



The effect of management on forest microclimate: observational and experimental approaches

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MTA
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Introduction

- **Why is microclimate important in forests?**
 - dispersal, persistence of forest-dwelling species
 - broader context: effect on regional changes – e.g. ameliorating the effects of climate change
- **Forest stands create special below-canopy climate -> buffered extremes, ... stable environment**
- **Forest management practices can alter the microclimate through changes in canopy closure and stand structure**

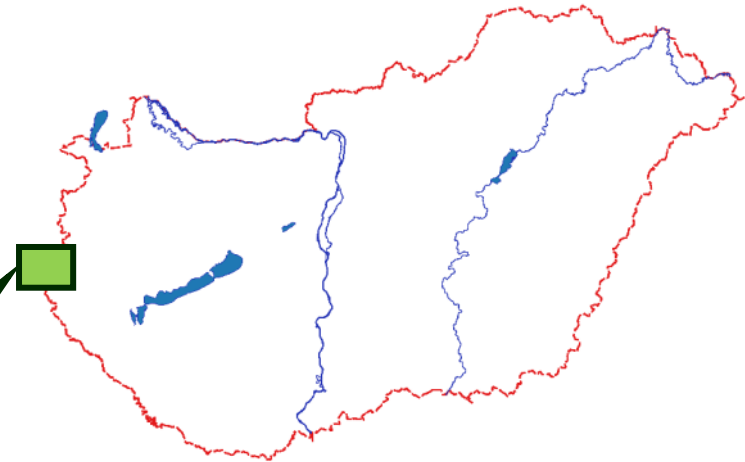
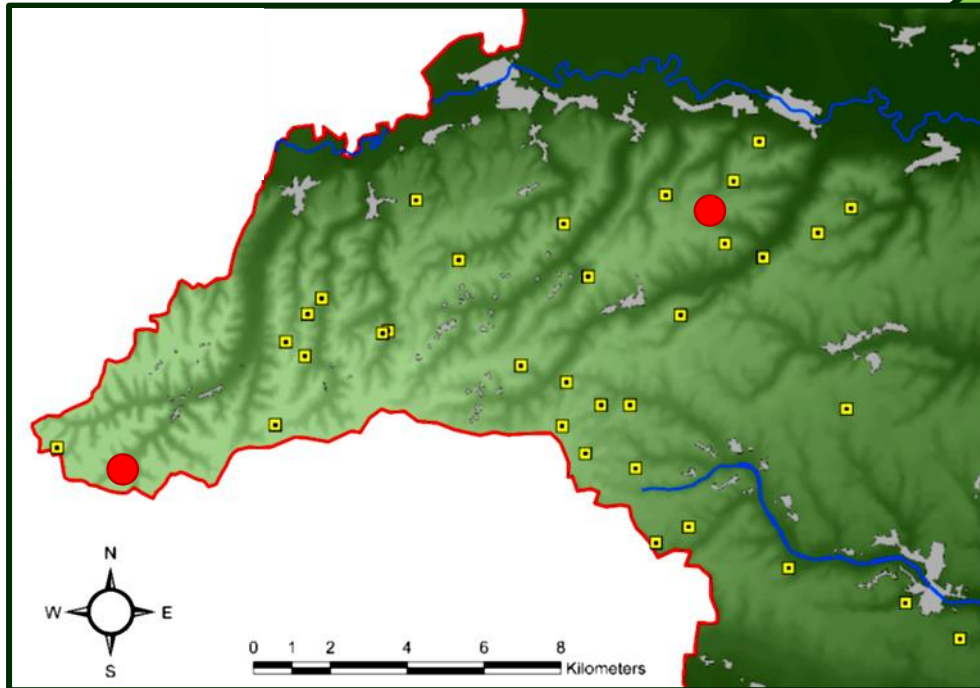


Observational study in Órség NP

To what extent are the microclimate variables correlated?

Which stand structure and landscape variables affect forest microclimate?

- 35 mature, managed mixed forest stands
- stratified random sampling -> different combinations of the dominant tree species (Ø distinct groups by tree sp.)



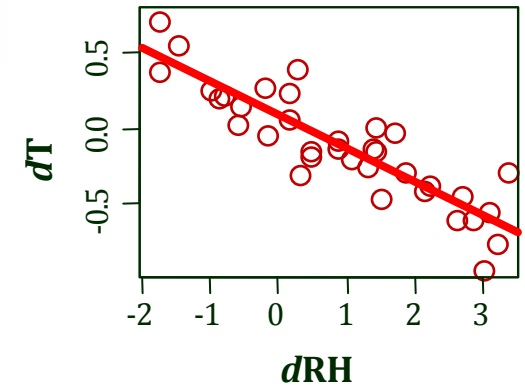
- air temperature and relative humidity -> 24-hr logging periods; relative values (reference loggers); 8 measurement periods
- relative diffuse light -> LAI-2000 analyser (*Flóra Tinya*)

