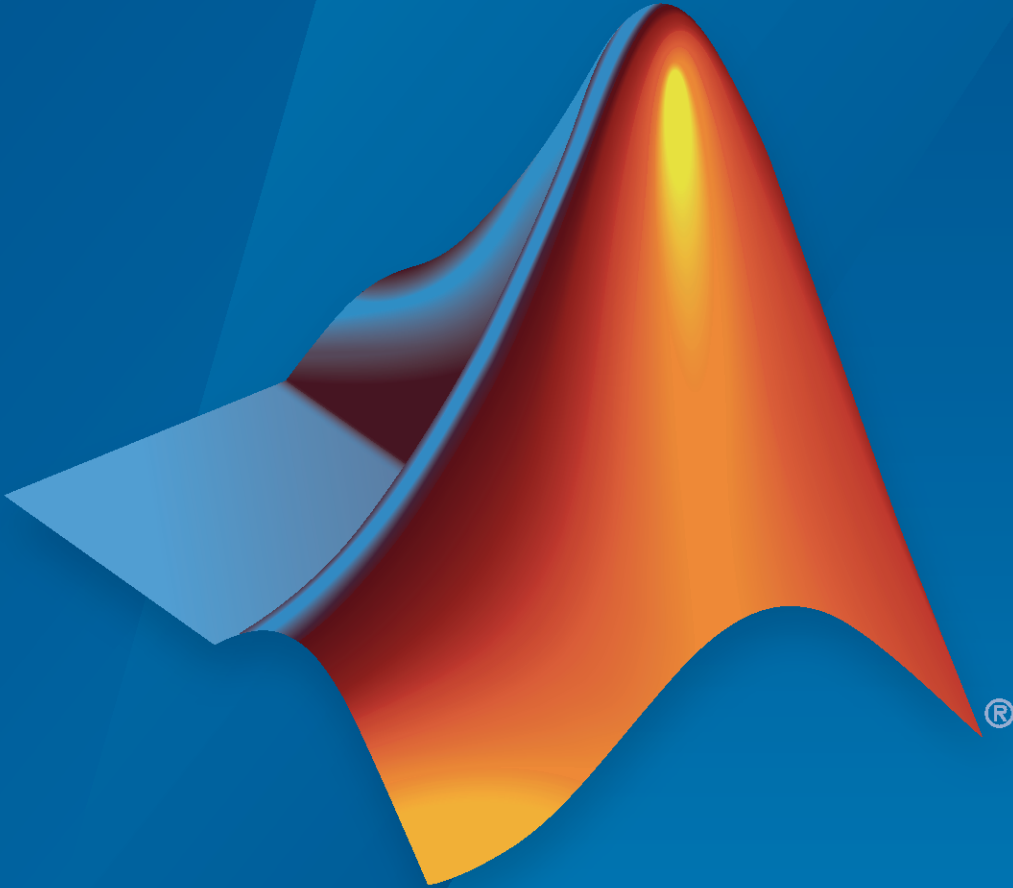


# Mapping Toolbox™ Release Notes



# MATLAB®



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### *Mapping Toolbox™ Release Notes*

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## R2025b

<b>Quality and stability improvements</b> .....	1-2
-------------------------------------------------	-----

## R2025a

<b>Geocoding: Use online provider to get shapes from street addresses and other placenames</b> .....	2-2
<b>Vector Import: Read vector data from GeoPackage files</b> .....	2-2
<b>Vector Data: Perform Boolean operations on shape objects</b> .....	2-2
<b>buffer Function: Improved performance when buffering multiple shapes in planar coordinates</b> .....	2-2
<b>Vector Data Plotting: Create data tips on point, line, and polygon shapes</b> .....	2-2
<b>Raster Import: readgeoraster automatically standardizes missing data</b> .....	2-3
<b>Raster Data: Resample raster data</b> .....	2-3
<b>Basemaps: Geographic axes use limits of custom basemaps</b> .....	2-3
<b>Basemaps: Add basemap picker to axes toolbar in any type of figure</b> ...	2-4
<b>Areas of Interest: Create quadrangular AOIs with boundaries that follow great-circle paths</b> .....	2-4
<b>3-D Geographic Plotting: Capture images of geographic globes</b> .....	2-4
<b>WMS Database: Search updated database</b> .....	2-4
<b>Functionality being removed or changed</b> .....	2-5
Web maps will be removed .....	2-5

<b>Icon Charts: Display icons at geographic coordinates</b> .....	3-2
<b>Offline Basemaps: Create MBTiles files and add custom basemaps from images or data grids</b> .....	3-2
<b>Basemaps: Add custom basemaps from Web Map Service data</b> .....	3-2
<b>Areas of Interest: Create quadrangular and circular areas of interest</b> ...	3-3
<b>Geocoding: Get shape object from specified placename</b> .....	3-3
<b>Vector Data: Calculate bounds of shape object</b> .....	3-3
<b>Vector Data: Buffer shape objects</b> .....	3-3
<b>Vector Data: Clip shape objects to polygon</b> .....	3-3
<b>Raster Import: Read data from compressed GRIB files</b> .....	3-3
<b>Raster Import: Read data using int8, int64, and uint64 data types</b> .....	3-3
<b>WMS Database: Search updated database</b> .....	3-3
<b>Functionality being removed or changed</b> .....	3-4
sdtsinfo will be removed on Windows and Mac platforms .....	3-4
sdtsinfo has been removed on Linux platforms .....	3-4
Some raster reading functions have been removed .....	3-4
Some functions that accept referencing matrices as inputs have been removed .....	3-4
Some functions no longer accept referencing vectors or referencing matrices as input .....	3-4
Some file import, map display, and geometric geodesy UI functions have been removed .....	3-5
Some clipping and trimming functions have been removed .....	3-6
DeLorme World Basemap base layer has been removed from web map ...	3-6

<b>Vector Data: Calculate area, perimeter, and line length of shape objects</b> .....	4-2
<b>Raster Data: Merge adjacent raster tiles</b> .....	4-2
<b>Map Axes: Customize behavior of interactions in apps</b> .....	4-2
<b>WMS Database: Search updated database</b> .....	4-2

<b>Functionality being removed or changed</b> . . . . .	<b>4-3</b>
dted will be removed . . . . .	<b>4-3</b>
Some clipping and trimming functions will be removed . . . . .	<b>4-3</b>
Some functions that accept referencing vectors or referencing matrices as inputs have been removed . . . . .	<b>4-3</b>
Some default colors for axesm-based maps have changed . . . . .	<b>4-3</b>
Ocean Basemap base layer in web map does not display text labels . . . . .	<b>4-4</b>

## R2023b

<b>Vector Import: Read data and buildings from OpenStreetMap files</b> . . . . .	<b>5-2</b>
<b>Vector Import: Read data from KMZ files</b> . . . . .	<b>5-2</b>
<b>Raster Import: Read data from GRIB files</b> . . . . .	<b>5-3</b>
<b>Raster Import: Read geospatial data from JPEG 2000 files</b> . . . . .	<b>5-3</b>
<b>readgeoraster Function: Improved performance when reading data with multiple bands</b> . . . . .	<b>5-3</b>
<b>shapewrite Function: Write projection file containing WKT string representation of CRS</b> . . . . .	<b>5-3</b>
<b>Basemaps: Some basemaps have improved appearance at high zoom levels</b> . . . . .	<b>5-3</b>
<b>3-D Geographic Plotting: Improved camera placement on geographic globe</b> . . . . .	<b>5-4</b>
<b>cropToBlock Function: Crop raster reference object to row and column limits of raster</b> . . . . .	<b>5-5</b>
<b>utmzone and utmzoneui Functions: Query nonstandard zones in northern Europe</b> . . . . .	<b>5-5</b>
<b>WMS Database: Search updated database</b> . . . . .	<b>5-6</b>
<b>Functionality being removed or changed</b> . . . . .	<b>5-6</b>
sdtsinfo will be removed . . . . .	<b>5-6</b>
Some functions will not accept referencing vectors or referencing matrices as input in a future release . . . . .	<b>5-6</b>
Some file import, map display, and geometric geodesy UI functions will be removed in a future release . . . . .	<b>5-8</b>
Some raster reading functions have been removed . . . . .	<b>5-8</b>
Some functions that return referencing vectors or referencing matrices have been removed . . . . .	<b>5-8</b>
Some functions that accept referencing vectors or referencing matrices as inputs have been removed . . . . .	<b>5-9</b>
Some function syntaxes that return referencing vectors or referencing matrices have been removed . . . . .	<b>5-9</b>

<b>Map Axes: Create maps in any supported projection using new axes type</b>	<b>6-2</b>
<b>Coordinate Reference Systems: Change projection parameters for projected CRS objects</b>	<b>6-3</b>
<b>Vector Basemaps: Add custom basemaps from vector basemaps hosted by Esri and from MBTiles files containing vector data</b>	<b>6-3</b>
<b>WMS Database: Search updated database</b>	<b>6-4</b>
<b>Functionality being removed or changed</b>	<b>6-5</b>
Some functions that accept referencing matrices as inputs will be removed in a future release	<b>6-5</b>
mfwdtran and minvtran will be removed in a future release	<b>6-5</b>
Some file import, map display, data analysis, and geometric geodesy functions have been removed	<b>6-5</b>

<b>Vector Data: Determine which shape objects are multipoint shapes</b>	<b>7-2</b>
<b>georasterinfo function: Read RPC coefficient tags from GeoTIFF files</b>	<b>7-2</b>
<b>projfwd and projinv functions: Improved performance on Windows with repeated use of projection</b>	<b>7-2</b>
<b>Web Map Service: New server with terrain elevation data hosted by MathWorks</b>	<b>7-3</b>
<b>WMS Database: Search updated database</b>	<b>7-3</b>
<b>Documentation refers to maps created using axesm, worldmap, or usamap as axesm-based maps</b>	<b>7-3</b>
<b>Functionality being removed or changed</b>	<b>7-3</b>
Adding new plot to geographic globe does not reset basemap or terrain	<b>7-3</b>
combntns has been removed	<b>7-4</b>
Some functions that accept referencing vectors or referencing matrices as inputs will be removed in a future release	<b>7-5</b>
Some functions will not accept referencing vectors or referencing matrices as input in a future release	<b>7-5</b>
Some file import, map display, and geometric geodesy UI functions will be removed in a future release	<b>7-6</b>
shapewrite truncates text when length exceeds 254 characters or value of FieldLength	<b>7-6</b>

<b>Vector Data: Create maps from point, line, and polygon shapes or geospatial tables</b> .....	<b>8-2</b>
<b>Vector Data: Clip point, line, and polygon shapes and determine if points are within polygons</b> .....	<b>8-2</b>
Clip point, line, and polygon shapes to bounding box .....	<b>8-2</b>
Determine if points are within polygons .....	<b>8-3</b>
<b>Basemaps: Add custom basemap from MBTiles file</b> .....	<b>8-3</b>
<b>Basemaps: Read georeferenced image from basemap</b> .....	<b>8-3</b>
<b>Raster Data: Read coordinate reference system for GeoTIFF files using geotiffinfo</b> .....	<b>8-4</b>
<b>LAS and LAZ Data: Read coordinate reference system for LAS and LAZ files using Lidar Toolbox</b> .....	<b>8-5</b>
<b>WMS Database: Search updated database</b> .....	<b>8-5</b>
<b>Functionality being removed or changed</b> .....	<b>8-5</b>
Some functions that return referencing vectors or referencing matrices will be removed in a future release .....	<b>8-5</b>
Some functions that accept referencing vectors or referencing matrices as inputs will be removed in a future release .....	<b>8-6</b>
Some function syntaxes that return referencing vectors or referencing matrices will be removed in a future release .....	<b>8-6</b>
Some file import, map display, data analysis, and geometric geodesy functions will be removed in a future release .....	<b>8-6</b>
Some file import, map display, and angle wrapping functions have been removed .....	<b>8-7</b>
USGS Shaded Relief base layer has been removed from web map .....	<b>8-8</b>
geopointshape and mappointshape objects with missing coordinate data have some changed property values .....	<b>8-8</b>

