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DECCON Software to Decompress NOAA IMGMAP Compressed Imagery and Convert to Common Image File Formats

by

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SUMMARY

The NOAA CoastWatch program produces mapped and processed satellite imagery of U.S. coastal waters. This imagery is saved in the NOAA IMGMAP compressed format, which is not readable by many generally-available products. To make the imagery available for viewing and analysis by a variety of programs, we developed the DECCON software package described in this document. DECCON decompresses the IMGMAP format, provides some user options, such as incorporation of color tables for display and processing of the channel 1 and channel 2 data to a product suitable for study of water reflectance, and converts the data into some common 8-bit image file formats, including GIF, TIFF and SunRaster. The program has been compiled and tested on Sun SPARCstations, Silicon Graphics workstations, IBM PCs, and IBM RS-6000 workstations. The program features online help and can be run interactively or in batch mode. The software package includes installation and usage documentation, source code, and binary executable files for the computer platforms on which it has been tested. DECCON is available through the Internet or postal mail. This document is consistent with DECCON version 1.4 and may differ wifh other versions.

TABLE OF CONTENTS

INTRODUCTION

The NOAA CoastWatch program produces and distributes satellite imagery of U.S. coastal waters through the National Marine Fisheries Service (NMFS) for research and management applications (Leshkevich et al., 1993; Pyke, 1989). The imagery is mapped to a standard map projection and processed to obtain information such as sea surface temperature (SST). The satellite information can be used for a variety of projects on coastal circulation, fisheries, and even some vegetation studies.

The imagery is saved in a format developed by NOAA called IMGMAP (previously a similar format called SSTMAP was used). This format contains compressed image data and graphics for such features as coastlines. Readability of the IMGMAP data is limited to some special packages, such as the NOAA IDIDAS software, which requires a special graphics board to run, or to programs for VAX computers or PCs with limited features and portability. Most common graphics and image analysis programs cannot easily import the data. To resolve this, the DECCON (DECompression and CONversion) package was developed to convert the imagery from IMGMAP format to some common 8-bit formats, such as TIFF, GIF, and simple raster files, to permit use by a variety of software. DECCON was designed to be compliant with ANSI-C, thereby permitting maximum portability on different platforms. DECCON also allows users to process data to obtain preliminary estimates of water reflectance and to perform simple adjustments of the imagery to correct for mapping errors.

SATELLITE INFORMATION

The CoastWatch imagery derives from the Advanced Very High Resolution Radiometer (AVHRR) on the NOAA Polar Orbiting Environmental Satellites (POES). These satellites include the series NOAA-6 to NOAA-14 and orbit the earth every 100 minutes in a sun-synchronous orbit, resulting in overpasses at about the same local time each day. Each satellite makes one daytime and one nighttime pass of a site daily. Usually two satellites are operational at the same time. The AVHRR has a swath of about 2500 km and a field-of-view at nadir of about 1 km. The current instrument records in 5 spectral bands, referred to as channels. Channel 1 detects red light, channel 2 records (reflected) near-infrared, channels 3, 4, and 5 record thermal-infrared radiation. Additional information on the satellite and sensors can be found in Kidwell (1991).

Combinations of channels 3 - 5 are used to obtain Sea Surface Temperature (SST). Details of the equations and methodology used to obtain SST are described in Walton (1987), and McClain et al. (1985). Channels 1 and 2 have been used to evaluate vegetation (e.g. Prince, 1991), coastal water clarity (e.g. Stumpf, 1992), and for techniques such as cloud detection.

The CoastWatch imagery is presently mapped to a Mercator projection. Two image scales are produced, a local, high resolution view with an effective image pixel size of 1.5 km at the equator and regional views with 4 km pixel size at the equator. Most images have 512 lines of 512 pixels (512 X 512). Details on image areas and data types can be obtained from the NOAA CoastWatch Regional Site and Operations Managers (Table 1). Additional details on CoastWatch programs and imagery may also be obtained from these sites.

FORMAT CONVERSION

The IMGMAP file format consists of a block of header information followed by compressed 11-bit imagery and four 1-bit graphic planes containing shoreline and other data. DECCON extracts the image header information, the image data, and the graphics data from the

file. The image and graphics data are converted from 11-bit to 8-bit data, either merged in one file, or in separate files.

