K&C Phase 4 – Status report

Inundation mapping in East and Southern Africa

Lisa-Maria Rebelo
International Water Management Institute (IWMI)
Regional office for South East Asia and the Mekong
Vientiane, LAOS

Science Team meeting #24
Tokyo, Japan, January 29-31, 2018

Project outline and objectives

Development of regional-scale applications: identifying seasonal patterns of inundation

- PALSAR/2 ScanSAR mosaics will be used to determine flooding patterns and to map the temporal dynamics of inundation across selected regions

Project activities will involve mapping regional scale patterns of flooding and inundation across East and Southern Africa

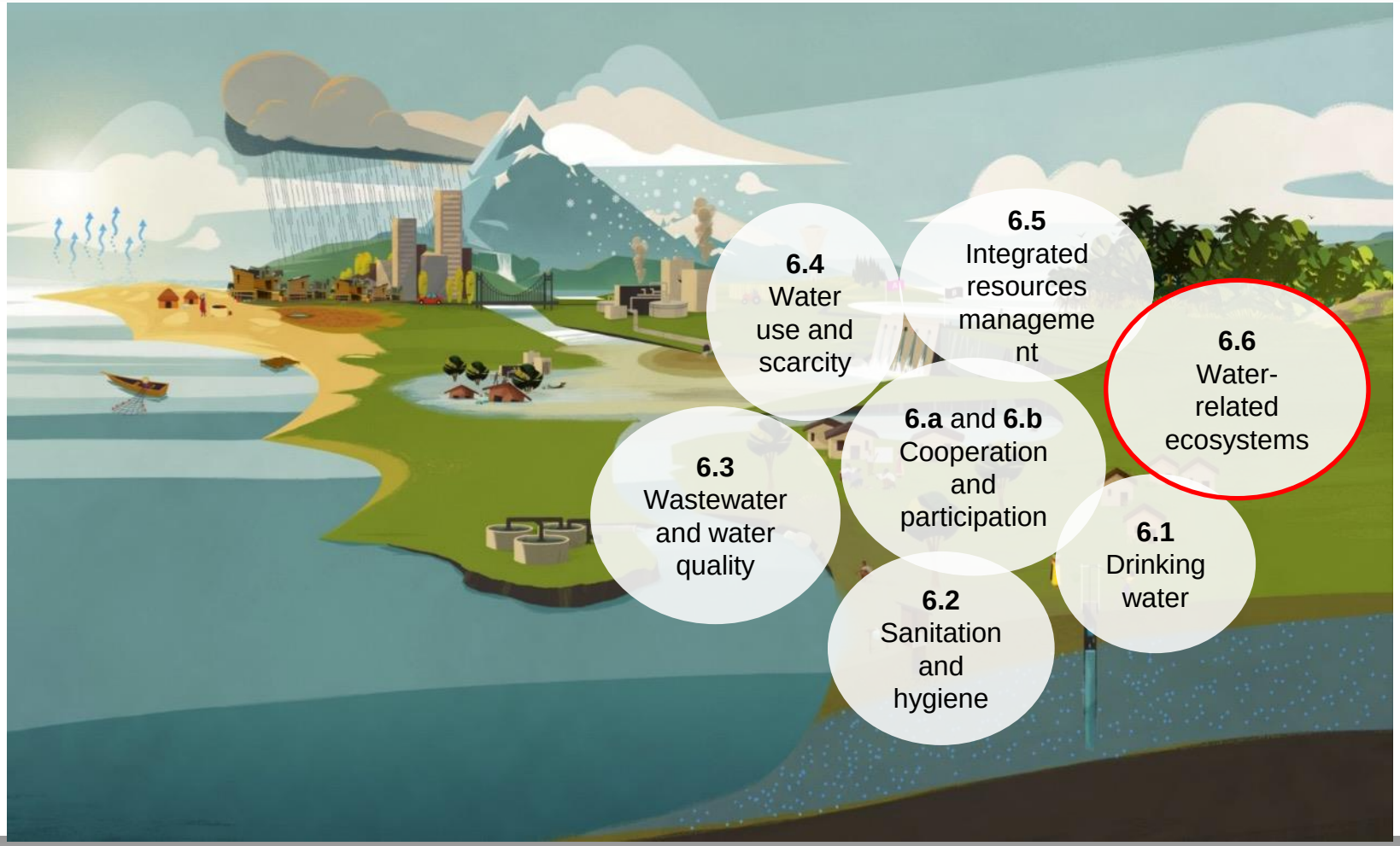
- Initial assessment of these ecosystems and their seasonal dynamics was undertaken during the first phases of the K&C, and with data acquired by ALOS 1. The continuation of the data archives with acquisitions from ALOS 2 allows for the continued monitoring of these important wetlands, and provides the opportunity to better understand their dynamics over a longer period

Links to the K&C “3C” thematic drivers:

- The activities are of direct relevance to the Ramsar Convention on Wetlands of International Importance, demonstrating the application and use of L-band SAR for wetland assessment, inventory and monitoring. The deliverables will also provide the information required for environmental conservation in the relevant regions

6 CLEAN WATER AND SANITATION

"Ensure availability and sustainable management of water and sanitation for all"



- **The guidance for Goal 6.6 recommends the use of EO data to establish a baseline for water related ecosystems**

6 CLEAN WATER AND SANITATION

"By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes"

6.6.1 Change in the extent of water-related ecosystems over time

Ecosystem category	Extent indicators
Vegetated wetlands (vegetation and water dominated ecosystems such as swamps, swamp forests, marshes, peatlands and mangroves)	Spatial extent/area Water quality Wetland health indices
Inland open waters (lakes and reservoirs)	Spatial extent/area and Quantity (volume) Water quality Ecosystem health indices
Rivers and estuaries	Quantity (streamflow) and environmental flows Water quality Biological indices or Ecosystem health indices
Groundwater	Quantity (depth to groundwater table) Water quality

Guidance on wetland extent and change:

Optical datasets acquired by a single sensor rarely provide sufficient information to determine *maximum* wetland extent

Provide useful information during the dry season and can be used to identify areas of "permanent inundation"; but

- **Cloud cover during period of maximum inundation**
- **Vegetation can not be used as a proxy during the wet season**

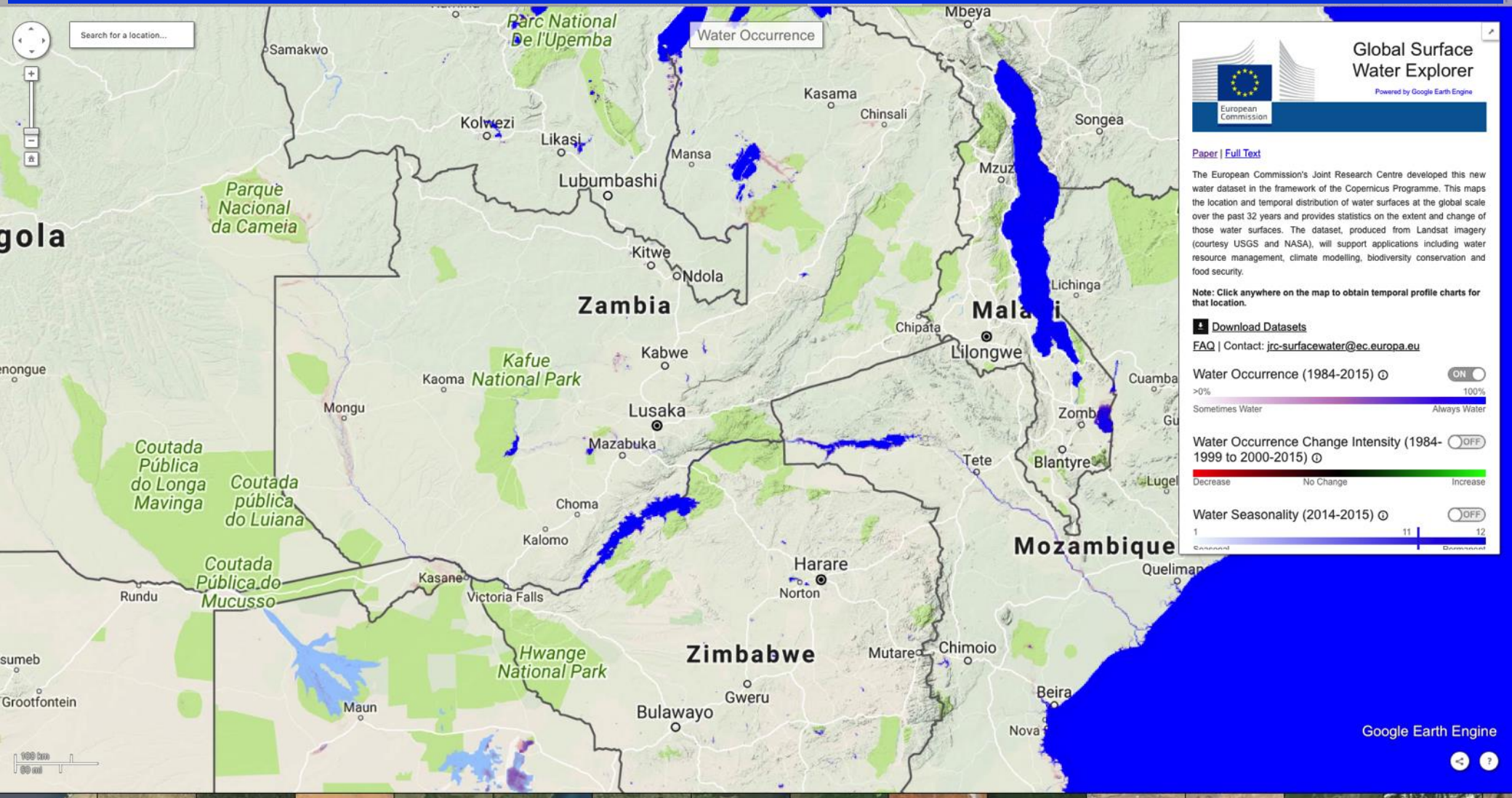
Analysis-Ready-Data is needed along with tools and workflows to establish national 2017 baselines

