Expects from Sentinel-2 for, wide and small, temperate and tropical, wetlands monitoring based on 2013 and 2015 Take-Five experiment

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Burnham J. & Huber C.

ICube – SERTIT

04-2016

Study context

Assessment of the potential and expected contributions of Sentinel-2 data, for detecting and monitoring wetlands and inland water bodies and related applications

Two study sites:

1. European temperate continental wetlands: flood plain wetlands which fall-winter inundation control the ecosystem quality
2. Sub tropical Asian wetlands , dry/wet season

Exploiting:

- Core set; Take Five data set
- Landsat 8
- Sentinel2 imagery

Take Five Experiment

- The SPOT (Take5) experiments consist in using SPOT as a simulator of the image time series that ESA's Sentinel-2 mission will provide.

- Experiment proposed by CESBIO, operated by CNES It received support from ESA, NASA, JRC and CCRS .

- SPOT4 (Take5) February to June 2013 over 45 sites with the SPOT4 satellite.
- SPOT5 (Take5) April to September 2015 over 150 sites with the SPOT5 satellite.

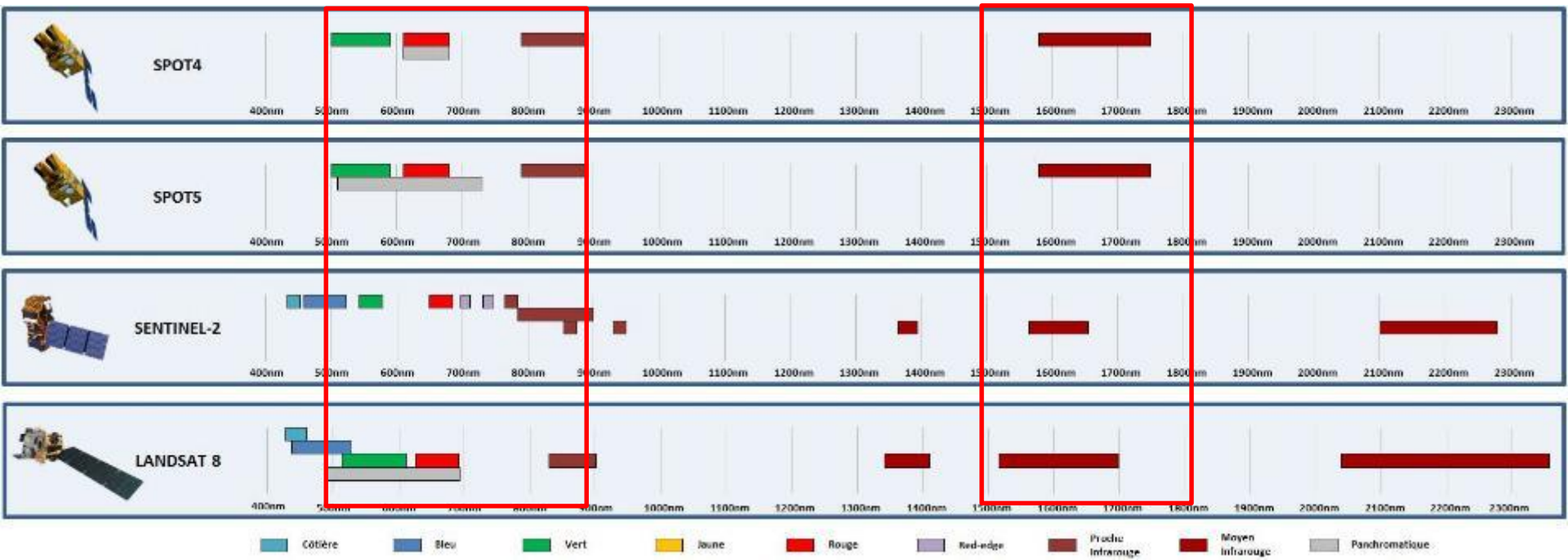
- Data processed by Cesbio (2013) and Theia Land Data Center (2015) :
  - Level 1C (data orthorectified reflectance at the top of the atmosphere)
  - Level 2A (Data ortho-rectified surface reflectance after atmospheric correction, along with a mask of clouds and their shadows, as well as a mask of water and snow).

- Worldly accessible: https://spot-take5.org/client/#/home

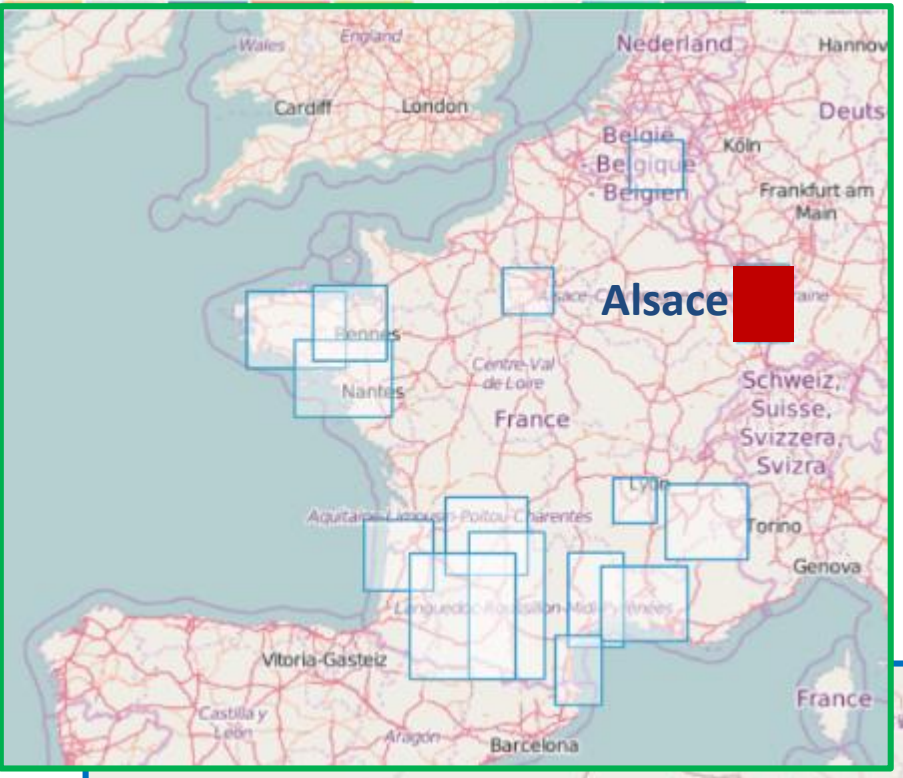
Take Five Experiment

The SPOT (Take5) experiments : simulator of the image time series that ESA's Sentinel-2 mission in terms of

- revisit, ie 5 days,
- resolution 20m (2013) and 10 m (2015)
- Spectral contains, VIR, NIR and SWIR bands



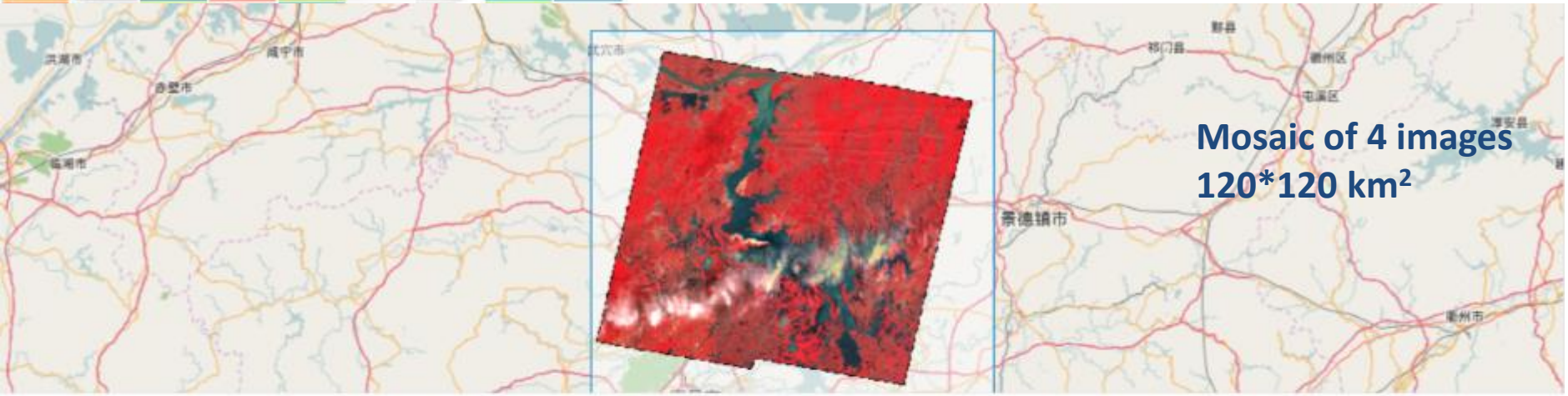
Take Five SPOT4: 2013

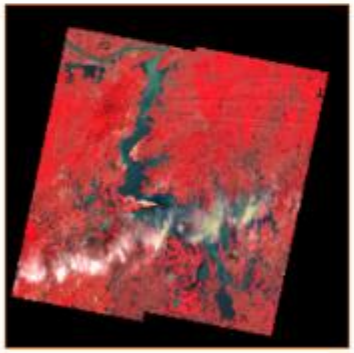


CESBIO

cnes

Take Five SPOT4: 2013





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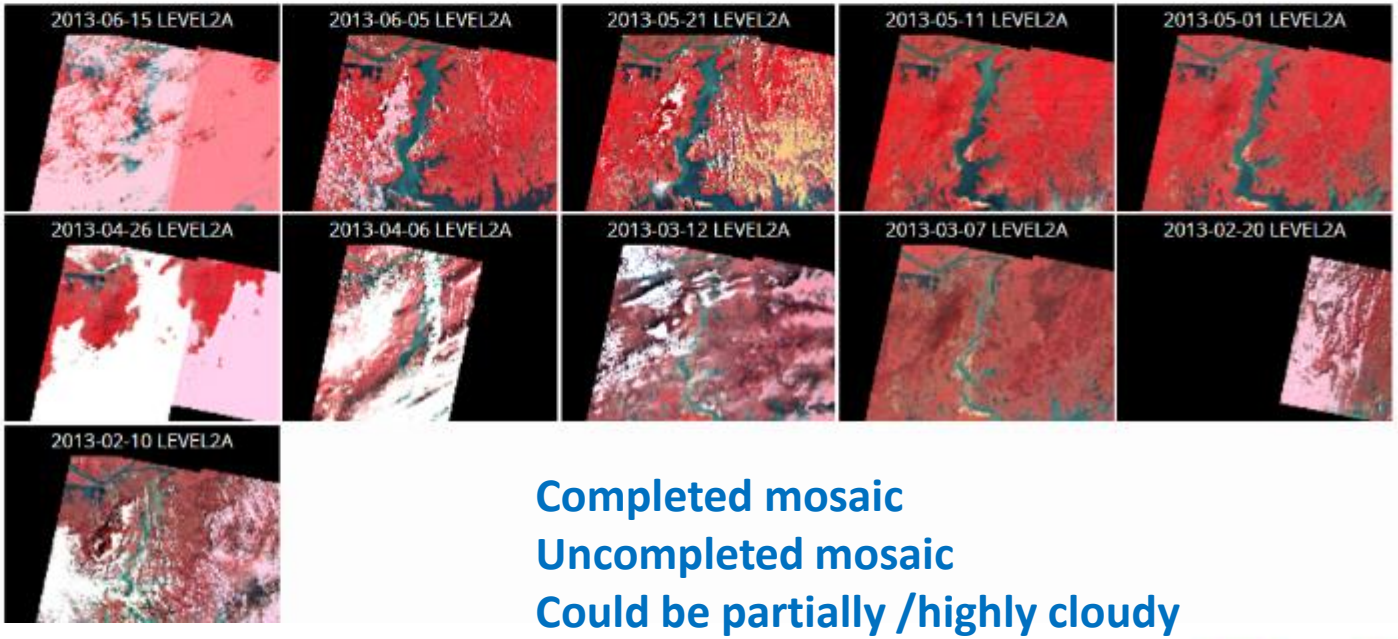
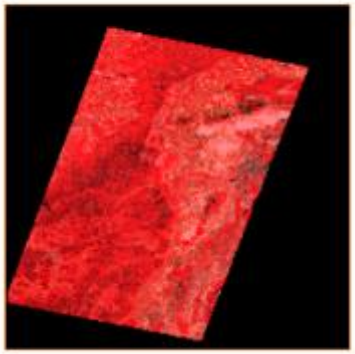
sensorMode : XS



