

Quantifying incremental value in mature fields using unconventional high resolution modelling workflows, supported by field analogues from Myanmar

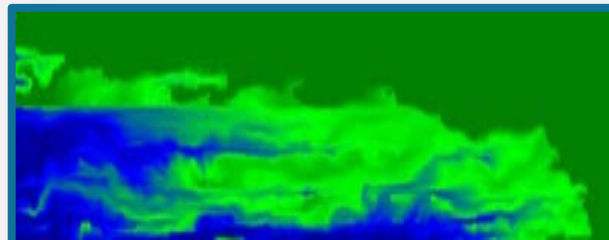
Mark Bentley

TRACS Training & Heriot-Watt University

Maggie Murison

TRACS Training Manager

EAGE Hanoi December 2019



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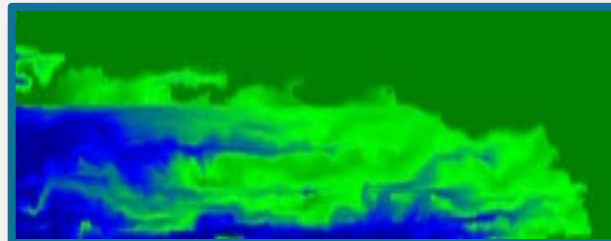
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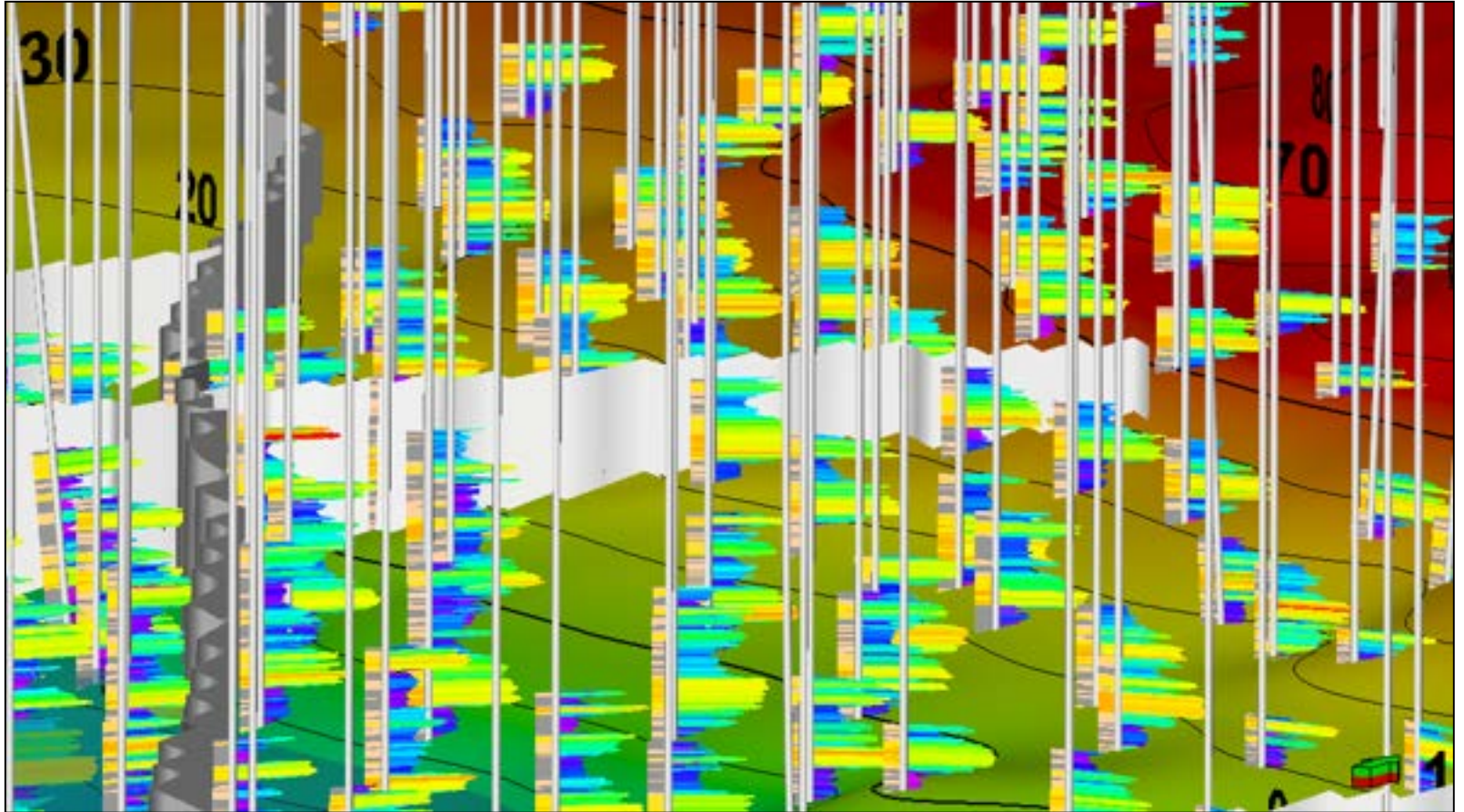
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We tend to build big full-field models



Model choices

A detailed, full-field 3D model

Analytical models only (type wells, decline curves)

Low-mid-high versions of the above

Multiple models – statistical (more stochastic) – *the ensemble*

Multiple models – conceptual (more deterministic) - *scenarios*

2D maps and Monte-Carlo models

2D cross-sectional models

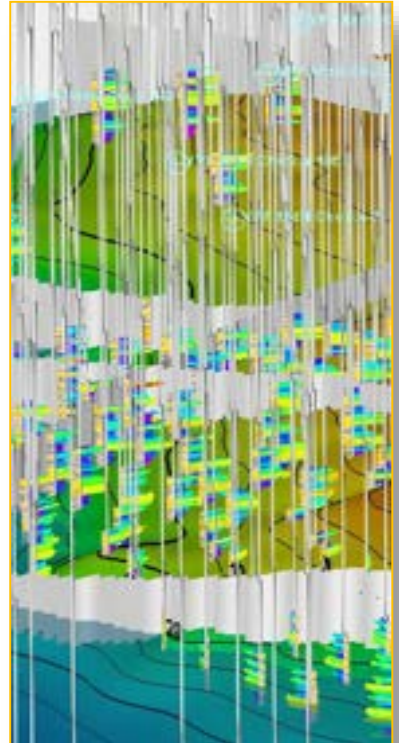
Mechanistic ‘box models’

Sector models

REV models (multi-scale)

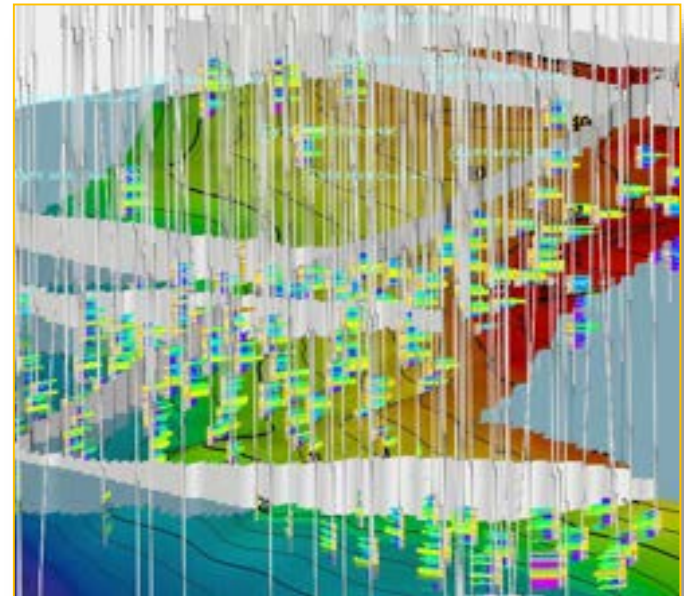
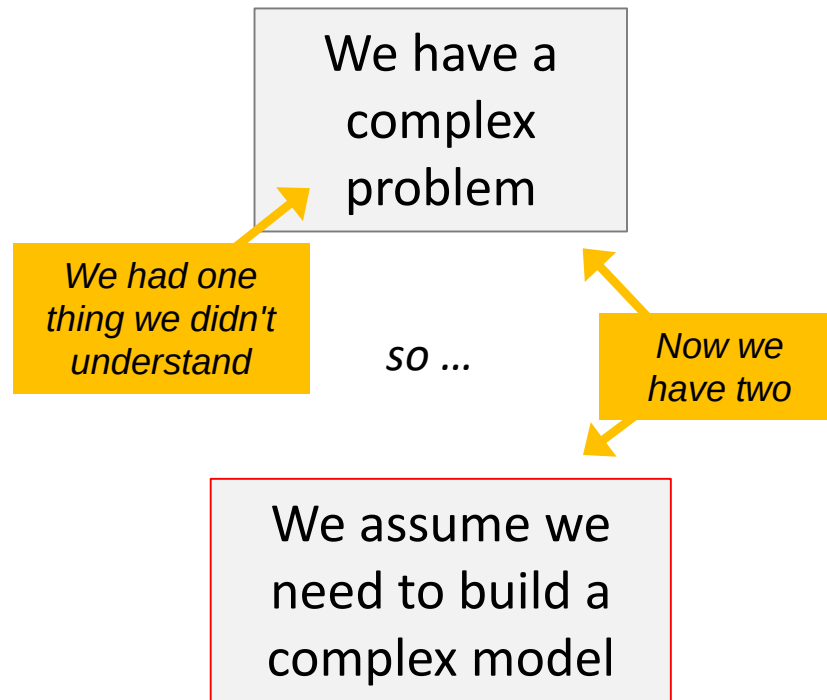
Well models

