



Host

31 October - 3 November 2022

Abu Dhabi, United Arab Emirates

AI Assisted Well Performance Prediction Based On Production Profiles Clustering

SPE-211364-MS

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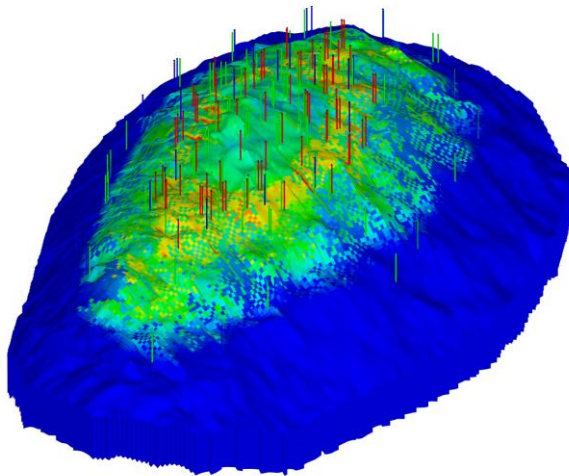
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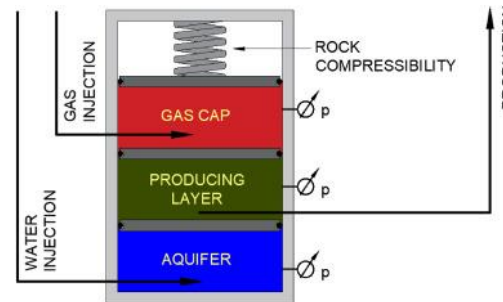
Problem Statement

