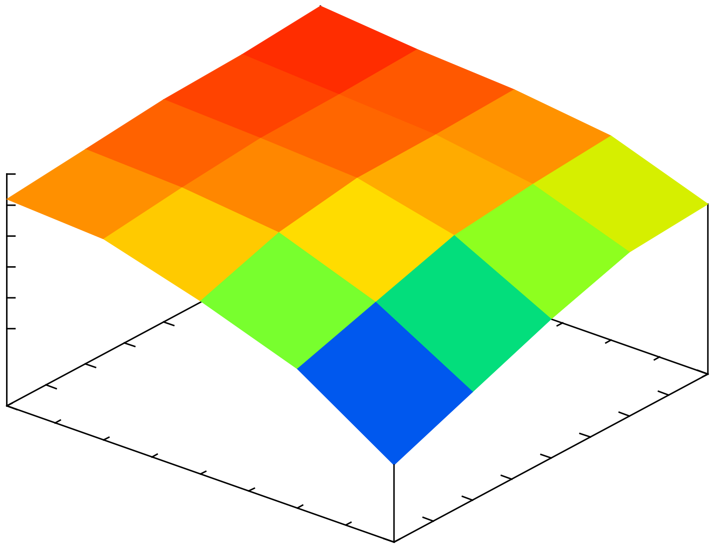
Increased information flow between hydropower scheduling models through extended

cut sharing



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~~What?~~ Why?

ProdRisk can already share information with SHOP, but

- ProdRisk run once gives results for X prices. SHOP run with current (or other) price could be one of the X prices or in between by interpolation => re-run Prodisk if price change
- Rapid changes in market calls for manual corrections or rapid recalculations – don't want to re-run ProdRisk if it can be avoided
- Autocorrelation in price and in inflow not taken into account in the old coupling
- Multi-scenario analyses in SHOP with possibly large variation in input (price/inflow) requires more refined description of endpoint values

  Or use SHARM for this (with new coupling!)

User feedback:

- SHOP results tend to stretch the limits for "preferred" dispatching
- "Soften" results and possibly avoid interference with tactical and other limitations.

  Could potentially remove limitations which often have an effect on marginal costs representation
- Can increased correlation in price and water value give a flatter price-production curve (i.e., lower production sensitivity on price)?

Equations!

$$J_t = \min(\alpha_t + \mathbf{c}_t^{\mathbf{x}}\,t)$$

$$\mathbf{v}_t = \mathbf{v}_{t-1} + \mathbf{q}_t + \mathbf{A}_V \mathbf{x}_t$$

$$\mathbf{S}_t \mathbf{x}_t = \mathbf{D}_t$$

$$\alpha_t + (\lambda_t^r)^\intercal \mathbf{v}_t + (\nu_t^r)^\intercal \mathbf{z}_t \geq b_t^r\ , \quad r \in [1, R]$$

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Minimise future costs

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given certain constraints

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supply = demand

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limits on hydro levels and discharge: practical, environmental …

inflow equations (ask if interested)

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Relates future costs and current state of reservoir levels and inflow

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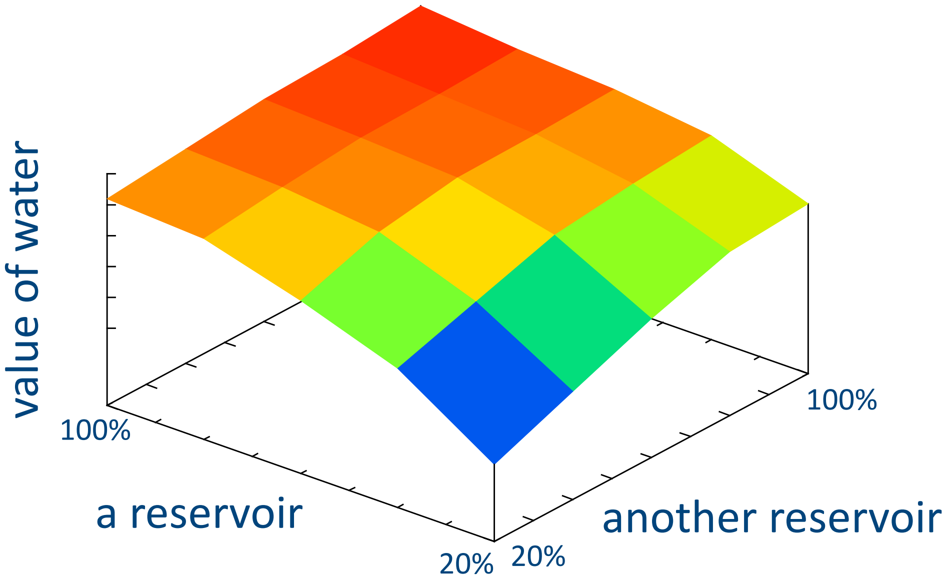
Called cut because it cuts off the solution space through the inequality

Key point: the value of water in a reservoir is dependent on the water level in *all reservoirs*!



