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Integrating ER Mapper into AGSO's Spatial IT Environment

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AGSO

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Abstract

This Record provides details of how the ER Mapper image processing system and its data holdings can be integrated with AGSO's other spatial IT systems and their data. The necessary mechanisms for moving data between these other systems and ER Mapper are explained and illustrated with practical examples.

The procedures that are described provide the basic tools for integrating ER Mapper with the other AGSO spatial IT systems. Links between ER Mapper and I²S, Arc/Info, Oracle, Petroseis, Intrepid and the Intergraph system are described. File transfers, dynamic links and data format conversions are documented for each system, as appropriate, for raster (image) data, and vector (point, and line) data.

However, using the tools described here is really only the first step in successfully integrating data. The users must still make important judgements about which data are to be integrated, in what form they will be integrated, how they will be processed prior to, and after integration, and how conflicts between different data sets will be resolved.

Introduction

What is ER Mapper?

ER Mapper is a sophisticated image processing software package produced by Earth Resource Mapping Pty. Ltd. of Subiaco W.A. ER Mapper runs under the X Windows System, Version 11, Revision 4 (and later) as developed by the Massachussetts Institute of Technology in the USA. This windowing system which is normally referred to as X Windows or X11, is a hardware and operating-system independent graphics environment. ER Mapper is therefore being developed to run on a wide range of computer systems.

In AGSO, ER Mapper is installed on the GARNET SUN 4/690 fileserver and it can be used on a variety of workstations attached to this fileserver via the AGSOnet Ethernet backbone. SUN workstations, Tektronix and Labtam X terminals and PC workstations running the HCL-eXceed/W X11 software (Chopra, 1991a and 1991b) can all access ER Mapper.

The purpose of this Record is not to provide a user training manual for ER Mapper since a good reference manual comes with the software and there is also an excellent tutorial manual which takes new users through all the capabilities of the software. Rather, the purpose is to detail the integration of ER Mapper with AGSO's other IT systems so that data can be moved from one system to another.

AGSO's other core spatial IT systems

AGSOnet connects the ER Mapper software to the other major spatial information technology (IT) systems in the organisation. These IT systems include:

- the Oracle relational database management system (RDBMS) which is running on a Data General AViiON 6240 computer.

- the Arc/Info geographic information system (GIS) which is installed on the ZIRCON Sun 4/670 fileserver.

- the I^2S image processing system which is installed on the GARNET Sun 4/690 fileserver.

- the Intergraph digital cartographic system which runs on VAX and Intergraph hardware both in the Anzac Park East building and at NRMA house.

- the Petroseis basin analysis system which is installed on VAX hardware.

- the Intrepid airborne geophysics data processing system which is installed on Sun hardware.

The DISCO software which runs on the Convex supercomputer in the seismic processing centre is also physically connected but there are currently no clear plans to link it with ER Mapper.

Data held on all these systems can, in many cases, be usefully combined with the ER Mapper system and its data holdings. The integration of raster data, which is ER Mapper's main *raison d'être,* with other spatial data such as point location information (e.g. geochemical analyses such as those held in the Oracle RDBMS) and vector boundaries (e.g. mapped lithological boundaries stored in the Arc/Info and Intergraph systems) can lead to considerable synergy because of the differing views of the "real world" that they provide (Chopra and Creasey, 1992). However, it is also true that such data integration can, at times, raise as many questions as it provides answers. Care must be taken when planning processing strategies prior to integration and when resolving the inevitable conflicts that arise between datasets when they are integrated (Chopra et al, 1992).

Thus, the procedures that are described in this Record provide the basic tools for integrating data in ER Mapper with data held in AGSO's other spatial IT systems. However, using these tools is really only the first step in successfully integrating data however. The users must still make important judgements about which of their data are to be integrated, in what form they will be integrated (e.g. lithological boundaries can be integrated with images either as polygons or as vectors), how these data will be processed prior to, and after integration, and how data conflicts will be resolved. All these issues must be addressed on a case by case basis.

Using ER Mapper

Image processing systems have evolved over the years and continue to do so. These developments can be loosely grouped into 3 generations. The first generation of image processing systems depended upon custom hardware and used command-line driven controls which were often cryptic. The second generation was characterised by a move toward general purpose hardware and by improvements in some of the aspects of the user interface. The I²S System 600 that AGSO uses can be classed as a second generation system. The I²S system is based on Sun general purpose computers together with custom display hardware (the IVAS systems) and custom processing engines (the BITE and the Model 75).

ER Mapper on the other hand, can be described as a third generation image processing system. With the forthcoming release of version 4.0 of the software, ER Mapper becomes device and operating system independent. This independence is achieved by using the Massachussetts Institute of Technology's X11 Windows display technology which is available on a very wide range of today's computer systems. Moreover, ER Mapper is distinguished from older image processing systems by its easy-to-use graphical user interface. This interface makes learning to operate the software a far simpler and less time consuming task than has been the case in the past with command-line driven systems such as the I²S System 600 product.

ER Mapper is controlled through a series of pop-up menus. The ER Mapper Main menu and the all-important Overlays menu are illustrated in Figure 1. These menus, and all the others used by ER Mapper, can be moved, resized, reduced to icons on the "desktop" and put behind or brought in front of other windows and menus.

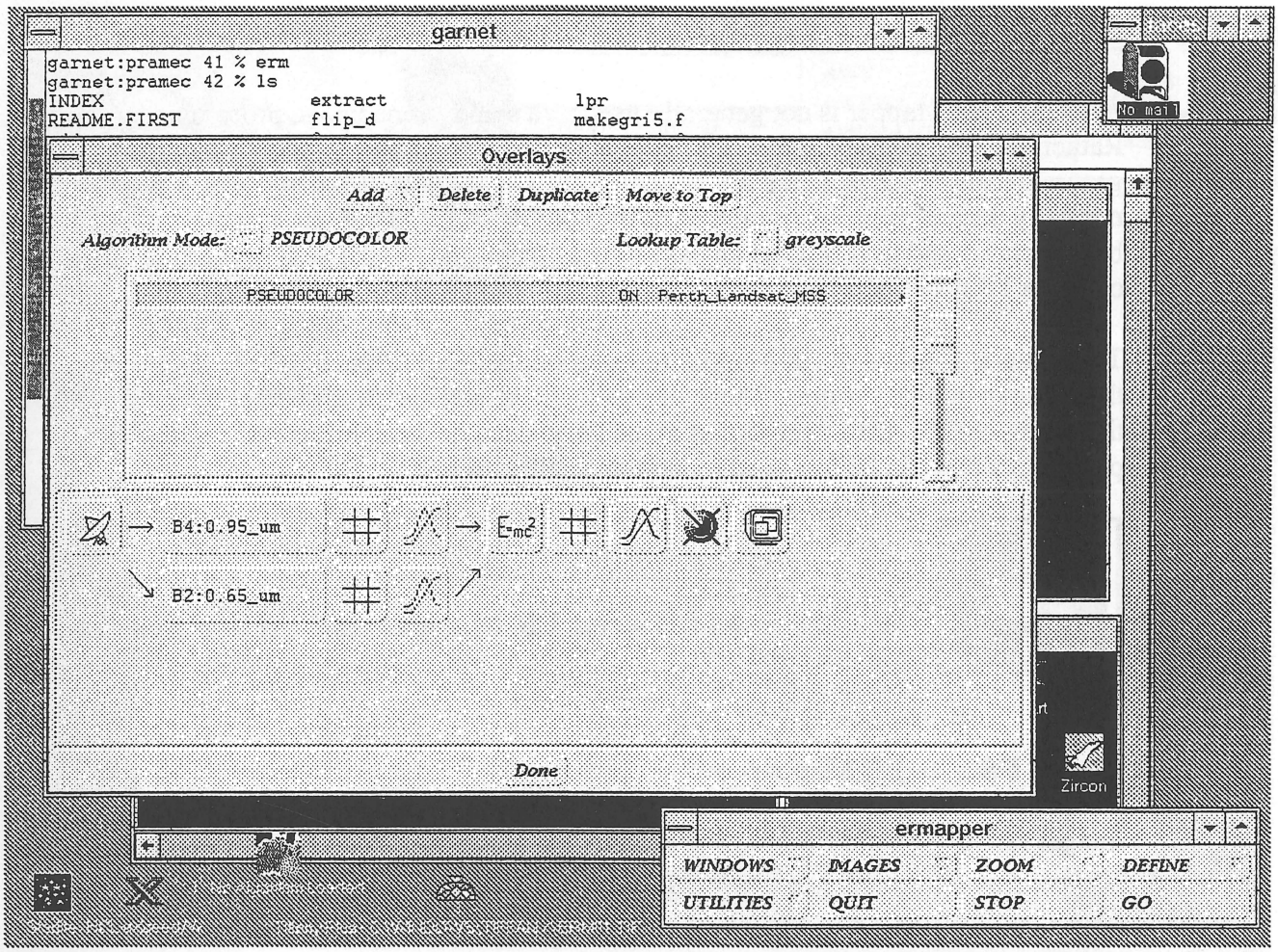


Figure 1 The ER Mapper Main menu and Overlays menu. These menus are the most frequently used of ER Mapper's menus.

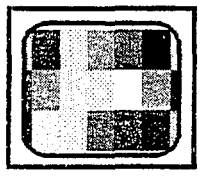
The Overlays menu is the main processing instrument of ER Mapper. On this menu, a dynamic algorithm is constructed (Nixon, 1991). This algorithm controls the data sources to be processed, be they images, vectors, points or annotations, and the ways in which they are processed and combined. ER Mapper uses these algorithms to create a final dataset from one or many initial sources of data and it does this each time the GO button on the ER Mapper Main menu is pressed.

An algorithm such as that shown in Figure 1 can be saved to disc as an ER Mapper **.alg** file and can be called up whenever it is needed. The beauty of the algorithm approach lies in the fact that it is unnecessary to generate intermediate data files during the processing of a geo-registered dataset from its raw state to its final form. When data files run into hundreds of megabytes (as they do with LANDSAT TM data) this dynamic algorithm approach can result in very large savings in required disc space.

Integrating ER Mapper

In AGSO, ER Mapper is not generally used as a stand-alone image processing system. Rather, the image datasets that are manipulated and processed in ER Mapper have generally originated from the I²S system. Similarly, vector data displayed in ER Mapper normally derives from Intergraph, Arc/Info or ORACLE. Thus ER Mapper has to date been mainly used in AGSO as an easy to use "front-end" to the data held in the other complex IT systems.

This pattern of usage of ER Mapper relies upon the establishment of effective links with the other spatial IT systems. These links should, at best, be transparent to the user, but if this is impossible, then they should at the very least, be straightforward and reliable procedures that can be followed by non-specialist users.



