

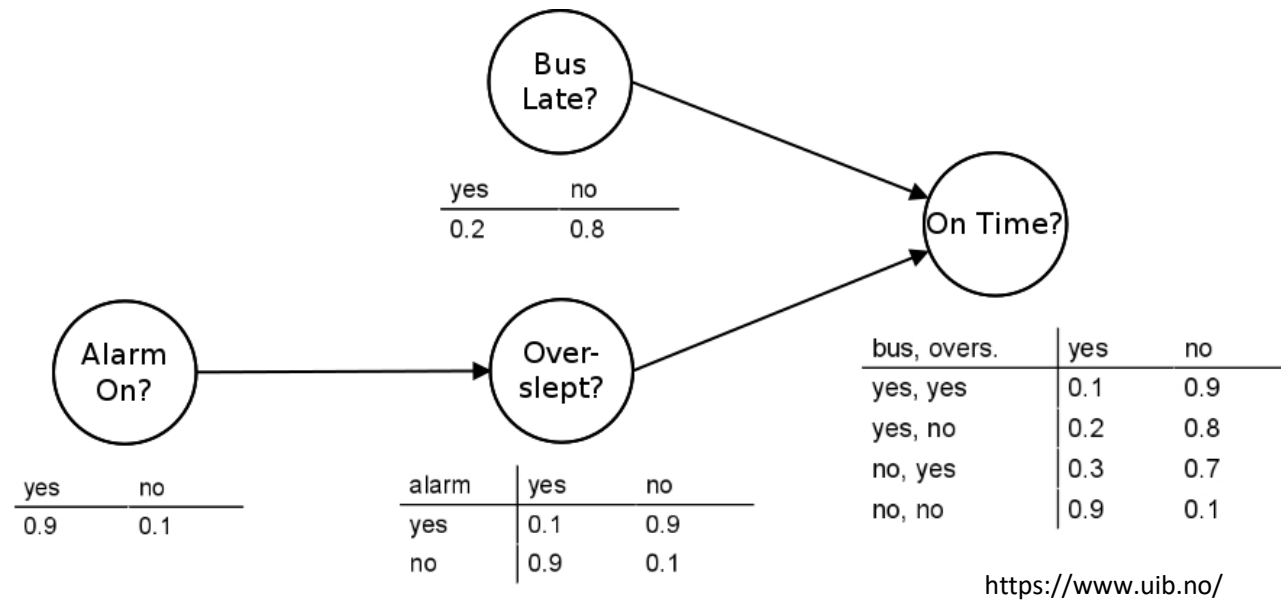


Estimating mean groundwater levels in peatlands using a Bayesian belief network approach with remote sensing data

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Power to the Peatlands Conference 02-04.09.2026, 's-Hertogenbosch, the Netherlands

