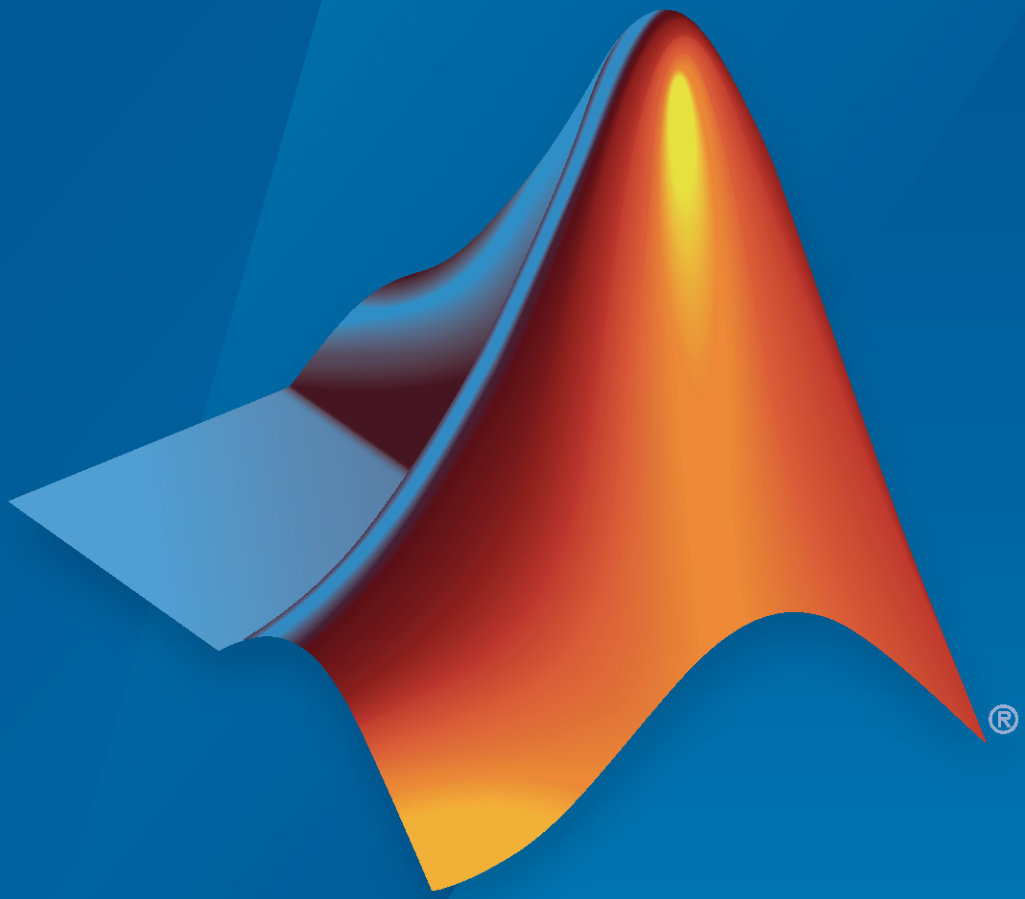
Mapping Toolbox™ Release Notes



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Mapping Toolbox™ Release Notes

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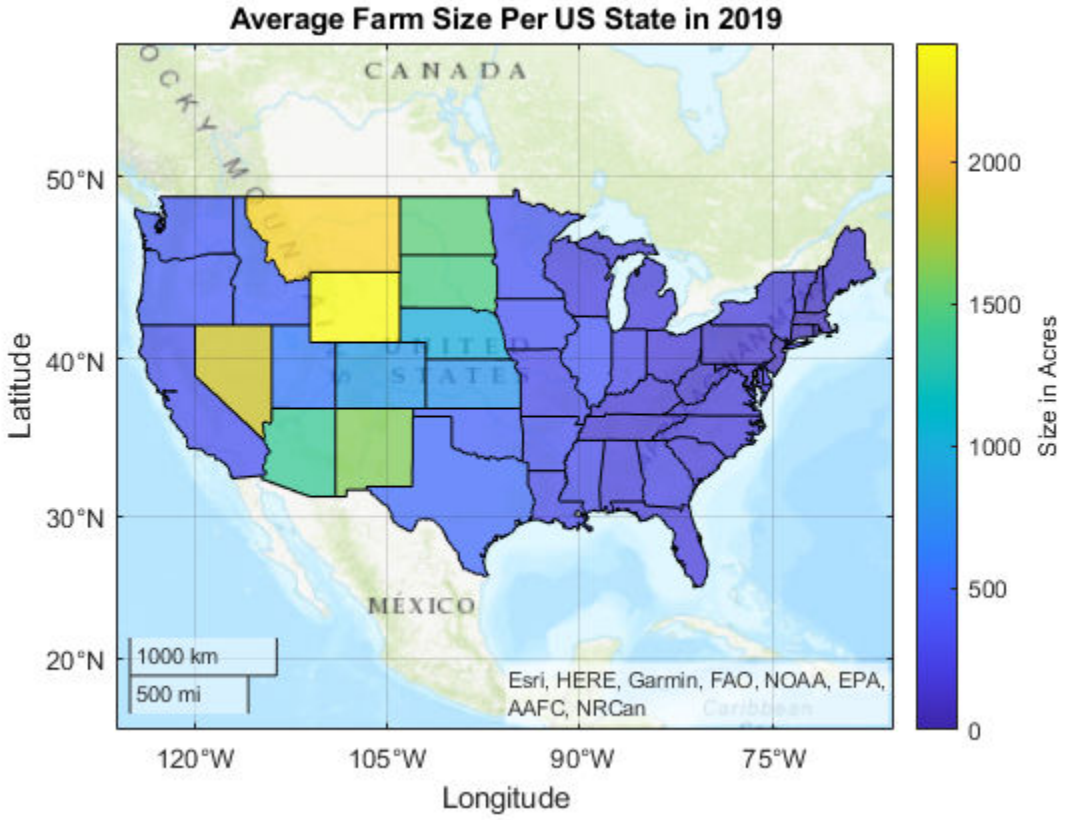
Vector Data: Create maps from point, line, and polygon shapes or geospatial tables

Create maps over geographic axes from point, line, and polygon shapes or from geospatial tables by using the `geoplot` function. The `geoplot` can display shapes and geospatial tables with coordinates in any supported geographic or projected coordinate reference system.

When you plot data over geographic axes, you can change the basemap by using the `geobasemap` function and change the map limits by using the `geolimits` function. You can also customize the map by modifying properties of the parent `GeographicAxes` object.

This image shows a choropleth map of average farm size per US state in 2019. For more information about creating choropleth maps, see “Create Choropleth Map from Table Data”.



Vector Data: Clip point, line, and polygon shapes and determine if points are within polygons

Clip point, line, and polygon shapes to bounding box

Clip geographic point, line, and polygon shapes within `geopointshape`, `geolineshape`, and `geopolyshape` objects to a geographic quadrangle by using the `geoclip` function.

Clip planar point, line, and polygon shapes within `mappointshape`, `maplineshape`, and `mappolyshape` objects to a rectangle in *xy*-coordinates by using the `mapclip` function.

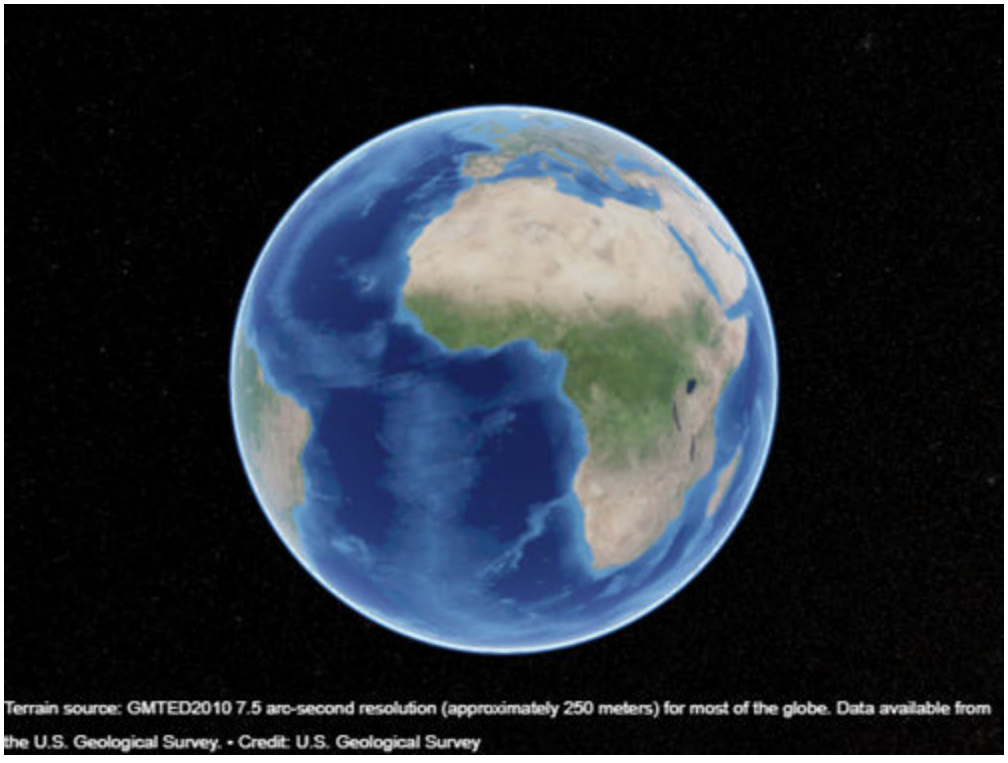
Determine if points are within polygons

Determine if geographic or planar point shapes are within a geographic or planar polygon shape, respectively, by using the `isinterior` function. Specify the point shapes as `geopointshape` or `mappointshape` objects and specify the polygon shape as a `geopolyshape` or `mappolyshape` object.

Basemaps: Add custom basemap from MBTiles file

Add a custom basemap from an MBTiles file containing raster map tiles by using the `addCustomBasemap` function.

Creating custom basemaps from MBTiles files is useful when you do not have internet access. Mapping Toolbox includes an MBTiles file with low-resolution USGS imagery called `usgsimagery.mbtiles`. This image shows a geographic globe using the USGS imagery basemap.

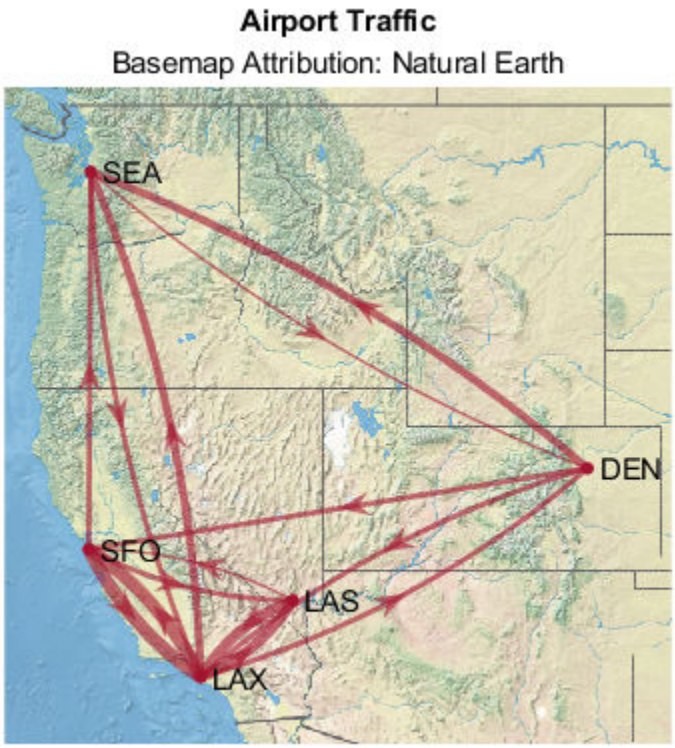


Basemaps: Read georeferenced image from basemap

Read a basemap image, as an array and a `MapCellsReference` object in Web Mercator coordinates, by using the `readBasemapImage` function. You can read the image from any basemap supported by the `geobasemap` function or any custom basemap created using the `addCustomBasemap` function.

You can display data over basemap images by using the `mapshow` function. For examples of creating plots over basemap images, see “Create Common Plots Over Basemap Images”.

This image shows a digraph of sample airport traffic data over the `"landcover"` basemap.



Raster Data: Read coordinate reference system for GeoTIFF files using geotiffinfo

The `geotiffinfo` function now reads the projected or geographic coordinate reference system (CRS) for GeoTIFF files as a `projcrs` or `geocrs` object, respectively.

To find the CRS, get information about the GeoTIFF file using the `geotiffinfo` function, returned as a structure array. Then, query the CRS property of the raster reference object within the `SpatialRef` field of the structure array. If the file is referenced to a projected CRS, query the `ProjectedCRS` property. If the file is referenced to a geographic CRS, query the `GeographicCRS` property. This code snippet shows how to get the CRS of the `boston.tif` file, which is referenced to a projected CRS.

```
info = geotiffinfo("boston.tif");
crs = info.SpatialRef.ProjectedCRS
```

```
crs =

  projcrs with properties:

                  Name: "NAD83 / Massachusetts Mainland"
          GeographicCRS: [1×1 geocrs]
       ProjectionMethod: "Lambert Conic Conformal (2SP)"
             LengthUnit: "U.S. survey foot"
    ProjectionParameters: [1×1 map.crs.ProjectionParameters]
```

You can also get the CRS for a GeoTIFF file by using the `georasterinfo` or `readgeoraster` function.

LAS and LAZ Data: Read coordinate reference system for LAS and LAZ files using Lidar Toolbox

Read the coordinate reference system (CRS) for a LAS or LAZ file by using a `lasFileReader` object and the `readCRS` function. The function returns a `projcrs` object when the file is referenced to a projected CRS and returns a `geocrs` object when the file is referenced to a geographic CRS.

Determine if a LAS or LAZ file has CRS data by using a `lasFileReader` object and the `hasCRSData` function.

For information about creating a spatially referenced digital surface model (DSM) from a LAS or LAZ file, see “Create, Process, and Export Digital Surface Model from Lidar Data”.

WMS Database: Search updated database

The WMS Database has 581 new servers and 29,815 layers. In addition, 105 servers and 3030 layers have been removed. The updated database contains 4318 servers and 93,486 layers. Search the database for layers using the `wmsfind` function.

The WMS Database has these specific updates.

- There are 372 new WMS servers from the NOAA Environmental Research Division Data Access Program (ERDDAP). For more information about these data sets, see the ERDDAP list of data sets on the NOAA website. You can search for these servers and layers by specifying the search string as `"coastwatch.pfeg.noaa.gov"`.

  ```
  layer = wmsfind("coastwatch.pfeg.noaa.gov", ...
                  "SearchFields","serverurl");
  ```

- There is 1 new WMS server from the European Space Agency (ESA) EOX server. For more information about EOX, see the EOX::Maps website. You can search for these servers and layers by specifying the search string as `"tiles.maps.eox.at"`.

  ```
  layer = wmsfind("tiles.maps.eox.at", ...
                  "SearchFields","serverurl");
  ```

Functionality being removed or changed

Some functions that return referencing vectors or referencing matrices will be removed in a future release

Warns

Some functions that return referencing vectors or referencing matrices will be removed in a future release. Use functions that return reference objects instead.

Functions that return referencing vectors

- The `zerom` function will be removed in a future release. Use the `georefcells` and `zeros` functions instead.
- The `onem` function will be removed in a future release. Use the `georefcells` and `ones` functions instead.

- The `nanm` function will be removed in a future release. Use the `georefcells` and `NaN` functions instead.
- The `spzerom` function will be removed in a future release. Use the `georefcells` and `sparse` functions instead.
- The `sizem` function will be removed in a future release. Instead, create a geographic raster reference object, and then query its `RasterSize` property.
- The `refmat2vec` function will be removed in a future release. Instead, convert referencing matrices to geographic raster reference objects by using the `refmatToGeoRasterReference` function.

Functions that return referencing matrices

- The `makerefmat` function will be removed in a future release. Use the `georefcells`, `georefpostings`, `georasterref`, `maprefcells`, `maprefpostings`, or `maprasterref` function instead.
- The `worldFileMatrixToRefmat` function will be removed in a future release. Use the `georasterref` or `maprasterref` function instead.
- The `refvec2mat` function will be removed in a future release. Instead, convert referencing vectors to geographic raster reference objects by using the `refvecToGeoRasterReference` function.

Some functions that accept referencing vectors or referencing matrices as inputs will be removed in a future release

Warns

Some functions that accept referencing vectors or referencing matrices as inputs will be removed in a future release. Use functions that accept reference objects instead.

- The `ltln2val` function will be removed in a future release. Use the `geointerp` function instead.
- The `maptrims` function will be removed in a future release. Use the `geocrop` function instead.
- The `resizem` function will be removed in a future release. Use the `georesize` function instead.
- The `limitm` function will be removed in a future release. Instead, create a geographic raster reference object, and query its `LatitudeLimits` and `LongitudeLimits` properties.
- The `mapbbox` function will be removed in a future release. Instead, create a map raster reference object, and query its `XWorldLimits` and `YWorldLimits` properties.

Some function syntaxes that return referencing vectors or referencing matrices will be removed in a future release

Warns

The `worldfileread` and `egm96geoid` function syntaxes that return referencing vectors or referencing matrices will be removed in a future release. Use syntaxes that return reference objects instead.

Some file import, map display, data analysis, and geometric geodesy functions will be removed in a future release

Warns

File import functions to be removed

- The `readfields` and `readmtx` functions will be removed in a future release. Depending on the file format, use the `readmatrix` function, the `readtable` function, or a different file import

function. For more information about common supported file formats and their import functions, see “Supported File Formats for Import and Export”.

- The `spcread` function will be removed in a future release. Use the `readmatrix` function instead.
- The `readfk5` function will be removed in a future release.

Map display functions, UIs, and app to be removed

- The `panzoom` function will be removed in a future release. Use the `zoom` function instead.
- The `project` function will be removed in a future release. Use the `projfwd` function instead.
- The `makemapped` function and `colorm`, `mobjects`, and `qrydata` UIs will be removed in a future release.
- The `mapview` app will be removed in a future release.

Data analysis functions and UIs to be removed

- The `extractm` function will be removed in a future release. Use geospatial tables instead. For more information about geospatial tables, see “Create Geospatial Tables”.
- The `getseeds` function and the `seedm` UI will be removed in a future release.

Geometric geodesy functions to be removed

- The `ecef2lv` function will be removed in a future release. Use the `ecef2enu` function instead.
- The `lv2ecef` function will be removed in a future release. Use the `enu2ecef` function instead.
- The `geocentric2geodeticLat` function will be removed in a future release. Use the `geodeticLatitudeFromGeocentric` function instead.
- The `geodetic2geocentricLat` function will be removed in a future release. Use the `geocentricLatitude` function instead.
- The `elevation` function will be removed in a future release. Use the `geodetic2aer` function instead.
- The `npi2pi` function will be removed in a future release. Use the `wrapTo180` or `wrapToPi` function instead.
- The `zero22pi` function will be removed in a future release. Use the `wrapTo360` or `wrapTo2Pi` function instead.
- The `epsm` function will be removed in a future release. For accuracy in degrees, use `1.0E-6`. For radians, use `deg2rad(1.0E-6)`.

Some file import, map display, and angle wrapping functions have been removed

Errors

File import functions that have been removed

- The `dcwdata` function has been removed. Use the VMAP0 data set and the `vmap0data` function instead.
- The `dcwgaz` function has been removed. Use the VMAP0 data set and the `vmap0ui` function instead.
- The `dcwread` function has been removed. Use the VMAP0 data set and the `vmap0read` function instead.
- The `dcwrhead` function has been removed. Use the VMAP0 data set and the `vmap0rhead` function instead.

- The `fipsname` and `tgrline` functions have been removed. Use a more recent TIGER/Line data set and the `readgeotable` function instead.
- The `grepfields` function has been removed. Use the `textscan` function instead.

Map display functions that have been removed

- The `cometm` function has been removed. Use the `projfwd` and `comet` functions instead.
- The `comet3m` function has been removed. Use the `projfwd` and `comet3` functions instead.
- The `symbolm` function has been removed. Use the `scatterm` function instead.
- The `colorui` function has been removed. Use the `uisetcolor` function instead.
- The `restack` function has been removed. Use the `uistack` function instead.
- The `rootlayr` function and `mlayers` UI have been removed.

Angle wrapping functions that have been removed

- The `eastof` and `westof` functions have been removed. Use the `mod` function instead.

USGS Shaded Relief base layer has been removed from web map

Errors

Starting in R2022a, the `webmap` function issues an error when you specify the base layer as `"USGS Shaded Relief"`. In previous releases, the web map window shows red tiles. Update your code by specifying a different base layer, such as `"World Shaded Relief"`.

geopointshape and mappointshape objects with missing coordinate data have some changed property values

Behavior change

When a `geopointshape` or `mappointshape` object has missing coordinate data, its `NumPoints` property has a value of `0` and its coordinate properties (`Latitude` and `Longitude` or `X` and `Y`, respectively) have `NaN` values.

- When you create a point by specifying both coordinates as `NaN` values, its `NumPoints` property has a value of `0`. In the previous release, the property had a value of `1`.
- When a `geopointshape` object has no coordinate data, its `Latitude` and `Longitude` properties each have a value of `NaN`. In the previous release, the properties were each empty `double` values.
- When a `mappointshape` object has no coordinate data, its `X` and `Y` properties each have a value of `NaN`. In the previous release, the properties were each empty `double` values.

These changes make it easier to create and access the properties of `geopointshape` and `mappointshape` arrays when the input coordinates contain missing data. For example, you can now access the coordinates of a `geopointshape` or `mappointshape` array when the array contains a combination of points with coordinate data (`NumPoints` is `1`) and without coordinate data (`NumPoints` is `0`). In the previous release, MATLAB® issued an error.

R2021b

Vector Data: Read, display, and write vector data using geospatial tables

Read vector data from files into geospatial tables

Read point, line, and polygon data from a file into a geospatial table by using the `readgeotable` function. You can read data from formats with these file extensions.

File Format	Extension
Esri file geodatabase	`.gdb`
GeoJSON	`.json` or `.geojson`
GPX	`.gpx`
KML	`.kml`
Shapefile	`.shp`

A geospatial table is a `table` or `timetable` object with a `Shape` variable and attribute variables.

- The `Shape` variable contains 2-D information about point, line, and polygon shapes. Shapes with coordinates in geographic coordinate reference systems (CRSs) are represented by `geopointshape`, `geolineshape`, and `geopolyshape` objects. Shapes with coordinates in projected CRSs are represented by `mappointshape`, `maplineshape`, and `mappolyshape` objects. The `Shape` variable can contain combinations of point, line, and polygon shapes.
- Attribute variables contain data such as names, classifications, and measurements.

When vector data files contain CRS information, the `readgeotable` function stores the information as a `projcrs` or `geocrs` object within each shape object.

For more information about geospatial tables, see Create Geospatial Tables.

Create maps using geospatial tables

Create maps by passing a geospatial table directly to the `geoshow` and `mapshow` functions. Use the `geoshow` function when the `Shape` variable of the table uses geographic coordinates and the `mapshow` function when the `Shape` variable uses projected coordinates.

Create web maps by passing a geospatial table directly to the `wmmarker`, `wmline`, or `wmpolygon` function. These functions require that the `Shape` variable of the table use geographic coordinates.

Write geospatial tables to shapefile and KML formats

Write geospatial tables to shapefile and KML formats by using the `shapewrite` and `kmlwrite` functions. Create an attribute specification for shapefile formats by using the `makedbfspec` function and for KML formats by using the `makeattribspec` function.

Convert between structures, tables, and geospatial tables

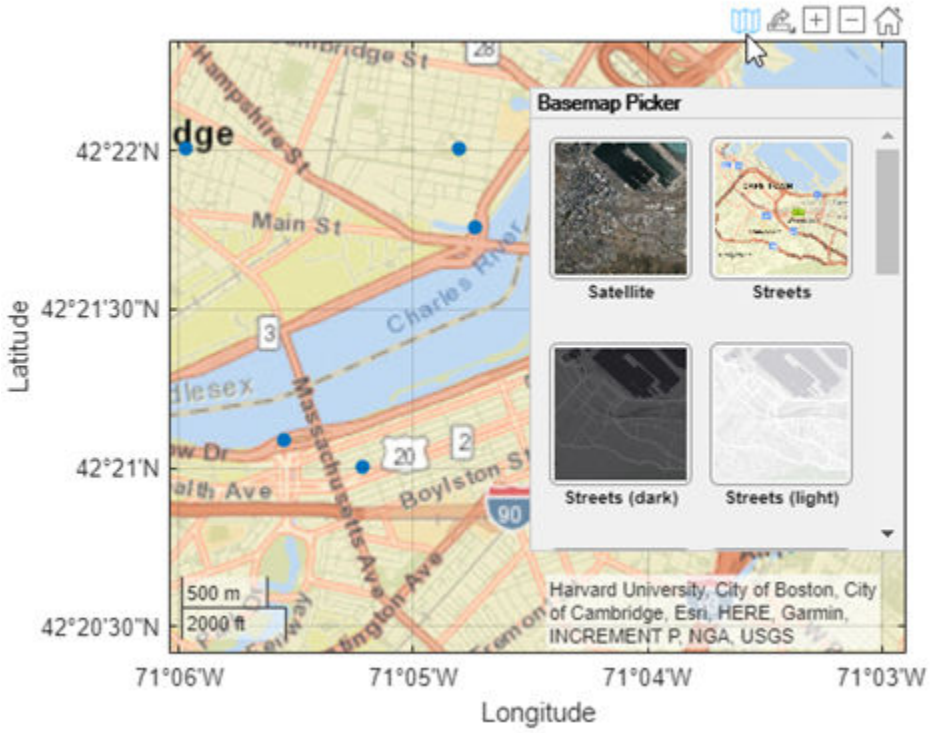
Convert tables and structures with point, line, or polygon data into geospatial tables by using the `table2geotable` and `struct2geotable` functions. Specify the point, line, or polygon shapes as numeric latitudes and longitudes or numeric *x*- and *y*-coordinates. For `table2geotable`, you can also specify the shapes as geometric objects in well-known text (WKT) strings.

Convert geospatial tables to tables using the `geotable2table` function. You can convert the `Shape` variable of the geospatial table to latitude and longitude coordinate variables, *x*- and *y*-coordinate variables, or WKT strings.

Basemaps: Interactively change basemap of geographic plots

Interactively change the basemap of geographic plots by adding a basemap picker to the axes toolbar. Add the basemap picker to the axes toolbar by using the `addToolbarMapButton` function. You can add the basemap picker to plots created using functions such as `geoplot`, `geoscatter`, `geodensityplot`, and `geoaxes`. To use the `addToolbarMapButton` function, the plot must be in a figure created using the `uifigure` function.

Remove the basemap picker by using the `removeToolbarMapButton` function.



Raster Import: Read SRTM Height data

You can now read SRTM Height data files with extension `.hgt` by using the `readgeoraster` function. You can also get information about these files by using the `georasterinfo` function.

WMS Database: Search updated database

The WMS Database has 37 new servers and 1570 new layers. In addition, 155 servers and 2218 layers have been removed. The updated database contains 3921 servers and 66,878 layers. Search the database for layers using the `wmsfind` function.

The WMS Database has these specific updates.

- Eleven new WMS servers from the NOAA Environmental Research Division Data Access Program (ERDDAP). For more information about these data sets, see the ERDDAP list of data sets. You can search for these servers and layers by specifying the search string as `"coastwatch.pfeg.noaa.gov"`.

  ```
  layer = wmsfind("coastwatch.pfeg.noaa.gov", ...
                  "SearchFields","serverurl");
  ```

- One new WMS server from the NASA WorldWind server. For more information about NASA WorldWind, see the NASA WorldWind website. You can search for these servers and layers by specifying the search string as `"worldwind26.arc.nasa.gov"`.

  ```
  layer = wmsfind("worldwind26.arc.nasa.gov", ...
                  "SearchFields","serverurl");
  ```

Functionality being removed or changed

Some functions that accept referencing matrices as inputs will be removed in a future release

Still runs

Some functions that accept referencing matrices as inputs will be removed in a future release. Use functions that accept reference objects instead.

- The `pix2map` function will be removed in a future release. Use the `intrinsicToWorld` function instead.
- The `map2pix` function will be removed in a future release. Use the `worldToIntrinsic` function instead.
- The `pix2latlon` function will be removed in a future release. Use the `intrinsicToGeographic` function instead.
- The `latlon2pix` function will be removed in a future release. Use the `geographicToIntrinsic` function instead.

Some raster reading functions that do not return reference objects will be removed in a future release

Warns

Some raster reading functions that return referencing vectors, referencing matrices, or latitude-longitude grids will be removed in a future release. The functions that will be removed are `usgsdem`, `etopo`, `globedem`, `gtopo30`, `satbath`, `sdtsdemread`, `tbase`, and `usgs24kdem`. In most cases, use the `readgeoraster` function to return a raster reference object instead.