Spreadsheet

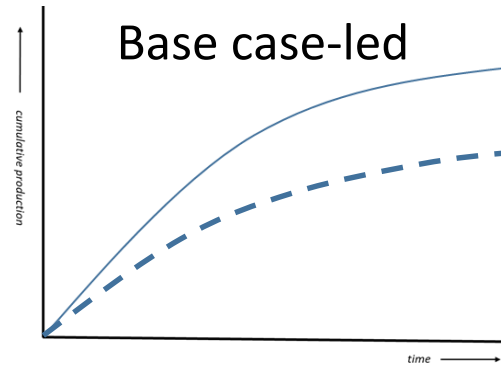


No model at all

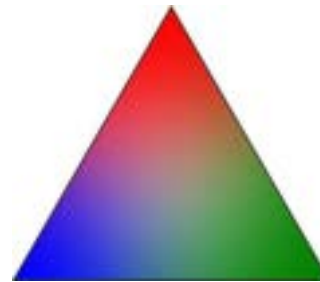
Why?



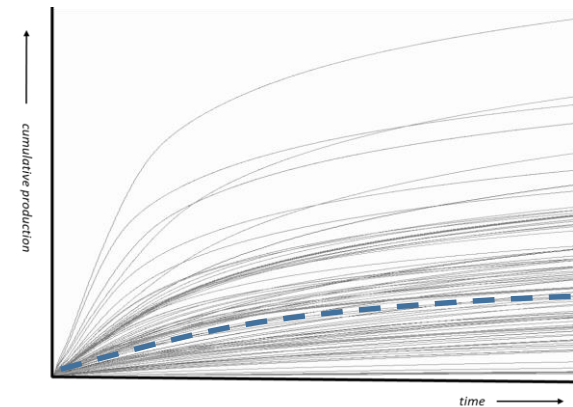
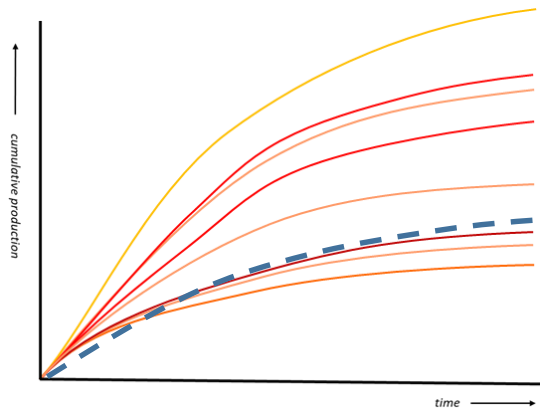
Errors in forecasting



Scenarios



Ensemble



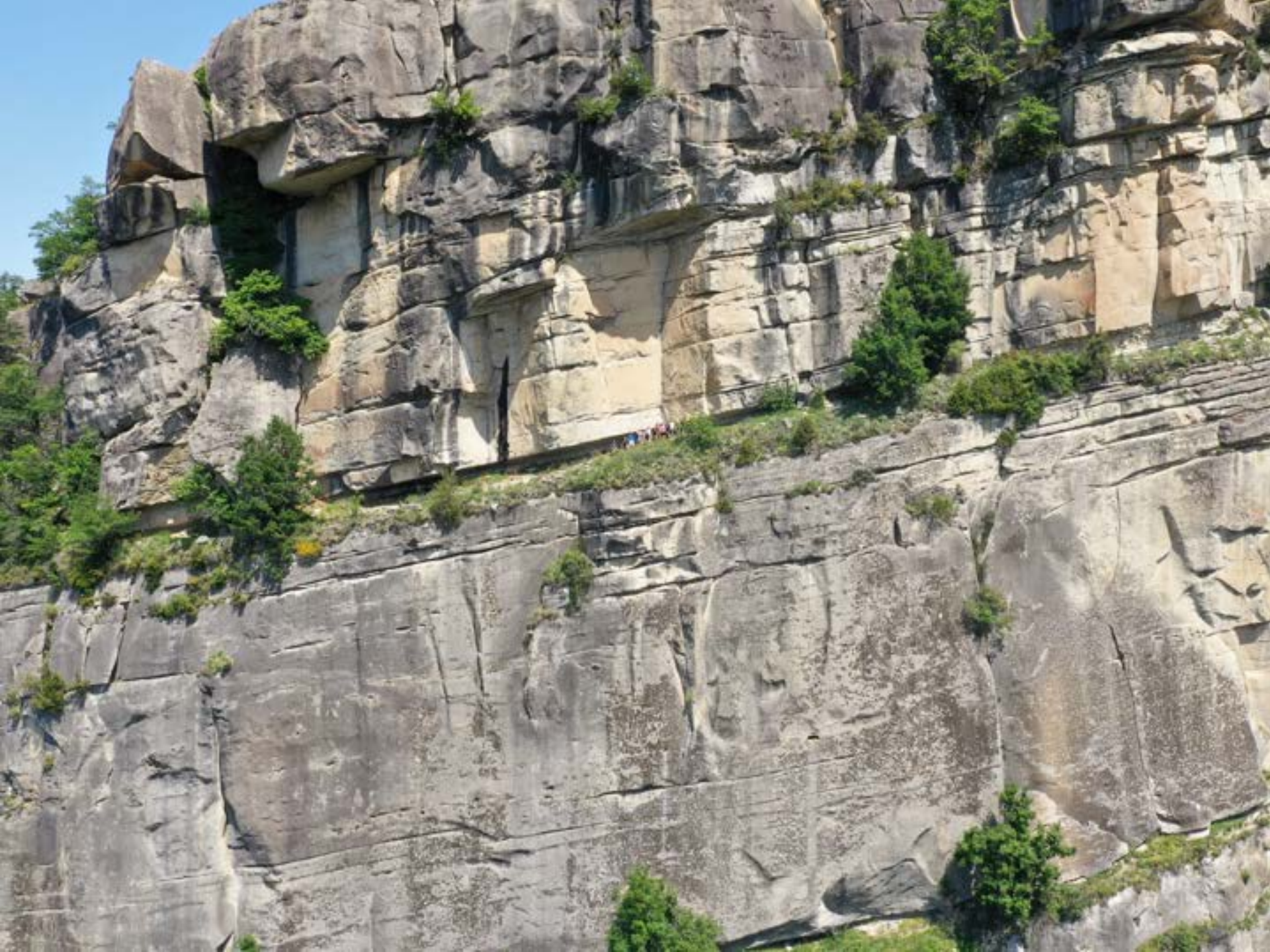
Why?

