

35th INTERNATIONAL COTTON CONFERENCE BREMEN 2021



Presentation

Session: **Cotton Production and Ginning (T3)**

Title: **Monitoring cotton fields with satellite imagery**

Speaker: **Sabrina Melchionna**, Melchionna – Remote Sensing, Bremen, Germany

Presentations are available on the conference archive: <https://baumwollboerse.de/en/cotton-conference/lectures/>

Conference Organization

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Bremer Baumwollbörse, Bremen, Germany. E-Mail: info@baumwollboerse.de

*Monitoring cotton fields
with
satellite imagery*

Dr. Sabrina Melchionna

17.03.2021, International Cotton Conference, Bremen



Outlines

- ❖ Challenges in Agricultural Production
- ❖ Benefits of Satellite Monitoring
- ❖ Remote Sensing: Optical vs SAR
- ❖ Applications
 - ❖ Mapping
 - ❖ Soil Moisture
 - ❖ Yield Estimation
 - ❖ Flood and Drought Monitoring
- ❖ More spectacular images from space

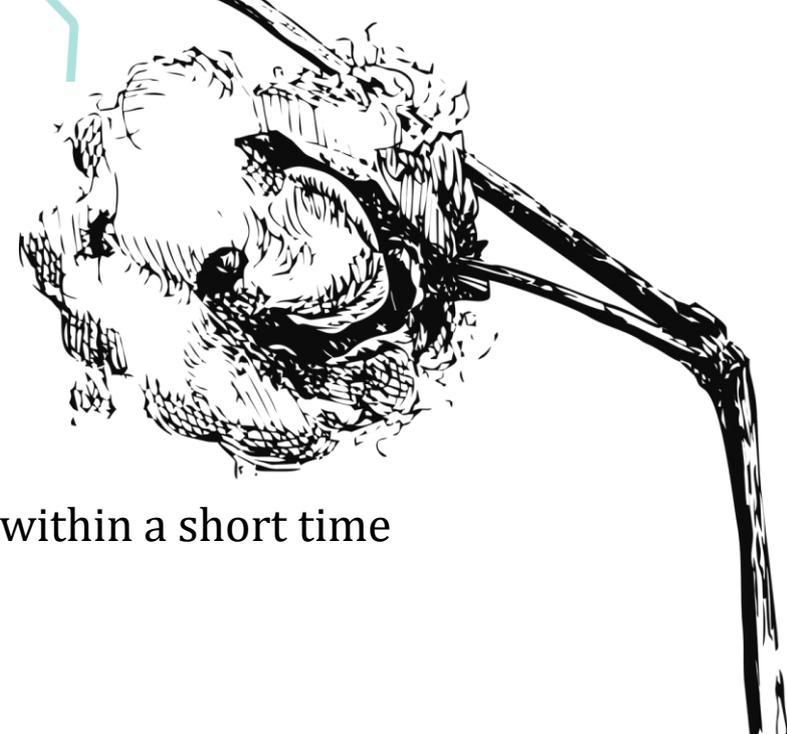
*A Satellite Image
is more than just
a Spectacular Photo*



Challenges in Agricultural Production

Agricultural Production depends on:

- physical landscape
- climatic driving variables
- agricultural managing practices



Unfavorable growing conditions \Rightarrow change of productivity within a short time

Major factor for agricultural monitoring is the **timeliness**

Satellite Remote Sensing can help in agricultural management
and in increasing agricultural production

Spatial and temporal monitoring
for sustainable management of agricultural activities
to support
timely responses and to improve decision making



Benefits for Farmers and for Decision Makers

Satellite Remote sensing has the potentiality to increase efficiency and production.

Farmers

get information on:

- growth - health -

to reduce: **water consumption** and **use of pesticides**

Decision makers

get information on:

yield estimation

to estimate production early in the year (**trading market**)



Reduced number and cost of field inspections

- identify crops areas
- check the validity of farmers' management practices
- evaluate support needs



A Spectacular Photo - Optical

Optical image of Bremen area, 11 August 2020

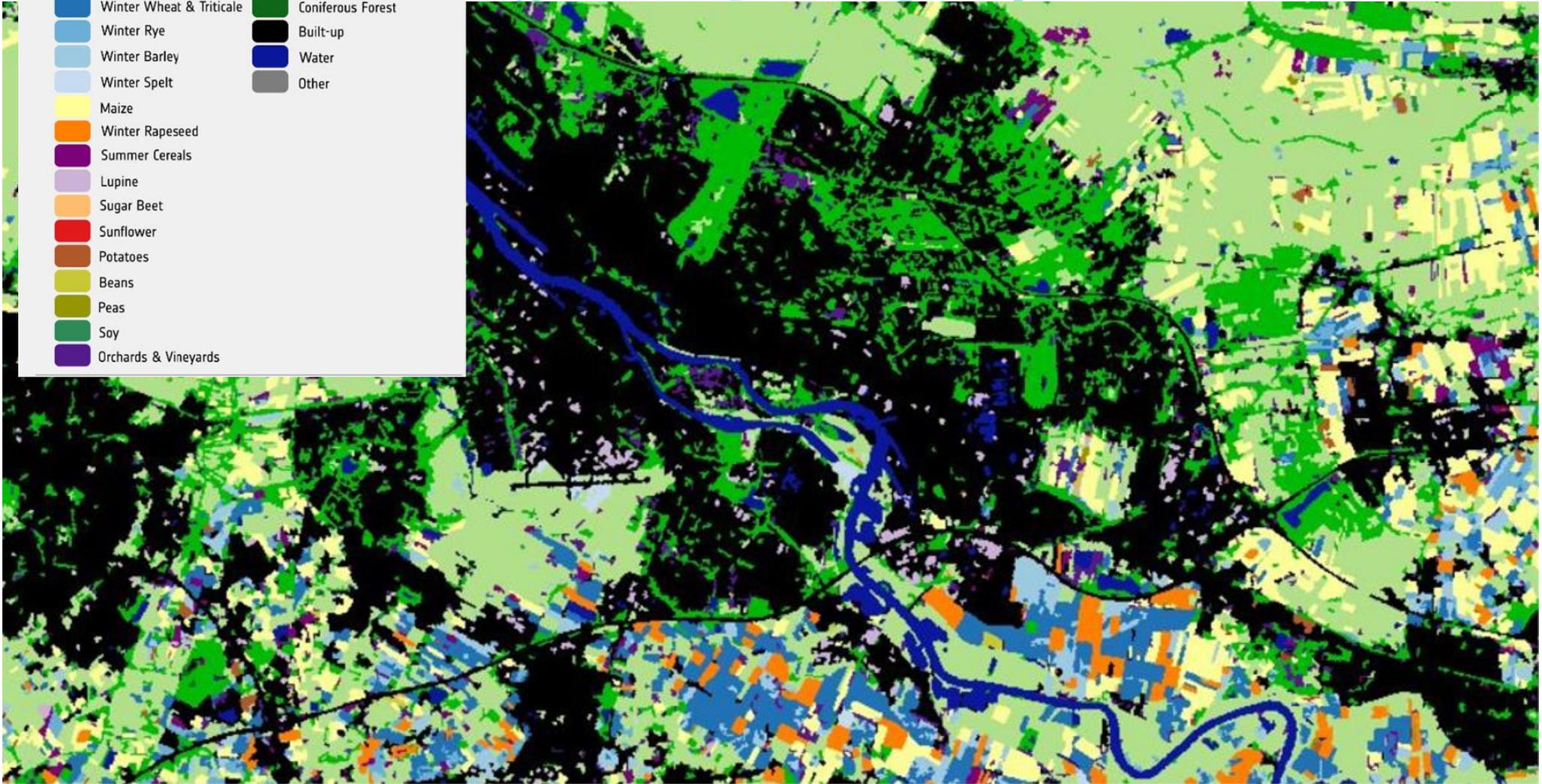


*Contains modified Copernicus
Sentinel data [2020], processed by
Melchionna - Remote Sensing*



