Copernicus Sentinels for Agriculture
From Mapping to Monitoring

Benjamin Koetz
European Space Agency, Earth Observation Directorate
Sentinels Looking after Agriculture
## Sentinel contribution to GEOGLAM

<table>
<thead>
<tr>
<th>Req#</th>
<th>Spatial Resolution</th>
<th>Spectral Range</th>
<th>Effective observ. frequency (cloud free)*</th>
<th>Sample Type</th>
<th>Field Size</th>
<th>Target Products</th>
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</thead>
<tbody>
<tr>
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<td>Crop Mask</td>
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<td>Crop Type Area and Growing Calendar</td>
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<td>Crop Condition Indicators</td>
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<td>Crop Yield</td>
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<td>Crop Biophysical Variables</td>
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<td>Environ. Variables</td>
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<td>Ag Practices / Cropping Systems</td>
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<tr>
<td>1</td>
<td>500 - 2000 m</td>
<td>thermal IR + optical</td>
<td>Daily</td>
<td>Wall-to-Wall</td>
<td>All</td>
<td>X</td>
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<tr>
<td>2</td>
<td>100-500 m</td>
<td>optical + SWIR</td>
<td>2 to 5 per week</td>
<td>Cropland Extent</td>
<td>All</td>
<td>X</td>
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<tr>
<td>3</td>
<td>5-50 km</td>
<td>microwave</td>
<td>Daily</td>
<td>Cropland Extent</td>
<td>All</td>
<td>X</td>
</tr>
<tr>
<td>4</td>
<td>10-70m</td>
<td>optical + SWIR + TIR</td>
<td>Monthly (min 2 out of season + 3 in season), Required every 1-3 years.</td>
<td>Cropland Extent</td>
<td>All</td>
<td>X</td>
</tr>
<tr>
<td>5</td>
<td>10-70m</td>
<td>optical + SWIR + TIR</td>
<td>Weekly (min. 1 per 16 days)</td>
<td>Sample</td>
<td>All</td>
<td>X</td>
</tr>
<tr>
<td>6</td>
<td>10-100m</td>
<td>SAR</td>
<td>Weekly (min. 1 per 2 weeks)</td>
<td>Cropland Extent of persistant cloudy areas/Rice</td>
<td>All</td>
<td>X</td>
</tr>
</tbody>
</table>

*Sentinel-3

*Sentinel-2

*Sentinel-2

*Sentinel-1
Copernicus Sentinel-1

- Launch: **S1a**: 3\(^{rd}\) April 2014, **S1b**: 25\(^{th}\) April 2016
- Constellation of two satellites
- C-Band Synthetic Aperture Radar
- Nominal lifetime in orbit of 7 years (max. 12 yrs)
- 6 days revisit at equator with 2 satellites
- Sees through cloud cover!
Rice Monitoring: Crop Stages & Area

Winter-Spring Rice 2015/16
• March 2016: 1.4 Million ha rice
• March 2015: 1.7 Million ha rice
• **16.5% loss in rice area** due to drought & salt water intrusion caused by El Nino
• 976,000 people affected, 67 Mil.$ estimated damage (UN estimates)

The Mekong Delta, Vietnam
300 km x 300 km, 20 m resolution
Copernicus Sentinel-2

- Launch: June 2015 & March 2017
- 13 bands (VIS, NIR & SWIR)
- 290 km swath at 10, 20 and 60 m
- Systematic acq. of all land and coasts
- 5 days repeat cycle with 2 satellites
- 7 years design lifetime (max. 12 yrs)
Crop Growth Monitoring at Field Scale

Contains modified Copernicus Sentinel data [2016]
S1 & S2 Dynamic National Crop Type Mapping

CZECH AGRICULTURE FROM SPACE

Sentinel-1 time series

Contains modified Copernicus Sentinel data [2016]
Copernicus Sentinel-3

- **Ocean and Land Colour Instrument (OLCI)**
  - 21 channels, 300 m resolution, 1270 km swath

- **Sea and Land Surface Temperature Radiometer (SLSTR)**
  - 9 channel, 500m – 1km resolution, 1675 km swath

- **Sea & Ice Topography Payload**
  (SRAL, MWR, GNSS, DORIS, LRR)

  - Revisit at equator = 2 days (or daily with 2 satellites)
  - 7 year lifetime (max. 12 yrs)
  - **S3A launched on 18 February 2016**, S3B in Q4 2017
Sentinel-3 vegetation status and land surface temperature

OLCI Terrestrial Chlorophyll Index
global mean, 20-23 September 2016

< 2 days global coverage
(with 2 Satellites)

Land Surface Temperature
monthly composite for September 2016

Credit: S3 MPC

Credit: D. Ghent, University of Leicester
Copernicus Evolution: Sentinel Expansion

It is assumed that the following Sentinels are confirmed as a result of the user consultation process and following a gap analysis:

- **Sentinel-7**: a anthropogenic CO\textsubscript{2} monitoring mission
- **Sentinel-8**: a Thermal Infrared Imager (companion to Sentinel-2 C/D)
- **Sentinel-9**: components:
  - S-9 ICE: Enhanced Ice and Snow Continuity mission
  - S-9 HEO: Polar Weather Payload on a Highly Elliptical Orbit
- **Sentinel-10**: a Hyper-spectral mission
Copernicus: A Success Story

status as of 26th of June 2017

Registered Users: 85,293
Published Products: 3,058,444
Volume of User Downloads: 27.96 PB
Open Access Hub Availability in the past month: 99.4%
G20 Action Plan on Food Price Volatility
Paris 2011

The G20 Ministerial Declaration (2011) states that GEOGLAM "will strengthen global agricultural monitoring by improving the use of remote sensing tools for crop production projections and weather forecasts."
Endorsement of Copernicus for Use within the CAP

Commissioner P. Hogan: “...already Paying Agencies using data of the Sentinels ... In the near future satellite monitoring of parcels could replace most of the OTSC – this kind of simplification is very much in my plans...”
Sen2Agri – Evolution & Future

1st Sen2-Agri Users Workshop – FAO May 2014

2nd Sen2-Agri Users Workshop – EU Nov. 2015