Výmena CO_2 ako indikátor stavu lesných ekosystémov postihnutých prírodnými disturbanciami

CO_2 fluxes as an indicator of forest regeneration status after natural disturbances impact

Peter Fleischer jr, Peter Fleischer

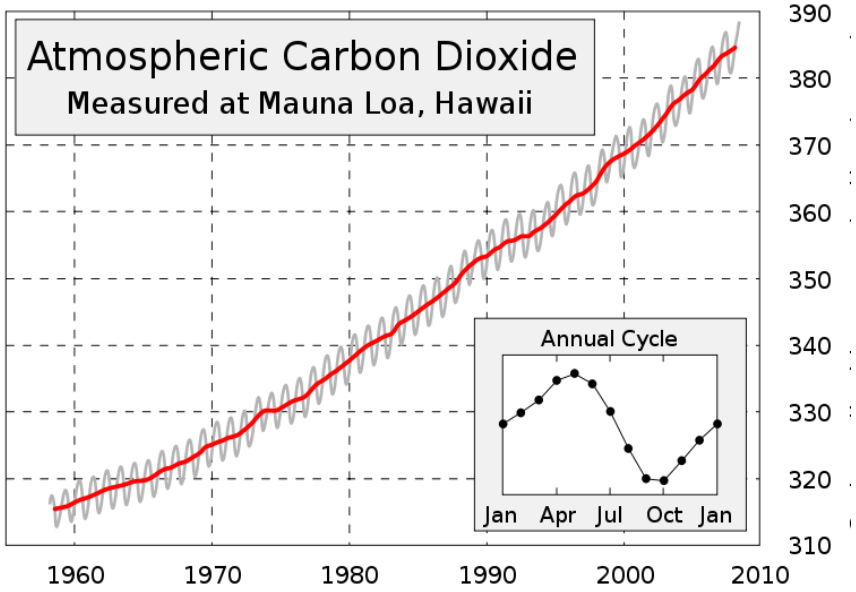
Monitoring a modelovanie prízemného ozónu, Stará Lesná, 8.10.2015

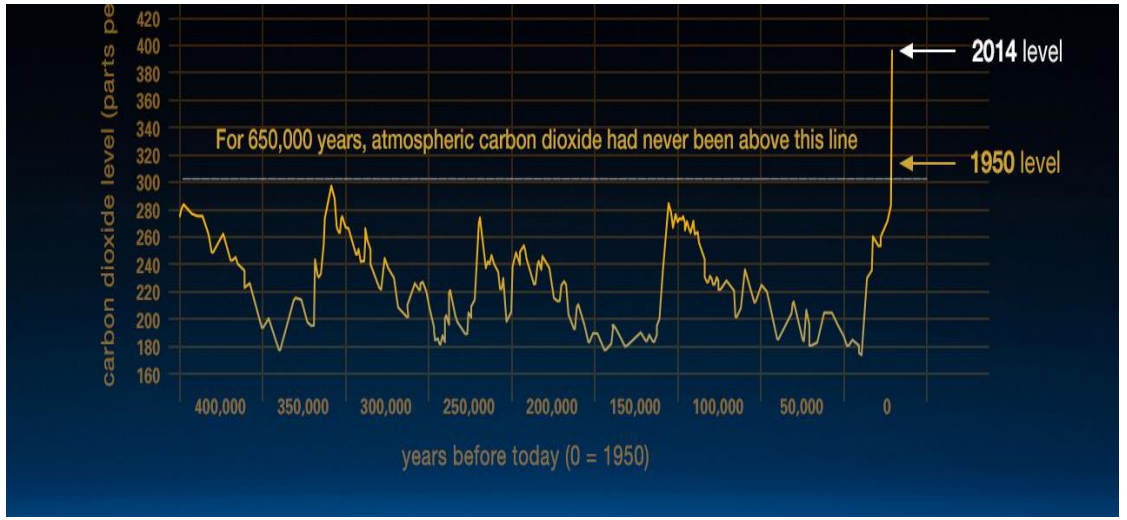
CO_2 as an objective

CO_2 – greenhouse gas

GPP = photosyntehesis (fixation of CO_2 in plants)

Forest – important C sink (vegetation, soil)





C fluxes prior and after disturbance in forest ecosystem

- 2004 windthrow
- 2007 bark beetle

- **Questions:**

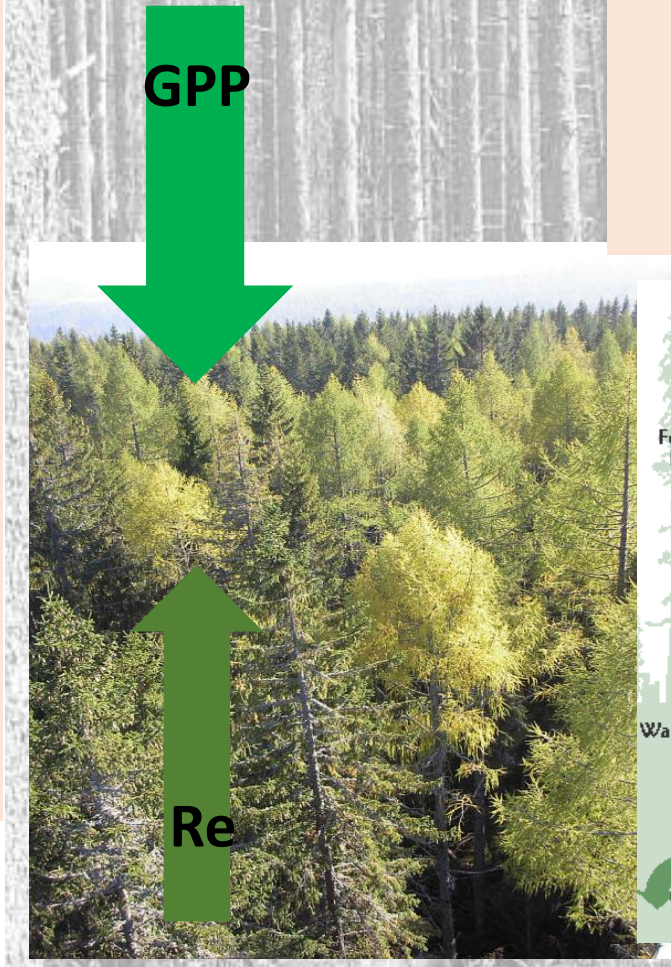
1. Area C source?
2. If Y, how long?
3. Indicator?

