Vegetation Spectral Measurements and Field Data Collections in Support of HysplRI

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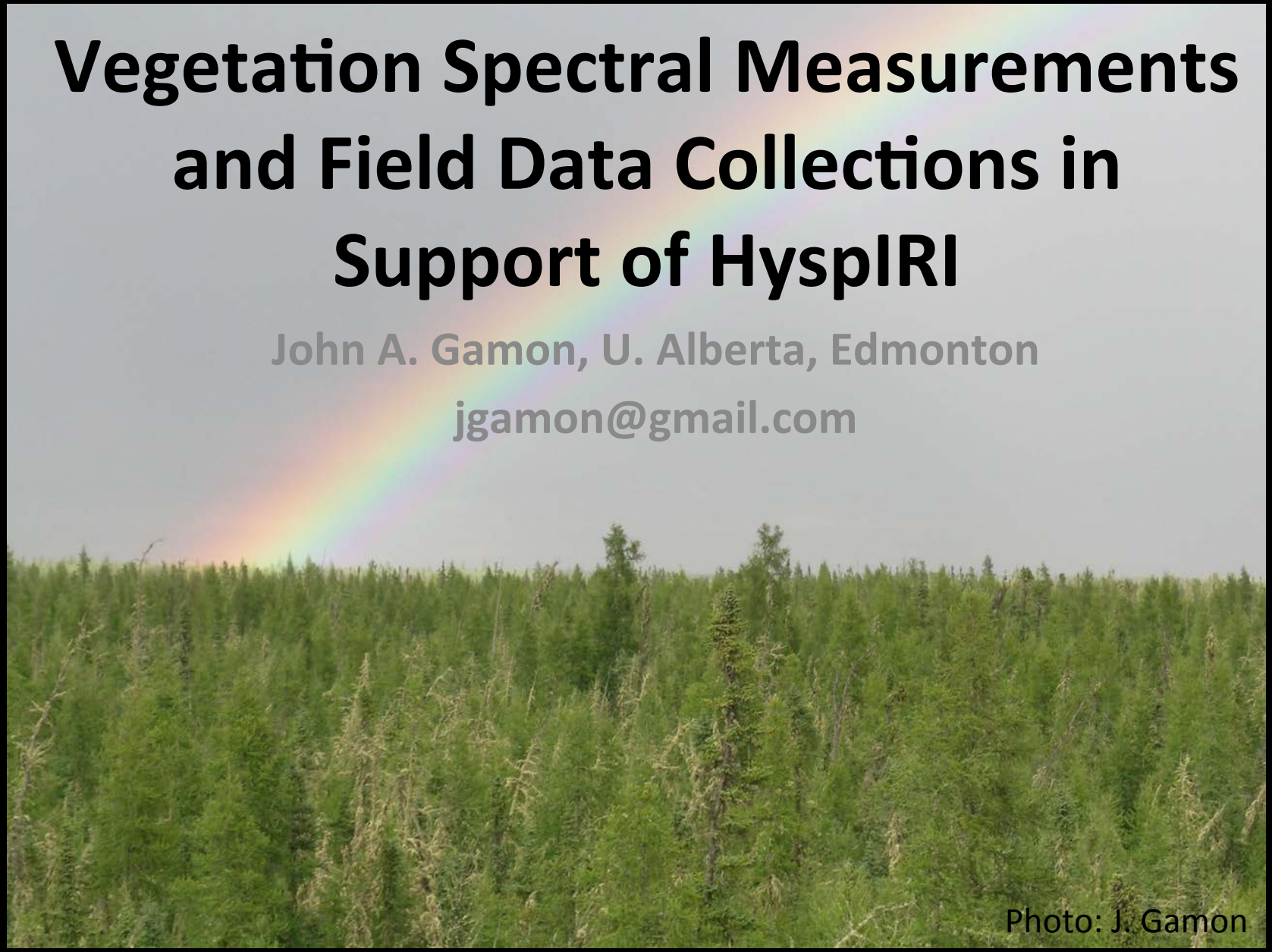


Photo: J. Gamon

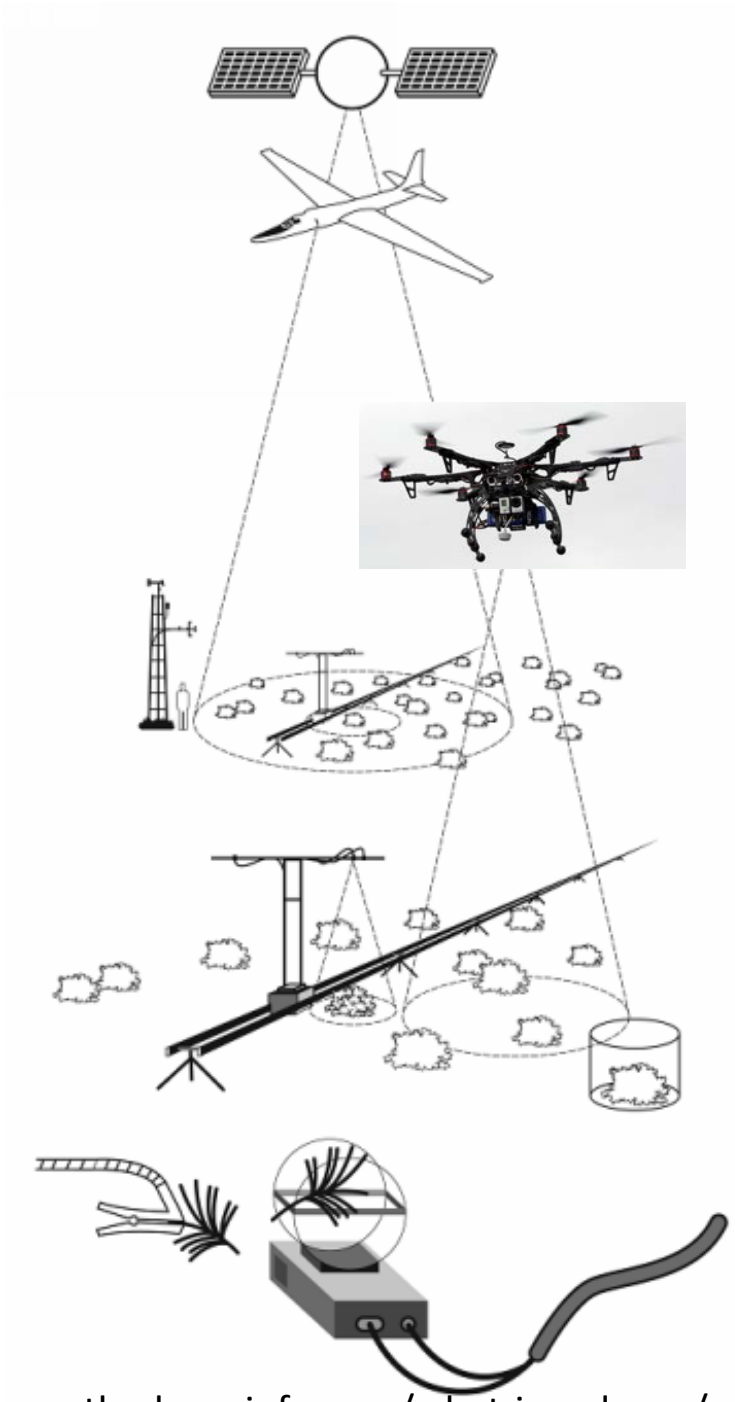
Western Peatlands, Alberta, Canada

Multi-Scale Sampling

Applications:

1) Monitoring photosynthetic phenology & productivity (NPP)

2) Assessing biodiversity (optical diversity)



http://www.thedroneinfo.com/what-is-a-drone/

SpecNet

FIELD SITES ABOUT SPECNET SPECNET TOOLKIT THEMES CONTACT

SpecNet - Linking optical measurements with flux sampling around the world.

