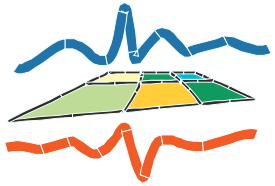


Transregional
Collaborative Research
Centre TR32

Spatial Fluorescence Patterns in a Heterogeneous Agriculture Landscape

Maria Matveeva, Patrick Rademske, Alexander Damm,
Cosimo Brogi, Guido Waldhoff, and Uwe Rascher

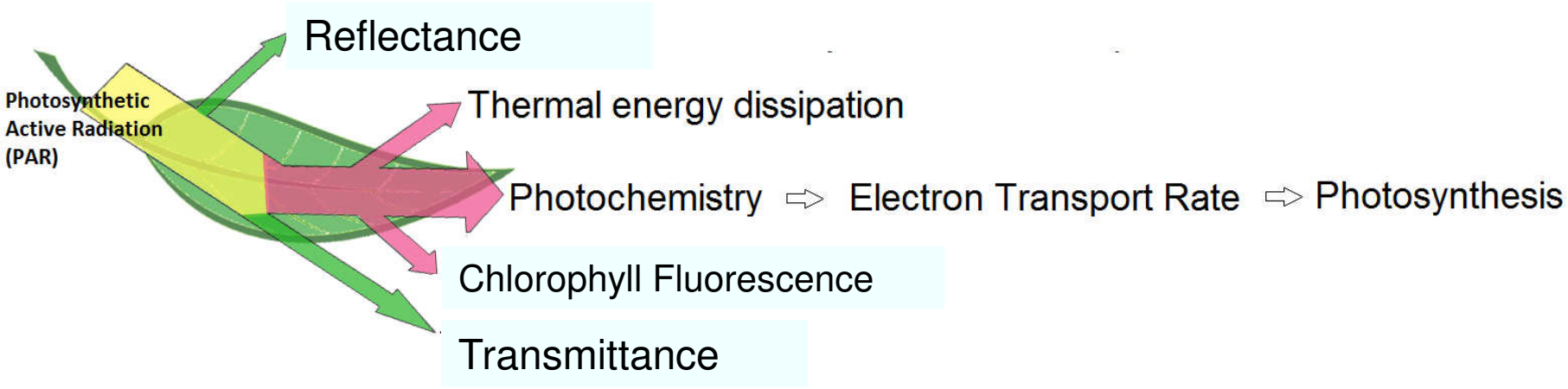
EARSeL 2017, 19-21 April 2017

m.matveeva@fz-juelich.de

Objectives of the work

Investigate the within- and between-species variability of red (F_{687}) and far-red (F_{760}) fluorescence and vegetation indices (VIs) on large areas

Fluorescence

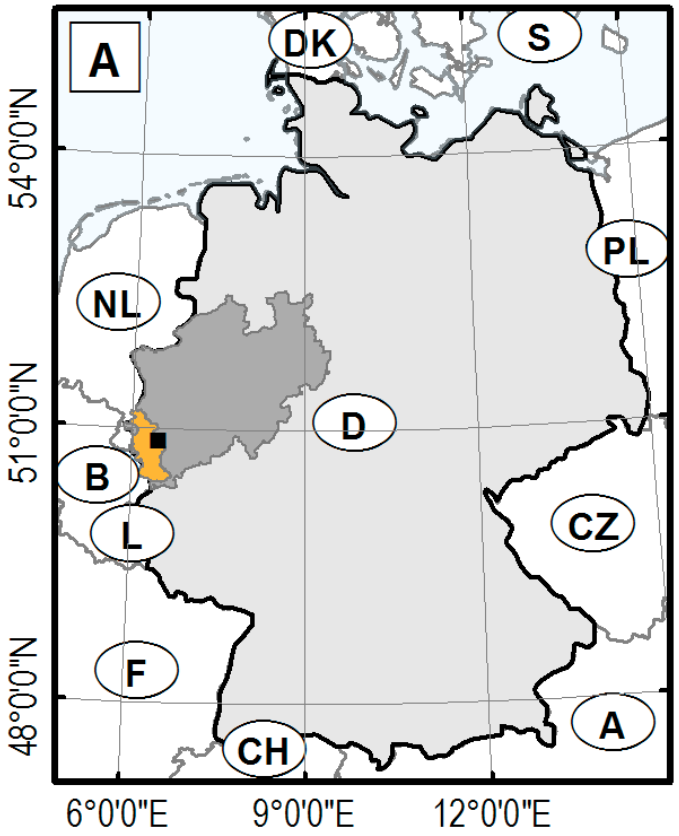


Vegetation indices

Biophysical vegetation parameters, such as LAI, can be approximated from different VIs

Data collection

Agricultural area in Rur catchment, NRW, Germany
~15×15 km



Airborne data: high-performance imaging spectrometer HyPlant

U. Rascher

Dedicated fluorescence spectrometer
Spectral ranges:

- 380–970 nm, FWHM 2.6-3.5 nm
- 970–2500 nm, FWHM 8.0-10.4 nm
- 670–780 nm, FWHM 0.2 nm

Spatial resolution of 3 meter per pixel

Experiment

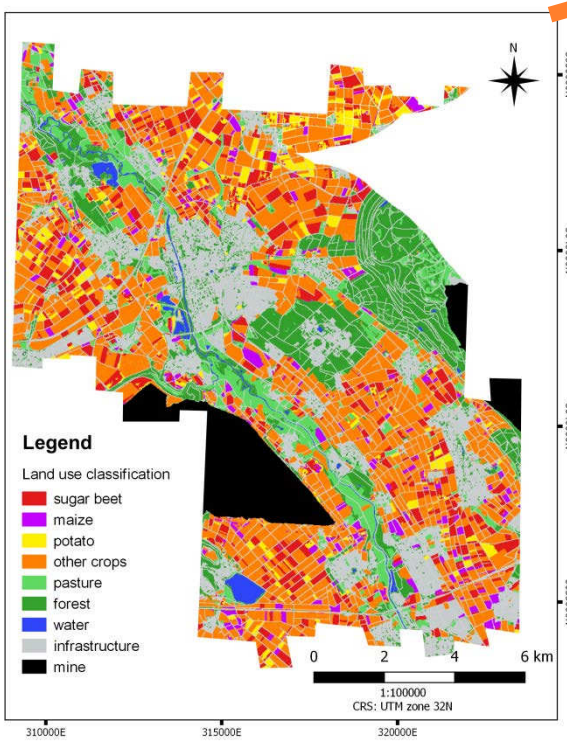
Airborne data (19-20th July 2016)

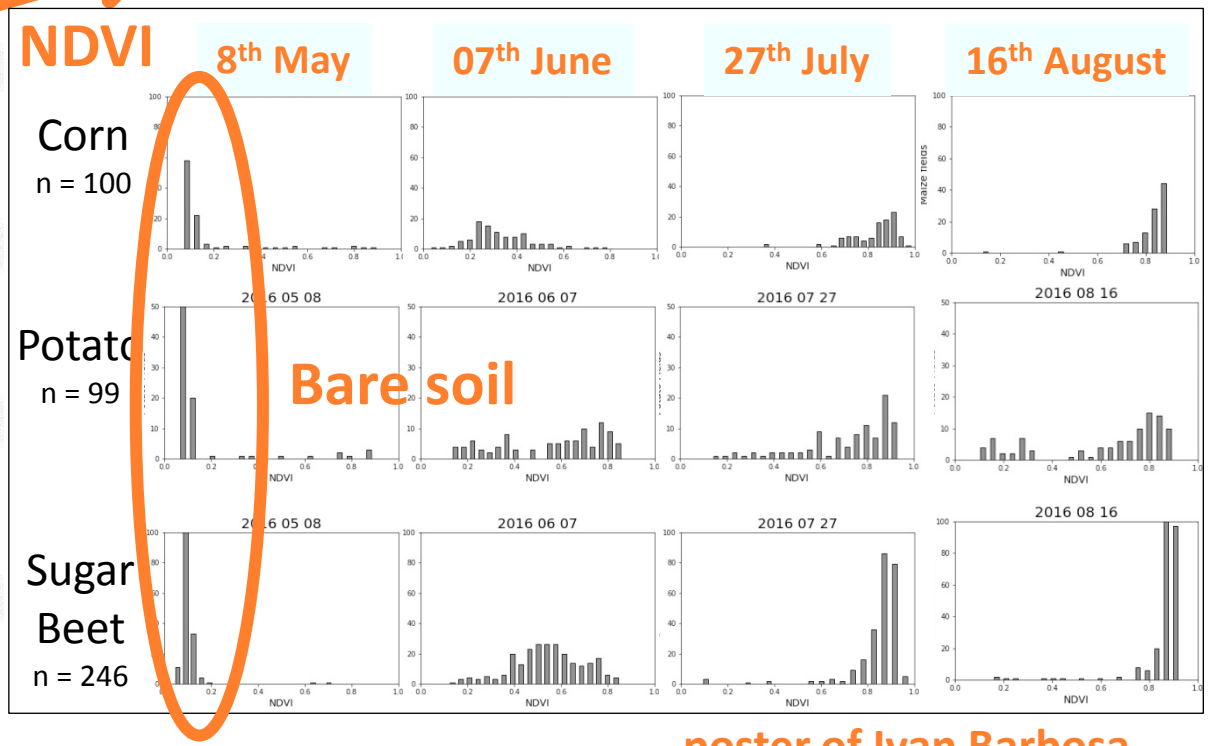
- Top of Canopy (TOC) Reflectance
- Sun Induced Fluorescence

