

# iTOUGH2-FloWell

## Reservoir and Wellbore Simulation

Jean-Claude Berthet<sup>1</sup>, Andri Arnaldsson<sup>1</sup>  
Halldóra Guðmundsdóttir<sup>2</sup>, Magnús Þór Jónsson<sup>3</sup>  
Stefan Finsterle<sup>4</sup>

<sup>1</sup>Vatnaskil Consulting Engineers

<sup>2</sup>Stanford University

<sup>3</sup>University of Iceland

<sup>4</sup>Finsterle GeoConsulting



## iTOUGH2-FLOWELL

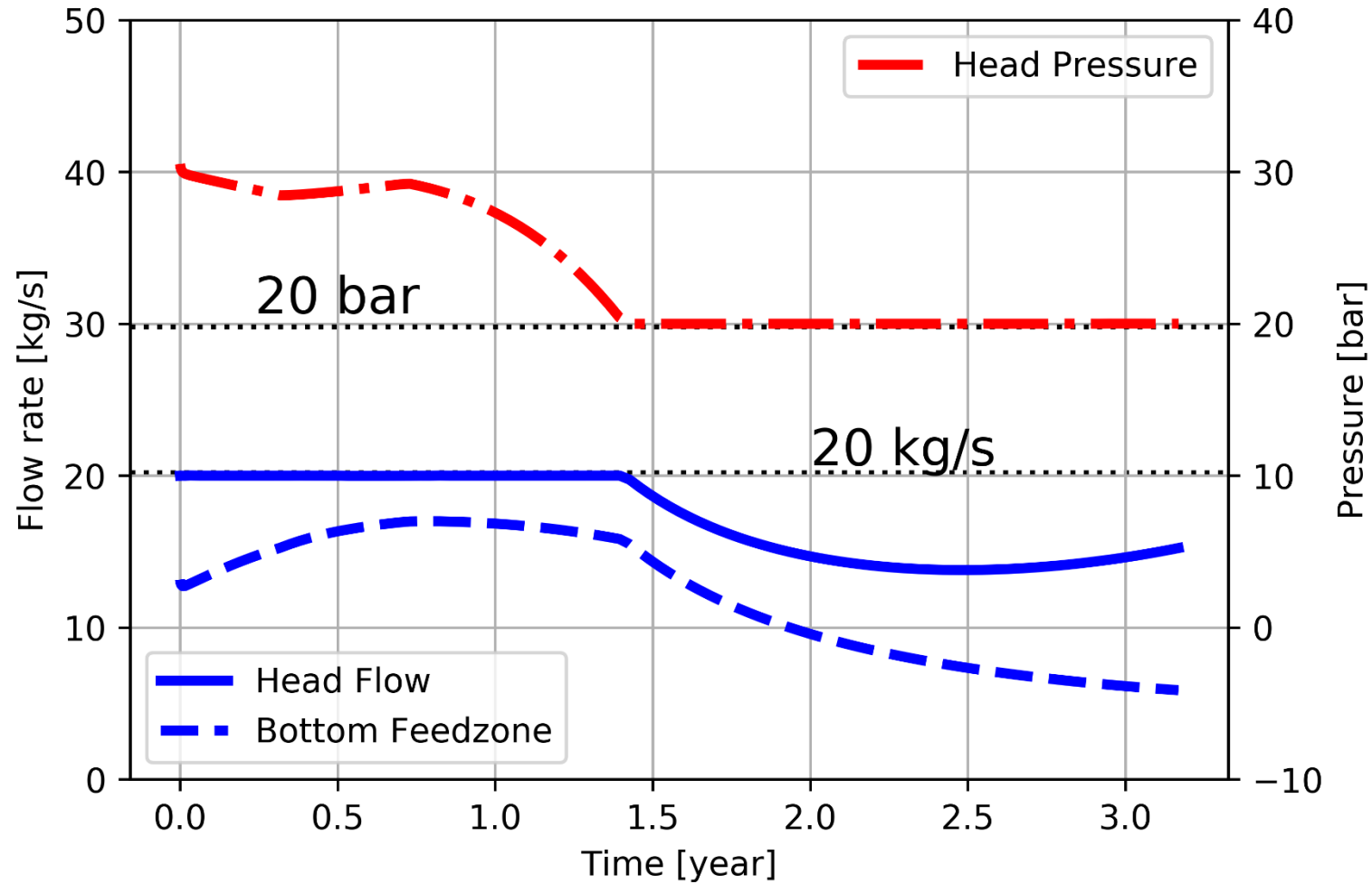
- Coupled reservoir-wellbore simulator
- Multiple feedzones
- Multiple diameters
- Deviated wells
- Production and injection
- Several friction and 2-phase flow models
- Production at constant wellhead pressure
- Provides time-series
  - Wellhead flow rate
  - Wellhead pressure
  - Wellhead enthalpy
  - Wellhead temperature
  - Wellhead saturation
- FloWell standalone mode
  - Optimize wellbore model using iTOUGH2
  - Estimate enthalpy
  - Find feedzones

