MRST Symposium 2021

Uncertainty Analysis of SCAL Data

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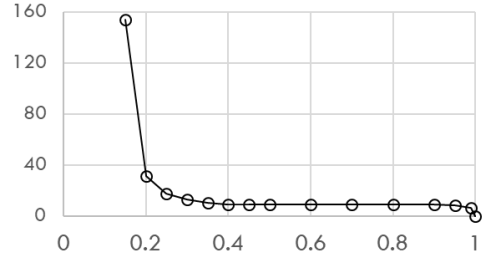
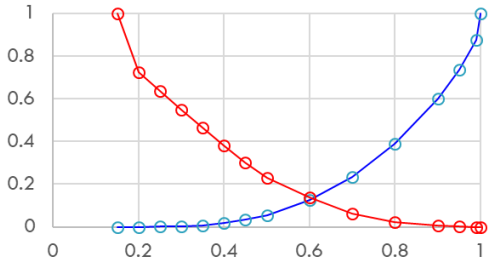
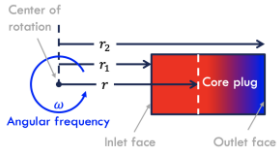
Why do we need the tool?

Unknown Parameters

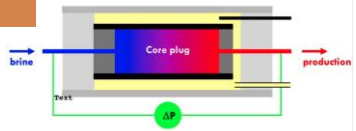




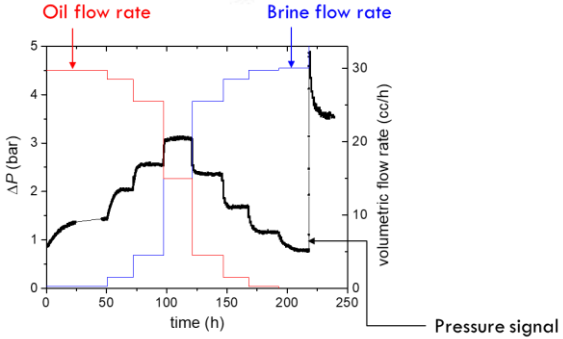
Steady State



Centrifuge

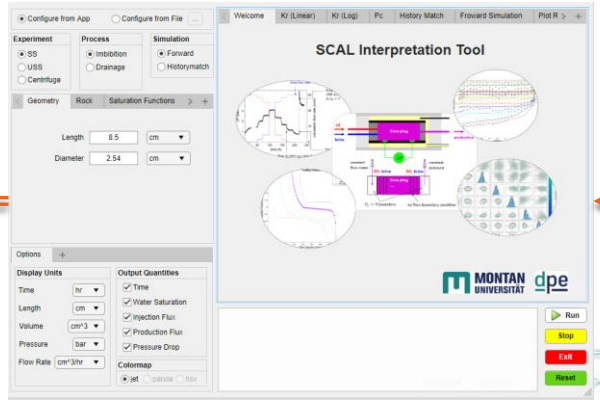


Measurement



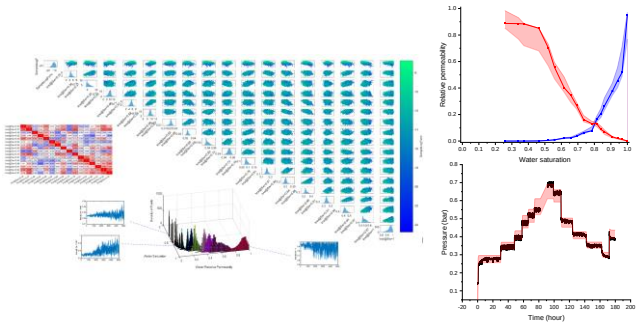
Analytical solutions (Darcy, Hassler Bruner) have assumptions:

- Darcy and JBN ignore Pc for SS and USS
- Interpretation is done in a sequence



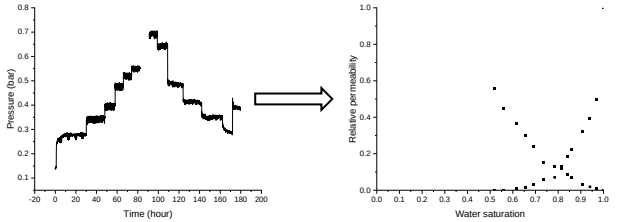
Simultaneously matching the flooding and centrifuge measurements to provide more accurate interpretation

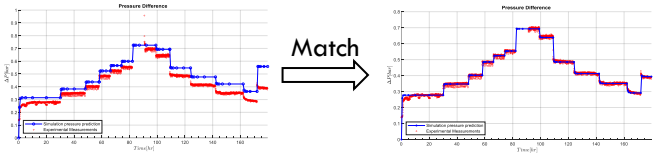
How does it work?



