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1 How to conduct a Remote Sensing case study

a) Designing a case study

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EARTH OBSERVATION RESEARCH

Learning objectives

1) Understand how to structure a remote sensing study

1) Learn the key steps in conducting a case study

1) Recognize the relevance of Sentinel-2 data in vegetation and land cover analysis

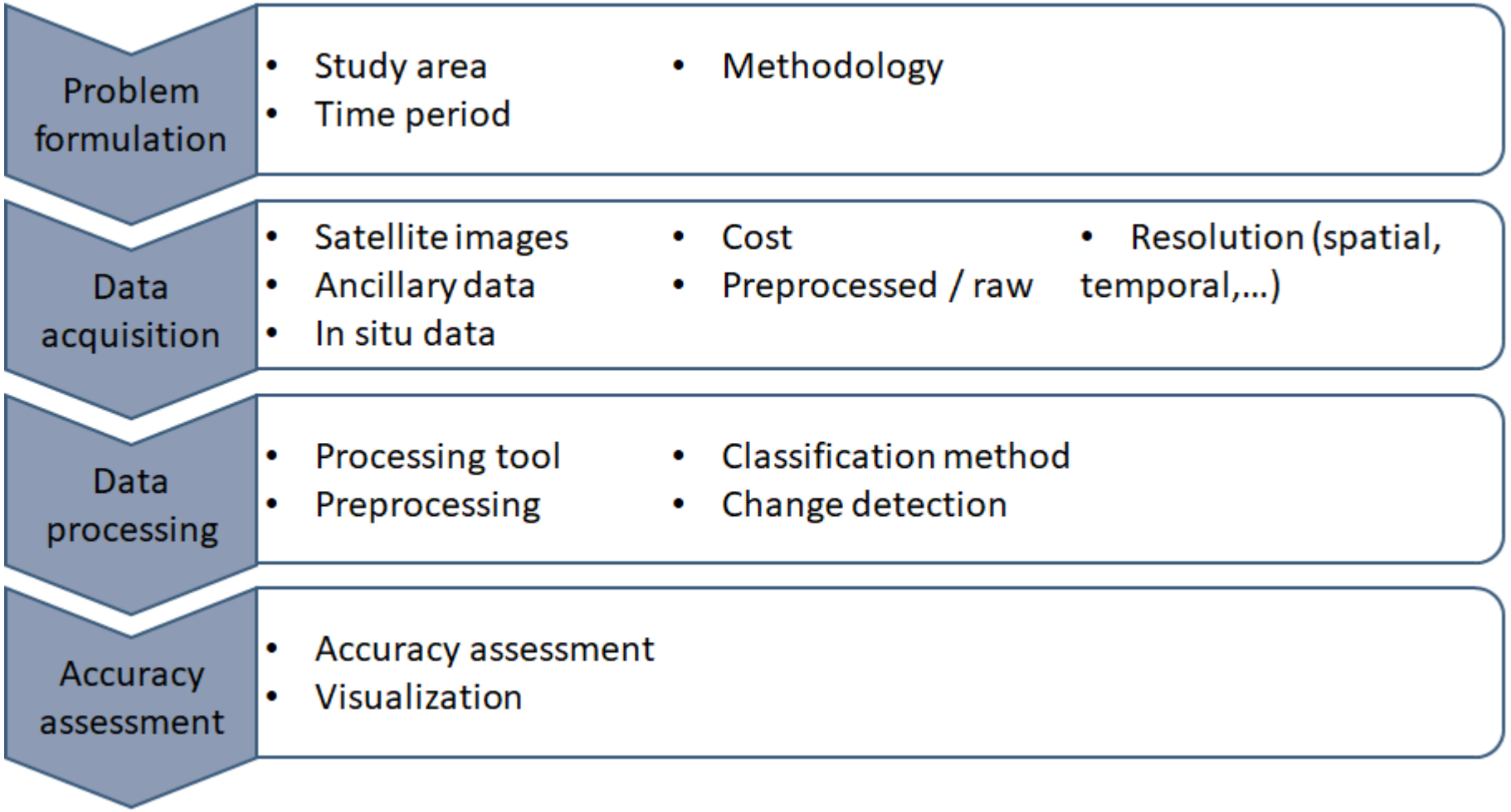
What is a Remote Sensing case study

A structured research approach that uses satellite imagery and geospatial analysis to investigate environmental, urban, or agricultural changes

Why use case studies?