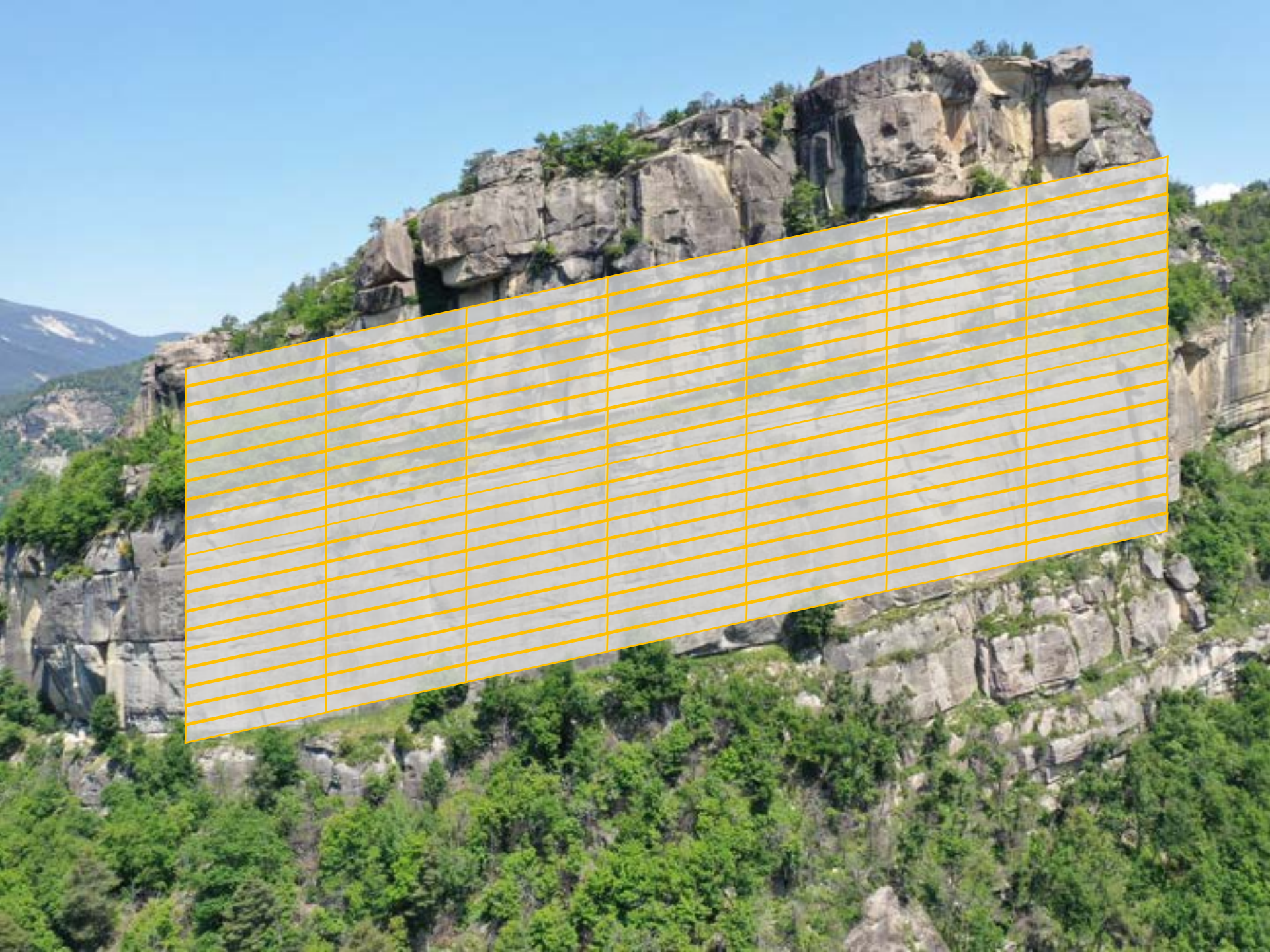
In reservoir modelling and simulation,
we are still missing **heterogeneity**
which impacts on mature field
decisions









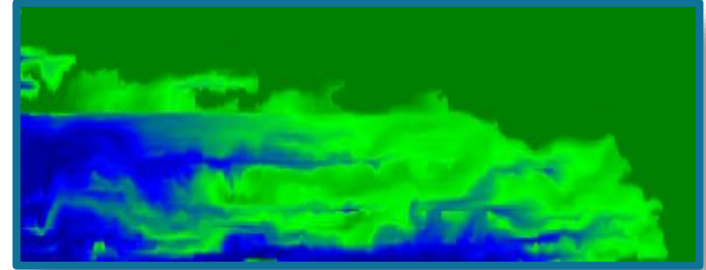




This talk adjust the workflow

A refinement

'Truth Models'



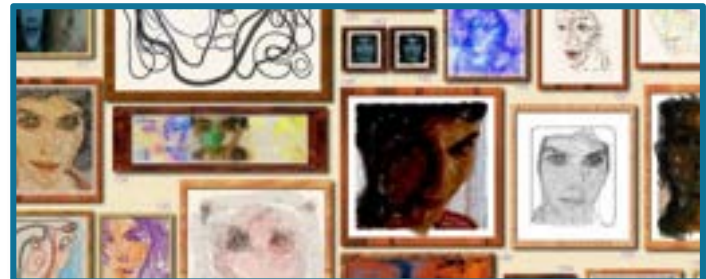
Myanmar mature fields

'How would that work here'



A different approach

'Modelling for Understanding'



