Moderate Resolution Imaging Spectroradiometer (MODIS) Reprojection Tool
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MRT README

The MRT directory structure stores each application in a separate
directory,
with a separate Makefile for each application. Shared modules reside in
the
shared_src directory, which also contains any include files that are
specific
to the shared modules. The COTS/GOTS libraries (szip, hdf, hdfeos, tiff,
geotiff, jpeg, zlib) reside in the libs directory and associated includes
reside in the include directory. (No source code will be packaged with
the
MRT for the COTS/GOTS libraries. Only the libraries will be provided.
The
user can freely obtain the source code for all these libraries via the
Web.)
The local gctp and geolib libraries and header files reside in the gctp
and
geolib directories.

In general, here's the MRT directory structure:

application directories - Contain source and include files that are
specific
  to that particular application (append_meta, dumpmeta, hdf2rb, hdflist,
  mrtmosaic, resample, sdslist, update_tile_meta.)
shared_src - Contains modules and include files shared by many of the
  applications.
gctp - Contains GCTP source code, include files, and built libraries.
geolib - Contains Geolib source code, include files, and built libraries.
lib - Contains the external COTS/GOTS libraries used by the project
(hdf4,
  hdfeos2, tiff, geotiff, zlib, szip, jpeg).
include - Contains the header files for the external COTS/GOTS libraries.
bin - Contains the executables for each MRT application. Also contains
the
  .jar and icon files for the GUI, along with the world.jpg image. In
addition,
  some simple test data resides in the directory.

data - Contains the datum and spheroid text files that will be used by
GCTP.
doc - Contains the User's Manual and Release Notes for the project.
JavaGuiSrc - Contains the Java source code for the GUI.

Building the source code

The MRT is packaged with pre-compiled binaries for each platform. If the
user desires to compile the source code on their local machine, the
source
should be built in the following order.

1. Obtain (or build) libraries for jpeg, szip, zlib, tiff, geotiff, hdf,
   and hdfeos. These are provided for our supported platforms in the lib
   directory.
2. Build the gctp library.
3. Build the geolib library.
4. Build the MRT library in shared_src.
5. Build the applications: append_meta, dumpmeta, hdflist, sdslist,
     update_tile_meta, hdf2rb, mrtmosaic, resample.

The gctp, geolib, and MRT libraries and include files should remain in
their particular directory. Thus 'make install' will do nothing. The
executables for each of the applications need to be moved to the bin
directory, and 'make install' will handle that appropriately.

Platform specific info

We have dropped support for SGI/IRIX and SUN/SOLARIS, but one should
still be
able to compile the source. It is suggested that one use the source
contained
in the Linux package. The dependent libraries (hdf4, hdf-eos2, szlib,
zlib,
jpeg, tiff, and geotiff) need to be built prior to building the MRT
package.
The Makefiles may need to be adjusted to point to these headers and
libraries
and the CFLAGS and LDFLAGS may need to be changed for your platform. GNU
make
and gcc were used to build our current packages, so if another make
utility or
compiler is used, additional changes may be required.

The following are suggestions if built on the specified platform:

SGI/IRIX   - These platforms commonly don't come with the GNU CC
compiler,
              so the CC definition in the Makefile may need to be changed
to
              cc instead of gcc. If the compiler does not support the -s
              option, then compile without -s. After compiling, run
              "strip <executable>".

SUN/SOLARIS - An additional library must be linked in before the math
library.
                  Thus "-lm -s" needs to be "-lnsl -lm -s".

GNUMakefile

Using gmake (and make on systems where make and gmake are linked to each
other) will automatically pick up the GNUMakefile. This makefile is
mainly
for the EROS developers to be used during development. It automatically
detects the users platform and sets up the environment variables
appropriately
based on the users platform, specifically for pointing to the appropriate
vendor libraries and include files as well as for certain build
libraries.

In order to build the software in the EROS environment using the
GNUmakefiles,
there must be a script or program called .mrt_config that resides in the
home
directory that returns either nothing, TS1, or TS1_DEBUG. This script
can be
as simple as containing a single line such as 'echo $MRT_DEV_MODE'. In
this
case you need to set your MRT_DEV_MODE environment variable to "TS1". If
you
want your CFLAGS set for debug, then set the environment variable to
"TS1_DEBUG". As an alternative, if you do not want to use the
MRT_DEV_MODE
environment variable (which is used for other things as well), then you
could
use the line 'echo "TS1"' in the ~/.mrt_config script. Make sure the
~/.mrt_config script is executable.

Various Environment Variables

Used for internal development.

MRT_DEV_HOME   Points to the top level MRT development directory.
MRT_DEV_MODE   Uses GNU make to compile debug or not and whether
for OPS
                      or TS1. The difference is that in TS1 mode,
additional
                      programs (e.g. fcgtiff, revendian, gtiff_composite)
are
                      also compiled. Valid values are TS1, DEBUG, or
TS1_DEBUG.
MRT_LIB_INSTALL   Points to the top level "installed" third party
directory
                      where the headers, libraries, man pages,
executables, etc.
                      reside. Used when running the MRT_config scripts.

MRT_DEV_INSTALL_HOME Points to the top level MRT_Install directory.

