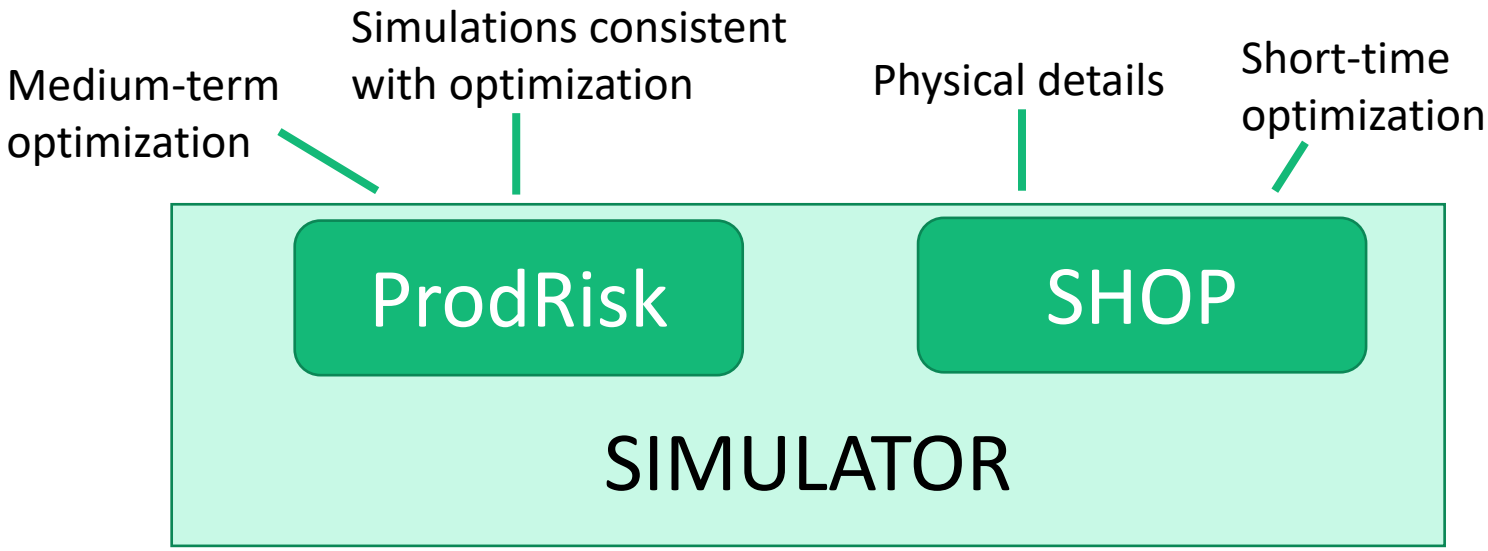
