Spatial assessment of inland excess water hazard using combined machine learning and geostatistical methods

Annamária LABORCZI [1], Csaba BOZÁN [2], Gábor SZATMÁRI [1], János KÖRÖSPARTI [2], László PÁSZTOR [1]

[1] Institute for Soil Sciences and Agricultural Chemistry, Centre for Agricultural Research, Herman Ottó út 15, H-1022 Budapest, Hungary

[2] Research Institute of Irrigation and Water Management, National Agricultural Research and Innovation Centre, Anna-liget str. 35, H-5540 Szarvas, Hungary

What is Inland Excess Water (IEW)?

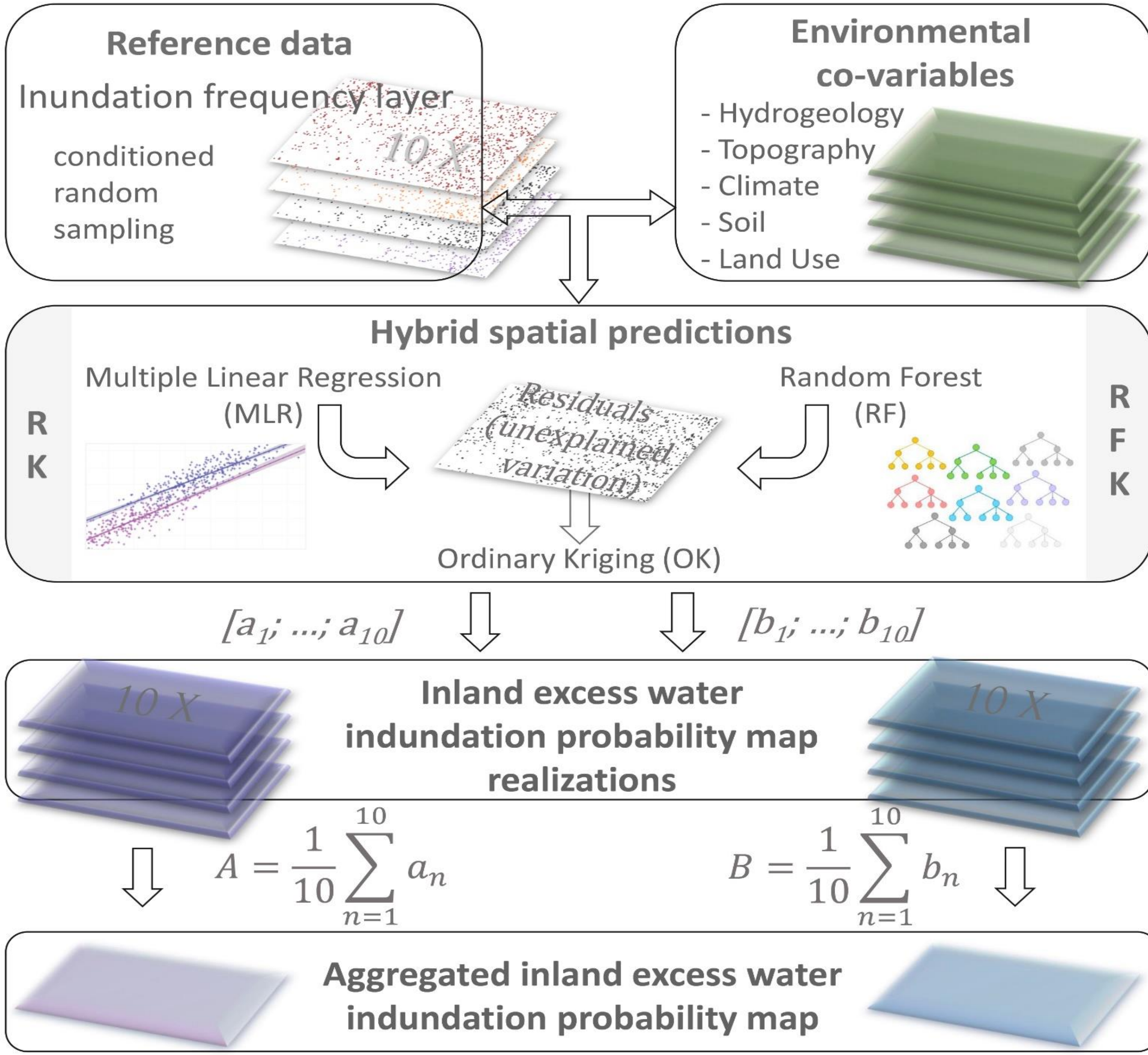
- Temporary water inundation, a form of surplus surface water.
- In flatlands: due to both precipitation and groundwater emerging on the surface.
- Most frequently in local depressions of large flat areas, irrespective of river floods.
- Literature frequently uses the phrase ‘waterlogging’.