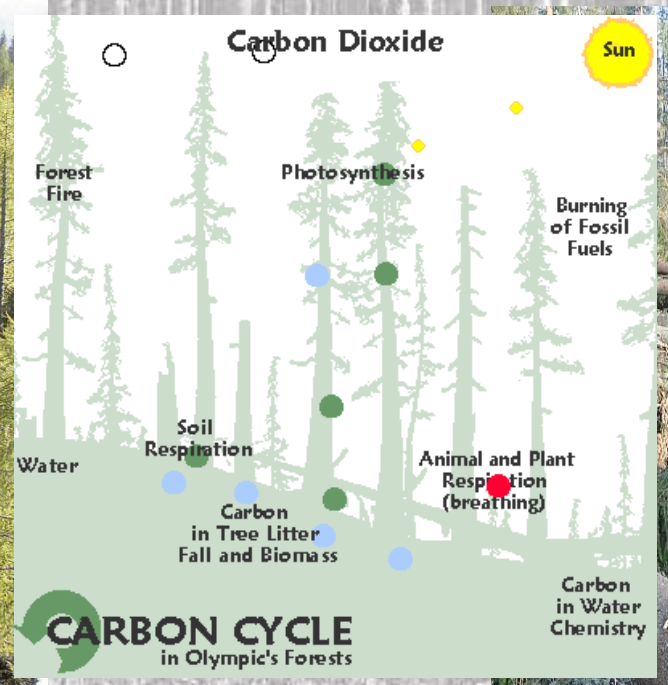
GPP > Re

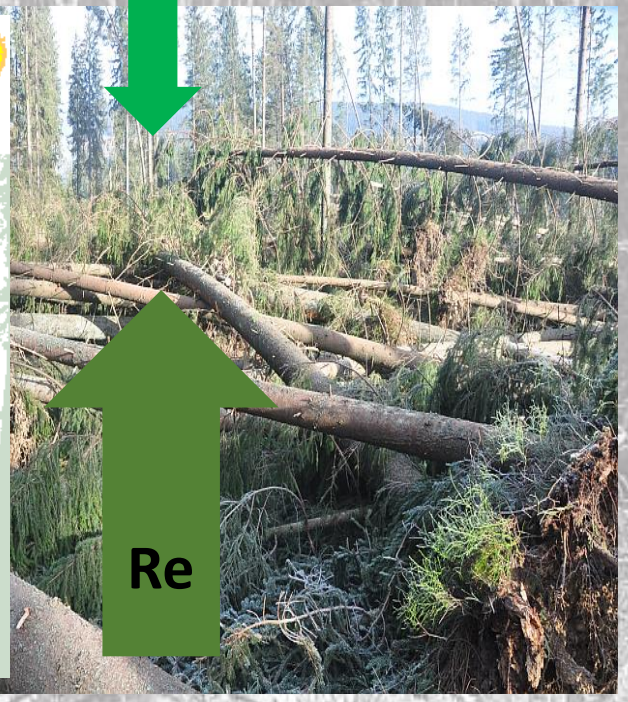
ecosystem is carbon SINK

GPP < Re

ecosystem is carbon SOURCE C







CO2 fluxes and NEE - methods

Balance between C (CO2) uptake and release

NEE=GPP-Re

Eddy covariance

GPP

Re

chamber

Eddy covariance instalation 2005-2007

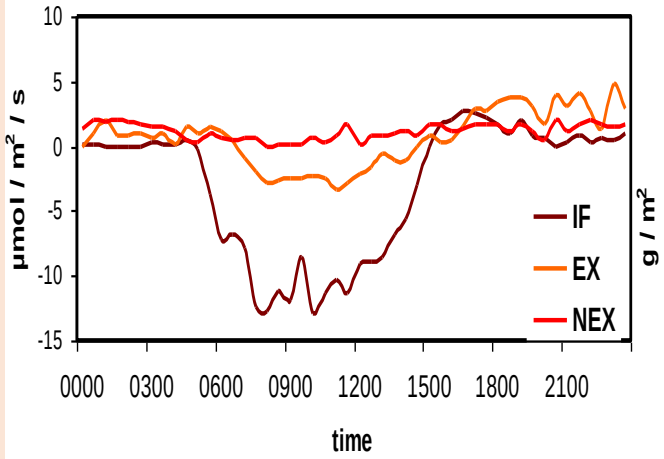


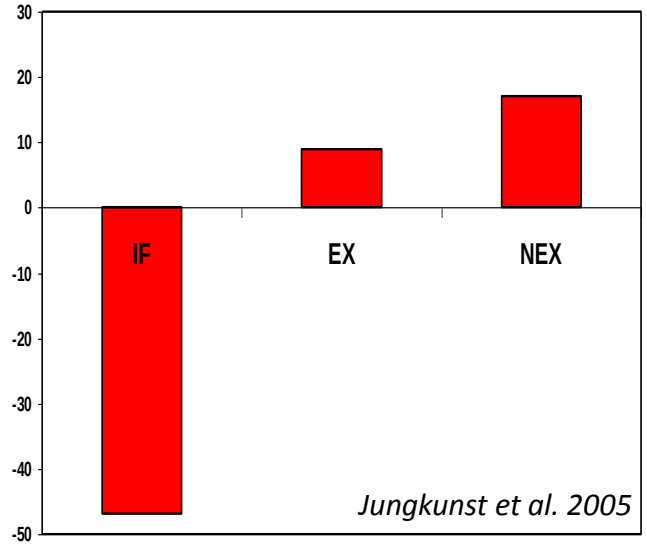

Localities (cca 100 ha)

