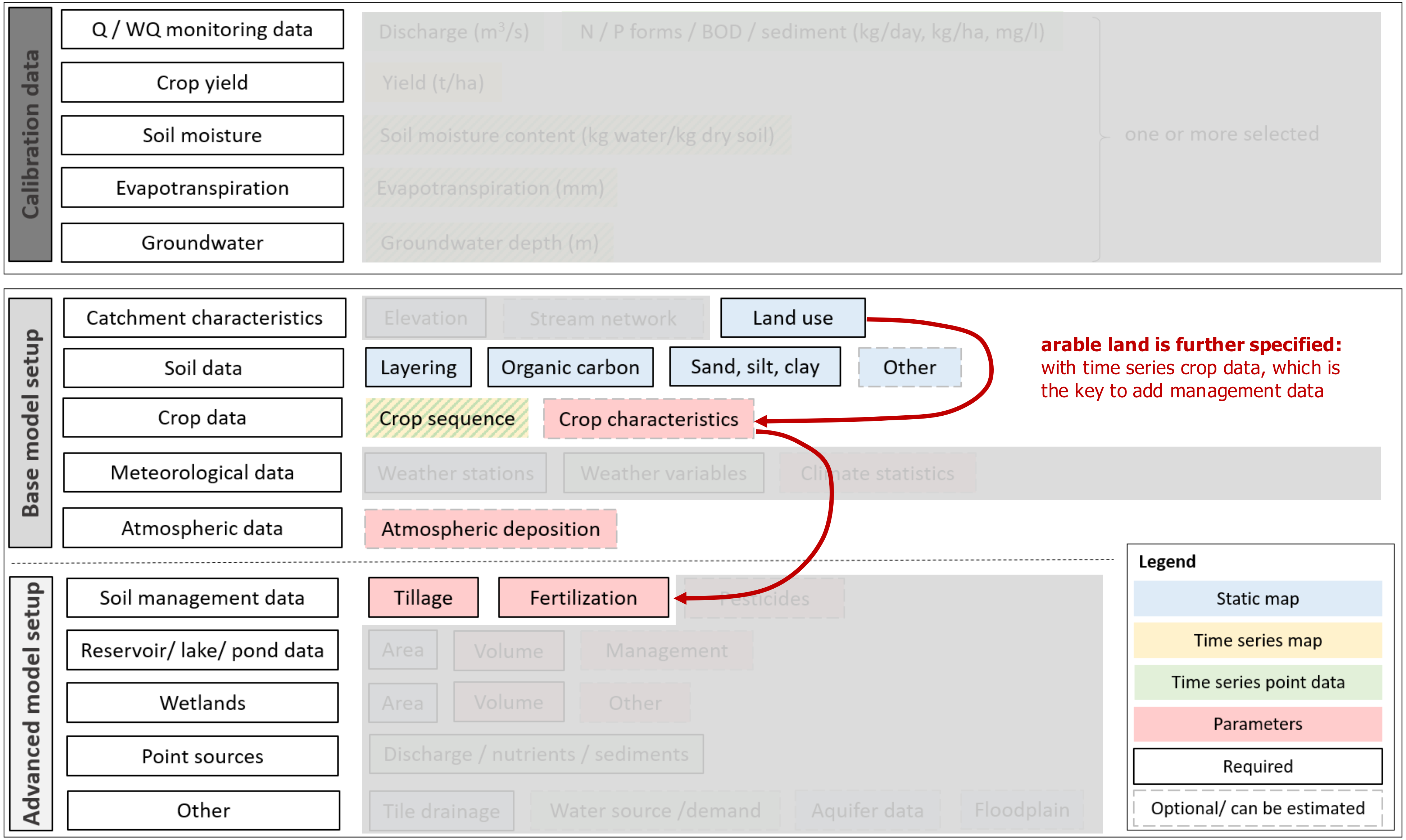
Modeling challenge #2

Prepare inputs and overcome data scarcity

Brigitta Szabó, **Svajūnas Plungė**, Piroska Kassai, Attila Nemes, Péter Braun, Michael Strauch, Felix Witing, János Mészáros, Natalja Čerkasova

