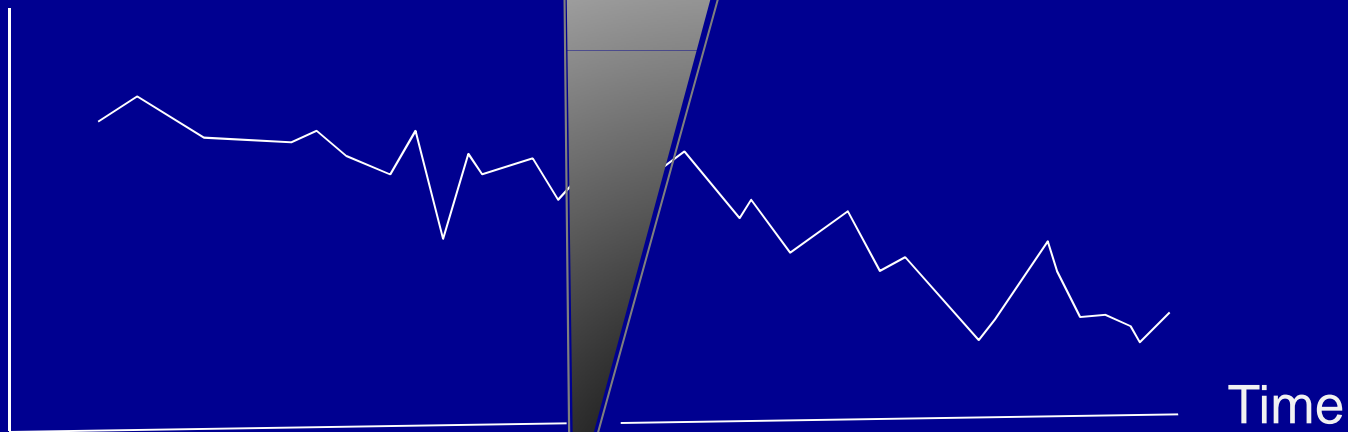


# Time Scales Sustainability and the Memory of Soils

Hannes Flüeler,  
ETH Zürich

Soil  
function



Our  
aperture

Time

# Summary

Soil is a life-support capital which is changing in time

The time scale of soil formation is far beyond that of sustainable land use.

Soils remember undergone damage. Recovery takes much longer than degradation

Our time window for observing gains or losses of this capital is short compared with the time of the capital's change

# Concept of Sustainability

# Origin of the Sustainability Concept

Rio 1992 (Earth Summit, Agenda 21)

Limits to Growth (Limits to growth, Meadows et al 1972)

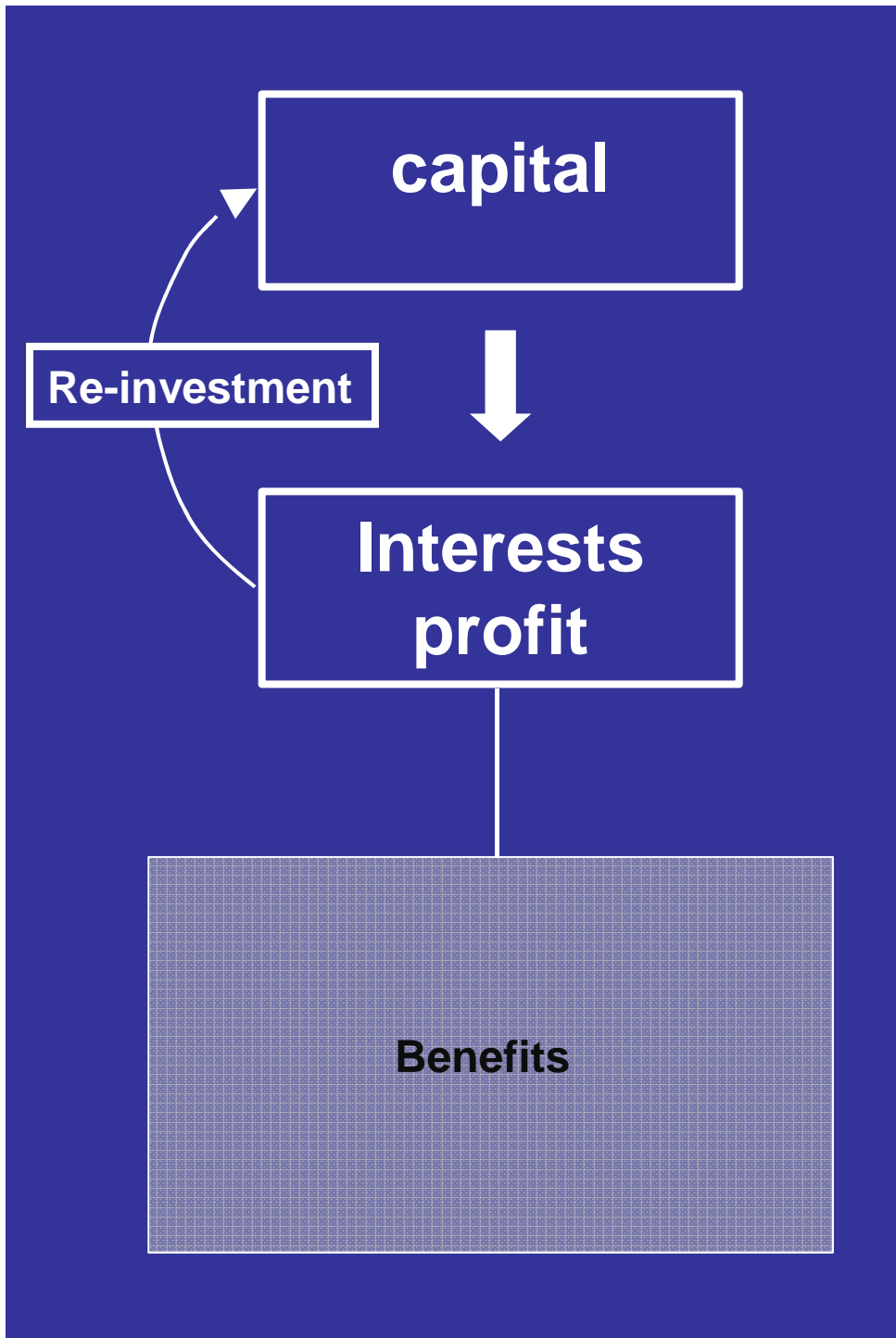
- ....