Previous removal of coast.mat file

Errors

The `coast.mat` file, which contains global coastline coordinates in the variables `lat` and `long`, was removed in R2020b. Use the `coastlines.mat` file instead. The `coastlines.mat` file contains global coastline coordinates in the variables `coastlat` and `coastlon`.

To update your code, replace instances of `coast.mat` with `coastlines.mat`, instances of `lat` with `coastlat`, and instances of `long` with `coastlon`.

R2021a

Raster Import: Read data in Vertical Mapper Grid formats

You can now read data in the Vertical Mapper Numeric Grid and Vertical Mapper Classified Grid formats by using the `readgeoraster` function. You can also get information about data in these formats by using the `georasterinfo` function.

Raster Analysis: Get geographic or world coordinates of raster elements

Get coordinates of raster elements using the `geographicGrid` and `worldGrid` functions. Use the `geographicGrid` function for geographic coordinates and the `worldGrid` function for world coordinates.

3-D Geographic Plotting: Use geographic globes in MATLAB Online

You can now create, plot data on, and manipulate your view of geographic globes in MATLAB Online™. Create a geographic globe by using the `geoglobe` function.

Prior to R2021a, geographic globes were not supported in MATLAB Online.

Code Generation: Generate C and C++ code using MATLAB Coder

These functions and objects now support code generation:

- 3-D coordinate and vector transformation functions such as `ecef2enu`, `geodetic2ned`, and `ecef2enuv`
- The `oblateSpheroid` object and `wgs84Ellipsoid` function
- The `wrapToPi`, `wrapTo2Pi`, `wrapTo180`, and `wrapTo360` functions

Web Map Service: Read WMS capabilities documents from additional servers, get additional keywords, get additional layer information

There are several improvements to reading Web Map Service (WMS) capabilities documents. Read capabilities documents using the `wmsinfo` function.

- Read capabilities documents from servers that are not supported in releases prior to R2021a. For example, you can read capabilities documents from the Lunaserv Global Explorer.
- The `KeywordList` property of the `WMSCapabilities` object returned by the `wmsinfo` function can contain additional keywords.
- The `Layer` property of the `WMSCapabilities` object returned by the `wmsinfo` function can contain additional details about layer styles and legend graphics.
- The `Layer` property of the `WMSCapabilities` object returned by the `wmsinfo` function excludes coordinate reference system codes if the codes do not have a corresponding bounding box.

WMS Database: Search updated database

The WMS Database has 34 new servers and 2248 new layers. In addition, 86 servers and 3531 layers have been removed. The updated database contains 3955 servers and 67,139 layers. Search the database for layers using the `wmsfind` function.

The WMS Database has these specific updates.

- 12 new WMS servers from the NOAA Environmental Research Division Data Access Program (ERDDAP). For more information about these data sets, see the ERDDAP list of data sets. You can search for these servers and layers by specifying the search string as `'coastwatch.pfeg.noaa.gov'`.

  ```
  layer = wmsfind('coastwatch.pfeg.noaa.gov', ...
                  'SearchFields','serverurl');
  ```

- 11 new WMS servers from the NASA NCCS THREDDS data server. For more information about these data sets, see the THREDDS Data Server. You can search for these servers and layers by specifying the search string as `'dataserver3.nccs.nasa.gov'`.

  ```
  layer = wmsfind('dataserver3.nccs.nasa.gov', ...
                  'SearchFields','serverurl');
  ```

Functionality being removed or changed

Web maps appear in multiple windows and have a default size
Behavior change

Starting in R2021a, web maps created using the `webmap` function have these differences from previous releases:

- Each web map appears in a separate window. In previous releases, each web map appeared as a tab in a single window.
- Web maps have a default size of 750-by-550 pixels. In previous releases, each new web map matched the size of the previous web map.
- You cannot dock a web map.

Some functions that accept referencing vectors or matrices as inputs will be removed in a future release
Still runs

Some functions that accept referencing vectors or matrices as inputs will be removed in a future release. Use functions that accept reference objects instead.

- The `setltln` function will be removed in a future release. Use the `intrinsicToGeographic` function instead.
- The `meshgrat` function will be removed in a future release. Use the `geographicGrid`, `linspace`, or `ndgrid` function instead.
- The `setpostn` function will be removed in a future release. Use the `geographicToDiscrete` function instead.
- The `pixcenters` function will be removed in a future release. Use the `worldGrid` or `geographicGrid` function instead.

geoloc2grid and vec2mtx functions return raster reference objects
Behavior change

Starting in R2021a, the `geoloc2grid` function and most syntaxes of the `vec2mtx` function return a raster reference object instead of a referencing vector. This change is unlikely to affect your existing code because most Mapping Toolbox functions that accept referencing vectors as inputs also accept

raster reference objects. For more information about raster reference objects, see the `GeographicCellsReference`, `GeographicPostingsReference`, `MapCellsReference`, or `MapPostingsReference` object.

If you specify a referencing vector or matrix as an input, then the `vec2mtx` function still returns a referencing vector or matrix.

R2020b

Version: 5.0

New Features

Version History

3-D Geographic Plotting: Programmatically navigate geographic globe using camera functions

Programmatically navigate `GeographicGlobe` objects by using object functions that control the camera position and camera rotation angles.

- Use `camheight` to control the ellipsoidal height of the camera.
- Use `campos` to control the latitude, longitude, and optionally the ellipsoidal height of the camera.
- Use `camroll`, `campitch`, and `camheading` to rotate the camera around its *x*-, *y*-, and *z*-axes, respectively.

Coordinate Reference Systems: Create projected and geographic CRS objects from imported data, named spatial reference codes, or well-known text strings

Get information about projected and geographic coordinate reference systems (CRS) by using `projcrs` and `geocrs` objects. You can create `projcrs` and `geocrs` objects by importing vector or raster data, by specifying named spatial reference codes, or by specifying well-known text strings.

Coordinate Reference Systems: Project or unproject coordinates using projcrs objects and additional map projection structures

Project or unproject coordinates by using the `projfwd` or `projinv` object function and specifying a `projcrs` object. A `projcrs` object allows you to transform coordinates using projection methods not available in earlier releases, such as Hotine Oblique Mercator.

Additionally, you can now project or unproject coordinates by using the `projfwd` or `projinv` function and specifying a map projection structure with any valid `mapprojection` field. For a list of `mapprojection` field options, use the `maplist` or `maps` function.

Coordinate Reference Systems: Use reference ellipsoid information in geocrs objects with analysis functions

The `gradientm`, `mapprofile`, `areamat`, and `geopeaks` functions now perform calculations using the reference ellipsoid for the specified geographic raster reference object. To find the reference ellipsoid for a geographic raster reference object, `R`, first get its geographic coordinate reference system as a `geocrs` object. Then, query the `Spheroid` property of the `geocrs` object.

```
g = R.GeographicCRS;
g.Spheroid
```

To use these functions with a different spheroid or ellipsoid, specify the `spheroid` or `ellipsoid` argument.

WMS Database: Search updated database

The WMS Database has 22 new servers and 1189 new layers. In addition, 144 servers and 1166 layers have been removed. The updated database contains 4005 servers and 68,388 layers. Search the database for layers using the `wmsfind` function.

For example, the database contains 20 new WMS servers from NOAA's Environmental Research Division Data Access Program (ERDDAP). For more information about these data sets, see the ERDDAP list of data sets. You can search for these servers and layers by specifying the search string as `'coastwatch.pfeg.noaa.gov'`.

```
layer = wmsfind('coastwatch.pfeg.noaa.gov', ...
                'SearchFields','serverurl');
```

Functionality being removed or changed

mfwdtran will be removed in a future release
Still runs

The `mfwdtran` function will be removed in a future release. Use the `projfwd` or `geodetic2ecef` function instead.

minvtran will be removed in a future release
Still runs

The `minvtran` function will be removed in a future release. Use the `projinv` or `ecef2geodetic` function instead.

Some functions that return referencing matrices will be removed in a future release
Still runs

Some functions that return referencing matrices will be removed in a future release. Use functions that return reference objects instead.

- The `makerefmat` function will be removed in a future release. Use the `georefcells`, `georefpostings`, `georasterref`, `maprefcells`, `maprefpostings`, or `maprasterref` function instead.
- The `worldFileMatrixToRefmat` function will be removed in a future release. Use the `georasterref` or `maprasterref` function instead.

Some functions that accept referencing vectors or matrices as inputs will be removed in a future release
Still runs

Some functions that accept referencing vectors or matrices as inputs will be removed in a future release. Use functions that accept reference objects instead.

- The `ltln2val` function will be removed in a future release. Use the `geointerp` function instead.
- The `maptrims` function will be removed in a future release. Use the `geocrop` function instead.
- The `resizem` function will be removed in a future release. Use the `georesize` function instead.
- The `limitm` function will be removed in a future release. Instead, create a geographic raster reference object, and query its `LatitudeLimits` and `LongitudeLimits` properties.
- The `mapbbox` function will be removed in a future release. Instead, create a map raster reference object, and query its `XWorldLimits` and `YWorldLimits` properties.

Some function syntaxes that return referencing vectors or referencing matrices will be removed in a future release
Still runs

The `worldfileread` and `egm96geoid` function syntaxes that return referencing vectors or referencing matrices will be removed in a future release. Use syntaxes that return reference objects instead.

Name property for some referenceEllipsoid objects has changed
Behavior change

The `Name` property of `referenceEllipsoid` objects now always contains the names of the ellipsoids as they appear in the EPSG Geodetic Database. In R2020a and previous releases, the value of the `Name` property depended on the name or code you used to create the object.

If you have existing code in which you create a reference ellipsoid object by specifying a name to the `referenceEllipsoid` creation function, you do not need to update your code to correspond to a name in the EPSG Geodetic Database.

Path for example data files has changed
Behavior change

Most of the example data files for Mapping Toolbox are now in *`matlabroot`*`/examples/map/data`. In R2020a and earlier releases, many example data files were in *`matlabroot`*`/toolbox/map/mapdata`.

EPSG CSV files have been removed
Behavior change

The folder *`matlabroot`*`/toolbox/map/mapproj/projdata/epsg_csv` and its data files have been removed, including `pcs.csv` and `gcs.csv`. Instead of using these files to find EPSG codes for the `geotiffwrite` function, find valid EPSG codes using resources such as the EPSG registry.

R2020a

Version: 4.10

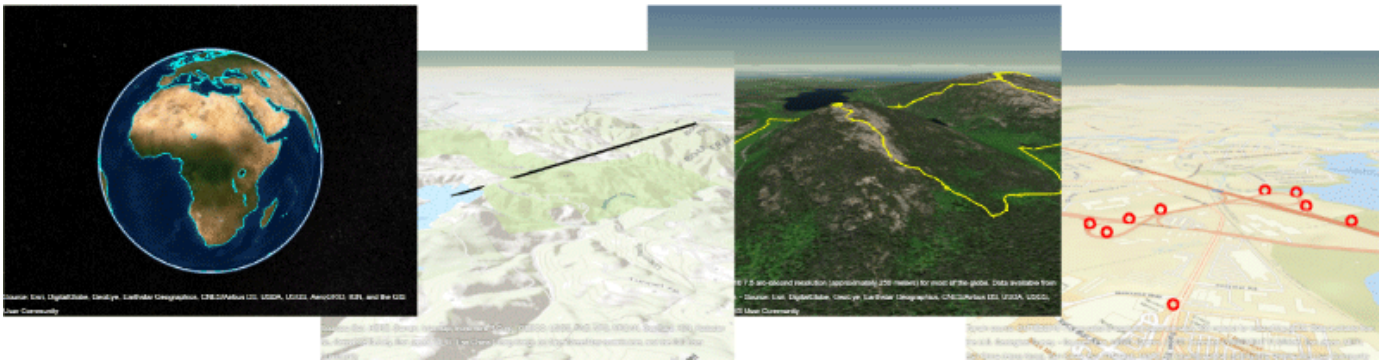
New Features

Version History

3-D Geographic Plotting: Plot 3-D data on globe display using geoglobe and geoplot3

Create a geographic globe display with high-zoom-level basemaps and terrain using the `geoglobe` function. Add custom basemaps for use with geographic globe displays using the `addCustomBasemap` function.

Plot lines and markers on a geographic globe using the `geoplot3` function. You can reference the height data of lines and markers to the geoid (mean sea level), the terrain, or the WGS84 reference ellipsoid.



3-D Geographic Plotting: Add and remove custom terrain

Add custom terrain data to use with the geographic globe by using the `addCustomTerrain` function. Once you have added custom terrain, apply it to a geographic globe by setting its `Terrain` property. Otherwise, the geographic globe uses default terrain derived from the GMTED2010 model.

Remove custom terrain using the `removeCustomTerrain` function.

egm96geoid Function: Return geoid heights referenced to geographic reference object

Use the `egm96geoid` function to return geoid heights and a reference object from the Earth Gravitational Model of 1996 (EGM96). You can specify `GeographicCellsReference` or `GeographicPostingsReference` objects, or return geoid heights and a reference object for the entire globe spaced at 15-minute intervals.

MATLAB Online: Mapping Toolbox is supported on MATLAB Online

Mapping Toolbox is now supported on MATLAB Online. For more information about supported toolboxes, see Specifications and Limitations.

Raster Cropping: Crop raster data using mapcrop and geocrop

Crop raster data using the `mapcrop` or `geocrop` functions. Use `mapcrop` with data referenced to projected coordinates by a `MapCellsReference` or `MapPostingsReference` object. Use `geocrop`

with data referenced to geographic coordinates by a `GeographicCellsReference` or `GeographicPostingsReference` object.

Raster Import: Read geospatial raster data from a file using readgeoraster and georasterinfo

Read geospatial raster data from a file using the `readgeoraster` function. Get information about a file using the `georasterinfo` function. You can read data from formats with these file extensions. In some cases, you can read supported file formats using extensions other than the ones listed.

File Format	Extension
GeoTIFF	`.tif` or `.tiff`
Esri Binary Grid	`.adf`
Esri ASCII Grid	`.asc` or `.grd`
Esri GridFloat	`.flt`
DTED	`.dt0`, `.dt1`, or `.dt2`
SDTS	`.DDF`
USGS DEM	`.dem`
ER Mapper ERS	`.ers`
ENVI	`.dat`
ERDAS IMAGINE	`.img`

WMS Database: Search updated database

25 new servers and 1374 layers have been added to the WMS Database. 17 servers and 1056 layers have been removed. The updated database contains 4129 servers and 68,381 layers. Search the database for layers using the `wmsfind` function.

For example, the database contains 18 new WMS servers from NOAA's Environmental Research Division Data Access Program (ERDDAP). For more information about these data sets, see https://coastwatch.pfeg.noaa.gov/erddap/info/index.html. You can search for these servers and layers by specifying the search string as `'coastwatch.pfeg.noaa.gov'`.

```
layer = wmsfind('coastwatch.pfeg.noaa.gov', ...
                'SearchFields','serverurl');
```

Functionality being removed or changed

arcgridread and geotiffread are not recommended
Still runs

`arcgridread` and `geotiffread` are not recommended, except when reading a GeoTIFF file from a URL or when reading multiple GeoTIFF images from the same file. In other situations, use `readgeoraster` instead.

There are some differences between these functions that require updates to your code. For more detailed information about how to update your code, see the reference page for each function.

Raster reading functions that do not return reference objects will be removed in a future release
Still runs

Raster reading functions that return referencing vectors, referencing matrices, or latitude-longitude grids will be removed in a future release. These functions are `usgsdem`, `dted`, `etopo`, `globedem`, `gtopo30`, `satbath`, `sdtsdemread`, `tbase`, and `usgs24kdem`.

In most cases, use the `readgeoraster` function to return a raster reference object instead. For information about how to update your code to use `readgeoraster`, see the reference page for each function.

Compiling web maps using Linux requires files in directory of application
Behavior change

Starting in R2020a, to compile web maps created with the `webmap` function using MATLAB Compiler™ on Linux®, you must copy these files to the application directory and distribute them with the application.

- `icudtl.dat`
- `natives_blob.bin`
- `snapshot_blob.bin`

You can find the path to these files using the command `fullfile(matlabroot,'bin','glnxa64')`.

R2019b

Version: 4.9

New Features

Version History

egm96geoid Function: Return geoid heights at specified latitudes and longitudes

Return geoid height in meters from the Earth Gravitational Model of 1996 (EGM96) with the `egm96geoid` function by specifying latitude and longitude in degrees. For example, find the geoid height at a latitude of 42.3601 degrees and a longitude of -71.589 degrees:

```
N = egm96geoid(42.3601,-71.589);
```

egm96geoid Function: Return geoid heights with improved performance

In previous releases, `egm96geoid` accessed geoid heights using `WW15MGH.GRD`, a file that you downloaded from the Internet. Starting in R2019b, a grid of geoid heights from EGM96 is included with Mapping Toolbox, and `egm96geoid` no longer reads data from `WW15MGH.GRD`.

As a result, the `egm96geoid` function shows improved performance. For example, this code shows about a 15x speed-up when you return the entire grid of geoid heights:

```
function timingTest
N = egm96geoid(1);
end
```

The approximate execution times are:

- **R2019a:** 0.1838 s
- **R2019b:** 0.0121 s

This code was timed on a Windows® 10 test system with a 3.6-GHz Intel® Xeon® W-2133 CPU using the `timeit` function:

```
timeit(@timingTest)
```

WMS Database: Modified or removed servers

The WMS database changes on a release-to-release basis. Some servers are added, and other servers are removed because they are offline or their availability is too sporadic. A total of 101 servers (2.43% of the number of servers listed in R2019a) and 5550 layers have been removed from the database. A total of 58 new servers, with 2022 layers, have been added. The new database contains a total of 4122 servers and 68,071 layers.

Find layers using the `wmsfind` function. To find layers provided by particular servers, specify the `SearchField` name-value pair argument as `'serverurl'`. Return the URLs of the servers using the `servers` function.

```
layers = wmsfind(urlSearchString,'SearchField','serverurl')
urls = servers(layers)
```

The most recent and up-to-date version of the database is hosted on the MathWorks® website. To use this version, call `wmsfind` and specify the `Version` name-value pair argument as `'online'`.

The following specific updates have been made to the WMS database since the last release:

- 1 new WMS server from Esri® provides Landsat layers. Search for these servers and layers by specifying `urlSearchString` as `'landsat2.arcgis.com'`. Use the layers `'PS:Pansharpened Enhanced with DRA'` or `'PS:Pansharpened Natural Color'`.
- 11 new WMS servers from the USGS National Map provide layers that contain data about land cover, tree canopies, hydrology, shaded relief, and impervious surfaces. Search for these servers and layers by specifying `urlSearchString` as `'nationalmap.gov'`.
- 16 new WMS servers from NOAA's Environmental Research Division Data Access Program (ERDDAP) provide layers that contain oceanographic data. For more about these data sets, see https://coastwatch.pfeg.noaa.gov/erddap/info/index.html. Search for these servers and layers by specifying `urlSearchString` as `'coastwatch.pfeg.noaa.gov'`.
- The USGS Multi-Resolution Land Characteristics Consortium (MRLC) servers from https://www.mrlc.gov/ are no longer available. Use the USGS servers from https://www.usgs.gov/core-science-systems/national-geospatial-program/national-map instead.

Functionality being removed or changed

Different polygon vertex order for poly2v and bufferm function output
Behavior change

Starting in R2019b, the `poly2fv` and `bufferm` functions might return polygon vertices in a different order. The polygons that these vertices define are geometrically equivalent to those in previous releases.

R2019a

Version: 4.8

New Features

mapresize function: Resize projected raster geospatial data

Use `mapresize` to resize projected raster geospatial data in *x*- and *y*-coordinates. The `mapresize` function can transform a projected raster to a more manageable size or increase the size of a raster size to have more granularity.

georesize function: Resize unprojected raster geospatial data

Use `georesize` to resize unprojected raster geospatial data in latitude and longitude coordinates. The `georesize` function can transform a unprojected raster to a more manageable size or increase the size of a raster size to have more granularity.

WMS Database Modified

The WMS Database changes on a release-to-release basis, as some new servers are added and other servers are removed because they are no longer online or because their availability is too sporadic. A total of 59 servers (1.54% of the number of servers listed in R2018b) and 4,659 layers have been removed from the database. A total of 393 new servers, with 6,703 layers, have been added. The new database contains a total of 4,170 servers and 71,662 layers. A total of 3,662 servers are using HTTPS.

If you want to find a server, use the server URL or a server URL search string with `wmsfind` to search for layers provided by the server or servers. Use the `servers` method of the `WMSLayer` object returned by `wmsfind` to obtain the server or server URLs as in the following example.

```
layers = wmsfind(urlSearchString,'SearchField','serverurl')
urls = servers(layers)
```

If you want to use the most recent and up-to-date version of the database, use the version hosted on the MathWorks website. Specify the `'Version','online'` Name-Value pair argument with `wmsfind`.

The following specific updates have been made to the WMS Database since the last release:

- 36 new WMS servers from the USGS Science Catalog servers providing layers containing a variety of scientific data. Search for the layers and servers using the `urlSearchString 'sciencebase.gov'`.
- 53 new WMS servers from the USDA Forest Service servers providing layers containing land management and fire data. Search for the layers and servers using the `urlSearchString 'apps.fs.usda.gov'`.
- 25 new WMS servers from NOAA's Environmental Research Division Data Access Program (ERDDAP) providing layers containing oceanographic data. To find out more about them, visit the ERDDAP web site. Search for the layers and servers using the `urlSearchString 'coastwatch.pfeg.noaa.gov'`.

R2018b

Version: 4.7

New Features

Bug Fixes

Custom basemaps: Access high zoom-level custom basemaps by URL for use in web map and geographic plots in MATLAB

You can now specify custom basemaps when calling the `webmap` function. You use the `addCustomBasemap` function to specify a custom basemap. To remove the basemap, use the `removeCustomBasemap` functions.

WMS Database Modified

The WMS Database changes on a release-to-release basis, as some new servers are added and other servers are removed because they are no longer online or because their availability is too sporadic. A total of 207 servers (5.26% of the number of servers listed in R2018a) and 4,180 layers have been removed from the database. A total of 100 new servers, with 4,074 layers, have been added. The new database contains a total of 3,828 servers and 69,531 layers.

If you want to find a server, use the server URL or a server URL search string with `wmsfind` to search for layers provided by the server or servers. Use the `servers` method of the `WMSLayer` object returned by `wmsfind` to obtain the server or server URLs as in the following example.

```
layers = wmsfind(urlSearchString,'SearchField','serverurl')
urls = servers(layers)
```

If you want to use the most recent and up-to-date version of the database, use the version hosted on the MathWorks website. Specify the `'Version','online'` Name-Value pair argument with `wmsfind`.

The following specific updates have been made to the WMS Database since the last release:

- Five new WMS servers from British Columbia's Open Map servers providing layers containing orthophoto mosaics, satellite imagery, and hill shaded relief data. Search for the layers and servers using the `urlSearchString 'openmaps.gov.bc.ca'`.
- Three new WMS servers from the USGS Multi-Resolution Land Characteristics Consortium (MRLC) servers providing layers containing land cover, land fire, and GTOPO data. Search for the layers and servers using the `urlSearchString 'www.mrlc.gov'`.
- 29 new WMS servers from NOAA's Environmental Research Division Data Access Program (ERDDAP) providing layers containing oceanographic data. To find out more about them, visit the ERDDAP web site. Search for the layers and servers using the `urlSearchString 'coastwatch.pfeg.noaa.gov'`.
- The USGS server `http://raster.nationalmap.gov/arcgis/services/LandCover/USGS_EROS_LandCover_NLCD/MapServer/WMSServer` is no longer available. Instead use the USGS server from `https://www.mrlc.gov/arcgis/services/NLCD/USGS_EDC_LandCover_NLCD/MapServer/WMSServer`.

R2018a

geotiffwrite function: Export data containing more than 4 GB in BigTIFF format

The `geotiffwrite` function now supports a `TiffType` name-value pair that lets you choose the format of the GeoTIFF file being written. You can choose either classic TIFF format or BigTIFF format. The BigTIFF format enables you to create files that exceed 4 GB in size.

WMS Database Modified

The WMS Database changes on a release-to-release basis, as some new servers are added and other servers are removed because they are no longer online or because their availability is too sporadic. A total of 681 servers (15% of the number of servers listed in R2017b) and 2,747 layers have been removed from the database. A total of 73 new servers, with 2,369 layers, have been added. The new database contains a total of 3,935 servers and 69,637 layers.

If you want to find a server, use the server URL or a server URL search string with `wmsfind` to search for layers provided by the server or servers. Use the `servers` method of the `WMSLayer` object returned by `wmsfind` to obtain the server or server URLs as in the following example.

```
layers = wmsfind(urlSearchString,'SearchField','serverurl')
urls = servers(layers)
```

If you want to use the online and most recent up-to-date version of the database hosted on the MathWorks website, use the `'Version','online'` Name-Value pair argument of `wmsfind`.

The following specific updates have been made to the WMS Database since the last release:

- Seven new WMS servers from NOAA's National Weather Service servers providing layers containing climate outlook, forecast guidance, and weather observations data. Search for the layers and servers using the `urlSearchString 'idpgis.ncep.noaa.gov'`.
- Two new WMS servers from NOAA's Environmental Web Mapping Portal to Real-Time Coastal Observations, Forecasts, and Warning (now Coast) servers providing layers containing weather data. Search for the layers and servers using the `urlSearchString 'nowcoast.noaa.gov'`.
- 54 new WMS servers from NOAA's Environmental Research Division Data Access Program (ERDDAP) providing layers containing oceanographic data. To find out more about them, visit the ERDDAP web site. Search for the layers and servers using the `urlSearchString 'coastwatch.pfeg.noaa.gov'`.
- The USGS server `http://raster.nationalmap.gov/arcgis/services/Orthoimagery/USGS_EROS_Ortho_1Foot/ImageServer/WMSServer` is no longer available. Instead, use the USGS server from `http://basemap.nationalmap.gov/ArcGIS/services/USGSImageryOnly/MapServer/WMSServer` .

Functions Being Removed

Functionality	What Happens When You Use This Functionality?	Use This Instead	Compatibility Considerations
`polybool`	Still works.	`polyshape`	Consider using the MATLAB `polyshape` function instead of `polybool`. Create the shapes with the `polyshape` function and then use `polyshape` object functions to perform the Boolean operation. For an example, see `polybool`.

R2017b

Version: 4.5.1

Bug Fixes

WMS Database Modified

The WMS Database changes on a release-to-release basis, as some new servers are added and other servers are removed because they are no longer online or because their availability is too sporadic. A total of 83 servers (1.8% of the number of servers listed in R2017a) and 4,365 layers have been removed from the database. A total of 21 new servers, with 1,895 layers, have been added. The new database contains a total of 4,543 servers and 70,015 layers.

If you want to find a server, use the server URL or a server URL search string with `wmsfind` to search for layers provided by the server or servers. Use the `servers` method of the `WMSLayer` object returned by `wmsfind` to obtain the server or server URLs as in the following example.

```
layers = wmsfind(urlSearchString,'SearchField','serverurl')
urls = servers(layers)
```

If you want to use the online and most recent up-to-date version of the database hosted on the MathWorks website, use the `'Version','online'` Name-Value pair argument of `wmsfind`.

The following specific updates have been made to the WMS Database since the last release:

- 4 new WMS servers from the Goddard Earth Sciences Data and Information Services Center (GES DISC) providing layers containing atmospheric data. Search for the layers and servers using the `urlSearchString 'disc1.sci.gsfc.nasa.gov'`.
- 16 new WMS servers from NOAA's Environmental Research Division Data Access Program (ERDDAP) providing layers containing oceanographic data. To find out more about them, visit the ERDDAP web site. Search for the layers and servers using the `urlSearchString 'coastwatch.pfeg.noaa.gov'`.
- 26 servers from the United States Naval Research Laboratory (NRL) Geospatial Computing Tile Server have been removed since they have moved to using HTTPS and their certificates are signed by the DOD Certificate Authorities. These certificates are not typically installed by browsers and are not installed with MATLAB. These include the servers providing OpenStreetMap and the USGS Digital Raster Graphics layers.

R2017a

Version: 4.5

New Features

Bug Fixes

Raster Interpolation: Interpolate images and raster grids referenced to geographic and projected map coordinates

The new functions, `geointerp` and `mapinterp`, interpolate images and raster grids referenced to geographic and projected map coordinates.

wmsfind: Search Online Version of WMS Database

The `wmsfind` function `Version` parameter supports a new value, `'online'`, that you can use to search a version of the WMS Database hosted on the MathWorks website. The information in this web-hosted version of the database is more up-to-date than searching the database included with the product because it is updated regularly. Note, however, that searching the online version requires an Internet connection.