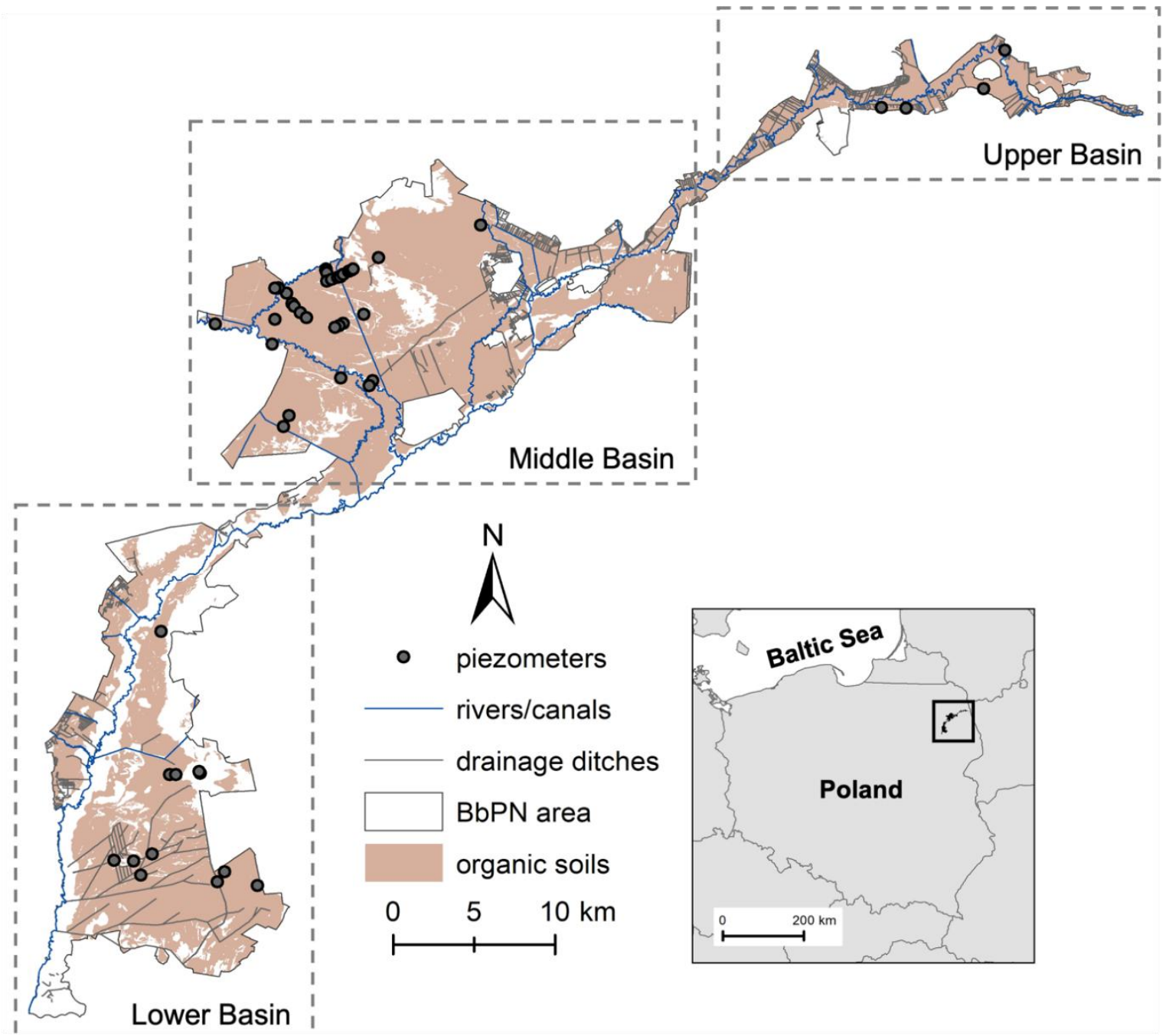
Bayesian Belief Network



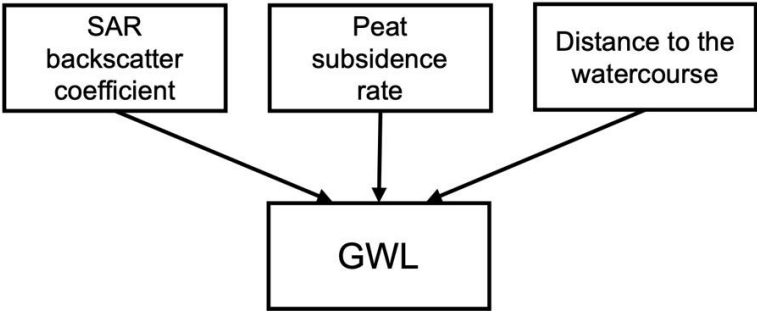
- A probabilistic model in the form of a directed acyclic graph (DAG).
- Defines conditional relationships between variables using Bayes' theorem.
- The network is made up of nodes that represent model variables and arcs that determine the mutual influence of the nodes.
- It provides a range of possible outcomes with some level of uncertainty in the form of conditional probabilities.

