ERASMUS-EDU-2023-CBHE
Project number: 101129032

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

LESLIE
LAND MANAGEMENT
ENVIRONMENT &
SOLID-WASTE

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Πανεπιστήμιο Κύπρου
University of Cyprus

MICRO-CREDENTIAL

Climate Change of Sustainable Land Management in Central Asia

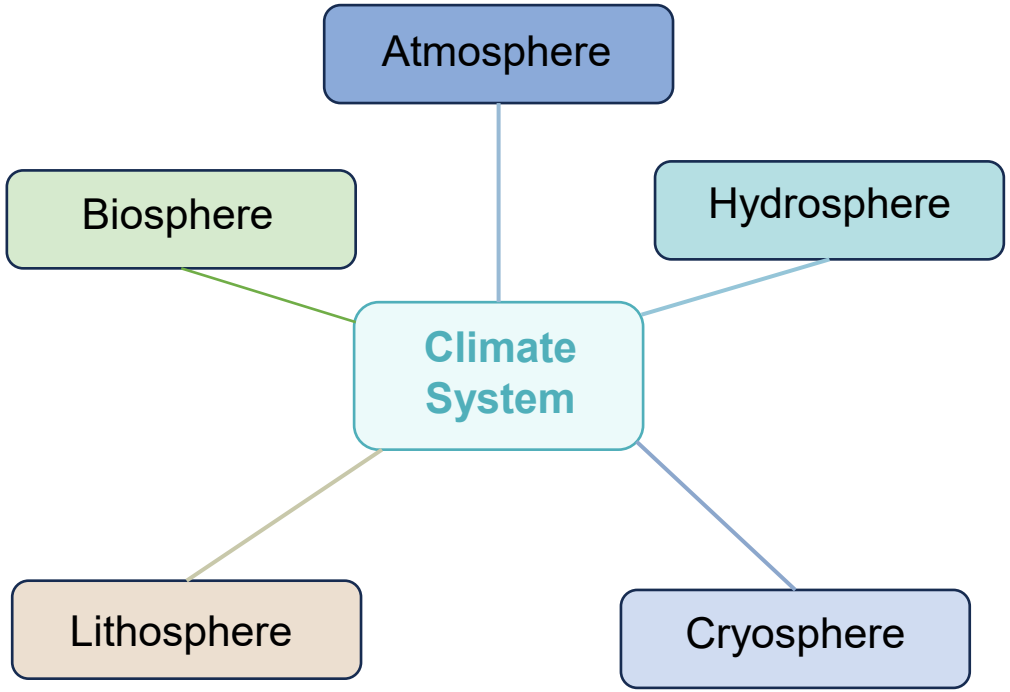
1- Climate vs Weather and Why Climate Change Matters

The Climate System: Atmosphere, Ocean, Land and Ice

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Learning goals and system overview



