ERASMUS-EDU-2023-CBHE
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(01/01/2024 – 31/12/2026)

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LAND MANAGEMENT
ENVIRONMENT &
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Co-funded by
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# MICRO-CREDENTIAL

# LAND MANAGEMENT IN CENTRAL ASIA

## 12.- Sensors and Remote Sensing Platforms

## *Sensors and Platforms Review*

*LM-W12-V84*

# Sensors and Platforms Review

LM-W12-V84 | Week 12 synthesis lecture

**SENSORS**

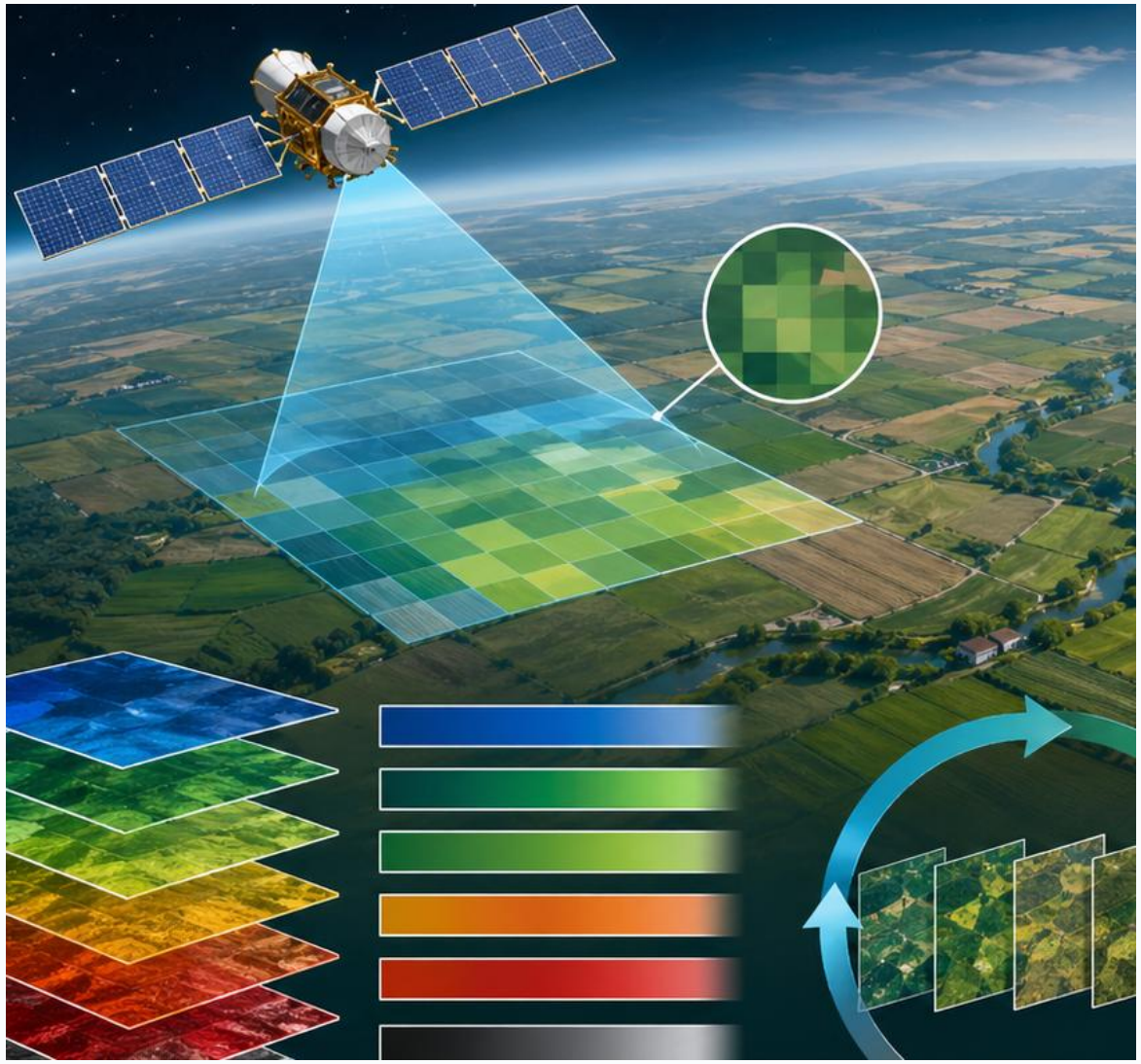
- measure reflected, emitted, or returned energy

