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LUXEMBOURG
INSTITUTE
OF SCIENCE
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UNESCO-IHE
Institute for Water Education



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

Boud Verbeiren & HiWET Team
BEoday, Barvaux - Belgium

Belgian Science Policy Office



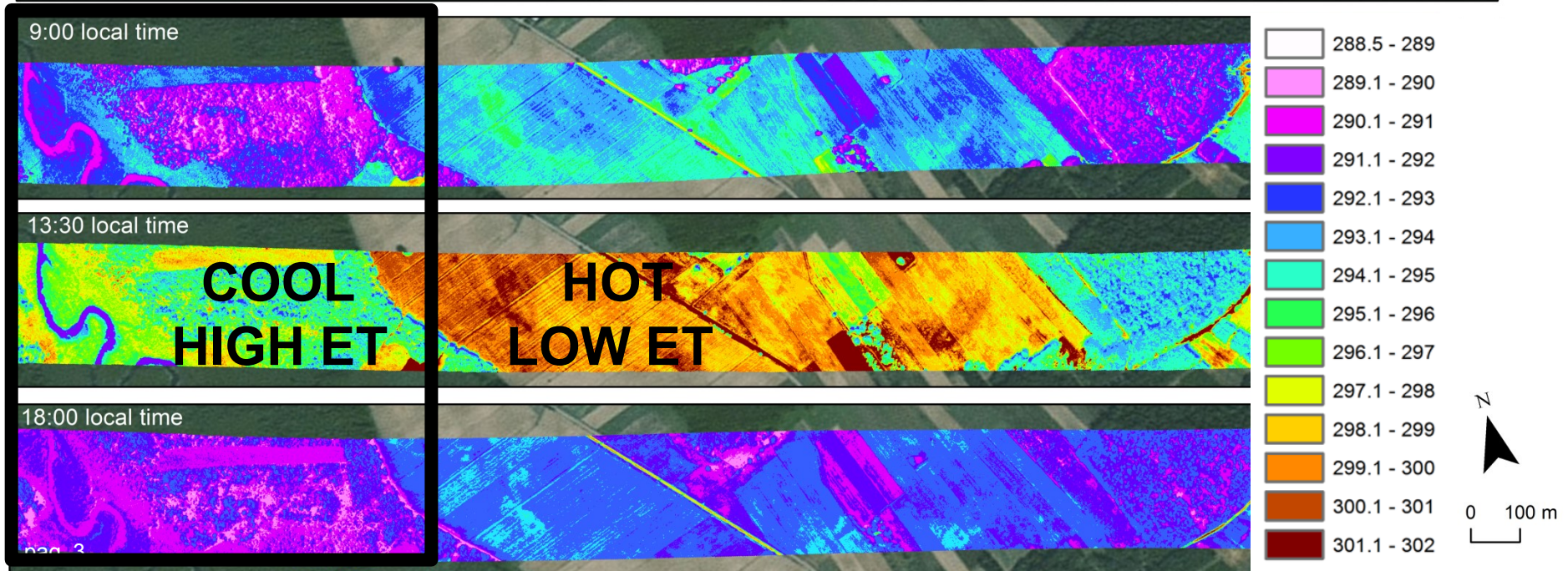
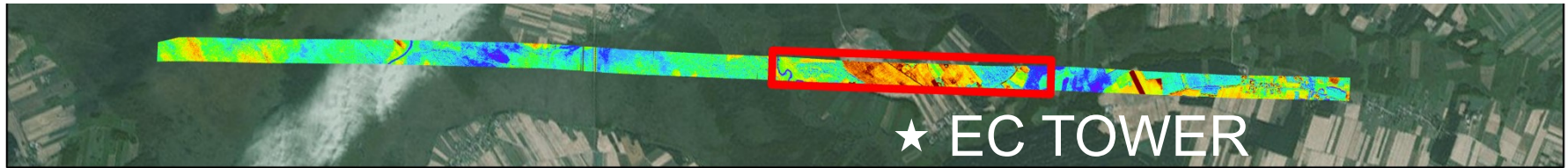
belspo

BIEBRZA WETLAND, Poland



Wetlands show high thermal variability

BIEBRZA WETLAND: Radiometric Surface Temperature [$^{\circ}\text{K}$]