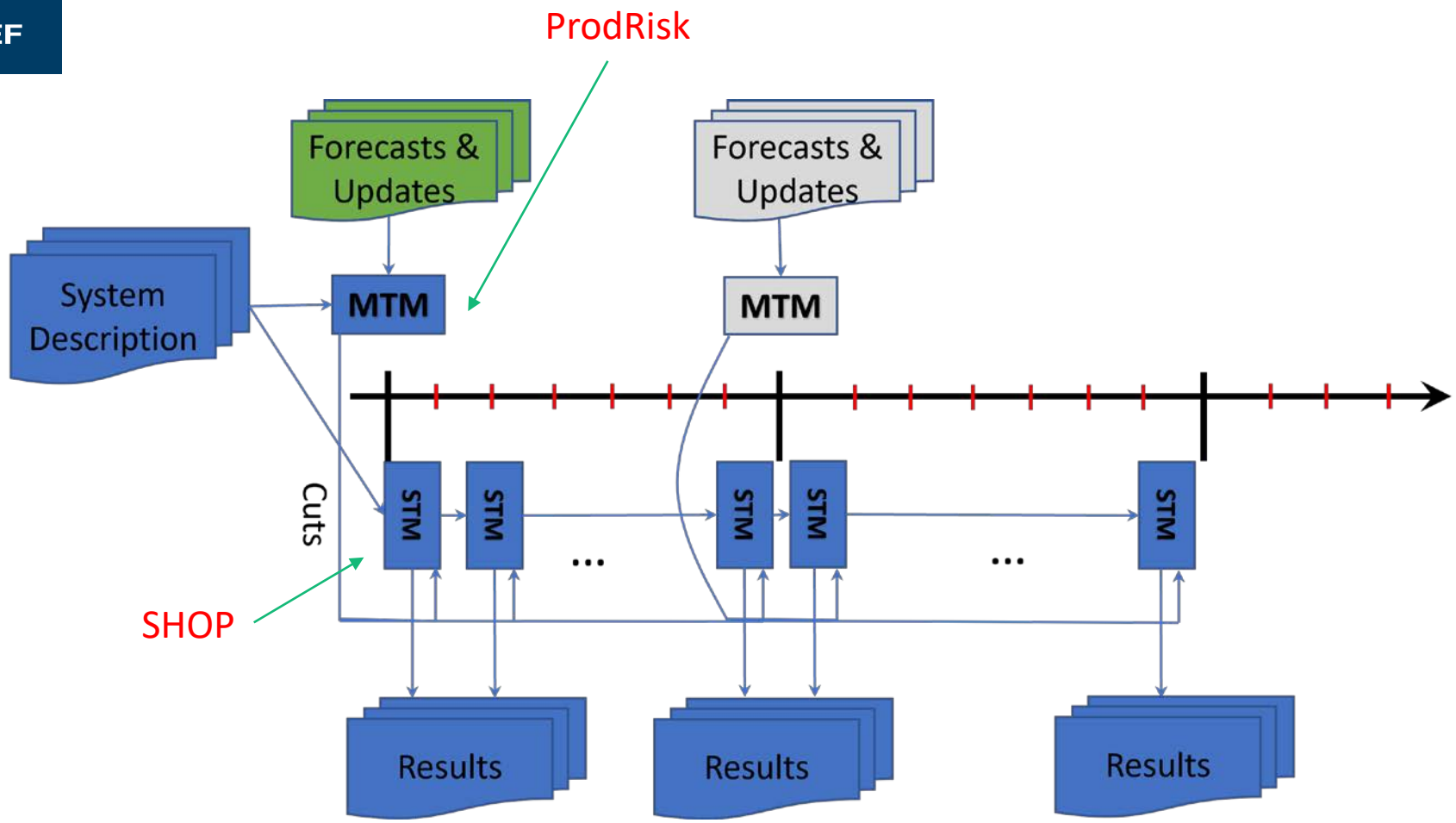
ProdRisk-SHOP simulator

