A comparison between SWAT and WETSPA hydrological models for riparian fen modelling at the catchment scale

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3) UNESCO - IHE

SWAT 2017

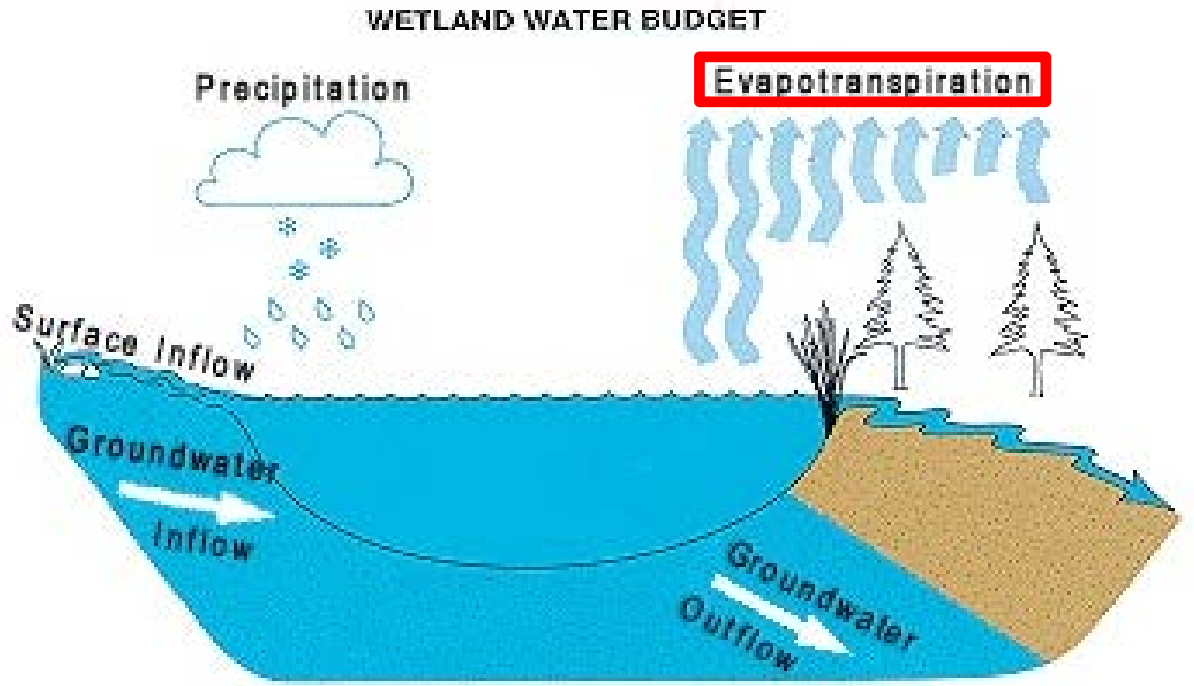
The main objective:

to make a **comparison** of **ET** simulations in **wetlands** using two models:

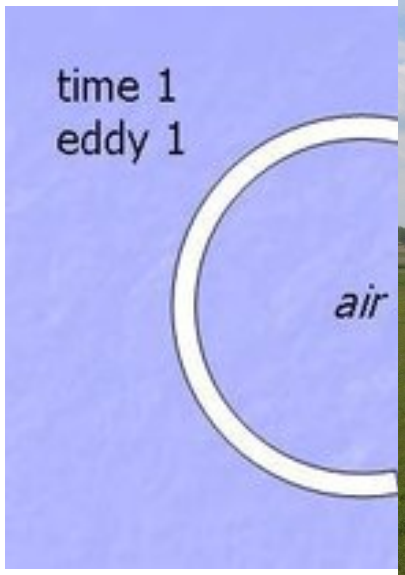
SWAT and **WETSPA**

Why ET in Wetlands?

- Huge variability
- ET is a dominat process



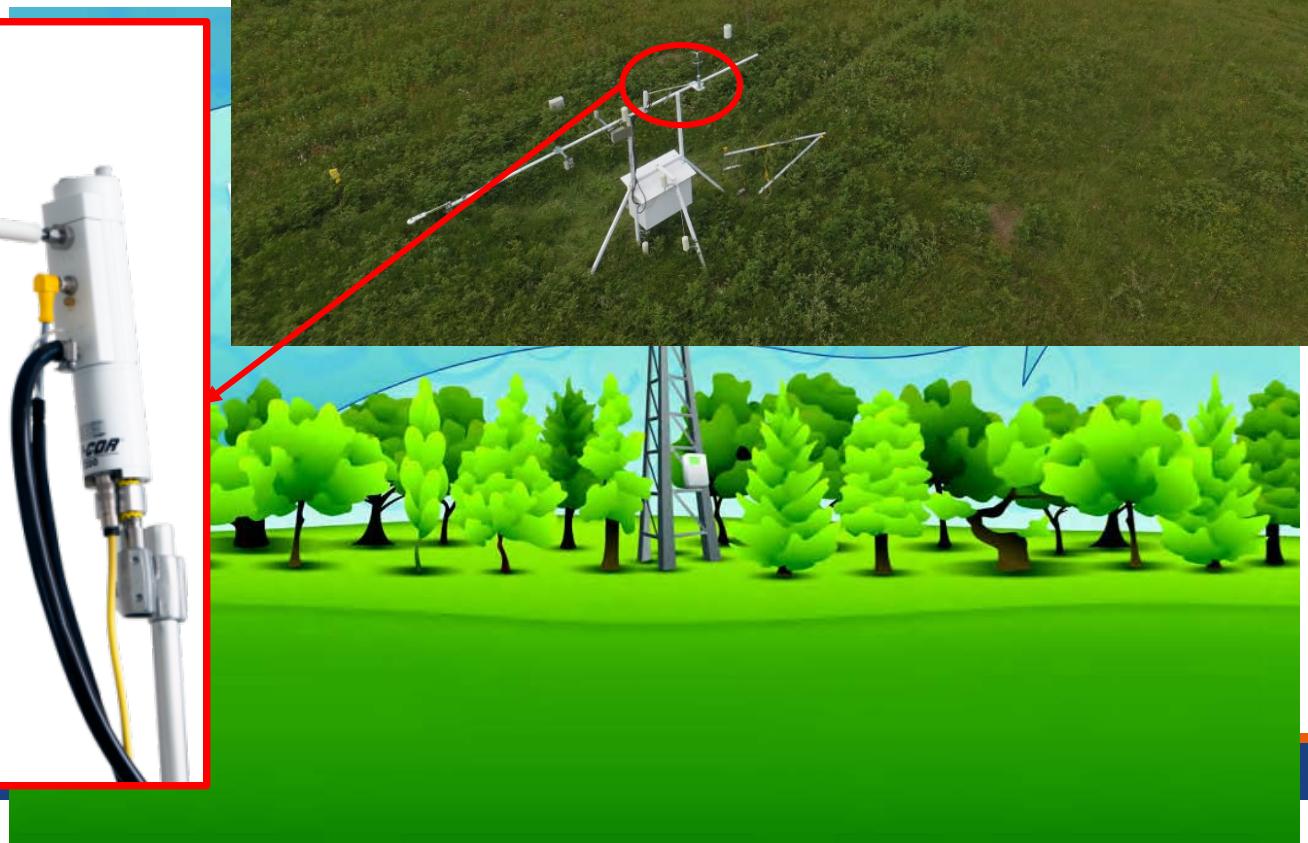
Eddy Covariance method



Based on high frequent (minimum 10 Hz) measurements of vertical wind velocity (ω) and gas concentration fl
Gas flux (Fs) is e
mean covariance
measurements.