IF - Intact Forest

EX - Extracted windthrow

NEX – Non extracted windthrow

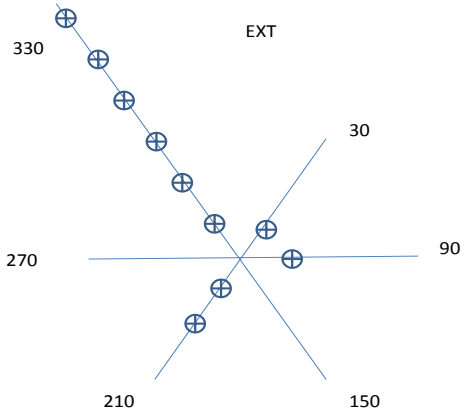




Alternative methods – chambers – soil respiration

Fixed points

Long-term on fixed points
14-day interval, 8-22 points
on site



Specific

Instant measurement
on dominant vegetaion/microsite
types, ad-hoc frequency

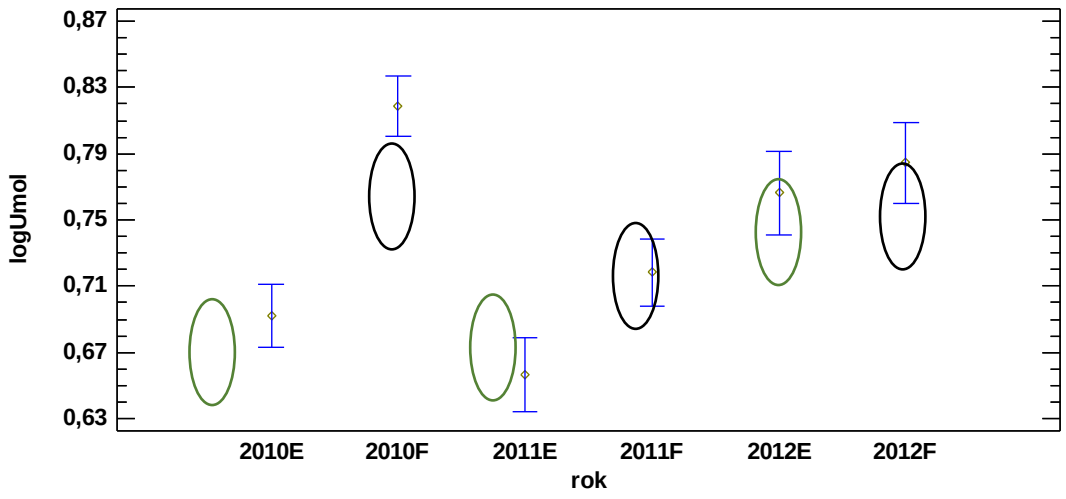
Continuous

Continuous unattended
measurement every 5-10 min
reading every 5 seconds

Soil respiration

Small differences among localities since 2012

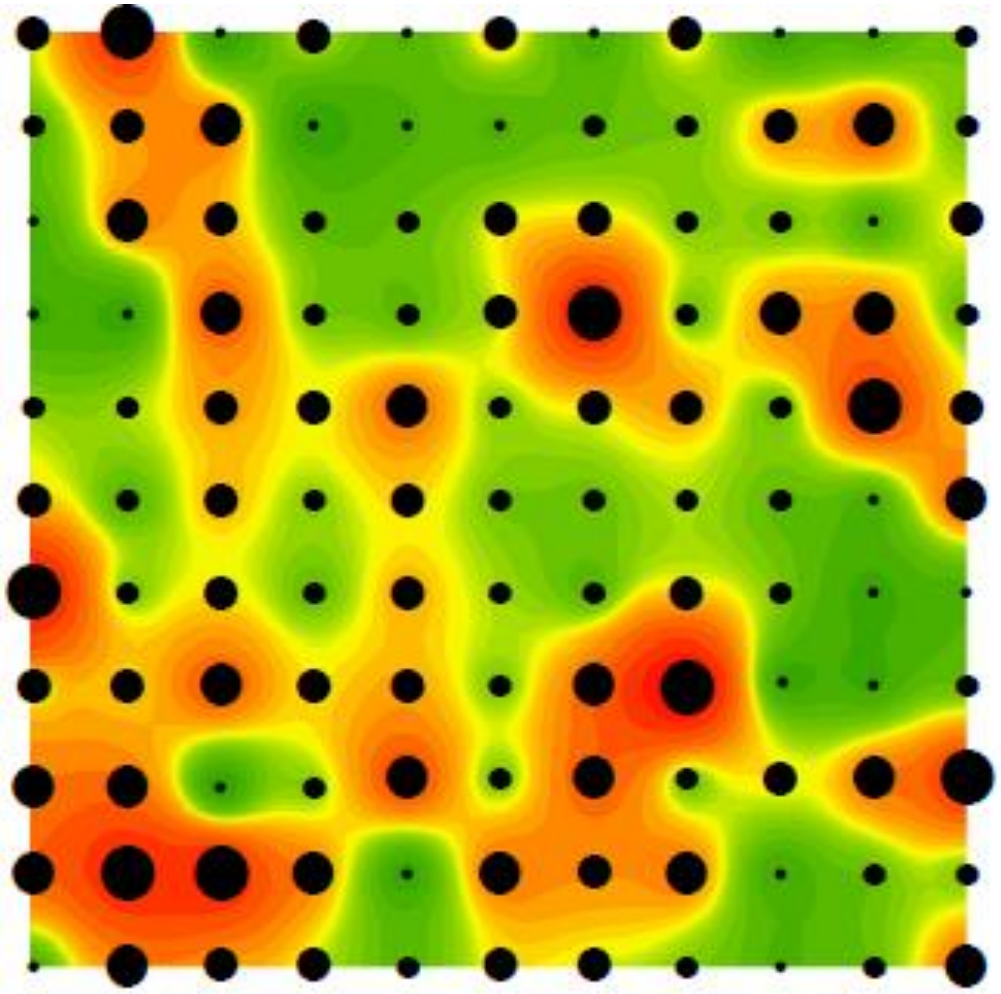
EXT FIR



EXT FIR

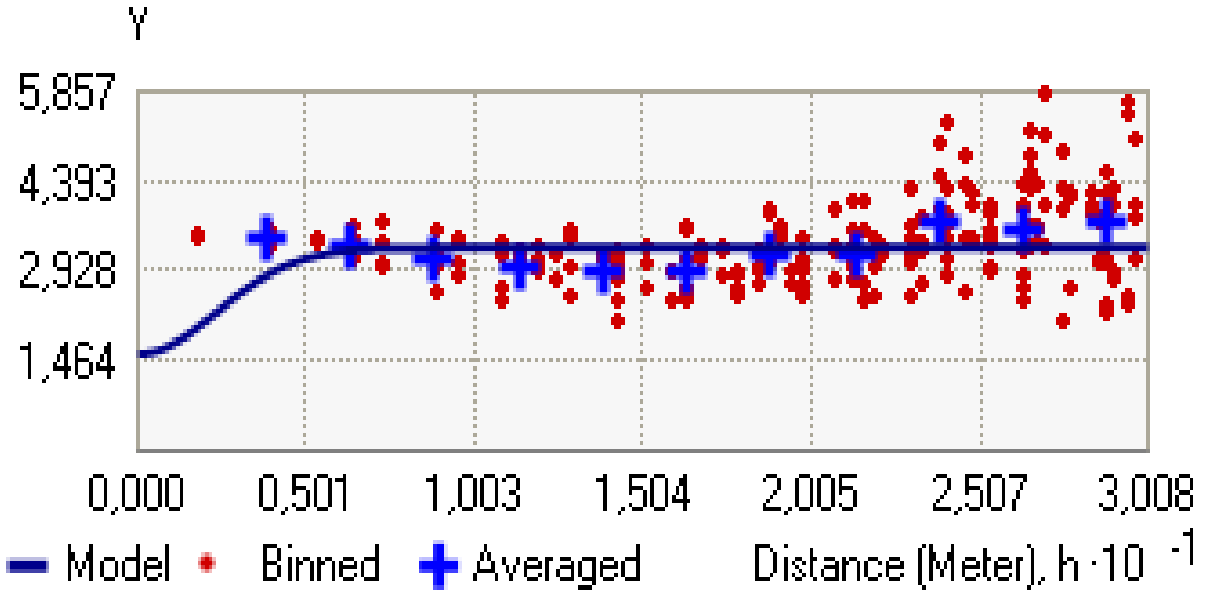
Spatiat variability and factors controlling SR

