Carbon Fluxes

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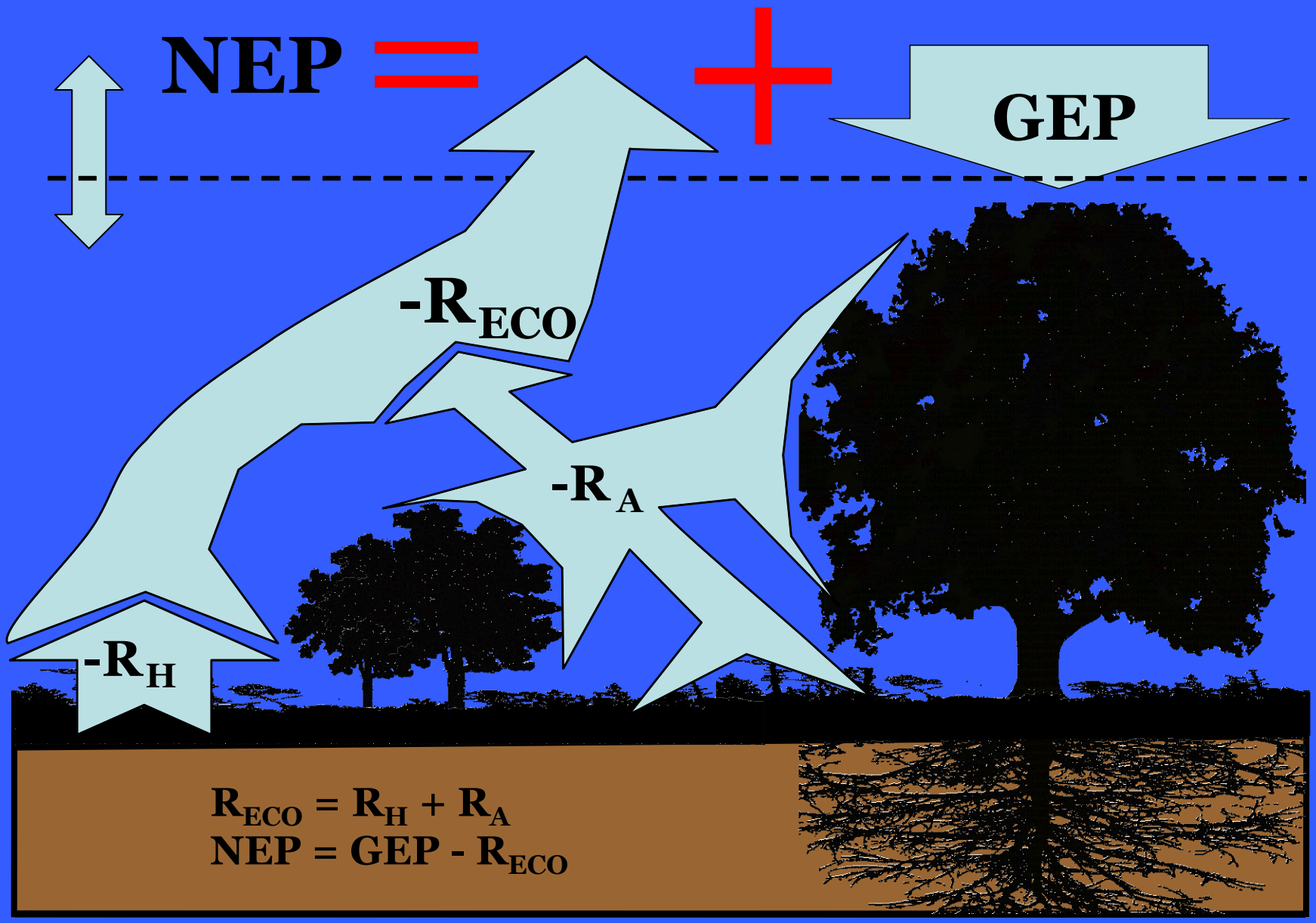
OP Vzdělávání pro konkurenceschopnost
INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

Content:

Carbon balance
Radiation
Photosynthesis
Respiration
Eddy covariance + result samples
What is forest able to do?

Carbon balance

CO_2 forest ecosystem balance



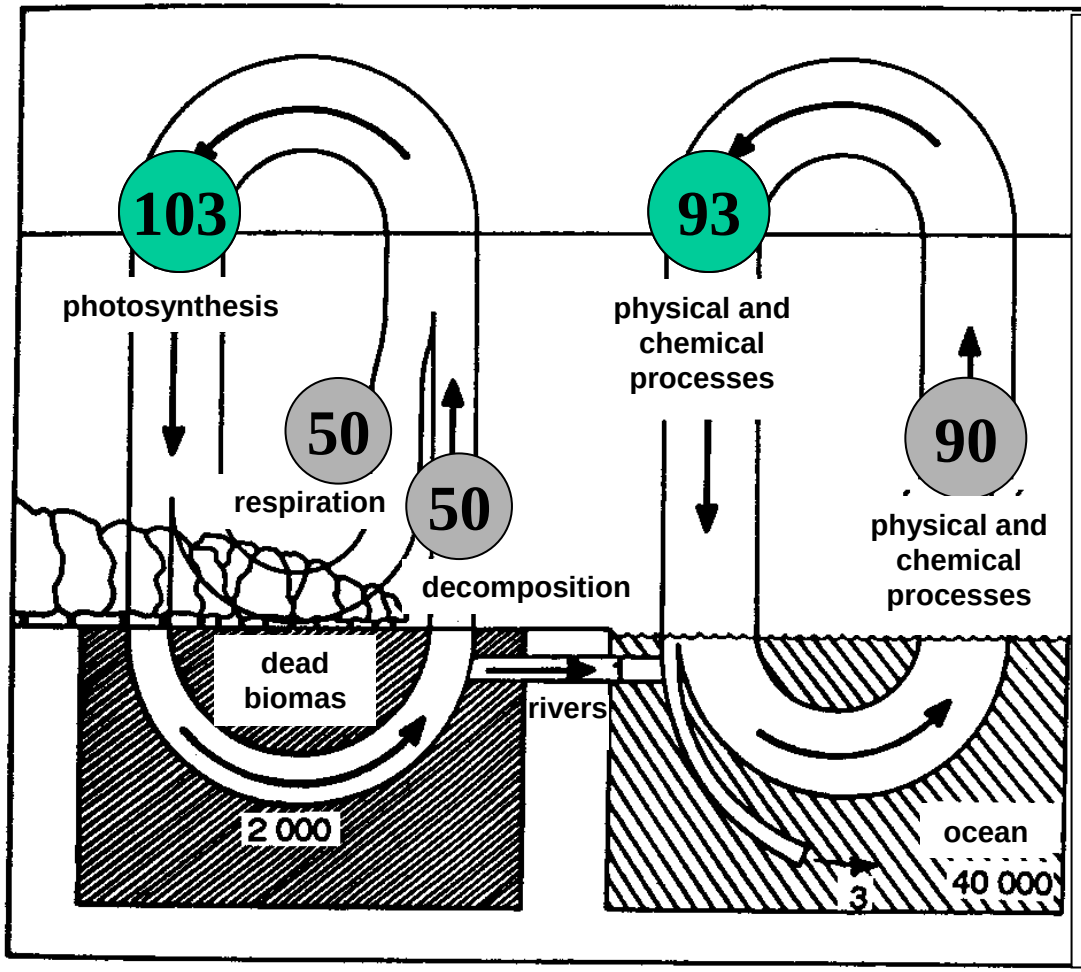
$$CO_2 + 2H_2O + H\nu \rightarrow [CH_2O] + H_2O + O_2$$

Photosynthesis

Respiration

$$[CH_2O] + O_2 + H_2O \rightarrow CO_2 + 2H_2O$$

Carbon balance = lifecycle of planet



Long time ago...

... balance

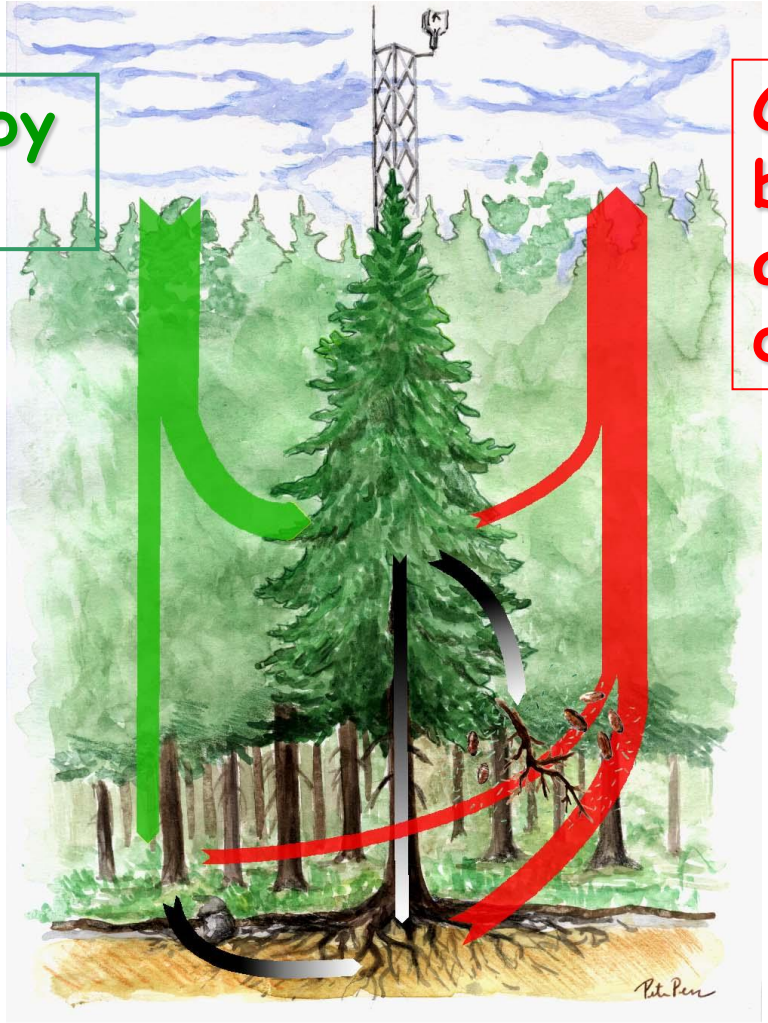
Carbon reservoirs on Earth, i.e. in biosphere, oceans and atmosphere, and yearly CO_2 exchanged among the reservoirs (expressed as Gt of carbon contained in CO_2).