Complex interaction of contributing factors:

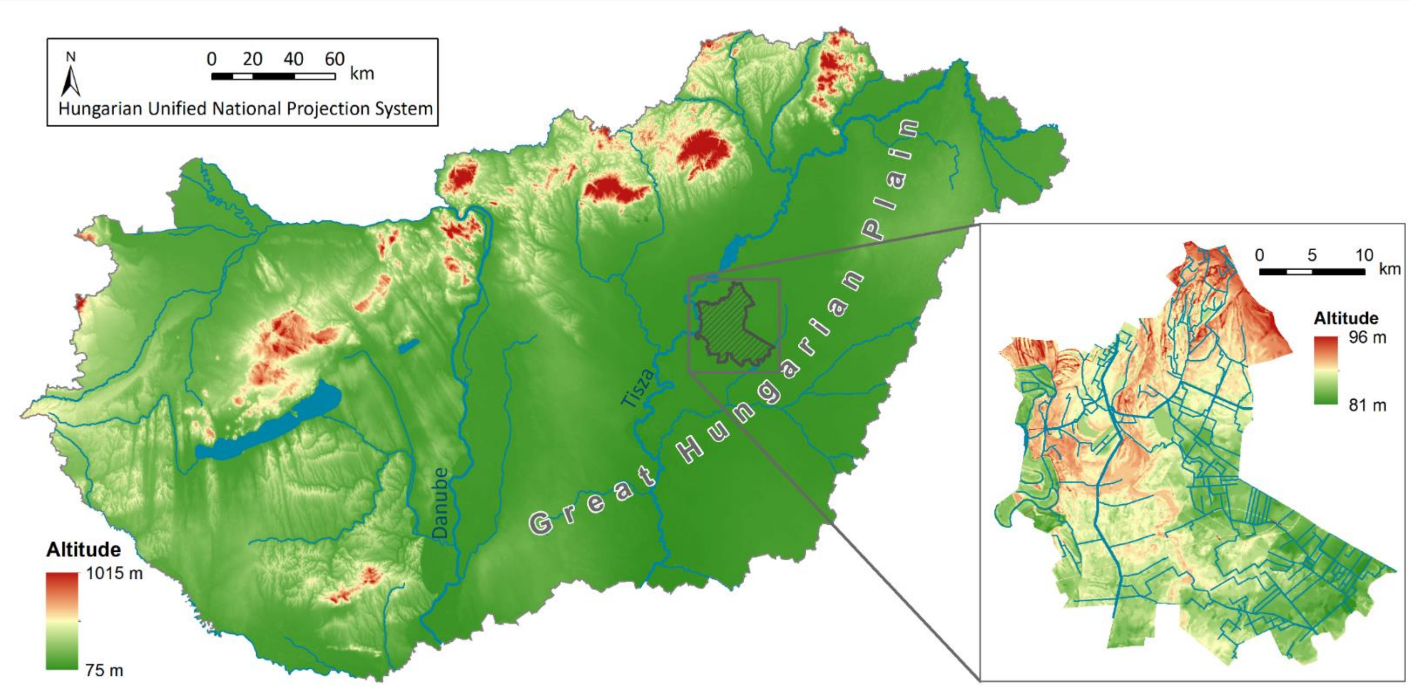
- natural (e.g. meteorological, hydrogeological, pedological, topographical),
- anthropogenic (e.g. land use, agricultural engineering).

IEW causes several social, economic, and environmental problems in the flatland regions of Hungary, covering nearly half of the country.

