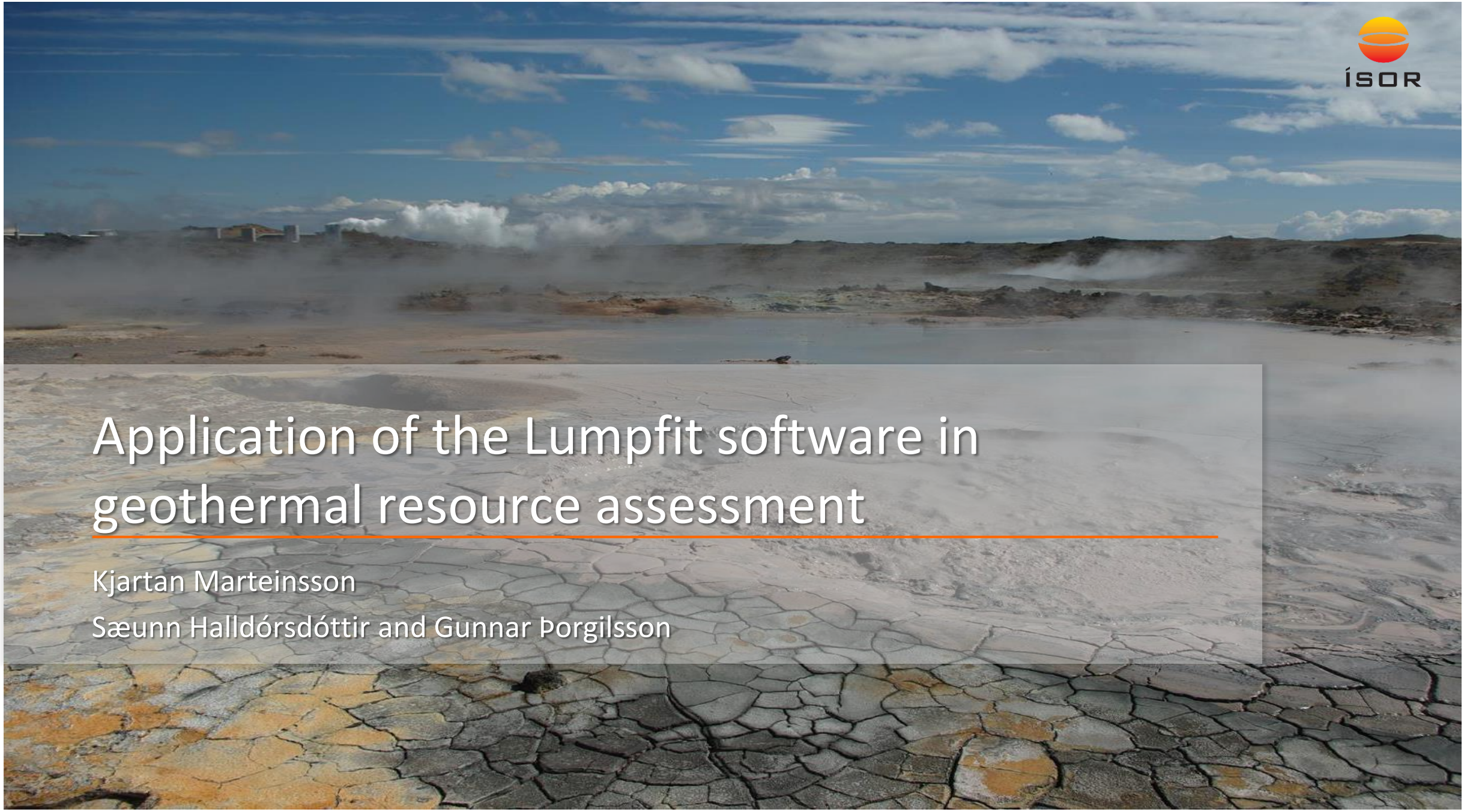


Application of the Lumpfit software in geothermal resource assessment

Kjartan Marteinsson

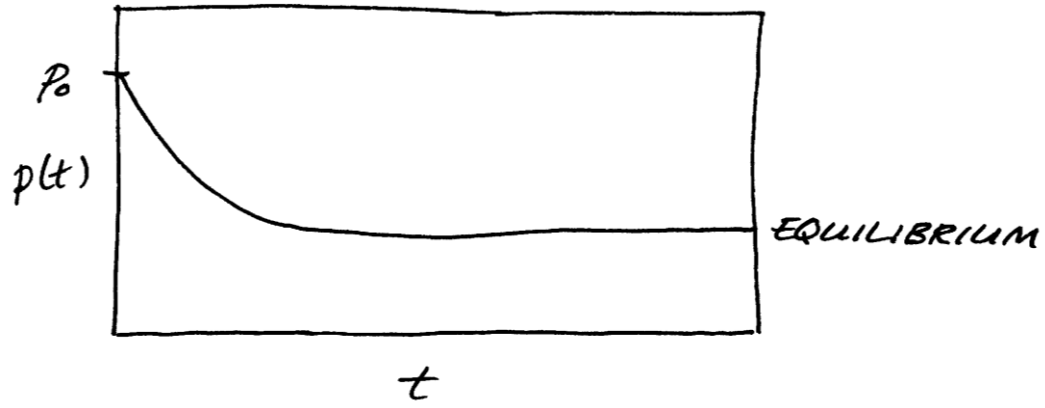
Sæunn Halldórsdóttir and Gunnar Þorgilsson

Presently implemented method

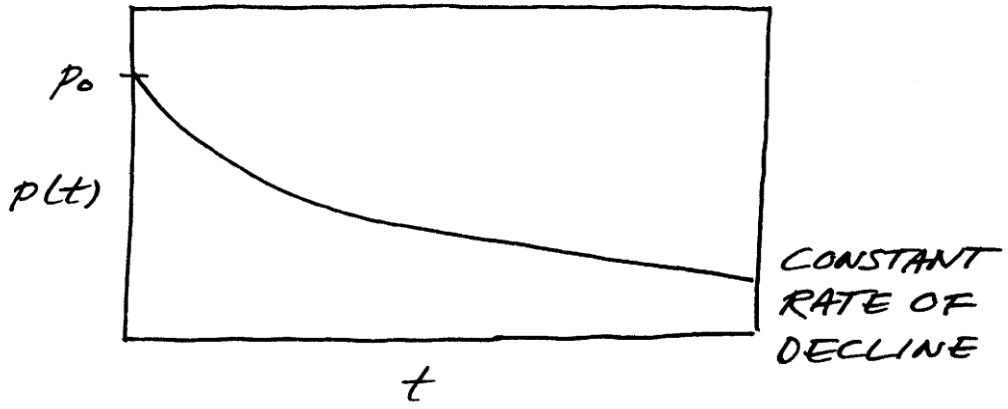
- Developed in 1989 (Gudni Axelsson and others)
- The method has proved to be very successful in predicting pressure changes in geothermal systems
- Physical system reduced and properties lumped into two parameters
- Numerous field cases
- Key tool for resource assessment