History

Version 4.1 (March 2011)
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1. Windows version was compiled with Visual Studio Express 2008. It no
   longer depends on Cygwin.

2. Support for Windows 85/98 was dropped.

3. Support for Solaris was dropped.

4. MRT can now be installed into and work with input and output data
   contained in directories with spaces.

5. Due to conflicts with the MRTDATADIR environment variable with
MRTSwath
   and the HEG tool, MRT now uses MRT_DATA_DIR as the default. It will
   use MRTDATADIR if MRT_DATA_DIR is not defined, however.

6. The included example test.prm and test1.prm parameter files in the
   MRT bin directory now work.

7. Several buffer overruns were fixed which may have caused the MRT to
   core or create a segmentation fault. These types of errors affected
   the inputing and/or outputing of FLOAT32 data and in error reporting.

8. Pixel values are now rounded when writing integer output images.

9. The mrtmosaic application will not create an HDF file greater than 2G
   due to a file limitation in the HDF v4 file format. An error message
   is displayed instead.

10. Name of install scripts was changed to "mrt_install" to avoid
conflicts
    with other install software.

11. A typo in the GUI parameters dialog for Transverse Mercator was
corrected
    to read "OriginLat" instead of "OrginLat."

12. The automated batch processing service formerly distributed
separately
    from the MRT software (MRTBatch.jar) has been incorporated with the
MRT
    package downloads.

Version 4.0 (September 2007)
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1. Restructured the source code so that each application within the MRT
   resides in its own separate directory. The shared routines reside in
   the shared_src directory. And, as was the case before, the vendor
   libraries and include files reside in the lib and include directories.
   The GCTP and Geolib source code and libraries reside in their own
   directory as well.

2. Added support for Mac OS X and 64-bit Linux platforms.

3. Fixed a bug in the mrtmosaic application which incorrectly dumped out
a
   "File does not exist" error message when loading M[O|Y]D09GA tiles.

4. A bug in the Geolib source code was causing resampling errors on Linux
   systems when using the NAD27 datum. This bug has been fixed.

5. When resampling using the Nearest Neighbor resampling option, the MRT
   was incorrectly rounding when determining the nearest neighbor pixel.
   This bug has been fixed. Thanks to Maosheng Zhao with the Numerical
   Terradynamic Simulation Group at the University of Montana for
pointing
   this out.

6. When using raw binary as the output format, the MRT previously used
   big endian byte-ordering regardless of the platform. This has been
   modified due to user requests. The MRT now writes raw binary products
   using the native byte ordering based on the users machine. A new
field
   has been added to the raw binary header to specify the byte order of
   the product. This field is now required for reading raw binary
headers,
   since the MRT needs to know the byte ordering of the input product.

7. The MRT will now be provided to the user in one gzip file. After
   downloading and unzipping that file, the user can install the software
   using the provided installation scripts. One single download will
make
   downloading easier for the user, especially with Windows platforms.

8. When specifying output projection x/y for spatial subsetting, the LR
   corner specified by the user is now modified to be an integral number
   of lines and samples, if necessary.

9. When specifying spatial subsetting using input lat/long coordinates,
the
   MRT now squares the spatial subsetting off in input lat/long space.
Thus
   the UR and LL input lat/long corners are determined from the UL and LR
   input lat/long corners. These corners are then converted to output
   projection coordinates. Previously the MRT converted the UL and LR
input
   lat/long coordinates to input projection coordinates. The UL and LR
   input projection coordinates were then used to determine the UR and LL
   corner. Then the boundary of the subset in input projection space was

walked and each point converted to output projection space. This process
   still occurs when processing the entire granule and/or when specifying
   input line/sample for subsetting, but not when speciying input lat/long
   coordinates for subsetting.

Version 3.3a (January 2006)
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1. An issue arose with mosaicking tiles that wrapped around the international
   dateline. The MRT would process the data, but not the correct subset of
   data. Often the output product contained all background fill data.

2. hdf2rb was reading the datum value from the HDF file, but then setting it
   to No Datum during processing. The datum value is now output as read from
   the HDF file.

Version 3.3 (December 2005)
----
1. Modified the resampler and mrtmosaic to verify that the values specified
   by the -s (spectral subset) switch are only 0s and 1s. Also, fixed the
   use of the -s switch which was not being parsed correctly with the previous
   version.

2. When mosaicking files with a multitude of bands/SDSs, the resample
   executable would core dump. The problem has been tracked to a buffer
   that was not large enough to handle the huge list of input bands. The
   size of the buffer has been increased and the bug fixed.

3. The HDF-EOS documentation specifies that angular coordinates in the
   projection parameters are specified as DMS. The MRT expects the values
   to be input as decimal degrees for raw binary, so the DMS values are
   converted to decimal degrees after they are read from the HDF file.
   This has not been an issue to this point for Sinusoidal or Integerized
   Sinusoidal data, since the only angular projection parameter for these
   two data sets contains a value of 0.0. Thanks to Terry Haran from NSIDC
   for pointing out this problem and providing the appropriate changes.

4. The HDF-EOS documentation specifies that angular coordinates in the
   projection parameters are specified as DMS. The MRT stores the projection
   parameter values internally as decimal degrees, therefore they need to be
   converted to DMS before writing to the output HDF-EOS file. The values

will still be written as decimal degrees to the output raw binary
files.
    Thanks to Terry Haran from NSIDC for pointing out this problem and
    providing the appropriate changes.

