European Commission

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

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Joint Research Centre

EXPO MILANO 2015

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

Sentinel-1A

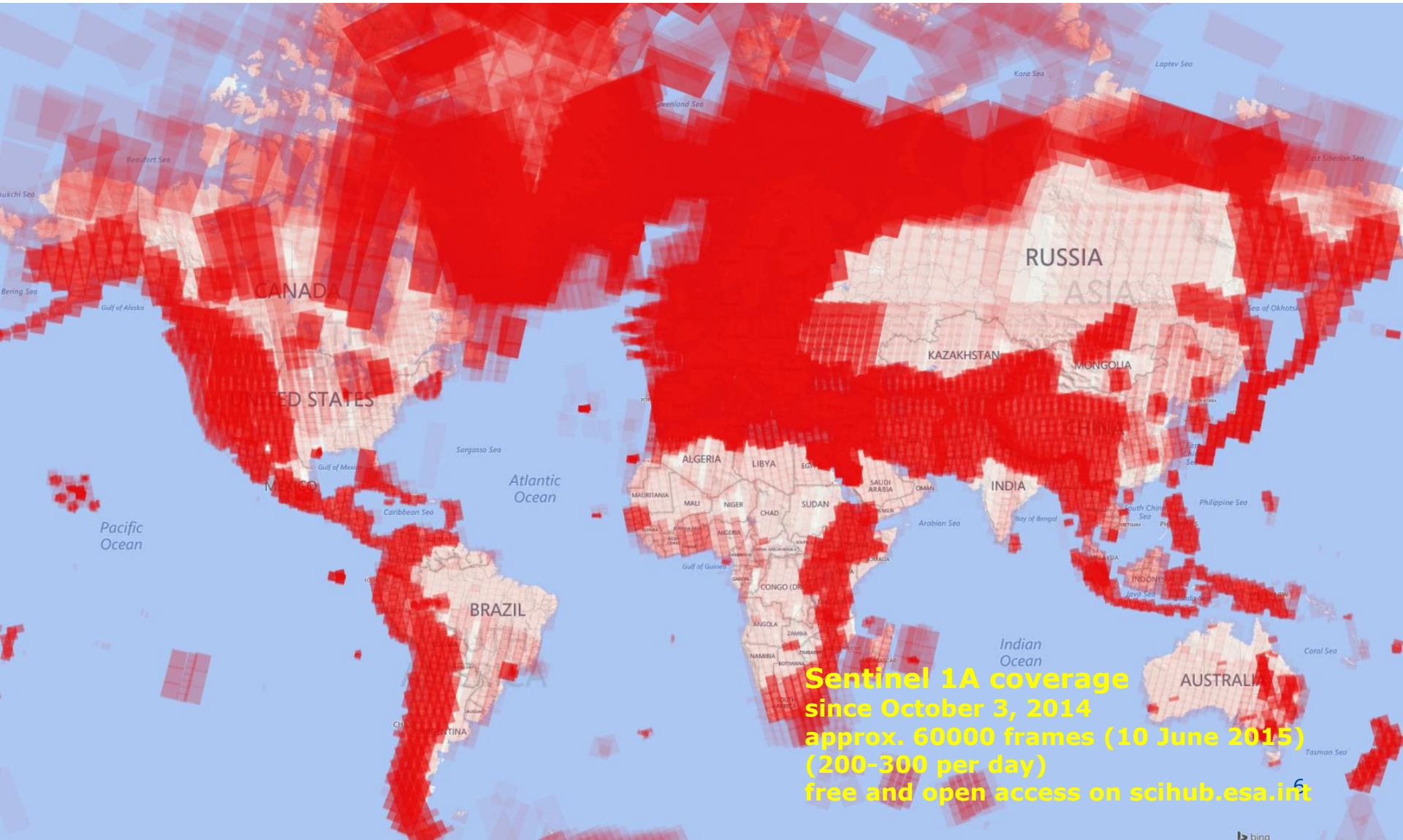
S1A is the very first of the Copernicus Sentinels.

