

Evolution of Copernicus Land Services based on Sentinel data  
23rd MARS Conference  
28–29 November 2017  
Gormanston, Ireland

## ECoLaSS



**Horizon 2020**

Call - Earth Observation:  
EO-3-2016: Evolution of Copernicus services

# **Working Towards Next-Generation Copernicus Agricultural Services: The ECoLaSS Project**

**Linda Moser, Markus Probeck, Gernot Ramminger (GAF)  
and Pierre Defourny (UCL)**

**GAFAG**

**SIRS**

**JOANNEUM  
RESEARCH**

**UCL**  
Université  
catholique  
de Louvain

**DLR**

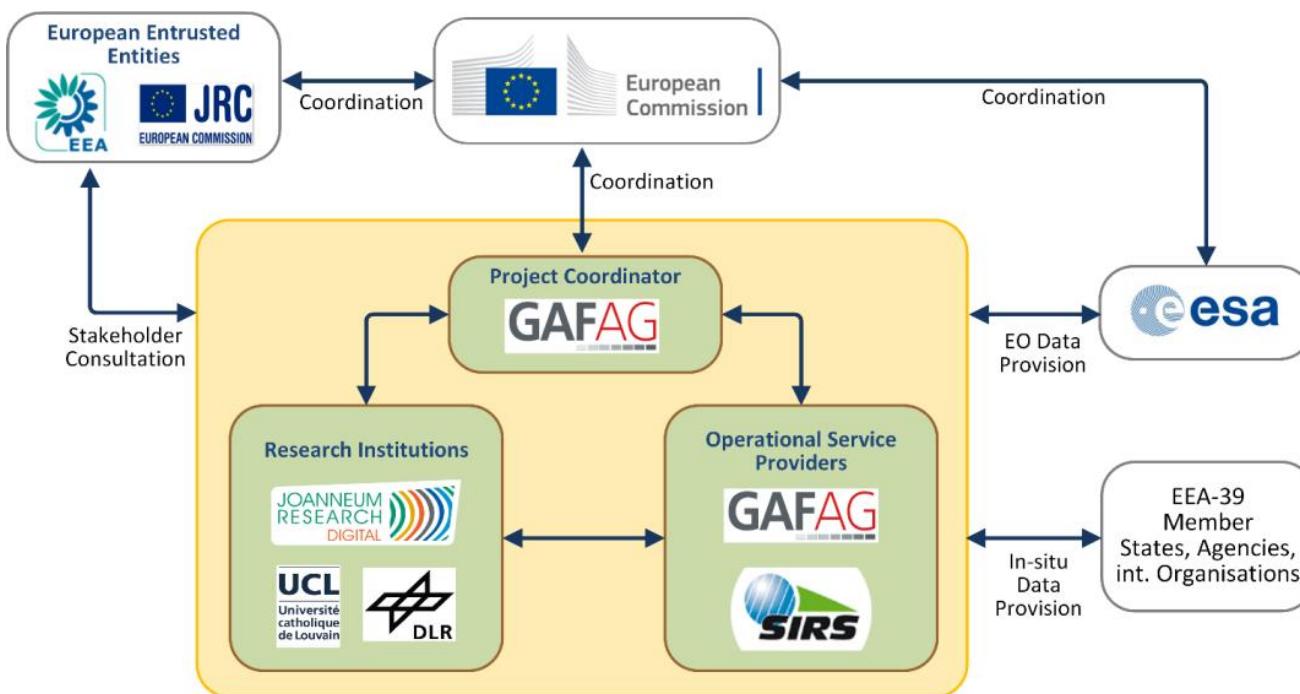


## Objectives & Setup

**ECoLaSS:** “Evolution of **Copernicus Land Services** based on **Sentinel data**”

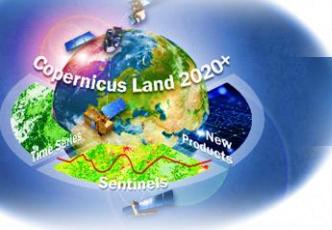
**Key Objective** = **improve** existing & develop **novel** products/services for future operational pan-European & Global Copernicus Land Components 2020+ :

### Organizational Setup



### Dates & Timing:

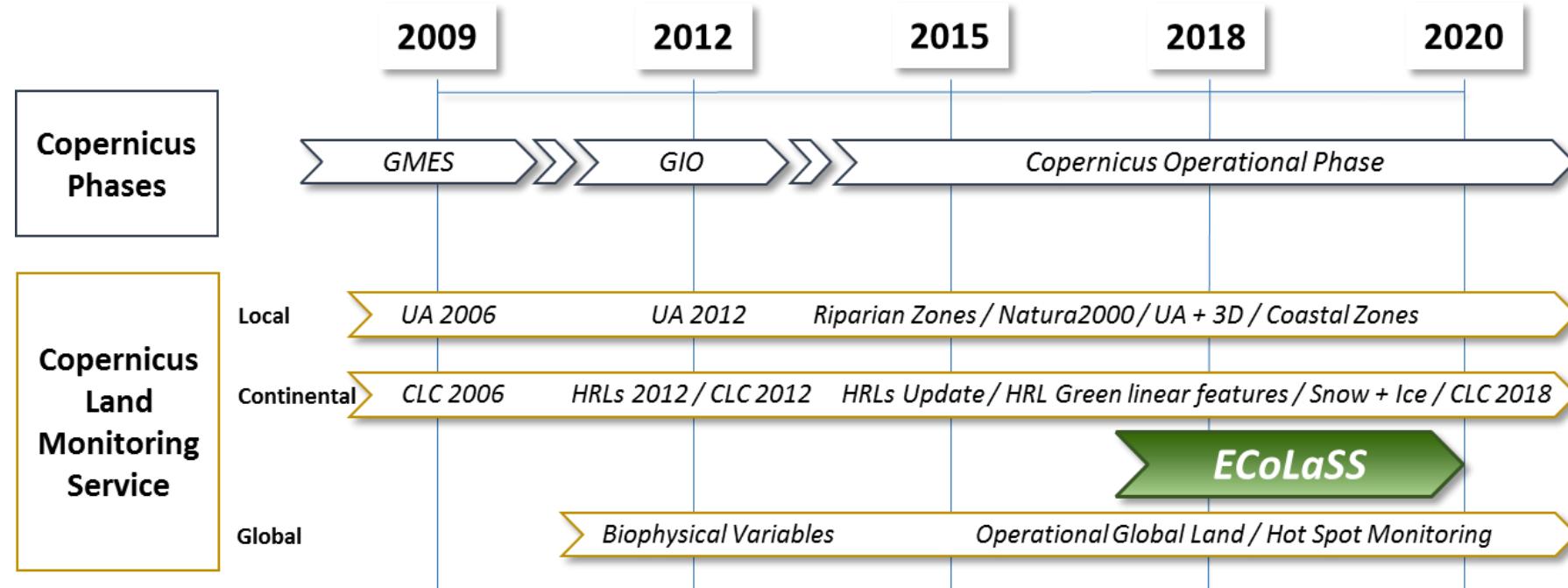
- Dez 2015: Horizon 2020 WP, Call: „*Evolution of Copernicus Land Monitoring Services*“
  - Jan 2017: Project Start
- Runtime: Jan 2017–Dec 2019 (3 years)



## Timeline

### ECoLaSS: "Evolution of Copernicus Land Services based on Sentinel data"

**Key Objective** = **improve** existing & develop **novel** products/services for future operational pan-European & Global Copernicus Land Components 2020+:





## Background: High Resolution Layers (HRLs) 2015

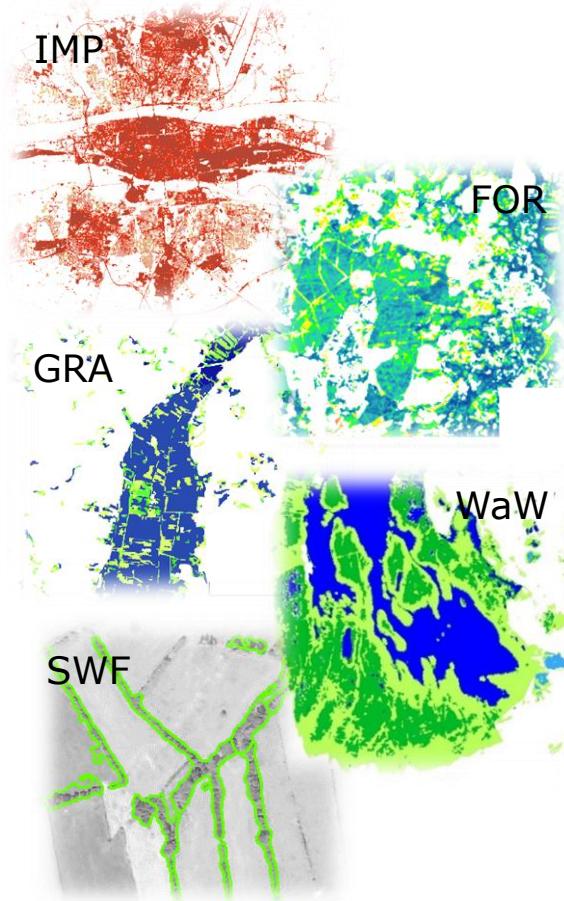
### Copernicus Land Monitoring Service – High Resolution Layers (HRLs) 2015