5. Modified the output for unsigned 32-bit GeoTiff values. A break in
    the switch statement was left out and caused the unsigned 32-bit
GeoTiff
    tags to be specified as float 32-bit values.

6. The previous release specified that the Geotiff files would have the
UL
    corner refer to the center of the UL corner pixel. An incorrect
Geotiff
    tag was used in this modification. RasterPixelIsArea actually refers
to
    the UL corner of the pixel instead of the center of the pixel. This
has
    been changed and we are now using RasterPixelIsPoint so that the
center
    of the pixel is specified appropriately.

7. Updated the resampling routines to resample from the center of the
pixel
    rather than from the UL extent of the pixel. The weights in the
resampling
    kernal were set up based on using the center of the pixel, so the
calling
    routines needed to be changed to send in the center of the pixel as
the
    location to be resampled. This also required that the routine to
calculate
    the ISIN shift be modified to work from the center of the pixel
instead of
    the UL extent so that the shift could be applied correctly in the
    resampling algorithm.

8. Created a routine called update_tile_meta to get the user-specified
    horizontal and vertical tile information from the command-line and
then
    write it to the CoreMetadata.0 structure in the specified HDF file.
This
    was requested for use with some of the LDOPE applications.

9. Created a more efficient tool to convert from HDF to raw binary
products.
    hdf2rb is very similar to the MRT, however it does not rely on the
internal
    use of lat/longs. This allows bounding tiles to be processed with
better
    results. This tool does not do any resampling. It is only meant to
take
    the input product, spatially and spectrally subset it, then write it
out

as a raw binary product.

10. Tightened up the boundary on the output products to get a more true
    minimum-bounding product for input line/sample and input lat/long
    spatial subsetting.

Version 3.2a (July 2004)
----
1. Modified the Geotiff output to correctly handle signed vs. unsigned
   integers. Previous versions tagged unsigned values in the GeoTiff file
   as signed values.

2. Previous versions of the MRTSwath output the GeoTiff UL corner point
as
   the outer extent of the UL corner. This has been modified to represent
   the center of the pixel of the UL corner. In addition, the
   GTRasterTypeGeoKey GeoTiff tag has been modified to RasterPixelisArea
to
   correctly represent that the corner point is the center of the pixel.
   The corner point representations for HDF-EOS and raw binary will
remain
   the outer extent of the pixels.

Version 3.2 (April 2004)
----
1. Modified the Windows install script to work with Windows XP systems.

2. Modified the SGI version to be compiled using the SGI CC compiler
rather
   than the gcc compiler. Users on IRIX64 were not able to run the
mrtmosaic
   executable successfully. The software is built using -n32 on an IRIX
   system, which should be compatible for running on IRIX64. The change
in
   compilers has fixed the problem at this point. It did not appear that
   the resample executable had this same problem with the IRIX64
environment.

3. Cleaned up variables not needed in the software that were pointed out
   by CC -fullwarn.

4. Calls to WriteRow were not being checked for errors. This has been
fixed.
   If WriteRow returns an error, then an error message is printed and
   processing is stopped.

5. The read_parameter routine read (s and)s and replaced them with " ("
   and ") " to follow the MRT parameter file standards. This replacement
   with spaces caused problems for users that had (s and)s in their
   directory name. This has been fixed.

6. The mosaic tool and MRT use the SDS name along with the name of the 3rd
   and 4th dimensions when processing 3D and 4D data. The output products
   are 2D, using SDS_name.3rd_dim_name.4th_dim_name as the output SDS
name.
   In some cases, the length of this SDS name was larger than allowed by
HDF.
   The processing didn't provide an error, but instead ultimately used
the
   same SDS name for each SDS to be processed (since the actual name was
   truncated to the allowed SDS name length).

7. Fixed a bug in the GUI for reloading parameter files for mosaicking
   several tiles together. Previously, the GUI would load a parameter
file
   containing several input tiles. The mosaicking would be implemented
   appropriately, however the resampler would issue an error that it
couldn't
   read the TmpHdr.hdr file.

8. Created a utility to append bounding coordinates and
horizontal/vertical
   tile information to an HDF-EOS file that does not contain that
information.
   The MRT requires the BOUNDING COORDINATES to be present when
processing
   bounding tiles. In addition, the HORIZONTAL TILE and VERTICAL TILE
   parameters need to be available when mosaicking tiles together. We
have
   found that the LDOPE tools do not output this information in many
cases,
   specifically in the cp_proj_parm utility.

9. When reading the Struct, Core, and Archive metadata, the MRT would
check
   the status value returned by the HDF library to make sure the metadata
   was found and read successfully. We ran into a case where a file had
   the ArchiveMetadata defined, but the attribute didn't contain any
values.
   This caused the MRT to core dump, since the MRT was at the very least
   expecting that the END field would denote the end of the metadata.
The
   MRT has been modified to also check if the attribute contains any
data,
   before trying to process the specified attribute.

Version 3.1a (July 2003)
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1. A bug was fixed in Version 3.1 to fix the output number of lines and
   samples. This introduced a bug in which the output number of lines and
   samples was not accurately getting calculated to a whole line or
sample.

