

Modul Bodenökologie WS 2019/20 :

Stoffkreisläufe in Bodenökosystemen

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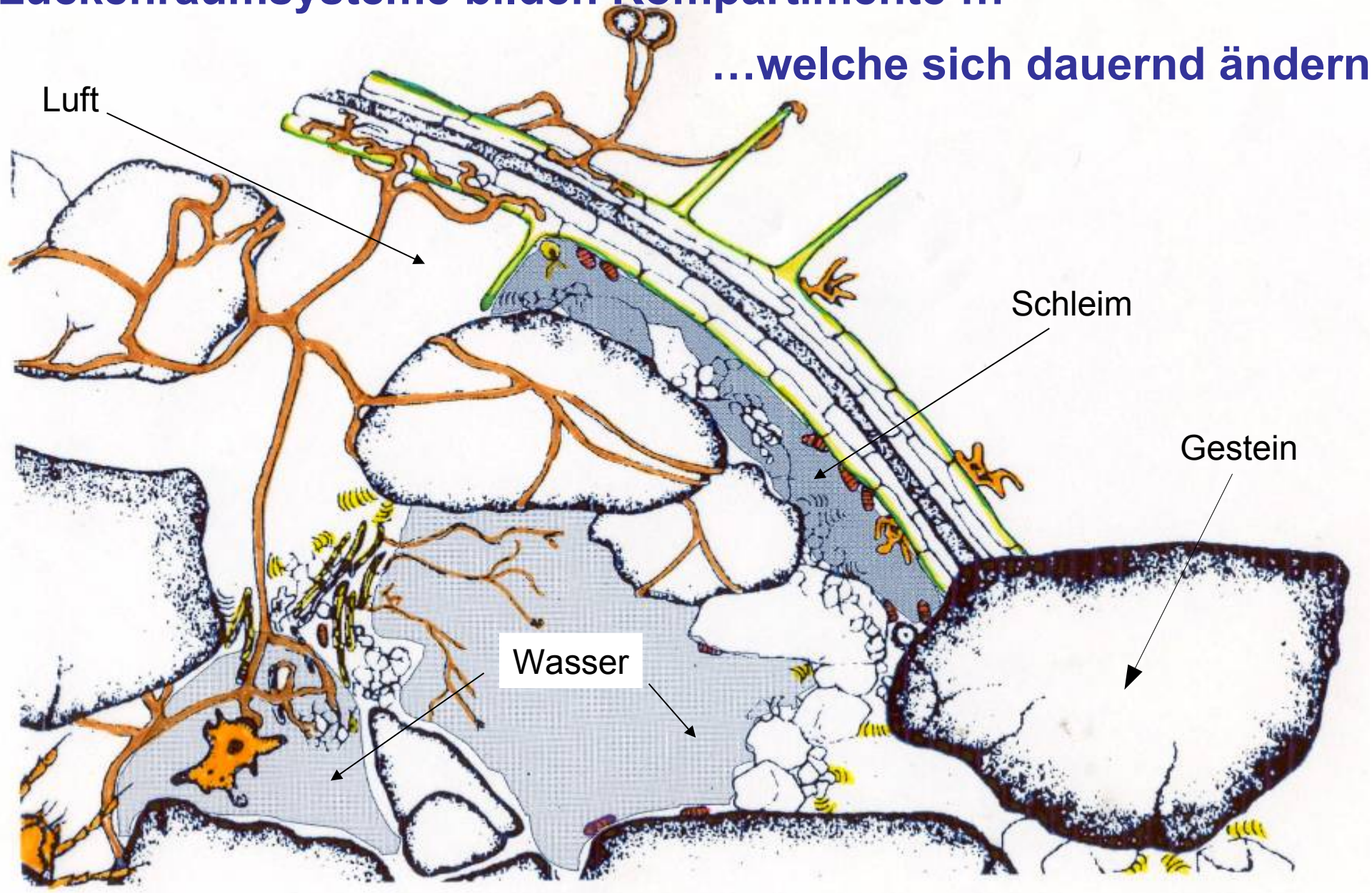
- **Vom allgemeinen Schema zum spezifischen Ökosystemmodell**
- Pools und Flüsse verstehen
- Systeme vergleichen
- Systemänderungen abschätzen

THERE'S TREASURE EVERYWHERE

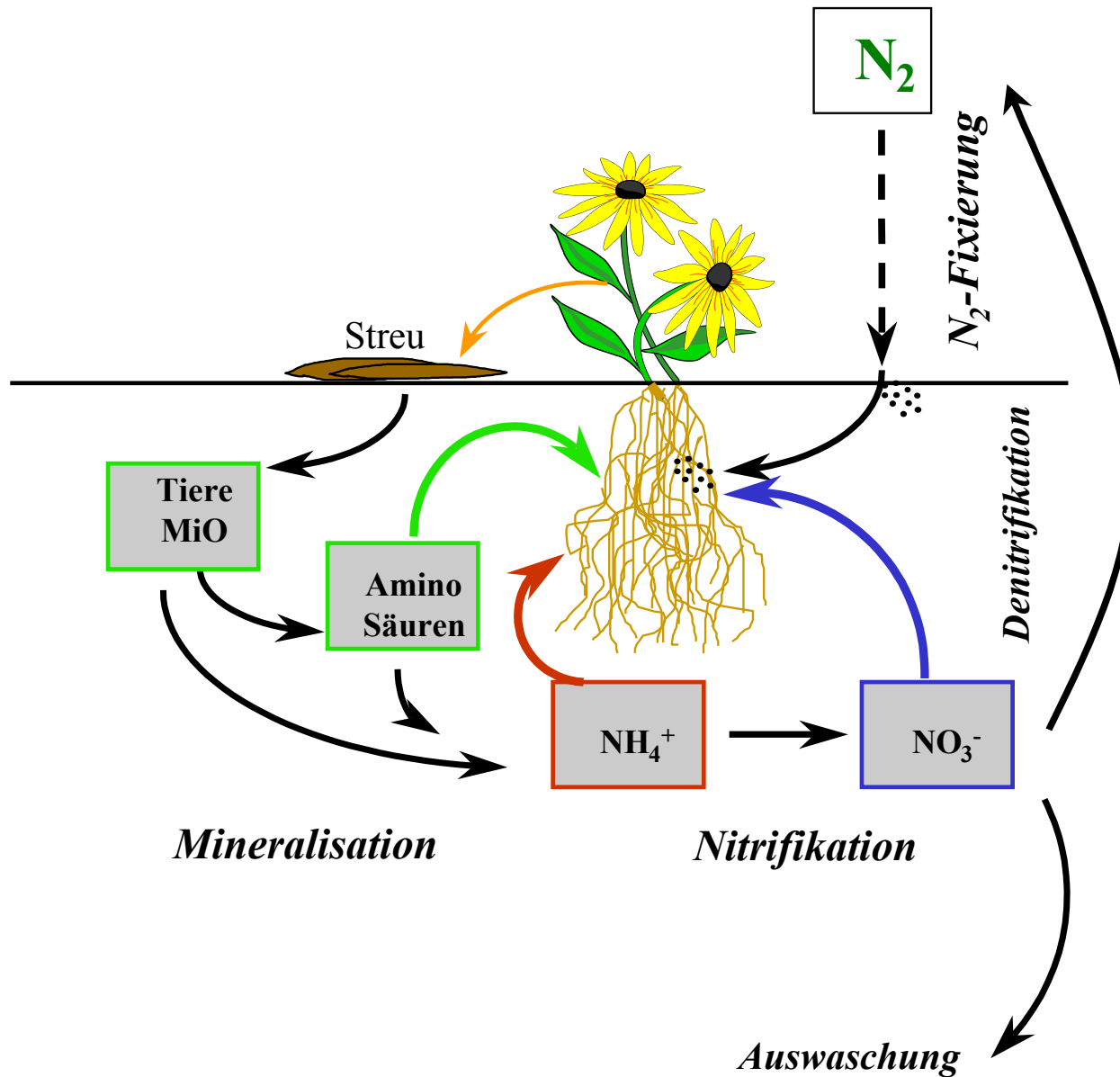


Lückenraumsysteme bilden Kompartimente ...

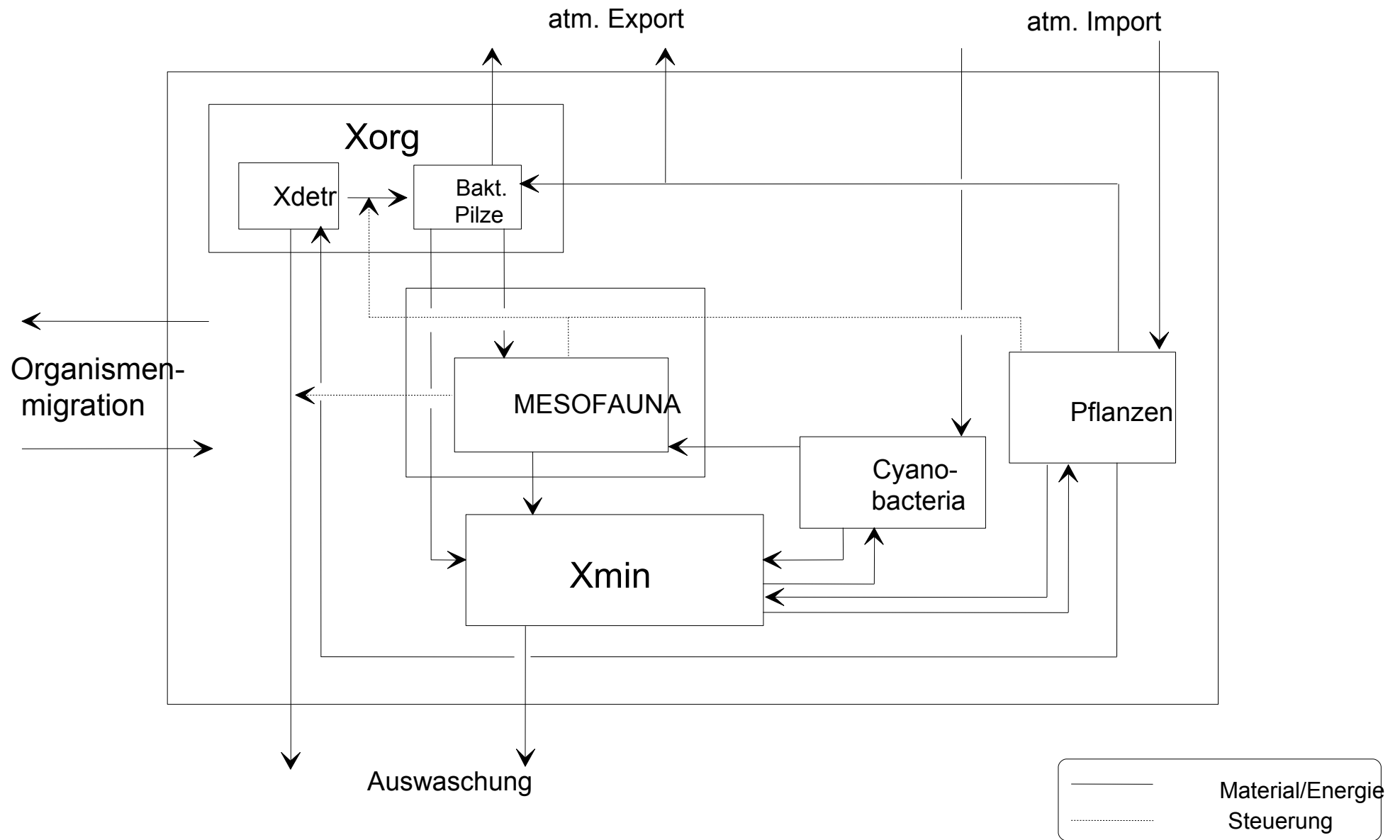
...welche sich dauernd ändern!



Der Stickstoffkreislauf im Ökosystem



Basisinteraktionen, mechanistischer Ansatz



Die Darstellung maximaler Komplexität hilft nicht weiter ...