Remote sensing data + ground measurements

- Land Use classification

Chosen crops: **corn, potato, sugar beet**





poster of Ivan Barbosa

Experiment

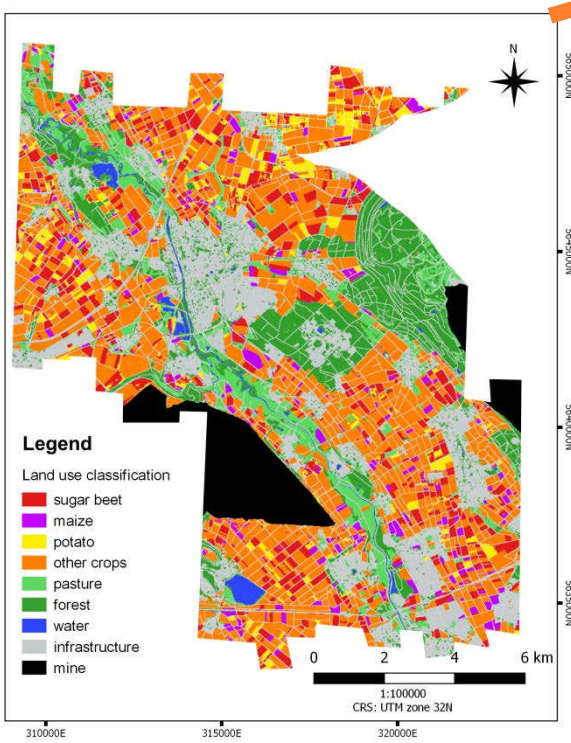
Airborne data (19-20th July 2016)

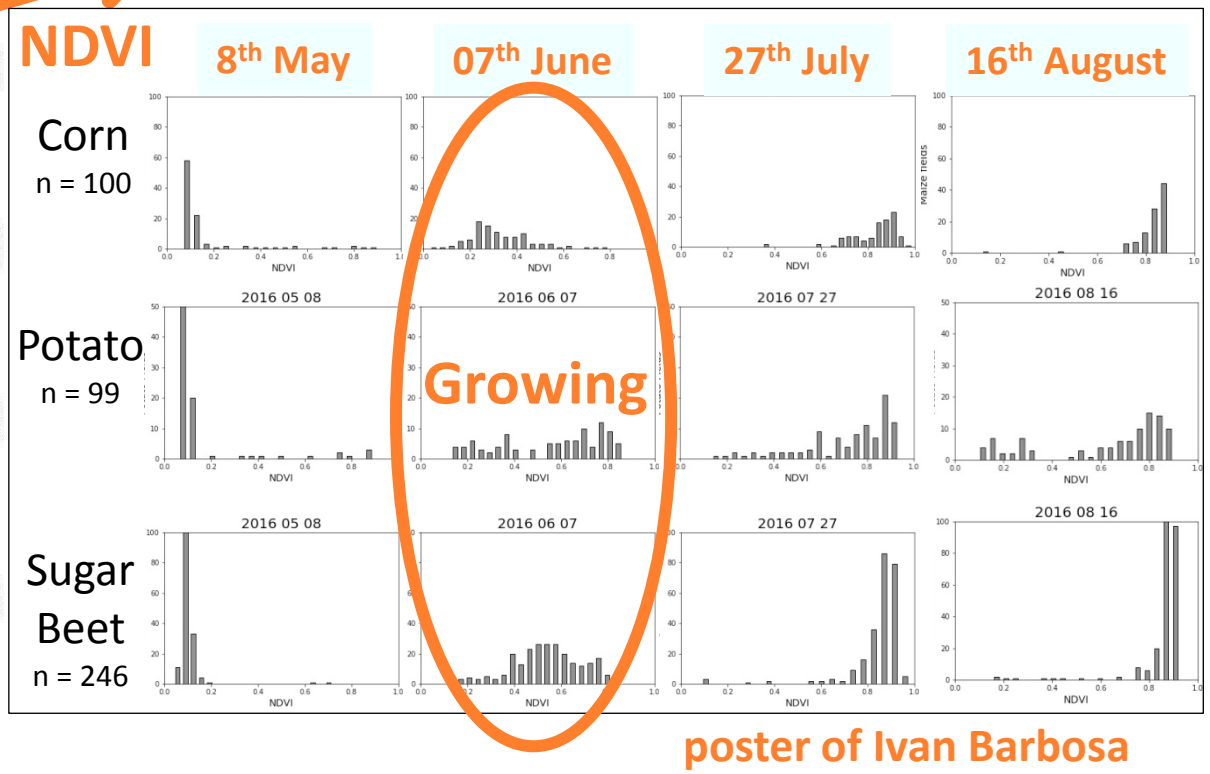
- Top of Canopy (TOC) Reflectance
- Sun Induced Fluorescence

Remote sensing data + ground measurements

- Land Use classification

Chosen crops: **corn, potato, sugar beet**





poster of Ivan Barbosa

Experiment

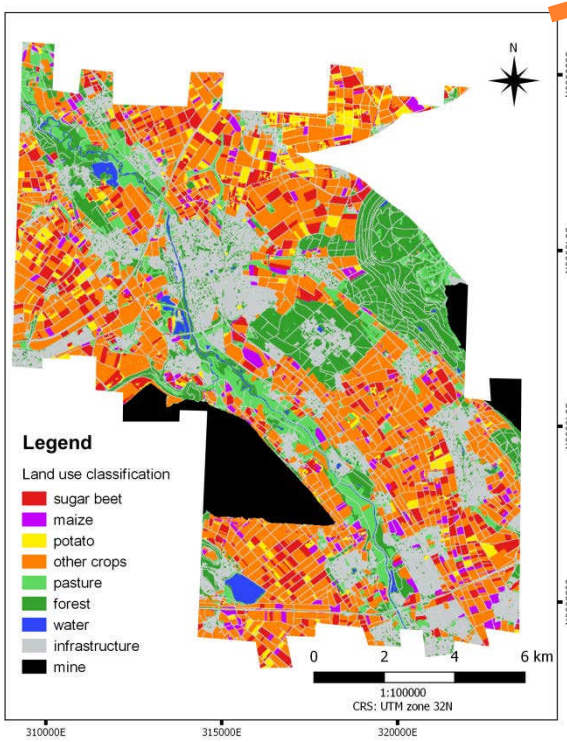
Airborne data (19-20th July 2016)

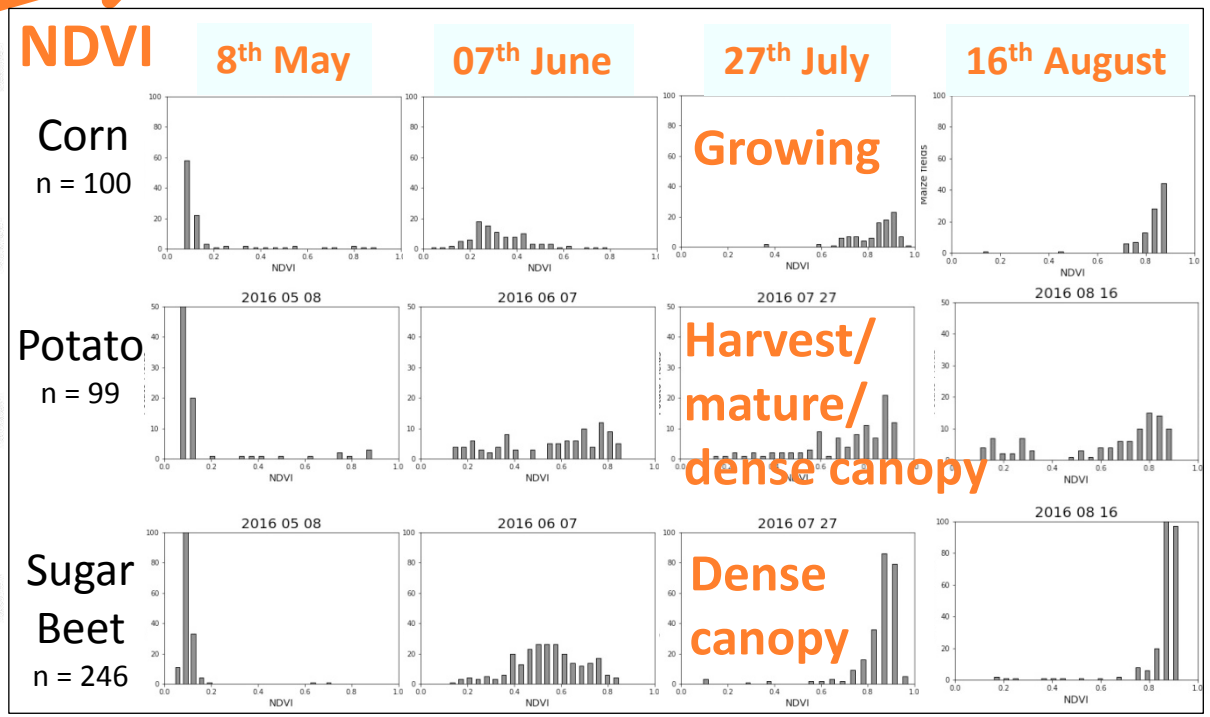
- Top of Canopy (TOC) Reflectance
- Sun Induced Fluorescence

