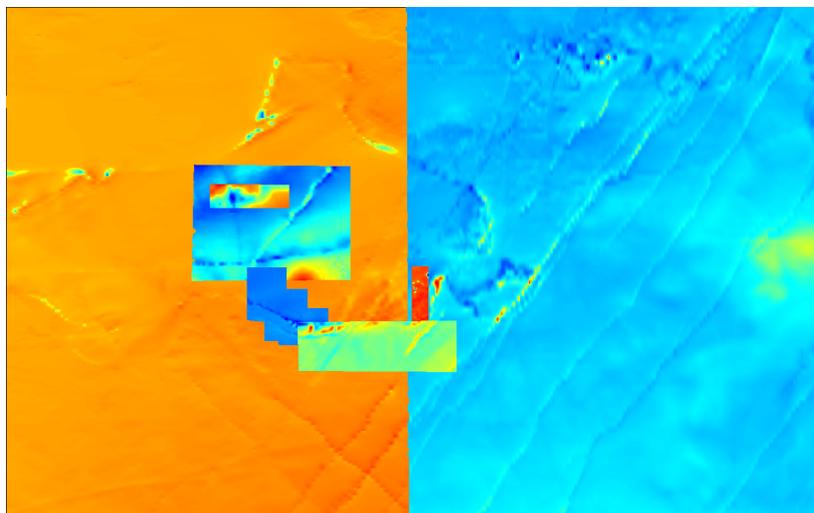


# Grid merging (G08)

You may sometimes wish to combine geographically adjacent or overlapping grid datasets. The INTREPID Gridmerge is a powerful tool which enables you to quickly merge many grids at once. Gridmerge moves away from the traditional approach of 'stitching' pairs of grid files together and, instead, treats the requirement that grids match together in the best possible way as a single inverse problem.

This guided tour conducts you through a simple grid merging operation. We cover the basic DC Shift, Surface Adjust and FeatherMerge operations.

The following image shows a mosaic of several grids with differing cell sizes, overlap zones, and base levels. The data is West ArnhemLand **magnetics** grid data. The data custodians are the Northern Territory Geological Survey, Darwin, Australia. (This data is not confidential). In this guided tour we merge these grids together to produce a single seamless merged grid.



## Overview



The INTREPID Gridmerge tool can:

- Combine hundreds of geographically adjacent or overlapping grid datasets. GSWA (Western Australia, regular use 2500+ grids in one operation).
- Achieve in hours what used to take weeks
- Support adjacent, overlaid, and irregular shaped grid joins
- Support different grid cell sizes
- Feather and merge grid edges to create seamless joins
- Minimise long wavelength errors in regional compilations of airborne magnetic data
- Incorporate new surveys without re-levelling the entire grid database
- Work over the network, to access many CPU's, to enhance productivity.
- At v5.0, we are also starting to support vector and tensor grids in this process.

## Context of this guided tour

In the context of your data processing cycle, this tour represents a process of data compilation that you may need to perform on a group of geographically overlapping grids that have been processed to completion.

### Location of sample data for Guided Tours

We provide two complete sets of sample datasets, one in INTREPID format and one in *Geosoft* format. INTREPID works equally well with both formats. When you want to open a dataset, navigate to the directory containing the required data format.

Where *install\_path* is the path of your INTREPID installation, the project directories for the *Guided Tours* sample data are

*install\_path*\sample\_data\guided\_tours\intrepid\_datasets and  
*install\_path*\sample\_data\guided\_tours\geosoft\_datasets.

For example, if INTREPID is installed in

**C:\Program Files\Intrepid\Intrepid4.5.nnn,**

then you can find the INTREPID format sample data at

**C:\Program Files\Intrepid\Intrepid4.5.nnn\sample\_data\  
guided\_tours\intrepid\_datasets**

This is the default location for the sample data. If you have installed INTREPID normally, the data resides there. If you have installed INTREPID elsewhere, the exercises will work just as well. Just use the appropriate pathnames.

For more information about installing the sample data, see "[Sample datasets—installing, locating, naming](#)" in [INTREPID Guided Tours Introduction \(G01\)](#)

For a more detailed description of INTREPID datasets, see [Introduction to the INTREPID database \(G20\)](#). For even more detail, see [INTREPID database, file and data structures \(R05\)](#).

