

Modelling Resource Studies



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Who am I?

- Sophie Pearson
- Geothermal Geophysicist at GNS Science
- Primarily reservoir modeller
- Degree in Geophysics from Leeds Univ., UK 2005
- PhD in volcanology, Univ. of South Florida, USA 2010



Introduction

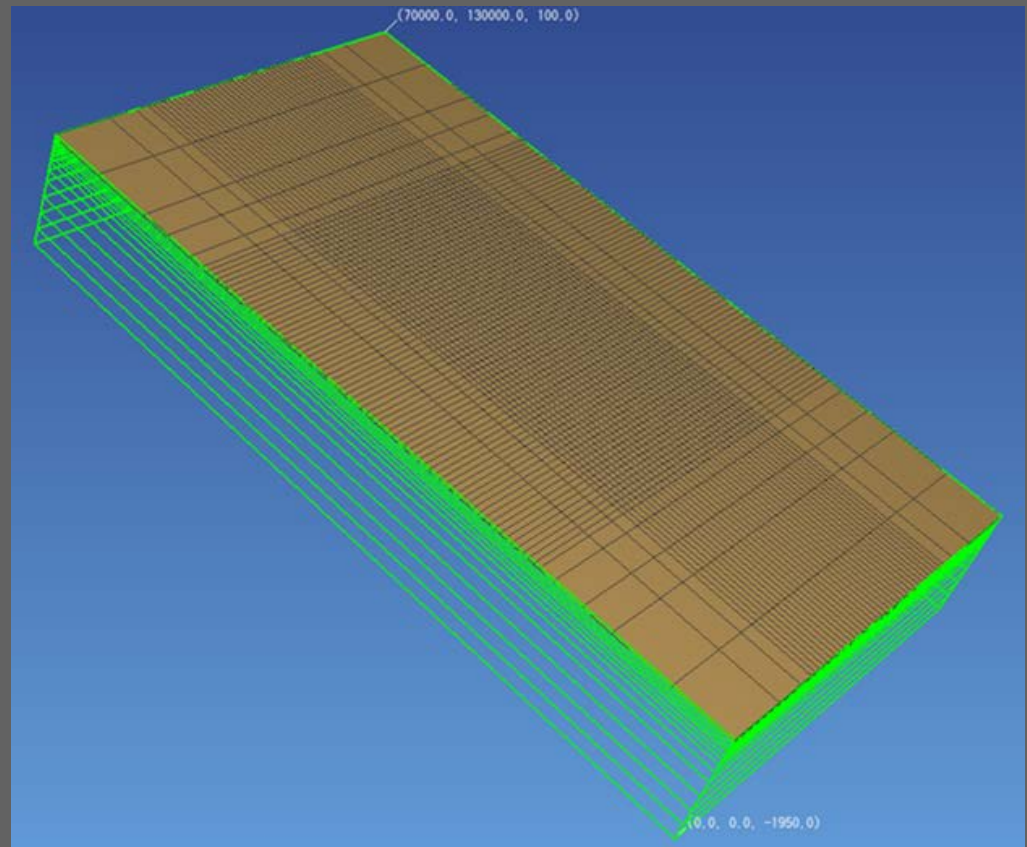
- Reservoir modelling – the basics
- Low-temperature research case studies:
 - Tauranga Geothermal Field
 - Sophie Pearson at GNS Science
 - Whitford Geothermal Field
 - Charles Molière, Masters student at University of Auckland

Reservoir modelling

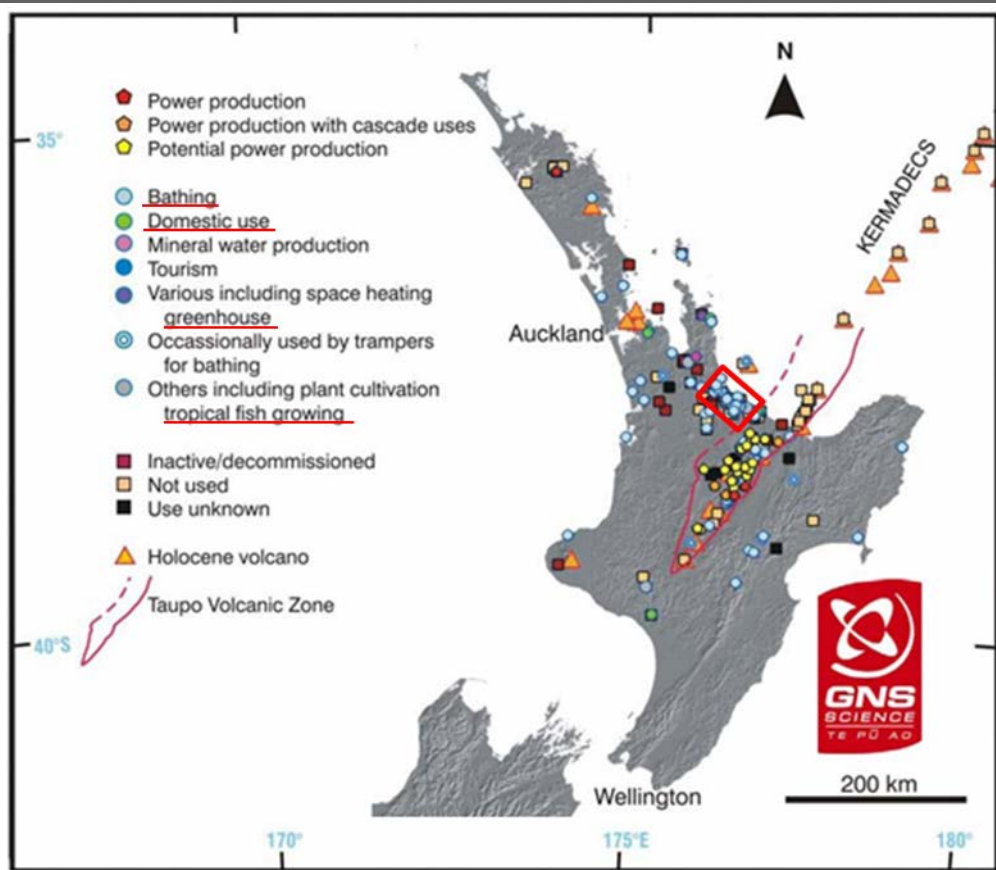
- Create a numerical simulation of geological system to see how heat and fluid flow
- Use specialised code (TOUGH2)
- Based on physical laws of heat and fluid flow
- Can deal with different phases and components
- Used in ~300 organisations in ~30 countries

What goes into a model?

