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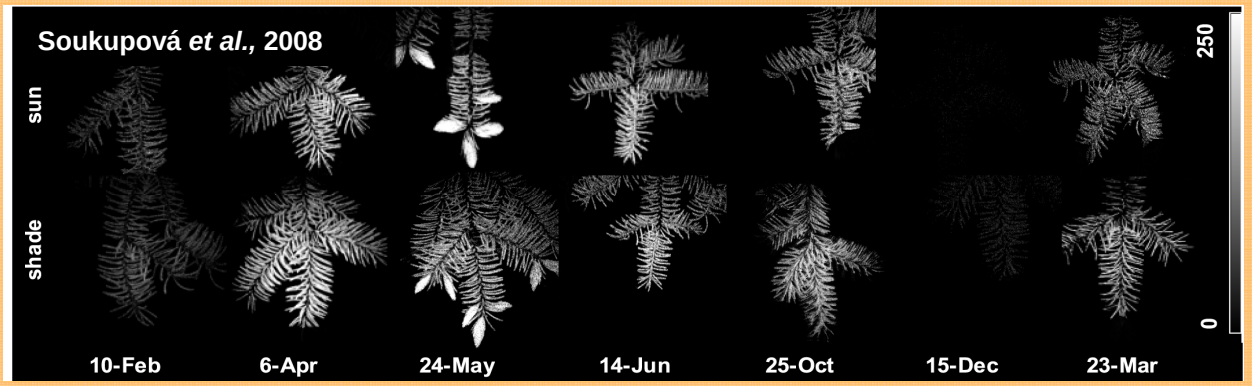
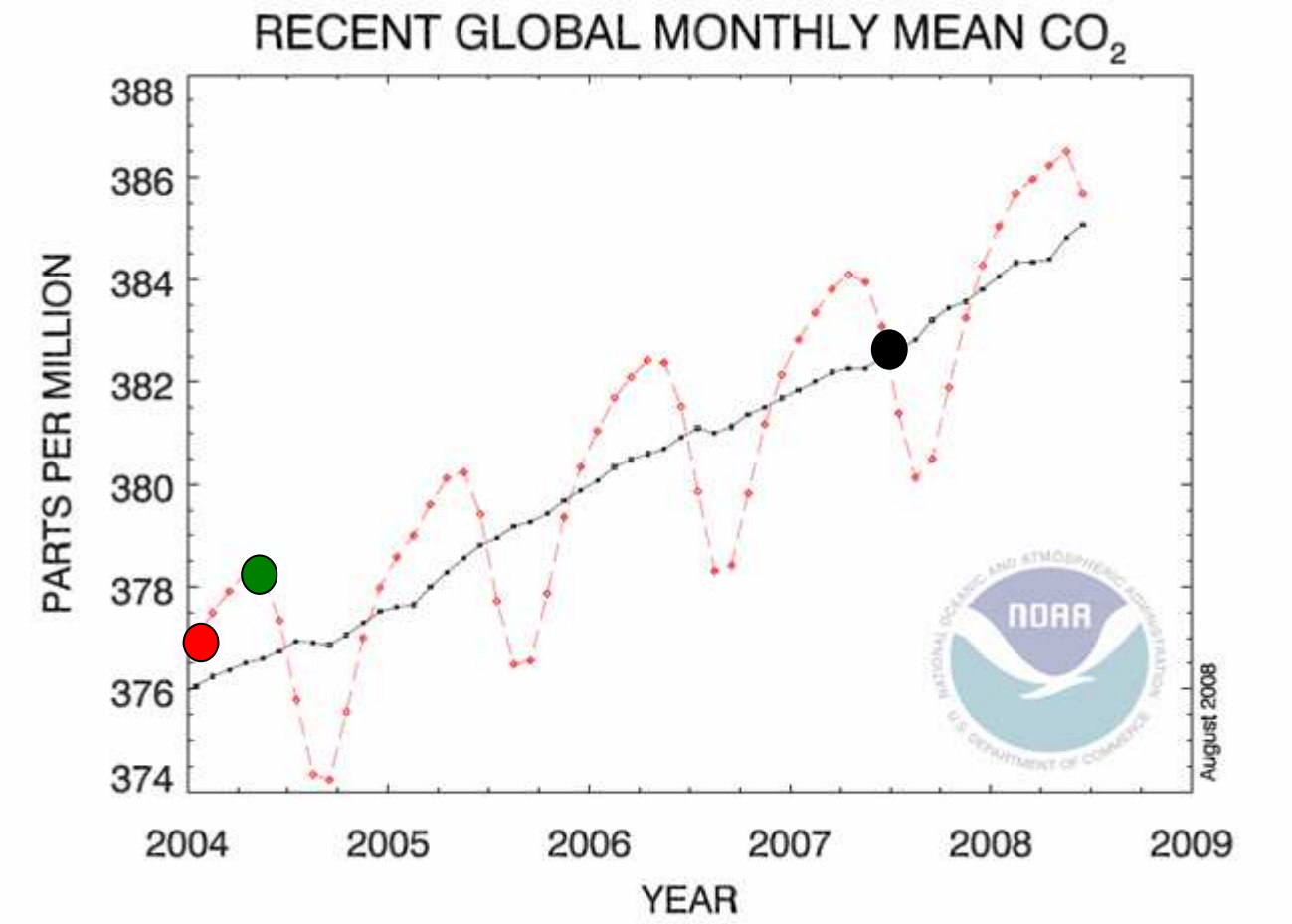
Towards remote sensing of vegetation processes

