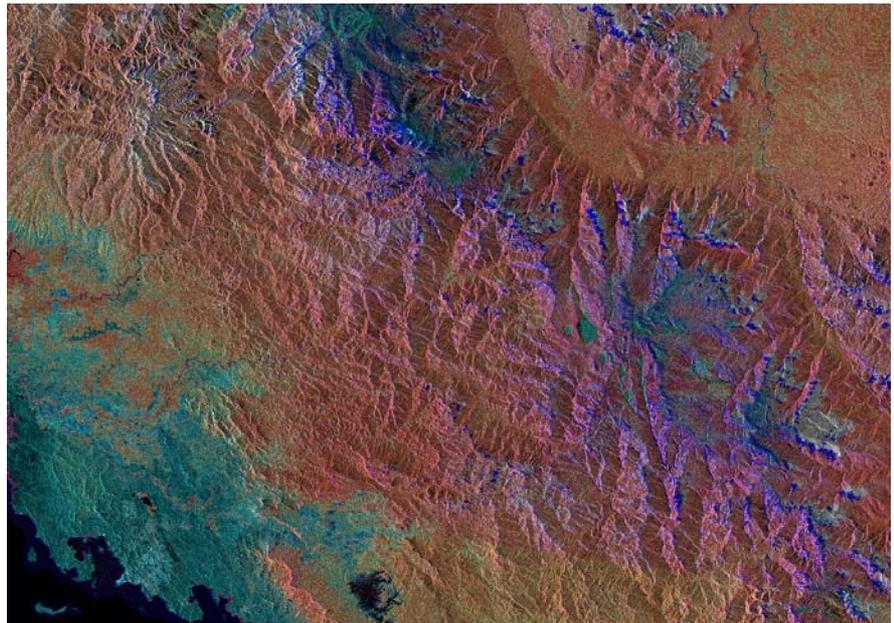British
Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Introduction to ERMapper 6.4 for Satellite Image Processing

Information Systems Development Programme

Internal Report IR/05/159

Introduction to ERMapper 6.4 for Satellite Image Processing

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Keyworth, Nottingham   British Geological Survey   2005

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1 Introduction

These training notes accompany a 1-day course that introduces BGS staff with a remote sensing background to the user interface of ERMapper 6.4. The course guides the user through the steps involved in importing two raw Landsat ETM$^+$ scenes through to producing a mosaiced image suitable for interpretation.

2 ERMapper file formats

As with all proprietary software packages, ERMapper works with its own native data format types. The basic raster dataset consists of two linked files:

1. The data file consists of a two dimensional grid (or raster) of digital numbers. Each digital number represents an area of the earth's surface and is called a pixel. While most files in Microsoft Windows have a root and an ending/extension e.g. *wordfile.doc* the ERMapper data files have no ending e.g. it could simply be called *image*. For Landsat imagery the digital values lie between 0 and 255 (8 bit data) whereas for other data such as radar they can range between 0 and 65536 (16 bit data). The data file can be many Gigabytes in size.

2. Associated with each data file is the header file which has an *ers* ending, i.e. it would be called *image.ers*. This header file contains information about the data file such as how many rows and columns there are in the raster grid, along with its geographic extents and projection. The header file can be opened and edited (if necessary) with Notepad / MSWord etc. and is generally around 10KB in size.

Importantly, ERMapper manipulates the dataset files with what are called Algorithms. Rather than saving a new dataset each time it is processed and altered in some way, an algorithm file is saved. The algorithm will have an *alg* ending after the filename. Therefore, if you create a 321 band combination from the original image dataset that could be saved as *image_321.alg*. The next time you require to view a 321 band combination you would open the algorithm which recreates it from the original dataset 'on the fly'. The power of this setup is that there should be one dataset file and any number of algorithms working from that which reduces the amount of filespace required.

There are also 'virtual datasets' that are used for some specialised processing steps. In this case a dataset is not created but a header file is used to replicate one. A virtual dataset file will have an *ers* ending but can be distinguished from a real dataset by the fact that it will be very small, in the region of 10KB.

ERMapper uses a wavelet compression system to compress the size of files. As with the other dataset type, this compressed dataset consists of two linked files. The data file will have an *ecw* ending and the header file will have an *ers* ending. It is important to be careful not to overwrite the original dataset when creating the compressed one as they both use an *ers* ending.

Occasionally auxiliary files will be created automatically. It is safer not to delete these files though they generally do not serve any vital purpose and will be recreated automatically if needed. The file ending is *aux*.

ERMapper also has its own native vector file format that has an *erv* ending. These vector files are used mostly when plotting from ERMapper because the digitising capability of a GIS is often superior so the imagery is generally taken into a GIS before linework is added. Many vector formats can be viewed in ERMapper without the need to import them.

Region Layers are used within ERMapper to define regions within an *ers* file that require special processing or masking etc. The regions are stored within the *ers* raster data file itself.

ERMapper will open many raster file formats without the need to import them, however if you wish to process further the datasets they will need to be imported into the ERMapper native format.