- Geometry
- Structure
- Rock properties
- Temperature
- Pressure
- Heat flux

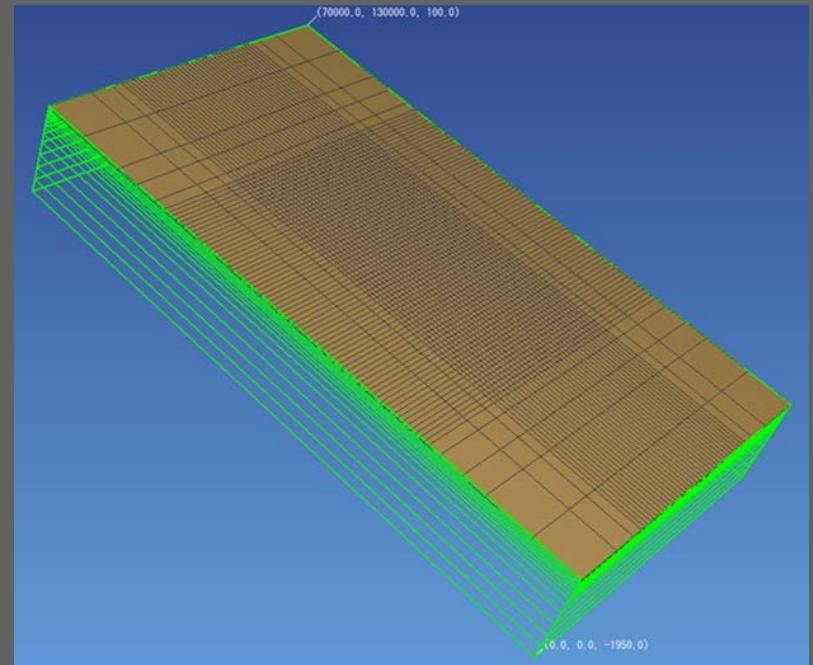
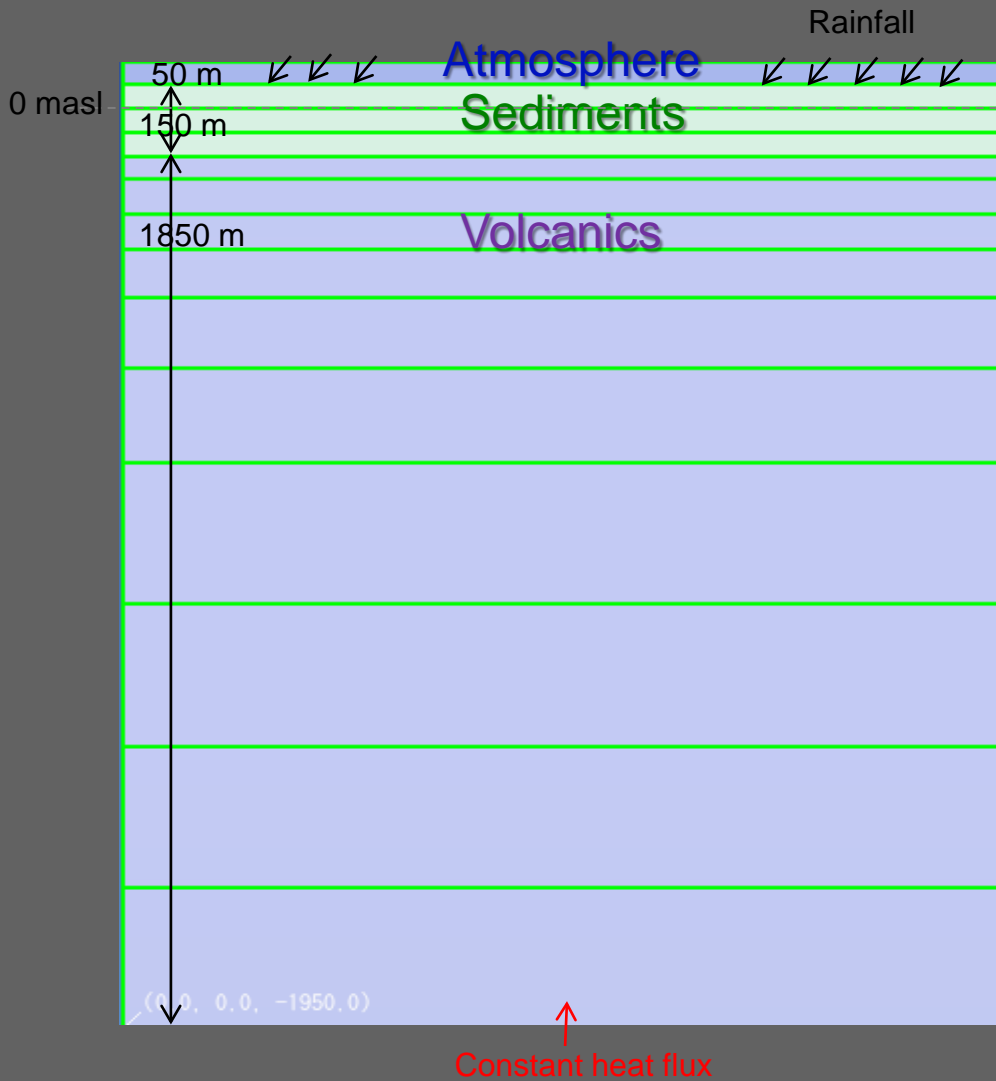


Case Study: Tauranga

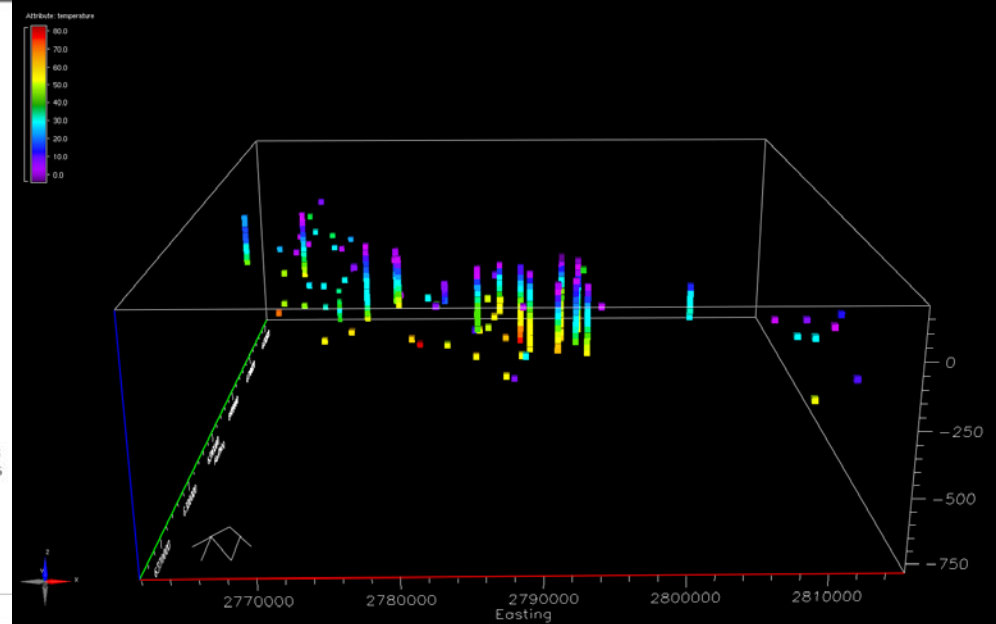
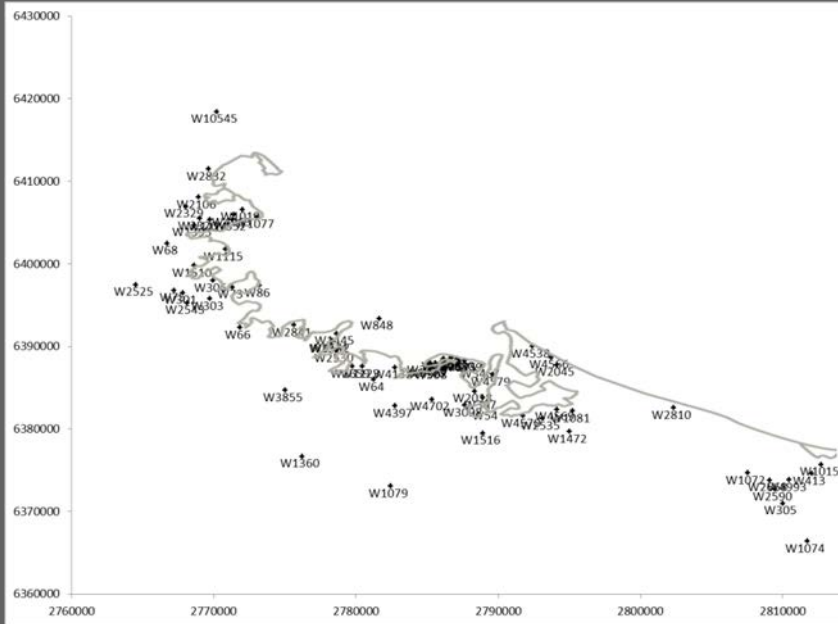