Sensing Changing World
19-11-2008



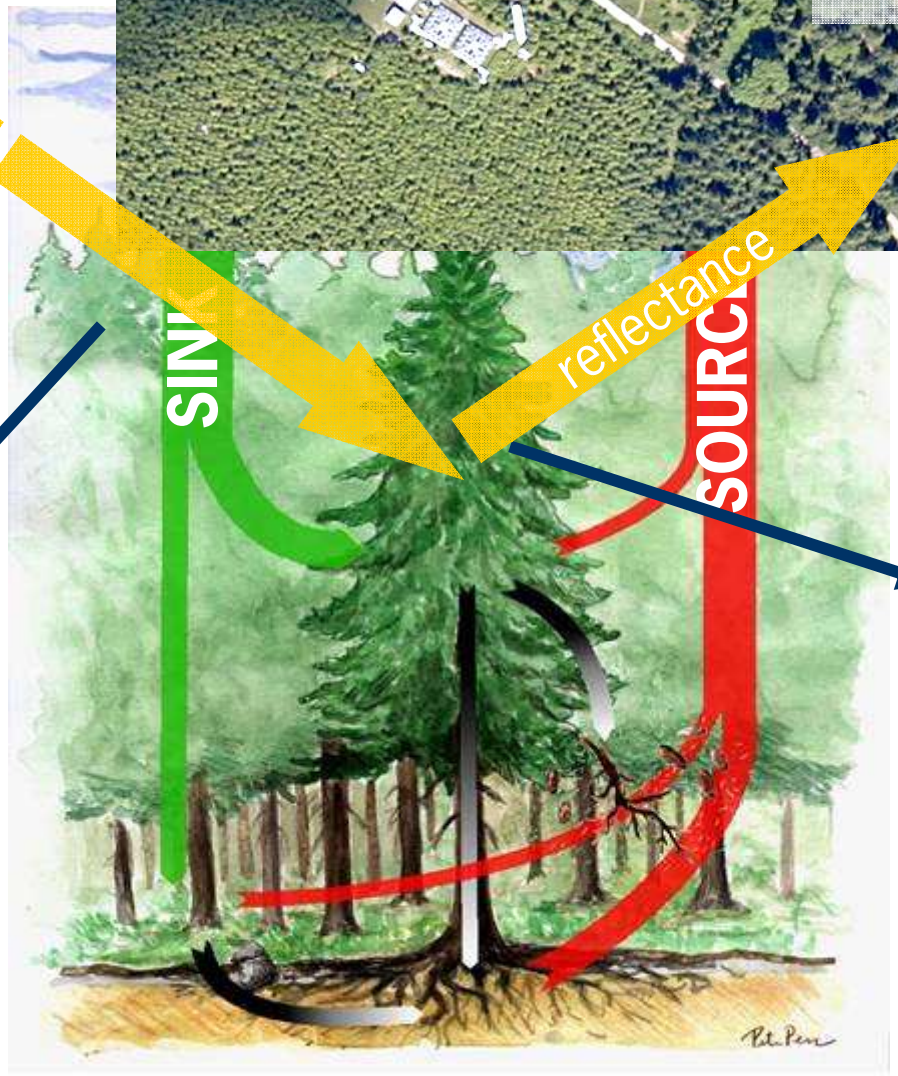
Institute of Systems Biology and Ecology
ACADEMY OF SCIENCES OF THE CZECH REPUBLIC



