ArcGIS® 9

Using ArcGIS 3D Analyst™

DATA CREDITS

Exercise 1: Death Valley image data courtesy of National Aeronautics and Space Administration (NASA)/Jet Propulsion Laboratory (JPL)/Caltech.

Exercise 2: San Gabriel Basin data courtesy of the San Gabriel Basin Water Quality Authority.

Exercise 3: Belarus CS137 soil contamination and thyroid cancer data courtesy of the International Sakharov Environmental University.

Exercise 4: Hidden River Cave data courtesy of the American Cave Conservation Association.

Exercise 5: Elevation and image data courtesy of MassGIS, Commonwealth of Massachusetts Executive Office of Environmental Affairs.

Exercise 6: Las Vegas Millennium Mosaic (Year 2000 Landsat) and QuickBird images data courtesy of DigitalGlobe.

Exercise 7: Ozone concentration raster derived from data courtesy of the California Air Resources Board, Southern California Millennium Mosaic (Year 2000 Landsat) image courtesy of DigitalGlobe, Angelus Oaks imagery courtesy of AirPhoto USA, Southwestern U.S. elevation data derived from U.S. National Elevation Data courtesy of the U.S. Geological Survey.

Exercise 8: Spot elevation points and breaklines are of the Napa River Watershed area. GIS data courtesy of the County of Napa.

Exercise 9: Quickbird imagery of London courtesy of DigitalGlobe. Multipatch buildings Copyright © 2008 Google. All rights reserved.

CONTRIBUTING WRITERS

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ArcGIS 3D Analyst Tutorial

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The best way to learn ESRI® ArcGIS® 3D Analyst™ is to use it. In the exercises in this tutorial, you will:

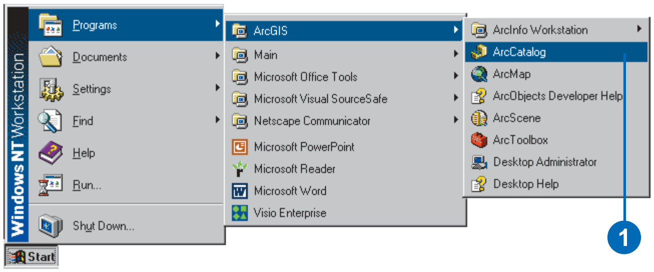
- Use ArcCatalog™ to find and preview 3D data.
- Add data to ArcScene™.
- Set 3D properties for viewing data.
- Create new 3D feature data from 2D features and surfaces.
- Create new raster surface data from point data.
- Build a TIN surface from existing feature data.
- Make animations.
- Learn how to use ArcGlobe™ and manage its data content.

In order to use this tutorial, you need to have the 3D Analyst extension and ArcGIS installed and have the tutorial data installed on a local or shared network drive on your system. Ask your system administrator for the correct path to the tutorial data if you do not find it at the default installation path specified in the tutorial.

Copying the tutorial data

First you will copy the tutorial data to a local drive. You will use ArcCatalog to browse to and copy the data.

1. Click Start, point to Programs, point to ArcGIS, and click ArcCatalog.

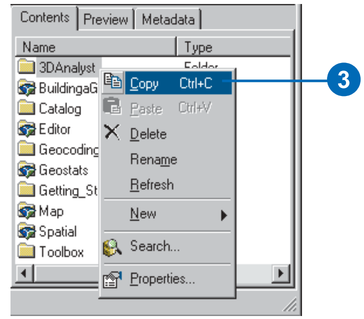


ArcCatalog lets you find and manage your data. The left side of the ArcCatalog window is called the *Catalog tree*; it gives you a bird's-eye view of how your data is organized and provides a hierarchical view of the geographic data in your folders. The right side of the Catalog window shows the contents of the selected branch of the Catalog tree.

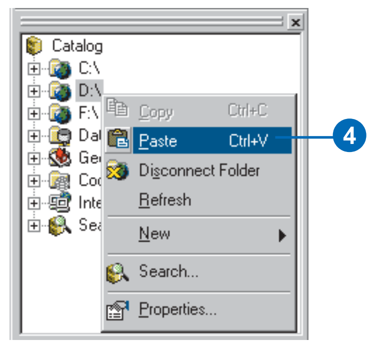
2. Click in the Location combo box and type the path to the \arcgis\ArcTutor folder on the drive where the tutorial data is installed. Press Enter.

The ArcTutor folder is now the selected branch of the Catalog tree. You can see its contents in the Contents tab.

3. Right-click the 3DAnalyst folder and click Copy.

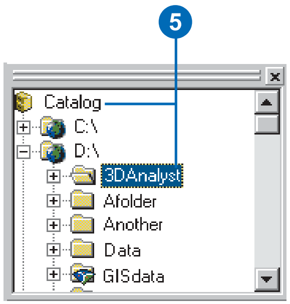


4. Right-click the local drive where you want to place the tutorial data and click Paste.



The folder is copied to your local drive. Now you'll make a folder connection to the 3DAnalyst folder in the Catalog tree.

5. Click the 3DAnalyst folder on your local drive and drag it onto the top-level node, Catalog, of the Catalog tree.



There is now a folder connection in the Catalog for your local copy of the tutorial data.

In the graphics illustrating this tutorial, the ArcCatalog option to use a special folder icon for folders containing GIS data is turned on. That is why the folder GISdata, in the graphic above, looks different from the other folders. You can turn this option on in ArcCatalog, in the Options dialog box, on the General tab. ArcCatalog works faster when this option is turned off, so it is off by default.

Exercise 1: Draping an image over a terrain surface

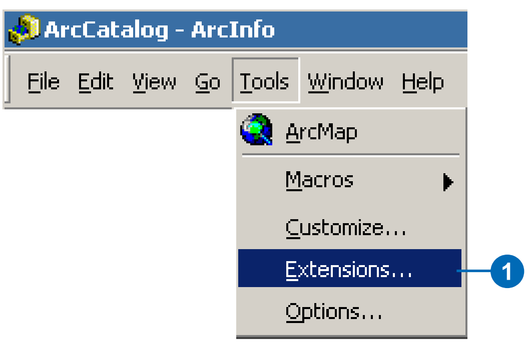
Viewing a remotely sensed image draped over a terrain surface can often lead to greater understanding of the patterns in the image and how they relate to the shape of the earth's surface.

Imagine that you're a geologist studying Death Valley, California. You have collected a TIN that shows the terrain and a satellite radar image that shows the roughness of the land surface. The image is highly informative, but you can add a dimension to your understanding by draping the image over the terrain surface. Death Valley image data was supplied courtesy of NASA/JPL/Caltech.

Turning on the 3D Analyst extension

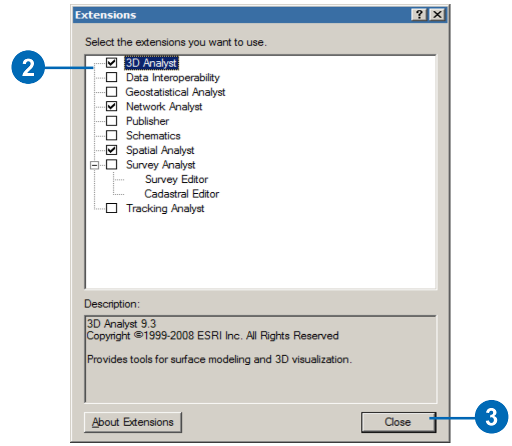
You'll need to enable the 3D Analyst extension.

1. Click Tools and click Extensions.



2. Check 3D Analyst.

3 Click Close.

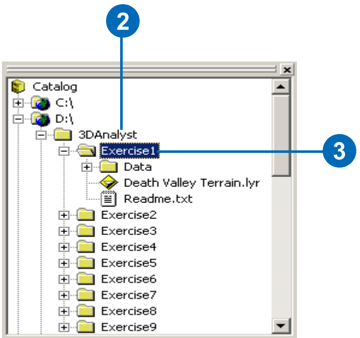


Previewing 3D data in ArcCatalog

Before you drape the image, you'll browse to the terrain data and preview it in ArcCatalog.

1. Navigate to the 3DAnalyst folder connection in the Catalog tree.

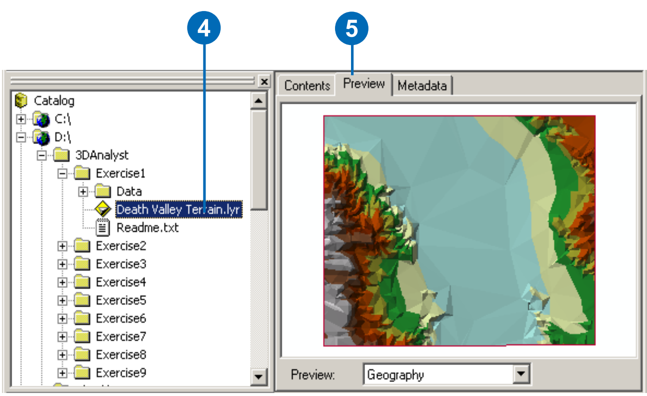
2. Double-click 3DAnalyst.
3. Double-click Exercise1.



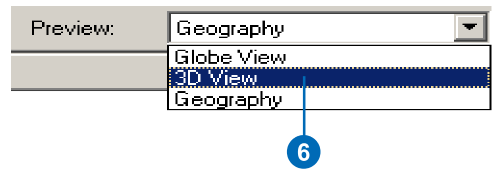
You see a folder called Data and a TIN layer called Death Valley Terrain.

A layer is a shortcut to geographic data. It also stores information about how the geographic data should be drawn on a map or in a 3D scene.

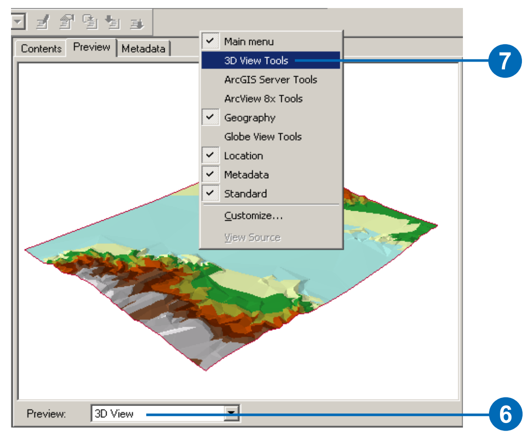
4. Click Death Valley Terrain.



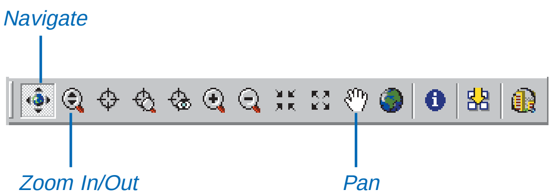
5. Click the Preview tab. You can preview your GIS data in ArcCatalog. With 3D Analyst installed, you can also preview some data in three dimensions.
6. Click the Preview drop-down arrow and click 3D View.



7. Right-click above the preview window and click 3D View Tools.



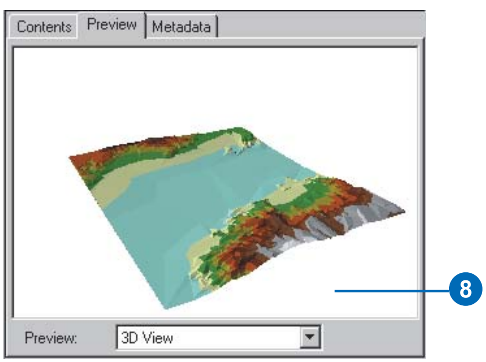
The preview becomes a 3D preview, and a new set of tools appears on the 3D View Tools toolbar.



The Navigate tool is active when you first preview data in 3D. You can see the names of tools by hovering the pointer over the tool.

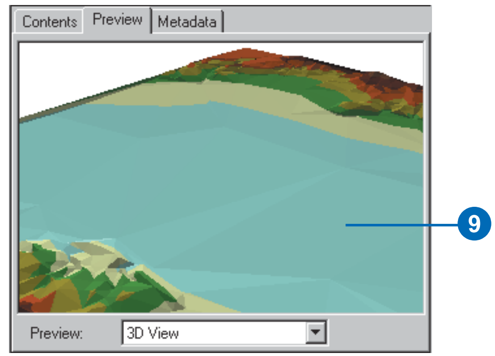
The Navigate tool allows you to rotate 3D data and change the apparent viewer height by clicking and dragging left and right and up and down, respectively, in the 3D preview.

8. Click the 3D preview and drag to the right.



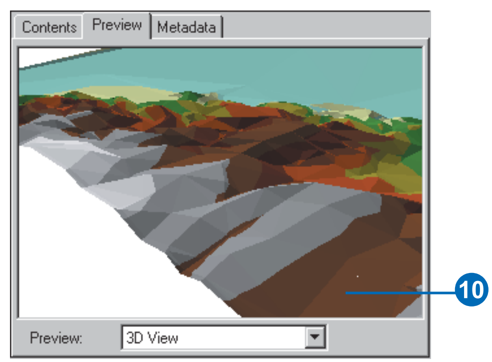
The data rotates around its center. The Navigate tool also allows you to zoom in and out and pan across the data, depending on the mouse button that you click while dragging in the 3D preview.

9. Right-click the 3D preview and drag down.



The pointer changes to the Zoom In/Out pointer, and the view zooms in to the data.

10. Click the middle button—or both the right and left buttons if you have a two-button mouse—and drag to the right.

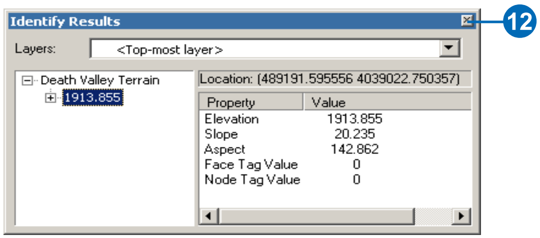


The pointer changes to the Pan pointer, and the view pans across the data.