- ....

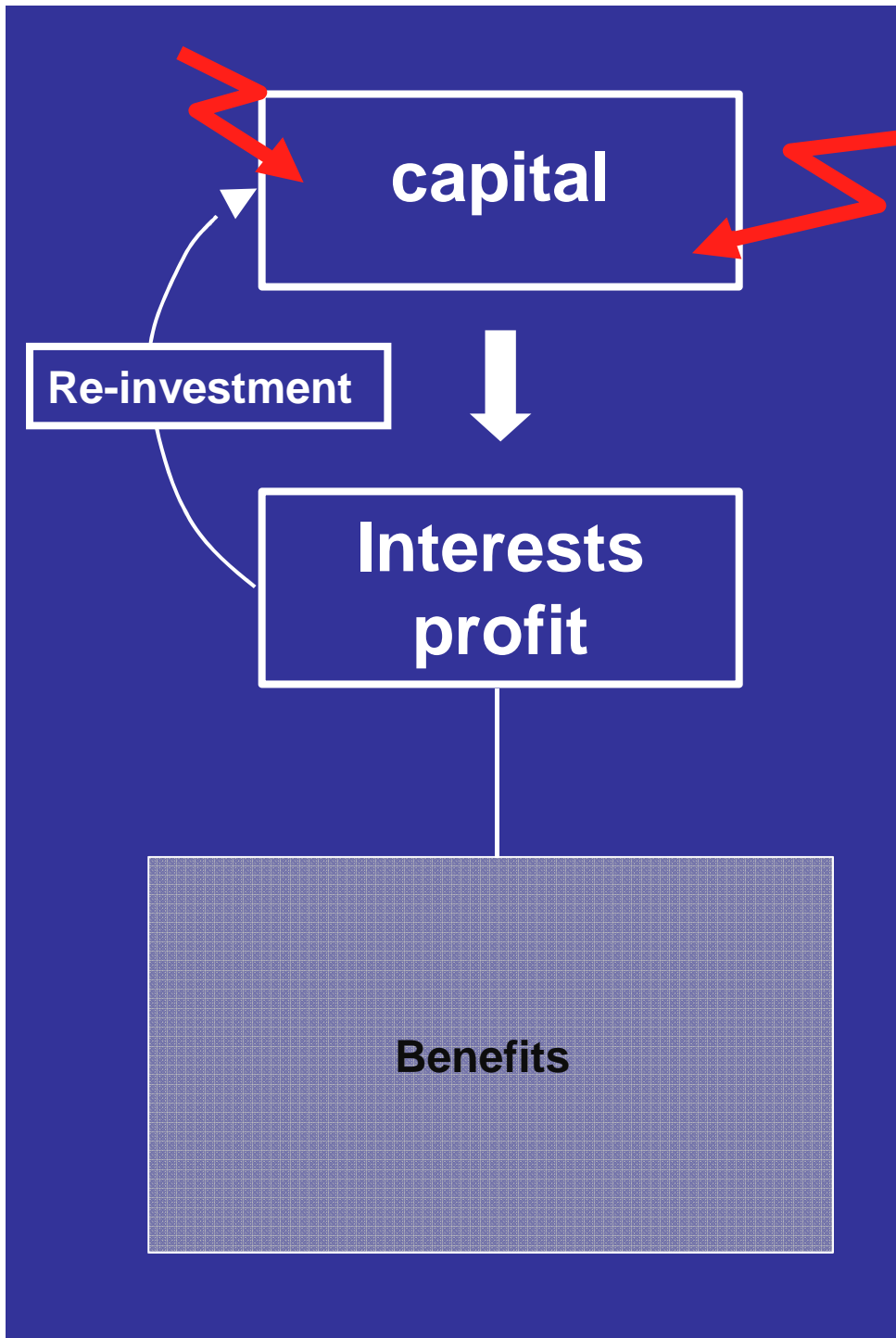
Swiss Forest Protection Law (1902 Nachhaltigkeitsgebot)

- ....