The highest atmospheric CO_2 concentration in the last 800 000 years

INTRO

CARBON FLUX MONITORING

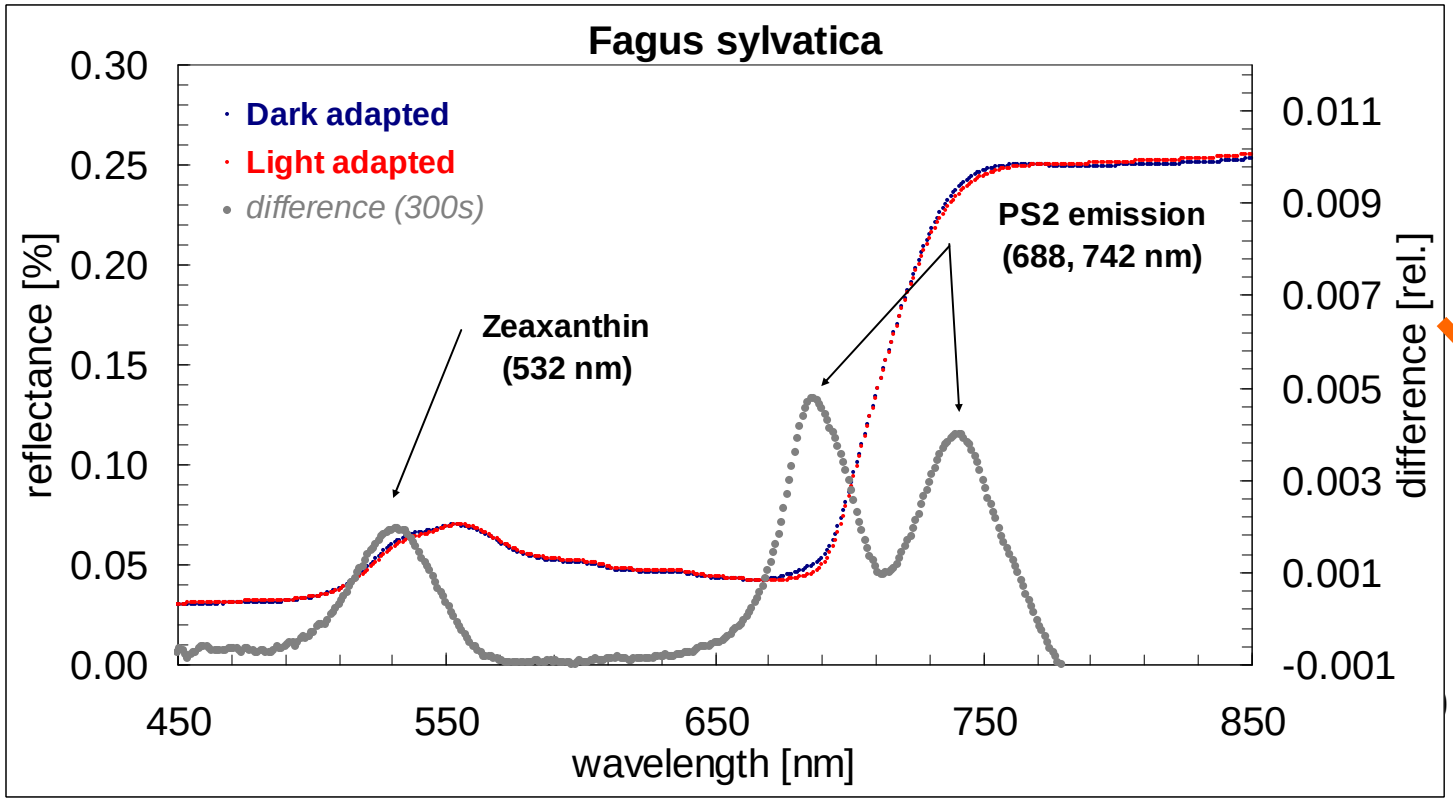


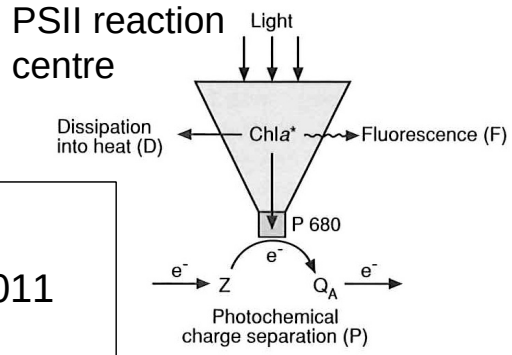
canopy scale

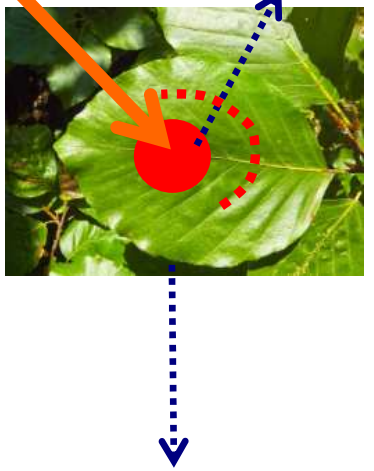
leaf scale

Leaf reflectance &

steady-state fluorescence (Fs) measurements







Vegetation ‚process-related' remote sensing (RS)

EXPERIMENT 1

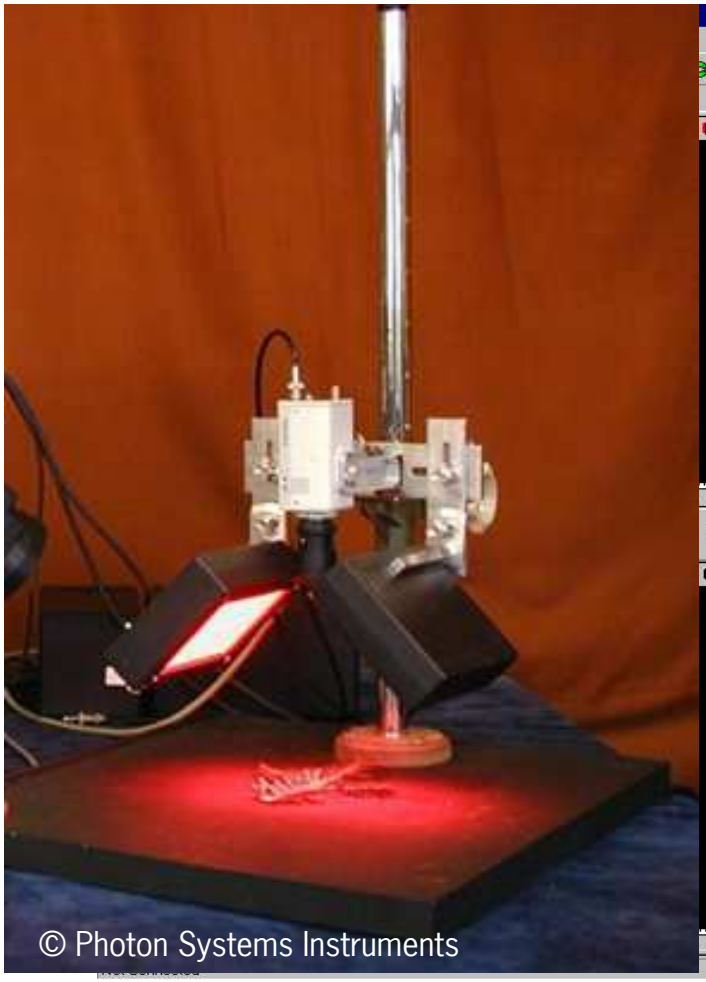
OBJECTIVE

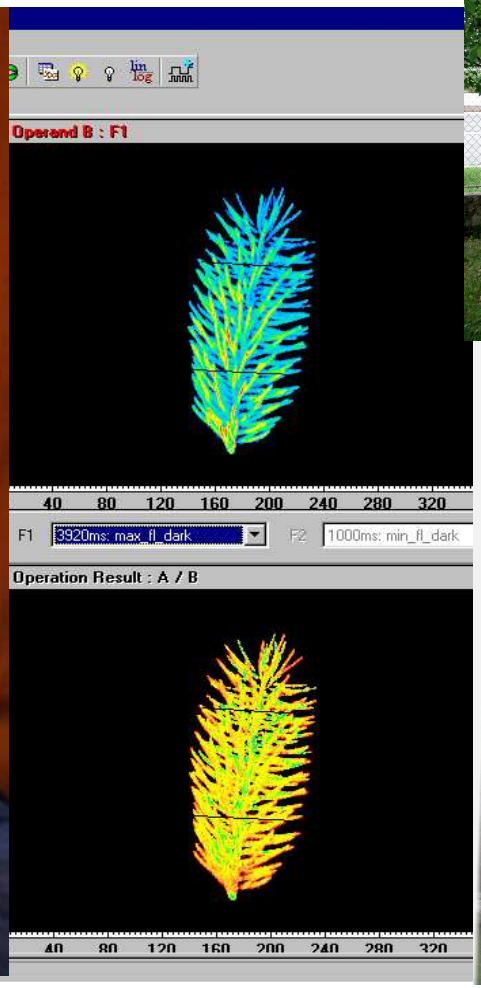
To investigate the information content in annual changes of steady-state chlorophyll fluorescence yield (Fs) of evergreen plant species, as being a passively remotely sensed signal.