5. Uncertainty Quantification

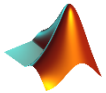
1. Analytical Solution



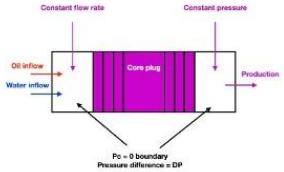


4. History Matching

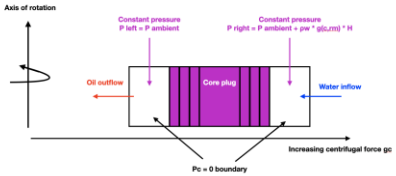
2. MRST Forward Simulation



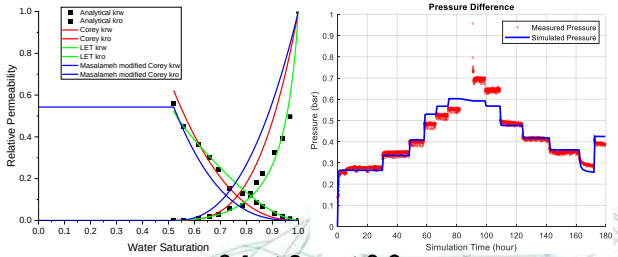
Flooding schematic



Centrifuge schematic

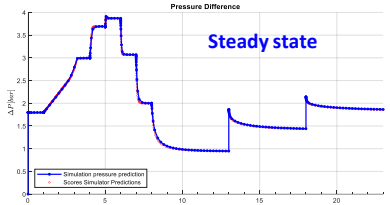


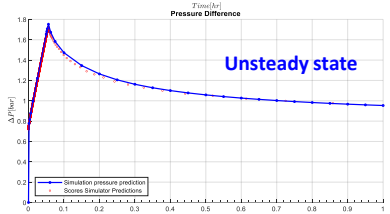
3. Saturations functions choice and constrains