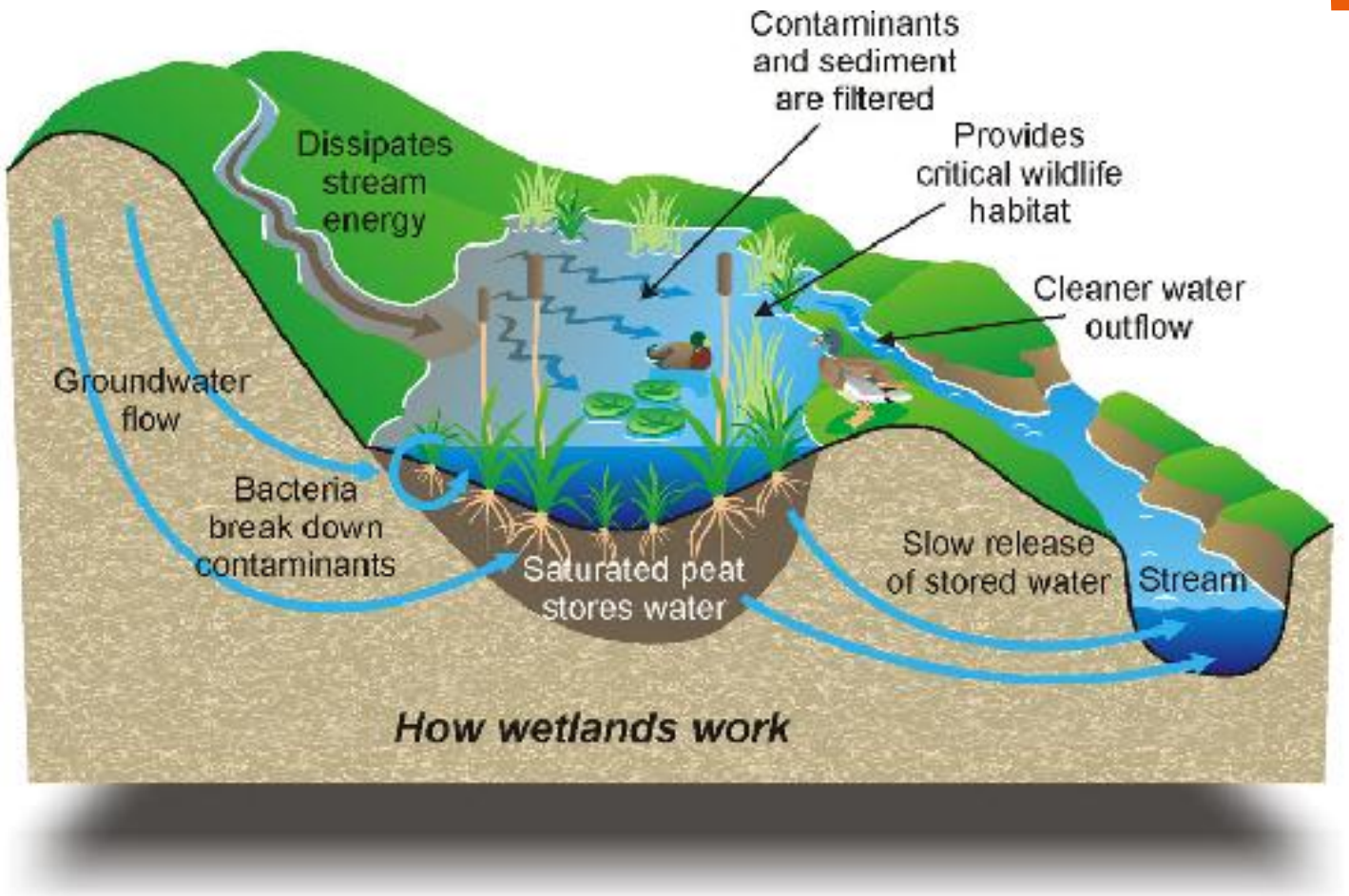
$$F_s = \overline{\omega}$$

Eddy covariance
allowed to meas
evapotranspirat
whole footprint



Why Wetlands?

- Wetlands have a significant impact on hydrological regime
- Transition zone between terestial and aquatic ecosystems
- Plenty of ecosystem services



Study site: wetlands in the Biebrza Valley, Poland

A comparison of hydrological models in 3 steps

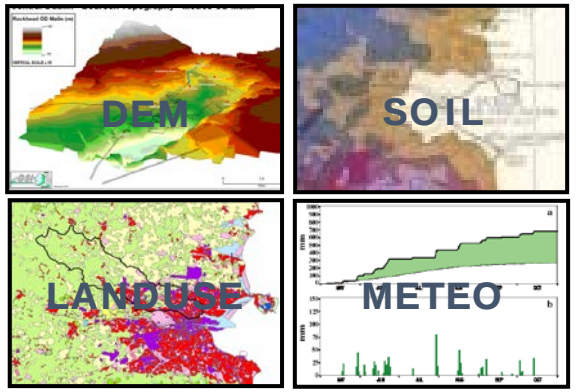
Data

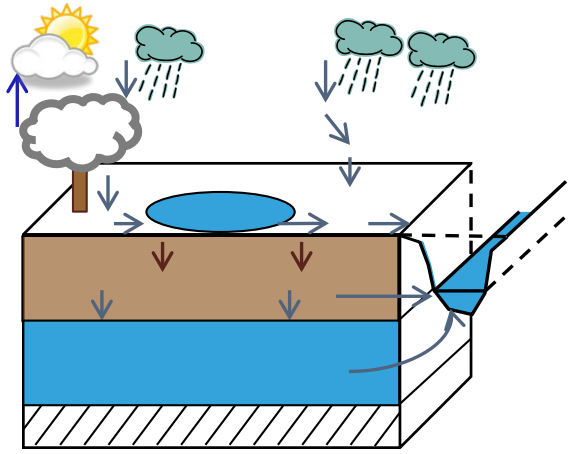
input

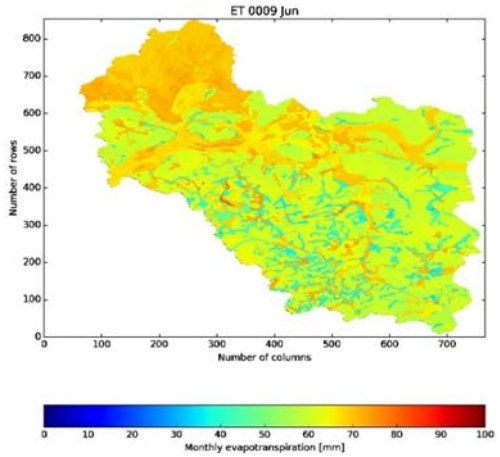
Hydrological model

output

ET estimation







STEP 1 – data input

Meteorological data

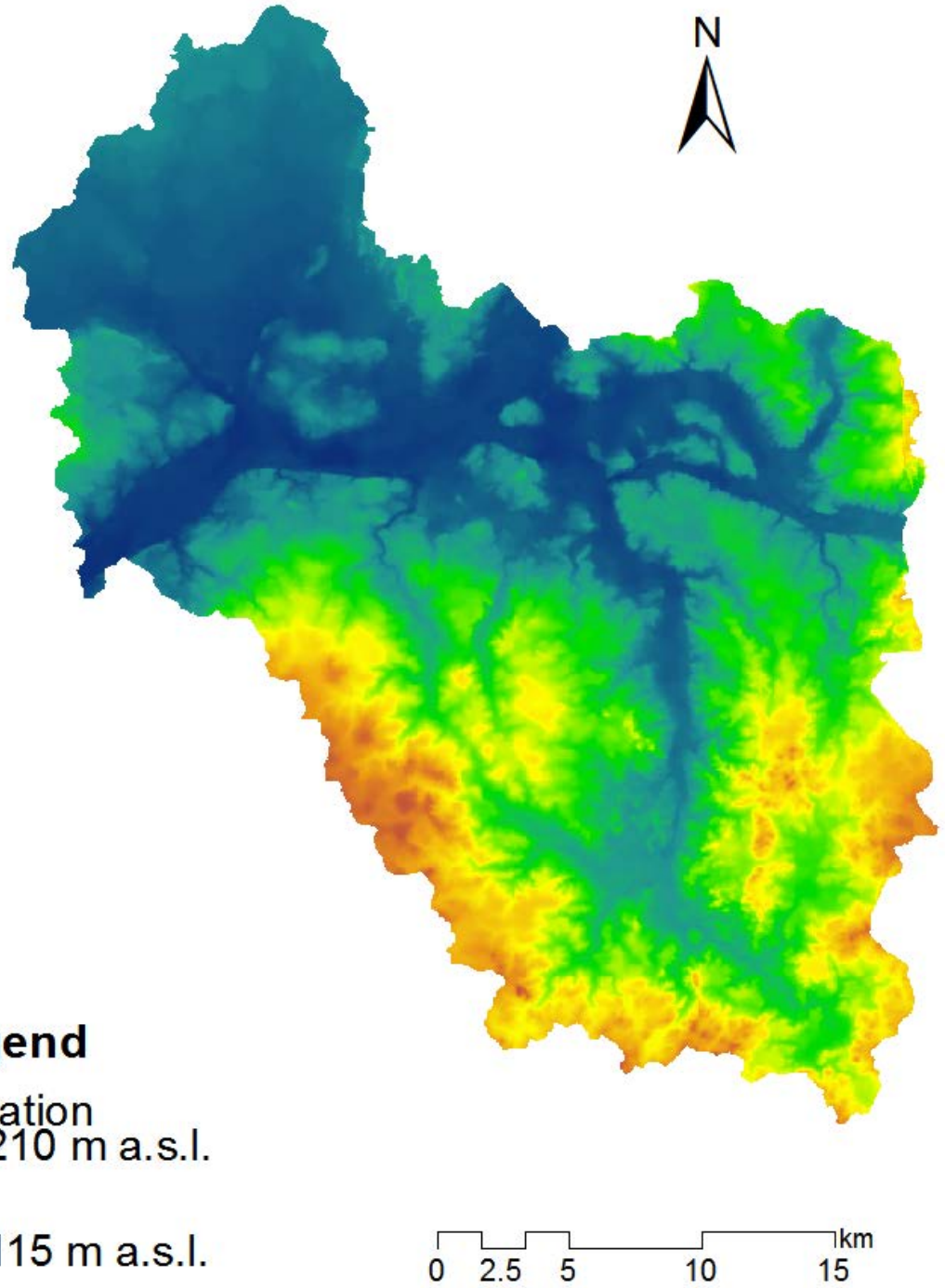
- Temperature min/max
- Precipetation
- Discharge
- PET

