ESA–MOST Dragon Cooperation
中国科技部-欧洲空间局“龙计划”合作

# EOWAQYWET
# ID 32442

# New Earth Observations tools for Water resource and quality monitoring in Yangtze wetlands and lakes

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Dr. Claudia KUENZER, Pr. WANG Yeqiao, Pr. S. LOISELLE, Pr. DUAN Hongtao

26–30 June 2017 | Copenhagen, Denmark
2017年6月26-30日，丹麦 哥本哈根

# DRAGON 4 EOWAQYWET

## New Earth Observations tools for Water resource and quality monitoring in Yangtze wetlands and lakes

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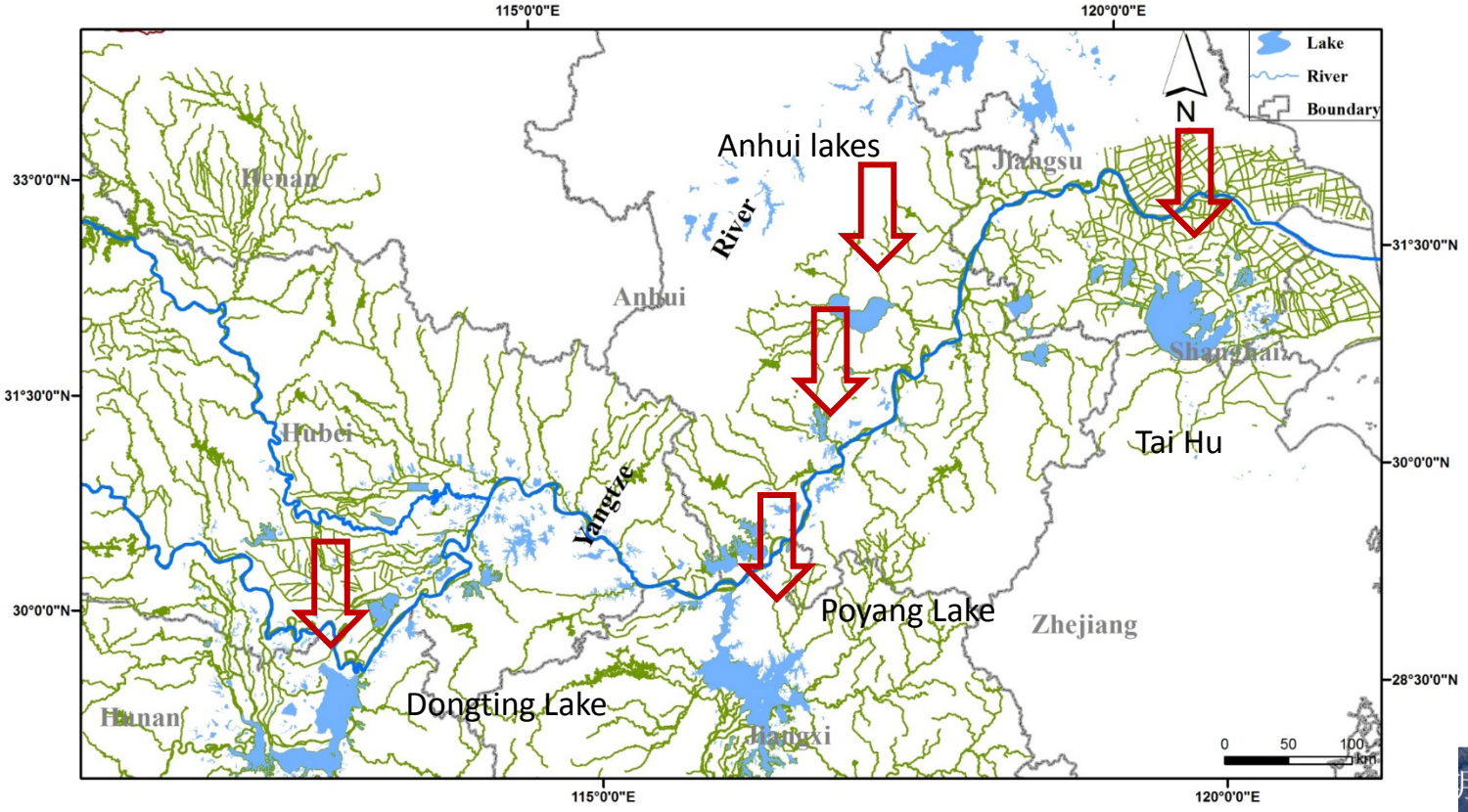
### 1 - WaRYWeBio
Water resource behaviors in Yangtze intermediate basin and wetlands' biodiversity

### 2 - BioGeoLakes
New Earth Observation tools for biogeochemical studies of Yangtze Valley lakes

# EOWAQYWET – Study areas



# One year of life of DRAGON 4 EOWAQYWET

Data Access (EO & in situ)

Publications activities

Key events

Young scientists contribution

Academic exchange

# EO data access

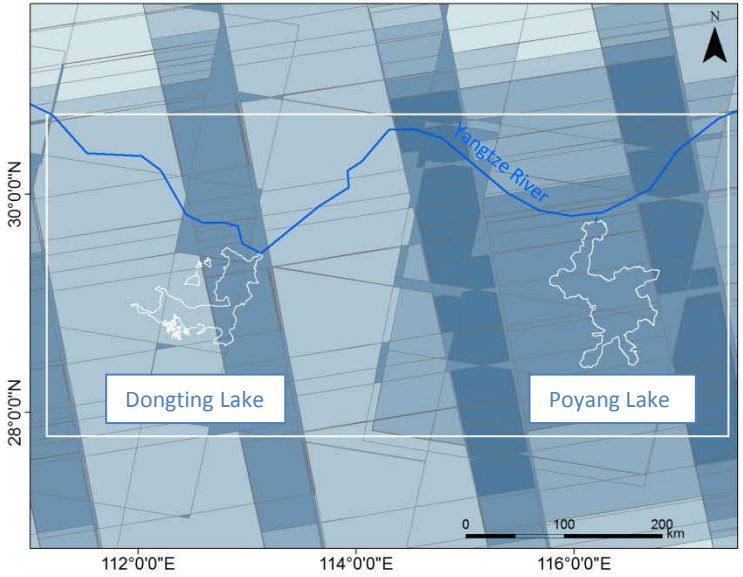
| ESA & ESA TPM DATA | Nos. scenes or inform if by FTP |
|---|---|
| ERS SAR | |
| ASAR | |
| MERIS | |
| AATSR | |
| SMOS | |
| etc.Radarsat | 12 |
| **TOTAL** | |

| SENTINELS 1, 2 & 3 DATA | Nos. scenes |
|---|---|
| Sentinel 1-A/B SAR | 300 |
| Sentinel 2-A/B MSI | |
| Sentinel 3-A OLCI | |
| Sentinel 3-A SLSTR | |
| Sentinel 3-A SLAR | No yet available |
| Etc. | |
| **TOTAL** | |

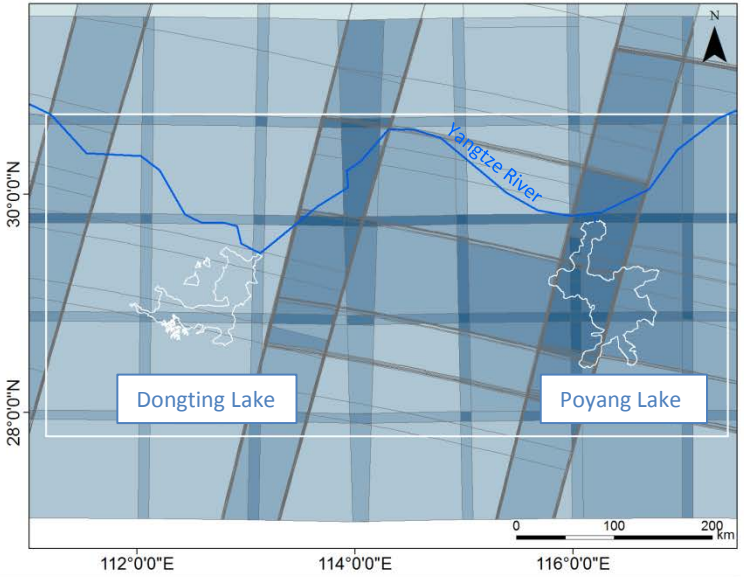
| CHINESE EO DATA | Nos. scenes |
|---|---|
| HJ-A/B | |
| GF-1 | 126 |
| GF-2 | |
| HY-A | |
| FY-1 | |
| Etc. ZY3 | |
| **TOTAL** | |

# Sentinel 1/2 data availability (acquisitions from beginning until 14.06.2017)

Sentinel-1A/B SAR-C, GRD, 818 Scenes, 1.2 TB data volume

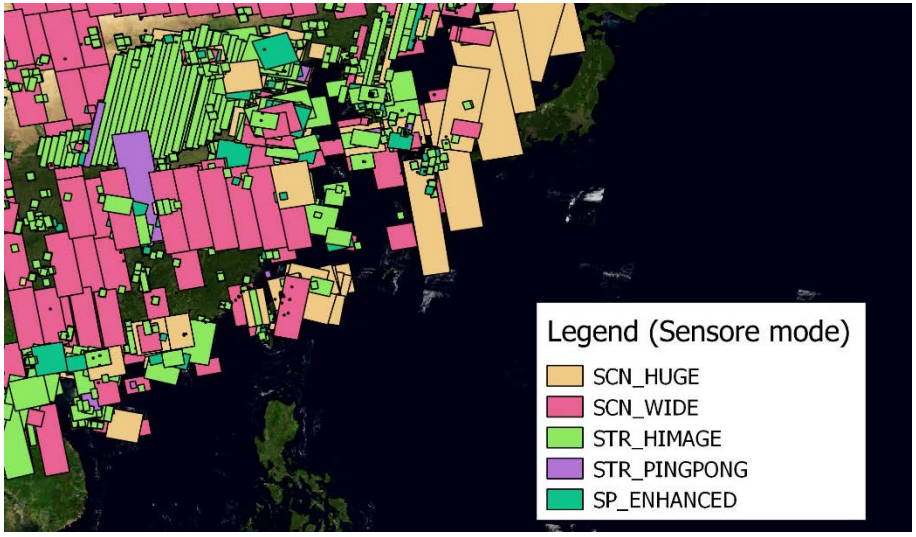


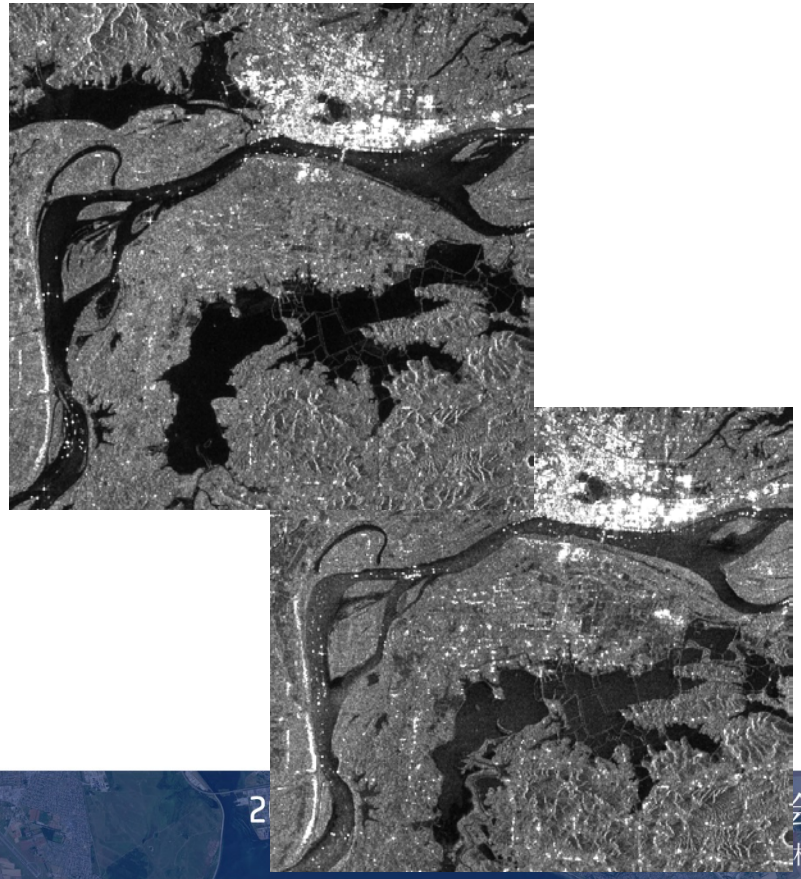

Sentinel-2A/B MSI, Level 1C, 1318 Scenes, 1.3 TB data volume




Number of scenes

# COSMO SKYMED ASI

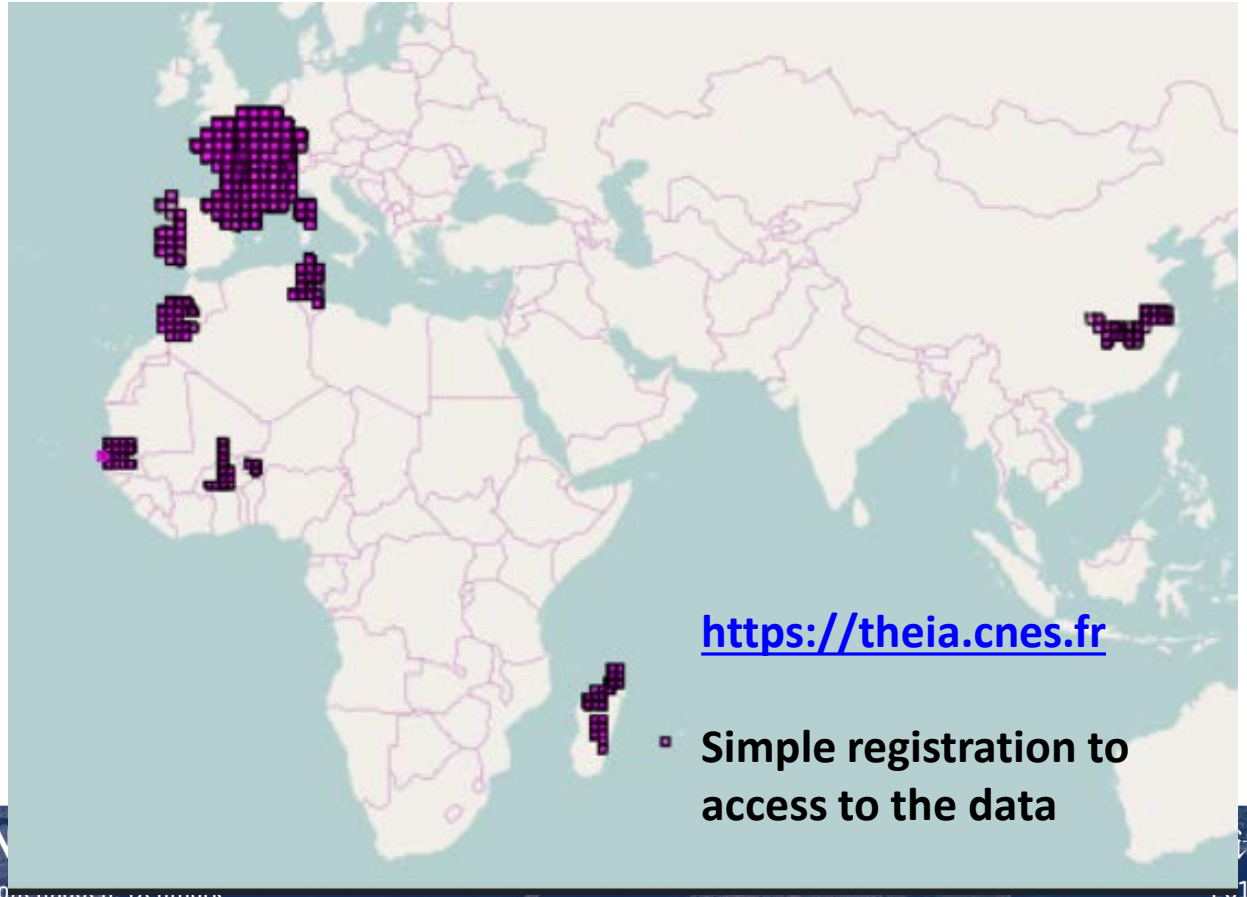


Two areas targeted: historical+ new acquisitions

- Dongting
- Anhui lakes

# Sentinel 2 Level 2: TOC data



https://theia.cnes.fr

- Simple registration to access to the data

# Sentinel 2 Level 2

10 jours

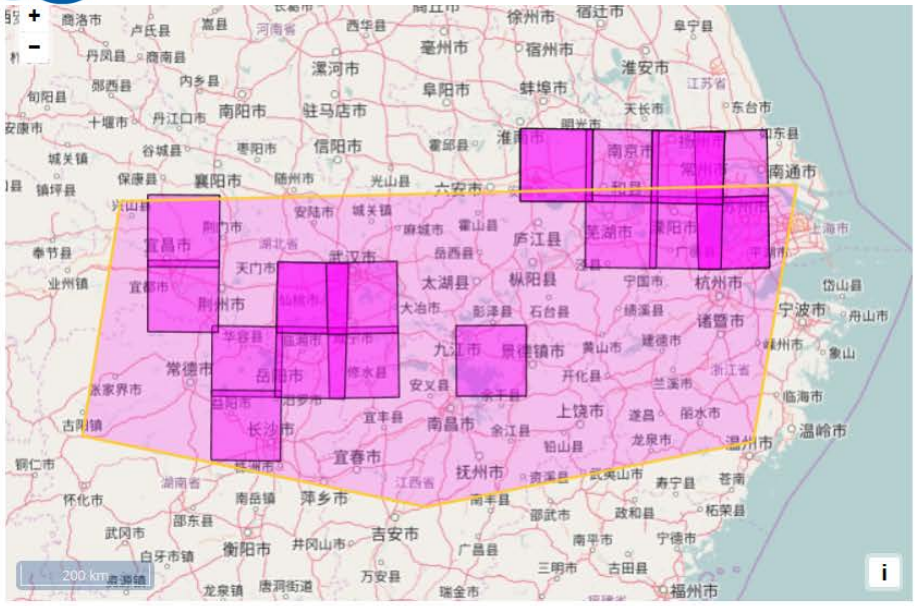
20-30 jours

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 50SNA | 50SPA | 50SQA | 51STR |
| 49RDQ | 49REQ | | | | | | 50RNV | 50RPV | 50RQV | 51RTQ |
| | 49REP | 49RFP | 49RGP | 50RKU | 50RLU | 50RMU | 50RNU | | | |
| | | 49RFN | 49RGN | | 50RLT | 50RMT | | | | |
| | | 49RFM | | | 50RLS | 50RMS | | | | |


S2 systematic atmospheric correction based on MUSCATE processing chain (CNES CESBIO)

Accessible through THEIA Web site
**https://theia.cnes.fr**

# Sentinel 2 Level 2




DATE MIN

date...

DATE MAX

date...

SATELLITE

SENTINEL2A

INSTRUMENT

---

NIVEAU DE TRAITEMENT

LEVEL2A

TYPE DE PRODUIT

---

CAPTEUR

---

ORGANISME

Organisme

TUILE (EX: "T31TCJ")

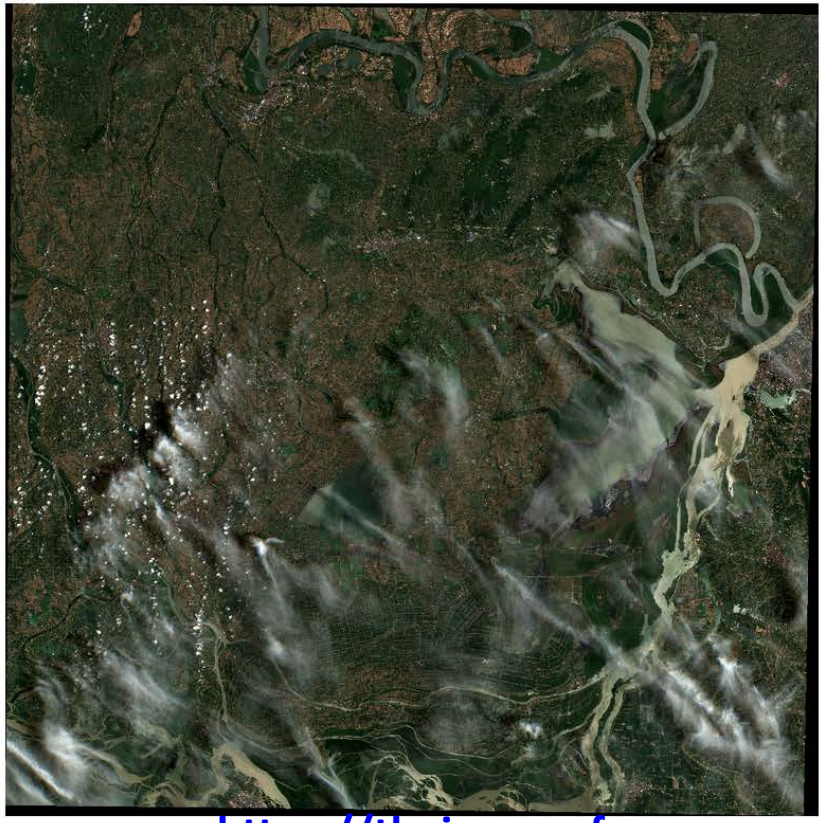
Tuile (ex: "T31TCJ")

mots-clefs

Dessiner une zone d'intérêt | Réinitialiser les filtres | Lancer la recherche

https://theia.cnes.fr

# Sentinel 2 Level 2: Dongting



https://theia.cnes.fr

| | |
|---|---|
| processingLevel | LEVEL2A |
| platform | SENTINEL2A |
| instrument | |
| resolution | 10 |
| sensorMode | |
| orbitNumber | 10225 |
| updated | 2017-06-11T06:09:35Z |
| published | 2017-06-11T06:09:35Z |
| waterCover | 0 |
| snowCover | 0 |
| cloudCover | 21 |
| version | 1-4 |
| location | T49RFN |
| productionDate | 2017-06-11T03:55:20Z |
| bands | B2;B3;B4;B5;B6;B7;B8;B8A;B11;B12 |
| thermBands | |

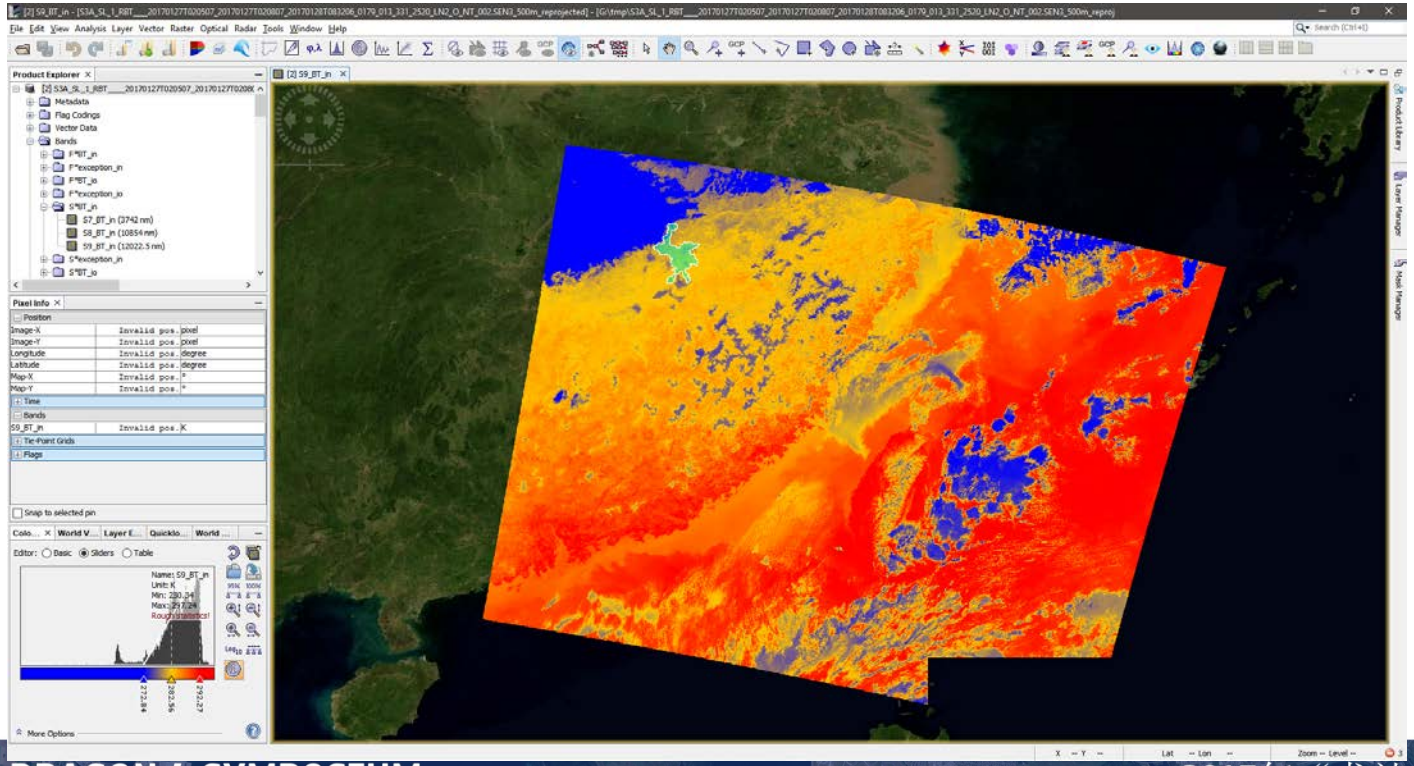
# Sentinel 2 Level 2: Thai Hu

https://theia.cnes.fr

| | |
|---|---|
| processingLevel | LEVEL2A |
| platform | SENTINEL2A |
| instrument | |
| resolution | 10 |
| sensorMode | |
| orbitNumber | 10239 |
| updated | 2017-06-11T15:15:08Z |
| published | 2017-06-11T15:15:08Z |
| waterCover | 0 |
| snowCover | 0 |
| cloudCover | 43 |
| version | 1-4 |
| location | T51RTQ |
| productionDate | 2017-06-11T14:51:11Z |
| bands | B2;B3;B4;B5;B6;B7;B8;B8A;B11;B12 |

