High-resolution modelling and monitoring of **w**ater and **e**nergy **t**ransfers in **wet**land ecosystems (**HiWET**)

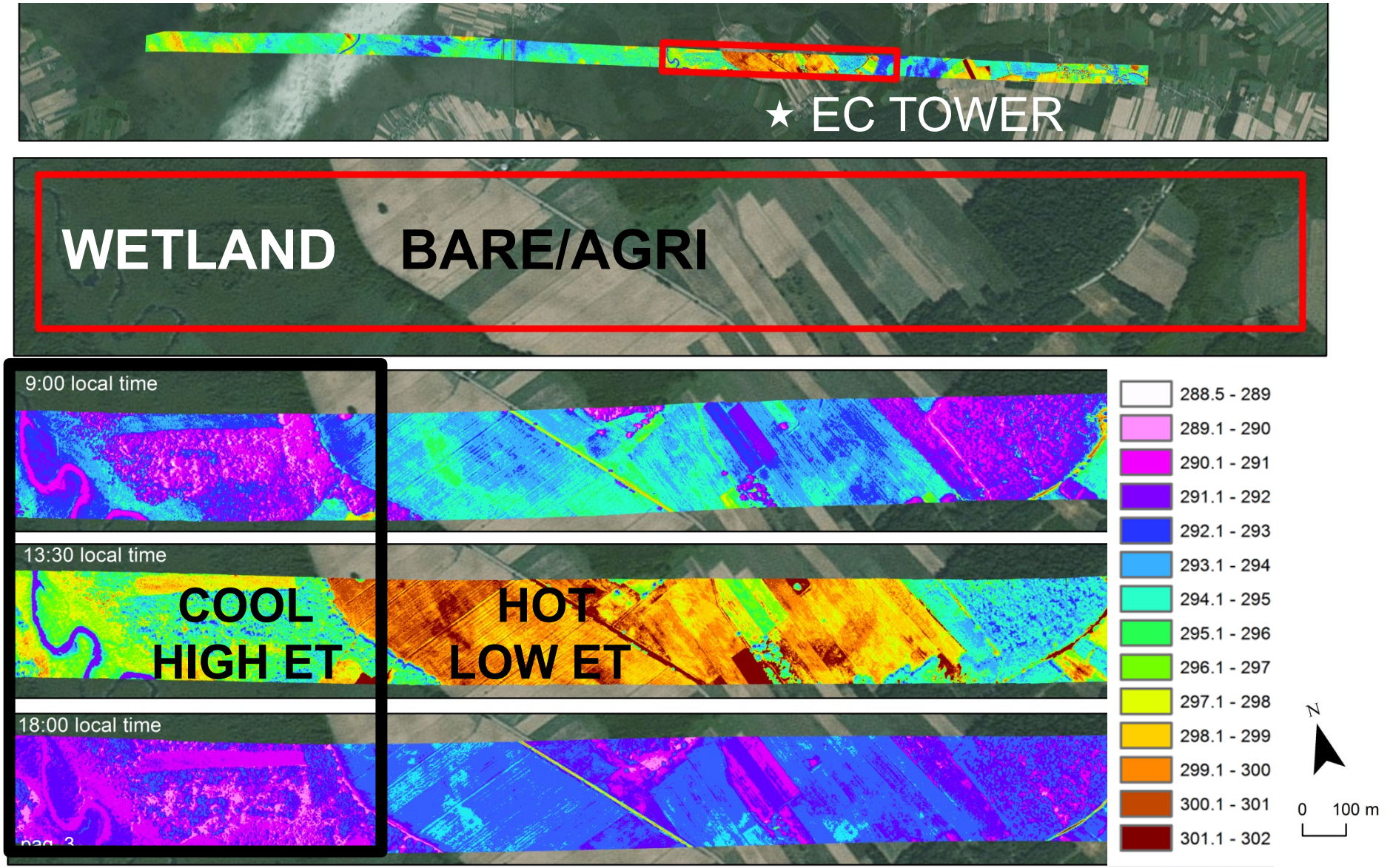
Boud Verbeiren & HiWET Team

BEOday, Barvaux - Belgium

BIEBRZA WETLAND, Poland

Wetlands show high thermal variability

BIEBRZA WETLAND: Radiometric Surface Temperature [°K]



