# Predicting stream flow from forested catchments

The movement of water through the forest and soil to the stream is an important ecosystem service. Forest and water resource managers use tools to predict the effect of forest management on catchment water balance and streamflow.

A new model developed in the Forest Flows research programme accurately predicts tree growth, forest water-use and streamflow.



*Smart dendrometer measures tree growth and water use.*

## Predicting water movement in New Zealand forests

Old hydrology models are too simplistic for New Zealand forests, they:

- Are based on agricultural soil models.
- They don't represent the different soil compositions, steeper topography, water drainage or soil systems found in New Zealand soils.
- Use static values (constants) to estimate forest water use (crop factors) or use a 'tipping bucket' model.

We know that water movement in New Zealand forest environments is more complex than accounted for by these models. We needed a suitable model to be able to predict movement over entire catchments, including streamflow.

## Linking forests the stream

In Forest Flows we built a new model called the Forest Flows Hydrological model that links the forest with the stream and tested it using data collected in New Zealand.

For the new model, we built upon two existing models:

- We modified the water balance of CABALA, a well-regarded model of forest growth to create CABALA-W.
- We linked CABALA-W with a two-dimensional hillslope model of streamflow.

CABALA relied on a 'tipping bucket' flow where water can only move downwards, draining from the layer above only when full. In CABALA-W, water can move up or down with no threshold requirement for movement between layers. The more realistic water balance improves accuracy of predictions.
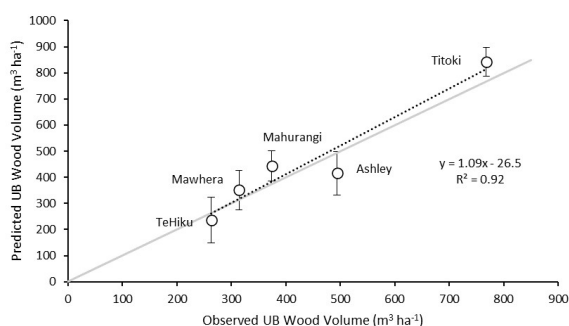


*The predicted and observed (direct measurements) wood volume at the five primary Forest Flows sites across a rainfall gradient demonstrates the accuracy of the model.*

The Forest Flows Hydrological model produces very realistic predictions of streamflow. By making a very simple change we were able to predict both the peak flows and how quickly streamflow returned to baseline after a rainfall event in the Forest Flows Catchments.

Scion's Forest Flows research programme fills a gap in forest hydrology research over the last 40 years. Extensive, integrated sensor networks were set up at five primary forest sites across New Zealand. They cover a range a catchment sizes and are across a rainfall gradient (800-3000mm per year). Rainfall, tree growth, soil moisture, water age and more have been measured and analysed. The programme was supported by the MBIE Endeavour fund.
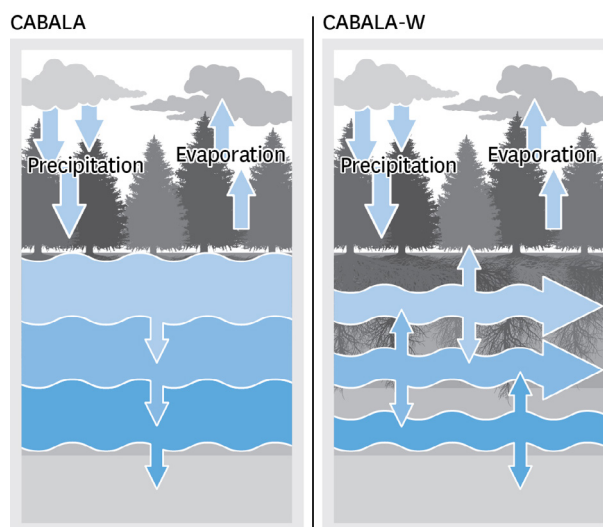
*A representation of the main differences between the old CABALA model and improved water balance in CABALA-W.*

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## About Scion

Scion is the Crown research institute that specialises in research, science and technology development for forestry, wood and wood-derived materials, and other biomaterial sectors.

Scion's purpose is to create economic value across the entire forestry value chain, and contribute to beneficial environmental and social outcomes for New Zealand.