

A NEW CO-OPERATIVE INVERSION STRATEGY VIA FUZZY CLUSTERING TECHNIQUE APPLIED TO SEISMIC AND MAGNETOTELLURIC DATA

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**European Geosciences Union
General Assembly 2015
Vienna, Austria, 12 – 17 April 2015**

Introduction

- Inversion of multiple geophysical data can build a better model than individual data does.
- Challenging:
 - scale data
 - define relationship between parameters
- Co-operative inversion of seismic and magnetotellurics (MT) using petrophysical constraint via fuzzy c means (FCM) clustering.
- Our strategy:
 - no need to scale data
 - no need to form a relationship formula

Workflows

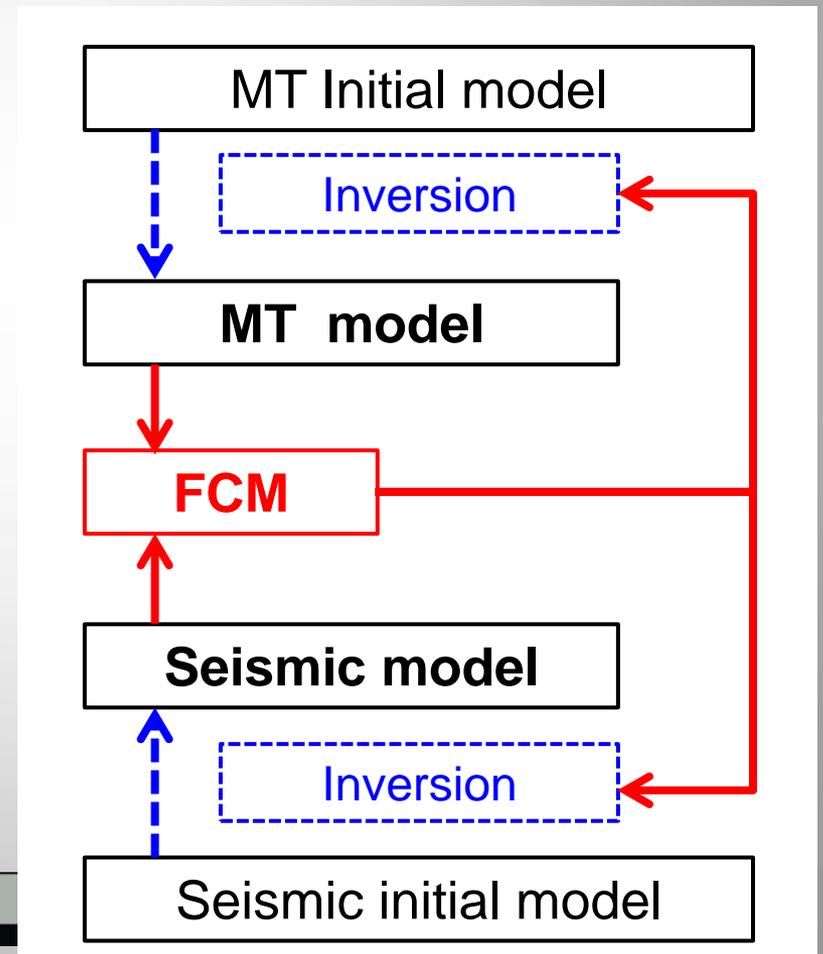
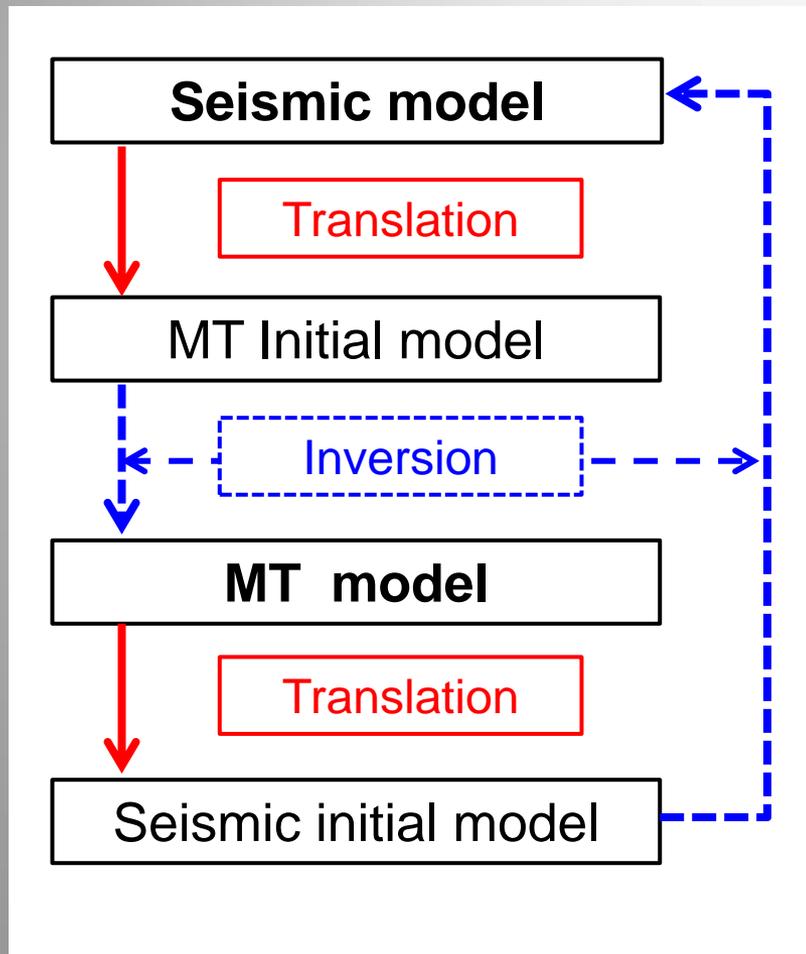
Joint inversion

