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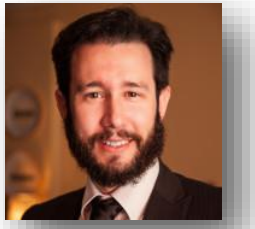
Geothermal / GSHP systems for heating and cooling in Victoria

Ian Johnston & Guillermo Narsilio



Melbourne - State of Victoria

Melbourne:

~4 M inhabitants

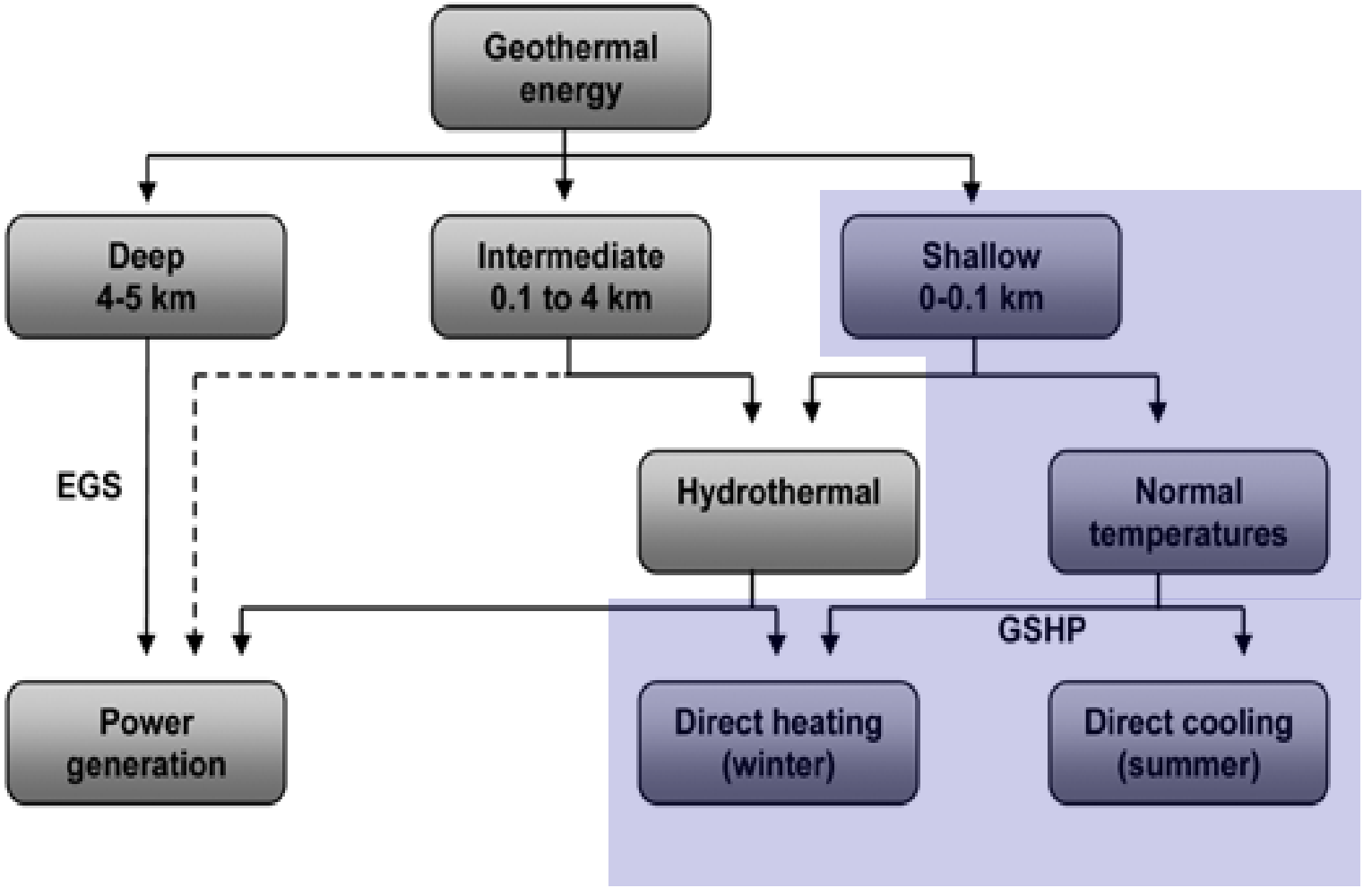
Latitude 37 South

Temperate

Summary – Geothermal Heat Pumps

- Establishing the technology in Victoria
- Showing Casing
- Detailed Performance Monitoring of the Ground Heat Exchangers
- Analysis and modeling
    - Using the data to calibrate mathematical models
    - Reduce cost of GHE's
- Team of ten researchers at University of Melbourne
- Well connected with the industry

