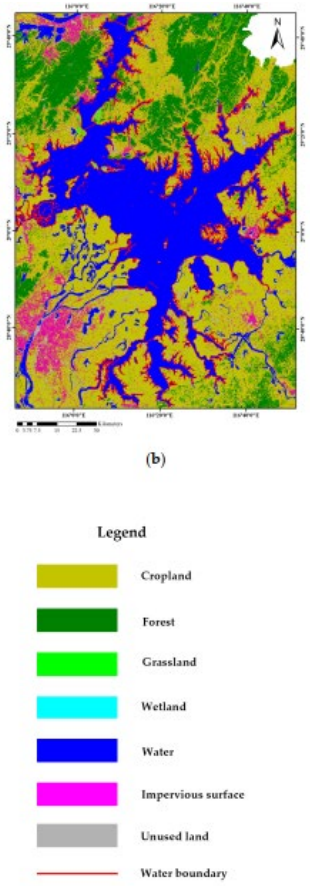
- ✓ On June 2, 2020, the area under very high flood risk assessed by the flood risk model accounted for 52.65%, followed by the area under high flood risk with 42.92%.
- ✓ On June 20, 2020, the presented flood risk model accurately predicted 77.66% of flood-prone areas with a very high-risk level, followed by the area under high flood risk with 14.99%.
- ✓ On July 14, 2020, the area under high and very high flood risk assessed by the flood risk model accounted for 91.39%, among which the area under very high flood risk with 51.19%.

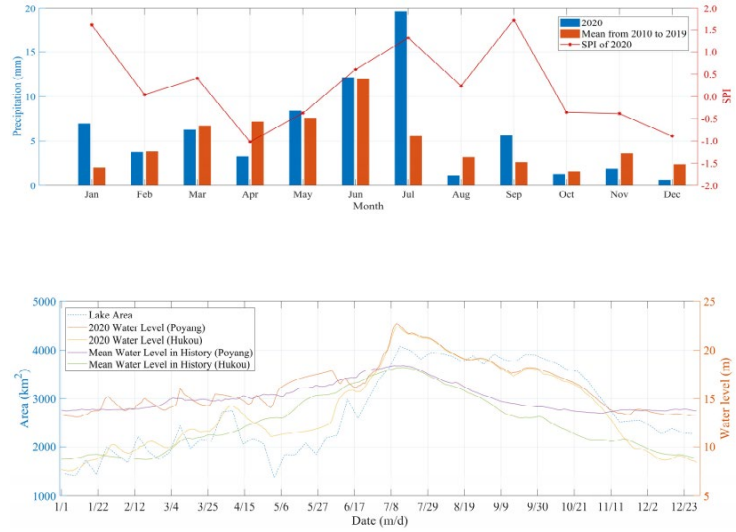
Full Lifecycle Monitoring on Drought-Converted Catastrophic Flood Using Sentinel-1 SAR

- Full Lifecycle Monitoring on Drought-Converted Catastrophic Flood Using Sentinel-1 SAR



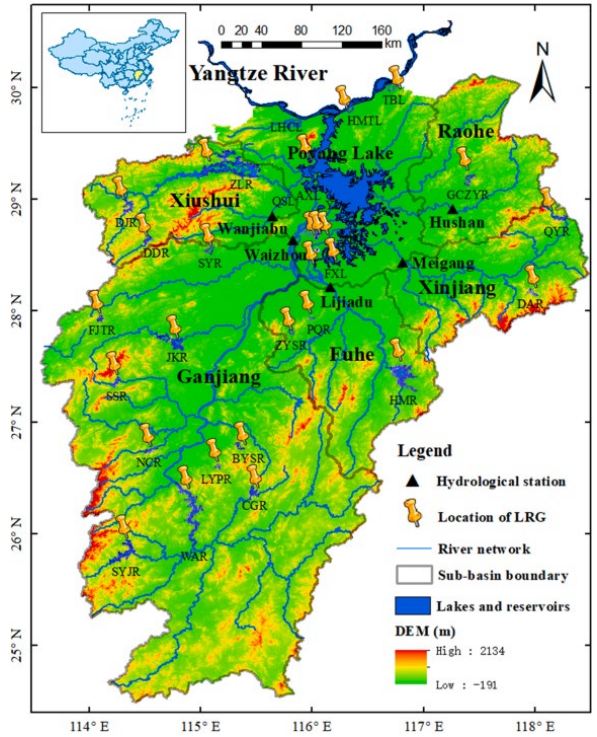


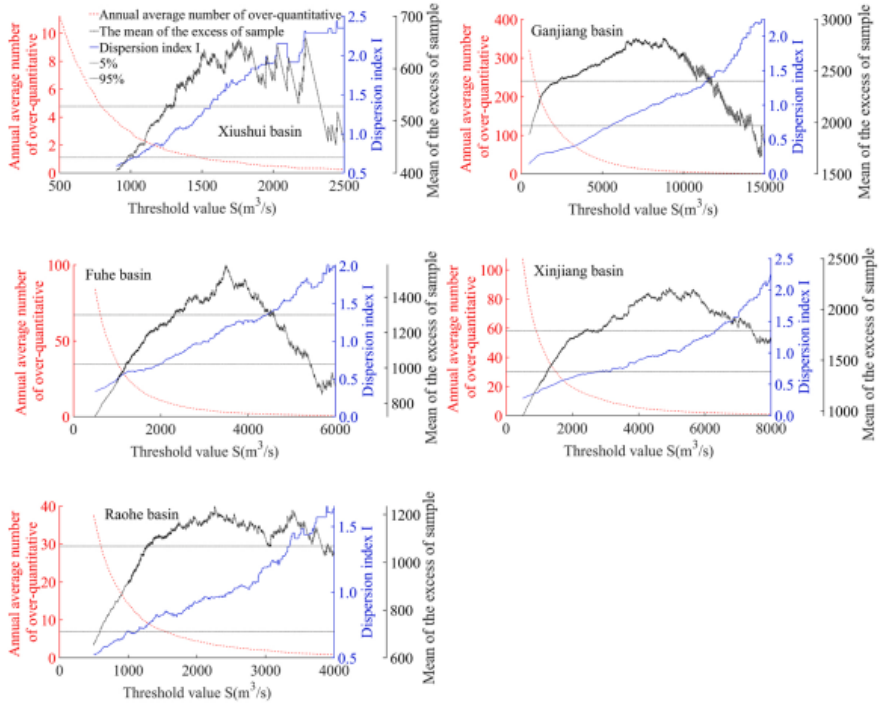


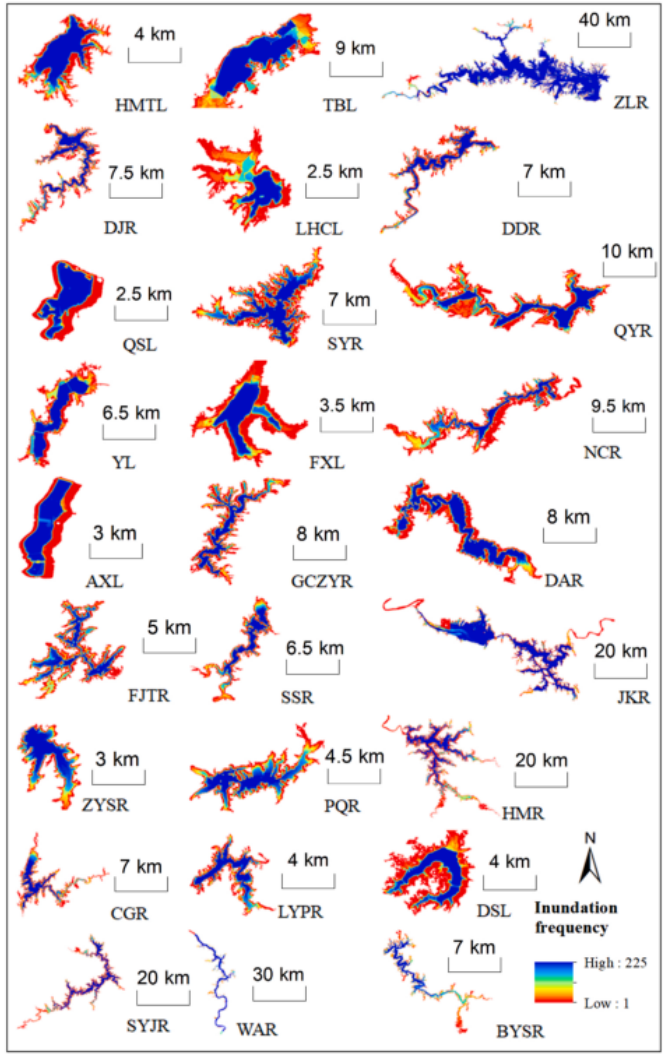


Flood mitigation effects of lake-reservoir group on the Poyang Lake watershed

- Flood mitigation effects of lake-reservoir group on the Poyang Lake watershed based on runoff-weighted model from multi-satellite weekly observation





