ERASMUS-EDU-2023-CBHE
Project number: 101129032

Duration: 36 months
(01/01/2024 – 31/12/2026)

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LAND MANAGEMENT ENVIRONMENT & SOLID-WASTE

Co-funded by the European Union

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MICRO-CREDENTIAL

LAND MANAGEMENT IN CENTRAL ASIA

12.- Sensors and Remote Sensing Platforms

Satellite Remote Sensing Platforms

LM-W12-V81

Satellite Remote Sensing Platforms

ORBIT

where the satellite travels

LEO, polar, sun-synchronous, GEO

SWATH

how much area is seen

coverage, overlap, revisit

SYSTEM

how data becomes usable

downlink, processing, distribution

The platform determines coverage, repeat observation, viewing geometry, and practical usefulness.

Learning outcomes

Define the role of satellite platforms in remote sensing.

Compare low Earth, polar, sun-synchronous, and geostationary orbits.

Explain swath, revisit time, nadir, inclination, and ground track.

Recognize major Earth observation satellite missions.

Select a platform type for common monitoring tasks.

Platform question

How often do we need observations?

How wide an area must be monitored?

How much spatial detail is required?

Practical message

A satellite platform is not only a "carrier." It shapes the whole observation strategy.

Three levels of thinking

1. Orbit: where and when it observes.
2. Sensor: what physical signal it records.
3. System: how data reaches users.

What makes satellite platforms different?

Satellites trade local flexibility for repeatable large-area observation.

Strengths

Large-area coverage and systematic repeat observations.

Consistent digital records for time-series analysis.

Limitations

Less flexible acquisition timing than UAVs or aircraft.

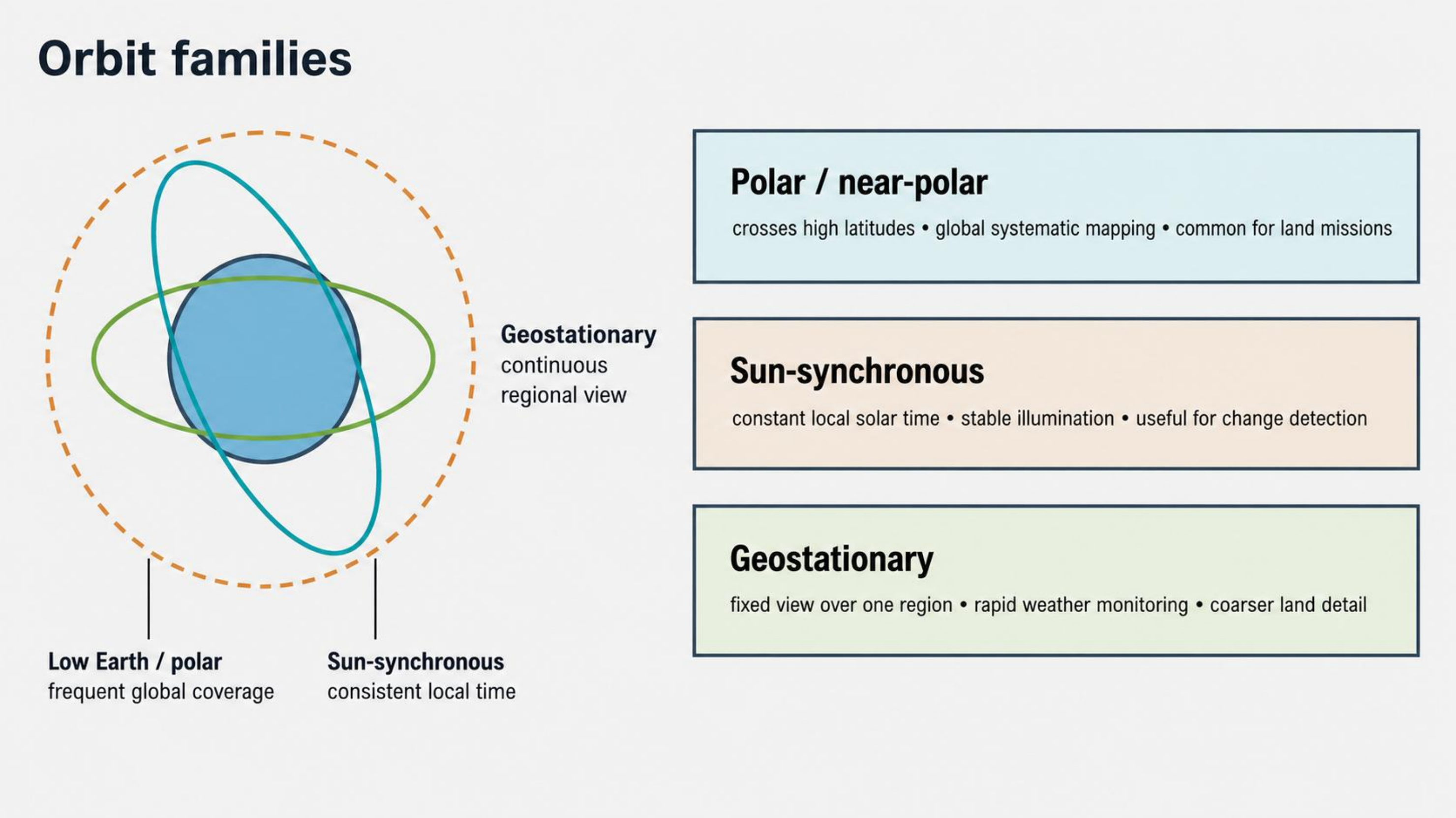
Clouds affect optical satellites; resolution trade-offs always exist.

