Data Source & Methodology – Sentinel-2 L2A

🌍 Technical Report

Data Source & Methodology – Sentinel-2 L2A (Copernicus Program)

1. Introduction & Purpose

This report is based on **satellite imagery acquired from the European Space Agency's (ESA) Sentinel-2 mission**, processed and accessed through the **Sentinel Hub platform**. The purpose of this analysis is to provide accurate, repeatable, and scientifically validated insights for the area of interest (AOI) defined by the client.

2. Data Source Transparency

- **Satellite & Mission:** Sentinel-2A and Sentinel-2B, part of the **Copernicus Earth Observation Program (EU/ESA)**.
- **Product Used: Level-2A (L2A)** – atmospherically corrected surface reflectance data.
- **Spectral Bands:** 13 multispectral bands ranging from visible (443 nm) to short-wave infrared (2190 nm).
- **Spatial Resolution:**
  - 10m: Visible & NIR (e.g., Red, Green, Blue, NIR).
  - 20m: Red Edge & SWIR.
  - 60m: Atmospheric correction bands.
- **Temporal Resolution (Revisit Frequency):**
  - ~5 days at the equator (Sentinel-2A + 2B).
  - 2–3 days at mid-latitudes due to overlapping orbits.
- **Historical Archive:** Available since June 2015.
- **Access Method:** Imagery accessed via **Sentinel Hub APIs**, which connect directly to Copernicus repositories.

3. Methodology

- **Area of Interest (AOI):** Defined using client-specified coordinates/polygon (to be inserted).
- **Time Frame:** Imagery retrieved for the period *(insert start date – end date)*.
- **Preprocessing:**
    - Cloud masking using Sentinel-2 Scene Classification Layer (SCL).
    - Band resampling to 10m resolution for harmonization.
    - Normalization of surface reflectance values (0–1 scale).
- **Analysis Conducted:**
    - Derived indices (e.g., NDVI, NDWI, NDBI) depending on client requirement.
    - Statistical aggregation (mean, median, distribution) over AOI.
    - Comparison of multiple timestamps to identify temporal changes.
- **Tools & Environment:** Python (sentinelhub-py), Sentinel Hub APIs, GIS software (QGIS/ArcGIS).

4. Accuracy & Reliability

- **Source Reliability:** Sentinel-2 is an **official ESA mission**, part of the EU-funded Copernicus program, ensuring authoritative and standardized data.
- **Geometric Accuracy:** Better than 20m RMSE.
- **Radiometric Accuracy:** <5% absolute radiometric uncertainty.
- **Temporal Reliability:** Global coverage with guaranteed revisit every 5 days (shorter at higher latitudes).
- **Limitations:**
    - Optical data is affected by cloud cover and shadows.
    - Atmospheric correction (L2A) may still introduce slight uncertainties in reflectance.
    - Data availability may vary in case of acquisition gaps.

5. Proof of Authenticity

- **Product IDs:** Each Sentinel-2 scene is traceable with an ESA product identifier (example: S2B_MSIL2A_20230815T104021_N0509_R008_T32TNR_20230815T124532).

- **Acquisition Metadata:** Retrieved via Sentinel Hub Catalog API, ensuring transparency.
- **Verification:** Clients can independently download and cross-check scenes via the **Copernicus Open Access Hub** or the **Sentinel Hub EO Browser**.

6. Results Presentation

- **Maps:** AOI highlighted with cloud-free mosaics.
- **Indices:** NDVI / NDWI / Urban Index layers visualized with clear legends.
- **Statistics:** Tabulated summaries (mean vegetation index, water coverage, etc.).
- **Change Detection:** Time-series graphs showing trends across selected dates.

(Insert your actual outputs here – images, charts, tables)

7. Limitations & Assumptions

- Cloud-free imagery is subject to atmospheric conditions; multiple scenes may be composited to reduce cloud impact.
- Classification thresholds (e.g., NDVI > 0.3 = vegetation) are based on standard remote sensing practices but may vary with local ground conditions.
- Sentinel-2 L2A provides **surface reflectance**, not raw radiance; some post-processing decisions (e.g., scaling) are applied consistently.

8. Conclusion & Assurance

This analysis is based entirely on **Sentinel-2 L2A data** – one of the most trusted, open, and globally validated Earth Observation datasets available today.

- **Transparency:** All inputs are traceable to ESA's Copernicus archive.
- **Reliability:** Frequent revisit time ensures up-to-date monitoring capability.
- **Reproducibility:** The workflow is fully automated using Sentinel Hub APIs and can be repeated anytime for validation.

We assure that the insights presented in this report are derived from

We assure that the insights presented in this report are derived from authoritative, scientifically validated data sources and processed using industry-standard methodologies.

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