



SENTINEL-2 User Handbook



DOCUMENT



Sentinel-2 User Handbook

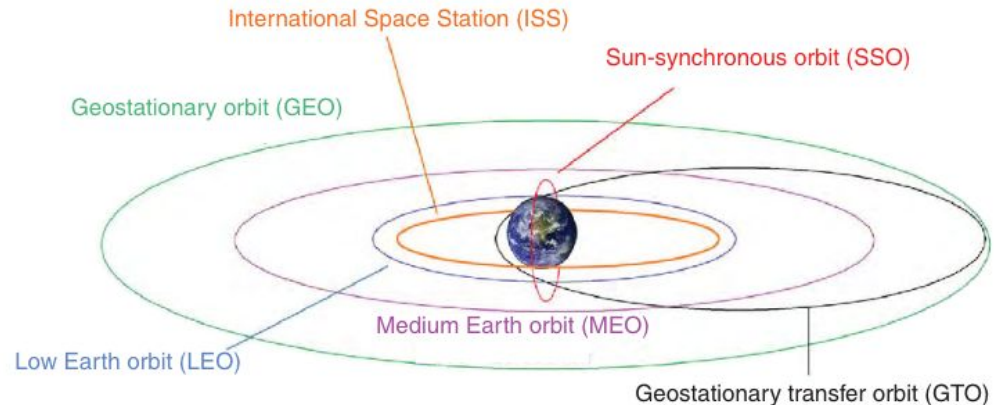
Thijs van der Plas, 9 May 2024, RS reading group