Lumped models, general solutions

- Open lumped model:

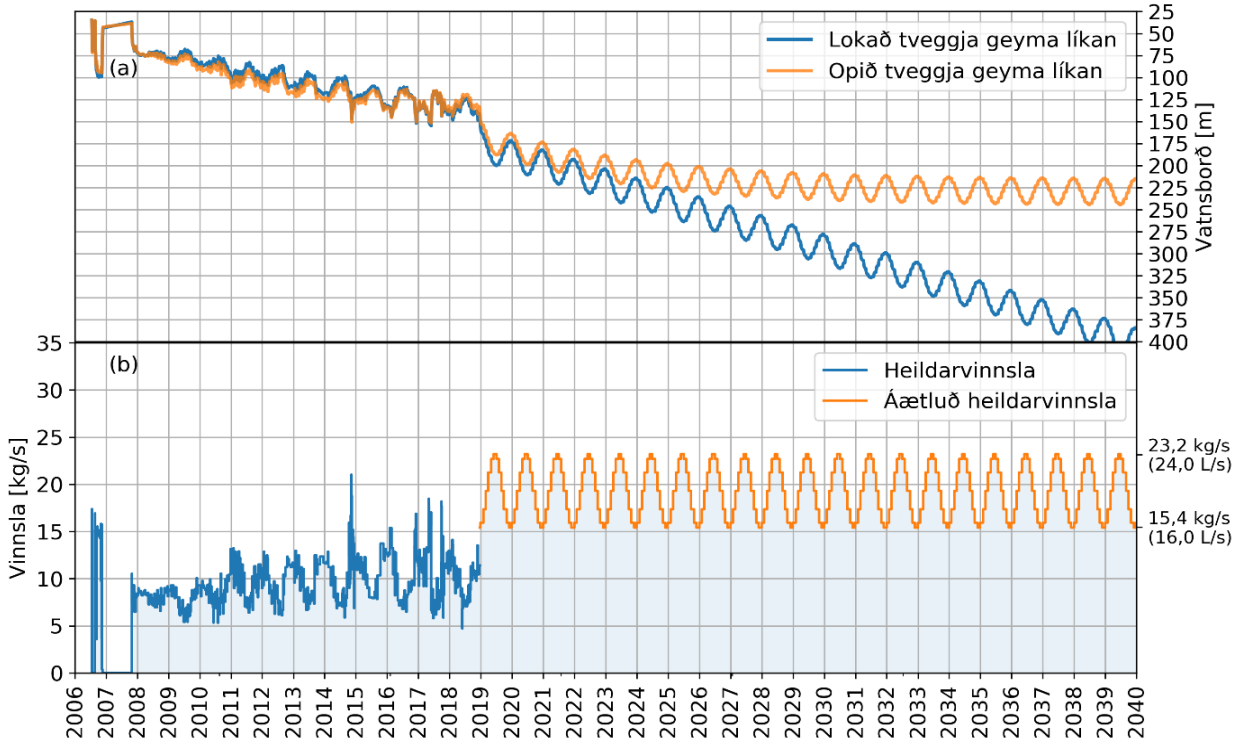


- Closed lumped model:

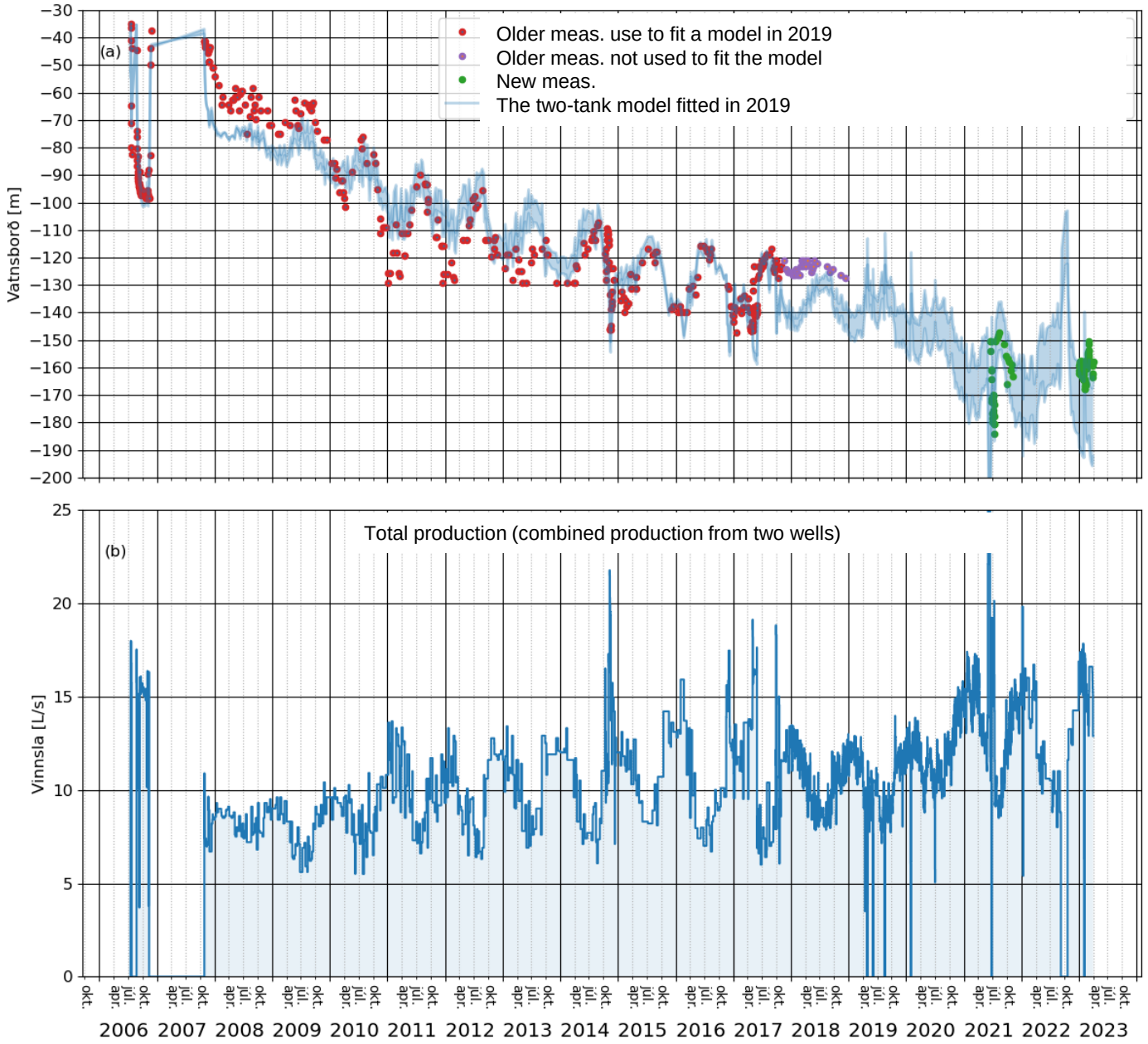


Predicting the effect of different scenarios

Production increased by 82%



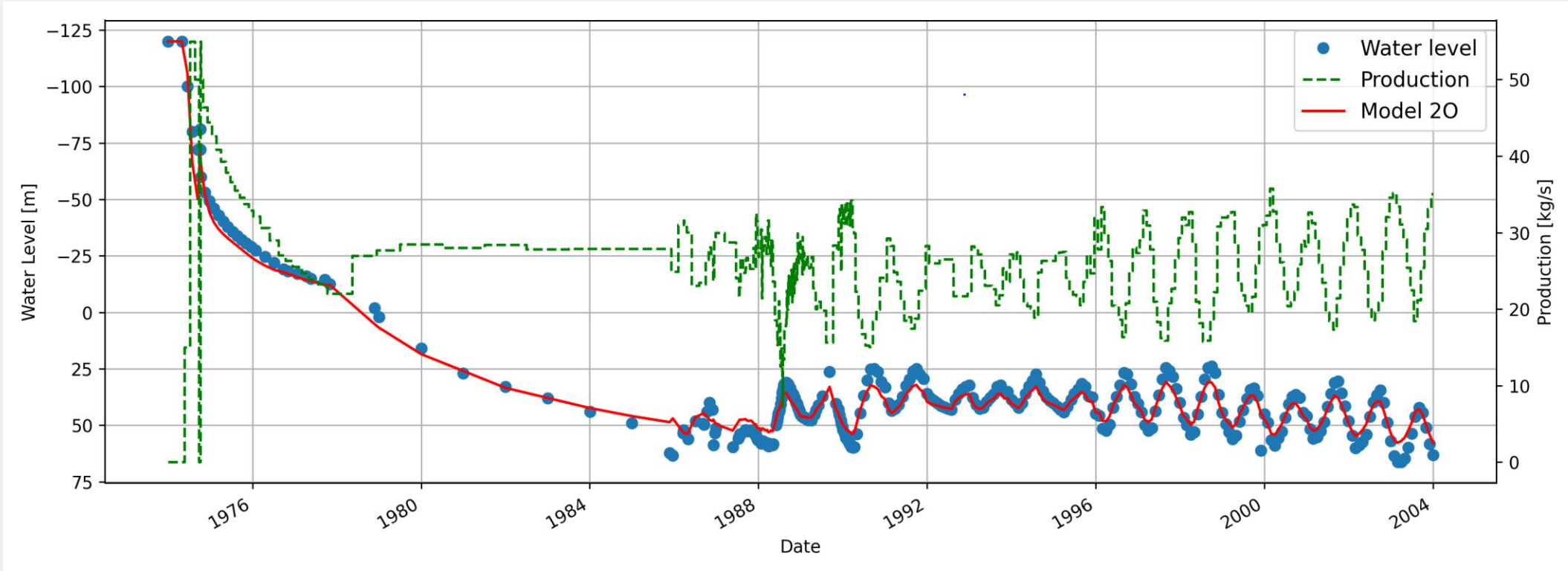
Testing the reliability of an existing model



Work of Gunnar Þorgilsson

Lumpfit v3.0

File Properties Graph



Parameters

A_1	3.04e-07	L_1	2.51e-07	B	
A_2	3.31e-08	L_2	6.22e-09		
A_3		L_3			

Status

Fit found for Two Tanks Open model

Properties

			Confined	Unconfined
κ_1	309 kg/Pa	V_1	5.01 km^3	0.00606 km^3
σ_1	7e-05 kg/s/Pa	k_1	33.4 mD	33.4 mD
κ_2	3e+03 kg/Pa	V_2	48.7 km^3	0.0589 km^3
σ_2	2.06e-05 kg/s/Pa	k_2	4.9 mD	4.9 mD
κ_3		V_3		
σ_3		k_3		

Model

- ○ One Tank Closed
- ○ One Tank Open
- ○ Two Tanks Closed
- ◉ Two Tanks Open
- ○ Three Tanks Closed
- ○ Three Tanks Open