EXPERIMENT 1

METHODOLOGY

FLUORCAM (CCD fluorescence camera)

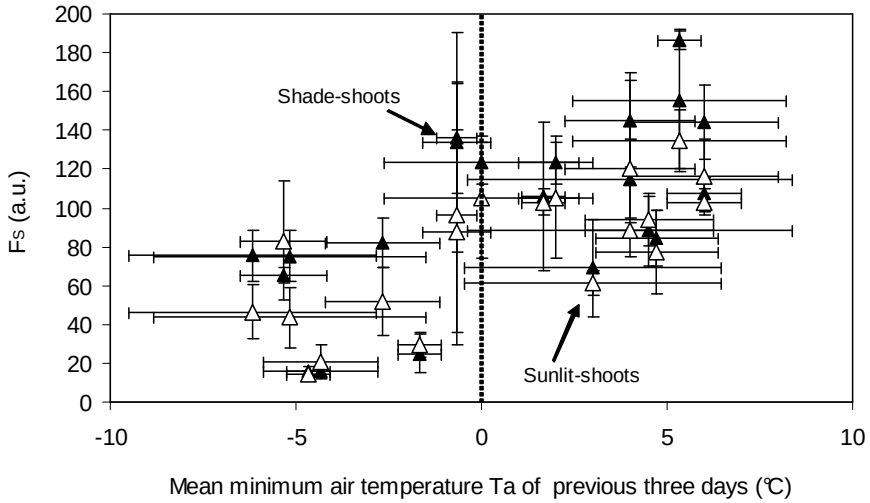


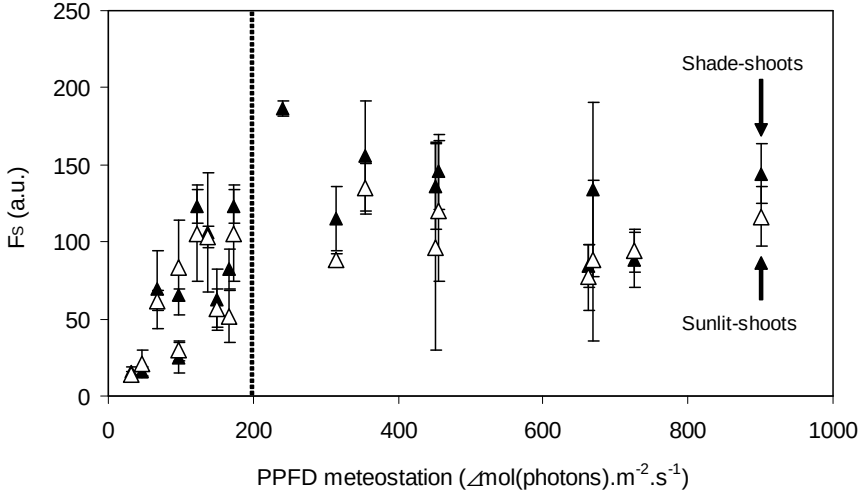


EXPERIMENT 1

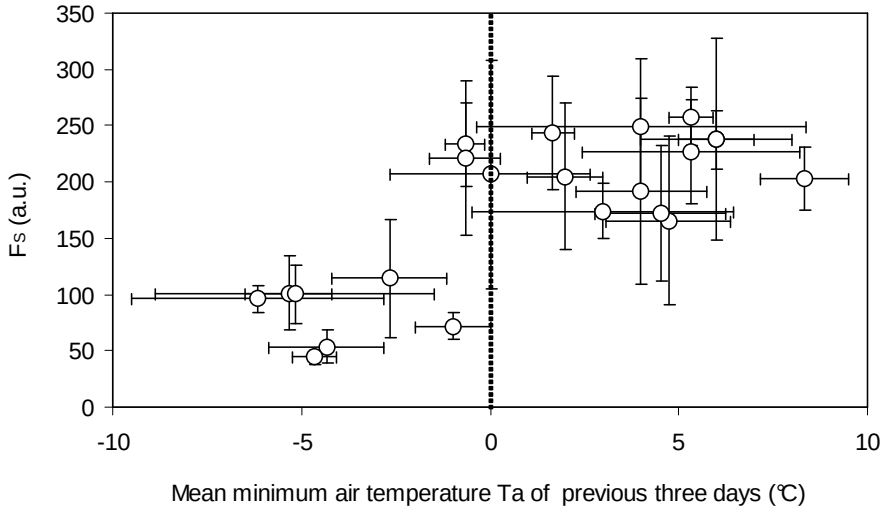
RESULTS

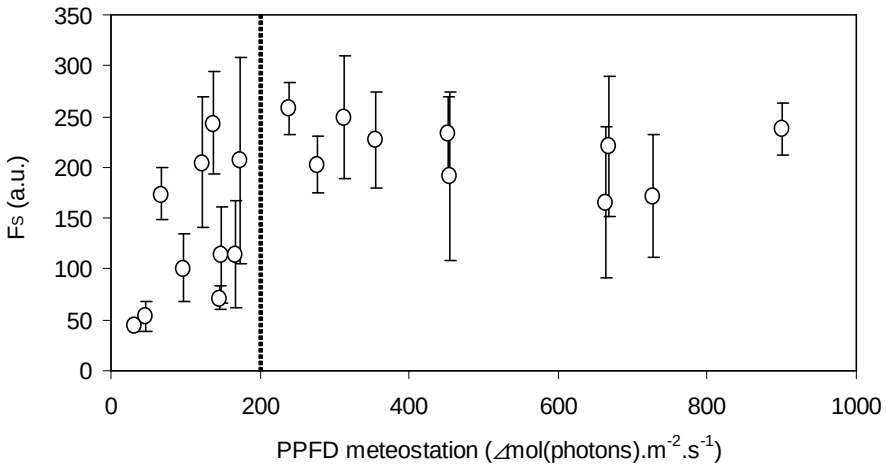
Picea omorika





Rhododendron x hybridum





EXPERIMENT 2

OBJECTIVES

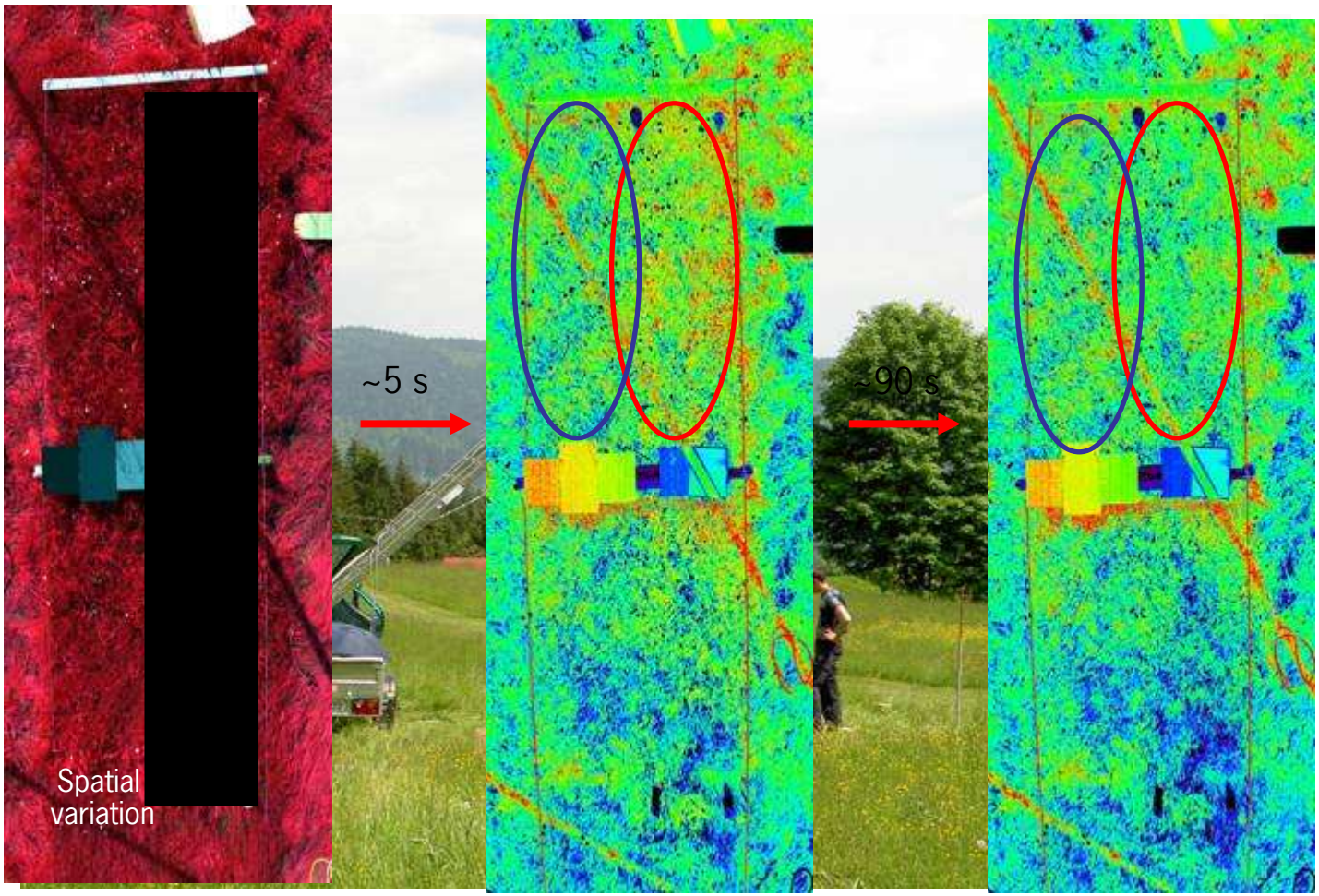
① To test sensitivity of the AISA Eagle VNIR imaging spectroradiometer for sensing the grassland and spruce canopy fluorescence signals.

② To investigate potential relationships between 'process-related' vegetation optical indices and eddy-covariance flux parameters.

EXPERIMENT 2

METHODOLOGY i.

Airborne Imaging Spectrometer for Applications (AISA Eagle) => *spatial* and *temporal* distribution of the vegetation optical indices.



EXPERIMENT 2

METHODOLOGY ii.

Eddy-covariance system measures exchange of CO_2 and H_20 between air and ecosystem canopy resulting in following parameters:

NEE – Net Ecosystem Exchange

GPP – Gross Primary Production

R – Respiration

RUE – Radiation Use Efficiency (= NEE/PPFD)

gRUE – gross Radiation Use Efficiency (= GPP/PPFD)

