

Models to demonstrate the importance of geological correlations

An example based on the Walloons-Springbok interval of the Surat Basin

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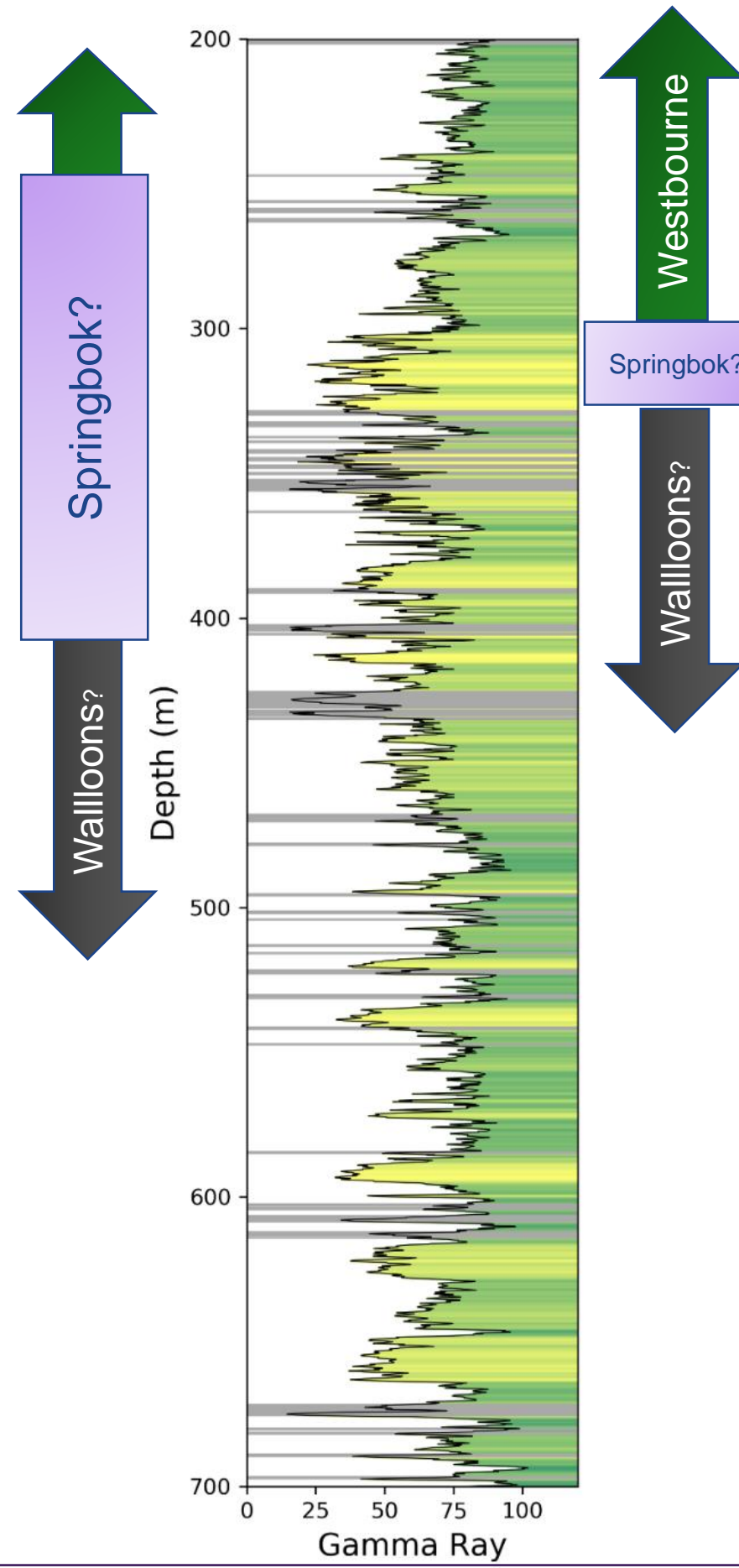
Background

The Walloon Coal Measures and Springbok Sandstone:

- Are extremely lithologically heterogeneous (ironically, they are not mostly coal, or mostly sand).
- Have lithologies that can be hard to identify in wireline logs (coals, low potassium clays).