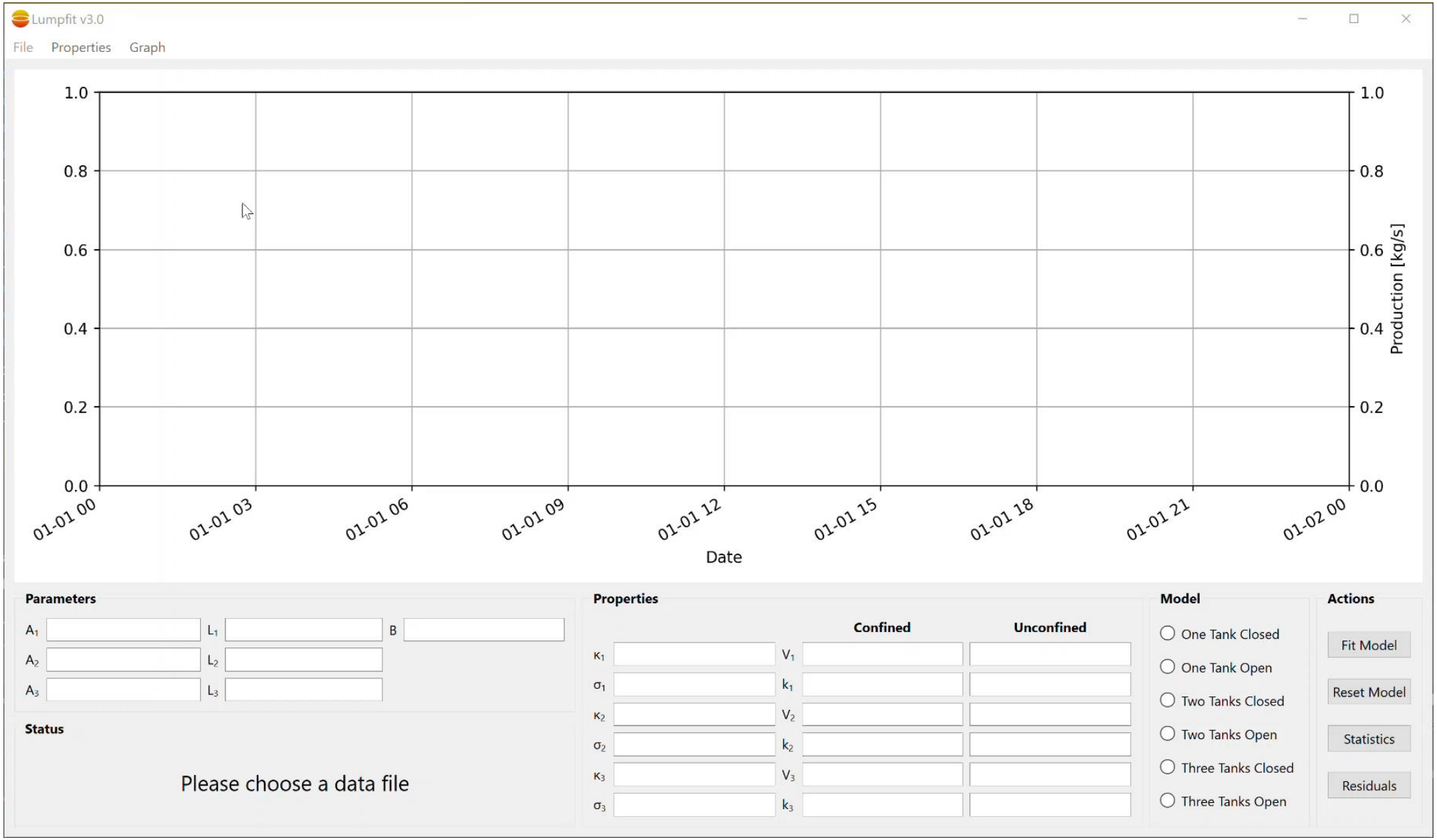
Actions

Fit Model

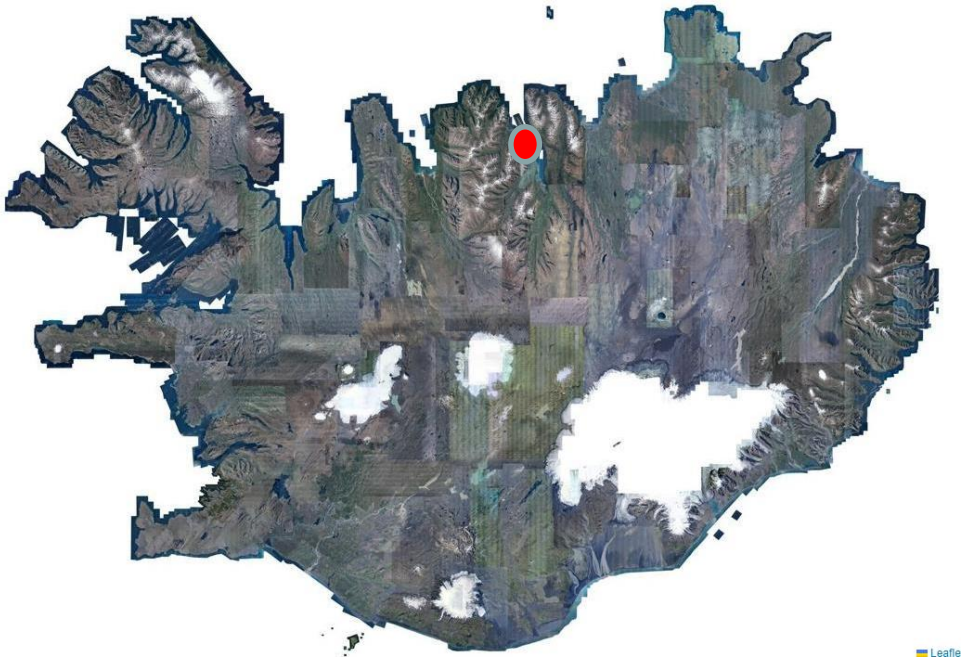
Reset Model

Statistics

Residuals

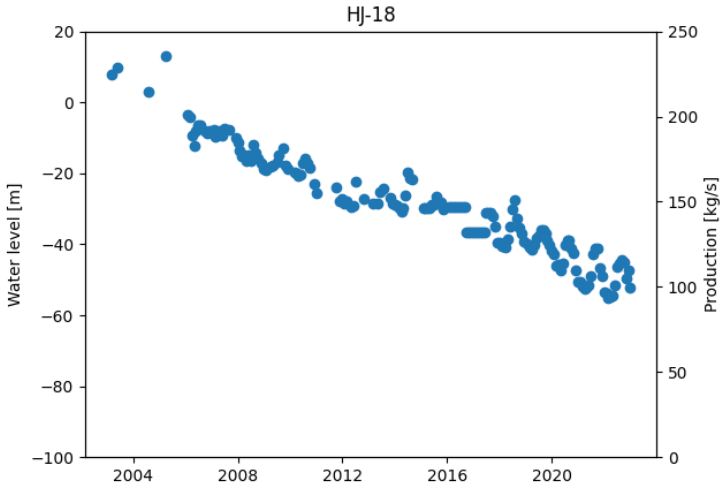

Lumpfit v3.0
File
Properties
Graph
1.0
0.8
0.6
0.4
0.2
0.0
01-01 00
01-01 03
01-01 06
01-01 09
01-01 12
01-01 15
01-01 18
01-01 21
01-02 00
Date
Production [kg/s]
Parameters
A1
L1
B
A2
L2
A3
L3
Status
Please choose a data file
Properties
Confined
Unconfined
κ1
V1
σ1
k1
κ2
V2
σ2
k2
κ3
V3
σ3
k3
Model
One Tank Closed
One Tank Open
Two Tanks Closed
Two Tanks Open
Three Tanks Closed
Three Tanks Open
Actions
Fit Model
Reset Model
Statistics
Residuals

