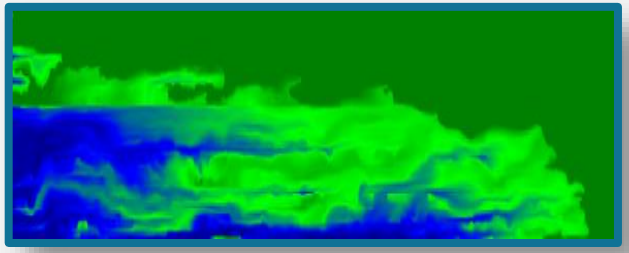
Quantifying incremental value in mature fields using unconventional high resolution modelling workflows, supported by field analogues from Myanmar

Mark Bentley

TRACS Training & Heriot-Watt University

Maggie Murison

TRACS Training Manager



EAGE Hanoi December 2019

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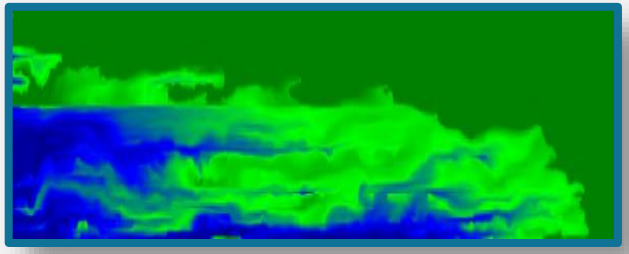
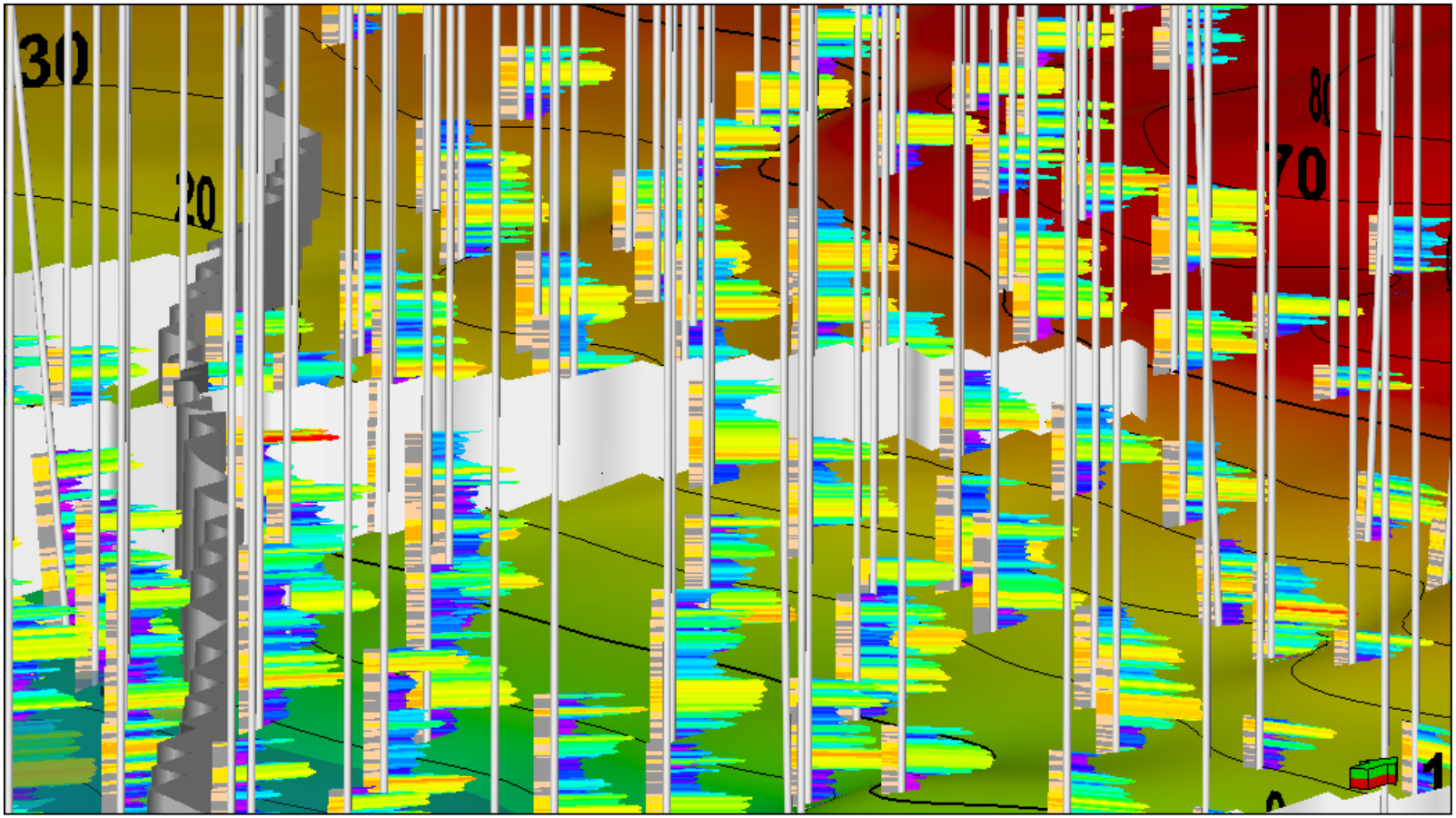


We tend to build big full-field models



Model choices

A detailed, full-field 3D model

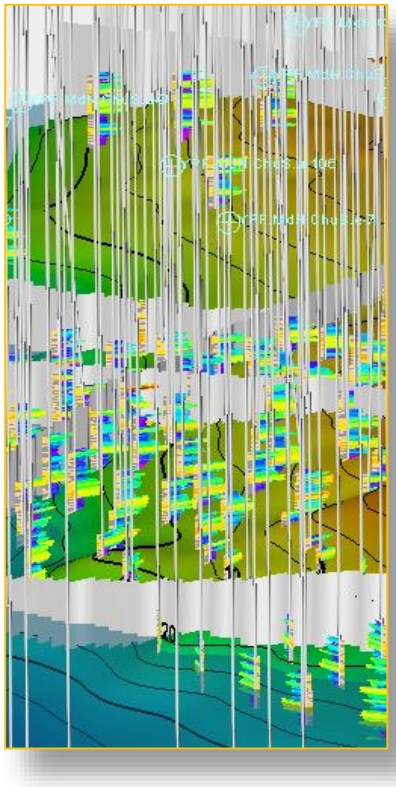
Analytical models only (type wells, decline curves)

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

Sector models

Well models

Mechanistic ‘box models’

REV models (multi-scale)

Spreadsheet

No model at all

Why?

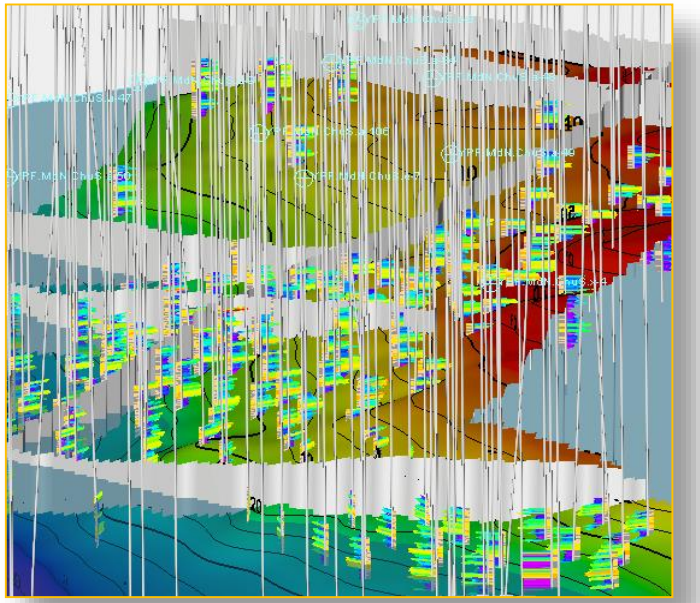
We have a complex problem

We had one thing we didn't understand

so ...