The scale gap

Core Plug

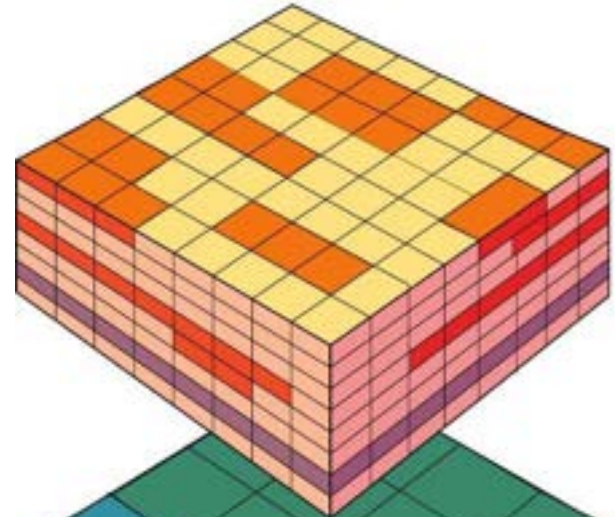
0.03m x 0.012m radius



X 23 million

Static Model

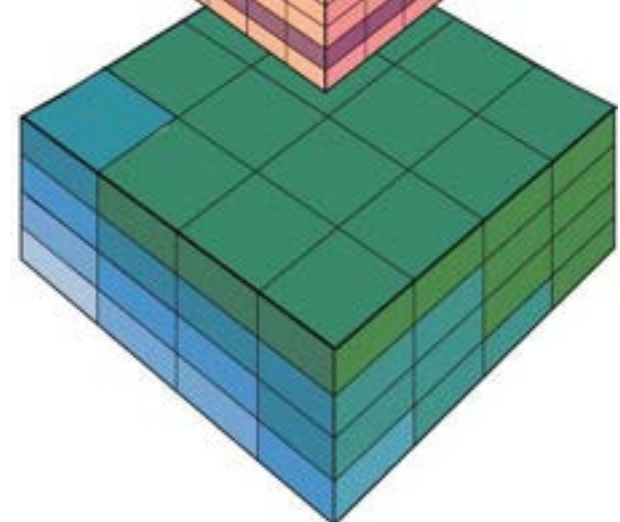
25m x 25m x 0.5m
Cell size

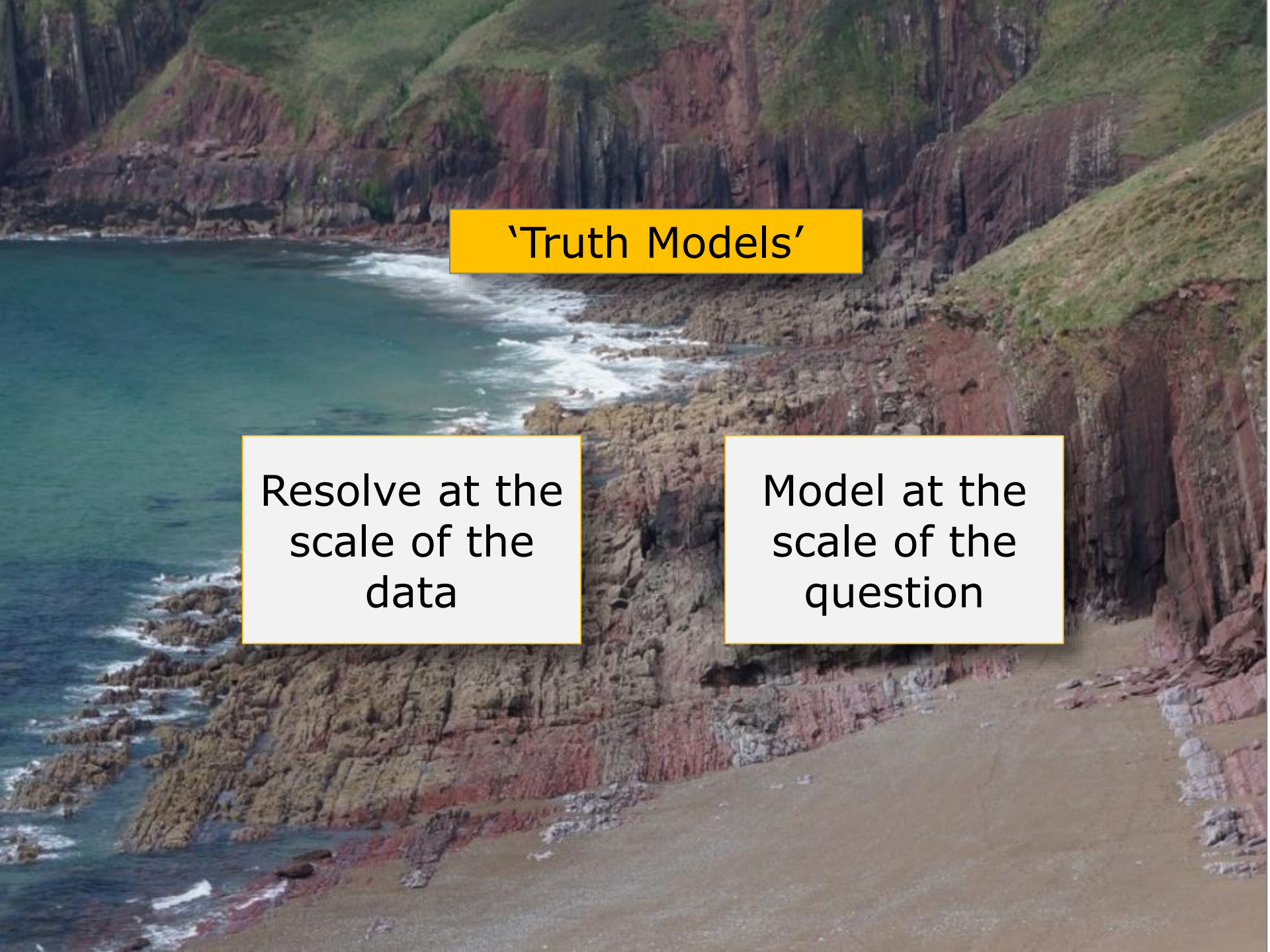


X 16

Dynamic Model

50m x 50m x 2m
Cell size



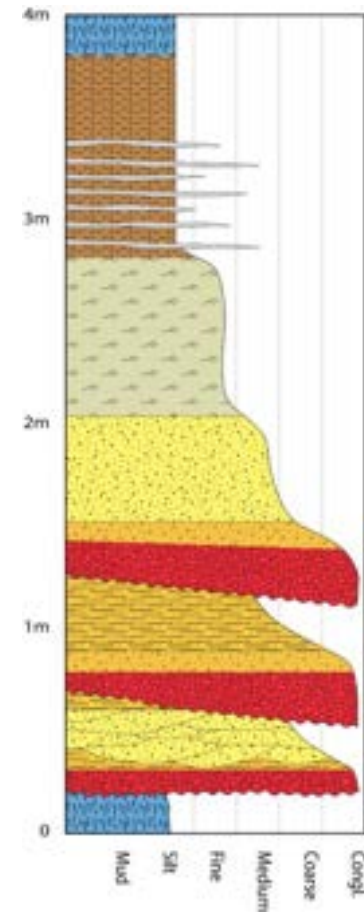


'Truth Models'

Resolve at the
scale of the
data

Model at the
scale of the
question

Understand one heterogeneous bed

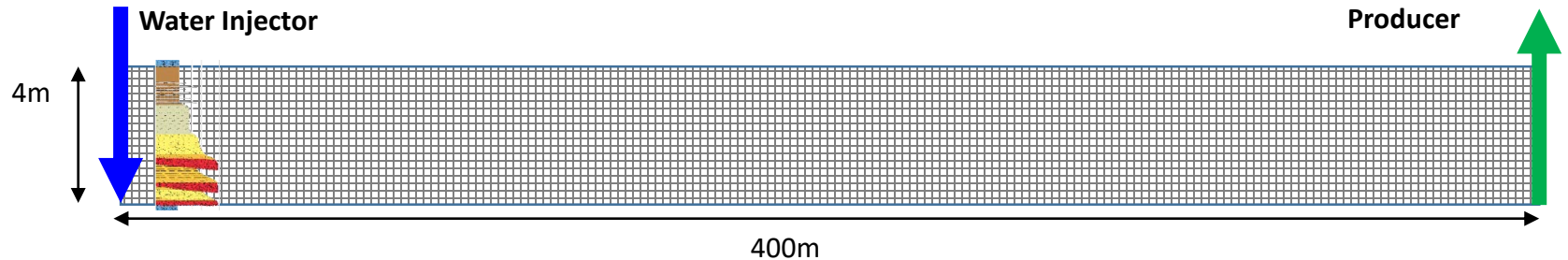
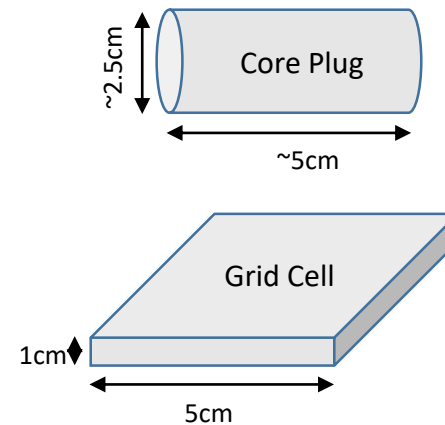


'Truth modelling'

2D cross-sectional model

Typical offshore well spacing

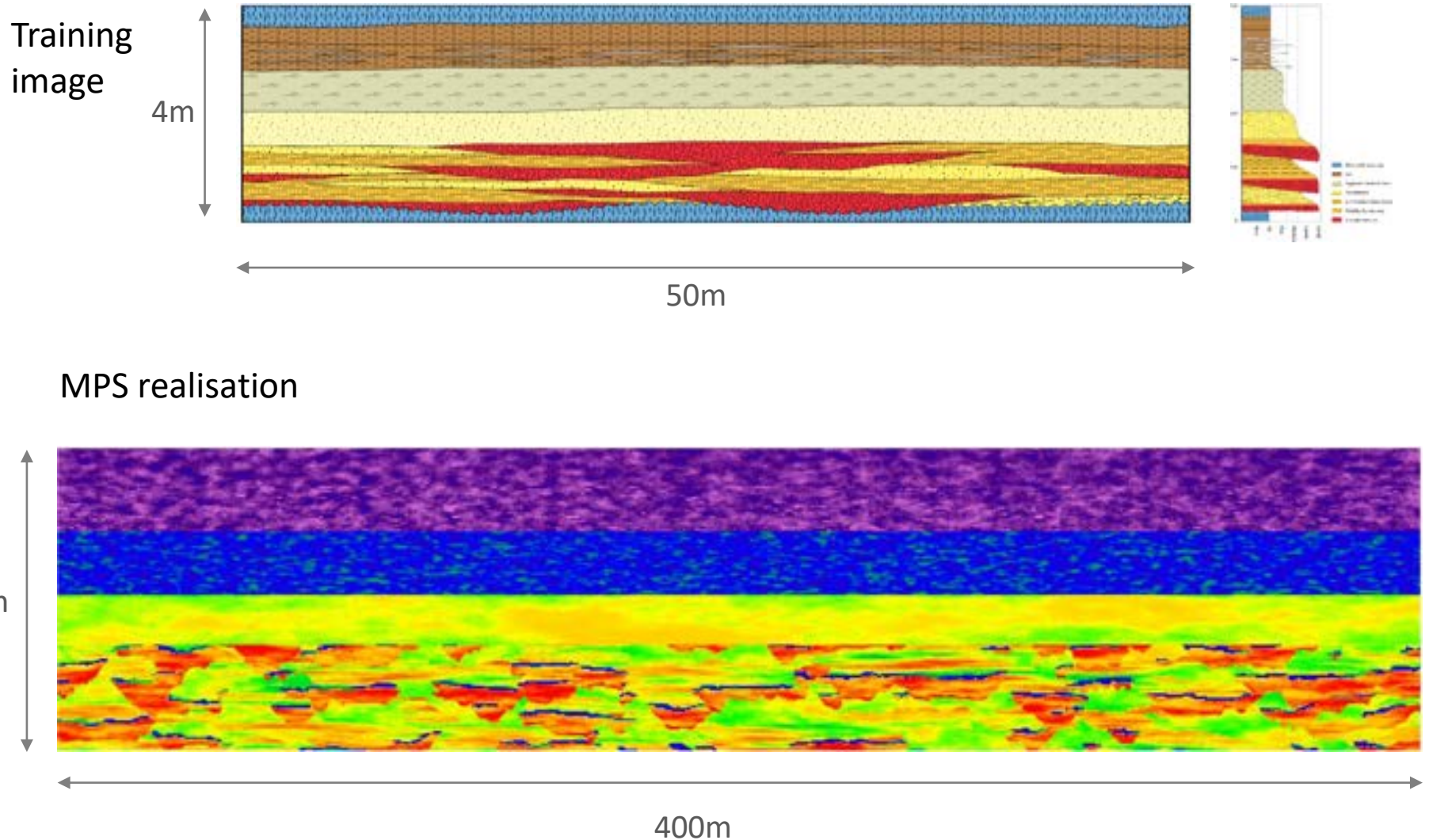
Cell resolution close to the scale of the input data (SCAL)



