

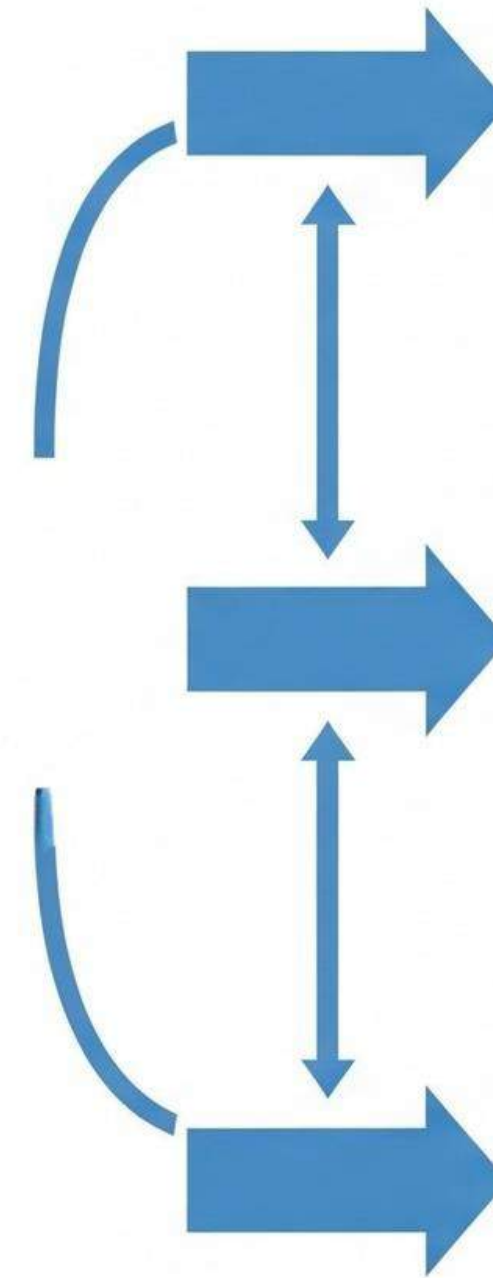
# Satellite-Based Carbon Sequestration Monitoring in Agriculture

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Harnessing satellite data to monitor carbon sequestration and build climate-resilient agriculture

# Climate Change and Agriculture

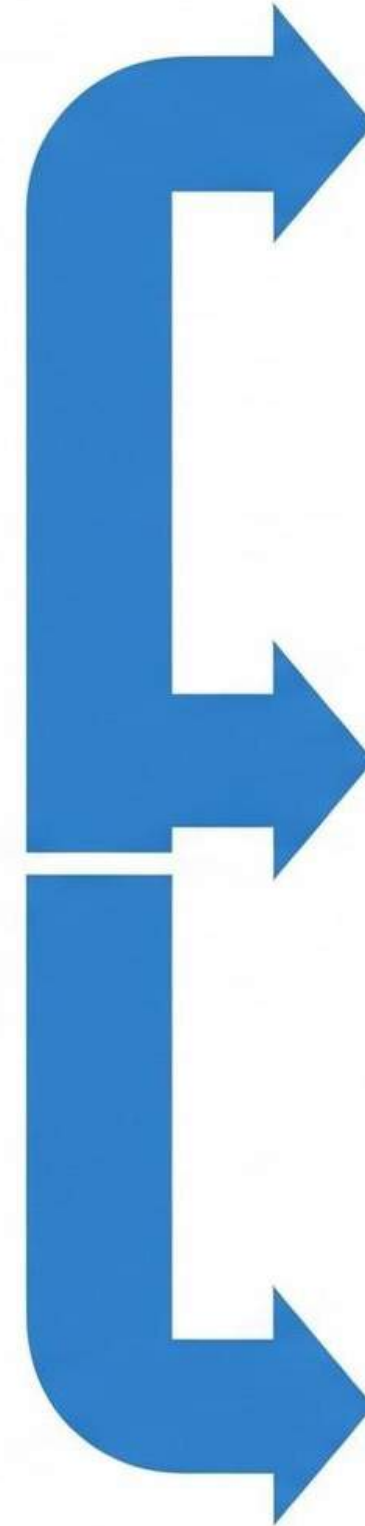
1. Atmospheric carbon dioxide (CO<sub>2</sub>) levels are increasing due to human activities such as fossil fuel use and land-use change.
2. Rising greenhouse gases contribute to global warming and climate change.
3. Agriculture is both affected by climate change and also has the potential to help mitigate it.
4. Agricultural soils and vegetation can act as natural carbon sinks by storing carbon.
5. Carbon sequestration in agriculture is emerging as an important solution for climate mitigation.