Raster links between ER Mapper and the I²S System

Raster: I²S ----> ER Mapper

Images residing on the I²S image processing system can be readily converted into ER Mapper's own format by using the UTILITIES / Import Raster / Import S600 command from within ER Mapper. The procedure for doing this is illustrated in Figures 2 and 3. This procedure creates 2 new files for ER Mapper. The first file contains the image data extracted from the I²S image file. These data are stored in a binary form and, in the case of multi-band data, the storage format is BIL (i.e. band inter-leaved by line). This first file is slightly smaller than the I²S file. The second file is a small ASCII header file which contains information about the image. Details such as the image's coordinate system, scale, spatial extent, cell size, data type (e.g. unsigned 16-bit integer), byte order, number of lines, number of cells per line and number of bands are stored in this file.

Images can also be imported from I²S without entering ER Mapper directly. From the UNIX prompt the command:

$ERMAPPER/bin/sun4/imports600 [I²S filename] [ER Mapper filename.ers]

will create the two ER Mapper files. This can be a quick and useful way of importing a large number of I²S files into ER Mapper without having to go through a repetitive procedure using the dialog boxes in ER Mapper.

The **imports600** command will accept a number of switches and these can be listed by typing:

$ERMAPPER/bin/sun4/imports600 -help

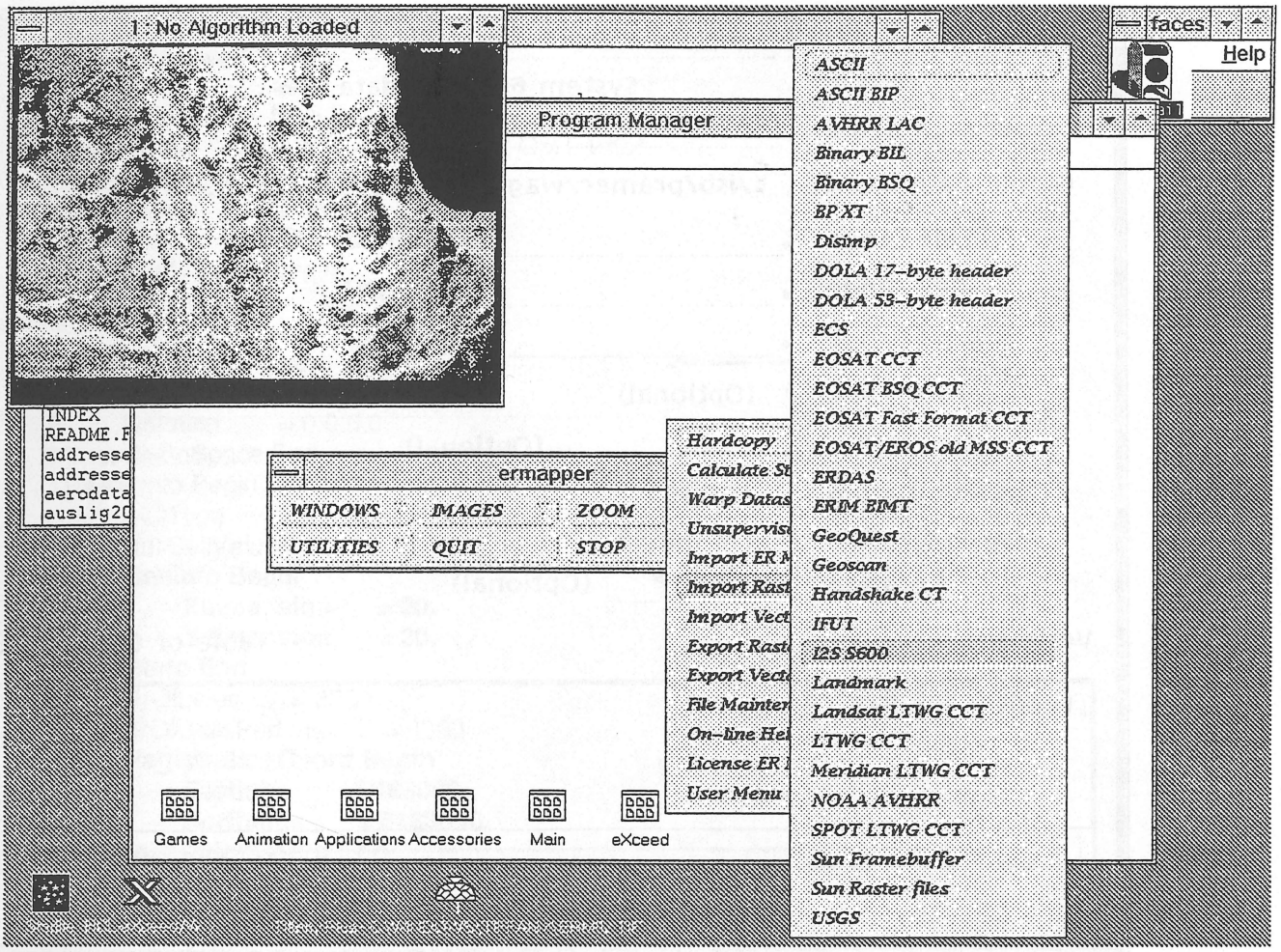


Figure 2 The procedure for importing an I²S image into ER Mapper (see text).

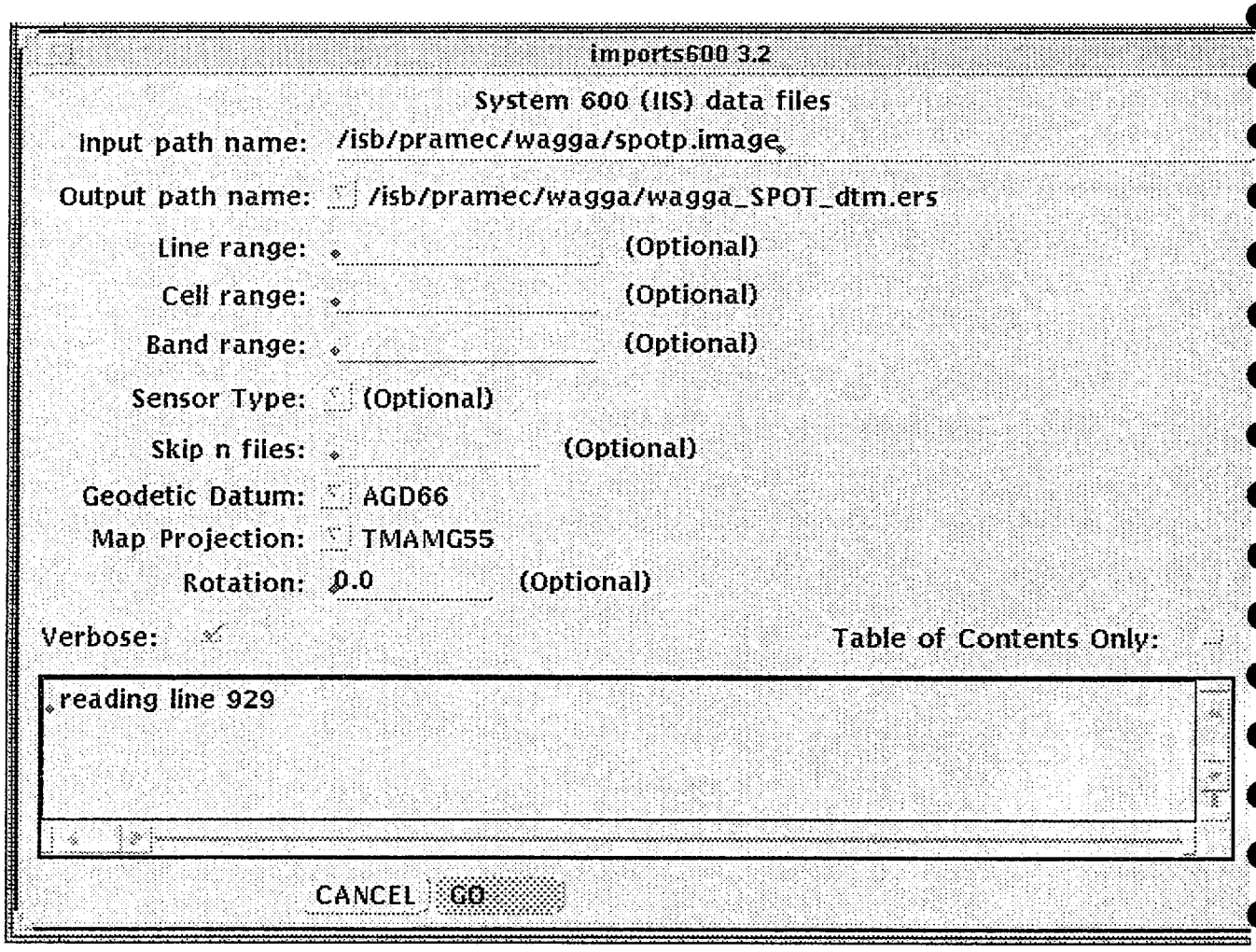


Figure 3 The dialog box used for importing an I²S image into ER Mapper.

The following is an example of the use of the command line to import an I²S file. The I²S file had been warped to the Australian Map Grid (a Universal Transverse Mercator (UTM) projection) in Zone 55 using the AGD66 geodetic datum. To do the import we use the -v switch to turn on verbose reporting to monitor the progress of the import. We use the -D switch to specify the geodetic datum and the -P switch to specify the desired projection type (here Transverse Mercator AMG Zone 55).

$ERMAPPER/bin/sun4/imports600 -v -D AGD66 -P TMAMG55 wagga_SPOT_dtm.image wagga_SPOT_dtm.ers

With version 3.2 and earlier releases of ER Mapper, some editing of the **.ers** file is required before it can be used. In the example in Figure 4, the lines in bold have been added to the **.ers** file created by the **imports600** routine. The information to be added can be obtained from the I²S image file by typing the following command in **de** (the I²S display executive): **dir filename.image -full** (see Figure 6).

```
DatasetHeader Begin
    Version        = "3.2"
    LastUpdated    = Mon Dec  7 05:45:20 GMT 1992
    SenseDate      = Mon Dec  7 05:36:12 GMT 1992
    DataSetType    = ERStorage
    DataType       = Raster
    ByteOrder      = MSBFirst
    CoordinateSpace Begin
        Datum          = "AGD66"
        Projection     = "TMAMG55"
        CoordinateType = EN                    <----------
        Units          = "METERS"
        Rotation       = 0:0:0.0
    CoordinateSpace End
    RasterInfo Begin
        CellType       = Unsigned16BitInteger
        NullCellValue  = 0
        CellInfo Begin                         <----------
            Xdimension     = 20.
            Ydimension     = 20.
      CellInfo End
        NrOfLines      = 3350
        NrOfCellsPerLine       = 4000
        RegistrationCoord Begin                <----------
            Eastings       = 483000.
            Northings      = 6133000.
     RegistrationCoord End
        NrOfBands      = 1
        BandId Begin
            Value          = "band 1"
        BandId End
    RasterInfo End
DatasetHeader End
```

Figure 4 An example of an **.ers** file created by **imports600** and the edits (in bold and arrowed) needed to correctly geo-register the data for version 3.2c and earlier of ER Mapper (see text).