**PLATFORMS**

- carry sensors at ground, airborne, or satellite scale

**OUTPUTS**

- turn signals into images, maps, and decisions

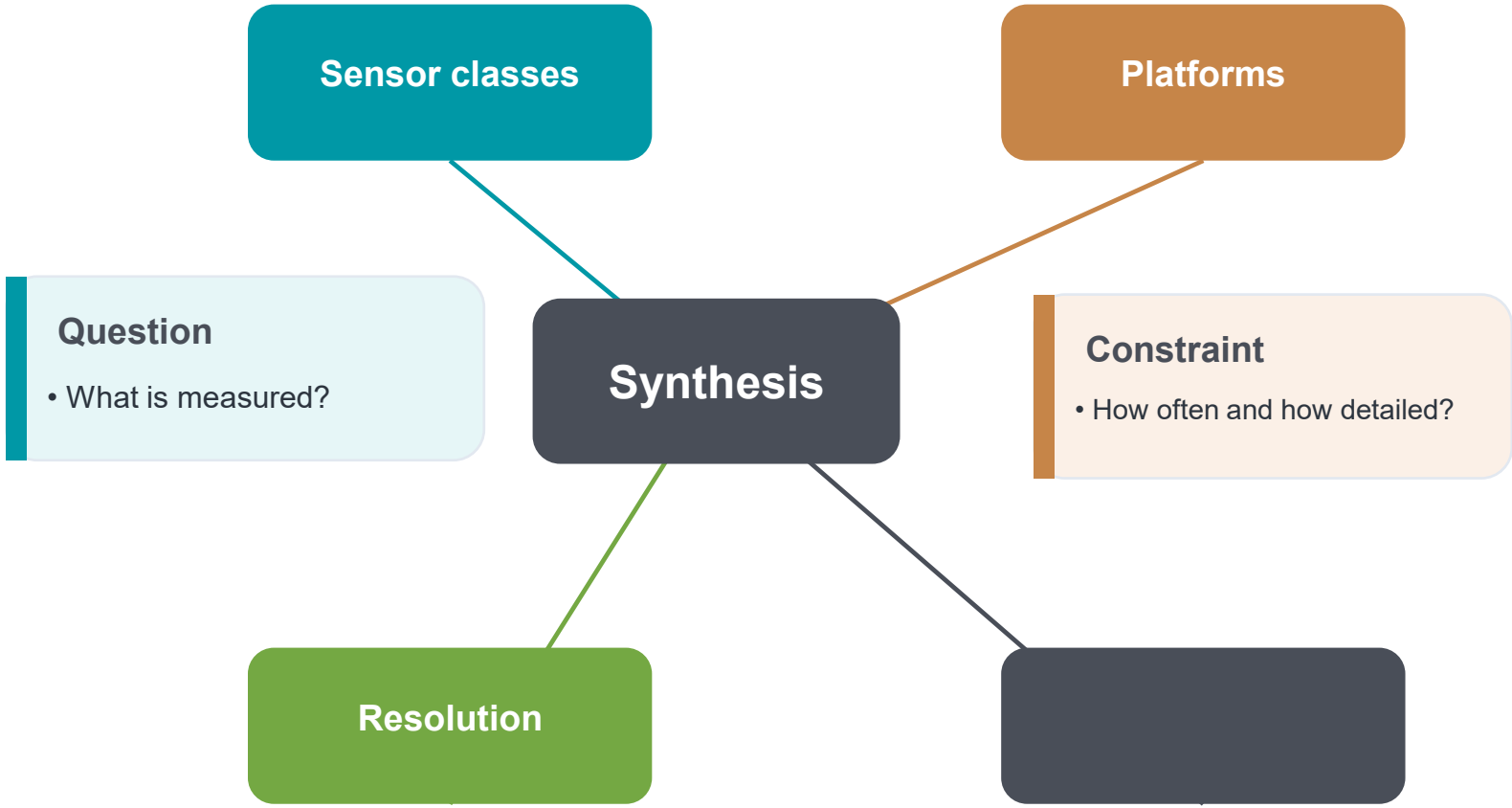


# Review learning map

This lecture connects the main sensor and platform concepts from Week 12.

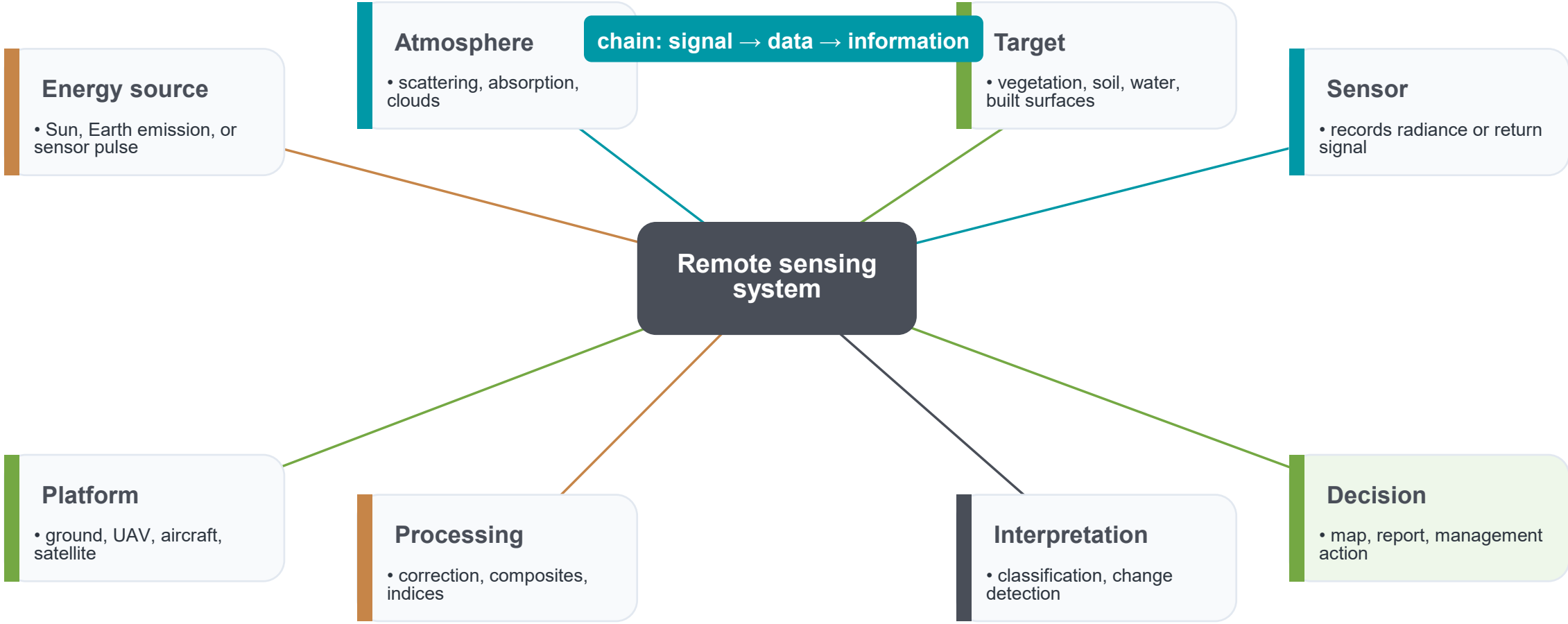
**By the end, students should be able to:**

- classify sensors by energy source and spectral region
- compare ground, aerial, UAV, and satellite platforms
- explain the four main resolution concepts
- match sensors and platforms to practical land-management tasks



# A complete remote sensing system

Sensors and platforms only become useful when they are linked to processing and interpretation.