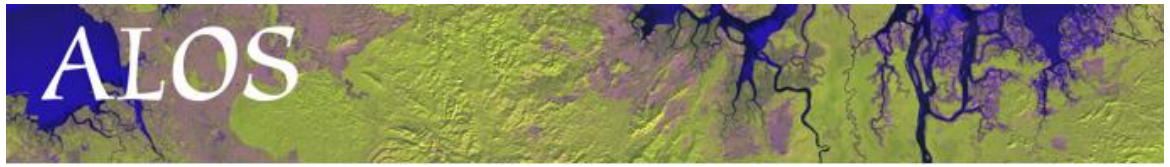
ALOS

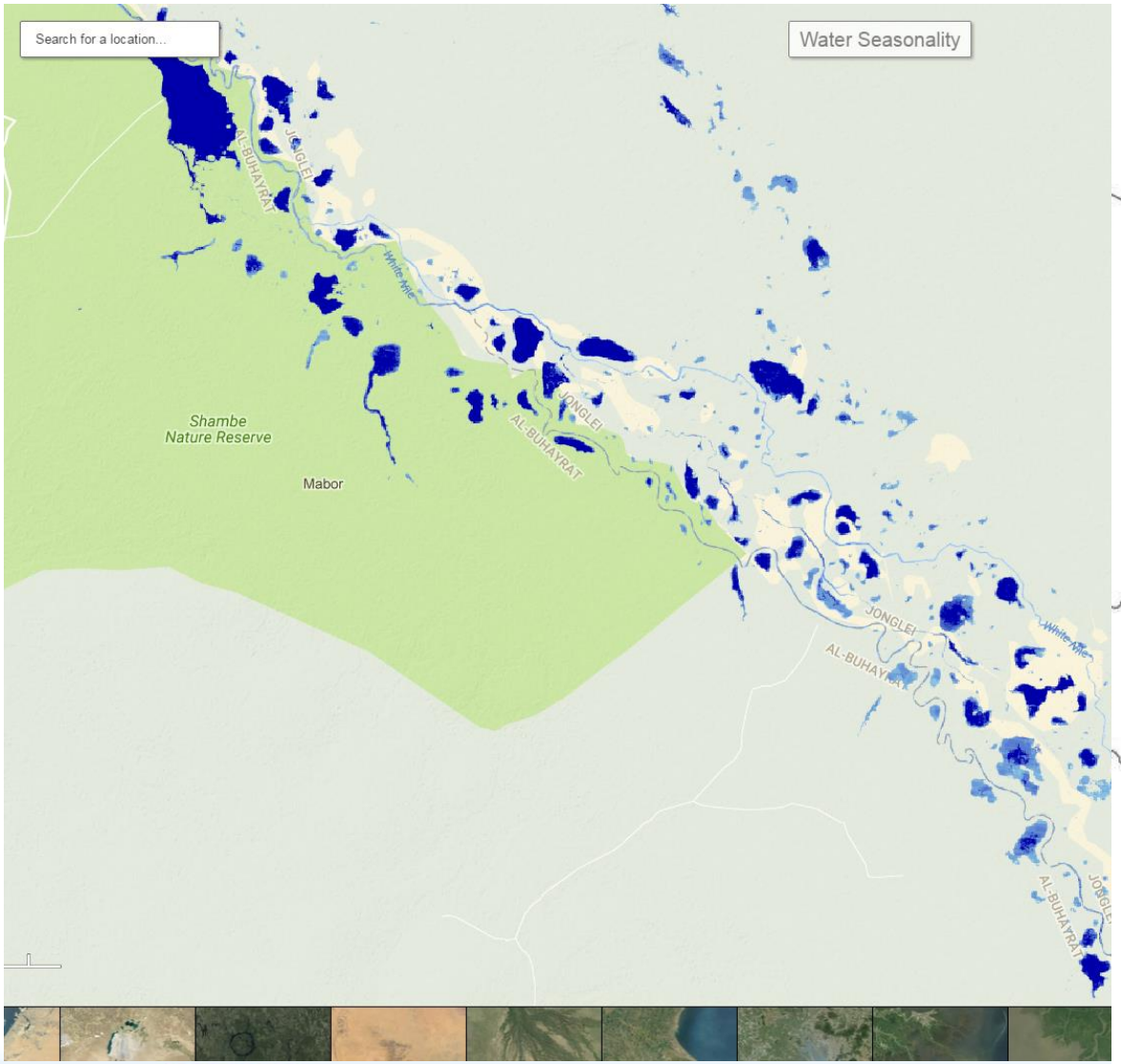
K&C Initiative

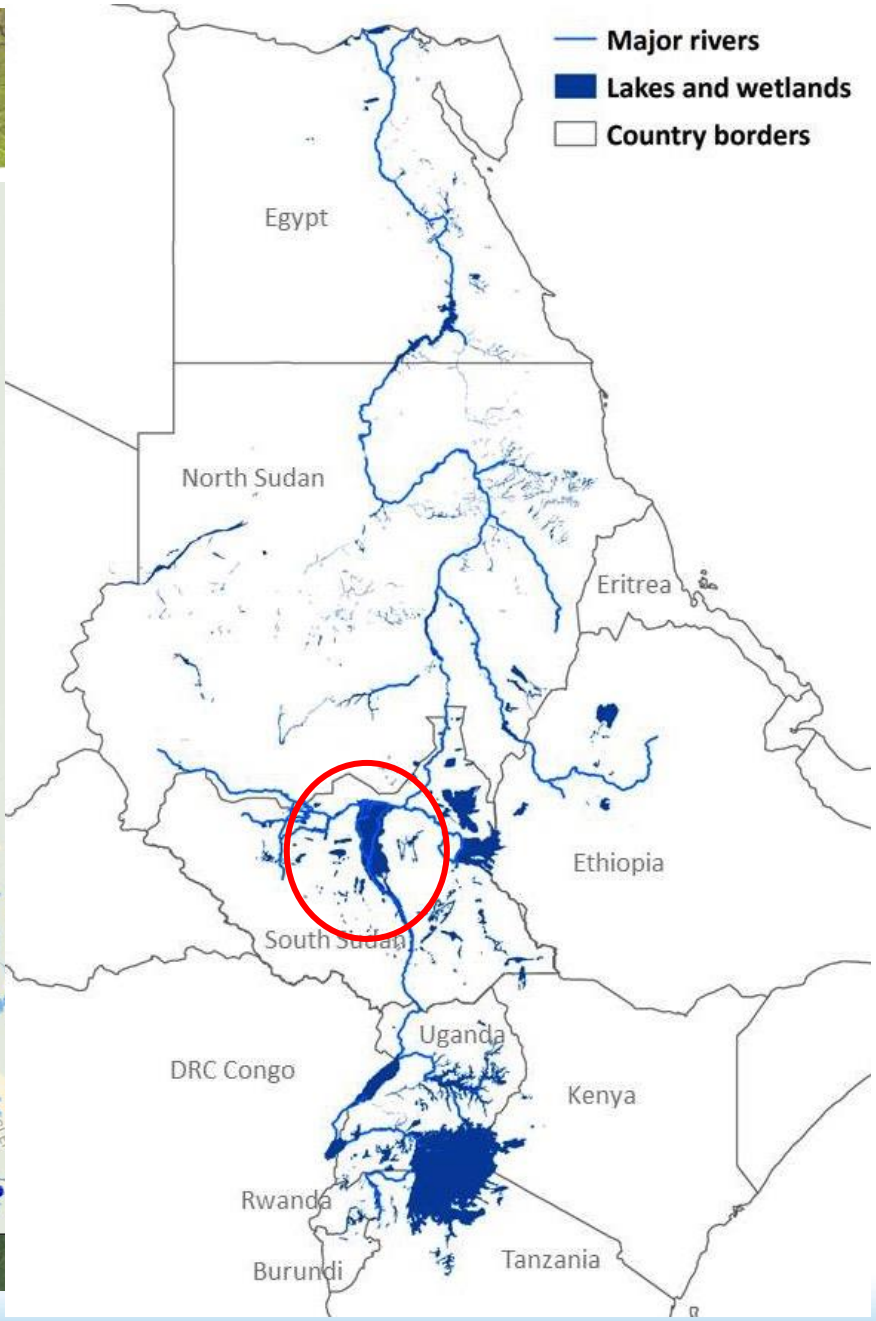
An international science collaboration led by JAXA

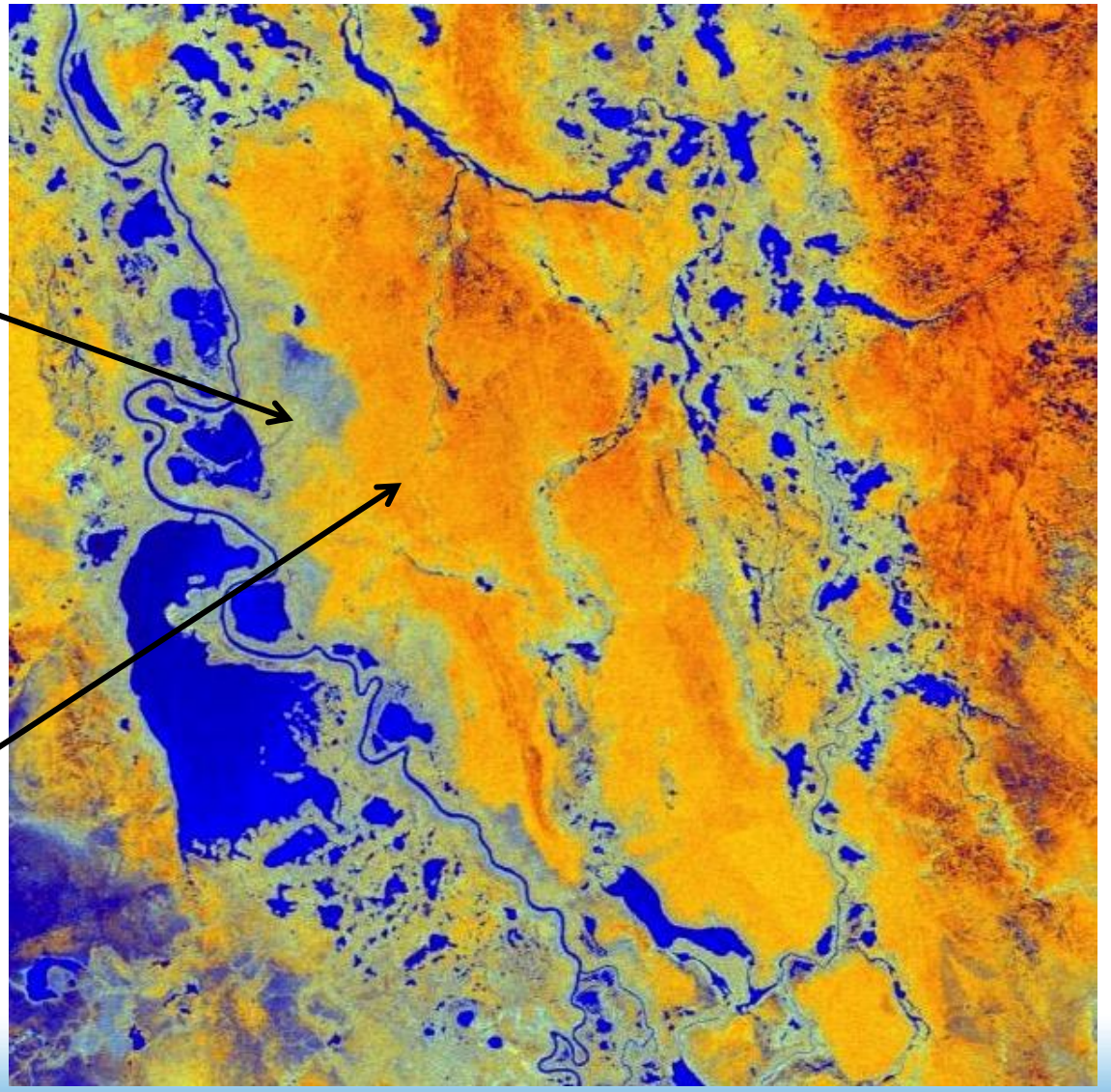
Global Data Sets at high resolution (10-30m)