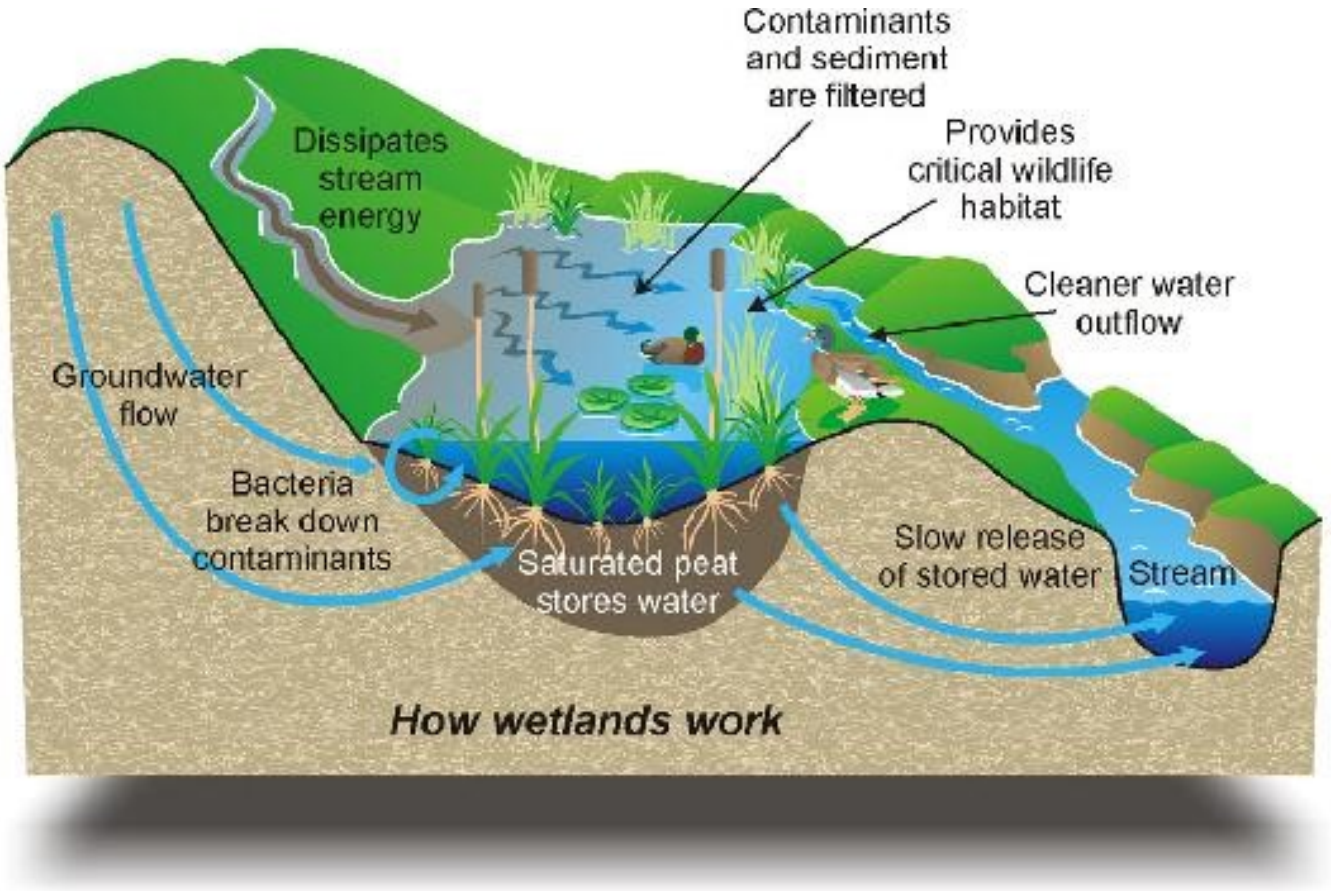
Need for wetland ecosystem monitoring

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

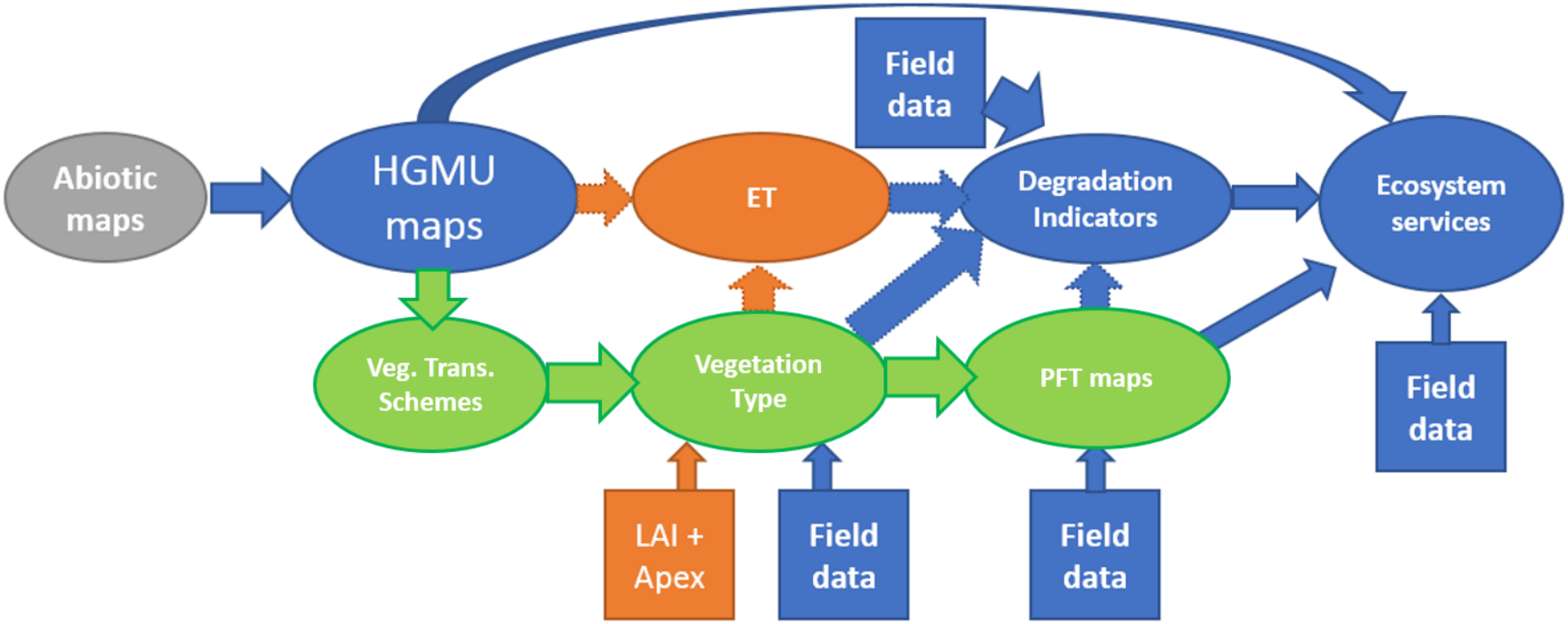
OPTICAL

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

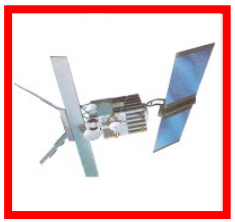
FIELD

FUNCTIONING

