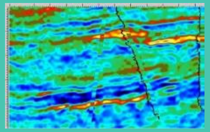
# Consistently integrate static and dynamic data into reservoir models while accounting for uncertainty – the **ResX** approach

Resoptima

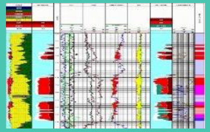
FORCE Workshop
Uncertainty handling in static-dynamic modelling workflows
Jon Sætrom
Stavanger, 9th of May

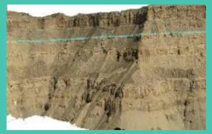
# Reservoir modelling – the challenge

Static data

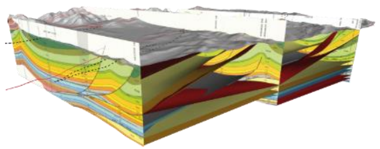

**Seismic surveys**

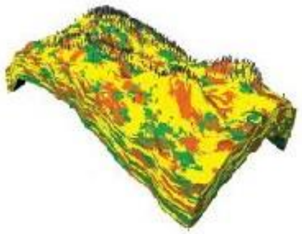

**Well cores**

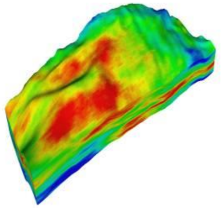

**Well logs**

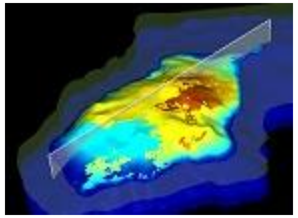

**Geological analogues**

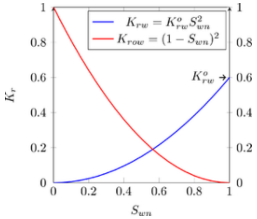
Millions of unknowns


Structure

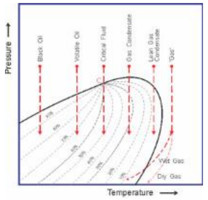

Facies


Petrophysics


Water saturation

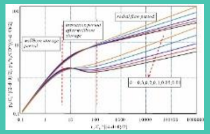


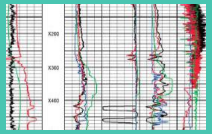
Rel.perm



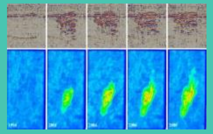
PVT

Dynamic data


**DST**

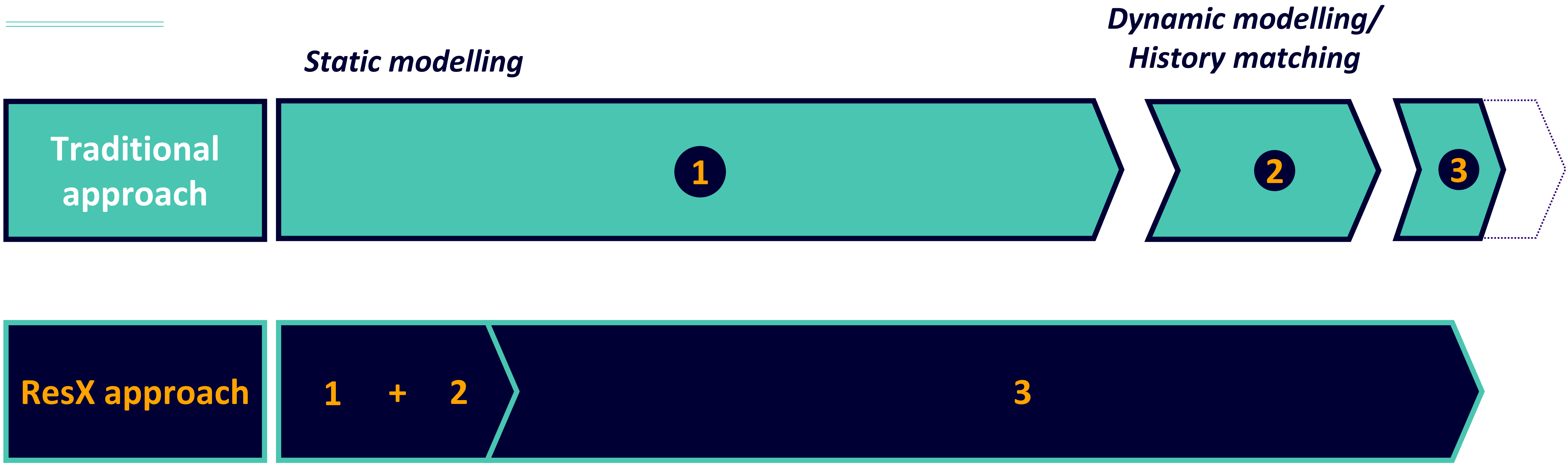