Co-operative inversion

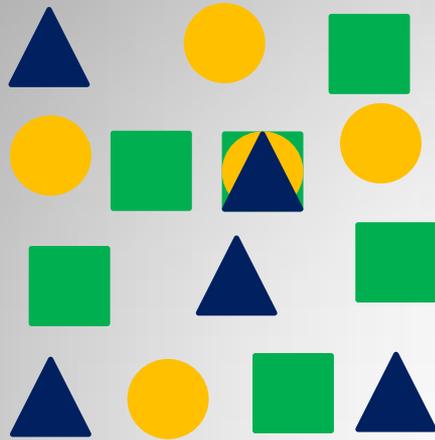
Hybrid workflow

Translation

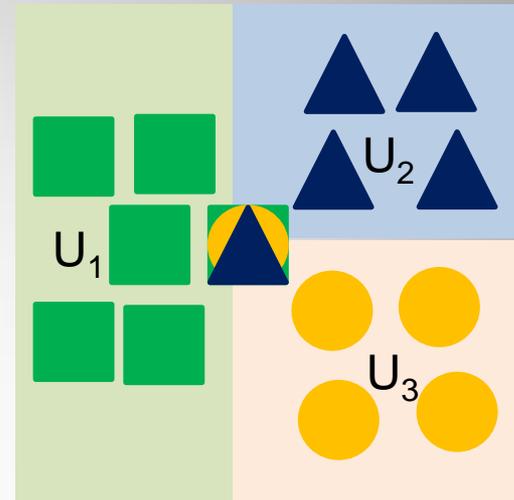
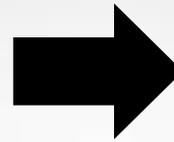
FCM