<b>Vector Data: Read, display, and write vector data using geospatial tables</b> .....	<b>9-2</b>
Read vector data from files into geospatial tables .....	<b>9-2</b>
Create maps using geospatial tables .....	<b>9-2</b>
Write geospatial tables to shapefile and KML formats .....	<b>9-2</b>
Convert between structures, tables, and geospatial tables .....	<b>9-2</b>
<b>Basemaps: Interactively change basemap of geographic plots</b> .....	<b>9-3</b>
<b>Raster Import: Read SRTM Height data</b> .....	<b>9-3</b>

<b>WMS Database: Search updated database</b> .....	<b>9-3</b>
<b>Functionality being removed or changed</b> .....	<b>9-4</b>
Some functions that accept referencing matrices as inputs will be removed in a future release .....	<b>9-4</b>
Some raster reading functions that do not return reference objects will be removed in a future release .....	<b>9-4</b>
Previous removal of coast.mat file .....	<b>9-4</b>

## R2021a

<b>Raster Import: Read data in Vertical Mapper Grid formats</b> .....	<b>10-2</b>
<b>Raster Analysis: Get geographic or world coordinates of raster elements</b> .....	<b>10-2</b>
<b>3-D Geographic Plotting: Use geographic globes in MATLAB Online</b> ...	<b>10-2</b>
<b>Code Generation: Generate C and C++ code using MATLAB Coder</b> ....	<b>10-2</b>
<b>Web Map Service: Read WMS capabilities documents from additional servers, get additional keywords, get additional layer information</b> ..	<b>10-2</b>
<b>WMS Database: Search updated database</b> .....	<b>10-2</b>
<b>Functionality being removed or changed</b> .....	<b>10-3</b>
Web maps appear in multiple windows and have a default size .....	<b>10-3</b>
Some functions that accept referencing vectors or matrices as inputs will be removed in a future release .....	<b>10-3</b>
geoloc2grid and vec2mtx functions return raster reference objects .....	<b>10-3</b>

## R2020b

<b>3-D Geographic Plotting: Programmatically navigate geographic globe using camera functions</b> .....	<b>11-2</b>
<b>Coordinate Reference Systems: Create projected and geographic CRS objects from imported data, named spatial reference codes, or well- known text strings</b> .....	<b>11-2</b>
<b>Coordinate Reference Systems: Project or unproject coordinates using projcrs objects and additional map projection structures</b> .....	<b>11-2</b>
<b>Coordinate Reference Systems: Use reference ellipsoid information in geocrs objects with analysis functions</b> .....	<b>11-2</b>
<b>WMS Database: Search updated database</b> .....	<b>11-2</b>

<b>Functionality being removed or changed</b> .....	<b>11-3</b>
mfwdtran will be removed in a future release .....	<b>11-3</b>
minvtran will be removed in a future release .....	<b>11-3</b>
Some functions that return referencing matrices will be removed in a future release .....	<b>11-3</b>
Some functions that accept referencing vectors or matrices as inputs will be removed in a future release .....	<b>11-3</b>
Some function syntaxes that return referencing vectors or referencing matrices will be removed in a future release .....	<b>11-3</b>
Name property for some referenceEllipsoid objects has changed .....	<b>11-4</b>
Path for example data files has changed .....	<b>11-4</b>
EPSG CSV files have been removed .....	<b>11-4</b>

## R2020a

<b>3-D Geographic Plotting: Plot 3-D data on globe display using geoglobe and geoplot3</b> .....	<b>12-2</b>
<b>3-D Geographic Plotting: Add and remove custom terrain</b> .....	<b>12-2</b>
<b>egm96geoid Function: Return geoid heights referenced to geographic reference object</b> .....	<b>12-2</b>
<b>MATLAB Online: Mapping Toolbox is supported on MATLAB Online</b> ...	<b>12-2</b>
<b>Raster Cropping: Crop raster data using mapcrop and geocrop</b> .....	<b>12-2</b>
<b>Raster Import: Read geospatial raster data from a file using readgeoraster and georasterinfo</b> .....	<b>12-3</b>
<b>WMS Database: Search updated database</b> .....	<b>12-3</b>
<b>Functionality being removed or changed</b> .....	<b>12-3</b>
arcgridread and geotiffread are not recommended .....	<b>12-3</b>
Raster reading functions that do not return reference objects will be removed in a future release .....	<b>12-4</b>
Compiling web maps using Linux requires files in directory of application .....	<b>12-4</b>

## R2019b

<b>egm96geoid Function: Return geoid heights at specified latitudes and longitudes</b> .....	<b>13-2</b>
<b>egm96geoid Function: Return geoid heights with improved performance</b> .....	<b>13-2</b>

<b>WMS Database: Modified or removed servers</b> .....	<b>13-2</b>
<b>Functionality being removed or changed</b> .....	<b>13-3</b>
Different polygon vertex order for poly2v and bufferm function output .....	<b>13-3</b>

# R2025b

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**Version: 25.2**

**Bug Fixes**

## **Quality and stability improvements**

R2025b delivers quality and stability improvements, building on the new features introduced in R2025a.

# R2025a

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**Version: 25.1**

**New Features**

**Bug Fixes**

**Compatibility Considerations**

## ★ **Geocoding: Use online provider to get shapes from street addresses and other placenames**

The `geocode` function uses an online provider in addition to the installed list of placenames. As a result, you can now geocode the names of street addresses, provinces, counties, and land or water features. You can also geocode the names of additional regions, states, and cities.

## ★ **Vector Import: Read vector data from GeoPackage files**

The `readgeotable` function enables you to read vector data from files in the GeoPackage format (`.gpkg`).

## ★ **Vector Data: Perform Boolean operations on shape objects**

Calculate the intersection, union, difference, or exclusive OR of shape objects by using the `intersect`, `union`, `subtract`, or `xor` function, respectively.

## **buffer Function: Improved performance when buffering multiple shapes in planar coordinates**

The `buffer` function shows improved performance when buffering multiple shapes in planar coordinates. Represent shapes in planar coordinates using `mappointshape`, `maplineshape`, or `mappolyshape` objects.

For example, this code creates 500 line shape objects and then buffers the shapes using the `buffer` function. The code is about 1.9 times faster than in the previous release.

```
function timingTest
    % Get shapes
    x = linspace(1,100,1000);
    shp = maplineshape(x,x);
    shps = repmat(shp,500,1);

    % Buffer shapes
    b = buffer(shps,1);
end
```

The approximate execution times are:

- **R2024b:** 0.72 s
- **R2025a:** 0.37 s

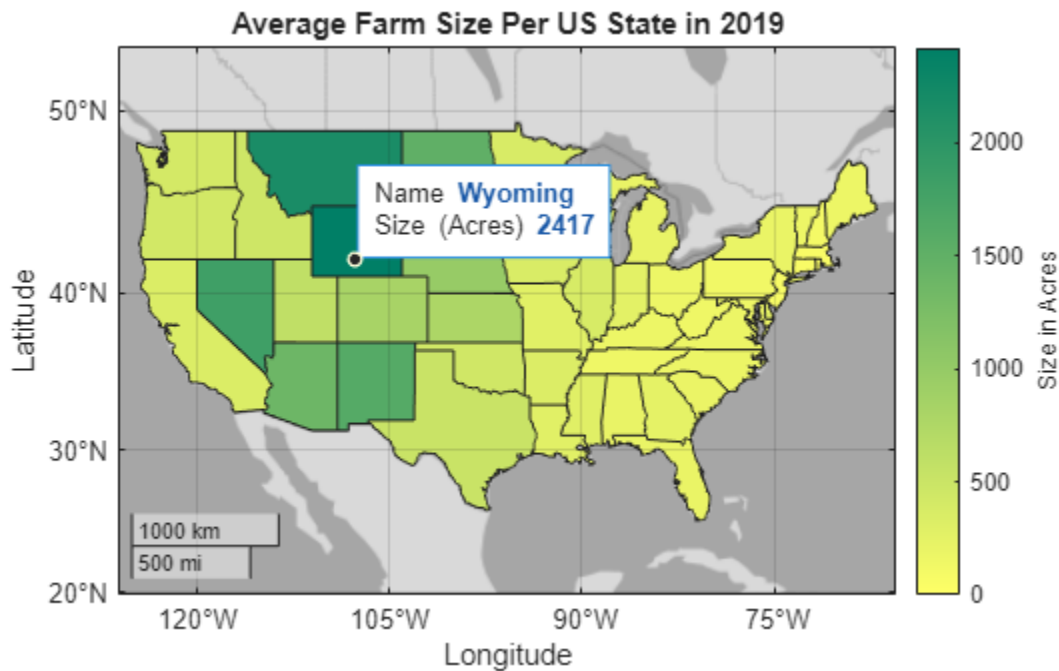
This code was timed on a Windows® 11, AMD EPYC™ 74F3 24-Core Processor @ 3.19 GHz test system, using the `timeit` function:

```
timeit(@timingTest)
```

## **Vector Data Plotting: Create data tips on point, line, and polygon shapes**

Create custom data tips on point, line, and polygon shapes displayed using the `geoplot` function. You can programmatically add data tips by using the `datatip` function, or interactively add data tips by

pausing on, clicking, or tapping the shape. For more information, see [Add Data Tips to Point, Line, and Polygon Shapes](#).



### ▲ **Raster Import: readgeoraster automatically standardizes missing data**

When the `readgeoraster` function returns data using the `single` or `double` data type, the function automatically replaces missing data with `NaN` values. In previous releases, the function did not replace missing data. You can prevent the function from replacing missing data by specifying the `StandardizeMissing` name-value argument as `false`.

As a result of this change, you might need to update your code. For more information about updating your code, see the [Version History](#) section of the `readgeoraster` reference page.

### **Raster Data: Resample raster data**

Resample raster data in geographic coordinates by using the `georesample` function, and resample raster data in planar map coordinates by using the `mapresample` function. You can use these functions to match the resolution, size, or limits of a data set to the resolution, size, or limits of a related data set.

### **Basemaps: Geographic axes use limits of custom basemaps**

When you create a custom basemap from an image, a data grid, an MBTiles file, or Web Map Service (WMS) data by using the `addCustomBasemap` function, and then create a geographic axes that uses the custom basemap, MATLAB® sets the limits of the axes to closely match the limits of the basemap data. This capability is useful for viewing custom basemaps added from local or regional data. Note

that, when you plot additional data, the limits of the axes can change from the limits of the basemap data.

## **Basemaps: Add basemap picker to axes toolbar in any type of figure**

The `addToolBarMapButton` function enables you to add a basemap picker to an axes toolbar in any type of figure. In previous releases, the function required you to create the figure using the `uifigure` function.

## **Areas of Interest: Create quadrangular AOIs with boundaries that follow great-circle paths**

Use the `aoiquad` function and the `InterpolationMethod` name-value argument to create areas of interest (AOIs) with boundaries that follow great-circle or geodesic paths.

## **3-D Geographic Plotting: Capture images of geographic globes**

Capture images of geographic globes by using the `getframe` function. For an example that shows how to write an image of a geographic globe to a file, see [Capture Image of Geographic Globe](#).

## **WMS Database: Search updated database**

The WMS Database has 54 new servers and 41,015 new layers. In addition, 656 servers and 14,761 layers have been removed. The updated database contains 1335 servers and 77,714 layers. Search the database for layers using the `wmsfind` function.

The WMS Database has these specific updates.

- There are 37 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 layers from this server by specifying the search string as `"coastwatch.pfeg.noaa.gov"`.