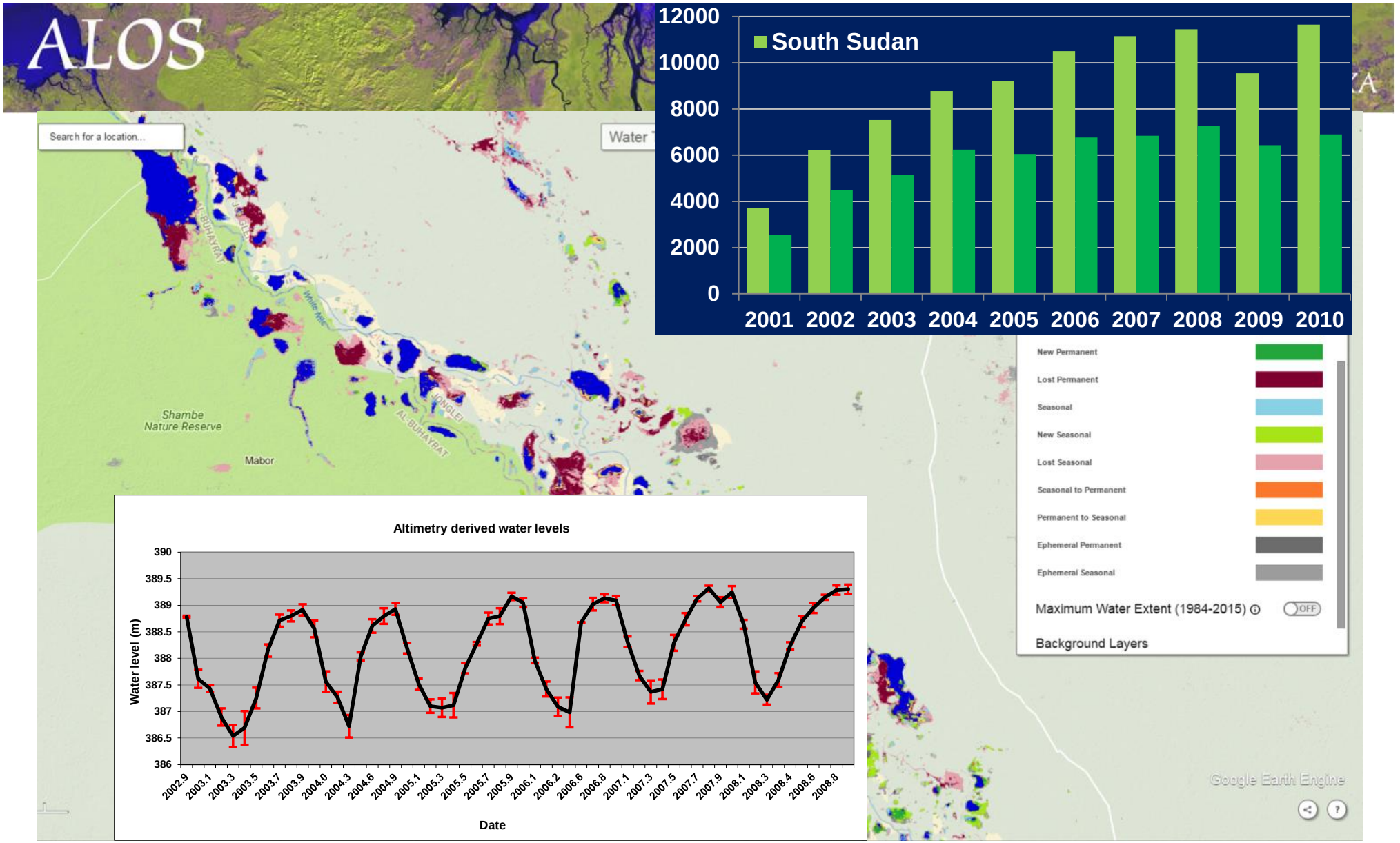



ALOS


Search for a location...
Water Seasonality
Shambe
Nature Reserve
Mabor
AL-BUHAYRAT
JONGLEI
White Nile


Major rivers
Lakes and wetlands
Country borders
Egypt
North Sudan
Eritrea
Ethiopia
South Sudan
Uganda
DRC Congo
Kenya
Rwanda
Burundi
Tanzania

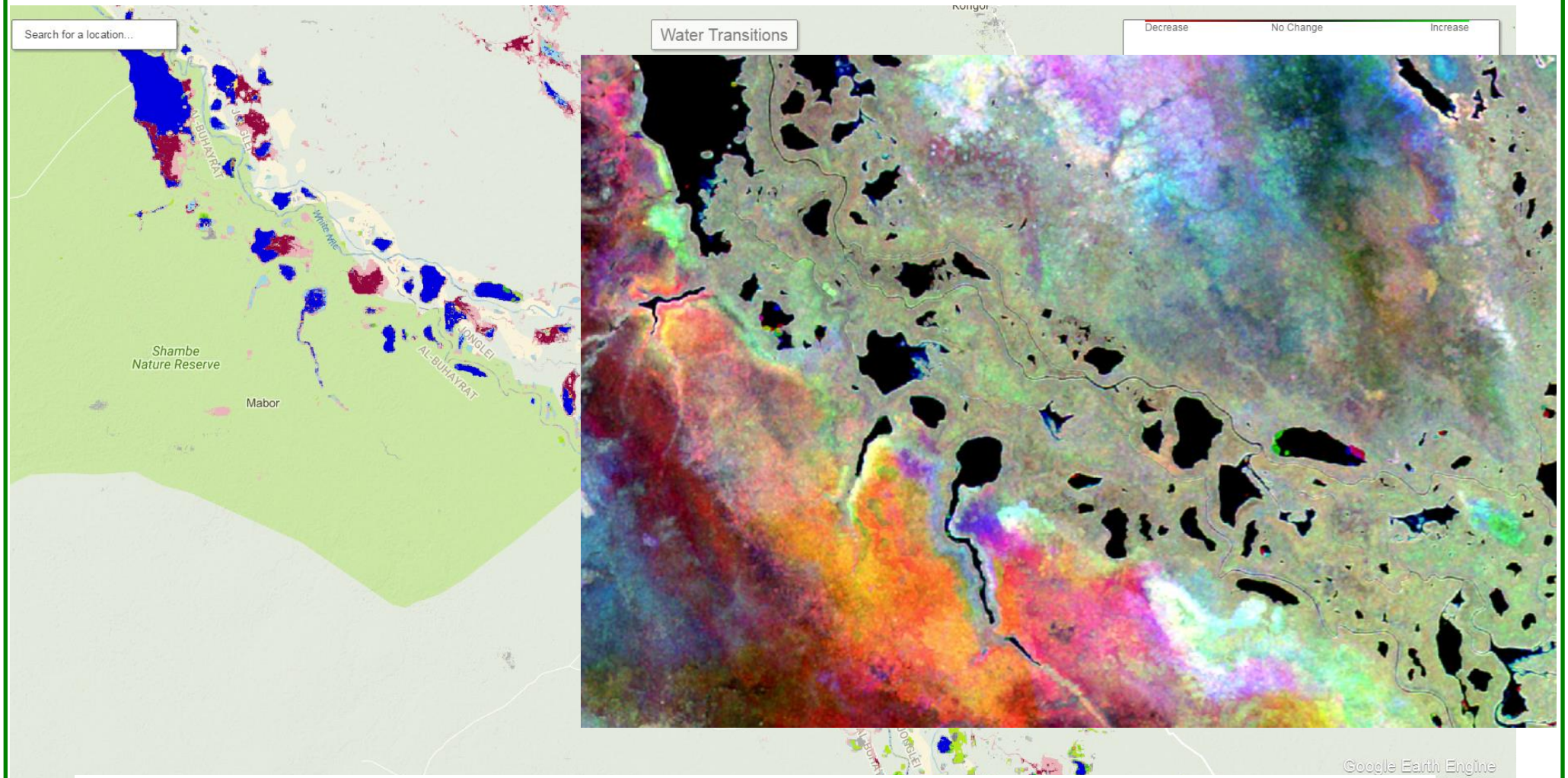



ALOS
South Sudan
12000
10000
8000
6000
4000
2000
0
2001 2002 2003 2004 2005 2006 2007 2008 2009 2010
Search for a location...
Shambe Nature Reserve
Mabor
AL-BUHAYRAT
JONGLEI
New Permanent
Lost Permanent
Seasonal
New Seasonal
Lost Seasonal
Seasonal to Permanent
Permanent to Seasonal
Ephemeral Permanent
Ephemeral Seasonal
Maximum Water Extent (1984-2015)
OFF
Background Layers
Google Earth Engine
Altimetry derived water levels
Water level (m)
390
389.5
389
388.5
388
387.5
387
386.5
386
2002.9 2003.1 2003.3 2003.5 2003.7 2003.9 2004.0 2004.3 2004.6 2004.9 2005.1 2005.3 2005.5 2005.7 2005.9 2006.1 2006.2 2006.6 2006.8 2007.1 2007.3 2007.5 2007.7 2007.9 2008.1 2008.3 2008.4 2008.6 2008.8
Date

ALOS

K&C Initiative

An international science collaboration led by JAXA



➢ **Guidance is needed for the use the available data and products**

Best practice guidelines for the use of Earth Observation for wetland inventory, assessment and monitoring

An information source for wetland managers provided by the Ramsar Convention for Wetlands

How is the EO community getting organised to support Ramsar?

***GEO-Wetlands mission**: Develop sustained & global approaches to wetland inventory, mapping, monitoring and assessment*

- A new GEO Initiative focusing on **wetland ecosystem/habitat monitoring** and on the specific needs of the wetlands community **(Policy & User Driven)**
- A **community and open platform of wetland observation practitioners** including academia, NGOs, national agencies, private companies, space agencies & international conventions **(International Collaborative Effort)**
- A framework for the **co-design of the Global Wetlands Observation System** (GWOS) **(GEO-Wetlands Community Portal & Knowledge-Hub)**

*A collaborative framework for **international cooperation**, co-design of **innovative solutions** and **community engagement***

Projects contributing to GEO Wetlands

Satellite-based Wetland Observation Service

- European & African Wetland Mapping and Monitoring
- Service, Software and Portal Development

Global Mangrove Watch

Global Mangrove Mapping & monitoring

DeMo-Wetlands

National Wetland Mapping and Monitoring - Rwanda

GlobWetland-Africa

- Inventory, Assessment and monitoring of African Wetlands
- “open-sourceSoftware" Toolbox Development

