30 Years' Global Scale Mapping of surface Water Dynamics at 30 m resolution

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[*] European Commission - Joint Research Centre, Italy
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Mapping Water Bodies from Space - MWBS 2015.
ESA – ESRIN (Frascati - Italy) the 18 and 19 of March 2015

Our knowledge concerning surface water locations and dynamics is inadequate and the information gap is significant

- What about the extent of the water surfaces at any time ?
- Where are permanent water surfaces found ?
- Where are seasonal water surfaces found ?
- When do they fill and empty?
- What about the inter / intra-annual variability?
- What about new and ex water surfaces?

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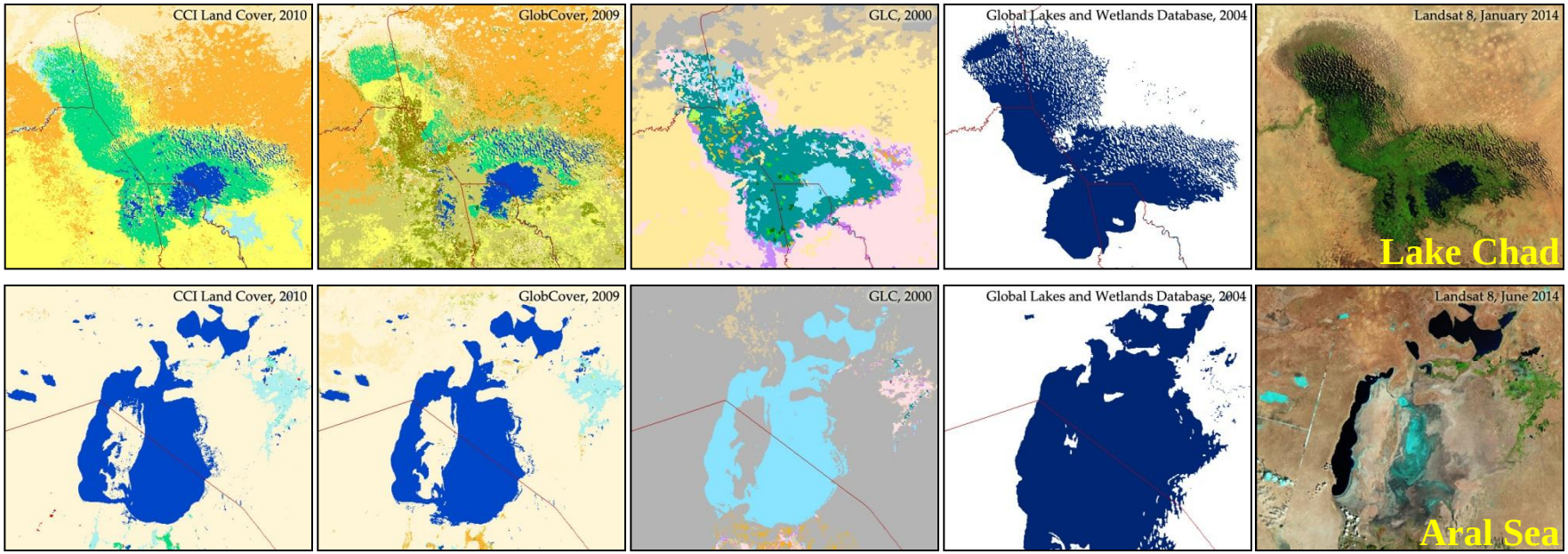
Global maps are generally characterized by coarse spatial resolution, and are static in time



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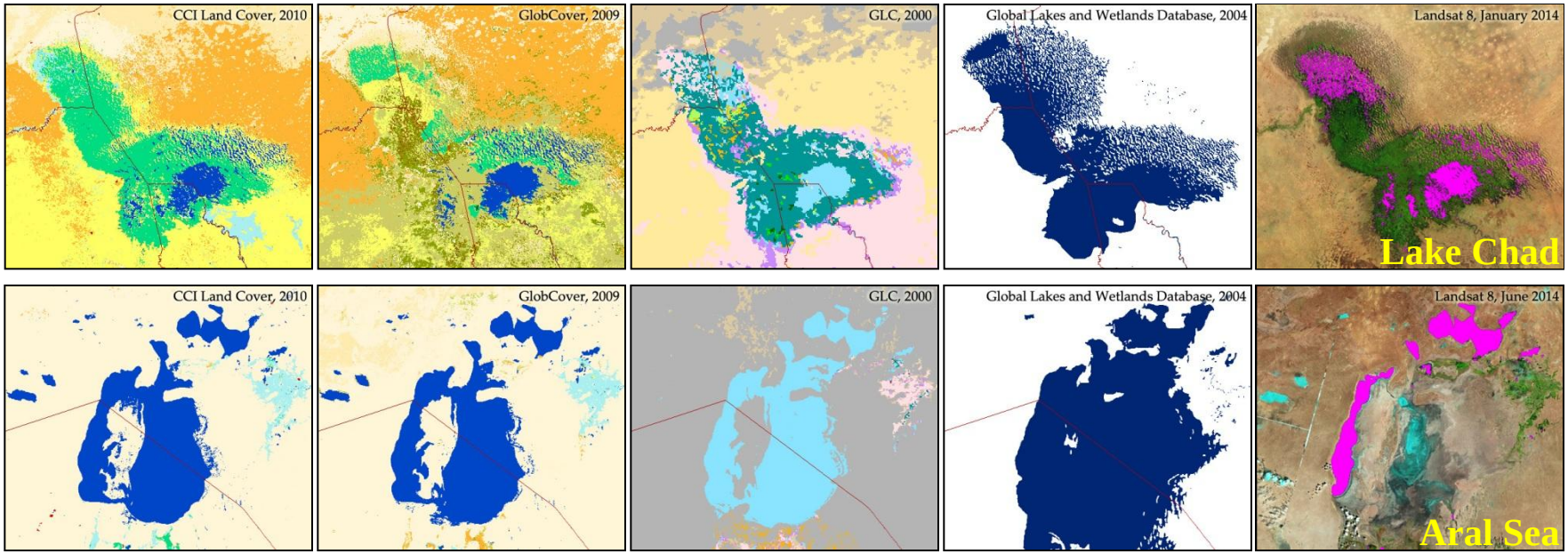
European Commission

Global maps are generally characterized by coarse spatial resolution, and are static in time



Needs Dynamic Water Mapping at the highest possible spatial and temporal resolution

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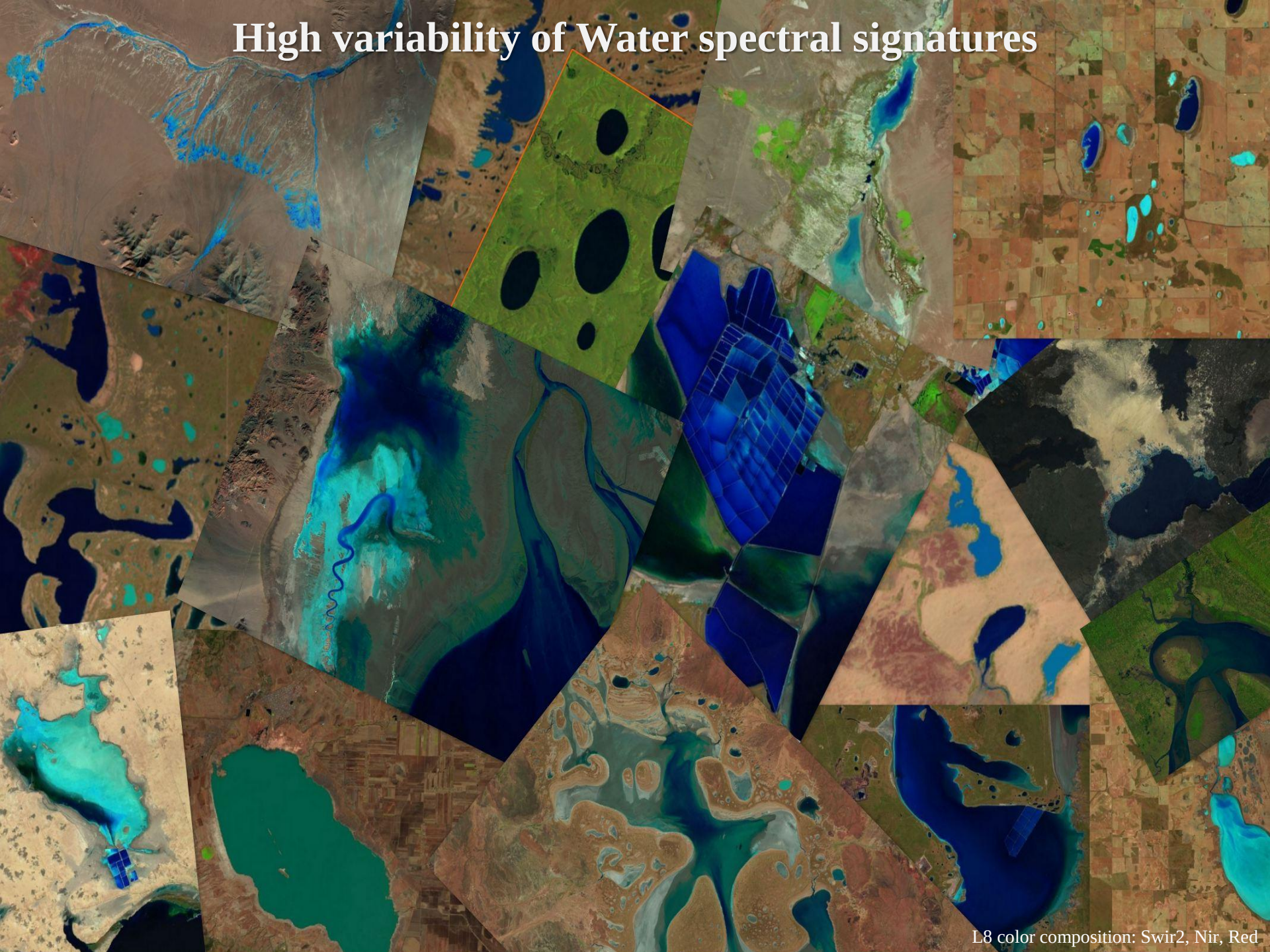
High variability of Water spectral signatures



L8 color composition: Swir2, Nir, Red

Methodology

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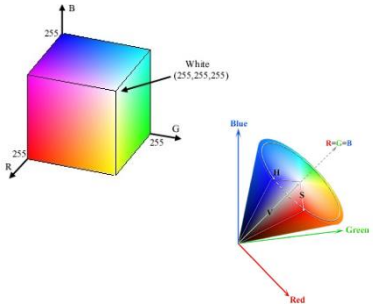
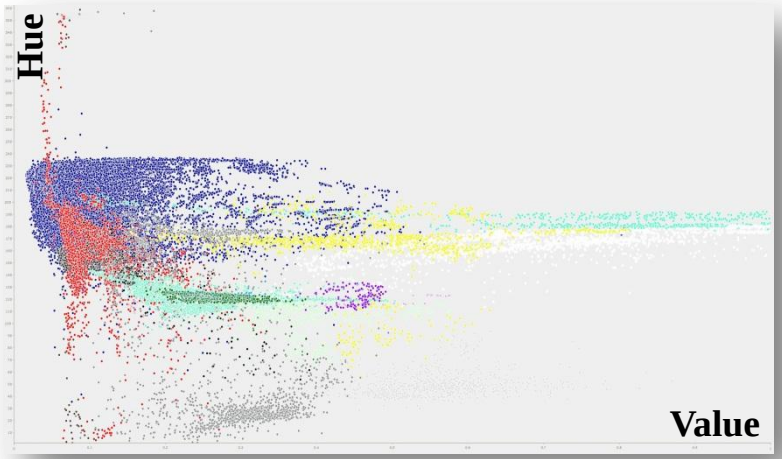
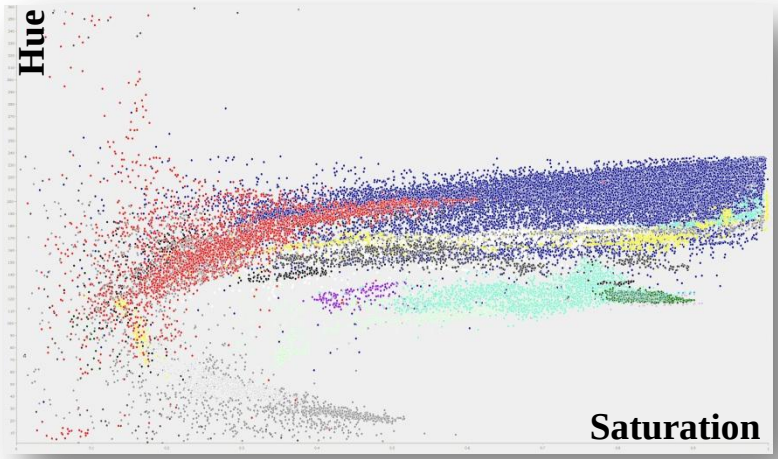
- Pixel-based
- Sensor neutral (L5, L7, L8 and MODIS)
- Based on Hue/Saturation/Value colour model – rather than RGB
- Algorithm calibrated based on a large sample (> 30.000 pixels)







Example derived from SWIR2, NIR, RED bands

- Building a number of dynamic masks to deal with: Mountain cast shadow, Cloud shadow, Clouds, Snow, Lava flows, etc
- We developed tools built on top of GEE for spectral library development and validation

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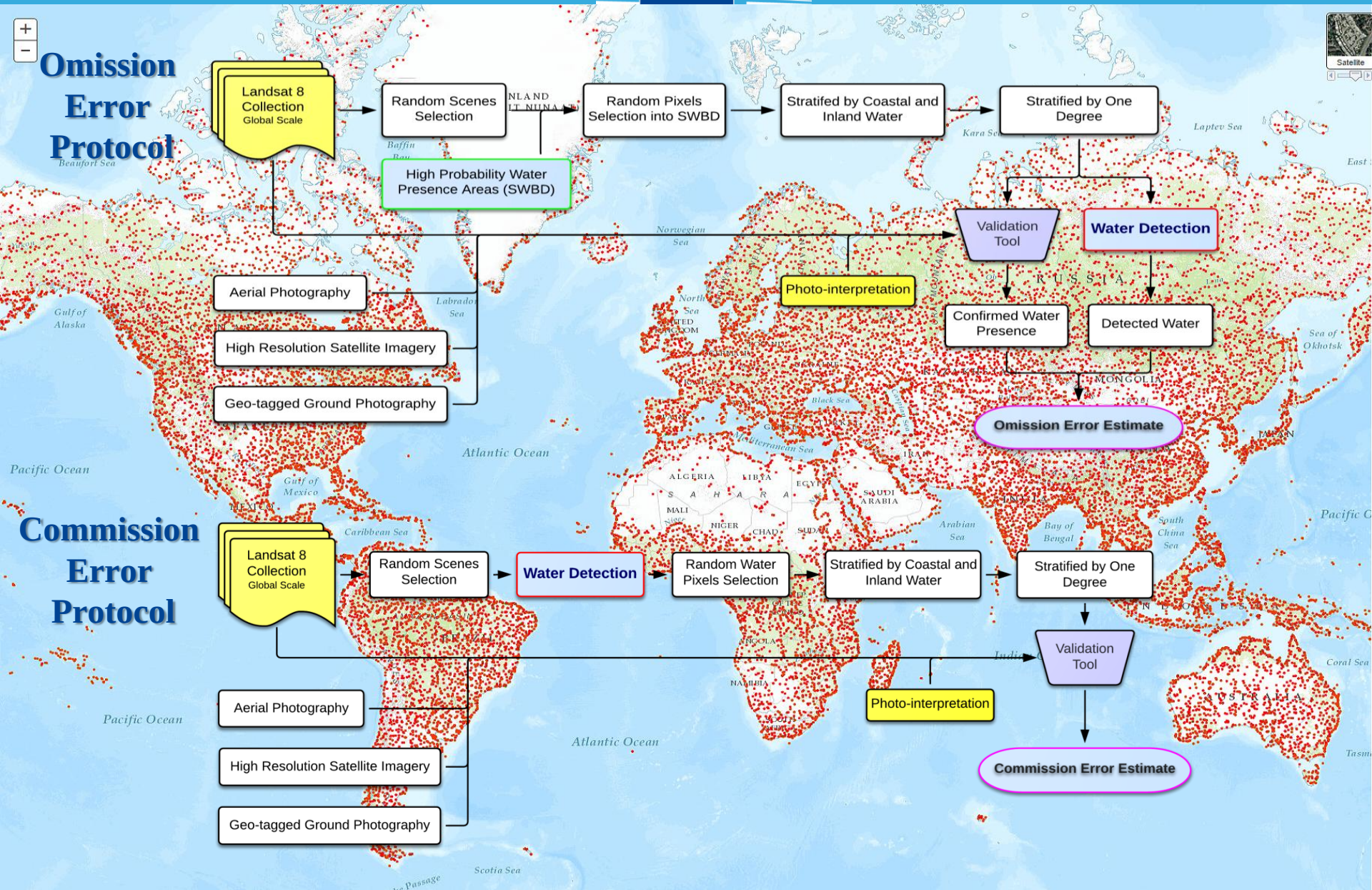
Spatiotemporal Validation