Remote sensing data + ground measurements

- Land Use classification

Chosen crops: **corn, potato, sugar beet**





poster of Ivan Barbosa

Experiment

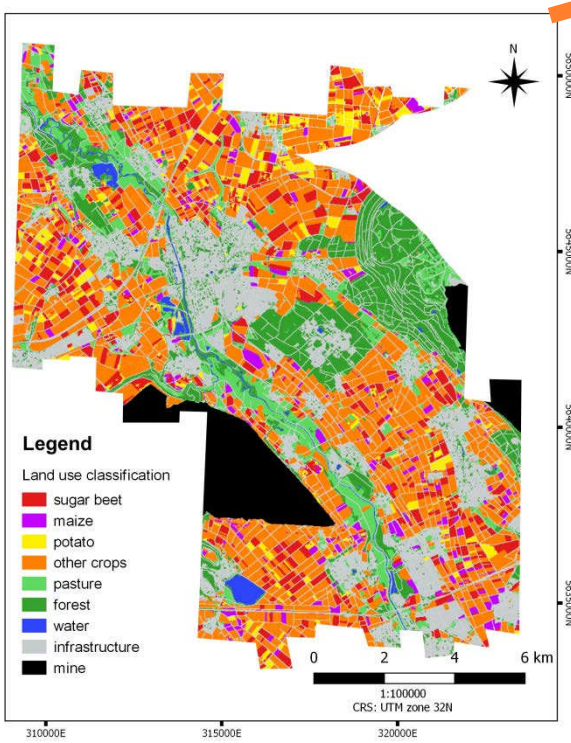
Airborne data (19-20th July 2016)

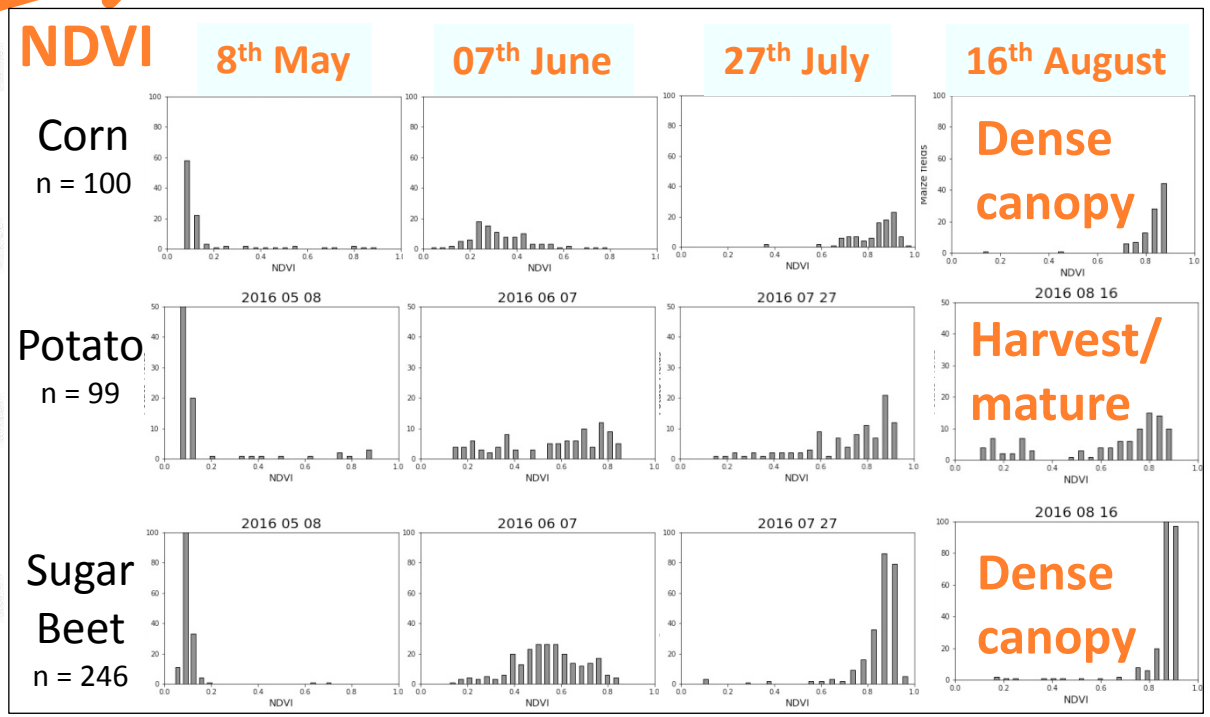
- Top of Canopy (TOC) Reflectance
- Sun Induced Fluorescence

Remote sensing data + ground measurements

- Land Use classification

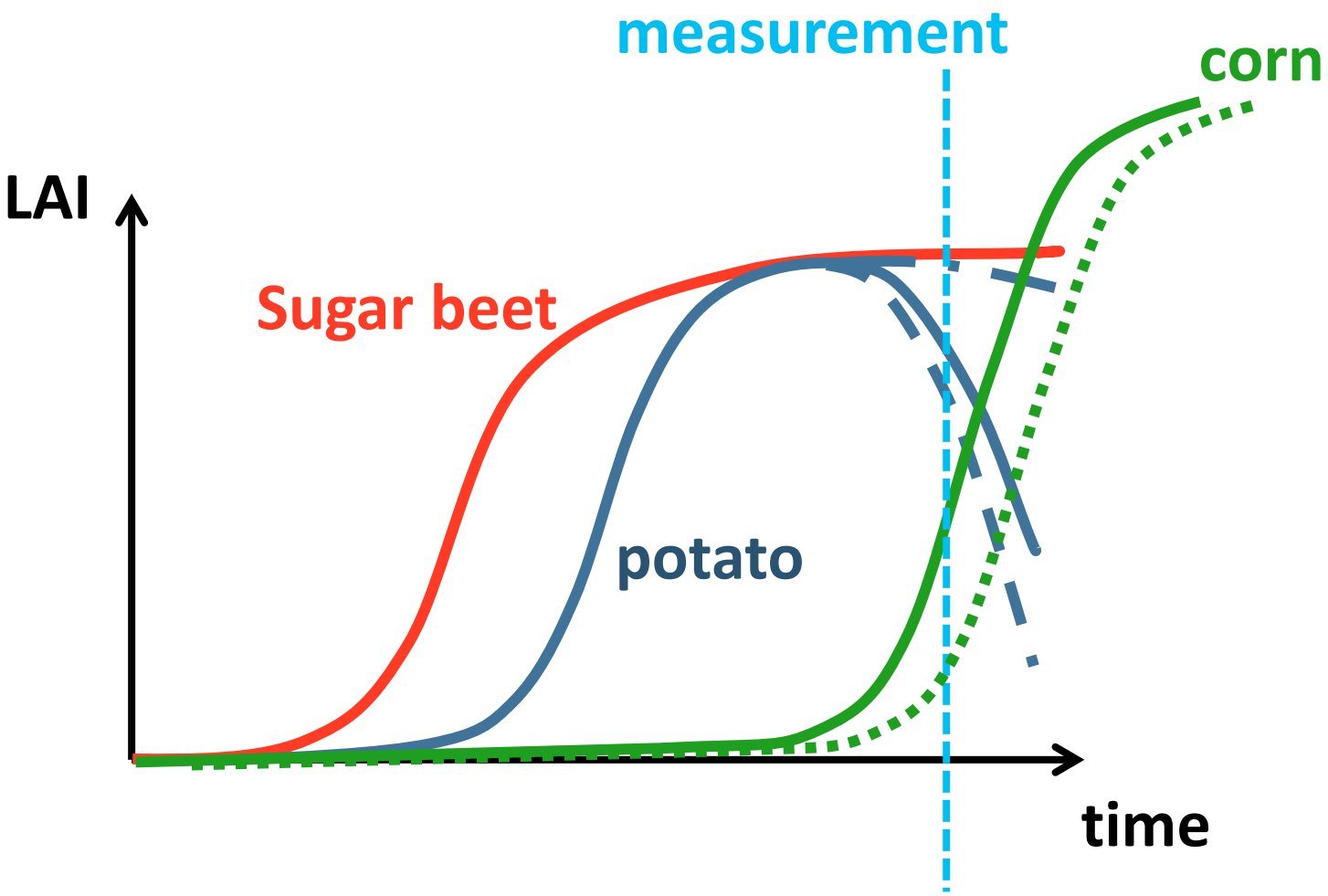
Chosen crops: **corn, potato, sugar beet**





