The synergetic use of SAR and optical time-series for agricultural and forest applications

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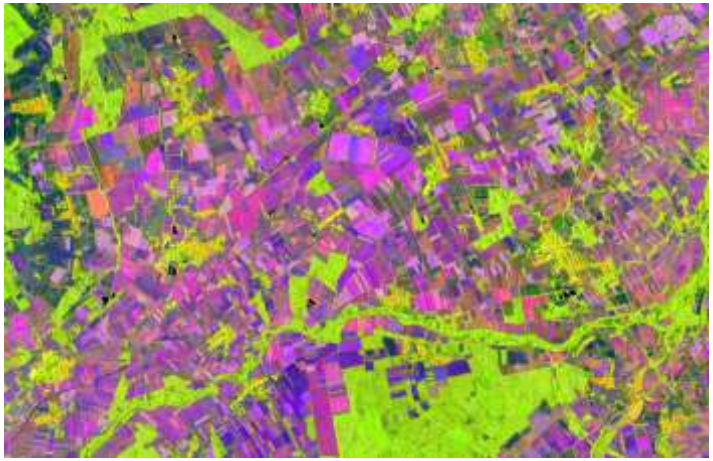
What provides remote sensing?

GEO-SPATIAL and TEMPORAL DATA

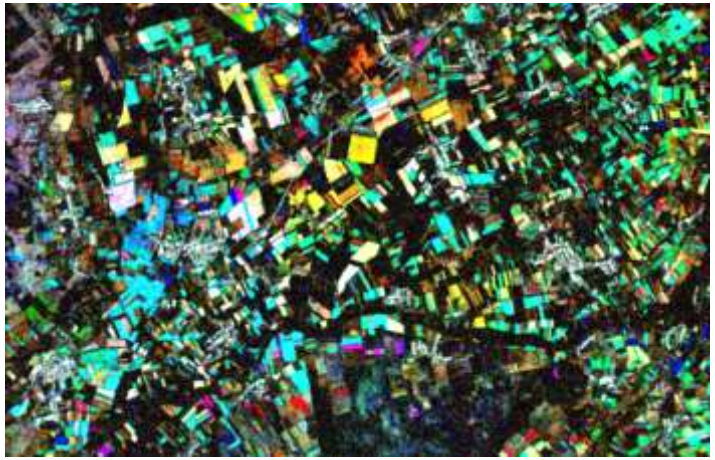
- **GEO**: the data is geo-referenced
- **SPATIAL**: it enables to analyse the spatial dependency, i.e. the co-variation of properties within the geographic space.
- **TEMPORAL**: it enables to analyse the temporal dependency, i.e. the co-variation of properties over the time.
- **DATA**: is a physical measurement, hence objective information

Geo-Spatial – Optical and Synthetic Aperture Radar (SAR)

Optical – NDVI

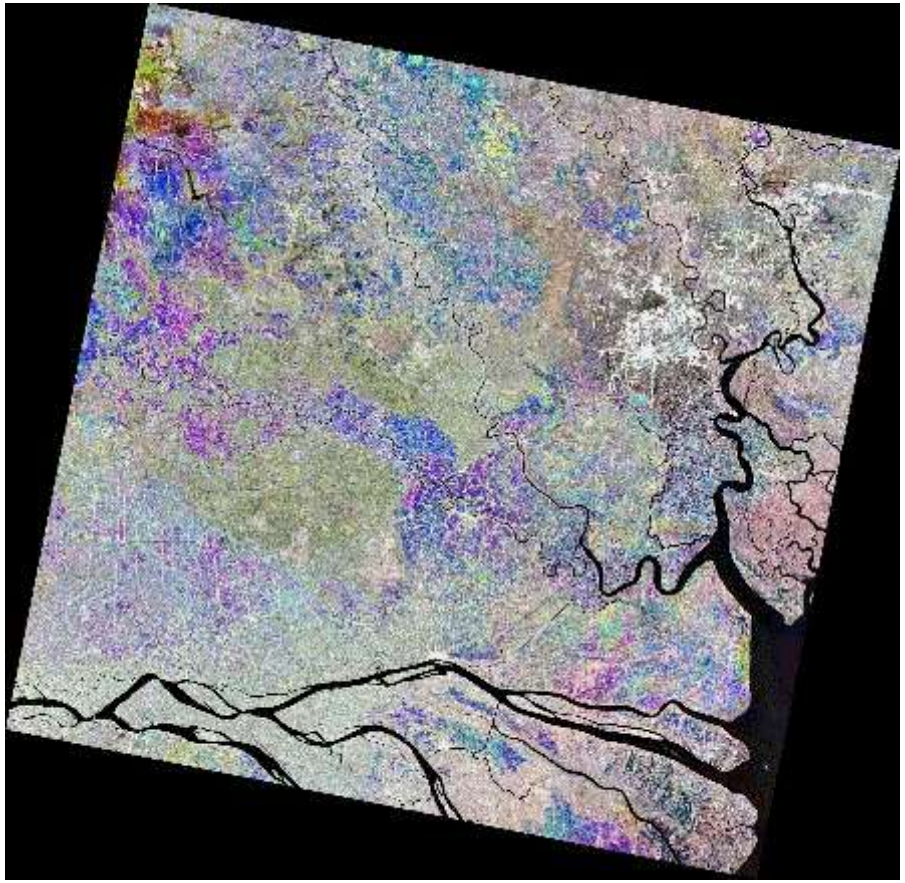


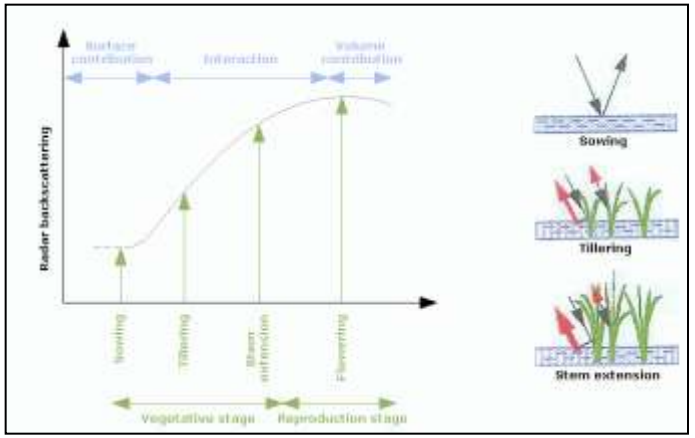
SAR – backscattering coefficient



SAR – coherence

Temporal – Synthetic Aperture Radar

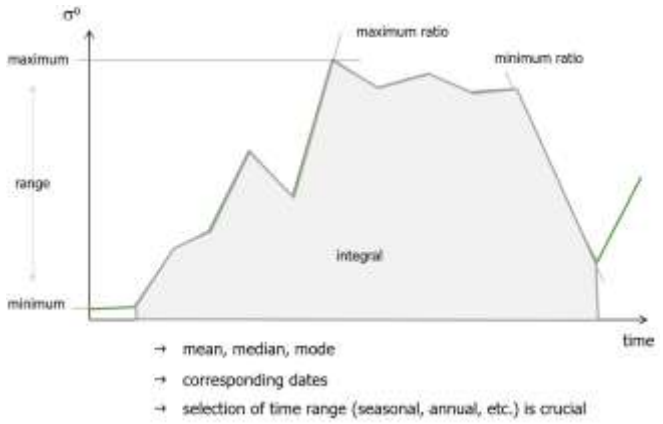




How temporal data should be used?

1. Temporal descriptors

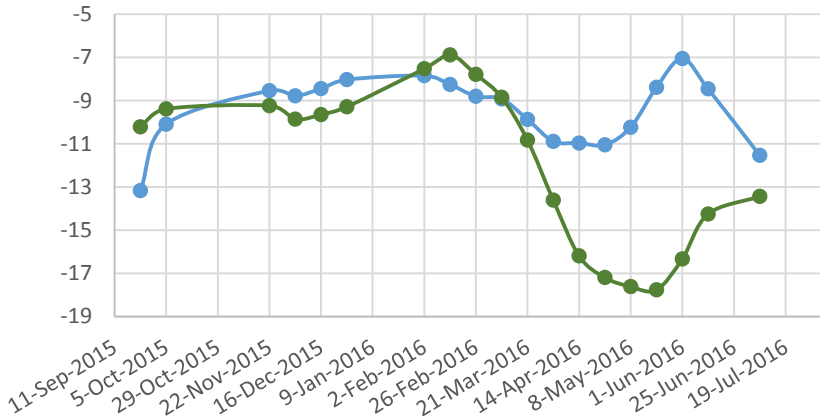
A priori information is not required



2. Dedicated temporal analysis (including modeling)

A priori information is required, as for instance

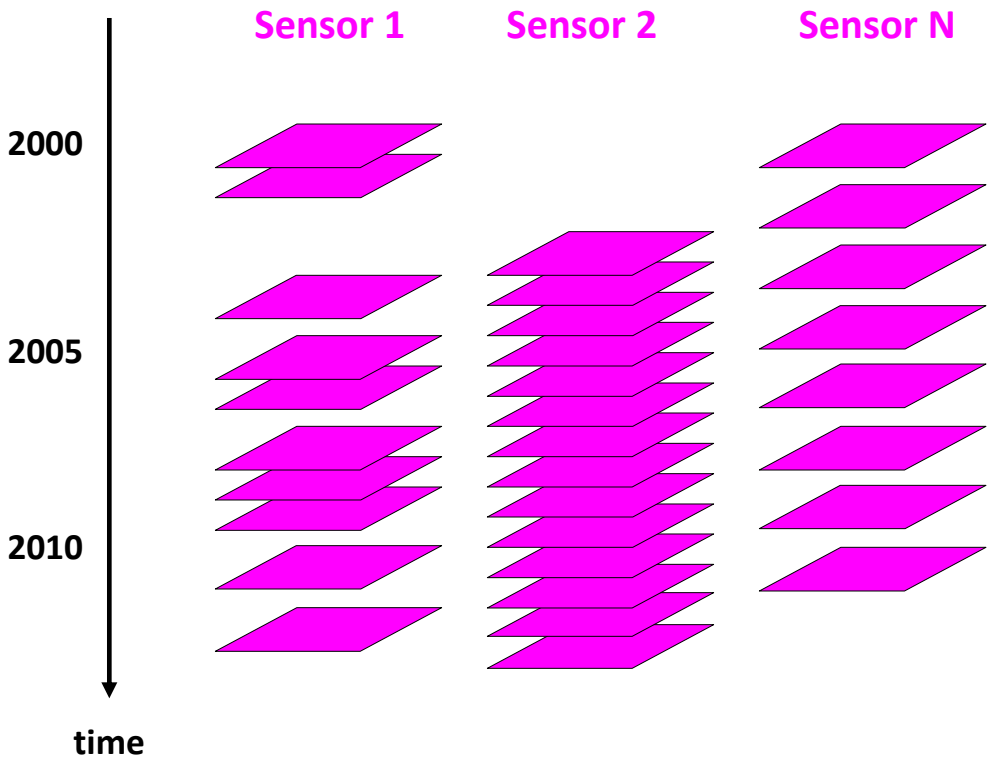
- crop type,
- calendar,
- phenology,
- duration,
- practices