http://specnet.info

Biospheric Carbon Our Partners Join the E-Group

The problem of evergreen ecosystems

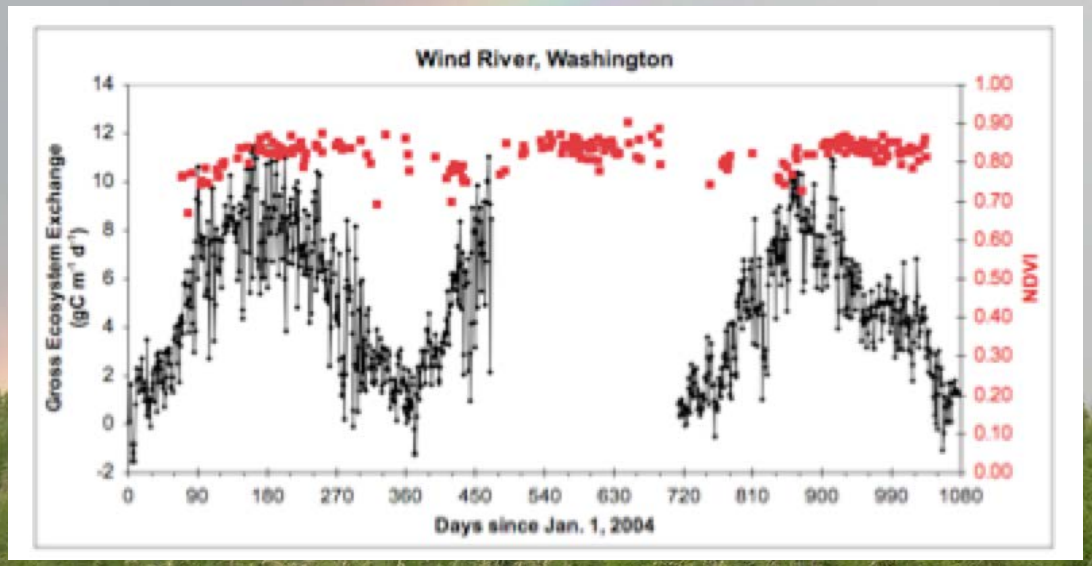
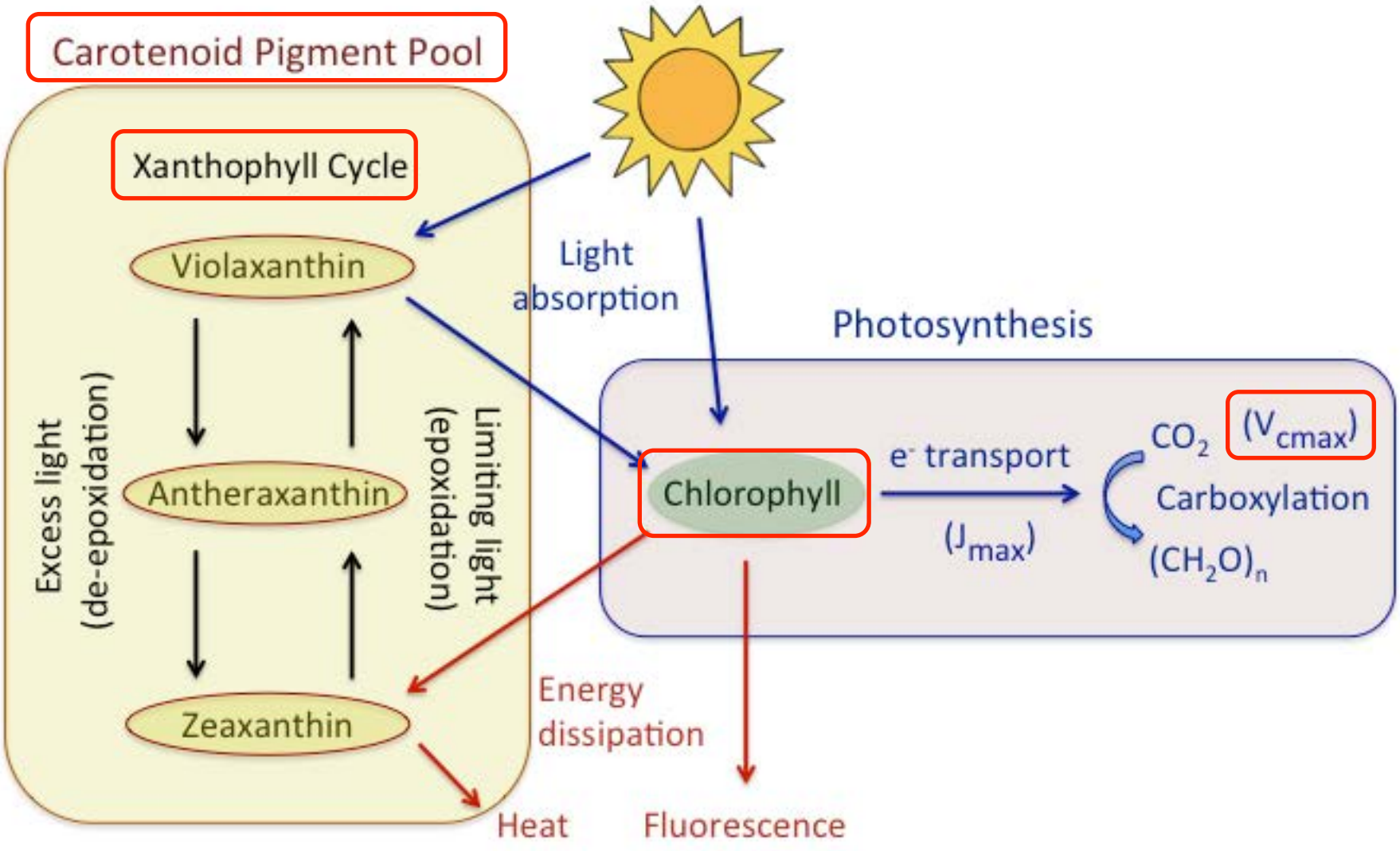


