

Mapping Toolbox Release Notes

The “Mapping Toolbox 2.0.2 Release Notes” on page 1-1 describe the changes introduced in the latest version of the Mapping Toolbox. The following topics are discussed in these Release Notes:

- “New Feature” on page 1-2
- “Major Bug Fixes” on page 1-3

The Mapping Toolbox Release Notes listed below provide information about recent versions of the product.

- “Mapping Toolbox 2.0.1 Release Notes” on page 2-1
- “Mapping Toolbox 2.0 Release Notes” on page 3-1
- “Mapping Toolbox 1.3.1 Release Notes” on page 4-1
- “Mapping Toolbox 1.3 Release Notes” on page 5-1
- “Mapping Toolbox 1.2 Release Notes” on page 6-1

Note Mapping Toolbox versions 2.0 and 2.0.1 were released in Web download form after Release 13 with Service Pack 1 was shipped.

Printing the Release Notes

If you would like to print the Release Notes, you can link to a PDF version.

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New Features

Version 2.0.2 of the Mapping Toolbox adapts Version 2.0.1 to the MATLAB 7 (Release 14) environment. Versions 2.0.1 and 2.0 were Release 13SP1+ web releases. The resulting changes are transparent to users, except as noted below.

If you are upgrading from a version earlier than Version 2.0.1, then you should also see “New Features” on page 3-2 in the Mapping Toolbox 2.0 Release Notes.

The following enhancements are included in Mapping Toolbox 2.0.2.

Mapping Toolbox Compilability Enhanced

Almost all Mapping Toolbox command line functions can be compiled using the new MATLAB Compiler. However, large Atlas Data MAT-files need to be added explicitly to use them in applications. For details, see “Using the Compiler with the Mapping Toolbox” in the MATLAB Compiler Release Notes.

SDTS Functions Now Available on HPUX

The input functions `sdtsinfo` and `sdtsdemread` are now available on the HPUX platform.

Major Bug Fixes

Mapping Toolbox Version 2.0.2 contains no significant bug fixes. However, Version 2.0.1 did address a number of bugs. See “Major Bug Fixes” on page 2-3 for details.

Mapping Toolbox 2.0 included a number of significant bug fixes made since Version 1.3.1. For a description of those Mapping Toolbox bug fixes, see “Major Bug Fixes” on page 3-13 in the Version2.0 release notes.

If you are upgrading from a version earlier than 2.0, then see should also see “Bug Fixes and Enhancements” on page 4-2 in the Mapping Toolbox 1.3.1 Release Notes.

Mapping Toolbox 2.0.1

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New Feature

The following enhancement has been added to Mapping Toolbox 2.0.1.

If you are upgrading from a version earlier than Version 2.0, then you should also see “Mapping Toolbox 2.0 Release Notes” on page 2-1 in the Mapping Toolbox 2.0 Release Notes.

mapexreg Demo (Georeferencing an Image to an Orthotile Base Layer) Generalized and Clarified

Calls to `imtransform` and `makerefmat` are no longer hard-coded for an output pixel size of one meter. The choice of output pixel size now is explained in detail.

Major Bug Fixes

Mapping Toolbox Version 2.0.1 fixes several significant bugs that existed in Version 1.x which were not addressed in Version 2.0.

Mapping Toolbox 2.0 included a number of significant bug fixes made since Version 1.3.1. For a description of those Mapping Toolbox bug fixes, see “Major Bug Fixes” on page 2-13 in the Version 2.0 release notes.

If you are upgrading from a version earlier than 2.0, then see should also see “Bug Fixes and Enhancements” on page 1-2 in the Mapping Toolbox 1.3.1 Release Notes.

Version 2.0.1 contains the following bug fixes:

almanac

Function `almanac` now gives a precise inverse flattening ($1/f$) value for Bessel 1841 ellipsoid. Previously, `almanac` used a truncated value (299.1528) instead of the full precision value (299.1528128).

axesm

Function `axesm` now accepts the `'meridianlabel'` parameter. Previously, `axesm` would throw an error if the `'meridianlabel'` parameter was specified.

distance

Function `distance` now computes correct results for rhumbline distances along a parallel (including the equator) on a (non-spherical) ellipsoid.

distance

Function `distance` now uses the robust "haversine formula" to compute great circle distances on a sphere. For certain inputs roundoff sensitivities in the previous implementation resulted in a small, but non-zero, distance between identical points.

distance

Function `distance` now correctly obtains correct results for rhumb lines that follow the equator, or any other parallel, and cross the 180-degree meridian; it gives the distance along the short arc of the parallel. Previously the length of the long arc could be returned instead.

distance, azimuth

Functions `distance` and `azimuth` now produce accurate results even for long geodesics on an ellipsoid, up to near-antipodal distances.

projfwd/projinv

Functions `projfwd` and `projinv` now use NaN separators on all platforms. Previously, under certain circumstances, `projfwd` and `projinv` returned coordinate arrays with Inf separators rather than NaNs.

reckon

Function `reckon` now supports geodesics on an ellipsoid, in addition to rhumbines on an ellipsoid and both geodesics and rhumbines on a sphere

Mapping Toolbox 2.0

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New Features

This section summarizes the new features and enhancements added in the Mapping Toolbox 2.0 since Version 1.3.1.