### Location of sample data for CookBooks

Right next to the Guided tours data, is a rich set of more exotic geophysics datasets and grids, already prepared for the cookbook training sessions. A casual user might also gain some trial and error insights into the capabilities of the software, just by testing the Project Manger's ability to preview and describe the attributes of each of the cookbook datasets.

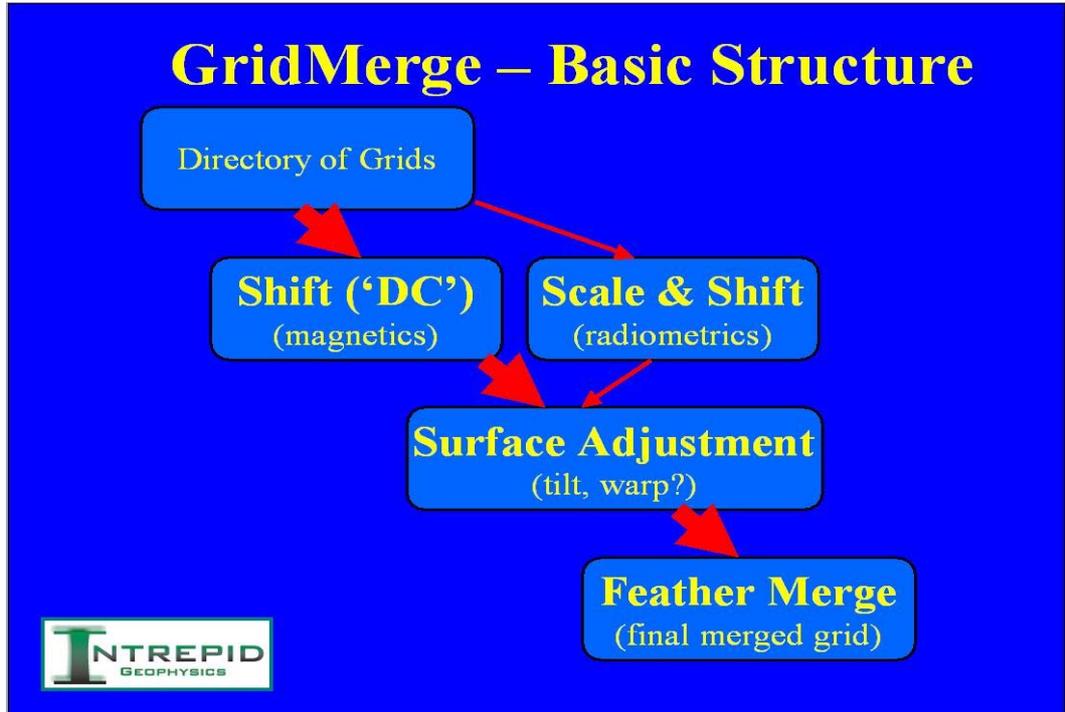
## Should you complete this guided tour?



This guided tour is intended for introductory level users. It contains full detailed instructions. If you are not currently interested in this process you can omit this guided tour without affecting your understanding of other processes. If you need to perform grid merging with your data we recommend that you complete this demonstration of the INTREPID Gridmerge tool.

## What you will do

### Flowchart Summary



The flowchart summary (above) illustrates how Gridmerge works. Gridmerge starts with a directory of grids. This means that you put all the grids that you want merged into a single directory. We have created a directory called **Raw**, which contains all of the grids we want to merge. This is the starting position, and all other intermediate directories, you have to create as necessary.

Each Gridmerge process creates a new directory and writes a new set of adjusted grids into the directory. The final FeatherMerge process create the final merged grid.