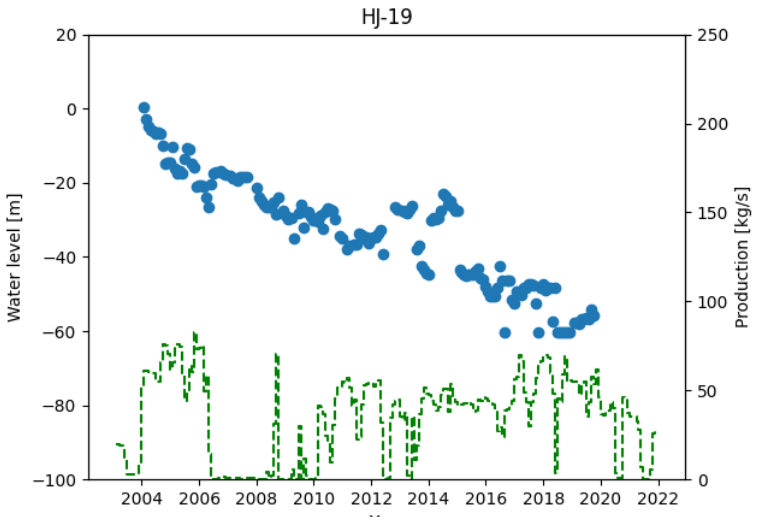
Hjalteyri – North Iceland

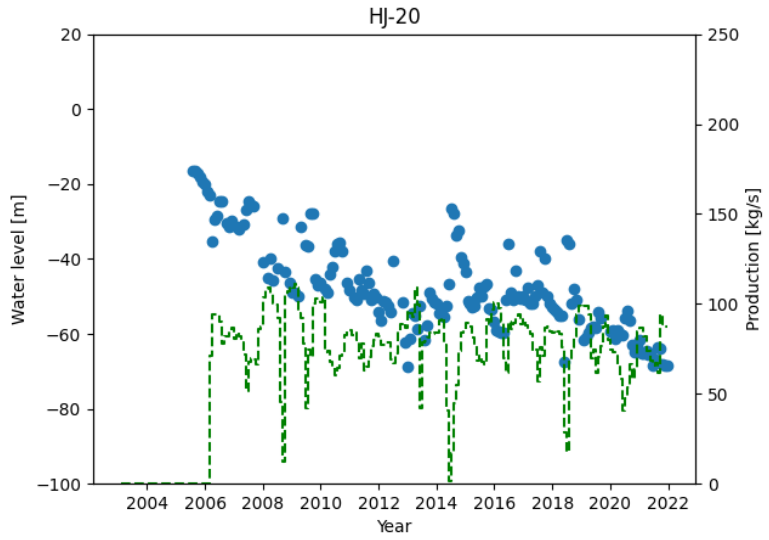


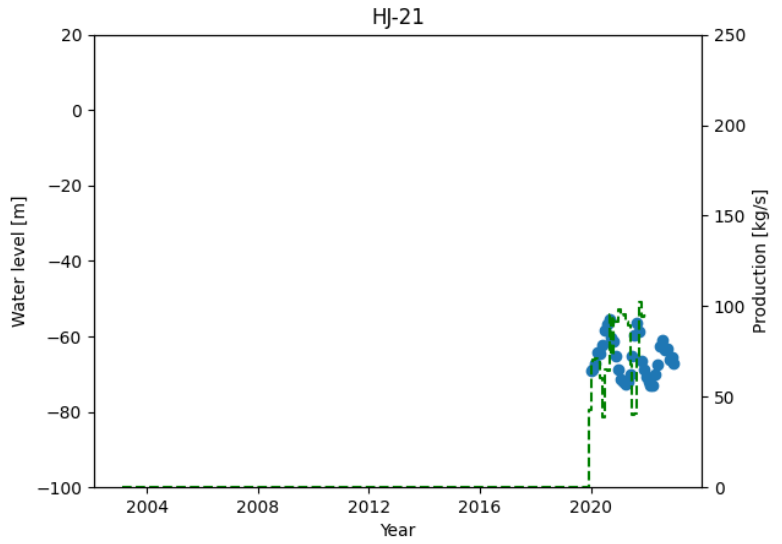
Case study by Kjartan Marteinsson

20 years of production

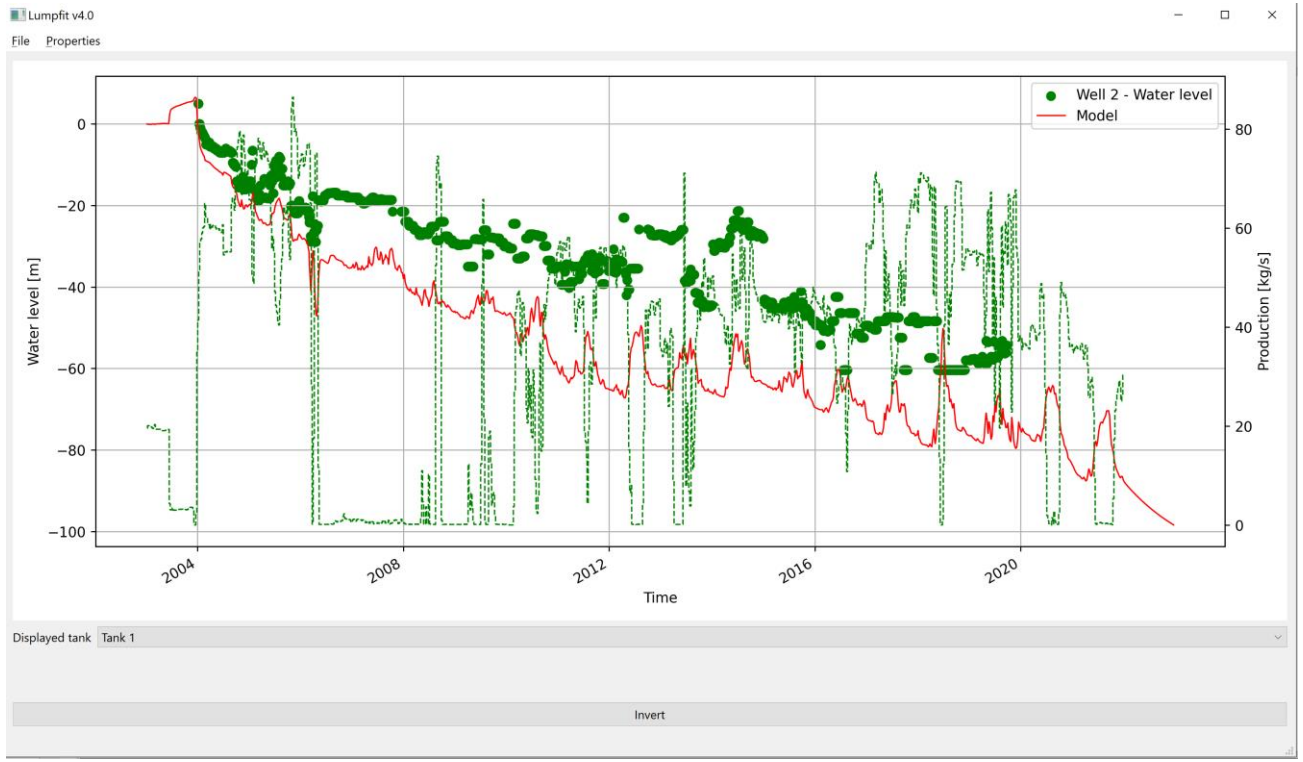