# Sentinel3 SLSTR

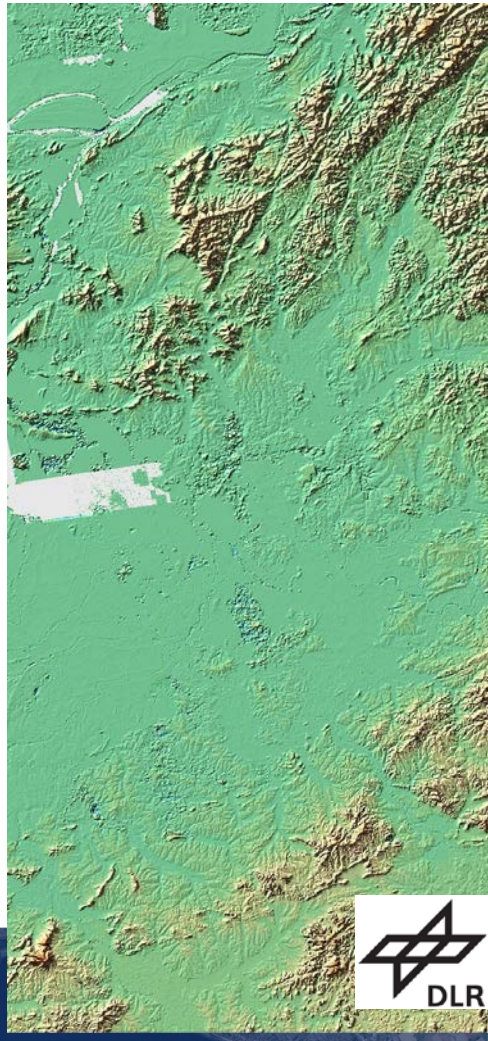
## Validation of water surface Temperature



# DLR Tandem X DEM

- 30 m: credit 11 tiles, ordered : 4 tiles
- 12 m: credit de 16: 4 tiles

DEM_HYDR083 project
(many thanks Thomas Busche –DLR- to his strong support)

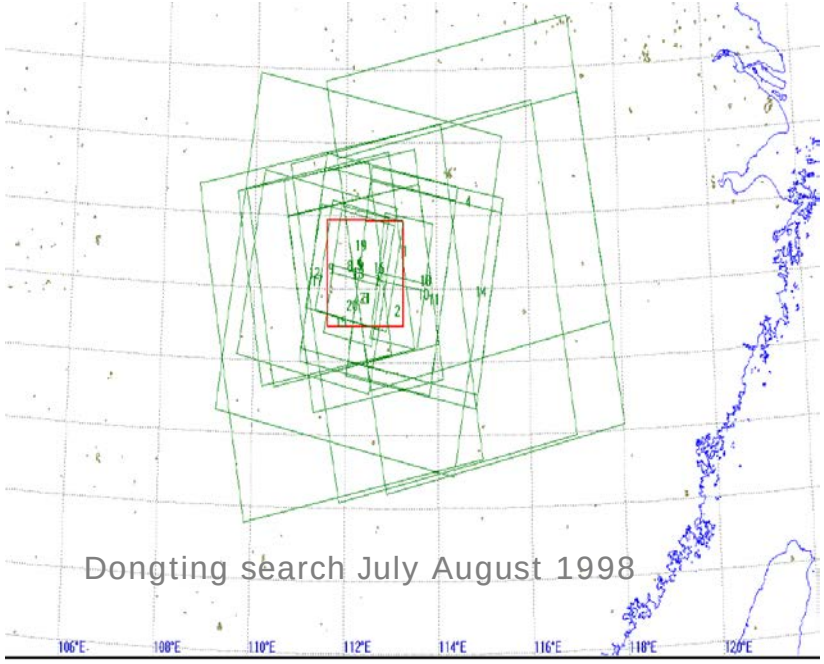


# Venus: Pending acceptance


Launch July 2017:
30 months mission
10 m
12 spectral bands (VIS PIR eq S2)
Every two days
Level 1 and Level 2A Level 3

# Radarsat over 1998 Yangtze historical flood

UM-SB Project Proposal id37253 (many thanks to Rafaelle Rigoli to his strong su

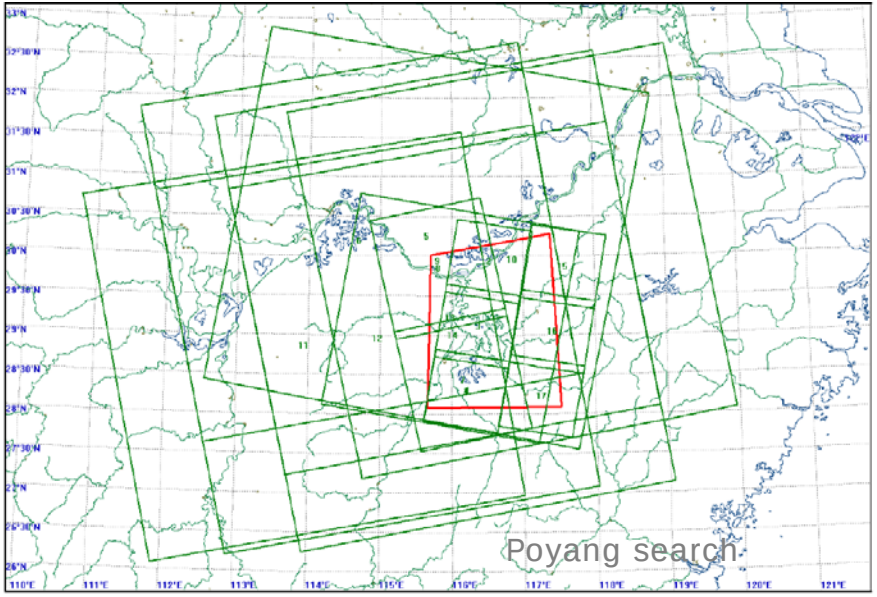



Dongting search July August 1998

sertit

LIESMARS

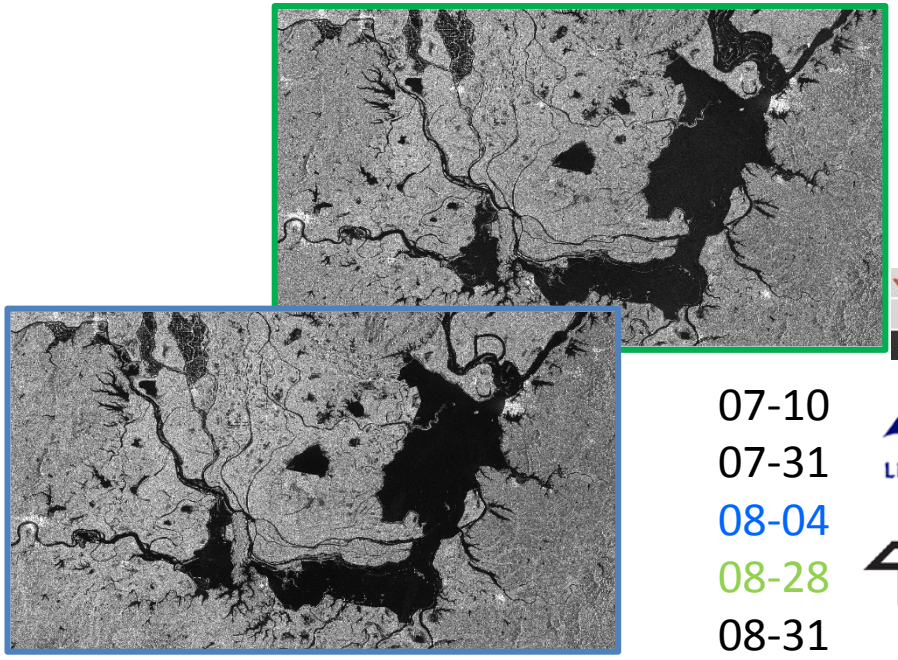
DLR



Poyang search

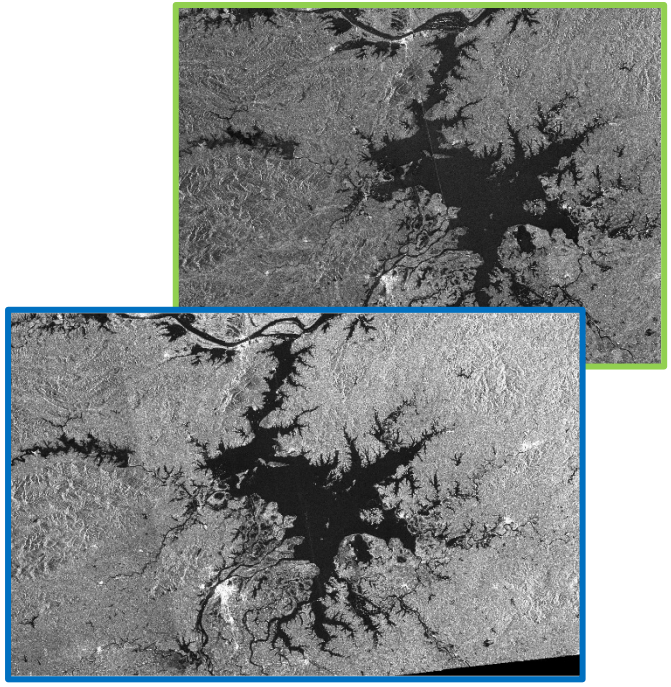
# Radarsat over 1998 Yangtze historical flood

UM-SB Project Proposal id37253 (many thanks to Rafaelle Rigoli to his strong su



07-10
07-31
08-04
08-28
08-31

Dongting 1998: SCN, SCW, SGF



07-22
07-25
07-31
08-04
08-07
08-14
08-17
08-31

Poyang 1998: SGF, SCW,

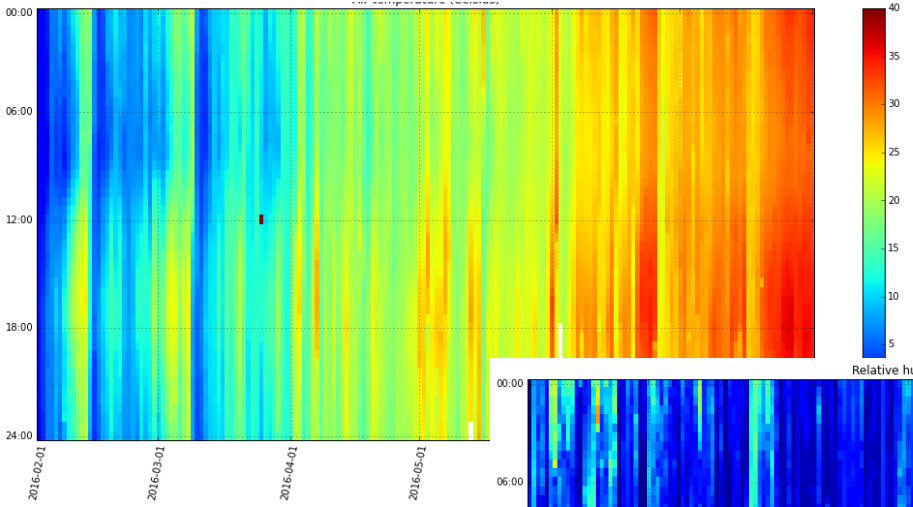
# Poyang Flux measurement station

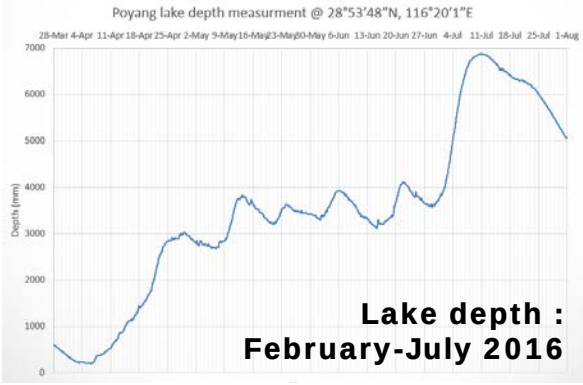
- Eddy covariance: CSAT-3
- H2O analyzer, CO2 analyzer : LI-7500A
- Photosynthetic active radiation sensor : LI-190SL
- Net radiation sensor: KIPP&Zonen CNR4
  Air temperature and humidity gauge: Vaisala HMP 155
- Rain gauge: TR-525USW
- Soil thermal flux sensor: Hukseflux HFP01
- Soil temperature sensor: LI-COR 7900-180
  Underground water level gauge: OnsetHOBO, U20-001-02
- Surface water level gauge: Decagon, CTD

- Base altitude : 13 m .a.m.s.l.
- Eddy cor. sensors height : 17.5m

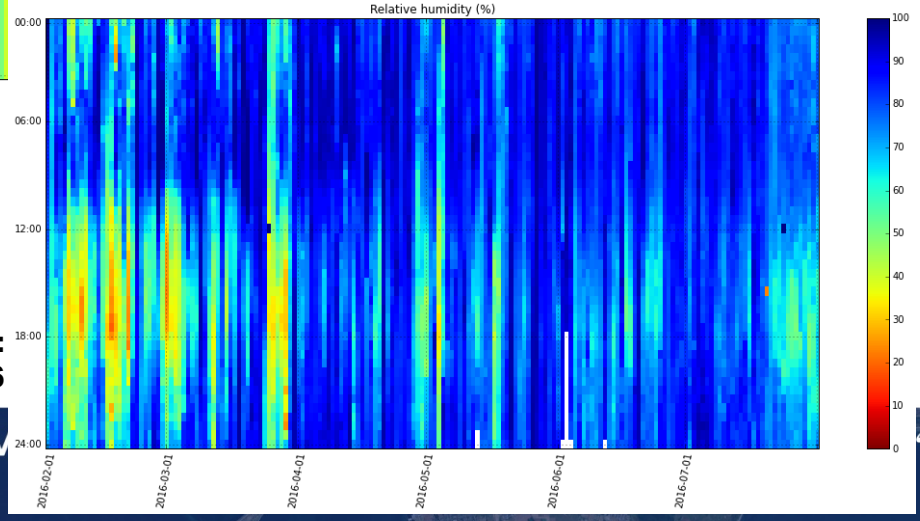
# Poyang Flux measurement station

**Air temperature February-July 2016**



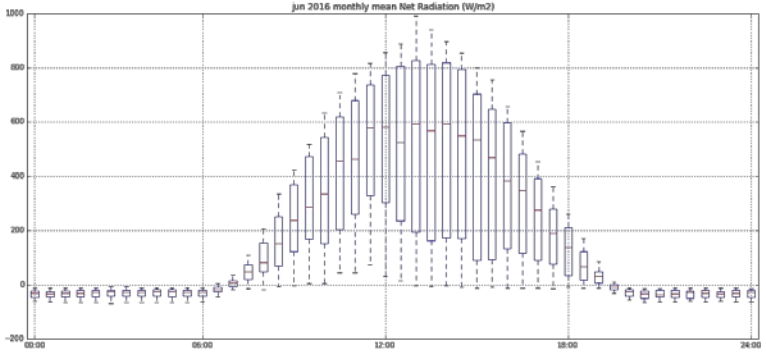

**Lake depth : February-July 2016**



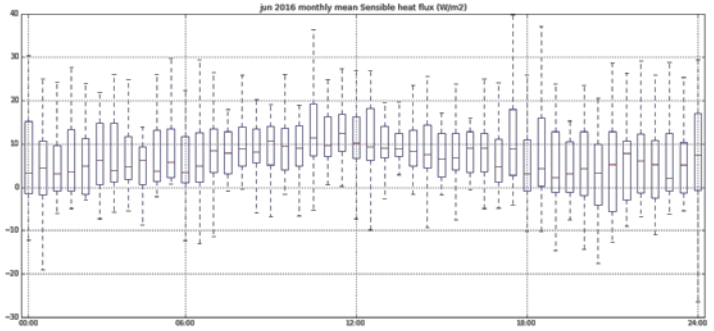

**Relative humidity: February-July 2016**

# Poyang Flux measurement station

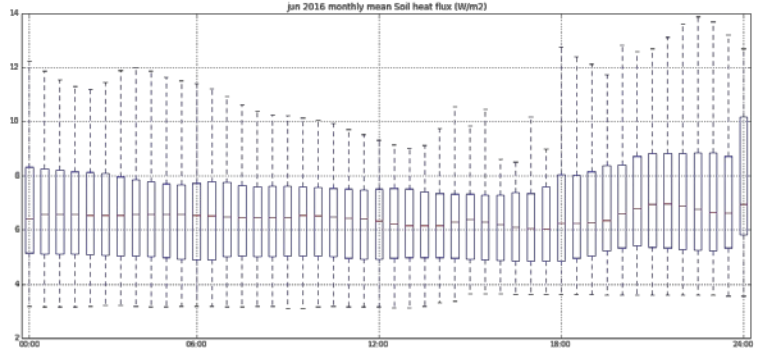
## Net radiation



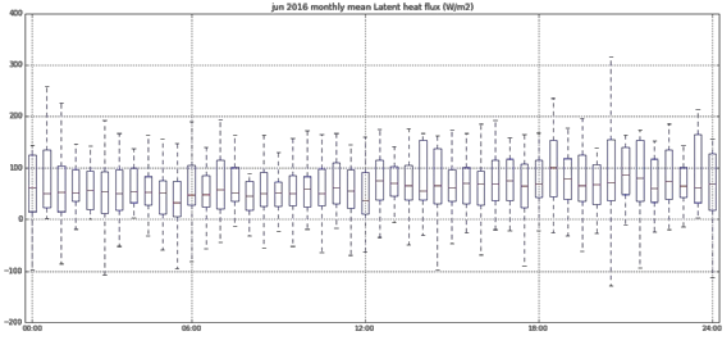

## Sensitive heat flux




## Soil heat flux




## Latent heat flux

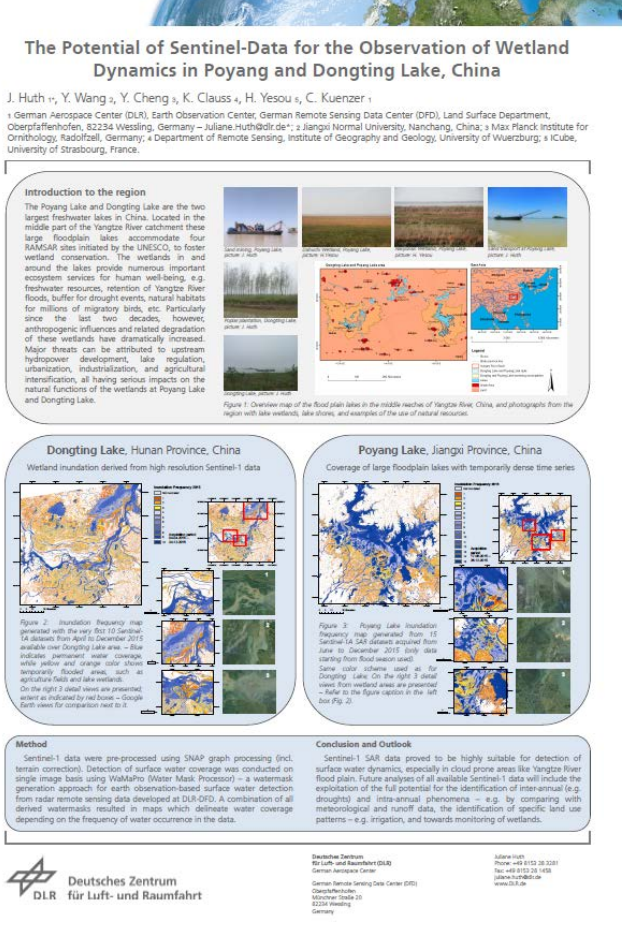



# Publications WaRYWeBio

- Huth, Juliane, Wang Yeqiao, Cheng, Yachang, Clauss, Kersten, Yesou, Herve, Kuenzer, Claudia (**2017**) *The Potential of Sentinel-Data for the Observation of Wetland Dynamics in Poyang and Dongting Lake, China. 37th* International Symposium on the Remote Sensing of the Environment (ISRSE 37), May 8-12, 2017, Tzwane, South Africa. – contribution as poster, see on the right

- Huth, Juliane and Kuenzer, Claudia (**2016**) *The Potential of Innovative Earth Observation Approaches to Assess Ecologic Dynamics in Wetlands and their Water Sheds.* Advanced International Forum on Ecological Security of Poyang Lake, Aug 27-30, 2016, Nanchang, China.

- Hervé Yésou, Claire Huber, Carlos Uribe, Sylviane Daillet, Henri Giraud, Mathias Studer, Sadri Haouet, Robin Faivre (**2016**) Sixteen years of over Poyang Lake monitoring exploiting satellite images applications to water resources analysis and biodiversity maintain. Advanced International Forum on Ecological Security of Poyang Lake, Aug 27-30, 2016, Nanchang, China.


The Potential of Sentinel-Data for the Observation of Wetland Dynamics in Poyang and Dongting Lake, China

J. Huth [1*], Y. Wang [2], Y. Cheng [3], K. Clauss [4], H. Yesou [5], C. Kuenzer [1]

[1] German Aerospace Center (DLR), Earth Observation Center, German Remote Sensing Data Center (DFD), Land Surface Department, Oberpfaffenhofen, 82234 Wessling, Germany – Juliane.Huth@dlr.de*; [2] Jiangxi Normal University, Nanchang, China; [3] Max Planck Institute for Ornithology, Radolfzell, Germany; [4] Department of Remote Sensing, Institute of Geography and Geology, University of Wuerzburg; [5] iCube, University of Strasbourg, France.

Introduction to the region

Dongting Lake, Hunan Province, China

Wetland inundation derived from high resolution Sentinel-1 data

Poyang Lake, Jiangxi Province, China

Coverage of large floodplain lakes with temporarily dense time series

Method

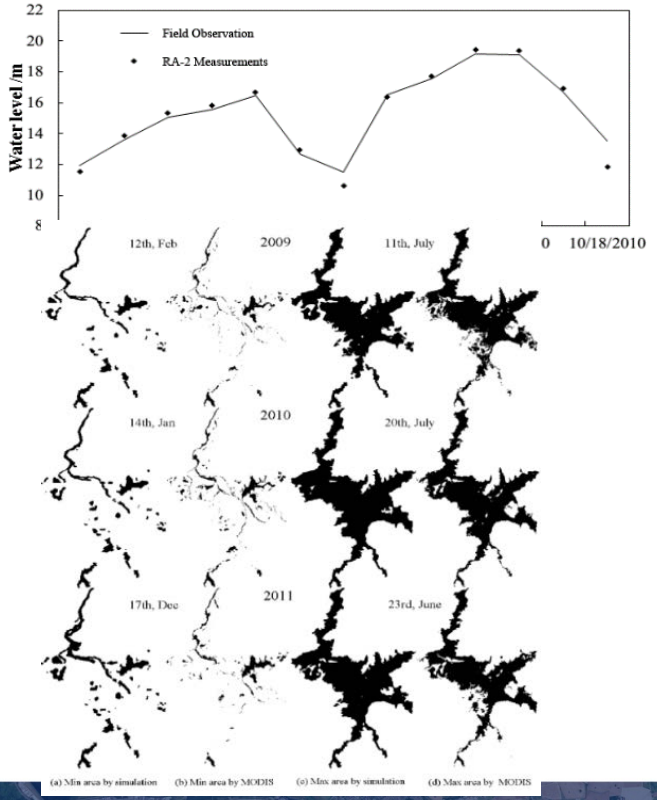
Conclusion and Outlook

Deutsches Zentrum für Luft- und Raumfahrt

# Publications WaRYWeBio

1. Hengda Qi, Jianzhong Lu, Xiaoling Chen, Sabine Sauvage, José -Miguel Sánchez-Pérez, Water age prediction and its potential impacts on water quality using hydrodynamic model for Poyang Lake, China. Environment Science and Pollution Research, 2016, 23(13), 13327-13341

2. Jianzhong Lu, Xiaolin Cui, Xiaoling Chen, Sabine Sauvage, José -Miguel Sánchez-Pérez, Evaluation of hydrological response to climate variability using SWAT model: application to the Fuhe Basin of Poyang Lake watershed, China. Hydrology Research, Dec. 2016, nh2016115; DOI: 10.2166/nh.2016.115



# Publications BioGeoLakes

Duan, HT, Tao, M., Loiselle S.A., Zhao W., Cao Z., Ma R., Tang X., MODIS observations of cyanobacterial risks in a eutrophic lake: implications for long-term safety evaluation in drinking-water source. Water Research doi.org/10.1016/j.watres.2017.06.022 (in print)

Liang, Q., Zhang, Y., Ma, R., Loiselle, S., Li, J. and Hu, M., **2017**. A MODIS-Based Novel Method to Distinguish Surface Cyanobacterial Scums and Aquatic Macrophytes in Lake Taihu. Remote Sensing, 9(2), p.133

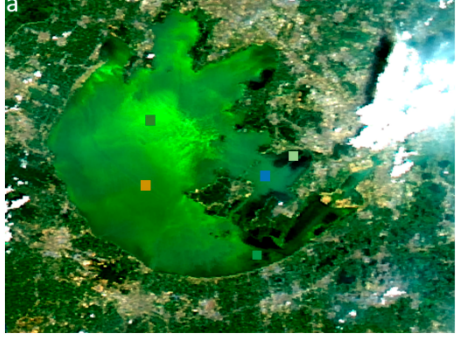
Zhang, Y., Ma, R., Duan, H., Loiselle, S., Zhang, M. and Xu, J., **2016**. A novel MODIS algorithm to estimate chlorophyll a concentration in eutrophic turbid lakes. Ecological Indicators, 69, pp.138-151.