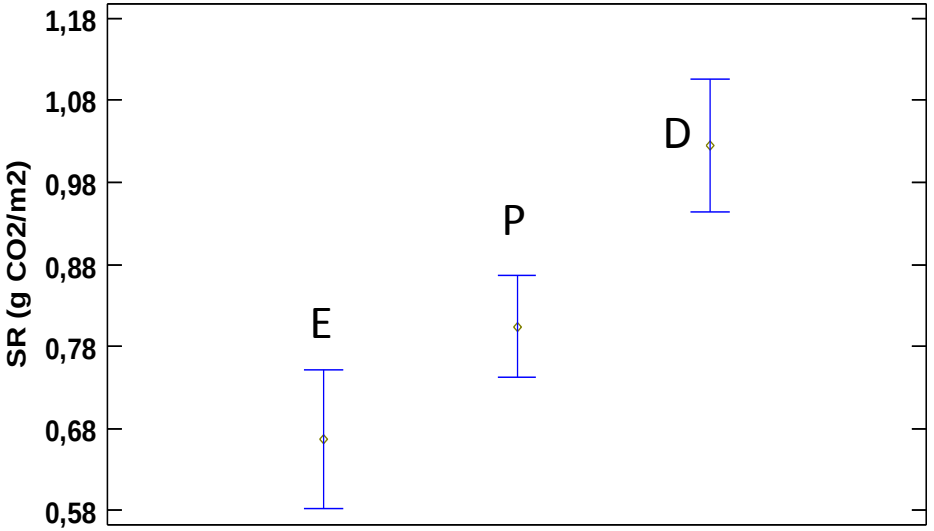
- microtopography
- semivariance



30x30 m

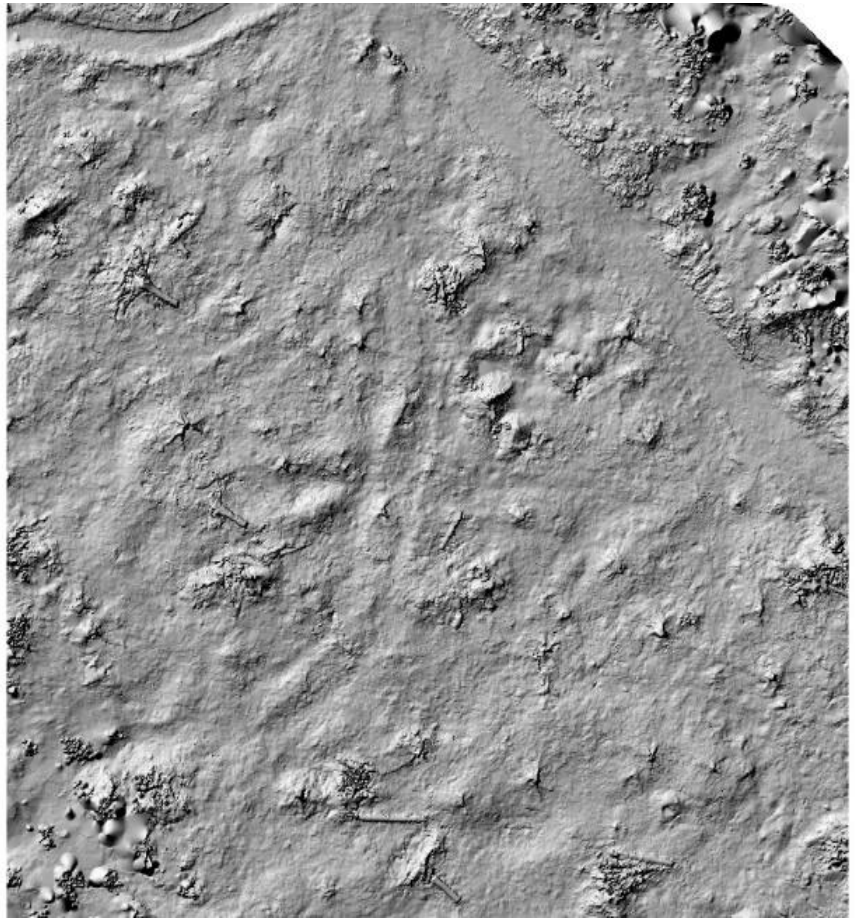
0,26 - 0,53
0,54 - 0,77
0,78 - 1,01
1,02 - 1,37
1,38 - 2,27





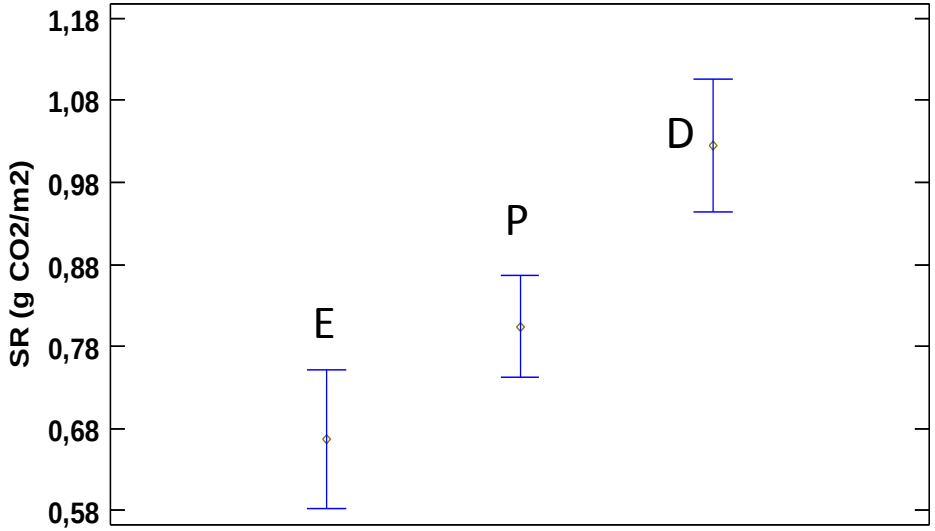
Spatial variability and factors controlling SR