WETSPA requires PET as input data (Penman Monteith)

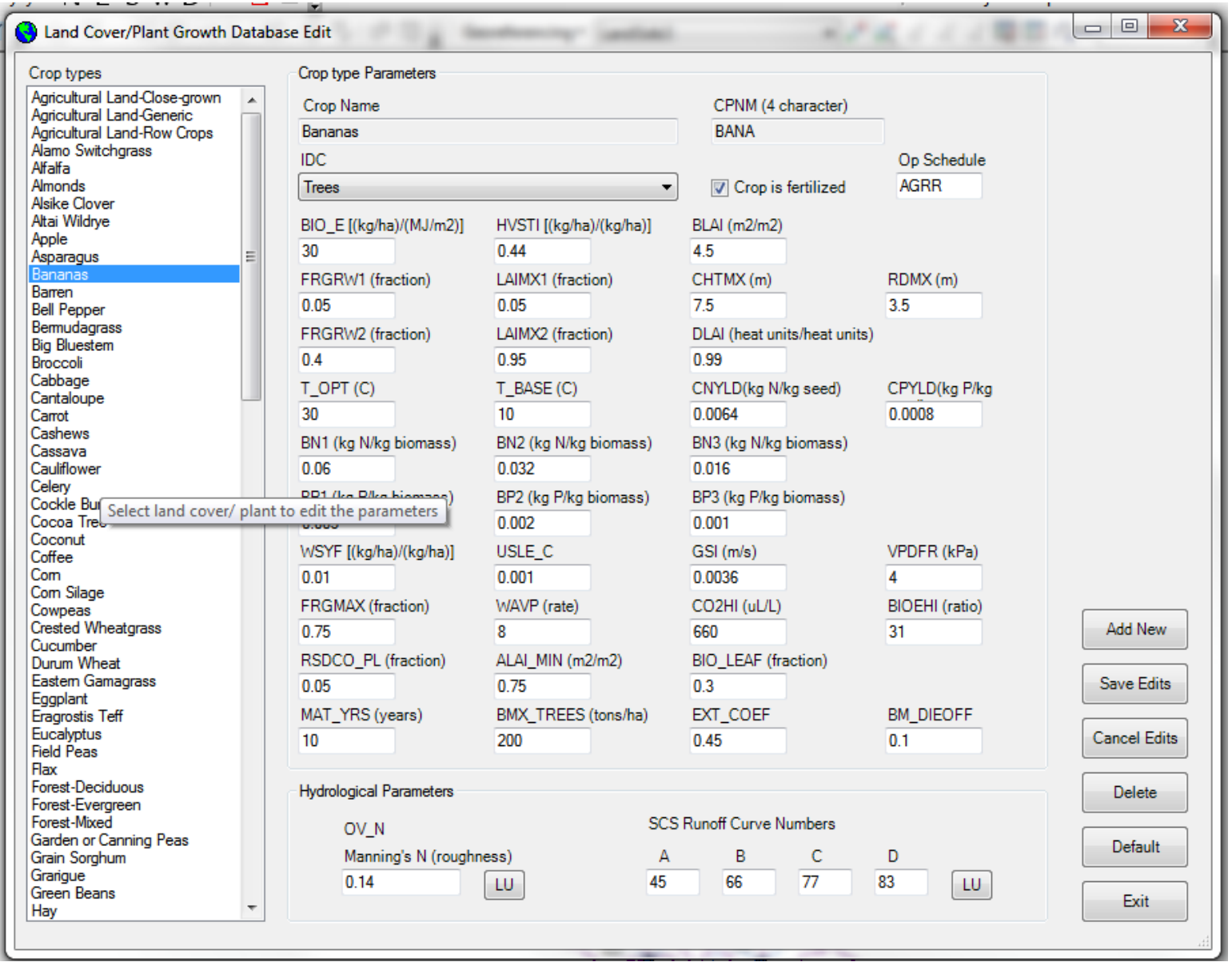
Study site

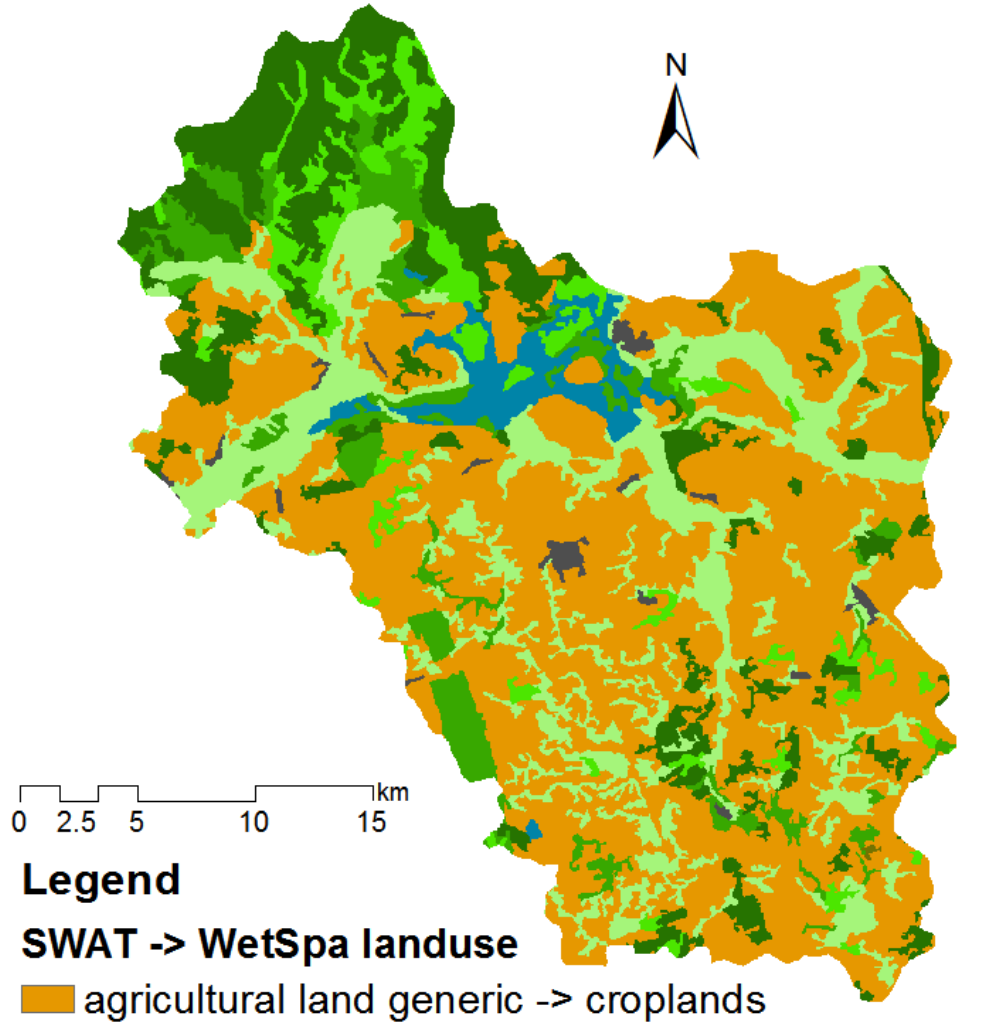
Biebrza Valley, Poland

- Upper Basin – 800 km2
- Riparian wetlands
- Peatlands: 4-6m depth



Landuse





Legend

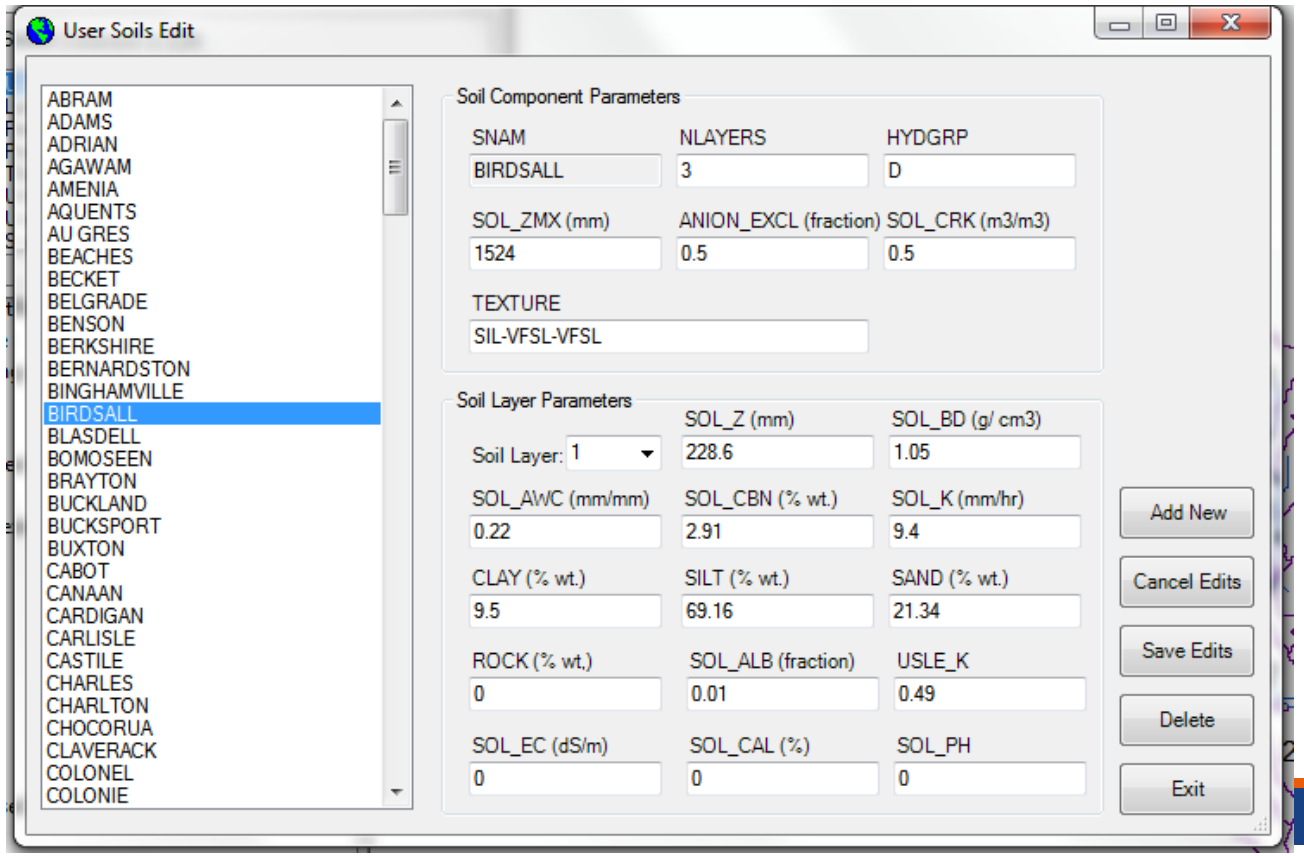
SWAT -> WetSpa landuse

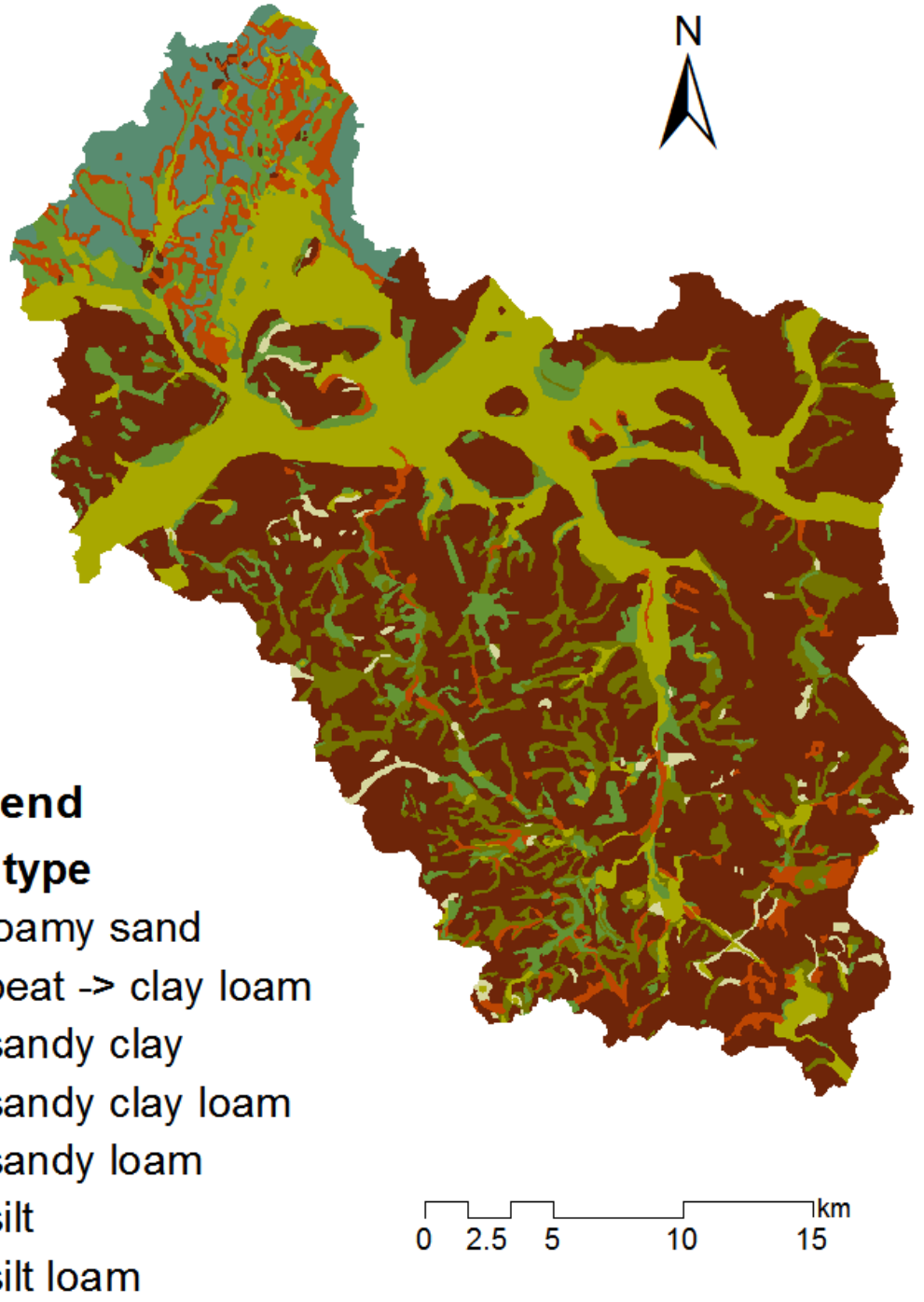
- agricultural land generic -> croplands
- deciduous forest -> deciduous broadleaf forest
- evergreen forest -> evergreen needleaf forest
- mixed forest -> mixed forest
- mixed wetlands -> permanent wetlands
- pasture -> grasslands
- range brush -> open shrublands
- residential med/low density -> urban and built-up

SWAT soils parameters

Same type of soil in both model

In SWAT division for layers with different parameters





STEP 2 - Simulation

Both WETSPA and SWAT models:

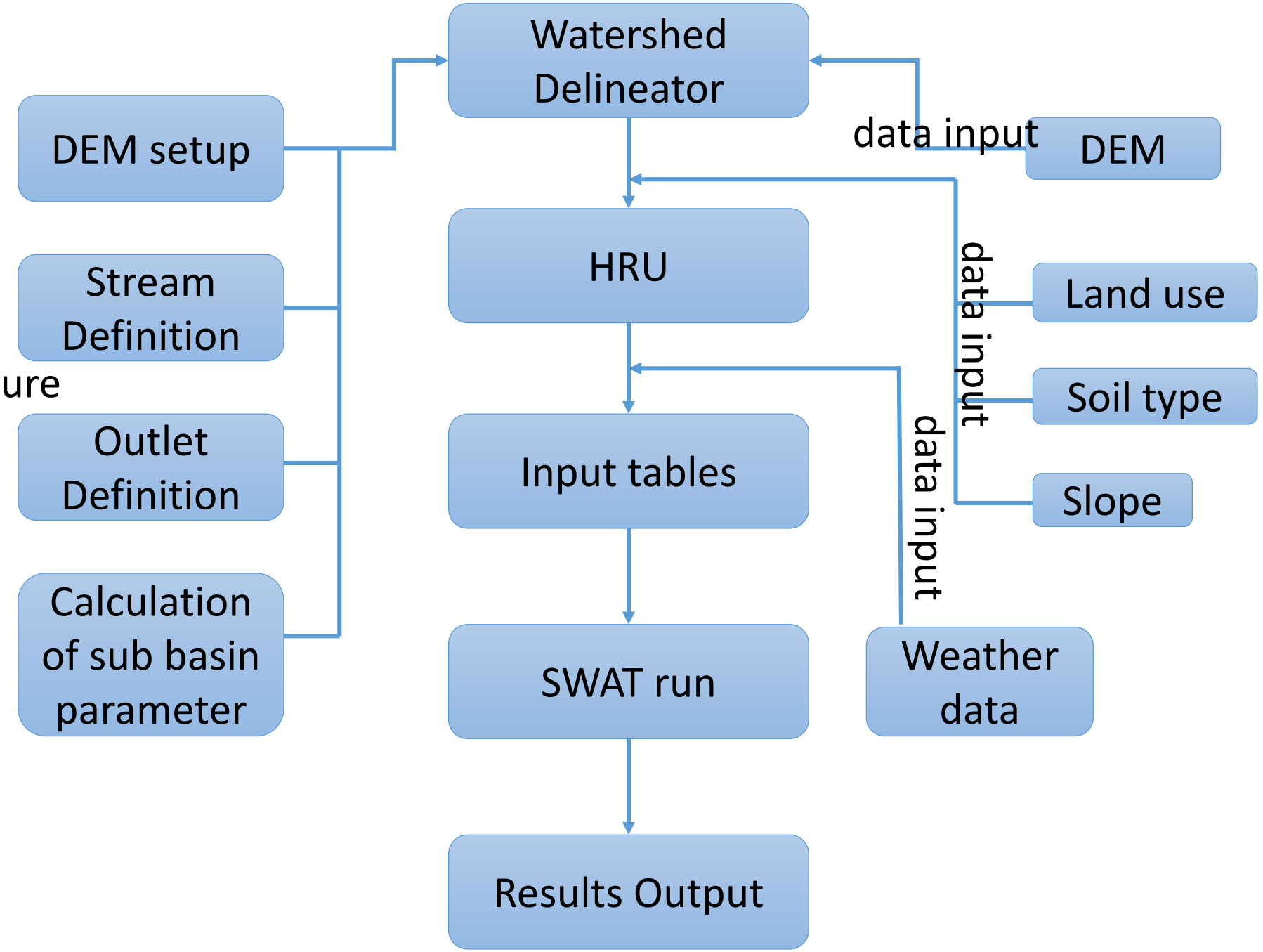
- Daily timestep
- 50m resolution
- Same input data

SWAT model

SETUP

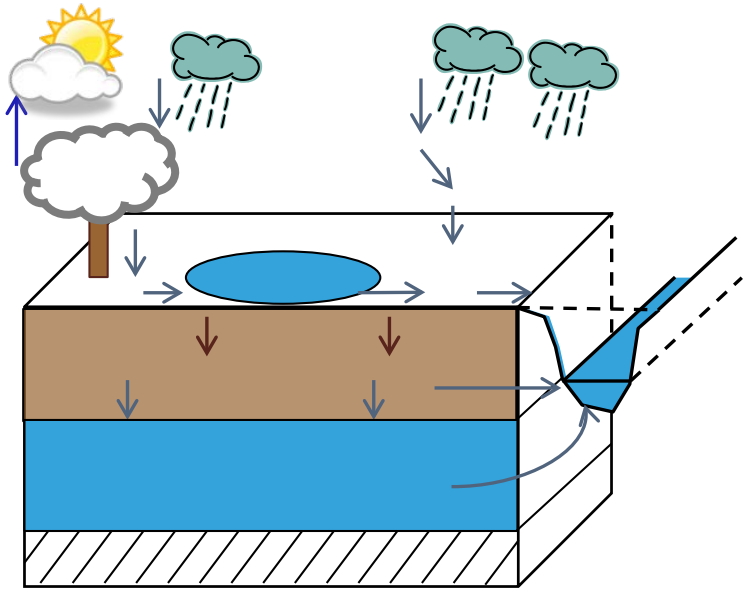
- PET: Hargrave's method
- Runoff:

SCS Curve Number Procedure

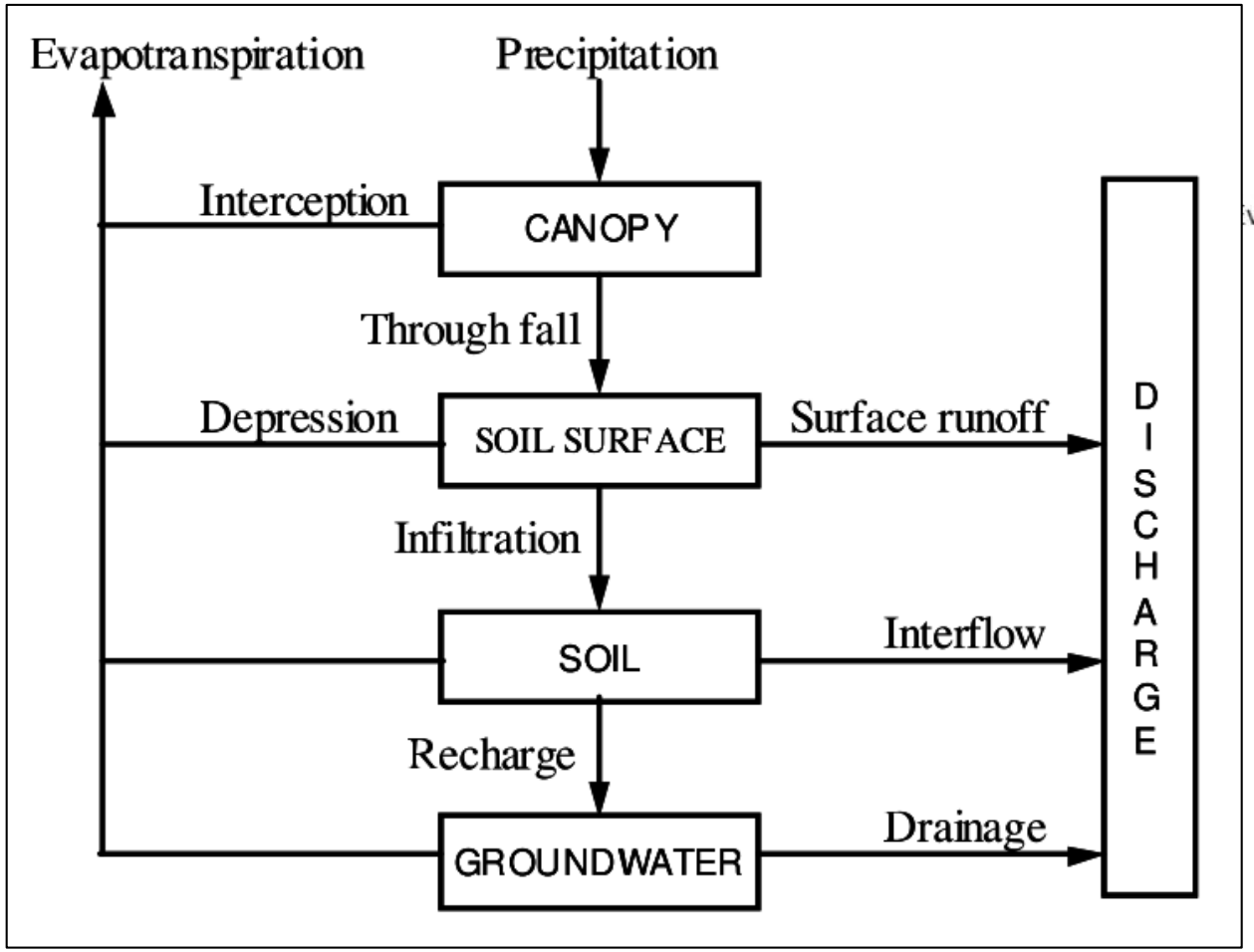


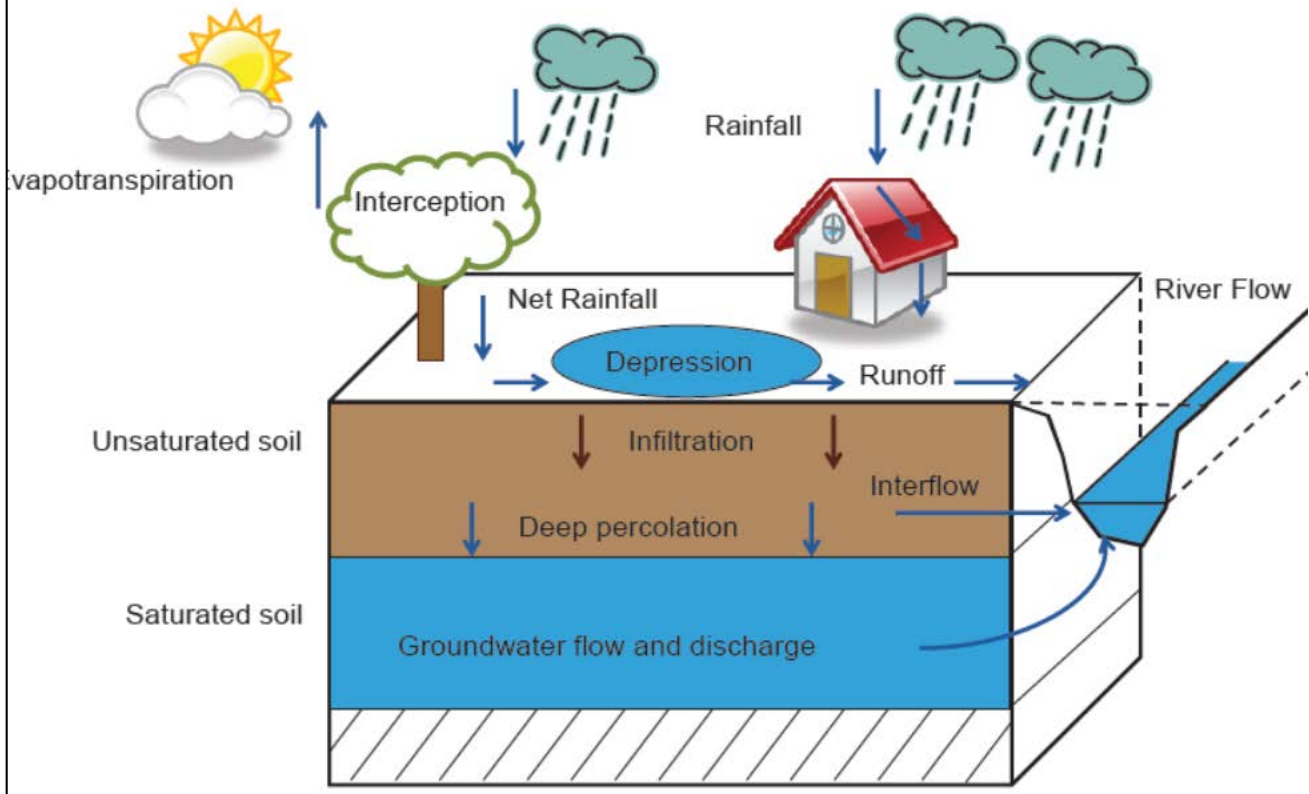
WETSPA model

- Developed in VUB – Vrije Universiteit Brussels in 1997
- Written in Fortran and Python
- Non-commercial
- Daily time step
- Spatially distributed
- Parameter based
- PET as input data (Penman Monteith)