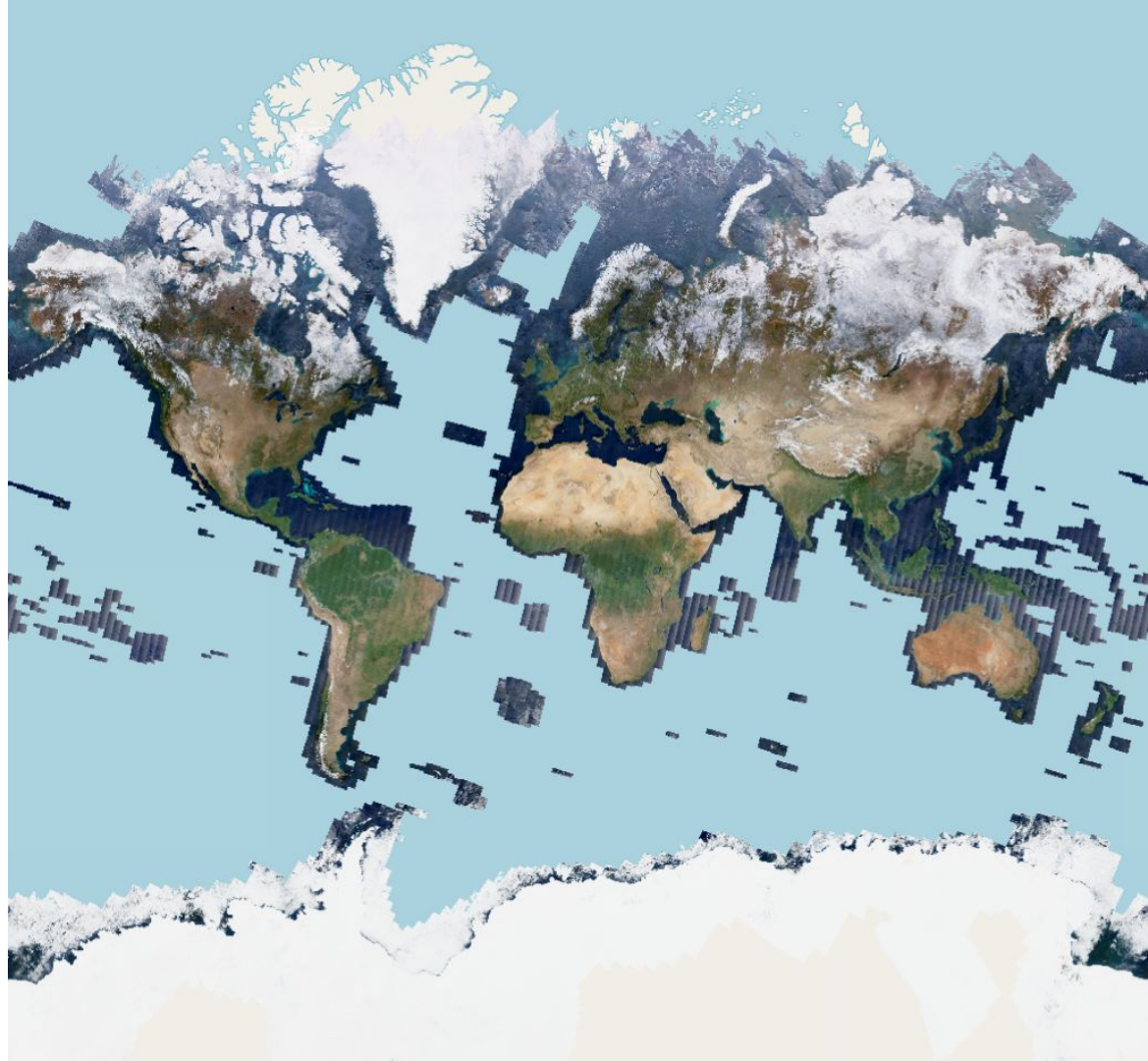
Outline

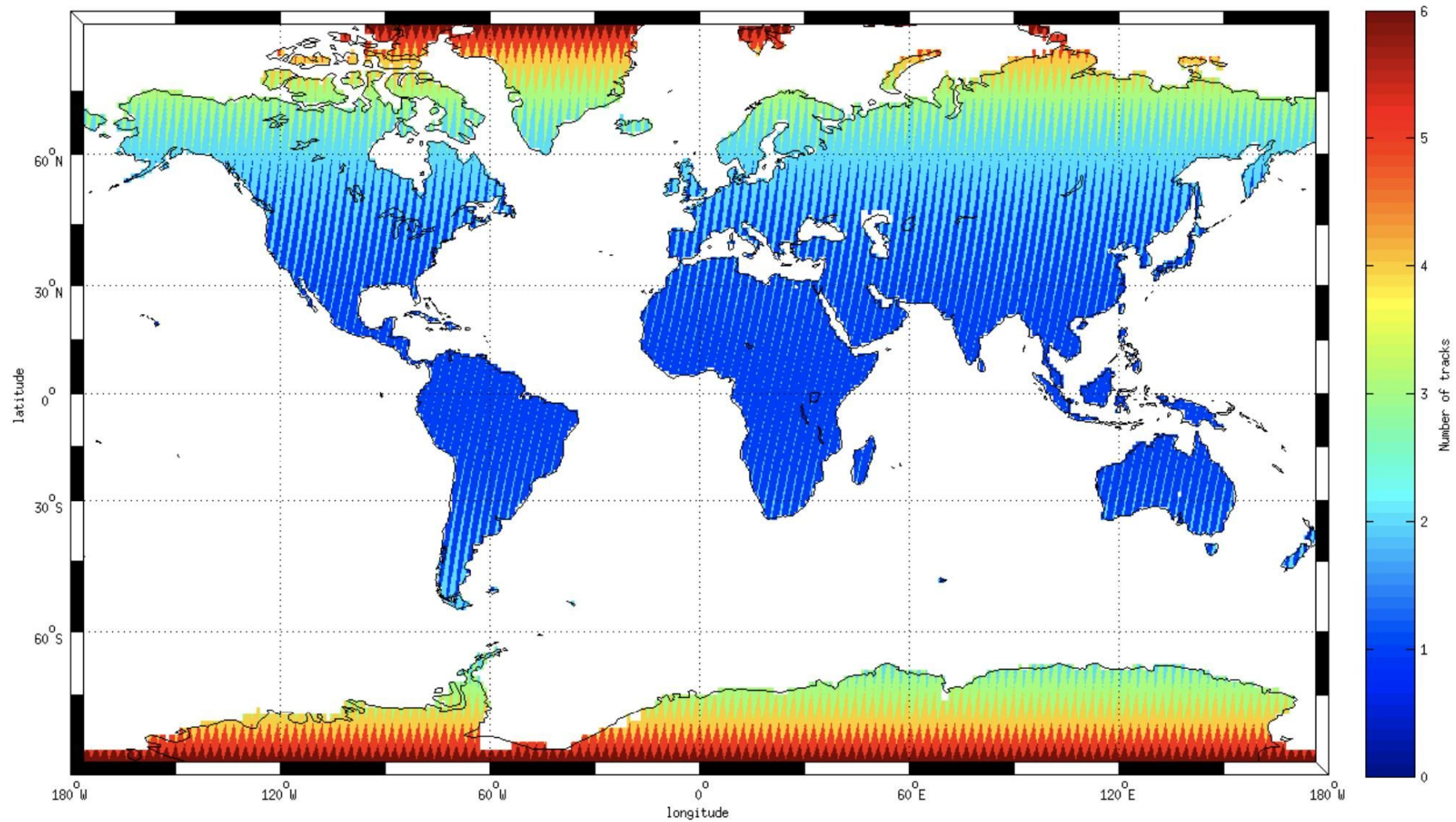
- Basic satellite info
- Pre-processing steps for different products
- Bands imaged, use cases of each band.
- Accessing the data

