Utilizing SAR data for land monitoring - LandScane project

University of Pécs & SARMAP

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Scerin-3 Capacity Building Workshop,

Transilvania University in Brasov, Romania

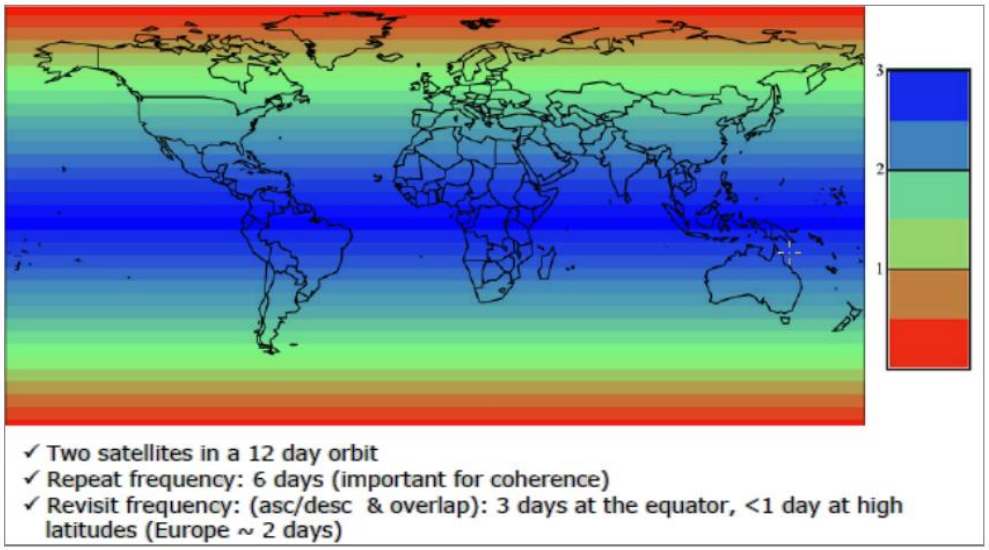
Outline

- General overview of LandScane project:
  - Partners,
  - Hardwer background,
  - Software components,
  - Main targets.
- Present status of LandScane project:
  - RS data processing
  - Capacity building
- Further development

General idea of the project

- Sentinel-1A has opened a new age in SAR remote sensing,
- Regulary collected and freely available SAR data,
- Directly downlaodable via Sentinel Data Hub,
- This development pararelly led to challenges for EO data users:
  - Computing capacity of desktop PCs
  - storage capacity on local harddrive

Revisit time



https://sentinel.esa.int/web/sentinel/user-guides/sentinel-1-sar/overview

SAR system

- SAR vs other Earth Observation Instruments

	Lidar	Optical Multi-Spectral	SAR
Platform	airborne	airborne/spaceborne	airborne/spaceborne
Radiation	own radiation	reflected sunlight	own radiation
Spectrum	infrared	visible/infrared	microwave
Frequency	single frequency	multi-frequency	multi-frequency
Polarimetry	N.A.	N.A.	polarimetric phase
Interferometry	N.A.	N.A.	interferometric phase
Acquisition time	day/night	day time	day/night
Weather	blocked by clouds	blocked by clouds	see through clouds

http://earth.eo.esa.int/download/eoedu/Earthnet-website-material/to-access-from-Earthnet/2008_Bilko-SAR-Land-Applications-Tutorial/sar_land_apps_1_theory.pdf

LandScan project

- Partners:
  - SARMAP SA, Purasca Switzerland, www.sarmap.ch
  - University of Pécs, Institute of Mathematics and Informatics, Institute of Geography
    - NIIF (National Information Infrastructure Development Institute)– owner of the HPC network in Hungary
- Duration: 06.2015 – 06.2016

SARPROC project

Hardware background

- Currently we use the ***SGI UV 1000*** supercomputer placed at the University of Pecs, which is a ***1152 core*** SMP computer with ***6 Terabyte memory*** and ***10 Tflops*** computing capacity. The main advantege of this computer is the **unified memory acces** for the whole of the memory for a process.
- In the near we will use the supercomputer HP SL250s in Debrecen. This computer consists of 84 nodes and has all together ***1344 cores***. One node can access 125 Gigabyte of memory, and has ***2 Nvidia K20x*** accelerator cards. The total computing capacity of this new computer is **202 Tflops**. The main advantage of this computer are the Nvidia accelerator cards, which give the computer its main computing power.

http://www.111.hu/blog/ujra-van-magyar-szuperszamitogep-a-Top500-listan

MAPscape

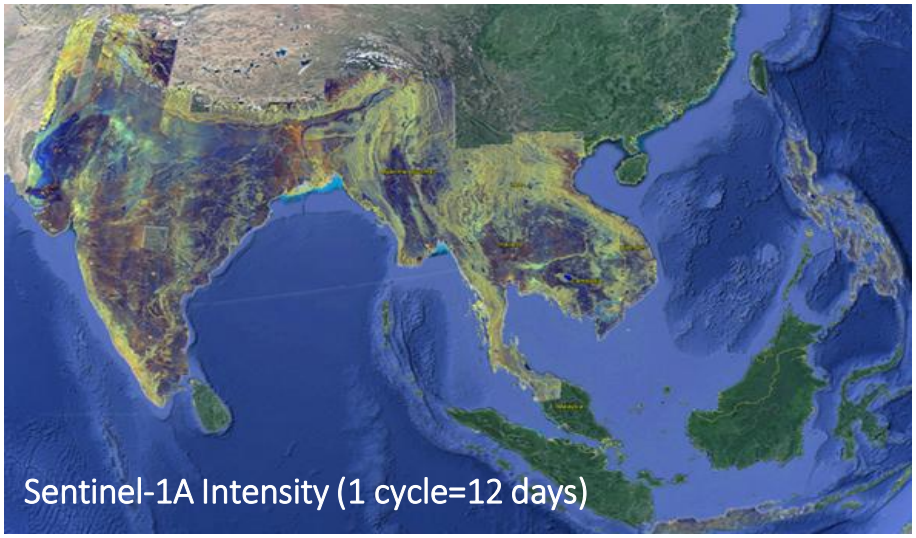
- It is a dedicated remote sensing processing chain developed by sarmap and written in C++. It is interfaced to IDL Virtual Machine (free software) to manage, through panels, input/output files and related input parameters.