- Allow detailed investigation of specific geographic areas
- Provide real-world applications for **environmental monitoring, agriculture, disaster response, and land use planning**

Structure of a Remote Sensing case study



Structure of a Remote Sensing case study

1) Define the research question

Key considerations

- What problem do you want to address?
- Which area will you study?
- What time period will you analyze?

Our example

- How has vegetation cover changed in east Africa over the last 10 years?

Structure of a Remote Sensing case study

2) Select appropriate remote sensing data

Choosing the right data depends on

- Spatial resolution (What level of detail is needed?)
- Temporal resolution (How frequently is data needed?)
- Spectral resolution (What bands are necessary for analysis?)

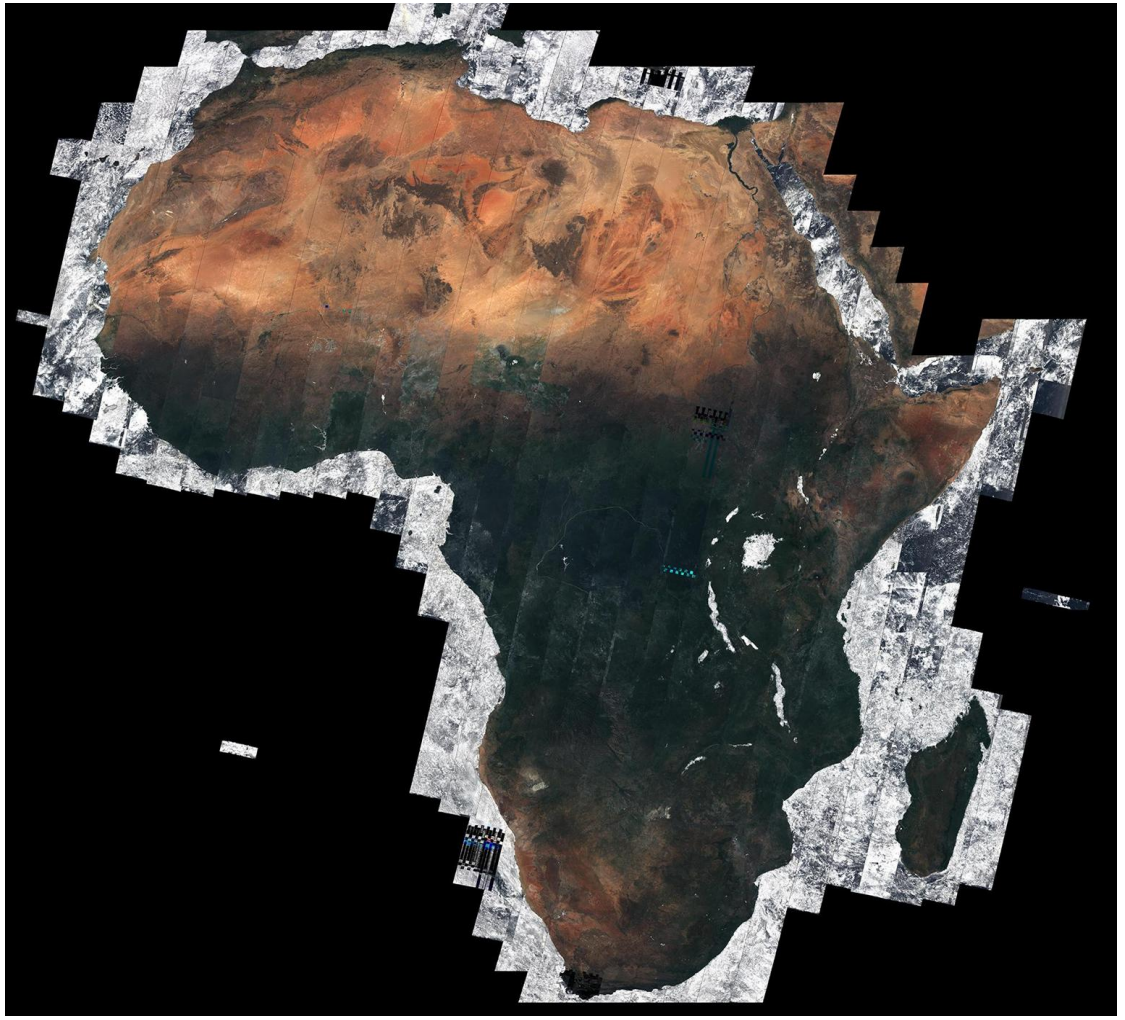
Our example: Sentinel-2 for vegetation analysis

