

Global Mapping of Crop Area in support to Food Security Analysis using “Free and open” satellite imagery

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*Serving society
Stimulating innovation
Supporting legislation*



Overview

Free and Open **high resolution** sensors: the Copernicus Sentinels

Don't wait for **Sentinel 2...**, **Sentinel 1** is alive and kicking!

Expectations for S1 and S2 use in **Crop Area Mapping** and **Food Security Analysis**

Use of satellite imagery in agriculture

Resolution	Revisit	Application	Limits
300 m – 1 km	Daily	Global crop production trends	Not crop specific, difficult to separate area and phenology
10-30 m	Weekly	Crop area, crop type, phenology, crop diversity/rotation	Requires massive data processing, globally consistent methodology
0.5-5 m	On demand	Area measurement, detailed measures, precision farming	Costly, on sample basis only

Free & Open →

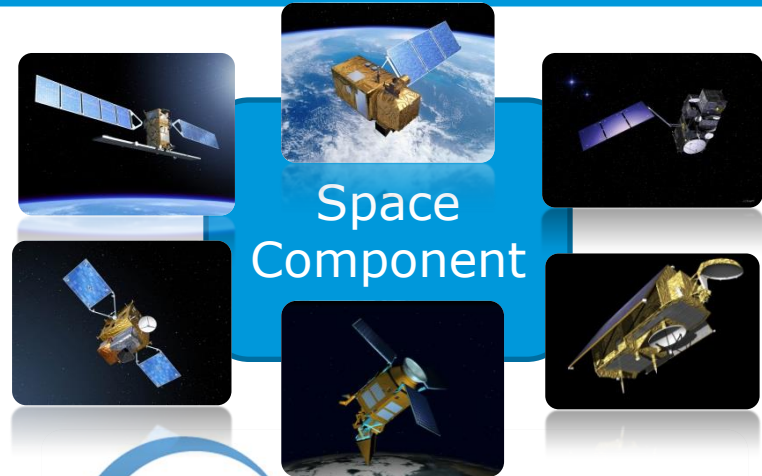
Commercial, but plenty choice →

What is Copernicus?



European
independence &
contribution to
global observing
system

Global, timely and
easily accessible
information



Copernicus



Sentinel-1A

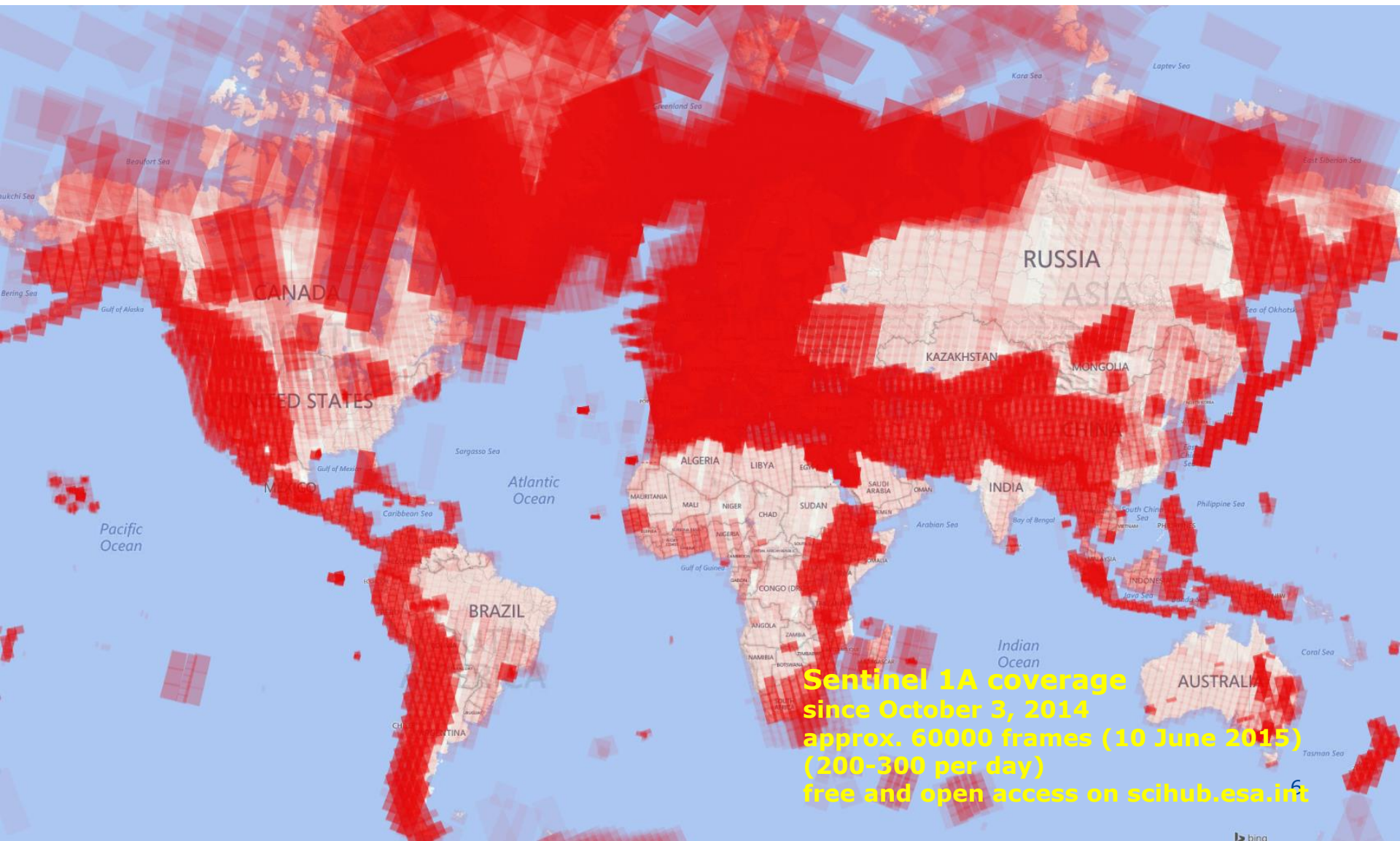
S1A is the very first of the Copernicus Sentinels.

A C-band SAR, dual-polarization, with several “modes”, 12 day repeat cycle. Together with S1B (2016), 6 day repeat cycle!