**RFT/PLT**


**Production data**


**4D Seismic**

# Resoptima offers technology to unlock the potential

90% or more reduced cycle-time in your reservoir modelling efforts



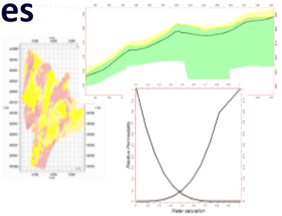
① Reservoir modelling

② Dynamic data conditioning

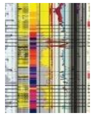
③ Reservoir insight/management & decision making

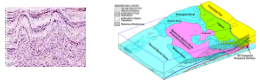
# Ensemble based reservoir modelling

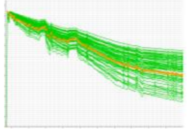
Automated modelling, driven by your data and ranges



All your data and subsurface know-how!



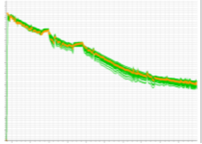




Probable given static data

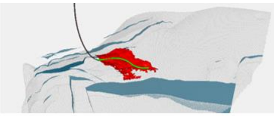
**New data**, re-run and **update**!

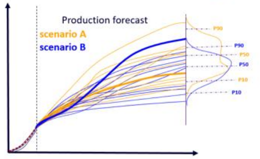
ResX



Dynamic data conditioning, as small changes as possible.

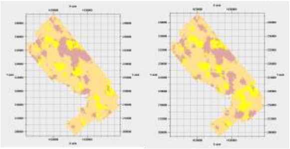
Improved field understanding, and efficiency.





Prescriptive analytics

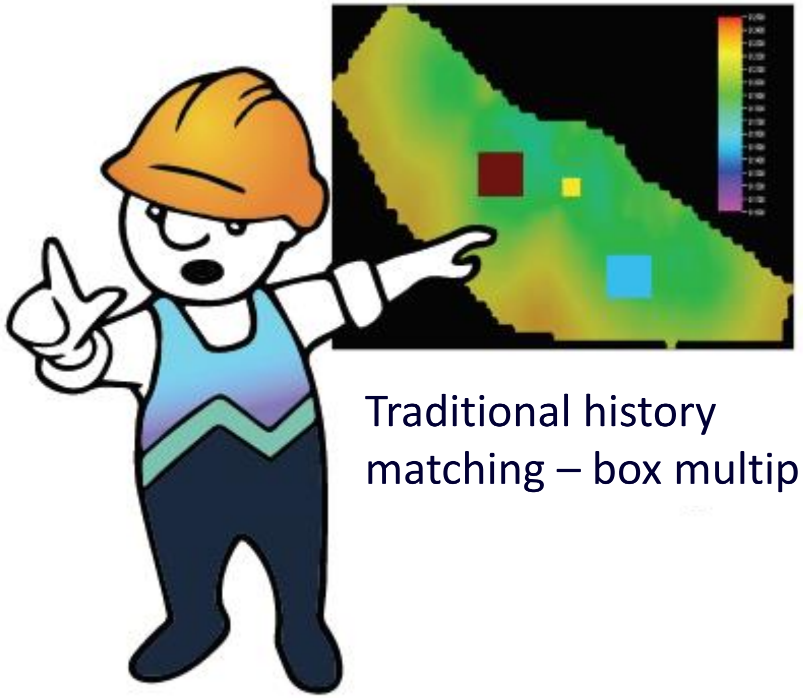
Equally probable, given current data, consistent across the team.