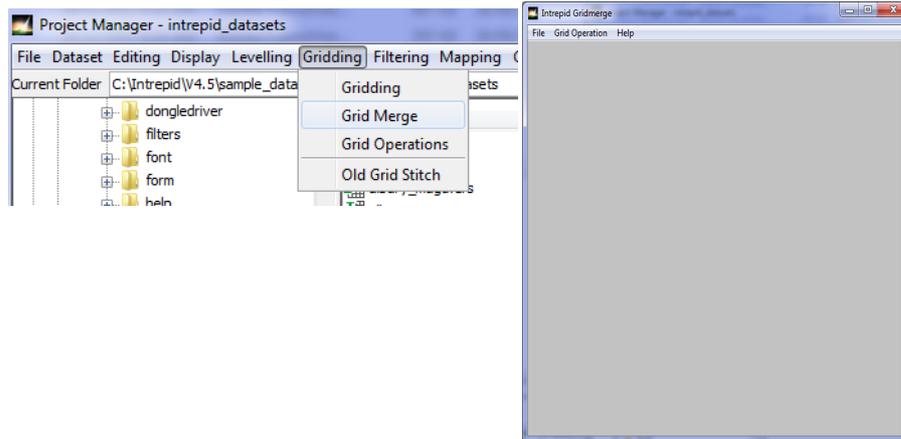
## Steps to follow

- 1 *Launch the Gridmerge tool.*

Start the Project Manager. Navigate to the directory `install_path\sample_data\guided_tours\intrepid_datasets\Gridmerge`.

See [Locating datasets, viewing, statistics, launching tools \(G02\)](#) for instructions about navigating to different directories.

From the **Grid** menu choose **Grid Merge**. INTREPID displays the **Gridmerge Main** window.

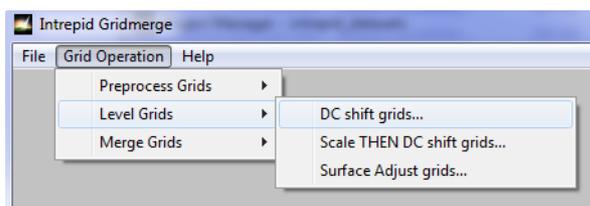


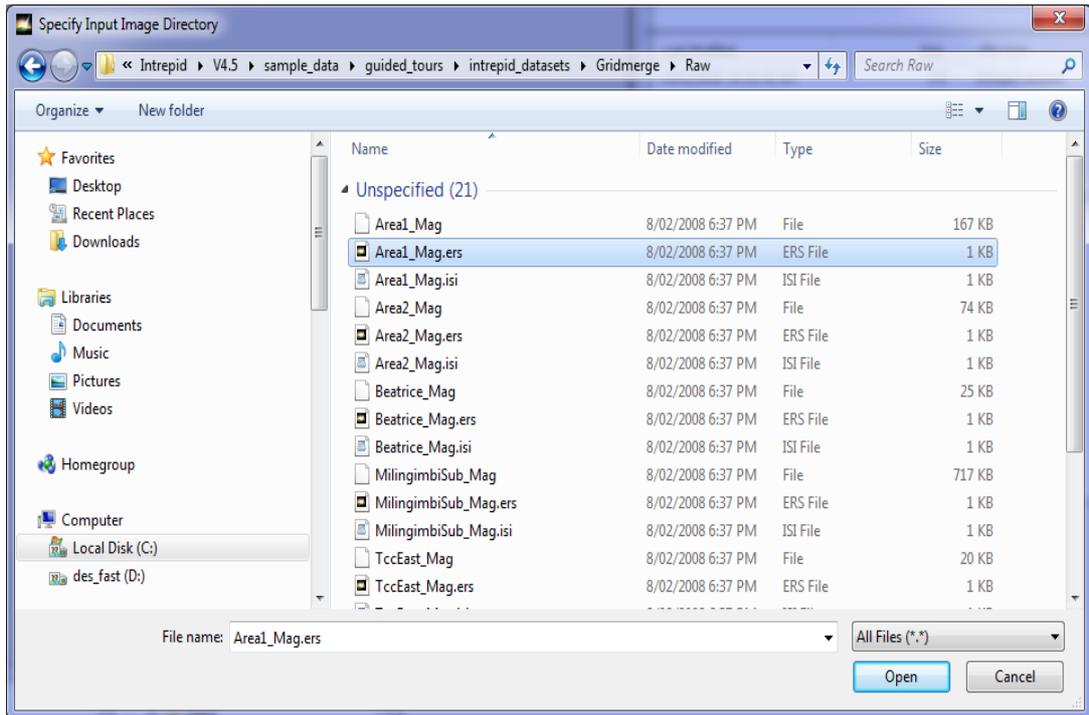
- 2 *Select the input grids and perform a DC shift operation.*

This first exercise uses the 'raw' grid files (in the **Raw** directory) and writes DC shifted output files into a new directory **DC**.