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

- There are 4 new WMS servers from the Getmapping Web Map Service. You can search for layers from these servers by specifying the search string as `"getmapping.com"`.

```
layer = wmsfind("getmapping.com",SearchFields="serverurl");
```

- There is 1 new WMS server for the GeoMet-Climate service from the MSC GeoMet platform. You can search for layers from this server by specifying the search string as `"geo.weather.gc.ca/geomet-climate"`.

```
layer = wmsfind("geo.weather.gc.ca/geomet-climate",SearchFields="serverurl");
```

- There are 3 new WMS servers from the Earth Observation Center (EOC) Geoservice. You can search for layers from these servers by specifying the search string as `"geoservice.dlr.de/eoc"`.

```
layer = wmsfind("geoservice.dlr.de/eoc",SearchFields="serverurl");
```

- There is 1 new WMS server from the US Naval Research Laboratory (NRL) Tileserver. You can search layers from this server by specifying the search string as `"geoint.nrlssc.navy.mil"`.

```
layer = wmsfind("geoint.nrlssc.navy.mil",SearchFields="serverurl");
```

- There is 1 new WMS server from the Bhuvan Indian Geo Platform of ISRO. You can search for layers from this server by specifying the search string as "bhuvan-vec1.nrsc.gov.in".

```
layer = wmsfind("bhuvan-vec1.nrsc.gov.in",SearchFields="serverurl");
```

## ▲ Functionality being removed or changed

### Web maps will be removed

*Still runs*

Web maps will be removed in a future release. Use geographic axes instead. Unlike web maps, geographic axes enable you to:

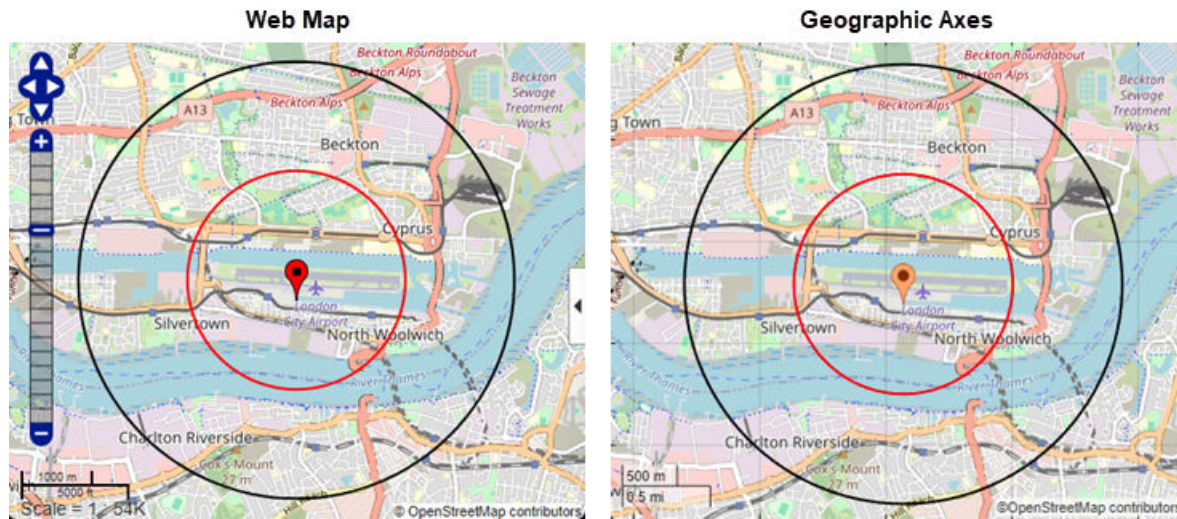
- Customize your maps using MATLAB graphics functions. For example, you can add text and legends, specify the color order palette, and change the appearance of the grid lines.
- Display data using additional plots types, including density plots and bubble charts.
- Build apps using App Designer.

As a result of this change, these functions will be removed in a future release. In many cases, you can update your code by using these replacement patterns.

To Be Removed	Replacement Pattern
webmap	<p>Use a geographic axes object instead.</p> <ul style="list-style-type: none"> <li>• Create a geographic axes object by using a geographic plotting function such as <code>geoplot</code> or <code>geobasemap</code>.</li> <li>• When you want advanced control of the geographic axes object, use the <code>geoaxes</code> function.</li> </ul> <p>To use base layer options such as "Open Street Map" and "World Physical Map", add a custom basemap by using the <code>addCustomBasemap</code> function. Then, display the custom basemap in a geographic axes object by using the <code>geobasemap</code> function.</p>
wmmarker	Use the <code>geoiconchart</code> function instead.
wmline	Use the <code>geoplot</code> function instead.
wmpolygon	Use a <code>geopolyshape</code> object and the <code>geoplot</code> function instead.
wmremove	Use the <code>delete</code> function instead.
wmcenter	Use the <code>MapCenter</code> property of the geographic axes object instead.
wmzoom	Use the <code>ZoomLevel</code> property of the geographic axes object instead.
wmlimits	Use the <code>geolimits</code> function instead.

To Be Removed	Replacement Pattern
wmclose	Use the cclose function instead.
wmprint	Use an export option from Compare Ways to Export Graphics from Figures instead.

This image shows a web map created using the `webmap`, `wmline`, and `wmmarker` functions and a geographic axes object created using the `geoplot`, `geoiconchart`, `addCustomBasemap`, and `geobasemap` functions.



For more information about updating your code to use geographic axes, see [Web Map Migration Strategies](#).

# R2024b

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**Version: 24.2**

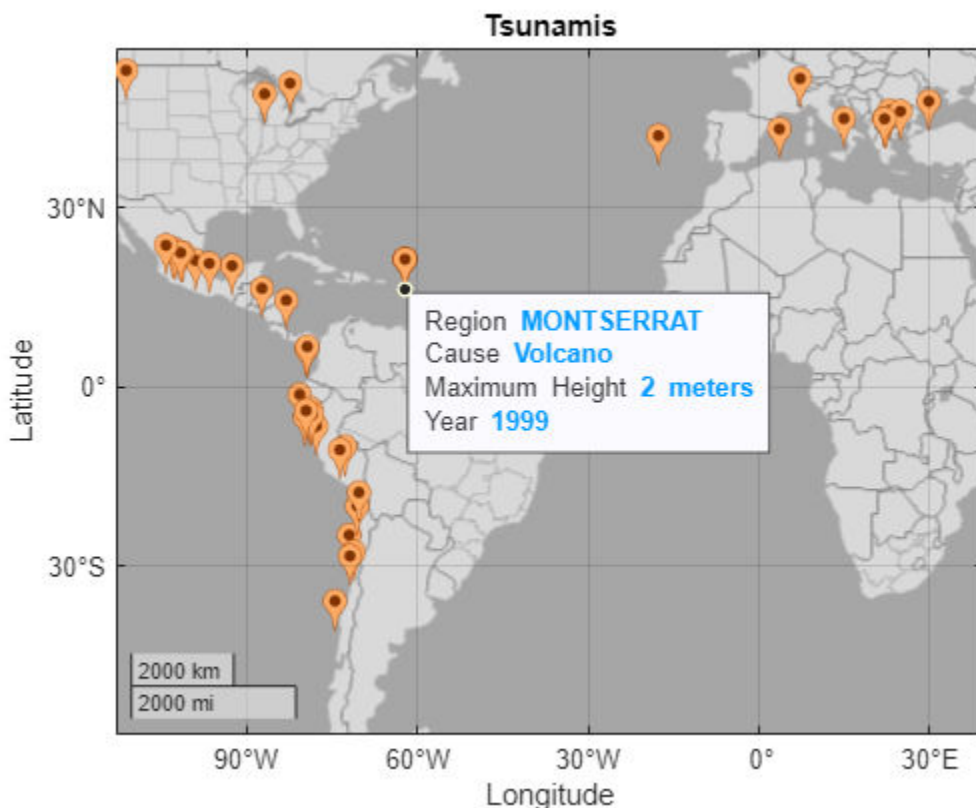
**New Features**

**Bug Fixes**

**Compatibility Considerations**

## ★ Icon Charts: Display icons at geographic coordinates

The `geoiconchart` function enables you to display icons on a map at the specified latitude-longitude coordinates. You can display icons on geographic axes or map axes. For more information about displaying icons on maps, see [Create Maps Using Icons](#).



## ★ Offline Basemaps: Create MBTiles files and add custom basemaps from images or data grids

These capabilities enable new strategies for using custom basemaps in offline environments:

- Add a custom basemap from a georeferenced image or data grid by using the `addCustomBasemap` function. Specify the image or data grid by using an array and a raster reference object.
- Write a georeferenced image or data grid to an MBTiles file by using the `mbtileswrite` function. You can create custom basemaps from MBTiles files by using the `addCustomBasemap` function.

### Basemaps: Add custom basemaps from Web Map Service data

You can now use the `addCustomBasemap` function to add custom basemaps from these sources:

- Web Map Service (WMS) layers — Specify the layers using `WMSLayer` objects.
- URLs containing WMS GetMap requests — Get a URL by querying the `RequestURL` property of a `WMSMapRequest` object.

---

For more information about adding custom basemaps from WMS data, see [Add Custom Basemaps from WMS Data](#).

## ★ **Areas of Interest: Create quadrangular and circular areas of interest**

An area of interest (AOI) defines a focus area for a map analysis and visualization. Create quadrangular AOIs by using the `aoiquad` function, and create circular AOIs by using the `aoicircle` function. These functions represent AOIs using shape objects in geographic or planar coordinates. For more information about creating AOIs, see [Define Areas of Interest](#).

## **Geocoding: Get shape object from specified placename**

The `geocode` function enables you to get a shape object in geographic coordinates by geocoding the specified placename. You can search an installed list of regions, states, and cities, or specify a custom list. Use the `placenames` function to view the installed list of placenames.

## **Vector Data: Calculate bounds of shape object**

The `bounds` function enables you to calculate the limits of the smallest quadrangle or rectangle that encloses the specified shape objects.

## **Vector Data: Buffer shape objects**

The `buffer` function creates a polygon shape that buffers the specified shape object by a specified distance.

## **Vector Data: Clip shape objects to polygon**

You can now use the `geoclip` and `mapclip` functions to clip shape objects to a polygon shape.

## **Raster Import: Read data from compressed GRIB files**

You can now use the `readgeoraster` and `georasterinfo` functions to read data from GRIB files that use Consultative Committee for Space Data Systems (CCSDS) compression, as defined by CCSDS recommended standard 121.0-B-3. Starting in July 2023, many GRIB files from the European Centre for Medium-Range Weather Forecasts (ECMWF) use this compression algorithm.

## **Raster Import: Read data using int8, int64, and uint64 data types**

The `readgeoraster` function now supports the `int8`, `int64`, and `uint64` data types.

## **WMS Database: Search updated database**

The WMS Database has 82 new servers and 7649 new layers. In addition, 1774 servers and 22,446 layers have been removed. The updated database contains 1937 servers and 51,460 layers. Search the database for layers using the `wms find` function.

The WMS Database has these specific updates.

- There are 10 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 are 2 new WMS servers from the Toporama Web Map Service (Toporama WMS) of the Earth Sciences Sector (ESS) at Natural Resources Canada (NRCan). You can search for these servers and layers by specifying the search string as "wms.ess-ws.nrcan.gc.ca".

```
layer = wmsfind("wms.ess-ws.nrcan.gc.ca",SearchFields="serverurl");
```

## ▲ **Functionality being removed or changed**

### **sdtsinfo will be removed on Windows and Mac platforms**

#### *Warns*

On Windows and Mac platforms, the `sdtsinfo` function will be removed in a future release. In most cases, use the `georasterinfo` function instead.

### **sdtsinfo has been removed on Linux platforms**

#### *Errors*

On Linux® platforms, the `sdtsinfo` function has been removed. In most cases, use the `georasterinfo` function instead.

### **Some raster reading functions have been removed**

#### *Errors*

The `etopo`, `globedem`, `gtopo30`, `satbath`, and `tbase` functions have been removed. In most cases, use the `readgeoraster` function instead.

### **Some functions that accept referencing matrices as inputs have been removed**

#### *Errors*

Some functions that accept referencing matrices as inputs have been removed. Use functions that accept reference objects instead.

- The `pix2map` function has been removed. Use the `intrinsicToWorld` function instead.
- The `map2pix` function has been removed. Use the `worldToIntrinsic` function instead.
- The `pix2latlon` function has been removed. Use the `intrinsicToGeographic` function instead.
- The `latlon2pix` function has been removed. Use the `geographicToIntrinsic` function instead.

### **Some functions no longer accept referencing vectors or referencing matrices as input**

#### *Errors*

Some file export, map display, and data analysis functions no longer accept referencing vectors or referencing matrices as input. Use raster reference objects as input instead.

