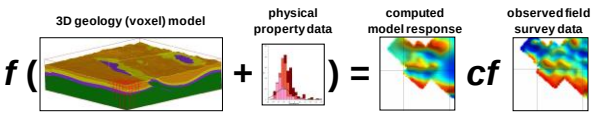
GeoModeller Stochastic Exploration

Trend Matching Issues

GeoModeller Stochastic Exploration

COMPARE Computed vs. Observed?

- I want to compare a 'computed' solution to 'observed' data
- There will be differences …
  - Because there is 'error' or 'uncertainty' on both sides of this equation. Which side is more certain … more reliable?
  - And there are 'regional trends' in the observed field data



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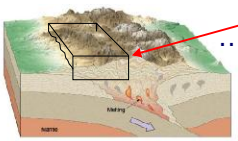
Regional Trends … from Regional Geology

We compare …

- measured gravity from the *real* world
- and computed gravity from a *model*



… so some adjustments …

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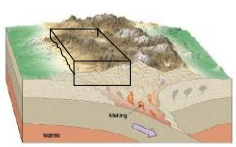
Gravity Data Preparation: Regional?



Since regional geology is not in the model …
… then regional gravity trends should be removed from the measured data

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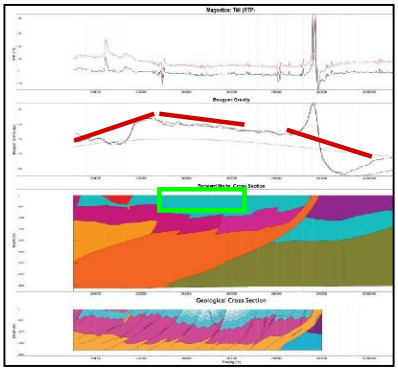
Regional Trend in Gravity/Magnetics

FIELD gravity and magnetics are measured over the whole Earth – and these observed data will always include a component of response derived from geology that lies outside the 3D model

COMPUTED gravity and magnetics is the predicted response of that portion of Earth geology that is included in the 3D geology model



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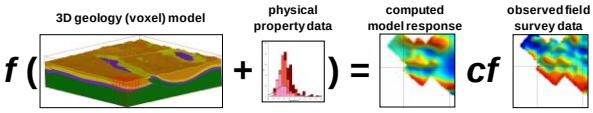
Equation: f(Geometry + Props.) = Obs.

- Which side of this equation is most reliable?
- There is uncertainty in our 'geometry', and often poor knowledge of 'properties' … so that is quite 'uncertain' …
- Whereas on the other side, a geophysical contractor or instrument manufacturer will say "My system is accurate to 0.001nT" … so that appears to be highly accurate and reliable?
- And … in any case … surely 'observed' data is 'observed', unchangeable fact?



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From a different viewpoint, however, …

- From another viewpoint …
  - Computed solutions will be identical … regardless of which software package I use! (… well … nearly identical!)
  - Field data will be highly variable if I get data from a dozen different data sources!

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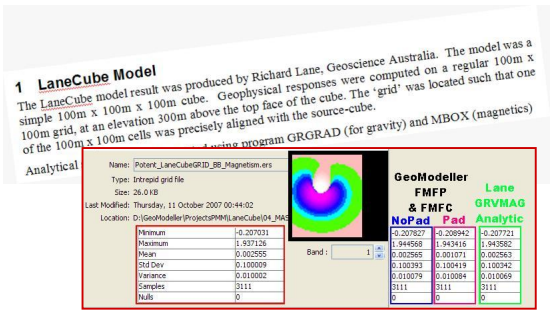
LaneCube Model – Expect Same Results



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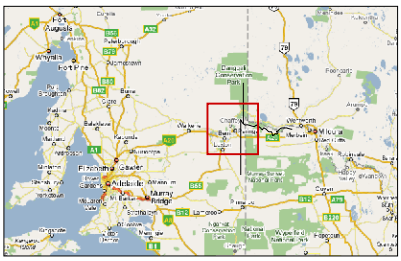
Get data from 10 sources … Same?



Get 'observed' data from SA, Vic, NSW, GA, BIG Oil Inc., Fly-by-Night Uranium Inc. …

… same? … or perhaps very very different?

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Source of Differences? … Processing

Surely if I repeated a survey – to identical specs. … and used state-of-the-art error-free processing … I'd get the same result? Yes … sort-of …

- In reality … there are many minor variations in acquisition and processing which will cause *minor* differences …
- And then … I can get *huge* differences …
  - one processor will remove the IGRF …
  - another will (identically) remove IGRF and 'add back' the average amount
  - and yet another will remove IGRF and add back 55000nT (… because that's what he always does)

How can I make a comparison to highly variable 'observed' data?

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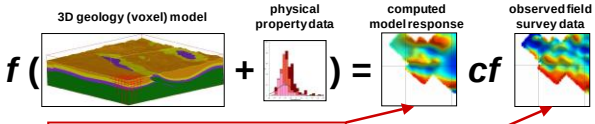
Differences? … we adjust the 'Observed'!



Identical 'computed' solutions

Variable 'observed' data

- There *are* systematic differences between the computed and the observed – due to 'regional' trends (in geology) and 'processing differences' in the 'observed' … and we must remove these 'differences' before we can do a meaningful comparison of 'computed' vs. observed
- Which do we 'adjust'? We apply our 'adjustment' to the observed!