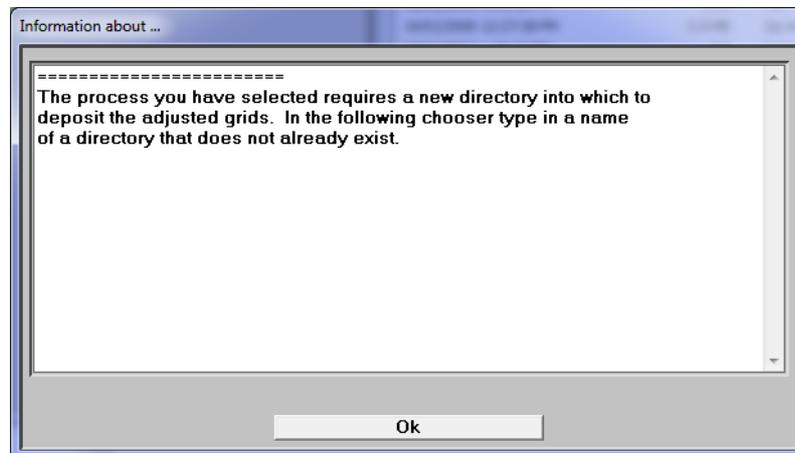
**Note:** **Raw** in this context simply means unprocessed by Gridmerge.

From the **Grid Operation** menu choose **Level Grids**, then **DC shift grids**. INTREPID displays the **Specify Input Image Directory** dialog box. Select the directory called **Raw**, choose **Open**, and then select **any** file in that directory.

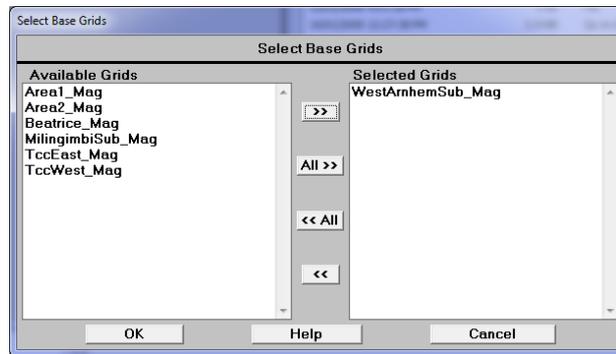




Choose **Open**. INTREPID displays the **Information about** dialog box. Read the information about creating a directory for the output DC shifted files and choose **OK**.



Specify the output directory name **DC**. The tool will create this directory for you, if it does not exist yet. Do not try to reuse the RAW directory, as this should just contain the starting grids. You can always re-start again if you want too. Choose **Open**. INTREPID displays the **Select Base Grids** dialog box.



In **Select Base Grids**, select **WestArnhemSub\_Mag** and move into **Selected Grids**. Choose **OK**. This is your Base grid, to which INTREPID adjusts all other grids. This may well be your best effort previously at creating a regional grid of all these surveys.

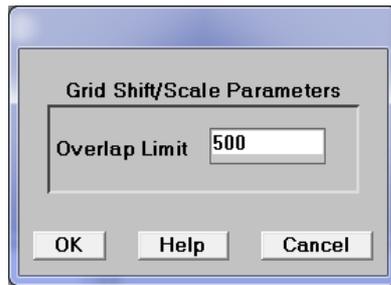
The **High Rank Grid List** dialog box appears.

In the **High Rank Grid List** dialog box, move **Beatrice\_Mag** into **High Ranked Grids** and choose **OK**. This is your High Ranked grid, which overlies all the other grids in the final merged grid. What this actually means is that its high frequency data at the edges will not be compromised. Typically, you select your highest resolution grid for this.