Fig. courtesy Fred. Huemmrich

Photo: J. Gamon

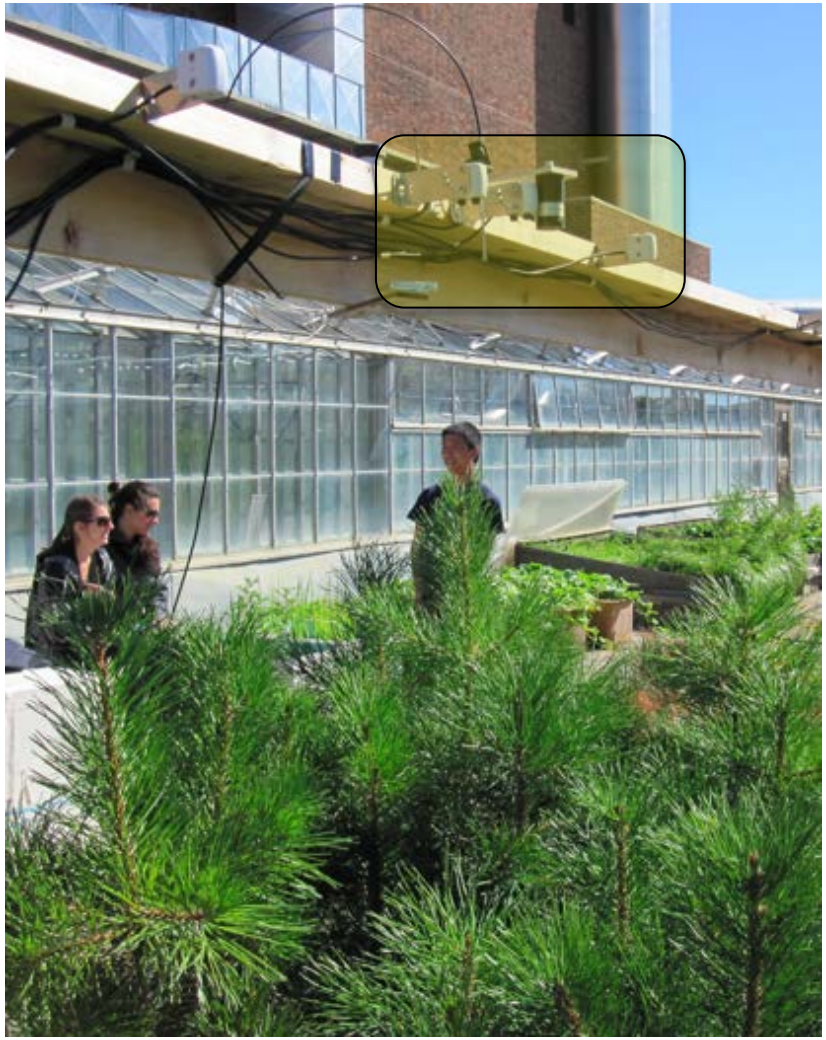
Photosynthetic Energy Distribution



Gamon (2015) Biogeosciences Discussion

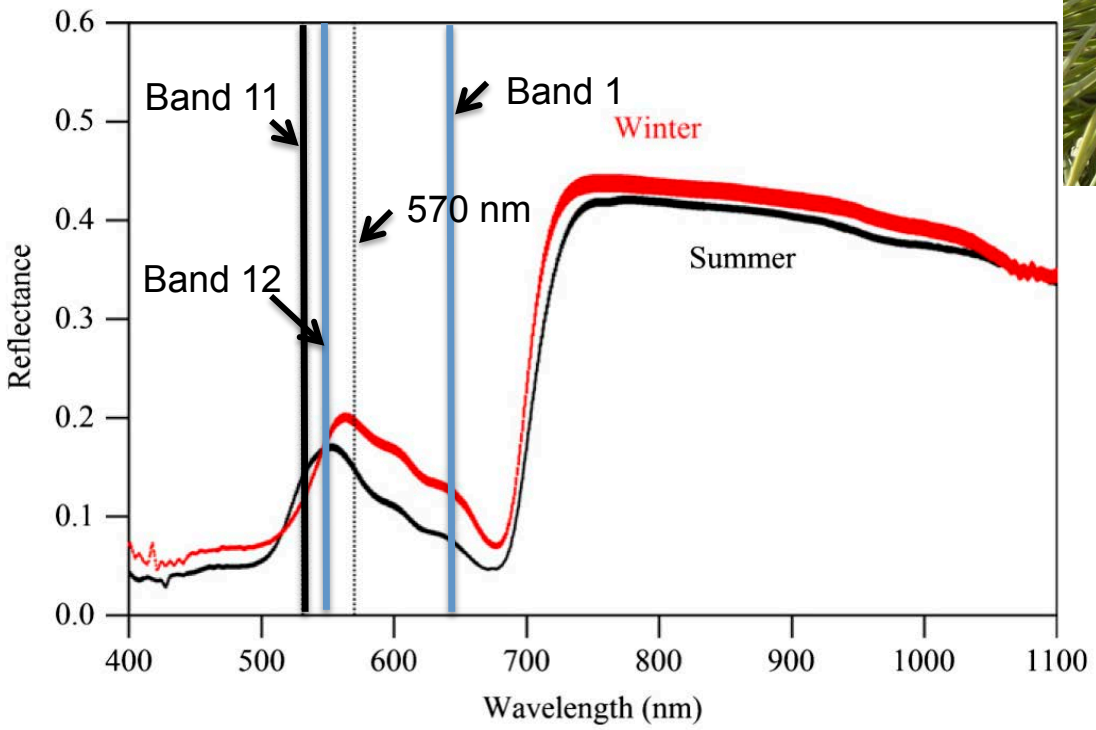
Leaf & Canopy Reflectance (Pine)

Leaf reflectance sampling



Canopy reflectance sampling

Seasonal change in conifer needle reflectance



Photochemical Reflectance Index:

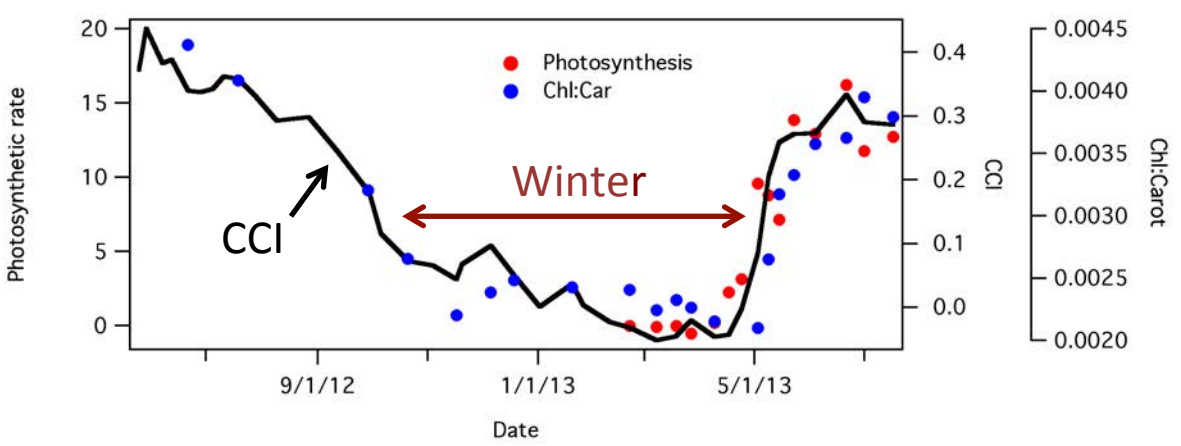
$$PRI = \frac{(R531 - R570)}{(R531 + R570)}$$

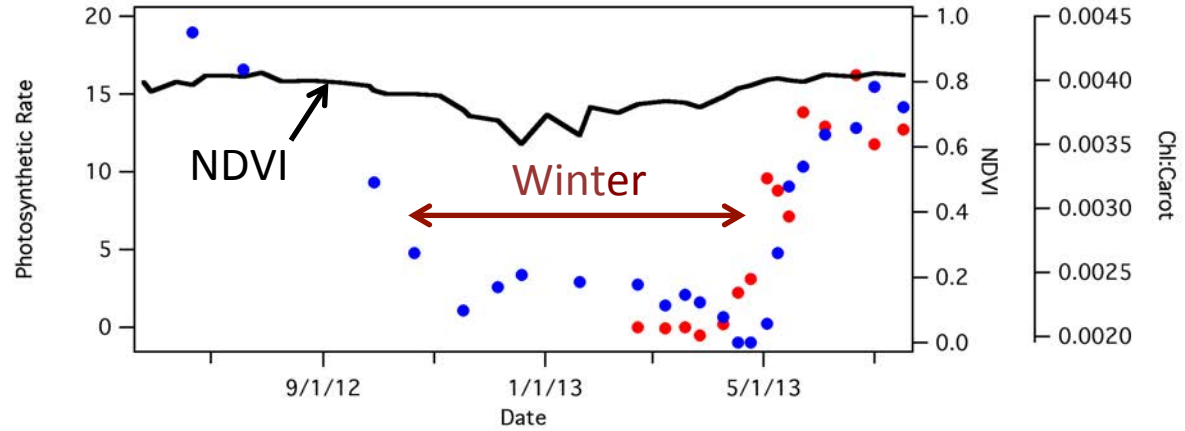
Chlorophyll:Carotenoid Index:

$$CCI = \frac{(Band\ 11 - Band\ 1)}{(Band\ 11 + Band\ 1)}$$

Can "pigment indices" from MODIS ocean and terrestrial bands to monitor "invisible" photosynthetic phenology (ε) in evergreens?

Winter Downregulation in Boreal Conifers



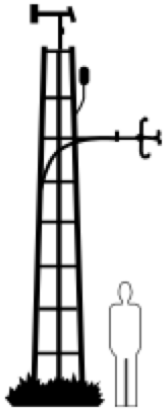


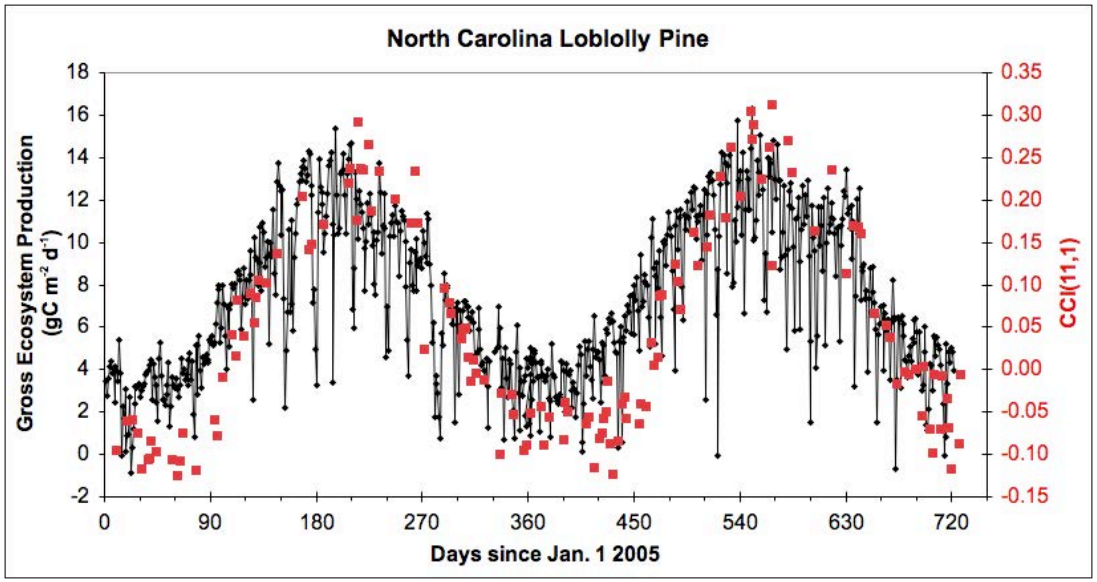
Red: photosynthesis rate
Blue: chl:carotenoid ratios

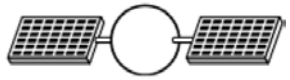
Chlorophyll:Carotenoid Indices (PRI & CCI), but not NDVI, detects invisible photosynthetic phenology and winter downregulation (reduced ε) in evergreen conifers.