Raster: ER Mapper ----> I²S

Images in ER Mapper format can be imported to the I²S system by again following a fairly straightforward procedure. As discussed above, ER Mapper's native format for images is BIL. Such images can be read by the I²S S600 software by using the **disk'read'binary** command from within the display executive (**de**) or the batch executive (be). Figure 5 is an example of a **de** session in which an ER Mapper image file called cy_rasters which is 1334 samples wide by 1788 lines high, is read into the I²S file, junk.

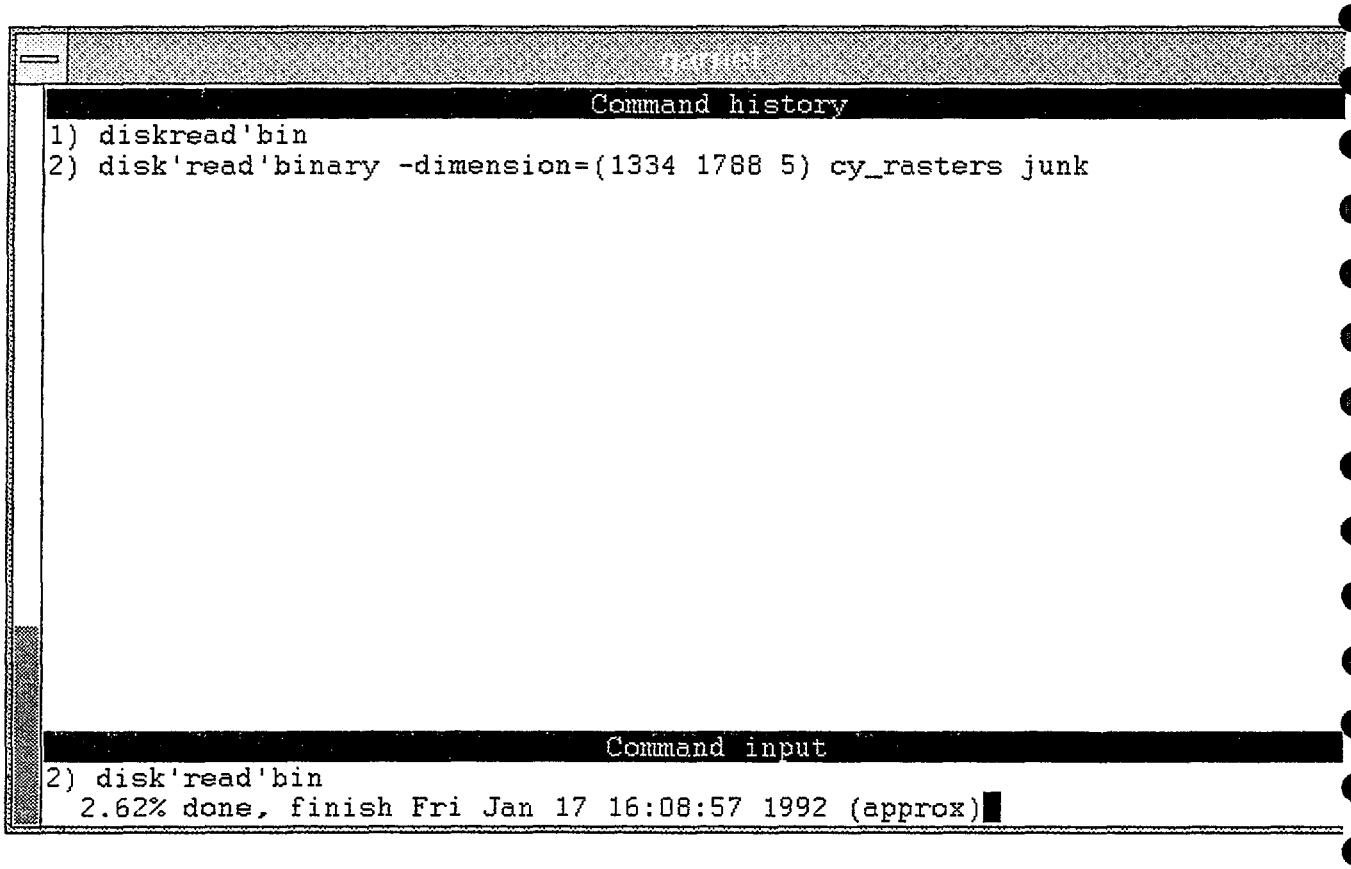


Figure 5 The procedure for importing an ER Mapper image into I²S (see text).

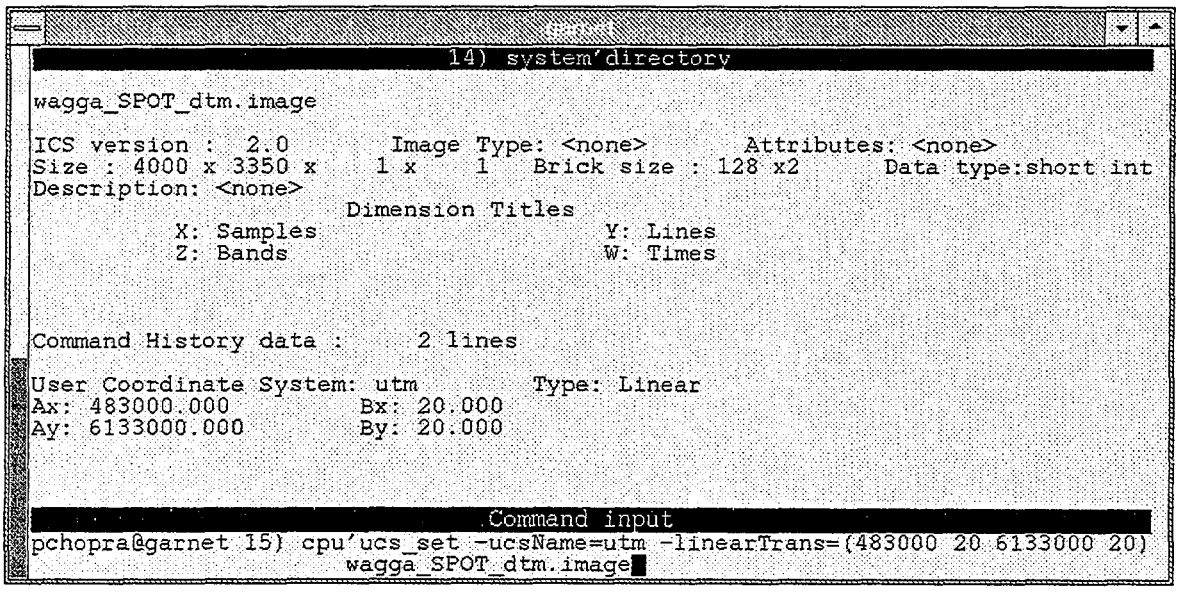
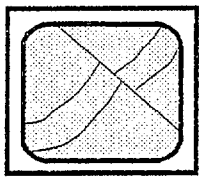


Figure 6 An example in the lower part of the screen showing how the **cpu'ucs_set** can be used in I²S to geo-reference an image imported from ER Mapper. The information in the upper part of the screen was produced by the command **dir wagga_SPOT_dtm.image -full.**

Geo-referenced images which are read into I²S using **disk'read'binary** must subsequently have a User Coordinate System (UCS) created in I²S using the **cpu'ucs_set** command to again geo-reference them. A **de** session illustrating the use of **cpu'ucs_set** is shown in Figure 6. This example uses the dataset associated with Figure 4. The UCS listed in the upper part of Figure 6 was created by the command shown in the bottom of the figure and is displayed here using **dir**.



Vector links between ER Mapper and I²S

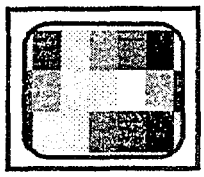
ER Mapper can present vector data from a variety of sources in its display windows. These data can originate from ER Mapper itself as annotation overlays, or they can derive from dynamic links to geographic information systems (GISs) such as Arc/Info and Genamap or relational database management systems (RDBMSs) such as Oracle and Ingres. Alternatively, vector data can be imported into ER Mapper from other spatial IT systems using interchange standards such as dxf, AS2482 and DLG-3. In this case, the imported data are converted into ER Mapper's own vector data format. This format is an open standard and is described at length by Anon (1991).

ER Mapper version 3.2c can export vector data in two formats, viz. as a **dxf** file and as a file formatted for import to Arc/Info using the **generate** command.

The I²S System 600 software as supplied to AGSO is however, essentially a closed proprietary environment. I²S use a format for vectors which they call **grph** which is incompatible with AGSO's other spatial IT systems. In order to circumvent this incompatibility, two I²S user routines have been written in AGSO to provide some import/export capability. These routines are **disk'read'generate** and **disk'write'generate** and they are used in the same way as **disk'read'binary** which is illustrated in Figure 5. These routines read vector data from, and write them to, data files which are in the format used by the Arc/Info **generate** command.

Vector data, such as annotation overlay lines, can be exported from ER Mapper with the UTILITIES / Export Vector / Arc/Info GENERATE Lines command and can then be read into I²S by using **disk'read'generate** command. Vector data files produced by the **ungenerate** command in Arc/Info can also be imported into I²S with **disk'read'generate.** Note however that **disk'read'generate** cannot be used at present to transfer text to I²S, it only works with lines.

Vector data can be exported from I²S using the **disk'write'generate** command. These vector data can then be imported into Arc/Info quite readily. Version 3.2c of ER Mapper does not currently support the **generate** format for data input however. Thus, if vector data are to be moved from I²S to ER Mapper, Arc/Info must be used as an intermediary. Once the data are in Arc/Info, they can be re-exported in **dxf** format and loaded into ER Mapper using the UTILITIES / Import Vector / AutoCAD DXF command.



Raster links between ER Mapper and the Arc/Info GIS

Raster: ER Mapper ----> Arc/Info

As discussed above, ER Mapper's native image file format is band interleaved by line (BIL). Images in this format can be displayed in Arc/Info version 6.1 using the Image Integrator once two files are created and some information is added to them.

The first task in importing an ER Mapper image to Arc/Info ver. 6.1 is to copy it using UNIX to a file with the extension **.bil**. This extension is required for the Image Integrator to recognise the file type. Thus the ER Mapper image file wagga_SPOT_dtm would be renamed to wagga_SPOT_dtm.bil so that Image Integrator could use it.