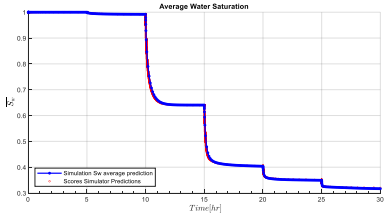


$0.1 < Swc < 0.2$

Verification with available simulators

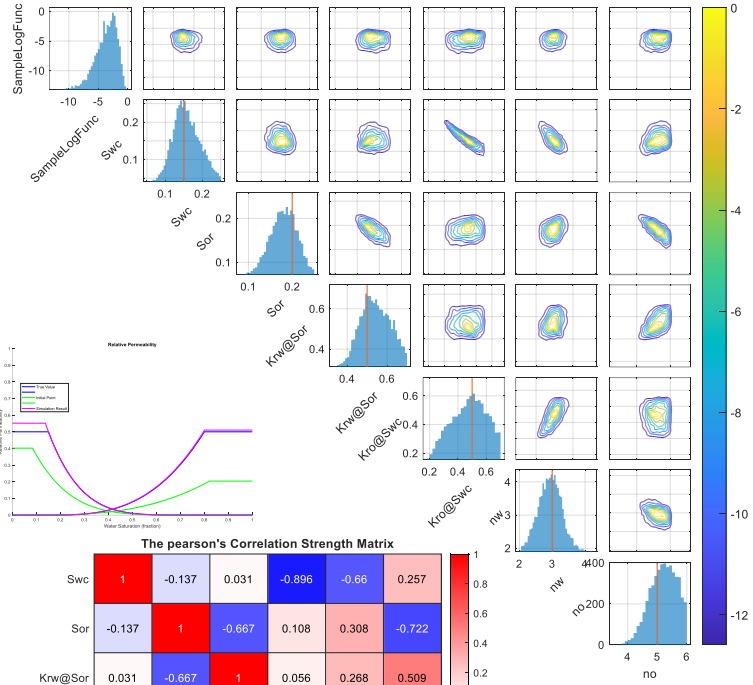


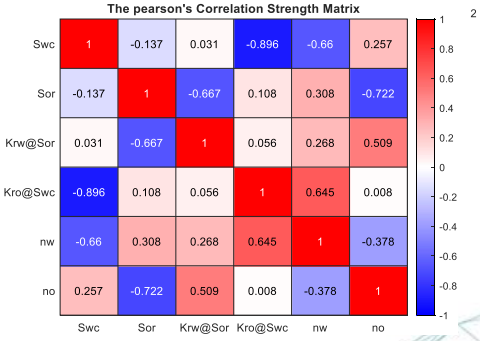




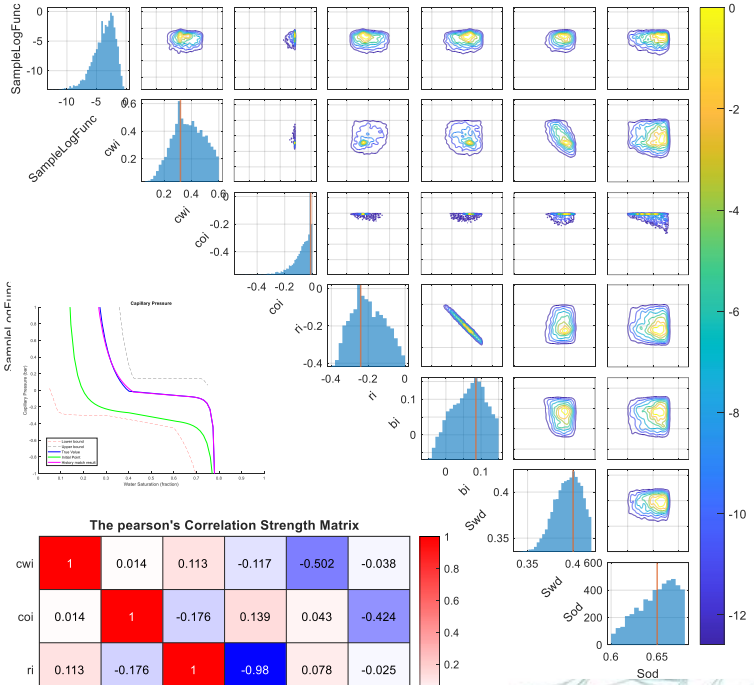
CYDAR, PORLAB, SCORES, SENDRA (Lenormand et al. 2017)

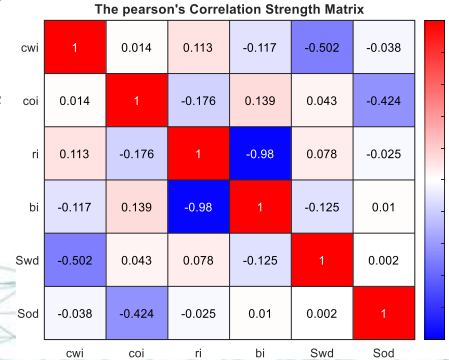
Corey Relative permeability Grid Plots





Skjaeveland capillary pressure Grid Plots

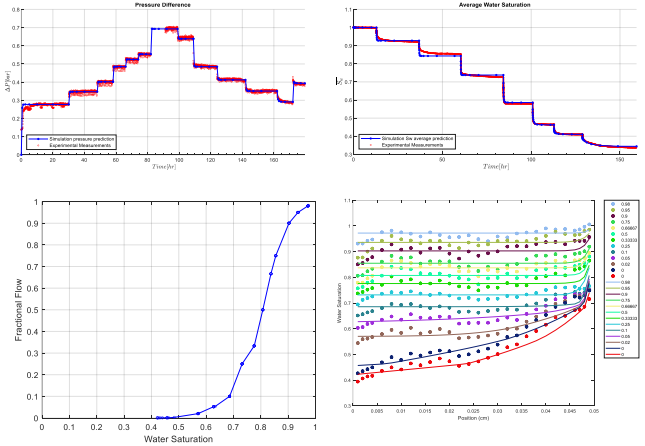


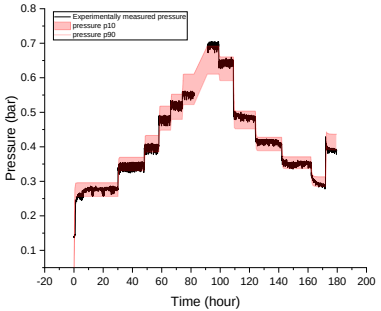


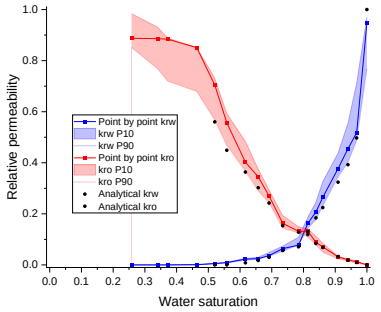
Simultaneous history matching with SCORES (Loeve et al. 2011)