Interferometric Wide (IW) mode is default [land] mode, 10 m resolution, 185 km swath. ~0.8 Gb per polarisation channel.

“Full, Free and Open” access. Geocoding, calibration possible with the open source S1-toolbox. Interactively or in batch mode.

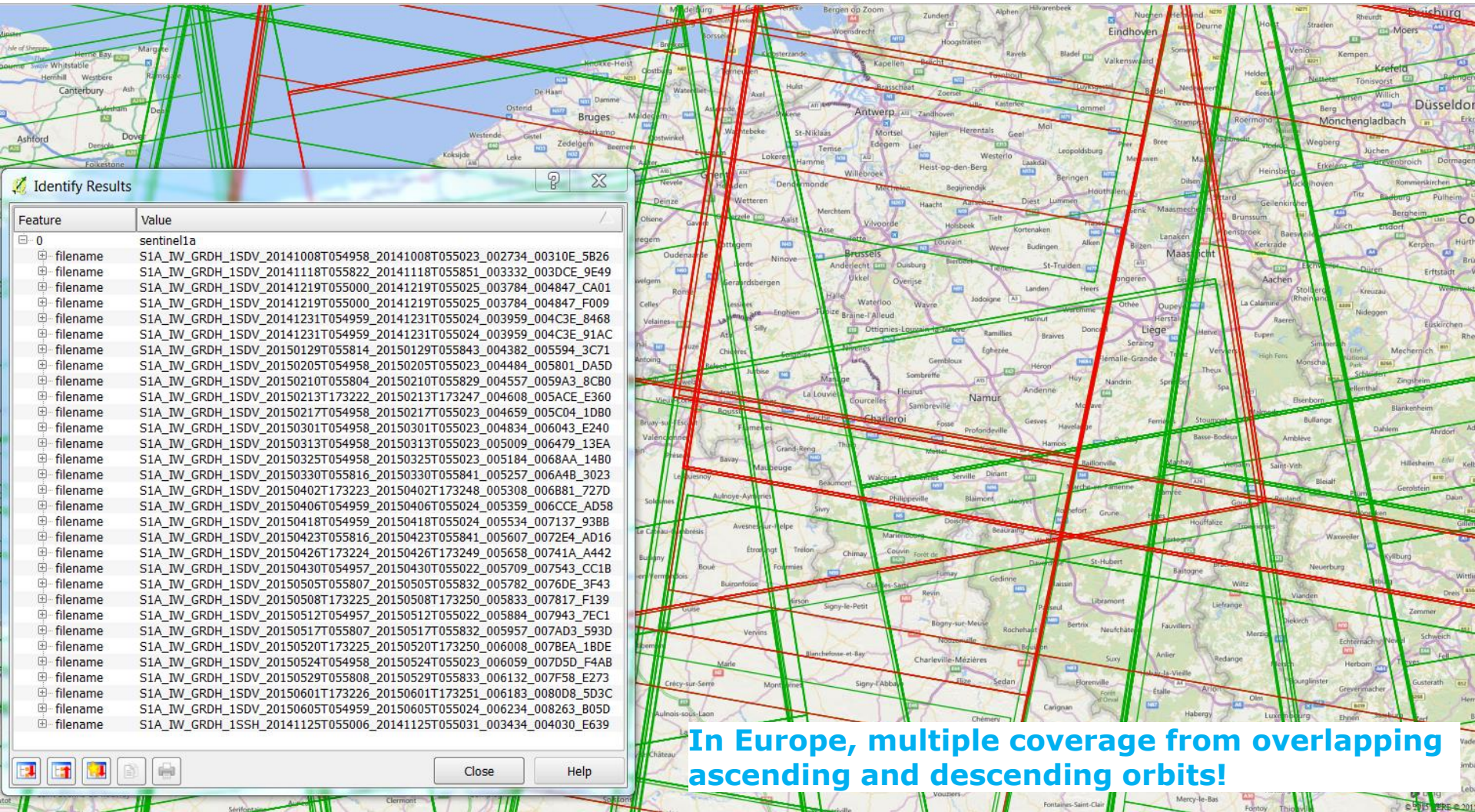
“Hands-free” process to deliver GIS-ready national coverage!



Sentinel 1A coverage
since October 3, 2014
approx. 60000 frames (10 June 2015)
(200-300 per day)
free and open access on scihub.esa.int