Correlation analyses

- T and RH was consistently correlated (-)
- light was independent

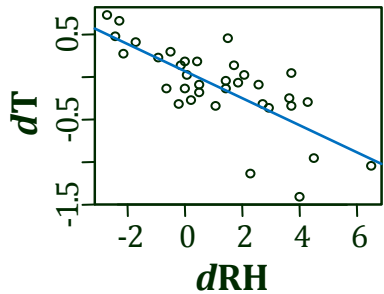
Mean

$R = -0.89^{***}$



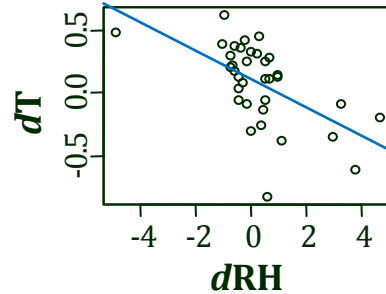
June 2009

$R = -0.74^{***}$



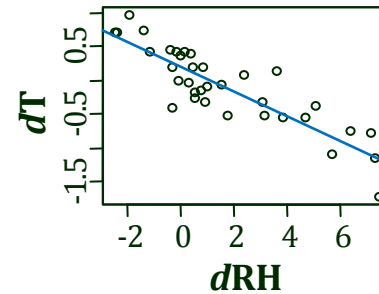
October 2009

$R = -0.58^{***}$



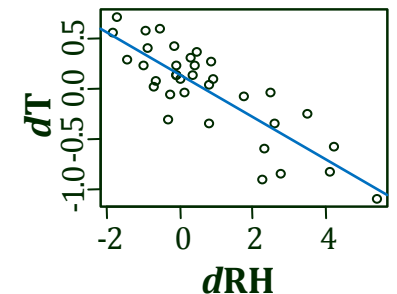
June 2010

$R = -0.87^{***}$



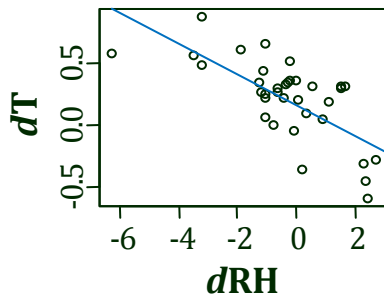
July 2010

$R = -0.84^{***}$



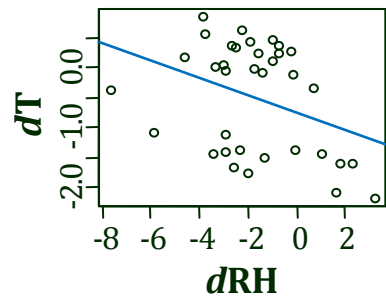
September 2010

$R = -0.69^{**}$



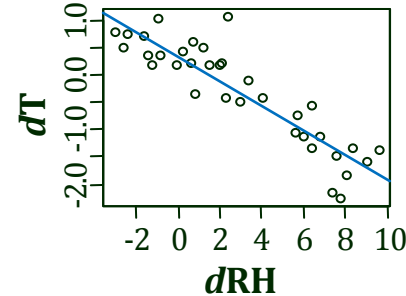
October 2010

$R = -0.36^{**}$



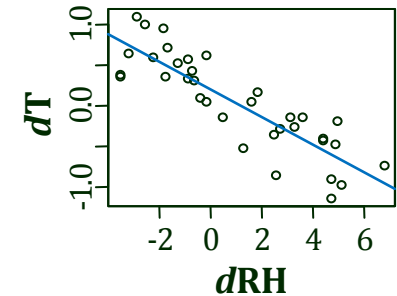
March 2011

$R = -0.89^{***}$

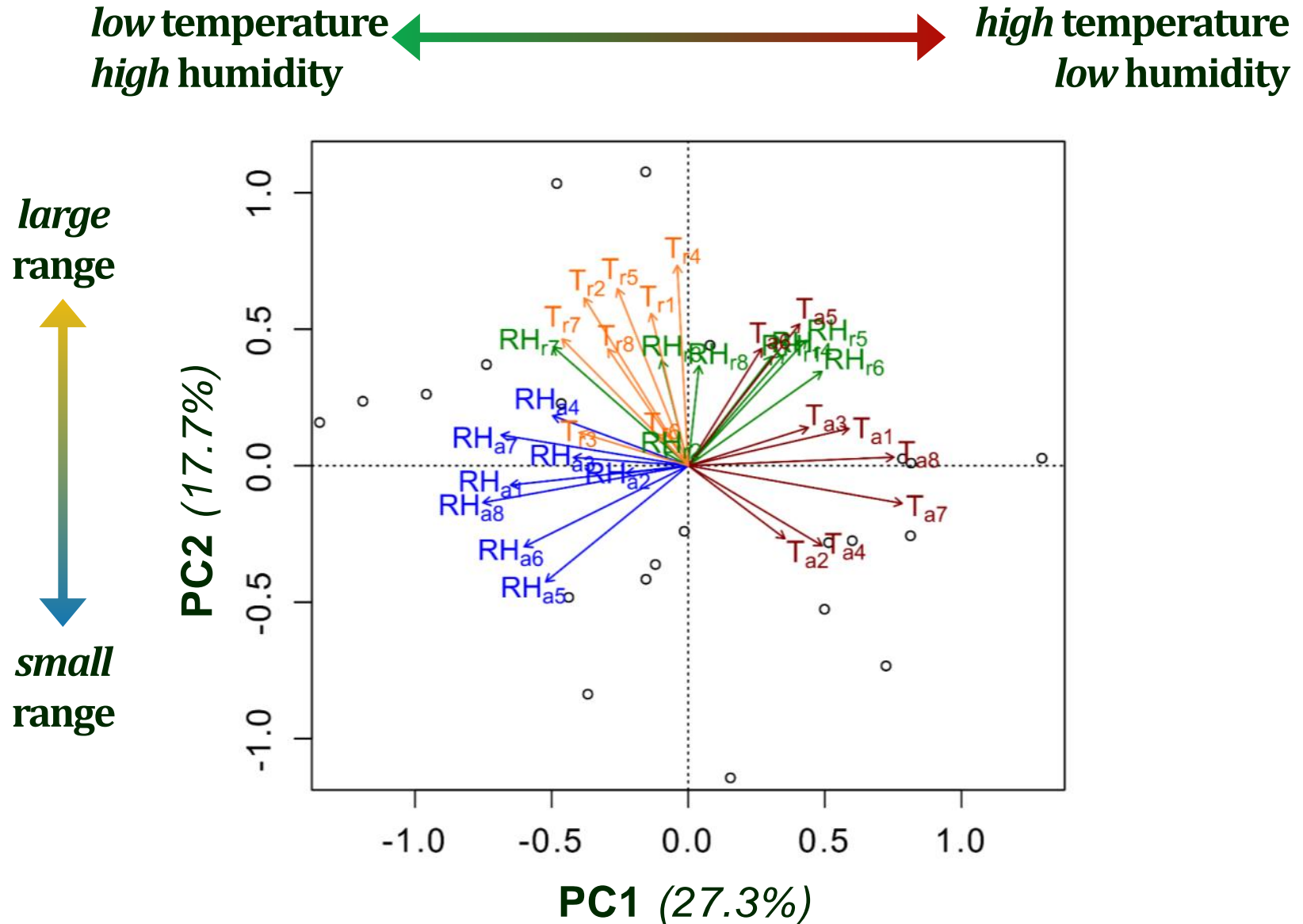


May 2011

$R = -0.87^{***}$



Generalization of microclimate variables



Potential explanatory variables

Tree species composition

Stand structure:

Diameter classes

Large trees

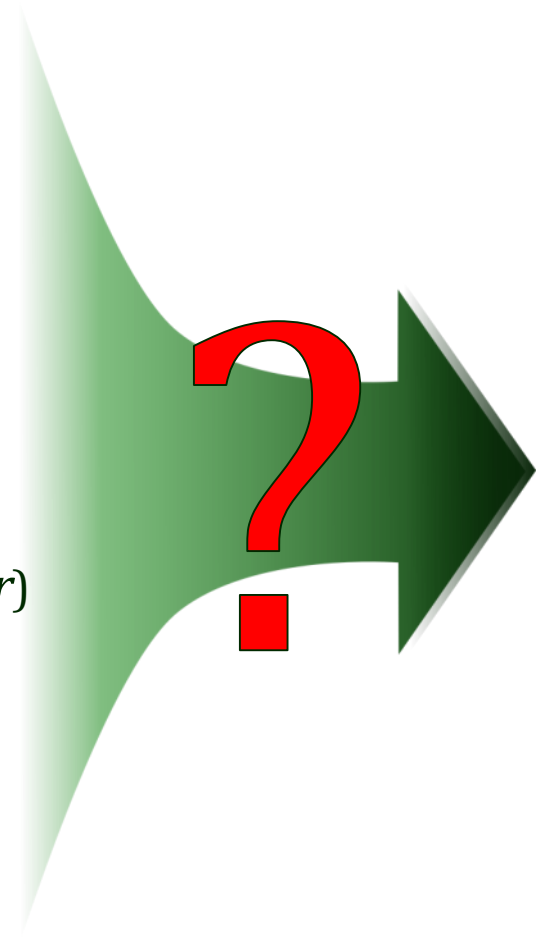
Shrub layer

Deadwood

Herb layer and bryophytes (*cover*)

Litter (*cover and compounds*)