# The Challenge of Monitoring Carbon in Agriculture

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1. Rising atmospheric CO<sub>2</sub> levels are a major driver of climate change.
2. Agricultural lands have the potential to store large amounts of carbon, but this potential is not fully measured or utilized.
3. Traditional methods of measuring soil carbon and biomass are time-consuming, expensive, and limited in scale.
4. Monitoring carbon sequestration across large agricultural landscapes is challenging.
5. There is a need for efficient, scalable, and reliable monitoring systems.

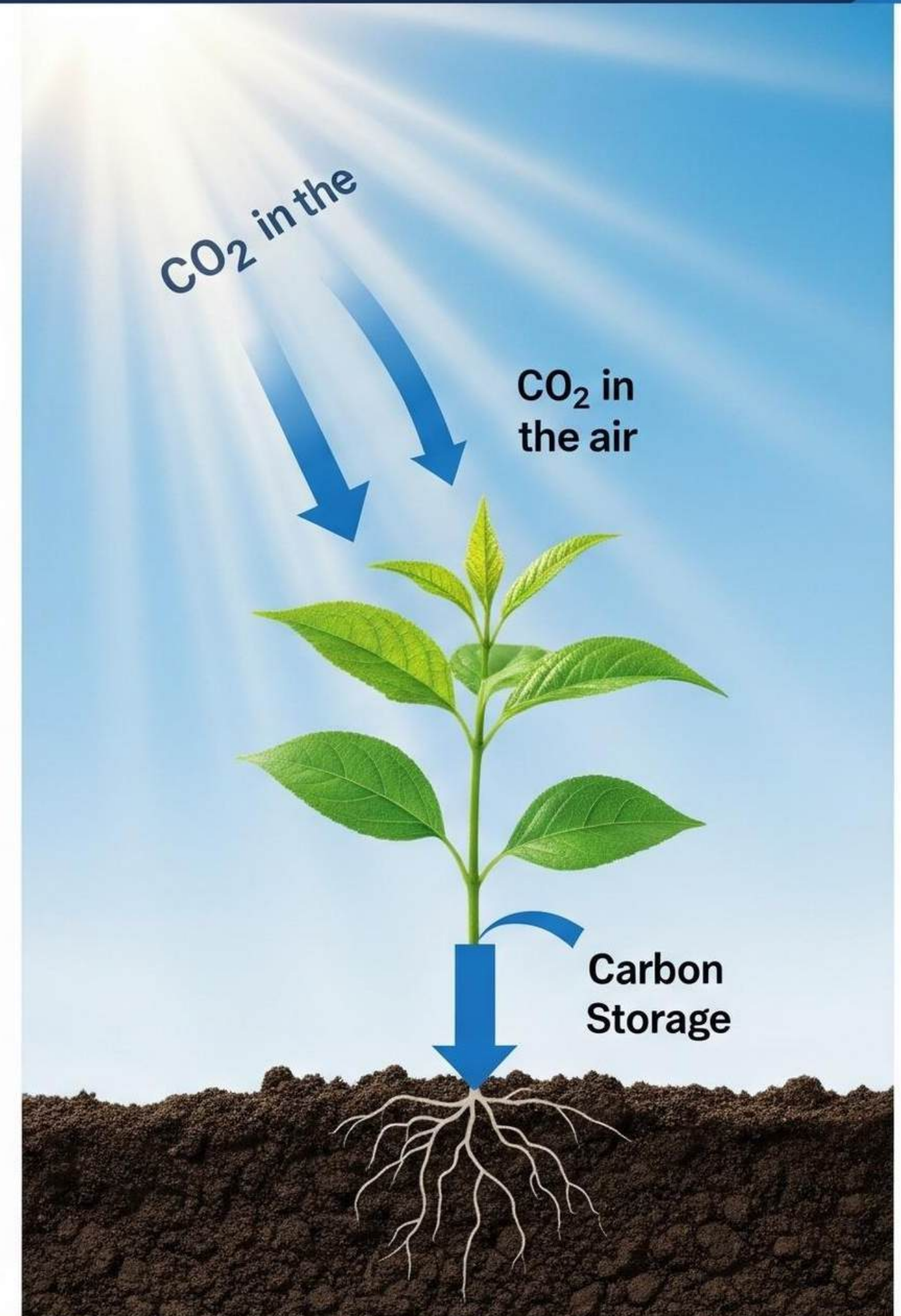


## What is Carbon Sequestration

Carbon sequestration is the process of capturing carbon dioxide (CO<sub>2</sub>) from atmosphere and storing it in natural systems such as plants, soil, and ecosystems.

### How It Happens

1. Plants absorb CO<sub>2</sub> from the atmosphere through photosynthesis.
2. The absorbed carbon is stored in:
  - i. Plant biomass (leaves, stems, roots)
  - ii. Soil organic carbon
3. This process helps reduce the amount of CO<sub>2</sub> in the atmosphere.