SWAT input data requirement

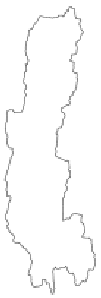


Deriving crop map based on remote sensing data

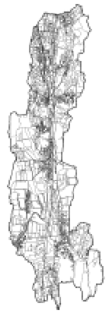
Steps to derive time series crop maps

1. Preprocess required input data

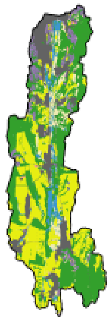
Define shape of target area



Acquire or digitize field boundary map



Acquire local land use map or CORINE dataset



Collect local crop data and/ or use relevant OA crop database

e.g.: LUCAS Land Use / Cover Area Frame Survey

eurostat

	A	B	C	D
1	lat	long	crop	year
2	17.6056663191892	46.8797386730075	canp	2020
3	17.7395846345672	46.8794488087538	wwht	2020
4	17.5990793754461	46.8962809402309	wwht	2020
5	17.7660145416835	46.8989774449713	corn	2020
6	17.6992509441987	46.8820361523306	wbar	2020
7	17.6985149791102	46.8811332312419	alfa	2020
8	17.6994759092169	46.883503396597	sunf	2020
9	17.7034859315421	46.8813072994923	corn	2020
10	17.6820935064206	46.8760190206474	corn	2020
11	17.6254365299096	46.881223821273	alfa	2020

Acquire time series radar back-scatter data

Sentinel-1A and -1B satellite radar images in Google Earth Engine

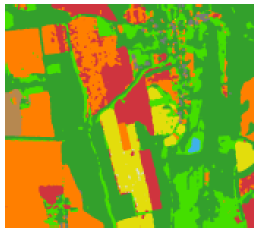
sentinel-1

2. Derive crop classification method

Random forest method, based on crop dataset + time series radar back-scatter data

3. Apply crop classification method for the predifined years

Pixel-based prediction of the crop types

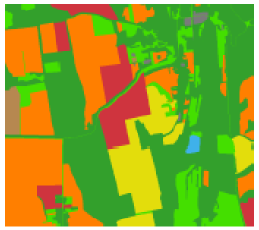


+

Field bound. map

→

Majority of crop type within the field



4. Finalize crop maps

Merge land use map and crop map

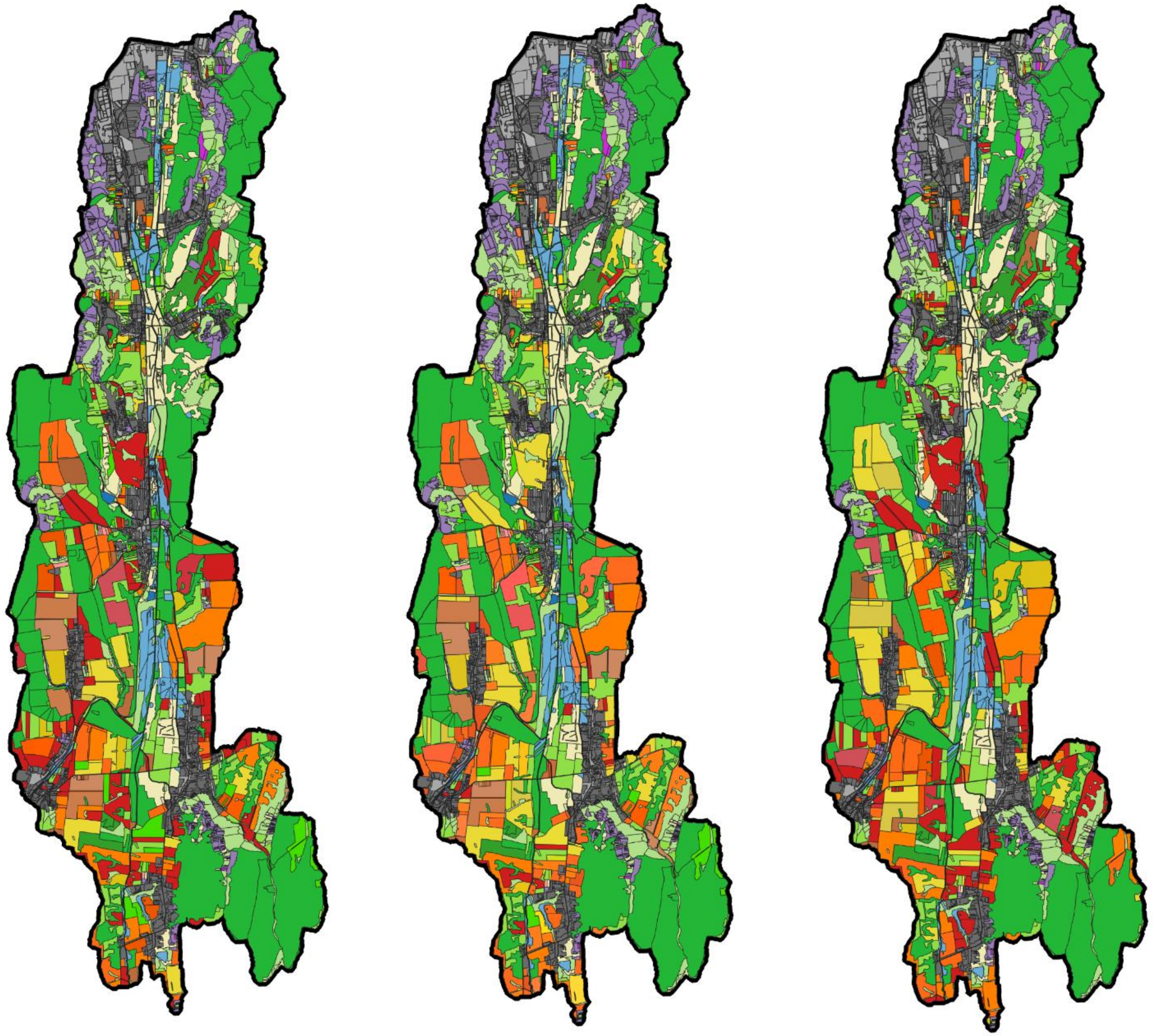
Compare proportion of mapped crops with local/ regional crop statistics