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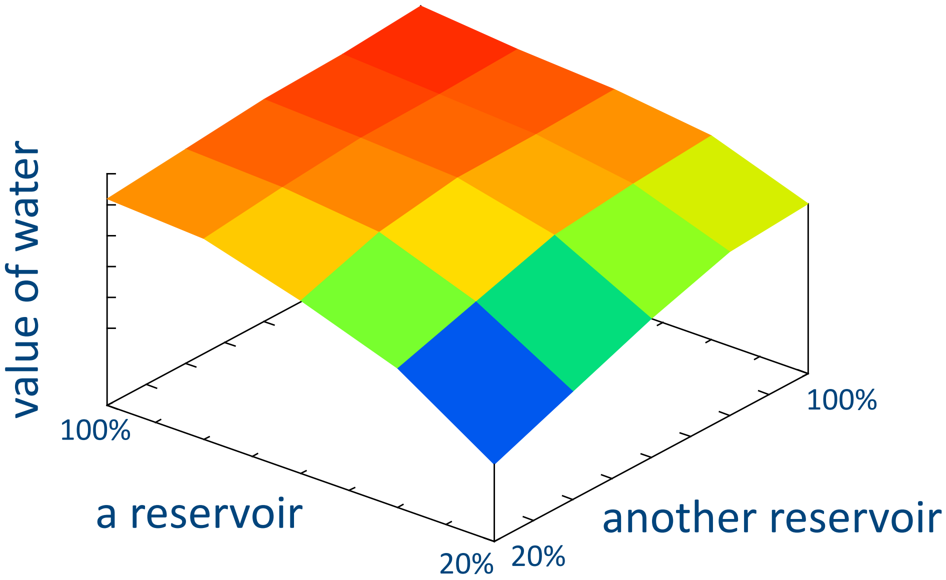


Can increased correlation in price and water value give a flatter price-production curve?

New coupling: *Push all cut information over to SHOP/SHARM*

In practise, ProdRisk now outputs complete cut information for all prices in ProdRisk:

cut value, reservoir levels, cut coefficients for hydro storage and inflow.

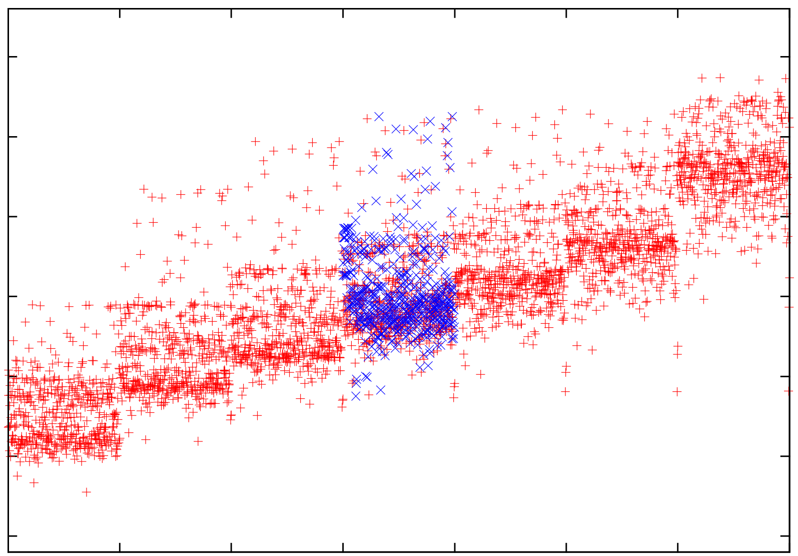
This information is read in and used as linearized to desired price *n**(SHOP)
multiple scenarios (SHARM)

fitted end value description
for each scenario in SHARM

Cut information

cut value

value of water



old cut information new cut information

On the SHOP side (SHARM "=" stoch. multi-SHOP)

