EOCap4Africa

3 Overview of available Spatial Data and respective Sources

a) Sentinel 2 Images - Spectral, temporal and spatial resolution

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

View on North Pole

View on Equator

Deep Space

Deep Space

10:30 LTDN

10:30 LTDN

Sun

Sun
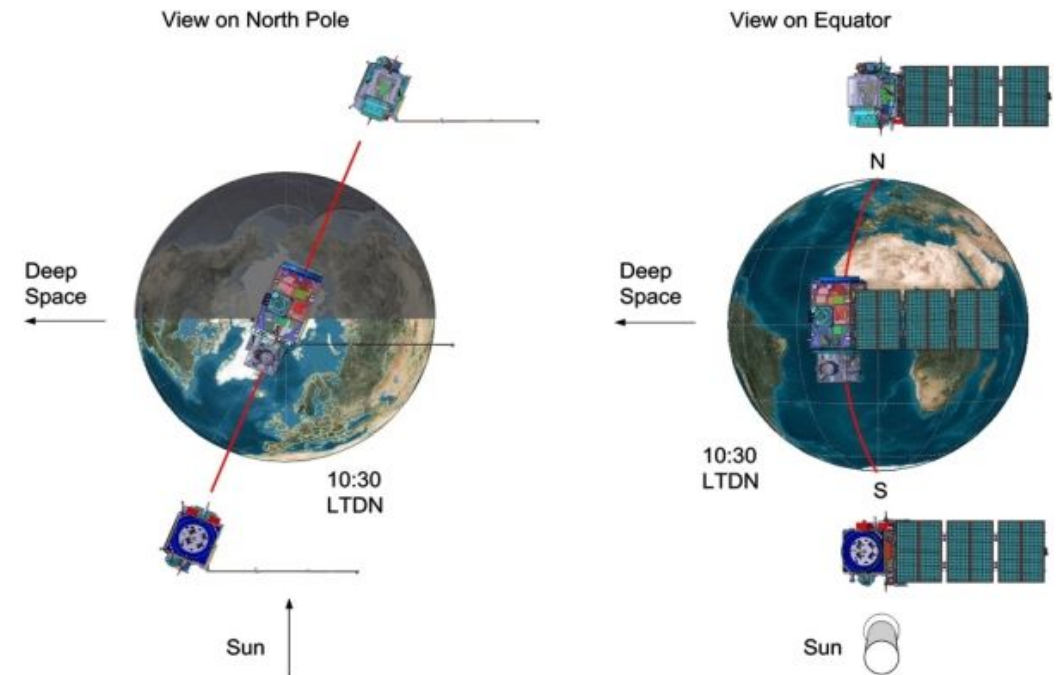
(Copernicus n.d.)

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)

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
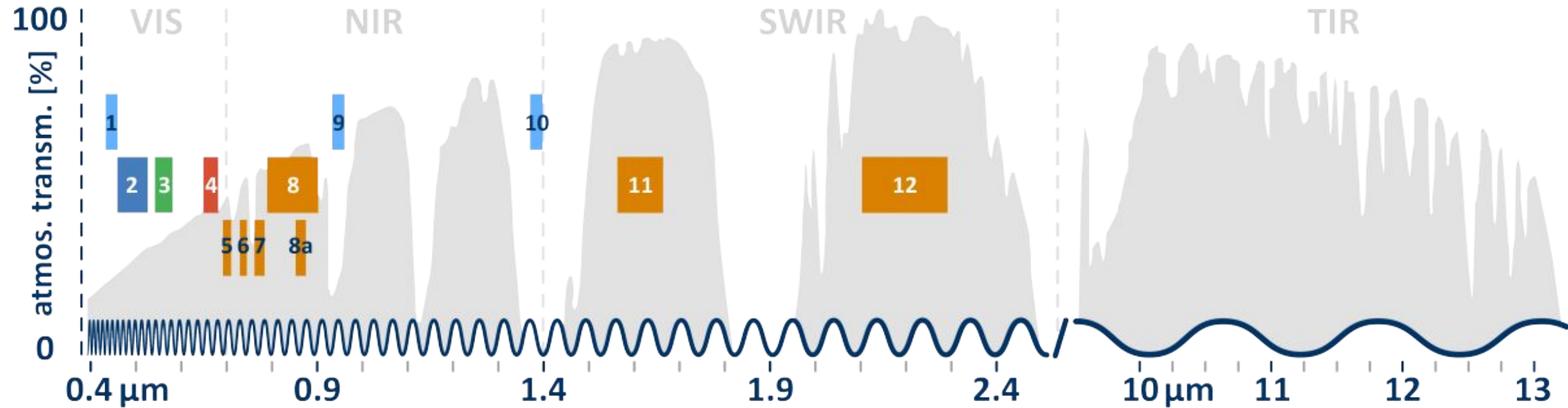
(Freie Universität Berlin n.d.)

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 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 index 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

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Thank you for your attention!

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