ERASMUS-EDU-2023-CBHE
Project number: 101129032

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

LESLIE
LAND MANAGEMENT
ENVIRONMENT &
SOLID-WASTE

Co-funded by
the European Union

BUKHARA STATE UNIVERSITY
1930

MICRO-CREDENTIAL

CLIMATE CHANGE FOR SUSTAINABLE LAND MANAGEMENT IN CENTRAL ASIA

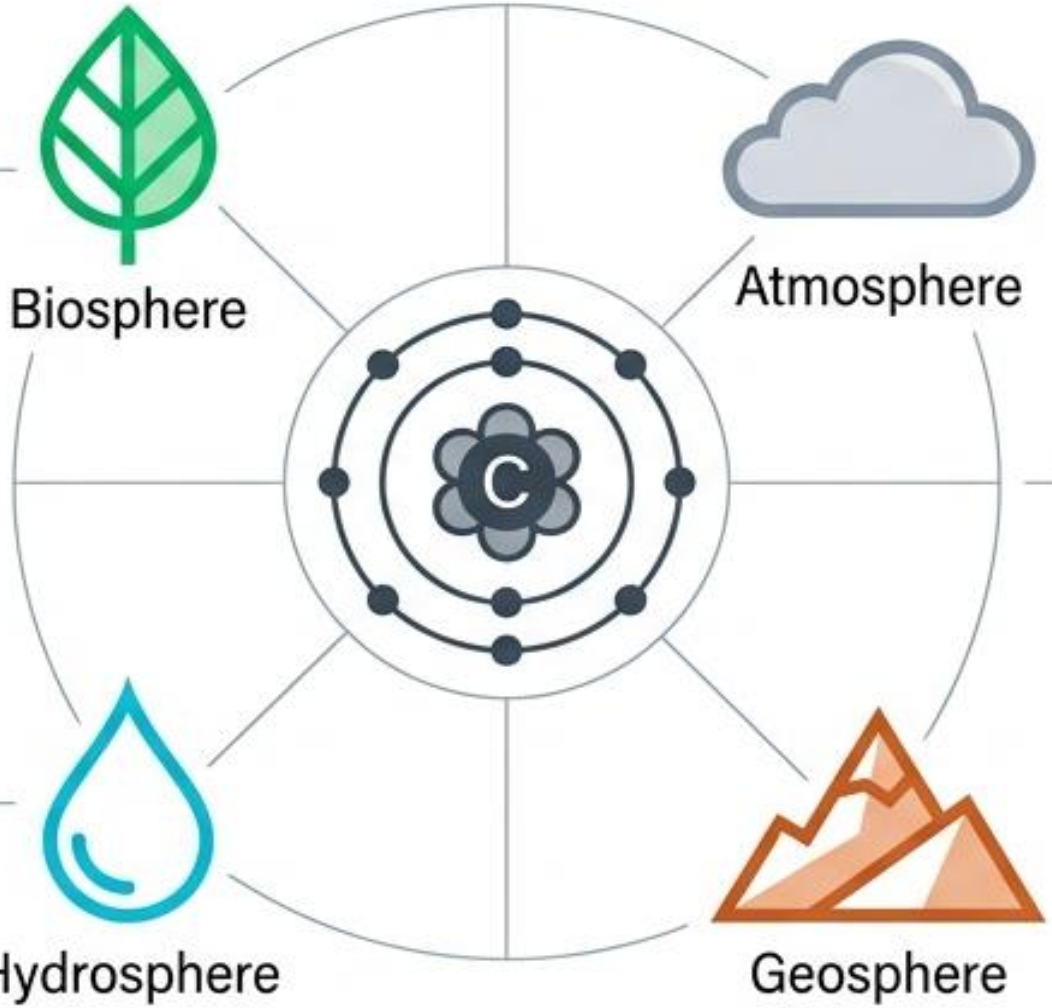
3.- The Carbon Cycle, Land Use and SLM

Natural Carbon Cycle: Sources, Sinks and Fluxes

CC-W03-V09