Revise the derived crop sequence based on locally specific crop rotation data

Refine the revised crop map based on local management information
e.g. specific tillage, fertilization, green cover, etc.

OPTAIN

2019 2020 2021



Crop types

- ALFA
- CORN
- CORN early
- CORN extra early
- covcrop CORN
- SUNF
- SUNF mintill
- covcrop SUNF
- covcrop SUNF mintill
- WBAR mintill
- CANP
- CANP mintill
- WWHT mintill
- WWHT mintill early
- WWHT mintill manure

Land cover/ land use types

- UIDU
- URBN
- URHD
- URLD
- UTRN
- WATR
- WETN
- AGRL
- GRAP
- ORCD
- PAST
- RNGB
- RNGE
- FRSD
- FRSE

Missing soil data to cover

Soil properties:

- physical and hydrological parameters,
- soil nutrient content.

An important aim of the OPTAIN project is to derive missing information on necessary model input variables in a harmonized way to allow for a sound cross-case study assessment of NSWRM effectiveness.

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Provide approaches applicable for all OPTAIN case studies (CS) to fill data gaps.

Analysed soil properties

Physical parameters

- bulk density
- porosity
- moist soil albedo
- soil erodibility factor

Hydraulic parameters

- water retention curve
- saturated hydraulic conductivity

Chemical parameters

- soil phosphorus content

Database with measured values – prediction performance

EU-HYDI

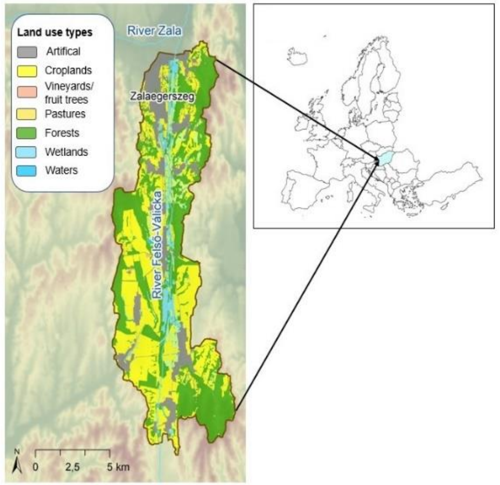
- 18,682 samples from 6,014 profiles
- used to derive euptfs