Research area

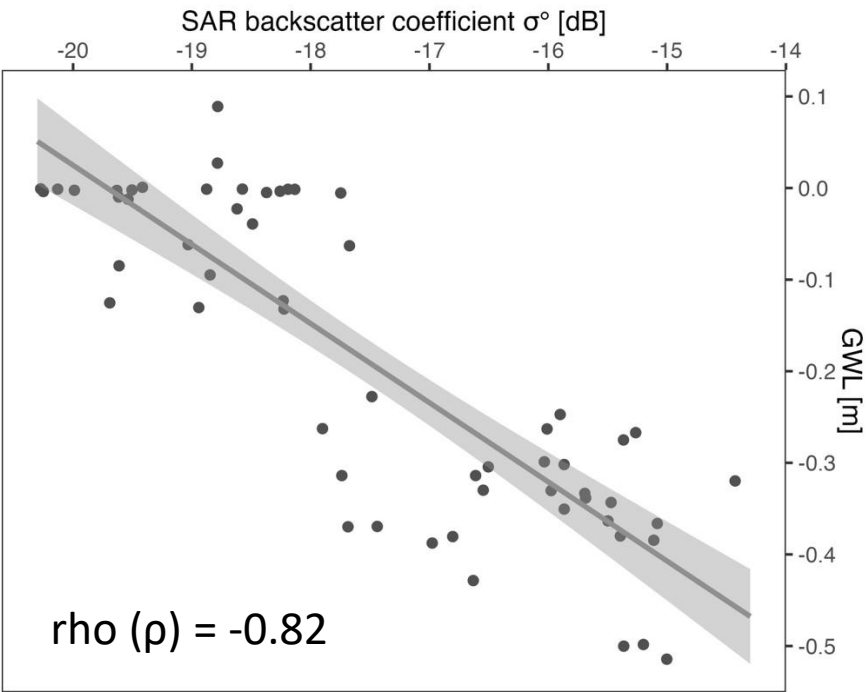
- Biebrza National Park
- Long-term groundwater monitoring
- Includes different types and states of peatlands
- 45 piezometers selected



