ERASMUS-EDU-2023-CBHE
Project number: 101129032

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(01/01/2024 – 31/12/2026)

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LAND MANAGEMENT
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LAND MANAGEMENT IN CENTRAL ASIA

10.- Introduction to Remote Sensing

Development of Remote Sensing Technologies

LM-W10-V66

A simple timeline of technological development

Remote sensing evolved step by step rather than appearing all at once.

1840s–1900s

Balloon, kite, and pigeon photography

1900s–1940s

Aircraft imaging and photogrammetry

1950s–1970s

Rockets, astronauts, weather satellites, Landsat

1980s–2000s

Digital sensors, multispectral systems, radar, lidar

2000s–today

Open archives, GIS integration, cloud and time series

Each phase solved a limitation of the earlier one: altitude, coverage, spectral range, repeat observation, or data handling.

Origins: photography before the satellite era

The earliest technologies focused on getting a camera above the surface.

Ground camera
The camera made image capture possible, but observation was still limited by the viewer's location and perspective.

Balloon / kite
Higher viewing position improved topographic observation.

Pigeon camera
A novel but real step toward mobile aerial imaging.

Aerial idea
The key insight was that looking downward changed what could be mapped.

What changed technically?

- The platform moved upward, giving a synoptic view.
- Image recording became a tool for mapping, not just a picture.
- The same area could be documented faster than by hand sketching.
- Remote sensing began to separate observation from direct contact.

Airborne photography and photogrammetry

Aircraft transformed remote sensing from experiment into an operational mapping tool.

Aircraft platform
Aircraft provided controlled flight paths and wider coverage.

Stereo viewing
Overlapping aerial images made height and shape interpretation more reliable.

Photogrammetric maps
Aerial photography became essential for mapping, surveying, and military reconnaissance.

Why this stage matters

Airborne technology improved image quality, repeatability, and mapping accuracy long before Earth observation satellites became common.

The beginning of the space age

Rockets and satellites changed remote sensing from regional observation to repeated global observation.

1940s–1950s
Rocket-mounted cameras and astronaut photography

1960s
Weather satellites with early space imagery

1972
Landsat 1 launched for systematic land observation

Later decades
Continuous Earth observation and digital archives

Key effect of satellite technology

The same place could now be observed again and again from orbit, which made long-term monitoring possible.

From film to digital sensors

A major technological shift occurred when remote sensing moved from photographic recording to electronic measurement.

Earlier approach: film and analog imagery

- Strong for visual photographs
- Useful, but limited in spectral separation
- Harder to automate and share for large digital analysis
- Interpretation depended heavily on the human analyst

New approach: electronic and digital sensing

- Scanners and electronic detectors recorded energy as digital values
- Multiple bands could be stored and processed by computer
- Correction, enhancement, and classification became easier
- Satellite data could be transmitted, archived, and reused

Technology expanded across the electromagnetic spectrum

Modern remote sensing progressed by measuring more than visible light.

Visible
Basic photographs and familiar colour information

Near infrared
Vegetation and land-surface differences become clearer

Thermal infrared
Surface temperature and heat-related patterns

Microwave
All-weather and surface-structure information

Development trend
As sensors improved, remote sensing moved from simple imaging toward measurement of physical and bio-physical properties.

The active sensing revolution: radar and lidar

New technologies could generate their own signal instead of depending only on sunlight or natural emission.

Passive systems

Measure natural reflected or emitted energy

Best known from optical and thermal observation

Strong, but sometimes limited by clouds, darkness, or the type of target property needed.

Radar

Active microwave sensing

Useful for roughness, moisture, structure, and some all-weather observation.