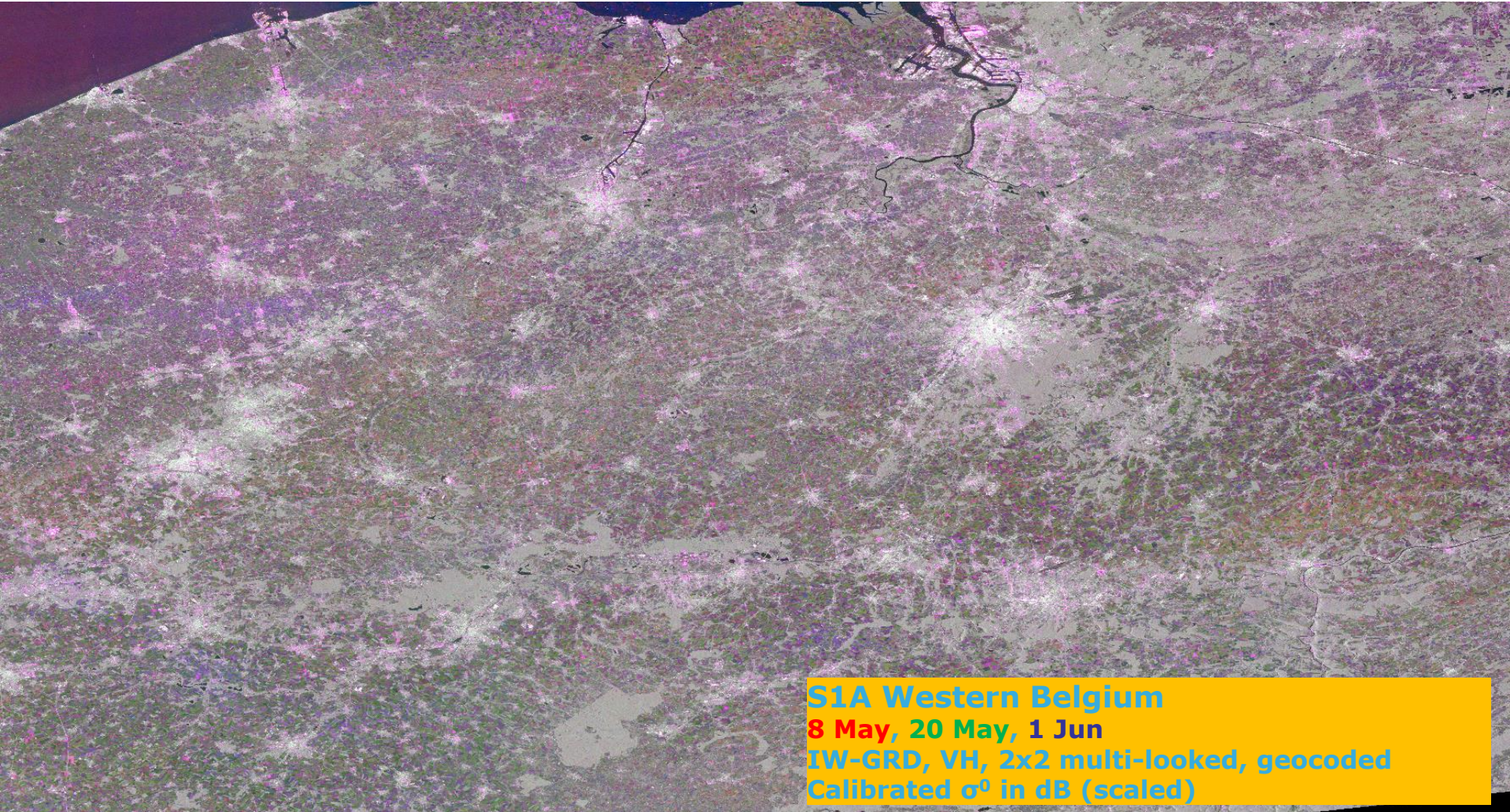


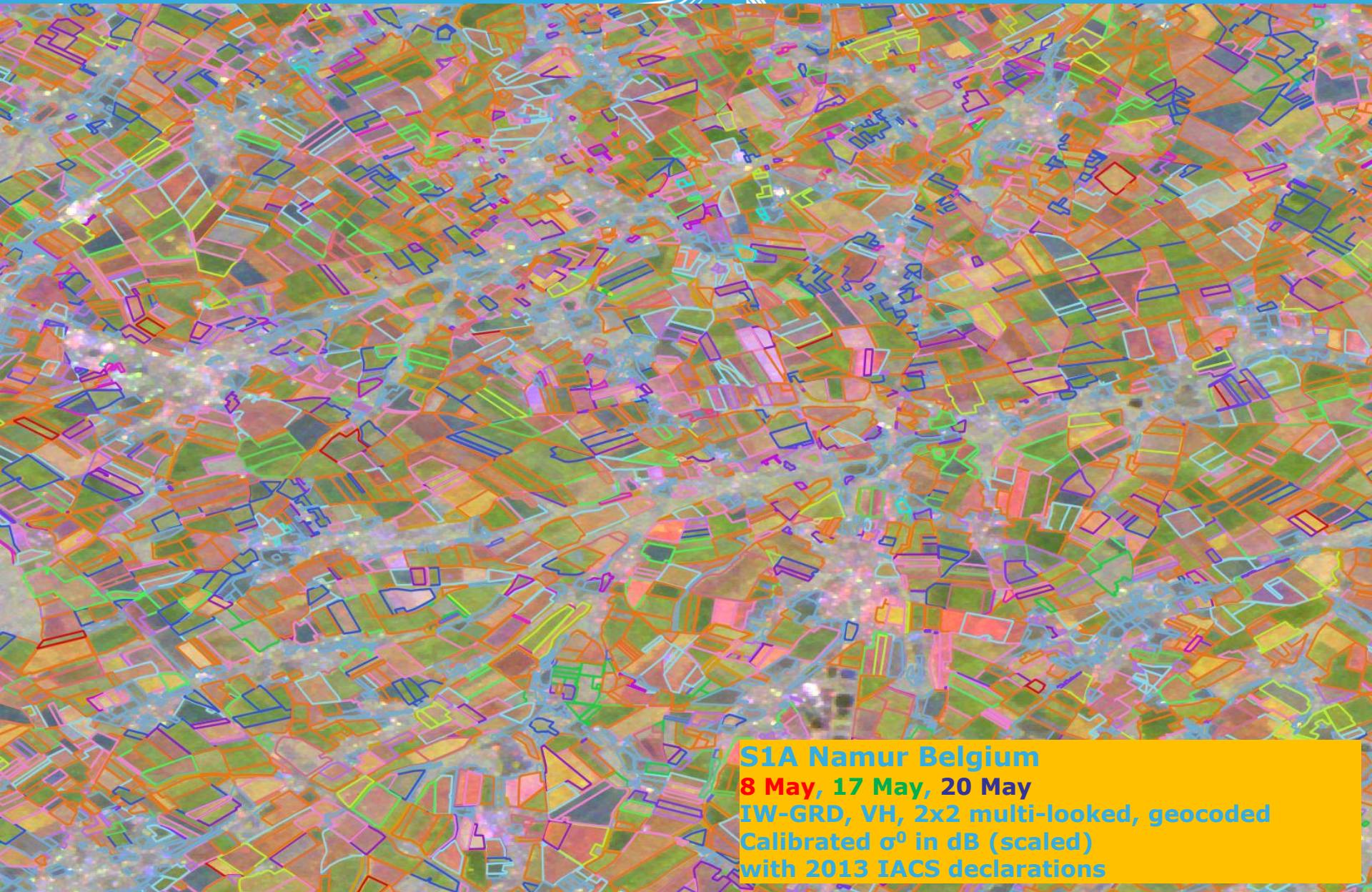
European Commission



Feature	Value
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In Europe, multiple coverage from overlapping ascending and descending orbits!