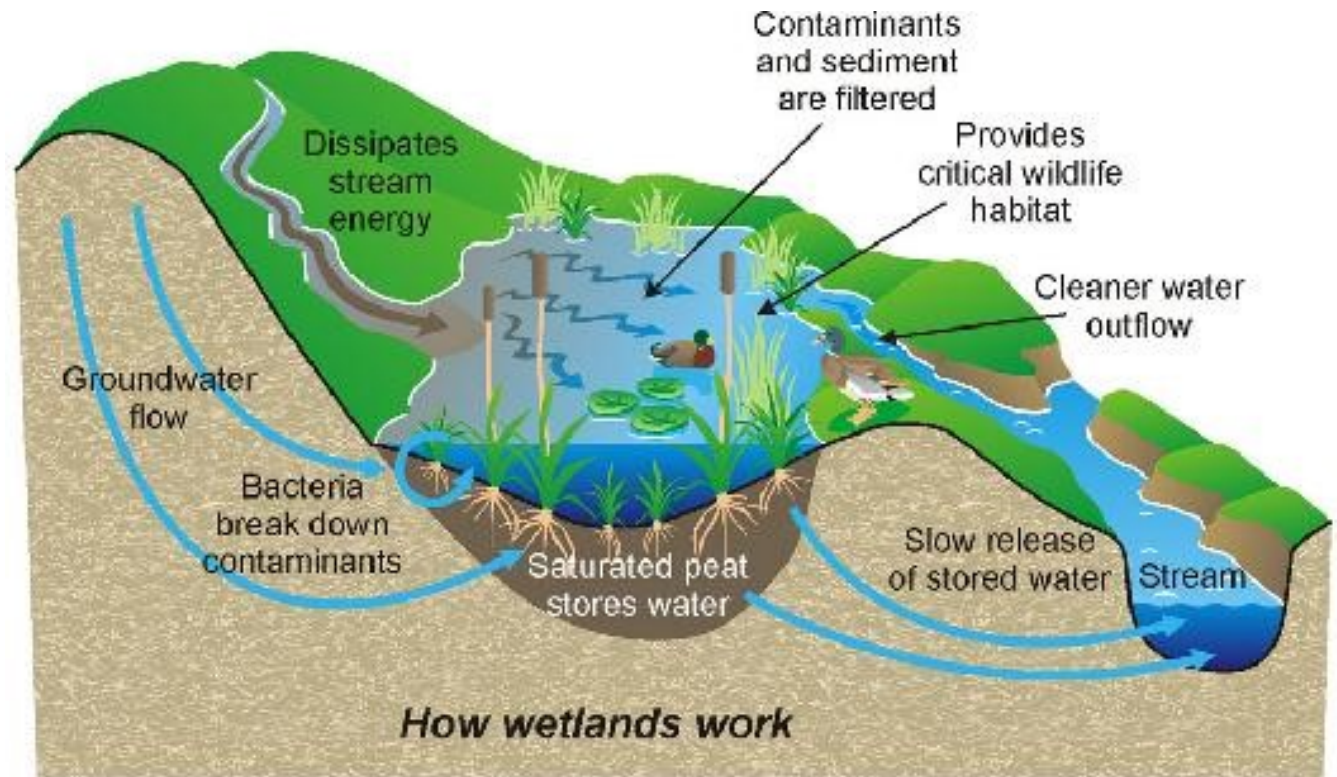


Need for wetland ecosystem monitoring

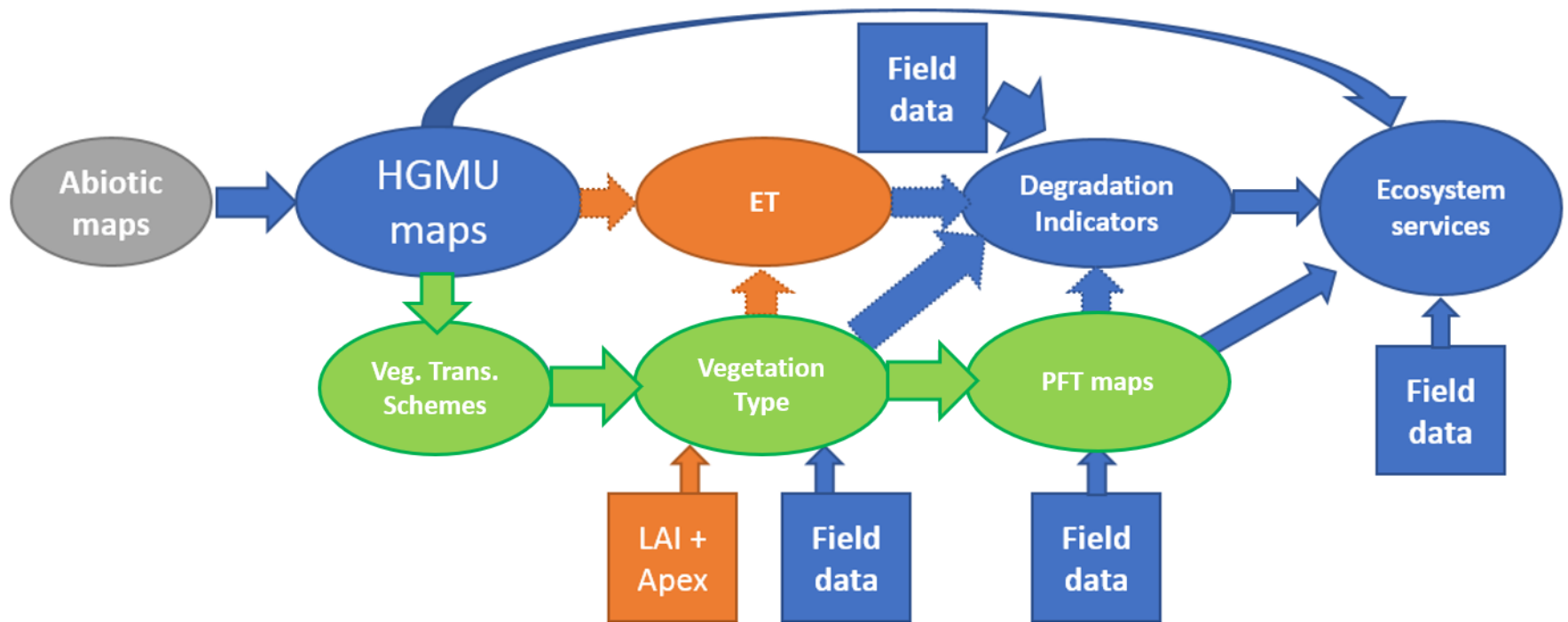
Wetlands are beneficial for society, but suffer from degradation → monitoring