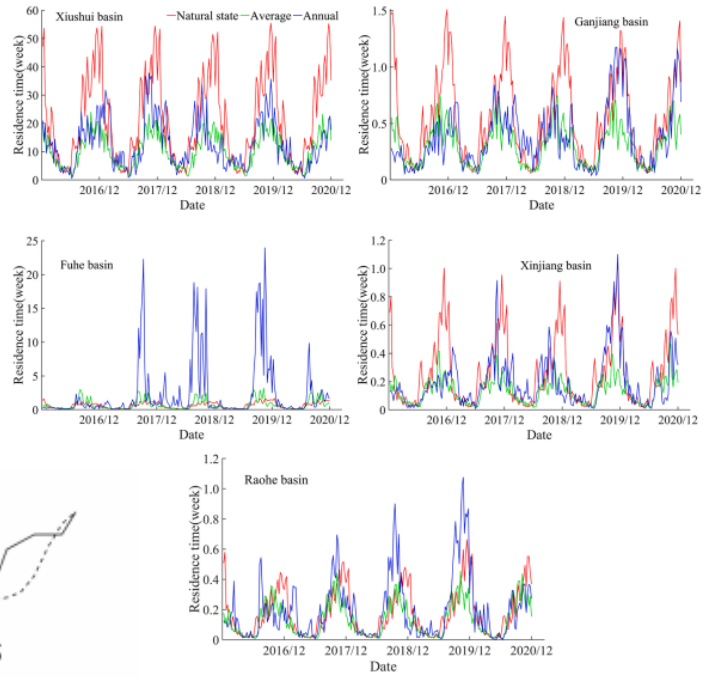


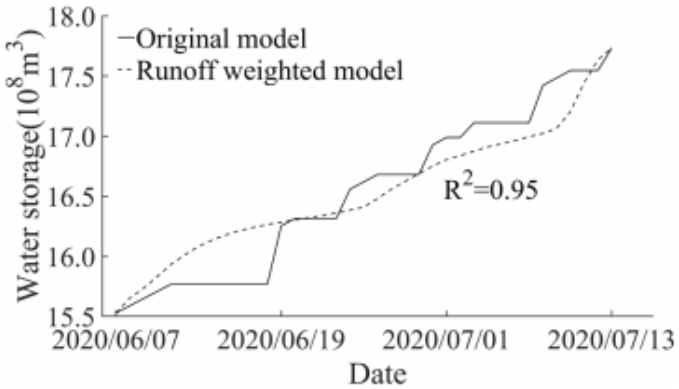
- Water boundaries of 27 lakes and reservoirs in the Poyang Lake watershed were extracted from 1300 GF-1 WFV images and 3500 Sentinel-1 SAR images during 2016-2020.
- Weekly water storage was calculated based on the capacity-area model.
- Flood events were determined based on Peaks-Over-Threshold (POT).

Flood mitigation effects of lake-reservoir group on the Poyang Lake watershed

- Flood mitigation effects of lake-reservoir group on the Poyang Lake watershed based on runoff-weighted model from multi-satellite weekly observation

  - The proposed runoff-weighted model was prior to the calculated detained flood volume and residence time of the retained flood, compared to the traditional precipitation-ET model.



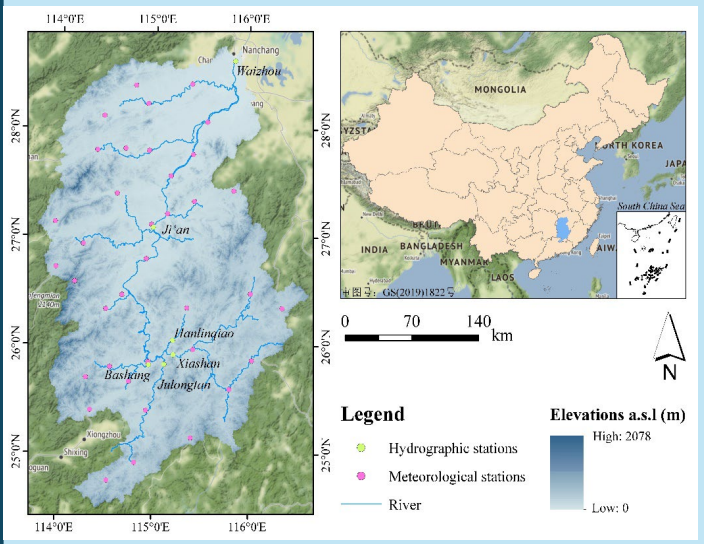


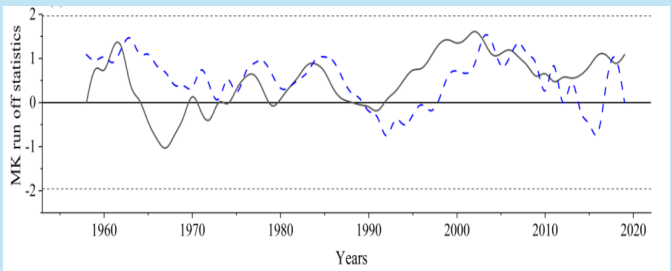
Flood detention and flood duration of the LRG in each basin of the Poyang Lake watershed from 2016 to 2020.

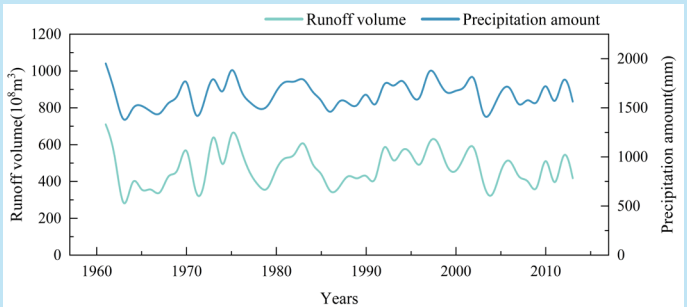
Basin	Start Date	Flood Peak Date	End Date	Flood Detention Capacity (10^8 m^3)	Annual Average Flood Detention Capacity (10^8 m^3)
Xiushui basin	2016/05/30	2016/07/05	2016/07/05	3.86	4.39
	2017/06/12	2017/06/24	2017/07/16	5.68	
	2020/05/27	2020/07/09	2020/08/01	3.65	
Ganjiang basin	2017/06/06	2017/06/30	2017/07/17	4.70	5.06
	2019/05/27	2019/07/11	2019/07/31	3.70	
	2020/05/21	2020/07/11	2020/07/31	6.78	
Fuhebasin	2016/05/06	2016/05/10	2016/05/18	2.14	1.64
	2017/05/19	2017/06/29	2017/07/20	1.97	
	2018/06/01	2018/07/07	2018/07/19	1.34	
	2019/05/27	2019/07/10	2019/08/07	1.47	
	2020/06/26	2020/07/10	2020/07/20	1.28	
Xinjiang basin	2016/04/07	2016/05/11	2016/05/11	0.69	0.54
	2017/06/01	2017/06/27	2017/07/24	0.67	
	2019/05/23	2019/07/10	2019/07/21	0.29	
	2020/05/16	2020/07/10	2020/08/01	0.49	
Raohe basin	2017/06/13	2017/06/25	2017/07/24	0.21	0.15
	2019/05/23	2019/07/13	2019/08/02	0.11	
	2020/04/28	2020/07/09	2020/07/15	0.12	