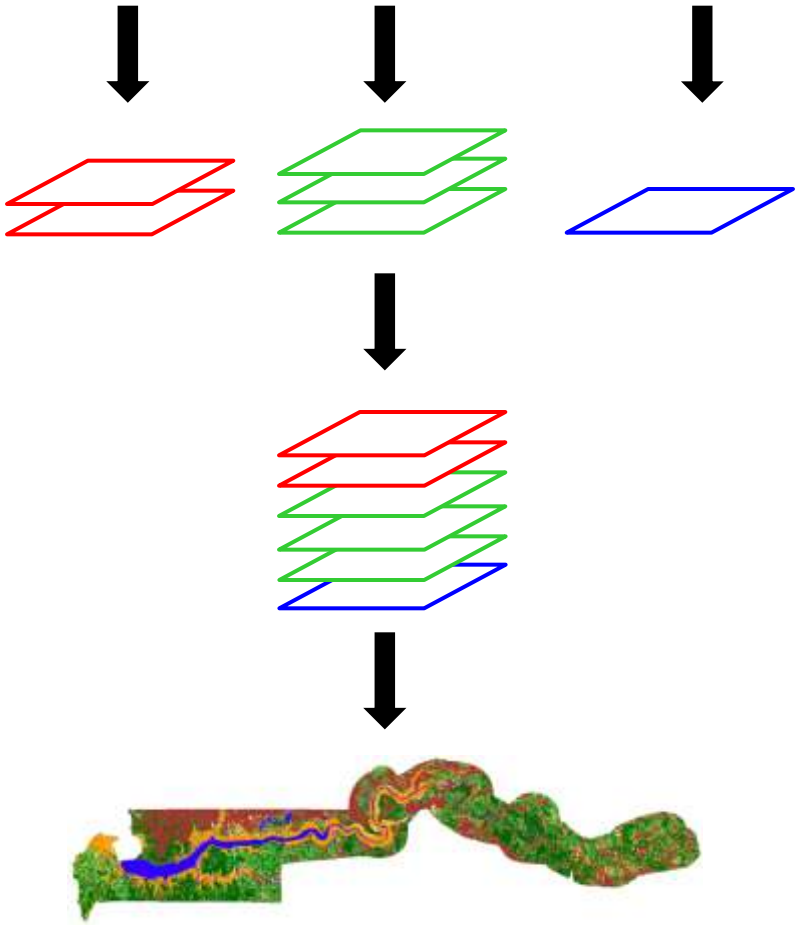
Three selected examples

- Gambia and Malawi
- Hungary
- SE-Asia

Multi-temporal multi-sensor time-series analysis



Multi-temporal multi-sensor time-series analysis

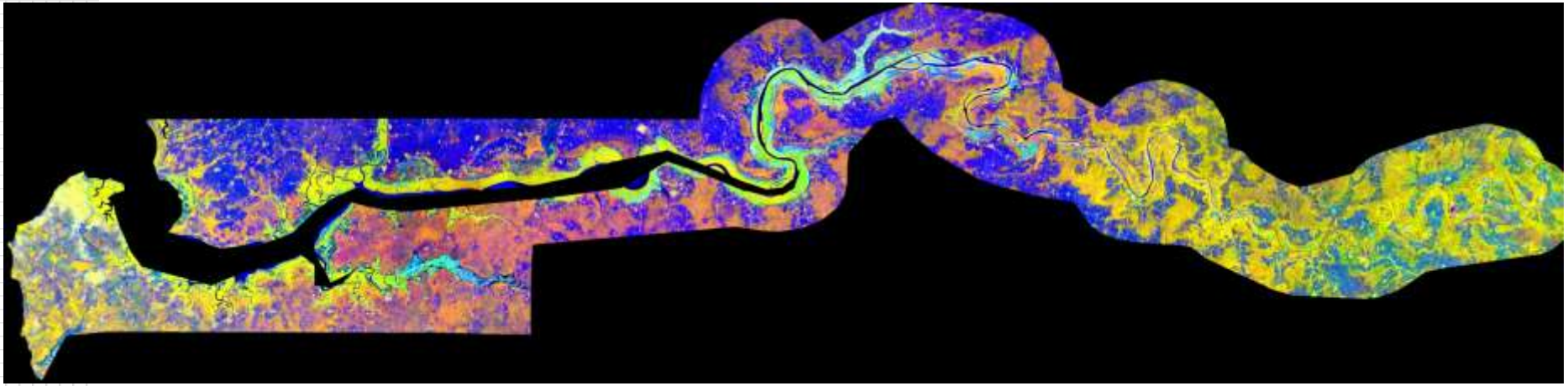


temporal-spectral descriptors for a given time period

temporal-spectral descriptors fusion

Land Cover Map

Gambia – Multi-annual ASAR AP and ALOS PALSAR-1 FBD mosaic, 15m

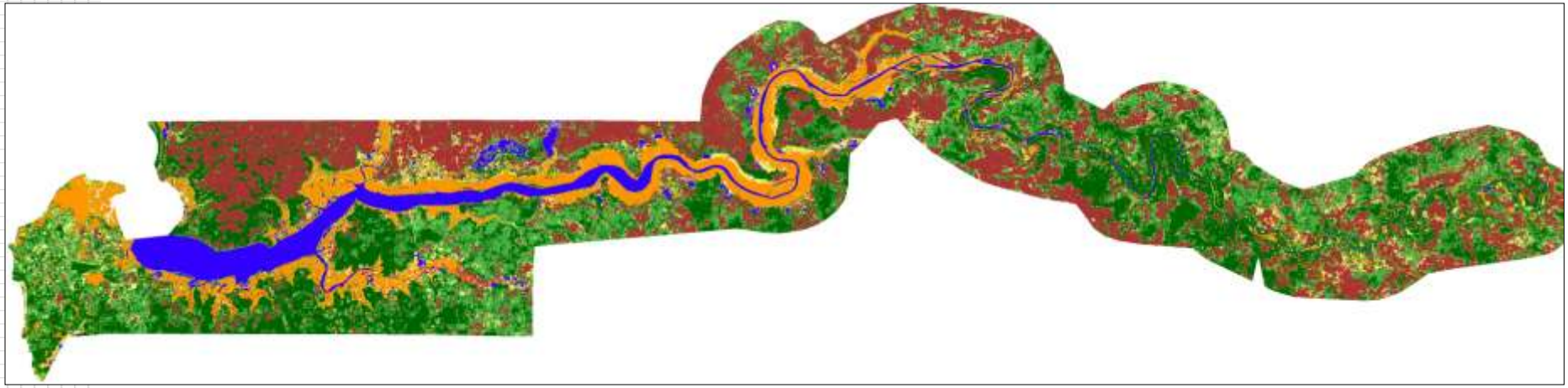


ALOS PALSAR-1 mean L-HV pre-crop season

ENVISAT ASAR mean C-HH pre-crop season

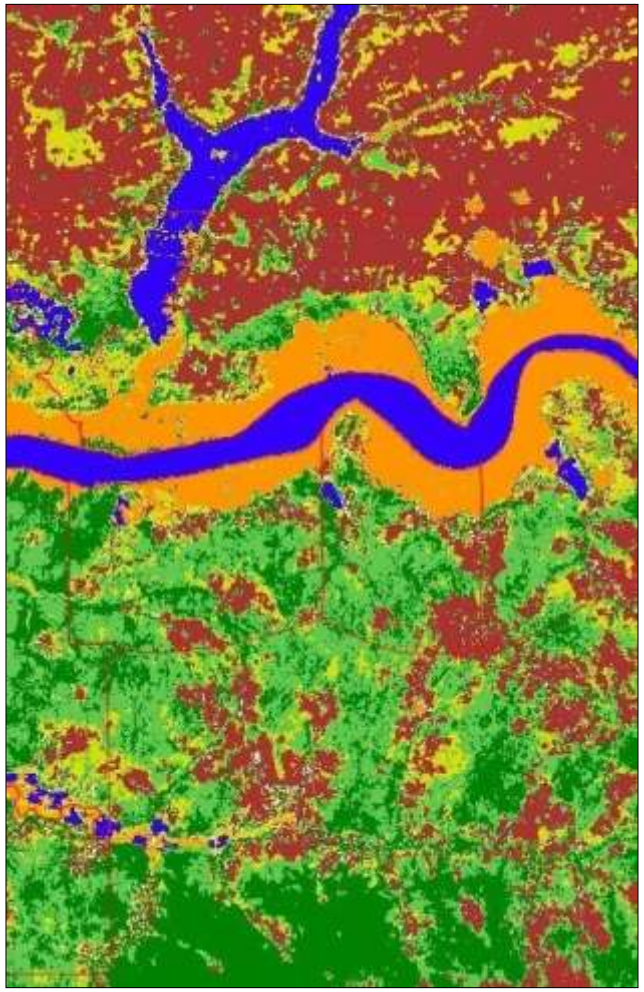
ENVISAT ASAR C-HH difference crop and pre-crop season