Instead fractional lines and samples were being used. This bug has
been
    fixed.

2. Added Equirectangular as another supported projection.

Version 3.1 (March 2003)
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1. In Version 3.0a, for Windows platforms, the ViewMetadata option caused
   the GUI to hang. This was due to informational messages being output
by
   dumpmeta that the Windows platforms could not handle in the GUI. This
   has been fixed.

2. Added Mercator as another supported projection.

3. When mosaicking more than 15 tiles at one time, the MRT would exit
with
   an error message specifying that a certain .hdf file could not be
opened.
   This bug has been fixed. In addition, instead of opening all the input
   HDF-EOS files at once and processing the data on a row-by-row basis,
the
   mosaic tool now opens only the HDF-EOS files from the current row
being
   processed.

4. When reprojecting to Interrupted Goodes Homolosine, the resampler
output
   a message stating that "projection 24 was unknown". This occurred in
   the section of the resampler that prints out the projection
information.
   This bug has been fixed.

5. When reprojecting bounding tiles to Interrupted Goodes Homolosine, the
   resampler exited with an error while converting the lat/long
coordinates
   to output projection coordinates. This was due to the fact that IGH
   contains breaks in the projection. Many of the ISIN bounding tiles
fell
   into the IGH interrupted areas. The GCTP software returns an IN_BREAK
   value when the data point falls within the IGH break areas. The
resampler
   software has been modified to look for the IN_BREAK return value. If
that
   value is returned, the particular pixel is tagged as a background fill
   pixel and processing continues.

6. Previous versions of the MRT had prevented the user from processing
data
   that crossed the International Dateline. A bug in the international
dateline

software prevented users from processing valid data that covered the
entire
    globe which did not cross the international dateline. This bug has
been
    fixed.

Version 3.0a (December 2002)
----
1. Version 3.0 prevented datum conversions for sphere-based projections.
   The MRT incorrectly classified Geographic as a sphere-based projection
   when instead datum conversions should be allowed for the Geographic
   projection. This has been fixed.

2. Version 3.0 added a check to the subsetting values to verify that an
   integral number of lines and samples were being processed. If the
number
   of lines or samples was not an integer, then the LR corner was
readjusted
   such that the subset was an integral number of lines and samples. Due
to
   computer roundoff, the implementation added an extra line and sample
in
   almost all cases. This has been fixed.

Version 3.0 (December 2002)
----
1. Version 2.3 introduced a bug for line/sample subsetting when using the
   No_Datum option. This has been fixed.

2. Previous versions of the MRT did not output an exact number of lines
   and samples. The actual corner points were not an exact number of
lines
   and samples (unless the user was doing a format conversion), even
though
   the MRT output reported an integer value for the lines and samples.
   After the MRT determined the minimum bounding rectangle in output
space,
   that rectangle was not expanded to be an exact number of lines and
   samples. Instead it had a fractional number of lines and samples,
depending
   on the image. This has been fixed.

3. Previous versions of the MRT output citation keys in GeoTiff for UTM
   projections when not outputting to WGS84. The current version will
support
   other datums supported by GeoTiff for UTM. GeoTiff supports WGS84 and
WGS72
   for all UTM zones (1N - 60N and 1S - 60S). GeoTiff supports NAD27 for
UTM
   zones 3N to 22N. GeoTiff supports NAD83 for UTM zones 3N to 23N. Any
other
   combinations are output by the MRT to GeoTiff using citation keys.

4. Previous versions of the MRT GUI read the .met file associated with the
   HDF file when pressing ViewMetadata. A new executable now exists that
   will allow the user to view the metadata associated with the HDF file
   itself, which is different than viewing the .met file. The ViewMetadata
   button will now use 'dumpmeta' to output a temporary metadata file for
   the .hdf file and display it in the GUI. Thus the ViewMetadata file will
   now display the metadata for the .hdf file itself, not the .met file
   associated with the .hdf file. If the user wants to use this executable
   on the command-line, simply type
   'dumpmeta <input HDF file> <output metadata text file>'.

5. A change in version 2.1 or 2.2 of the MRT broke the default GUI spatial
   subsetting in some cases. If the spatial subsetting in the parameter file
   was exactly the same as the input UL and LR corners (as is the case when
   using the GUI and processing the entire image), then the output image
   was getting cut off in some cases. If the UR corner was to the east of the
   LR corner then the image was cut off at the LR corner, due to this bug
   which has now been fixed.

6. A change in version 2.2 did not allow the MRT to process input raw binary
   ISIN files. This too has been fixed.

7. When implementing Cubic Convolution on an area which was highly reflective
   (i.e. cloud region) the MRT was overflowing the double buffer. This has
   been fixed.

8. The MRT will now allow for mosaicking. When using the GUI, the user may
   select several input filenames for processing. The View Mosaic option will
   allow the user to view the tiles that were selected for processing. The
   processing involves mosaicking the tiles selected (only for the specified
   bands) and then resampling the mosaic.
   A command-line version of the mosaic tool also exists. The user can mosaic
   several tiles together by using mrtmosaic on the command-line. The names
   of the tiles must be specified in a parameter file. In addition, the user

may select which bands to be processed in the mosaic by using the -s
switch.