From: Reyes, A.G. (2006) Geyserslands. In: Graham, I. (ed) GSNZ monograph.

The Model

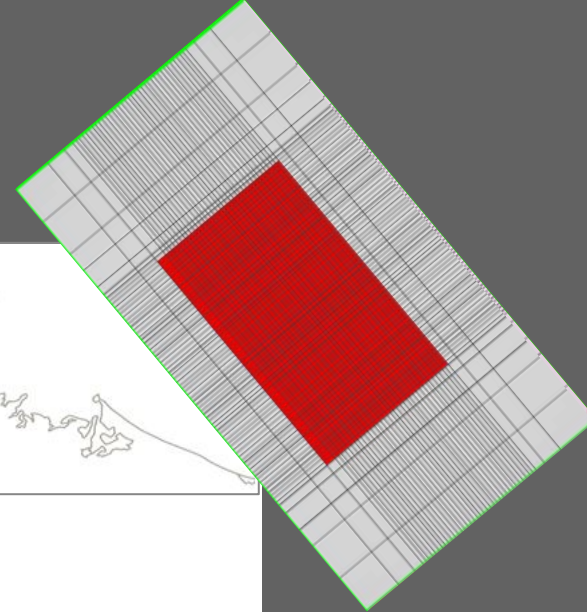
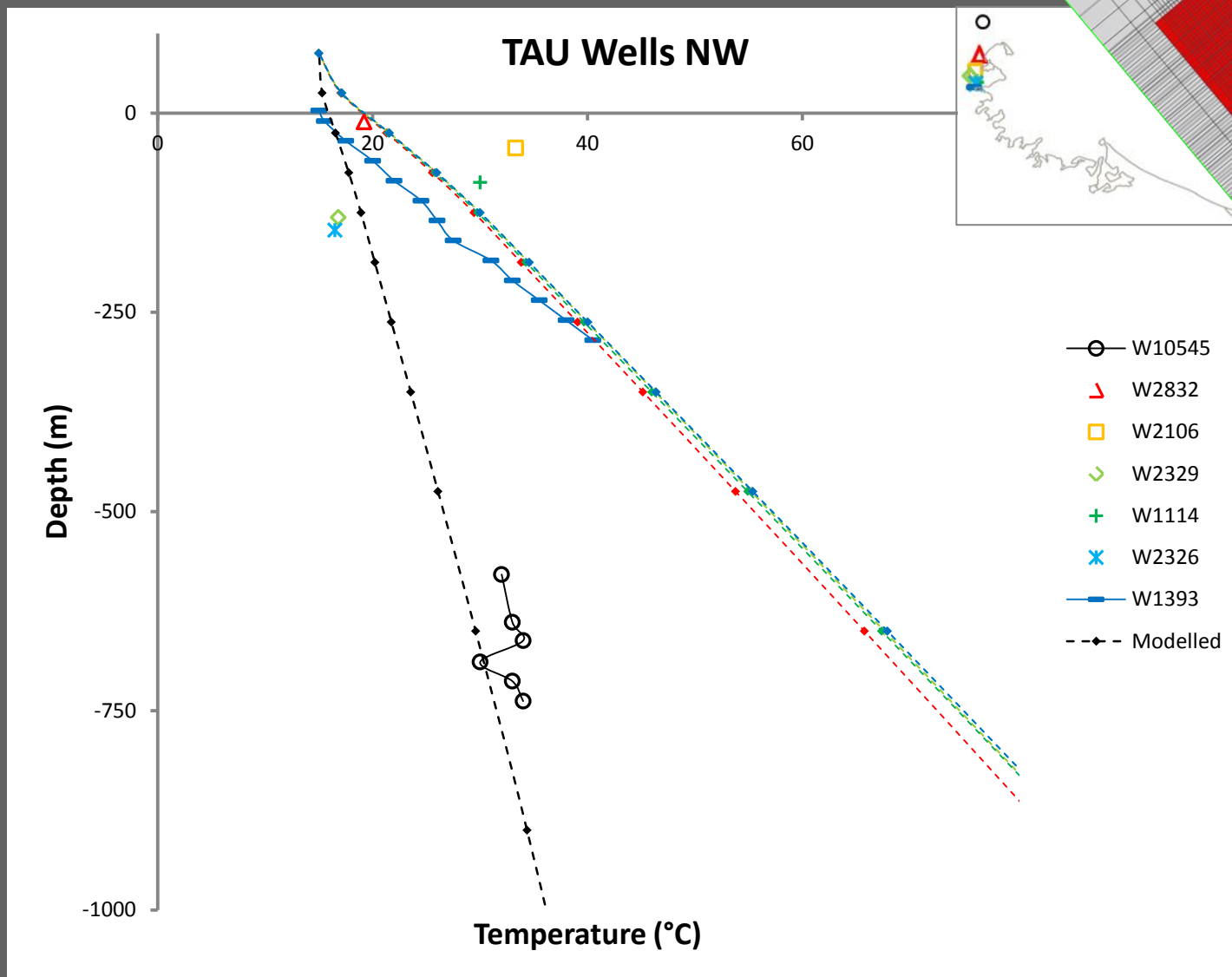


