

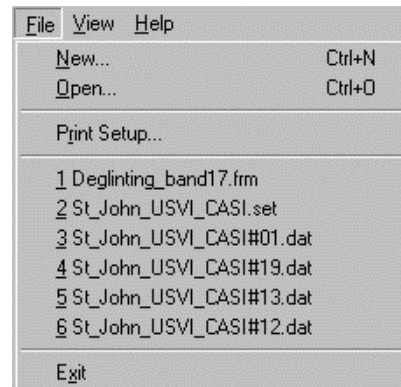
2. OPENING, VIEWING AND SAVING IMAGES

Aim: To introduce you to the details of opening, viewing and saving images in *Bilko*.

Objectives: You will learn (i) how to open a complex binary “flat file” image, (ii) details of the structure of images, (iii) how to save an image in *Bilko* data format, (iv) how to connect related images so that they can be readily compared or made into colour composites, (v) to create a “set” of related images, (vi) how to zoom in and out of an image, and (vii) how to open a hierarchically structured file in a format such as N1, HDF or netCDF.

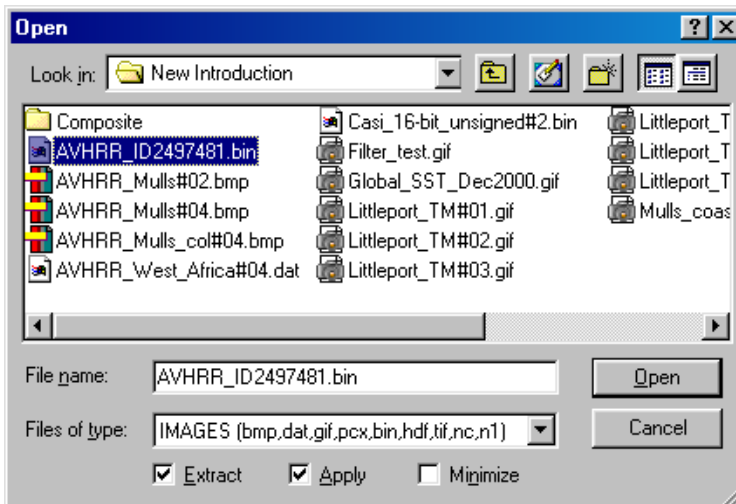
To make use of the *Bilko* software it is necessary to provide an image on which to perform the available operations. *Bilko* works with various types of ‘documents’ (files), as was noted in the [Using Bilko Help](#) section. If you are on a computer network, find out the drive and folder where images, palettes, stretches and other files used by *Bilko* are stored in case you need to tell the program software where to find them.

Activity: Click on the **File** menu: note that the names of the six most recently used files are indicated on the menu (see example to right). Then click on **Open**. This brings up the **Open** dialog box, which will initially be looking to list files of the IMAGES document type, since nothing useful can be done until an image is opened. [*Note: make sure the Extract and Apply check boxes are checked, and the Minimize button is unchecked for this tutorial*].



Images may be stored in a number of formats, which are denoted by the various file extensions in parentheses after IMAGES in the **Files of type:** box (see below). In order to introduce you to the range of options available for opening images, you will start with a complex image; as you will see later, opening images is normally much more straightforward. Once you have mastered how to open this complex image you should be able to open any appropriately formatted image in *Bilko*.

Activity: The file you will work with first is called **AVHRR_ID2497481.bin**. If this is listed in the **File name:** list box, double-click on it to open it.



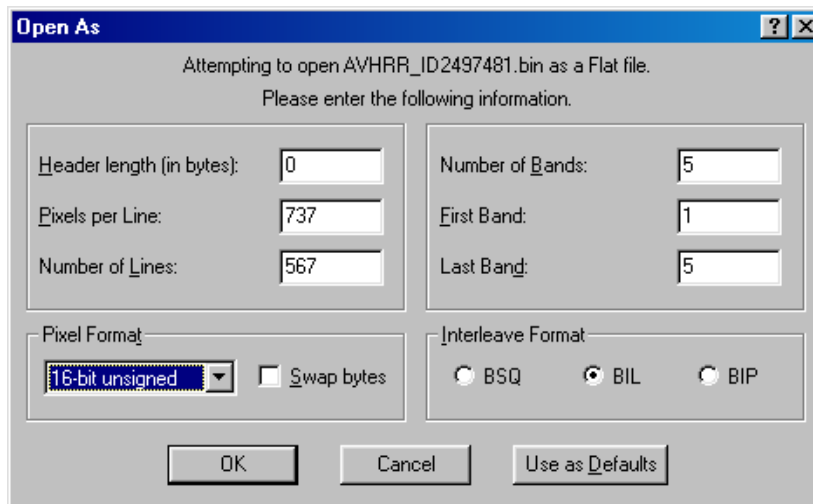
If necessary: Use the **Look in:** box to tell *Bilko* where the images are stored (normally the **Introduction** folder within the **Module07** or later module folder) and then click on **AVHRR_ID2497481.bin** followed by the **Open** button.