- microtopography
- semivariance

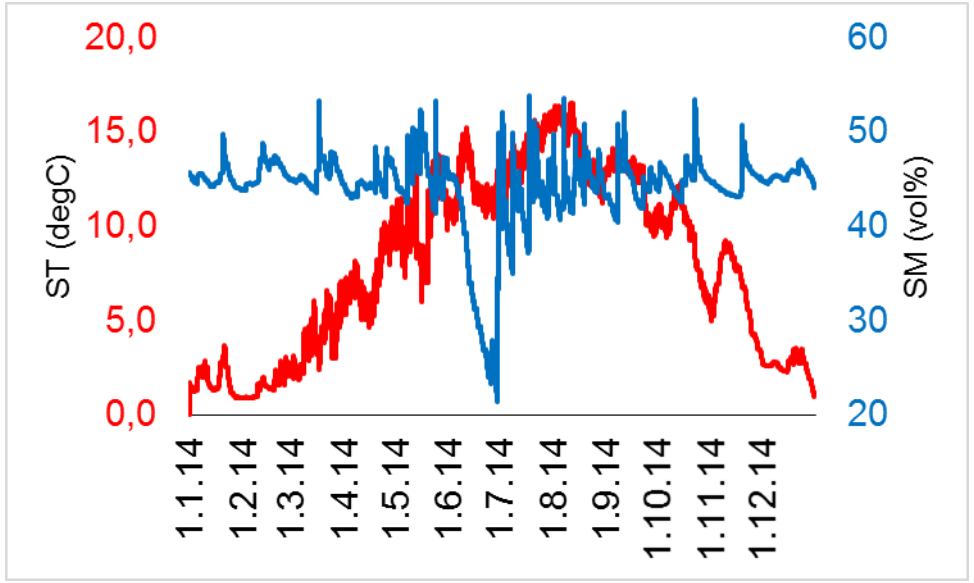


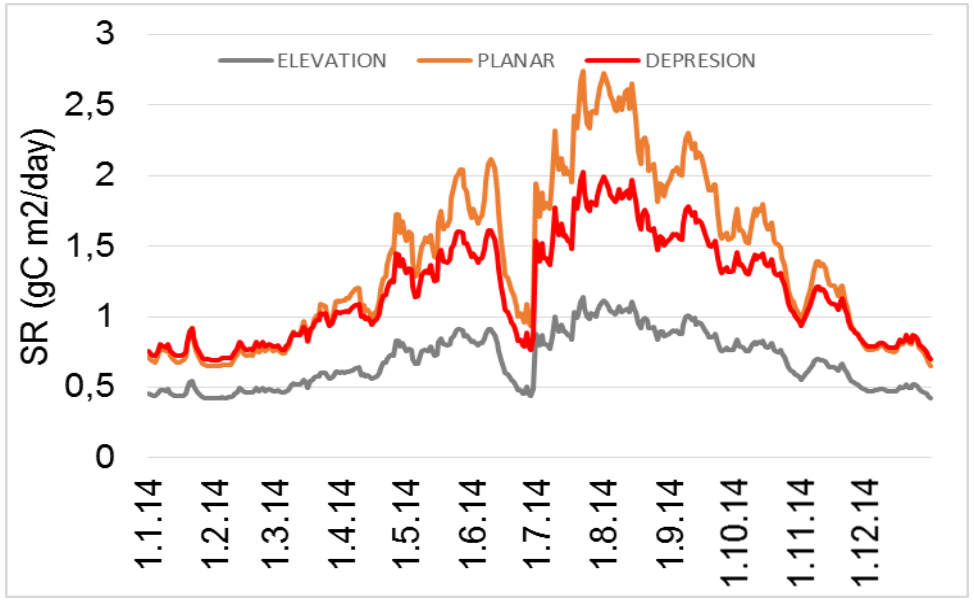
30x30 m

Topo-type	%
ELEVATION	26
PLANAR	46
DEPRESION	28
TOTAL	100



Temporal SR variability





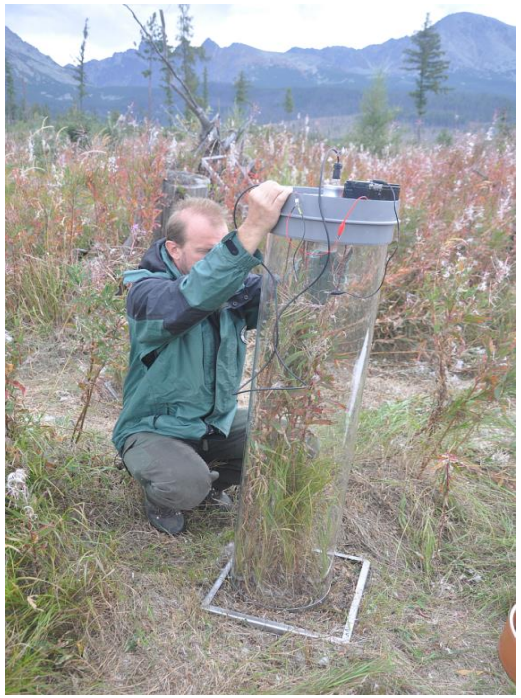
$$SR = a * SM * e^{(b*T)}$$

Topo-type	%	Veg-type	SR (gC/m2) season	SR (gC/m2) year
ELEVATION	26	*Calluna*	124	250
PLANAR	46	*Calvil*	273	505
DEPRESION	28	*Rubus*	218	432
TOTAL	100		615	1187