#### Updated & new HRLs 2015:

- Imperviousness (sealed areas) (IMP)
- Forest (FOR)
- Grassland (GRA)
- Water/Wetness (WaW)
- Small Woody Features (SWF)

#### Consortium:

- GAF: Lead (FOR & GRA)
- GeoVille: Lead (IMP & WaW)
- SIRS: Lead (SWF)
- e-Geos: Partner (GRA)



#### Requirements:

- Consistent and harmonized products across EEA-39 – 5.8 Mio km<sup>2</sup>
- 65,000 HR; 35.000 SAR; > 20.000 VHR
- Thematic accuracies: exceeding 85–90% 20 m high spatial resolution/5 m and 1:5000 vector product (SWF)
- Reference year 2015 status layers: time series 2015+- 1 year (IMP, FOR, GRA, SWF) and multi-year time series (WaW, GRA);
- Change layers:
  - 2012/2015 (FOR),
  - 2006/2009/2012/2015 (IMP)

L. Moser/G. Ramminger et al. (2017): Sentinel-based Evolution of Copernicus Land Services on Continental and Global Scale: <http://worldcover2017.esa.int/files/2.3-p2.pdf>



European Environment Agency



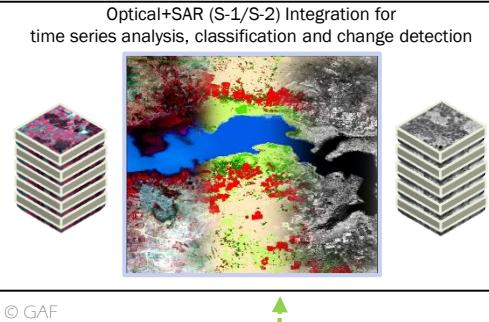
Copernicus  
Europe's eyes on Earth



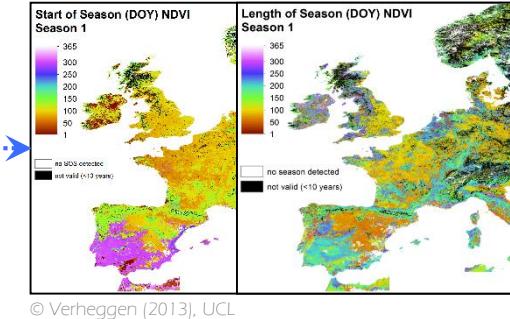


# Concept

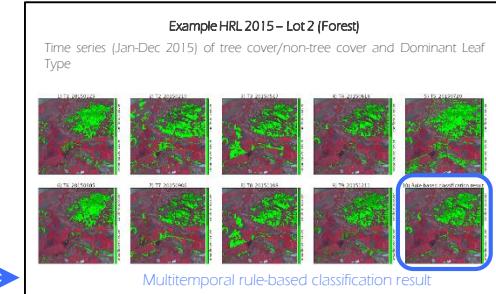
## Optical+SAR Integration



## Indicators from High Spatial & Temporal Data



## HRL Incremental Updates

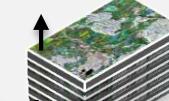


## Service Requirements



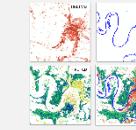
- ✓ User Needs
- ✓ EO and Other Data
- ✓ Infrastructure & Architecture

## Methods



- ✓ Sentinel Optical+SAR Integration
- ✓ Time Series Analysis, Classification & Change Detection
- ✓ Incremental HRL Updates

## Prototypes



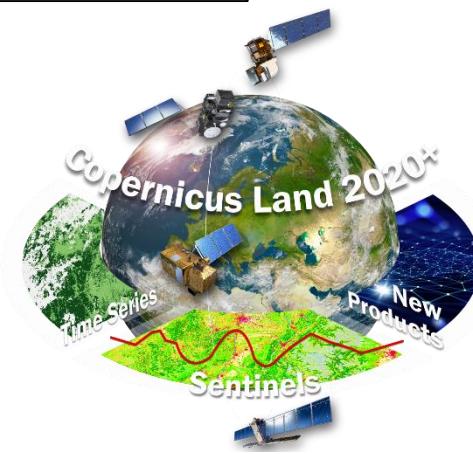
- ✓ Next-generation Services/Products for Continental & Global Component
- ✓ Demonstrated on Large Sites (Europe & Africa)

## Operationalization

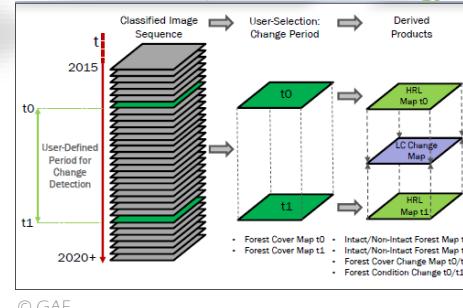


- ✓ Stakeholder Consultation & Endorsement
- ✓ Operational Maturity
- ✓ Integration into Copernicus Land 2020+