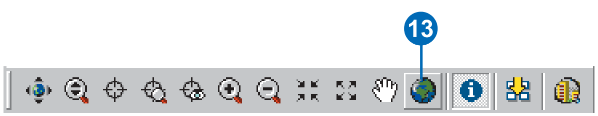
11. Click the Identify button and click on the TIN.

The Identify Results window shows you the elevation, slope, and aspect of the surface at the point you clicked.

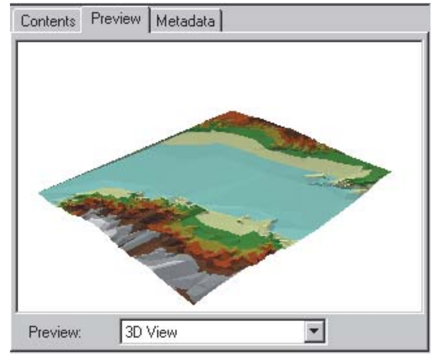
12. Close the Identify Results window.



13. Click the Full Extent button.



The view returns to the full extent of the data.

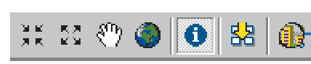


Now you’ve examined the surface data and begun to learn how to navigate in 3D. The next step is to start ArcScene and add your radar image to a new scene.

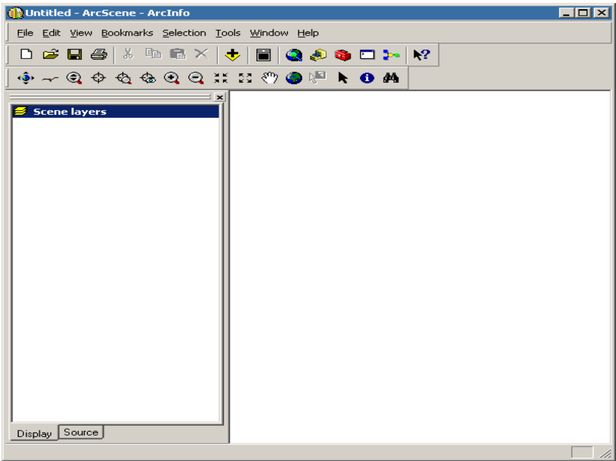
Starting ArcScene and adding data

ArcScene is the 3D viewer for 3D Analyst. Although you can preview 3D data in ArcCatalog, ArcScene allows you to build up complex scenes with multiple sources of data.

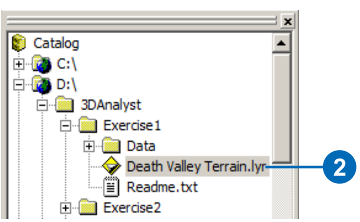
1. Click the ArcScene button on the 3D View Tools toolbar.



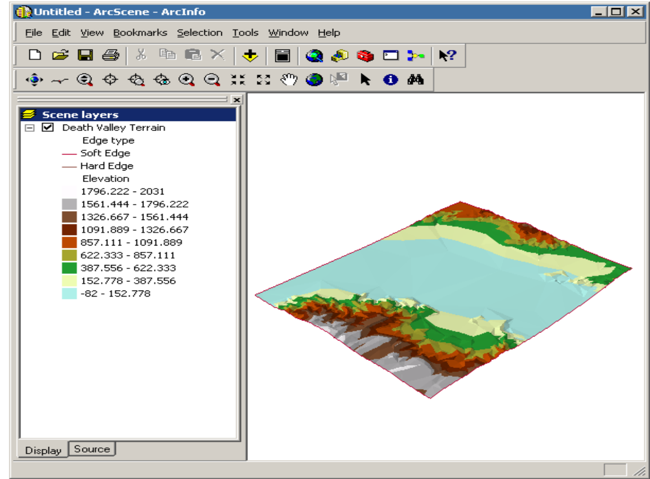
ArcScene starts. Note that many of the tools on the ArcScene Standard toolbar are the same as the 3D navigation tools that you see in ArcCatalog.



2. Click the Death Valley Terrain layer in the Catalog tree and drag it onto the right-hand side of the ArcScene window, then release the mouse button.

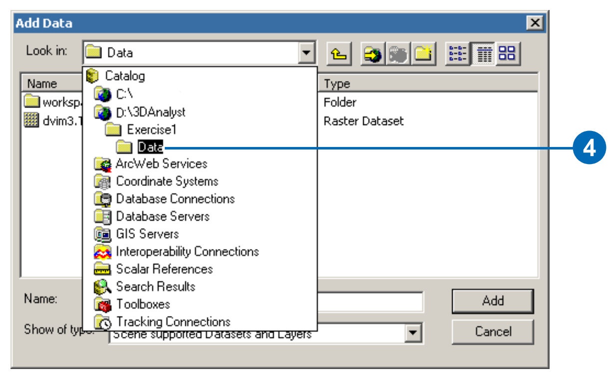


The TIN is drawn in the new scene.

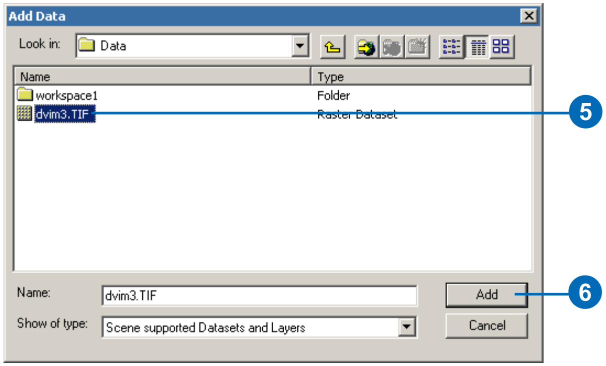


3. Click the Add Data button on the ArcScene Standard toolbar.

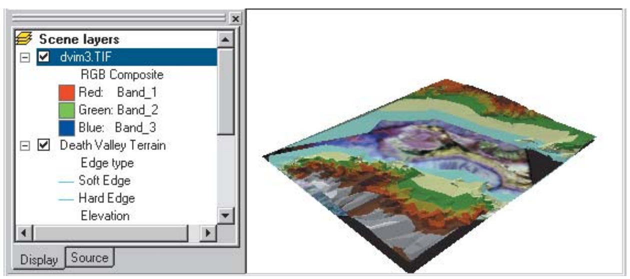
4. Navigate to the Data folder for Exercise1.



5. Click dvim3.TIF.
6. Click Add.

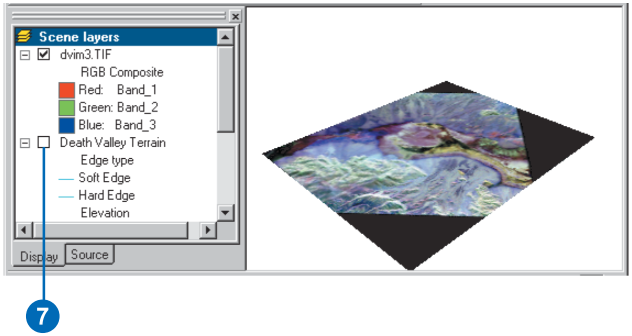


The image is added to the scene.



The image is drawn on a plane, with a base elevation value of zero. You can see it above the Death Valley terrain surface where the terrain is below 0 meters elevation (sea level); it is hidden by the terrain surface everywhere else.

7. Uncheck the Death Valley Terrain layer.



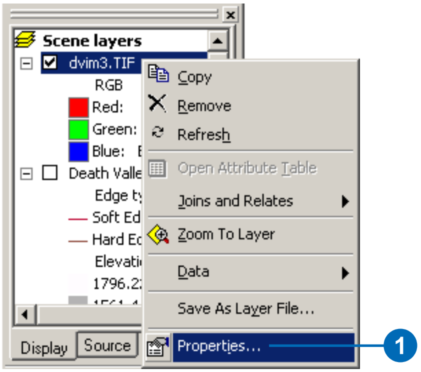
Now you can see the whole image. The black areas are parts of the image that contain no data and are a result of previous processing to fit the image to the terrain.

You have added the image to the scene. Now you will change the properties of the image layer so that the image will be draped over the terrain surface.

Draping the image

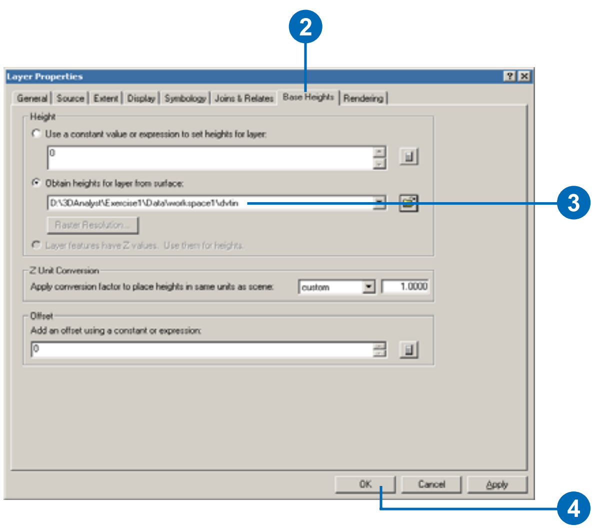
While the surface texture information shown in the image is a great source of information about the terrain, some relationships between the surface texture and the shape of the terrain will be apparent when you drape the image over the terrain surface. In ArcScene, you can drape a layer—containing a grid, image, or 2D features—over a surface (a grid or TIN) by assigning the base heights of the layer from the surface.

1. Right-click dvim3.TIF in the ArcScene table of contents and click Properties.



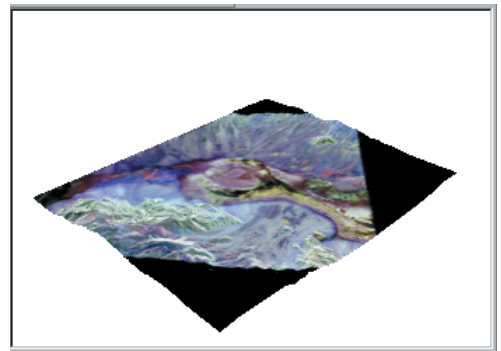
The layer Properties dialog box appears. You can change how a layer is drawn on a map or in a scene by setting its properties.

2. Click the Base Heights tab.



3. Click the option to Obtain heights for layer from surface.

Because the TIN is the only surface model in the scene, it appears in the surface drop-down list.



4. Click OK.

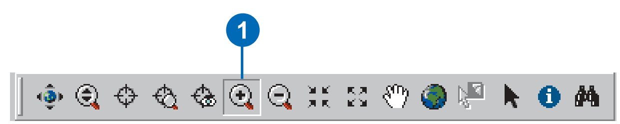
The image is draped over the terrain surface.

Now you will be able to navigate around the image and see the relationship between surface texture, as shown by the image colors, and the shape of the terrain.

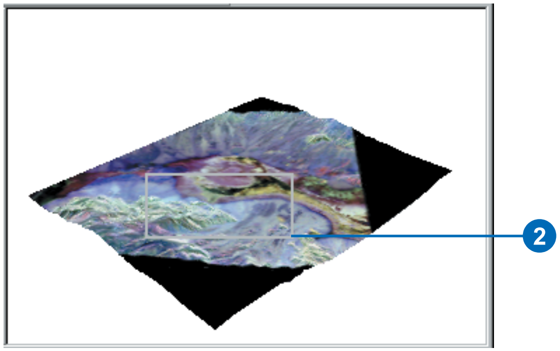
Exploring the image

You will use the navigation tools on the ArcScene Tools toolbar to explore the draped image.

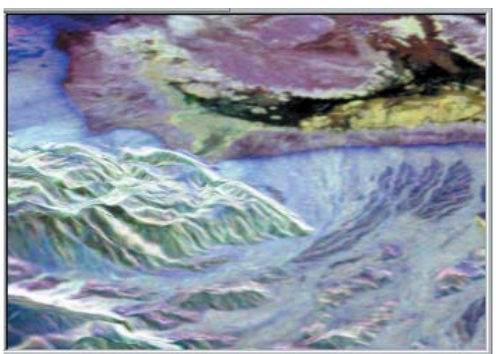
1. Click the Zoom in button.



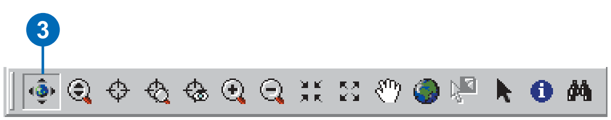
2. Click and drag a rectangle around the middle of the image.



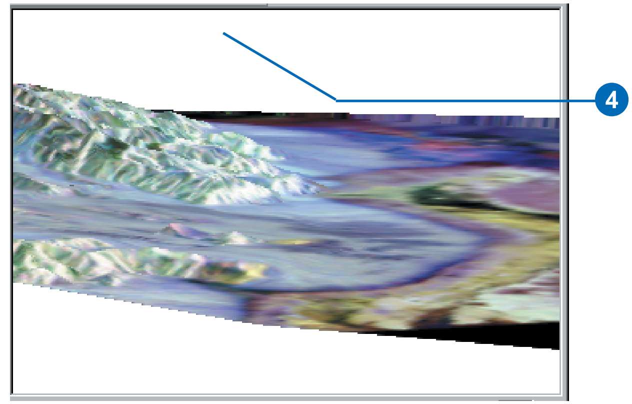
The scene zooms to the middle part of the image.



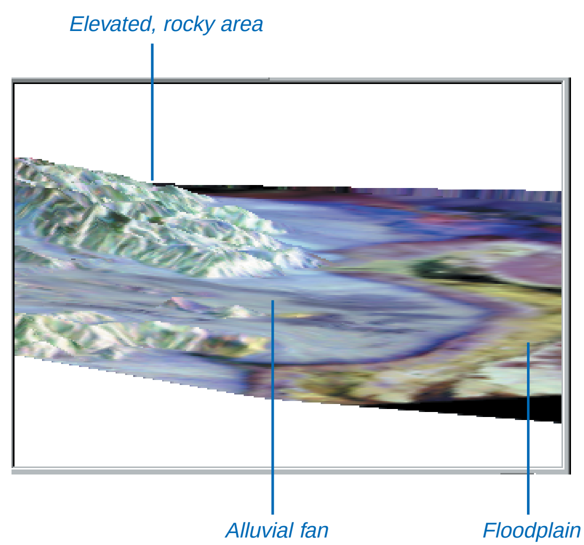
3. Click the Navigate button.