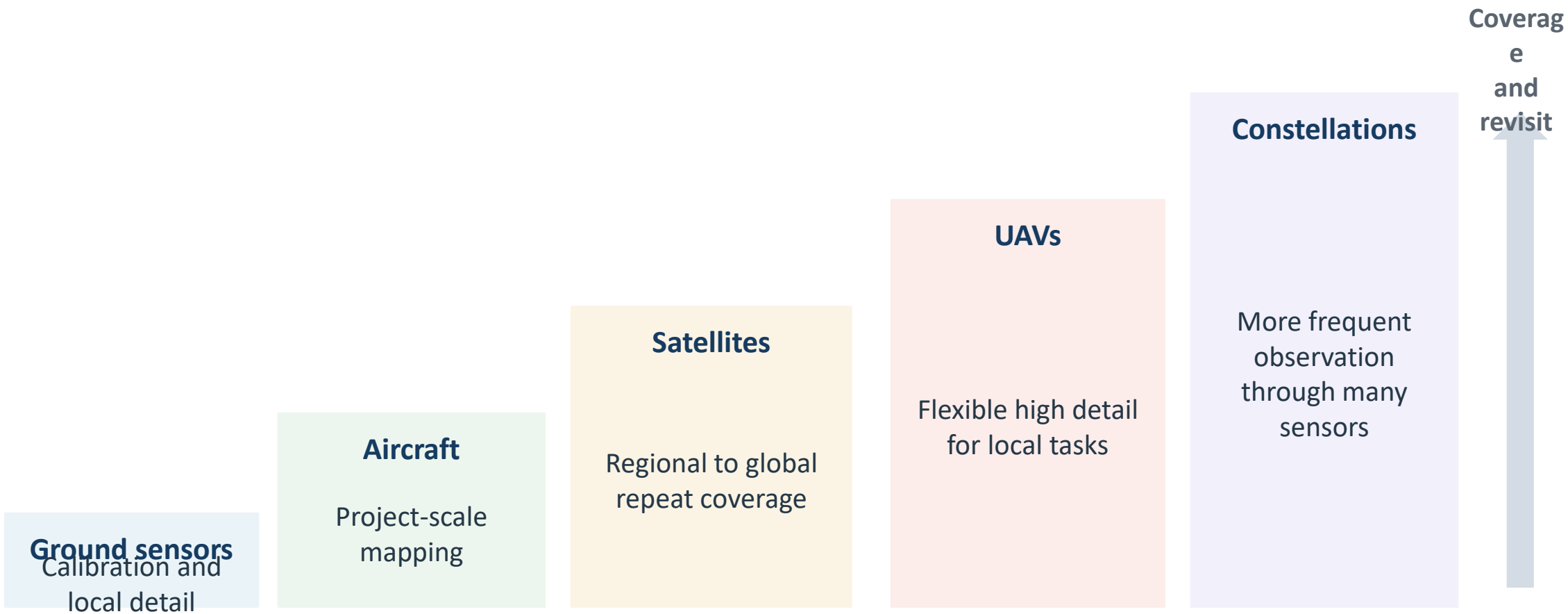
Lidar

Active laser sensing

Provides precise distance and height information and supports 3D surface modelling.

Platforms kept diversifying

Technology development did not stop at one platform type.



Data processing changed the field

Remote sensing became far more powerful when computers joined the workflow.

Visual interpretation

Human analyst reads analog or displayed images

Digital correction

Radiometric and geometric corrections on computer

Feature extraction

Enhancement, classification, and measurement

GIS integration

Maps, layers, and decision support products

Automated workflows

Computers assist large-scale, repeated, and multi-band analysis.

Capability grew through better resolution and system design

Development meant not only new sensors, but also better performance.

Spatial resolution
Smaller ground detail could be distinguished.

Spectral resolution
More bands improved material discrimination.