WMS Database Modified

The WMS Database changes on a release-to-release basis, as some new servers are added and other servers are removed because they are no longer online or because their availability is too sporadic. A total of 4,327 servers (48.6% of the number of servers listed in R2016b) and 15,496 layers have been removed from the database. A total of 24 new servers, with 2,167 layers, have been added. The new database contains a total of 4,605 servers and 72,485 layers.

If you want to find a server, use the server URL or a server URL search character vector with `wmsfind` to search for layers provided by the server or servers. Use the `servers` method of the `WMSLayer` object returned by `wmsfind` to obtain the server or server URLs as in the following example.

```
layers = wmsfind(urlSearchString, 'SearchField', 'serverurl')
urls = servers(layers)
```

The following specific updates have been made to the WMS Database since the last release:

- 2 new WMS servers from the USGS National Map server providing layers containing orthographic (`USGSImageOnlyLarge`) and NAIP (`USGSNAIPPlus`) imagery. Search for the layers and servers using the `urlSearchString` `'nationalmap.gov'`.
- 11 new WMS servers from the United States Census Bureau Tiger web server providing layers containing census information. Search for the layers and server using the `urlSearchString` `'tigerweb.geo.census.gov'`.
- 3 servers from the USGS National Map server have been removed since they have moved and are no longer accessible. These include the servers providing the `USGS_EROS_Ortho`, `USGS_EROS_Ortho_NAIP_Scale`, and `USGS_EROS_Ortho_SCALE` layers.
- 3,861 servers from the service `http://gstore.unm.edu` have been removed since they are no longer accessible.
- 376 servers from the service `http://thredds.met.no/thredds` have been removed since they are no longer accessible.

R2016b

lookAtSpheroid: Trace line of sight from points in space to oblate spheroid

The new function, `lookAtSpheroid`, computes the latitude and longitude of the intersection of the line of sight from a viewpoint in space with the surface of an oblate spheroid.

worldfileread: Achieve high-precision raster referencing

The `worldfileread` function can compensate for truncated repeating decimals (not uncommon in world files in geographic coordinates), creating high-precision raster reference objects from limited-precision input, and thus avoiding round-off errors in downstream computations.

Version History

`worldfileread` might return slightly different results than in previous releases. Additionally, some cases that previously caused an error will no longer error.

wmsfind: Specify which Web server database to use

The `wmsfind` function supports a new parameter, `Version`, that you can use to specify which server database you want to use. By default, the value for this new parameter is `'installed'` which causes the `wmsfind` function to use the database included with the toolbox. You use the other option, `'custom'`, to specify another version of the server database.

wmsfind and WMSLayer.refine: Accept string inputs

The `wmsfind` and `WMSLayer.refine` functions can now accept string inputs as well as character vector inputs.

Map Quest Layers and USGS Hydrography Layer No Longer Available

The Map Quest layers and USGS Hydrography layer are no longer available in the web map. Map Quest now requires a key to access their Open Data maps. The Hydrography layer is no longer available.

los2: Improved performance

There have been incremental improvements in the efficiency of the `los2` function, which should also slightly improve viewshed performance.

WMS Database Modified

The WMS Database changes on a release-to-release basis, as some new servers are added and other servers are removed because they are no longer online or because their availability is too sporadic. A total of 633 servers (11.9% of the number of servers listed in R2016a) and 32,522 layers have been removed from the database. A total of 4,224 new servers, with 8,904 layers, have been added. The new database contains a total of 8,908 servers and 85,814 layers.

If you want to find a server, use the server URL or a server URL search character vector with `wmsfind` to search for layers provided by the server or servers. Use the `servers` method of the

WMSLayer object returned by `wmsfind` to obtain the server or server URLs as in the following example.

```
layers = wmsfind(urlSearchString, 'SearchField', 'serverurl')
urls = servers(layers)
```

The following specific updates have been made to the WMS Database since the last release:

- 337 new WMS servers from NOAA's Environmental Research Division Data Access Program (ERDDAP) providing layers containing oceanographic data. To find out more about them, visit the ERDDAP web site. Search for the layers and servers using the `urlSearchString 'coastwatch.pfeg.noaa.gov'`.
- 1 new WMS server (`http://geoservice.dlr.de`) from the Earth Observation Center (EOC) basemap server providing layers containing Natural Earth images, GSHHS vector overlays, and OpenStreetMap overlays. Search for the layers and servers using the `urlSearchString 'geoservice.dlr.de'`.
- 4 servers from the United States Geological Survey (USGS) National Map have been removed since they are no longer accessible. These include the servers providing the `TNM_Vector_Fills_Small`, `TNM_Vector_Small`, `TNM_Contours`, and `USGSHydroNHD` layers.
- 1 server from the service `http://wms.openweathermap.org/service` has been removed since it is unreliable.

Functions Being Removed

Function Name	What Happens When You Use the Function?	Use This Instead	Compatibility Considerations
`sizem`	Still runs	Consider using `georefcells` and accessing the `RasterSize` property.	None.

R2016a

kmlwrite and kmlwritepolygon: Export polygons to KML file format

The new `kmlwritepolygon` function writes a geographic polygon specified by latitude and longitude coordinate vectors, and optionally an altitude vector, to a KML file. KML stands for Keyhole Markup Language which is an XML dialect used to structure geographic data for display in an Earth browser, such as Google Earth™. The function `kmlwritepolygon` joins the two existing functions `kmlwritepoint` and `kmlwriteline` to provide simple interfaces to write shapes to a KML file. You can also use the existing `kmlwrite` function to write polygons to a KML file—it now accepts polygon geoshape objects as input.

wmpolygon: Display polygons on Web Maps

The new `wmpolygon` function supports displaying polygon features on web maps. This function complements the `wmline` and `wmmarker` functions for displaying shapes on web maps.

arcgridread: Import data in GridFloat format, including USGS elevation grids

The `arcgridread` function now supports the GridFloat format, in addition to the Arc Grid ASCII format that it already supported. GridFloat is one of the data formats supported by the USGS.

geocontourxy: Contour data gridded in local Cartesian system and transform to latitude-longitude geoshapes

The new `geocontourxy` function contours data gridded in a local Cartesian coordinate system and transforms the data to a geographic coordinate system, returning latitude and longitude values in geoshapes.

webmap: Display data over high-resolution world imagery

The `webmap` function now includes high-resolution world imagery as one of its base layer options. Use this function to view detailed images of the world’s surface in a web browser and to overlay your data onto these images.

New KML options: Control transparency of icons, points, and lines, and polygon faces and edges

The KML functions, `kmlwrite`, `kmlwritepoint`, `kmlwriteline`, and `kmlwritepolygon`, now all support several new optional parameters, including the Alpha option to control transparency of icons, points, and lines, and the faces and edges of polygons.

arcgridread: Return raster reference objects

The `arcgridread` function can now return raster reference objects when it can determine information about the coordinate system used in the data.

Version History

In previous releases, `arcgridread` returned only referencing matrix. Now, `arcgridread` can return a raster referencing object, if it can determine the coordinate system. For all uses of this information, the switch to a raster reference object should be transparent.

WMS Database Modified

The WMS Database changes on a release-to-release basis, as some new servers are added and other servers are removed because they are no longer online or because their availability is too sporadic. A total of 4247 servers (44.8% of the number of servers listed in R2015b) and 27,217 layers have been removed from the database. A total of 85 new servers, with 4,565 layers, have been added. The new database contains a total of 5,318 servers and 109,432 layers.

If you want to find a server, use the server URL or a server URL search character vector with `wmsfind` to search for layers provided by the server or servers. Use the `servers` method of the WMSLayer object returned by `wmsfind` to obtain the server or server URLs as in the following example.

```
layers = wmsfind(urlSearchString, 'SearchField', 'serverurl')
urls = servers(layers)
```

The following specific updates have been made to the WMS Database since the last release:

- 57 new WMS servers from NOAA's Environmental Research Division Data Access Program (ERDDAP) providing layers containing oceanographic data. To find out more about them, visit the ERDDAP web site. Search for the layers and servers using the `urlSearchString 'coastwatch.pfeg.noaa.gov'`.
- 1 new WMS server (`http://geoint.nrlssc.navy.mil/nrltileserver/wms/bluemarblebymonth`) from the United States Naval Research Laboratory (NRL) Geospatial Computing Tile Server providing layers containing monthly Blue Marble images. Search for the layers and servers using the `urlSearchString 'geoint.nrlssc.navy.mil'`.
- 14 new WMS servers from the United States Geological Survey (USGS) National Map providing layers containing small scale map features including shaded relief, land cover, impervious surface, tree canopy, boundaries, hydrography, and transportation. Search for the layers and server using the `urlSearchString 'services*SmallScale'`.
- 1 new WMS server from the United States Geological Survey (USGS) National Map providing layers containing National Agriculture Imagery Program (NAIP) imagery. Search for the layer and server using the `urlSearchString 'USGSNAIPImagery'`.
- The Jet Propulsion Laboratory's WMS servers, `onearth.jpl.nasa.gov` and `onmars.jpl.nasa.gov`, have been removed since they are no longer accessible.
- 3871 servers from the service `http://gstore.unm.edu/apps/rgis/datasets` have been removed since they are no longer accessible.

R2015b

New functions to make raster referencing objects with specific cell extents or sample spacings

The toolbox includes four new functions that make it easier to create raster reference objects, listed in the following table.

Function	Description
`georefcells`	Reference raster cells to geographic coordinates
`georefpostings`	Reference raster postings to geographic coordinates
`maprefcells`	Reference raster cells to map coordinates
`maprefpostings`	Reference raster postings to map coordinates

Raster reference objects returned by wmsread and included in WMSMapRequest

The `wmsread` function now returns a raster reference object and the `WMSMapRequest` class has a new property named `RasterReference` that contains a raster reference object.

Version History

In previous releases, `wmsread` returned a referencing matrix. This change requires no action because a referencing object can be substituted for a referencing matrix in essentially all Mapping Toolbox functions. The most likely exception is if your code calls `mapshow` with the data returned by `wmsread`. `mapshow` expects data in a projected coordinate system and the data returned by `wmsread` is in a geographic coordinate reference system. `mapshow` errors in this case, use `geoshow` instead.

TIFF RPCCoefficientTag tags enabled in GeoTIFF file import and export

The `geotiffinfo` and `geotiffwrite` functions now support the `RPCCoefficientTag`. `geotiffinfo` returns this value, if the tag is present in the file, in a `map.geotiff.RPCCoefficientTag` object. `geotiffwrite` can write a GeoTIFF file that contains this object.

Improved viewshed and line of sight performance due to the new MATLAB execution engine

The performance of the `viewshed` and `los2` functions has been further improved over the R2015a improvement. The R2015b improvement is due directly to the new MATLAB execution engine.

deg2rad and rad2deg functions moved to MATLAB

The `deg2rad` and `rad2deg` functions have been moved from the Mapping Toolbox to MATLAB. The behavior of some of the functions has changed slightly, as described in the compatibility considerations section.

Use of the Mapping Toolbox functions `degtorad` and `radtodeg` is not recommended. Use `deg2rad` and `rad2deg` instead.

Version History

In previous releases, `deg2rad` and `rad2deg` accepted input arguments of integer types, such as `uint8`. Now that they are in MATLAB,these functions only accept input arguments of type `single` or `double`.

ispolycw function more robust

The `ispolycw` function is now more robust with the way it handles self-intersections (often called bow-ties). Even though such self-intersections are corruptions, `ispolycw` returns a value based on the direction of the curve bounding the larger part (or parts) of the closed self-intersecting curve. The result is now also invariant with regard to rotations of the input polygon in the plane.

WMS Database Modified

The WMS Database changes on a release-to-release basis, as some new servers are added and other servers are removed because they are no longer online or because their availability is too sporadic. A total of 237 servers (2.5% of the number of servers listed in R2015a) and 5,377 layers have been removed from the database. A total of 251 new servers, with 7,224 layers, have been added. The new database contains a total of 9,480 servers and 132,084 layers.

If you want to find a server, use the server URL or a server URL search character vector with `wmsfind` to search for layers provided by the server or servers. Use the `servers` method of the WMSLayer object returned by `wmsfind` to obtain the server or server URLs as in the following example.

```
layers = wmsfind(urlSearchString, 'SearchField', 'serverurl')
urls = servers(layers)
```

The following specific updates have been made to the WMS Database since the last release:

- 193 new WMS servers from the National Aeronautics and Space Administration (NASA) Center for Climate Simulation THREDDS server containing the NASA Earth Exchange Global Downscaled Daily Downscaled Projections (NEX-GDDP). For reference, see: https://cds.nccs.nasa.gov/nex-gddp. Search for the layers and servers using the `urlSearchString 'nccs.nasa.gov'`.
- 12 new WMS servers from the United States Naval Research Laboratory (NRL) Geospatial Computing Tile Server containing a variety of layers including OpenStreetMap. Search for the layers and servers using the `urlSearchString 'geoint.nrlssc.navy.mil'`.
- 1 new WMS server from the Meteorological Service of Environment Canada OWS Data Server containing global weather observations. Search for the layers and server using the `urlSearchString 'geo.weather.gc.ca'`.
- 3 new WMS servers from the Kansas Applied Remote Sensing (KARS) WMS server containing land cover, elevation, and county boundaries for Kansas. Search for the layer and server using the `urlSearchString 'kars.ku.edu'`.

Functions Being Removed

Function Name	What Happens When You Use the Function?	Use This Instead	Compatibility Considerations
`nanm`	Still runs	Consider using `georefcells` with `nan`.	None.
`onem`	Still runs	Consider using `georefcells` with `ones`.	None.
`spzerom`	Still runs	Consider using `georefcells` with `sparse`.	None.
`zerom`	Still runs	Consider using `georefcells` with `zeros`.	None.

R2015a

Version: 4.1

New Features

Bug Fixes

Settable raster reference cell extent and sample spacing properties

Several properties of the `map.rasterref.MapRasterReference` and `map.rasterref.GeographicRasterReference` classes that were read-only are now settable.

stereographic Properties	pre-preference Properties
`CellExtentInLatitude`	`CellExtentInWorldX`
`CellExtentInLongitude`	`CellExtentInWorldY`
`SampleSpacingInLatitude`	`SampleSpacingInWorldX`
`SampleSpacingInLongitude`	`SampleSpacingInWorldY`

Support for reading non-standard USGS 24K DEM files

The `usgs24kdem` function has been enhanced to read digital elevation model (DEM) data from a broader range of sources.

Improved viewshed function performance

The performance of the `viewshed` function has been improved.

WMS Database Modified

The WMS Database changes on a release-to-release basis, as some new servers are added and other servers are removed because they are no longer online or because their availability is too sporadic. A total of 155 servers (2.75% of the number of servers listed in R2014b) and 5,054 layers have been removed from the database. A total of 3,982 new servers, with 12,903 layers, have been added. The new database contains a total of 9,466 servers and 130,237 layers.

If you want to find a server, use the server URL or a server URL search character vector with `wmsfind` to search for layers provided by the server or servers. Use the `servers` method of the WMSLayer object returned by `wmsfind` to obtain the server or server URLs as in the following example.

```
layers = wmsfind(urlSearchString, 'SearchField', 'serverurl')
servers = layers.servers
```

The following specific updates have been made to the WMS Database since the last release:

- 1 new WMS server from the United States Geological Survey (USGS) National Map containing small-scale contours generated for the conterminous United States from the 1 arc-second National Elevation Dataset (NED), which can be displayed between 1:289K and 1:72K scales. Search for the layer and server using the `urlSearchString 'TNM_Contours'`.
- 1 new WMS server from the United States Geological Survey (USGS) National Map containing the National Hydrography Dataset (NHD) at small-scale resolutions. Search for the layer and server using the `urlSearchString 'USGSHydroNHD'`.
- 1 new WMS server from the United States Geological Survey (USGS) National Map containing a combination of imagery and contours, along with vector layers, that provide a composite base map that resembles the US Topo product. Search for the layer and server using the `urlSearchString 'basemap*USGSImageryTopo'`.

- 1 new WMS server from the United States Geological Survey (USGS) National Map containing the USGS Hill Shade base map. Search for the layer and server using the `urlSearchString 'USGSShadedReliefOnly'`.
- 3,871 new WMS servers from the Earth Data Analysis Center at the University of New Mexico. These servers provide geographic data layers for New Mexico that include political boundaries, ortho and aerial photography, satellite imagery, elevation data, and natural resources data. Search for the layers and servers using the `urlSearchString 'gstore.unm.edu'`.
- 8 new WMS servers from the United States Census Bureau containing geography, census, and physical features. Search for the layers and servers using the `urlSearchString 'tigerweb'`.
- 4 new WMS servers from the United States National Atlas hosted by the USGS National Map servers. Search for the layers and servers using the `urlSearchString 'nationalatlas'`.
- 1 new WMS server from Chart Bundle hosting aviation charts and maps. Search for the layers and server using the `urlSearchString 'chartbundle'`.

R2014b

Version: 4.0.2

Bug Fixes

Version History

WMS Database Modified

The WMS Database changes on a release-to-release basis, as some new servers are added and other servers are removed because they are no longer online or because their availability is too sporadic. A total of 477 servers (9.1% of the number of servers listed in R2014a) and 5,016 layers have been removed from the database. A total of 1,168 new servers, with 15,514 layers, have been added. The new database contains a total of 5,641 servers and 122,388 layers.

If you want to find a server, use the server URL or a server URL search character vector with `wmsfind` to search for layers provided by the server or servers. Use the `servers` method of the WMSLayer object returned by `wmsfind` to obtain the server or server URLs as in the following example.

```
layers = wmsfind(urlSearchString, 'SearchField', 'serverurl')
servers = layers.servers
```

The following specific updates have been made to the WMS Database since the last release:

- 16 new WMS servers from the Arctic Research Mapping Application (ARMAP) hosted by the University of Texas at El Palo. Search for the layers and servers using the `urlSearchString 'arcticdata.utep.edu'`.
- 11 new map servers of the European Environment Agency. These servers obtain a wide range of environmental data for Europe. Search for the layers and servers using the `urlSearchString 'discomap.eea.europa.eu'`.
- 104 new WMS servers from NOAA's National Ocean Service supporting coastal communities, promoting a robust economy, and protecting coastal and marine ecosystems. Search for the layers and servers using the `urlSearchString 'egisws02.nos.noaa.gov'`.
- 41 new WMS servers from the California Natural Resources Agency / Map Server. These servers provide map services for departments, boards and commissions within the Natural Resources Agency, and to make some of these services available to the public. Search for the layers and servers using the `urlSearchString 'atlas.resources.ca.gov'`.
- 103 new WMS servers from the Illinois State Geological Survey Prairie Research Institute. These servers provide scientific data layers in Earth science. Search for the layers and servers using the `urlSearchString 'geothermal.isgs.illinois.edu'`.
- 169 new WMS servers from the Spatial Data Infrastructure Government of La Rio (Spain). These servers provide data layers in basic topographic cartography, orthoimagery, and thematic maps for the comprehension and study of La Rio. Search for the layers and servers using the `urlSearchString 'ogc.larioja.org'`.
- 20 layers from the Solar Energy Environmental Mapper server. The server provides environmental data for the U.S. in the context of utility-scale solar energy development. Search for the layers and servers using the `urlSearchString 'solarmapper.anl.gov'`.
- 17 layers from the Open Weather Map server. The server provides meteorological data for the world. Search for the layers and servers using the `urlSearchString 'openweathermap'`.

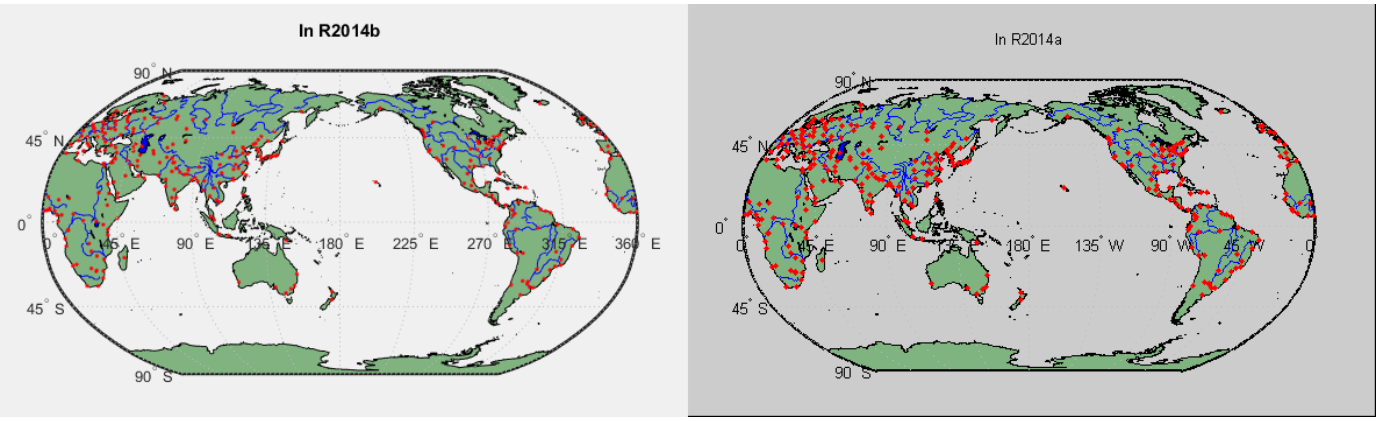
New look of map graphics with improved clarity and aesthetics

MATLAB graphics has a new look and graphics produced by Mapping Toolbox functions benefits from these updates, including:

- Lines and edges are anti-aliased, producing a smoother, cleaner look.

- Text, even when rotated, is clearer.
- The new default colormap, called `parula`, meets modern standards for color perception. See `colormap` for more information.

For example, compare these two maps created using the `worldmap` function. In the R2014b map, note the new background color, the smoothness of the lines and edges, and, in particular, the clarity of the degree symbols in the text labels.



copyobj does not work with certain Map graphics

Some functions in Mapping Toolbox return graphics that are a composite of standard MATLAB graphics objects. When you copy these graphics, `copyobj` copies only the primary object, so the result of the copy operation may look different and appear incomplete. Property updates and other interactions with the copied object might not work as expected.

Version History

Rather than copying Mapping Toolbox graphics objects using `copyobj`, repeat the construction of the object in the new axis.

Functions Being Removed

Function Name	What Happens When You Use the Function?	Use This Instead	Compatibility Considerations
`lightmui`	Errors	Consider using `lightm` with `inputm` to position the light source.	Remove all existing instances of `lightmui`.
`roundn`	Still runs	Use `round` instead.	Consider replacing all existing instances of `roundn` with `round`.

R2014a

Zoom via Standard MATLAB Tools and Functions

In the `colorm`, `maptool`, `maptrim`, and `seedm` interfaces, zoom and pan operations are now provided through the standard MATLAB tools. The `panzoom` function is now nearly the same as the MATLAB `zoom` function.

Version History

`panzoom` will be removed in a future release. You can use `zoom` instead of `panzoom` for all panning and zooming operations, except for `'fullview'`. To replace `zoom fullview`, use the following sequence of commands:

```
axis auto   % Reset the axes limits
zoom reset  % Clear the zoom limit settings
zoom on     % Enable/re-enable zoom
```

Streamlined maptool Interface

The `maptool` interface is simpler and more standard.

- The MATLAB figure toolbar is no longer hidden when `maptool` is opened.
- The **Zoom**, **Rotate**, and **Origin** buttons are no longer added to the map axes when `maptool` is opened.
- The **Zoom Tool** and **Rotate** entries are no longer present in the Tools menu that `maptool` adds to the current figure.
- The **Edit—>Latest Object** entry is no longer present in the **Tools** menu.
- The **climits** button is no longer present on the contour dialogs invoked via `maptool`.
- Opening `maptool` no longer adds a **Session** menu to the figure.

Version History

You should use the standard MATLAB Zoom In, Zoom Out, Pan, and Rotate tools to zoom, pan, and rotate your axes. There is no replacement for **Tools->Edit->Latest Object**. There are no replacements for the **climits** button or the **Session** menu.

X Label, Y Label, and Title removed from Map Viewer

The **X Label**, **Y Label**, and **Title** menu items are no longer present in the Map Viewer **Insert** menu.

Version History

If you need a title and/or labels, use a standard MATLAB axes instead of a Map Viewer window, and display objects with the `mapshow` function.

Less Obtrusive Contextual Help

Contextual help for many dialog boxes, including those accessed via `maptool`, is now provided via tool tip messages. The **Help** button transforms the dialogs into a temporary state in which clicking on a button presents help text rather than performing an action.

Standard Property Editing

For most map display objects, "extended click" now opens the MATLAB graphics property editor, instead of opening up a custom property edit dialog specific to Mapping Toolbox.

namem and handlem no longer create an axes

The `namem` and `handlem` functions no longer create an axes when one does not already exist.

WMS Database Modified

The WMS Database changes on a release-to-release basis, as some new servers are added and other servers are removed because they are no longer online or because their availability is too sporadic. In R2014a, a total of 106 servers (4.7% of the number of servers listed in R2013b) and 5,040 layers have been removed from the database and 2,771 new servers, with 50,477 layers, have been added. The updated database contains a total of 4,920 servers and 111,890 layers.

If you want to find a server, use the server URL or a server URL search character vector with `wmsfind` to search for layers provided by the server or servers. Then use the `servers` method of the WMSLayer object to obtain the server or server URLs:

```
layers = wmsfind(urlSearchString, 'SearchField', 'serverurl')
servers = layers.servers
```

The following specific updates have been made to the WMS Database since the last release:

- Three new WMS servers from NASA Goddard Earth Sciences Data and Information Services Center (GES DISC). These servers provide near real-time Atmospheric Infrared Sounder (AIRS) Calibrated Radiance data, Atmospheric Infrared Sounder (AIRS) data, and Tropical Rainfall Measurement Mission (TRMM) Gridded Rainfall data. Search for the layers and servers using the `urlSearchString 'disc1.sci.gsfc.nasa.gov'`.
- Twenty new WMS servers from the U.S. Naval Research Laboratory's Geospatial Computing Tile Server. These servers provide Digital Nautical Charts, Electronic Nautical Charts, OpenStreetMap for the World, FAA Sectionals, Terminal Area Charts, World Aeronautical Charts, and NOAA Raster Navigation Charts. Search for the layers and servers using the `urlSearchString 'geoint.nrlssc.navy.mil'`.
- Three new WMS servers from Webservice-Energy.org. The Global Atlas for Solar and Wind Energy provides solar and wind data designed to support policy formulation, planning, and pre-feasibility studies for wind and solar projects. Search for the layers and servers using the `urlSearchString 'geoserver.webservice-energy.org'`.
- Fifty-two new WMS servers from the Pacific Islands Ocean Observing System THREDDS servers. These servers provide bathymetry, water salinity, temperature, velocity, sea surface height, and wave and tide model layers. Search for the layers and servers using the `urlSearchString 'oos.soest.hawaii.edu'`.

- 2609 new WMS servers from the Norwegian Meteorological Institute THREDDS server. These servers provide scientific data layers in meteorology, atmosphere, climate, ocean, and Earth science. Search for the layers and servers using the `urlSearchString 'thredds.met.no'`.
- Ten new WMS servers from the Balearic Islands Coastal Observing and Forecasting System THREDDS server. These servers provide scientific data layers in meteorology, atmosphere, climate, ocean, and Earth science. Search for the layers and servers using the `urlSearchString 'thredds.socib.es'`.
- Over 7,000 layers from the Oak Ridge National Laboratory Distributed Active Archive Center (ORNL DAAC) for biogeochemical dynamics. The server provides a number of land cover, biophysical, elevation, and geopolitical layers. Search for the layers and servers using the `urlSearchString 'webmap.ornl.gov'`.
- Three layers from the LANCE FIRMS WMS server from NASA. This server provides layers for the latest MODIS Fire/Hotspot data. Search for the layers and servers using the `urlSearchString 'eosdis.nasa.gov'`.
- Over 60 layers form the National Renewable Energy Laboratory WMS server. This server provides layers for solar and wind energy resource assessment. Search for the layers and servers using the `urlSearchString 'mapservices.nrel.gov'`.

Functions Being Removed

Function Name	What Happens When You Use the Function?	Use This Instead	Compatibility Considerations
`combntns`	Warns	`nchoosek`	Replace all existing instances of `combntns` with `nchoosek`.
`mlayers`	Warns	N/A	N/A
`panzoom`	Still runs.	`zoom`	Replace all existing instances of `panzoom` with `zoom`.
`rootlayr`	Warns	N/A	N/A

R2013b

Web map display with dynamic base maps from OpenStreetMap and other sources

The new `webmap` function displays map base layers obtained from Web servers located on the Internet in a browser window. Map base layers are either named layers, such as `Open Street Map`, `World Terrain Base`, or `Ocean Basemap`, or Web Map Service layers (WMSLayer). You can dynamically switch base layers by selecting a base layer from the layer manager in the window and add vector overlay layers to web maps. You can use the `wmclose` function to close the web map window and `wmprint` to print your web map to a printer. You can also publish a web map using the MATLAB `publish` command.

