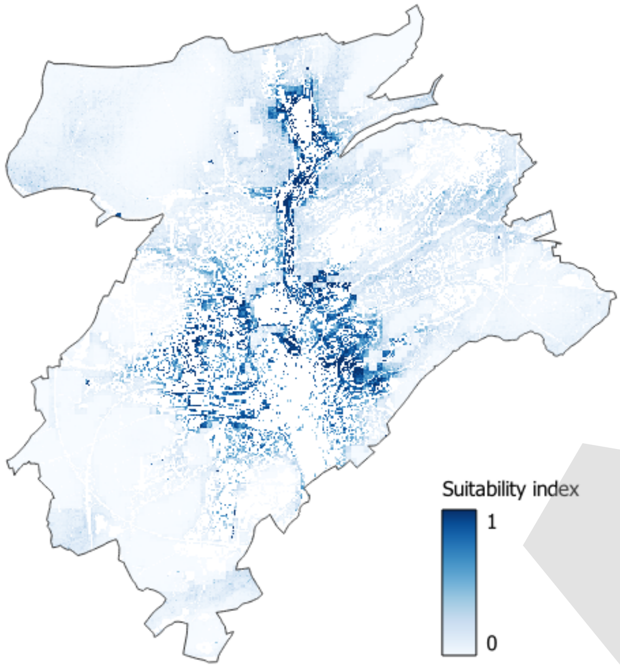
Invasive plant species in Luxembourg city

Reynoutria Japonica

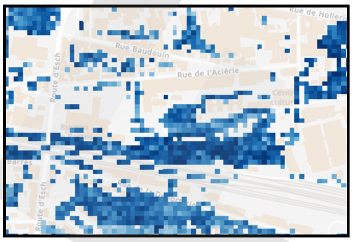
The Japanese Knotweed creates problems on biodiversity, flooding management and damage to property.

Suitability map

Suitability maps are generated using the species distribution model MaxEnt, which combines presence data and environmental variables to determine the probability of an area to support the plant growth.

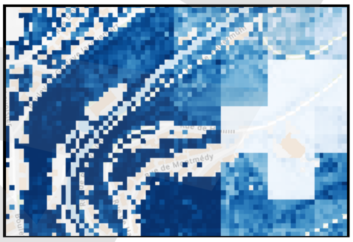


According to the model, Reynoutria Japonica is most likely to grow in densely urbanised areas, and in the valley, such as the Alzette valley.