Mangrove Watch Africa

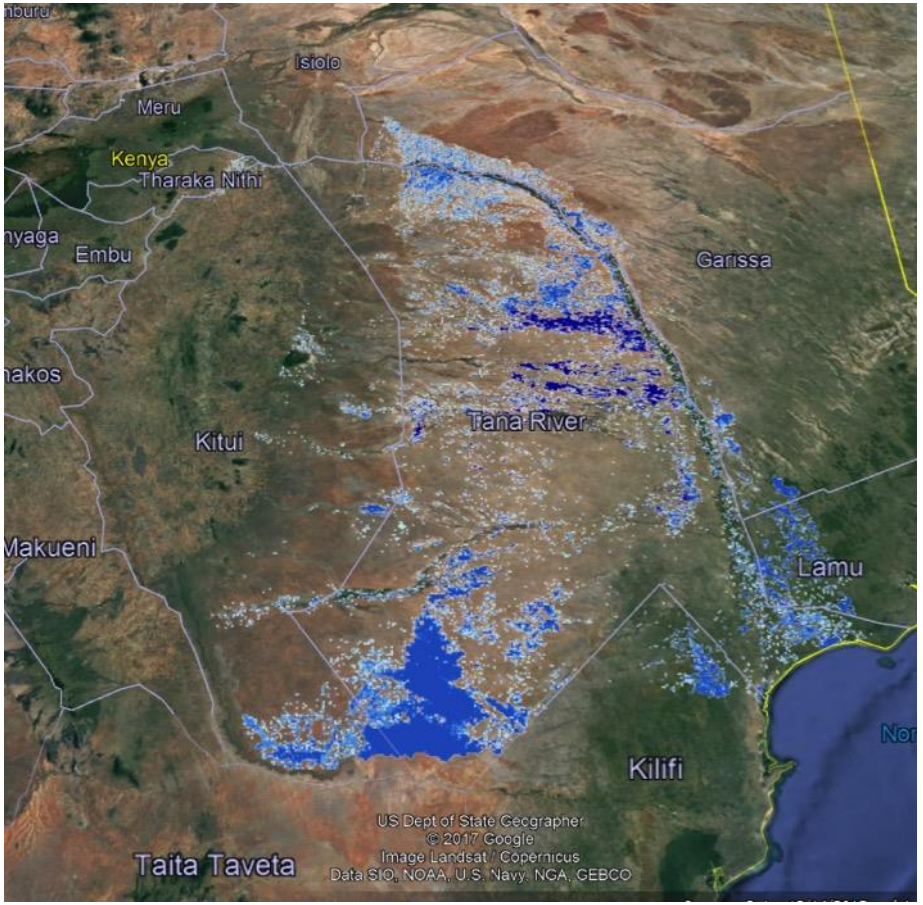
Community based mangrove change mapping

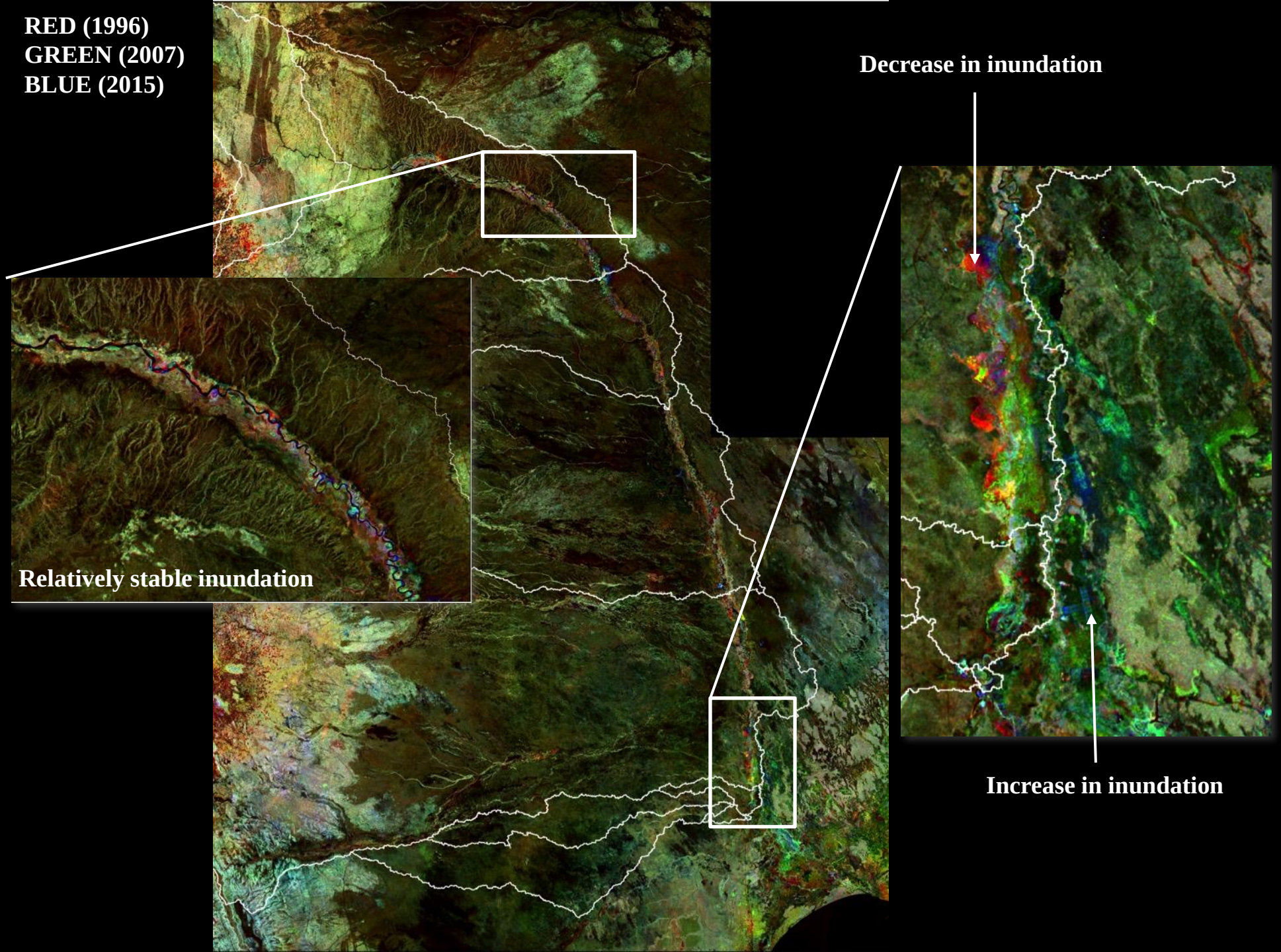
Wetlands Monitoring with Earth Observation Data

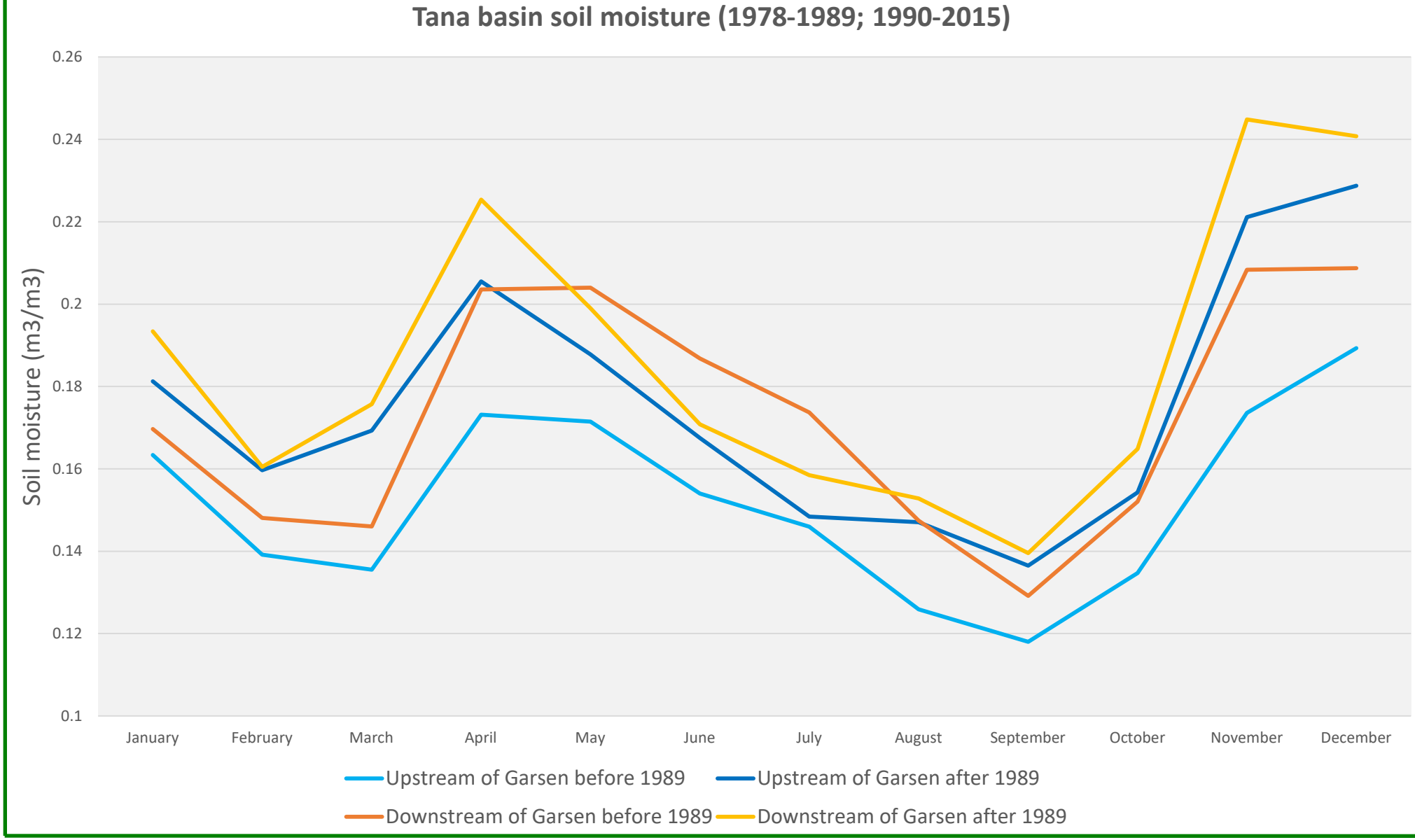
EO based National Wetland Inventory for Uganda

Tana Delta, Kenya

- How "nature-based" solutions can contribute to climate change adaptation and sustainable development - portfolios of both built and natural infrastructure
- Upper basin - ecosystem services influence delivery of water to dams
- Lower basin, water-dependent ecosystem services (fisheries, cultivation, cattle grazing on floodplains) support hundreds of thousands of people
- The impact of climate change on these ecosystem services depends greatly on how natural and built infrastructure interact and are managed under future climate conditions