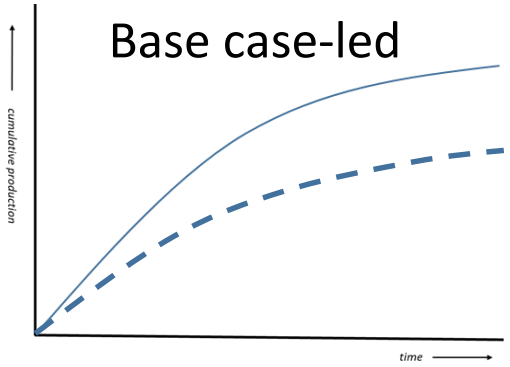
Now we have two

We assume we need to build a complex model

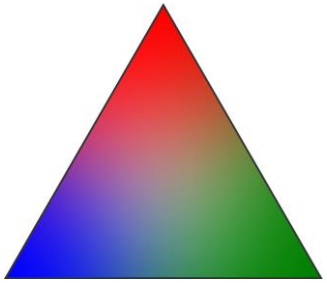


... with a thank you to Phil England

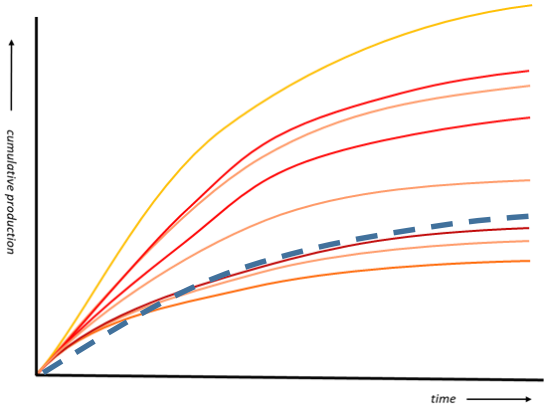
Errors in forecasting

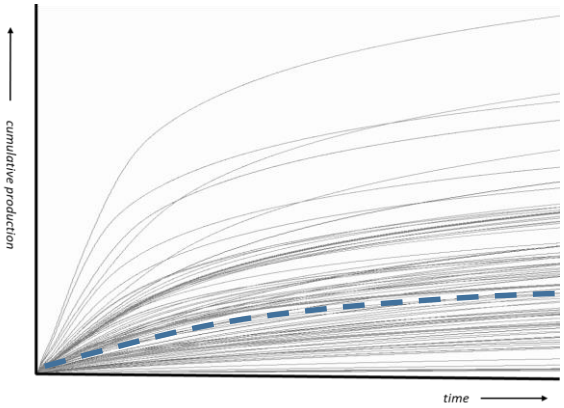


Scenarios



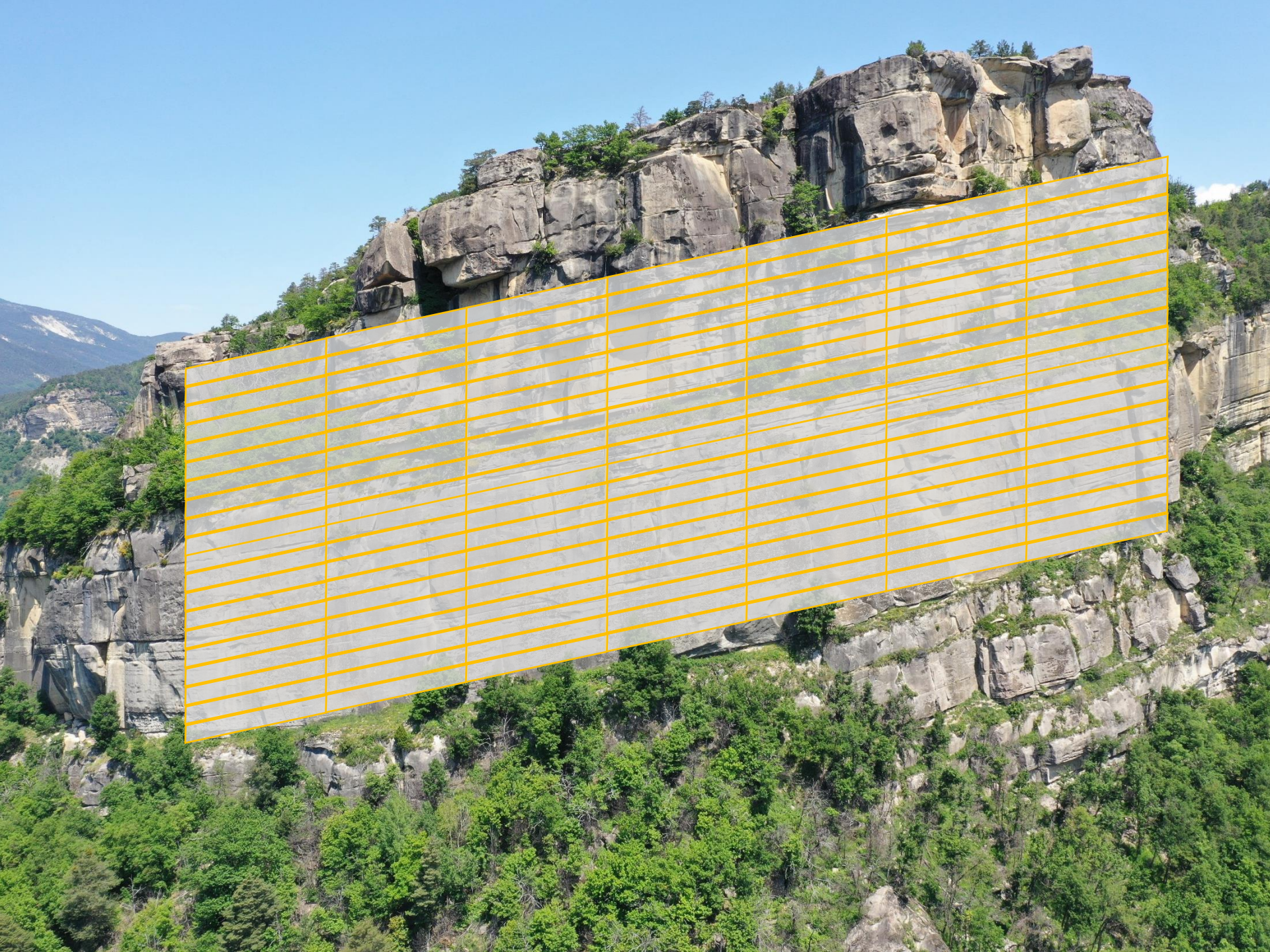
Ensemble





Why?

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

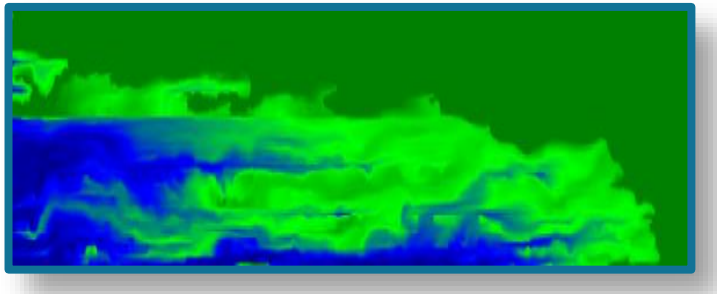



aer
TRACS

This talk …. adjust the workflow

A refinement

'Truth Models'



Myanmar mature fields

'How would that work here'

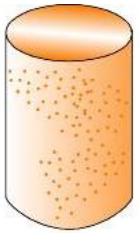
A different approach

'Modelling for Understanding'