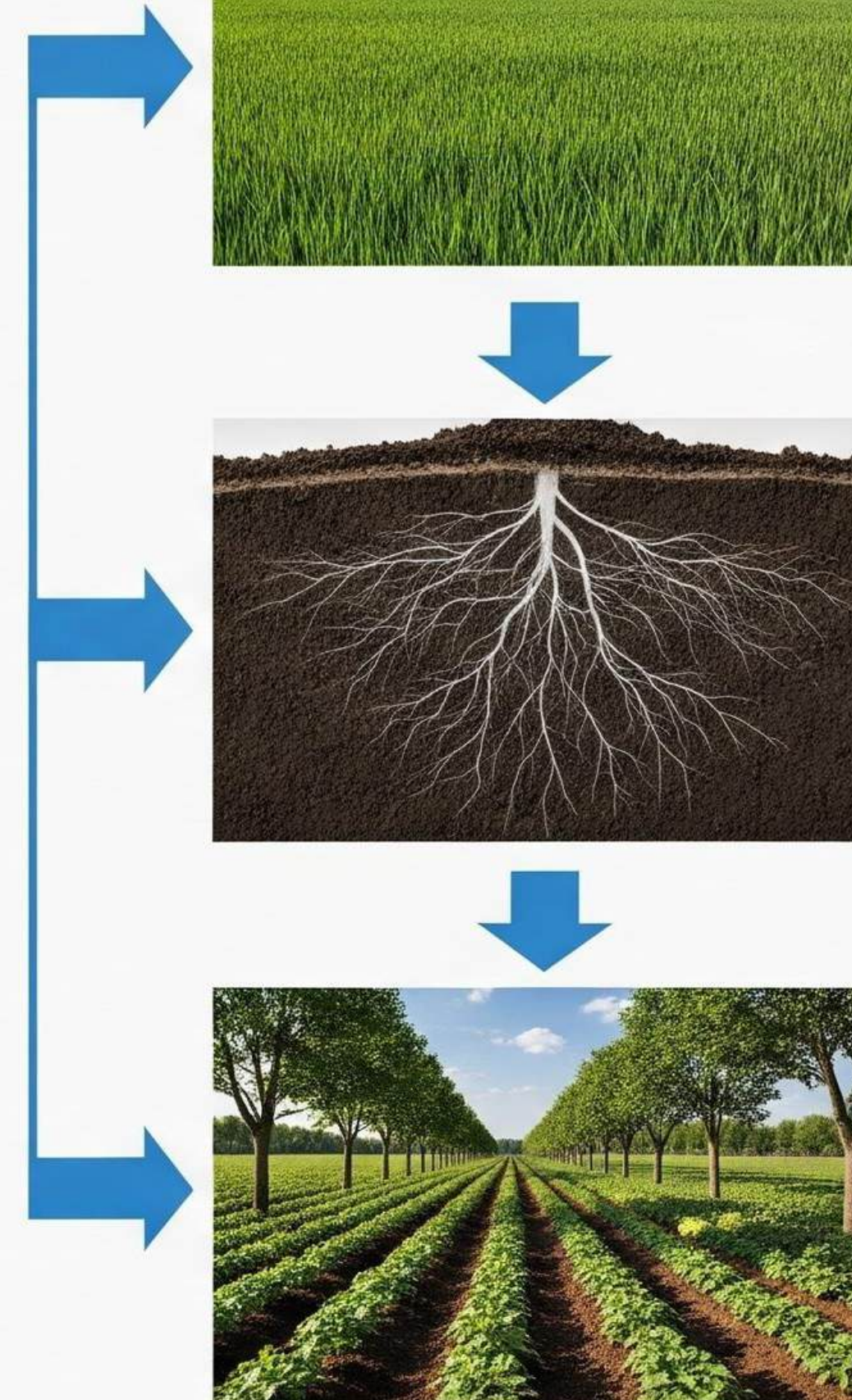
# Carbon Sequestration in Agriculture

## Carbon Storage in Agricultural Systems

1. Agricultural lands have significant potential to store carbon in soil and vegetation.
2. Crops absorb CO<sub>2</sub> during photosynthesis, converting it into plant biomass.
3. Part of this carbon is transferred to the soil through roots and organic matter.
4. Farming practices can increase or decrease soil carbon levels.

## Agricultural Sources of Carbon Sequestration

1. Soil Organic Carbon (SOC) stored in agricultural soils
2. Crop biomass including roots and residues
3. Agroforestry systems integrating trees with crops
4. Organic matter addition such as compost and crop residues



# Why Carbon Sequestration Matters

## Importance of Carbon Sequestration

1. Reduces atmospheric CO<sub>2</sub> levels, helping mitigate climate change.
2. Improves soil health and soil organic matter, which enhances soil fertility.
3. Increases water retention and soil structure, improving crop resilience.
4. Supports sustainable agricultural systems and long-term productivity.
5. Creates opportunities for carbon credit programs, climate initiatives, incentives for farmers.