Why Carbon Matters

The Foundation of Life

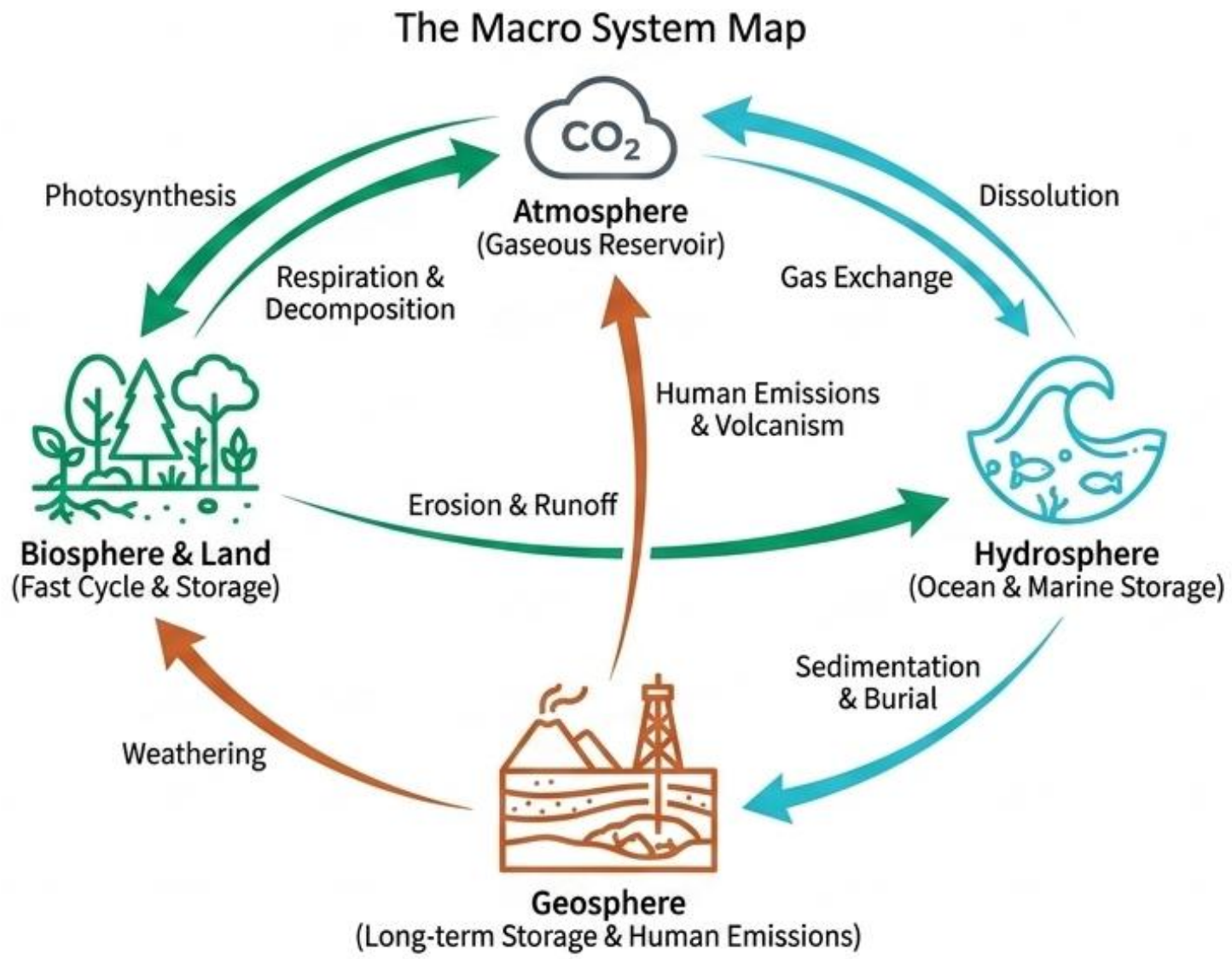


The Global Connector

The Climate Regulator

Co-funded by
the European Union

What is the Carbon Cycle?



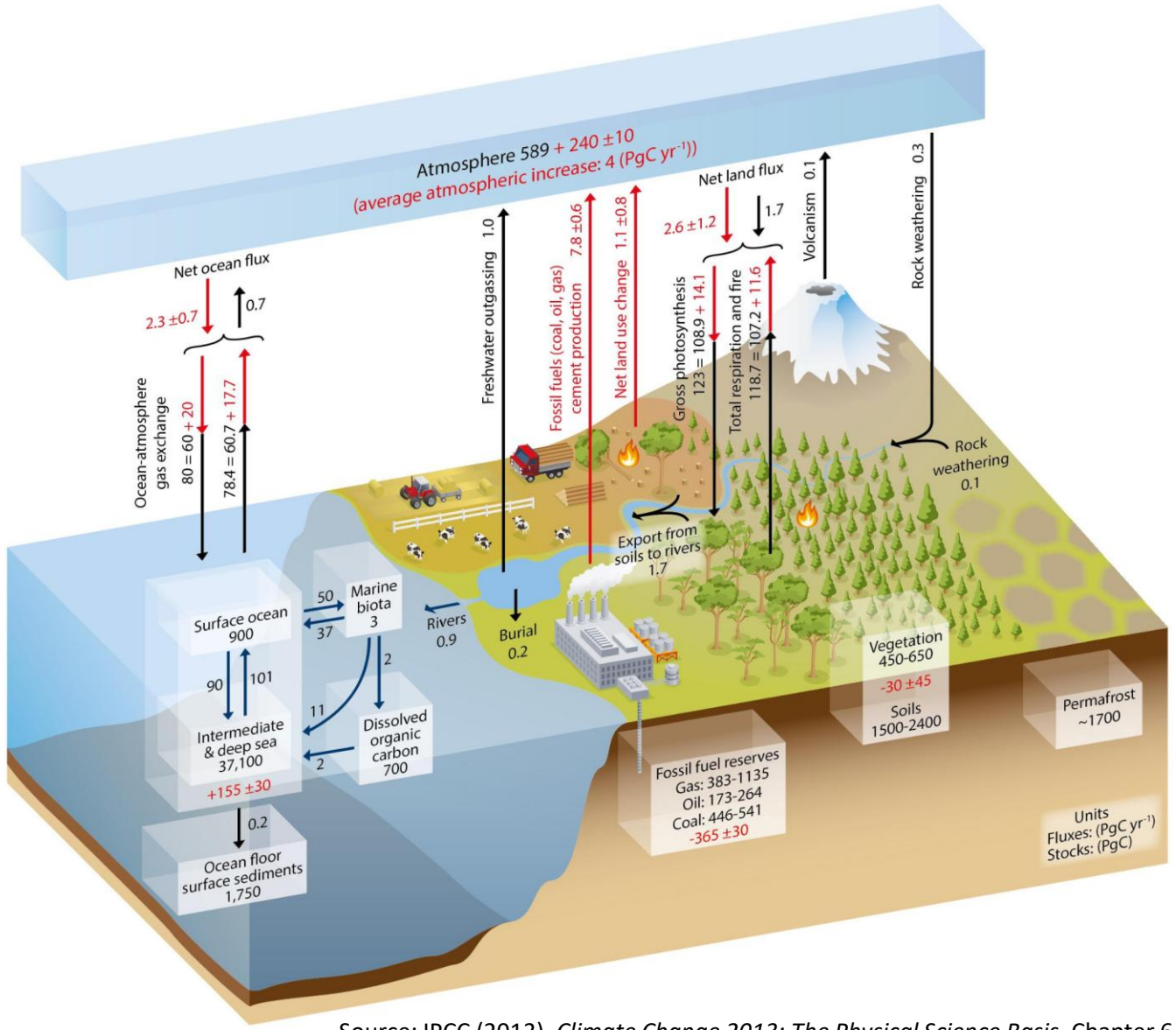
Co-funded by
the European Union

Major Carbon Reservoirs

Key Carbon Reservoirs

Reservoir	Approximate Carbon Storage
Oceans	~38,000 PgC
Soils	~1,500–2,400 PgC
Permafrost	~1,700 PgC
Vegetation	~450–650 PgC
Atmosphere	~589 PgC