The scale gap

Core Plug

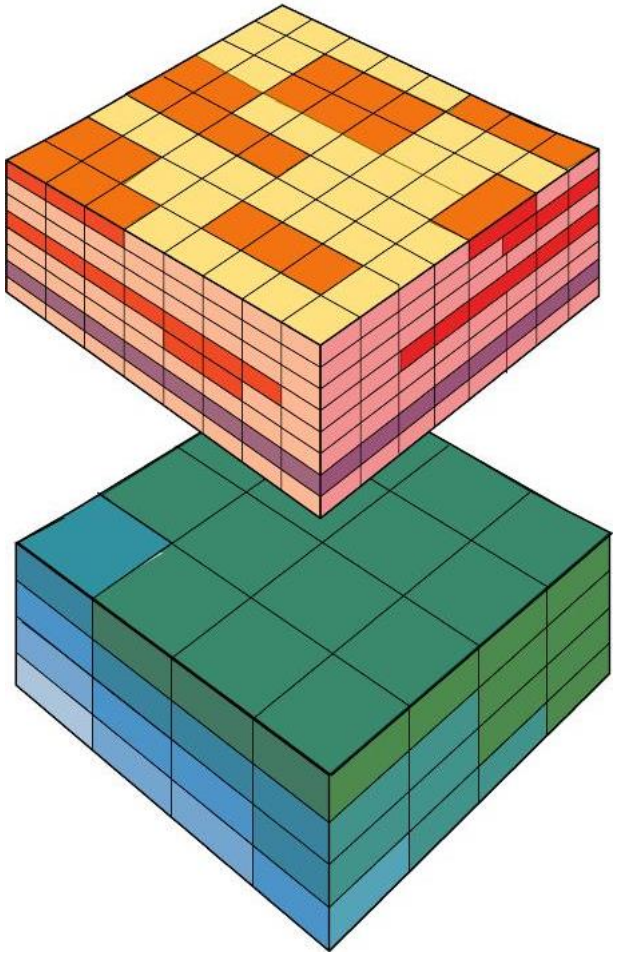
0.03m x 0.012m radius



X 23 million

Static Model

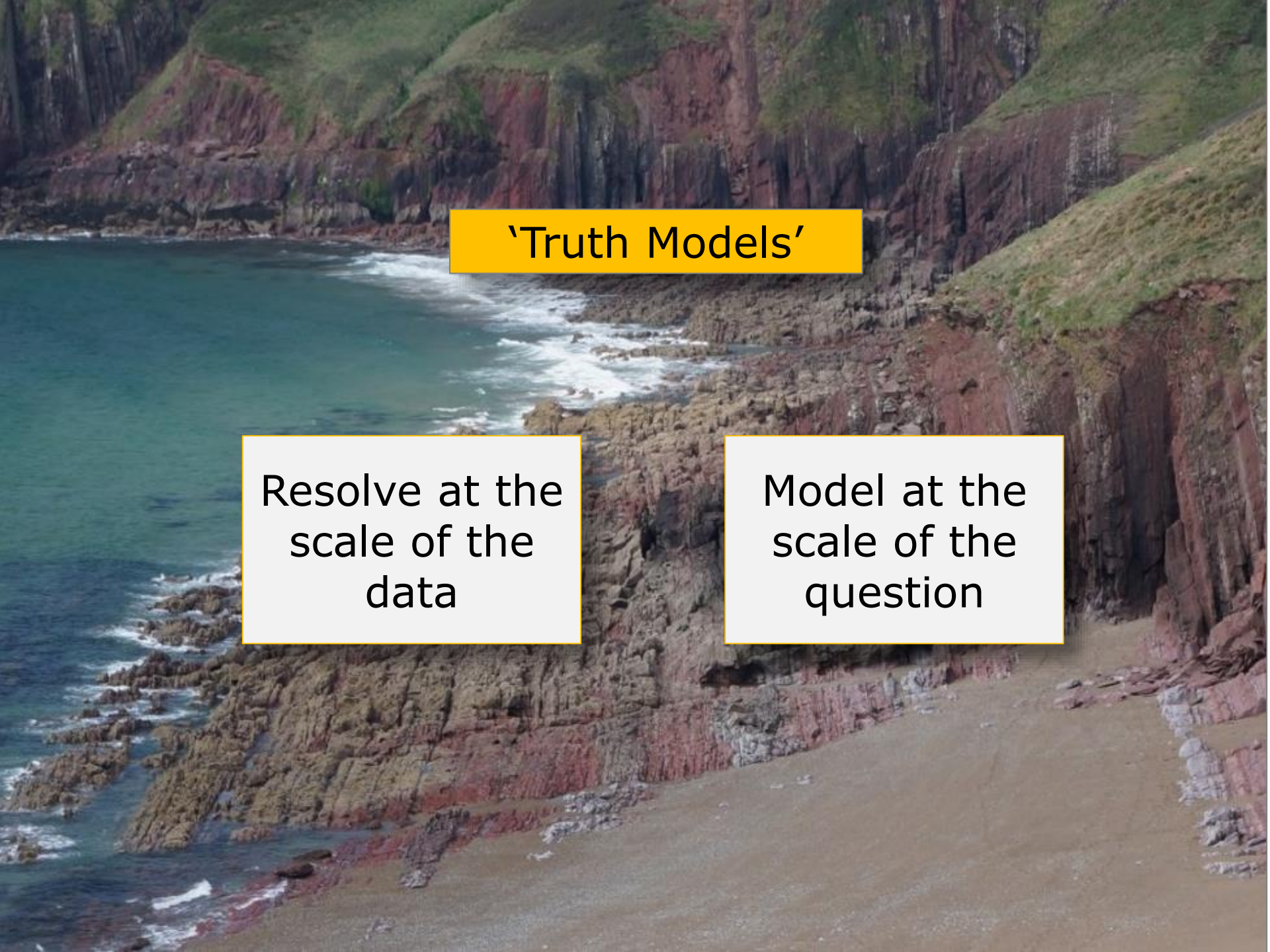
25m x 25m x 0.5m
Cell size



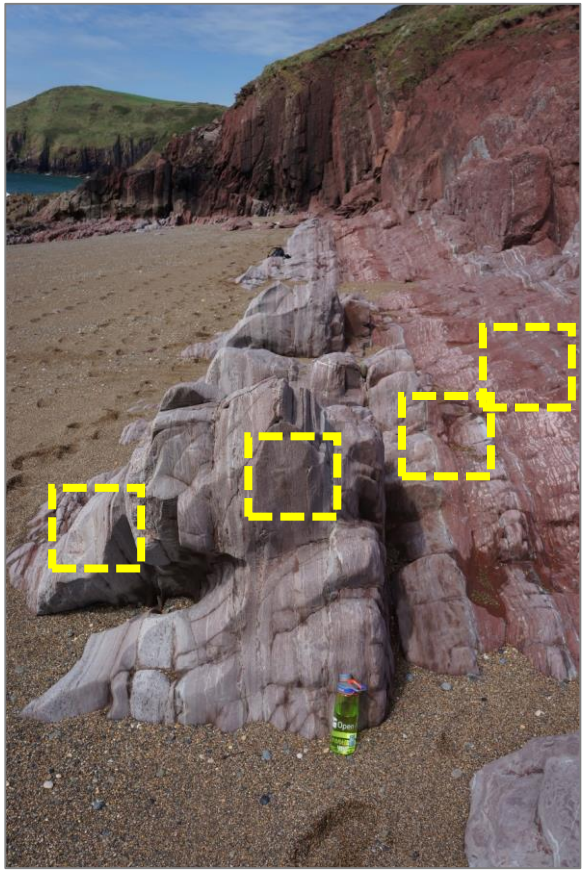
X 16

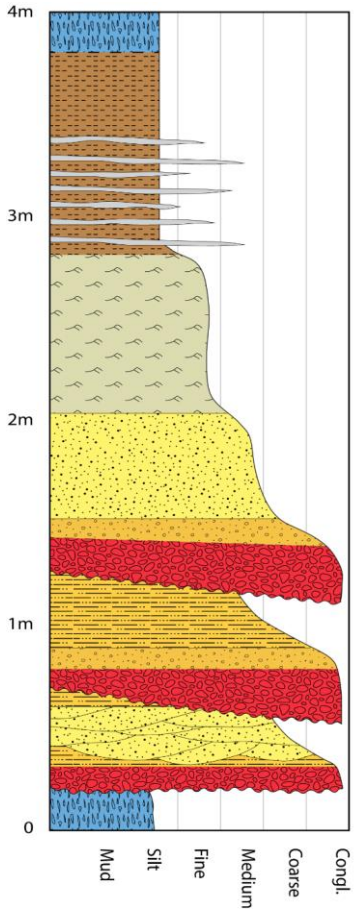
Dynamic Model

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



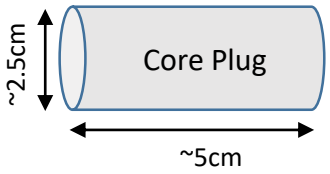


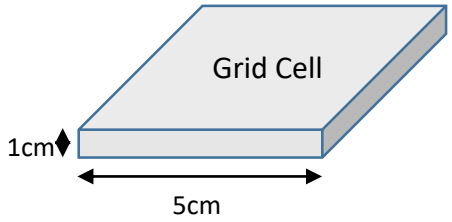
‘Truth modelling’