Healthy soils not only support crops but also act as important carbon sinks for the planet



# Benefits of Carbon Sequestration in Agriculture

## For Farmers

1. Improved soil fertility and productivity
2. Better soil structure and water retention
3. Potential additional income through carbon credits



## For the Environment

1. Reduction of atmospheric CO<sub>2</sub> levels
2. Improved soil health and ecosystem stability
3. Support for climate change mitigation



## For Agribusiness & Industry

1. Helps companies achieve sustainability and climate targets
2. Supports carbon markets and environmental initiatives
3. Enables sustainable supply chains



# Agricultural Practices for Carbon Sequestration

Conservation Tillage



Reduced Tillage



Crop Rotation



Agroforestry



Organic Matter



Sustainable farming practices not only improve productivity but also enhance carbon sequestration in agricultural soils

# Challenges in Measuring Carbon Sequestration

1. Large Agricultural Areas
2. Soil Carbon Variability
3. Time-Consuming Field Sampling
4. Limited Spatial Coverage
5. Continuous Monitoring Difficulty



# Geospatial Technologies in Carbon Monitoring

## Role of Geospatial Technologies

Geospatial technologies enable

1. large-scale monitoring
2. analysis of agricultural landscapes
3. making it possible to assess carbon sequestration across extensive regions.

## Key Technologies

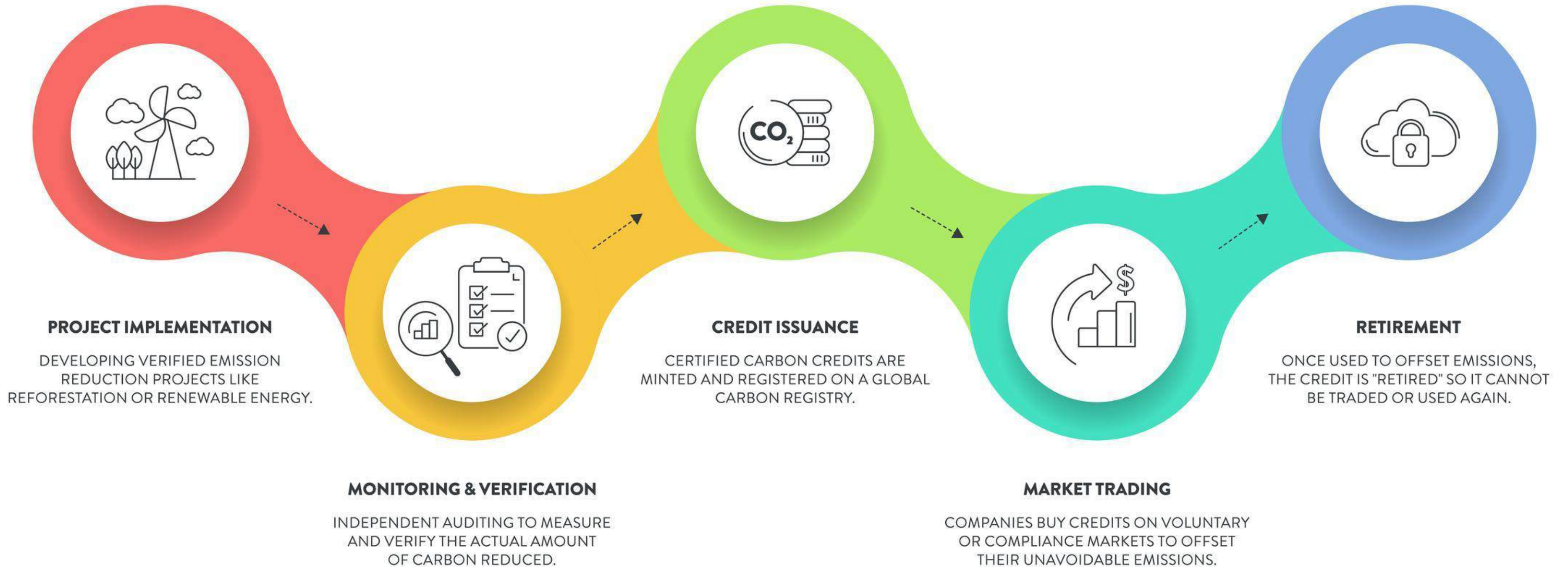
1. Satellite Data
2. Remote Sensing
3. Geographic Information Systems (GIS)
4. Artificial Intelligence (AI)

**“Geospatial technologies make it possible to monitor carbon sequestration across large agricultural areas efficiently and continuously.”**



# THE LIFECYCLE OF A CARBON CREDIT

FROM PROJECT VALIDATION TO CARBON OFFSETTING & RETIREMENT



# Major Carbon Credit Registries



## Verra (Verified Carbon Standard – VCS)

One of the largest voluntary carbon registries globally. Registers projects and issues **Verified Carbon Units (VCUs)** for verified carbon reductions or removals.