Siri Mathisen

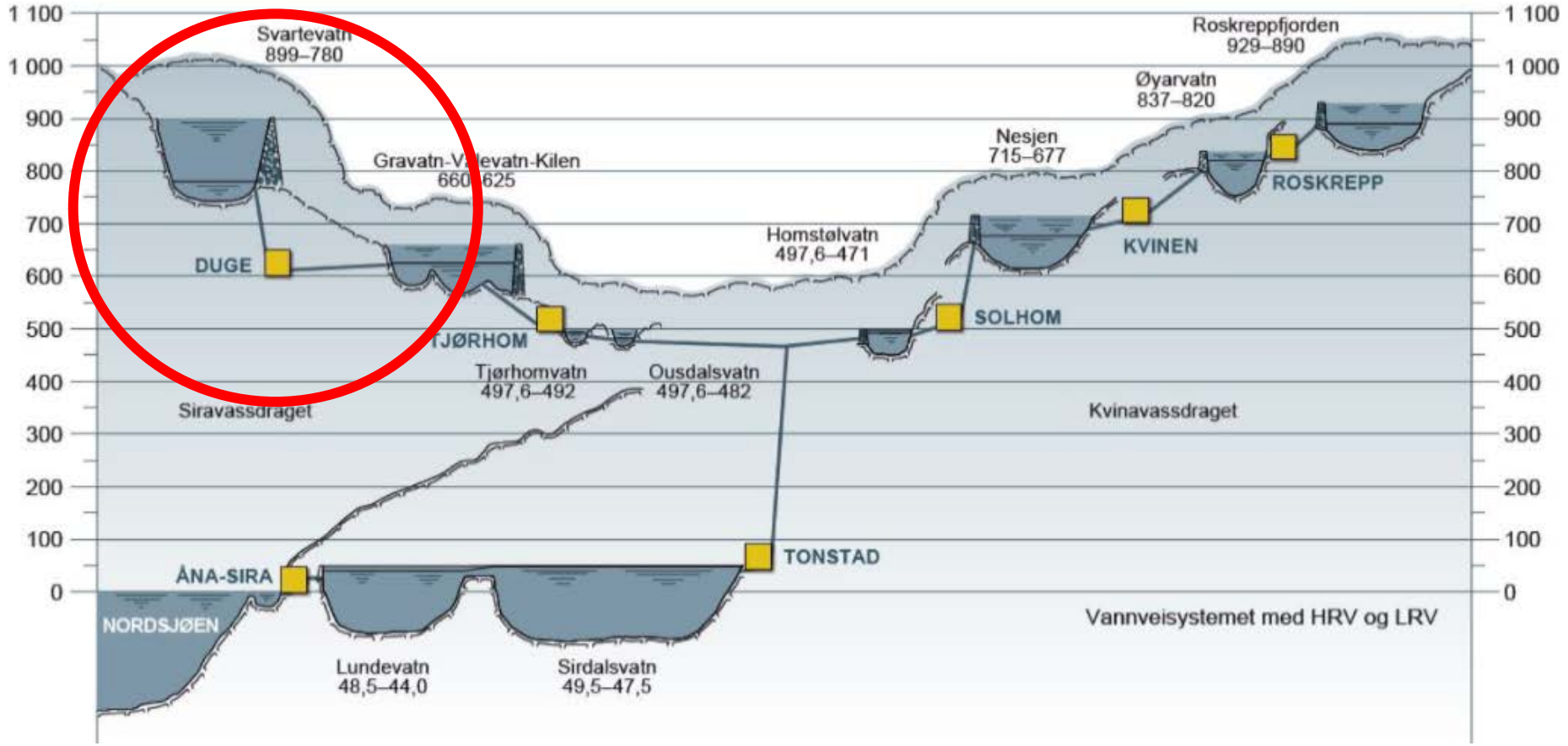
Motivation

- Combination of optimization and simulation
- Economic results
- Physical details