# Input block FLOWELL

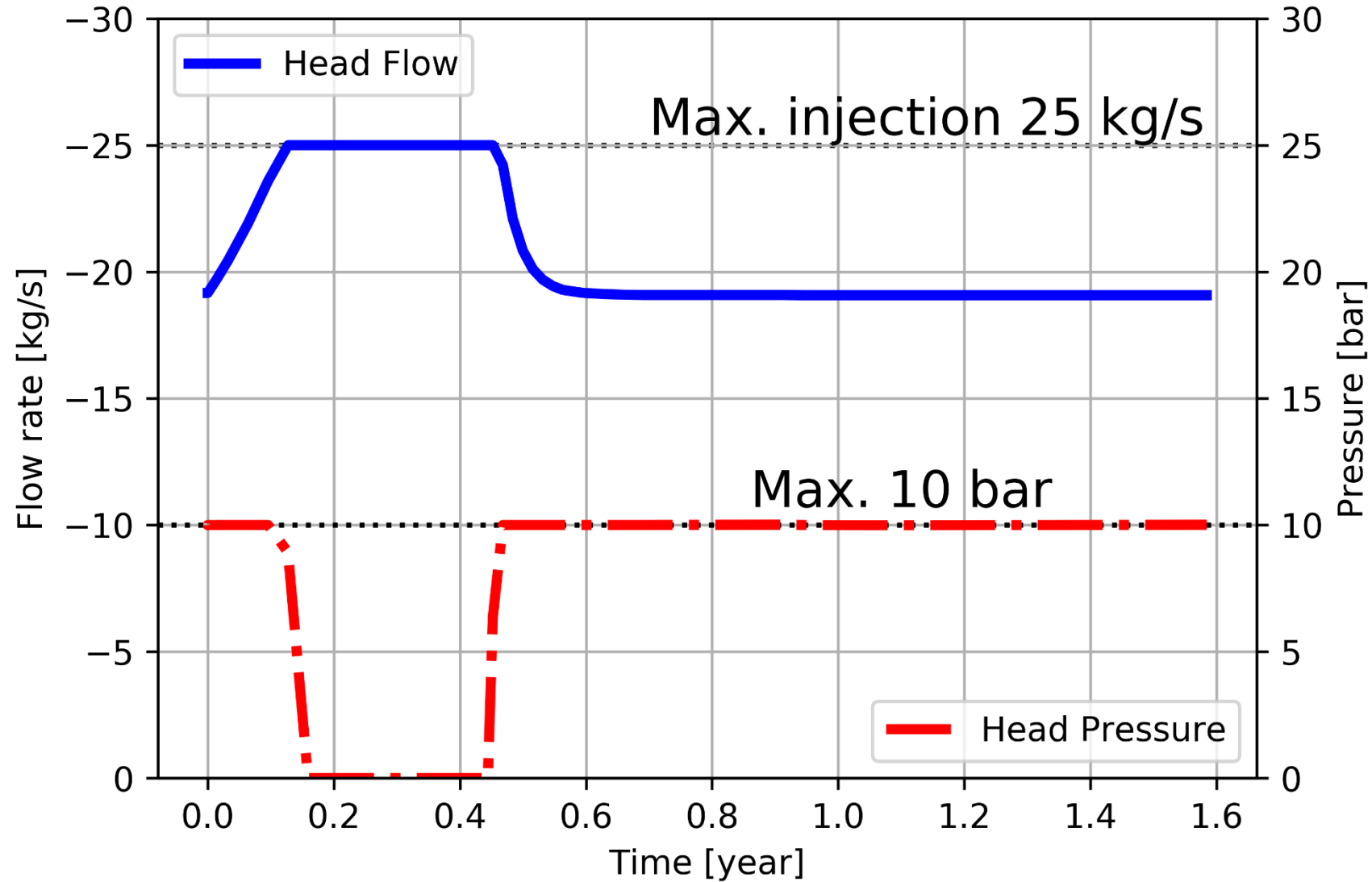
GENER	1	*	2	*	3	*	4	*	5	*	6	*	7	*	8	
BA215FLV10					1	MASS			-10.0							
AA215FLV11					1	MASS			-10.0							
AA192FLV20					1	MASS			-10.0							
BA228FLV30					1	DELV			1.0e-12							
AA228FLV31					1	DELV			1.0e-12							
Number of sections																
FLOWELL0	1	TFF	*	2	*	3	*	4	*	5	*	6	*	7	*	8
	3	11	226			20.0e5										
BA215FLV10			1.0E-12		200.0	0.23		0.0E-5			0.12				1.0	
AA215FLV11			1.0E-12		578.0	0.23		0.0E-5			0.12				1.0	
					842.0	0.32		4.6E-5							1.0	
	2	11	226		20.0e5											
AA192FLV20			1.0E-12		598.0	0.23		0.0E-5			0.12				1.0	
					822.0	0.32		4.6E-5			0.12				1.0	
	3	11	226		20.0e5											
BA228FLV30			-10.0		200.0	0.23		0.0E-5			0.12				1.0	
AA228FLV31			-5.0		578.0	0.23		0.0E-5			0.12				1.0	
					842.0	0.32		4.6E-5			0.12				1.0	