The **Low Rank Grid List** dialog box appears. Move **MilingimbiSub\_Mag** into the list of **Low Ranked Grids** and choose **OK**. This is your Low Ranked grid. All of the other grids in the final merged grid overlie it. Typically, select your lowest resolution, oldest survey data grid for this. The frequencies we see in any adjoining Higher ranked grid may bleed into this low rank grid, as the tool attempts to make joins that are “fractal” without any hard lines visible.

INTREPID displays the **Grid Shift/Scale Parameters** dialog box. Set **Overlap Limit** to 500 (default) and choose **OK**. This is the minimum number of grid cells in an overlap between 2 grids required for statistical significance. Ignore the overlap if less cells.



**Do you want to proceed with the DC Shift?** Choose **Yes**.

**Optional:** If you know how to launch a command.exe window, you can examine the logfile to monitor progress. (Use the command `tail -f nt.username.log`)

The DC Shift operation is fast, and takes about half a minute or less for this small test dataset.

**GridMerge Processing Completed**—Choose **OK**.

Review the **gridMerge.rpt** file which pops up in your preferred text editor (or *Notepad*). Scroll down to the **bottom** of the report and read the **Final grid adjustment summaries**. This shows you exactly what adjustments were made to each grid during the DC Shift process. Note that the Base grid is unchanged by the process.

```
Final overlap summaries
Total number of overlaps 11

  scale      shift  mean2-mean1  gridname1/gridname2
  1.000  44578.039    -0.95  Beatrice_Mag
  1.000  44578.039     0.95  Beatrice_Mag
  1.000  44576.738     2.46  Tccwest_Mag
  1.000  44576.738    -3.36  Tccwest_Mag
  1.000  44576.738     0.90  Tccwest_Mag
  1.000  44574.395    -2.64  TccEast_Mag
  1.000  44574.395     2.64  TccEast_Mag
  1.000  46574.898     1.51  Area1_Mag
  1.000  46576.359    -1.49  Area2_Mag
  1.000  46576.359    -1.86  Area2_Mag
  1.000   -0.000    -0.78  MilingimbiSub_Mag

Final grid adjustment summaries

  shift      Scale  BeforeMean  AfterMean  diff  Status  Grid Name
44578.04  1.000    1990.84    46568.88  44578.04  BEAT  Beatrice_Mag
44576.74  1.000    2031.94    46608.68  44576.74  TCCW  Tccwest_Mag
44574.39  1.000    2055.74    46630.14  44574.39  TCCW  TccEast_Mag
46574.90  1.000         5.41    46580.31  46574.90  AREA  Area1_Mag
46576.36  1.000        51.06    46627.42  46576.36  AREA  Area2_Mag
-0.00    1.000   46591.89    46591.89   -0.00  BASE  WestArnhemSub_Mag
44762.38  1.000    1876.07    46638.46  44762.38  MILI  MilingimbiSub_Mag

*****
End processing - 10/12/2012 16:26:46
*****
```

In the above, there are 11 pairs of grids involved in the merge. Each pair is listed in turn, with the DC adjustment of reater than 44000 nT being applied to most of the pairs. This is the IGRF being removed in the DC sense. After this has happened, the remianing average mis-fit for the overlap portion is reported, typically around 1 or 2 nT ( mean2 - mean1). The report then ends with a Final summary for each grid’s adjustment. There is no adjustment done to the Base grid, as this is the nominated one to preserve.

**Important Tip:** Make a habit of reviewing the report file. If a particular grid is not merging well with its neighbours, the report file may help you understand why.

When you are finished reviewing the report, exit from *Notepad*. (Choose **File > Exit**.)

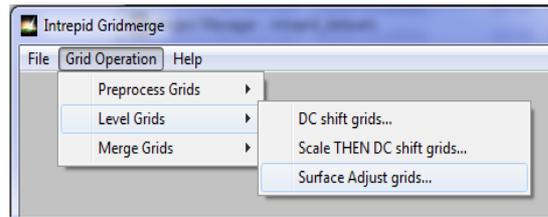
Move to the next exercise (Surface Adjustment)

**3** *Select the input grids and perform a Surface Adjustment operation.*

This second exercise carries on from step 2 above, where optimised DC shifts were applied. This tutorial takes input from the directory of DC results, and writes Surface-Adjusted files into a new directory **SA**.

