

Factsheet 05

Te Whakaheke o Te Wai

Data-driven modelling

We are developing machine learning techniques to better characterise groundwater age (see Factsheet 6). These techniques have shown promise in predicting groundwater age from chemistry and from properties that are available consistently for all of New Zealand (e.g., rainfall recharge, geology). These models rely on statistical relationships between predictive variables and outputs. In data-rich areas, the outputs can provide a cost-effective alternative to traditional physics-based modelling when extrapolating information from age data.



Our models are informed by:

- Physical properties (e.g., geology, rainfall recharge, permeability, well depth)
- Geography (e.g., distance from the coast, or a stream)
- Groundwater chemistry and tracer measurements (see Figure).

Data-driven modelling

These models help "fill in the gaps" from measured groundwater observation data. Our novel techniques allow extension of spatial coverage for groundwater age. Relationships between existing and routinely collected groundwater monitoring data (e.g., age, chemistry) can be defined. The models continuously improve as new data is added. National models were developed using only properties that are consistently available across New Zealand. In data-rich areas, regional models can be developed using enhanced datasets, for example Hawke's Bay where a extensive (space and time) chemistry dataset is available.

The types of questions (predictions) that groundwater age information and maps enable us to answer include:

- Where is groundwater likely to be young or old?
- How long will it take for a contaminant to reach a bore?
- Which areas are unlikely to see legacy contaminant events for some time?
- Where should we site groundwater wells for secure drinking water?



Ultimately, through machine learning we can make better use of data for decisions. This supports stakeholders and decisionmakers to safeguard and preserve critical freshwater resources for future generations. To date, these models have been developed and tested in Heretaunga Plains, Wairau Plains, and in the Manawatu.

<u>Tschritter et al., 2023.Estimation of groundwater age distributions from</u> <u>hydrochemistry: comparison of two metamodelling algorithms in the</u> <u>Heretaunga Plains aquifer system, New Zealand. Hydrology and Earth System</u> <u>Sciences DOI:10.5194/hess-27-4295-2023</u>