OPTICAL
THERMAL
ET = good
indicator



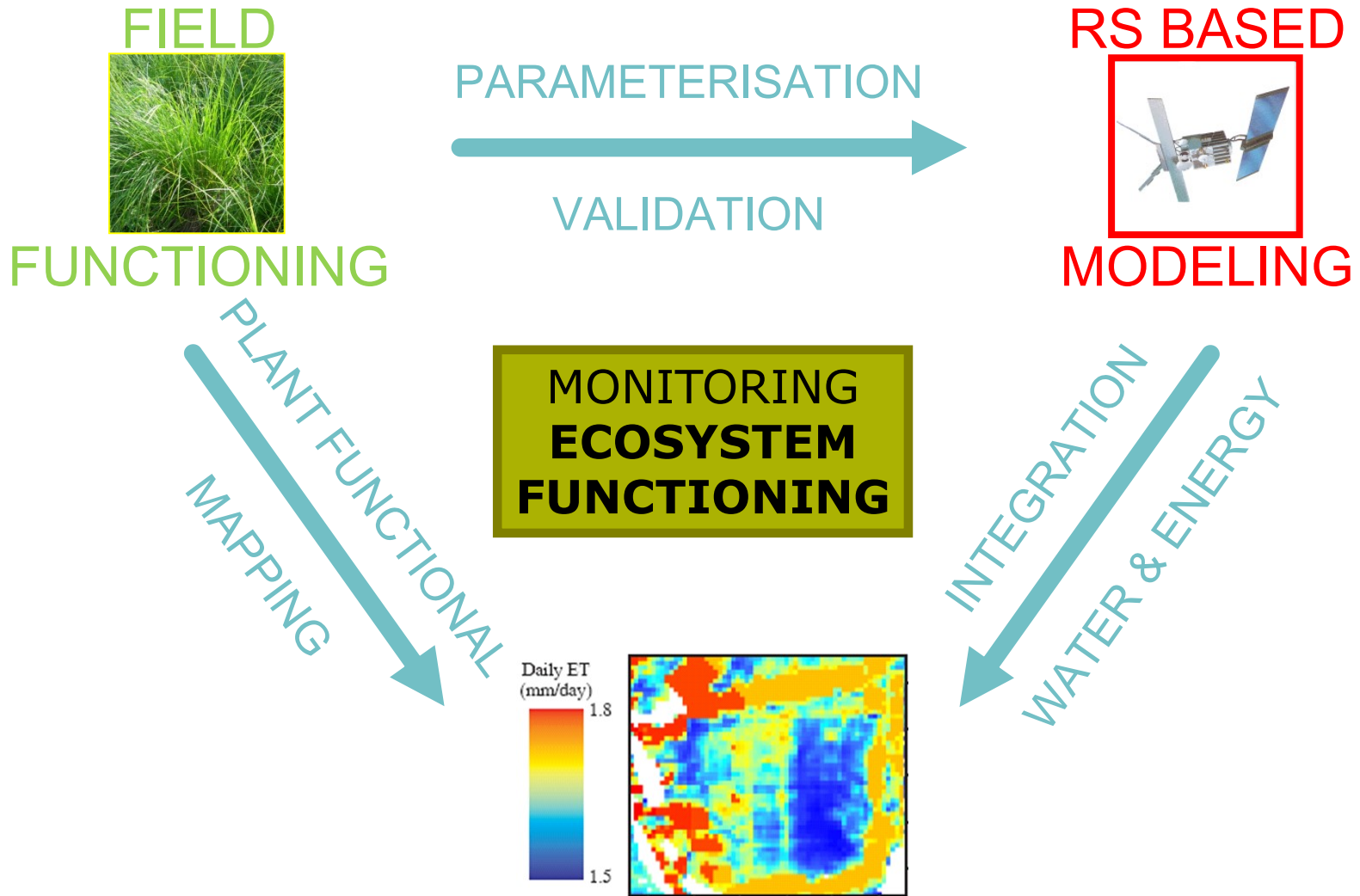
How to assess ecosystem functioning?



Contribution via Earth Observation:

1. Modelling ET
2. Land cover & LAI mapping

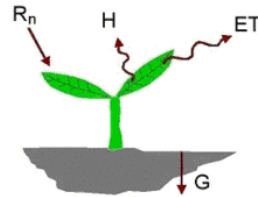
Combination RS, MODELING and FIELD

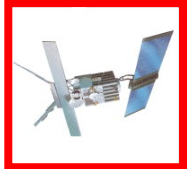


Timeseries of High-resolution ET maps

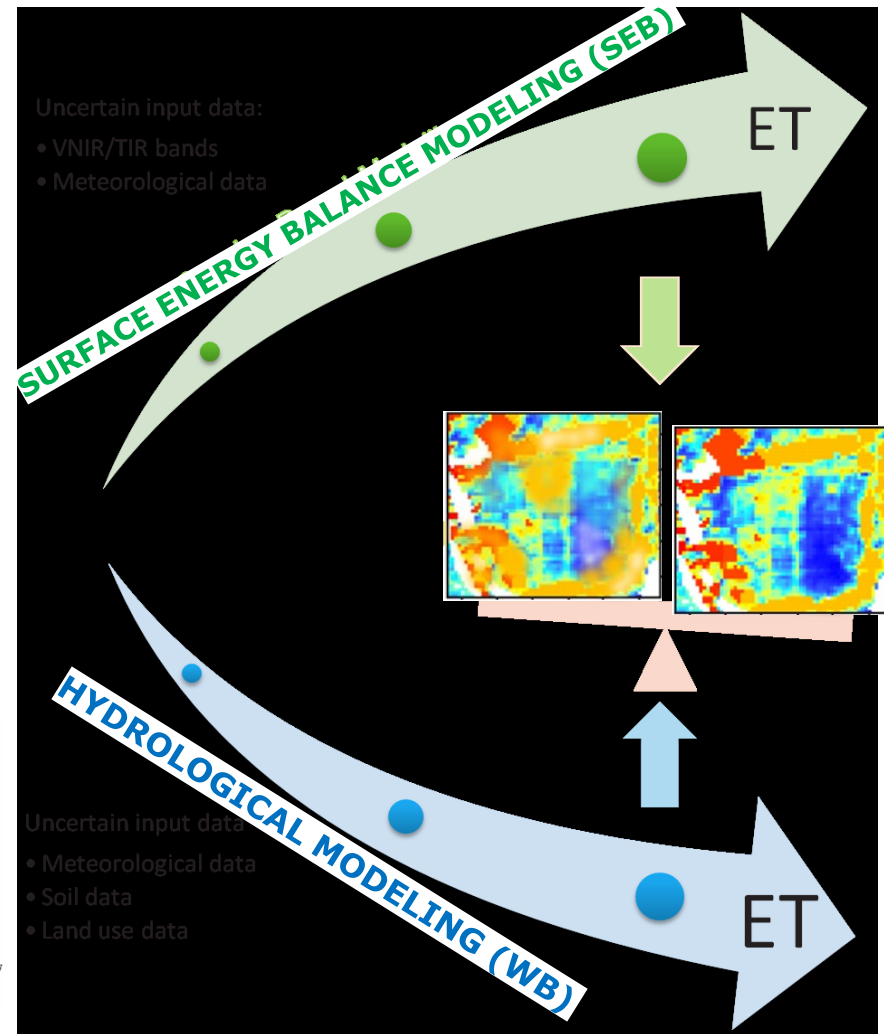
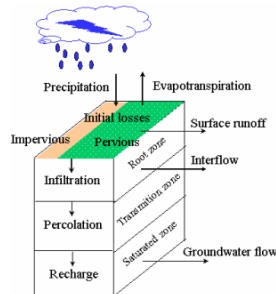
A multi-model approach: data assimilation