Model inputs

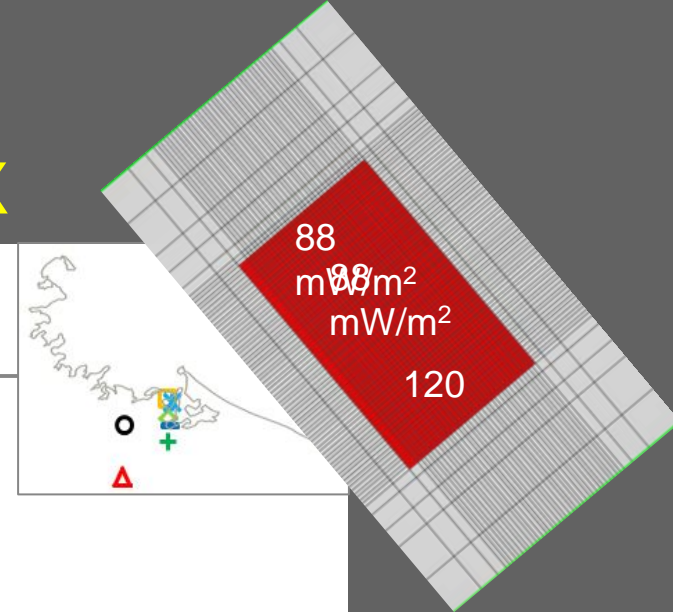
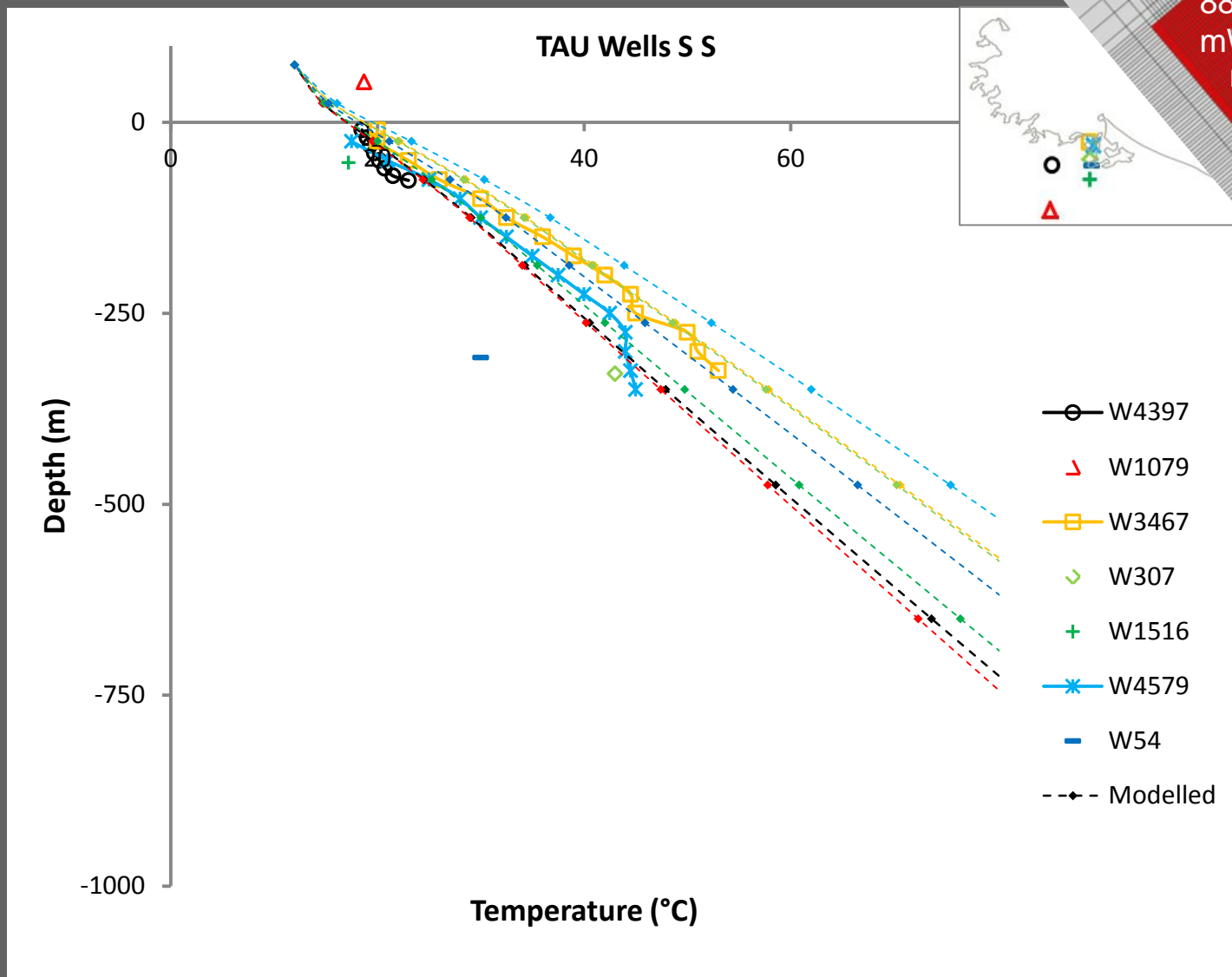