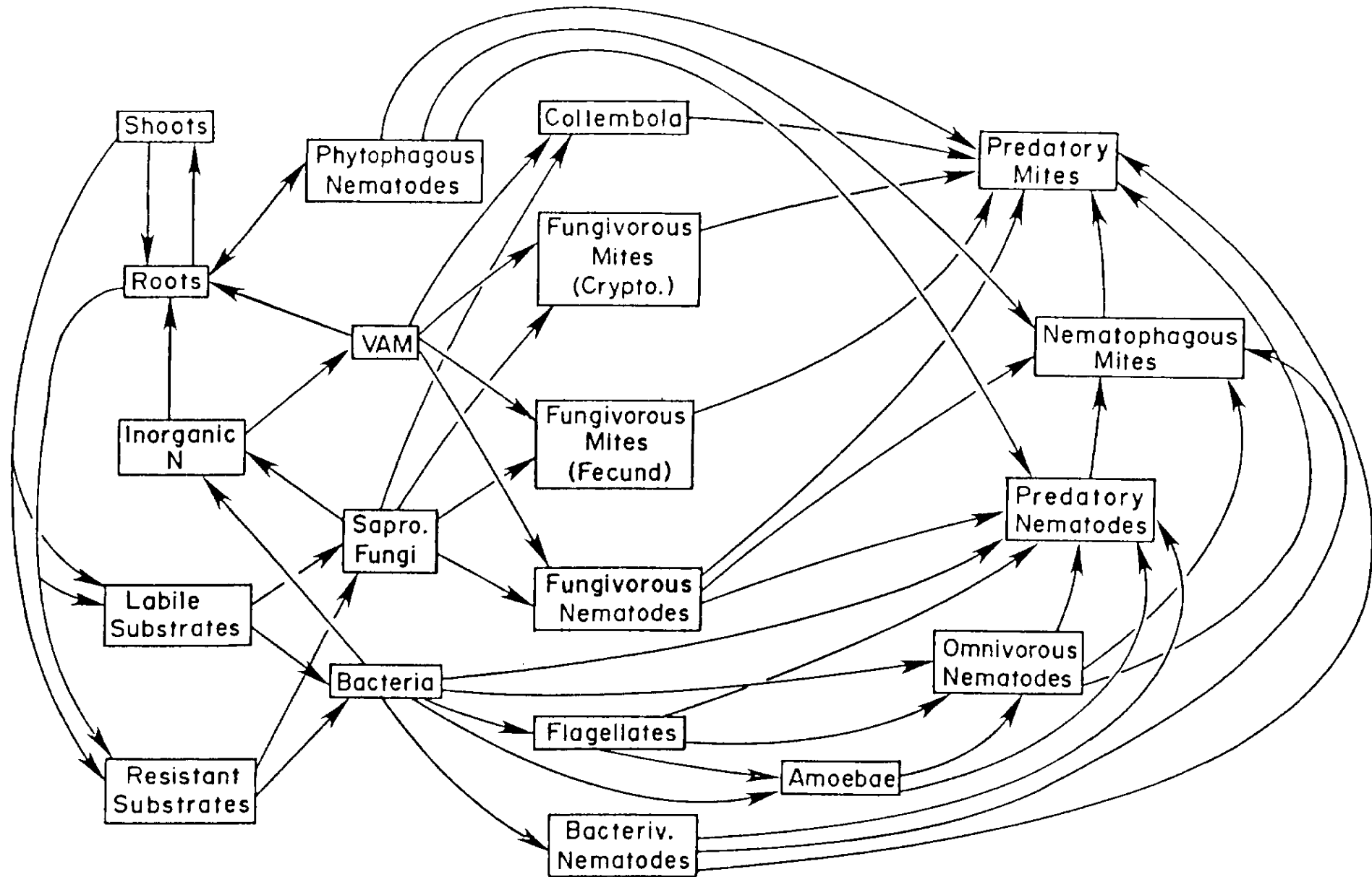
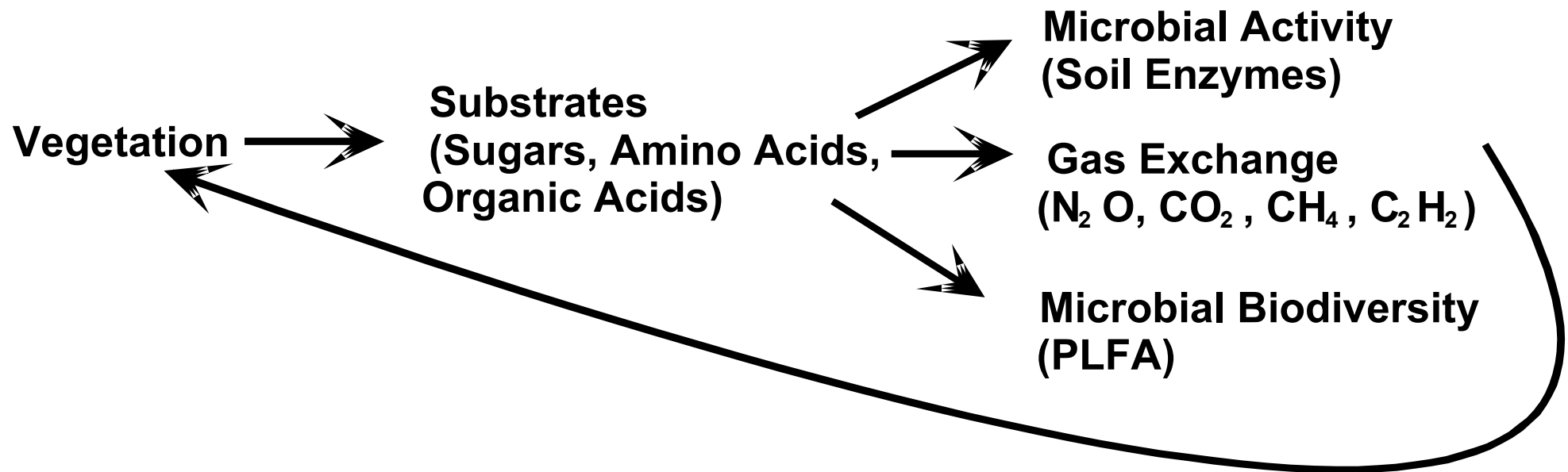
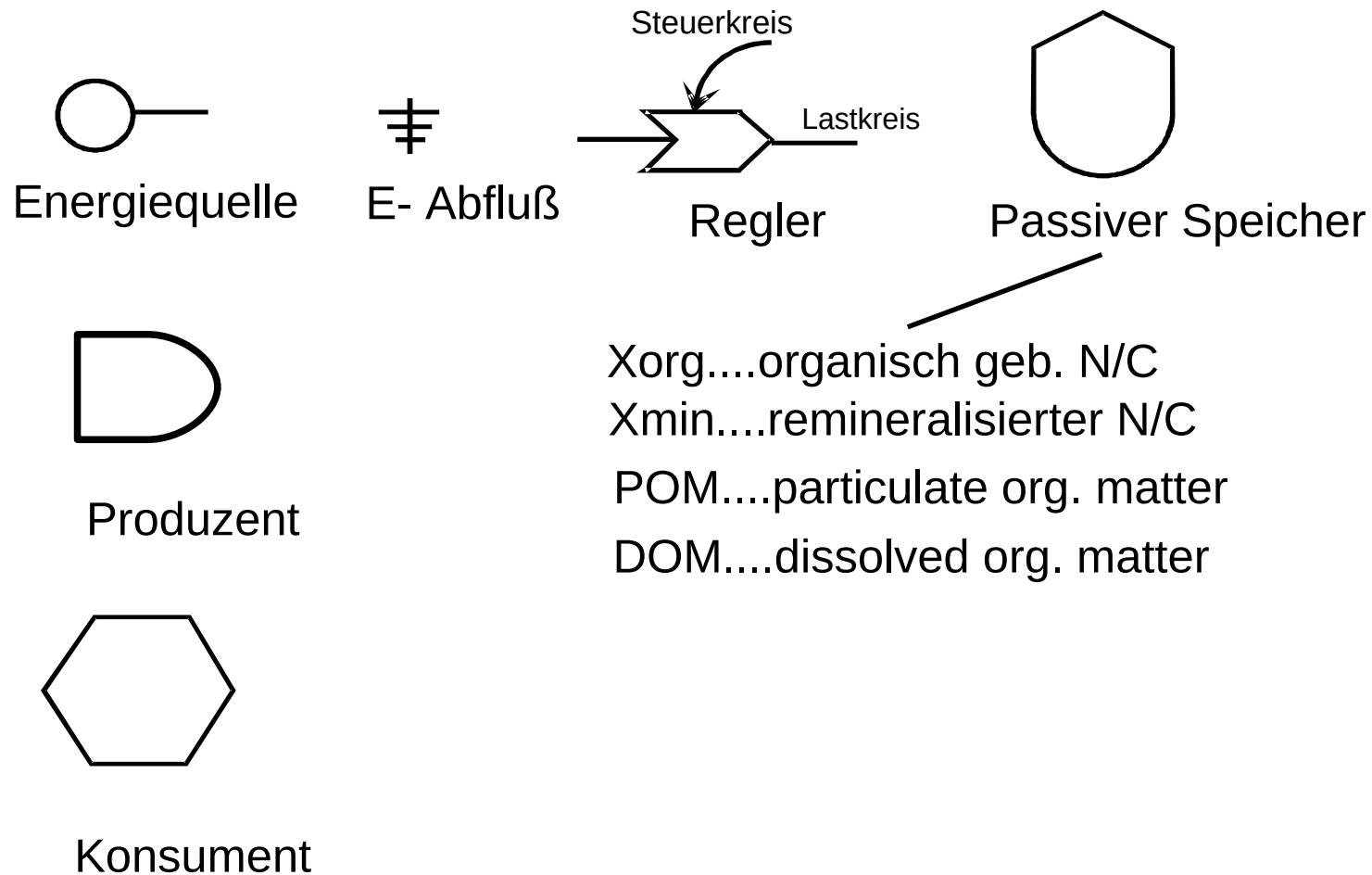


FIG. 9. A model of trophic interactions among plants, substrates, microflora, and fauna in a shortgrass