Based on 20.000 validation pixels

Overall accuracy : > 90%



Intra annual variation

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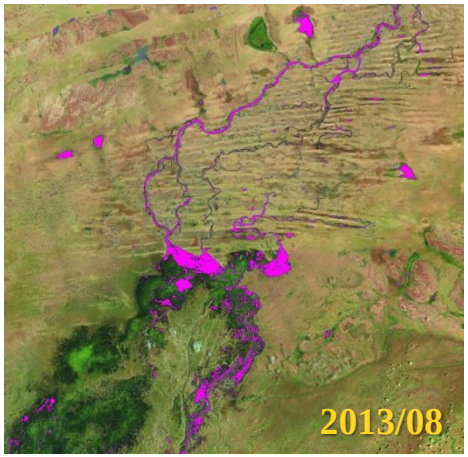
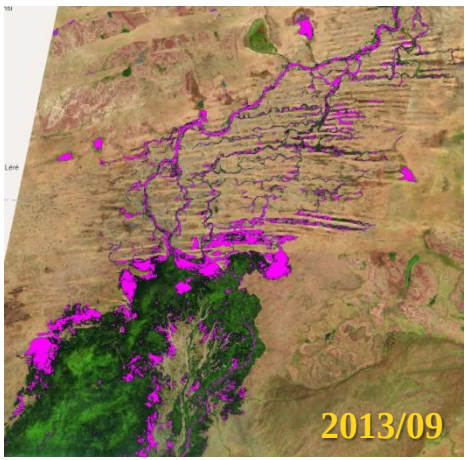
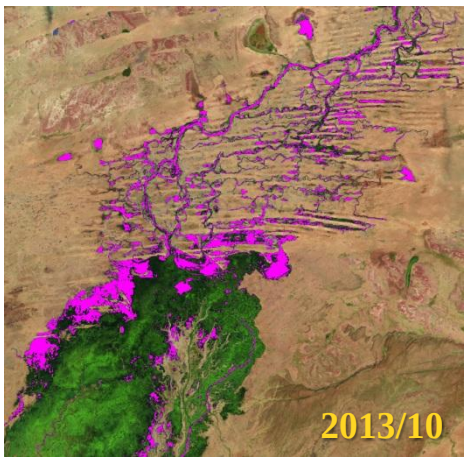
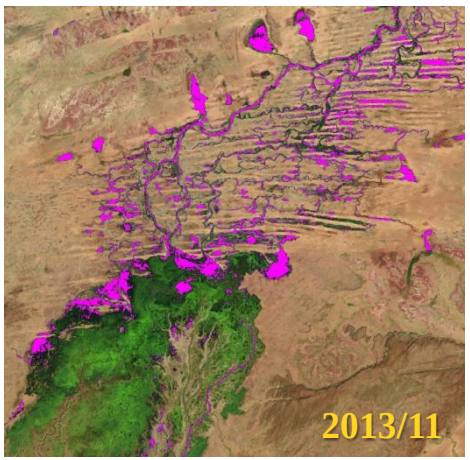
Monthly, 16 days, 8 days Water Maps

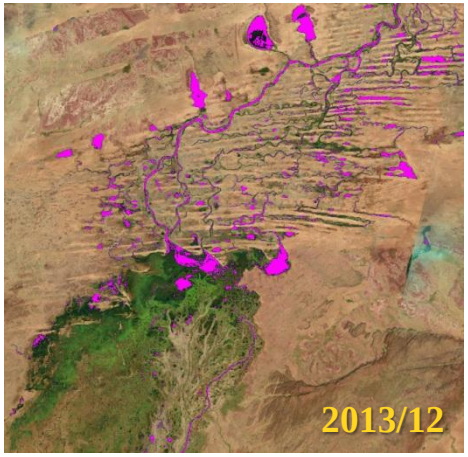
Providing on a per-pixel basis, the areas covered by water (in pink)

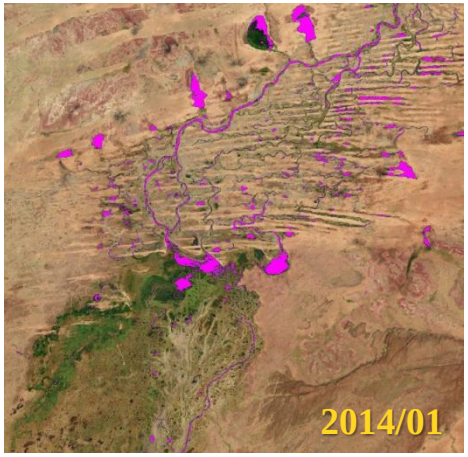


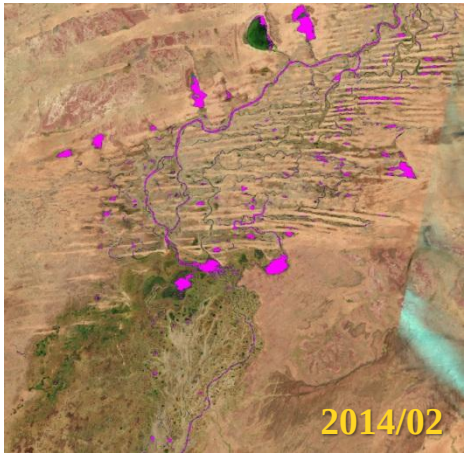


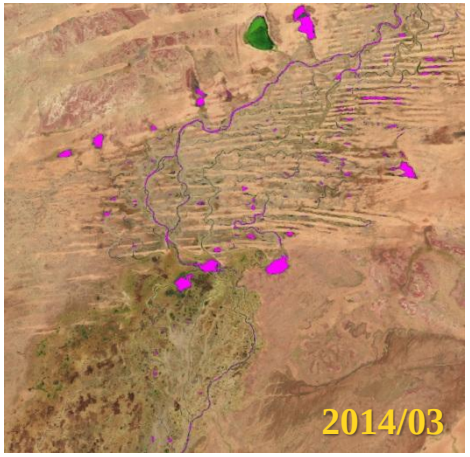












Mali, the Inland Niger Delta

40 km

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Inter and intra-annual variation:

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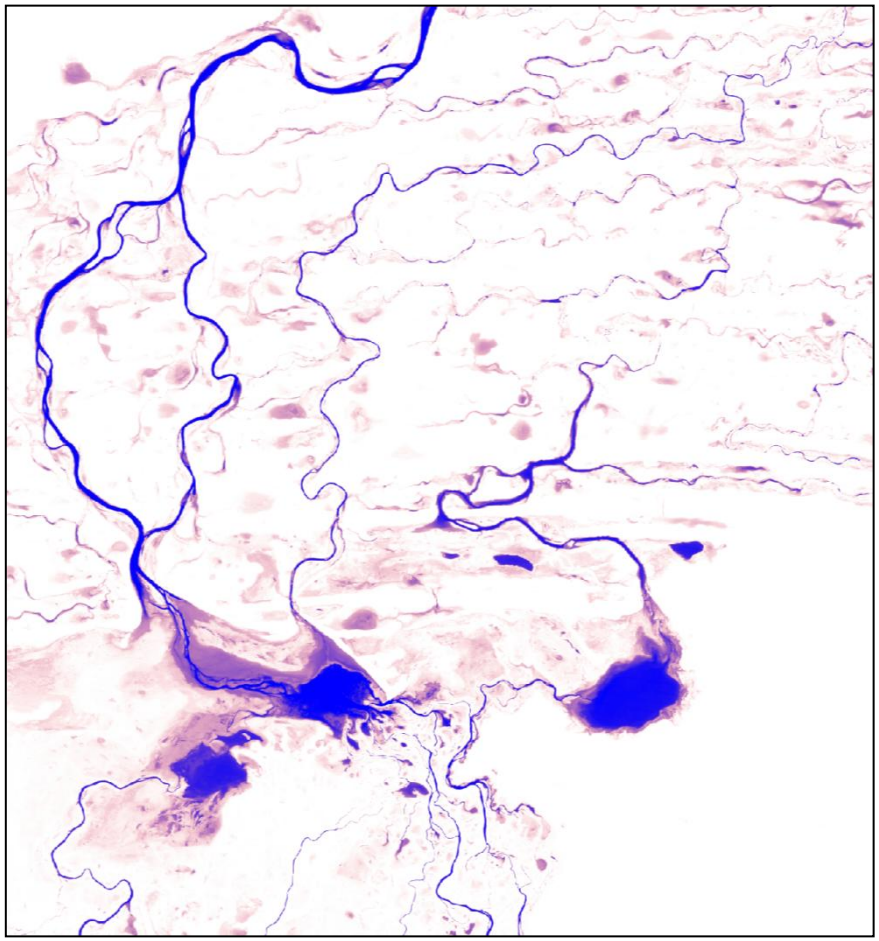
Annual / Multiannual Occurrence Maps

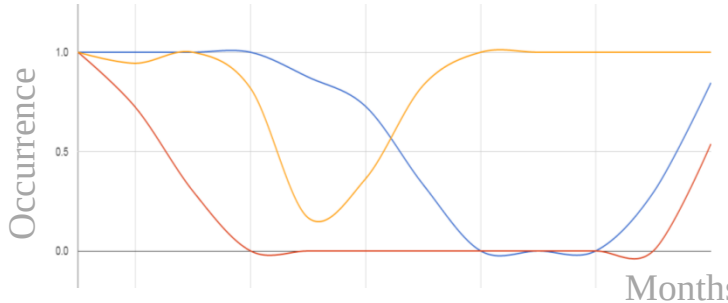
Record, on a per-pixel basis, the time period (%) during which the ground surface is detected as water.



Thanks to a single product, the user knows :

- The water dynamic in both space and time
- The permanent water areas (annual/multiannual base)
- The occurrence of the seasonal water areas
- The current situation vs the past.

& Temporal profile (LT and Current)