Fuzzy c-means clustering



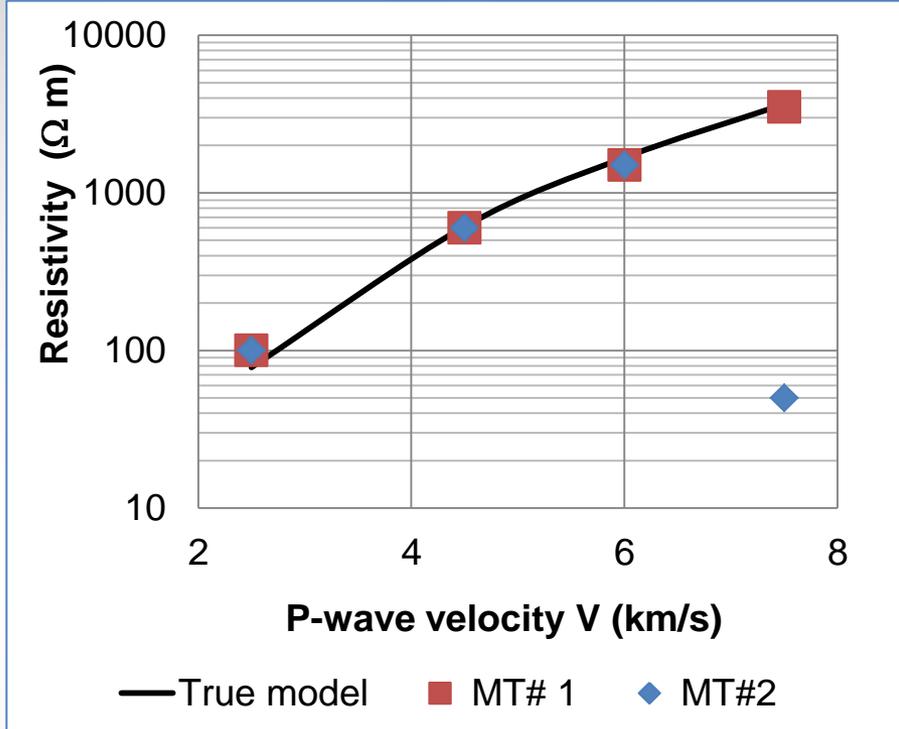
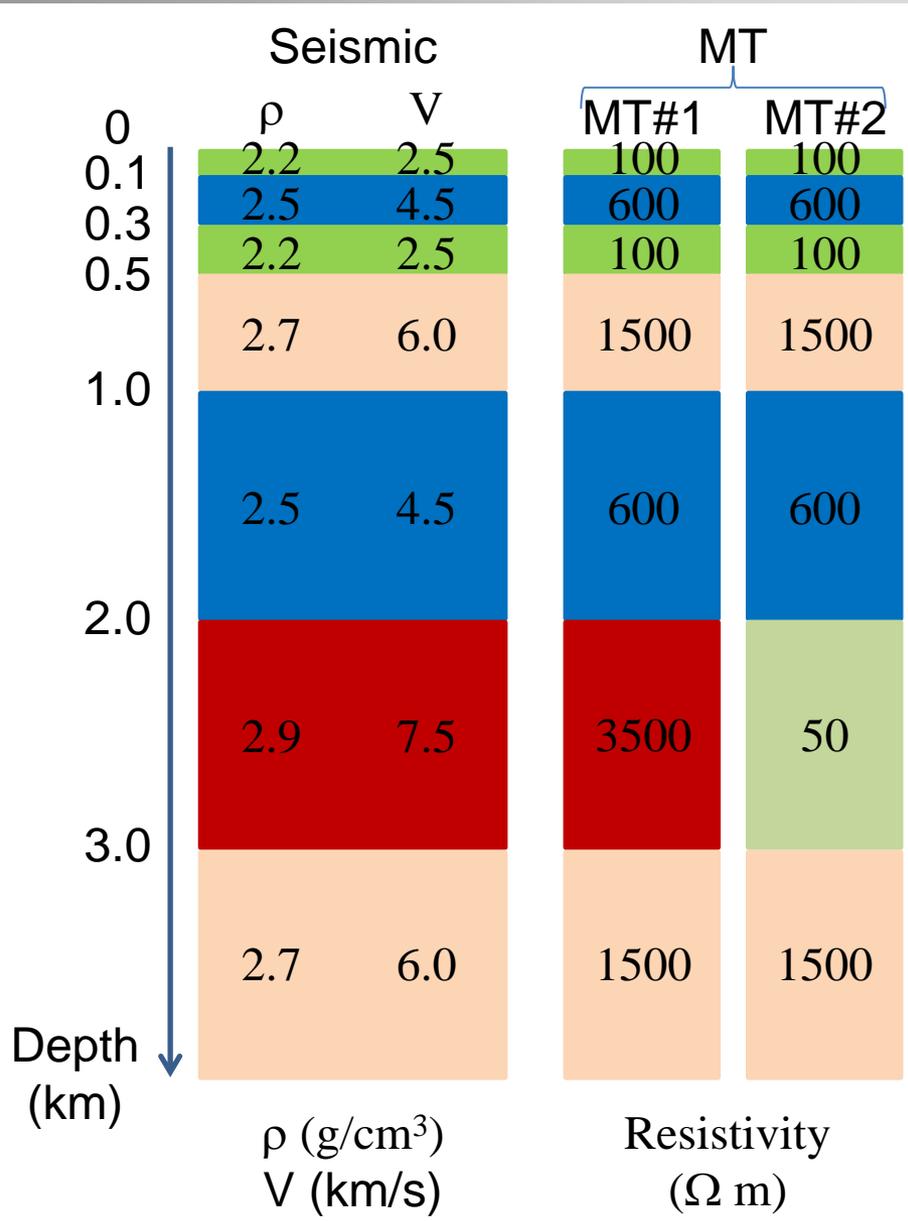
dataset