Water yield in the Ganjiang River Basin and its driving mechanism

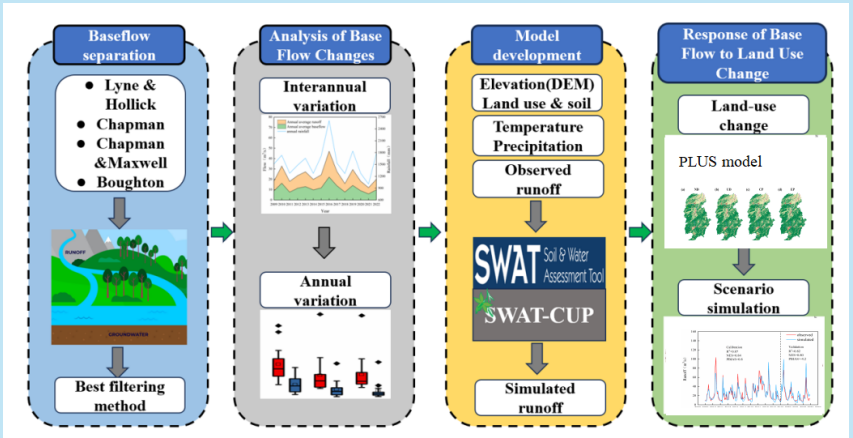
The study area and analysis of hydro-meteorological elements