O2
PHOTOSYNTHESIS
CO2
CO2
W
CO2
RESPIRATION
O2
CO2
O2
O2
W
W
K1....K2....K3...
DECOMPOSITION

Carbon balance/disbalance is „product“ of two oposite fluxes

Carbon uptake	Equilibrium	Carbon release
growth	climax state	ecosystem decay

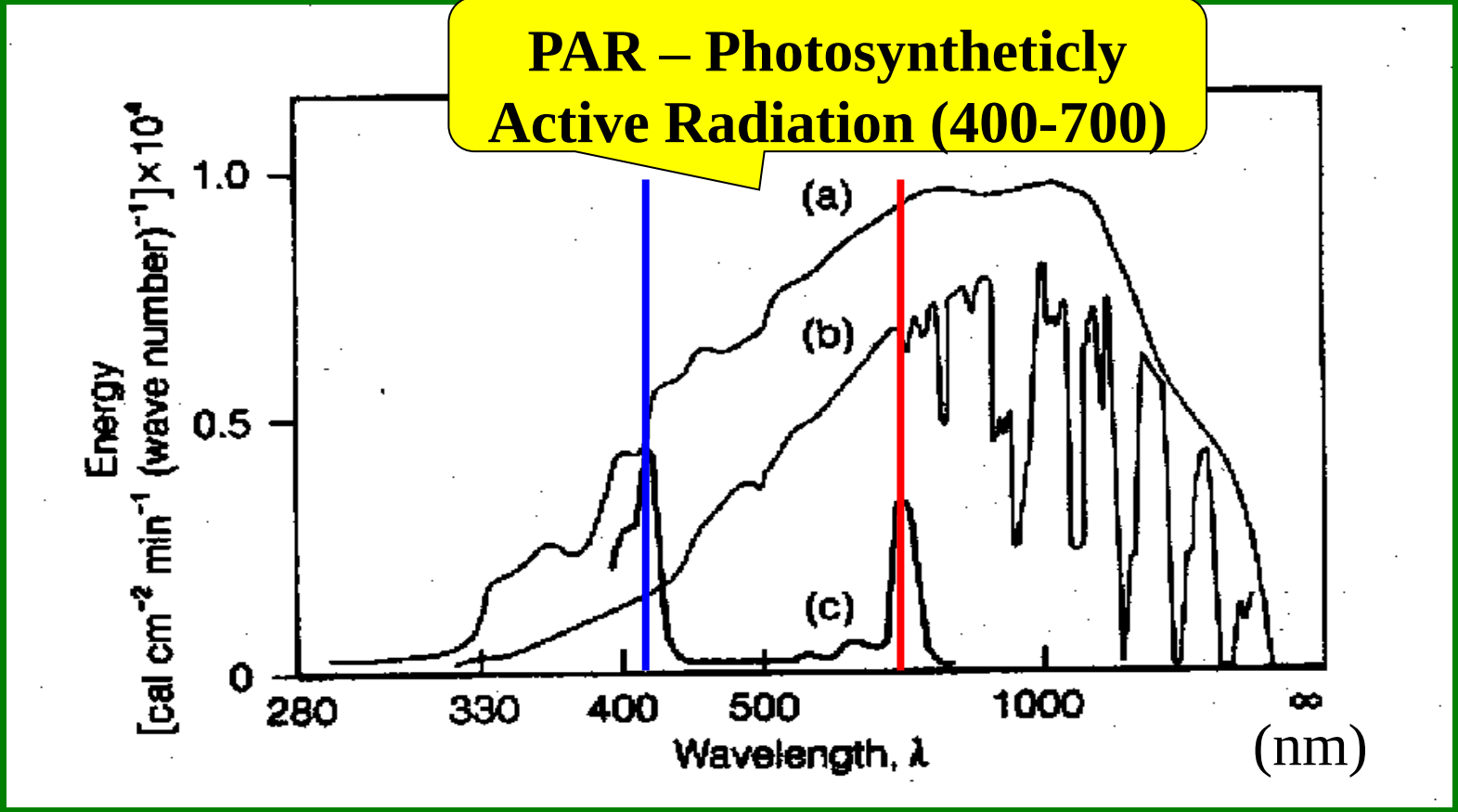
Carbon uptake by photosynthesis



Carbon release by respiration and by decomposition

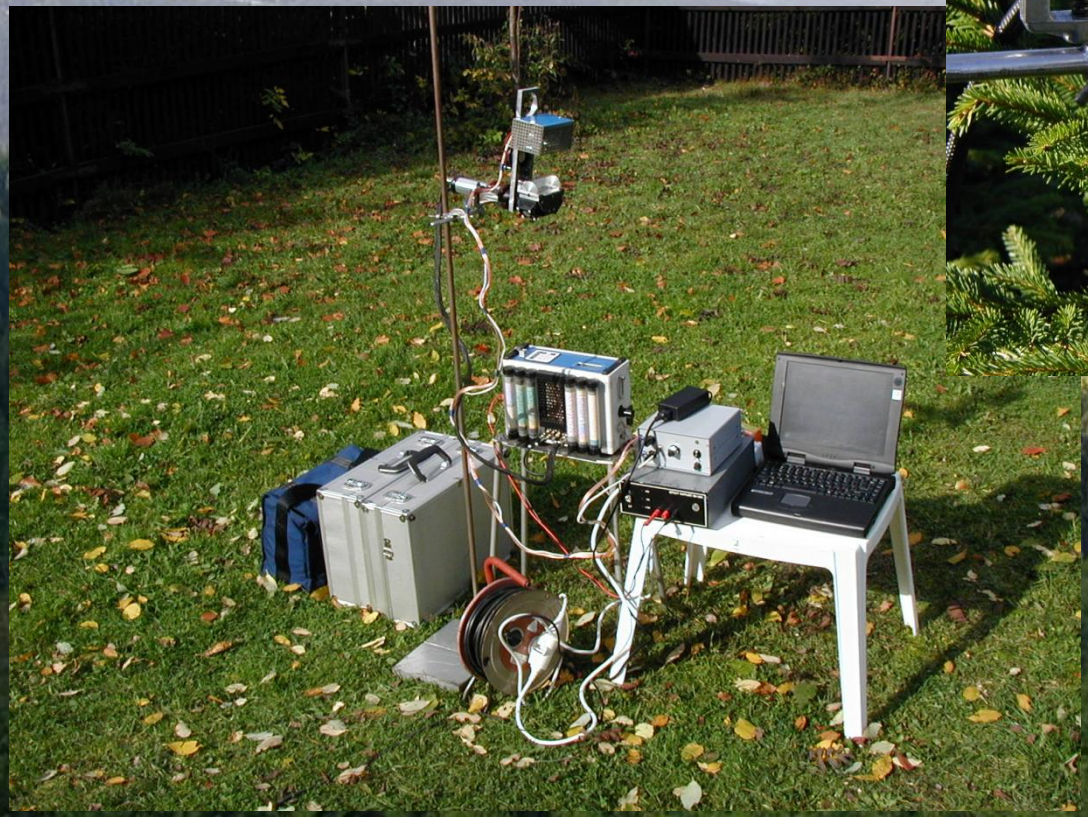
Radiation

SUN RADIATION SPECTRUM



A) Energy radiated by Sun
B) Sun radiation incomming to Earth surface
C) Absorption spectrum of chlorophyl

