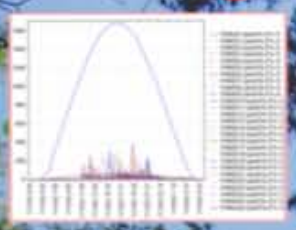
Q: How does light penetrate into understorey of Norway spruce forest?

A: Very heterogeneously (matter of sampling time and space)



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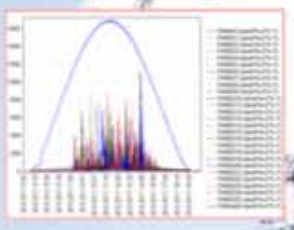

MOTIVATION:

It is suggested that, on average, atmospheric CO_2 concentration, temperature, canopy leaf area index (LAI), and cloud ceilings will rise with a warming climate (IPCC 2007) and influence thus the light environment of forests. To properly evaluate carbon sequestration of ecosystems and predict its future changes, well done light measurements with sufficient spatial and temporal resolution are necessary.

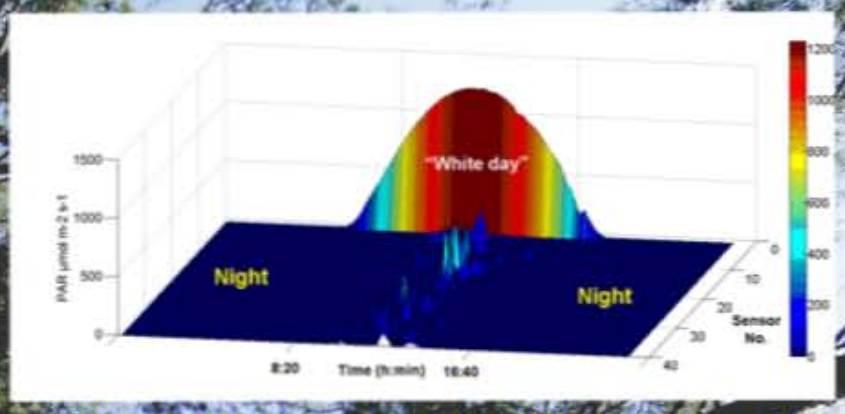

Fig. 1 Light in our understorey transect on SEP 23 2011 (clear day). - Deep shade, occasionally punctuated by sunflecks. "Gauss resembling" shape on the backs light incomming on forest.

!!! Through poster - "Light" = photosynthetically active radiation (PAR) in wavelength range 400 - 700 nm !!!

CONCLUSIONS:

1/ Whole-season transmitances within our transect were between ca. 1.3% (clear days) and 4% (fully overcast days). Seasonal changes in LAI had mild effect (Fig. 3).

2/ Sunflecks had "small grain", decorelates within distance 33 cm or less (Fig. 2).

3/ Statistical distribution of light was strongly positively skewed, intensities above 250 µmol m^{-2} s^{-1} were very rare (see conference proceeding).

4/ 10min averaging underestimated sunflecks contribution by factor, which increases with increasing threshold chosen for sunfleck onset (Fig. 4).

5/ Beside diurnal cycle, there were no obvious dominant frequences of light fluctuations as Fourier transform shows (not shown).

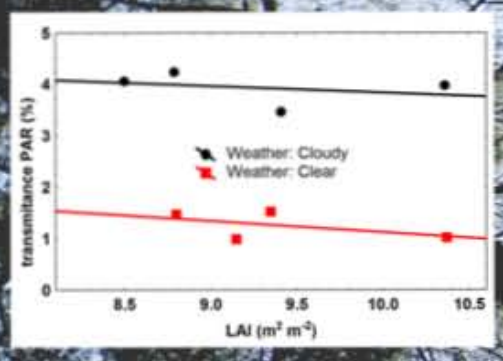

Fig. 3 Diffuse light during cloudy days penetrates much better than predominantly direct light during clear days. Putative dependence on leaf area index (LAI) could not be exactly tested because this effect is superimposed at changes in sun elevation.