Production forecast is an important part of Field Development Planning

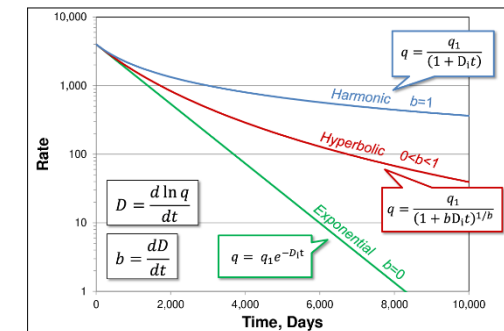
Dynamic Modeling



Material Balance



Decline Curve Analysis



Method complexity from **complex** to **simple**

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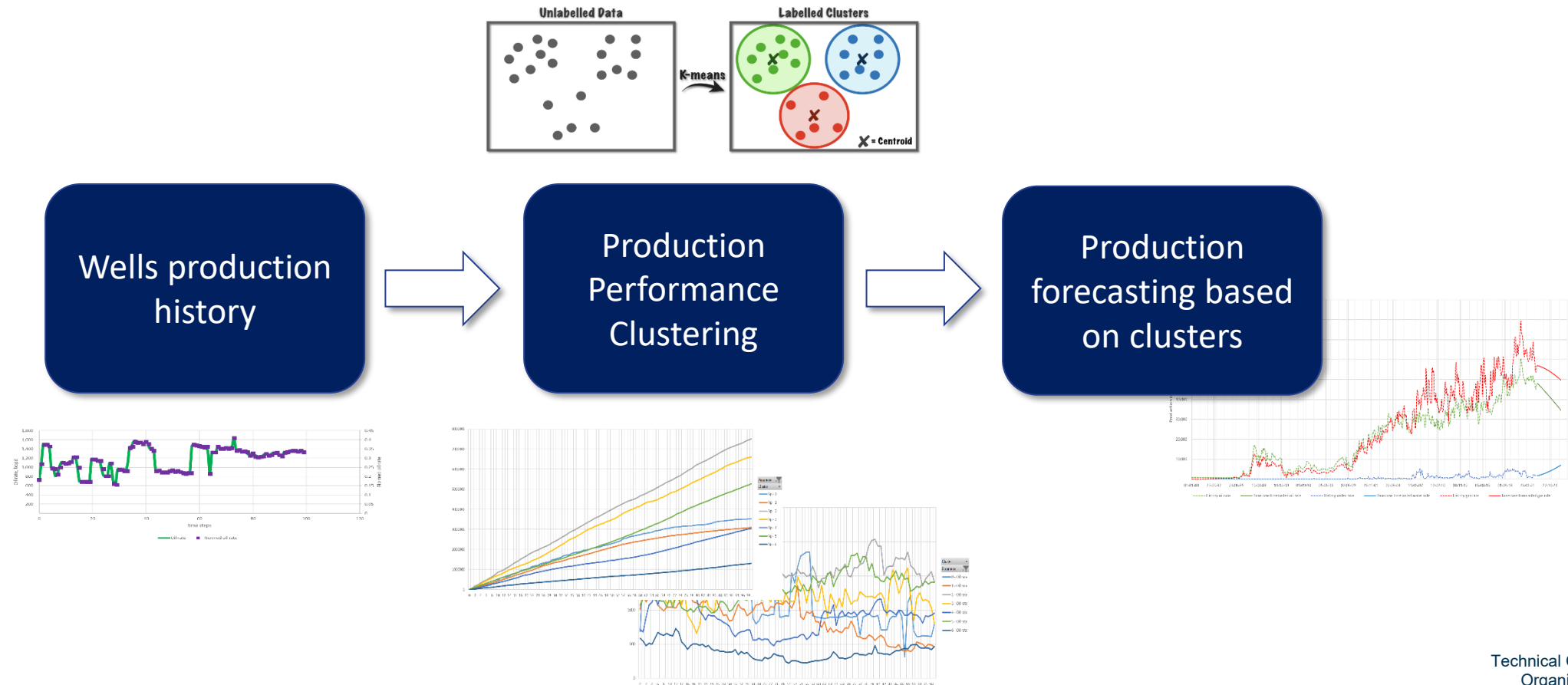
Study Objective

- To study AI/ML methods in classification of wells by their historical behavior
- To forecast production of producing wells