Completed mosaic
Uncompleted mosaic
Could be partially /highly cloudy

Take Five SPOT4: 2013



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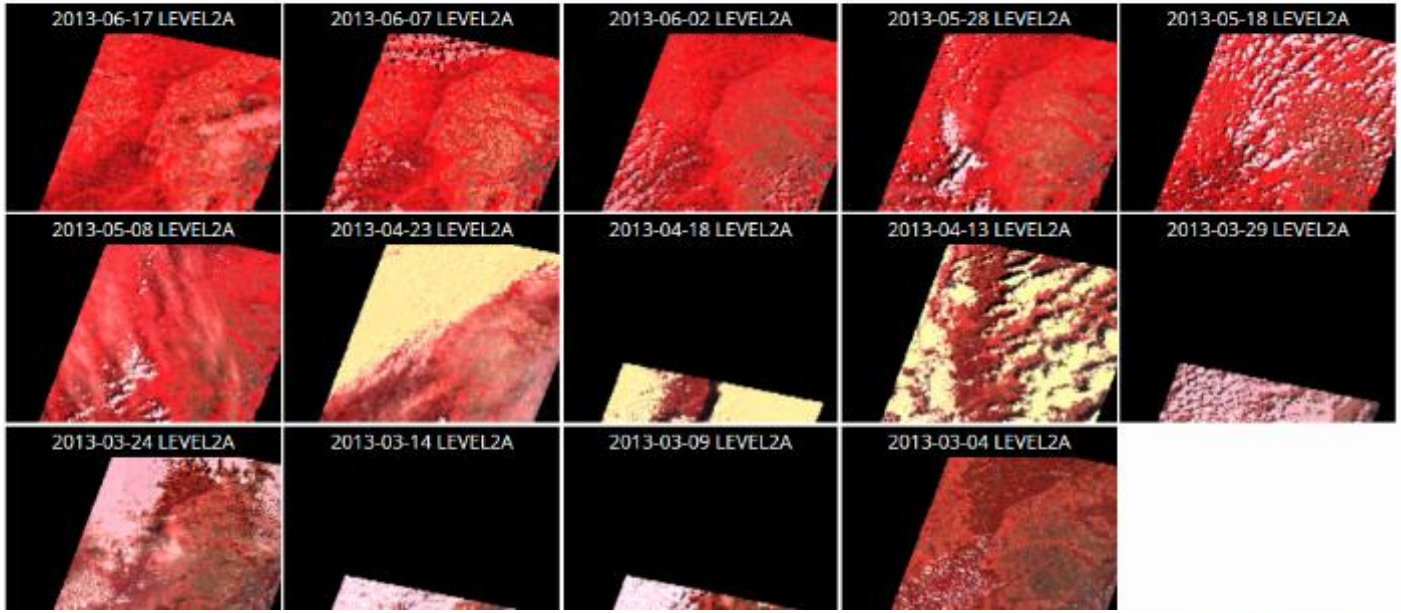
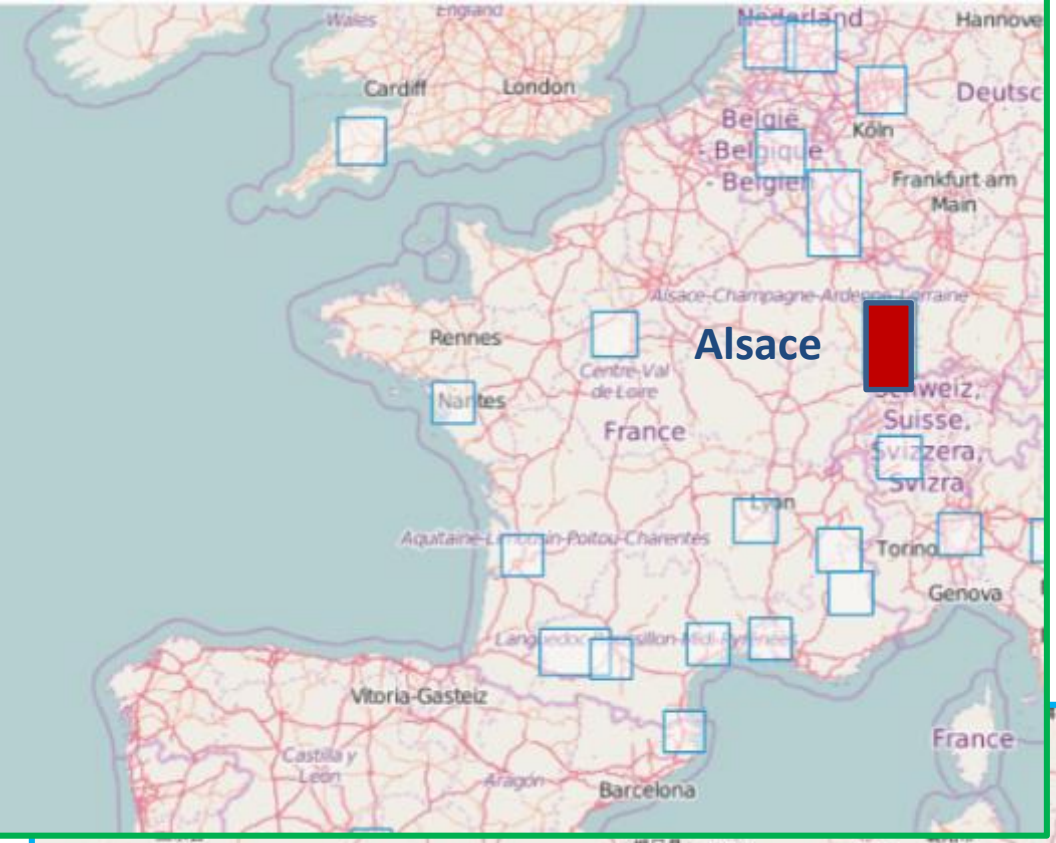


Take Five SPOT5: 2015



CESBIO cnes Theia Pôle Thématique Surfaces Continentales esa spot take 5

Take Five SPOT5: 2015

Mosaic of 2 images
60*120 km^2

date : 2015-09-08T09:08:08Z
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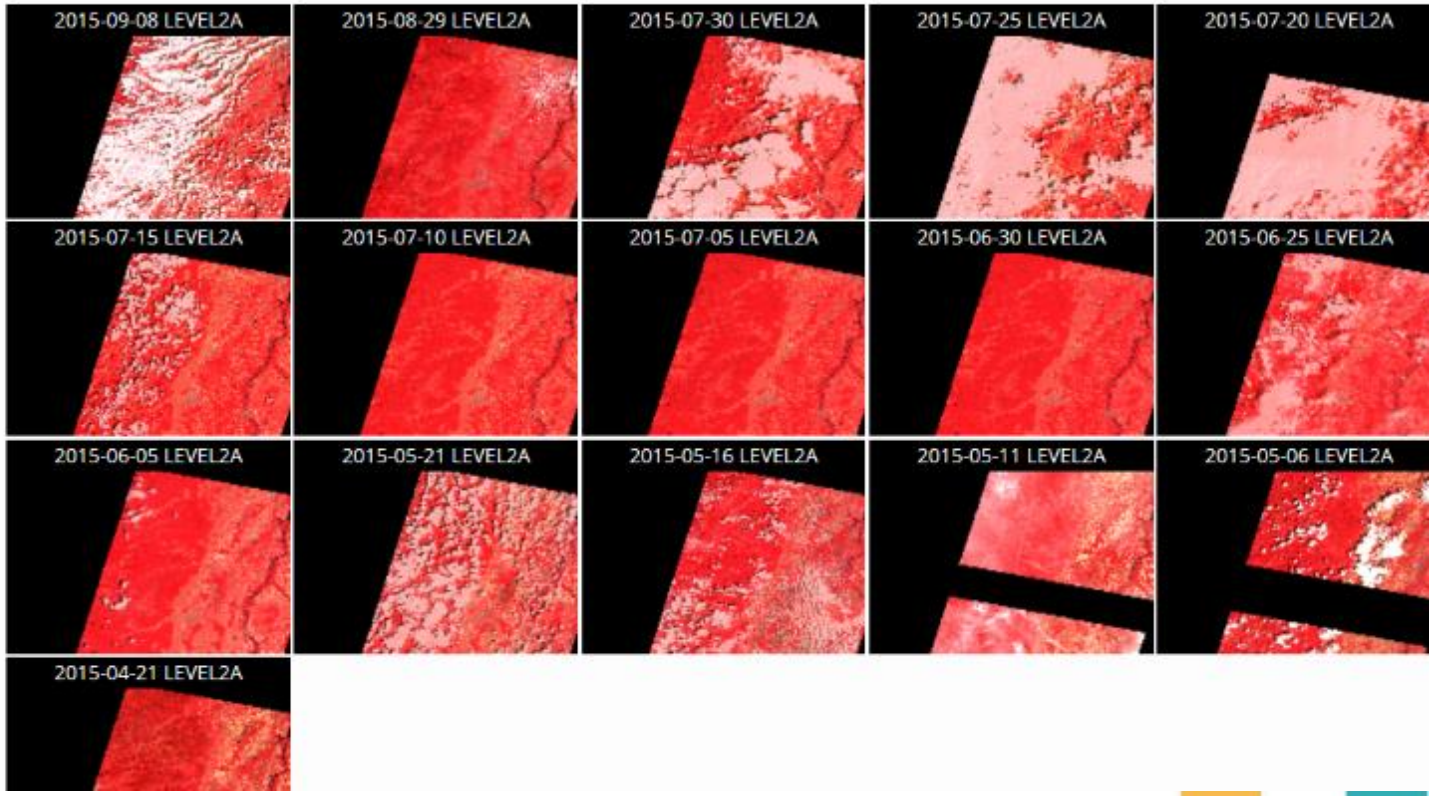
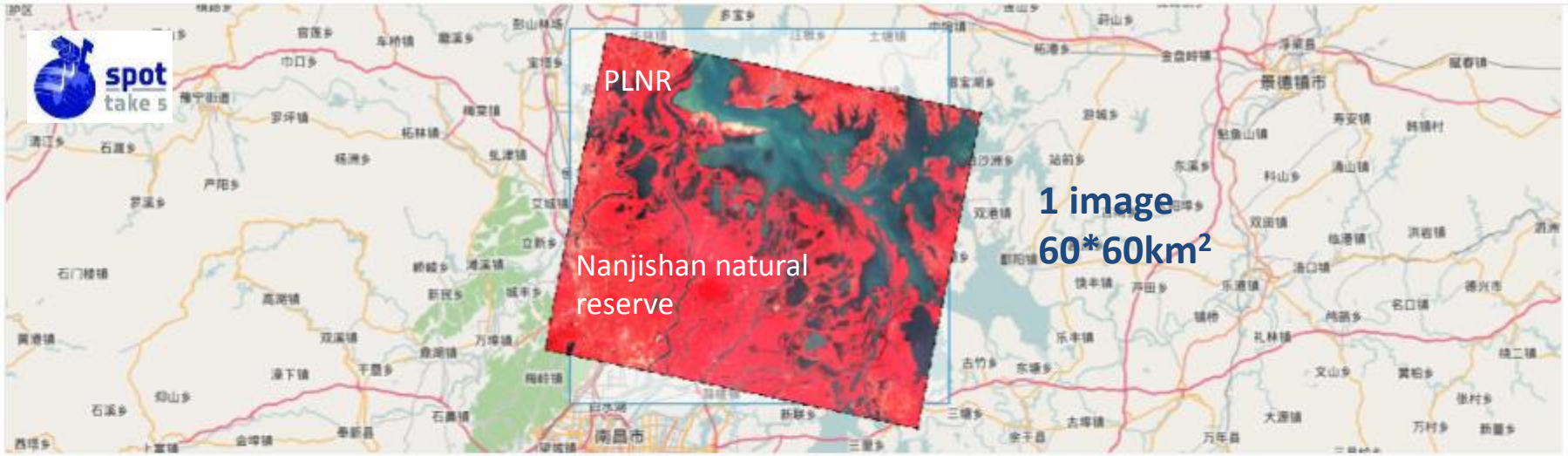
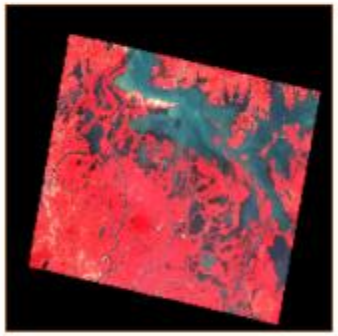
platform : SPOT5
instrument : HRG1
resolution : 10
sensorMode : XS



Take Five SPOT5: 2015





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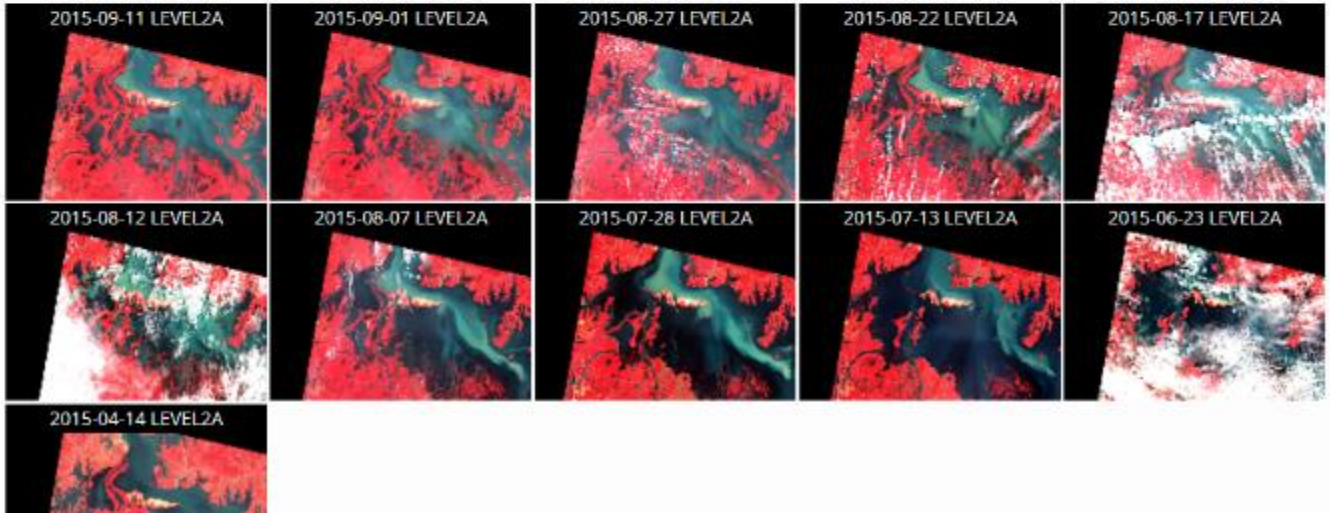
instrument : HRG2



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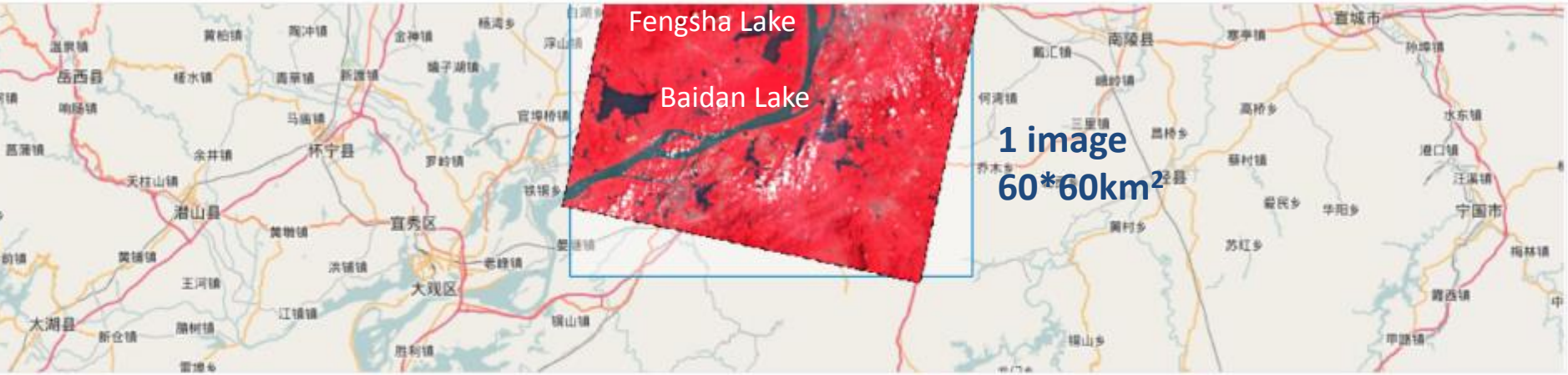

