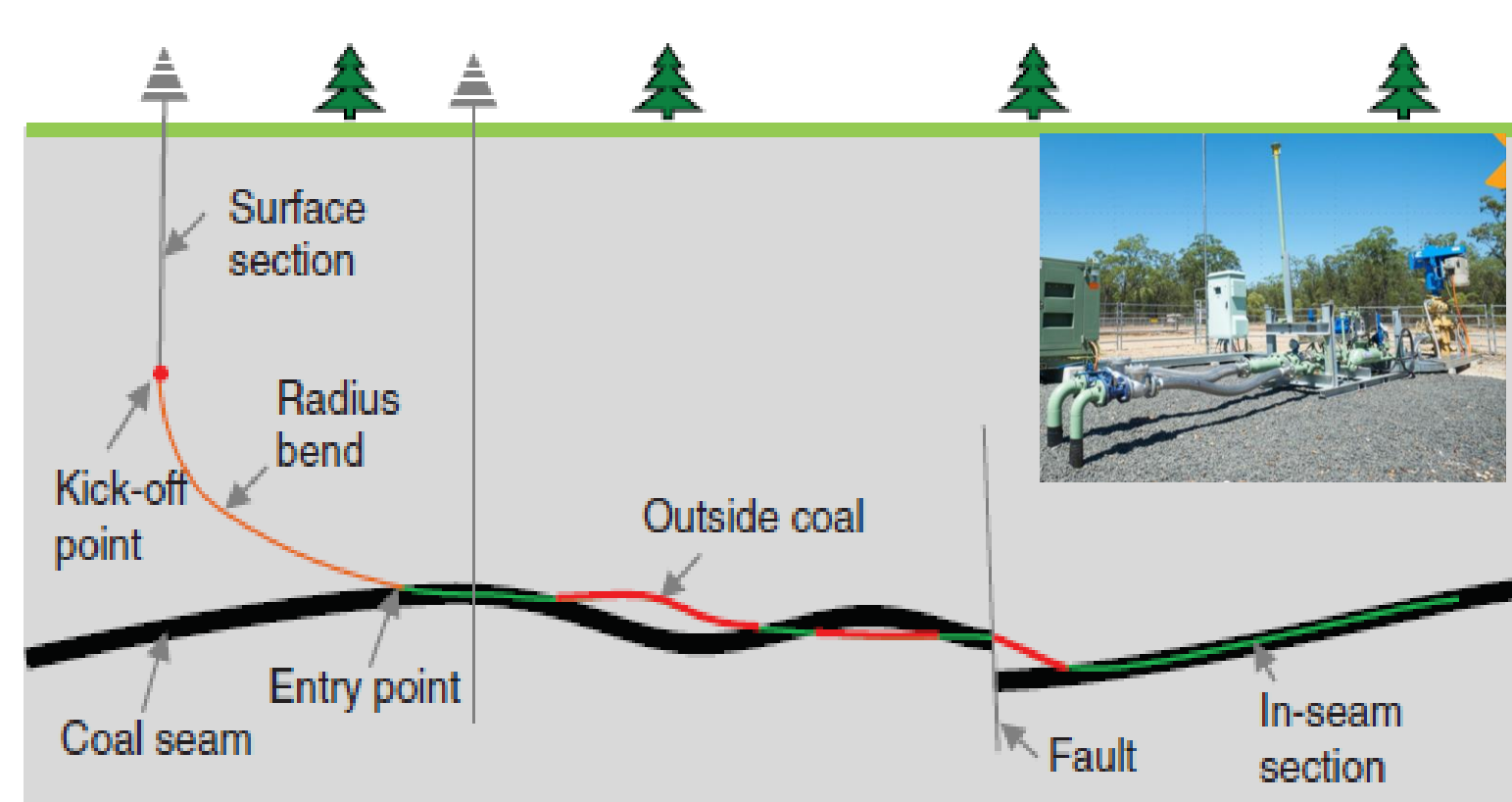


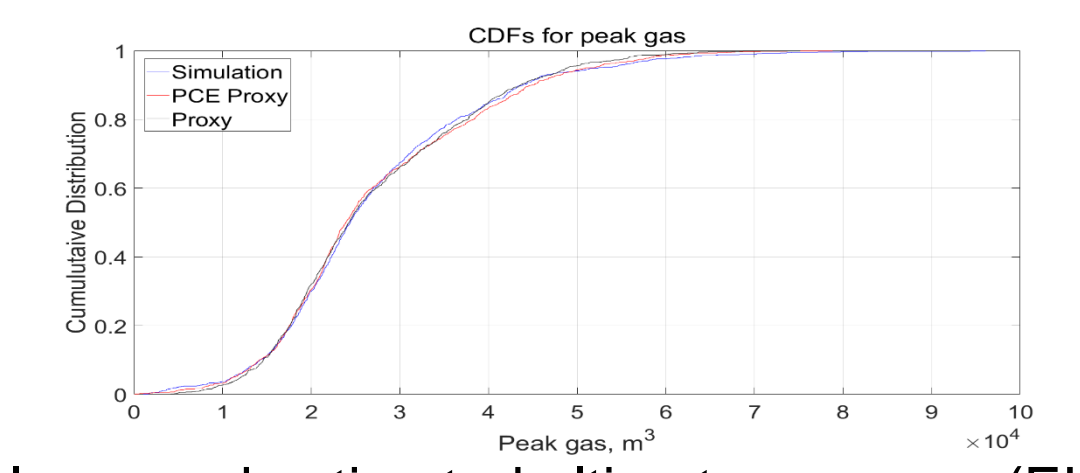