An ASCII header file for the image must then be created. This file must have the same name as the image file but with the extension **.hdr**. Thus, following on from the example above, the file wagga_SPOT_dtm.hdr would be created using a text editor such as **vi** or **textedit**. An example of a header file is illustrated in Figure 7 using the data for the ER Mapper image wagga_SPOT_dtm and its header file wagga_SPOT_dtm.ers (see Figure 4).

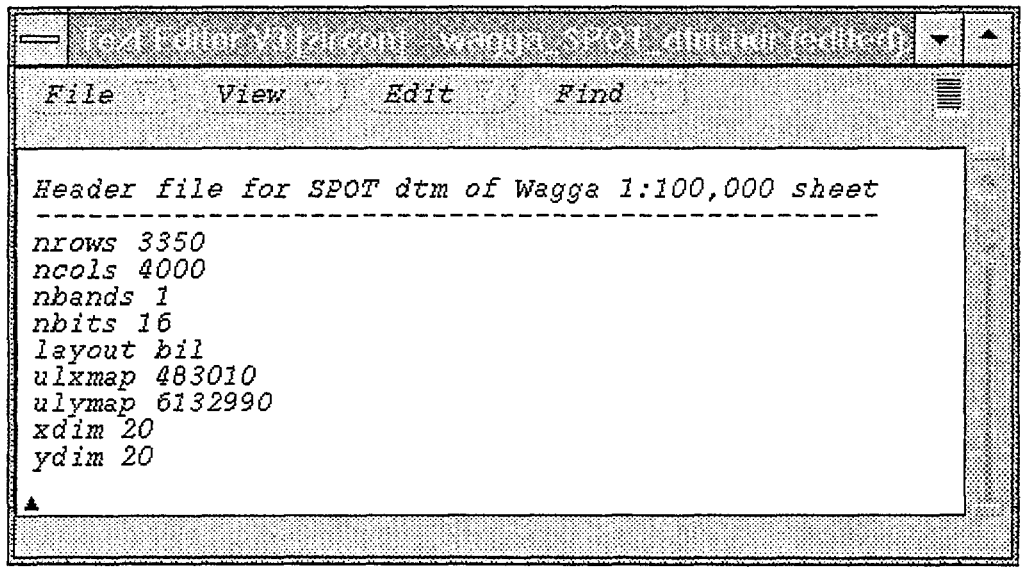


Figure 7 An example of a header file created to allow an ER Mapper image to be imported into Arc/Info's Image Integrator.

The data that must be added to this file can be found in the ER Mapper .ers file (see Figure 4). The nrows value here equates to the value of the **NrofLines** variable in the .ers file. The ncols value equates to NrOfCellsPerLine, nbands to NrOfBands and nbits to CellType. The layout field will always be bil for ER Mapper images. The last four lines

contain the georeferencing information. The xdim and ydim variables equate to the ER Mapper Xdimension and Ydimension variables (i.e. they are the pixel size information in the x and y dimensions --- eastings and northings for images projected in AMG).

The **ulxmap** and **ulymap** variables in the **.hdr** file specify the geo-location of the centre of the top left pixel in the image (i.e. the origin of the image). This convention for the location of the origin in Arc/Info differs from that used by I²S and ER Mapper. In both the latter systems, the origin is defined as the top left corner of the top left pixel.

Because of the different geo-referencing convention in Arc/Info, the values of **ulxmap** and **ulymap** must be calculated as follows for data projected in AMG:

Formulae	**Example from the data of Figure 4**
$\text{ulxmap} = \text{Eastings} + \frac{\text{Xdimension}}{2}$	$\text{ulxmap} = 483000\text{E} + \frac{20}{2} = 483010\text{E}$
$\text{ulymap} = \text{Northings} - \frac{\text{Ydimension}}{2}$	$\text{ulymap} = 6133000\text{N} - \frac{20}{2} = 6132990\text{N}$

Equivalent calculations must be made and the results must be added to the appropriate **.hdr** file before images geo-referenced in other projections can be imported into Arc/Info's Image Integrator as geo-located backdrops.

In most cases a suitable contrast stretch will need to be applied to the image to be imported into the Image Integrator before it will be useful. Image statistics including the maximum and minimum pixel values and preferably, the mean and standard deviation of the distribution of pixel values are required in order to calculate a contrast stretch. These statistics can be easily obtained from ER Mapper by examining the original source image with the UTILITIES / Calculate Statistics command. This procedure is illustrated in Figures 8, 9 and 10. An example of the statistics produced is shown in Figure 11.

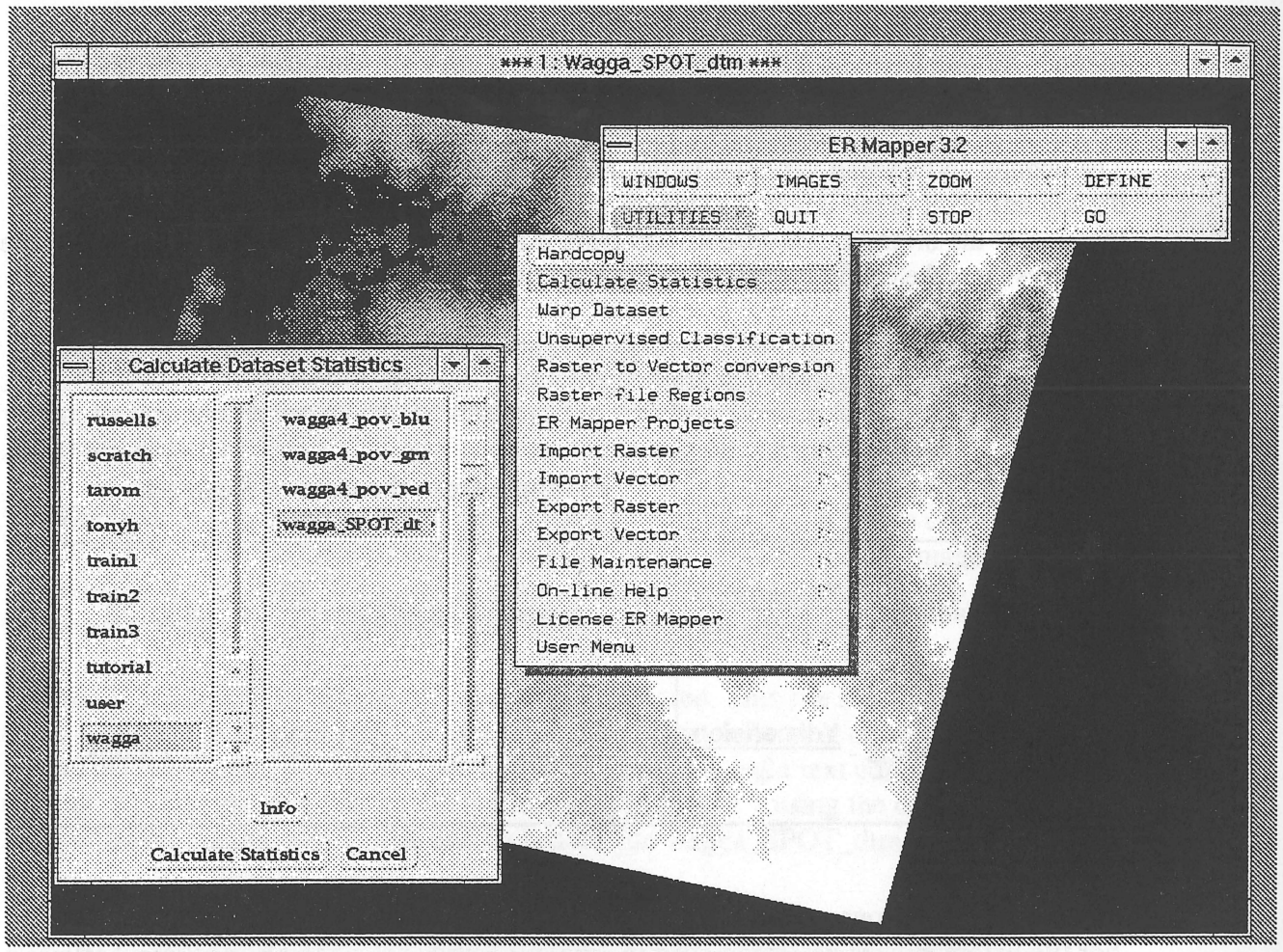


Figure 8 The procedure used in ER Mapper to calculate the statistics of an image. Right click the mouse on **UTILITIES** then left click on **Calculate Statistics** in the drop-down menu. Finally, select the desired dataset from the pick list in the pop-up dialog box and left click on **Calculate Statistics** in that box.

Once the statistics have been displayed as in Figure 11, an ASCII image statistics file for the image must be created. This file must have the same name as the image file but with the extension **.stx**. Thus, following on with the example I have been using, the file wagga_SPOT_dtm.stx would be created using a text editor such as **vi** or **textedit**. An example of such an image statistics file is illustrated in Figure 12 using the data produced by ER Mapper that are shown in Figure 11. The image statistics are entered on a single line for each band of the image. In this case, the image has only one band so there is only one line of data. The comments in the file are all ignored by Arc/Info but serve as a useful description for the user.