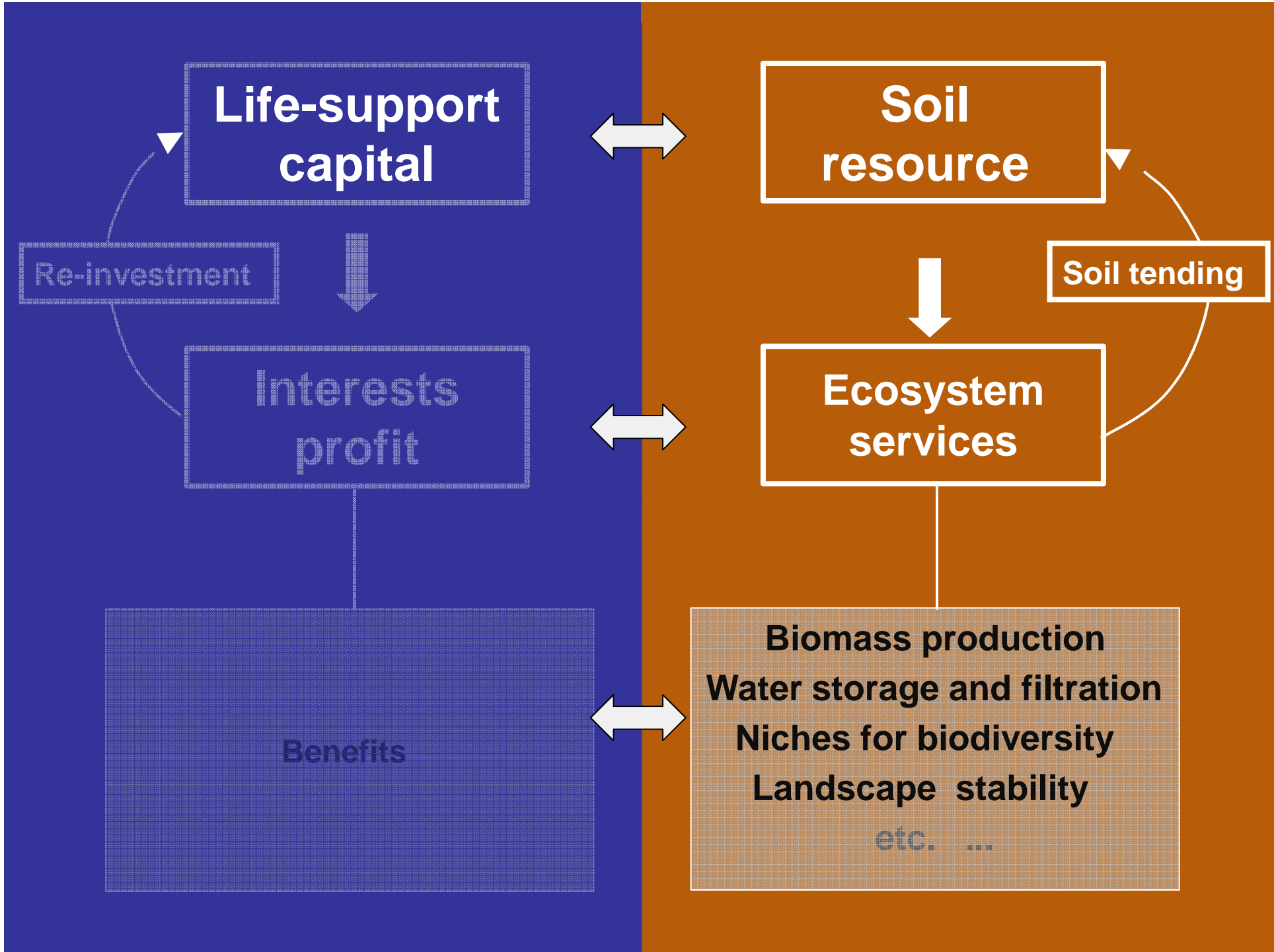
- ....



Consuming only  
the benefits is  
**sustainable**



**Unsustainable**  
when the capital  
gets diminished by  
external controls  
or  
overconsumption



**(Un)sustainable use of soils**

# Soil loss in 105 years



**Groundwater control drained cultivated peat land ...**

**Drainage aerated the peat soil ...**

**Peat got respired and escaped as CO<sub>2</sub>**

**Drain pipes,  
originally placed at  
depth 80 cm,  
are ploughed to the  
surface**





**Peat harvesting in Galway (Ireland)**



**Heating with peat**

**Peat growth      s**  
**~ 1 to 2 mm/y**

**Probably  
sustainable (?)**



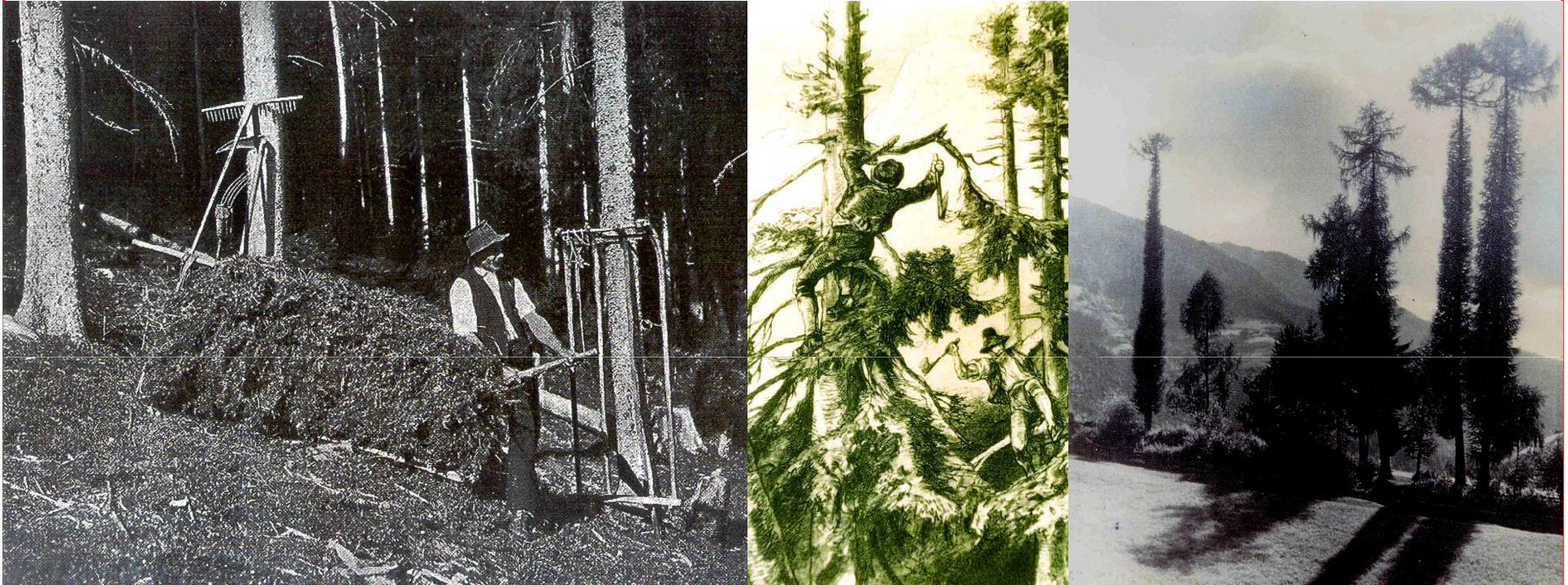
## Peat for Powerplant

SOD PEAT-BURNING  
ELECTRICITY STATION  
Capacity 5,000 Kilowatts

sustainable ???