Graphical Abstract



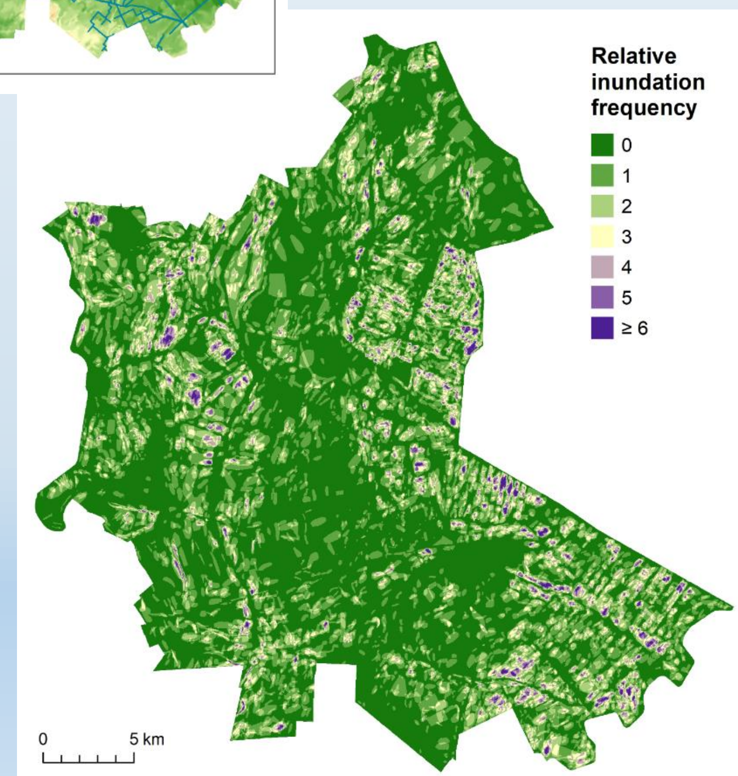
Source: Laborczi et al. 2020. https://doi.org/10.3390/ijgi9040268



Study area

'10.07. Kisújszállás Excess Water Protection Section'

Overview map with relief of Hungary



Reference Data

Map of temporally aggregated legacy information on inland excess water inundation frequency.

The values do not show real frequencies, they can be considered as an indicator (Number of inundation events occurred within the period from where observations are available).

Source: Laborczi et al. 2020.
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Environmental Co-Variables

Soil

Digital Kreybig Soil Information System
-soil physical property layer,
-‘landscape management soil type’

3D Soil Hydraulic Database of Europe
EU-SoilHydroGrids ver1.0

Climate

Average annual
- precipitation,
- temperature,
- evaporation,
- evapotranspiration

Humidity index

Land use

National CORINE Land Cover database

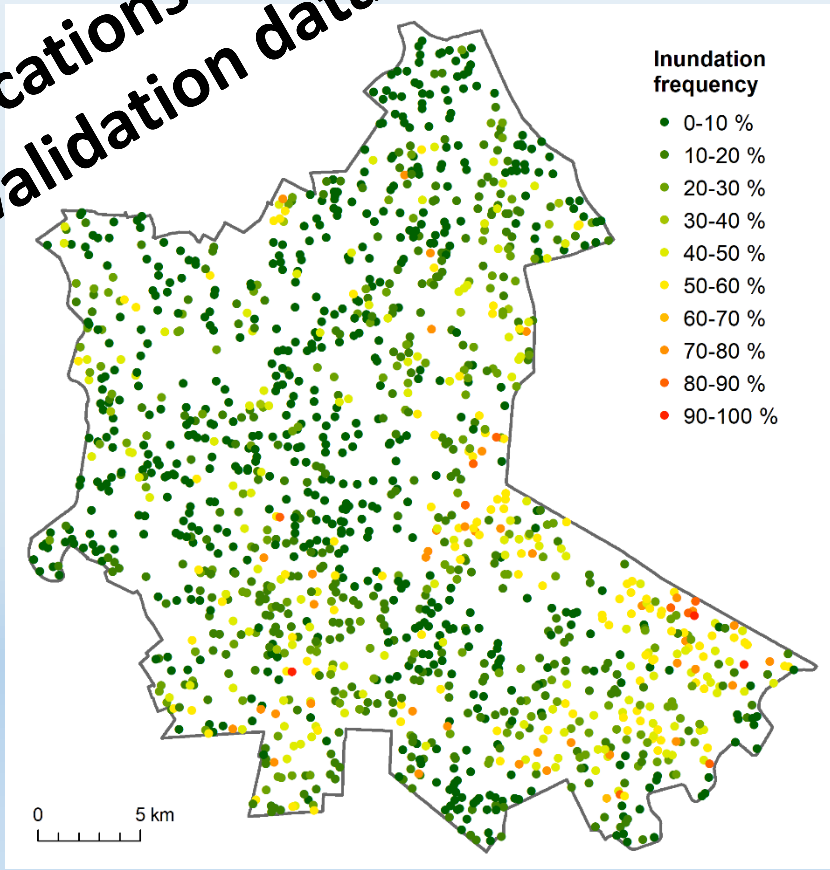
Topography

Hungarian HydroDEM
Digital Elevation Model
and its derivatives

Hydrogeology

Depth and the thickness of the uppermost aquitard
Standard depth of groundwater
Groundwater recharge and discharge areas