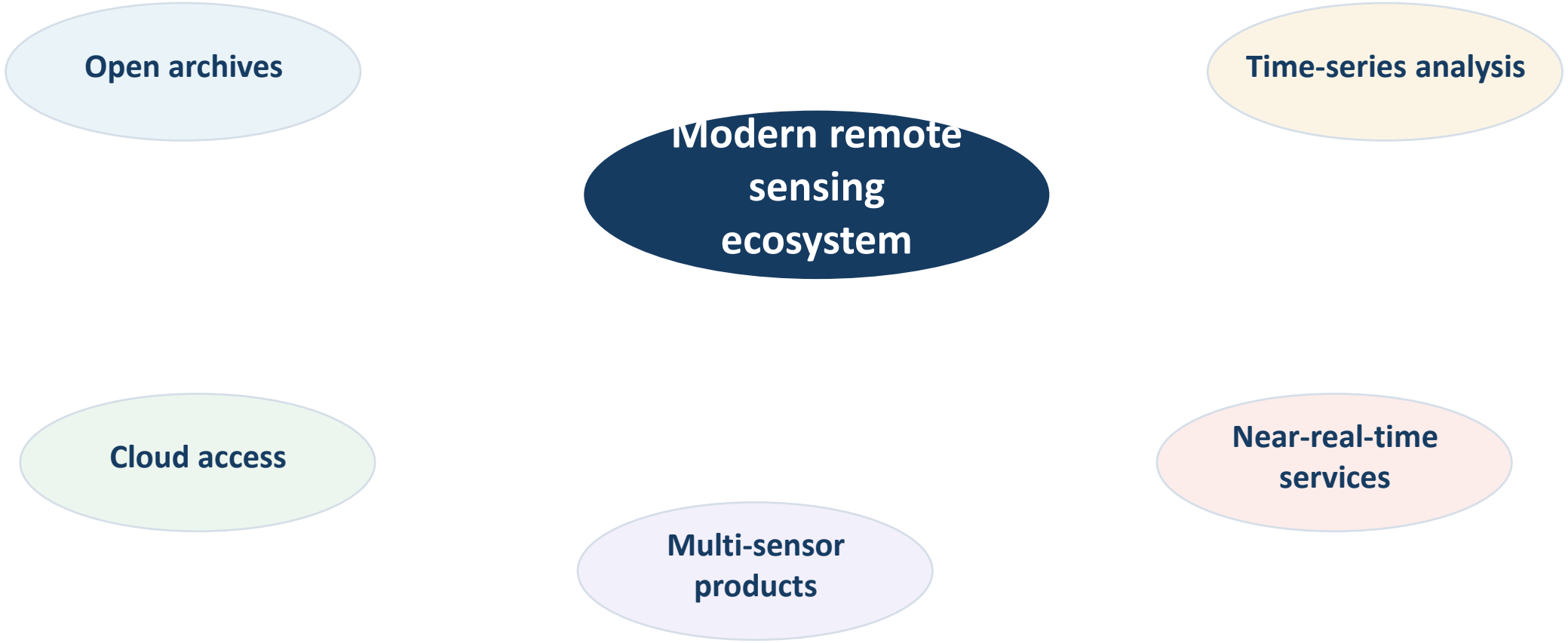
Radiometric resolution
Subtle energy differences could be recorded better.

Temporal resolution
Repeat imaging became more frequent and useful.

Improvement in resolution expanded what could be mapped, measured, and monitored.

The modern Earth observation ecosystem

Today the technology includes not only sensors, but also access, archives, and services.



Regional relevance: why these technologies matter in Central Asia

Technology development matters because it improves real observation tasks on the ground.