- Springs 22-39°C
- Wells 20-80°C
- 73 wells, 17 profiles

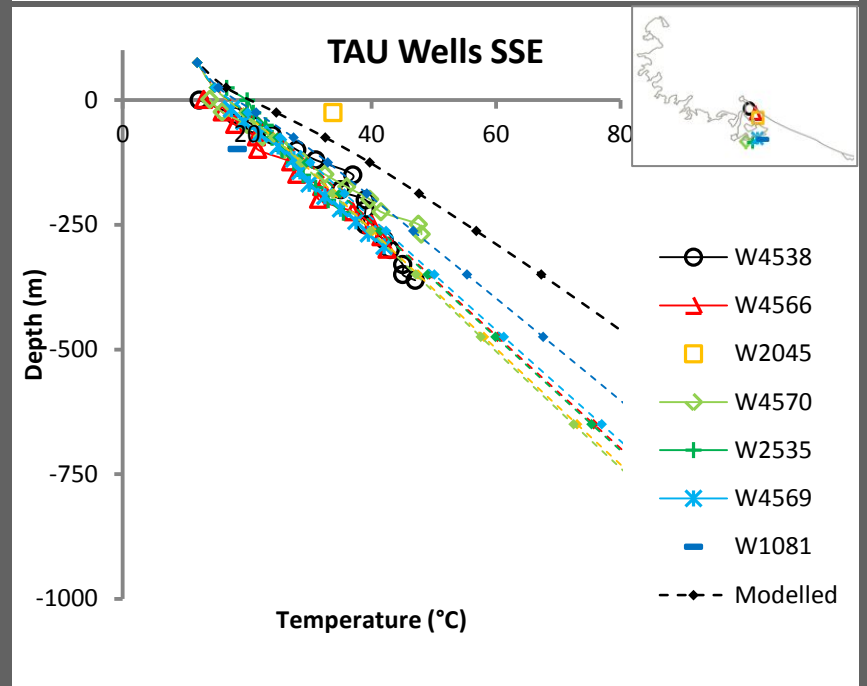
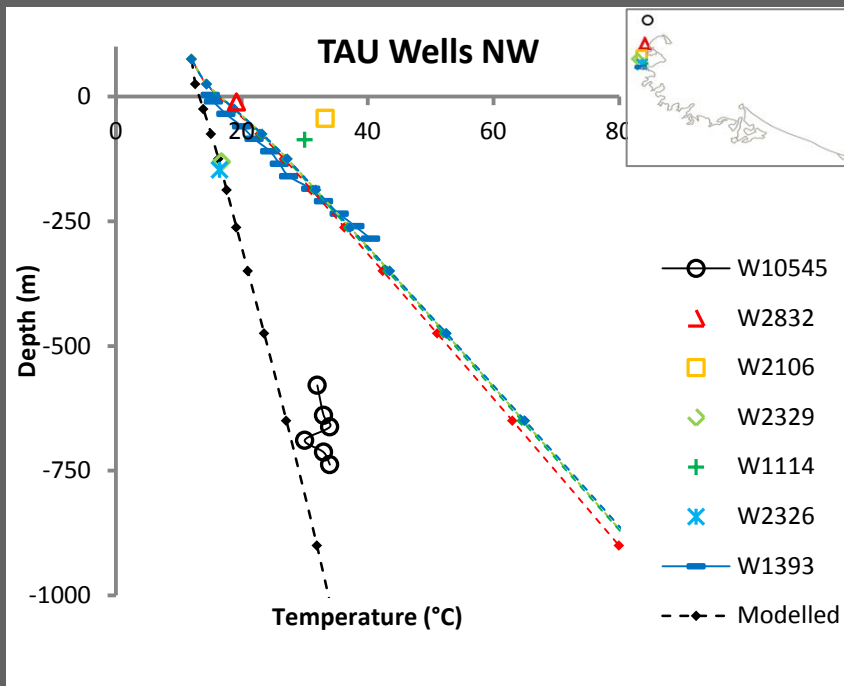
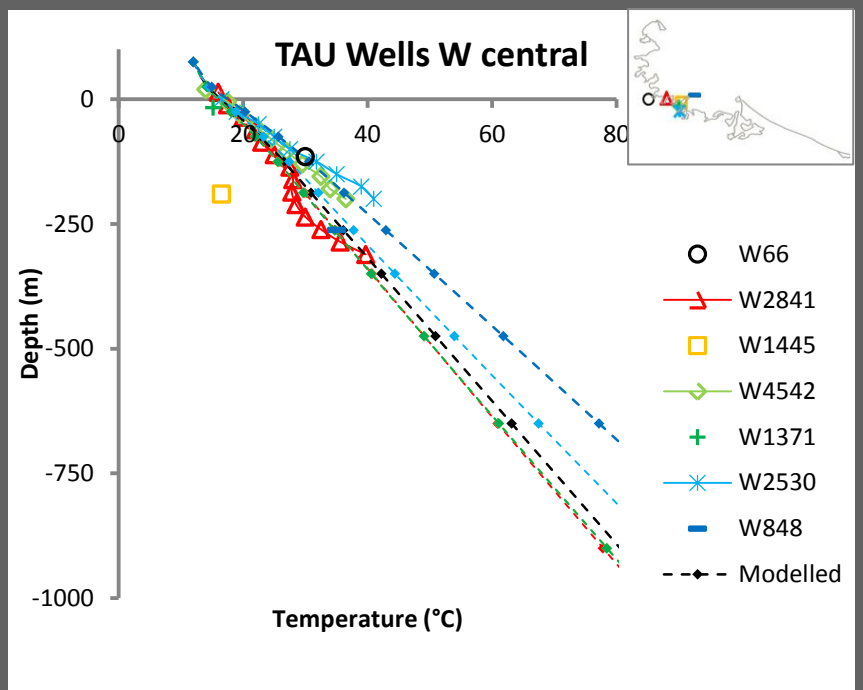
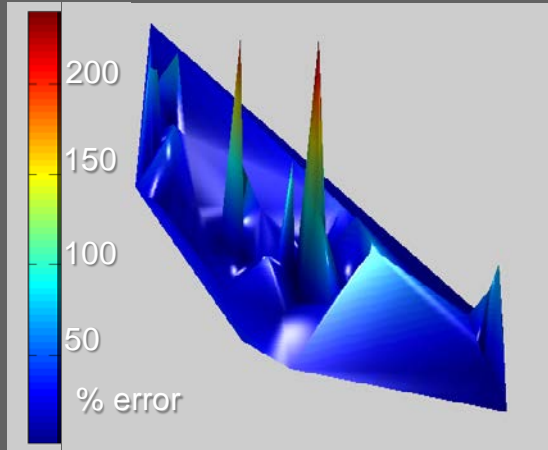
Model Inputs: Heat Flux