If you are upgrading from a Version earlier than 1.3.1, then you should also see “Bug Fixes and Enhancements” on page 4-2 of the Mapping Toolbox 1.3.1 Release Notes.

Release Summary

Mapping Toolbox 2 provides a comprehensive set of functions and graphical user interfaces for building map displays and performing geospatial data analysis in MATLAB. In this major release of the toolbox, new functions and capabilities include:

- Support for standard GIS and geospatial file formats:
 - ESRI shapefile; GeoTIFF; Arc ASCII Grid; SDTS Raster Profile (read only)
 - “Worldfiles” for spatially-registered images (read and write)
- New display functions for vector features, georeferenced imagery, and data grids in x - y map coordinates (as well as unprojected latitude-longitude)
- New functions for vector symbolization based on feature attributes
- Transverse Mercator projection and PROJ.4 projection library support
- A new interactive Map Viewer with the following features:
 - Support for multiple raster and vector layers
 - Data import from file or workspace
 - Zooming/panning/map navigation tools
 - Cursor coordinate and map-scale readout
 - Data tip and info tools
 - Graphical overlays
 - Map exporting/printing
- A major update of the Mapping Toolbox User’s Guide, focused on clarifying concepts and terminology, explaining features and functions, adding new and enhancing existing examples, and organizing and cross-referencing material to make the documentation easier to access

These and other new features are described on the following pages.

New Demos and Sample Data

The Mapping Toolbox now has six new demos, available from the **Demos** tab of the Help Browser. You can also access this demos page by typing

```
mapdemos
```

The demos consist of the following:

- `mapexenhance` — Enhancing Multispectral GeoTIFF Images
- `mapexfindcity` — Interactive Global City Finder
- `mapexgeo` — Creating Maps using `geoshow` (for latitude, longitude data)
- `mapexmap` — Creating Maps using `mapshow` (for x, y data)
- `mapexrefmat` — Creating and Using Referencing Matrices
- `mapexreg` — Georeferencing an Image to an Orthotile Base Layer
- `viewmaps` — GUI Demonstrating Map Projections (not new in 2.0)

Note that the above commands run the demo scripts to produce figures, whereas `mapdemos` describes and illustrates the demos in the Help Browser.

In addition, a number of new sample data sets containing vector features, digital elevation models, and georeferenced images have been added for use in demos and examples. The new data includes satellite images of the Boston area, topographic grids of the White Mountains in New Hampshire, and vector data for roads and hydrographic features in the Boston area. The data sets are provided in standard geospatial and GIS formats: GeoTIFF, TIFF images with worldfiles, SDTS Raster Profile, Arc ASCII Grid, and ESRI shapefiles. They are accompanied by ASCII text files (with suffix `.txt`), containing descriptive metadata.

The new data files are in addition to existing sample data sets stored in MAT-files, such as `geoid`, `russia`, and `korea`. In addition, metadata indicating the source and describing the contents of most sample data and atlas data has been added to their respective MAT-files.

To read the metadata for a Mapping Toolbox MAT-file data set, load it and inspect the source and description workspace variables.

To read brief descriptions of the demos and sample data sets, type

```
help mapdemos
```

New Map Viewer

The toolbox includes a new interactive tool for displaying and examining map data, called the Map Viewer. The Map Viewer helps you work with data that is already in a projected map coordinate system, which is the case for many high-resolution satellite and aerial imagery products, as well as many vector map data sets that cover small areas of the earth in substantial detail. The Map Viewer gives you a view (or views) of an x - y map coordinate plane where, for example, x and y may correspond to the easting and northing coordinates of a given UTM or State Plane zone. If some of your data is referenced to geographic (latitude-longitude) coordinates, you first need to use an appropriate projection to transform it to map coordinates.