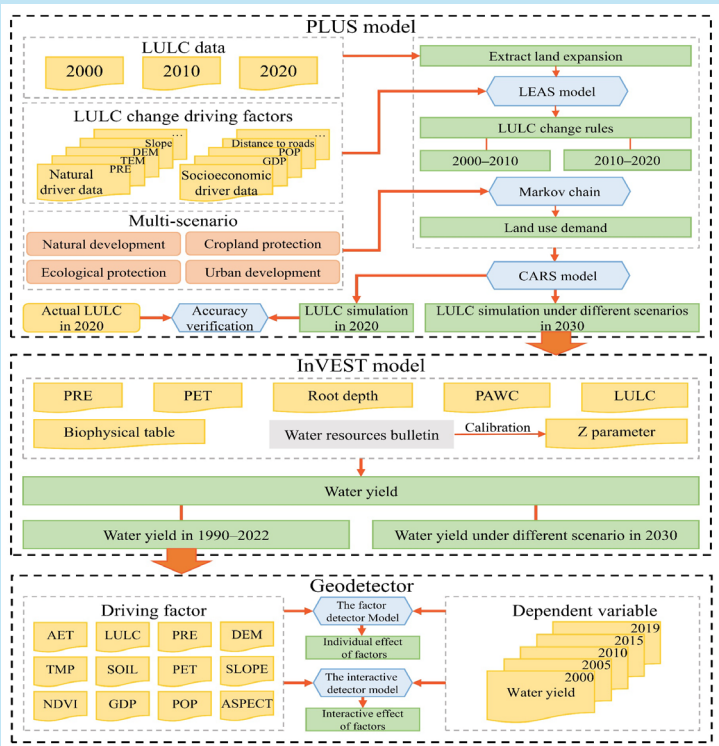




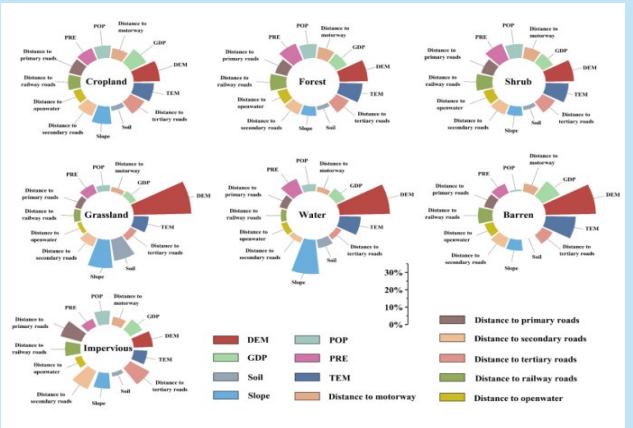


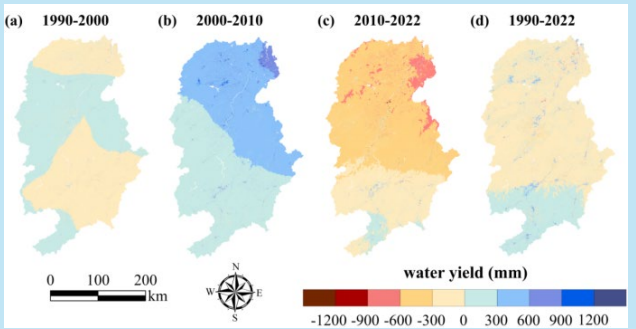
The framework of methodology

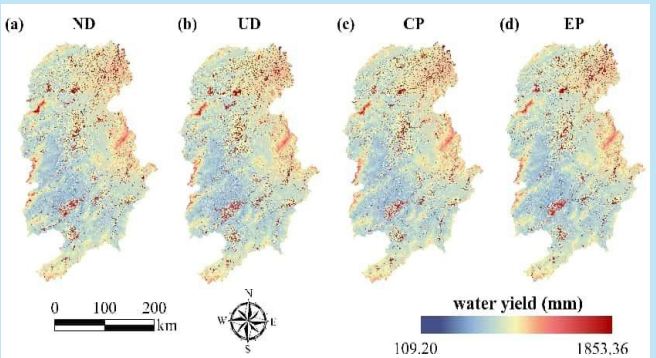




Results





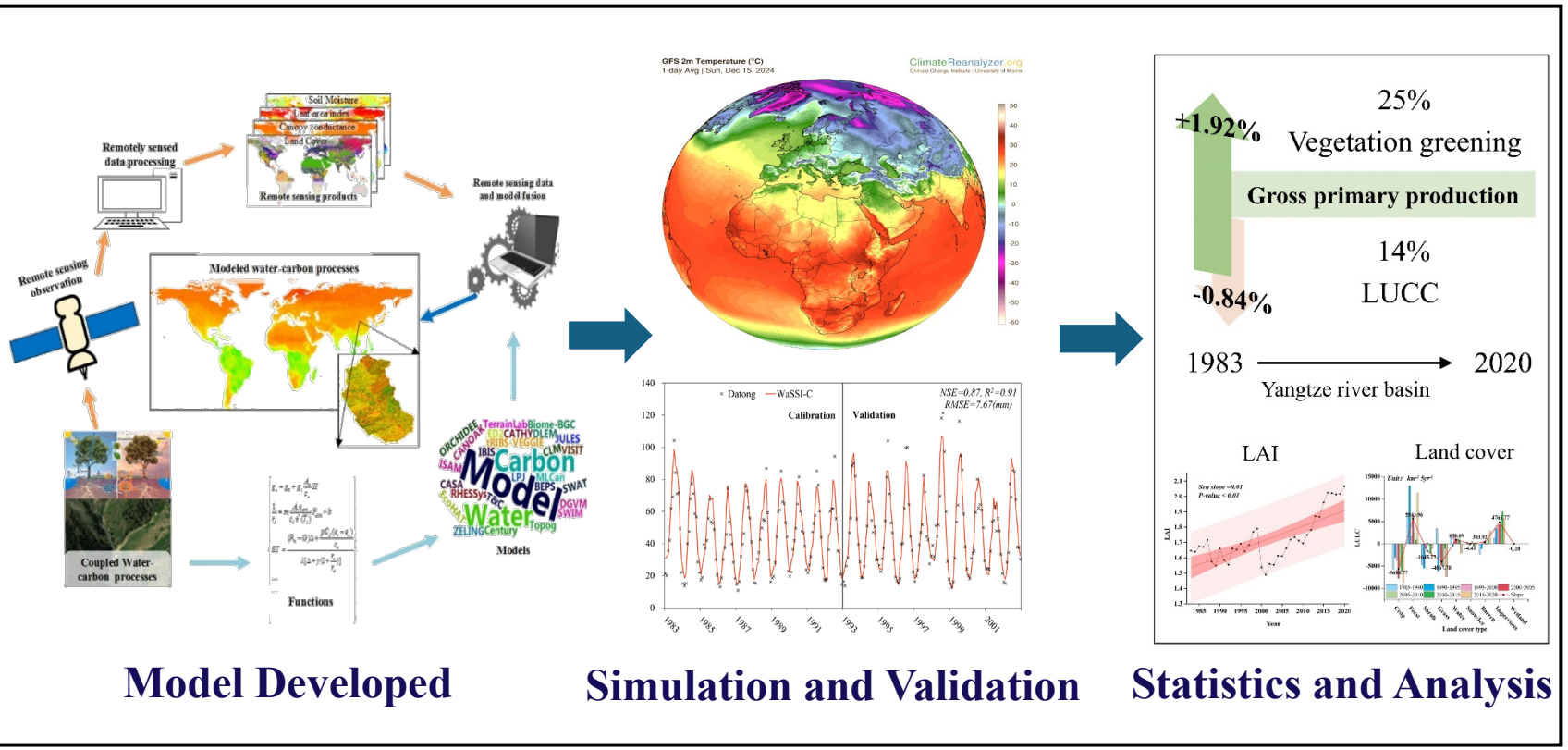


Water yield in the Ganjiang River Basin and its driving mechanism

- LULC changes and their driving mechanisms in the Ganjiang River Basin from 1990 to 2022
  - From 2010 to 2020, the topography (as revealed by the DEM) emerged as the dominant factor influencing all six LULC types;
  - The distance to tertiary roads stands out as the principal driver for the expansion of impervious surfaces, accounting for 34.75% of the changes observed.
- Water yield in the Ganjiang River Basin from 1990 to 2022
  - Over the 33-year period, the water yield in the GRB initially increased, followed by a decline, stabilizing at approximately 6.50×1010 m^3 from 2017 to 2022.
  - AET, LULC, and PRE were the primary factors affecting water yield.

Carbon-water cycle fluxes in terrestrial ecosystems of the Yangtze River Basin

Ecosystem services are undergoing impressive changes. This has profound implications for the carbon and water cycles, but human understanding is still relatively limited.



Methodology: We built a research solution based on the theory of water-carbon coupling combined with multi-source remote sensing technology.

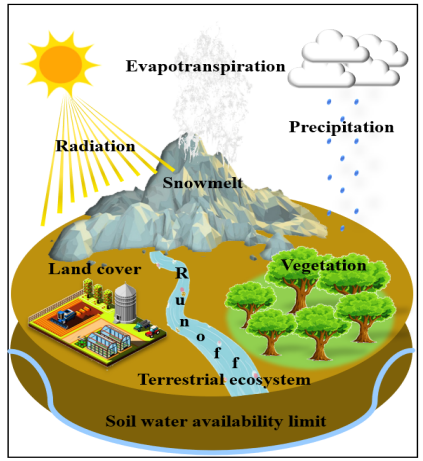
Goal: To investigate status of the water-carbon cycle and analyze the relationship between water-carbon fluxes and coupled elements.

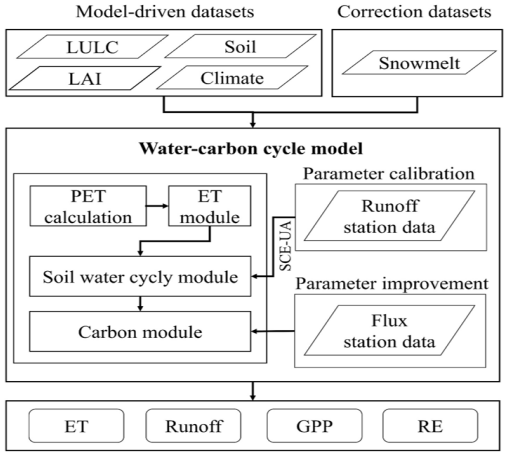
Carbon-water cycle fluxes in terrestrial ecosystems

Carbon - Water Cycle Coupled Models was developed and applied in the Yangtze River Basin(YRB)

Input

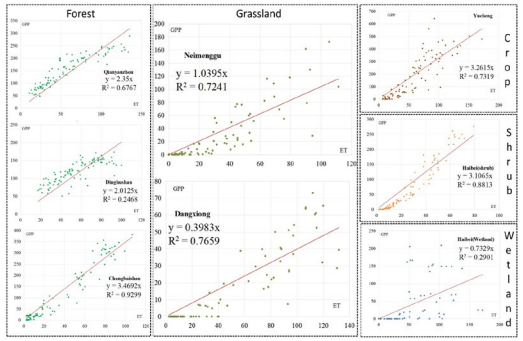
- Climate:(precipitation, temperature)
- Vegetation——leaf area index LAI)
- Soil:(texture, thickness, CN value)
- Land cover datasets
- Coupling parameter