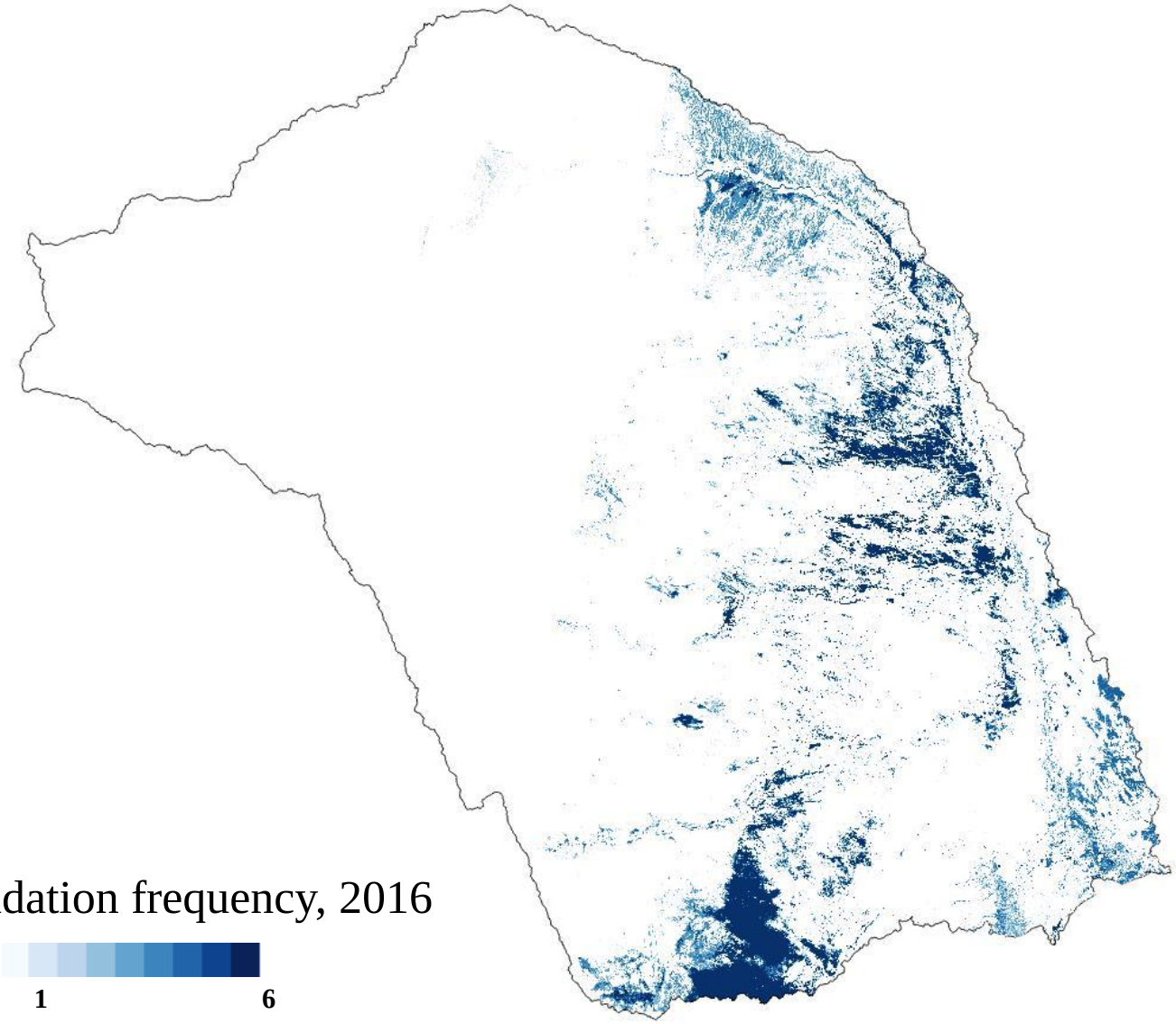

RED (1996)
GREEN (2007)
BLUE (2015)
Decrease in inundation
Relatively stable inundation
Increase in inundation

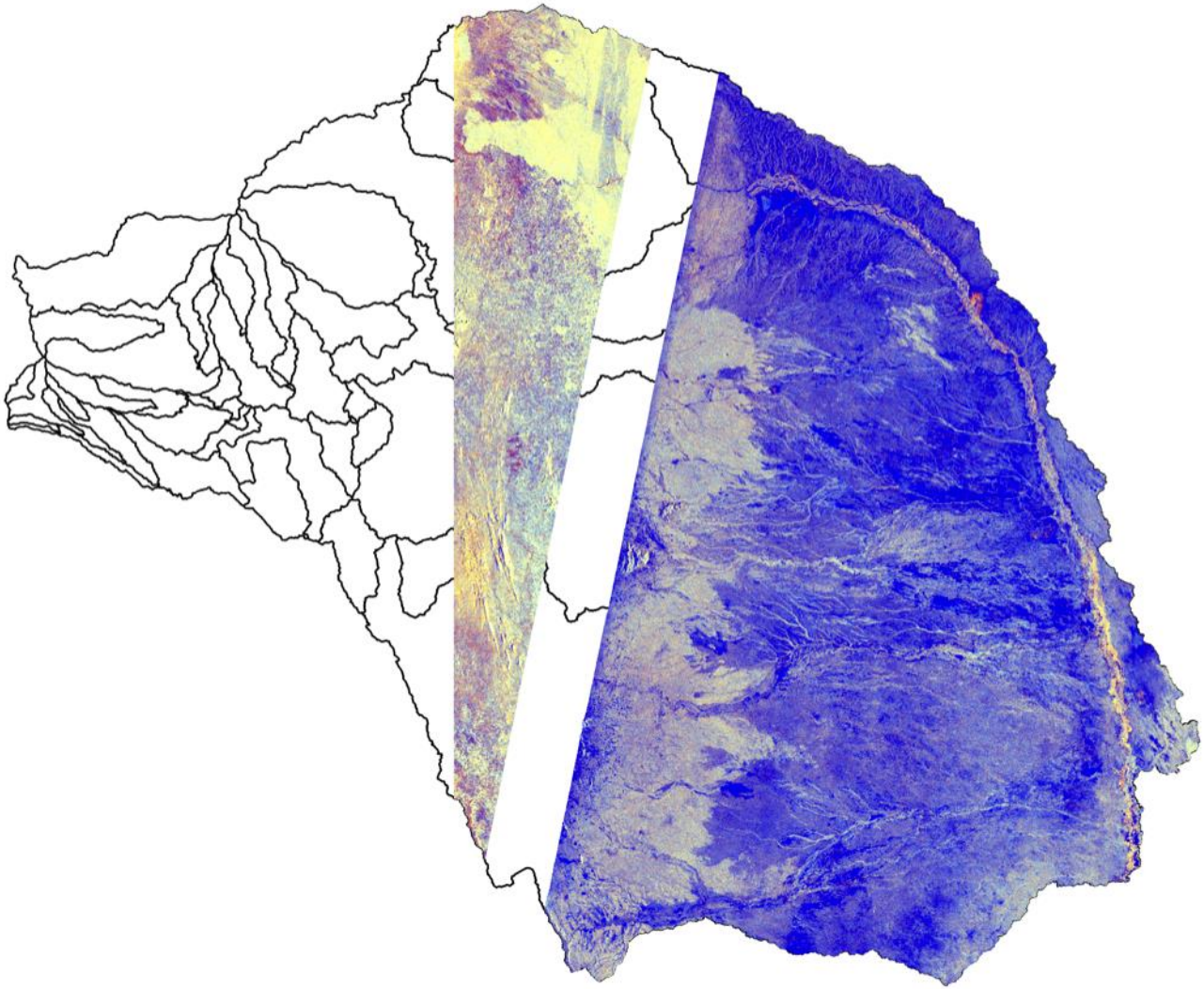

Tana basin soil moisture (1978-1989; 1990-2015)
Soil moisture (m3/m3)
0.26
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0.1
January
February
March
April
May
June
July
August
September
October
November
December
Upstream of Garsen before 1989
Upstream of Garsen after 1989
Downstream of Garsen before 1989
Downstream of Garsen after 1989