poster of Ivan Barbosa

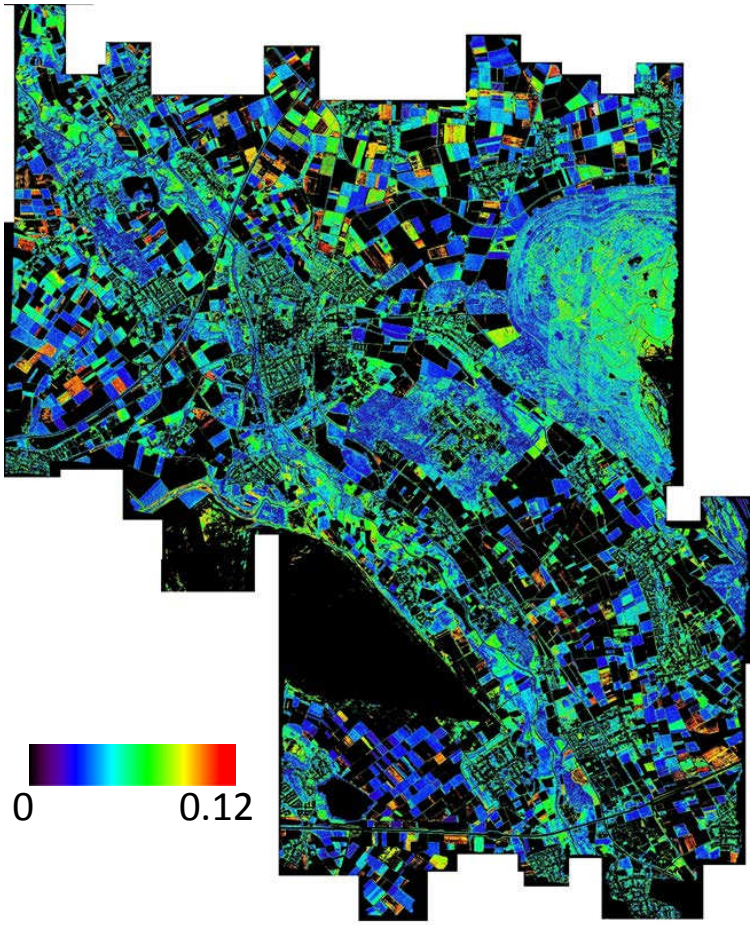
Changes in greenness with time



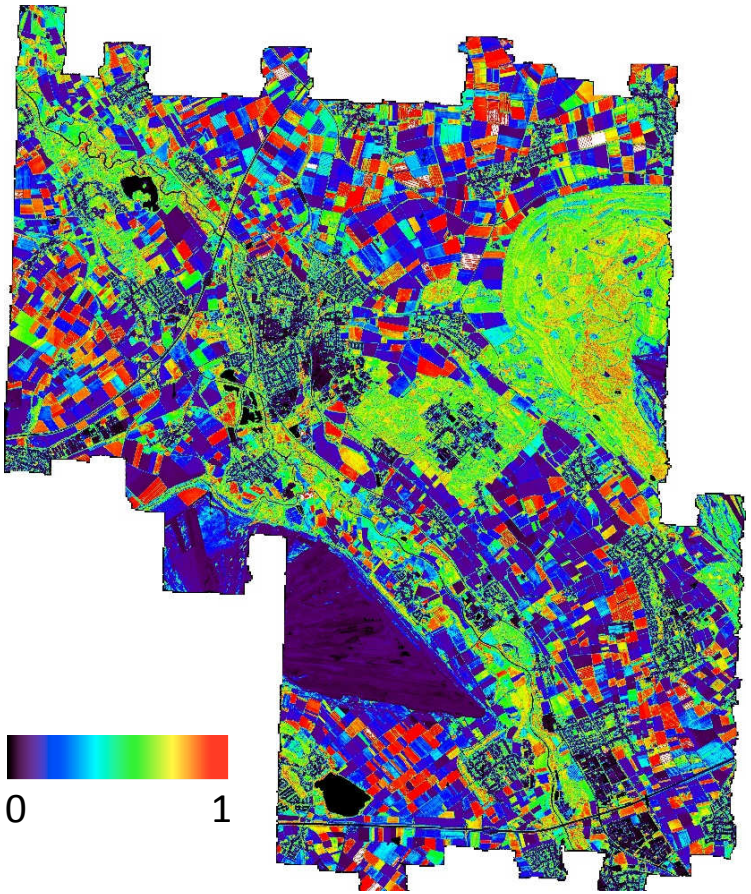
Examples of VIs and fluorescence maps

JÜLICH FORSCHUNGSZENTRUM

PRI

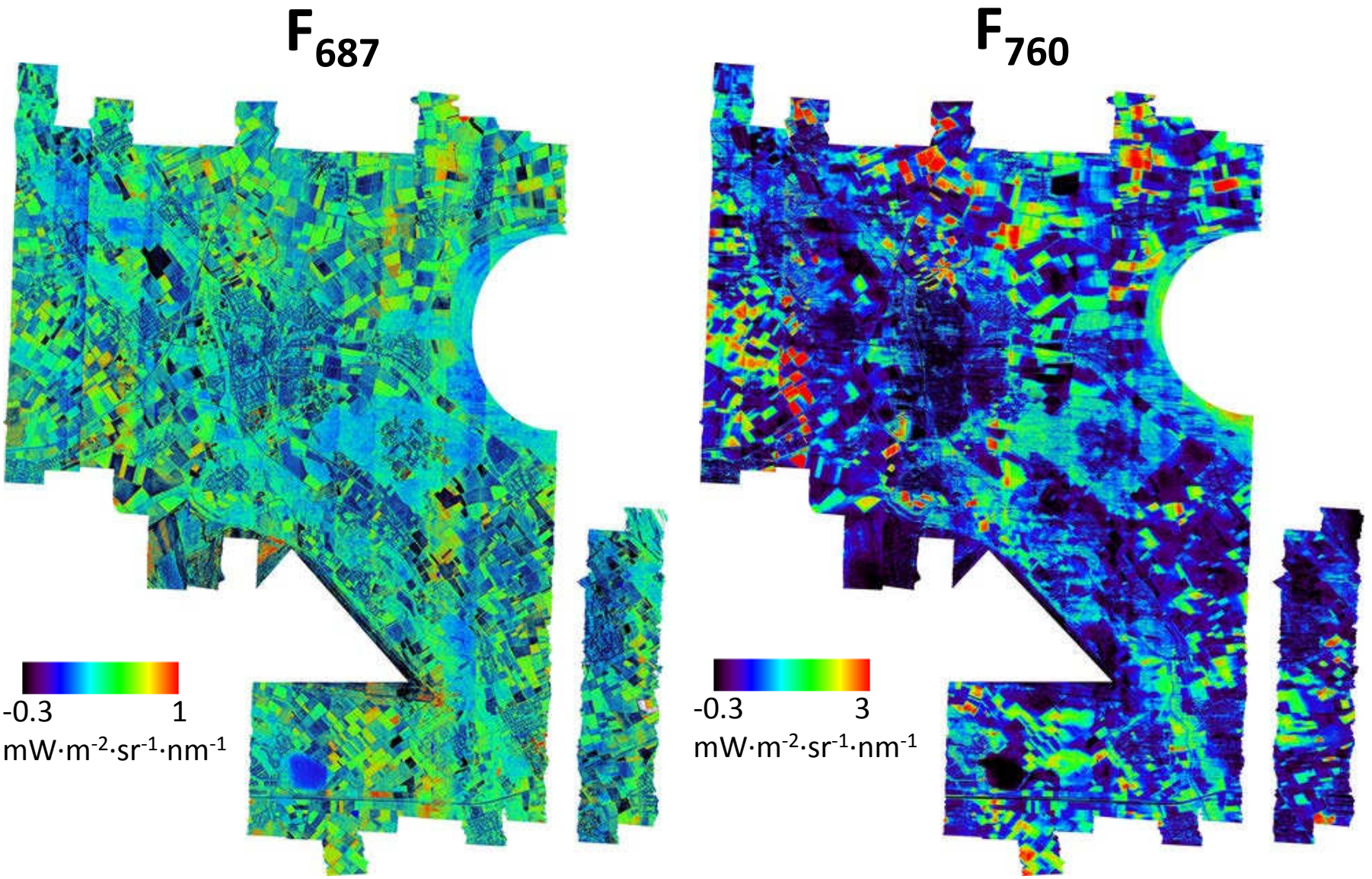


EVI

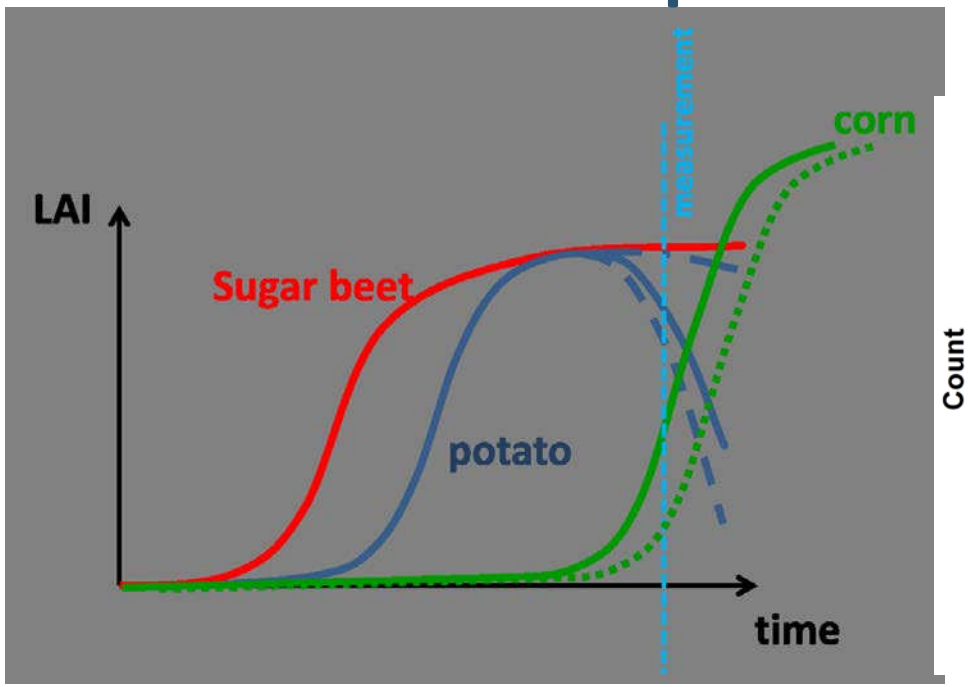


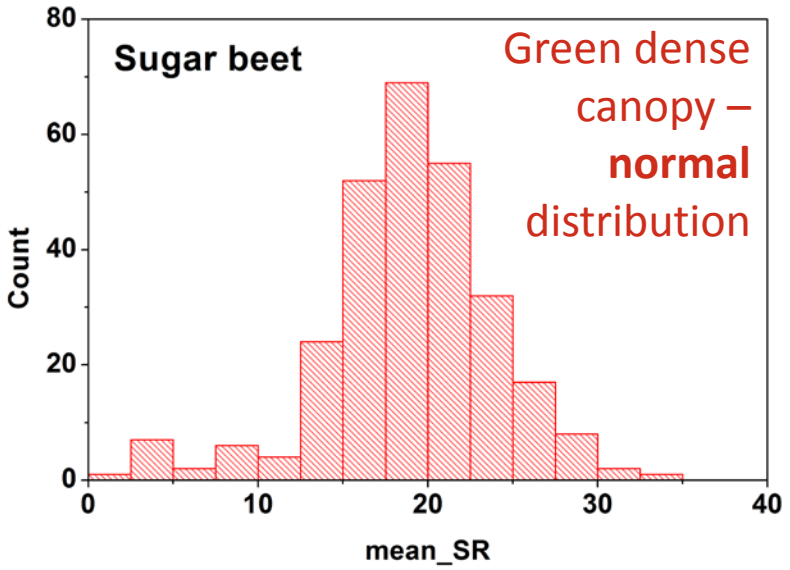
(All not-vegetated pixels are masked out)

