

Supported by:



Federal Ministry
for the Environment, Nature Conservation
and Nuclear Safety



Federal Agency for
Nature Conservation



EOCap4Africa

3 Overview of available Spatial Data and respective Sources

a) Sentinel 2 Images - Spectral, Temporal and Spatial resolution



INES Ruhengeri
Institute of Applied Sciences





Learning Objectives

Explain what Sentinel-2 is and its role in Earth observation

Define spectral, temporal, and spatial resolution in remote sensing

Understand how Sentinel-2's resolution impacts different applications

Identify the strengths and trade-offs of Sentinel-2 data

What is Sentinel-2



Sentinel-2 is part of the European Space Agency's (ESA) Copernicus Program, designed for land monitoring applications

The mission consists of two satellites (Sentinel-2A & Sentinel-2B) working together to provide frequent, high-resolution imagery



(ESA 2015)

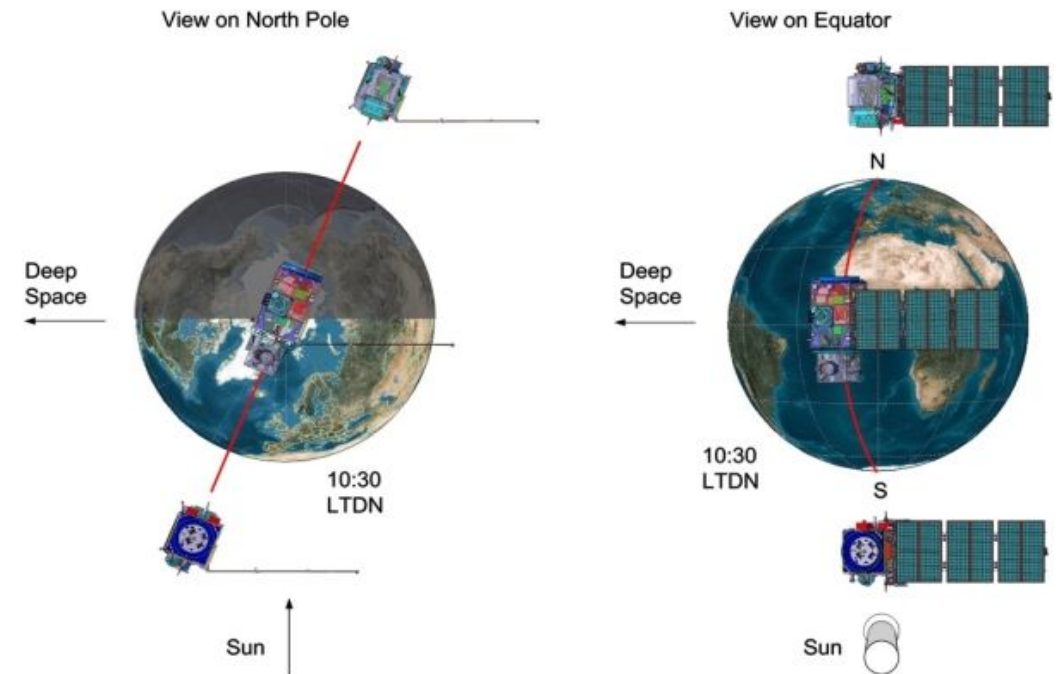
Sentinel-2 Twin Configuration

Why Two Satellites?

- Improves temporal resolution – Each satellite orbits 180° apart, covering the same location every 5 days (instead of 10 days with one satellite)
- Ensures mission continuity – If one satellite fails, the other continues operations
- Enhances global coverage – Together, they provide complete Earth coverage at high frequency

Orbits & Positioning:

- Sentinel-2A launched on June 23, 2015
- Sentinel-2B launched on March 7, 2017
- Both operate in sun-synchronous orbits at 786 km altitude



(Copernicus n.d.)

Key Applications of Sentinel-2



Vegetation monitoring (e.g., crop health, deforestation)

Land use & land cover mapping

Water resource monitoring

Disaster response (wildfires, floods, droughts)

Spectral Resolution



What is Spectral Resolution?

- The ability of a satellite to capture information in different wavelengths of the electromagnetic spectrum

Why Spectral Resolution Matters:

- Different wavelengths allow differentiation between land cover types
- Enables vegetation indices (e.g., NDVI, EVI) for monitoring crop health and forest conditions



Temporal resolution

What is Temporal resolution

- The frequency of satellite revisits over the same area

Why Temporal resolution matters

- Enables time-series analysis (e.g., monitoring seasonal vegetation cycles)
- Allows change detection (e.g., wildfire burn area before/after an event)

Sentinel-2 Temporal resolution

- 5-day revisit time (when both Sentinel-2A and Sentinel-2B are operational)
- Frequent coverage makes it ideal for monitoring rapid changes (e.g., agriculture, disasters, deforestation)



Spectral resolution

What is Spectral resolution

- The ability of a satellite to capture information in different wavelengths of the electromagnetic spectrum

