



VRIJE
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LUXEMBOURG
INSTITUTE
OF SCIENCE
AND TECHNOLOGY



UNESCO-IHE
Institute for Water Education



High-resolution modelling and monitoring of water and energy transfers in wetland ecosystems (**HiWET**)

Boud Verbeiren & HiWET Team
BE0day 2016, Saintes - Belgium

Belgian Science Policy Office



OUTLINE

HiWET project

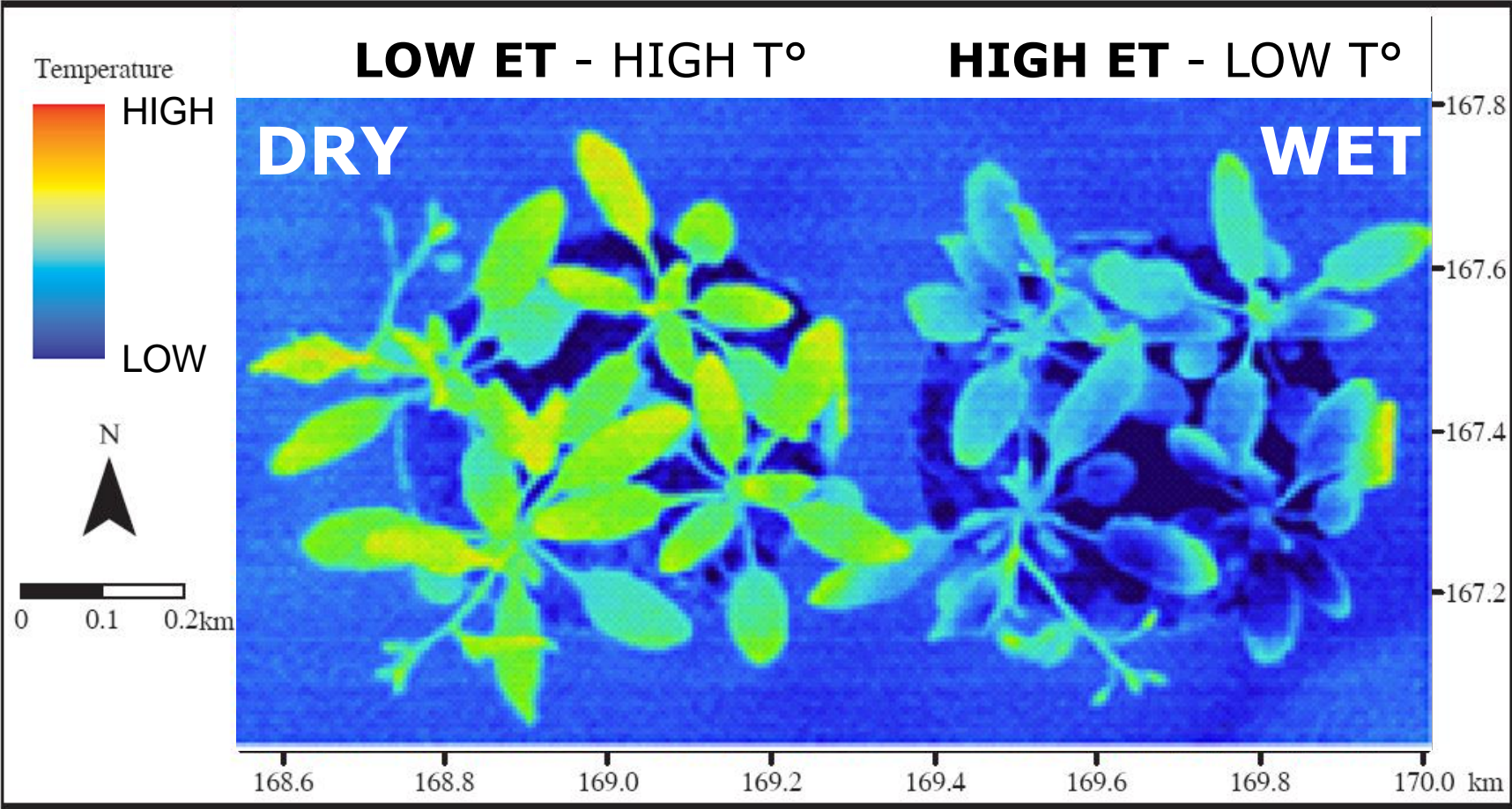
