

# « Monitoring water turbidity: contribution of SPOT5 TAKE5 to health hazard monitoring in West Africa (Bagre Lake, Burkina Faso) »

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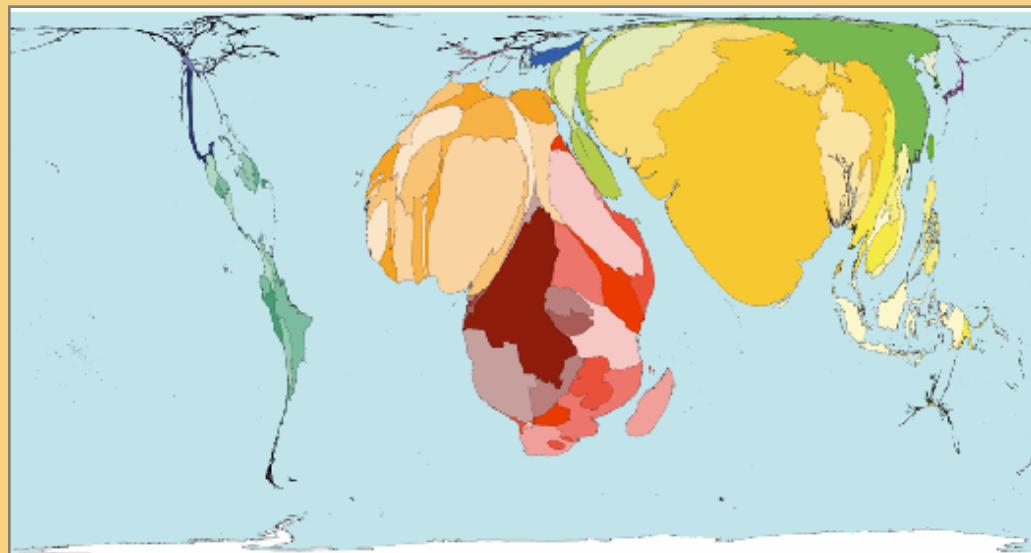
Living Symposium - ESA, Prague, 12/05/2016



## **Issues, Problematic, Objectives**

- Human health in Southern Countries: “faecal peril”:

Diarrheal diseases, affect every year 1.7 billion people and cause 2 millions deaths, mostly children under 5 y



*Diarrheic mortality in the world (2012) (HCWC)*

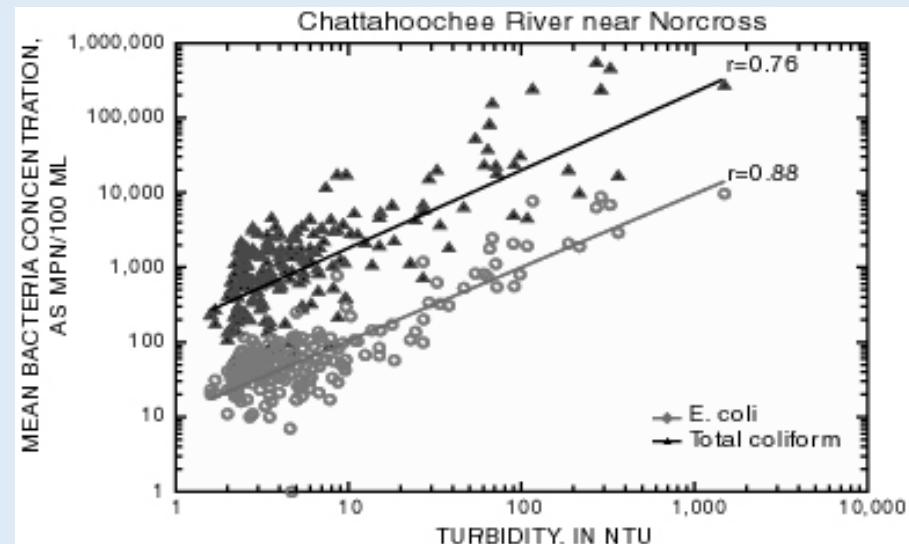
# Issues, Problematic, Objectives

Water turbidity and SSSC (Surface Suspended Sediment Concentration)

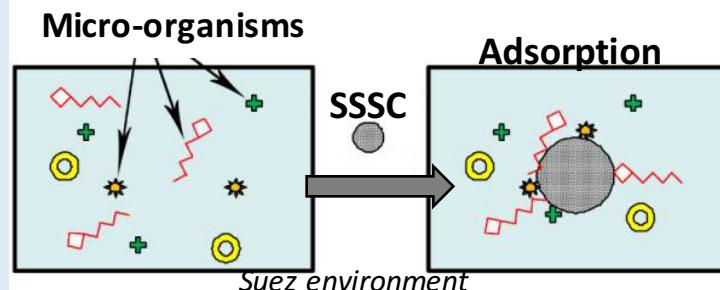


Vector of microbiological contaminants (diarrheal diseases, *E. coli*).

Transport of contaminants  
Adsorption



Georgia Water Science Center



# **Issues, Problematic, Objectives**

**Water turbidity and SSSC (Surface Suspended Sediment Concentration)**



**Vector of microbiological contaminants  
(diarrheal diseases, *E. coli*).**



**Health hazard**

+

**Health vulnerabilities**



**Health risk**

## **Issues, Problematic, Objectives**

- **Monitor turbidity** in West Africa
- Mapping **health hazard** related to turbidity => **health risks**.

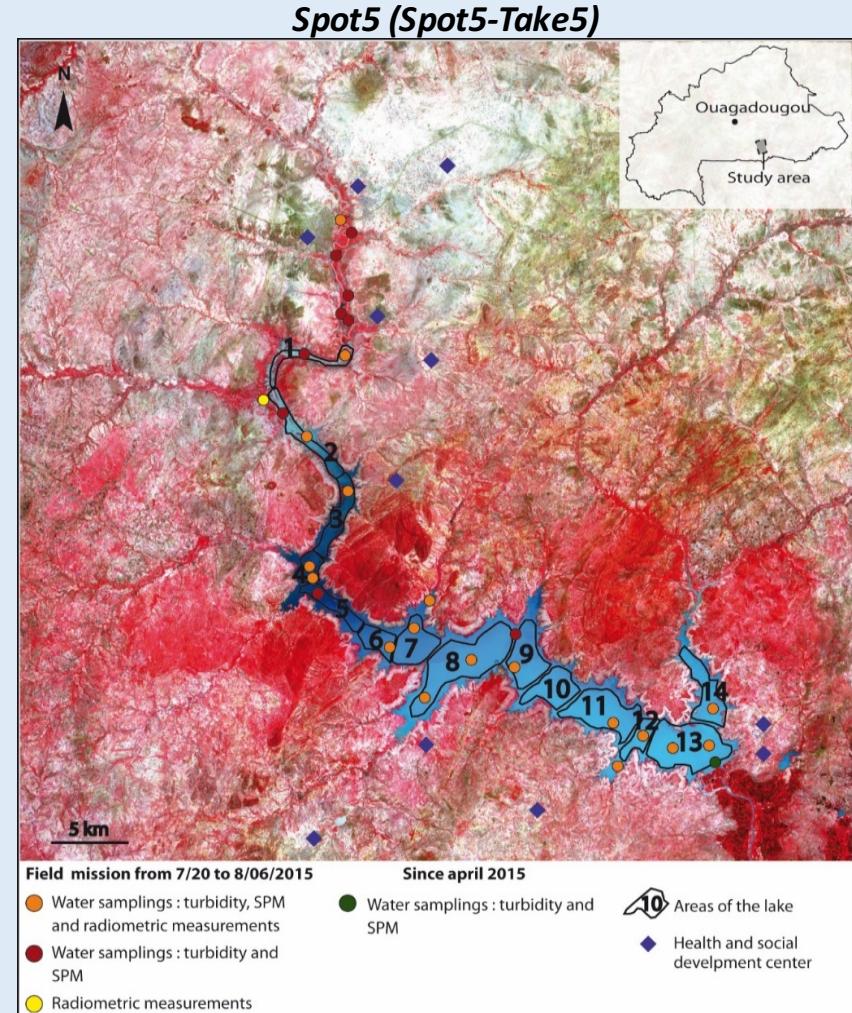
**Turbidity of inland water by remote sensing:** Martinez et al. 2009; Espinoza Villar et al. 2012, Kaba et al. 2014

### **Challenges in WA**

- **High atmospheric load (aerosols and water vapour)**
- **High values and heterogeneous** in space and time (Robert 2014),  
→ use of high temporal and spatial resolution sensors (**SPOT5/TAKE5 → Sentinel-2**).