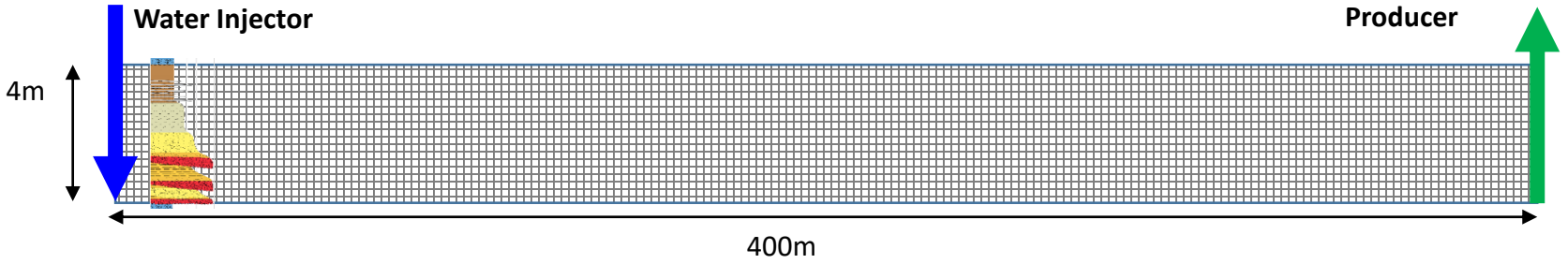
2D cross-sectional model

Typical offshore well spacing

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







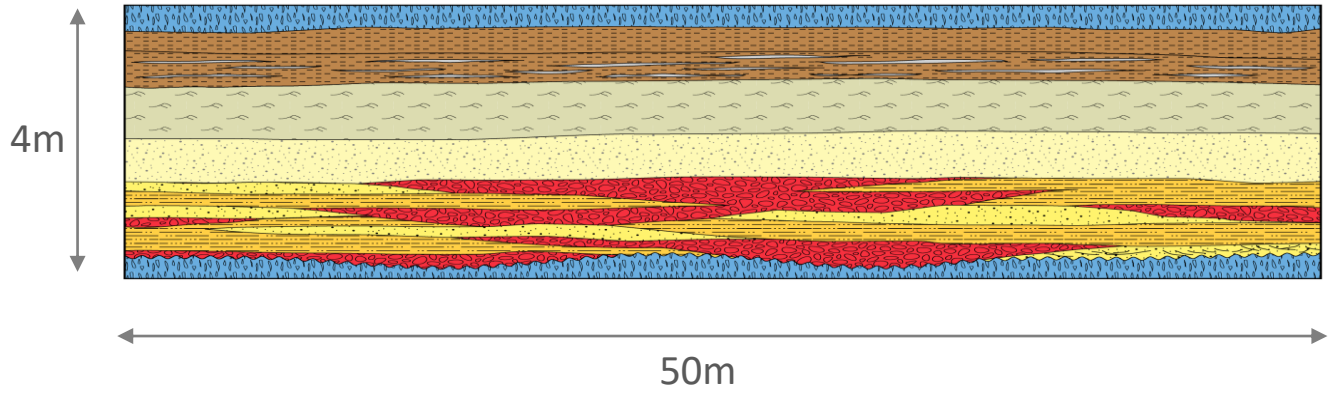
3.2 million cells

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

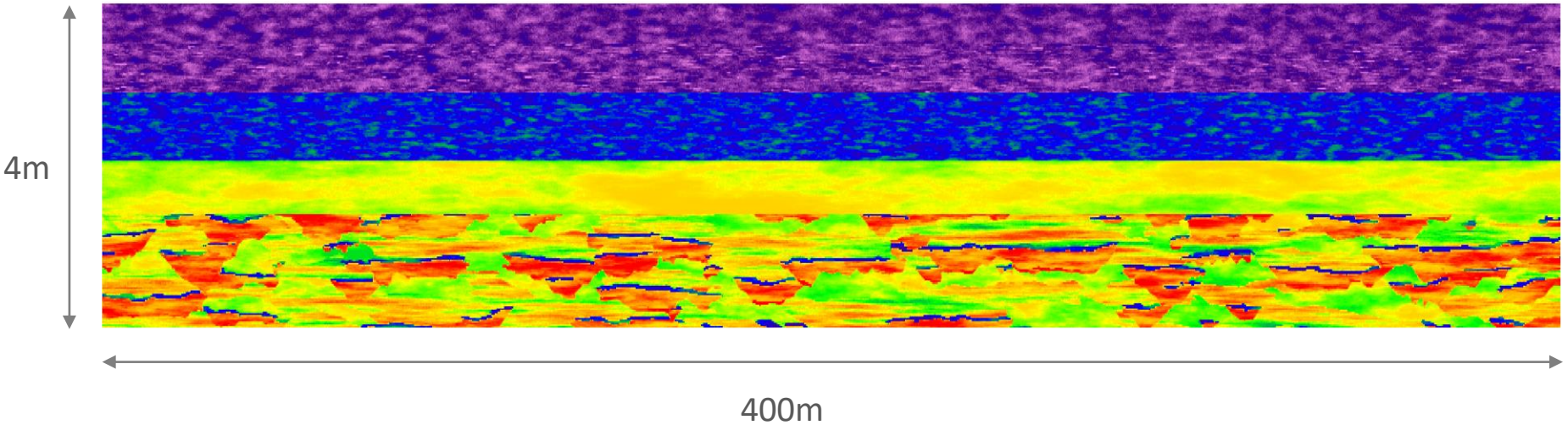
from: Bentley, Stephens, Buckle & Hutton 2018, EAGE Copenhagen

Heterogeneity – *if you can sketch it …*

Training image

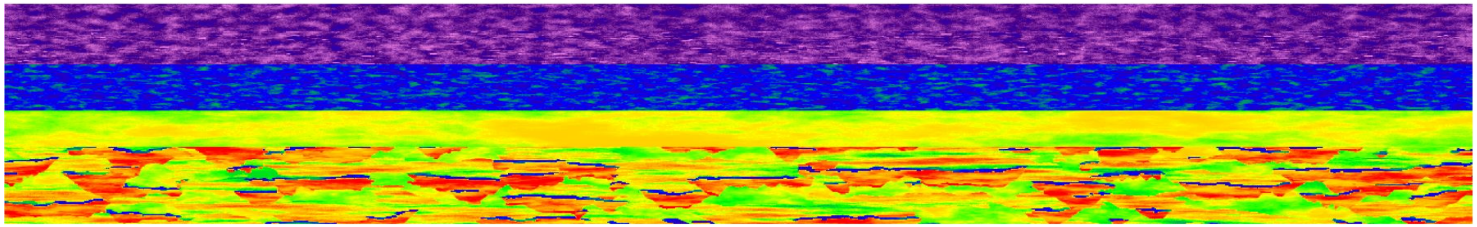


MPS realisation

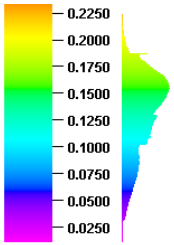


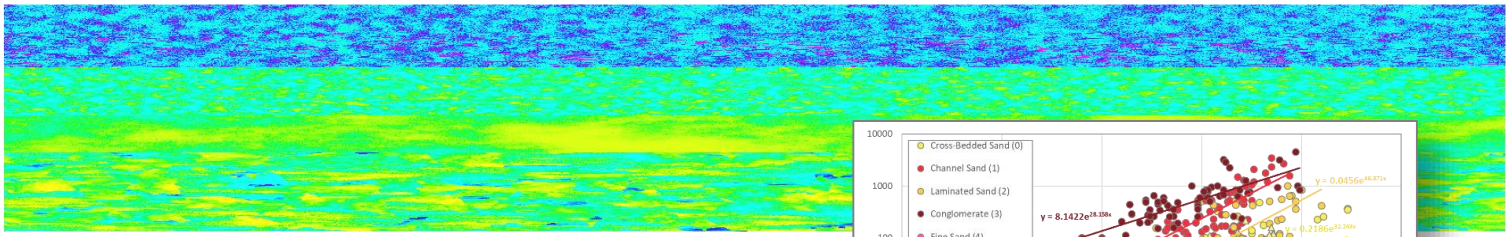
from: Bentley, Stephens, Buckle & Hutton 2018, EAGE Copenhagen

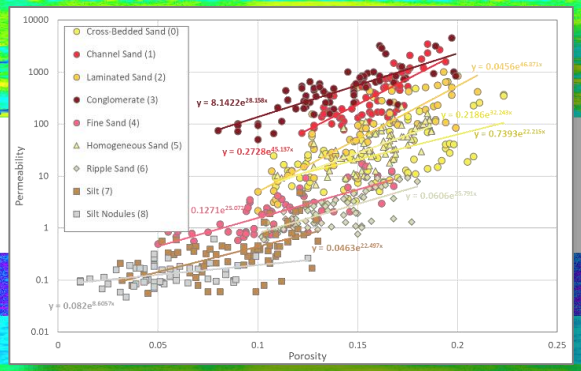
If you can sketch it ….