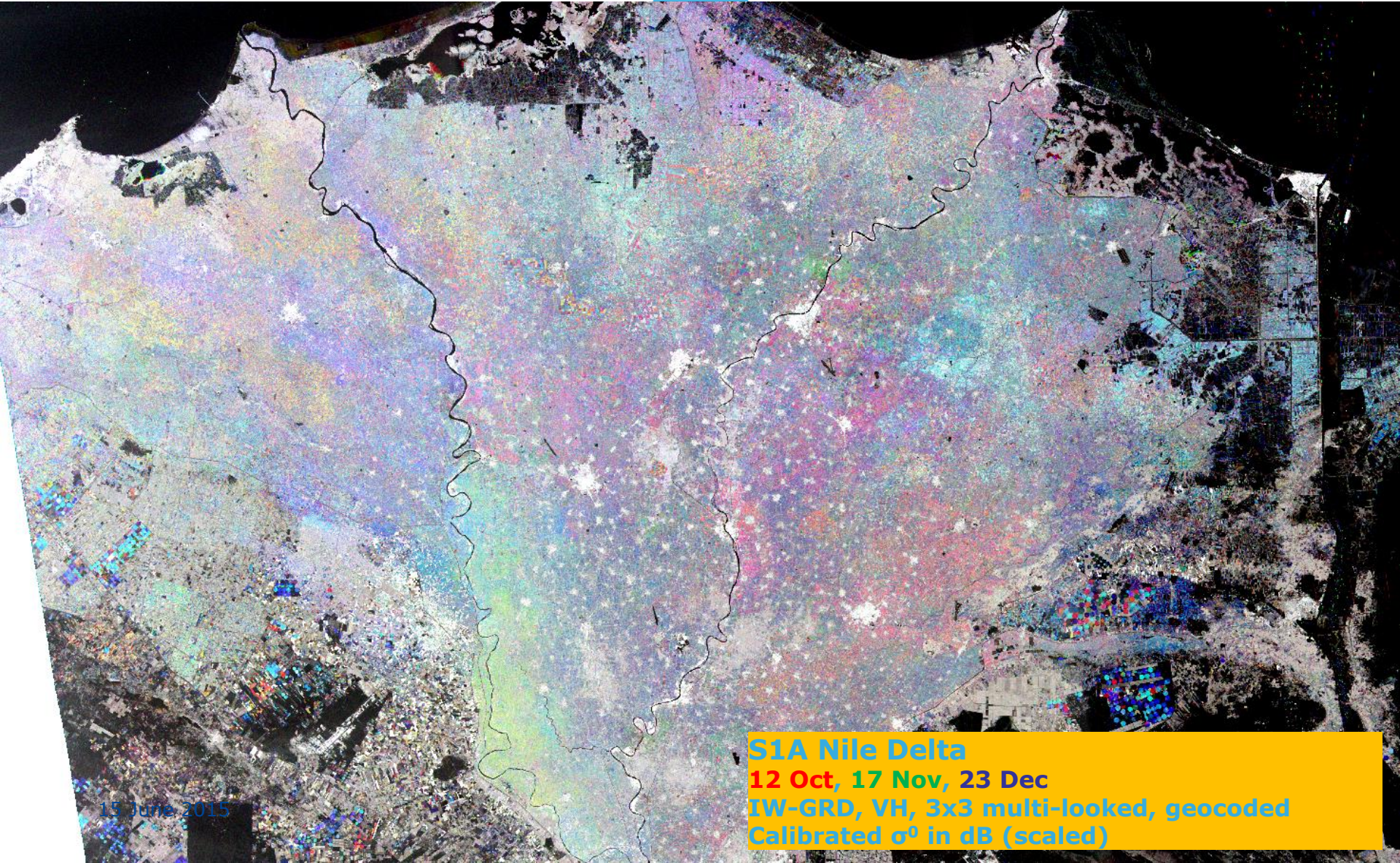




S1A Namur Belgium
8 May, 17 May, 20 May
IW-GRD, VH, 2x2 multi-looked, geocoded
Calibrated σ^0 in dB (scaled)
with 2013 IACS declarations