Hypothesis

Goals

Methodology

Preliminary results

Wetlands show high thermal variability



Doode Bemde Wetland - Land Surface Temperature

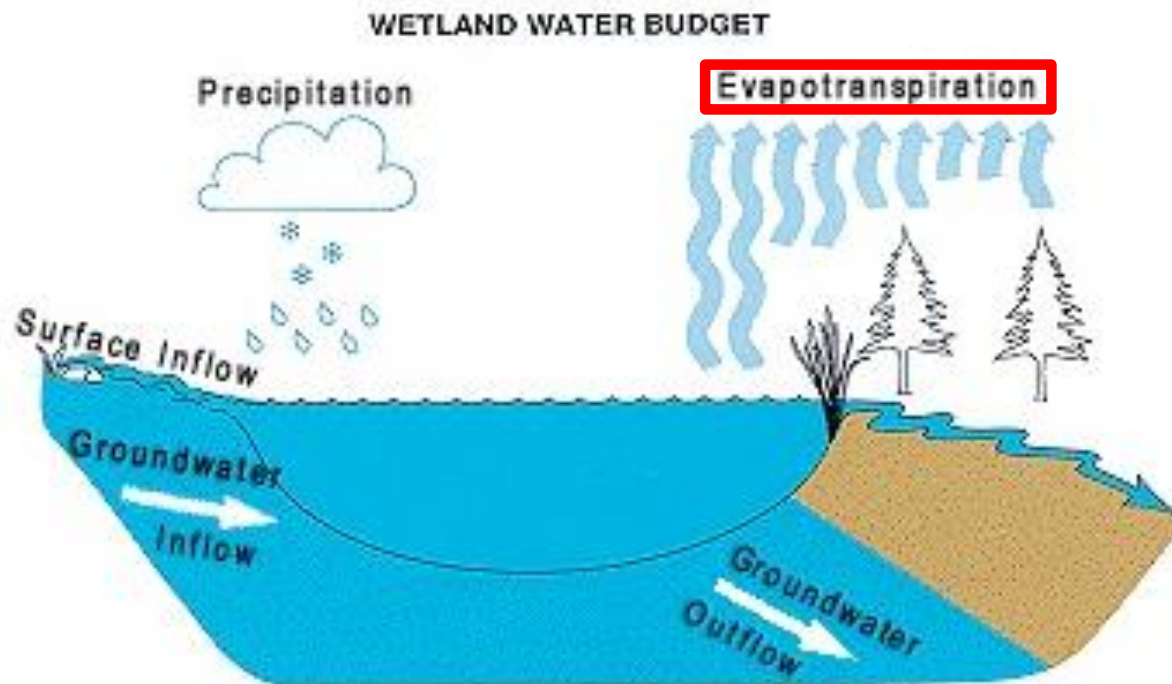
Need for wetland ecosystem monitoring

Wetlands are beneficial for society, but suffer from degradation → monitoring



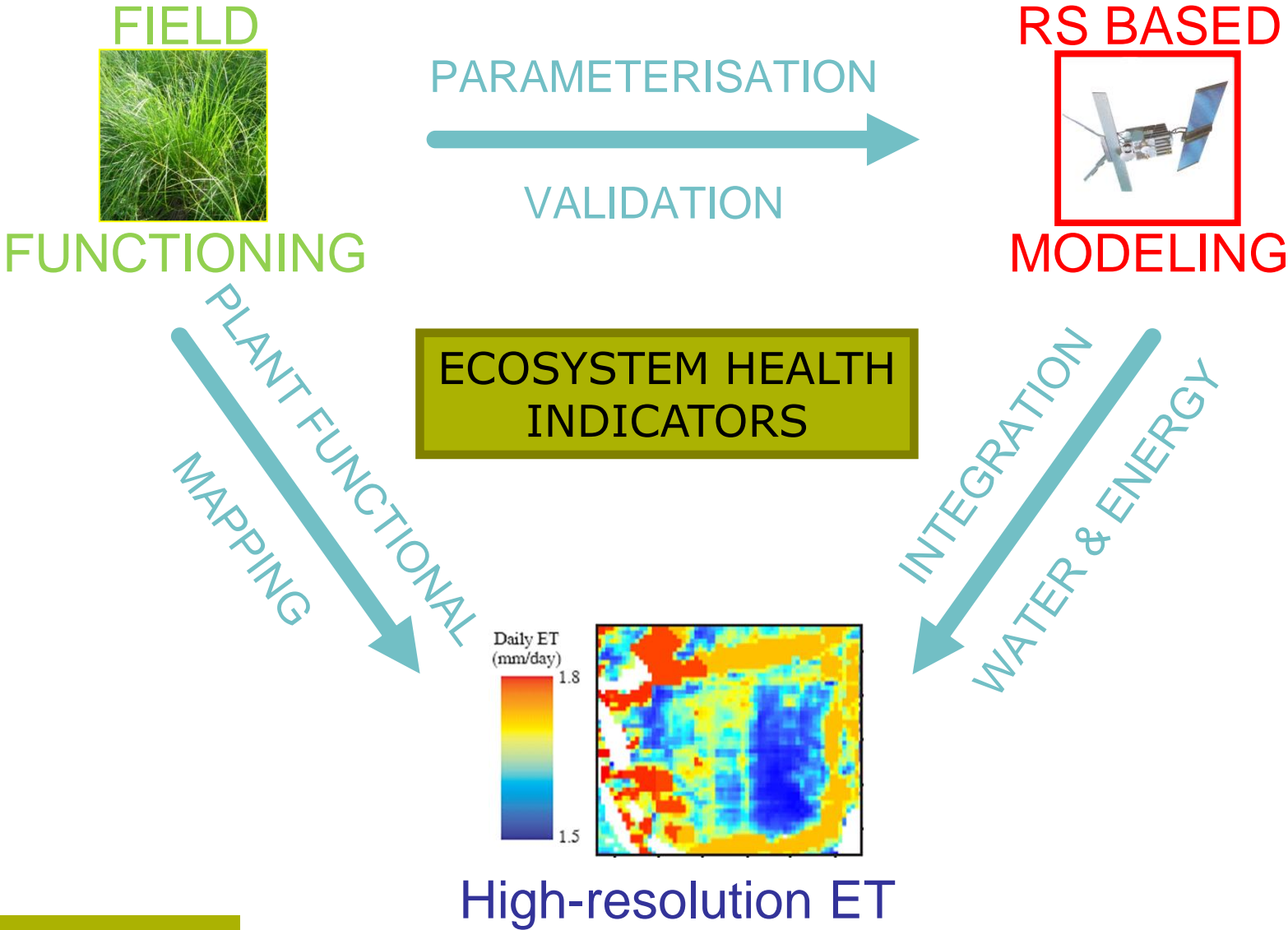
Evapotranspiration good indicator?