DECCON can create GIF 87a, TIFF 5.0, SunRaster, and generic raster output image file formats. These are standard 8-bit formats that can be imported or displayed by such graphics and image analysis software as PV-Wave, IDL, PCI, ERDAS, CorelDraw, and PhotoShop. GIF is a compressed format intended for viewing without analysis. TIFF, SunRaster, and generic raster preserve the count values of the data set and are most suitable for analysis. GIF, TIFF, and SunRaster formats can utilize either a black and white or a spectrum colormap for display of the images. Additional colormaps can be added to the DECCON package (instructions are provided in **USER'S MANUAL** below).

The DECCON code performs a number of conversion and analysis functions on raw CoastWatch image data. It will convert the 11-bit SST data to 8-bit data either by scaling the full 11-bit data range to 8-bits (0 - 255 counts), or by scaling a user-defined temperature range to 8-bits. The channel 1 and channel 2 count data can be converted to "albedo" as defined by the calibration in Kidwell, 1991. The albedo, A, is defined as $\pi L / E'_0$ where L is measured radiance, and E'_0 is the mean solar constant (Kidwell, 1991). The channel 1 and channel 2 data may also be converted to an aerosol-corrected and solar zenith angle normalized water reflectance as expressed by Stumpf (1992). The ranges may be specified by the user.

PROCESSING ALGORITHMS:

Image subtraction involves computation of aerosol-corrected reflectance for water, an approximation of the bias correction described by Stumpf (1992). Pixel by pixel subtraction uses the following equation from DECCON function *subtract_img()* (actual computer code necessarily differs in appearance):

$$R = [(A(\lambda_1) / T_1(\lambda_1)T_0(\lambda_1)) - (A(\lambda_2) / T_1(\lambda_2)T_0(\lambda_2))] (1 / (1/r^2)) (1 / \cos\Theta_0)$$

where λ_1 and λ_2 denote AVHRR channel 1 and channel 2 respectively.

Values used in the above equation are computed in function *get_correction_values()*; $A(\lambda)$ is the albedo as defined above, r is the normalized distance from the earth to the sun, T_0 is the transmission through the atmosphere from the sun to the earth, T_1 is the transmission back from the earth to the sun, and Θ_0 is the solar zenith angle at the scene center. T_0 is estimated from

$$T_0(\lambda) = \exp [- (T_r(\lambda) / 2 + T_g(\lambda)) / \cos\Theta_0]$$

where T_r is the Rayleigh optical depth defined in the code as a constant 0.056 for channel 1 and 0.022 for channel 2, and T_g is the gaseous absorption optical depth (i.e. for ozone and water vapor) defined in the code as a constant 0.035 for channel 1 and 0.093 for channel 2. T_1 is estimated as

$$T_1(\lambda) = \exp [- (T_r(\lambda) / 2 + T_g(\lambda)) / \cos\Theta_1]$$

where Θ_1 is the satellite viewing angle defined in the code as a constant 0.35 radians (20 degrees). Solar zenith angle at scene center is computed as

$$\cos\Theta = \sin\sigma \sin\phi + \cos\sigma \cos\phi \cos(t_h)$$

where t_h is the solar hour angle, defined from solar noon:

$$t_h = ((T_{local} - 12.00) * 15 * 2\pi) / 360$$

and

$$T_{local} = T_{gmt} + (\Theta/15)$$

where t_{gmt} is the GMT time, ϕ is the average latitude, and Θ is the average longitude taken from the IMGMAP header. Average latitude and longitude are found by adding the beginning and ending latitude/longitude values, located in the IMGMAP header, and dividing by 2. Solar declination, σ, is estimated by:

$$\sigma = 0.006918 - 0.399912\cos\varepsilon + 0.070257\sin\varepsilon - 0.006758\cos2\varepsilon + 0.000907\sin2\varepsilon$$

where $\varepsilon = 2\pi J/365$ and J is the Julian day of the year. The normalized distance from the earth to the sun, r, is derived from

$$r = 1 - 0.0167\cos(2\pi(J-3)/365)$$

Final reflectance values are converted form double precision floating point to integer values as required by the output image file formats.