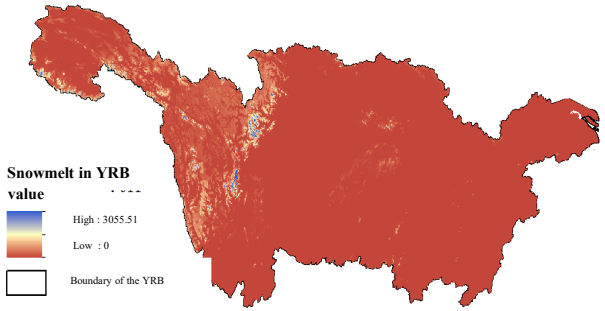
Model

Local Flux Site Data Driver



Copling Parameter Correction

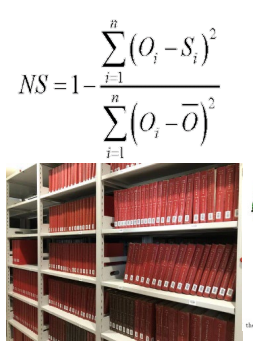
Snowmelt Water Sub-Input

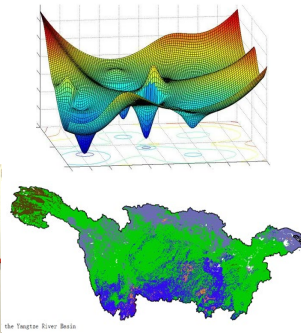


Water Balance Correction

Soil water availability

$$NS = 1 - \frac{\sum_{i=1}^{n}(O_i - S_i)^2}{\sum_{i=1}^{n}(O_i - \bar{O})^2}$$

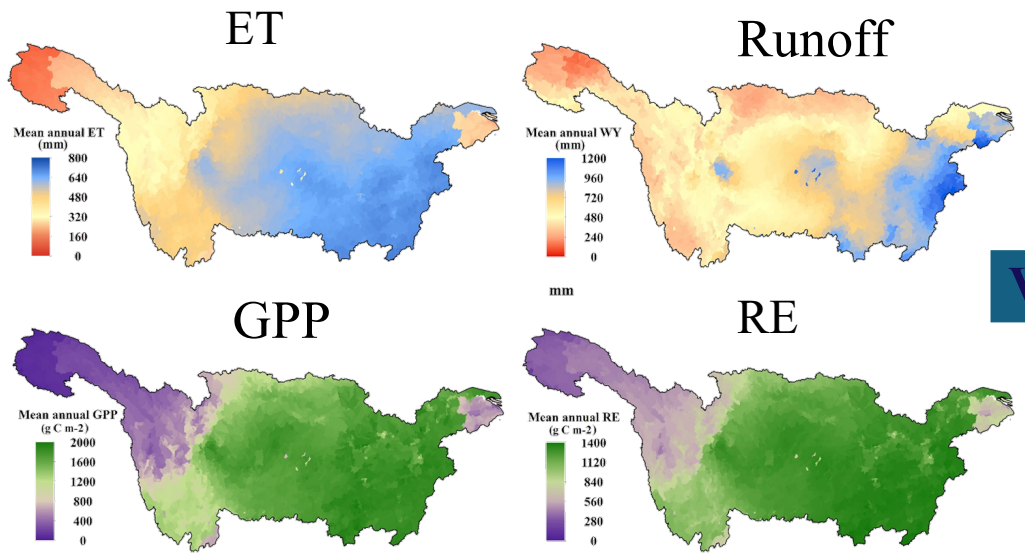




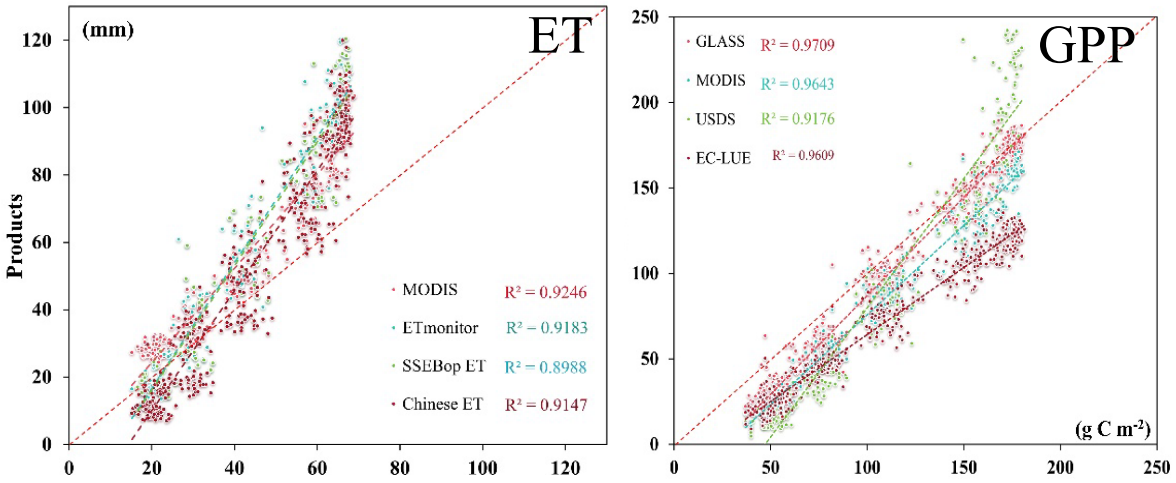
Soil parameter calibration

Carbon-water cycle fluxes in terrestrial ecosystems

Monthly water-carbon key fluxes in the Yangtze River Basin were simulated for the period 1983-2020.



Validation

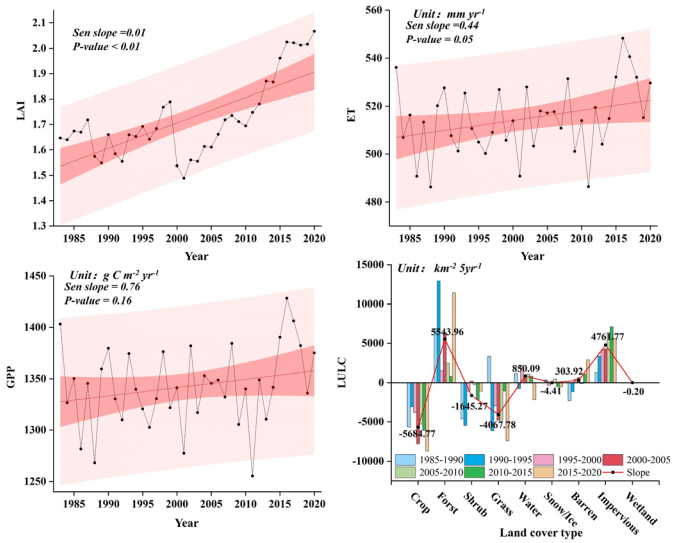


Simulation results: The annual mean ± standard deviation of ET, Runoff, GPP, RE are 515±15 mm yr^{-1}, 573±59 mm yr^{-1}, 1343±39 g C m^{-2} yr^{-1}, 1036±21 g C m^{-2}.

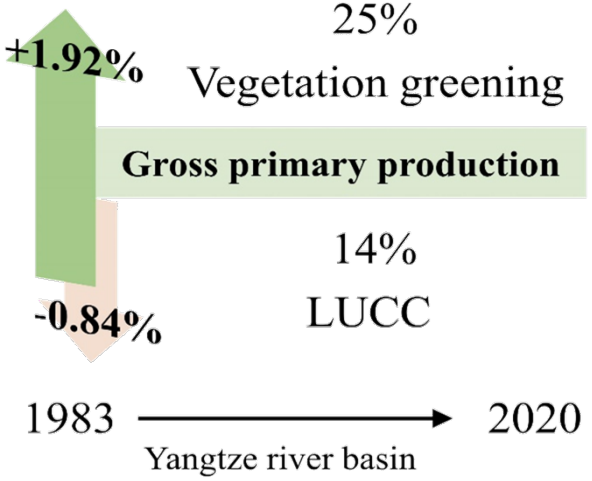
Validation results: The R^2 values for MODIS, ETmonitor, SSEBop, ETa, and Chinese Eta in ET products were 0.925, 0.918, 0.939, 0.915. The corresponding RMSE values were 16.89, 24.89, 18.01, and 18.77 (mm $month^{-1}$).

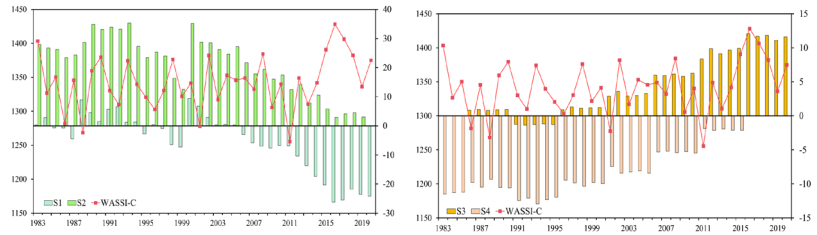
Carbon-water cycle fluxes in terrestrial ecosystems

To reveal the spatial and temporal trends of watershed fluxes of carbon and water with coupled environmental elements and their correlations through statistical analysis and scenario modeling.