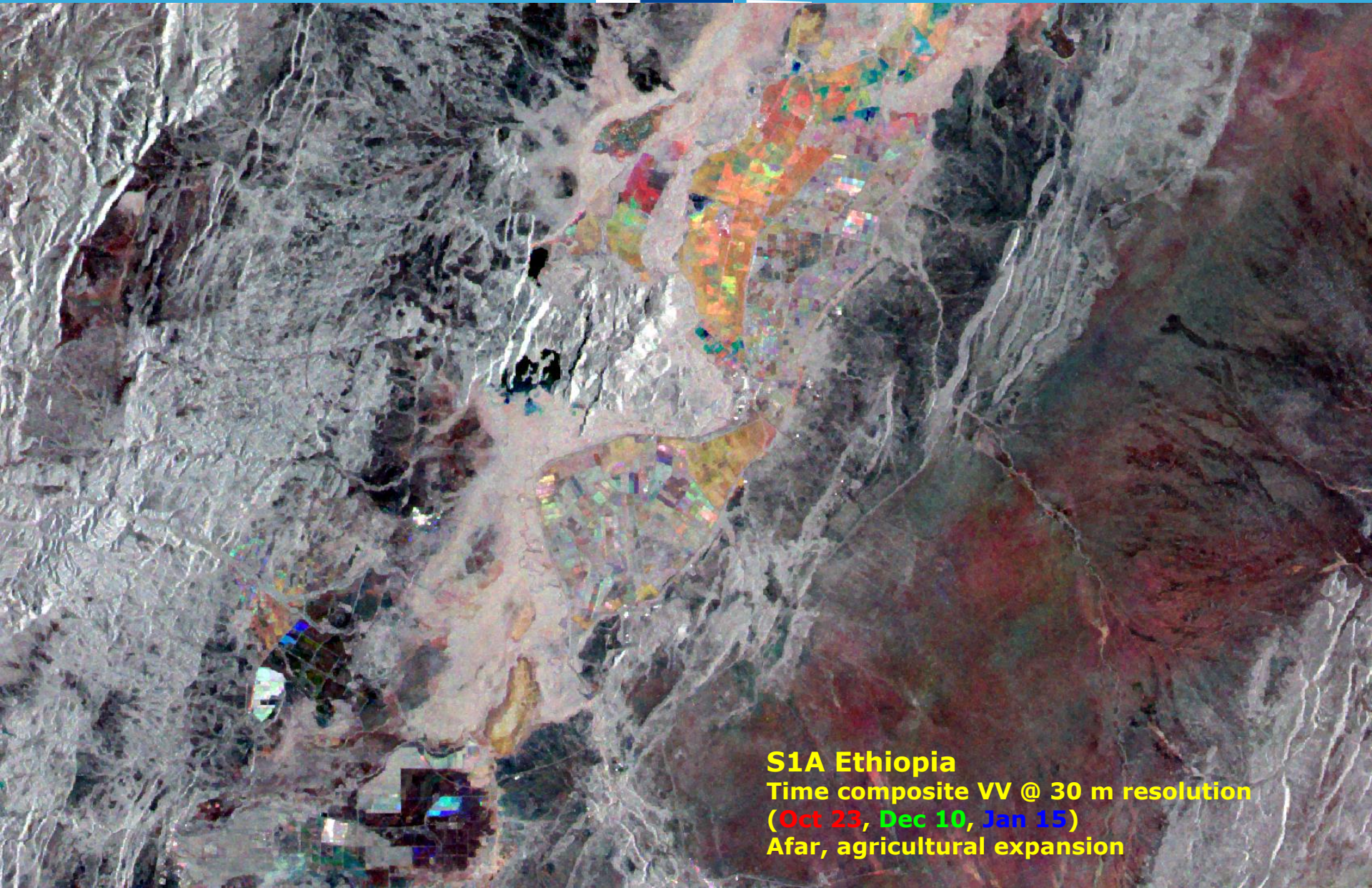


European
Commission



13 June 2015

S1A Nile Delta
12 Oct, 17 Nov, 23 Dec
IW-GRD, VH, 3x3 multi-looked, geocoded
Calibrated σ^0 in dB (scaled)



S1A Ethiopia
Time composite VV @ 30 m resolution
(Oct 23, Dec 10, Jan 15)
Afar, agricultural expansion

Copernicus Sentinels



S1A/B: Radar Mission

3 Apr 2014/early 2016



S2A/B: High Resolution Optical Mission

JUNE 23, 2015/2016



S3A/B: Medium Resolution Imaging and Altimetry Mission

2015/2017



S4A/B: Geostationary Atmospheric Chemistry Mission

2021/2027



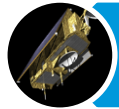
S5P: Low Earth Orbit Atmospheric Chemistry Mission

2015



S5A/B/C: Low Earth Orbit Atmospheric Chemistry Mission

2021/2027



S6A/B: Altimetry Mission

2020/2026

Copernicus: the (near) future

S1A will eventually produce approx. 1 Tb/day (~ Q2/2015).

S2A will produce 3 Tb/day (10 m BGRN (4x), 20 m RNS (6x), 60 m BNS (3x) with global land coverage, every 12 days.

S1B and S2B scheduled for launch in 2016. Another 4 Tb/day.

S1/2 C&D planned to guarantee continuity until, at least, 2025.

To be followed by S1/2 “next generation”.

“**Big Data**”, but still manageable at Member State scales!



European Commission

Google Earth Engine

Search places and datasets...



Scripts Docs

NSW_S1A_combi

Get Link

Save

Run

Reset



Inspector

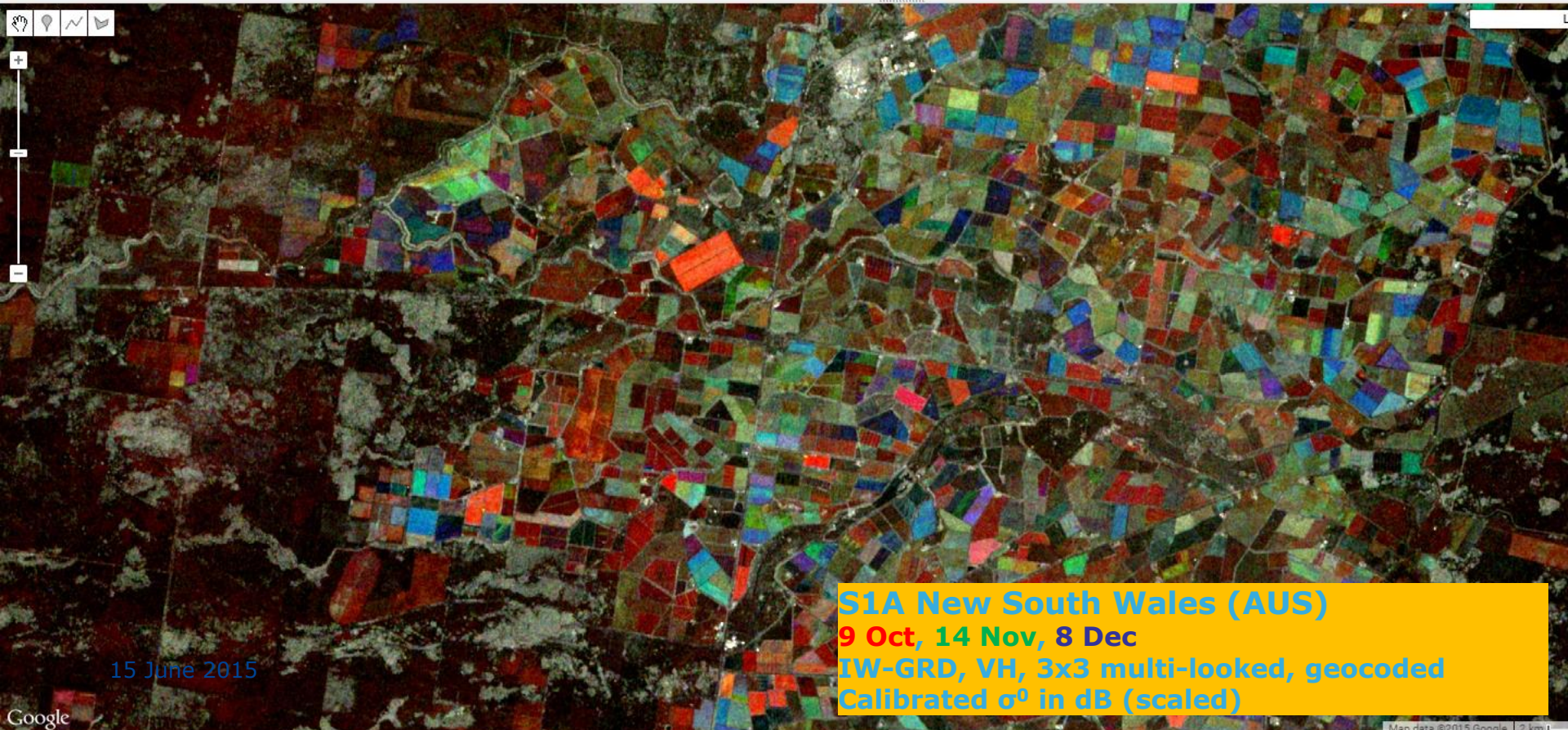
- NSW_S1A_combi
- NAIP_features2
- NCEP display test
- NDWI_extract
- NHU_S1A_combi
- NHU_S1A_only
- NSW_S1A_combi

```

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2 // ASC
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4 var s1_20141021 = ee.Image('04506042925739229745-02094782379573228579');
5 var s1_20141114 = ee.Image('04506042925739229745-18217876338472823932');
6 var s1_20141126 = ee.Image('04506042925739229745-06060588760989137524');
7 var s1_20141208 = ee.Image('04506042925739229745-06060588760989137524');
8 // DESC