# What makes ResX unique?

# Reservoir models defined by unknowns

- 2-D surfaces, 3D properties and scalars – **ResX handles it all!**
- Why re-parameterize in the history matching phase?
- Do not neglect uncertainties
    - Primary reason for failures in predictions(*)



Traditional history matching – box multipliers

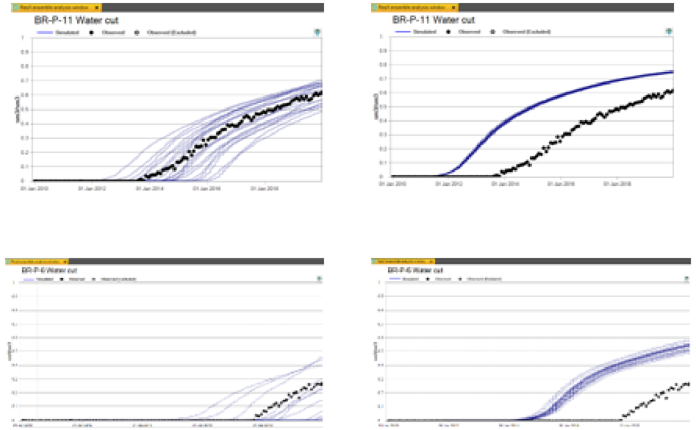
*Silver (2012) *The signal and the noise*