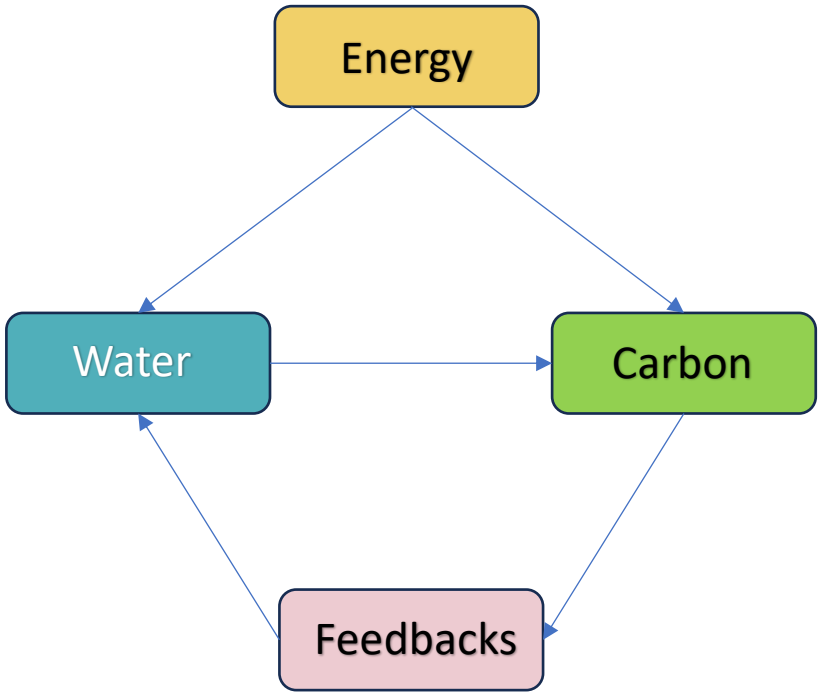
Source: Author's Creation

- Identify the main climate-system spheres: atmosphere, hydrosphere, cryosphere, lithosphere, and biosphere.
- Explain how energy, water, and carbon move between these spheres.
- Recognise feedbacks: a change in one sphere can trigger change in the others.
- Connect Earth-system understanding to sustainable land management decisions.



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The climate system is a network of exchanges



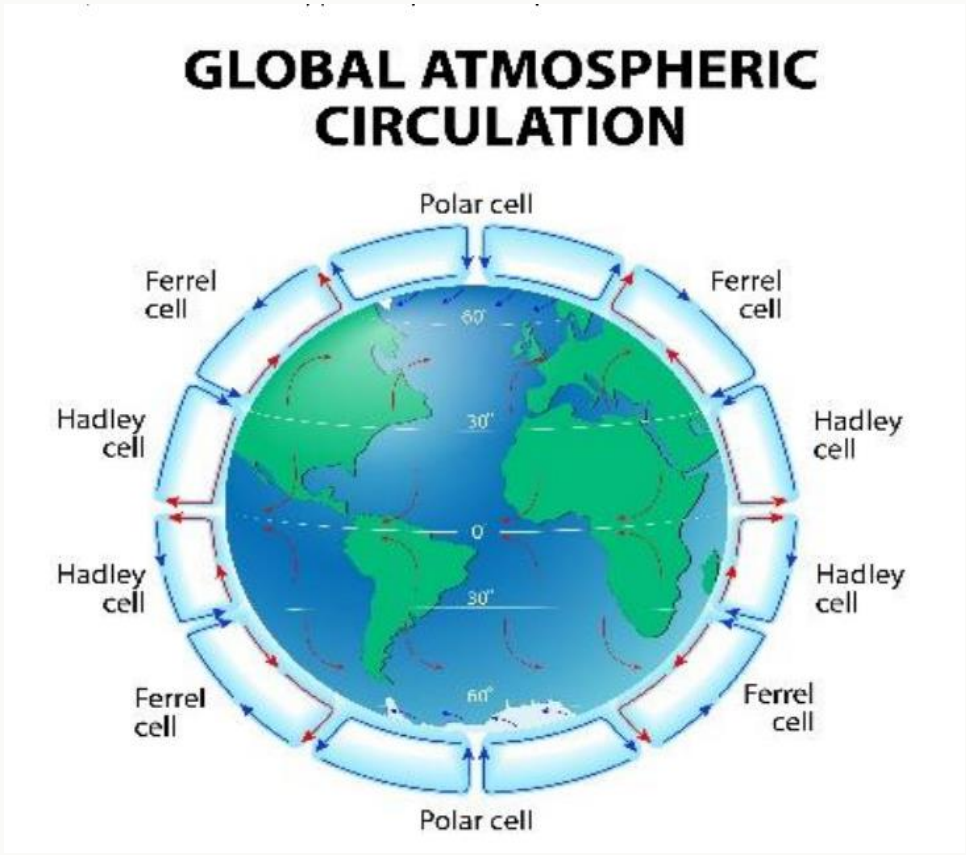
Source: Author's Creation

- Solar energy enters the system, while heat leaves it as longwave radiation.
- Water moves through evaporation, condensation, precipitation, runoff, and storage.
- Carbon circulates through vegetation, soils, oceans, ice, and the atmosphere.
- Feedbacks make the system dynamic rather than static.