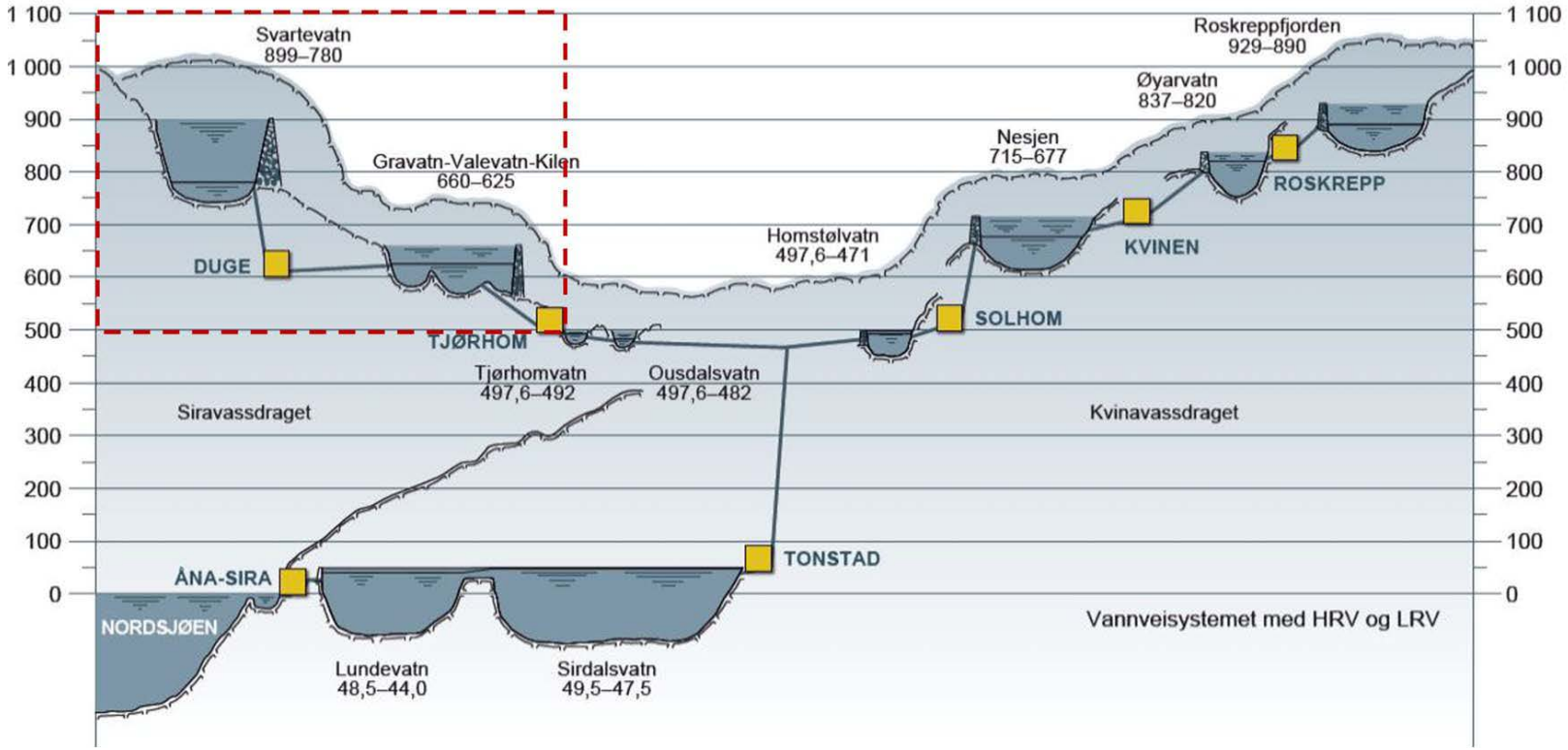

ProdRisk
Forecasts & Updates
Forecasts & Updates
System Description
MTM
MTM
Cuts
STM
STM
STM
STM
STM
...
...
SHOP
Results
Results
Results

Case: Upgrade of pump in Duge, Sira-Kvina



Simulator set-up

	Runtime
ProdRisk (full system, 7 parallel processes)	26 h
SHOP (full system)	58 h
SHOP (snippet system)	10 h



Intel(R) Xeon(R) Silver 4116 processor with maximum frequency of 2,1 GHz, with two kernels (8 virtual processors) and 16 GB RAM.

But can we take this short cut?

- Simulation results from ProdRisk are available to snipped system
- Discharge/bypass/overflow from modules upstream the snipped system are treated as inflow to the snipped system
- Simulated reservoir volumes from ProdRisk are not significantly different from the optimized SHOP reservoir volumes

$$\alpha + \left(\pi_{j,m}^{\top} - \pi_{j,dm}^{\top}\right) v_m \leq \alpha_j^{***} - \pi_{j,dm}^{\top} v_{m,sim} \tag{5}$$

$$\alpha + \left(\pi_{j,m}^{\top} - \pi_{j,dm}^{\top}\right) v_m \leq \alpha^{****}, \tag{6}$$