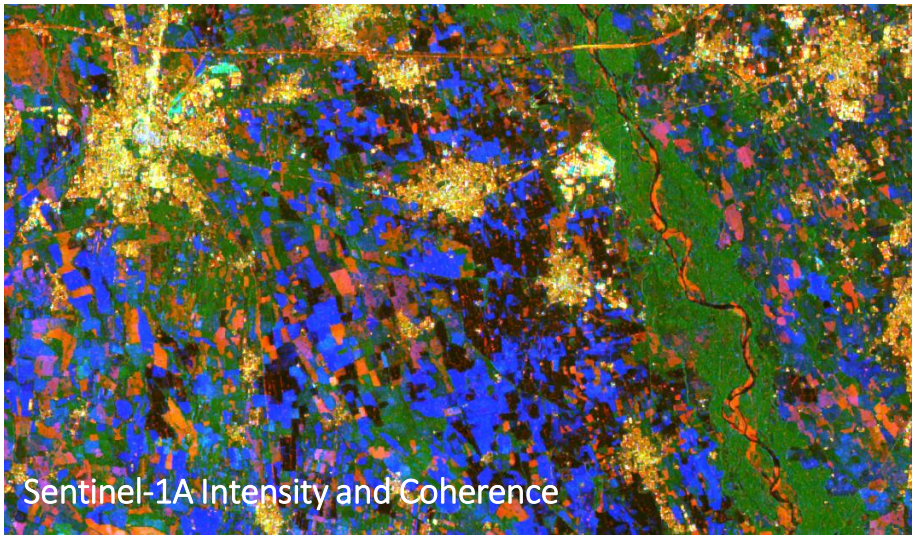
- Processing environment
  - Stand-alone PC
  - Cluster solution
  - Cloud computing on Amazon AWS
  - SGI University of Pécs

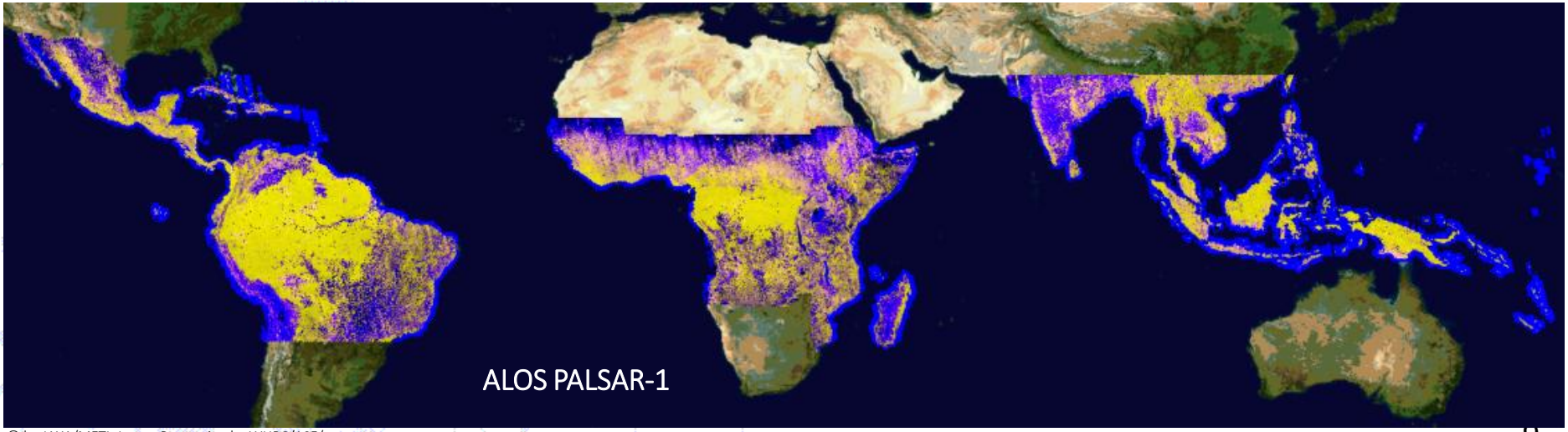
MAPscape – Supported sensors

ENVISAT ASAR	ESA	free of charge
ALOS PALSAR-1	JAXA, Japan	commercial
COSMO-SkyMed-1-4/5-8	ASI, Italy	commercial
TerraSAR-X	AIRBUS	commercial
RISAT-1	ISRO, India	commercial
RADARSAT-2	MDA, Canada	commercial
Sentinel-1A/B	ESA	free of charge
ALOS-2	JAXA, Japan	commercial
PAZ-1	Hisdesat	commercial
SAOCOM-1A/B	CONAE, Argentina	commercial
Landsat-5	NASA	free of charge
Landsat-8	NASA	free of charge
Sentinel-2A/B	ESA	free of charge
MODIS	NASA	free of charge
Sentinel-3	ESA	free of charge

MAPscape – Examples


Sentinel-1A Intensity (1 cycle=12 days)