NAVIGATIONAL CORRECTIONS

DECCON allows for vertical and horizontal corrections to align imagery with graphic overlay planes. This feature was included to compensate for navigational errors on the AVHRR, which may cause errors of several kilometers. Adjustments are measured in terms of the number of pixels moved. During an adjustment, a specified number of rows and columns along two contiguous sides of image data are discarded, the remaining rows and columns adjusted over the necessary number of pixels to fill the spaces of the discarded rows and columns, and the resulting gaps filled in with the background color. This essentially adjusts the image data under the graphic overlays, which are not altered. This procedure requires the user to know the offsets. This will usually mean running DECCON without corrections and viewing an uncorrected image with the graphic overlays (using the viewing software supplied by the user) then re-running DECCON with the appropriate values.

CONVERSION ALGORITHMS

In DECCON source code, raw AVHRR visible channel 11-bit data values are converted to albedo percentages using the following scheme from the function *albedo()*:

albedo = raw_imagery_data / 20.47

AVHRR thermal channel 11-bit data are converted to Centigrade temperatures according to these equations in function *temp()*:

if (0 < raw_imagery_data <= 920)

$$temp = ((count\_value - 1) * 0.1 + 178.0) - 273.15$$

if (921 <= raw_imagery_data <= 1720)
$$temp = ((count\_value - 921) * 0.05 + 270.0) - 273.15$$

if (1721 <= raw_imagery_data <= 2047)
$$temp = ((count\_value - 1721) * 0.1 + 310.0) - 273.15$$

Following these conversions, data are still 11-bit and must be fit to 8-bit or the values 0 - 255. The data, if scaled as 8-bit (255 counts) data, are actually truncated to the range 1 - 250 so that the highest values can be used for graphic overlays and zero can be used for missing data. Data values from 251 to 255 are set to 250 and non-missing values of 0 are set to 1. The user defined range for the conversion output is expanded to fit a range of 0 - 250 so that all values may be utilized. For example, a range of 0 to 50 degrees Celcius will result in 1/5 degree per count. DECCON accomplishes this in functions *albedo()* and *temp()* with the following sequence of equations:

```
/* compute slope */
slope=250 / (user_defined_range_high - user_defined_range_low)

/* compute intercept */
intercept = slope * user_defined_range_low

/* for each datum in the image */
if (datum = 0)
        output_value = 0
if (datum > range_high)
        output_value = 250
if (datum < range_low)
        output_value = 1
otherwise
        output_value = slope * datum - intercept
```

When no conversion has been specified, function *truncate()* truncates the 11-bit data to 8-bit by stripping off the 3 least significant bits, which is equivalent to dividing the original values by 8.

DECCON accepts a series of parameters which can be entered interactively or read from an ASCII file. These parameters allow users to specify the output image file format, a colormap to use for display of the image, whether to perform an albedo or temperature conversion on the data, a range for the conversion, whether to adjust the imagery to correct for navigational errors, whether to embed in the image or store separately shoreline, latitude and longitude graphics, the color of the graphic overlays and background, whether to record salient information from the IMGMAP header to an ASCII file, and whether to compute aerosol corrected reflectance for water through processing of channel 1 and channel 2 imagery with solar zenith angle corrections; an approximation of the bias correction described by Stumpf (1992). DECCON also features on-line help and usage information.

The DECCON package of software includes all source code and include files to compile the program on Sun SPARCstations, IBM RISC machines, Silicon Graphics workstations, PCs, and any other machine with an ANSI standard C compiler. Also included are a user's manual

and documents describing IMGMAP header and imagery data. Finally, two viewing programs, XV and VPIC, are supplied for the convenience of users with limited resources. XV is a public domain image viewer compiled for Sun SPARC computers. It will accept TIFF, GIF, and SunRaster formats and perform conversions, including Postscript output. VPIC is a shareware GIF viewer for PCs. Information on using and registering VPIC are contained in the VPIC files. DECCON is available via FTP at wayback.er.usgs.gov, or by contacting Rick Stumpf or Bill Townsley at the U.S. Geological Survey's Center for Coastal Geology, 813-893-3100, or by SMTP e-mail, rstumpf@wayback.er.usgs.gov, townsley@wayback.er.usgs.gov. Support questions can also be directed to the aforementioned telephone numbers and e-mail addresses.