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Proposed Solution



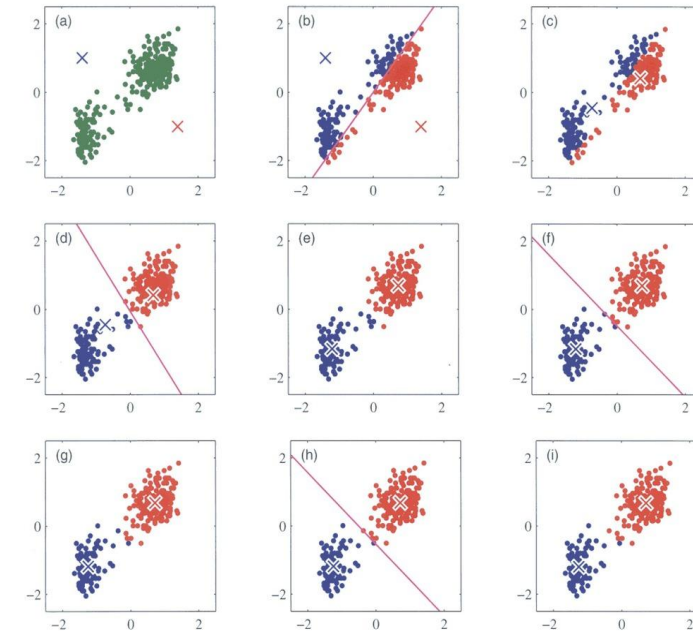
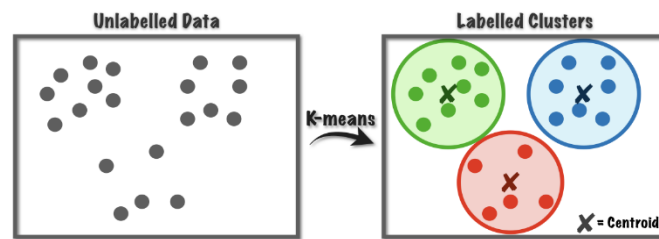
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Method Description

Cluster analysis or clustering is the task of grouping a set of objects in such a way that objects in the same group (called a cluster) are more similar (in some sense) to each other than to those in other groups.