GPP measurement - chamber method

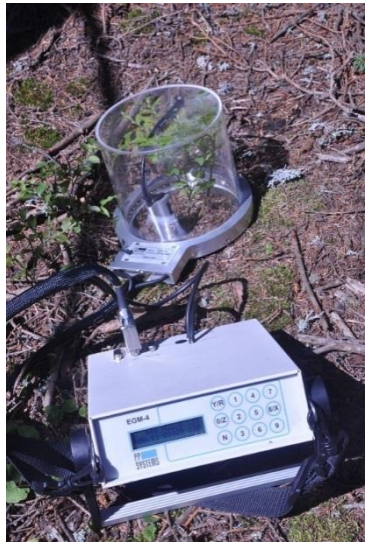
fixed

Long-term on fixed points
14-day interval



specific

Instant measurement
on dominant vegetaion/microsite
types, ad-hoc frequency



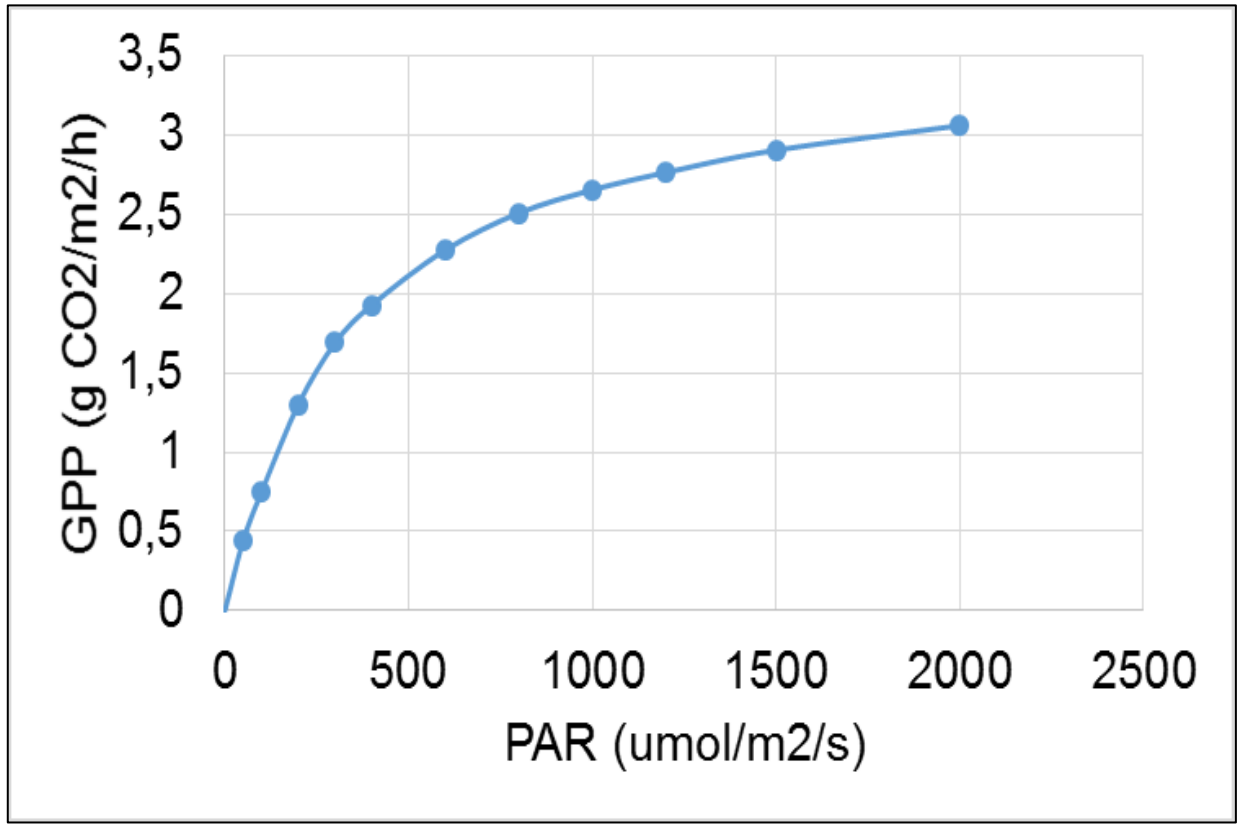
continuous

Continuous unattended
measurement every 5 min

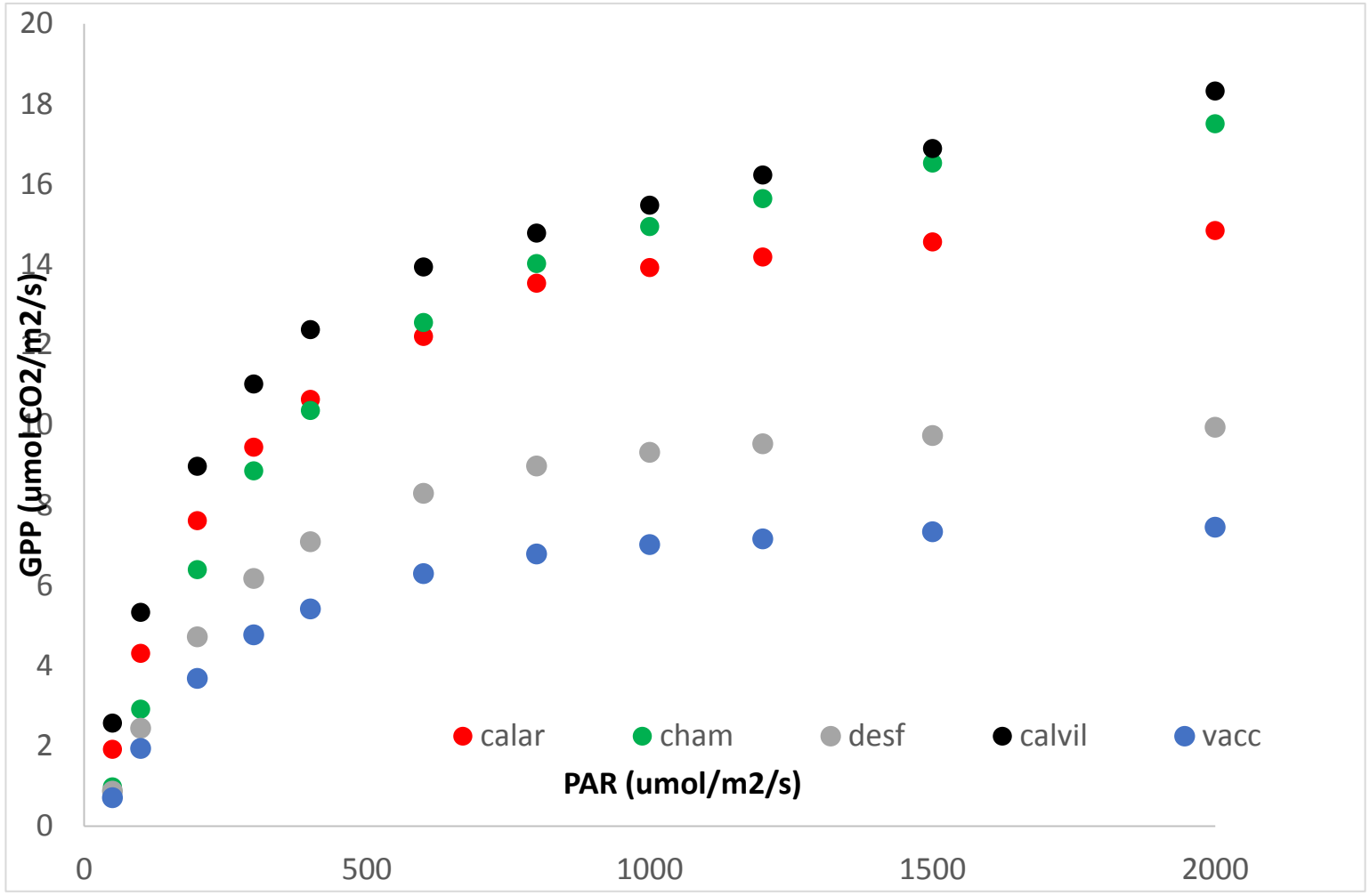
GPP measurement - Couvette LicorXT

- Species specific
- Leaf-wise measurement
- GPP-PAR response (light) curve

$$GPP = \frac{(GPPmax * \alpha * PAR)}{(GPPmax + \alpha * PAR)} * LAI$$



GPP – species specific



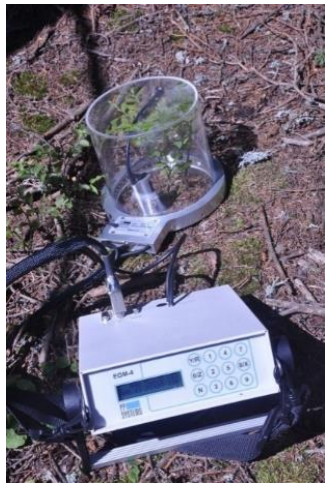
$$GPP = \frac{(GPPmax * \alpha * PAR)}{(GPPmax + \alpha * PAR)} * LAI$$

GPP by chambers

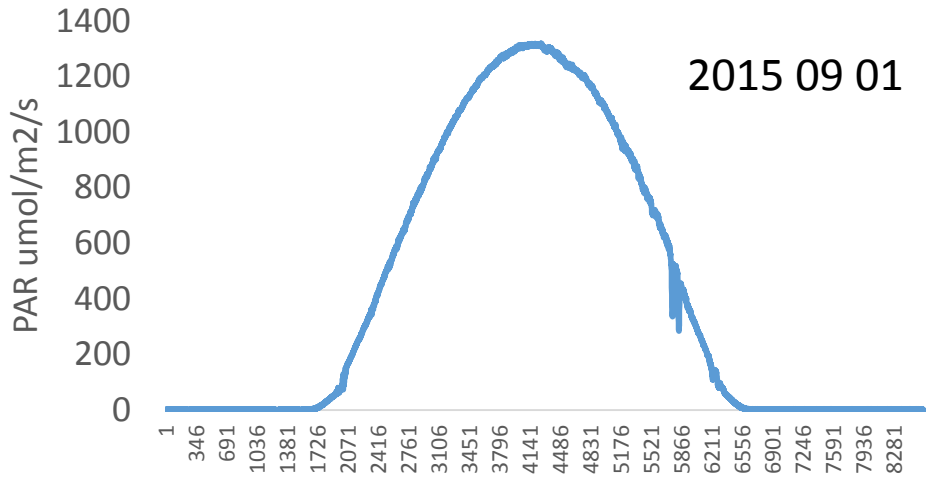
Transparent chambers

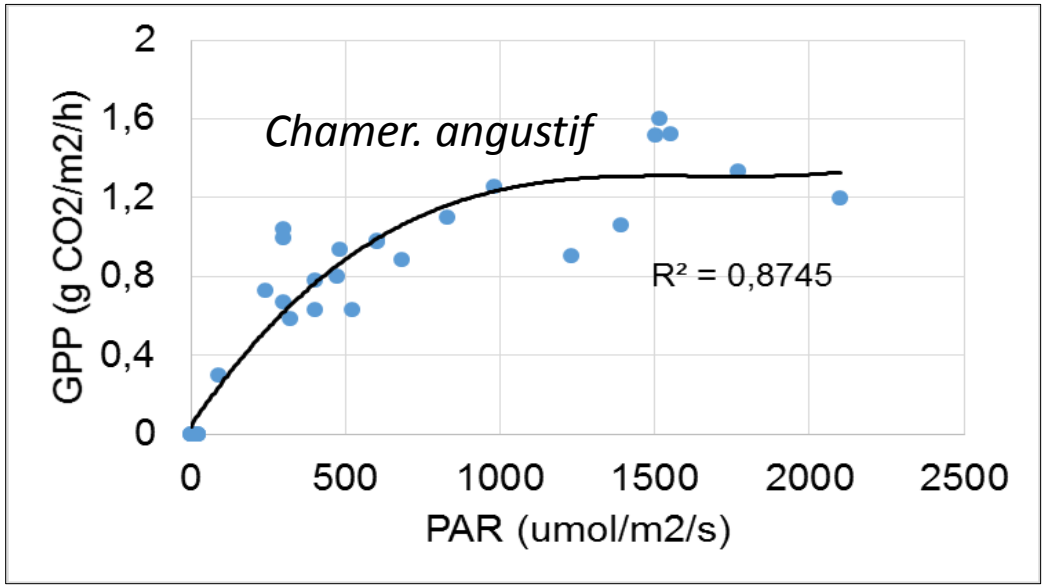
(PPSystems, Vaisala, custom built)

