

MODIS Reprojection Tool (MRT) Release Notes
Version 4.0
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Land Processes DAAC

USGS Center for Earth Resources Observation and Science (EROS)
in collaboration with the
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Capabilities

1. MODIS Data Products

The MODIS Reprojection Tool currently allows the user to reproject gridded (Level-2G, Level-3, and Level-4 land products) MODIS data products. This includes both ISIN (version 001, 002, and 003) data and SIN (version 004 and 005) data. Support for swath (Level-1 and Level-2) data products is provided by the MRTSwath application.

2. Map Projections

The MODIS Reprojection Tool allows the user to reproject to and from the following map projections:

- * Albers Equal Area
- * Equirectangular
- * Geographic
- * Hammer
- * Integerized Sinusoidal
- * Interrupted Goode Homolosine
- * Lambert Azimuthal
- * Lambert Conformal Conic
- * Mercator
- * Mollweide
- * Polar Stereographic
- * Sinusoidal
- * Transverse Mercator
- * Universal Transverse Mercator

3. ISIN-Enhanced GCTP

As part of this software, the Generalized Cartographic Transformation Package (GCTP) has been modified to incorporate the new Integerized Sinusoidal Projection.

4. Spectral Subsetting

Any subset of the input bands may be selected for reprojection. The default is to reproject all input bands.

5. Spatial Subsetting

Two corners (upper left and lower right) of a rectangle in input/output space may be specified. These corners may be given as coordinates in input latitude and longitude, input line/sample pairs, or output projection coordinates. If specifying line/sample pairs specify as (start line, start sample) and (end line, end sample), using a zero-based coordinate system where the upper left corner is (0, 0). When specifying input lat/long or input line/sample, the other two rectangle corners (upper right and lower left) are computed automatically in input space. Then all four corners are reprojected into output space, using the specified map projection and datum. Finally, a minimum-bounding rectangle is computed that contains the four reprojected points, in output space. All points inside this rectangle in output space are mapped back into input space for reprojection. The default is to reproject the entire input image.

When specifying output projection coordinates, specify as (start projection x, start projection y) and (end projection x, end projection y). These coordinates must be specified in the same units as is used for the projection (degrees for geographic and meters for all other projections). The upper right and lower left corners are computed from the specified upper left and lower right corners to create a rectangle in output space. Using these coordinates in output space, the corners are mapped back into input space to determine the spatial subset corners in input space. The output image corner coordinates are used exactly, as specified by the user. However, if the LR corner is not an integral number of lines and samples from the UL corner, then the LR corner is modified as such.

6. Resampling

Resampling may be nearest neighbor, bilinear, or cubic convolution. Background fill values are supported. If the majority of values that lie under the resampling kernel are background fill values, then a

background fill value is output. Otherwise, resampling is performed only from non-background fill values, and kernel weights are adjusted accordingly.

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 shift 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 MRT processing times.

7. Datum Conversions

A limited number of input and output datums are supported by the MRT for datum conversions. Supported datums are NAD27, NAD83, WGS66, WGS72, and WGS84. When reprojecting to a sphere-based projection, datum conversions are not allowed. In addition, datums are not output for sphere-based projections. It is up to the user to know the origin of their data. For MODIS users, the MODIS data is "referenced to" the WGS84 datum.

8. Format Conversion

The MRT supports format conversion, which allows the user to output the data to a new data format without resampling the input image. The user may specify spectral and spatial subsetting, along with the output format. A simple command-line tool (hdf2rb) for format conversion from HDF to raw binary is available as of version 3.3. It does not rely on lat/long for information and therefore works well with bounding tiles as well.

9. Output Pixel Size

An output pixel size may be specified. If so, it will be used for all bands. The default is to use the same input and output pixel size for corresponding input and output bands.

10. Data Types

The MODIS Reprojection Tool supports 8-bit, 16-bit, and 32-bit integer

data (both signed and unsigned), as well as 32-bit float data. Support for ASCII data is planned. The same data type is used for the corresponding input and output bands.

11. File Formats

HDF-EOS and raw binary files are supported on input. HDF-EOS, GeoTIFF, and raw binary files are supported on output.

12. Platforms

The MODIS Reprojection Tool is highly portable software. It currently runs on the following platforms:

- * Windows 2000/ME/XP
- * Windows NT
- * Linux
- * 64-bit Linux
- * Sun/Solaris
- * SGI/Irix
- * Mac OS X

(See Caveats below.)

13. Interfaces

The MODIS Reprojection Tool may be invoked either from a user-friendly GUI or from a powerful command-line interface. The GUI allows novices and users with light processing requirements to reproject MODIS imagery, with little training required. The GUI also allows easy inspection of metadata. The scriptable command-line interface, with its variety of command-line options, is likely to be the method of choice for reprojecting large numbers of files.

14. Mosaic Tool

The MODIS Reprojection Tool will allow the user to mosaic several tiles together, then resample them. The GUI will support the input of several filenames, or the user may use the mrtmosaic command-line software. The GUI also provides an option to view which tiles have been selected for processing.