K-Means clustering is one of the simplest and popular unsupervised machine learning algorithms. The objective of K-Means clustering is to group similar data points together and discover underlying patterns. The term “cluster” refers to a collection of data points aggregated together because of certain similarities. K-means algorithm identifies k number of centroids and then distributes each data point to the nearest cluster using certain measure of similarity.



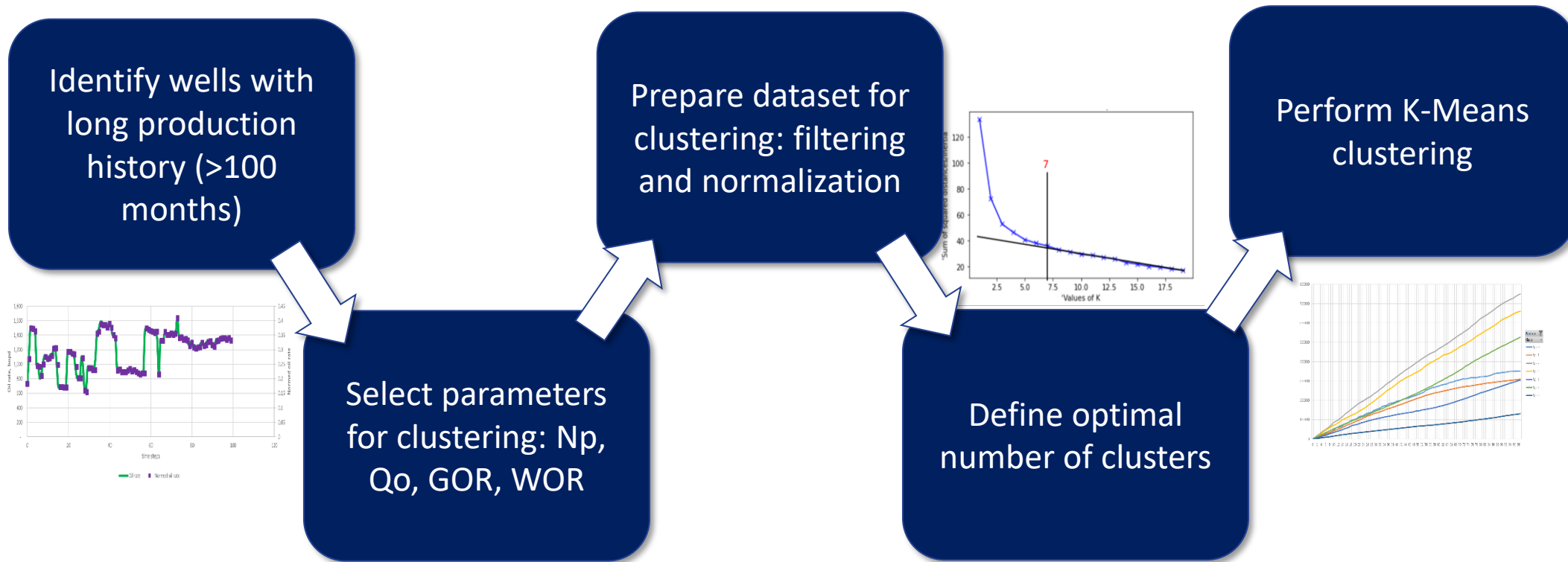
$$S_i^{(t)} = \left\{ x_p : (x_p - m_i^t)^2 \leq (x_p - m_j^t)^2 \forall j, 1 \leq j \leq k \right\} - \text{Euclidean distance}$$

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Wells Clustering Based on Production Profiles

The method proposes to identify clusters with similar production behavior and to assign the defined clusters to the wells with shorter production history.