Landscape variables (*r=300 m*)



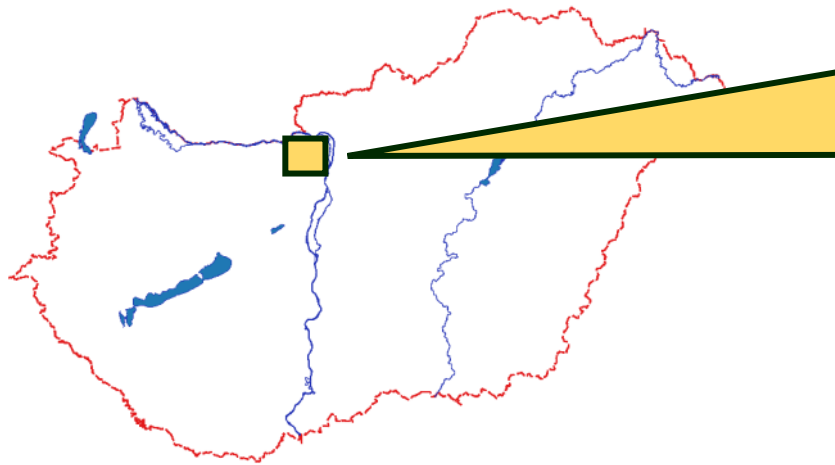
***Forest
microclimate***

Linear models: „microclimate” + light

Explanatory variables	Estimate sign	Variance %
PC 1 ~ “Warm and less humid microclimate”		
<i>$R^2=0.61, F(4,30)=14.3, p<0.001$</i>		
Relative volume of hornbeam	-	33.31
Density of shrubs and trees (0-5 cm DBH)	-	14.05
Proportion of deciduous stands in the landscape	+	11.62
Relative volume of oak species	+	6.62
PC 2 ~ “Higher daily microclimate range”		
<i>$R^2=0.22, F(3,31)=4.19, p=0.013$</i>		
Cover of total litter	-	11.09
Proportion of forests in the landscape	-	9.74
Shannon-diversity of DBH categories	-	8.02
Mean of relative diffuse light		
<i>$R^2=0.65, F(3,31)=21.64, p<0.001$</i>		
Total basal area of mapped trees	-	37.06
Shannon-diversity of DBH categories	-	19.67
Relative volume of oak species	+	10.95
CV of relative diffuse light		
<i>$R^2=0.49, F(3,31)=11.94, p<0.001$</i>		
Average DBH	-	35.56
Total basal area of mapped trees	-	13.48
Relative volume of beech	-	4.56

Experimental study in Pilis Mts.