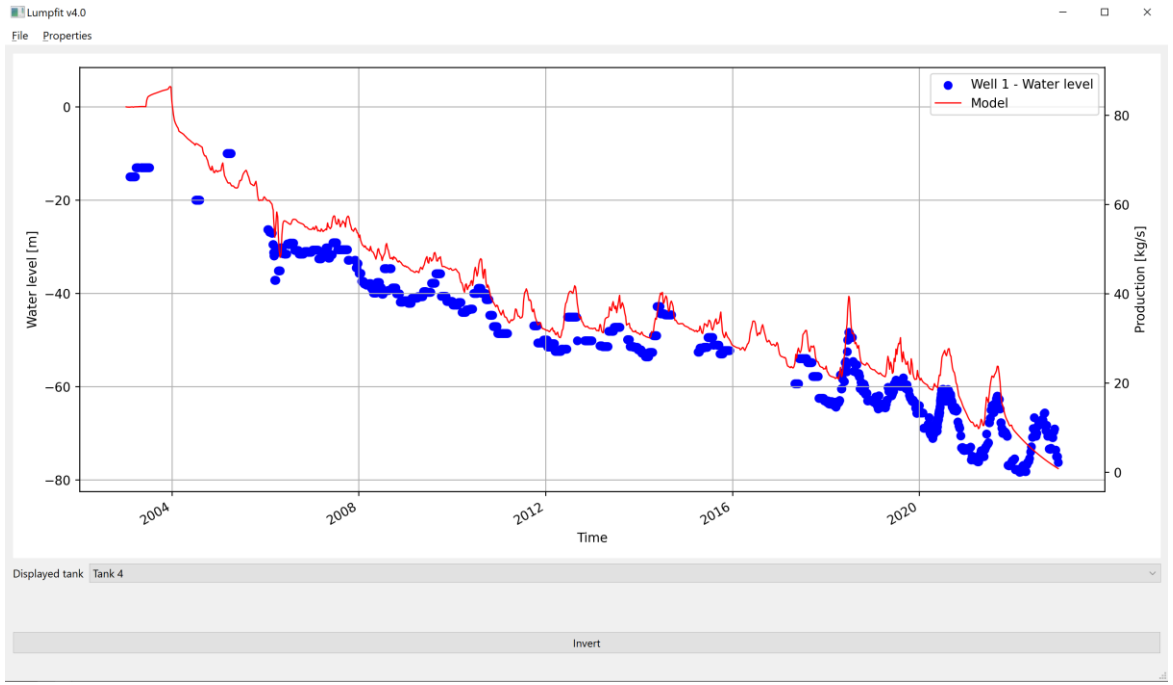




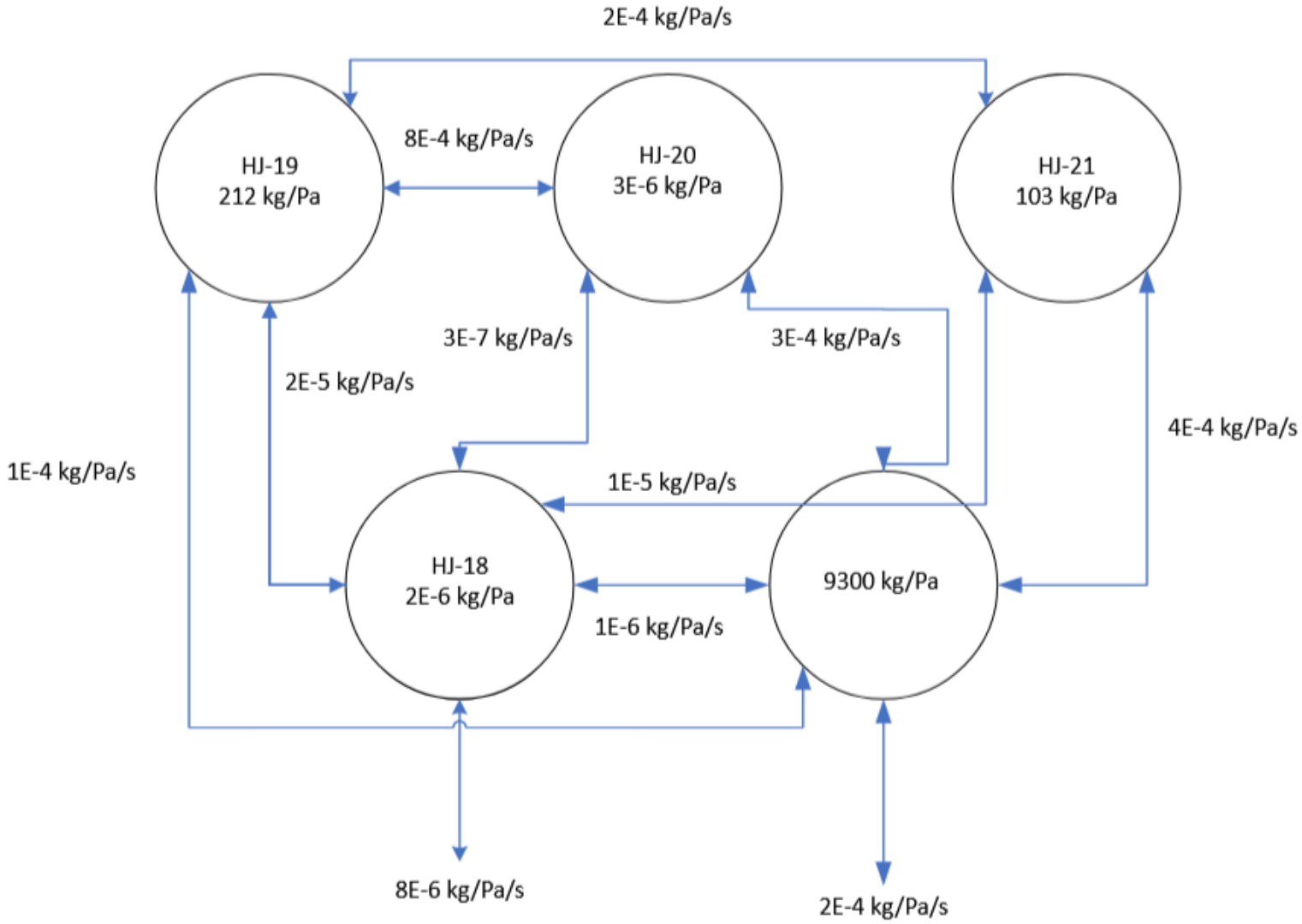


LUMPFIT++ - WIP

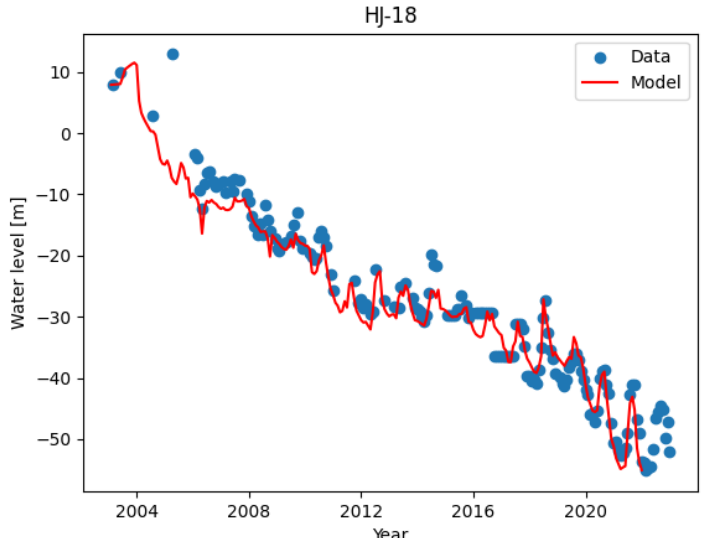

Lumpfit v4.0
File Properties
Well 2 - Water level
Model
Water level [m]
Production [kg/s]
Time