9. The changes made to the MRT GUI for mosaicking require the user to
   use the later versions of Java 1.3 or Java 1.4. Java 1.2 will no
longer
   support the functions in the MRT.

10. Added support for Albers Equal Area (AEA or ALBERS_EQUAL_AREA).

11. When outputting sphere values to GeoTiff using the
GeogSemiMajorAxisGeoKey
    and GeogSemiMinorAxisGeoKey, some software packages require both the
    GeogSemiMajorAxisGeoKey and GeogSemiMinorAxisGeoKey values to be the
    radius of the sphere. Previously the MRT set the value of the
    GeogSemiMinorAxisGeoKey to 0.0. This has been changed and the
    GeogSemiMinorAxisGeoKey value is now set to the radius of the sphere.

12. ISIN data has a shift between lines on a per pixel basis. This shift
is
    linear per line, thus the slope of the shift can be calculated by
    determining the shift for the first pixel and the shift for the last
    pixel in a line and dividing by the number of pixels in the line. The
    MRT resampling processes account for this pixel shift (as of Release
3.0)
    in the Nearest Neighbor, Bilinear, and Cubic Convolution resampling
    processes. The shifts for SDSs of the same resolution are the same.
The
    shifts will be recalculated when a new resolution is encountered in
the
    image. Shift statistics are output for the user. It is important to
note
    that the shift handling slows down the resampling process, so the
user
    will see a slow-down in the overall MRT processing times.

13. The previous versions of the MRT were not able to handle sphere
radius
    values other than 6370997.0 (radius of sphere 19) for sphere-based
    projections while implementing datum conversions. This was hard-coded
    in GCTP. Version 3.0 of the MRT will support 6371007.181 as a sphere
    radius value in the MODIS Sinusoidal data.

14. The MRT will no longer allow datum conversions when reprojecting to
    sphere-based projections. In addition datums are no longer output for
    sphere-based projections. The MRT used to output WGS84, by default,
    for all projections. However, technically sphere-based projections do
    not have a datum. Thus, now it will be up to the user to know the
origin
    of their data. For MODIS users, the original MODIS data is
"referenced
    to" the WGS84 datum.

15. The HDF-EOS documentation specifies that when dealing with the
Geographic
    projection, the upper left and lower right corner points will be
output
    in DMS rather than decimal degrees. Version 3.0 of the MRT outputs
    the upper left and lower right corners for the Geographic projection
    to HDF-EOS data files as DMS. In addition, the MRT also requires the
    input HDF-EOS Geographic corner points to be in DMS. All other
projections
    are still expected to be in meters. When dealing with Geographic and
    raw binary data, the MRT still outputs the corner points as decimal
    degrees and requires decimal degrees on input for raw binary as well.

16. Previous versions of the MRT used a minimum-bounding rectangular box
    to determine the spatial subsetting for format conversions. When
format
    converting the entire image, it only makes sense to output the image
    exactly as it is and not determine a minimum-bounding rectangle. When
    working in the Western hemisphere, the minimum-bounding rectangle (in
    most cases) produced an output exactly as the input. However, for
some
    cases in the Eastern hemisphere, the minimum-bounding rectangle
produces
    an output product that contains extra fill on the left and right of
the
    image. This issue has been resolved in version 3.0.

17. Users may now set default input, output, and parameter file
directories.
    If specified, then the MRT will use these directory settings as the
    default for the specific directory. If not specified, then the MRT
will
    use the local directory as the default (which is currently the case).
    Windows users will need to click on the desired directory, then also
type
    the final directory name in the text box. Unix and Linux users should
be
    able to simply click on the desired directory names. These can be set
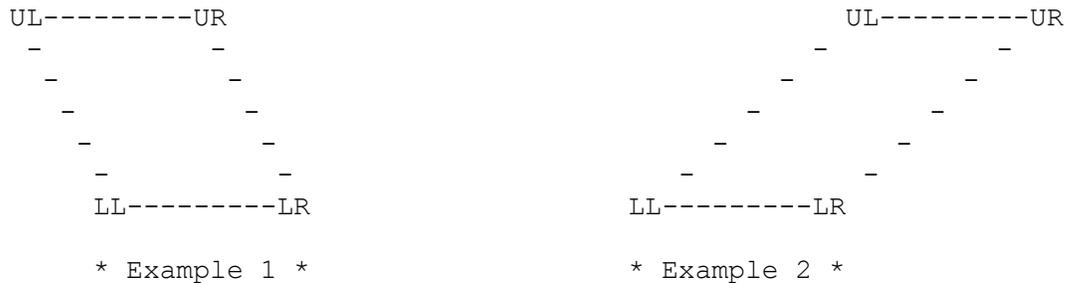   using the 'Settings' option on the MRT GUI toolbar.

Version 2.3 (May 20, 2002)
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1. The MRT was not correctly defaulting to reference the WGS84 datum for
   raw binary data, if an input datum was not specified in the raw binary
   header. This has been fixed.

2. The fix in version 2.2 to handle crossing the International Dateline
   introduced a bug if the data straddles the 0 degrees longitude line.
   This has been fixed.