2.1   FILE NAMING CONVENTIONS

It is extremely important to use a consistent file naming convention, especially if the files are to be shared between users. It should be clear from the name alone exactly what each file contains. When dealing with basic Landsat scenes it is recommended to use the path and row numbers in the title. The convention used in this course is as follows:

173_78_7b   =>path 173, row 78, 7 band data (will be approx 350Mb)

173_78_7b.ers   =>header file linked to the above dataset

173_78_7b_321.alg   =>algorithm linked to the dataset used to produce a true colour image

173_78_pan   => path 173, row 78, panchromatic band (will be approx 200Mb)

173_78_pan.ers   =>header file linked to the above dataset

173_78_321_8_15m.alg   =>algorithm linked to both of the datasets above used to produce a true colour image with the panchromatic band merged to 15m spatial resolution

173_78_321_15c.ecw =>bands 3,2,1 compressed using a compression ratio of 15

173_78_321_15c.ers =>header file linked to the above compressed dataset.

3 ERMapper 6.4 User Interface

When you first open ERMapper you should see the main Toolbar window, a Viewer Window, and maybe a 'hint box' depending on the software preferences that have been set. A license dialogue box will also open if you are running an evaluation copy. The other interface you will use frequently is the Algorithm window.

The Toolbar window should start with the two main toolbars active i.e. Standard and Common Functions (as shown below). If they are absent you can add them by clicking on `Toolbars` and selecting `Standard` and `Common Functions` from the top of the list. A short description of what the icon does will appear when the mouse hovers over it.

Figure 1 ERMapper main toolbar

There are an additional 17 toolbars as standard with ERMapper as well as the main two. The toolbars consist of several icons that act as shortcuts to processes and wizards.

Figure 2 Toolbar selector

If set in the preferences, a viewer window opens automatically when ERMapper is started. New viewers can be opened by clicking on the icon. There is no limit to the number of viewers that can be opened simultaneously. The viewer windows (as displayed below) do not contain any toolbars or icons, all actions are accessed from the main menu, the algorithm window or by right-clicking on the mouse.
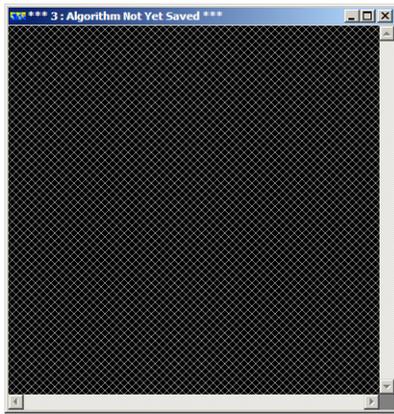
Figure 3 A blank ERMapper Viewer window

The algorithm window is where the data are manipulated (below). It can be opened via `View`, `Algorithm` in the main Toolbar window or by right-clicking in a Viewer and selecting Algorithm.
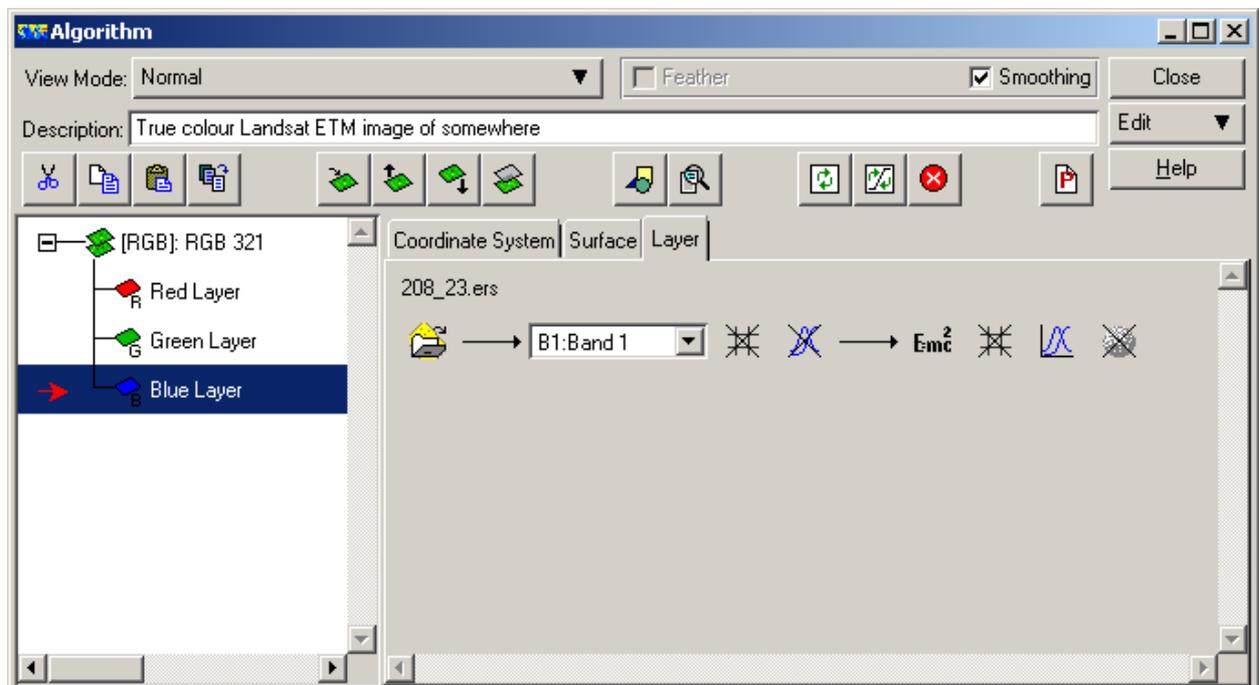
Figure 4 The Algorithm window

A brief overview of the Algorithm window:

- The View Mode enables you to choose between Normal, page layout, 3D perspective and 3D flythrough.