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The atmosphere: the global engine



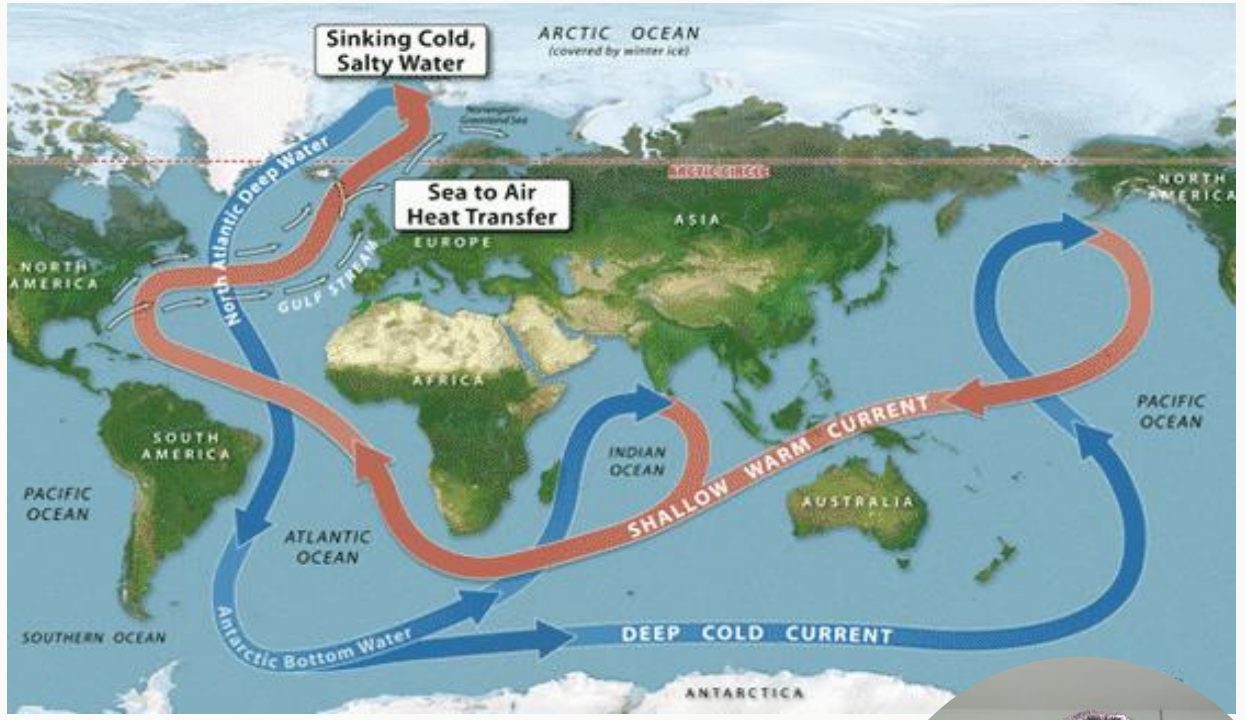
- The troposphere contains most atmospheric mass and is the main arena for weather.
- The atmosphere transports heat away from the equator and moisture toward land areas.
- Large-scale circulation helps explain deserts, storm tracks, and rainfall zones.
- The same circulation patterns matter for agriculture and water supply.



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The hydrosphere: the planetary heat bank