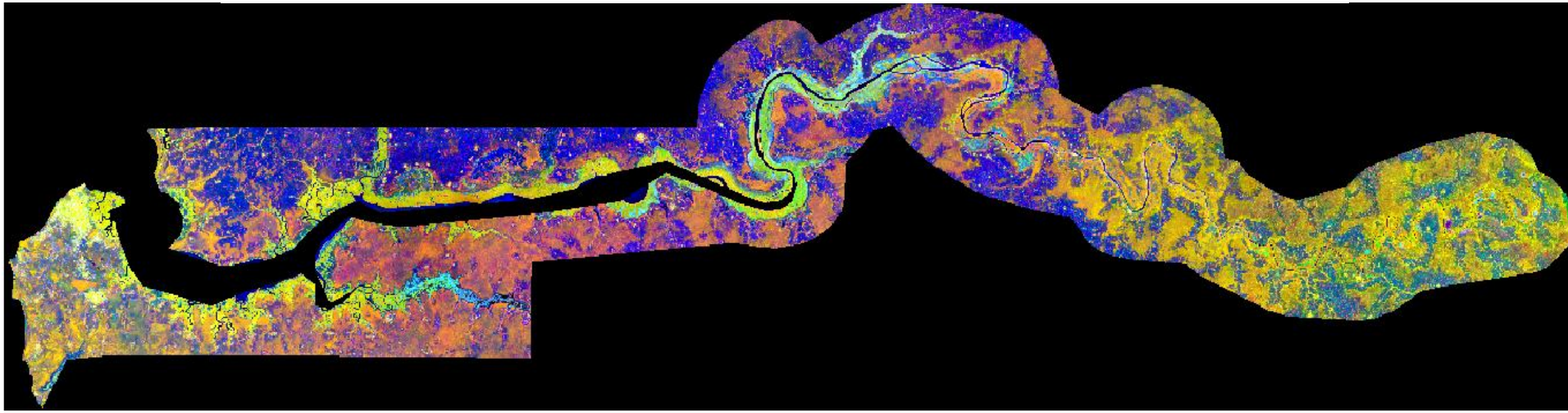

Sentinel-1A Intensity and Coherence


ALOS PALSAR-1

© by JAXA/METI, Image Processing by WHRC/ASF/sarmap.

MAPscape – Example

Multi-annual, multi-sensor (ALOS-ASAR) – Temporal descriptors



ALOS PALSAR-1, 15m (pre-crop season) -2007-2010

ENVISAT ASAR, 15m (pre-crop season) – 2005-2010

ENVISAT ASAR, 15m (difference crop and pre-crop season) – 2005-2010

Agricultural area

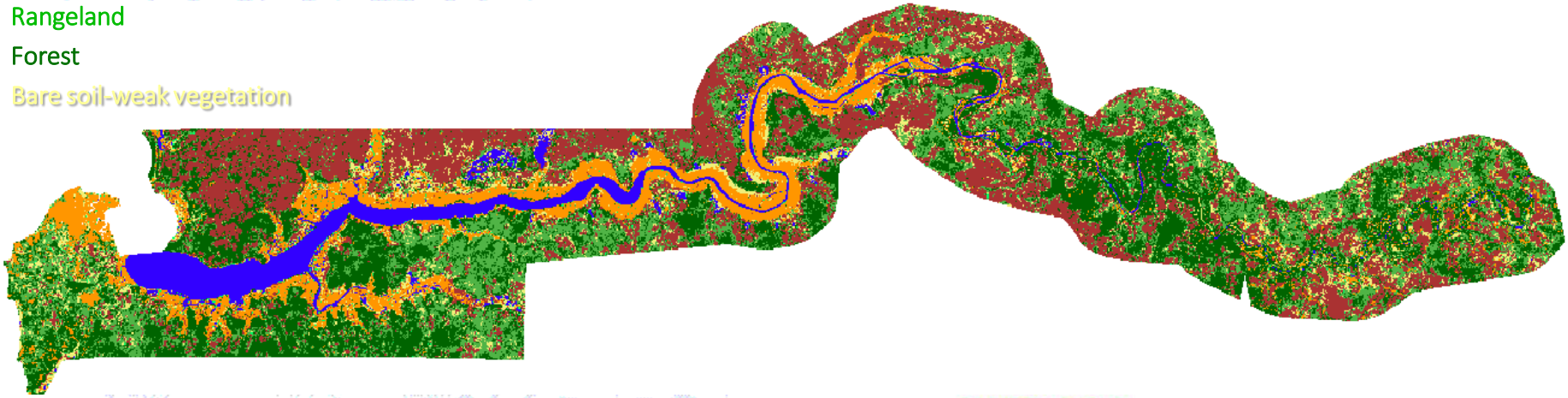
Mangrove

Water

Rangeland

Forest

Bare soil-weak vegetation



Multi-annual, multi-sensor – Land Cover Map

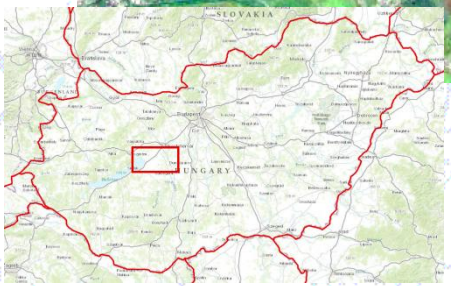
The main goal of LandScane project

- Set up an operational land monitoring system based on SAR data and supercomputing technology.
- The ultimate goal of the project is to implement an automated, operational service for land monitoring purposes at national scale, based on Sentinel-1/-2 data and on sarmap technology.

Identification of stakeholders and definition of stakeholder needs → **Definition of remote sensing products** → **Definition of remote sensing processing chain** → **Evaluation of HPC performance with respect to sarmap solution**