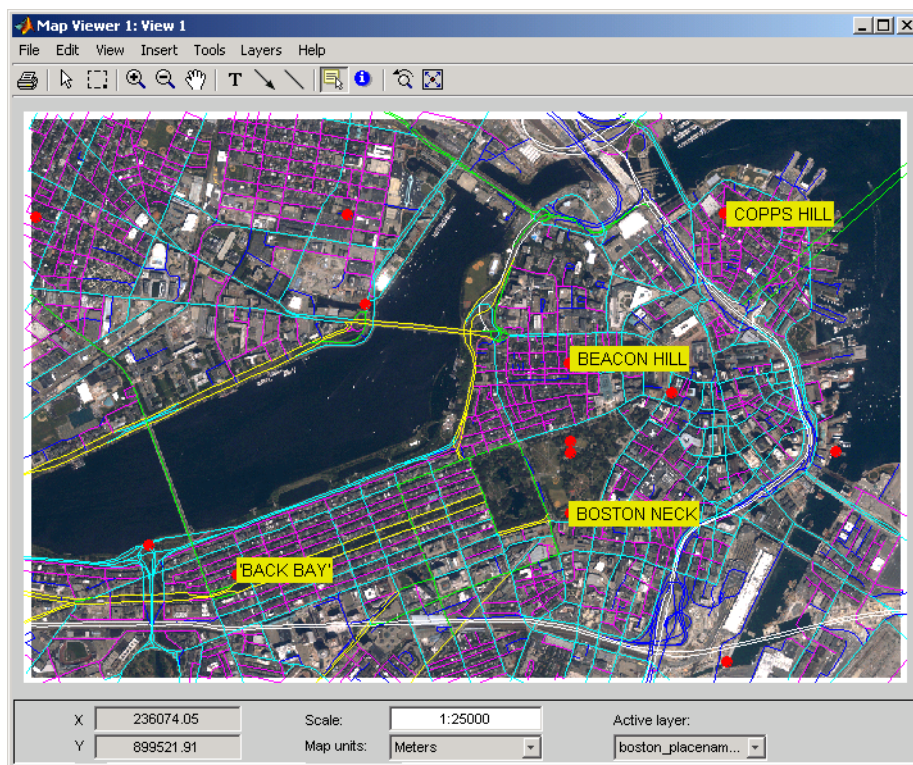
Key features of the Map Viewer include:

- A two-dimensional view of the x - y map plane with interactive tools for navigating in that plane: magnification, de-magnification, panning, setting the map scale, and zooming the view to the extent of a given data set, or all data sets
- Vector and image data import from files or from the MATLAB workspace
- Management of each data set in a separate layer. You can control layer ordering and visibility to bring what you need into view.
- Multiple, simultaneous views (differing in scale or view extent) of the same data layers.
- A data tip tool to identify vector shapes or query a feature attribute that you specify
- An info tool to display, in a separate window, all the attributes of a selected feature
- Tools to annotate the map with lines, arrows, and text
- Ability to export a raster snapshot of the map view

To start the Map Viewer, use the `mapview` function. Typing

```
mapview
```

will open a Map Viewer window. You can then import standard format files or load workspace data into the Map Viewer. The following figure shows the Map Viewer's main window after loading image, line, and point data sets, also illustrating user-specified symbology for streets and landmarks, and Data Tip labels for selected point features:



You can print maps as they appear in the Map Viewer window, to either a printer or a file. Either click the **Print** button on the left end of the toolbar or select **Print** in the **File** menu. A standard figure print dialog appears. You should consider selecting a driver appropriate to your printer; this may be necessary if you attempt to print in color.

Spatially Referenced Image Formats

The toolbox adds support for several industry-standard formats for spatially referenced images and data grids: Arc ASCII Grid files, GeoTIFF files, and worldfiles. You do this by using the following new functions: `arcgridread`, `geotiffinfo`, `geotiffread`, `getworldfilename`, `worldfileread`, and `worldfilewrite`.

The grid and image file-reading functions construct referencing matrices, enabling a general and consistent approach to managing the relationship between map coordinates and pixel columns and rows (see below).

Working with Images Referenced to Map Coordinates

The toolbox includes a family of functions supporting images and gridded data sets that are referenced to two-dimensional projected map coordinates. These functions represent the relationship between a point at position (row,col) in an image and point in map coordinates (x,y) with a *referencing matrix*. A referencing matrix is a 3-by-2 matrix, R, that represents a general affine transformation such that

$$[x \ y] = [\text{row} \ \text{col} \ 1] * R$$

Most often the image (or data grid) consists of square pixels and has edges that align with the map coordinate axes, but you are not limited to this situation.

