Sentinel-2 Mission Status

Bianca Hoersch, Enrico Cadau and Sentinel-2 teams

5th GEOGLAM RAPP WORKSHOP, ESRIN, 16-17 May 2017
Two satellites on the same orbit
180° apart from each other

Global geometric revisit
of 5 days at equator with 2 satellites

Sun Synchronous Orbit,
786 km mean altitude

Swath of 290 Km
Sentinel-2 MSI spectral bands

- **VIS (Visible)**
  - B1: Aerosols
  - B2, B3, B4, B8: Vegetation
  - B5, B6, B7, B8a: Red-edge

- **NIR (Near-Infrared)**
  - B9: Water-vapour

- **SWIR (Short-Wave Infrared)**
  - B10: Cirrus
  - B11: Snow / ice / cloud discrimination
  - B12: Vegetation status

Spectral bands range from 400 nm to 2400 nm.
Sentinel-2 status

- **Sentinel-2A nominal routine operations continue**
  - Systematic coverage of **Europe, Greenland and Africa every 10 days** (at equator). Rest of the World (due to reduced illumination at Northern latitudes): 20-day revisit till additional station (Inuvik) and/or EDRS is introduced (~summer 2017)
  - First Sentinel-2 Validation Team (S2VT) and 2\textsuperscript{nd} Sentinel-2 Quality Working Group meeting held in November 2016 confirming excellent performance of S2A. Product evolution recommendations being analysed.
  - Improved mission planning check procedures have been introduced, based on in-orbit experience, to minimise outages.
  - Pre-operational Level-2A ‘Europe’ released on 2 May 2017 via Open Access Hub (see below)
  - **Sentinel-2B launch 6 March 2017, IOC phase proceeding nominally**
Sentinel-2: we have twins!

#Sentinel2Go: 15,000 messages on Twitter, Facebook, Instagram, etc. were posted in 48 hrs and ~ 100 million people were reached all over the world
Sentinel-2B first image
15 March 2017

Applications
- Plant health
- Changing lands
- Water bodies
- Disaster mapping

About the mission
- Facts and figures
- Satellite constellation
- Instrument
- About the launch

Brindisi, Italy
Sentinel-2B – 16 Mar 2017

One week after the launch!
Sentinel-2B

Netherlands
16 Mar 2017
**Sentinel-2B status**

- All satellite functions are performing nominally.
- Several absolute calibration acquisitions were carried out with different integration times for the MSI SNR evaluation.
- About 6 hours of MSI image acquisitions were performed last week covering systematically Europe and vicarious sites for performance refinement.
- MSI decontamination took place 2-3 May

**Upcoming**

- Finalise IOC Phase activities, IOCR (mid-June 2017)
- OCP Inter-Satellite Link to show the functional capability of transmitting data to ground via a GEO counter-terminal
- Reselection of defective detector element, update of GIPP/NUC
- Sample products release to QWG for assessment prior to IOCR
Sentinel-2B acquisition areas during phase E1
Sentinels Data Access – Current Configuration

**Copernicus Open Access Hub**
- LATEST NEWS
- 78,112 Self registered Users
- 16,299,049 Products Downloaded
- 14.09 PB Volume Downloaded
- No Rolling Policy
- Sentinel-1 NTC
- Sentinel-2 L1C
- Sentinel-3 (preops)
- Max 2 concurrent Downloads

**Collaborative Hub**
- LATEST NEWS
- 13 Collaborative GS
- 7 Data Hub Relays
- 6,864,273 Products Downloaded
- 6.88 PB Volume Downloaded
- Node1: 30 days
- Node2: 9 days
- Sentinel-1 NRT & NTC
- Sentinel-2 L1C
- Node1: Max 10 downloads
- Node2: No Limits

**International Hub**
- LATEST NEWS
- 4 International Agreements
- 2,303,826 Products Downloaded
- 2.08 PB Volume Downloaded
- 30 days
- Sentinel-1 NTC
- Sentinel-2 L1C
- Max 10 concurrent downloads

**Copernicus Services Hub**
- LATEST NEWS
- 185 Registered Users
- 919,802 Products Downloaded
- 710.71 TB Volume Downloaded
- No Rolling Policy
- Sentinel-1 NTC
- Sentinel-2 L1C
- Max 10 concurrent downloads

Statistics: 16 May 2017
Sentinels Data Access – User Registration

81,171 self-registered unique users (status 5 May 2017)
Sentinels Data Distribution – Overall Statistics

Statistics: 15 May 2017

- Registered Users: 78,321
- Published Products: 2,570,812
- Volume of User Downloads: 24.43 PB
- Open Access Hub Availability in the past month: 98.8%
Sentinel-2: Data Distribution Statistics

Approx. 2,7 million products were downloaded during Q4-2016 (1,75PB of data)

Exploitation ratio - 1:10
on average each product published has been downloaded 10 times
Sentinel-2 Data Access (since Dec 2015)

More than 7,000,000 Sentinel-2 products downloaded in 16 months!