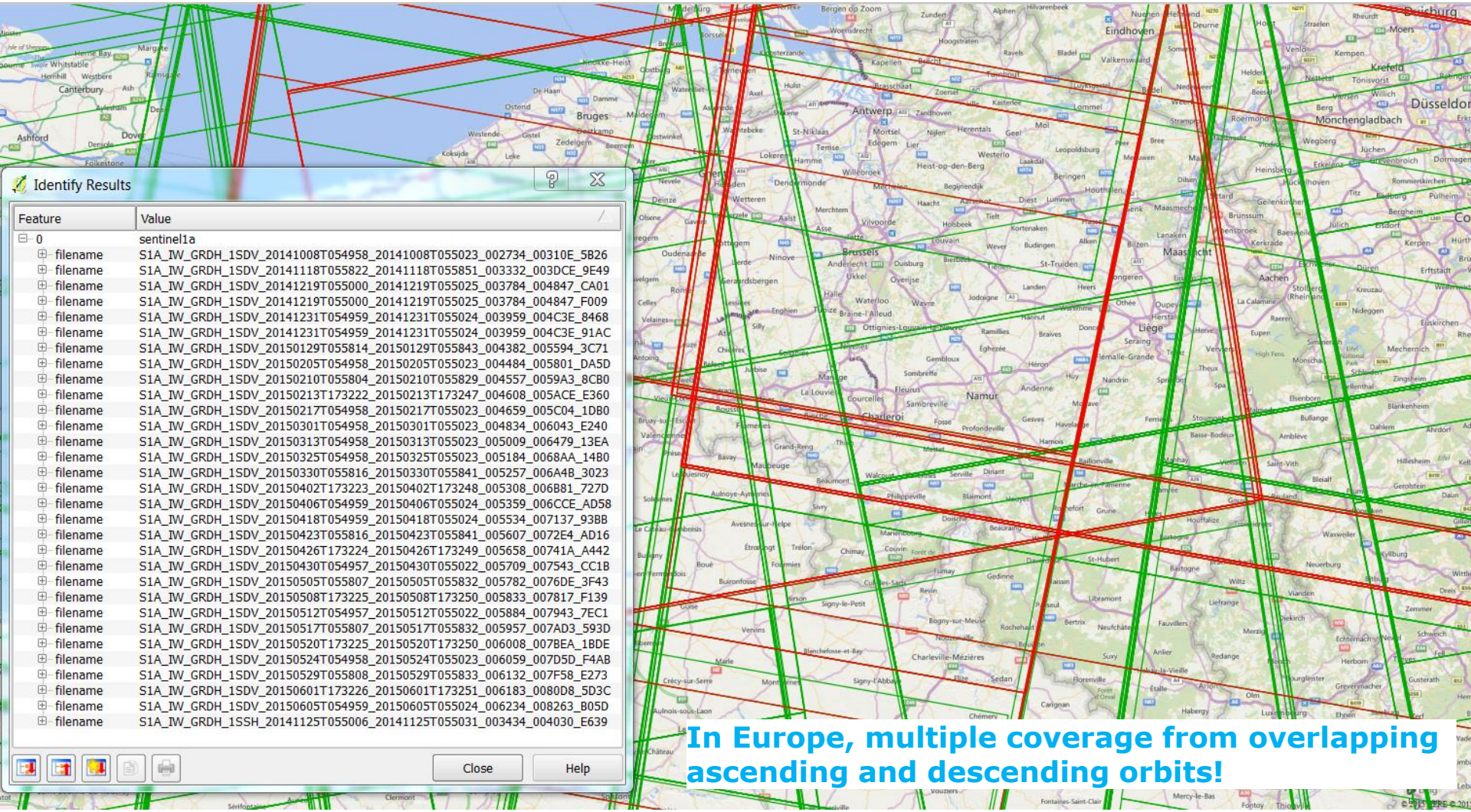
A C-band SAR, dual-polarization, with several "modes", 12 day repeat cycle. Together with S1B (2016), 6 day repeat cycle!

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

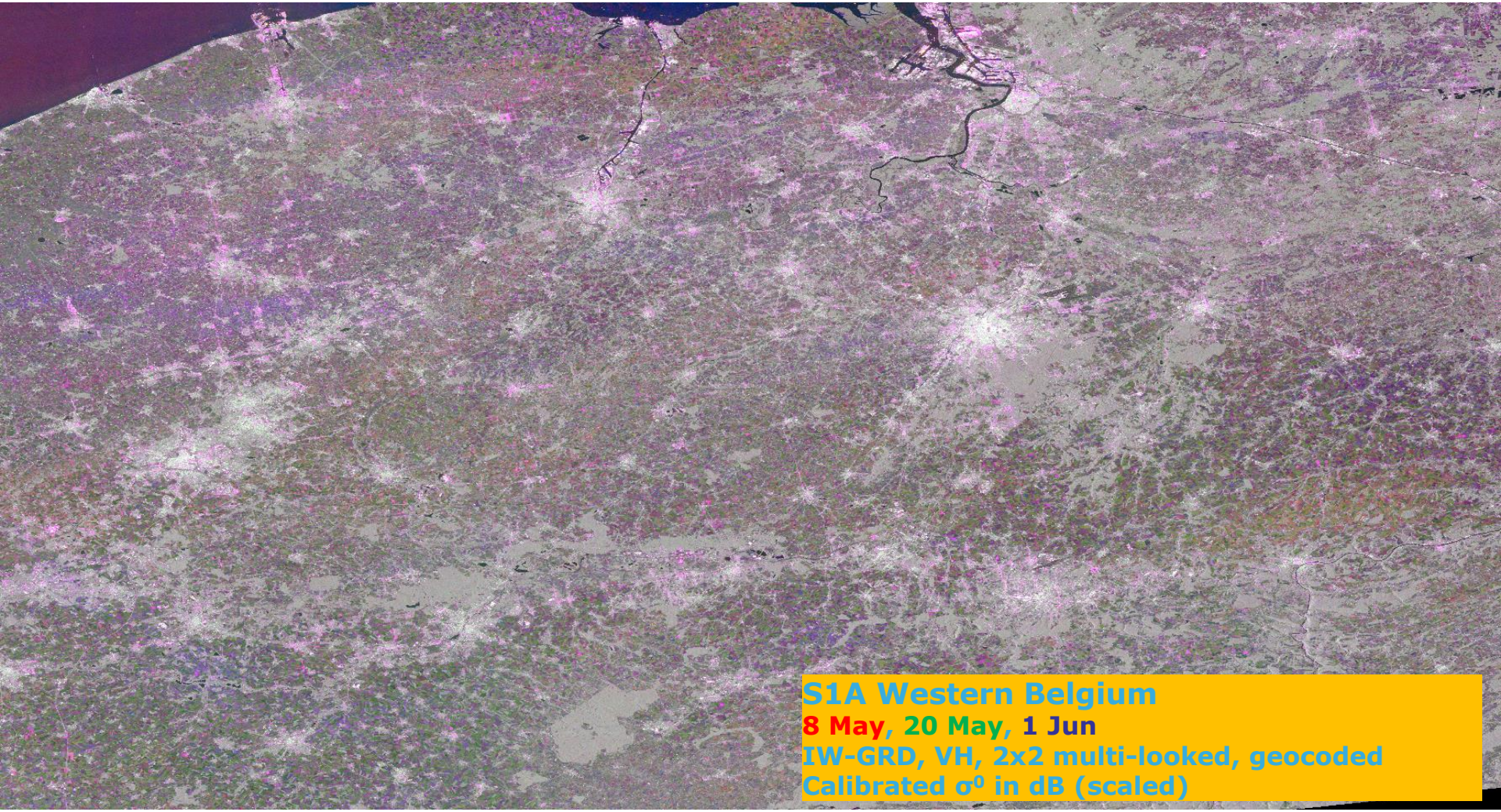
"Full, Free and Open" access. Geocoding, calibration possible with the open source S1-toolbox. Interactively or in batch mode.