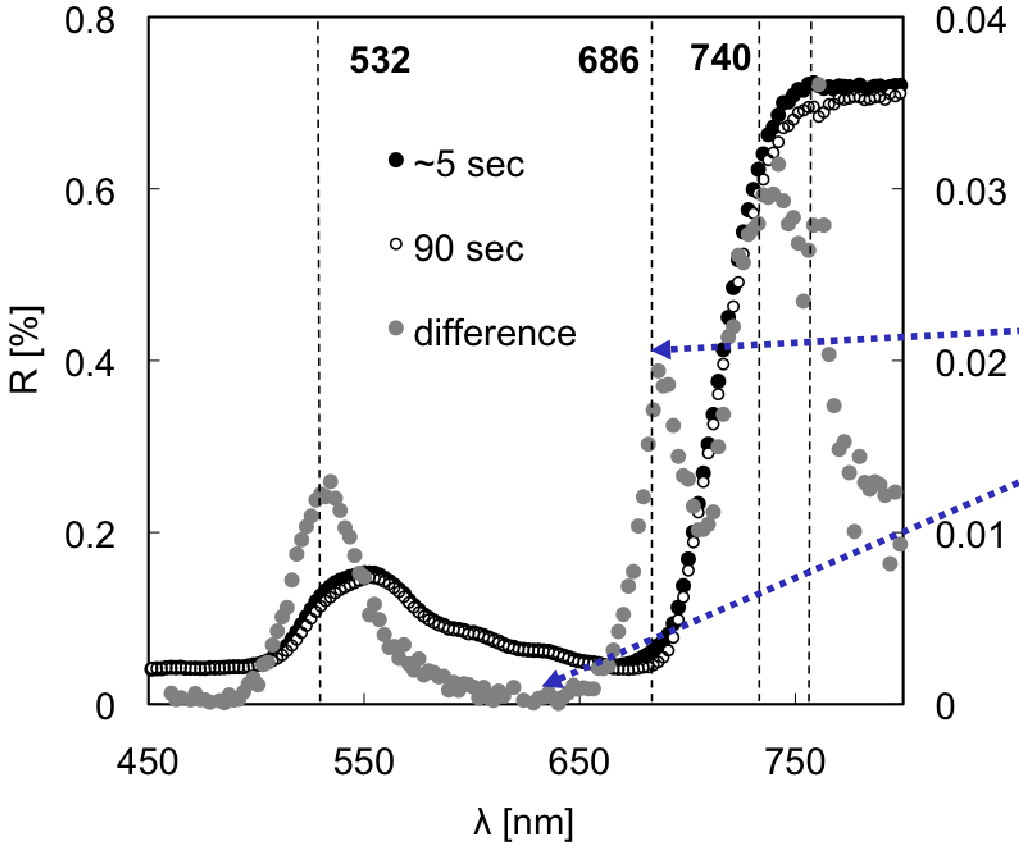
EXPERIMENT 2

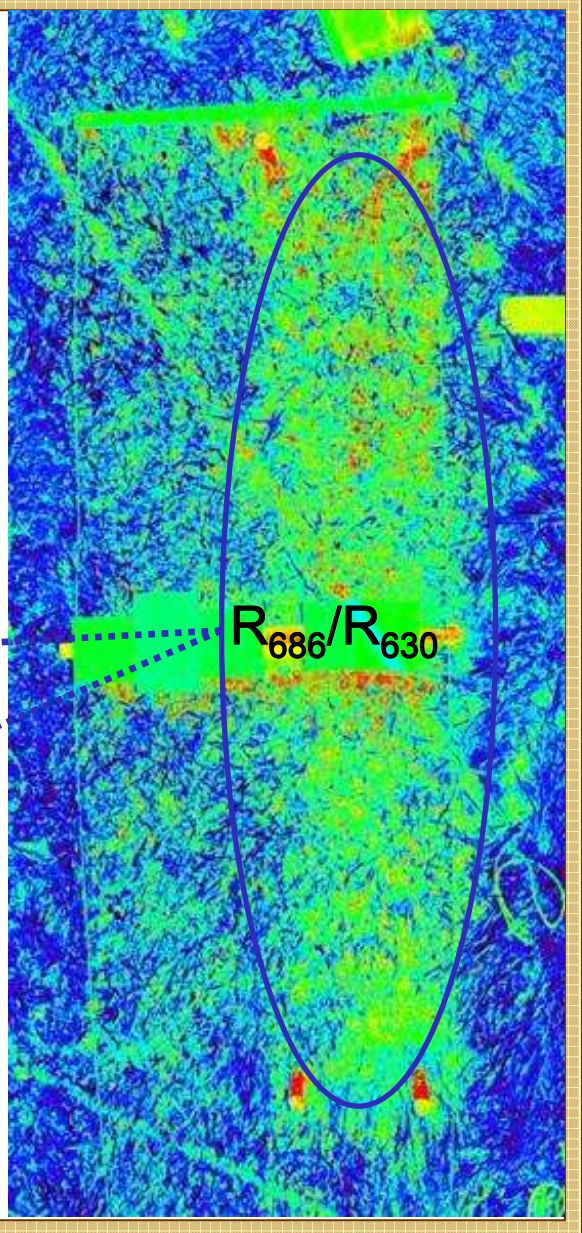
RESULTS i.

Vegetation indices used:

$PRI = (R_{532}-R_{570})/(R_{532}+R_{570})$;

R_{688}/R_{630} & R_{740}/R_{800}





EXPERIMENT 2

RESULTS ii.