Best use

Monitoring crops, water, land cover, snow, drought, disasters, and regional change.

Main orbit types used in remote sensing

Orbit type controls the viewing pattern and monitoring strategy.



Core idea

Low Earth / polar orbits are common for land mapping; geostationary orbits are essential for continuous weather monitoring.

Key orbit parameters

These terms help describe how a satellite observes the Earth.

Altitude

Average height above the Earth; affects coverage, pixel size, and orbital period.

Inclination

Angle between the orbit and the equator; controls latitude coverage.

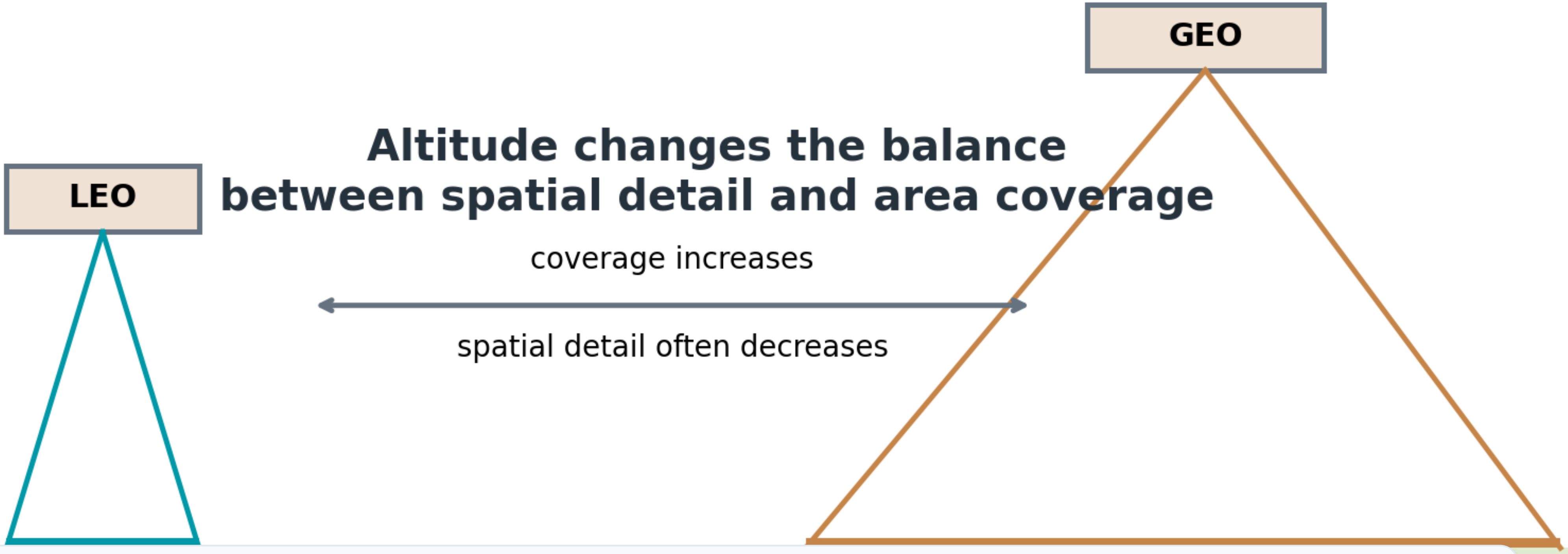
Period

Time required to complete one orbit around Earth.

Repeat cycle

Time required for the satellite ground track pattern to repeat.