LUCAS Topsoil dataset

- 2009
- 2018: 5821 samples

Locally measured data on soil phosphorus content

- 2009: 34 agricultural parcels



Database used for comparison

MCD43A3 database

- 2022

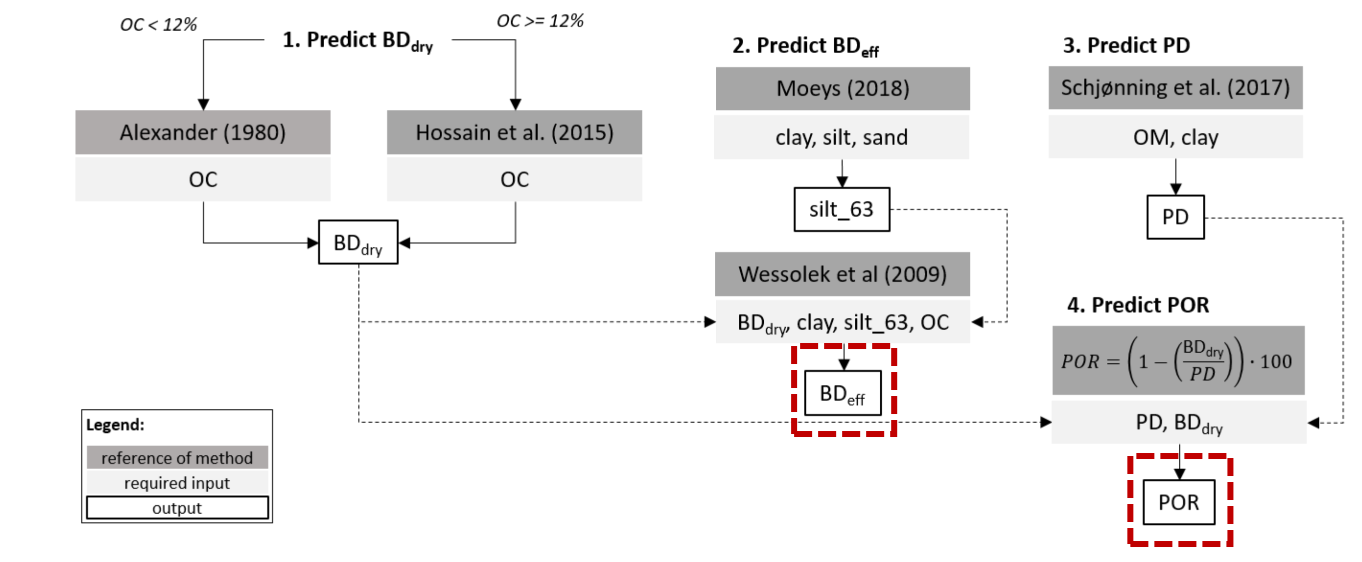
European soil erodibility map

(Panagos et al., 2014)

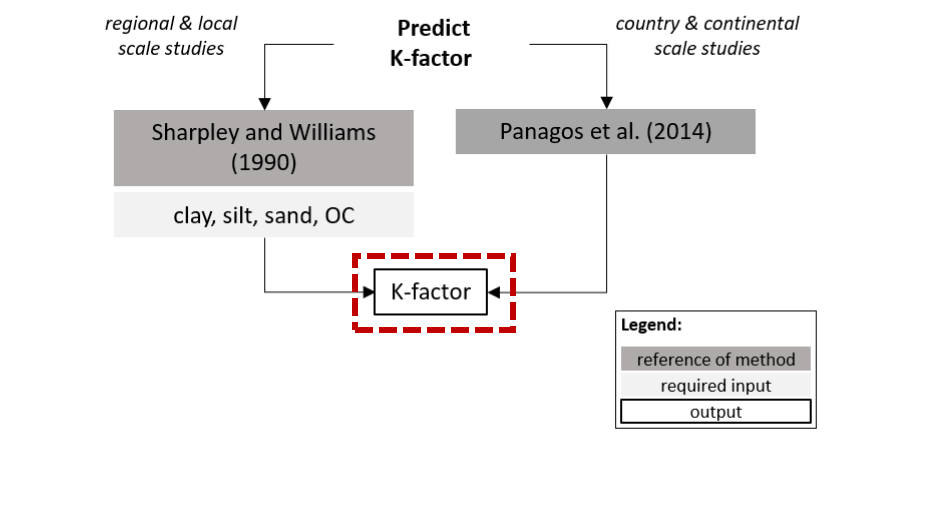
European topsoil P content map

(Ballabio et al., 2019)