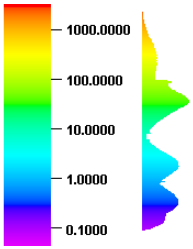
Porosity (frac)

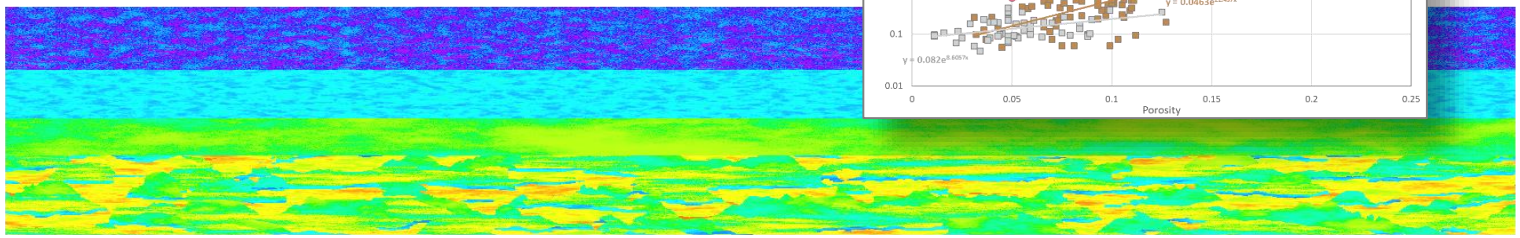






Permeability (mD)





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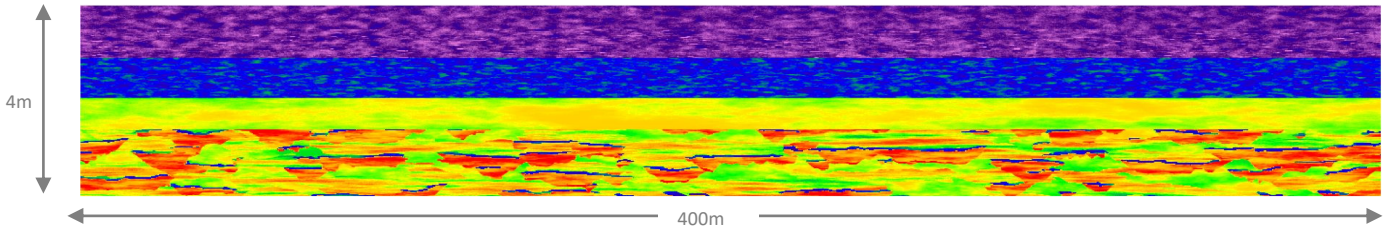
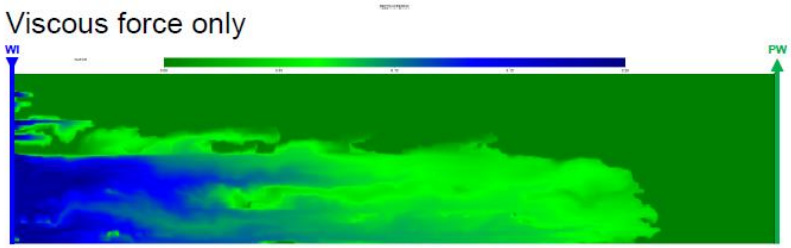
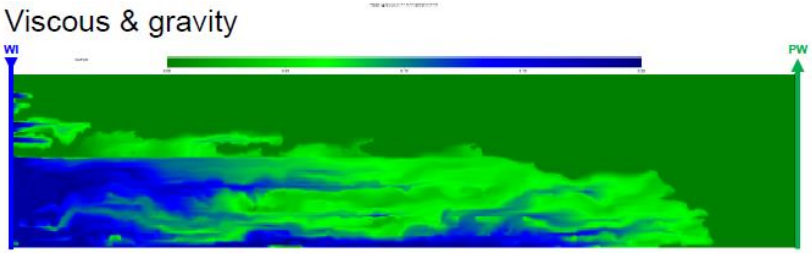
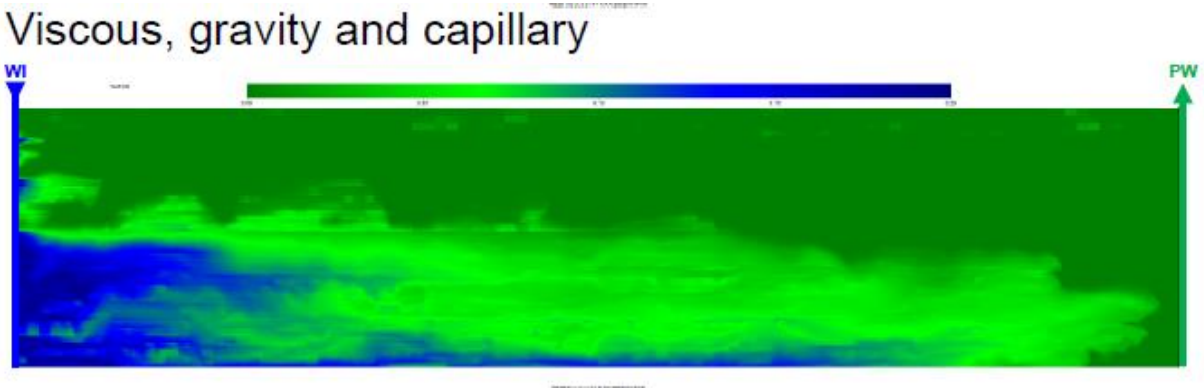
Truth models – building understanding