3.2 million
cells

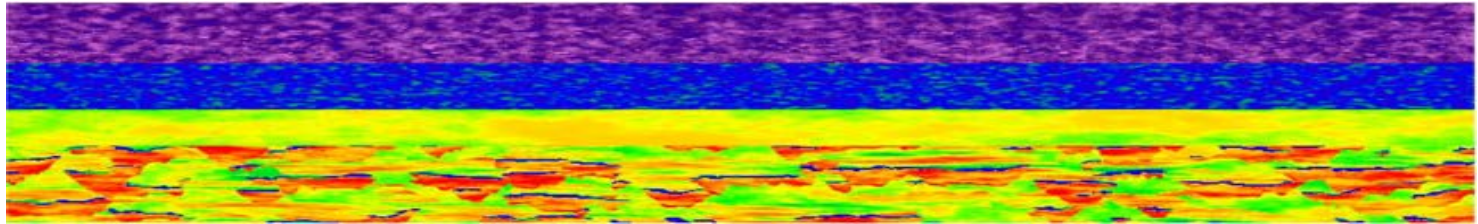
(the full field equivalent would be a few trillion cells)

Heterogeneity – *if you can sketch it ...*

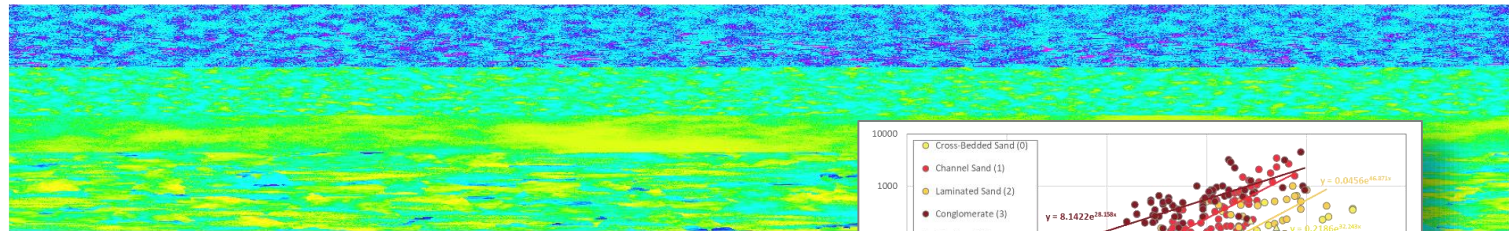
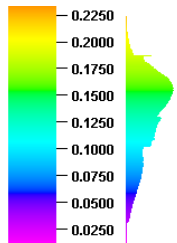


from: Bentley, Stephens, Buckle & Hutton 2018, EAGE Copenhagen

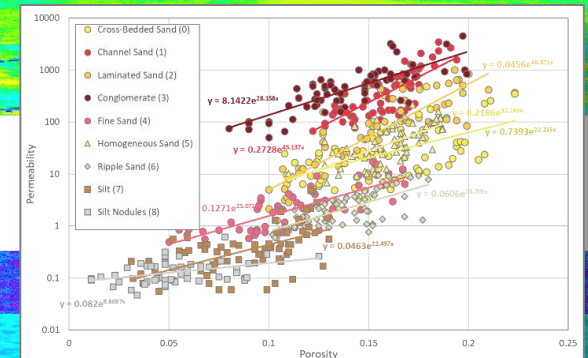
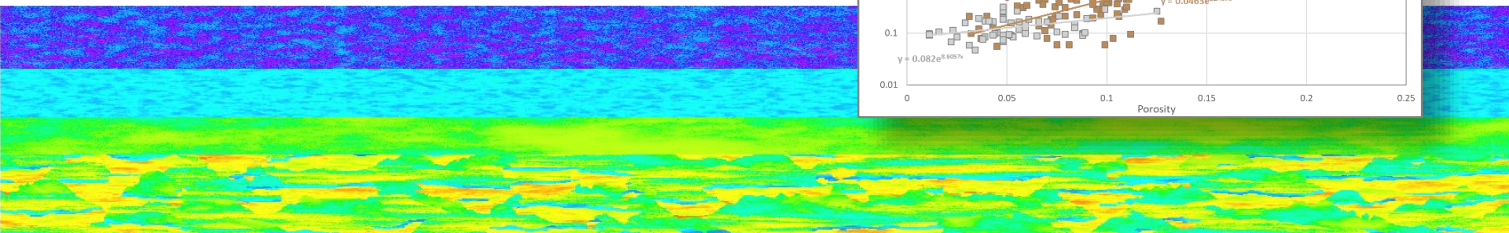
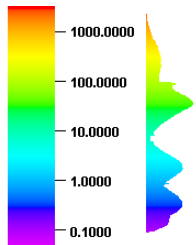
If you can sketch it



Porosity (frac)

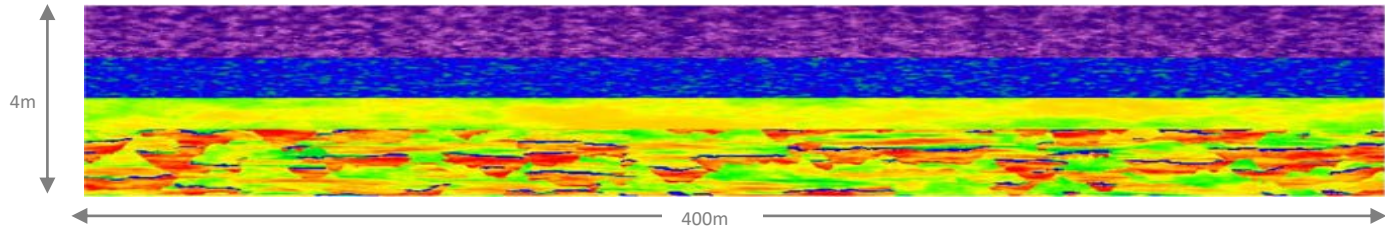


Permeability (mD)

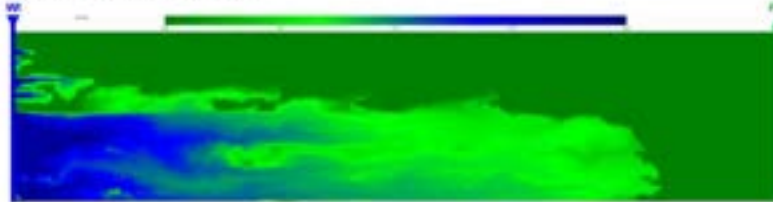


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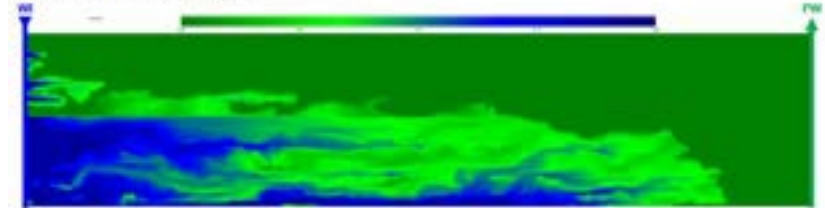
Truth models – building understanding