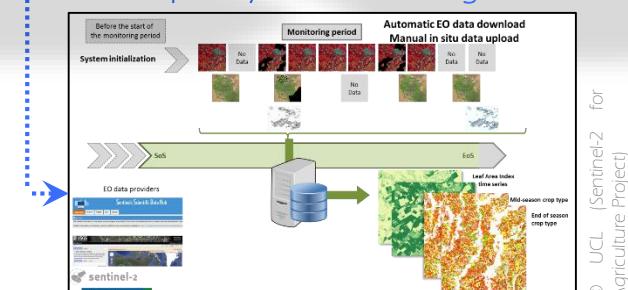
New Products



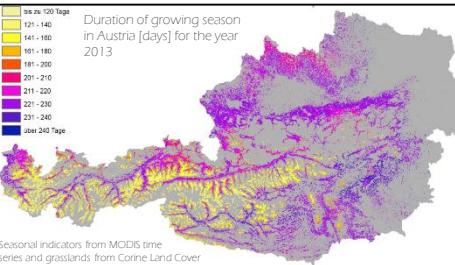
## Incremental Update Methodology



## Crop Area/Status Monitoring



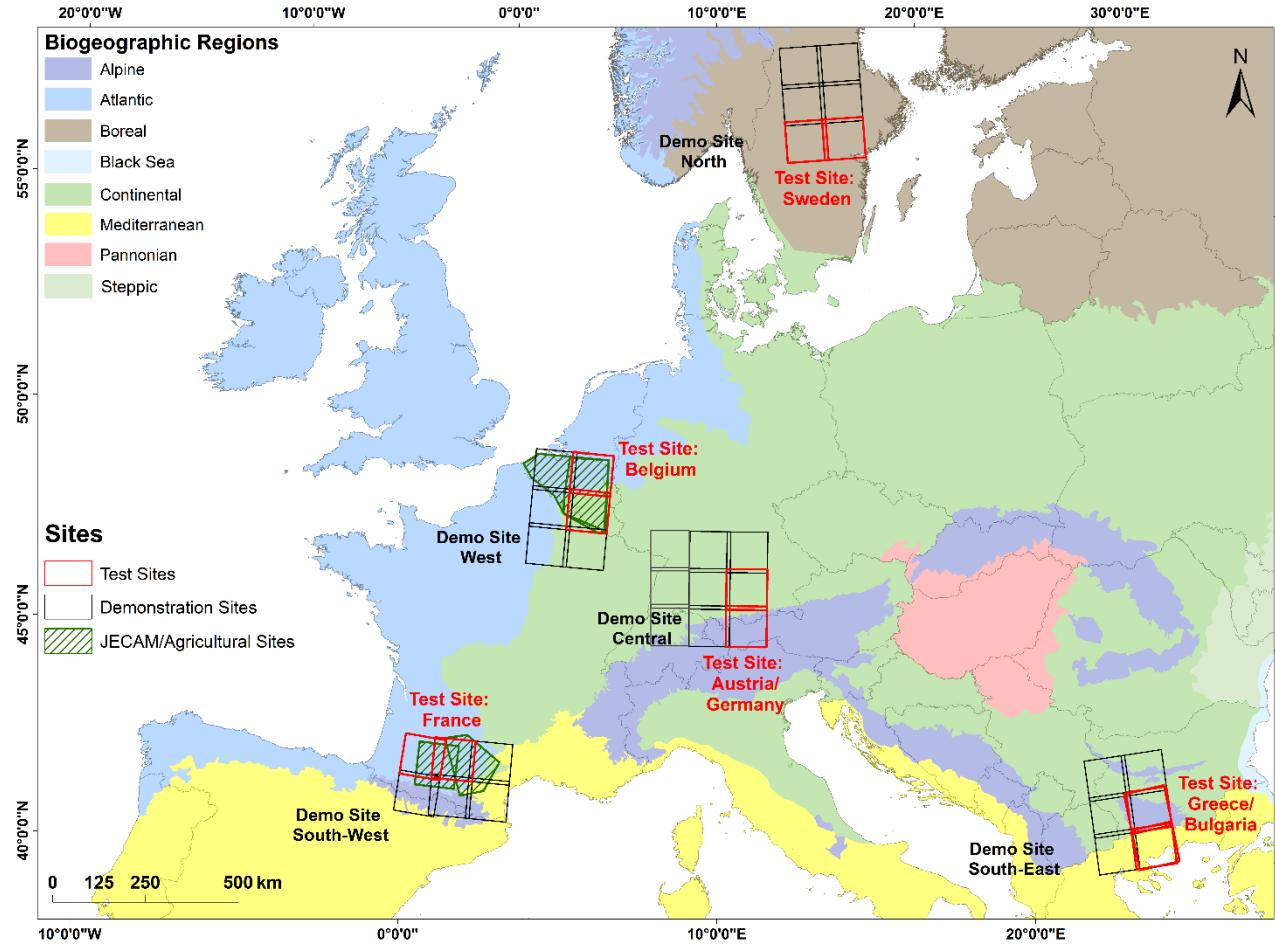
## Permanent Grassland Identification



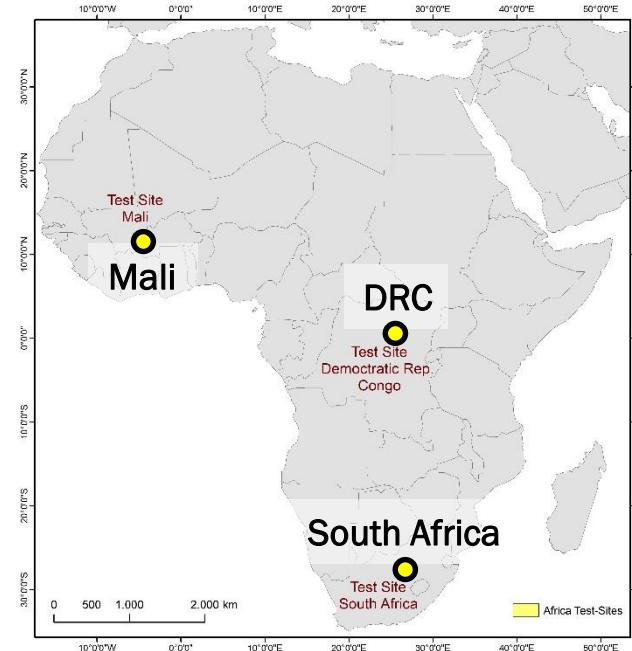


## Test- & Demonstration Sites

# European and African Test- & Demonstration Sites



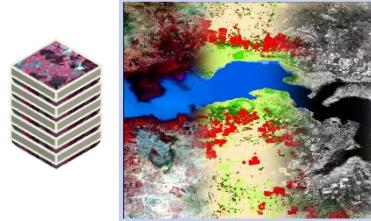
- 5 demonstration (prototype) sites
- 5 test sites within demo sites
- 4 JECAM sites: specific in-situ data
- 3 African sites



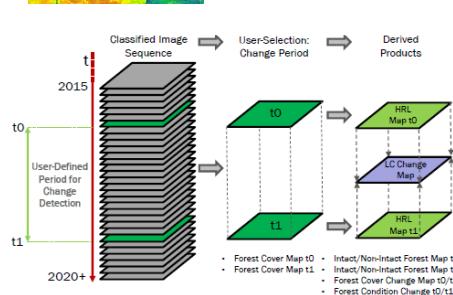
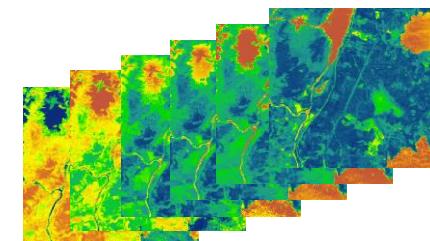
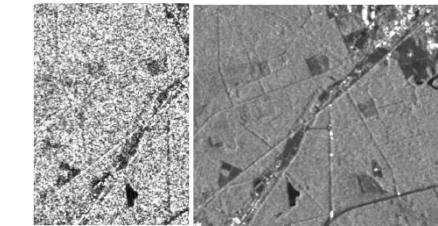


## Methods and Prototypes

### Methods and Prototypes



- Sentinel-1/2/3 integration
- Sentinel/time series Pre-processing
- Time series classification
- Time series change detection
- Incremental updates



### Benchmarking Approach



High-volume data processing chains:  
automated, flexible & customizable



### Prototypes:

- Indicators and variables
- HRL incremental updates
- Grassland characterisation
- Crop status/monitoring
- New Products



## HRL Incremental Updates – HRL IMP

- HRLs to be addressed :
  - **Imperviousness (sealed areas)**: 2006, 2009, 2012, 2015, **2017 changes\***
  - **Forest**: 2012, 2015, **2017 changes\***
  - Potentially **Grassland**: 2015, **2017 changes\***
- Incremental Updates:
  - **Time intervals** likely to be **specific** per HRL
  - Need to determine rules for so-called "**technical changes**"
  - Strategy to deal with detection of **anomalies/errors from previous period**

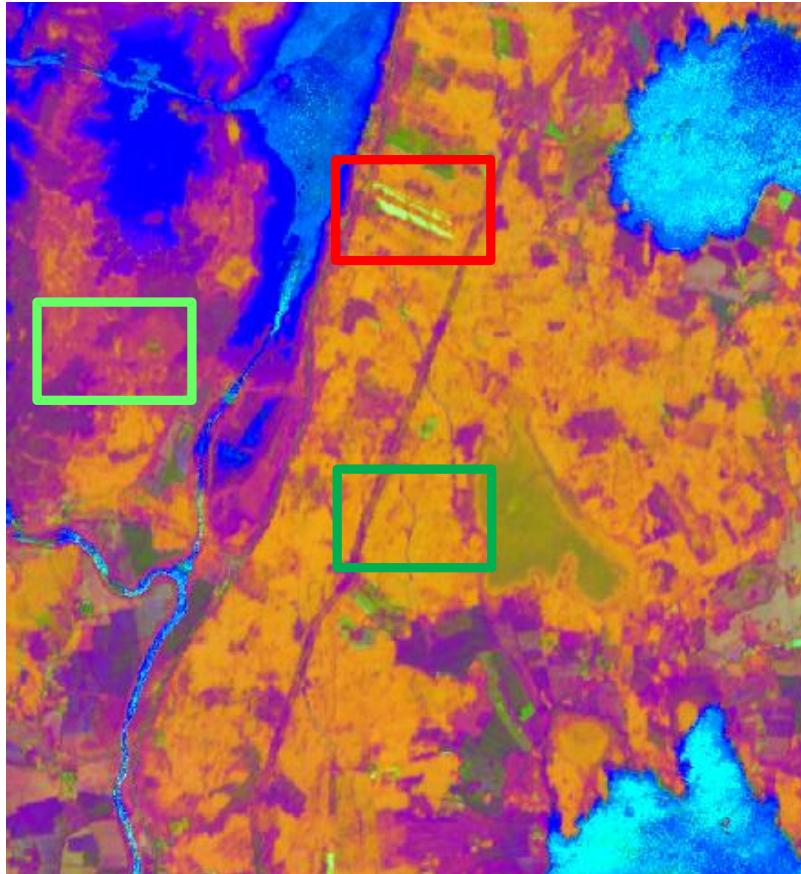
\* proxy for future incremental update time steps



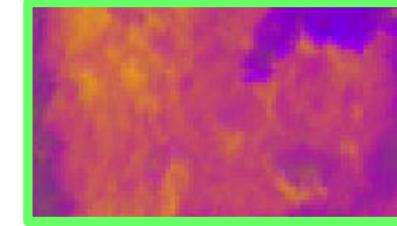


## HRL Incremental Updates – HRL FOR

### Change Detection based on S-2 Multitemporal Metrics Forest Types & Clear Cuts – Test Site: Sweden



**GAFAG**



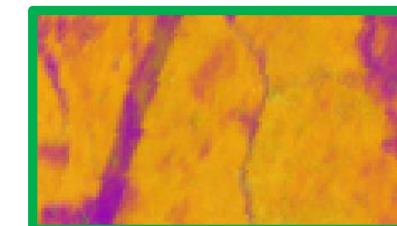
Broadleaved F.



May



Jun



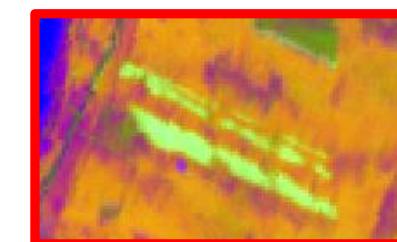
Coniferous F.