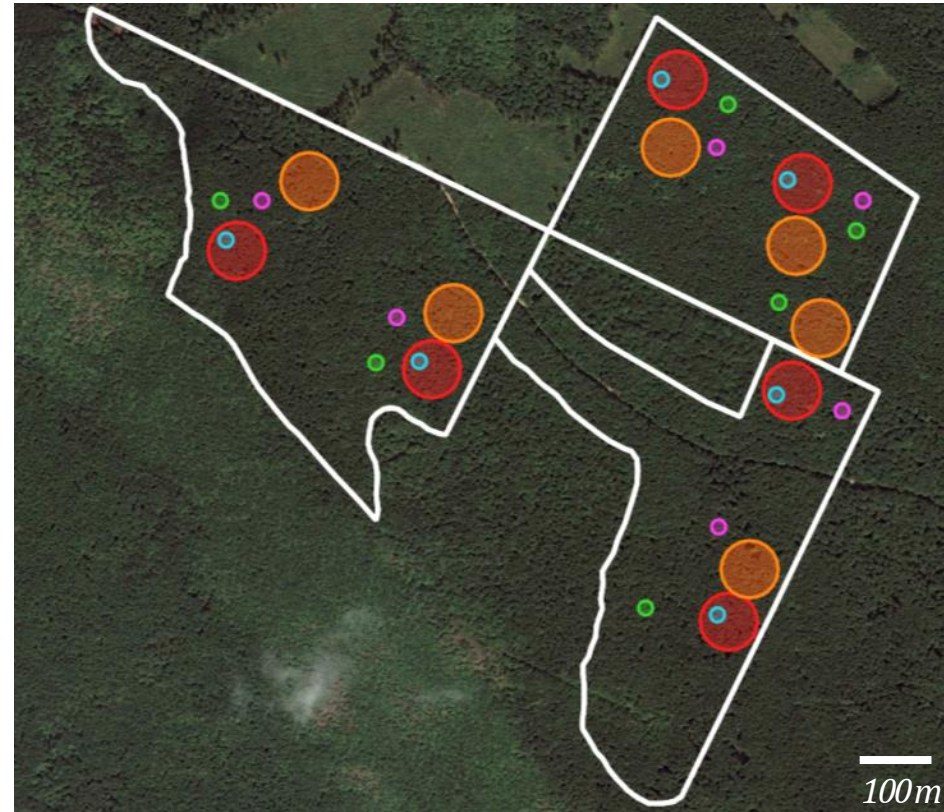
How do forestry treatments affect microclimatic variables?