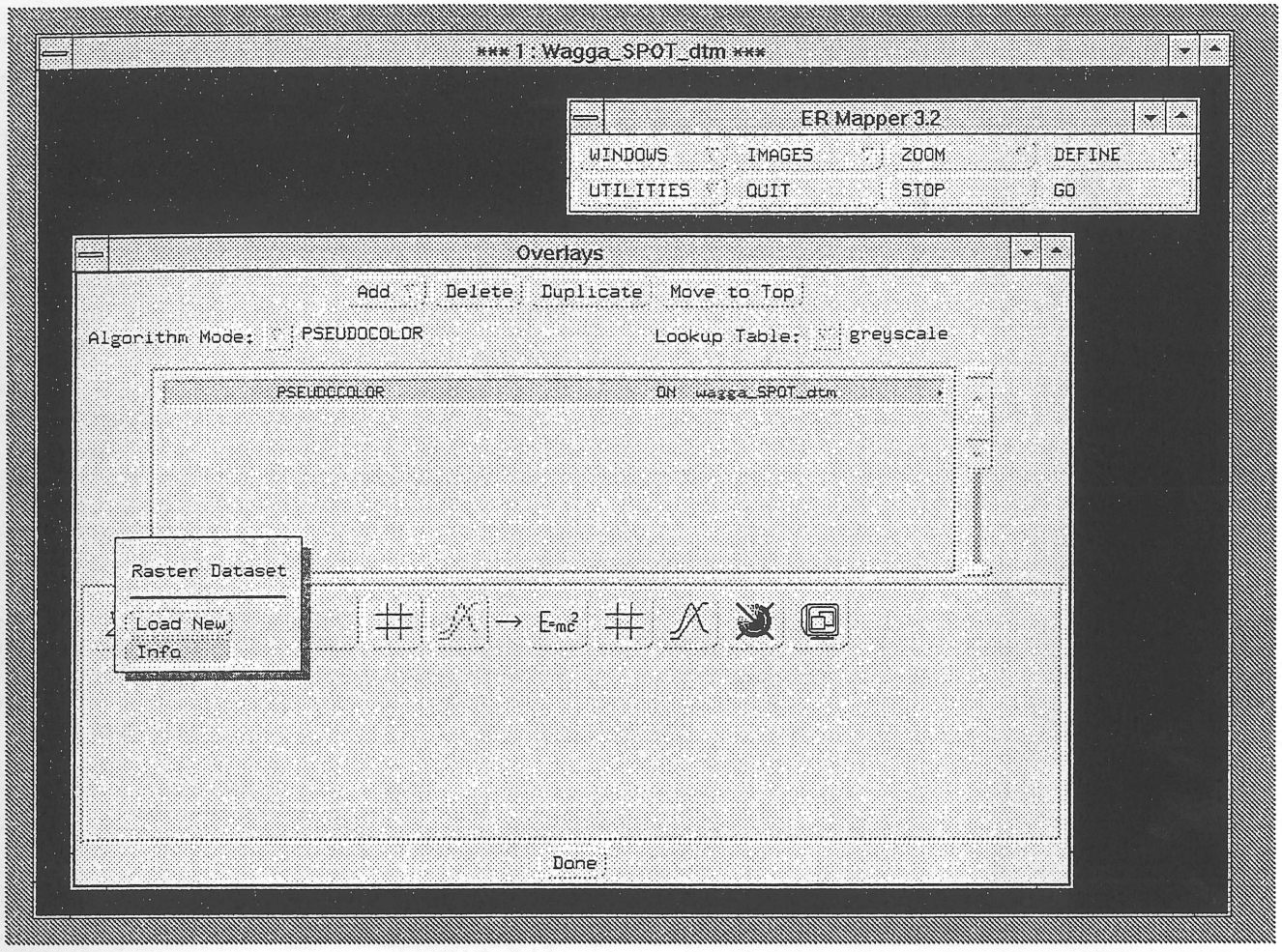


Figure 9 The calculated image statistics can be retrieved by firstly selecting **Info** from the **Raster Datasets** pop-up menu on the "Overlays" menu. The pop-up is accessed by clicking the right mouse button with the cursor over the datasets glyph (now partially obscured by the pop-up in the figure).

Once the **.hdr** and **.stx** files have been created, the image can be displayed in Arc/Info. The commands to do this are illustrated in Figure 13. Note that the spatial extent of the image in Arc/Info (as reported by the **show mapextent** command) is 10% larger than that of the original image in ER Mapper. This larger size arises because Arc/Info puts a border around its datasets which has a width equal to 5% of the data extent.

The **display colormap 256 0** command used in Figure 13 is optional. This command sets the colour look up table to the best available for the image being displayed but it can make for a flashing display when the mouse cursor is moved out of the **Arcplot** window.

Alternatively, a colour look up table can be constructed for single band images. The procedure for doing this is described in the Arc/Info Image Integrator manual (page 5-11 in version 6.1 of Arc/Info).

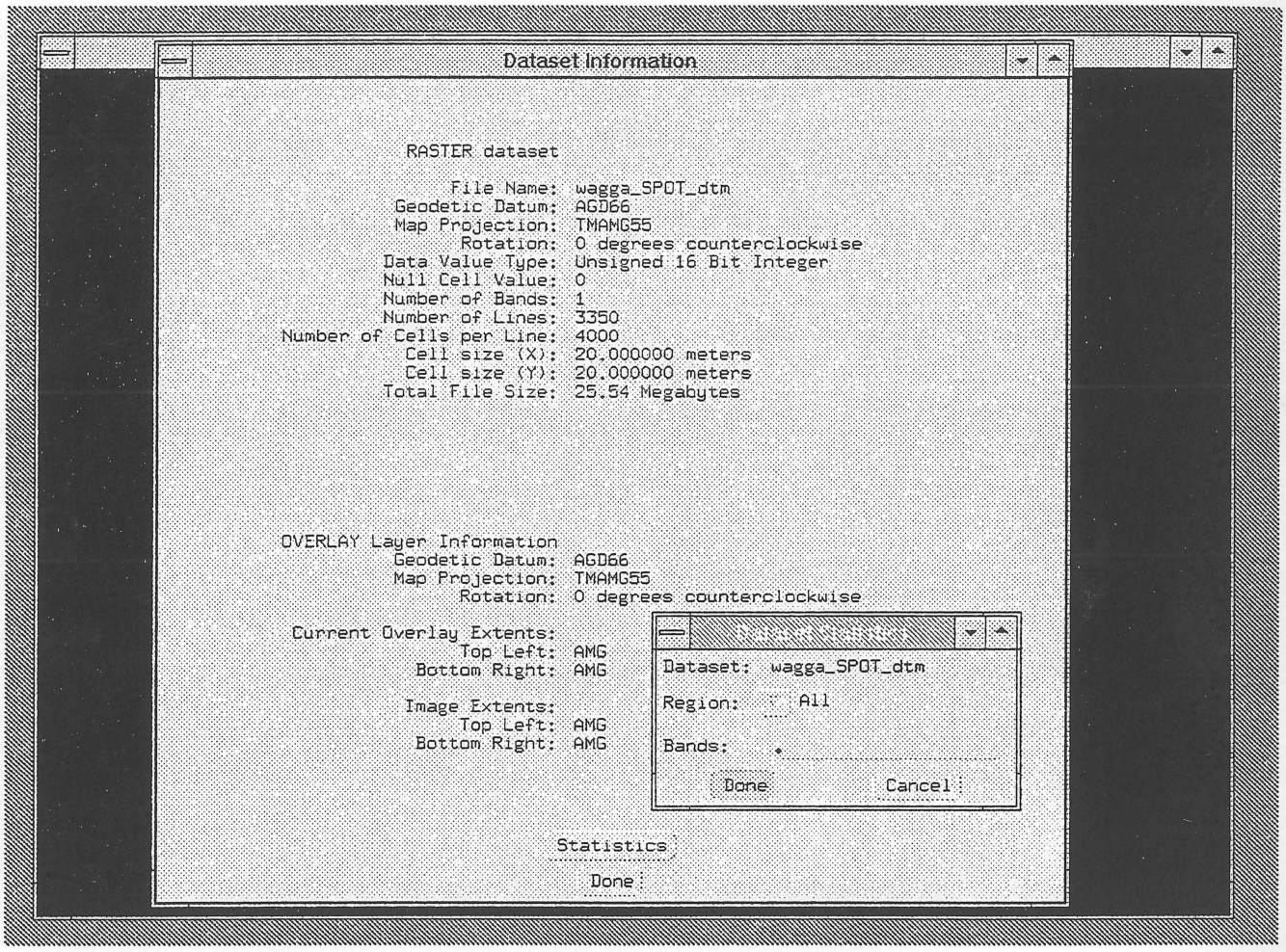


Figure 10 The dataset statistics are accessed by selecting **Statistics** from the "Dataset Information" screen and then selecting **Done** on the "Dataset Statistics" pop-up dialog box.

Once the image is accessible by Arc/Info it can be used as a static backdrop to polygon, vector and point coverages. It can also be converted into an Arc/Info **grid** to permit raster modelling and some image processing. The procedure for converting an image into a grid and then displaying it on an X11 device is illustrated in the following example:

```
Arc: &stat 9999
Arc: imagegrid wagga_SPOT_dtm.bil wagga_spotdtm
Arc: arcplot
Arcplot: map dtm_grid
Arcplot: mapextent wagga_spotdtm
Arcplot: gridpaint wagga_spotdtm value equalarea # gray
Arcplot: map end
```

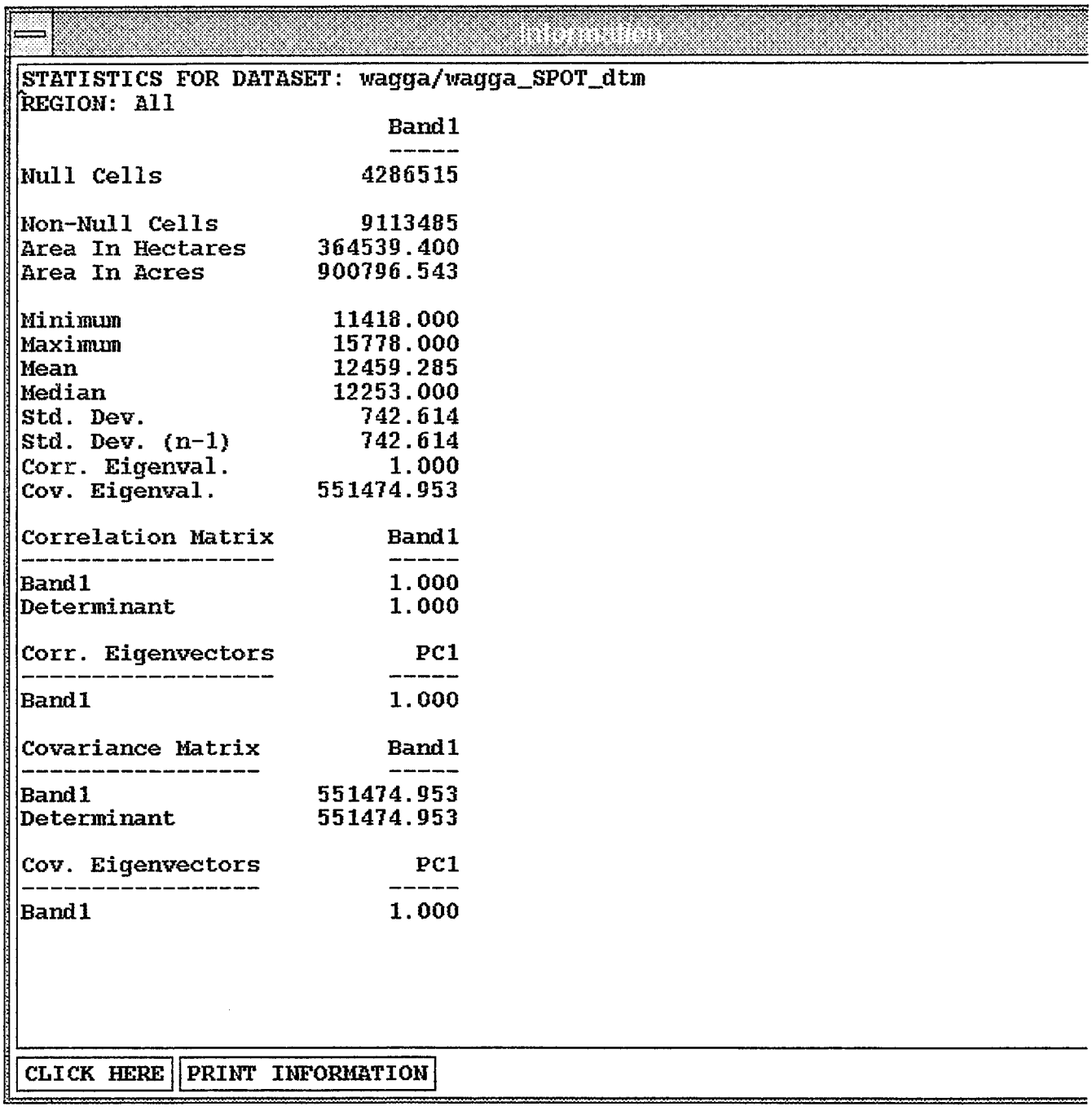


Figure 11 The dataset statistics for an ER Mapper image produced by the UTILITIES / Calculate Statistics command.

