History Matching and Uncertainty Quantification of Reservoir Performance with Generative Deep Learning And Graph Convolutions

Gleb Shishaev, Prof. Vasily Demyanov, Dr. Daniel Arnold, Roman Vygon

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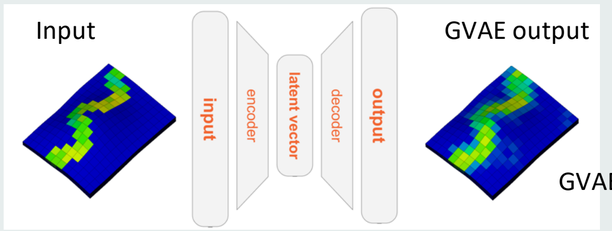
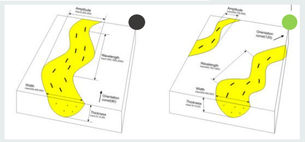
INTRODUCTION, AIM & METHOD

We tackle the challenge of reservoir model conditioning to static and dynamic data under uncertainty across multiple geological concepts. We demonstrate a viable solution with Variational Autoencoder based on Graph Convolutions (GVAE), that links the reservoir property distribution with dynamic model response through the latent space (LS) and provide the answers to the following questions:

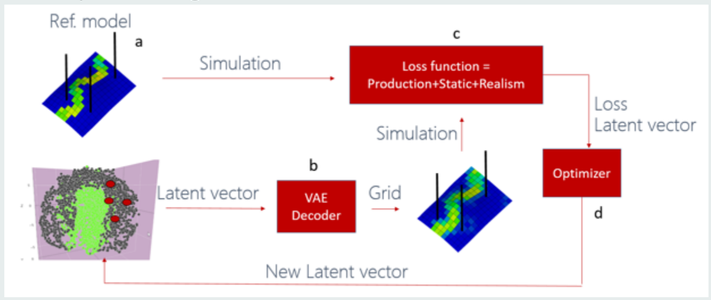
1. Can GVAE reliably reproduce geology?
2. Can GVAE LS depict a variation of geological concepts?
3. Can GVAE provide History Matching through the LS?



Dataset: single/double channel concepts

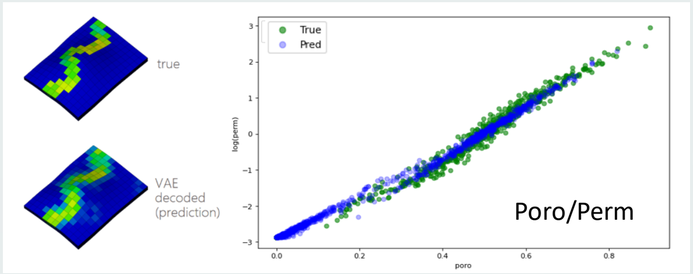


History Matching workflow

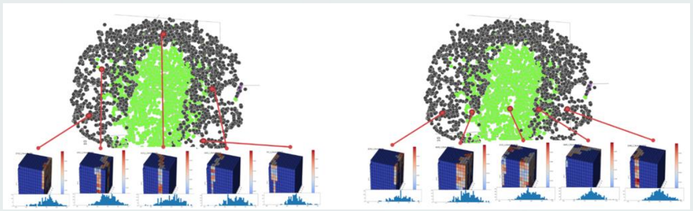


RESULTS

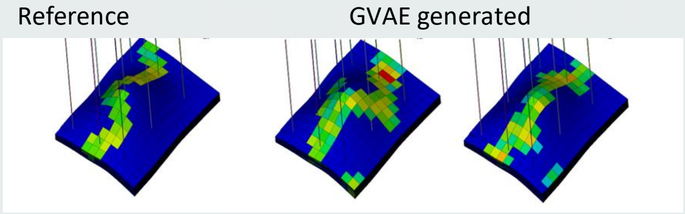
1.

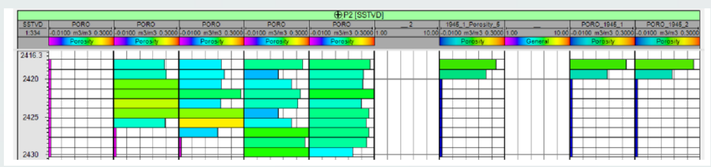


2. Navigation across the Variety of geological concepts in LS



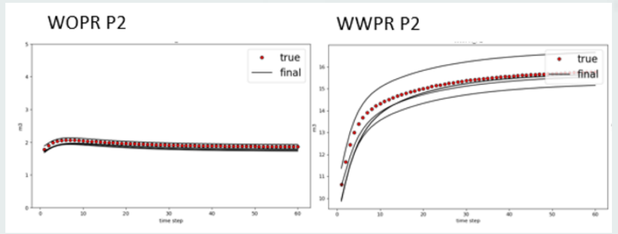
3. Static data conditioning:





RESULTS

4. Dynamic data conditioning:



CONCLUSIONS

GVAE:

1. Provides geologically realistic representation of reservoir property distribution and can handle unstructured data represented as graphs
2. Represents variation of reservoir realization across different geological concepts by links the static model and its dynamic response via the latent space.
3. Conditions property distribution to both static and dynamic data.
4. Enables reservoir model update to match to dynamic data via navigation with optimization through the LS.
5. Provides an ensemble of HM models

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