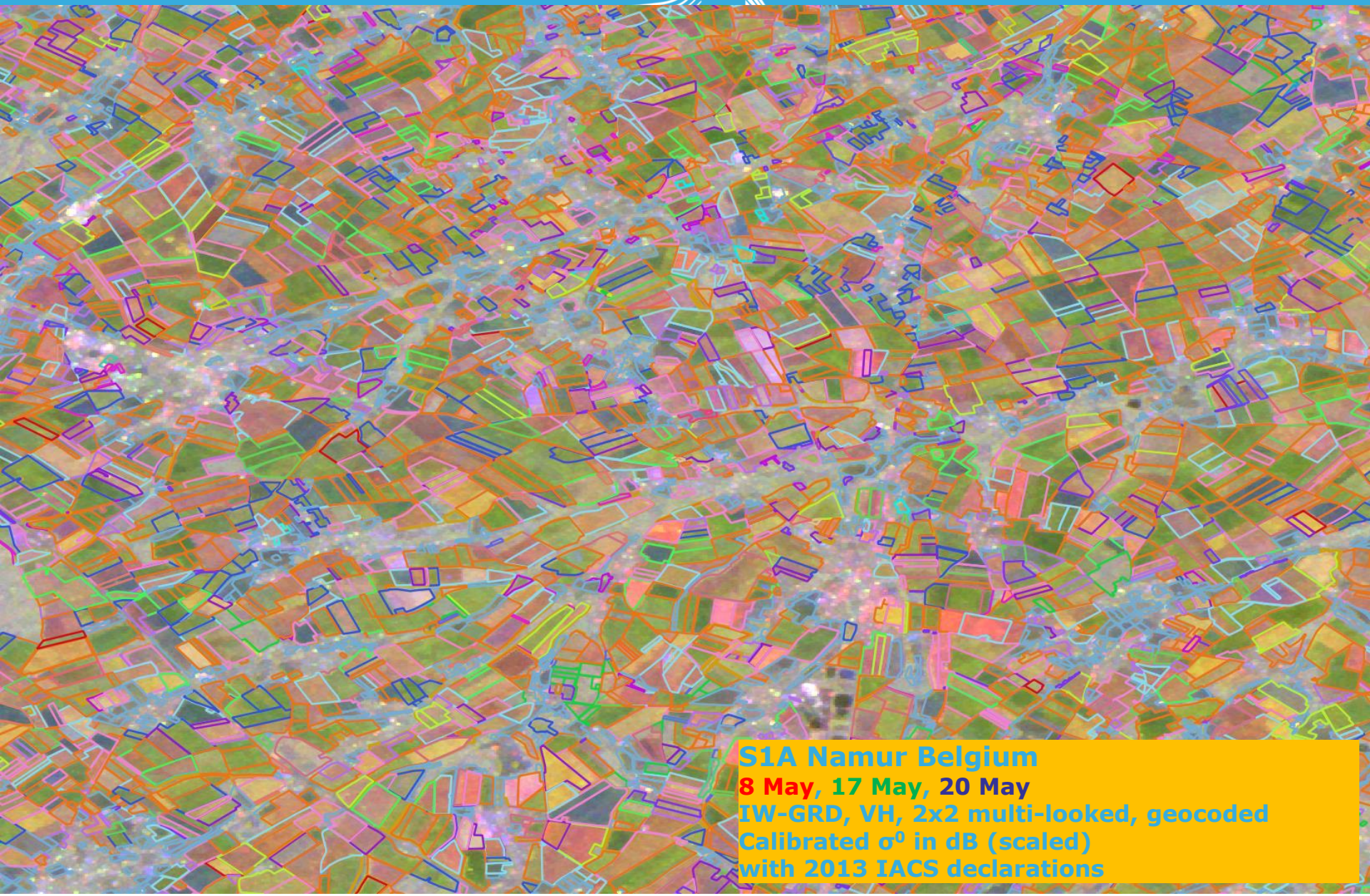
"Hands-free" process to deliver GIS-ready national coverage!