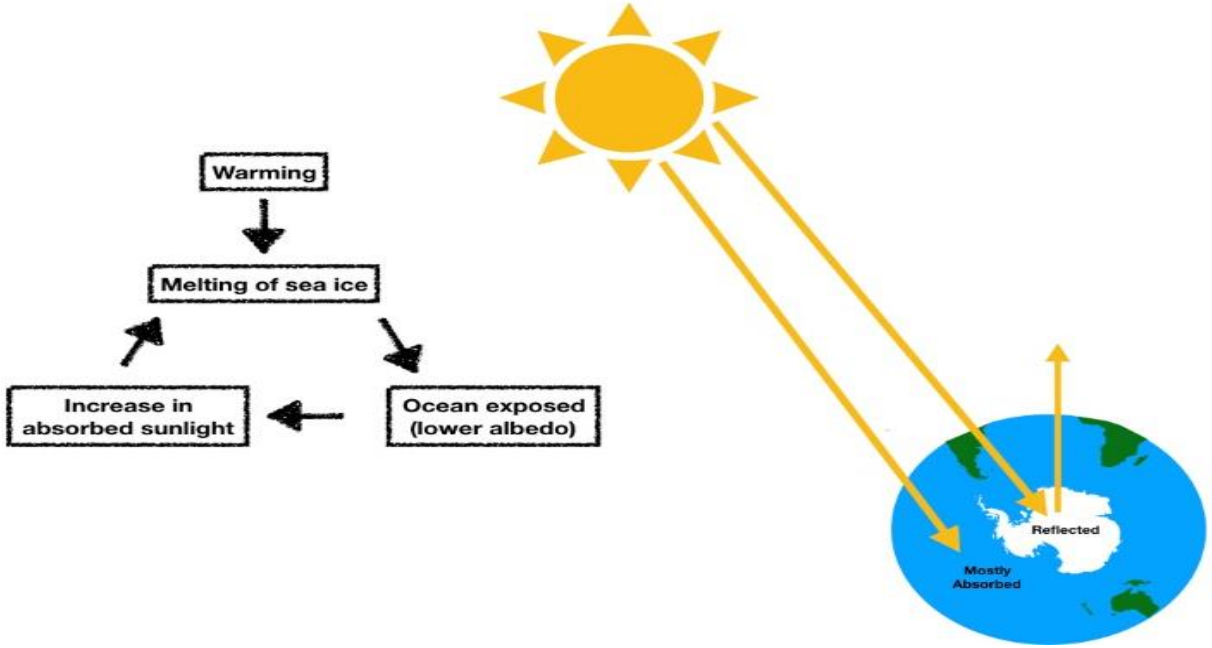
- Water has a high heat capacity.
- Oceans store large amounts of thermal energy.
- Deep circulation redistributes heat and dissolved carbon over long timescales.
- Ocean buffering slows atmospheric warming but creates new stresses such as acidification.





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The cryosphere: Earth's reflective shield