Duan, H., Loiselle, S.A., Li, Z., Shen, Q., Du, Y. and Ma, R., **2016**. A new insight into black blooms: Synergies between optical and chemical factors. Estuarine, Coastal and Shelf Science, 175, pp.118-125.

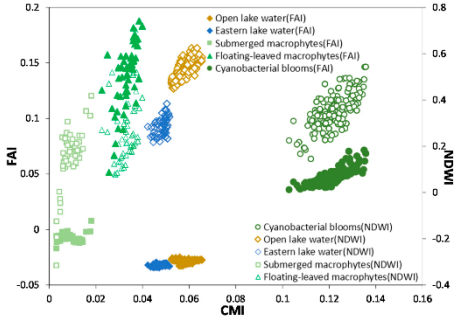
Zhang, Y., Ma, R., Duan, H., Loiselle, S. and Xu, J., **2016**. Satellite analysis to identify changes and drivers of CyanoHABs dynamics in Lake Taihu. Water Science and Technology: Water Supply, p.ws2016074.

Li, J., Zhang, Y., Ma, R., Duan, H., Loiselle, S., Xue, K. and Liang, Q., **2016**. Satellite-Based Estimation of Column-Integrated Algal Biomass in Nonalgae Bloom Conditions: A Case Study of Lake Chaohu, China. IEEE Journal of Sel Topics Applied Earth Observations and RemSen.

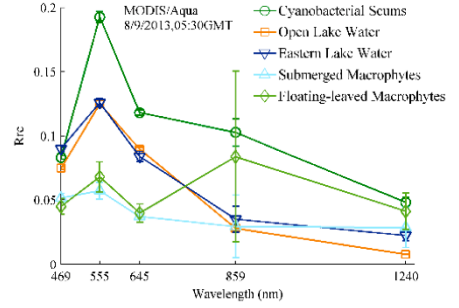
Young scientists contributed to all of the above publications




(a)




(b)

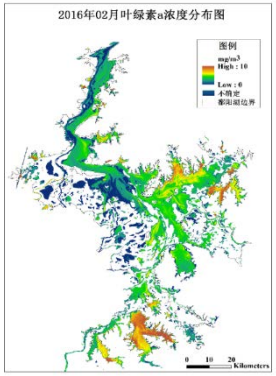


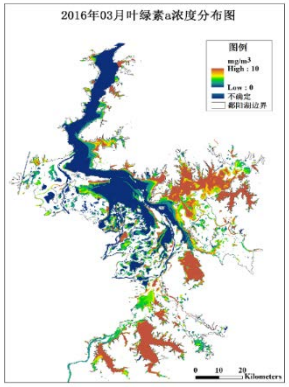

(c)

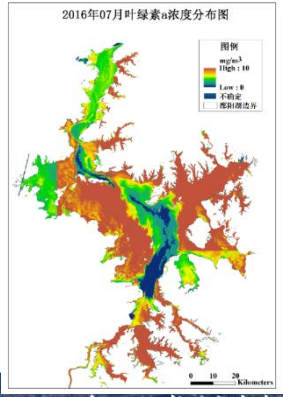
# Publications BioGeoLakes

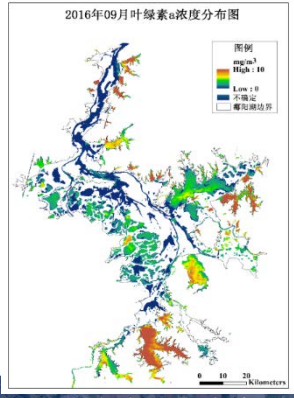
1. Xingxing Han, Lian Feng, Xiaoling Chen and Herve Yesou. MERIS observations of chlorophyll-adynamics in Erhai Lake between 2003 and 2009. International Journal of Remote Sensing. 2014, 35(24):8309-8322

2. Huang Jue、Chen Liqiong、Chen Xiaoling、Tian Liqiao、Feng Lian、Yesou Herve、 Li Fangfang，Modification and validation of a quasi-analytical algorithm for inherent optical properties in the turbid waters of Poyang Lake, China. Journal of Applied Remote Sensing. 2014, 8(1):083643



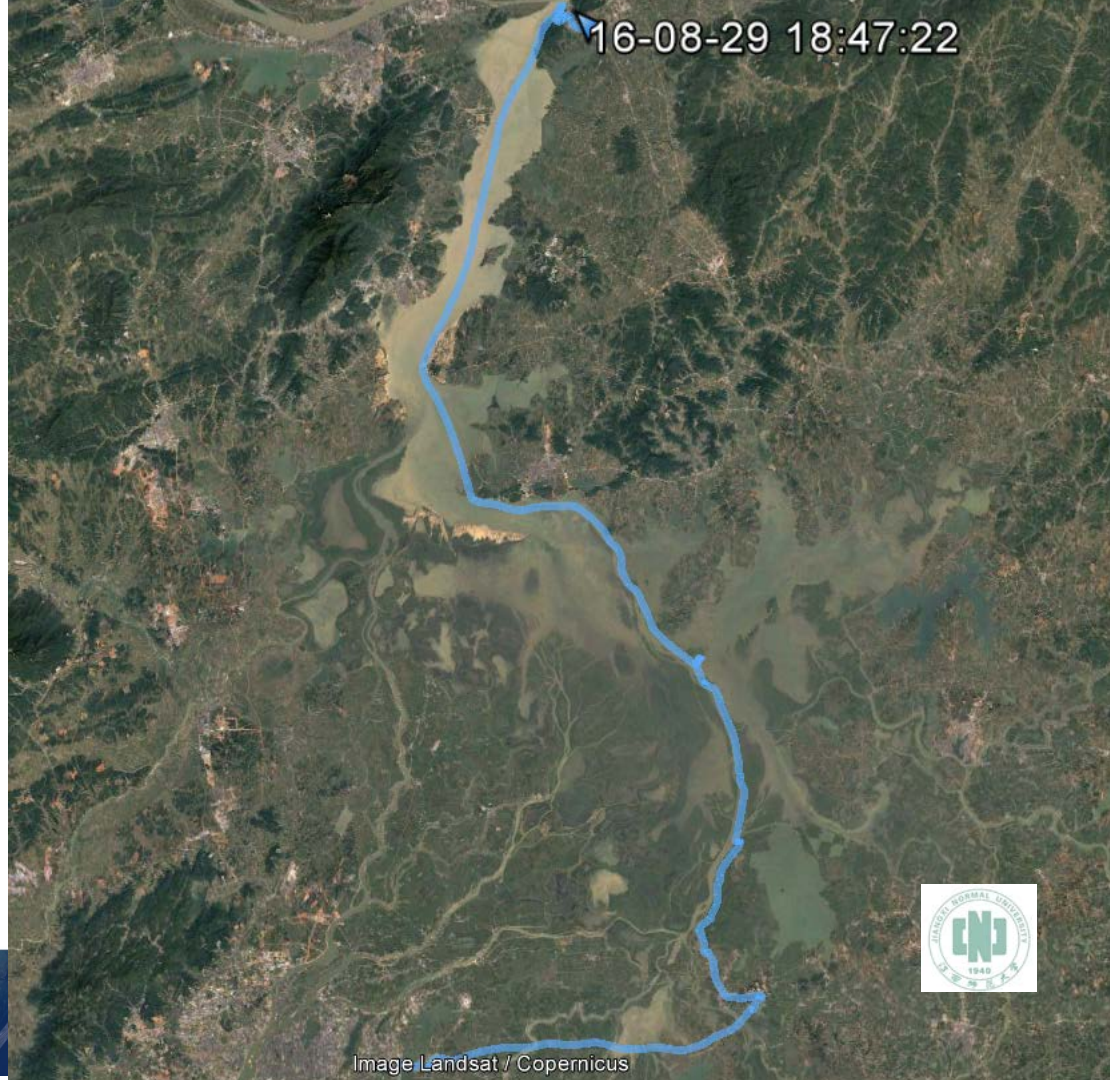



# Key events: WaRYWeBio


江 西 师 范 大 学
JIANGXI NORMAL UNIVERSITY

Advanced International Forum on Ecological Security of Poyang Lake
(AIFESPYL2016)

2017 DRAGON 4 SYMPOSIUM
26–30 June 2017 | Copenhagen, Denmark



# Young scientists contribution linked to Dragon 4 – MSc and PhD involved in WaRYWeBio

- Cheng Yachang – MPI Ornithology, Radolfzell Germany
  - Finished Master thesis with the title: "Home Range and Habitat Selection of Wintering White-naped Crane Grus vipio Through GPS Telemetry in Poyang Lake, China."
  - Preliminary PhD topic – currently working on at MPIO and supervised by Prof. M. Wikelski – is related to „Movement Ecology of Waterbirds“.

Zhang Li ESA-ESRIN: international research fellow, 09/2015-09/2016

- Map wetland changes over the Poyang lake region by using time-series ASAR and Sentinel data.

5 Master students

4 PhD candidates

+ 4 Vice-professors /Post Doctors

# Young scientists contribution linked to Dragon 4 – MSc and PhD involved within **BioGeoLakes**

- Zhigang Cao, Min Shen, Tianchi Qi

- Chen Liqiong  ESA-ESRIN: international research fellow, 03/2017-03/2018

✓ Analysis the relationship between algal bloom and water temperatures in inland lakes by using Sentinel 2 and 3 data.

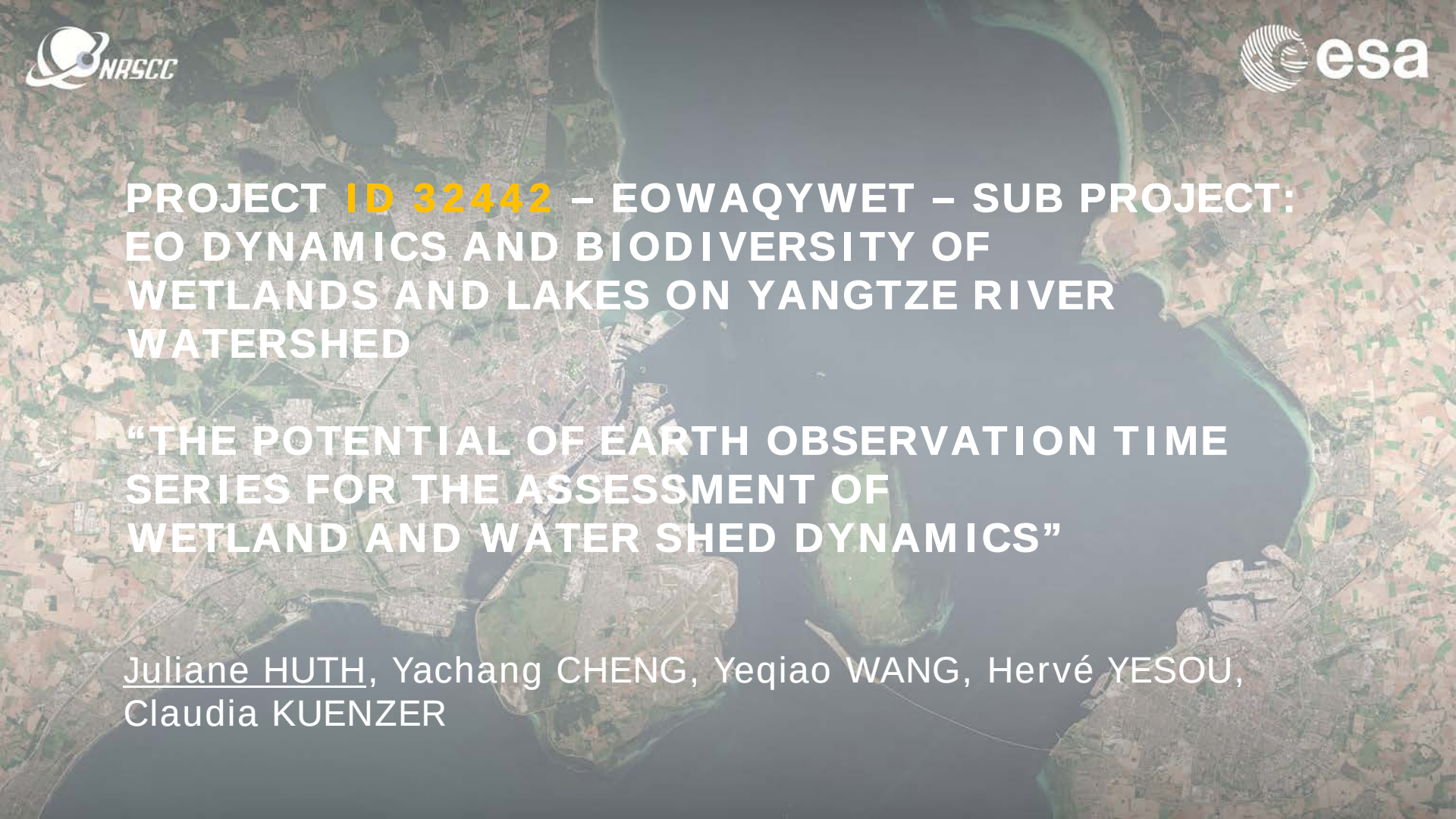
# Academic exchange linked to Dragon 4

- Chinese Visiting Scientists at DLR since summer 2016


  - Dr. DU Xiaoping – topic: focus on wetlands in coastal China – CSC stipend from Sep. 2016 – Feb 2018 – home institution RADI, Beijing
  - Dr. XU Di – topic: wetland monitoring in Asia – University stipend from Oct. 2016–May2017 – home institution Shanghai University

- BioGeoLakes Exchanges:

  number of studies initiated last year including  a citizen science project in the Huangpu area, and studies on lakes Taihu and Chaohu.



# PROJECT ID 32442 – EOWAQYWET – SUB PROJECT: EO DYNAMICS AND BIODIVERSITY OF WETLANDS AND LAKES ON YANGTZE RIVER WATERSHED

## "THE POTENTIAL OF EARTH OBSERVATION TIME SERIES FOR THE ASSESSMENT OF WETLAND AND WATER SHED DYNAMICS"

Juliane HUTH, Yachang CHENG, Yeqiao WANG, Hervé YESOU, Claudia KUENZER

# DRAGON 4 WaRYWeBio : Water resource behaviors in Yangtze intermediate basin and wetlands' biodiversity

DLR

sertit

INTERNATIONAL CRANE FOUNDATION

WUHAN UNIVERSITY 1893

BEIJING NORMAL UNIVERSITY 1902

JIANGXI NORMAL UNIVERSITY 1940

LIESMARS

TRIO

LEGOS

RADI

1958 University of Science and Technology of China

NIGLAS

## Project researchers (in collaboration with BioGEOLakes)

- DLR – **Dr. Claudia KUENZER,** Juliane HUTH
- Jiangxi Normal University – **Pr Dr. WANG Yeqiao**, ZHANG Li, Pr Dr. FANG Chaoyang ..
- NIGLAS – Pr Dr. LAI Xijun
- CAS, State Key Laboratory of Urban and Regional Ecology – Pr Dr. CAO Lei
- Max Plant Institute – Pr Dr. Martin WIKELSKI, CHENG Yachang
- Wuhan University – Pr Dr. CHEN Xiaoling
- Beijing Normal University – Pr Dr. LI Jing
- RADI – Pr NIU Zhenguo, CHEN Yanfen
- ICube-SERTIT – Dr. Hervé YESOU, Claire HUBER, Mathias STUDER, Sadri HAOUET
- ICube-TRIO – Dr Jerome COLIN
- LEGOS – Dr Jean François CRETAUX, Laurence FRUTEAU
- ICF – Dr Dorn MOORE, Dr LI Fengshan

**12 Institutes or research labs**

# WaRYWeBio – Workpackages

## WP1: Water extent monitoring

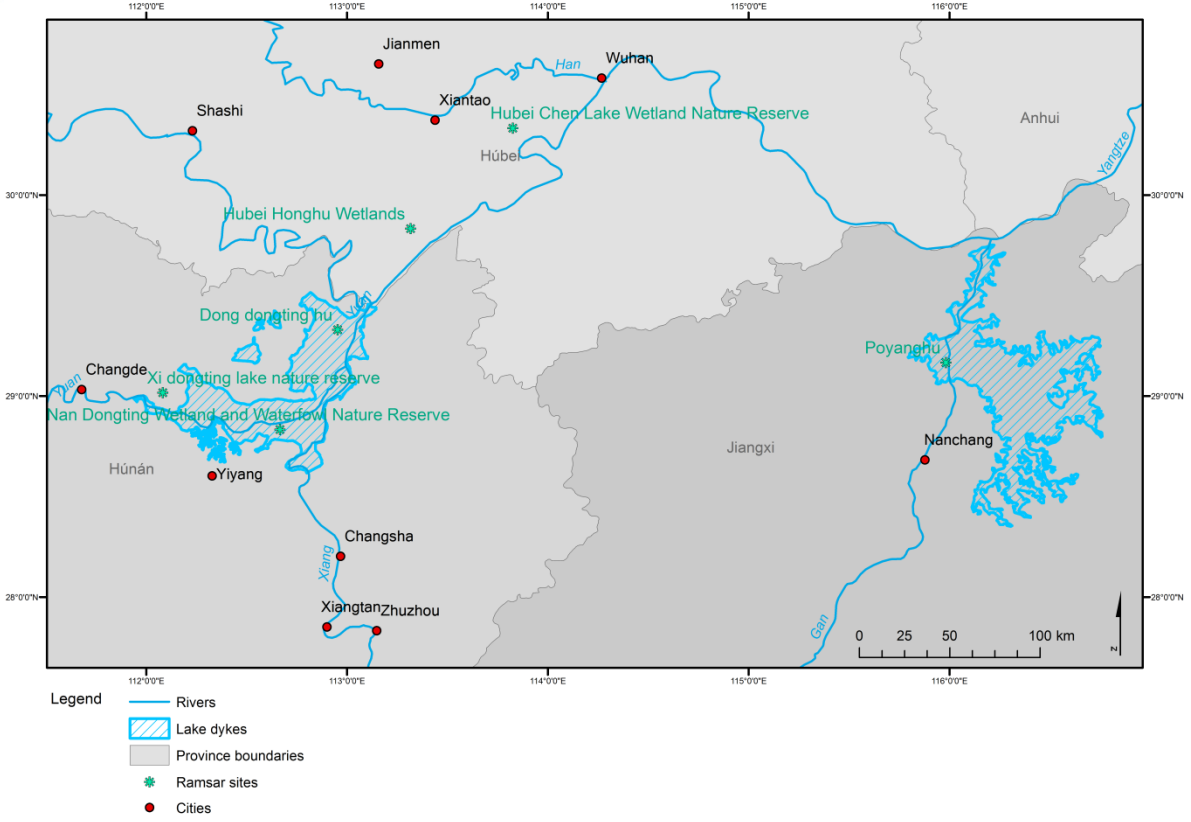
## WP2: Water height monitoring from space

## WP3: Wetland mapping and biodiversity values analysis

## WP4 :Regional and global interactions



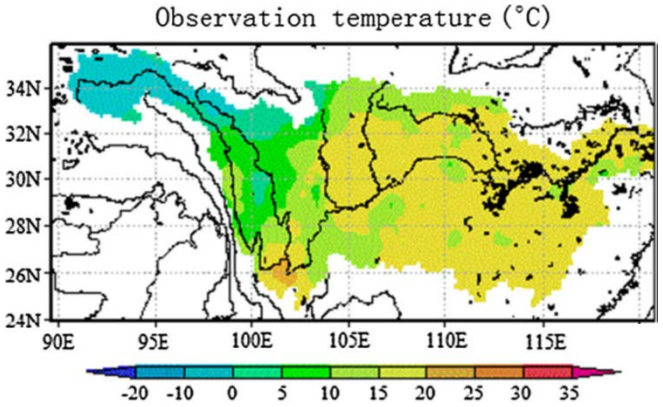
# Overview of project region

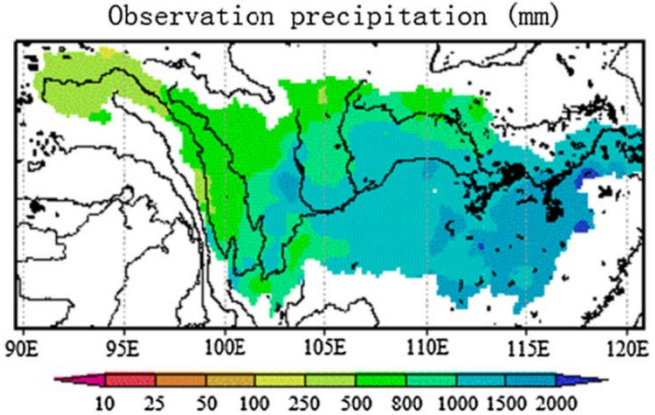



- Middle reaches of Yangtze river including floodplain lakes Poyang Lake and Dongting Lake
- Chinas 2 largest fresh water lakes
- 4 Ramsar sites – wetlands of international importance
- Project region with strong anthropogenic influence through urbanization, land use intensification, natural resource exploitation, etc.

