Local to Country Scale Flood Forecasting

Robert Berry[1], Neil Hunter[1], John Bevington[1] and Rob Lamb[1,2] | [1]JBA Consulting, UK [2]JBA Trust, UK

JBA trust

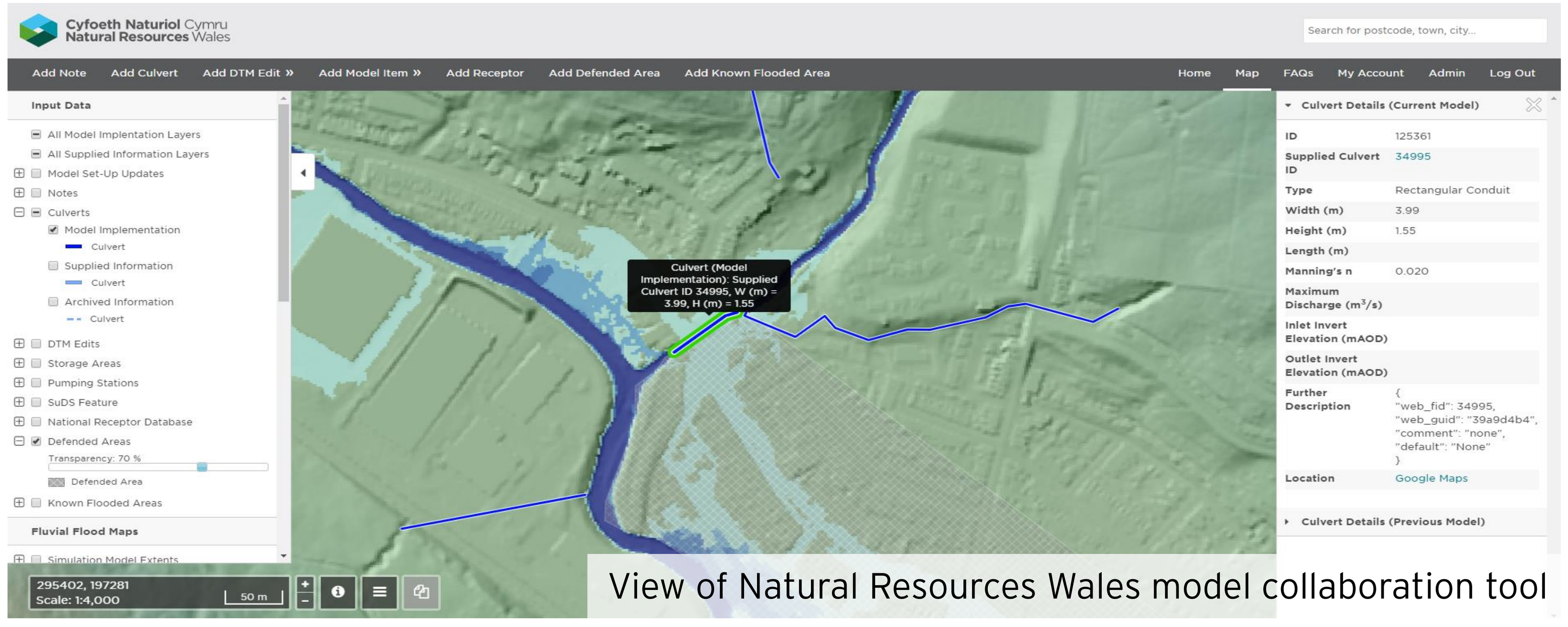
JBA consulting

Machine Learning (ML) to reduce model setup time

ML can be combined with Google Street View to find culverts and bridges. This is important to correct for flow routes not "seen" by the DEM. In the UK Surface Water Map we manually made 96,000 edits to the model.

We are using ML to detect levees in the US from DSM/DEM data, trained from our levee line datasets – we hope to extend this with remote sensing data to gather information on levee deterioration and/or failure.