4. Click and hold the scene with the cursor, and slowly drag up and to the left.



The scene rotates, and the view angle lowers, so it looks as though you are looking down the valley, past the higher land on the left side of the scene.



The elevated land is visibly rougher terrain than the flat valley bottom. The surface texture—and therefore the color, in the radar image—of this rocky area is different than the fine sediment of the floodplain—the yellow and black region in the valley bottom. The rocky area is also a different texture from the gently sloping alluvial fan that runs past it, down onto the valley floor.

Draping the radar image over the terrain surface allows you to see the relationship between the general shape of the land surface and the texture of the rocks and sediment that make up the surface.

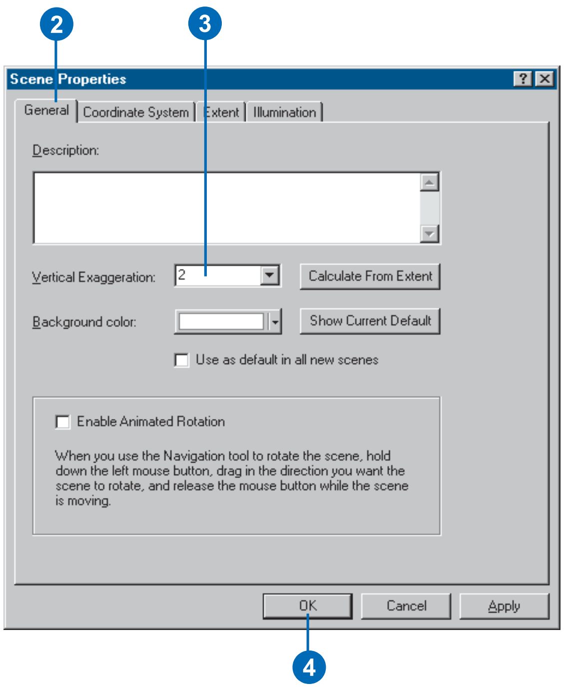
Exaggerating the terrain

The valley is a broad area, relative to the height of the terrain, even though the mountains at the edge of the scene are more than 2,000 meters above the valley floor. In order to enhance the sense of depth in the scene, and to bring out subtle features in the terrain, you will exaggerate the height of the terrain.

1. Right-click Scene layers in the table of contents and click Scene Properties.

The Scene Properties dialog box lets you set properties that are shared by all of the layers in the scene. These include the vertical exaggeration, the background (sky) color, the coordinate system and extent of the data, and the way that the scene is illuminated (the position of the light source relative to the surface).

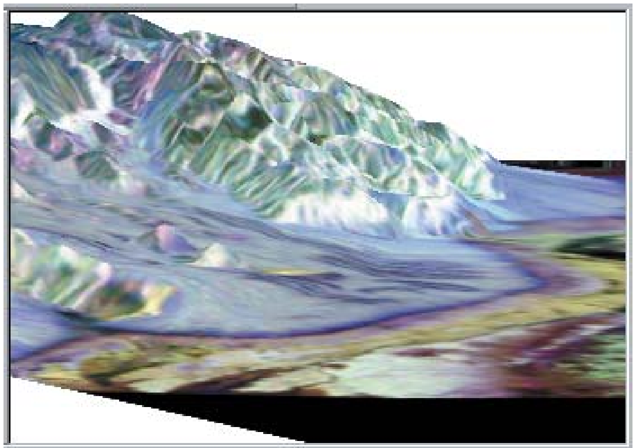
2. Click the General tab.
3. Type “2” in the Vertical Exaggeration combo box.



4. Click OK.

The apparent height of the terrain is now doubled.

You can now clearly see how the alluvial fan spreads out onto the valley floor, between the larger rocky area at the center of the scene and the smaller rocky area in the foreground at the left side of the scene.



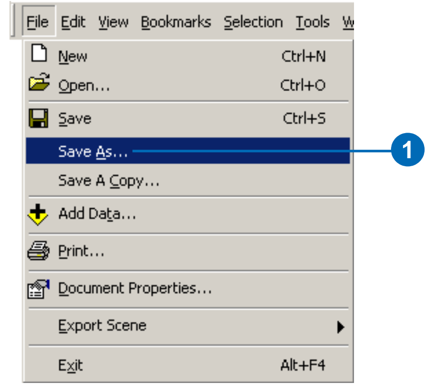
You have added depth to the radar image, explored the general relationship between the data in the image and the terrain data, and enhanced the scene so that you can perceive more subtle variations in the terrain.

Now that you've built the scene, you will save it so that you can explore it later if you choose.

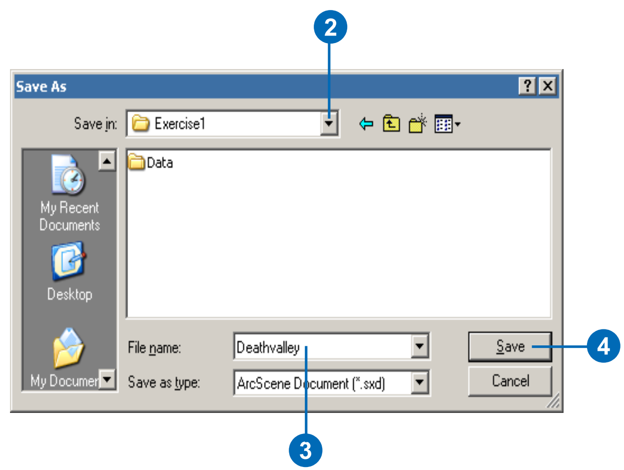
Saving the scene

Scenes, also called Scene Documents, are like maps. They contain information about how the layers that are in the scene should be rendered and where the data is located.

1. Click File and click Save As.



2. Navigate to the Exercise 1 folder.
3. Type "Deathvalley".



4. Click Save.

The scene will now be available for you to open later.

Exercise 2: Visualizing contamination in an aquifer

Imagine that you work for a water district. The district is aware of some areas where volatile organic compounds (VOCs) have leaked over the years. Scientists from your department have mapped some plumes of VOCs in the aquifer, and you want to create a 3D scene to help officials and the public visualize the extent of the problem.

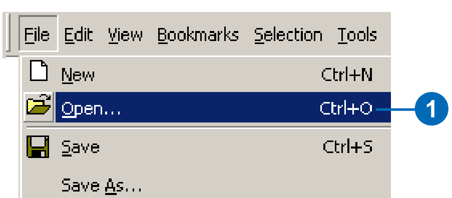
Some of the data for the scene has already been assembled in the Groundwater scene. You will modify the scene to better communicate the problem.

VOC data was supplied courtesy of the San Gabriel Basin Water Quality Authority.

Opening the Groundwater scene document

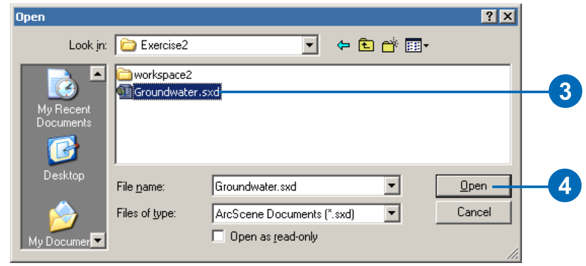
This scene document contains a TIN that shows the shape of the contaminant plume, a raster that shows the concentration of the contaminant, and two shapefiles that show the locations of parcels and wells. You will drape the concentration raster over the plume TIN, extrude the building features and change their color, and extrude the well features so that the wells that are most endangered by the contamination may be more easily recognized.

1. In ArcScene, click File, then click Open.



2. Navigate to the Exercise2 folder.

3. Click Groundwater.sxd.



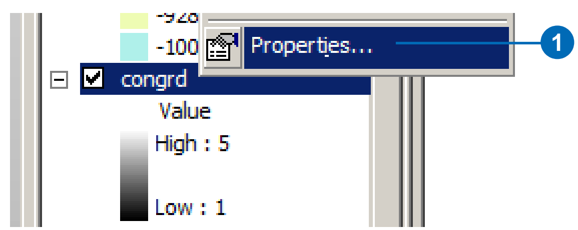
4. Click Open.

   The Groundwater scene opens. You can see the four layers in the table of contents.

Showing the volume and intensity of contamination

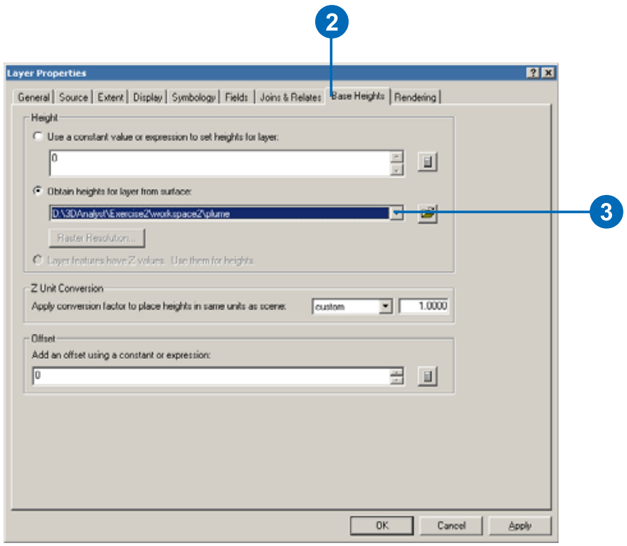
You'll drape the raster of VOC concentration over the TIN of the contaminant plume surface to show the volume and intensity of contamination in the aquifer.

1. Right-click congrd and click Properties.



2. Click the Base Heights tab.

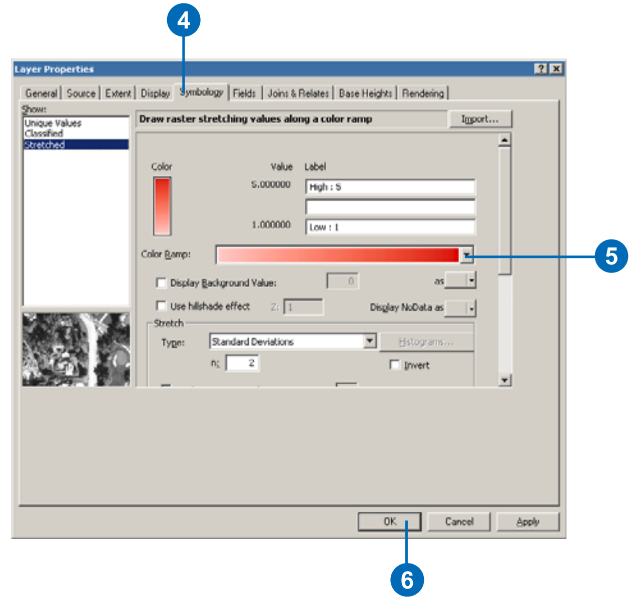
3. Click the drop-down arrow and click plume to get the heights from the plume TIN.



Now you will change the symbology of the raster to show the intensity of the contamination.

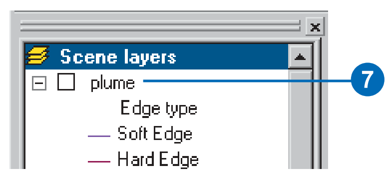
4. Click the Symbology tab.

5. Click the Color Ramp drop-down arrow and click a red color ramp for the raster.



6. Click OK.

7. Uncheck plume in the table of contents.



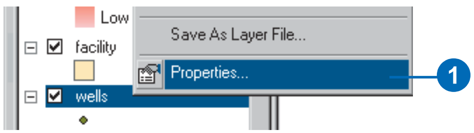
Now it is possible to see the shape of the plume and its intensity in 3D.

Showing the relationship of the plume to wells

You can see that some of the wells are within the area of the plume. However, it is difficult to see which wells are most seriously affected because the contamination is more widespread but less concentrated at greater depths.

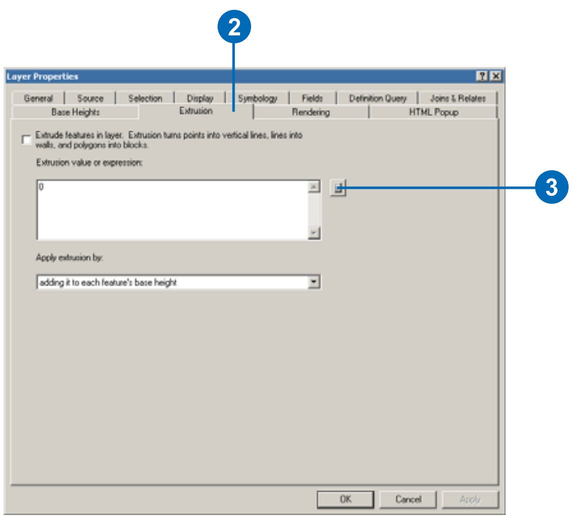
You will extrude the well features based on their depth attribute in order to see which wells intersect the plume.