# Climate Information for the study region

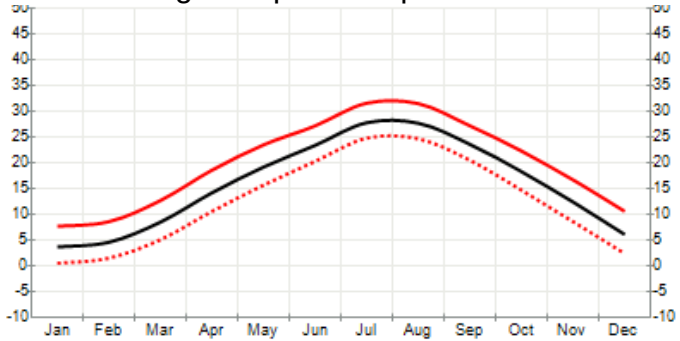
1971-2000 average temperature and precipitation [1]



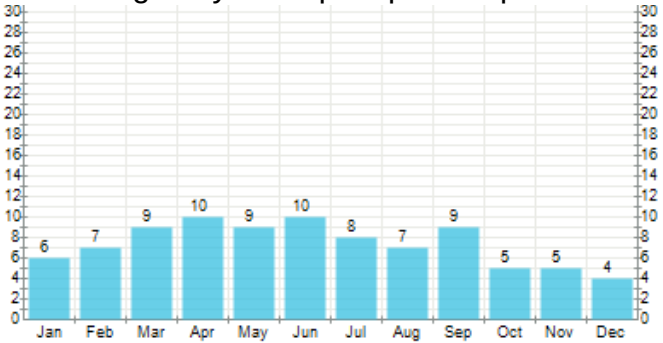




Average temperature and precipitation measured during 1961-1990 at Shanghai weather station: 74 km away from Yangtze River [2]

Average temperature per month




Average days with precipitation per month




[1] Huanghe Gu et al., 2014
[2] YR website

# Challenges at Dongting and Poyang Lake

Economic Use of Wetland Areas

Hydropower plants

**Floods and Droughts**

**Habitat for migratory birds and endangered species**

Cash Crops

Water Quality

Urban Growth

Sand dredging

# Poyang Lake Inundation Frequency Map 2014 from Sentinel-1 SAR


winter season

**3.10.14 – 26.12.14**

# Poyang Lake Inundation Frequency Map 2015 from Sentinel-1 SAR


summer-winter season

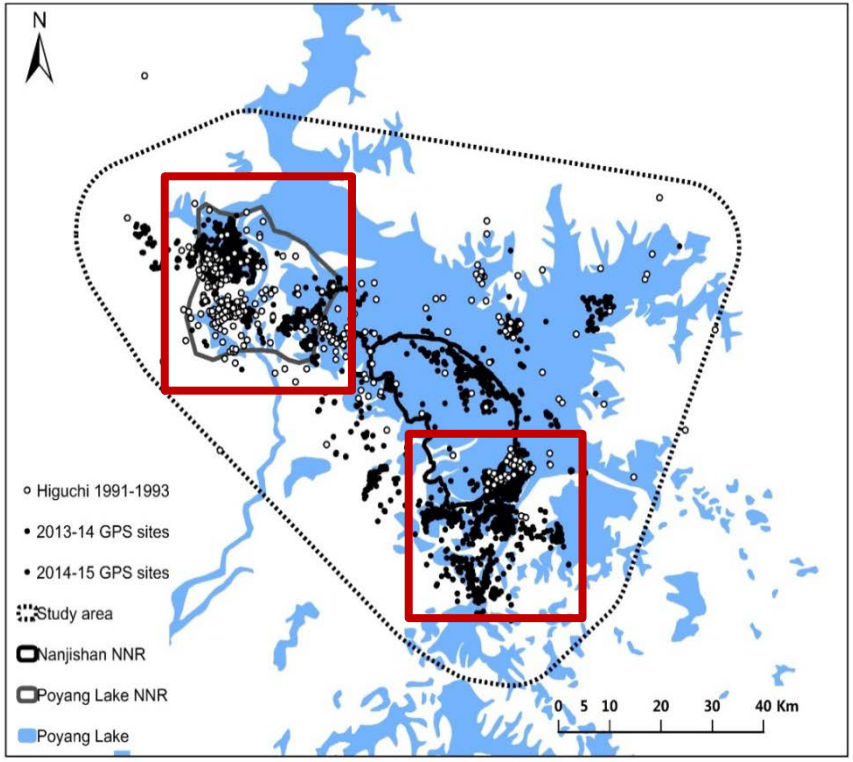
**17.6.15 – 26.12.15**

# Poyang Lake Inundation Frequency Map 2016 from Sentinel-1 SAR


winter-spring season

**7.1.16 – 11.6.16**

# Winter home range and habitat of White-naped Crane




| Year | No. | Number of sites in total | Percentage of sites within the Nature Reserves |
|---|---|---|---|
| 2013-2014 | X01 | 234 | 44.44% |
| | X03 | 202 | 99.50% |
| | X06 | 2733 | 98.83% |
| 2014-2015 | X06 | 2493 | 41.32% |
| | T2 | 4628 | 8.51% |
| | T3 | 5973 | 7.47% |
| | T4 | 2590 | 47.68% |
| | T5 | 322 | 32.92% |
| | T6 | 319 | 8.15% |

The GPS sites of tracked White-naped Crane in winter of 2013-14 and 2014-15

Cheng Y. et al., publication in preparation

# Methods – GPS Telemetry

Table 1. Arrival and departure time of GPS tracked White-naped Crane at Poyang Lake

| Winter | ID | Age | Type of tracker | Arriving time (y/m/d) | Departure time (y/m/d) |
|---|---|---|---|---|---|
| 2013-2014 | X01 | Juvenile | GPS-PTT | 2013/11/12 | 2014/3/10 |
| | X03 | Juvenile | GPS-PTT | 2013/11/18 | 2014/3/10 |
| | X06 | Adult | GPS-GSM | 2013/11/5 | 2014/3/10 |
| 2014-2015 | X06 | Adult | GPS-GSM | 2014/11/2 | 2015/3/11 |
| | T2 | Juvenile | GPS-GSM | 2014/11/3 | 2015/3/7 |
| | T3* | Juvenile | GPS-GSM | 2014/11/2 | 2015/3/13 |
| | T4* | Adult | GPS-GSM | 2014/12/5 | 2015/3/13 |
| | T5 | Adult | GPS-PTT | 2014/11/2 | 2015/3/12 |
| | T6* | Adult | GPS-PTT | 2014/11/2 | 2015/3/13 |

* (1) T3 was family with T6, (2) T4 was poisoned during autumn migration and rehabilitated on November 11, 2014 in Shandong Province, China

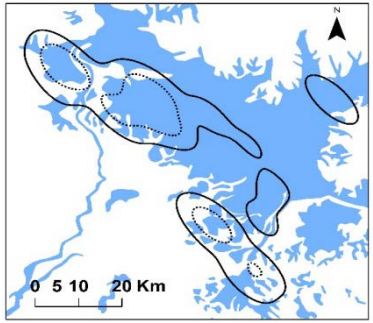
Cheng Y. et al., publication in preparation

# Winter Home Range Variation

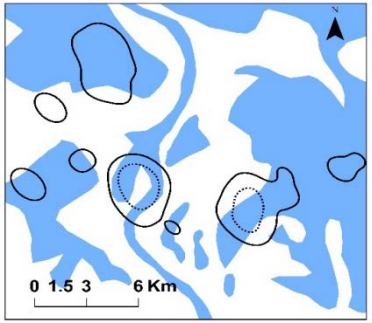
95% FKE Home range size: 30.52-996.42 km$^2$ , mean: 483.30±399.32km$^2$

60% FKE Home range size: 5.85-236.31 km$^2$ , mean: 120.42±108.18km$^2$

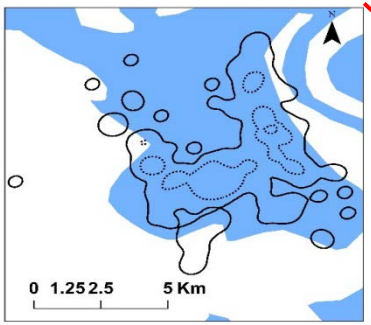
1. X01(2013-14)



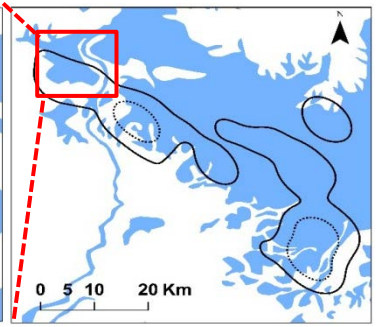

2. X03(2013-14)



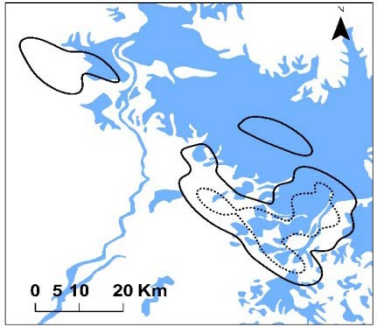

3. X06(2013-14)



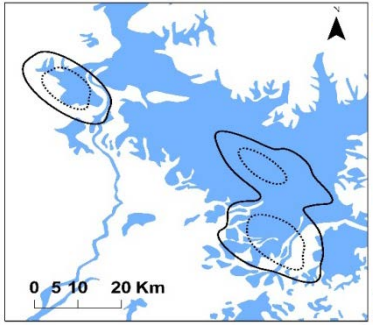

4. X06(2014-15)



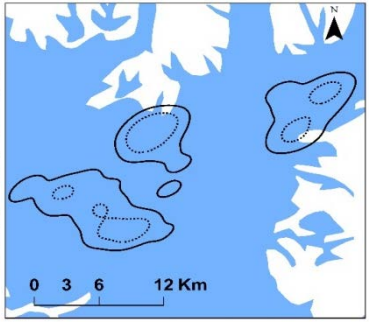

5. T2(2014-15)



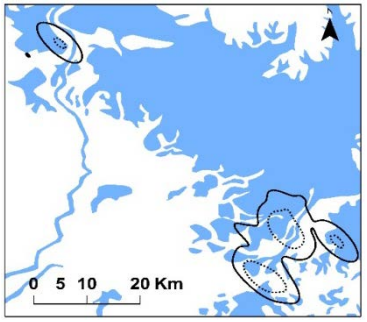

6. T4(2014-15)




7. T5(2014-15)




8. T6(2014-15)




Cheng Y. et al., publication in preparation

95%FKE 60%FKE * The offspring of T6, the T3, was removed from analysis

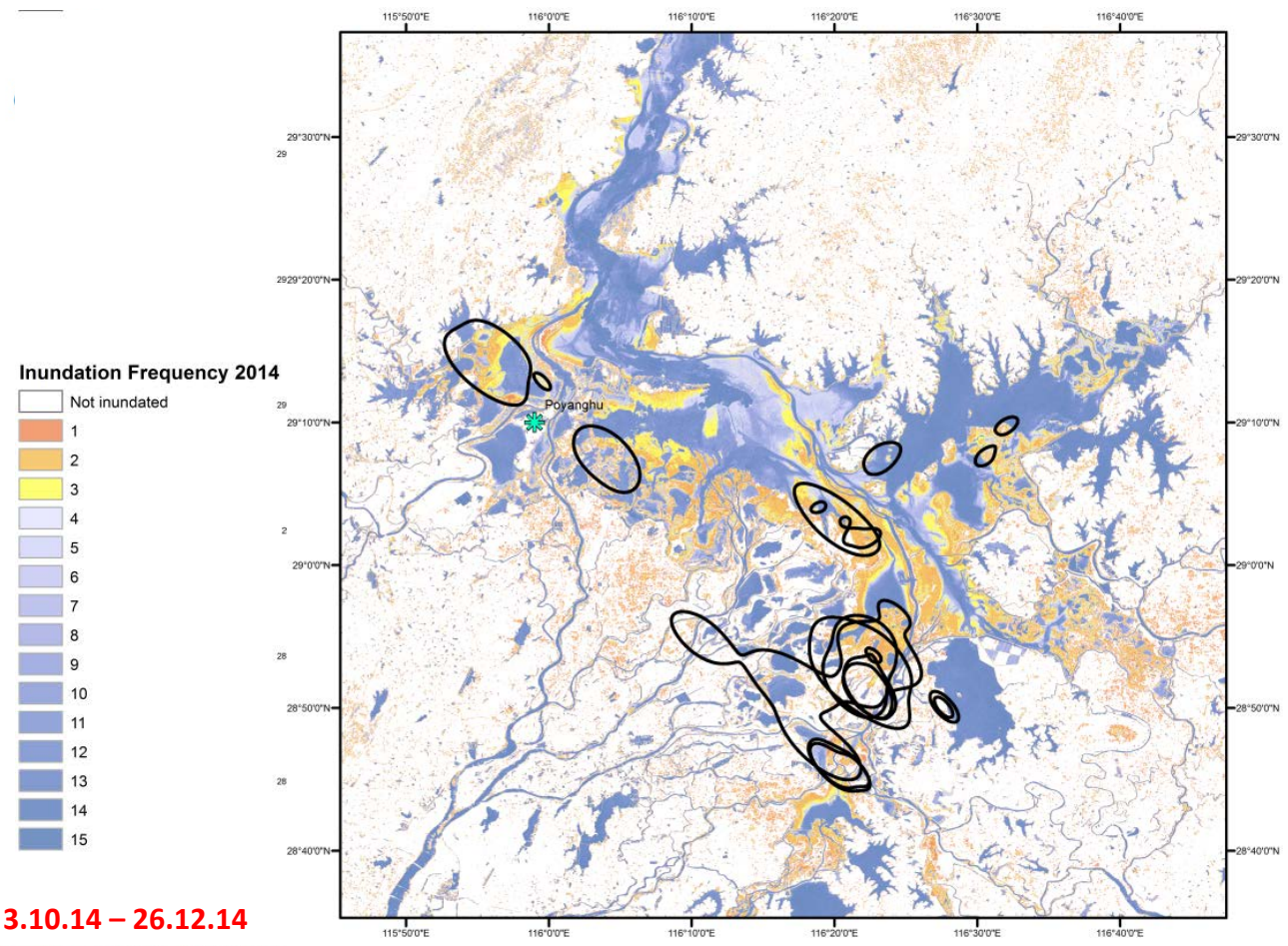
# Sentinel-1 Acquisition Dates for Poyang Lake

| 2014 | | | 2015 | | | 2016 | | |
|---|---|---|---|---|---|---|---|---|
| nr. | Scene date | Scene code | nr. | Scene date | Scene code | nr. | Scene date | Scene code |
| 1 | 03.10.2014 | 0F3E | 1 | 17.06.2015 | E23C | 1 | 07.01.2016 | 0B8E |
| 2 | 08.10.2014 | BE52 | 2 | 29.06.2015 | F6FC | 2 | 19.01.2016 | BDB7 |
| 3 | 15.10.2014 | 57C7 | 3 | 11.07.2015 | C8A1 | 3 | 31.01.2016 | 580C |
| 4 | 20.10.2014 | 37B4 | 4 | 23.07.2015 | 0FE5 | 4 | 12.02.2016 | 4082 |
| 5 | 27.10.2014 | 6255 | 5 | 16.08.2015 | C32E | 5 | 24.02.2016 | 4C3D |
| 6 | 01.11.2014 | F9F3 | 6 | 28.08.2015 | B9A2 | 6 | 07.03.2016 | 792B |
| 7 | 08.11.2014 | 5947 | 7 | 09.09.2015 | DDDA | 7 | 19.03.2016 | 0AEF |
| 8 | 13.11.2014 | 016A | 8 | 21.09.2015 | A3D4 | 8 | 31.03.2016 | C2AF |
| 9 | 20.11.2014 | 2FA3 | 9 | 03.10.2015 | AF34 | 9 | 12.04.2016 | 14D1 |
| 10 | 25.11.2014 | FD1B | 10 | 15.10.2015 | 3B0A | 10 | 24.04.2016 | DF07 |
| 11 | 02.12.2014 | 342B | 11 | 27.10.2015 | C736 | 11 | 06.05.2016 | A090 |
| 12 | 07.12.2014 | 11D6 | 12 | 20.11.2015 | 89B6 | 12 | 30.05.2016 | A928 |
| 13 | 14.12.2014 | BD81 | 13 | 02.12.2015 | DA25 | 13 | 11.06.2016 | DC87 |
| 14 | 19.12.2014 | 8C9E | 14 | 14.12.2015 | 4560 | | | |
| 15 | 26.12.2014 | F178 | 15 | 26.12.2015 | 5273 | | | |

**3.10.14 – 26.12.14**

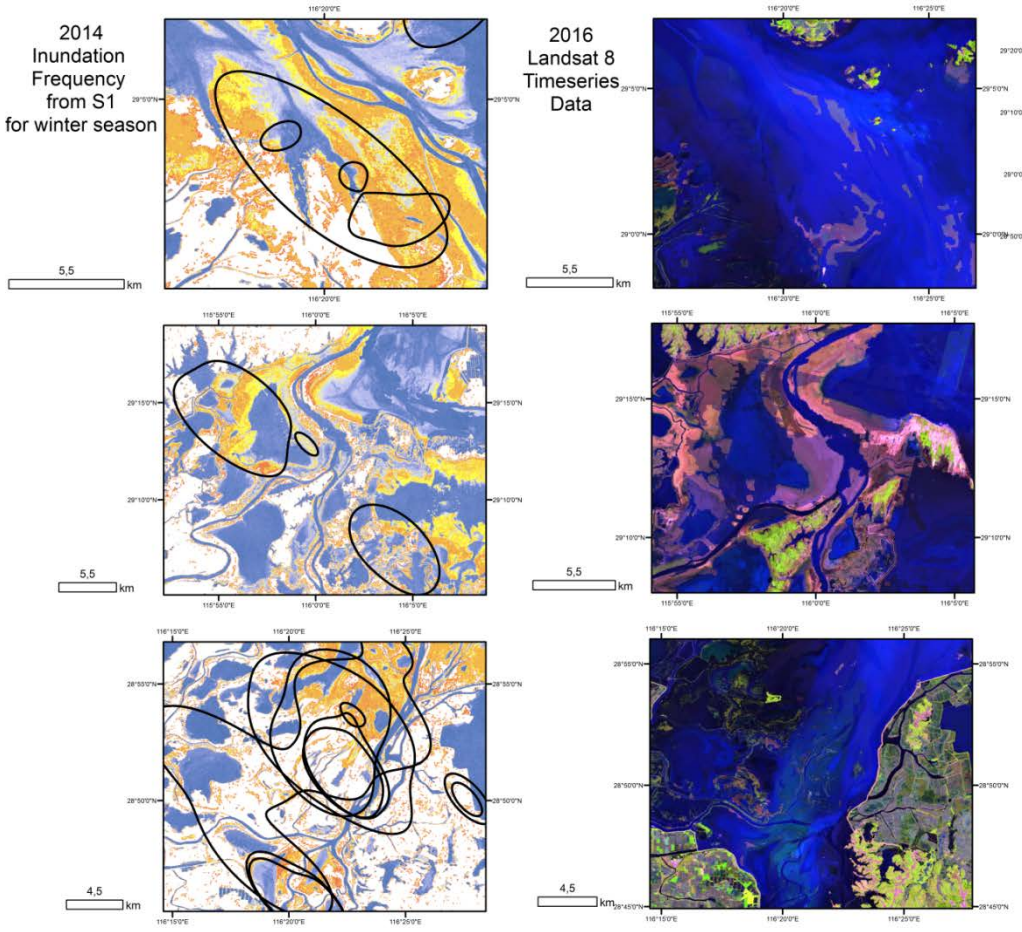
17.6.15 – 26.12.15

7.1.16 – 11.6.16




3.10.14 – 26.12.14

# Inundation frequency map 2014 – combined with wintering bird home range data (2014.11-2015.03)




Detail views from map overlay of wintering season 2014 - compared with Landsat time series 2016

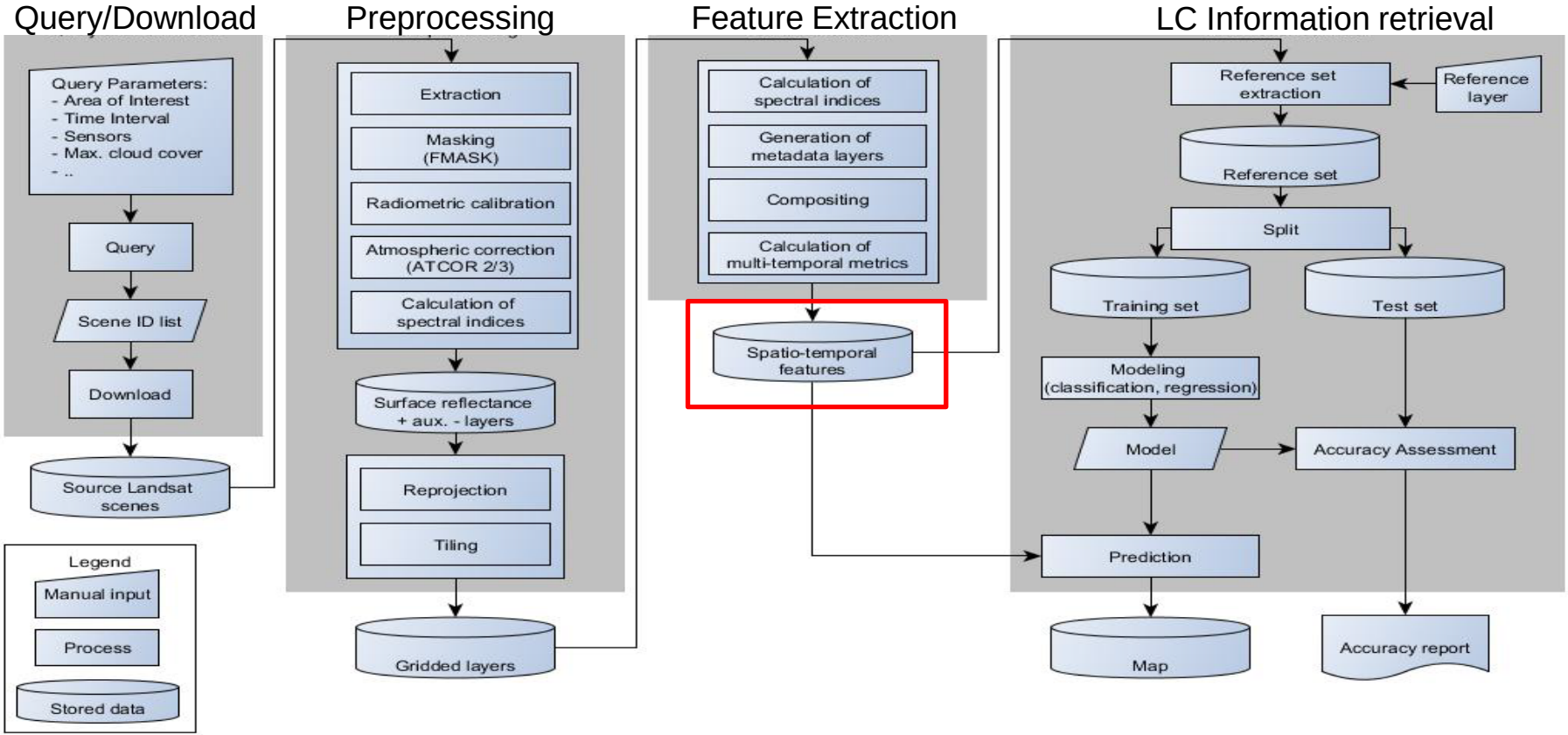
# Idea behind combination of EO with ornithological data

- Goals of EO scientists: wetland mapping and change estimation
- Goals of biologists: habitat mapping

What can be probably done with remote sensing?

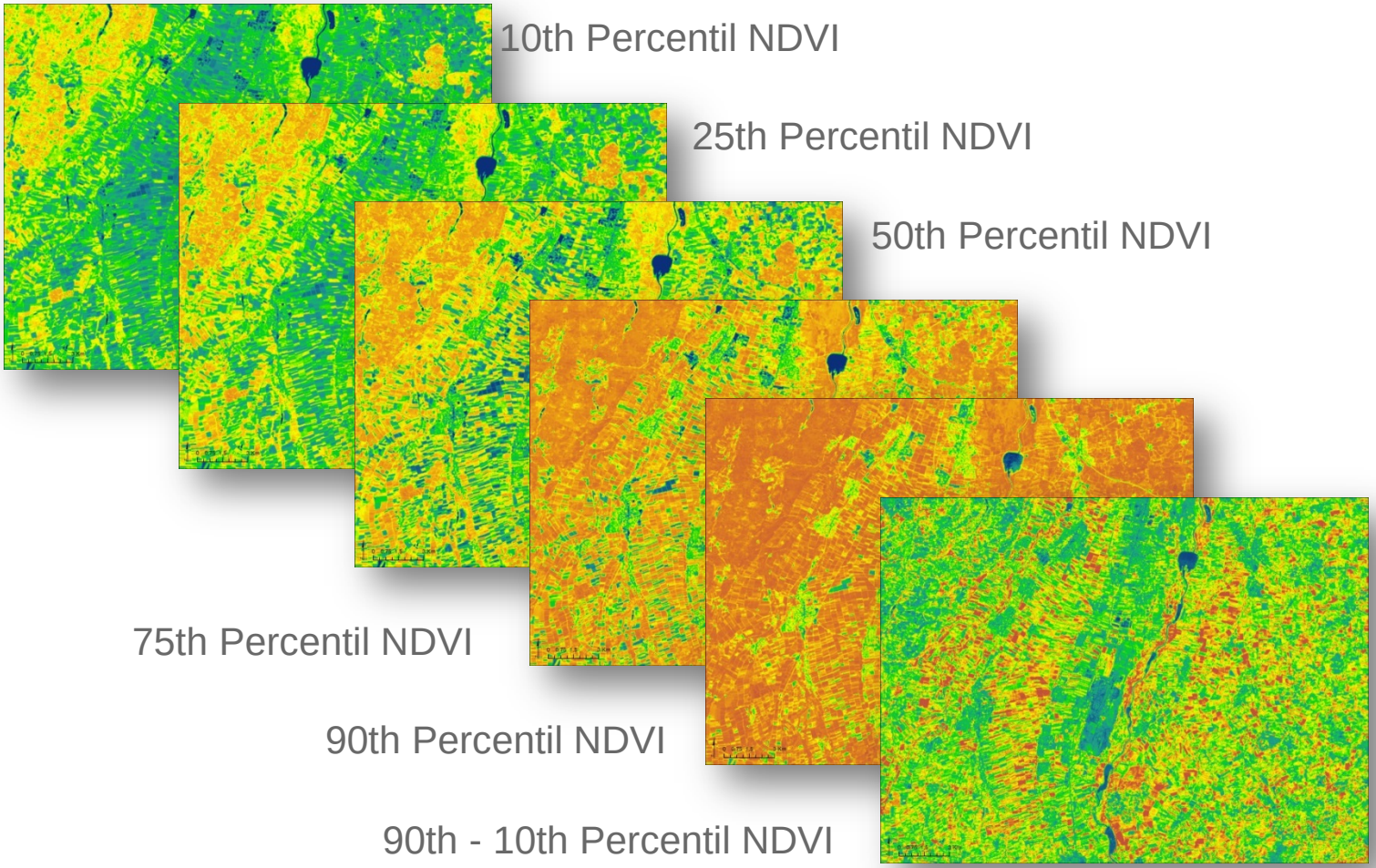
- Wetland localization in an extremly dynamic environment
- Support habitat localization and further description with inundation and land cover type maps