Soils store more carbon than the atmosphere and vegetation combined



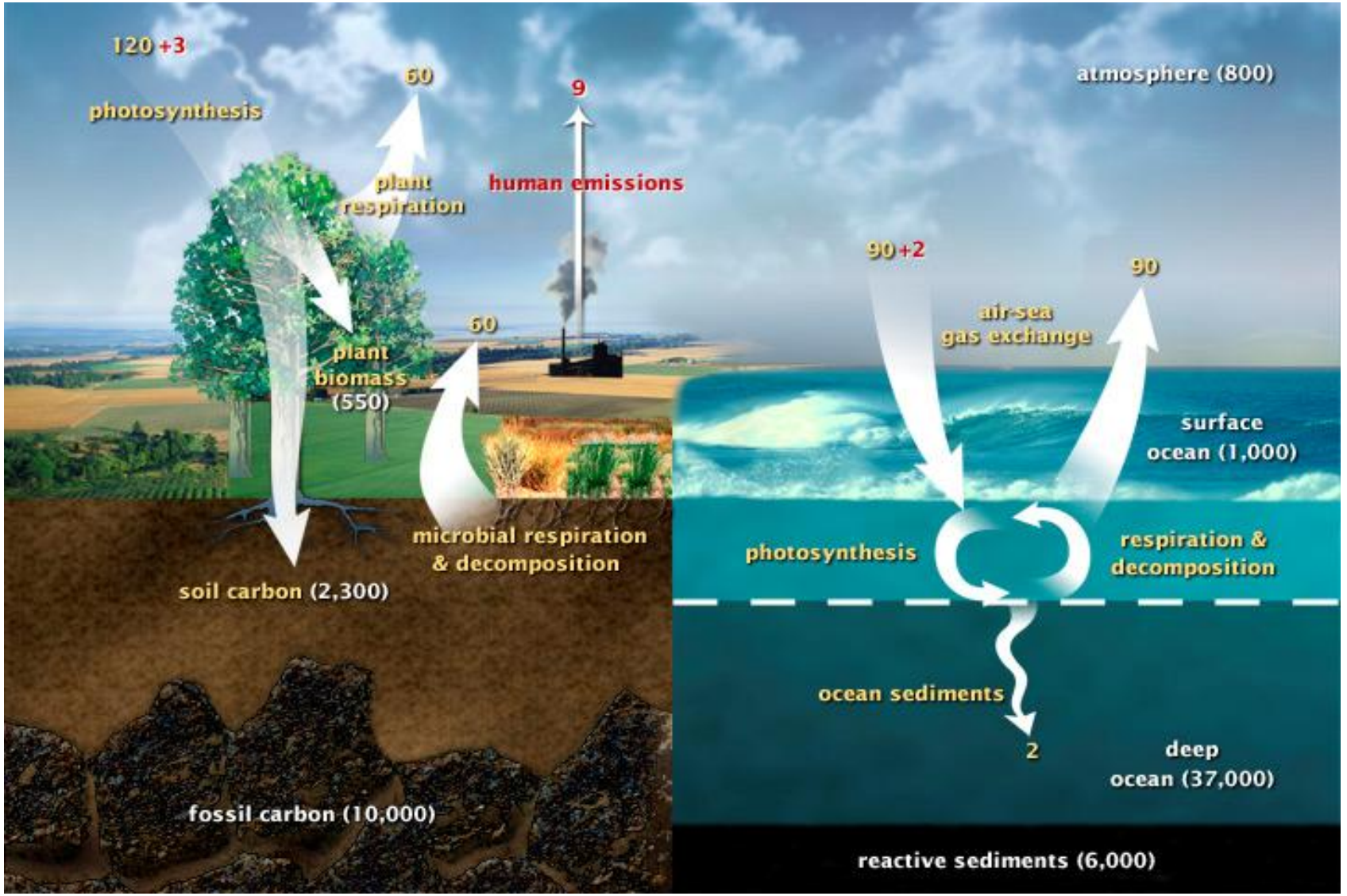
Source: IPCC (2013), *Climate Change 2013: The Physical Science Basis*, Chapter 6.

Co-funded by the European Union

The Fast Carbon Cycle

Key processes:

- Photosynthesis
- Respiration
- Decomposition
- Air-sea exchange

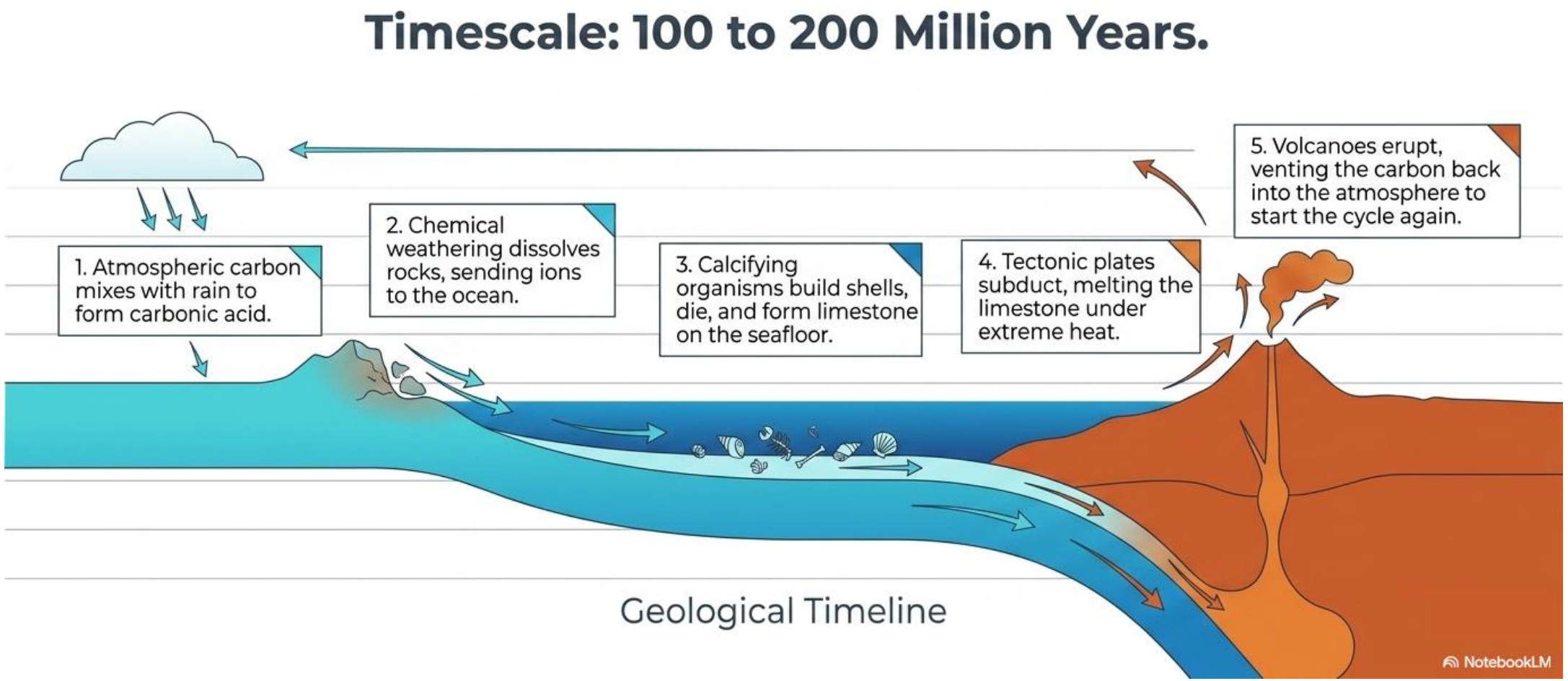


Source: NASA Earth Observatory (2024). *The Carbon Cycle*.