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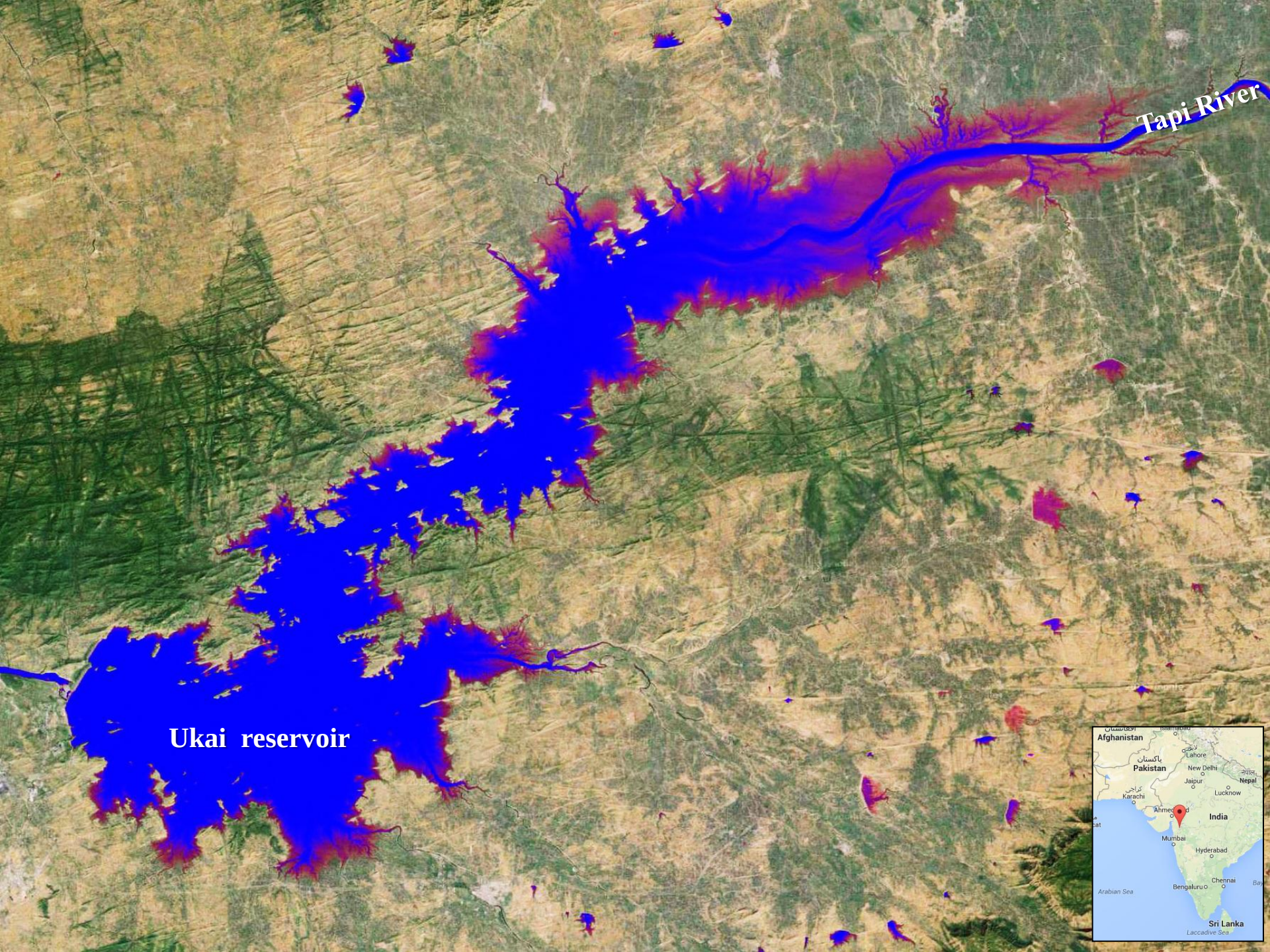
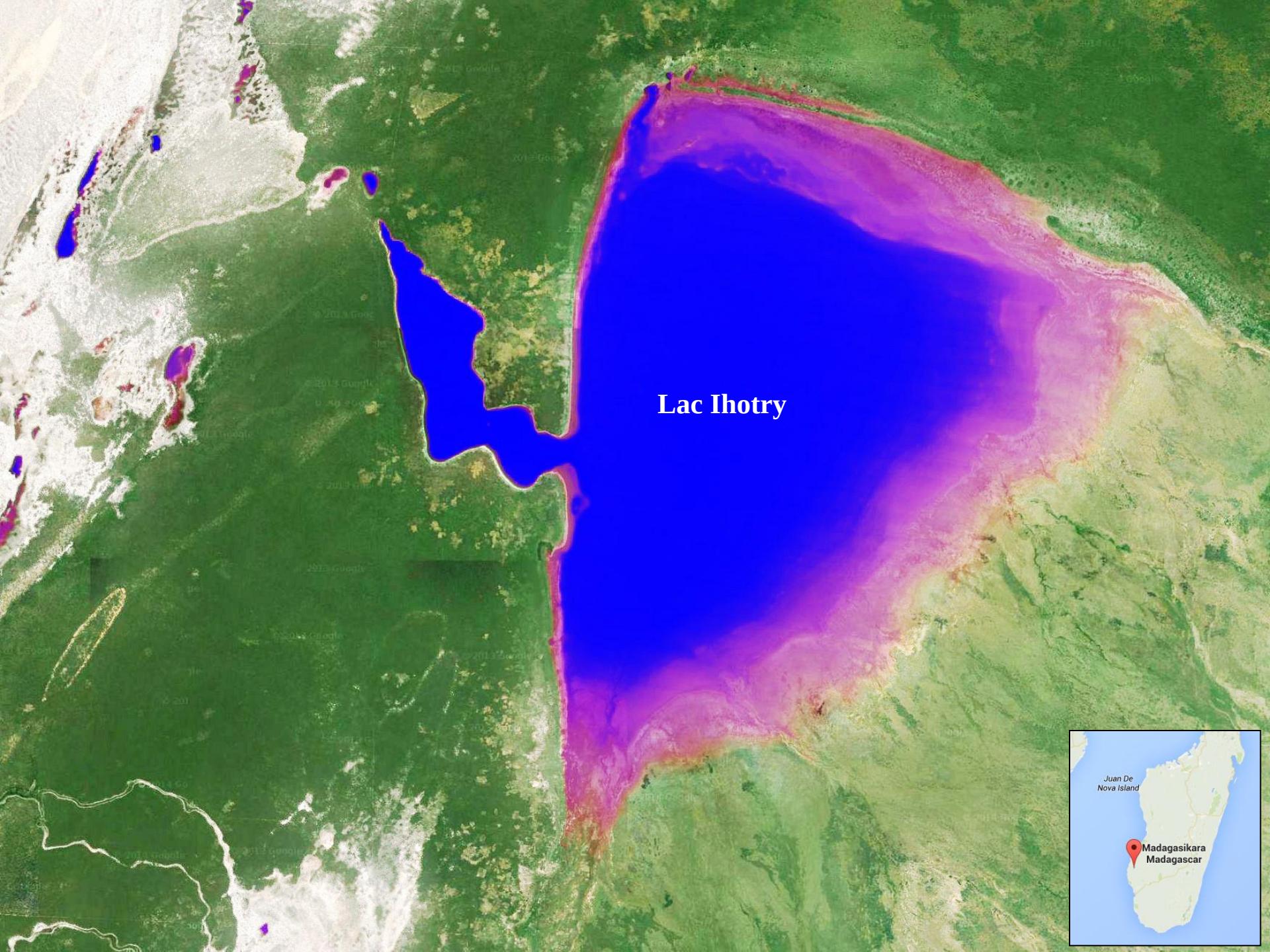
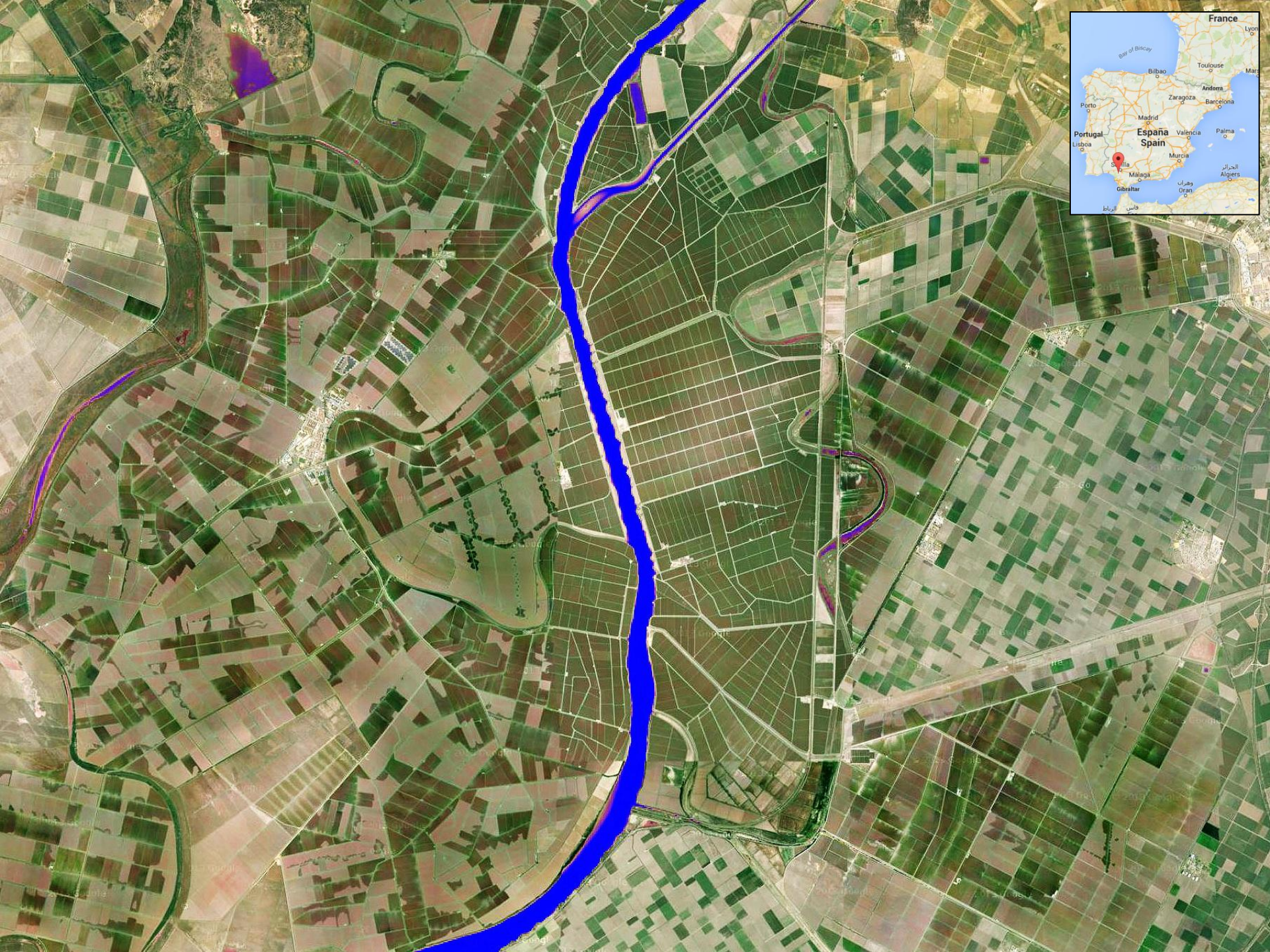
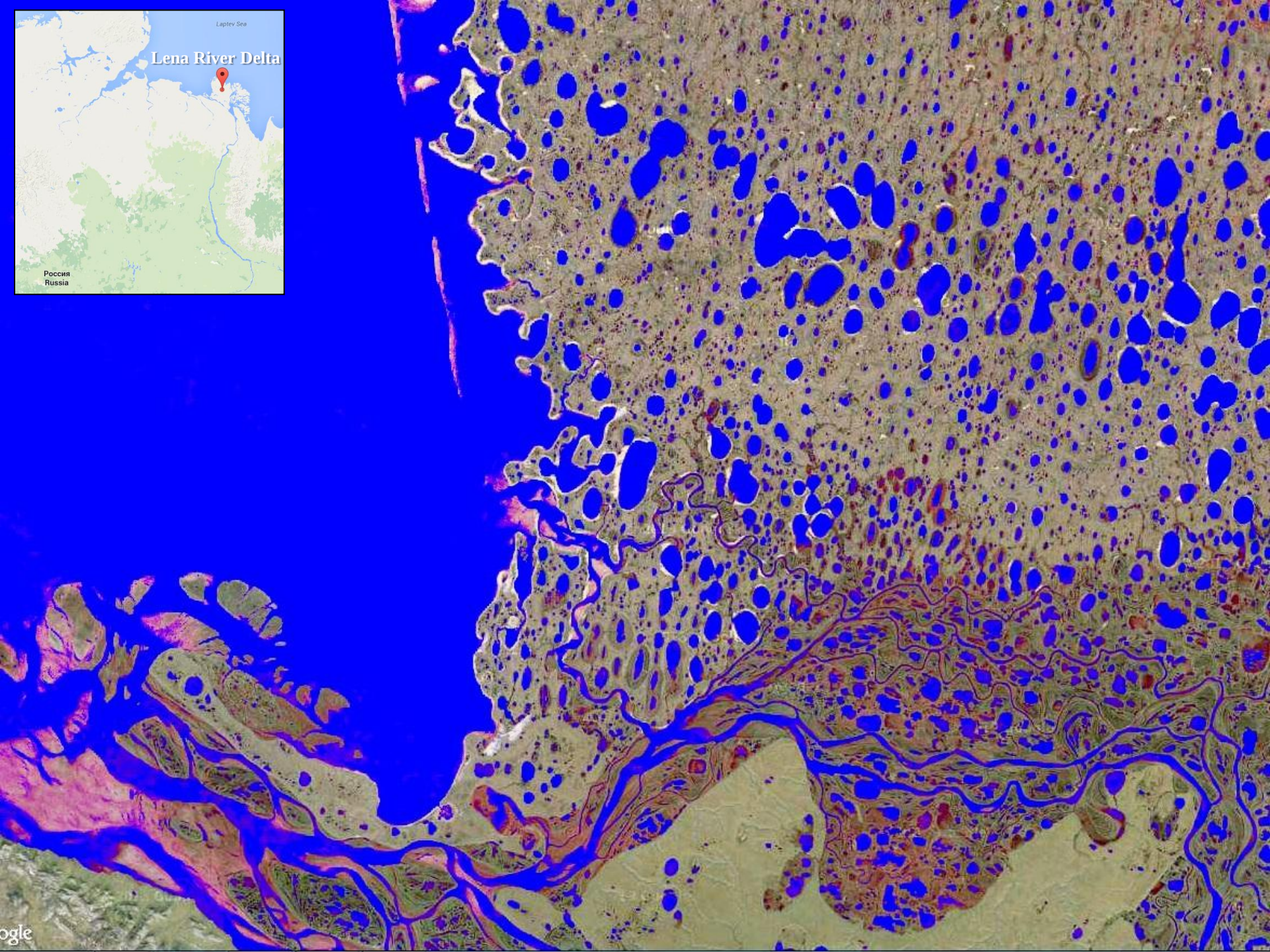
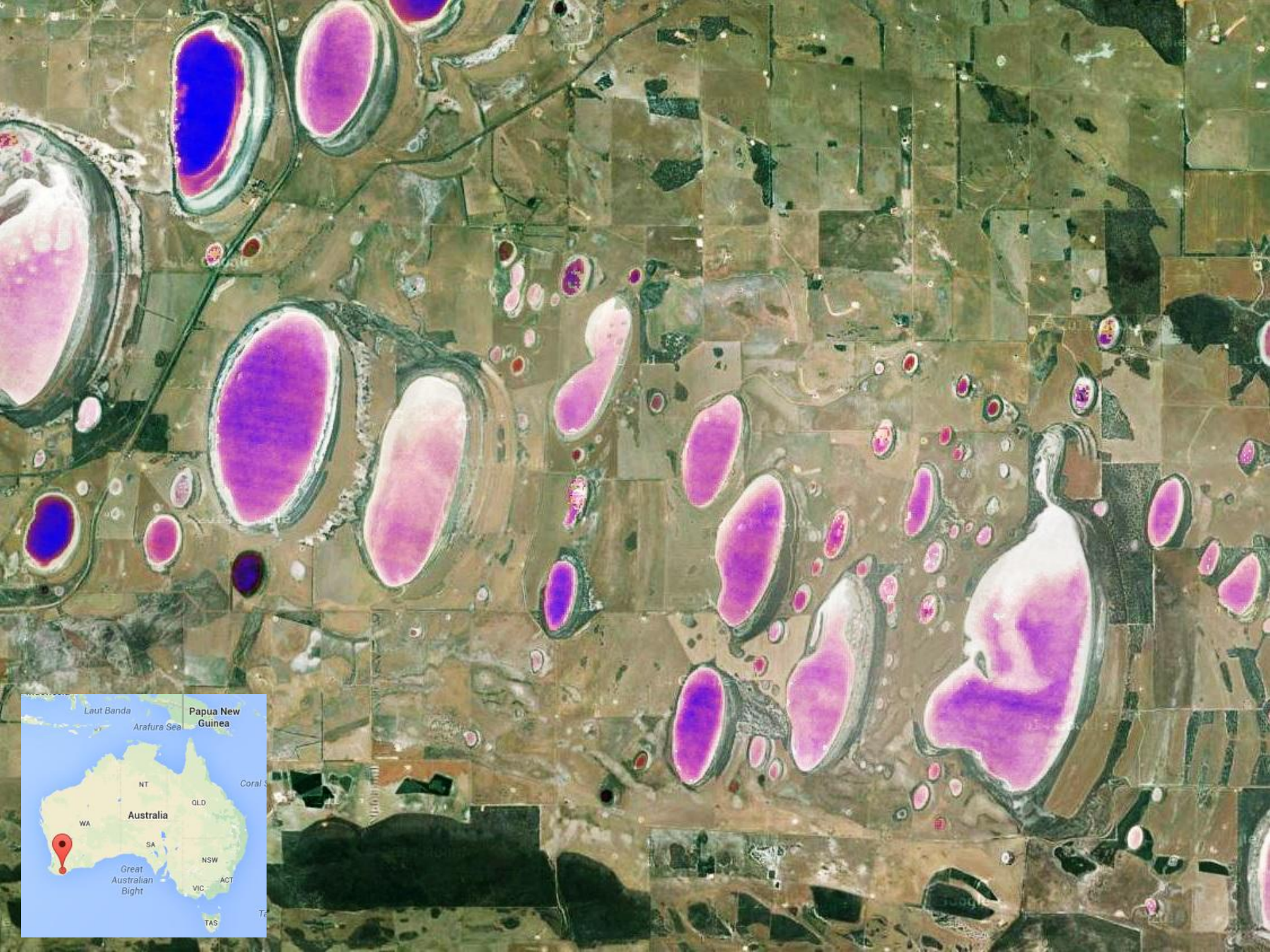

Tapi River
Ukai reservoir
Afghanistan
Pakistan
Lahore
New Delhi
Nepal
Jaipur
Lucknow
Karachi
India
Mumbai
Hyderabad
Chennai
Bengaluru
Arabian Sea
Sri Lanka


Lac Ihotry
Juan De
Nova Island
Madagasikara
Madagascar

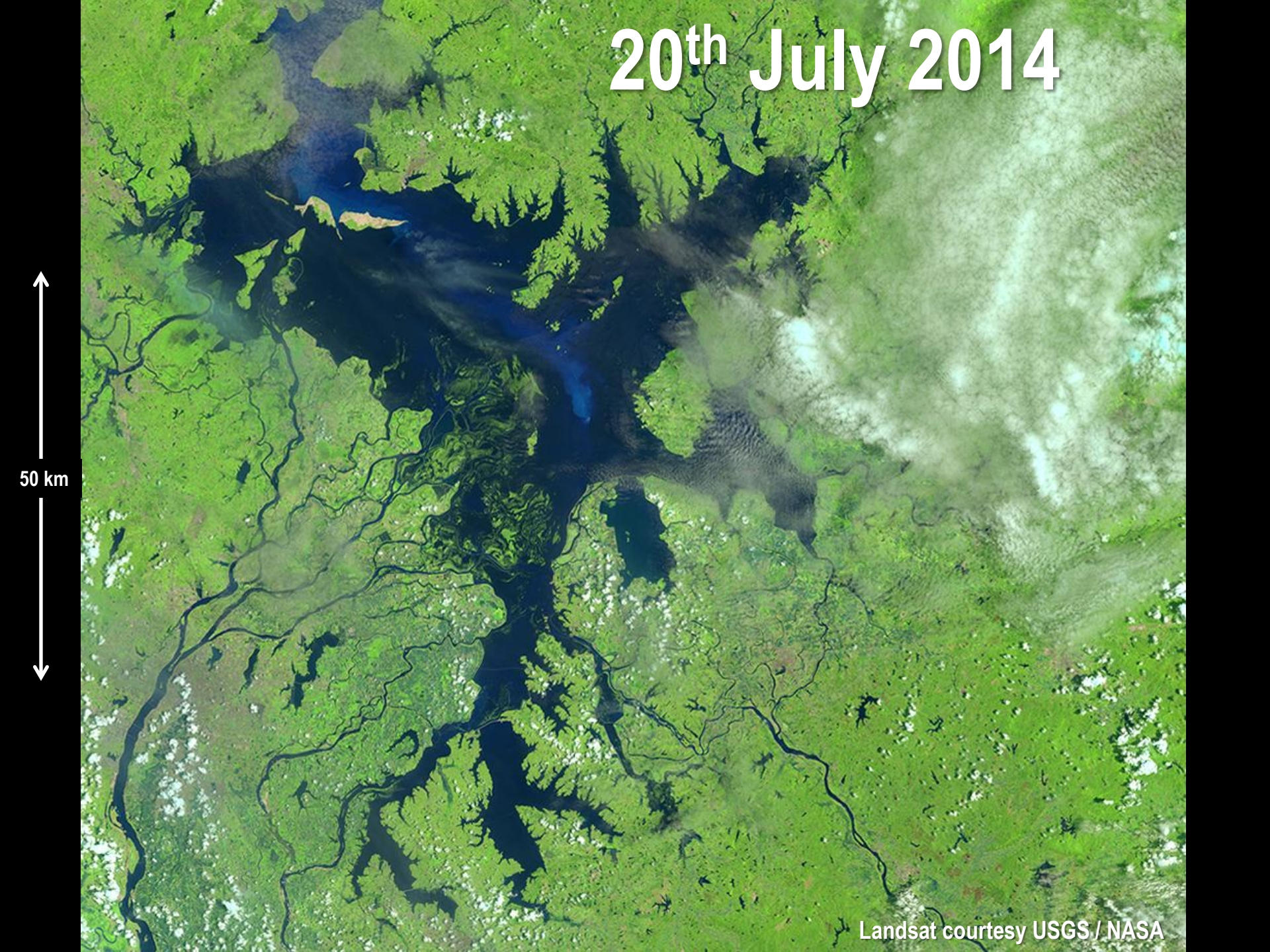

France
Lyon
Bay of Biscay
Bilbao
Toulouse
Andorra
Zaragoza
Barcelona
Porto
Madrid
Portugal
España
Spain
Valencia
Palma
Lisboa
Murcia
Malaga
Gibraltar
Oran
Algiers

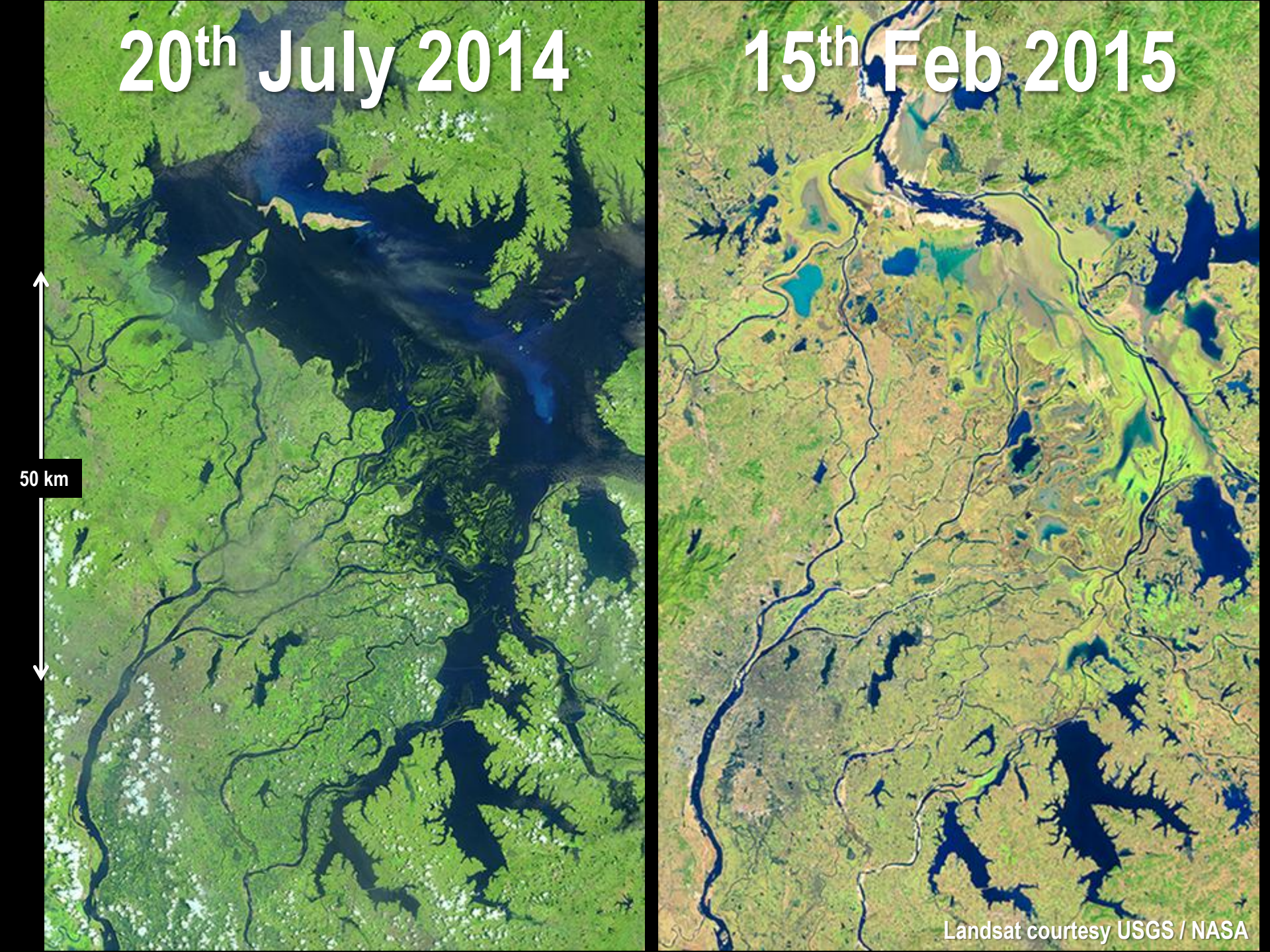

Paddy fields
France
Bay of Biscay
Bilbao
Toulouse
Andorra
Zaragoza
Barcelona
Porto
Madrid
Portugal
España
Spain
Valencia
Palma
Lisboa
Murcia
Malaga
Gibraltar
Oran
Algiers