# Time series processing workflow for Landsat / Sentinel-2

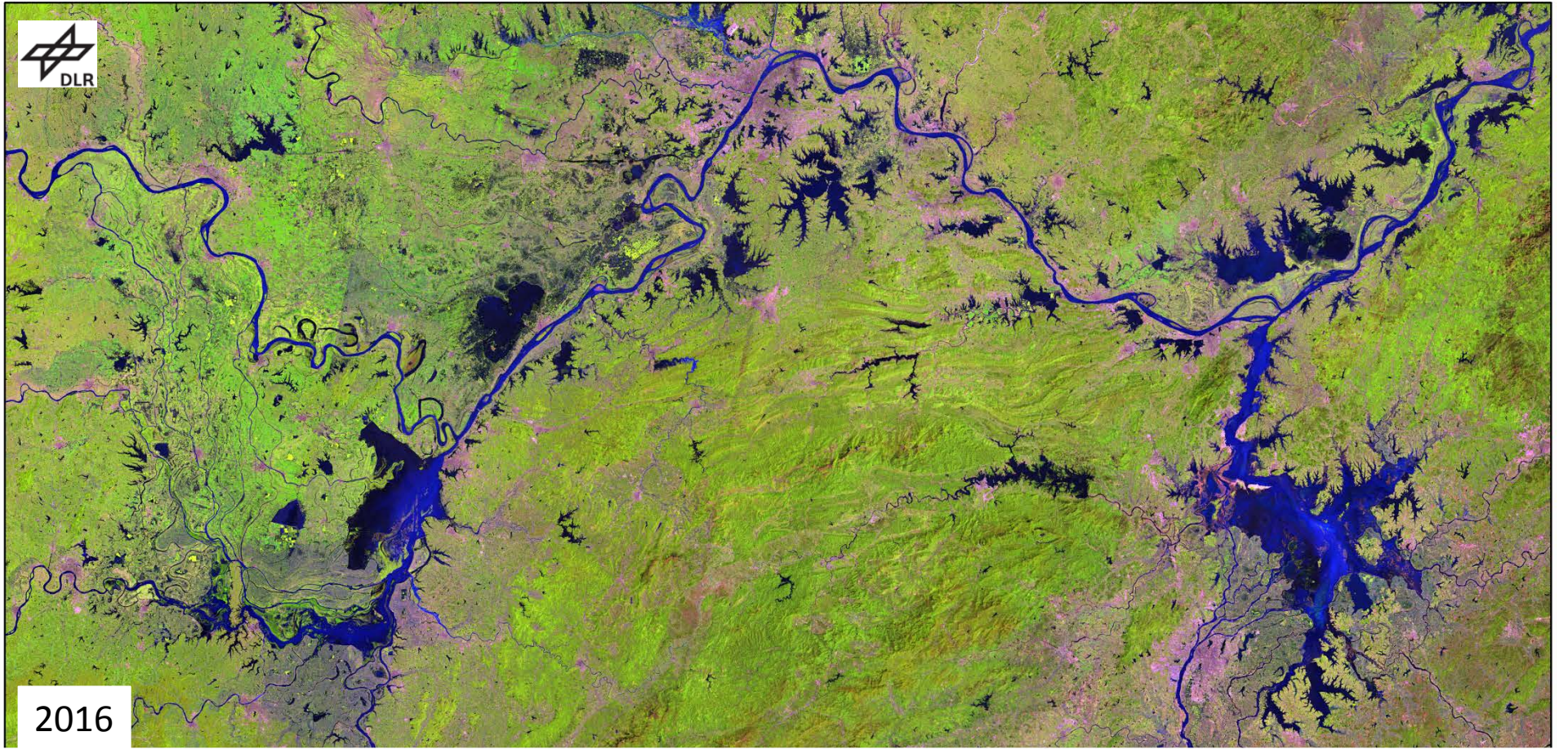



Mack, B.und Leinenkugel, P.und Künzer, C.und Dech, S. (2017): A semi-automated approach for the generation of a new land use and land cover product for Germany based on Landsat time-series and Lucas in-situ data. Remote Sensing Letters, 8 (3), Seiten 244-253.

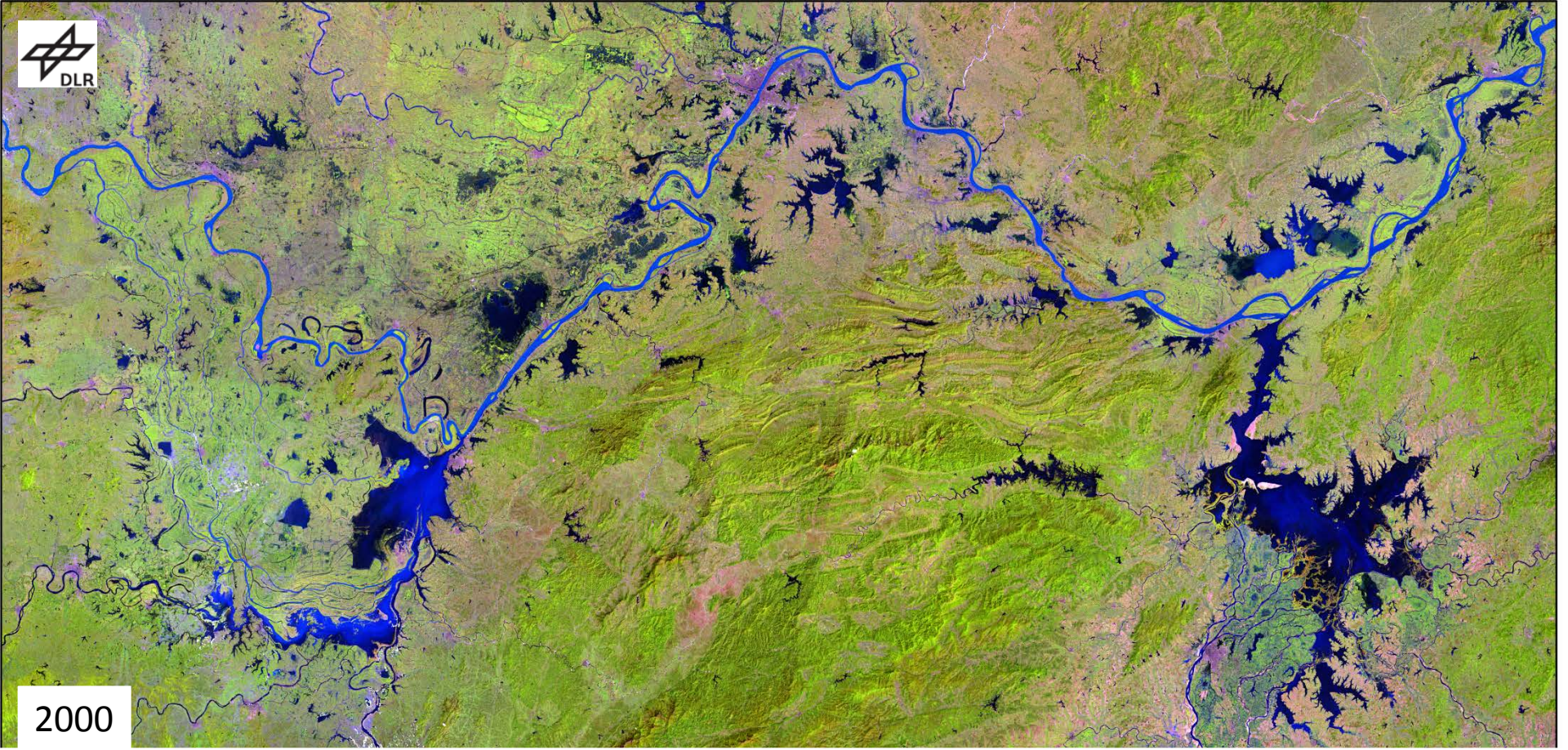
# Time series processing-Multi-temporal metrics



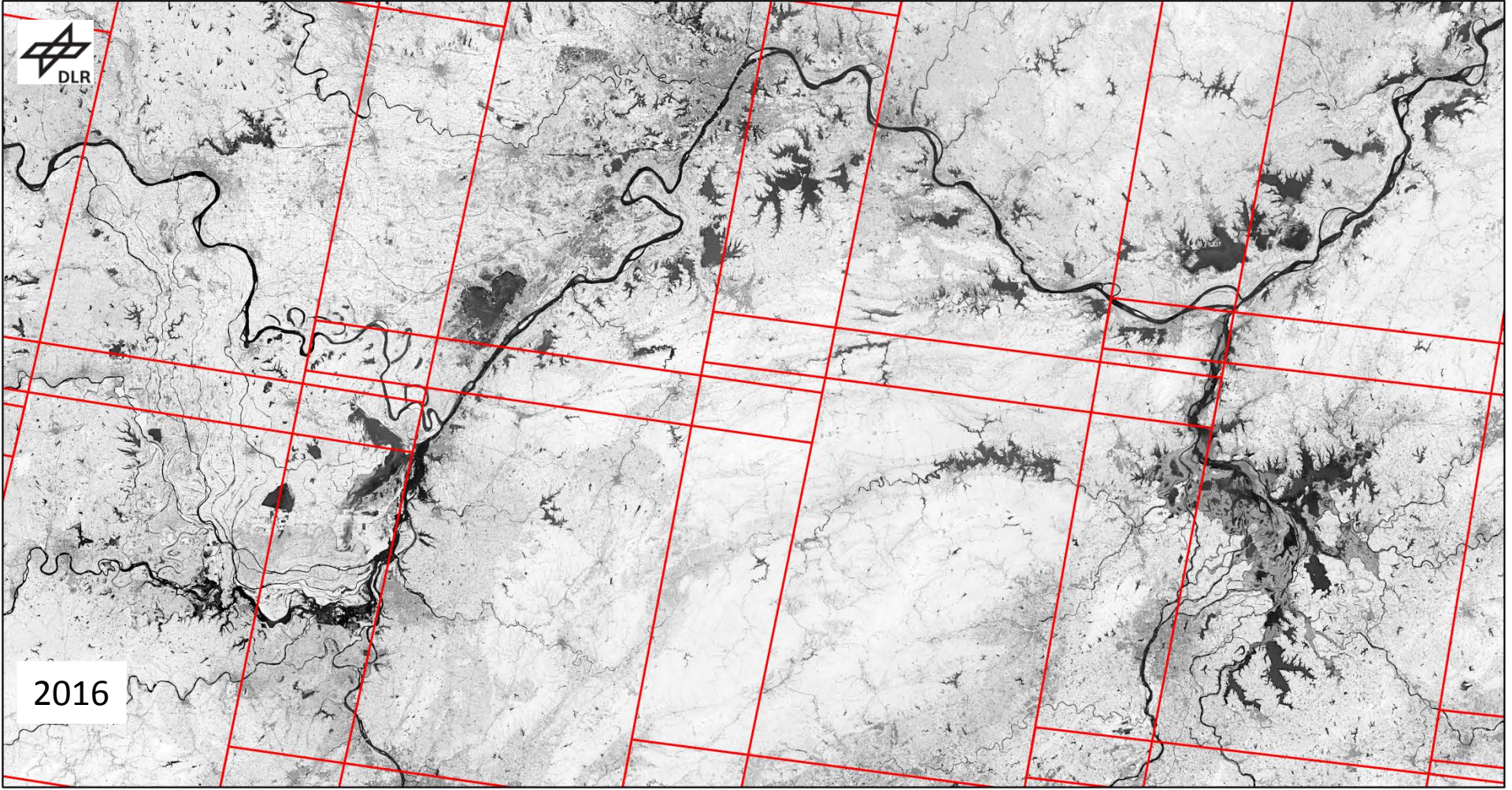

Mack, B. et al. 2017



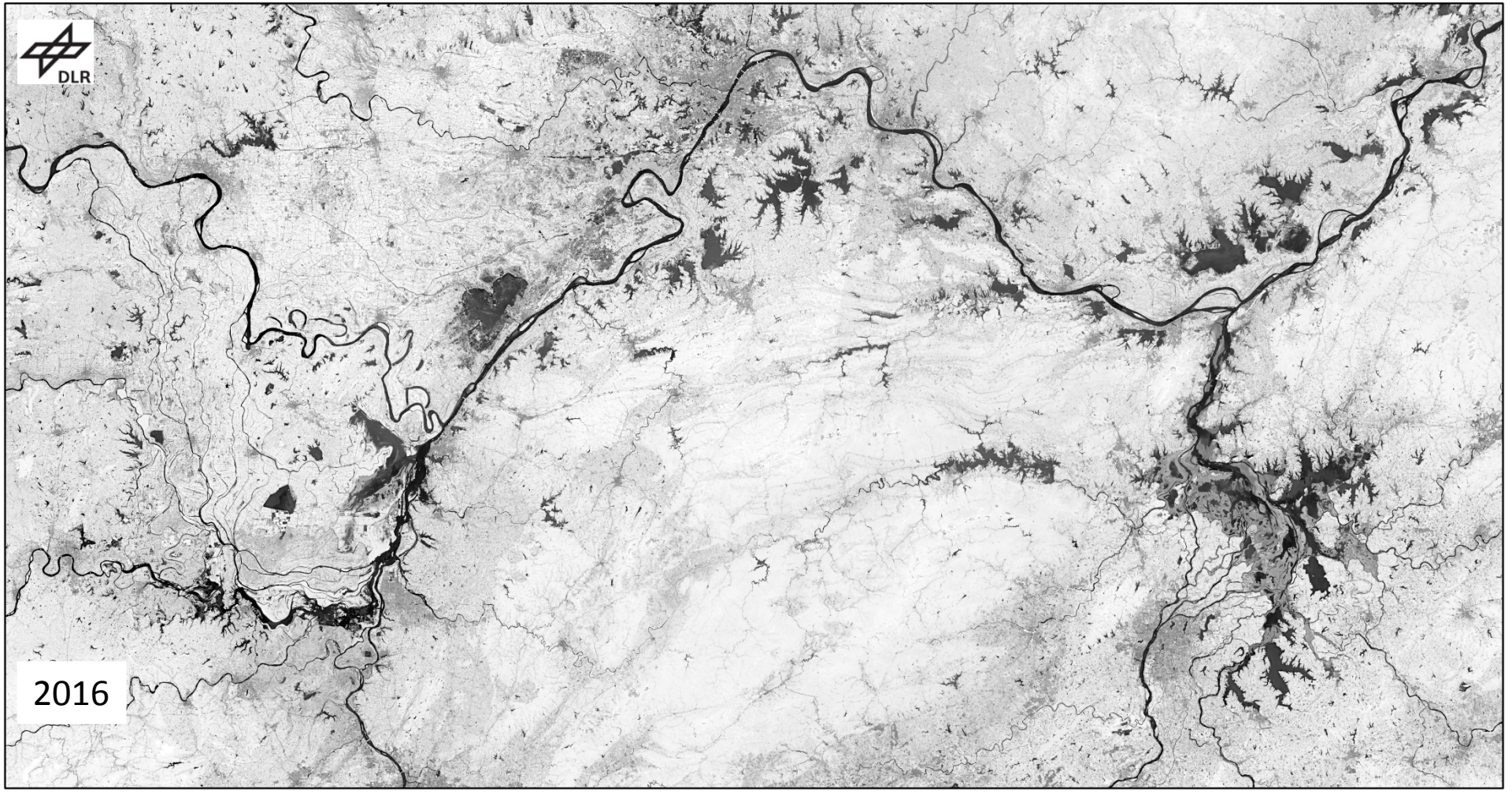

Landsat Time Series Data – generated with 41 Landsat 8 scenes = data with <30% CC, out of all available datasets for 1 year.
DLR method development : *B Mack, P Leinenkugel, C Kuenzer, S Dech„A semi-automated approach for the generation of a new land use and land cover product for Germany based on Landsat time-series and Lucas in-situ data – Remote Sensing Letters, 2017*



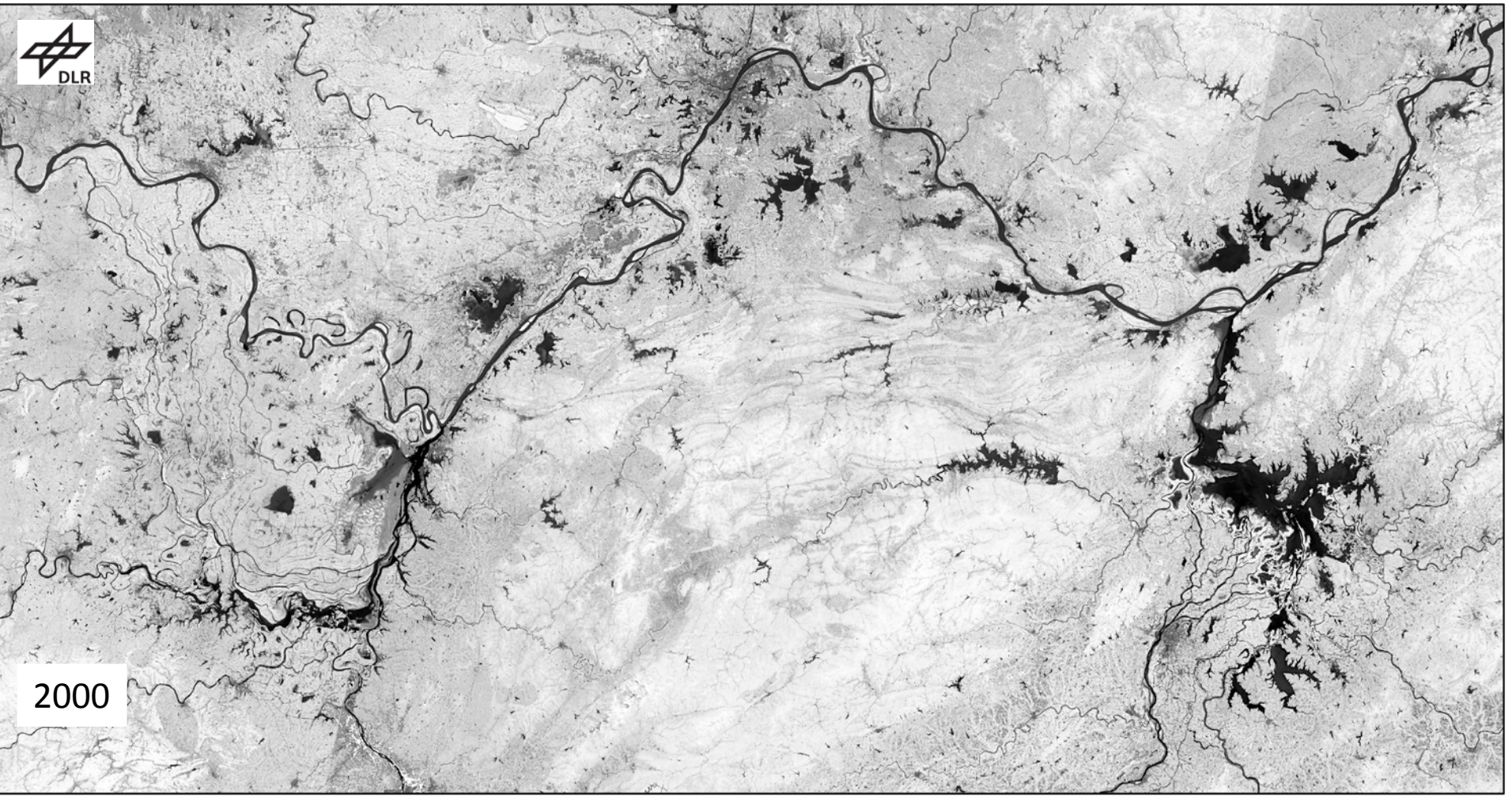

Landsat Time Series Data – generated with 62 Landsat TM and ETM scenes = data with <30% CC,
out of all available datasets for 1 year.