PARAMETERISATION

VALIDATION

RS BASED

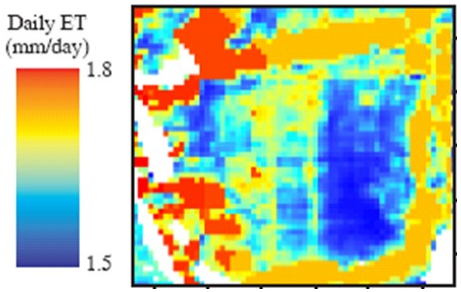


MODELING

PLANT FUNCTIONAL MAPPING

MONITORING **ECOSYSTEM FUNCTIONING**

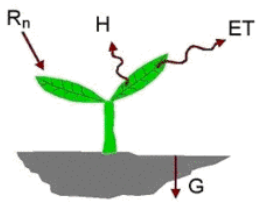
INTEGRATION WATER & ENERGY



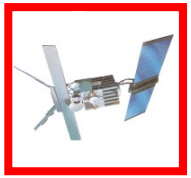
Timeseries of High-resolution ET maps

A multi-model approach: data assimilation

- LSA-SAF
- STIC
- SEBS
- SEBAL

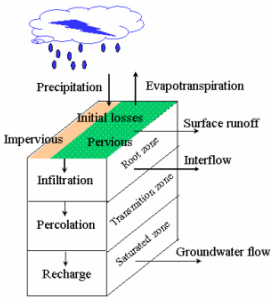


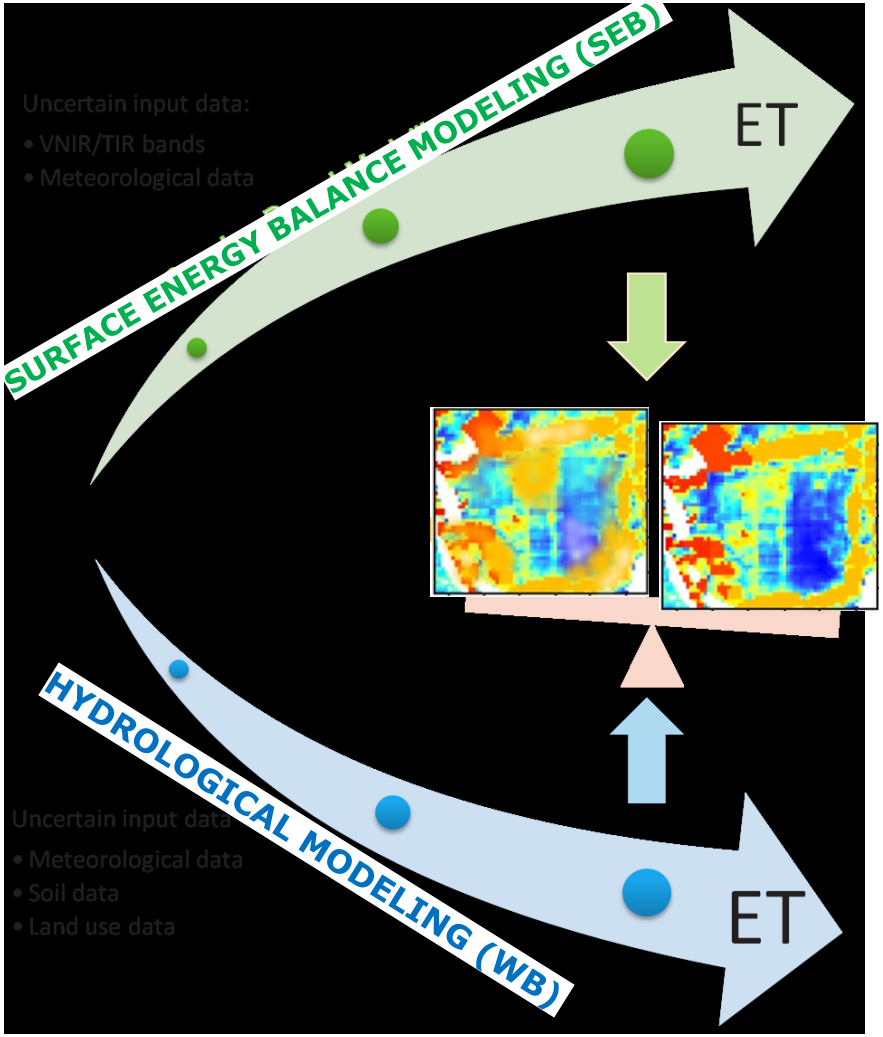
RS BASED



MODELING

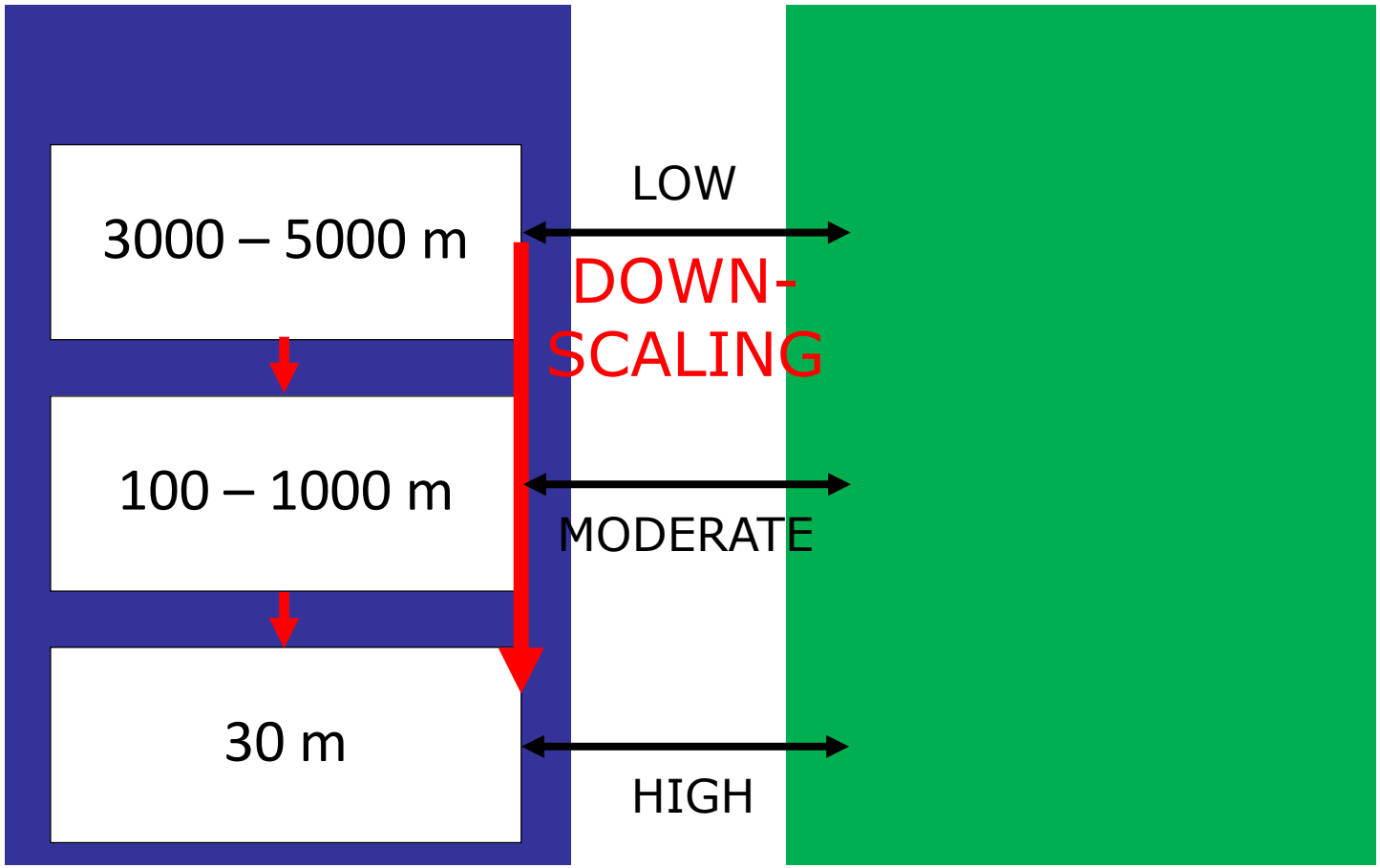
- WetSpa
- Updated concept





A multi-resolution approach