## *Methods and study area*

- **Bagré reservoir (1992)**
- Second largest Burkinabe dam ( $250 \text{ km}^2$ ).
- **North-Sudanese:** 800-900 mm.
- **Land use change**, agropastoral activities.
- **Diarrheic diseases: third pathology.**



## **Methods and study area**

- **In situ measurements:**
  - **Water samples: turbidity and SSSC**
    - Continuous measurements:  
16 Apr to 13 Sep 2015 (*SPOT5 Take5*) :  
25 (turbidity) & 25 (SSSC)
    - Field campaign July-August 2015 (*PNTS*) :  
70 (turbidity) & 53 (SSSC)
  - **Radiometric:** TriOs Ramses radiometer (350-900nm), 28 measurements.



## **Methods and study area**

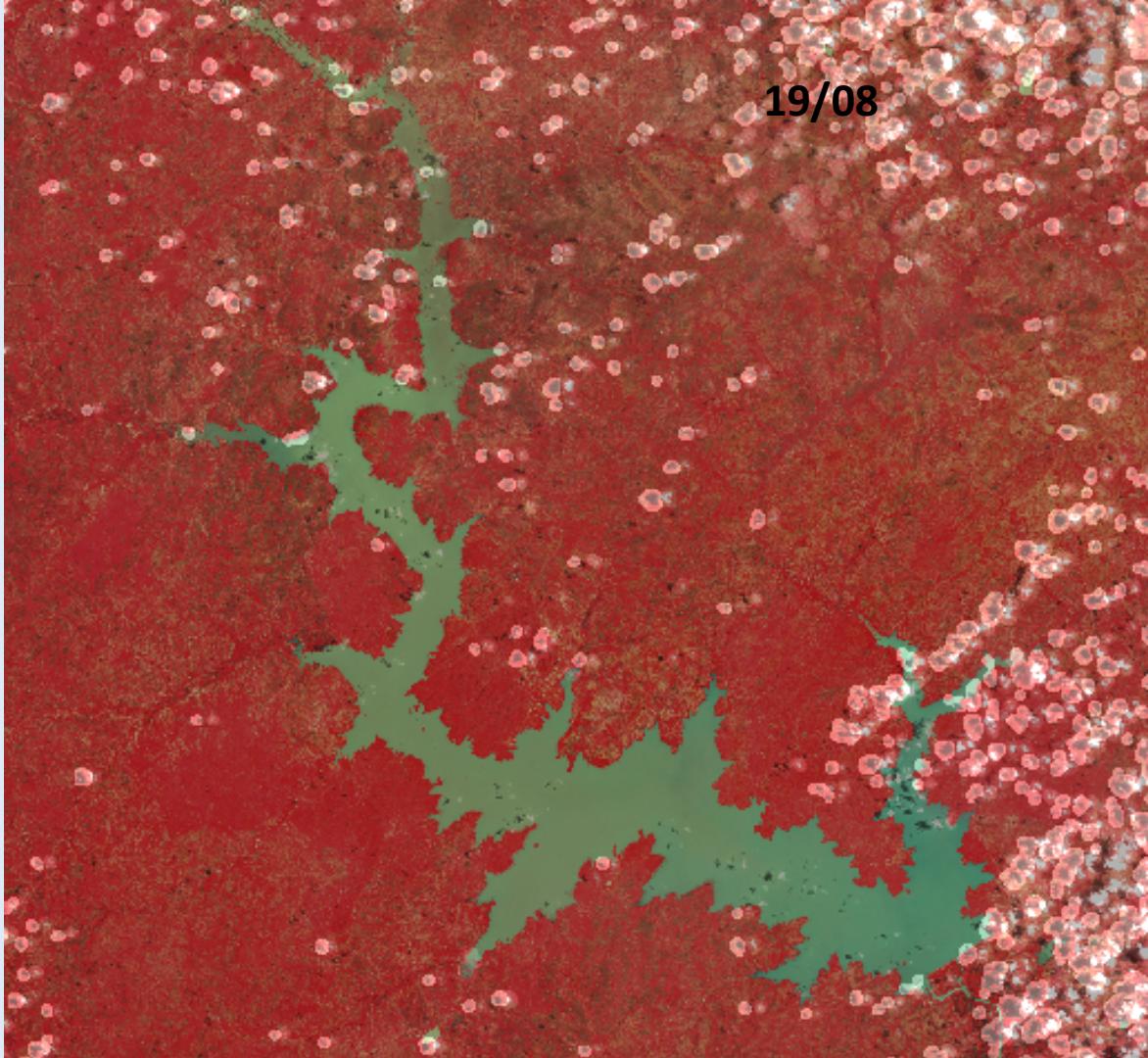
- Satellite data:

**26 images SPOT5/Take5 5 days, 10 m**

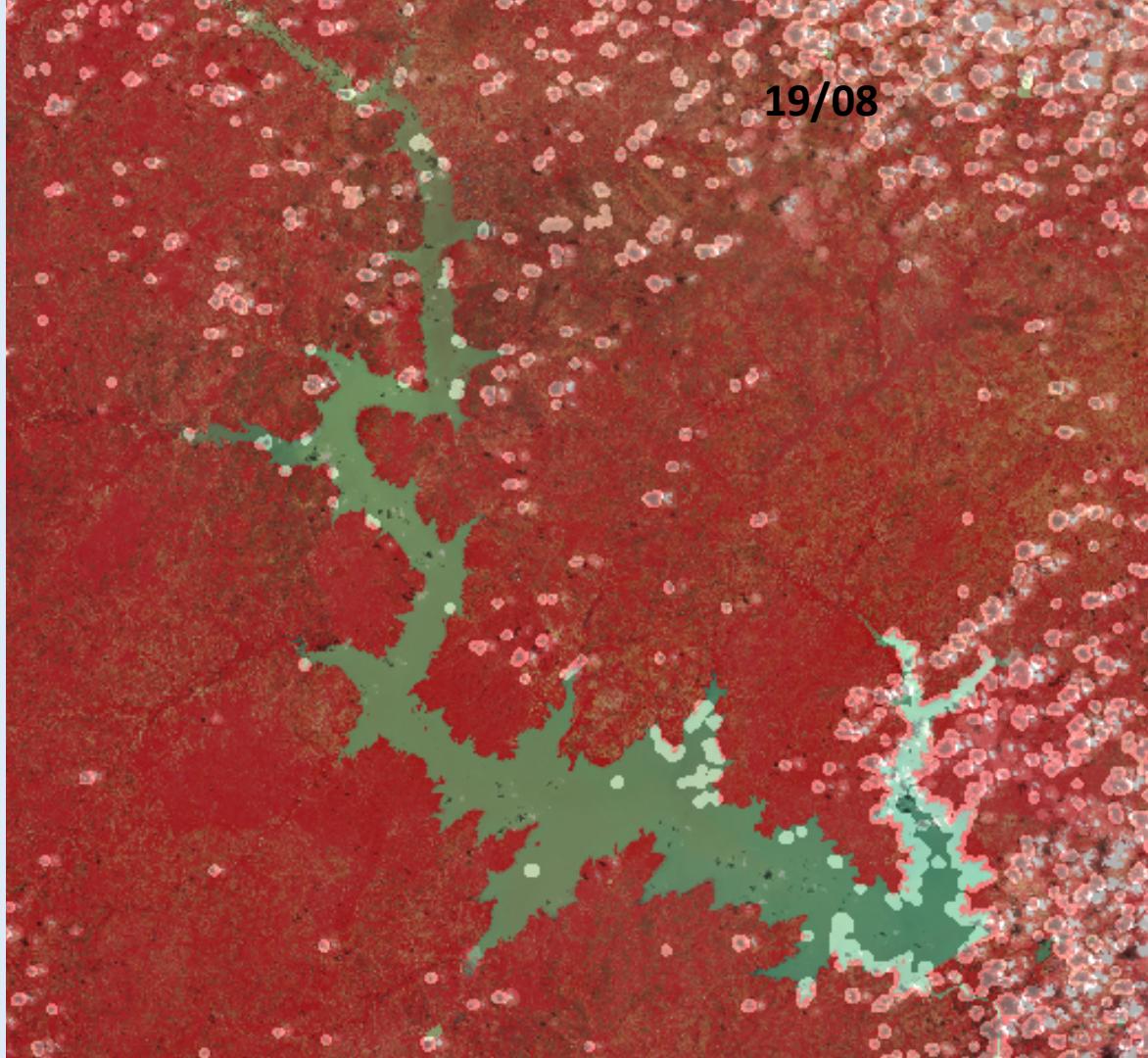
**16 April to 13 September 2015**

	No clouds on the lake	Some clouds on the lake	Clouds on the lake	Unusable images
Images	8	8	4	6