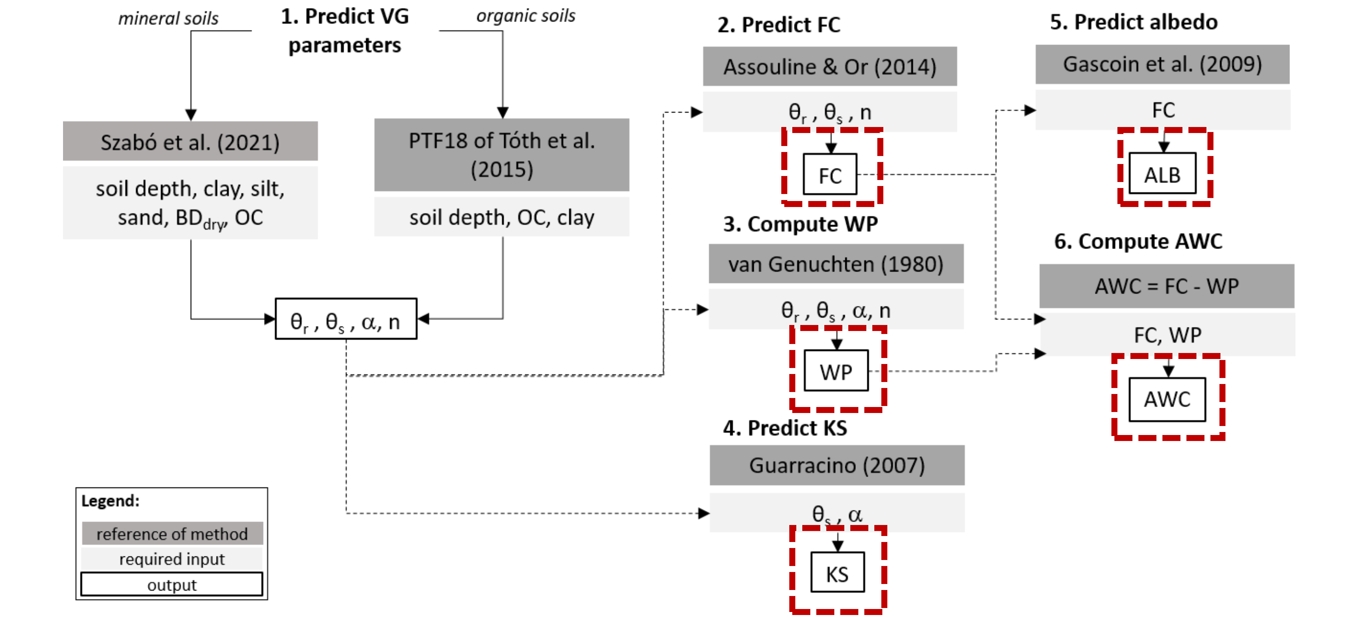
Prediction of **soil physical properties**.



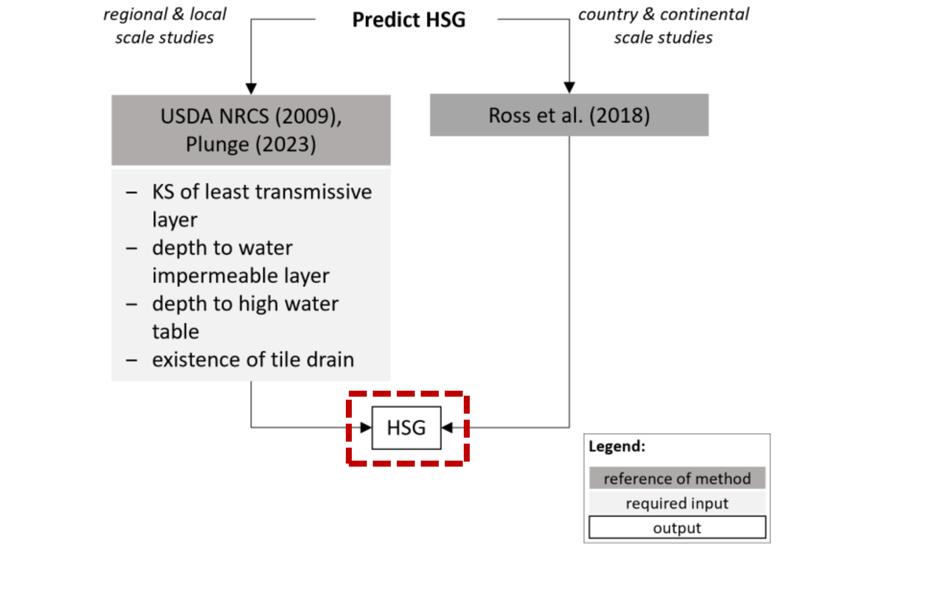
Prediction of **soil erodibility factor (K-factor)**.