Model Results: Heat Flux



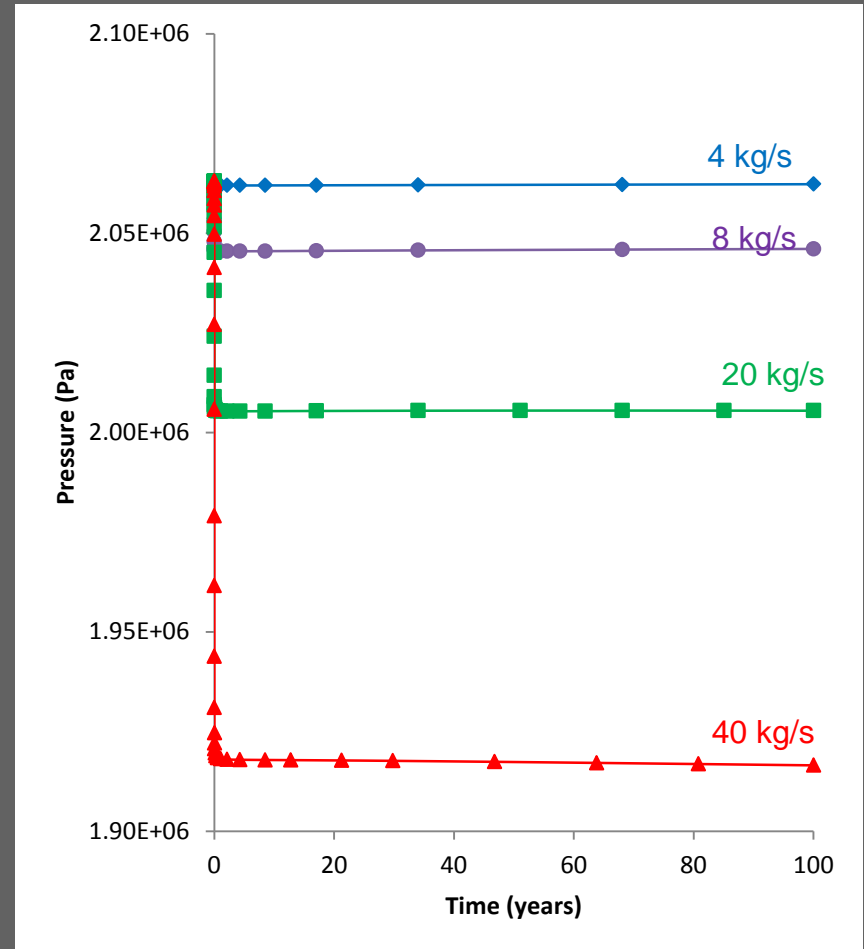
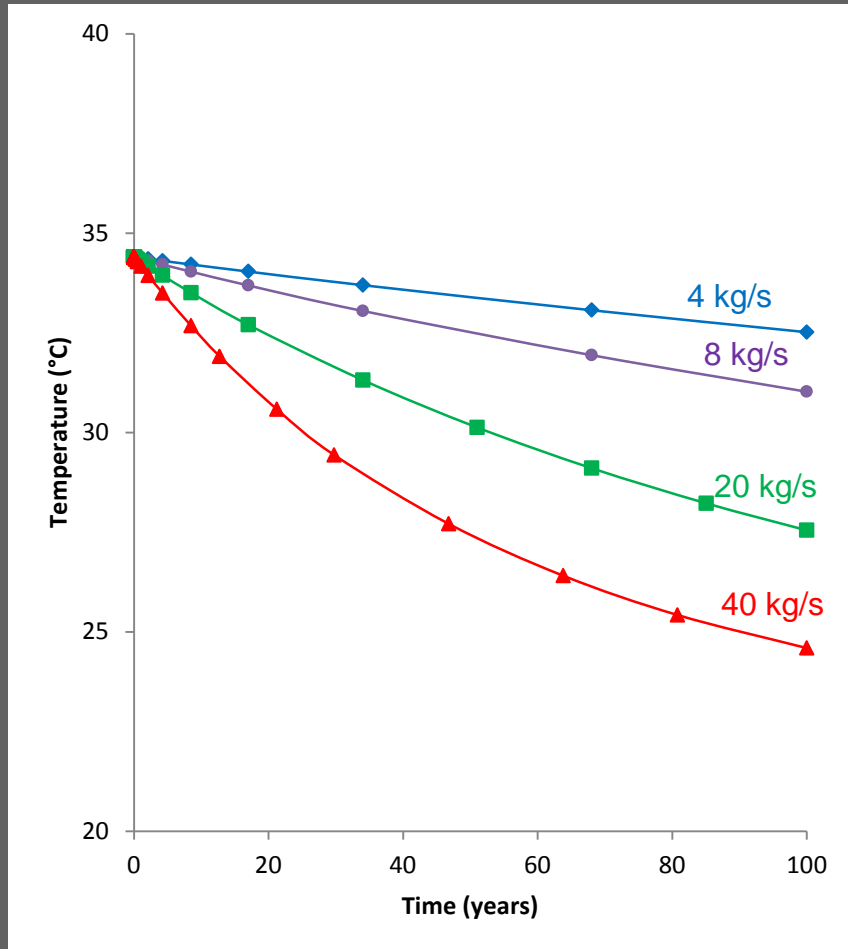
Results



Results

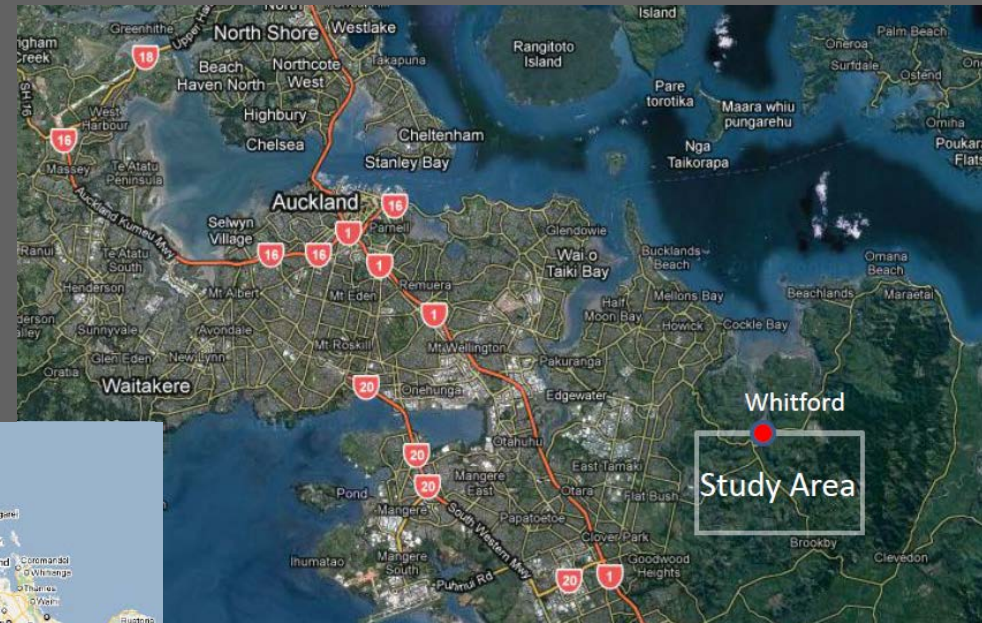
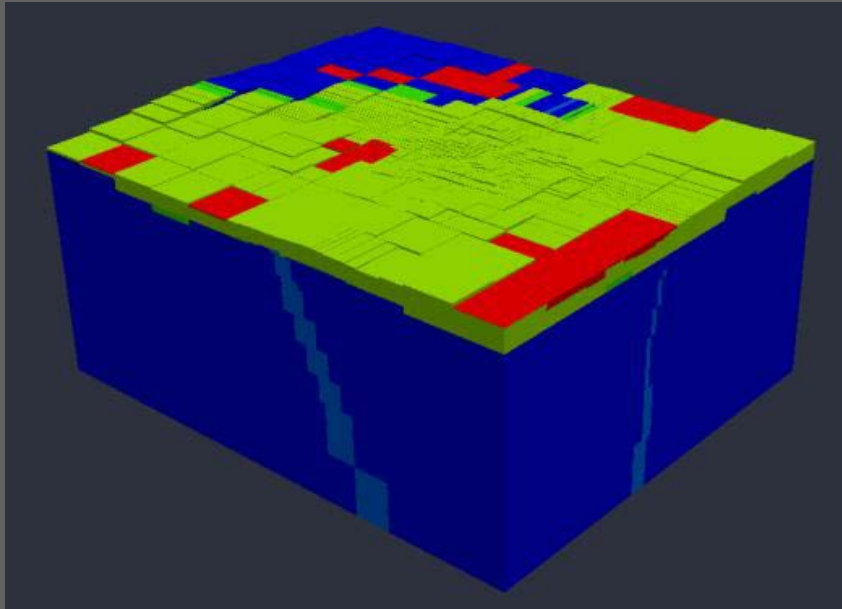
- Total energy 228 MW
- Area 2360 km²
- Maximum fluid flux 1.51 kg/s → 0.5 MW
- Ave fluid flux 0.03 kg/s → 0.08 MW