Functions to add or remove geographic point marker and line overlays on a web map display

You can add geographic point markers and line overlays on a web map display using the `wmmarker` and `wmline` functions, and remove them using the `wmremove` function.

Interactive navigation and commands to control web map limits, center, and zoom level

You can navigate around a web map, using a mouse, or by using the `wmlimits`, `wmcenter`, and `wmzoom` functions.

Additional object properties for referencing images or data grids to geographic or planar coordinates

The geographic raster reference and map raster reference classes include new properties that describe the dimensions of cells or spacing between postings. The following table lists the properties in relation to the class types, coordinate system type, and key properties.

Class Name	Coordinate System Type	RasterInterpretation	Cell Dimensions
`map.rasterref.GeographicCellsReference`	`geographic`	`cells`	`CellExtentInLatitude` `CellExtentInLongitude`
`map.rasterref.GeographicPostingsReference`	`geographic`	`postings`	`SampleSpacingInLatitude` `SampleSpacingInLongitude`
`map.rasterref.MapCellsReference`	`planar`	`cells`	`CellExtentInWorldX` `CellExtentInWorldY`
`map.rasterref.MapPostingsReference`	`planar`	`postings`	`SampleSpacingInWorldX` `SampleSpacingInWorldY`

These new properties are unsigned because the existing `ColumnStartFrom` and `RowStartFrom` properties already provide directional information.

These new properties make the `DeltaLat`, `DeltaLon`, `DeltaX`, and `DeltaY` properties redundant. These older properties still exist but are hidden.

The four new classes replace the two existing classes `spatialref.GeoRasterReference` and `spatialref.MapRasterReference`.

georasterref, maprasterref, and worldfileread functions return new types

The `georasterref` and `maprasterref` functions return new types of objects, depending on the value of the `RasterInterpretation` parameter. By default, if you do not specify this parameter, the functions return an object with the raster interpretation `cells`.

The `worldfileread` function returns new types of objects, depending on the value of the `coordinateSystemType` parameter.

The following table lists these classes.

Function	Type Returned When RasterInterpretation Is 'cells'	Type Returned When RasterInterpretation Is 'postings'
`georasterref`	`map.rasterref.GeographicCellsReference`	`map.rasterref.GeographicPostingsReference`
`maprasterref`	`map.rasterref.MapCellsReference`	`map.rasterref.MapPostingsReference`
`worldfileread(___,'geographic',___)`	`map.rasterref.GeographicCellsReference`	n/a
`worldfileread(___,'planar',___)`	`map.rasterref.MapCellsReference`	n/a

Version History

It is no longer possible to set the `RasterInterpretation` property of a referencing object once it has been created (because there are now separate classes for each raster interpretation). This reduces the possibility of having a referencing object with incorrect property values.

Raster reference conversion functions accept new parameter and return new types

The `refmatToGeoRasterReference` and `refmatToMapRasterReference` functions accept an optional input argument and return new types of objects. Using the new `rasterInterpretation` input argument, you can create a raster reference object with the raster interpretation `cells` or `postings`. By default, if you do not specify this parameter, the functions return an object with the raster interpretation `cells`.

The `refvecToGeoRasterReference` function does not accept a new parameter but does return a new type of object, as shown in this table.

Function	Type Returned When rasterInterpretation is 'cells'	Type Returned When rasterInterpretation is 'postings'
refmatToGeoRasterReference	map.rasterref.GeographicCellsReference	map.rasterref.GeographicPostingsReference
refmatToMapRasterReference	map.rasterref.MapCellsReference	map.rasterref.MapPostingsReference
refvecToGeoRasterReference	map.rasterref.GeographicCellsReference	N/A

Properties and method name changes

The geographic raster reference and map raster reference classes include the following changed property names. The properties with the old names still exist but are hidden.

Existing Property Name	New Property Name
Geographic Raster Reference Classes	
XLimIntrinsic	XIntrinsicLimits
YLimIntrinsic	YIntrinsicLimits
Latlim	LatitudeLimits
Lonlim	LongitudeLimits
AngleUnits	AngleUnit
Map Raster Reference Classes	
XLimIntrinsic	XIntrinsicLimits
YLimIntrinsic	YIntrinsicLimits
XLimWorld	XWorldLimits
YLimWorld	YWorldLimits
RasterWidthInWorld	RasterExtentInWorldX
RasterHeightInWorld	RasterExtentInWorldY
AngleUnits	AngleUnit

The geographic raster reference class and map raster reference class have one changed method name. The methods with the old names still exist but are hidden.

Existing Method Names	New Method Names
Geographic Raster Reference Classes	
geographicToSub	geographicToDiscrete
Map Raster Reference Classes	
worldToSub	worldToDiscrete

Parameter names (for name-value pairs) supported by `georasterref` and `maprasterref` functions that correspond to the changed property names have been changed.

Existing Parameter Names	New Parameter Names
Geographic Raster Reference Classes	
`Latlim`	`LatitudeLimits`
`Lonlim`	`LongitudeLimits`
Map Raster Reference Classes	
`XLimWorld`	`XWorldLimits`
`YLimWorld`	`YWorldLimits`

Maps in the Stereographic Projection can extend more than 90 degrees from the origin

When using `axesm` to construct a map axes with `MapProjection` set to `'stereo'`, the map is no longer limited to areas within 90 degrees of the origin. Instead, areas can extend out as far as 179.5 degrees, although the largest practical range is probably somewhere between 120 and 150 degrees.

Spheroid objects display additional properties

The command-line display for single instances of the oblateSpheroid and referenceEllipsoid classes now lists the following additional (and dependent) properties:

- `Flattening`
- `ThirdFlattening`
- `MeanRadius`
- `SurfaceArea`
- `Volume`

The display for a single instance of referenceSphere now lists `SemimajorAxis`, `SemiminorAxis`, `InverseFlattening`, `Eccentricity`, along with the five properties already included in the preceding list. To avoid cluttering the display, the numerical values of these additional properties are omitted, but can be view individually.

WMS Database Modified

The WMS Database changes on a release-to-release basis, as some new servers are added and other servers are removed because they are no longer online or because their availability is too sporadic.

A total of 297 servers (12.5% of the number of servers listed in R2013a) and 15,907 layers have been removed from the database. A total of 174 new servers, with 6,077 layers, have been added. The new database contains a total of 2,253 servers and 66,453 layers.

A total of 17 new servers, with 1,896 layers, have been added. The new database contains a total of 2,378 servers and 76,283 layers.

If you want to find a server, use the server URL or a server URL search character vector with `wmsfind` to search for layers provided by the server or servers. Then use the `servers` method of the WMSLayer object to obtain the server or server URLs:

```
layers = wmsfind(urlSearchString, 'SearchField', 'serverurl')
servers = layers.servers
```

The following specific update has been made to the WMS Database since the last release:

- The Unidata Program Center's THREDDS Data Server (TDS) using the domain name `motherlode.ucar.edu` has been upgraded to use the domain name `thredds.ucar.edu`. The domain name `motherlode.ucar.edu` will not work after August 1, 2013. These layers have been updated in the database to use the new `thredds.ucar.edu` domain name.
- The notable new servers added to the database are from the USGS National Map:

`'http://basemap.nationalmap.gov/ArcGIS/services/USGSTopo/MapServer/WMSServer?'`
`'http://basemap.nationalmap.gov/ArcGIS/services/USGSImageryOnly/MapServer/WMSServer?'`
`'http://basemap.nationalmap.gov/ArcGIS/services/NHD_Small/MapServer/WMSServer?'`
`'http://services.nationalmap.gov/ArcGIS/services/US_Topo/MapServer/WMSServer?'`
`'http://services.nationalmap.gov/ArcGIS/services/TNM_Vector_Large/MapServer/WMSServer?'`

Functions Being Removed

Function Name	What Happens When You Use the Function?	Use This Instead	Compatibility Considerations
`colorm`	Still runs	N/A	N/A
`extractm`	Still runs	N/A	The use of display structures is not recommended. Use `geoshape` vectors instead.
`geodetic2geocentricLat`	Still runs	Use `geocentricLatitude` instead.	Examine instances of `geodetic2geocentricLat` and consider replacing them with calls to `geocentricLatitude`
`geocentric2geodeticLat`	Still runs	Use `geodeticLatitudeFromGeocentric` instead	Examine instances of `geocentric2geodeticLat` and consider replacing them with calls to `geodeticLatitudeFromGeocentric`
`getseeds`	Still runs	N/A	N/A
`makemapped`	Still runs	N/A	N/A
`mlayers`	Still runs	N/A	N/A
`mobjects`	Still runs	N/A	N/A

Function Name	What Happens When You Use the Function?	Use This Instead	Compatibility Considerations
`project`	Still runs	N/A	N/A
`qrydata`	Still runs	N/A	N/A
`readfk5`	Still runs	N/A	N/A
`refmat2vec`	Still runs	Use `refmatToGeoRasterReference` instead	Examine usages of `refmat2vec` and consider replacing them with calls to `refmatToGeoRasterReference`
`refvec2mat`	Still runs	Use `refvecToGeoRasterReference` instead	Examine usages of `refvec2mat` and consider replacing them with calls to `refvecToGeoRasterReference`
`rootlayr`	Still runs	N/A	N/A
`seedm`	Still runs	N/A	N/A
`smoothlong`	Errors	Use `unwrapMultipart`	Use `unwrapMultipart` instead. Note that `unwrapMultipart` requires its input to be in radians. When working in degrees, use `unwrapMultipart(lon,'degrees')`.
`unitstr`	Errors	Use `validateLengthUnit` instead	N/A

R2013a

KML export for line features

The new `kmlwriteline` function writes a geographic line specified by latitude and longitude coordinate vectors, and optionally an altitude vector, to a KML file. The existing `kmlwrite` function can now write geographic line features from a `geoshape` vector or line `geostruct` vector to a KML file.

Additional KML attributes for both points and lines: AltitudeMode, Camera, Color, and LookAt

The `kmlwrite` function can now include additional KML attributes when writing exporting geographic points or lines to a KML file: `AltitudeMode`, `Camera`, `Color`, `LookAt`, and `Width`.

Multiple track log and route import in gpxread function

The `gpxread` function can now read multiple track logs or routes from a GPX file

Dynamic vector input in shapewrite, geoshow, and mapshow

The `geoshow`, `mapshow`, `shapewrite` and `kmlwrite` functions now accept dynamic vectors as input. The following table lists the functions and identifies the specific dynamic vectors that they accept.

	`geoshow`	`mapshow`	`shapewrite`	`kmlwrite`
`geopoint`	Yes	—	Yes	Yes
`mappoint`	—	Yes	Yes	—
`geoshape`	Yes	—	Yes	Yes
`mapshape`	—	Yes	Yes	—

Auxiliary latitude converter objects

The toolbox includes several new classes, listed below, that provide methods for performing conversions between geodetic latitude and the four types of auxiliary latitude commonly used to implement map projections: authalic, conformal, isometric, and rectifying.

`map.geodesy.authaliclatitudeconverter`	Convert between geodetic and authalic latitudes
`map.geodesy.conformallatitudeconverter`	Convert between geodetic and conformal latitudes
`map.geodesy.isometriclatitudeconverter`	Convert between geodetic and isometric latitudes
`map.geodesy.rectifyinglatitudeconverter`	Convert between geodetic and rectifying latitudes

When using these classes, make sure there is no variable named `map` in the same workspace. The existence of a variable named `map` will cause MATLAB to return an error with the message:

```
"Attempt to reference field in non-structure array."
```

Additional KML enhancements

The toolbox supports the following enhancements to KML support:

- The new `kmlwritepoint` function writes a geographic line specified by latitude and longitude coordinate vectors, and optionally an altitude vector, to a KML file
- The `kmlwrite` function can now export geographic point features from a geopoint vector or geoshape vector to a KML file.
- The `kmlwrite` function now accepts a vector of altitudes in addition to latitude and longitude coordinate vectors.

Geocentric and parametric latitude functions

Four new functions, `geocentricLatitude`, `geodeticLatitudeFromGeocentric`, `parametricLatitude`, and `geodeticLatitudeFromParametric` provide conversions between geodetic latitude and either geocentric latitude or parametric latitude.

Predicate for checking and validating angle unit inputs

The new `map.geodesy.isDegree` function provides an easy consistent mechanism for checking and validating angle unit inputs in which the alternatives `'degrees'` and `'radians'` are supported.

When using the `map.geodesy.isDegree` function, make sure there is no variable named `map` in the same workspace. The existence of a variable named `map` will cause MATLAB to return an error with the message:

```
"Attempt to reference field in non-structure array."
```

Support for PolarStereographic (Variant B) Projection

The functions `geotiffinfo`, `geotiff2mstruct`, `projfwd`, and `projinv` now support the PolarStereographic (Variant B) projection, which is used in various coordinate systems such as WGS84/Antarctic Polar Stereographic.

Enhancements to geoshape and mapshape classes

The dynamic shape classes `geoshape` and `mapshape` have been made more robust with respect to possible data corruptions given invalid inputs in set operations.

Improved performance for gpxread function

Enhanced performance for reading GPX files containing waypoints using the `gpxread` function.

WMS Database Modified

The WMS Database changes on a release-to-release basis, as some new servers are added and other servers are removed because they are no longer online or because their availability is too sporadic. A total of 279 servers (10.6% of the number of servers listed in R2012b) and 21,761 layers have been removed from the database.

A total of 17 new servers, with 1,896 layers, have been added. The new database contains a total of 2,378 servers and 76,283 layers.

If you want to find a server, use the server URL or a server URL search character vector with `wmsfind` to search for layers provided by the server or servers. Then use the `servers` method of the WMSLayer object to obtain the server or server URLs:

```
layers = wmsfind(urlSearchString, 'SearchField', 'serverurl')
servers = layers.servers
```

The following specific update has been made to the WMS Database since the last release:

- The USGS retired the Seamless Server on July 31, 2012. Services have been moved to the National Map at '**nationalmap.gov**'. Search for equivalent layers using the `urlSearchString` `'nationalmap.gov'`.

Functions Being Removed

Function Name	What Happens When You Use the Function?	Use This Instead	Compatibility Considerations
`combntns`	Still runs	`nchoosek`	Replace all existing instances of `combntns` with `nchoosek`.
`epsm`	Still runs		If necessary, you can replace the expressions below with the constants to the right: `epsm()` `1.0E-6` `epsm('deg')` `1.0E-6` `epsm('rad')` `deg2rad(1.0E-6)`
`cometm`	Still runs		Replace instances of cometm with the following: `[x,y] = mfwdtran(lat,lon); comet(x,y,p)`
`cometm3`	Still runs		Replace instances of cometm3 with the following: `[x,y,z] = mfwdtran(lat,lon,z); comet3(x,y,z,p)`
`restack`	Still runs	`uistack`	Replace all existing instances of `restack` with `uistack`
`grepfields`	Still runs	`textscan`	Replace all existing instances of `grepfields` with `textscan`

Function Name	What Happens When You Use the Function?	Use This Instead	Compatibility Considerations
`fipsname`	Still runs	`shaperead`	Import the more recent TIGER/Line data set, available in shapefile format, using `shaperead`
`colorui`	Warning	`uisetcolor`	Replace all existing instances of `colorui` with `uisetcolor`
`dcwdata`	Still runs	`vmap0data`	The VMAP0 dataset has replaced DCW and can be accessed using `vmap0data`.
`dcwgaz`	Still runs	`vmap0ui`.	The VMAP0 dataset has replaced DCW and can be explored using `vmap0ui`.
`dcwread`	Still runs	`vmap0read`	The VMAP0 dataset has replaced DCW and can be read using `vmap0read`.
`dcwrhead`	Still runs	`vmap0rhead`	The VMAP0 dataset has replaced DCW, the header data for which can be read using `vmap0rhead`.

R2012b

Dynamic representation of geographic line and polygon features with geoshape class

Geographic multi-point, line, and polygon features, in a geographic coordinate system, are represented by a geoshape vector.

Dynamic representation of point, line, and polygon map features with mappoint and mapshape classes

Geographic point feature, in a planar coordinate system, are represented by a `mappoint` vector. Geographic multi-point, line, and polygon features, in a planar coordinate system, are represented by a `mapshape` vector.

Coordinate transformations to/from local east-north-up, north-east-down, and spherical systems

A new set of 20 functions for transforming between 3-D coordinate systems has been introduced. There are two global coordinate systems: the geodetic system and ECEF (Earth-Centered, Earth-Fixed) system. The three local coordinate systems are ENU (east-north-up), NED (north-east-down), and AER (azimuth-elevation-range).

- Geodetic to local coordinate transforms: `geodetic2enu, geodetic2ned, geodetic2aer`
- ECEF to local coordinate transforms: `ecef2enu, ecef2ned, ecef2aer`
- Local to geodetic coordinate transforms: `enu2geodetic, ned2geodetic, aer2geodetic`
- Local to ECEF coordinate transforms: `enu2ecef , ned2ecef, aer2ecef`
- Transformations between local systems: `aer2enu, aer2ned, enu2aer, ned2aer`
- 3-D vector transformations between the three Cartesian systems (ECEF, ENU and NED): `enu2ecefv, ned2ecefv, ecef2enuv, ecef2nedv`

Geographic quadrangles bounding points and lines with geoquadpt and geoquadline functions

`geoquadpt` computes a geographic quadrangle bounding scattered points. `geoquadline` computes a geographic quadrangle bounding a multi-part line. Both functions account for spherical topology.

Expanding latitude-longitude quadrangle with bufgeoquad function

The `bufgeoquad` function expands the latitude and longitude limits of geographic quadrangle, accounting for spherical topology.

Spheroid class methods for 3-D coordinate transformations

The three spheroid classes, `oblateSpheroid`, `referenceEllipsoid`, and `referenceSphere`, include 3-D transformation methods using geodetic and Earth-Centered Earth-Fixed (ECEF) Cartesian coordinates.

- `geodetic2ecef` - transforms geodetic to geocentric (ECEF) coordinates

- `ecef2geodetic` - transforms geocentric (ECEF) to geodetic coordinates
- `ecefOffset` - Computes Cartesian ECEF offset between geodetic positions

These methods can be used with either degrees or radians.

Version History

If you choose to replace calls to the existing `geodetic2ecef` and `ecef2geodetic` functions with calls to the new methods of the same names, be aware that the methods use latitude and longitude in units of degrees, but the functions assume units of radians.

Option to use in degrees in unwrapMultipart

The `unwrapMultipart` function now accepts an optional angle unit, which can match either `'degrees'` or `'radians'`.

Changes in geopoint class

A new collection property, `Geometry`, has been added to the `geopoint` class. Its value is always `'point'`.

Version History

- The `lat` and `lon` inputs are restricted to either class type single or double. In R2012a, the `lat` and `lon` inputs may be any numeric type.
- If a dynamic property is set with a cell array of values, the class type of the values are restricted to character vectors. In R2012a, the class type of the values in the cell array input may be numeric, logical, or character vectors.
- When the input coordinate vectors are of different lengths, the lengths of the Latitude and Longitude property values are set to the longest length of the input vectors. In R2012a, the lengths of the property values is set to the length of the Longitude property.

Links to Internet geodata resources moved to Mapping Toolbox documentation

The information on finding geospatial data on the Internet, previously located in "Tech Note 2101" at URL https://www.mathworks.com/support/tech-notes/2100/2101.html has been moved into the Mapping Toolbox documentation. The same content and links to external data sources, with some updates and improvements, can be found in “Find Geospatial Data Online”.

Version History

The MathWorks web site provides a seamless redirect from the old tech note URL to the new one in the web-based documentation, but If you have any browser favorites or bookmarks to the old tech note URL, you could update them.

Smoother colormap interpolation in function demcmap

The `demcmap` function uses a smoother colormap interpolation scheme.

Version History

Differences in colors may occur from earlier versions, but the change should be barely perceptible.

Change in gshhs output structure

In the structure returned by the `gshhs` function, the field name `CrossGreenwich` has changed to `CrossesGreenwich`.

Version History

In scripts, or other MATLAB files, that refer to it, the field name `CrossGreenwich` needs to be changed to `CrossesGreenwich`.

New method option in intrplat and intrplon

The `intrplat` and `intrplon` functions now accept the method `'pchip'`, which designates shape-preserving piecewise cubic interpolation (as in the MATLAB `interp1` function).

Version History

The option `'cubic'` is still accepted, but is now synonymous with `'pchip'`. Calls to `intrplat` and `intrplon` that use 'cubic' may interpolate slightly different latitude and longitude values.

Certain sample data files can be included in a deployed application

The `geoid` MAT-file and the following shapefiles can now be included, using the '-a' option, when using the MATLAB Compiler (TM) to build an application that uses Mapping Toolbox: `landareas, usastatehi, usastatelo, worldcities, worldlakes, worldrivers`.

WMS Database Modified

The WMS Database changes on a release-to-release basis, as some new servers are added and other servers are removed because they are no longer online or because their availability is too sporadic. A total of 7044 servers (75% of the number of servers listed in R2012a) and 15,488 layers have been removed from the database. The vast majority (6,982) of the servers no longer available are from the following server which has either changed its URL or is no longer in service.

`http://nomads.ncdc.noaa.gov/thredds/wms/ncdcPaleoClimate`

A total of 284 new servers, with 24,675 layers, have been added. The new database contains a total of 2,636 servers and 96,417 layers.

If you want to find a server, use the server URL or a server URL search character vector with wmsfind to search for layers provided by the server or servers. Then use the servers method of the WMSLayer object to obtain the server or server URLs:

```
layers = wmsfind(urlSearchString, 'SearchField', 'serverurl')
servers = layers.servers
```

The following specific updates have been made to the WMS Database since the last release:

- 19 new WMS servers from the USGS National Map Server. These servers provide ortho-imagery, land cover, scanned topo maps, and shaded relief layers. Search for the layers and servers using the `urlSearchString` **'isse.cr.usgs.gov'** or **'nationalmap.gov'**.
- 3 new WMS servers from the Intergovernmental Panel on Climate Change (IPCC). Search for the layers and servers using the `urlSearchString` **'ipcc-data.org'**.
- 29 new WMS servers from the University of San Diego focusing on natural disasters. Search for the layers and servers using the `urlSearchString` **'hyperquad.ucsd.edu'**.
- 33 new WMS servers from the USGS Energy Resources Program (http://energy.usgs.gov/). Search for the layers and servers using the `urlSearchString` **'certmapper.cr.usgs.gov'** .

The USGS is moving services from **imsortho.cr.usgs.gov** to **raster.nationalmap.gov**.

Some notable servers that have been removed are:

```
http://imsortho.cr.usgs.gov:80/wmsconnector/com.esri.wms.Esrimap/USGS_EDC_Ortho_Connecticut
http://imsortho.cr.usgs.gov:80/wmsconnector/com.esri.wms.Esrimap/USGS_EDC_Ortho_Iowa
http://imsortho.cr.usgs.gov:80/wmsconnector/com.esri.wms.Esrimap/USGS_EDC_Ortho_Mexico
http://imsortho.cr.usgs.gov:80/wmsconnector/com.esri.wms.Esrimap/USGS_EDC_Ortho_Minnesota
```

Search for equivalent layers using the `urlSearchString` **'isse.cr.usgs.gov'** or **'nationalmap.gov'**.

Microsoft has retired the TerraServer. The following servers have been removed.

```
http://terraserver-usa.com/ogccapabilities.ashx?
http://terraserver-usa.net/ogccapabilities.ashx?
http://terraservice.net/ogccapabilities.ashx?
http://columbo.nrlssc.navy.mil/ogcwms/servlet/WMSServlet/TerraServer.wms
```

Search for equivalent layers in the USGS National Map server by using the following `urlSearchStrings`:

- **'nationalmap.gov*Ortho'**
- **'nationalmap.gov*Scanned'**
- **'nationalmap.gov*DRG'**
- **'nationalmap.gov*Imagery'**
- **'isse*USGS_EDC_Ortho_HRO'**

R2012a

Version: 3.5

New Features

Version History

Data File Removal or Location Change

The following data files have been removed. (The data has been inlined in source code.)

```
toolbox/map/mapdisp/globedems.dat
toolbox/map/mapdisp/gtopo30s.dat
```

Also, the `usgsdems.dat` file has moved from `mapdisp`:

```
toolbox/map/mapdisp/usgsdems.dat
```

to `mapformats`:

```
toolbox/map/mapformats/usgsdems.dat
```

Version History

Before R2011b, you needed to include these three data files:

```
toolbox/map/mapdisp/globedems.dat
toolbox/map/mapdisp/gtopo30s.dat
toolbox/map/mapdisp/usgsdems.dat
```

and the –`a` flag when compiling code that used the functions, `globedems`, `gtopo30s` or `usgsdems`. You no longer need to do this.

geotiffinfo Now Handles Non-compliant GeoTIFF Files

Changes to the `geotiffinfo` function allow it to handle non-compliant GeoTIFF files better than in previous releases. If the `GTModelTypeGeoKey` is not set, `geotiffinfo` now issues a warning, assumes that the model type is `'ModelTypeProjected'`, and constructs a `spatialRef.MapRasterReference` object and a corresponding `RefMatrix`. If the `GTModelTypeGeoKey` is set to the value 3 (geocentric model), then `geotiffinfo` sets the `ModelType` field to `'ModelTypeGeocentric'` rather than empty (as in previous releases). When the `ModelTiepointTag` contains a nonsensical corner latitude, `geotiffinfo` issues a warning and clamps the corner latitude value to the interval `[-90 90]`.

Version History

Before R2012a, if a GeoTIFF file did not include either the `ModelTypeGeographic` or `ModelTypeProjected` tag, the `geotiffinfo` `RefMatrix` and `SpatialRef` fields were empty. The empty tags led to the creation of degenerative files.

geopoint Class to Hold Geographic Point Data

The new `geopoint` class provides a convenient, memory-efficient way to represent one or more geographic points. A geopoint vector can include a set of non-geographic attributes for each point. (When used for cities, for example, attributes might include name, country, population, and so on.) The `geopoint` class provides a rich set of properties and methods to describe, access and modify the geographic point data.

gpxread Function to Read GPX Files

Use the new `gpxread` function to read data from a GPX file. It enables import of GPS waypoints, routes, and track logs into MATLAB, via the GPS Exchange Format (GPX).

geotiffinfo Now Sets Filename to URL

If the input to `geotiffinfo` is a URL, then the value in the `Filename` field of the output structure equals the URL.

Version History

Before R2012a, the value in the `Filename` field was a temporary file name.

Length Unit Validation and Conversion

The new `validateLengthUnit` function validates and standardizes a length unit. It accepts a wide variety of abbreviations, and both plural and singular forms. The call `validateLengthUnit('km')` returns `'kilometer'`. The `unitsratio` function now handles several additional length units that are used for geodetic applications in different parts of the world.

Improved Reference Spheroid Representations and Support

New `referenceEllipsoid` and `referenceSphere` classes provide intuitive, self-documenting representations of reference ellipsoids and spheres, with name and length unit properties as well as geometric properties, The reference ellipsoid class is based on the new `oblateSpheroid` class, which encapsulates the purely geometric aspects of a flattened ellipsoid of revolution.

You can easily construct a reference ellipsoid object for most commonly used coordinate systems, including all those supported by the `almanac` function and those included in the EPSG/OGP Geodetic Parametric Dataset (which is used in connection with the GeoTIFF Format). Similarly, you can construct reference sphere objects representing spherical models of the Earth, Sun, Moon and planets.

wgs84Ellipsoid Function

Many users today work exclusively in the World Geodetic System of 1984 (WGS 84). Along with many other roles, it serves as the native coordinate system the NAVSTAR Global Positioning System (GPS). All that may be needed in this case is the new `wgs84Ellipsoid` function, which returns a `referenceEllipsoid` object with property settings appropriate to the WGS `84 ellipsoid.

Version History

In addition to the earlier “ellipsoid vector” representation, the following functions have been extended to work with reference ellipsoid, oblate spheroid, and reference sphere objects:

`areaint`, `areamat`, `areaquad`, `axesm`, `azimuth`, `convertlat`, `defaultm`, `departure`, `distance`, `ecef2geodetic`, `ecef2lv`, `elevation`, `ellipse1`, `eqa2grn`, `geodetic2ecef`, `gradientm`, `grn2eqa`, `hista`, `lv2ecef`, `mapprofile`, `meanm`, `meridianarc`, `meridianfwd`, `mfwdtran`, `minvtran`, `rcurve`, `reckon`, `rsphere`, `scircle1`, `scircle2`, `setm`, `stdist`, `stdm`, `track`, `track1`, `track2`, `vfwdtran`, `vinvtran`

An “ellipsoid vector” is a 2–by-1 double having the form [semimajor_axis eccentricity]. Ellipsoid vectors are not self-identifying, they do not have a name property, and the length unit of the semimajor axis must be known and managed separately.) For backward compatibility, these functions continue to support ellipsoid vectors as well as the new representations.