2004
2008
2012
2016
2020
Displayed tank Tank 1
Invert

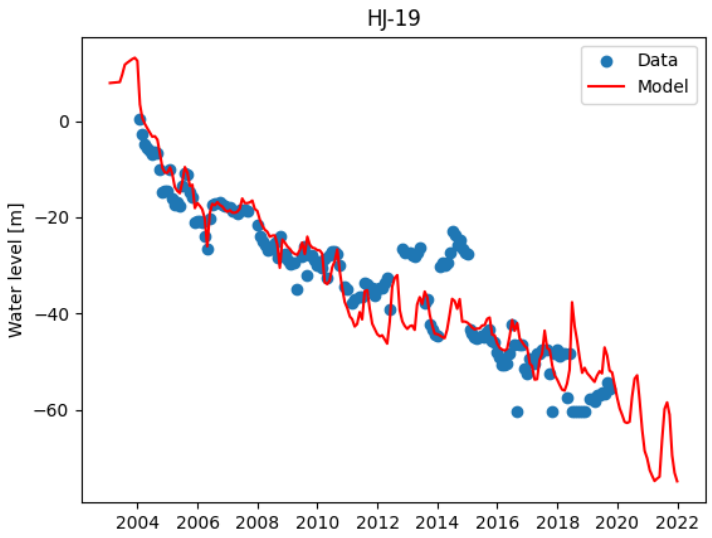

Lumpfit v4.0
File Properties
Well 1 - Water level
Model
Water level [m]
Production [kg/s]
Time
2004
2008
2012
2016
2020
Displayed tank Tank 4
Invert