This makes lithostratigraphy challenging, in particular identifying the boundary between the two.

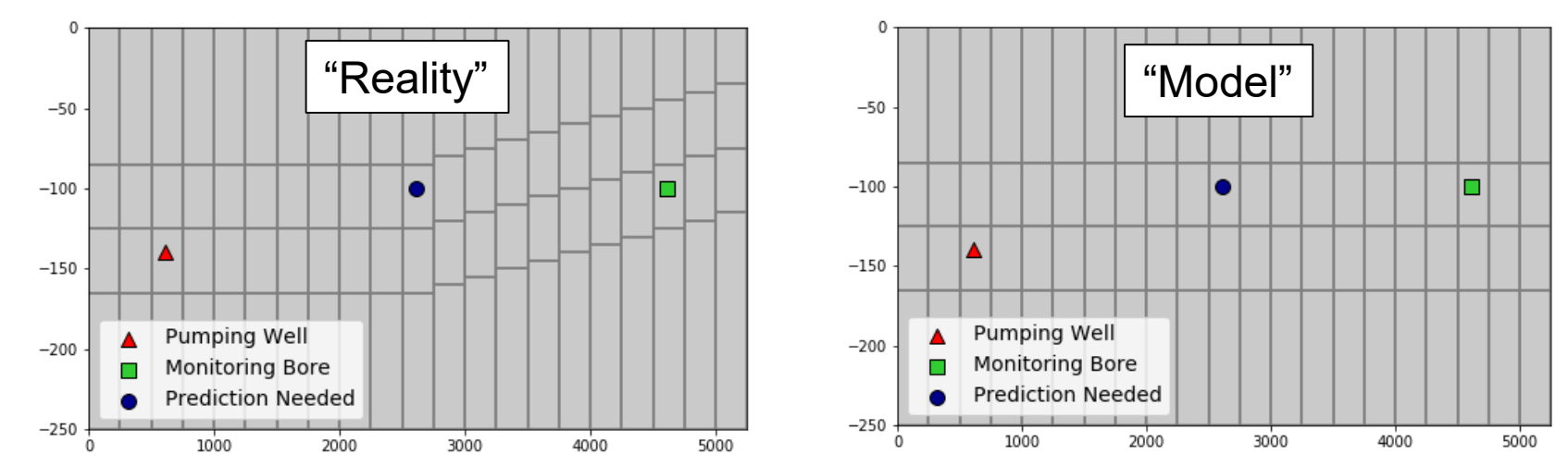
Alternative interpretations and correlations could have several impacts (e.g. on reserves, groundwater concerns). This work demonstrates the potentially important impact on flow models.



The Scenario

In our hypothetical scenario, we wanted to use a model to assess likely drawdown at one well caused by production from another nearby well. Head observations from the producing well and from a nearby monitoring bore were used for inversion (history matching) to “improve” the model.

Two models with alternate layering (i.e. correlations) were set up for MODFLOW. One model (“Reality”) was used to generate observations for inversion (history matching) using the other model.