Gambia – Land Cover Map, 15m



Agricultural area
Mangrove - Sandbanks
Water
Bare soil-weak vegetation (low biomass)
Medium vegetation (medium biomass)
Strong vegetation (high biomass)

Gambia – Land Cover Map, 15m – Detail



Agricultural area
Mangrove - Sandbanks
Water
Bare soil-weak vegetation (low biomass)
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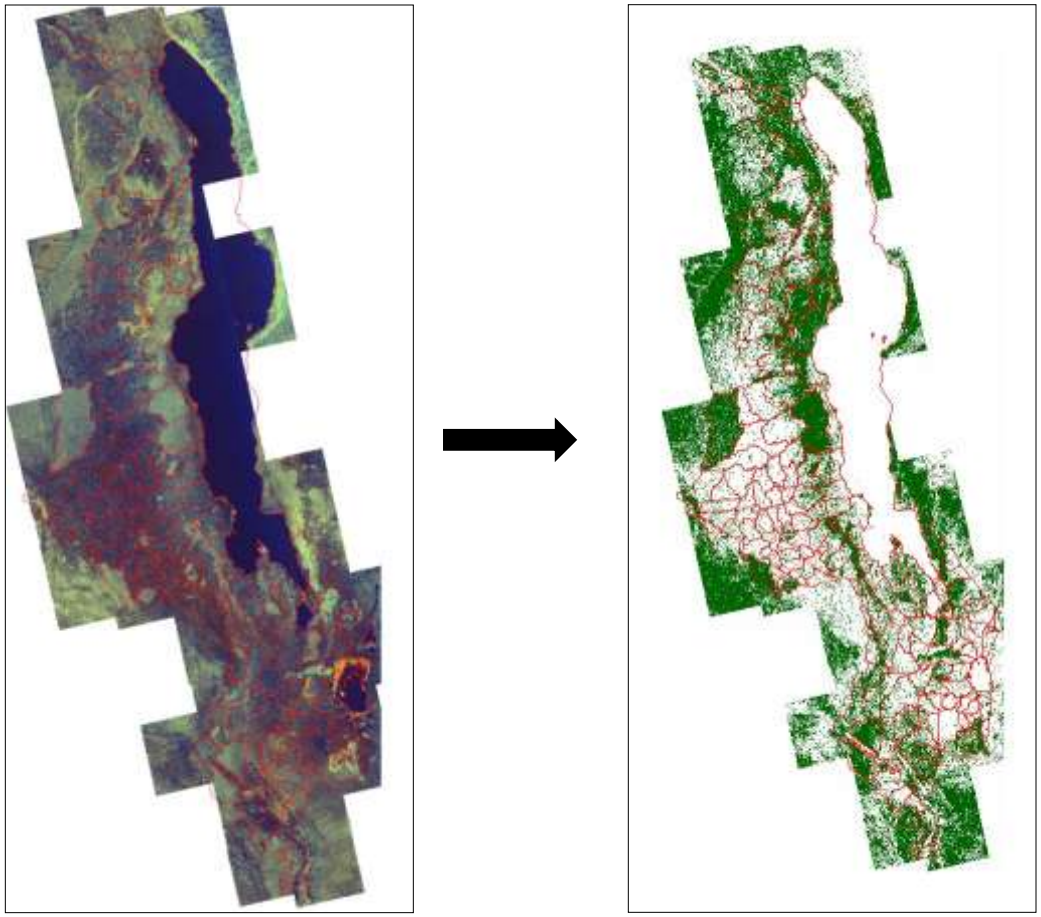
2002-12 Vegetation Productivity Index for agricultural area at 250 m

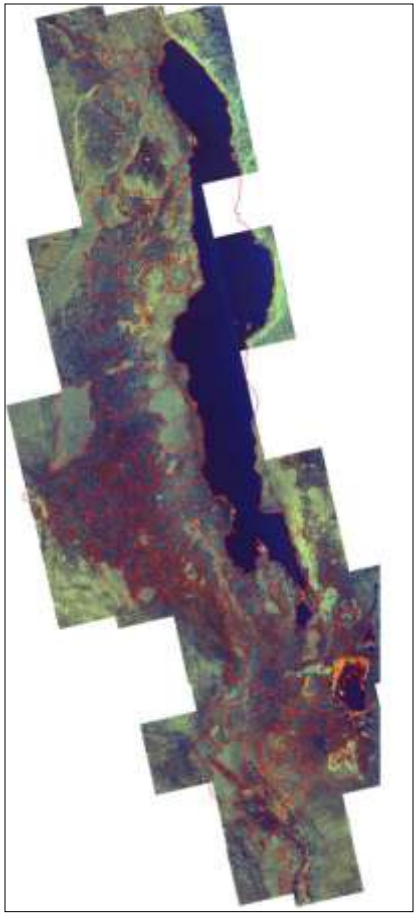
- The VPI has been derived from Aqua and Terra MODIS 250m every 8 days from 2002 to 2012
- It is relative to Mid September (approximately peak of season) of each year