Production at 125 m depth

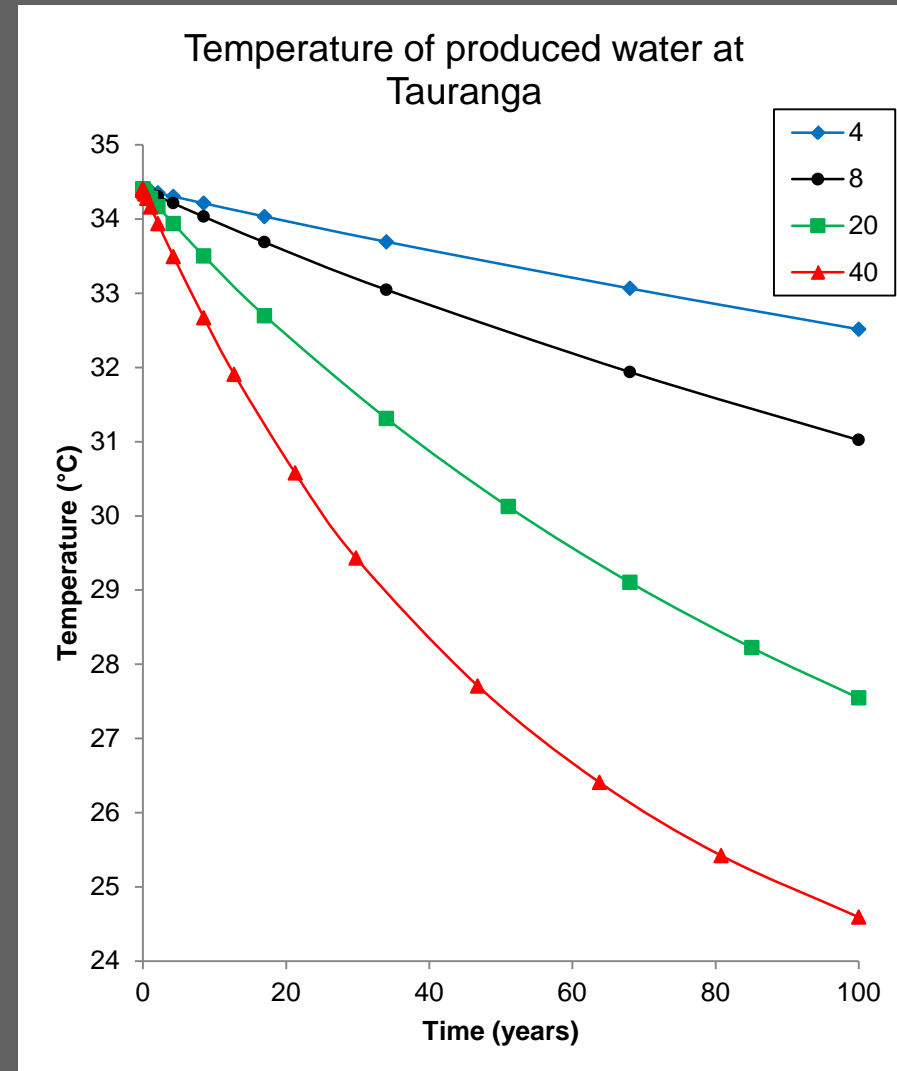
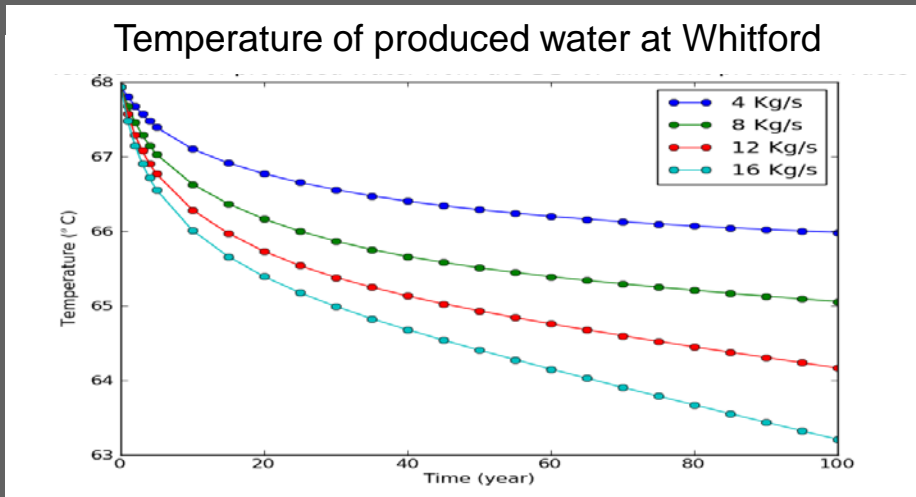


- Higher production rate, greater decrease in T and P
- Pressure re-equilibrates after ~2 months for shallow wells

Comparison with a Convective System: Whitford (by Charles Molière, U. Auckland)