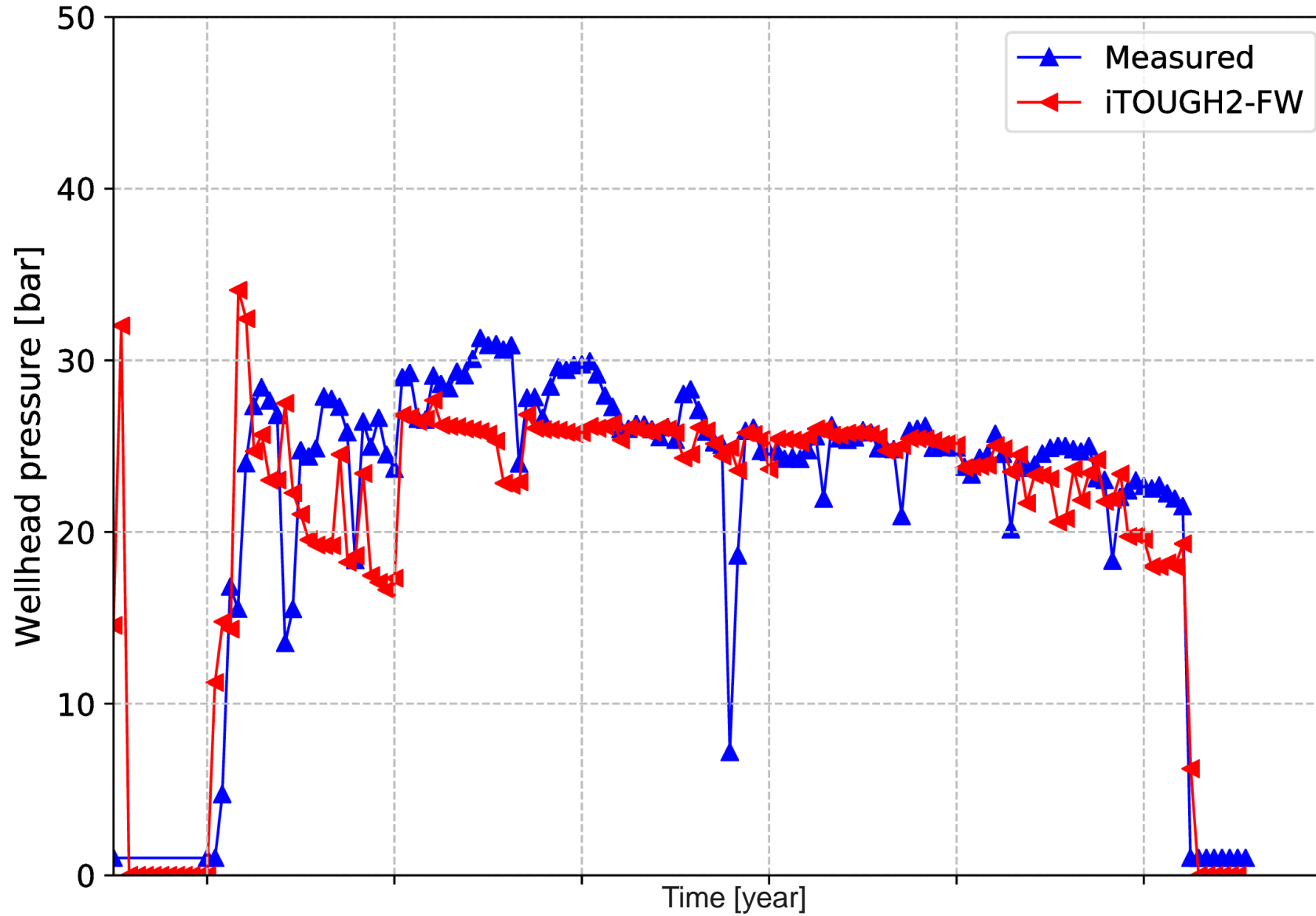


# Production

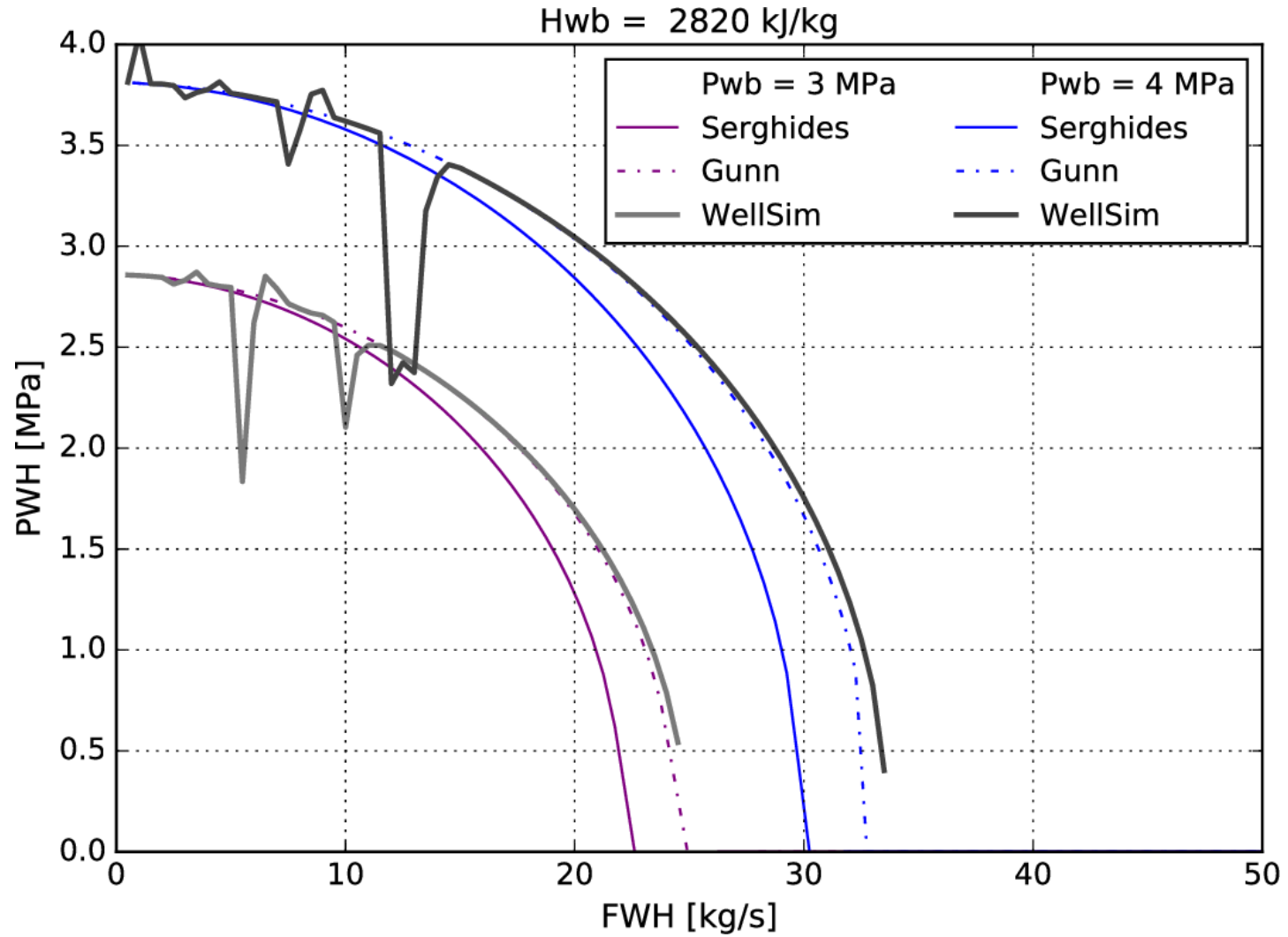


# Injection



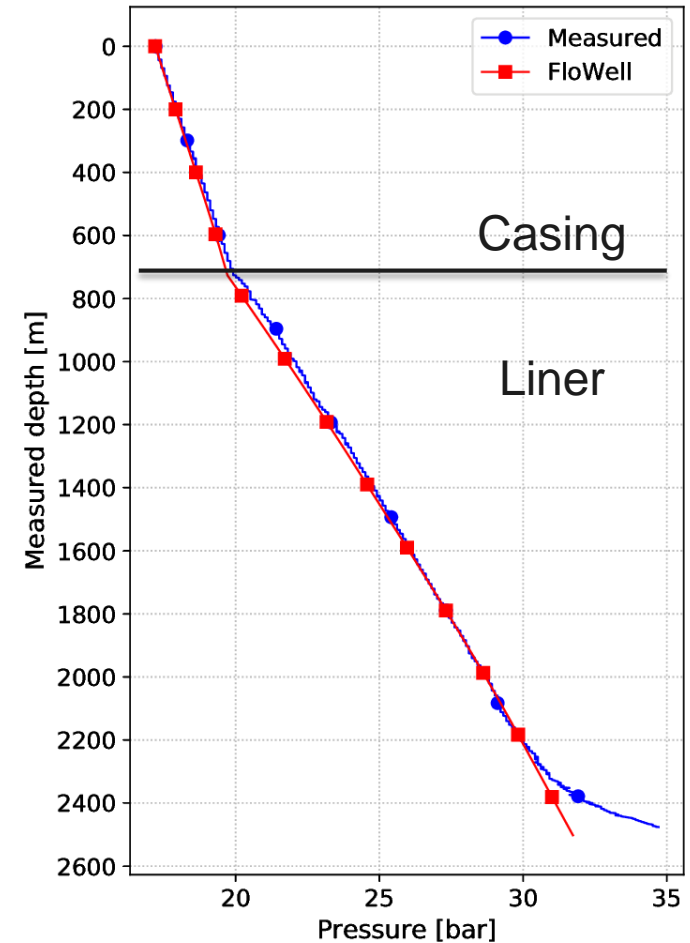


# Wellbore output curve



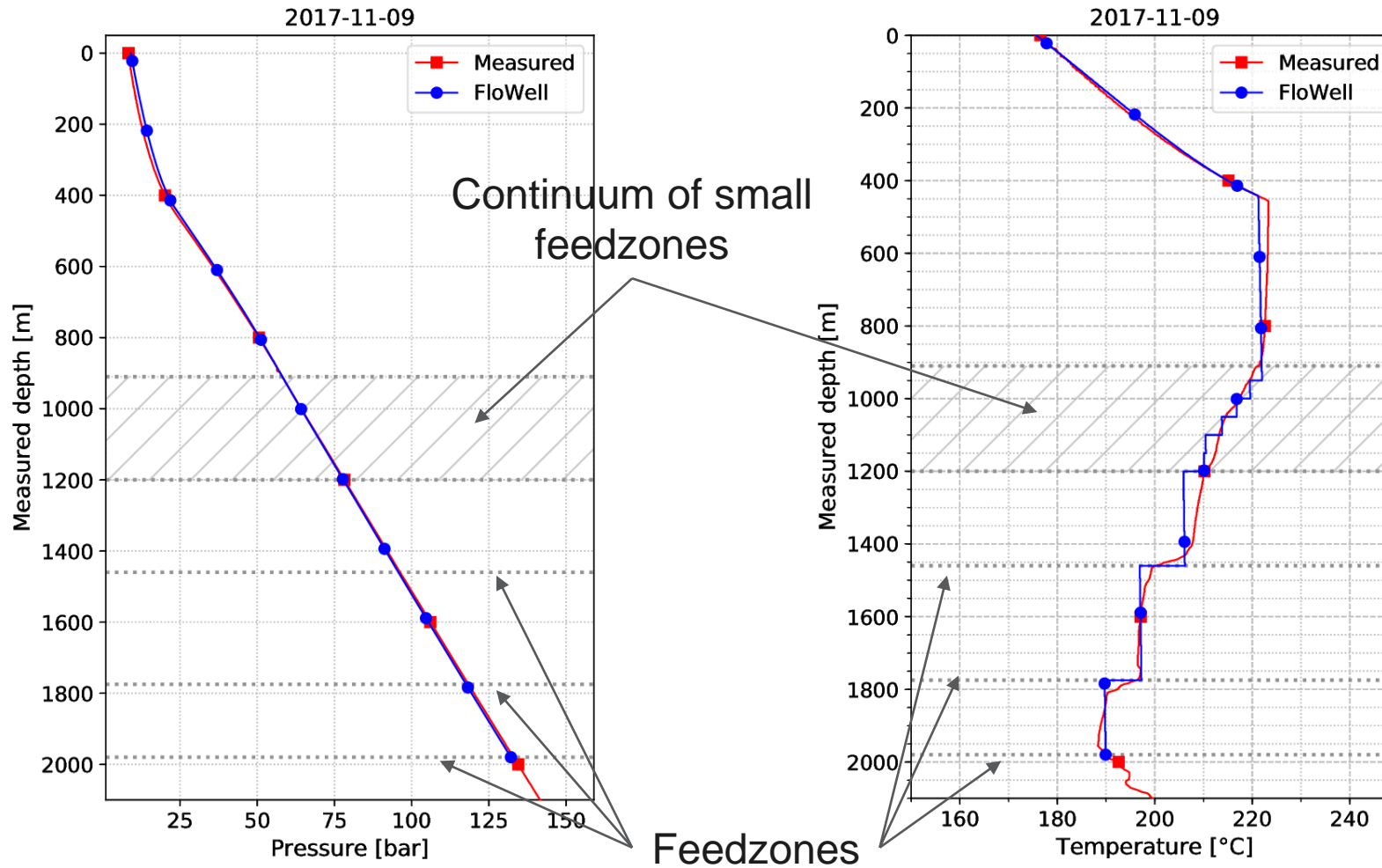
# Estimate enthalpy and-or mass rate

- A priori values
  - Mass flow rate: 9.2 kg/s
  - Specific enthalpy: 2640 kJ/kg
- Optimize mass rate and enthalpy
- Results
  - Mass flow rate: 9.8 kg/s
  - Specific enthalpy: 2470 kJ/kg





# Find feedzones



# Comparison with spinner

Flowell				Spinner	
Depth [m]	Pressure [bar]	Temperature [°C]	Flow Fraction	Temperature [°C]	Flow Fraction
Head	9.1	175.7	6.4 kg/s		
950	71.0	286.7	3%		
1000	74.0	289.4	3%		
1050	76.9	291.6	3%		
1100	79.9	292.3	3%		
1150	82.8	290.3	0%		
1200	85.8	288.0	4%		
1460	101.8	227.9	24%	> 200	~30%
1670-1680				> 200	~15%
1775	123.3	206.6	26%	> 200	~30%
1980	137.7	189.9	32%	< 200	~25%



# Thank you

And thanks to Landsvirkjun and HS Orka for supporting this project