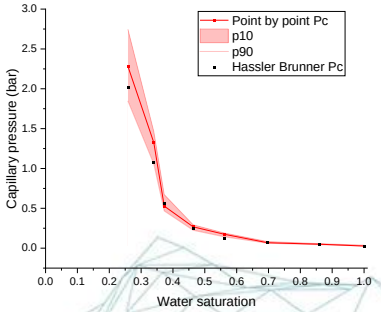
Estaillades Carbonate

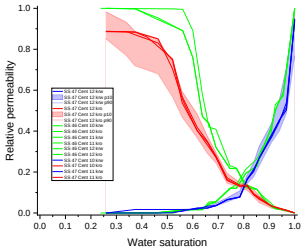
Sample	Porosity (fraction)	Absolute permeability (mD)	Available Data
46	0.293	142.3	Steady State Drainage
47	0.271	141.8	Steady State Drainage
10	0.283	204.1	Multispeed Centrifuge Drainage
11	0.283	141.2	Multispeed Centrifuge Drainage
12	0.274	189.8	Multispeed Centrifuge Drainage

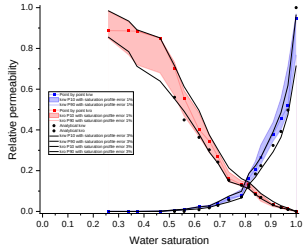


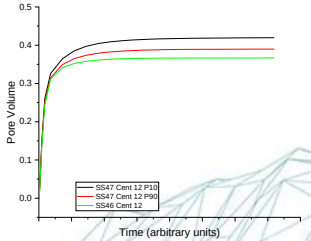












Estaillades Carbonate

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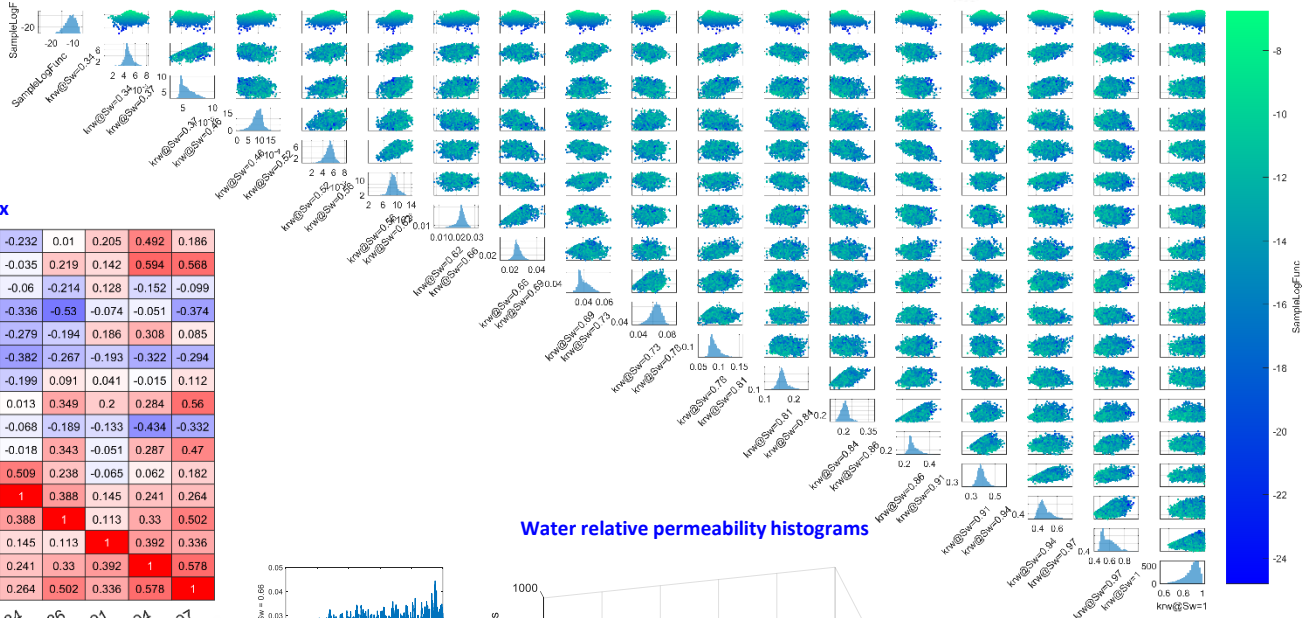
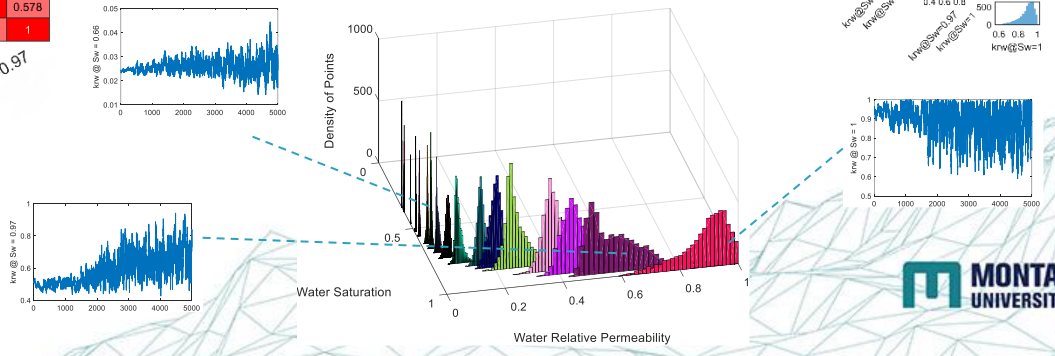
Water Relative permeability Grid Plots