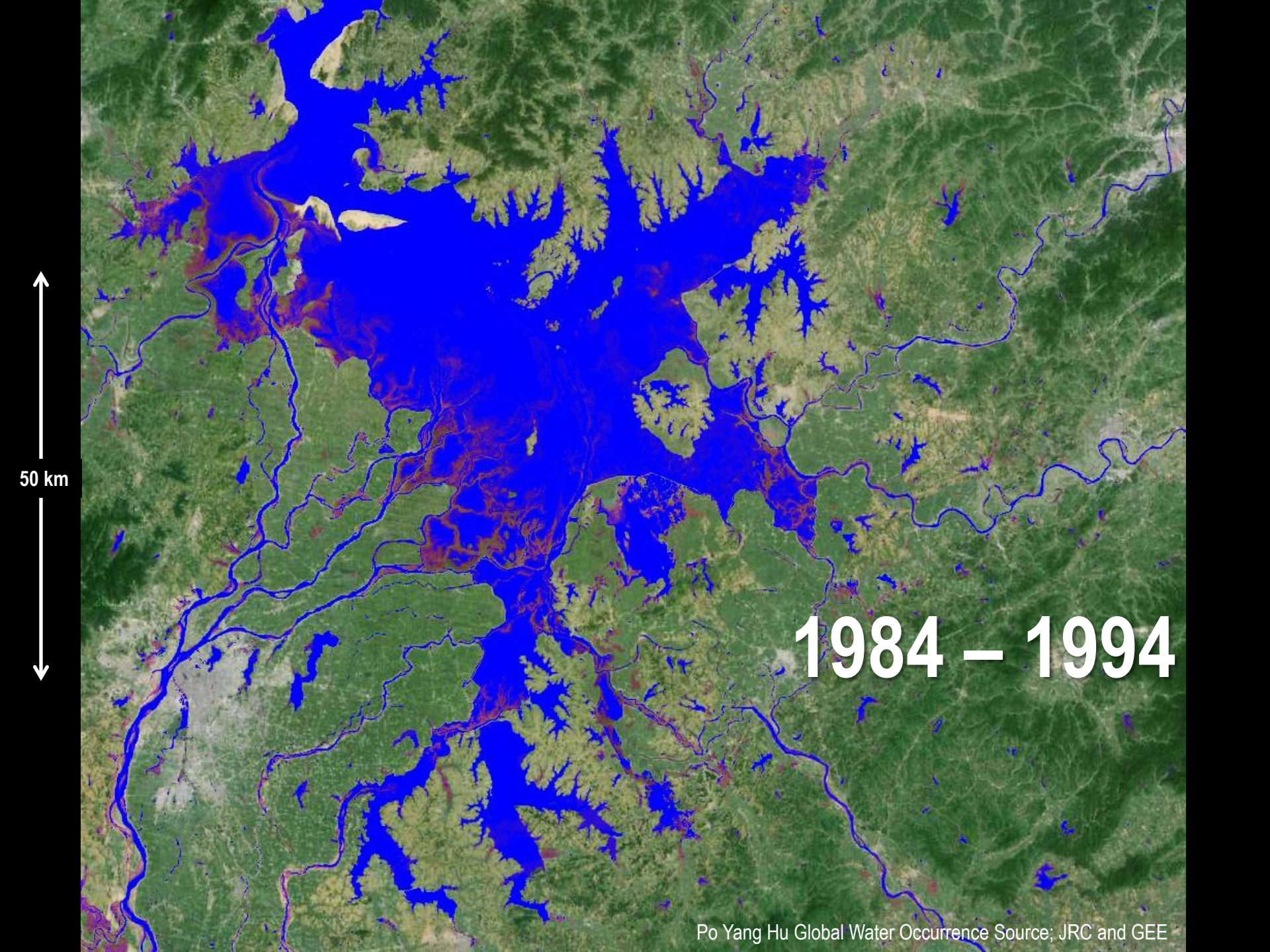

Laptev Sea
Lena River Delta
Россия
Russia

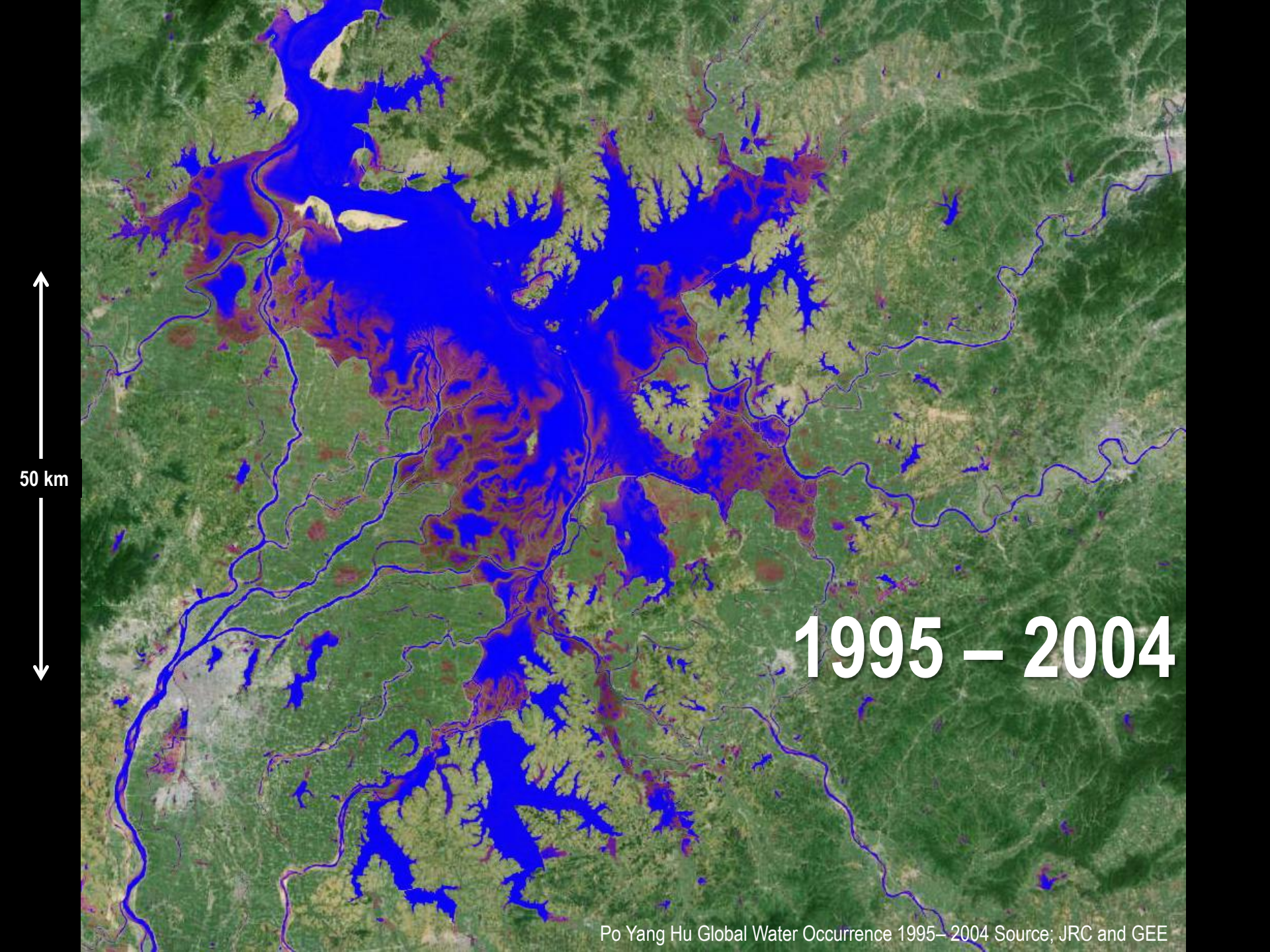

Laut Banda
Arafura Sea
Papua New Guinea
NT
QLD
Australia
WA
SA
NSW
Great Australian Bight
VIC
ACT
TAS


15th July 1989
Po Yang Hu
50 km
中国
China
成都
Chengdu
重庆
Chongqing
南京
上海
Shanghai
杭州
Hangzhou
广州
Guangzhou
台灣
Taiwan
Hà Nội
香港
Hong Kong
Laos
Landsat courtesy USGS / NASA