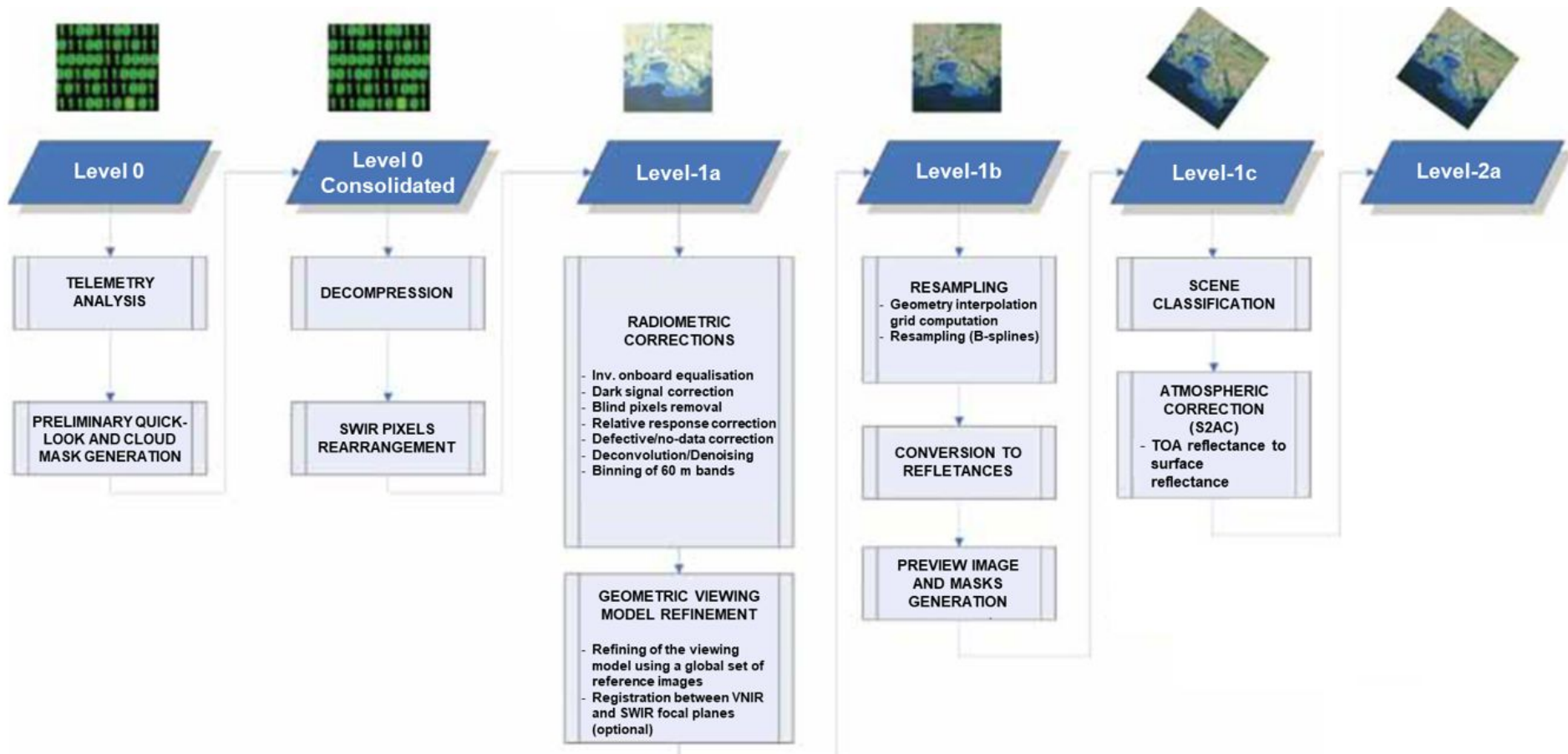
Sentinel 2 quick facts

- S2 passive (optical), S1 active (SAR)...: Clouds!
- Sun-synchronous orbit (10:30 AM), 2 twinned satellites at 180 deg phase difference. Sentinel 2A (2015) and 2B (2017).
- Copernicus: data open to all, 16TB per day
- Land + coast measurements
- Max 5 day revisit time
- 13 spectral bands
- 290 km swath width
- 'Spectral reflectance (SR)'
- Orthorectified