May



Jun



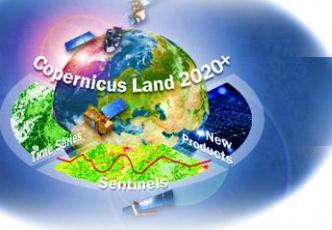
Clear Cuts



May



Jun



# Improved Permanent Grassland Identification

- Multi-sensor (S1/S2) time series analysis

HRL GRA 2015  
(yet unpublished  
product)



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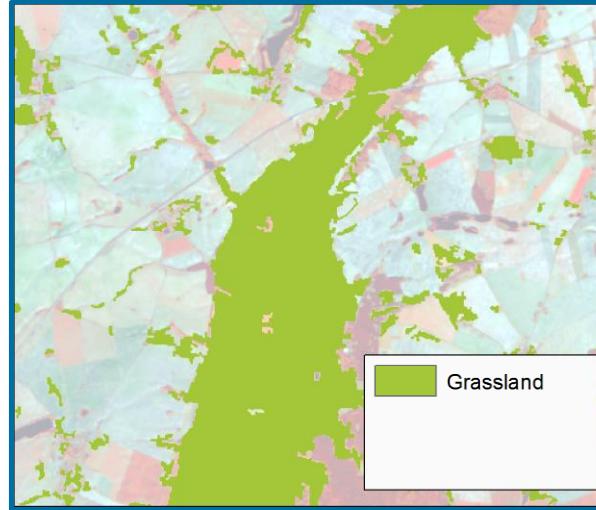


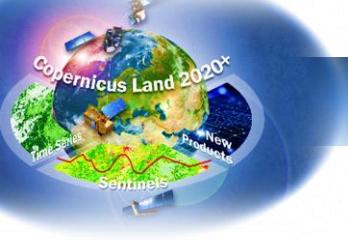
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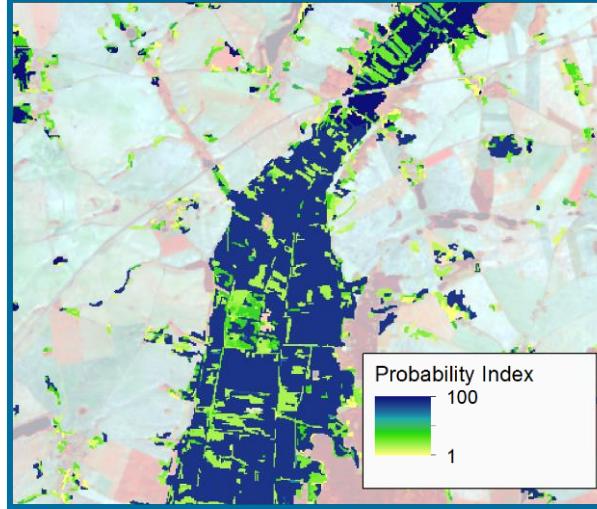


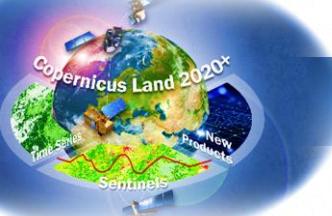
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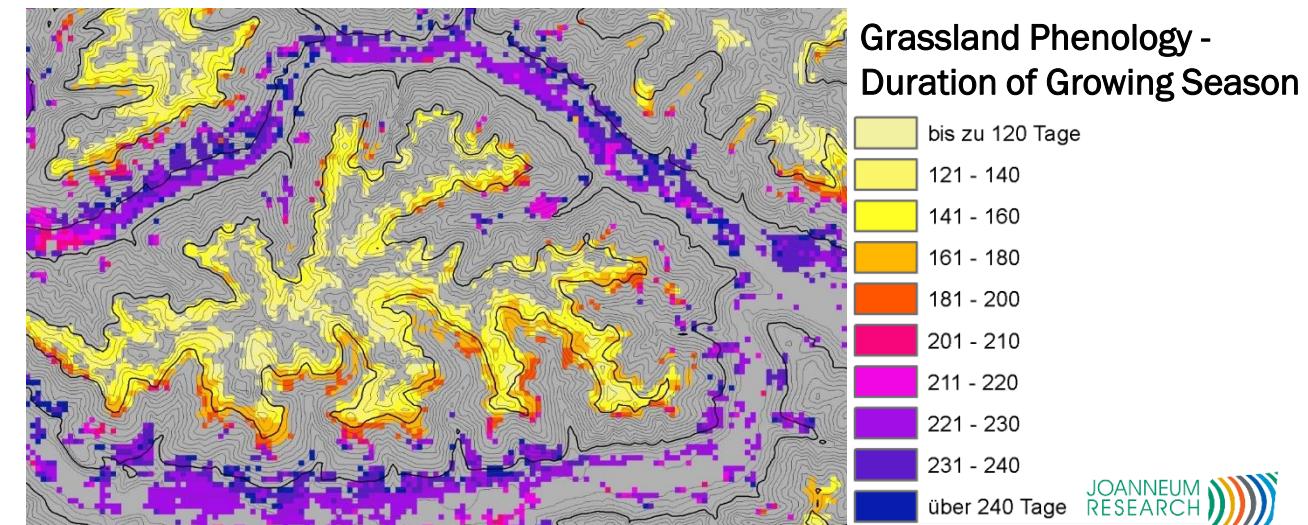
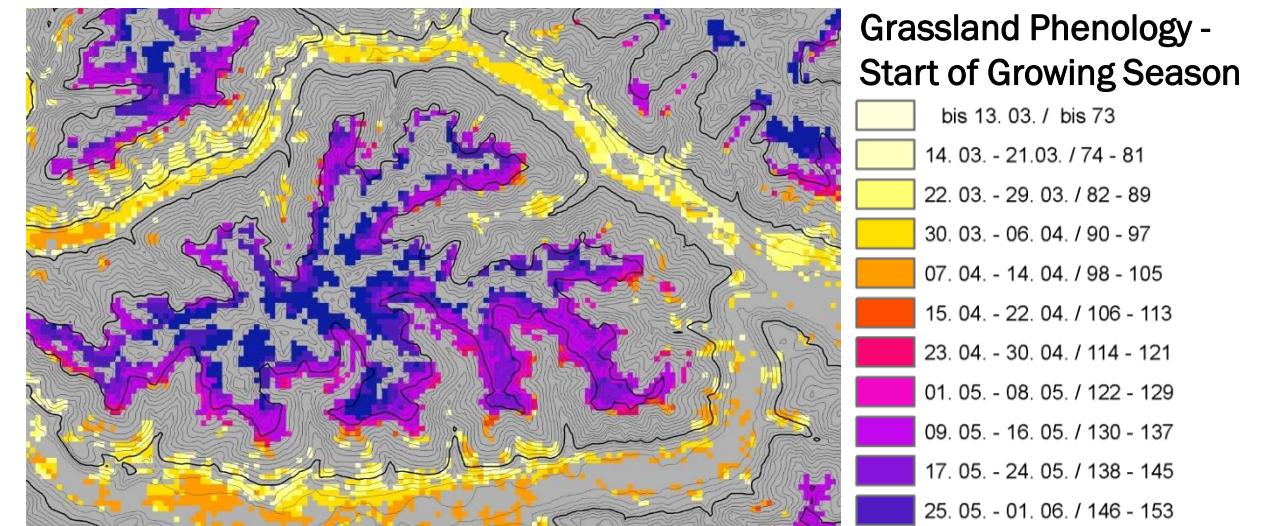
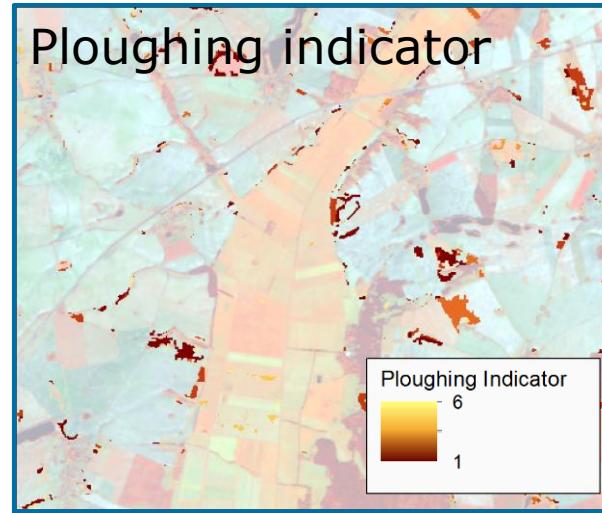