Your Asset: a Thematic Map

Germany's agricultural landscape



Contains modified Copernicus Sentinel and Landsat data [2015 - 2016], processed and analysed by Humbolt University Berlin – P. Griffiths.



A Spectacular Photo - SAR

SAR multitemporal color composite image of Bremen area, August 2019

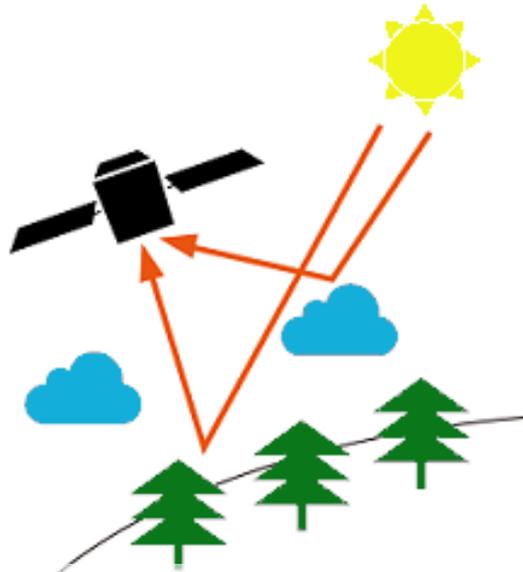


*Contains modified Copernicus
Sentinel data [2019], processed by
Melchionna - Remote Sensing*



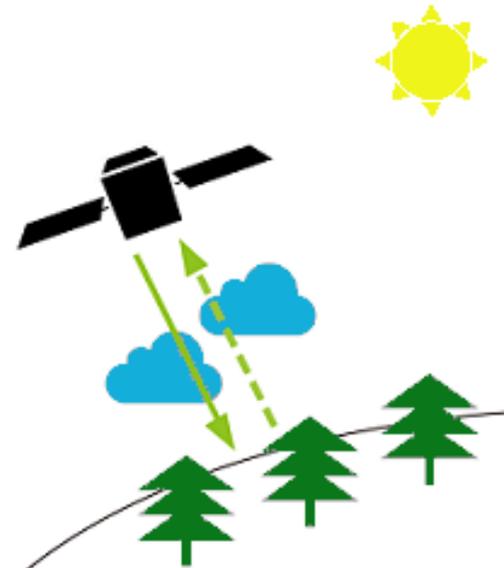
Space Based Monitoring Technologies

Optical sensor



- ✓ Based on the detection of solar radiation reflected from targets on the ground;
- ✓ Well understood and accurate classification results;
- ✓ During cloudy weather timeliness and quality cannot be guaranteed.

SAR sensor



- ✓ Based on scattering processes of electromagnetic waves with targets on the ground;
- ✓ Complex interactions and processing;
- ✓ All-weather imagery => Consistent and Cost effective surveying.

**SAR is highly sensitive to crop structure changes.
Despite cloudy sky during growing season, SAR ensures high temporal resolution to monitor rapidly changing agricultural classes.**