RUSSIA
CANADA
UNITED STATES
KAZAKHSTAN
MONGOLIA
CHINA
INDIA
BRAZIL
ALGERIA
LIBYA
SUDAN
Atlantic Ocean
Pacific Ocean
Indian Ocean
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



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


S1A Western Belgium
8 May, 20 May, 1 Jun
IW-GRD, VH, 2x2 multi-looked, geocoded
Calibrated σ⁰ in dB (scaled)


S1A Namur Belgium
8 May, 17 May, 20 May
IW-GRD, VH, 2x2 multi-looked, geocoded
Calibrated σ⁰ in dB (scaled)
with 2013 IACS declarations

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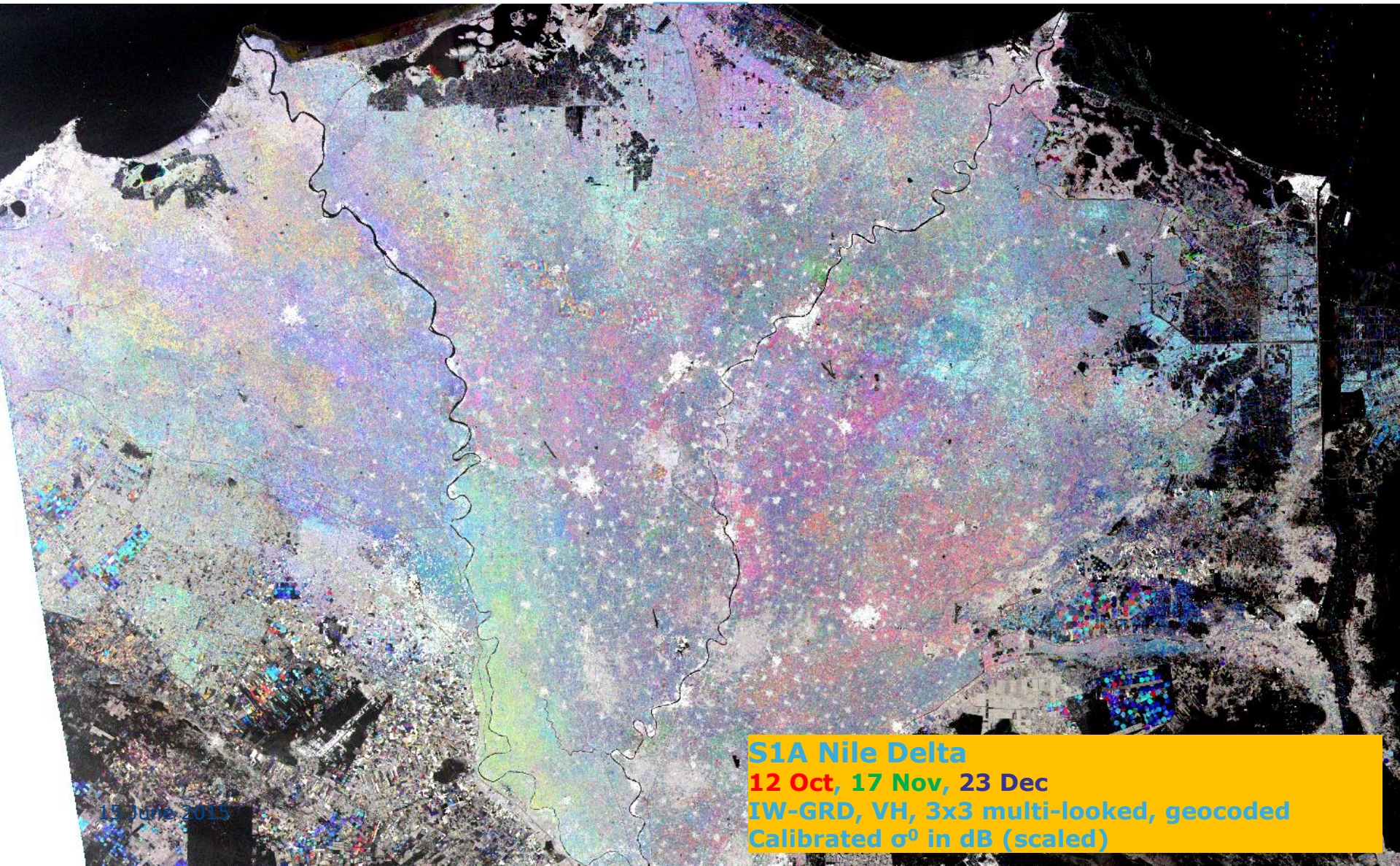
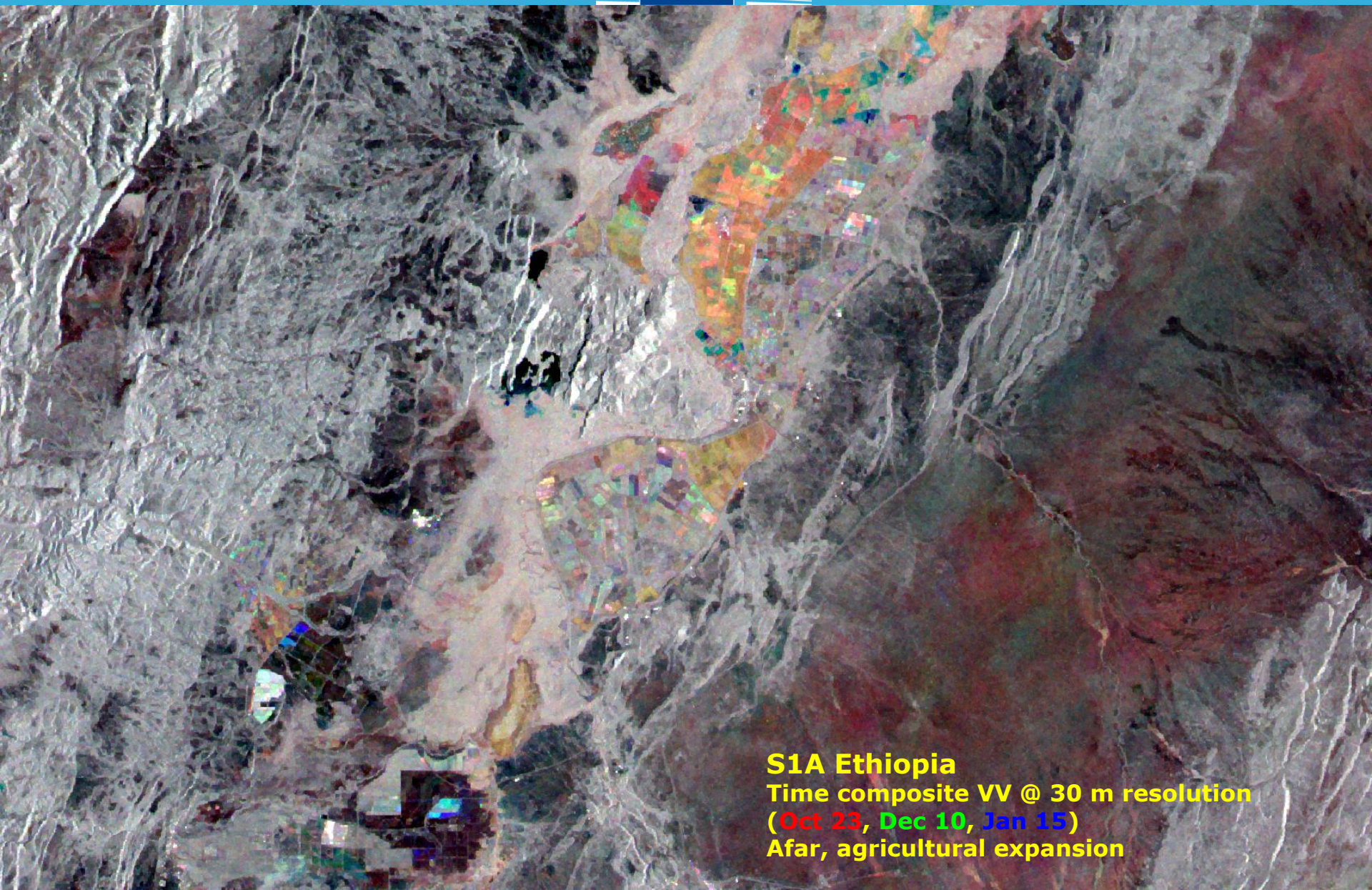