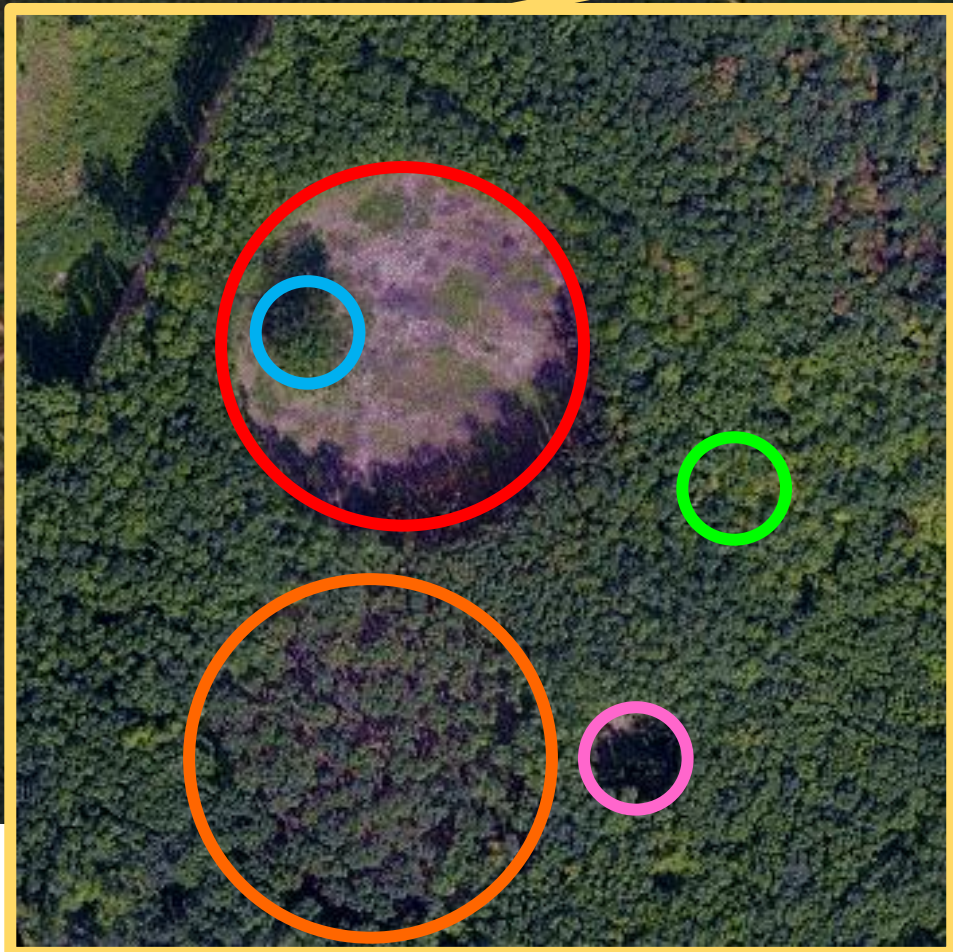
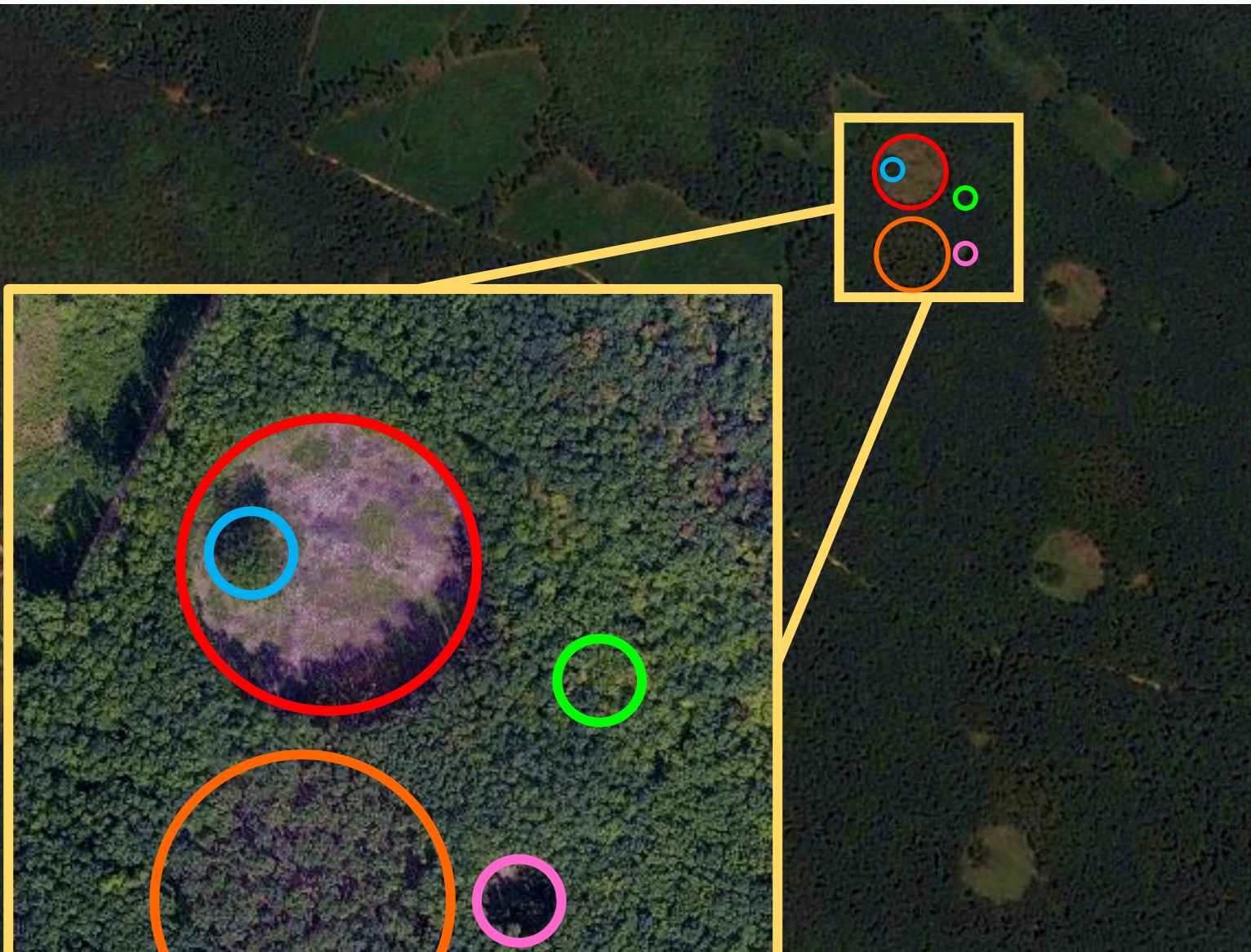


- **Pilis Mts., Hosszú Hill**
- **~40-ha homogeneous stand**
- **2-layered oak-hornbeam forest**
 - *Quercus petraea*: 21 m
 - *Carpinus betulus*: 10.5 m
- **average stand age: 70 yrs**