Malawi – Forest area

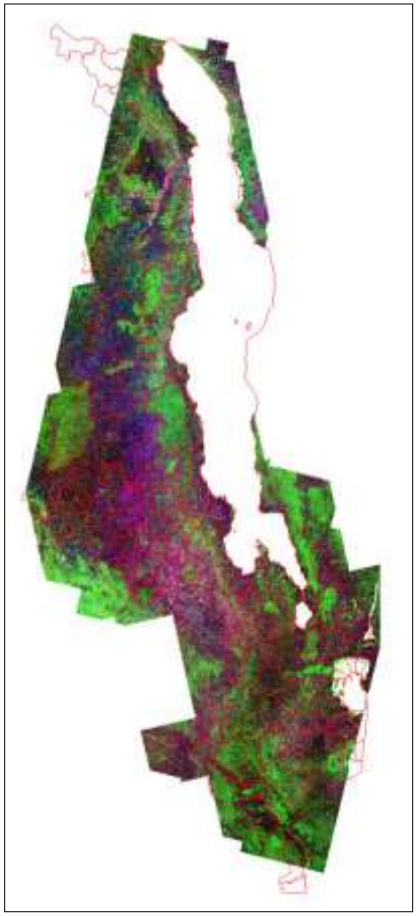


Multi-annual PALSAR-1 HH-HV during dry season

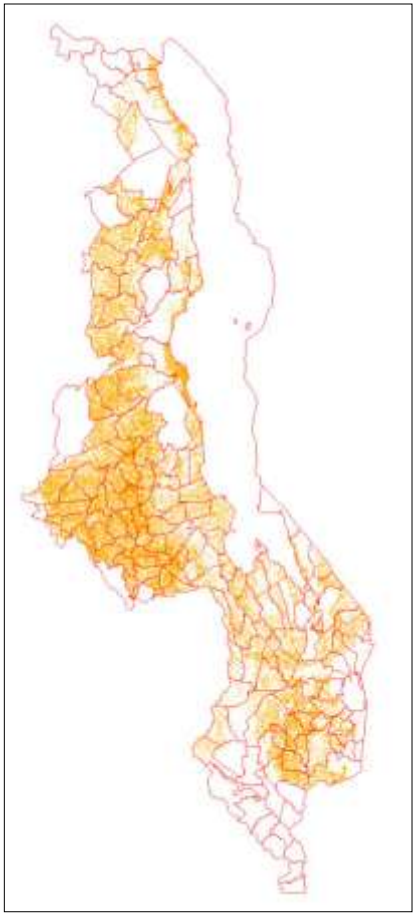
Malawi – Cultivated area



Multi-annual PALSAR-1 HH-HV
during dry season

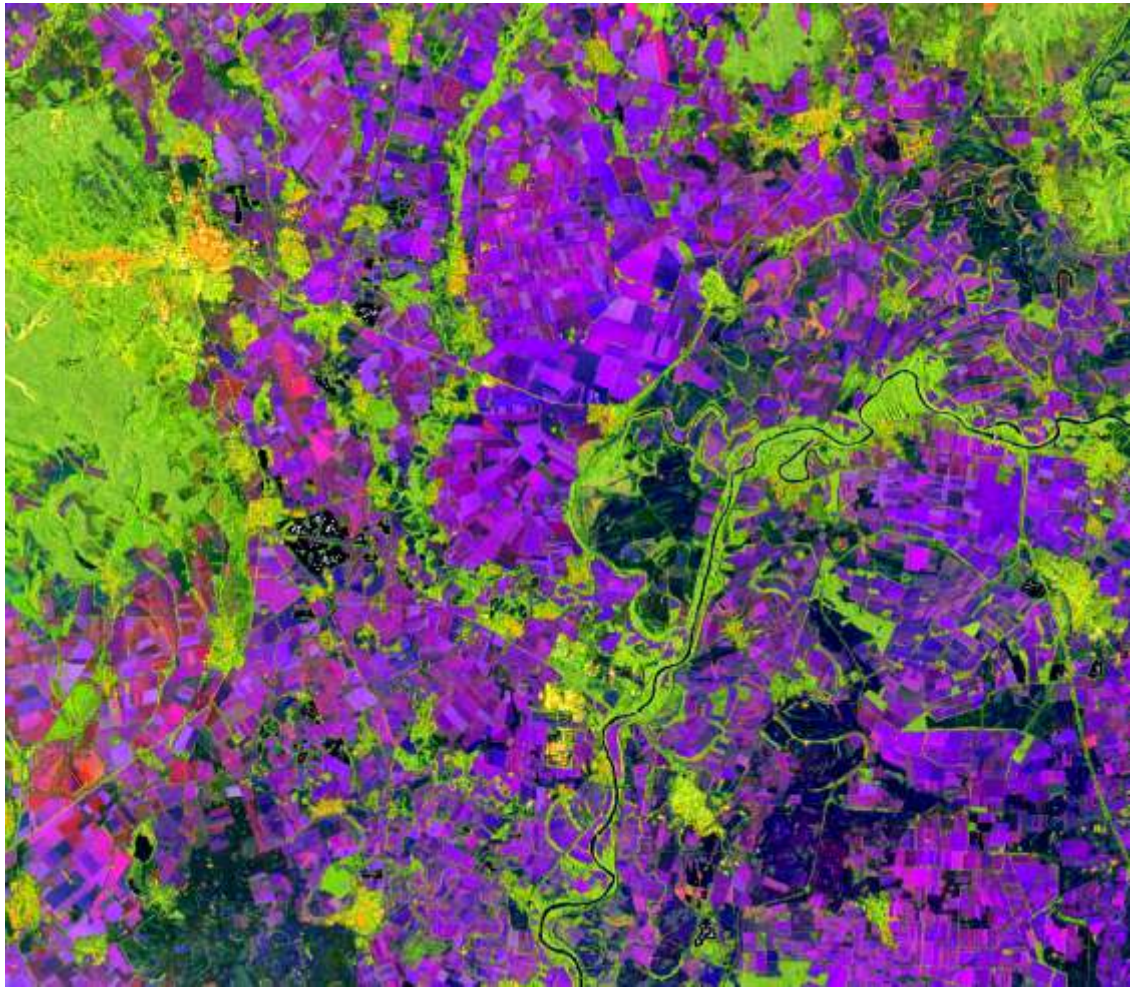


ASAR HH PALSAR HV ASAR HH
ASAR data during wet (crop) season

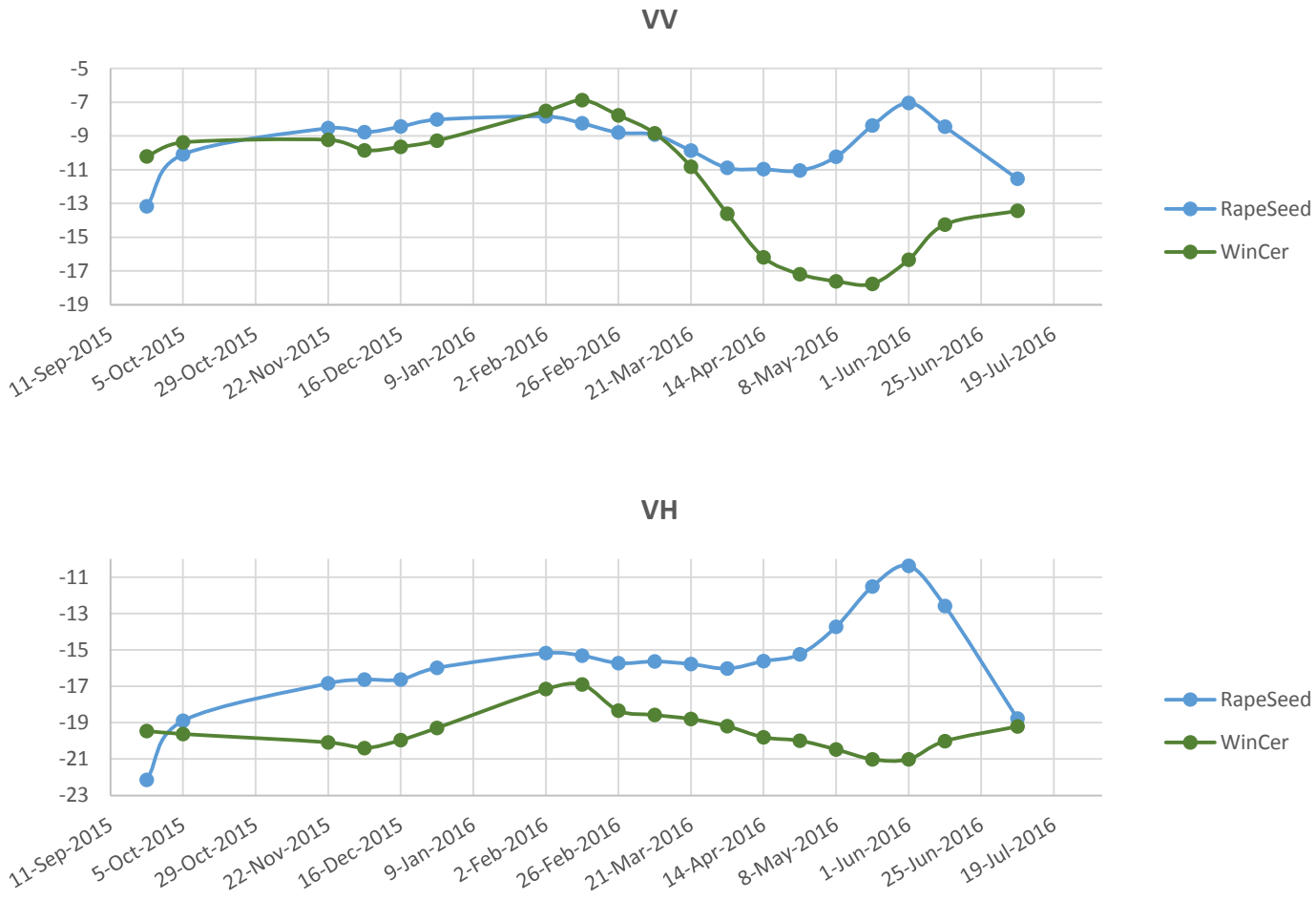