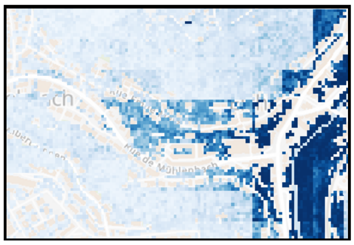


Along the railway line

By W.carter - Own work, CC0



Along the Alzette river

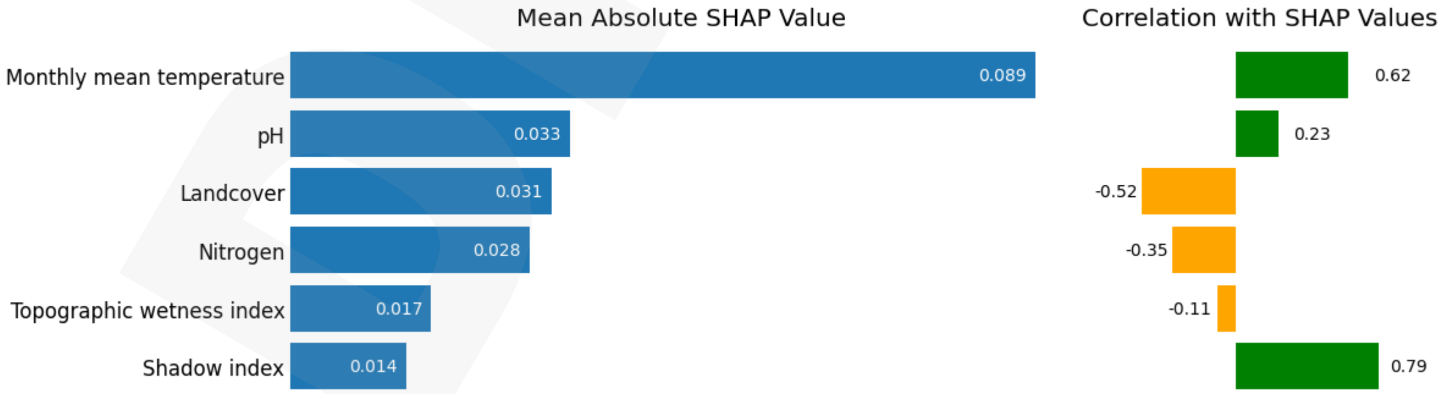


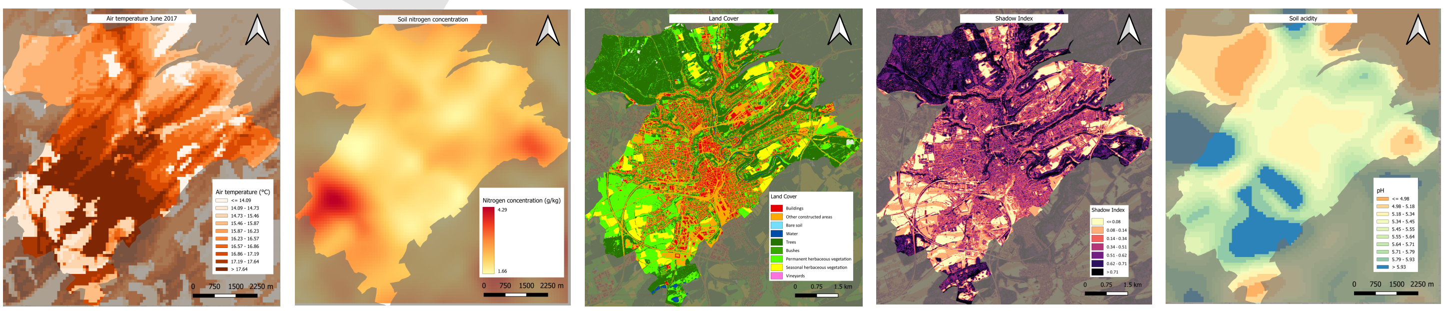
Mühlenbach

Explanatory model analysis with Shapely values

SHAP (SHapley Additive exPlanations) is a model interpretation technique that quantifies the contribution of each feature to a prediction. The mean absolute SHAP values measures the global variable importance, while the correlation of SHAP values with variables indicates the direction and strength of the influence.

Mean monthly temperature has the strongest influence on the suitability, with higher values increasing suitability in a relatively consistent way. **Soil acidity** is the second most influencial variable, closely followed by l**and cover**. Higher soil acidity values increase suitability, but their effect is less certain. On the other hand, low land cover categories (bare soil, trees and bushes) have a similar effect on the model, with higher reliability.





Model input variables

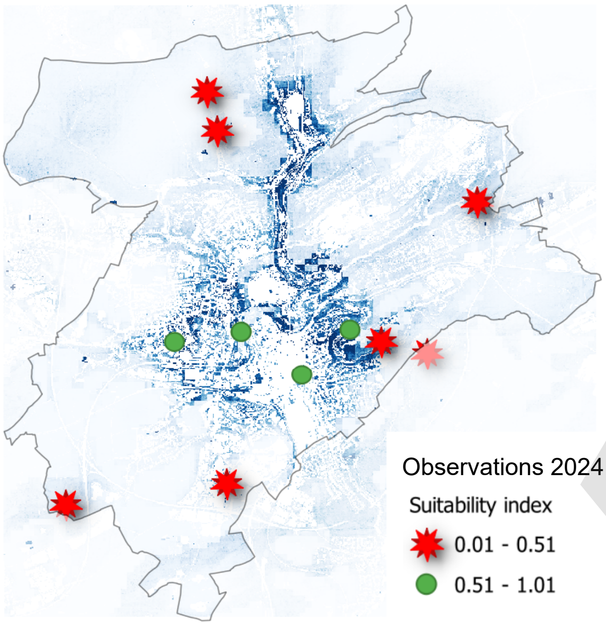
Invasive plant species in Luxembourg city

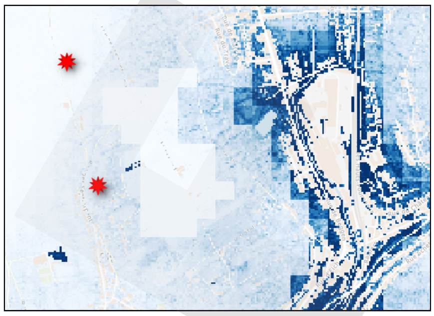
Reynoutria Japonica

Model validation

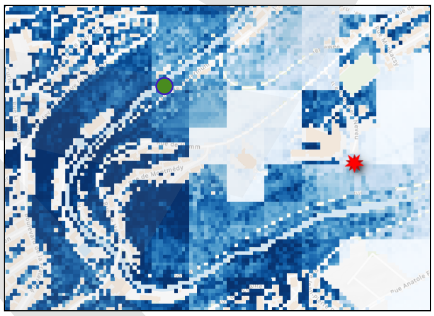
Number of observations: 104
AUC score > 0.9

The model output was validated new observations collected in 2024. Four out of the eleven plant occurrences were observed in an area with high probability of plant growth, while seven were discovered in low probability areas. This suggests that the current distribution model for the Japanese Knotweed might underestimate the spread of the plant.