**Gold Standard™**

## Gold Standard

Established by WWF and international NGOs. Focuses on projects that deliver carbon reductions along with **sustainable development benefits**.



## American Carbon Registry (ACR)

One of the first voluntary carbon registries. Develops standards and issues carbon credits for agriculture, forestry, and emission reduction projects.



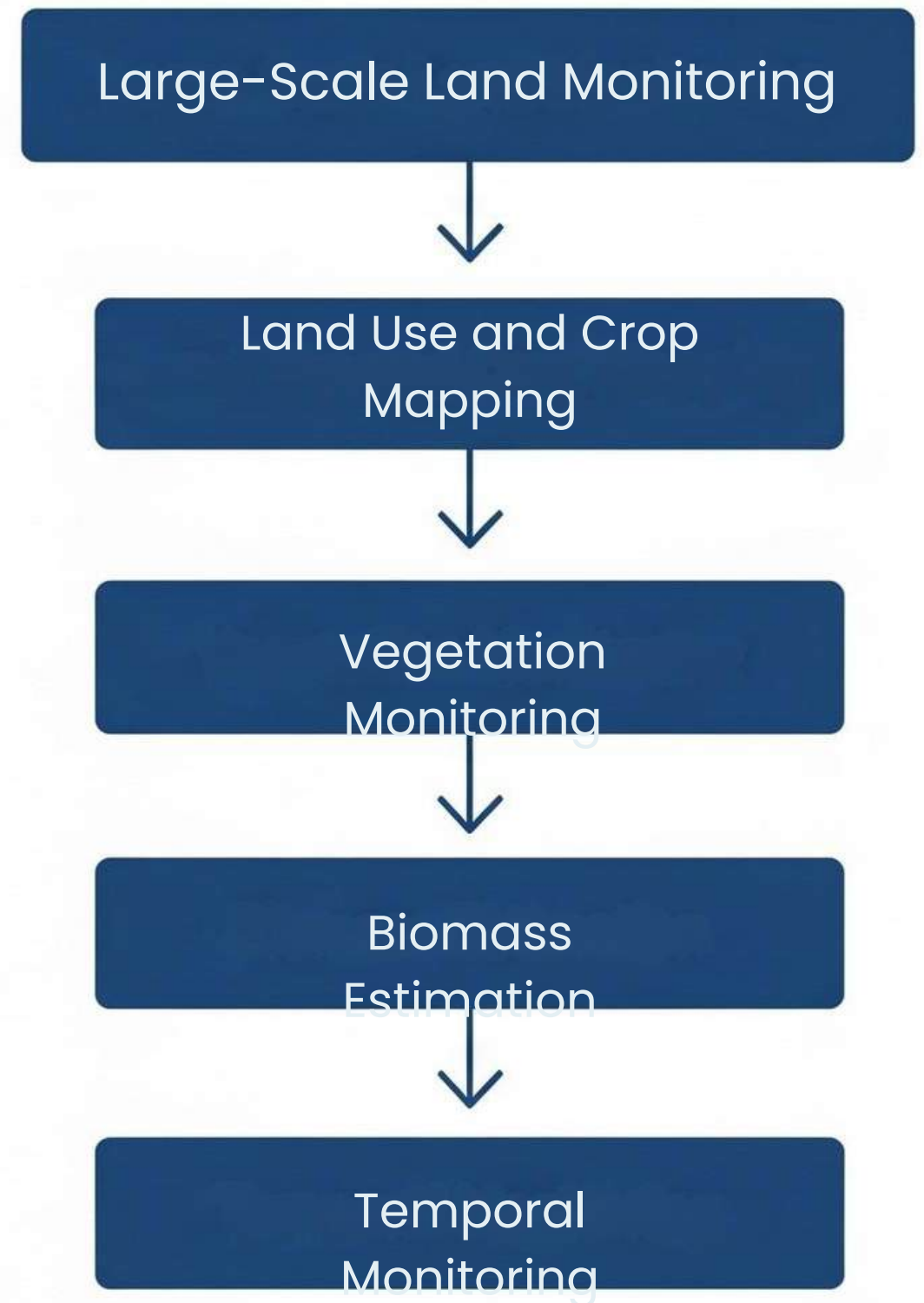
## Climate Action Reserve (CAR)

Develops carbon offset standards and maintains a transparent registry system to track and issue verified carbon credits.



Carbon registries ensure transparency, verification, and proper tracking of carbon credits in carbon markets.