---

### **File Export Functions**

- The `geotiffwrite` function no longer accepts referencing vectors or referencing matrices as input. Use a geographic raster reference object or a map raster reference object as input instead.
- The `worldfilewrite` function no longer accepts referencing matrices as input. Use a geographic raster reference object or a map raster reference object as input instead.

### **Map Display Functions**

These map display functions no longer accept referencing vectors or referencing matrices as input. Use a geographic raster reference object as input instead.

- `contourm`
- `contourfm`
- `contour3m`
- `meshm`
- `meshlsrm`
- `grid2image`

### **Data Analysis Functions**

These data analysis functions no longer accept referencing vectors or referencing matrices as input. Use a geographic raster reference object as input instead.

- `gradientm`
- `vec2mtx`
- `los2`
- `viewshed`
- `mapprofile`
- `imbedm`
- `areamat`
- `filterm`
- `findm`
- `neworig`

The `mapoutline` function no longer accepts referencing matrices or structure arrays as input. Use a geographic raster reference object or a map raster reference object as input instead.

### **Some file import, map display, and geometric geodesy UI functions have been removed**

#### *Errors*

#### **File Import UI Functions**

- The `demdataui` function has been removed. Use the `readgeoraster` function instead.
- The `vmap0ui` function has been removed. Use the `vmap0read` function instead.

#### **Map Display UI Functions**

- The `maptool` function has been removed. Select a replacement function based on the desired menu item. For more information about replacement functionality, see the `maptool` reference page.

- The `maptrim` function has been removed. Use the `geocrop` or `geoclip` function instead.
- The `originui` function has been removed. Instead, set the `Origin` property of the axesm-based map by using the `setm` function.
- The `parallelui` function has been removed. Instead, set the `MapParallels` property of the axesm-based map by using the `setm` function.
- The `clrmenu` function has been removed. Use the Colormap Editor instead.

#### **Geometric Geodesy UI Functions**

- The `trackui` function has been removed. Use the `trackg` function instead.
- The `surfdist` function has been removed. Use the `distance` function instead.
- The `scirclui` function has been removed. Use the `scircleg` function instead.
- The `sectorg` function has been removed. Use the `scircle1` function instead.

#### **Some clipping and trimming functions have been removed**

##### *Errors*

The `clipdata`, `trimdata`, `undoclip`, and `undotrim` functions have been removed.

#### **DeLorme World Basemap base layer has been removed from web map**

##### *Errors*

Starting in R2024b, the `webmap` function issues an error when you specify the base layer as "DeLorme World Basemap". In previous releases, the web map window shows red tiles. Update your code by specifying a different base layer, such as "World Street Map".

# R2024a

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**Version: 24.1**

**New Features**

**Bug Fixes**

**Compatibility Considerations**

## ★Vector Data: Calculate area, perimeter, and line length of shape objects

Calculate the area, perimeter, or line length of shape objects by using the `area`, `perimeter`, or `linelength` function.

- Use the `area` function to calculate the areas of polygon shapes represented by `geopolyshape` or `mappolyshape` objects.
- Use the `perimeter` function to calculate the perimeters of polygon shapes represented by `geopolyshape` or `mappolyshape` objects.
- Use the `linelength` function to calculate the lengths of line shapes represented by `geolineshape` or `maplineshape` objects.

## Raster Data: Merge adjacent raster tiles

Merge multiple adjacent raster tiles by using the `mergetiles` function.

## Map Axes: Customize behavior of interactions in apps

When you create map axes objects in App Designer or in figures created using the `uifigure` function, you can customize the behavior of axes interactions by using the `InteractionOptions` property of the map axes object. Customize the behavior of panning, zooming, adding data tips, and restoring the original view by changing properties of the `MapAxesInteractionOptions` object stored in the `InteractionOptions` property of the map axes object.

For a complete list of `MapAxesInteractionOptions` properties, see [MapAxesInteractionOptions Properties](#). For an example that shows how to customize the behavior of map axes interactions in an app, see [Create Map Axes in an App](#).

## WMS Database: Search updated database

The WMS Database has 101 new servers and 5258 new layers. In addition, 132 servers and 1,991 layers have been removed. The updated database contains 3632 servers and 66,299 layers. Search the database for layers using the `wmsfind` function.

The WMS Database has these specific updates.

- There are 7 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 are 42 new WMS servers from the Geoservices of the Government of Cantabria. For more information about these data sets, see [Servicios WMS - territorio de Cantabria](#) on the Cantabria Territory website. You can search for these servers and layers by specifying the search string as `"geoservicios.cantabria.es"`.

```
layer = wmsfind("geoservicios.cantabria.es",SearchFields="serverurl");
```

- 
- There are 2 new WMS servers from the Missouri Spatial Data Information Service (MSDIS). For more information about these data sets, see Imagery Data on the MSDIS website. You can search for these servers and layers by specifying the search string as "moimagery.missouri.edu".

```
layer = wmsfind("moimagery.missouri.edu", SearchFields="serverurl");
```

## ▲ Functionality being removed or changed

### **dted will be removed**

*Warns*

The `dted` function will be removed in a future release. Use the `readgeoraster` function instead.

### **Some clipping and trimming functions will be removed**

*Warns*

The `clipdata`, `trimdata`, `undoclip`, and `undotrim` functions will be removed in a future release.

### **Some functions that accept referencing vectors or referencing matrices as inputs have been removed**

*Errors*

Some functions that accept referencing vectors or referencing matrices as inputs have been removed. Use functions that accept reference objects instead.

- The `setltn` function has been removed. Use the `intrinsicToGeographic` function instead.
- The `meshgrat` function has been removed. Use the `geographicGrid`, `linspace`, or `ndgrid` function instead.
- The `setpostn` function has been removed. Use the `geographicToDiscrete` function instead.
- The `pixcenters` function has been removed. Use the `worldGrid` or `geographicGrid` function instead.

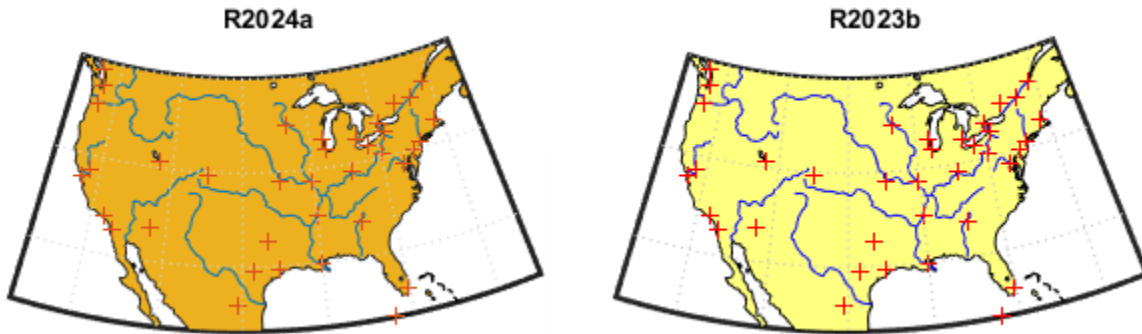
### **Some default colors for axesm-based maps have changed**

*Behavior change*

Starting in R2024a, axesm-based maps use some different default colors than in R2023b and previous releases. For example:

- When you plot vector data on axesm-based maps using functions such as `geoshow`, `mapshow`, `patchm`, and `linem`, the functions now use different default colors.
- When you create a map projection structure by using the `defaultm` function, or query a map projection structure of an axesm-based map by using the `getm` function, the value of the `FEdgeColor`, `GColor`, and `FontColor` fields is "default". When you query the `FEdgeColor`, `GColor`, or `FontColor` property of an axesm-based map by using the `getm` function, the function reports an RGB triplet instead of "default".

This image compares the default colors of points, lines, and polygons created by the `geoshow` function in R2024a and R2023b.



### **Ocean Basemap base layer in web map does not display text labels**

#### *Behavior change*

Starting in R2024a, the Ocean Basemap base layer in web map does not display text labels. In previous releases, the Ocean Basemap base layer might behave unexpectedly. For example, the web map might change the zoom level or display red tiles.

For information about how to display text labels on the Ocean Basemap base layer, see the Version History section of the webmap reference page.

# R2023b

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**Version: 23.2**

**New Features**

**Bug Fixes**

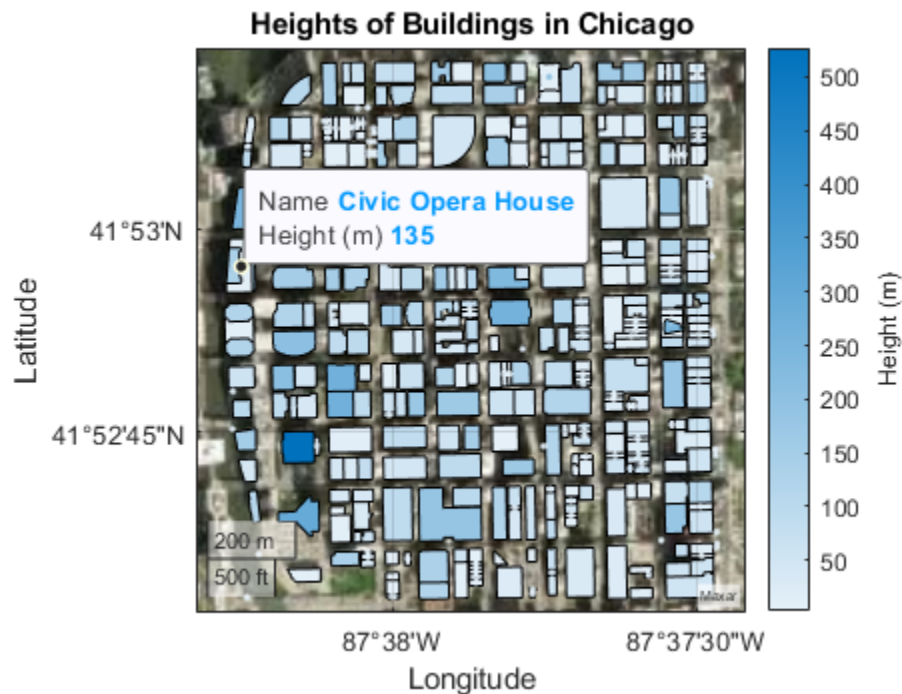
**Compatibility Considerations**

## Vector Import: Read data and buildings from OpenStreetMap files

Read data from a file in OpenStreetMap® format by using the `readgeotable` function.

- Read point, line, multilinestring, or multipolygon data from an OpenStreetMap file with the `.osm` or `.osm.pbf` extension by specifying the `Layer` name-value argument as `"points"`, `"lines"`, `"multilinestrings"`, or `"multipolygons"`, respectively. For an example that shows how to read data from OpenStreetMap files, see [Read Data from OpenStreetMap Files](#).
- Read buildings from an OpenStreetMap file with the `.osm` extension by specifying the `Layer` name-value argument as `"buildings"` or `"buildingparts"`. When you read buildings from an OpenStreetMap file, the function creates a geospatial table containing the building footprints and information such as the footprint centroids and the heights of the buildings. For an example that shows how to display buildings from OpenStreetMap files, see [Display Buildings from OpenStreetMap Files](#).

This image shows building footprints plotted over the "satellite" basemap in geographic axes.



You can download the OpenStreetMap file used to create this image from <https://www.openstreetmap.org>, which provides access to crowd-sourced map data all over the world. The data is licensed under the Open Data Commons Open Database License (ODbL), <https://opendatacommons.org/licenses/odbl/>.

## Vector Import: Read data from KMZ files

Read data from a file in KMZ format (`.kmz`) by using the `readgeotable` function. Similar to files in KML format, the function reads only the shapes, names, and descriptions from the file.

---

## Raster Import: Read data from GRIB files

Read data from a file in GRIB format (.grb, .grib, .grib2) by using the `readgeoraster` function. You can also get information about a GRIB file by using the `georasterinfo` function. In some cases, you can read a GRIB file when it has an extension other than the ones listed.

## Raster Import: Read geospatial data from JPEG 2000 files

Read geospatial data from a file in JPEG 2000 format (.jp2) by using the `readgeoraster` function. You can also get information about a JPEG 2000 file by using the `georasterinfo` function.