`referenceSphere`, `referenceEllipsoid` and `wgs84Ellipsoid` provide superior alternatives to the `almanac` function and should be used in its place going forward.

The etopo function now supports reading additional ETOPO1 data sets

The complete set of ETOPO1 supported data sets is as follows:

```
etopo1_ice_c.flt
etopo1_bed_c.flt
etopo1_ice_c_f4.flt
etopo1_bed_c_f4.flt
etopo1_ice_c_i2.bin
etopo1_bed_c_i2.bin
```

Improvement to Functions usamap and worldmap

In the functions `usamap` and `worldmap` the axes are initialized with a spherical Earth model having a radius of 6,371,000 meters rather than with a unit sphere, making 3D viewing more robust. The options `'all'` and `'allequal'` are now equivalent. In future releases `'allequal'` will be removed.

Version History

This radius change affects the X and Y limits of the axes. If you are setting the `CameraPosition`, `CameraTarget`, `CameraUpVector`, or `CameraLightPosition` properties of the axes with hardwired values determined in releases prior to R2012a, then you need to multiply the first two elements (X and Y values) by 6,371,000. Likewise, if you are using the `XLoc` or `YLoc` properties to position a scaleruler, you need to multiply their values by 6,371,000.

To opt out of this change, set the value of the `geoid` property as in the following code:

```
worldmap world
setm(gca,'geoid',[1 0])
```

or

```
ax = worldmap('world');
setm(ax,'geoid',[1 0])
```

WMS Database Modified

The WMS Database changes on a release-to-release basis, as some new servers are added and other servers are removed because they are no longer online or because their availability is too sporadic. A total of 265 servers (2.75% of the number of servers listed in R2011b) and 13,505 layers have been removed from the database. A total of 29 new servers, with 3,589 layers, have been added. The new database contains a total of 9,396 servers and 87,230 layers.

If you want to find a server, use the server URL or a server URL search character vector with `wmsfind` to search for layers provided by the server or servers. Then use the `WMSLayer.servers` method to obtain the server or server URLs:

```
layers = wmsfind(urlSearchString, 'SearchField', 'serverurl')
servers = layers.servers
```

A notable server that has been removed is:

```
http://aes.gsfc.nasa.gov/cgi-bin/wms?
```

Please use `"gsfc.nasa.gov"` rather than `"gsfc.nasa.gov` when finding layers from the NASA SVS Image Server.

R2011b

Version: 3.4

New Features

Version History

New contourcbar Function Creates Color Bar for Filled Contour Display

Use the `contourcbar` function to create a color bar associated with a filled contour display created with `contourfm`, `contourm`, `contour3m`, or `geoshow`.

Support for Web Map Service Version 1.3.0

Mapping Toolbox functions and classes now support Web Map Service (WMS) Version 1.3.0. See the tip in the `wmsread` reference page about how EPSG:4326 coordinates are encoded in WMS Version 1.3.0.

WMS Database Modified

The WMS Database changes on a release-to-release basis, as some new servers are added and other servers are removed because they are no longer online or because their availability is too sporadic. A total of 151 servers (7.52% of the number of servers listed in R2011a) and 16,466 layers have been removed from the database. A total of 7,768 new servers, with 30,525 layers, have been added. The new database contains a total of 9,632 servers and 97,146 layers.

If you want to find a new server, use the server URL or a server URL search character vector with `wmsfind` to search for layers provided by the server or servers. Then use the `WMSLayer.servers` method to obtain the server or server URLs:

```
layers = wmsfind(urlSearchString, 'SearchField', 'serverurl')
servers = layers.servers
```

The following updates have been made to the WMS Database since the last release:

- 7,708 new WMS servers from Unidata's Thematic Realtime Environmental Distributed Data Services (THREDDS) project. These servers are provided through several different institutions. Search for the layers and servers using the `urlSearchString`: `'thredds'`.
- 7 new WMS servers from various institutions that provide layers focused on Japan:

  ```
  http://cernunosat05.cern.ch/ArcGIS/services/Japan/...
     Japan_earthquake_Tsunami_area/MapServer/WMSServer?
  http://cernunosat05.cern.ch/arcgis/services/Japan/...
     SendaiMosaic/ImageServer/WMSServer?
  http://hazardmap.service-section.com/cgi-bin/...
     mapserv?map=/map/UserRaster/alav2a_0312_1.map
  http://hyperquad.telascience.org/cgi-bin/jp_earthquake?
  http://openls.geog.uni-heidelberg.de/geoserver/wms?
  http://ows.geogrid.org/JapanBaseMap?
  http://www.geographynetwork.ne.jp/ogc/wms?
  ```

- 21 new servers from the European Space Agency's ERDAS Apollo servers. To search for them, use the `urlSearchString`: `'erdas.esrin'`.

Two of the servers from the European Space Agency (ESA) are no longer available:

```
http://mapdev.eo.esa.int/mapServer/mapServer
http://mapdev.esrin.esa.int/mapServer/mapServer
```

You can find many of the layers from these servers on the new ERDAS Apollo servers. These changes have resulted in slight modifications to the documentation examples for the `WebMapServer.getMap` and `WebMapServer.updateLayers` methods since the global MODIS layer has moved.

Some notable servers that have been removed are:

```
http://ims.cr.usgs.gov/wmsconnector/...
   com.esri.wms.Esrimap/USGS_EDC_Ortho_StateLocal?
http://ims.cr.usgs.gov/wmsconnector/...
   com.esri.wms.Esrimap/USGS_EDC_Ortho_Urban?
http://nhdgeo.usgs.gov/wmsconnector/...
   com.esri.wms.Esrimap/nhdgeowms?
http://nmcatalog.er.usgs.gov/catalogwms/base
http://nmcatalog.usgs.gov/catalogwms/base
http://columbo.nrlssc.navy.mil/ogcwms/servlet/...
   WMSServlet/OpenGIS_Web_Mapping_Services_(WMS).wms?
```

Changes to Error and Warning Identifiers

In R2011b, some error and warning message identifiers in Mapping Toolbox have changed.

Version History

If you have scripts or functions that use specific identifiers, you must update the code to use the new identifiers. Typically identifiers are used to turn off specific warnings, or in code that uses a `try/catch` statement and performs an action based on a specific error identifier.

For example, the `map:eastof:obsolete` identifier has changed to `map:removing:eastof`. If your code checks for `map:eastof:obsolete`, you must update it to check for `map:removing:eastof` instead.

To determine the identifier for a warning, run the following command just after you see the warning:

```
[msg,msgid] = lastwarn;
```

This command saves the message identifier to the variable `msgid`.

To determine the identifier for an error, run the following commands just after you see the error:

```
exception = MException.last;
msgid = exception.identifier;
```

For a mapping of the new warning identifiers to the original identifiers, see the solution Why is my code that includes Mapping Toolbox message identifiers not working?

New Location for Sample Data

The Mapping Toolbox sample data sets, such as `coast.mat` and `boston.tif`, moved from `toolbox/map/mapdemos` to `toolbox/map/mapdata`. All these data sets are still on the MATLAB path, but it's helpful to know their specific location if you want to peruse them (or their attributions),

or use them to try out the Map Viewer. Also note that the sample SDTS DEM data has moved into its own subfolder, `sdts`, within the `mapdata` folder.

almanac Function Now Returns More Precise Eccentricity Value

When used with parameter `'airy'`, the `almanac` function now returns an eccentricity value derived from a full-precision value of inverse flattening.

Version History

In previous releases, the inverse flattening value used to calculate eccentricity was truncated and therefore less precise.

Note When `'airy'` is used, almanac returns an ellipsoid vector for the Airy 1830 reference ellipsoid. This has always been the case and has not changed in R2011b, but through R2011a the documentation incorrectly indicated that `'airy'` was the designation for the Airy 1849 reference ellipsoid. In R2011b this documentation error has been corrected. There is no Airy 1849 option in almanac, but if you need to you can construct an ellipsoid vector for the 1849 ellipsoid as follows:

```
[6377.340189   flat2ecc(1/299.3249646)]
```

In this case, the semi-major axis length is given in kilometers, which is consistent with the length unit default of almanac.

R2011a

Version: 3.3

New Features

Version History

Spatial Referencing Improvements

Raster Referencing Classes

The new `spatialref.GeoRasterReference` and `spatialref.MapRasterReference` classes relate georeferenced images or data to geographic or planar coordinates. Most Mapping Toolbox functions that work with referencing vectors and matrices now work with referencing objects, as well. Unlike the older referencing matrix and vector representations, a referencing object is self-documenting, providing a rich set of properties to describe both the intrinsic and extrinsic geometry.

These functions now work with `GeoRasterReference` objects:

`areamat`	`contour3m`	`contourfm`	`contourm`
`filterm`	`findm`	`geoshow`	`geotiffinfo`
`geotiffread`	`gradientm`	`grid2image`	`imbedm`
`latlon2pix`	`limitm`	`los2`	`ltln2val`
`mapprofile`	`maptrims`	`meshgrat`	`meshlsrm`
`meshm`	`neworig`	`pix2latlon`	`resizem`
`setltln`	`setpostn`	`usamap`	`vec2mtx`
`viewshed`	`worldfileread`	`worldfilewrite`	`worldmap`

These functions now work with `MapRasterReference` objects:

`geotiffinfo`	`geotiffread`	`map2pix`	`mapbbox`
`mapoutline`	`mapshow`	`mapview`	`pix2map`
`pixcenters`	`worldfileread`	`worldfilewrite`	

Use the new `georasterref` and `maprasterref` functions to construct `GeoRasterReference` and `MapRasterReference` objects.

Version History

Use the new referencing classes instead of referencing matrices and referencing vectors. To convert referencing matrices or referencing vectors to the `GeoRasterReference` class, use the conversion functions `refvecToGeoRasterReference` and `refmatToGeoRasterReference` as shown:

```
R = refvecToGeoRasterReference(refvec, rasterSize)
R = refmatToGeoRasterReference(refmat, rasterSize)
```

To convert a referencing matrix to the `MapRasterReference` class, use the conversion function `refmatToMapRasterReference` as shown:

```
R = refmatToMapRasterReference(refmat, rasterSize)
```

New geotiffwrite Function to Write GeoTIFF Files

The `geotiffwrite` function exports georeferenced images or data. Now, in addition to reading georeferenced images with `geotiffread`, you can also write them, with `geotiffwrite`.

WMS Database Modified

The WMS Database changes on a release-to-release basis, as some new servers are added and some unavailable servers are removed. A total of 666 servers (26.8% of the number of servers listed in R2010b) and 234,156 layers have been removed from the database. A total of 190 new servers, with 16,395 layers, have been added. The new database contains a total of 2,023 servers and 83,087 layers. Since the number of layers stored in the database is significantly reduced from earlier versions, the access time is quicker.

If you want to find one of the new servers, use `wmsfind` to search for the URL:

```
wmsfind(URL, 'SearchField', 'serverurl')
```

The following updates have been made to the WMS Database since the last release:

- 57 new WMS servers from NOAA's Environmental Research Division Data Access Program (ERDDAP):

  `http://coastwatch.pfeg.noaa.gov/erddap/wms`

  These servers provide oceanographic data. To find out more about them, visit the ERDDAP web site.
- Two new WMS servers from the U.S. Geological Survey Coastal and Marine Program ncWMS program:

  `http://coast-enviro.er.usgs.gov/ncWMS/wms)`
- A new Mars Space Flight Facility MapServer:

  `http://ms.mars.asu.edu/TES_TI_Putzig?`
- Two new servers from the Bureau of Land Management in partnership with the U.S. Forest Service:

  `http://www.geocommunicator.gov`
- A new Metacarta WMS server providing images from VMP0 tiles:

  `http://vmap0.tiles.osgeo.org/wms/vmap0`
- A new server from the NASA Goddard Space Flight Institute providing data for the Tropical Rainfall Measuring Mission (TRMM):

  `http://gdata2.sci.gsfc.nasa.gov/daac-bin/wms_trmm?`
- This version of the database is significantly reduced from earlier versions primarily due to the reduction of servers (servlets) hosted by the NRL GIDB Portal server:

  `http://columbo.nrlssc.navy.mil`

  In R2010b, 425 servers with 228,227 layers were listed in the database. At the time of qualification, the portal server is hosting data from only 51 servers, with a total of 10,715 layers.
- The JPL Global Imagery Service server:

  `http://onearth.jpl.nasa.gov/wms.cgi?`

  is no longer providing full WMS services for any of the datasets. Any server (e.g., `http://webapps.datafed.net/OnEarth_JPL.ogc?`) that cascades data from this server is also affected by the change. The server is still included in the database. Examples in the help and reference pages that referred to this server have been updated to use a different server.

A small subset of the data can be accessed using a non-standard `TiledWMS` request. The available tiled patterns can be found at:

```
http://pat.jpl.nasa.gov/wms.cgi?request=GetTileService
```

The WMS parameters must be in the exact order. If you wish to obtain a tile, you can use the prefix:

```
 'http://onearth.jpl.nasa.gov/wms.cgi?/SERVICE=WMS&'
```

in front of the request (found in the CDATA section of the `GetTileService` request). For example:

```
url = ['http://onearth.jpl.nasa.gov/wms.cgi?/SERVICE=WMS&' ...
   'request=GetMap&layers=global_mosaic&srs=EPSG:4326&'  ...
   'format=image/jpeg&styles=visual&width=512&height=512&' ...
   'bbox=-180,58,-148,90'];
[A, R] = wmsread(url);
```

Enhancements to geotiffinfo, geotiffread, and worldfileread

The `geotiffinfo`, `geotiffread`, and `worldfileread` functions now have additional syntax options. Also, the `geotiffinfo` function now returns information about GeoTIFF tags.

Improved Performance for gtopo30

Enhanced performance for reading GTOPO30 tiles using the `gtopo30` function.

Improved Performance for gshhs

Enhanced performance for reading GSHHS data sets using the `gshhs` function. The `gshhs` function has been qualified on GSHHS releases 1.1 through 2.1 (version 8). Also, it can now read even newer versions, if they adhere to the same header format as releases 2.0 and 2.1.

The improved `gshhs` can now read the files below:

```
wdb_borders_x.b
wdb_rivers_x.b
```

where `x` is one of the letters `c`, `l`, `i`, `h`, and `f`, corresponding to increasing resolution.

Second Input Argument of roundn No Longer Optional

The second input argument to `roundn`, a real, integer-valued exponent `n`, is no longer optional.

Version History

If you omitted `n` in previous releases, a warning was issued and a default value of −2 was used. Now, if you omit `n`, you will receive an error. Change any code that calls `roundn` with one input argument like this: `roundn(x)` to this: `roundn(x,-2)`.

Comet Menu Item Removed from maptool

The **Comet** menu item is no longer available in `maptool`. You can still call `cometm` directly from the command line.

R2010b

Version: 3.2

New Features

Version History

MATLAB Plot Selector Now Includes mapshow and geoshow

The Plot Selector workspace tool creates graphs of workspace variables. The `mapshow` and `geoshow` functions have been added to the list of possible plotting functions available in the Plot Selector. For more information about the Plot Selector, see Enhanced Plot Selector Simplifies Data Display.

Support for Retrieving Web Map Service Data in Image/BIL Format

Some servers render layers in the `'image/bil'` format as a single band with a class type of `int16` or `int32`. You can now use the `wmsread` function to retrieve this data.

Expanded Data Type Support for mapshow and geoshow

The `mapshow` and `geoshow` functions now have expanded class support for raster data display.

WMS Database Modified

The WMS Database changes on a release-to-release basis, as some new servers are added and some unavailable servers are removed. A total of 244 servers (10.4% of the number of servers listed in R2010a) and 111,514 layers have been removed from the database. A total of 380 new servers, with 65,834 layers, have been added. The new database contains a total of 2,502 servers and 300,848 layers. Some notable new servers in the database are:

- 242 new WMS servers from NOAA's Environmental Research Division Data Access Program (ERDDAP) (`http://coastwatch.pfeg.noaa.gov/erddap/wms`). These servers provide oceanographic data, and additional information about them may be found at `http://coastwatch.pfeg.noaa.gov/erddap/info/index.html`.
- A server from the European Space Agency, removed in R2010a but now back in the Database (`http://ssems1.esrin.esa.int/mapServer/mapServer?`).
- 115 new servers from the DataFed Web Map Server (`http://webapps.datafed.net`).
- Two new servers from NASA WorldWind WMS (`http://www.nasa.network.com/elev?` and `http://www.nasa.network.com/wms?`). The `'elev'` server provides data in the `'image/bil'` format.
- Two new servers from the USGS dedicated to emergency operations. These servers provide imagery of the 2010 oil spill in the Gulf of Mexico:

  ```
  http://hdds.usgs.gov/arcgis/services/...
     201004_OilSpill_GulfOfMexico/MapServer/...
     WMSServer
  ```

  and the 2010 earthquake in Haiti:

  ```
  http://hdds.usgs.gov/ArcGIS/services/...
     201001_Earthquake_Haiti/MapServer/...
     WMSServer?
  ```

KML Schema Updated to Version 2.2

The KML schema has been updated to Version 2.2.

Population Density Data Added to usastatelo.shp

The `usastatelo` shapefile now contains average population density data by state for the year 2000 from the U.S. Census Bureau Web site.

Elements in korea.mat File Rounded

In the `korea.mat` file, the numbers in the referencing vector (the `refvec`) were very nearly integer valued. Elements of these variables have been rounded slightly to become exact integers, as follows:

```
[12 45 115]
```

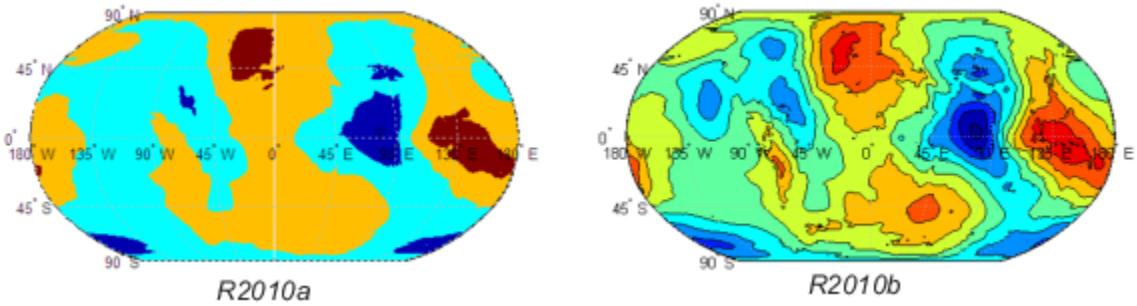
Version History

If you use the new version of the `korea.mat` file, your results will be slightly different than those obtained with the older version of the file.

Changes in Behavior for Contouring Functions

Due to a recent bug fix, the contouring functions now exhibit many improvements. The bug fix in question, Bug 192285, addressed problems with contours displayed by `contourm`, `contour3m`, and `contourfm`. The following figure illustrates filled contours produced by the `contourfm` function in R2010b, as compared to R2010a and earlier releases.

```
figure('Color','white');
worldmap world;
load geoid;
contourfm(geoid, geoidrefvec)
```



Version History

If you call any of the contouring functions, expect the behavior changes described in the following table.

Summary	New Behavior	Compatibility Considerations
Handles	Each of the three contouring functions now returns a handle to an `hggroup` object as its second output.	In previous releases, `contourm` returned a handle to a MATLAB contourgroup object as its second output, while `contourfm` and `contour3m` each returned an array of patch handles.
Contour lines and levels	The contouring functions now produce one line per contour level. The hggroup returned by `contourm` has exactly one line child per contour level.	The contouring functions now construct an equivalent (or better) display using fewer graphics objects than in previous releases.
Default contour levels	In `contourfm` and `contour3m`, the default contour levels are now consistent with `contourm`, as well as the MATLAB `contour` and `contourf` functions.	The default contour levels have changed from those in previous releases.
Non-positive contour levels	If you supply 0 or a negative number for `V` in the syntaxes `contourm(Z,R,V)` or `contourm(lat,lon,Z,V)`, `contourm` creates a plot with a single contour at that level.	In previous releases, if you supplied 0 or a negative number for `V`, the `contourm` function drew no contour lines, returned an empty contour matrix, and constructed a contourgroup with no children.
Parameter settings	The parameter settings for `contourm` and `contourfm` are both more selective and more fully documented. You can set only the parameters described in the `contourm` reference page.	In previous releases, you could set any valid contourgroup property (possibly with unexpected results).
Contour level tag	In R2010b, each contour line has its `Tag` property set to a character vector representation of its contour level, preceded by `'contour line:'`. These tags display in the lower left of the axes when you click on a contour line.	In previous releases, the tags contained only the contour level character vectors.
Filled area tag	In R2010b, each fill polygon (patch) has its `Tag` property set to a character vector beginning with `'contour interval:'` and followed by its minimum and maximum levels (as character vectors) in square brackets. These tags display in the lower left of the axes when you click within a fill polygon.	In previous releases, the tags in patches created by `contourfm` contained the character vector `'Cpatches'` and did not display when you clicked.

Summary	New Behavior	Compatibility Considerations
`AppData` and `UserData`	Each contour line object now has a contour `Level` field in its `AppData` property, and the patches representing fill polygons have `'MinLevel'` and `'MaxLevel'` `AppData` fields. `contourm` and related functions no longer set the `UserData` property of any graphics object.	Previously, `UserData` was set to the contour level value for each line and to a minimum contour level value for each patch. If you have an application or GUI that checks `UserData` values for individual lines or patches, work with the `getappdata` function instead.
Contours separating filled areas	By default, the `contourfm` function now draws black contour lines to separate filled areas of different colors.	In previous releases, the function did not draw lines by default. To suppress the lines, specify `'LineColor','none'`.
Border of data	When `'LineColor'` is set to a value other than `'none'`, the `contourfm` function no longer draws lines around the boundary of the data. The data boundary is not a contour, so it is not treated as such. The only lines drawn are true contours.	In previous releases, the function drew lines around the boundary of the data, in addition to the contour lines themselves.
Line colors	If you set `'LineColor'` for `contourm` or `contour3m` to `'auto'` or `'flat'`, the line colors come from the figure's colormap, as always. But, as of R2010b, if you change the figure's colormap after creating the contours, the line colors do not change.	In previous releases, if you changed the figure's colormap after creating the contours, the line colors changed. To change the line colors, use `contourcmap`.
Fill colors	When you call `contourfm`, the fill colors are derived from the figure's colormap, as in previous releases. As of R2010b, if you change the figure's colormap after calling `contourfm`, the fill colors are not affected.	To change the fill colors after plotting the filled contours, call `contourcmap`.
Globe map display	You can now use the `globe` map display with the contouring functions. The `contour3m` function warns, but if you are careful to scale your input data correctly relative to the radius of your reference sphere, you can still use it.	In previous releases, you could not use the `globe` map display with the contouring functions.

Now that `contourfm` produces correct results more consistently, it also takes somewhat longer to run.

clabelm No Longer Breaks Contour Lines

In previous releases, the `clabelm` function broke contour lines to display the contour level tag. The breaks failed to scale appropriately during zooming or when the figure size changed. Now, instead of breaking the contour line, the `clabelm` function sets the color of the background where the tag is inserted to the color of the ancestor axes or line.

Version History

If you want to display the contour labels without a background color, as in previous releases, use `set` to specify `'BackgroundColor','none'` on the text object handle array returned by `clabelm`.

Changes in geoshow Behavior with 'DisplayType', 'contour'

Many aspects of the fix to Bug 192285 apply to `geoshow` contouring options as well as to `contourm`. When applied to a data grid with the `DisplayType` parameter set to `'contour'`, `geoshow` now contours the grid in the same way that `contourm` would, constructs a handle to the same sort of hggroup, and accepts the same set of optional parameters (as documented on the `contourm` reference page).

Version History

When used with `'DisplayType','contour'` in previous releases, `geoshow` constructed a MATLAB contourgroup and returned its handle. In previous releases, you could set any contourgroup property via `geoshow` (possibly with unexpected results); you can now set only the parameters described in the `contourm` reference page—a useful, relevant, and validated subset.

Changes in geoshow Behavior with 'DisplayType', 'surface'

When applied to a data grid with the `'DisplayType'` parameter set to `'surface'`, `geoshow` now sets the `'FaceColor'` property to `'interp'`, unless the `'CData'` property is also passed into the function. In that case, the `'FaceColor'` is set to `'texturemap'`.

Version History

When used with `'DisplayType'`, `'surface'`, in previous releases, `geoshow` set the `'FaceColor'` property to `'texturemap'`.

Changes in Behavior for the handlem Function

Changes in Finding Filled Contour Handles

The `'Cpatches'` option has been removed in R2010b and replaced by `'fillcontour'`.

Version History

In earlier versions of MATLAB, you could do the following:

```
load geoid
worldmap world
contourfm(geoid, geoidrefvec, 10)
h = handlem('Cpatches');
```

(The output `h` is an array of patch object handles.)

In R2010b, to achieve a comparable result, you can use either:

```
h = handlem('fillcontour');
```

or

```
h = handlem('contour');
```

(The output `h` is a handle to an hggroup.)

In cases where hggroups with both filled and unfilled contours exist, use the `'fillcontour'` syntax to return only handles to the hggroups with filled contours. If you use the `handlem('contour')` syntax, you will return handles to all hggroups containing contours generated by Mapping Toolbox functions.

Changes in Finding 3-D Contour Handles

The `'contour3d'` syntax has been removed in R2010b and replaced by `'contour'`.

Version History

In earlier versions of MATLAB, you could do the following:

```
load geoid
worldmap world
contour3m(geoid, geoidrefvec, 10)
h = handlem('contour3d');
```

(The output `h` is an array of patch object handles.)

In R2010b, to achieve a comparable result, you can use:

```
h = handlem('contour');
```

(The output `h` is a handle to an hggroup.)

Changes in Finding Contour Label Handles

The documentation in R2010a noted `'clabels'` as the character vector to use in finding contour labels. This is incorrect and should be `'clabel'`. The documentation has been changed to `'clabel'` in R2010b.

Syntax Changes for contourcmap

In previous releases, the `contourcmap` function had the following syntax:

```
contourcmap(cdelta,cmapstr)
```

Now, `contourcmap` accepts the colormap character vector by itself:

```
contourcmap(cmapstr)
```

Or the colormap character vector with `cdelta`:

```
contourcmap(cmapstr,cdelta)
```

Notice that the position of the two input arguments has changed. The `cdelta` argument now appears after the colormap character vector.

In addition to this change in syntax, the `contourcmap` function exhibits some changes in behavior:

- When the axes contains Mapping Toolbox contour objects, `cdelta` is ignored and the resultant colormap contains the same number of colors as the original colormap. The `ColorAlignment` is set to `'center'` for contour lines and `'ends'` for filled contours and cannot be modified.
- After you have created a `contourcmap`, if you change the figure's colormap, the colorbar will change colors. The contour lines and the fill will not change colors. To work around this problem, do not set the figure colormap directly; set `contourcmap`.
- You can now set the `'Colorbar'` parameter to `'off'` to remove it from your map.

Version History

The original syntax, with the colormap character vector and `cdelta` in the reverse order, still works. In a future release, this undocumented syntax will be removed.

Change in Behavior for bufferm

If you specify `'out'` for the `direction` argument when calling the `bufferm` function, the returned buffer zone will include all points outside the polygon within a specified distance of its edge. In previous releases, the returned buffer zone also included the points within the polygon.

Version History

If you have code that specifies `'out'` for the `direction` argument, you now receive only the region outside the polygon but not the polygon itself. If you want to receive the union of the polygon and the buffer zone, as you did in previous releases, use the `polybool` function.

maptrims No Longer Trims Edge Rows and Columns

In previous releases, you could call `maptrims` with an input value for `latlim` or `lonlim` that corresponded to a parallel or meridian that ran precisely along a cell boundary. However, when you did so, the cells adjacent to that boundary would be trimmed off even if they fell completely within the requested limits. Now, if `latlim` or `lonlim` corresponds to a cell boundary, the output grid extends all the way to that limit. If a limiting parallel or meridian cuts through a column or row of input cells, the limit is truncated to avoid partial cells.

Change in Longitude Limits for WMSMapRequest and WMSLayer

The `WMSMapRequest` and `WMSLayer` objects now accept longitude limits from `[0 360]` or from `[-180 180]`. In previous releases, longitude limits had to be from `[-180 180]`.

polyxpoly Now Issues Warning when 'unique' Option Combined with Segment Indices

If you attempt to use the following syntax:

```
[xi,yi,ii] = polyxpoly(x1,y1,x2,y2,'unique')
```

`polyxpoly` issues a warning and ignores the `'unique'` flag.