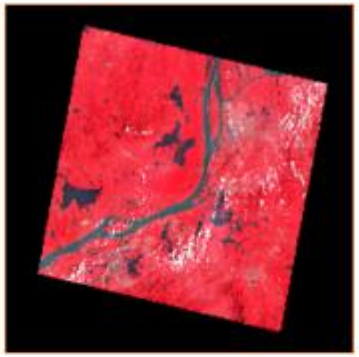

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instrument : HRG2
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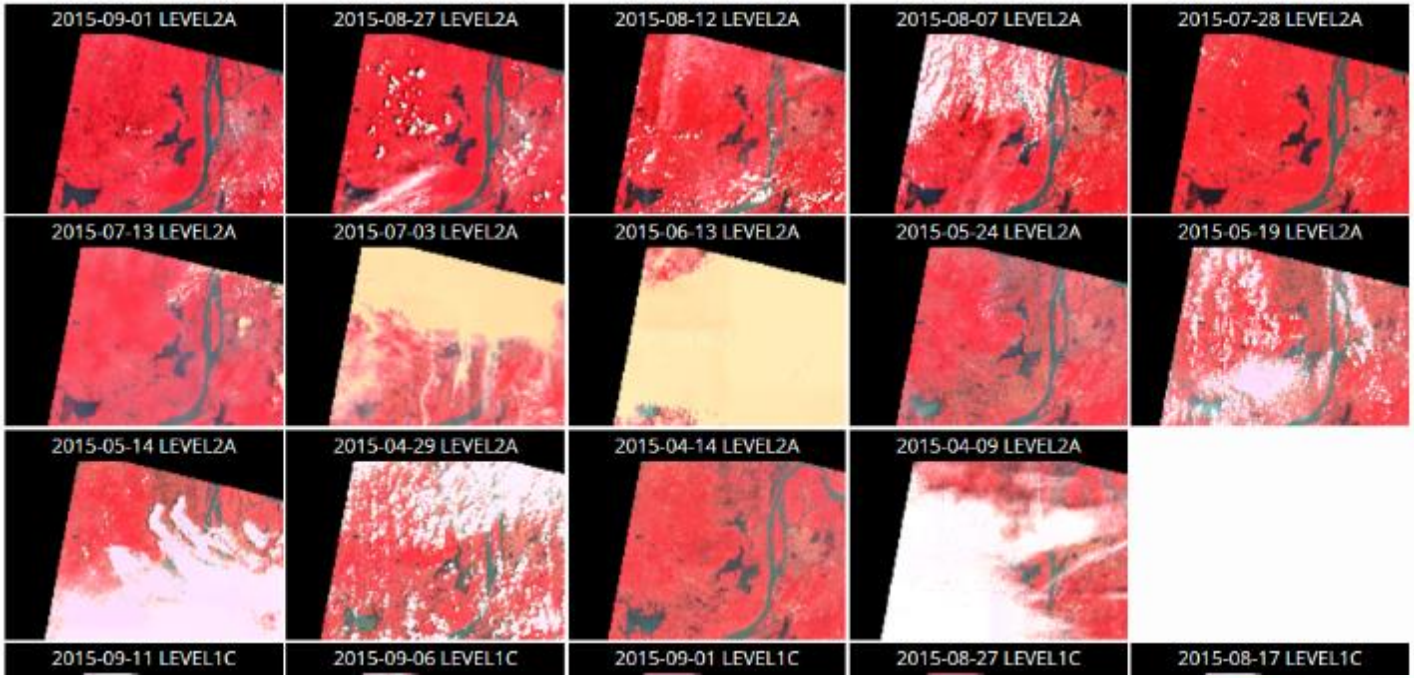
sensorMode : XS



First gained experience: rate of success

Take Five		Alsace	Poyang	Tonglin
		48°23’	29°10’	30°48’
2013	02 to 06	43%	28%	
2015	04 to 09	25%	30%	36%

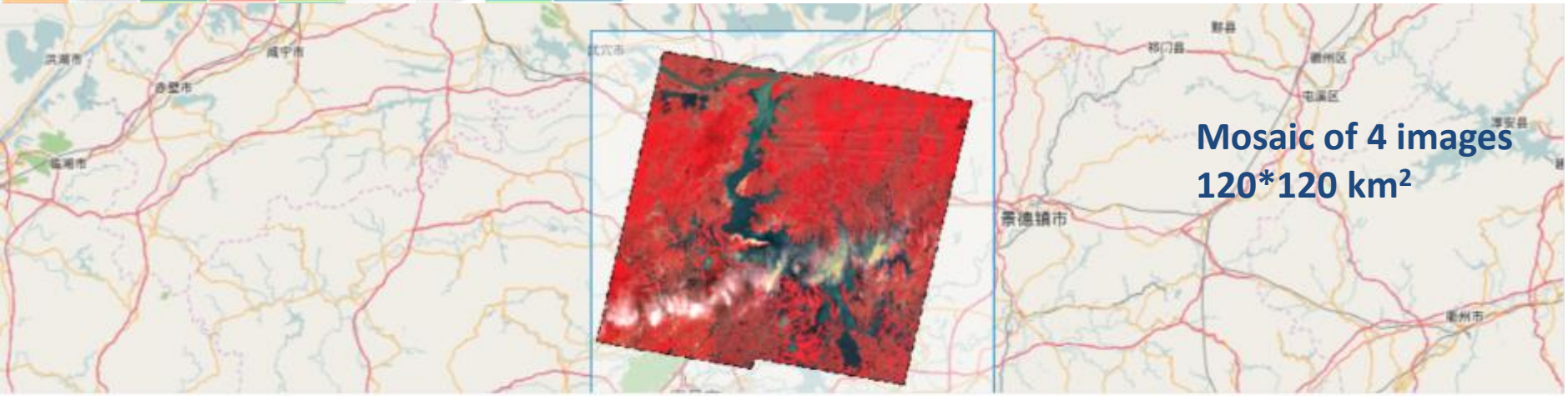
Data lost, cloudy images versus exploitable image

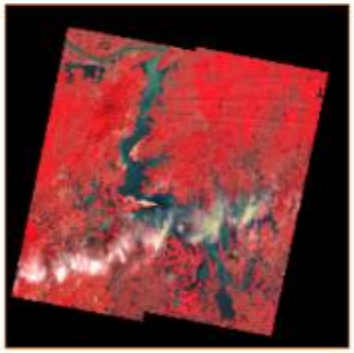
Sentinel2	Alsace		Poyang		Tonglin	
Period: 0,5 months	2015-11-30 to 2016-04-18		2015-12-01 to 2016-04-20		2015-11-29 to 2016-04-20	
Accessible images on ESA Hub & exploitable ones	33	4	22	2	21	3
	12 %		9 %		14%	

Hopefully some images acquired before the ramp up phase:

- Alsace: S2 acquired in August 2015-08-12
- Poyang: S2, nice time series , 13 September, 03, 20 & 23 October 2015 (Thanks Bianca Hoersh and Kris Lemmens)

Take Five SPOT4: 2013





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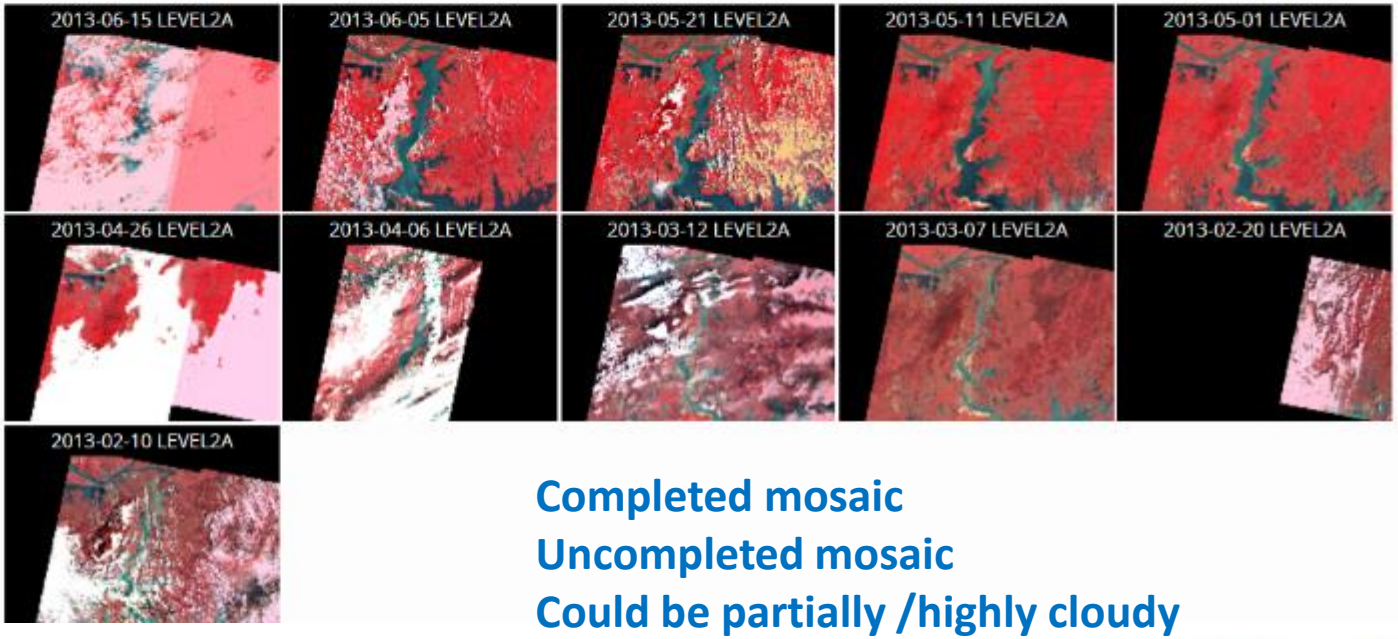
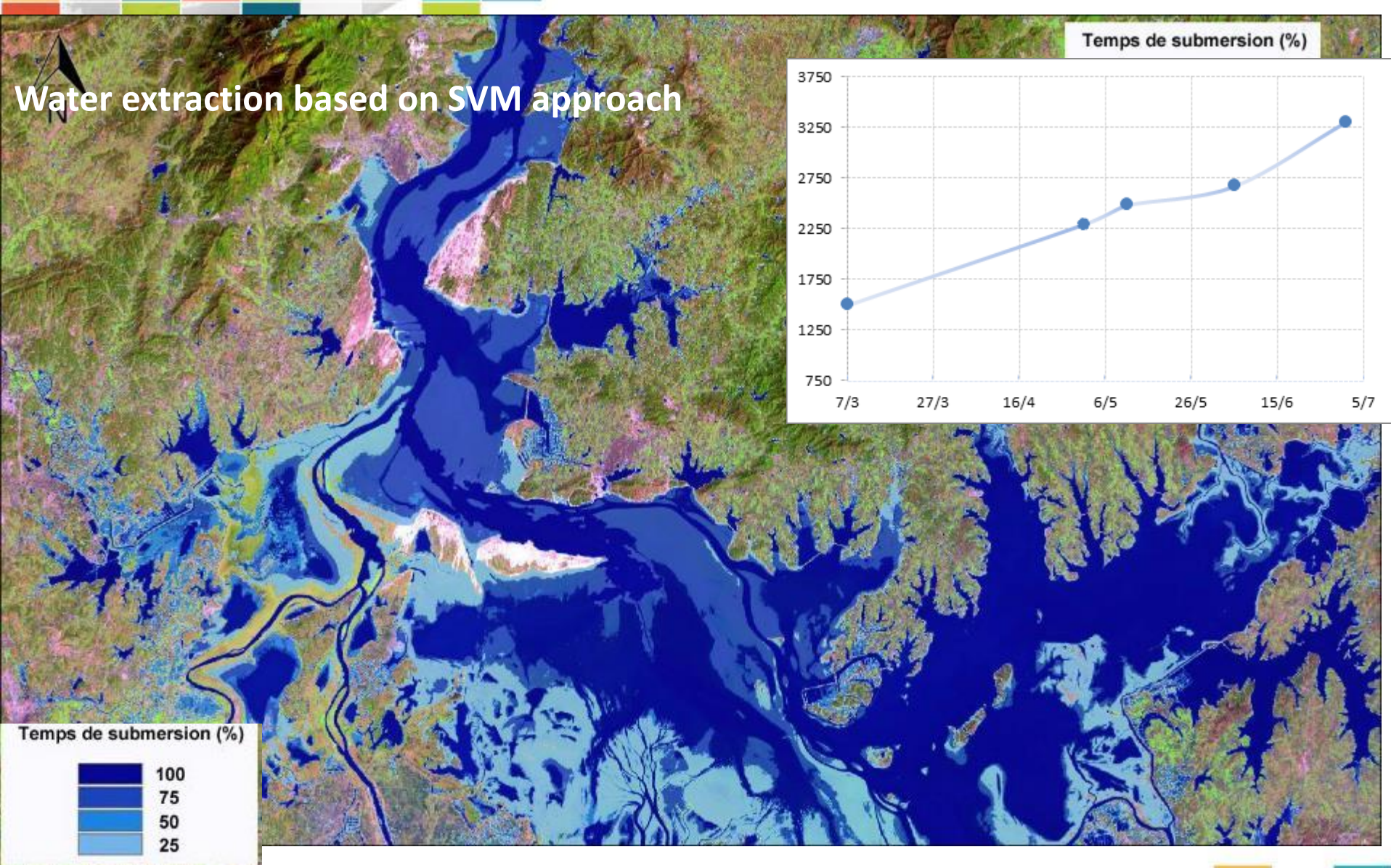
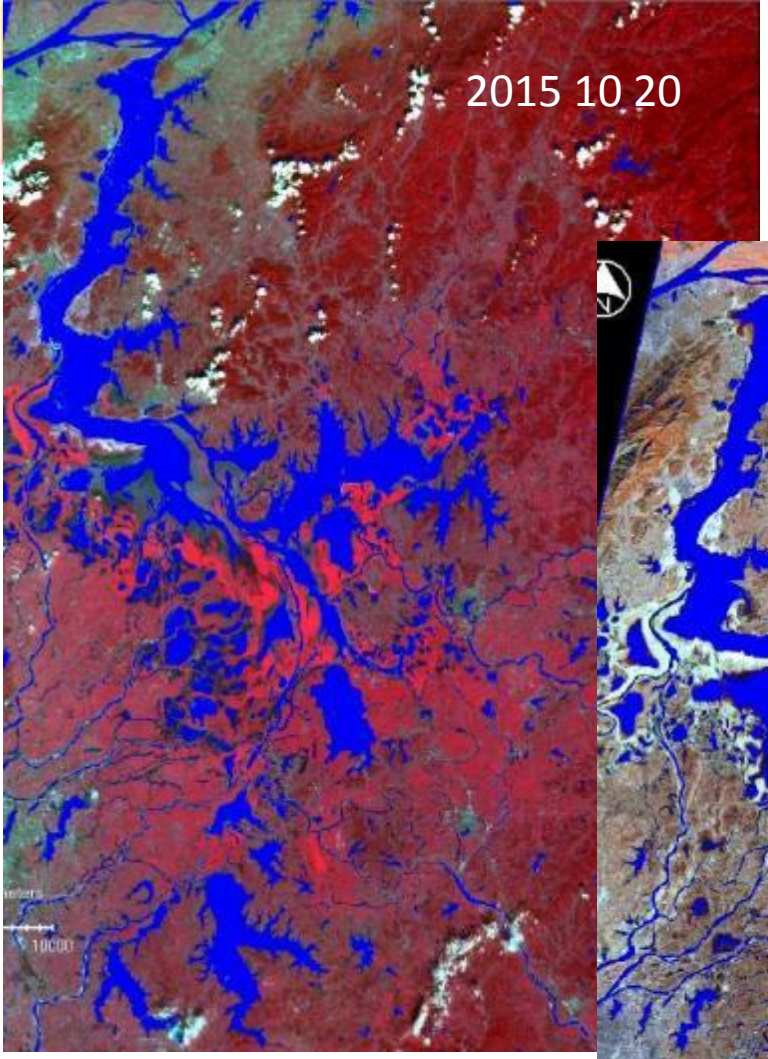