... probably not

# Unsustainable nutrient export



**Harvesting leaves, needles twigs  
("Streunutzung" , "Schneiteln)**

Illustrations by G. Glatzel (BoKu Vienna)

## EFFECT OF LITTER RAKING ON SOIL NUTRIENT STORES IN ZILLERTAL (TYROL)

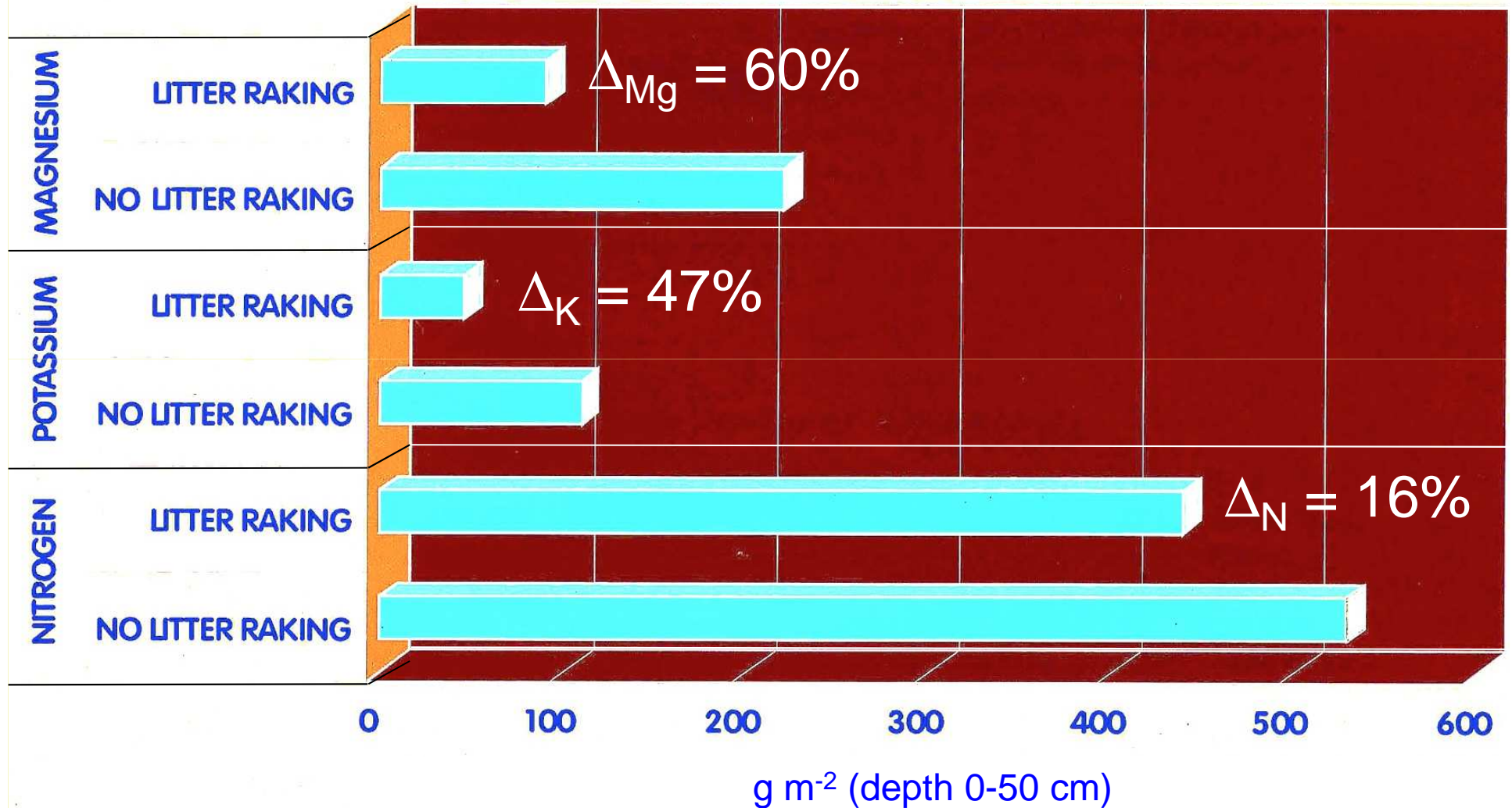
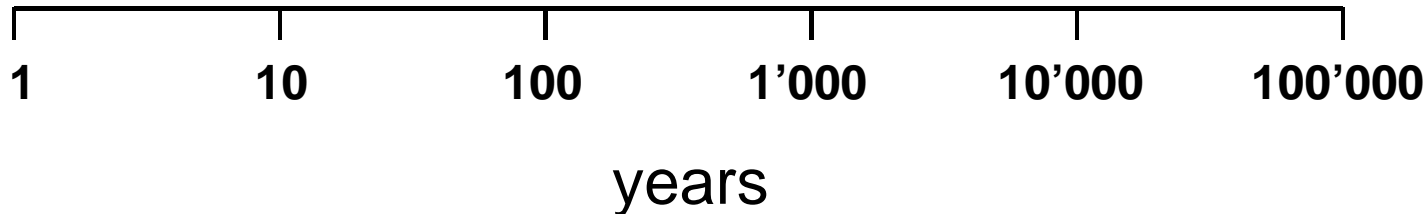


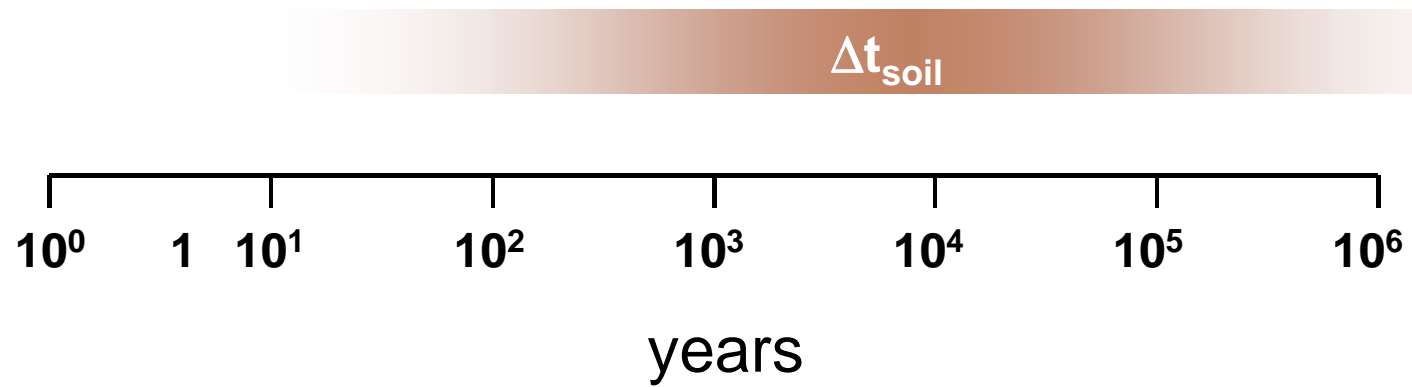
Illustration by G. Glatzel (BoKu Vienna)