The Pearson's correlation matrix

	krw@Sw=0.34	krw@Sw=0.37	krw@Sw=0.46	krw@Sw=0.52	krw@Sw=0.56	krw@Sw=0.62	krw@Sw=0.66	krw@Sw=0.69	krw@Sw=0.73	krw@Sw=0.78	krw@Sw=0.81	krw@Sw=0.84	krw@Sw=0.86	krw@Sw=0.91	krw@Sw=0.94	krw@Sw=0.97
krw@Sw=0.34	1	0.563	-0.218	0.193	0.483	0.016	0.099	0.347	-0.47	0.458	-0.252	-0.232	0.01	0.205	0.492	0.186
krw@Sw=0.37	0.563	1	-0.203	0.044	0.296	0.01	0.288	0.467	-0.48	0.618	0.121	-0.035	0.219	0.142	0.594	0.568
krw@Sw=0.46	-0.218	-0.203	1	0.253	0.301	-0.187	-0.45	-0.058	0.308	-0.352	-0.083	-0.06	-0.214	0.128	-0.152	-0.099
krw@Sw=0.52	0.193	0.044	0.253	1	0.352	0.179	-0.271	-0.37	0.062	-0.123	-0.019	-0.336	-0.53	-0.074	-0.051	-0.374
krw@Sw=0.56	0.483	0.296	0.301	0.352	1	-0.275	-0.354	0.335	-0.052	0.14	-0.089	-0.279	-0.194	0.186	0.308	0.085
krw@Sw=0.62	0.016	0.01	-0.187	0.179	-0.275	1	0.467	-0.301	-0.025	-0.051	-0.054	-0.382	-0.267	-0.193	-0.322	-0.294
krw@Sw=0.66	0.099	0.288	-0.45	-0.271	-0.354	0.467	1	0.094	-0.173	0.486	-0.005	-0.199	0.091	0.041	-0.015	0.112
krw@Sw=0.69	0.347	0.467	-0.058	-0.37	0.335	-0.301	0.094	1	-0.08	0.453	0.169	0.013	0.349	0.2	0.284	0.56
krw@Sw=0.73	-0.47	-0.48	0.308	0.062	-0.052	-0.025	-0.173	-0.08	1	-0.297	-0.157	-0.068	-0.189	-0.133	-0.434	-0.332
krw@Sw=0.78	0.458	0.618	-0.352	-0.123	0.14	-0.051	0.486	0.453	-0.297	1	0.111	-0.018	0.343	-0.051	0.287	0.47
krw@Sw=0.81	-0.252	0.121	-0.083	-0.019	-0.089	-0.054	-0.005	0.169	-0.157	0.111	1	0.509	0.238	-0.065	0.062	0.182
krw@Sw=0.84	-0.232	-0.035	-0.06	-0.336	-0.279	-0.382	-0.199	0.013	-0.068	-0.018	0.509	1	0.388	0.145	0.241	0.264
krw@Sw=0.86	0.01	0.219	-0.214	-0.53	-0.194	-0.267	0.091	0.349	-0.189	0.343	0.238	0.388	1	0.113	0.33	0.502
krw@Sw=0.91	0.205	0.142	0.128	-0.074	0.186	-0.193	0.041	0.2	-0.133	-0.051	-0.065	0.145	0.113	1	0.392	0.336
krw@Sw=0.94	0.492	0.594	-0.152	-0.051	0.308	-0.322	-0.015	0.284	-0.434	0.287	0.062	0.241	0.33	0.392	1	0.578
krw@Sw=0.97	0.186	0.568	-0.099	-0.374	0.085	-0.294	0.112	0.56	-0.332	0.47	0.182	0.264	0.502	0.336	0.578	1