Co-funded by the European Union

The Slow Carbon Cycle

Carbon is stored in rocks and sediments and recycled trough geological processes

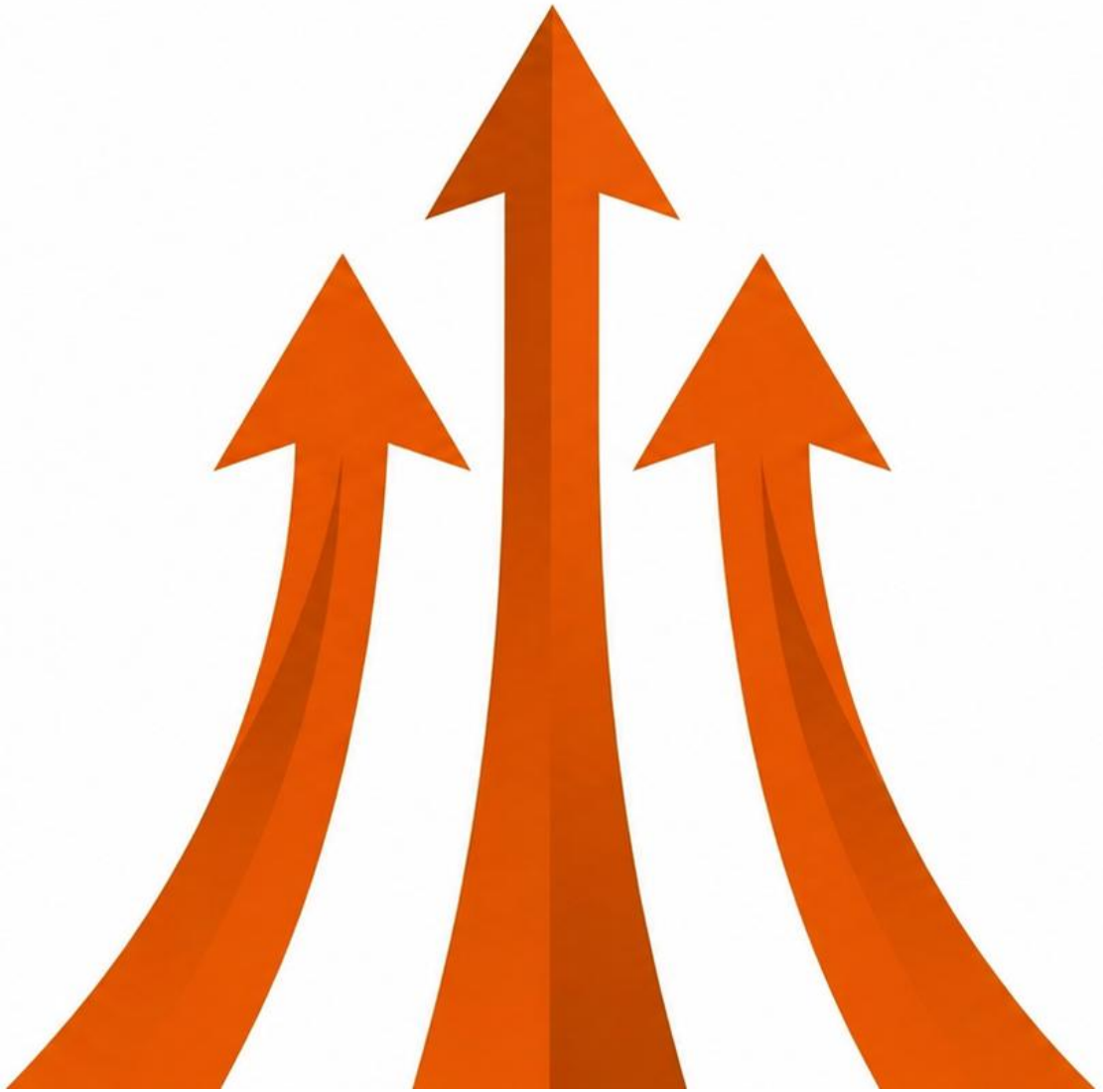


Co-funded by the European Union

Natural Carbon Sources

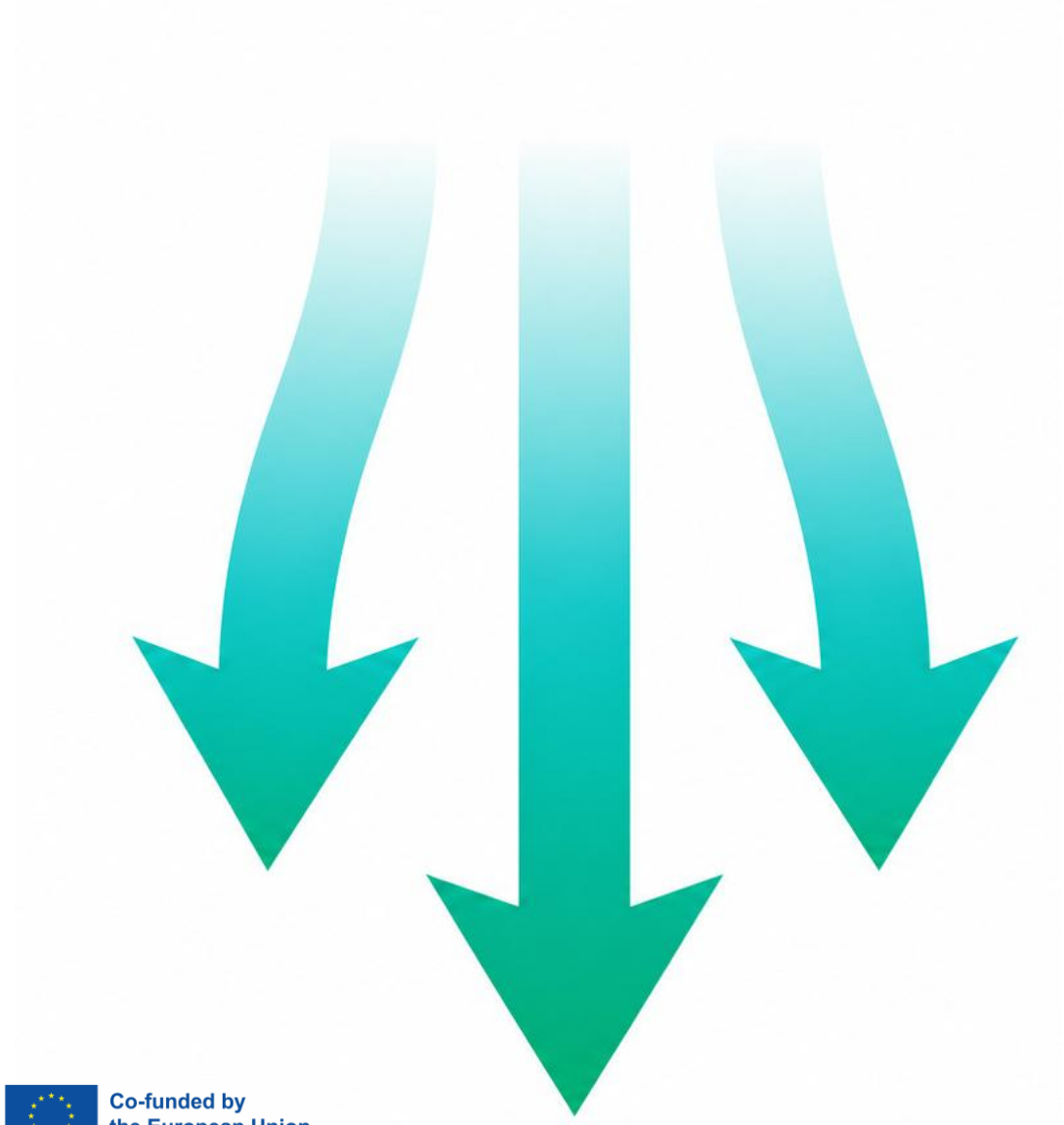
Natural sources transfer stored carbon back into the atmosphere

- **Biological Respiration:** Every time plants and animals exhale, oxygen is combined with sugar to release energy, water, and carbon dioxide.
- **Decomposition:** When organisms die, bacteria break down their bodies, venting carbon from decayed organic matter.
- **Natural Fires:** The combustion of biomass rapidly releases carbon previously locked in Wood, leaves, and bark.
- **Volcanism:** Melting silicate rocks in subduction zones vent between 130 and 380 million metric tons of carbon dioxide per year back in the atmosphere.



Co-funded by the European Union

Natural Carbon Sinks



Natural carbon sinks absorb more carbon than they release, helping regulate Earth's climate

- **Terrestrial Sinks (Forests and grasslands):** Forests and grasslands remove CO_2 through photosynthesis.
- **Soils and Wetlands:** Carbon from dead plant matter is integrated into the ground. Cold enviroments (like permafrost) slow decay, turning vast landscapes into massive storage vaults.
- **The Oceanic Sink:** The ocean absorbs up to 85% of extra carbon over millenia. Carbon dioxide gas reacts with wáter to reléase hydrogen and produce bicarbonate ions, safely storing carbon in the depths.