- Feather averages the images along join lines.

- Smooth applies a low pass filter to the image.

- The RGB layer on the left indicates which colour gun is being used for which band. In this case band 1 is being displayed through the blue gun.

- The Edit button (below) enables layers and surfaces to be added, edited and deleted.

The remaining icons will be dealt with later in this manual.

4 Landsat ETM Image Processing Steps

4.1 RAW DATA READ / IMPORT

Raw Landsat ETM data are supplied in a variety of formats and media. The most common is to receive the data as separate GeoTIFF files for each band. In this course we will start with each GeoTIFF compressed in GZ format. Each Landsat scene comprises of 9 separate files, each relating to a spectral band acquired by the satellite sensor. Each scene covers an area of 180x180km.

An additional wizard is available to streamline the process of importing GZ data so will install this. This has not been done for you in case you need to do it yourself at a later date e.g. if overseas. Firstly close ERMapper if it is running and uncompress glcf_Landsat_wizard.zip and copy the extracted files into the relevant folder in the ERMapper application directory i.e. batch, bin, config and icons folders. When you restart ERMapper, activate the GLCF Landsat Wizards toolbar and the main menu should have three new icons.

Figure 5 ERMapper Toolbar window including the GLCF Wizard

For the GLCF wizard to work, your 8 compressed GZ files for each scene must be saved together in a single folder, with a separate folder for each scene e.g. create a folder called 204_024 and put each of the relevant 8 GZ files in it, likewise for 204_025 etc.

Click on the **GZ** icon to activate the wizard and follow the instructions. This will uncompress each of the GZ files to GeoTIFF format and delete the GZ files.

Next click on the icon and follow the instructions to create an ERS header file for each GeoTIFF image and to set all null values to zero.

Now click on the **TM** icon to combine the individual scenes into a virtual dataset and view them on screen. Ensure that Display Virtual Dataset as RGB image is activated, select a suitable band combination but <u>do not</u> Add Pan band as an intensity layer. Note that the image is displayed on screen and a virtual dataset has appeared in the folder where the data are held. We can open the ERS file in Wordpad to see the data structure and projection information.

Now we must save this as a real dataset containing the 30m resolution bands to make it easier to process. Open the Algorithm window. Note that only three bands are shown in the Default Surface. We must add the other bands we require to this surface before saving it as a new dataset. There are several ways of doing this but the easiest is to highlight a layer by left-clicking on it and using the copy and paste icons to paste that band three times, rename the layers from 1 to 7 (excluding 6), ensure that the correct dataset is linked to each layer, that no transforms have been applied, and change each layer to type Intensity as shown below. Next click on File and

choose Save as to save as an ERMapper Raster Dataset with 8 bit data type and 28.5m pixel size.
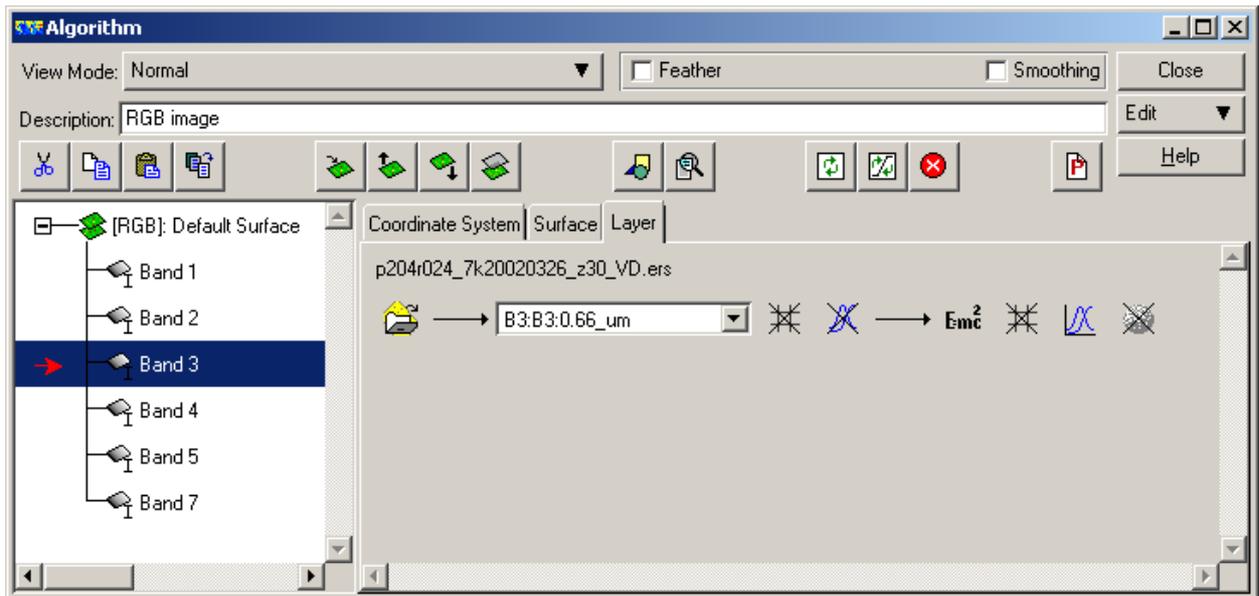
Next save the Panchromatic band as an ERS Raster dataset.