19/08



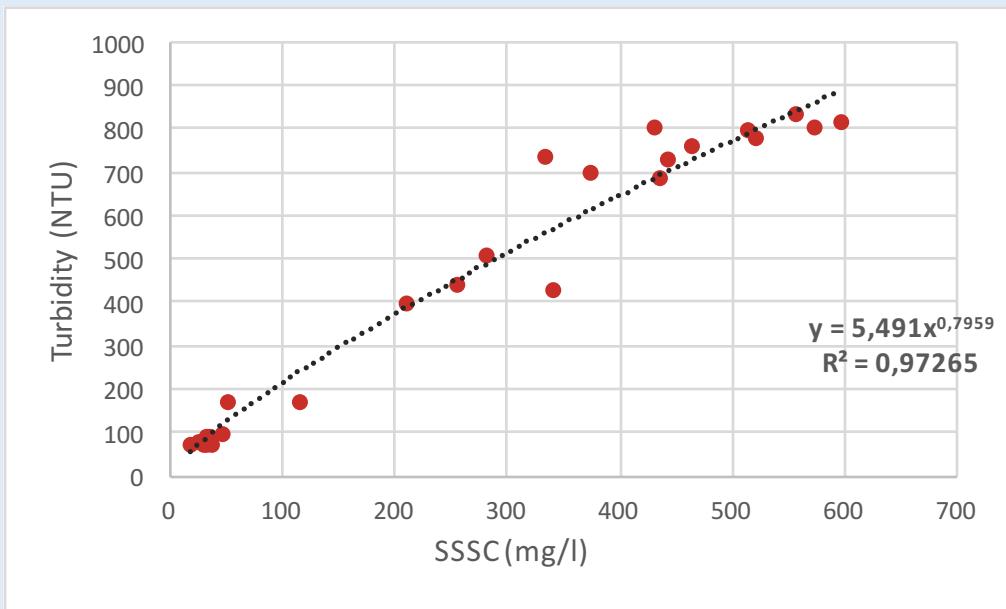
19/08



## *Results: in-situ turbidity and SSSC*

- SSSC: 18 to 927 mg/l
- Turbidity: 51 to +1000 NTU

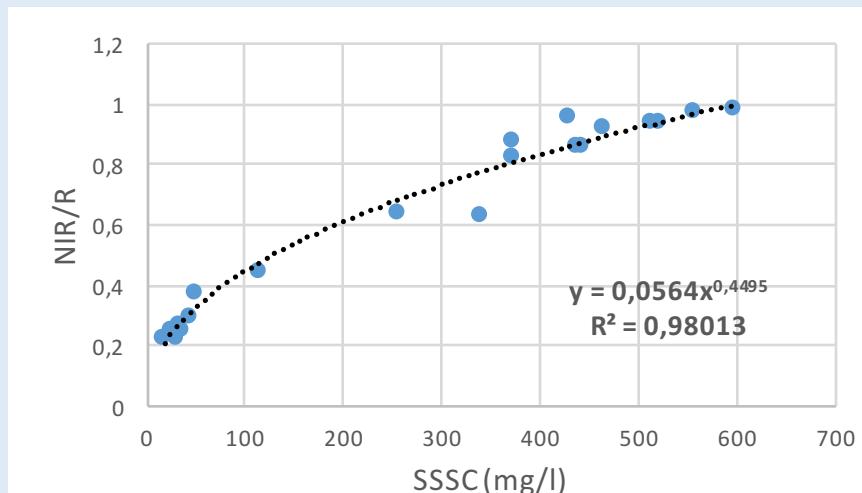
*In Situ*



## Results: spectroradiometry

NIR/R index = Turbidity index

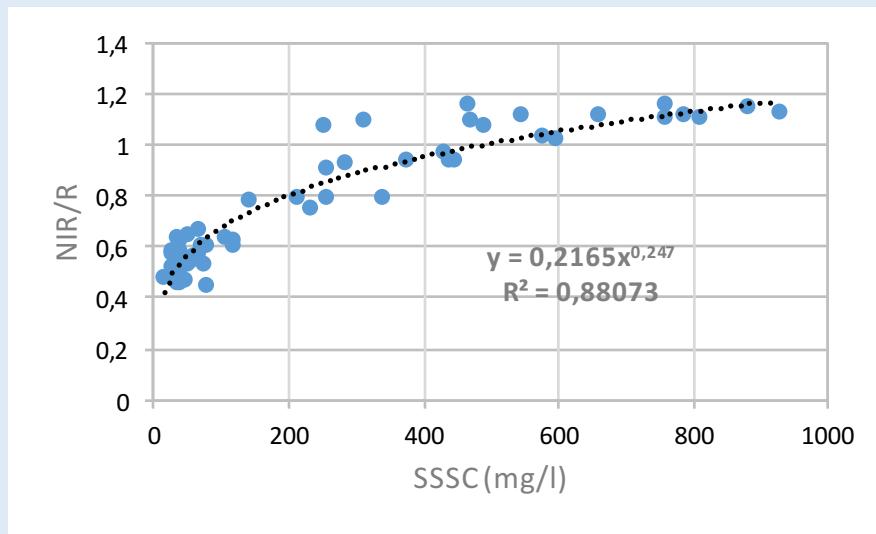
*Variation of the NIR/R index from spectroradiometric measurements as a function of SSSC*



## Results: SPOT5/Take5

NIR/R index = Turbidity index

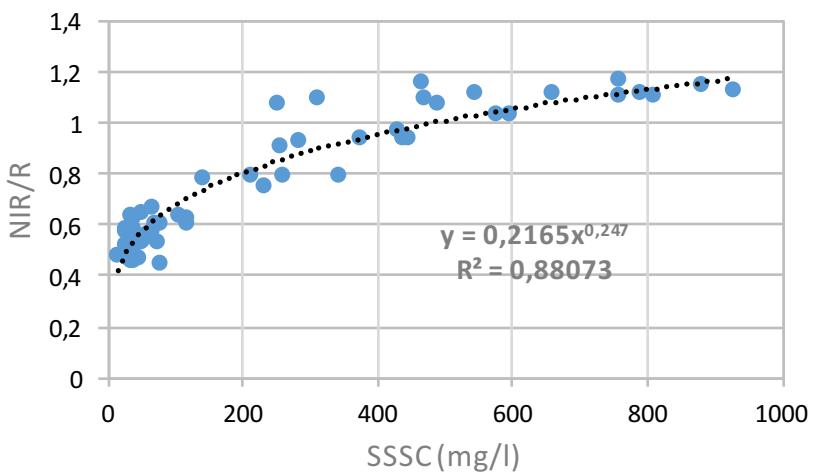
*Spot 5-Take 5 NIR/R index as a function of SSSC*