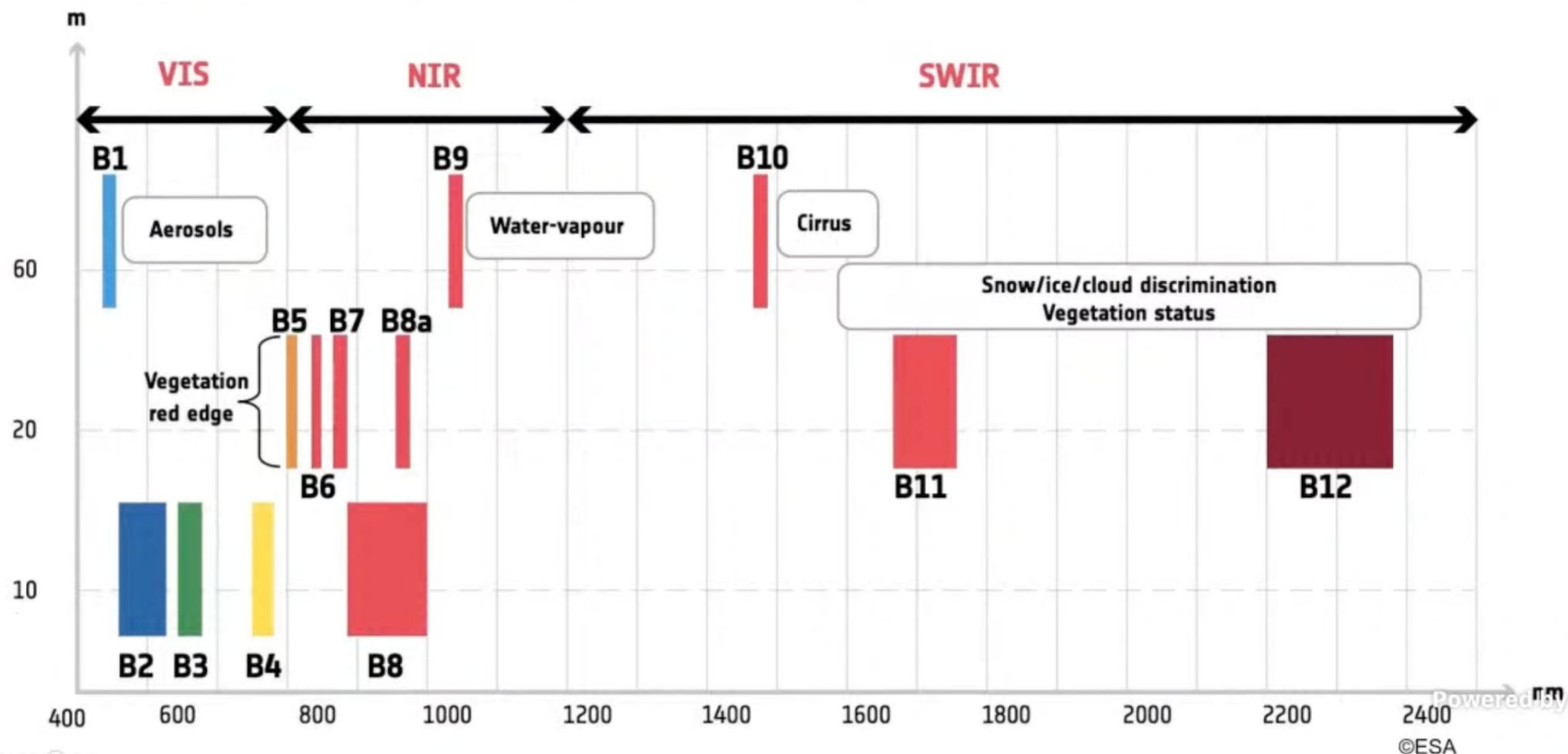






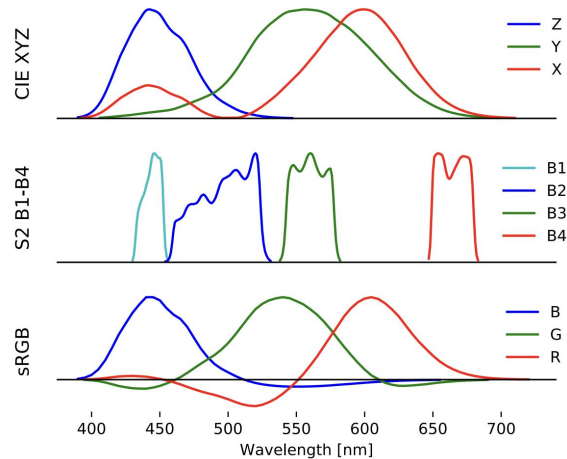


ESA Sentinel-2 satellite spectral channels



Visible light bands

- True colour or natural colour
- True colour value range
- Important considerations when using pre-trained models!



[Sovdat et al., 2019, RS of Env](#)

True colour



Natural colour



Near infrared band

- False Colour Infrared (CIR)
 - Normalized Difference Vegetation Index NDVI
- $$\text{Index NDVI} = (\text{NIR} - \text{RED}) / (\text{NIR} + \text{RED})$$