Cultivated Area

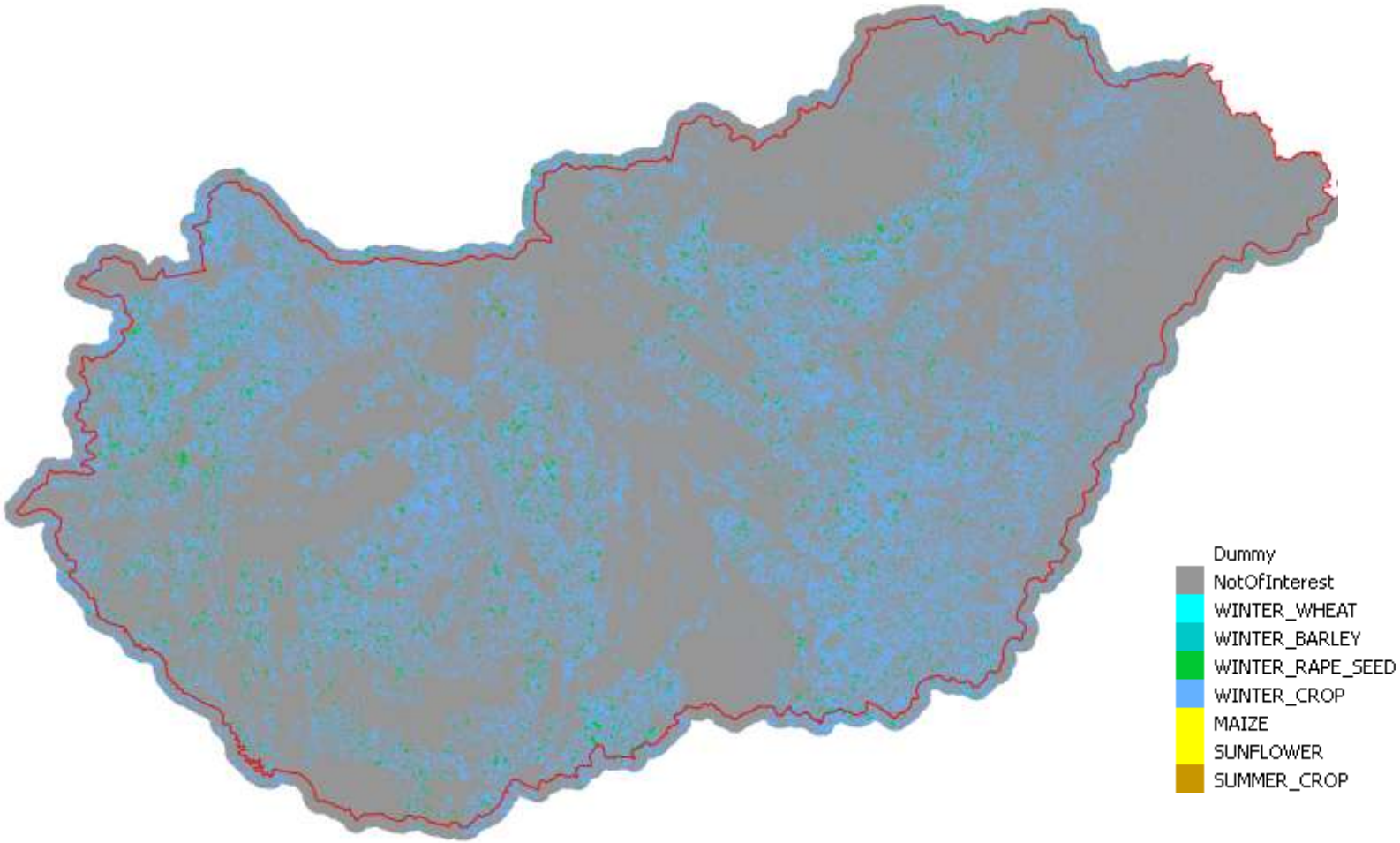
Hungary – Sentinel-1 national coverage



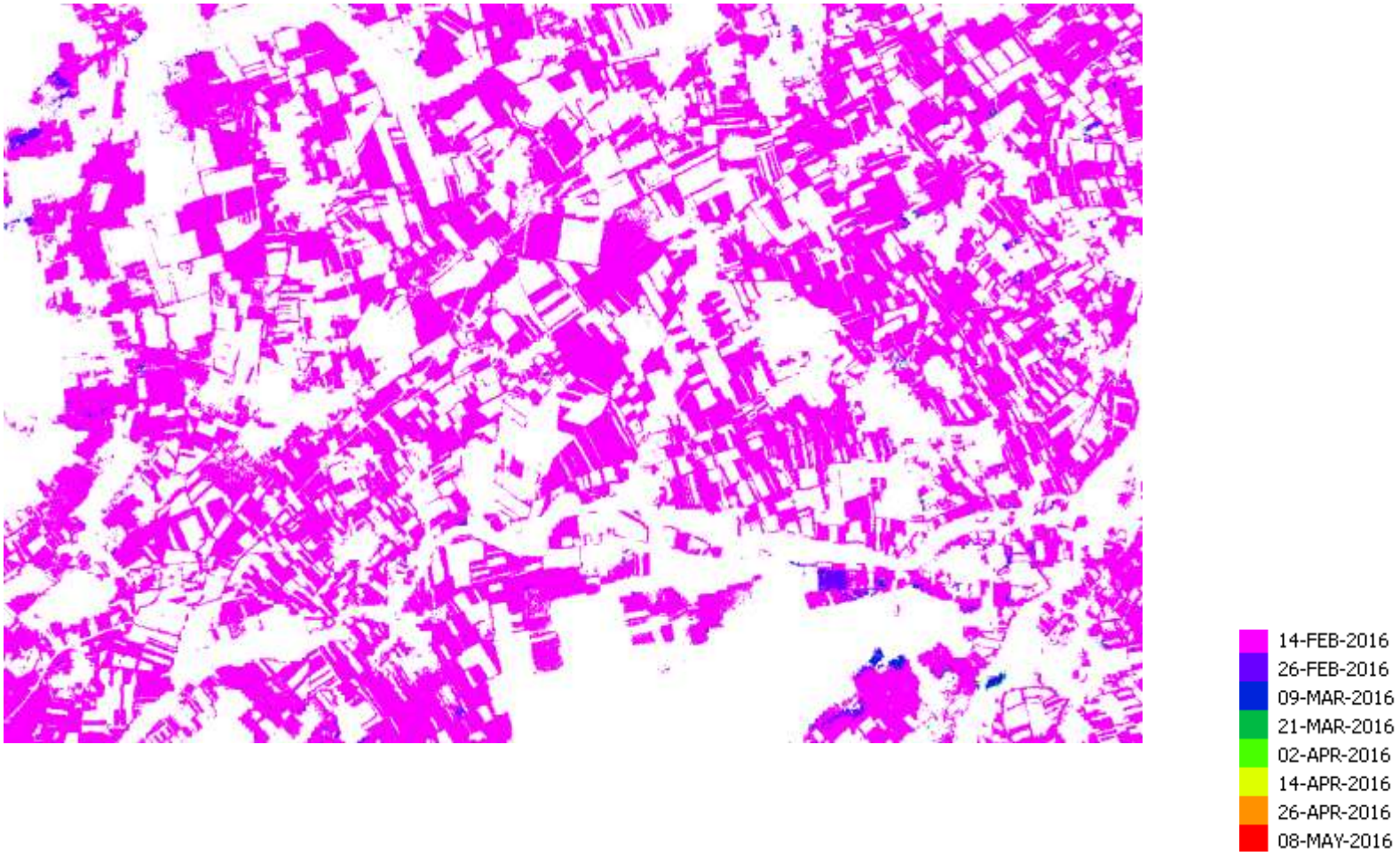
Hungary – Sentinel-1 Intensity temporal signature



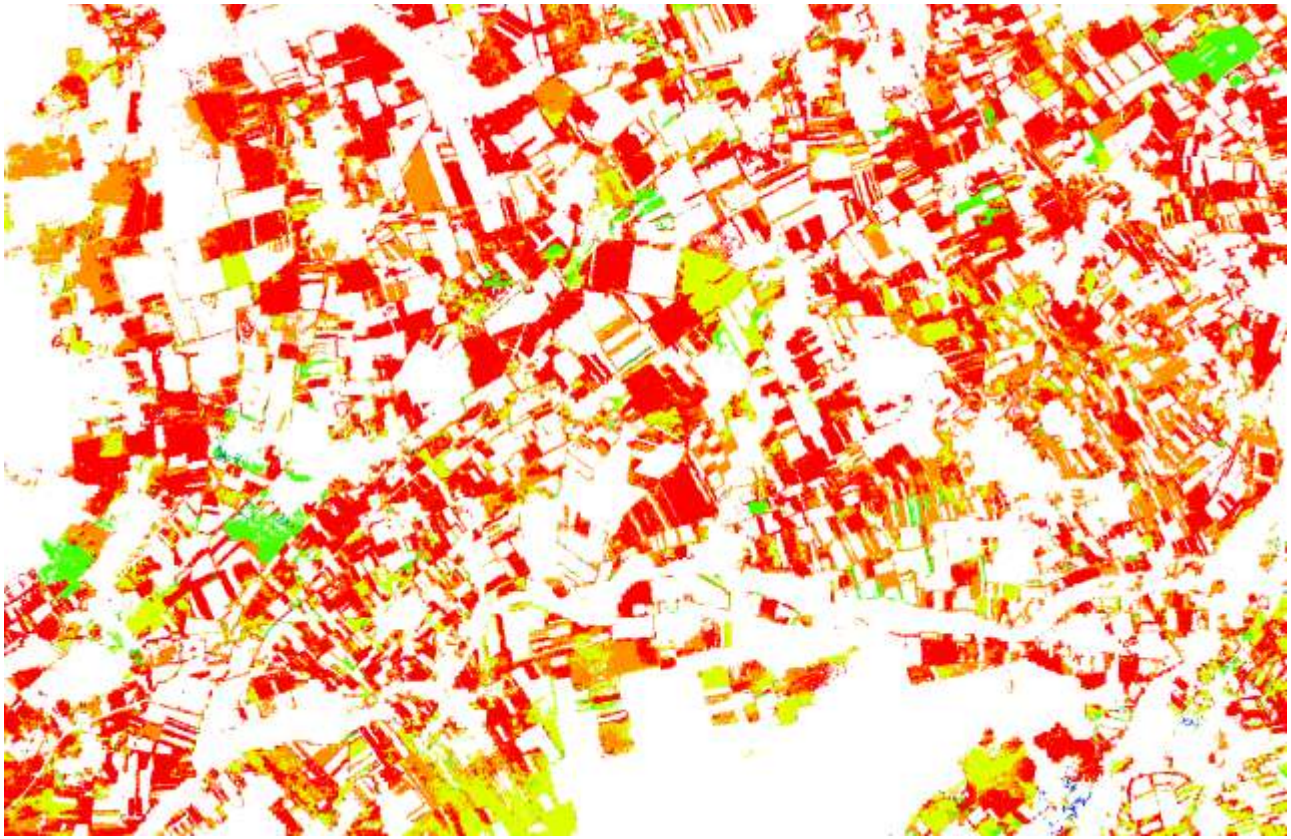
Hungary – Winter crop map 2015-2016



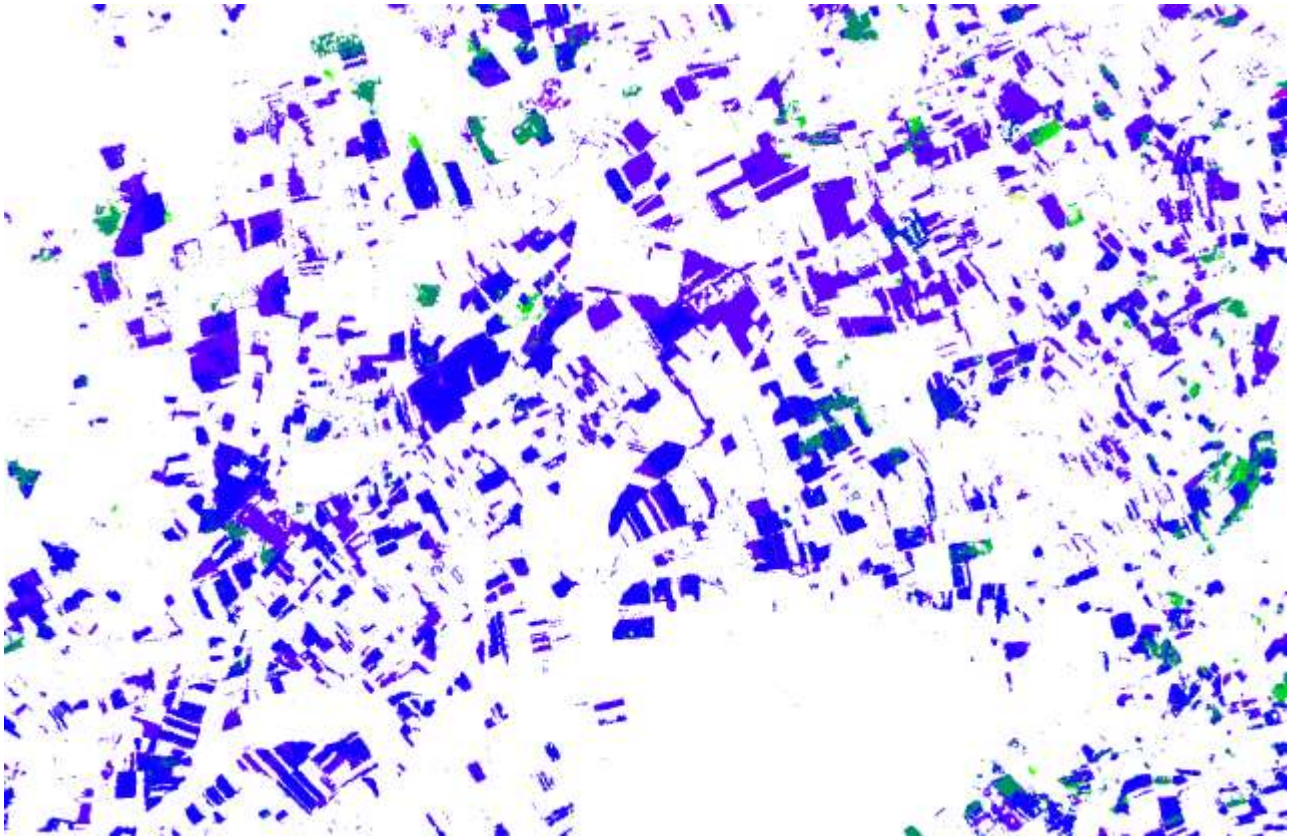
Crop Development Index – Start of Vegetative phase (winter cereal)