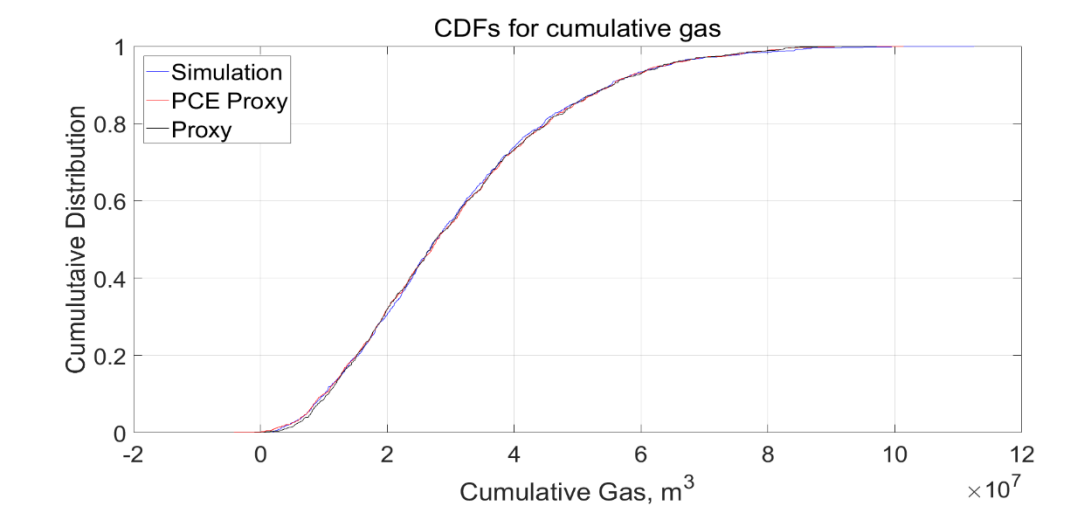
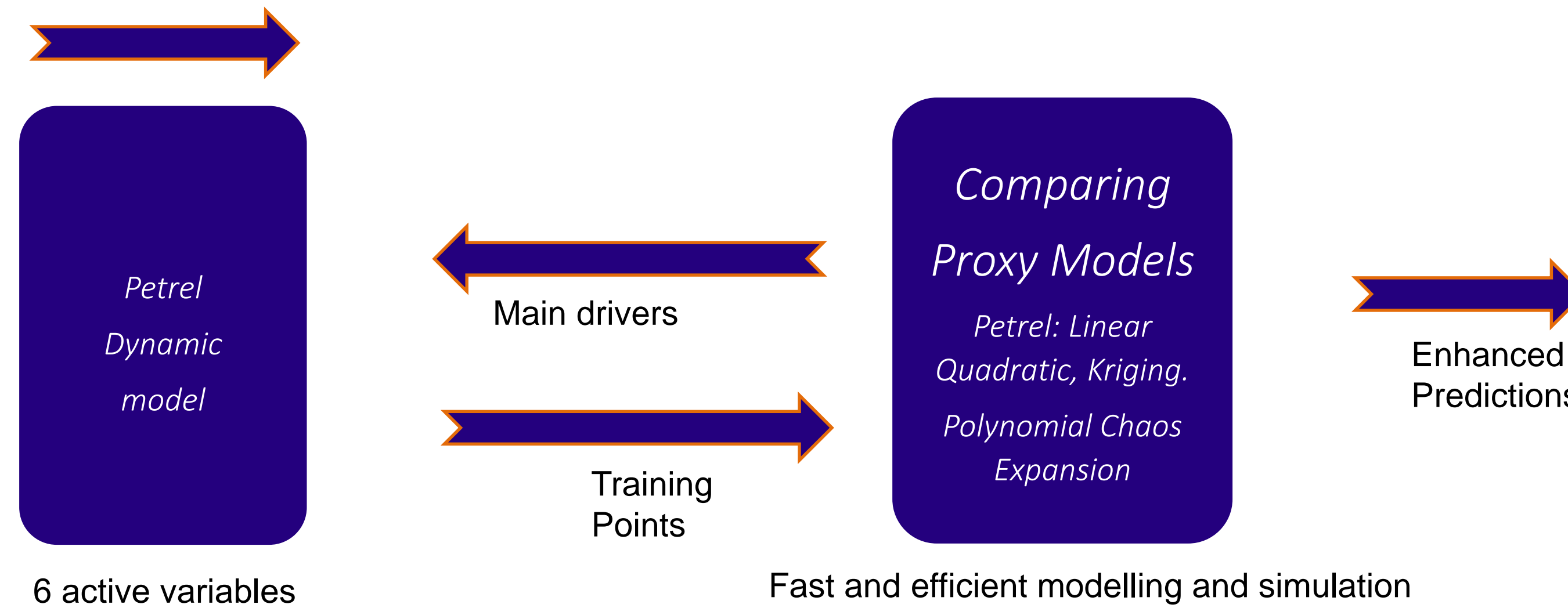
Proxy modelling for horizontal well coal seam gas production