Input data



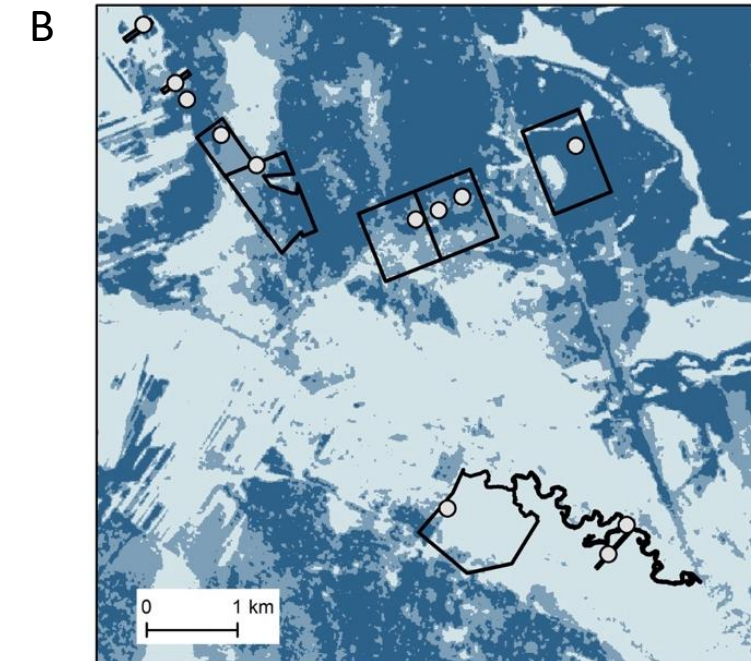
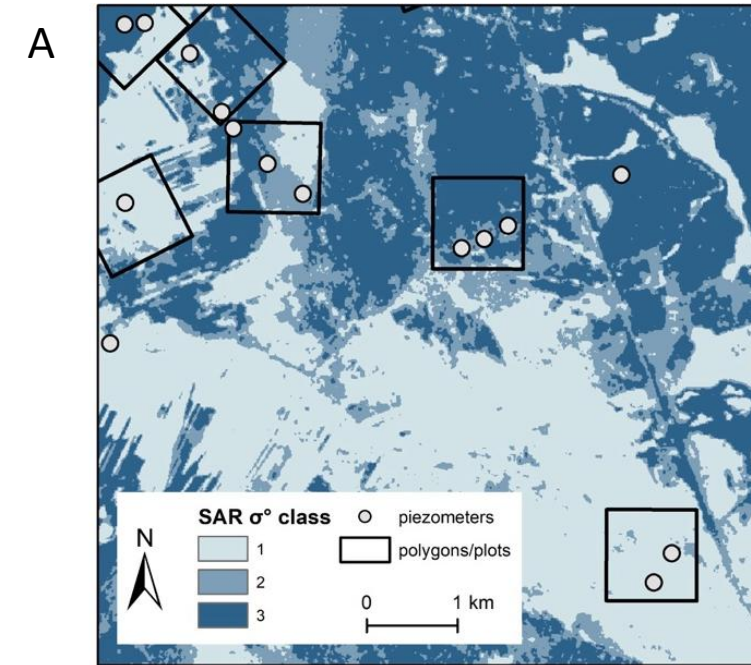
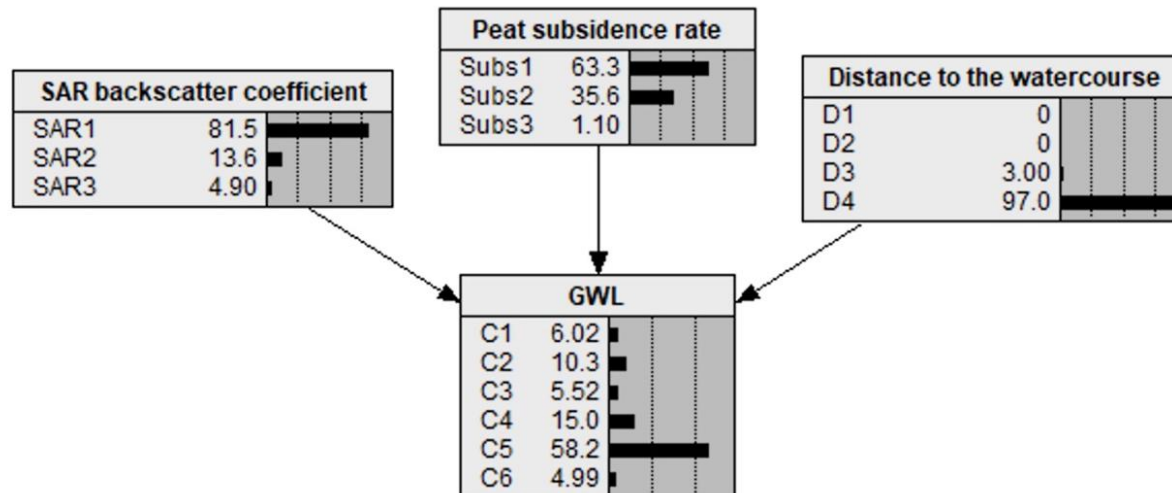
- Remote sensing data were allocated to each point feature corresponding to piezometer locations.



Parameter	Class	Values
Groundwater level [m]	C1	< -0.4
	C2	-0.4 to -0.3
	C3	-0.3 to -0.2
	C4	-0.2 to -0.1
	C5	-0.1 to 0.0
	C6	> 0.0
SAR backscatter coefficient σ^0 [dB]	SAR1	< -18
	SAR2	-18 to -16
	SAR3	> -16
Peat subsidence rate [m · year ⁻¹]	Subs1	-0.05 to -0.02
	Subs2	-0.02 to -0.01
	Subs3	-0.01 to 0.05
Distance to the watercourse [m]	D1	0 to 25
	D2	25 to 100
	D3	100 to 440
	D4	> 440