Heating and cooling buildings



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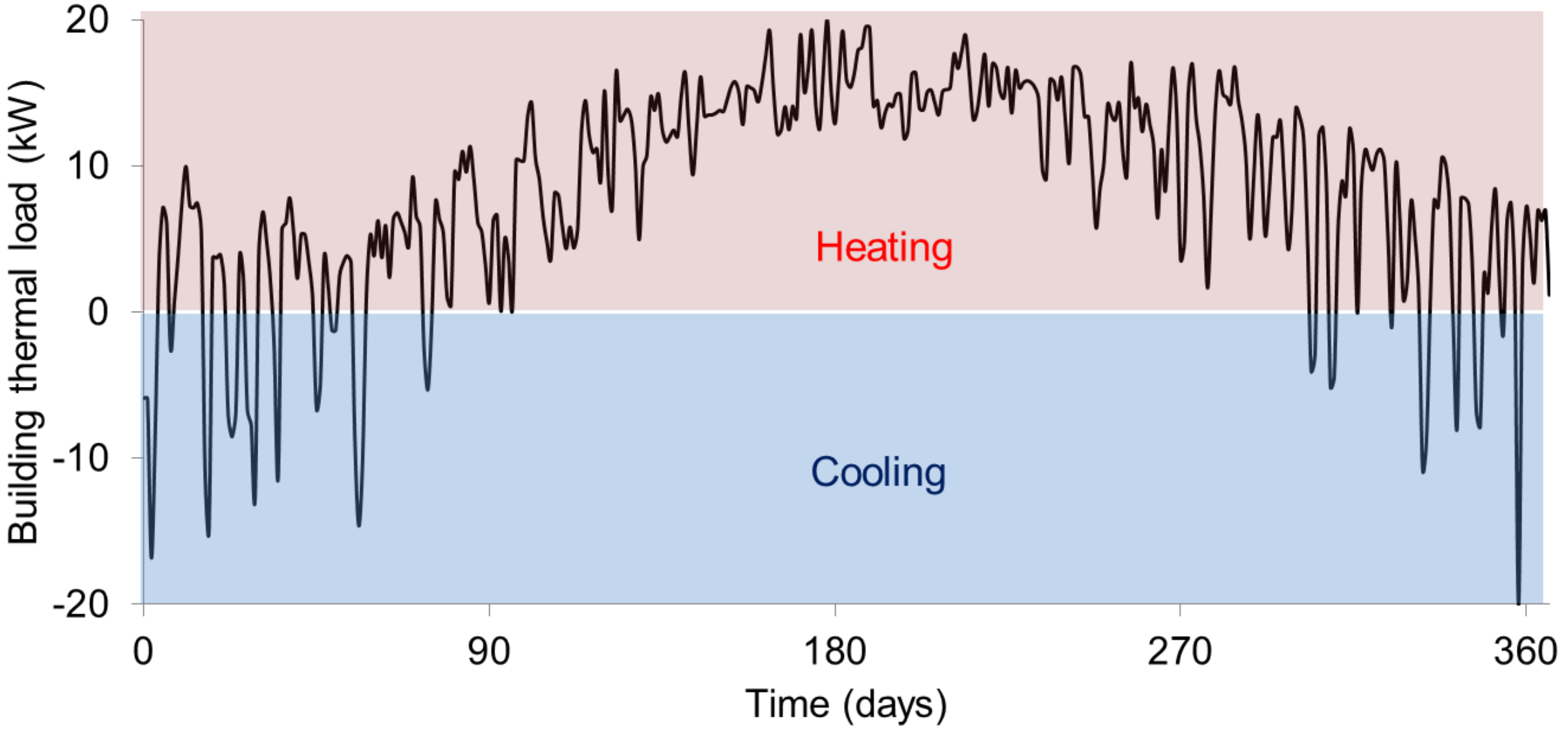
Heating and Cooling



Work

Full Scale Pilot Projects

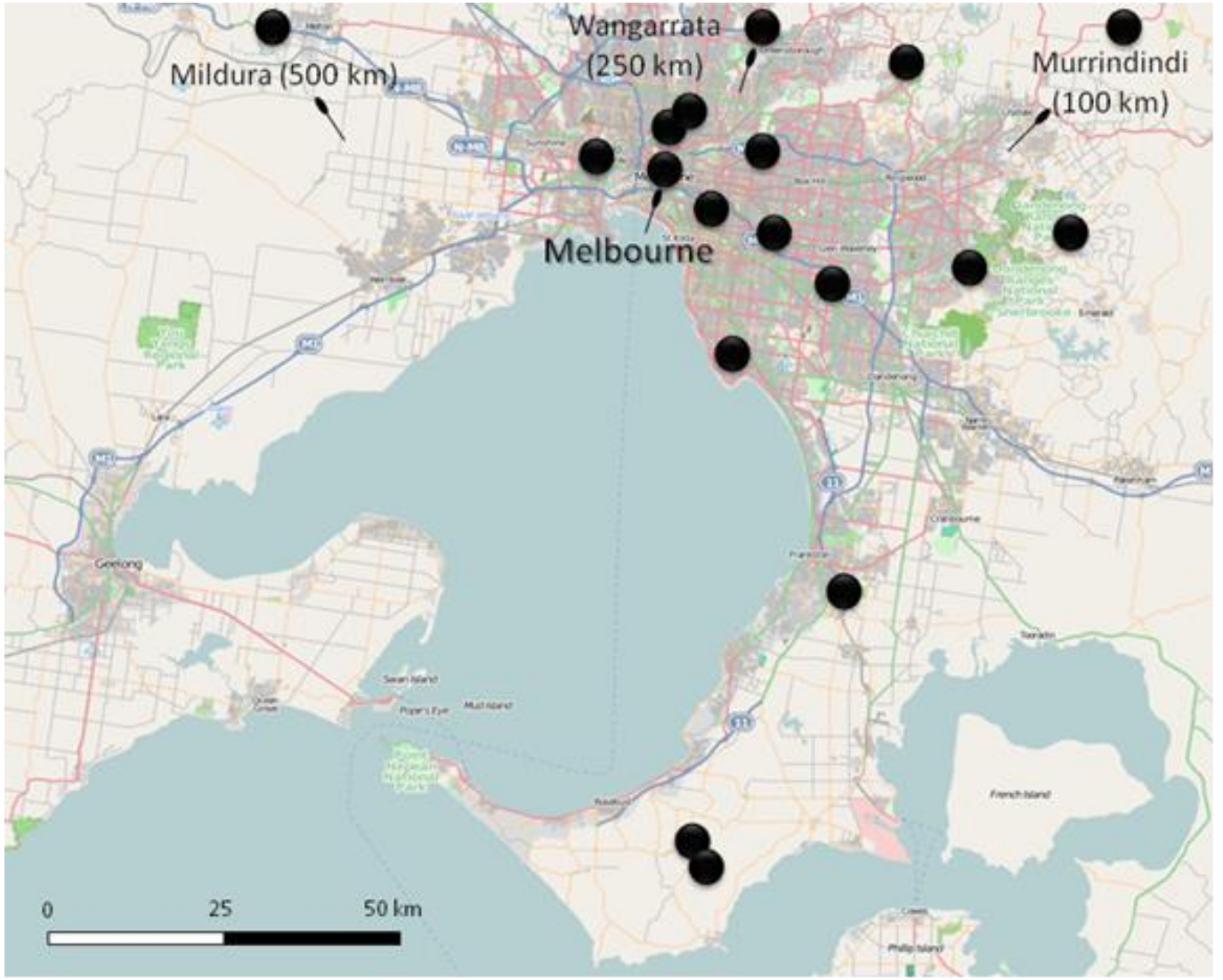
- Borehole heat exchangers at University and elsewhere
- Horizontal heat exchangers – other locations in Victoria