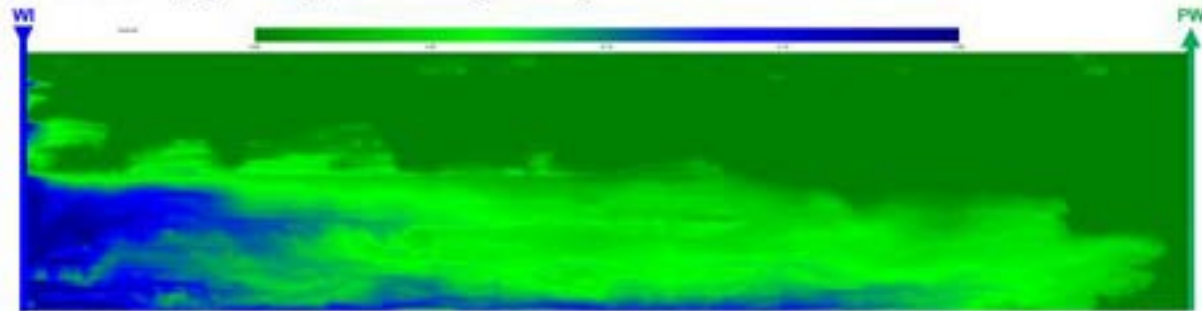
Viscous force only



Viscous & gravity



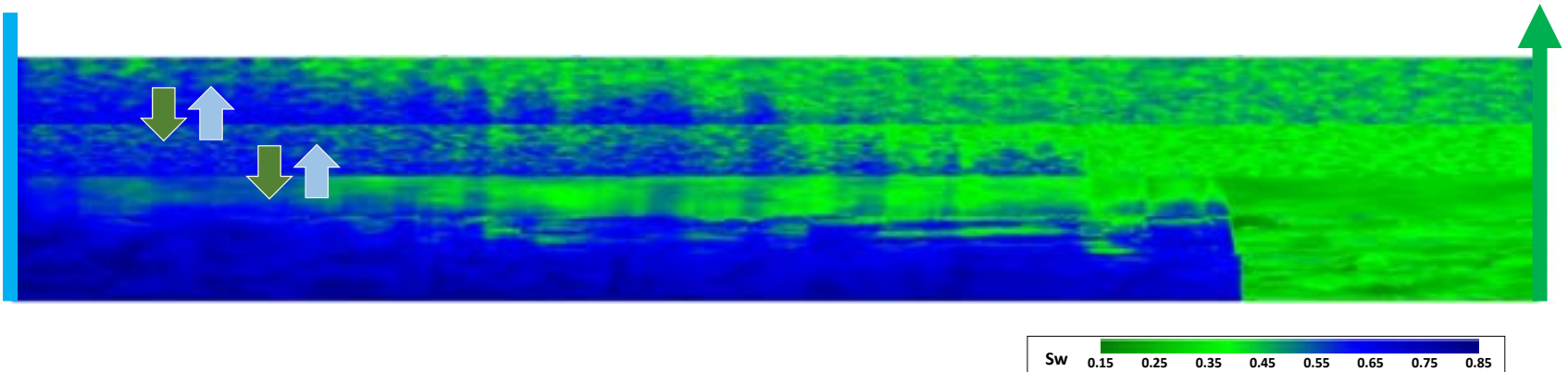
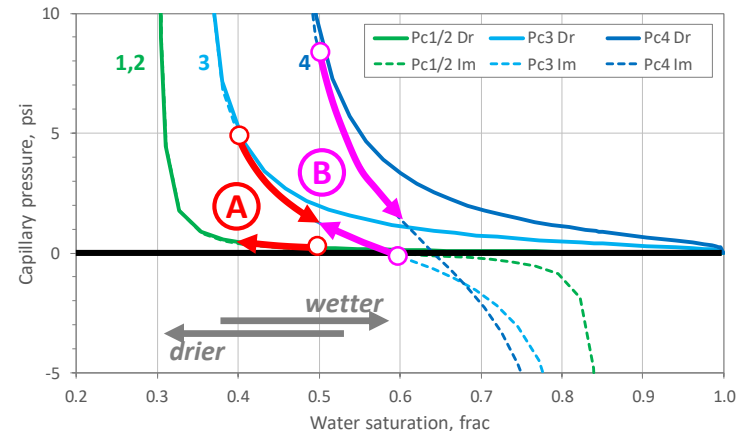
Viscous, gravity and capillary



Understanding 1– impact of capillary forces

Water drawn up displaces oil down

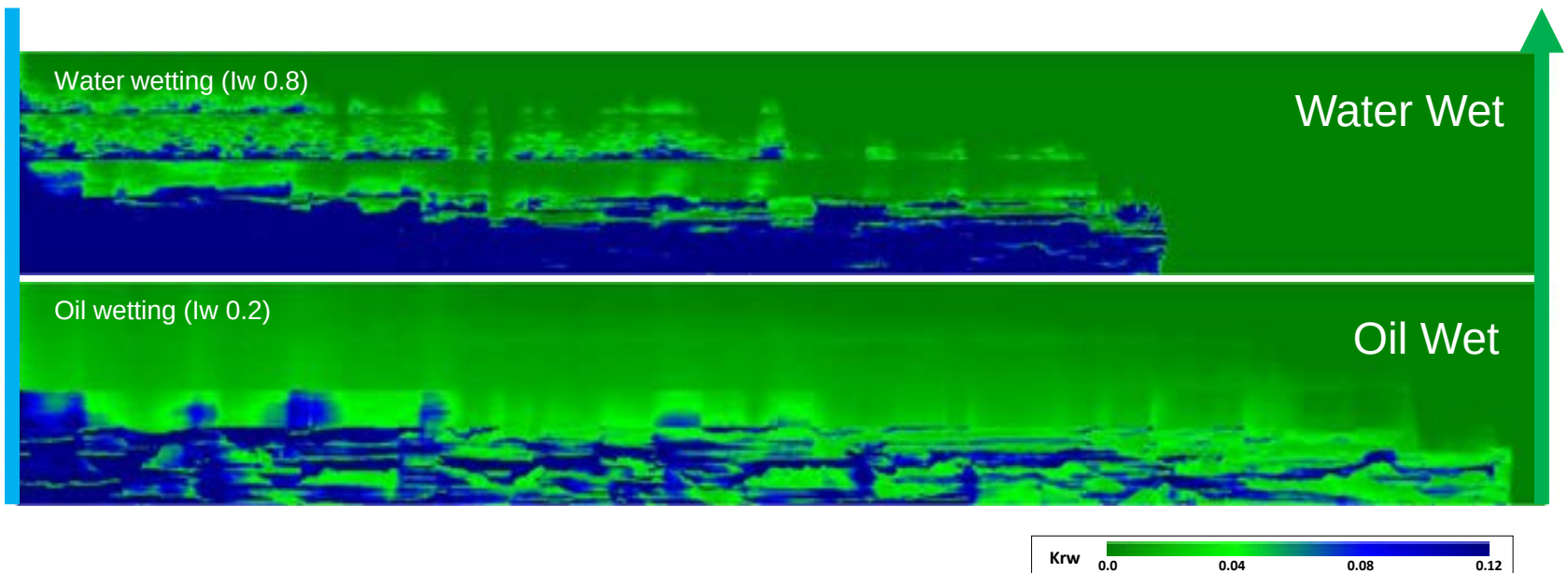
Additional recovery from nominally 'non-net' material



Understanding 2 – value of knowing wettability

WW: WBT later by ~ 10%,
RF higher by ~ 3%
Stronger spontaneous
imbibition into upper units

OW: WBT earlier by ~ 20%,
RF lower by ~ 10%
Bypass of lower perm
material within lower unit



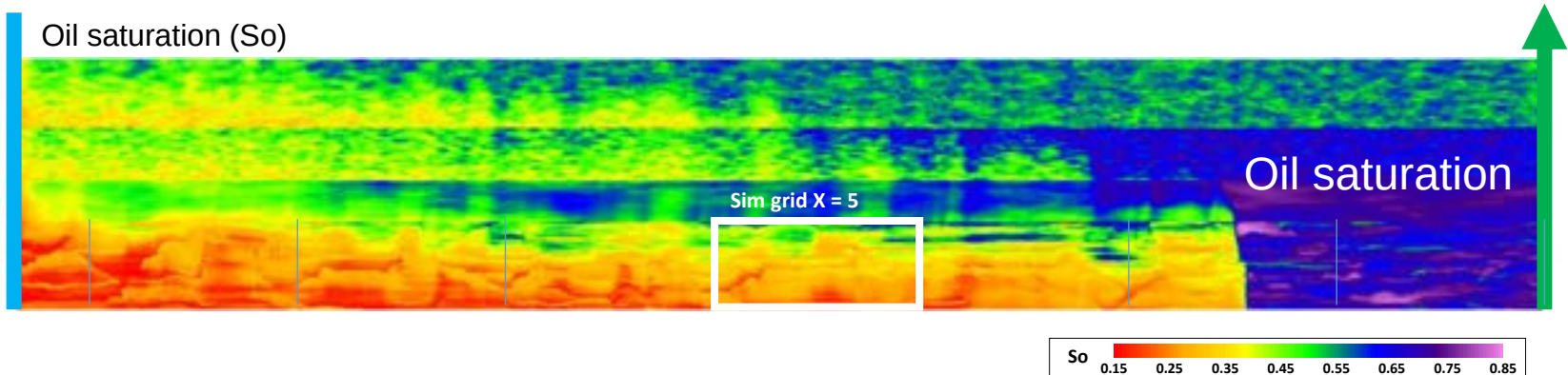
Understanding 3 – locating remaining oil

Saturation behind the flood front

Explore sim grid cell X=5 flowing ~90% water-cut

Model	Swi	W/cut	Krw	Kro	Soil
Ultra fine grid	30.7%	87%	0.1305	0.0188	34%
Sim grid X=5	30.6%	93%	0.0992	0.0076	34%

Oil saturation (So)