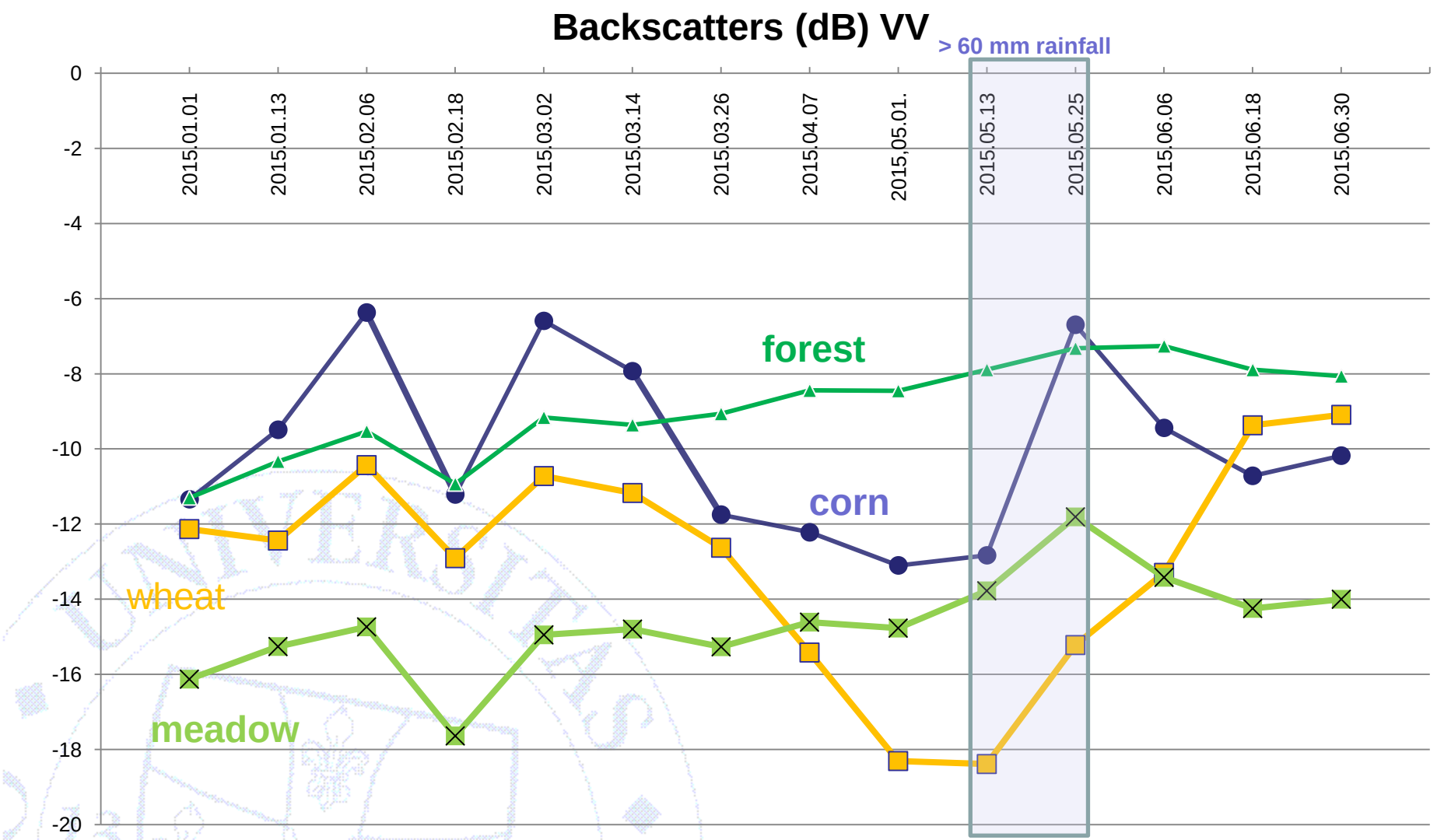
Sentinel-1A Example > Hungary

Inland high ground water level and ice detection

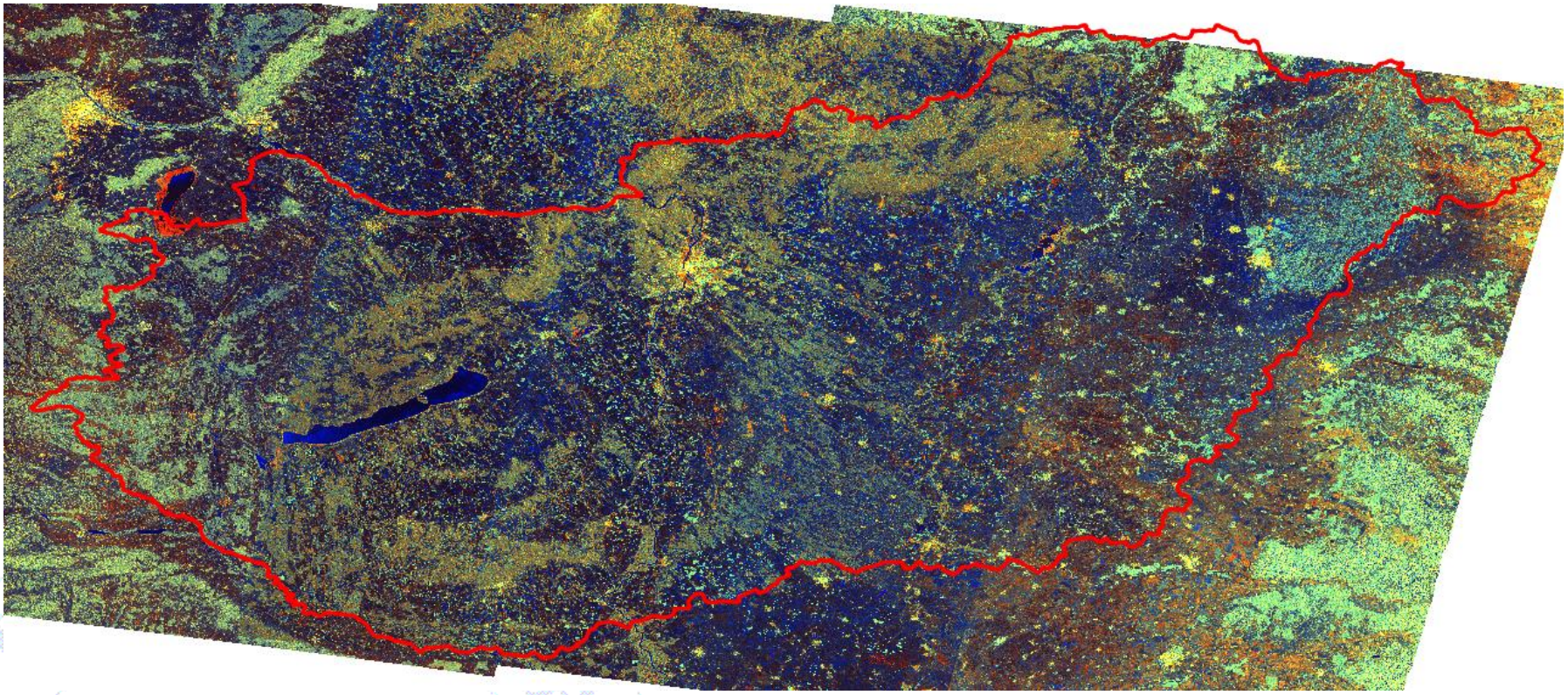


RGB (**13 Jan. 2015** / **09. Oct. 2014** / **01 May 2015**)

Land monitoring – Temporal dynamics of vegatetion (dB VV S1A)