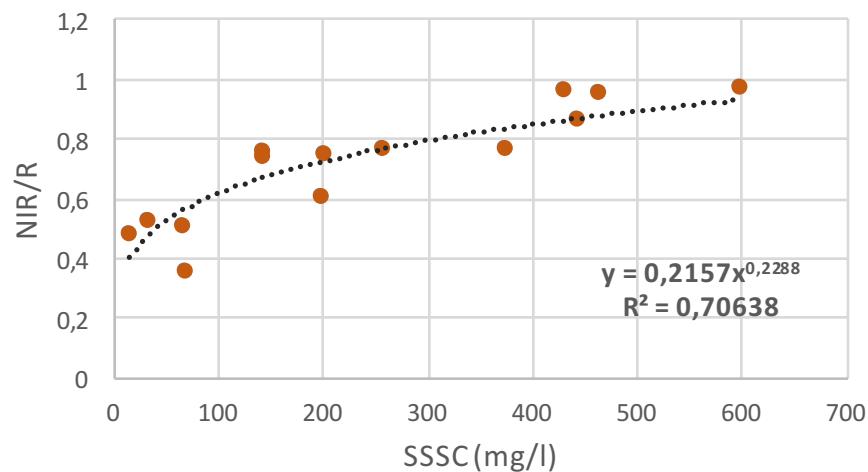
## Results: Spot5/Take5 & Modis

NIR/R index = Turbidity index

Spot 5 Take 5 NIR/R index as a function of SSSC



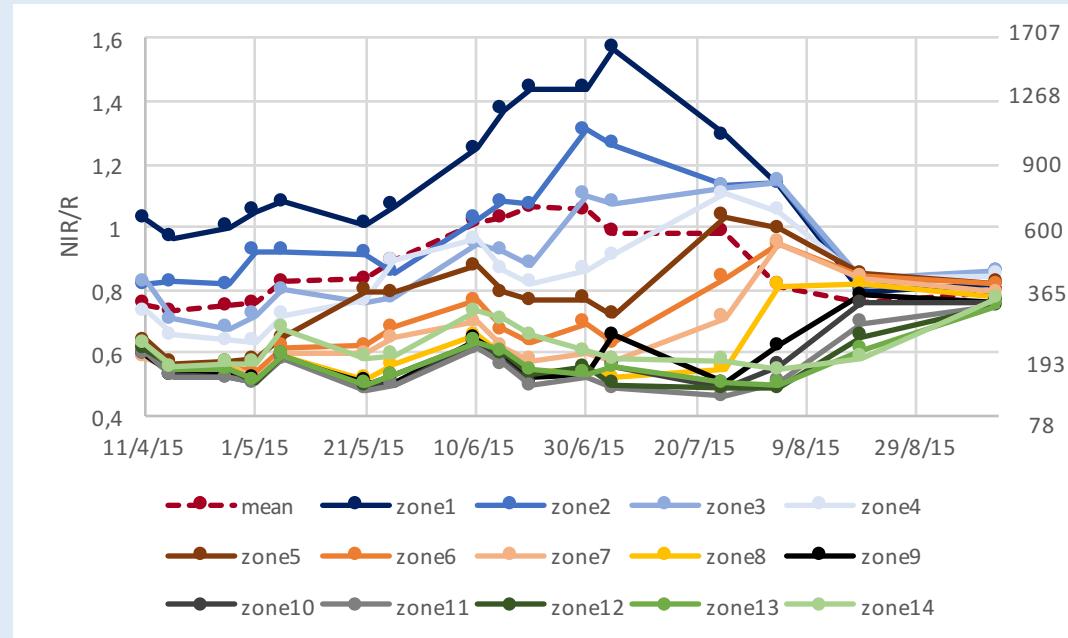
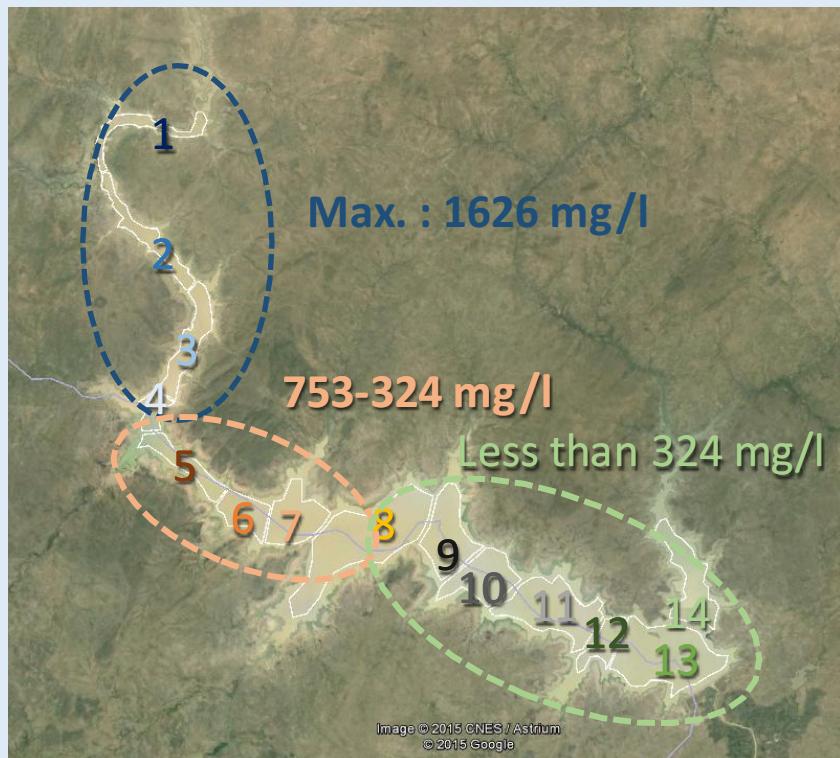
Daily MODIS NIR/R index as a function of SSSC



Robert et al. under revision (JAEG)

## Results: seasonal evolution

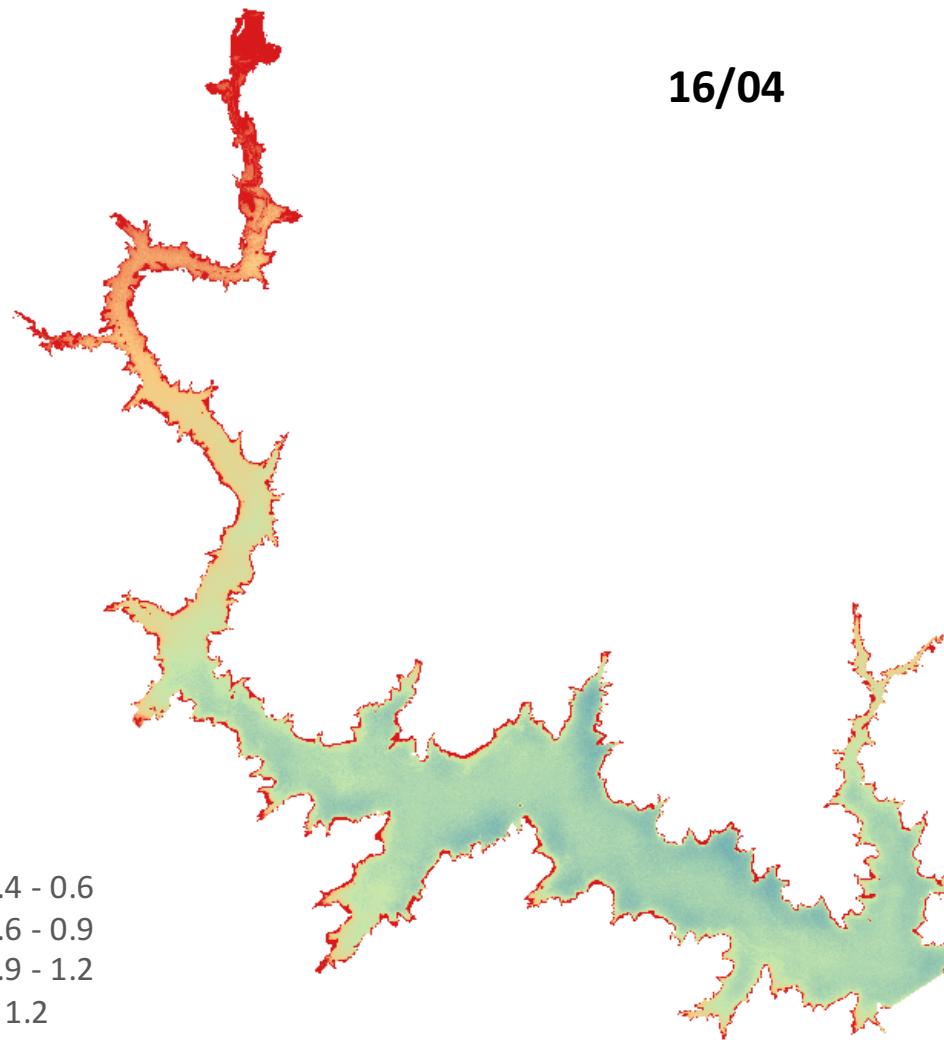
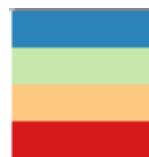
Areas of the Bagre Lake



*Seasonal cycle for different areas of Bagre Lake (April to September 2015) as a function of NIR/R turbidity index from Spot5/Take5*