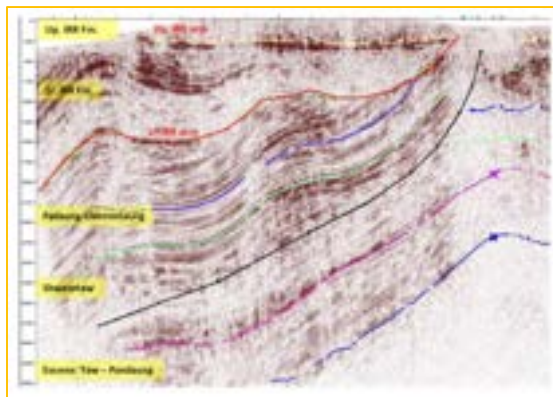




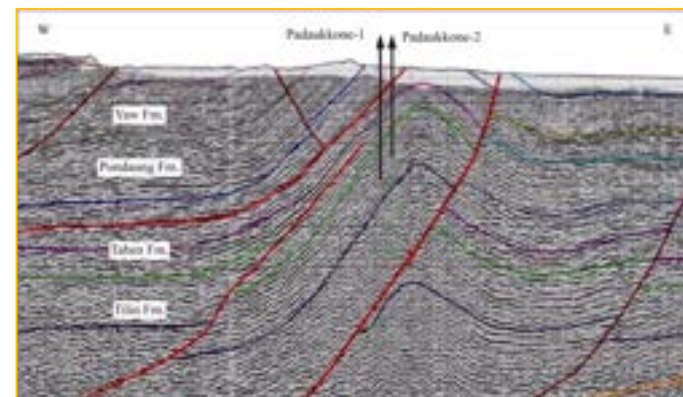
Central Myanmar analogue outcrops



Gwegyo seismic

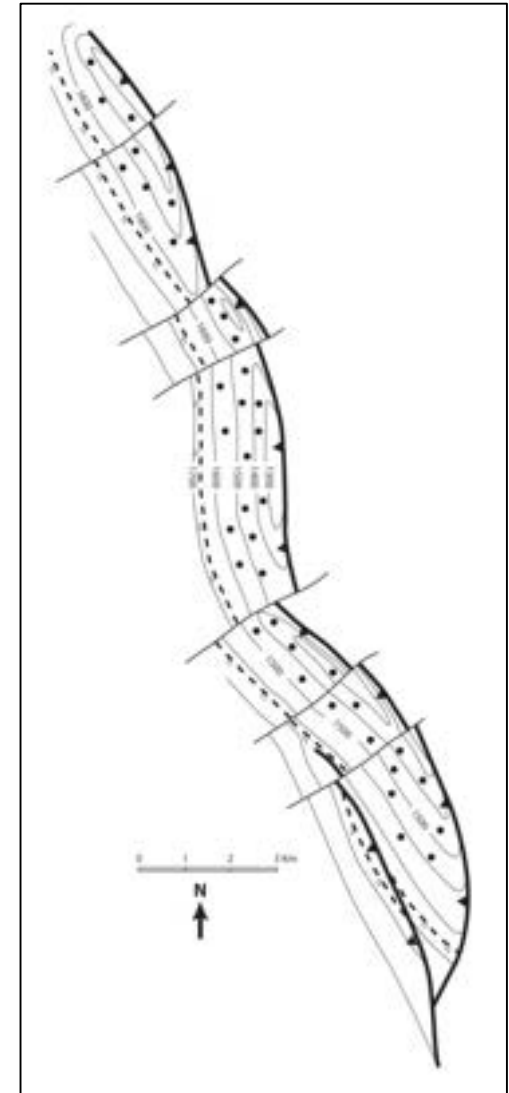


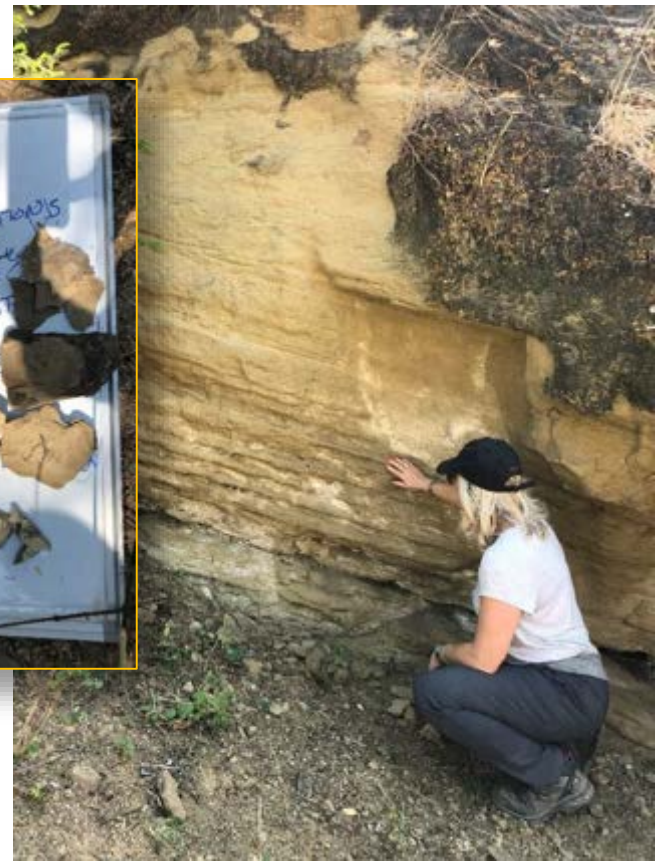
Analogue seismic



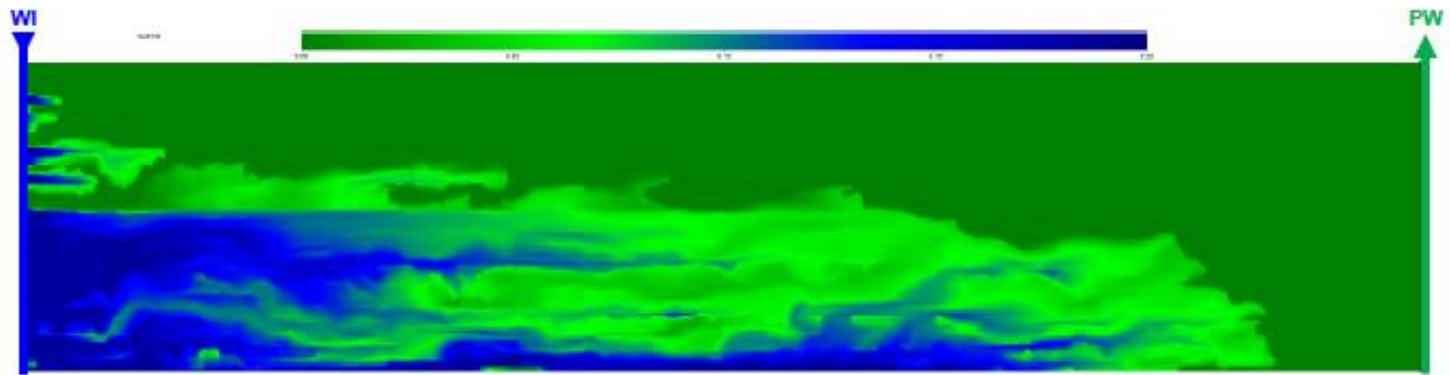
from Racey & Ridd, Geol Soc London

Synthetic field case for study





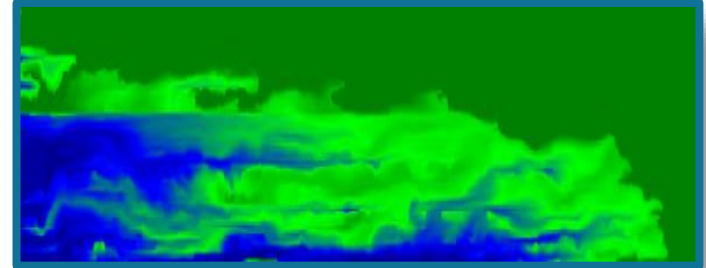
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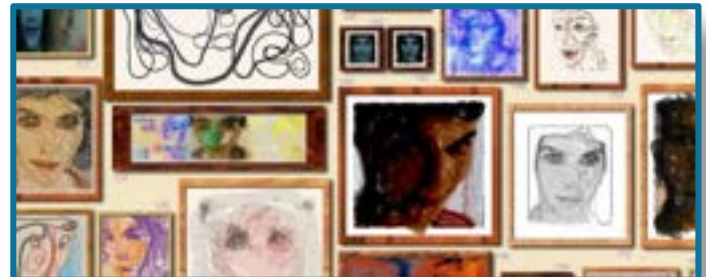
Myanmar mature fields

'How would that work here'