- ET dominant hydrological process in wetlands



- Hypothesis: ET variation is good indicator for ecosystem health status

Combination RS, MODELING and FIELD



Study sites: Temperate freshwater wetlands



SIZE

140.0 km²

45.0 km²

10.5 km²

2.5 km²

TYPE

PEAT
SEDGE

PEAT BOGS
MOORLANDS

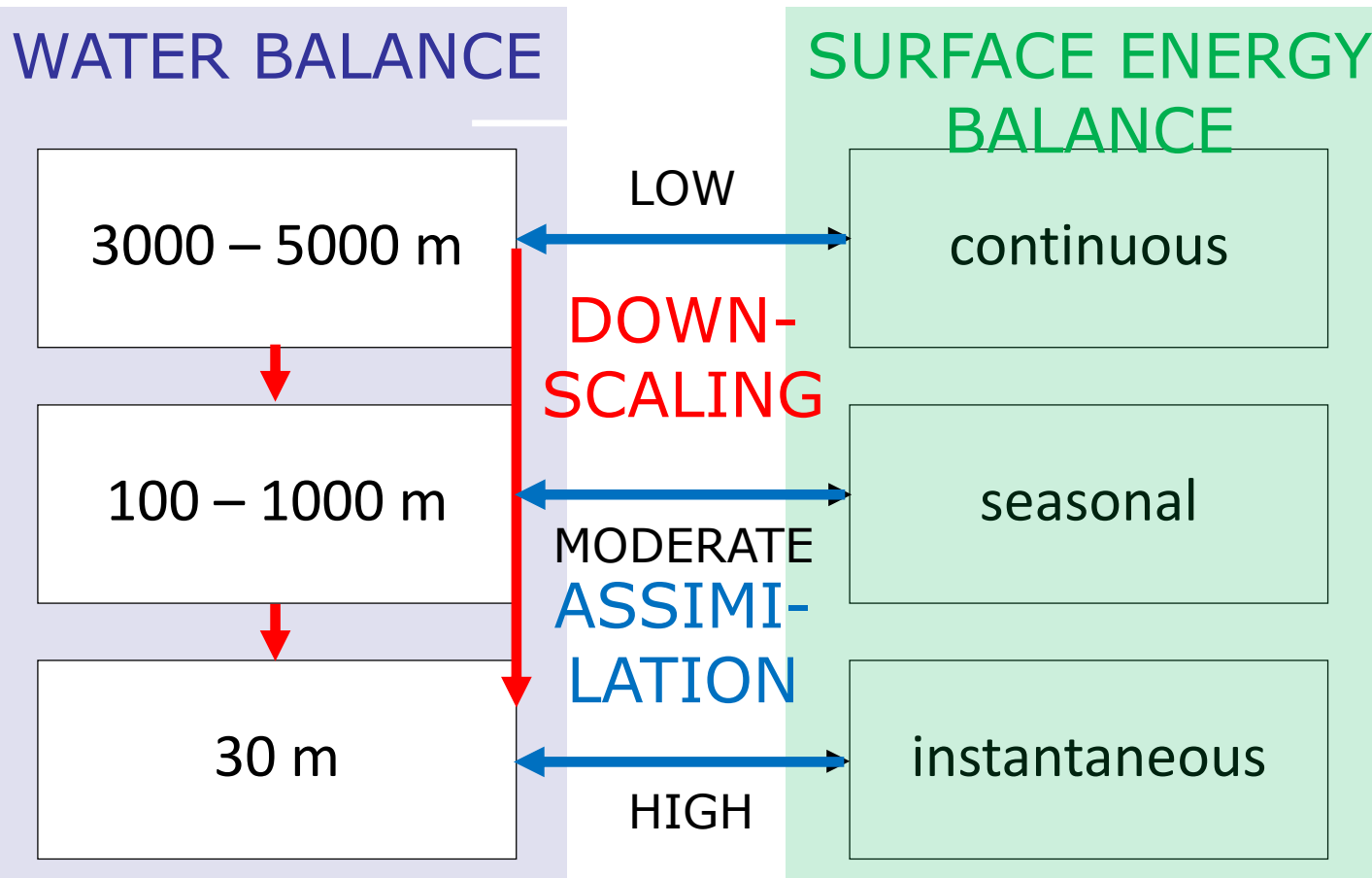
HUMID
MEADOWS

HUMID
MEADOWS

DATA AVAILABILITY FAMILIARITY

A multi-resolution approach

Consistent ET estimates across spatial and temporal scales

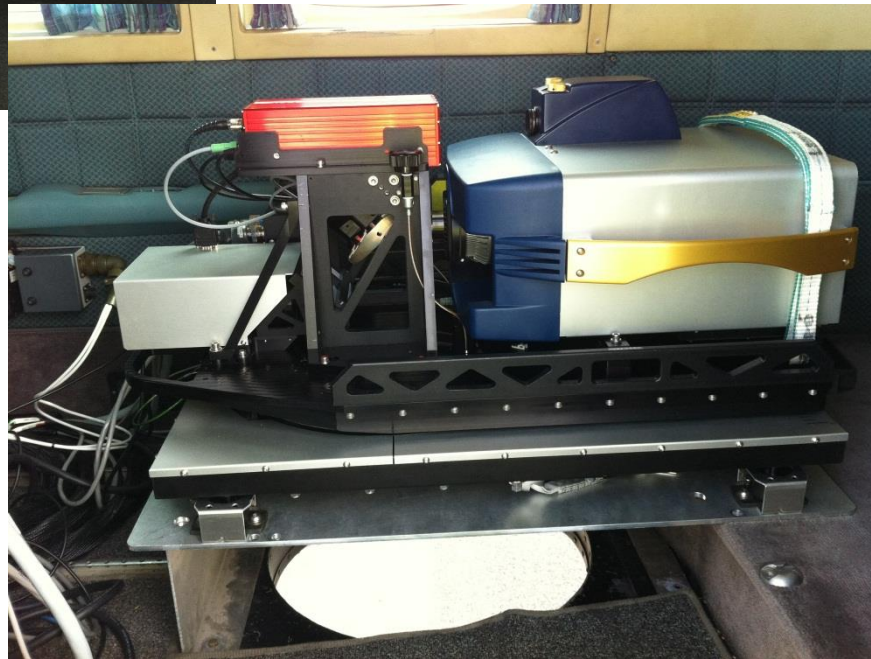


Preliminary Results (1)