R2010a

WMS Database Modified

The WMS Database changes on a release-to-release basis, as some new servers are added and some unavailable servers are removed. A total of 199 servers (10.2% of the original number of servers) and 66,270 layers have been removed from the database. A total of 602 servers, with 207,269 layers, have been added.

Some notable new servers in the database are:

- The OnMars (`http://onmars.jpl.nasa.gov/wms.cgi`) and OnMoon (`http://onmoon.jpl.nasa.gov/wms.cgi`) servers from the Jet Propulsion Laboratory
- The MassGIS server (`http://giswebservices.massgis.state.ma.us/geoserver/wms`) from the Massachusetts Office of Geographic and Environmental Information
- The National Map Seamless servers (`http://ims.cr.usgs.gov`, `http://imsortho.cr.usgs.gov`, and `http://imselev.cr.usgs.gov`) from the U.S. Geological Survey

Version History

Some servers are no longer accessible and have been removed from the database. If you have code based on these servers, it will no longer run. To fix this problem, search the WMS Database for another comparable server.

Some examples from the R2009b documentation have been modified due to server inaccessibility. Some notable servers that have been removed are:

- Several of the servers from CubeWerx® (`http://demo.cubewerx.com/dem/cubeserver/cubeserv.cgi`)
- Two of the servers from the European Space Agency (ESA) (`http://mapdev.eo.esa.int/mapServer/mapServer` and `http://mapdev.esrin.esa.int/mapServer/mapServer`)

The etopo Function Now Supports the ETOPO1 and ETOPO2v2 Data Sets

Before R2010a, the `etopo` function supported ETOPO2–2001 (2-minute) and ETOPO5 (5-minute) data. Support has been added for ETOPO2v2c (2-minute) and ETOPO1c (1-minute) data. The ETOPO1 model, released in March 2009, is the most recent and contains the highest resolution data. For information on downloading the ETOPO data sets, see Technical Note 2101: Accessing Geospatial Data on the Internet for the Mapping Toolbox on the Mathworks Web site.

Version History

The `etopo` function still works with ETOPO2 and ETOPO5 data.

Now Possible to Retrieve Legend for WMS Map

The `Details` property of the `WMSLayer` class contains a `Style` field. A `LegendURL` structure has been added to this field. The information in the `LegendURL` structure, if provided by the server, enables you to retrieve a legend image for a specific WMS map.

Clipping Property Default Now Set to 'off'

Clipping is now `'off'` by default for both map frames and graticule ("grid") lines. This is advantageous in certain display situations, but it also means that the frame and graticule may extend outside the axes limits (unlike the data plotted on the map), if you zoom in on a figure containing a map. You can use `set` to turn clipping back on, like this, for example:

```
set(handlem('frame'),'Clipping','on')
set(handlem('grid'),'Clipping','on')
```

Version History

In releases before R2010a, the default for the Clipping property was `'on'`.

The shaperead and shapewrite Functions Now Support Non-ASCII Characters

You can now use the `shaperead` and `shapewrite` functions to import and export attributes with non-ASCII characters. To use this feature, you must set your character encoding scheme to match that used by the shapefile. For example, if your session is configured to support `US_ASCII` character encoding and you want to import a shapefile with Japanese characters, you must first change your configuration to support `Shift_JIS`.

Display Range Increased for eqdazim and eqaazim Projections

In previous releases, the Equidistant Azimuthal (`eqdazim`) and Lambert Azimuthal Equal-Area (`eqaazim`) projections did not allow projection or display of data points farther than 160 degrees from the projection origin. Now you can set the projection radius for either of these projections to up to 179.5 degrees.

Use the `FLatLimit` property to control this setting. For example, to choose the largest possible value, pass the following property name-value pair to `axesm` or `setm`:

```
'FLatLimit',[-Inf 179.5]
```

Version History

The default value of the projection radius remains 160 degrees, so you do not need to update any code that relies on the default value.

Before R2010a, you could use the following line of code to initialize the equatorial aspect of an azimuthal projection:

```
axesm(projectionName,'MapLonLimit',westernAndEasternLimits)
```

Now, if you enter this line of code with `eqdazim` or `eqaazim` in place of *`projectionName`*, you will receive a warning message, and your `'MapLonLimit'` input will be ignored. To use the `'MapLonLimit'` property to initialize the equatorial aspect of an azimuthal projection, you should enter the following:

```
axesm(projectionName,'FLatLimit',[], ...
   'MapLonLimit',westernAndEasternLimits)
```

See Example 7: Equatorial Azimuthal Projection in the Axes for Drawing Maps section in the User's Guide for an illustration of this usage.

The GUIs mlayers and mobjects No Longer Support EraseMode

The `EraseMode` property, represented by the **Emode** button, has been removed from the `mlayers` and `mobjects` GUIs.

Version History

Before R2010a, the `mlayers` and `mobjects` GUIs had an `EraseMode` option, which made it possible to set the erase mode on a particular map layer or object. This property controlled the technique MATLAB used to draw and erase hggroup child objects.

scatterm Now Returns a Handle to an hggroup Object

The function `scatterm` in the syntax

```
h = scatterm(...)
```

now returns a handle to an hggroup.

Version History

In previous releases, `scatterm` returned a vector of `patch` handles.

mdistort Now Returns a Handle to a contourgroup Object

The output of the syntax

```
h = mdistort(...)
```

is now a scalar handle to a contourgroup object containing the contours and text.

Version History

In previous releases, `mdistort` returned handles to the line and text objects and used the syntax

```
[h,ht] = mdistort(...)
```

with two output arguments. The second output of `mdistort` is now redundant because these handles will be available as children of `h`.

polybool No Longer Errors when Given Empty Input Vertex Arrays

When one or both pairs of input vertex arrays is empty, the `polybool` function now returns either empty values or the values of the non-empty input pair, depending on the requested operation.

For example, consider the following case:

```
[x,y] = polybool('union', [0 0 1 1], [0 1 1 0], [], [])
```

The `polybool` function returns the first input pair: `[0 0 1 1], [0 1 1 0]`. Now consider the `'intersection'` operation:

```
[x,y] = polybool('intersection', [0 0 1 1], [0 1 1 0], [], [])
```

The `polybool` function returns `[], []`.

Version History

In previous releases, if one or both pairs of input vertex arrays were empty, the `polybool` function would issue an error.

Functions Being Removed

Function Name	What Happens When You Use the Function?	Use This Instead	Compatibility Considerations
`etopo5`	Errors	`etopo`	Replace all existing instances of `etopo5` with `etopo`.

R2009b

Version: 3.0

New Features

Version History

New Features for Creating Web Map Service Maps

New functions and classes now make it possible to interact with Web Map Service (WMS) servers and render WMS maps. Use the new features to search a built-in database of pre-qualified WMS servers and layers. Retrieve customized geographic data sets and related metadata from WMS servers. The new classes encapsulate WMS servers, data layers, metadata, and map requests. See the Creating Web Map Service Maps chapter in the User's Guide and related Class Reference for more information.

New makerefmat Syntax for Constructing Referencing Matrices

A new parameter name-value pair syntax makes it easier to construct referencing matrices with `makerefmat`. You can use the new syntax for an image or raster grid that is referenced to and aligned with a geographic coordinate system but not for one that is referenced to a 2-D map coordinate system. Use parameters to set the number of rows (M) and columns (N) of the raster or image to be used with the referencing matrix; the latitude and longitude limits of the geographic quadrangle bounding the georeferenced raster; and the edges from which row and column indexing start, designating, for example, columns that run either south-to-north or north-to-south.

Some Functions Now Accept Referencing Matrices as Input

The functions below now accept referencing matrices as input, and some of them (`maptrims`, `resizem`, and `vec2mtx`) also generate referencing matrices as output. The functions that generate referencing matrices as output do so only in cases where referencing matrices are used as input. If referencing vectors are used as input, referencing vectors are also generated as output. Note that the functions in this table work exclusively with data grids or images that are referenced to geographic (latitude or longitude) coordinates.

`areamat`	`imbedm`	`maptrims`	`setltln`	`usamap`
`filterm`	`limitm`	`meshgrat`	`setpostn`	`worldmap`
`findm`	`los2`	`meshlsrm`	`resizem`	
`getseeds`	`ltln2val`	`meshm`	`vec2mtx`	
`gradientm`	`mapprofile`	`neworig`	`viewshed`	

Expanded Support for GSHHS Global Coastline Data

The `gshhs` function now supports Versions 1.4 and later of the Global Self-Consistent, Hierarchical, High-Resolution Shoreline Database (GSHHS).

New Behavior for polymerge when Three or More Line Segments Have Common End Point

The behavior of the `polymerge` function has changed in cases of three or more distinct parts with a common end point. In such cases, the choice of which parts to merge is ambiguous; therefore, none of the corresponding parts are connected at that common point.

Version History

In previous releases, if three or more parts shared a common end point, the `polymerge` function attempted to merge them. The result, however, was unspecified and sometimes obviously wrong.

Automatic Conversion of Latitude Limits to Ascending Order

The functions `axesm` and `setm` require that the latitude limits in the `'MapLatLimit'` property be provided in ascending order. If you enter the limits in descending order, these functions will now automatically convert the limits to ascending order, and return a warning message notifying you of this change.

Version History

In previous releases, if you entered the latitude limits of the `'MapLatLimit'` property in descending order when using `axesm` or `setm`, you could end up with a map axes that was internally inconsistent, possibly resulting in unexpected errors during subsequent operations. This is no longer the case.

Second Input Argument of roundn No Longer Supports Complex Numbers, Non-integers, or Default Values

`roundn` no longer accepts certain types of input for the second input argument, `N`, which is supposed to be a real, integer-valued exponent. Now, if you use a complex number or non-integer as the second input to `roundn`, you will receive an error; and if you omit `N`, you will receive a warning. You will also receive an error if you call `roundn` with a second output argument to capture error messages.

Version History

In previous releases, if you used a complex number or non-integer as the second input to `roundn`, this number would be converted into a real integer. If you called `roundn` with a second output argument to capture error messages, you would receive an obsolete syntax warning.

In R2009b, `-2` is still the default value for the second input argument. This default is being phased out, however, and in the future you will receive an error if you fail to supply the second input argument. If there are any instances in your code with the usage `roundn(x)`, you should replace them with `roundn(x,-2)`.

The two-output syntax option was previously deprecated and has resulted in a warning in the past several releases.

Functions Removed

Functions Being Removed in a Future Release

Name	Stage	Compatibility Considerations
`colorui`	Still runs	Replace all existing instances of `colorui` with `uisetcolor`.

`eastof`	Warns	If you are using degrees, replace
		`eastof(lon, meridian, 'degrees')`
		with
		`meridian + mod(lon - meridian, 360)`
		and if you are using radians, replace
		`eastof(lon, meridian, 'radians')`
		with
		`meridian + mod(lon - meridian, 2*pi)`

`imagem`	Errors	Replace all existing instances of `imagem` with `grid2image`.
`smoothlong`	Warns	Use `unwrapMultipart` instead. This function requires its input to be in radians. When working in degrees, use `rad2deg(unwrapMultipart(deg2rad(lon)))`
`tgrline`	Still runs	More recent Tiger/Line® data sets are available in shapefile format and can be imported using `shaperead`.
`unitstr`	Warns	The syntax `str = unitstr(str,'times')` has already been removed.

`westof`	Warns	If you are using degrees, replace
		`westof(lon, meridian, 'degrees')`
		with
		`meridian - mod(meridian - lon, 360)`
		and if you are using radians, replace
		`westof(lon, meridian, 'radians')`
		with
		`meridian - mod(meridian - lon, 2*pi)`

Functions Removed in R2009b

deg2dm	hms2hm	hr2sec	sec2hms	cmapui
deg2dms	hms2hr	mat2dms	sec2hr	tigermif
dms2deg	hms2mat	mat2hms	time2str	tigerp
dms2dm	hms2sec	rad2dm	timedim	
dms2mat	hr2hm	rad2dms	contorm	
dms2rad	hr2hms	sec2hm	contor3m	

The functions above have been completely removed from the toolbox and error if used.

R2009a

Version: 2.7.2

New Features

Version History

geoshow and mapshow Now Construct Ordinary Patch Objects

When displaying polygons, instead of constructing graphics objects whose classes derive from patch, `geoshow` and `mapshow` now construct ordinary patch objects.

Version History

This change has no effect on the display, but it does have some effect on your ability to load and save figures. If you have a figure containing a polygon displayed by `geoshow` or `mapshow` that was saved in R2008b or earlier, you will not be able to load it in R2009a.

You may also notice the change if you call `get` on a handle. The older (derived) class included several extra properties used only for internal bookkeeping. In R2009a, these properties have been removed, and the output of `get` looks different in terms of both layout and property order. (It now looks the same as for any ordinary patch.)

R2008b

Version: 2.7.1

New Features

Version History

Using the Map Axes Map Limit Properties with axesm, setm, and defaultm

Changes and enhancements have been made to `axesm`, `setm`, and `defaultm` with respect to map axes properties that affect the fundamental display geometry:

- `MapProjection`
- `Zone`
- `Origin`
- `FLatLimit`
- `FLonLimit`
- `MapLatLimit`
- `MapLonLimit`

The changes result in the following improvements:

- The use of the map limit properties to set up a map axes is more intuitive.
- The way in which `defaultm` resolves possible inconsistencies between these properties is now consistent with the behavior of `axesm` and `setm`.
- The map limit properties (`MapLatLimit` and `MapLonLimit`), the frame limit properties (`FLatLimit` and `FLonLimit`), and the `Origin`, `MapProjection`, and `Zone` properties interact in a more clear and predictable fashion.

For more information, see the section Using the Map Limit Properties in the *Mapping Toolbox User's Guide* and bug report 319891 on the MathWorks Web site.

Changing Projection Type of an Existing Map Axes with setm

In previous releases, calling the `setm` function to change the `MapProjection` property of a map axes, especially when switching between an azimuthal and non-azimuthal projection (e.g., a conic or cylindrical projection), often resulted in the following types of problems:

- The modified map axes might cover a different part of the Earth.
- The map frame and graticule might fail to update properly.
- Map limit properties changed at the same time as the projection might not have the proper effect.

The `setm` function now more effectively resets the projection, clearing out settings that were specific to the earlier projection, updating the map frame and graticule, and staying in the same general part of the world (even when switching between azimuthal and non-azimuthal projections).

Version History

You may need to change the way in which you reset various map axes properties, such as `Origin`, `FLatLimit`, and `FLonLimit` after changing projections, as discussed in the section Switching Between Projections. In many cases it will no longer be necessary to reset as many properties.

Other Bug Fixes

Version History

- The default `FLatLimit` for `lambert` and `lambertstd` has been changed to `[-45 45]`. In previous releases, `axesm` produced huge map frames, due to the `FLatLimit` default of `[-90 90]`.
- The function `gridm` now returns handles to the line objects used to display the parallels and meridians. In previous releases, a call to `gridm` using `linespec` or property name/property value syntaxes returned empty.
- The function `geotiff2mstruct` no longer sets the `maplatlimit` and `maplonlimit` fields.
- A reference ellipsoid set to a non-default value (via the `geoid` property) no longer reverts to the default when the UTM zone is reset. For more information, see bug report 459353 on the MathWorks Web site.
- The `daspectm` function now works for azimuthal projections and units of radians.

coast.MAT Data File Revised

Portions of the global coastline latitude-longitude vectors in the `coast.MAT` data file have been revised to ensure proper polygon topology. The data edits comprise the following:

- Replacing or removing various "bow-tie" and degenerate linear (non-polygonal) island features.
- Opening a "pinched" section in the middle of Lake Balkhash in Central Asia.
- Merging the eastern and western sections of Wrangel Island near the Bering Strait (cut by the 180-degree meridian) into a single polygon with longitudes ranging from slightly less than 180 to slightly greater than 180.
- Eight additional edits to pull apart landmasses with points of contact and remove coastal "spikes."

Map Limit Syntaxes Removed

The following syntaxes are obsolete. An error occurs if you use them.

- `pcolorm(Z)`
- `pcolorm(Z,gratsize)`
- `surfacem(Z)`
- `surfacem(Z,gratsize)`
- `surflm(Z)`
- `surflm(Z,s)`
- `surfm(Z)`
- `surfm(Z,gratsize)`

These syntaxes displayed a data grid with geographic limits that matched the map latitude and longitude limits in the current map axes. Using the old syntaxes correctly involved knowing the latitude and longitude limits of your data and matching them to the values listed under `maplatlimit` and `maplonlimit` in the map axes properties. We have replaced these syntaxes with a more direct approach that requires you to enter the latitude and longitude limits for the data grid.

Version History

The table below suggests alternative code to replace the obsolete syntaxes. In the following table, `Z` is a regular data grid (a 2-D array of class `double`) and `gratsize` is a two-element vector specifying the size of the graticule on which `Z` displays:

```
gratsize = [number_of_parallels number_of_meridians]
```

`h` is a handle to the surface that is displayed. And `latlim` and `lonlim` are the geographic limits of the data grid (in degrees):

```
latlim = [southern_limit northern_limit]
```

```
lonlim = [western_limit eastern_limit]
```

Original Syntax	Replacement Syntax

`h = pcolorm(Z)`
 	
constructs a surface using the regular data grid `Z` and a graticule mesh (using `meshgrat`) with size equal to `size(Z)` and with geographic limits that match the map latitude and longitude limits in the current map axes.
	`[lat,lon] = meshgrat(latlim,lonlim,size(Z));`
	
	`h = pcolorm(lat,lon,Z)`

`h = pcolorm(Z,gratsize)`
 	
uses a graticule mesh with size equal to `gratsize`.
	`[lat,lon] = meshgrat(latlim,lonlim,gratsize);`
	
	`h = pcolorm(lat,lon,Z)`

`h = surfacem(Z)` constructs a surface using the regular data grid `Z` and a graticule mesh (using `meshgrat`) of size 50-by-100. The geographic limits match the map latitude and longitude limits in the current map axes.	`h = surfacem(latlim,lonlim,Z)`

`h = surfacem(Z,gratsize)`
 	
uses a graticule mesh with size equal to `gratsize`.
	`[lat,lon] = meshgrat(latlim,lonlim,gratsize);`
	
	`h = surfacem(lat,lon,Z)`

`h = surflm(Z)` constructs a surface using the regular data grid `Z` and a graticule mesh (using `meshgrat`) with size equal to `size(Z)` and with geographic limits that match the map latitude and longitude limits in the current map axes. It is displayed with a default light source.	`h = surflm(latlim,lonlim,Z)`

Original Syntax	Replacement Syntax
`h = surflm(Z,s)` specifies the direction of the light source. `s` is a two- or three-element vector that specifies the direction from the surface map to the light source as defined in the documentation for `surfl`.	`h = surflm(latlim,lonlim,Z,s)`
`h = surfm(Z)` constructs a surface using the regular data grid `Z` and a graticule mesh (using `meshgrat`) with size equal to `size(Z)` and with geographic limits that match the map latitude and longitude limits in the current map axes.	`h = surfm(latlim,lonlim,Z)`

`h = surfm(Z,gratsize)`
 	
uses a graticule mesh with size equal to `gratsize`.
	`[lat,lon] = meshgrat(latlim,lonlim,gratsize);`
	
	`h = surfm(lat,lon,Z)`

R2008a

Version: 2.7

New Features

Version History

Functions for Working with Geographic Quadrangles

A geographic quadrangle is an area on the surface of a sphere or ellipsoid bounded on the east and west by a pair of meridians and on the north and south by a pair of parallels. In many ways, such an object is similar to a bounding rectangle in the plane, but they can be difficult to work with because of the way longitudes wrap around and the way meridians converge at the poles. For example,

- The western longitude limit can have a larger numerical value than the eastern longitude limit.
- If one of the bounding latitudes is +90 or -90 degrees, the quadrangle has three sides rather than four.
- As noted below, the intersection of two geographic quadrangles might possibly comprise two separate parts—with the eastern end of the first quadrangle intersecting the western end of the second quadrangle, and vice versa.

Mapping Toolbox software typically represents a geographic quadrangle in terms of its latitude and longitude limits, stored in 1-by-2 vectors having the forms

```
latlim = [southern_limit northern_limit]
lonlim = [western_limit eastern_limit]
```

Vectors like these have been used in various Mapping Toolbox functions since its inception, and can appear in the input or output argument lists of over dozen functions.

In R2008a, three new functions let you query, intersect, and display geographic quadrangles, and account for subtleties such as those described above:

- `ingeoquad` — Returns `true` for points inside or on latitude-longitude quadrangle
- `intersectgeoquad` — Returns intersection(s) of two latitude-longitude quadrangles
- `outlinegeoquad` — Returns sampled polygon vertices for a latitude-longitude geographic quadrangle

Use `ingeoquad`, for example, to check whether a geographic point is located within the area covered by a regular data grid, given the latitude and longitude limits computed by `limitm`.

Use `intersectgeoquad` to compute overlap, if any, between two quadrangles. Interestingly, three general results are possible: no intersection, an intersection that is itself a geographic quadrangle, and an intersection the comprises two distinct geographic quadrangles. (The intersection can have two parts if the input quadrangles wrap around in longitude to overlap on both their eastern and western sides. This case, of course, is not possible for bounding boxes in the plane.)

Use `outlinegeoquad` to generate a pair of latitude and longitude coordinate vectors that define a polygon that traces the outline of a geographic quadrangle. This can be useful for displaying the quadrangle graphically using `geoshow`, for example, especially on a projection where the meridians and/or parallels do not project to straight lines, because in addition to connecting the four corners `outlinegeoquad` lets you interpolate additional vertices along parallels, meridians, or both.

Fixes and Improvements to Function avhrrgoode

Function `avhrrgoode` has been rewritten to improve its efficiency and to remove a number of problems and limitations:

- Fixed a spatial referencing problem when a nonglobal region has been specified which caused locations to be offset by half a pixel.

- The function no longer returns incorrect NaN coordinate values at the equator when given certain latitude limits that cross the equator.
- The function no longer errors when attempting to read a file name with certain legal latitude and longitude limits.
- The new version executes at least five times faster.

Version History

- The nonfunctional syntaxes `avhrrgoode` and `avhrrgoode(region)` have been removed from the documentation.
- The function now returns empty when the user-supplied limits are outside data limits.
- The function no longer permits longitude limits to be specified outside the interval [-180 180].
- Parameters other than `region` and `filename` can be specified as empty to use their default values.
- In versions prior to R2008a, when reading from the global data set and a smaller region data set, the size of the outputs differed by one column from each other when given identical latitude and longitude limits. Now the sizes are the same.

Improved Accuracy for the limitm and setpostn Functions

In previous releases, after calculating the latitude and longitude limits of the geographic quadrangle bounding a regular data grid, function `limitm` arbitrarily rounded those limits to the nearest one millionth of a degree (equivalent to about 10 cm in latitude or equatorial longitude). Although it is small, this rounding operation in effect applied an arbitrary shift to points on or very near the edge of the grid. The direction of the shift and its magnitude were arbitrary because rounding can either increase or decrease a value. In any given case, the shift depended on the specific referencing vector and the number of columns and rows in the data grid. This behavior unnecessarily degraded the numerical accuracy of `limitm` and those functions which depend on it, and it has now been removed. For more information, see bug report 420038 on the MathWorks Web site.

In the `setpostn` function , an identical rounding step has been removed. Additional changes eliminate a problem for certain input points near boundaries between grid cells that caused row and column subscripts returned by `setpostn` to be off by 1. For points near the northern and eastern edges of the data grid—but still within the grid—returned subscript values could exceed the corresponding grid size. For more information, see bug report 173338 on the MathWorks Web site.

Version History

These corrections can cause subtle changes in the behavior of other functions that work with regular data grids referenced to latitude-longitude, for example, `imbedm`.

If your referencing vector contains approximations to rational numbers that do not have an exact a 64-bit floating point representation (e.g., for cells that are 1.5 degrees wide, `refvec(1)` is 0.666666...), you may still find that certain points that are extremely close to a grid cell boundary cross into a neighboring cell just across the boundary. Such numerical ambiguity is inevitable given how the information in a referencing vector is encoded. Although it cannot be eliminated within `setpostn`, the inexactness only affects points that fall within a few factors of `eps` (very much less than a millionth of a degree) away from a given cell boundary.

New Point Location Demo Data for Tsunami Events

The Mapping Toolbox demo data in the `$MATLABROOT/toolbox/map/mapdata` directory now includes a global tsunami data set in shapefile format with `'Point'` geometry. The data set comprises four files:

```
tsunamis.dbf
tsunamis.shp
tsunamis.shx
tsunamis.txt
```

`tsunamis.txt` is not part of the shapefile set. It is a text file documenting the data set.

The data includes tidal wave events for which the maximum water height was at least one meter, ranging for the years 1950 to 2006, inclusive. The Global Tsunami Database, U.S. National Geospatial Data Center (NGDC), National Oceanic and Atmospheric Administration (NOAA), available at `https://www.ngdc.noaa.gov/hazard/tsu.shtml`, is the source of the data. (To find the tsunami data shapefile, go to https://pubs.usgs.gov/dds/dds-76/HAZPAC_ARCEX/DATA/SHAPE/.) All the files consist of U.S. Government information that is in the public domain and is not subject to copyright protection.

The approximate location of each event is a single point in geodetic coordinates (latitude-longitude) with an unspecified datum. The `.dbf` file contains 18 separate text or numeric attributes for most events, including wave height, causes and seismic magnitudes, and location and country names.

The shapefiles were created at MathWorks from querying the online source data, importing the results into the MATLAB workspace, and exporting them using the Mapping Toolbox `shapewrite` function. For more information, type

```
edit tsunamis.txt
```

at the MATLAB prompt.

Better Trimming Benefits fillm Function

The changes described in the Versin 2.6 (R2007b) release note “Improvements to Data Trimming in patchm and patchesm” on page 30-5 resulting from improved polygon trimming also apply to the `fillm` function.

Restored units Options for Function angl2str

The `angl2str` function once again can format character vectors for angles in degrees-minutes (DM) and degrees-minutes-second (DMS) notations. These options were removed in Version 2.6 (R2007b), and have now been restored. In addition to the `'degrees'` and `'radians'` *`units`* options, you can now obtain DM- and DMS-formatted character vectors by specifying

- `'degrees2dm'` — for degrees-decimal minutes formatting
- `'degrees2dms'` — for degrees-minutes-decimal seconds formatting

To use these options, input angles must be in degrees. That is, `angl2str` uses the *`units`* argument to indicate both the units in which the `angle` argument is provided *and* to control the output format.

This change restores the behavior of `angl2str` prior to Version 2.6 in a slightly different form. Before V. 2.6, the DM and DMS options were specified by *`units`* of `'dm'` and `'dms'`, respectively.

The new options that replace them signify that the functions `degrees2dm` and `degrees2dms`, introduced in Version 2.5 (R2007a), perform the conversions of inputs given in degrees to DM and DMS notation.

New Longitude-Wrapping Option in the closePolygonParts Utility

The `closePolygonParts` function now accepts an optional third argument, `angleunits`, that can be either `'degrees'` or `'radians'`. If you include this argument with a value appropriate for the first two `(lat, lon)` arguments, `closePolygonParts` can correctly account for longitude wrapping. For example, a polygon that begins at a given latitude with a longitude of -180 degrees, and ends at the same latitude with a longitude of 180 degrees is regarded as closed and an additional vertex is not added.

Changes to Terminology for Geographic Data Structures

From Version 2.0 onward, the Mapping Toolbox documentation has referred to “version 1 geographic data structures” and “version 2 geographic data structures,” using the terms “geostruct1” and “geostruct2” respectively as shorthand for them. To reflect current usage, starting with this version of the toolbox, these terms are obsolete; new terms and distinctions have been defined to help clarify what these structures are and can be used for:

- Geographic data structure arrays, introduced in Version 2.0, contain vector features and are called either
  - Geostructs, if they contain geographic coordinates (latitudes and longitudes)
  - Mapstructs, if they contain projected map/planar coordinates (*x* and *y*)
- Display structure arrays, dating from Version 1, also used to be called geographic data structures, and can contain either vector features or raster geodata.

Due to their greater generality, geostructs and mapstructs are the preferred form in which to represent vector features in the toolbox. The preferred way to package raster geodata is with regular or geolocated data grids (2-D numeric arrays accompanied by referencing matrices or vectors). There are only a few Mapping Toolbox functions that can still generate display structures (by importing data from external file formats):

- `dcwdata` — Returns line/patch display structures
- `dcwgaz` — Returns line/patch display structures
- `demdataui` — Returns “regular”—as in regular data grid, that is—display structures
- `mlayers` — GUI to control plotting of display structure elements
- `tgrline` — Returns line/patch display structures
- `vmap0data` — Returns line/patch display structures
- `vmap0ui` — GUI for selecting data from Vector Map Level 0

Even fewer functions accept display structures as inputs:

- `displaym` — Displays elements of a display structure
- `extractm` — Extracts lat-lon coordinates from line/patch display structure

In addition to `displaym` and `extractm`, the `updategeostruct` function converts a line or patch display structure to a geostruct.