- LSA-SAF
- STIC
- SEBS
- SEBAL



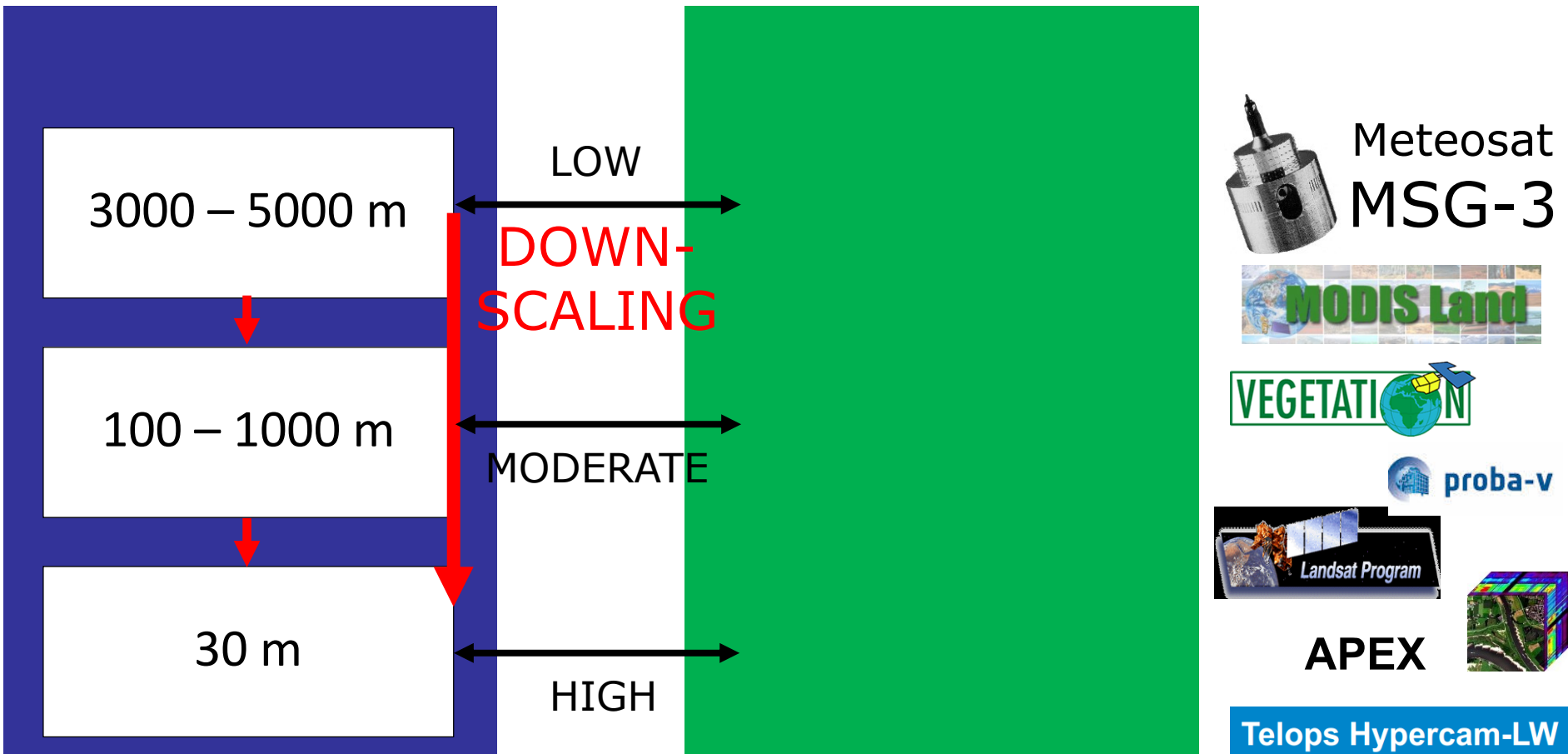
RS BASED

 MODELING

- WetSpa
- Updated concept



A multi-resolution approach

Consistent ET estimates across spatial and temporal scales



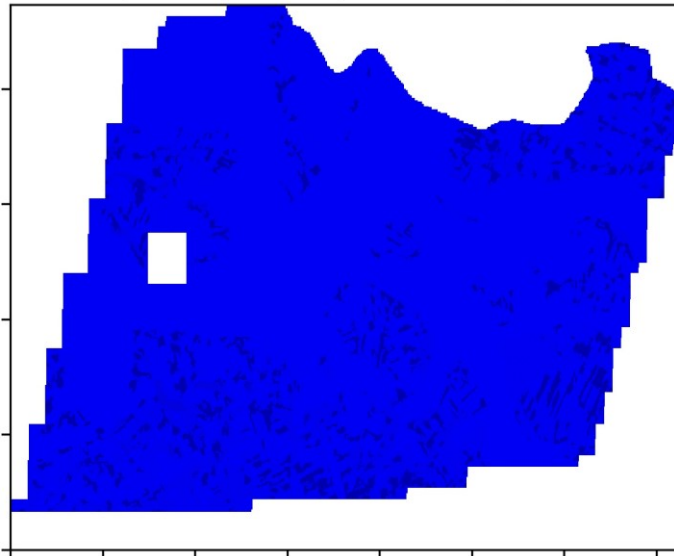
Period-specific high-resolution ET maps

Monthly ET 2015 (in mm)