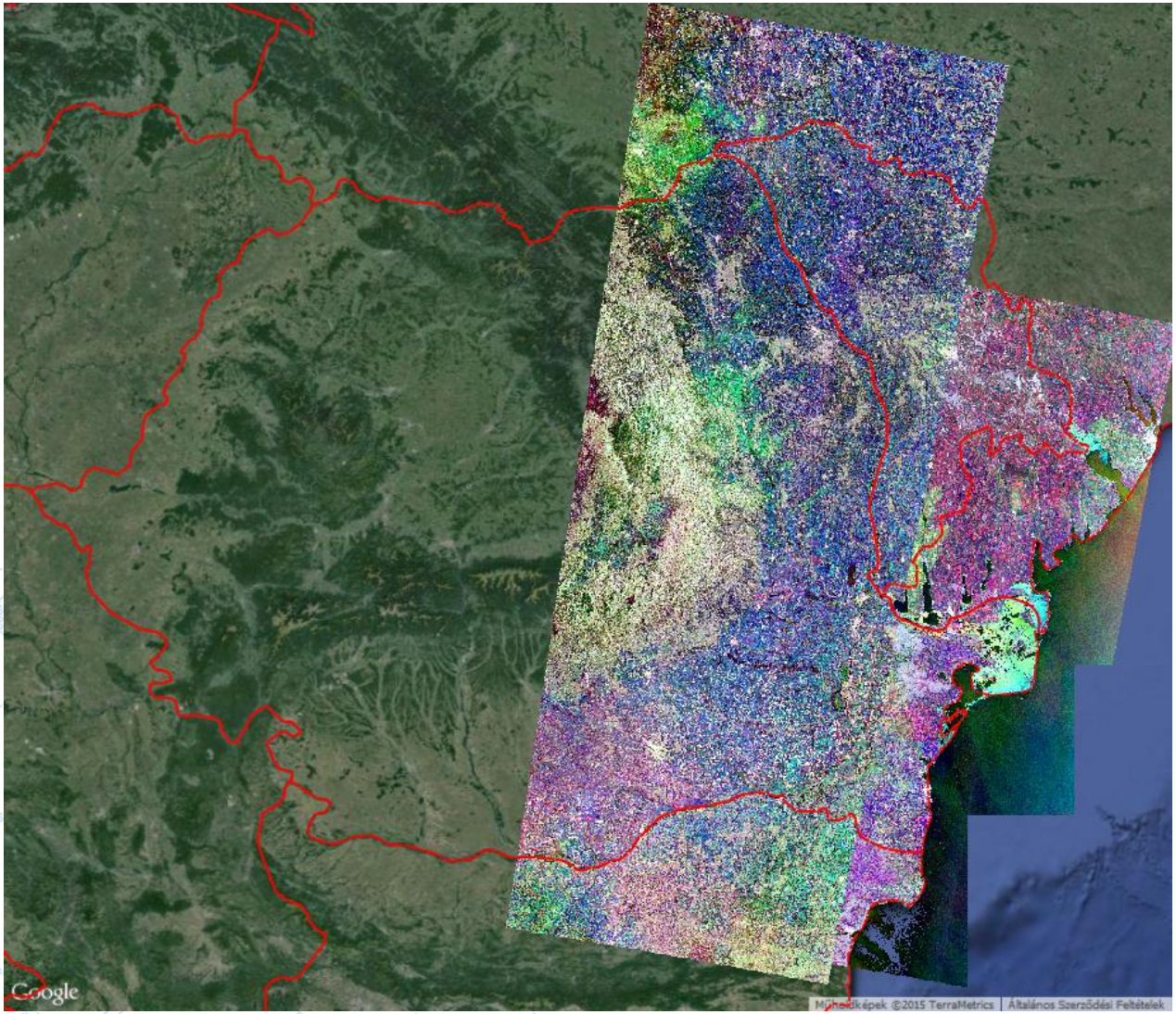


National wide mosaic



Sentinel-1A
20x20 m resolution (**R= VV G=VH B=arctan transformation**)