Kompletter Reduktionismus hilft auch nicht

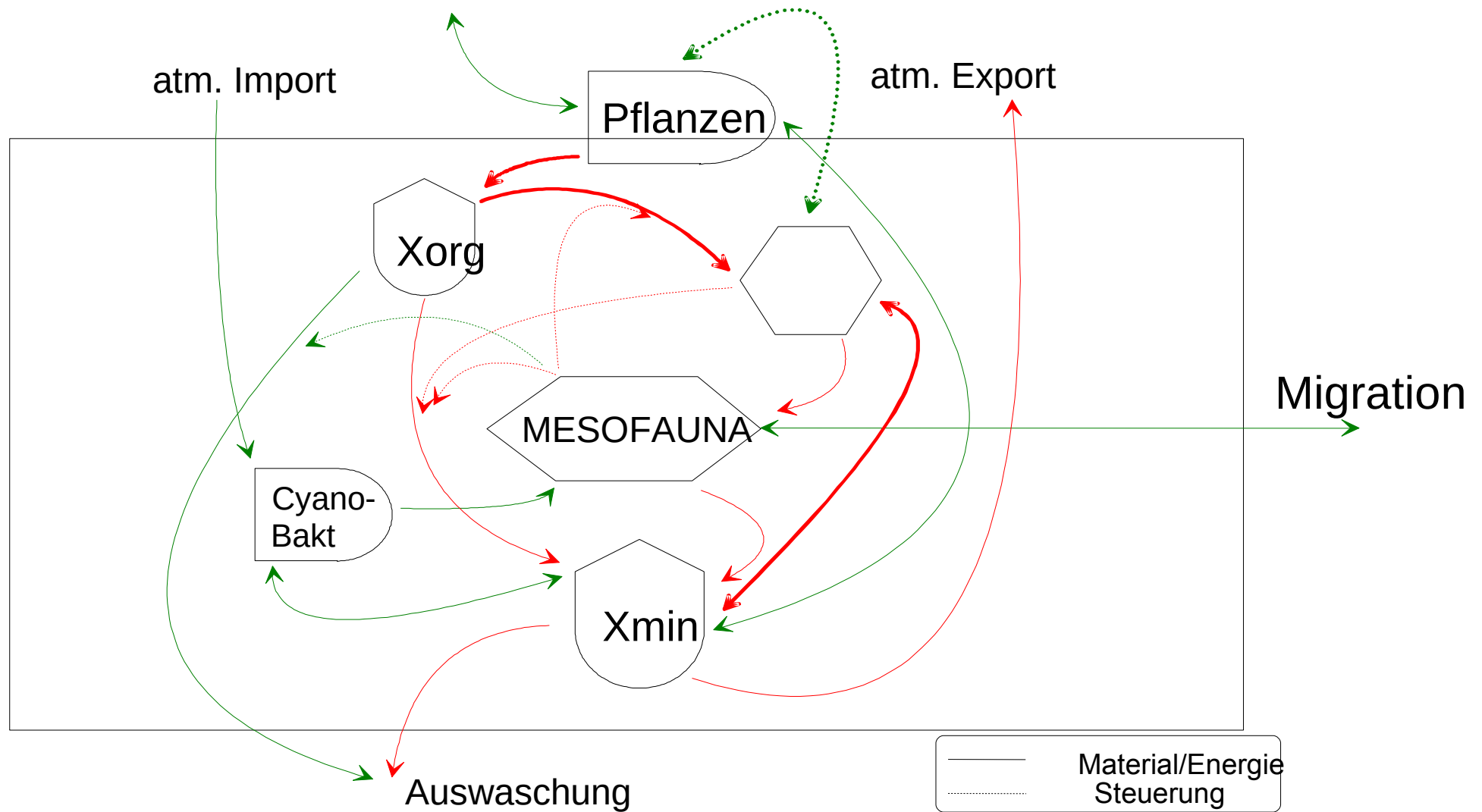


Formelsprache für Ökosysteme mit Symbolen



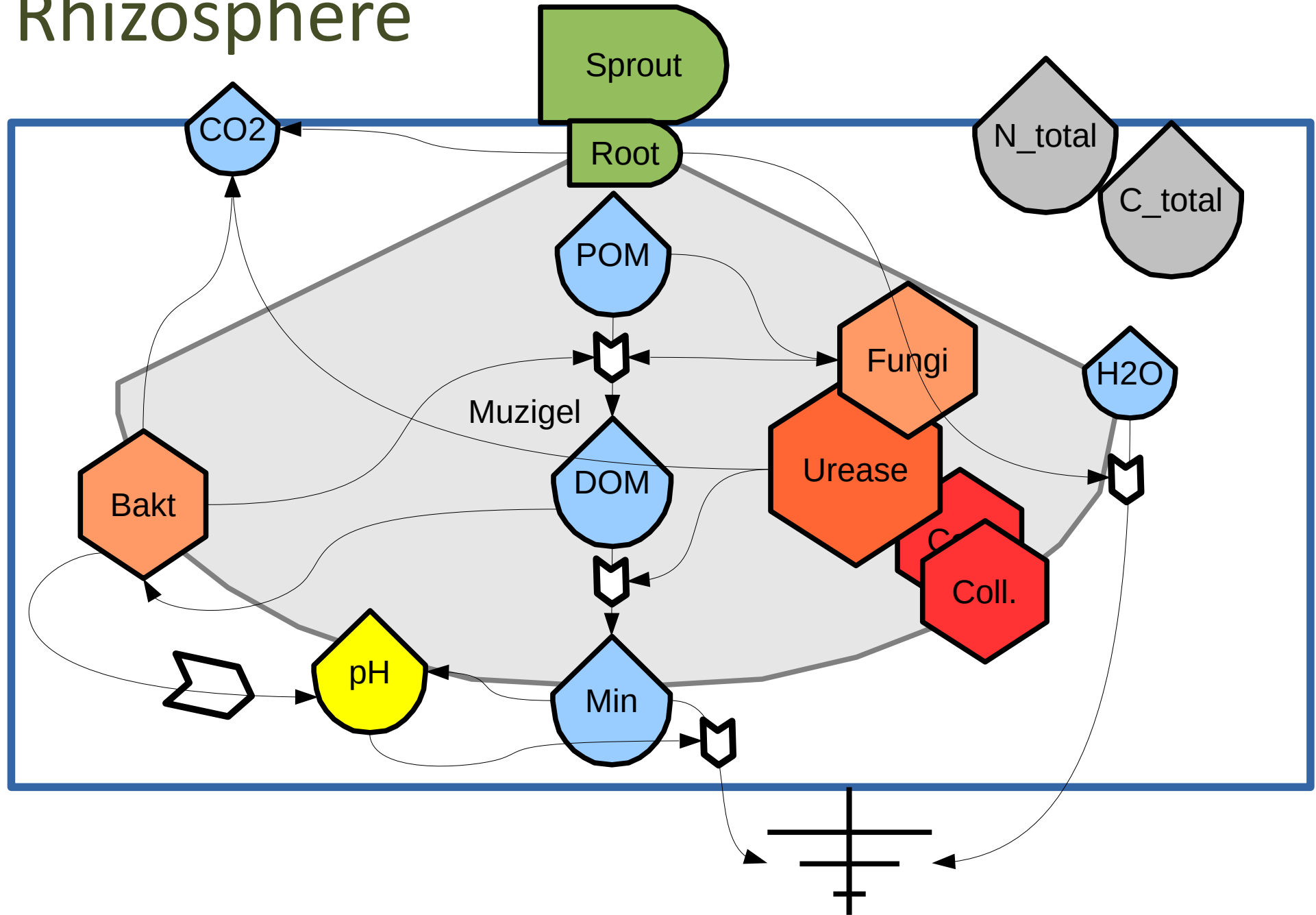
Nach H.T.Odum, 1971

Basisinteraktionsdiagramm / mechanistisches Modell

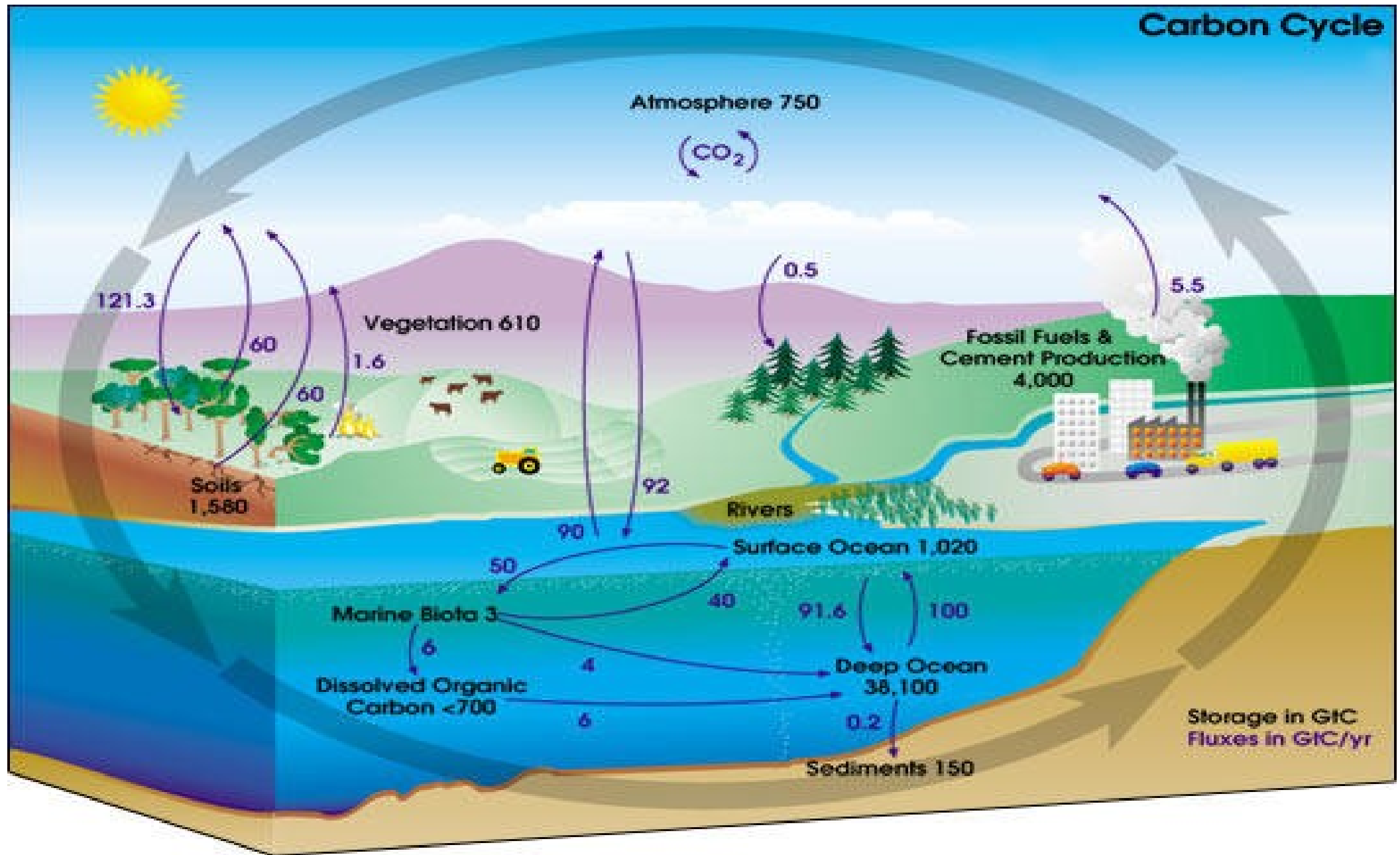


„Conceptual Model“

Rhizosphere



The carbon cycle



C-Quellen (sources)

	Gt	+/-
Fossil	6,4	0,5
Agrar	1,6	1,0
Total	8,0	1,1

C-Senken (sinks)

	Gt	+/-
Ozeane	2,0	0,8
Bor.Wälder	0,5	0,5
Atmosphäre	3,2	0,2
Total	5,7	0,2

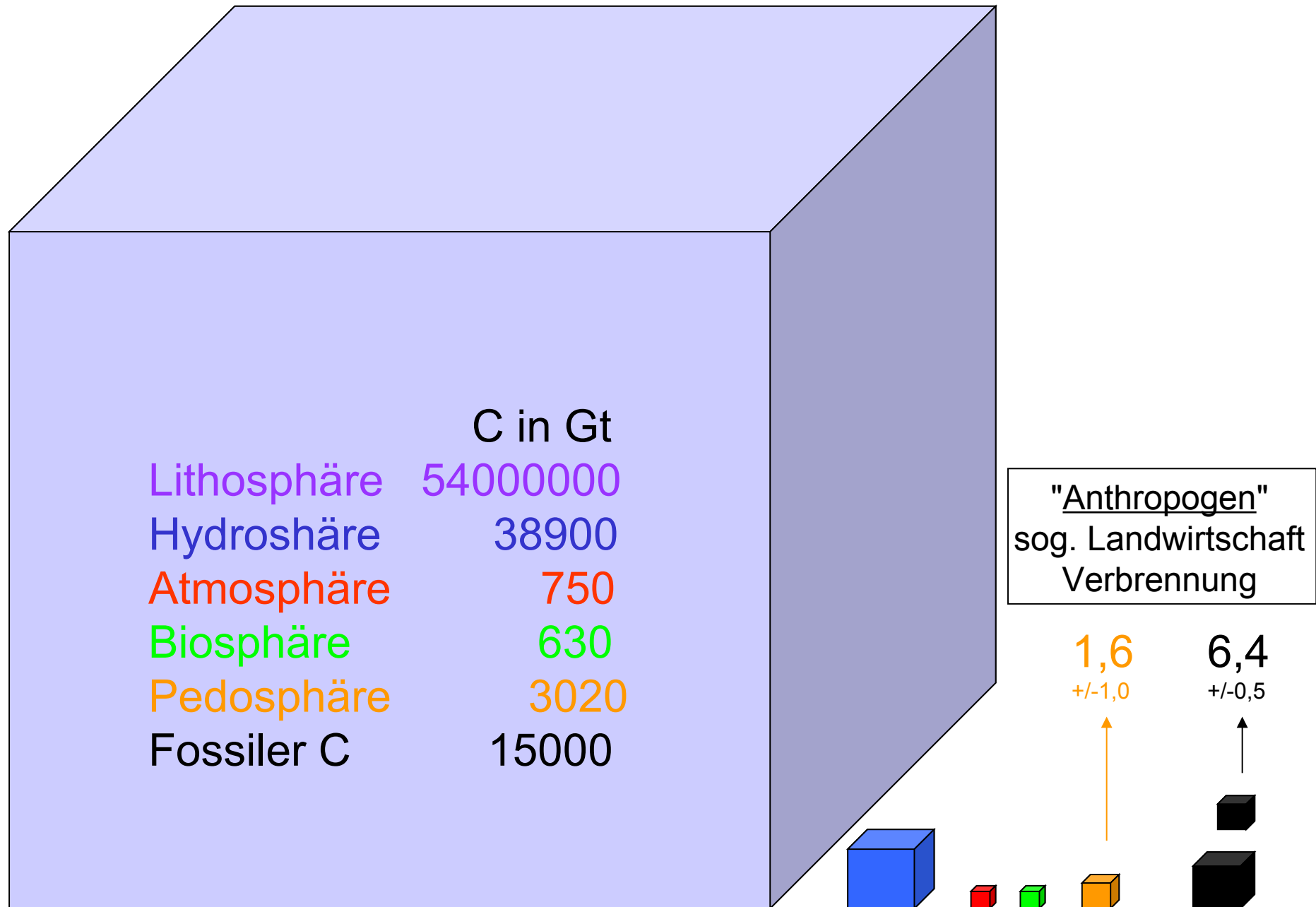
"Missing Carbon Sink": 2,3 Gt/a +/-2,0

"Natürliche" C-Deposition: ca. 0,0025 Gt/a

Flussmatrix

	Litho	Hydro	Atmo	Bio	Pedo	Fossil
Litho	0					
Hydro		0	105			
Atmo		107	0	120		
Bio			60	0	60	
Pedo			60		0	
Fossil						0

Globale Kohlenstoffpools



Key concerns associated with thawing permafrost



- Threats to ecosystems, loss of wildlife habitat, geopolitical issues

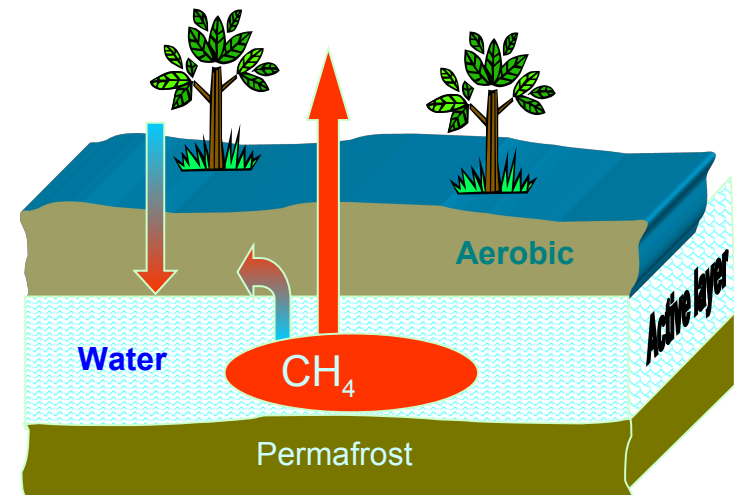
Vicinity of Yakytsk, 2008. Photo: T.Maksimov



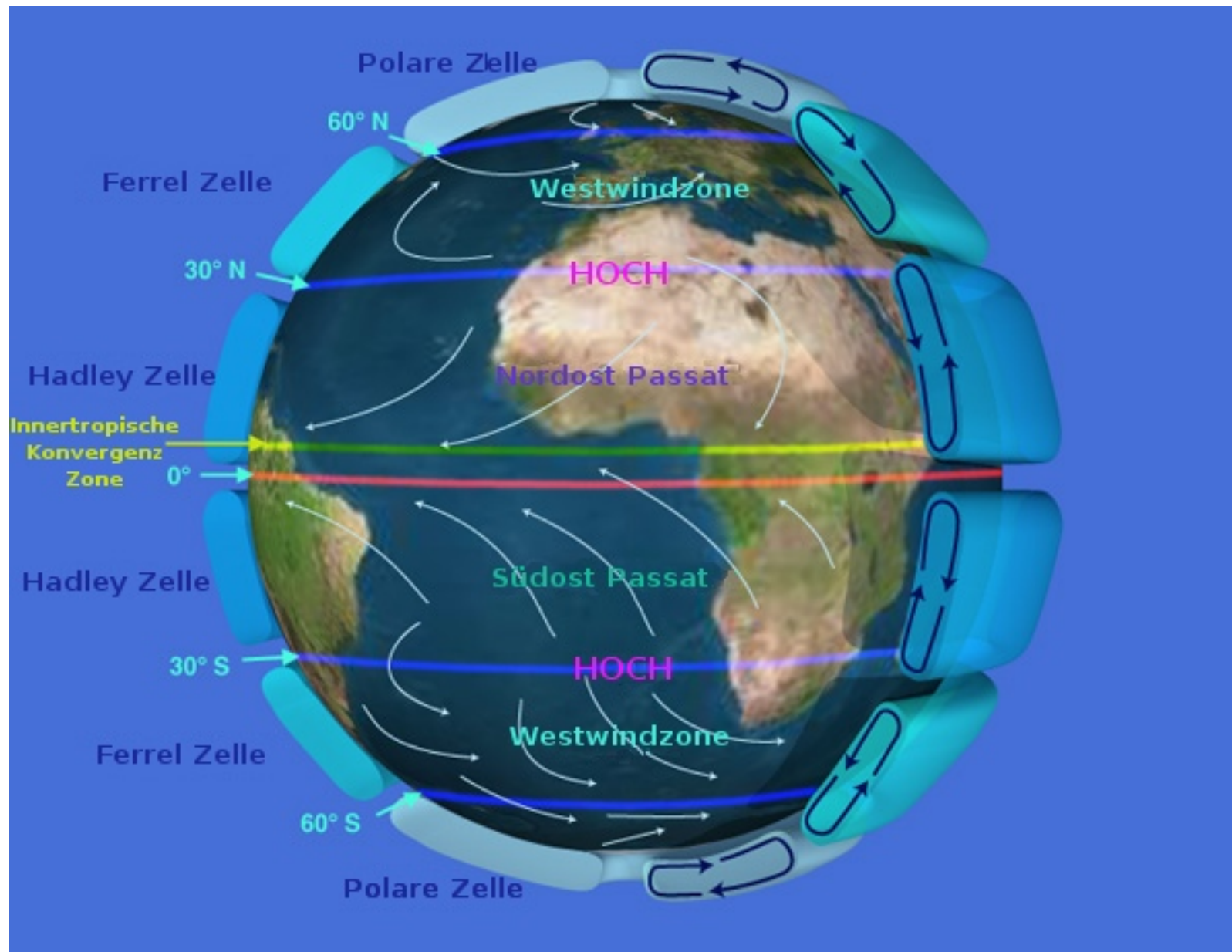
- Permafrost and economy of the North: impacts on the infrastructure