## readgeoraster Function: Improved performance when reading data with multiple bands

The `readgeoraster` function shows improved performance when reading data with multiple bands.

For example, this code creates a GeoTIFF file with 225 bands and then reads the file using the `readgeoraster` function. The code that reads the file is about 55 times faster than in the previous release.

```
function timingTest
    % Create a GeoTIFF file
    A1 = ones(180,360,225,"uint8");
    R1 = georefcells([-90 90],[-180 180],size(A1));
    geotiffwrite("mytif.tif",A1,R1)

    tic
    [A2,R2] = readgeoraster("mytif.tif");
    toc

    delete mytif.tif
end
```

The approximate execution times are:

- **R2023b:** 0.062 s
- **R2023a:** 3.43 s

This code was timed on a Windows 10 Intel® Xeon® CPU W-2133 @ 3.6 GHz test system, by calling the function `timingTest`.

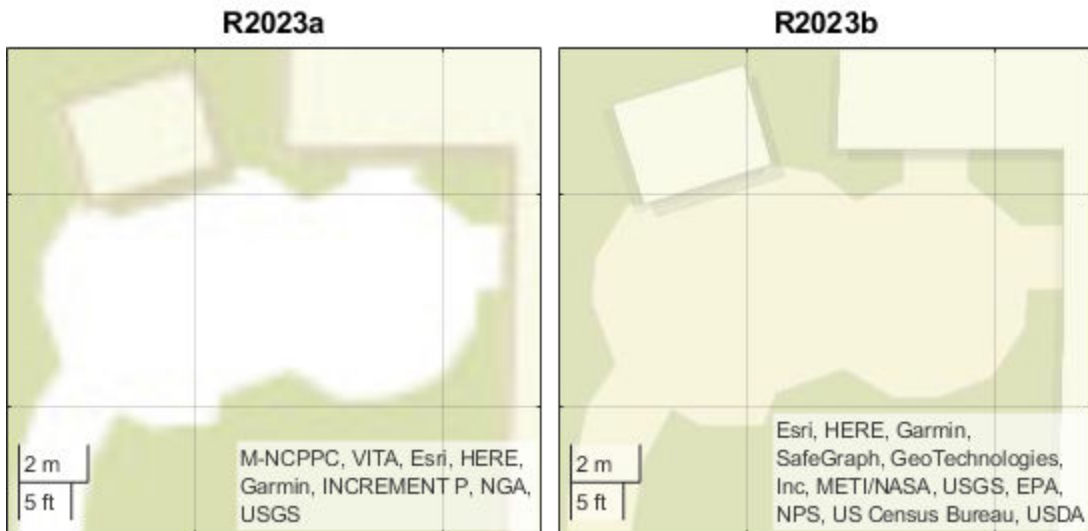
## shapewrite Function: Write projection file containing WKT string representation of CRS

When you create a shapefile from a geospatial table that contains a coordinate reference system (CRS) object, the `shapewrite` function creates a projection file with the .prj extension that contains the well-known text (WKT) string representation of the CRS.

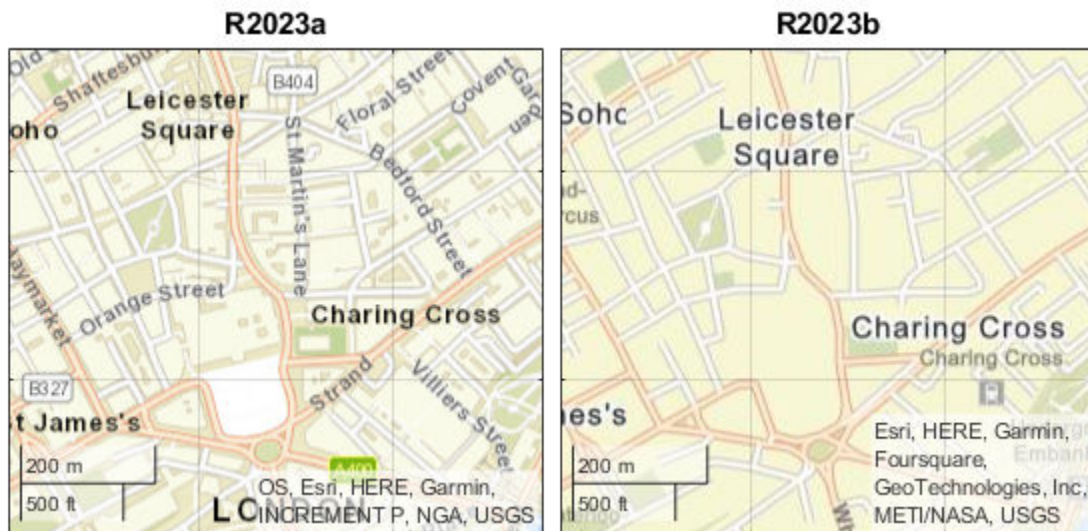
## Basemaps: Some basemaps have improved appearance at high zoom levels

The "streets-light", "streets-dark", "streets", and "topographic" basemaps hosted by Esri®, which are used by geographic globe objects and other objects with a `Basemap` property, have

an improved visual appearance at high zoom levels. For example, this image compares a basemap at zoom level 21 in R2023a with the same basemap and zoom level in R2023b.



The basemaps can also have different appearances at other zoom levels. For example, this image compares a basemap at zoom level 15 in R2023a with the same basemap and zoom level in R2023b.



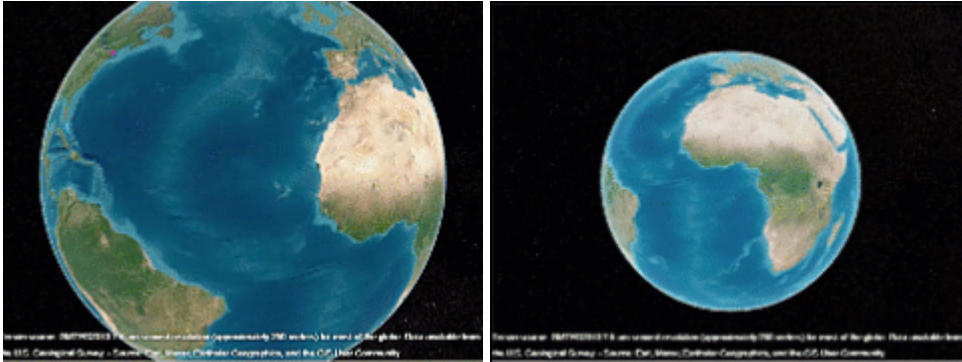
For more information about changing the basemap of a geographic globe, see [geobasemap](#).

The basemaps hosted by Esri update periodically. As a result, you might see differences in your visualizations over time.

### 3-D Geographic Plotting: Improved camera placement on geographic globe

When you plot data on a geographic globe by using the `geoglobe` and `geoplot3` functions, the globe positions the camera using these improvements:

- The camera snaps to the plot. In R2023a and earlier releases, the camera flew to the plot. The image on the left shows the camera behavior in R2023a. The image on the right shows the camera behavior in R2023b.



- When the data covers a small region, the globe places the camera closer to the plotted data. In R2023a and earlier releases, the globe placed the camera farther away.
- When you set the hold state to "on", then pan or zoom within the globe, and then plot data, the camera does not move. In R2023a and earlier releases, the camera centered on the data.

### **cropToBlock Function: Crop raster reference object to row and column limits of raster**

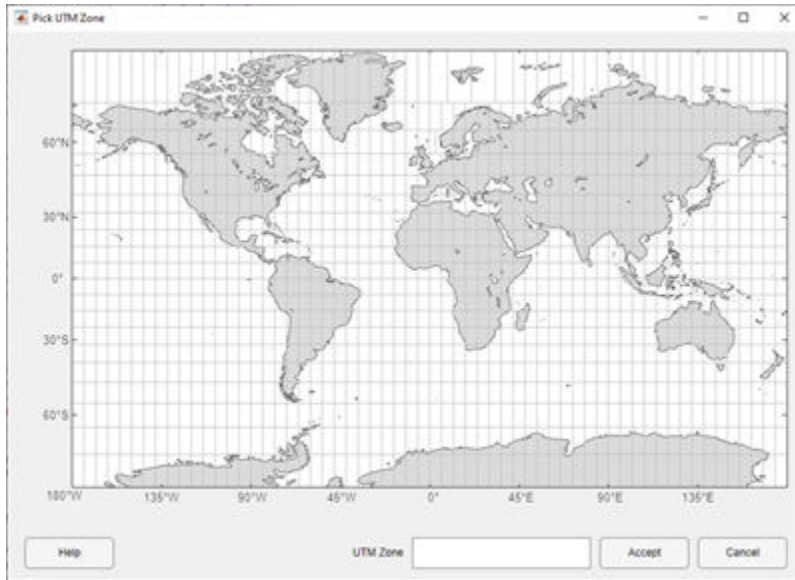
Crop a raster reference object to the specified row and column limits of the raster by using the `cropToBlock` function.

The `cropToBlock` function does not require you to specify an array of raster data as input. As a result, the `cropToBlock` function is useful for cropping reference objects that are associated with data that does not fit in memory. To read the data, you can use `blockedImage` (Image Processing Toolbox) objects.

### **utmzone and utmzoneui Functions: Query nonstandard zones in northern Europe**

The `utmzone` and `utmzoneui` functions now enable you to query the nonstandard zones in northern Europe: 30V, 31V, 32V, 31X, 33X, 35X, and 37X. In earlier releases, the functions did not account for nonstandard zones.

In addition, the Pick UTM Zone dialog box that you can open by using the `utmzone` and `utmzoneui` functions is now resizable and has an improved appearance.



## WMS Database: Search updated database

The WMS Database has 167 new servers and 4483 new layers. In addition, 682 servers and 12,929 layers have been removed. The updated database contains 3666 servers and 63,032 layers. Search the database for layers using the `wms find` function.

The WMS Database has these specific updates.

- There are 166 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 one updated server URL from the MassGIS GeoServer, which hosts map data for Massachusetts. You can search for the updated server and layers by specifying the search string as `"gis-prod.digital.mass.gov/geoserver/wms"`.

```
layer = wmsfind("gis-prod.digital.mass.gov/geoserver/wms", SearchFields="serverurl");
```

## ▲ Functionality being removed or changed

### **sdtsinfo will be removed**

*Still runs*

The `sdtsinfo` function will be removed in a future release. In most cases, use the `georasterinfo` function instead.

### **Some functions will not accept referencing vectors or referencing matrices as input in a future release**

*Warns*

Some file export, map display, and data analysis functions will not accept referencing vectors or referencing matrices as input in a future release. Use raster reference objects as input instead.

---

### **File Export Functions**

- The `geotiffwrite` function will not accept referencing vectors or referencing matrices as input. Use a geographic raster reference object or a map raster reference object as input instead.
- The `worldfilewrite` function will not accept referencing matrices as input. Use a geographic raster reference object or a map raster reference object as input instead.

### **Map Display Functions**

- The `contourm` function will not accept referencing vectors or referencing matrices as input. Use a geographic raster reference object as input instead.
- The `contourfm` function will not accept referencing vectors or referencing matrices as input. Use a geographic raster reference object as input instead.
- The `contour3m` function will not accept referencing vectors or referencing matrices as input. Use a geographic raster reference object as input instead.
- The `meshm` function will not accept referencing vectors or referencing matrices as input. Use a geographic raster reference object as input instead.
- The `meshlrm` function will not accept referencing vectors or referencing matrices as input. Use a geographic raster reference object as input instead.
- The `grid2image` function will not accept referencing vectors or referencing matrices as input. Use a geographic raster reference object as input instead.