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USER'S MANUAL

DECCON Version 1.4 by Bill Townsley 3/95
DECompression and CONversion of NESDIS CoastWatch Imagery Files

Introduction

DECCON is a program which decompresses NESDIS CoastWatch imagery files in IMGMAP format and converts the data to GIF, TIFF, SunRaster, and plain raster image file formats. DECCON was created to increase the accessibility of CoastWatch satellite imagery to the user community. Formerly, users who did not have IDIDAS workstations had limited capabilities to decompress the satellite image files produced by the CoastWatch program. Fortran programs for PC and VAX existed to decompress imagery into 8-bit raster files, but these programs did not provide decompression of the overlay or header data. DECCON was developed by Rick Stumpf and Bill Townsley of the U.S. Geological Survey's Center for Coastal Geology to enable the user community to decompress and save NESDIS CoastWatch header, imagery, and graphics data. Included in the DECCON package are a public domain image viewer for Sun SPARCstations and a shareware image viewer for IBM PCs.

Installation

DECCON can be compiled on any machine with a C compiler and has been tested on Sun SPARCstations, Silicon Graphics Indigos (SGI), IBM-PCs and PC-compatibles, and IBM RS/6000s*. Installation is easy...

1. Place the DECCON package in an arbitrary directory.

2. Untar/Unzip the DECCON package by typing one of the following commands:
   SPARC: 'tar xvf deccon.tar'
   IBM-PC: 'pkunzip deccon.zip'
   RS/6000:   'tar xvf deccon.tar'
   SGI: 'tar xvf deccon.tar'
   These files should now exist in the working directory:
   HEADER.DOC -   IMGMAP header description
   IMGFILE.DOC -   IMGMAP data format description
   albedo.h -   Albedo percentages data base
   clrmaps.h -   Colormaps data base
   raster.h -   SunRaster format definition
   temps.h -   Temperatures database
   tiff.h -   TIFF definition
   deccon.c -   Source code
   dcn_lib.c -   Source code
   dcn_lib.h -   DECCON typedefs and definitions
   deccon.sun -   Sun SPARCstation executable
   deccon.pc -   IBM PC executable
   deccon.rs -   IBM RS/6000 executable
   deccon.sg -   Silicon Graphics executable
   param.eg -   Sample parameter file

vpic60.zip -	GIF file viewer for IBM PCs
xv -	Image viewer for Sun SPARCstations
xv.man -	xv manual page

The .DOC files describe in detail NESDIS CoastWatch imagery files. The .c and .h files are DECCON source code and include files respectively. deccon.sun, deccon.pc, deccon.rs, and deccon.sg are DECCON executables which have been compiled on a Sun SPARCstation, an IBM PC, an IBM RS/6000, and a Silicon Graphics Indigo respectively. param.eg is an example parameter file (see PARAMETER FILES). vpic60 is a shareware GIF file viewer for IBM PCs. xv is a public domain image file viewer for Sun SPARCstations. xv.man is the manual for xv.

3. If you have an ANSI compliant C compiler and wish to compile DECCON yourself to produce the executable file, deccon or deccon.exe, use one of the following commands:

SPARC:	'gcc -o deccon deccon.c dcn_lib.c -lm'
IBM-PC:	'tcc -ml -edeccon deccon.c dcn_lib.c'
RS/6000:	'cc -o deccon.x deccon.c dcn_lib.c -lm'
SGI:	'cc -o deccon deccon.c dcn_lib.c -lm'

Note: Compilers which are not ANSI compliant, such as Sun's cc, may not compile DECCON correctly.

4. Place the executable file in the directory of your choice. The directory path should be a searched one or you should modify your path to include the directory.

Command Line Options

After DECCON has been properly installed, the first time user will find it easy to decompress a NESDIS CoastWatch imagery file and create output suitable for viewing or for intended applications. The command line options and their purposes are...

synopsis: deccon [-h] [-v] [-p pfile] [-s sfile] ifile

[-h] - will print the DECCON help page to the screen. This page has more lines than will fit on a screen, so it would be best to pipe the command into a scrolling text browser such as more (eg. 'deccon -h | more'). Any other options supplied on the command line with the -h option will be ignored.

[-v] - will run DECCON in verbose mode. When supplied with additional options described below, the -v option causes DECCON to print to the screen information on the status of image decompression, image subtraction, image conversion, image adjustment, graphics decompression, file creation and program completion.