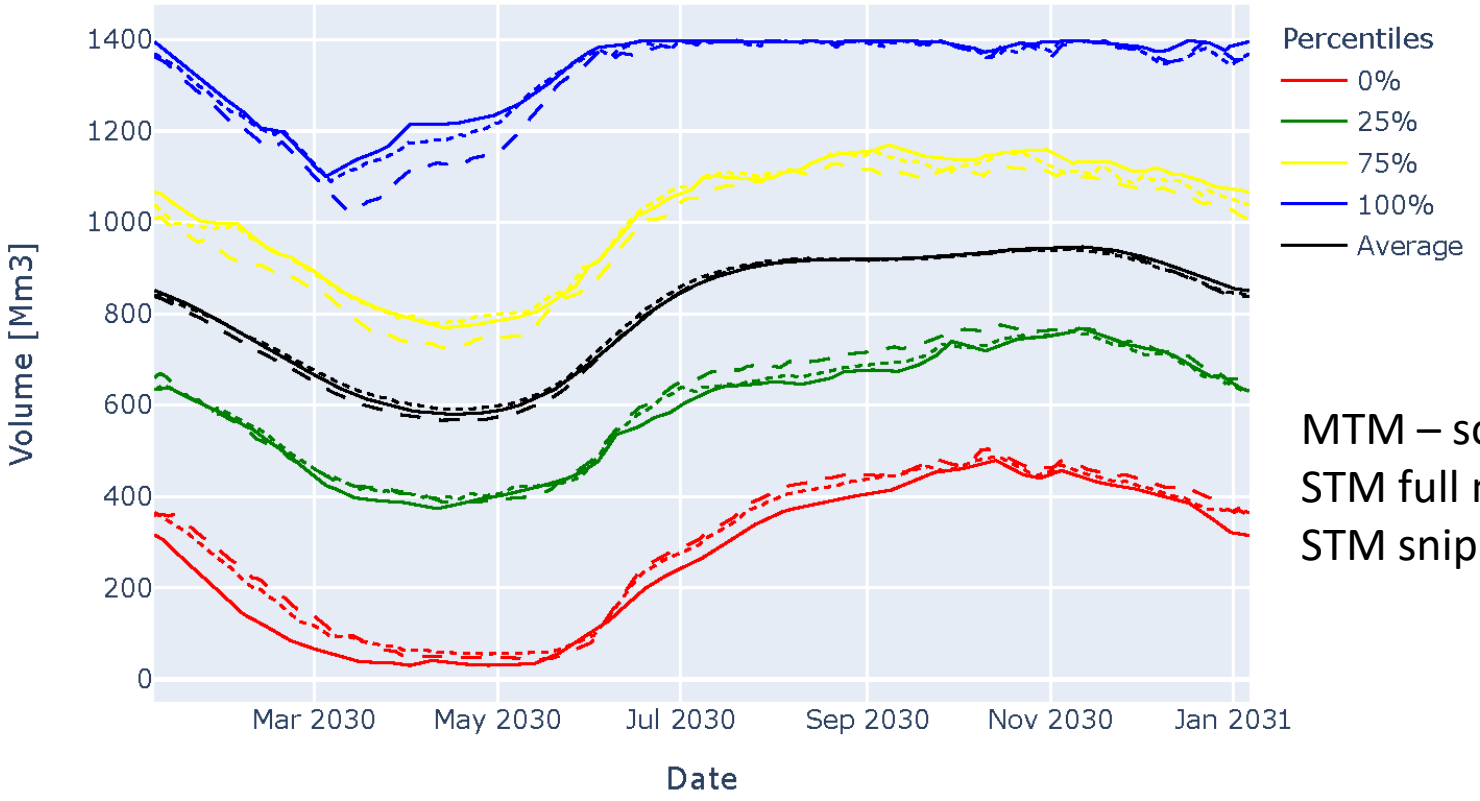
$$\begin{aligned}
\alpha_j^{****} =& \alpha_j^{***} - \pi_{j,dm}^{\top} v_{m,sim} \\
=& \alpha_j^{**} - \mu_{j,u}^{\top} v_u - \pi_{j,u}^{\top} v_{u,sim} \\
& - \mu_{j,d}^{\top} v_d - \pi_{j,d}^{\top} v_{d,sim} \\
& - \mu_{j,m}^{\top} v_m - \pi_{j,dm}^{\top} v_{m,sim}
\end{aligned}$$