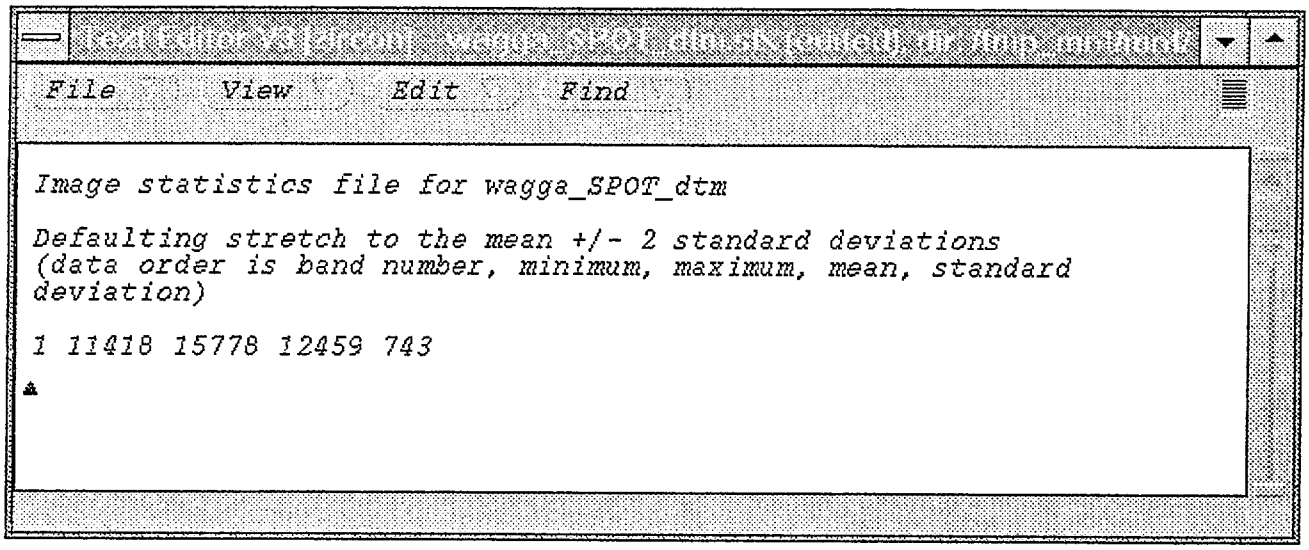


Figure 12 An example of a **.stx** file created for Arc/Info's Image Integrator. The data in the file come from ER Mapper's Dataset Statistics function (see text).

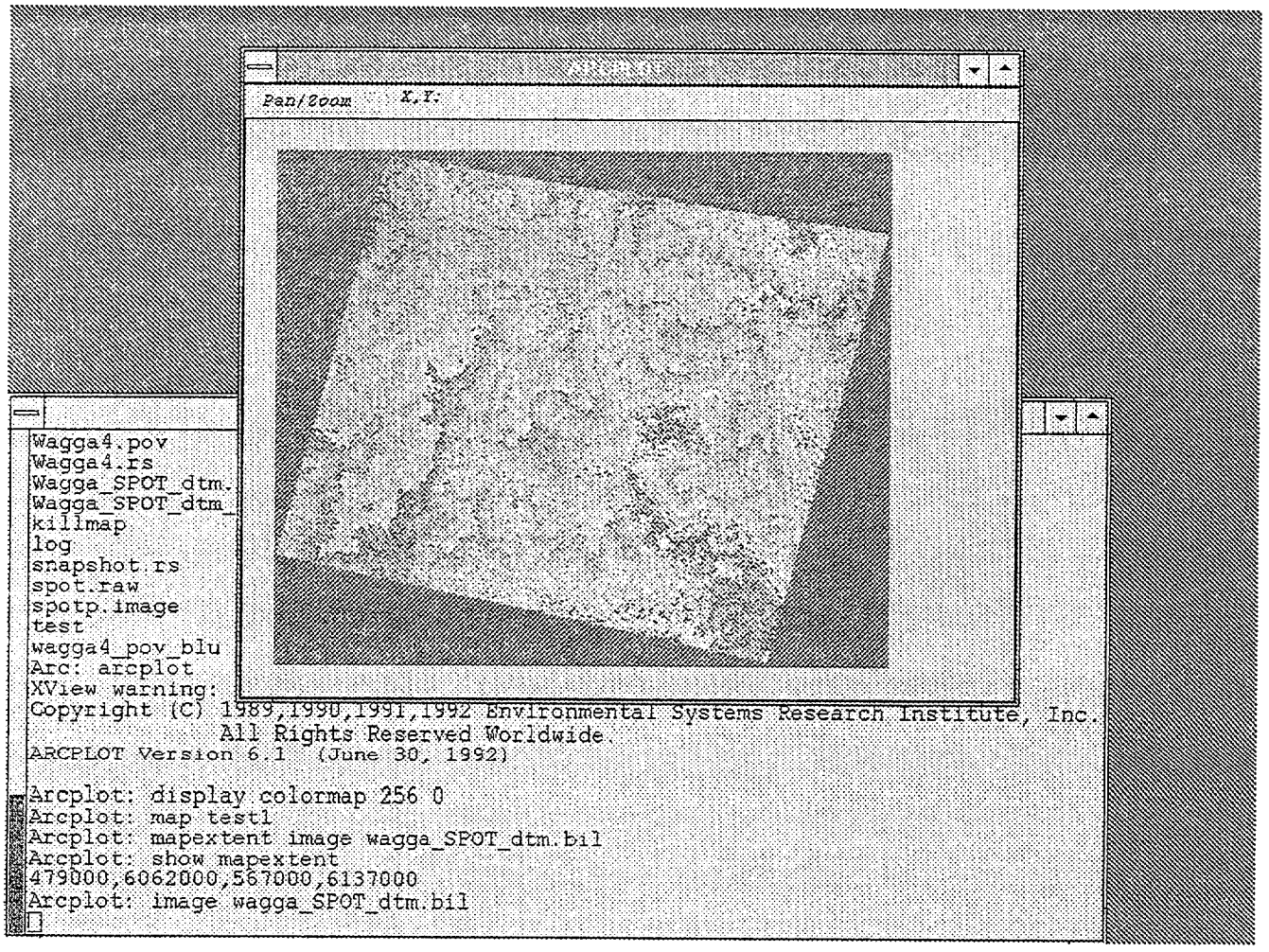


Figure 13 The ER Mapper image now imported into Arc/Info's Image Integrator, correctly geo-referenced and intensity stretched. This image can now be converted into an Arc/Info grid using the **imagegrid** command (see text).

Raster: Arc/Info ----> ER Mapper

Arc/Info's Image Integrator supports eight image file formats in version 6.1 of the software. Six of these formats (viz. Erdas, TIFF, Sun rasterfile format, BIL and band interleaved by pixel) are valid import formats for ER Mapper. Thus the image data from these files can be read into ER Mapper using the UTILITIES / Import Raster command and then picking the appropriate image format from the drop-down menu (see Figure 2). The other three formats supported by Arc/Info's Image Integrator (viz. GRASS, Run-length compressed and grid) can be converted to one of the six compatible formats by using the Arc/Info **convertimage** command.

Once an image has been imported into ER Mapper, any geo-referencing data that was associated with it in Arc/Info must also be copied over. This task is essentially the same as was described previously for image transfers between I²S and ER Mapper (i.e. the entries in the **.ers** file shown in Figure 4 must again be made).

As remarked previously, Arc/Info uses a different origin convention for its images to that of ER Mapper (and I²S). This requires that the origin be recalculated before the edits can be made to the **.ers** file.

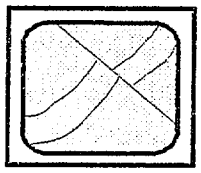
The geo-referencing information for the Arc/Info image can be found in its associated ASCII header file. This header file will generally have the same name as the image but will have the extension **.hdr** appended. It should be in the same directory as the image.

The **xdim** and **ydim** variables are the sizes of the pixels in the x and y dimensions (Eastings and Northings for AMG). These values equate to the **Xdimension** and **Ydimension** variables which must be added to the **.ers** file (see Figure 4).

Because of the different geo-referencing convention in Arc/Info however, the values of **ulxmap** and **ulymap** do not equate directly to the **RegistrationCoord** fields in the **.ers** file. The values for these fields must be calculated as follows for data projected in AMG:

Formulae	**Example from the data of Figure 7**
$\text{Eastings} = \text{ulxmap} - \frac{\text{xdim}}{2}$	$\text{Eastings} = 483010\text{E} - \frac{20}{2} = 483000\text{E}$
$\text{Northings} = \text{ulymap} + \frac{\text{ydim}}{2}$	$\text{Northings} = 6132990\text{N} + \frac{20}{2} = 6133000\text{N}$

Equivalent calculations must be made and the results must be added to the ER Mapper **.ers** file before images geo-referenced in other projections in Arc/Info's Image Integrator can be used in ER Mapper as geo-located images.



Vector links between ER Mapper and the Arc/Info GIS

Vector: Arc/Info ----> ER Mapper

There are two ways in which vector data in Arc/Info can be displayed in ER Mapper.

1) Data imports
Vector data in an Arc/Info coverage can be exported in a **dxf** file by using the **arcdxf** command in Arc/Info. The resulting **dxf** file can then be imported into ER Mapper by using the UTILITIES / Import Vector / AutoCAD DXF command.

The **dxf** file contains all the necessary geo-referencing information for the data including such things as the maximum and minimum spatial extents of the data, the scale and the units. These details are all correctly picked up by the ER Mapper import routine and they are incorporated in the **.erv** file that is created. No editing of the **.erv** file is necessary before it can be used.

To display the vector data, use the OVERLAYS / Add / Annotation overlay command in ER Mapper to create a new overlay in the "Overlays" menu (see Figure 1). Associate this overlay with the new vector data by clicking SELECT on the dataset glyph for the new overlay. Then pick the new vector dataset from the "Load Annotation overlay" pop-up menu and click on Done to close it.