3. A bug has existed in previous versions of the MRT which crops the
output
   image (in some cases) when processing with the GUI. The GUI creates a

temporary parameter file using the original UL and LR lat/long
coordinates
as the subsetting coordinates. The resampler software then uses the
corner
coordinates from the parameter file to determine the minimum bounding
rectangular box for output. In many cases, when dealing with the
coordinates
output by the GUI to process the entire image, the bounding
rectangular box
crops the image. Instead of simply using the UL and LR corners (as the
resampler does when spatial subsetting coordinates are specified), the
resampler should use the UL, UR, LL, and LR to find the minimum
bounding
rectangular coordinates. In version 3.0 of the MRT, the resampler
checks
the spatial subset UL and LR corners and compares them with the
original
corners in the image. If the spatial subset and the original corners
are
within a small epsilon of each other, then the MRT assumes that the
user
wants to process the entire image and not specifically use the UL and
LR
corners as reported by the GUI. This fix should prevent the cropping
seen
when processing an entire image in the GUI.

For many tiles (Example 1) this bug will not be a problem, however for
some tiles (Example 2) this bug is a serious problem.

```
   UL---------UR                               UL---------UR
    -         -                                 -         -
     -         -                                 -         -
      -         -                                 -         -
       -         -                                 -         -
        -         -                                 -         -
         LL---------LR                      LL---------LR

          * Example 1 *                    * Example 2 *
```

4. Previous versions of the MRT have actually been dealing with
Geographic
units in degrees, not arc-seconds as the User's Guide and the GUI had
specified. The User's Guide and GUI have been updated to note that the
units are in degrees.

5. The Geotiff output from the MRT still had a couple of tag issues that
needed to be fixed so that the output Geotiff data followed the
Geotiff
standard. Among these issues were that only the UL corner point should
be
output to the Geotiff tiepoint tag, not all four corner points.
Another

issue was that the Geographic output was being tagged as both
Geographic
   and user-defined. The user-defined tag was removed.

6. Previous versions of the MRT would not allow the user to enter a pixel
   size of 0.xxxx into the GUI. The GUI would allow .xxxx, however.
   Fractional pixel sizes less than one are common for outputting to
   Geographic, since the units are in degrees (used to be arc-seconds).
   This error occurred when pressing the Run, the ConvertFormat, or the
   SaveParameters buttons. This bug has been fixed.

7. Many of the MRT users have noted how the status box in the GUI takes
   "total" control of the system. In previous versions of the MRT, if you
   tried to close, minimize, or move the status box to the background,
the
   status box would take focus again. Thus the user could not work on
   anything else because the status box would always steal the focus.
   This has been fixed. The status box can now be minimized or placed in
   the background (and it will remain there until the user brings it to
   the foreground). The status box can also be closed. If the status box
   is closed, it will remain closed but the resampler/format converter
   will continue to run in the background. It will be up to the user to
   determine when the process has completed ... by viewing the
resample.log
   file and/or the output image files.

8. Previous versions of the MRT did not correctly support unsigned 32-bit
   or signed 32-bit data. This has been fixed.

9. A temporary fix has been added to allow the user to use the NO DATUM
   option to specify their own radius of the sphere. The user may now
   specify the radius of the sphere in the projection parameters (first
   parameter), however the user must select the NO DATUM option for this
   user-specified radius to be used. Previous versions of the MRT
   automatically used the radius of Sphere 19 as the radius of any
sphere-
   based projection, regardless of the value that the user specified.

   If the user is not going to specify their own radius value and instead
   use an output datum, then 0.0 must be used in the first two projection
   parameters. This will allow the MRT to use the default value in GCTP.

   If the user chooses to use the NO DATUM option for the output product,
   the MRT will also require that the radius of the sphere (for the input
   projection) is specified in the input projection parameter as well.
   This is not a problem for the traditional MODIS ISIN HDF-EOS data, but
   it may be a problem for other non-traditional data sets that the MRT
   will support.

10. Version 2.2 of the MRT would not allow the user to specify the
latitude
    and longitude of their UTM zone, if a datum had been specified. Thus
    only the UTM zone number could be used with a datum. This has been

fixed and the user can now specify the first two projection
parameters
    instead of the UTM zone, even when specifying a datum.

11. Previous versions of the MRT allowed the user to specify the radius
of
    the sphere or the semi-major and semi-minor values in the first two
    projection parameters, along with specifying a datum. The MRT then
    checked the first two projection parameters with default values for
    that projection and datum in GCTP. If the first two projection
    parameters did not agree with the defaults in GCTP (when also
specifying
    a datum), then the MRT would exit with an error. This has been a
point
    of confusion for many users, thus the MRT will no longer allow the
    user to specify both the first two projection parameters (except for
    UTM) and the output datum. If the user wants to specify their own
    radius of the sphere or semi-major and semi-minor, then the NO_DATUM
    option must be used.

12. Previous versions of the MRT specified the Vgroup name of the output
    HDF-EOS files to be the output filename plus the output pixel size.
    If the input file is an HDF-EOS file, then the output HDF-EOS file
    will now retain the Vgroup name of the input HDF-EOS file. If the
    input file is a raw binary file, then the Vgroup naming convention
    uses the output filename plus the output pixel size.

Version 2.2 (February 15, 2002)
----
1. A bug was introduced in Release 2.1 that added an extra line and
sample
   to the output product. This same bug also caused the pixel size to be
   incorrect. This has been fixed.