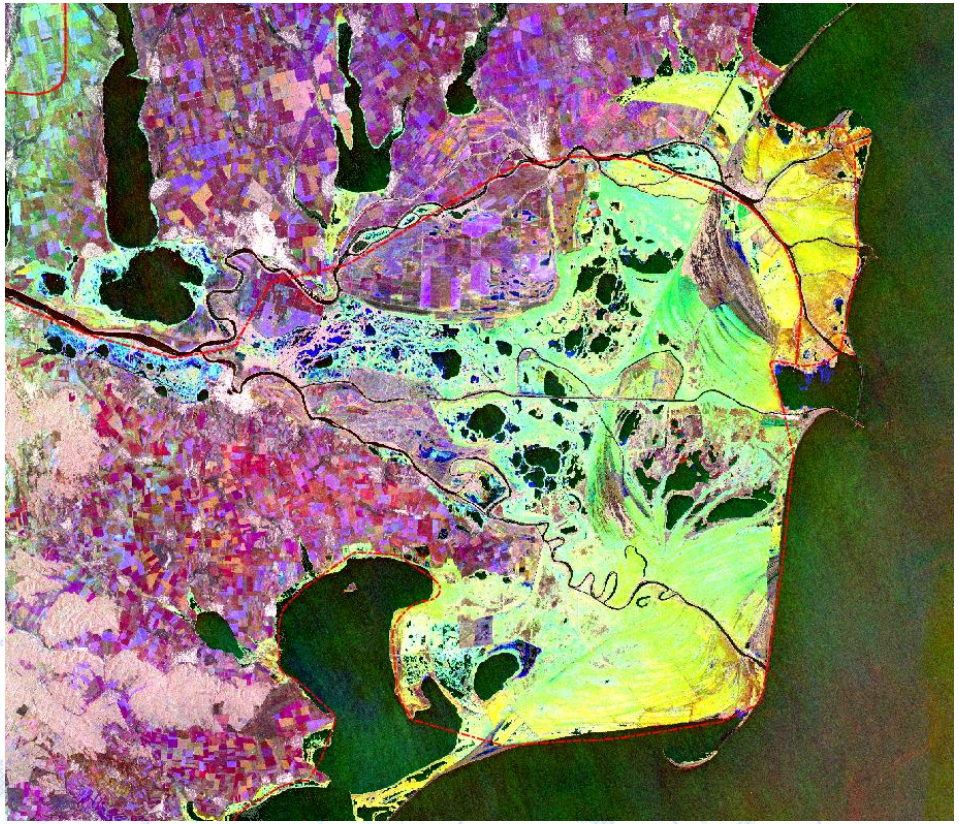
Romanian example of Sentinel-1A



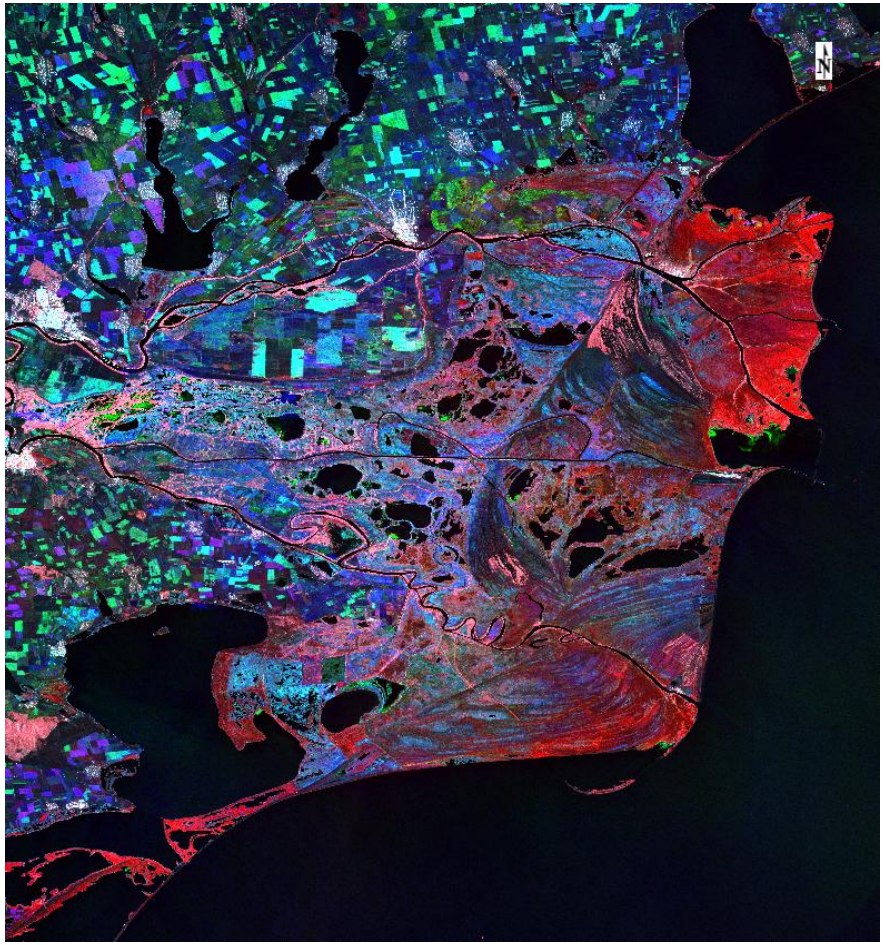
Romanian example > Danube mouth

Sentinel -1A

RGB (March 25 VV / April 30 VV / June 30 VV)

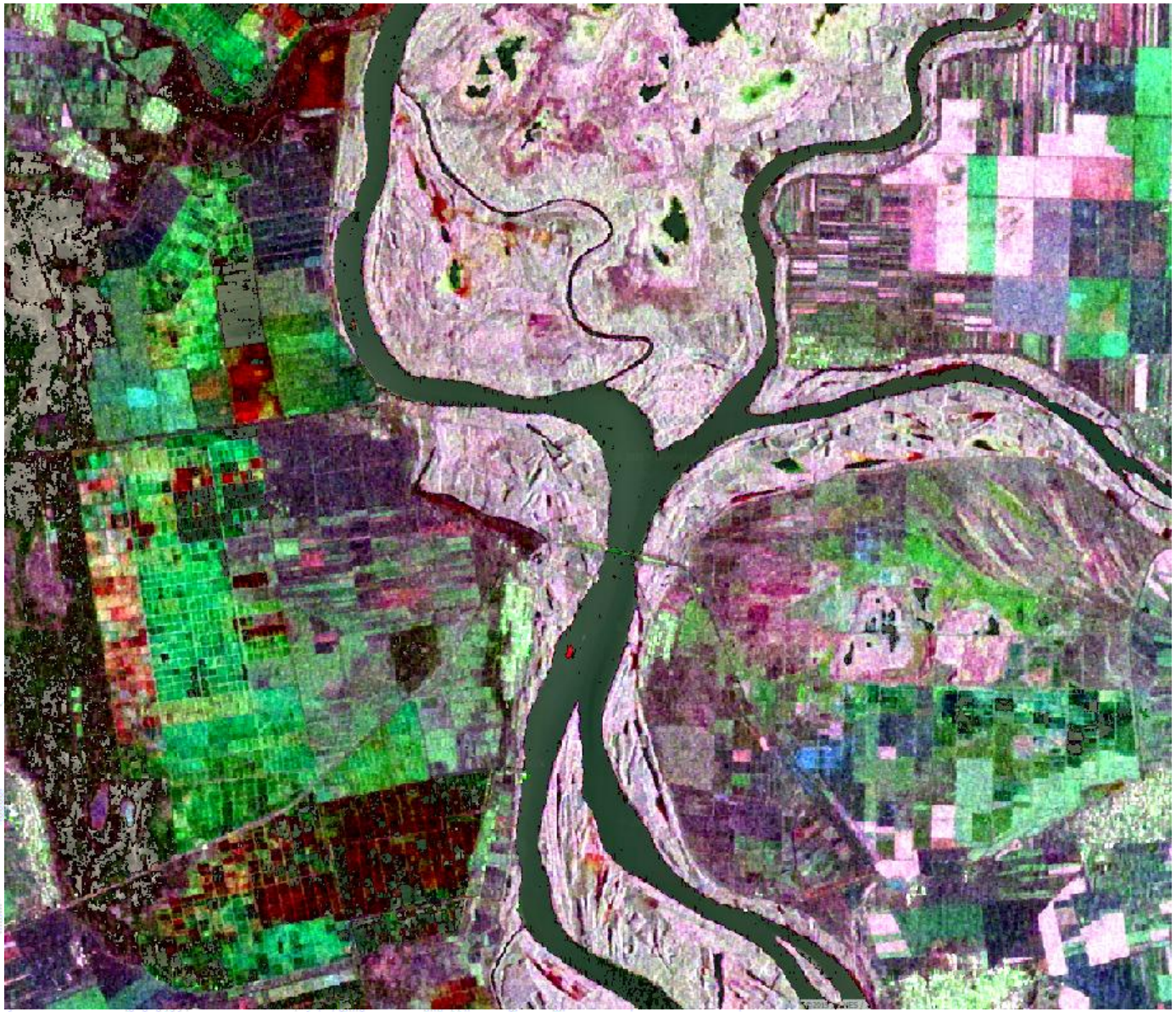


RGB (March 25 VH / June 29 VV / June 05 VV)