From the **Grid Operation** menu choose **Level Grids**, then **Surface Adjust grids**. INTREPID displays the **Specify Input Image Directory** dialog box. Select the directory called **DC**, choose **Open**, and then select **any** filename in that directory.

This indicates you want to use this collection of grids for this part of the process.



Choose **Open**. INTREPID displays the **Information about** dialog box. Read the information about creating a directory for the output Surface Adjusted files and choose **OK**.

Specify the output directory name **SA**. Choose **Open**.

If you are new to this tool, you may get confused about the requirement to either choose data within a current directory, or to create a new directory to receive data as a result of running a process with this tool. So, to clarify what is required here, you should have chosen the DC directory, created as a result of the shiftDC process, and now specify a SA directory, ready to receive new output grids. Once this is set up, the workflow is similar to what was explained previously. The previous answers to the grids chosen for ranking of grids is remembered.

INTREPID displays the **Select Base Grids** dialog box.

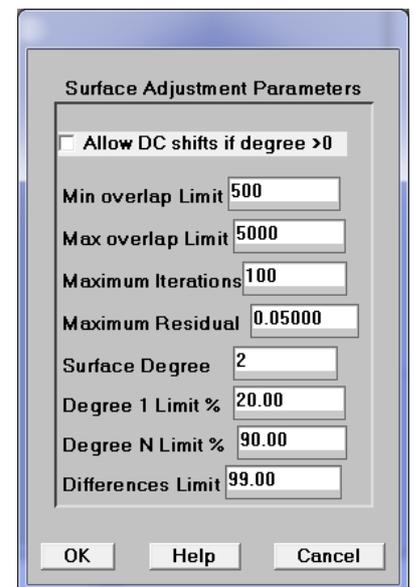
In **Select Base Grids**, accept **WestArnhemSub\_Mag** in the list of **Selected Grids** and choose **OK**.

In the **High Rank Grid List** dialog box, accept **Beatrice\_Mag** in the list of **High Ranked Grids** and choose **OK**.

In the **Low Rank Grid List** dialog box, accept **MilingimbiSub\_Mag** in the list of **Low Ranked Grids** and choose **OK**.

INTREPID displays the **Surface Adjustment Parameters** dialog box. Set the following parameter values:

- Allow DC shifts** - No, do not check the box.
- Min overlap Limit** 500 (default)
- Max overlap Limit** 5000 (default)
- Maximum Iterations** 100 (default)
- Maximum Residual** 0.05 (default)
- Surface Degree** 1 <<< SET THIS to 1
- Degree 1 Limit %** 20 (default)
- Degree N Limit %** 90 (default)
- Difference Limit** 99 (default)



When you have finished adjusting the parameters choose **OK**.

**Do you want to proceed with the Surface Adjust?**  
Choose **Yes**.

**Optional:** 'Tail' the logfile to monitor progress  
(Use the command `tail -f nt.username.log`)

The Surface Adjust process is also fast. It takes about half a minute or less for this small grid set. Some explanation about these parameters, the 500 cells is the minimum, the 5000 is the maximum cells to consider in the statistics of each

overlap, the resampling involves using the Minimum Curvature algorithm, so residuals and iterations are for that process. A first order surface adjust is implied by a Surface Degree 1. The rest are to do with ignoring outliers.

**GridMerge Processing Completed**—choose **OK**.

Review the **gridMerge.rpt** file which pops up in your preferred text-editor (or *Notepad*).