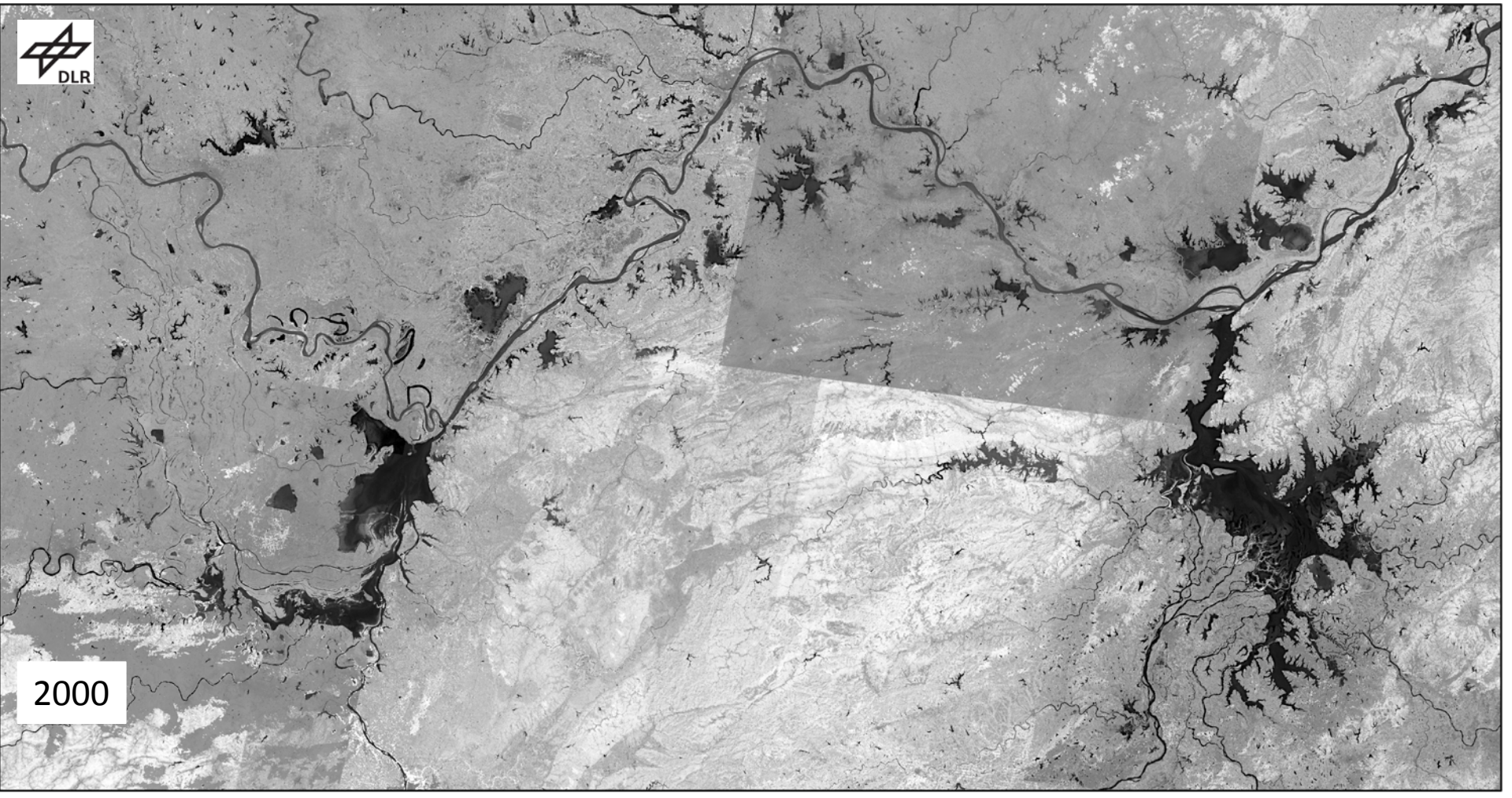

2014 Time Series Data – NDVI minimum (p100)

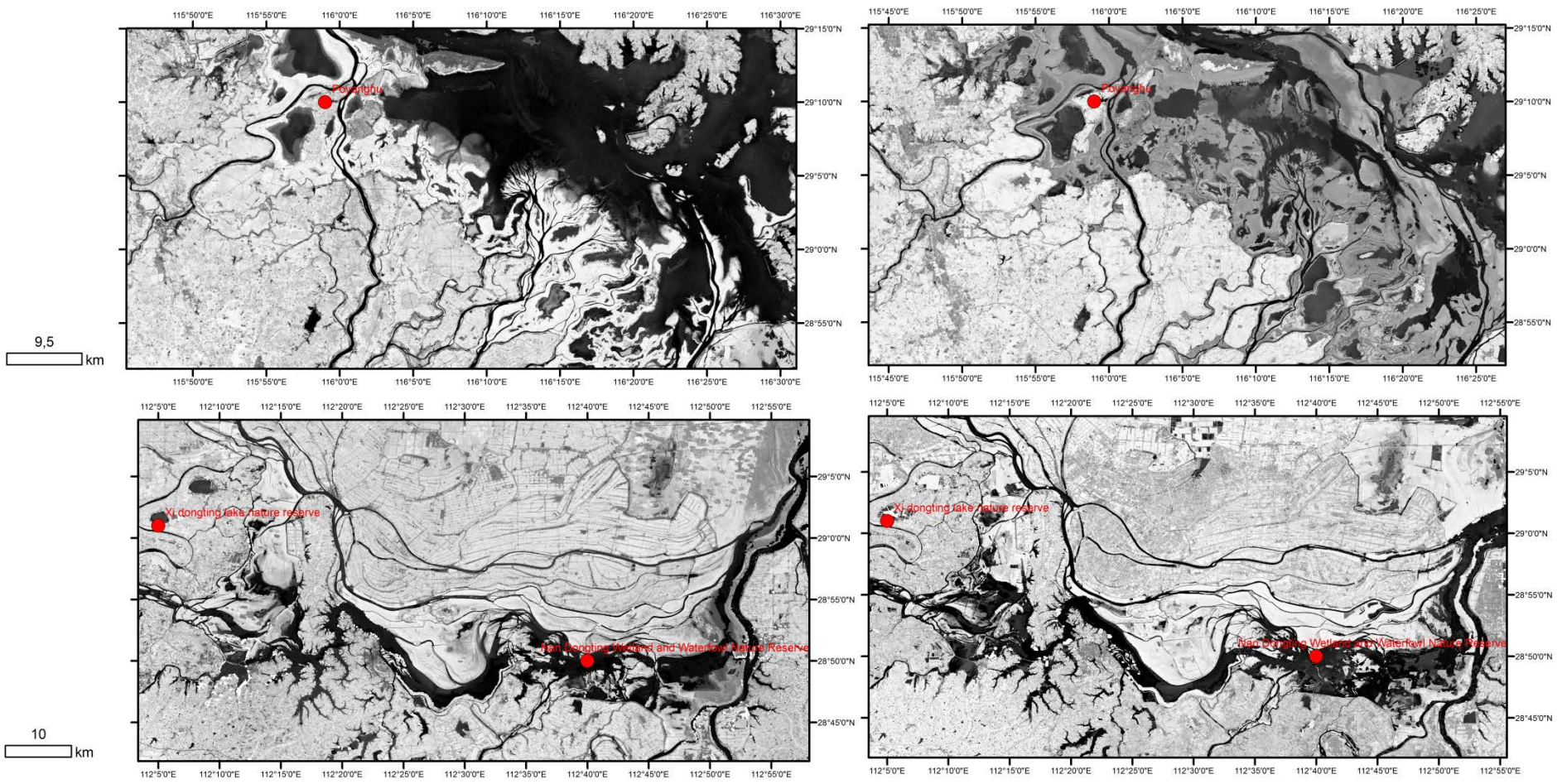



2014 Time Series Data – NDVI minimum (p100)

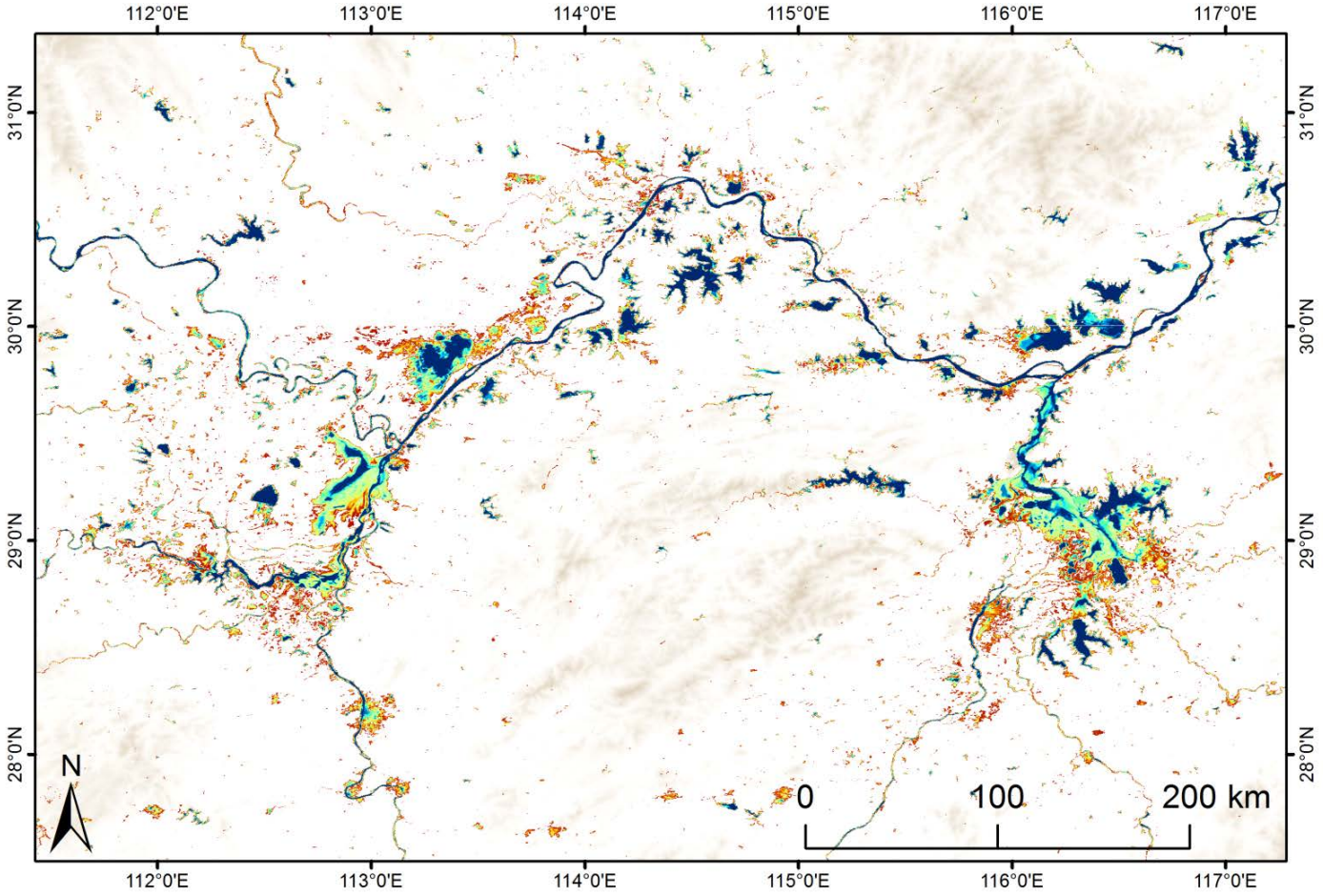

DLR
2000


2014 Time Series Data – NDVI maximum (p0)


DLR
2000


Poyanghu
Xi dongting lake nature reserve
Nan Dongting Wetland and Waterfowl Nature Reserve
9,5
km
10
km

# DLR's Global WaterPack – Poyang and Dongting Lake




Inundation duration (days)

0 61 122 183 244 305 365

Klein, Igor , Dietz, Andreas, Gessner, Ursula, Dech, Stefan und Künzer, Claudia (2015) Results of the Global WaterPack: a novel product to assess inland water body dynamics on a daily basis. Remote Sensing Letters, 6 (1)

# Plan for the next 1 – 2 years

1. Data Processing and Analyses – according to proposal tasks
- DLR:
    - Water surface monitoring for Dongting and Poyang Lake (Sentinel data)
    - Land cover (e.g. 2000 and 2016) and wetland extraction – assessment of change
- DLR/MPI for Ornithology – Assessment of EO potential to support habitat monitoring of birds (migratory or/and domestic)
    - […]
2. Publication activity
3. Young Scientist Exchange (in case of available funding)




Thank you
for your attention!

juliane.huth@dlr.de

# CHANGES MONITORING IN POYANG LAKE WITH MULTI-SOURCES REMOTE SENSING IMAGES

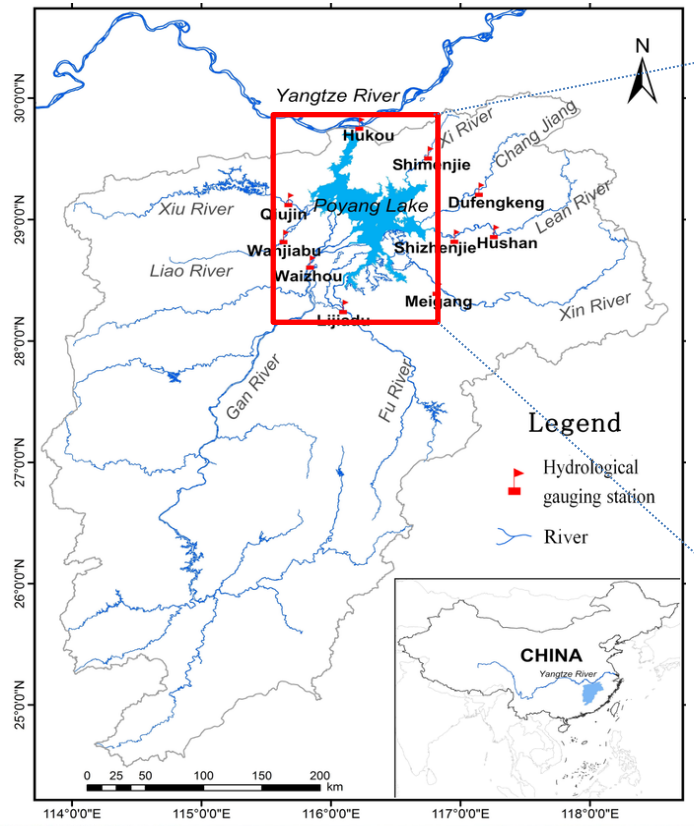
Shuhua Qi  Yeqiao Wang  Dan Wang  Zhang Li

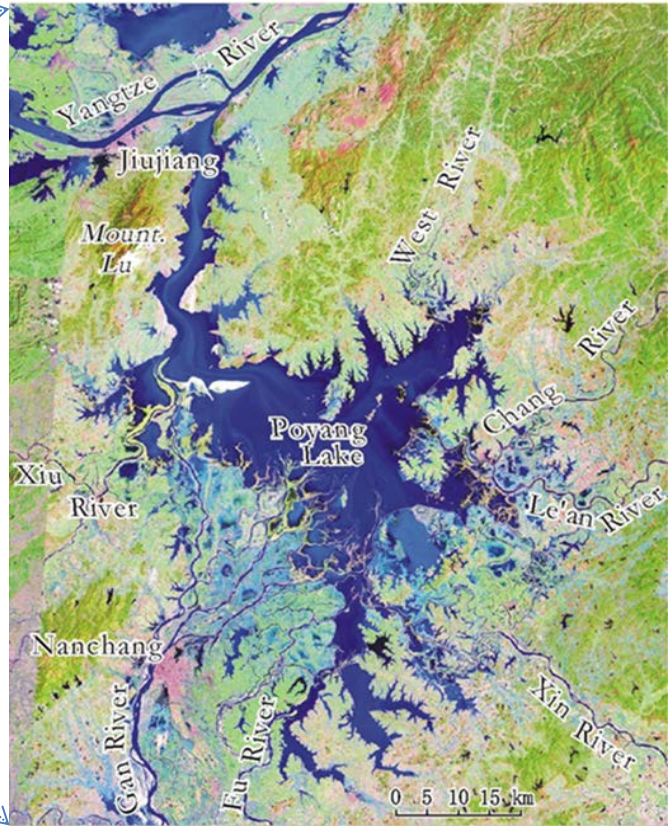
Key Laboratory of Poyang Lake Wetland and Watershed Research, Ministry of Education, Jiangxi Normal University

# Report Outline

1. *Poyang Lake*
2. *Multi-Source Remote Sensing Images*
3. *Water Extent Change*
4. *Suspended Sediment Change*
5. *Landscape Change*

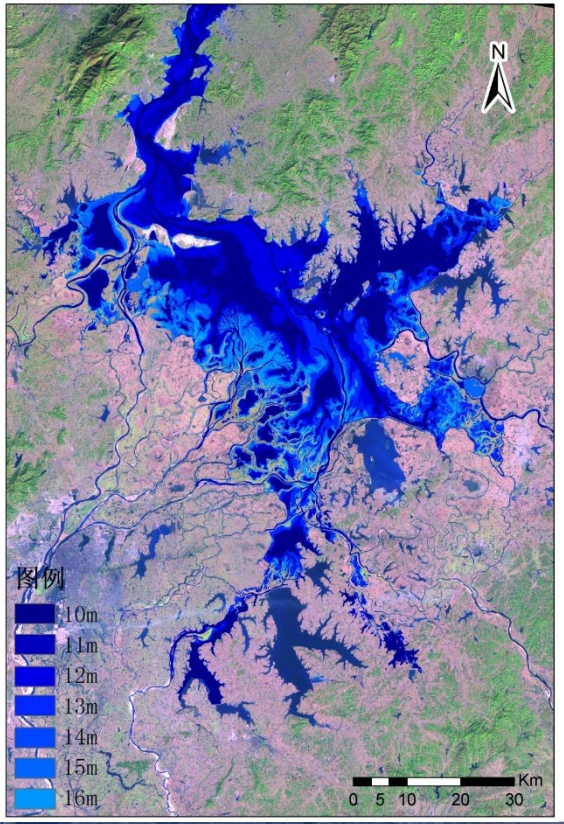
# Poyang Lake


N
Yangtze River
Hukou
Shimenjie
Poyang Lake
Duofengkeng
Qujin
Wanjiabu
Shizhenjie
Hushan
Waizhou
Meigang
Lijiadu
Xiu River
Liao River
Chang Jiang
Lean River
Xin River
Gan River
Fu River
Legend
Hydrological gauging station
River
CHINA
Yangtze River
0 25 50 100 150 200 km
114°0'0"E
115°0'0"E
116°0'0"E
117°0'0"E
118°0'0"E
30°0'0"N
29°0'0"N
28°0'0"N
27°0'0"N
26°0'0"N
25°0'0"N

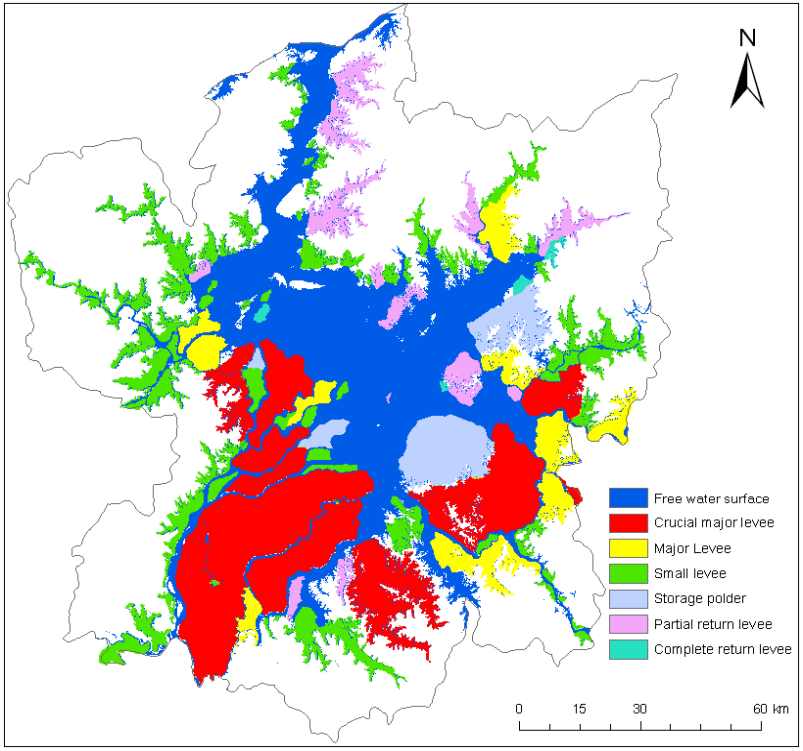

Yangtze River
Jiujiang
Mount. Lu
West River
Poyang Lake
Chang River
Xiu River
Le'an River
Nanchang
Gan River
Fu River
Xin River
0 5 10 15 km

# Poyang Lake

Affected by subtropical monsoon climate, rainfall is abundant in PYLW with a mean annual precipitation of 1,680 mm. And most precipitation happened in April-June, account for about 45%. Water level in Poyang Lake shows great fluctuation seasonally and water extent also fluctuations from <1,000 $km^2$ to >4,000 $km^2$



# Poyang Lake




**The water body in Poyang Lake was shaped by the water poured from the five rivers and the levees around Poyang Lake.**

**It was estimated that there were more than 6000km levees around Poyang Lake.**

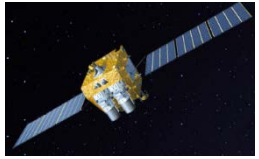
**And these levees were responsible for protecting farmland about $24*10^4$ ha and 3.5 million population**

# Report Outline

1. *Poyang Lake*
2. *Multi-Source Remote Sensing Images*
3. *Water Extent Change*
4. *Suspended Sediment Change*
5. *Landscape Change*

# Multi-Sources Remote Sensing Images

## Images parameters from GF-1 Satellite



| | Band NO. | Spectrum Range (μm) | Spatial Resolution (m) | Images width (km) | Revisiting days (day) |
|---|---|---|---|---|---|
| Pan and multi-spectral camera PMS | 1 | 0.45～0.90 | 2 | 60 | 4 |
| | 2 | 0.45～0.52 | 8 | | |
| | 3 | 0.52～0.59 | | | |
| | 4 | 0.63～0.69 | | | |
| | 5 | 0.77～0.89 | | | |
| multi-spectral camera WFV | 6 | 0.45～0.52 | 16 | 800 | 2 |
| | 7 | 0.52～0.59 | | | |
| | 8 | 0.63～0.69 | | | |
| | 9 | 0.77～0.89 | | | |

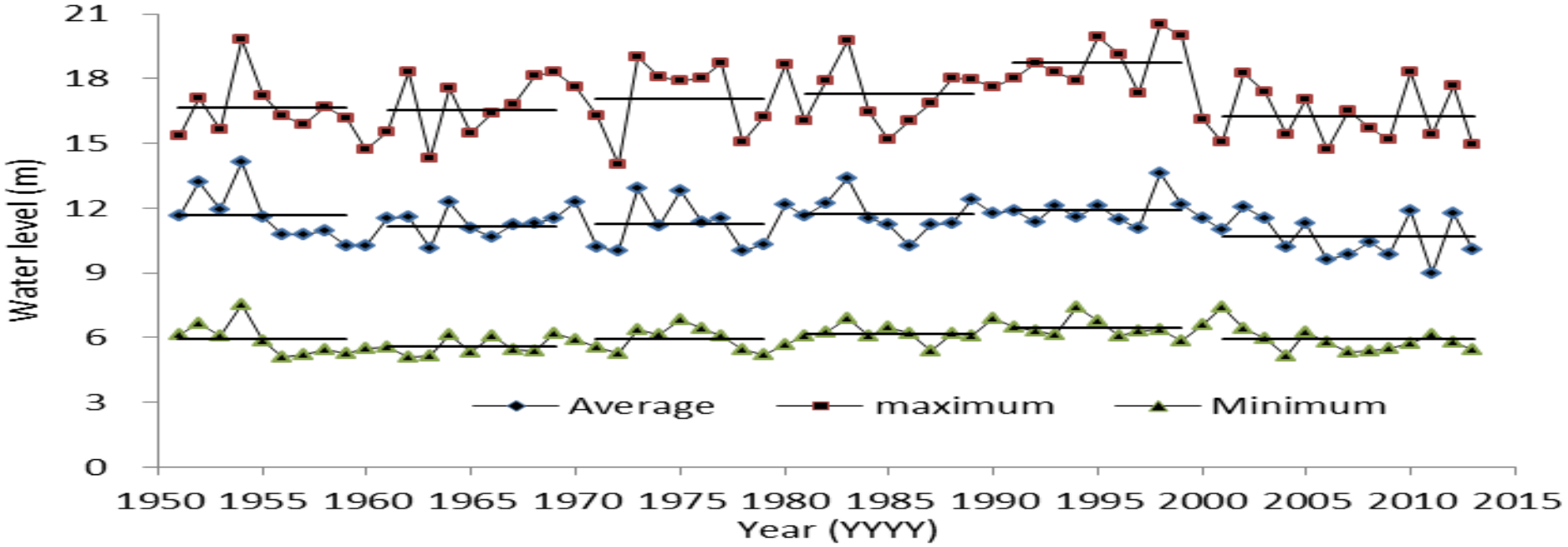
# Multi-Sources Remote Sensing Images

- 126 cloud free images received by GF-1/WFV in 41 days covering Poyang Lake were collected during 2013-2016. These images were used to mapping the water extent and suspended sediment content
- 8-days composite MODIS-NDVI product were also collected for mapping the water extent of Poyang Lake and annual inundating frequency during 2000-2016
- Sentinel 1A and Sentinel 2A images were used to mapping the wetland landscape
- Landsat TM/ETM/OLS images were used to monitoring the water extent changes with water level. And they were also used to monitoring the vessels involved in sand dredging

# Report Outline

1. *Poyang Lake*
2. *Multi-Source Remote Sensing Images*
3. *Water Extent Change*
4. *Suspended Sediment Change*
5. *Landscape Change*

# Water Extent Change

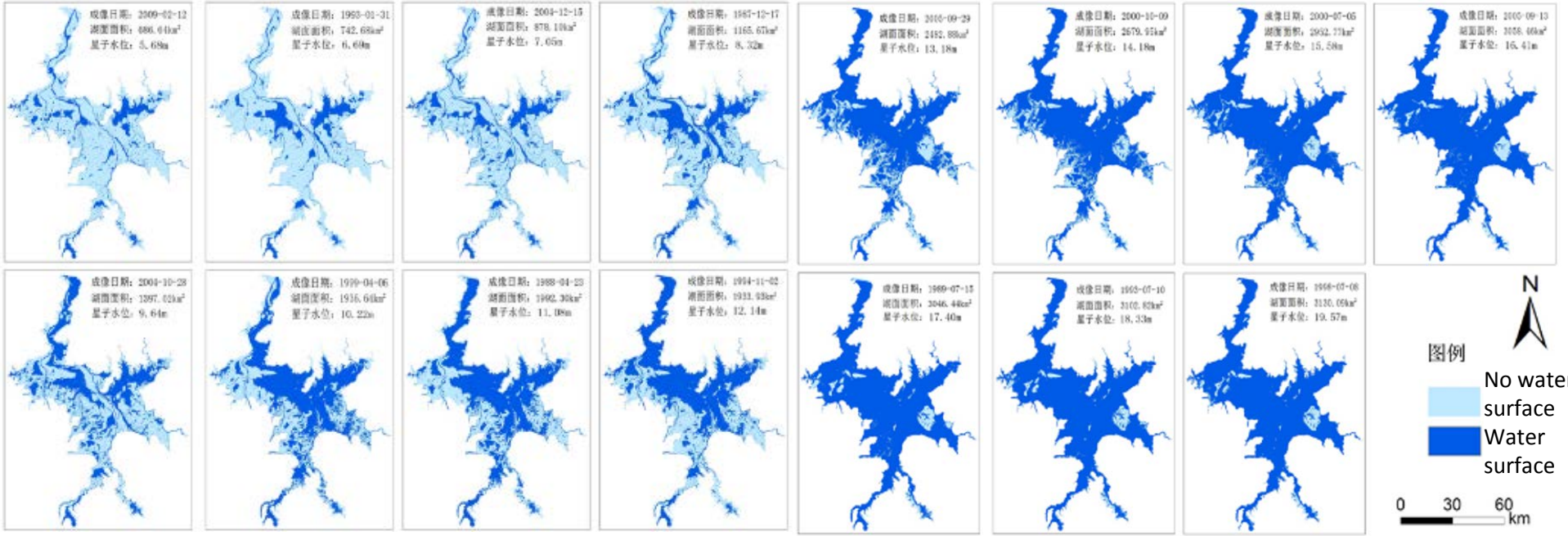


# Water Extent Change

**The drought duration in recent years according to water level records from Xingzi station since 2003**

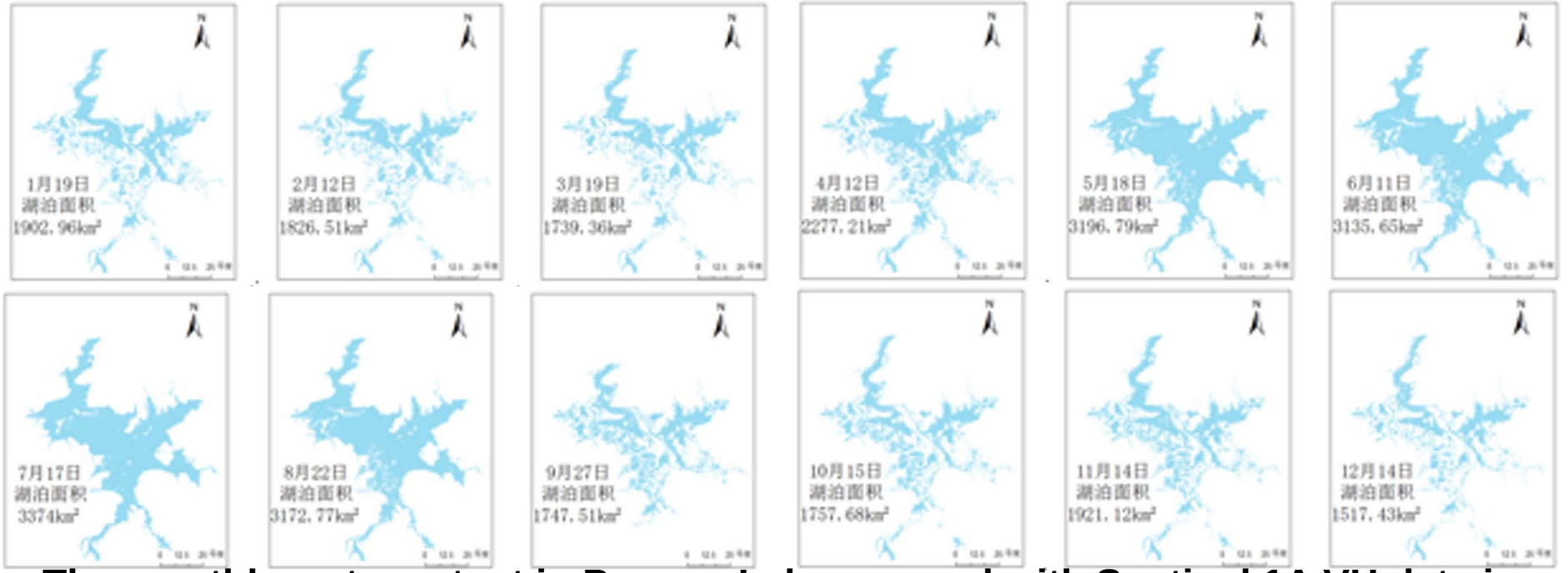
| Days | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 1951-1999 | 2000-2013 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| <5.5 m | 0 | 31 | 0 | 0 | 20 | 9 | 0 | 0 | 0 | 0 | 3 | 3.4 | 4.5 |
| <=6m | 1 | 61 | 0 | 6 | 61 | 42 | 55 | 13 | 0 | 9 | 16 | 12.7 | 18.9 |
| <=7m | 31 | 83 | 34 | 83 | 100 | 86 | 123 | 57 | 70 | 19 | 69 | 42.7 | 56.6 |
| <=8m | 54 | 118 | 71 | 139 | 145 | 109 | 141 | 88 | 181 | 59 | 122 | 73.5 | 97.8 |
| <=9m | 83 | 175 | 95 | 184 | 195 | 127 | 167 | 122 | 239 | 104 | 148 | 100.0 | 136.0 |
| <=10 m | 118 | 190 | 152 | 229 | 222 | 159 | 188 | 142 | 264 | 134 | 188 | 126.4 | 169.5 |