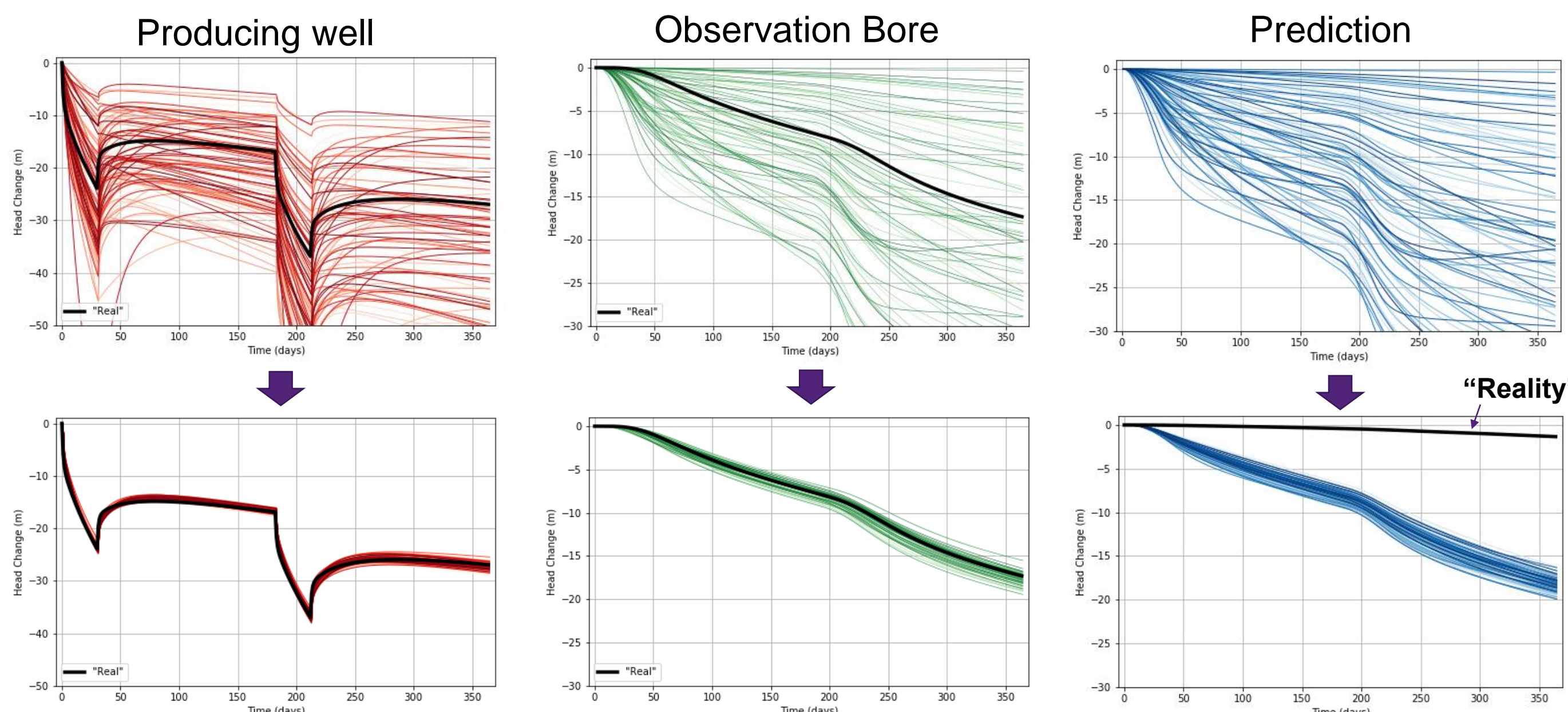


Inversion

- The “Model” (pre-inversion) was homogeneous, parameterised with typical Walloons/Springbok values.
- The inversion algorithm used (IES) creates ensembles of models and alters the parameters to better match the observations, while remaining within parameter bounds shown in the table.

Initial Values			Parameter Min/Max Multipliers Allowed			
Kh (m/day)	Kv (m/day)	Ss (m ⁻¹)	K _{min}	K _{max}	Ss _{min}	Ss _{max}
1.0E-01	1.0E-06	2.0E-06	0.01	100	0.1	10

Very anisotropic (but not unusual for these formations)



Before Inversion

- Model doesn't match observations
- High uncertainty in prediction

After Inversion

- Model matches observations (perhaps giving confidence).
- Low uncertainty in prediction (perhaps giving more confidence).
- **But prediction is now useless!**

Comments

- It is possible to history match one model with observations generated using another model with different structure, providing the parameter bounds are wide enough (as in the Walloons and Springbok).
- While the observations may match, predictions using the history matched model may be very inaccurate, particularly in systems with high anisotropy (again, as in the Walloons and Springbok).
- **A good history match does not necessarily mean a good predictive model if the static model (correlation) is wrong.**

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