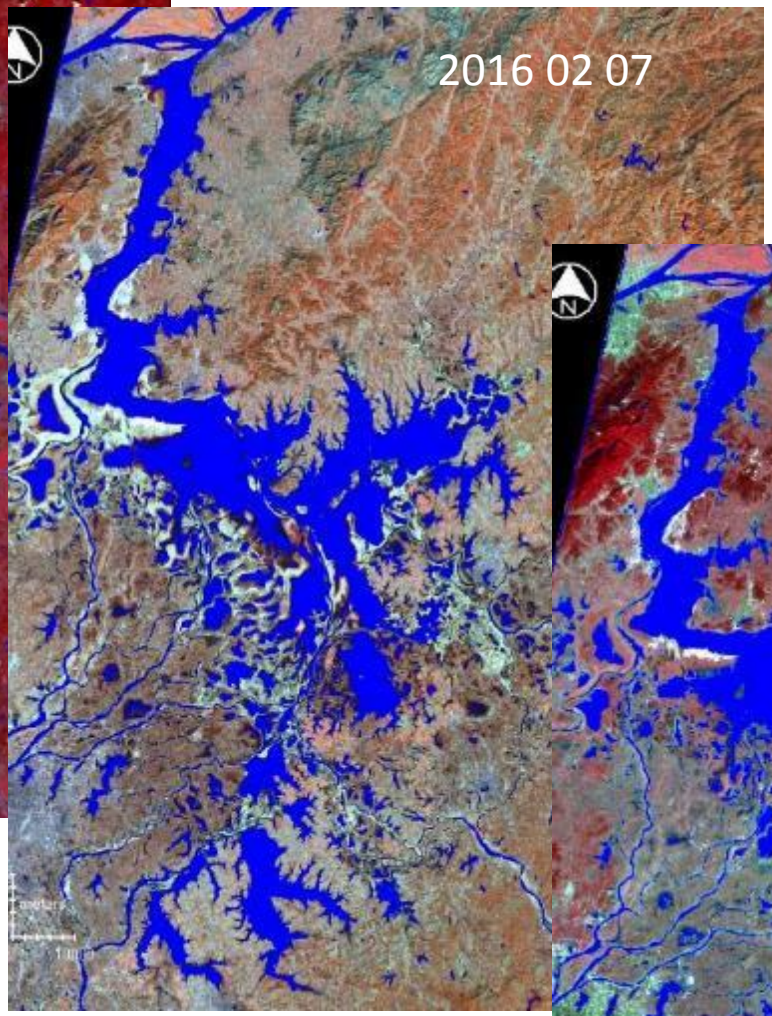
Completed mosaic
Uncompleted mosaic
Could be partially /highly cloudy

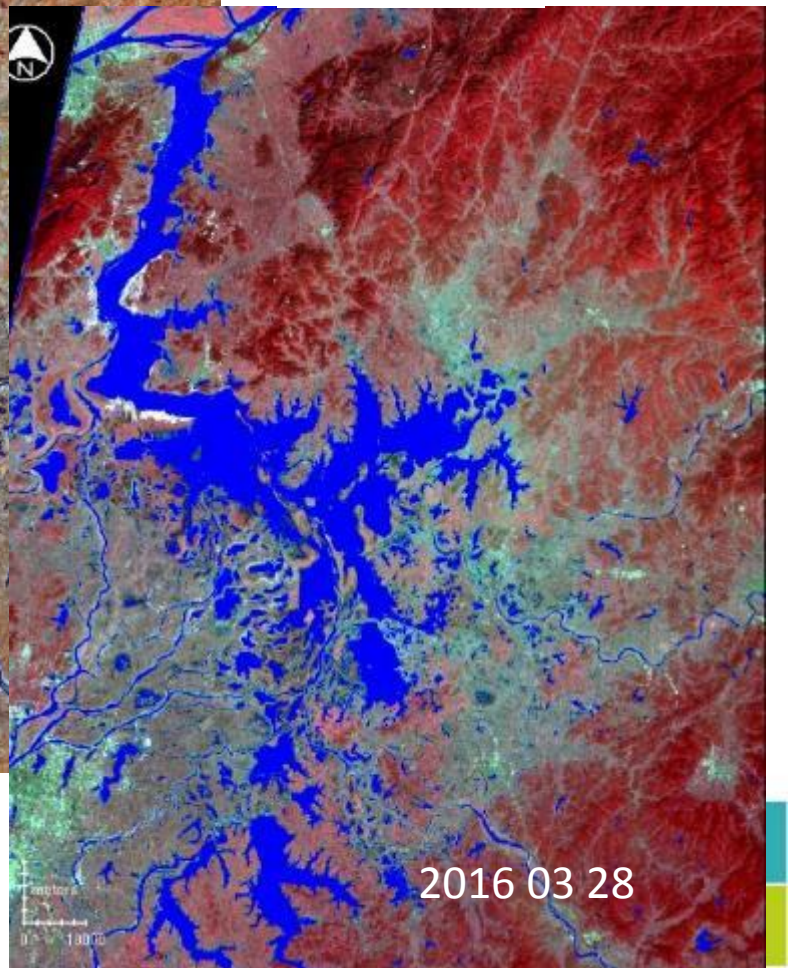


Submersion time based on the T5 time series: input for
Water resource monitoring, biodiversity assessment, epidemiology

On going work now with Sentinel2 images



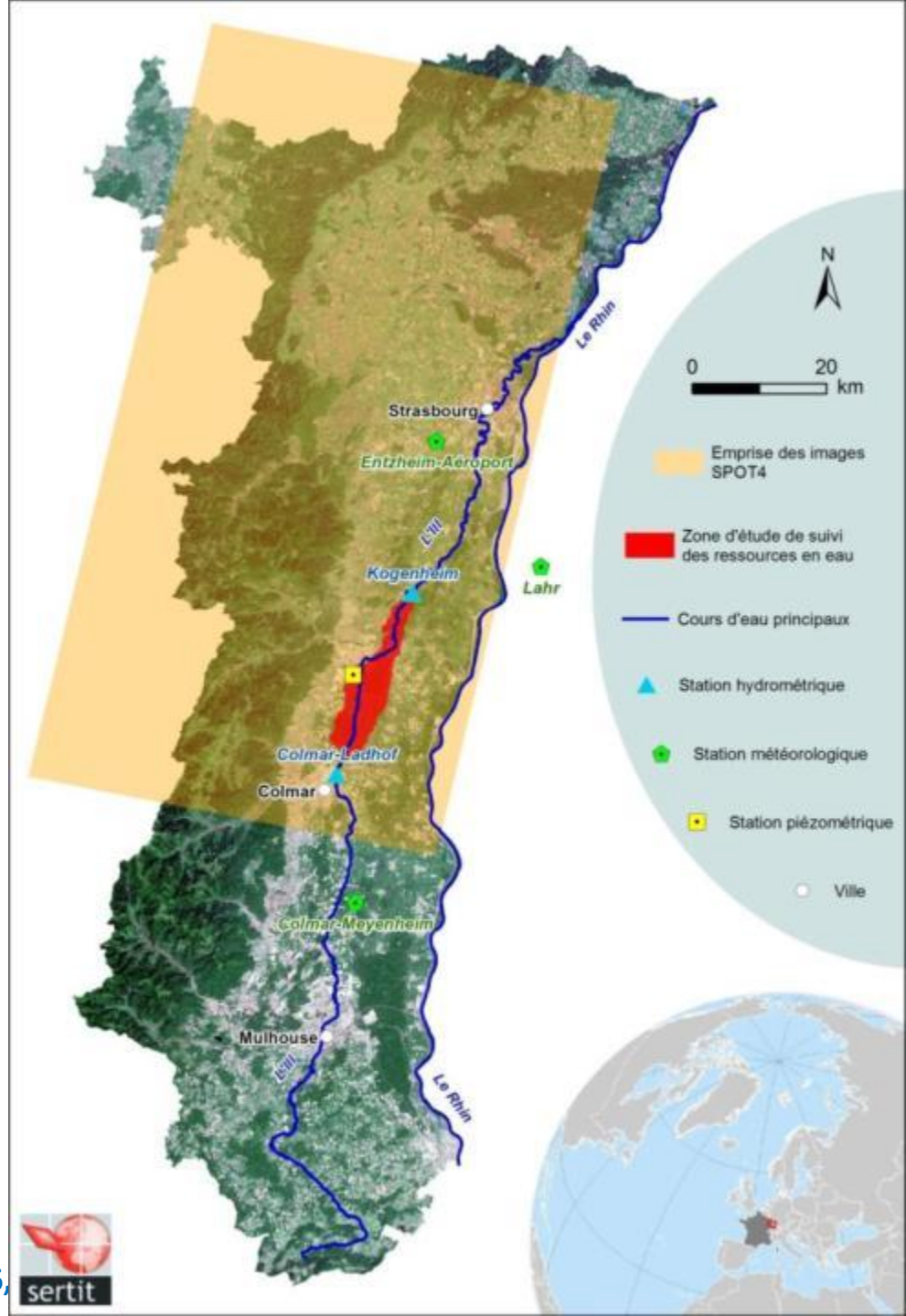




Hydrology in Alsace

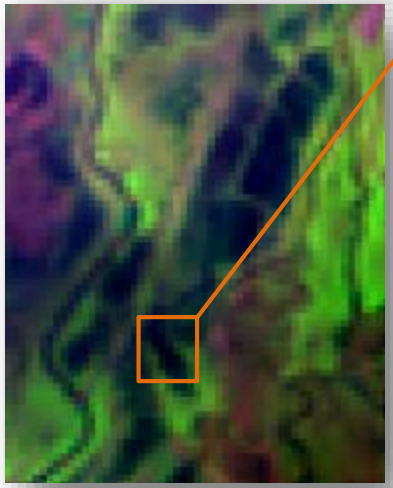
Context and study area :

- A well know but complex area : the Ried Central Alsace (flood plain with wetlands/flooded meadows)
- Many years of experiences : MANHUMA MANagement and conservation of HUMid Area (1998), SPOT4 project with CNES (2000) and SAR CosmoSkyMed monitoring with ASI, CNES and SCHAPI (2011) concerning flood risk management, hydraulic processes identification,…)



Ground truth observation

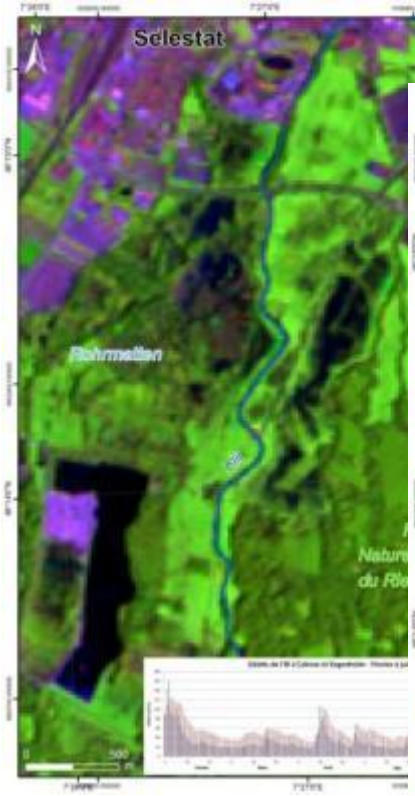
Field SURVEY , synchronous with SPOT4 acquisition