Adapted from Wong & Gamon (2015)

CCI does a better job of describing “invisible” evergreen phenology than NDVI







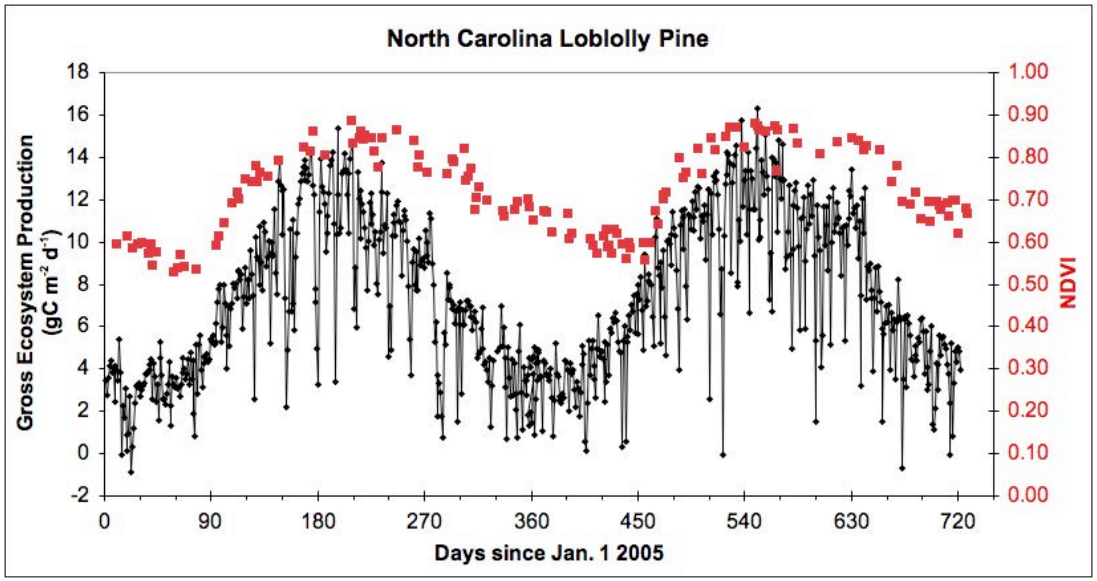


Fig. courtesy Fred Huemmrich

Conclusions:

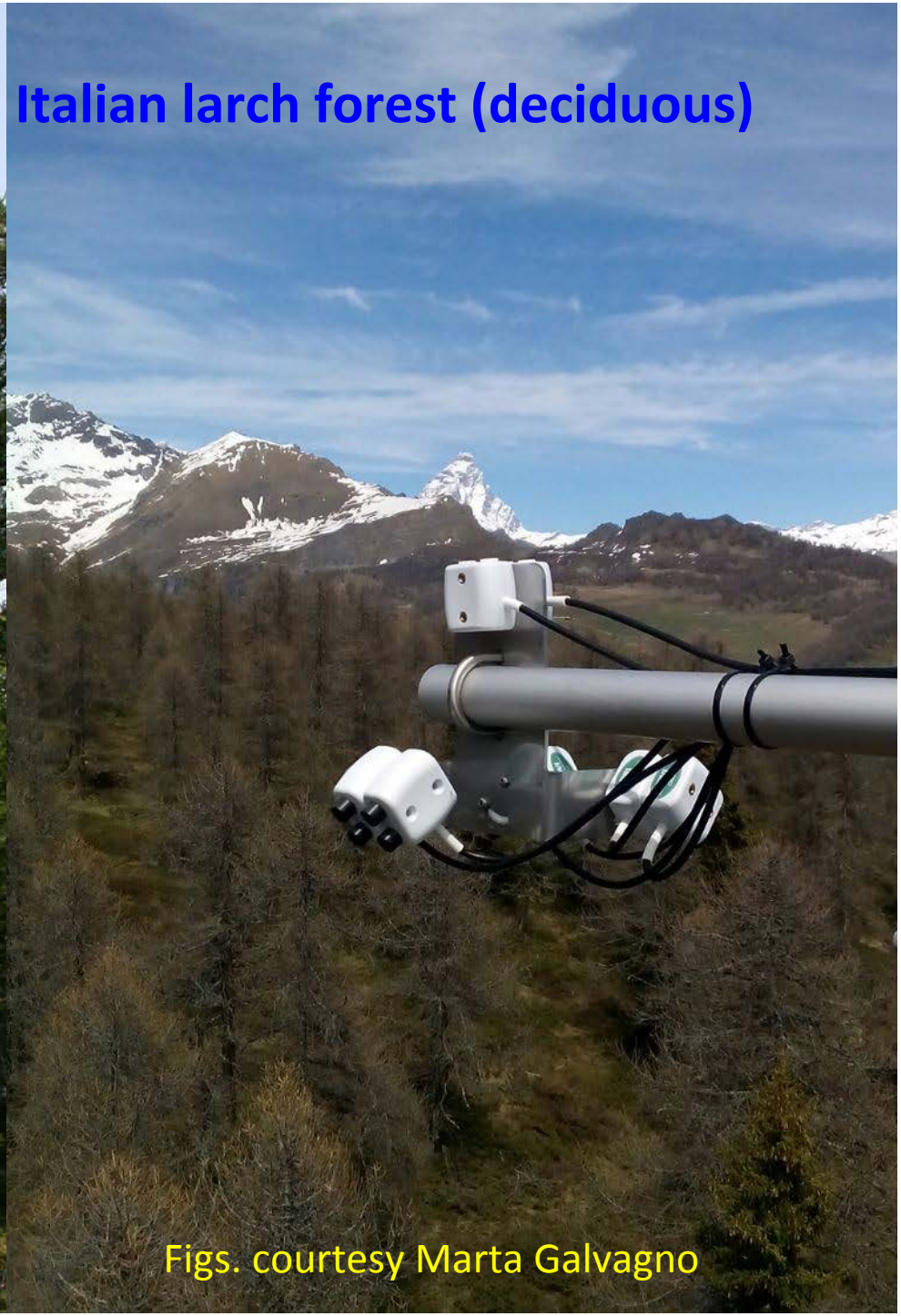
Pigment bands (combining MODIS ocean and terrestrial bands) can improve assessment of photosynthetic phenology.

(especially in evergreens!).