Spectral signature

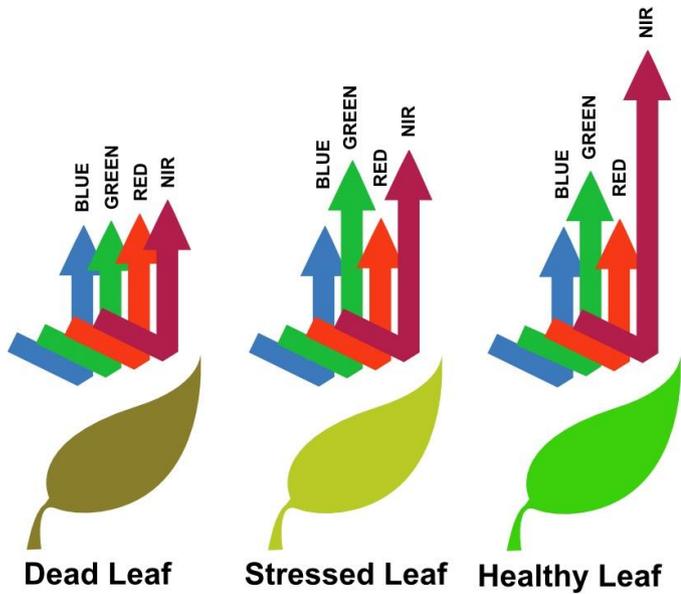


Figure 2. Plant Canopy Reflectance

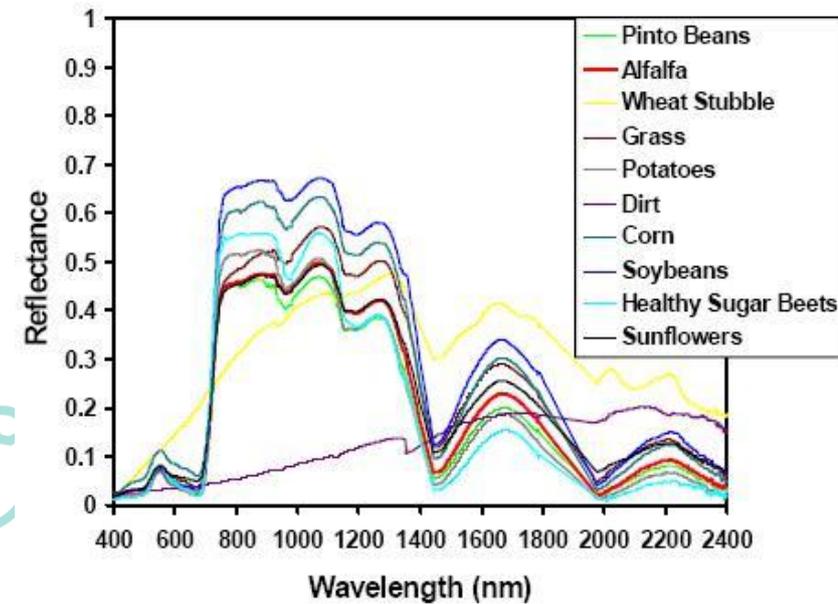
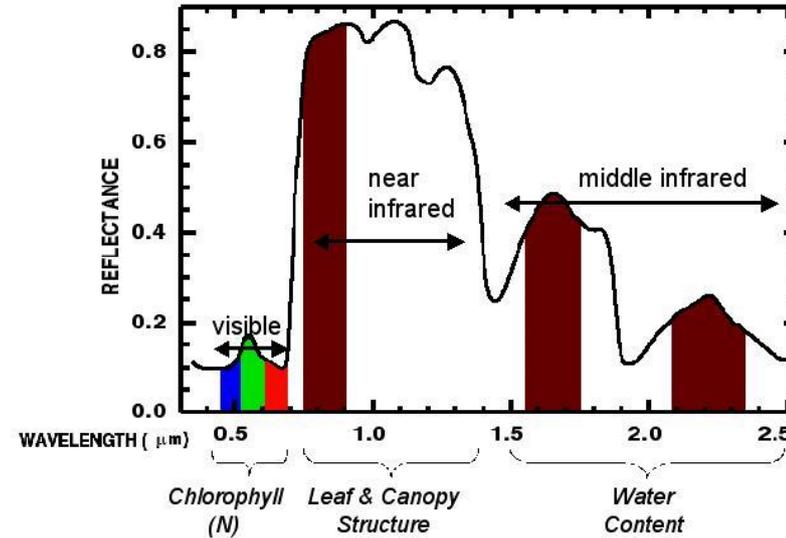
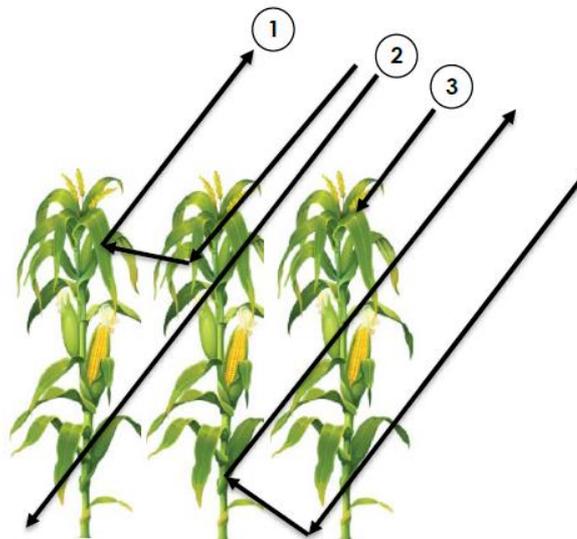
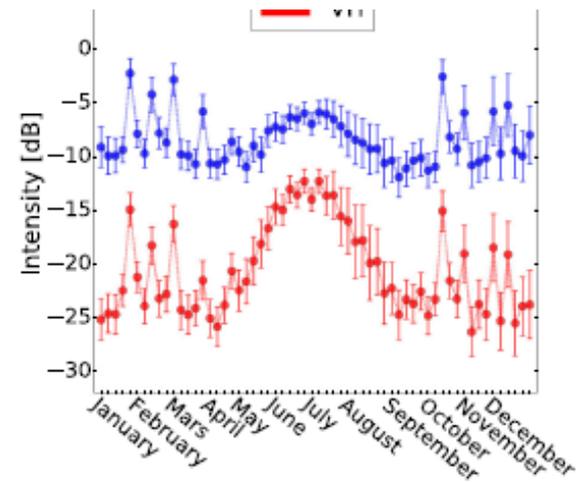
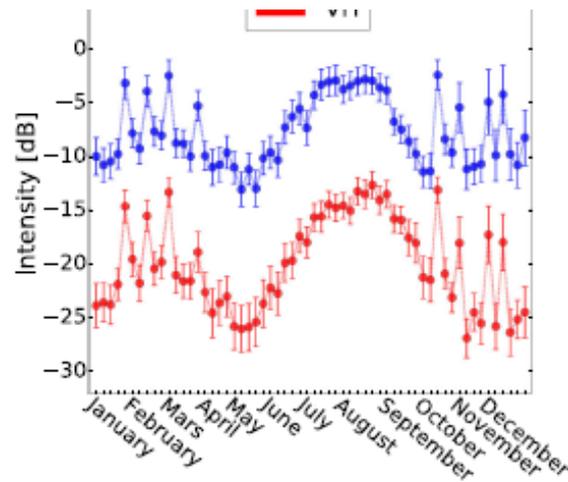
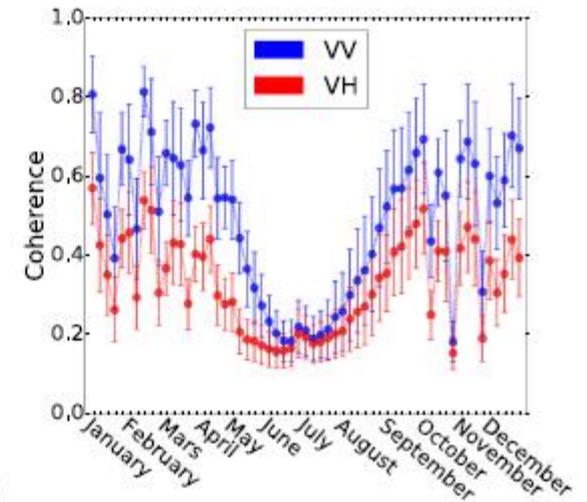
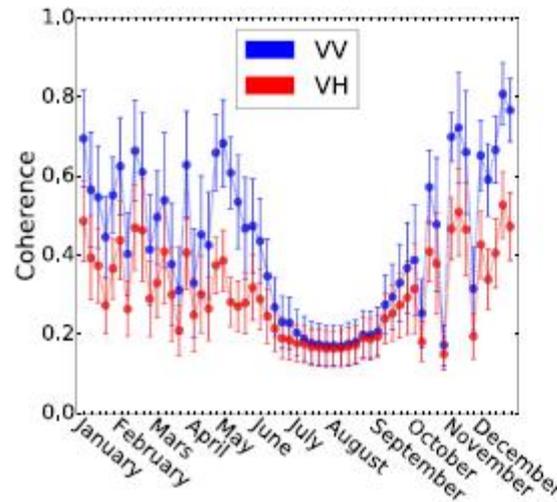


Figure 2. Spectral signatures of crops and soil (Kyllo, 2003).