This will start the process of displaying the image file named **AVHRR_ID2497481.bin**. This is a so-called binary “flat file” which can be read by most image processing programs if you

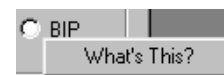
know its structure.

In this case you need to tell the computer what the structure of the binary file is in some detail as it is very different from the default settings (512 pixels per line, 256 lines, 8-bit unsigned, BSQ, 1 band only, etc.). The details of the **AVHRR_ID2497481.bin** image file are as follows:

- (i) the image has no header (**Header Length:** is 0),
- (ii) it has **737 Pixels per Line:** (i.e. the image has 737 columns or its DX: = 737),
- (iii) the **Number of Lines:** per band is 567 (i.e. the image has 567 rows/lines; its DY: = 567),
- (iv) the **Pixel Format:** is 16-bit unsigned (i.e. each pixel value is stored as an integer value in 2 bytes = 16-bits, with no negative values); there is no need to “Swap bytes” as the flat binary file was created on another PC. However, if it had been created on an Apple Macintosh or Unix system, then you might have needed to check this box (see *Bilko Help* for further details).
- (v) the **Number of Bands:** is 5,
- (vi) you want to display all bands, so set **First Band:** to 1 and **Last Band:** to 5.
- (vii) the **Interleave Format** is BIL (Band Interleaved by Line). This means that the first 737 pixels [stored as 1474 bytes (= 2 x 737)] record data values in band #1, the next 737 pixels cover the same strip of the Earth’s surface but record data values in band #2, the next 737 pixels the same strip in band #3, and so on). Thus line 1 of the image is recorded in each band followed by line 2 in each band, and so on until line 567. Note the other interleave format options, which are Band Sequential (BSQ) and Band Interleaved by Pixel (BIP) – see *Bilko Help* if you do not know what these terms mean.

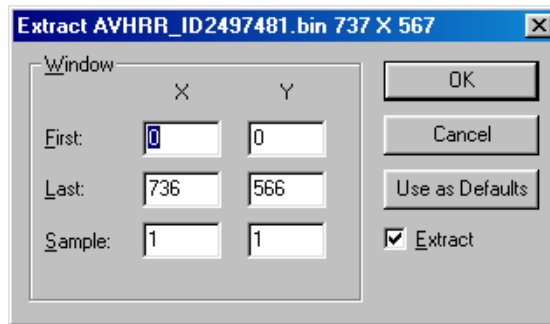


Activity: Click on the Help button **?** at the top right corner of the **Open As** dialog box and note that the context-sensitive help pointer appears. Move this over **Pixels per Line:** data entry box in the dialog and click the left mouse button. A popup with help relating to this part of the dialog box appears. Click on the **?** button again, move the pointer over the **BIL** radio button area and click for help on this interleave format. Then try right-clicking on the **BIP** radio button; you will be offered a **What’s This?** dialog (see right). Click on this and help on BIP interleave format appears. Remember that Help is never far away!

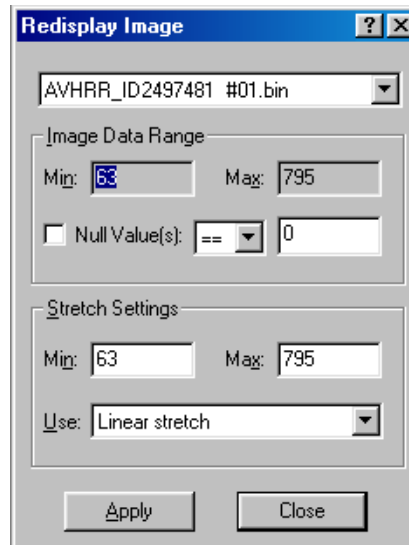


Now, use the data in (i) – (vii) above to fill in the **Open As** dialog box so that it looks like the image above. When finished, click on **OK**.