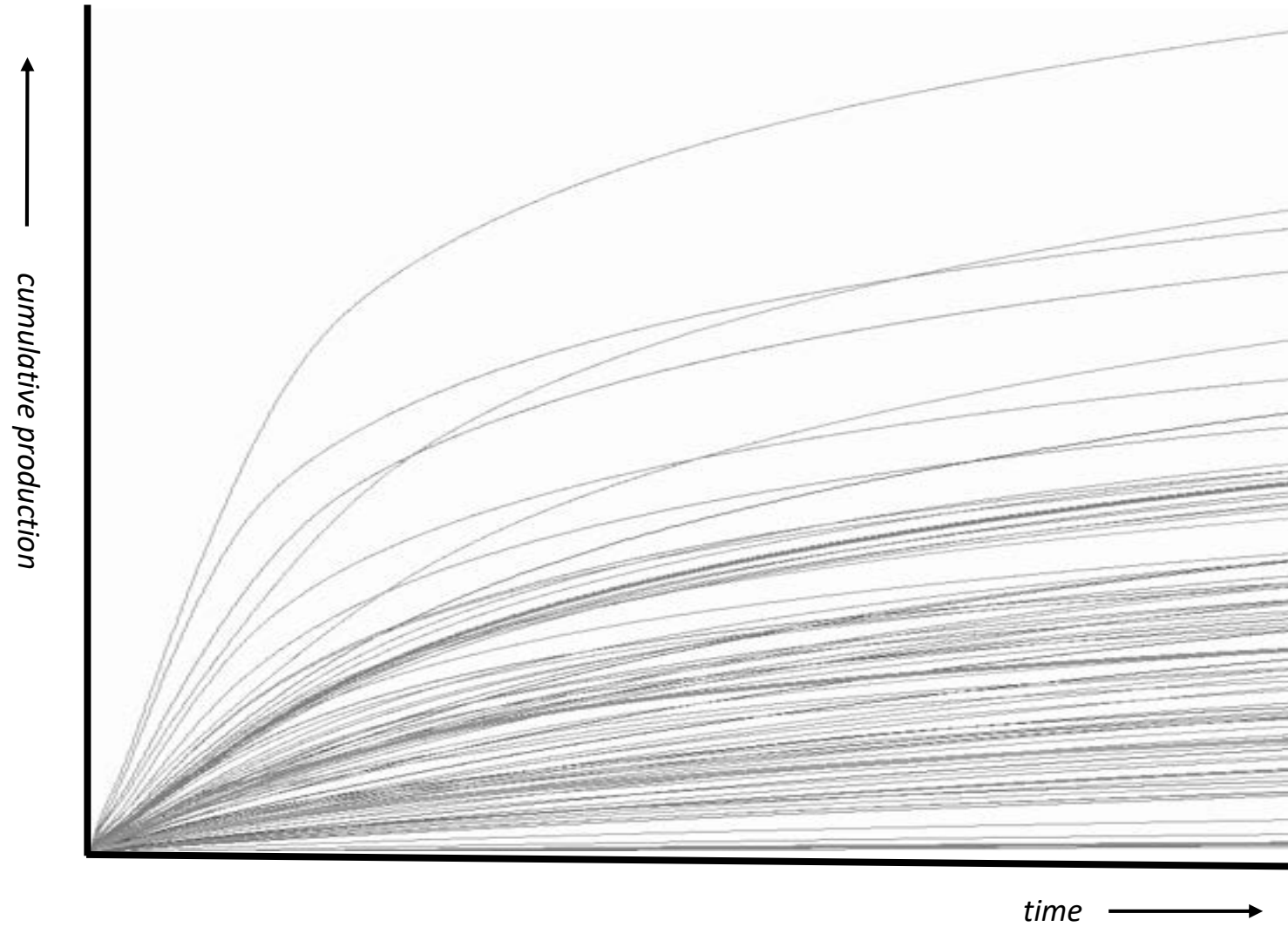


A different approach

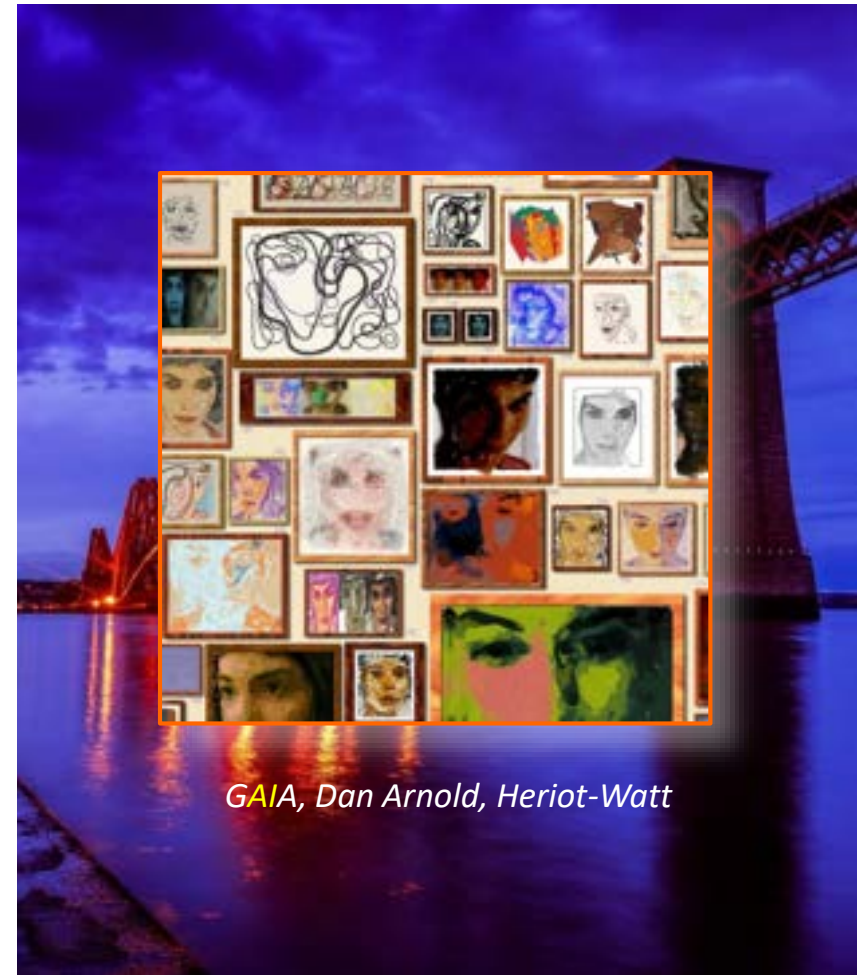
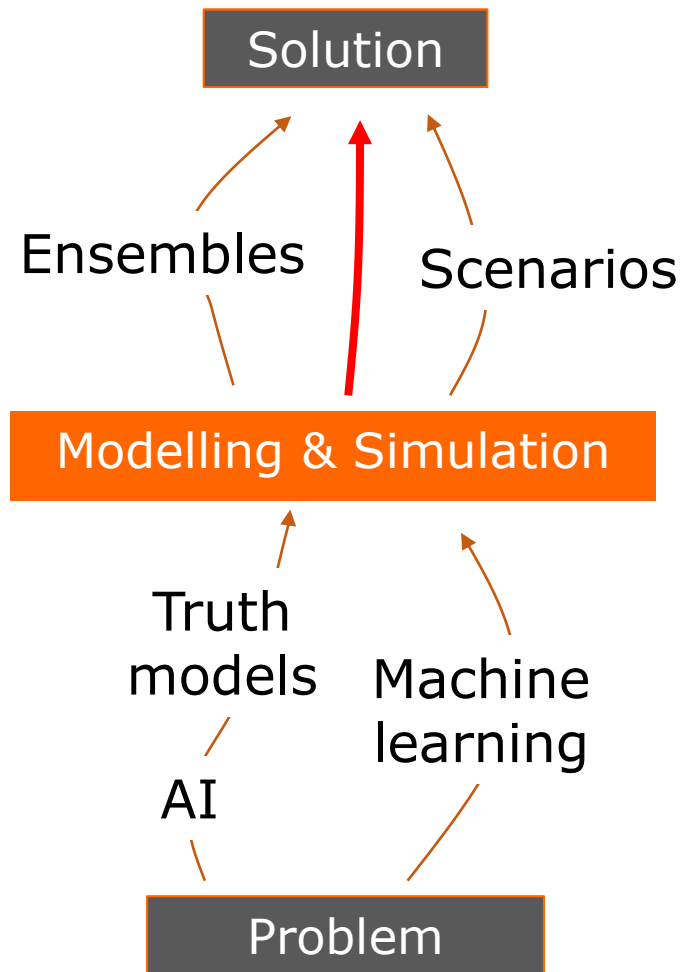
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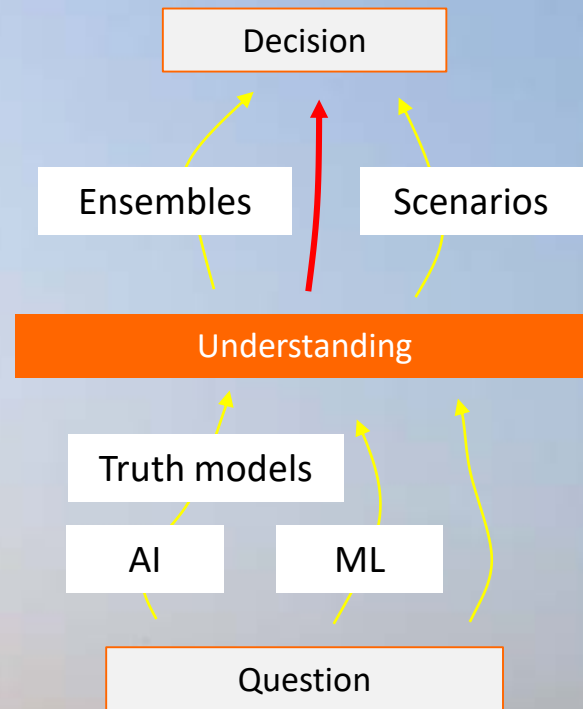


Modelling uncertainty



Questions and decisions in mature fields





Maybe modelling to
understand the
question is more
important than
building big complex
models ...