SAR signature



1. Multiple volume scattering from within canopy
2. Direct scattering from soil
3. Direct scattering from canopy
4. Multiple scattering between soil and canopy

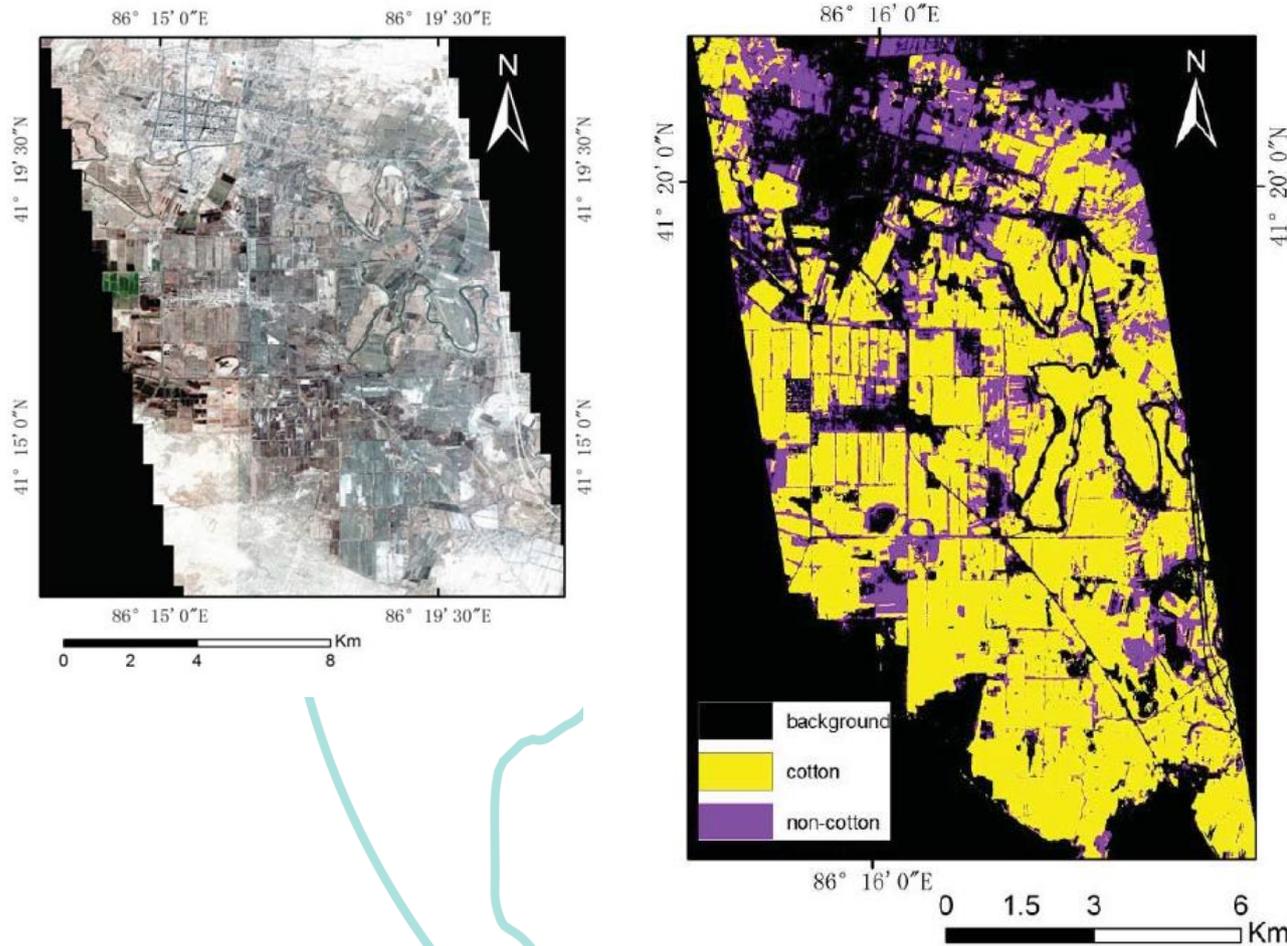


Cotton

Tomato



Mapping - 1

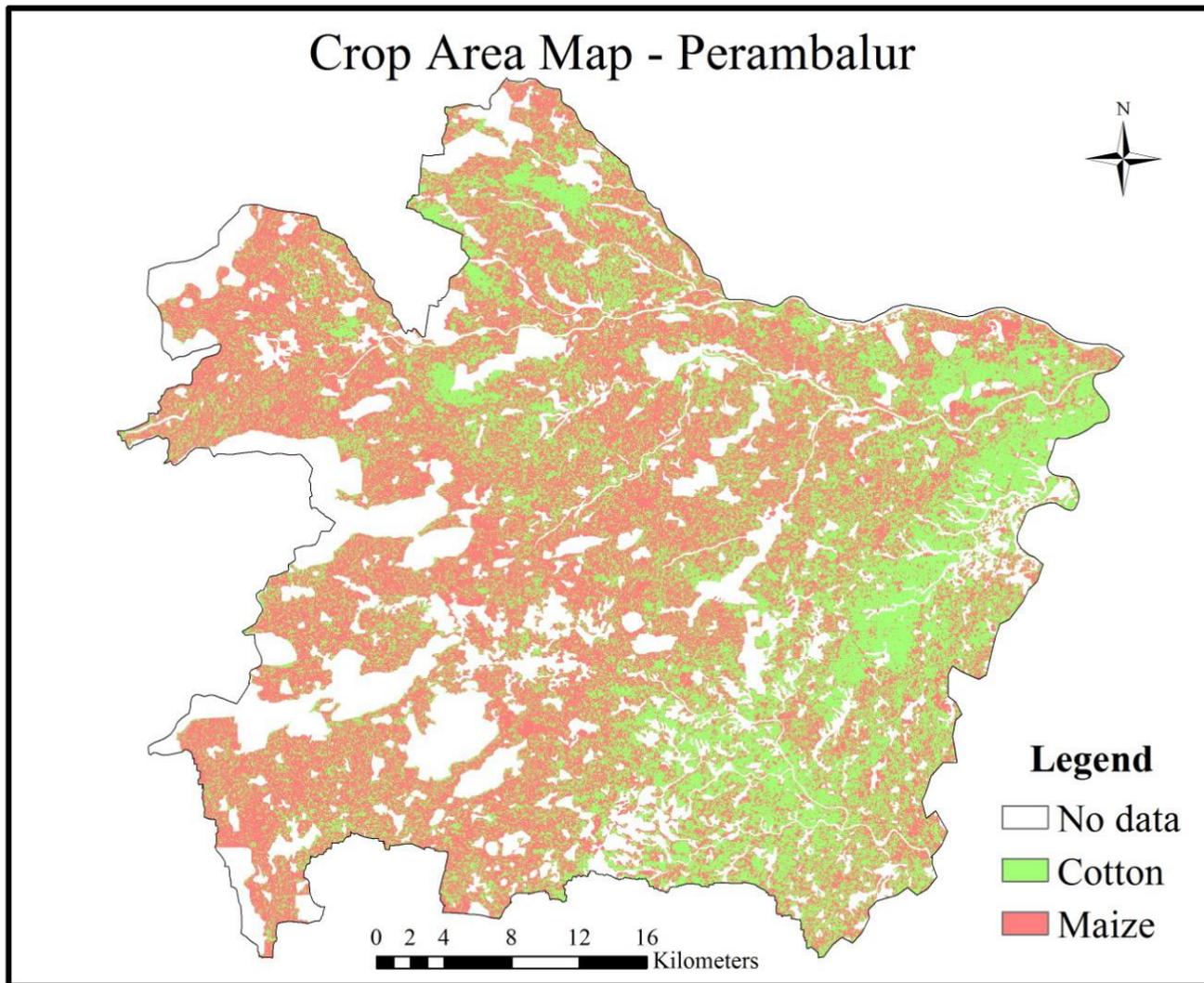


Feature fusion of time series Sentinel-1 and Sentinel-2 data for cotton field mapping in heterogeneous smallholder agricultural systems in Xinjiang, China.