Locations of the validation dataset

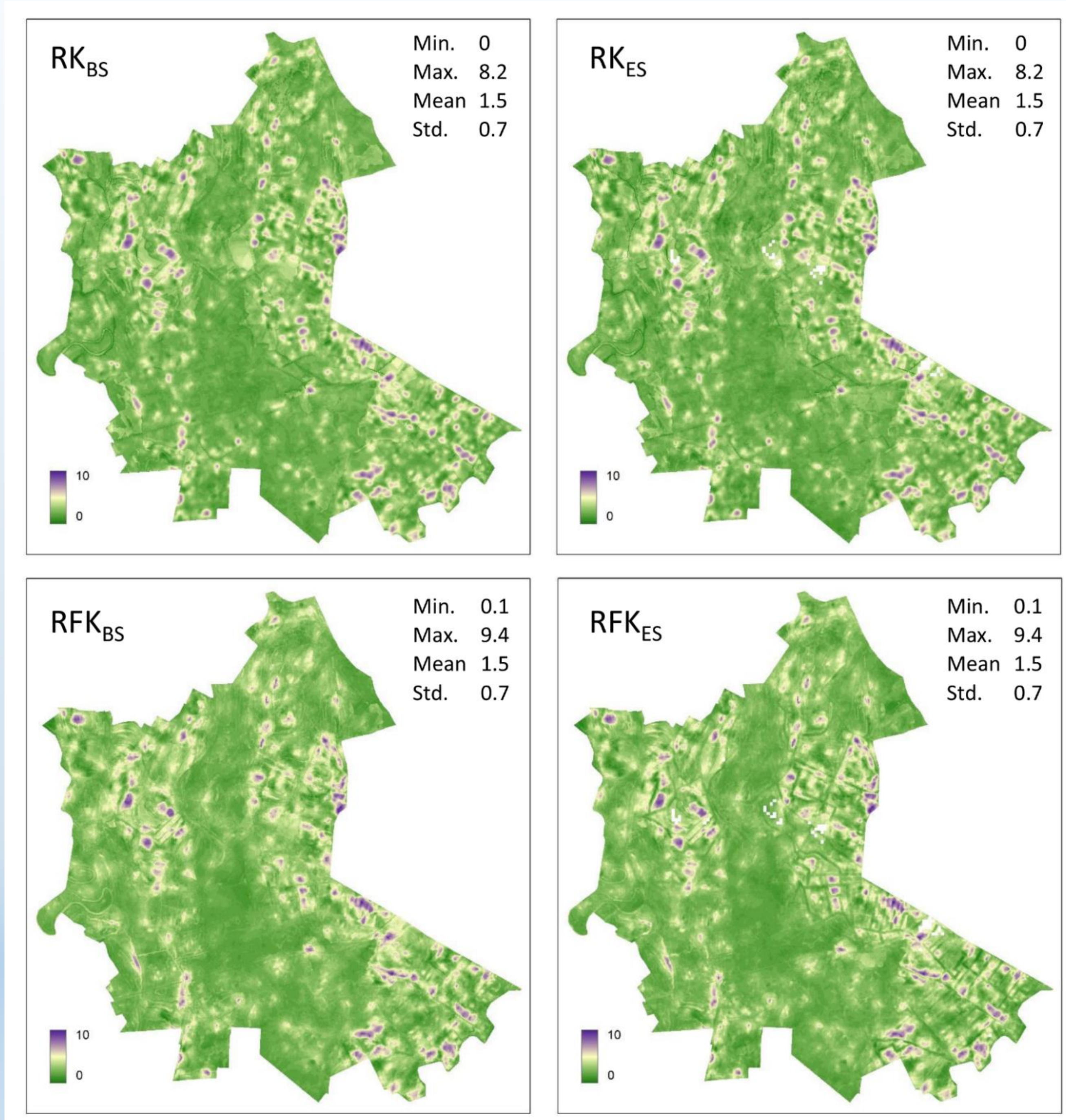


Source: *Laborczi et al. 2020.* https://doi.org/10.3390/ijgi9040268