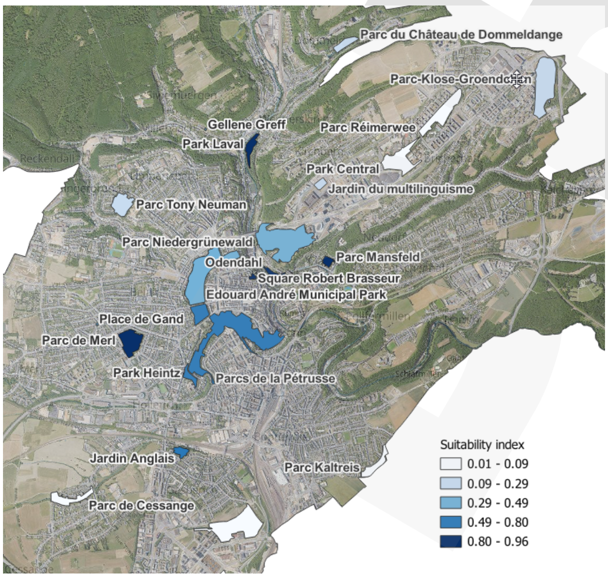
Two occurrences observed in the Bambesch forest. The model suitability prediction for this area is below 0.2.

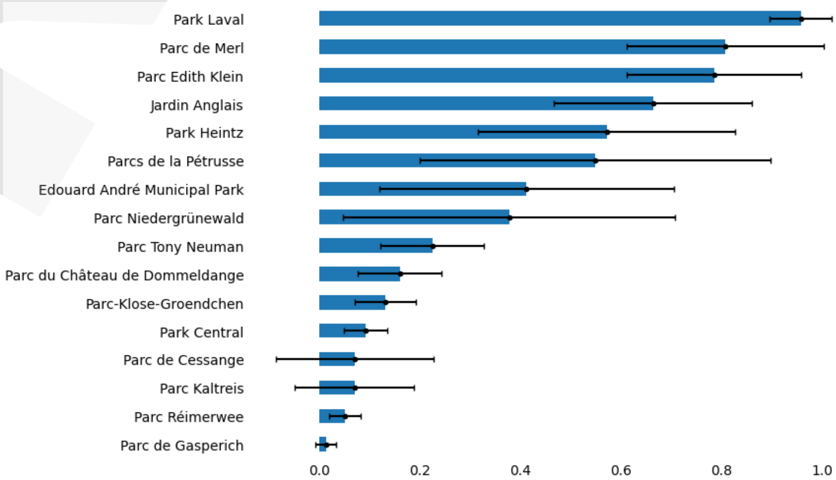


One occurrence of Japanese Knotweed observed along the Alzette river, in green (suitability >0.7) and one on top of the hill, where the suitability is below 0.2, although the area show high variability.

Impact assessment - City parks

The Japanese Knotweed is likely to grow in municipal parks, too. **Park Laval**, located along the Alzette river, and **Parc de Merl** present the most suitable conditions. Of the 16 parks considered, six of them show an average suitability index above 0.5. The size of the park plays a role: **Parc de la Pétrusse** has an average index of 0.58, but with considerable variations.





Parks ranked by average suitability index. The black line indicates the standard deviation.

Further information and credits

elapid: Anderson, C. B. (2023). elapid: Species distribution modeling tools for Python. Journal of Open Source Software, 8(84), 4930. https://doi.org/10.21105/joss.04930

shap: Lundberg, S. M., & Lee, S.-I. (2017). A Unified Approach to Interpreting Model Predictions. In Advances in Neural Information Processing Systems 30

Metadata records of the input variables are available in the FAIRiCUBE STAC Catalog.

Species occurrence data were downloaded from mdata.mnhn.lu and GBIF (DOI: 10.15468/dl.sqknbh).

This project has received funding from the Horizon Europe programme under grant agreement No 101059238.