Experimental design

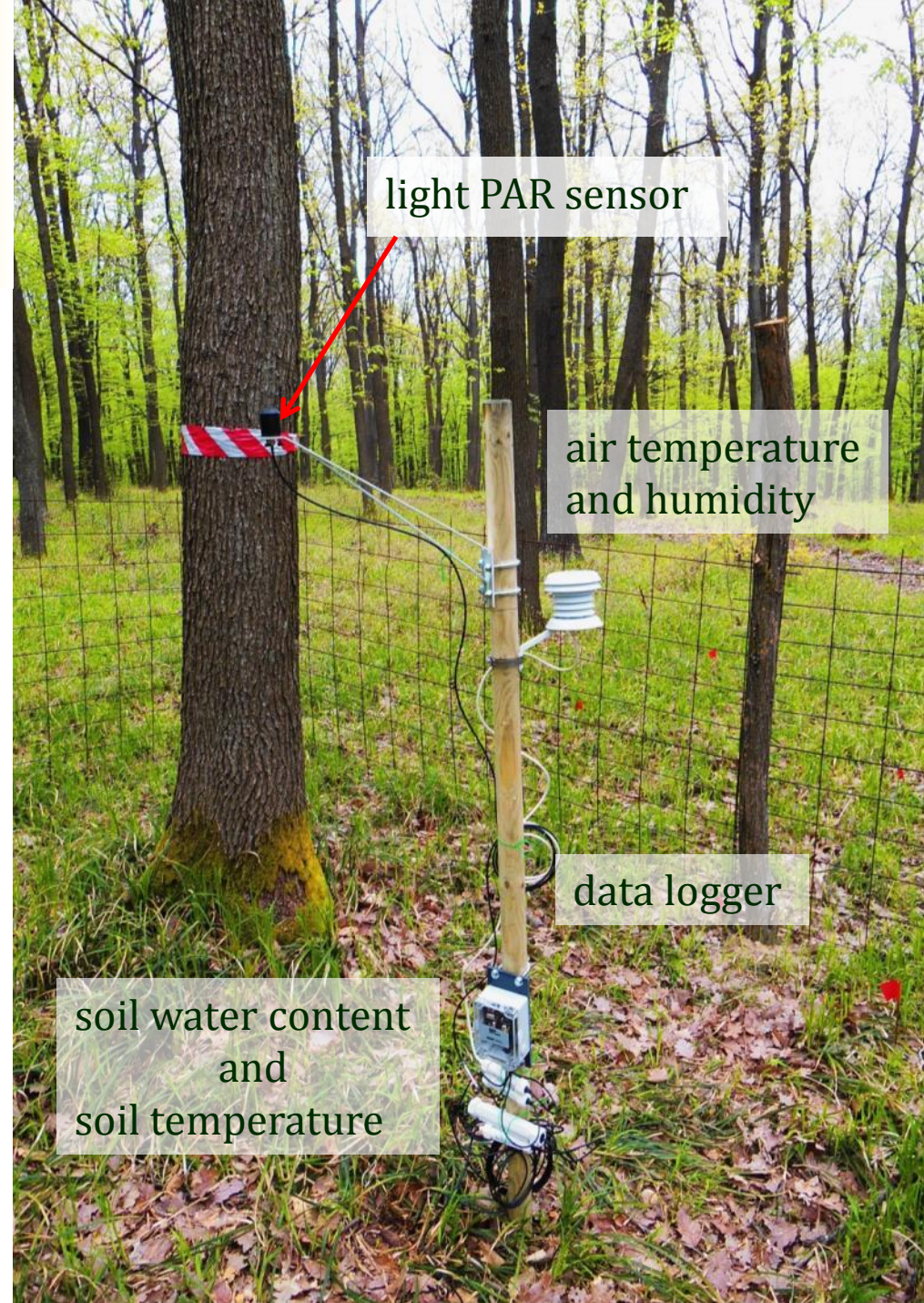
- 5 treatments
 - preparation cutting (d=80 m)
 - gap cutting (d=20 m)
 - micro-clearcut (d=80 m)
 - retention tree group (d=20 m)
 - control
- 6 replicates
- complete block design
- fenced plots (6×6 m)
- BACI (Before-After-Control-Impact)
all measurements started in 2014
- double control (temporal and spatial)



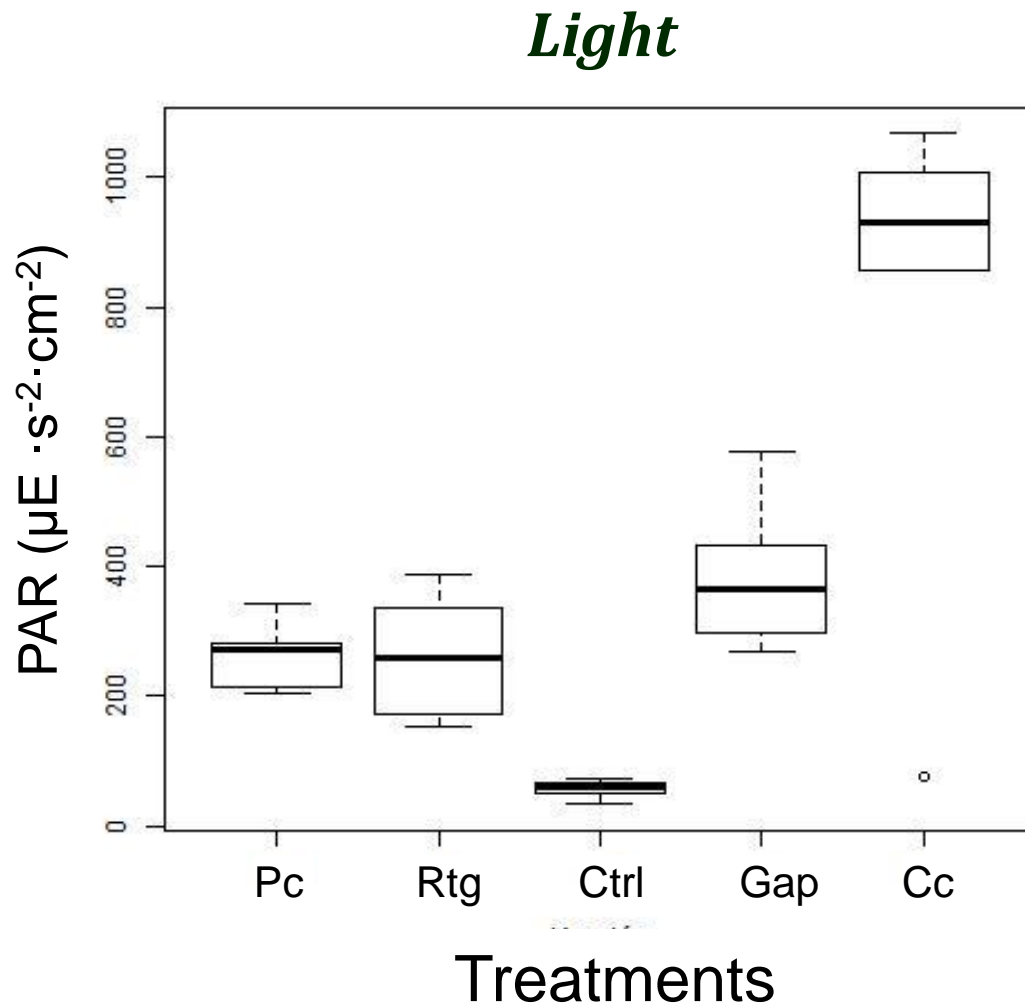


Microclimate measurements

- **72-hr measurements/month**
- **systematic data collection – synchronized data loggers**
- **in the center of the treatments: 5 variables are measured + VPD is calculated**
- **for analysis: 24-hr datasets**
- **+ additional measurements: DIFN, densiometer, TDR (SWC variability)**