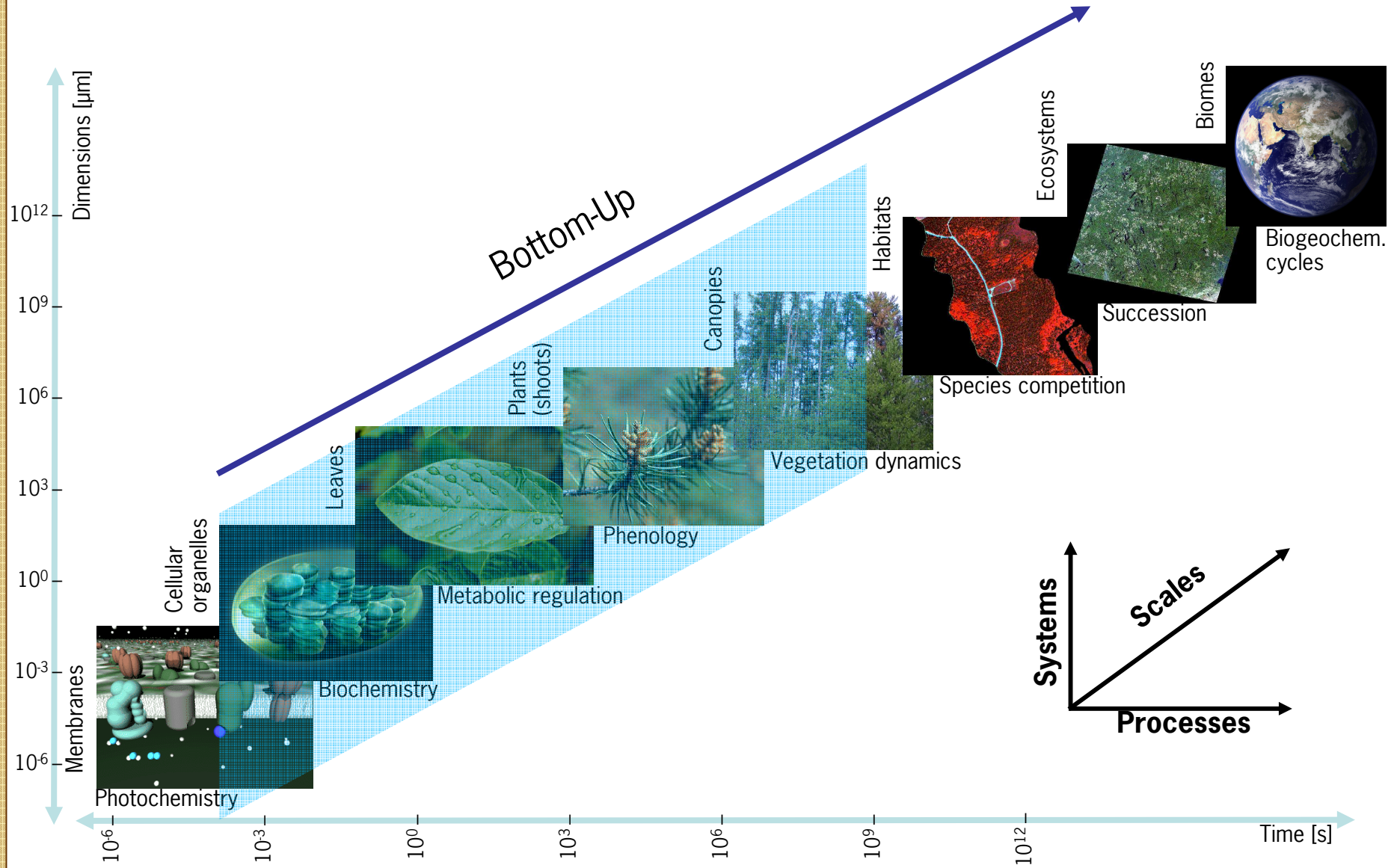
Pearson correlation coefficients between eddy-flux physiological parameters and 'process-related' VIs (grassland and forest data sets analyzed together):

VIs	*Respiration*	*GPP*	*NEE*	*gRUE*	*RUE*
PRI	-0.51	0.16	0.25	0.61	0.52
R_{686}/R_{630}	0.15	*0.93*	*0.91*	-0.45	*-0.73*
R_{740}/R_{800}	0.59	0.33	0.22	*-0.93*	0.09

Towards remote sensing of vegetation physiological processes using fluorescence signals

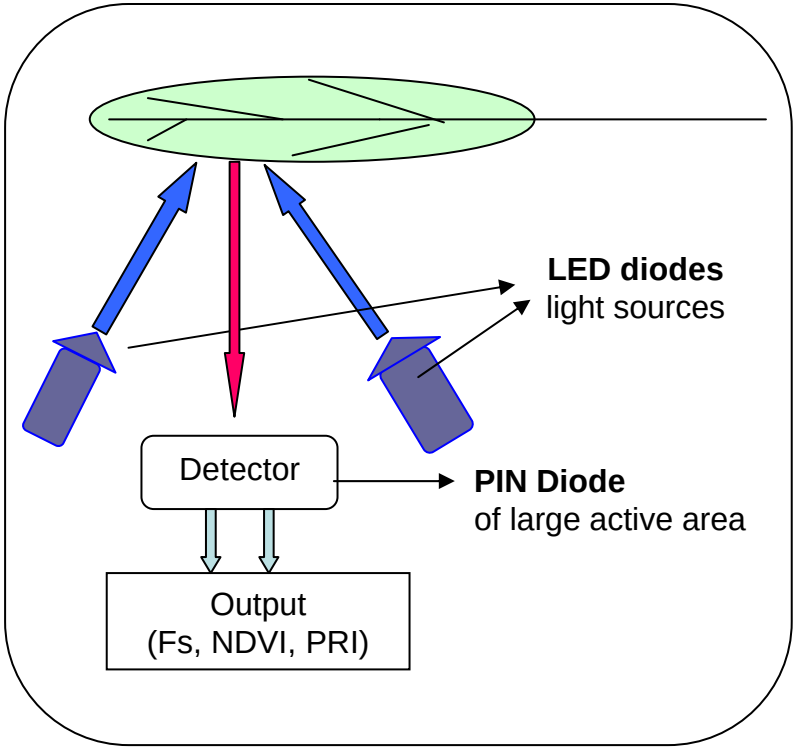
OBJECTIVE

UP-SCALING



SENSOR NET

POCKET-SIZE FLUORMETERS



FLUORESCENCE PARAMETERS

(LED light source at 470 nm)

F(t) – fluorescence at any time

Fv/Fm – quantum efficiency of fluorescence

Fs – steady-state fluorescence

REFLECTANCE PARAMETERS

(LED light source at 644 nm & 760 nm)