Why Spectral resolution matters

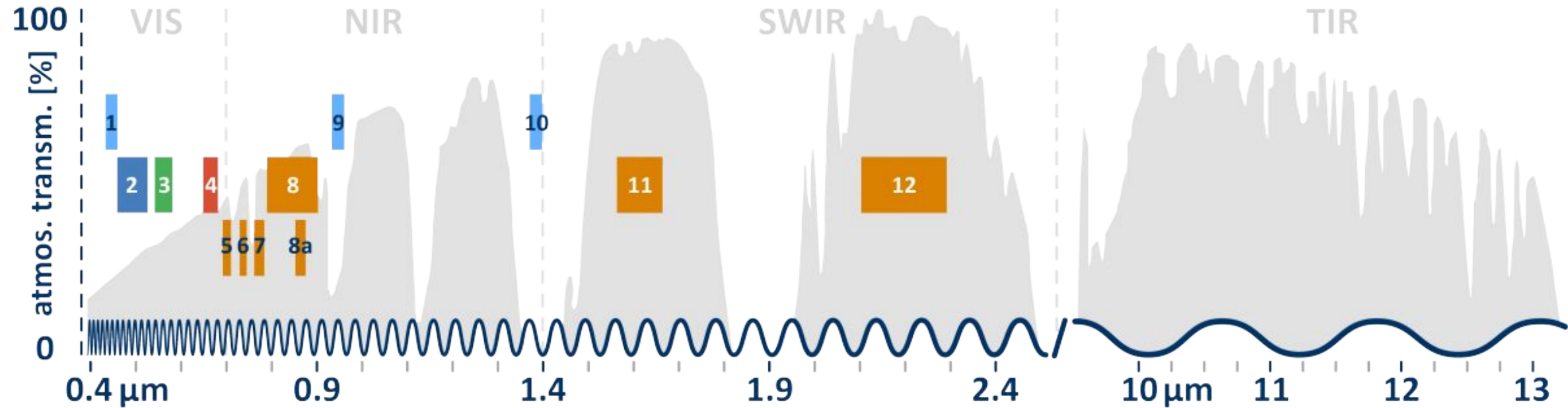
- Different wavelengths allow differentiation between land cover types
- Enables vegetation indices (e.g., NDVI, EVI) for monitoring crop health and forest conditions

Spectral resolution of Sentinel-2

BAND	SPECTRAL	WAVELEN. [μm]	GEOM. [m]	SENSOR
1	aerosols	0.429 – 0.457	60	MSI
2	blue	0.451 – 0.539	10	MSI
3	green	0.538 – 0.585	10	MSI
4	red	0.641 – 0.689	10	MSI
5	red edge	0.695 – 0.715	20	MSI
6	red edge	0.731 – 0.749	20	MSI
7	red edge	0.769 – 0.797	20	MSI
8	NIR	0.784 – 0.900	10	MSI
8a	narrow NIR	0.855 – 0.875	20	MSI
9	water vapour	0.935 – 0.955	60	MSI
10	SWIR cirrus	1.365 – 1.385	60	MSI
11	SWIR	1.565 – 1.655	20	MSI
12	SWIR	2.100 – 2.280	20	MSI

(Freie Universität Berlin n.d.)

Spectral resolution of Sentinel-2



(Freie Universität Berlin n.d.)



Spatial resolution

What is Spatial resolution

- Describes the pixel size in Raster data
- Eg. the size of the smallest object that can be detected in an image

Sentinel-2 Spatial resolution

- **10m resolution:** Visible and NIR bands (detailed vegetation and urban analysis)
- **20m resolution:** Red Edge, SWIR (biophysical parameters like water content, biomass)
- **60m resolution:** Atmospheric bands (used for corrections, not surface analysis)



Spatial resolution

What is Spatial resolution

- Describes the pixel size in Raster data
- Eg. the size of the smallest object that can be detected in an image

Sentinel-2 Spatial resolution

- **10m resolution:** Visible and NIR bands (detailed vegetation and urban analysis)
- **20m resolution:** Red Edge, SWIR (biophysical parameters like water content, biomass)
- **60m resolution:** Atmospheric bands (used for corrections, not surface analysis)

Spatial Resolution of Sentinel-2



Image of Kilimanjaro
highlighting the spatial
resolution

(ESA 2022)

Hands-On Sentinel-2 Bands

Spectral Indices with Sentinel-2

Let's get started:

- Name all bands with a 20m resolution of Sentinel-2
- Name all bands with a 60m resolution of Sentinel-2

Rebuild the following equations with Sentinel-2 bands

- NDVI
- EVI
- NDWI
- NBR



Summary & Key Takeaways

Sentinel-2 has 13 spectral bands, allowing detailed vegetation, water, and land monitoring

10m, 20m, and 60m spatial resolutions balance high detail with wide coverage

5-day temporal resolution makes it ideal for **tracking changes over time**

Different resolutions **serve different applications**, from **agriculture to disaster management**

Sources



Copernicus. (n.d.). *Sentinel-2 mission overview*. Retrieved February 10, 2025, from <https://sentiwiki.copernicus.eu/web/s2-mission>

European Space Agency (ESA). (2022, September 15). *A snowy Kilimanjaro - ESA-Sentinel-2-L1C-Image* [Satellite image]. Retrieved February 10, 2025

European Space Agency (ESA). (2015, June 11). *Sentinel-2 hat die Erdoberfläche im Blick*. Retrieved February 10, 2025, from [https://www.esa.int/Space in Member States/Germany/Sentinel-2 hat die Erdoberflaeche im Blick](https://www.esa.int/Space_in_Member_States/Germany/Sentinel-2_hat_die_Erdoberflaeche_im_Blick)

Freie Universität Berlin. (n.d.). *Sentinel-2*. Retrieved February 10, 2025, from <https://blogs.fu-berlin.de/reseda/sentinel-2/>

Supported by:



Federal Ministry
for the Environment, Nature Conservation
and Nuclear Safety



Federal Agency for
Nature Conservation



Thank you for your attention!

Dr. Insa Otte, Hanna Schulten
(on behalf of the EOCap4Africa Team)
and colleagues

insa.otte@uni-wuerzburg.de



INES Ruhengeri
Institute of Applied Sciences