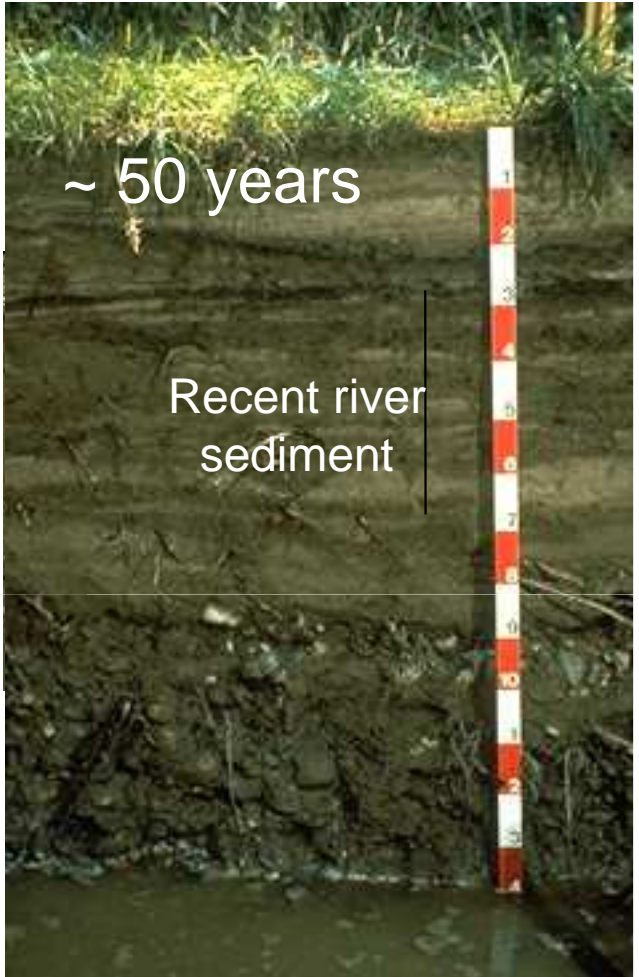
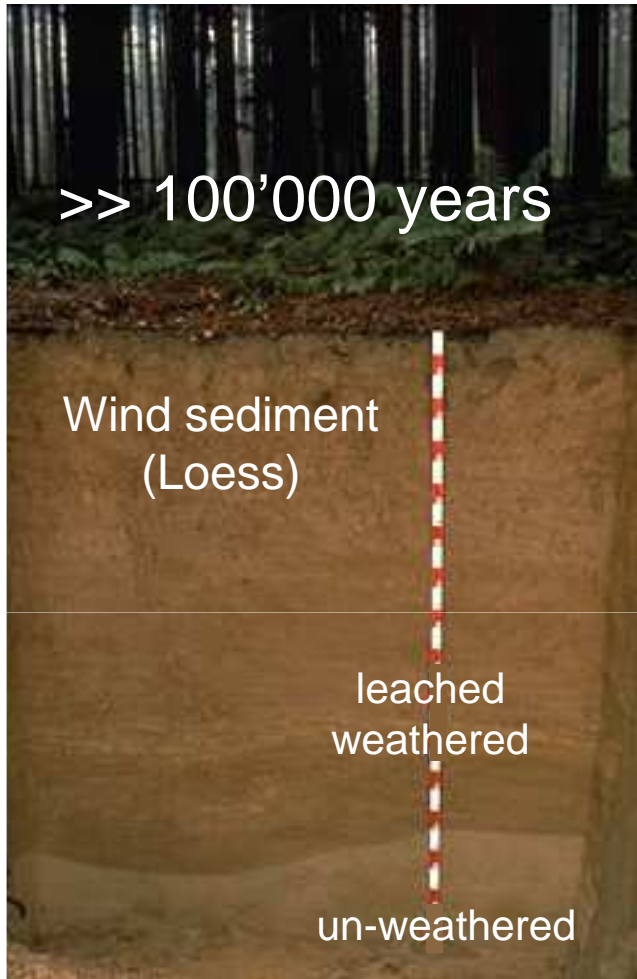
# Time scales

- of a soil's life span
- of soil degradation and recovery
- of various soil observers