If the **Extract** checkbox is checked, then you have the option at this stage to just display part of an image (i.e. a “Window” within an image). In the **Extract** dialog box (right) the **First: X** and **Y** boxes allow you to set the pixel where the image window begins (top left of rectangle within the image) and the **Last: X** and **Y** boxes allow you to set the pixel where it ends (bottom right of a rectangle within the image). Unless the file you are looking at is very large you will normally wish to display all pixels. In this case **Sample:** will be set to **1** for both x-axis (columns) and y-axis (rows). If **Sample:** is set to **2** for the x-axis (columns), then every other pixel on each line is displayed. If **Sample:** is set to **2** for the y-axis (rows) then every other row of pixels will be displayed.



Activity: For now, uncheck the **Extract** checkbox (to the bottom right of the **Extract** dialog box) as this will not be needed for this image, but leave the **Window** settings as they are. Then click on **OK** or press <Enter> to open the image. A **Redisplay Image** dialog box will appear for each band. Note that the minimum and maximum values (often referred to as DNs = Digital Numbers) in each waveband of the image are listed. For the AVHRR (Advanced Very High Resolution Radiometer) sensor these DNs are between 0 and 1024. Ignore the **Redisplay Image** dialog box for now and just click on **Apply** for each band until all 5 wavebands of the AVHRR satellite image are displayed. Select the band #2 image (**AVHRR_ID2497481 #02.bin**) and examine it. If it looks recognisable then congratulations, you’ve opened the image successfully!



[Note: the image may be a little dark on poorly set up monitors; if so, increase the brightness]. If it looks a mess, then go through the sequence again being very careful to make sure the **Open As** dialog box values are filled in correctly.



Question 1: What are the five main countries in the area covered by the image?

Note: i) that each image is displayed in shades of grey and has a grey scale with 256 brightness levels (ranging from black=0 to white=255) displayed beneath it,

ii) that the menu bar has changed with four new menus (**Edit**, **Image**, **Stretch** and **Window**) appearing.




To manage efficiently the 5 different wavebands (all recorded at the same time), which together provide our AVHRR image data, we can “connect” them using the **Image, Connect** menu option.

Activity: Select **Image, Connect** to bring up the **Connect** dialog box. You should see a list of the five constituent image files read from the binary flat file. Select all five images¹, check the **Stacked** option, and then click on . The 5 bands are now “stacked” like a series of layers with band #1 on top and band #5 on the bottom. Use the <Tab> key to view each band in turn. Note how the relative brightnesses of the bands differ with band #3 being much brighter. You can automatically flip through the bands by clicking on the **Loop** button . To stop the loop, click the button again.

Note: This provides a useful way of comparing images of the same area taken at different times as well as comparing the same scene recorded in different wavebands.


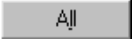
Opening a binary flat file is not very convenient because you need to remember all kinds of information about the file in order to open it. So your next task is to store the file in *Bilko* data format (.dat file format) so that you can open it more easily.

Activity: Make sure band #1 at the top of the stack is the active file. Select **File, Save As** from the menu. In the **Save As** dialog box select the folder where you want to save the images in the **Save in:** box (if necessary) and make sure that Bilko .dat is selected as the file type in the **Save as type:** drop down menu (this should be set as the default file type). The **File name:** should now be set to **AVHRR_ID2497481 #01.dat**. Click on  to save band #1. Press the <Tab> key to move to band #2 and repeat the save as process to save band 2 in *Bilko* .dat format. Then repeat for the bands #3 to #5 until all 5 bands are in *Bilko* .dat format. When finished, use the <Tab> key to flip through the images in the stack to check that they all now have .dat extensions.

Note: If the file pixel format for the images had been 8-bit unsigned (integer) you could have saved the images in CompuServe .gif format or in Windows .bmp format.

Since the 5 images are all likely to be used together, now that they re in *Bilko* .dat format, you can further simplify opening them by saving them as a “set” of image files which can all be opened together (rather like the original wavebands were combined together in the original binary flat file, but much simpler!).

Activity: Select **File, Save Set** and in the **File name:** box enter **AVHRR_ID2497481**, then click on the Save button. Once the set is saved, select **Window, Close All** to clear all the files cluttering the *Bilko* workspace.

Now click on **File, Open** and in the **Open** dialog box select SETS (*.set) from the **Files of type:** drop-down menu and then *either* double-click on **AVHRR_ID2497481.set** in the file list *or* click on it once and then click . This time, in the **Redisplay Image** dialog box, use Auto linear stretch as the stretch setting (this is discussed further in Tutorial 5), and then click on the  button. The stacked set of images is restored and can be tabbed through as before.