### **Data Analysis Functions**

- The `gradientm` function will not accept referencing vectors or referencing matrices as input. Use a geographic raster reference object as input instead.
- The `vec2mtx` function will not accept referencing vectors or referencing matrices as input. Use a geographic raster reference object as input instead.
- The `los2` function will not accept referencing vectors or referencing matrices as input. Use a geographic raster reference object as input instead.
- The `viewshed` function will not accept referencing vectors or referencing matrices as input. Use a geographic raster reference object as input instead.
- The `mapprofile` function will not accept referencing vectors or referencing matrices as input. Use a geographic raster reference object as input instead.
- The `imbedm` function will not accept referencing vectors or referencing matrices as input. Use a geographic raster reference object as input instead.
- The `areamat` function will not accept referencing vectors or referencing matrices as input. Use a geographic raster reference object as input instead.
- The `filterm` function will not accept referencing vectors or referencing matrices as input. Use a geographic raster reference object as input instead.
- The `findm` function will not accept referencing vectors or referencing matrices as input. Use a geographic raster reference object as input instead.
- The `mapoutline` function will not accept referencing matrices or structure arrays as input. Use a geographic raster reference object or a map raster reference object as input instead.
- The `neworig` function will not accept referencing vectors or referencing matrices as input. Use a geographic raster reference object as input instead.

**Some file import, map display, and geometric geodesy UI functions will be removed in a future release***Warns***File Import UI Functions**

- The `demdataui` function will be removed in a future release. Use the `readgeoraster` function instead.
- The `vmap@ui` function will be removed in a future release. Use the `vmap@read` function instead.

**Map Display UI Functions**

- The `maptool` function will be removed in a future release. Select a replacement function based on the desired menu item. For more information about replacement functionality, see the `maptool` reference page.
- The `maptrim` function will be removed in a future release. Use the `geocrop` or `geoclip` function instead.
- The `originui` function will be removed in a future release. Instead, set the `Origin` property of the axesm-based map by using the `setm` function.
- The `parallelui` function will be removed in a future release. Instead, set the `MapParallels` property of the axesm-based map by using the `setm` function.
- The `clrmenu` function will be removed in a future release. Use the Colormap Editor instead.

**Geometric Geodesy UI Functions**

- The `trackui` function will be removed in a future release. Use the `trackg` function instead.
- The `surfdist` function will be removed in a future release. Use the `distance` function instead.
- The `scirclui` function will be removed in a future release. Use the `scircleg` function instead.
- The `sectorg` function will be removed in a future release. Use the `scircle1` function instead.

**Some raster reading functions have been removed***Errors*

The `usgsdem`, `sdtsemread`, and `usgs24kdem` functions have been removed. Use the `readgeoraster` function instead.

**Some functions that return referencing vectors or referencing matrices have been removed***Errors*

Some functions that return referencing vectors or referencing matrices have been removed. Use functions that return reference objects instead.

**Functions That Return Referencing Vectors**

- The `zerom` function has been removed. Use the `georefcells` and `zeros` functions instead.
- The `onem` function has been removed. Use the `georefcells` and `ones` functions instead.
- The `nanm` function has been removed. Use the `georefcells` and `NaN` functions instead.
- The `spzerom` function has been removed. Use the `georefcells` and `sparse` functions instead.
- The `sizem` function has been removed. Instead, create a geographic raster reference object, and then query its `RasterSize` property.

- 
- The `refmat2vec` function has been removed. Instead, convert referencing matrices to geographic raster reference objects by using the `refmatToGeoRasterReference` function.

#### **Functions That Return Referencing Matrices**

- The `makerefmat` function has been removed. Use the `georefcells`, `georefpostings`, `georasterref`, `maprefcells`, `maprefpostings`, or `maprasterref` function instead.
- The `worldFileMatrixToRefmat` function has been removed. Use the `georasterref` or `maprasterref` function instead.
- The `refvec2mat` function has been removed. 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 have been removed**

##### *Errors*

Some functions that accept referencing vectors or referencing matrices as input have been removed. Use functions that accept reference objects instead.

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

#### **Some function syntaxes that return referencing vectors or referencing matrices have been removed**

##### *Errors*

The `worldfileread` and `egm96geoid` function syntaxes that return referencing vectors or referencing matrices have been removed. Use syntaxes that return reference objects instead.



# R2023a

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**Version: 5.5**

**New Features**

**Bug Fixes**

**Compatibility Considerations**

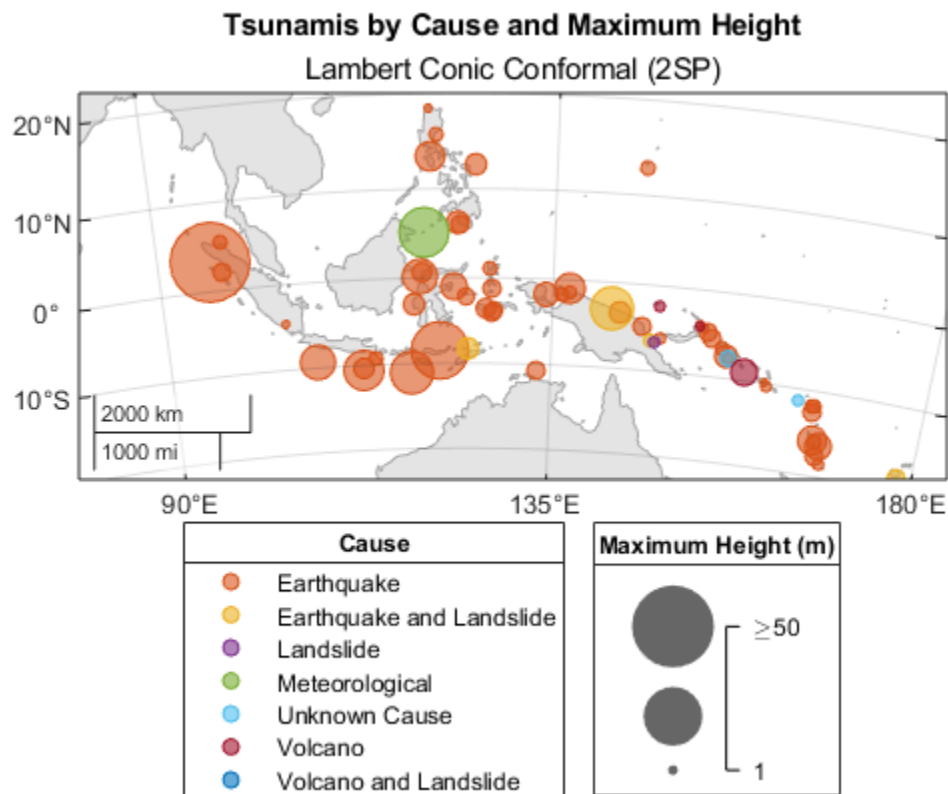
## Map Axes: Create maps in any supported projection using new axes type

Set up a map display from a projected coordinate reference system (CRS) by using the `newmap` or `mapaxes` function. Specify the projected CRS by using a `projcrs` object.

- Use `newmap` when you want to create a map in a specified projection.
- Use `mapaxes` when you want advanced control of the map, or when you want to include the map in an app.

You can change aspects of the resulting map axes, such as the projection or the appearance, by setting `MapAxes` Properties.

Map axes enable you to display data with coordinates in any supported geographic or projected CRS. Display data by using functions such as `geoplot`, `geoscatter`, and `bubblechart`. For more information about creating plots using map axes, see [Create Common Plots Using Map Axes](#).



Map axes integrate with MATLAB graphics, so you can use map axes with many MATLAB graphics functions. For example, you can change the map limits using `geolimits`, add text using `text`, interactively query point locations using `ginput`, and build apps using App Designer. For an example that shows how to include map axes in apps, see [Create Map Axes in an App](#).

In many cases, you can replace `axesm`-based maps created using the `axesm`, `worldmap`, or `usamap` function with map axes created using the `newmap` or `mapaxes` function.

---

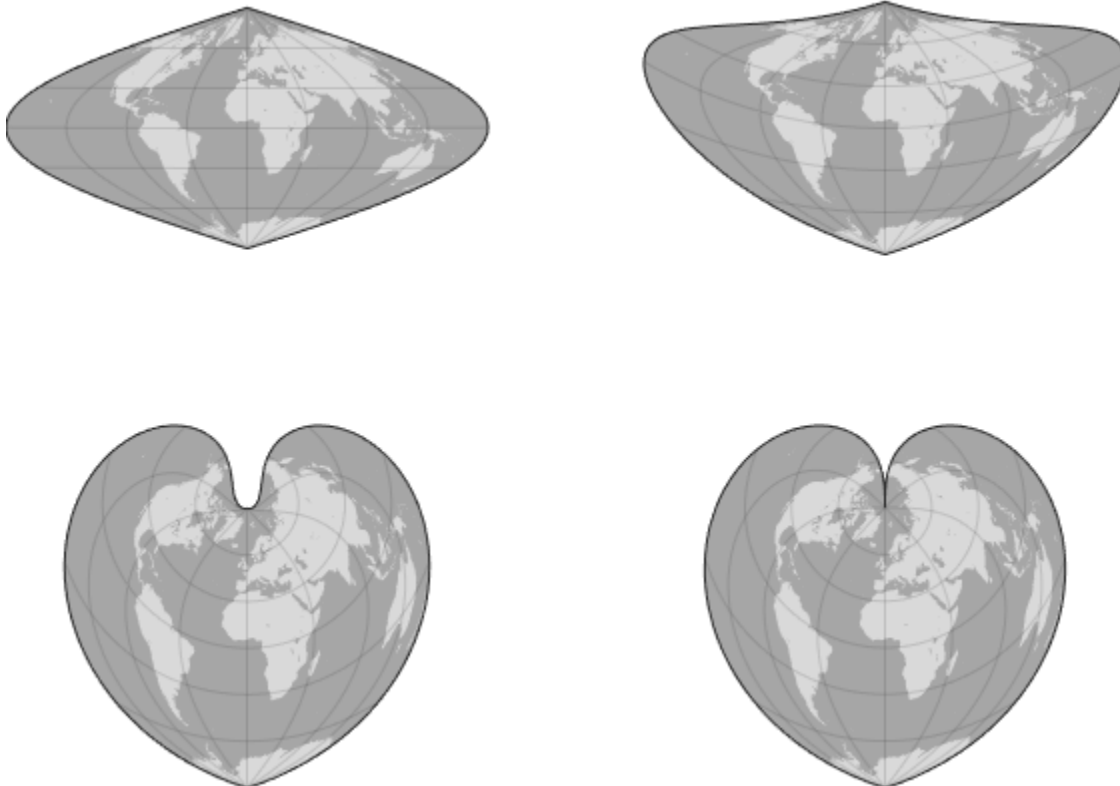
## Coordinate Reference Systems: Change projection parameters for projected CRS objects

You can now change the values of projection parameters for a projected CRS by setting the parameters of the object stored in the `ProjectionParameters` property of a `projcrs` object. In previous releases, the `ProjectionParameters` property was read-only.

This capability enables you to customize `projcrs` objects created from authority codes without using well-known text (WKT) strings. For example, this code creates a `projcrs` object for a Bonne projection and then changes the latitude of natural origin.

```
p = projcrs(54024, "Authority", "ESRI");  
p.ProjectionParameters.LatitudeOfNaturalOrigin = 90;
```

This capability also enables you to customize the projections used by map axes. For example, this image shows four world maps that use a Bonne projection. Each map uses a different latitude of natural origin. For examples of how to customize the projections used by map axes, see [Change Projection and Projection Parameters](#).