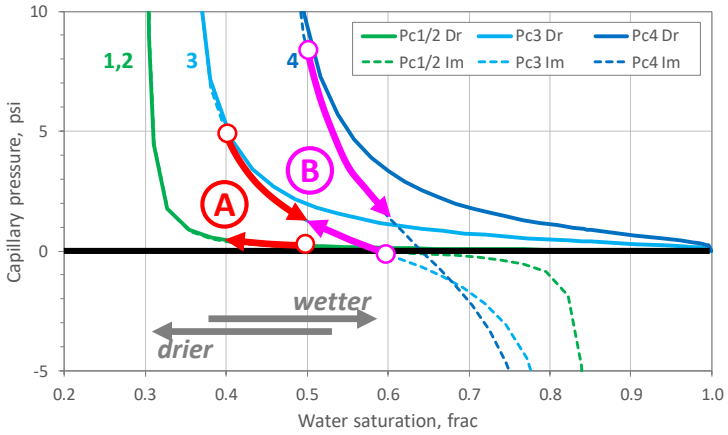


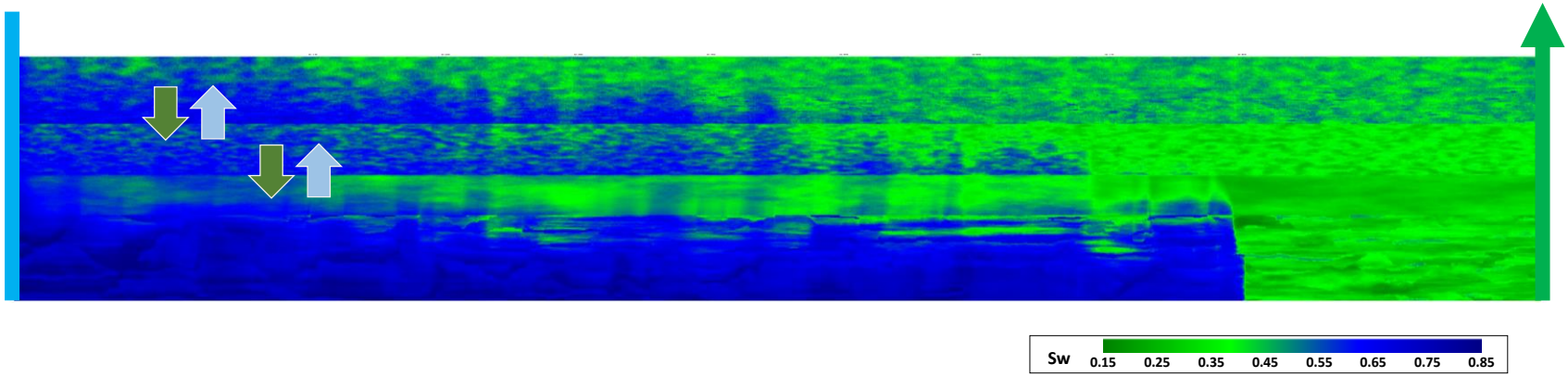


Understanding 1– impact of capillary forces

Water drawn up displaces oil down

Additional recovery from nominally ‘non-net’ material



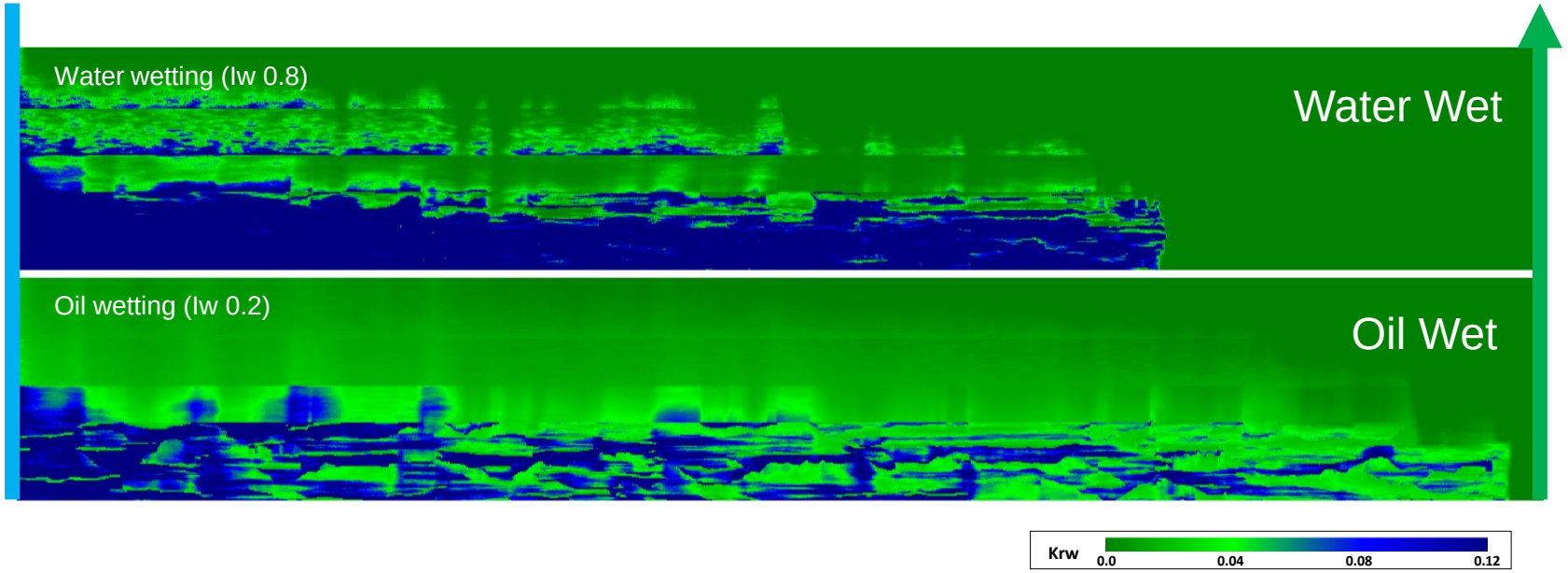


from: Bentley, Stephens, Buckle & Hutton 2018, EAGE Copenhagen

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

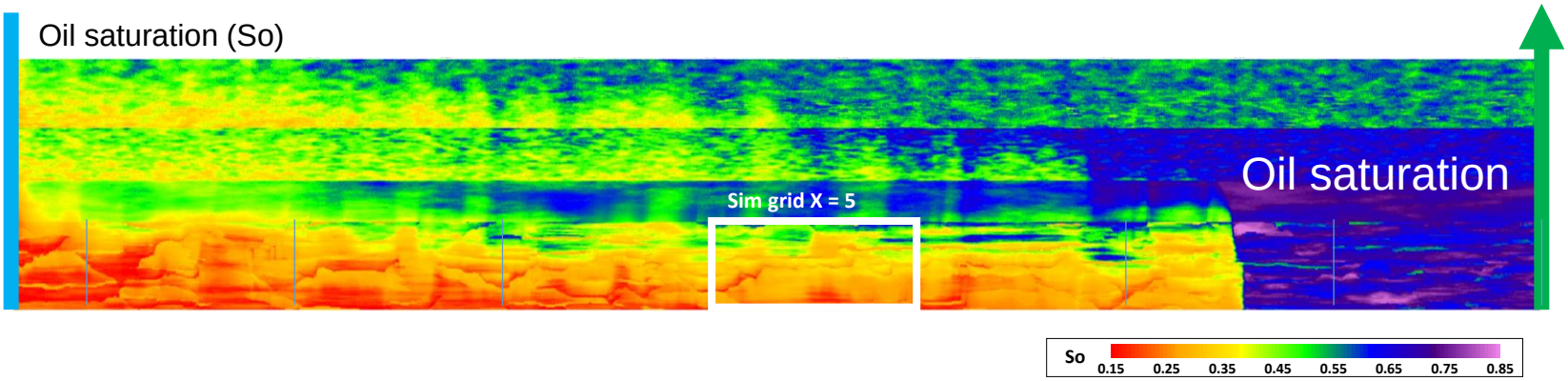


from: Bentley, Stephens, Buckle & Hutton 2018, EAGE Copenhagen

Understanding 3 – locating remaining oil

Saturation behind the flood front
Explore sim grid cell X=5 flowing ~90% water-cut

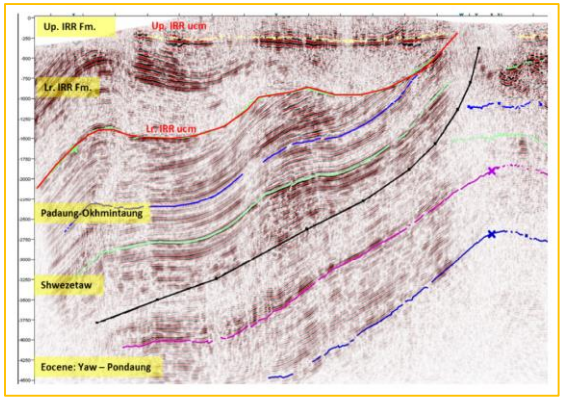
Model	Swi	W/cut	Krw	Kro	Soil
Ultra fine grid	30.7%	87%	**0.1305**	**0.0188**	**34%**
Sim grid X=5	30.6%	93%	**0.0992**	**0.0076**	**34%**



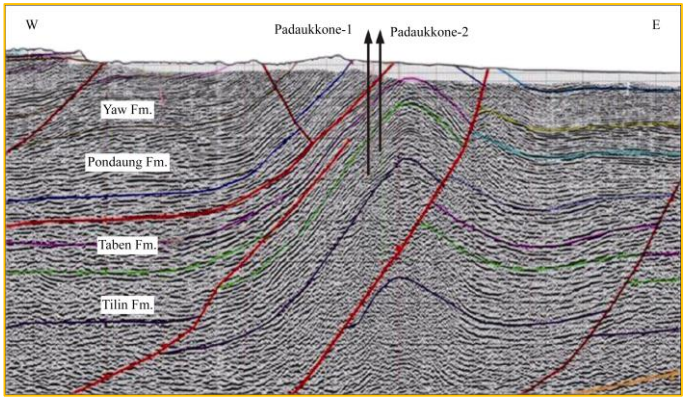
from: Bentley, Stephens, Buckle & Hutton 2018, EAGE Copenhagen