```

- Use print(... console.
- ImageColle
- ImageColle
- FeatureCol



15 June 2015

S1A New South Wales (AUS)

9 Oct, 14 Nov, 8 Dec

IW-GRD, VH, 3x3 multi-looked, geocoded
Calibrated σ^0 in dB (scaled)



European Commission

Google Earth Engine

Search places and datasets...



- Scripts
- Docs
- NSW_S1A_combi
- NAIP_features2
- NCEP_display_test
- NDWI_extract
- NHU_S1A_combi
- NHU_S1A_only
- NSW_S1A_combi

NSW_S1A_combi

Get Link Save Run Reset Inspector

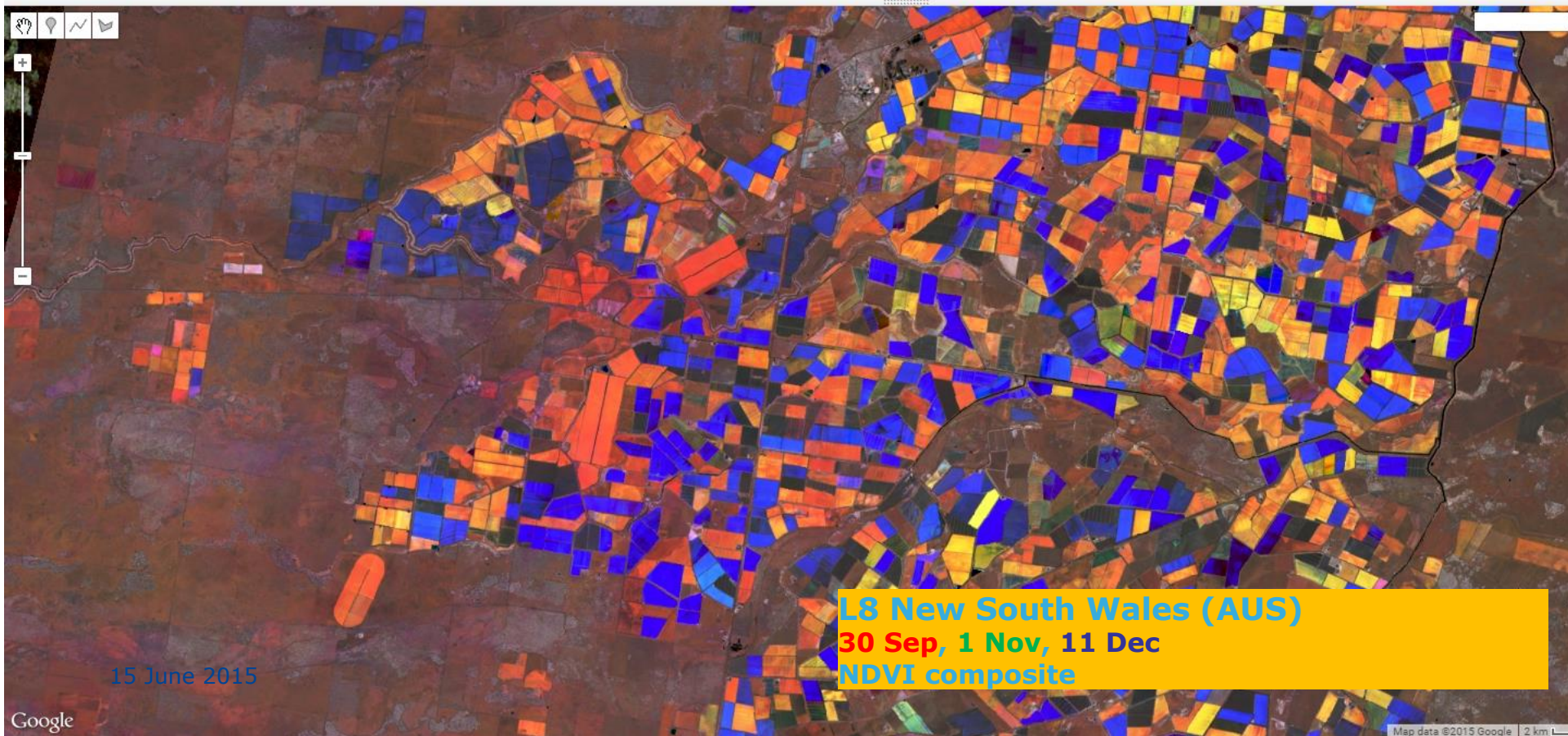
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1 // NSW_S1A_combi
2 // ASC
3 var s1_20141009 = ee.Image('04506042925739229745-04010150827404158855');
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5 var s1_20141114 = ee.Image('04506042925739229745-18217876338472823932');
6 var s1_20141126 = ee.Image('04506042925739229745-06060588760989137524');