15 June 2015


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!

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Google Earth Engine

Search places and datasets...

Scripts | Docs

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

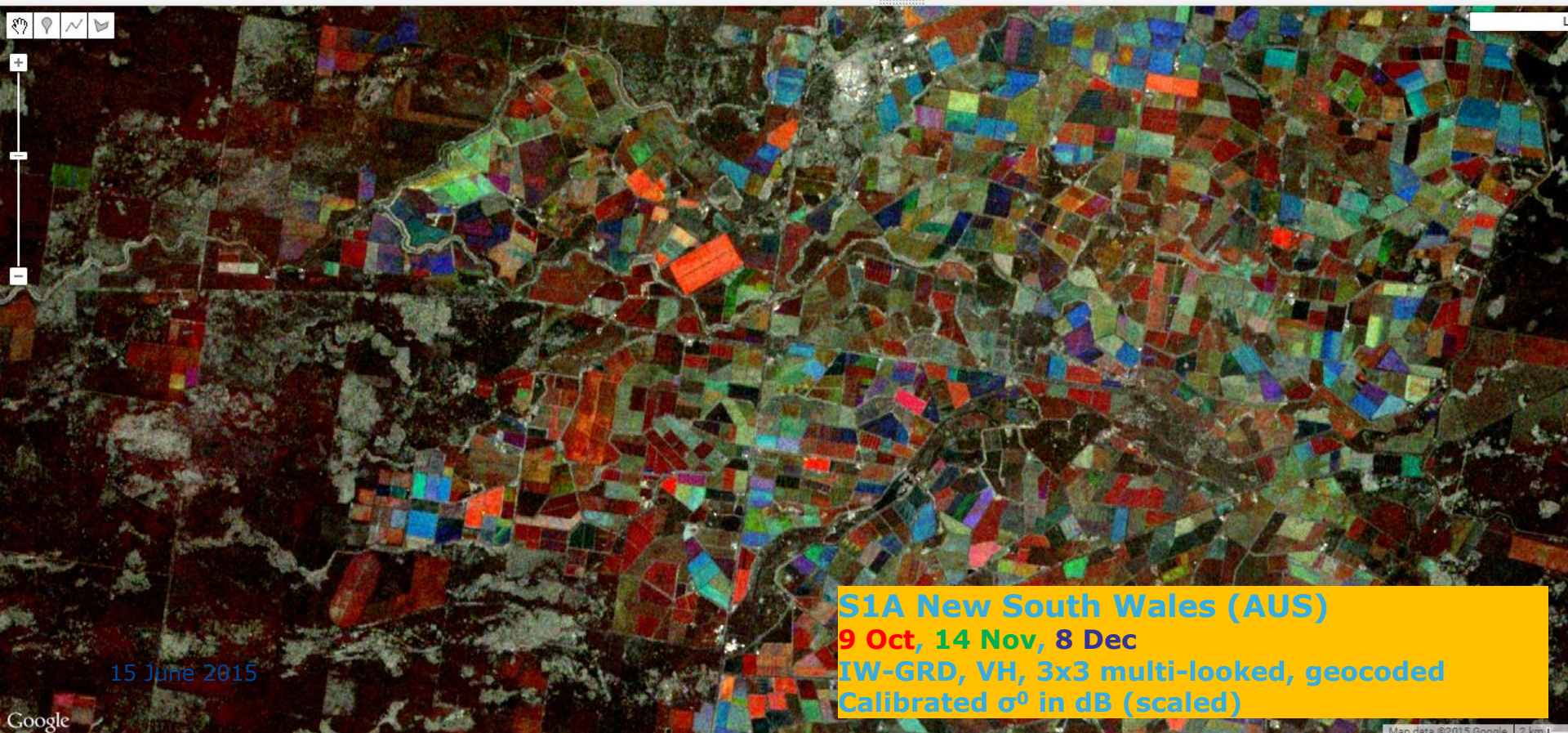
NSW_S1A_combi | Get Link | Save | Run | Reset

```
1  // NSW_S1A_combi
2  // ASC
3  var s1_20141009 = ee.Image('04506042925739229745-04010150827404158855');
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
```

Inspector

Use print(..
console.