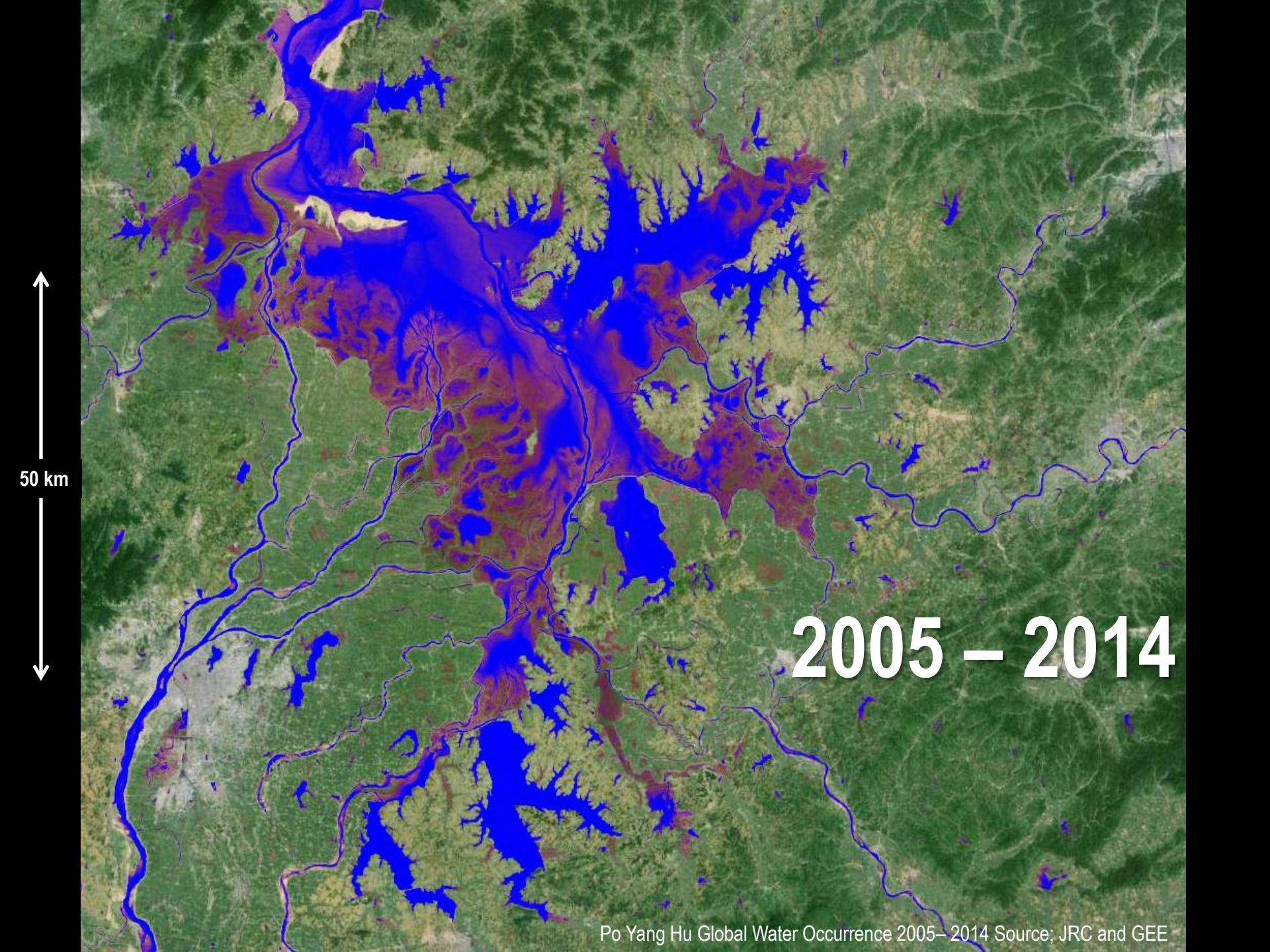

20th July 2014
50 km
Landsat courtesy USGS / NASA


20th July 2014
15th Feb 2015
50 km
Landsat courtesy USGS / NASA

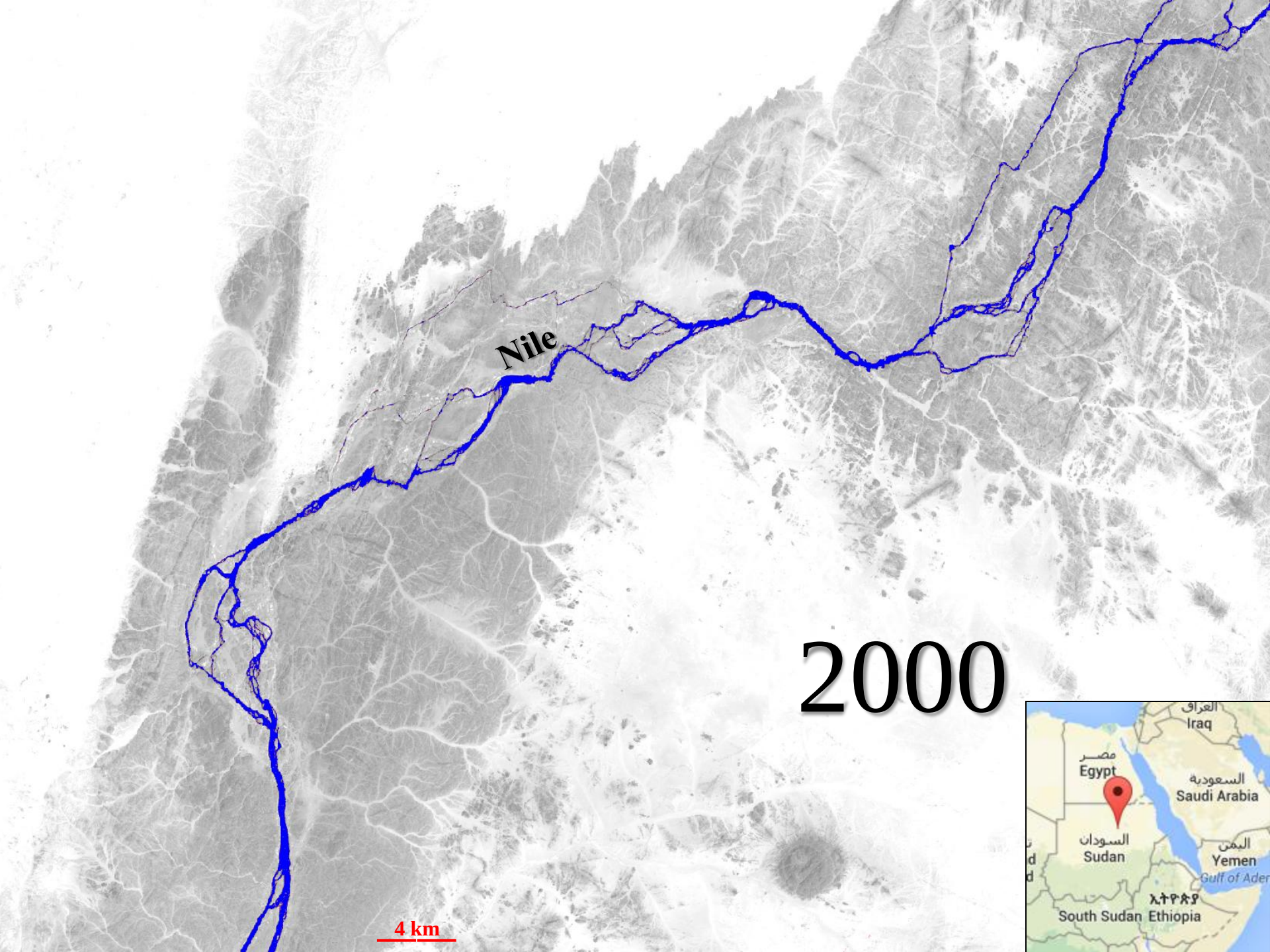

50 km
1984 – 1994
Po Yang Hu Global Water Occurrence Source; JRC and GEE

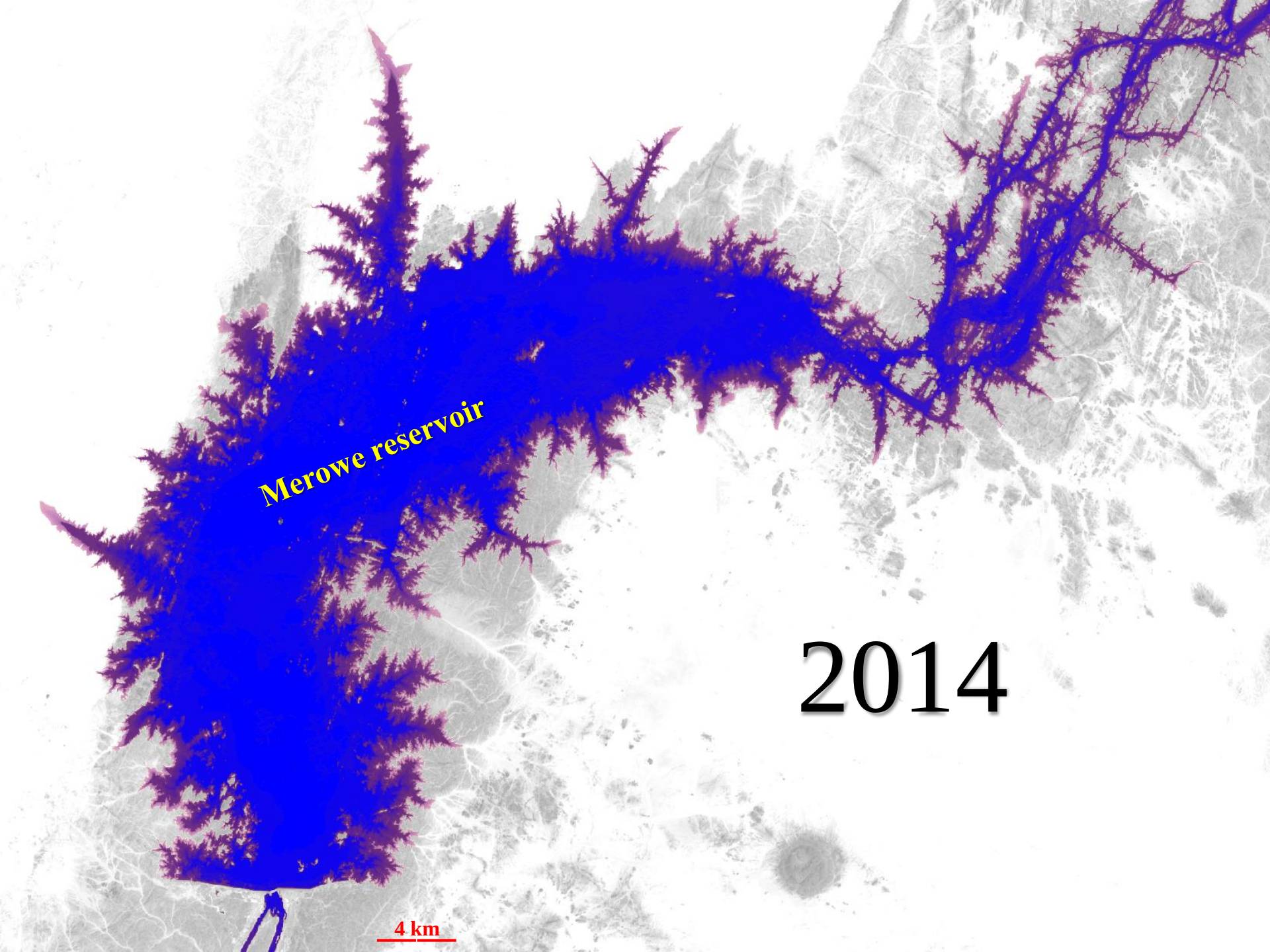


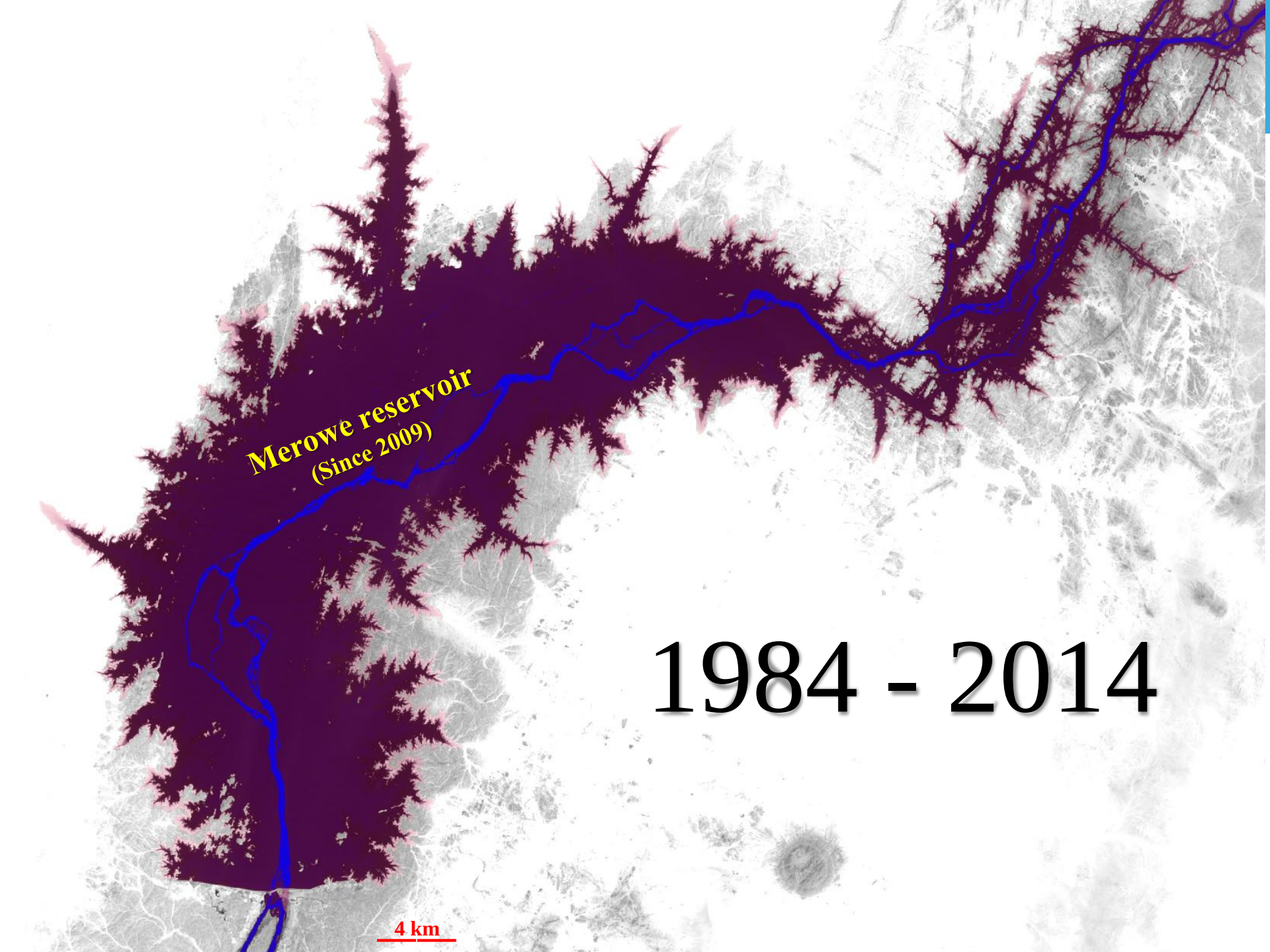
Po Yang Hu Global Water Occurrence 1995– 2004 Source; JRC and GEE



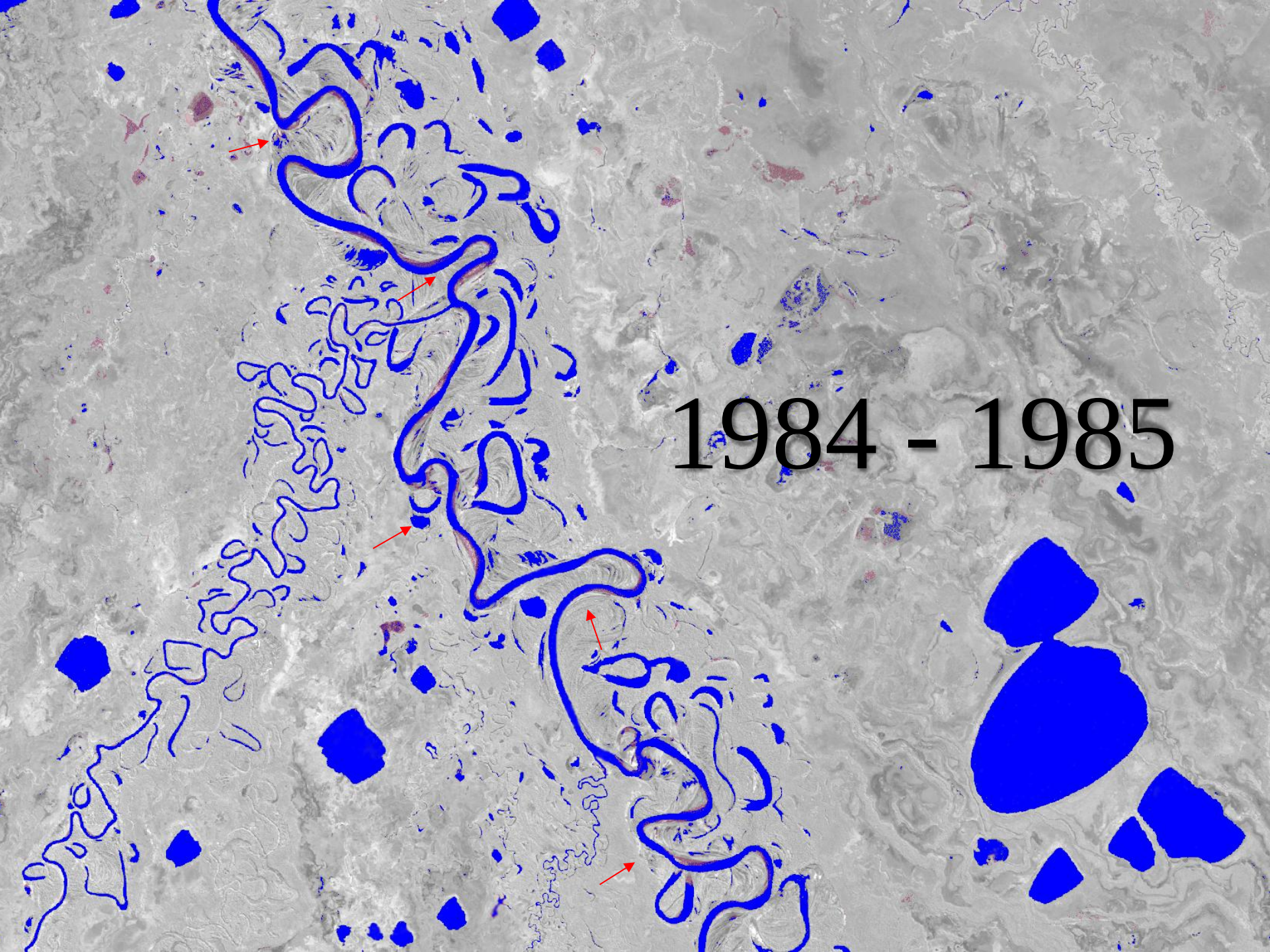
Po Yang Hu Global Water Occurrence 2005– 2014 Source; JRC and GEE

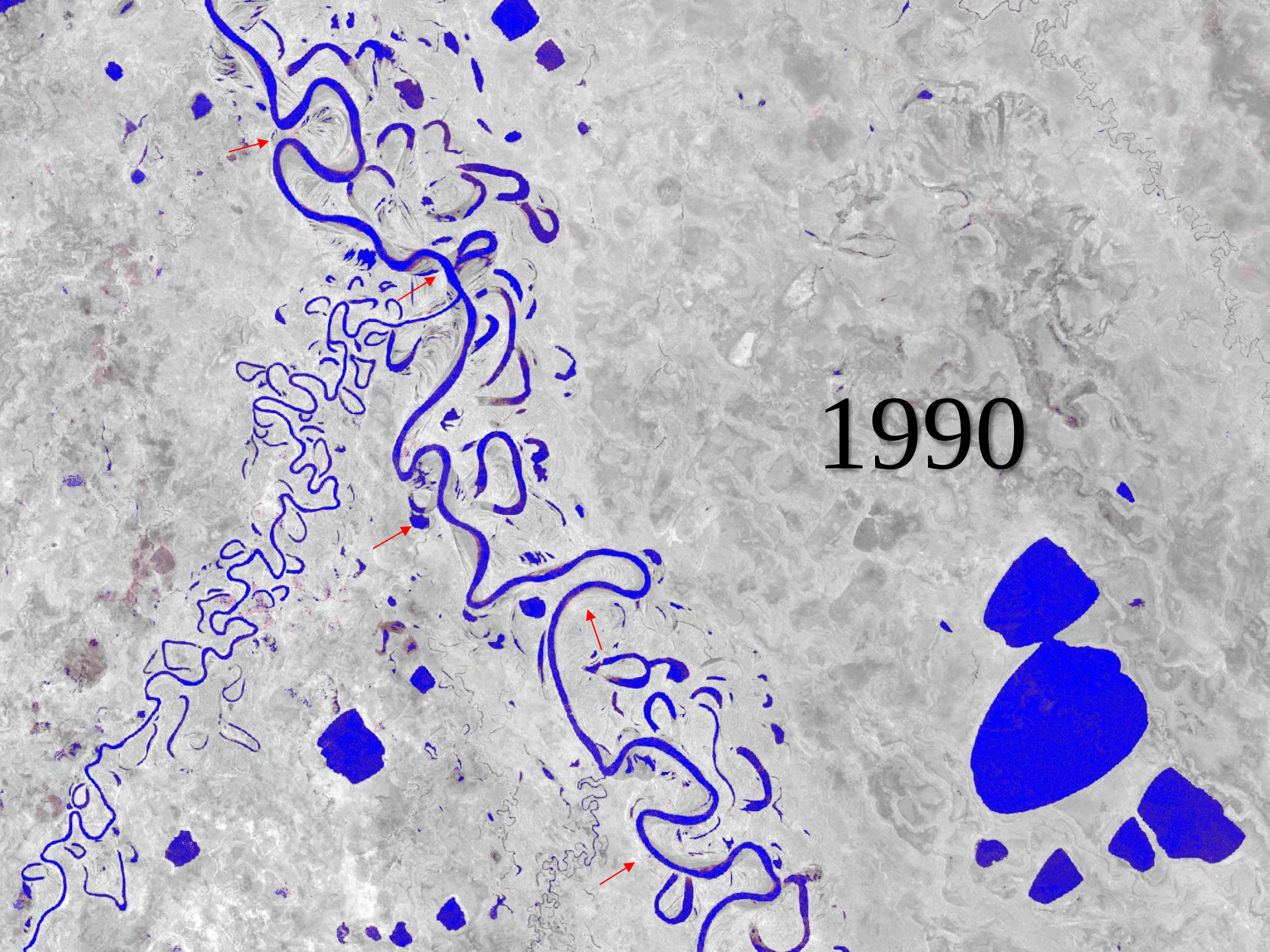

Nile
2000
4 km
العراق
Iraq
مصر
Egypt
السعودية
Saudi Arabia
السودان
Sudan
اليمن
Yemen
Gulf of Aden
South Sudan
ኢትዮጵያ
Ethiopia