Google Street View used to infer flow route in model not "seen" by the DEM



View of Natural Resources Wales model collaboration tool

Collaboration tools to generate training data for local model corrections

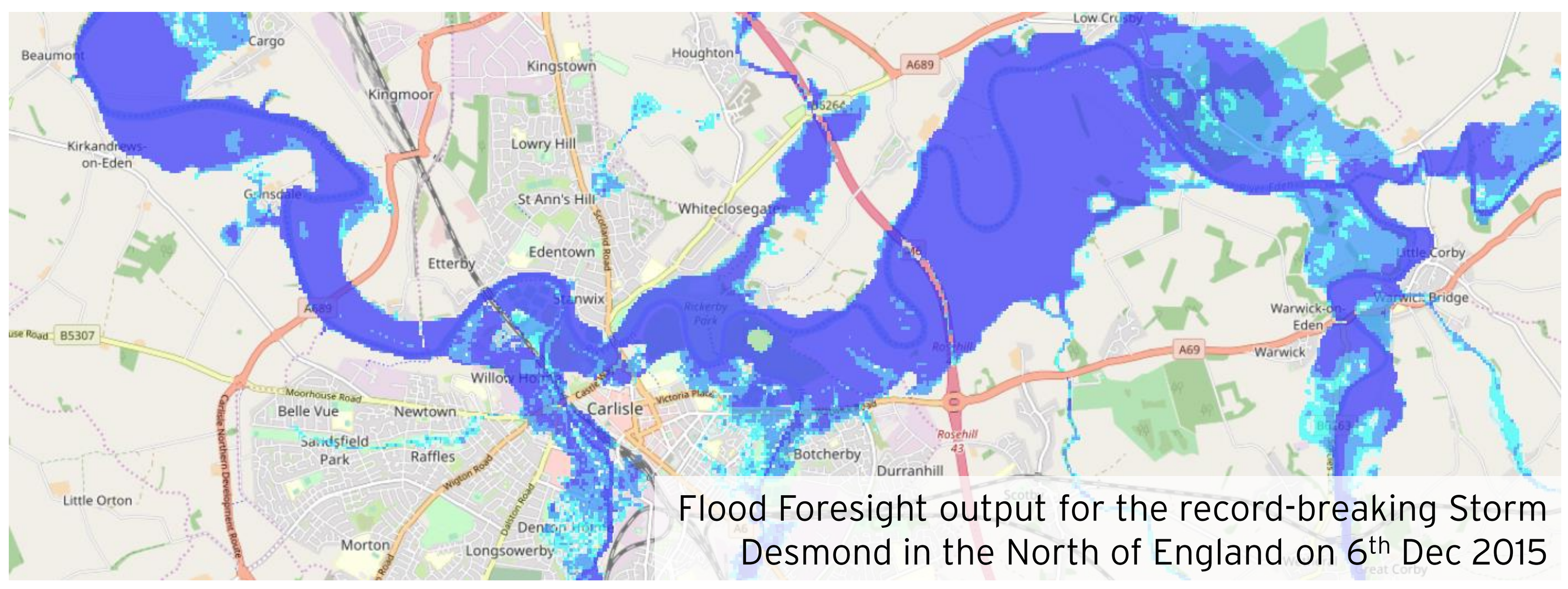
In recent projects in the UK and Belgium, we have developed collaboration tools which can help obtain local knowledge and data from stakeholders and seek their opinion on model outputs. This provides a useful dataset for ML training in the future.

	Local (~1 – 10km)	Blurring the line	Country (~100 – 1000+ km)
Model preparation	Physical and process detail is usually fully represented e.g. channel, structures and flow routes, detailed hydrology Long time to setup (weeks + $000's per km) Models typically based on routing, 1d, 2d or quasi 2d	Collaboration tools can help obtain additional data from stakeholders ML to reduce model setup time Local forecasting towards 1d ensembles, 2d and pre-computed. Country scale forecasting towards 2d with smaller cell size	Physical detail is partially considered, dependent on available date and model type Relatively quick to setup Models typically based on routing, pre-computed library approach, 2d with larger cell size or quasi 2d
	Both scales can involve significant time in processing terrain / weather and vulnerability data		
During events	Computational effort is straightforward – model runtimes ideally < five minutes but many models required for a large area Monitoring flood impacts and emergency response is typically a manual process	Becoming easier with increased compute power and horizontal cloud scaling	Computational effort generally higher – ranging from pre-computed/routing, to quasi 2d, to 2d. GPU technology often required for 2d.
	Antecedent catchment conditions and interactions between different flood sources rarely considered in forecasting		
After events	(Re-) Calibration involves hydrological and hydraulic processes, comparing flows and water levels in and out of bank, along with the timing of the hydrograph Effectiveness of flood warnings assessed by manual review of actions and outcomes	RS and ML processes for training models Moving towards targeting of semi-automated alerts	(Re-) Calibration usually involves timing of the flood and the area inundated Effectiveness of warning at the local scale is not yet fully assessed
	UK research suggests that people just want to be informed if they are in danger of flooding and what action to take – don't make them interpret		

Development of a new forecasting system for England

The English Environment Agency's "Flood Information Service" delivers fluvial and coastal flood warnings to the public. Warnings are generated from the forecasting service which is currently being re-developed by Deltares and JBA. In the future we hope to be able to enable ML to move towards semi-automated warnings for fast responding catchments.

Environment Agency flood incident room – Copyright Environment Agency – John Curtin



Flood Foresight output for the record-breaking Storm Desmond in the North of England on 6th Dec 2015

Flood forecasting in near real time

Our Flood Foresight system uses our library of pre-computed global flood maps to deliver an innovative forecasting product. With modest resources we can generate near real-time flood hazard and risk maps from gauge sensors or outputs of rainfall-runoff models.

Robert Berry | robert.berry@jbaconsulting.com | www.jbaconsulting.com | @JBAConsulting | JBA Consulting