# Water Extent Change



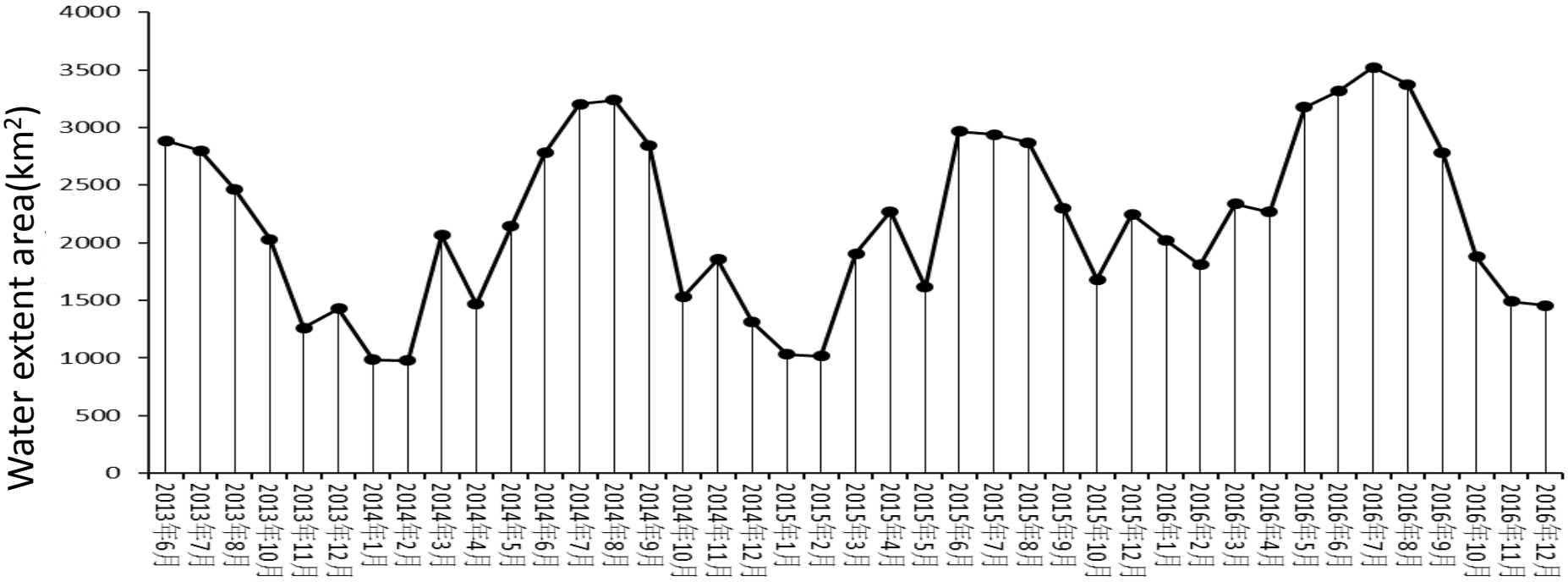

**The water extent in Poyang Lake with different Xingzi water level monitoring with Landsat images**

# Water Extent Change



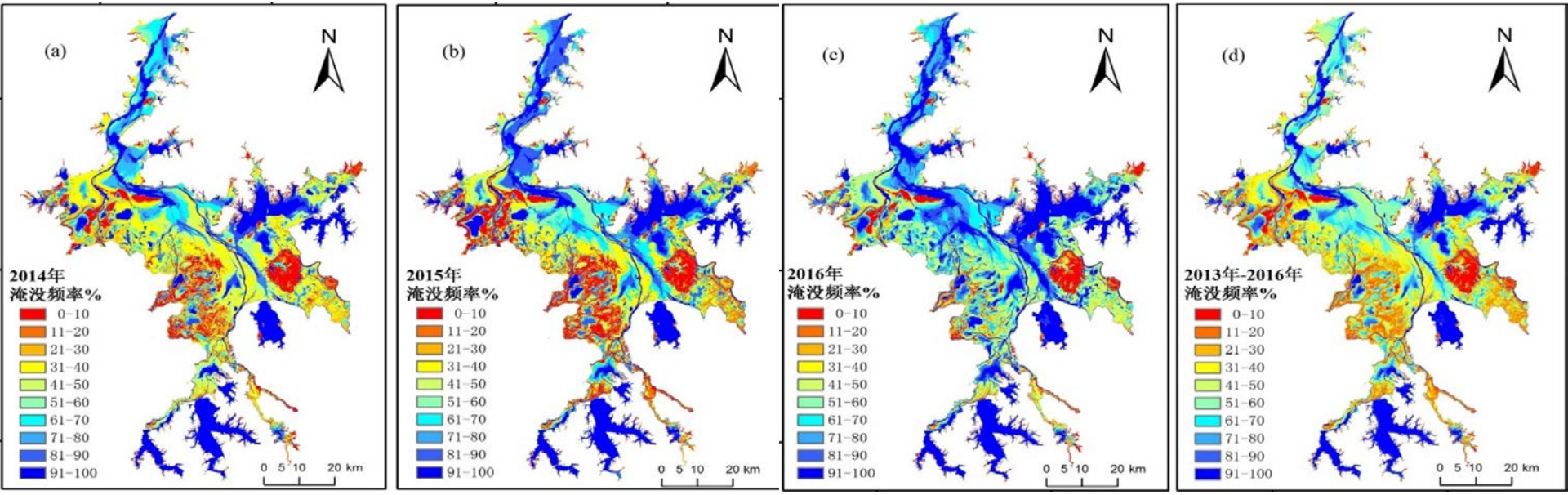

**The monthly water extent in Poyang Lake mapped with Sentinel 1A VH data in 2016**

# Water Extent Change



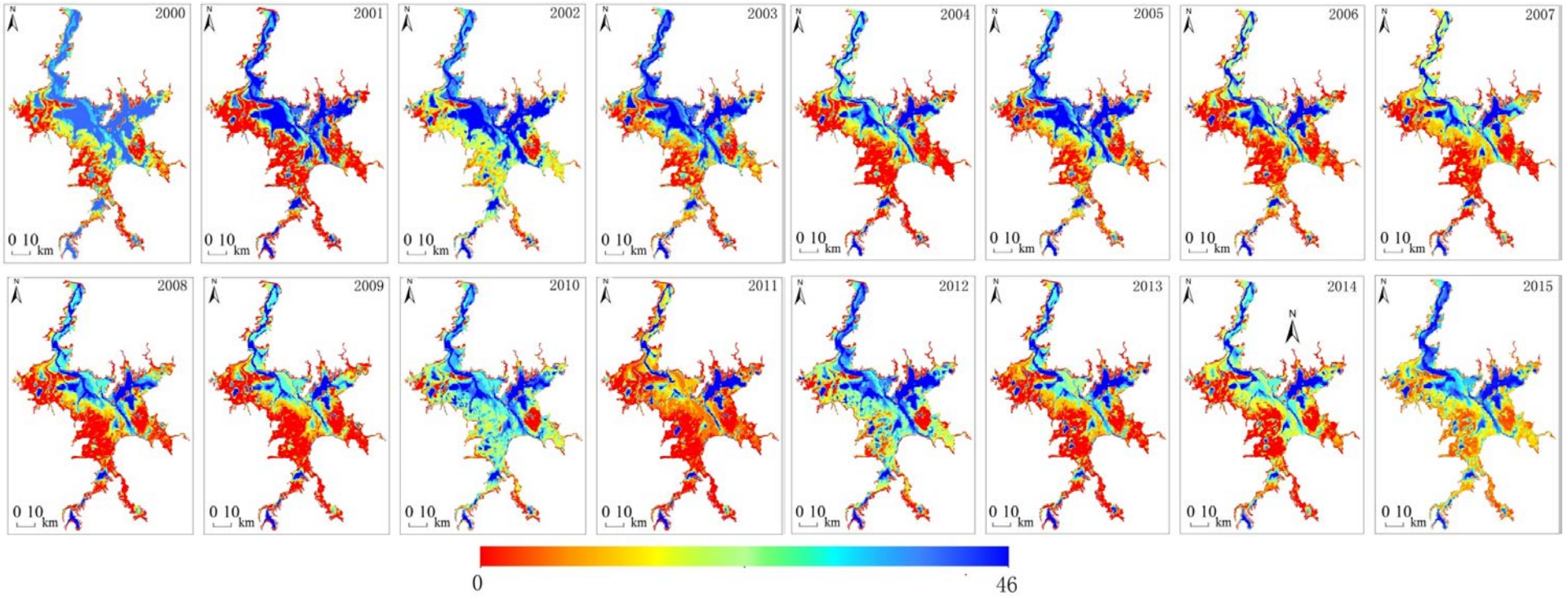

The water extent area in Poyang Lake during 2013-2016 monitoring with GF-1

# Water Extent Change

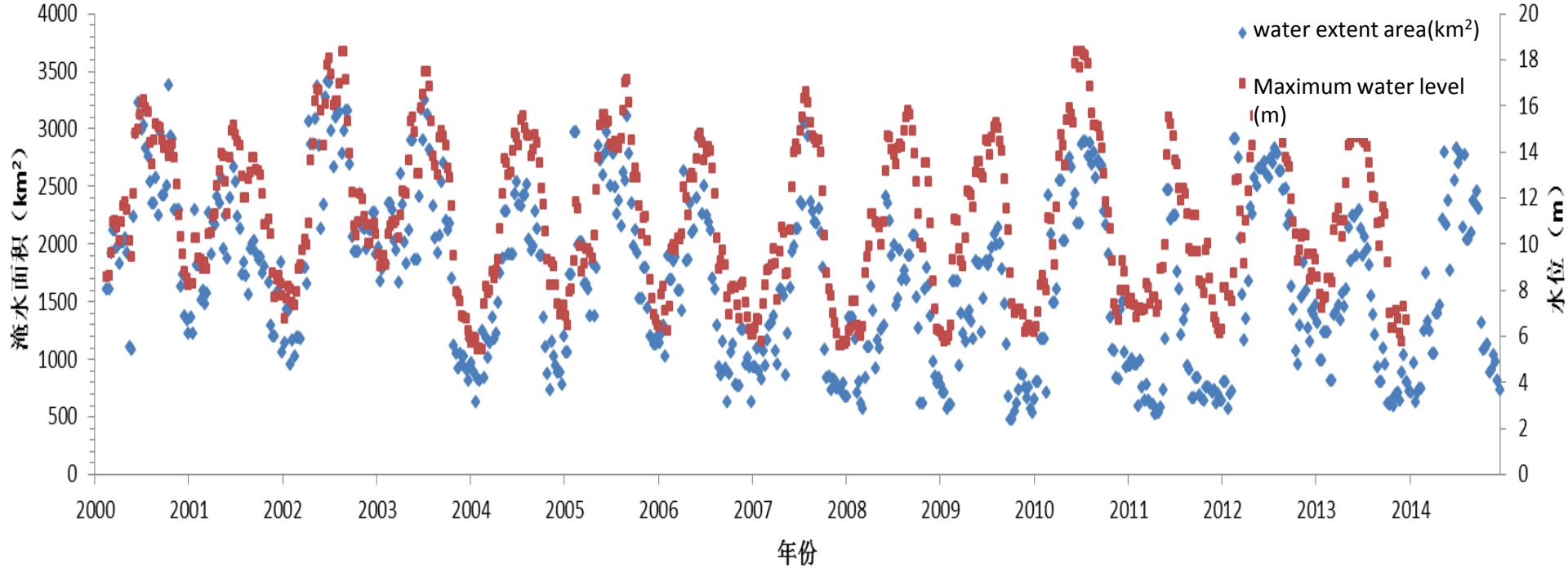



The water annual inundating frequency in Poyang Lake during 2014-2016 with GF-1 images

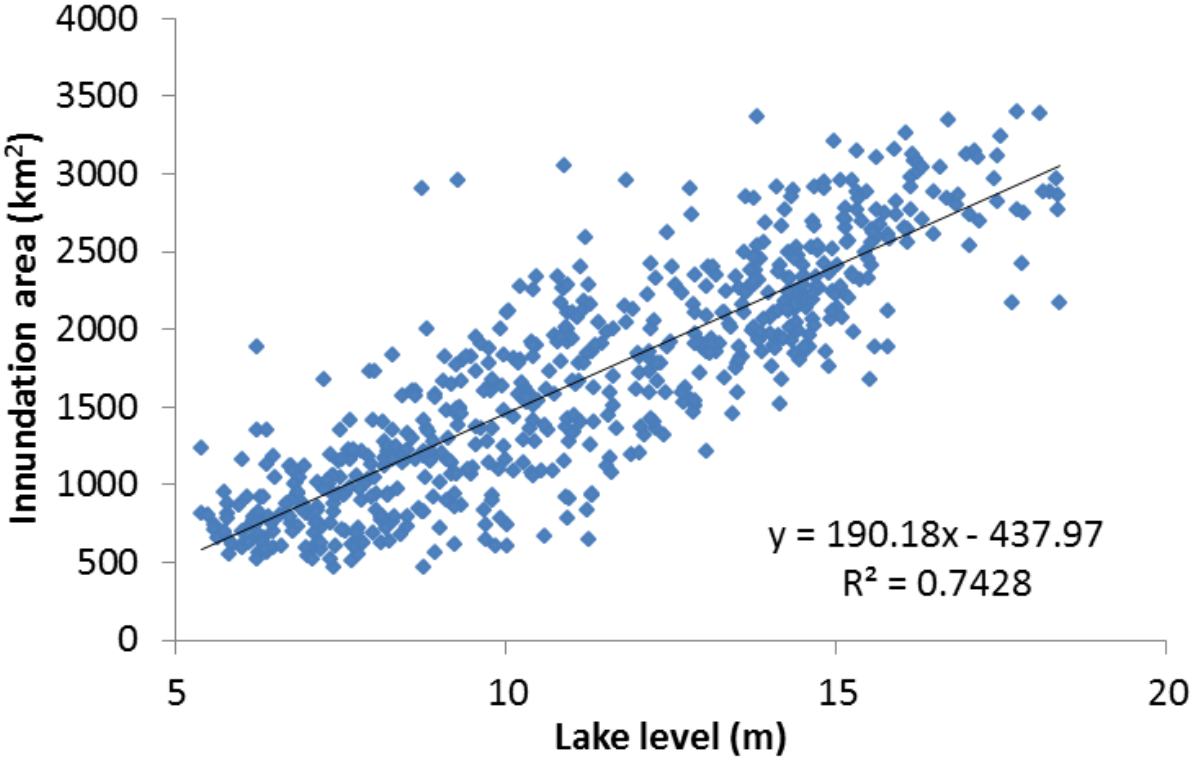
# Water Extent Change



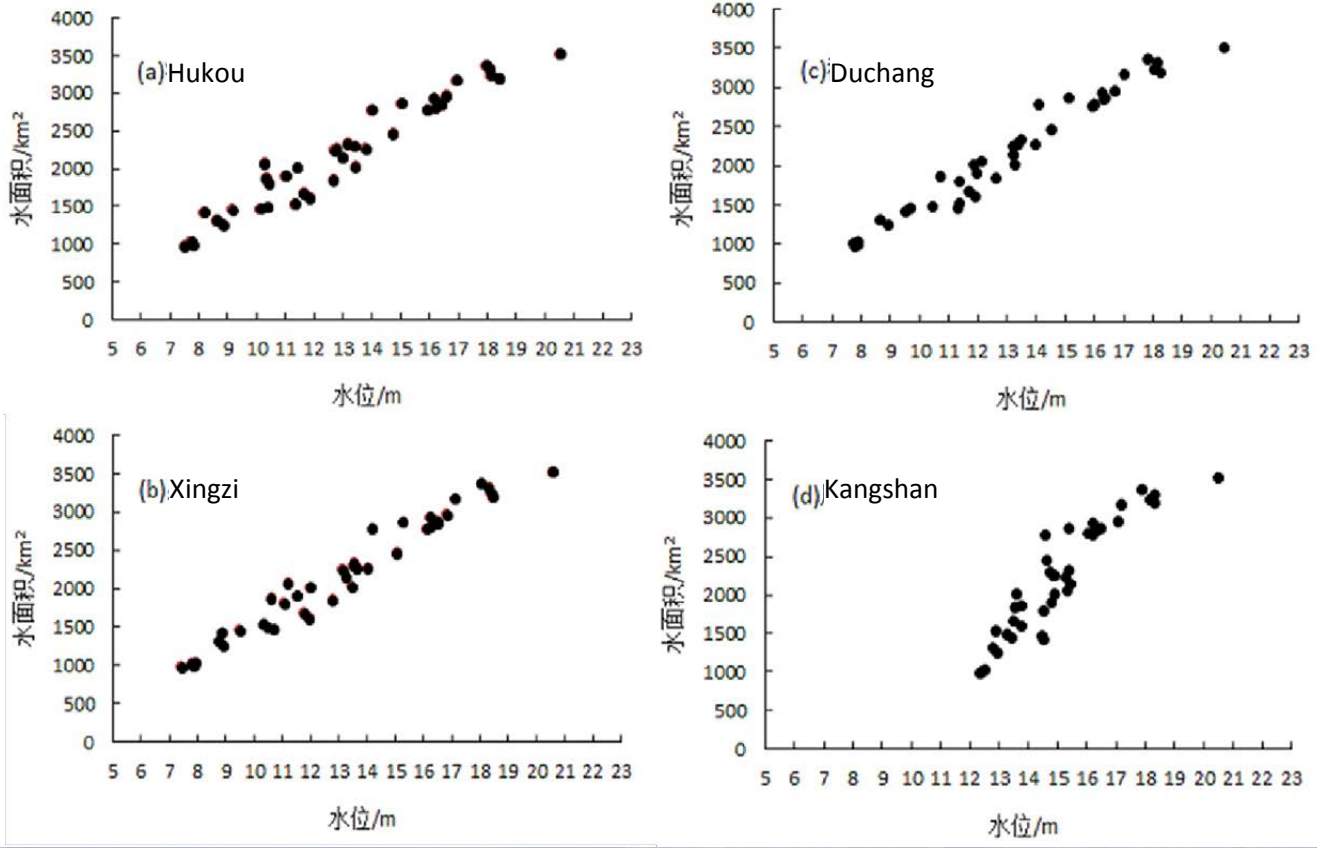
# Water Extent Change



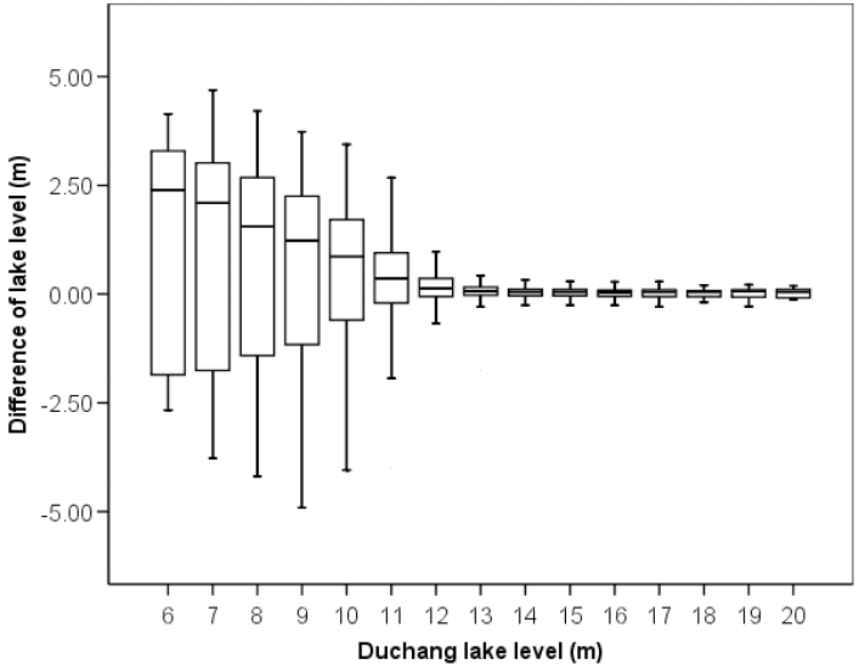
# Water Extent Change

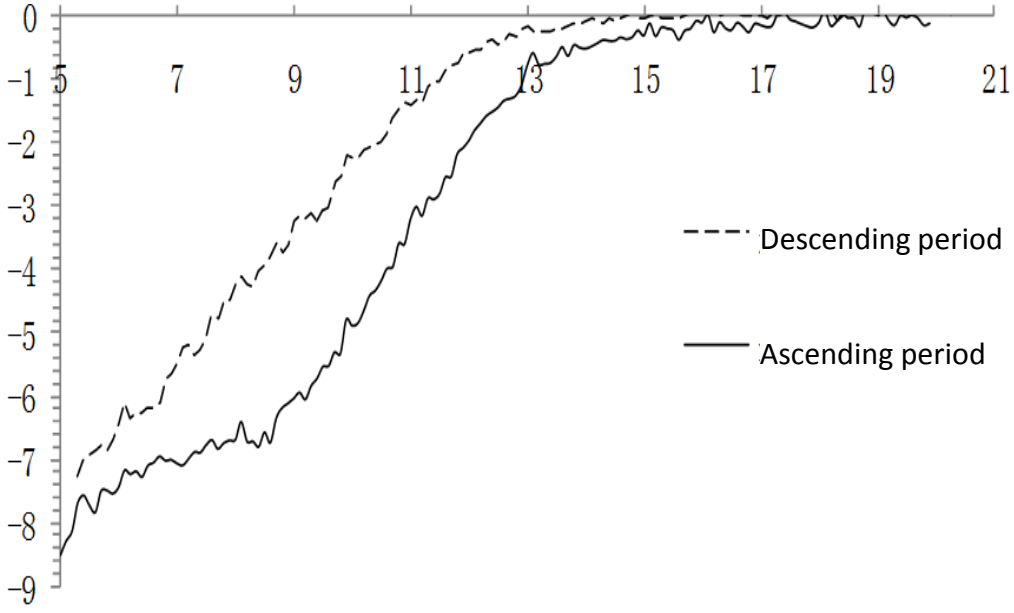


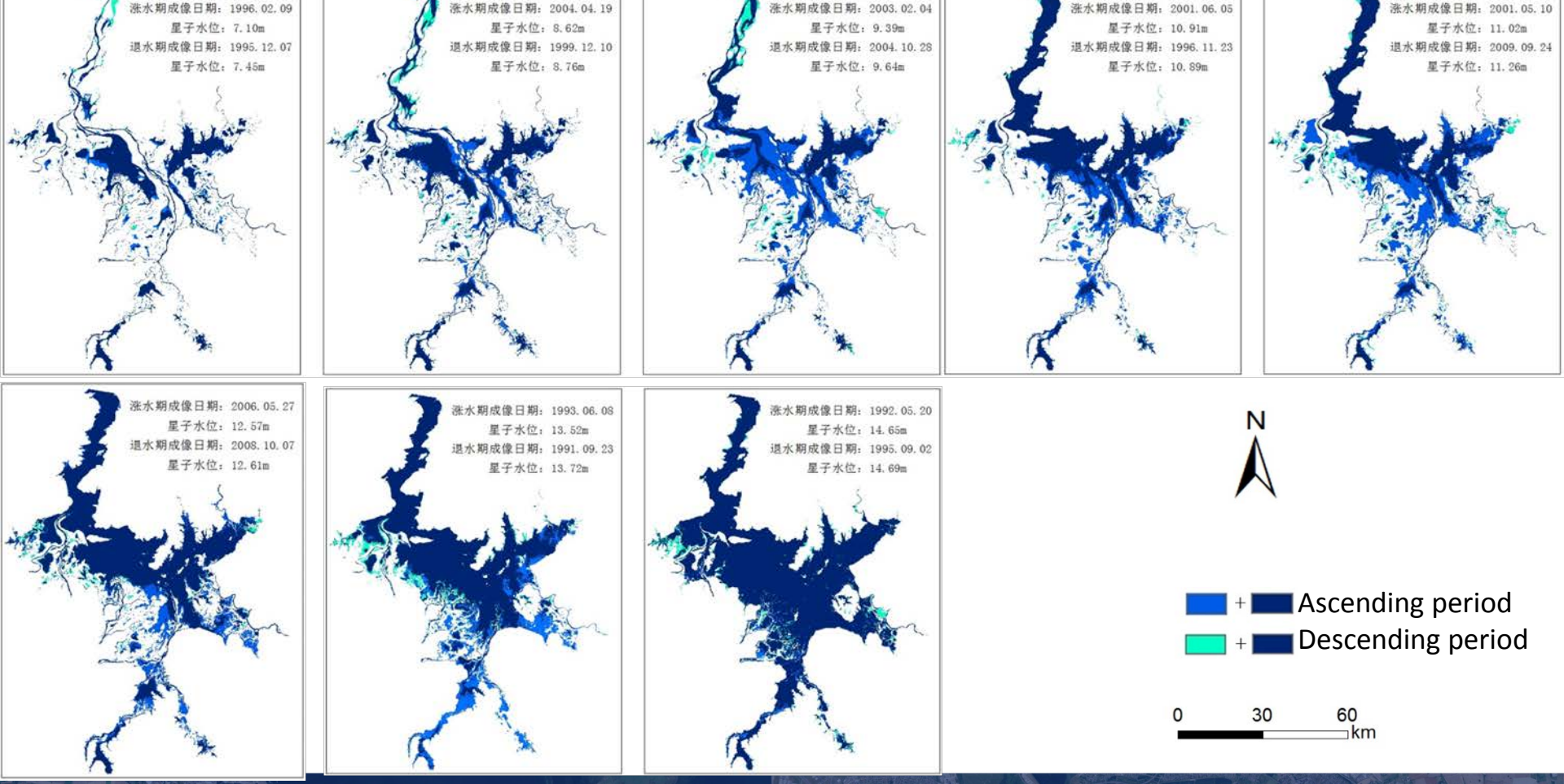
# Water Extent Change



# Water Extent Change




涨水期成像日期：1996.02.09
星子水位：7.10m
退水期成像日期：1995.12.07
星子水位：7.45m
涨水期成像日期：2004.04.19
星子水位：8.62m
退水期成像日期：1999.12.10
星子水位：8.76m
涨水期成像日期：2003.02.04
星子水位：9.39m
退水期成像日期：2004.10.28
星子水位：9.64m
涨水期成像日期：2001.06.05
星子水位：10.91m
退水期成像日期：1996.11.23
星子水位：10.89m
涨水期成像日期：2001.05.10
星子水位：11.02m
退水期成像日期：2009.09.24
星子水位：11.26m
涨水期成像日期：2006.05.27
星子水位：12.57m
退水期成像日期：2008.10.07
星子水位：12.61m
涨水期成像日期：1993.06.08
星子水位：13.52m
退水期成像日期：1991.09.23
星子水位：13.72m
涨水期成像日期：1992.05.20
星子水位：14.65m
退水期成像日期：1995.09.02
星子水位：14.69m
N
+ Ascending period
+ Descending period
0 30 60
km