Airborne acquisitions

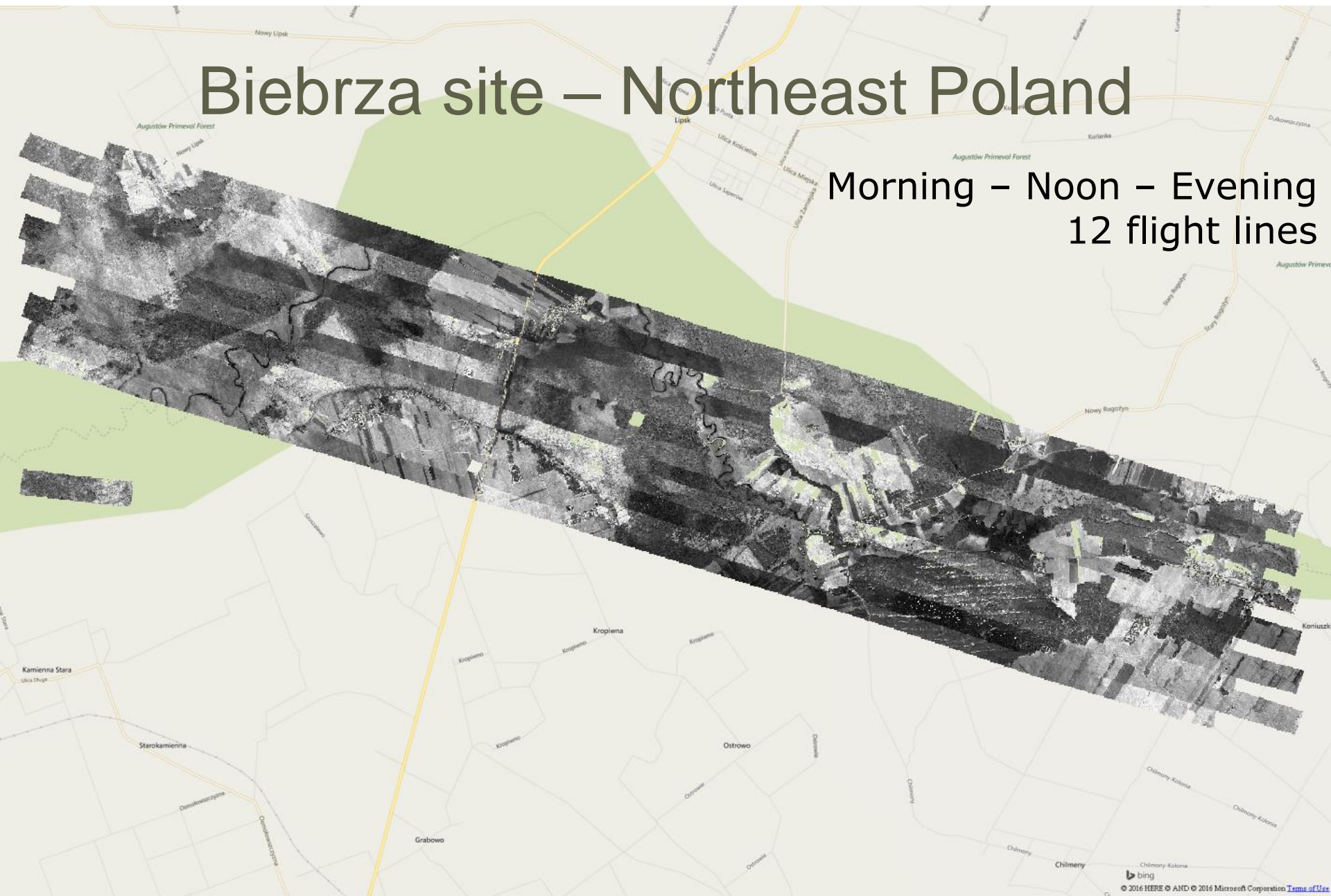
- *TELOPS Hyper-Cam (Thermal) – July 2016*
- *APEX (Hyperspectral) – July 2015*

Hyper-Cam installation to Cessna

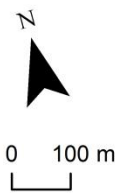
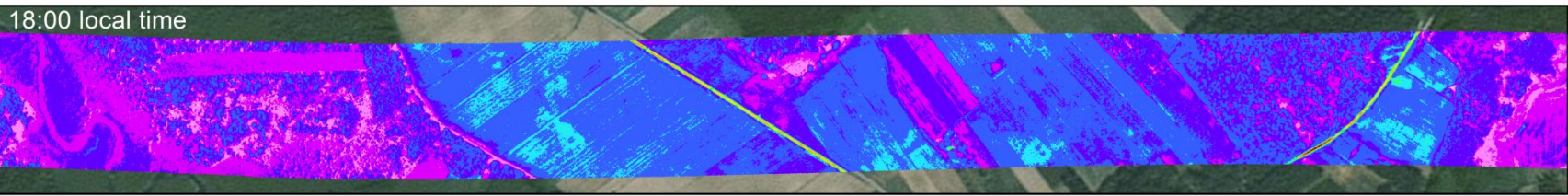
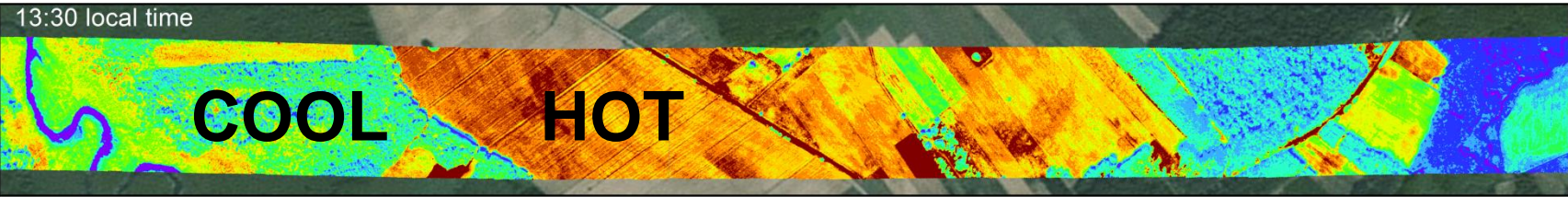
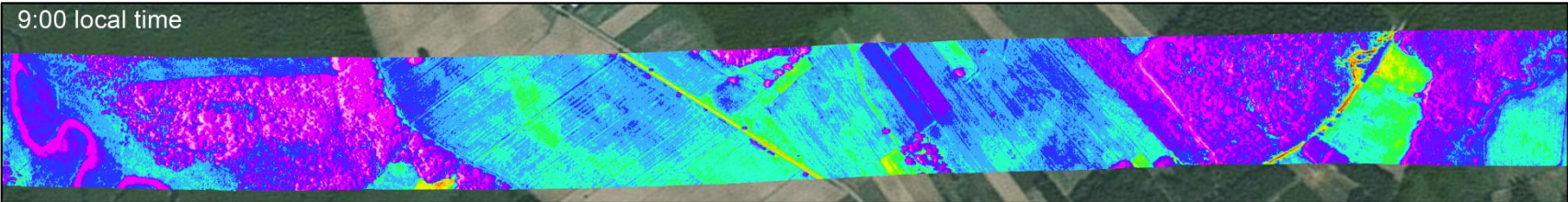
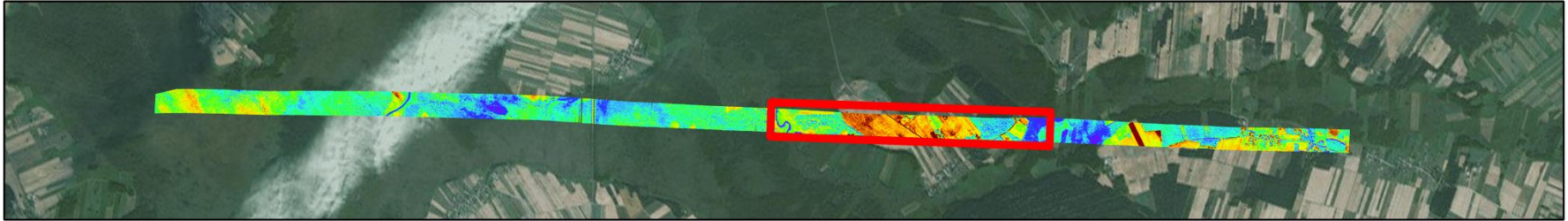