## Soil formation

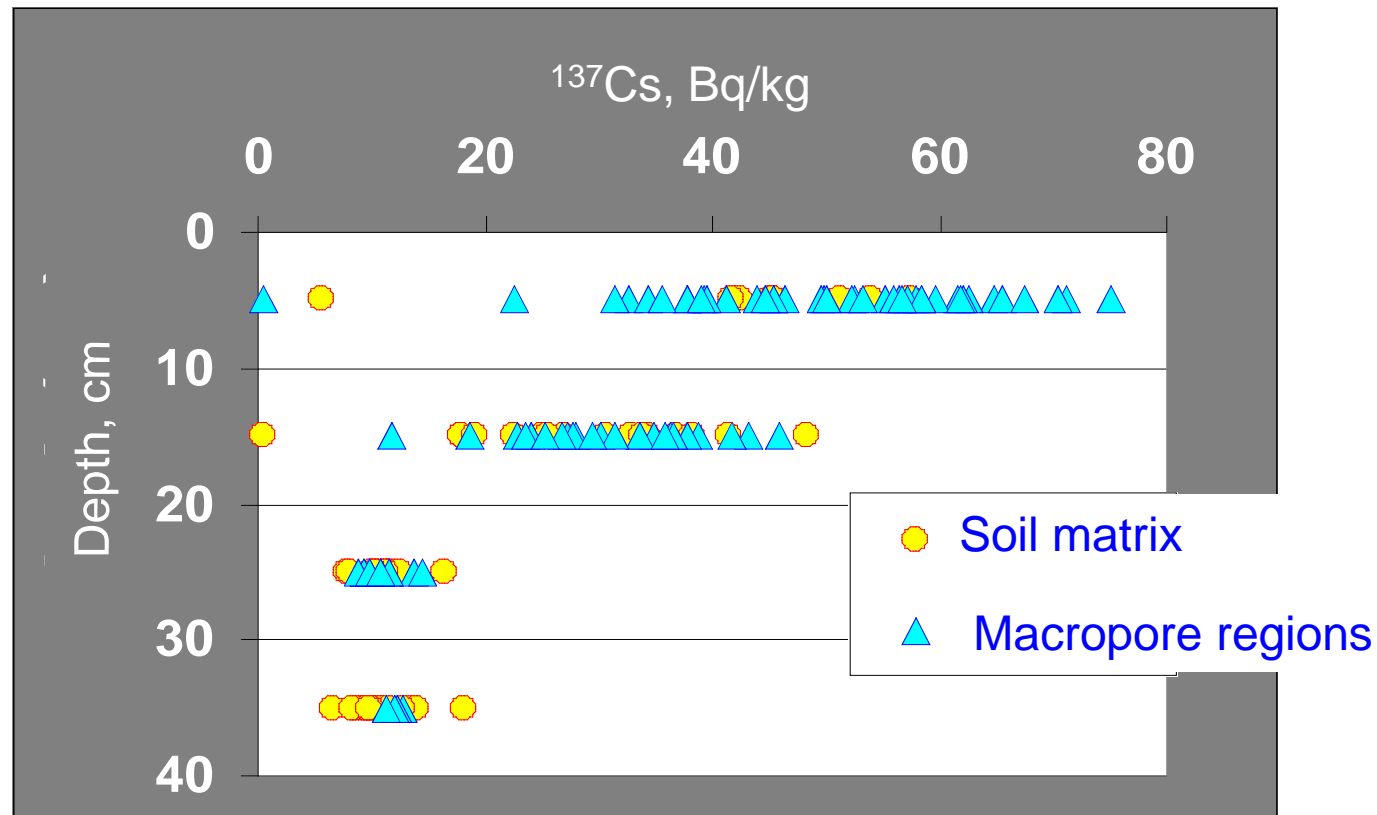




Soils are aging

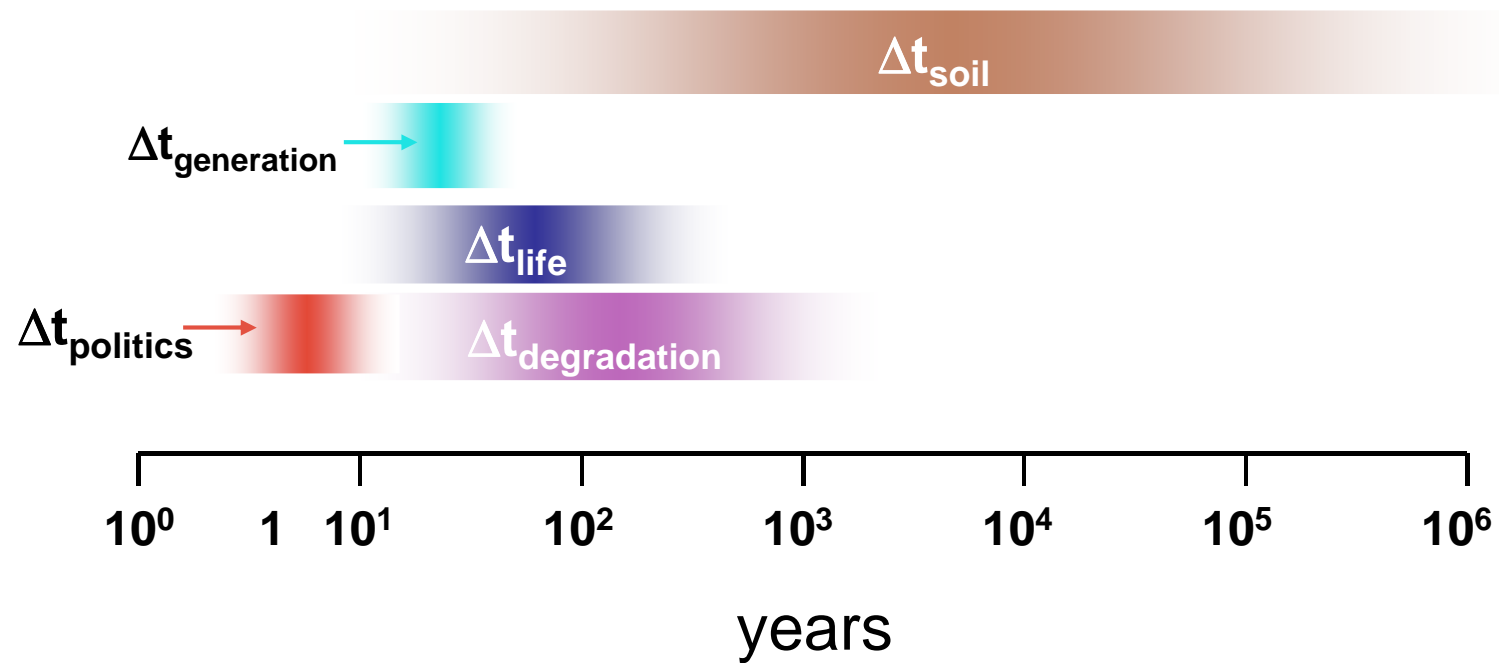
# Tschernobyl $^{137}\text{Cs}$ in a Swiss meadow soil (Cambisol)

$^{137}\text{Cs}$  should be gradually leached out of the root zone ...