It is useful to visually inspect the imagery so open the raster datasets in a viewer and use the
 icons, or select the relevant tool from the right-click menu to zoom and pan around the image to ensure there are no data errors. A useful tip is to use the hand tool for most panning and zooming – to zoom in or out with the hand tool simply hold down the shift button at the same time as the left mouse button and move the mouse to zoom interactively.
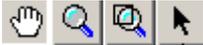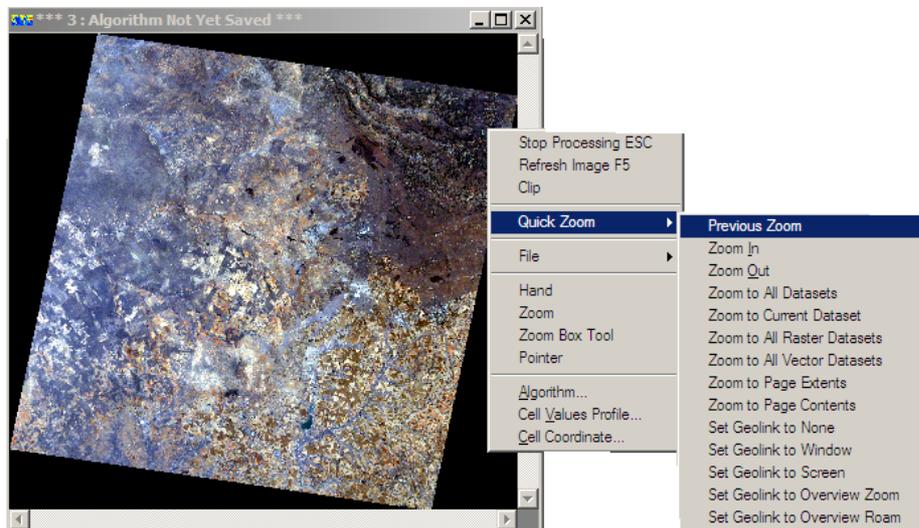

Figure 6 ERMapper viewer and right-click menu

4.2   IMAGE REGISTRATION

Registration is the process of registering the digital image to the map base. This is done so that the images can be displayed in the correct geographical space, with the appropriate geographic coordinates and so that other datasets such as vector linework can be displayed on top of the raster imagery. We will assume that the images are properly rectified (for internal geometric errors) and will simply reproject the datasets to the British National Grid.

The GLCF GeoTIFF data are supplied with geographic coordinates in WGS84, within a suitable UTM Zone. To start the reprojection, click on `Geocoding Wizard` under `Process` in the main window. As shown below, there are various methods that can be used. Select the Input File by clicking the open file icon in the top right of the window and use a `Map to map Reprojection` to convert them from WGS84 to the local datum and spheroid.

Move to the next step of the process by clicking the second tab on the top of the window `2) Map to Map Setup`. Change the `Output Coordinate Space` so that the `Datum` is **OSGB36**, and the `Projection` is **TMOSGB.** Leave the `Optimize` button turned on and the tolerance at 5%.

Move to the next step of the process by clicking the third tab on the top of the window `3) Rectify`. Choose the Output filename e.g. 204_024_7b_OSGB.ers and leave the cell size as shown, but ensure that `Null Cell Value` is ticked on (as **zero**) and the `Resampling` is **Cubic Convolution**. Next press the green box 'Save file and start rectification' and wait for the process to finish.
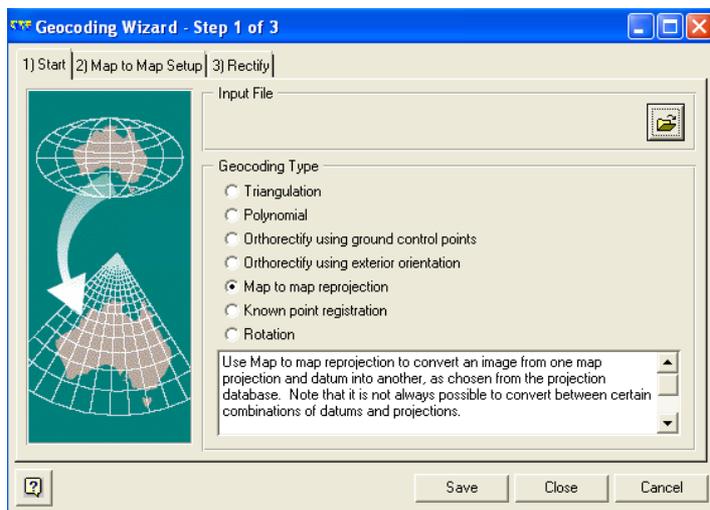

Figure 7 Geocoding wizard window for image registration step

The coordinate scheme and pixel size etc of an image can be checked by right-clicking a layer name in the left of the Algorithm window and selecting Properties. The information is laid out as shown below.
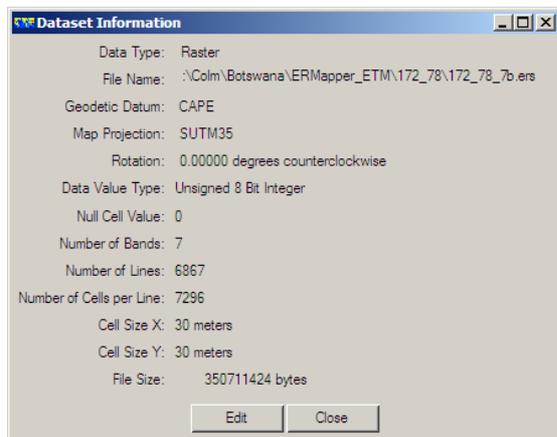
Figure 8 Dataset Information dialogue box.