Energy Pilot Demonstration Program – Government support

- Elizabeth Blackburn School of Sciences at University
- 20 to 40 residential-equivalent buildings

Detailed 3D Numerical Models

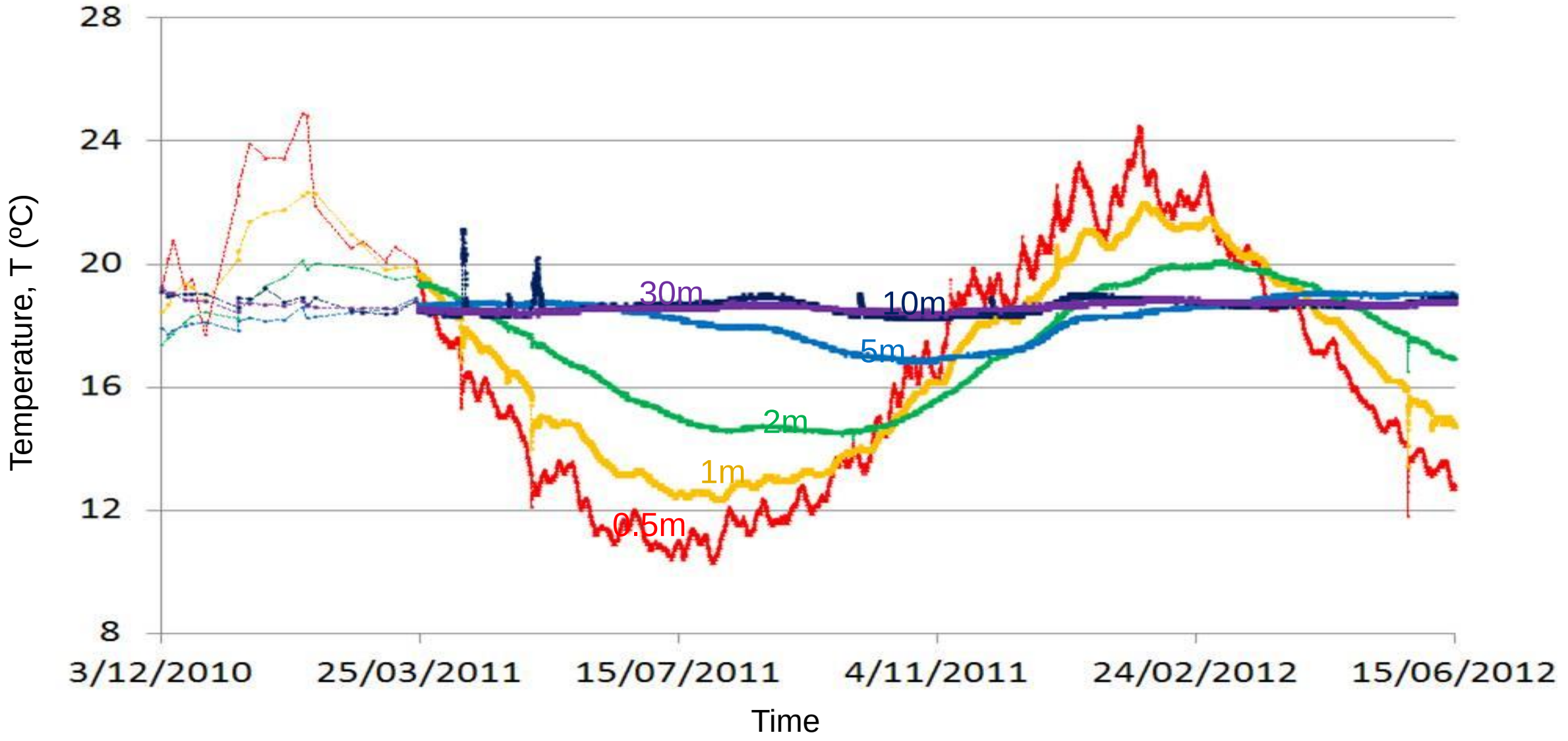
Instrumented Geothermal Heat Pump Systems