The new function `makerefmat` provides several options for constructing referencing matrices from scratch. See its M-file help for further information. However, you can most often obtain a referencing matrix from a world file, via `worldfileread`, or from a GeoTIFF file via `geotiffread`. If you have created a new referencing matrix for an image in a generic image format such as TIFF or JPEG, you can save this information in a world file using `worldfilewrite`.

New functions `pix2map` and `map2pix` implement the basic transformation defined above, along with its inverse. With functions `mapbbox` and `mapoutline` you can calculate the image bounds or perimeter in map coordinates. You can use the function `pixcenters` to calculate the coordinates of the center of each image pixel. This is helpful if you have a data grid that you want to display using surface.

The new function `mapshow` accepts a referencing matrix in order to correctly position an image in a standard Handle Graphics axes (i.e., not a map axes).

Because the affine transformation is extremely general, it can equally well represent the registration of an image to geographic coordinates, with longitude taking the place of map x and latitude replacing map y:

$$[\text{lon} \ \text{lat}] = [\text{row} \ \text{col} \ 1] * R$$

A referencing matrix is a more general version of the 1-by-3 map legend vector, perhaps better characterized as a *referencing vector*, that many toolbox functions already use. To convert a referencing vector to a referencing matrix, you can use function `refvec2mat`. The inverse transformation exists only for referencing matrices having a special form, but if it does you can compute it with `refmat2vec`. Functions `latlon2pix` and `pix2latlon` support transformations for referencing matrices in geographic coordinates, allowing for longitude-wrapping differences.

Use the new function `geoshow` along with map axes to display data grids referenced to latitude and longitude via either a referencing vector or a referencing matrix. Or, you can use the new function `grid2image` to quickly display an unprojected grid with latitude as the ordinate (*x*-axis) and longitude as the abscissa (*y*-coordinate).

SDTS Terrain Data Access

The Mapping Toolbox can now import terrain grids stored in United States Spatial Data Transfer Standard (SDTS) raster profile format, giving you access to a wide selection of public domain terrain data sets, principally those prepared by the U.S. Geological Survey (USGS). USGS DEM data is no longer distributed from government Internet sites. Instead, these and other USGS files are now available from a commercial server at no charge. For further information, see <http://edc.usgs.gov/products/elevation/dem.html> and <http://edc.usgs.gov/geodata/>.

Two new Mapping Toolbox functions support SDTS data handling:

- `sdtinfo` returns a structure containing metadata for an SDTS data set.
- `sdtsemread` returns elevation data and a referencing matrix from an SDTS DEM data set.

For details, type `help sdtinfo` or `help sdtsemread` at the MATLAB prompt.

Shapefiles and Vector Features

The toolbox now reads the shapefile format defined by Environmental Systems Research Institute (ESRI) and widely used as a data exchange format for nontopological GIS data. You can query a shapefile for its shapetype, attribute names and types, number of records, etc., using `shapeinfo`, and read 2-D shapes using `shaperead`. The `shaperead` function constructs a *geostruct2*

geographic data structure array (see “Geographic Data Structure Enhancements” on page 3-8), tailored to the contents read in from shapefiles.

The shape data is represented in MATLAB as a 1-D structure array, with one element per feature. Attribute values are stored in structure fields, or in a separate, parallel structure array. Because attributes are defined according to the needs of the shapefile author and might be unknown until the time a given shapefile is read, the new geographic data structures (described below) are necessarily more general than the geographic data structures already in use in the Mapping Toolbox.

Geographic Data Structure Enhancements

Certain functions introduced in Version 2 of the Mapping Toolbox use an enhanced geographic data structure layout (called a *geostruct2*) to store and manipulate vector geodata. This layout has the flexibility to store any kind and number of attributes, and handles either geographic (latitude and longitude) or plane (*x* and *y*) coordinates. In contrast, a Version 1 geographic data structure (*geostruct1*) — which is still supported — is limited to a fixed set of fields and can contain geographic coordinates only.

One way to create a Version 2 geographic data structure is to input vector geodata to the workspace from a shapefile. The function `shaperead` returns a *geostruct2* that encapsulates some or all of the data stored in a shapefile and its supporting index and dBASE files. To determine what kinds of data a shapefile contains, you can use the `shapeinfo` function to query it.

The new functions `mapshow`, `geoshow`, and `mapview` each display vector data in *geostruct2* form. Use `geoshow` when Lat and Lon coordinate fields exist in the *geostruct*, and use `mapshow` or `mapview` when *X* and *Y* fields are present.

You can transform a *geostruct1* into a *geostruct2* (but not the reverse). Use the function `updategeostruct` for this purpose. See the section “Mapping Toolbox Geographic Data Structures” in the Mapping Toolbox documentation for descriptions of *geostruct* formats and uses.