Central Myanmar analogue outcrops

Gwegyo seismic

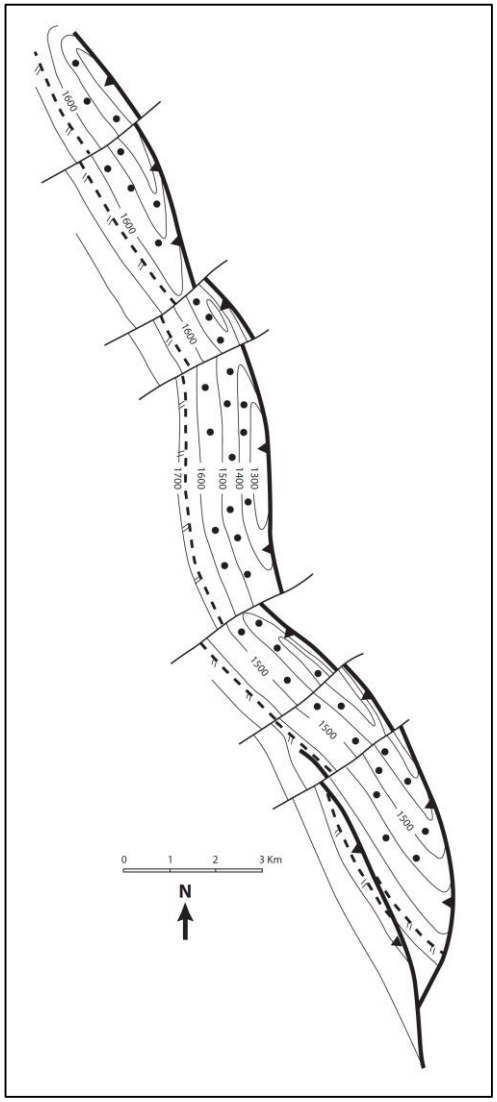


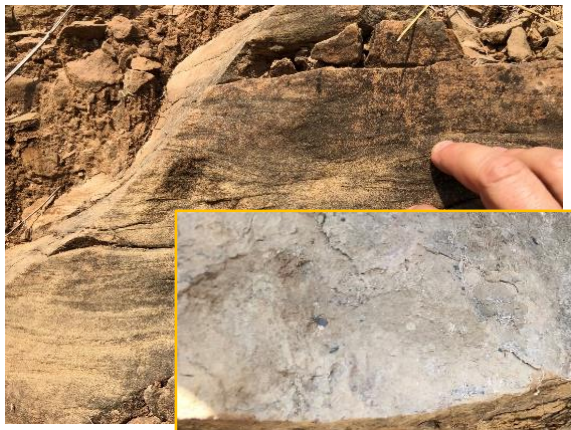
Analogue seismic



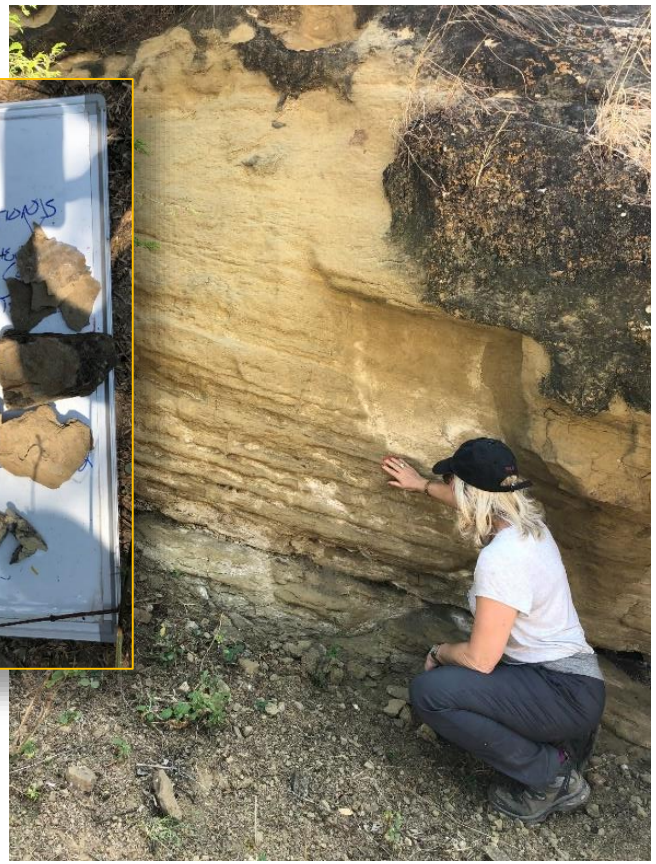
from Racey & Ridd, Geol Soc London

Synthetic field case for study

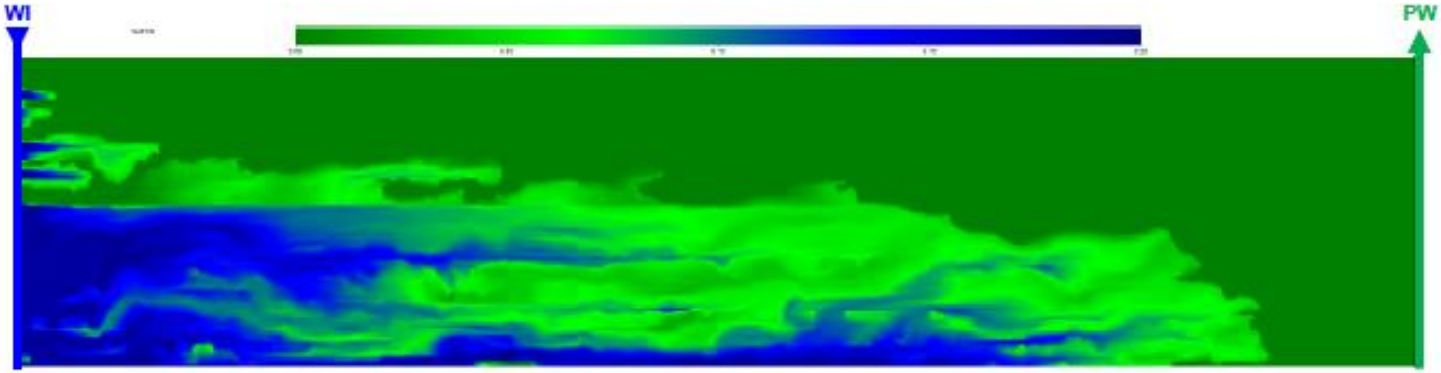





HETEROGENEITY
- DIAGENETIC CONCRETIONS
- FRACTURES → MINERALIZ
GYPSUM
- LAMINATED FINE SS
- RIP-UP CLASTS
- BEDDED / X-BEDDED
- COARSE SST
- SILICIFIED WOOD
- MASSIVE
SHALE



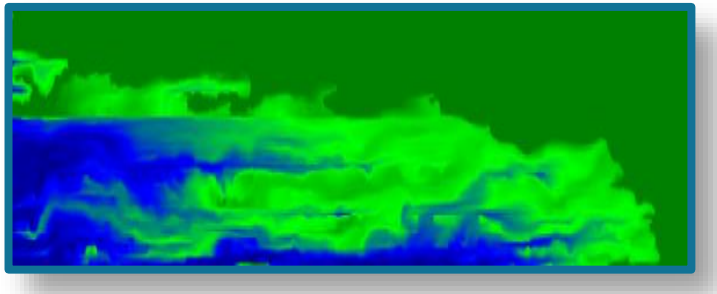
Truth models – building understanding



This talk …. adjust the workflow

A refinement

'Truth Models'