Biebrza site – Northeast Poland

Morning – Noon – Evening
12 flight lines



Radiometric Surface Temperature [°K]



Preliminary Results (2)

Airborne acquisitions > thermal, hyperspectral

Field mapping > Plant Functional Traits (PFT)

e.g. LAI

Plant Functional Traits

Whole plant related traits

- E.g. earliest flowering month, max plant height, water loss on drying, plant N/P ratio

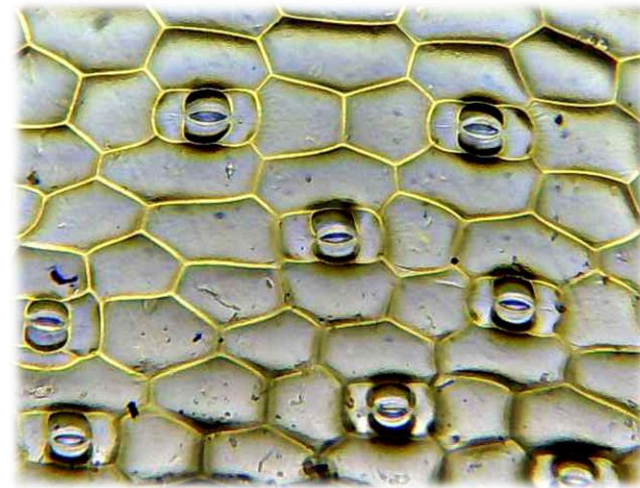
Leaf traits

- E.g. stomata, Leaf Dry Matter Content, leaf surface

Stem & root traits

- E.g. stem hollowness, aerenchyma presence

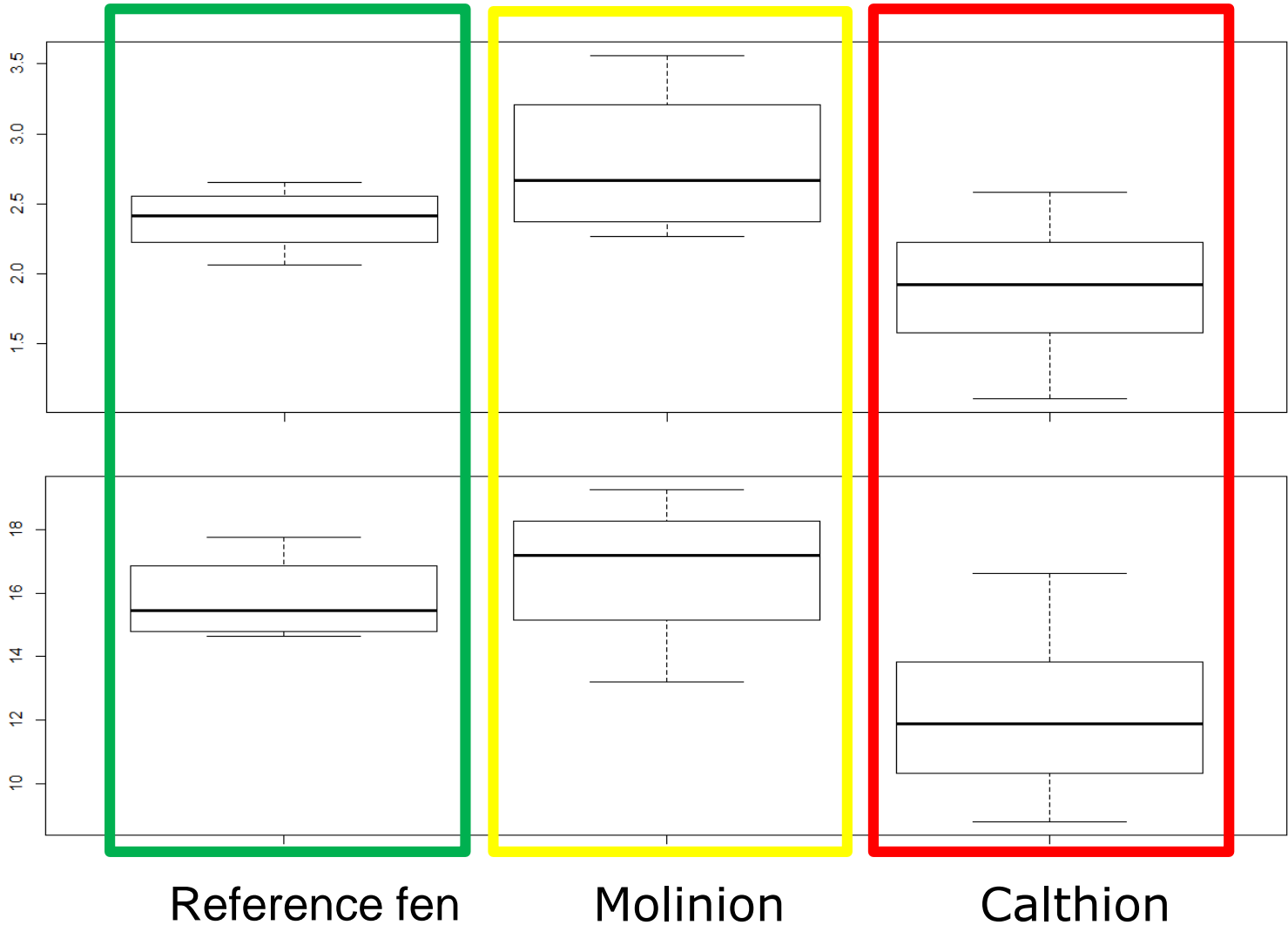
→ 32 traits in total



Significant relation PFT - degradation

Stem
Hollowness
(categorical)
1= <25% hollow
2= 25-50%
hollow
3= 50-75%
hollow
4 = >75% hollow

Leaf N/P
ratio
(mg N/ng P)