Mapping - 2

Crop Area Map - Perambalur

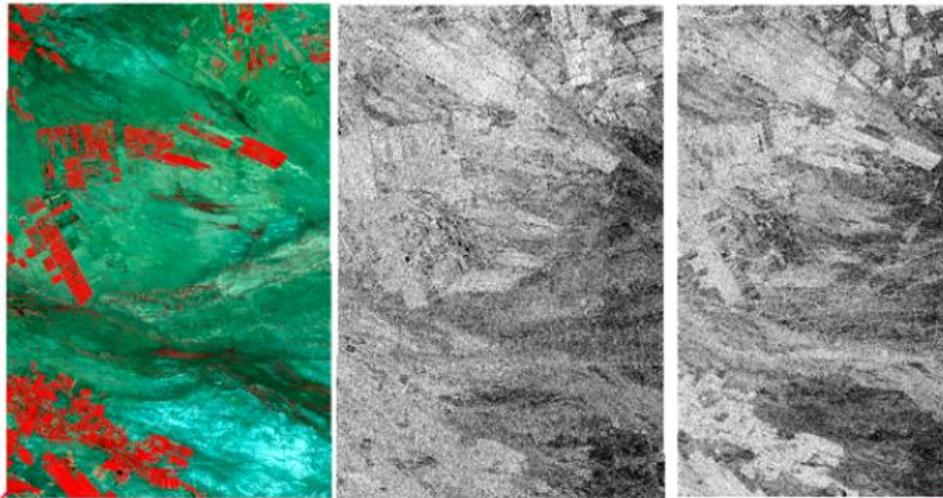


Estimation on the area of cotton and maize crops in Perambalur district of Tamil Nadu using multi-temporal Sentinel-1A SAR data and Landsat 8 optical data.

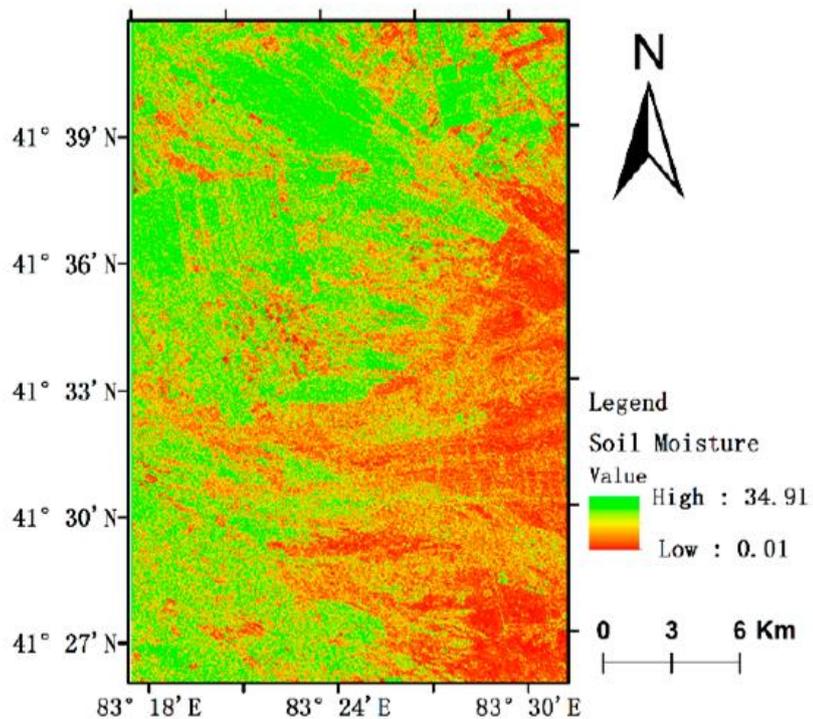


Soil moisture

Landsat8 OLI VV Polarization VH Polarizati

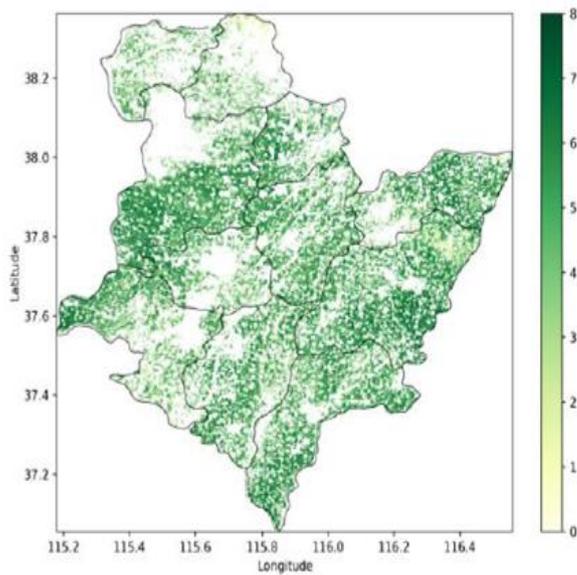


Extraction of soil moisture content information from a model for arid area based on Sentinel-1 data

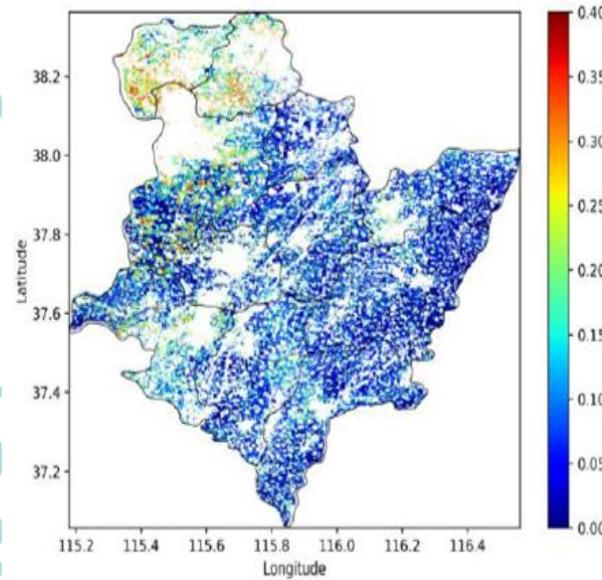


Huang, Shuai & Ding, Jianli & Zou, Jie & Liu, Bohua & Zhang, Junyong & Chen, Wenqian. (2019). Soil Moisture Retrieval Based on Sentinel-1 Imagery under Sparse Vegetation Coverage. Sensors.