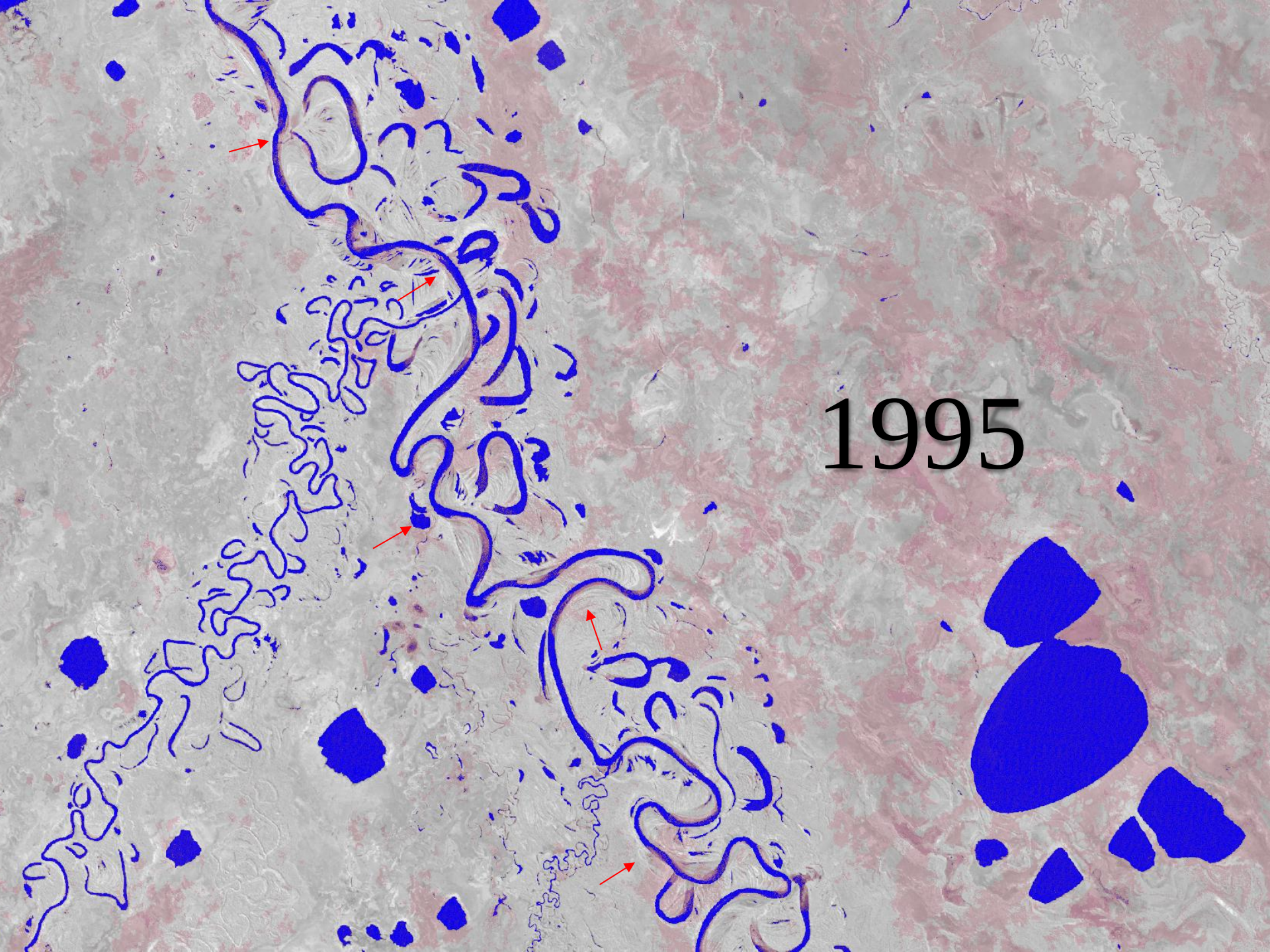

Merowe reservoir
2014
4 km

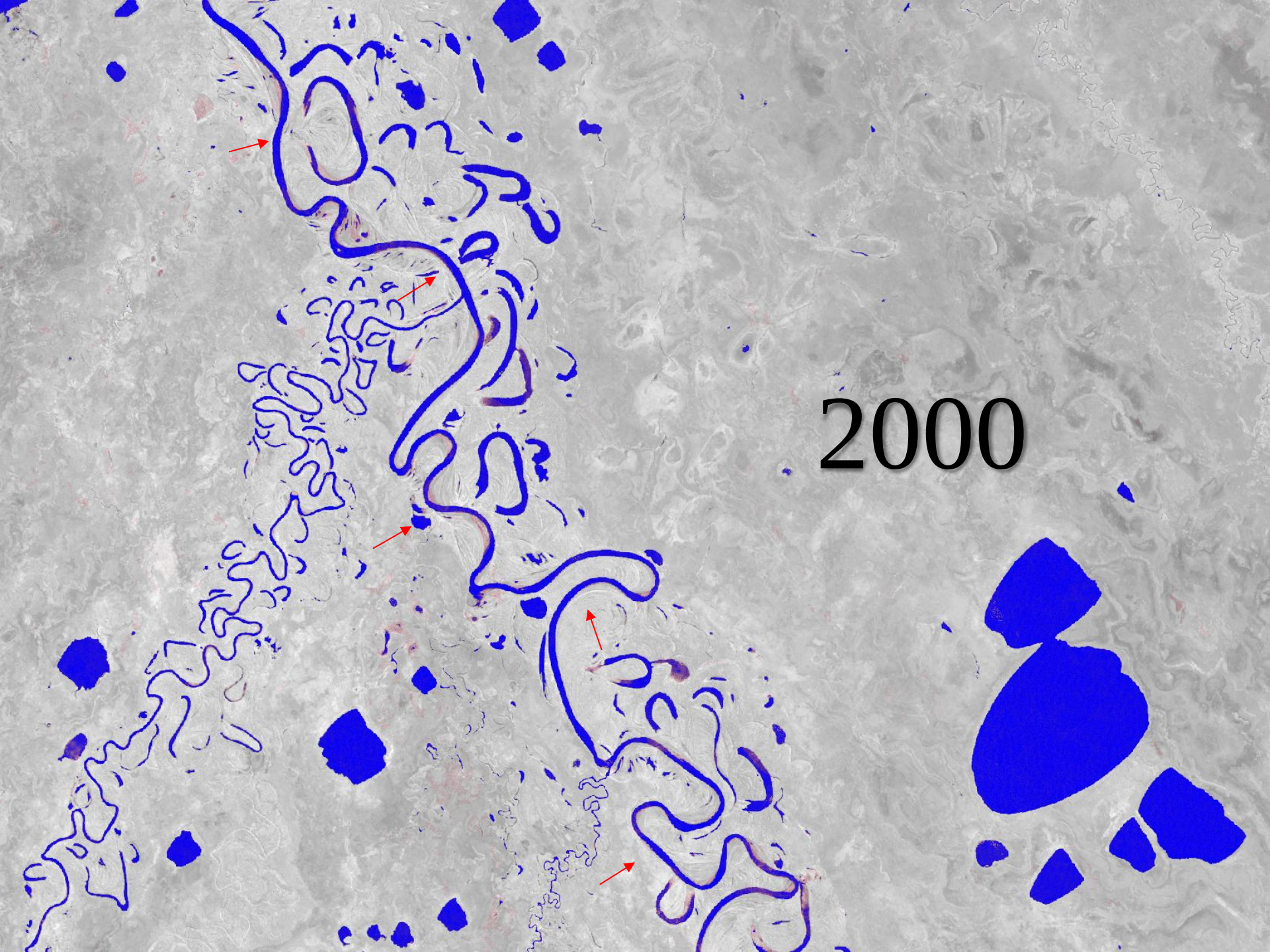

Merowe reservoir
(Since 2009)
1984 - 2014
4 km

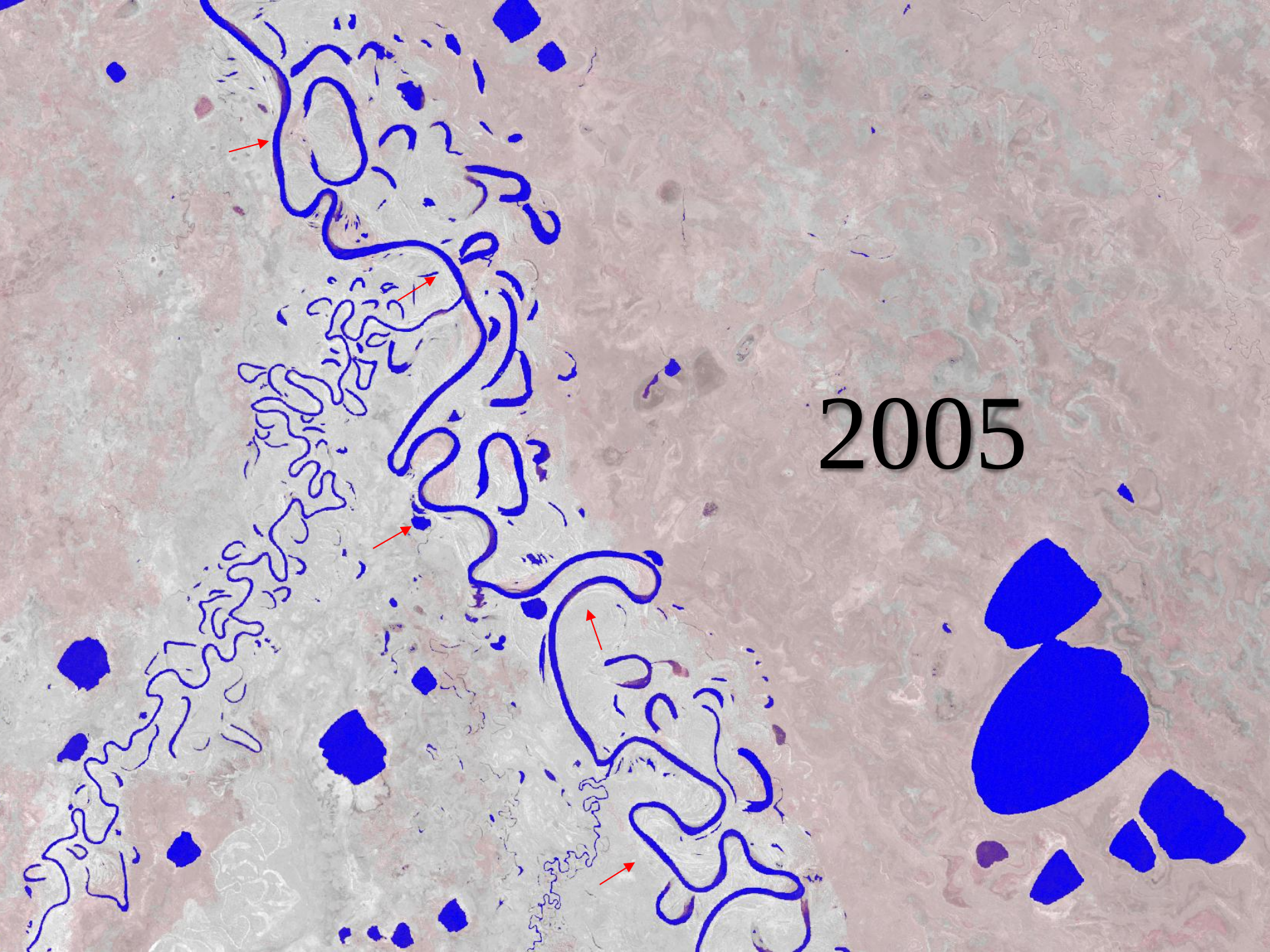
Bolivian River's Timelaps 1984 to 2014

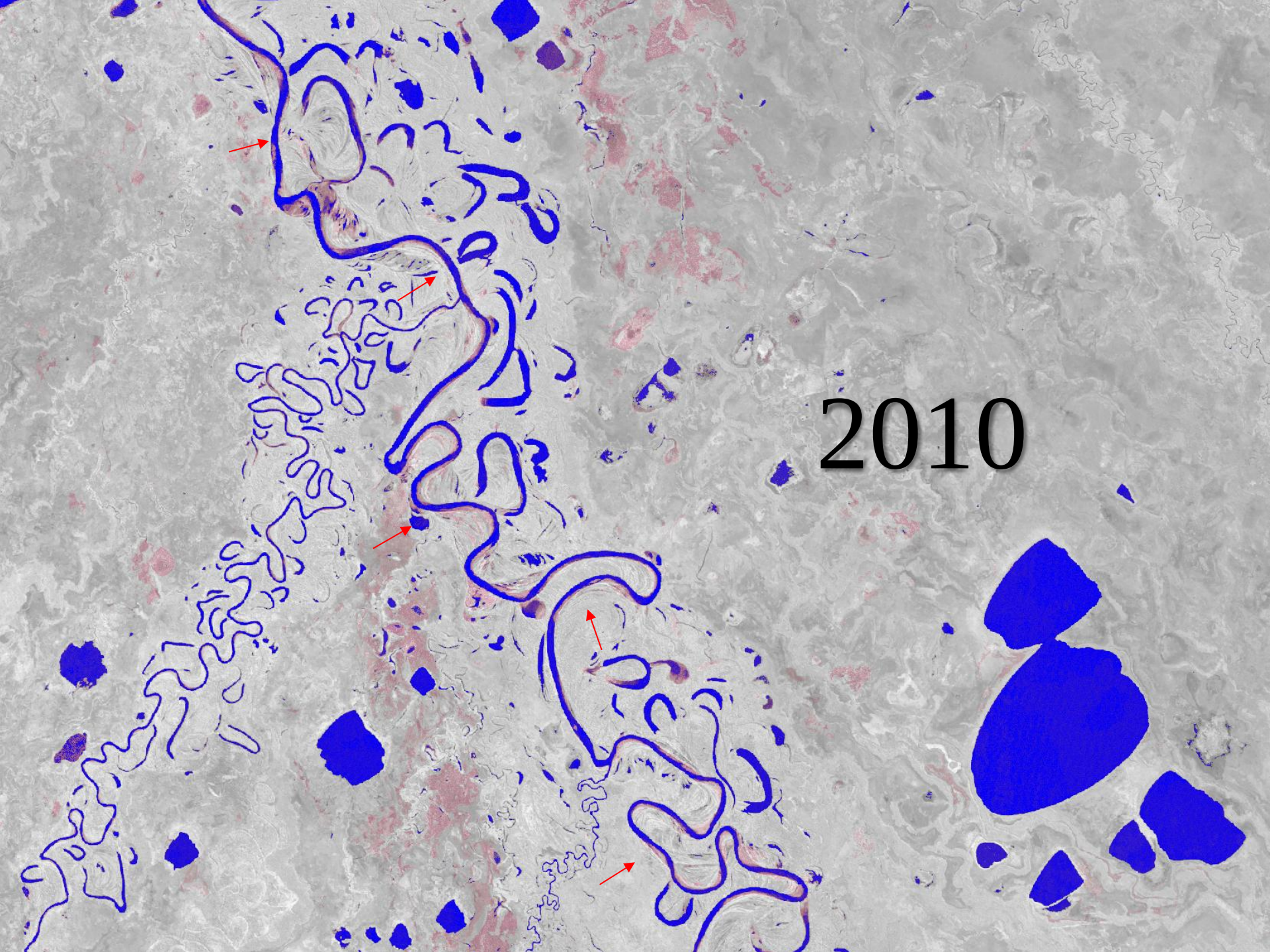

1984 - 1985

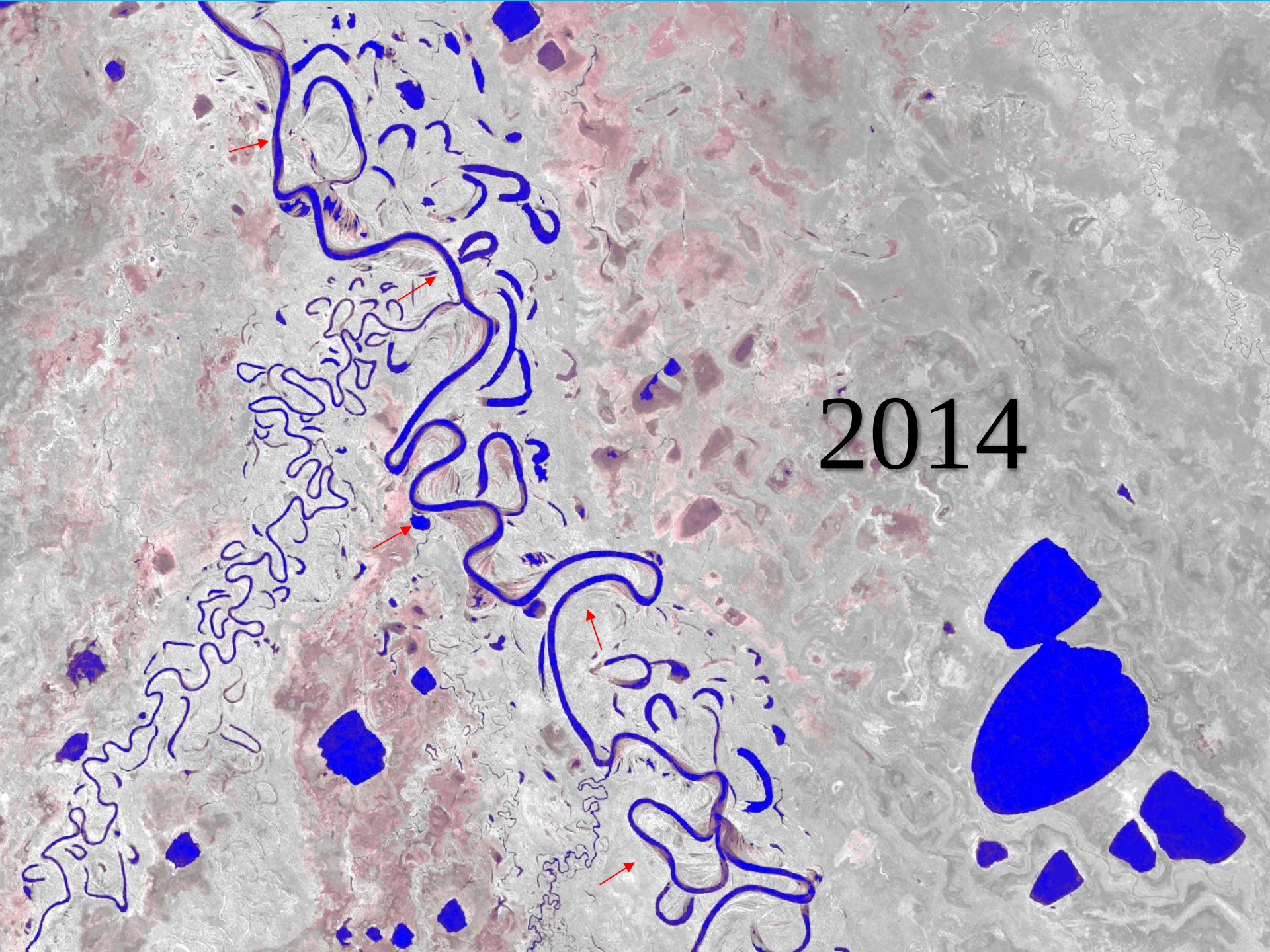

1990


1995


2000


2005


2010


2014

Louisiana Coastline Timelaps 1984 to 2014


1984-1985


1990


1995


2000


2005

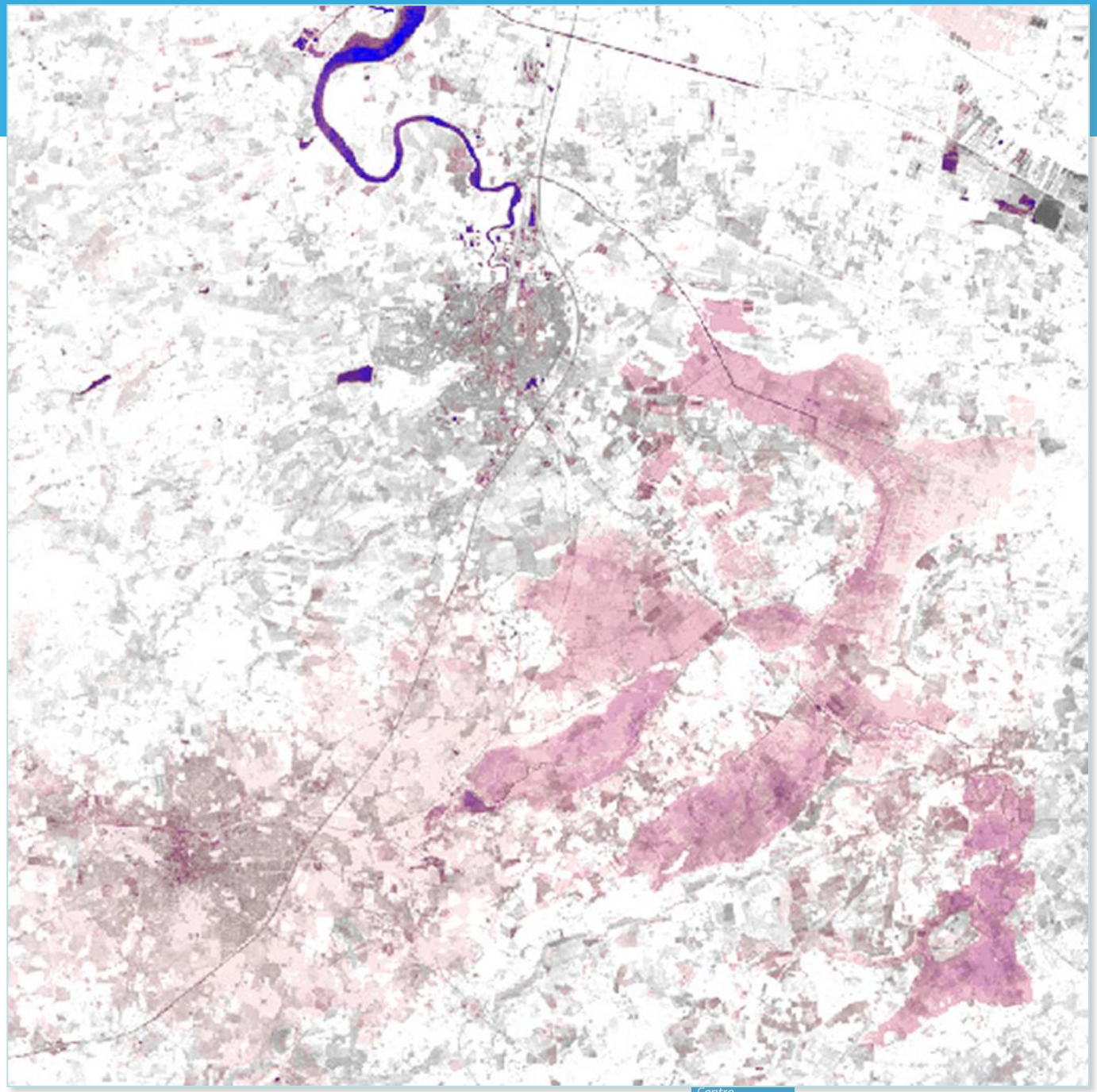

2010

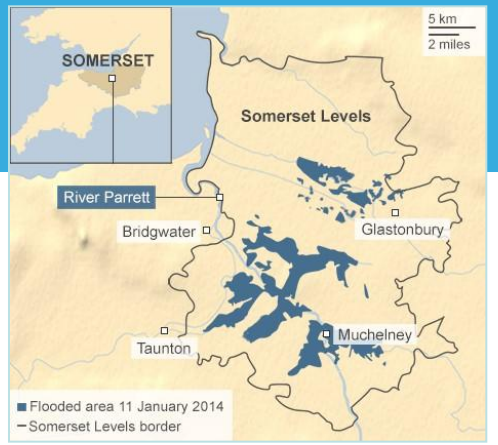

2014


Wax Lake Pass
Lake Salve
Sweetbay Lake
Shell Island Pass
Lake Gascha
Atchafalaya River
Bayou Sale Bay
Belle Isle Lake
Atchafalaya River
Atchafalaya Bay
Fourleague Bay
Lake Chapeau
Coastline erosion


1984-1986
Coastline erosion


2014
Coastline erosion





Somerset levels (UK)
Source*: Flood Map and in situ photo (BBC News), Water Occurrence (JRC / GEE)*

Conclusions

- A Global Water Surface Dynamic Mapping at 30m resolution is here
- Current overall accuracy > 90 %
- 30 years' global scale processing is ongoing thanks to Google Earth Engine