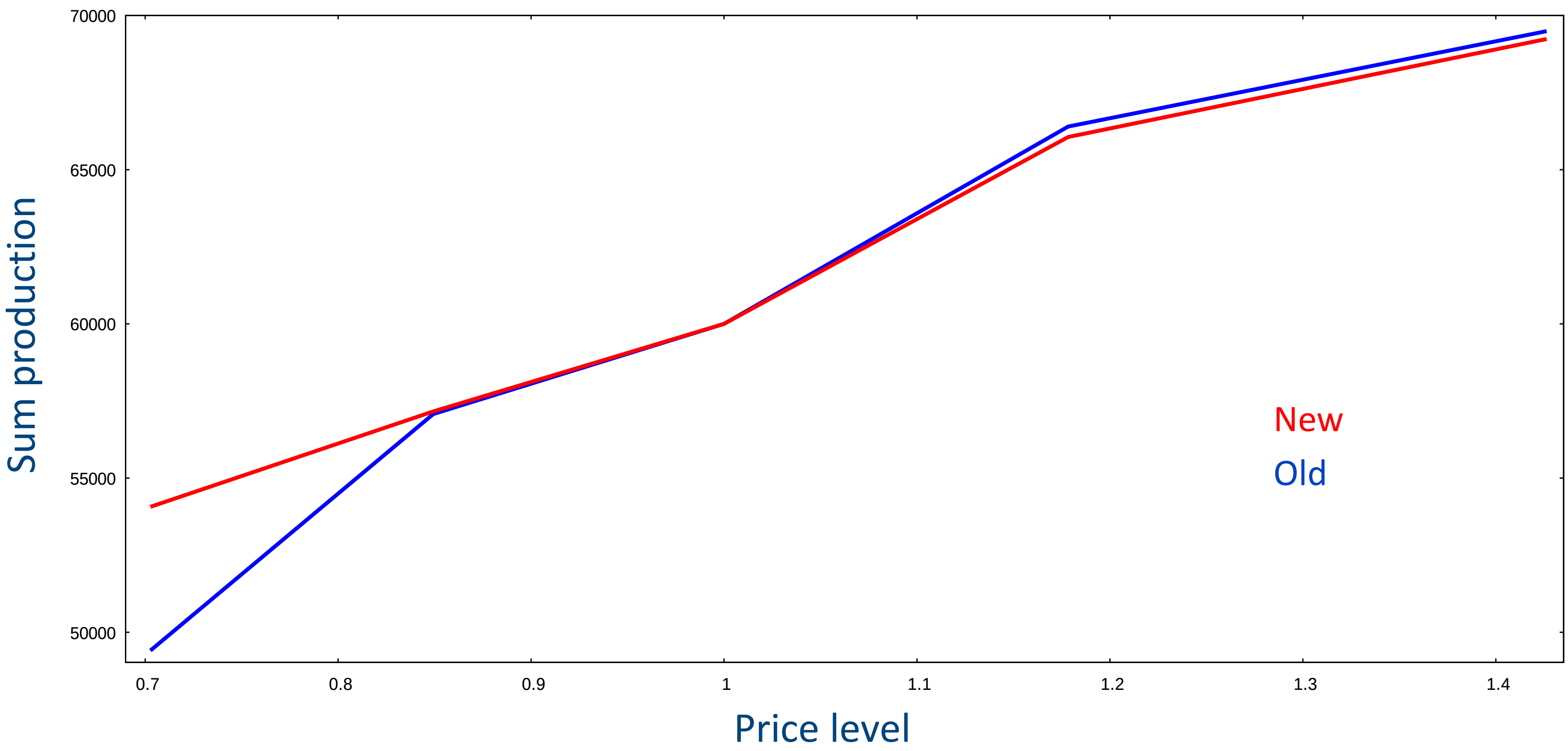
Old method uses cut coefficient for hydro storage and the reservoir level the cut was calculated for in ProdRisk:

$$\max \alpha$$
$$s.t. \quad \alpha \leq b_i + \sum_r \kappa_{r,i}(V_r - V_{r,i}^{\text{ref}})$$

New method includes inflow information:

$$\max \alpha$$
$$s.t. \quad \alpha \leq b_i^* + \sum_r \kappa_{r,i}^*(V_r - V_{r,i}^{\text{ref}}) + \lambda_{s,i}^*(I_s - I_{s,i}^{\text{ref}})$$
$$x_i^* = \Delta x_i^{\text{up}} + (1-\Delta)x_i^{\text{down}}$$
$$\Delta = \frac{\bar{p} - p_{\text{down}}}{p_{\text{up}} - p_{\text{down}}}$$

Yes, expected impact on production curves!



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Technology for a better society

Cut sharing is caring