Reference fen

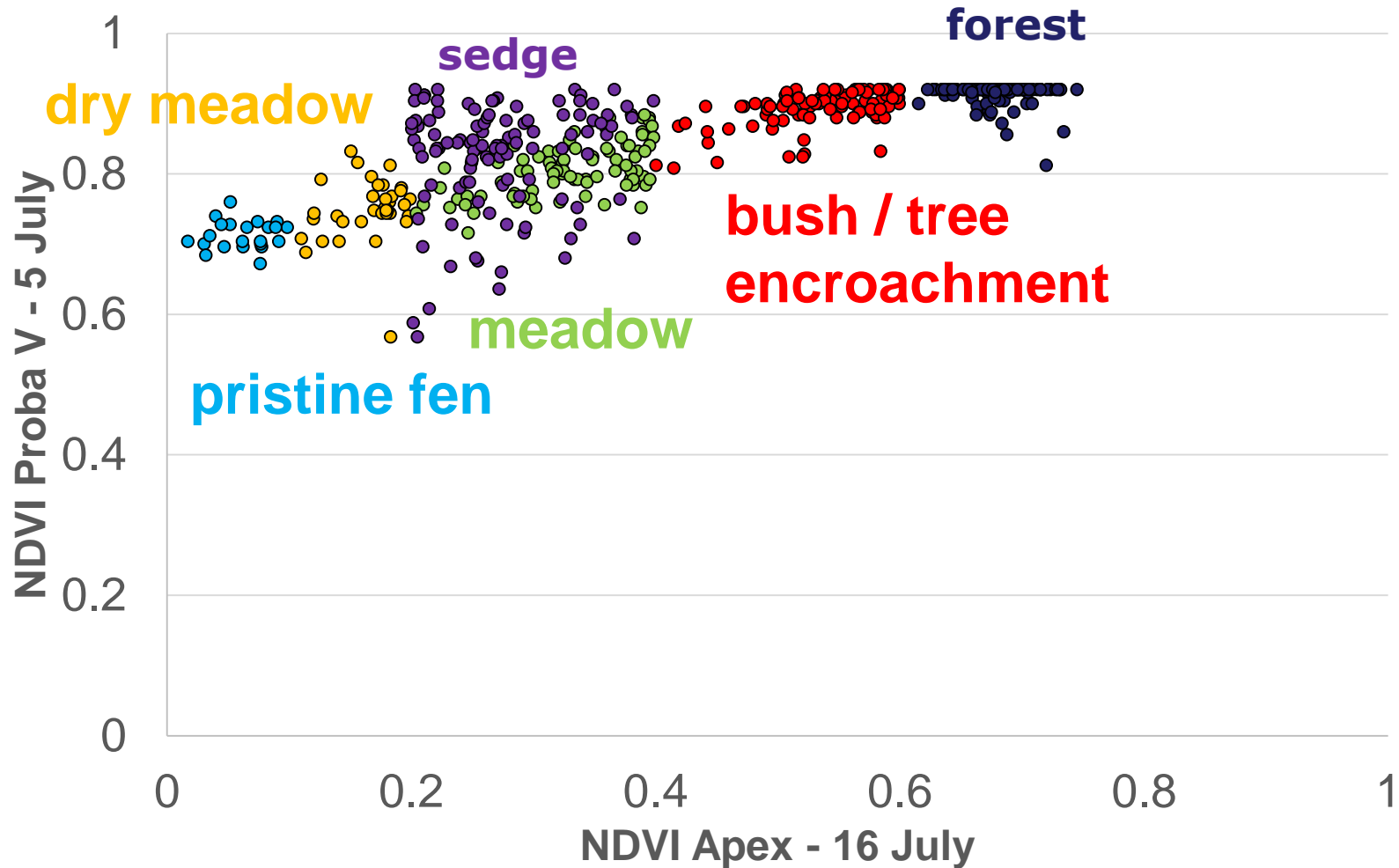
Molinion

Calthion

Increasing drainage

Matching airborne & satellite RS data

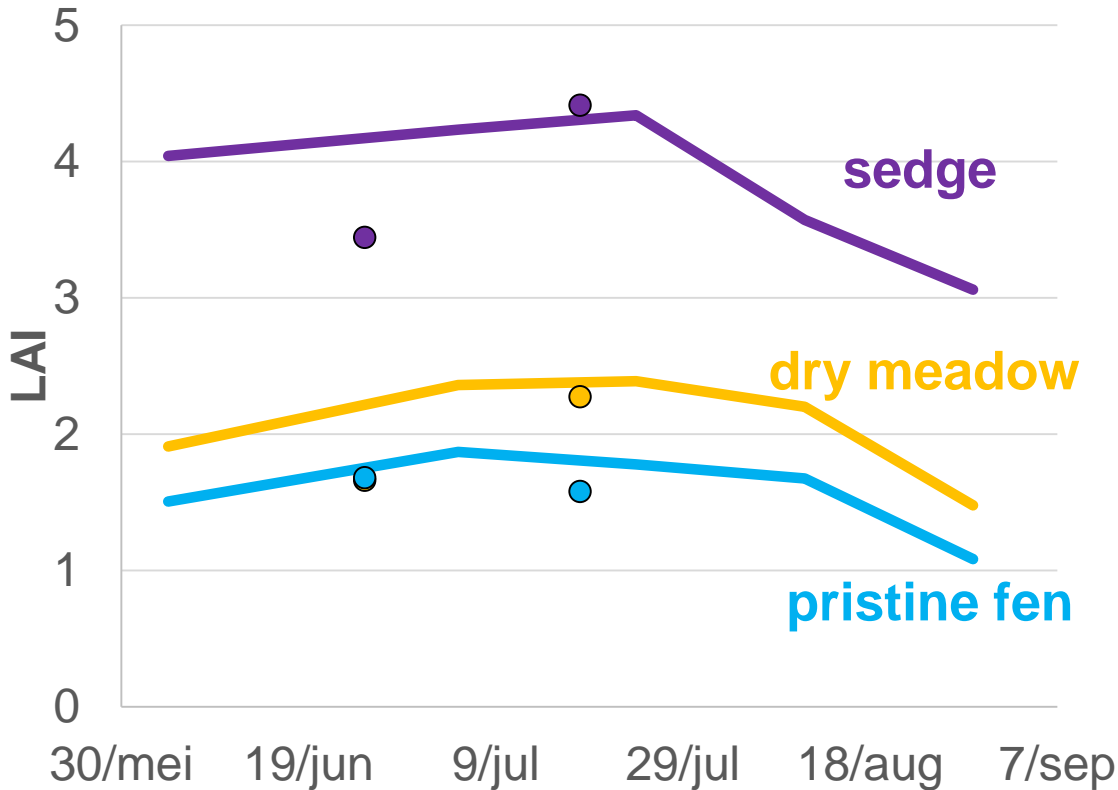
Vegetation dynamics



Capturing natural dynamics

Biebrza WETLAND site

Field measurements (●) of Leaf Area Index (LAI) give similar values like Proba-V (—)