Looking at Photosynthesis in Evergreens

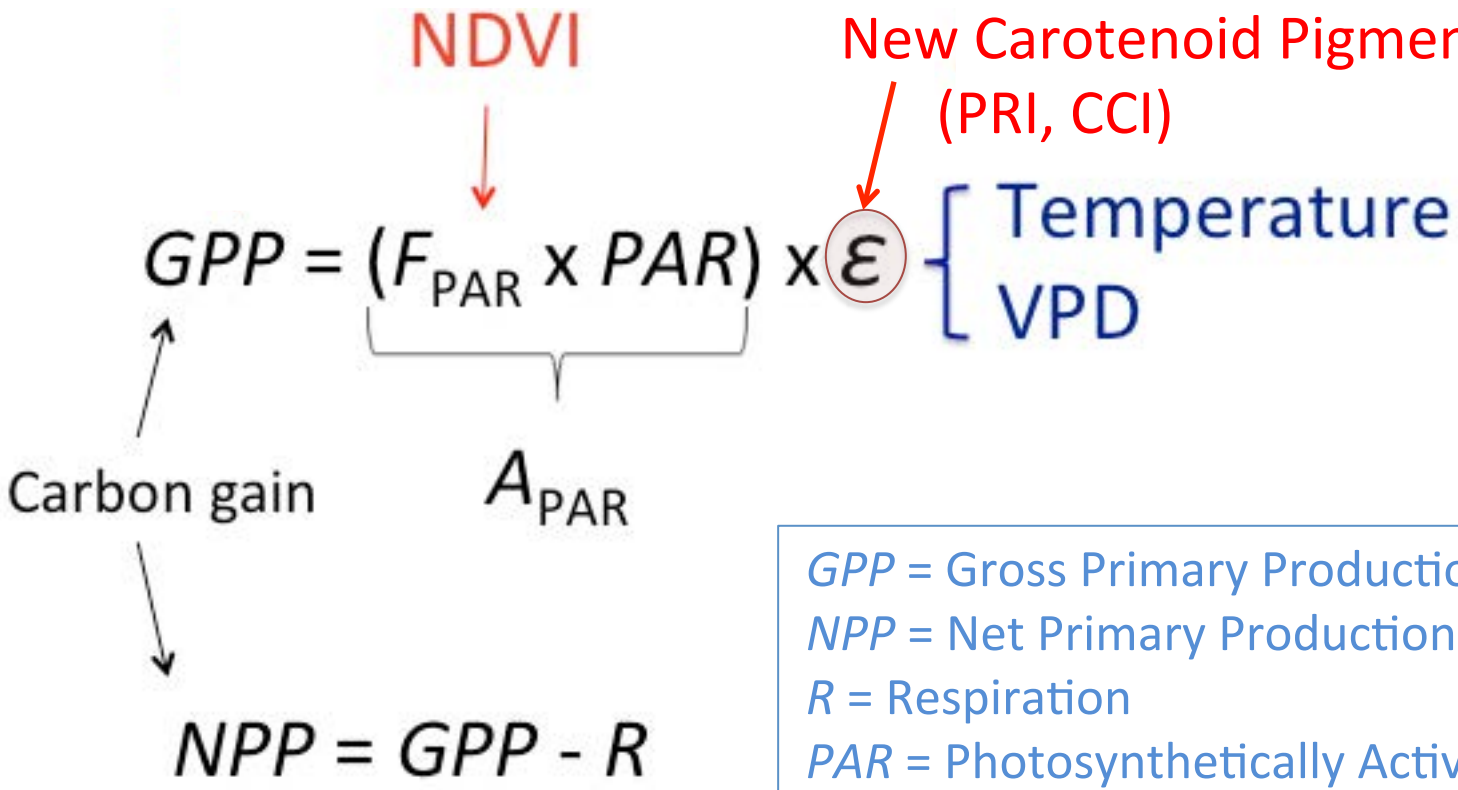
Fig. Courtesy Albert Porcar-Castel, Hyytiala, Finland

Monitoring photosynthesis in Italian larch forest (deciduous)



Figs. courtesy Marta Galvagno

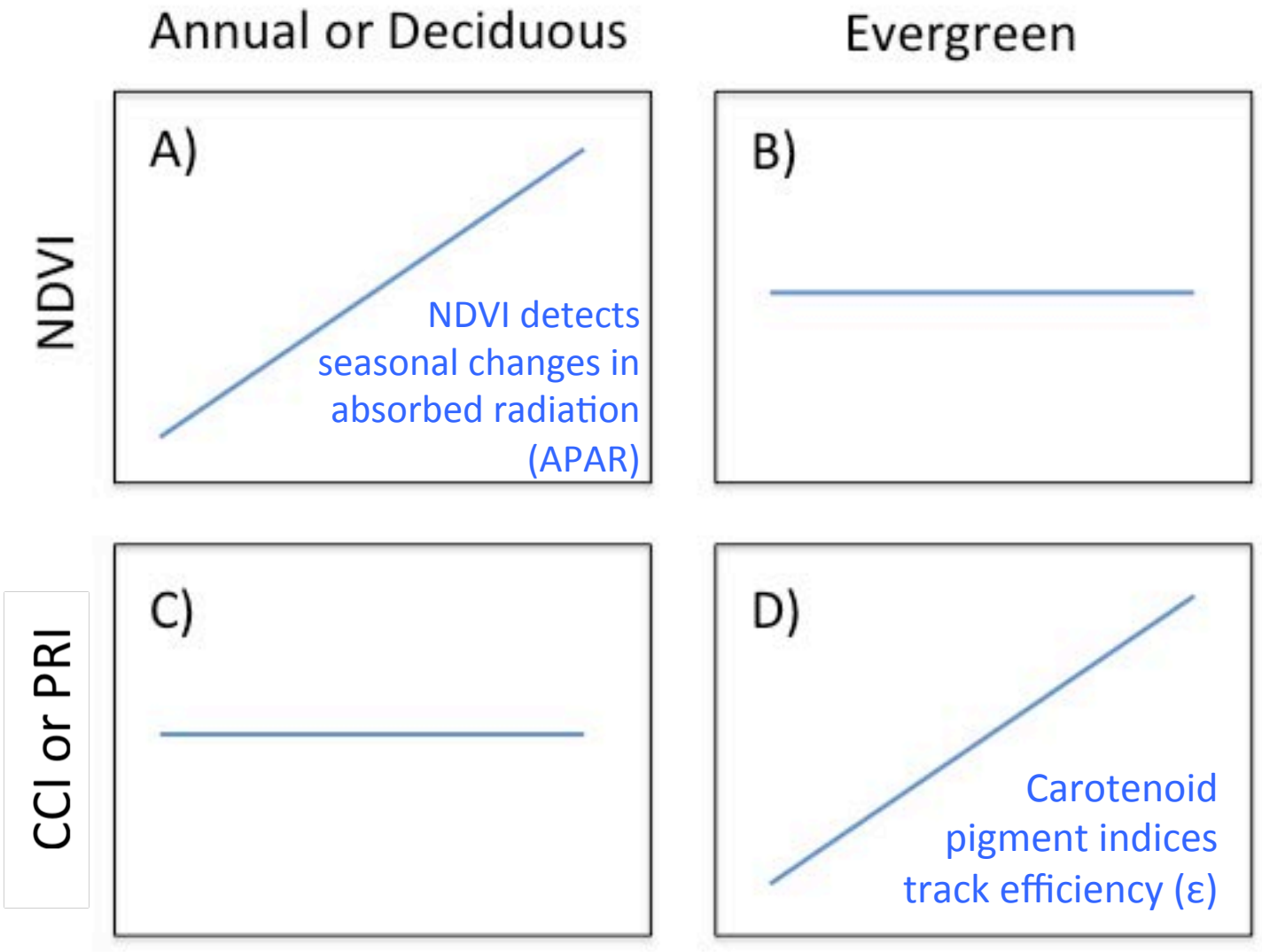
Light-Use Efficiency Model



GPP = Gross Primary Production
NPP = Net Primary Production
R = Respiration
PAR = Photosynthetically Active Radiation
F_{PAR} = Fraction of PAR absorbed
A_{PAR} = Absorbed radiation

Gamon (2015) *Biogeosciences Discussion*

Defining "Functional Types" according to Complementary Ecosystem Optical Behavior



Gamon (2015)

Optical Diversity Studies (Cedar Creek, Minnesota)

(J. Cavender-Bares, P. Townsend, A. Zygielbaum, M. Madritch…)