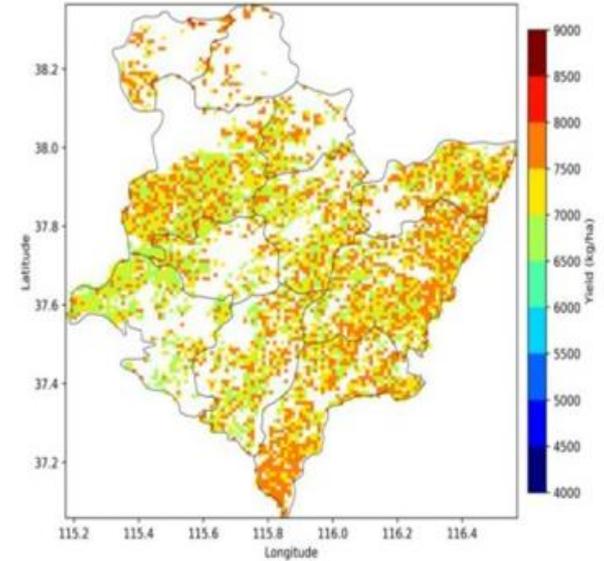
LAI, SM, and Yield Estimation



Leaf Area Index



Soil Moisture



Winter wheat yield simulation

Timely crop growth monitoring and accurate crop yield estimation at a fine scale is of vital importance for agricultural monitoring and crop management. Crop growth models have been widely used for crop growth process description and yield prediction. In particular, the accurate simulation of important state variables, such as Leaf Area Index (LAI) and root zone Soil Moisture (SM), is of great importance for yield estimation.

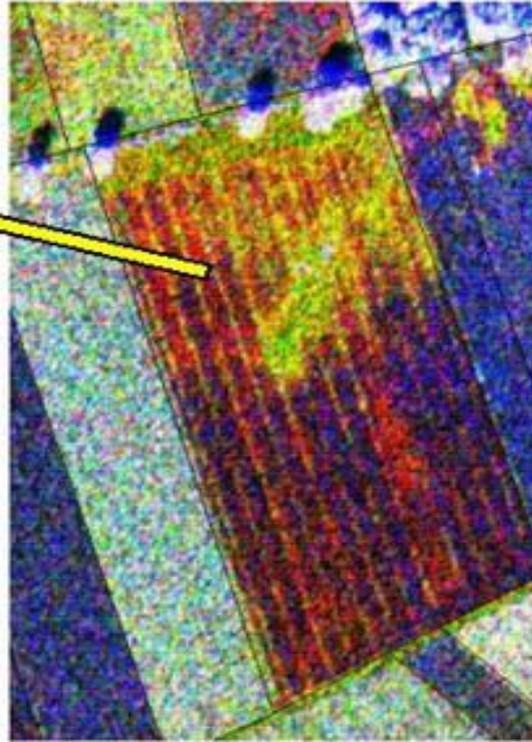


Flood and Drought Monitoring

Reduced Productivity due to Floods



summer barley
south: 60 – 70 cm / north: 10 – 40 cm



Spectacular images from space

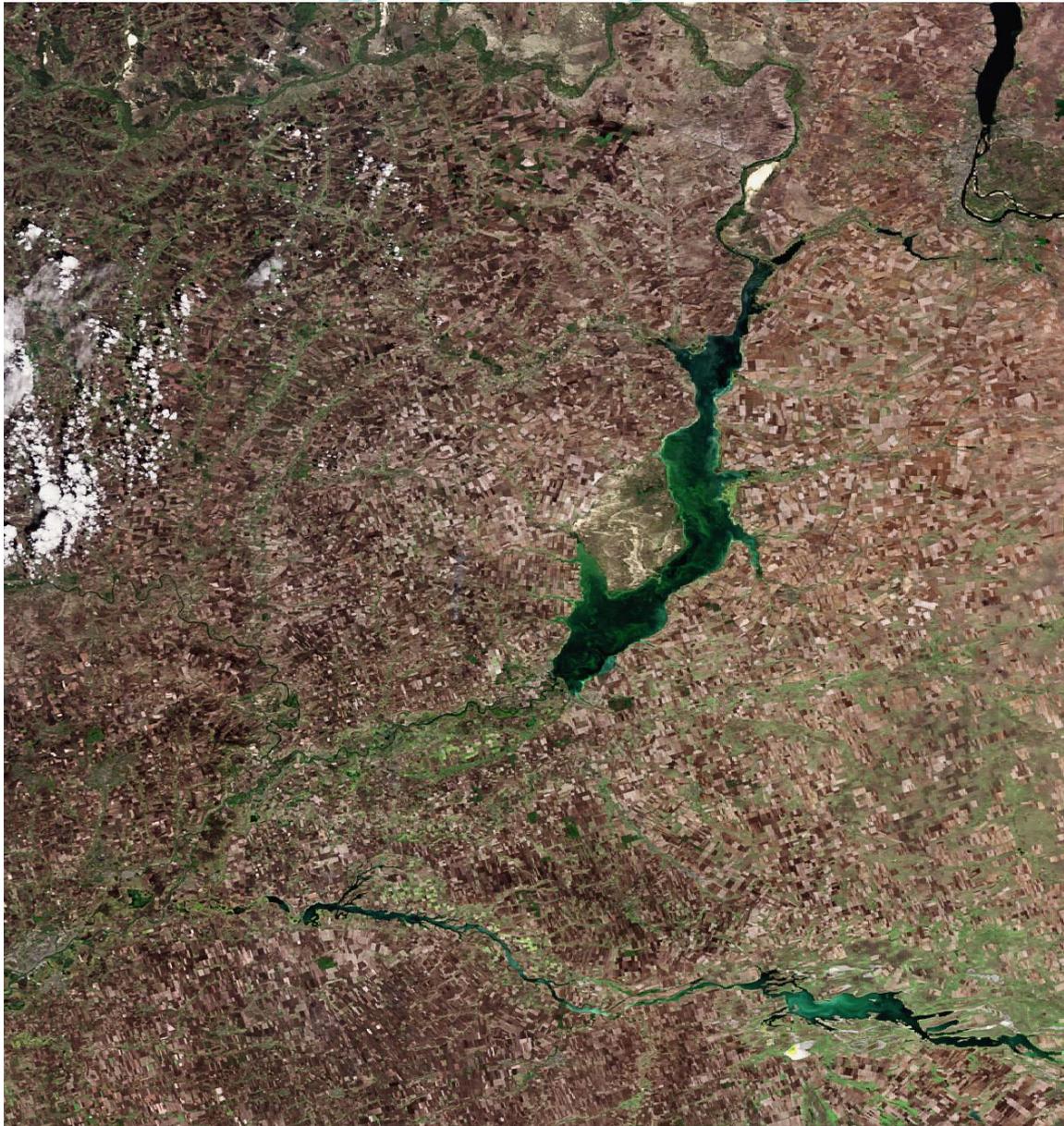


Aral Sea
Envisat
July 2006 – July 2009

https://www.esa.int/ESA_Multimedia/Images/2009/07/The_dramatic_retreat_of_the_Aral_Sea