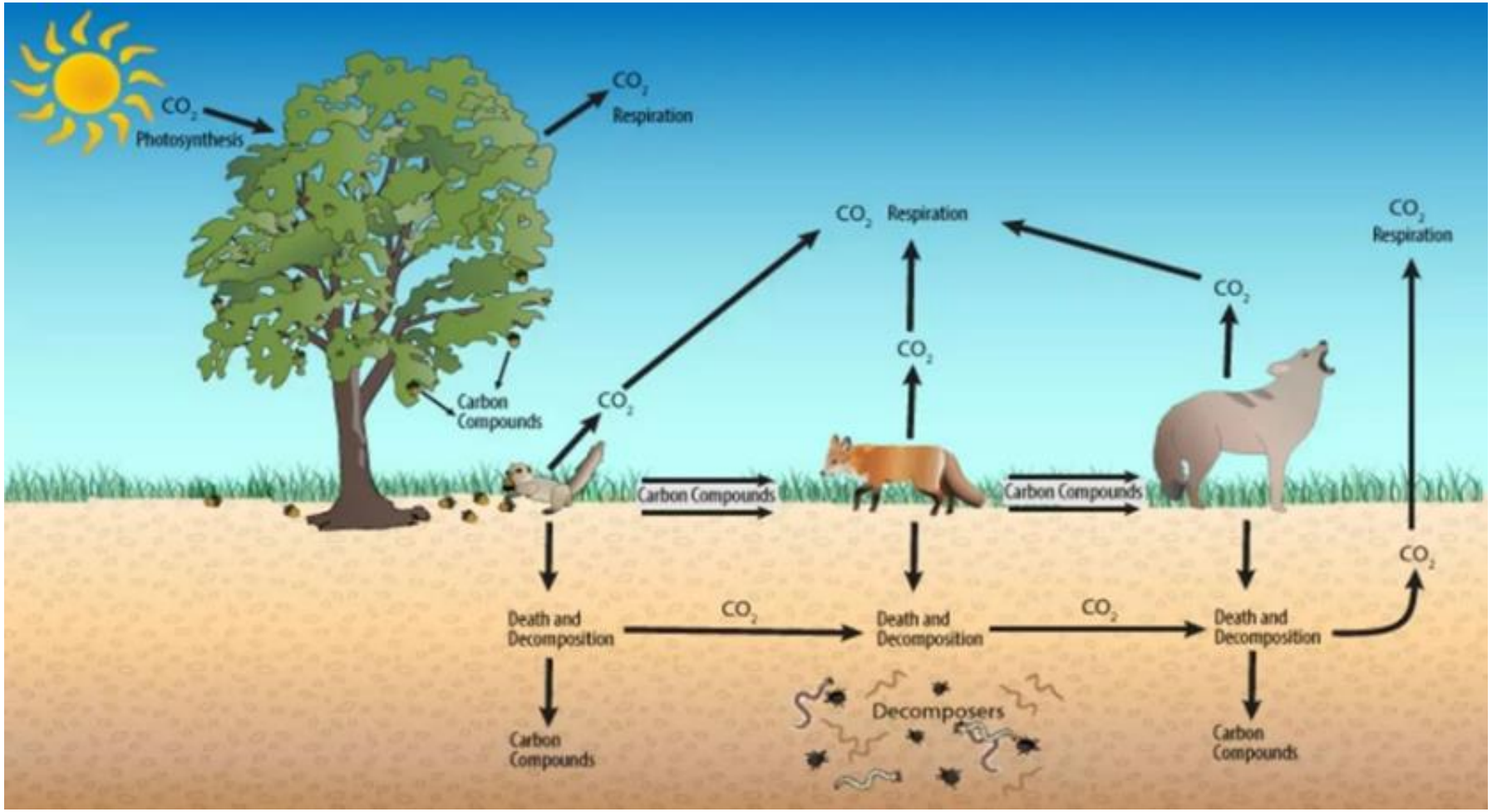


- Sea ice, glaciers, snow, and permafrost are part of the cryosphere.
- Bright ice reflects a large fraction of incoming sunlight.
- When ice melts, darker land or water absorbs more heat and accelerates warming.
- For Central Asia, glacier retreat means changes in seasonal water storage.



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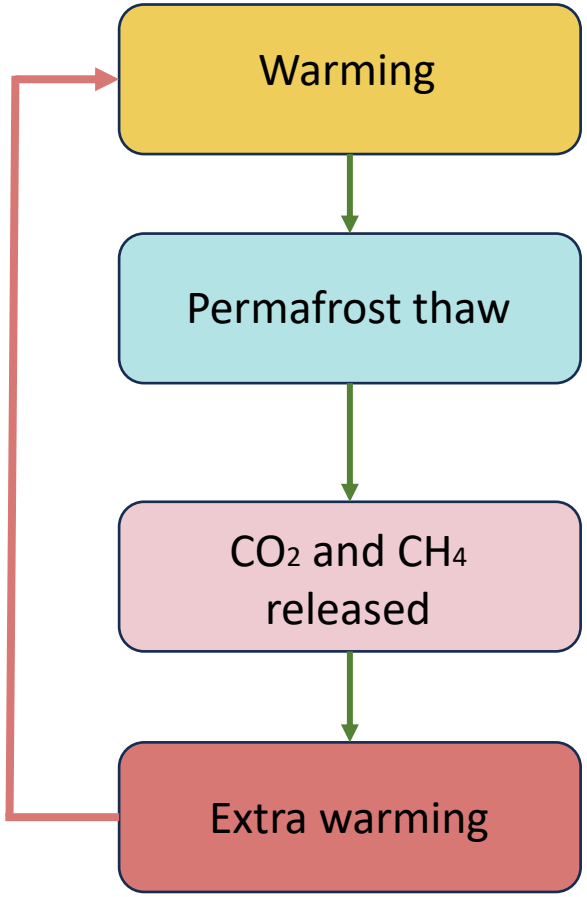
The lithosphere and biosphere as carbon regulators





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Permafrost and delayed greenhouse release