Around Melbourne ≈ 25 systems in place

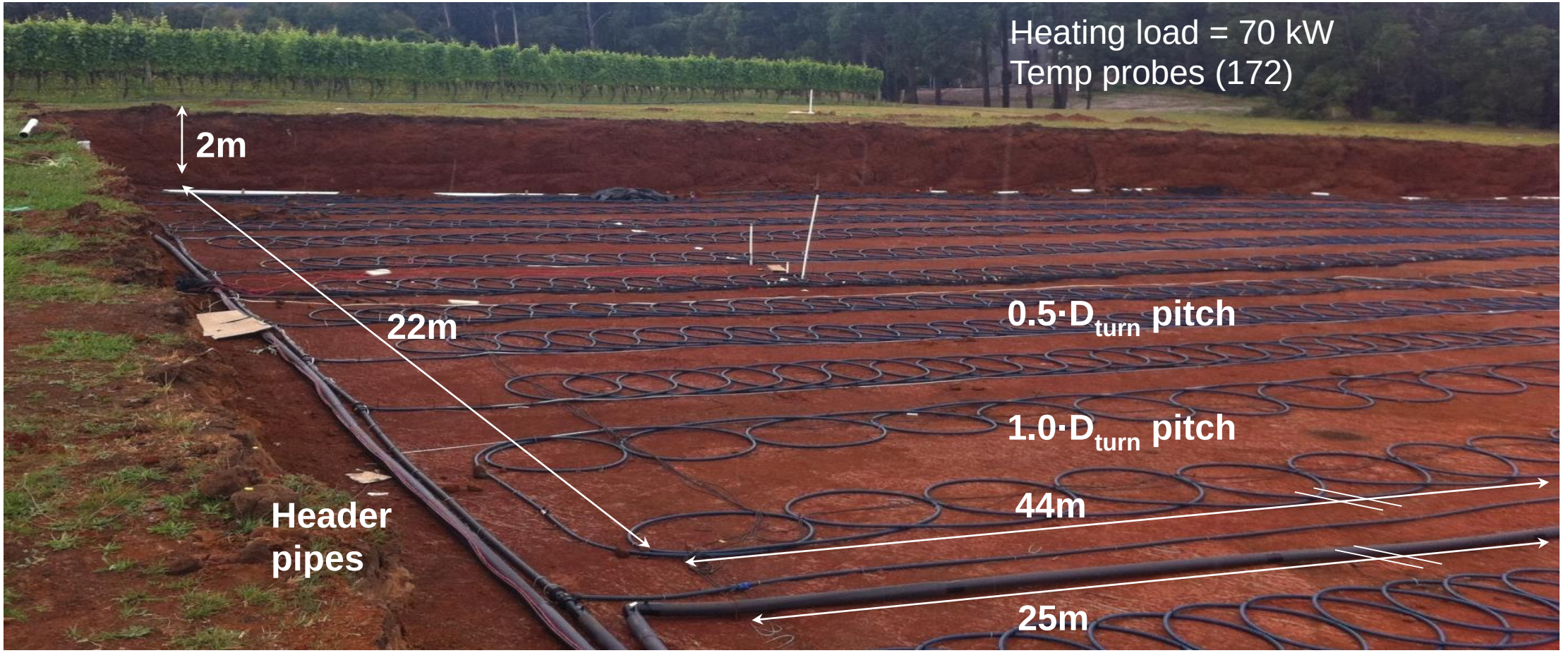
Ground temperature below 10 m typically 18 C