Sensor families

Optical
Thermal
Radar
Lidar
Time series

Information products

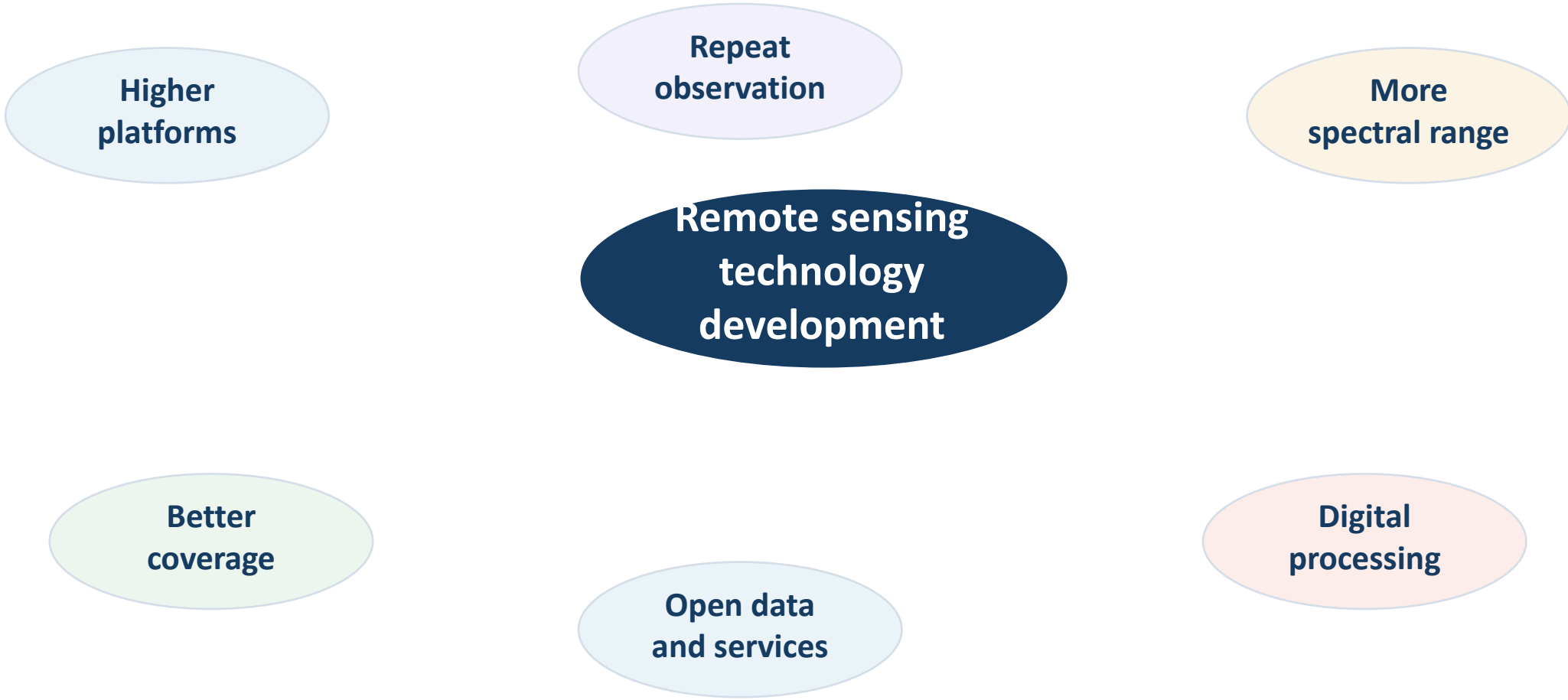
Crop maps
Water extent
Elevation models
Change layers
Condition indices

Regional applications

Irrigation monitoring
Crop condition assessment
Snow and glacier observation
Salinity and land degradation mapping
Water-body and environmental change analysis

Integrated review: what changed over time?

The development of remote sensing can be understood as several connected advances.



These advances together turned remote sensing from image collection into an analytical Earth observation system.

Conclusion and references

The lesson shows how platforms, sensors, and computing evolved together.

Key conclusion

Remote sensing technologies developed from simple photographs to digital, multi-platform, multi-sensor observation systems that support mapping, measurement, monitoring, and decision-making over large areas and long time periods.

Selected references

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- NASA. What are passive and active sensors?
- USGS. Landsat Satellite Missions.
- NOAA National Ocean Service. What is lidar?

For deeper study, review the references and compare how each source explains the technological shift from analog imagery to digital Earth observation.

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