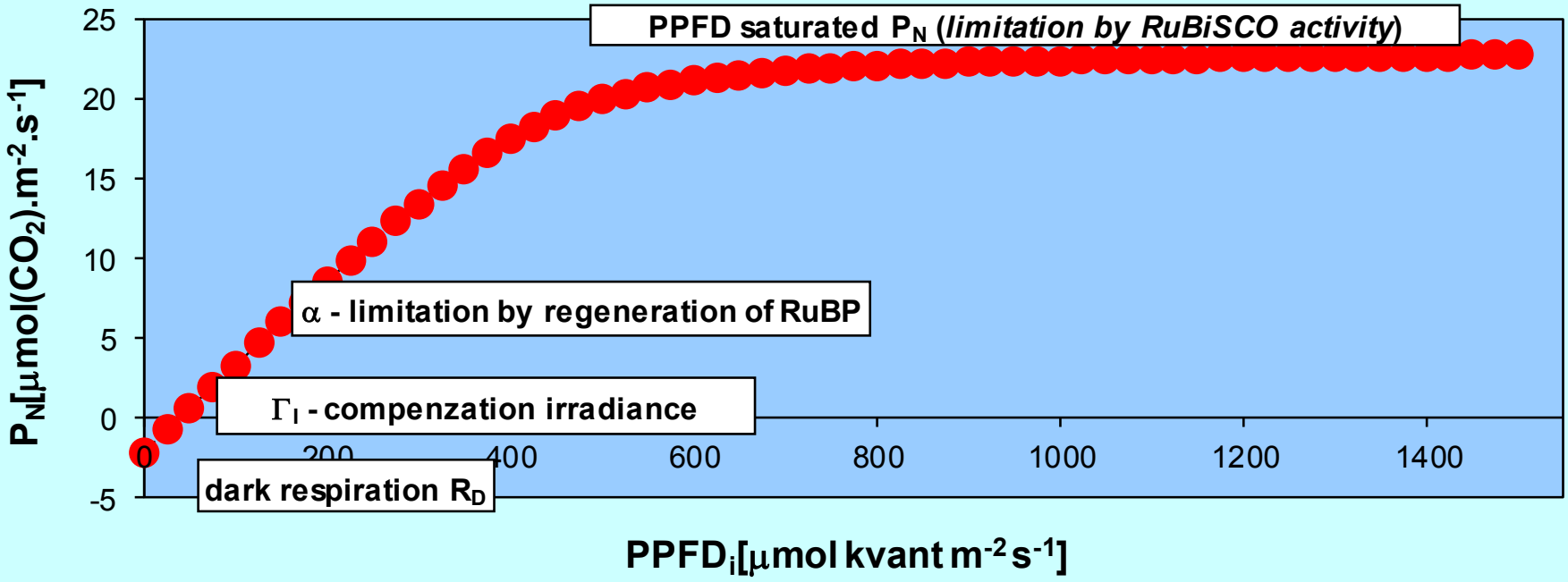
Photosynthesis



PHOTOSYNTHESIS MEASUREMENT

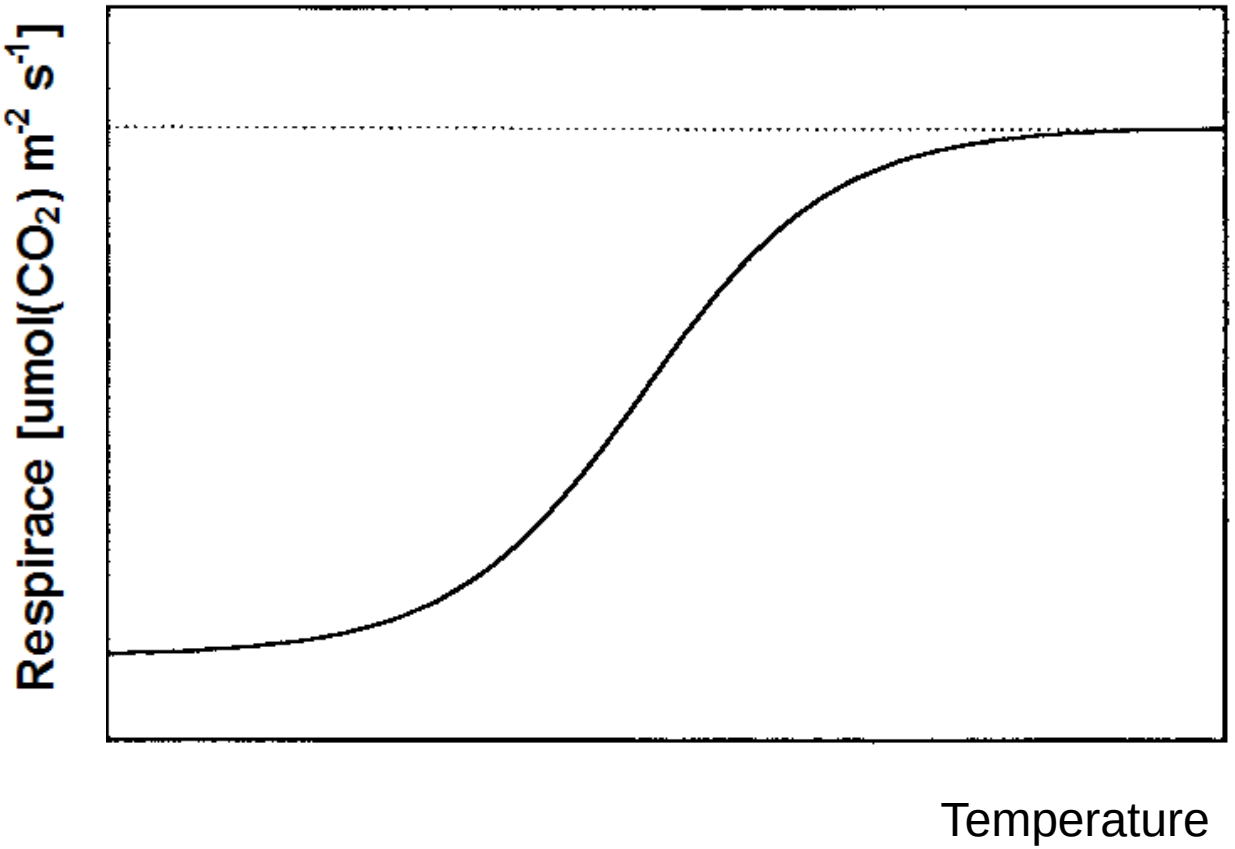
PHOTOSYNTHESIS MEASUREMENT

Dependence of CO_2 assimilation rate on incoming radiation



Respiration

Respiration dependency on temperature



Eddy covariance

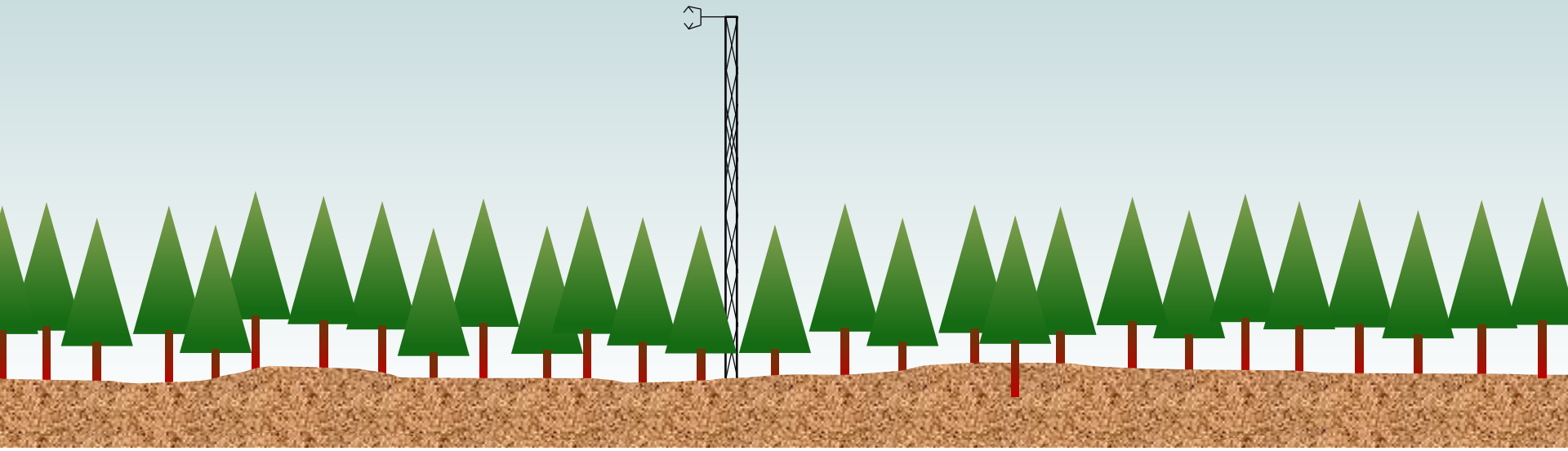
Eddy covariance technigue

3D ultrasonic anemometr

eddy covariance tower

Infrared gas analyser and control computer

Principle of eddy-covariance method



Equation: $F_C = \overline{w}\,\overline{\rho_C} + \overline{w'\rho'_C}$

average vertical flux — eddy flux

w – vertical component of a wind velocity vector

ρ - a scalar (temperature, gas concentration)

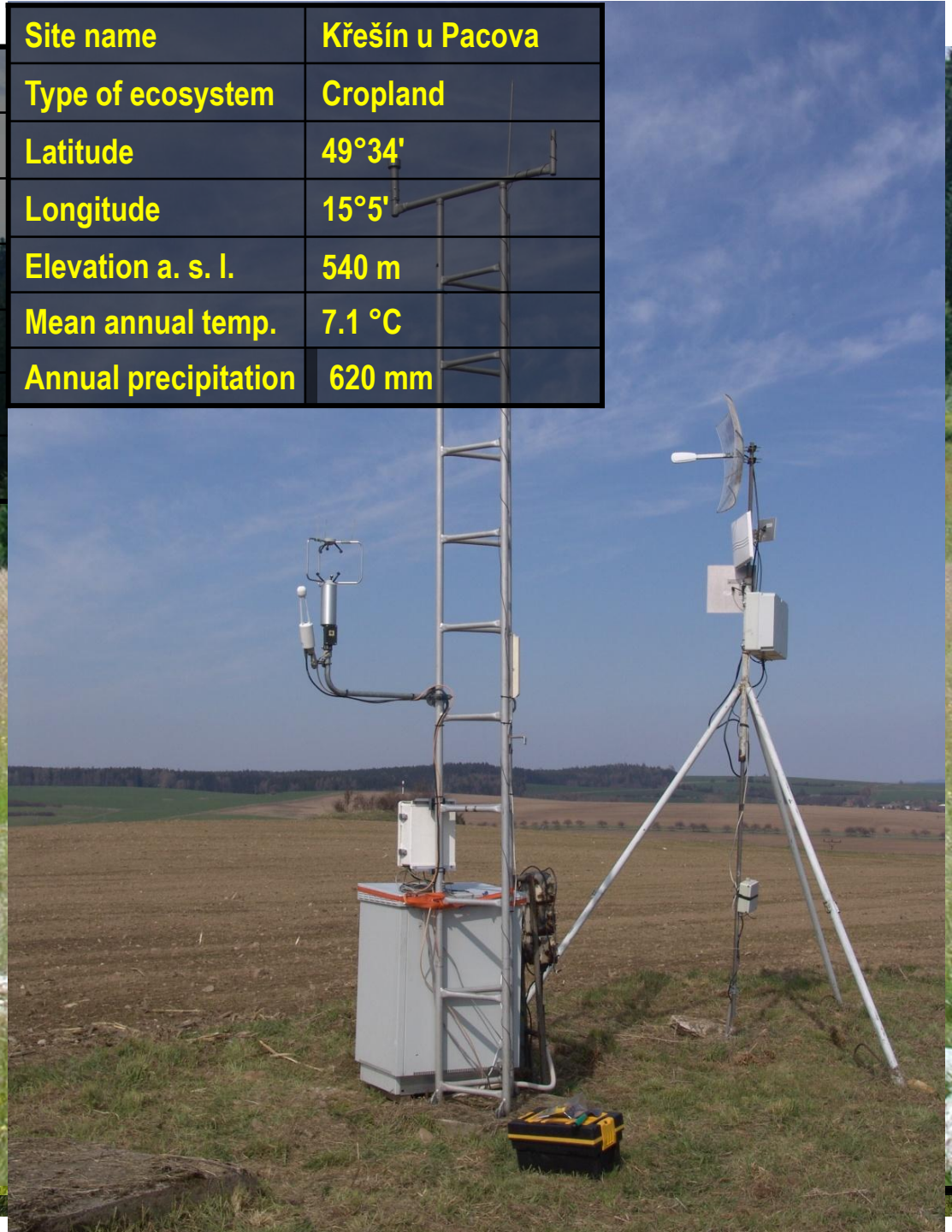
In suitable (long time) interval → $\overline{w} = 0$

Final form : $F_C = \overline{w'\rho'_C}$

eddy flux

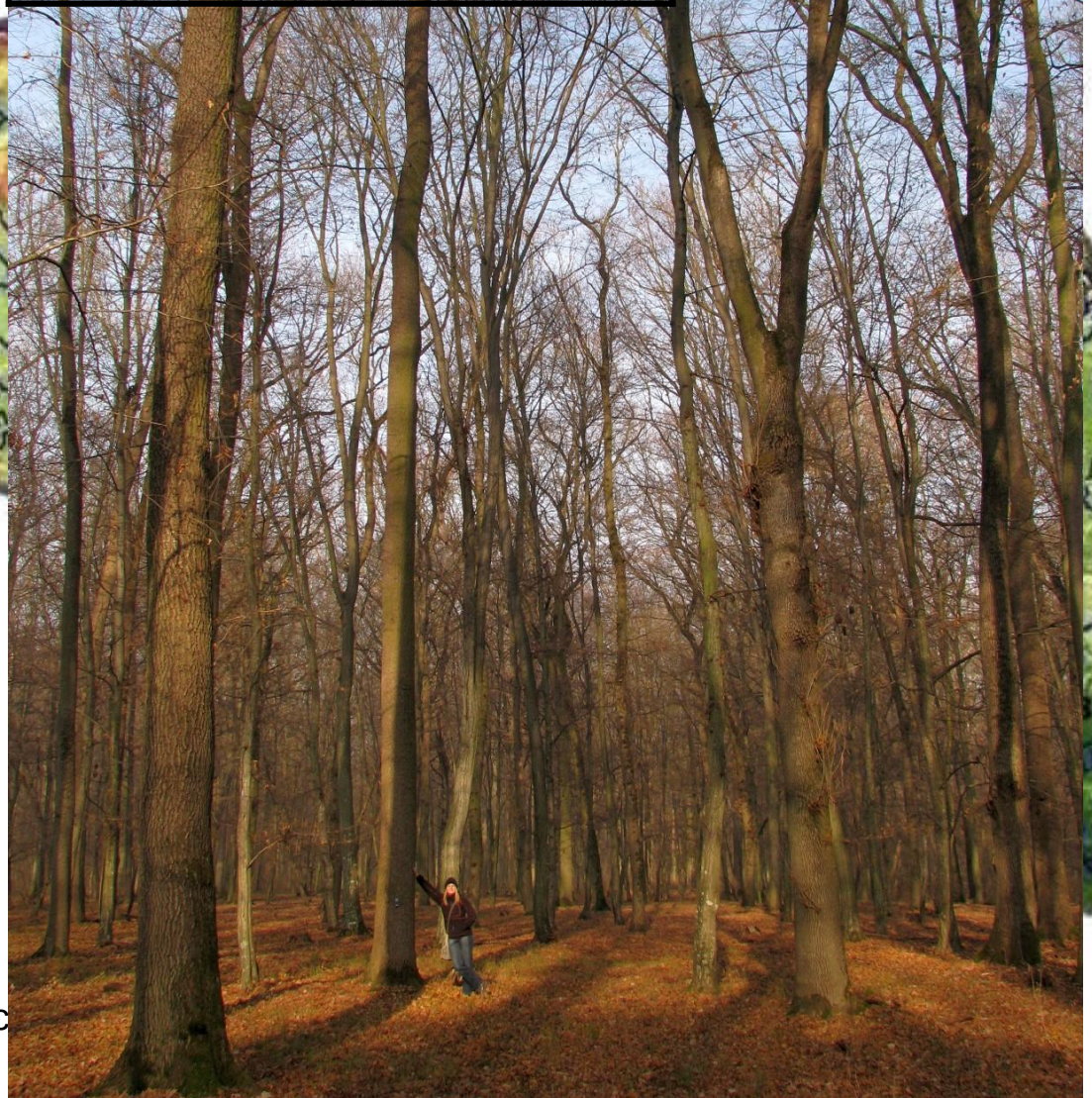
Site name	Křešín u Pacova
Type of ecosystem	Cropland
Latitude	49°34'
Longitude	15°5'
Elevation a. s. l.	540 m
Mean annual temp.	7.1 °C
Annual precipitation	620 mm