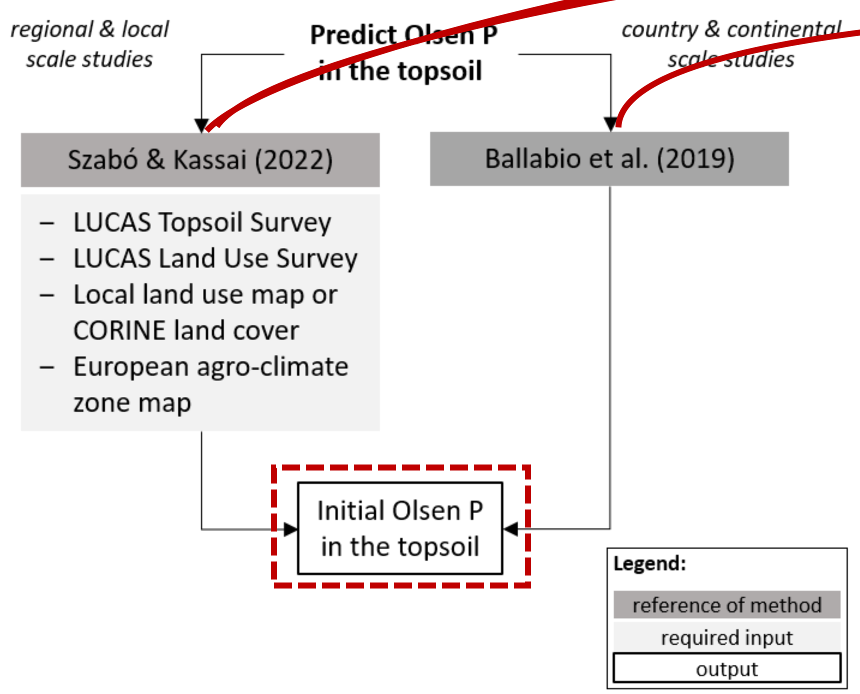
Prediction of **soil hydraulic properties** and **moist soil albedo**.