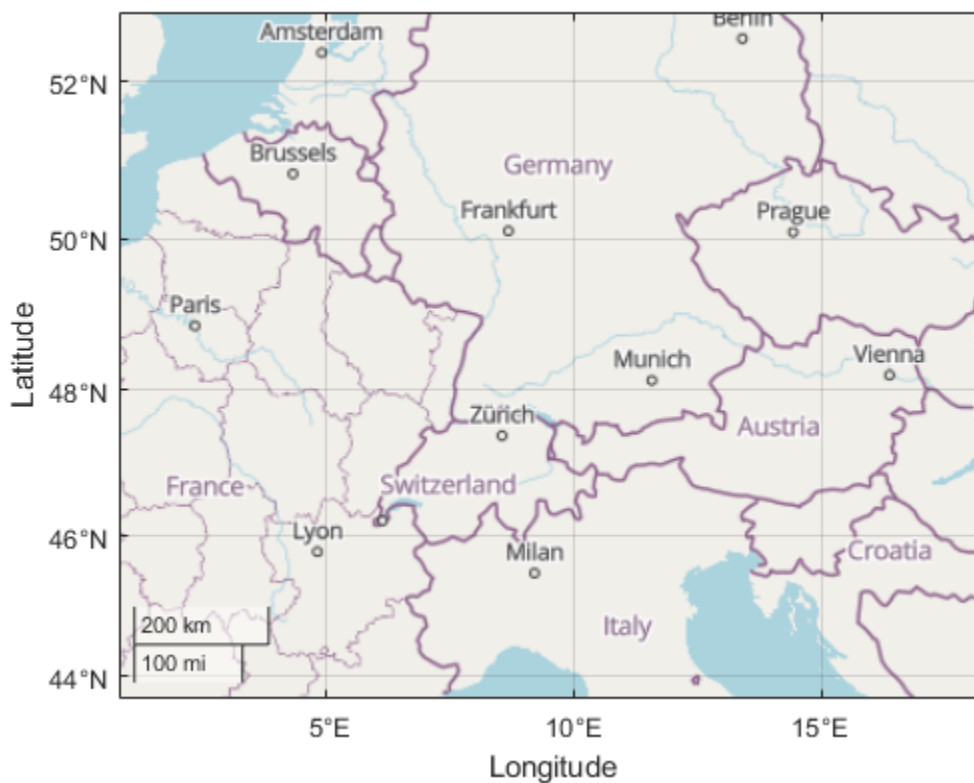
## Vector Basemaps: Add custom basemaps from vector basemaps hosted by Esri and from MBTiles files containing vector data

You can now use the `addCustomBasemap` function to add vector basemaps from these sources:

- Vector basemaps hosted by Esri. Specify the basemap using a URL.
- MBTiles files containing vector map tiles.

The appearance of a vector basemap, such as line colors and font names, depends on the style you specify when you add the basemap. For more information about customizing the appearance of vector basemaps, see [Customize Appearance of Vector Basemaps](#).

Mapping Toolbox includes a vector MBTiles file, `naturalearth.mbtiles`, with low-zoom levels of region and land boundaries.<sup>1</sup> The file was created using data from Natural Earth. This image shows a geographic axes with a vector basemap added from the MBTiles file. The basemap uses a predefined style with colors based on OpenStreetMap.



## WMS Database: Search updated database

The WMS Database has 70 new servers and 1417 new layers. In addition, 157 servers and 23,667 layers have been removed. The updated database contains 4177 servers and 71,448 layers. Search the database for layers using the `wms find` function.

The WMS Database has these specific updates.

- There are 66 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

<sup>1</sup> Alignment of boundaries and region labels are a presentation of the feature provided by the data vendors and do not imply endorsement by MathWorks®.

---

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 one updated server URL from the NASA Earth Observations (NEO) server. You can search for the updated server and layers by specifying the search string as "neo.gsfc.nasa.gov/wms/wms".

```
layer = wmsfind("neo.gsfc.nasa.gov/wms/wms", SearchFields="serverurl");
```

- There is one new WMS server from the United States Geological Survey National Map server. You can search for this server and layer by specifying the search string as "services.nationalmap.gov/arcgis/services/USGSNAIPImagery/ImageServer/WMServer".

```
layer = wmsfind("services.nationalmap.gov/arcgis/services/USGSNAIPImagery/ImageServer/WMServer", SearchFields="serverurl");
```

## ⚠ Functionality being removed or changed

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

#### *Warns*

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.

### **mfwdtran and minvtran will be removed in a future release**

#### *Warns*

- The `mfwdtran` function will be removed in a future release. Use the `projfwd` or `geodetic2ecef` function instead.
- The `minvtran` function will be removed in a future release. Use the `projinv` or `ecef2geodetic` function instead.

### Some file import, map display, data analysis, and geometric geodesy functions have been removed

#### *Errors*

#### File import functions have been removed

- The `readfields` and `readmtx` functions have been removed. 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 `spreadd` function has been removed. Use the `readmatrix` function instead.
- The `readfk5` function has been removed.

#### **Map display functions, UIs, and app have been removed**

- The `panzoom` function has been removed. Use the `zoom` function instead.
- The `project` function has been removed. Use the `projfwd` function instead.
- The `makemapped` function and `colorm`, `mobjects`, and `qrydata` UIs have been removed.
- The `mapview` app has been removed.

#### **Data analysis functions and UIs have been removed**

- The `extractm` function has been removed. Use geospatial tables instead. For more information about geospatial tables, see Create Geospatial Tables.
- The `getseeds` function and the `seedm` UI have been removed.

#### **Geometric geodesy functions have been removed**

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

# R2022b

---

**Version: 5.4**

**New Features**

**Bug Fixes**

**Compatibility Considerations**

## Vector Data: Determine which shape objects are multipoint shapes

Determine which shape objects are multipoint shapes by using the `ismultipoint` function. A shape object is a multipoint shape when it is a `geopointshape` or `mappointshape` object and the value of its `NumPoints` property is greater than 1.

## georasterinfo function: Read RPC coefficient tags from GeoTIFF files

Read RPC coefficient tags from GeoTIFF files by using the `georasterinfo` function. The function stores RPC coefficient tags as `RPCCoefficientTag` objects in the `Metadata` property of the returned `RasterInfo` object.

## projfwd and projinv functions: Improved performance on Windows with repeated use of projection

The `projfwd` and `projinv` functions show improved performance on Windows when used multiple times in the same MATLAB session with the same `projcrs` object or map projection structure as input.

For example, this code is about 1.67 times faster than in the previous release. The code:

- Gets the grid coordinates for a DTED file
- Projects and unprojects the coordinates using a `projcrs` object
- Gets the grid coordinates for a different DTED file
- Measures the time required to project and unproject the coordinates using the same `projcrs` object

```
function timingTest
    info1 = georasterinfo("n39_w106_3arc_v2.dt1");
    R1 = info1.RasterReference;
    [latGrid1,lonGrid1] = geographicGrid(R1);

    p = projcrs(4088);
    [xfwd1,yfwd1] = projfwd(p,latGrid1,lonGrid1);
    [latin1,loninv1] = projinv(p,xfwd1,yfwd1);

    info2 = georasterinfo("n40_w106_3arc_v2.dt1");
    R2 = info2.RasterReference;
    [latGrid2,lonGrid2] = geographicGrid(R2);

    tic
    [xfwd2,yfwd2] = projfwd(p,latGrid2,lonGrid2);
    [latin2,loninv2] = projinv(p,xfwd2,yfwd2);
    toc
end
```

The approximate execution times are:

- **R2022a:** 0.70 s
- **R2022b:** 0.42 s

---

This code was timed on a Windows 10 Intel Xeon CPU W-2133 @ 3.6 GHz test system, by calling the function `timingTest`.

## Web Map Service: New server with terrain elevation data hosted by MathWorks

MathWorks hosts a Web Map Service (WMS) server with a layer that provides terrain elevation data derived from GMTED2010. You can search the WMS Database for this server and layer by using the `wmsfind` function. Specify the search string as `"wms.mathworks.com"`.

```
layer = wmsfind("wms.mathworks.com",SearchFields="serverurl");
```

You can read data from the layer as an image or as quantitative data. For an example that shows how to read an image from the layer, see the [Customize Map Appearance](#) example on the `wmsread` reference page. For examples that show how to read quantitative data from the layer, see [Read Quantitative Data from WMS Server](#).

## WMS Database: Search updated database

The WMS Database has 19 new servers and 2721 new layers. In addition, 67 servers and 2277 layers have been removed. The updated database contains 4263 servers and 93,712 layers. Search the database for layers using the `wmsfind` function.

The WMS Database has these specific updates.

- There are four 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 are four new WMS servers from the European Environment Agency (EEA). For more information about these data sets, see the EEA public map services website or the services directory on the EEA DiscoMap website. You can search for these servers and layers by specifying the search string as `"discomap.eea.europa.eu"`.

```
layer = wmsfind("discomap.eea.europa.eu",SearchFields="serverurl");
```

## ▲ Documentation refers to maps created using `axesm`, `worldmap`, or `usamap` as `axesm`-based maps

Starting in R2022b, the documentation refers to maps created using the `axesm`, `worldmap`, or `usamap` function as *axesm-based maps*. In previous releases, the documentation referred to these maps as *map axes*.

## ▲ Functionality being removed or changed

### Adding new plot to geographic globe does not reset basemap or terrain

*Behavior change*

When you add a plot to a geographic globe by using the `geoplot3` function, MATLAB does not reset the basemap or terrain. In R2022a and earlier releases, the basemap and terrain reset when you add new plots.

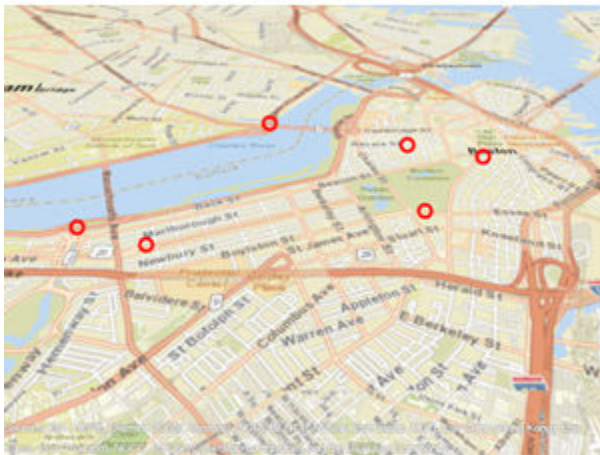
As a result, you can specify the basemap or terrain and then visualize data without using the `hold` function. For example, this code creates a globe using the "streets" basemap and no terrain data. Then, it displays a plot and adjusts the camera view. In R2022b, the basemap and terrain do not reset. In R2022a and earlier releases, the basemap reset to the default "satellite" and the terrain reset to the default "gmted2010".

```
lat = [42.3501 42.3515 42.3598 42.3584 42.3529 42.3626];
lon = [-71.0870 -71.0926 -71.0662 -71.0598 -71.0662 -71.0789];

uif = uifigure;
g = geoglobe(uif,Basemap="streets",Terrain="none");

p = geoplot3(g,lat,lon,0,"ro",LineWidth=3);
campos(g,42.33,-71.0756,2113)
campitch(g,-42.2458)
```

R2022b



R2022a



This change does not affect existing code that sets the hold state to "on" between commands.

To reset the basemap and terrain, set the Basemap and Terrain properties to the defaults after you create the plot.

```
g.Basemap = "satellite";
g.Terrain = "gmted2010";
```

For more information about changing the basemap and terrain of geographic globes, see [Access Basemaps and Terrain for Geographic Globe](#).

### **combntns has been removed**

#### *Errors*

The `combntns` function has been removed. Use the `nchoosek` function instead.

---

## **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 `setltn` 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.

## **Some functions will not accept referencing vectors or referencing matrices as input in a future release**

### *Still runs*

Some file export, map display, and data analysis functions will not accept referencing vectors or referencing matrices as input in a future release. Use raster reference objects as input instead.

### **File Export Functions**

- The `geotiffwrite` function will not accept referencing vectors or referencing matrices as input. Use a geographic raster reference object or a map raster reference object as input instead.
- The `worldfilewrite` function will not accept referencing matrices as input. Use a geographic raster reference object or a map raster reference object as input instead.

### **Map Display Functions**

- The `contourm` function will not accept referencing vectors or referencing matrices as input. Use a geographic raster reference object as input instead.
- The `contourfm` function will not accept referencing vectors or referencing matrices as input. Use a geographic raster reference object as input instead.
- The `contour3m` function will not accept referencing vectors or referencing matrices as input. Use a geographic raster reference object as input instead.
- The `meshm` function will not accept referencing vectors or referencing matrices as input. Use a geographic raster reference object as input instead.
- The `meshlsm` function will not accept referencing vectors or referencing matrices as input. Use a geographic raster reference object as input instead.

### **Data Analysis Functions**

- The `gradientm` function will not accept referencing vectors or referencing matrices as input. Use a geographic raster reference object as input instead.
- The `vec2mtx` function will not accept referencing vectors or referencing matrices as input. Use a geographic raster reference object as input instead.
- The `los2` function will not accept referencing vectors or referencing matrices as input. Use a geographic raster reference object as input instead.