clusters

- The FCM algorithm is a classification method (Bezdek, et al., 1984)
 - Dividing a dataset into clusters
 - Every element has a membership degree to clusters

Models

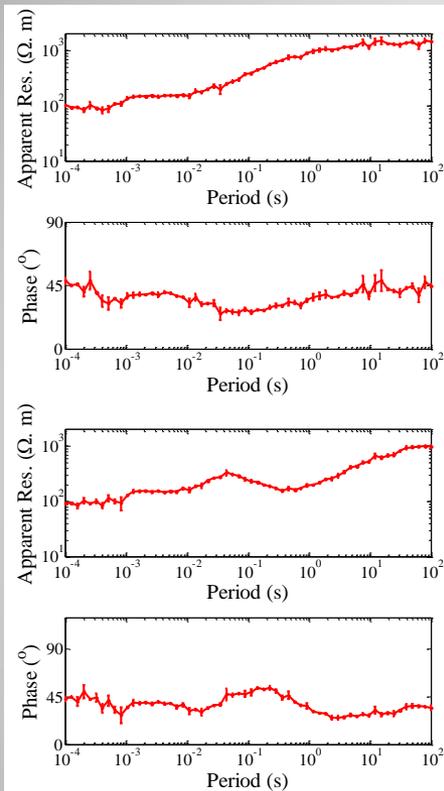


- $V=109 \cdot \rho^4$
- $\text{Log}_{10}(V) \cong 3.5 \cdot \text{Log}_{10}(R) - 10$