- 10m spatial resolution allows detailed vegetation mapping
- Frequent revisits (every 5 days) allow time-series analysis
- Red, NIR, and SWIR bands are useful for detecting vegetation health (NDVI, EVI)

Structure of a Remote Sensing case study

2) Select appropriate remote sensing data

Mosaic of the African continent created using Sentinel-2 data



(ESA 2016)

Structure of a Remote Sensing case study

3) Preprocessing the data

Common preprocessing steps

- Atmospheric correction – Removing atmospheric distortions
- Cloud masking – Filtering out cloudy pixels
- Radiometric calibration – Adjusting brightness values for analysis
- Georeferencing – Ensuring spatial accuracy

Why this matters

- Poor preprocessing leads to inaccurate results

Structure of a Remote Sensing case study

4) Data analysis

What analysis methods to use?

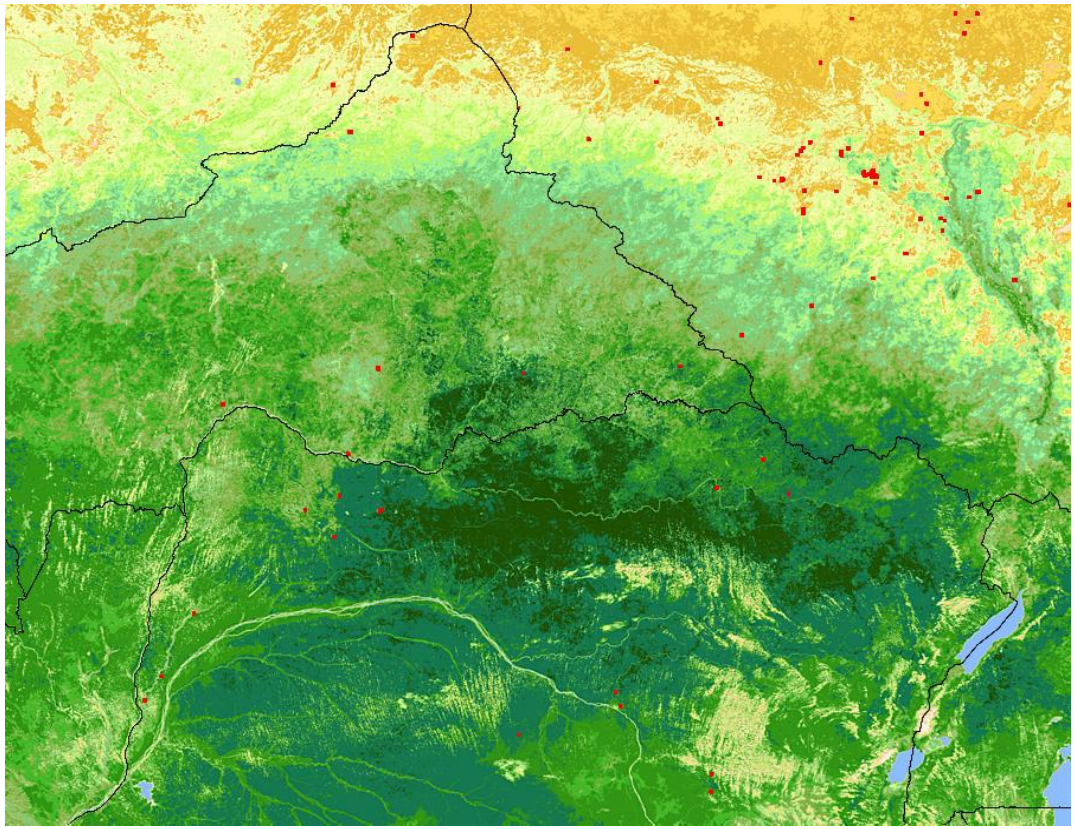
- Vegetation indices (NDVI, EVI) – Assessing vegetation health
- Land cover classification – Identifying different land types
- Time-series analysis – Detecting changes over time
- Change detection – Comparing before/after images
- Harmonization, data fusion