Scene



Display



True colour



Natural colour



False CIR



NDVI



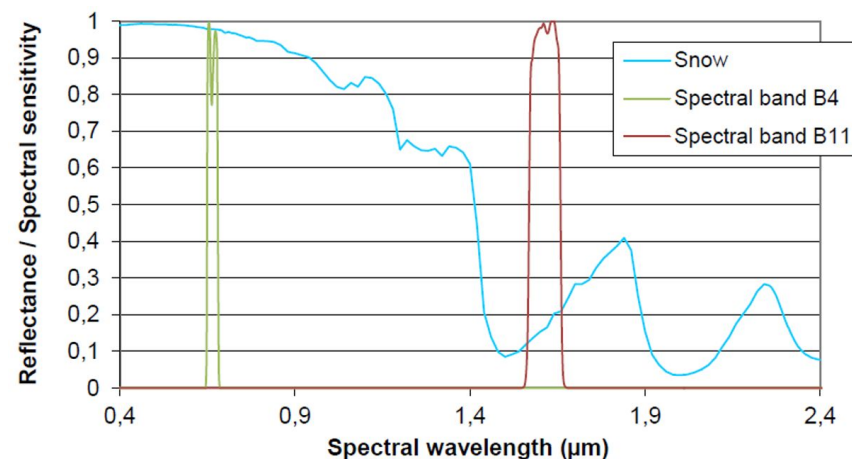
Other bands, composites and indices

Composite: map 3 bands onto RGB visualisation (CIR)

SWIR composite: B12, B8a, B4: snow vs white, water cloud vs ice cloud. Fire (damage) mapping, geology.

Right: Sentinel-2 L1C cloud mask
pre-processing snow index = $B4 / B11$

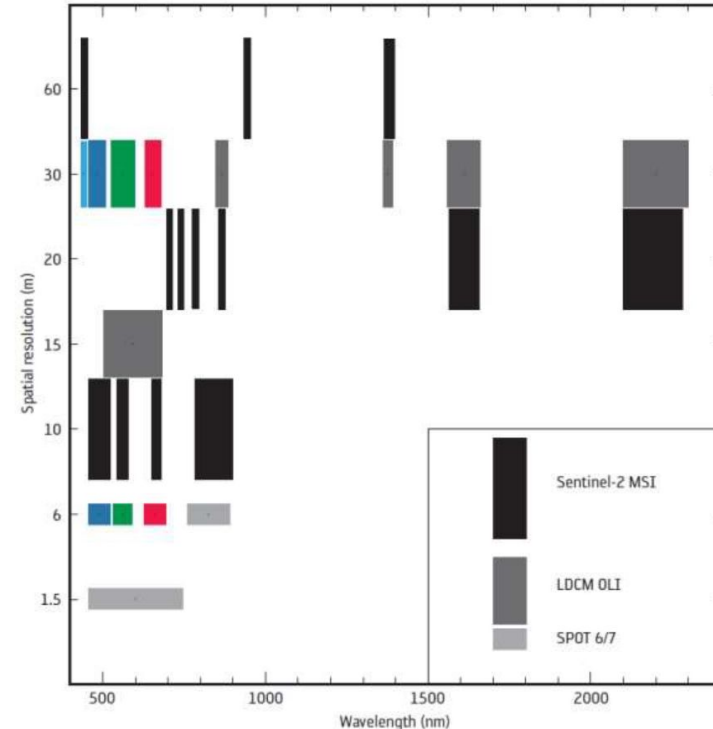
Custom index examples: e.g., oil spill
index = $(B3 + B4) / B2$.