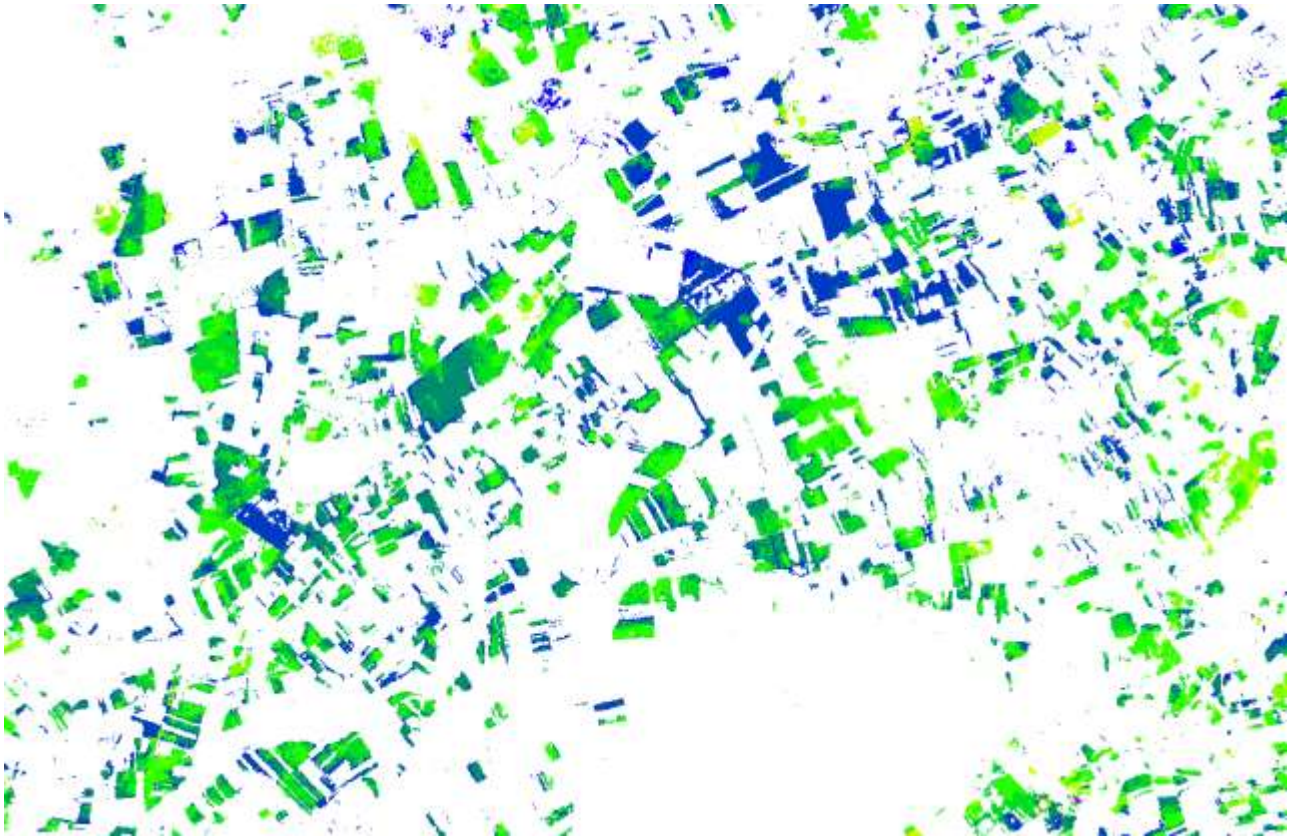
Crop Development Index – Vegetative Peak (winter cereal)



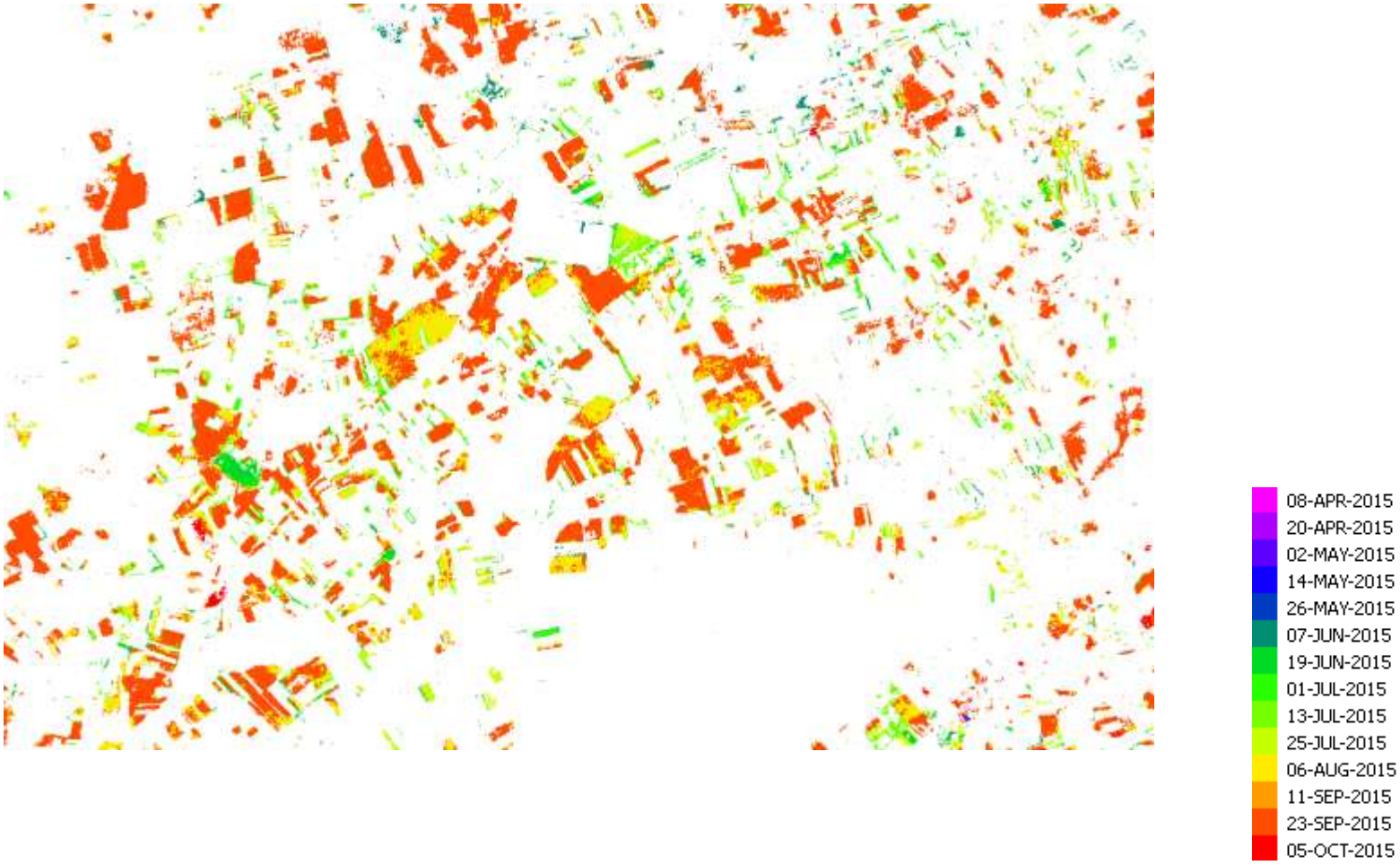
Crop Development Index – Start of Season (summer crop)