Finally, click on GO on the main ER Mapper menu to display the data.

An example of the overlay of imported Arc/Info vector coverage data on an ER Mapper image is shown in Figure 14.

2) Dynamic Links
ER Mapper has a dynamic link facility which allows it to extract vector information from GISs such as Arc/Info and Genamap on a temporary, as required basis. When such a dynamic link has been set up, each time the GO button is pressed in ER Mapper, a request is sent to the GIS for the current version of the specified vector coverage. These vector data are then processed by ER Mapper and rendered to the display screen as a colour Postscript overlay.

To set up a dynamic link between ER Mapper and an Arc/Info coverage use the OVERLAYS / Add / Dynamic Link to ARC/INFO / ARC/INFO Release 6 command.

For the dynamic link to work, ER Mapper must be able to locate the Arc/Info executable and it must be pointed at the directory which contains the coverage to be linked. The location of Arc/Info and the coverages are specified in the configuration file:

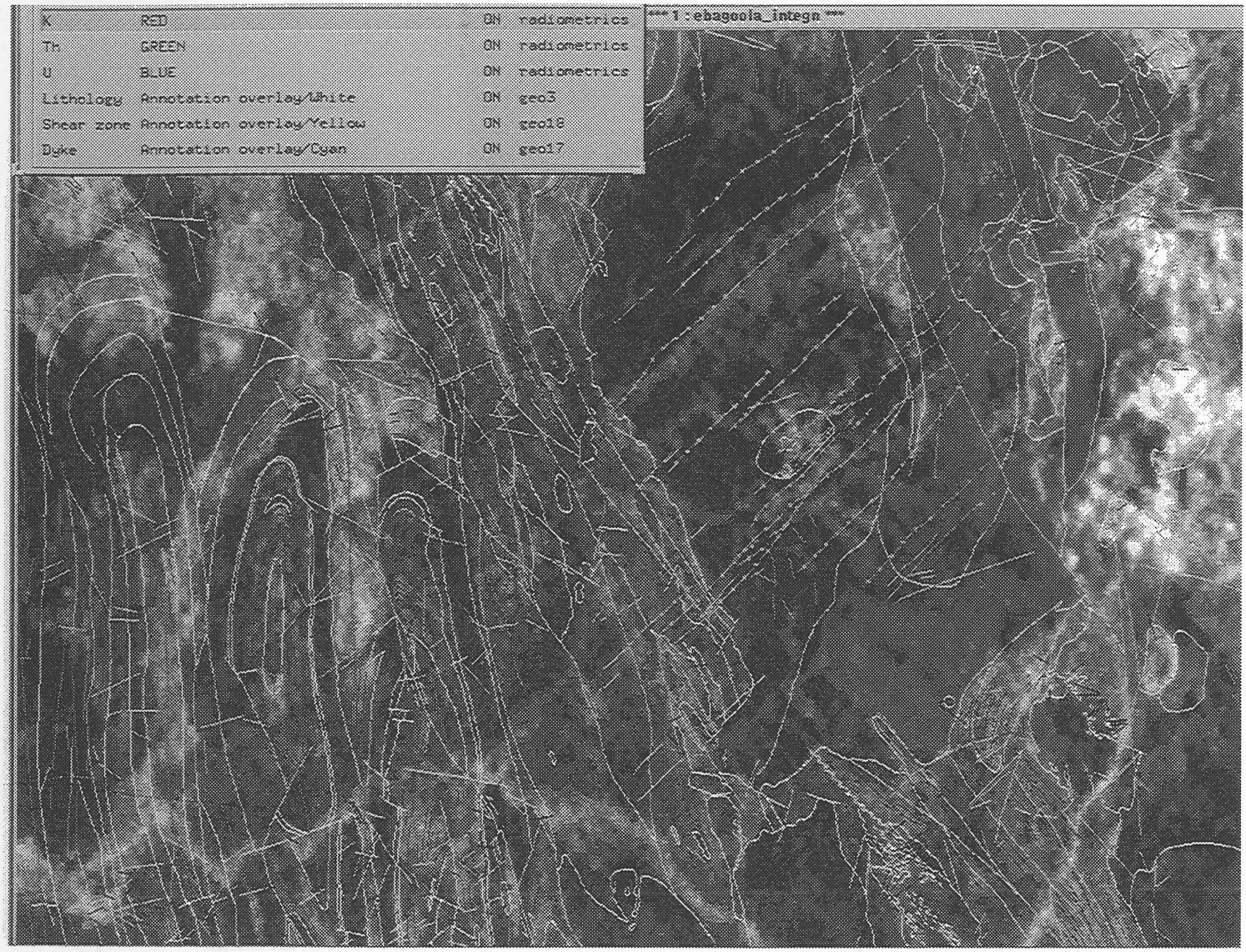


Figure 14 An example of vector data (representing geological boundaries) from Arc/Info overlain on airborne gamma spectrometry (K in red, Th in green and U in blue) for part of the Ebagoola 1:250,000 sheet. The image data come from the AGSO National Airborne Geophysical Database, 1992. The vectors are from the NGMA North Queensland Project.

$ERMAPPER/config/site.erm

This file contains a section which specifies the Arc/Info environment. It should look something like the following example:

```
################## ARC/Info ############################
# The ARC/Info workspace to access.  Normally the full unix path name.
# The dynamic link programs ignore case for workspace. (forced to lower-
# case)
ARC_WORKSPACE  = "/itch/ermapper"     # The Arc/Info workspace

# the Arc/info command.  Normally the full path to ARC/Info,
# as that is needed by rsh
ARC_ARC        = "/usr/esri/arcexe61/programs/arc" # full pathname of arc

# Comment this line out if ARC/Info is on the same machine as ER Mapper
# ARC_REMOTE   = "zircon"     # the remote host to access via rsh and
rcp
```

A symbolic link must be created in the /itch/ermapper directory using the command:

ln -s <filename> <linkname>

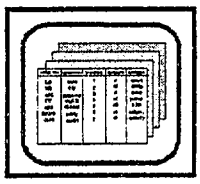
where	<filename>	is the full pathname of the Arc/Info coverage
and	<linkname>	is the name to be given to the link. This is the name which appears in the ER Mapper pick-list dialog box when the dynamic link is set up.

Some examples of symbolic links used in creating dynamic links between ER Mapper and Arc/Info vector coverages are as follows:

```
lrwxrwxrwx  1 pchopra     22 Sep 17 10:58 ebag_geol1 -> //isb/ebagoola/structures
lrwxrwxrwx  1 pchopra     29 Sep  7 11:35 ebagoola_geol ->/isb/ebagoola/lithology
lrwxrwxrwx  1 dwyborn      25 Jun 25 20:15 faults -> /mnt/tonyh/blayney/faults
lrwxrwxrwx  1 dwyborn      23 Jun 24 09:13 geol -> /mnt/tonyh/blayney/geol
lrwxrwxrwx  1 dwyborn      19 Dec 14 14:17 lachmap -> /gis/doonew/lachmap
```

ER Mapper ----> Arc/Info

Vector data, such as annotation overlay lines, in ER Mapper's own format (i.e. stored as a data file and a **.erv** header file) can be exported to other spatial data systems such as Arc/Info by using the UTILITIES / Export Vector / AutoCAD DXF command. The **dxf** file that is produced contains all the necessary geo-referencing information and can be read into Arc/Info using the **dxfarc** command.



Linking Point Data in the Oracle RDBMS to ER Mapper

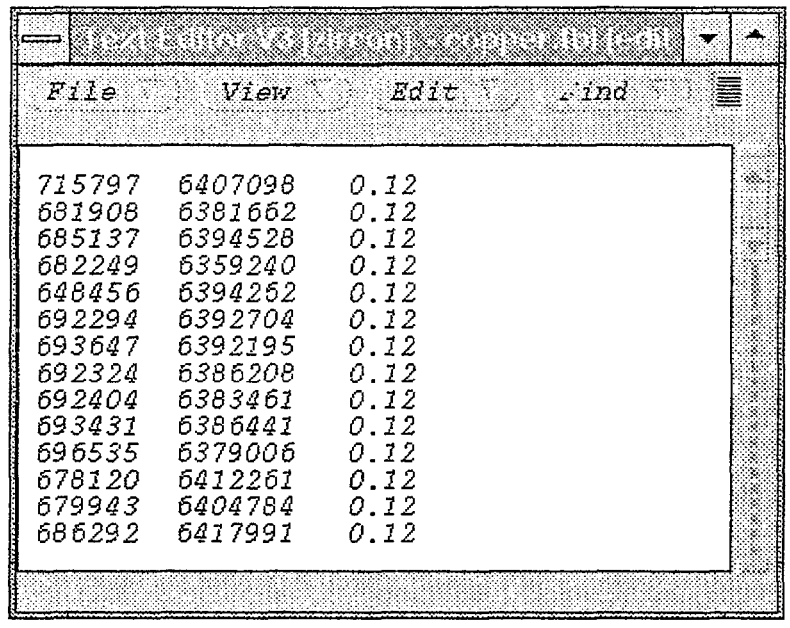
There are two ways in which point data in the Oracle RDBMS can be displayed in ER Mapper.

1) Data imports
Point data held in the Oracle RDBMS on the AViiON 6240 computer can be exported to an ASCII data file which can be read into ER Mapper and displayed. The data must be written to a file with the extension **.tbl** for ER Mapper to recognise it as valid tabular data. The data are read into ER Mapper using the OVERLAYS / Add / External Vector Formats / Table of data shown as circles command.

The format of the ASCII data file must conform to the following template. Note, no header information is allowed in the file so it is a good idea to give each data file a meaningful name.

X-coordinate	Y-coordinate	Value

The "Value" variable is the diameter of the circle that is to be drawn around the plotted point on the display and/or hardcopy. This diameter is expressed in display and plotter inches. Thus, the following example **.tbl** file would result in a circle with a diameter of 0.12" being drawn around each point in a display which is geo-referenced in AMG.

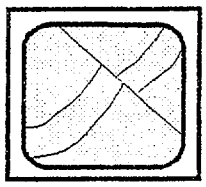


By constructing a suitable query, it is possible to have the Oracle RDBMS put a value into column three which is scaled by one of the attribute fields in the database table. Thus for example, the diameter of the circles drawn by ER Mapper in its displays could be made a function of the concentration of Ni in geochemical analyses from the ROCKCHEM database.

2) Dynamic links

ER Mapper also has a dynamic link facility which allows it to extract point data from RDBMSs such as Oracle and Ingres on a temporary, as required basis. When such a dynamic link has been set up, each time the GO button is pressed in ER Mapper, a request is sent to the RDBMS for the current version of the specified data. These data are then processed by ER Mapper and rendered to the display screen as a colour Postscript overlay.