Site name
Type of ecosystem
Latitude
Longitude
Elevation a. s. l.
Mean annual temp.
Annual precipitation

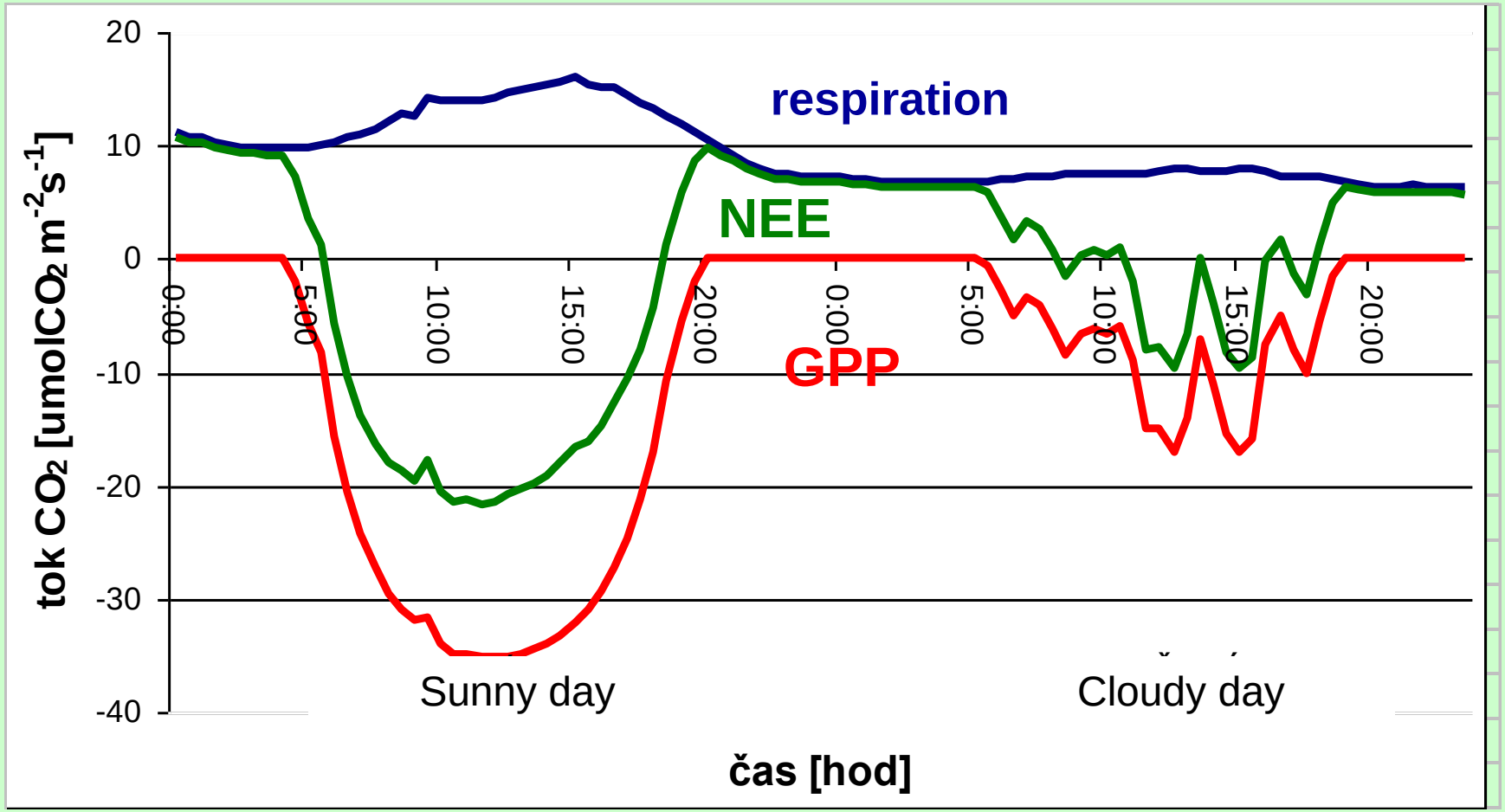


paration ES

Site name	Lanžhot
Type of ecosystem	Floodplain forest
Latitude	48°41'
Longitude	16°57'
Elevation a. s. l.	150 m