Prairie Plots maintained at different levels of biodiversity

Optical Diversity Studies

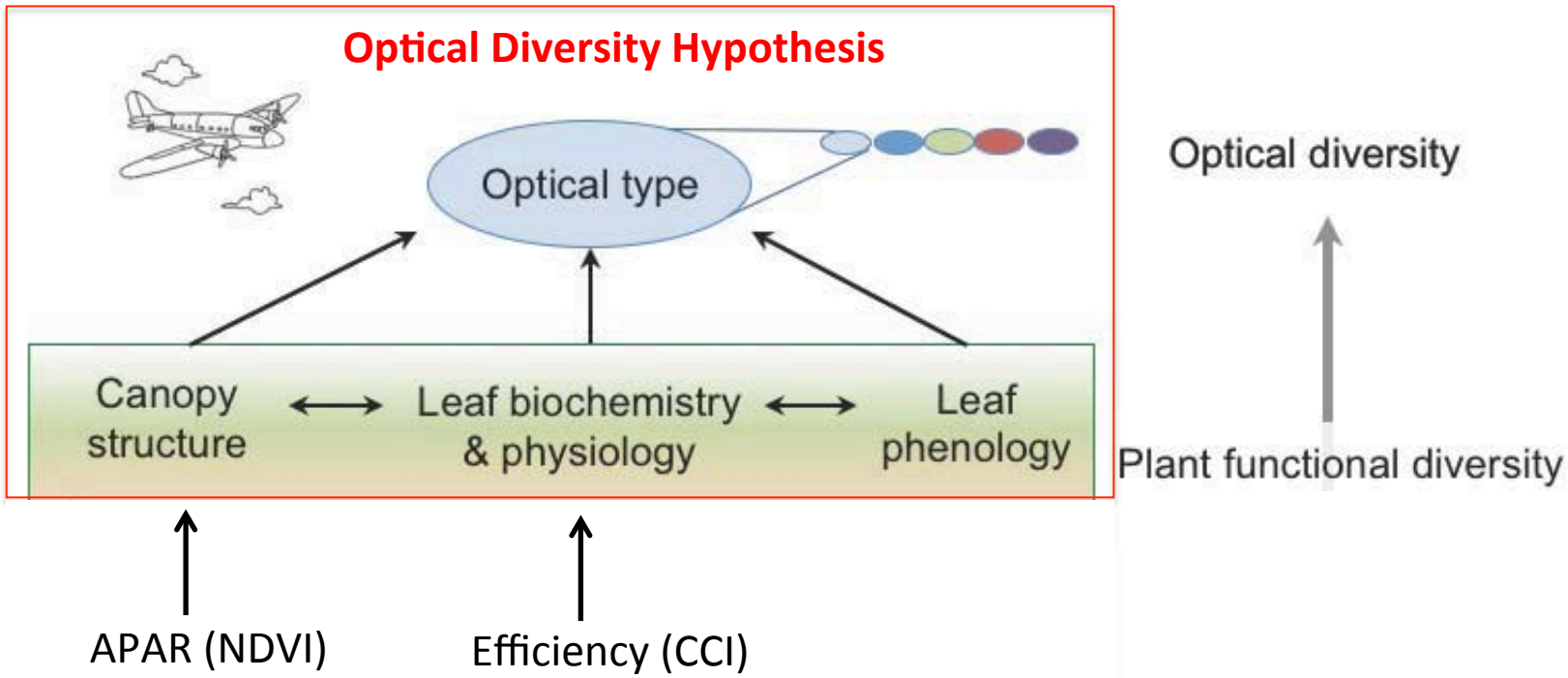
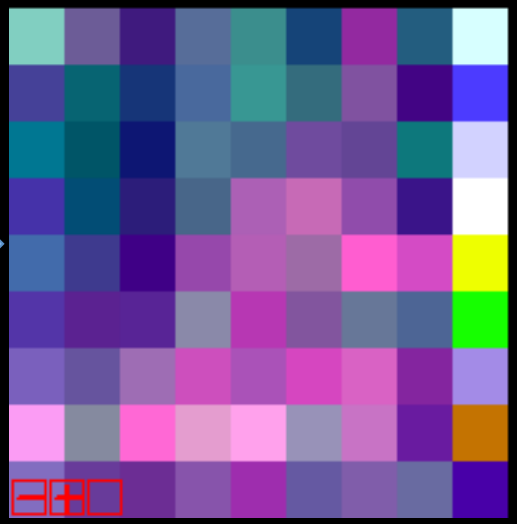


Figure courtesy J. Cavender-Bares (after Ustin & Gamon 2010)

Optical Diversity studies – Cedar Creek



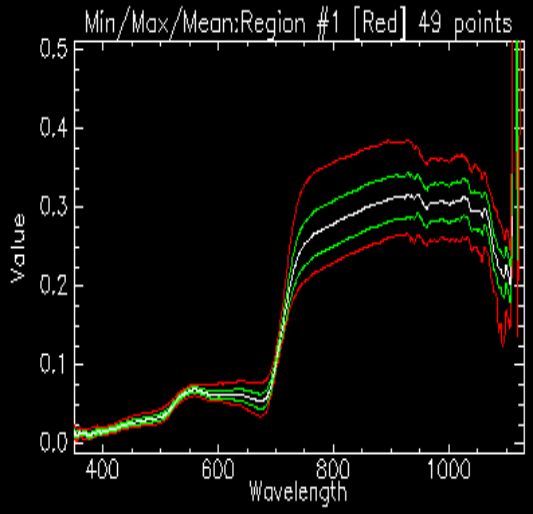
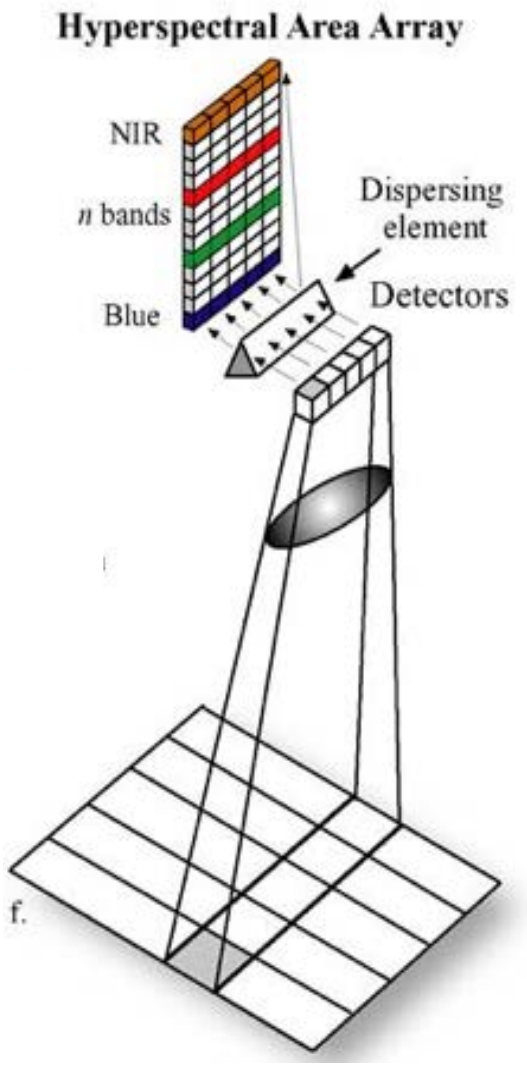


Fig: Ran Wang

Imaging Spectrometer on Robotic “Tram”

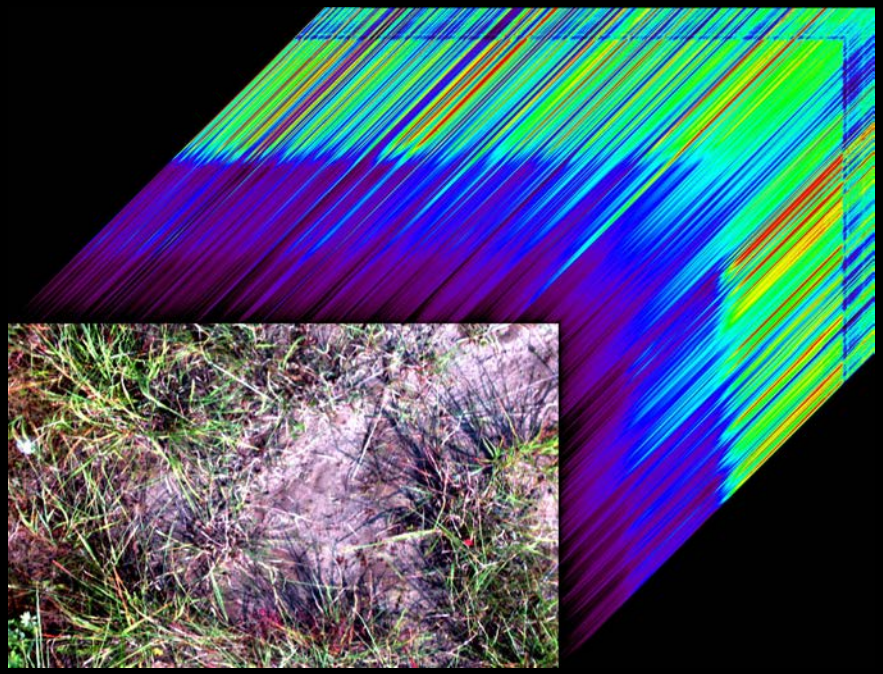
Ran Wang operating the Headwall E-Series