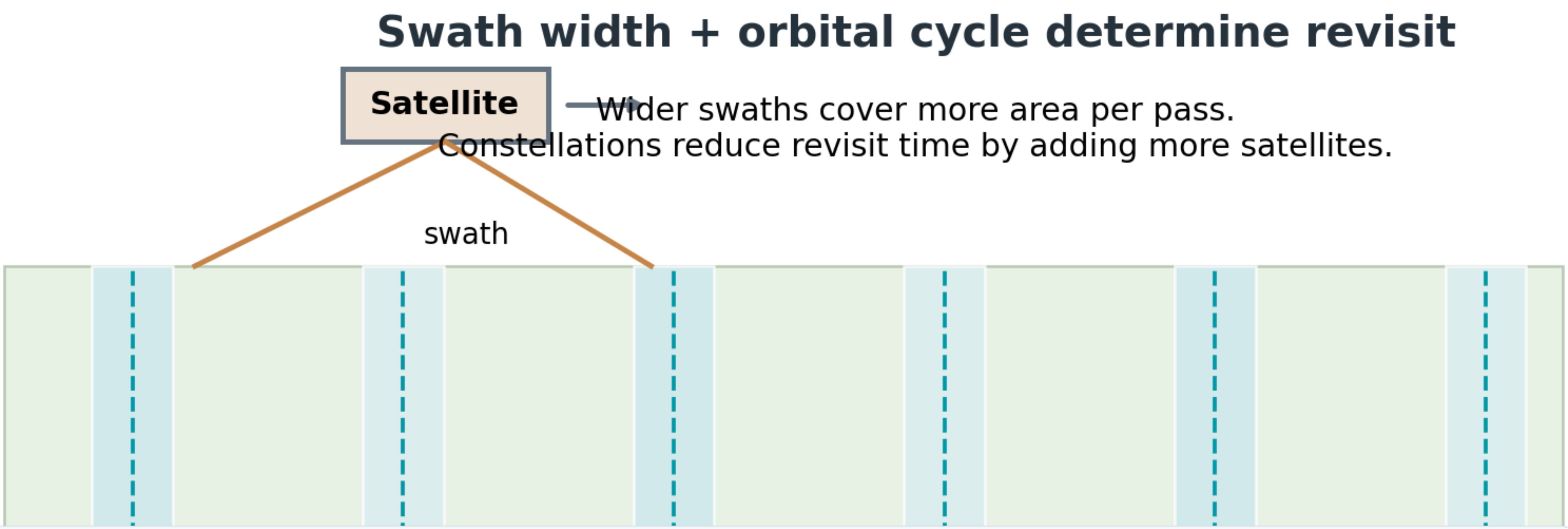
Higher platforms see wider areas, while lower platforms usually support finer detail.



Teaching point

Platform height, sensor design, and mission objective must be considered together; altitude alone does not define image quality.

Monitoring depends on both how much the sensor sees per pass and how often it returns.



Example logic

A narrow-swath high-resolution satellite may be excellent for detail, while a wide-swath system may be better for drought, snow, or regional water monitoring.

Ground track, nadir, and scene reference systems

Satellite data is organized by repeatable paths, rows, and viewing geometry.

Nadir

The point directly below the satellite on the Earth surface.

Images near nadir usually have less geometric distortion.

Off-nadir viewing can improve revisit but changes geometry.

Ground track

The path traced by the satellite over the Earth surface.

Earth rotation shifts successive passes.

Repeated tracks support systematic mapping.