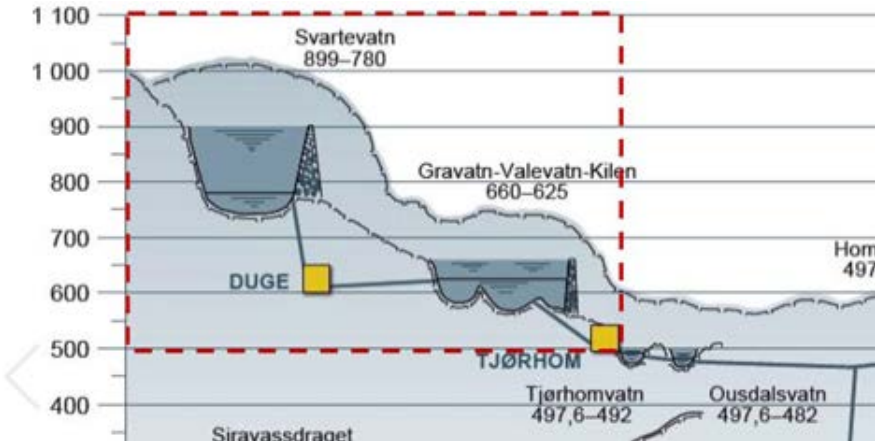
Economic results

MEUR	Current			Upgraded			Diff=Upgraded-Current		
Plant	MTM	STM	STM snipped	MTM	STM	STM snipped	MTM	STM	STM snipped
Duge production	19.1	18.8	18.9	19.8	19.9	20.0	0.9	1.1	1.1
Duge pumping	-5.0	-5.3	-5.2	-5.6	-6.1	-6.0	-0.5	-0.8	-0.8
Tjørhom	26.1	25.2	26.0	26.2	25.4	26.0	0.1	0.2	0.0
Rosskrepp	5.6	5.6		5.5	5.6		0.0	0.0	0.0
Kvinen	11.7	11.8		11.7	11.8		0.0	0.0	0.0
Solhom	38.3	36.7		38.3	36.7		0.0	0.1	0.0
Tonstad	189.7	185.3		189.6	185.9		-0.1	0.6	0.0
Åna-Sira	30.0	28.8		30.0	28.9		0.0	0.1	0.0
Total start-up costs	0.0	-1.4	-0.4	0.0	-1.4	-0.4	0.0	0.0	0.0
NET INCOME	315.3	305.5	39.2	315.7	306.7	39.6	0.4	1.3	0.4
NET INCOME SNIPPED*	40.2	38.7	39.6	40.6	39.2	40.0	0.4	0.5	0.4

TABLE I
ECONOMIC RESULTS
*DOES NOT INCLUDE START-UP COSTS, AS "SUM START-UP COSTS" ARE NOT COMPARABLE FOR DIFFERENT SYSTEMS.