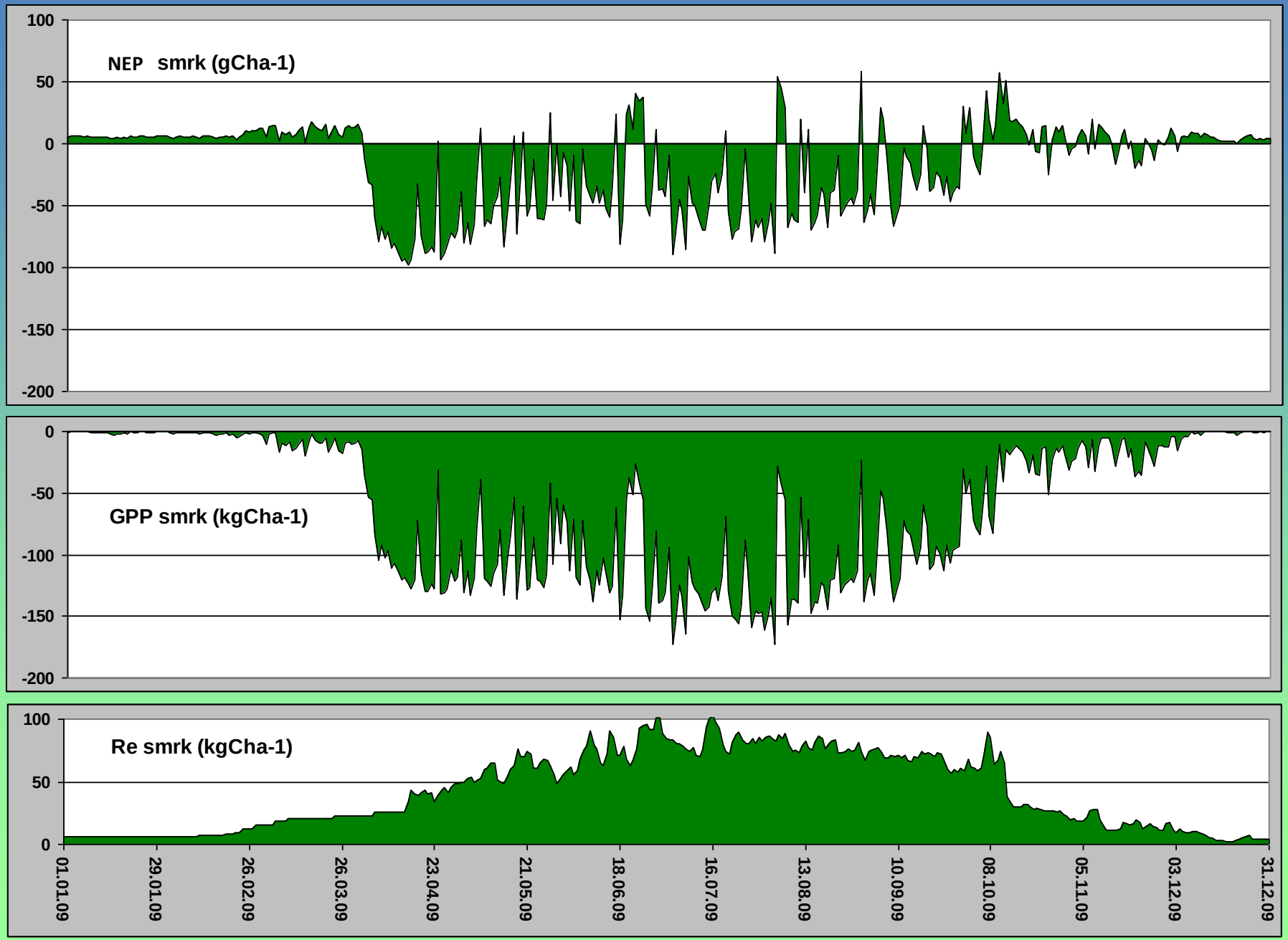


Daily courses of CO_2 fluxes

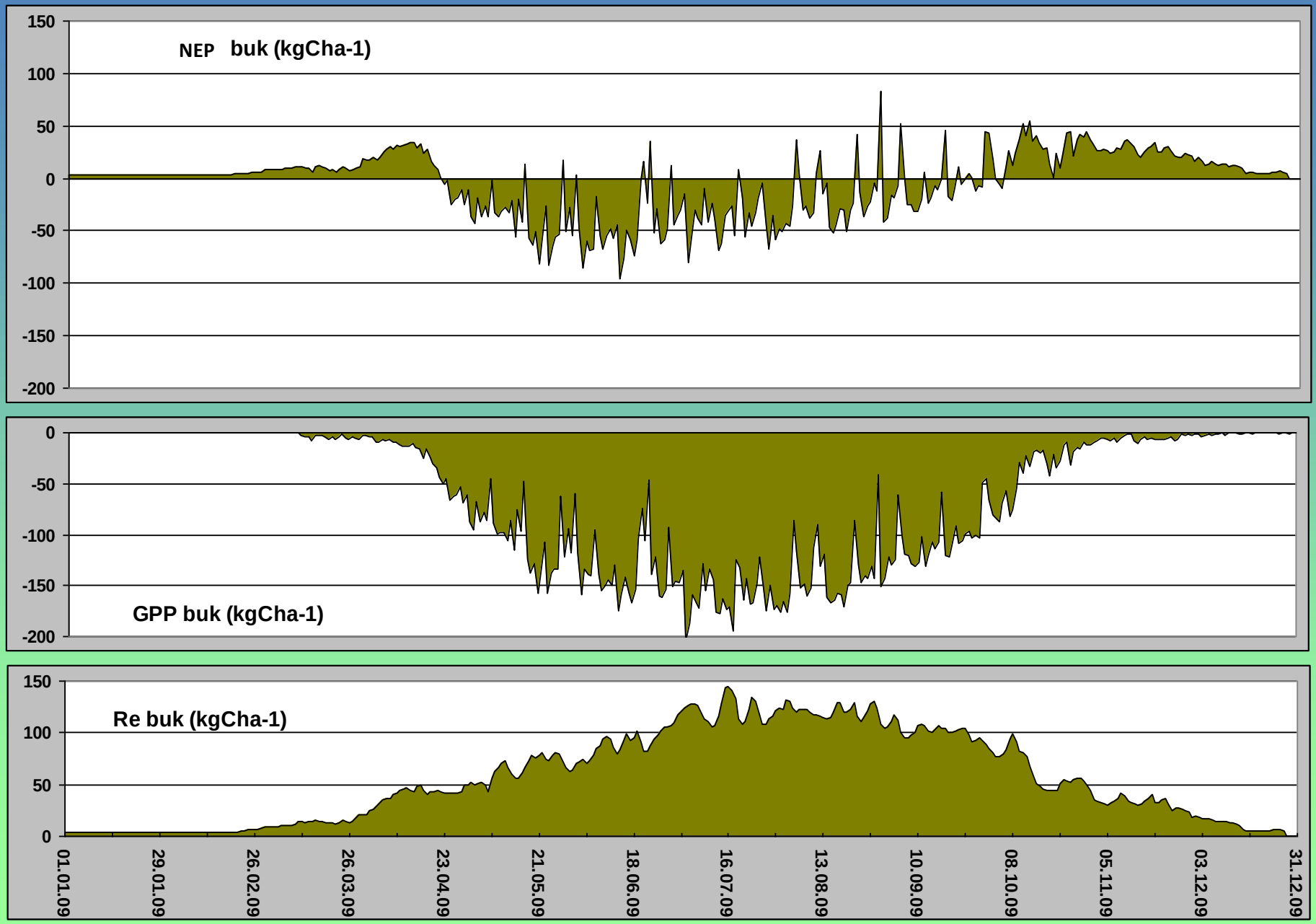


NET ECOSYSTEM PRODUCTION

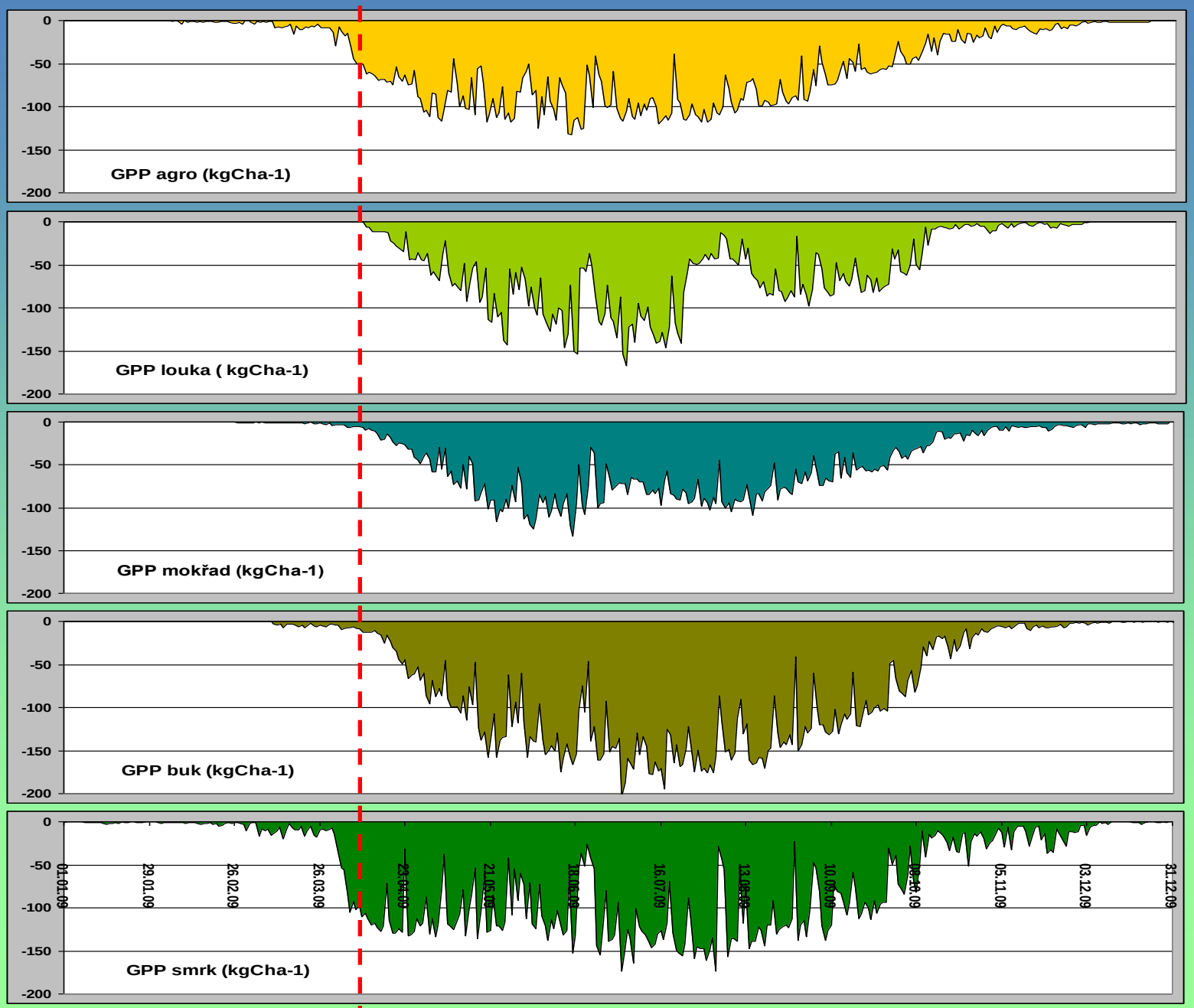
spruce mountain forest



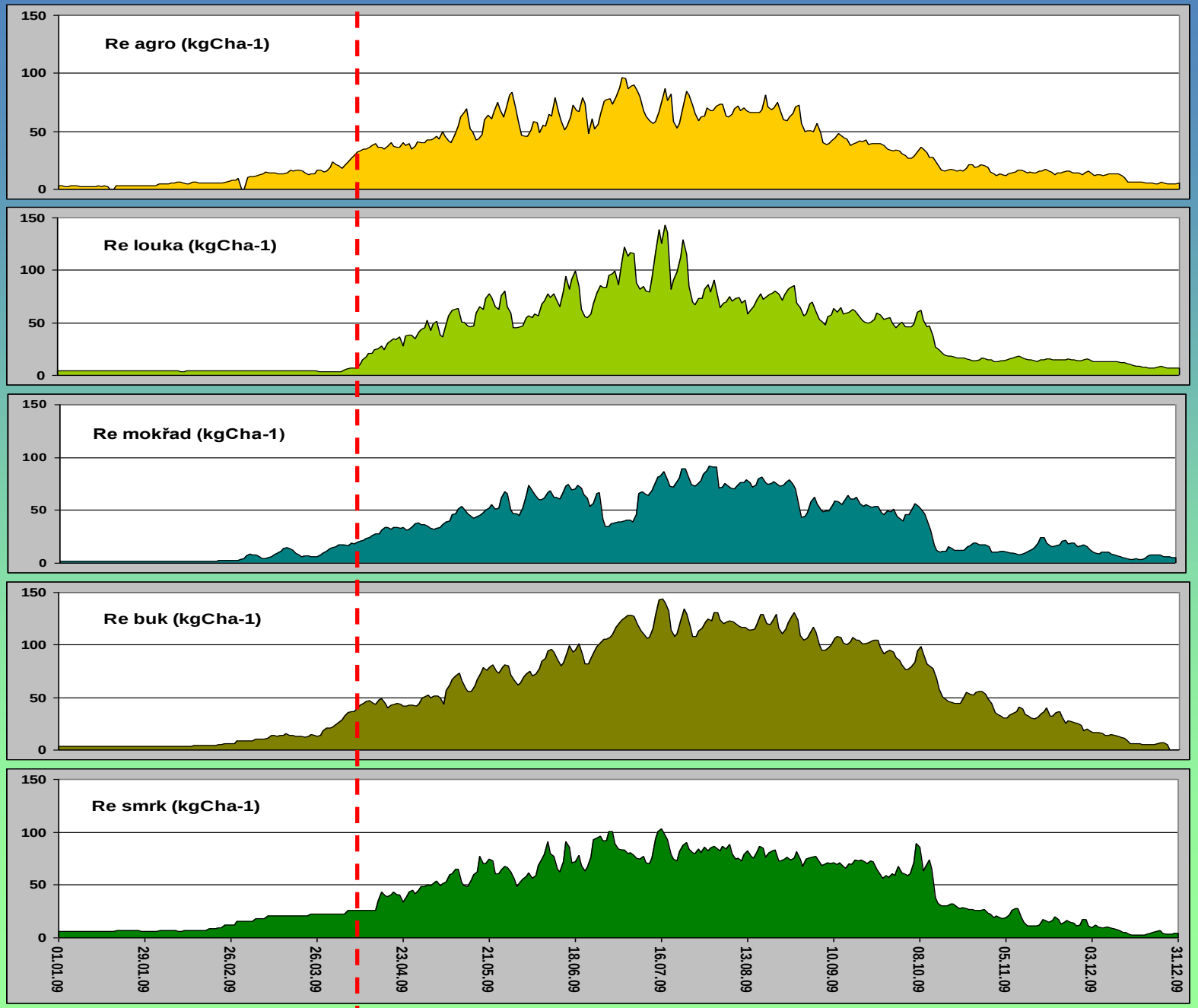
NET ECOSYSTEM PRODUCTION *beech mountain forest* 2009



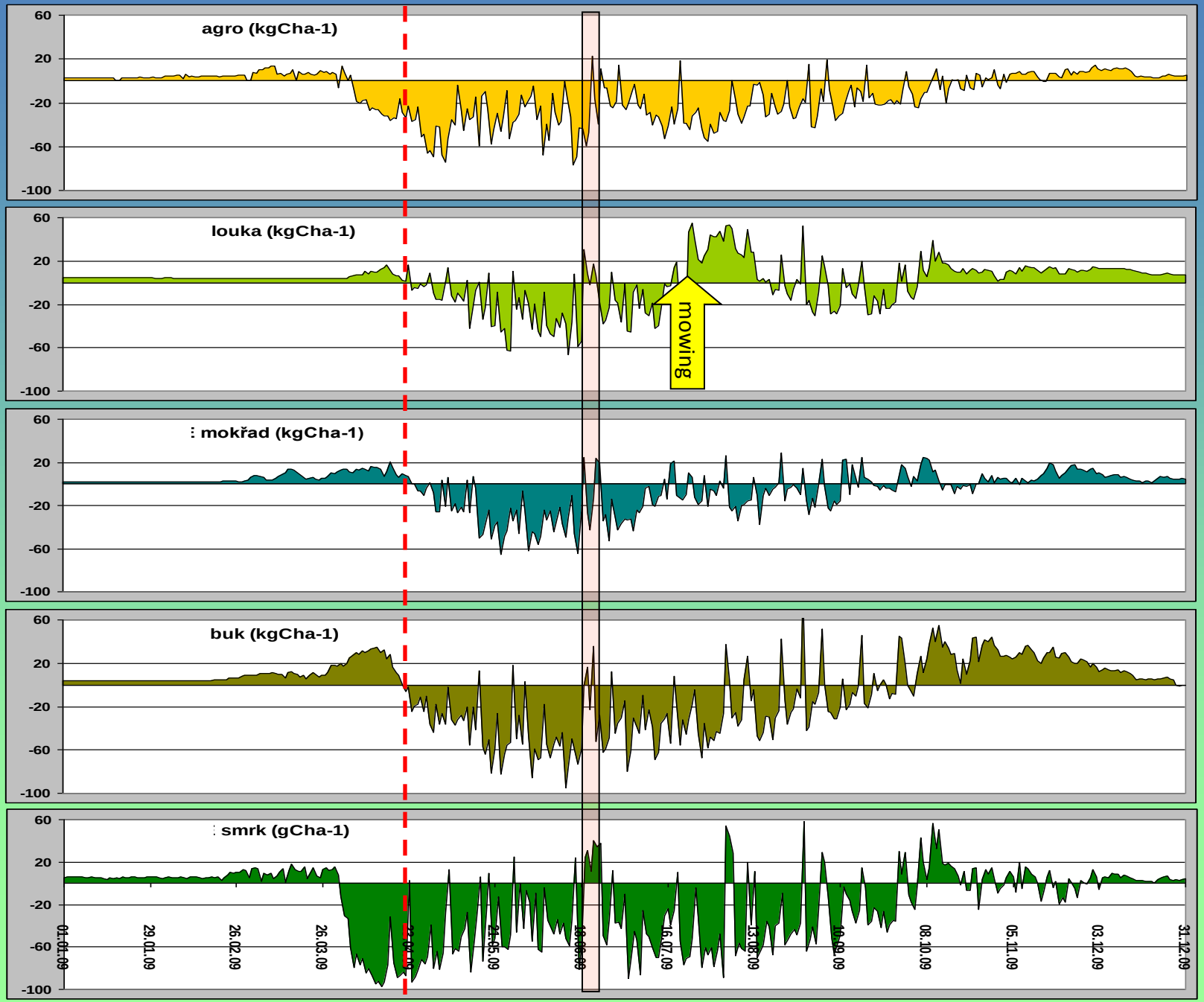
Gross primary production of different ecosystems