Note that the log information is **appended** to the existing file, so you need to scroll down to the end to read the most recent entry!

```

Fitting degree 2 polynomials
-----
Iteration  Max Adjustment  Grid
1          3.2188      TccEast_Mag
2          1.7600      Area2_Mag
3          1.3257      Tccwest_Mag
4          0.6599      Area1_Mag
5          0.6895      Tccwest_Mag
6          0.3745      Beatrice_Mag
7          0.3292      Area2_Mag
8          0.4089      TccEast_Mag
9          0.2350      MilingimbiSub_Mag
10         0.1484      Area1_Mag
11         0.1642      Tccwest_Mag
12         0.0757      Area2_Mag
13         0.0714      Beatrice_Mag
14         0.0649      Tccwest_Mag

Applying 2D Polynomial Surface adjustments
of degree 2 to output grids.

Grid Correction Summary
-----

List of corrections applied to each grid via surface Adjustment
and statistics on the final overlap differences.
(Corrections listed below were added to the original grids).

Seq  Ref  Count  Mean  Minimum  Maximum  FINAL OVERLAP  DIFFERENCES  Grid
1     2     0.006  -0.619  1.310    0.149    0.890    -4.484    2.512  Beatrice_Mag
2     4    -0.565  -4.867  6.925   -1.483   21.115   -99.180   99.582  Tccwest_Mag
3     2    -0.002  -4.805  12.423  -1.255   29.908   -96.512   90.008  TccEast_Mag
4     2     0.040  -2.169  2.931   -0.840    1.681   -11.133    7.309  Area1_Mag
5     3    -0.369  -3.459  4.206    1.427   19.057   -99.582   99.180  Area2_Mag
6     0    -0.000  -0.000  -0.000    0.788   11.822   -90.008   81.199  westArnhemSub_Mag
7     1    -0.006  -0.355  0.987   -0.724   13.532   -85.656   96.512  MilingimbiSub_Mag

*****
End processing - 10/12/2012 18: 8: 0
*****
    
```

Observe the following in the report file:

- In particular, examine the list of Maximum Adjustments performed with each iteration.
- Note that the mean adjustments being applied to the grids during this operation are quite small...with an order of 1 nT or less.

When you have finished reviewing the report, exit from *Notepad*. (Choose **File > Exit.**)

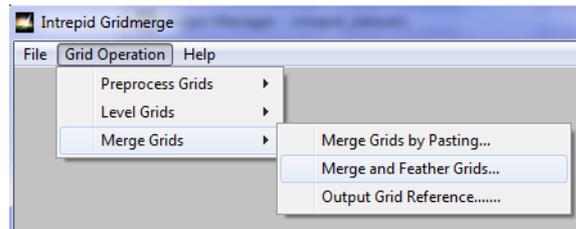
Now the grids are ready to be merged !

Move to the next and final exercise, the FeatherMerge.

4 Select the input grids and perform FeatherMerge to create the output merged grid.

This third exercise carries on from Step 3 above, where optimised Surface Adjustments were applied. This exercise takes input from the directory of SA results and generates the final feather-merged grid. This is easily the most time consuming aspect of this tool, as we work hard on the joins.

From the **Grid Operation** menu choose **Merge Grids**, then **Merge and Feather Grids**. INTREPID displays the **Specify Input Image Directory** dialog box. Select the directory called SA, choose **Open**, and then select any filename in that directory.



Choose **Open**. INTREPID displays the **Specify Output Image** dialog box. We are now just going to create one final grid, so unlike before, we do not need to create a new directory to receive all the adjusted grids. Specify the output grid name **ArnhemLand\_MergedMag1.ers** Choose **Open/Accept**.

In **Select Base Grids**, select **WestArnhemSub\_Mag** and move into the list of **Selected Grids** and choose **OK**.

In the **High Rank Grid List** dialog box, select **Beatrice\_Mag** and move into the list of **High Ranked Grids** and choose **OK**.

In the **Low Rank Grid List** dialog box, select **MilingimbiSub\_Mag** and move into the list of **Low Ranked Grids** and choose **OK**.

INTREPID displays the **Grid Feathering Parameters** dialog box. Enter the following parameters:

- Trim resampled grids** - No check (default), you trust your edge estimates are good.
- Overlap Limit 500** (default)
- Filter length (m) 5000** (default)
- Smoothing Iterations 3** (default)
- Smoothing Residual 0.00** (default)

When you have finished adjusting the parameters choose **OK**.

INTREPID displays the **Clip Merged Grid** dialog box. Select **No Clipping** and then choose **OK**.

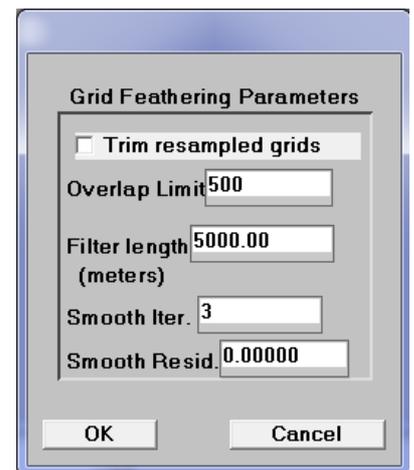
Do you want to proceed with the Merge and Feather? Choose **Yes**.

