Wales Data Nation Accelerator

Using AI and big data to optimise land management decisions for reducing river flood risk

Summary

Challenge

Local authorities across Wales are increasingly seeking natural approaches to river flood management, especially the role of land management decisions in reducing peak flows. Physics-based hydrological models, which simulate river flood response to storm events, can provide multi-scenario assessment of land-use changes on floods. However, they require prior calibration of parameters using measured streamflow data, which is not available for many rivers. We investigate how AI and big data can be used to implement hydrological models in river basins with no streamflow data.

Solution

We developed an AI toolkit to relate observed streamflow from several river basins to their physical attributes (land use, topography, soils) and data from SWAT+ hydrological model. Three AI algorithms, ANN, SVM, and RNN, were tested across 12 river basins in Gwynedd, Wales. Best performing AI models (ANN and RNN) have the potential to assess the impact of land management on flooding.

AI model training input data (left), trained AI model input data and output data (right)

Calibrated SWAT+ catchments used to train the AI models

1. Erch
2. LLyfni
3. Dwyfor
4. Gwyrfai
5. Glaslyn
6. Peris
7. Elwy
8. Gelyn
9. Tryweryn
10. Mawddach
11. Dee (at New Inn)
12. Cerist

Benefits

- Open-source web application created – SWAT+ AI: https://github.com/alexrigby/SWAT_AI

- SWAT+ AI builds on our previous land use change toolkit (LUCST) developed in collaboration with Gwynedd Council.

- Reduced streamflow prediction times and potentially greater accuracy than previous methods.

- AI powered flood scenarios can be made accessible to non-technical users.

- Increasing the size of training dataset has the potential to improve the toolkit's usability.

Further exploitation/next steps

- Increase the training hydrological data to > 100 river basins across Wales and England to improve the AI model's accuracy.

- Couple SWAT+ AI and LUCST toolkits to streamline land management scenarios.
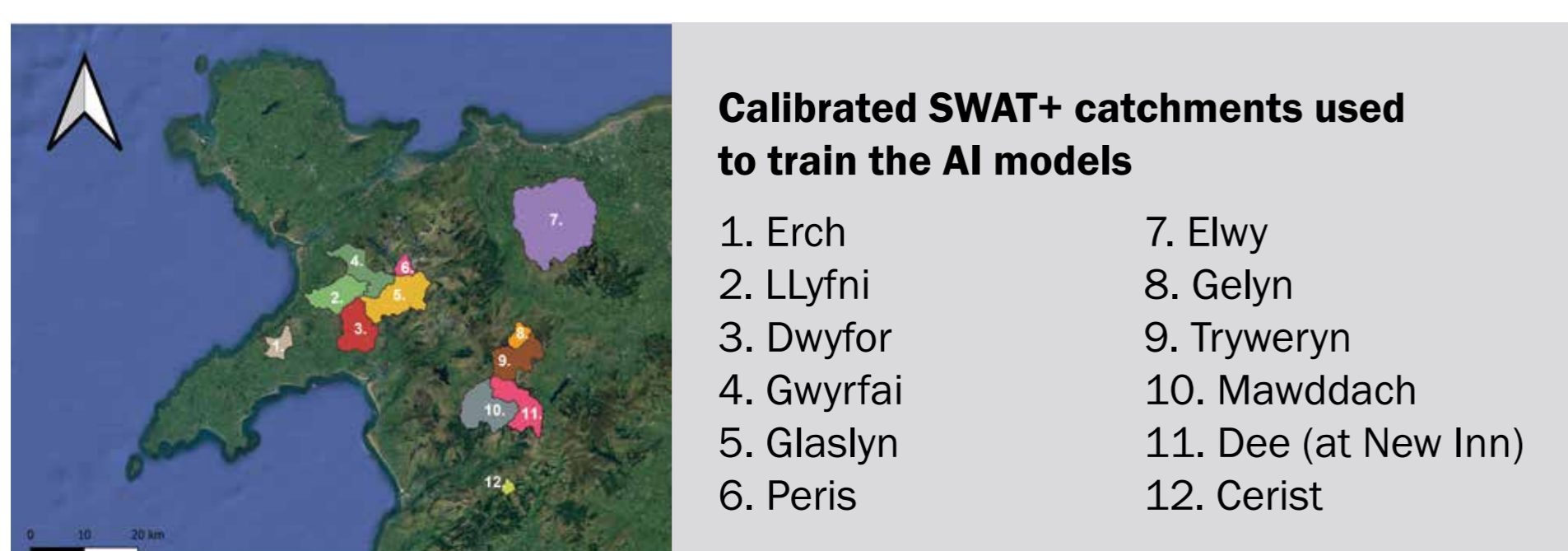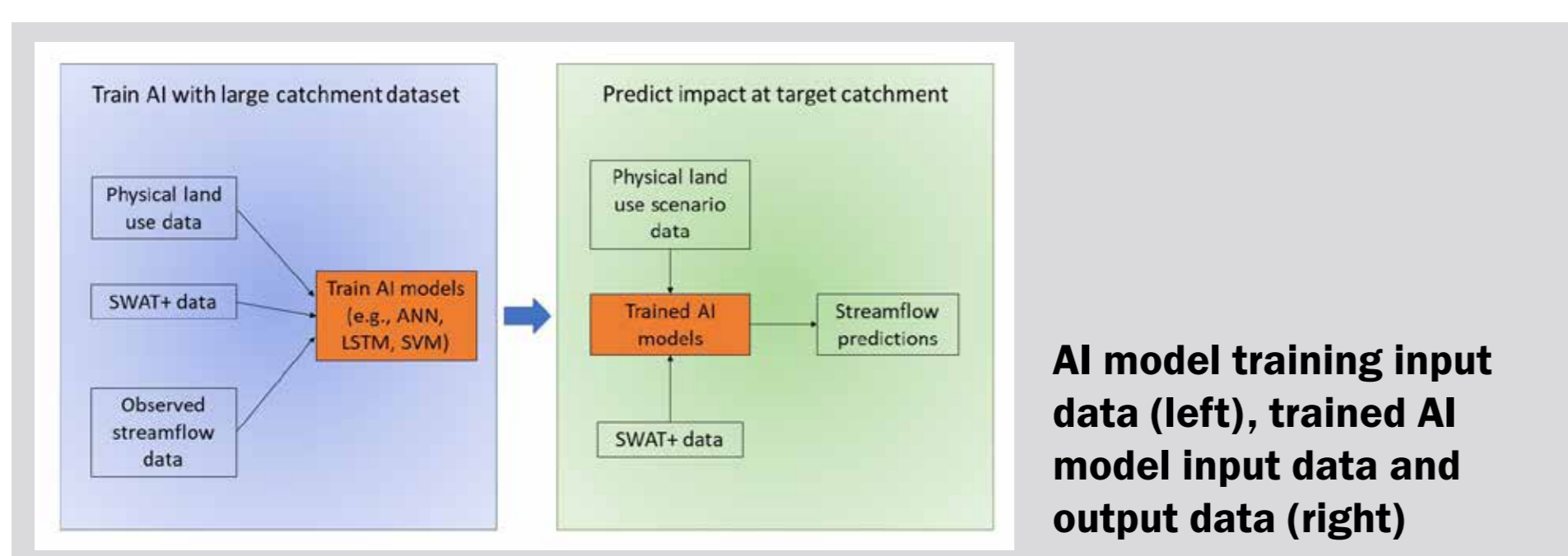
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