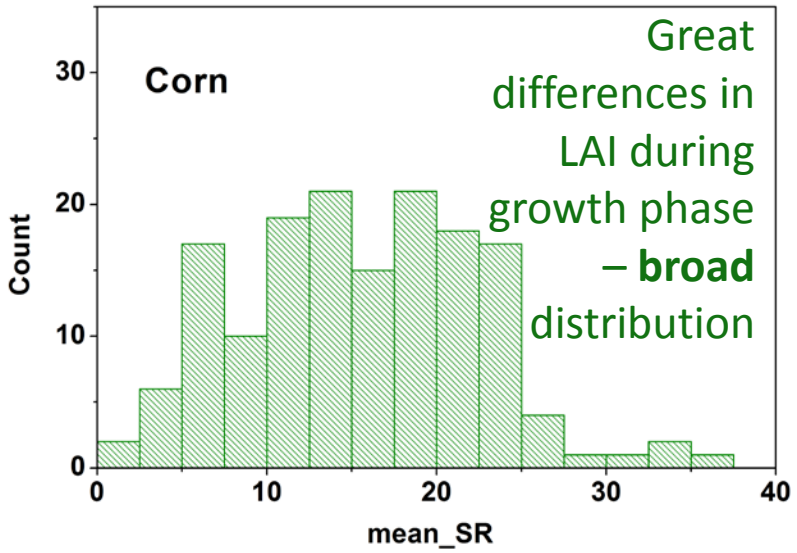
Examples of VIs and fluorescence maps

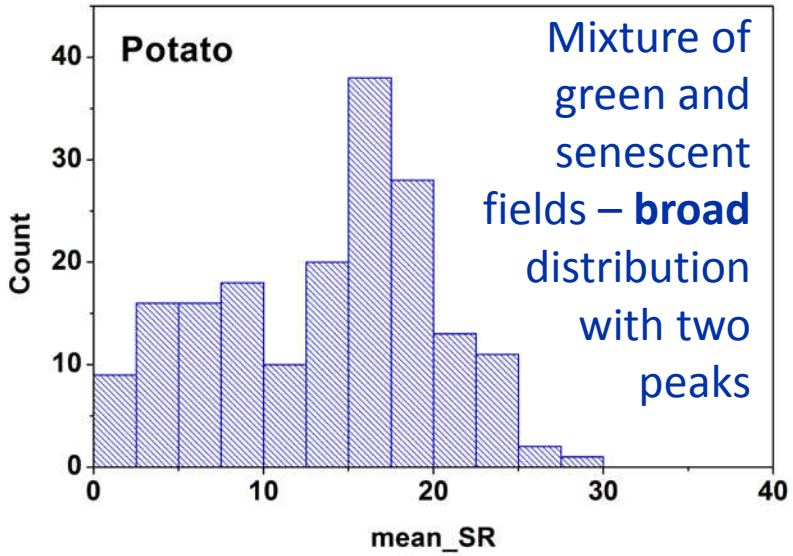


Distribution of Simple Ratio ($SR = \frac{R_{<800>}}{R_{<680>}}$)

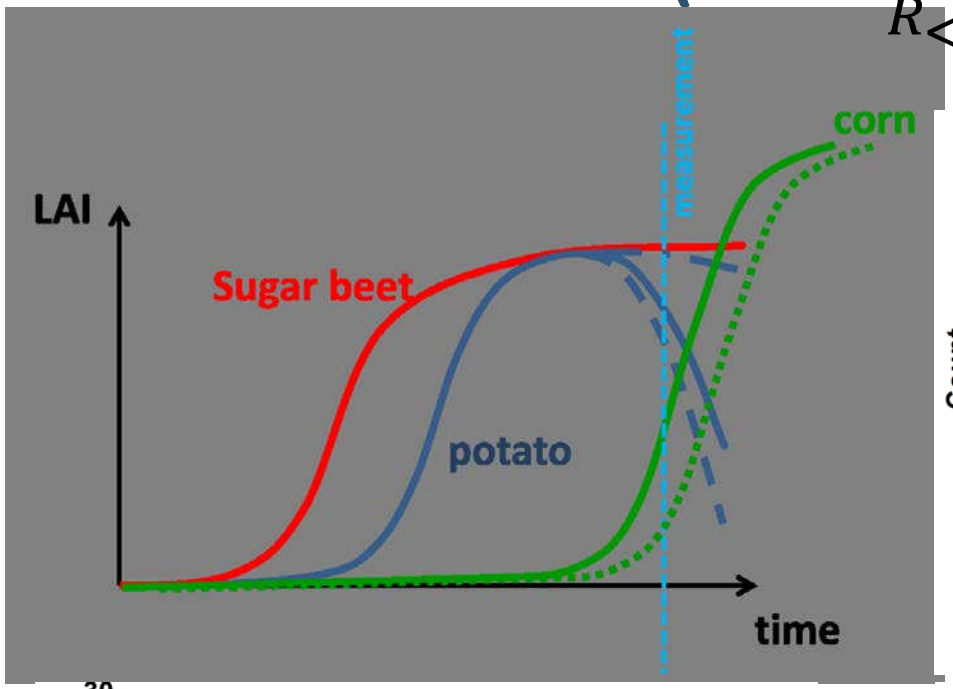


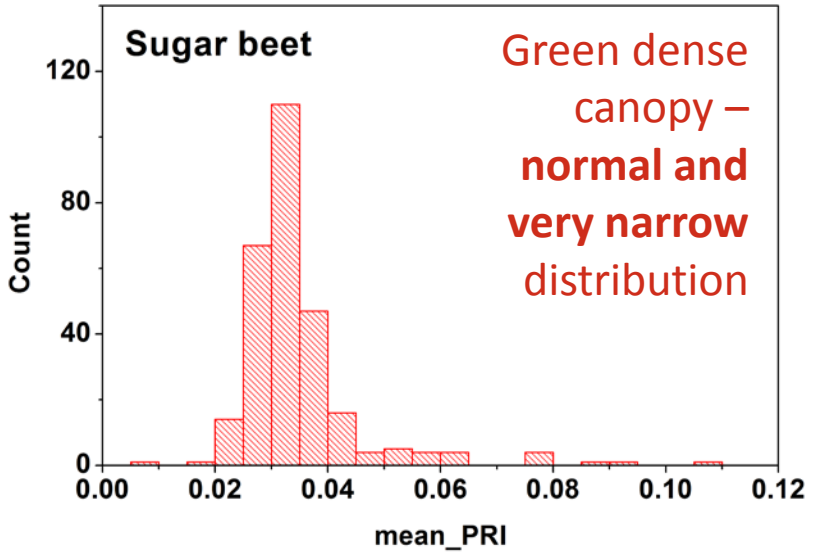




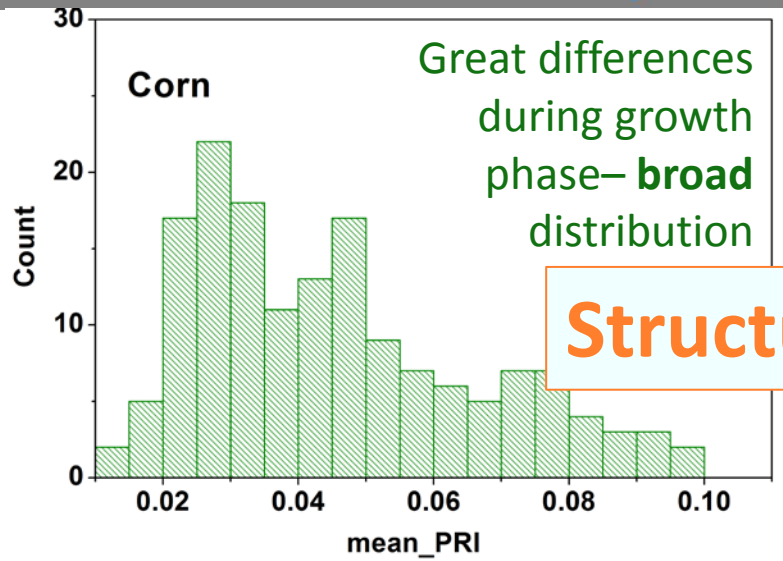


Distribution of PRI ($PRI = \frac{R_{<570>} - R_{<531>}}{R_{<570>} + R_{<531>}}$)