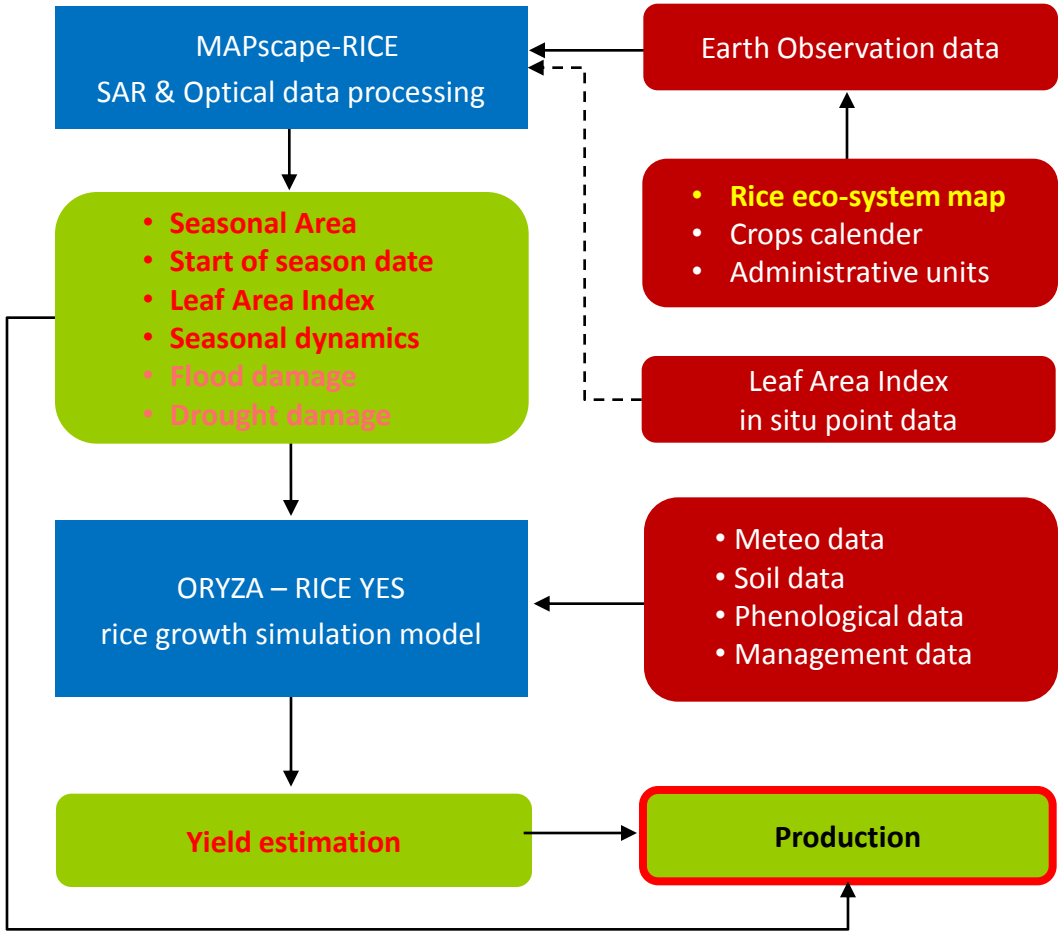
Crop Development Index – Start of Vegetative phase (summer crop)



Crop Development Index – Start of Maturity phase (summer crop)



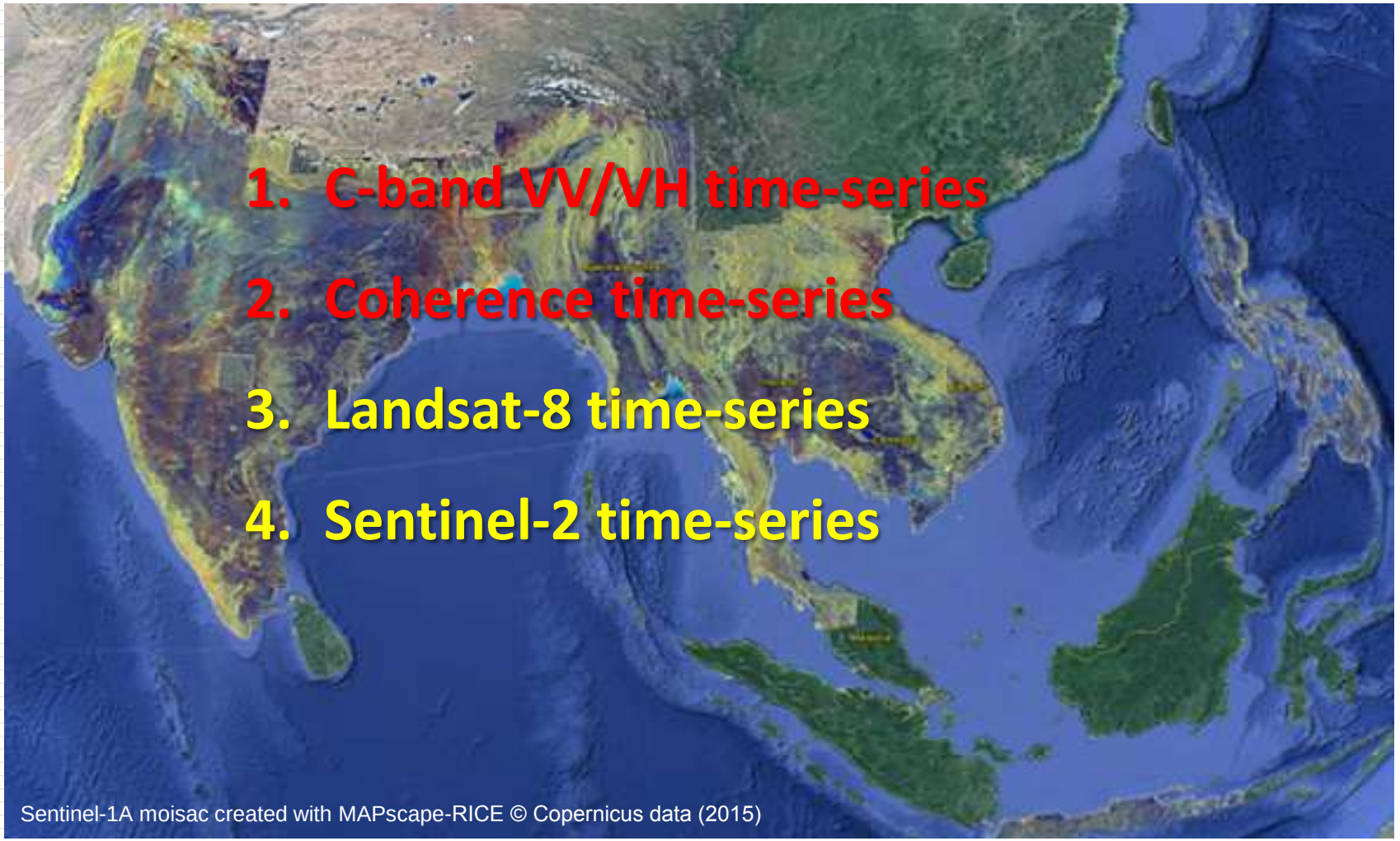
Remote sensing and yield modeling – The RIICE service



RIICE answers to three crucial questions:

- **Where?**
- **When?**
- **How much?**

National to continental scale



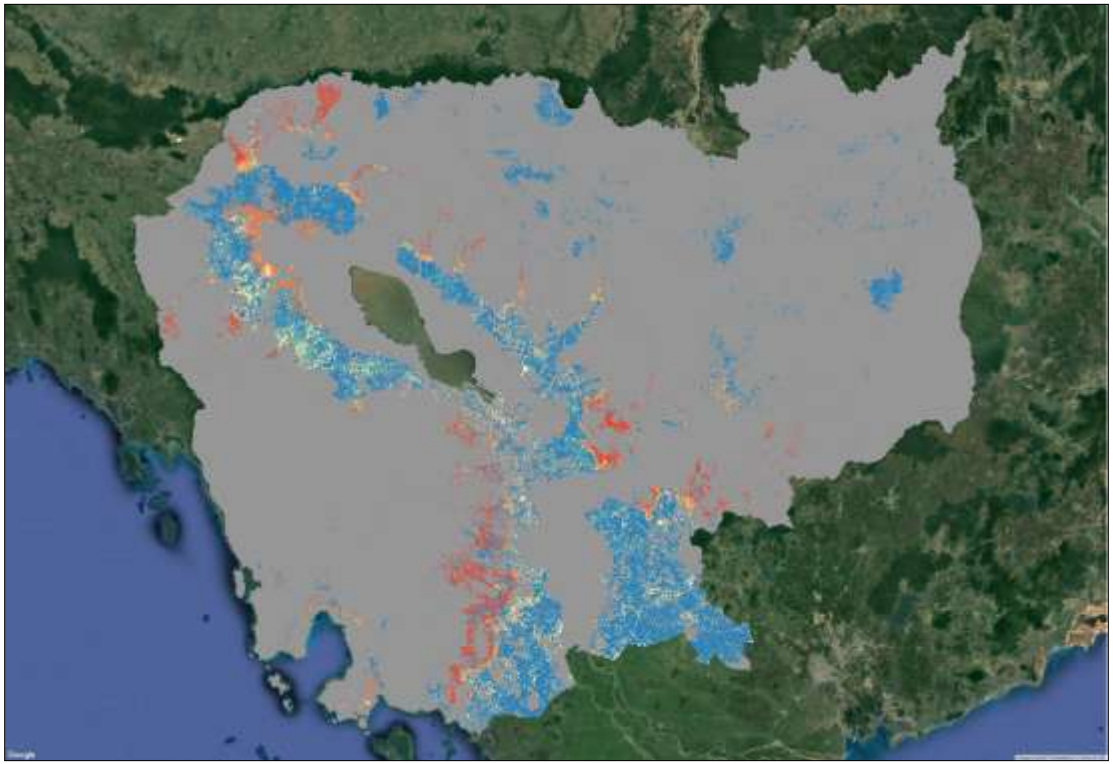
Service infrastructure

All **Earth Observation** data are transferred, stored, processed and analyzed on the cloud.

All **field data** collected by mobile phone, sent to the cloud over mobile or Wi-Fi network.

Users **access information via a web-based** platform from any internet enabled device.