[-p pfile] - will specify pfile as a parameter file. When pfile is supplied as an argument, DECCON will read its parameters from that file rather than initiate an interactive sequence (see INTERACTIVE SEQUENCE). You can create a parameter file yourself (see PARAMETER FILES), or you can have DECCON create one for you at the end of the interactive sequence. Using a parameter file can save a great deal of time when processing multiple imagery files, helps to avoid errors, and documents processing tasks.

[-s sfile] - will inform DECCON to subtract sfile from ifile (see below). DECCON will decompress imagery data from sfile and subtract it from decompressed imagery data in

ifile. This feature is intended specifically to allow you to obtain an image of water reflectance corrected for some aerosols by subtracting channel 2 albedo from channel 1 albedo. This is useful for detecting turbidity patterns in coastal areas. The feature corrects for the solar zenith angle at the scene center. This option presumes that the inputs (ifile and sfile) are channel 1 and channel 2 albedo images, which are normally available in CoastWatch imagery. In the parameter file or the interactive sequence specify albedo image as output. The sfile must be a compressed NESDIS CoastWatch imagery file (see INTERACTIVE SEQUENCE and PARAMETER FILES).

ifile - DECCON will use ifile as the main input file. The ifile must be a compressed NESDIS CoastWatch imagery file. DECCON will decompress header, imagery and graphics data from ifile and use ifile's name as the base for all output file names. This argument is required unless the -h option is given.

The following are examples of DECCON command line arguments and their results.

'deccon s9316309.sc1'
will use s9316309.sc1 as the main input file and prompt the user for parameters in an interactive sequence.

'deccon -p params s9316309.sc1'
will read parameters to DECCON from a file named params (no interactive sequence) and use s9316309.sc1 as the main input file.

'deccon -v -p params s9316309.sc1'
will display program activity in verbose mode, read parameters to DECCON from a file named params and use s9316309.sc1 as the main input file.

'deccon -v -s s9316309.sc2 s9316309.sc1'
will prompt the user for parameters in an interactive sequence, display program activity in verbose mode and subtract the imagery data in s9316309.sc2 from the imagery of s9316309.sc1.

Interactive Sequence

The DECCON parameters determine the output it will create. These parameters may be read from a file as described above in **Command Line Options** or entered during an interactive seqeuence in which the user will be prompted to specify...

1. Output image file format - DECCON allows the imagery to be converted into several common image file formats including GIF, TIFF, SunRaster, and plain raster. GIF is primarily a viewing format and does not necessarily preserve data values. The other formats can be used for quantitative analysis. GIF format requires image compression and is therefore the most efficient option in terms of storage, but it is the most CPU intensive and slowest to create. SunRaster format is an obvious option for Sun systems. The TIFF option produces the most portable of all the file formats, though it is slightly larger than SunRaster or plain raster. A plain raster option is also available and creates a file containing only 8-bit

imagery and/or graphics data with no formatting or headers of any kind. Enter the number of the image file format you wish DECCON to create.

2. Which colormap to use - 2 colormaps, an equal RGB colormap (essentially black and white) and a spectrum colormap are supplied with DECCON. The equal RGB colormap produces standard black and white images. The spectrum colormap was supplied by Rick Stumpf of the U.S. Geological Survey's Center for Coastal Geology and produces images of spectral reflectance. The colormap option is not available if plain raster output is specified. Enter the number of the colormap you wish DECCON to use. Additional colormaps may be added, see file clrmaps.h.

3. Whether to perform an albedo or centigrade temperature conversion - NESDIS CoastWatch image data can be converted to albedo percentages or centigrade temperatures. The 11-bit data is converted and the range specified (see below) is fit to 8-bits, actually 1 - 250. If none is specified, the full range of values is truncated from 11-bits to 8-bits by discarding the 3 least significant bits. This is equivalent to dividing the original value by 8. Enter the number of the conversion you wish DECCON to perform or zero for none.

4. A range of values for the conversion - Conversions are mapped to a range of values. You may specify this range by entering numerical values at the prompts or 'd' for the default values.

5. Whether to adjust the image and by how many pixels - Due to navigational errors, image data may need a linear adjustment in order for ground features to correctly line-up with graphics overlay planes. DECCON allows an up or down, left or right correction by pixel unit. If you wish DECCON to perform an image adjustment enter the direction of the adjustment and the distance in pixels to move in that direction. Enter zero for no adjustment.