# The algorithm *appears* to be simple…but*….

**Textbook equations** (e.g. Burgers et al. 1998)

Prior

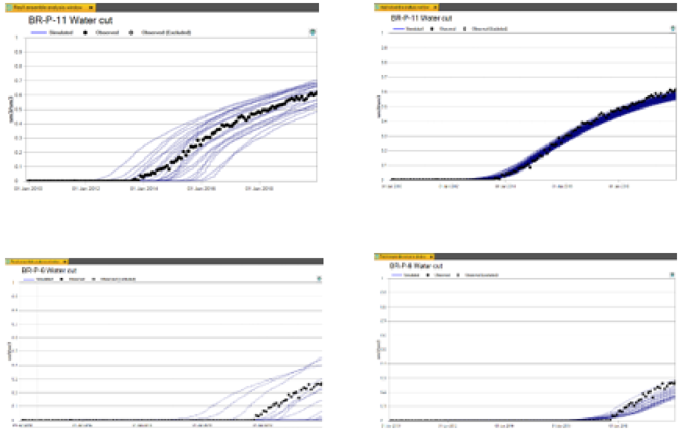
Posterior



**ResX** (commercial tool based on 20 years of research)

Prior

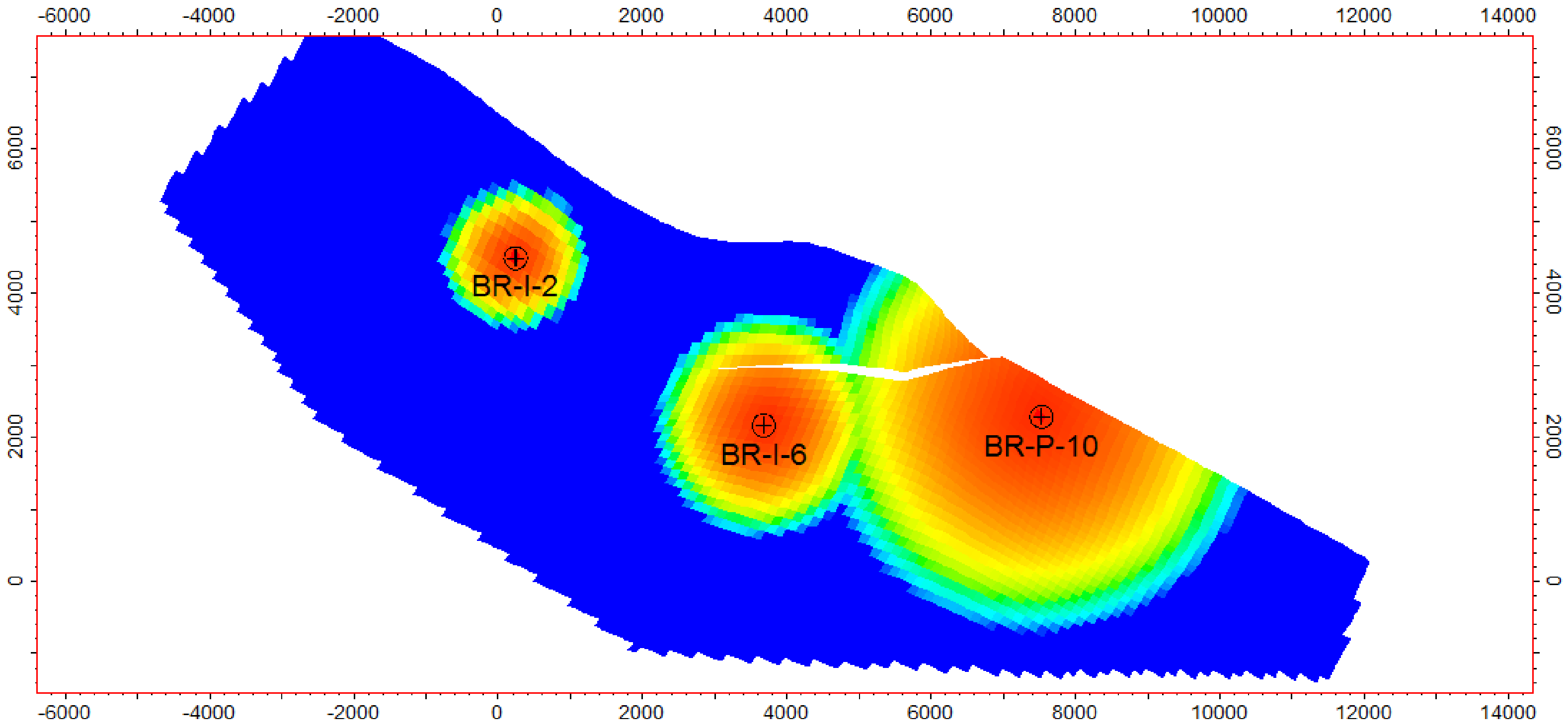
Posterior



*Source: Sætrom et. al, (2015) Petroluem Geostatistics

# Spatially dependent objective function – for every model parameter

Same principal as used in static data conditioning since the 1950s(*)



Trying to minimize a global objective function is an uphill battle for spatially dependent data as the dimension grows...