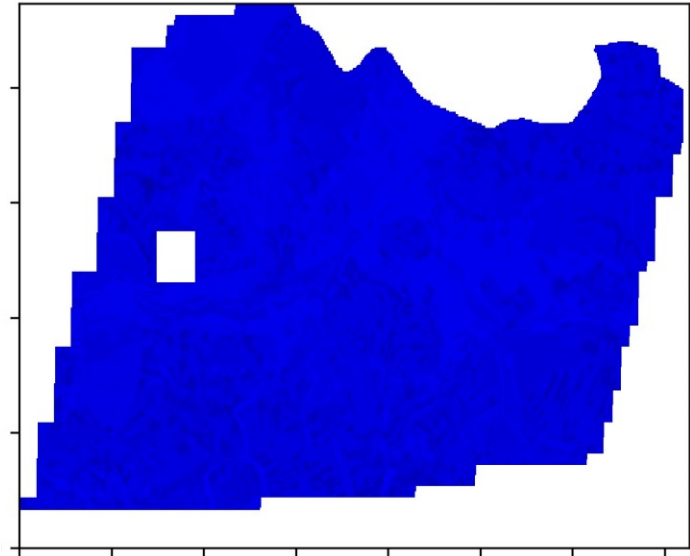
Water balance

Data assimilation

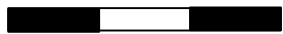
Wetspa Evapotranspiration for Jan-2015



DA Evapotranspiration for Jan-2015



0 3 6 9 km



0 20 40 60 80 100 120 140

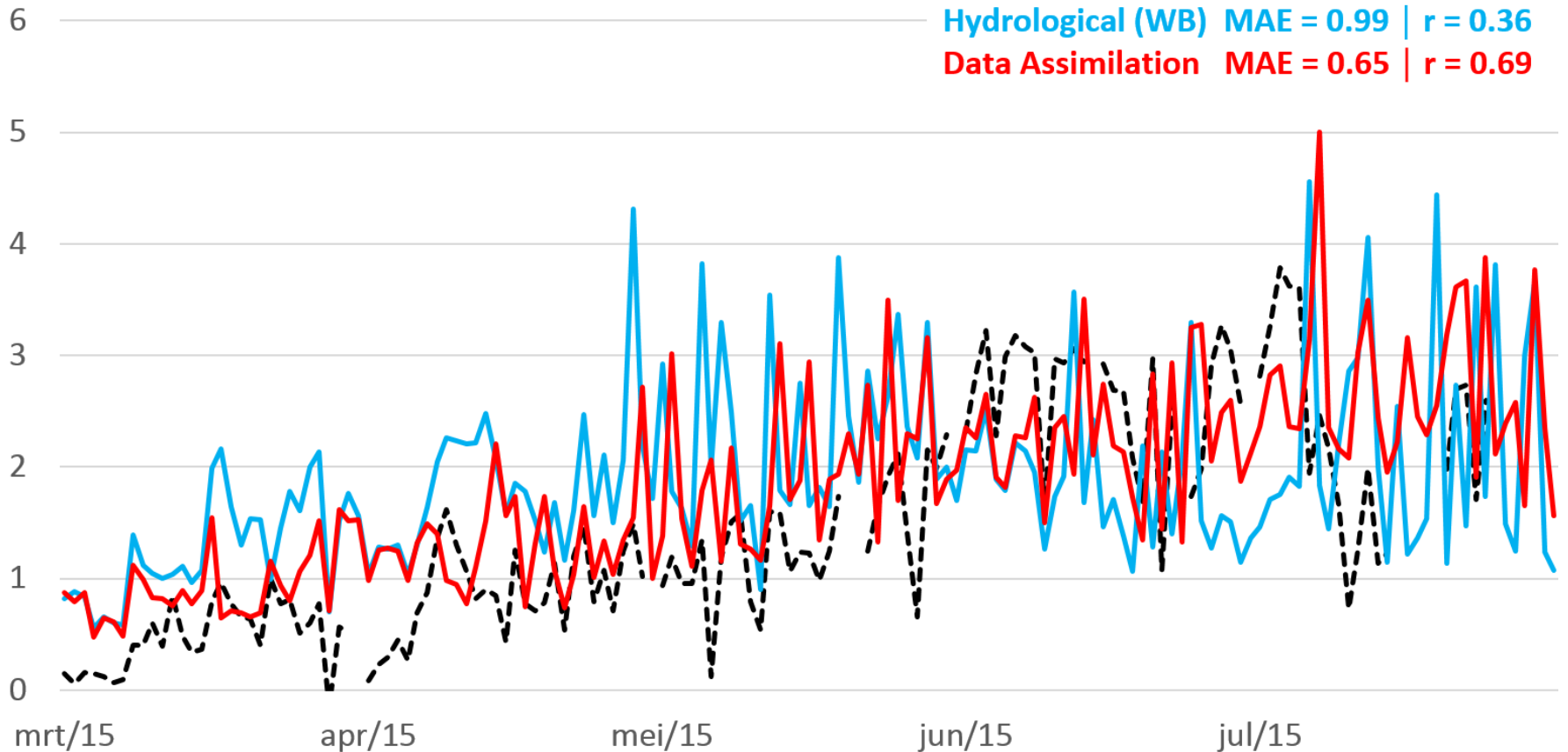
Evapotranspiration in [mm]