Compatibility with other satellites

- Compatible with Landsat & SPOT
- Harmonized Sentinel Landsat ([HSL](#)) product

	LANDSAT 1-7	SPOT	SENTINEL-2
Mission Lifetime	1972 - present	1986 - present	See Copernicus pages
Instrument principle	Scanner	Pushbroom	Pushbroom
Repeat cycle (days)	16	26	5*
Swath width (km)	185	2 x 60	290
Spectral bands	7	4	13
Spatial resolution (metres)	30, 60	2.5, 10, 20	10, 20, 60



Accessing Sentinel 2 data



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1.6.1.1.4 *Innovative Tools and Applications*

The free and open data policy and data access concept for the SENTINEL missions may lead to the development of particular, yet unforeseen, "apps" (application software) by and for the general public.

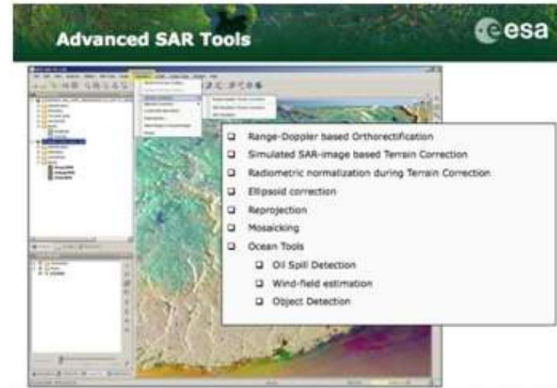


Figure 5: Application Software

Copernicus
BROWSER

EN ▼ [Login](#) ◀

VISUALIZE

SEARCH

<

2024-05-07

>

30%

▼

Default

▼

Sentinel-2 L2A

▼

LAYERS:

True color
Based on bands B4, B3, B2

False color
Based on bands B8, B4, B3

Highlight Optimized Natural Color
Enhanced natural color visualization

NDVI
Based on a combination of bands (B8 - B4)/(B8 + B4)

False color (urban)
Based on bands B12, B11, B4

Moisture index
Based on a combination of bands (B8A - B11)/(B8A + B11)

SWIR
Based on bands B12, B8A, B4

NDWI
Based on a combination of bands (B3 - B8)/(B3 + B8)

NDSI
Based on a combination of bands (B3 - B11)/(B3 + B11)

Scene classification map
Classification of Sentinel-2 data as result of ESA's Scene classification algorithm.