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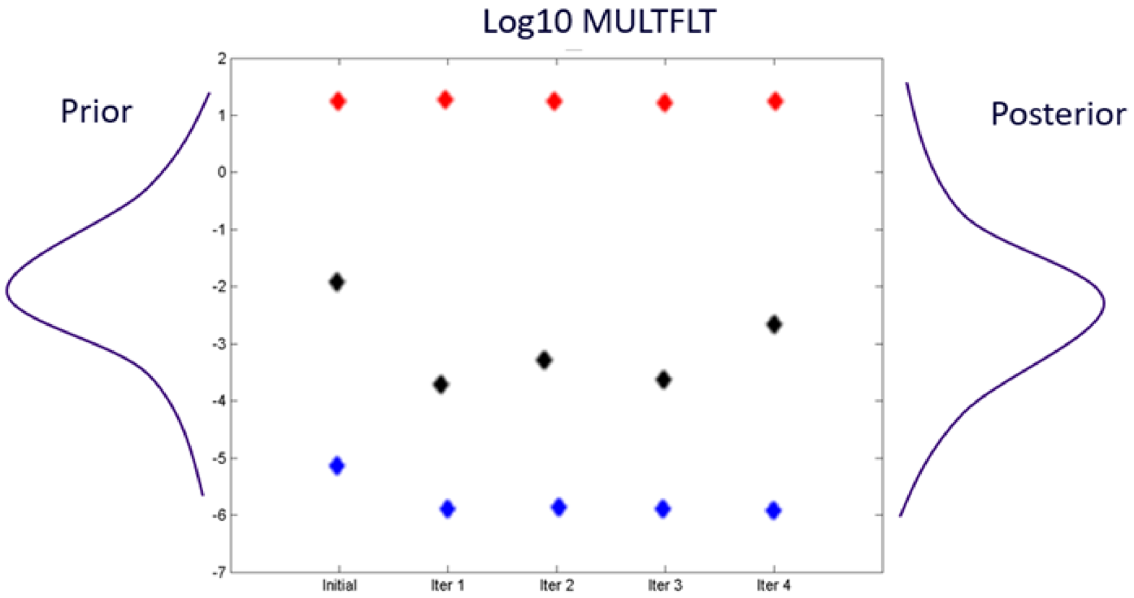
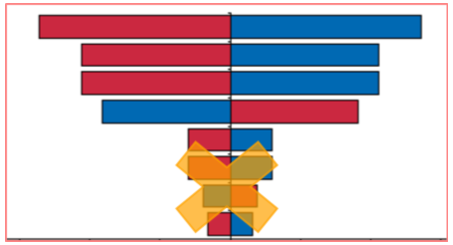
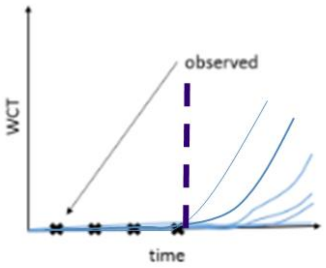
(*) Krige, Danie G. (1951). "A statistical approach to some basic mine valuation problems on the Witwatersrand". *J. of the Chem., Metal. and Mining Soc. of South Africa*. **52** (6): 119–139.

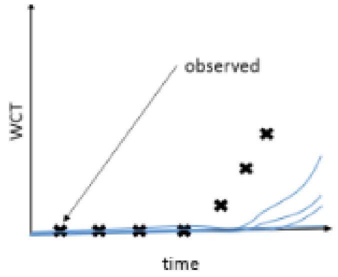
# Reduce uncertainty, only if data supports it…



**NOTE:** Parameter “insensitivity” does not imply that (prior) uncertainty in the parameter can be ignored:







Neglecting/discarding uncertainties leads to poor predictions!

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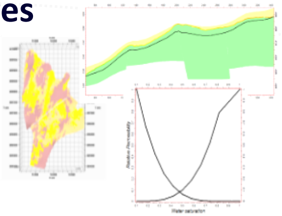

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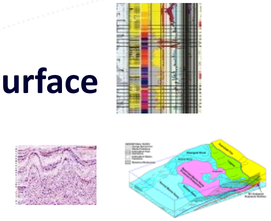

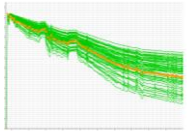

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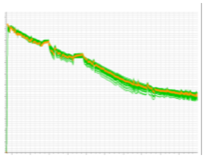

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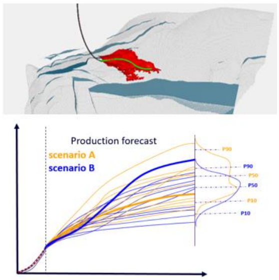