Qian Wang¹, Diane Donovan^{2,3}, Fengde Zhou⁴, Thomas Reay², Iain Rodger³, Bevan Thompson², Xianbo Su⁵, Sule Yazici⁶

¹UQ School of Mechanical and Mining Engineering, ²UQ Faculty of Science (Mathematics), ³UQ Centre for Natural Gas, ⁴Arrow Energy, ⁵Henan Polytechnic University (China) Unconventional Gas Research Institute, ⁶Koç University (Istanbul) Department of Mathematics



5m by 2km by 2km Wright coal seam, Baralaba coal measure, Bowen Basin, burial depth 475m, gridded by 25m cells, 1km horizontal well



Improved estimated ultimate recovery (EUR) techniques

What is the essence of the simulations?

- A **proxy model** is built to approximate a computationally expensive model.
- It emulates the behaviour of the original model, honouring the underlying physics.
- It accurately and efficiently performs:
 - Uncertainty propagation.
 - Sensitivity analysis.
- Facilitates processes such as estimated ultimate recovery (EUR) calculations and history matching.

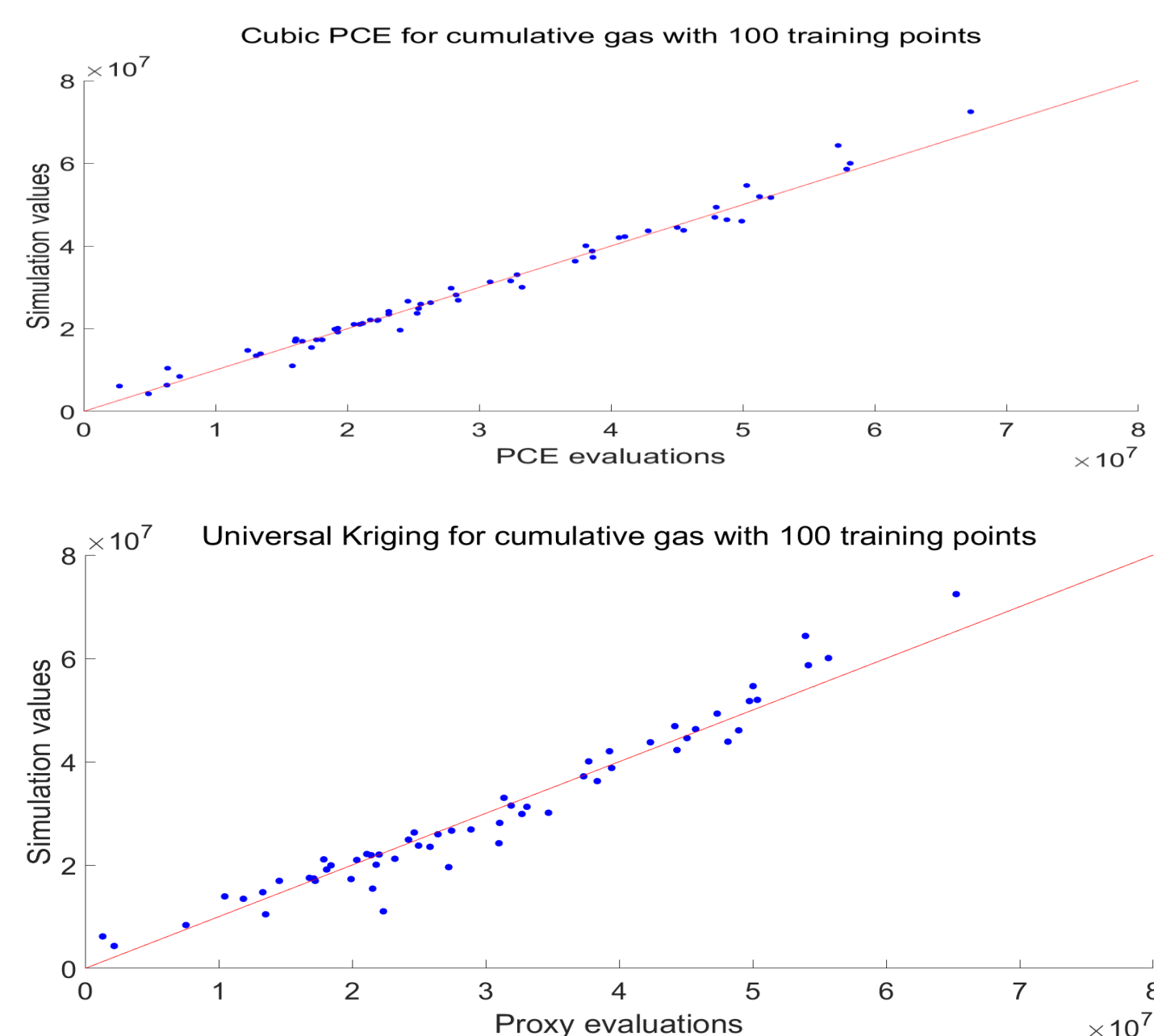
What are the desirable properties?

- Trained on actual field data.
- Accurate predictions using a small set of training and validation data.
- Fast evaluations across the entire variable space.
- Respects the statistical distributions of uncertain input variables.
- Direct access to sensitivity analysis.

What is the pay off?