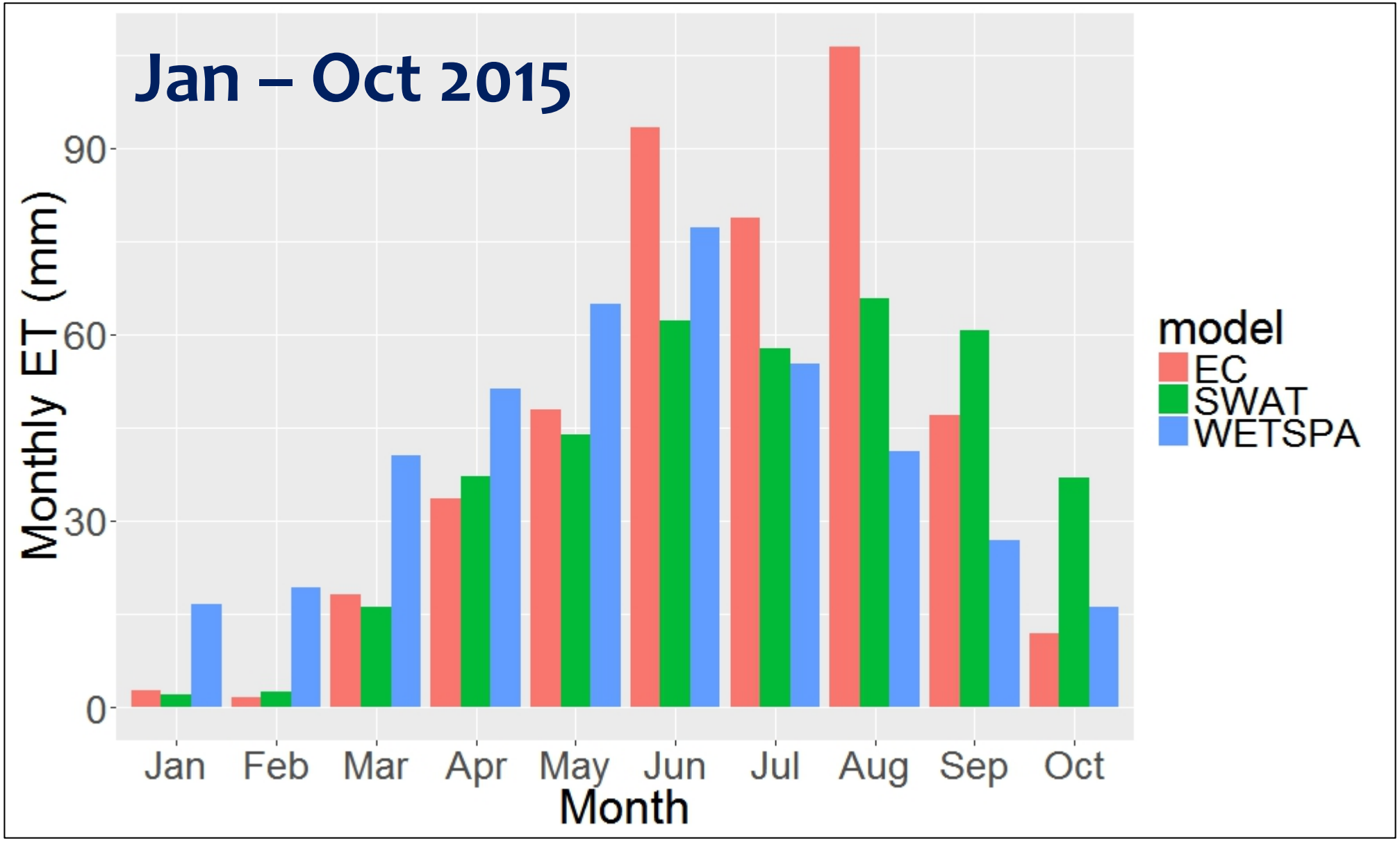


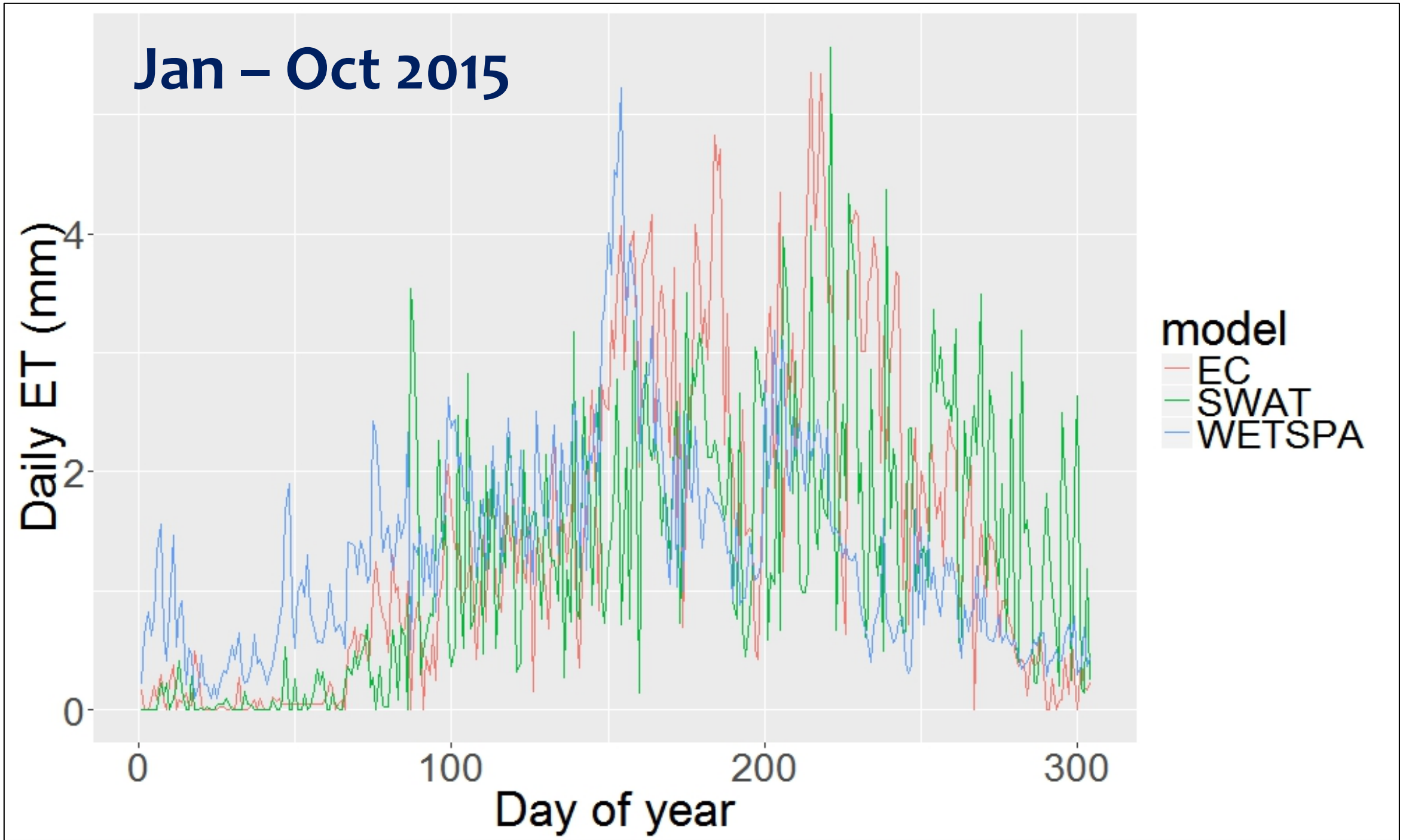
WETSPA model





STEP 3 - Results

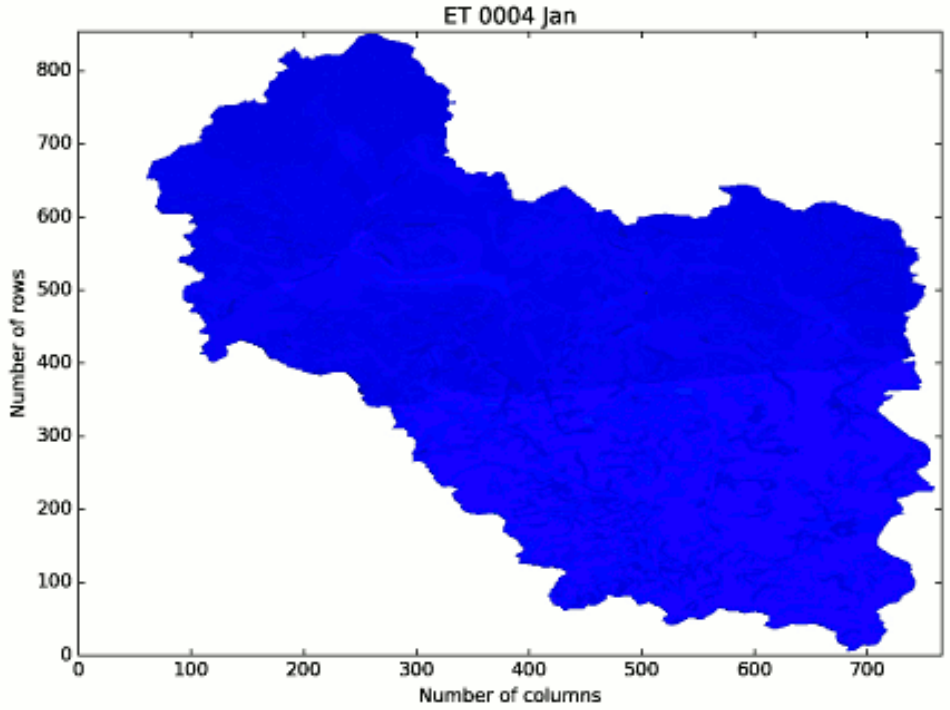


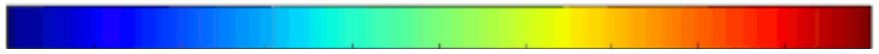

Jan – Oct 2015
Daily ET (mm)
0
2
4
0
100
200
300
Day of year
model
EC
SWAT
WETSPA

ET variability in Wetlands (WetSpa)