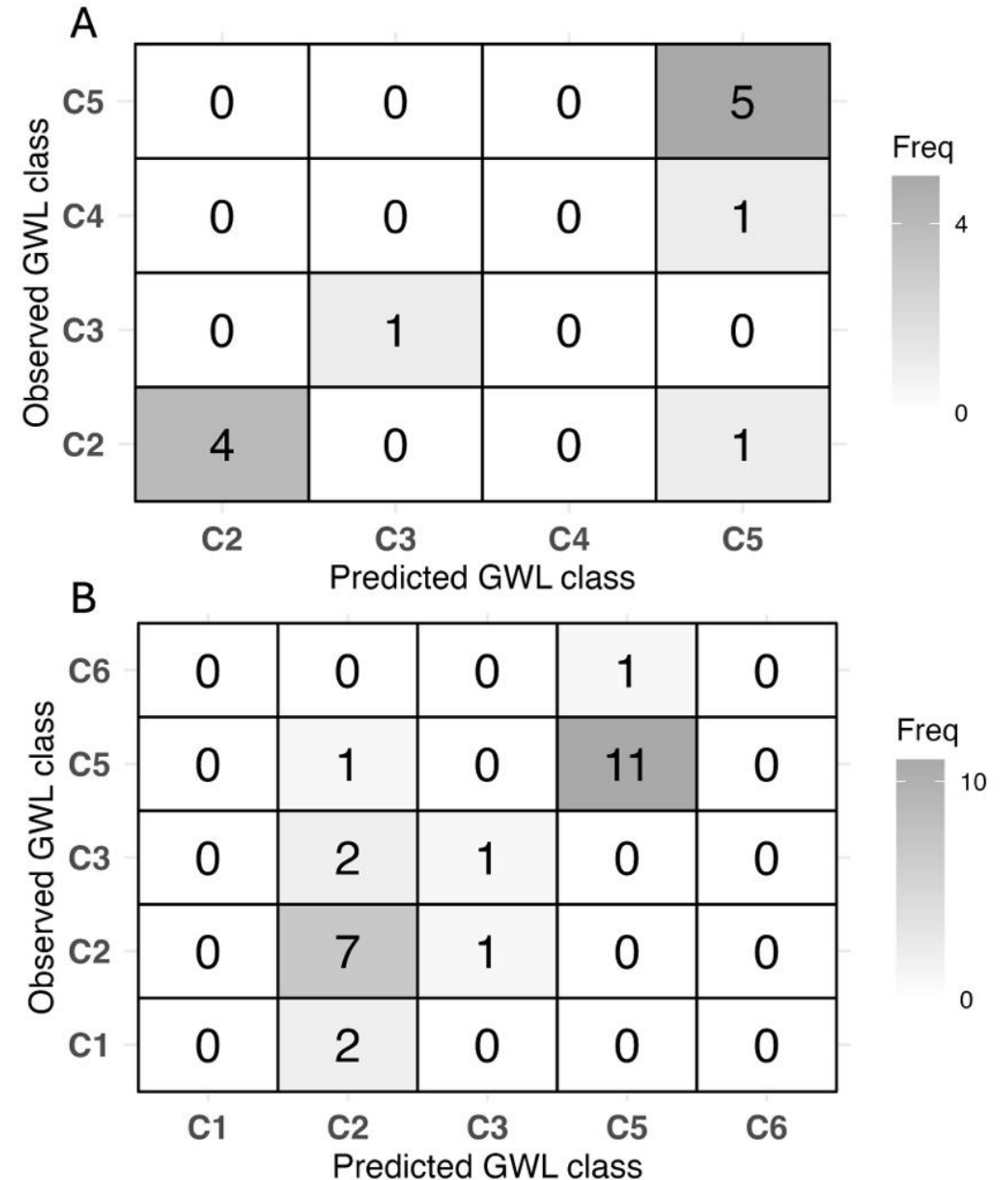
Model validation and results

- Due to the limited availability of data, two approaches were used to validate the network.
- The first approach involved the creation of 12 random polygons of 100 hectares (Figure A), each of which included at least two piezometers, in order to calculate the average GWL over their area.
- In the second approach, 26 BbPN plots were used (Fig. B).
- The percentage of area of each model parameter class was then determined within each polygon/parcel.



Model validation

- Random 100 ha polygon method (Fig. A):
 - 10 out of 12 matched classes
 - 83.3% accuracy
- BbPN plot method (Fig. B):
 - 19 out of 26 matched classes
 - 73.1% accuracy
- Sensitivity analysis:
 - SAR backscatter coefficient has the strongest influence over the model's result



Model uncertainties

- Low variability of the observed ground ZW
- Small amount of data for model training
- Uncertainty due to the nature of remote sensing data
- Is the level of accuracy obtained sufficient for practical applications such as estimating GHG emissions?