7 var s1_20141208 = ee.Image('04506042925739229745-06060588760989137524');
8 // DESC

```

Inspector

- Use print(. console.
- ImageColle
- ImageColle
- FeatureCol



LS New South Wales (AUS)
30 Sep, 1 Nov, 11 Dec
NDVI composite

15 June 2015

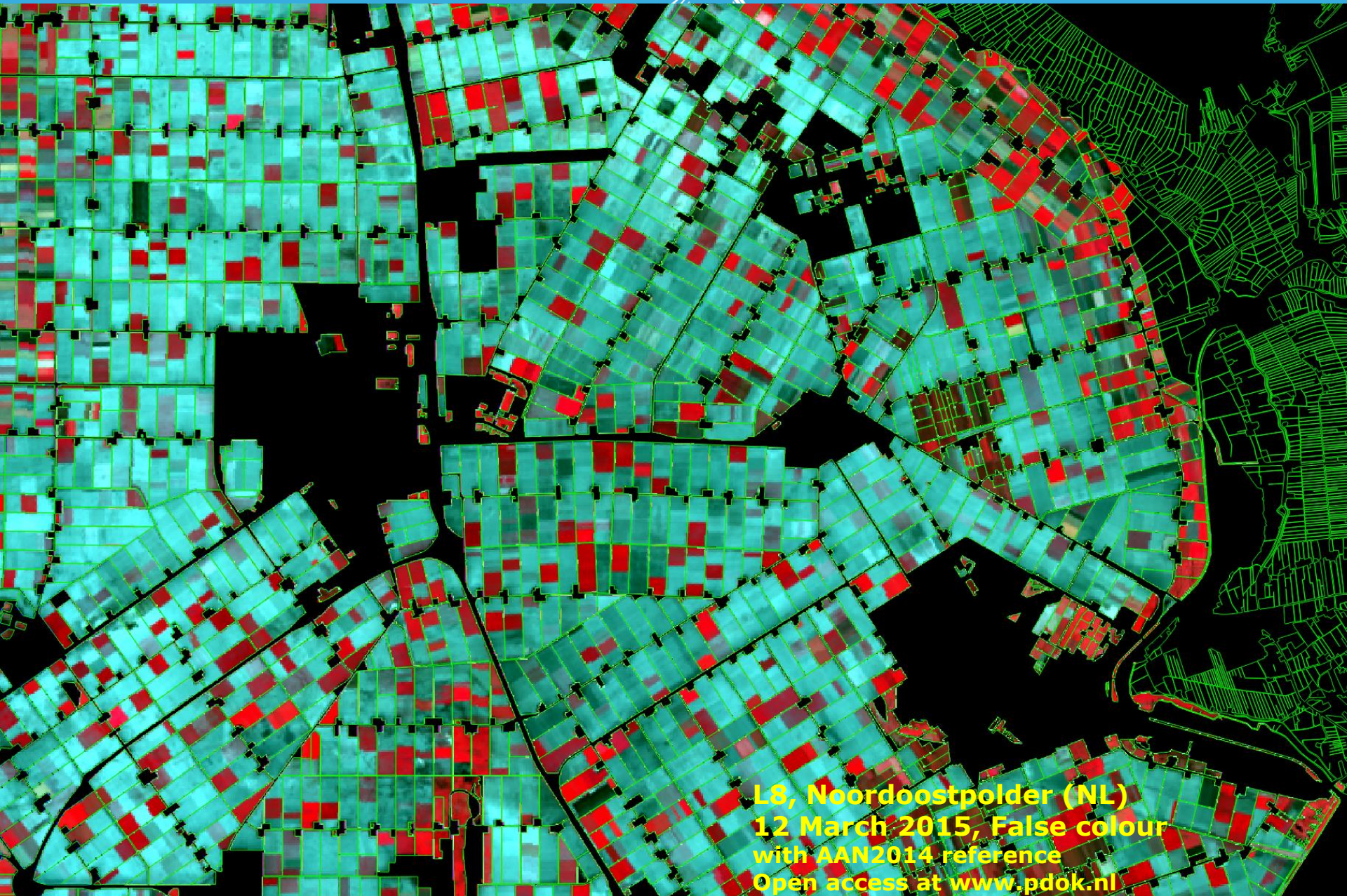
Expectations for S-1 and S-2 use

Sentinel-2 will become the prime satellite source for (public and private) agri-monitoring applications with S-1 as complimentary, consistent reference and Landsat-8 as a gap-filler;

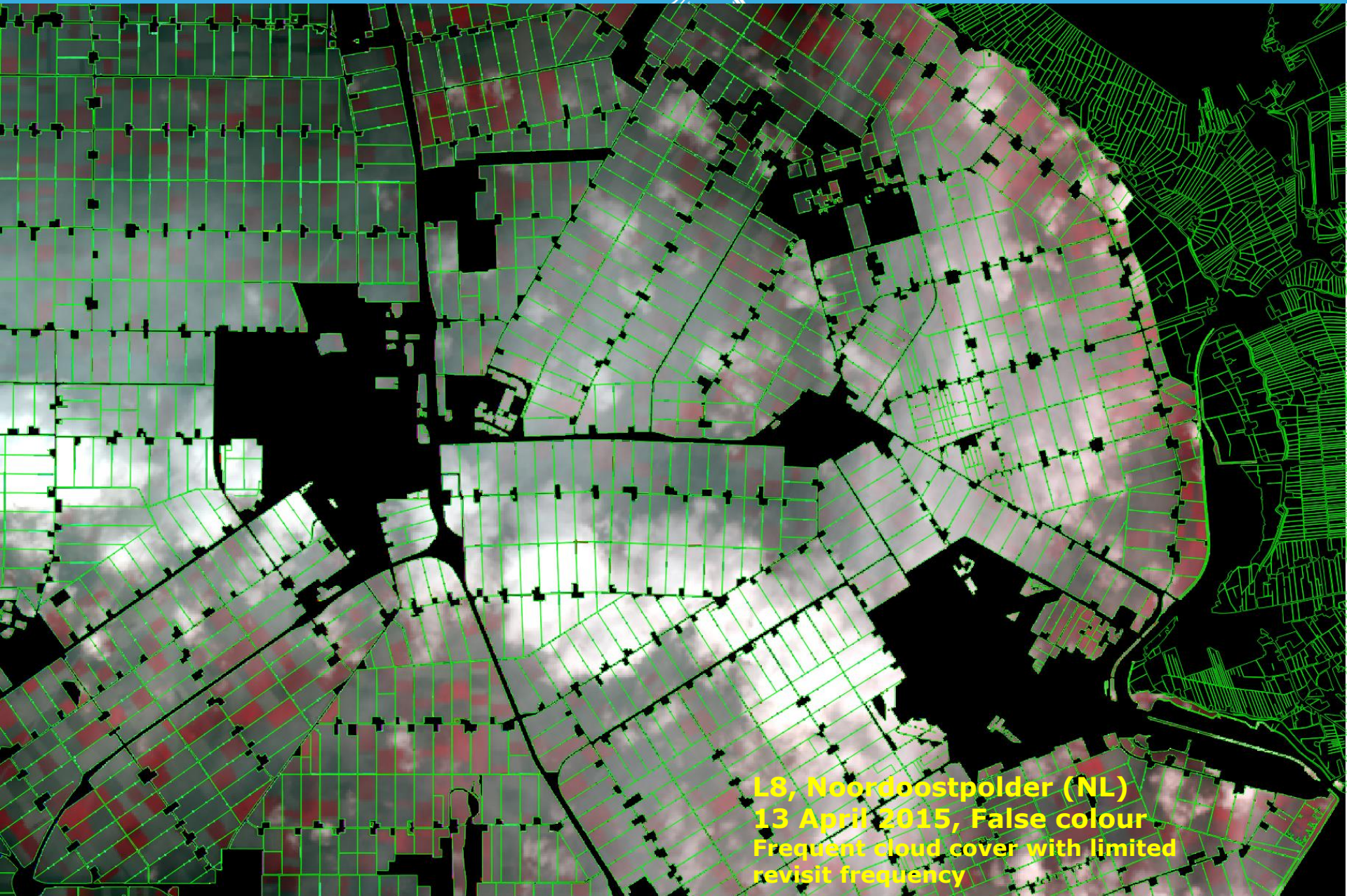
S-1 and S-2 will enable globally consistent crop area delineation, crop area change detection and crop status indicators, complementing index-only approaches with low resolution imagery;

Most sophisticated applications combine with open reference data, infrastructure and logistics, smart surveying and feedback loops;