15. MRT and LDOPE Tools

It has been brought to our attention that the MRT will not process data output by the LDOPE Tools. In most cases, this is due to the fact that the MRT requires HDF-EOS files on input and the LDOPE Tools produce HDF files. One LDOPE Tool, cp_proj_parm, does use HDF-EOS for its output. However, this utility does not output the appropriate metadata information, which is expected by the MRT (namely the BOUNDING COORDINATES for use when processing bounding tiles and also the HORIZONTAL and VERTICAL TILE information for use when mosaicking tiles together). If the user is trying to process files output by the cp_proj_parm utility, they currently are not able to process bounding tiles and they are not able to mosaic tiles in the MRT. Version 3.2 added a utility called append_meta that appends the appropriate metadata information to the specified HDF-EOS file. If the user runs append_meta on their file that was output from cp_proj_parm, then the appropriate metadata will be appended and the user will then be able to use these files with the MRT.

We are working with the LDOPE Tools group to find a better solution to this issue.

History

Version 4.0 (February 2008)

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. Also verified that this was being done correctly for Bi-Linear and Cubic Convolution resampling as well.

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 specifying input lat/long coordinates for subsetting.

Version 3.3a (January 2006)

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)

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)

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)

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).

Caveats

1. MODIS swath (Level-1 and Level-2) data is not supported. Only Level-2G, Level-3, and Level-4 Land products are supported in HDF-EOS.
2. The output GeoTiff products follow the GeoTiff standard that has been in use at the USGS EROS. ENVI supports the output GeoTiff products from the MRT, but we have been informed that other software does not always support ingesting our GeoTiff products.
3. The GCTP software automatically uses the radius of Sphere 19 when reprojecting to a sphere-based projection. To work around this caveat, the user should use the No Datum option and specify the desired sphere radius in the first projection parameter.
4. When using the No Datum option, the software requires that the projection parameters are used to specify the radius of the sphere or the semi-major and semi-minor of the output spheroid. The software also requires that the projection parameters be used for the input data product as well. The input datum will not be used.
5. Many versions of Windows are hanging the MRT GUI when trying to process data products which live in a directory name that uses blank spaces. It is highly recommended that directory names with blank spaces NOT be used in the MRT. For example, "c:\Modis Data" should instead be "c:\ModisData".

Installation

Obtain the MODIS Reprojection Tool software by downloading the appropriate installation files for your platform from the USGS EROS MODIS Reprojection Tool web site (<http://lpdaac.usgs.gov/landdaac/tools/modis/index.asp>). The installation files include a zip archive containing the MRT software (MRT_Sun.zip, MRT_Win.zip, etc.), an installation script (install), and an executable file named unzip. (On the Windows platform, there will be

several other executable files as well.) These executable files (install, unzip, *.bat, *.exe) need to have execute permissions. After downloading these files from the webpage, make sure these files have execute permissions before starting with the installation process. Ask your system administrator if you do not understand file permissions.

Installation requires that the zip archive be unpacked into an appropriate directory on your system. This process will create an MRT directory containing several subdirectories (bin, data, doc, geolib, include, JavaGuiSrc, lib, src). Once the software has been unpacked, the MRT bin directory need to be added to your path, and an environment variable named MRTDATADIR needs to be set to the MRT data directory.

In order to run the MODIS Reprojection Tool GUI, you must have a current version of Java installed on your system (at least the Java2 v1.3 Runtime Environment or the Java 2 SDK v1.3). If you do not plan to use the MRT GUI, and only intend to use the command-line resampler, then Java is not required for your installation.

In order to install the MRT GUI, you must know the path to your Java directory. On Unix systems, you can type "which java" (no quotes) to determine the path to your current Java executable. This method will only work if the Java executable is on your path. You can also try typing "find / -name java", but this will search all mounted file systems and may take a while to complete. If necessary, ask your system administrator where the Java bin directory is located.

To determine the Java bin directory on Windows, click on the Windows Start button and select Find, Files or Folders... Fill in the dialog box to search all local hard drives for a file named java.exe. Make note of the directory containing the most recent version of java.exe. If java.exe does not appear in the Find Files listing, then Java may not be installed on your system.

If the Java executable is on your path, you can tell which version of Java is installed on your machine by typing `java -version`, which will give you an output similar to the following:

```
java version "1.3.1"
```

If the version number is older than 1.3.1, the MRT GUI is not guaranteed to work with your version of Java. In this case, you should install a newer version of Java. The latest version of Java 1.3 or Java 1.4 are

now required for the MRT GUI.

For automatic installation of the MRT, you must be able to supply the complete pathname of the directory in which you want to install the MRT, and the pathname of the directory containing the Java executable program (java or java.exe) on your system.

Once you have this information, you can run the install script. Make sure you are in the directory containing the installation files (the zip archive, the unzip program, and the install script) that you have downloaded from the USGS EROS web site. On UNIX systems, type `./install`. On Windows, just type `install`. Follow the installation instructions carefully. The installation program will automatically unzip the zip archive into the MRT directory, and will prompt you for the information needed to set up your path and environment variables correctly.