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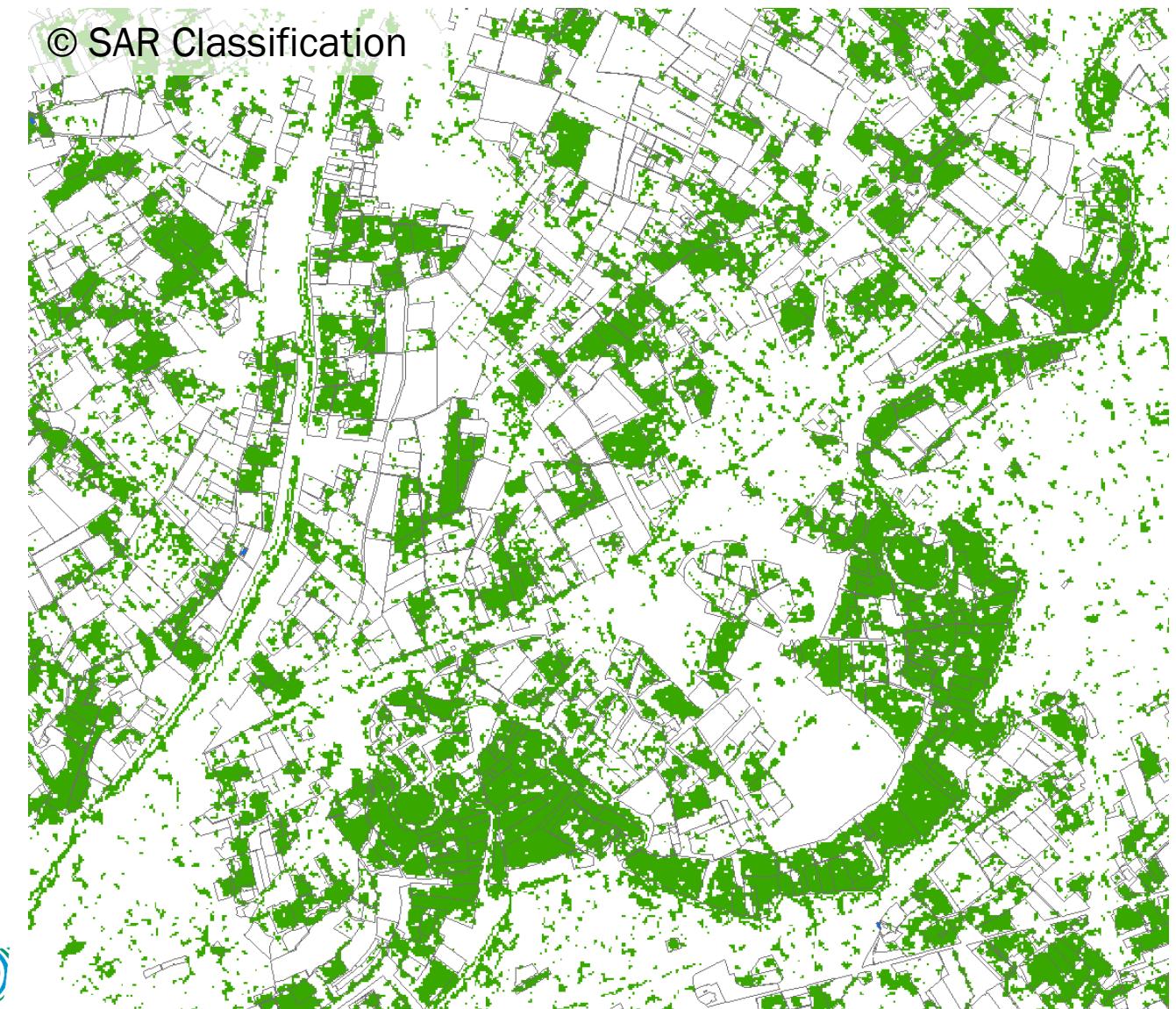


# Improved Permanent Grassland Identification

## S-1 Multi-temporal SAR Classification of Grassland, Test site: Belgium

- Cloud cover
- Low tree cover (vineyards, orchards)
- Ploughed areas

**1. SAR classification (March-June 2017)** based on S-1 multitemporal metrics, thresholding mean and coefficient of variation



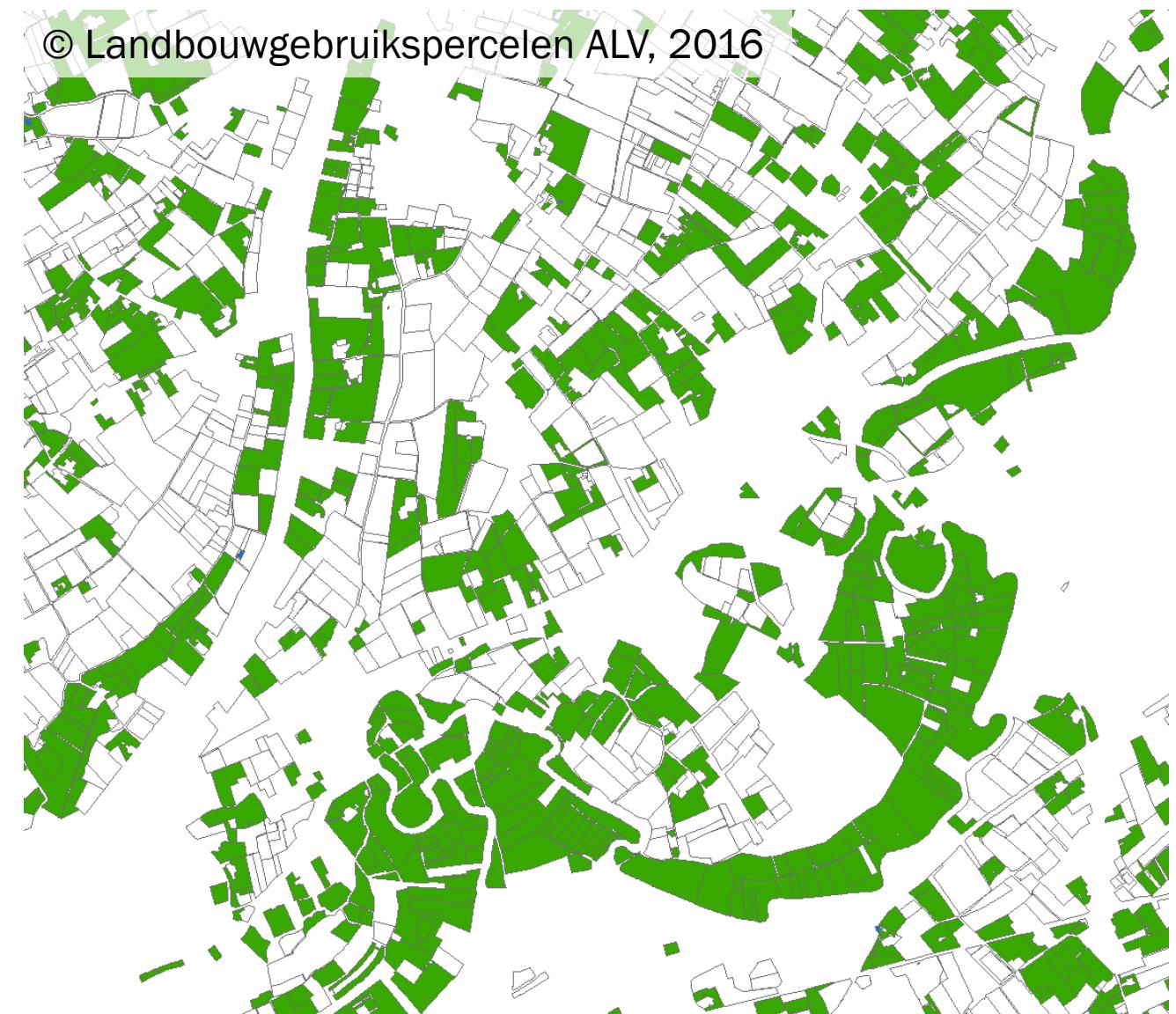


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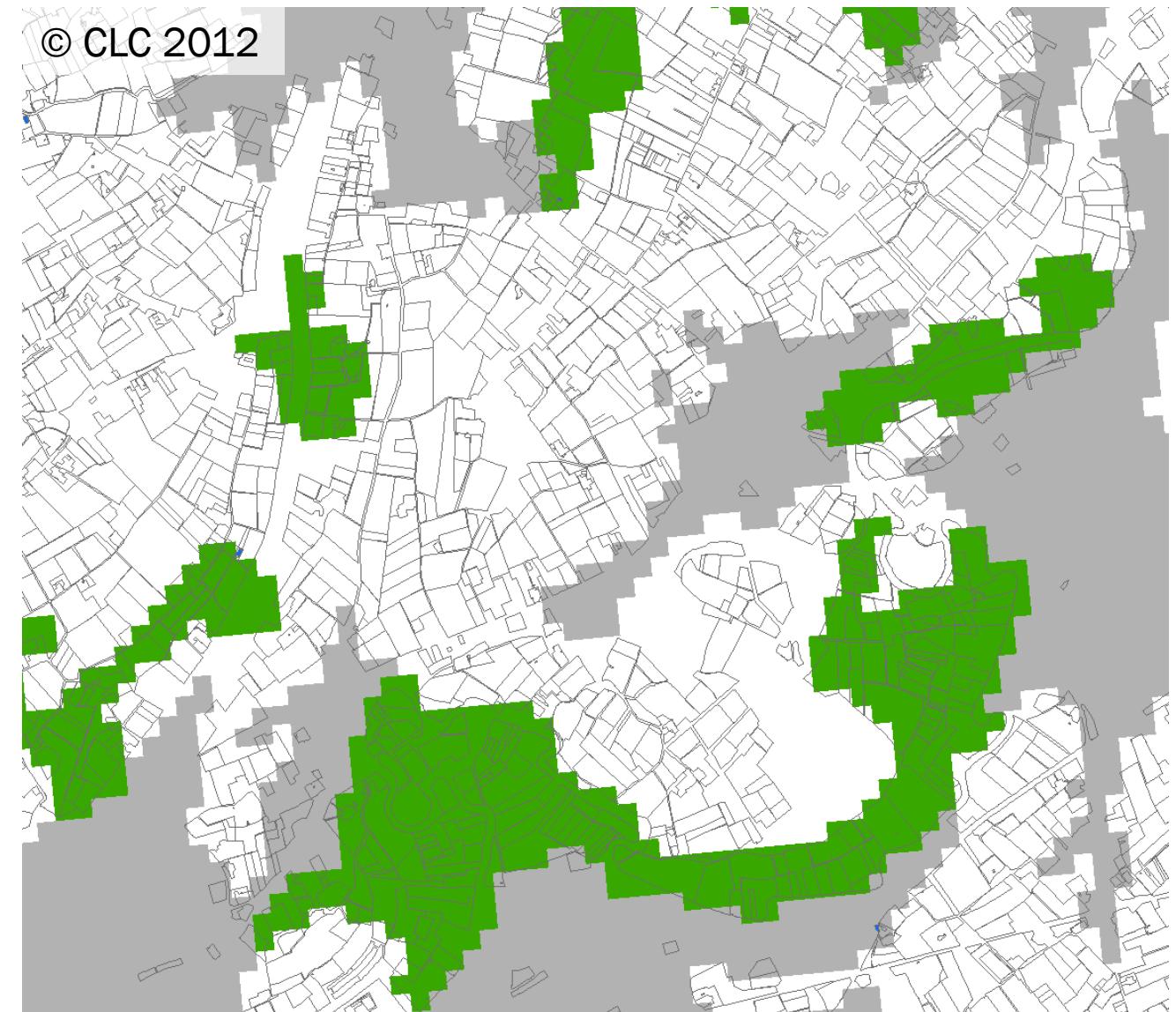