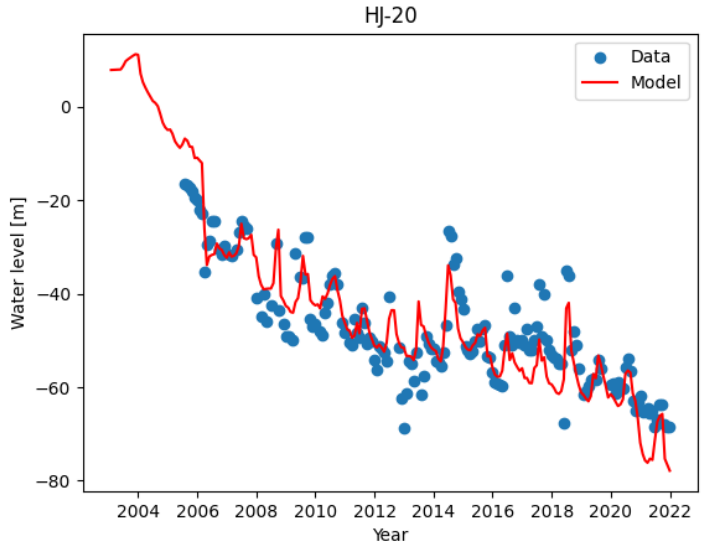
Lumped model system

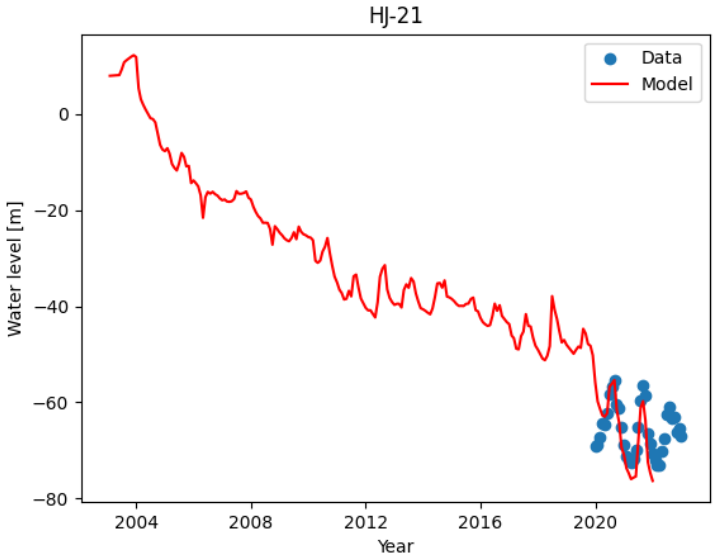


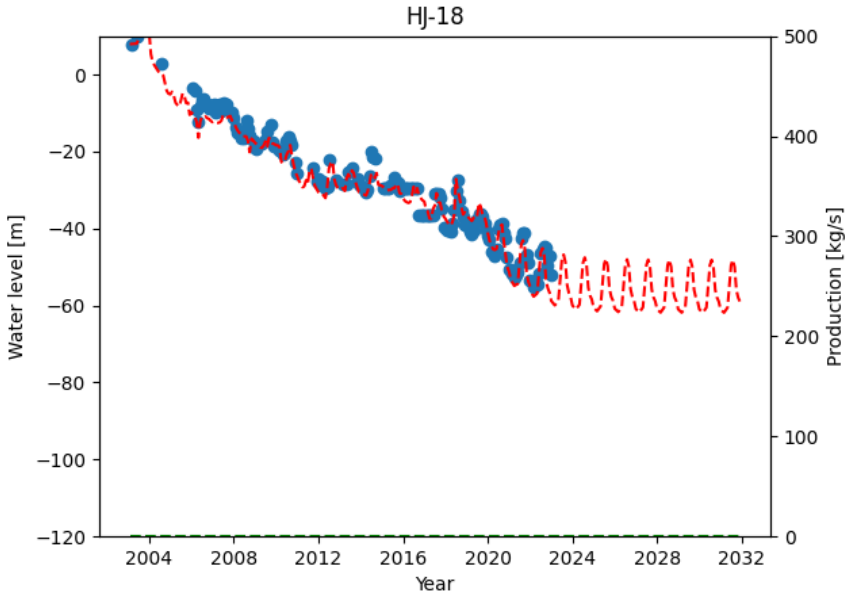
Water level comparison

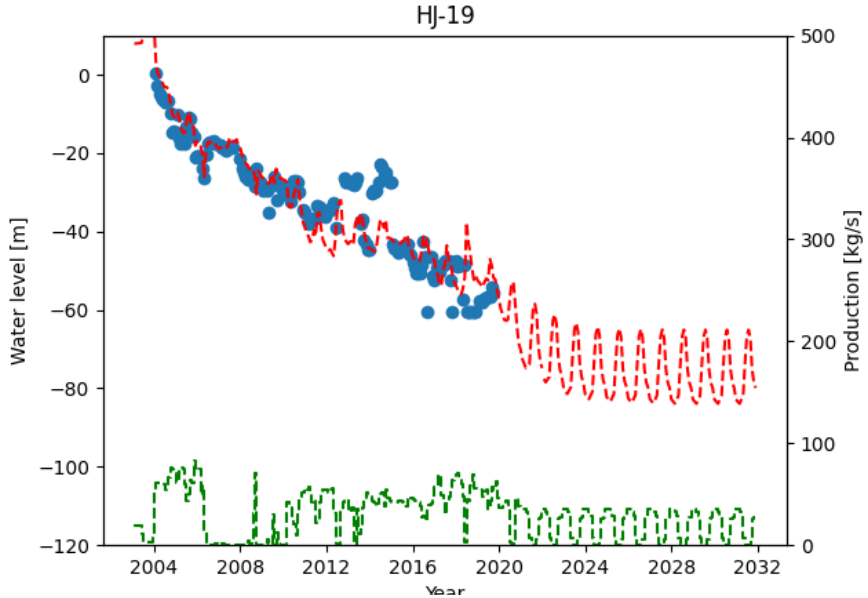


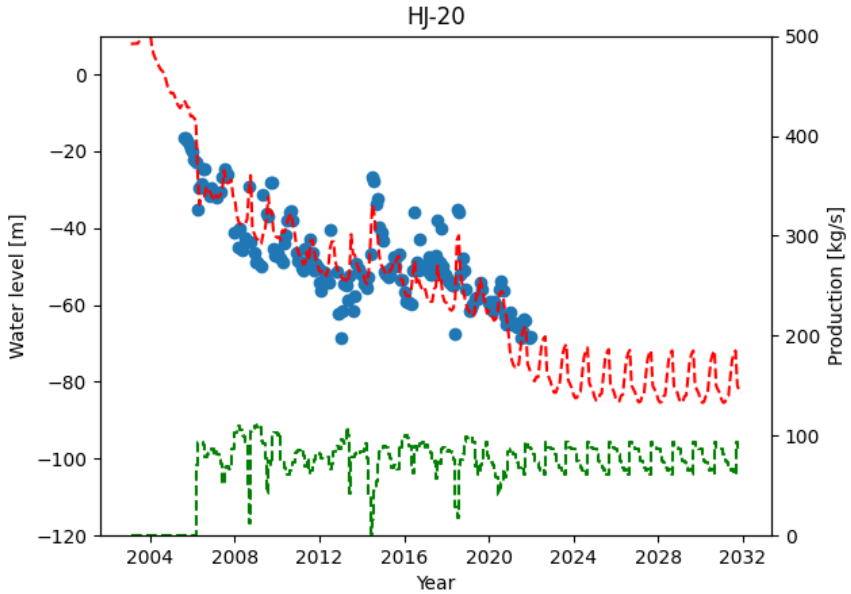


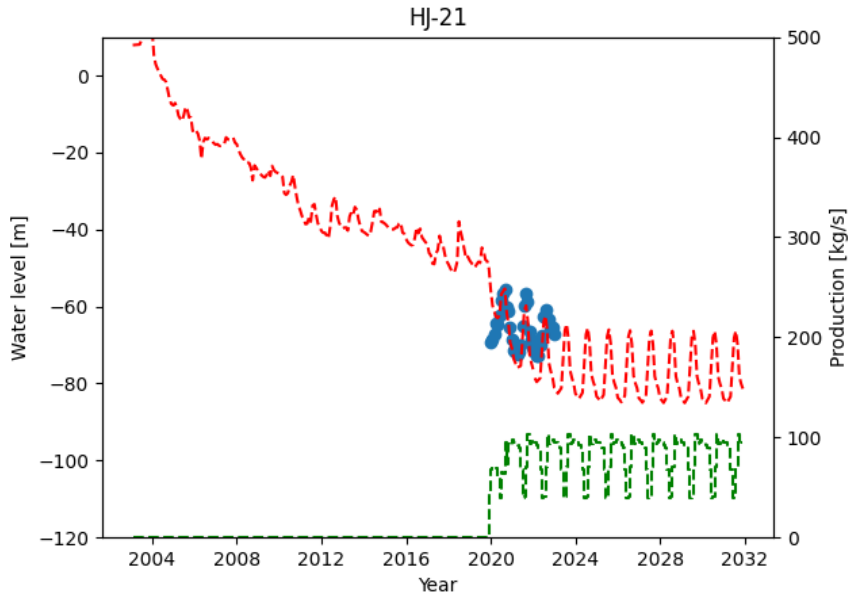





HJ-18
Water level [m]
Production [kg/s]
Year
0
−20
−40
−60
−80
−100
−120
500
400
300
200
100
0
2004
2008
2012
2016
2020
2024
2028
2032


HJ-19
Water level [m]
Production [kg/s]
Year
0
−20
−40
−60
−80
−100
−120
500
400
300
200
100
0
2004
2008
2012
2016
2020
2024
2028
2032


HJ-20
Water level [m]
Production [kg/s]
Year
0
−20
−40
−60
−80
−100
−120
500
400
300
200
100
0
2004
2008
2012
2016
2020
2024
2028
2032


HJ-21
Water level [m]
Production [kg/s]
Year
0
−20
−40
−60
−80
−100
−120
500
400
300
200
100
0
2004
2008
2012
2016
2020
2024
2028
2032