6. Which graphics overlay planes to display - NESDIS CoastWatch images include up to 4 graphics overlay planes. These graphics planes define such things as latitude/longitude markings and coastlines. Enter 'y' (yes) if you wish the overlay plane displayed or 'n' (no) if you do not wish the overlay plane displayed.

7. Whether to embed or separate the graphics overlay planes. The graphics may be separate in which case two files will be created, one containing imagery data and one containing graphics data. The graphics may also be embedded and one image file will be created containing both the imagery data and whatever overlay planes have been chosen. Enter 0 to separate the graphics or 1 to embed the graphics in the imagery data.

8. Overlay and background color - The color of the overlay planes and background color may be specified to ensure maximum contrast to the underlying imagery. For example, when using the equal RGB colormap, specify overlay color as 0 (black) and background color as 255 (white) for maximum contrast.

9. Whether to record the header data - The header data from NESDIS CoastWatch images may be recorded in an ASCII file. Enter 'y' (yes) if you would like to record the header data in a separate file or 'n' (no) if you would not like to record the header data.

10. Whether to record the parameters - A parameter summary is printed to the screen after the interactive sequence. You may save these parameters in a separate file if you wish to use

them at a later time. Enter 'y' (yes) if you would like to record the parameters in a separate file or 'n' (no) if you would not like to record the parameters.

Parameter Files

A DECCON parameter file consists of numerical entries which represent DECCON parameters. Using a parameter file instead of initiating the interactive sequence each time you wish to process an imagery file can save considerable time. In addition, using a parameter file ensures identical processing of multiple imagery files. You may give the parameter file any name you wish. You may even desire to keep several of them on hand with names such as gif_param which could be used to create a particular output file format type, or FL_param which could be used on imagery files of a particular area-of-interest and contain the proper adjustment values or conversions. In a parameter file, a single value for every parameter must be present on a line by itself and in the correct order. Comments may also be included in a parameter file provided that each line of comment is preceeded by the character '#'. The proper order and numerical value of the parameters are as follows:

    Entry #1: Output Image File Format
        1 = SunRaster
        2 = GIF (87a)
        3 = TIFF (5.0)
        4 = plain raster

    Entry #2: Colormap
        1 = Equal RGB Colormap (Black & White)
        2 = Spectrum Colormap

    Entry #3: Conversion
        0 = Perform no conversion
        1 = Convert data to albedo percentages
        2 = Convert data to centigrade temperatures

    Entry #4: Low Conversion Range Value (ignored if #3 = 0)
        A single floating point value
        (default for albedo conversion is 0.0)
        (default for centigrade temperature conversion is -5)
        (0 - 100 for an albedo conversion)
        (-95.250008 - 109.249992 for a temperature conversion)
        (ignored if #3 = 0)

    Entry #5: High Conversion Range Value (ignored if #3 = 0)
        A single floating point value
        (default for albedo conversion is 12.5)
        (default for centigrade temperature conversion is 36.677)
        (0 - 100 for an albedo conversion)
        (-95.250008 - 109.249992 for a temperature conversion)
        (ignored if #3 = 0)

    Entry #6: Vertical Adjustment
        0 = Perform no vertical adjustment

1 = Adjust image up
2 = Adjust image down

Entry #7: Vertical Adjustment Value
The distance in pixels to move the image up or down
(ignored if #6 = 0)

Entry #8: Horizontal Adjustment
0 = Perform no horizontal adjustment
1 = Adjust image to the left
2 = Adjust image to the right

Entry #9: Horizontal Adjustment Value
The distance in pixels to move the image left or right
(ignored if #7 = 0)

Entry #10-13: Graphics Overlay Planes 1-4
0 = Do not display
1 = Display

Entry #14: Overlay Display
0 = Create 2 output image files, 1 containing only
imagery data and the other containing only graphics
1 = Create 1 output image file containing both imagery
and graphics data

Entry #15: Overlay Color
Any value between 0 and 255
(use this value as the color index of all overlays)

Entry #16: Background Color
Any value between 0 and 255
(use this value as the color index of the background)

Entry #17: Record NESDIS CoastWatch header data
0 = Do not write header data to disk
1 = Write header data to disk