Consistent ET estimates across spatial and temporal scales

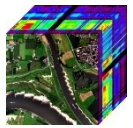


Meteosat MSG-3

MODIS Land

VEGETATION

proba-v



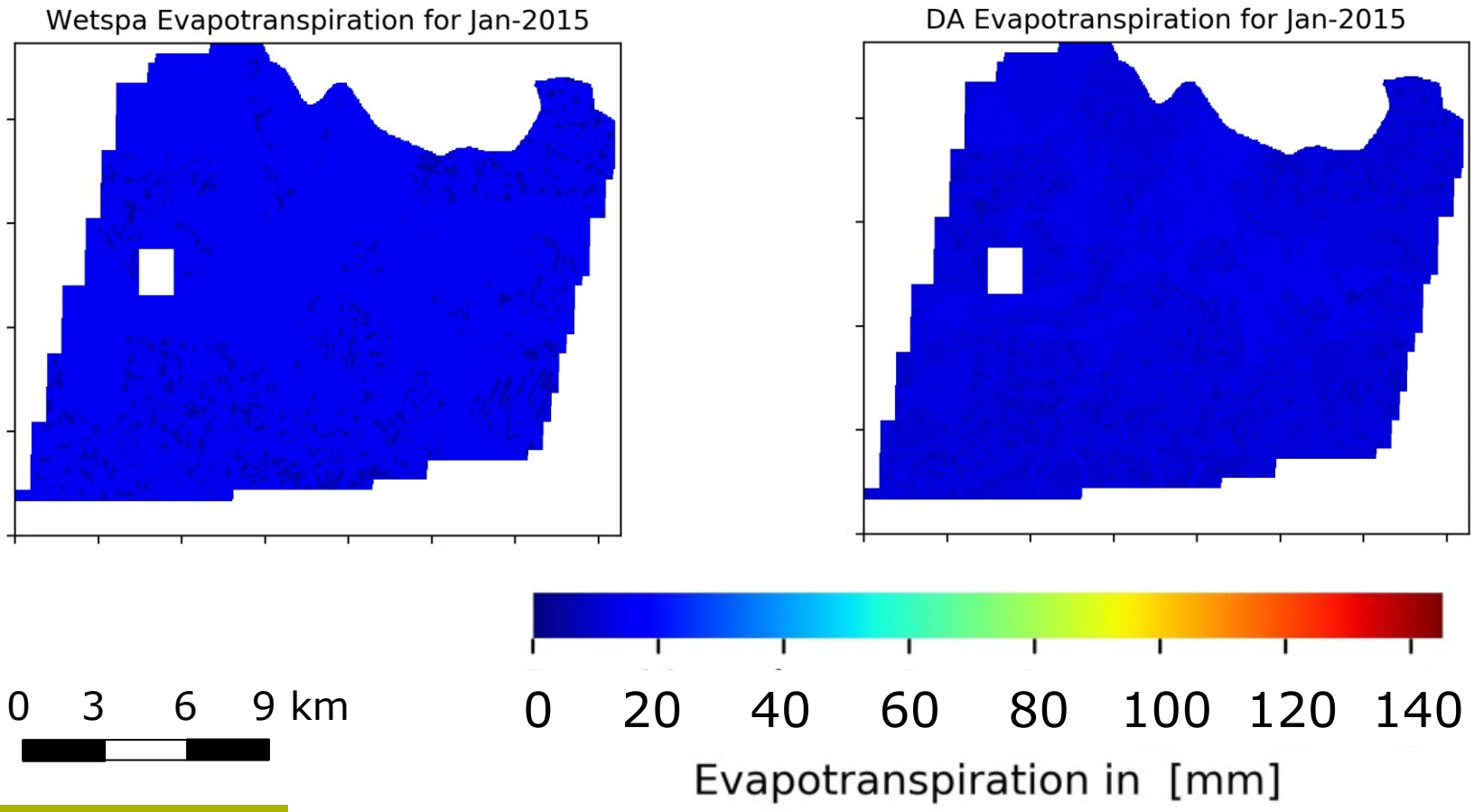
APEX

Telops Hypercam-LW

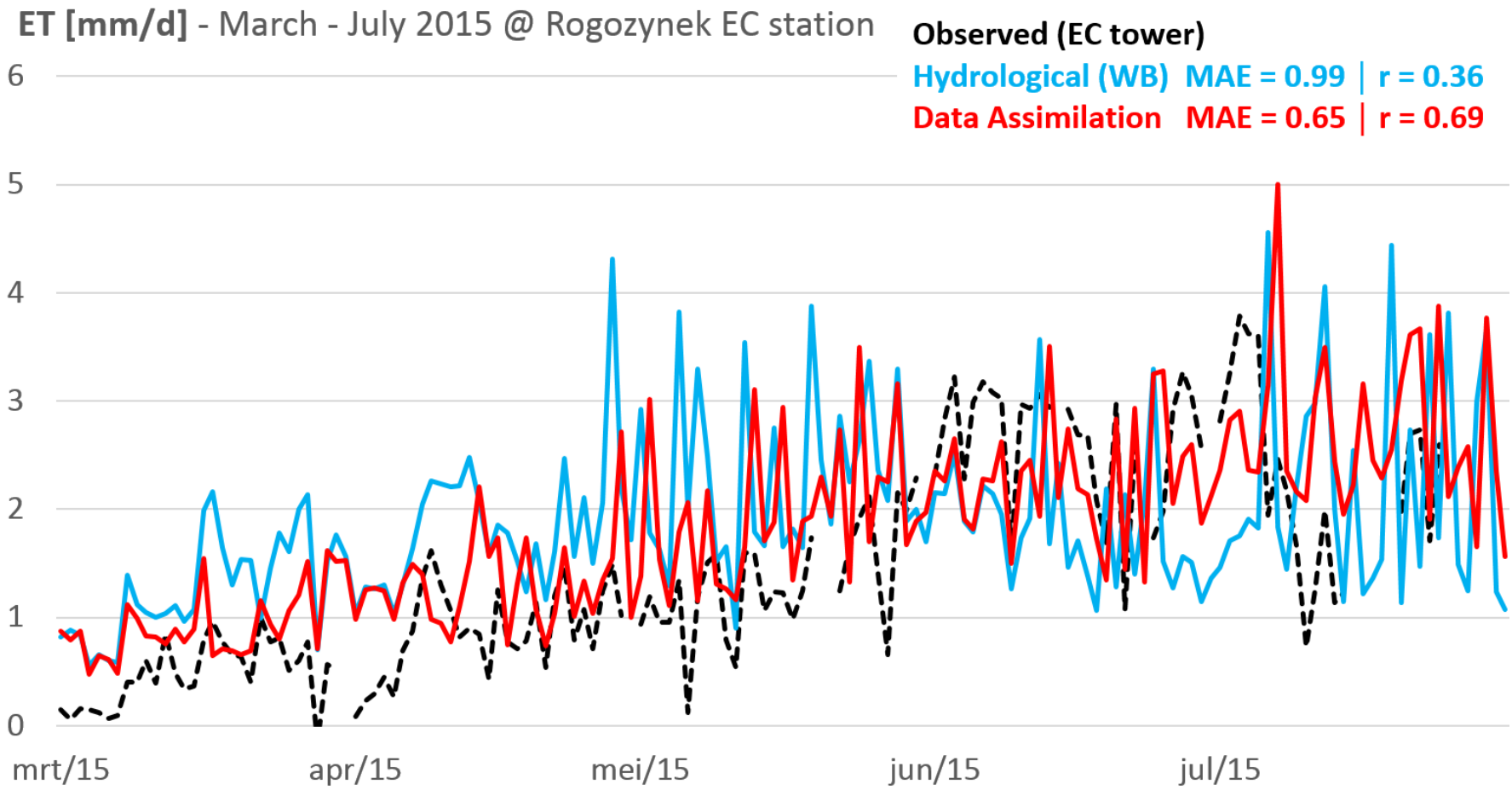
Period-specific high-resolution ET maps
Monthly ET 2015 (in mm)