1. Right-click wells and click Properties.

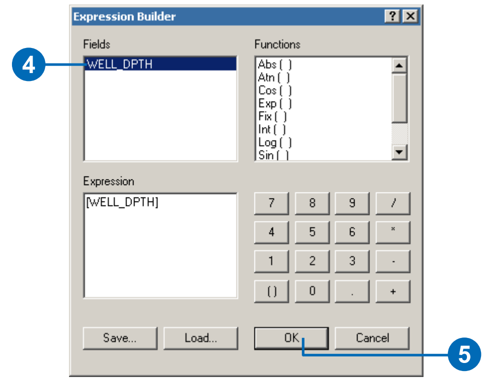


2. Click the Extrusion tab.
3. Click the Calculate Extrusion Expression button.

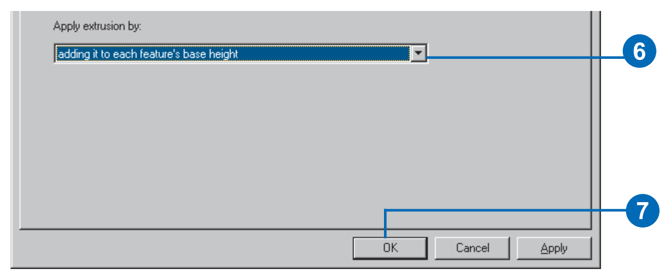
   You will display the well points as vertical lines equal to the depth of the well. This information is stored in the WELL_DPTH field.



4. Click WELL_DPTH.
5. Click OK.



6. Click the drop-down arrow to apply the extrusion expression by adding it to each feature's base height. The well depths are expressed as negative values, so they'll be extruded downward.



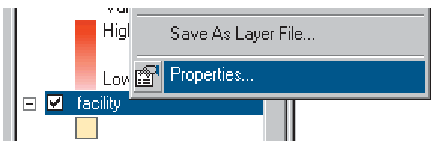
7. Click OK.

You can see the places where the wells intersect, or are close to, the plume. Now you will modify the scene to show the priority of various facilities that have been targeted for cleanup.

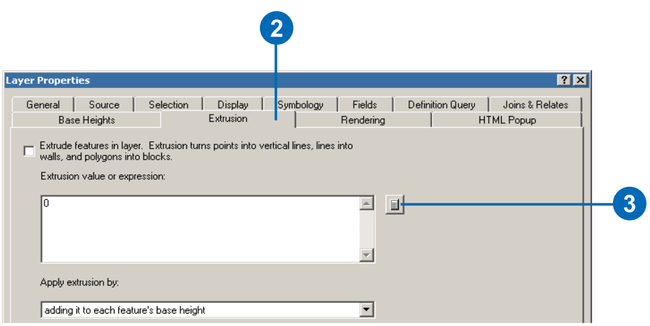
Showing the facilities with a high cleanup priority

Analysts in your department have ranked the facilities according to the urgency of a cleanup at each location. You'll extrude the facilities into 3D columns and color code them to emphasize those with a higher priority for cleanup.

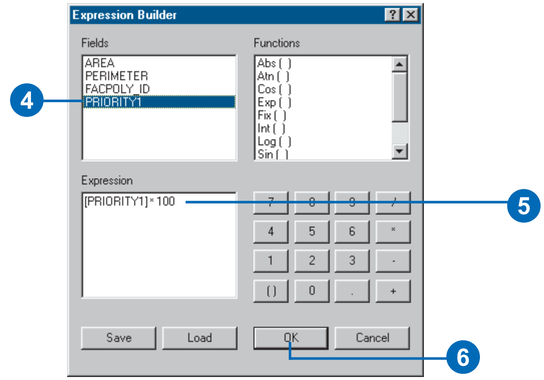
1. Right-click facility and click Properties.



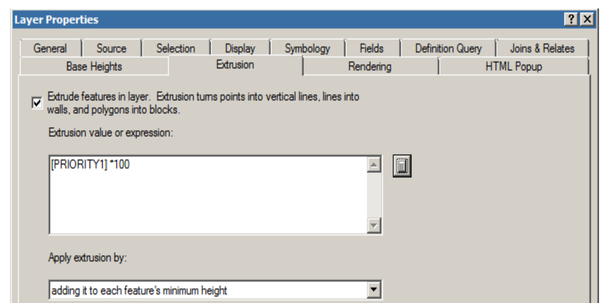
2. Click the Extrusion tab.
3. Click the Calculate Extrusion Expression button.



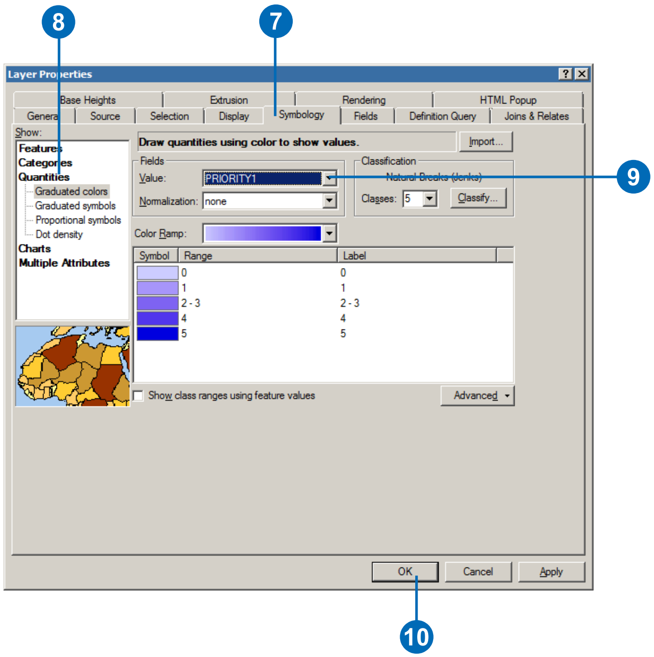
4. Click PRIORITY1.
5. Type "* 100".
6. Click OK.



The expression you created appears in the Extrusion value or expression box.



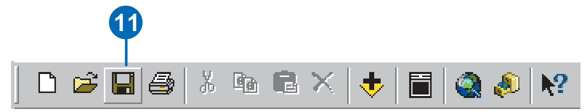
7. Click the Symbology tab.
8. Click Quantities.
9. Click the Value drop-down list and click PRIORITY1.



10. Click OK.

The facilities are now extruded in proportion to their priority score. The scene now shows the shape and intensity of the contamination, the wells in relationship to the plume, and the facilities that need to be cleaned up in order to prevent further pollution of the groundwater.

Now you'll save your changes to the scene.



11. Click the Save button.

Exercise 3: Visualizing soil contamination and thyroid cancer rates

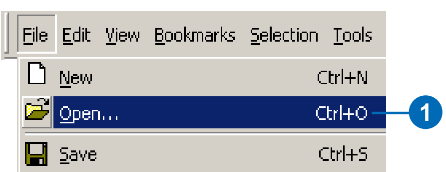
In 1986, after the catastrophic accident at the Chernobyl nuclear power plant in Ukraine, a large amount of radioactive dust fell on Belarus. Since then, scientists have studied the aftermath of the accident. One tool for exploring the data is 3D visualization. In this exercise, you will create two surfaces from point data collected in Belarus. One set of points contains measurements of soil CS137 concentrations. CS137 is one of several radioactive isotopes released by the accident. The other set of points shows the rates of thyroid cancer, aggregated by district, with the sample point placed near the district centers.

The CS137 contamination and thyroid cancer data was supplied courtesy of the International Sakharov Environmental University.

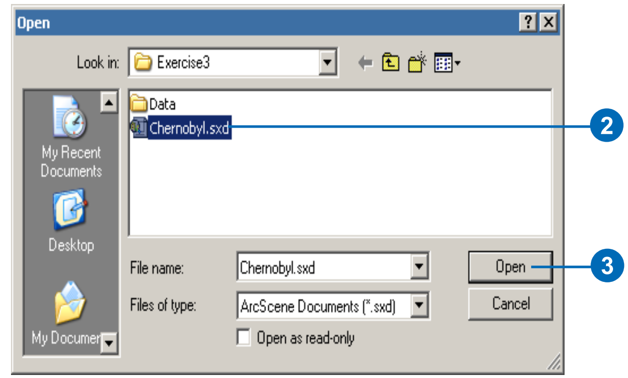
Viewing the point data

First, you will open the Chernobyl scene and view the point data.

1. In ArcScene, click File and click Open.



2. Navigate to Exercise3 and click Chernobyl.



3. Click Open.

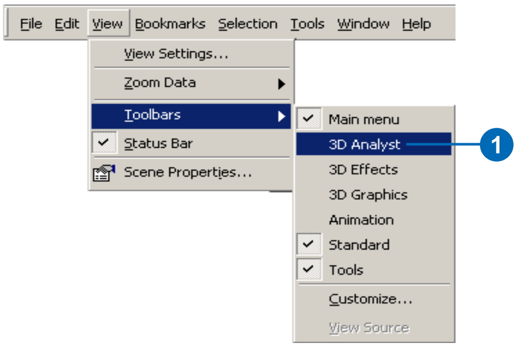
The CS137 soil measurements are shown with small point symbols, using a graduated color ramp to show the intensity of the contamination. The districts' thyroid cancer rates are shown with larger symbols, using a different color ramp.

Creating 3D point features

The soil CS137 samples are 2D points with some attributes. One way to view 2D points in 3D is by setting an extrusion expression, or a base height. You can also incorporate a z-value into a feature's geometry to allow it to be directly viewed in 3D without the need to set a base height from a surface or an attribute.

This exercise requires the 3D Analyst toolbar. You'll need to add it to ArcScene if not already present from the previous exercise.

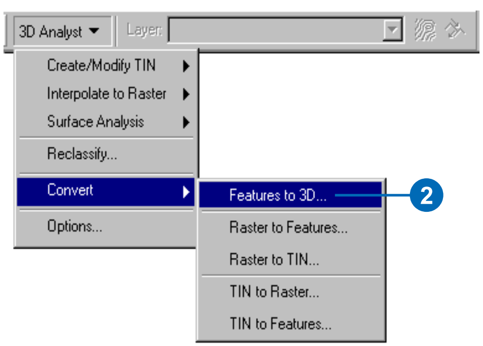
1. Click View, point to Toolbars, and click 3D Analyst.



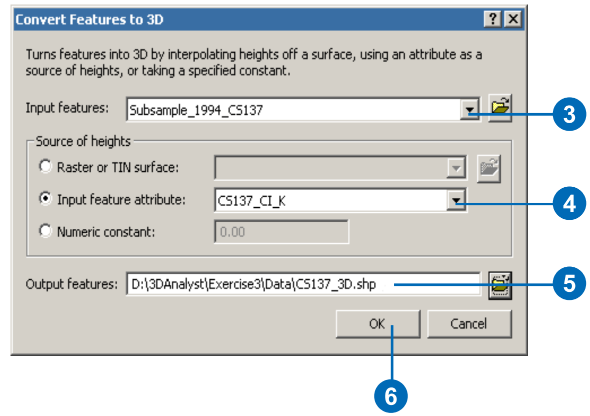
The 3D Analyst toolbar in ArcScene contains several 3D analysis and data conversion tools. The ArcMap 3D Analyst toolbar contains the same tools, plus several additional tools that you can use in ArcMap.

Now you will create 3D point features from the soil CS137 points.

2. Click 3D Analyst, point to Convert, and click Features to 3D.



3. Click the Input Features drop-down list and click Subsample_1994_CS137.
4. Click the Input Feature Attribute button, then click the Input Feature Attribute drop-down list and click CS137_CI_K.
5. Change the output feature name to CS137_3D.



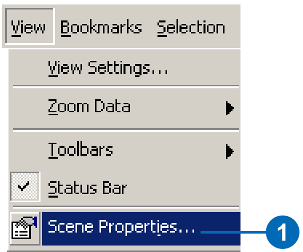
6. Click OK.

The features are converted to 3D point features. However, they still seem to be resting on a flat plane because the CS137 concentration values range from 0 to 208.68, which is small, relative to the horizontal extent of the data.

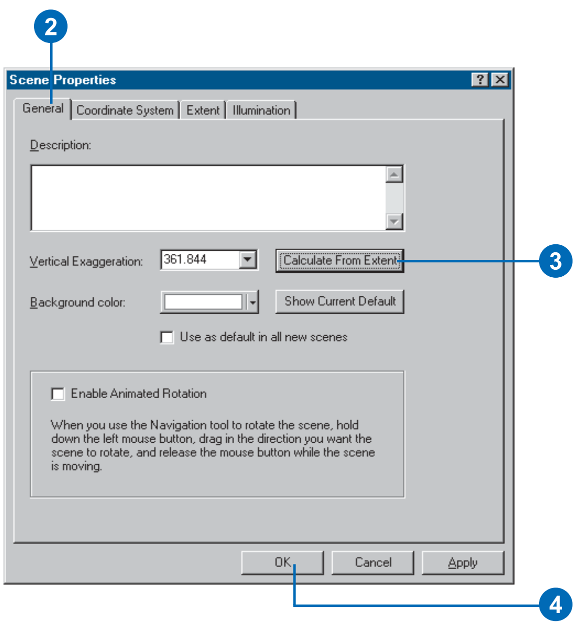
Increasing the vertical exaggeration

You will exaggerate the scene to show the new points with their height embedded in the feature geometry.

1. Click View and click Scene Properties.



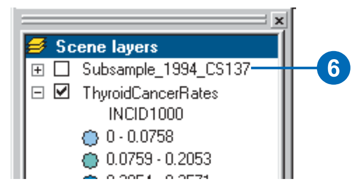
2. Click the General tab.
3. Click Calculate From Extent.



4. Click OK.
5. Click the Full Extent button.

Now that you can see the new 3D points in the scene, you can turn off the original CS137 sample point layer.

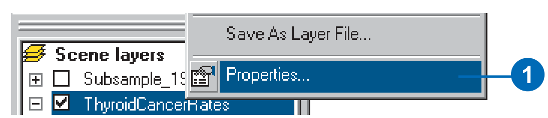
6. Uncheck the box in the table of contents beside Subsample_1994_CS137 and click the minus sign beside the box to hide the classification.