Example Parameter File:

```
#This is an example parameter file which creates a
#SunRaster output image file using an equal RGB colormap.
#The data will be converted to albedo percentages using the
#DECCON default range.  No vertical adjustment will be
#performed, but the image will be adjusted left by 3 pixels.
#Overlays 1-4 will be displayed and written to a separate
#file.  The overlays will be black and background color will
#be white.  Header information will be recorded.
#FORMAT: 1=SunRaster, 2=GIF, 3=TIFF, 4=plain raster
1
#COLORMAP: 1=Equal RGB, 2=Spectrum Colormap
1
```

```
#CONVERSION: 0=None, 1=Albedo, 2=Temperature
1
#LOW RANGE VALUE:
0.00000
#HIGH RANGE VALUE:
12.50000
#VERTICAL ADJUSTMENT: 0=None, 1=Up, 2=Down
0
#VERTICAL NUMBER OF PIXELS:
0
#HORIZONTAL ADJUSTMENT: 0=None, 1=Left, 2=Right
1
#HORIZONTAL NUMBER OF PIXELS:
3
#OVERLAYS 1-4: 0=not displayed, 1=displayed
1
1
1
1
#OVERLAY DISPLAY: 0=Separate, 1=Embedded
0
#OVERLAY COLOR: Color range = 0-255
0
#BACKGROUND COLOR: Color range = 0-255
255
#RECORD HEADER DATA: 0=FALSE, 1=TRUE
1
```

Deccon Output

DECCON output filenames are based upon the name of the main input NESDIS CoastWatch imagery file plus a prefix indicative of the data contained within the output file. This naming convention was chosen since only the last 9 digits of NESDIS CoastWatch imagery file names are unique (see IMGFILE.DOC) The prefix IMG indicates output imagery data, SUB pertains to imagery data that has had an image subtraction performed on it, GFX signifies graphics data, DAT refers to output header data, and PRM labels an output parameter file. For example, depending upon parameters, command line options, and using the file s9316309.sc1 as the main input file (ifile), DECCON could produce the following output files:

    SUN16309.sc1 - an imagery data image file in SunRaster format
    GIF16309.sc1 - an imagery data image file in GIF format
    TIF16309.sc1 - an imagery data image file in TIFF format
    RAS16309.sc1 - an imagery data image file in plain raster format
    SUB16309.sc1 - an imagery data image file (after subtraction)
    GFX16309.sc1 - a graphics data image file
    DAT16309.sc1 - an ASCII file of header information
    PRM16309.sc1 - an ASCII parameter file

Deccon Errors

If DECCON encounters an error it will print a descriptive message to the screen (stderr) and terminate. Storage space is assumed to be adequate for DECCON output and no error checking is performed when writing output files to disk. DECCON will print an error and terminate under the following conditions:

Failure to access a file
Failure to create a file
Failure to read from a file
Failure to skip through a file
Invalid parameters
Failure to allocate memory
Unexpected end of file

Adding Colormaps

DECCON allows additional colormaps to be added to the package by those with knowledge of the C programming language. These colormaps must be 2 dimensional, 3 by 256 arrays of type unsigned char. First, all 3 * 256 values of the new colormap must be defined in the file clrmaps.h using the declaration and naming conventions as shown in that file. Second, the global variable CLRMAP_NUM, defined in the file dcn_lib.h, must be incremented for each new colormap added to the DECCON package. Third, source code lines in dcn_lib.c functions *get_prms()*, *write_prm_file()*, and *print_prms()* must be uncommented or modified to reflect the addition of a new colormap. These source code locations are marked by comment lines in the source code and examples are provided. Next, source code in dcn_lib.c functions *create_sun_clrmap()*, *create_tiff_clrmap()*, and *create_gif_clrmap()* must be uncommented to accomodate the new colormap. Again, these source code locations are marked by comment lines in the source code and examples are provided. Finally, the DECCON package must be re-compiled following the INSTALLATION instructions delineated above.

Distribution and Availability

DECCON is available via FTP at wayback.er.usgs.gov, or by contacting Rick Stumpf or Bill Townsley by phone at the U.S. Geological Survey's Center for Coastal Geology 813-893-3100, or by SMTP e-mail, rstumpf@wayback.er.usgs.gov, townsley@wayback.er.usgs.gov. Support questions can also be directed to the aforementioned telephone numbers and e-mail addresses.