ALOS

K&C Initiative

An international science collaboration led by JAXA



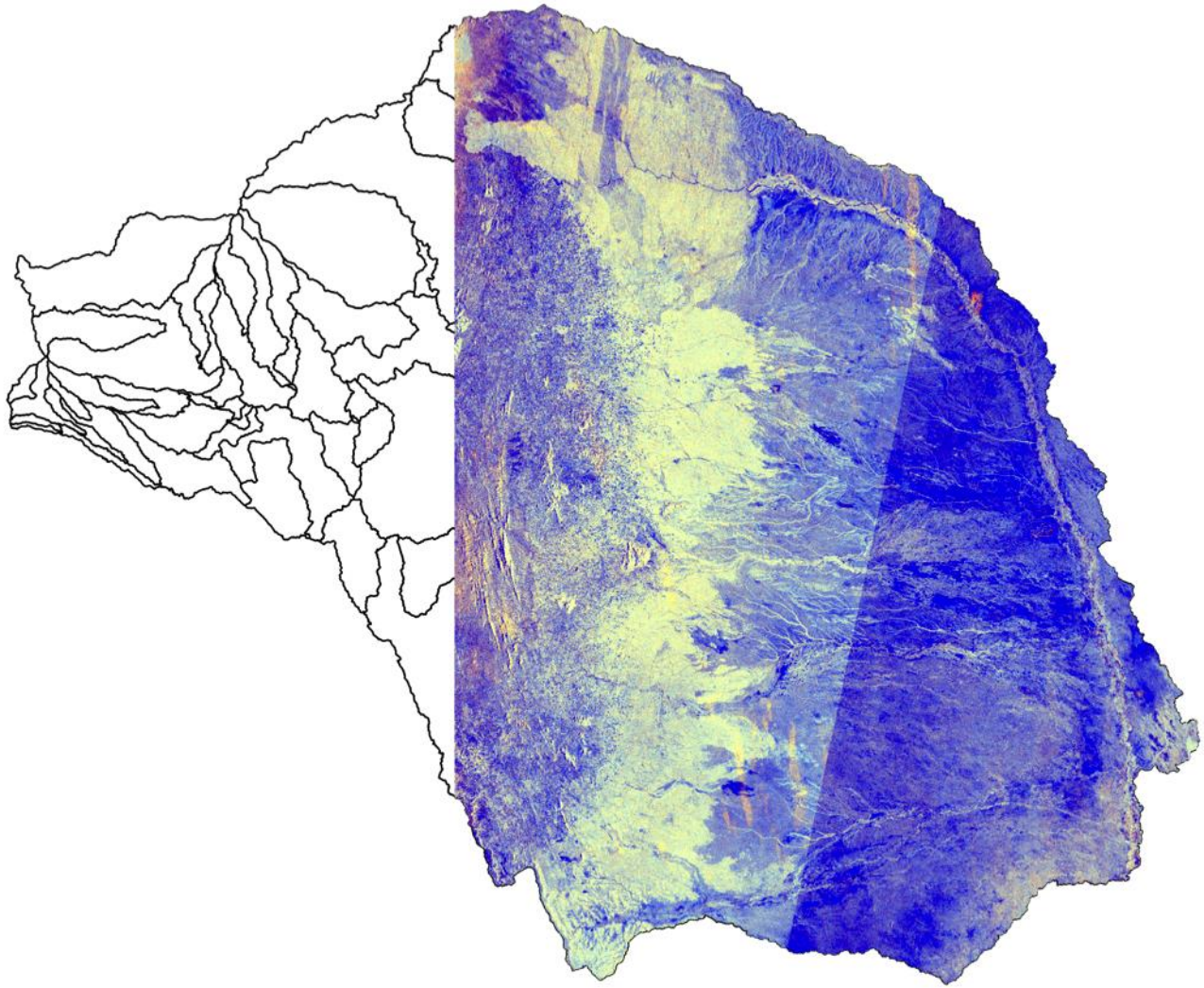


C048

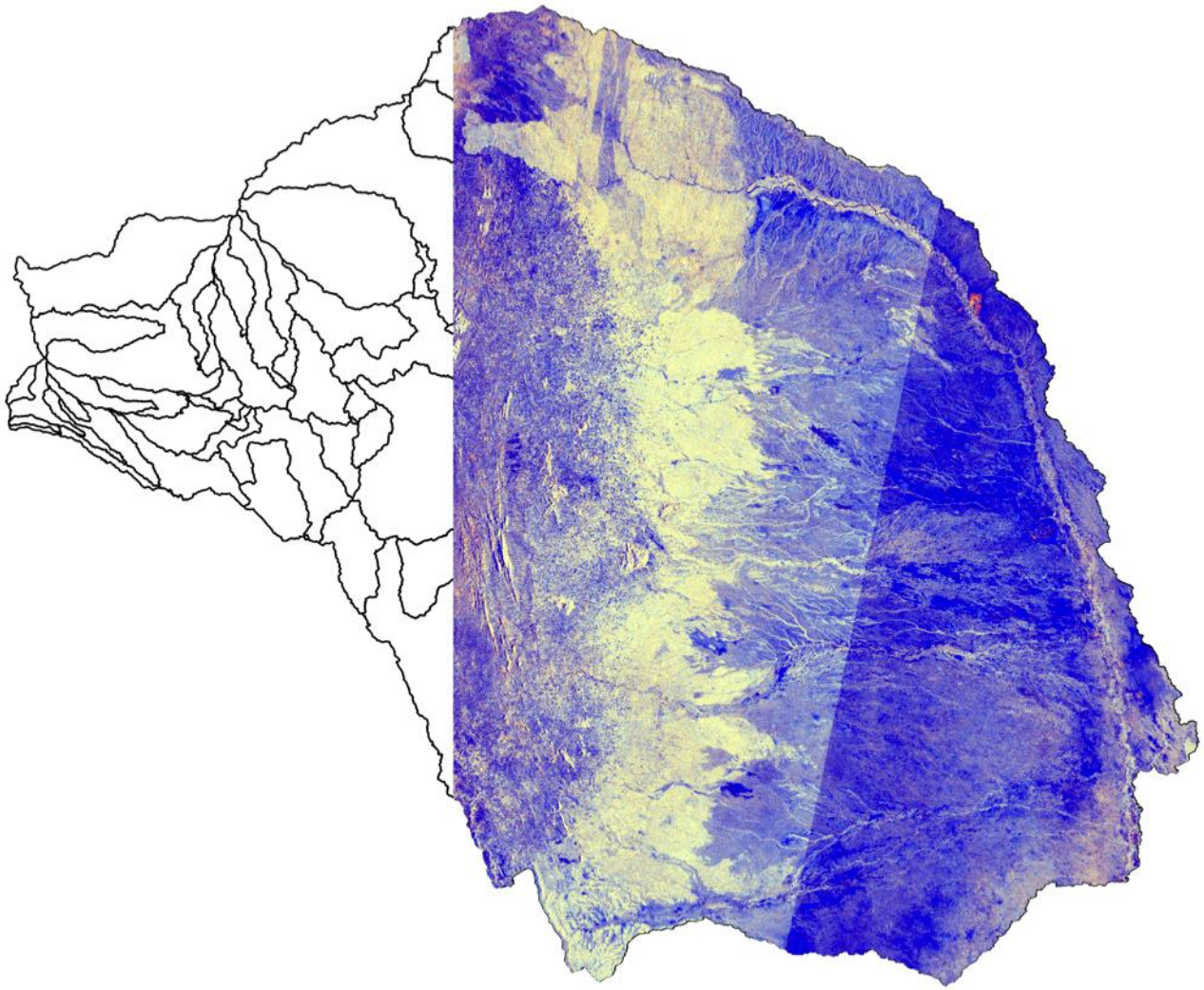
ALOS

K&C Initiative

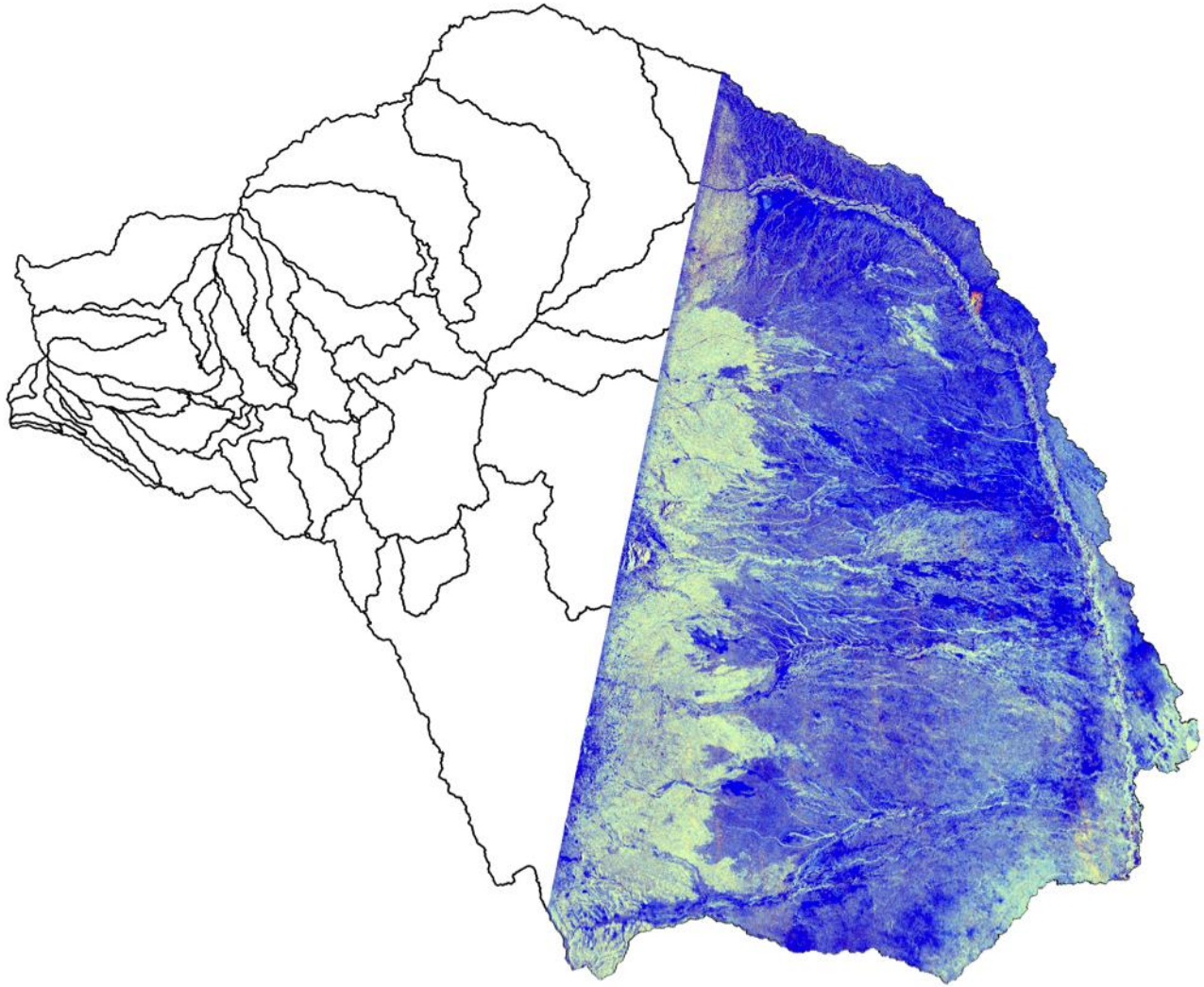
An international science collaboration led by JAXA