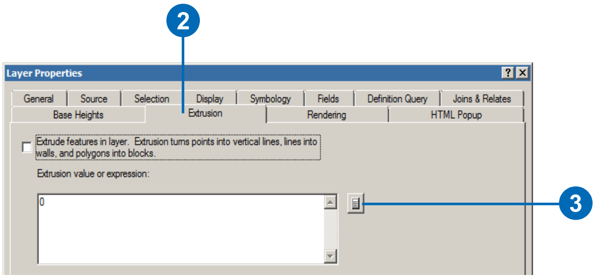
Extruding columns

Viewing points in 3D space is one way to investigate data. Another way is to extrude points into columns. You will extrude the thyroid cancer points into columns to compare them to the contamination data.

1. Right-click ThyroidCancerRates and click Properties.

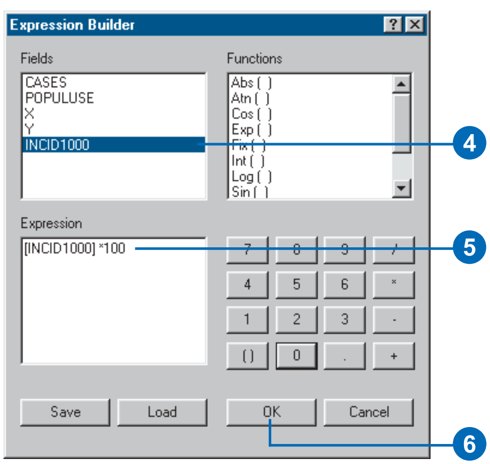


2. Click the Extrusion tab.
3. Click the Calculate Extrusion Expression button.



4. Click INCID1000 (the rate of cases per 1,000 persons).

   Because the z-values of the phenomena that you are comparing have different ranges, you will multiply the cancer rate by 100 to bring the values into a range similar to that of the CS137 measurements.
5. Type "* 100".
6. Click OK on the Expression Builder dialog box.



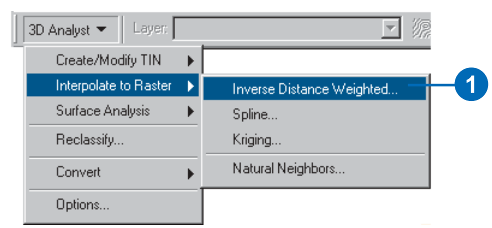
7. Click OK on the Layer Properties dialog box.

   Now the district centroid points are shown with columns proportionate to the thyroid cancer rates. If you navigate the scene you will see that the areas with the highest contamination levels also tend to have high thyroid cancer rates, although there are areas with lower CS137 contamination levels that also have high cancer rates.

Creating a surface from point sample data

You know what the soil concentrations of CS137 are at the sample point locations, but you do not know what they are at the locations between sample points. One way to derive the information for locations between sample points is to interpolate a raster surface from the point data. There are many ways to interpolate such surfaces, which result in different models of varying accuracy. In this exercise you will interpolate a surface from the samples using the Inverse Distance Weighted (IDW) interpolation technique. IDW interpolation calculates a value for each cell in the output raster from the values of the data points, with closer points given more influence and distant points less influence.

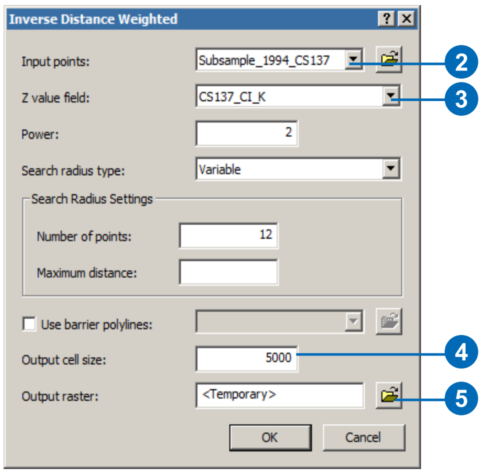
1. Click 3D Analyst, point to Interpolate to Raster, and click Inverse Distance Weighted.



2. Click the Input points drop-down list and click Subsample_1994_CS137.

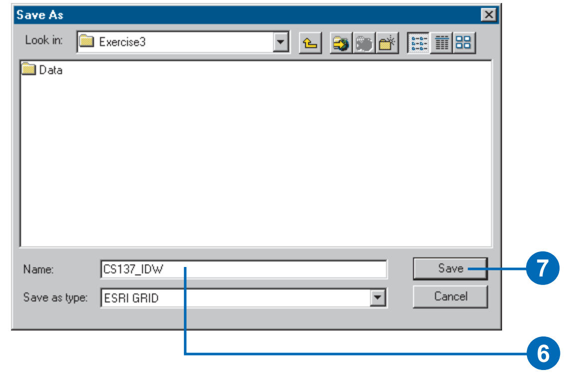
3. Click the Z value field drop-down list and click CS137_CI_K.

4. Click inside the Output cell size box and increase the value to 5000.



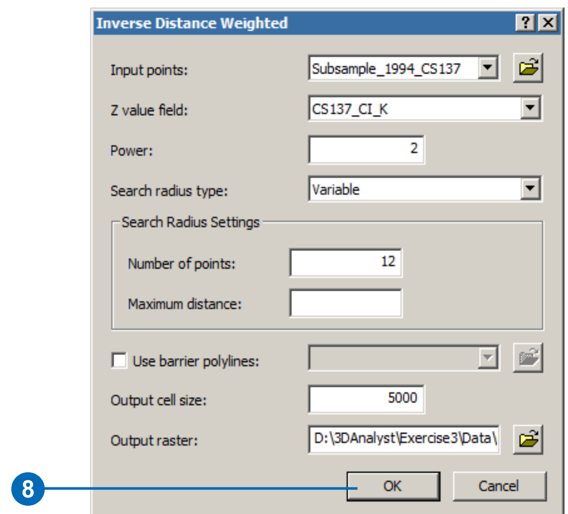
5. Click the Browse button to set the output raster location.

6. Navigate to the Exercise3 folder and type "CS137_IDW" in the Name field.



7. Click Save.

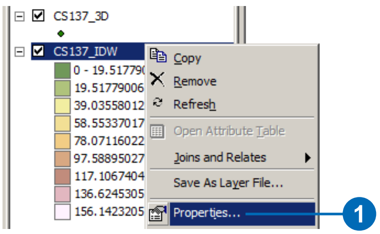
8. Click OK. ArcScene interpolates the surface and adds it to the scene.



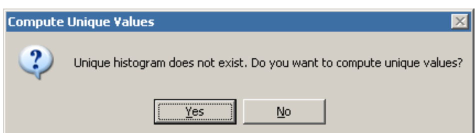
Viewing the interpolated surface

Now that the surface has been added to the scene, you can see that there are two areas with very high concentrations of CS137. You will view the surface in perspective, with a new color ramp, to better see its shape.

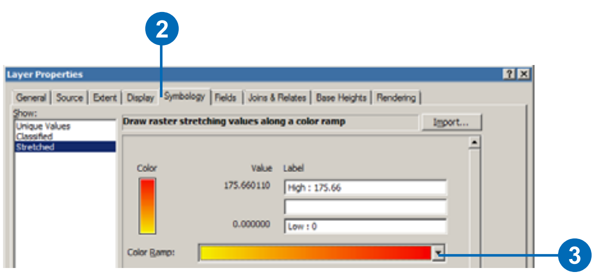
1. Right-click CS137_IDW and click Properties.



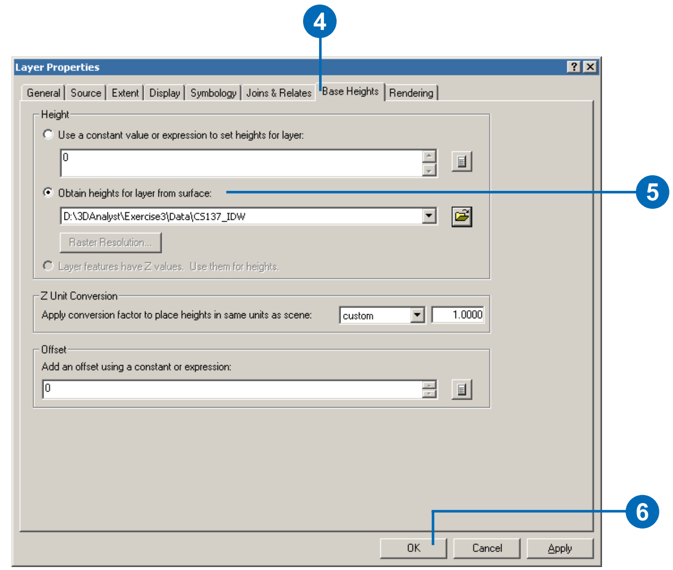
If prompted to create a unique values histogram for the new raster data, click Yes.



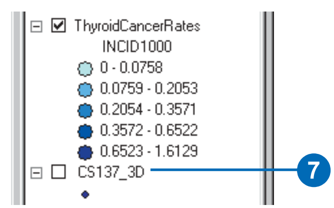
2. Click the Symbology tab and select Stretched from the Show category.
3. Click the Color Ramp drop-down arrow and click a new color ramp.



4. Click the Base Heights tab.
5. Click Obtain heights for layer from surface.
6. Click OK.

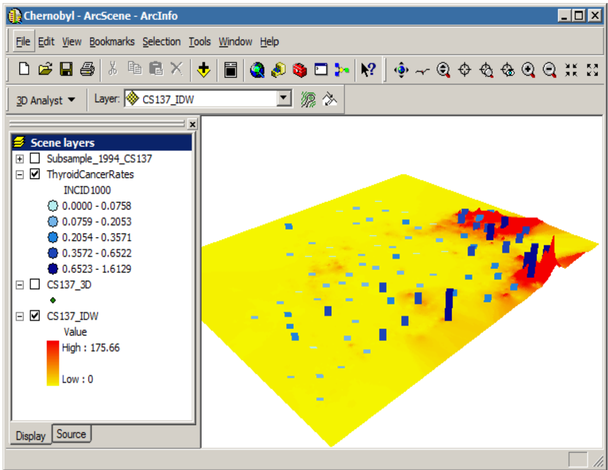


7. Uncheck CS137_3D in the table of contents.



Now you can see the interpolated surface of CS137 contamination, along with the thyroid cancer rate data.

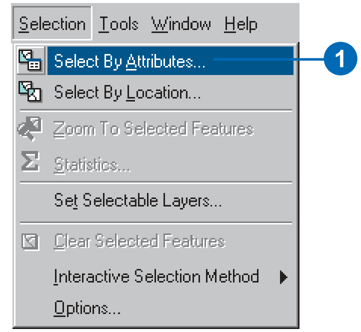
Next, you will select the province centers with the highest rates of thyroid cancer.



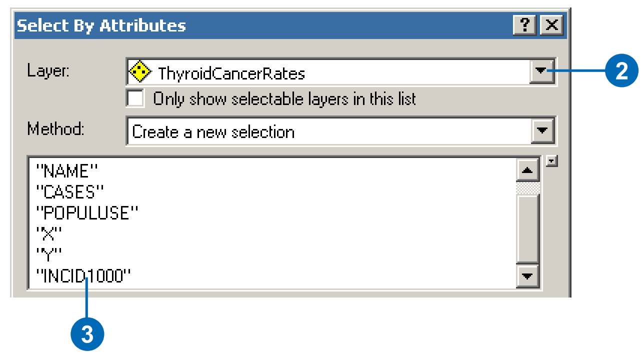
Selecting features by an attribute

Sometimes it is important to focus on a specific set of data or specific features. You can select features in a scene by their location, by their attributes, or by clicking them with the Select Features tool. You will select the province centers by attribute to find the locations with the highest rates.

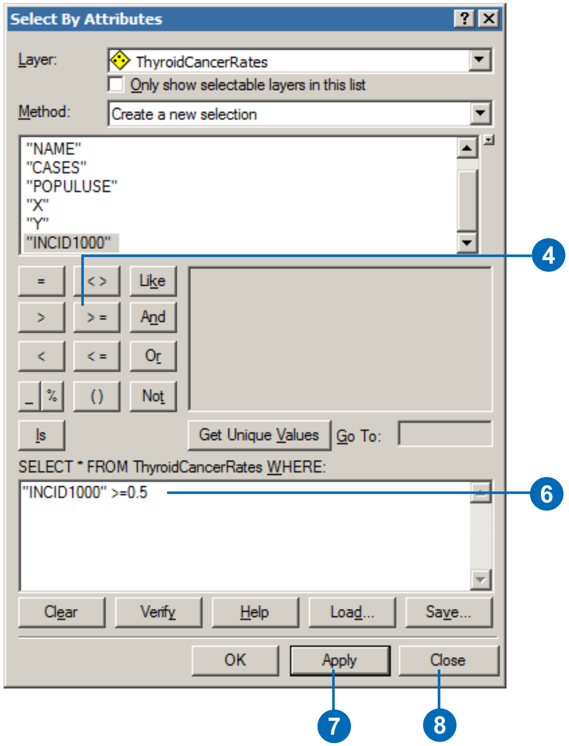
1. Click Selection and click Select By Attributes.



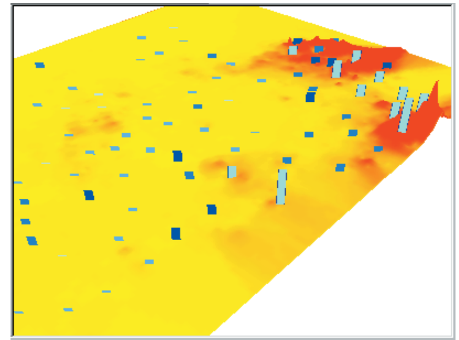
2. Click the Layer drop-down arrow and click ThyroidCancerRates.
3. Double-click INCID1000 in the Fields list.