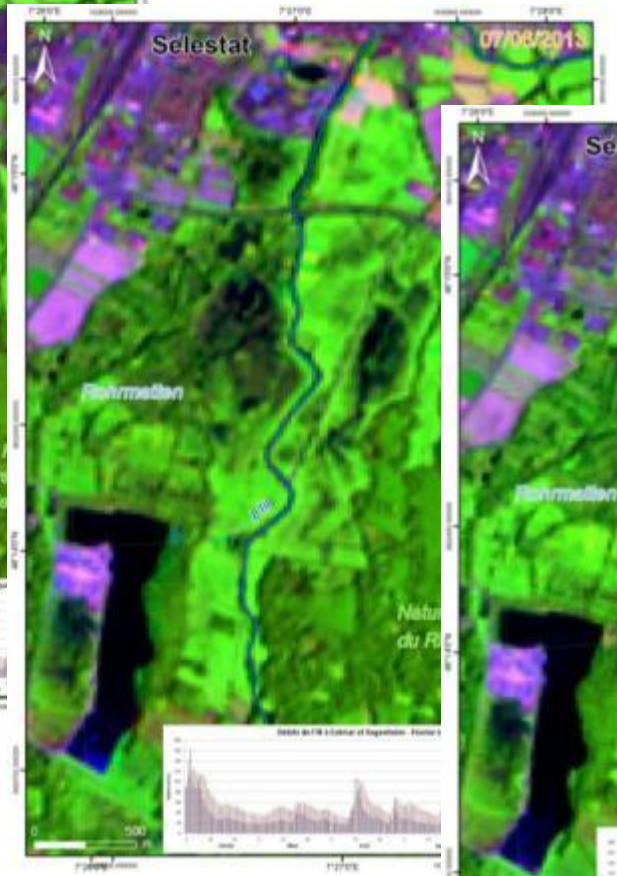
GPS track

TAKE5 SPOT4 exploitation

Relation between flooded areas observed and flow measured along the Ill river (area less than 25 km^2)

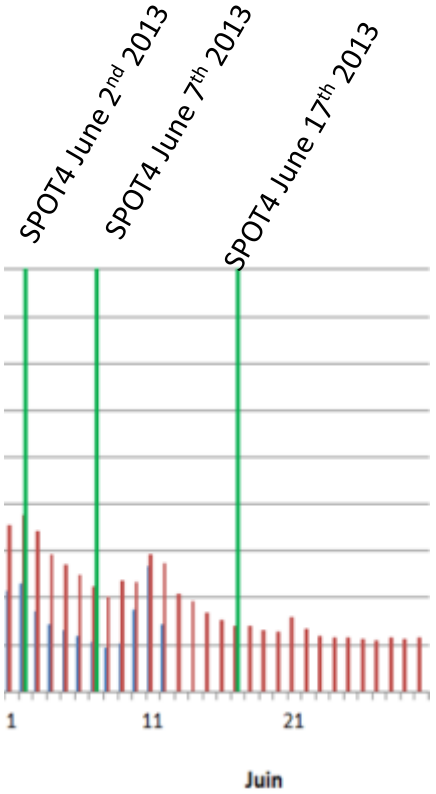


SPOT4 June 2nd 2013



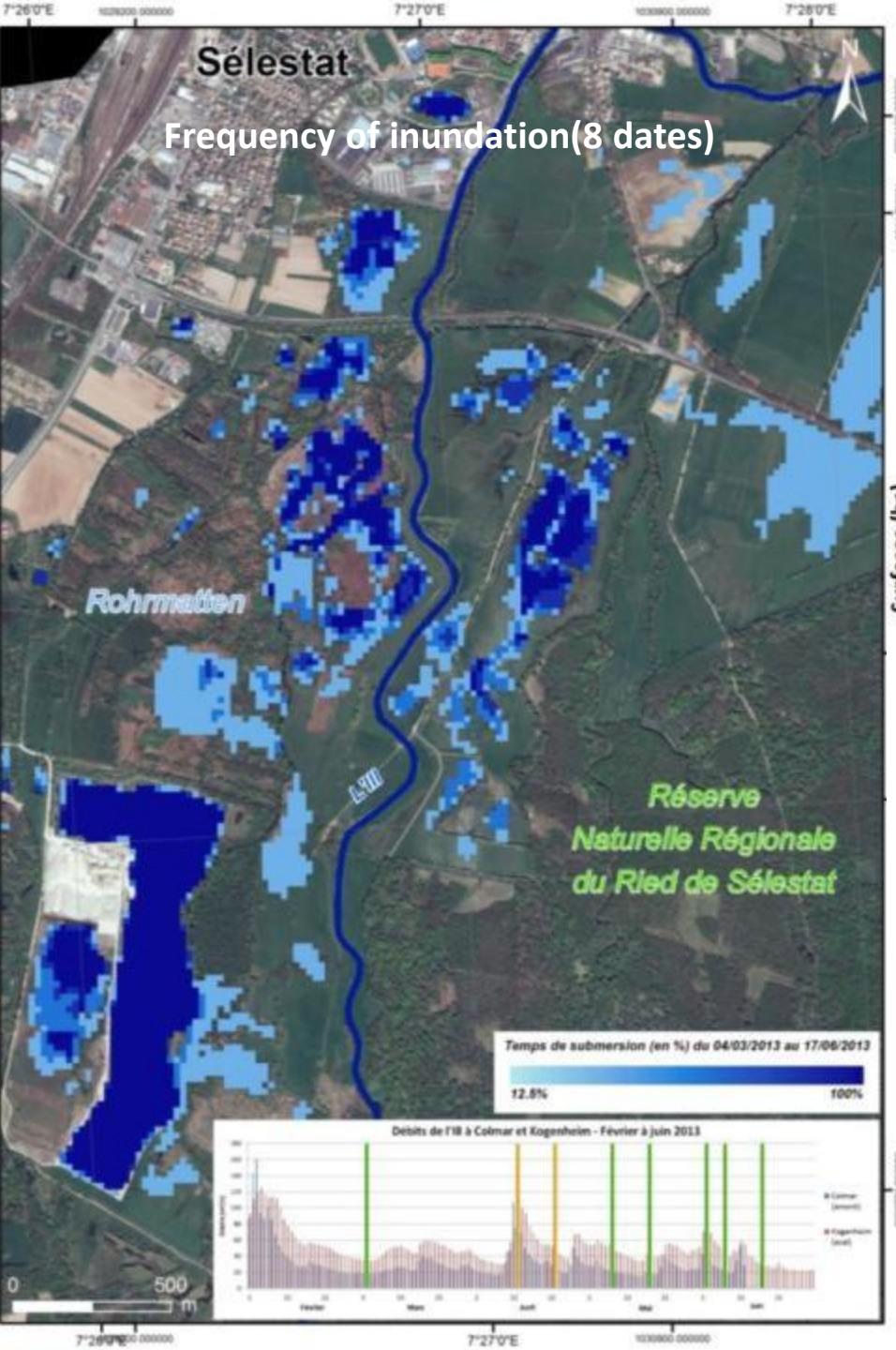
SPOT4 June 7th 2013

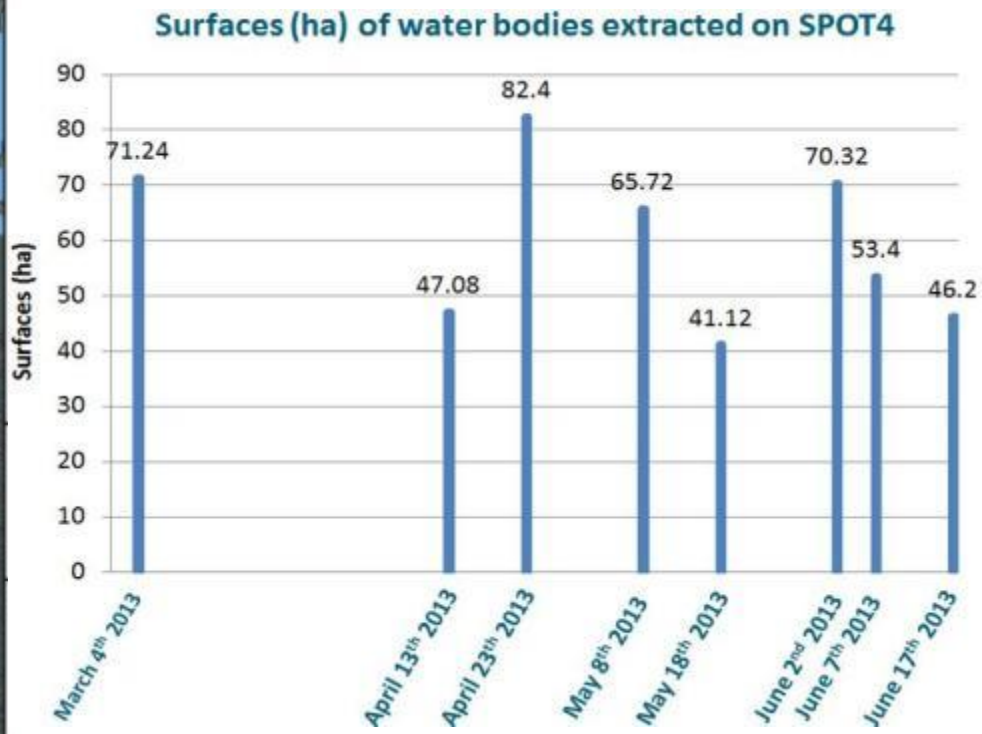
SPOT4 June 17th 2013



Visible decrease of water surface in 15 days

TAKE5 SPOT4 exploitation

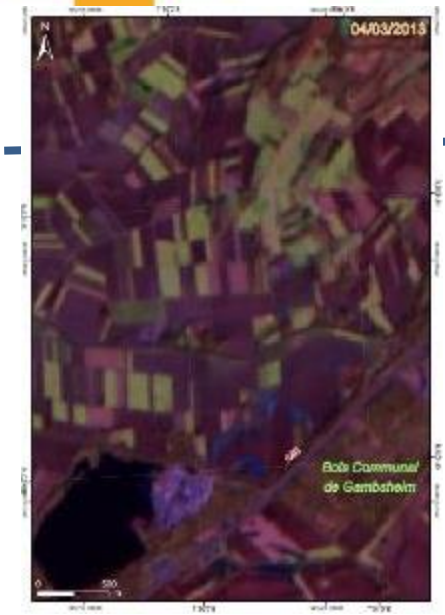


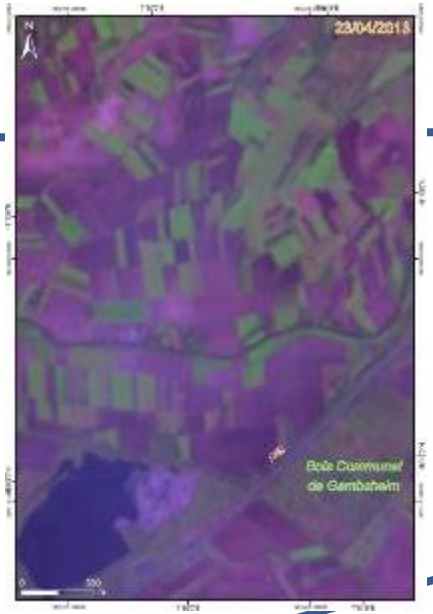


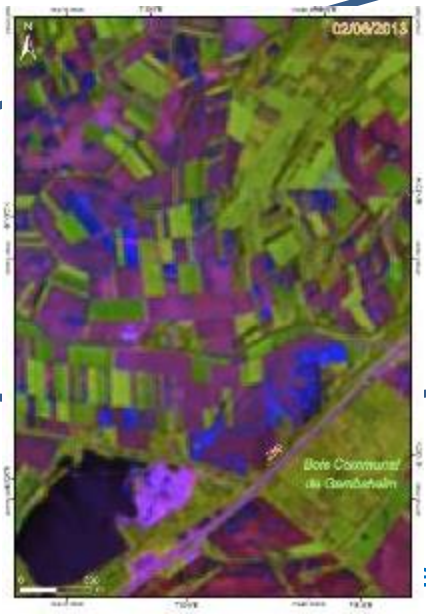
Possibility to follow very small wetlands complex presenting in fact an unexpected/unknown dynamic.