Another new function, `extractfield`, lets you conveniently combine all the values of a given *geostruct* field into a single array. For example, given a shapefile with a 'Name' attribute, `extractfield` can output a cell array of feature names from the *geostruct* returned by `shaperead`.

Attribute-Driven Vector Data Symbolization

When you display shape features as points, lines, or polygons using `mapview`, `mapshow`, and `geoshow`, you can make feature attributes control how they are symbolized. This lets the data control graphic attributes such as color, line width, marker symbol, and visibility on a per-feature basis. In prior versions of the toolbox, attribute-specific symbology was difficult to accomplish, but now a general mechanism exists for this purpose. The new function `makesymbolspec` generates a structure called a *symbolspec* that maps specific attribute values (or ranges) to symbology parameters, and lets you specify default parameters for unspecified values. For example, the following `symbolspec` colors all roads of `class` 1 red, all roads of `class` 2 green, all roads of `class` 3 blue, and defaults other classes to black (where `class` is an attribute of the road layer):

```
roadColors = makesymbolspec('Line',{ 'CLASS',1, 'Color','r'},...
                            { 'CLASS',2, 'Color','g'},...
                            { 'CLASS',3, 'Color','b'},...
                            { 'Default','Color','k'});
```

To see an example of what you can do with `symbolspecs`, look at the illustration for “New Map Viewer” on page 3-4. For details, type `help shaperead`, `help mapshow`, `help geoshow`, `help mapview`, or `help makesymbolspec` at the MATLAB prompt.

Access to PROJ.4 Map Projections

The Mapping Toolbox now incorporates the PROJ.4 cartographic projections library, originally written by Gerald Evenden of the USGS. Currently the toolbox uses this library primarily to support the GeoTIFF format. You can access selected PROJ.4 projections and their inverses using new functions `projfwd` and `projinv`. Use the `projlist` function to learn about which PROJ.4 projections are available. In addition to accepting GeoTIFF `info` structures, `projfwd` and `projinv` also work with a standard map projection structure (`mstruct`) used to define projections within map axes.

Minor Enhancements

In addition to the major new features described above, this release includes the following enhancements and new functions, among others.

almanac

Now accepts 'ellipsoid' as a synonym for 'geoid' as a parameter or reffbody value.

convertlat

A new function that unifies the latitude conversions previously dispersed among functions geod2aut, aut2geod, etc. For a list of the files it replaces, see “Upgrading from an Earlier Release” on page 3-14.

geoloc2grid

New function for converting a geolocated data grid (general matrix map) to a regular gridded data set (matrix map). Easier to use for this purpose than imbedm, and produces a smoother output with 2-D resampling.

grid2image

New function to display a regular data grid, with a referencing matrix or referencing vector, as an image. The grid can contain double, uint8, or uint16 values. grid2image replaces the obsoleted function imagem.

tranmerc

A new map projection, Transverse Mercator, has been added. This is a general Transverse Mercator, as opposed to the more specific Universal Transverse Mercator supported by the utm function.

unitsratio

Provides conversion factors among units of length, and between radians and degrees. Supports a wider range of length units than distdim.

For information on using any of these functions, type `help function` at the MATLAB prompt.

Summary of Functions Added in Version 2.0

Version 2.0 features many new functions, all of which are itemized below. Several existing functions have been deprecated or deleted. These are described in “Upgrading from an Earlier Release” on page 3-14.

Geospatial Data Import and Access

- `arcgridread` — Read a gridded data set in Arc ASCII Grid Format.
- `geotiffinfo` — Information about a GeoTIFF file
- `geotiffread` — Read a georeferenced image from GeoTIFF file.
- `getworldfilename` — Derive a worldfile name from an image file name.
- `sdtsemread` — Read data from an SDTS raster/DEM data set.
- `sdtinfo` — Information about an SDTS data set
- `shapeinfo` — Information about a shapefile
- `shaperead` — Read vector feature coordinates and attributes from a shapefile.
- `worldfileread` — Read a worldfile and return a referencing matrix.
- `worldfilewrite` — Construct a worldfile from a referencing matrix.

Vector Map Data and Geographic Data Structures

- `extractfield` — Extract the field values from a structure.
- `updategeostruct` — Update a geographic data structure.