Water relative permeability histograms



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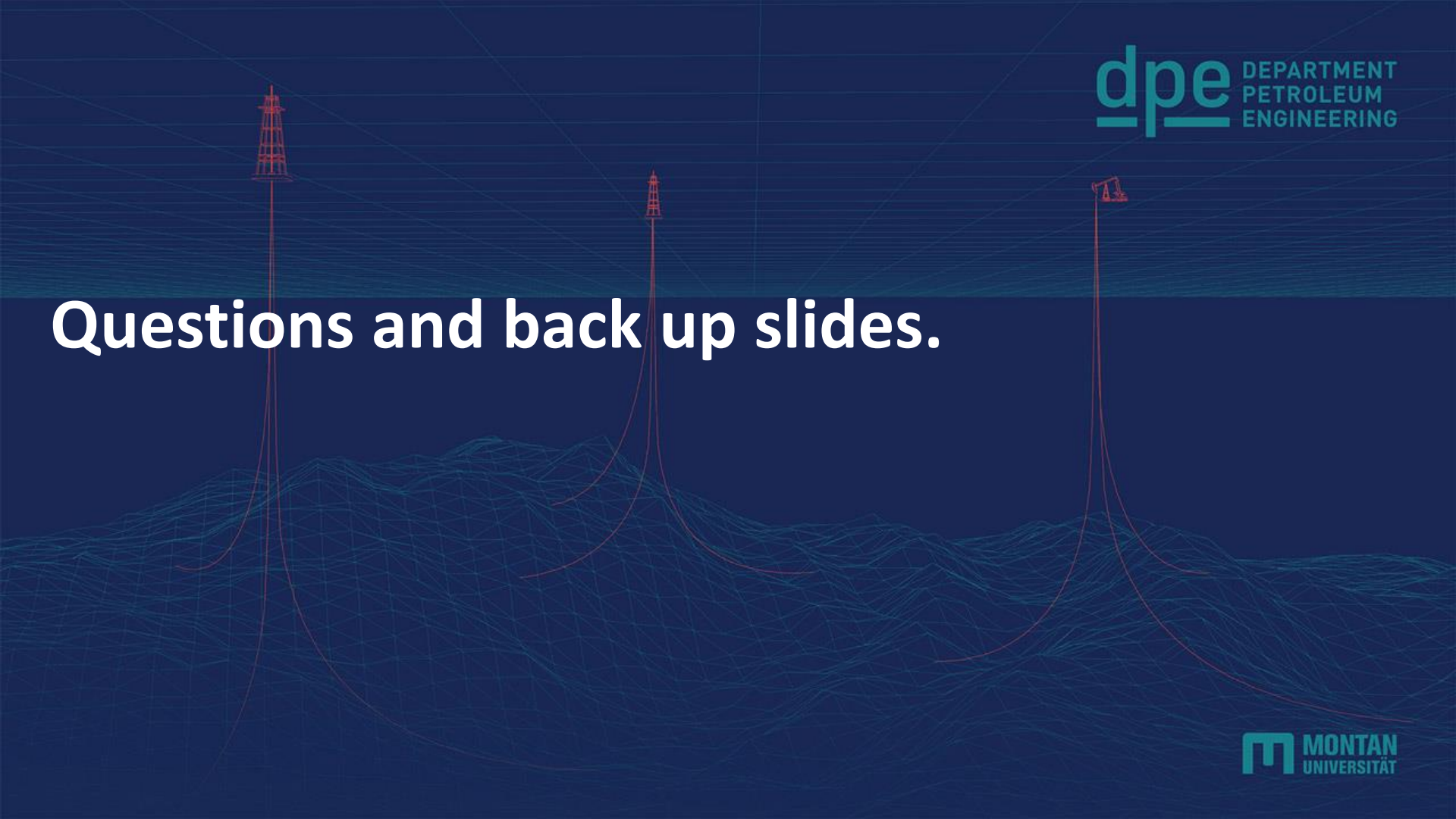
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Questions and back up slides.
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