IEW indundation probability result maps

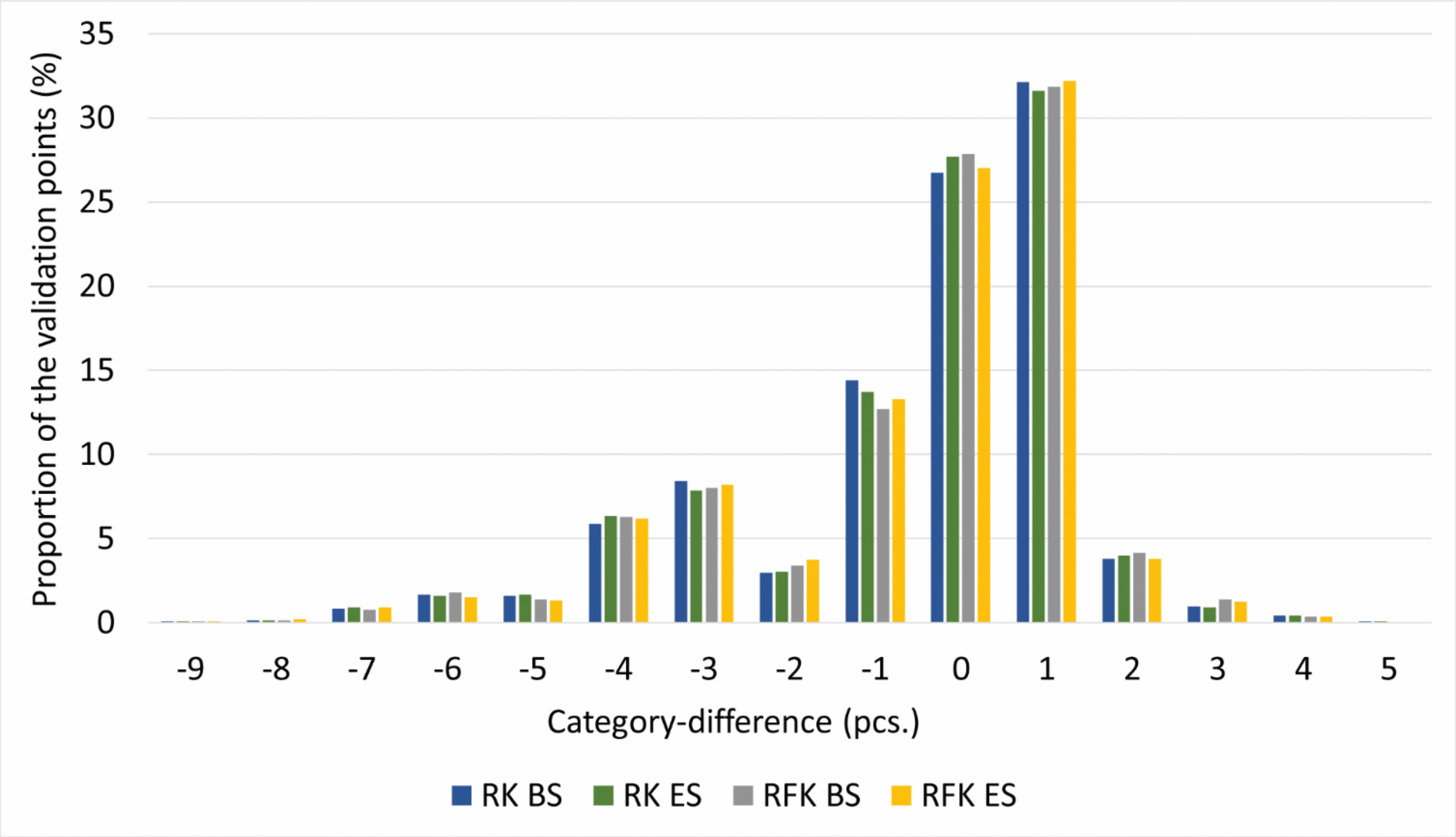
two methods:
RK – Regression Kriging,
RFK – Random Forest combined with Ordinary Kriging