Co-funded by the European Union

Major Carbon Flux Pathways

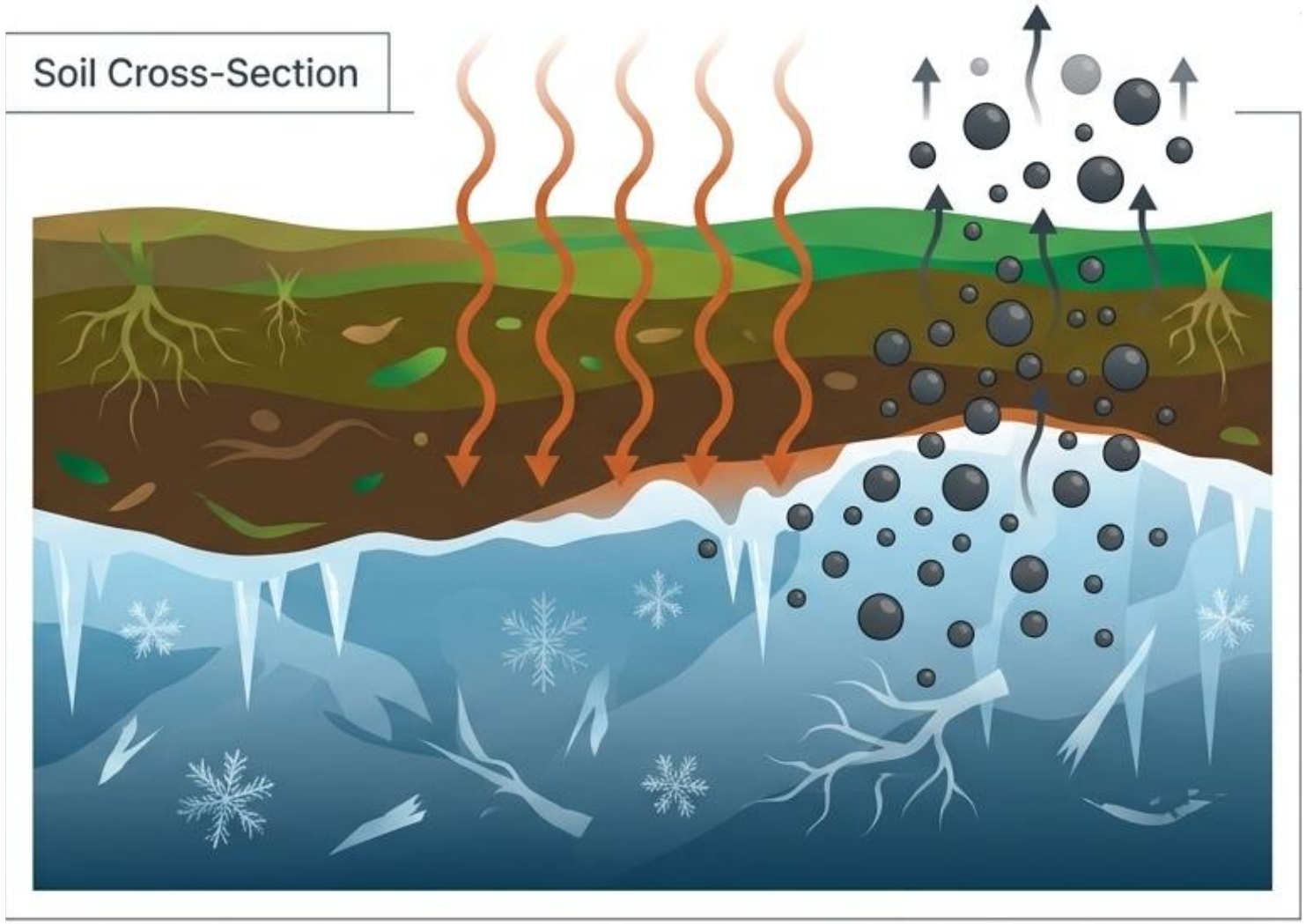
Diagnostic Matrix		
Biosphere ↔ Atmosphere	Hydrosphere ↔ Atmosphere	Geosphere ↔ Hydrosphere
Photosynthesis: Pulls CO_2 from the air to create plant food. 	Dissolution & Ventilation: The steady, physical exchange of gases at the ocean's surface driven by wind and temperature. 	Chemical Weathering: Acidic rain dissolves rocks, sending calcium ions via rivers to the ocean. 
Respiration & Decay: Returns CO_2 to the air. 	Oceanic Photosynthesis: Phytoplankton utilizing CO_2. 	Sedimentation: Marine shells and skeletons fall to the seafloor, compressing into limestone rock. 