Time-series analysis of key elements





Scenario simulation results

Conclusions:

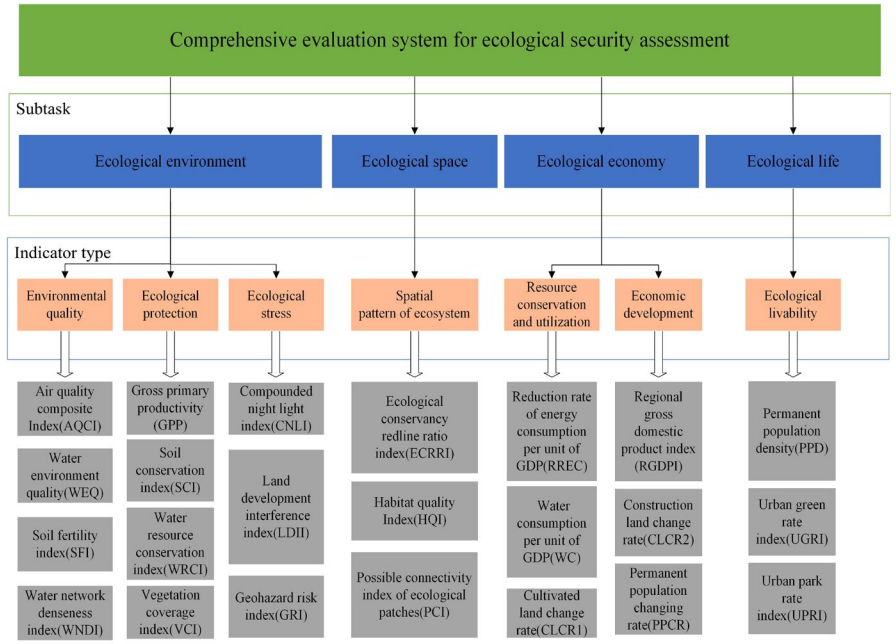
① Vegetation greenness compensated for the effects of anthropogenic LUCC on terrestrial ecosystem GPP and dominated past GPP growth in the YRB.

② Temperature, precipitation, ET, GPP, vegetation greenness show an increasing trend

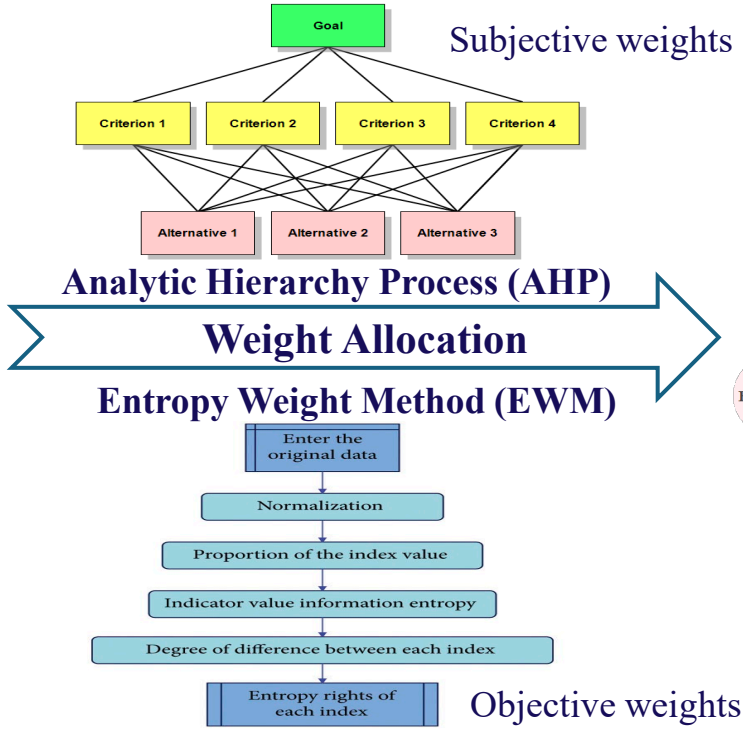
Comprehensive evaluation of ecological security

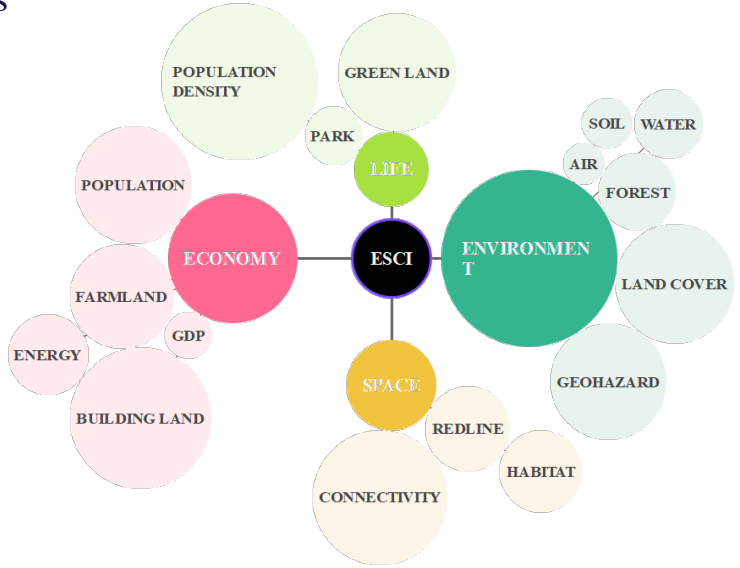
To solve the problem of limited effectiveness of existing ecological evaluation in integrating multi-source data, the study proposes an integrated universal framework.

Universal Ecological Safety evaluation Framework



Basic indicator framework(including water, soil, air, forest, society, etc.)

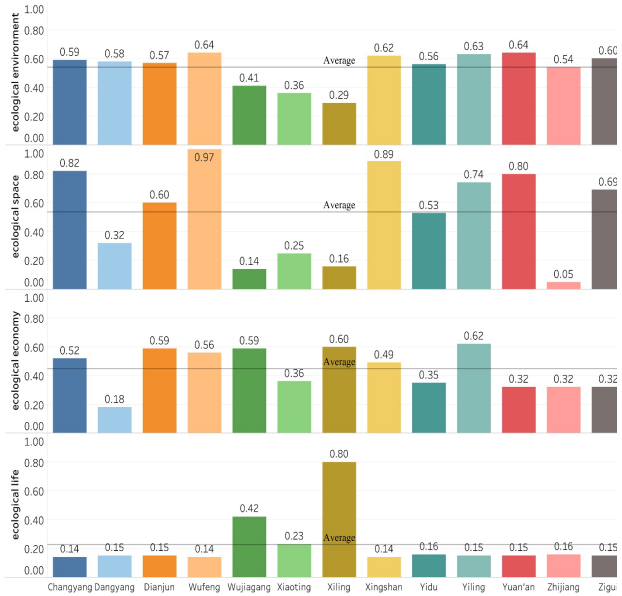




- A **Hierarchical Indicator Framework** based on 23 ecological evaluation indicators was developed.
- **Weight Allocation** combines the Analytic Hierarchy Process (AHP) and Entropy Weight Method (EWM).
- General **Ecological Security Comprehensive Index (ESCI)** was developed and applied to Yichang.

Comprehensive evaluation of ecological security

- **Our generalized framework has the following advantages: (1) actionable data collection (2) diverse assessment objectives (3) subjective-objective interaction.**



subindicators of each city



ESCI map

➢ **Imbalances within urban areas**:

Urban planning is unbalanced. Xiling District has the highest ESCI, but Yiling District, which is also the center of Yichang, has the lowest ESCI.

➢ **Imbalance between urban and suburban areas:**

Urban areas face environmental and livelihood challenges. Suburbs are economically and spatially backward.