Far field temperature with depth at UoM



Walter Boaz Building – UoM – 50m Vertical

Main Ridge – Mornington Peninsula

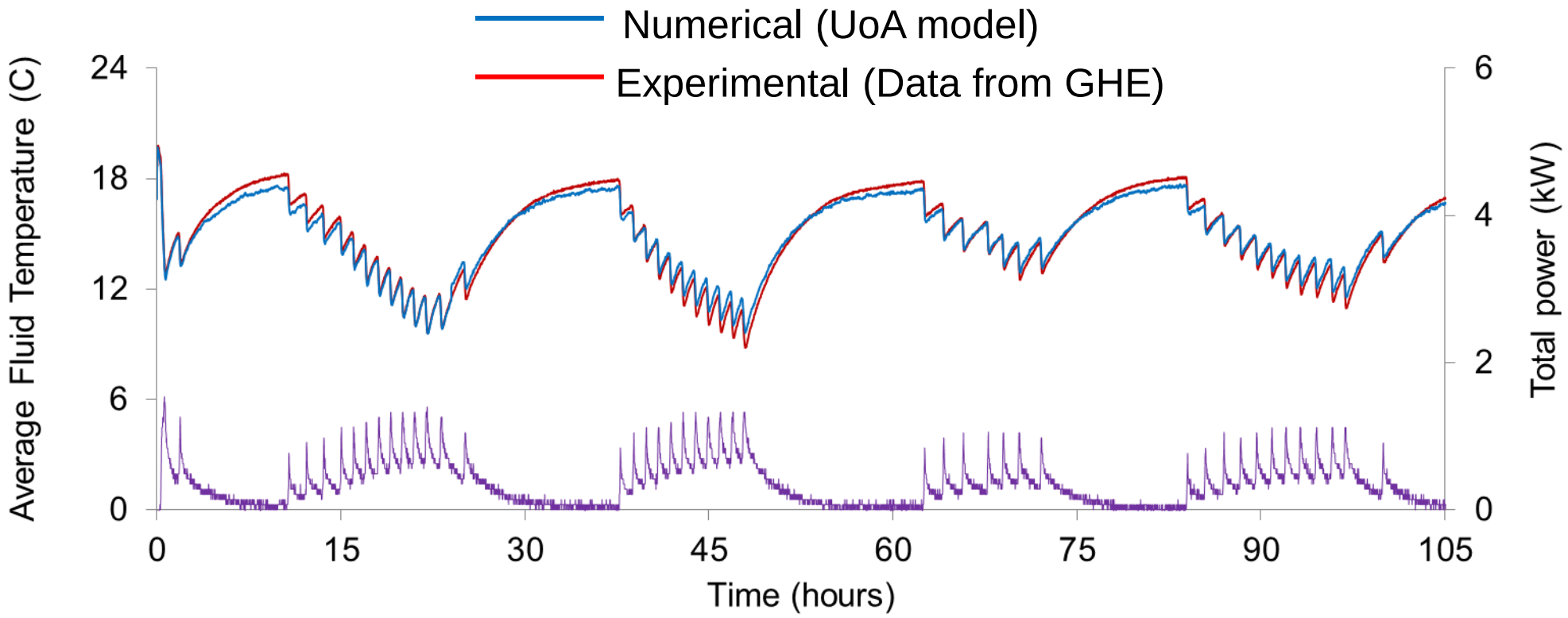


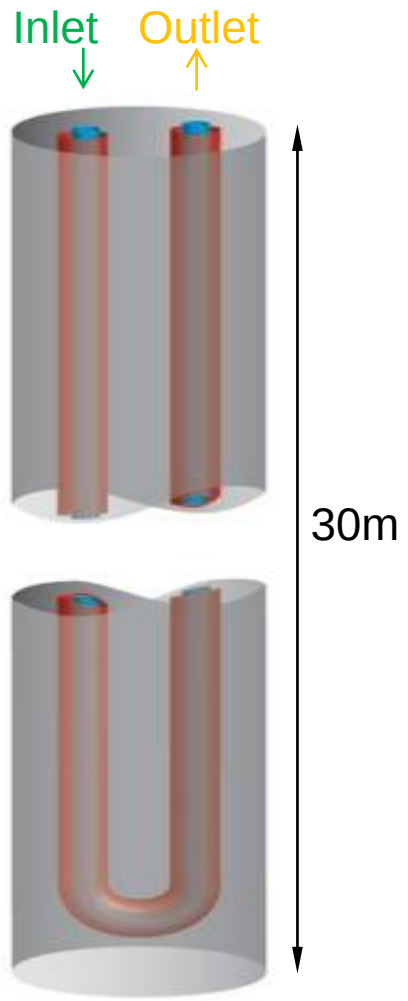
Energy Piles - Beaurepaire Sports Centre Facility

30m Energy Piles

Numerical Model Validation

Data from: Colls, S., Johnston, I., and Narsilio, G., 2015(?), “Observations from an experimental ground-source heat pump system”, *Geothermics* (Under review).