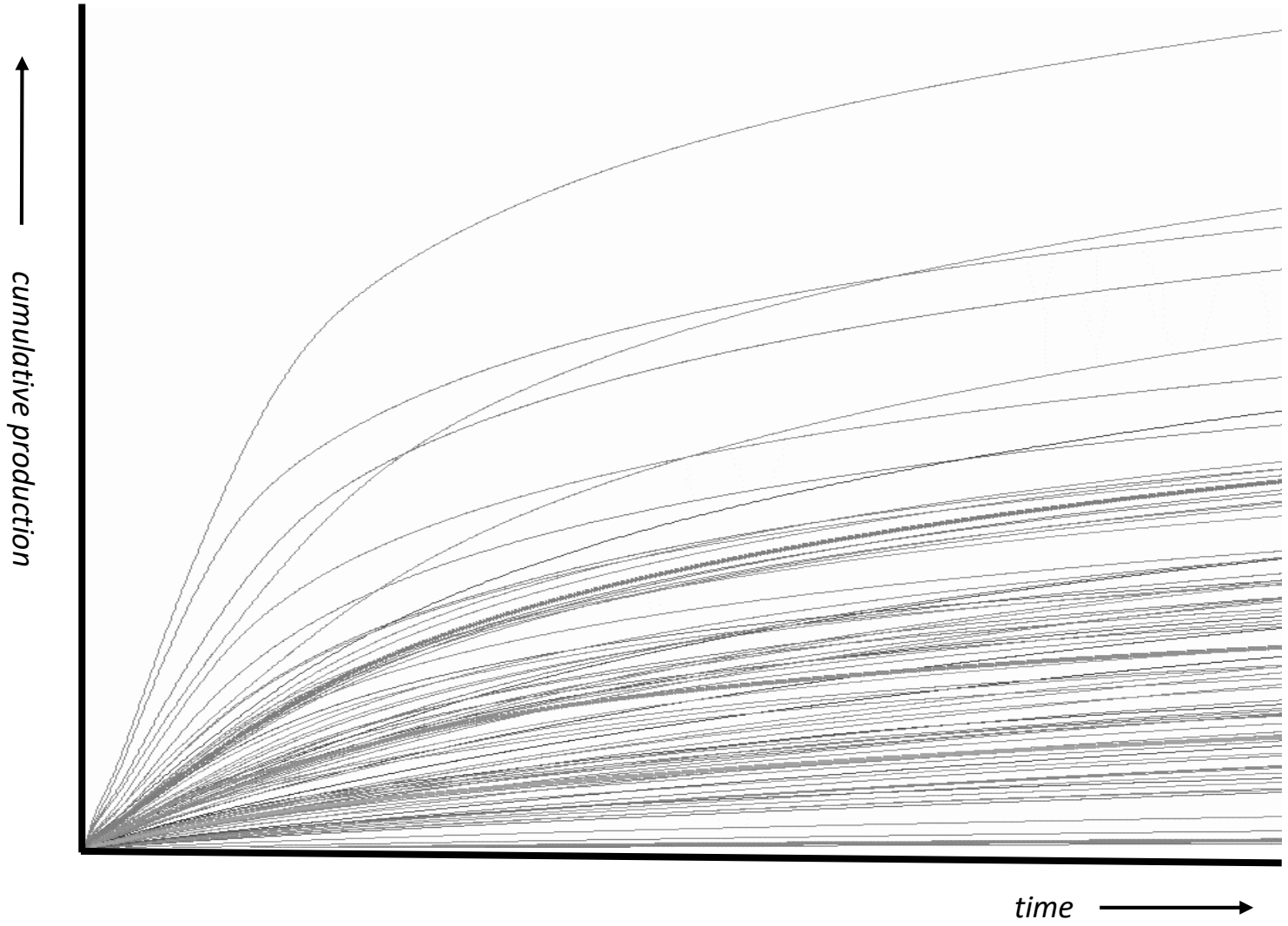
Myanmar mature fields

'How would that work here'

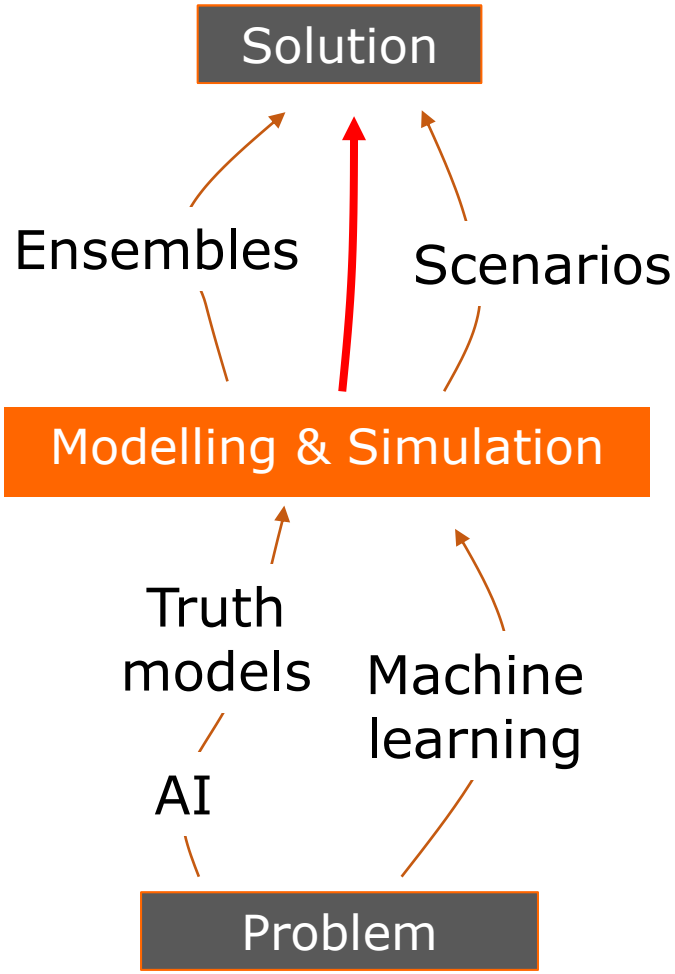
A different approach

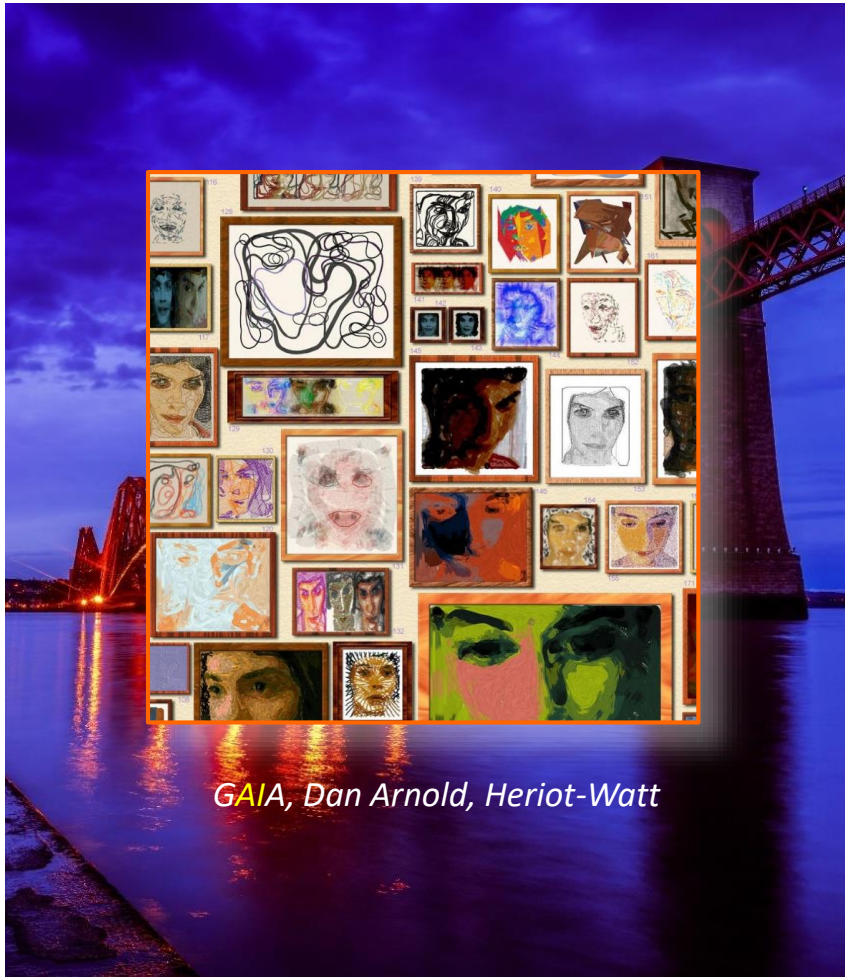
'Modelling for Understanding'

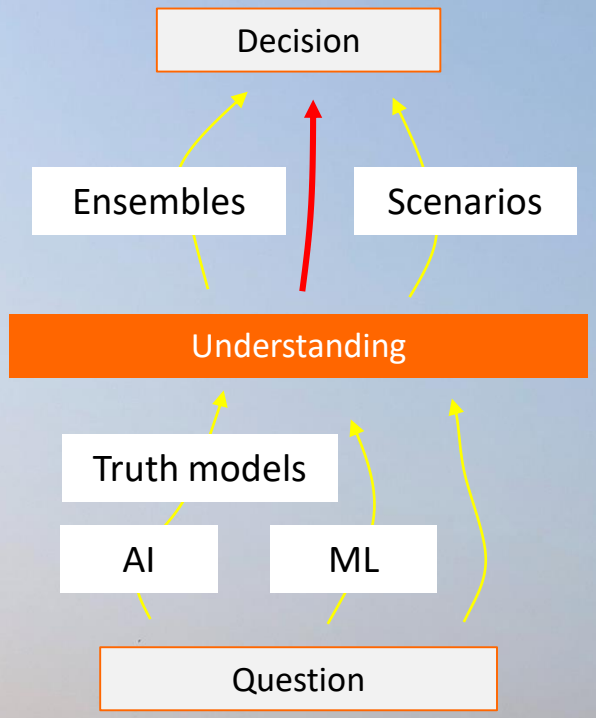
Modelling uncertainty



Questions and decisions in mature fields







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