Caveat 1

The standard NESDIS CoastWatch imagery file contains an image that is 512 rows by 512 columns, though files containing larger images do exist. DECCON was designed to decompress and convert any NESDIS CoastWatch imagery file with up to 1400 rows. However, when installed on a PC, DECCON might not work with images larger than the standard 512 rows. Therefore, if you use a PC, it is recommended that you modify the constant definition of MAX_SIZE in file dcn_lib.h from 1400 to 512 before compiling. The definition of MAX_SIZE as 1400 appears on line 108 of the file dcn_lib.h. If you are installing DECCON on a PC, change the 1400 on line 108 to 512 (ie #define MAX_SIZE 512).

DECCON ONLINE HELP

DECCON Version 1.4 by Bill Townsley 3/95
DECompression and CONversion of NESDIS CoastWatch Imagery Files

NAME
 DECCON

SYNOPSIS
 deccon [-h] [-v] [-p pfile] [-s sfile] ifile

DESCRIPTION
 DECCON reads header, image and graphics data from NESDIS CoastWatch imagery files
 and creates output based on user defined, or default parameters. These parameters may be
 read from a file or entered during an interactive sequence which prompts the user to specify...
  - ouput image file format
  - which colormap to use
  - whether to perform an albedo or temperature data conversion
  - range of values for the conversion
  - whether to adjust the image and by how many pixels
  - which graphics overlay planes to display
  - whether to embed or separate the graphics overlay planes
  - the color of the graphics overlay planes
  - whether to record the header data
  - whether to record the above parameters

OPTIONS
 -h show help page
 -v verbose mode
 -p pfile
   Read parameters to DECCON from pfile.
 -s sfile
   Subtract image data in sfile from image data in ifile
 ifile (REQUIRED)
   Use ifile as the main input file.

PARAMETER FILE
 A DECCON parameter file (pfile) consists of numerical values which represent DECCON
 parameters. Text comments may also be included in the file provided that each line of
 comment is preceeded by the character '#'. The values are expected to be in the correct
 order and unpredictable results may occur if they are not. The order and numerical values of
 the parameters are...
  - Format: 1=SunRaster, 2=GIF, 3=TIFF, 4=plain raster
  - Colormap: 1=Equal RGB, 2=Spectrum Colormap
  - Conversion: 0=None, 1=Albedo, 2=Temperatures
  - Range low: Celsius for temperatures, % for albedo reflectance
  - Range high: Celsius for temperatures, % for albedo refectance
  - Vertical adjustment: 0=None, 1=Up, 2=Down
  - Vertical correction in pixels

- Horizontal adjustment: 0=None, 1=Up, 2=Down
- Horizontal correction in pixels
- Overlays: 0=Not displayed, 1=Displayed
- Overlay Display: 0=Embedded, 1=Separate
- Overlay Color: 0=Black, 255=White
- Background color: 0=Black, 255=White

DECCON will produce a pfile in the correct format at the end of the interactive sequence if requested.

OUTPUT
DECCON output filenames are based upon the name of the ifile plus a prefix indicative of the data contained within the output file...
- SUN indicates the output image file in SunRaster format
- GIF indicates the output image file in GIF format
- TIF indicates the output image file in TIFF format
- RAS indicates the output image file in plain raster format
- SUB indicates the output image file after a subtraction
- GFX indicates the output graphics file
- DAT indicates the output header data file
- PRM indicates the output parameter file

EXAMPLES
The following command:

      deccon s9316309.sc1

will use s9316309.sc1 as the main input file and prompt the user for parameters in an interactive sequence.

The following command:

      deccon -p params s9316309.sc1

will read parameters to DECCON from the file params (no interactive sequence) and use s9316309.sc1 as the main input file.

The following command:

      deccon -v -p params -s s9316309.sc2 s9316309.sc1

will display program workings in verbose mode, read parameters from file params, and subtract s9316309.sc2 from s9316309.sc1.

Depending on user specifications, the output for the above examples would be...
- SunRaster image file (no subtraction):   SUN16309.sc1
- GIF image file (no subtraction):   GIF16309.sc1
- TIFF image file (no subtraction):   TIF16309.sc1
- plain raster image file (no subtraction):   RAS16309.sc1
- image file after the subtraction: SUB16309.sc1
- graphics file: GFX16309.sc1

- header data: DAT16309.sc1
- parameter file: PRM16309.sc1

* (References to specific products are made for identification purposes only and do not indicate an endorsement on the part of either the U.S. Geological Survey or the National Oceanic and Atmospheric Administration).

TABLE 1

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