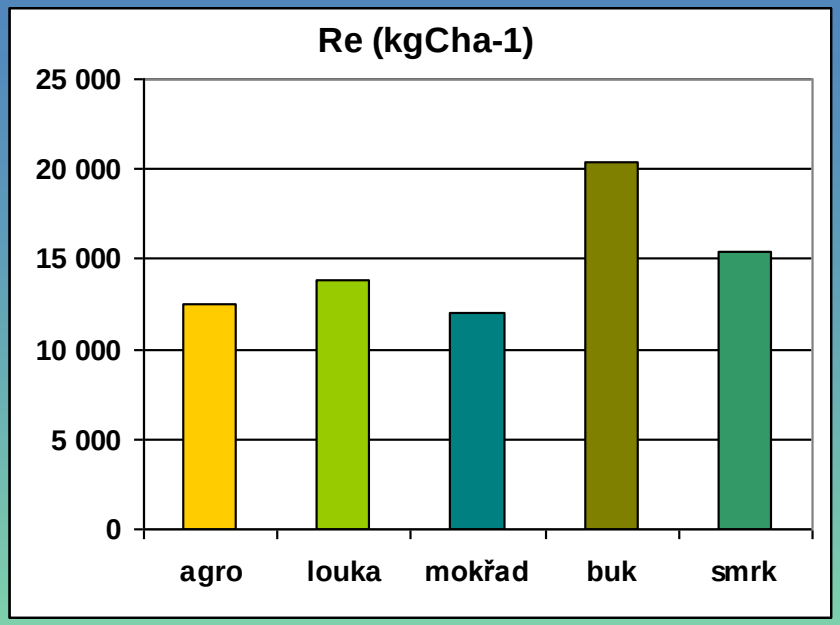
Respiration of different ecosystems

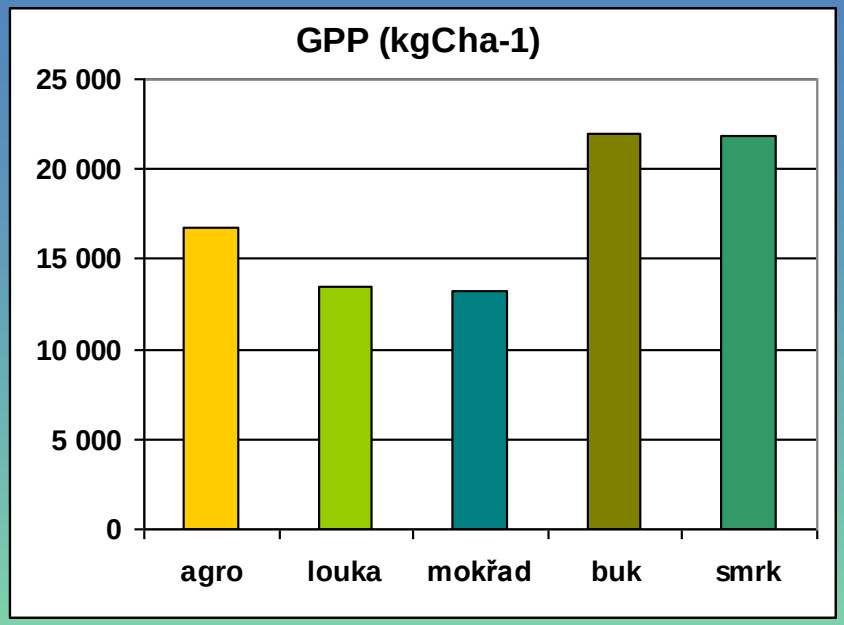


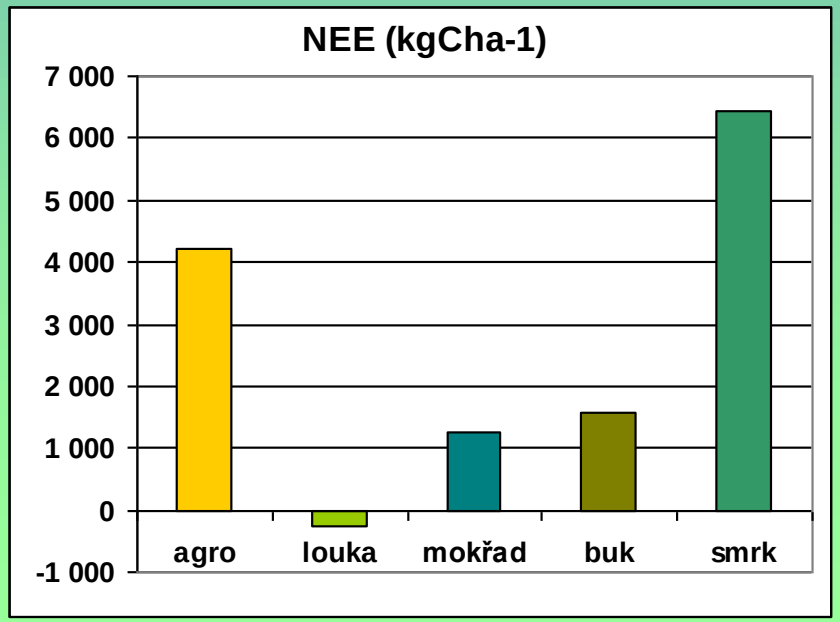
Net ecosystem production of different ecosystems