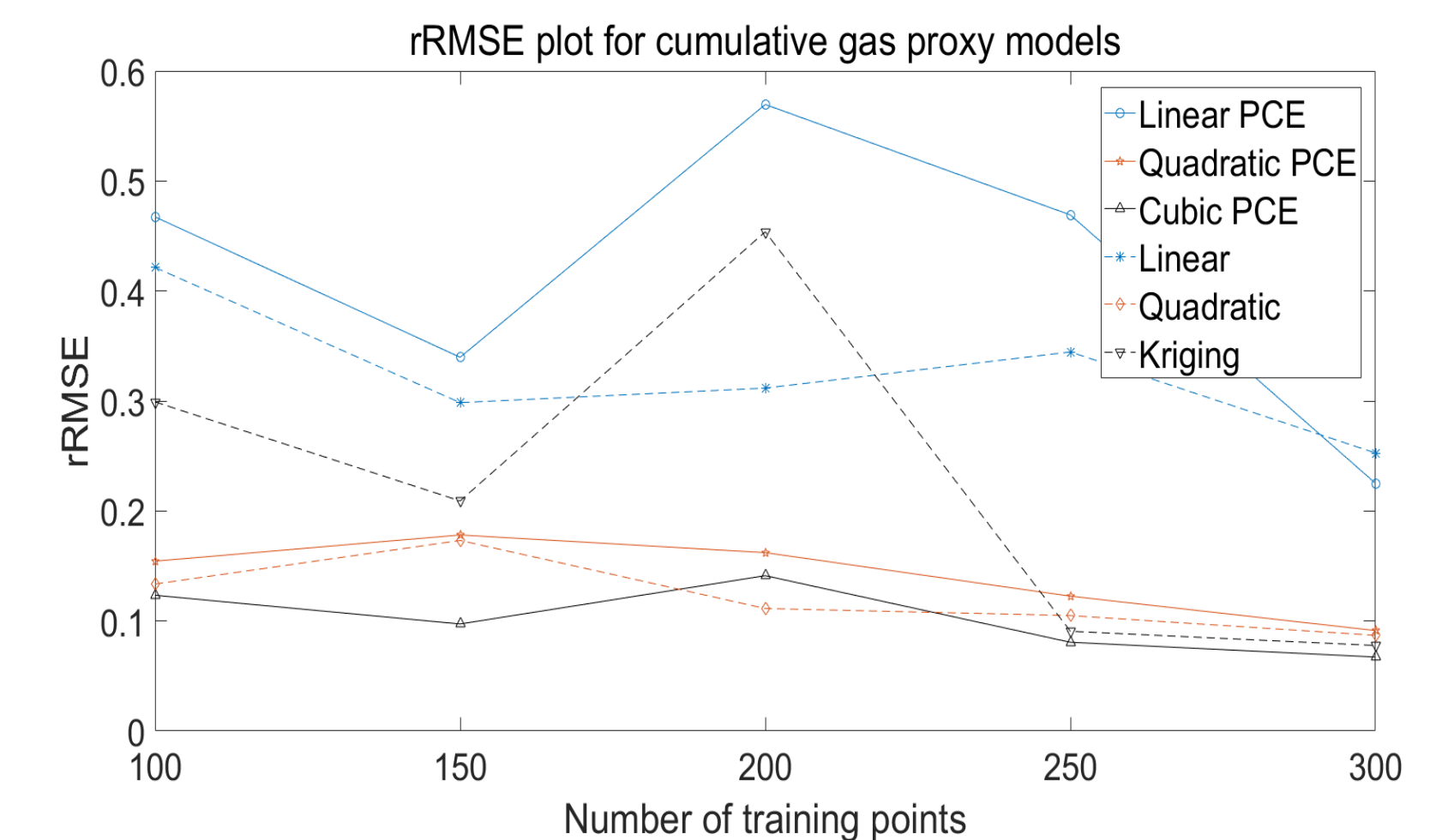
- Statistical information and uncertainty propagation: mean, variance and higher moments, cumulative distribution.
- Sensitivity analysis – identifying key input and parameter variance.
- History matching through fast and comprehensive exploration of the response surface.

Proxy vs full simulation predictions



How do the proxy models compare?

Outputs	Number of training points	rRMSE (Petrel proxy models)			rRMSE (PCE)	
		linear	quadratic	kriging	linear	cubic
Cum. gas	99	0.421	0.134	0.299	0.467	0.131
	148	0.299	0.173	0.209	0.340	0.094
	297	0.253	0.087	0.078	0.225	0.067
Peak gas	99	0.363	0.229	0.163	0.282	0.185
	148	0.833	0.535	0.392	0.817	0.139
	297	0.326	0.197	0.116	0.307	0.104



Future directions?

Applying the proxy models to field data, streamlines the prediction process, i.e. no requirement for an established model.