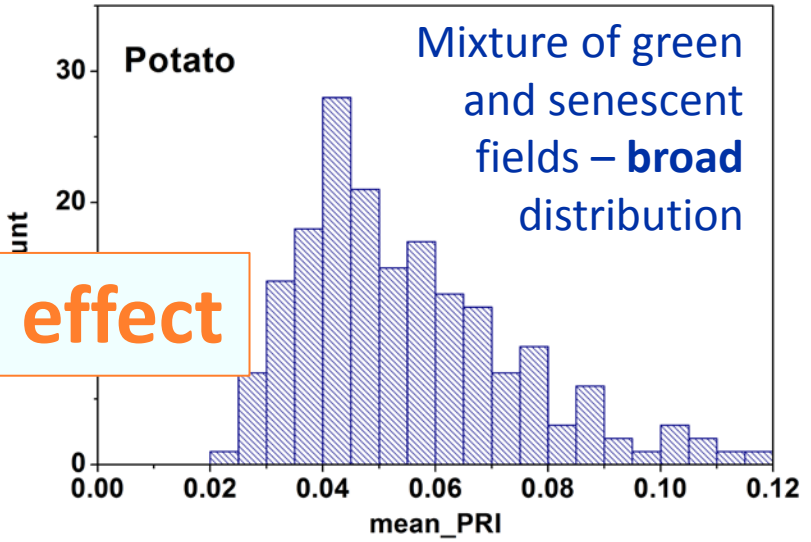




Green dense canopy – **normal and very narrow** distribution



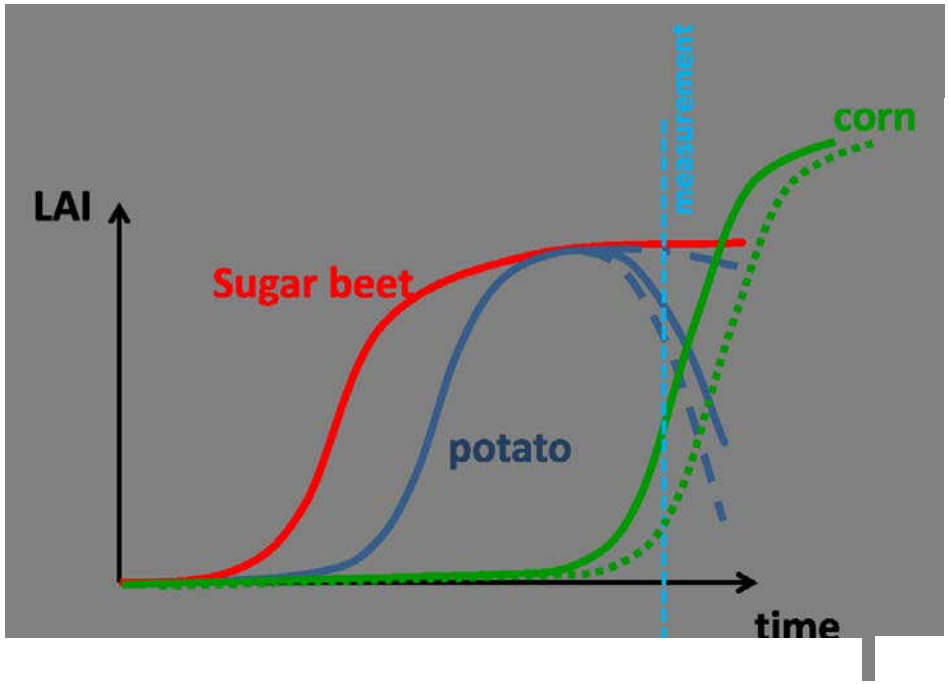
Great differences during growth phase– **broad** distribution

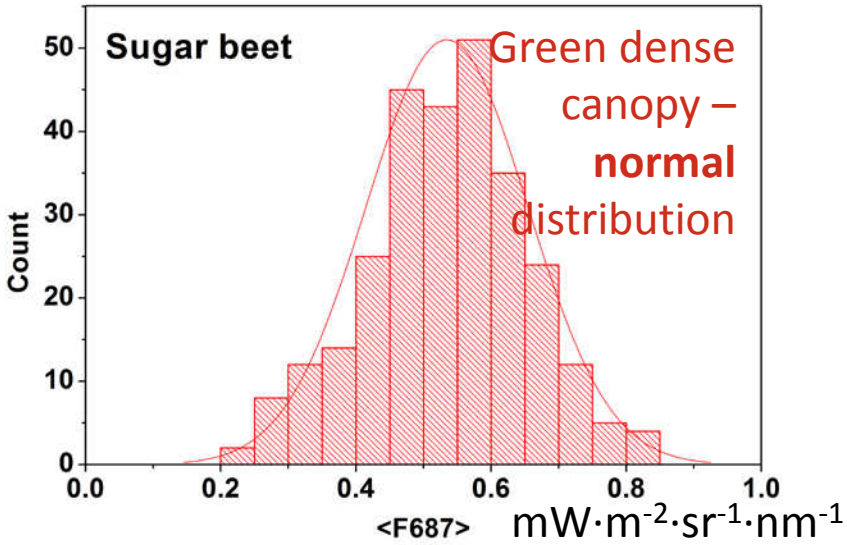


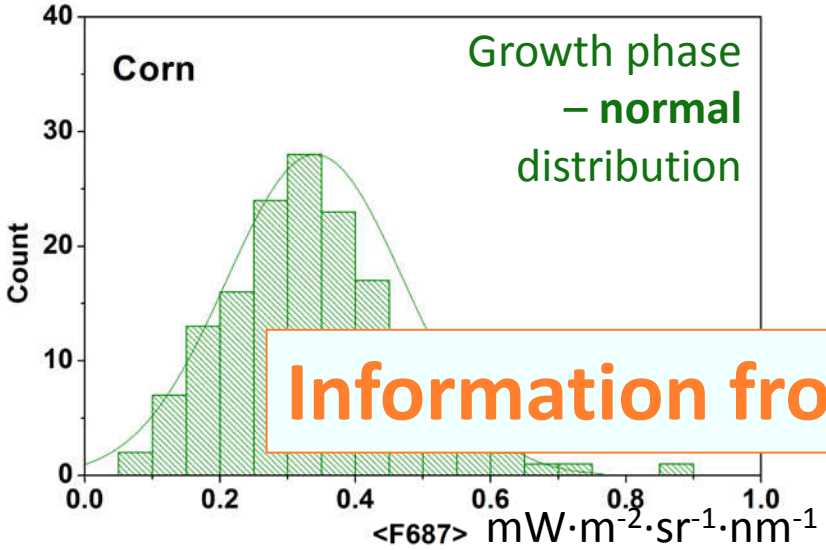
Mixture of green and senescent fields – **broad** distribution