4.3   IMAGE ENHANCEMENT

Satellite image enhancement is generally carried out in order to increase the amount of geological information available to the interpreter. There are complete textbooks written on this topic alone but some of the basic issues will be addressed in these training notes.

4.3.1   Band combinations

As explained above, the computer uses Red, Green and Blue colour guns to display imagery. Landsat ETM data covers the visible part of the electromagnet spectrum as well as the short, mid. and thermal regions of the infrared. The ETM bands, their spectral locations and principal applications are listed earlier in this document. The colour guns are always listed in texts in RGB order, so when you see that an image is 4,5,7, this means that band 4 is displayed through the red gun, band 5 though the green gun, and band 7 through the blue gun.

ERMapper has built-in 'wizards' to help display certain combinations of the spectral bands through the three colour guns. Add the `Landsat TM Wizard` to the main ERMapper window by adding the `Remote Sensing` toolbar. Click on the `TM` icon. When the new window opens simply choose the dataset that you want to use and then choose the band combination you want, and then click on `Finish`.

A true colour image is the best to start with. It is called true colour because it replicates what the human eye would see from space, *i.e.* just like a colour photograph. Therefore the red, green and blue spectral bands of the satellite are displayed through the red, green and blue guns of the display device respectively. In the TM Wizard window this is called `RGB 321`. If you wish you can save any band combination as a new dataset or as an algorithm.

When the colour image is displayed you can open the algorithm to see how it was constructed. Each combination will highlight various Earth surface properties. By right-clicking on a layer on the left of the Algorithm window you can turn a layer on or off etc.

If you want to display a single band on its own change the layer to `Intensity` or `Greyscale`. Individual layers in the Algorithm can be turned on or off by right-clicking on the layer and choosing Turn On or Turn off.

4.3.2   Contrast stretching

When the images are first displayed they will appear dark as they lack contrast. It is necessary to stretch the contrast levels to brighten the dark areas and possibly even make certain bright areas darker. Although Landsat TM has an 8-bit radiometric resolution entitling digital numbers from 0-255 to be used, the full range of these values is rarely utilised as few scenes will include landcover types from both the darkest and brightest ranges of the sensor in that particular band. The concept of histogram enhancement involves 'stretching' those digital numbers that have been sensed in order that they may fill the entire dynamic range available within the specifications of the display device.

The process for stretching the contrast of the data is undertaken interactively using histograms. The stretch need not be equal across the input range, which means that areas of interest can be highlighted, and unwanted data can be visually discarded with ease. By performing this operation interactively on screen with one display gun being altered at any one time, the optimum image can be achieved in a short space of time. The final result of this procedure is to refine the image so that areas of interest are displayed more clearly, while simultaneously reducing the contrast in the remainder of the image thereby making the image more interpretable for the given application.

The histograms are accessed through the graph icon ![icon] in the Algorithm window. There will be individual graphs for the red, green and blue guns (though only one if you are displaying a greyscale image). The contrast is altered by clicking and dragging anywhere along the line across the histogram with the changes made in real time in the associated image window. The original values are in colour (red in this case) and the Look up Table values are in grey. You can jump between the RGB histograms by clicking in the appropriate colour in the Transform dialogue.

Note: sometimes the refresh stalls so it is necessary to click the ![icon] icon on the Algorithm window to manually refresh the display.

Experiment with getting a balanced image. A well balanced image is necessary to ensure that each image can be interpreted and also for masking differences between adjoining images when creating a mosaic. The results of the contrast stretch can be saved as new algorithms or simply by updating the existing algorithm.
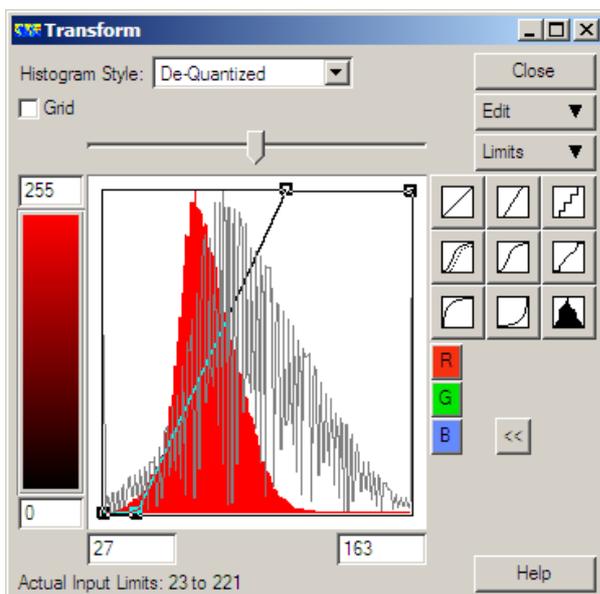

Figure 9 Histogram contrast stretch

4.3.3   Filtering

Filtering is used to augment or reduce the input of certain data frequencies within the imagery to enhance it visually for any number of reasons such as visual interpretation. The filter you have already seen is the Smooth option in the Algorithm window which uses a Low Pass filter on the data. The filter dialogue box is accessed using the icon [icon] in the Algorithm window. The icon changes to [icon] when a filter has been applied. In the Filter dialogue box (below) click on File, and then Load to see the list of available filters in the ERMapper\Kernel folder. Once loaded, the values in the kernel can be viewed and edited in the dialogue box. High pass filters exaggerate the high frequency data (i.e. sharpen the image) while low pass filter smooth the data. There are also direction filters to highlight e.g. lineaments with dominant orientations and general edge detectors to highlight any edges in the imagery.