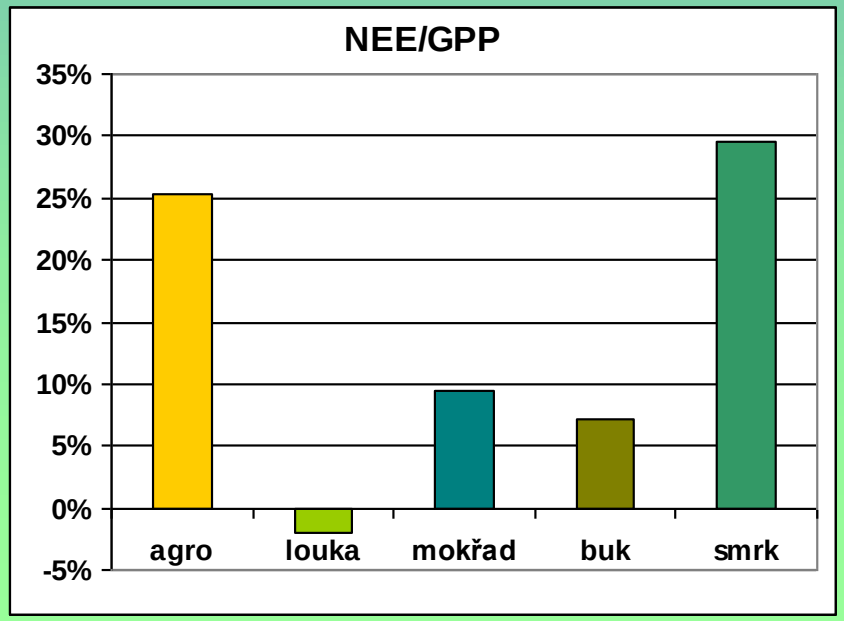


Production of different ecosystems

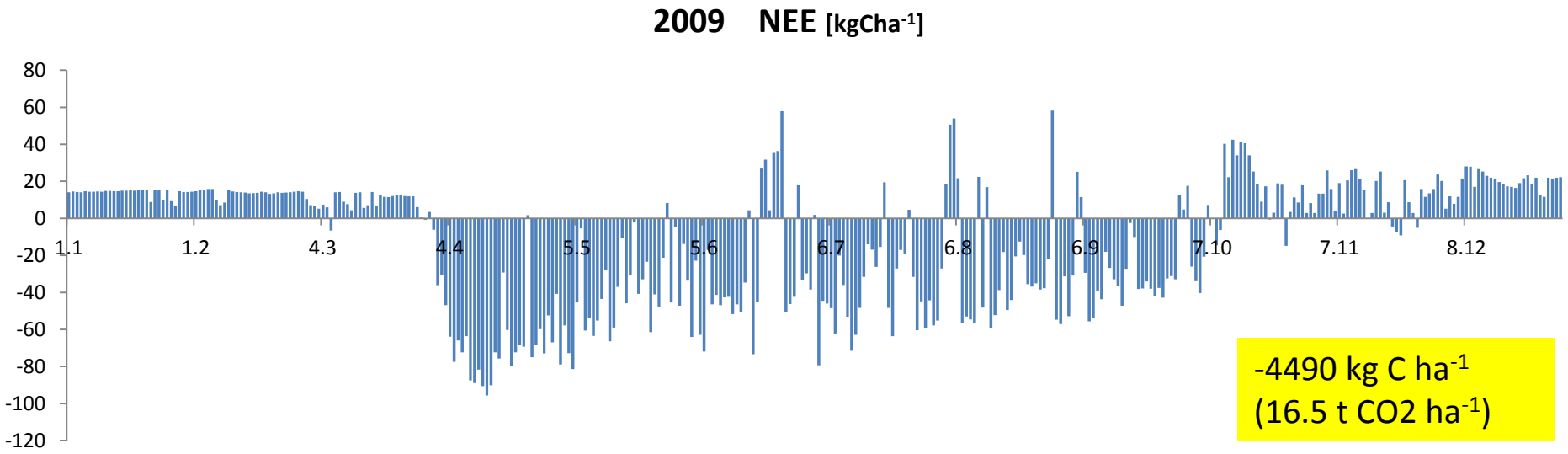


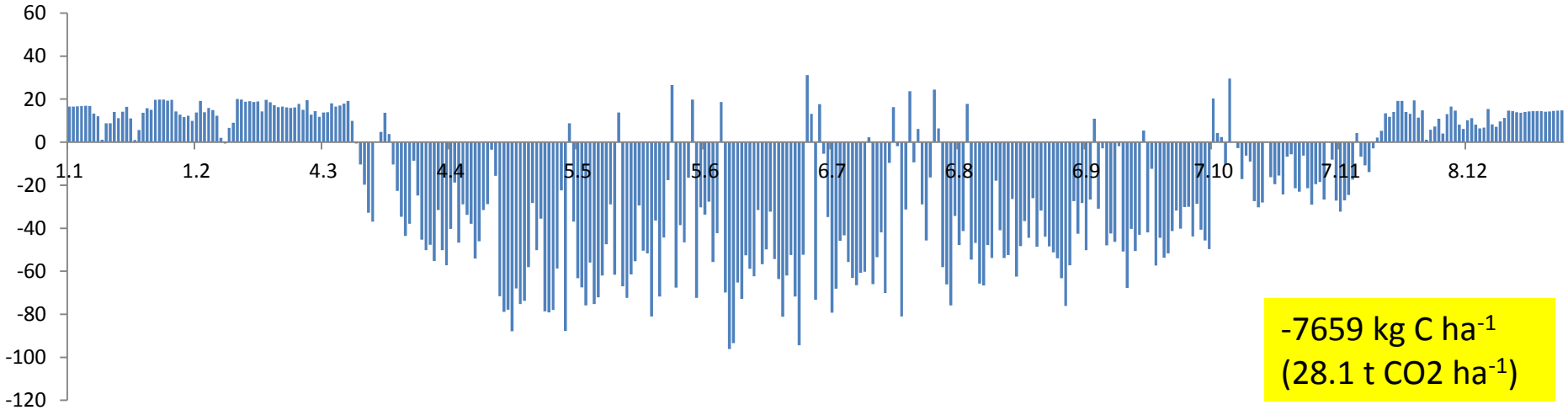




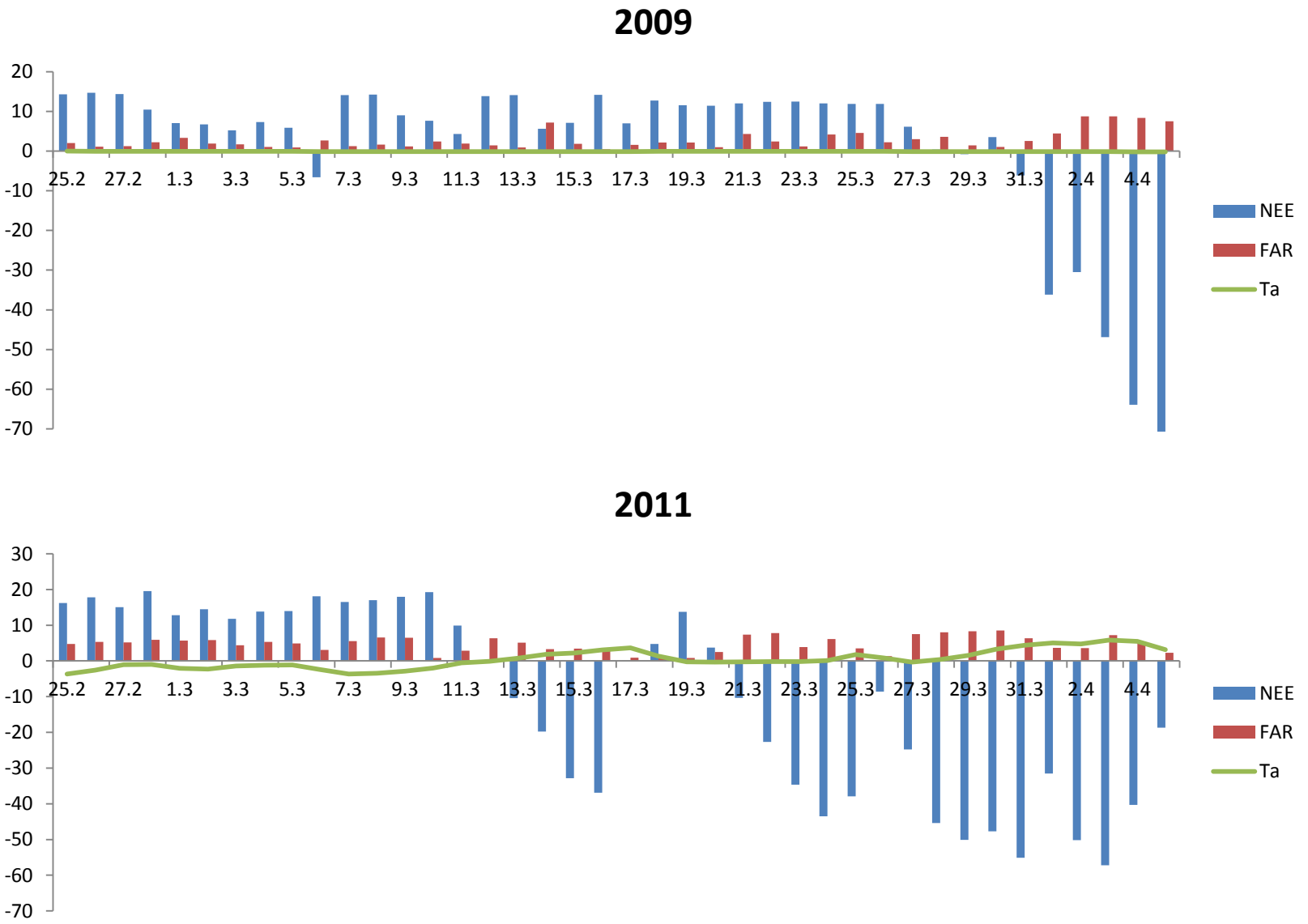


NET ECOSYSTEM PRODUCTION *spruce mountain forest*

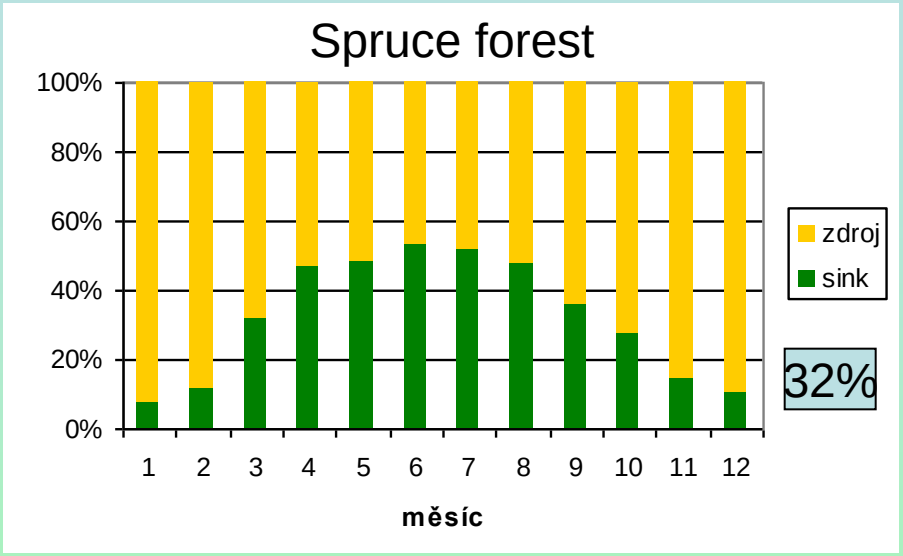


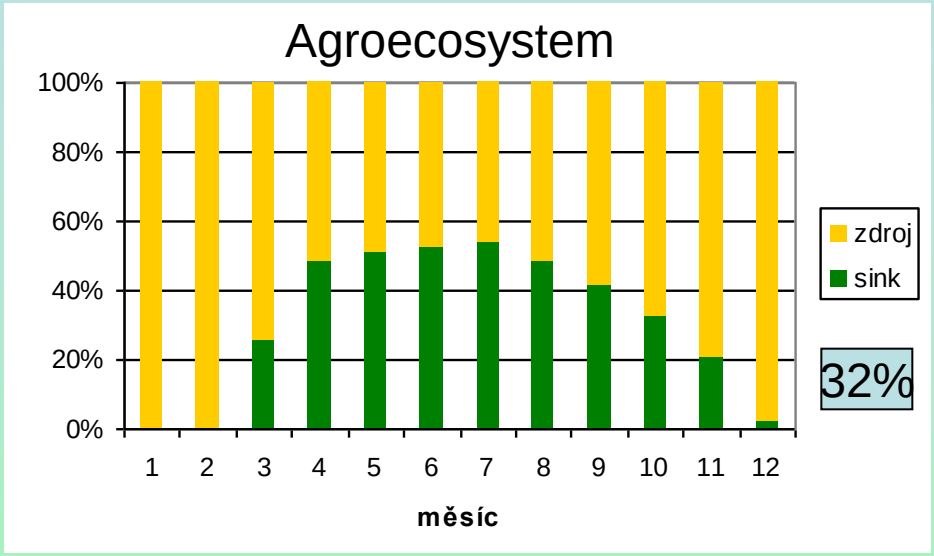


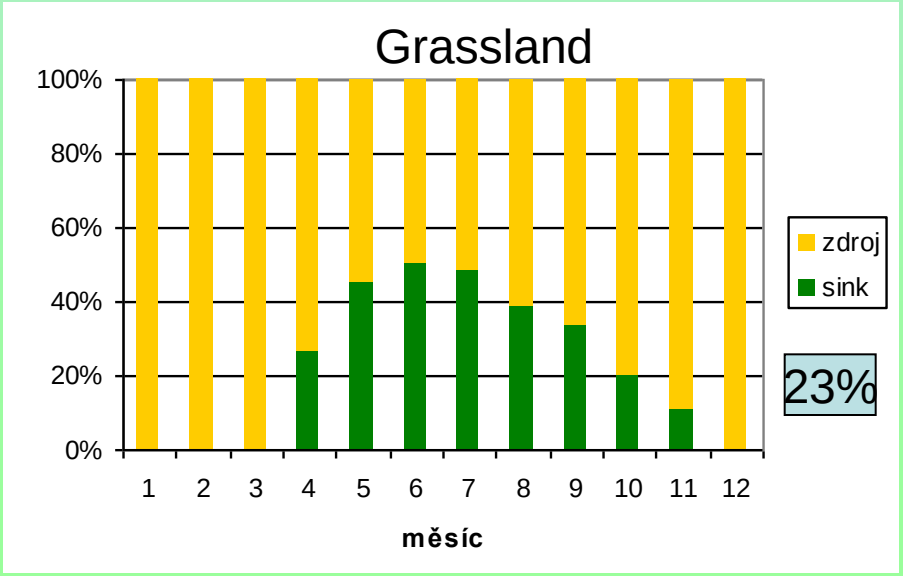
spring differences in NEE

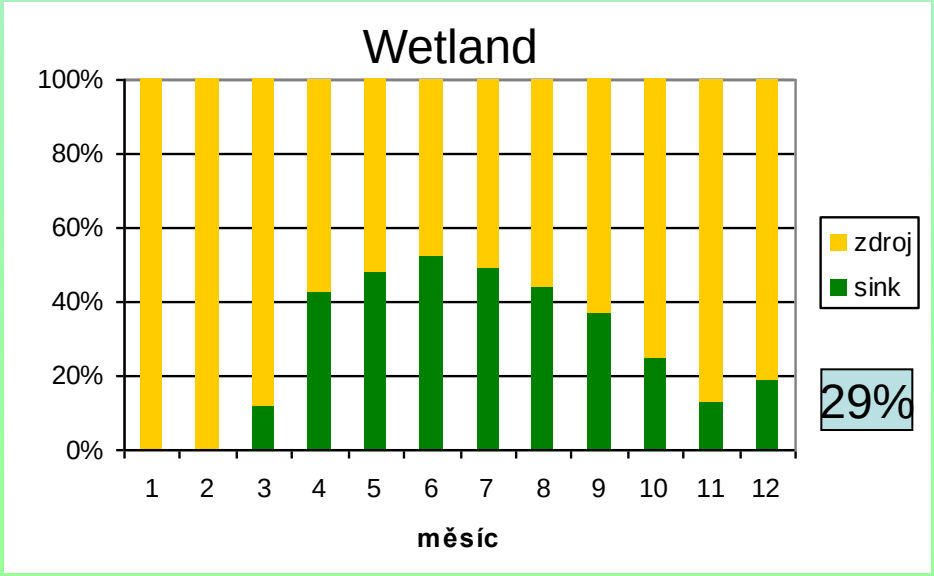


Production activity – temporal aspect





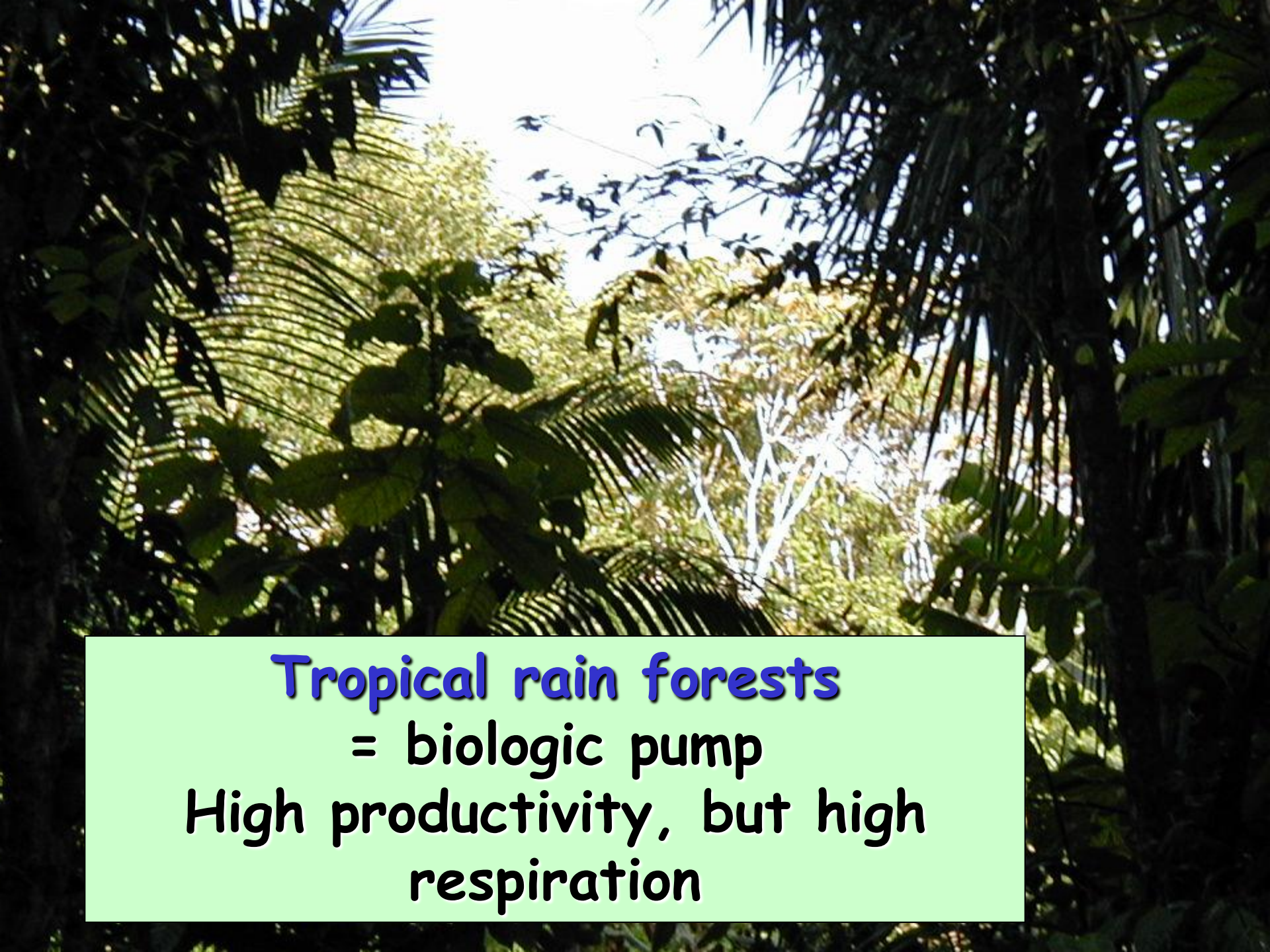




What is forest able to do?

CARBON DEPONIUM

Carbon is pumped from atmosphere to biomass and soil



Tropical rain forests

= biologic pump

High productivity, but high respiration

Temporal forests

=carbon deponium with middle strength

Boreal forests
– the highest C deponium of Earth