Spatial Referencing of Georeferenced Images and Data Grids

- `latlon2pix` — Convert latitude-longitude coordinates to pixel coordinates.
- `makerefmat` — Construct an affine spatial-referencing matrix.
- `map2pix` — Convert map coordinates to pixel coordinates.
- `mapbbox` — Compute bounding box of a georeferenced image or data grid.
- `mapoutline` — Compute outline of a georeferenced image or data grid.
- `pix2latlon` — Convert pixel coordinates to latitude-longitude coordinates.
- `pix2map` — Convert pixel coordinates to map coordinates.
- `pixcenters` — Compute pixel centers for georeferenced image or data grid.
- `refmat2vec` — Convert a referencing matrix to a referencing vector.
- `refvec2mat` — Convert a referencing vector to a referencing matrix.
- `geoloc2grid` — Convert a geolocated data array to a regular data grid.

Map Projection Properties and Transformations

- `geotiff2mstruct` — Convert GeoTIFF info to a map projection structure.
- `projlist` — List map projections supported by `projfw` and `projinv`.
- `projfw` — Forward map projection using the PROJ.4 library
- `projinv` — Inverse map projection using the PROJ.4 library
- `tranmerc` — Transverse Mercator Projection

Map Display and Interaction

- `geoshow` — Display map latitude and longitude data.
- `grid2image` — Display a regular data grid as an image.
- `mapshow` — Display map data.
- `mapview` — Interactive map viewer
- `makesymbolspec` — Construct a vector symbolization specification.

Geographic Calculations

- `convertlat` — Convert between geodetic and auxiliary latitudes.

Utilities

- `ind2rgb8` — Convert an indexed image to a uint8 RGB image.
- `unitsratio` — Unit conversion factors

Major Bug Fixes

This section describes major Mapping Toolbox bug fixes for Version 2.0. Mapping Toolbox 1.3.1 included several dozen bug fixes made since Version 1.3. Most were minor or cosmetic in nature. However, there were several significant Version 1.3 bug fixes.

Mapping Toolbox 2.0 includes the following bug fixes:

size

`size` now respects the order of its longitude limits. Now, for example, `[r,c] = size([-5 5],[170 -170],1)` sizes a 10-by-20 grid that crosses the 180-degree meridian, rather than a 10-by-340 grid that extending from -170 all the way to 170. `maptrim1`, `maptrimp`, and `maptrims` now respect the order of their longitude limits as well.

Fixed Error in Inverse UTM Projection

This release corrects an error in the inverse UTM projection. This error caused mislocations that ranged from negligible near the central meridian to several meters at the east-west zone boundaries.

This release also removes the rounding that decreased precision of the latitude-longitude outputs.

Improved Numerical Behavior of Geodetic-to-Conformal Latitude Conversion

A new formulation, using the new `convertlat` function, fixes subtle inaccuracies near the poles that could cause unexpected, hard-to-explain behavior in the stereographic projection.

Line-of-Sight Computation Corrected for Observer at Zero Elevation

A problem that caused `los2` and `viewshed` to report some visible points as invisible has been fixed.

Upgrading from an Earlier Release

If you are upgrading from Version 1.2.1, see “Upgrading from an Earlier Release” on page 5-5 in the Mapping Toolbox 1.3 Release Notes.

Functions Obsolete in Version 2.0

The following functions are still available but should no longer be used.

- `imagem` — which displayed a regular matrix map as an image — has been replaced by `grid2image`.
- The following 12 latitude conversion functions have been replaced by a single utility function, `convertlat`:
 - `aut2geod`
 - `cen2geod`
 - `cnf2geod`
 - `iso2geod`
 - `par2geod`
 - `rec2geod`
 - `geod2aut`
 - `geod2cen`
 - `geod2cnf`
 - `geod2iso`
 - `geod2pa`
 - `geod2rec`

This improves the stability of numerical results in certain projections.

Functions Deleted in Version 2.0

The following functions are no longer available in the Mapping Toolbox.

- `coast` — This function simply loaded the `coast` MAT-file containing world coastlines. Instead of calling it, type
`load coast`
- `loadmoonalb` — This function simply loaded the `moonalb` MAT-file of the Moon’s albedo. Instead of calling it, type
`load moonalb`

- `maskm` — This function, which reassigned a scalar value to an array based on a Boolean mask, has been removed. Ordinary MATLAB command syntax does the same thing.
- `movescale` — This undocumented function now is a subfunction of `scaleruler`.
- `surfdist` — This function was in fact obsolete prior to Version 1.3, and has now been removed. Use `trackg` instead.

Changes in Nomenclature

To achieve greater consistency with the literature on geospatial data handling, documentation for Version 2.0 of the Mapping Toolbox has changed the usage of certain terms and names of variables provided as sample data. The primary changes are described below.