C051



C053

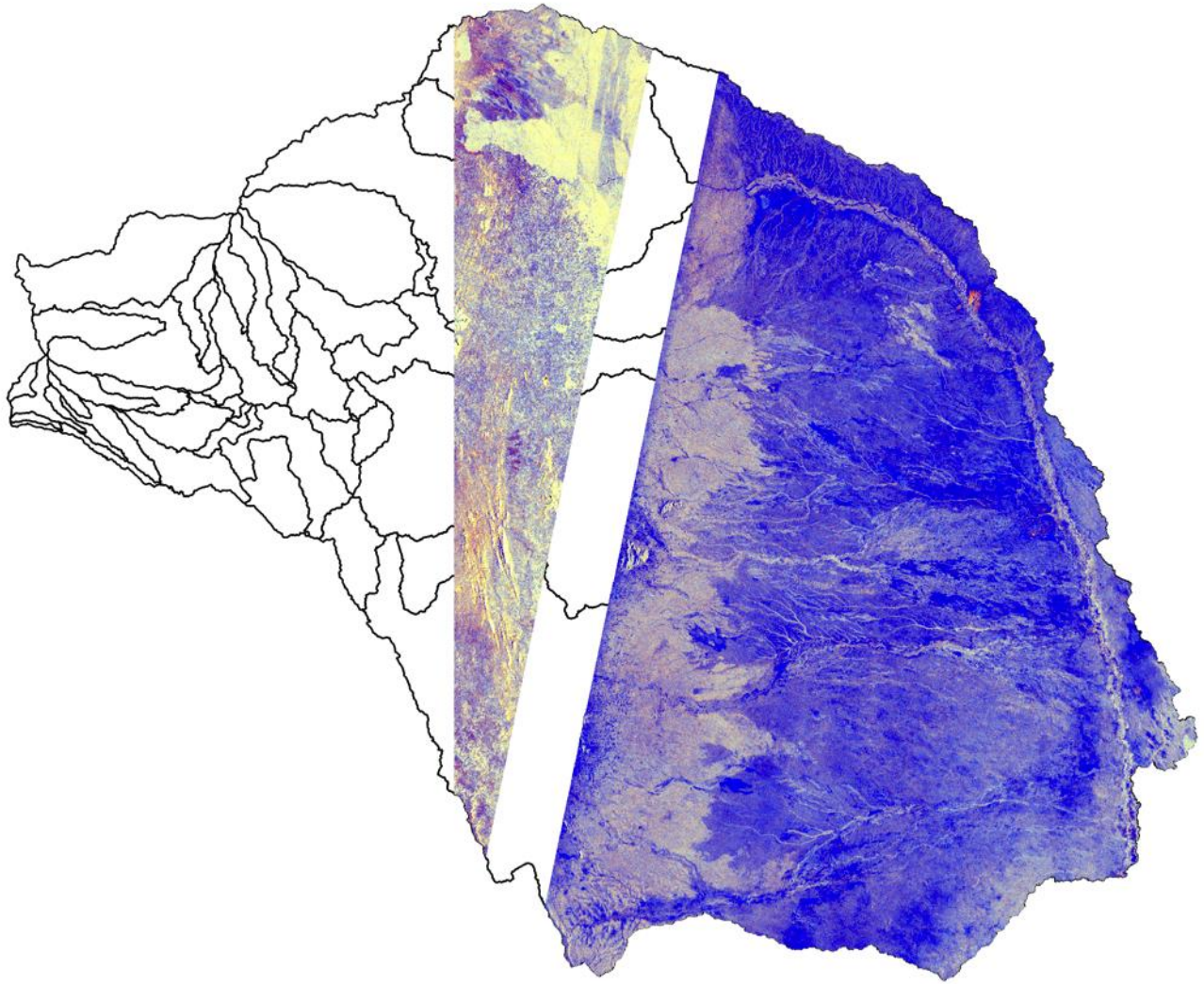


C056

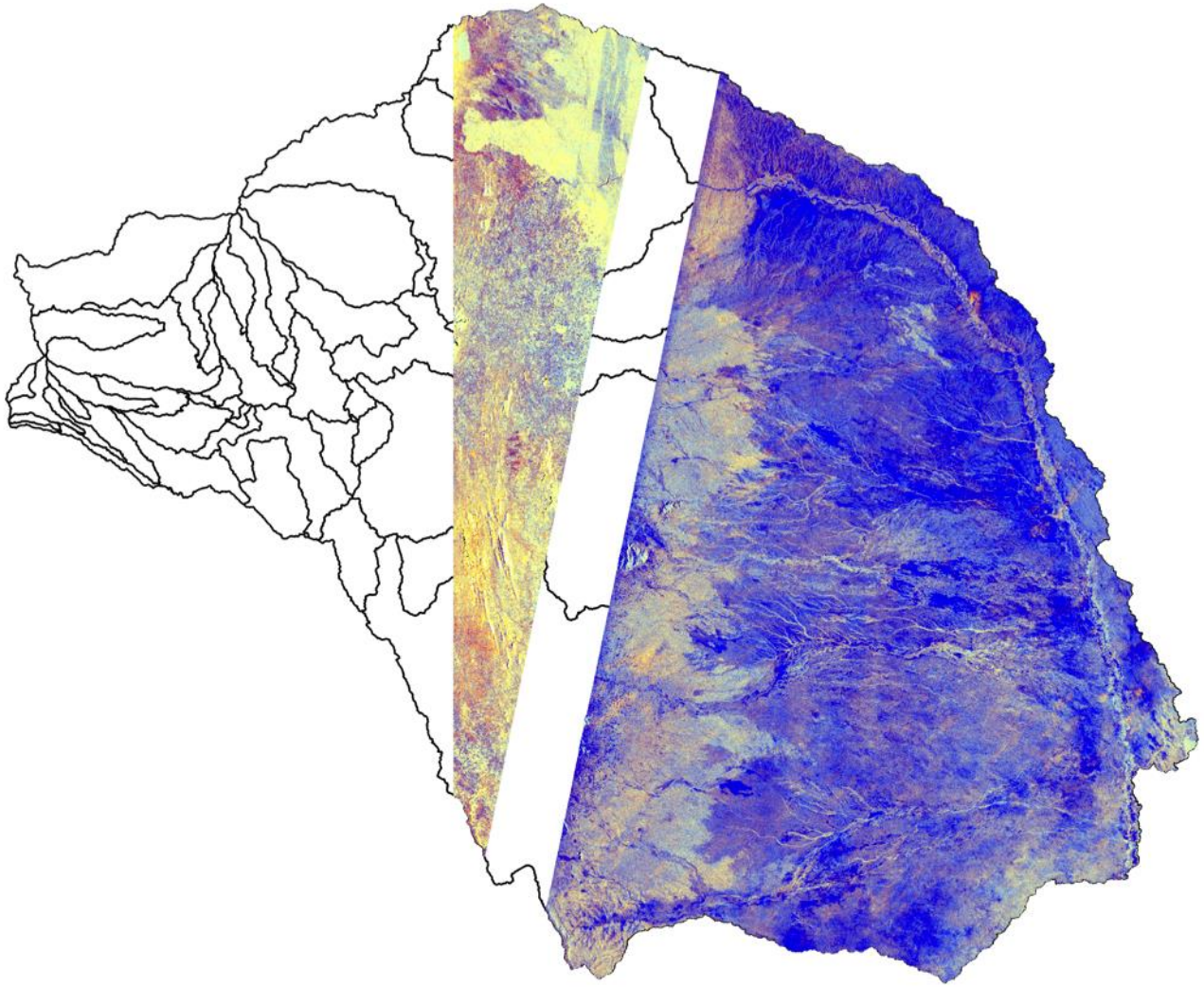
ALOS

K&C Initiative

An international science collaboration led by JAXA



C059

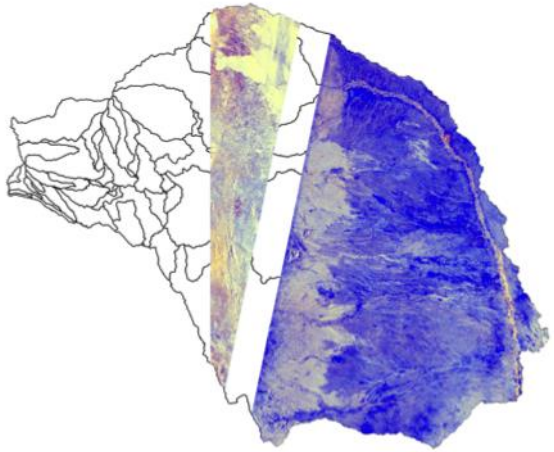


C062

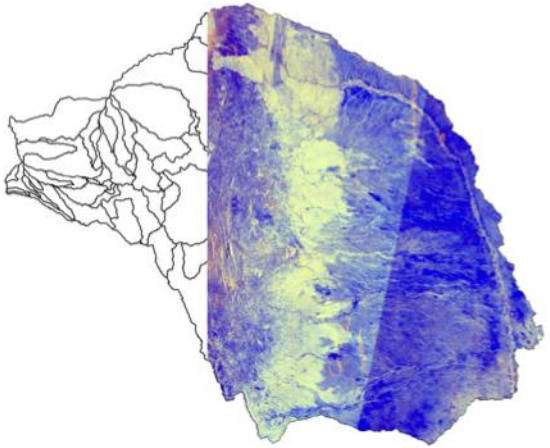
ALOS

K&C Initiative

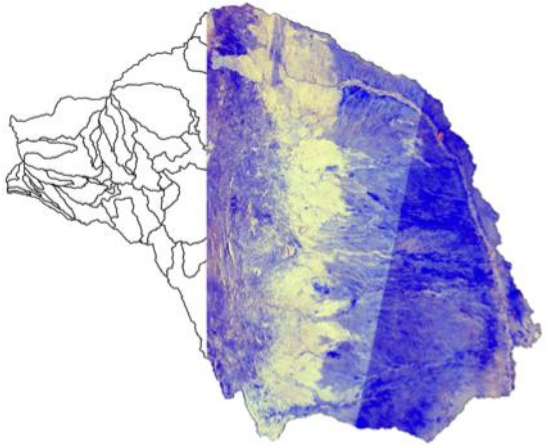
An international science collaboration led by JAXA