Sedge community
H > 0.8 m



Dry meadow
H > 0.4 m

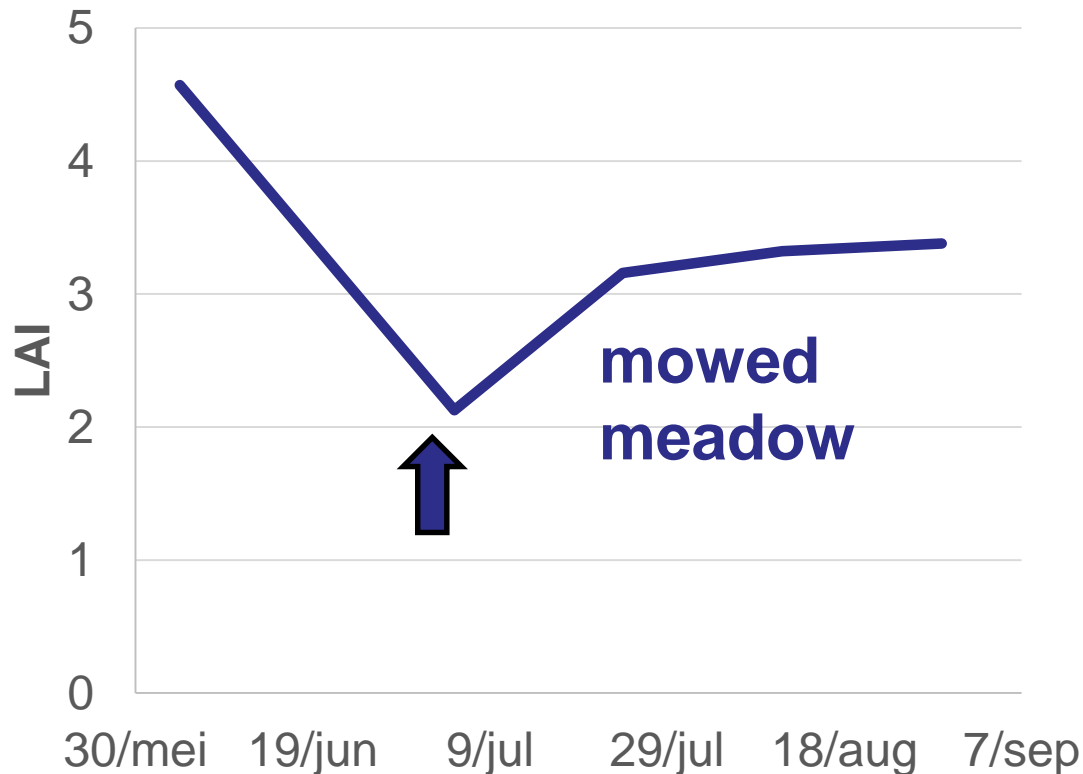


Pristine fen
H > 0.3 m

Capturing management practices

WETLANDS Biebrza site

Proba V allowed to capture a moment of mowing



Meadow
H > 0.5 m

Preliminary Results (3)

Airborne acquisitions > thermal, hyperspectral

Field mapping > Plant Functional Traits (PFT)

e.g. LAI

ET estimation through modeling

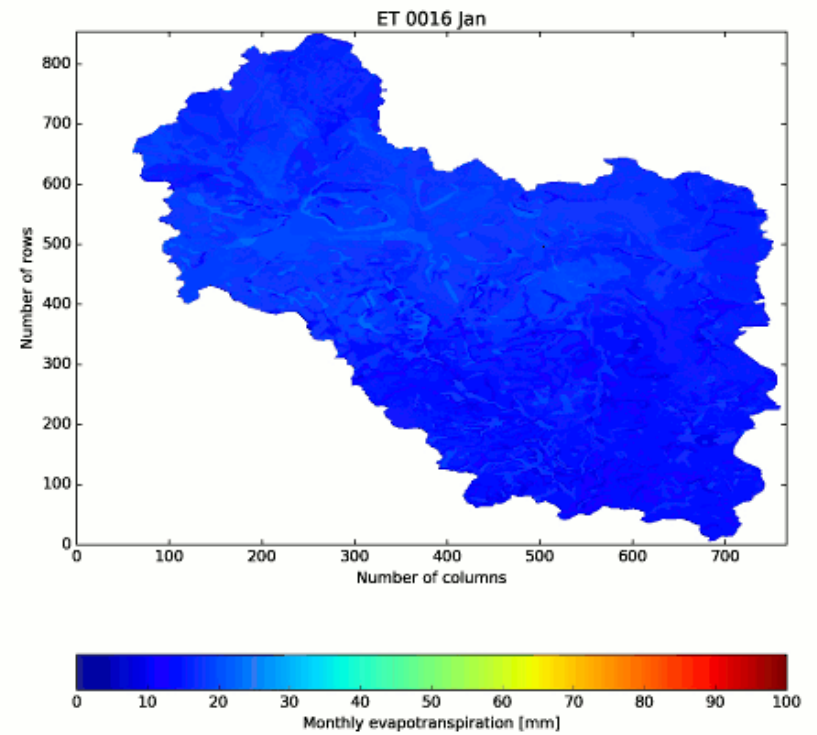
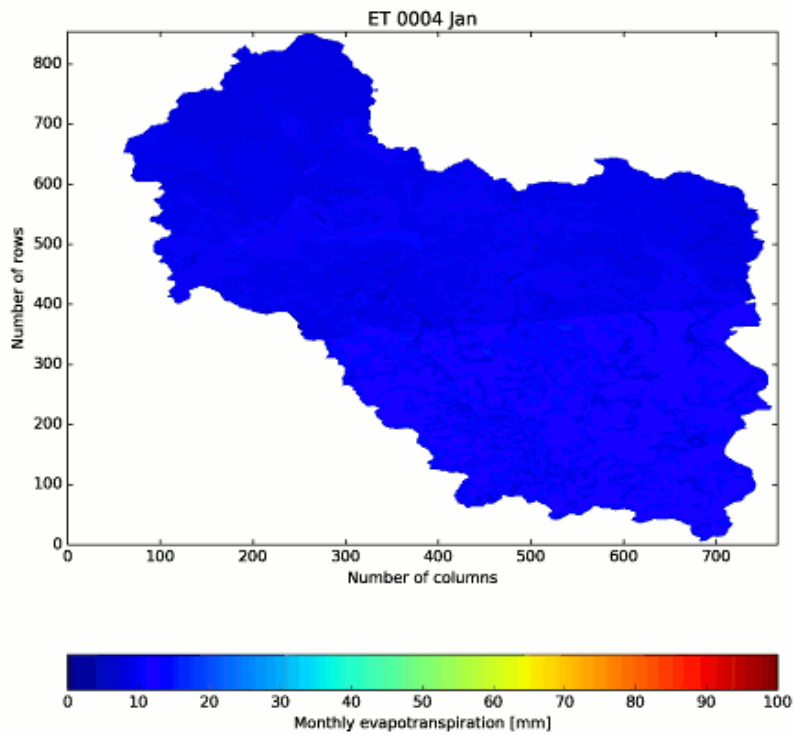
Hydrological (water balance)