Note that you can have several filters applied to each image, and that you can apply different filters to each layer of imagery if you wish. Filters applied to the imagery can be deleted or appended by clicking on the Edit button in the dialogue box.
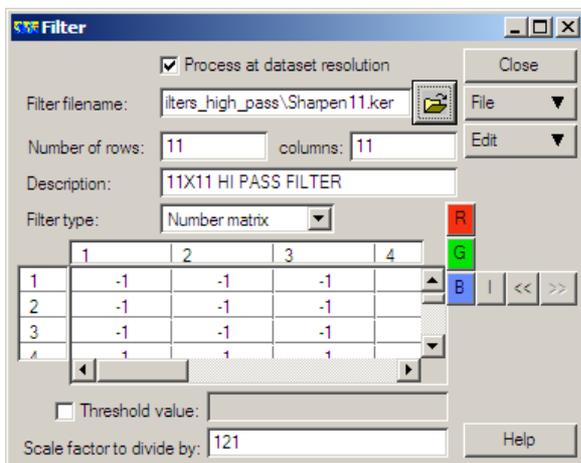

Figure 10 Filter dialogue box

4.4   SUBSETTING AN IMAGE

It is possible to subset part of the image at full resolution and save it as a new dataset for use in a GIS or another application. This can be done two ways, either by digitising a vector region (polygon) and masking everything either inside or outside that region. The simpler option, if you only require a rectangular-shaped subset, is to zoom into the area you require so that it fills the viewer. Then simply use the `Save As` option to create a new dataset from the data currently visible in the viewer. Only the data in the viewer will be saved so if you want to save 7 bands then they must all be in the Algorithm.

4.4.1   Subsetting an irregular area (polygon) in ERMapper.

Open the image in a new window and zoom in to an area you want to subset. In the Algorithm, click on Edit, and Add Vector Layer and choose `Region Layer`. Click on the Annotate icon [icon] to start the editing tools that will enable you to define the polygon you want to subset. Using [icon] and the left mouse button, digitise the polygon, and remember to double-click to close the polygon. Save the file using the [icon] icon in Tools. (Note that the polygon is saved as a

region into the actual raster dataset). Now close the Tools dialogue and you will see that the polygon has been named Region_0. Now use the Formula tool ![Emc²] in the Algorithm window to access the `Standard` tools and select `Inside Region Polygon Test`. Click the Regions option and select Region_0. This means that data within the region will be kept but the remainder will not. Ensure you have done this for R G and B in the Formula Editor dialogue box and you will see only the part of the image delineated by the polygon in the viewer and none of the surrounding image. This subset can be saved as a new dataset.

4.5   RESOLUTION MERGE

Landsat ETM imagery contains one more band than the older TM data. The extra band (Band 8) is a 15m panchromatic image while the other 7 bands are 30m resolution (except band 6 which is 60m). We will merge the 15m and 30m data to increase the amount of information we would see with the 30m data alone. This is a straightforward task in ERMapper.

Open the panchromatic band as a greyscale image and apply a suitable contrast stretch to ensure that the data are satisfactory. The easiest way to proceed is open a new Viewer with a three band combination. Then open the Algorithm for that combination and add an intensity layer beneath the RGB that are already there. When adding the panchromatic band using the icon circled below, ensure that you press 'Apply this layer only' in the Raster Data dialogue or you will overwrite the existing layers in the algorithm.
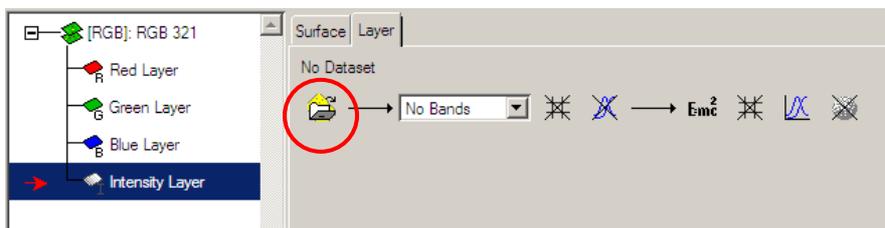

Figure 11 Adding a new layer to an algorithm

The intensity layer will make the image dark when it appears on the screen so you will need to alter its contrast via the Histogram tool. Turn off the Smooth option and zoom in to an area and turn the panchromatic band on and off to gauge the resolution increase.

4.6   COMPRESSING IMAGERY

Raster imagery is often used as a backdrop in Geographical Information Systems (GIS). ArcView and ArcGIS (with extensions) will open native ERMapper data files and algorithms. However as the image datasets are large, often gigabytes in size, the GIS software cannot cope as they are designed more to handle vector datasets. It is therefore necessary to compress the imagery into a suitable format.