For more information, see Mapping Toolbox Geographic Data Structures.

Identifiers Provided for all Warnings

All warnings issued from within Mapping Toolbox functions now include identifiers, enabling you to suppress them at your own discretion. Previously, this was possible for only certain warnings, but with the addition of new identifiers in over two dozen functions in R2008a, all warnings are now covered. For example, you can turn off the warning that `setpostn` issues when given a latitude-longitude position outside the limits of the specified data grid. In this case, the warning identifier is

```
'map:setpostn:pointOutsideLimits'
```

You can suppress it using the following statement:

```
warnstate = warning('off','map:setpostn:pointOutsideLimits');
```

Then, after making your call to `setpostn`, you can restore the original warning state with

```
warning(warnstate);
```

See the MATLAB `warning` function reference page for the for more information on turning warnings off and on and managing the warning state.

Documentation for Functions tigermif and tigerp Removed

The reference pages for following functions, which themselves were removed in R2007b, have been removed from the Mapping Toolbox User's Guide:

- `tigerp` — Read TIGER *p* and *pa* thinned boundary files (ArcInfo format)
- `tigermif` — Read the TIGER MIF thinned boundary file (MapInfo format)

Version History

See the R2007b release note “Functions tigermif and tigerp Are Obsolete and Error if Used” on page 30-10 for alternatives to `tigermif` and `tigerp`.

Removed Syntaxes that Returned Error Messages in Optional Argument

In earlier versions, the following Mapping Toolbox functions supported syntaxes that included an optional output argument called `msg`. If this output argument was included in a call to one of these functions, and certain error conditions were encountered while executing the function, then instead of issuing an error, the function would return the corresponding error message in `msg`. The following functions are affected:

- `axesm`
- `defaultm`
- `displaym`
- `gcm`
- `handlem`

- `lightm`
- `linem`
- `maps`
- `meshm`
- `namem`
- `patchesm`
- `roundn`
- `surfacem`
- `surflsrm`
- `textm`
- `unitstr`
- `utmzone`
- `utmzoneui`

For example, even with no map axes present, the command

```
[mstruct, msg] = gcm
```

returned without error in R2007b and earlier, but placed an error message in `msg`.

These syntaxes have been disabled in R2008a. If you try to use them, a warning is issued. The warning may be followed by an error, depending on whether or not an error condition is encountered within the function. For example, if a map axes is present, the command above results in

```
Warning: Function GCM no longer returns error message strings in
output argument MSG. Instead any errors are thrown where they occur.
You should remove the last output argument (MSG) from your call to
GCM in order to avoid this warning. If you want to handle errors
yourself, call GCM in a try-catch block.
> In mapdisp/private/warnObsoleteMSGSyntax at 6
  In gcm at 20
```

If there is no map axes, it results in

```
Warning: Function GCM no longer returns error message strings in
output argument MSG. Instead any errors are thrown where they occur.
You should remove the last output argument (MSG) from your call to
GCM in order to avoid this warning. If you want to handle errors
yourself, call GCM in a try-catch block.
> In mapdisp/private/warnObsoleteMSGSyntax at 6
  In gcm at 20
??? Error using ==> gcm>checkaxes at 41
No axes in current figure.
Select a figure with map axes or use AXESM to define one.

Error in ==> gcm at 24
h = checkaxes(varargin{:});
```

Version History

As suggested by this warning, if you have any scripts or functions of your own that depend on the old syntax, you should remove the `msg` argument and place the function call in a `try-catch` block instead.

R2007b

Version: 2.6

New Features

Version History

Exporting Vector Geodata to Earth Browsers

`kmlwrite` is a new function for exporting vector point data to a file in KML format. KML stands for Keyhole Markup Language; it is an XML dialect used to structure geographic data for display in an Earth browser, such as Google Earth, Google Maps™, and Maps for Google Mobile™. KML has a hierarchical structure of nested elements and attributes. `kmlwrite` has a simple API that lets Mapping Toolbox users write vector data to a KML file in order to subsequently display the data onto an Earth browser.

When used with Google Earth, files output from `kmlwrite` can be seen immediately in Google Earth, if that application is available to the user. If the files are uploaded to a publicly accessible Web server, they can be viewed by anyone on the Internet via Google Maps or other Web sites and browser utilities that can read and display KML files. Google Maps and Google Maps for mobile do not support the range of KML markup that Google Earth supports (for example, placemark locations must be specified to them as coordinates, not as addresses). See the Google KML documentation at https://code.google.com/apis/kml/documentation/mapsSupport.html for more information.

`kmlwrite` accepts latitude and longitude point vectors, passed either in geostructs or as column arrays. It also accepts addresses, which can be as general as a country's name or as specific as a street address. When geostructs are the input, the attribute data in the geostruct can be formatted as HTML tables and included in the KML output. When latitude-longitude arrays are input, you can pass attributes to `kmlwrite` with character vectors. When addresses are the input, geostructs are not used.

To customize placemarks, you can control formatting of geostruct attributes in the KML file with an attribute specification, a struct used to format them (for example, to add units to length attributes or to control the number of decimal places for numeric values). A new support function, `makeattribspec` lets you change the names used as labels in placemarks (geostruct field names are used by default), omit fields from placemarks, and add HTML markup to the attributes displayed in placemark tables.

See Exporting Vector Geodata in the Mapping Toolbox User's Guide and `Exporting Vector Data to KML` for more information.

Improved Conversion Between Angle Units

The `angledim` function has been replaced by four, more specific, functions: `fromRadians`, `fromDegrees`, `toRadians`, and `toDegrees` (described below in “Four New Angle-Unit Conversion Functions” on page 30-3). However, `angledim` has been retained in Version 2.6 for backward compatibility. The functions `deg2rad`, `rad2deg`, and `unitsratio` provide additional alternatives.

Because it must resolve both the input and output units, `angledim` is excessive for most applications. It works only for class `double` and it quietly discards the imaginary part of any complex input. You can use any of several more efficient alternatives:

If you are working from the command line, you can often replace `angledim` with `deg2rad` or `rad2deg`. If you are converting angle units within a script or function and you know both the *`from`* and *`to`* unit names at the time of coding, then you can also replace `angledim` with `deg2rad` or `rad2deg`. If you know either *`from`* or *`to`* at the time of coding, then you can use `fromRadians`, `fromDegrees`, `toRadians`, or `toDegrees`. Apply one of the following transformations to your code:

- `angledim(angleIn,'radians',`*`to`*`)` ⇒ `fromRadians(`*`to`*`,angleIin)`

- `angledim(angleIn,'degrees',to)` ⇒ `fromDegrees(to,angleIin)`
- `angledim(angleIn,from,'radians')` ⇒ `toRadians(from,angleIn)`
- `angledim(angleIn,from,'degrees')` ⇒ `toDegrees(from,angleIn)`

Also note that the functions in the `fromRadians` family can convert multiple variables in a single function call. For example, you can replace this code

```
angle1 = angledim(angle1InRadians,'radians',to);
angle2 = angledim(angle2InRadians,'radians',to);
```

with

```
[angle1,angle2] = fromRadians(to,angle1InRadians,angle2InRadians);
```

If you do not know either *`from`* or *`to`* at the time of coding, then you can call `unitsratio` to obtain the correct conversion factor, then multiply the values of one or more variables. For example, you can replace:

```
angle1Out = angledim(angle1In, from, to);
angle2Out = angledim(angle2In, from, to);
```

with

```
 r = unitsratio(to, from);
 angle1Out = r * angle1In;
 angle2Out = r * angle2In;
```

Four New Angle-Unit Conversion Functions

The following functions have been added for efficient conversion of angle units (degrees or radians) when either the target or destination units (but not both) are unknown before run time.

- `toDegrees` — Convert angles to degrees
- `toRadians` — Convert angles to radians
- `fromDegrees` — Convert angles from degrees
- `fromRadians` — Convert angles from radians

If the output units match the inputs units, as in `toDegrees(units, angle1, angle2,...)`, where `units` turns out to equal `'degrees'`, then the input angles are simply copied to the output angles.

Use these functions in place of `angledim`. The new functions are more efficient, especially when the value of either the `from` or `to` argument of `angledim` is known in advance and the value of the other angle-unit argument is not.

Improvements in Handling Length Units

Alternatives to the distdim Function

There are now more efficient ways to convert length and distance units than the `distdim` function. In place of `distdim`, you can use `unitsratio` to compute multiplicative factors to apply when converting between different units of distances and angles, which you can use in subsequent calculations. For other alternatives, see Replacing distdim in the `distdim` reference page for details.

The unitstr function Is Obsolete

The `unitstr` function, which validates names and abbreviations for units of distance, angle, and time, is obsolete and will be removed in a future release. The syntax `str = unitstr(str,'times')` has already been removed. Instead, see the documentation for `unitsratio` for a list of valid unit character vectors.

Version History

There is no replacement for `unitstr`, but `unitsratio` recognizes all the unit strings known to the toolbox.

Interpretation of “Miles” Units has Changed

As of R2007b, the following functions interpret distance units specified as `'miles'` as *International Miles*, not *Statute Miles*:

- `almanac`
- `daspectm`
- `elevation`
- `mapprofile`
- `paperscale`
- `scaleruler`

Version History

This will not materially affect the accuracy of results in most cases; the lengths of the two types of miles only differ by about two parts per million (three millimeters). The `distdim` function's interpretation of miles has not changed. However, there are better alternatives to it; see the release note “Alternatives to the distdim Function” on page 30-3.

New Angle Wrapping Functions

Four new low-level functions have been added that force longitudes, azimuths, or phase angles to span intervals of `[0 360]` or `[-180 180]` degrees or `[0 2*pi]` or `[-pi pi]` radians.

- `wrapTo180` — Wrap angle in degrees to [-180 180]
- `wrapTo360` — Wrap angle in degrees to [0 360]
- `wrapToPi` — Wrap angle in radians to [-pi pi]
- `wrapTo2Pi` — Wrap angle in radians to [0 2*pi]

The first two functions work in degrees, the next two in radians. None of them perform argument checking.

You can use the new wrapping and functions in place of `npi2pi` and `zero22pi` for greater efficiency. The older functions will eventually be removed from the toolbox.

New Function to Unwrap Sequences of Angles

The new `unwrapMultipart` function unwraps vectors of angles similarly to the function `unwrap`, except that it handles vectors that include NaN separators, unwrapping each section separately. Use

it to remove discontinuities from vectors of longitudes, azimuths, or phase angles that contain NaN-delimited sequences and as a replacement for the obsolete function `smoothlong`.

Improvements to Data Trimming in patchm and patchesm

The `patchm` and `patchesm` functions now completely trim away polygons and parts of polygons that fall outside your current map limits. This improvement also affects `fillm`, which calls `patchm`. Previously the patch functions simply shifted coordinates inward so that vertices collected at the edge of the limits, where they would appear as lines along map borders, unless obscured by the map frame. This change allows OpenGL to better render the patch objects constructed by `patchm` and `patchesm`, making them more compatible with the use of `AlphaData` to achieve transparency. See the release note “Map Axes Now Display Transparent Objects More Easily” on page 30-6 for more details.

Version History

The more complete trimming in `patchm` and `patchesm` means that there are circumstances under which automatic reprojection can no longer display all the data provided to these functions. Automatic reprojection causes map objects created with `plotm`, `linem`, `patchm`, `patchesm`, and certain other display functions (but not `geoshow`) to be removed, projected, and redisplayed whenever a call to `setm` changes certain map axes properties, including the map limits and projection type. In the case of `patchm`, a set of polygons will become unavailable for automatic reprojection if *all* of the polygons are trimmed away completely. In the case of `patchesm`, which constructs a separate object for each polygon, *any* polygon that is trimmed away completely will be unavailable for reprojection, even if it would lie within newly defined map limits. In either of these cases, you should delete the handle(s) returned by `patchm` or `patchesm`, then repeat the original calls after changing your map axes properties.

Other potential compatibility issues:

- `patchm` and `patchesm` exhibit greater sensitivity to incomplete or incorrect polygon topology.
- You might need to manually set the renderer for proper display of some patch data

See the release note “Map Axes Now Display Transparent Objects More Easily” on page 30-6 for information about rendering and `Converting Coastline Data (GSHHG) to Shapefile Format` for an example of a situation where polygon topology necessitates manual setting of the renderer.

Higher Quality boston.tif GeoTIFF Satellite Image

The original `boston.tif` GeoTIFF satellite image has been replaced by a higher resolution image, created by and provided courtesy of GeoEye™. The new image has the same name as the old one, `boston.tif`. The new `boston.tif` file, and an overview image in JPEG format, `boston_ovr.jpg`, include material copyright © by GeoEye, all rights reserved. The new image is 2881-by-4481 pixels, with a ground pixel size of 3.2808333333 U.S. survey feet (one meter). The original image was 720-by-1120 pixels and had a ground pixel size of four meters. Both images cover the downtown section of Boston, Massachusetts, the Charles River, and parts of Cambridge. The new image is a “pan-sharpened” multispectral image with visible red, green, and blue bands, and is stored in RGB form. The original image was also multispectral, but was a simple composite of red, green, and blue bands, and it was written to the GeoTIFF file as an indexed-color image. One additional change is that rather using meters, the new image is spatially referenced to the Massachusetts State Plane Mainland

coordinate system with units of U.S. survey feet. The overview image, `boston_ovr.jpg`, is referenced to latitude-longitude, with a ground pixel size of approximately 16 meters. For further information, refer to the text files `boston.txt`, `boston_ovr.txt`, and `boston_metadata.txt` in `toolbox/map/mapdata`.

Version History

Older satellite images of Boston and a demo have been removed from Mapping Toolbox directories. The new `boston.tif` and `boston_ovr.jpg` images replace the images having the same names previously included in `toolbox/map/mapdemos`. In addition, several older images related to `boston.tif` have been removed:

- `boston_red.tif`
- `boston_green.tif`
- `boston_blue.tif`
- `boston_pan.tif`
- `boston_enhanced_pan.tif`

The `mapexenhance` demo (“Enhancing Multispectral GeoTIFF Images”), which used several of these images, has also been removed.

Map Axes Now Display Transparent Objects More Easily

It is now much easier to achieve transparency effects from the toolbox by setting the `AlphaData` property of an object. Previously, functions `axesm`, `lightm`, `contourm`, and `contour3m` set the figure's `Renderer` property: `axesm` and `lightm` set it to `'zbuffer'`, while `contourm` and `contour3m` set it to `'painters'`. You then had to manually reset `Renderer` to `'opengl'` in order for transparency to take effect.

Now the `RendererMode` of the figure retains the default MATLAB value of `'auto'`, causing MATLAB to select the most appropriate renderer for you; it will use OpenGL when appropriate, given your `AlphaData` settings. Using OpenGL not only enables transparency effects, it also can make use of hardware graphics acceleration capabilities should they be available.

Version History

If you need a particular map display to look the same as it did in Mapping Toolbox Version 2.5 (R2007a), in most cases you can just issue the command

```
set(gcf,'Renderer','zbuffer')
```

after you construct your map axes. If you are calling `contourm` or `contour3m`, issue the command

```
set(gcf,'Renderer','painters')
```

after you call the contouring function.

The consequence of doing this is that you will not be able to use transparency with that map figure until you reset its renderer to `'opengl'` or set its `'RendererMode'` back to `'auto'`, which is its default state.

The arcgridread Function Now Imports Noninteger Data Grids

In previous releases of the toolbox, `arcgridread` could only import data grids that had integer values (often of meters or feet). This limitation has now been removed, such that input grids can contain arbitrary values in decimal notation.

Change to avhrrlambert Function Behavior When No Data Is Available

In previous releases of the toolbox, `avhrrlambert` would error if the quadrangle defined by `latlim` and `lonlim` (when projected to form a polygon in the appropriate Lambert Equal Area Azimuthal projection) failed to intersect the bounding box of the data in the projected coordinates. In this release, `avhrrlambert` does not error when this occurs but returns empty matrices.

Version History

If you depend on `avhrrlambert` to error when there is no data in your quadrangle, you will need to change your code.

Enhancements to Mapping Toolbox User's Guide

Several sections of the chapter Understanding Geospatial Geometry have been rewritten and new material has been added to better explain critical topics such as ellipsoid models, units of and notations for angles and length, and the conversions that are possible between various units. There is also a new section, Exporting Vector Geodata, explaining and illustrating how to use the new `kmlwrite` and `makeattribspec` functions.

Functions deg2rad and rad2deg No Longer Convert Complex to Real

In prior versions, when given complex inputs, functions `deg2rad` and `rad2deg` issued a warning and then converted their inputs to real. Now they no longer do either of these things.

Version History

In the unlikely event of complex input, these functions simply scale the imaginary part by the same factor as the real part. For example, in R2007a and earlier releases, they behave as follows:

```
>> deg2rad(180i)
Warning: Imaginary parts of complex ANGLE argument ignored
> In deg2rad at 16
ans =
             0
```

Going forward from this release, the result is

```
>> deg2rad(180i)
ans =
        0 + 3.1416i
```

Degrees-Minutes-Seconds Conversion Functions Are Obsolete and Error if Used

The following functions, which accepted or produced double scalars to represent degrees, minutes, and seconds now error when used, and will be removed completely from the toolbox in a future release:

- `deg2dm`
- `deg2dms`
- `dms2deg`
- `dms2dm`
- `dms2mat`
- `dms2rad`
- `mat2dms`
- `rad2dm`
- `rad2dms`

The scalar DM and DMS encodings are being eliminated from the toolbox because they were never used for internal computations, and always had the potential to generate serious numerical errors if passed accidentally to functions that expected normal latitude-longitude tuples. They also made the functions that accepted them less efficient due to the need to convert from DM or DMS to fractional latitudes and longitudes before processing the input data.

In every case, an alternative that does not use the old degrees-minutes-seconds scalar encoding exists. See the following section on compatibility for replacements and “New Functions for Degrees-Minutes-Seconds Conversions” on page 31-3 in the V2.5 Release Notes for descriptions of replacement functions, and the compatibility considerations below for descriptions of alternative syntaxes and expressions you can use for degrees-minutes-seconds conversions.

Version History

DM and DMS representations are widely used in published reports and can occur in geodata that you want to read into the MATLAB workspace. You can still import and export DM and DMS data, but Mapping Toolbox functions no longer accepts the old encodings as alternatives to floating-point representations of latitude and longitude for internal manipulations.

The following functions (which all use scalar DMS encoding) are being retired. They remain in the product for R2007b, but now generate errors when used. They will be removed completely in the next version. Use the alternative suggested in lieu of these functions.

- `deg2dm` — Instead use `degrees2dm` to convert degrees to degrees-minutes vector.
- `deg2dms` — Instead use `degrees2dms` to convert degrees to degrees-minutes-seconds vector.
- `dms2deg` — Instead use `dms2degrees` to convert degrees-minutes-seconds vector to degrees.
- `dms2dm` — Instead combine `dms2degrees` and `degrees2dm`, as in `degrees2dm(dms2degrees([-29 42 18.7]))` to remove the seconds component from a degree-minutes-second vector.
- `dms2mat` — Instead use `degrees2dms` to convert degrees to degrees-minutes-seconds vector.
- `dms2rad` — Instead use `dms2degrees` to convert degrees-minutes-seconds vector to degrees and call `deg2rad` or multiply by `pi/180`.

- `mat2dms` — Instead use `dms2degrees` to convert degrees-minutes-seconds vector to degrees.
- `rad2dm` — Instead, call `rad2deg` or multiply input arguments by `180/pi`, and then call `degrees2dm`.
- `rad2dms` — Instead, call `radtodeg` or multiply input arguments by `180/pi`, and then call `degrees2dms`.

In addition, the `axesm` and `setm` functions no longer accept the character vectors `'dms'` and `'dm'` for setting either the *`AngleUnits`* or *`LabelUnits`* properties of a map axes.

Many other Mapping Toolbox functions optionally accept angle character vectors for their `units` parameter; the following 57 functions now only accept `'degrees'` and `'radians'`, whereas in prior versions they would also accept `'dm'` and `'dms'` as values for *`units`*:

`angl2str`	`distance`	`histr`	`putpole`	`stdist`
`angledim`	`eastof`	`imbedm`	`rcurve`	`stdm`
`antipode`	`elevation`	`interpm`	`reckon`	`timezone`
`areaint`	`ellipse1`	`intrplat`	`rhxrh`	`track`
`areamat`	`epsm`	`intrplon`	`rotatem`	`track1`
`areaquad`	`eqa2grn`	`mapprofile`	`rsphere`	`track2`
`axesm`	`gc2sc`	`meanm`	`scaleruler`	`unitstr`
`azimuth`	`gcxgc`	`meshgrat`	`scircle1`	`westof`
`convertlat`	`gcxsc`	`neworig`	`scircle2`	`zero22pi`
`crossfix`	`gradientm`	`newpole`	`scxsc`	
`daspectm`	`grn2eqa`	`npi2pi`	`setm`	
`departure`	`hista`	`org2pol`	`smoothlong`	

These functions now error when provided `'dm'` or `'dms'` for their `units` argument.

Time Conversion Functions Are Obsolete and Error if Used

The following functions, which converted time representations, now error when used and will be removed completely from the toolbox in a future release:

- `hms2hm`
- `hms2hr`
- `hms2mat`
- `hms2sec`
- `hr2hm`
- `hr2hms`
- `hr2sec`
- `mat2hms`
- `sec2hm`
- `sec2hms`
- `sec2hr`

- `time2str`
- `timedim`

Version History

These functions now raise errors when they are invoked. They will be completely removed in a future version of the toolbox. No substitutes have been provided, as no operations of the toolbox have ever depended on them.

cmapui GUI is now Obsolete

`cmapui` GUI will be completely removed from the next Mapping Toolbox version.

Version History

It now errors if you attempt to use it. Use the MATLAB `colormapeditor` GUI instead, which provides better functionality. You can also use the **Colormap** drop-down menu in the Property Editor (part of the MATLAB plotting tools and available via the `propedit` command) to select a built-in colormap; the `custom` option on that drop-down menu opens `colormapeditor`. To set up a colormap for terrain displays, you can use the `demcmap` function. To generate an appropriate (but random) colormap for political maps, use the `polcmap` function.

Functions tigermif and tigerp Are Obsolete and Error if Used

The following functions error and issue an error message when you attempt to use them:

- `tigerp` — Read TIGER p and pa thinned boundary files (ArcInfo format)
- `tigermif` — Read the TIGER MIF thinned boundary file (MapInfo format)

Version History

In place of these format readers, download U.S. Census cartographic boundary files in shapefile format and use `shaperead` to import them.

R2007a

Version: 2.5

New Features

Version History

Performance Improvements for los2 and viewshed

This release includes a faster `los2` function (which computes intervisibility between locations on or above a terrain grid). The `viewshed` function (which computes the portions of a terrain grid that can be seen from a given viewpoint) has also been accelerated as a result.

Utility Functions for Computing Distance and Position Along Meridians

Two functions that reckon position and distance along a meridian on the ellipsoid are now available:

- `meridianarc` — Computes distance along a meridian between two latitudes
- `meridianfwd` — Reckons position along meridian given a starting point and distance

Some GUIs Are No Longer Available from the Command Line

In prior releases, when you typed certain Mapping Toolbox function names with no argument list, a specialized GUI appeared that enabled you to interactively set parameters related to the function. This feature was seldom used and sometimes raised errors when users attempted to operate the GUIs. Starting in this release, a GUI will no longer appear when you issue the following commands:

- `comet3m`
- `cometm`
- `contourfm`
- `contour3m`
- `contourm`
- `demcmap`
- `fill3m`
- `fillm`
- `lightm`
- `limitm`
- `linem`
- `meshlsrm`
- `meshm`
- `patchesm`
- `patchm`
- `pcolorm`
- `plot3m`
- `plotm`
- `quiver3m`
- `quiverm`
- `scatterm`
- `stem3m`
- `surfacem`

- `surflm`
- `surfm`
- `surflsrm`
- `symbolm`
- `textm`

Version History

Use the above functions with arguments to avoid raising errors. Their GUIs will continue to be available via `maptool` (which places menus on a figure containing map axes), but they are not being actively supported and will be eliminated in a future release.

New Functions for Degrees-Minutes-Seconds Conversions

Four new functions have been added to convert to and from decimal degrees and degrees-minutes-seconds (DMS):

- `dms2degrees` — Convert degrees-minutes-seconds to degrees
- `dm2degrees` — Convert degrees-minutes to degrees
- `degrees2dms` — Convert degrees to degrees-minutes-seconds
- `degrees2dm` — Convert degrees to degrees-minutes

The DMS inputs and outputs of these functions are vectors of one row and three columns for each row in the decimal degrees input or output. The first column contains the “degrees” element and is integer-valued. The second column contains the “minutes” element and is integer-valued. The third column contains the “seconds” element, and may have a nonzero fractional part. Similarly, DM inputs and outputs are two-column vectors with integer degrees and fractional minutes parts.

The new conversion functions dispense with the DMS encoding used in prior versions of the toolbox. These represented DMS angles by a single real number, the format of which is `dddmm.ss`. Such an encoding is no longer used internally by Mapping Toolbox functions, as it is not self-documenting and can lead to erroneous computations. For example, two DMS-encoded real numbers cannot be added to obtain a meaningful result.

Version History

DM and DMS representations are widely used in published reports and can occur in geodata that you want to read into the MATLAB workspace. You can still import and export DM and DMS data, but Mapping Toolbox functions no longer accepts the old encodings as alternatives to floating point representations of latitude and longitude for internal manipulations.

The scalar DM and DMS encodings are being eliminated from the toolbox because they were never used for internal computations, and always had the potential to generate serious numerical errors if passed accidentally to functions that expected normal latitude-longitude tuples. They also made the functions that accepted them less efficient due to the need to convert from DM or DMS to fractional latitudes and longitudes before processing the input data.

The following existing functions (which all use scalar DMS encoding) are being retired. They remain available but now issue warnings that they are obsolete when used:

- `deg2dm` — Instead use `degrees2dm` to convert degrees to degrees-minutes vector
- `deg2dms` — Instead use `degrees2dms` to convert degrees to degrees-minutes-seconds vector
- `dms2deg` — Instead use `dms2degrees` to convert degrees-minutes-seconds vector to degrees
- `dms2mat` — Instead use `degrees2dms` to convert degrees to degrees-minutes-seconds vector
- `dms2rad` — Instead use `dms2degrees` to convert degrees-minutes-seconds vector to degrees and call `deg2rad` or multiply by `pi/180`
- `mat2dms` — Instead use `dms2degrees` to convert degrees-minutes-seconds vector to degrees
- `rad2dm` — Instead, call `radtodeg` or multiply input arguments by `180/pi`, and then call `degrees2dm`
- `rad2dms` — Instead, call `radtodeg` or multiply input arguments by `180/pi`, and then call `degrees2dms`

In addition, the `axesm` and `setm` functions no longer accept the character vectors `'dms'` and `'dm'` for setting either the `AngleUnits` or `LabelUnits` properties of a map axes.

Many other Mapping Toolbox functions optionally accept angle character vectors for their `units` parameter; the following 57 functions now only accept `'degrees'` and `'radians'`, whereas in prior versions they would also accept `'dm'` and `'dms'` as values for *`units`*:

`angl2str`	`distance`	`histr`	`putpole`	`stdist`
`angledim`	`eastof`	`imbedm`	`rcurve`	`stdm`
`antipode`	`elevation`	`interpm`	`reckon`	`timezone`
`areaint`	`ellipse1`	`intrplat`	`rhxrh`	`track`
`areamat`	`epsm`	`intrplon`	`rotatem`	`track1`
`areaquad`	`eqa2grn`	`mapprofile`	`rsphere`	`track2`
`axesm`	`gc2sc`	`meanm`	`scaleruler`	`unitstr`
`azimuth`	`gcxgc`	`meshgrat`	`scircle1`	`westof`
`convertlat`	`gcxsc`	`neworig`	`scircle2`	`zero22pi`
`crossfix`	`gradientm`	`newpole`	`scxsc`	
`daspectm`	`grn2eqa`	`npi2pi`	`setm`	
`departure`	`hista`	`org2pol`	`smoothlong`	

These functions now issue warnings when provided `'dm'` or `'dms'` for their `units` argument.

Time Conversion Functions to be Removed

The following functions to convert between time units and encodings will be removed from a future release of the toolbox:

- `hms2hr`
- `hms2hm`
- `hms2mat`
- `hms2sec`
- `hr2hm`

- `hr2hms`
- `hr2sec`
- `mat2hms`
- `sec2hm`
- `sec2hms`
- `sec2hr`
- `time2str`
- `timedim`

Version History

These functions remain available, but when they are invoked now issue warnings that they are obsolete.