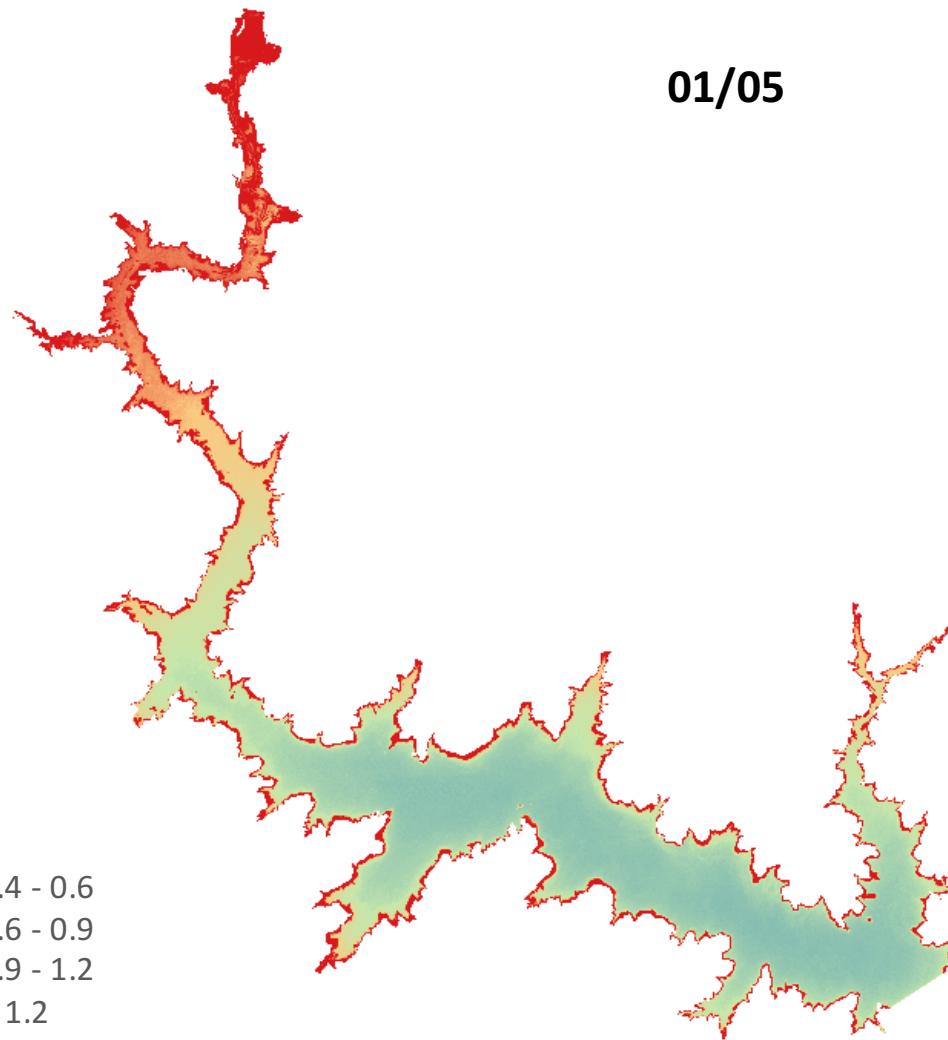
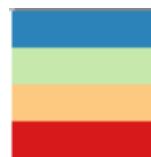
16/04

NIR/R



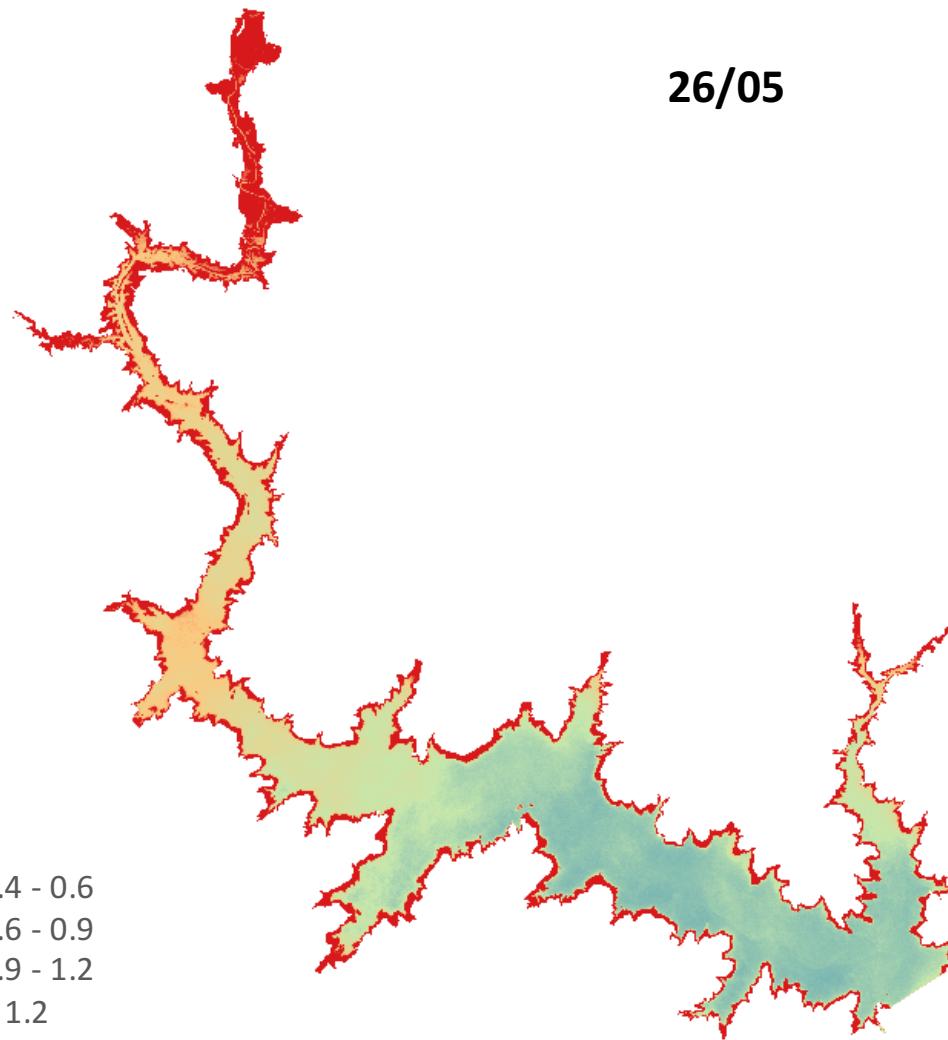
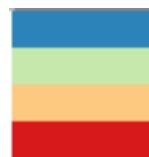
01/05

NIR/R



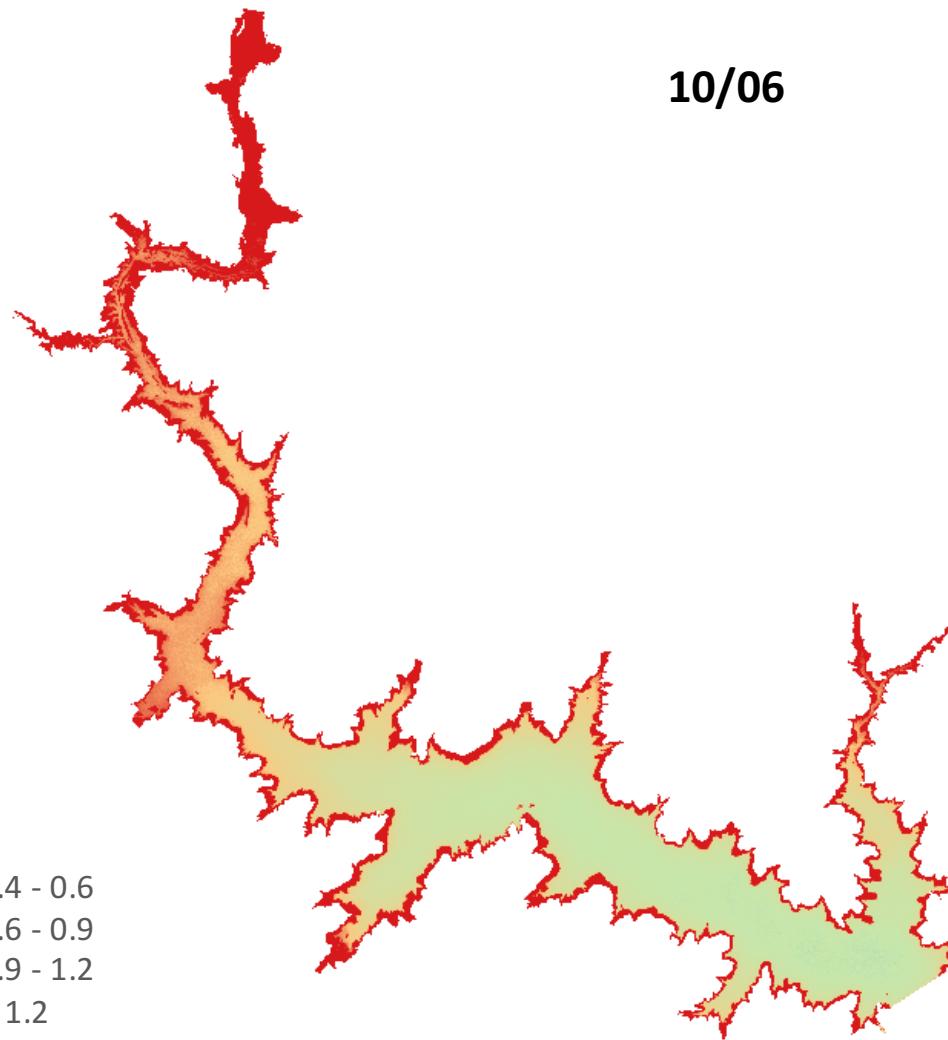
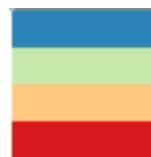
26/05