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- 3. CORINE LC 2012, 100m**





# Crop Area/Status Monitoring

© Google Maps



Test site in Germany:  
~20 Sentinel-2 scenes  
from Mar-Oct 2017

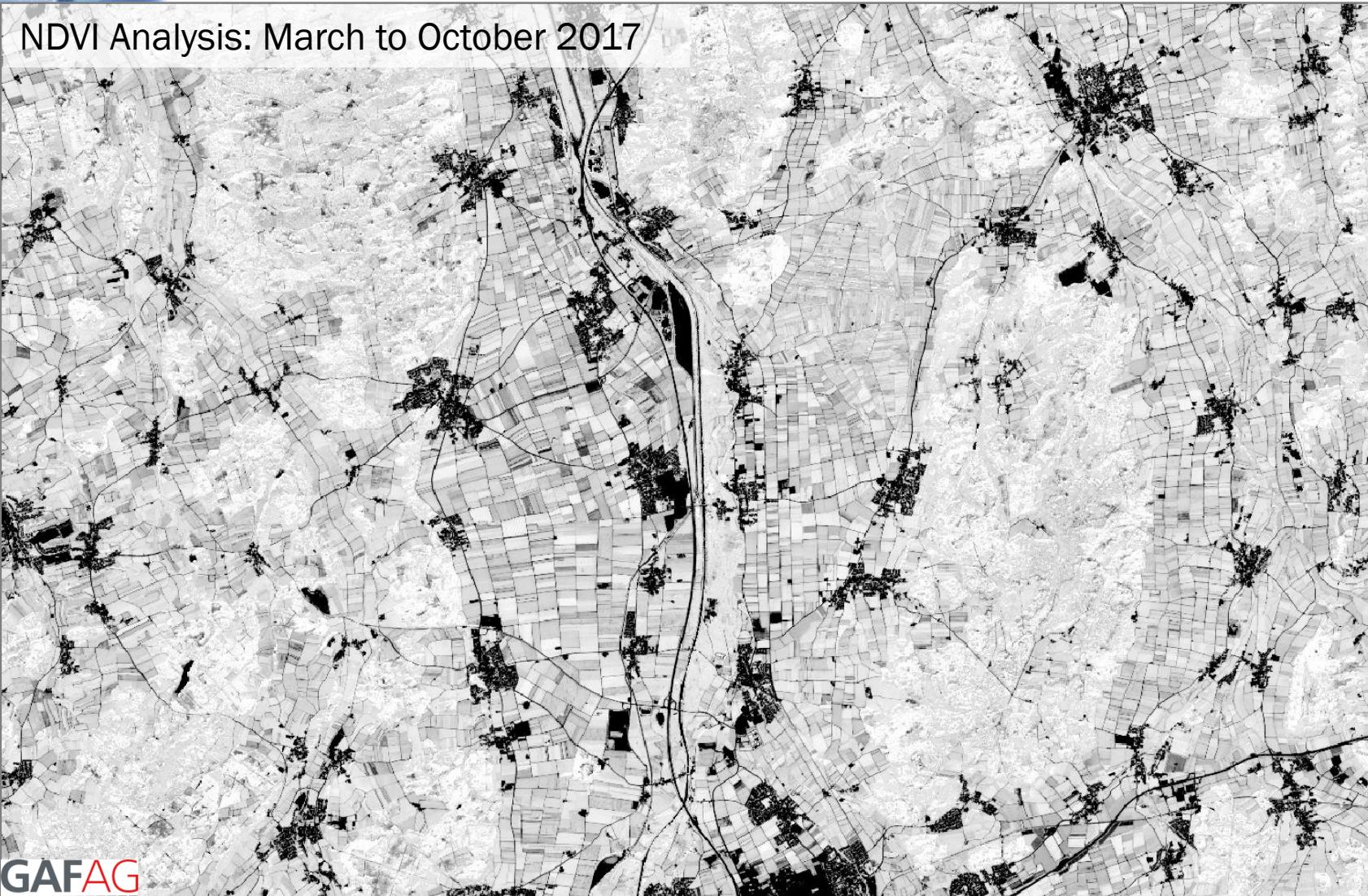
Time series  
classification in line  
with