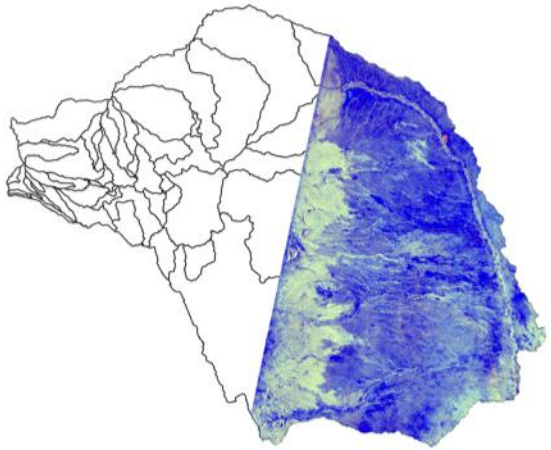
17/05/16



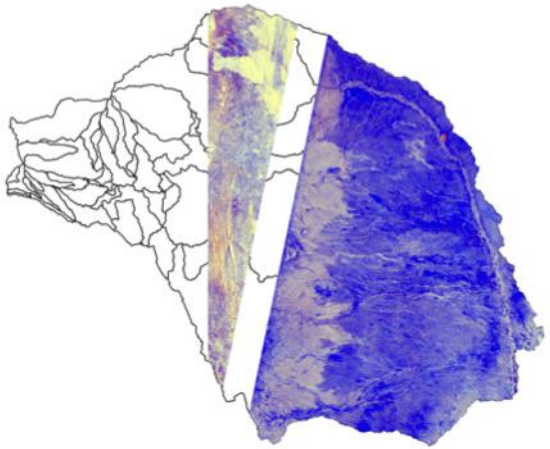
19/06/16



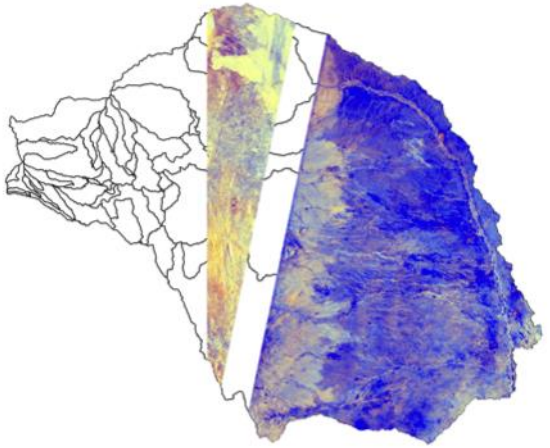
26/07/16



06/09/16



14/10/16

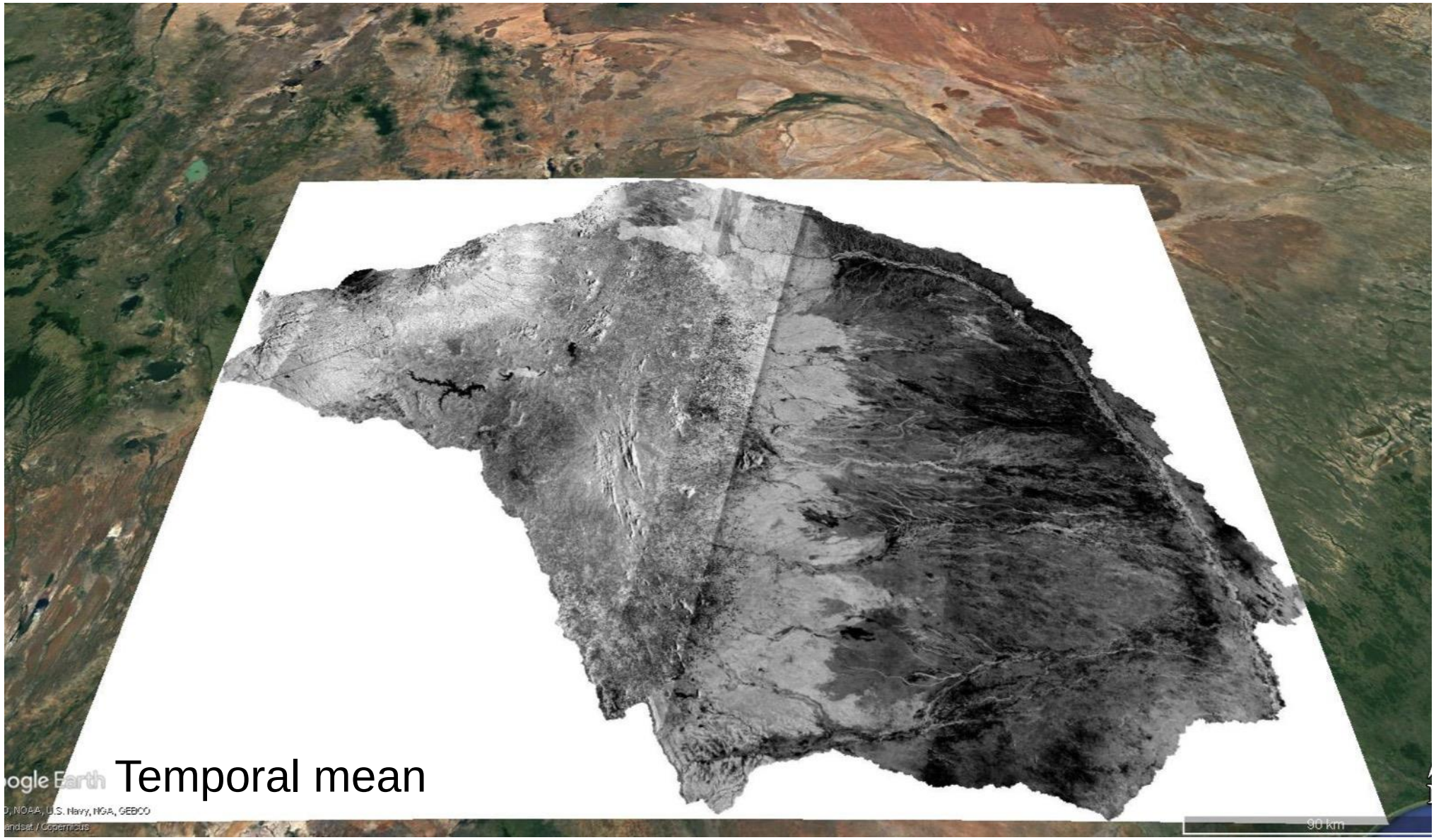


29/11/16

ALOS

K&C Initiative

An international science collaboration led by JAXA



ALOS

K&C Initiative

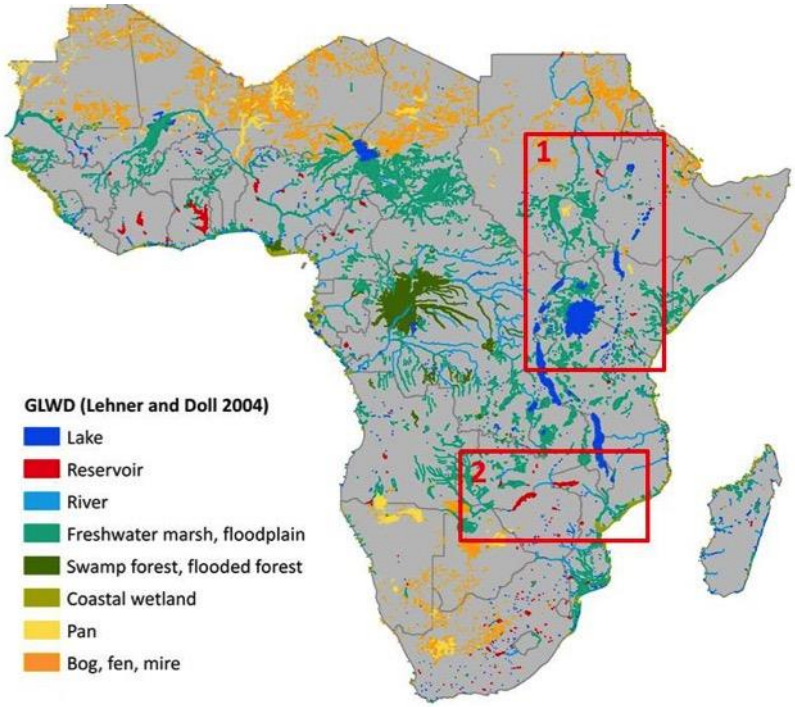
An international science collaboration led by JAXA

Sentinel 1A VH; 01/07-06/07 2016

Proposed deliverables:

Maps showing the spatial-temporal variations in inundation at a regional scale from ScanSAR data for the prototype areas including:

- Minimum water extent
- Maximum water extent
- Seasonal variations in inundation
- Analysis of intra as well as inter-annual variations and changes occurring to the wetlands during the full time period of analysis (2007 – 2018)



1 year extension requested due to late delivery of ScanSAR mosaics

Ayerwaddy Delta, Myanmar

- Deep water rice (floating rice/flood based farming system) (FBFS) are unique rice varieties grown under deep water conditions (> 50 cm) where typical rice varieties do not survive
- Known for their quick adaptation to flooding conditions by stem elongation at rates of up to 20-25 cm/day in order to float safely above water surface
- Considered environmentally friendly since they can be farmed without the use of agro-chemicals and serve as biodiversity hotspots for fish and other aquatic species
- Provide a number of ecosystems services including supporting services, provisioning services, regulating services and cultural services

- Over the last 3 decades production in southeast Asia has been on a steady decline
- Myanmar had a loss 42% between 1990 and 2015
  - drastic changes in rice production policies in favour of high yield varieties
  - development of flood control structures and irrigation schemes
  - rapid development of hydropower dams for energy generation and other major non-agricultural water uses
- Renewed focus on preserving and extending adaptation of FR farming
- FR varieties depend on the depth of flooded water, rate of water level increase and the recession characteristics of the floods

Quantify the flood pulse associated with floating rice systems using EO and field measured hydro-meteorological data

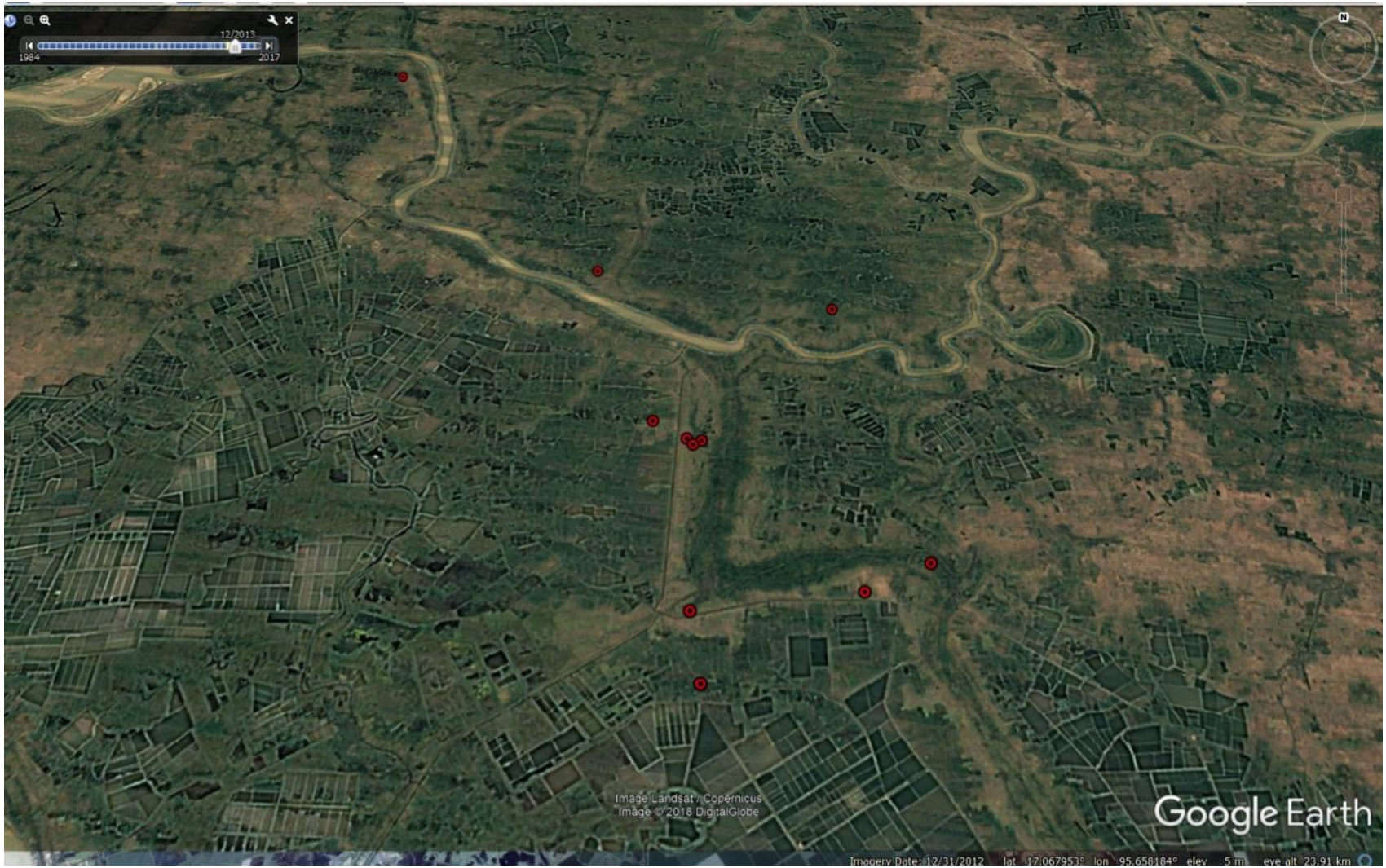
1984


12/2001
1984
2017
N
Image Landsat / Copernicus
Google Earth
Imagery Date: 12/31/2001 lat 16.922699° lon 95.788628° elev 7 m eye alt 22.74 km

2001


12/2008
N
Image Landsat / Copernicus
Image © 2018 DigitalGlobe
Image NASA
Google Earth
Imagery Date: 12/31/2008 lat 16.922698° lon 95.788628° elev 7 m eye alt 23.91 km

2008


12/2013
1984
2017
Image Landsat / Copernicus
Image © 2018 DigitalGlobe
Google Earth
Imagery Date: 12/31/2012 lat 17.067953° lon 95.658184° elev 5 m eye alt 23.91 km

2013

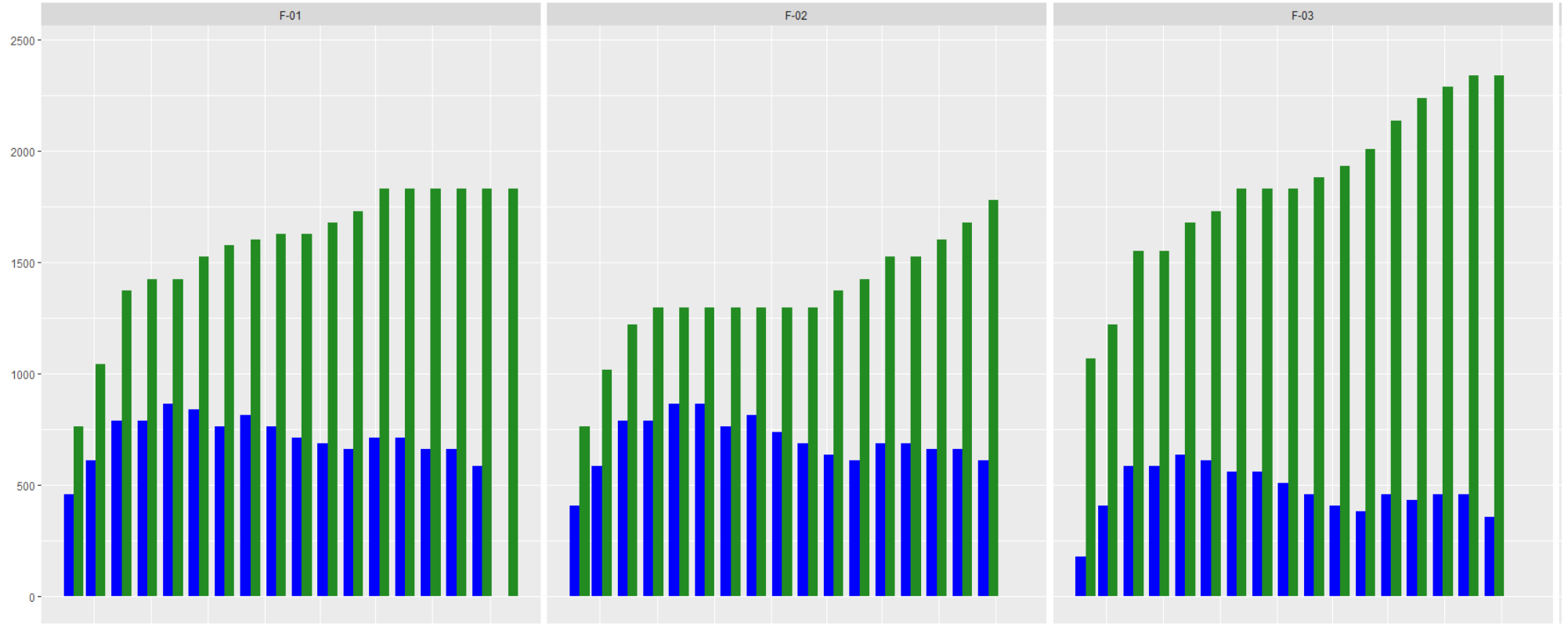

Image © 2018 CNES / Airbus
Image © 2018 DigitalGlobe
Image © 2018 DigitalGlobe
Google Earth
Imagery Date: 10/10/2017 lat 16.952450° lon 95.797408° elev 4 m eye alt 22.74 km

2017

ALOS

K&C Initiative

An international science collaboration led by JAXA



THANK YOU!