Spectacular images from space



Tsimlyansk, Russia
Envisat
27 September 2008



Spectacular images from space



Bahia, Brazil
Sentinel - 2
8 August 2016



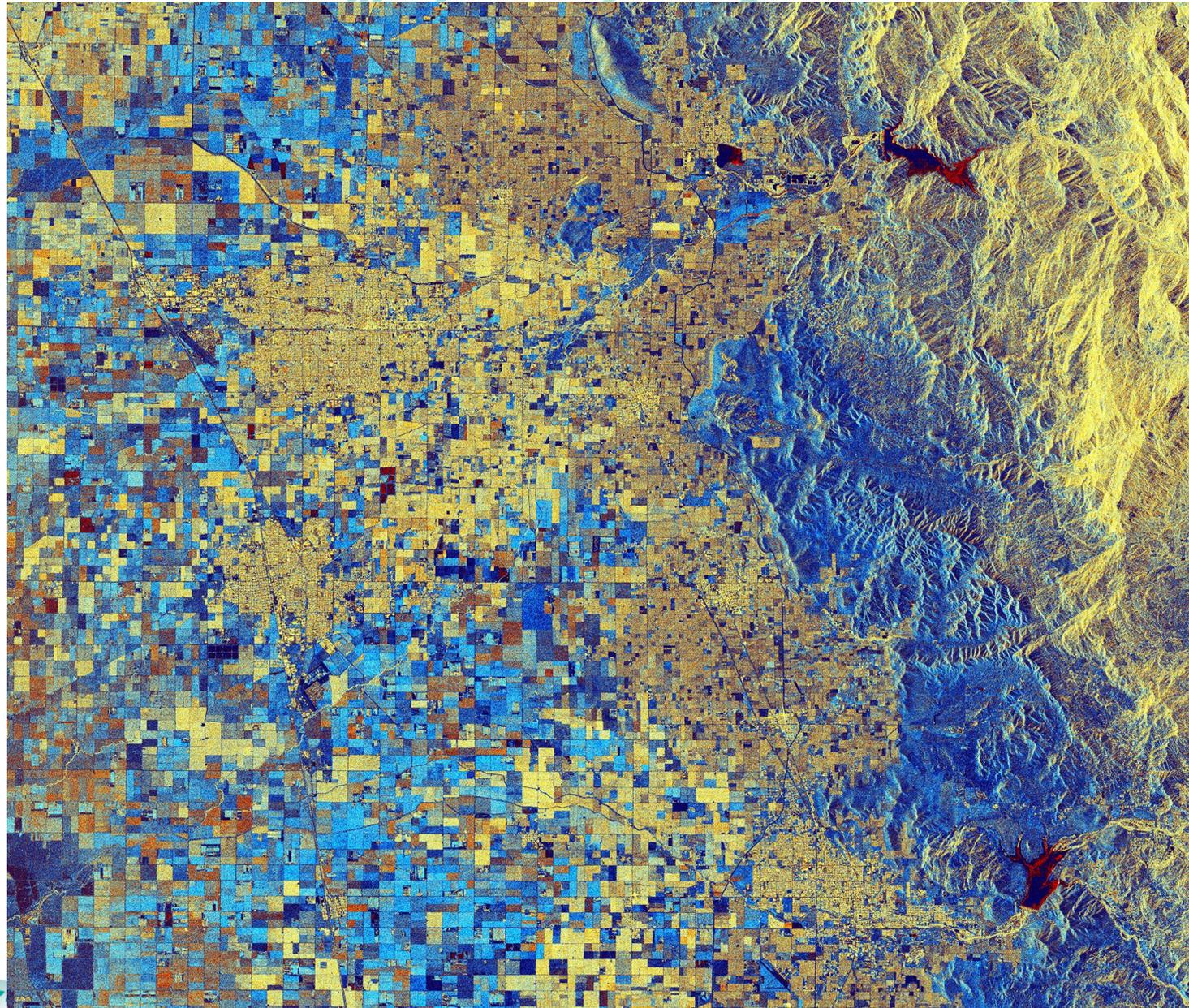
Spectacular images from space



Kansas, US
Landsat -5
4 May 2012

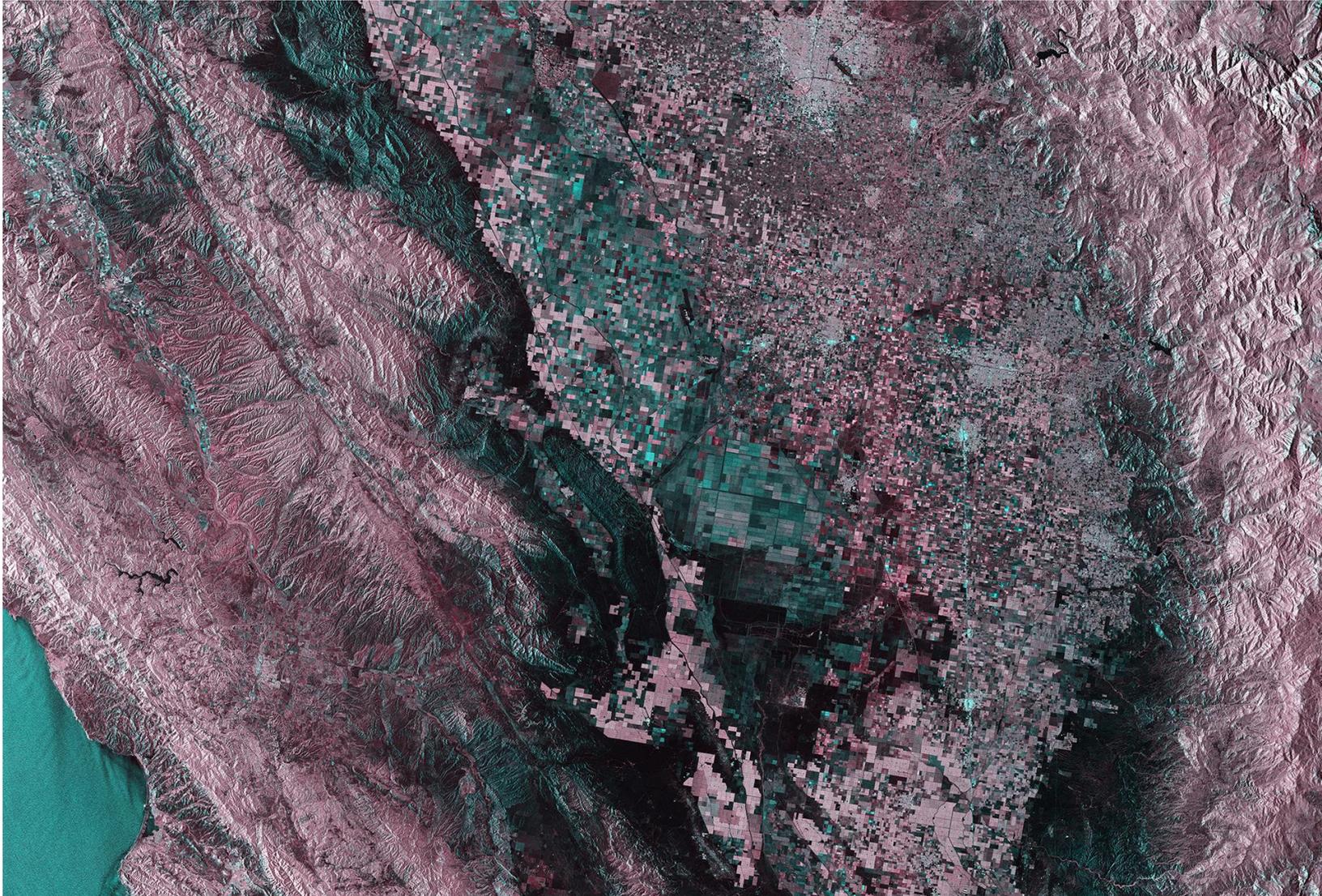


Spectacular images from space



California, US