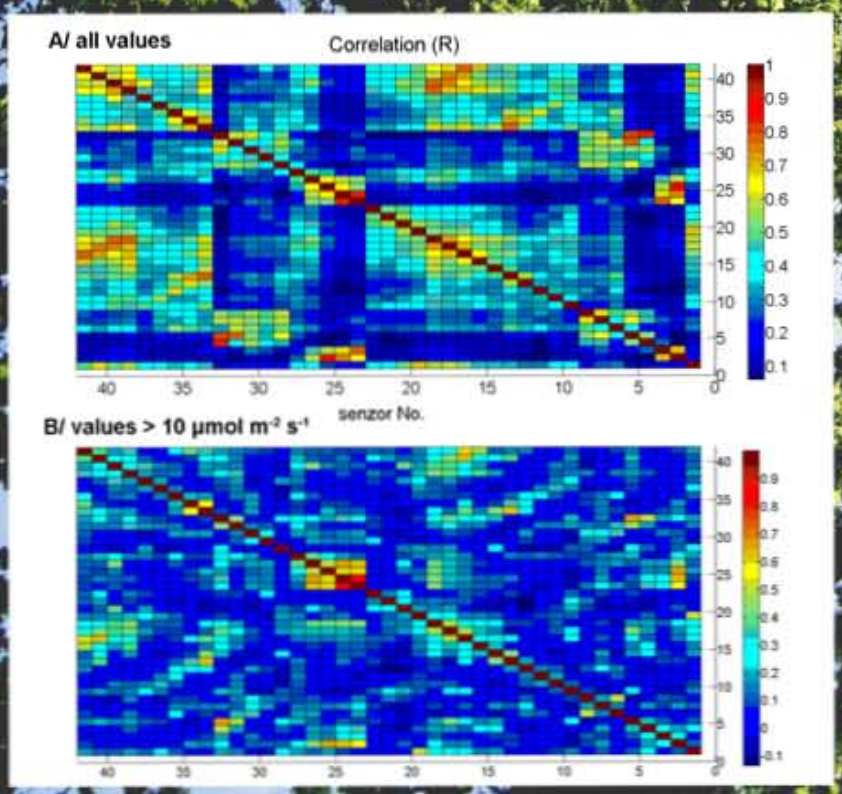

Fig. 2 Between senzor correlations. There is almost missing correlation due senzor vicinity (absent "high R ridge" along diagonale, upper plot). On the other hand, strongly shaded senzors correlate well (despite distance), because sunflecks are almost absent there and diffuse light penetration is highly correlated to incoming light on forrest. It may be seen when as low intensity as 10 µmol m^{-2} s^{-1} and above were ruled out (lower plot) - correlations diminished.

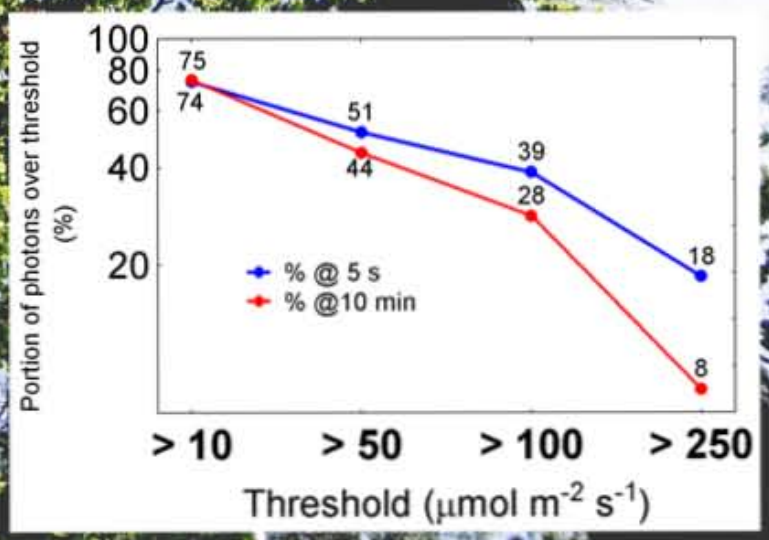

Fig. 4 Percentage of photons delivered to understorey by light of higher intensity than (four chosen thresholds, x axis). 10 min averages underestimate these percentages because short sunflecks of high intensity are "diluted" in surrounding shade. It is obvious from example courses of clear day @10min (left from "Jiri Kubasek" title) and @5s (right from Otmar Urban).

Acknowledgement & furher reading:

Authors are indebted to Irena Marková for helpful discussion. Description of experimental site, Methods of measurements and statistics, and References may be found in 3 Global Change Research Centre conference proceeding - poster should be brief.

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