- The `viewshed` function will not accept referencing vectors or referencing matrices as input. Use a geographic raster reference object as input instead.
- The `mapprofile` function will not accept referencing vectors or referencing matrices as input. Use a geographic raster reference object as input instead.
- The `imbedm` function will not accept referencing vectors or referencing matrices as input. Use a geographic raster reference object as input instead.
- The `areamat` function will not accept referencing vectors or referencing matrices as input. Use a geographic raster reference object as input instead.
- The `filterm` function will not accept referencing vectors or referencing matrices as input. Use a geographic raster reference object as input instead.
- The `findm` function will not accept referencing vectors or referencing matrices as input. Use a geographic raster reference object as input instead.
- The `mapoutline` function will not accept referencing matrices or structure arrays as input. Use a geographic raster reference object or a map raster reference object as input instead.
- The `neworig` function will not accept referencing vectors or referencing matrices as input. Use a geographic raster reference object as input instead.

### **Some file import, map display, and geometric geodesy UI functions will be removed in a future release**

*Still runs*

#### **File Import UI Functions**

- The `demdataui` function will be removed in a future release. Use the `readgeoraster` function instead.
- The `vmap0ui` function will be removed in a future release. Use the `vmap0read` function instead.

#### **Map Display UI Functions**

- The `maptool` function will be removed in a future release. Select a replacement function based on the desired menu item. For more information about replacement functionality, see the `maptool` reference page.
- The `maptrim` function will be removed in a future release. Use the `geocrop` or `geoclip` function instead.
- The `originui` function will be removed in a future release. Instead, set the `Origin` property of the `axesm`-based map by using the `setm` function.
- The `parallelui` function will be removed in a future release. Instead, set the `MapParallels` property of the `axesm`-based map by using the `setm` function.
- The `clrmnu` function will be removed in a future release. Use the `colormap` function instead.

#### **Geometric Geodesy UI Functions**

- The `trackui` function will be removed in a future release. Use the `trackg` function instead.
- The `surfdist` function will be removed in a future release. Use the `distance` function instead.
- The `scirclui` function will be removed in a future release. Use the `scircleg` function instead.
- The `sectorg` function will be removed in a future release. Use the `scircle1` function instead.

### **shapewrite truncates text when length exceeds 254 characters or value of FieldLength**

*Behavior change*

---

When a text attribute contains more than 254 characters, the `shapewrite` function issues a warning and truncates the text to 254 characters. In previous releases, the `shapewrite` function did not truncate the text and, as a result, created a file that does not conform to shapefile specifications.

When a text attribute contains more characters than the value stored in the `FieldLength` field of the `dbfspec` argument, the `shapewrite` function issues a warning and truncates the text to the number of characters equal to the value of `FieldLength`. In previous releases, the `shapewrite` function issued an error.



# R2022a

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**Version: 5.3**

**New Features**

**Bug Fixes**

**Compatibility Considerations**



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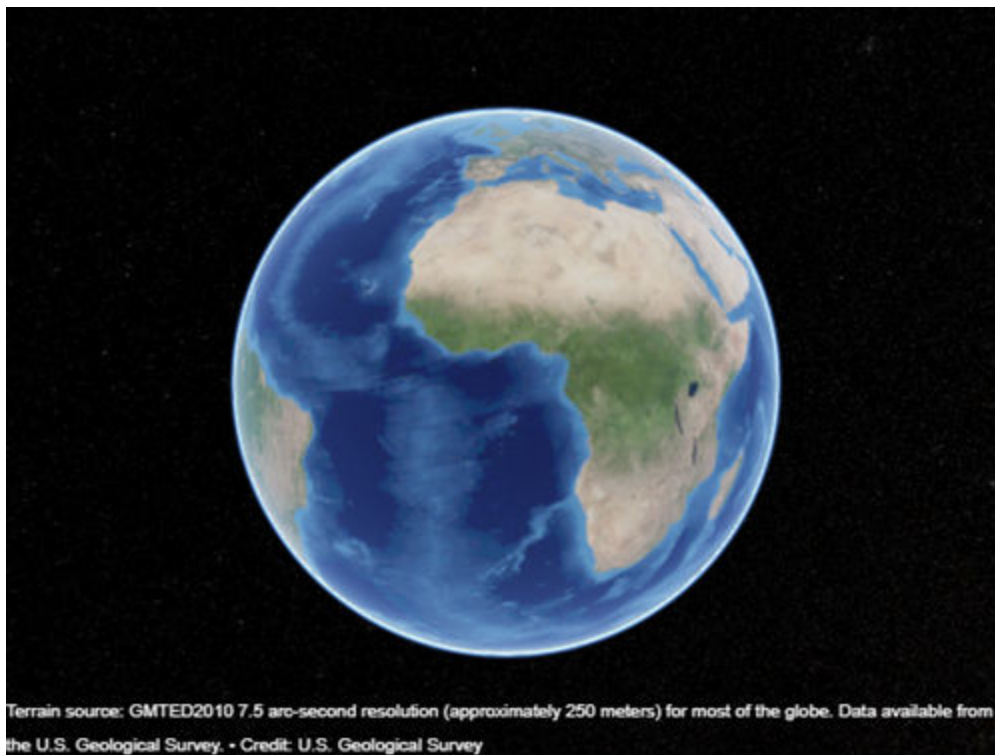
## Determine if points are within polygons

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.

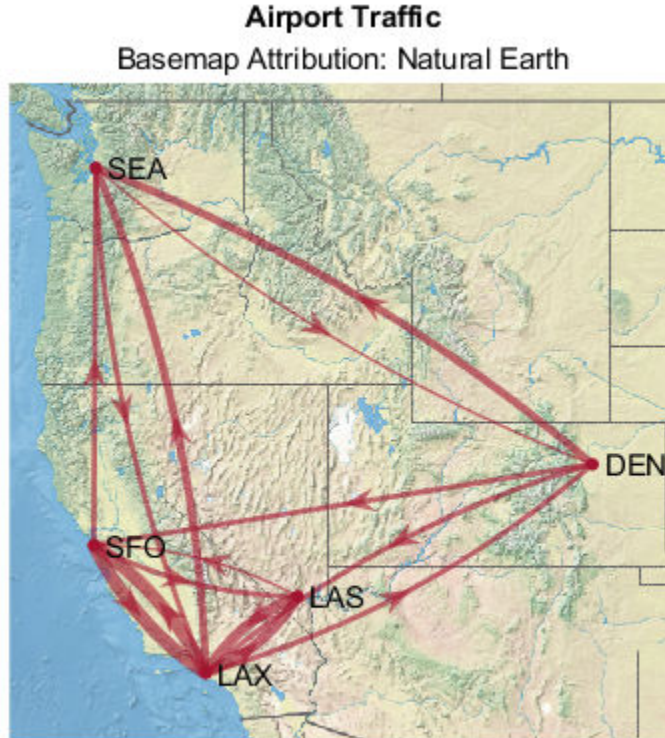


## Basemaps: Read georeferenced image from basemap

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: [1x1 geocrs]
        ProjectionMethod: "Lambert Conic Conformal (2SP)"
        LengthUnit: "U.S. survey foot"
        ProjectionParameters: [1x1 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` (Lidar Toolbox) object and the `readCRS` (Lidar Toolbox) 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` (Lidar Toolbox) 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 `spzerm` 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 `spread` 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 `uicolor` function instead.
- The `restack` function has been removed. Use the `uistack` function instead.
- The `rootlayer` function and `mayers` 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

---

**Version: 5.2**

**New Features**

**Bug Fixes**

**Compatibility Considerations**

## 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

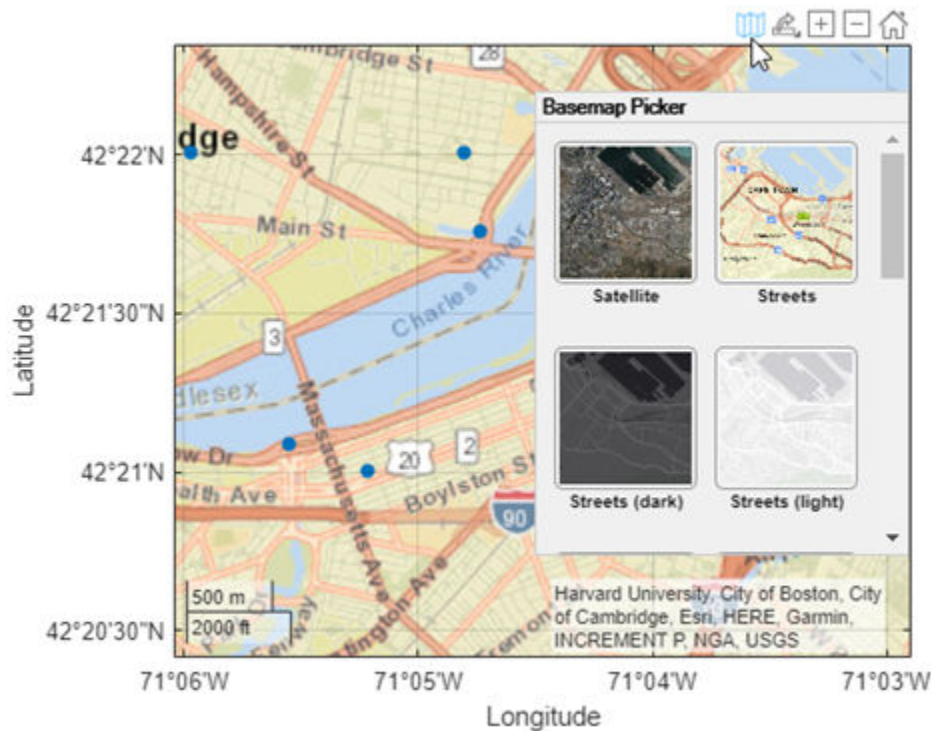
Convert tables and structures with point, line, or polygon data into geospatial tables by using the `table2geotable` and `struct2geotable` functions. Specify the point, line, or polygon shapes as numeric latitudes and longitudes or numeric *x*- and *y*-coordinates. For `table2geotable`, you can also 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`, `sdtsemread`, `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

---

**Version: 5.1**

**New Features**

**Bug Fixes**

**Compatibility Considerations**

## **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 `setltn` 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**

**Compatibility Considerations**

### **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**

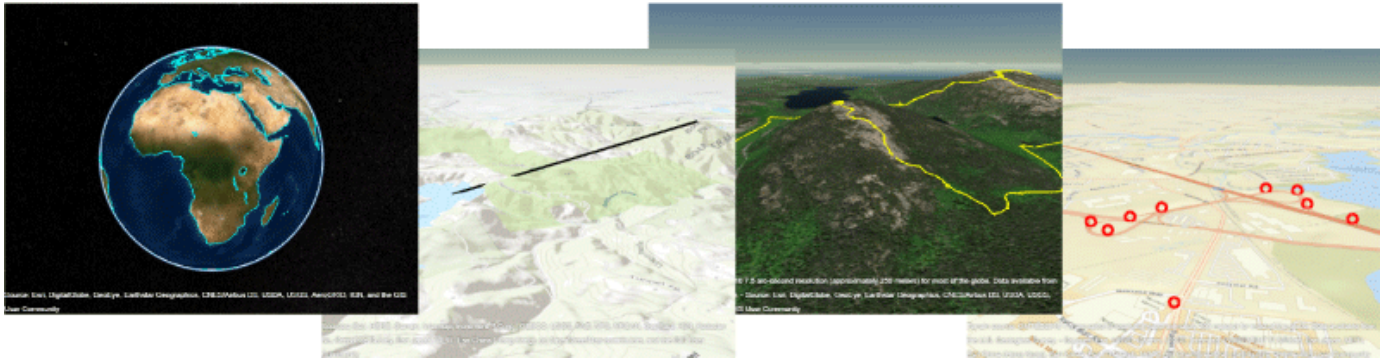
**New Features**

**Compatibility Considerations**

### 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`, `sdtsemread`, `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**

**Compatibility Considerations**

## 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.