- Sensor neutral methodology
- Temporal resolution is still coarse, but data integration (e.g. Sentinel 2 A and B, Sentinel 1) will improve this (next step)
- Free and open access to the products

Products:

- Intra annual variation:
  - Monthly Maps
  - Occurrence Maps

- Inter annual variation:
  - Multiannual Monthly Occurrence Maps
  - Multiannual Occurrence Maps (computed based on X years periods / since 1984)
  - Anomaly Maps (Current situation vs Long Term)
  - Coastline Dynamic Map

- Near Real Time:
  - Dynamic Map updated every 8 or 16 days (foreseen over Africa + transfer via GEONETCast)

- ++++

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Thank you

Contact: jean-francois.pekel@jrc.ec.europa.eu

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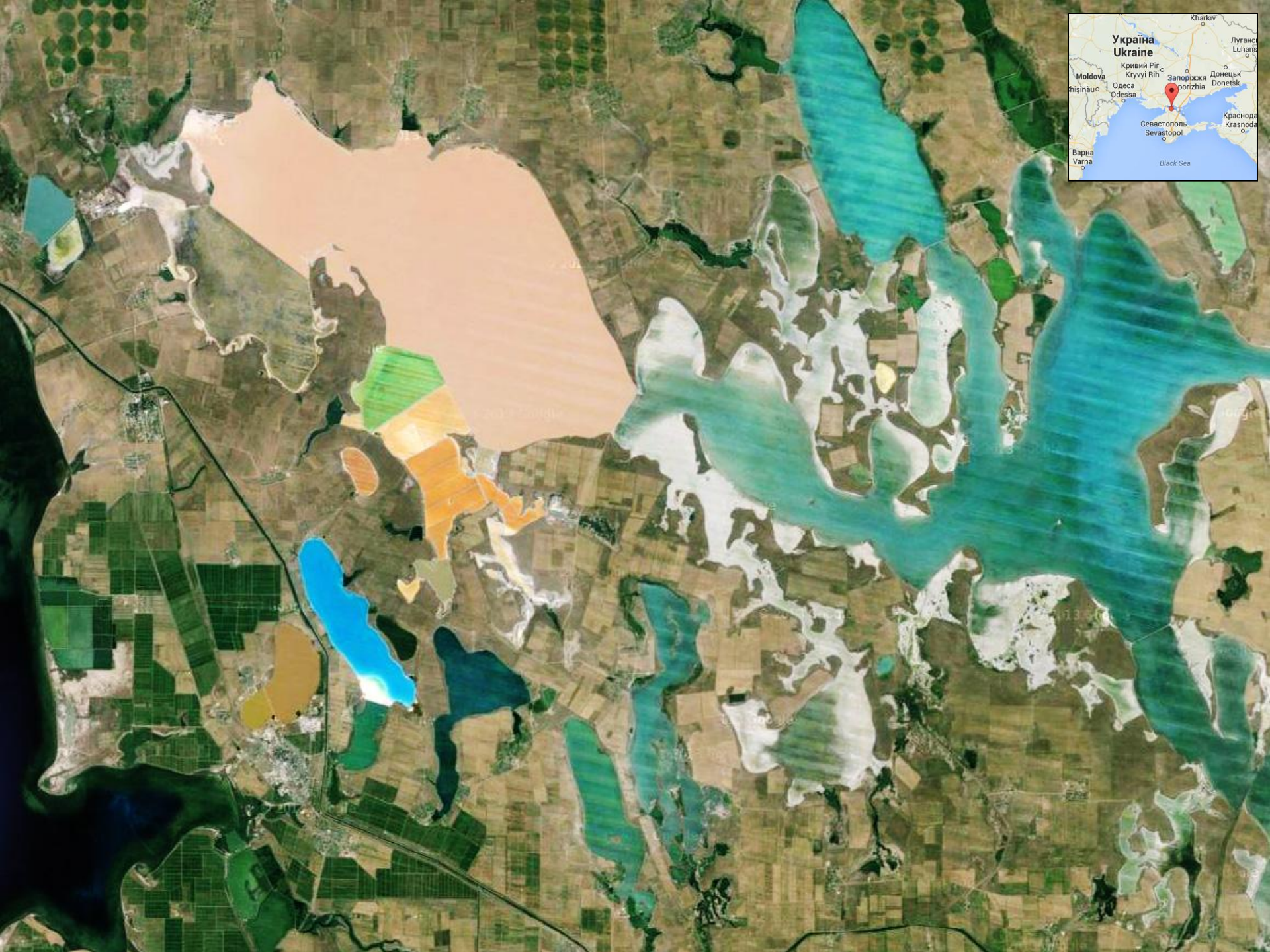
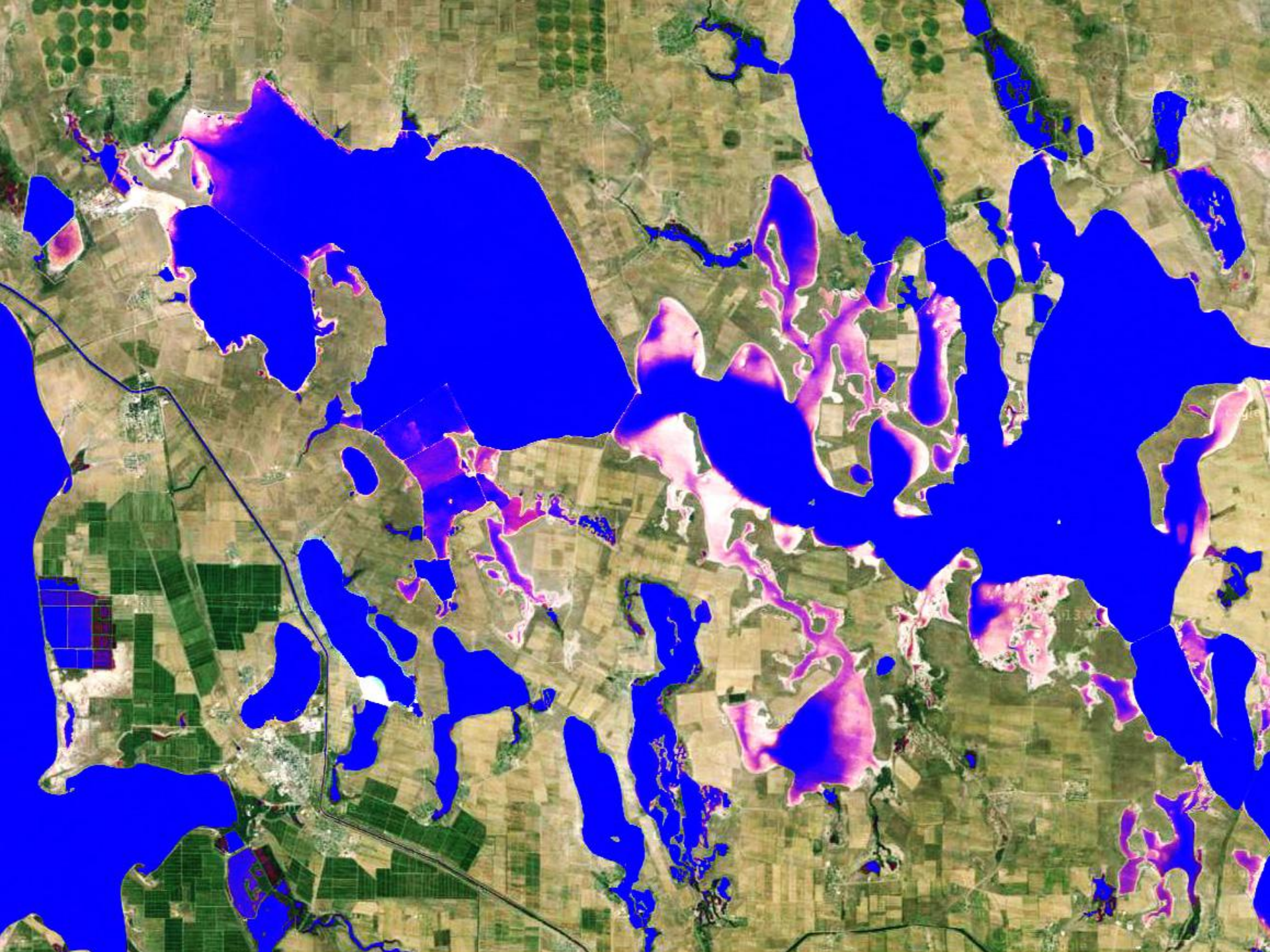
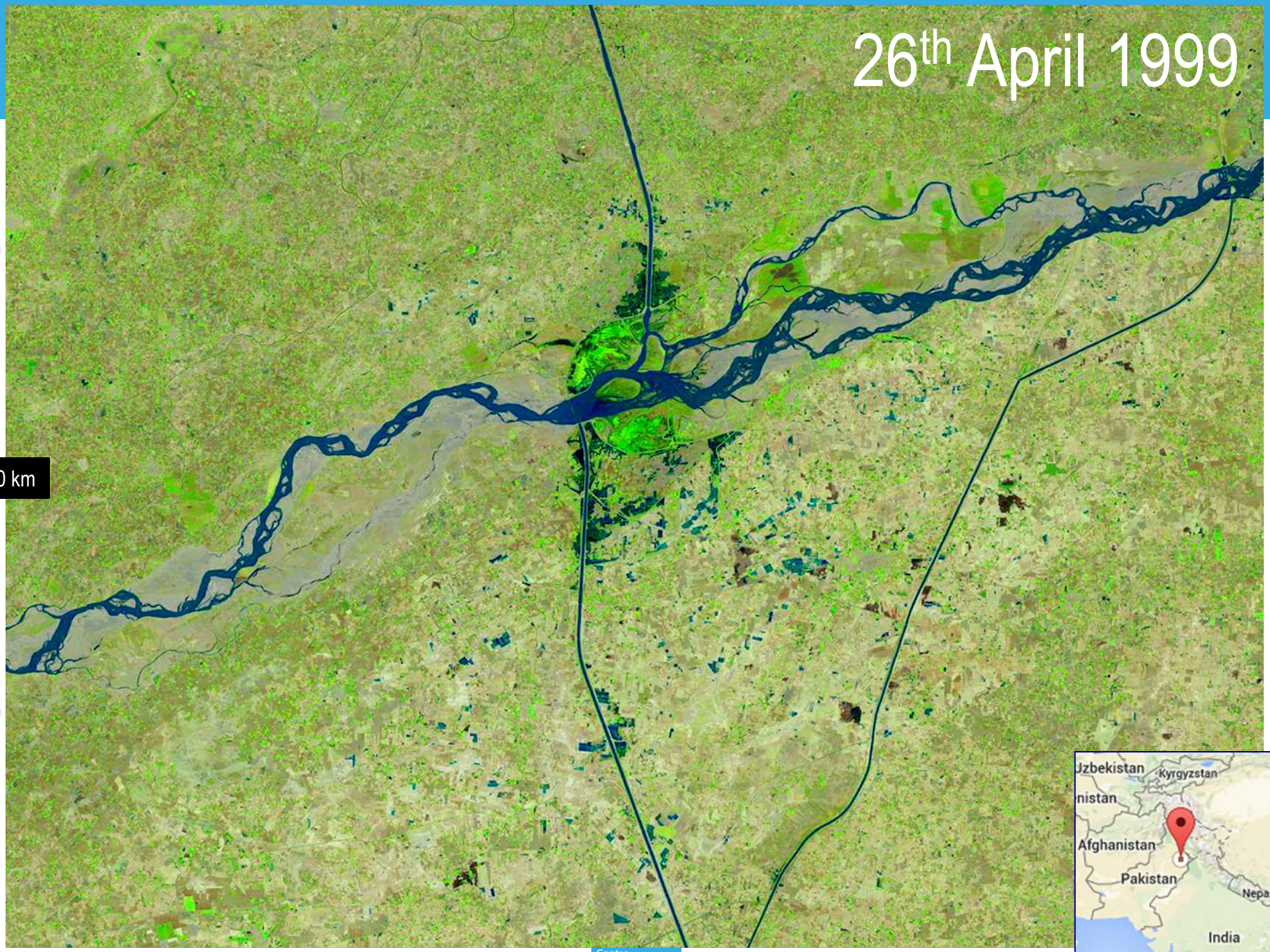
Additional examples…

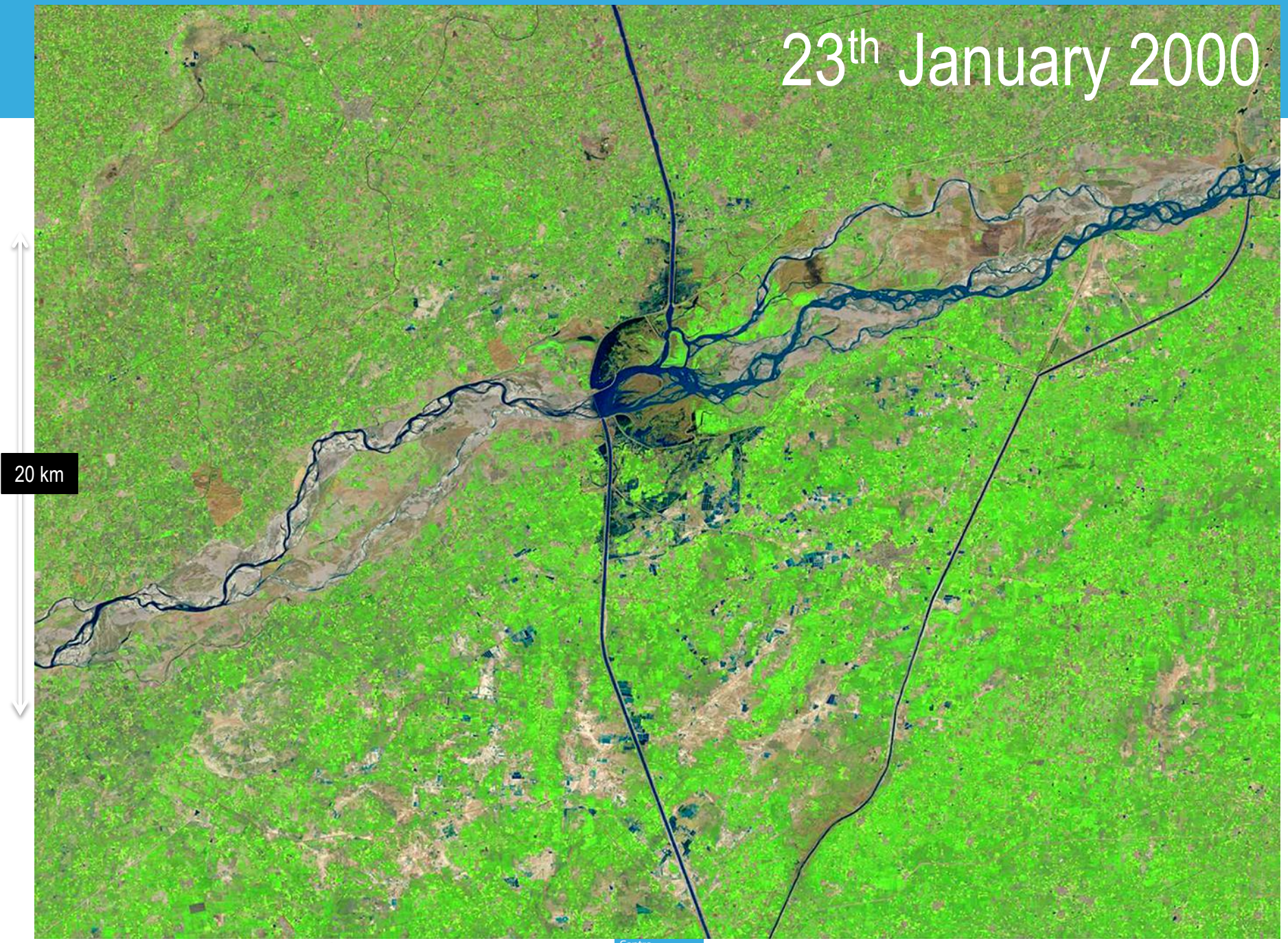

Україна
Ukraine
Kharkiv
Кривий Ріг
Kryvyi Rih
Moldova
Одеса
Odessa
Запоріжжя
Donetsk
Донецьк
Севастополь
Sevastopol
Краснода
Krasnoda
Варна
Varna
Black Sea