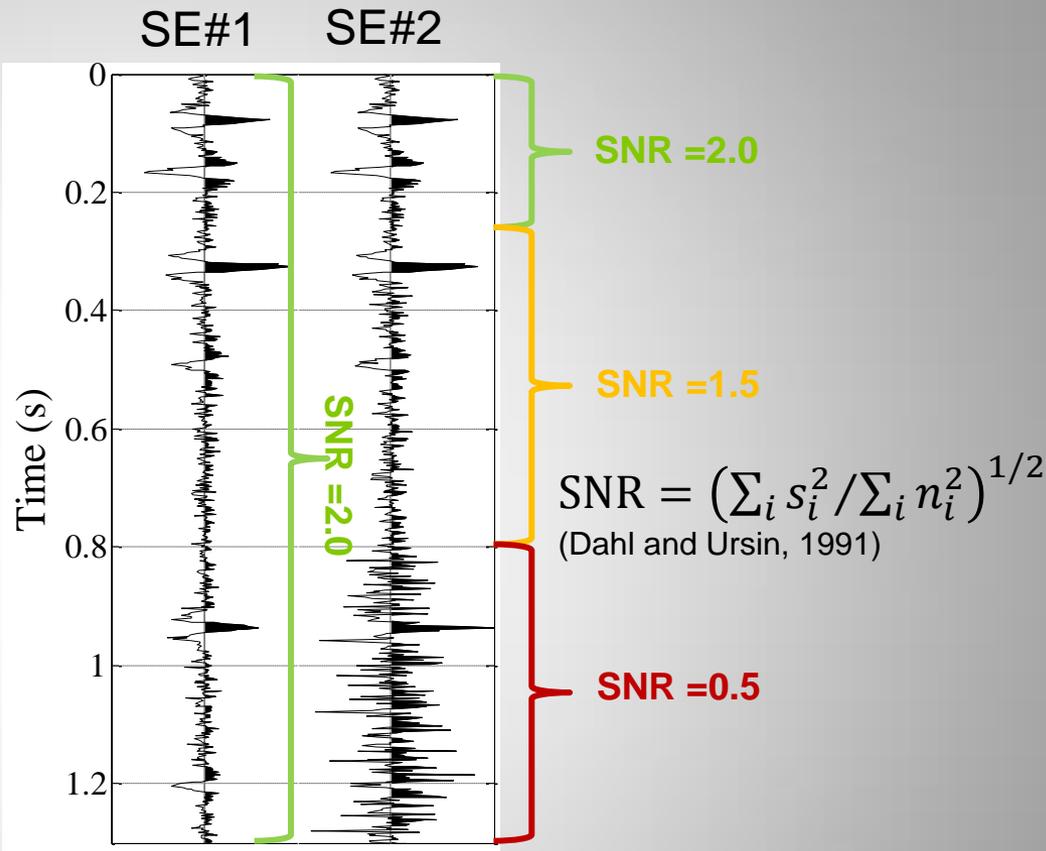
Synthetic data

MT#1

MT with noise level of 5 %, dead band (0.001-0.005 s) 10%.