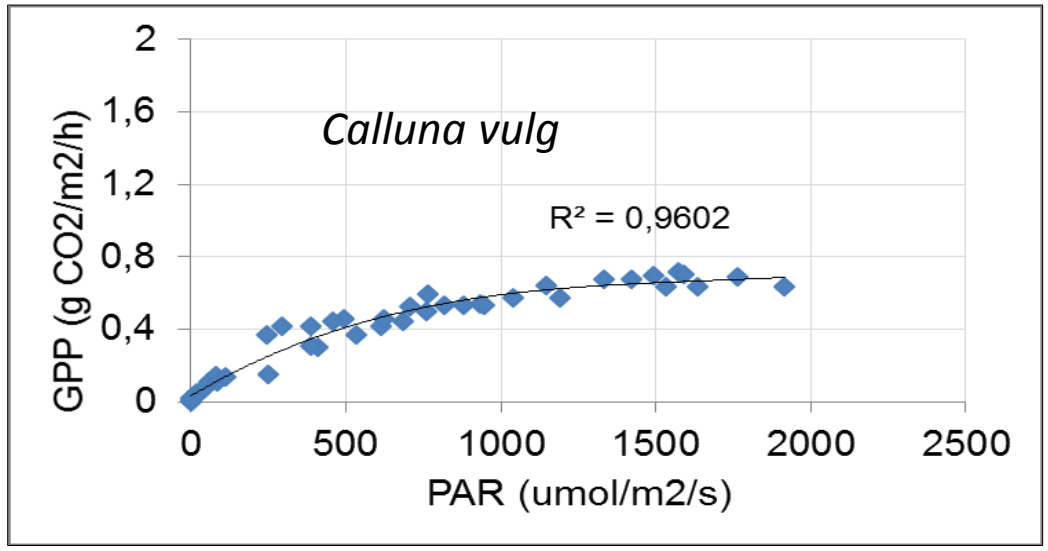
Plant-wise, microecosystem-wise

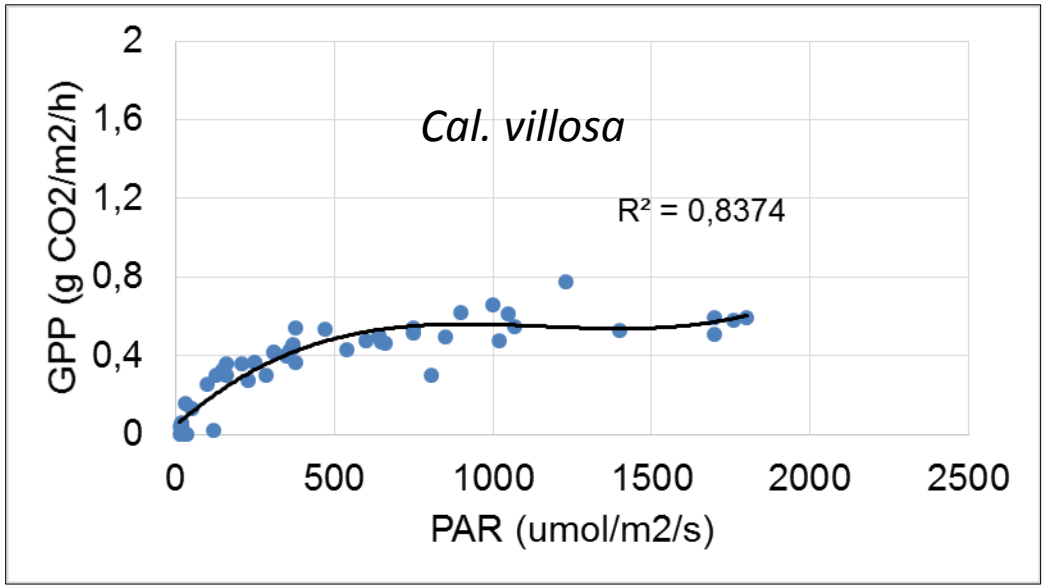


GPP – by chambers: PAR and species specific normalized light curves









GPP - extrapolation

LAI

to plant scale

to ecosystem

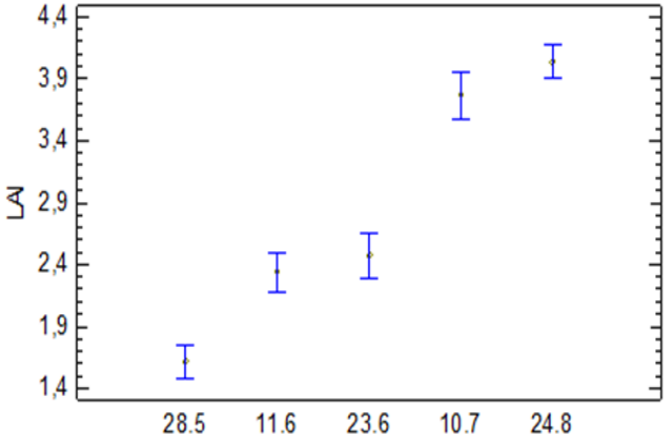
to landscape

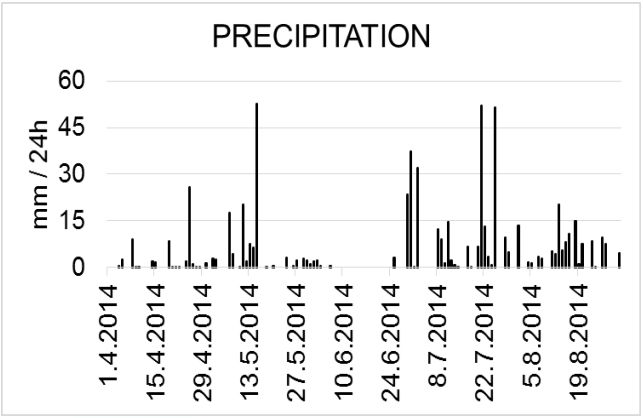
<u>What is needed</u>

- LAI and dynamic
- species share

1. scanning

2. Canopy analyzer LI2200





3.Allometry and biomass equations

Forest Ecology and Management 256 (2008) 1096–1103

Contents lists available at ScienceDirect

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Biomass functions and expansion factors in young Norway spruce (*Picea abies* [L.] Karst) trees

Jozef Pajtík[a], Bohdan Konôpka[a,b], Martin Lukac[c,*]

[a] National Forest Centre, Forest Research Institute, T.G. Masaryka 22, 960 92 Zvolen, Slovakia
[b] Czech University of Life Sciences, Faculty of Forestry and Wood Sciences, Department of Forest Protection and Game Management, Kamýcká 1176, Praha 6 – Suchdol 165 21, The Czech Republic
[c] NERC Centre for Population Biology, Division of Biology, Imperial College London, Silwood Park Campus, Ascot SL5 7PY, UK