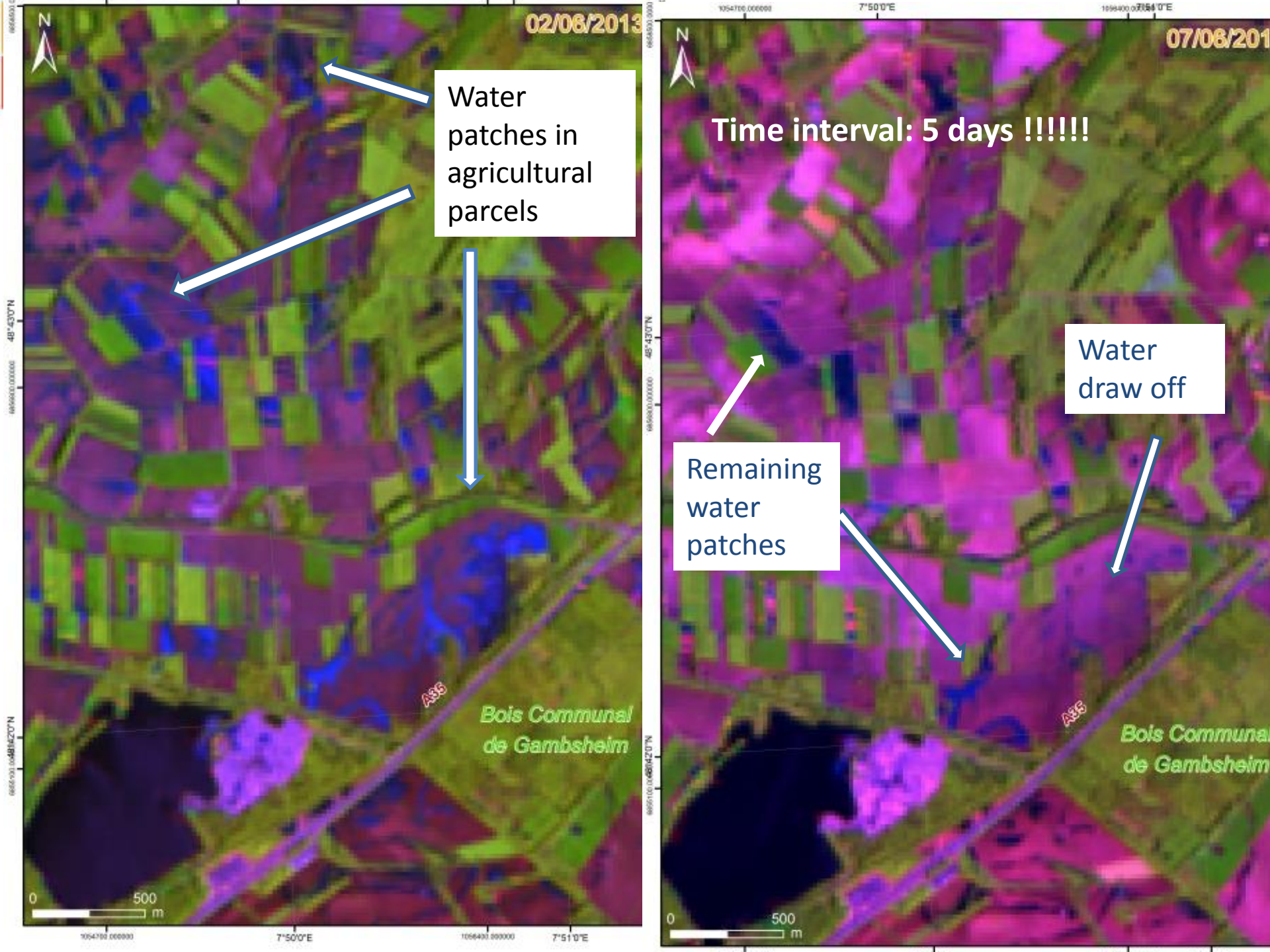
rague

Flooded crops lands, northern Strasbourg








02/06/2013
Water patches in agricultural parcels
A35
Bois Communal de Gambsheim
0
500
m
7°50'0"E
7°51'0"E
07/06/201
Time interval: 5 days !!!!!!
Water draw off
Remaining water patches
A35
Bois Communal de Gambsheim
0
500
m
7°50'0"E

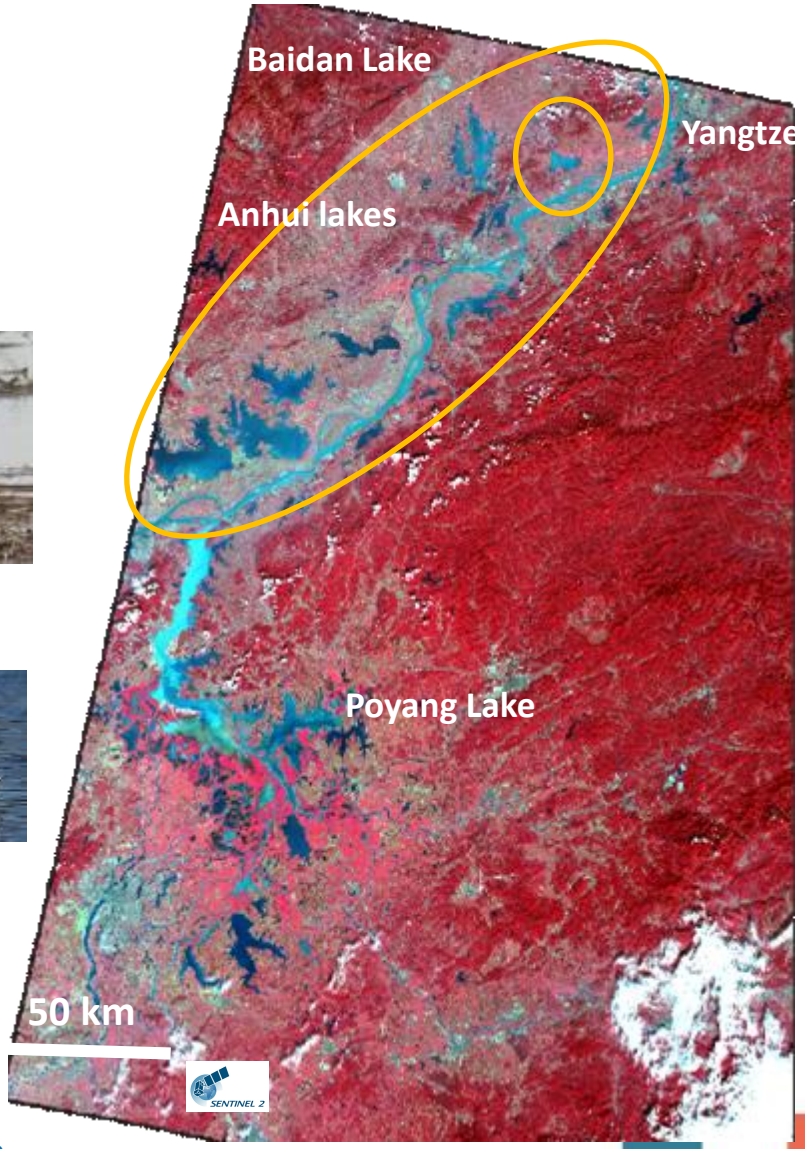
Monitoring aquatic vegetation of small lakes Anhui Province China: Baidan Lake case

Context:

Aquatic vegetation, generally existing in the shallow near-shore area, is a key component of lake ecosystems.

Providing food, shelter and breeding habitats for aquatic animals like invertebrates, fish and wading birds,

=>helps maintain the balance of the lake ecosystem.

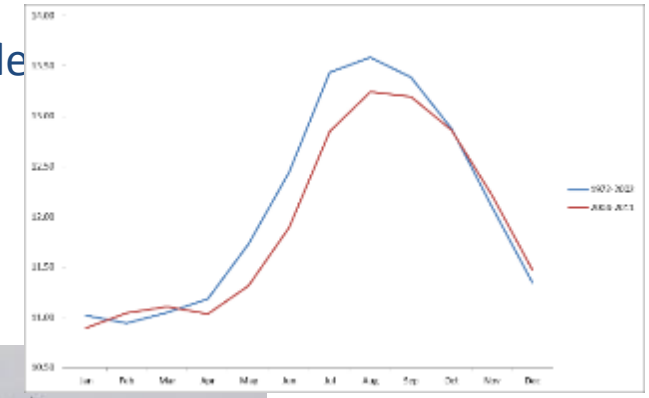


Monitoring aquatic vegetation of small lakes Anhui Province China: Baidan Lake case

Aquatic vegetation, benefits

Therefore just like other lakes along the Yangtze River, Anhui Lakes are threatened.

- Hydrological changes; more control, less water available
- Habitat loss
- Eutrophication
- Aquaculture development



Dynamic detection (Using RS tech)
Area changes:

- Water extent, water height
- Vegetation succession & dynamic
- Species identification, biomass
- …

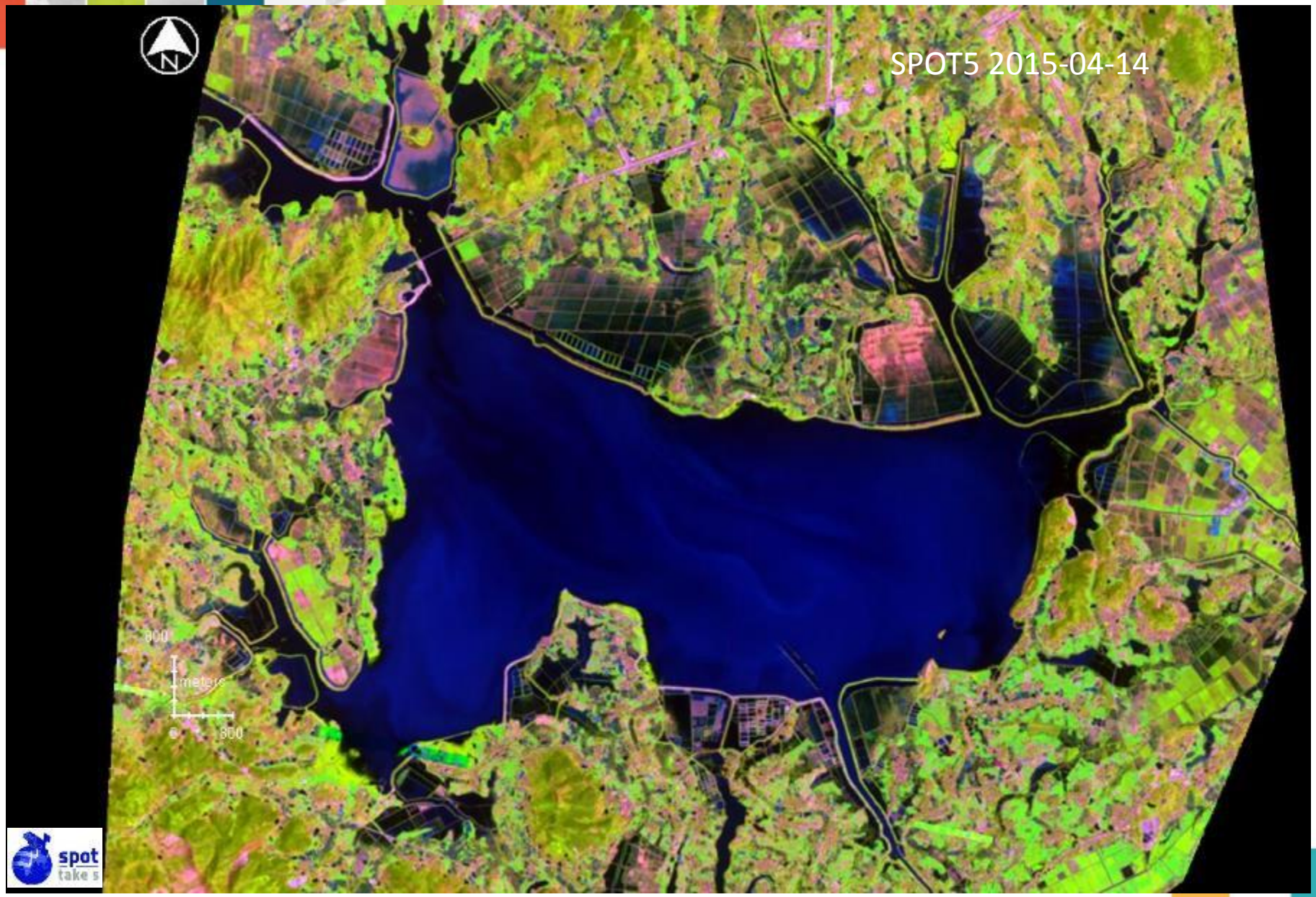
Exploited data set : 12-2014 to 02_2016

	SPOT5	LANDSAT-8	SENTINEL-2
Decembre 2014		30	
Janvier 2015			
Février		13	
Mars		01	
Avril	14, 29		
Mai	24		
Juin		05	
Juillet	13, 28		
Août	07, 12		
Septembre	01	09	
Octobre		11	20
Novembre			
Décembre 2015		30	
Fevrier 2016			07

NDVI = (Red-NIR)/(RED +NIR)

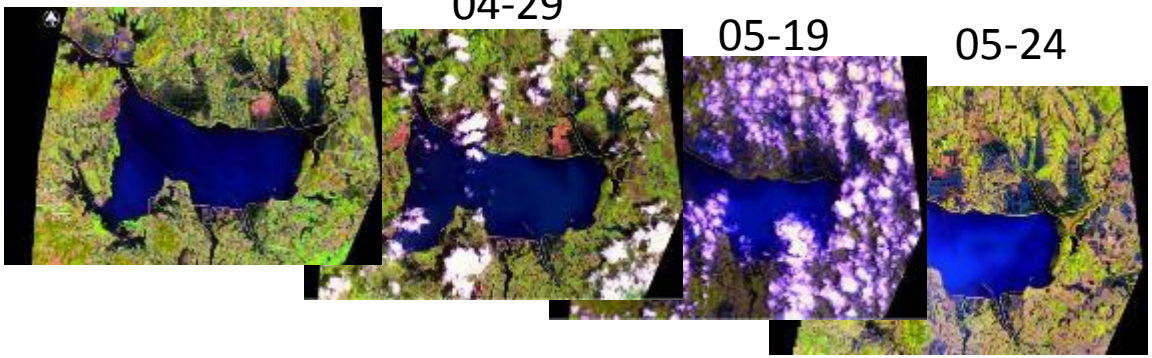
NDWI = (V-NIR)/(V+NIR)