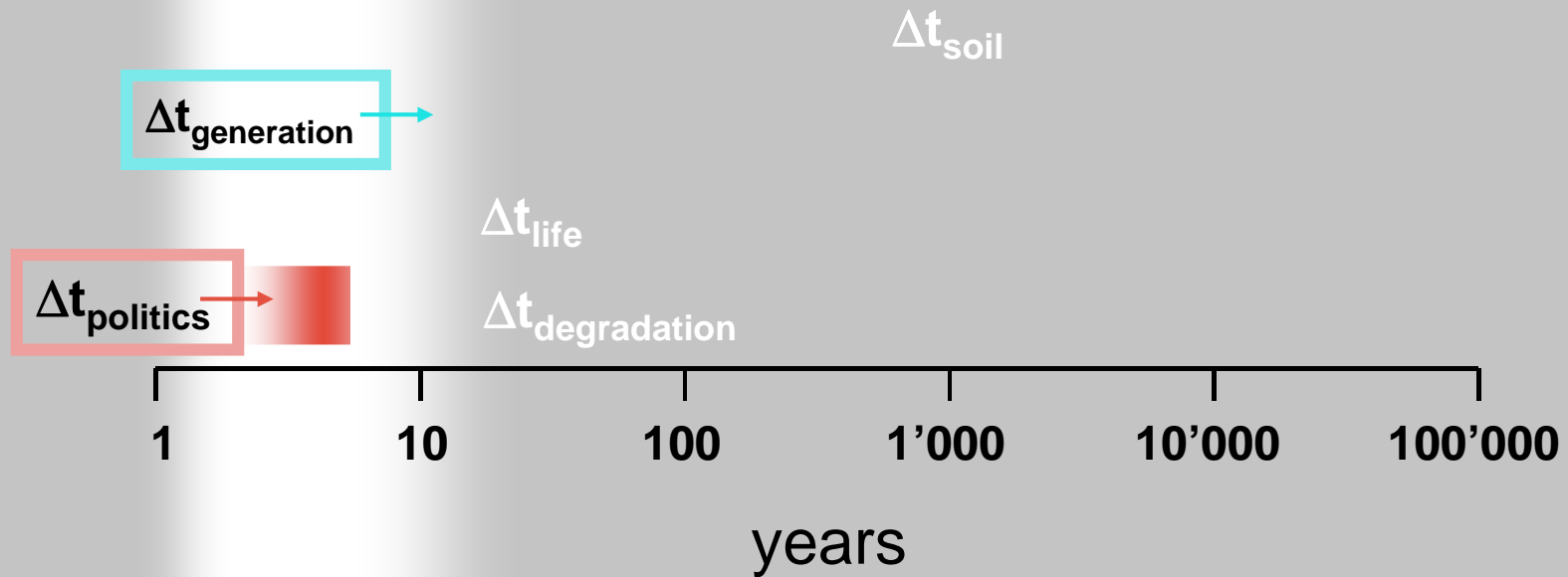


... but it remains within biologically active top soil

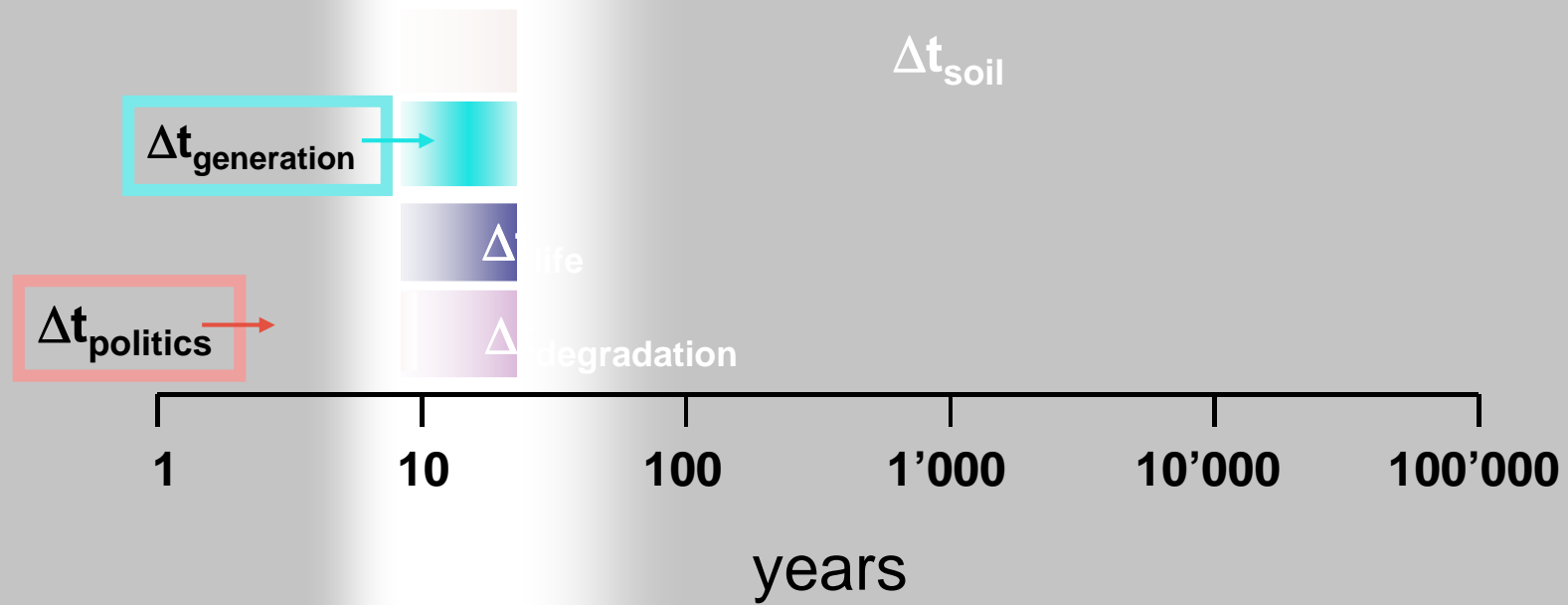
# Time scales of changes and human perception