ImageColle
ImageColle
FeatureCol



S1A New South Wales (AUS)
9 Oct, 14 Nov, 8 Dec
IW-GRD, VH, 3x3 multi-looked, geocoded
Calibrated σ^0 in dB (scaled)

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Search places and datasets...

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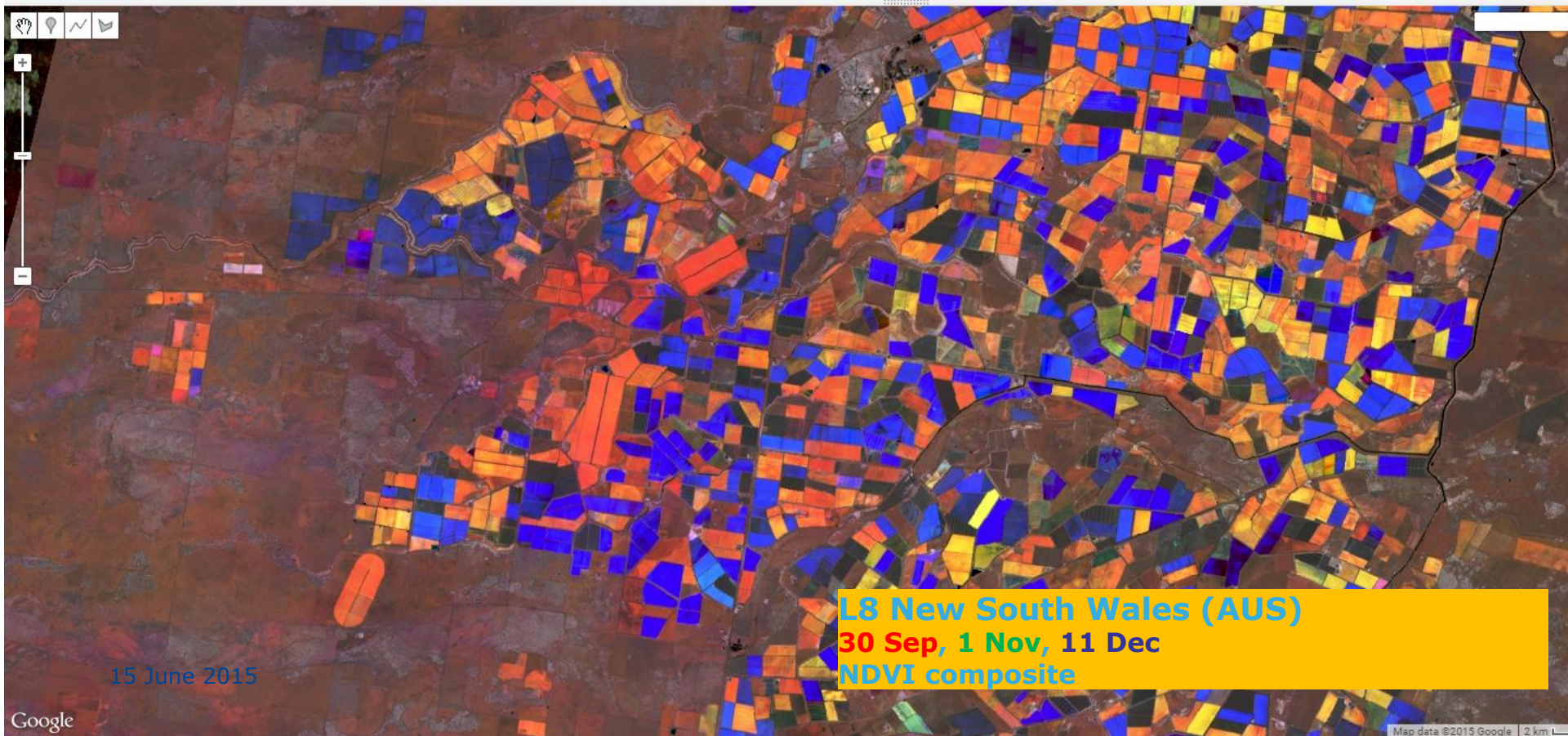