Baikal-Amur main track. Photo: D.Drozdov

- Permafrost and global climate: potential feedback through methane emission

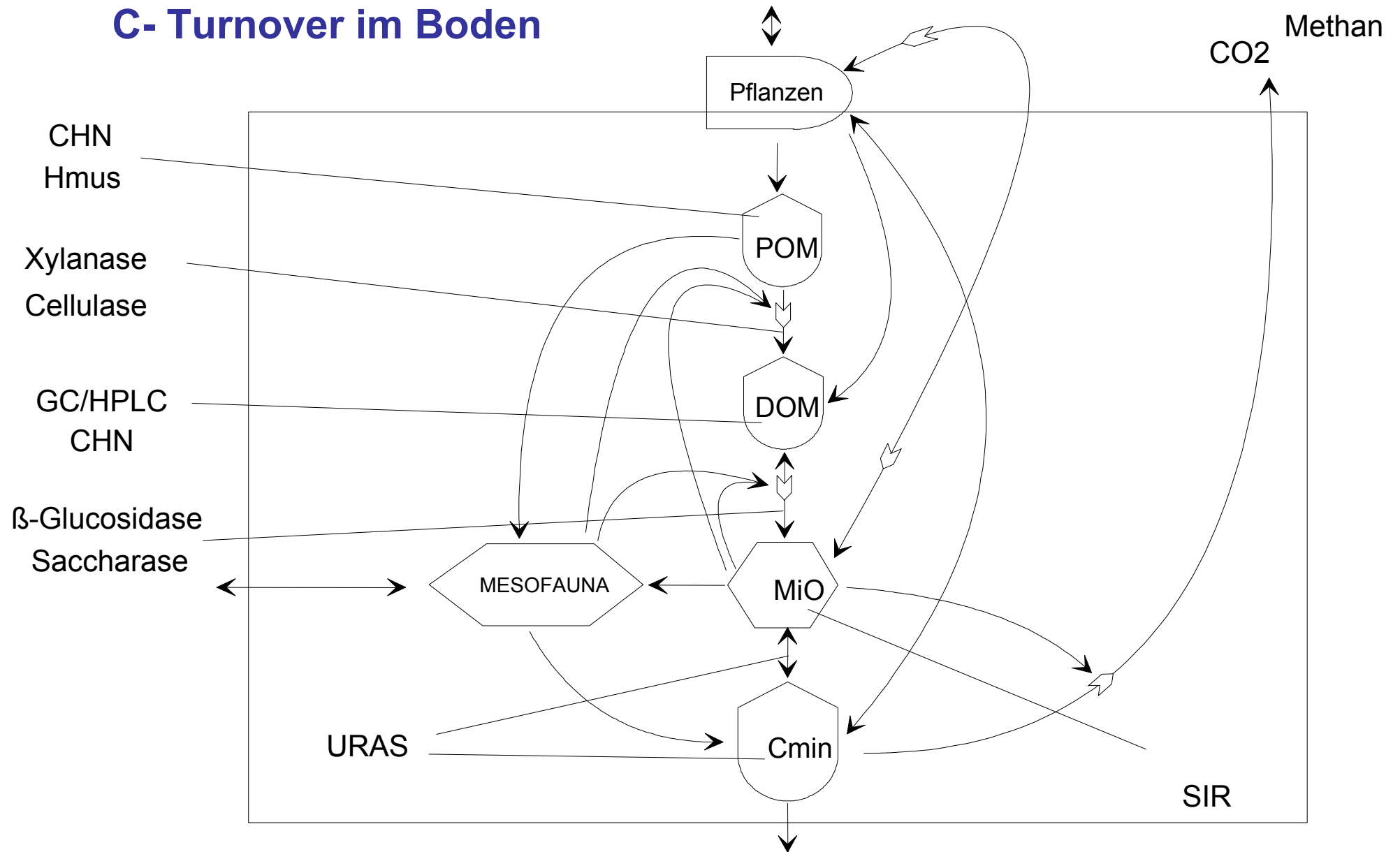


Klimaentwicklung als Folge der Vegetationsdecke (LUCC*)