4. Click the >= button.



5. Type "0.5".
6. Check the selection expression you've built.
7. Click Apply.
8. Click Close.

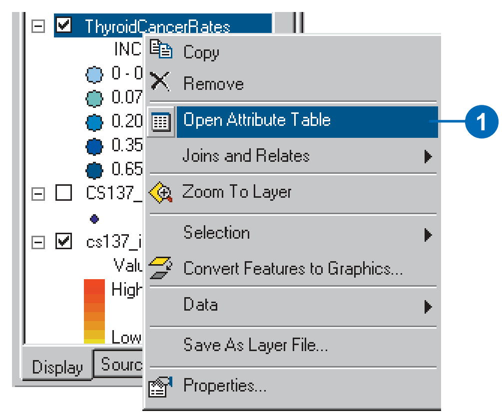


The province centers with thyroid cancer rates greater than 0.5 cases per 1,000 are now selected in the scene. They are drawn in light blue to indicate that they are selected.

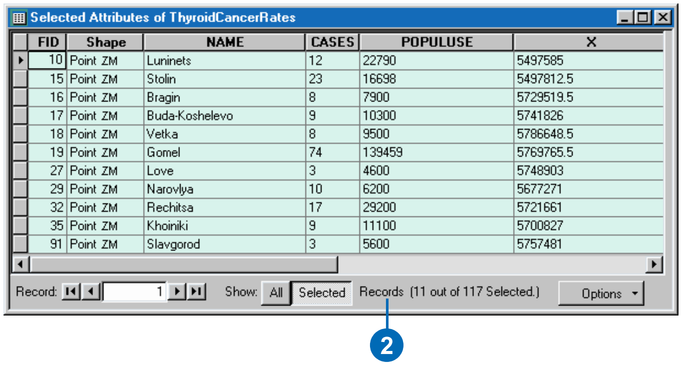
Viewing the attributes of features

You will investigate attributes of the selected locations and find out how many cases of thyroid cancer occurred in these districts.

1. Right-click ThyroidCancerRates and click Open Attribute Table.

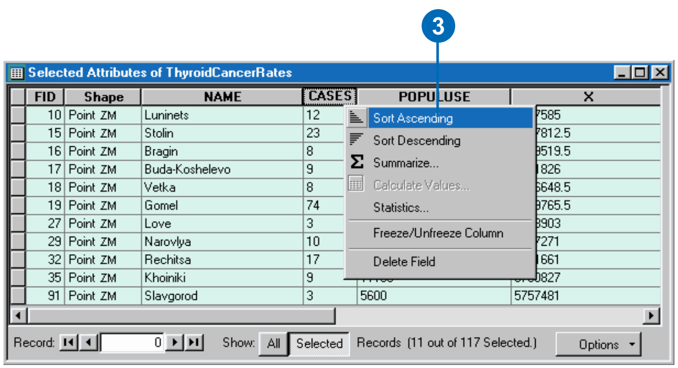


2. Click the Selected button.



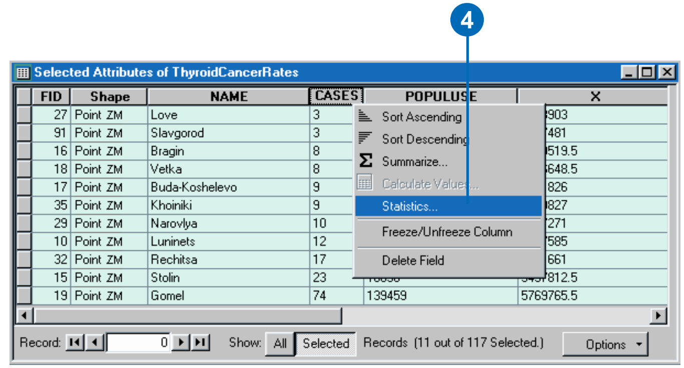
The table now shows only those features that you selected.

3. Right-click CASES and click Sort Ascending.



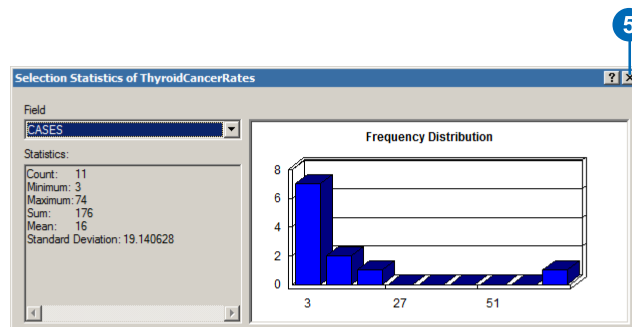
The selected province centers are sorted according to the number of cases.

4. Right-click CASES and click Statistics.

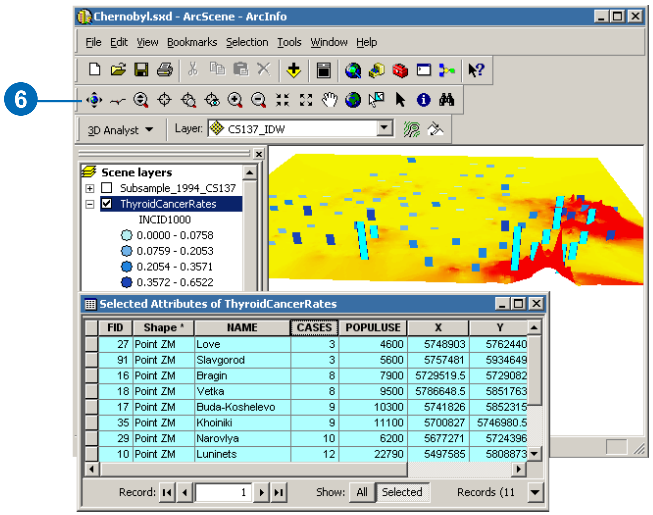


The total number of cases in the selected set of 11 province centers is 176.

5. Close the Selection Statistics dialog box.



6. Click the Navigate button and click on the scene.



You can work in ArcScene while the attribute table is open.

7. Click the Save button.

In this exercise you have created 3D features, extruded point features, and interpolated a raster surface from a set of data points. You’ve compared the extruded vector data to the surface data and explored the attributes of the vector data.

Exercise 4: Building a TIN to represent terrain

The town of Horse Cave, Kentucky, is situated above a cave that once served as the source of drinking water and hydroelectric power for the town. Unfortunately, the groundwater that flows in the cave was polluted by household and industrial waste dumped on the surface and washed into sinkholes. Dye tracing studies and a three-dimensional survey of the cave revealed the relationship between the cave passages and the town and demonstrated the connection between open surface dump sites and contamination of the groundwater in the cave below.

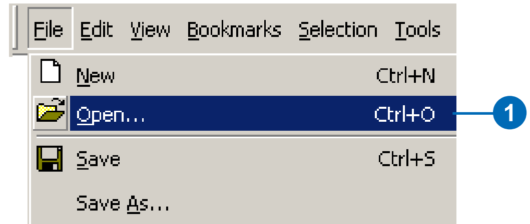
Thanks to the development in 1989 of a new regional sewage facility and the joint efforts of the Cave Research Foundation and the American Cave Conservation Association (ACCA), the groundwater is cleaner, and the cave has been restored. It is now operated as a tour cave and educational site by the ACCA.

Cave data was provided courtesy of the ACCA.

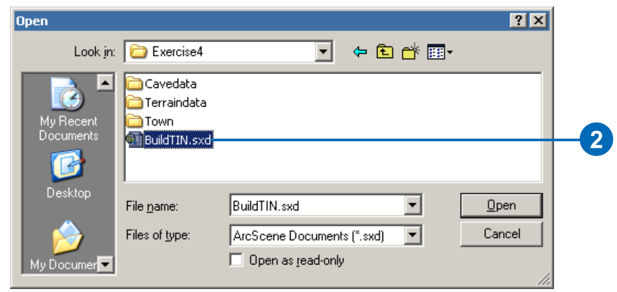
Viewing the cave and the landscape

First you will open the BuildTIN scene and view the cave survey and some terrain data layers. You’ll use this terrain data to create a TIN and drape some other layers on it to visualize the relationship of the cave to the town.

1. Click File and click Open.

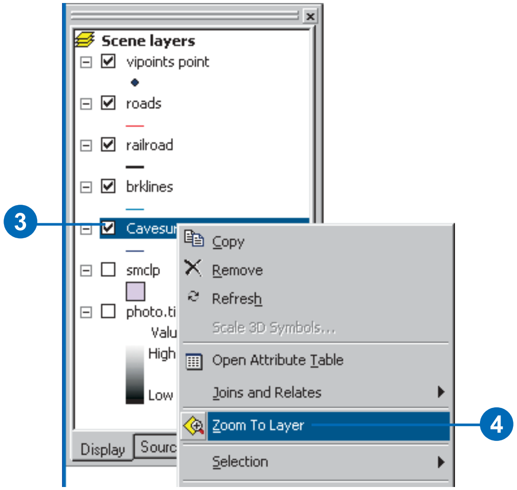


2. Navigate to the Exercise4 folder and double-click BuildTIN.sxd.



The scene opens, and you can see the location of roads and railroads, some sample elevation points, and a few significant contour lines. In the table of contents, you can see that some layers have been turned off.

3. Check the box to show the Cavesurvey layer.



4. Right-click Cavesurvey and click Zoom To Layer.

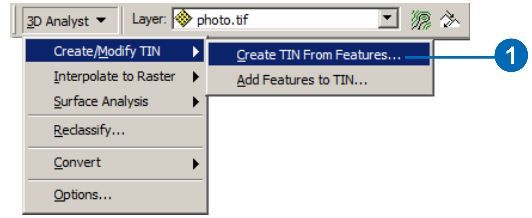
The cave survey data consists of PolylineZ features, which are automatically drawn in 3D because they have z-values embedded in their geometry. They appear above the rest of the data because all of the other layers are drawn with the default elevation of 0.

In the next steps you will build a TIN to provide the base heights for the streets and a photo of the town.

Creating a TIN from point data

You have a point layer called vipoints point. This coverage consists of points with an attribute called SPOT that contains elevation values taken at these points. You'll create the TIN surface model from these points.

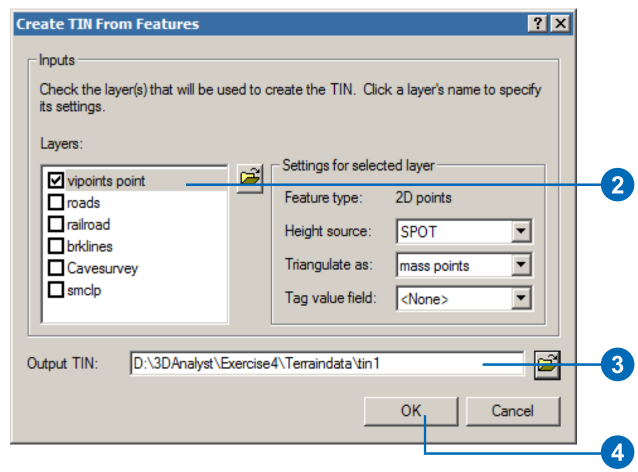
1. Click 3D Analyst, point to Create/Modify TIN, and click Create TIN From Features.



2. Check vipoints point.

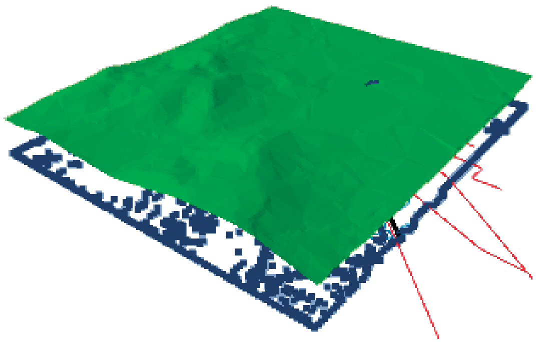
The SPOT field name appears in the Height source drop-down list, and the layer will be triangulated as mass points.

3. Change the default path so that the new TIN will be created in the Exercise 4\Terraindata\ folder and call it tin1.



4. Click OK.

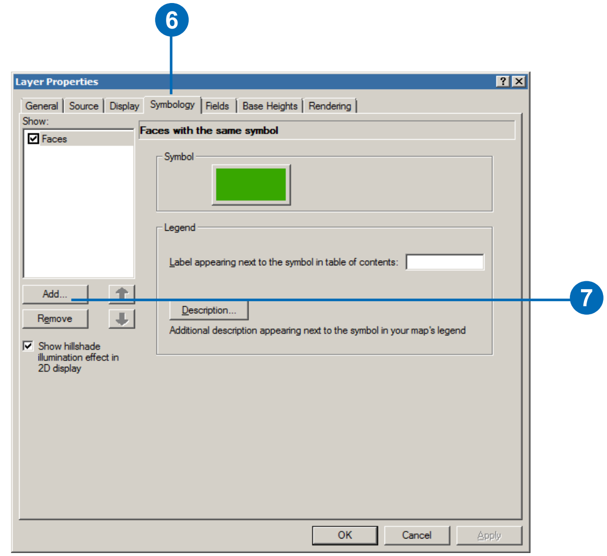
The TIN is created and added to the scene. Note that it is drawn above the Cavesurvey layer; the elevation values in the TIN define its base height.



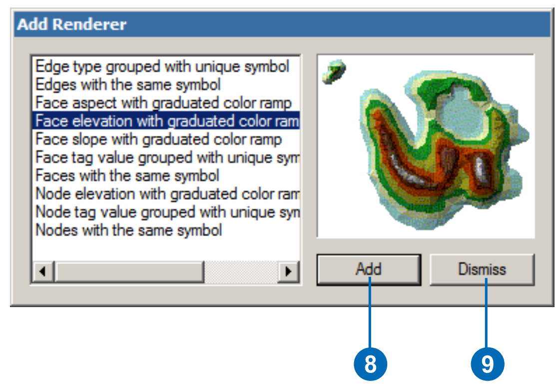
By default, the TIN is symbolized using a single color for every face.

5. Right-click the tin1 layer in the table of contents and click Properties.
6. Click the Symbology tab.

   You can see there is a single renderer in place, titled Faces.
7. Click the Add button to open up the Add Renderer dialog box.