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Trend Matching

- We do not 'de-trend' a dataset. Rather we do a process called 'trend-matching'
- In setting up a Case we can choose to …
  - Trend-match … or not
  - Specify the polynomial 'order': 0(=DC), 1, 2
  - Specify the frequency … from once only through to 'at every iteration'

```
rem MatchTrend: 0=NO detrend; 1=detrend; remove regional differences between the measured and computed grids
set MatchTrend=1

rem MatchTrendDegree: degree of detrending; 0=DC-shift, 1=planar gradient detrend, 2 is curved. RECOMMEND 1 (or 0
set MatchTrendDegree=1

rem MatchTrendRepetitionRate: 0=detrend ONCE ONLY; 'n'=detrend every 'n'th iteration. RECOMMEND 1
set MatchTrendRepetitionRate=1
```

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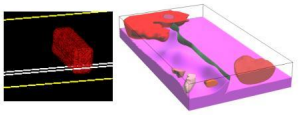
What is Trend Matching?

- For the specified polynomial order we determine the trend of the computed ('t_c') and the trend of the observed ('t_o')
- Compute the difference : $t_{diff} = t_c - t_o$
- ADD this difference to the 'observed'
- So …
  - We are 'adjusting' observed data – removing from the observed that portion of 'observation' that is due to the vagaries of how the data were processed, and removing also that portion (of field-measured 'signal') which is due to 'geology-outside-the-model'.
  - Then … we can compare our computed result to this *trend-adjusted-observed* dataset
  - And, in fact, compute a RMS difference to provide a single measure of misfit between computed and observed

The supplied Geology and Geophysical data (and direct 'copies' of those data in alternative formats) …

GeoModeller Project Files …
Case_PERFPROP_Field5.xml
Case_PERFPROP_Field5_s500mN.sec
Case_PERFPROP_Field5_s500mN_.1.s3d
Case_PERFPROP_Field5_s575mE.sec
Case_PERFPROP_Field5_s575mE_.1.s3d
Case_PERFPROP_Field5_TopoMap.sec
Case_PERFPROP_Field5_TopoMap_.1.s3d

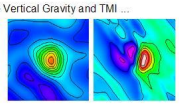


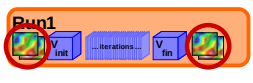
RECALL … the files of a Case …

Here … the original 'observed' geophysical data grids

Case_PERFPROP_Field5.vox

The 'observed' geophysical field data … in this case Vertical Gravity and TMI …
Slab_FieldData_v5_Gravity_Gauss_Trend
Slab_FieldData_v5_Gravity_Gauss_Trend.ers
Slab_FieldData_v5_Gravity_Gauss_Trend.isi
Slab_FieldData_v5_TMI_Gauss_Trend
Slab_FieldData_v5_TMI_Gauss_Trend.ers
Slab_FieldData_v5_TMI_Gauss_Trend.isi





Various geophysical grids for THIS RUN …
There are grids for …
- EACH geophysical data-type
- INITIAL and FINAL cases
- CALCULATED and OBSERVED(Trend-Matched)

Case_PERFPROP_Field5_Run_1_ObservedGridIndex_1_Gravimetry_calculated_final
Case_PERFPROP_Field5_Run_1_ObservedGridIndex_1_Gravimetry_calculated_final.ers
Case_PERFPROP_Field5_Run_1_ObservedGridIndex_1_Gravimetry_calculated_final.isi
Case_PERFPROP_Field5_Run_1_ObservedGridIndex_1_Gravimetry_calculated_initial
Case_PERFPROP_Field5_Run_1_ObservedGridIndex_1_Gravimetry_calculated_initial.ers
Case_PERFPROP_Field5_Run_1_ObservedGridIndex_1_Gravimetry_calculated_initial.isi
Case_PERFPROP_Field5_Run_1_ObservedGridIndex_1_Gravimetry_observed_trendmatched_final
Case_PERFPROP_Field5_Run_1_ObservedGridIndex_1_Gravimetry_observed_trendmatched_final.ers
Case_PERFPROP_Field5_Run_1_ObservedGridIndex_1_Gravimetry_observed_trendmatched_final.isi
Case_PERFPROP_Field5_Run_1_ObservedGridIndex_1_Gravimetry_observed_trendmatched_initial
Case_PERFPROP_Field5_Run_1_ObservedGridIndex_1_Gravimetry_observed_trendmatched_initial.ers
Case_PERFPROP_Field5_Run_1_ObservedGridIndex_1_Gravimetry_observed_trendmatched_initial.isi
Case_PERFPROP_Field5_Run_1_ObservedGridIndex_2_Magnetism_calculated_final
Case_PERFPROP_Field5_Run_1_ObservedGridIndex_2_Magnetism_calculated_final.ers
Case_PERFPROP_Field5_Run_1_ObservedGridIndex_2_Magnetism_calculated_final.isi
Case_PERFPROP_Field5_Run_1_ObservedGridIndex_2_Magnetism_calculated_initial
Case_PERFPROP_Field5_Run_1_ObservedGridIndex_2_Magnetism_calculated_initial.ers
Case_PERFPROP_Field5_Run_1_ObservedGridIndex_2_Magnetism_calculated_initial.isi
Case_PERFPROP_Field5_Run_1_ObservedGridIndex_2_Magnetism_observed_trendmatched_final
Case_PERFPROP_Field5_Run_1_ObservedGridIndex_2_Magnetism_observed_trendmatched_final.ers
Case_PERFPROP_Field5_Run_1_ObservedGridIndex_2_Magnetism_observed_trendmatched_final.isi
Case_PERFPROP_Field5_Run_1_ObservedGridIndex_2_Magnetism_observed_trendmatched_initial
Case_PERFPROP_Field5_Run_1_ObservedGridIndex_2_Magnetism_observed_trendmatched_initial.ers
Case_PERFPROP_Field5_Run_1_ObservedGridIndex_2_Magnetism_observed_trendmatched_initial.isi

And here … grids that are 'observed_trendmatched