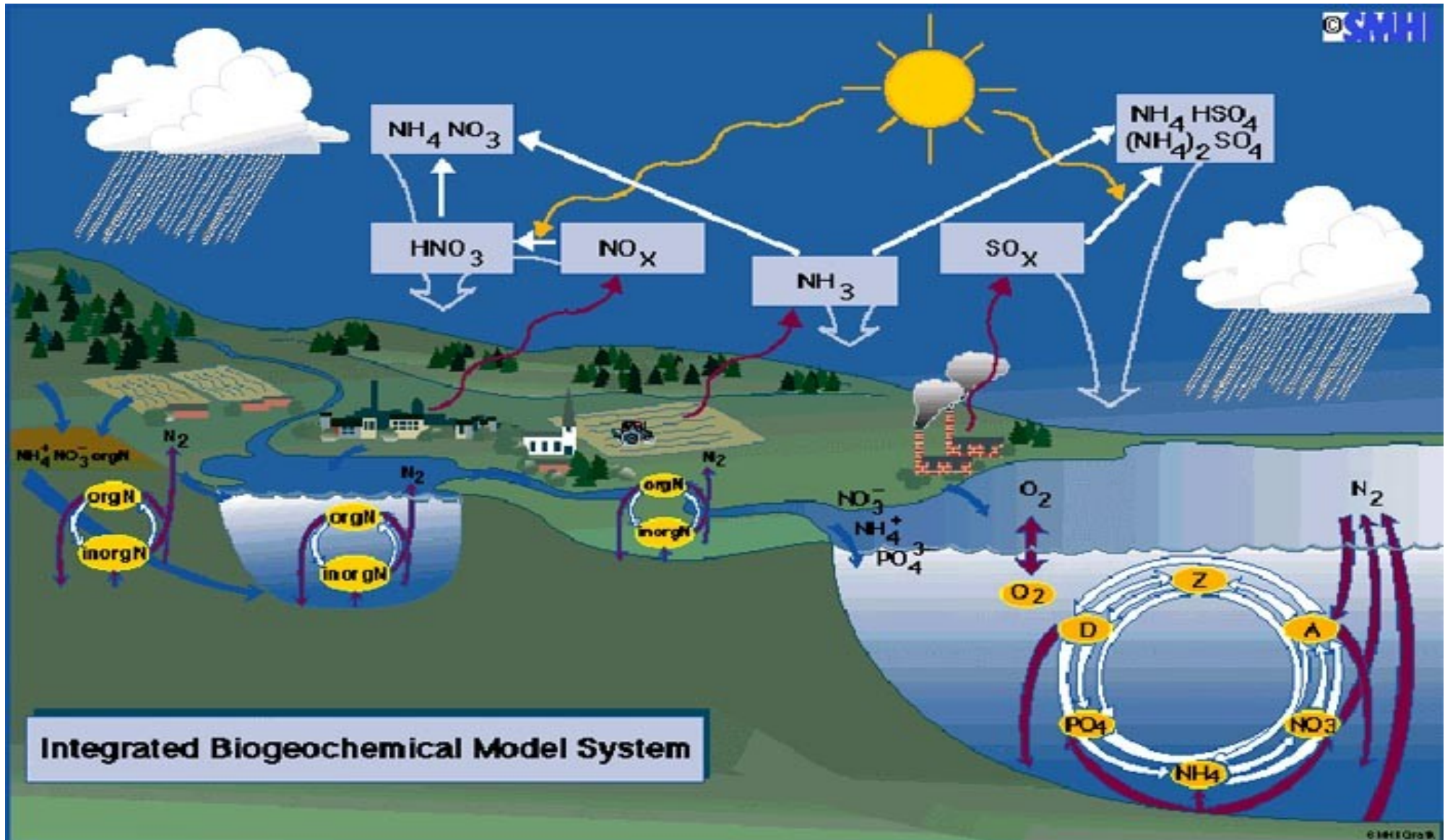


* LUCC: Land Use and Cover Change

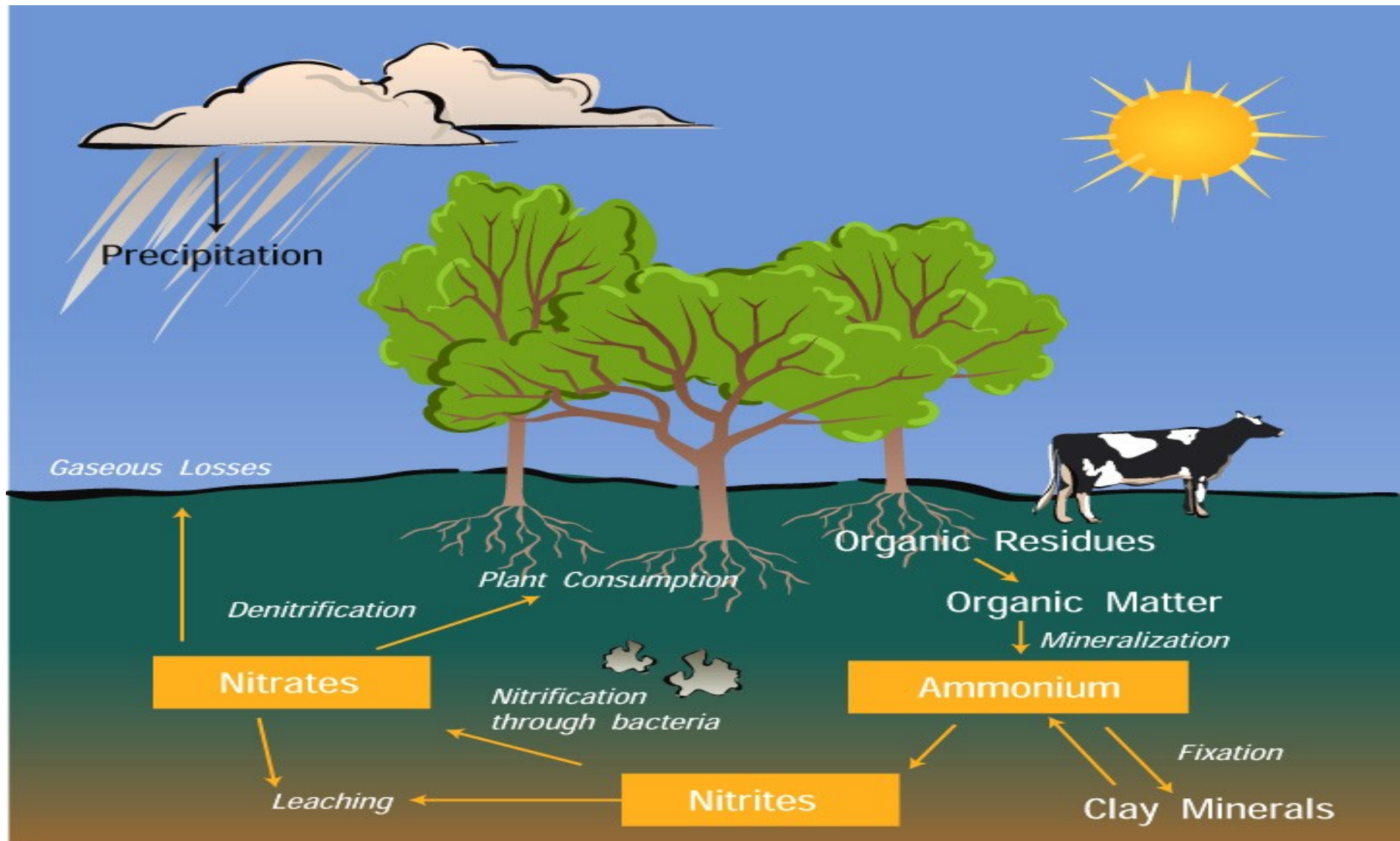
C- Turnover im Boden

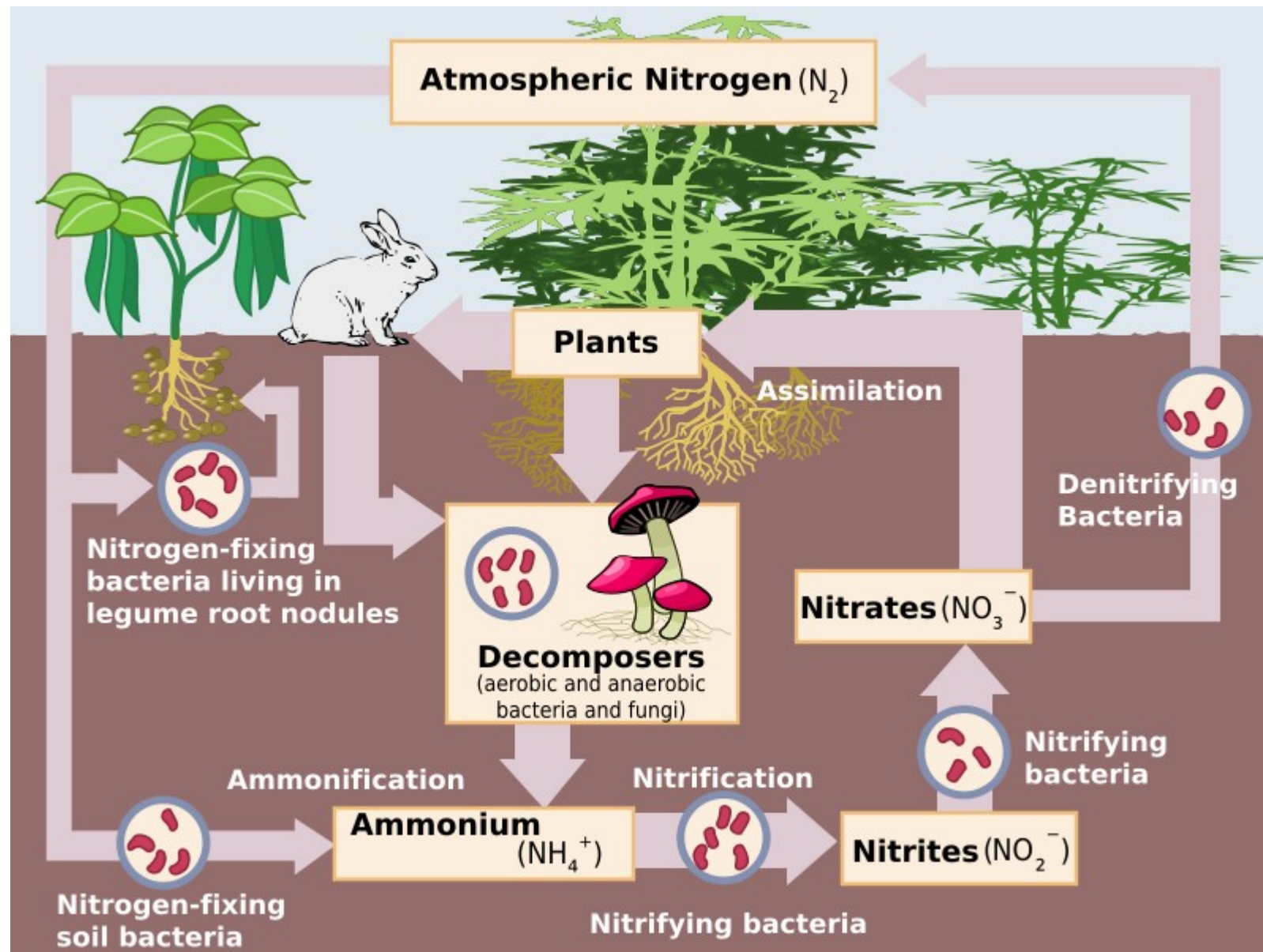


The N cycle

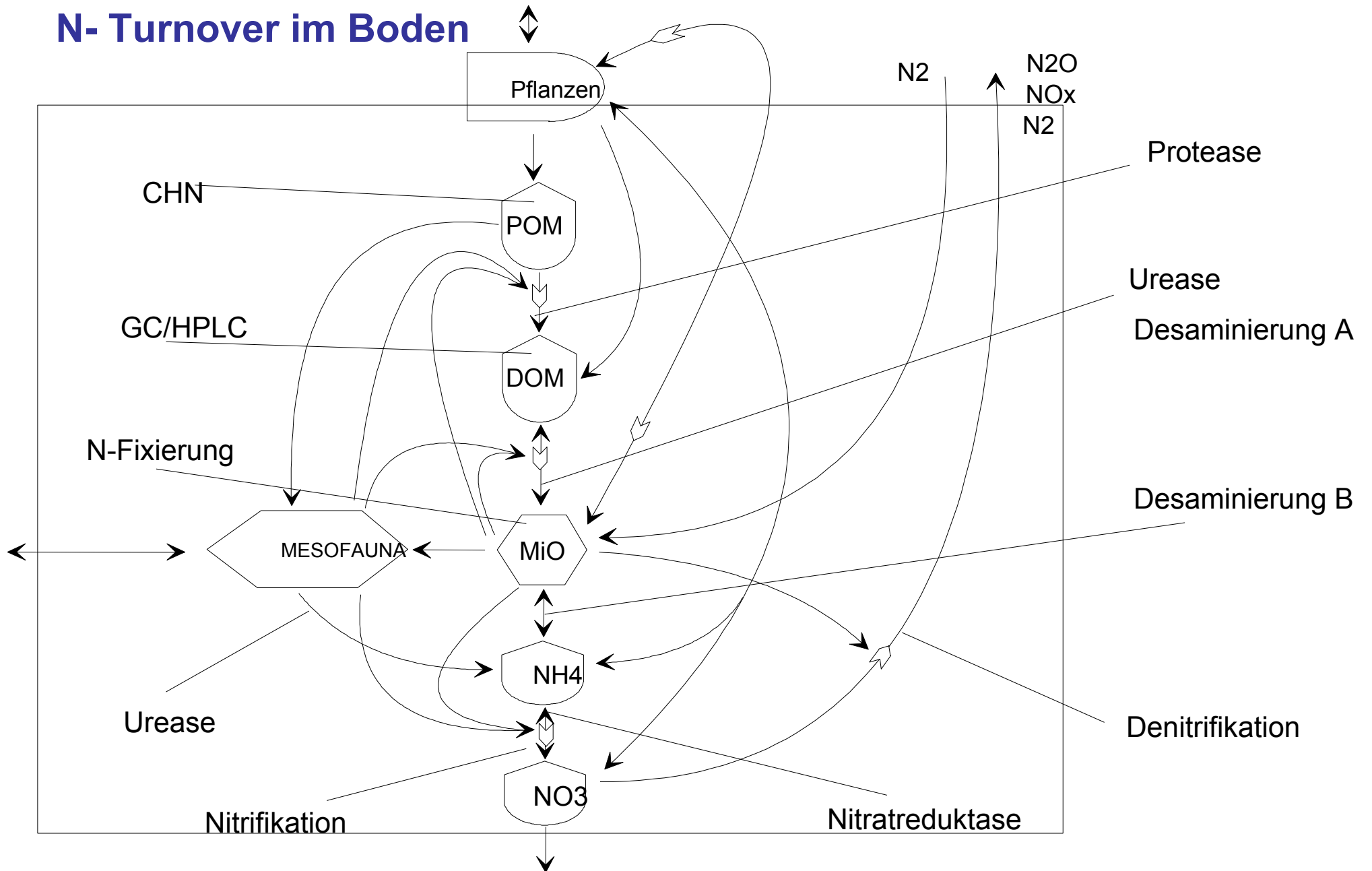


The N cycle, terrestrial





N- Turnover im Boden



The P cycle

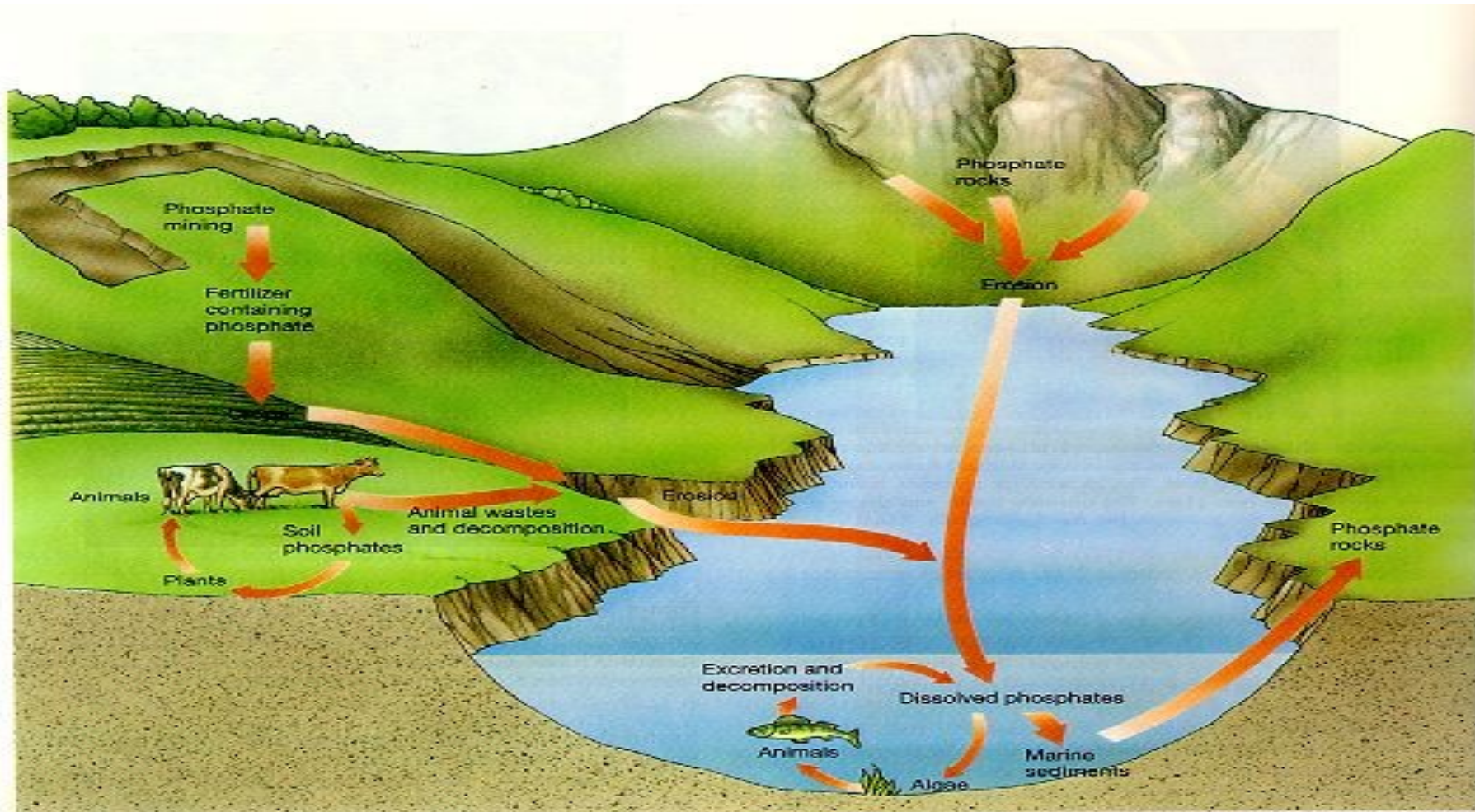
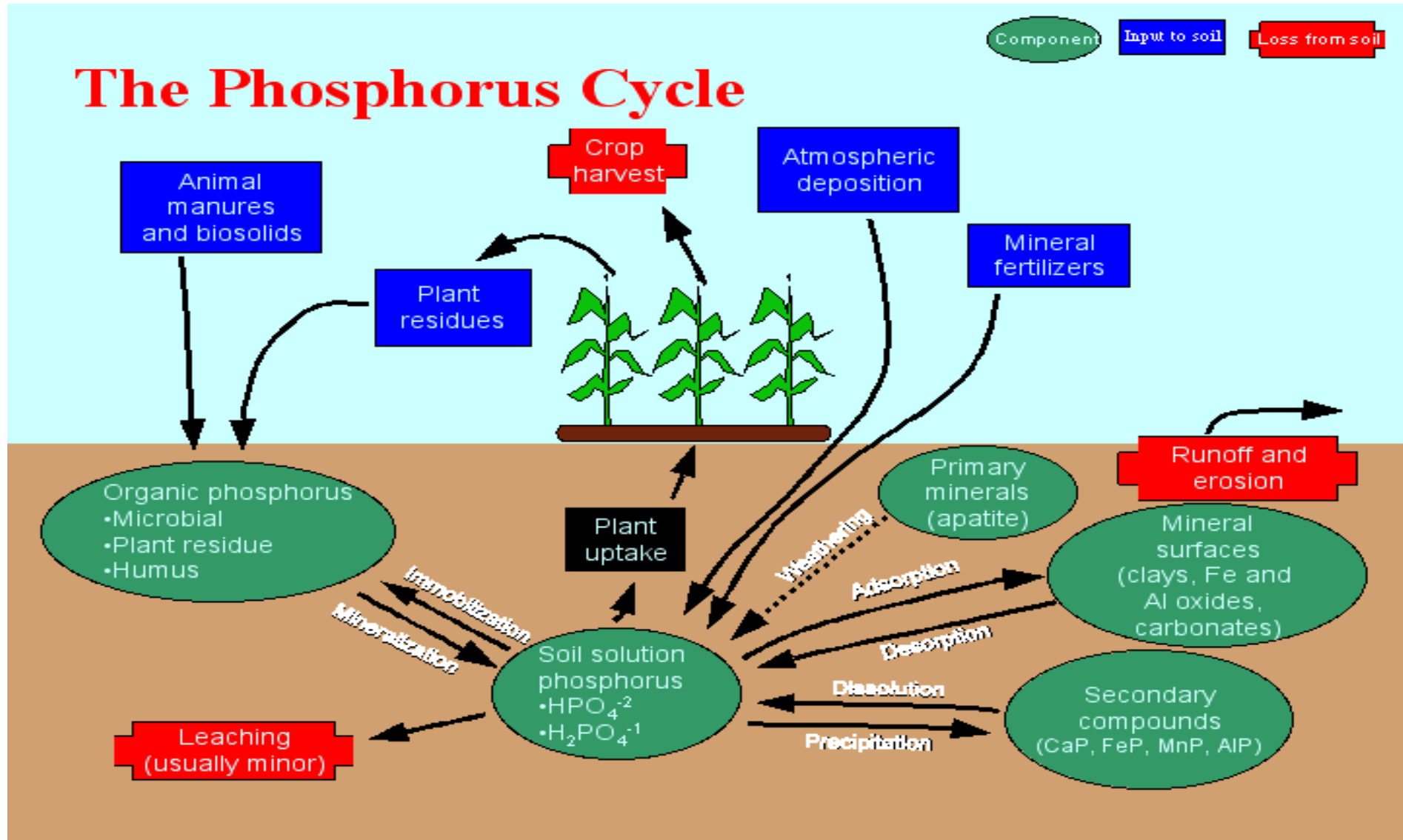


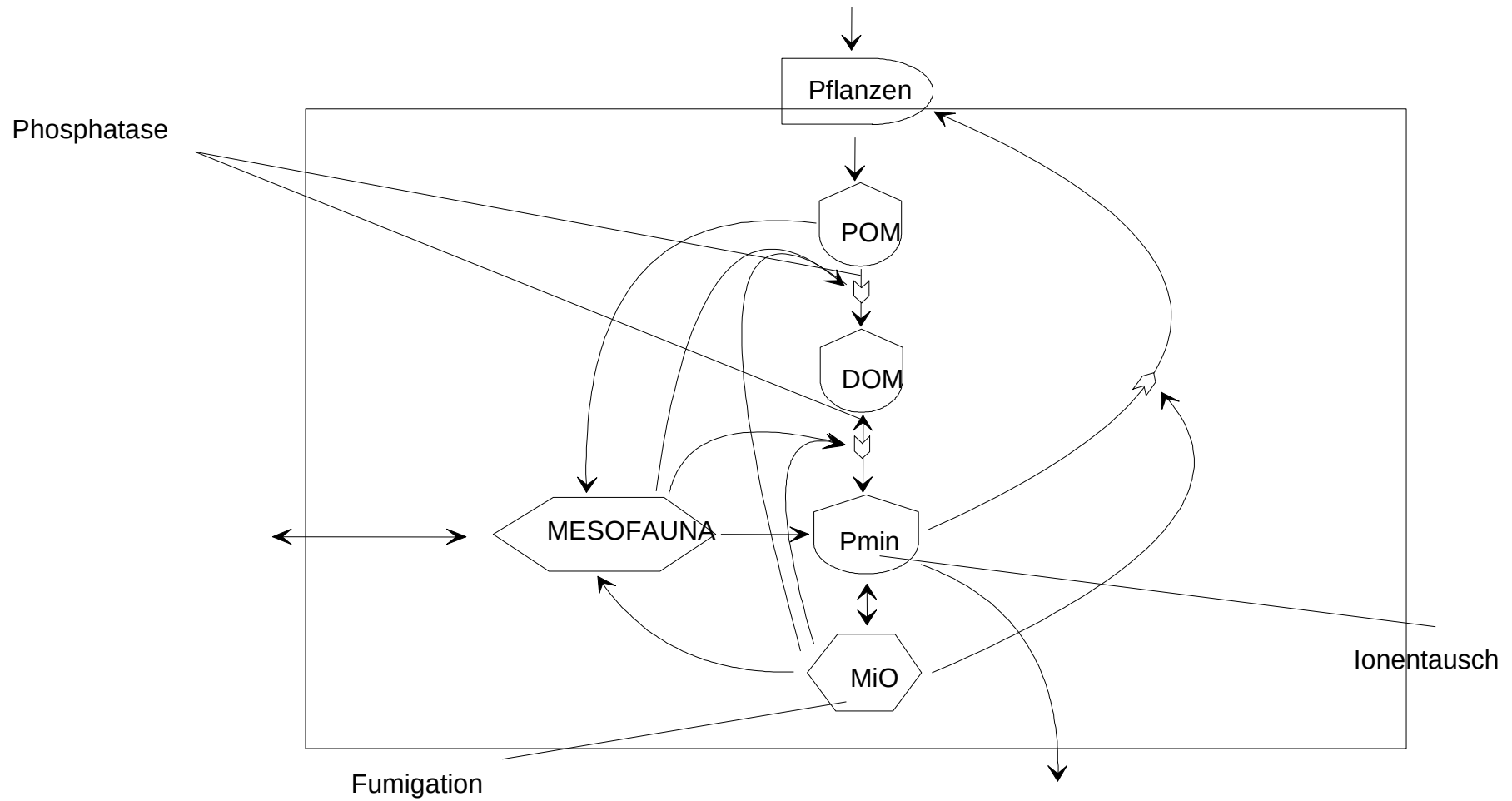
Figure 54-5 The phosphorus cycle in terrestrial and aquatic environments. Recycling of phosphorus (as phosphate, PO_4^{3-}) is slow because no biologically important form of phosphorus is

gaseous. Phosphate that becomes part of marine sediments may take millions of years to solidify into rock, uplift as mountains, and erode again to become available to living things.