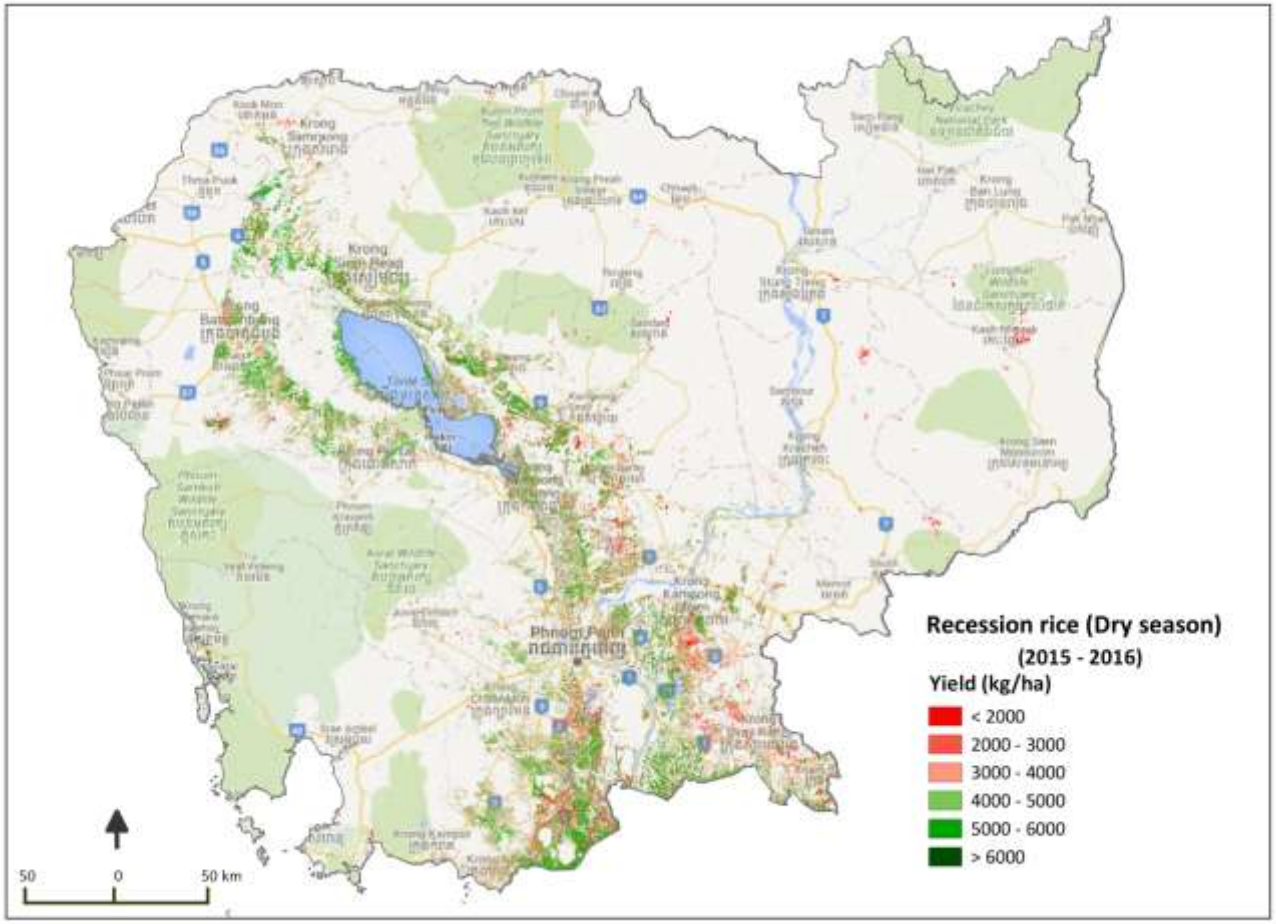
Cambodia – Rice eco-system map



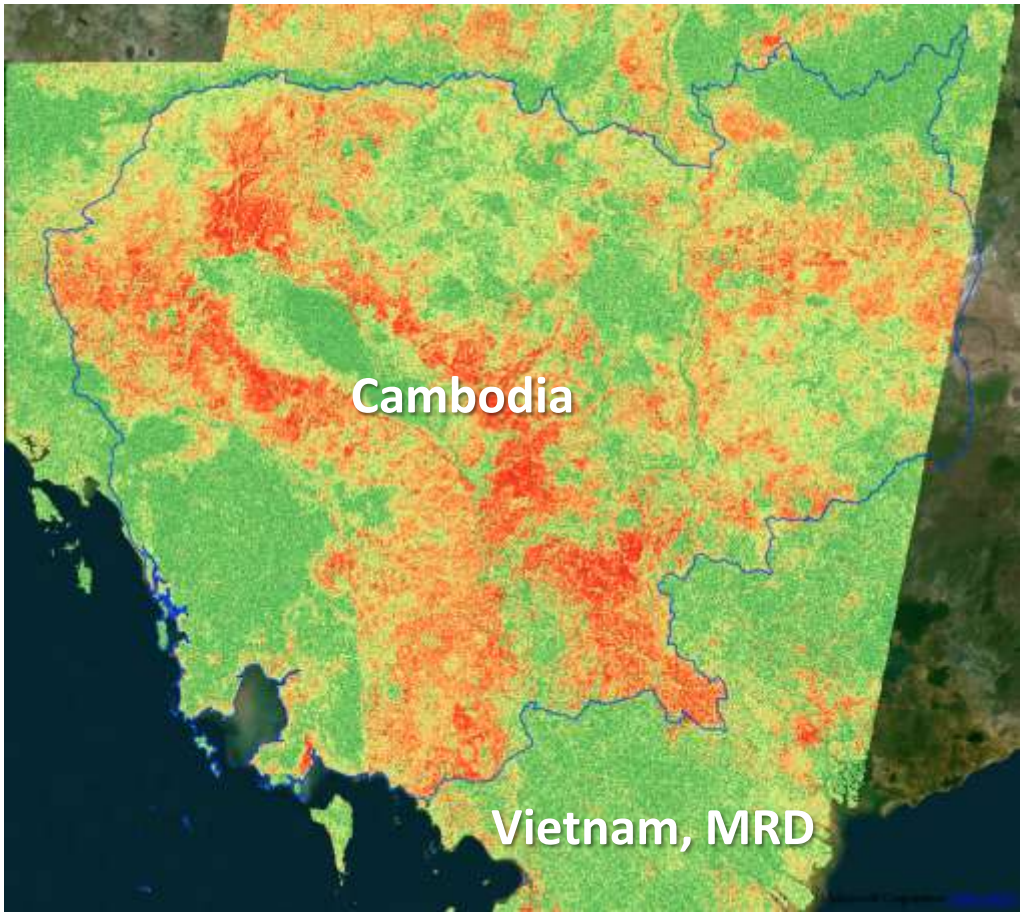
Map Class	Rice Ecosystem Class
0	No classified
1	Upland Rice (1)
2	Deepwater or Floating Rice (3)
3	Early Wet Season Rice (2.2; 2.4; 2.6)
4	Pre-rising EWS Rice (2.7)
5	Recession DS Rice (4.1)
6	Irrigated DS Rice (4.2)
7	Upper field RLR (2.2)
8	Medium field RLR (2.4)
9	Lower field RLR (2.6)
10	Upper field RLR (2.2)
11	Medium field RLR (2.3)
12	Lower field RLR (2.6)

Based on Sentinel-1 12 days VV/VH data acquired from January 2016 to March 2017

Cambodia – Dry season 2015-16



Cambodia – Early Wet Season 2016, Spring drought (El Niño)

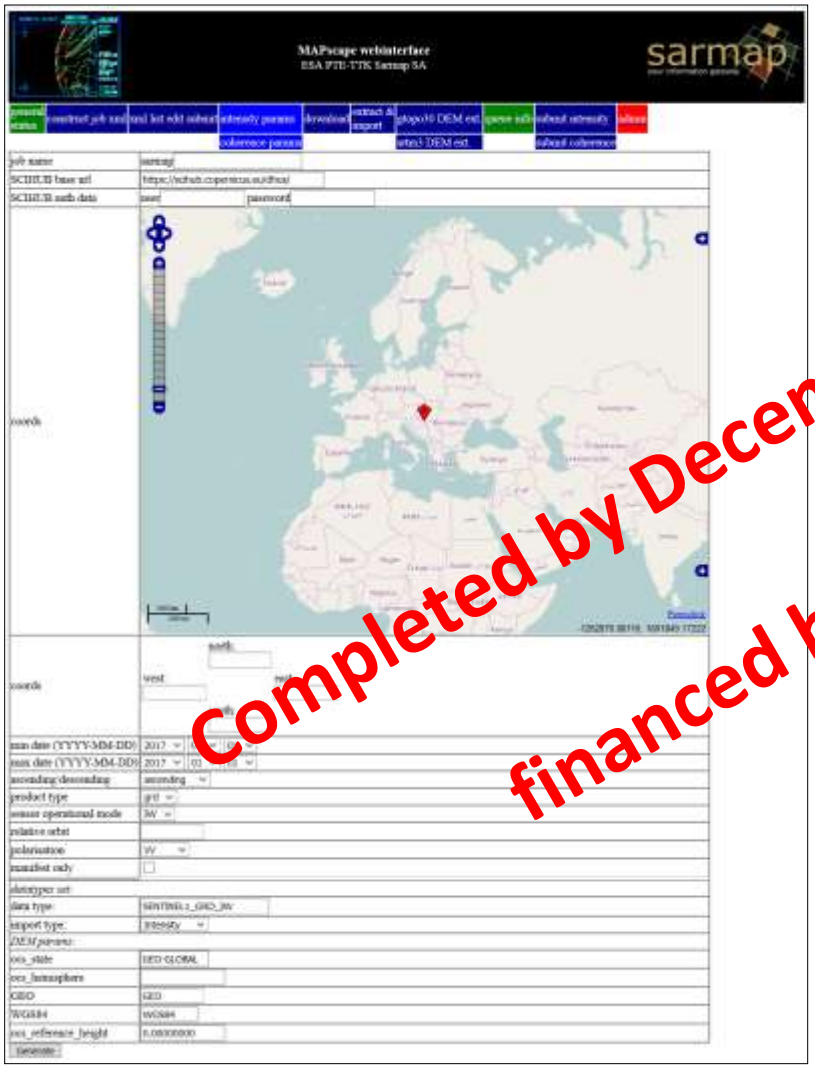


	slightly vegetated	bare soil/dry veg	bare soil

Big data
needs
big processing
capabilities!

Therefore …

Rapid Sentinel-1 processing chain on Pécs supercomputer



- Exploit supercomputer capabilities
- Highly automated
- Rapid data processing
- State-of-the-art algorithms

Completed by December 2017

financed by ESA

Rapid Sentinel-1 processing chain on Pécs supercomputer

Thank you for your time and attention

BTW … all data have been processed using