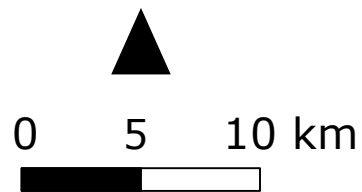
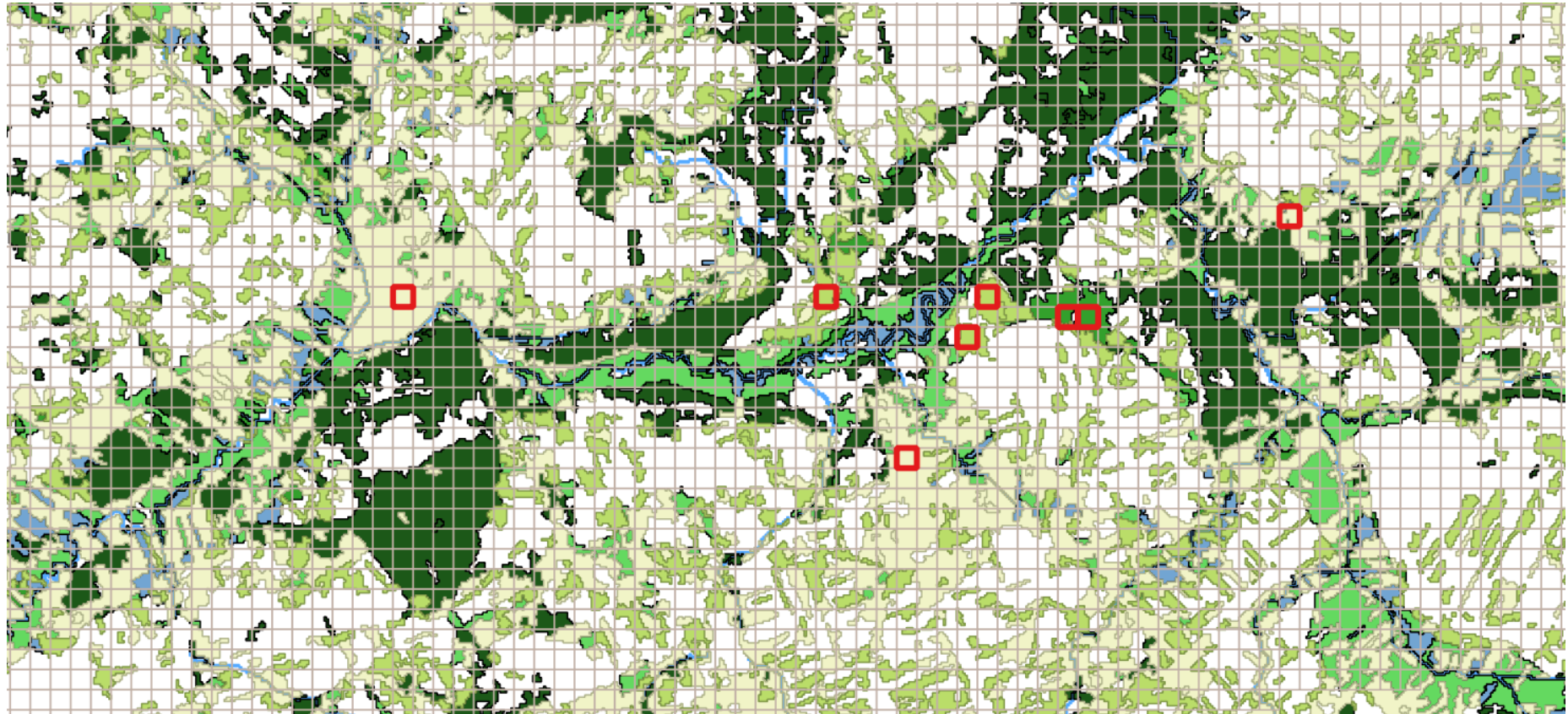
Data assimilation of SEB ET estimates into WB model improves daily ET timeseries!

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

Observed (EC tower)