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PART III VIRTUAL AND REAL COLLABORATIVE GEOGRAPHIC EXPERIMENTS FOR THE HUMAN-WATER RELATIONSHIP

PRESENTED BY: HUI LIN

➢ Twin Poyang Lake: A Human Water Relationship Experimental Platfo

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Realistic wetland landscape



Wetland migratory bird



Wetland landscape vegetation



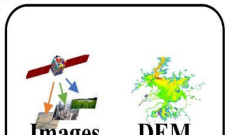
Typical wetland landscape scene

Modeling process of wetland virtual landscape

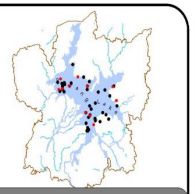
Data acquisition For Digital twin

Wetland virtual element modeling and scenario integration

Browser deployment and Cloud Render



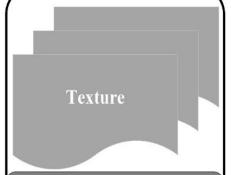
Images and DEM



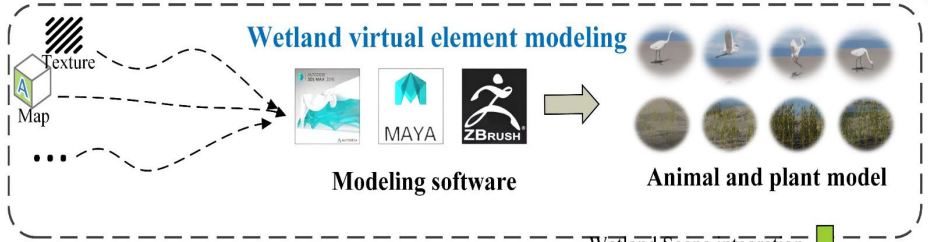
Shpfiles

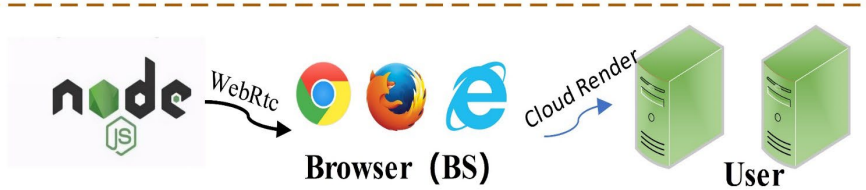


UAV and 3D scanning



Texture and map data

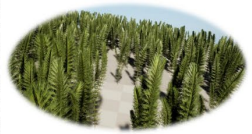




Virtual wetland landscape



Wetland migratory bird model



Wetland landscape vegetation model



Typical wetland landscape virtual scenarios

The Digital Twin of Poyang Lake uses UAV imagery, DEMs, and 3D scanning to build a detailed wetland model. Virtual birds and vegetation are created with MAYA for ecological realism. Unreal Engine and Cesium enable interactive simulation. Cloud rendering and browser access support real-time use and ecological monitoring.

➢3D Models: Migratory bird

Modeling migratory birds for Poyang Lake wetland required detailed consideration of external characteristics, body structures, and realistic proportions. Following species-specific rules, we created high-precision 3D models of **8 migratory bird species, each with 4 distinct poses**.

Siberian Crane				Egretta			
walk	fly	landfall	foraging	walk	fly	landfall	foraging
Platalea leucorodia				**Hooded Crane**			
walk	fly	landfall	foraging	walk	fly	landfall	foraging
White-naped Crane				**Ciconia boyciana**			
walk	fly	landfall	foraging	walk	fly	landfall	foraging
Oriental black stork				**swan goose**			
walk	fly	landfall	foraging	walk	fly	landfall	foraging



➢3D Models: Vegetation

Phragmites community

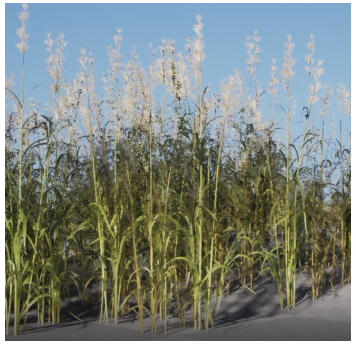




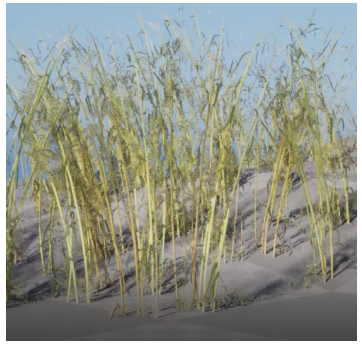
Sprout



Grow



Mature

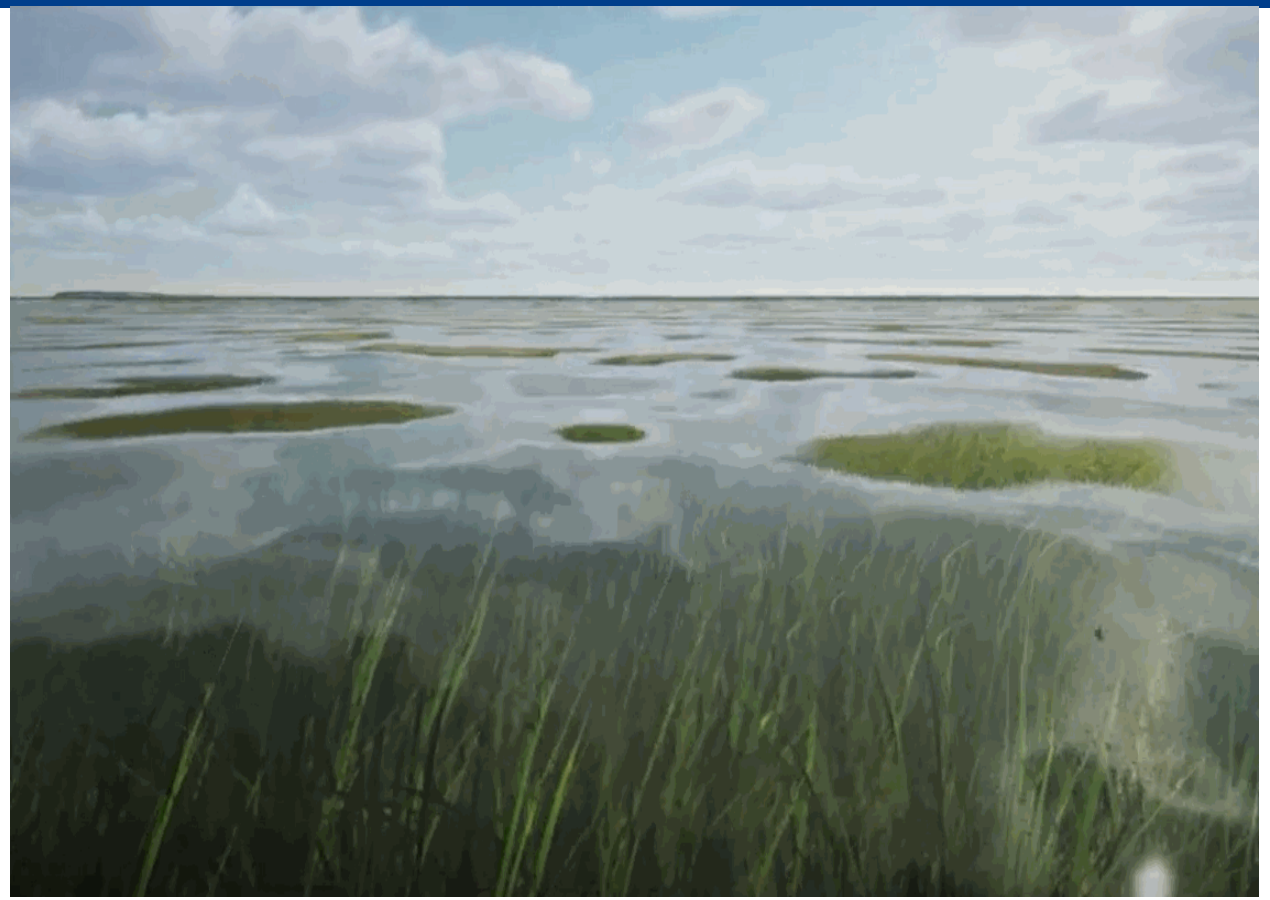


Decay

- Twelve prevalent wetland vegetation species, sourced from aquatic, marsh, and sandy landscapes.

- Four distinct morphological changes throughout their growth stages: sprout, grow, maturity, and decay.