The P cycle, terrestrial

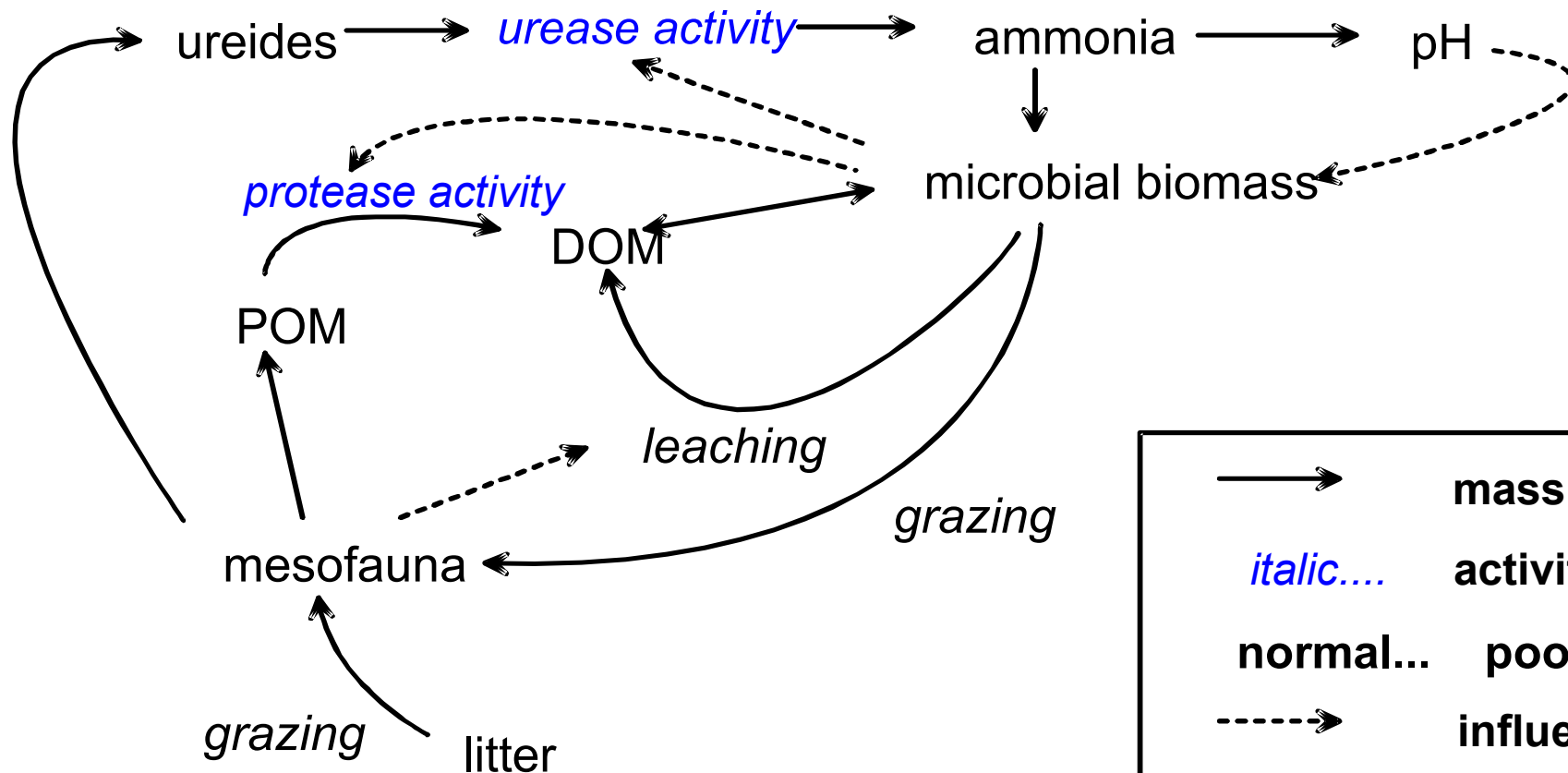


P- Turnover im Boden

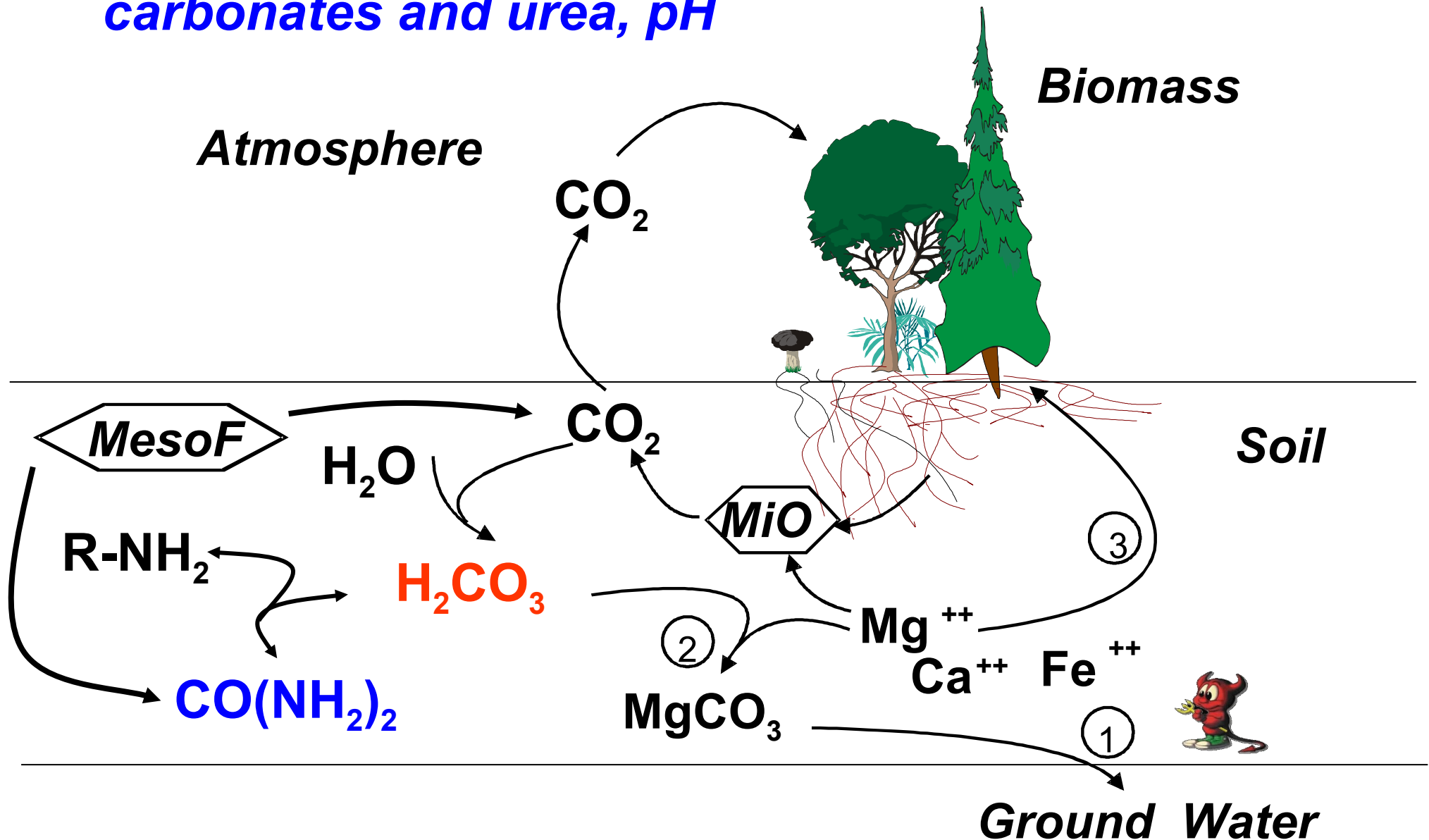


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Organisms, Activities, Pools, Transfers

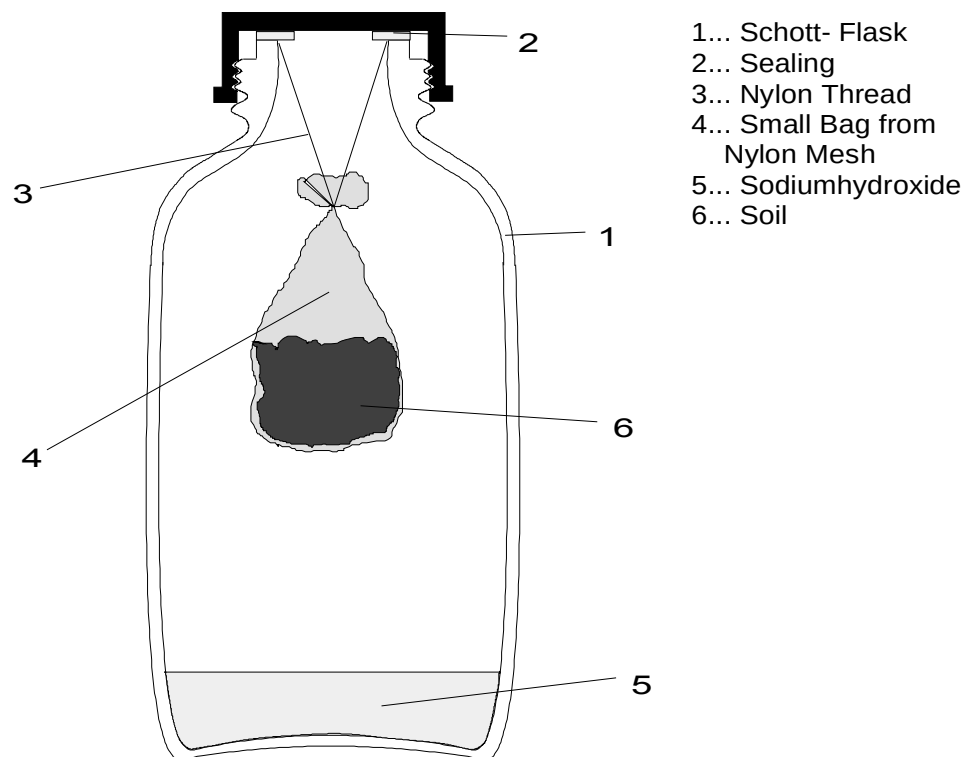


basal C/N transfer mechanisms in the soil system: *carbonates and urea, pH*



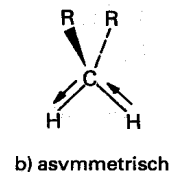
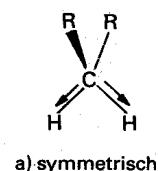
Rücktitration nach Isermeyer (1952)

IRGA (Infra Rot Gas Analyse)



14.2 Molekülschwingungen

Stretschwingungen



Deformationsschwingungen

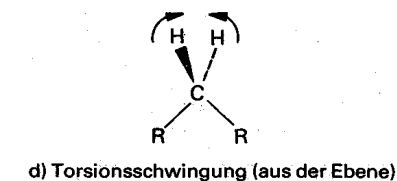
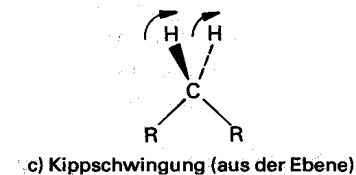
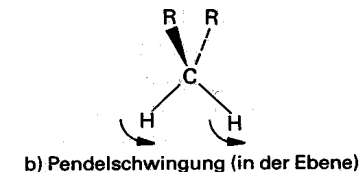
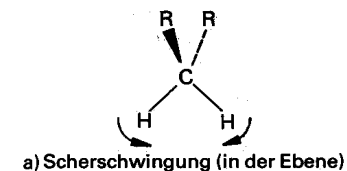
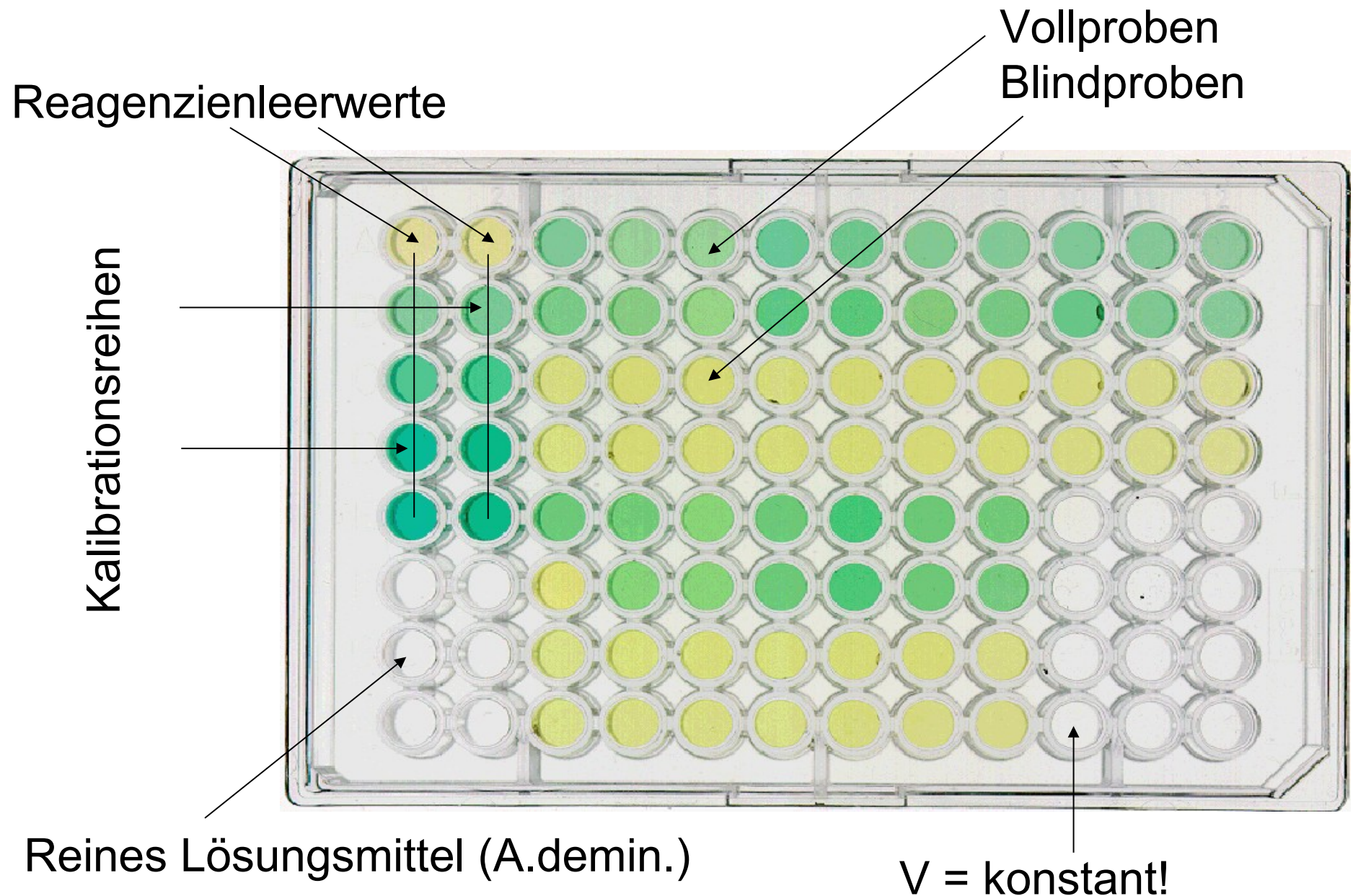