Wetland vegetation map Upper Biebrza



Linking ecological functioning to ET

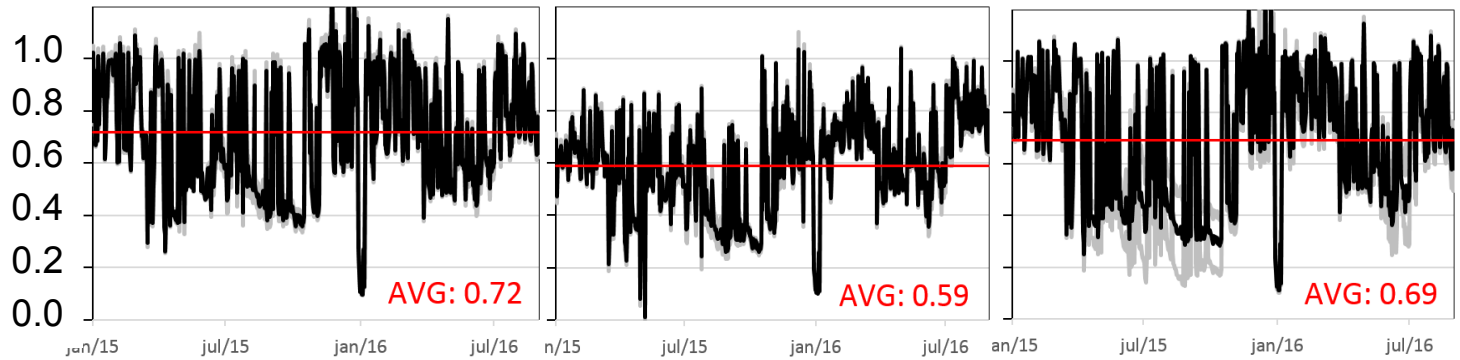
Vegetation transition scheme



degradation

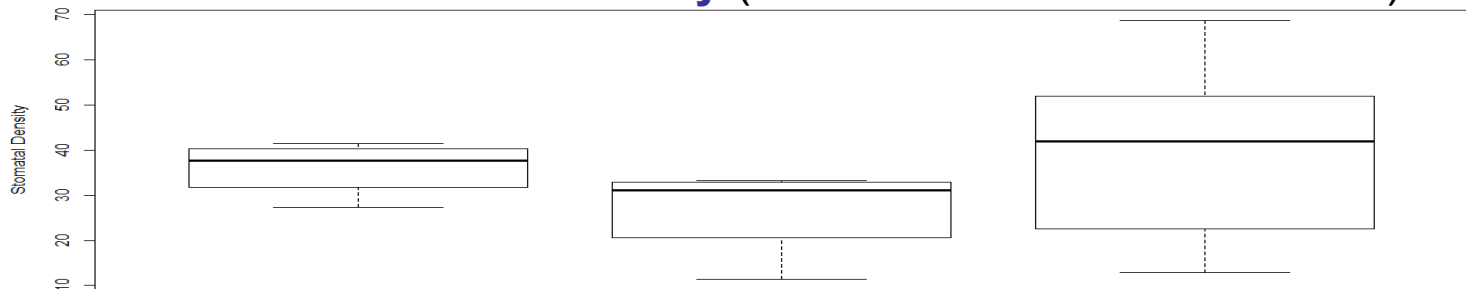
Drainage

Link to ET
DAILY ET/PET
[fraction]

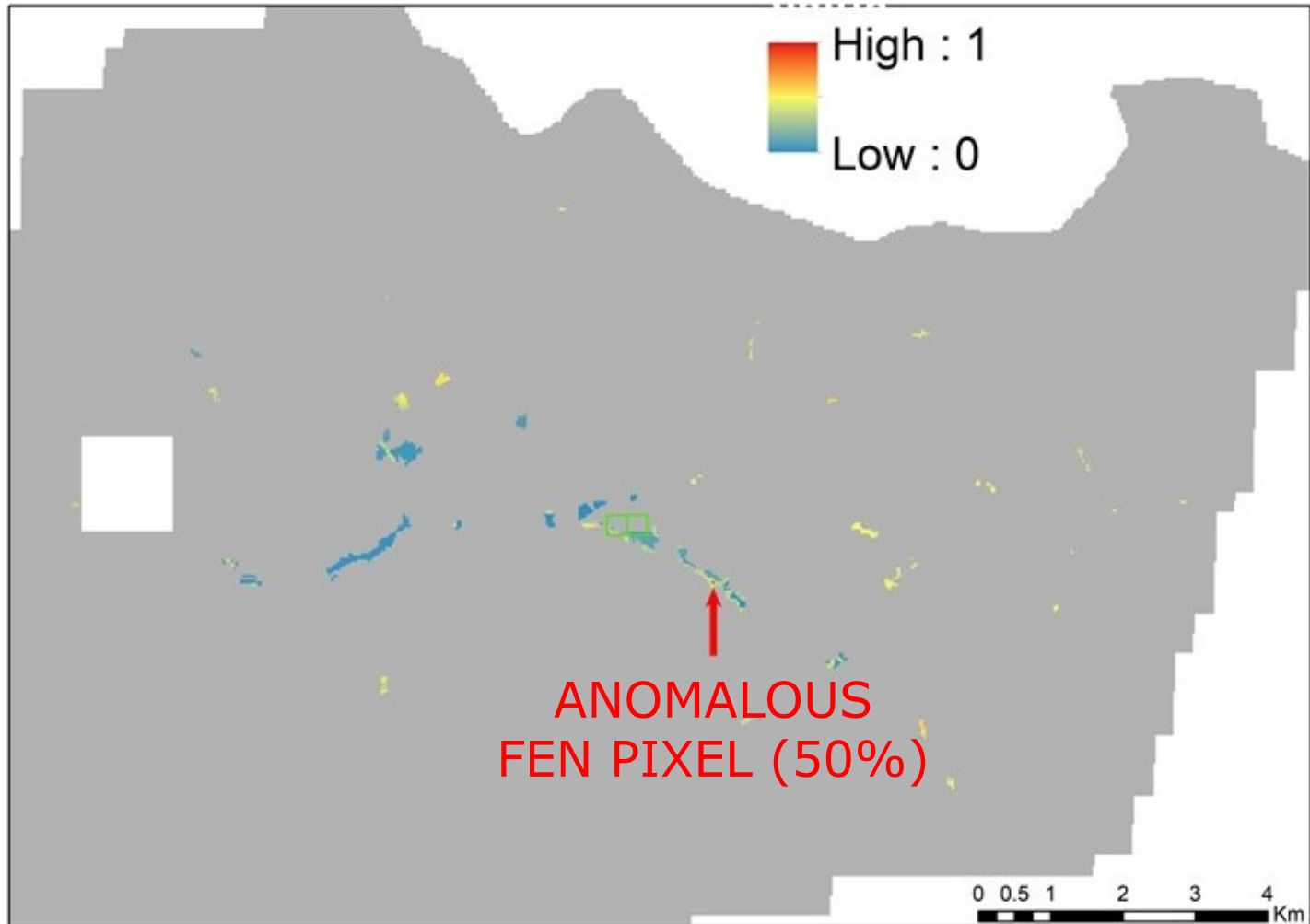


Abaxial stomatal density (# stomata/mm² underside leaf)