Our Example: Vegetation monitoring

- NDVI formula: (NIR - Red) / (NIR + Red)
- High NDVI = healthy vegetation, Low NDVI = stressed vegetation

Structure of a Remote Sensing case study

4) Data analysis



NDVI in central Africa

- High vegetation health = dark green
- Low vegetation health = red

(Descloitres 2004)

Structure of a Remote Sensing case study

5) Interpretation and validation

Why validation is important

- Remote sensing results must be verified with field data or high-resolution imagery

Ways to validate data

- Comparing with ground truth measurements
- Cross-checking with higher-resolution satellite images (e.g., PlanetScope, UAVs)
- Using historical records from local sources
- Speak to locals

Structure of a Remote Sensing case study

6) Visualisation

How to present findings effectively

- Maps (Land cover classification, NDVI maps, change detection)
- Graphs (Time-series vegetation trends)
- Statistical summaries (Mean NDVI values per region)

Best practices

- Use appropriate color scales for interpretation
- Label axes, legends, and provide contextual information
- Keep it simple but informative (avoid unnecessary complexity)

Structure of a Remote Sensing case study

7) Reporting and science communication

Why good reporting is crucial

- Allows reproducibility and transparency
- Helps policymakers and stakeholders make informed decisions

Report formats:

- Academic papers & reports.
- Technical documentation for projects.
- Presentations (PowerPoint, PDFs, web-based tools like StoryMaps).

Structure of a Remote Sensing case study

7) Reporting and science communication

What to include in a remote sensing report

- Introduction (Research question, study area, objectives)
- Methodology (Data sources, preprocessing, analysis methods)
- Results & discussion (Findings, interpretation, key patterns)
- Conclusion & recommendations (Key takeaways, limitations, future work)

Design your own Remote Sensing case study

Outline a case study using the discussed structure

Let's get started:

- Within the next 20 minutes, think of a region that you will use as study area for your own remote sensing case study!
- You can browse
  - https://earthengine.google.com/timelapse/
  - https://www.globalforestwatch.org/map/
  - https://pages.cms.hu-berlin.de/EOL/geo_rs/S12_CS_Change_detection.html
  - https://box.hu-berlin.de/d/af9c43d204b64bd7b72d/

  for inspirations on your future case study

Design your own Remote Sensing case study

Outline a case study using the discussed structure

Please prepare 1-3 slides in powerpoint and present the study area of your remote sensing case study.
By doing so, please try to answer the following questions:

- What is your research question?
- What satellite data will you use?
- Do you need more data than just satellite data?

- Who can benefit from your study?

Summary & key takeaways

A remote sensing case study follows **structured steps**, from problem definition to interpretation

A well-structured study includes **clear research questions, appropriate data selection, preprocessing, analysis, and validation**

Sentinel-2 data is valuable for vegetation and land cover studies due to its spectral richness and high resolution

Sources

European Space Agency (ESA). (2016). *African mosaic* [Image]. Retrieved February 10, 2025, from https://www.esa.int/ESA_Multimedia/Images/2016/05/African_mosaic

Descloitres, J. (2004, May 5). *Normalized Difference Vegetation Index (NDVI) image of Central Africa* [Image]. NASA Visible Earth. Retrieved February 10, 2025, from https://www.visibleearth.nasa.gov/images/71048/normalized-difference-vegetation-index-ndvi-image-of-central-africa

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Thank you for your attention!

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