Romanian example > Giurgeni wetland area

sarmap
your information gateway

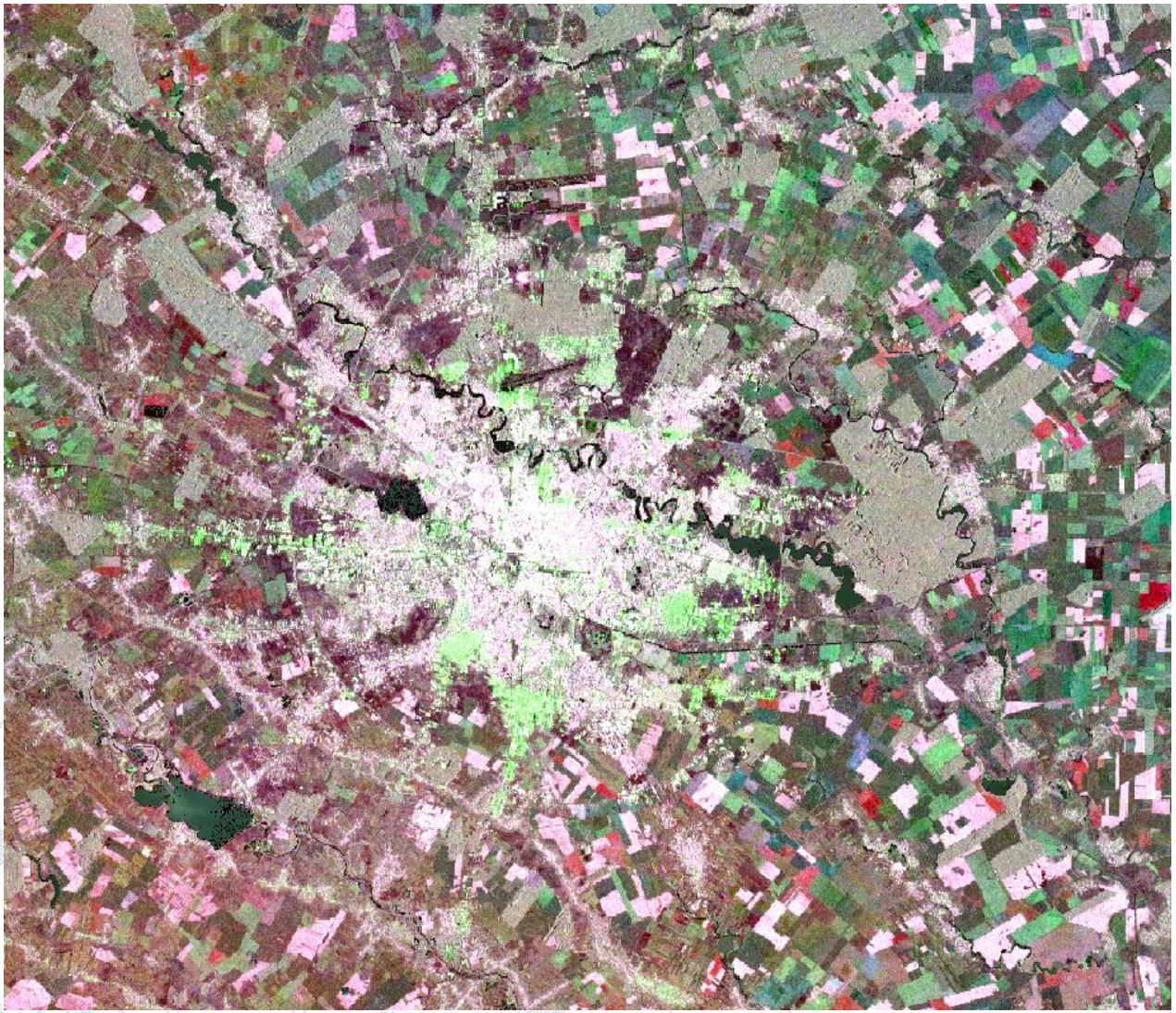


Geocoding accuracy: Zero values are masked out > Optical data presentening water bodies.

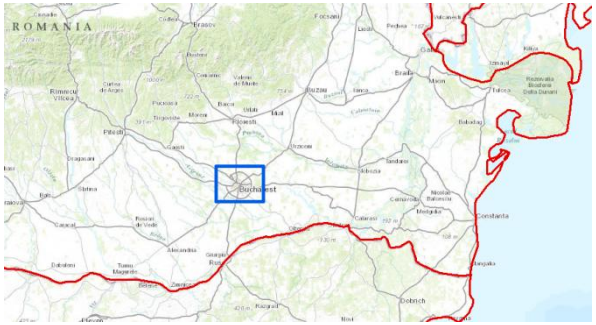
Sentinel-1A 2015
RGB
29 May VH
10 June VV
10 June VH

Land-Cover / Land-Use Change Program
GOFC-GOLD Global Observation of Forest and Land Cover Dynamics
esa
START