Reservoir volume Svartevann

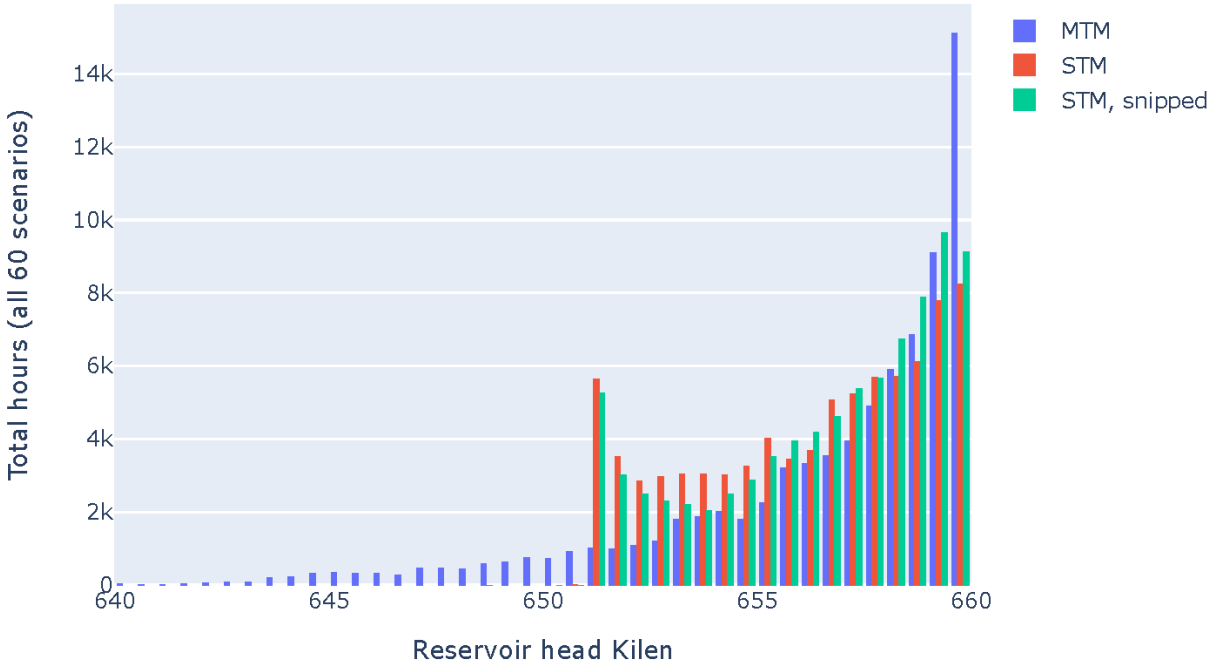




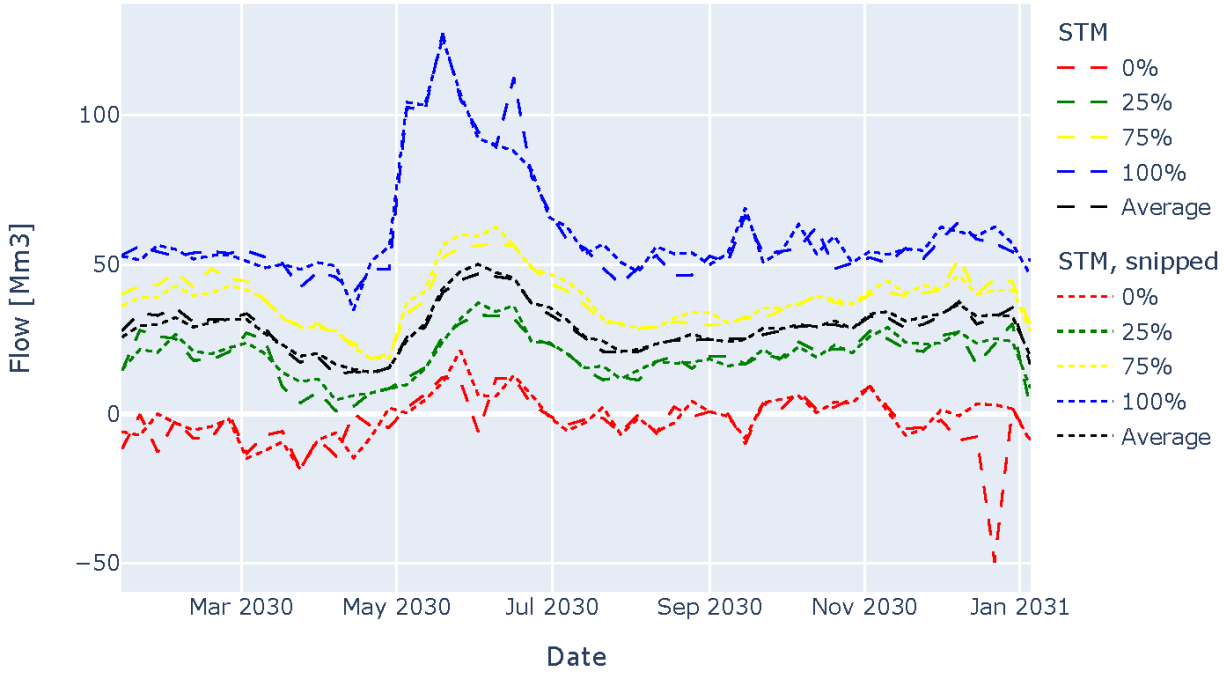
MTM – solid
STM full model – dashed
STM snipped model – dotted

Details from SHOP:

Pumping Duge



Flom Kilen-Gravann



Now what to decide?

- Combination of optimization and simulation: Support
- Economic results:
  - ProdRisk: Consistency, strategy optimized for this model
- Physical details
  - SHOP provides physical properties to fill in the gaps

  → based on strategy optimized for ProdRisk

→Choose snipped area carefully