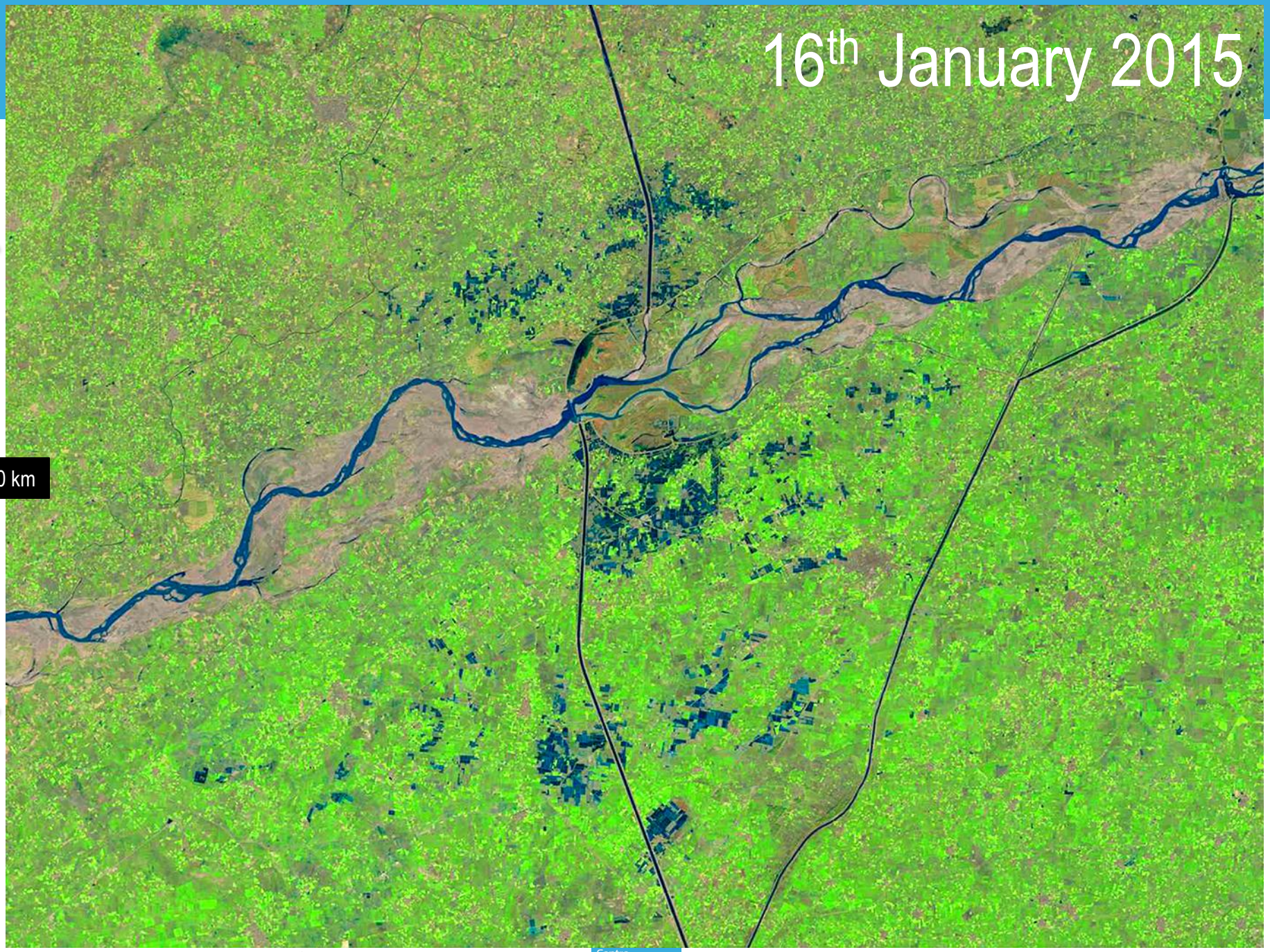
26th April 1999



23th January 2000

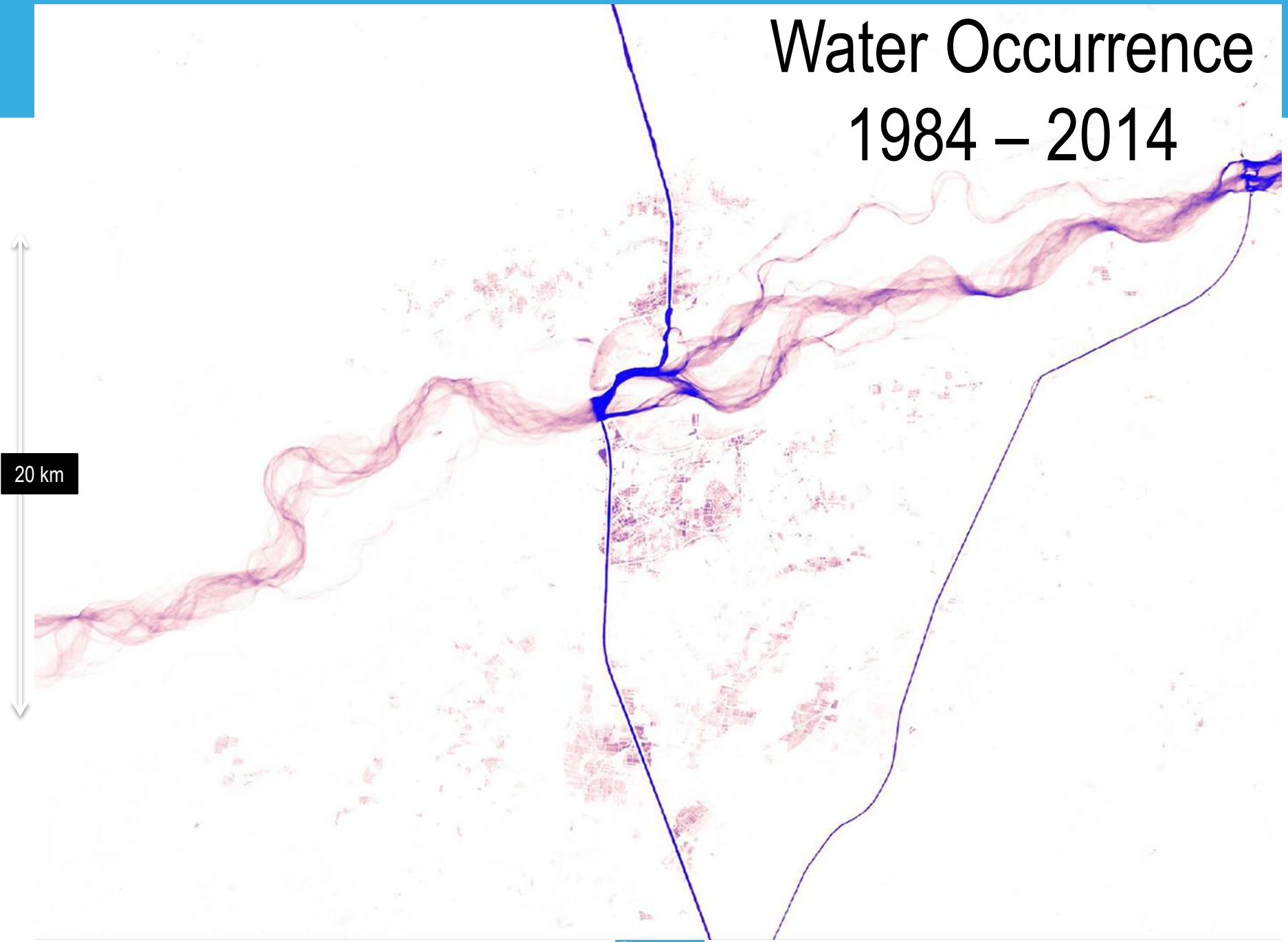


Qadirabad dam, River Chenab, Pakistan 23rd January 2000 Landsat courtesy USGS / NASA

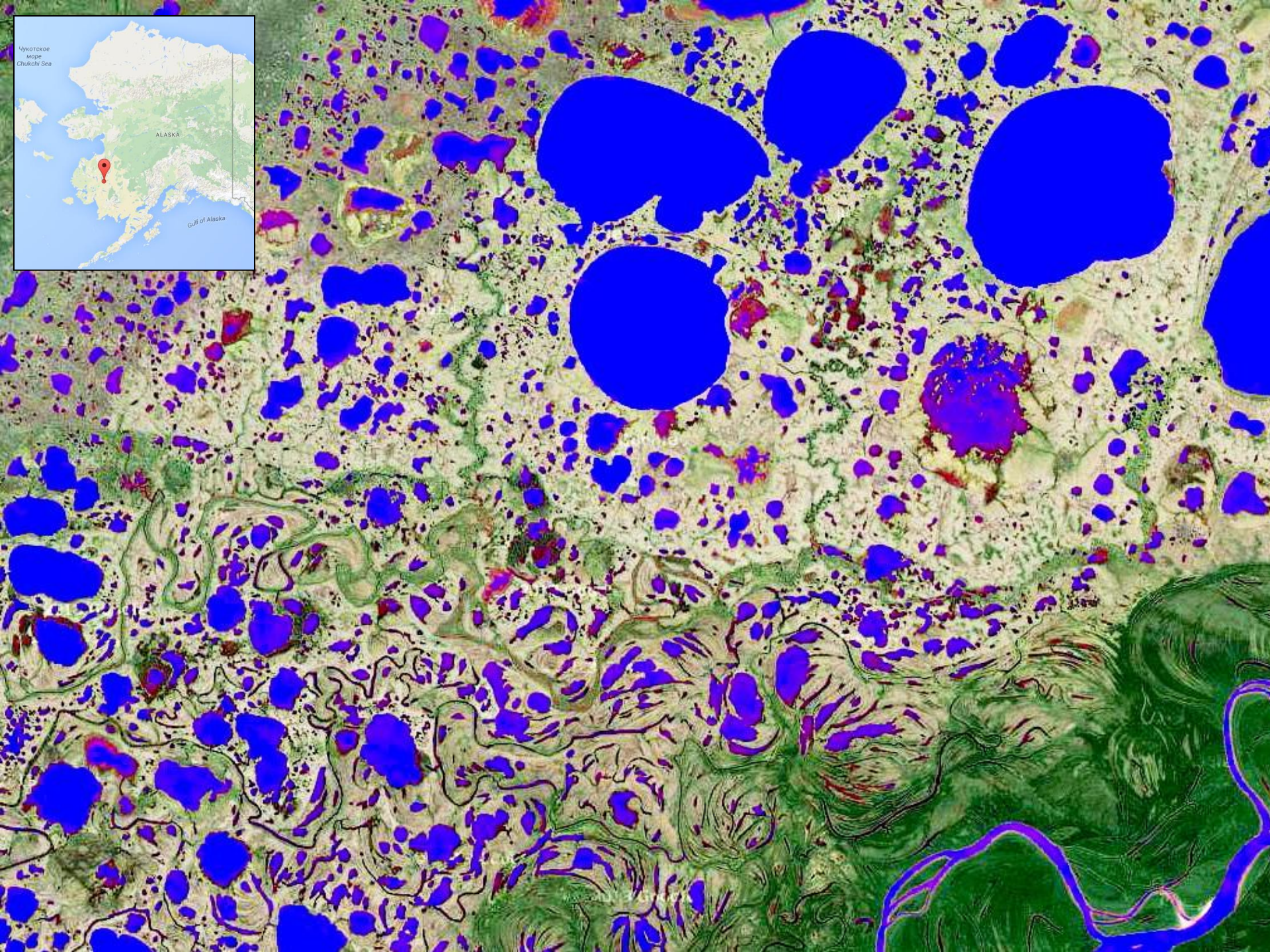


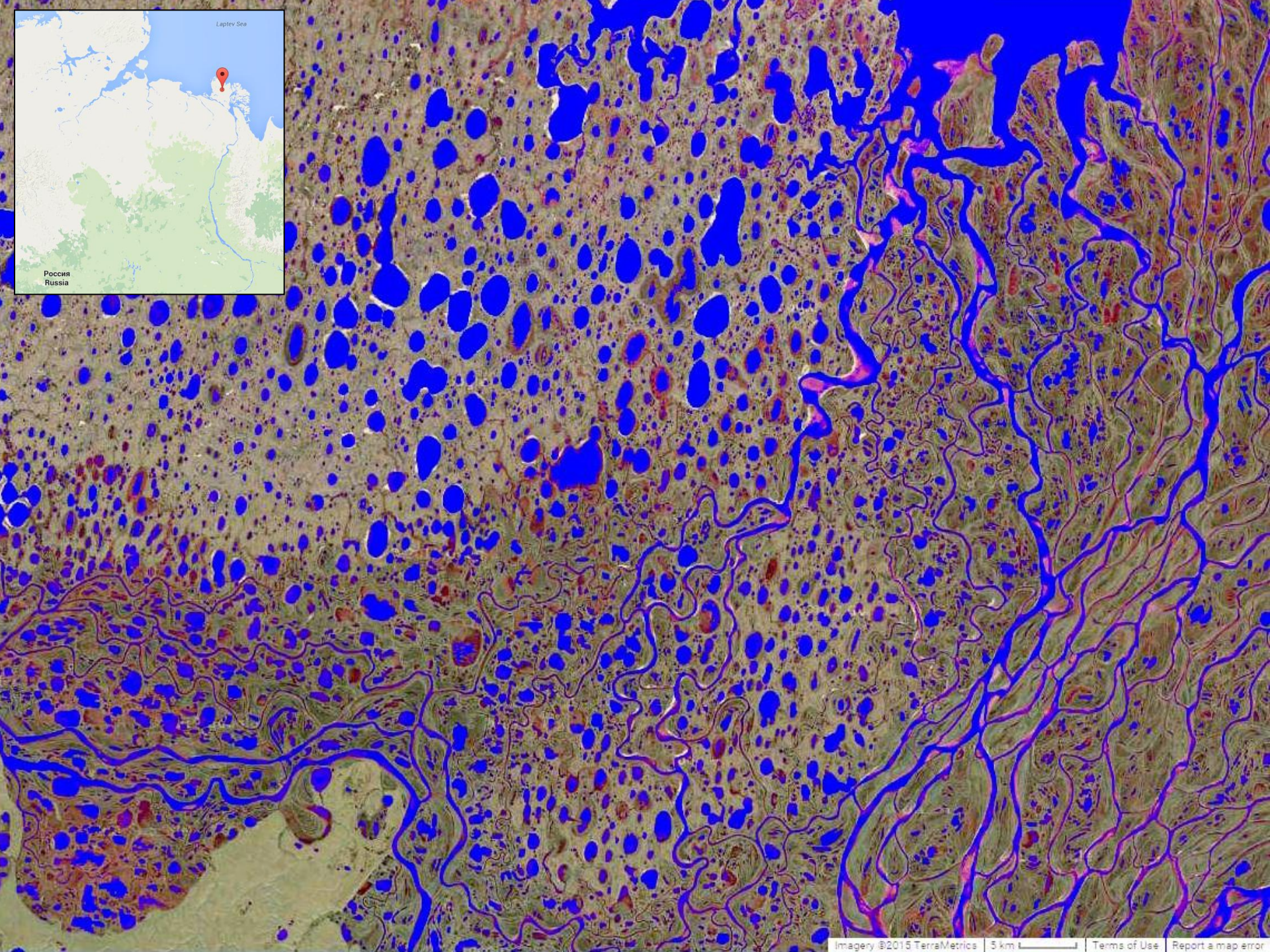
Qadirabad dam, River Chenab, Pakistan 16th January 2015 Landsat courtesy USGS / NASA

Water Occurrence 1984 – 2014



Qadirabad dam, River Chenab, Pakistan Global Water Occurrence 1984 – 2014 Source: JRC and GEE


Чукотское
море
Chukchi Sea
ALASKA
Gulf of Alaska


Laptev Sea
Россия
Russia
Imagery ©2015 TerraMetrics
5 km
Terms of Use
Report a map error