- ±5 Petabytes downloaded
- Start of format change to single tiles 100 x 100km
- More than 7,000,000 Sentinel-2 products downloaded in 16 months!
Ever increasing range of S2 Applications

- Forests & Carbon, Vegetation monitoring
- Agriculture, Fluorescence & biophysical parameters
- Emergency management
- European Land cover, human impact, high resolution layers
- Global Land use & land cover
- Water quality, Wetlands
- Regional to Urban Applications
- Glaciers & Ice
- Coastal zones/bathymetry
- Geology & Geomorphology
### Sentinel-2 Products:

<table>
<thead>
<tr>
<th>Name</th>
<th>High-level Description</th>
<th>Production</th>
<th>Preservation Strategy</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level-1C</td>
<td>Top-of-atmosphere reflectances in cartographic geometry</td>
<td>Systematic</td>
<td>Long-term</td>
<td>~500 MB (each 100x100km²)</td>
</tr>
<tr>
<td>Level-2A</td>
<td>Bottom-of-atmosphere reflectances in cartographic geometry</td>
<td>On user side* (using Sen2Cor on Sentinel-2 Toolbox**)</td>
<td>N/A</td>
<td>~800 MB (each 100x100km²)</td>
</tr>
</tbody>
</table>

*: European Pilot production just published, systematic global production of L2A planned.
Sentinel 2 products

Level-1C product status:

› Fist products released on December 2015 (baseline 02.00)
  ▪ Consolidation of processing chain => Baseline 02.04

› Corrected some minor errors
  ▪ Tile naming, detector footprint equators, physical gains metadata, clipping of reflectances at 1...

› Improvements performed
  ▪ Increased quantization depth, added meteorology auxiliary files
  ▪ Improvement of geometric and radiometric calibration
  ▪ Processing chain consolidation (robustness and processing time optimization)

› Single tile products and short file names
Sentinel 2 products

Level 1 C product outlook

› Short term: baseline 02.05 since beginning of May
  ▪ correction of errors affecting auxiliary files and metadata

› Medium term (~2018)
  ▪ Geometric refinement: 3 m multi-temporal geolocation accuracy
  ▪ Improved DEM: better geolocation for mountainous areas
  ▪ Masks in raster format
  ▪ Under study: offset on reflectances
### Mission Performances

- **Absolute geolocation**
  - CE 9.2 m at 95%, well below the mission specification without the GRI (20 m)
  - NB: the quality of the Digital Elevation Model can impact performance locally in mountainous areas

- **Multi-temporal registration**
  - The multi-temporal is the only mission requirement which is not yet met (as expected):
    - CE 1.12 pixels at 95%, vs. 0.3 pixel specified
    - The full performance will be reached after activation of the GRI
      - This has been verified on a few sample products during commissioning

- **Multi-spectral registration**
  - Performance **below 0.3 pixels at 99% for all bands**
  - This contributes to the quality of image composites (RGB)
  - Co-registration performance also depends on the quality of the DEM (dependent on the altitude of imaged objects)
### Sentinel 2 products

**Level 2A product**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Current status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definition</td>
<td>Bottom-of-Atmosphere reflectances</td>
</tr>
<tr>
<td>Projection</td>
<td>Same as L1C</td>
</tr>
<tr>
<td>Dissemination unit</td>
<td>Same as L1C</td>
</tr>
<tr>
<td>Production</td>
<td>User-side production with publicly available software Sen2cor</td>
</tr>
<tr>
<td>Preservation</td>
<td>N/A</td>
</tr>
<tr>
<td>Volume</td>
<td>~ 800 MB</td>
</tr>
<tr>
<td>Images format</td>
<td>JPEG 2000 15 bits integer with quantization value = 10000</td>
</tr>
<tr>
<td>Metadata</td>
<td>Same as L1C + Radiometric classification (cloud, cloud shadows, water, snow...)</td>
</tr>
<tr>
<td>Auxiliary data</td>
<td>Same as L1C + Retrieved aerosol optical thickness and water vapour</td>
</tr>
</tbody>
</table>
L2A Production over Europe, open on SCIHub since 2 May 2017

• The **Sen2Cor** processor (version 2.3.1) is generating bottom-of-atmosphere (BOA) reflectance products.

• It generates daily up to **300GB** of **L2A** products (~600 Tiles per Day).

• L2A products are made available as from 02 May 2017 through [http://scihub.esa.int](http://scihub.esa.int)

• Products granularity of **L2A** is the same as **L1C** available on SciHub.

• **Could the GEOGLAM-RAPP community assess the suitability of such L2A?**
Next steps for S2 mission...

- Continue EDRS ‘User Commissioning’ for S2A (started)
- Jun 2017: start **Reprocessing** of data acquired during Sentinel-2A commissioning phase and entire Sentinel-2 archive into new tile format
- 14 Jun 2017: **Sentinel-2B ‘First images’ event** with celebration ‘60 years Rome Treaty’
- Sentinel-2B IOC finalisation - **IOCR** on 15 June 2017, mission **handover** followed by **ramp-up** (IOCR+ 4 m), data release to be authorised @IOCR
- Jul 2017: Results of **Level-2A** feasibility study, objective to decide roadmap for systematic global L2A production
- Autumn: Sentinel-2B ‘User Commissioning’ EDRS
  - 2018: Start of GRI-based production for S2A and S2B.
  - 2018: Towards operational L2A processor for global production, tbc
  - 2018: Usage of better DEM, tbc
  - 2018: Start major reprocessing exercise of all S2A/S2B archived data with GRI and operational L2A processor (archive size ~5PB!).
Thank you very much for your attention!

http://sentinels.copernicus.eu