MONTHLY EVAPOTRANSPIRATION (mm) MAPS

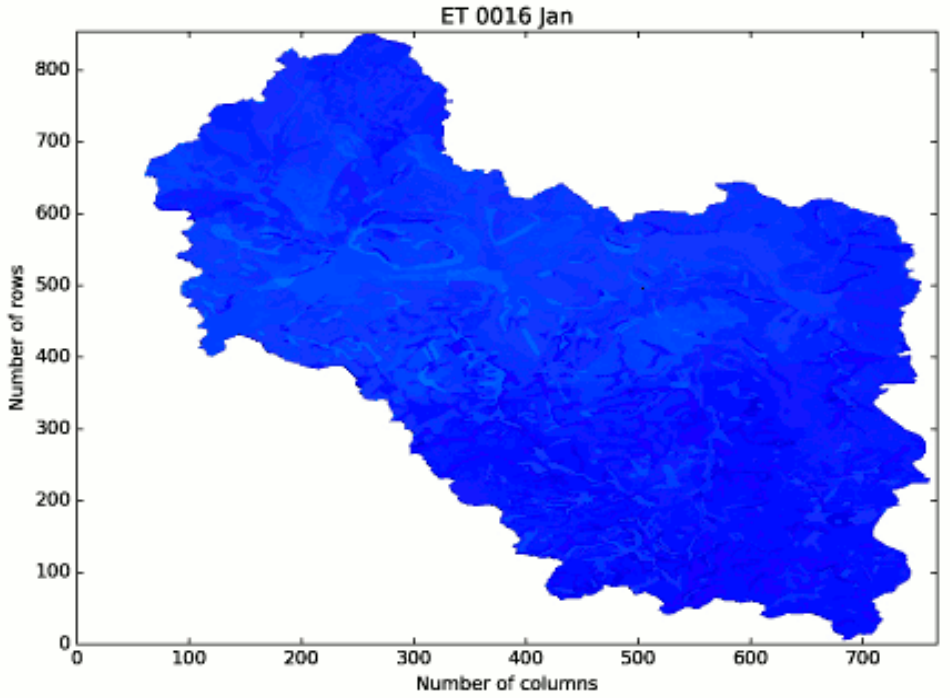
2012



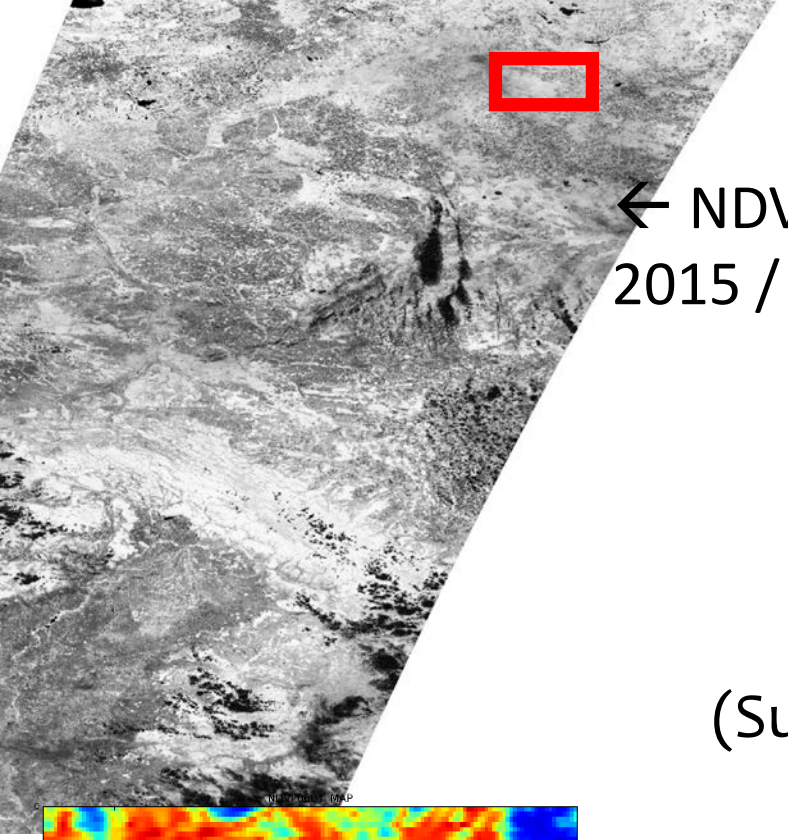


0 25 50 75 100

2013



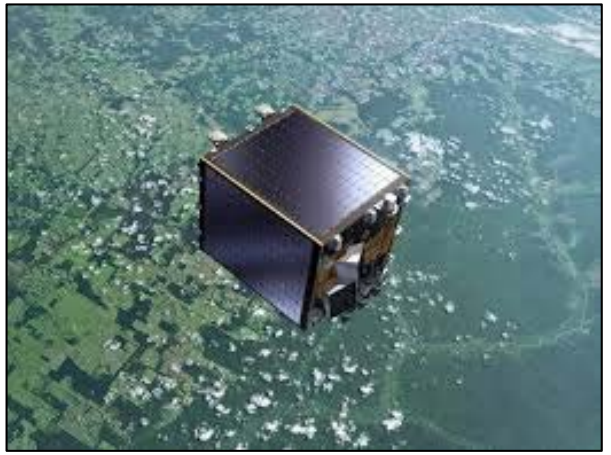
0 25 50 75 100



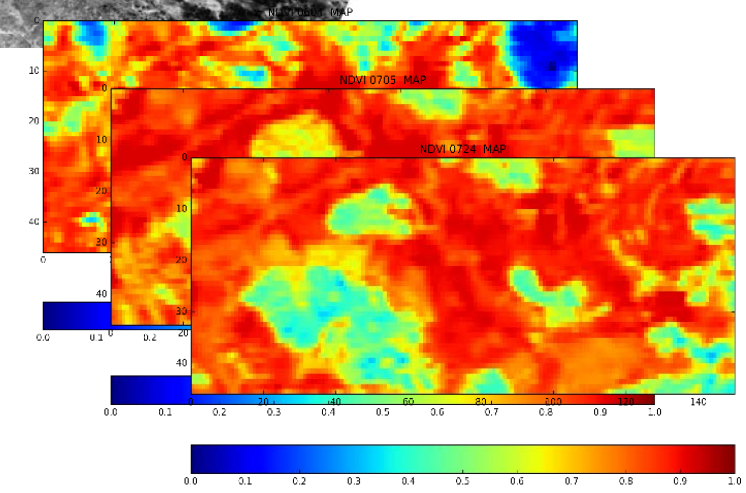
← NDVI image
2015 / 08 / 11 ESA

Proba V – sattelite (ESA)

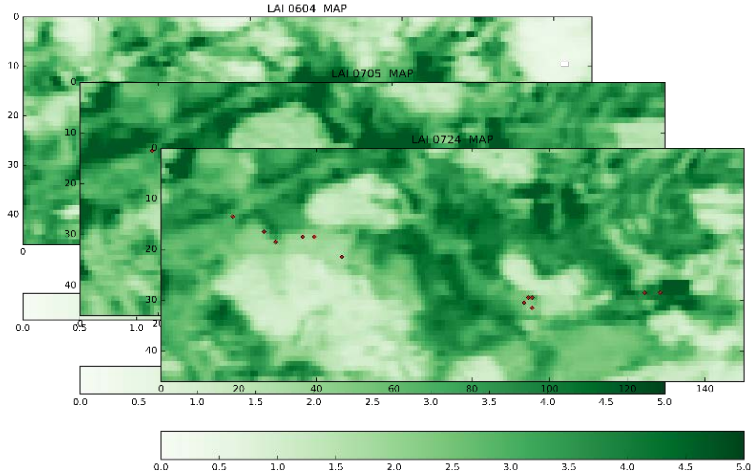
Daily products of **NDVI** at **100 m** resolution



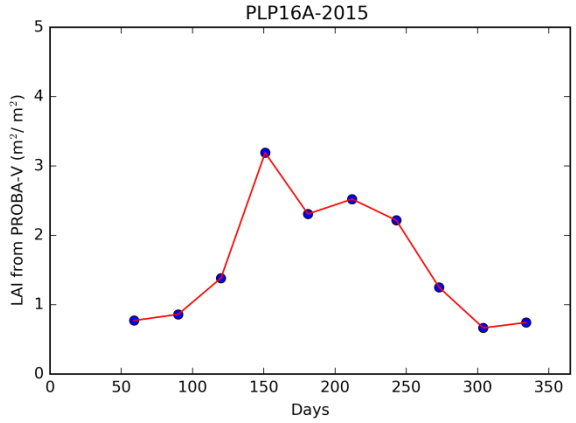
(Su, 2000) $$LAI = \sqrt{\left(NDVI \frac{1 + NDVI}{1 - NDVI}\right)}$$



NDVI maps



LAI maps

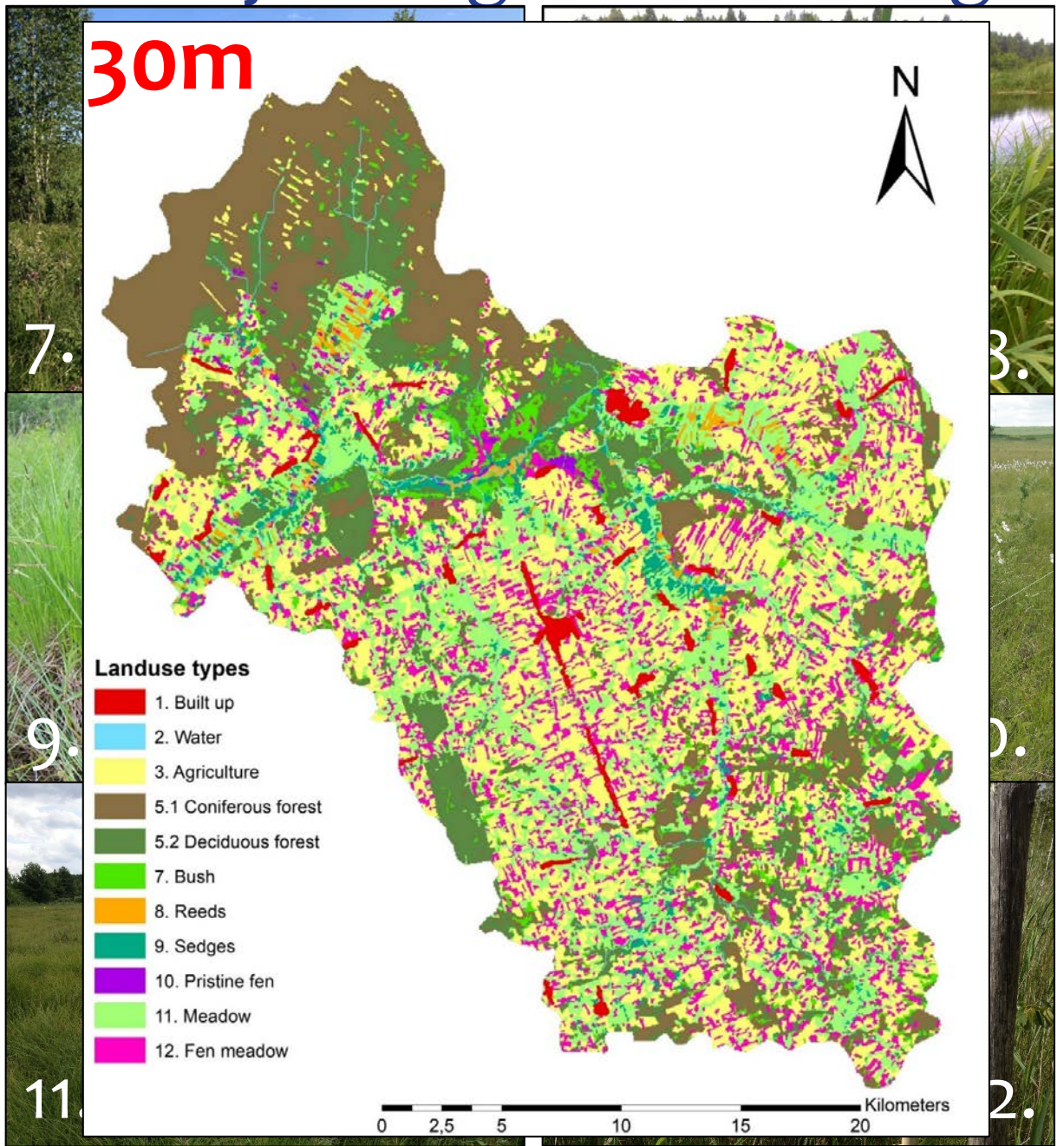


LAI dynamics per vegetation type

How to better represent wetlands in hydrological modelling?

WETLANDS

#	Land use
1	Built-up
2	Water
3	Agriculture
4	Bare soil
5.1	Coniferous forest
5.2	Deciduous forest
6	Bog
7	Bush
8	Reeds
9	Sedges
10	Pristine fen
11	Meadow
12	Fen meadow



Acknowledgments

- **HiWET** (www.hydr.vub.ac.be/projecthiwet)
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- IMGW – meteorological data

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Belgian Science Policy Office belspo

IMGW