Water balance

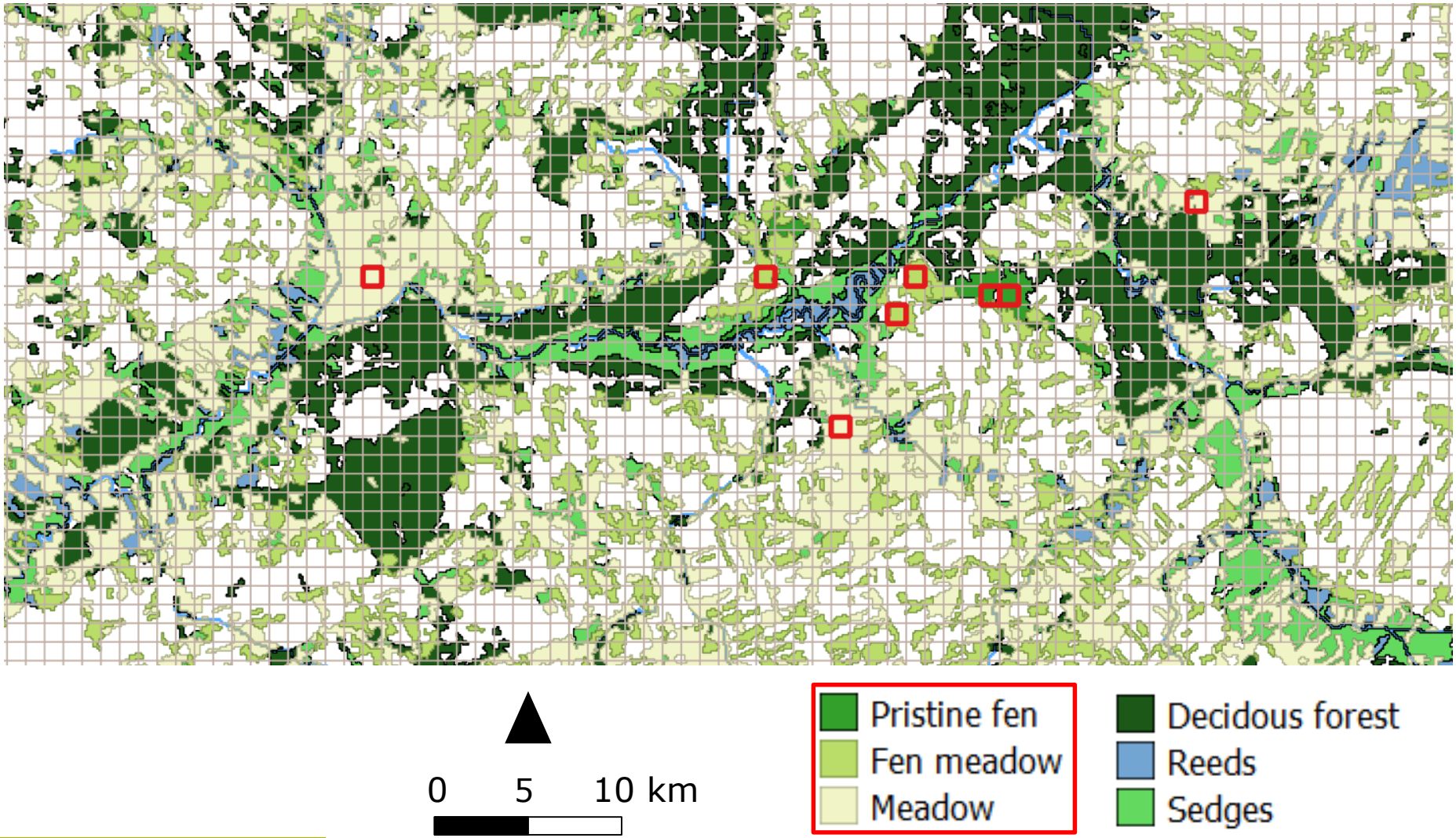
Data assimilation



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



Wetland vegetation map Upper Biebrza



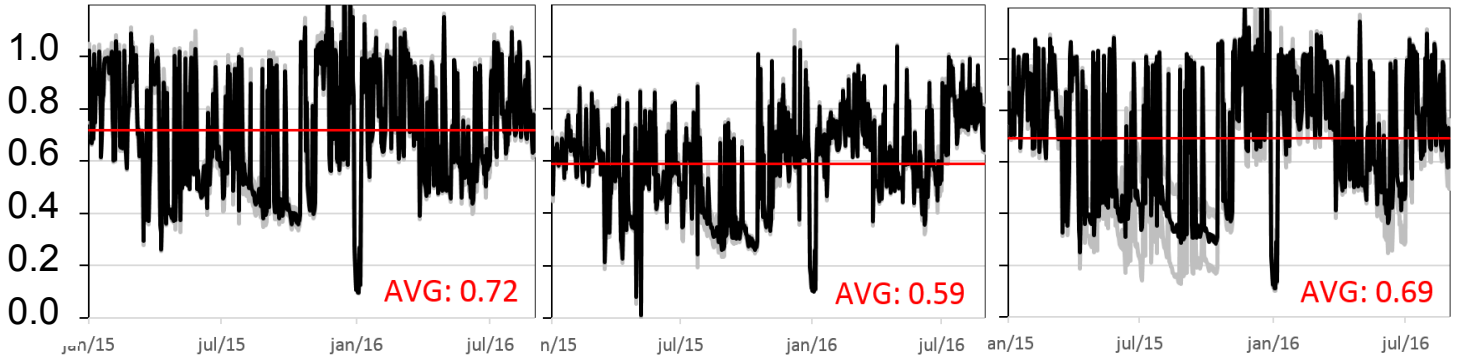
Linking ecological functioning to ET

Vegetation transition scheme

degradation

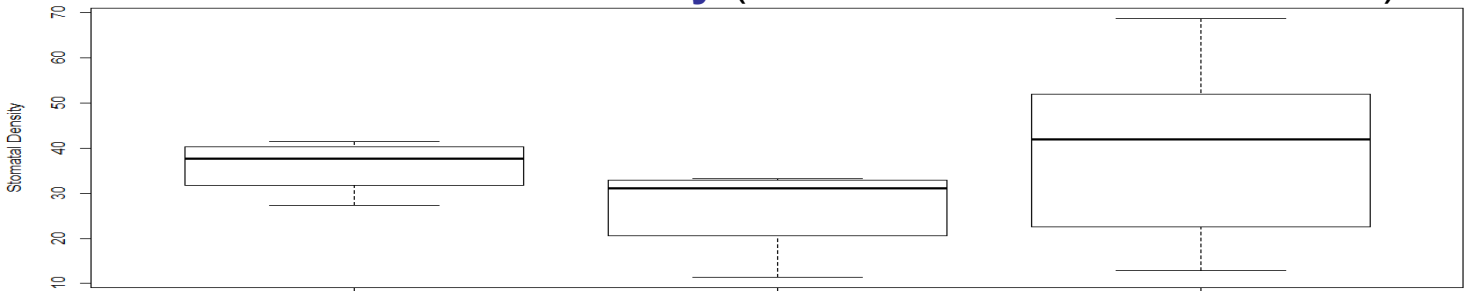
Link to ET

DAILY ET/PET [fraction]