To create some colour you can display three of the AVHRR wavebands through the different colour “guns” on your colour monitor. Your monitor has Red, Green and Blue (RGB) colour guns each of which can take any intensity value between 0 and 255. When you “connect” three or more images (using **Image, Connect**) you can assign them to the different colour guns using the **Selector** toolbar. Since you already have a stack of connected images you could just select **Image,**

¹ *Hint:* If you click on the top image on the list (**AVHRR_ID2497481 #01.bin**), hold down <Shift> and then click on the bottom image (**AVHRR_ID2497481 #05.bin**) you can select all the images at once. If you wanted to select just the band#1, band#2 and band#4 images, you would click on the top one (**AVHRR_ID2497481 #01.bin**), hold down <Ctrl> and then click on **AVHRR_ID2497481 #02.bin** and then **AVHRR_ID2497481 #04.bin**.

Composite and the top three images or layers in your stack would be displayed as a colour composite image with waveband #1 displayed in red, waveband #2 in green and waveband #3 in blue (hence the colours associated with the filenames in the **Selector** window of the stack).

Activity: Select **Image, Composite**. You will get a rather hazy blue image.

A more pleasing composite image is created using bands #1, #2 and #4.


Activity: Select **Image, Connect** and select bands #1, #2 and #4 (**AVHRR_ID2497481 #01.dat**, **AVHRR_ID2497481 #02.dat** and **AVHRR_ID2497481 #04.dat**). Do NOT check the **Stacked**: checkbox this time. Then click . A tile of the three connected images will appear along with a **Selector** toolbar (see right) near the middle of the screen. The button numbers correspond to the RGB gun order (R=1, G=2, B=3). For this colour composite you should put waveband #1 through the red gun (button 1), waveband #2 through the green gun (button 2), and waveband #4 through the blue gun (button 3). Just click each button in order from left to right to do this. Then select **Image, Composite**. You will get a somewhat better false colour composite image with land of a greenish colour and the sea dark. Before proceeding further, close (i) the hazy blue composite, (ii) the 3 connected images tile, and (iii) the set of 5 stacked images, but leave the nicer colour composite open.



To examine this image more closely you can zoom in and out in various ways.

Activity: Right-click on the colour composite image and select **Zoom** from the menu that appears (or click on **View, Zoom**). Enter 200 in the **Zoom %:** box to zoom in. Experiment with other zooms set using the menu. Then try double-clicking on the image to zoom in. Try holding down <Ctrl> and double-clicking to zoom out. Check how far you've zoomed in or out using the **View, Zoom** menu or by right-clicking on the image and selecting the **Zoom** option. Finish by setting the zoom to 100%.

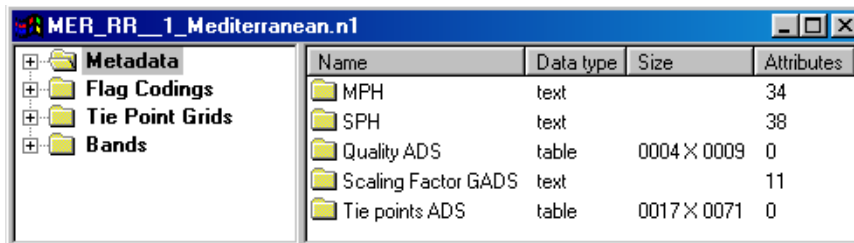
It can be useful to save an image as a picture to put in a document once processing has been completed. For example, one might wish to include a colour composite image in a report.

Activity: Firstly, note that the colour composite has three colour bars underneath the image to indicate that it is composed of three images, each displayed through a different colour gun on the monitor. With the colour composite as the active image select **File, Save As...** Note that the default file type is Bilko .set (i.e. a set of the three images which make up the composite). In this case you want a picture for a report rather than the three images that make up the composite, so select Windows .bmp (Windows bitmap format). This is a 24-bit colour picture format. The default filename is informative, indicating which bands have been used to make the composite image; however, you can change the name if you wish. Once you are happy with the name click . This saves a picture representation of the colour composite with the 16-bit unsigned integer values in each band reduced to 8-bit values (on a 0–255 scale). Close the bitmap file and then reopen it. Note that now it is a Windows bitmap it no longer has three colour intensity bars; close the composite again.

Many satellite images come in hierarchically structured formats, a bit like complex sets of images; these formats usually include considerable additional data apart from the images themselves. Many datasets that are freely available over the internet are stored in these hierarchical formats. Widely used formats include HDF (**.hdf**), the European Space Agency's N1 format (**.n1**) and netCDF (**.nc**). *Bilko* is able to read files in these formats, giving you access to huge amounts of valuable Earth observation and oceanographic data from a range of satellites. Such datasets are complex and exploring any one format in detail could be the subject of a lesson (or even several lessons!) in itself. Here you will just

examine one of these images with its associated data. This is an MERIS (Medium Resolution Imaging Spectrometer) image from the European Space Agency's ENVISAT satellite.