$NDVI = (R_{760} – R_{644})/(R_{760} + R_{644})$

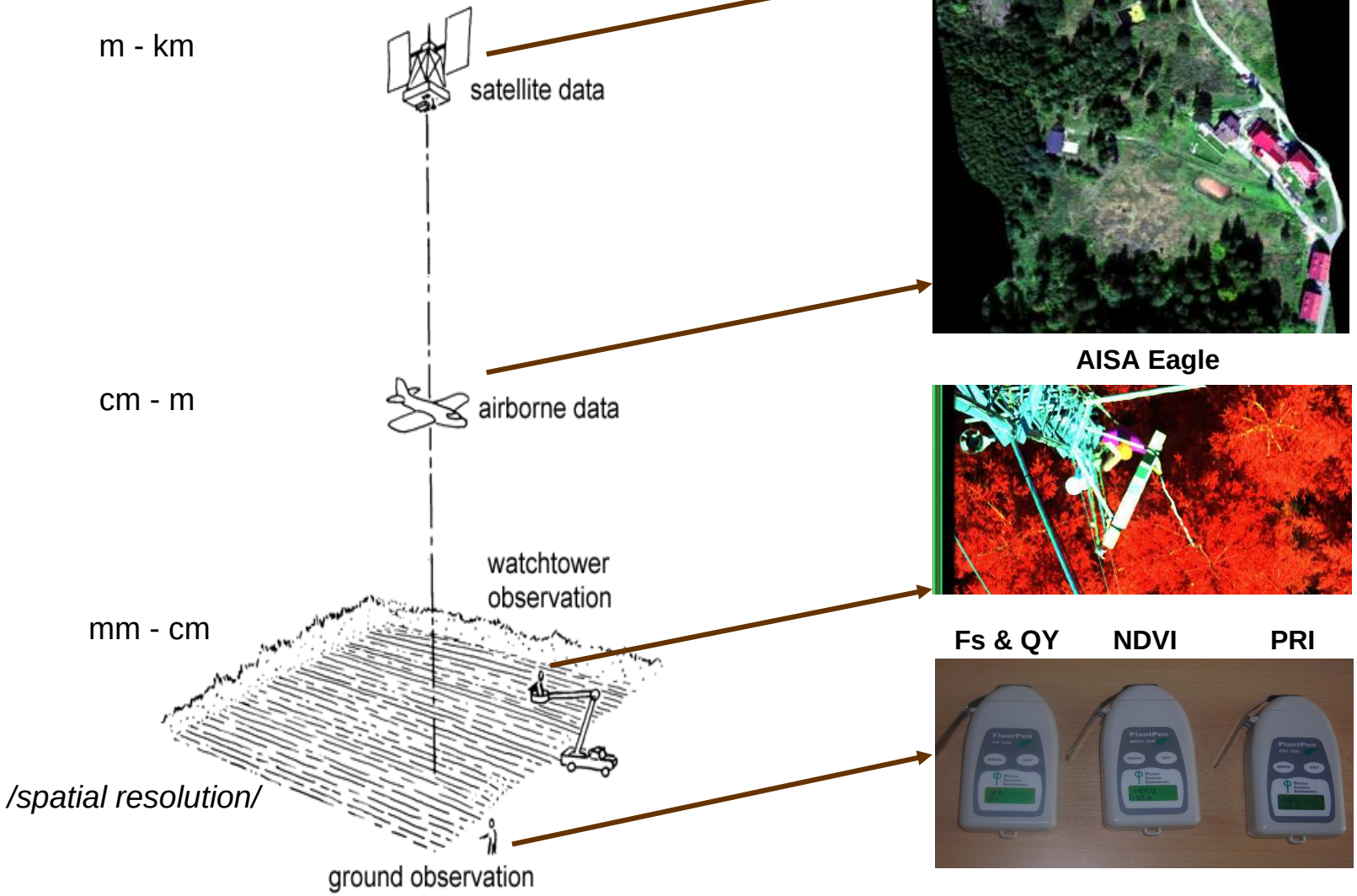
(LED light source at 531 nm & 570 nm)

$PRI = (R531 – R570)/(R531 + R570)$

A wide range of *two chips* light emitting diodes (LED's) as light sources and very sensitive PIN diode sensor allows to construct network of pocket size devices measuring nearly any combination of reflectance and fluorescence parameters.

OUTLOOK

MULTI-SCALE MONITORING



AISA Eagle

Fs & QY **NDVI** **PRI**

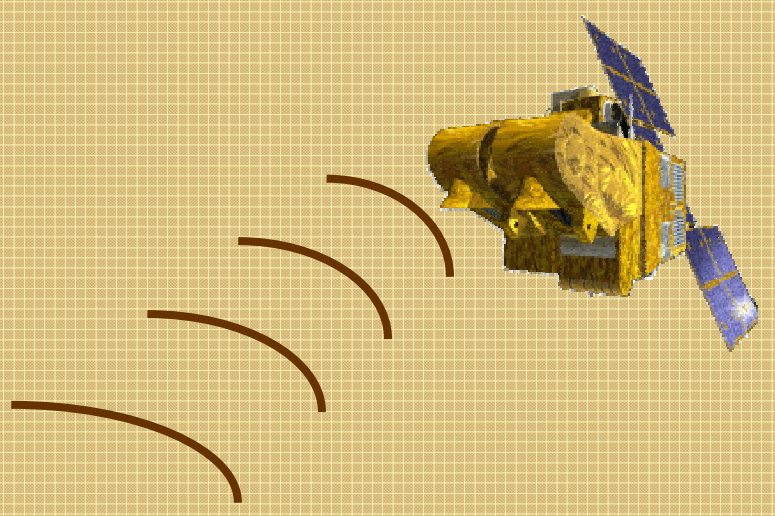
TAKE HOME MESSAGES

① Chlorophyll steady-state fluorescence is an accurate indicator of the active vegetation season for evergreens.

② Fluorescence related optical indices of canopy reflectance can be related with the vegetation radiation use and productivity.

③ Correct interpretation of the steady-state fluorescence signal needs an appropriate leaf-canopy up scaling approach, based on a joint ground and remote sensing monitoring network.

QUESTIONS ?



acalex@usbe.cas.cz

LAB. EXPERIMENT

PERFORMANCE

Beans

LL

ML

HL