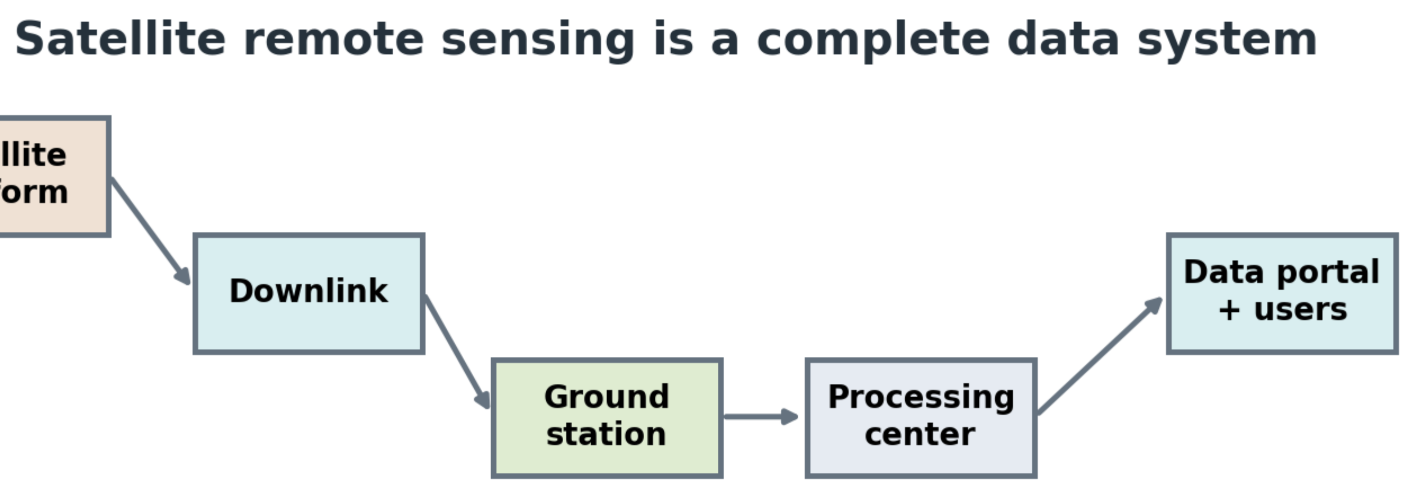
Path / row systems

Used to reference satellite scenes in catalogues.

Helpful for ordering and comparing images of the same area.

Landsat is a familiar example of path/row organization.

Operational remote sensing requires more than the spacecraft.



The platform only collects the signal. Operational value comes after downlink, correction, distribution, analysis, and decision support.

Practical reminder

A good platform must collect, store, downlink, process, and distribute data reliably for users.

Different missions are designed for different observation priorities.

Mission / platform	Orbit / platform class	Main sensor type	Typical strength
Landsat 8/9	Sun-synchronous LEO	Optical + thermal	long land record; change detection
Sentinel-2	Sun-synchronous LEO	Multispectral optical	wide swath; vegetation and land monitoring
Sentinel-1	Sun-synchronous LEO	SAR microwave	cloud-resistant radar observations
Terra / Aqua MODIS	Sun-synchronous LEO	Multispectral + thermal	daily regional/global monitoring
GOES-R series	Geostationary	Weather imaging/sounding	continuous weather monitoring

Interpretation

The mission name matters less than understanding the orbit, sensor, swath, revisit, and intended application.

Case type: sun-synchronous land-observation platforms

These platforms are widely used for land, water, agriculture, and environmental monitoring.

Typical design

Low Earth orbit with near-polar coverage.

Similar local solar time on each pass.

Supports comparable illumination for time-series analysis.

Typical sensors

Optical multispectral instruments.

Thermal sensors for temperature-related applications.

Radar instruments for cloud-resistant observation.

Typical uses

Land cover mapping.

Crop and water monitoring.

Change detection and disaster assessment.

Case type: geostationary weather platforms

Geostationary satellites continuously observe the same broad region.

What makes them special?

They orbit above the equator at the same rotational speed as Earth.

They appear fixed relative to one region on the surface.

This enables frequent weather observation and storm monitoring.

Trade-off

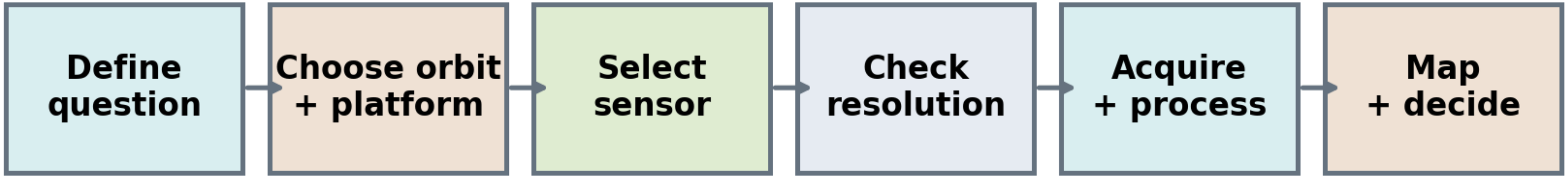
Excellent temporal monitoring, but usually coarser spatial detail for land applications.

They are less suitable for detailed field-level land mapping than low-Earth land missions.

They are essential for meteorology and disaster early warning.

A simple workflow helps students avoid choosing data only by popularity.

A practical platform-selection workflow



The best platform is the one that matches the monitoring question, not the one with the highest resolution alone.

Selection principle

Start from the question: area, frequency, target property, weather conditions, and required accuracy.

Review: platform trade-offs

A satellite platform is always a compromise between several competing needs.

Key message

For land management, the best satellite platform is the one that matches the monitoring scale, repeat frequency, spectral requirement, and decision need.

References

Selected introductory and authoritative sources

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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.

NASA Landsat 9 mission pages: Landsat 9, OLI, TIRS, and mission details.

ESA Copernicus Sentinel-2 mission documentation and Copernicus Data Space descriptions.

NOAA GOES-R / GOES operational satellite documentation.

NASA MODIS and Terra mission documentation.

Independent study suggestion

Students are encouraged to compare Landsat, Sentinel-2, Sentinel-1, MODIS, and GOES platforms by orbit, swath, revisit, sensor type, and application.

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