Co-funded by the European Union

Soil Carbon Storage

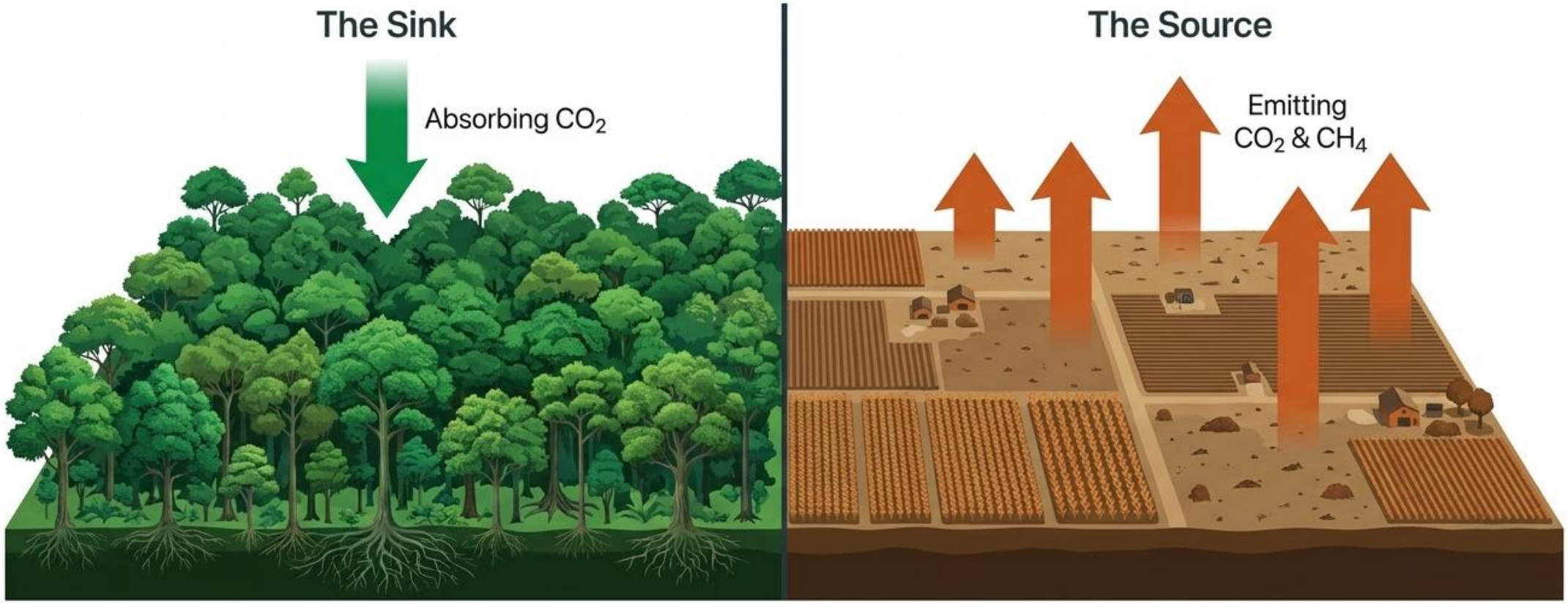
Key Facts

- Soils store about 2500 Gt of carbon globally.
- More carbon is stored in soils than in vegetation and the atmosphere combined.
- Land management influences carbon sequestration and carbon release.
- Soil degradation reduces carbon storage capacity.



Co-funded by the European Union

Sustainable Land Management and Carbon Balance



Land Conversion
Forest store large amounts of carbon in biomass and soils

Soil Disturbance
Tillage and land degradation accelerate carbon losses

Climate Impact
Land-use change contributes significantly to greenhouse gas emissions

Co-funded by the European Union

Central Asia Context

Vast Grassland Sinks:

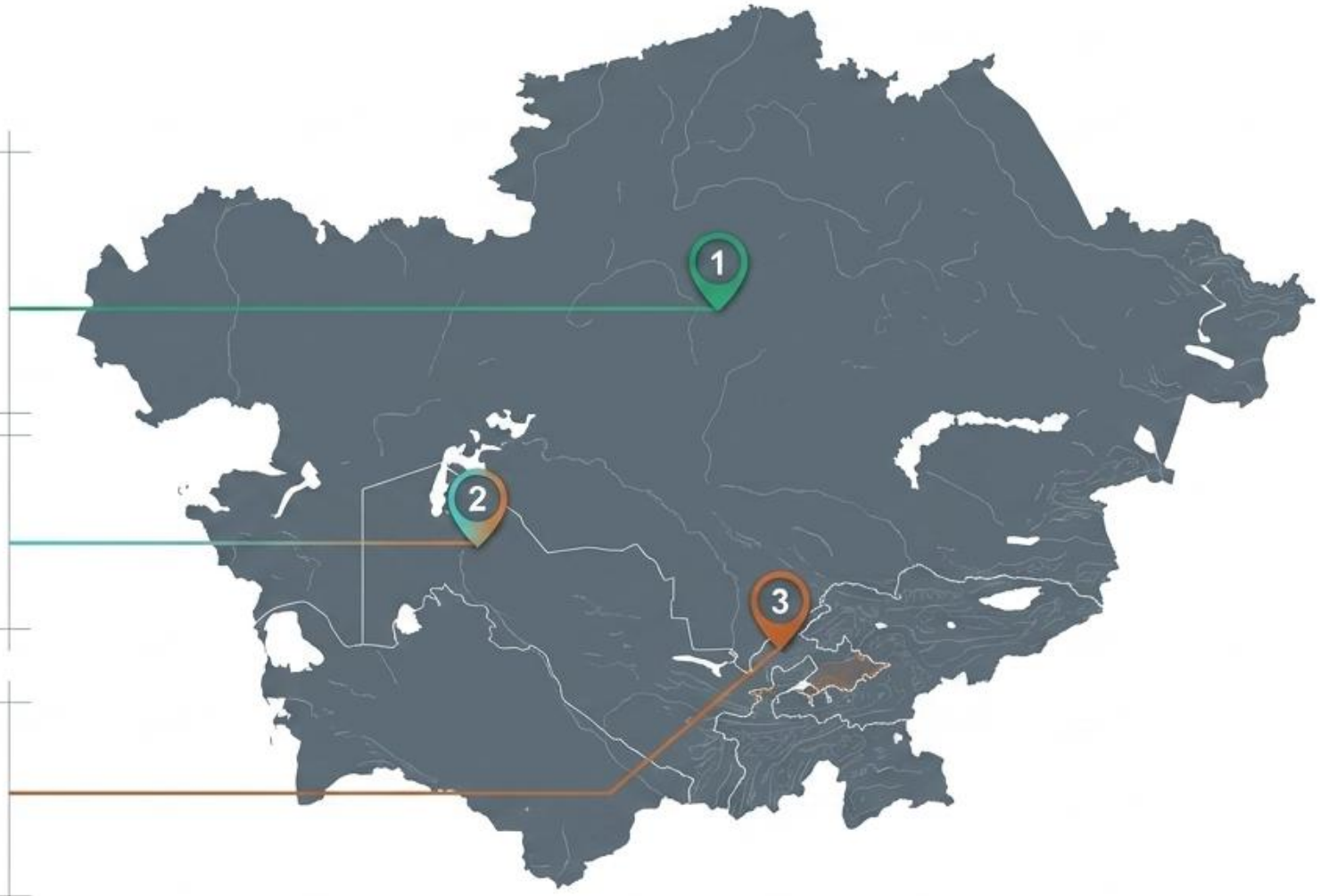
Central Asia is dominated by vast steppes and grasslands. Unlike forests, which store carbon above ground, these biomes store the majority of their carbon deep in the soil via extensive root networks.