ERMapper uses the ECW compression system. This is available once `Compression` is added from the Toolbar menu. The compression wizard is very straightforward. It is simply necessary to choose

- Whether you want a greyscale, colour or RGB output – choose greyscale if you are compressing just one band, and RGB if it is a three band composite;

- Not to compress the file for internet usage;

- The compression ratio. Generally 10 gives the best results for colour imagery though it might be necessary to use a higher ratio if the image is very large. A high ratio will make the compressed file smaller but will have some loss in quality;

- The output filename. It is recommended to use the same filename as the one you are compressing, but add _10c at the end if you use 10 compression ratio or _20c if you use 20 etc. Two files will be output from the process, one with an **.ers** ending and the other ending in **.ecw**.

It is recommended that you keep your compressed files in a suitably named separate folder. We will make a compressed file in the next exercise.

4.7   IMAGE MOSAICING

Several images can be displayed in the same window at the same time. As long as these are projected to the same datum they can be displayed in the same window. The easiest way to do this is to open a band combination and then copy and paste the `Surface` in the Algorithm window. It will then be necessary to open a new dataset (as you now have the same dataset open twice in one viewer) into the Surface you just created. This can be saved as an algorithm. The scenes are each opened in a different surface so that they can be manipulated independently. Once your scenes are in the viewer they can be saved as a single algorithm or as a new dataset if you require.

Creating a true mosaic involves saving multiple image datasets as a new single dataset. This is relatively easy when there is a small number of images but is more complex when there are several. The complexity arises when you try to match the contrast between various scenes (especially if they were captured in different seasons) to produce an image where the boundaries between the scenes are invisible.

ERMapper has Mosaic Wizard tools to assist in this process but often the automatic contrast stretches cannot cope with the complex data and they must be manipulated manually. In order to do this you must open each band combination into a new surface as described above, manually match the contrasts and then paste the bands into a single Surface. This mosaic can subsequently be saved as a new dataset.

Choose which 3 band combination you wish to mosaic (Band 4, 5, and 7 in this case) and open one of your images with that combination in a viewer. Alter the contrast stretch to an accepted level. In the Algorithm window copy that Surface and paste it into the same algorithm, and open your second image with the same band combination into the newly created surface, as shown below. After zooming to all datasets you should now see both scenes in the same viewer.
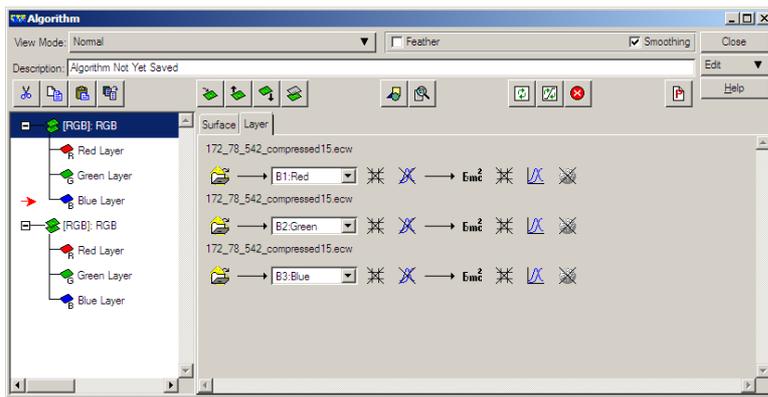
Figure 12 Copying and pasting Surfaces in the Algorithm window

Now you must apply a contrast stretch to the images so that they look as similar as possible. Once happy with the contrast stretch you can drag all the RGB Layers into one of the Surfaces. The empty Surface will be deleted automatically. Now simply select all the layers and save it them as a new dataset or compressed image.

4.8   OPENING ERMAPPER FILES IN ESRI

4.8.1   Opening ERMapper files in ArcView

Open Extensions via File in the main menu bar. Ensure that the "ECW v2.0 and ERMapper Images" extension is enabled. ERMapper *ers* files and **alg** algorithms can be opened directly however as they are generally large, they are too slow to manipulate in ArcView and it is recommended to use a compressed (*ecw*) file. Open a new View in ArcView. Add a theme to the view and under Data Source Type select Image Data Source rather than Feature Data Source.

There is not a lot that can be done in ArcView to further enhance or alter an existing raster file, which is why you must ensure you are content with your contrast stretch before you export to ecw. You can double click on the theme name in the view to open the Image Legend Editor (below) and see information about the image. In this window you can also alter the band combination, perform a linear histogram stretch and change the contrast.
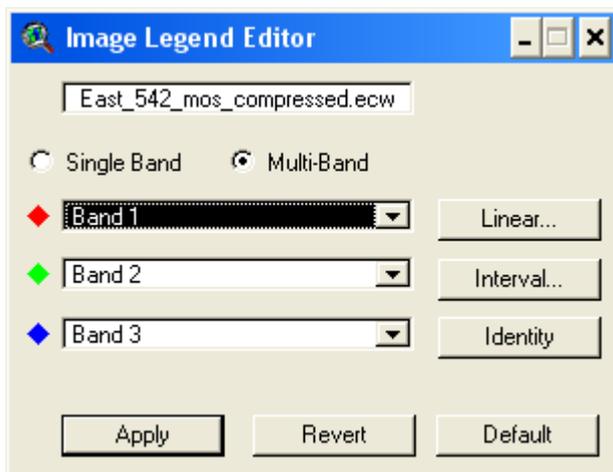

Figure 13 ArcView Image Legend Editor

Ensure that the view you are using has the correct projection information. Click on `Properties` in the `View` menu and then click on `Projection`. It is also necessary to change the `Map Units` and `Distance Units` to **meters**. The image will disappear when you OK the changes so it is necessary to refresh the View using the `Zoom to Active Themes` option. In the top right of ArcView you should now see both the geographical coordinates and the current viewing scale.