At present, the dynamic link to Oracle facility has not been set up at AGSO. This set up is complicated by the fact that the computers running ER Mapper and Oracle are not binary compatible (the former is a Sun computer running SunOS and the latter a Data General running DG/UX).



Vector links between ER Mapper and the Intergraph digital cartography system

Vector: Intergraph ----> ER Mapper

Vector data in the Intergraph system can be exported in a **dxf** file which can be transferred to the Sun computers which run ER Mapper. This **dxf** file can then be imported into ER Mapper by using the UTILITIES / Import Vector / AutoCAD DXF command.

Care must be taken, when transferring data in **dxf** files, that the data are in the appropriate units. For example, the 1:250,000 digital maps generated in AGSO's Intergraph system are normally projected in AMG with units of kilometres (e.g. 715.797E, 6407.098N) whereas the I²S and ER Mapper systems generally work in metres (e.g. 715797E, 6407098N). Thus in order to co-register normal Intergraph data with images in ER Mapper, the data must firstly be transformed to AMG space in metres. This transformation can be done in the Intergraph system, or it can be done in Arc/Info. In the latter case, the **dxf** file must be read into Arc/Info, the data transformed and then written back out as a new **dxf** file for ER Mapper. An example of how to transform data from kilometres (in the cover geol_250000) to metres (in the cover geol_250000_m) is shown below:

```
Arc: create geol_250000_m geol_250000
Creating coverage geol_250000_m
Arc: info
 INFO  EXCHANGE  CALL
04/08/1992  14:25:42
 INFO  9.42  11/11/86  52.74.63*
COPYRIGHT 1986 HENCO SOFTWARE, INC.
 ENTER USER NAME>ARC

 ENTER COMMAND >SEL GEOL_250000_M.TIC
    4 RECORD(S) SELECTED

 ENTER COMMAND >LIST
 $RECNO  IDTIC          XTIC          YTIC
    1     1        827.48740     8,338.37500
    2     2        661.27785     8,338.37500
    3     3        661.27785     8,451.75525
    4     4        827.48740     8,451.75525

 ENTER COMMAND >UPDATE XTIC,YTIC BY IDTIC PROMPT
 IDTIC?>1
          1
 XTIC          =       827.48740
 YTIC          =     8,338.37500
```

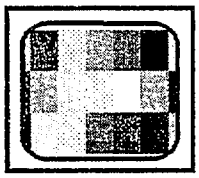
```
XTIC>827487.4
YTIC>8338375.0
 IDTIC?>2
          2
 XTIC        =      661.27785
 YTIC        =    8,338.37500
XTIC>661277.85
YTIC>8338375.0
 IDTIC?>3
          3
 XTIC        =      661.27785
 YTIC        =    8,451.75525
XTIC>661277.85
YTIC>8451755.25
 IDTIC?>4
          4
 XTIC        =      827.48740
 YTIC        =    8,451.75525
XTIC>827487.4
YTIC>8451755.25
 IDTIC?>

 ENTER COMMAND >LIST
 $RECNO  IDTIC          XTIC          YTIC
    1     1    827,487.40000  8,338,375.00000
    2     2    661,277.85000  8,338,375.00000
    3     3    661,277.85000  8,451,755.25000
    4     4    827,487.40000  8,451,755.25000

 ENTER COMMAND >Q STOP

Arc: transform geol_250000 geol_250000_m
Transforming coordinates for coverage geol_250000

Scale (X,Y) = (1000.000,1000.000)  Translation = (0.000,0.000)
Rotation (degrees) = (0.000)  RMS Error (input,output) = (0.000,0.000)

tic id      input  x       input  y
          output x       output y        x error         y error
------ --------------- --------------- --------------- ---------------
   1        827.487         8338.375
          827487.400      8338375.000         0.000           0.000
   2        661.278         8338.375
          661277.850      8338375.000         0.000           0.000
   3        661.278         8451.755
          661277.850      8451755.250         0.000           0.000
   4        827.487         8451.755
          827487.400      8451755.250         0.000           0.000

Arc: arcdxf geol_250000_m.dxf geol_250000_m
```

The **dxf** file contains all the necessary geo-referencing information for the data including such things as the maximum and minimum spatial extents of the data, the scale and the units. These details are all correctly picked up by the ER Mapper import routine and they are incorporated in the **.erv** file that is created. No editing of the **.erv** file is necessary before it can be used.

To display the vector data, use the OVERLAYS / Add / Annotation overlay command in ER Mapper to create a new overlay in the "Overlays" menu (see Figure 1). Associate this overlay with the new vector data by clicking SELECT on the dataset glyph for the new overlay. Then pick the new vector dataset from the "Load Annotation overlay" pop-up menu and click on Done to close it. Finally, click on GO on the main ER Mapper menu to display the data.

Vector: ER Mapper ----> Intergraph

Vector data, such as annotation overlay lines, in ER Mapper's own format (i.e. stored as a data file and a **.erv** header file) can be exported to other spatial data systems such as the Intergraph digital cartography system by using the UTILITIES / Export Vector / AutoCAD DXF command. The **dxf** file that is produced contains all the necessary geo-referencing information and can be read into the Intergraph system. Note again however that the map units may need to be transformed from metres to kilometres.

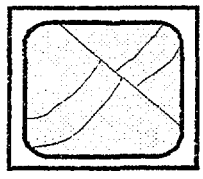


Raster links between ER Mapper and the Intergraph digital cartography system

At present, the only way of transferring image data between ER Mapper and the Intergraph system that has been tested is to use the I²S image processing system as an intermediary. The routines **disk'read'intergraph** and **disk'write'intergraph** were written in AGSO to permit image data traffic between I²S and Intergraph. The **disk'read'intergraph** routine reads single band Intergraph continuous tone files (**.cot**) and converts them to the I²S **flab** format. The **disk'write'intergraph** routine works in the opposite direction and can be used to generate files from the I²S system for output on the Optronics raster scanner/plotter.

Thus, users wanting to send ER Mapper image files to the Intergraph system should firstly export them to the I²S system (see the earlier section in this Record for the procedure) and then use **disk'write'intergraph** to convert them to **.cot** format. Users wanting to load Intergraph **.cot** files into ER Mapper (e.g. maps scanned on the Optronics raster scanner/plotter) should first import the files to I²S using **disk'read'intergraph** and then

import the I²S file into ER Mapper using the UTILITIES / Import Raster / Import S600 command.



Vector links between ER Mapper and the Petroseis basin analysis system

Petroseis ----> ER Mapper

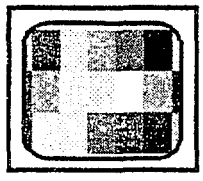
Vector data in the Petroseis system can be exported in a **dxf** file which can be transferred to the Sun computers which run ER Mapper. This **dxf** file can then be imported into ER Mapper by using the UTILITIES / Import Vector / AutoCAD DXF command.

The **dxf** file contains all the necessary geo-referencing information for the data including such things as the maximum and minimum spatial extents of the data, the scale and the units. These details are all correctly picked up by the ER Mapper import routine and they are incorporated in the **.erv** file that is created. No editing of the **.erv** file is necessary before it can be used.

To display the vector data, use the OVERLAYS / Add / Annotation overlay command in ER Mapper to create a new overlay in the "Overlays" menu (see Figure 1). Associate this overlay with the new vector data by clicking SELECT on the dataset glyph for the new overlay. Then pick the new vector dataset from the "Load Annotation overlay" pop-up menu and click on Done to close it. Finally, click on GO on the main ER Mapper menu to display the data.

ER Mapper ----> Petroseis

There is no straightforward way at present to transfer vector data from ER Mapper to the Petroseis system. Such transfers are severely hampered at the moment by the poor import capability of the Petroseis software.



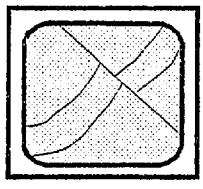
Raster links between ER Mapper and the Intrepid airborne geophysics data processing system

The Intrepid airborne geophysics data processing system uses ER Mapper's raster data format as its native image format. Thus, Intrepid image data are stored in a binary BIL file

and an accompanying ASCII **.ers** file in exactly the same way that ER Mapper's images are.

Intrepid uses the same naming conventions for projections and geodetic datums (e.g. TMAMG54 and AGD66) and the same structure in the **.ers** file as that which has been developed for ER Mapper. These conventions and structures are described by Anon (1991).

As a result of this format compatibility, image files from ER Mapper and Intrepid can be used interchangeably on both systems. There is no need to import and export image files from one system to the other.



Vector links between ER Mapper and the Intrepid airborne geophysics data processing system

The Intrepid airborne geophysics data processing system uses its own format for storing point, vector and polygon data. This format is incompatible with ER Mapper.

Vector data can only be imported into Intrepid at present in a BHP Data Definition File (**DDF**) format. Similarly, export of vector data from Intrepid is only possible in **DDF** format. **DDF** is a column delimited ASCII format.

Transferring vector data between ER Mapper and Intrepid at present is only possible by laboriously manufacturing a **DDF** file. In the case of vector data transfers from ER Mapper to Intrepid, the best starting point will probably be the ASCII file produced by the **UTILITIES** / **Export Vector** / **Arc/Info GENERATE Lines** command. For data transfers in the opposite direction, it will probably be necessary to convert a **DDF** file into the format required by the **generate** command in Arc/Info. Import into Arc/Info using **generate** and subsequent export using **arcdxf** would then produce a file that ER Mapper could read.

Conclusions

This Record provides details of how the ER Mapper image processing system and its data holdings can be integrated with AGSO's other spatial IT systems and their data. The necessary mechanisms for moving data between ER Mapper and the I²S, Arc/Info, Oracle, Petroseis, Intrepid and the Intergraph systems are described. These mechanisms are explained and illustrated with practical examples. File transfers, dynamic links and data format conversions are documented, as appropriate, for each system for raster (image) data, and vector (point, and line) data.

The procedures that are described provide the basic tools for integrating ER Mapper with the other AGSO spatial IT systems. However, using these tools is really only the first step in successfully integrating data. The users must still make important judgements about which of their data are to be integrated, in what form they will be integrated, how they will be processed prior to, and after integration, and how conflicts between different data sets will be resolved.

References

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Chopra P.N. and Creasey J.W. (1992). Integrating raster data into a spatial data system, *Bureau of Mineral Resources, Geology & Geophysics, Australia, Record* 1992/27, pp. 103-120.

Chopra P.N., Creasey J.W. and Wilford J.R. (1992). The nexus between image processing and GIS and its influence on the integration of high resolution geoscientific data, In: Proceedings of the 6th Australasian Remote Sensing Conference,Wellington N.Z., November 1992, pp. 2-328 to 2-337.

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