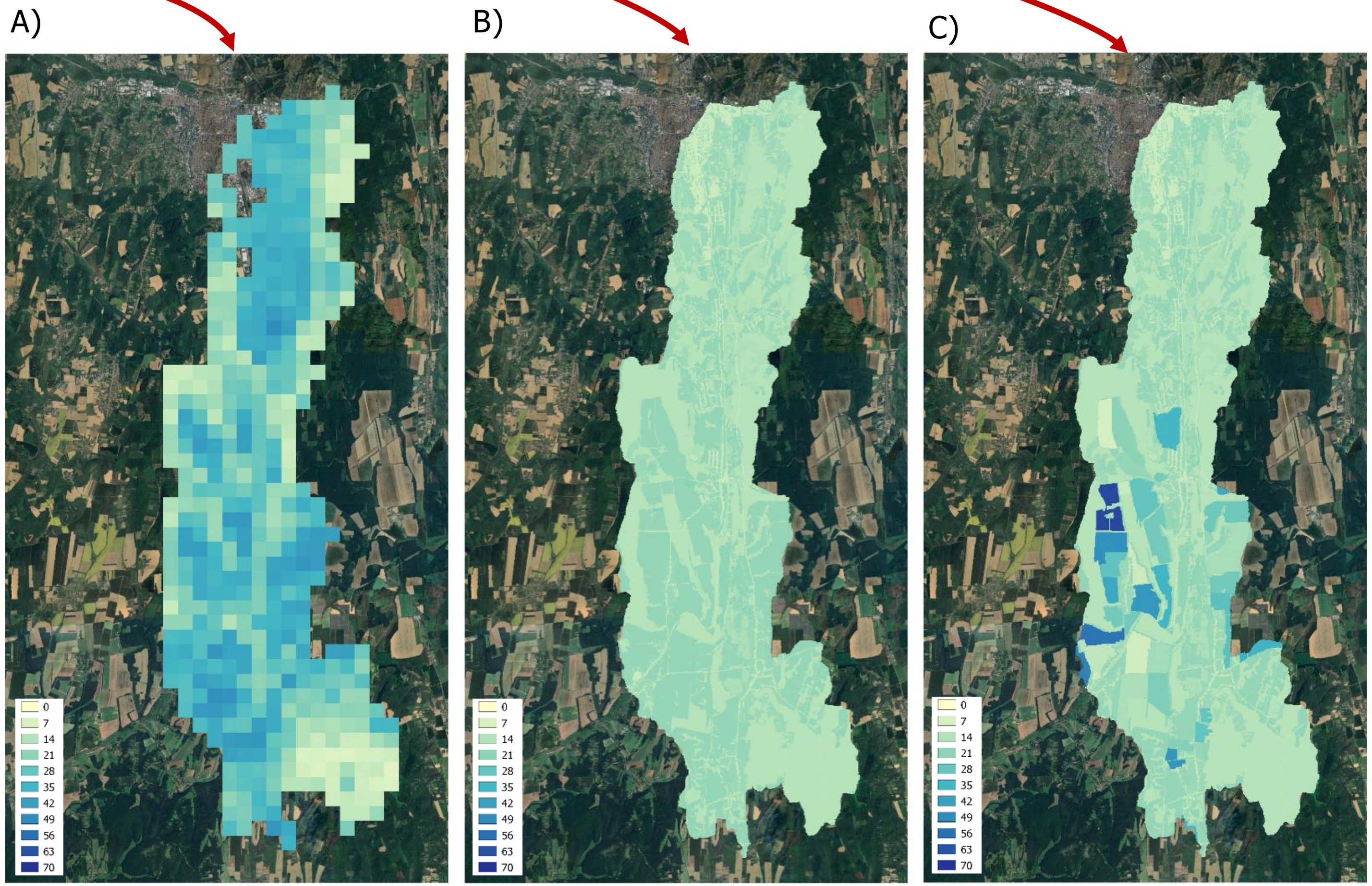


Prediction of **hydraulic soil groups (HSG)**.



Prediction of **Olsen phosphorus content** of the topsoil





European topsoil P content map (Ballabio et al., 2019) (A), region-specific mean statistics-based P content map (B), region-specific mean statistics-based P content map with locally measured soil P content (C) in the Felső-Válicka case study.

Tools to derive input data for the SWAT model

- derive time series crop maps:
  https://doi.org/10.5281/zenodo.6669644

- compute soil hydraulic properties with euptfv2:
  - user friendly web interface: https://ptfinterface.rissac.hu
  - R package: https://github.com/tkdweber/euptf2

- algorithm to harmonize soil particle size data (sand, silt and clay content) to the FAO/USDA system:
  https://doi.org/10.5281/zenodo.7353722

- map topsoil phosphorus content:
  https://doi.org/10.5281/zenodo.6656537

- **SWAT + input data preparation with R package SWATprepR:**
  https://github.com/biopsichas/SWATprepR

SWATprepR
SWAT+ input data preparation

Documentation

Schürz, C., Čerkasova, N., Farkas, C., Nemes, A., Plunge, S., Strauch, M., Szabó, B., Piniewski, M.: SWAT+ modeling protocol for the assessment of water and nutrient retention measures in small agricultural catchments. https://doi.org/10.5281/zenodo.7462415, 2022.

Plunge, S., Szabó, B., Strauch, M., Čerkasova, N., Schürz, C., Piniewski, M.: SWAT+ input data preparation in a scripted workflow — SWATprepR. Environ. Sci. Eur. 36, 1–15. https://doi.org/https://doi.org/10.1186/s12302-024-00873-1, 2024.

Szabó, B., Kassai, P., Plunge, S., Nemes, A., Braun, P., Strauch, M., Witing, F., Mészáros, J., and Čerkasova, N.: Addressing soil data needs and data-gaps in catchment scale environmental modelling: the European perspective, EGUsphere [preprint] Accepted for publication (SOIL), https://doi.org/10.5194/egusphere-2023-3104, 2024.