$$GPP = \frac{(GPPmax * \alpha * PAR)}{(GPPmax + \alpha * PAR)} * LAI$$

GPP extrapolation – species share

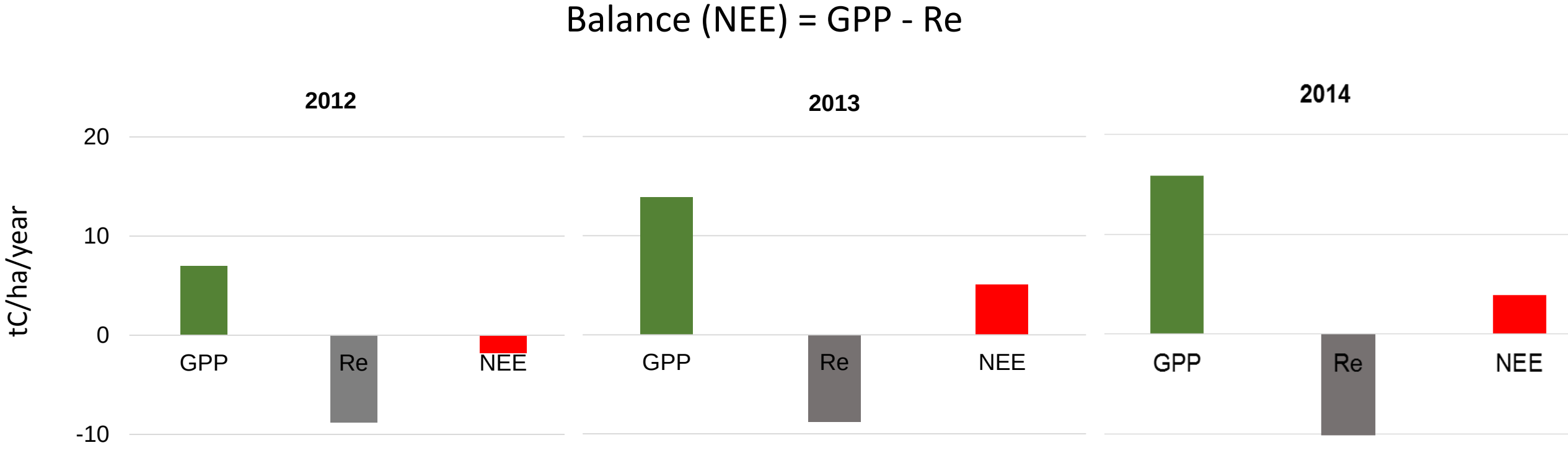
Aerial ortophotomap (20x20 cm pixel)

Detail 20x20 m

- *Calluna vulgaris, V. vitis idea*
- *Calamagrostis villosa*
- *Calamagrostis villosa,+Deschampsia flexuosa*
- *Chamaerion angustifolium*
- *Rubus ideaus, Salix caprea*
- shadows
- not identified
- rocks, roads

Dron, 5.9.2015

Results – carbon balance and disturbance index



2012: source -1,8 tC/ha

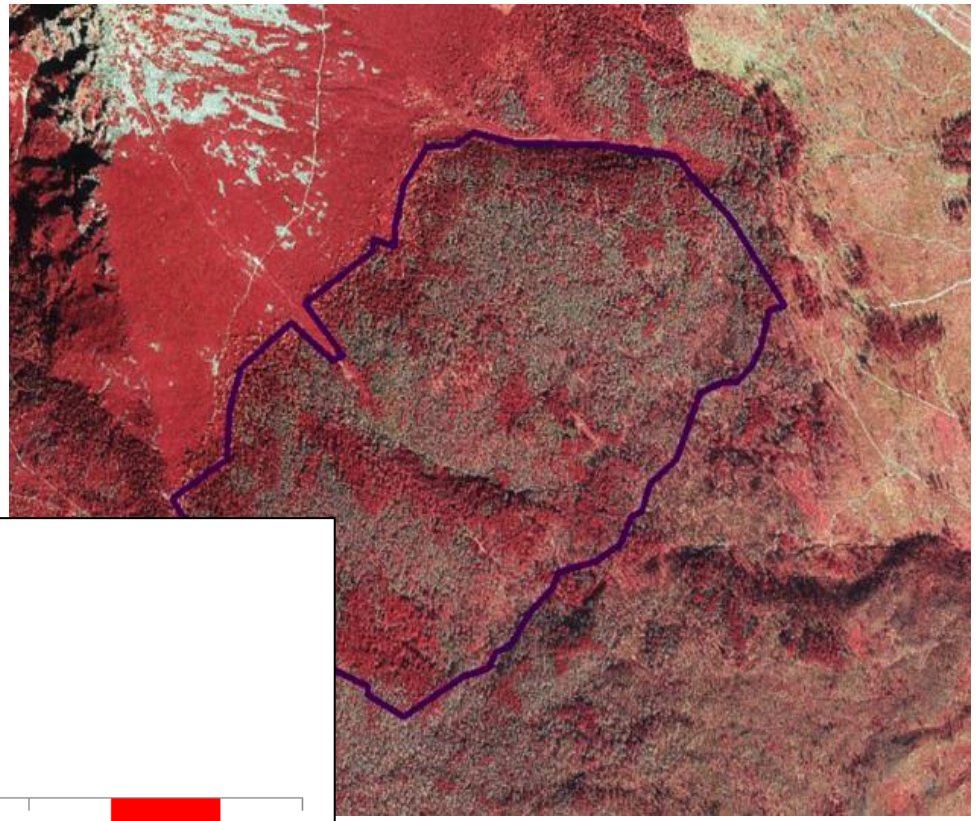
2013: sink +5,1 tC/ha

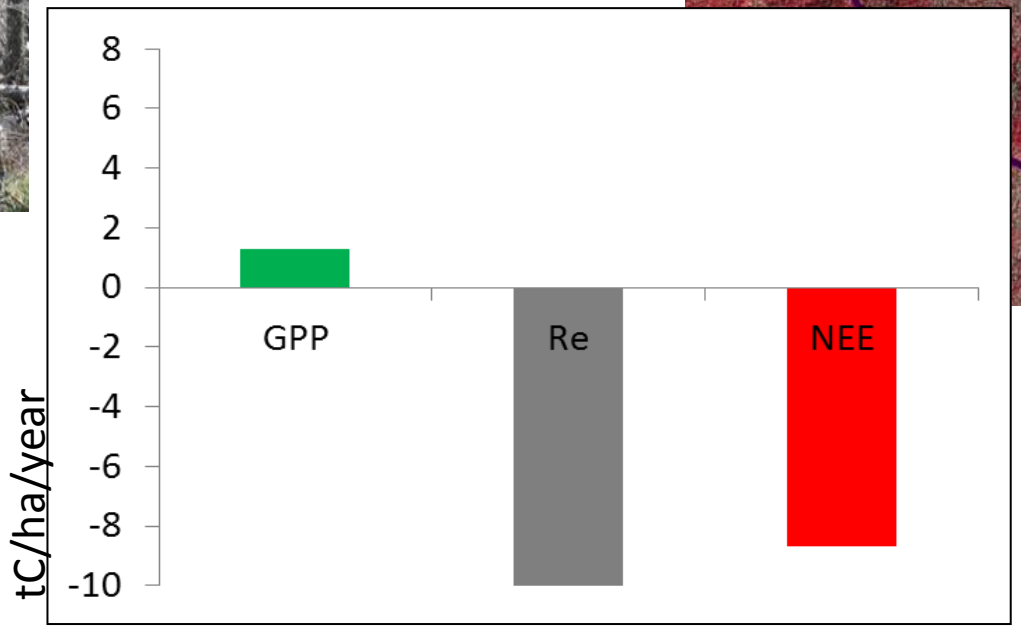
2014: sink +3,9 tC/ha

Id=GPP/Re **0,9** **1,23**

(Amiro et al. 2010)

Results - Carbon balance and DI on sites disturbed by bark beetle





Id=GPP/Re 0,25

Next steps

Warming experiments

Next steps - temperature manipulation

ITEX concept

(PLEXIglass hexagons)

Avg +2.0 ^{o}C

Biomas: 2x

NEE: ?

Note: GPP – response to extreme weather (drought)

- Extrapolation based on discrcete measurements

(representativness?)

- Ad hoc measurement – „good weather“
- By chanse extreme values