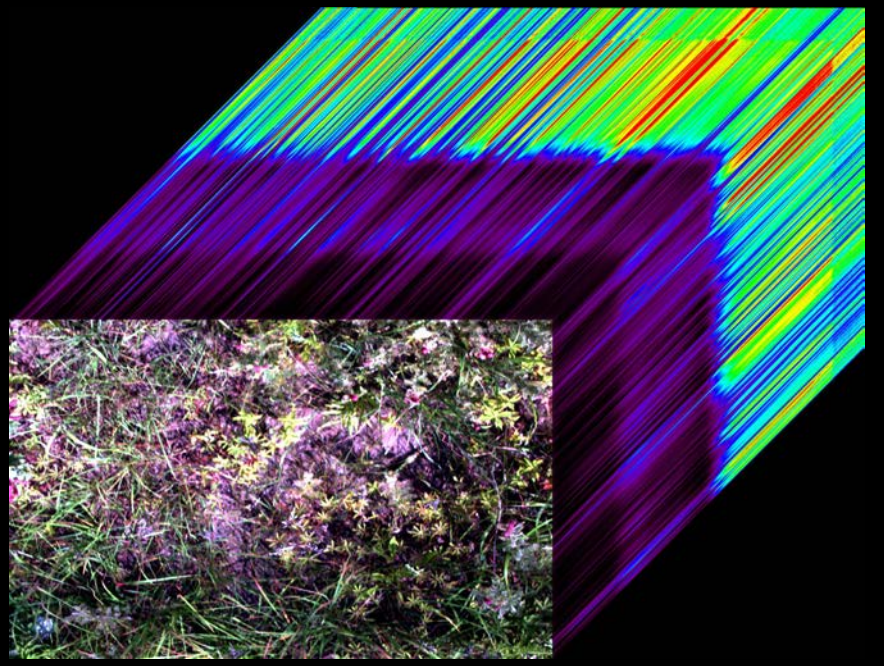


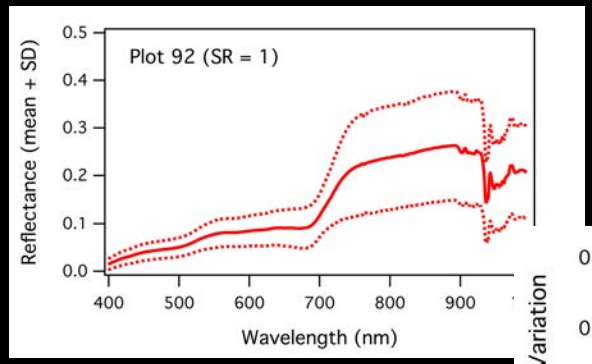
https://www.e-education.psu.edu/geog480/node/494
From Jensen (2007)

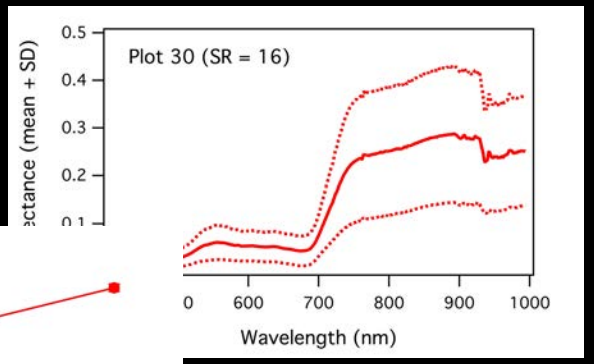
Plot 92 (Species Richness = 1)

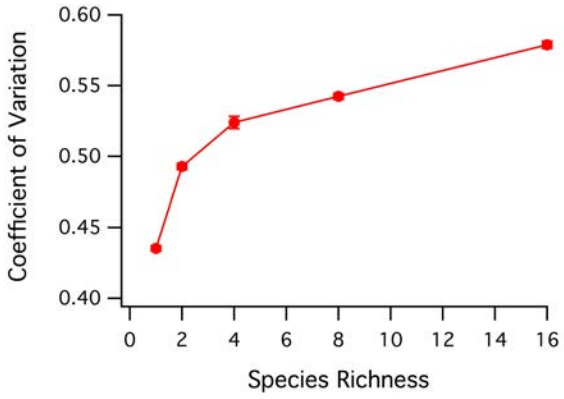
Plot 30 (Species Richness = 16)