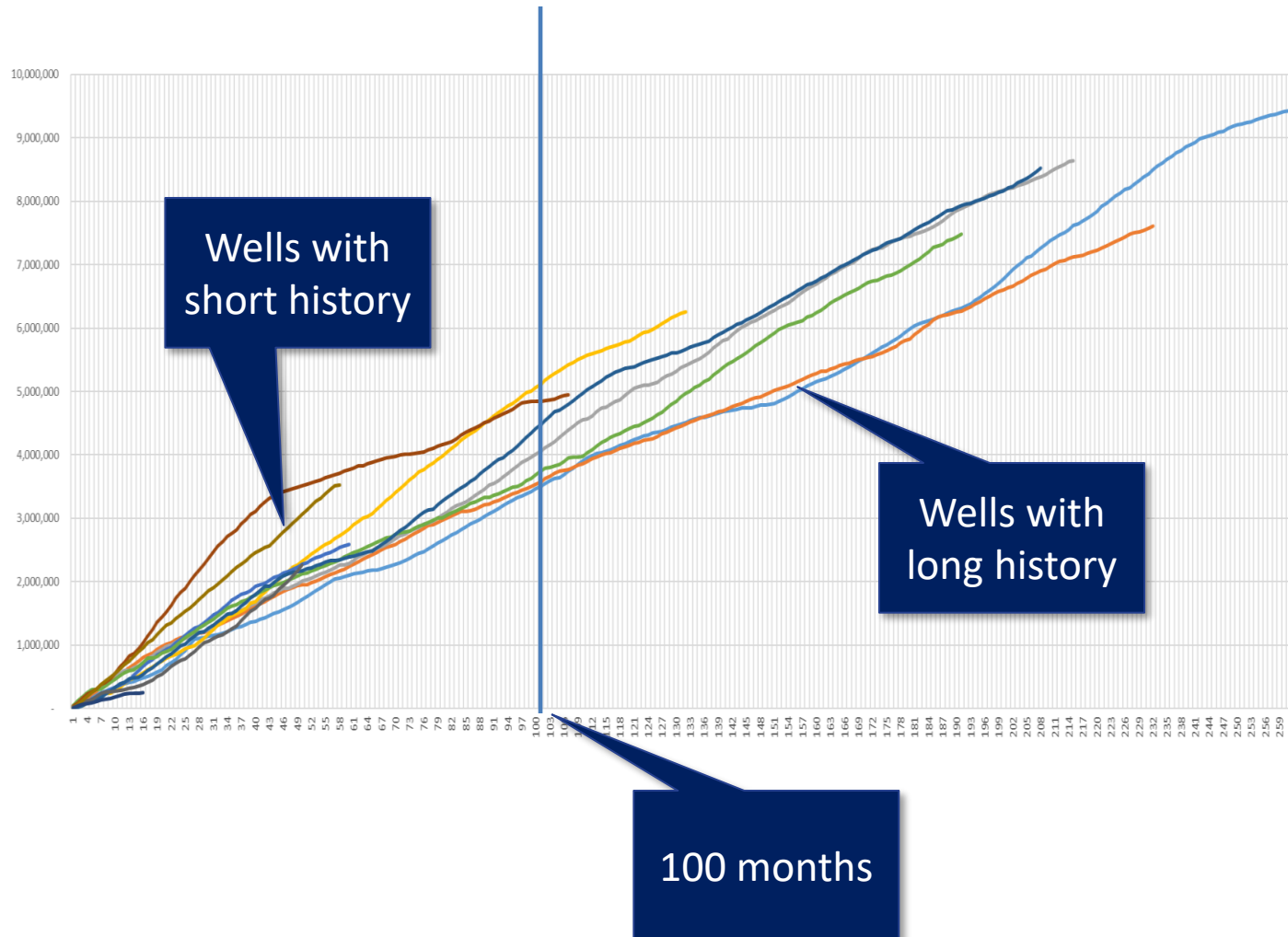


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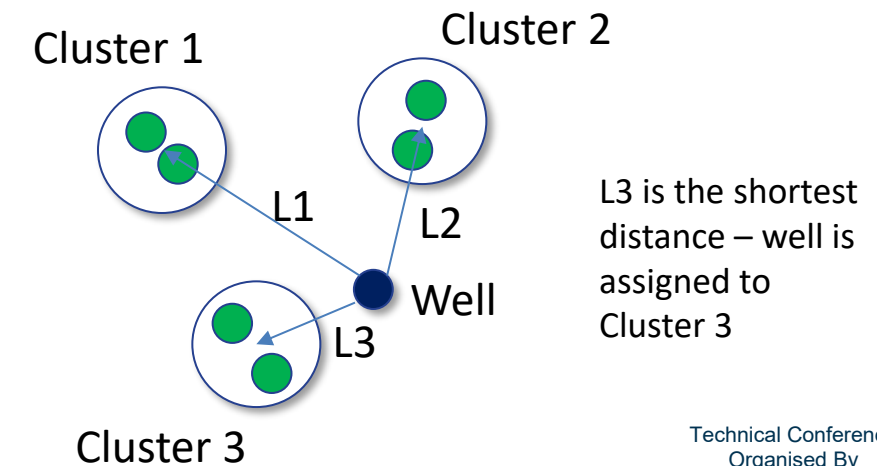
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Cluster Assignment for Wells with Shorter History



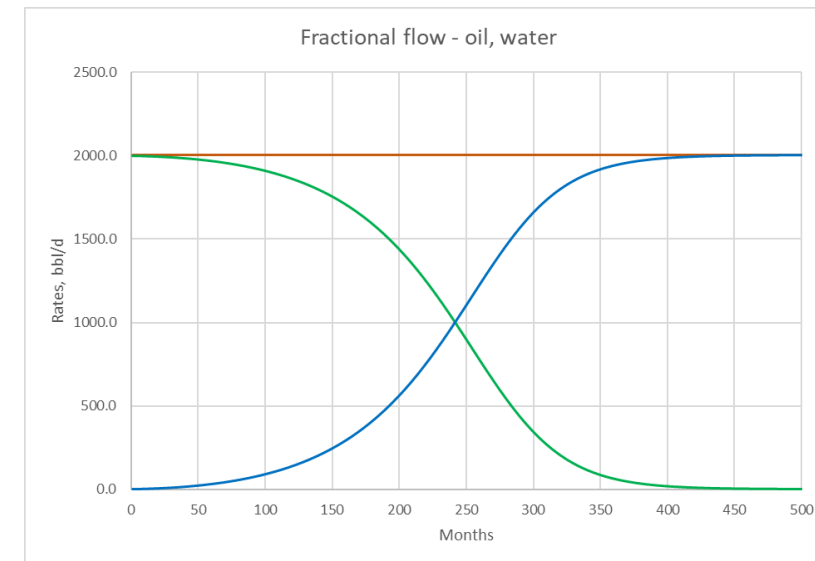