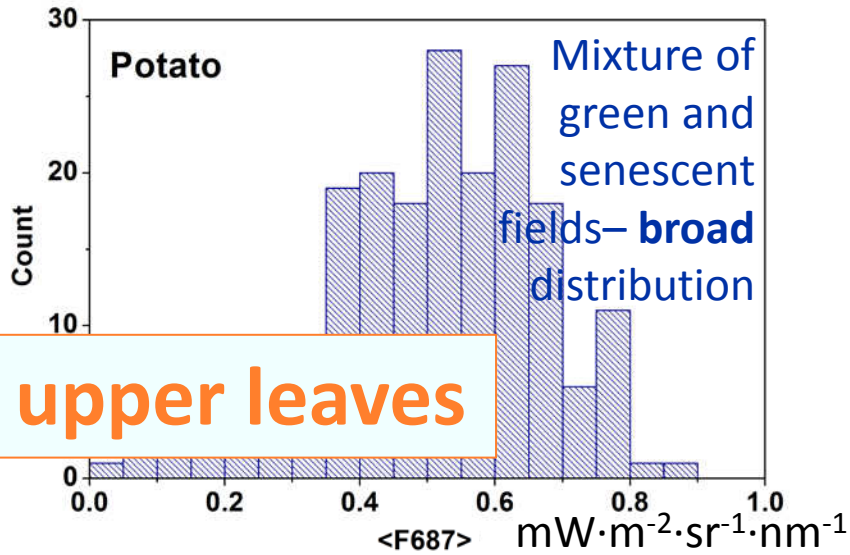
Structural effect

Distribution of red fluorescence F_{687}



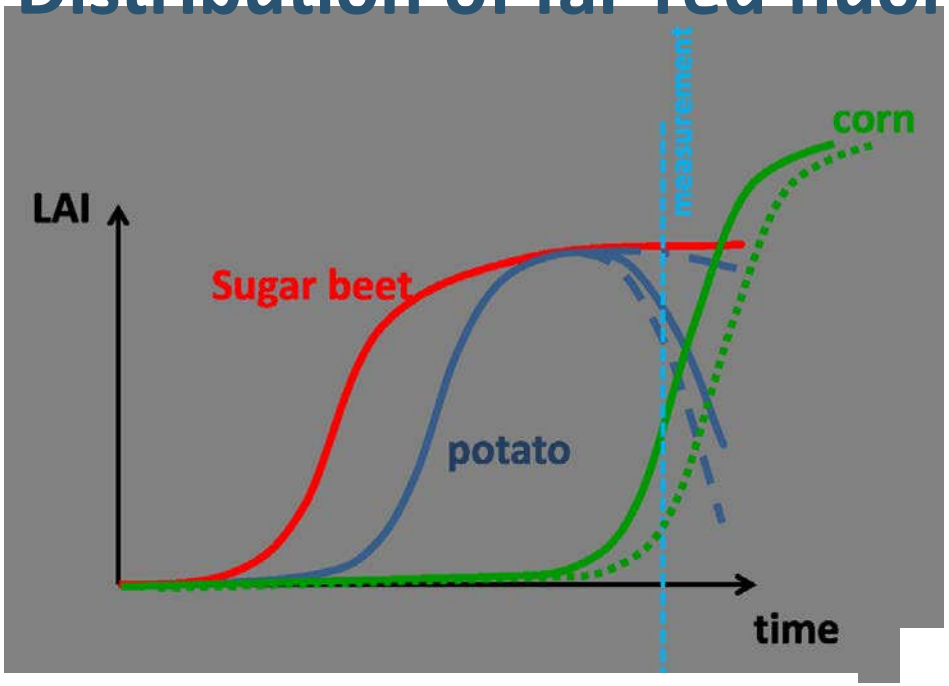


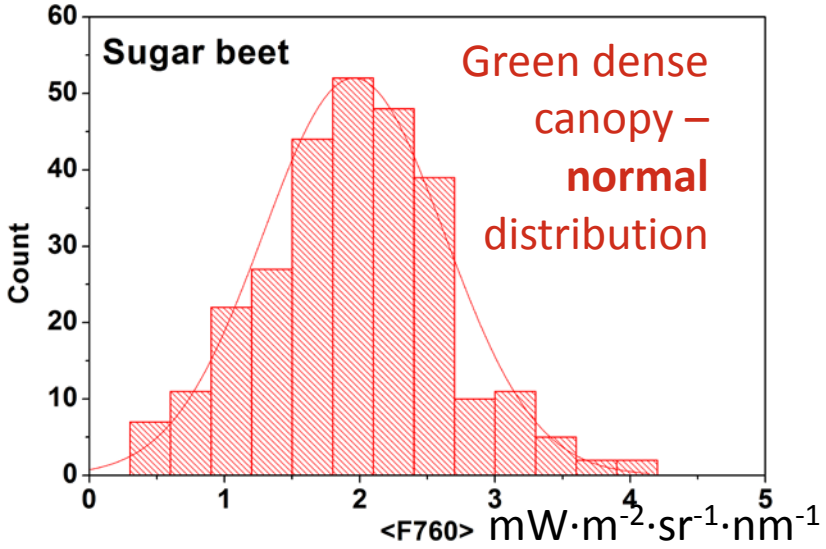


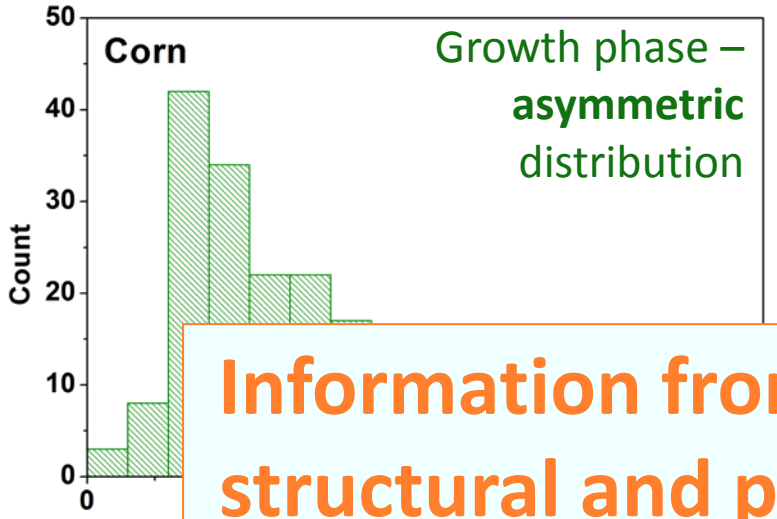


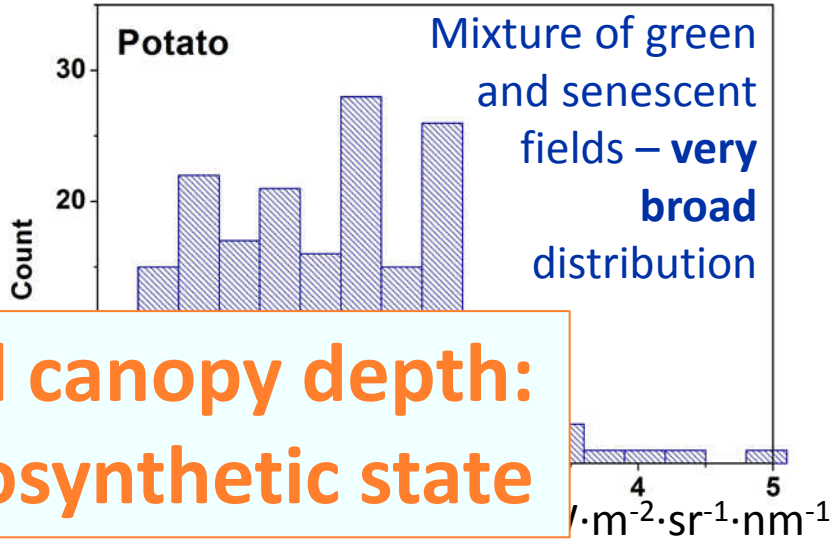
Information from upper leaves

Distribution of far-red fluorescence F_{760}



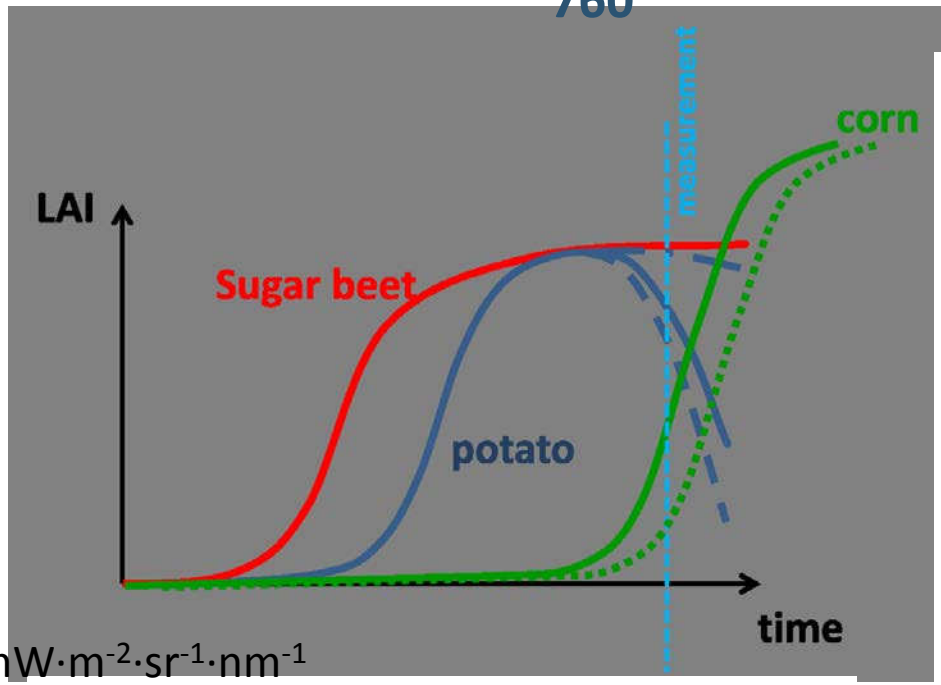




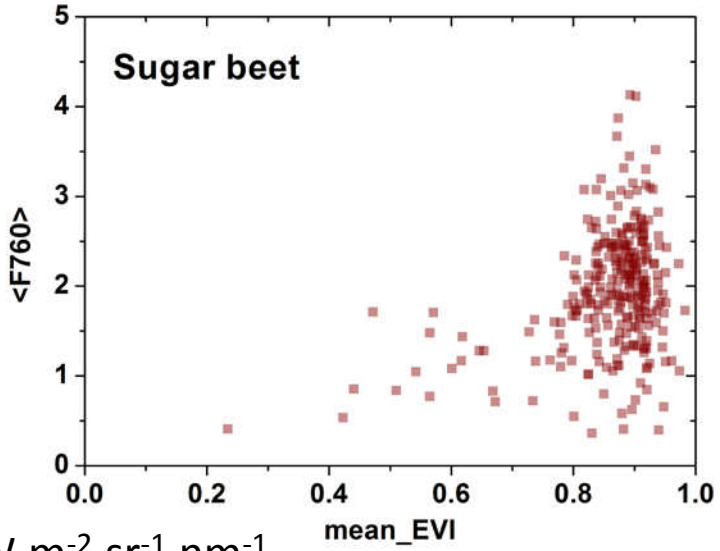


Information from all canopy depth: structural and photosynthetic state

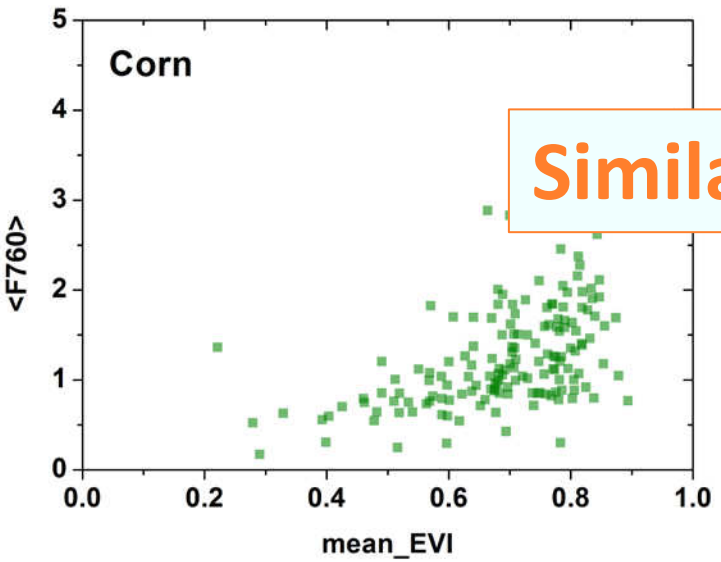
Correlation of F_{760} and EVI



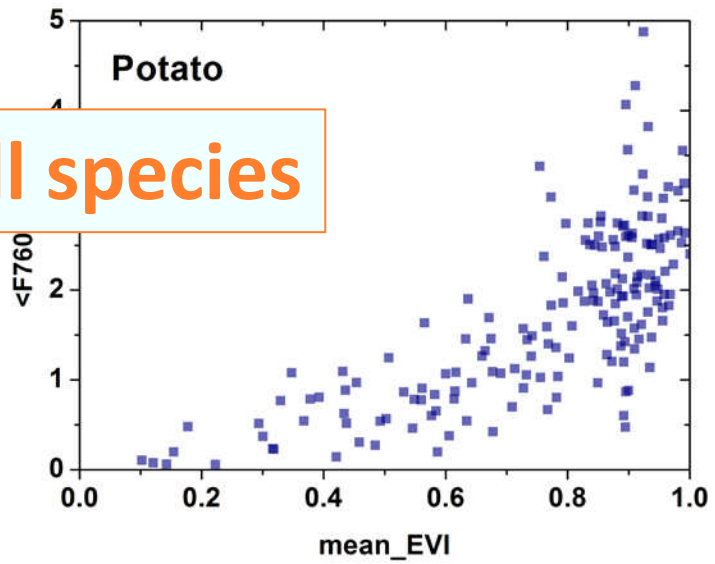
mW·m^{-2}·sr^{-1}·nm^{-1}



mW·m^{-2}·sr^{-1}·nm^{-1}



mW·m^{-2}·sr^{-1}·nm^{-1}

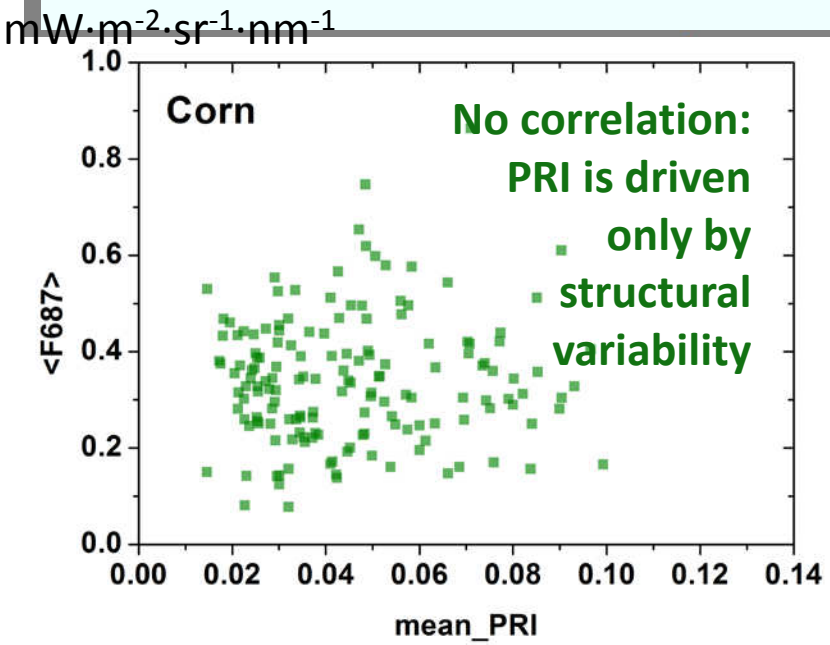


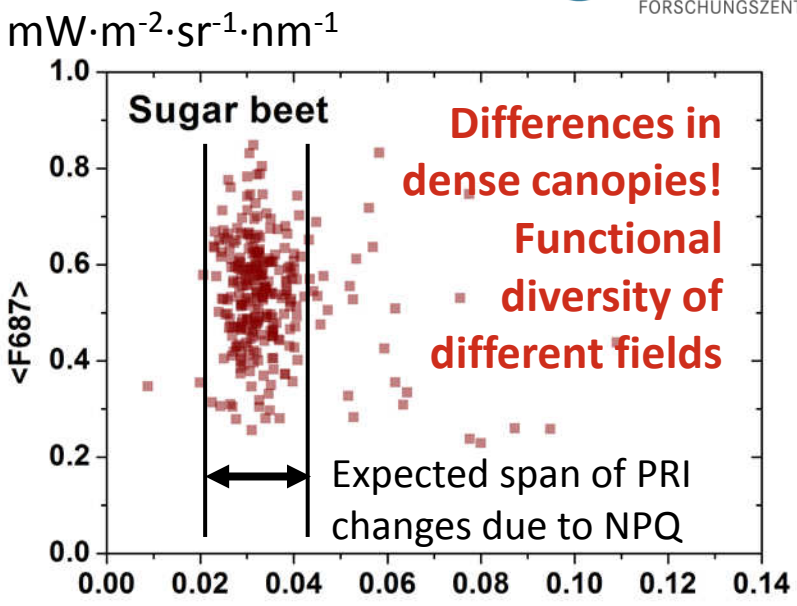
Similar for all species

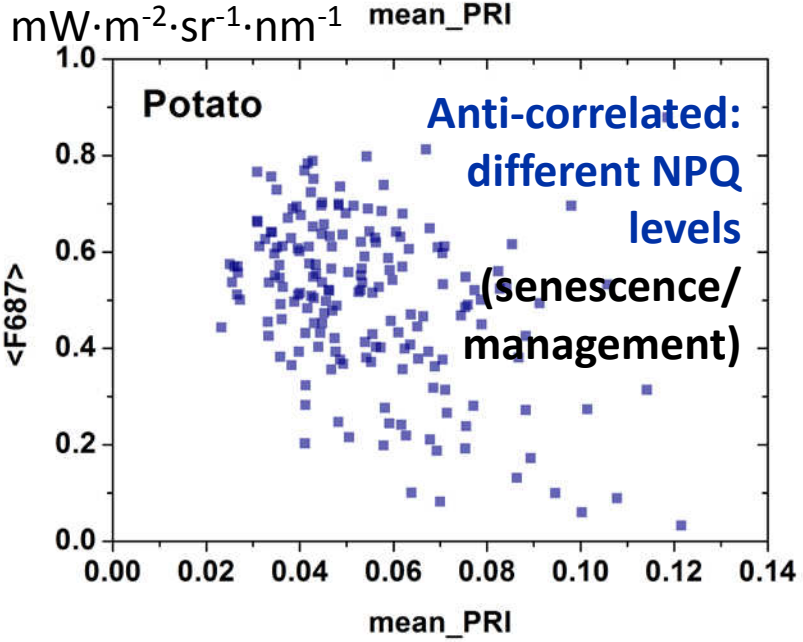
Correlation of F_{687} and PRI

- F_{687} is a proxy for photochemical efficiency
- PRI is a proxy for NPQ

Hence <u>they should be anti-correlated</u>





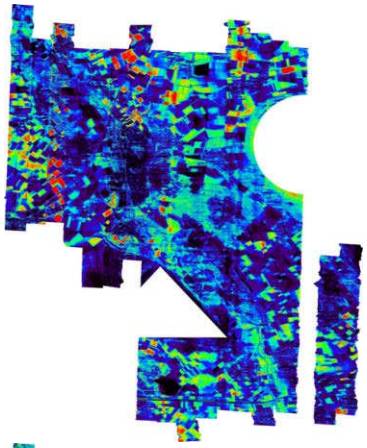


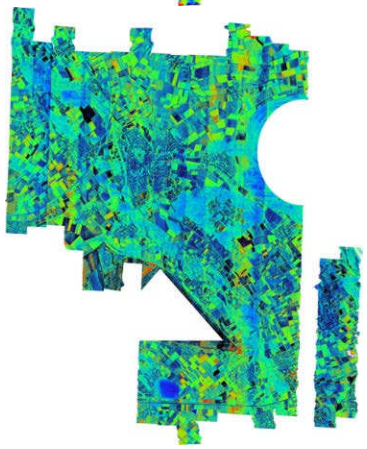
Functional diversity of different fields

Sugar beet fields
3 days before overflight

Effect of soil water holding capacity on canopy:
Field 1 – normal
Field 2 – drought stressed

Summary





- The heterogeneity of fluorescence (F) and vegetation indices (VIs) between fields was evaluated
- The **variability** of F_{687} and F_{760} , PRI and SR for **green dense canopy is normally distributed**
- **Broader distributions are caused by structural effects** (growing canopies) **or canopy senescence**
- The **correlation between F_{760} and EVI** was confirmed, with F_{760} still showing variability in dense canopies
- **When PRI** is driven by NPQ, **PRI and F_{687} are anti-correlated** and show functional diversity of different fields

Acknowlegements

- Project TR32 for financial support and great scientific network
- People organizing and performing the campaign: A. Schickling, P. Rademske, U. Rascher
- Data processing: A. Damm and P. Rademske
- Land Use data: C. Brogi and G. Waldhoff
- Ground soil moisture measurements: W. Korres and team

Thank you very much for your attention!