**Optional:** 'Tail' the logfile to monitor progress (Use the command `tail -f nt.username.log`)

The Feather Merge process is **slower**, and takes some minutes even for this small grid set.

**GridMerge Processing Completed**—choose **OK**.

Now review the **gridMerge.rpt** file which pops up in your preferred text-editor



(or *Notepad*).

The Merge and Feather operation has quite a short report.

```
Feathering filter parameters.
Pass No  Filter Length
  1      5000.0000
  2      2500.0000
  3      1250.0000
  4       625.0000
  5      312.5000
  6      156.2500
  7         0.0000

One additional pass at grid resolution : YES
Trim grids resampled on the fly       : NO

Processing Summary
-----

Grid ranking for feathering (low to high).
Each grid is overlaid by those that follow it in this list.

  1 MilingimbiSub_Mag WestArnhemSub_Mag Area2_Mag      Area1_Mag
  5 Beatrice_Mag      TccEast_Mag      TccWest_Mag

*****
End processing - 10/12/2012 18:18:38
*****
```

The 6 filter lengths used to feather each edge are shown. The priority order used to place the grids on top of each other is also shown.

When you are finished reviewing the report, exit from *Notepad*. (Choose **File > Exit**.)

**5** *Exit from INTREPID Gridmerge.*

To exit from the Gridmerge tool, choose **Quit** from the **File** menu.

**6** *Examine the merged grid you have created.*

**ArnhemLand\_MergedMag.ers** is a solution dataset we have provided which should be nearly identical to **ArnhemLand\_MergedMag1.ers**.

Recall the instructions in [Visualisation tools\(G05\)](#) for viewing the stitched grid. You can task switch to the Project Manager to launch this tool.

## Further things to consider

- Examine the grid seams. Any there any visible artefacts?
- Enhance the high-frequency to closely examine the seams (compute a first vertical derivative or use a sun-angle enhancement filter)

## Key points for this guided tour

In this guided tour you have used the Gridmerge tool to:

- Seamlessly join a group of seven adjacent and overlapping grids.

The Gridmerge tool can also:

- Scale and DC shift, to resolve variable ‘units’ problems in radiometrics data merging
- Incorporate new surveys without re-levelling the entire grid database, by re-running shift and tilt processes with the existing grids designated as Base grids
- Apply the computed adjustments back to the Line datasets (Gridmerge Pro). This is like microlevelling, just on steroids, as it is capable of writing a microlevelled channel to hundreds of survey datasets in a systematic manner.

## Acknowledgements

Tony Luyendyk, late of Geoscience Australia, was a key developer and contributor,

building on the original vision of Brian Minty and Phil McFadden

## Frequently Asked Questions



**Q : Can I merge a small high definition ground survey into my master grid of the African continent?**

*A : Yes, the tool supports input grids of different cell sizes. You can also control the final output grid cell size.*

**Q : Can the tool deal with complex join shapes?**

*A : Yes, the tool has extensive support for variable shape joins. It is also designed to cope with complex gradients around such joins.*

**Q : Can I merge grids which were flown at different heights?**

*A : Yes. The Gridmerge tool has a Scale and DC shift function which is especially suited to this problem.*

**Q : Can I merge a pair of grids with no overlap?**

*A : No. INTREPID Gridmerge tool cannot interpolate across gaps between grids.*

**Q : Can I merge a FTG grids?**

*A : At V4.5 INTREPID Gridmerge tool cannot interpolate between FTG grids. Wait for V5.0.*

**Q : Do 64 bit machine work better?**

*A : Due to the high workload INTREPID gives to swap/stack memory, as much useable memory space as possible greatly helps, so yes.*

**Q : Is this the tool that maintains all the super grids of Australian geophysics, especially the radiometrics and magnetics grids?**

*A : Yes it is. A standard desktop workstation can be use this tool to produce super high resolution and very large geophysical grids.*