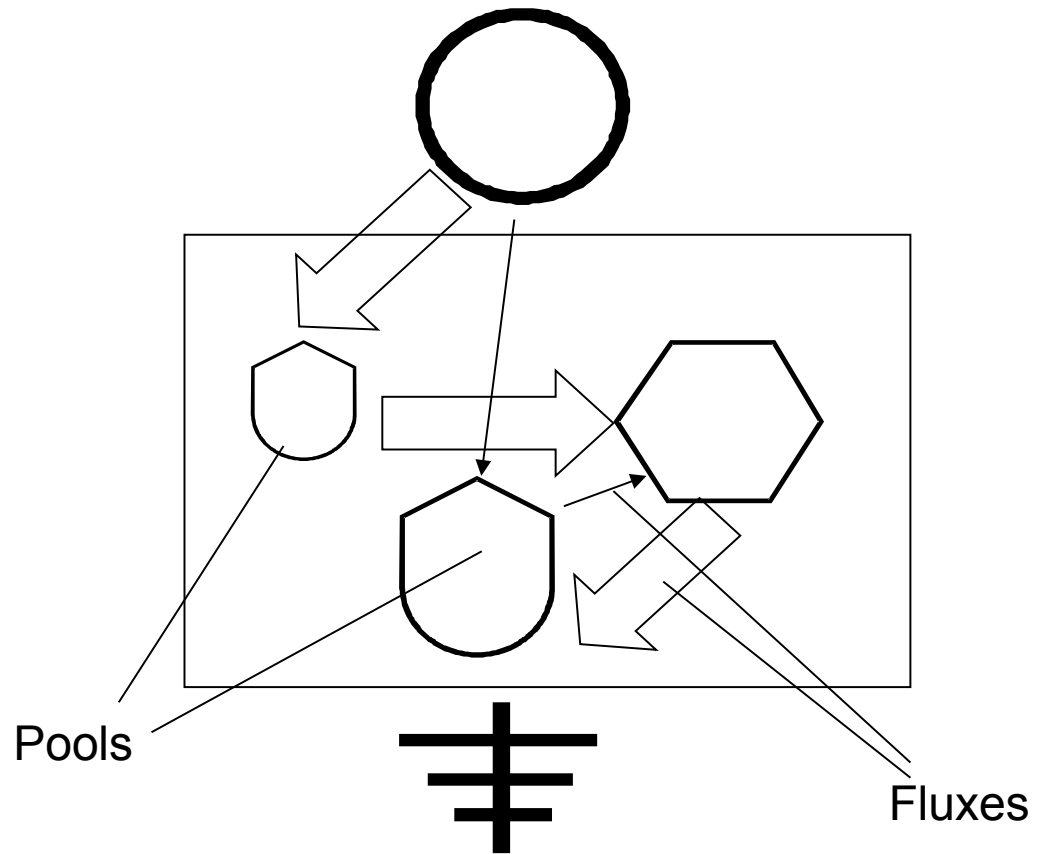
Abb. 14-4. Einige Schwingungsarten der Methylengruppe.

Mikroplattenphotometer, Enzymtests (Urease)

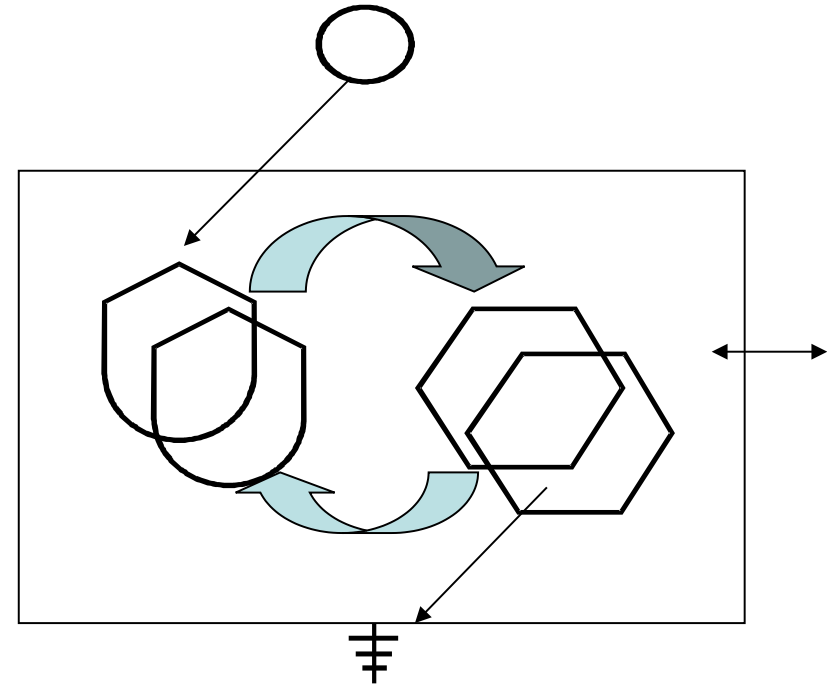


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Pools, Fluxes, metastabile Systeme