➢ **3D Models:** Wetland landscapes at different water levels











Water levels between 75 and 120 cm are optimal for bitterbrush growth. In contrast, environmental stresses may be increased within a water level range of 50-60 cm before leading to gradual wilting at water levels below 50 cm. However, the complete depletion of the lake water surface can result in the complete wilting of bitterbrush.

➢ **Scientific Models:** Hydrological and hydrodynamic models

Built on a robust 3D foundation platform, the system integrates advanced hydrological and hydrodynamic models including SWAT, HEC-RAS, and FVCOM. These models enable realistic simulation of flood dynamics in Poyang Lake, providing critical decision support for flood risk assessment and management.



SWAT



HEC-RAS



FVCOM

Simulation of the once-in-50-year flood event in Poyang Lake (2020)

➢ **Twin Poyang Lake:** A Human Water Relationship Experimental Platform

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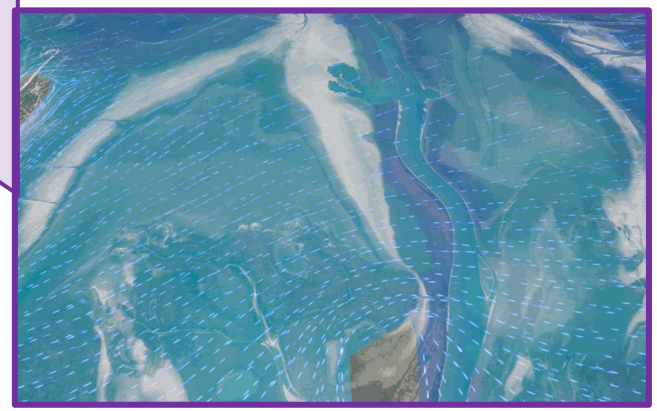
The future Digital Twin Poyang Lake platform will support simulation and experimentation of various scenarios, including floods, droughts, water pollution, and hydraulic engineering.





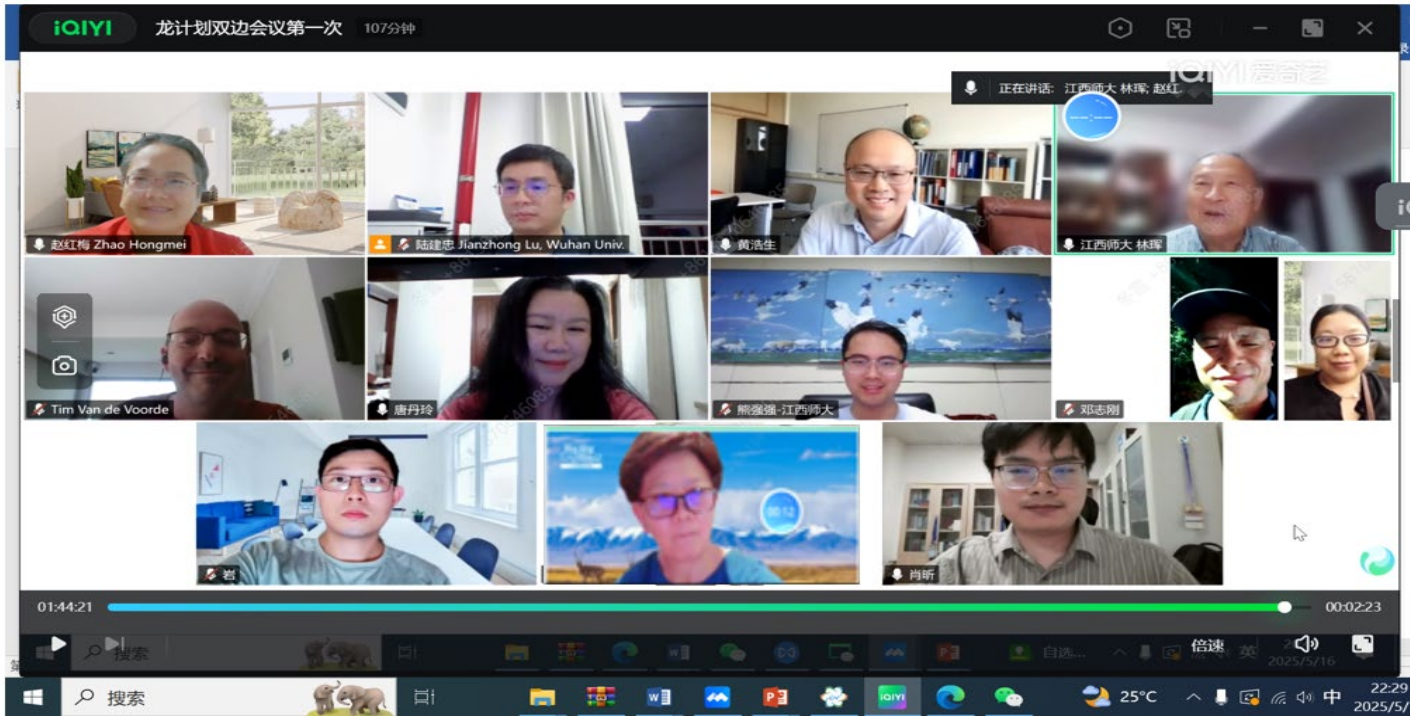


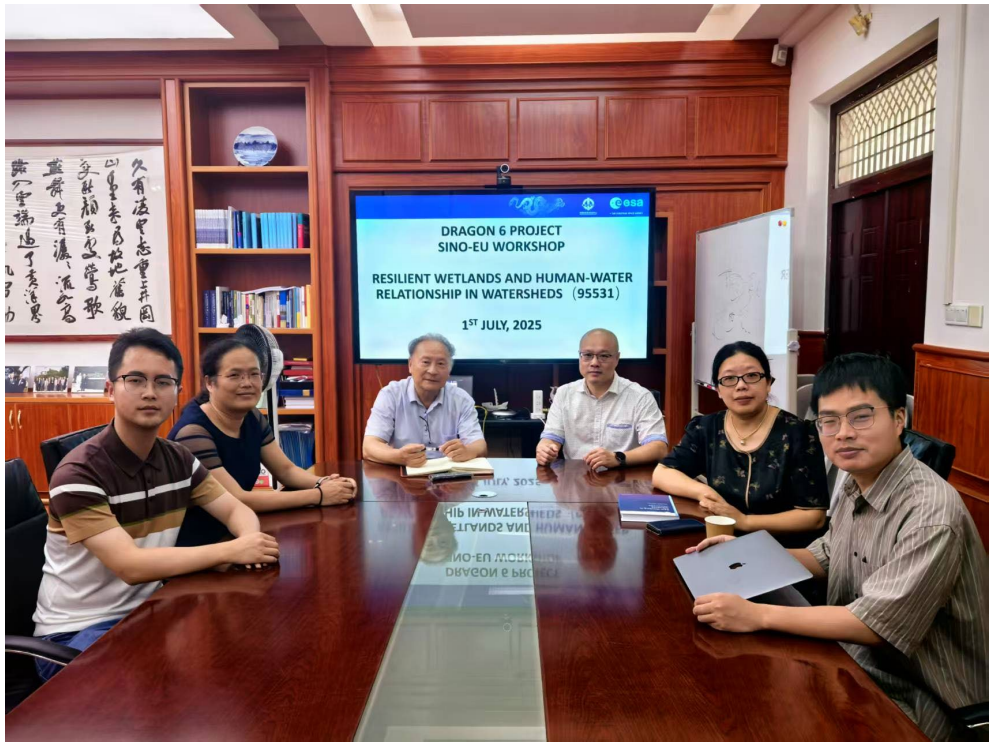




Future work

- ✓ Joint supervision and awarding of doctorate between Ghent University and Jiangxi Normal university
- ✓ Collaborative Publications on resilient wetland and human-water relations
- ✓ Strengthen bilateral exchange and visits







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Thanks for your attention !