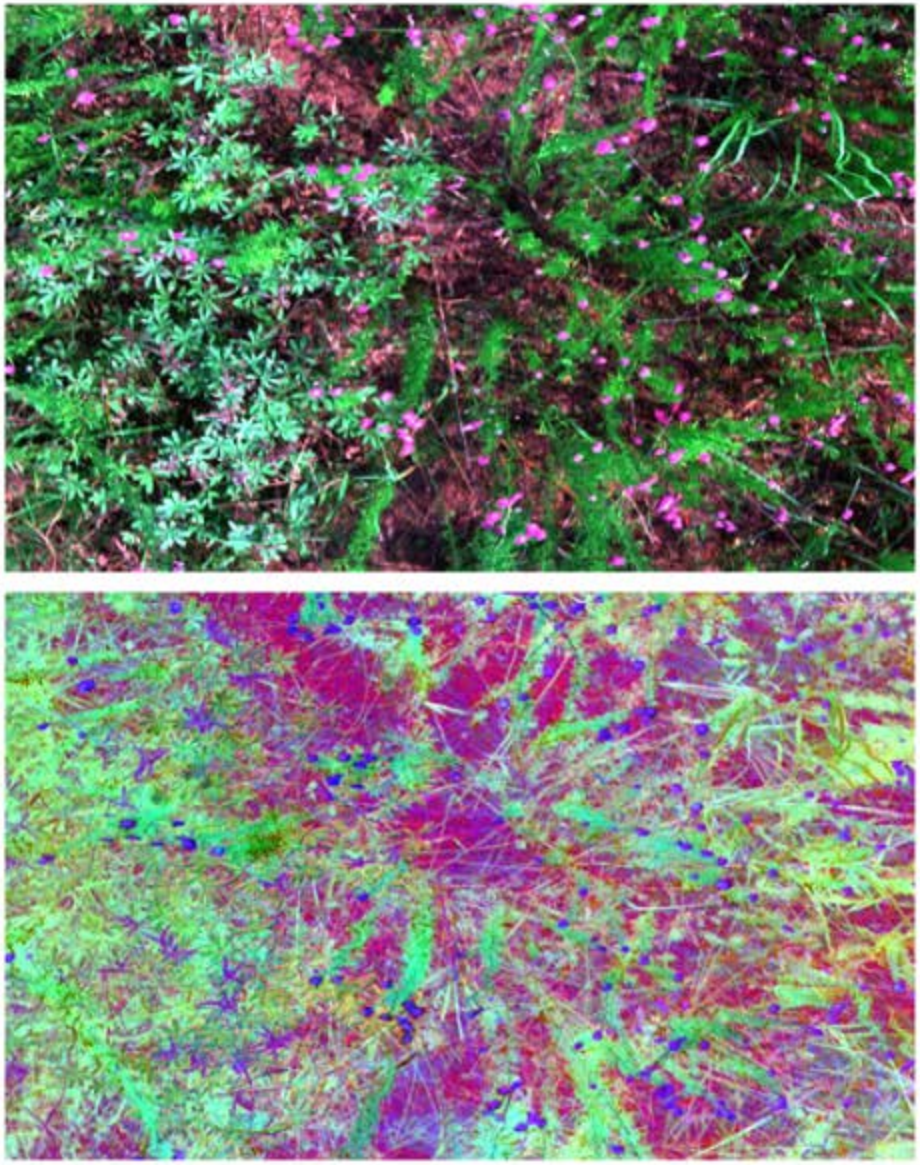


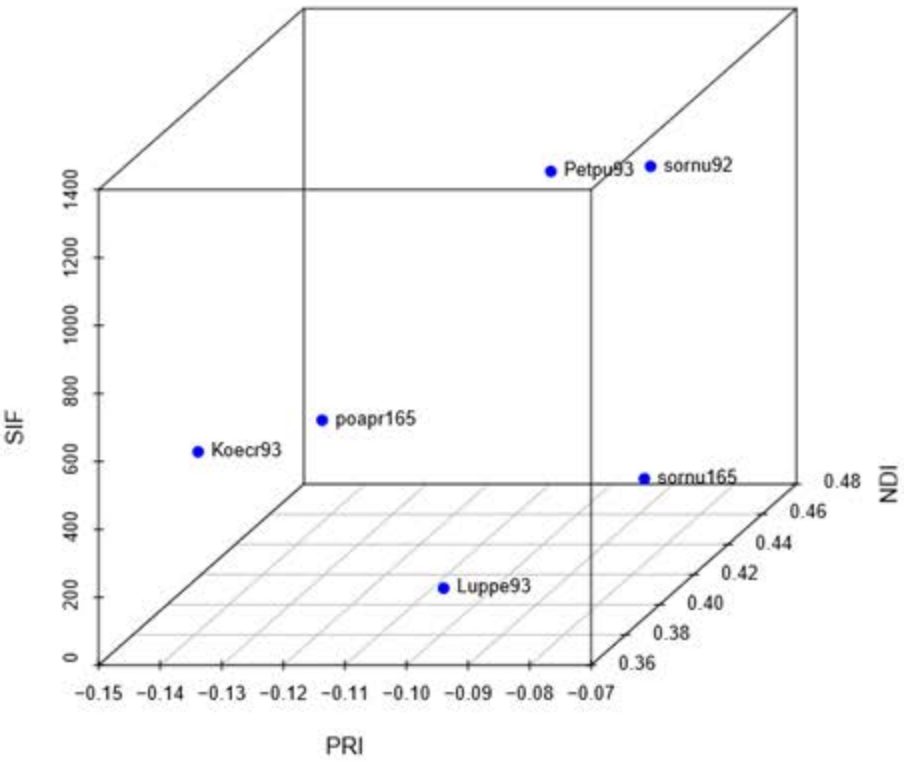




Wang et al.
(in prep)

Distinguishing Plant Species in Spectral Space



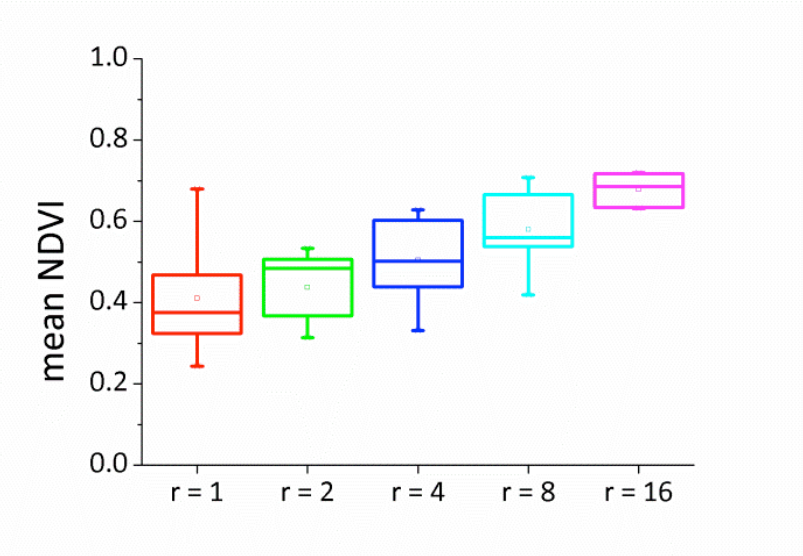


SIF = chlorophyll fluorescence
PRI = xanthophyll pigment index
NDI = chlorophyll pigment index

Wang et al. (in prep.)

Conclusions

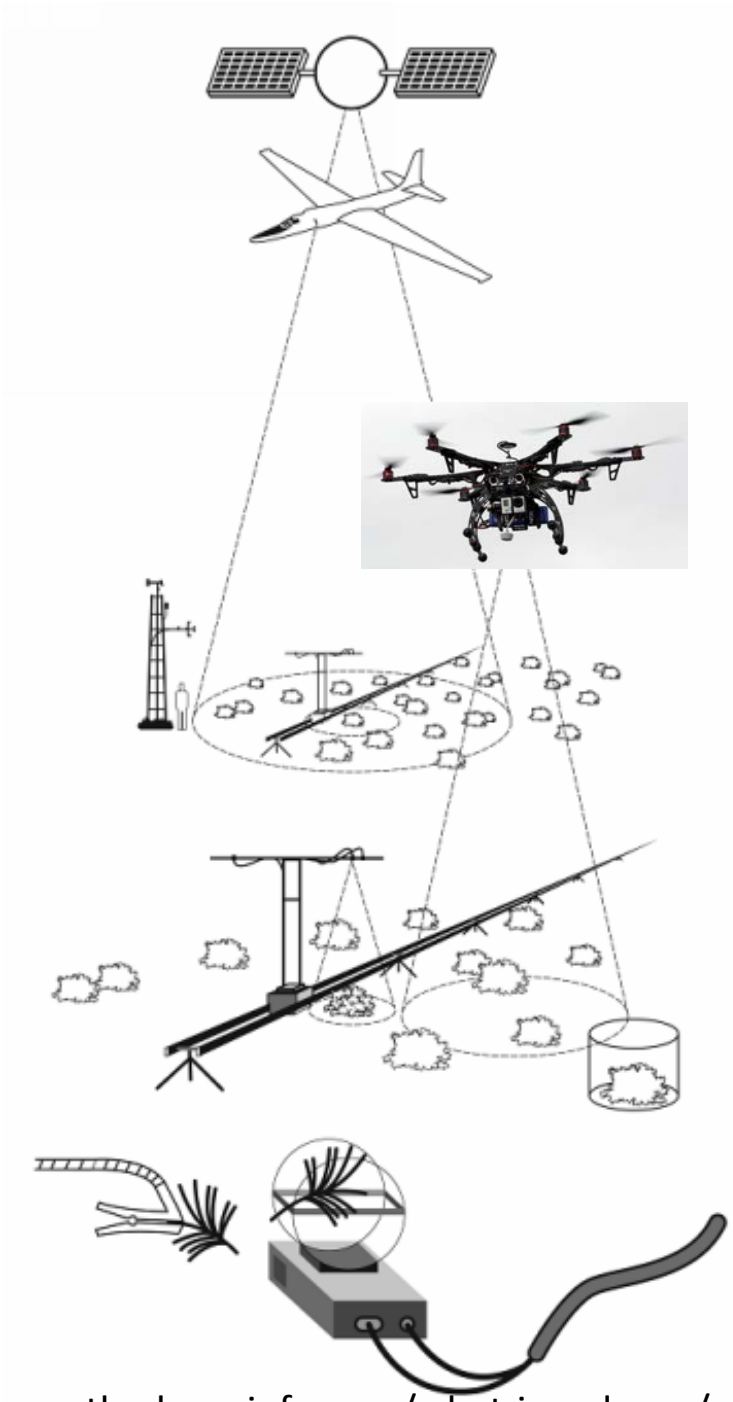
- Spectral measurements
  - Detect “invisible” photosynthetic phenology
  - Reveal biodiversity
- *Optical diversity* relates to *ecosystem function*
  - Photosynthetic types are spectrally distinguishable
  - More diverse ecosystems are more productive!



Wang et al. in prep.

Informatics Challenges:

- Multiple scales (temporal, spatial, spectral)
- Time series
- Multiple data formats
- Visualization & analytics (decision tools)



http://www.thedroneinfo.com/what-is-a-drone/

The value of a networked approach

- Spectral Networks
  - SpecNet
  - EuroSpec
- Flux Networks:
  - FLUXNET
  - Ameriflux
  - Euroflux,
  - Etc.

Data Systems:

- EcoSIS
- Optimise
- TERN/AusCover
- SPECCHIO
- NEON
- Etc.

The value of a networked approach

- Spectral Networks
  - SpecNet
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- Flux Networks:
  - FLUXNET
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  - Etc.

Data Systems/Databases:

- EcoSIS
- Optimise
- TERN/AusCover
- SPECCHIO
- NEON
- TRY
- Etc.

Thank You!

Spruce tree in Churchill, Manitoba