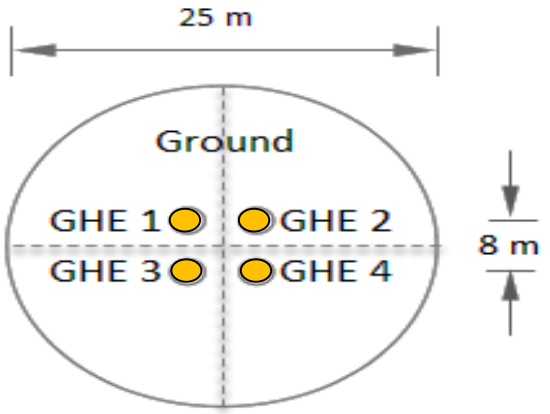


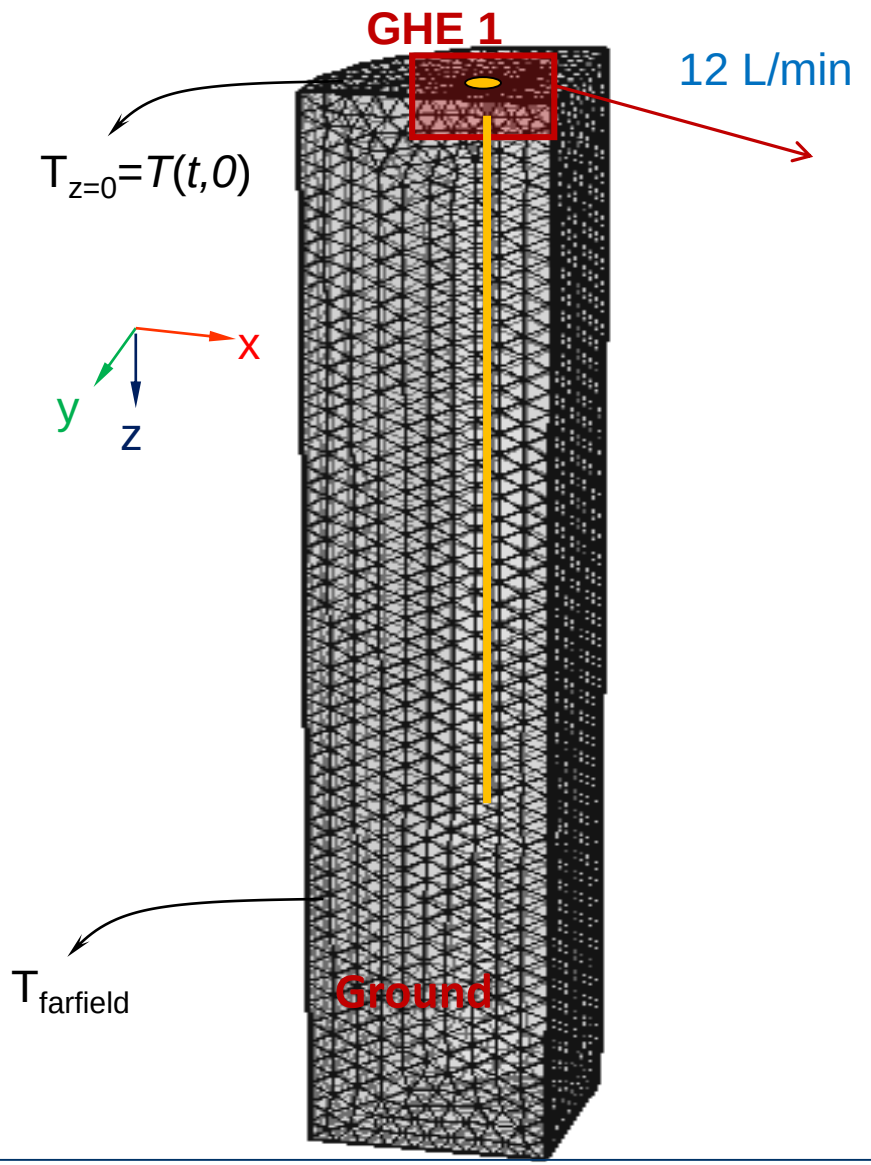


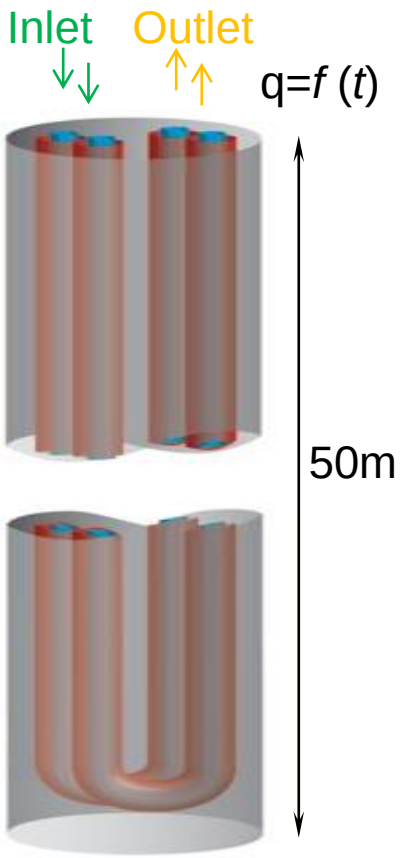
GHE, 125 mm Ø
Pipe, 20 mm Ø

Numerical Models

Borefield with 4 GHEs x 50m







GHE, 300 mm Ø
Pipe, 25 mm Ø

Numerical Model Validation – 30m Pile Cage

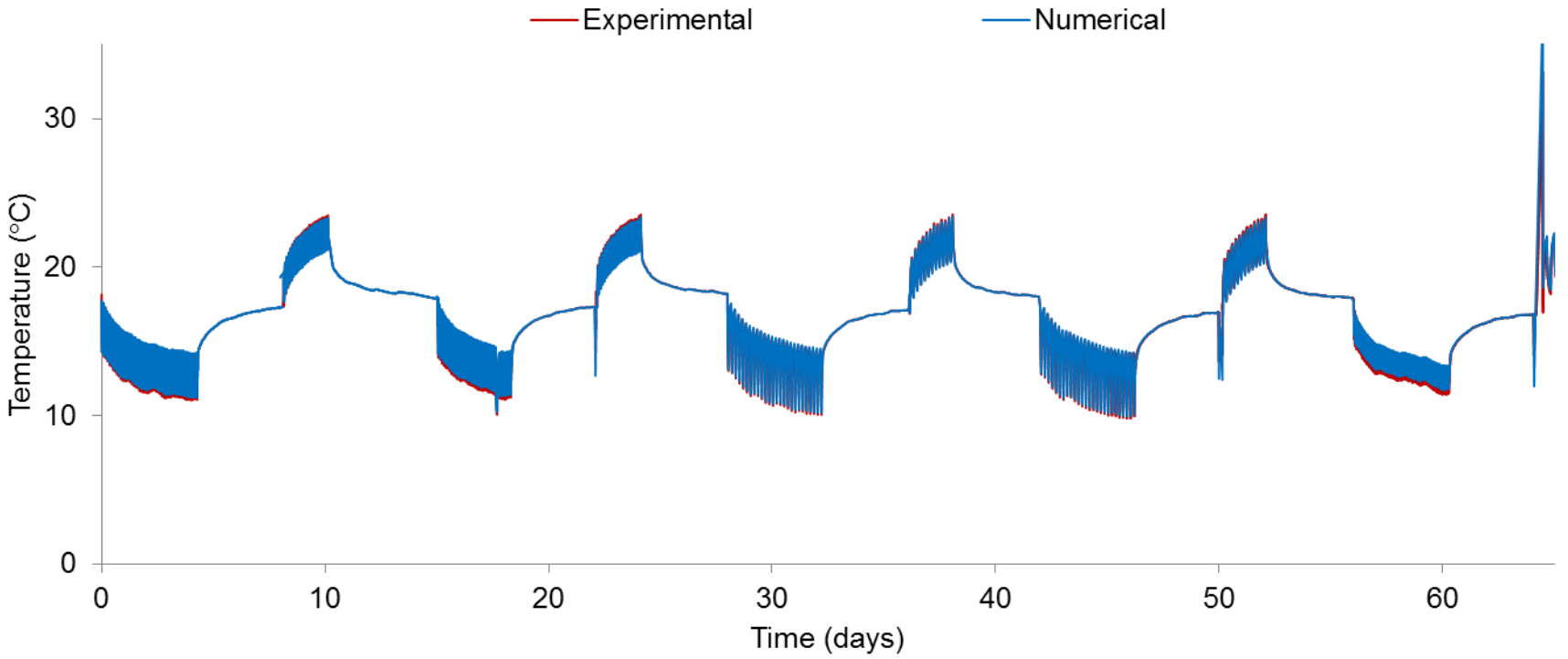
L_{GHE} = 30 m