MT#2



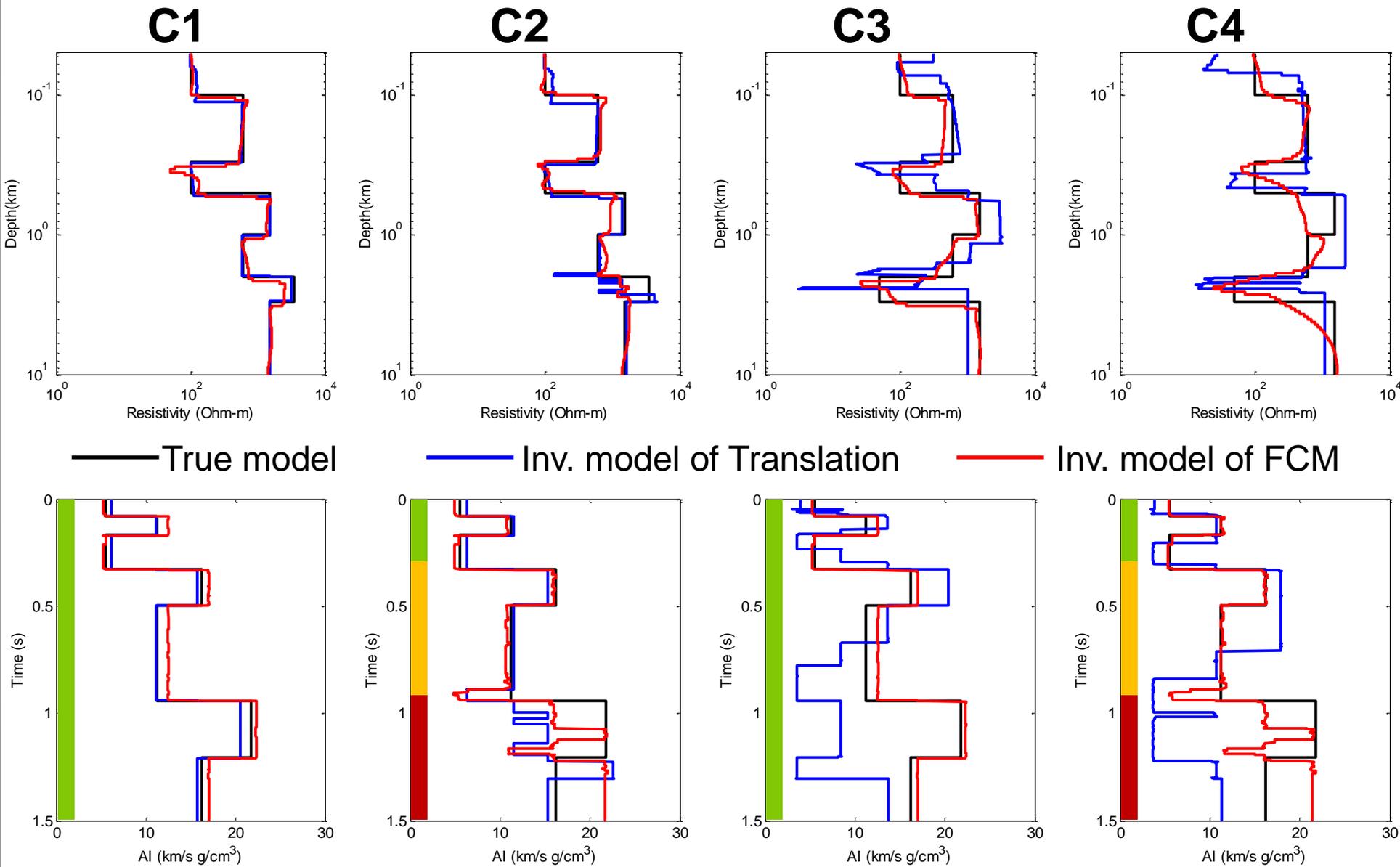
$$SNR = \left(\frac{\sum_i s_i^2}{\sum_i n_i^2} \right)^{1/2}$$

(Dahl and Ursin, 1991)

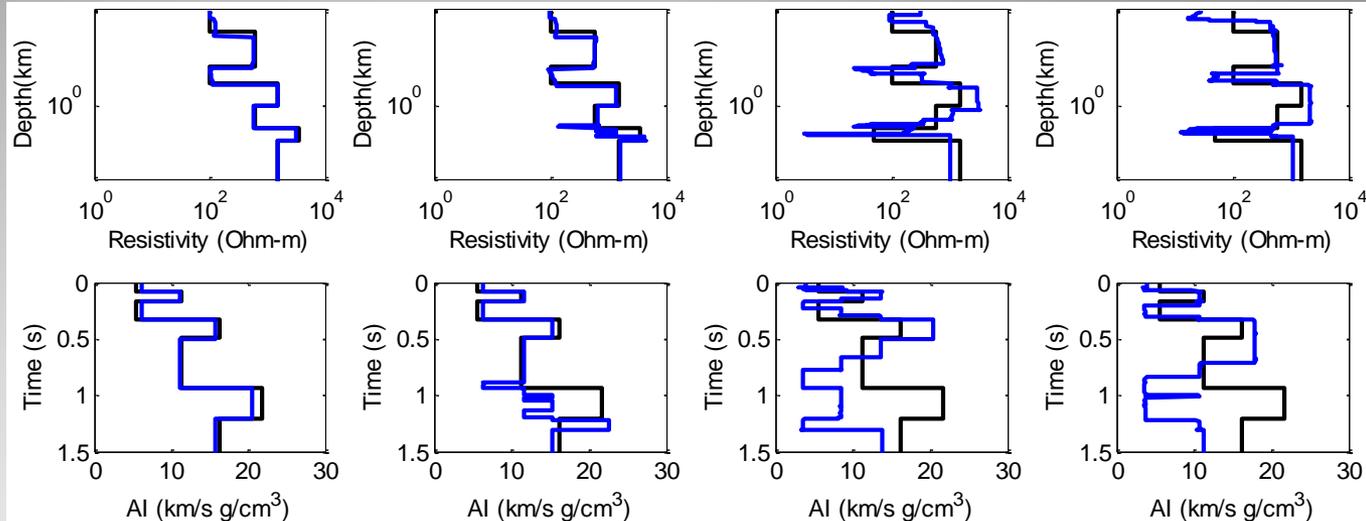
Relationship	Data	Good (SE#1)	Noisy (SE#2)
Good (MT#1)		C1	C2
Bad (MT#2)		C3	C4