→ AGRICULTURE



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Test site in Germany:  
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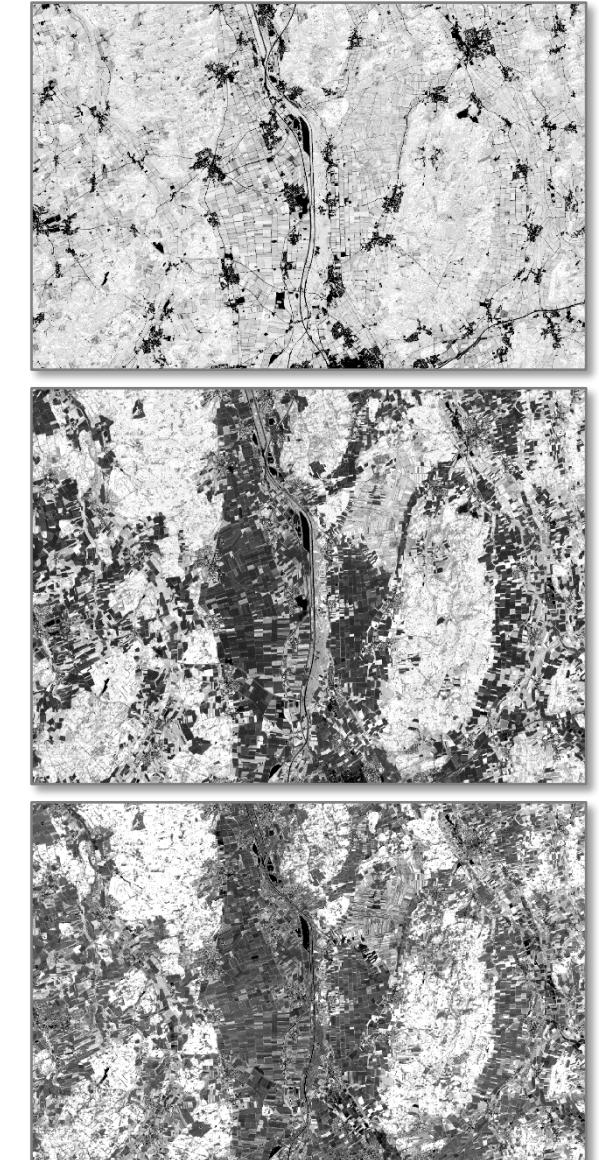
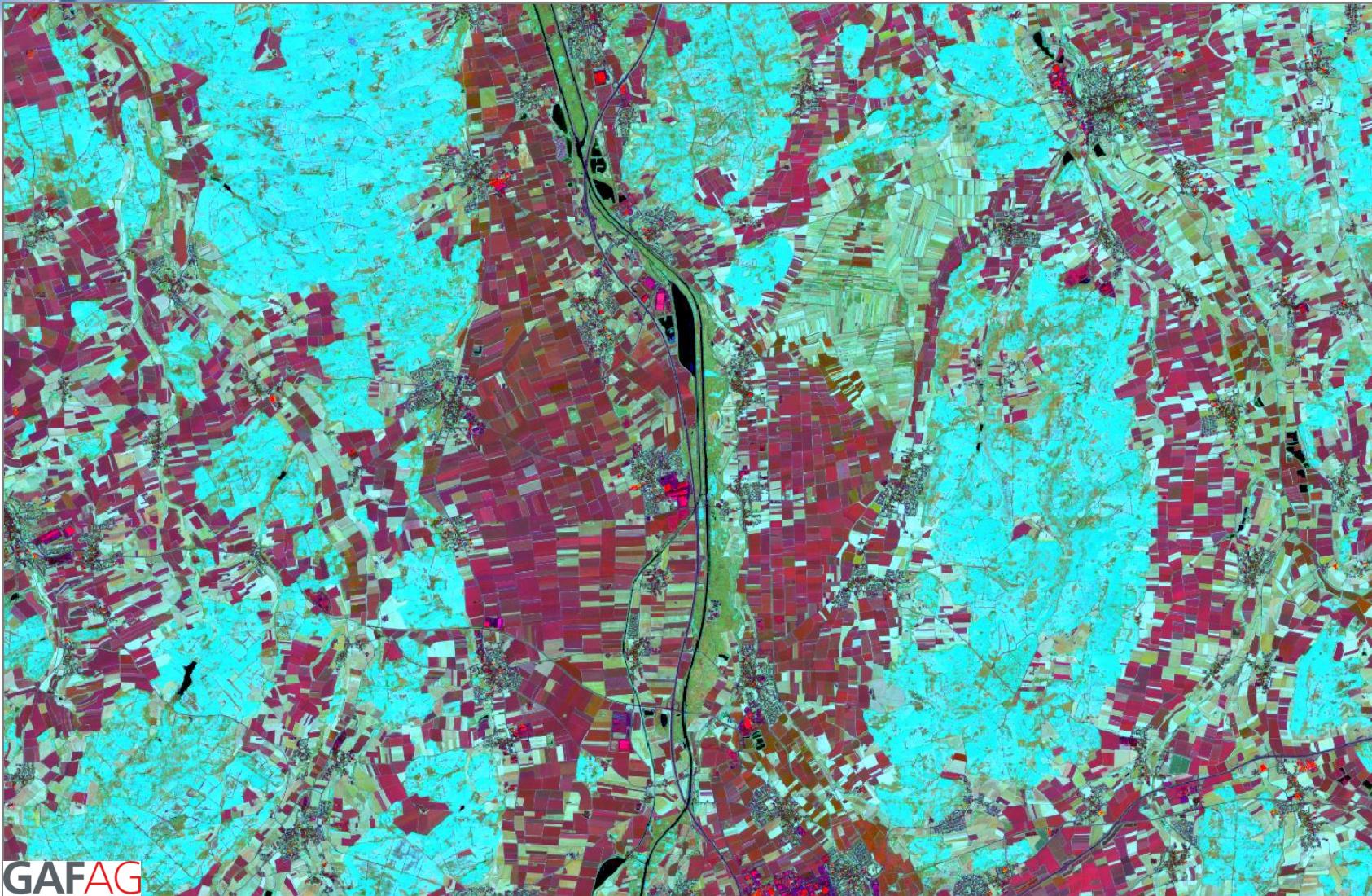
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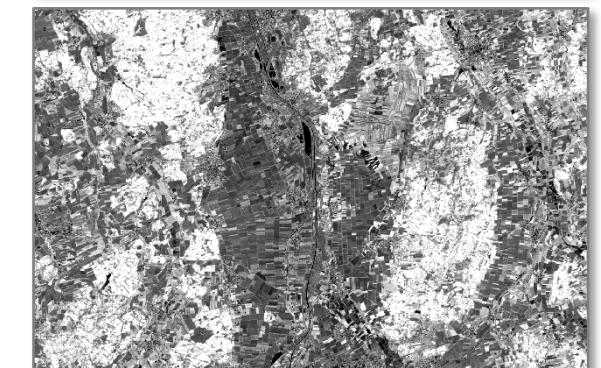
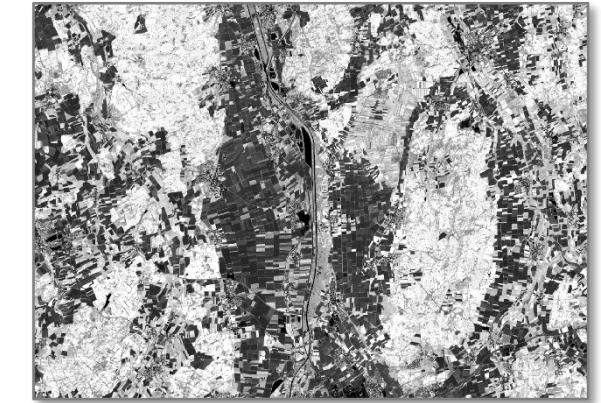
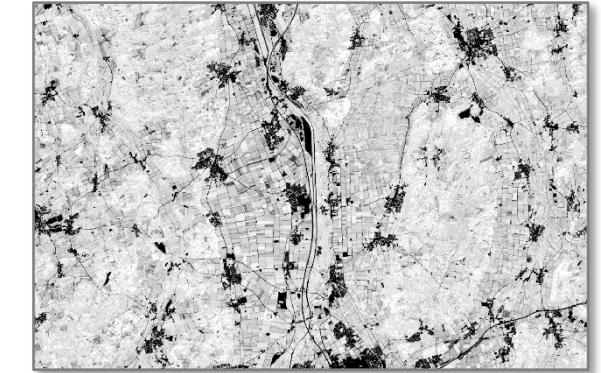
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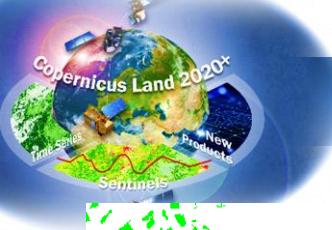