Geoid — Where it is used to describe the geometric shape of the earth (an equipotential surface), this term has been retained. Where it was used as a synonym for ellipsoid, occurrences of *geoid* have been changed to *ellipsoid*. This includes changing references to *geoid vector* to *ellipsoid vector*. You also now specify ellipsoid models for almanac data using the keyword 'ellipsoid' (however, 'geoid' still works). Note that a similar update has *not* been made for `axesm`, `getm`, or `setm`, which also 'geoid' as a keyword to identify the userdata structure (`mstruct`) field `geoid`.

Map — Where this term referred to data sets (either raster or vector), occurrences of *map* have been changed to *data grid*, *data set*, or some other appropriate term. Where it refers to a cartographic presentation of geodata, *map* has been retained.

Map legend — This term, which used to refer to a three-element vector that georeferenced a data grid, has been replaced with *referencing vector*. In some contexts (when more degrees of freedom are involved), the term *referencing matrix* replaces it.

Most sample data sets that contain `map` and `maplegend` as variables (data grids and referencing vectors, respectively) have been updated. For example, the `geoid` MAT-file now has variables `geoid` (the data grid), and `geoidrefvec` and `geoidlegend` (referencing vectors; the second is a copy of the first, provided to maintain compatibility). This file, along with most other sample data except for `topo` and `coast`, also now contains metadata in the form of source and description strings.

Known Software and Documentation Problems

axesm

To use function `axesm` with 'MapLonLim' values spanning the 180-degree meridian, such as [120 -60], one must add 360 degrees to the second limit (via function `zero22pi`, for instance).

cassini, eqaconic, eqdconic, lambert, polycon

Projection functions in the Mapping Toolbox, excluding `tranmerc` and those in the PROJ.4 library, implement changes in map origin as a solid-body rotation of the sphere. This differs from the standard formulation of the following projections, when the origin latitude is nonzero:

- `cassini` (Soldner-Cassini)
- `eqaconic` (Albers Equal-Area Conic)
- `eqdconic` (Equidistant Conic)
- `lambert` (Lambert Conformal Conic)
- `polycon` (Polyconic)

Results can be substantially different, and the differences are of the same order in both the spherical and ellipsoidal cases.

If these projections must be used with a non-zero origin latitude and the results must be combined with other, pre-projected data (for example when using `lambert` to project to a State Plane zone), users should preprocess their data with function `proj fwd` (or, if an inverse transformation is required, with `proj inv`). Then the preprojected data can be displayed directly in map (x - y) coordinates using `mapshow`, for example.

los2

Input parameter altitude in function `los2` currently must be a scalar. The M-file help and reference page do not make this clear.

polybool

The current algorithm for the `and` operation in function `polybool` seems to be over-sensitive to round-off error when some vertices are very close together compared to other vertices. This may cause `polybool` to exit with an error.

polymerge

For certain inputs, function `polymerge` joins segments incorrectly. This behavior is currently under investigation.

Polygons Display Shows Interior Islands Filled In

Polygons with interior islands (inner, hollow rings) can be represented in version 2 geographic data structures (`geostruct2s`), and may be read from polygon shapefiles. Islands in such polygons should display as transparent holes, but currently the holes are filled in displays created with functions handling `geostruct2s` (`geoshow`, `mapview`, and `mapshow`). The boundaries of the islands are visible, if the `EdgeColor` and `FaceColor` properties differ, but the island interiors are filled with the `FaceColor`.

Need to Skip `cpselect` in `mapexreg` on Macintosh Platform

When running demo `mapexreg` (Georeferencing an Image to an Orthotile Base Layer) on Macintosh, you need to skip the lines that call `cpselect`. This Image Processing Toolbox GUI is not currently available on the Macintosh platform.

Mapping Toolbox 1.3.1

Release Notes

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Bug Fixes and Enhancements

The Mapping Toolbox 1.3.1 includes several bug fixes and enhancements made since Version 1.3.

If you are upgrading from Version 1.2, you should also see the list of Version 1.3 bug fixes.

Bug Fixes for Functions

Function	Description of Fix/Enhancement
almanac	Minor typographical errors in defining the parameters for the Clarke 1866 and Clarke 1880 ellipsoids have been fixed.
areaint	Every simple polygon divides the earth's surface into two regions. Now <code>areaint</code> consistently returns the area of the smaller region.
avhrrgoode	No longer fails due to an illegal assignment of NaN to class logical (mitigated side effect of new logical class in Release 13)
axesmui	Now updates frame limits when the projection is changed
demdataui	No longer disables zoom mode

Mapping Toolbox 1.3

Release Notes

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New Features

This section summarizes the new features and enhancements added in the Mapping Toolbox 1.3.