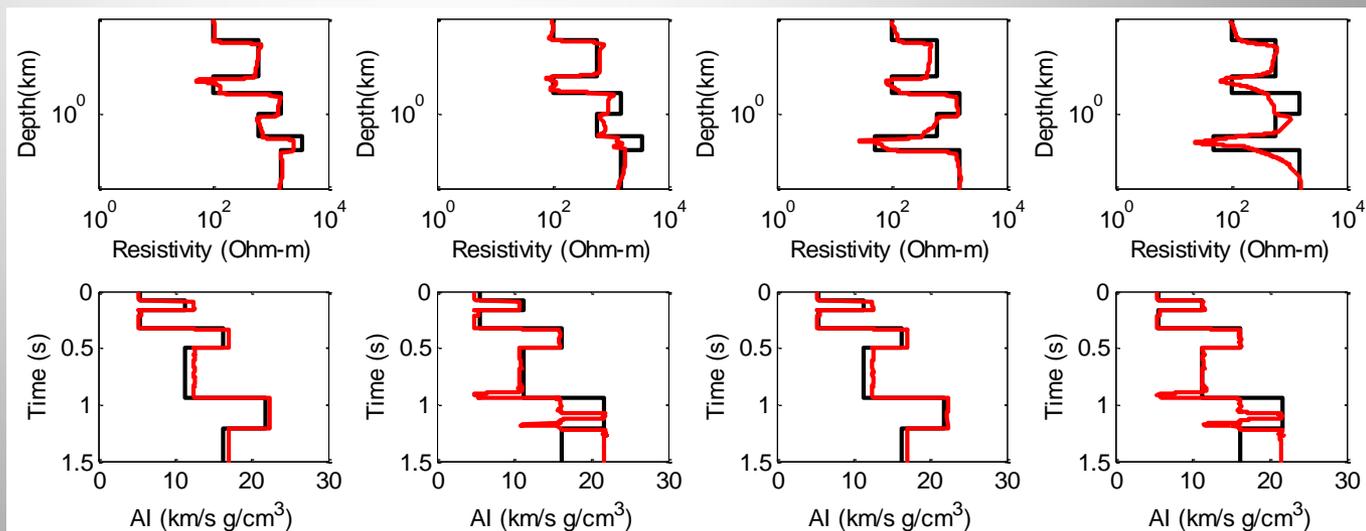
Results



Data \ Relationship	Good	Noisy
	Good	Bad
	C1	C2
	C3	C4



	C1	C2	C3	C4
Translation	Good	Medium	Bad	Bad
FCM	Good	Medium	Good	Medium

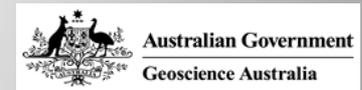


Conclusions

- Translation workflow produces very good results in case of C1. However, in the other cases the results are not as good due to the incorrect exchange of parameters.
- FCM workflow can produce good models *without knowing the relationship between resistivity and velocity*.

Acknowledgements

The work has been supported by the Deep Exploration Technologies Cooperative Research Centre (DET CRC) whose activities are funded by the Australian Government's CRC Programme.