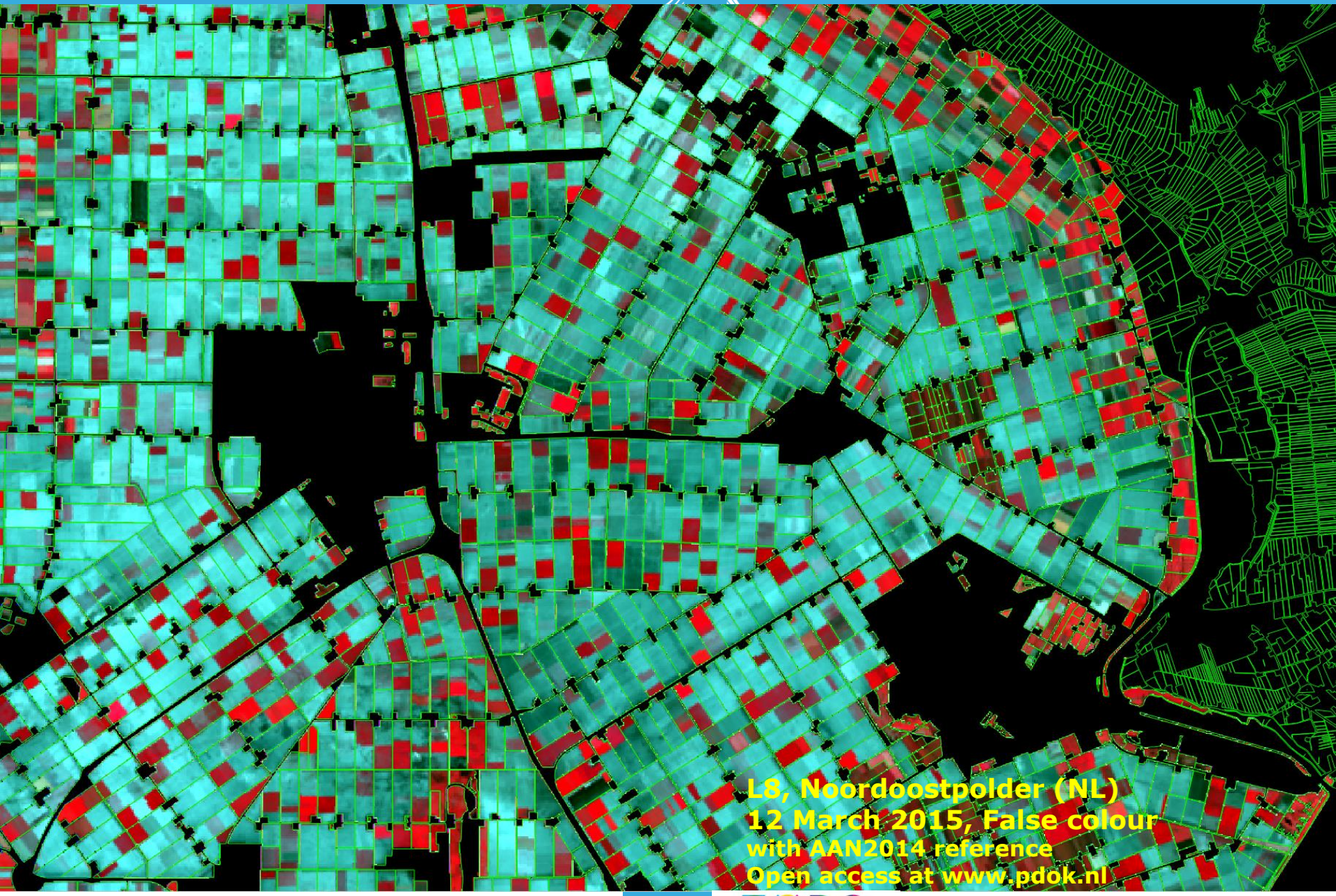
Expectations for S-1 and S-2 use

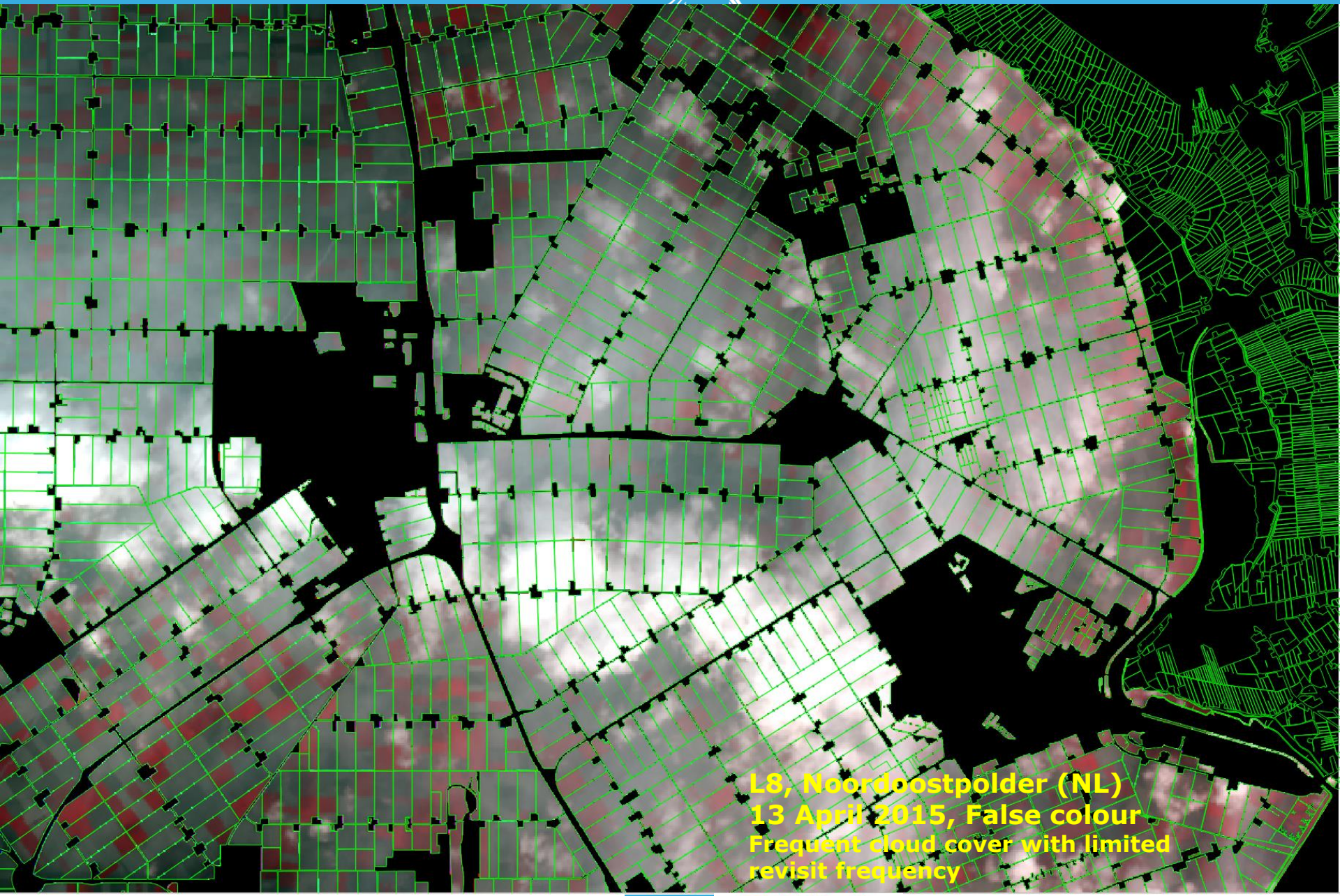
Sentinel-2 will become the prime satellite source for (public and private) agri-monitoring applications with S-1 as complimentary, consistent reference and Landsat-8 as a gap-filler;