# How Satellite Data Supports Carbon Monitoring



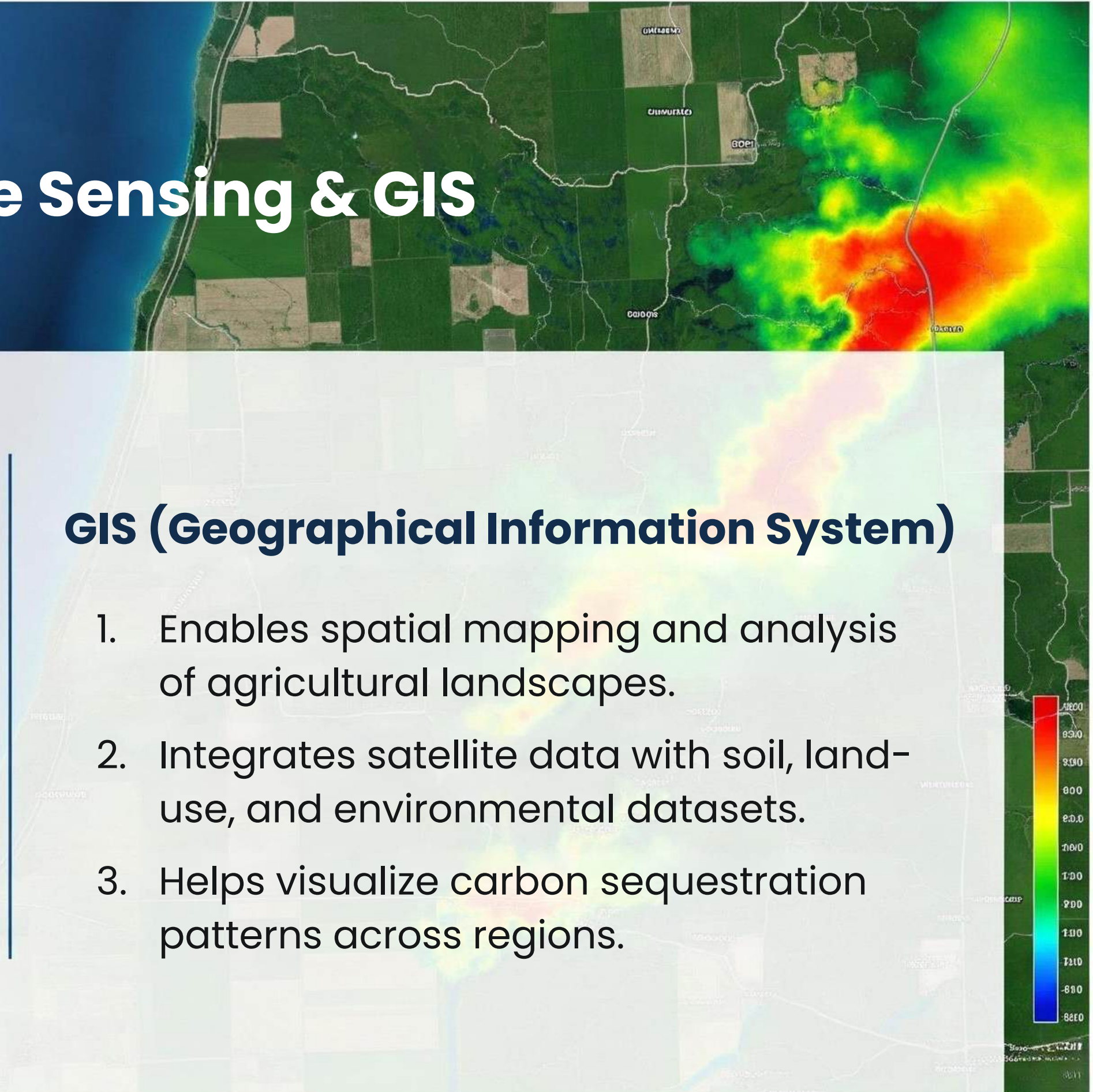
# Role of Remote Sensing & GIS

## Remote Sensing

1. Extracts useful information from satellite imagery.
2. Uses spectral indices (NDVI, EVI) to assess vegetation health.
3. Helps estimate vegetation density and biomass, which relate to carbon storage.

## GIS (Geographical Information System)

1. Enables spatial mapping and analysis of agricultural landscapes.
2. Integrates satellite data with soil, land-use, and environmental datasets.
3. Helps visualize carbon sequestration patterns across regions.