Arid Vulnerability:

Because these regions are arid or semi-arid, the carbon balance is highly sensitive to changes in moisture and temperature.

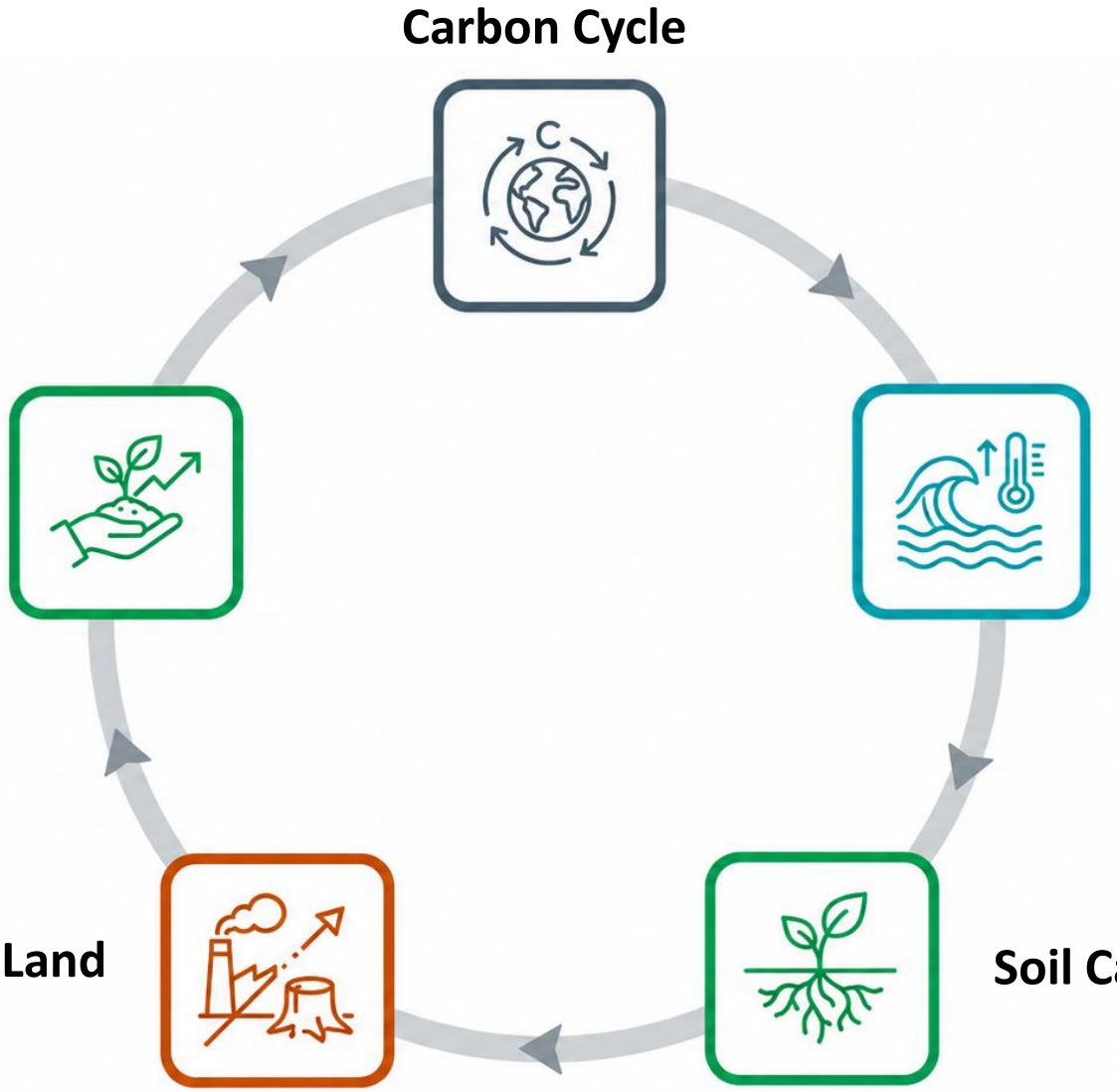
Human Pressures:

Intensive agriculture and overgrazing rapidly degrade these delicate soils, transforming historical carbon sinks into net sources of emissions.



Co-funded by
the European Union

Key Messages and Conclusions



Co-funded by the European Union

ERASMUS-EDU-2023-CBHE
Project number: 101129032

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

LESLIE
LAND MANAGEMENT
ENVIRONMENT &
SOLID-WASTE

Co-funded by
the European Union

BUKHARA STATE UNIVERSITY
1930

MICRO-CREDENTIAL

CLIMATE CHANGE FOR SUSTAINABLE LAND MANAGEMENT IN CENTRAL ASIA

3.- The Carbon Cycle, Land Use and SLM

Natural Carbon Cycle: Sources, Sinks and Fluxes

CC-W03-V09