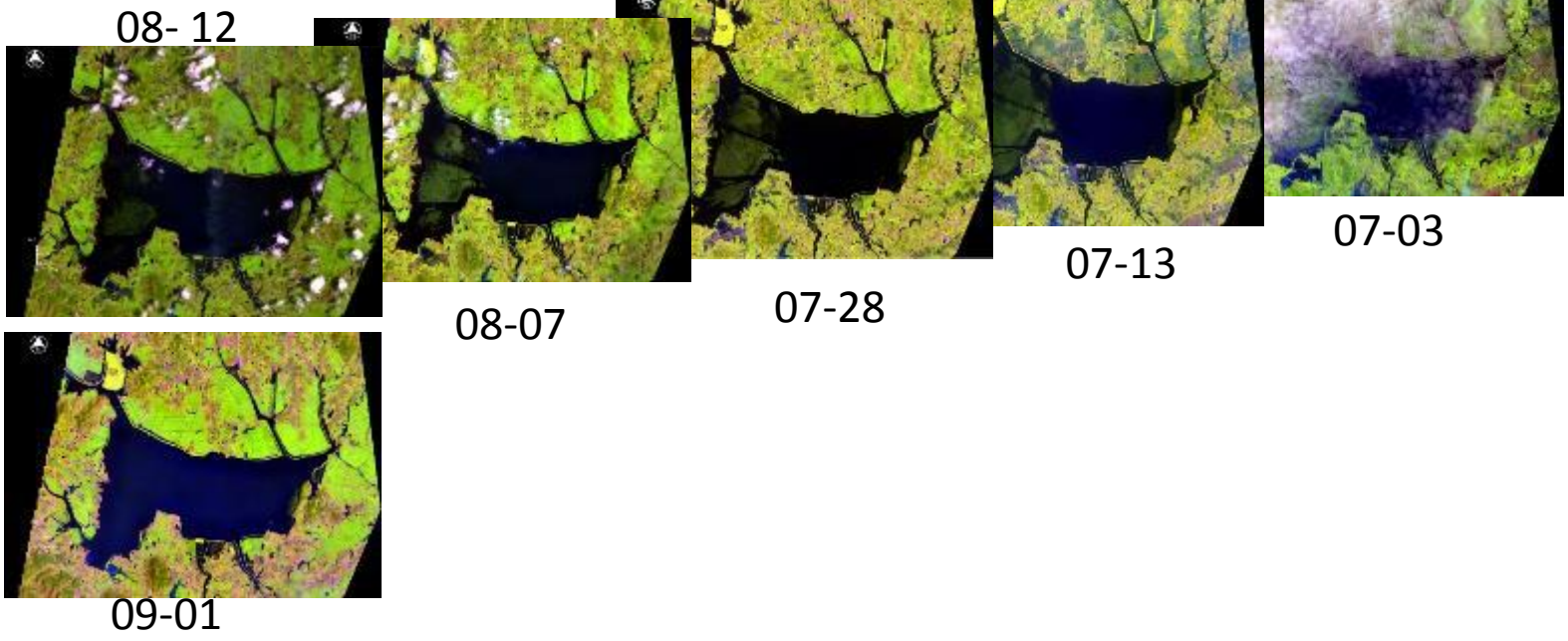
MNDWI = (V-SWIR)/(V+SWIR)


SPOT5 2015-04-14
N
300
meters
0
300
spot
take 5


SPOT5 2015-09-01
800
meters
0
800

Extension and densification of time series





Extension and densification of time series:
Landsat 8


L8 12-27


L8 02-13

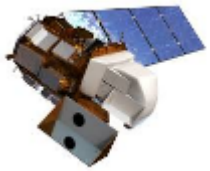

L8 03-01


04-14

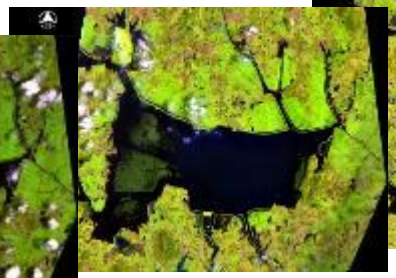

04-29

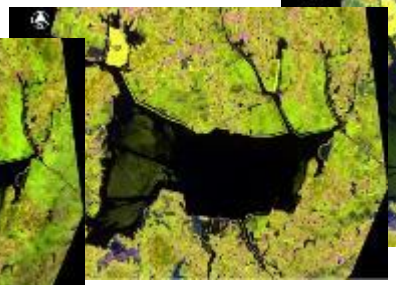

05-19


05-24

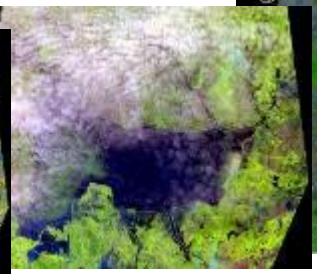


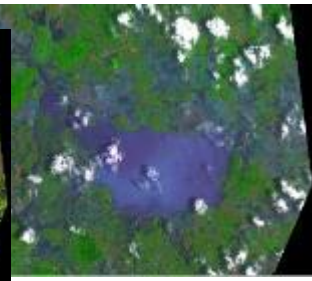

08- 12




07-28


07-13


07-03


L8 06-05

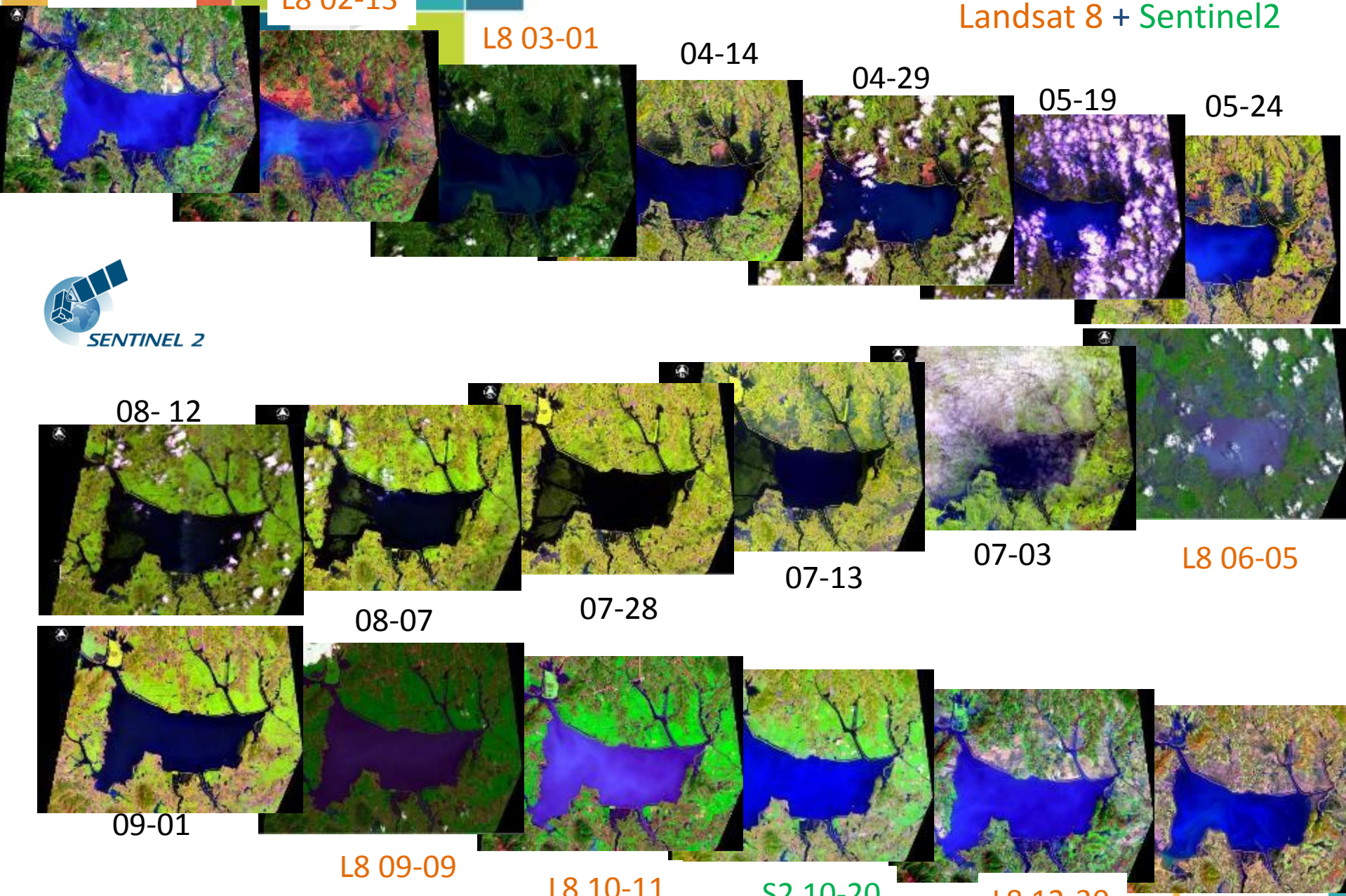

09-01


08-07
L8 09-09

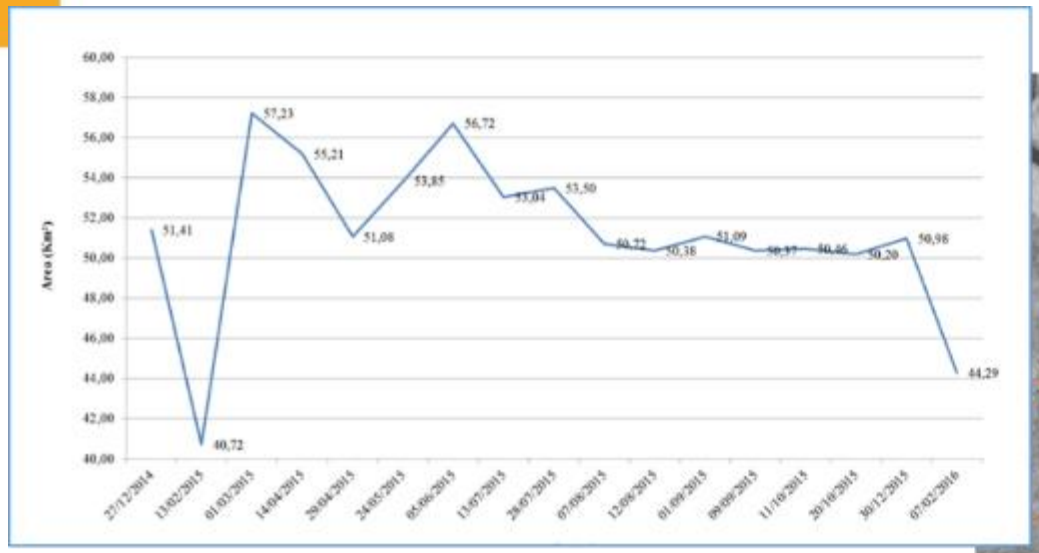

L8 10-11

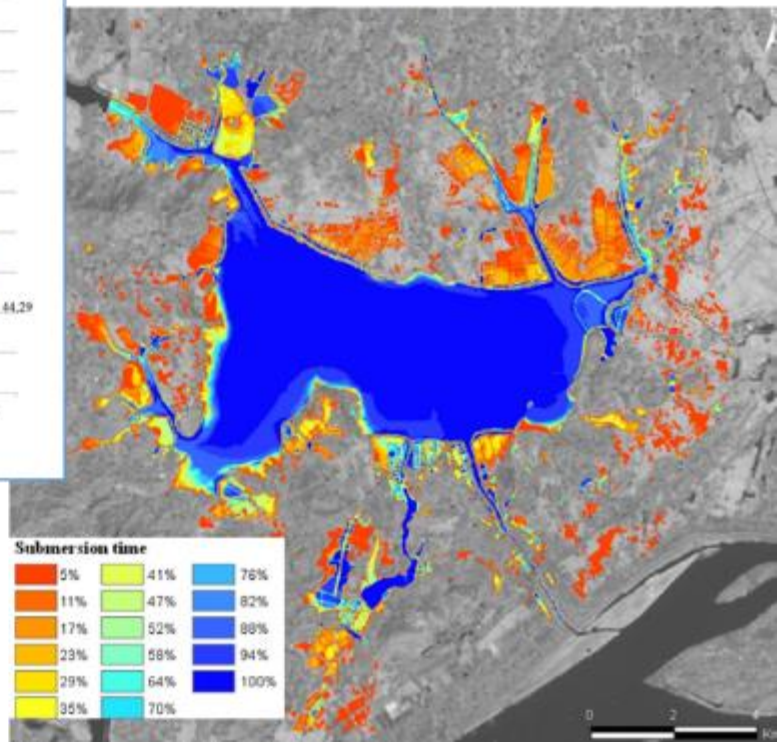

L8 12-30

Extension and densification of time series:
Landsat 8 + Sentinel2



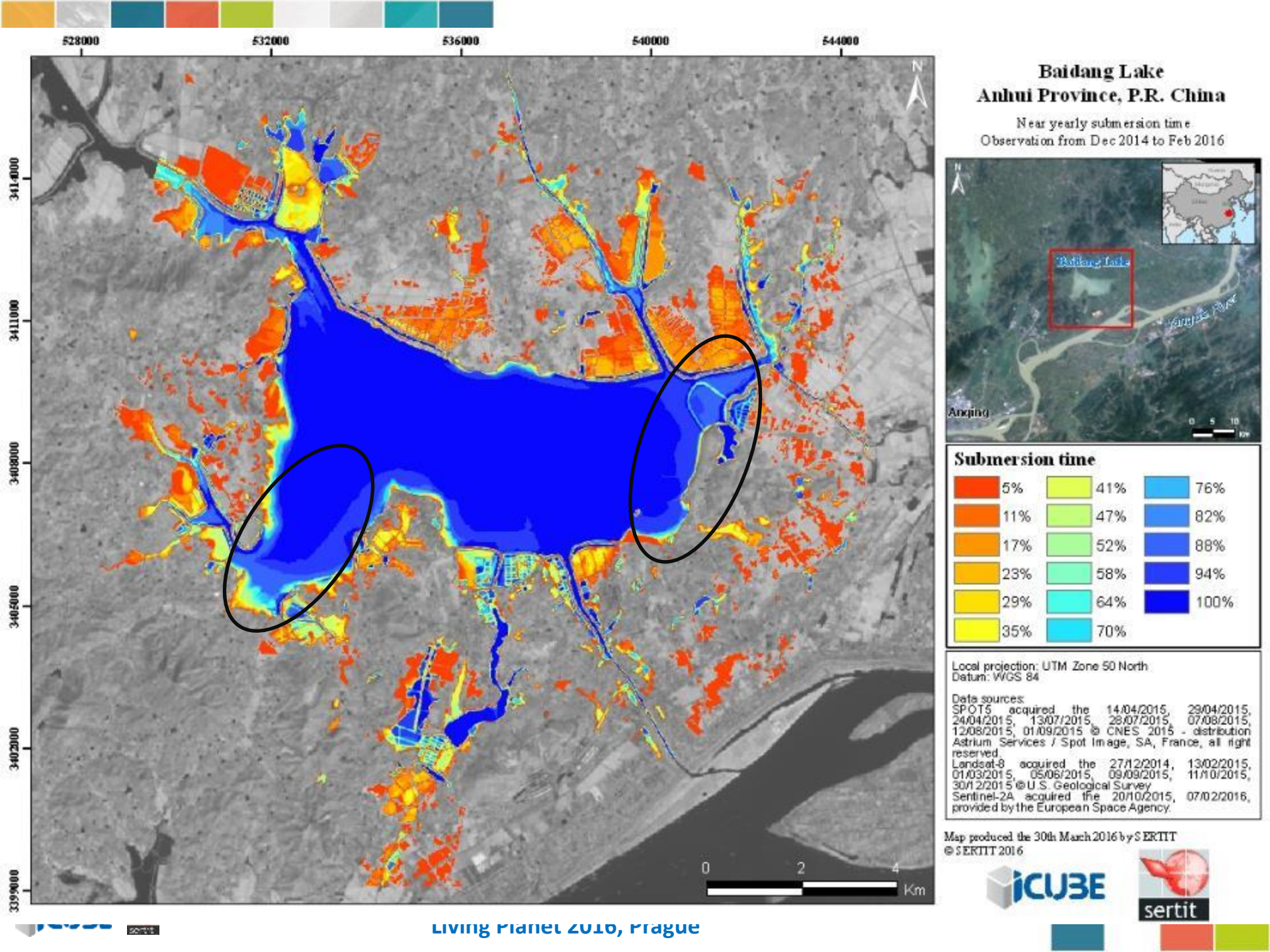
Monitoring water surfaces





Water surface change are mostly linked with agricultural practices outside the Baidan lake limits