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



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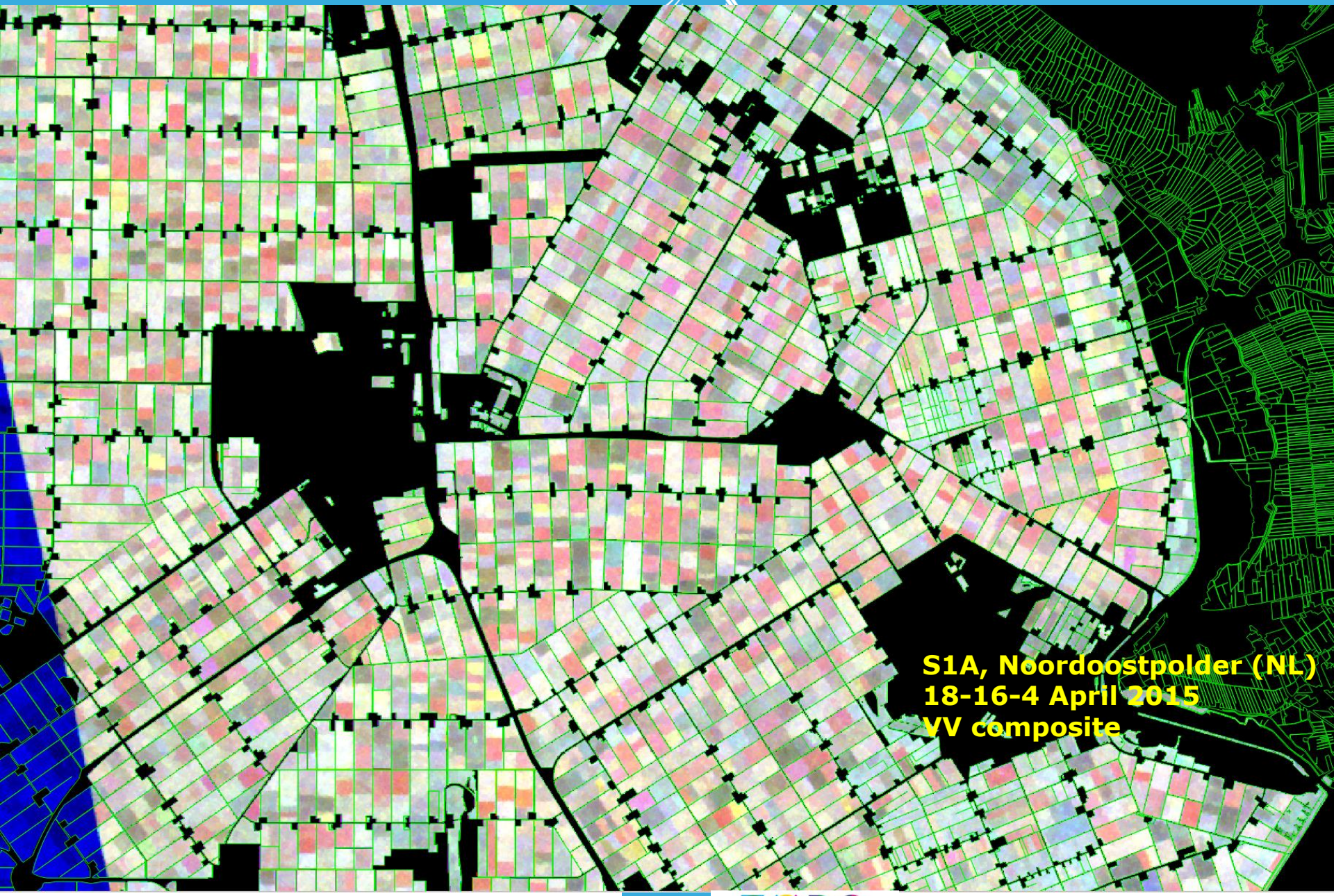
S1A, Noordoostpolder (NL)
18-16-4 April 2015
VV composite


Idem, VH composite
Almost all field already recognisable!

Thank you!

guido.lemoine@jrc.ec.europa.eu

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)