Surface Energy Balance

Period-specific high-resolution ET maps

2012

2013



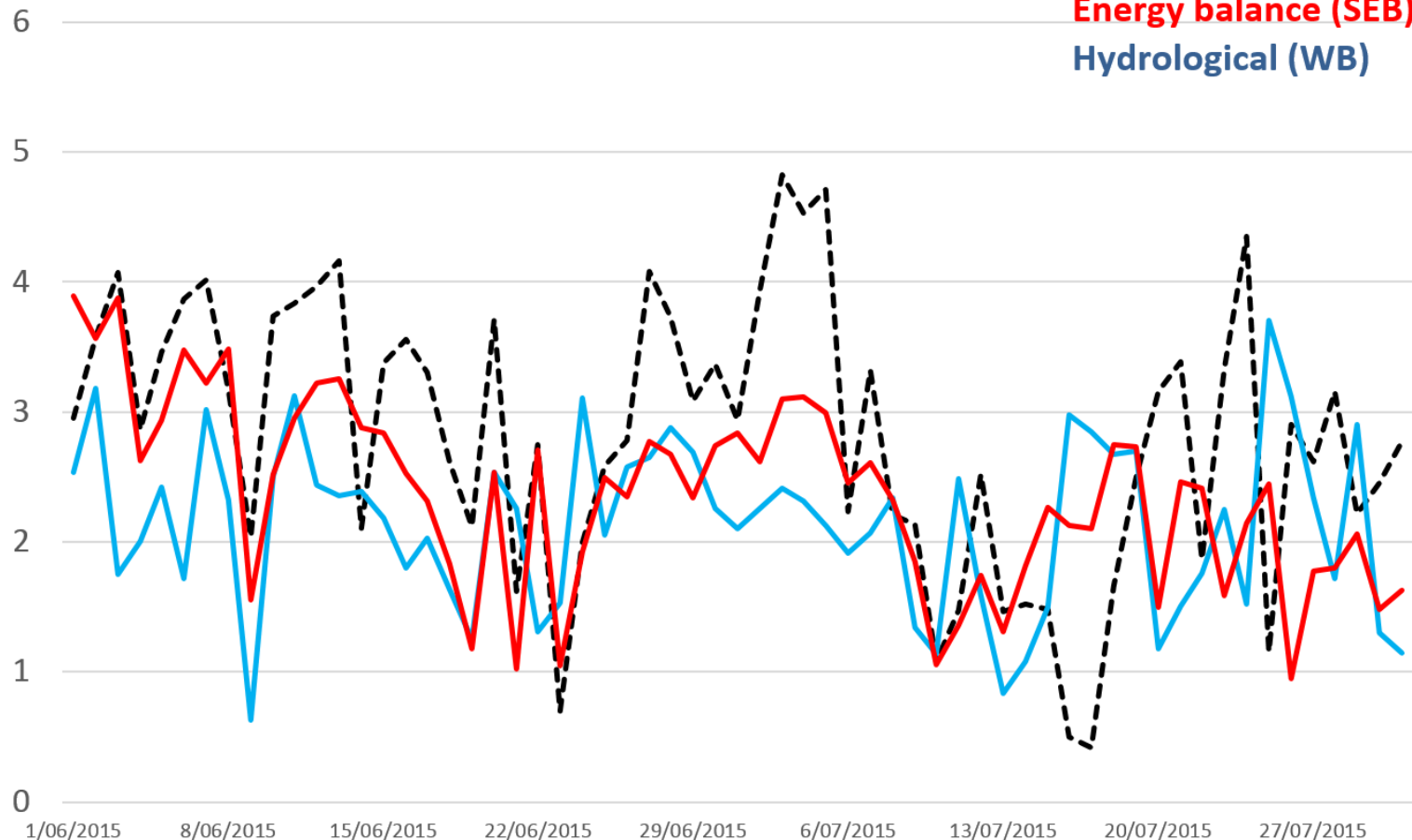
ET timeseries from different models show similar ranges but considerable variation

ET [mm/d] - June & July 2015 @ Rogozynek EC station

Observed (EC tower)

Energy balance (SEB)

Hydrological (WB)



<http://www.hydr.vub.ac.be/projecthiwet>

Introduction — HYDR x

hydr.squarespace.com/projecthiwet

Belgian Science Policy Office

THE HIWET PROJECT

High-resolution modelling and monitoring of water and energy transfers in wetland ecosystems

belspo

HiWET project

INTRODUCTION

RESEARCH SITES

PARTNERS

INTRODUCTION

Wetlands are linking terrestrial and aquatic ecosystems, therefore they are of great value and play a significant role in the natural environment. Wetlands are the source of sweet water and act as filters between upstream and rivers estuaries They are also characterized by high biodiversity and for being an important part of animal migration routes . Often, due to very high biomass production, wetlands are also responsible for recycling and storing large amount of methane, nitrogen, phosphorus, biogenic silica and carbon. Wetland ecosystems are