Romanian example > Bucarest



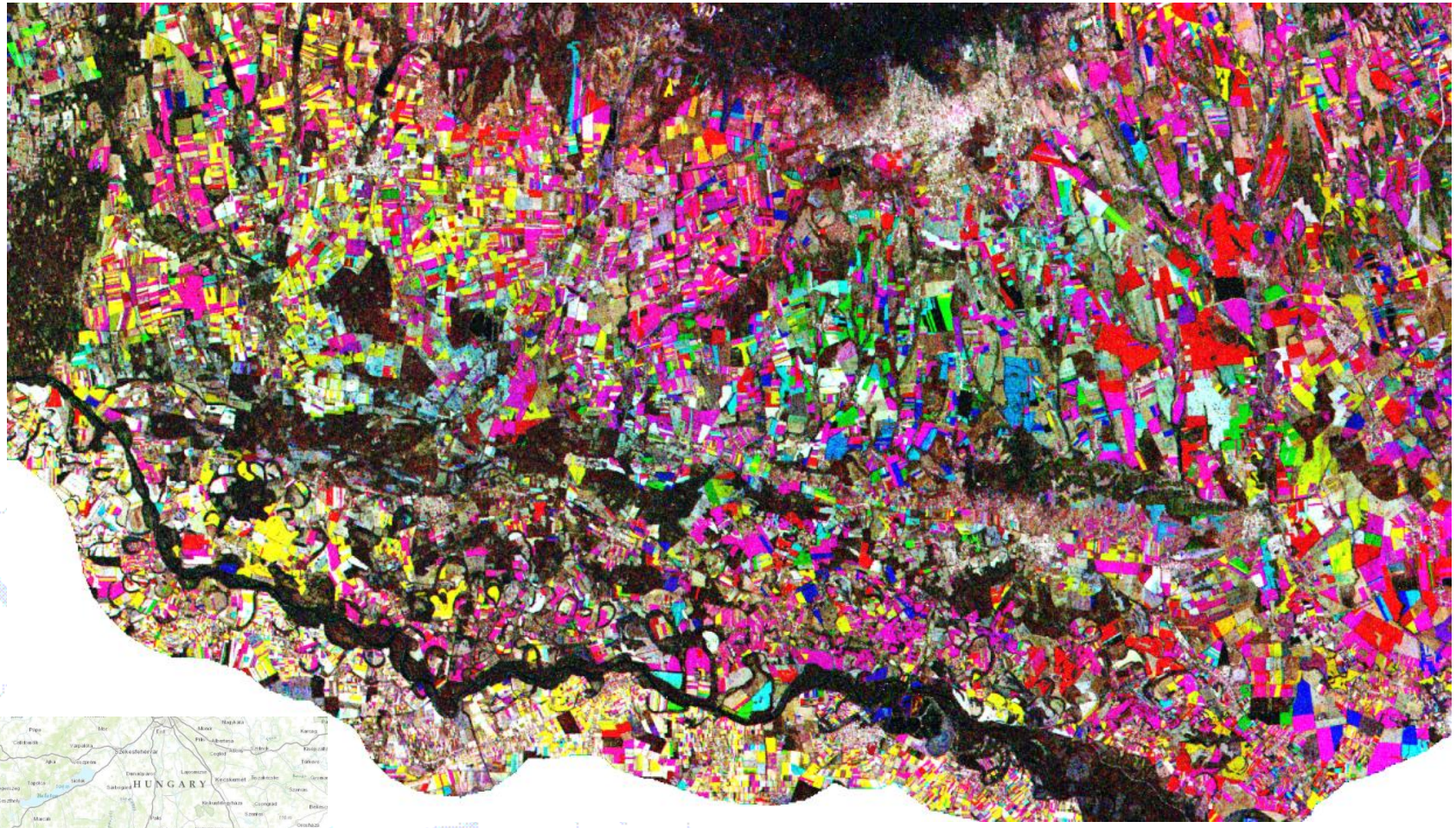
Sentinel-1A 2015
RGB
29 May VH
10 June VV
10 June VH



Land-Cover / Land-Use Change Program
GOFC-GOLD
esa
START

Phase information > Coherence Change Detection

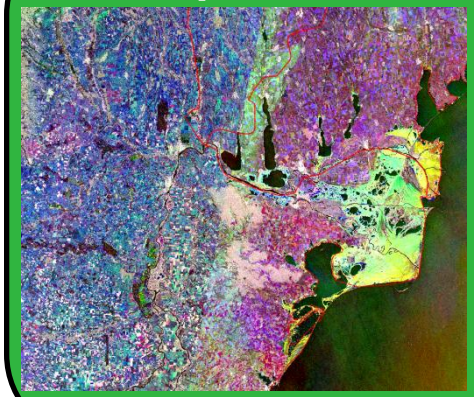
Sentinel-1A
Coherence RGB
02.03.2015-14.03.2015 / 14.03.2015-26.03.2015 / 26.03.2015-07.04.2015



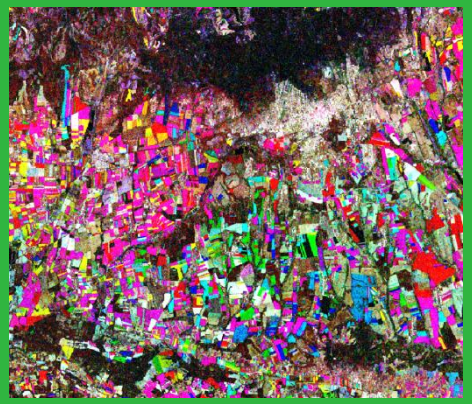
Further targets

SAR

Amplitude

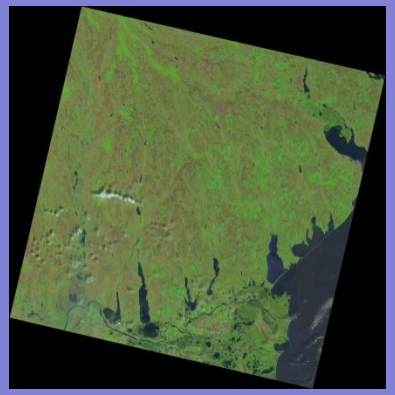


Coherence

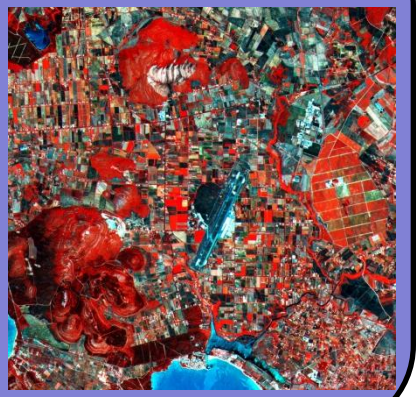


Optical

Landsat 8



Sentinel 2



LandScane project:
Wise Combination of Multi-Temporal, Multi-Sensor Data Using Supercomputing and SARMAP Technology

Thank you for your attention,

Vă mulțumim pentru atenție!