# Role of AI in Carbon Estimation

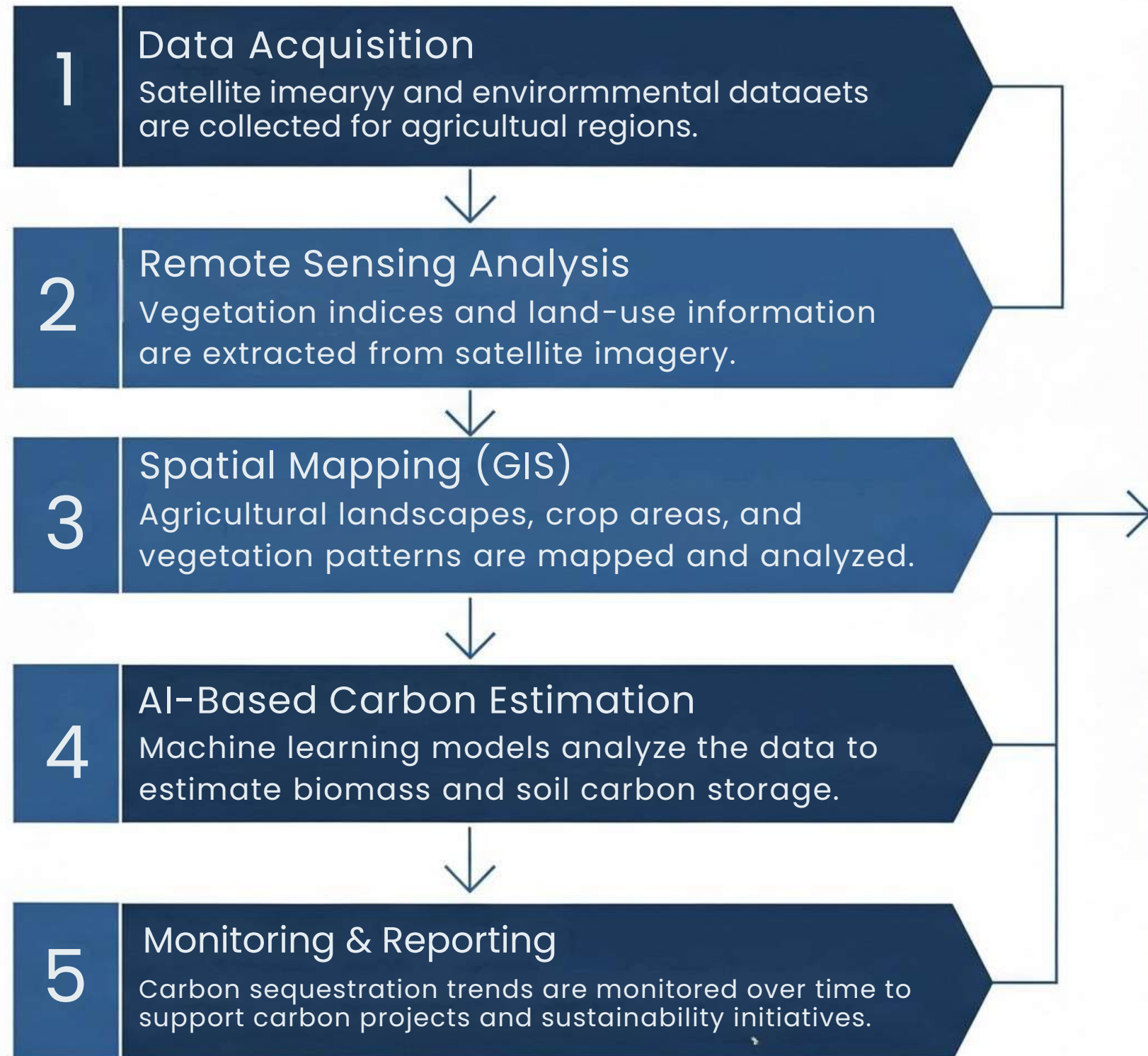
How Artificial Intelligence Supports Carbon Monitoring

1. Large Data Processing
2. Carbon Estimation Models
3. Pattern Detection
4. Predictive Analysis
5. Automation of Monitoring



# Carbon Monitoring Workflow

Typical Workflow for Monitoring Carbon Sequestration



$$\text{Biomass} = a \times \text{NDVI} + b$$

a — Slope coefficient  
b — Intercept



# Case Study: Satellite-Based Monitoring of Soil Carbon in Agricultural Lands

Regrow Ag / Indigo Ag Carbon Program (USA & Global)

Study Objective:

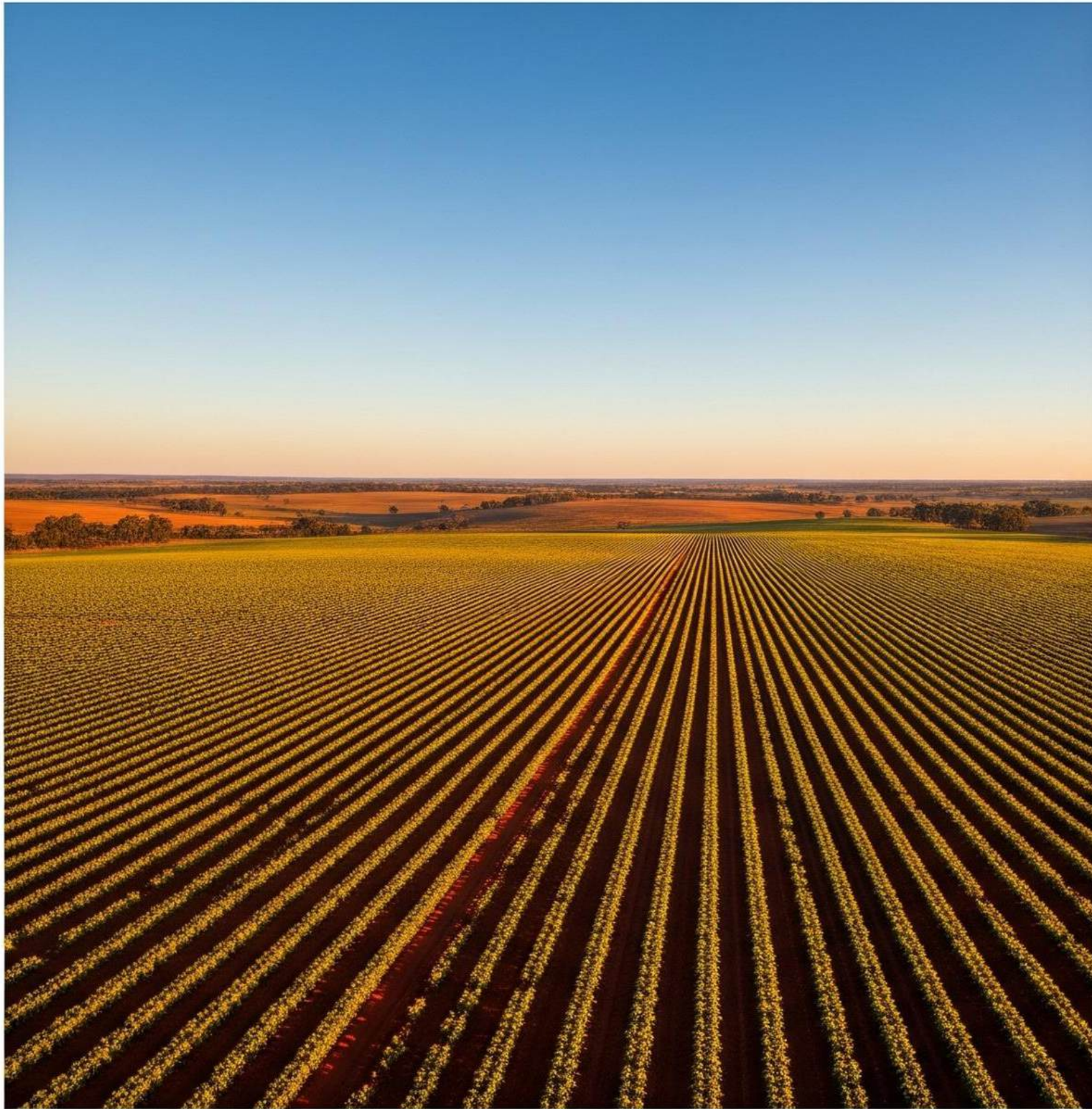
Estimate and monitor soil carbon sequestration in agricultural fields to support carbon credit generation using satellite data, remote sensing, and AI models.

## Methodology

1. Satellite Data (Landsat, Sentinel-2)
2. Remote Sensing Indices (NDVI, EVI)
3. GIS & Spatial Analysis
4. AI / Carbon Modeling

## Key Outcomes

1. Monitoring of millions of hectares of farmland for carbon sequestration potential.
2. Generation of verified carbon credits for farmers participating in regenerative agriculture.
3. Ability to track soil carbon changes over time using geospatial technologies.



## Australia Soil Carbon Projects (ERF Program)

### Under Australia's Emissions Reduction Fund (ERF)

1. Soil carbon in farmland is monitored using satellite data + soil sampling + carbon models.
2. Implemented by CSIRO and government agencies.
3. Farmers earn Australian Carbon Credit Units (ACCUs).

# Government Initiatives (India)



## National Initiatives Supporting Carbon Sequestration & Climate-Smart Agriculture

1. National Mission for Sustainable Agriculture (NMSA)
  - Budget Allocation: ~₹3,980 crore
1. National Mission for Green India (Green India Mission)
  - Budget Allocation: ~₹46,000 crore
1. Green Credit Programme (2023)
1. Indian Carbon Market (ICM)

# Future Opportunities & Conclusion

## Future Opportunities

1. Growing global focus on climate-smart agriculture and carbon sequestration.
2. Expansion of carbon markets and carbon credit mechanisms.
3. Increasing use of satellite, remote sensing, GIS, and AI technologies for environmental monitoring.
4. Potential for farmers and agribusinesses to participate in carbon initiatives.

## Key Takeaways

1. Agriculture can play a significant role in carbon sequestration and climate mitigation.
2. Monitoring carbon across large landscapes requires advanced geospatial technologies.
3. Satellite data, remote sensing, GIS, and AI enable scalable and continuous carbon monitoring.



# Thank You

PlaneteyeFarm AI



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