4.8.2   Opening ERMapper files in ArcGIS

A free extension is available to open ERMapper datasets, algorithms and compressed files in ArcGIS. Simply run the executable file you have been provided and you will see a new toolbar when you next open ArcGIS. Beware that there will be a substantial delay if you need to alter the contrast of the imagery (especially if it is an ECW file) as ArcGIS attempts to build the image statistics.

4.9   GEOLOGICAL IMAGE INTERPRETATION

There are numerous methods to extract geological / geoscientific information from Landsat satellite imagery. Unfortunately automated methods do not yet produce results of sufficient quality; therefore it is left to a geologist (preferably with structural geological or geomorphological experience) to interpret the images. The interpretation can be done on the computer screen (heads-up) or onto printed images *i.e.* hardcopy. The benefit of the digital environment is that the interpreter can zoom out to get a regional view of the area and then zoom in for detailed interpretations. Also, the digital linework can be attributed at the same time as it is being digitised so it is immediately ready for compilation and comparison with other data for use in the field or to produce a final map product.

While some interpreters prefer to annotate a printed copy of the imagery, this is generally less efficient as the linework still has to be digitised at a later date; if necessary this can be done with the A0 digitising tablet that has been set up in the computer room. Be sure to plot the imagery with an appropriate geographic grid so that it and the linework can be referenced properly once on the digitising tablet.

Heads-up digitising and interpretation can be done in ERMapper, but in this case it is more efficient to open the imagery in ArcView/ArcGIS and do the work in the GIS environment. This should ensure that the linework is correctly attributed at the outset, saving time later.

The satellite imagery is exported from ERMapper in a compressed (ECW) format enabling fast display times in the GIS. This is described in the section above. Advice and training on the actual process of interpreting the imagery is beyond this course but a good textbook on the subject is by Drury (2001). [**Drury S A** (2001) *Image Interpretation in Geology.* Chapman & Hall, London. pp283].

5 Advanced Image Processing

More advanced processing topics include:

- Principal Components Analysis

- Band ratios

- Geometric correction

- Vegetation Indices

- 3D data

- Integration with geophysical data

- Plotting / printing from ERMapper

These advanced processing techniques are accessed either through dedicated wizards or manually via the Formula Editor icon (Emc²) in the Algorithm window. Note that image statistics have to be calculated prior to advanced processing, and the results for the whole image or regions of interest can be viewed via View, Statistics, Show Statistics,

The Formula Editor button provides access to **Principal Components**, Ratios, Standard and Seismic formulas and you can edit these as you wish or write new ones. Start by creating a PC1 generic image from one of your six band images and add that as an Intensity layer beneath a three-band combination. Compare this to the Panchromatic band resolution merge.

To make a **mineral composite image** i.e.

- Input 1 (red) = 5/4 Ferrous

- Input 2 (green) = 5/7 Clay

- Input 3 (blue) = 3/1 Iron oxide

Use the BIF_subset image supplied and Select Ratio of two inputs from the Ratio option and simply fill in the blanks in the Formula Editor window to create a composite image following the formula above.

The result can be saved as an algorithm and recreated on the fly, or saved as a new dataset. Note again that an Intensity layer such as the panchromatic band of a PC can be input to give a spatial context to the resulting mineral composite image.

6 Troubleshooting

This section will deal with some of the basic problems that might arise, and provide some suggested solutions. If these suggestions, the online help, or the ERMapper manual, cannot resolve the difficulties encountered; software support can be obtained by emailing your local authorised support centre as part of the purchase deal of the ERMapper licenses. It is recommended to quote the Serial Number in correspondence so that the support centre is aware of the license status.

Rather than overlapping, there are black boundaries around the images

If there are black areas around the image which block out parts of the juxtaposed image it is because the border needs to be given NULL values to make the area transparent rather than black. With the image open, right click the Layer in the Algorithm window and click on Properties. Edit the Raster Info Properties and set the Null value to zero. Apply these changes.

Blank areas appear within the image when NULL values are enabled

If areas within the image area itself go blank (*i.e.* the same colour as the background 'paper') when NULL values are enabled it means that the pixel values at these locations within the image are zero. To solve this it is necessary to increase the value of the image by 1, *i.e.* add 1 to all the digital numbers. This is achieved within the Formula icon in the Algorithm window. As this adds 1 to all the image file (including the border) the border of the image can subsequently be made null (and therefore transparent when overlapping images are displayed) by editing it as a vector region and using the IF Region Null formula in the formula editor.

After opening a new image the viewer window goes blank

While there could be many reasons for this, the most likely is that you are trying to open windows of different Surface Type, or images with different projections.