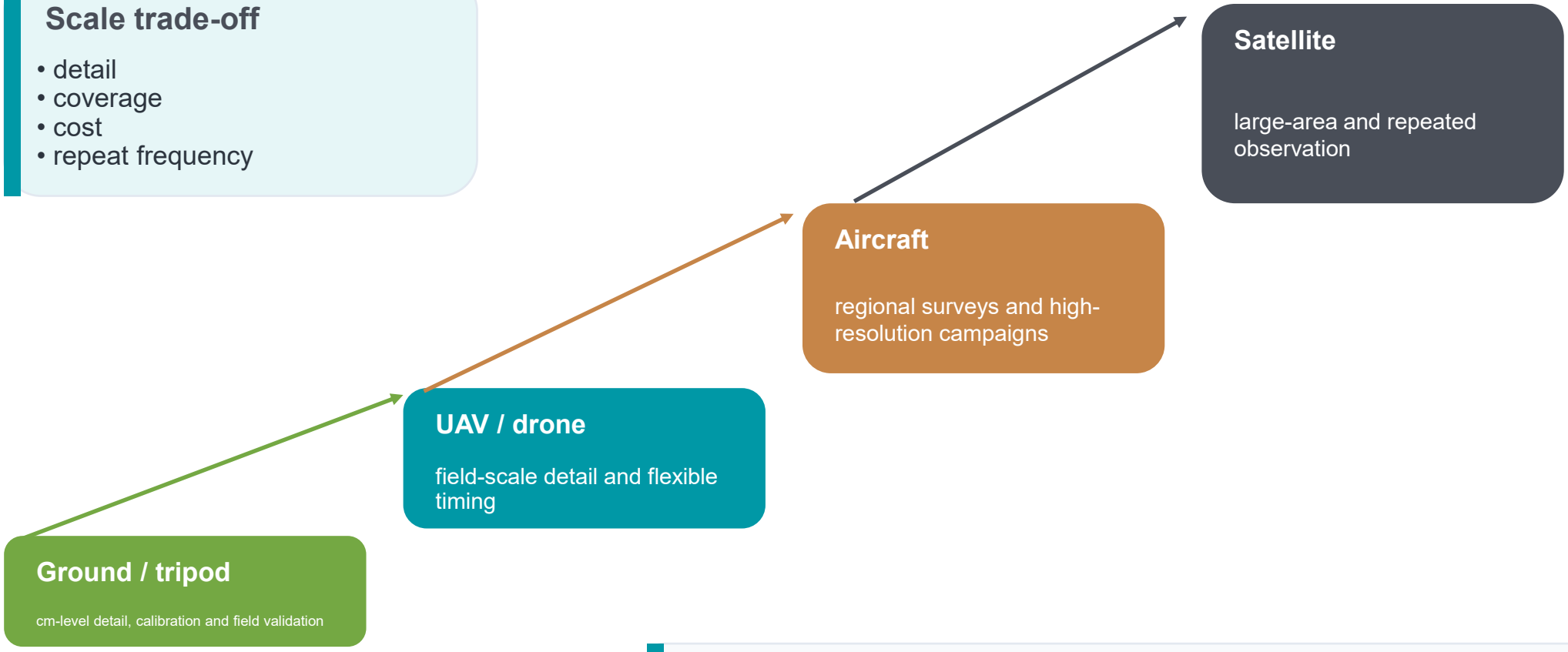


# Platform scale ladder

Closer platforms often provide more local detail; higher platforms usually provide broader coverage.

## Scale trade-off

- detail
- coverage
- cost
- repeat frequency




## Practical rule

# Sensor families at a glance

A useful review is to connect energy source with spectral region.

| | Optical | Thermal IR | Microwave |
|---|---|---|---|
| **Passive** | Multispectral<br>Hyperspectral<br>Camera | Thermal scanner<br>TIRS-like sensors<br>Thermal camera | Radiometer<br>soil moisture<br>sea surface studies |
| **Active** | Rare in Earth observation optics except illumination systems | Active thermal less common in standard EO mapping | Radar / SAR<br>Altimeter<br>Scatterometer |

# The four resolution concepts

Resolution controls how much detail, difference, and change a sensor can observe.