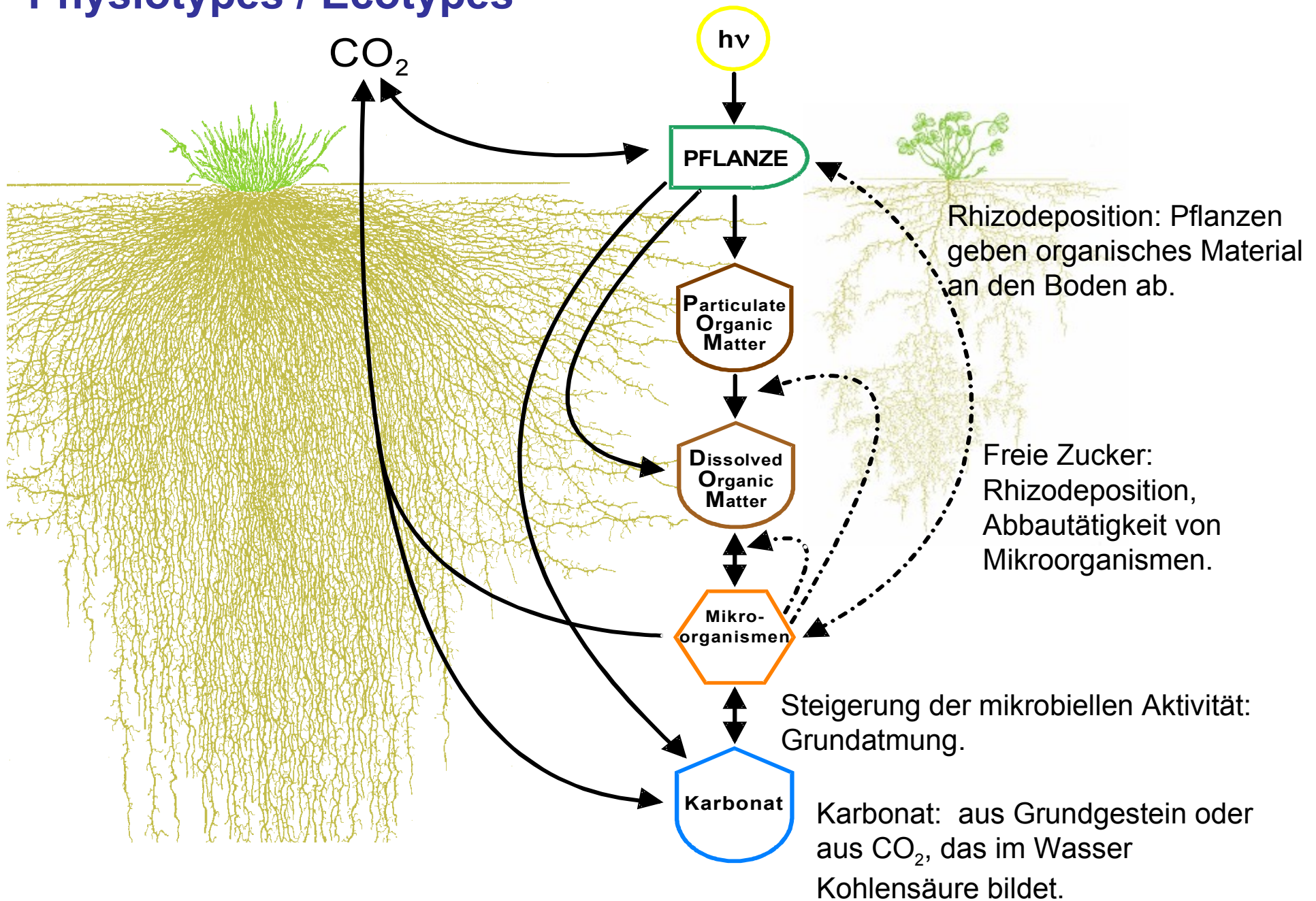


Durchfluss



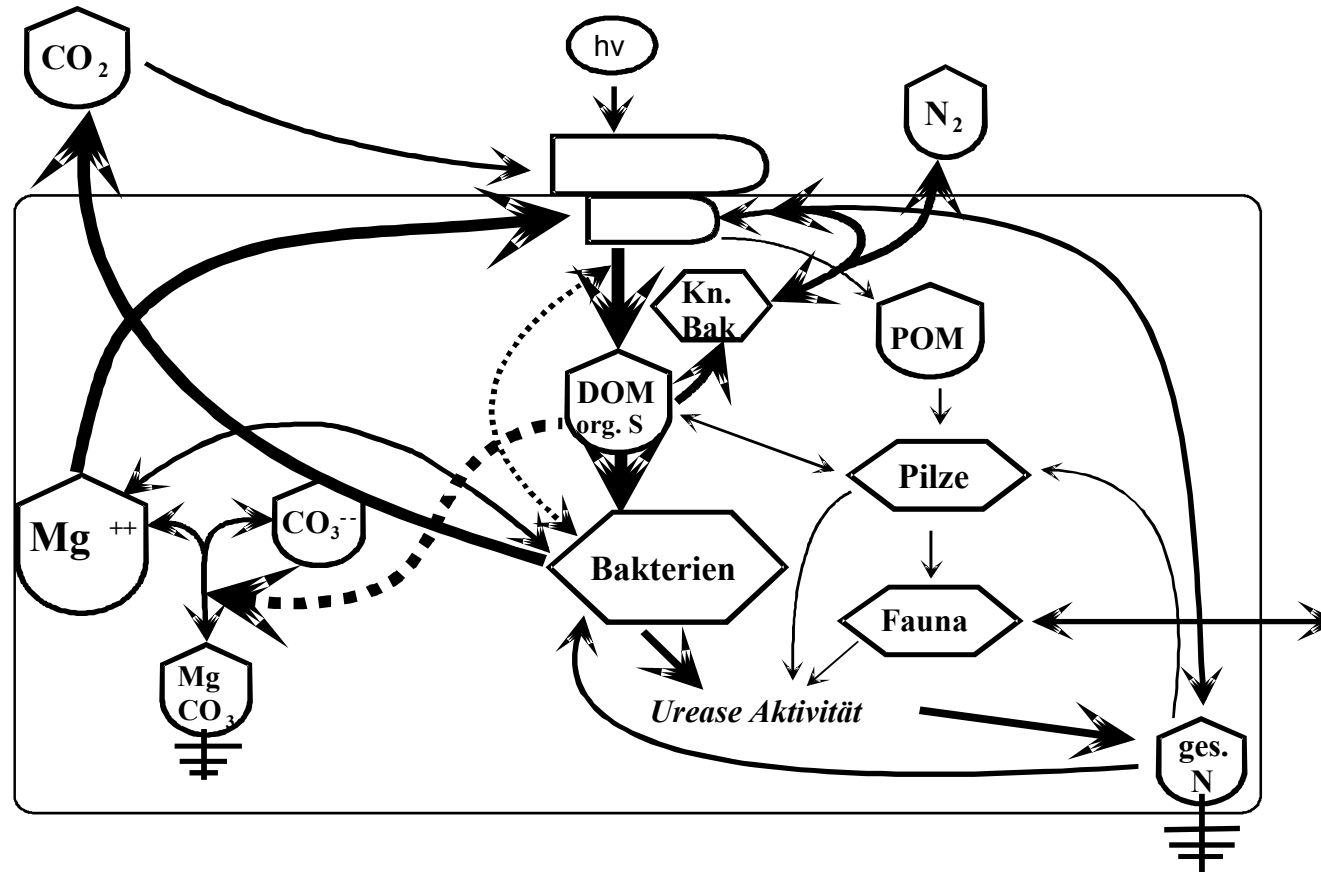
Recycling

Physiotypes / Ecotypes

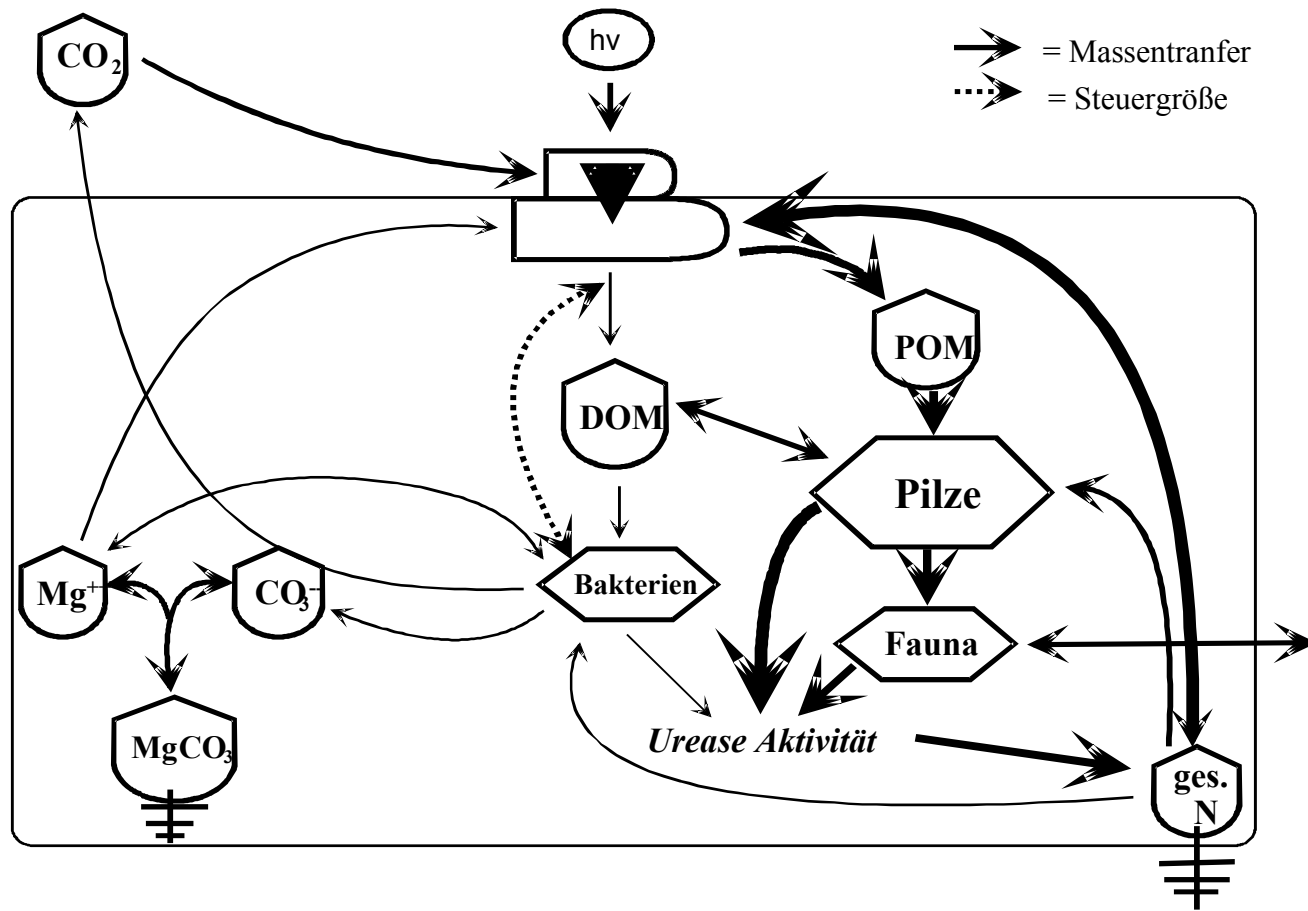


TRIFOLIUM

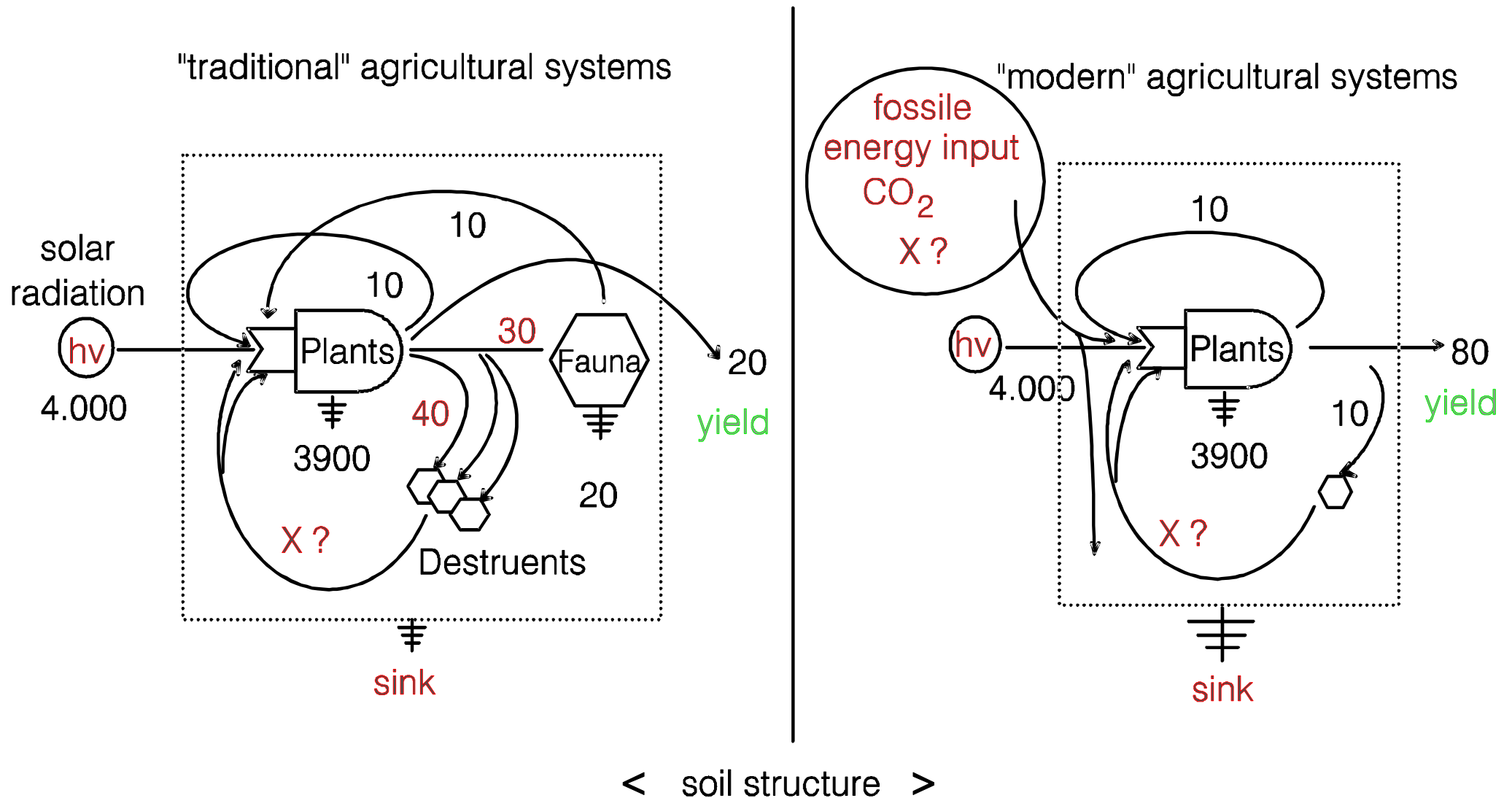
 = Massentransfer
 = Steuergröße



LOLIUM



Description of Sustainability



energy balance in agriculturally used systems (after H.T.Odum, 1971).

Rhizodeposition Strategies of Plant Species

high biomass production

- keeping a reserve for remineralisation by slow decomposers (K-strategy)

high exudation of low molecular weight organic substances

- quick substrates for fast remineralizing microorganisms (R- strategy)

Combinations (extremes) and their impact on ecosystems

high biomass and **high** exudation high turnover, steady state or shift?

high biomass and **low** exudation steady state, slow shift of biodiversity

low biomass and **high** exudation quick depletion of nutrients, degradation?

low biomass and **low** exudation steady state, slow turnover rates

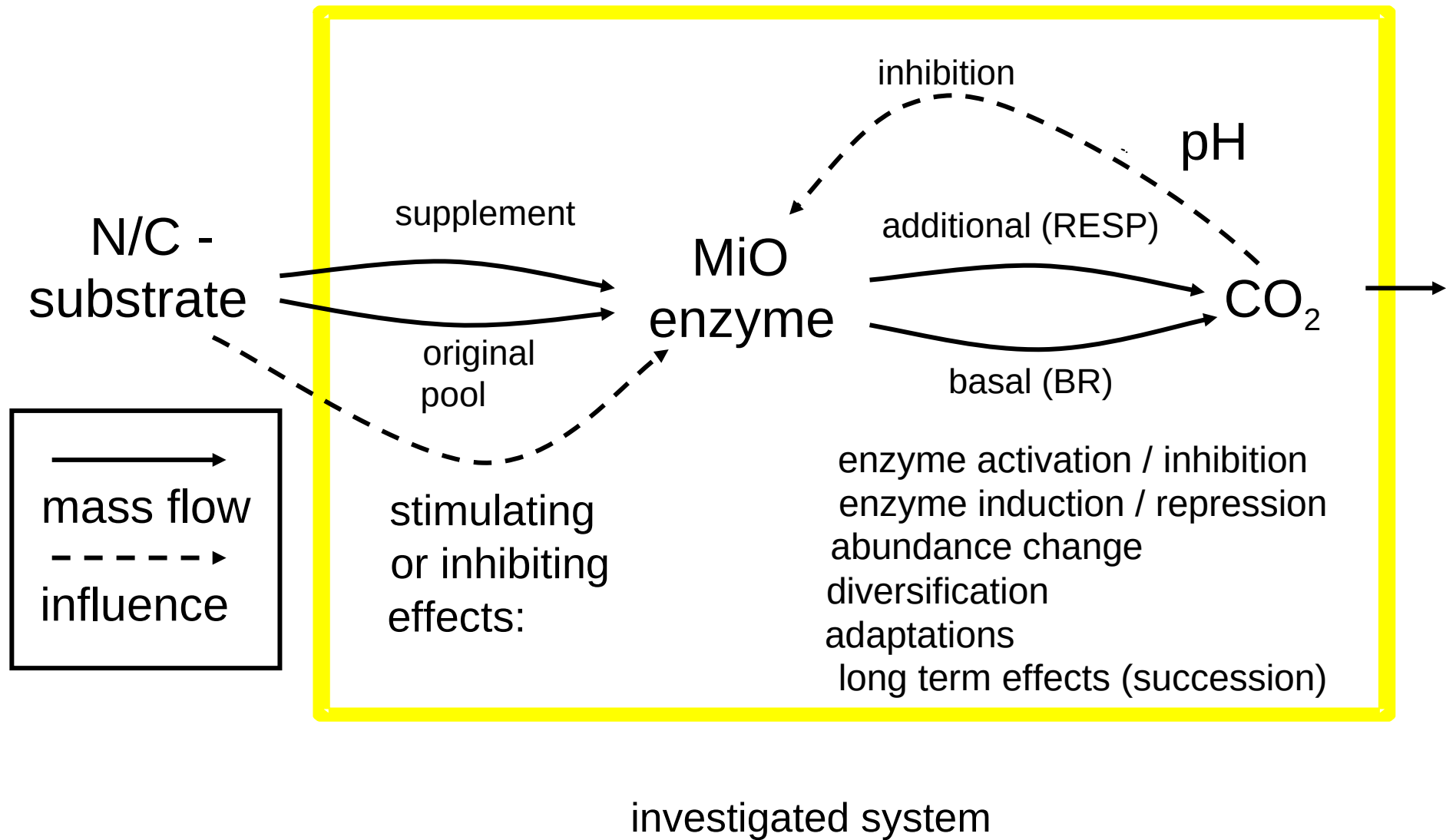
- Vom allgemeinen Schema zum spezifischen Ökosystemmodell
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Definitionen: Bodenökologie, Bioaktivität

Bodenökologie

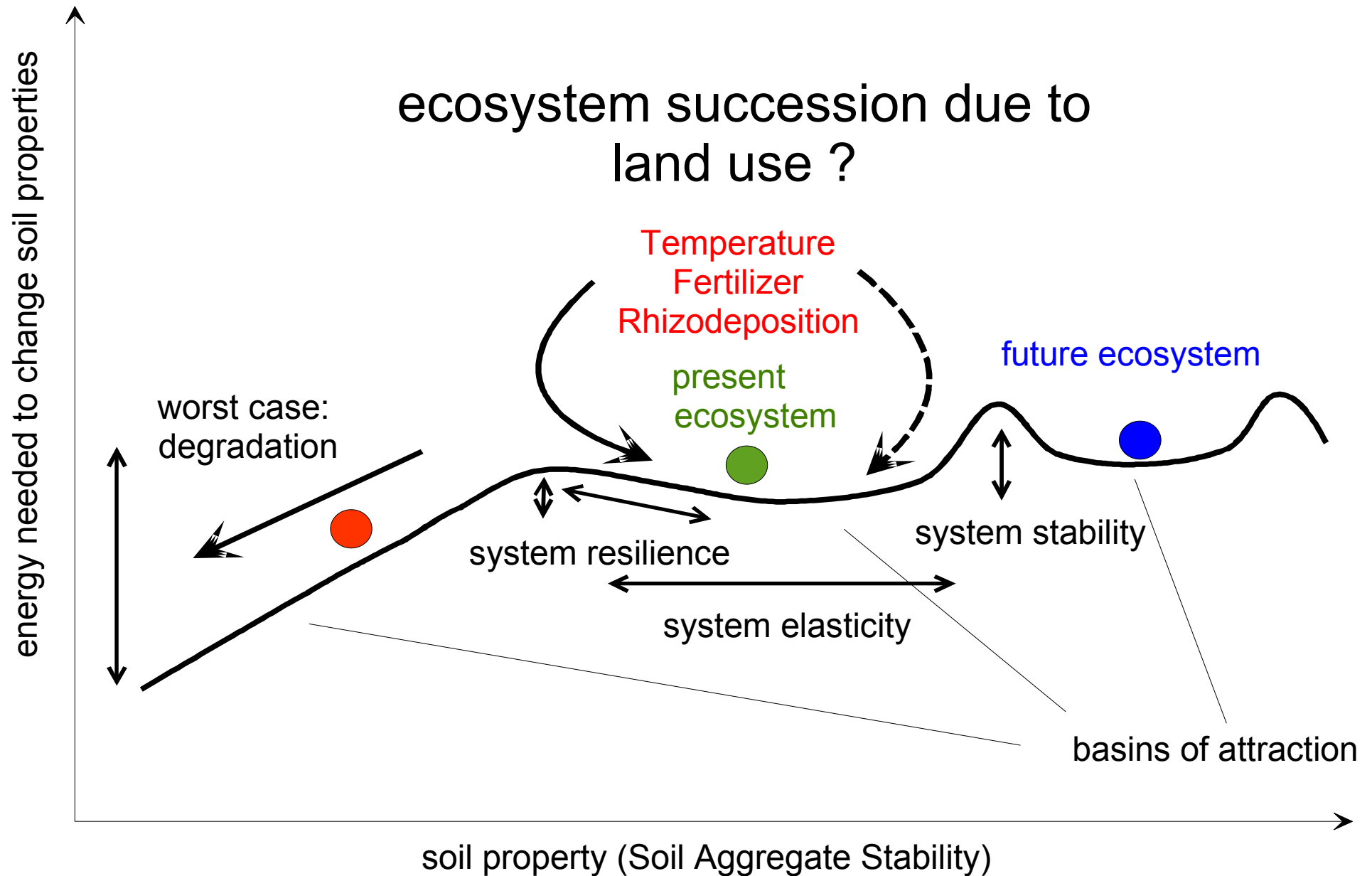
Rhizosphäre	Durchwurzelter Bodenraum, s.s. von der Wurzel direkt beeinflusster Boden.
Rhizoplane	Wurzeloberfläche, von Organismen besiedelt.
Rhizospährenorganismen	An der Wurzeloberfläche lebende Organismen.
Rhizodeposition	Deposition organischer fester und gelöster Substanz durch Wurzeln.
Wurzelexudation	Sekretion gelöster organischer Substanz durch die Wurzel.
Bioaktivität	Aktuelle meßbare metabolische Aktivität lebender Organismen oder Exoenzyme.
Potentielle Bioaktivität	Maximale induzierbare Bioaktivität.
Potentielle Biomasse	Maximale Abundanz bei optimalen Bedingungen (Induktion).
Biomasse	In g oder g C angegebene Masse lebender oder in Lysis befindlicher Organismen.
Abundanz	Häufigkeit der Individuen einer Art.
Artenreichtum	Artenanzahl in einem System „species richness“
Diversität	relative Anzahl vorhandener Arten bezogen auf....(Shannon Weaner u.v.a.m.)
Relative Bedeutung	Dominanz einzelner Arten bezogen auf Abundanz und Bioaktivität.
Poolgrößen	Mengen einzelner Metaboliten .
Flüsse	Umsatzraten einzelner Metaboliten.
Energiefluss	Translokation Potetieller Chemische Energie wie etwa ATP.
Materialfluss	Translokation von Substanz, s.s. potentieller Biosubstrate.
Residenzzeit	Verweilzeit einer Substanz in einem System.
Turnoverzeit	Zeitraum der vollständigen Rezyklierung einer Substanz in einem System.
Source_Quelle	Energie bzw. Kohlenstoffquelle
Sink_Senke	Ort, an dem eine Substanz bzw. Energie immobilisiert wird.

Level of Impact



Stability of Soil Systems

ecosystem succession due to
land use ?



THERE'S TREASURE EVERYWHERE