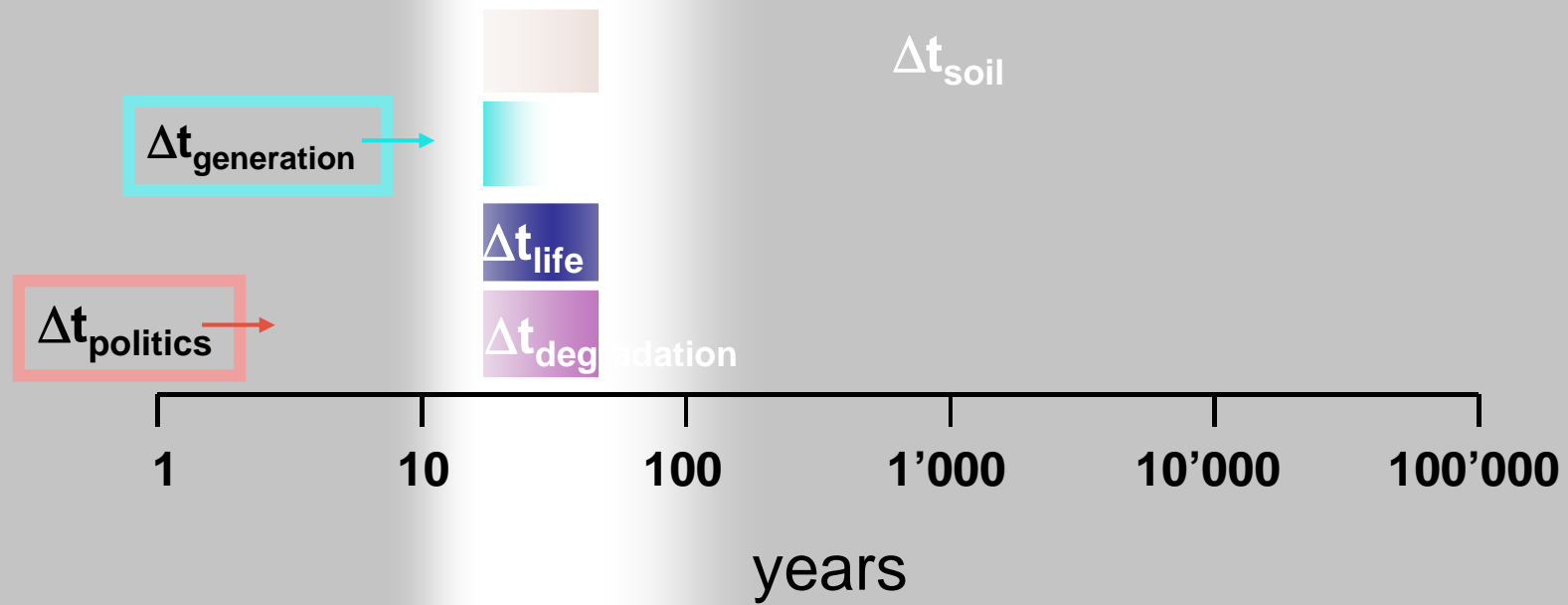
# Window of politics



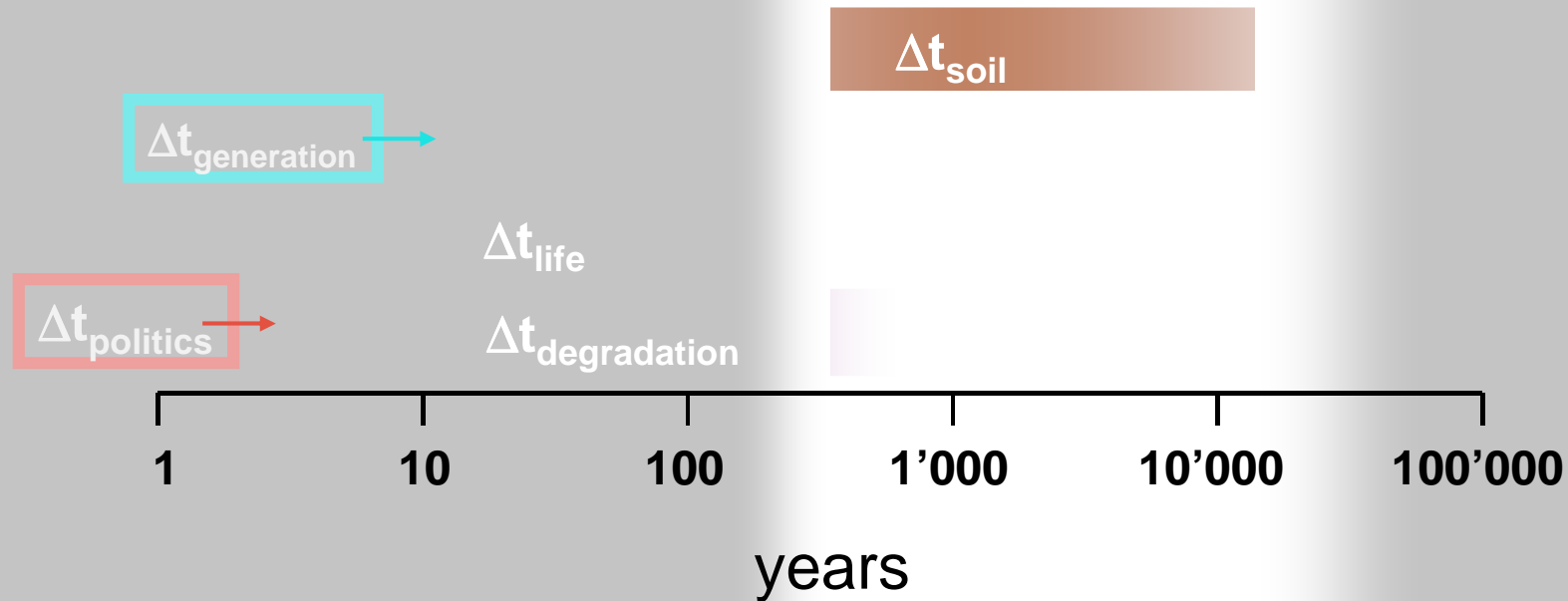
# Window of one generation




# Window of one individual



## Time scale of the changing capital



  
Time scale of the  
sustainable use of  
soils

... how many  
generations ???

# Summary

Soil is a life-support capital which goes through a “life cycle”

The time scale of soil formation is far beyond that of sustainable land use.

Soils remember undergone damage. Recovery takes in most cases much longer than degradation

Our time window for observing gains or losses of this capital is short compared with the time of its change