R2006b

Version: 2.4

New Features

Version History

Standard Formulations of Five Major Map Projections

New formulations of five conic map projections are provided. The existing implementations remain available under their old names. The new versions use the same names as the ones they supplement, appended with “std”:

- Cassini Transverse Cylindrical (`cassinistd`)
- Albers Equal-Area Conic (`eqaconicstd`)
- Equidistant Conic (`eqdconicstd`)
- Lambert Conformal Conic (`lambertstd`)
- Polyconic (`polyconstd`)

Computations used for the new versions differ from the old ones only when the latitude origin (the first element of the *origin vector*) is nonzero. In this case, the old versions shift the origin off the equator through a solid body rotation of the sphere (or, for an ellipsoidal earth model, a suitable auxiliary sphere). This is technically correct, but differs from accepted industry standards for these projections. The new versions use the standard formulations and give results that are consistent with projection results from other software packages, regardless of the latitude origin. The old versions are retained in the toolbox, with no change in behavior, to ensure backward compatibility.

See the Projections Reference documentation for more information.

Two New Geodetic/Geocentric Latitude Conversion Functions

Two new functions provide a more direct route to functionality already available via the `convertlat` function:

- `geocentric2geodeticlat` converts an array of geocentric latitude in radians to geodetic latitude in radians on a reference ellipsoid given a first eccentricity
- `geodetic2geocentriclat` converts an array of geodetic latitude in radians to geocentric latitude in radians on a reference ellipsoid given a first eccentricity.

Accelerated Performance for geoshow, mapshow, and bufferm

Functions `geoshow`, `mapshow`, and `bufferm` run substantially faster in many cases, especially when vector display is being controlled via symbol specs in `mapshow` and `geoshow`.

Changes in Behavior of mapshow and geoshow

In addition to operating faster, the `mapshow` and `geoshow` functions now behave slightly differently regarding their defaults, handles returned, warnings issued, and several other aspects:

Version History

Default Symbols and Colors

- Point marker type changes from `'X'` to `'+'`
- Point marker color changes from `'black'` to `'red'`
- Line color changes from `'black'` to `'blue'`

- Polygon facecolor changes from `'black'` to pale yellow

Polygon edgecolor remains `'black'`

Contour DisplayType Behavior Changes

- The `DisplayType` option `'contour'` now returns an hggroup handle. The children of the hggroup are patches. In prior versions, an array of line handles was returned.
- You can specify any contourgroup property as a parameter value pair. In previous versions, `mapshow` allowed you to set the `LineStyle` property, but no other contour properties.
- Both `mapshow` and `geoshow` might return a different number of contour levels by default than in previous versions, in which you could not specify contour intervals; in R2006b, you can control contour intervals and levels via the `LevelStep` or `LevelList` contourgroup properties, among others.
- In R2006b, when plotting contours on a regular axes (not a map axes), geoshow projects the contour lines using a Plate Carree projection; in previous versions it simply displayed longitudes as *x* and latitudes as *y* without doing any trimming or longitude wrapping.

Graphic Objects and Return Values for Vector Inputs

- Vector coordinate array input (*x*-*y* or latitude-longitude pairs) with a `DisplayType` of `'Line'` or `'Point'` now generates an ordinary line object instead of a map graphics line.
- For geostruct input, an hggroup object is constructed; its handle is returned instead of an array of handles to map graphic objects:

  - For polygon geostructs, map graphics polygon objects are still constructed, but become children of the hggroup.
  - For point, multipoint, and line geostructs, the children of the hggroup are ordinary line objects; map graphics objects are no longer constructed.

  In both cases each child of the hggroup, rather than each element in an array of handles, corresponds to a distinct feature in the geostruct.

Handles Returned for Graphic Objects

- Geostruct inputs result in an hggroup handle containing either line objects (for point, multipoint, and line inputs) or modified patch objects (for polygon inputs) as their children.
- Coordinate arrays (*x*,*y* pairs) displayed as lines now result in ordinary line objects.
- Geostructs containing lines result as ordinary line objects within hggroups.

New Warnings Issued

- `mapshow` and `geoshow` now warn when given a geostruct within which the `Geometry` field differs from a specified `'DisplayType'` parameter.
- `mapshow` will warn if it is given a geostruct containing `Lat` and `Lon` fields instead of `X` and `Y` fields.
- `geoshow` will warn if it is given a geostruct containing `X` and `Y` fields instead of `Lat` and `Lon` fields.

geoshow Supplies Default Projection

`geoshow` now projects vector and raster inputs using a default projection (Plate Carree) if the parent axes is not a map axes. The axes itself is unchanged (it is not modified to become a map axes), but the

scale factor of the projection is set such that latitudes and longitudes in degrees can be read directly from the axes ticks and grid lines.

Duplicate Parameter/Value Pair Inputs Allowed

`mapshow` no longer errors or warns if given duplicate Parameter/Value pair inputs; in such circumstances, `mapshow` now uses the last value (even with SymbolSpecs)

geoshow Supports True Surface Display

`geoshow` now creates a true 3-D surface if given a `'surface' DisplayType` rather than setting the `ZData` values to `0`.

Texturemap DisplayType Behavior Changes

The `'texturemap' DisplayType` now uses the pixel edges to create `XData` and `YData` grids rather than using the pixel centers, which correctly registers the display to map coordinates. The `ZData` contains an array of zeros having the same dimensions as the `XData` and YData `arrays`, which exceed the input grid in size by one in both the *x* and *y* dimensions.

You should use`'texturemap'` displays when the attribute being displayed is coded by color (i.e. 2-D displays); use `'surface'` displays when you need to show data with relief (nonzero `ZData`).

More General Support for Graphics Properties

All patch properties are now supported for polygon inputs.

All line properties are now supported for point and line inputs, except that `'linestyle'` is ignored for point inputs.

Limitations on Referencing Matrices for Geoshow Removed

`geoshow` is now capable of accepting any referencing matrix. Previously it could only accept those referencing matrices that were convertible to referencing vectors.

mapshow and geoshow Ignore Empty Inputs Rather than Erroring

In previous versions, `mapshow` and `geoshow` would throw errors when provided with empty (`[]`) arrays. This behavior could be inconvenient when running these functions via scripts. The new behavior is also more consistent with that of MATLAB plotting functions such as `plot`, `surf`, `mesh`, and `contour`.

dted Automatically Fixes Incorrectly Specified Longitude Directions in DTED Data

Some DTED level 0 files available via the National Geospatial-Intelligence Agency's (NGA) web interface may have minor errors. Specifically, Level 0 data for cells just to the east of the prime meridian may have longitude coordinate character vectors with 'W' substituted for 'E'. The `dted` function now detects and automatically corrects this data error.

R2006a

Version: 2.3

New Features

Version History

Full Support for 64-Bit Windows

Version 2.3 adds support for the mex- and library-based functions `geotiffinfo`, `geotiffread`, `sdtsinfo`, and `sdtsdemread` on this new MATLAB platform via library upgrades (described below) and a custom port of STDS++.

Third-Party Library and Code Upgrades

Third-party libraries and software packages have been upgraded to their current versions to ensure best performance and compatibility with external geospatial data sources and applications software:

- General Polygon Clipper (GPC) upgraded to Version 2.32
- PROJ.4 library upgraded to Version 4.4.9
- SDTS++ library upgraded to Version 1.5.1
- GeoTIFF library upgraded to Version 1.2.2

Support for 32-Bit Floating-Point GeoTIFF Images

The MATLAB function `imread` can now import TIFF images containing 32-bit floating-point data. As a result, `geotiffread` now reads the corresponding variety of GeoTIFF.

Version History

The structure returned by `geotiffinfo` in V. 2.3 has changed. The following table describes the differences between the current and previous versions:

Version 2.3	Previous Versions
The `TiePoints` structure contains two substructures, `ImagePoints` and `WorldPoints`. `ImagePoints` contains `[1-by-N]` arrays `Row` and `Col`; `WorldPoints` contains `[1-by-N]` arrays `X` and `Y`.	The `TiePoints` structure contained two `[3-by-1]` arrays, `ImagePoints` and `WorldPoints`.
The `CornerCoords` structure contains six `[1-by-4]` row vectors, respectively, `X`, `Y`, `Col`, `Row`, `Lat`, and `Lon`.	The `CornerCoords` structure contained six `[4-by-1]` column vectors: `PCSX`, `PCSY`, `X`, `Y`, `LAT`, and `LON`.
The `Zone` field contains `[]` if the UTM zone is not applicable or was missing from the metadata.	The `Zone` field contained `32767` if the UTM zone was not applicable or was missing from the metadata.

Utility Functions for NaN-Separated Polygons and Lines

closePolygonParts

Closes all rings in a multipart polygon to ensure proper analysis and rendering.

isShapeMultipart

Boolean-valued function that returns `true` if a polygon or line has multiple parts.

removeExtraNanSeparators

Eliminates redundant `NaN` separators that might exist in polygons and lines.

Standardized Vector Topology in coast.mat

Polygons in the low-resolution coastline sample data file `coast.mat` now follow the convention used by `geoshow`, `mapshow`, and `mapview` to display polygons with “holes” (inner rings representing lakes, inland seas, and islands within them). Outer contours now always run clockwise and inner contours run counterclockwise. These edits, which reversed the order of vertices in some rings, enable the display functions to fill outer rings properly while leaving inner rings blank.

Three New Demos

If you are viewing these release notes using the Help browser, clicking any of the demo links below will open the demo in a browser window. Click the links at the top of that window to view or run the code for the demo.

Converting Coastline Data (GSHHS) to Shapefile Format

Shows how to extract coastlines from the Global Self-consistent Hierarchical High-resolution Shorelines (GSHHS) data set, manipulate the polygon features, and save the result to a polygon shapefile.

Plotting a 3-D Dome as a Mesh Over a Globe

Illustrates how to construct a 3-D feature in a system of local vertical coordinates, then transform and combine it with a globe display in Earth-Centered, Earth-Fixed (ECEF) coordinates.

Unprojecting a Digital Elevation Model (DEM)

Shows how to unproject a georeferenced terrain elevation grid from Universal Transverse Mercator (UTM) into a regular latitude-longitude grid having comparable spatial resolution.

R14SP3

Version: 2.2

New Features

Version History

Geodetic-Geocentric Coordinate Conversion Functions

New three-dimensional coordinate conversion functions (`geodetic2ecef`, `ecef2geodetic`, `ecef2lv`, `lv2ecef`) transform 3-D point locations between geodetic (latitude, longitude, height), geocentric Cartesian (Earth Centered, Earth Fixed), and local vertical Cartesian coordinate systems.

Additional User Control Over Shapefile Content

Function `shapewrite` now allows user control over field names, lengths, and decimal precision when writing feature attributes to the DBF file, via a "DBF specification." The new function `makedbfspec` constructs a default DBF specification from a geographic data structure (geostruct2) array. Users can customize the output and pass it to `shapewrite`.

Shapefile Read/Write Efficiency Enhanced

Improved implementations of functions `shaperead` and `shapewrite` process data substantially faster (about four times faster for a 10-MB shapefile of major roads in Massachusetts).

Improved Rendering of Polygons with Inner Rings

The Map Viewer (function `mapview`) and functions `mapshow` and `geoshow` now properly render polygons containing inner rings (e.g., lakes and inland seas within a continent, islands within a pond). Features in underlying layers "show through" inner rings because they are not obscured by the patch faces used to render the polygons.

Version History

Polygon Vertex Ordering Is Now Significant for Properly Rendering Filled Polygons

The map display functions `geoshow`, `mapshow`, and `mapview` now require that coordinate vectors representing polygons have consistent directionality, such that

- Vertices defining outer rings (to be filled) be encoded in a *clockwise* direction.
- Vertices defining inner rings (often termed "lakes" or "islands," to be rendered as transparent holes) be encoded in a *counterclockwise* direction.

If you have vector map data sets that violate these conditions, the map display functions `geoshow`, `mapshow`, and `mapview` might not be capable of rendering them as filled polygons. To determine the directionality of polygon vertices, use the logical function `ispolycw`, which returns a separate result for each `NaN`-delimited polygon in an array of vertices. If you find inner rings which are clockwise or outer rings which are counterclockwise, use the utility functions `poly2ccw` or `poly2cw`, respectively, to reverse the direction of those rings.

Map Viewer Now Georeferences Images It Saves

When the Map Viewer saves the visible or selected area as a raster map (an image file), it now also writes a world file to georeference the image.

TIGER/Line File Support Upgraded

Function `tgrline` now supports the most recent (2003/2004) TIGER/Line data sets from the U.S. Bureau of the Census.

R14SP2

Version: 2.1

New Features

Version History

New Function Reads Both 5-Minute and 2-Minute ETOPO Data

The new function `etopo` reads from either the 5-minute (ETOPO5) or the 2-minute (ETOPO2) global terrain data set. This function supersedes function `etopo5` and fixes several significant bugs.

Function gshhs Now Returns a Version 2 Geostruct

Function `gshhs`, which reads the Global Self-consistent Hierarchical High-resolution Shoreline data set, has been upgraded. It now returns a Version 2 geographic data structure (geostruct2) array instead of a Version 1 geostruct. Polygons returned from `gshhs` now follow the shapefile vertex-ordering convention (supported by functions `polybool`, `shaperead`, and `shapewrite`, for example). Under this convention the coordinates of outer rings (e.g., continent outlines) are given in clockwise order, while counterclockwise ordering is used for inner rings (e.g., lakes and inland seas within a continent). Note that function `gshhs` does not yet support Version 1.3 of the data set, released on Sept. 27, 2004.

Geodata Can Now Be Exported in Shapefile Format

The new function `shapewrite` writes a geographic data structure to a shapefile. It exports a Version 2 geographic data structure array (geostruct2), creating `.shp`, `.shx`, and `.dbf` files. Like `shaperead`, the function supports the Point, MultiPoint, PolyLine, and Polygon shape types. The contents of character vector-valued attribute fields and scalar numerical attribute fields are written to the dBase (`.dbf`) file.

Accessing Geodata Resources on the Internet

Links and URLs to documentation and data files for various Internet sources of digital map data are now collected in the following technical note on the MathWorks Web site:

`https://www.mathworks.com/support/tech-notes/2100/2101.html`

This technical note replaces many individual links formerly scattered across the User's Guide, reference pages, and MATLAB function help. Collecting this information on a Web page rather than on product CDs or printed documentation should substantially mitigate recurrent problems with stale links. Please report any stale links that you might find in the technical note to MathWorks Technical Support (`https://www.mathworks.com/contact_TS.html`), so that it can be updated promptly.

Changes to Atlas Data and Associated Functions

Through Version 2.0.3, the toolbox included a set of *atlas data* with global geopolitical data embedded as MATLAB arrays in four MAT-files: `worldlo`, `worldhi`, `worldmtx`, and `worldmtxmed`. However, geopolitical data is difficult to keep current, and is subject to inaccuracies and interpretations that can cause contention. Therefore, starting with Version 2.1, Mapping Toolbox demo data now excludes geopolitical data that would specify national sovereignty over specific regions of the Earth. The only exceptions are the boundaries of the 50 U.S. states and the District of Columbia.

Version History

This change means that the `worldlo`, `worldhi`, `worldmtx`, and `worldmtxmed` MAT-files are no longer part of the toolbox. However, the nonpolitical data on global coastlines, major lakes and inland

seas, major rivers, and major cities and populated places that was in `worldlo.mat` has been retained in the toolbox and transformed into shapefile format. This includes the addition of name attributes for many previously unnamed features. There are four new shapefiles in this category: `landareas.shp`, `worldlakes.shp`, `worldrivers.shp`, and `worldcities.shp`.

For consistency, the atlas data for the United States that was originally stored in the `usalo` and `usahi` MAT-files has also been transformed, although none has been removed. These data sets now reside in the following shapefiles and MAT-files: `usastatelo.shp`, `usastatehi.shp`, `conus.mat`, and `greatlakes.mat`.

The toolbox originally included four functions dedicated to extracting data from the atlas data MAT-files: `worldlo`, `worldhi`, `usalo`, and `usahi`. With the data removal/transformation described above, these functions are no longer needed and have been removed from the toolbox in Version 2.1. You can easily access the new shapefiles using the `shaperead` function, which includes powerful and flexible options for selecting features and even controlling which attributes are read. In addition, function `country2mtx`, whose sole purpose was to rasterize the country boundary polygons in `worldlo.mat`, has been removed.

Related changes extend to the `worldmap` function, which formerly combined two purposes:

- Select an appropriate map projection and parameters with which to display a given latitude-longitude area.
- Automatically display atlas data for that area.

In Version 2.1, `worldmap` supports only the first of these actions. A call to `worldmap` constructs a map axes object and can easily be followed with a variety of Mapping Toolbox commands to display the map data of your choice. Because the `usamap` function is so similar to `worldmap`, corresponding changes have been made there as well.

To help those who have relied heavily on `worldmap` and `usamap` to plot base maps with automatically selected vector map data, examples throughout the User's Guide, reference pages, and MATLAB function help entries have been updated to illustrate the new behavior of `worldmap` and `usamap`, and to show how to create maps including vector shapefile data layers. These examples cover a wide variety of ways to read and subset data with `shaperead` and display data with `geoshow` and other Mapping Toolbox display functions. A good place to start is with the examples for the `worldmap` and `usamap` functions. Also see example code in “Changes to worldmap and usamap” on page 35-3.

To help you update commands, scripts, and data for constructing and maintaining base maps, a recently published technical note on the MathWorks Web site provides links to data and documentation for many sources of vector and raster digital map data that you can access over the Internet:

`https://www.mathworks.com/support/tech-notes/2100/2101.html`

Changes to worldmap and usamap

`worldmap` and `usamap` have been simplified to construct appropriate map axes for a given area without displaying any map data.

In all cases, map frames, latitude-longitude grid lines, meridian labels, and parallel labels are turned on. You can use the following command sequence to remove them:

```
framem off; gridm off; mlabel off; plabel off
```

Other changes include the following:

- `usamap` now accepts two-letter U.S. Postal Service abbreviations for state names (e.g., AL, AK, AR, etc.).
- `worldmap` and `usamap` functions no longer support the *`type`* input argument.

Changes to worldmap and usamap Display Types

As of this release, the `worldmap` and `usamap` functions no longer support the *`type`* input argument. This argument provided an easy way to control display behavior.

The *`type`* option in `worldmap` was a single argument that could be one of the following strings: `'none'`, `'line'`, `'lineonly'`, `'patch'`, `'patchonly'`, `'mesh'`, `'meshonly'`, `'dem'`, `'demonly'`, `'dem3d'`, `'dem3donly'`, `'lmesh3d'`, `'lmesh3donly'`, `'ldem3d'`, and `'ldem3donly'`. In `usamap`, *`type`* was a subset of the above names (the 3-D options were not supported).

In the current release, the various *`type`* display options can be simulated by following a call to `worldmap` or `usamap` with an appropriate set of Mapping Toolbox commands. The following table specifies how you can achieve the effects of the old `worldmap` *`type`* argument using such auxiliary methods:

Mapping 1.x to 2.0.x Usage	**Mapping 2.1 Usage**

`load topo`
 	
`worldmap(topo,topolegend,'dem')`
	`load topo`
	
	`worldmap(topo,topolegend)`
	
	`meshm(topo,topolegend)`
	
	`demcmap(topo)`
	
	`land = shaperead('landareas.shp','UseGeoCoords',true);`
	
	`geoshow([land.Lat], [land.Lon])`

`load topo`
 	
`worldmap(topo,topolegend,'demonly')`
	`load topo`
	
	`worldmap(topo,topolegend)`
	
	`meshm(topo,topolegend)`
	
	`demcmap(topo)`

Mapping 1.x to 2.0.x Usage	Mapping 2.1 Usage

`load topo`
 	
`worldmap(topo,topolegend,'dem3d')`
	`load topo`
	
	`worldmap(topo,topolegend)`
	
	`meshm(topo,topolegend,size(topo),topo)`
	
	`da = daspect;`
	
	`pba = pbaspect;`
	
	`da(3) = 7.5*pba(3)/da(3);`
	
	`daspect(da);`
	
	`demcmap(topo)`
	
	`land = shaperead('landareas.shp','UseGeoCoords',true);`
	
	`geoshow([land.Lat], [land.Lon])`

`load topo`
 	
`worldmap(topo,topolegend,'dem3donly')`
	`load topo`
	
	`worldmap(topo,topolegend)`
	
	`meshm(topo,topolegend,size(topo),topo)`
	
	`demcmap(topo)`

`load korea`
 	
`worldmap(map,refvec,'mesh')`
	`load korea`
	
	`worldmap(map,refvec)`
	
	`meshm(map,refvec)`
	
	`land = shaperead('landareas.shp','UseGeoCoords',true);`
	
	`geoshow([land.Lat], [land.Lon])`
	
	(Text North Korea and South Korea will be missing)

`load korea`
 	
`worldmap(map,refvec,'meshonly')`
	`load korea`
	
	`worldmap(map,refvec)`
	
	`meshm(map,refvec)`

Mapping 1.x to 2.0.x Usage	Mapping 2.1 Usage

`load topo`
 	
`worldmap(topo,topolegend,'mesh3d')`
	`load topo`
	
	`worldmap(topo,topolegend)`
	
	`meshm(topo,topolegend,size(topo),topo)`
	
	`da = daspect;`
	
	`pba = pbaspect;`
	
	`da(3) = 7.5*pba(3)/da(3);`
	
	`daspect(da);`

`load topo`
 	
`worldmap(topo,topolegend,'mesh3donly')`
	`load topo`
	
	`worldmap(topo,topolegend)`
	
	`meshm(topo,topolegend,size(topo),topo)`

`load topo`
 	
`worldmap(topo,topolegend,'ldem3d')`
	`load topo`
	
	`worldmap(topo,topolegend)`
	
	`meshm(topo,topolegend,size(topo),topo)`
	
	`da = daspect;`
	
	`pba = pbaspect;`
	
	`da(3) = 7.5*pba(3)/da(3);`
	
	`daspect(da);`
	
	`demcmap(topo)`
	
	`camlight(90,5);`
	
	`camlight(0,5);`
	
	`lighting phong`
	
	`material([0.25 0.8 0])`

Mapping 1.x to 2.0.x Usage	Mapping 2.1 Usage

`load topo`
 	
`worldmap(topo,topolegend,'ldem3donly')`
	`load topo`
	
	`worldmap(topo,topolegend)`
	
	`meshm(topo,topolegend,size(topo),topo)`
	
	`da = daspect;`
	
	`pba = pbaspect;`
	
	`da(3) = 7.5*pba(3)/da(3);`
	
	`daspect(da);`
	
	`demcmap(topo)`

`load topo`
 	
`worldmap(topo,topolegend,'lmesh3d')`
	`load topo`
	
	`worldmap(topo,topolegend)`
	
	`meshm(topo,topolegend,size(topo),topo)`
	
	`da = daspect;`
	
	`pba = pbaspect;`
	
	`da(3) = 2*pba(3)/da(3);`
	
	`daspect(da);`
	
	`camlight(90,5);`
	
	`camlight(0,5);`
	
	`lighting phong`
	
	`material([0.25 0.8 0])`

`load topo`
 	
`worldmap(topo,topolegend,'lmesh3donly')`
	`load topo`
	
	`worldmap(topo,topolegend)`
	
	`meshm(topo,topolegend,size(topo),topo)`
	
	`da = daspect;`
	
	`pba = pbaspect;`
	
	`da(3) = 2*pba(3)/da(3);`
	
	`daspect(da);`

Mapping 1.x to 2.0.x Usage	Mapping 2.1 Usage

`load korea`
 	
`worldmap(map, refvec)`
	`load korea`
	
	`worldmap(map,refvec)`
	
	`land = shaperead('landares.shp','UseGeoCoords',true)`
	
	`geoshow([land.Lat], [land.Lon])`
	
	(Text North Korea and South Korea will be missing. Land area boundaries resolution is lower.)

`load korea`
 	
`worldmap(map,refvec,'lineonly')`
	`load korea`
	
	`worldmap(map,refvec)`
	
	`land = shaperead('landareas.shp','UseGeoCoords',true);`
	
	`geoshow([land.Lat], [land.Lon])`

`load korea`
 	
`worldmap(map,refvec,'none')`
	`load korea`
	
	`worldmap(map,refvec)`

`load korea`
 	
`worldmap(map,refvec,'patch')`
	`load korea`
	
	`worldmap(map,refvec)`
	
	`land = shaperead('landareas.shp','UseGeoCoords',true);`
	
	`faceColors = makesymbolspec('Polygon',{'INDEX',[1 numel(land)],'Facecolor',polcmap(numel(land))});`
	
	`geoshow(land,'SymbolSpec',makesymbolspec('Polygon',faceColors))`
	
	(Text North Korea and South Korea will be missing. Country coloring will be missing.)

`load korea`
 	
`worldmap(map, refvec,'patchonly')`
	`load korea`
	
	`worldmap(map,refvec)`
	
	`land = shaperead('landareas.shp','UseGeoCoords',true);`
	
	`faceColors = {'INDEX',[1 numel(land)],'FaceColor',polcmap(numel(land))};`
	
	`geoshow(land,'SymbolSpec',faceColors)`
	
	(Country coloring will be missing.)

Version History

- The following input options are now obsolete (if used, a warning is issued):
  - A first argument equal to `'lo'` or `'hi'`.
  - The `regiononly` and `stateonly` syntax: a state or country name with the character vector `'only'` appended.
  - All `type` options are now obsolete. The new behavior matches the `'none'` option.

Data Files Added in This Release

The following files were added to the `mapdemos` directory, for use in toolbox demos and examples:

- `landareas` — Polygon shapefile: global coastlines, both exterior and interior, including names for larger land masses
- `worldlakes` — Polygon shapefile: coastlines and names of major lakes and inland seas worldwide
- `worldrivers` — PolyLine shapefile: major world rivers and their names
- `worldcities` — Point shapefile: locations and names of major cities and populated places worldwide
- `usastatelo` — Polygon shapefile: low-resolution outlines and names of the 50 U.S. states plus D.C.
- `usastatehi` — Polygon shapefile: moderate-resolution outlines and names of the 50 U.S. states plus D.C.
- `conus` — MAT-file: Low-resolution latitudes and longitudes, in degrees, for the perimeter of the conterminous United States (CONUS), the Great Lakes, and interstate borders
- `greatlakes` — MAT-file: A Version 1 geographic data structure (geostruct1) with outlines and names for the Great Lakes of North America

Atlas Data MAT-Files Removed in This Release

MAT-files containing Atlas Data have been removed in Version 2.1. Some of the data has been retained in a different form. The disposition of these data sets and variables is described below.

World MAT-File Data

- `worldlo.mat`, which contained the following variables:
  - `DNline` — Data moved to `worldrivers.shp`
  - `DNpatch` — Data moved to `worldlakes.shp`
  - `POline` — Data removed from toolbox
  - `POtext` — Data removed from toolbox
  - `PPpoint` — Data moved to `worldcities.shp`
  - `PPtext` — Data moved to `worldcities.shp`
  - `gazette` — Data removed from toolbox
- `worldhi.mat` — Data removed from toolbox
- `worldmtx.mat` — Data removed from toolbox

- `worldmtxmed.mat` — Data removed from toolbox

United States MAT-File Data

- `usalo.mat`, which contained the following variables (all retained):
  - `conus` — Data moved to `conus.mat`
  - `greatlakes` — Data moved to `greatlakes.mat`
  - `gtlakelat` — Data moved to `conus.mat`
  - `gtlakelon` — Data moved to `conus.mat`
  - `state` — Data moved to `usastatelo.shp`
  - `stateborder` — Data moved to `conus.mat`
  - `statelat` — Data moved to `conus.mat`
  - `statelon` — Data moved to `conus.mat`
  - `uslat` — Data moved to `conus.mat`
  - `uslon` — Data moved to `conus.mat`
- `usahi.mat` — Data moved to `usastatehi.shp`

Functions Being Removed

Functionality	What Happens When You Use This Functionality?	Use This Instead	Compatibility Considerations
`etopo5`	Still works but issues a warning	`etopo`	Replace instances of `etopo5` with `etopo`.
`tigerp`	Errors	`shaperead`	Download U.S. Census cartographic boundary files in shapefile format and use `shaperead` instead
`tigermif`	Errors	`shaperead`	Download U.S. Census cartographic boundary files in shapefile format and use `shaperead` instead
`country2mtx`	Errors	N/A	Functions that performed specific operations on Atlas Data sets have been removed.
`usahi`	Errors	N/A	Functions that performed specific operations on Atlas Data sets have been removed.

Functionality	What Happens When You Use This Functionality?	Use This Instead	Compatibility Considerations
`usalo`	Errors	N/A	Functions that performed specific operations on Atlas Data sets have been removed.
`worldhi`	Errors	N/A	Functions that performed specific operations on Atlas Data sets have been removed.
`worldlo`	Errors	N/A	Functions that performed specific operations on Atlas Data sets have been removed.