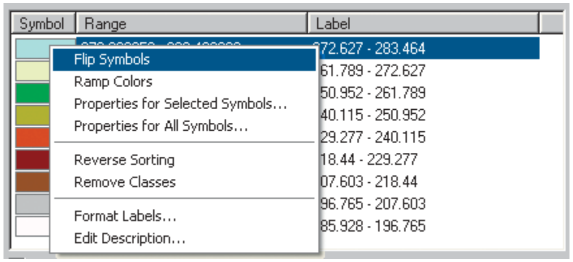


8. Click the Face Elevation with graduated color ramp option and click Add.



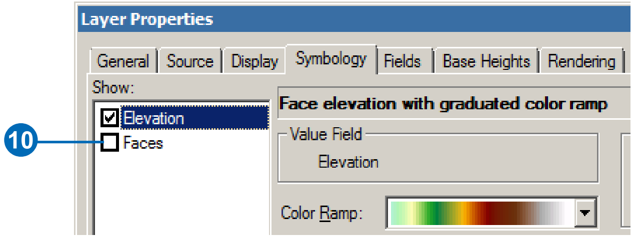
9. Click Dismiss to close the Add Renderer dialog box and return to the Layer Properties dialog box.

If the symbol for the highest elevation range is set to blue instead of white, then right-click on any of the symbols and click Flip Symbols.

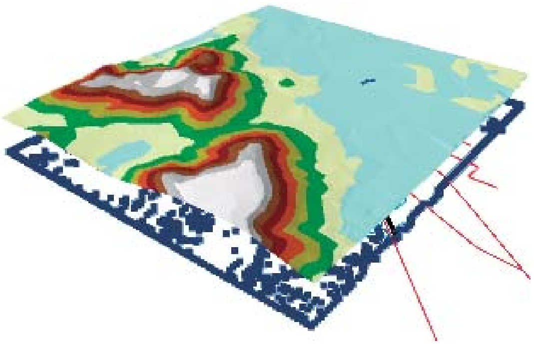


This will switch the order of the symbols and render the highest points of the TIN as snow capped peaks.

10. Switch off the original single color renderer by unchecking the Faces checkbox in the list of renderers.



11. Click OK to close the Layer Properties dialog box.

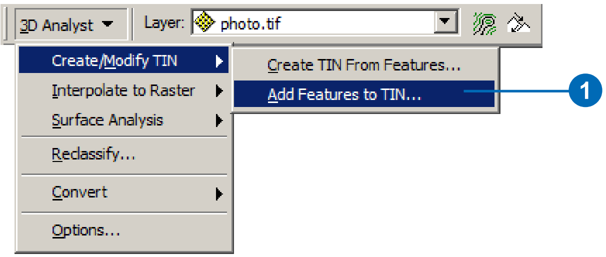


While this TIN is a fairly good model of the surface, you can make it more accurate by adding more features.

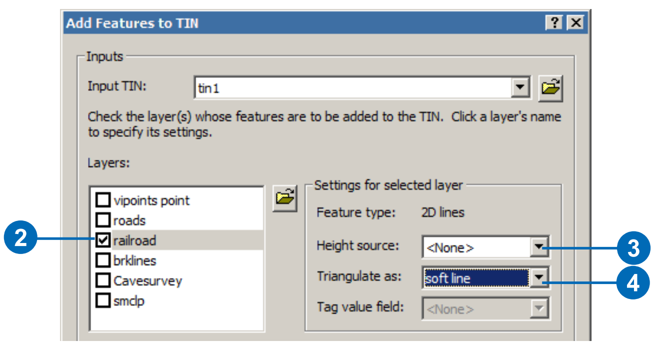
Adding features to a TIN

Now you will add hard and soft breaklines and a clip polygon to the TIN. You'll add the railroad features as soft breaklines, so they'll be represented on the surface but won't influence the shape of the surface. You'll add the brklines features as hard breaklines with elevation values to refine the shape of the surface in areas that you're most interested in. Finally, you will add the smclp polygon as a soft clip polygon to more smoothly define the edge of the TIN.

1. Click 3D Analyst, point to Create/Modify TIN, and click Add Feature to TIN.

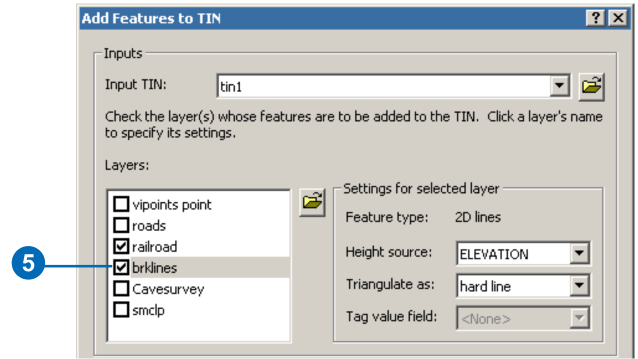


2. Check railroad.
3. Click the Height source drop-down arrow and click <None>.



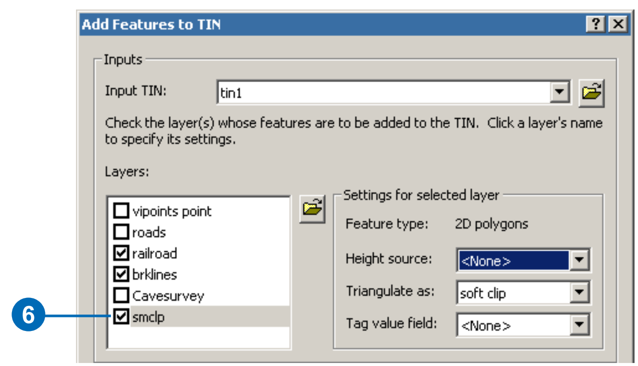
4. Click the Triangulate as drop-down arrow and click soft line.

5. Check brklines.



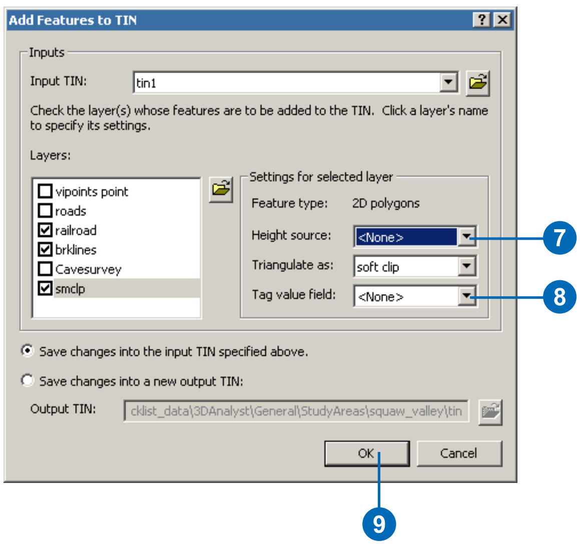
The Add Features To TIN tool detects that there is an ELEVATION field and uses it for the height source. You will accept the default and triangulate them as hard breaklines.

6. Check smclp.



7. Click the Height source drop-down arrow and click <None>.
8. Click the Tag value field drop-down arrow and click <None>.

   You have defined the feature layers that you want to add to your TIN and specified how they should be integrated into the triangulation.



9. Click OK.

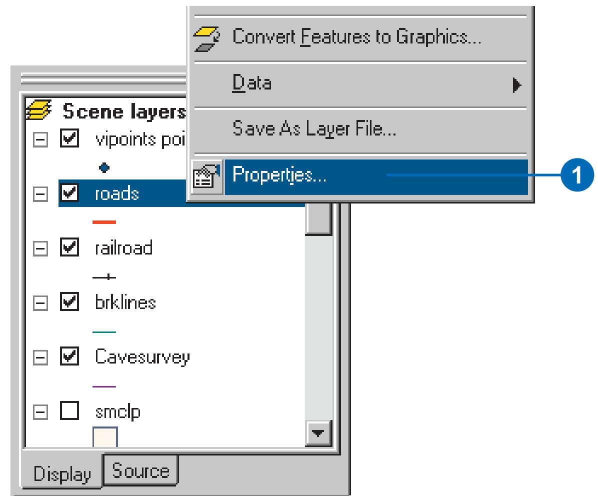
   The new features are added to the TIN.

After the next step you will see that the railroad follows a bed that has been leveled somewhat relative to the surface.

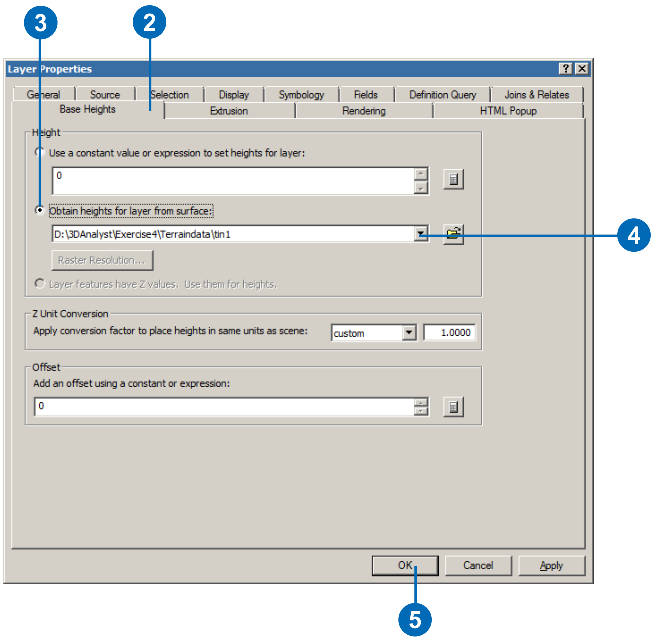
Setting feature base heights from the TIN

Now you will set the base heights for the road and railroad features from the new TIN.

1. Right-click roads and click Properties.



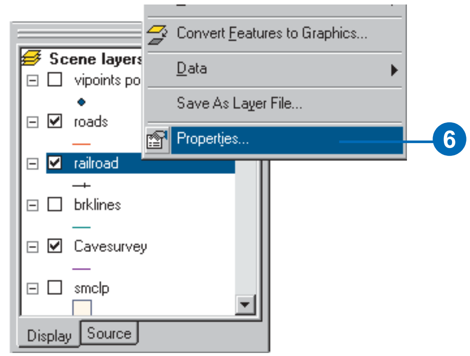
2. Click the Base Heights tab.
3. Click Obtain heights for layer from surface.
4. Click the drop-down arrow and click tin1.



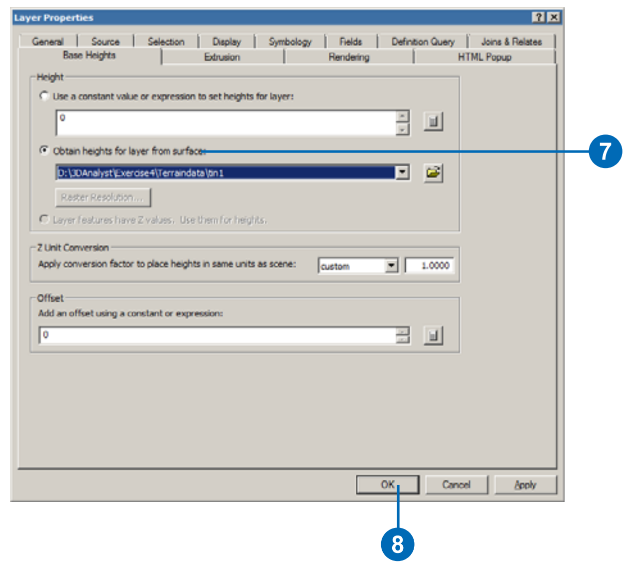
5. Click OK.

The road features are now draped over the TIN surface that you created. Now you will drape the railroad features over the surface.

6. Right-click railroad and click Properties.

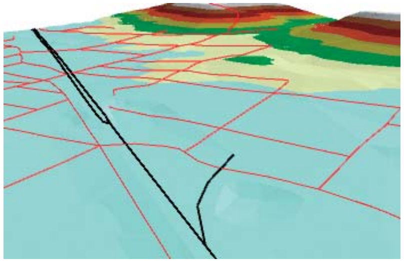


7. Click Obtain heights for layer from surface.



8. Click OK.

The railroad features are now draped over the TIN surface that you created.

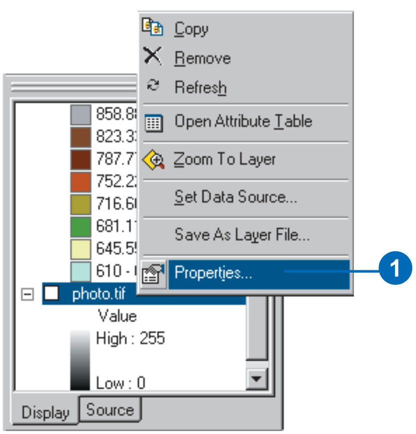


Next you'll drape the aerial photo over the TIN.

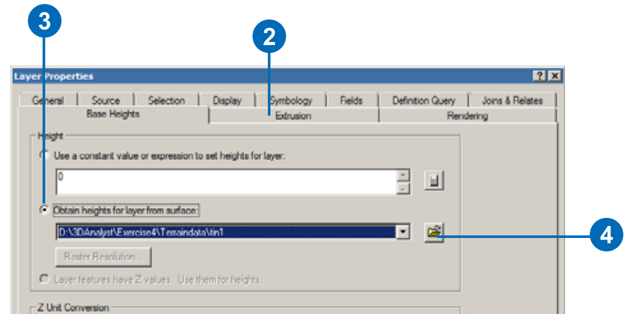
Setting raster base heights from the TIN

Including the aerial photo of the town in the scene makes the relationship between the cave and the town much more evident. You'll drape the raster over the TIN and make it partly transparent so that you'll be able to see the cave beneath the surface.