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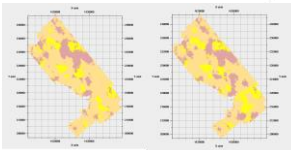
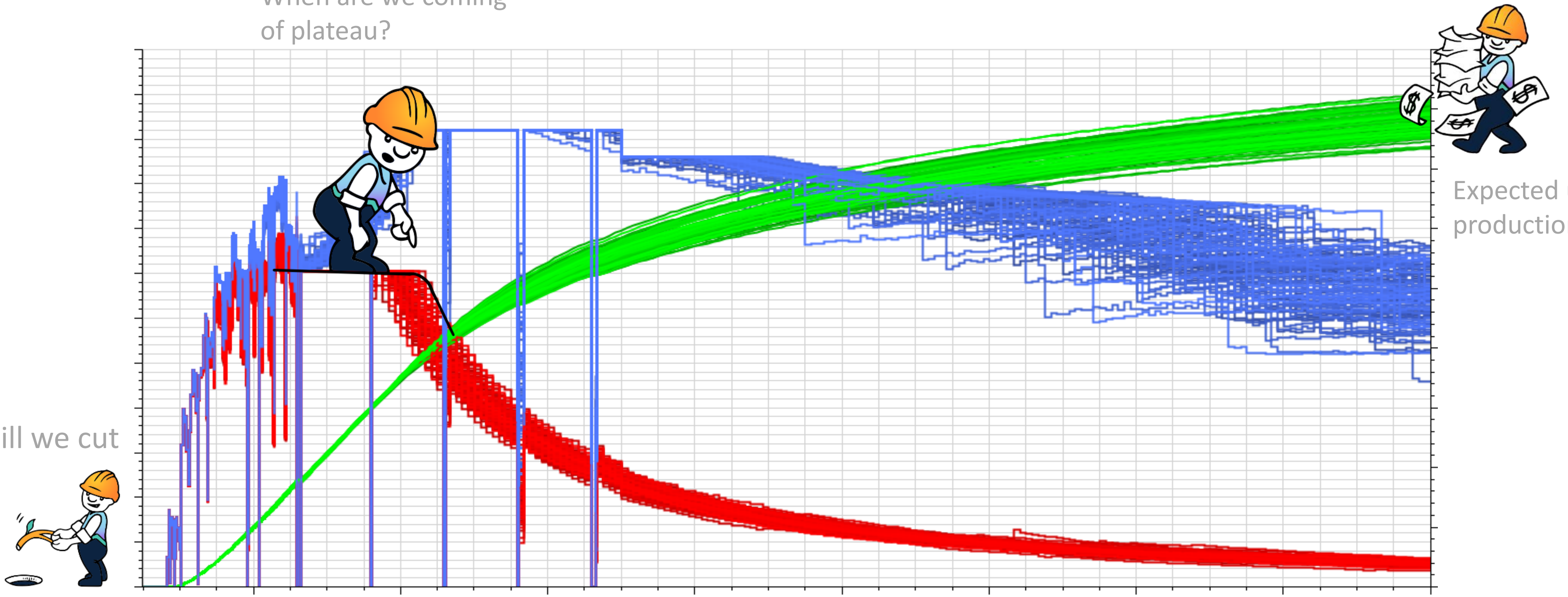


# Reservoir knowledge & management

When are we coming of plateau?



When will we cut water?

Expected ultimate oil production?

# Thank you!

# Selected ResX publications:

| | |
|---|---|
| Agostino et al. (2017), *Enhancing the Geological Models Consistency in Ensemble Based History Matching an Integrated Approach, in* Proceedings to the SPE Reservoir Characterization and Simulation Conference and Exhibition 8-10 May, Abu Dhabi, UAE | https://www.onepetro.org/conference-paper/SPE-186049-MS |
| Halset et al. (2017)*, Integrated Software Tool Brings Speed, Reliability to Reservoir Modeling on Barents Sea Project, in* Journal of Petroleum Technology | https://www.spe.org/en/jpt/jpt-article-detail/?art=2909 |
| Sætrom et al. (2016), *Consistently Integrating Static and Dynamic Data in the Facies Model Description Using an Ensemble Based Approach, in* Proceedings to the International Petroleum Technology Conference, Bangkok, 2016 | https://www.onepetro.org/conference-paper/IPTC-18868-MS |
| Sætrom et al. (2016), *Consistent Integration of Drill-Stem Test Data into Reservoir Models on a Giant Field Offshore Norway, in* Proceedings to the SPE ATCE 2016, Dubai | https://www.onepetro.org/conference-paper/SPE-181352-MS |