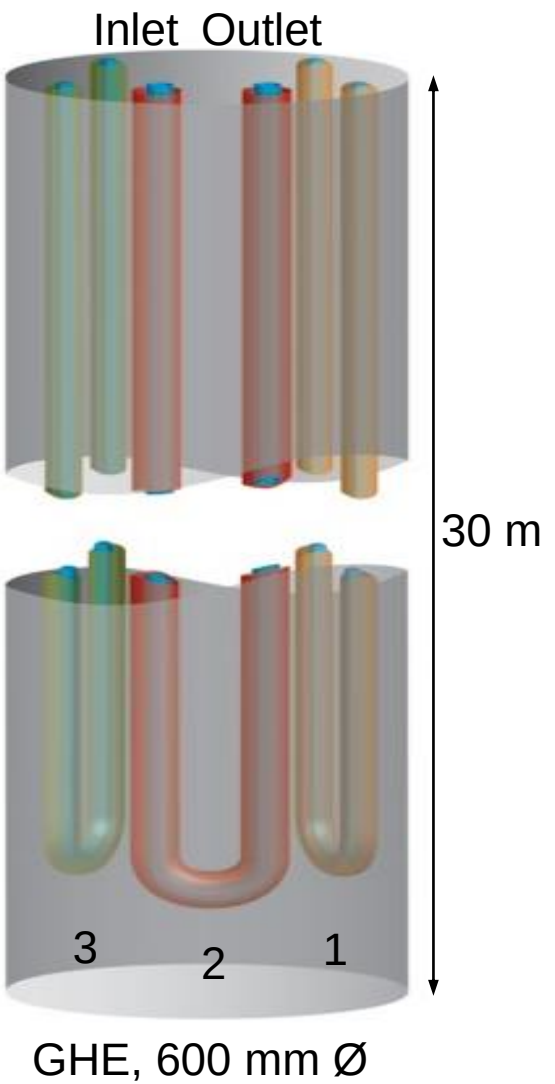
Flow rate = 6.9 L/min

$T_{farfield}$ = T(t,z)

Pipe, 20 mm Ø

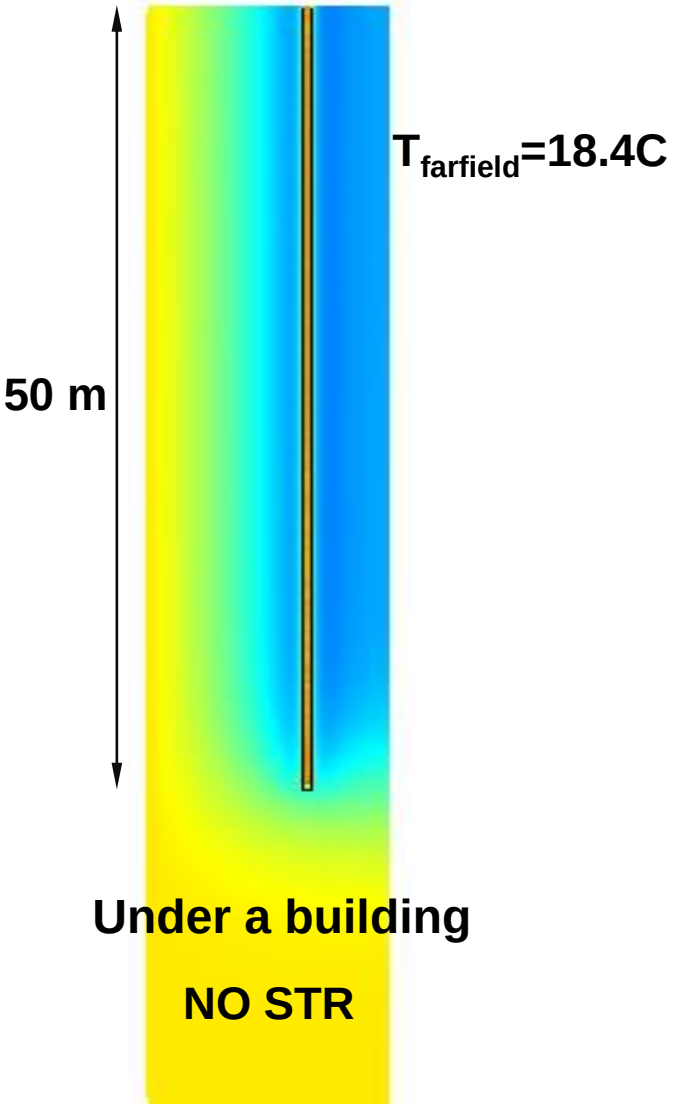
Material	k_m W/(mK)	$C_{p,m}$ J/(kgK)	ρ_m kg/m^3	Diameter m	Spacing m	Wall thickness mm
Soil	2.7	850	2,350	-	-	-
Pile (3 loops)	2.5	1,190	2,100	0.6	-	-
Pipe	0.4			0.02 (d_o)	0.105-0.23	1.84
Carrier fluid	0.582	4,180	1,000	-	-	-