Link to PFT



Detecting **anomalies** from high-resolution ET timeseries per wetland vegetation type

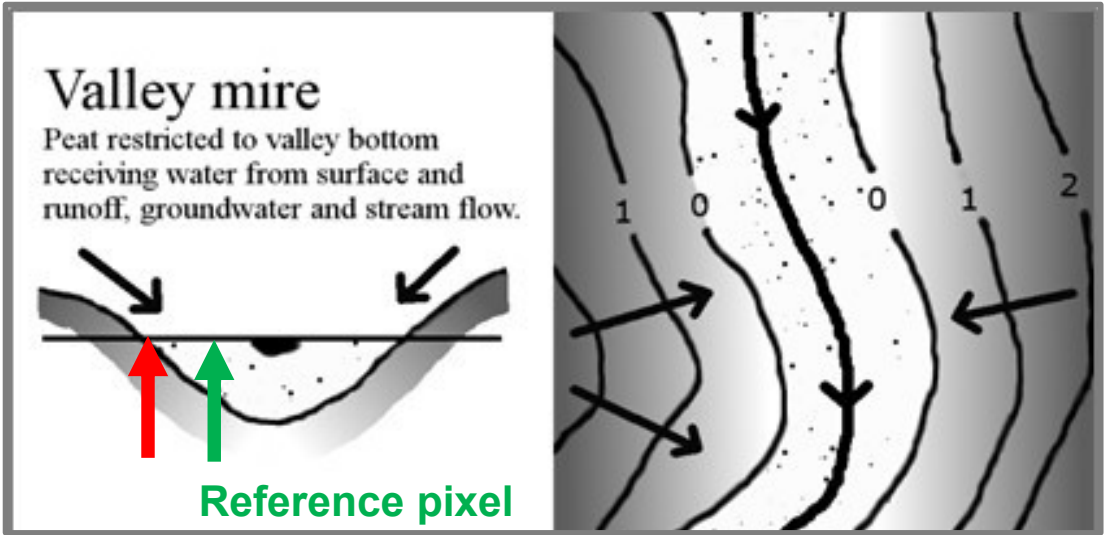
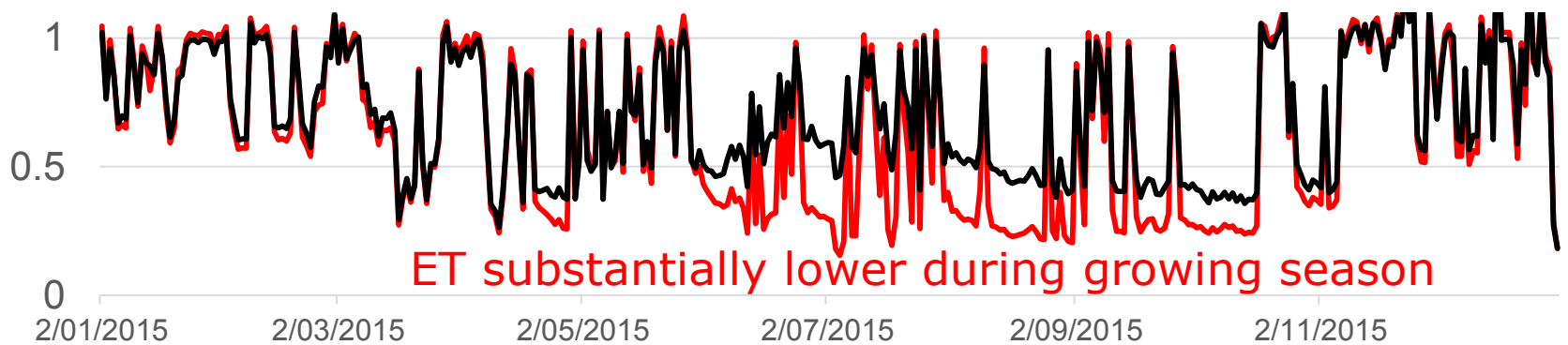


Anomaly = outside boundaries of normal ET behaviour (mean \pm STD) of a specific vegetation type (reference pixels)

Exploring and understanding ET anomalies

fen pixel (50%)

ET/PET



Detected **deviating pixel** (Indicator = 0.5) is located at the edge of peatlands which is more likely to be under water stress

Main ecosystem services of fens

- Climate mitigation
 - Total carbon accumulation
 - Methane emission
 - Water emission
 - N₂O mitigation
- Water flow regulation
 - Water storage
 - Extractable water volume
 - Flood mitigation
 - Flood speed reduction
 - Peak flow storage potential
- Water purification
 - P storage/uptake
 - N storage/uptake
- Biodiversity goals
 - Species richness
 - EU directive species potential



**Assessing impact on
ecosystem services!**

Conclusion: HiWET outcomes for end-users

Monitoring wetland vegetation dynamics

via **high-resolution timeseries of ET maps**

→ better understanding of ET behavior in wetland conditions

→ identification of locations within wetlands with ET anomalies

→ assess potential impacts on ecosystem services

via **high-resolution timeseries LAI maps**

→ capturing natural dynamics

→ capturing management practices

Acknowledgments

FUNDING: BELSPO STEREO III

DATA & END-USER INTERACTION:

- BNP (Biebrza National Park)

DATA SOURCES:

- IMGW (Polish Meteorological institute)
- Remote Sensing:
 - ESA
 - NASA
 - VITO
 - UrbanTEP

<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