Activity: Open the file **MER_RR_1_Mediterranean.n1**, which is a MERIS image of the central Mediterranean around Italy. For the purposes of this tutorial we have shortened the filename (originally: **MER_RR_1PNPDK20030813_094018_000022742019_00022_07591_4499.N1**). A window will open which displays the N1 hierarchical file structure (see below). The images (bands) and associated metadata, flag codings and tie point grids (to do with geolocating the image pixels), are listed as a series of nested folders on the left pane of the window. The **Metadata** folder is open and its five constituent folders are shown in the right pane. Examine the metadata folders by double-clicking on their



folder icons or right-clicking on them and selecting **Open Items**. In the **SPH** (Specific Product Header) folder you can find text indicating when and where the image was taken, the number of bands and their wavelengths and bandwidths, etc. Note that two of the folders contain tables of information. Using the **SPH** folder information answer the following questions.

Question 2: On what date was the MERIS image taken? How many bands were recorded?

Flag Codings are very important and indicate what the different values on a “flag” image included with the bands mean. These “flags” indicate such things as where there is land, water, cloud, coastline, sunglint, invalid data, etc. on the image. How to use these flag images is briefly introduced in the tenth tutorial on [using formula documents](#).

Activity: Open the **I1-flag** codings folder and note that land is coded as 16 and coastline as 64. Inspect the **Tie Point Grids** folder and note the fifteen sub-folders of information, which aid geolocation, interpretation and processing of the image data. Finally, open the **Bands** folder and note that there are 15 bands of radiance image data, a flags image and a detector index image. Right-click on the **radiance_1** folder in the right-hand pane and select **Open Properties** from the menu that appears.

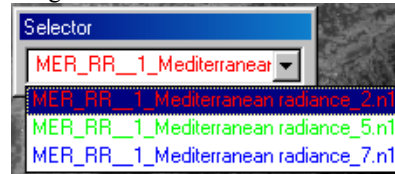
The properties of the band #1 image are displayed; these comprise a description, scaling factor and offset, units ($\text{mW}\cdot\text{m}^{-2}\cdot\text{sr}^{-1}\cdot\text{nm}^{-1}$), spectral band index, bandwidth (9.93 nm) and mid-wavelength (412.545 nm). To open the band #1 image, you can either double-click on the **radiance_1** folder or right-click on it and choose **Open Items**.

Activity: Experiment with opening the **radiance_1** image. Close the image when you have finished.

Click on the **radiance_2** folder in the right-hand pane, hold down the **<Ctrl>** key and then click on the **radiance_5** and **radiance_7** folders so that all three are highlighted. With the mouse pointer over one of the highlighted image folders, right-click and select **Open Connected** from the menu that appears. In the **Redisplay Image** dialog box, check the **Null Value:(s) == 0** checkbox, select Auto linear stretch and then click on the All button to apply this stretch to all three images. This displays the MERIS band 2 (in

the blue part of spectrum), band 5 (a green waveband) and band 7 (a red waveband) images.

A stack of the three connected images will appear along with a **Selector** window. Click on the drop-down list button of the **Selector** window and you will see band #2 in red, band #5 in green and band #7 in blue (see right). You want to create a colour composite with waveband #7 displayed through the red gun, waveband #5 through the green gun, and waveband #2 through the blue gun. To achieve this you need to make the band #2 image the third (blue) image) and the band #7 image the first (red) image. Make sure that the top (red) band #2 image is selected and press the <3> key. The colour of the filename changes to blue and if you click on the drop-down list you will see that band #7 is now in green. Select band #7 and press the <1> key. The colour of the filename changes to red and you are now ready to create a colour composite with each waveband displayed through the correct colour gun.



Select **Image, Composite**. You should get a nice false colour composite image with land of a brownish colour, the sea blue, and clouds and snow-capped peaks white. Examine the image.

Finally, open the **I1-flags** image, select the whole image (<Ctrl>+A) and apply an automatic linear stretch (**Stretch, Auto Linear**). Note how the coastline, land and cloud ("bright") areas are delineated.

When you have finished close all open images by selecting **Window, Close All**. Do not save any images.

In this section you have learnt how (i) to open complex images, (ii) to "connect" images to make "stacks" of overlaid images so that images can be readily compared, (iii) to connect images to make colour composites, (iv) to save images in various formats, (v) to link related images as "sets" so that it is easy to work on them, (vi) to zoom in and out of images, and (vii) to open a complex hierarchical image and associated data file.

In the next section you will learn how to use the [image toolbar selection buttons and the status bar](#) to find out more about the image.