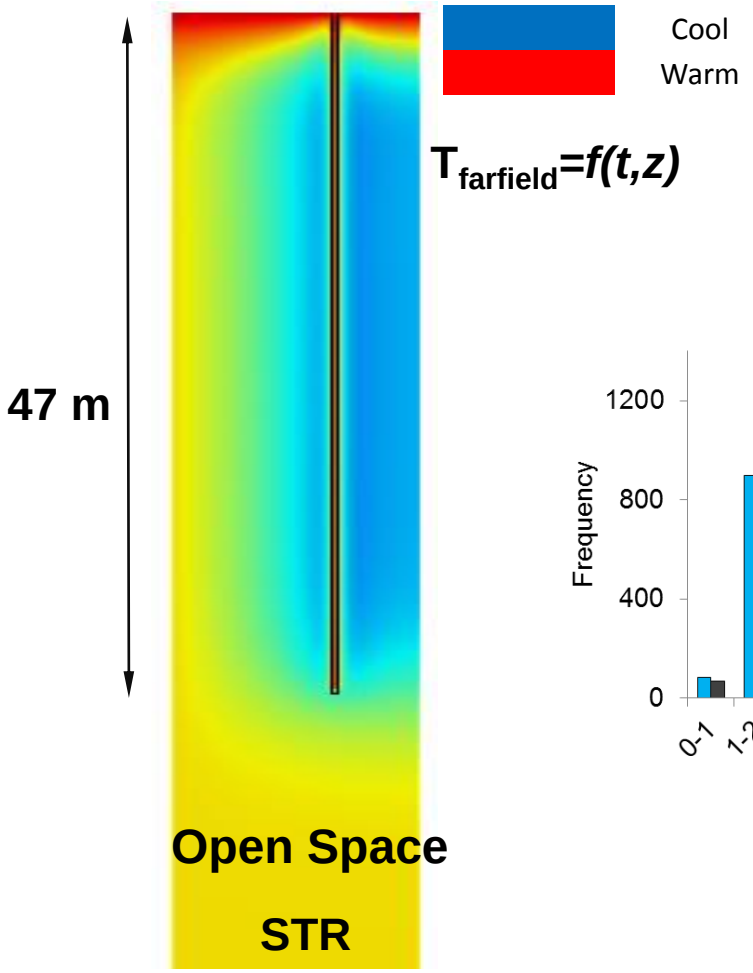


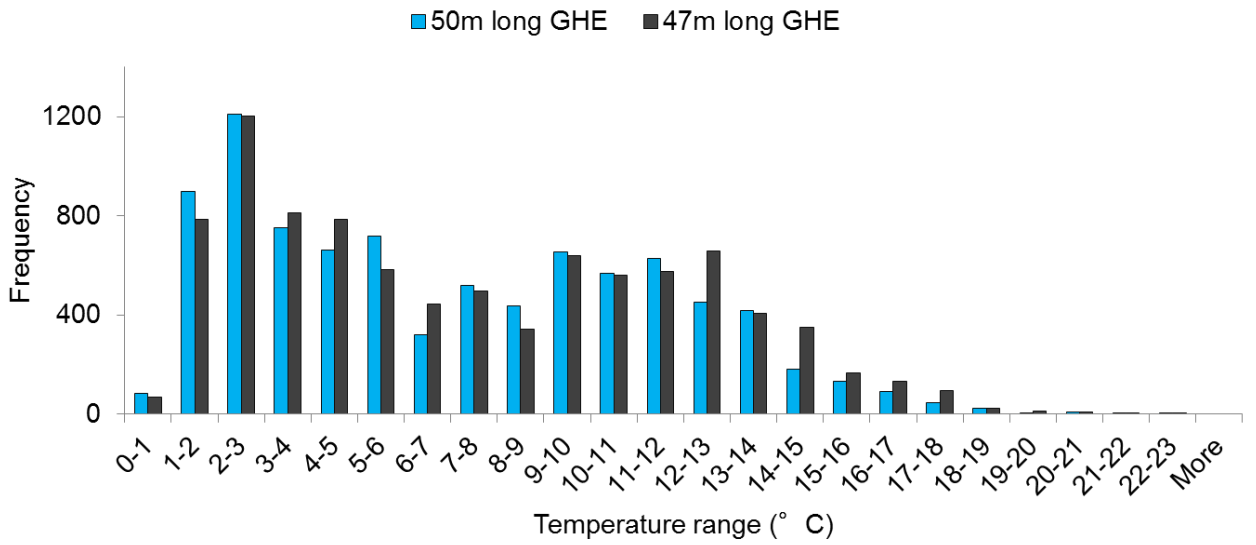


GHE, 600 mm Ø

Quantifying Surface Thermal Recharge







Surface Thermal Recharge = GHE cost savings

Keep a watch on the UoM work

10 Students written output will come

Theses are public

Two theses completed

Stuart Colls

Ground Heat Exchanger Design for Direct Geothermal Systems

Asal Bidarmaghz

Numerical Modelling

Papers are being produced

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