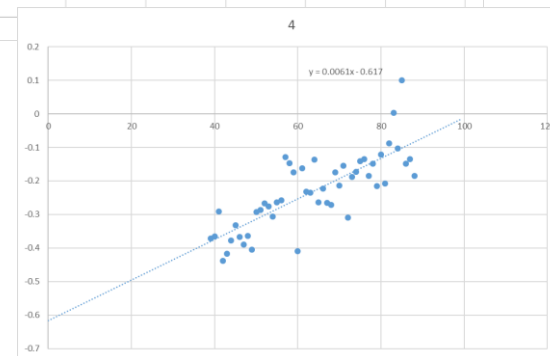
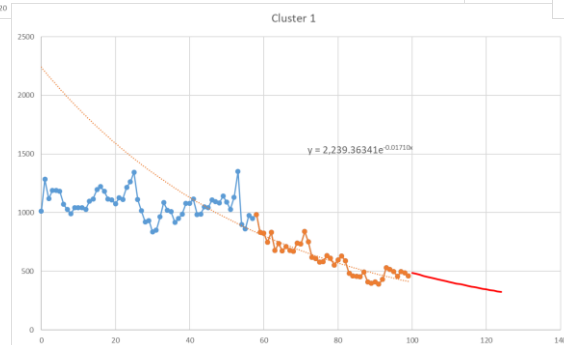
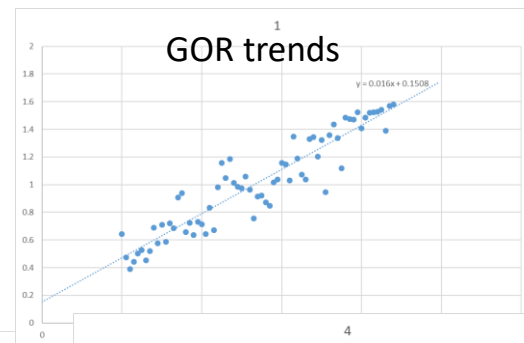
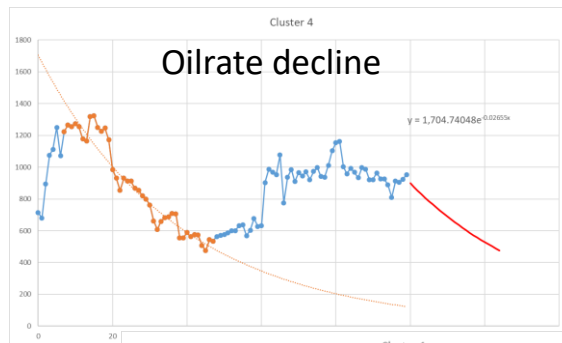
$$Cluster = \min \left[\sum_p^4 \sum_{t=1}^n (x_{pt}^w - x_{pt}^c) \right], \forall c$$