Extremly big deponium located in soil

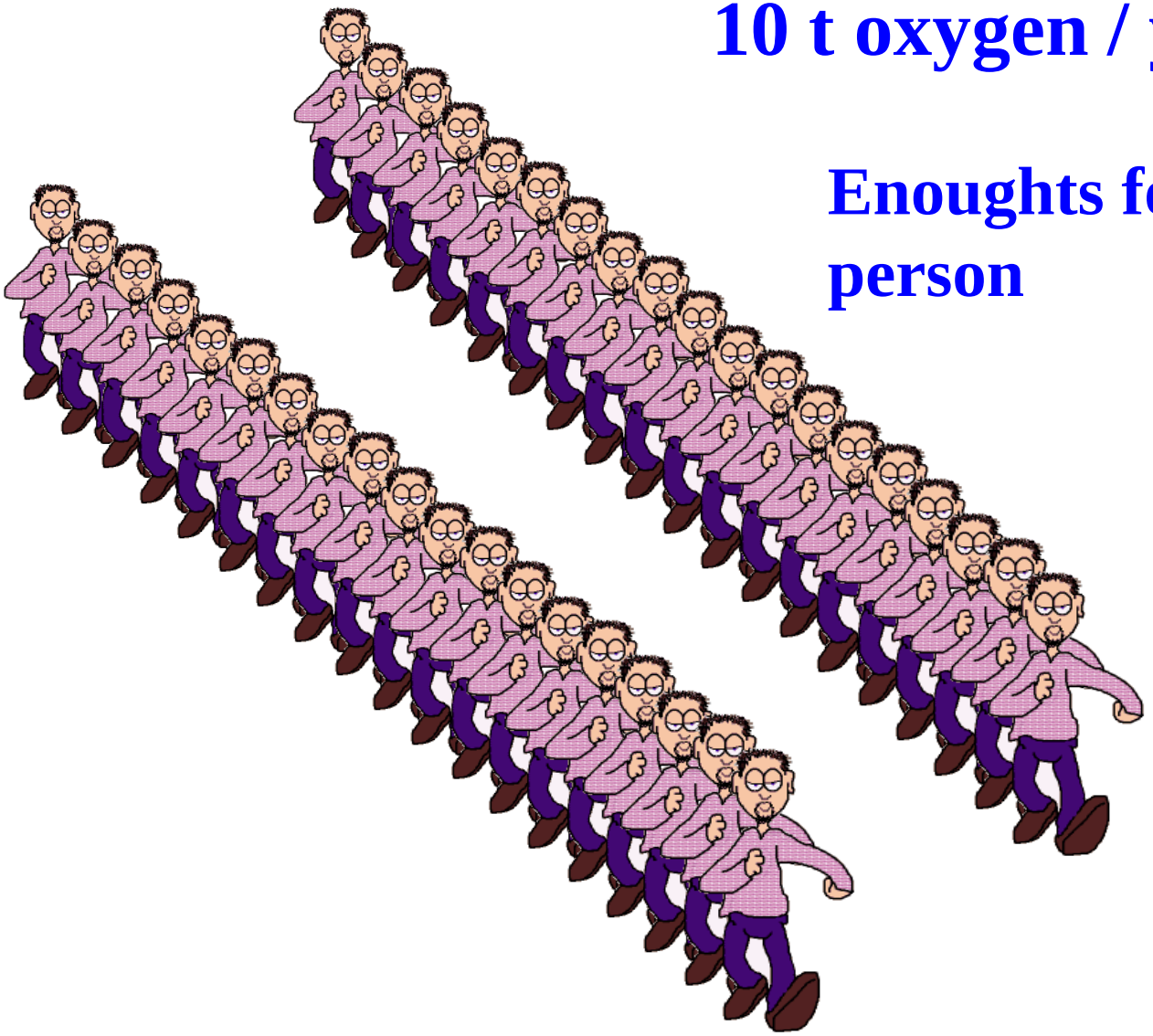
1 ha Spruce forest absorbs 15 t CO_2/year

= 2 x way around the Earth by car

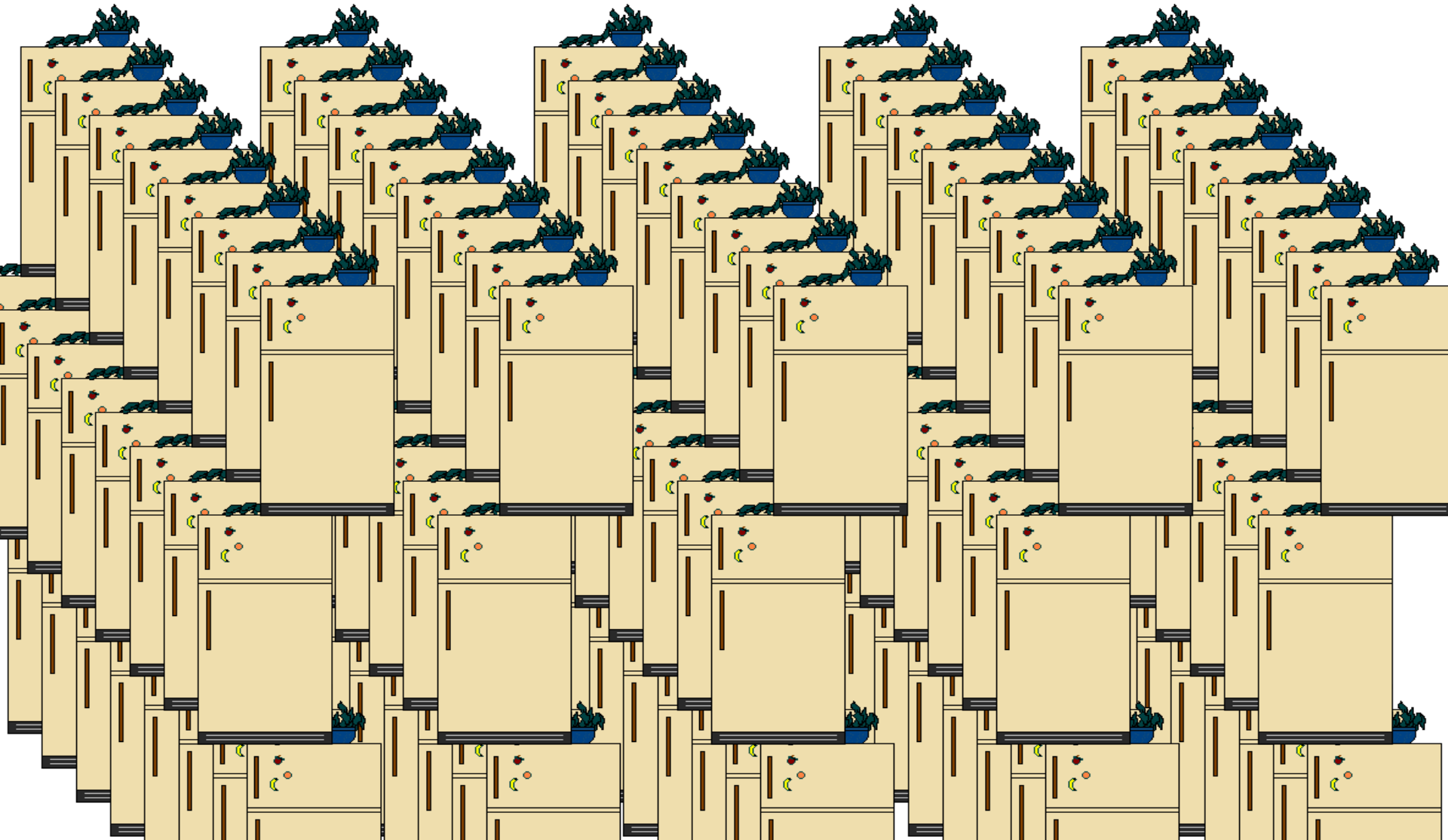
1 ha of forest / year captures energy = 8 t brown coal

1 ha of forest produces 10 t oxygen / year

Enoughts for 38 person



During sunny day 1 ha forest evaporates 40 000 l water = cooling effect – 2.5 refrigator / m^2



Conclusions:

Life = energy and carbon fluxes

Carbon (dis)balance = |photosynthesis| - |respiration|

Highest fluxes in broadleaf forest (beech), the biggest sink is our young needle forest (Norway spruce).

Needle forests can be photosyntheticly active during winter.

Old forests (climax) do not accumulate CO_2 = do not produce O_2

Thanks for your attention!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