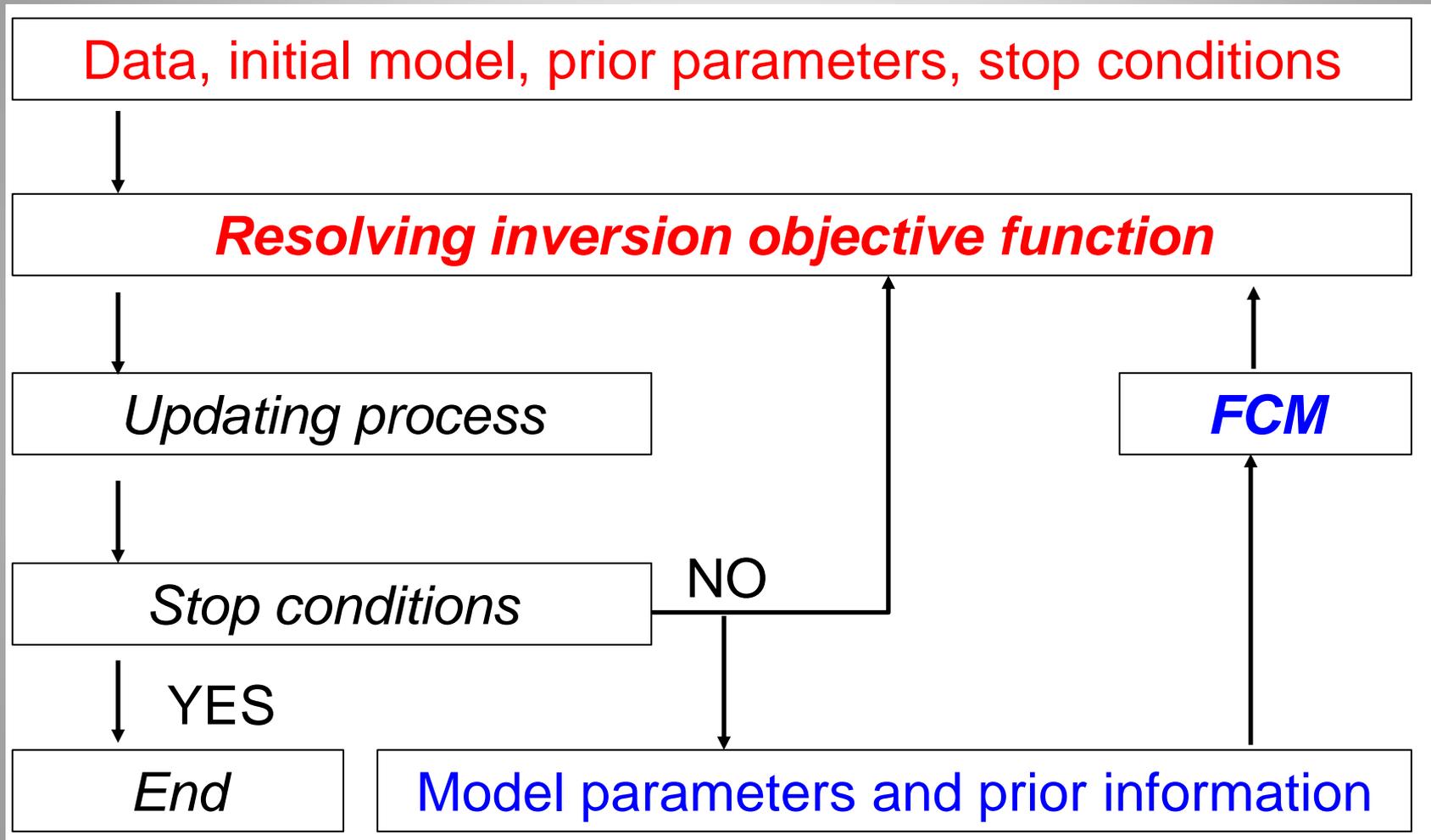


References

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Thank you

Separate inversion



Kieu D. T. and Kestic A. (2015)



ASEG-PESA 2015

Geophysics and Geology together for Discovery

24th International Geophysical Conference and Exhibition
15–18 February 2015 Perth, Western Australia

Seismic Impedance Inversion with Petrophysical Constraints via the Fuzzy Cluster Method

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