2. Previous versions of the MRT have not been able to process the
bounding
   ISIN tiles (tiles on the outer edge of the ISIN projection). Version
2.2
   now has the capability to handle these tiles. In addition, an issue in
   previous versions arose when a tile crossed the International
Dateline.
   Version 2.2 can now handle this as well.

3. Users reported problems ingesting the GeoTiff files created by the MRT
   into other GIS packages. The output GeoTiff files from the MRT now
follow
   the GeoTiff "standard" that is supported at the USGS EROS. ENVI
should
   support the GeoTiff products output by the MRT, however we realize
that
   some other software packages still may not be able to ingest these
GeoTiff
   products.

4. The format conversion option has been changed in Version 2.2 to output
   exactly the input file. No minimum bounding rectangle is created
around
   the input data, like with the resampling option.

5. We realize that some users want to be able to compare their output
data
   with data that may be referenced other datums than WGS84. Version 2.2
of
   the MRT now supports datum conversions. A limited number of
input/output
   datums are supported (NAD27, NAD83, WGS66, WGS72, WGS84, NODATUM). The
   NODATUM option allows the user to specify the semi-major and semi-
minor
   axes in the projection parameters. WGS84 is used by default. If you
are
   doing a datum conversion, expect the processing time to be 5-10 times
   slower than simply reprojecting without a datum conversion. For our
users
   that use the GCTP and Geolib (datum conversion layer), a bug fix was
made
   in Geolib to support the specified datums.

6. In many cases, the data output (especially in Geographic projections)
by
   the MRT was not able to be input back into the MRT. These problems
have
   been fixed.

7. When outputting HDF-EOS files from input raw binary data, the output
   HDF-EOS files did not contain all the grid data as when going from
   HDF-EOS to HDF-EOS. The raw binary to HDF-EOS conversions now contain
   the appropriate grid information for the output HDF-EOS file.

8. A request was made by our users to be able to specify the spatial
subset
   in output projection coordinates. This request has been implemented in
   Version 2.2. Spatial subsetting can now be input lat/long, input
   line/sample, and output projection x/y.
   *** This change will require a change to your existing parameter
files.
   If the SPATIAL_SUBSET_UL_CORNER or SPATIAL_SUBSET_LR_CORNER are
specified
   in your parameter files, you MUST specify the SPATIAL_SUBSET_TYPE to
be
   INPUT_LAT_LONG, INPUT_LINE_SAMPLE, or OUTPUT_PROJ_COORDS. Thus your
   parameter files now need to have the SPATIAL_SUBSET_TYPE parameter in
   order for the MRT to process your spatial subset corners properly. ***

9. Previous versions of the MRT have not been able to correctly subset an
   image when line/sample spatial subsetting was specified and the output
   projection type was geographic. This has been fixed.

10. Previous versions of the MRT have not properly processed 3-dimensional
    data products where the 3rd dimension was listed before the XDim and
    YDim dimensions (i.e. "Num_QC_Words", "YDim", "XDim" in the MOD12Q1 data
    products). This problem has been fixed and the MRT can properly handle
    3-dimensional data products with the dimensions listed in any order.
    The 4-dimensional data products were not affected by this bug.

11. Information on the different resampling types (NN, CC, and BI) has been
    added in the User's Guide. This information is to help the MRT users
    to understand the differences between these options. In addition,
    information on the ISIN bounding tiles and datum conversions has also
    been added in the User's Guide.

Version 2.1 (August 20, 2001)
----
1. A bug was introduced in Release 2.0 that broke the use of many
   command-line parameters. This has been fixed.

2. The GCTP software that was received from the USGS EROS used the radius of
   Sphere 19 (which is 6370997.0) instead of the radius of the MODIS sphere
   (which is 6371007.181). This bug has been fixed in the MRT GCTP software.
   This bug caused the output coordinates to be off by less than a pixel.

3. Bi-directional support has been added to the MRT. All output projections
   are now supported as input projections.

4. Format conversion is now available. This allows the input data to be output
   to a different data format without going through the resampling process. The
   user can specify spatial and spectral subsetting, along with the output data
   format.

5. The bounding tiles in the ISIN projection have at least one corner point that
   does not map to a valid latitude/longitude. Currently the MRT will not
   process these tiles due to the invalid latitude/longitude. We are working on
   a fix to support these tiles.

6. For the Windows users, a ModisTool icon has been created. See the User's
   Guide for setting up a shortcut for the MRT.

7. A bug existed in the GUI when saving and resaving parameter files. This bug
   has been fixed.

Version 2.0 (June 2001)
----
1. Transverse Mercator has been added to the list of output projections.

2. The user is now allowed to choose from WGS84, GRS80, and CLARKE1866
   for the UTM output projection. The default ellipsoid is WGS84, which has
   been the ellipsoid used for all previous releases. Both the GUI and the
   command-line resampler support the choice of ellipsoid. The ellipsoid
   value can be specified under Edit Projection Parameters for the UTM
   projections (along side the UTM Zone). The parameter file supports an
   ELLIPSOID_CODE parameter for specifying the output ellipsoid for the
   output UTM projection.