Preliminary results



Pc



Rtg



Ctrl



Gap

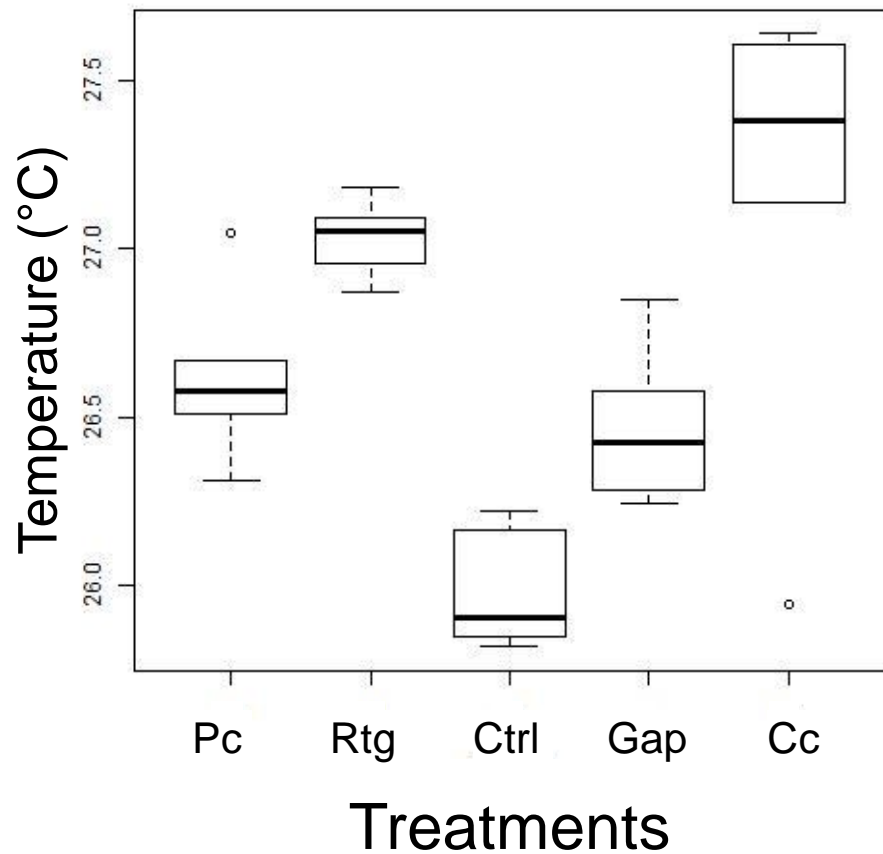


Cc

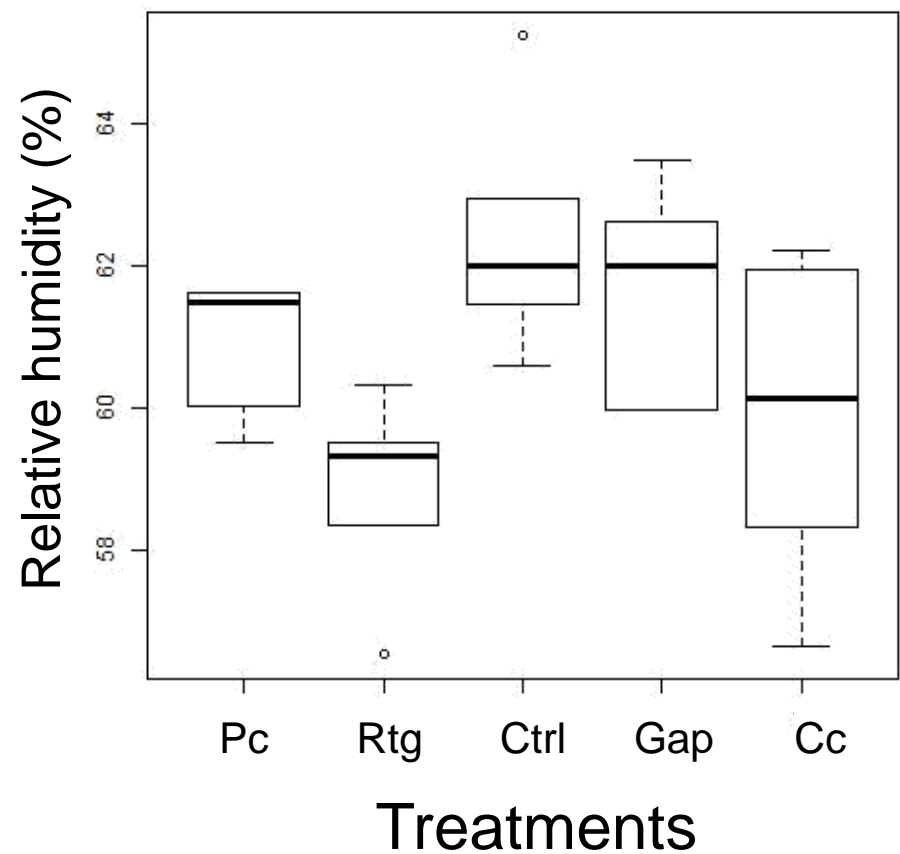


Preliminary results

Air temperature

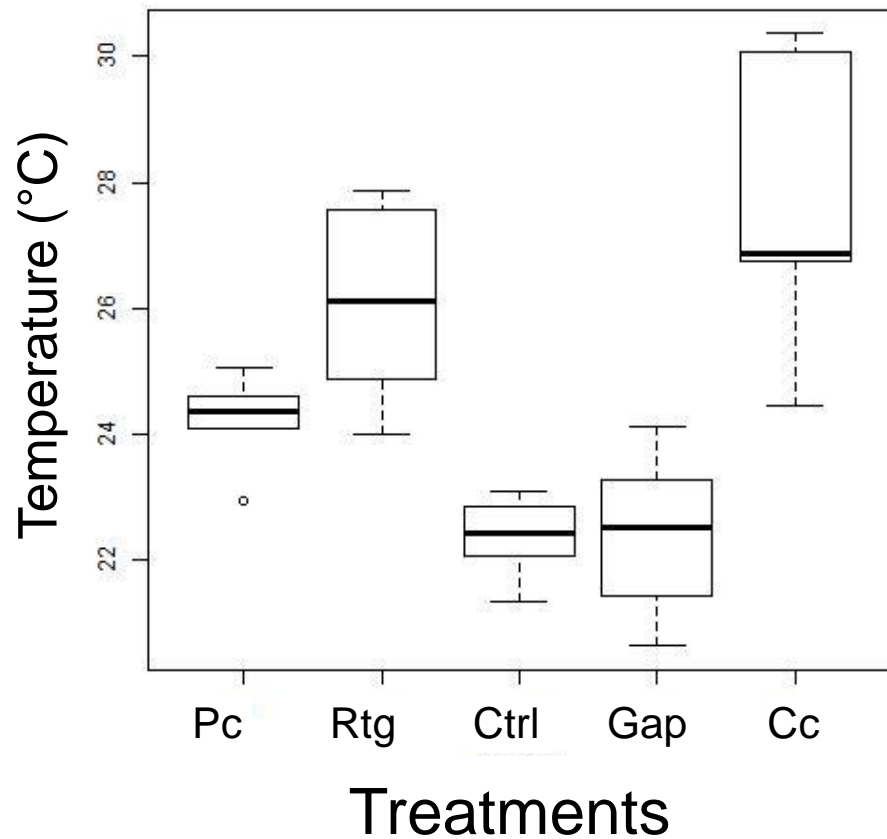


Air humidity

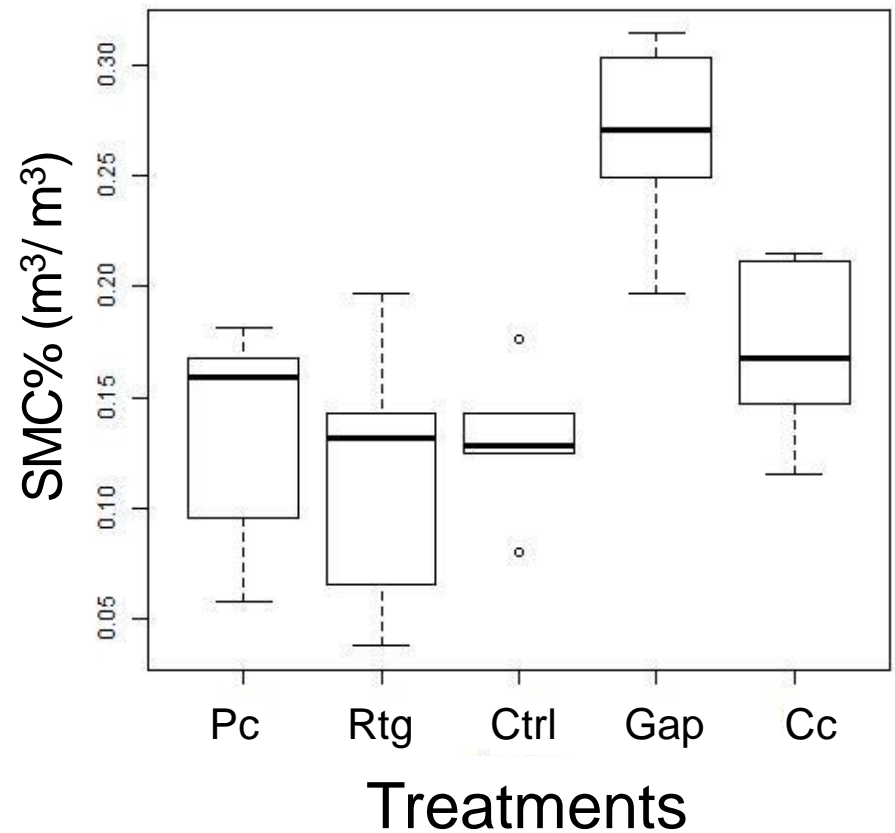


Preliminary results

Soil temperature



Soil moisture



Conclusions

- Well-developed shrub-layer and subcanopy are important for maintaining humid and cool microclimate
 - Tree size diversity and basal area are key factors of diffuse light in closed forests
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- Short response (2014->2015), preliminary results
 - Forestry treatments alter microclimate variables, e.g.:
 - *in gaps*: soil moisture and light increased
 - *in clearcuts*: extremes are more frequent, temperature increased
 - *in retention tree groups*: the buffering capacity seems to be lower than expected

Thank you for your kind attention!

Acknowledgement:



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