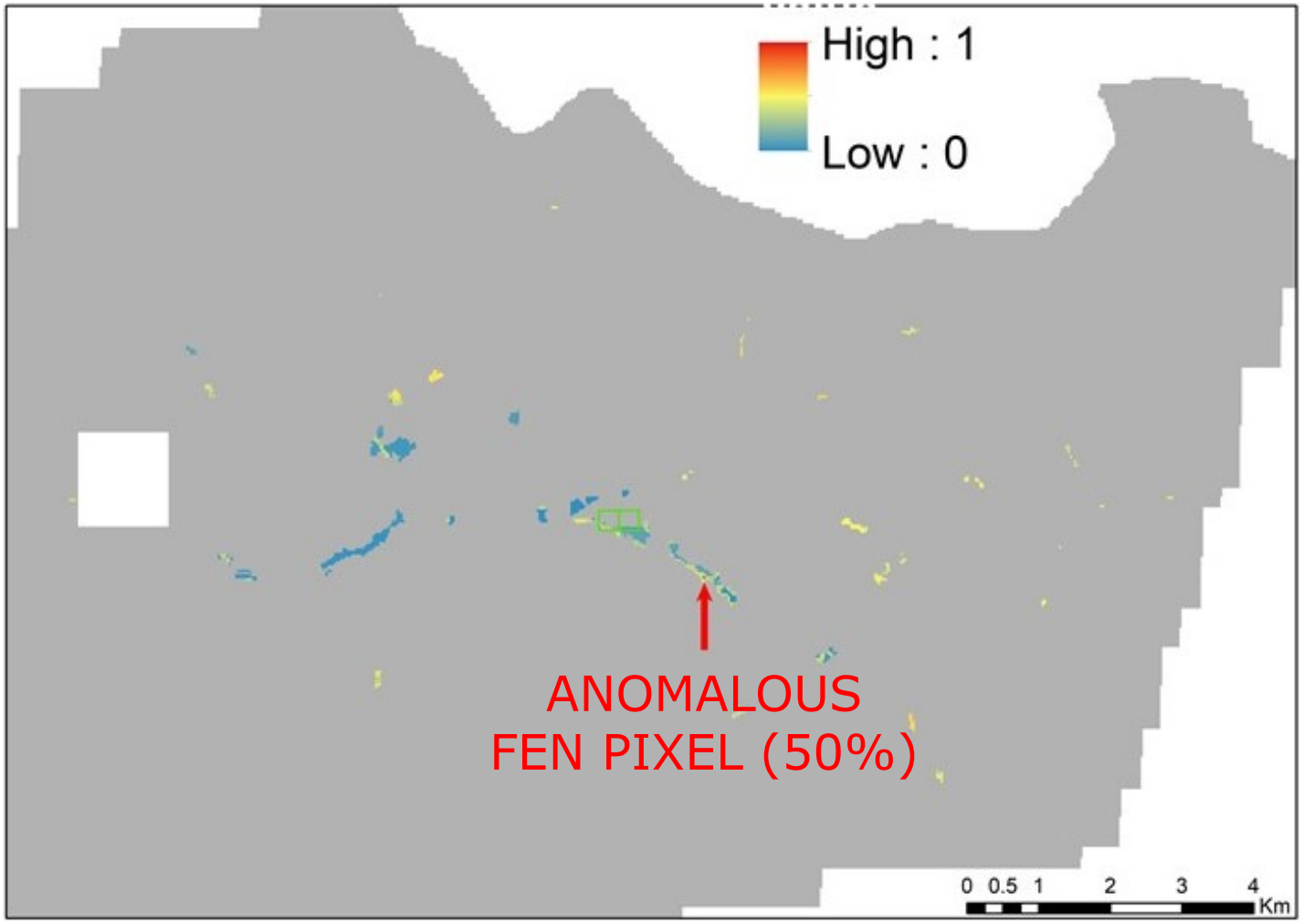


Abaxial stomatal density (# stomata/mm² underside leaf)

Link to PFT



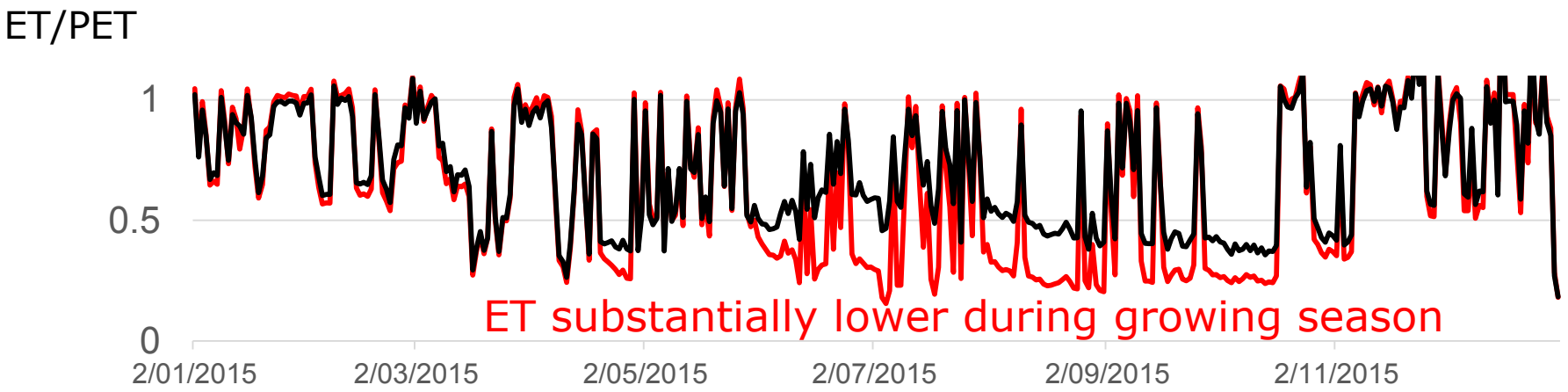
Detecting **anomalies** from high-resolution ET timeseries per wetland vegetation type



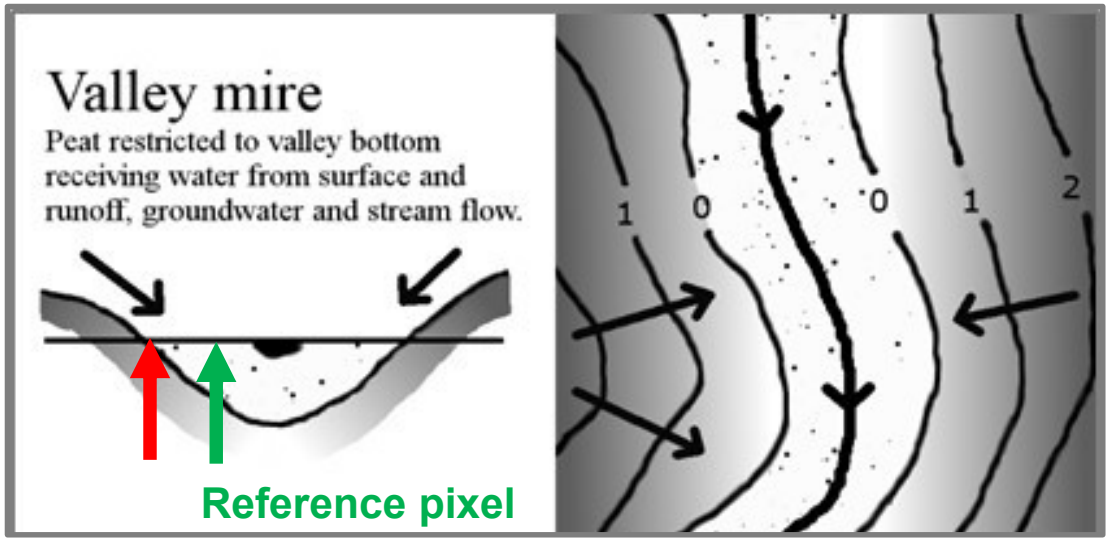
Anomaly = **outside** boundaries of **normal ET behaviour** (mean ± STD) of a specific vegetation type (reference pixels)

Exploring and understanding **ET anomalies**

fen pixel (50%)



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
    - Food 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