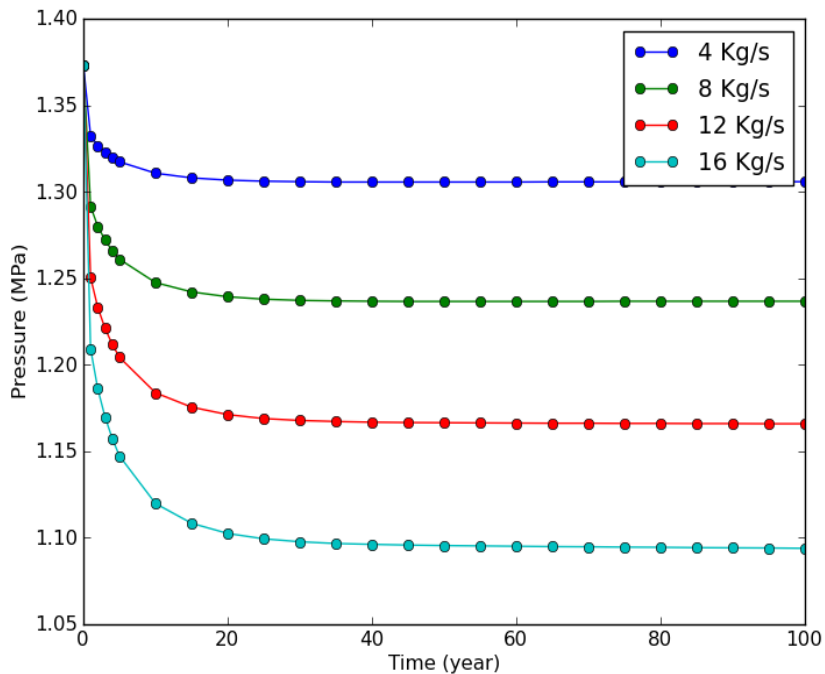


Comparison with a Convective System: Temperature

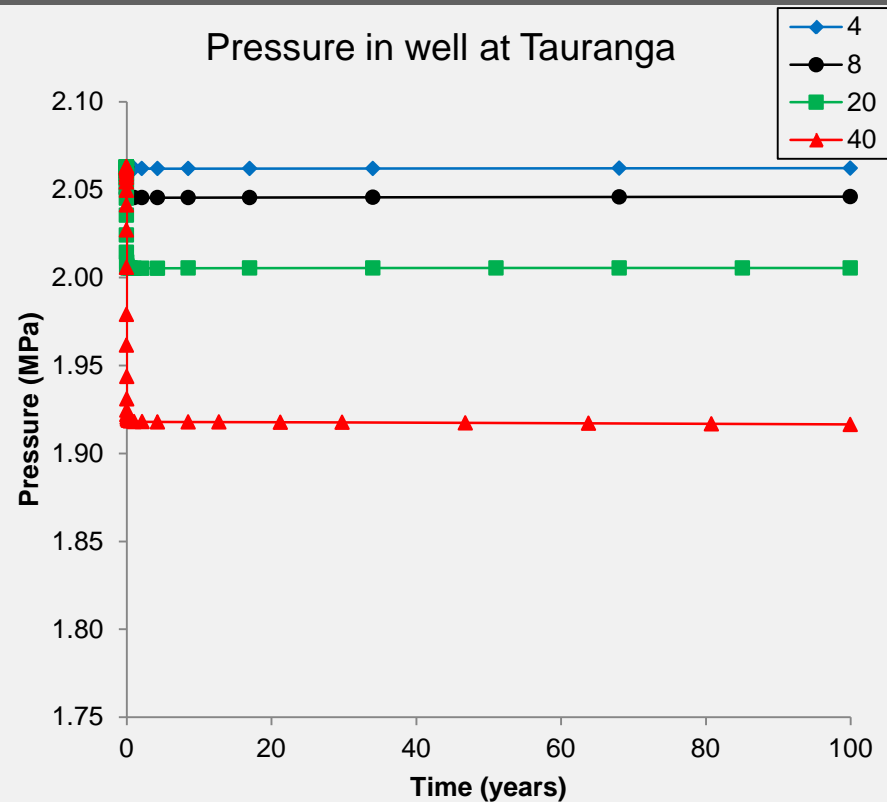


Comparison with a Convective System: Pressure

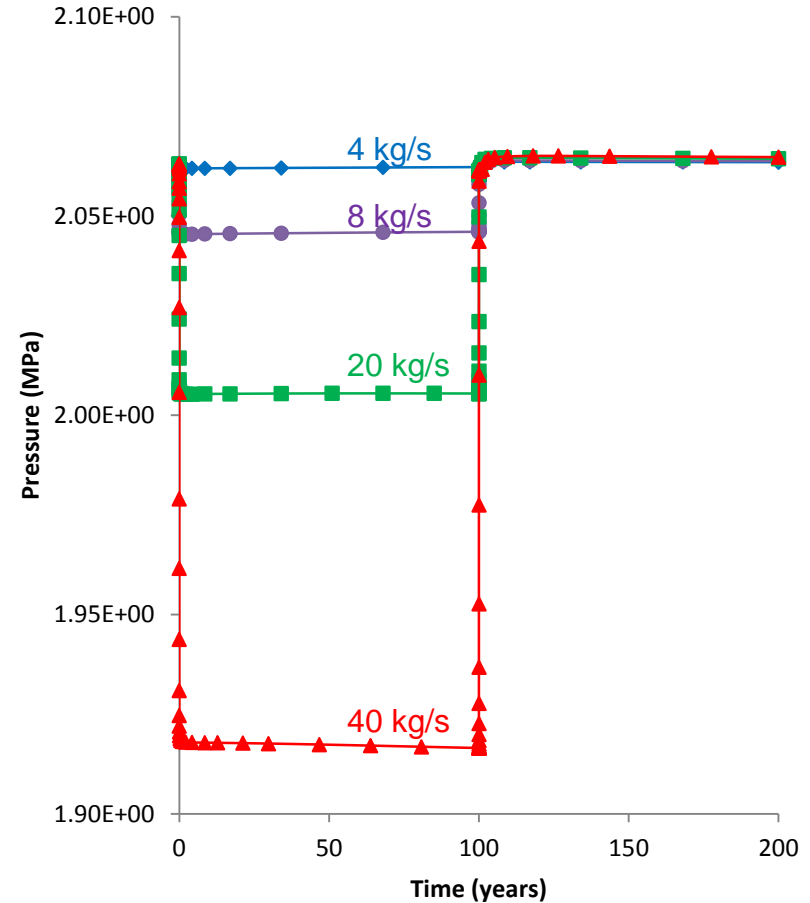
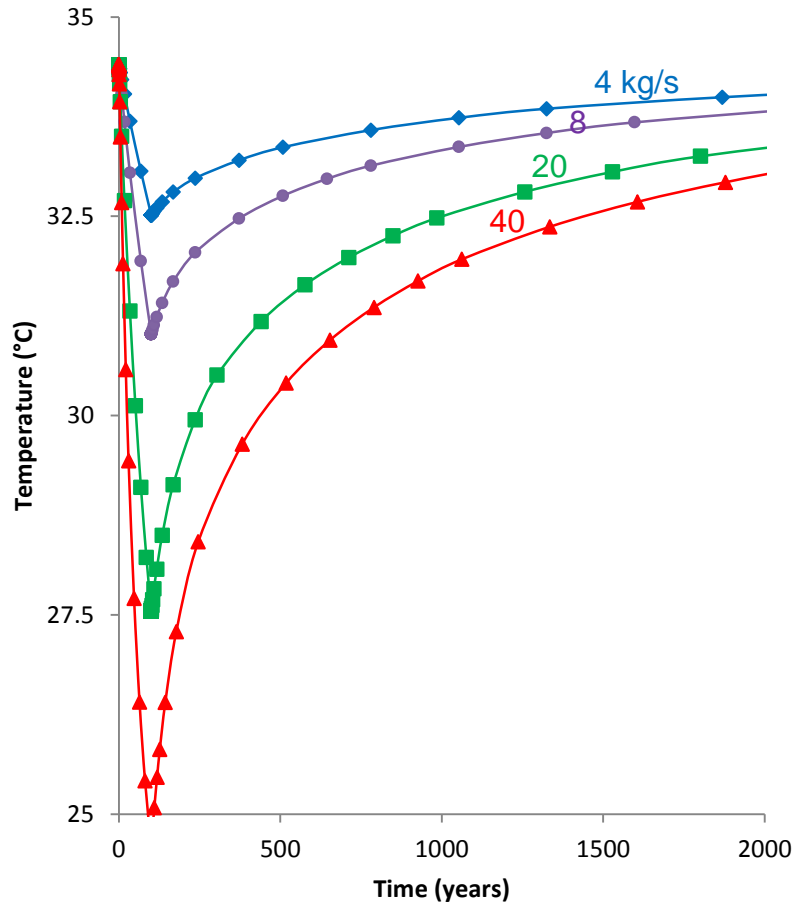
Pressure in well at Whitford



Pressure in well at Tauranga



Recovery



- Temperature recovers very slowly, 50% after ~1000 years
- Pressure increase over 2 months to original levels

Conclusions

- **Low-temperature systems appear to be stable even with low level of production**
- **Systems re-equilibrate quickly, but recover slowly**
- **Modelling allows the comparison of extraction rates and resulting changes in the system**
- **Systems are suitable for long-term direct use if managed**

Future Directions

- Refine Tauranga model
- Publicly-available GNS Science report
- Publish in peer-reviewed journal
- Look at other systems?