NIR/R



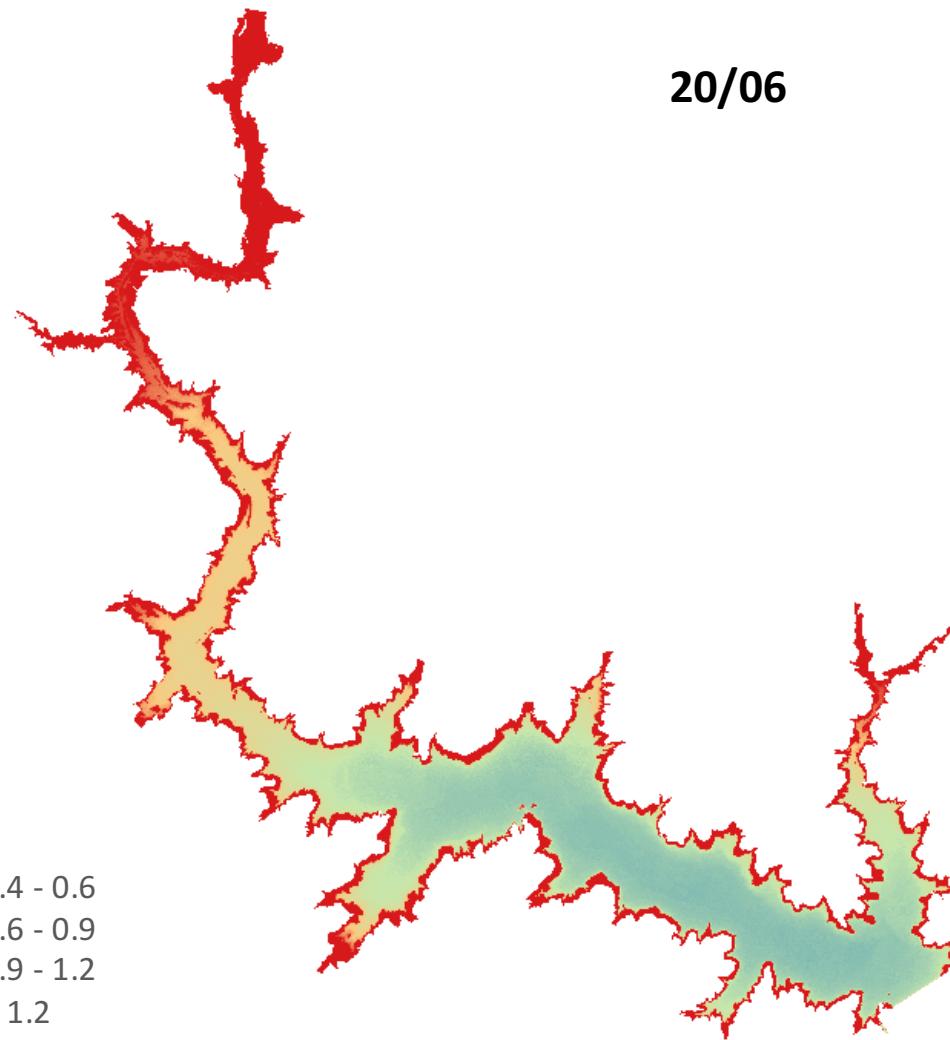
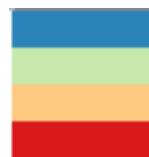
10/06

NIR/R



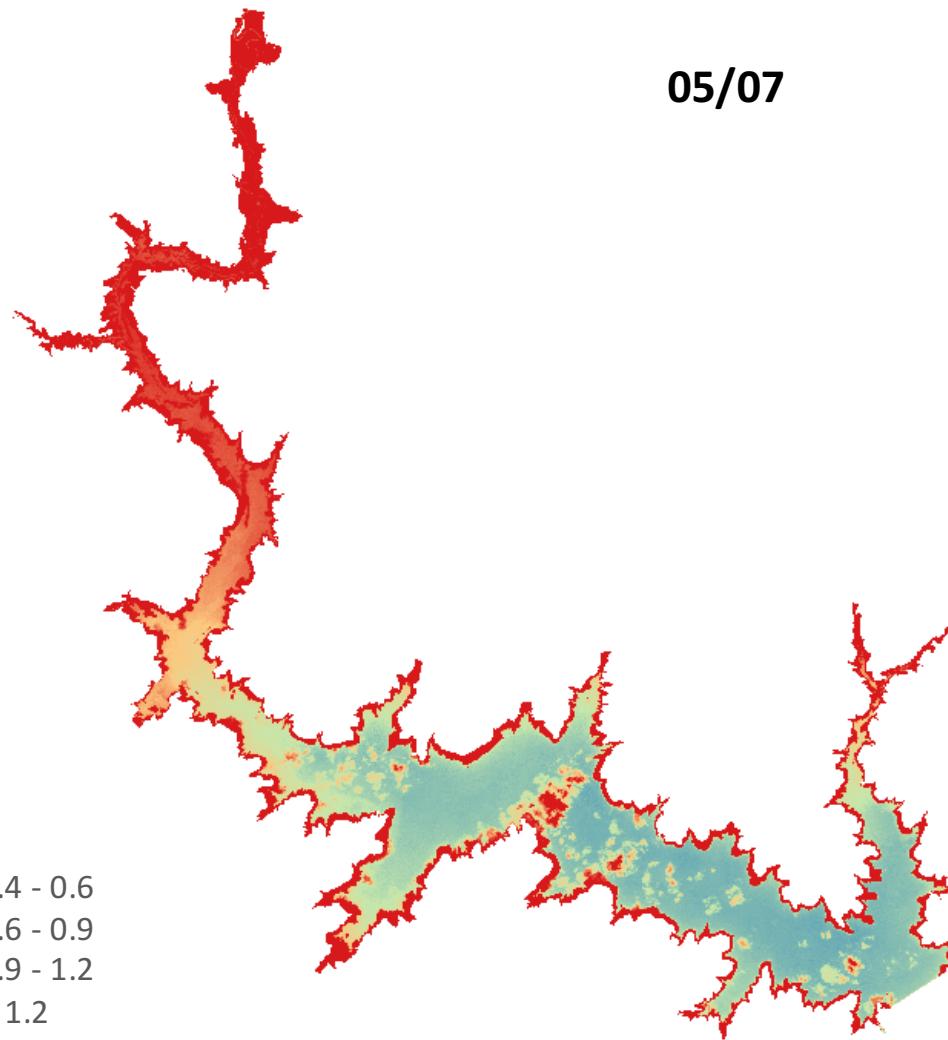
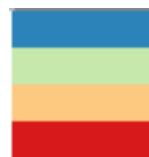
20/06

NIR/R



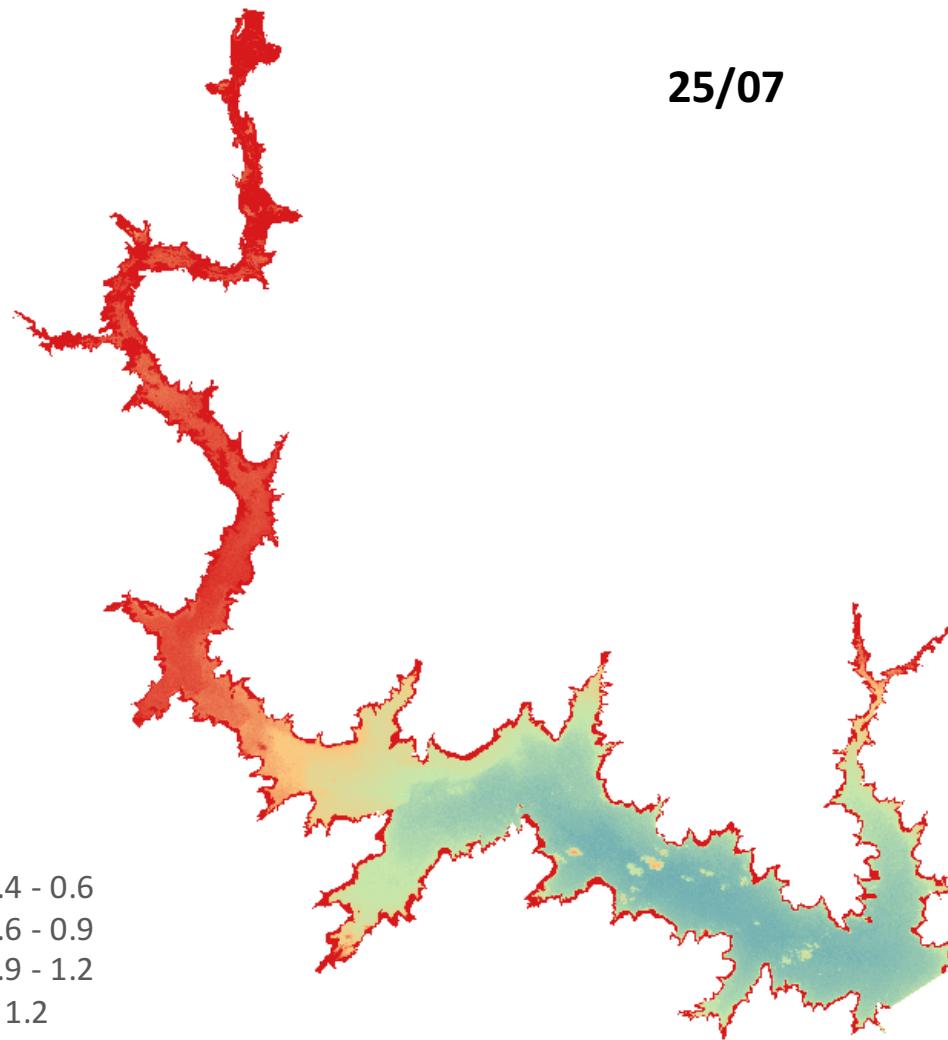
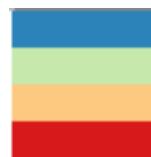
05/07