where x^w parameter value of well, x^c parameter value of cluster



Production Forecast

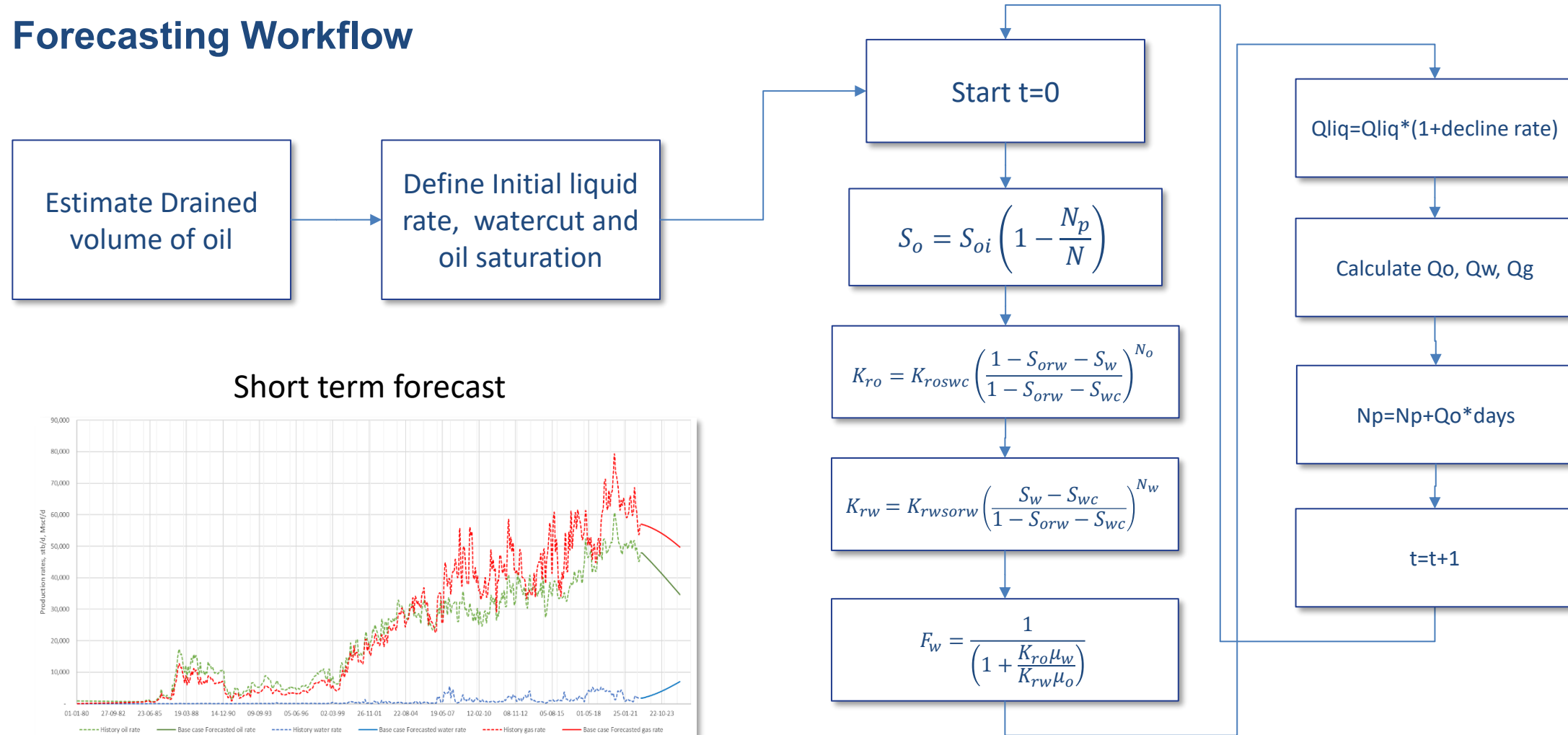
Production forecast is based on DCA (decline curve analysis) and fractional flow performed for each cluster



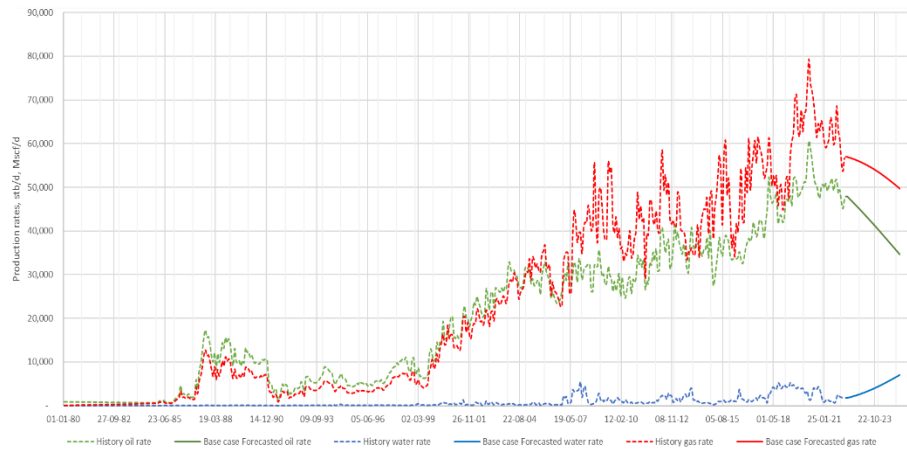
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Forecasting Workflow



Short term forecast



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Conclusions

- A new method of well clustering based on production profiles has been introduced and piloted on an oil field in Abu Dhabi area.
- This method allows expediting the production forecasting procedure and can help in reservoir characterization considering the correlation between production behavior and geological properties.
- The advantage of the method described in this study is the faster production analysis, it means that instead to analyze each of the 52 producing wells, it needs only to perform DCA for 7 clusters and then to apply production forecasting according to the wells cluster assignment. Therefore, the method saves about 84% of the computing resources.

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