two co-variable packages:
BS – basic set,
ES – extended set



Source: Laborczi et al. 2020. https://doi.org/10.3390/ijgi9040268

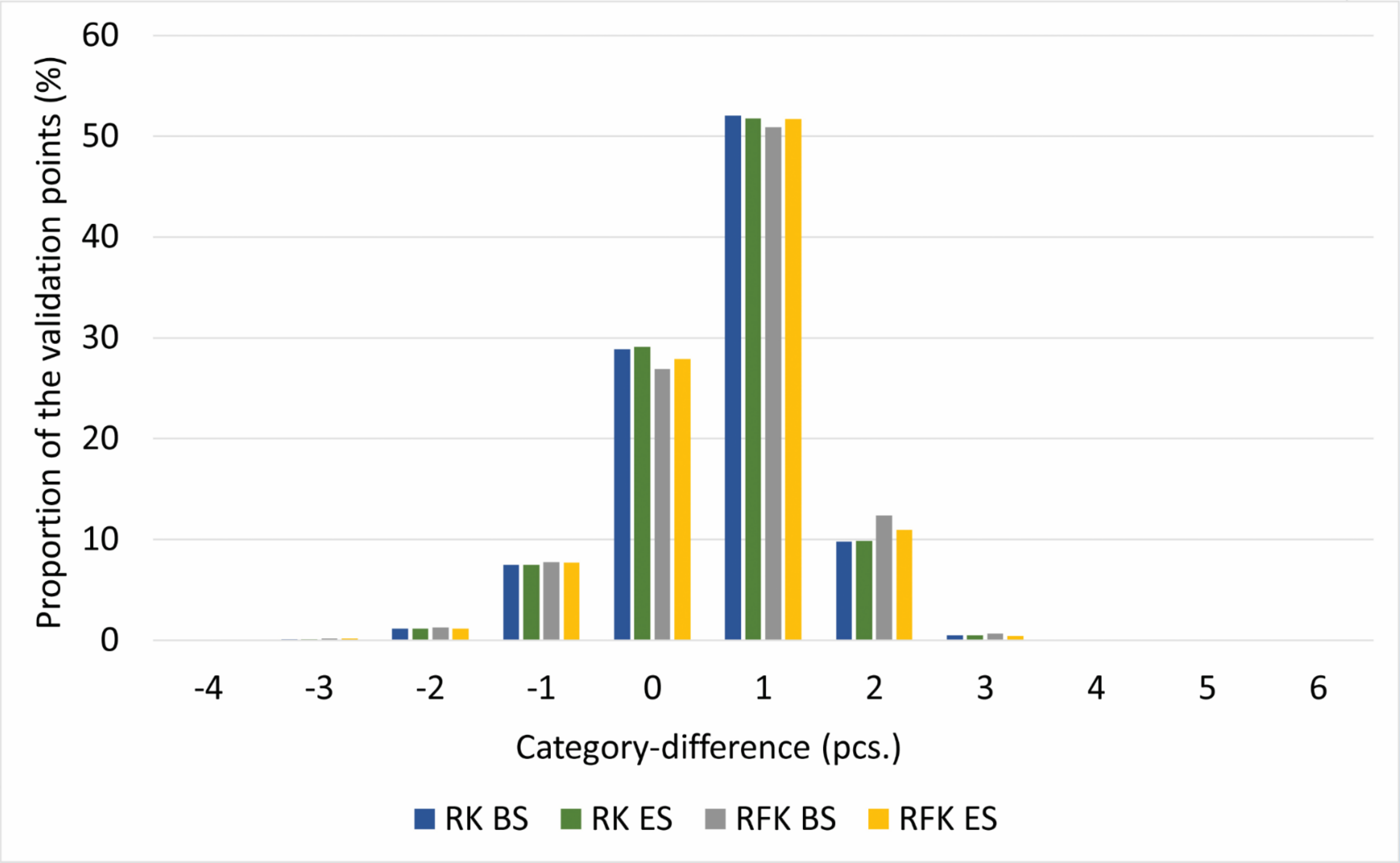
Validation



Category-difference between the independent validation dataset, and the categorized predicted values

Source: Laborczi et al. 2020. https://doi.org/10.3390/ijgi9040268

Validation



Difference between the legacy map's inundation frequency and the categorized inundation result maps.

Source: Laborczi et al. 2020. https://doi.org/10.3390/ijgi9040268

Conclusions

Comparing the results of the two approaches (RK and RFK), we did not find significant differences in their accuracy.

Both methods are appropriate for predicting inland excess water hazard, we suggest the usage of RFK, since

- it is more suitable for revealing non-linear and more complex relations than RK,
- it requires less presupposition on and preprocessing of the applied data,
- and keeps the range of the reference data, while RK tends more heavily to smooth the estimations, while
- it provides a variable rank, providing explicit information on the importance of the used predictors.

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Results & figures of the presentation comes from the above mentioned publication.

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