## Spatial

- pixel size on the ground
- 10 m vs 30 m changes the visible field detail

## Spectral

- number and width of bands
- narrower bands improve material discrimination

**Sensor design is always a compromise**

## Temporal

- how often a place is observed
- important for crops, floods, and seasonal change

## Radiometric

- sensitivity to energy differences
- 8-bit = 256 levels; 12-bit = 4096 levels

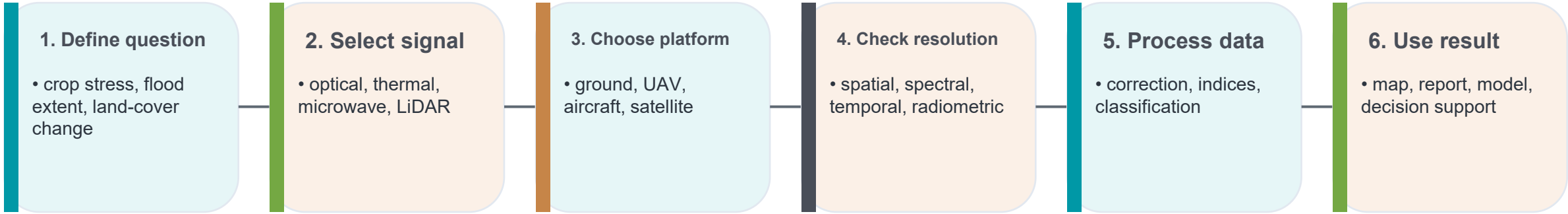
# Sensor–platform matching matrix

Matching a sensor to a platform depends on area size, detail, timing, and budget.

| Task need | Ground / field | UAV | Aircraft | Satellite |
|---|---|---|---|---|
| Calibration / truth | Excellent | Useful | Useful | Needs field link |
| Small field detail | Very detailed but local | Excellent | Excellent | Depends on pixel size |
| Regional coverage | Limited | Limited | Good | Excellent |
| Repeated monitoring | Labor-intensive | Flexible | Campaign-based | Systematic |
| Emergency mapping | Slow locally | Fast if available | Good if aircraft ready | Strong for large events |

# From question to decision: a review workflow

Remote sensing selection should start from the management question, not from the sensor name.




## Quality checkpoint

- Are the data cloud-free or appropriate for the weather?
- Is the pixel size suitable for the object?
- Is field validation or local knowledge available?

# Choosing sensors for common land-management cases

Different problems require different combinations of sensors and platforms.

### Irrigated agriculture

- Sentinel-2 / Landsat optical indices
- thermal data for crop water stress
- UAV for field-level validation

**field + satellite**

### Flood monitoring

- SAR for cloudy conditions
- optical for clear-sky mapping
- satellite platforms for large extent

**SAR priority**

### Urban expansion

- optical time series
- high-resolution satellite or UAV
- thermal for heat-island studies

**high detail**

### Land degradation

- multi-date optical indices
- SWIR for moisture/bare soil clues
- field data for validation

**multi-date**

# Review of typical remote sensing products

Products are not the sensor itself; they are processed representations of measured signals.

### Optical composite

• true color, false color, band combinations

### Vegetation index

• NDVI, EVI, SAVI and similar indicators

### Thermal map

• brightness temperature or land-surface temperature

### SAR product

• backscatter, coherence, flood extent, deformation

### Elevation product

• DEM, DSM, canopy height, 3-D structures

### Decision layer

• classified map, change map, risk or suitability layer

# Common mistakes and quality-control questions

A good analyst checks assumptions before trusting a map.