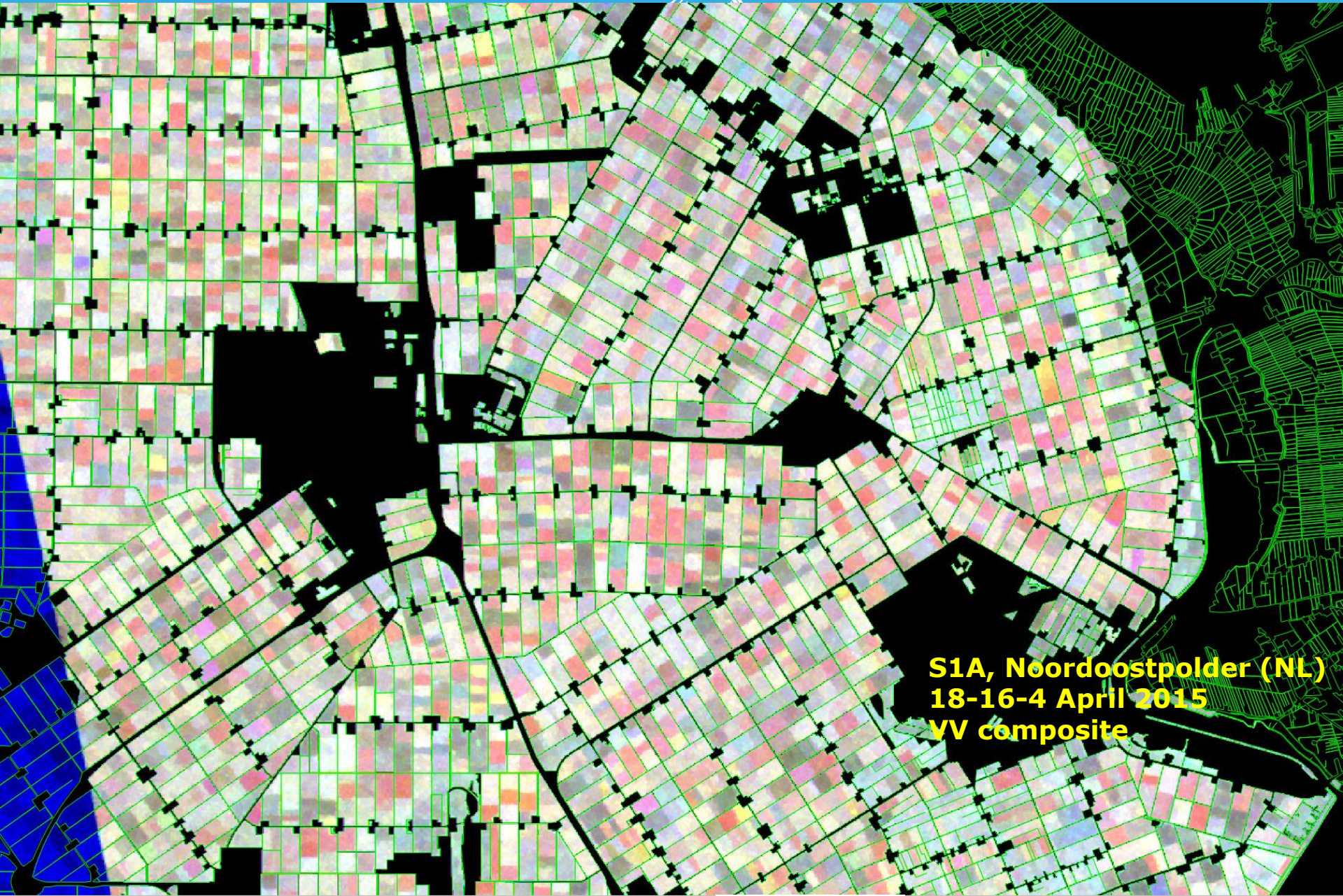
Long term Copernicus outlook will introduce these data to many new users, who will innovate on the basis of rich open source software solutions.



L8, Noordoostpolder (NL)
12 March 2015, False colour
with AAN2014 reference
Open access at www.pdok.nl



**L8, Noordoostpolder (NL)
13 April 2015, False colour
Frequent cloud cover with limited
revisit frequency**



S1A, Noordoostpolder (NL)
18-16-4 April 2015
VV composite



Idem, VH composite
Almost all field already
recognisable!

Thank you!

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Sentinel-1:

Data hub: <https://scihub.esa.int/dhus>
(requires registration and login)

Sentinel toolboxes: <https://earth.esa.int/web/sentinel-tbx>
(no registration required)