Custom
Create custom visualization

Show effects and advanced options

Hide layer

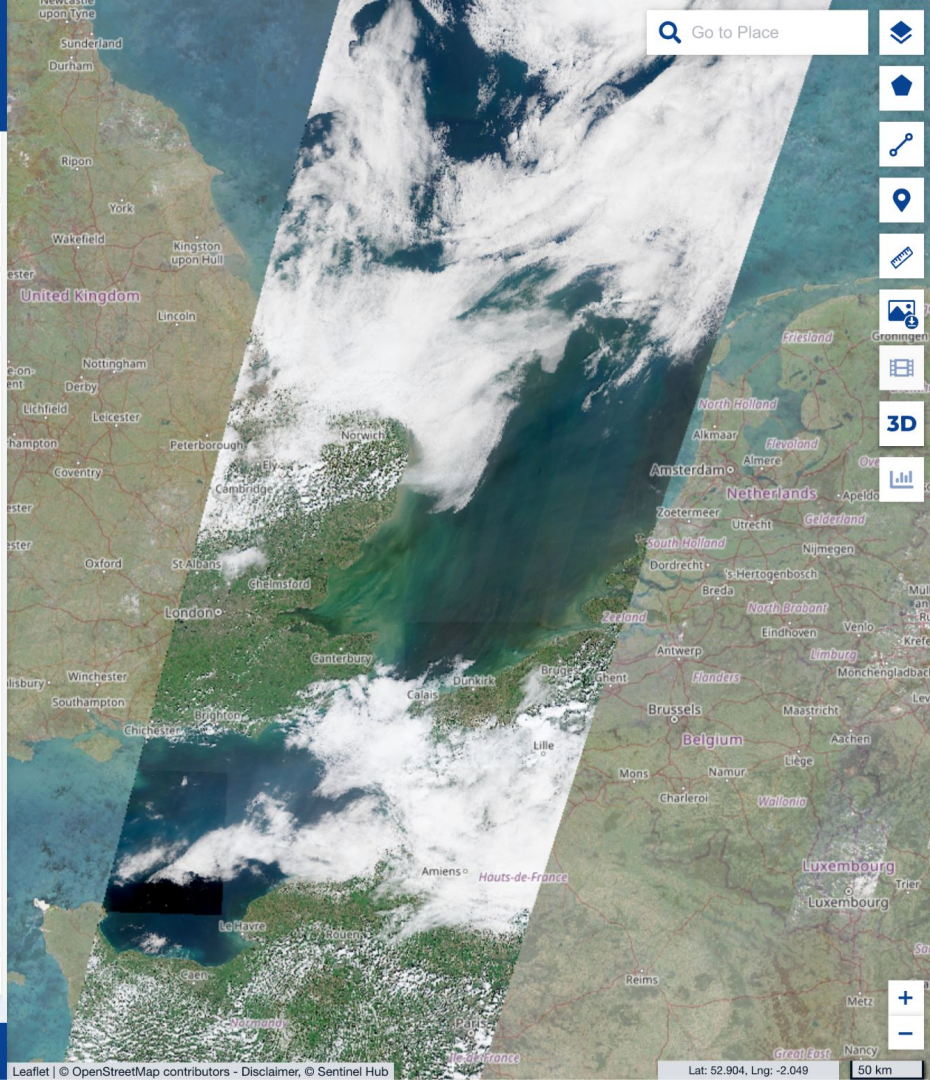
Share

Copernicus
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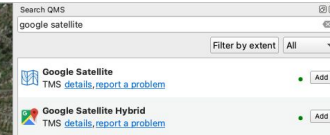
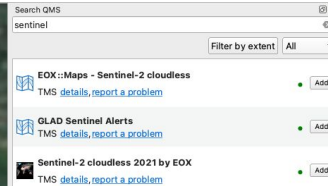
[About](#) [Support](#)

v1.10.1



QGIS (quick map search) web plugin

- Composite cloudless mosaics
- If just for visualisation, higher res available (but not for download)



Python download API

[GEE data catalogue](#)

[Geemap](#) for map interaction +
easier API (imo)

Data offline or cloud?

Alternatively, [Planetary
Computer](#)

Using Google Earth Engine

```
import ee
import geemap
Click to collapse the range. / as np

## authenticate:
API_KEY = 'name-ee-project'
ee.Authenticate()
ee.Initialize(project=API_KEY)

## define area of interest:
xy_coords = np.array([
    [-1.94414, 51.19521],
    [-1.94414, 51.21317],
    [-1.91548, 51.21317],
    [-1.91548, 51.19521],
    [-1.94414, 51.19521]])
aoi = ee.Geometry.Polygon(xy_coords.tolist())

## Download image:
ex_im_gee = ee.Image(ee.ImageCollection('COPERNICUS/S2_SR_HARMONIZED')
    .filterBounds(aoi)
    .filterDate(ee.Date('2023-01-01'), ee.Date('2023-04-01'))
    .sort('CLOUDY_PIXEL_PERCENTAGE')
    .first() # get the least cloudy image
    .select(['B4', 'B3', 'B2']) # get visible RGB bands
    .clip(aoi))

geemap.ee_export_image(ex_im_gee,
    filename="sentinel_oxfordwest_4band.tif", scale=10, region=aoi)
```

References

- Sentinel-2 user handbook [link](#)
- Sentinel-2 technical guide [link](#)
- Sentiwiki [link](#)
- Copernicus data space ecosystem (browser + API) ([video](#)), GEE (geemap), QGIS plugin.
- (All images are from ESA Copernicus unless noted otherwise)