Sentinel - 1
15 December and 26
January 2017

Spectacular images from space

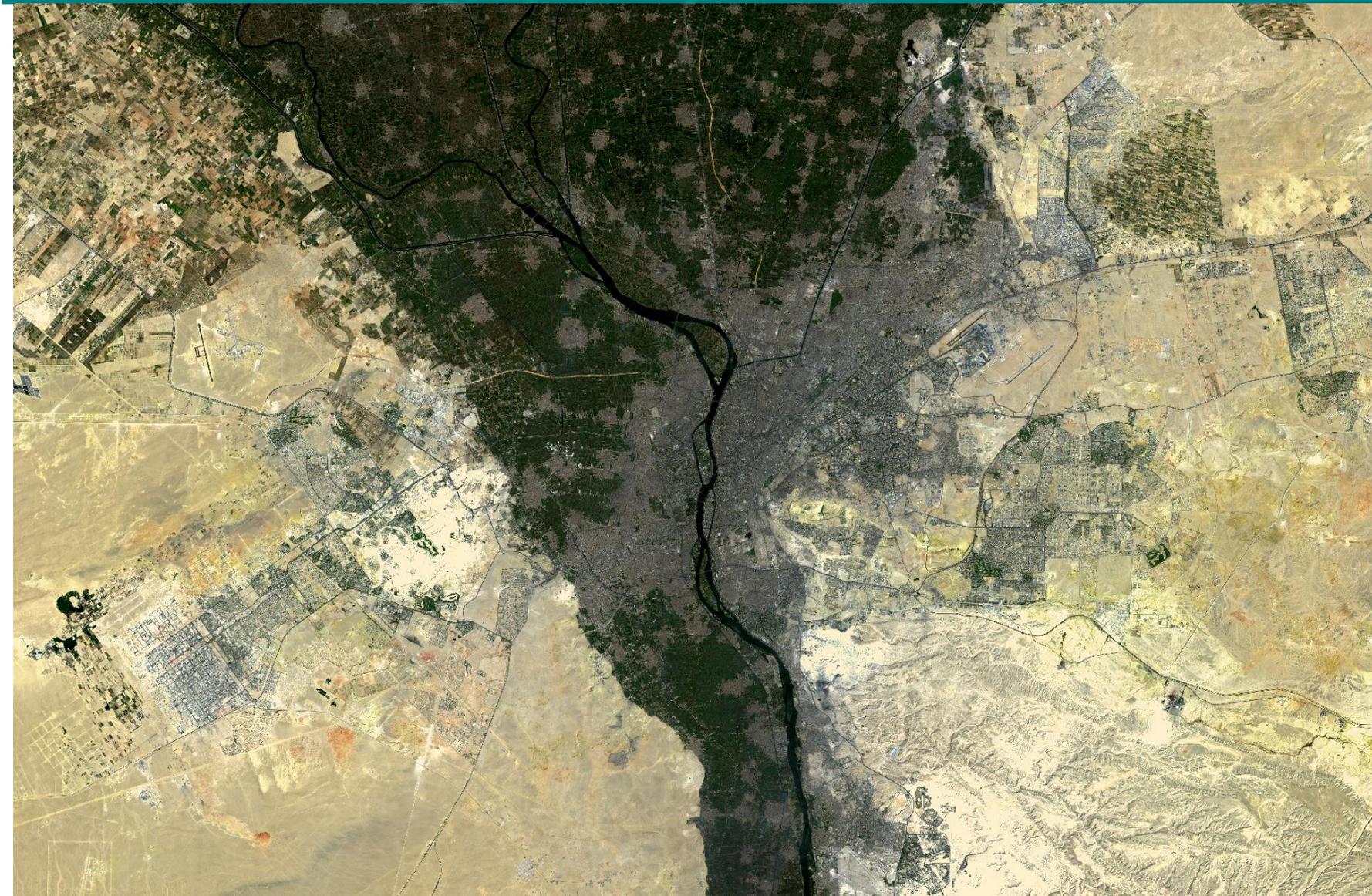


California, US
Sentinel - 1
1 April 2015

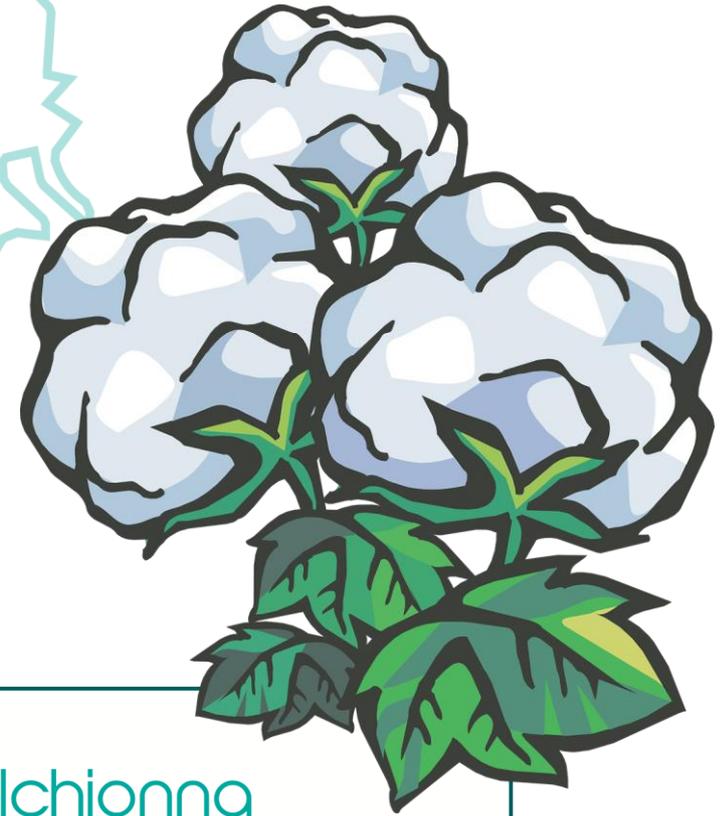


Spectacular images from space

Cairo, Egypt
Sentinel - 2
13 August
2015



Thank you!



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