## Common mistakes

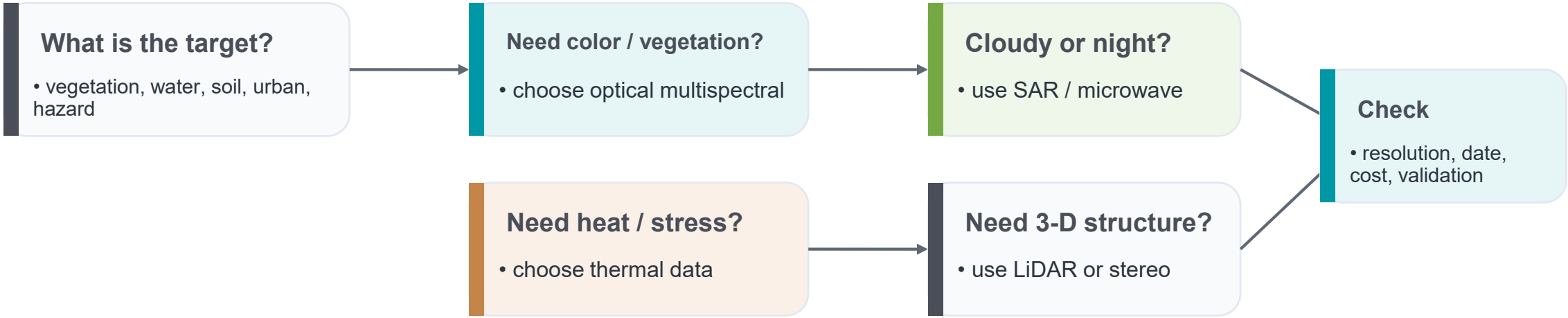
- choosing data only because it is familiar or free
- using an image without checking date, cloud, and season
- ignoring mixed pixels and scale mismatch
- treating classification output as truth without validation
- comparing images before correction or alignment

## Quality-control questions

- What exactly does the sensor measure?
- Is the platform suitable for the study area size?
- Which resolution is most critical?
- What validation data are available?
- How uncertain is the final product?

# A simple sensor-selection decision tree

Use this logic as a starting point for selecting data.




**Important**

- Real projects often combine several sensors because one data source rarely answers every question.

# Classroom review activity

Students choose a sensor-platform combination and justify it.

### Scenario A: Crop stress

- Area: 50 irrigated fields
- Need: weekly monitoring
- Challenge: water stress before yield loss

**Your task: choose data + explain why**

### Scenario B: Flood mapping

- Area: river basin
- Need: rapid response
- Challenge: cloudy weather

**Your task: choose data + explain why**

### Scenario C: Urban heat

- Area: city districts
- Need: identify hot zones
- Challenge: link heat with land cover

**Your task: choose data + explain why**

# Key takeaways from Week 12

Sensors and platforms form a measurement system, not isolated technologies.

1

## Start with the question

- Define the decision problem before choosing a dataset.

2

## Classify the sensor

- Energy source, spectral region, and imaging form explain what the sensor can measure.

3

## Match the platform

- Platform height controls coverage, detail, timing, logistics, and cost.

4

## Check resolution trade-offs

- Spatial, spectral, temporal, and radiometric resolution must fit the task.

5

## Validate the result

- Remote sensing products need field data, metadata, and quality control.

# References

Selected sources for deeper study


- Lillesand, T., Kiefer, R. W., & Chipman, J. (2015). Remote Sensing and Image Interpretation. Wiley.
- Jensen, J. R. (2016). Introductory Digital Image Processing: A Remote Sensing Perspective. Pearson.
- Campbell, J. B., & Wynne, R. H. (2011). Introduction to Remote Sensing. Guilford Press.
- NASA Earthdata and NASA Earth Observatory. Educational materials on sensors, platforms, and resolution.
- USGS Landsat Missions. Mission, sensor, and data-product documentation.
- European Space Agency (ESA) Sentinel Online. Sentinel mission and sensor descriptions.
- FAO and USGS educational resources on Earth observation for land and water applications.


**Independent study suggestion**

- Compare one optical, one thermal, and one SAR dataset for the same study area and describe what each dataset adds to land-management analysis.

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