South-West and North-Eastern parts of the lake, present water od few hundred meters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3408000
3405000
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4
Km
Baidang Lake
Anhui Province, P.R. China
Near yearly submersion time
Observation from Dec 2014 to Feb 2016
Anqing
Submersion time
5%
11%
17%
23%
29%
35%
41%
47%
52%
58%
64%
70%
76%
82%
88%
94%
100%
Local projection: UTM Zone 50 North
Datum: WGS 84
Data sources:
SPOT5 acquired the 14/04/2015, 29/04/2015, 24/04/2015, 13/07/2015, 28/07/2015, 07/08/2015, 12/08/2015, 01/09/2015 © CNES 2015 - distribution Astrium Services / Spot Image, SA, France, all right reserved.
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Map produced the 30th March 2016 by SERTIT
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Emergent macrophytes

Real rafts or moving islands

Zizania latifolia and Polygonum

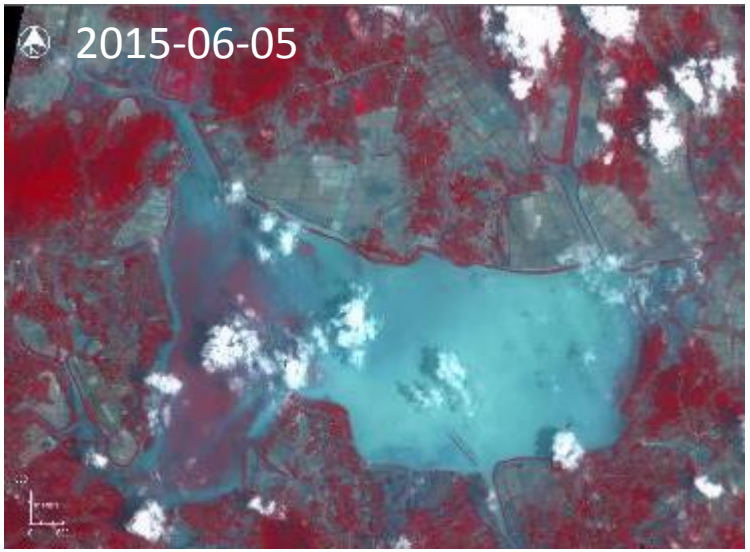
Floating and submerged vegetation

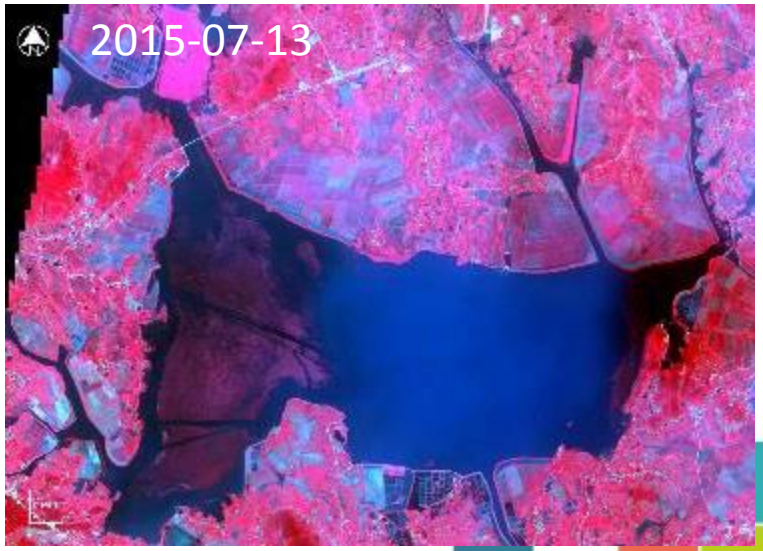
Trappa maximowiczii

Vallisneria spinulosa

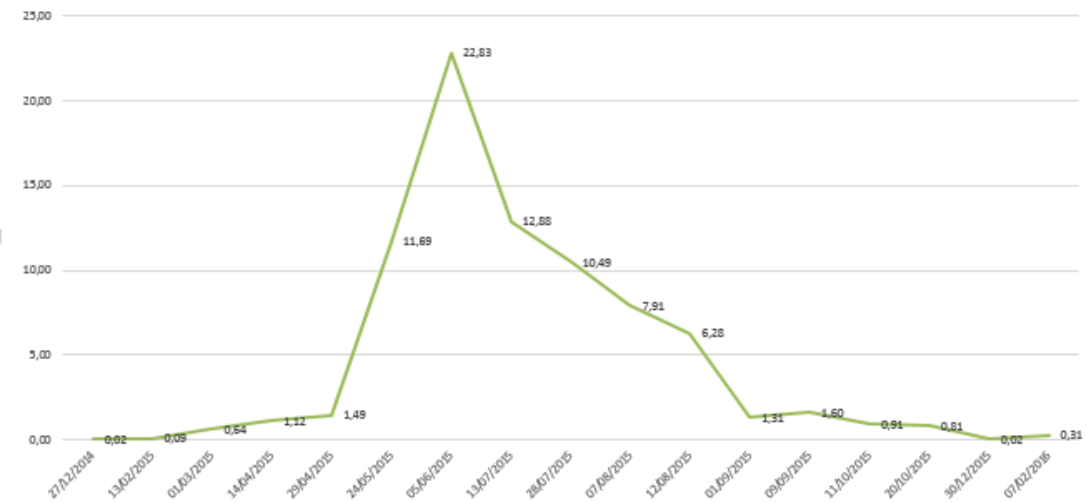
Acquatic vegetation monitoring

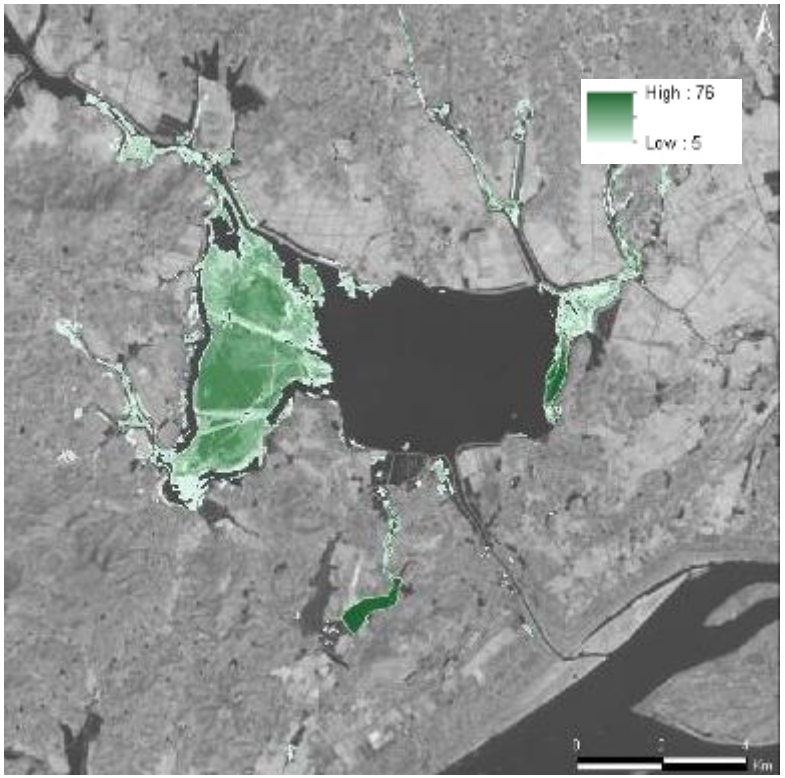
NDVI exploitation





Acquatic vegetation monitoring

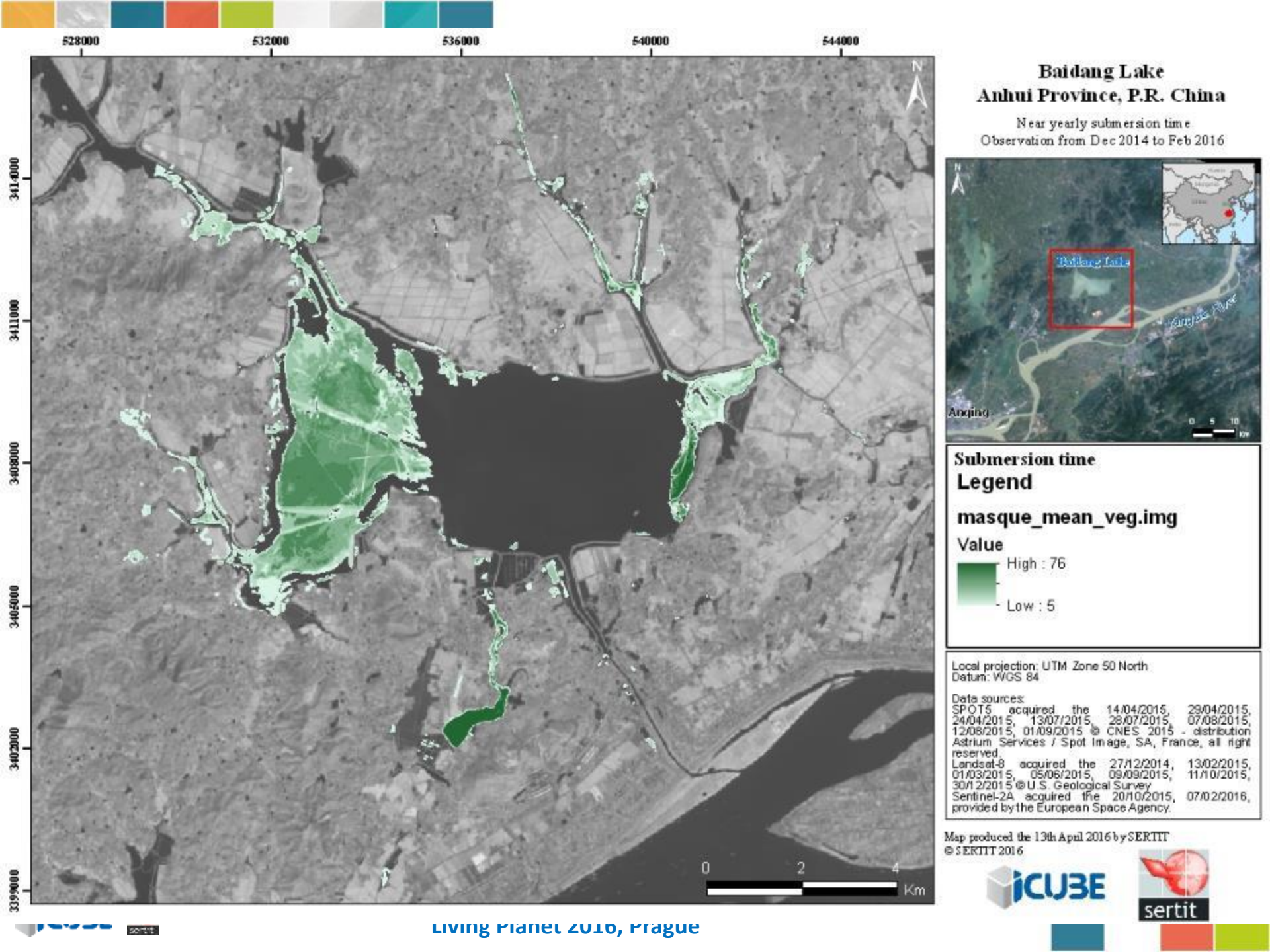




Very rapid onset of aquatic vegetation between the end of April (29 with 1,12 km^2) and end of May (24 with 11,7 km^2)

A peak on the 5 of June (22 km^2 ie near 50% of water surface)
=> correlated with the spring warm up

West part of the lake mostly affected and a lesser level the Eastern part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Km
Baidang Lake
Anhui Province, P.R. China
Near yearly submersion time
Observation from Dec 2014 to Feb 2016
Anqing
Submersion time
Legend
masque_mean_veg.img
Value
High : 76
Low : 5
Local projection: UTM Zone 50 North
Datum: WGS 84
Data sources:
SPOT5 acquired the 14/04/2015, 29/04/2015, 24/04/2015, 13/07/2015, 28/07/2015, 07/08/2015, 12/08/2015, 01/09/2015 © CNES 2015 - distribution Astrium Services / Spot Image, SA, France, all right reserved.
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Conclusion- perspectives

Take Five 5, 2013 & 2015: Great opportunity for Sentinel 2 simulation

Completed with Landsat 8 and possibility to join the series with real Sentinel2!!

Despite a relative small rate of exploitable images due to latitude location

⇒ Interest not only for large complex hydro system but also to small ones
⇒ Key factor the HR² (High Resolution and High Revisit) of Sentinel-2-like

Thematically speaking:
⇒ relative small hydrological systems of 2 to 10 ha, highlighting the important variability (25% to 35% in 5 to 10 days up and down; 87.5% of variation in 3 months
⇒ to characterize the invasive floating vegetation (Trappa, Zizania sp) over a year thought the growing season, but also on monitoring the macrophyte physiological status and its temporal dynamics.

⇒ Sentinel2 is powerful tool for wetlands monitoring

⇒ Future steps: exploit the Red Edge bands for macrophytes distinction and integrate the biomass estimation,

L'ESPACE...

...AU SERVICE DE LA TERRE

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