NIR/R



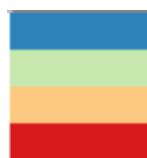
25/07

NIR/R

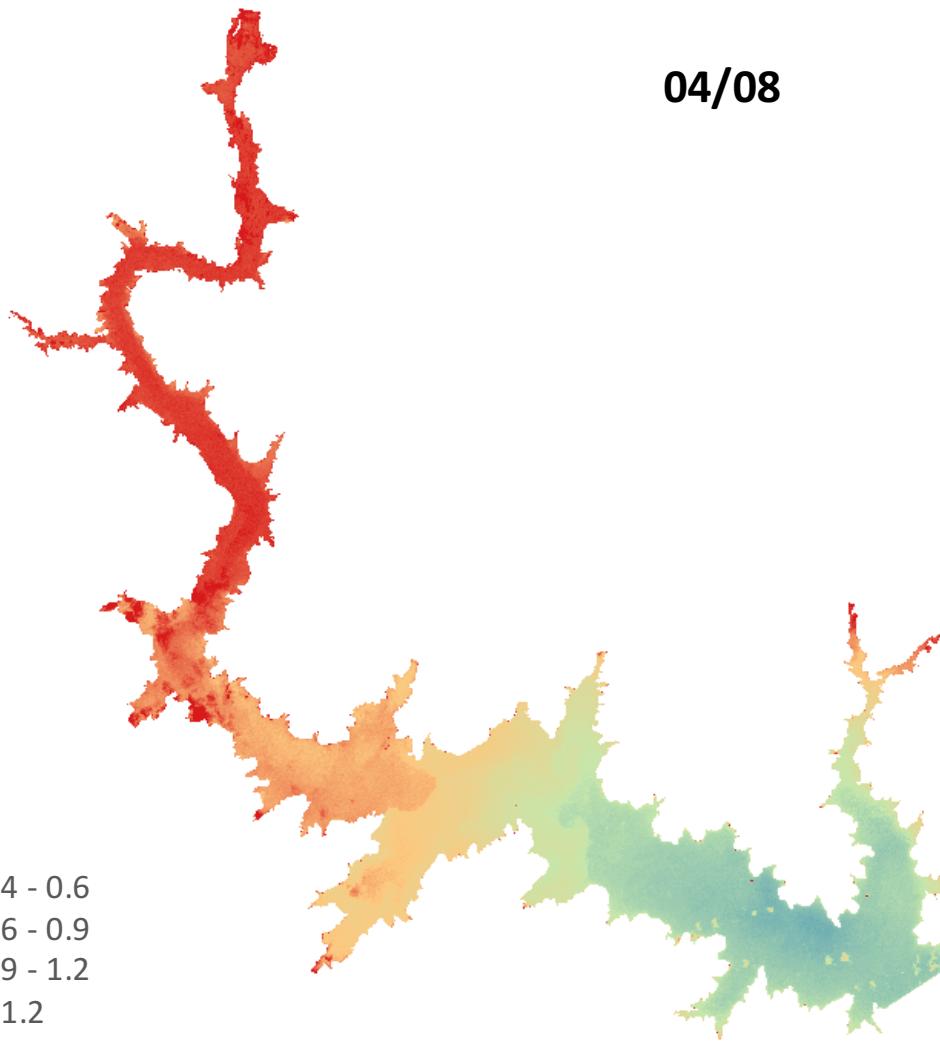


04/08

NIR/R

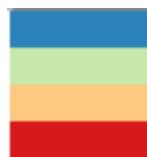


0.4 - 0.6  
0.6 - 0.9  
0.9 - 1.2  
> 1.2

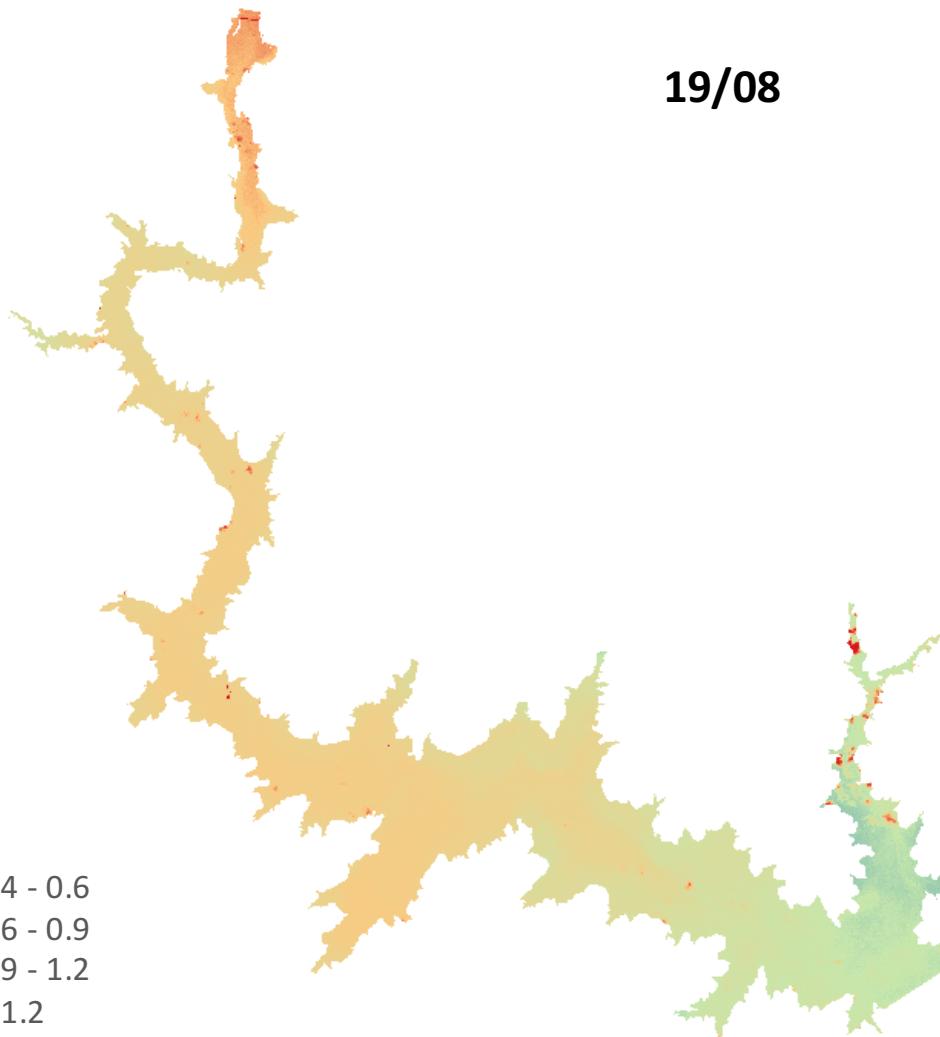


**19/08**

**NIR/R**

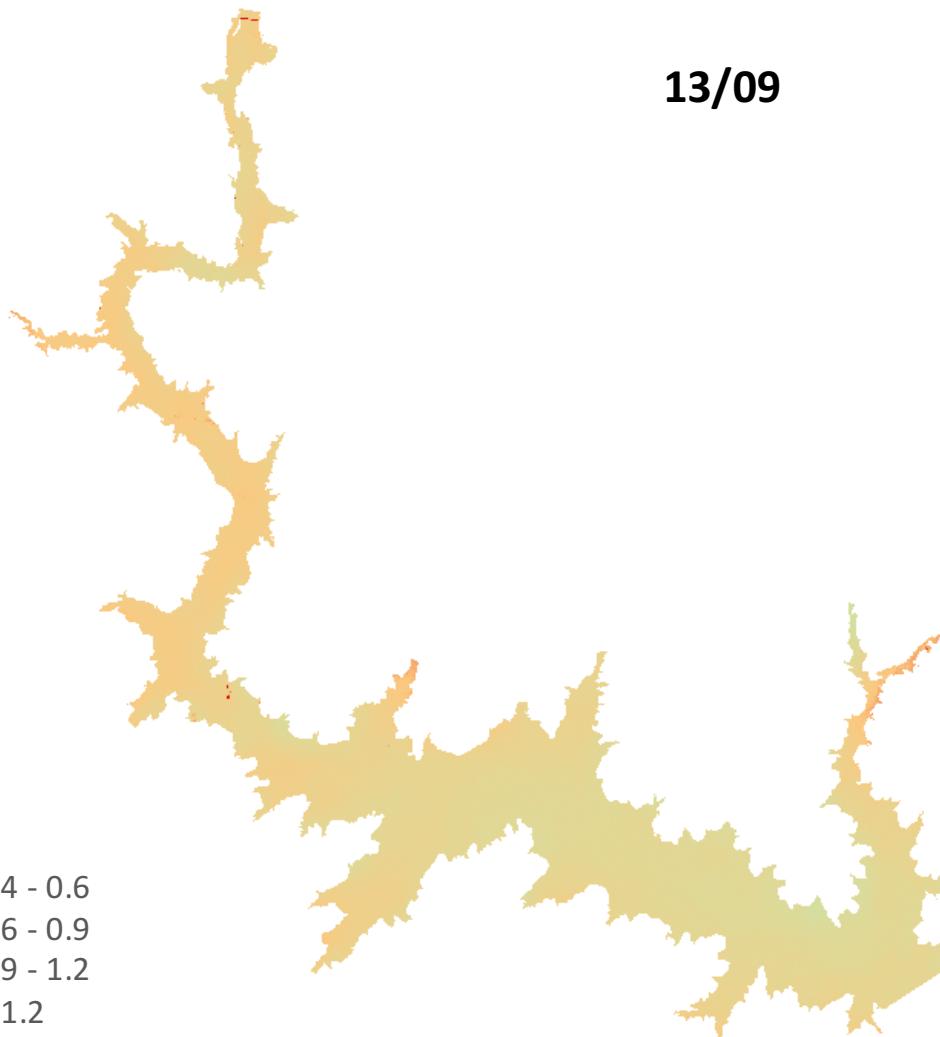
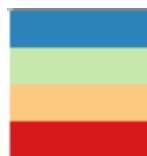


0.4 - 0.6  
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> 1.2



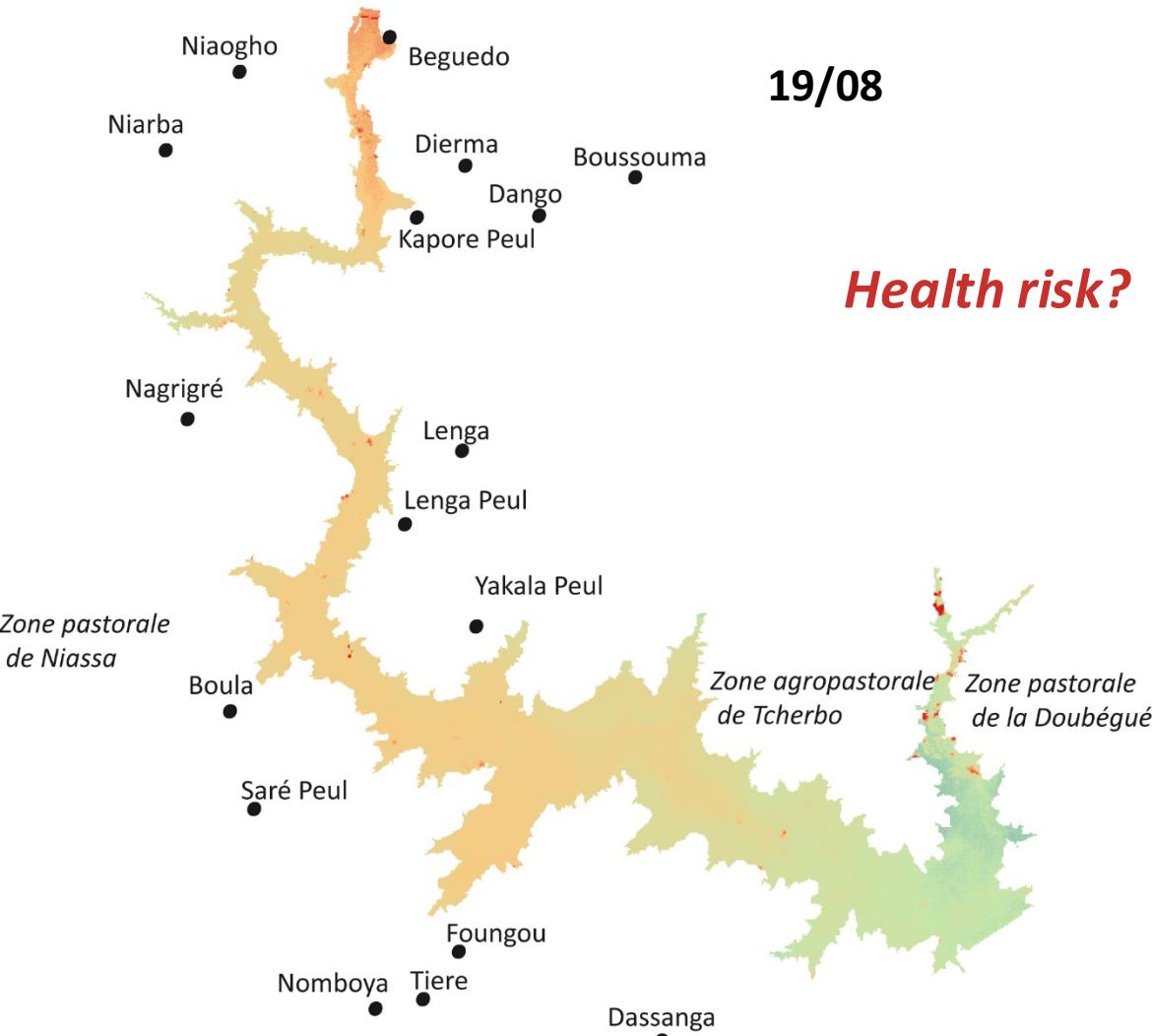
**13/09**

**NIR/R**



19/08

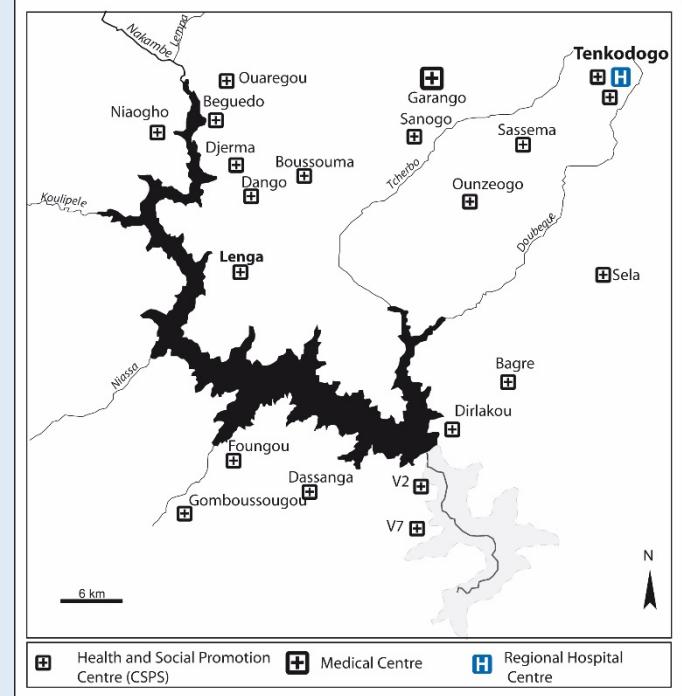
*Health risk?*



# Perspectives: health vulnerabilities

Field campaign (March 2016)

- High turbidity = high health hazard => health vulnerabilities? => health risk?
  - Combine turbidity data with epidemiologic data (CSPS): areas and periods with highest risk
    - ✓ Diarrheal disease (2009-2016) of : gender, age group
  - Interviews on practices, water uses, access to healthcare:
    - ✓ Criteria: living locality, distance to water, accessibility to water and category of actors
    - ✓ 3 sites: Founou, Djerma and Lenga



## Conclusion

- **NIR/R reflectance index (Modis, Spot5) = Turbidity index:** to monitor **turbidity** and **SSSC** up to **high values**.
  - **Spatio-temporal analysis of turbidity index:** sediment transport processes from upstream to downstream (especially between June and September).
- SPOT/TAKE5 well suited for Tele-epidemiology approaches

Next:

- **Sentinel2: monitoring turbidity (→health hazard) over the whole West Africa region**
- **Study health risk (diarrheal diseases): health hazard (turbidity + *E. coli*) + health vulnerabilities**

# THANKS FOR YOUR ATTENTION