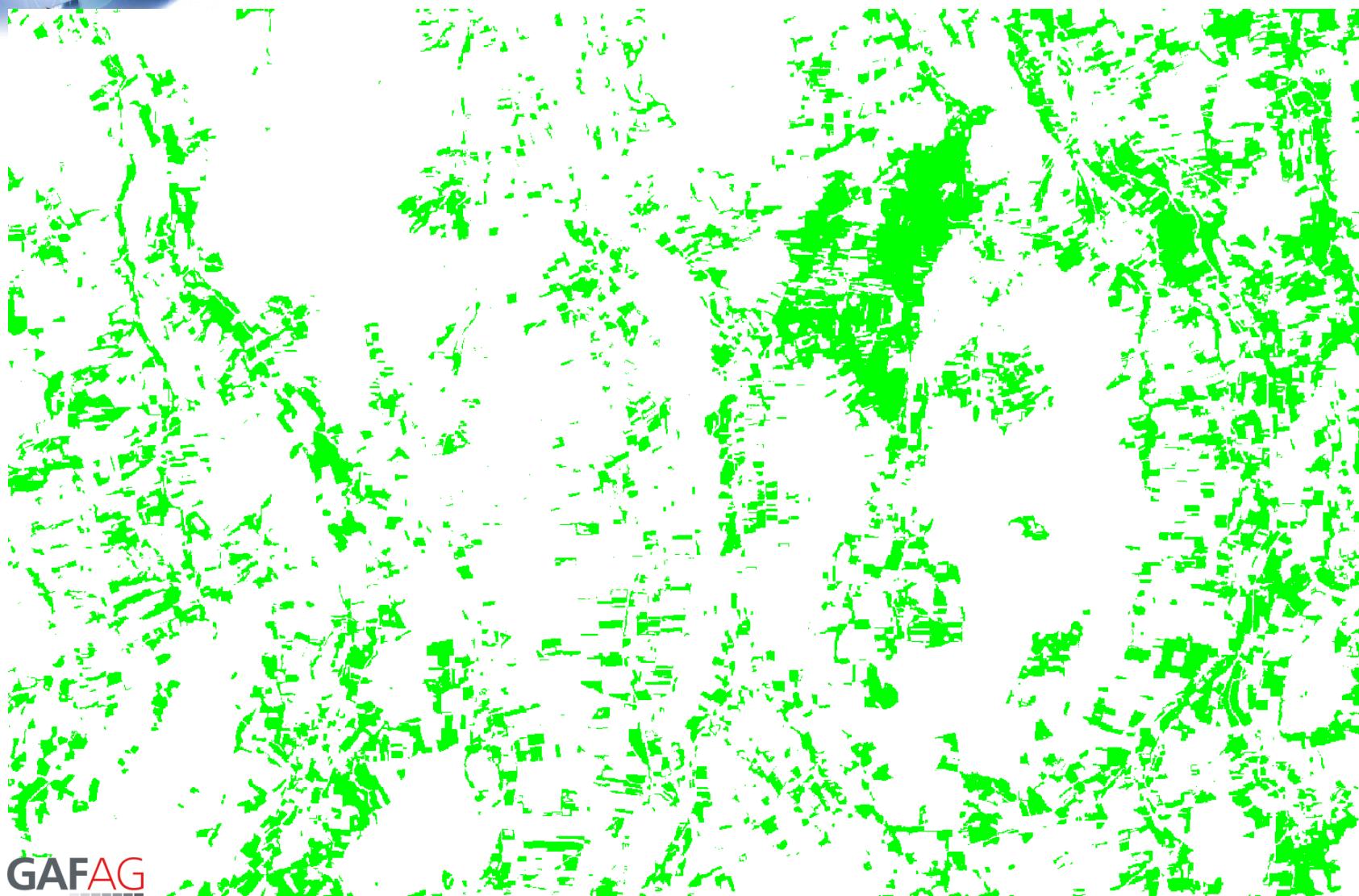
# Crop Area/Status Monitoring

© Google Maps





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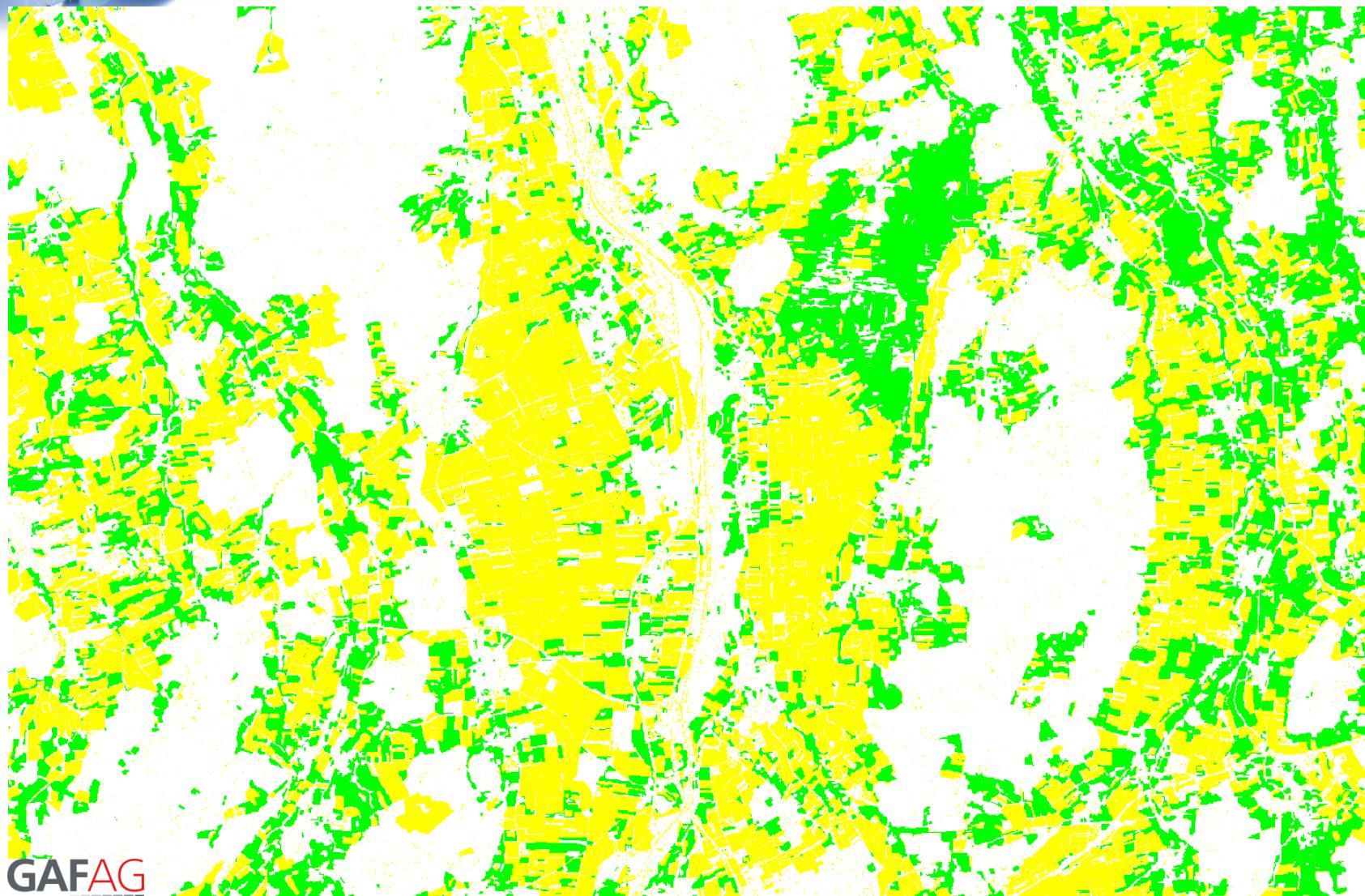
GAFAG



HRL GRA 2015  
(yet unpublished  
product)



# Crop Area/Status Monitoring



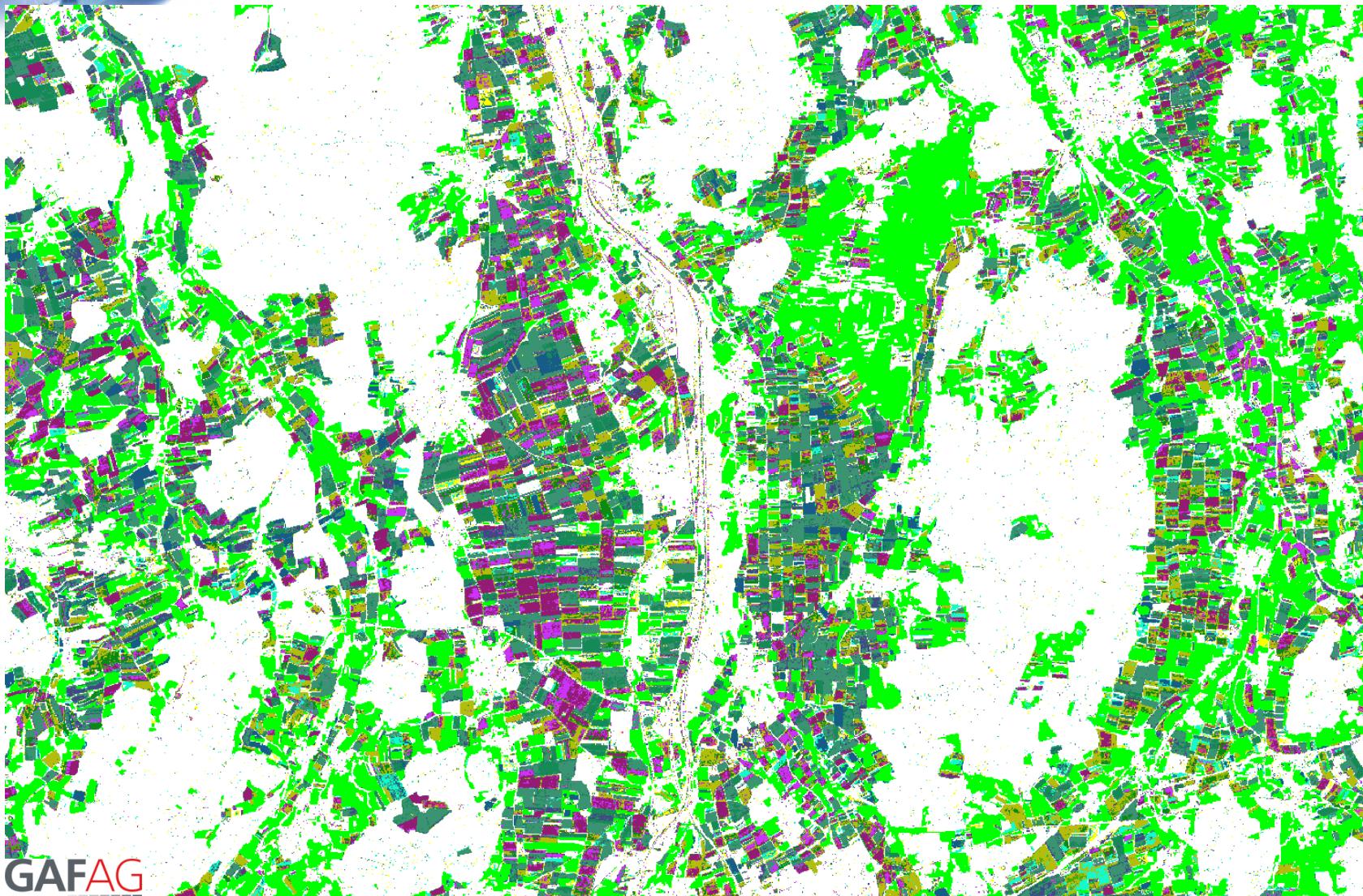
HRL GRA 2015  
(yet unpublished  
product)

ECoLaSS:

Crop mask



# Crop Area/Status Monitoring



HRL GRA 2015  
(yet unpublished product)

ECoLaSS:

Crop mask

Crop type (13 crops)



## Operationalization

### Key Challenges for Operationalization:

- **Large data volumes** from different sensors (S-1, S-2 and Copernicus contributing missions)
- Automation of algorithms in **cloud environment**
- **Novel product** development, as well as **complex change** products
- Stable & **high accuracy** levels on pan-European scale
- In-situ **reference & validation data** availability
- Integration of **regional knowledge/in-situ data** while preserving **European consistency**
- **Timing** and **infrastructure** requirements for the inclusion in Copernicus Service
- Definition of a systematic **benchmarking** procedure for **operational roll-out**



Horizon2020



## Summary & Outlook

### Summary:

- **Methods:** High volume data processing chains: automated, flexible, customizable, scalable
- **Next-generation of existing services:** improvement of existing HRLs 2015 + beyond 2018
- **New Service:** new Agricultural Service for EEA-39 under conceptualization and testing

### Outlook:

- **Prototypes:** Implemented in large demonstration sites; operational framework assessment
- Agricultural Service: Add **Sentinel-1 SAR time series** to processing chains
- **White paper**



# Thank you on behalf of the ECoLaSS team !!

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