# Water Extent Change

(1)Though a significant linear relationship was found for the water level and inundation area for the Poyang Lake, the water surface area shows uncertainty;

(2) Water level in Poyang Lake is higher in the south and lower in the north when lake water level is low, and the spatial heterogeneity of water level was decreasing with lake level increasing;

(3) Water level slope in Poyang Lake in the time period of water withdrawal was greater than that in flood period;

(4) Affected by fishery practice by levees of dish-shaped sublakes, the water surface area of the sublakes in water withdrawal period is greater than that in flood period. Sand mining also changed the water extent around the sandpits when in low lake level. Therefore the inundation extent for Poyang Lake was affected by topography of lake basin, water discharge from the tributaries in Poyang Lake watershed, and the backwater effect of the Yangtze River, as well as with human activities such as sand mining and fishing practice with levees.

# Report Outline

1. *Poyang Lake*
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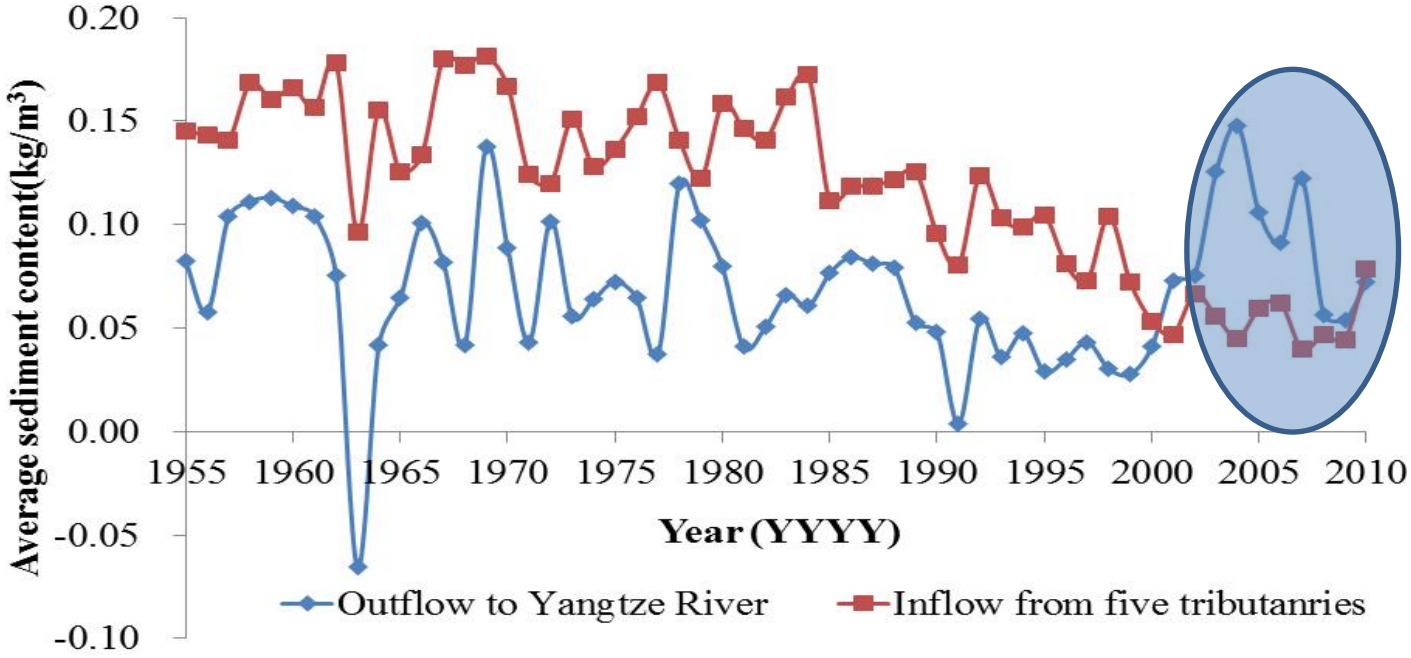
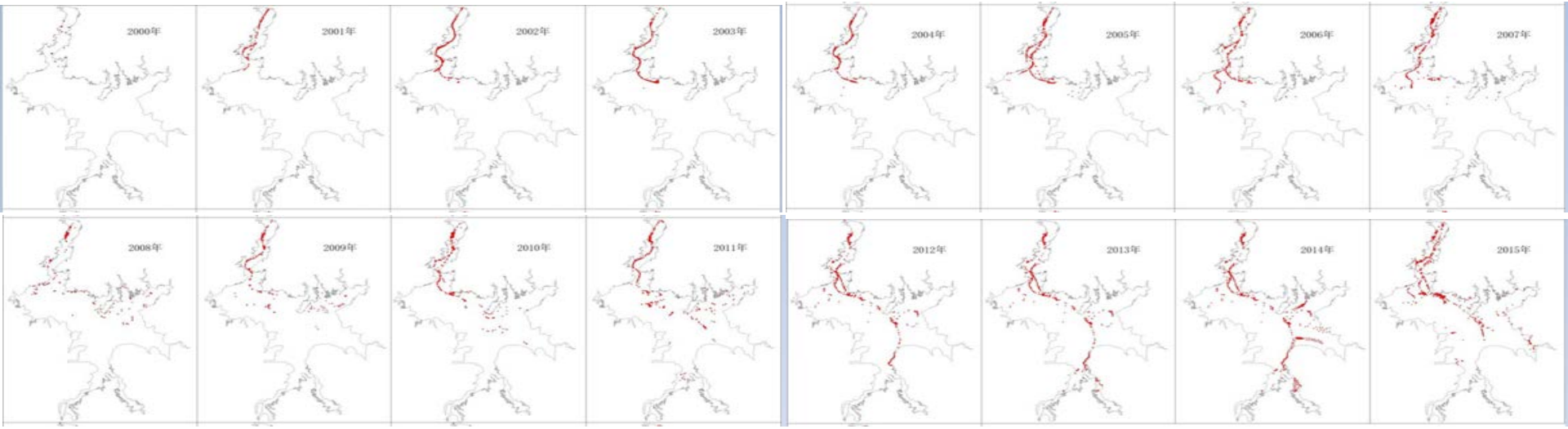
# Suspended Sediment Change



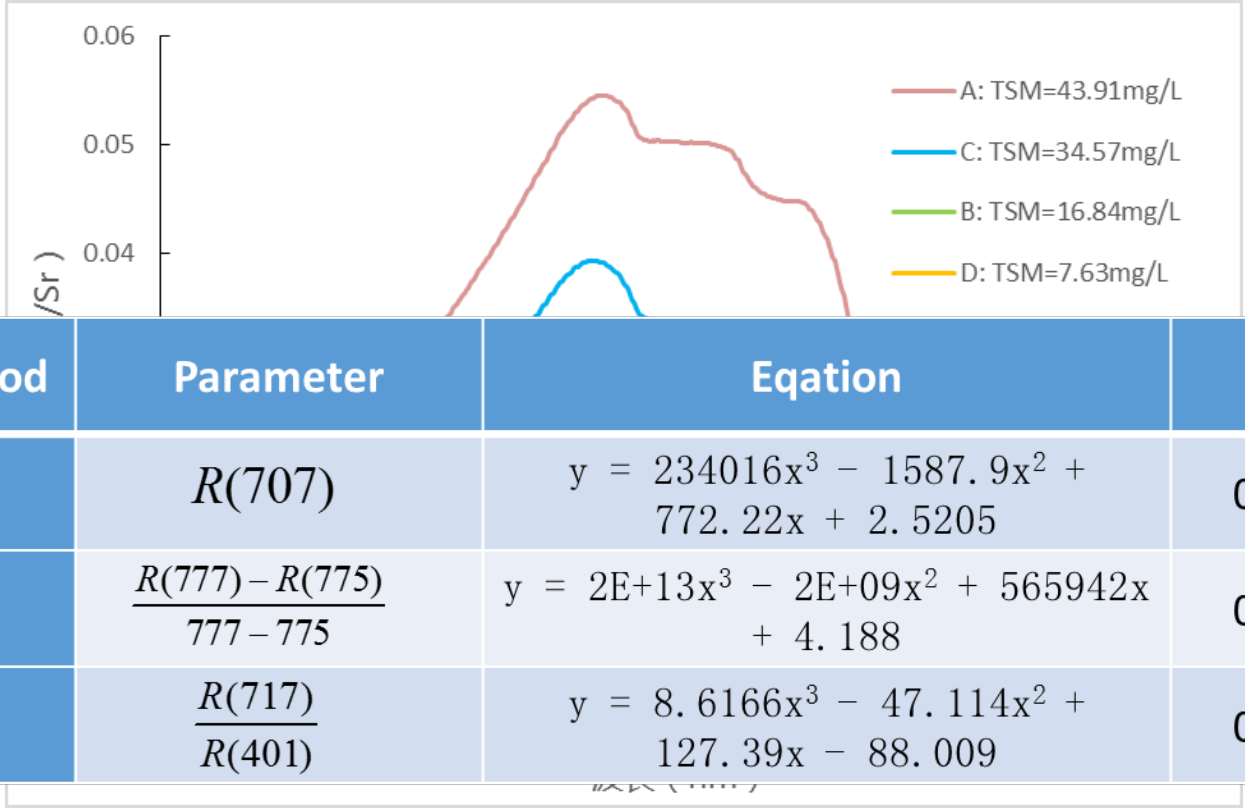

The yearly average sediment content for the water inflow to Poyang Lake and outflow to Yangtze River from Hukou gauging station

# Suspended Sediment Change



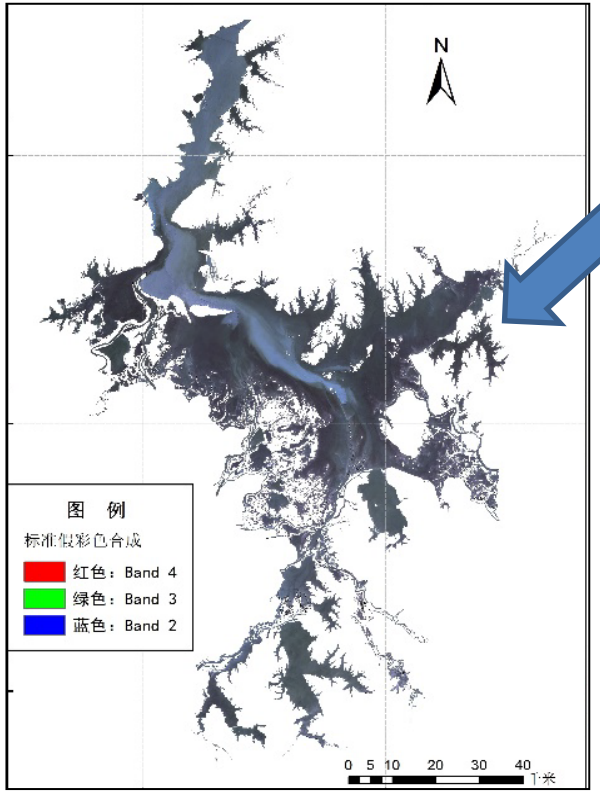

The vessels involved in sand dredging in Poyang Lake during 2000-2014 with Landsat images

# Suspended Sediment Change



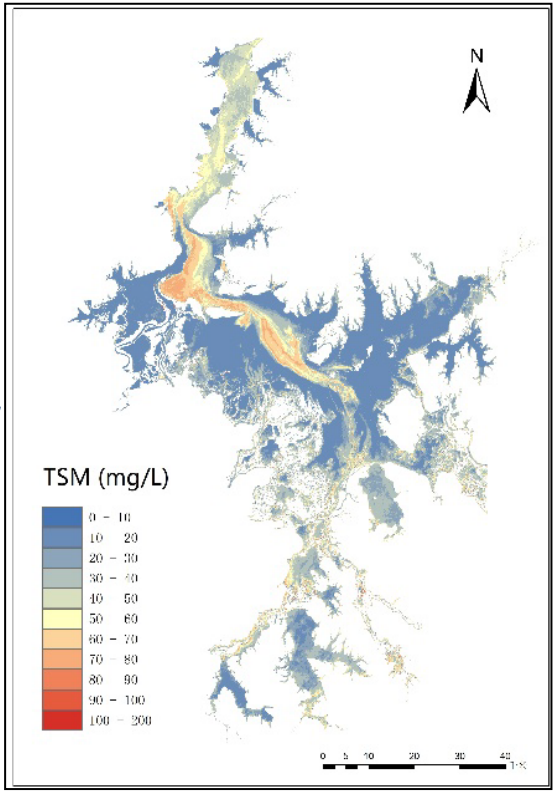

| Regress Method | Parameter | Eqation | $R^2$ |
|---|---|---|---|
| 单波段 | $R(707)$ | $y = 234016x^3 - 1587.9x^2 + 772.22x + 2.5205$ | 0.9917 |
| 一阶微分 | $\frac{R(777)-R(775)}{777-775}$ | $y = 2E+13x^3 - 2E+09x^2 + 565942x + 4.188$ | 0.9681 |
| 波段比值 | $\frac{R(717)}{R(401)}$ | $y = 8.6166x^3 - 47.114x^2 + 127.39x - 88.009$ | 0.9593 |

# Suspended Sediment Change




The GF-1 image composited with R4G3B2

The suspended sediment content from GF-1 image with a linear regress equation scheme.



# Report Outline

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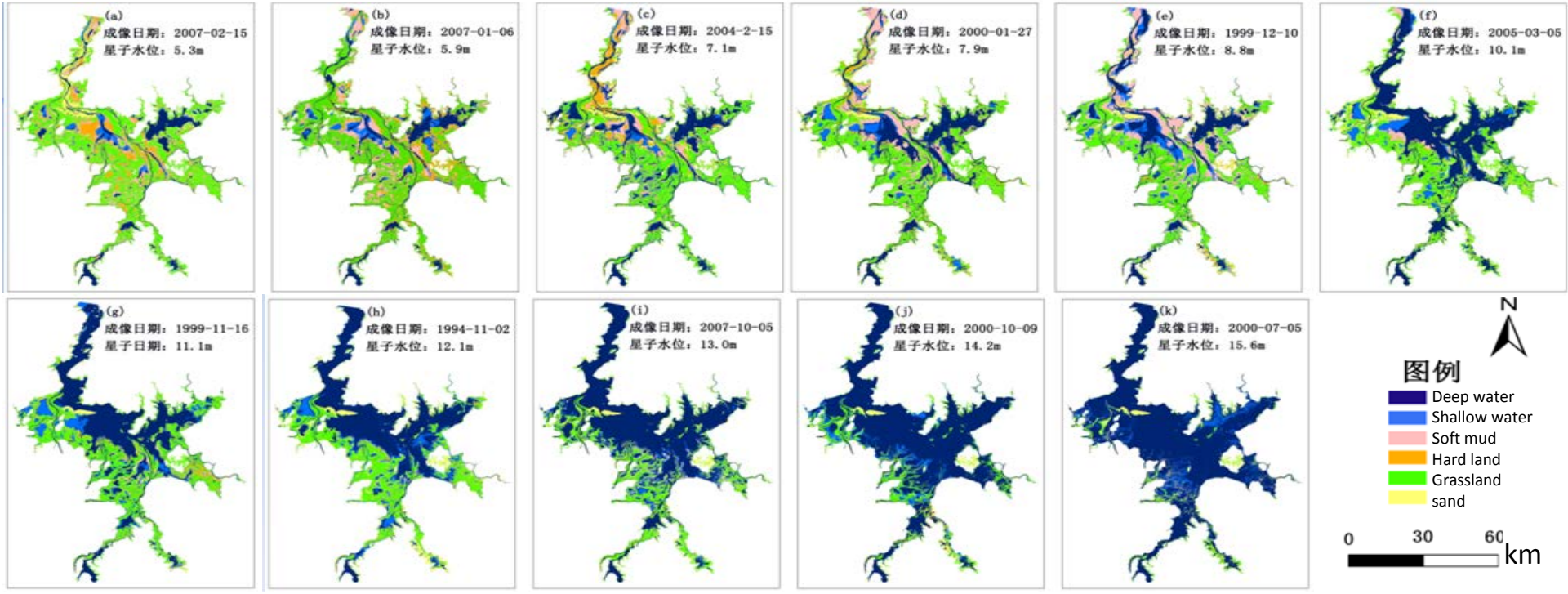
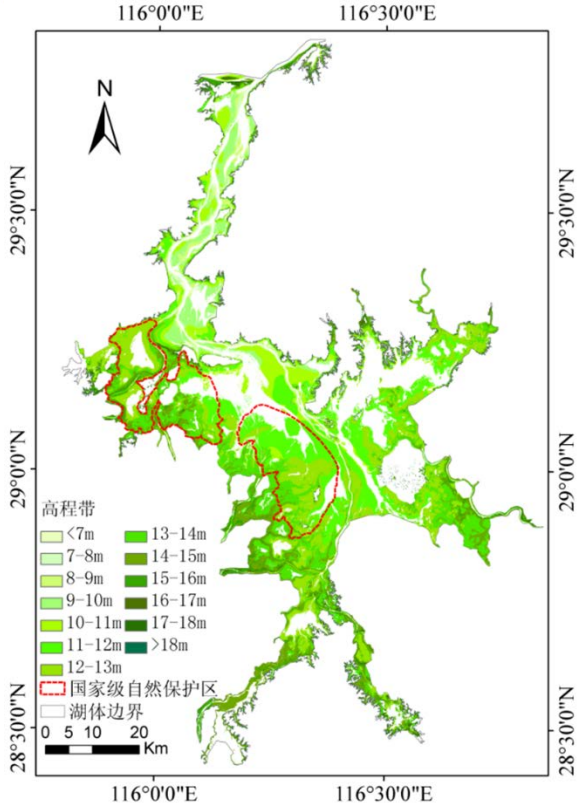
# Landscape Change



# Landscape Change




| Elevation Range | Area ($km^2$) | Area of potential grassland ($km^2$) | Proportion |
|---|---|---|---|
| <7m | 55.16 | 21.21 | 38.5% |
| 7-8m | 34.84 | 16.75 | 48.1% |
| 8-9m | 88.45 | 45.68 | 51.6% |
| 9-10m | 260.89 | 143.48 | 55.0% |
| 10-11m | 375.85 | 176.8 | 47.0% |
| 11-12m | 629.15 | 432.73 | 68.8% |
| 12-13m | 713.15 | 569.31 | 79.8% |
| 13-14m | 560.68 | 493.83 | 88.1% |
| 14-15m | 373.93 | 297.68 | 79.6% |
| 15-16m | 144.16 | 126.8 | 88.0% |
| 16-17m | 57.39 | 50.35 | 87.7% |
| 17-18m | 42.33 | 36.2 | 85.5% |
| >18m | 178.51 | 30.25 | 16.9% |
| Sum | 3514.49 | 2441.07 | 69.5% |

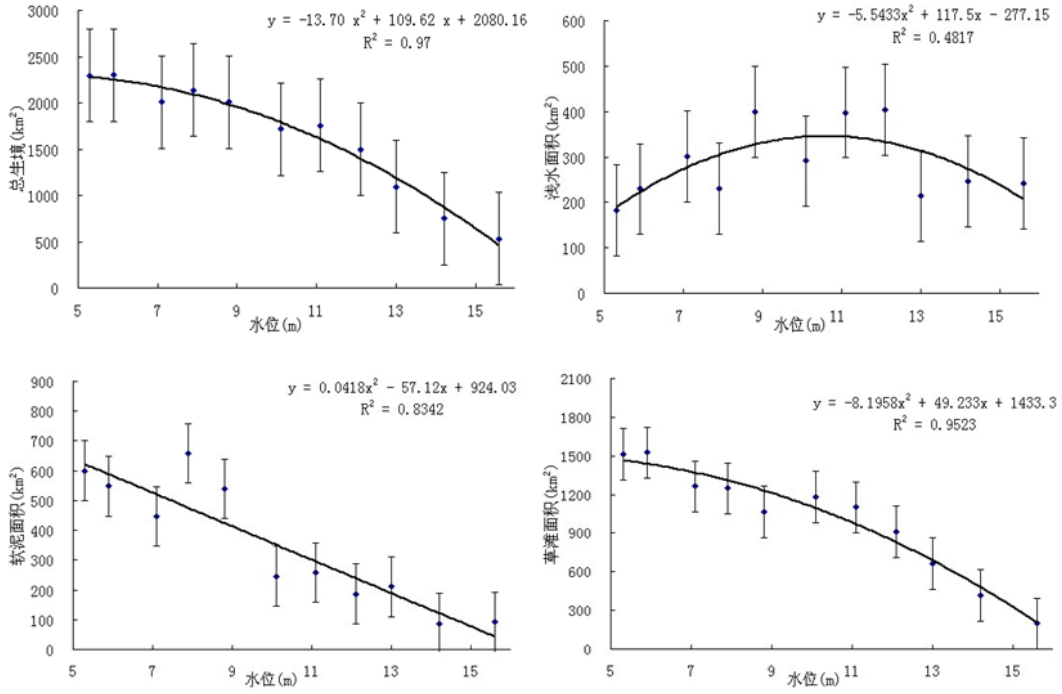



图 4 水位与越冬候鸟不同类型生境面积的关系

Fig 4 Relationship between water level and winter migrant birds' different habitat types


NRSCC
esa
ESA–MOST Dragon Cooperation
中国科技部-欧洲空间局“龙计划”合作
2017 DRAGON 4 SYMPOSIUM
2017年“龙计划”四期学术研讨会
Thanks For Attention
26–30 June 2017 | Copenhagen, Denmark
2017年6月26-30日，丹麦 哥本哈根