3. Cosmetic changes have been made to the GUI, along with some minor bug
   fixes. An Exit button has been added next to the Run button to allow for
   easier exiting from the MRT. The Resampling Type automatically defaults
   to Nearest Neighbor to match the command-line resampler. The View
   Metadata box can be left up while running the MRT. Previously the user
   had to close the View Metadata box before continuing in the MRT GUI.
   Similarly, the Status dialog box that pops up after pressing Run can now
   be minimized/maximized. Previously this box needed to remain in the
   foreground.

4. A bug was introduced in Version 1.2 that did not allow the user to do
   spatial subsetting from the GUI. The user was allowed to change the
   UL and LR corners in the GUI, however the entire image would be processed.
   This has been fixed in Version 2.0.

5. The View Metadata option in the GUI used to look for a metadata file of
   the name <basename>.met. Now the View Metadata option will look for and
   view the metadata for any file of the following names (in the listed order):
       <basename>.hdf.met
       <basename>_hdf.met
       <basename>.met

   For raw binary files, the following file formats will be supported by the
   View Metadata option (mainly for consistency):
       <basename>.hdr.met
       <basename>_hdr.met

```
        <basename>.met
```

6. Minor bug fixes have been made to the GeoTiff output format, which
will
   hopefully prevent the past problems of ingesting the GeoTiff files
into
   ENVI, ERDAS, IDL, and other such packages.

7. MOD11A1 and MOD12A1 both have internal data errors that did not allow
   them to be processed correctly by the MRT. The SphereCode is set to 1
   in these files, instead of -1. The MRT has a work-around for this
   SphereCode and will now process these data products. In addition, the
   MOD11A1 data files would cause a core dump in the MRT. This has also
   been fixed.

8. The MRT will now support multigrid/multiresolution data (i.e.
MOD09Q1).

9. The MRT will now support 3D/4D data. Each 3D or 4D slice will be named
   using the following format:
   <SDSname>.<third dimension name>_#.<fourth dimension name>_#
   where # is a 2-digit number representing the slice in that dimension
   that was processed. This naming convention produces very long names,
   which is not currently supported in the Windows version of the MRT.
   In the case of working on Windows and running the MRT on 3D/4D data
   products with long SDS and/or dimension names, the MRT will instead
   use the following format:
   <SDSname>.3_#.4_#

10. Using the command-line resampler, the resample.log file can be
renamed.
    The -g option will allow the user to specify a different name for the
    resample.log file. A full path can be specified with this name.

11. The MRT is not currently handling data that are very close to or
straddle
    the International dateline. We are working on a fix for this problem.
This
    has mainly been reported in the MOD13A1 data products.

12. The MOD09GHK data products have output the data attributes in a
different
    order than the image data itself. The MRT had made the assumption
that the
    data attributes would be output in the same order as the image data.
This
    causes a problem in the MOD09GHK data files, but only with the last
SDS
    which is the number of observations. We are working on a work-around
for
    this problem.

Version 1.2 (May 2001)

```
---------------------
1. In Version 1.1 we introduced a spatial subsetting (Lat/Long)
stipulation
   that the UL corner should be to the left of the LR corner. This was an
   invalid assumption and has been removed in Version 1.2.

2. In the resampling process when a pixel falls outside the image
boundary,
   previous versions of the MRT assigned this pixel a value of zero.
   Version 1.2 now uses the Background Fill Value for pixels that fall
   outside the image boundary. If the Background Fill Value is not
available,
   then a value outside of the Valid Range is used. If the Valid Range is
not
   available, then the pixel is assigned a value of zero.

3. For the HDF-EOS output images, the Dataset Attributes have been
carried
   through. These attributes include: long_name, units, valid_range,
   _FillValue, Nadir Data Resolution, scale_factor, scale_factor_err,
   add_offset, add_offset_err, and calibrated_nt. Since these attributes
   are not supported in the raw binary header, the scale_factor and
   offset are output as comments at the end of the raw binary header
file.

4. Bug fix: When specifying a new input file and output information,
   selecting Geographic as the Output Projection Type did not show
   the units (arc-sec) in the Output Pixel Size Units box. Fixed.

5. Back due to popular demand! The command "resample -h file.hdf"
produces
   a raw binary header file named TmpHdr.hdr from an HDF-EOS file
(file.hdf).
   This functionality was previously available via the command "hdf2hdr",
   which is no longer included in the distribution.


Version 1.1 (April 2001)
-----------------------
1. Windows version of MRT GUI now runs similarly to UNIX platforms.

2. Installation script is more robust, provides more defaults.

3. New command-line options: -u UTM_zone and -x pixel_size

4. Bug fixes:
   a. Resampler failed for HDF-EOS input, raw binary output. Fixed.
   b. Spatial subsetting was incorrect. Fixed.

5. Reorganized directory structure. Old geolib/gctp and geolib/geolib
   subdirectories are now just gctp and geolib.


Version 1.0 (March 2001)
```

```
------------------------
1. First public release.

2. Installation scripts provided.

3. Switched from DJGPP compiler to CygWin compiler on Windows, solved
long
   filename problem on Windows NT.

4. Many added capabilities and bug fixes from beta release.

5. Windows version of MRT GUI runs differently than UNIX versions
   (to run resampler, must exit GUI, open a DOS box, then restart GUI).
```