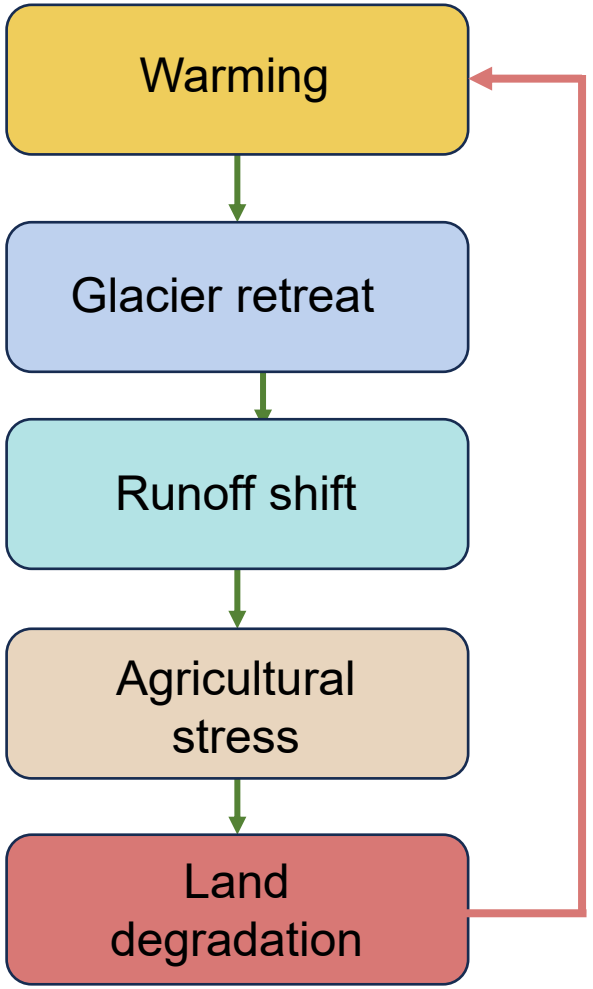
Source: Author's Creation

- Frozen ground stores carbon for very long periods.
- As permafrost thaws, methane and carbon dioxide can be released.
- That release adds greenhouse gases to the atmosphere and intensifies warming.
- Some climate impacts therefore unlock additional climate forcing.



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Coupled feedbacks and why systems thinking matters



Source: Author's Creation

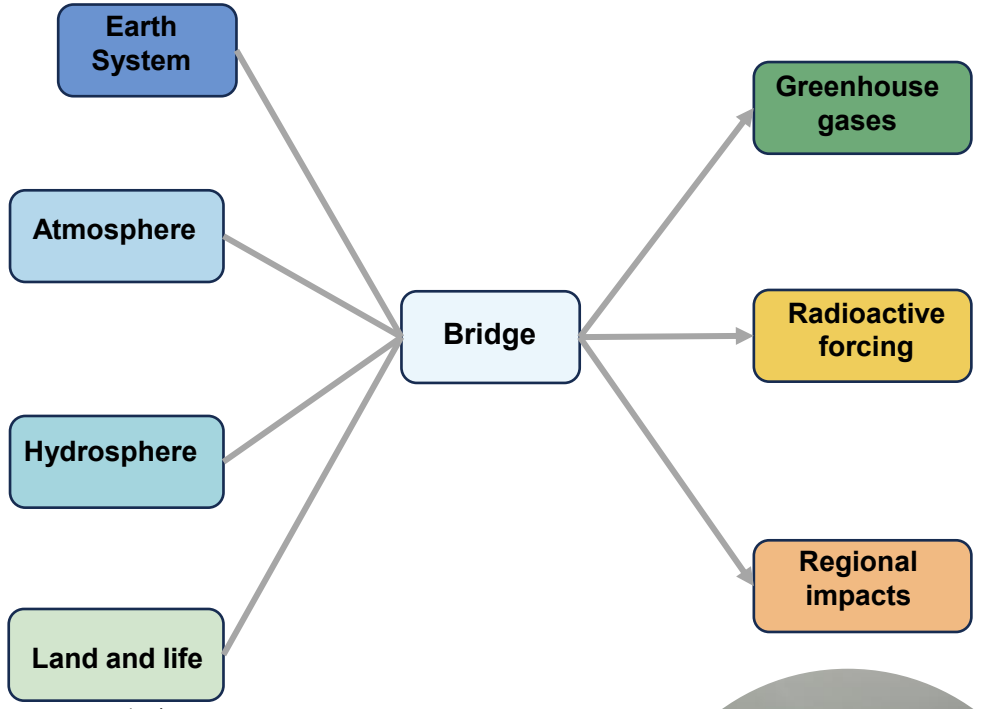
- A change in one sphere often creates secondary effects in others.
- Glacier retreat can alter runoff timing and downstream water stress.
- Soil degradation can reduce carbon storage and increase vulnerability.
- Climate and land management must therefore be taught together.



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Final

- Climate emerges from interacting spheres, not isolated components.
- The atmosphere redistributes heat, the hydrosphere stores it, and the cryosphere reflects it.
- Land and life regulate carbon and water in ways that affect climate directly.
- This systems view is the bridge to greenhouse gases and sustainable land management.



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