If you are upgrading from a release earlier than Release 12.0, then you should also see the Mapping Toolbox 1.2.1 Release Notes (for enhancements introduced between Release 11.0 and Release 12.0).

New and Enhanced Map Display Functions

New northarrow Annotation Function

The new `northarrow` function lets you add a north arrow symbol to a map, pointing to geographic north. You can reposition a north arrow by clicking and dragging it, or adjust other properties such as position, color, and size via alternate-clicking.

New `mlabelzero22pi` Axes Label Command

The new `mlabelzero22pi` command converts meridian labels to use the range 0 to 360 degrees, instead of the default -180 to 180 degrees.

Enhanced `clegendm` Contour Annotation Function

The `clegendm` function has been enhanced with a new, optional syntax that accepts a string indicating the contour line units. Alternatively, text label strings can be supplied for each and every contour level via a cell array.

New Interactive Interface

The new `lightmui` function provides an interactive, graphical user interface to control the position of lights on a globe or 3-D map.

Mapping Data Enhancement

Updated Atlas Data

Political boundaries and country names have been updated in both the `worldlo` and `worldhi` atlas files.

Other Enhancements

Ellipses Now Drawn More Smoothly

The `ellipse1` function has been modified to create smoother ellipses. A weighted distribution of azimuth points is used instead of the uniform distribution between the starting and ending points. More points are added at locations near the semi-major and semi-minor axes and fewer points at the other intermediate locations.

Major Bug Fixes

The Mapping Toolbox 1.3 includes several dozen bug fixes made since Version 1.2.1. Most are minor or cosmetic in nature. However, there are several significant Version 1.3 bug fixes.

If you are viewing these Release Notes in PDF form, please refer to the HTML form of the Release Notes, using either the Help browser or the MathWorks Web site and use the link provided.

Upgrading from an Earlier Release

This section describes an upgrade issue involved in moving from the Mapping Toolbox 1.2.1 to Version 1.3.

Obsolete Functions

Functions `contorm` and `contor3m` are now obsolete. You should now use `contourm` and `contour3m` instead, which are functionally identical. The older functions still exist, but have been removed from the Mapping Toolbox documentation.

Mapping Toolbox 1.2

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New Features

This section introduces the new features and enhancements added in the Mapping Toolbox 1.2 since the Mapping Toolbox 1.1 (Release 11.0).

Higher Resolution Atlas Data

There are now high-resolution country outlines and more city locations available through the `worldhi` database. The `worldmap` command automatically chooses this high-resolution data if the region's area is small enough.

The `worldlo` atlas file has been updated to make it coincide more closely with high-resolution coastlines and boundaries.

The `worldmtxmed` MAT-file provides a medium-resolution political world matrix map.

External Data Interface Improved

Importing high-resolution atlas data is now much easier with these two visual interfaces:

- Digital Elevation Map Data user interface (invoked with the `demdataui` function)
- Vector Map Level 0 user interface (invoked with the `vmap0ui` function)

Many of the matrix map data interface functions now automatically concatenate data across separate files.

The external interface now supports the GLOBE digital elevation map data, a product similar to GTPO30. Use the `globedem` function for working with that data.

New Interactive Interfaces

You can now adjust interactively, on a map display, geographic lines such as great circle tracks, small circles and sectors of small circles. Use the `trackg`, `scircleg`, and `sectorg` functions to make these interactive adjustments. While in an edit mode, you can drag the lines around on the map, modify the lines in a control panel, or read measurements.

There is a new visual interface to create colormaps. Use the `cmapui` function to invoke this new interface.

New Analysis Functions for Geographic Data

You can use the new `elevation` function to find the elevation angle of a geographic point.

The new `gradientm` function performs matrix map data calculations, including gradient, slope, and aspect.

You can use the new `los2` and `viewshed` functions with terrain data to check the line of sight visibility between points or the visibility of entire regions.

Several new functions have been added to support polygon operations.

Function	Description
<code>bufferm</code>	Compute polygon buffer regions
<code>polybool</code>	Perform polygon Boolean operations
<code>polyjoin</code>	Combine polygon segments into a NaN-clipped polygon
<code>polymerge</code>	Merge polygon segments with abutting ends
<code>polysplit</code>	Separate NaN-clipped polygon segments into cell arrays
<code>polyxpoly</code>	Polygon intersections

Other New Functions

Several new functions have been added to support polygon operations.

Function	Description
contourmap	Contour-like color jumps on surface objects
driftcorr	Compute correction for drift
driftvel	Compute drift speed and direction
flatearthpoly	Cut polygons at dateline
lcolorbar	Labeled colorbar
mapprofile	Matrix map values along a path
str2angle	String conversion to angle