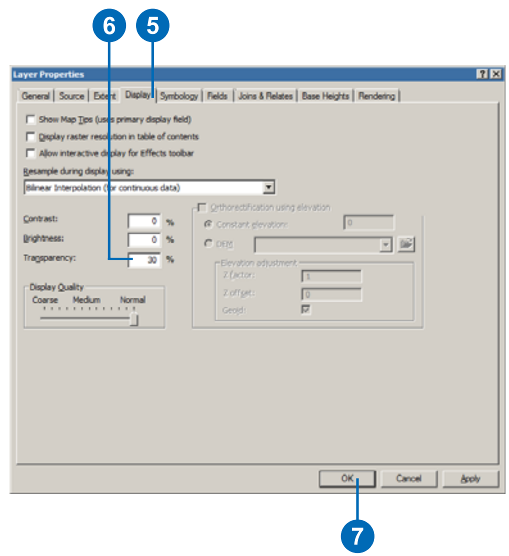
1. Right-click photo.tif and click Properties.



2. Click the Base Heights tab.
3. Click Obtain heights for layer from surface.
4. Click the drop-down arrow and click tin1.



5. Click the Display tab.
6. Type "30" in the Transparency text box.



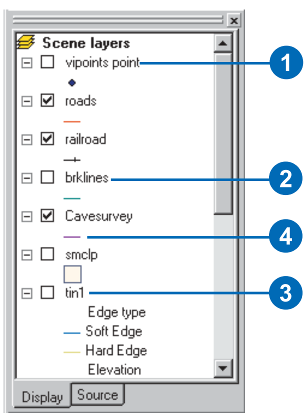
7. Click OK.
8. Check photo.tif in the table of contents so it becomes visible in the scene.

Now the aerial photo is 30 percent transparent. You can see large patches of the TIN over the photo because the TIN and the photo have the same drawing priority. If you wanted the TIN to be visible below the photo, you could change its drawing priority to 10 (lowest) on the Rendering tab of the TIN's Layer Properties dialog box. You could also offset the base height of the TIN or the photo by a small amount.

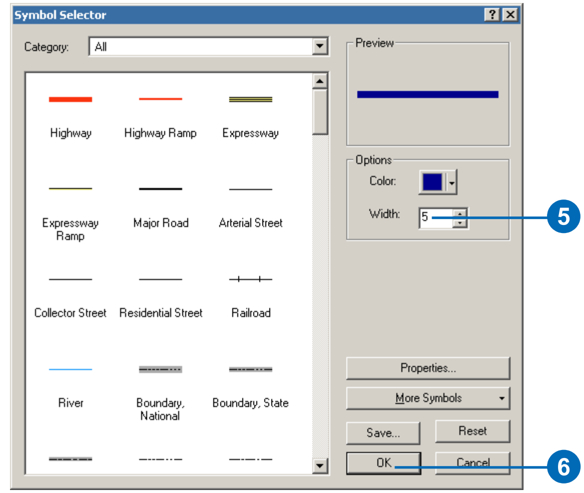
Cleaning up the scene

To clean up the scene you'll turn off some layers that are no longer needed and make the cave line symbol larger.

1. Uncheck vipoints point.
2. Uncheck brklines.
3. Uncheck tin1.
4. Click the line symbol for the Cavesurvey layer.

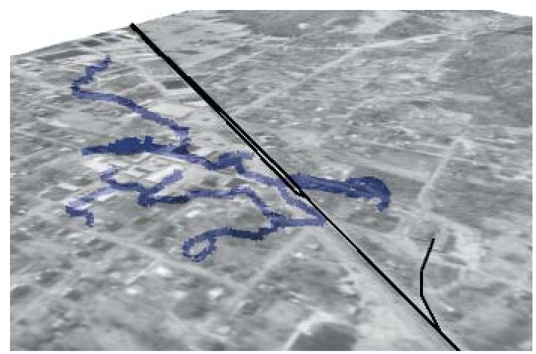


5. Type "5" in the Width box.



6. Click OK.

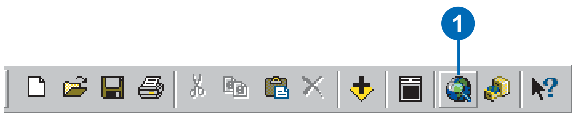
Now you can see the three-dimensional passages of the cave, symbolized by thick lines. The surface features and the aerial photo provide context, so you can easily see the relationship of the cave to the town.



Creating a profile of the terrain

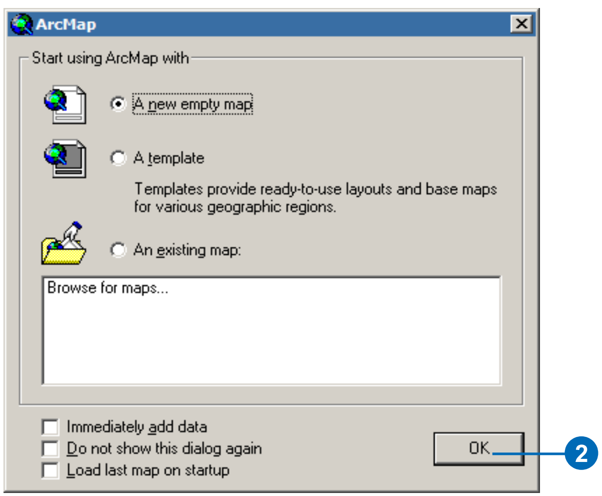
The cave follows the valley floor orientation. To get an understanding of the shape of the valley, you will create a profile across the TIN. In order to create a profile, you must first have a 3D line (feature or graphic). You will start ArcMap, copy the TIN to the map, and digitize a line to make your profile.

1. Click the Launch ArcMap button.



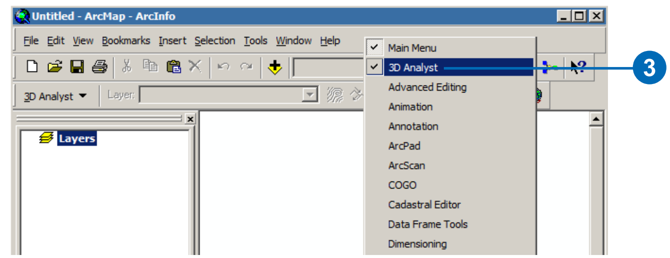
ArcMap starts.

2. Click OK to launch a new empty map.



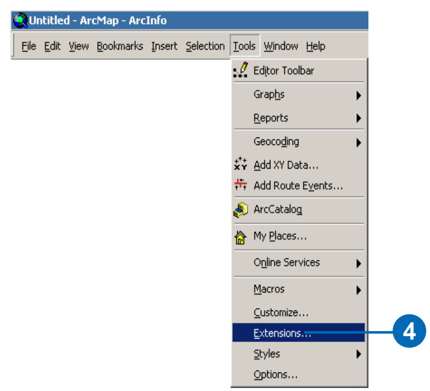
Now you will add the 3D Analyst toolbar to ArcMap. The ArcMap 3D Analyst toolbar contains a few tools that do not appear on the ArcScene 3D Analyst toolbar. Two of these are the Interpolate Line tool and the Create Profile Graph tool, which you will use to create your profile of the surface.

3. Right-click on one of the ArcMap toolbars and click 3D Analyst.

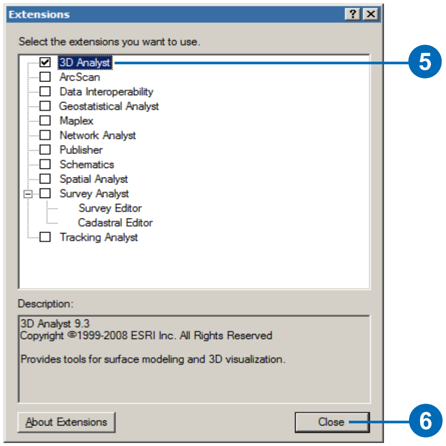


The 3D Analyst toolbar appears.

4. Click Tools and click Extensions.

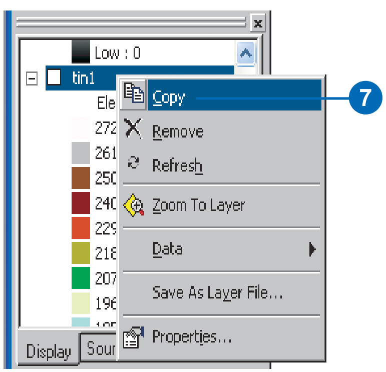


5. Check 3D Analyst.
6. Click Close.

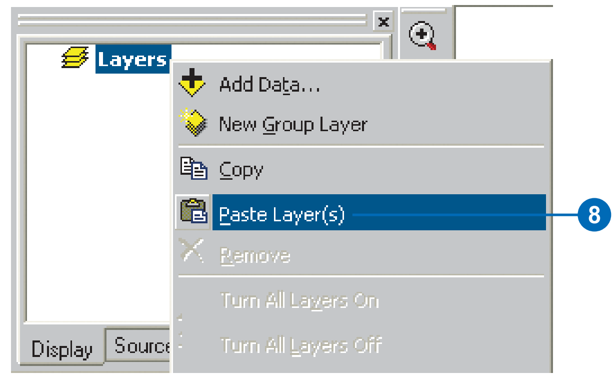


The 3D Analyst extension is enabled.

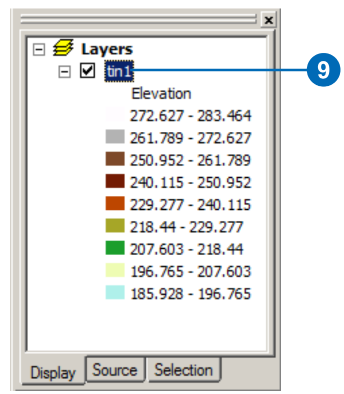
7. Right-click tin1 in the ArcScene table of contents and click Copy.



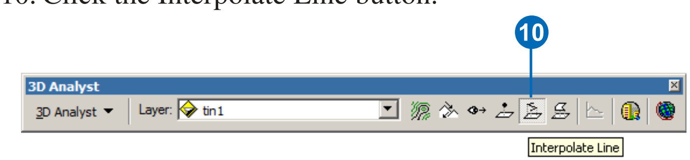
8. Right-click Layers in the ArcMap table of contents and click Paste Layer(s).



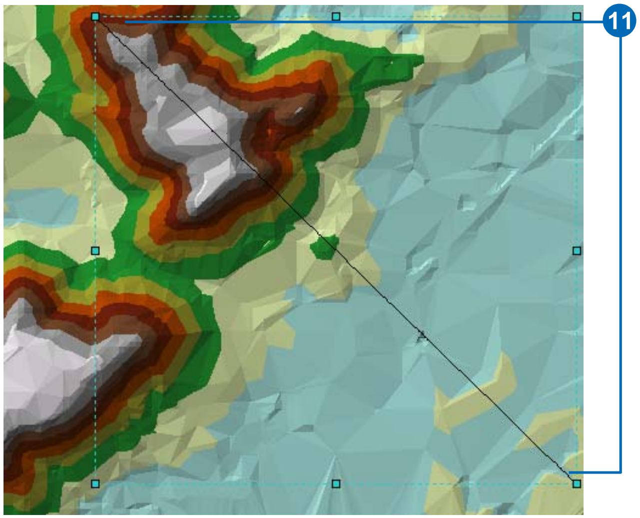
9. Check tin1 in the ArcMap table of contents to make the layer visible.



10. Click the Interpolate Line button.

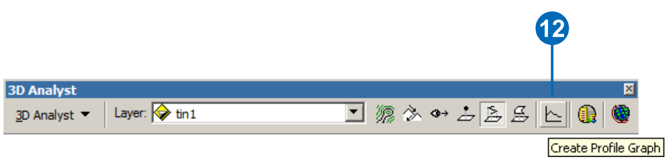


11. Click the upper-left corner of the TIN, drag the line to the lower-right corner, and double-click to stop digitizing.

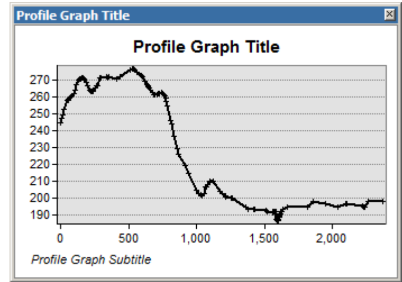


You can create a profile along a line with more than one segment, but in this case you'll just make one straight line.

12. Click the Create Profile Graph button.

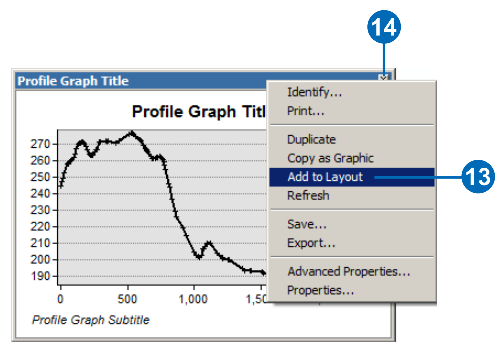


The profile graph is created.



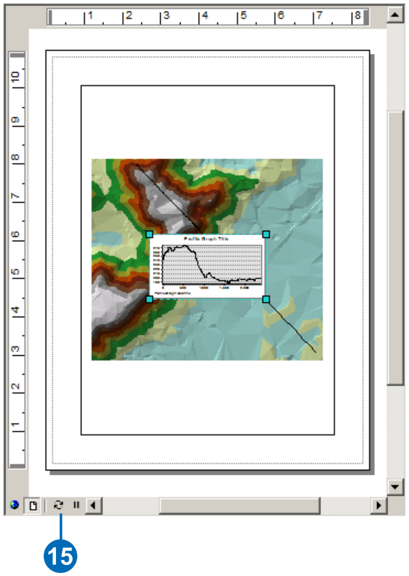
You can edit the title, subtitle, and other properties of the graph; you can save, print, or export the graph; you can copy it to the clipboard; and you can show the graph on the layout. You can also simply close the graph.

13. Right-click the Profile Graph Title bar and click Add to Layout.



14. Close the profile graph window.

You can see the graph on the layout of the map.



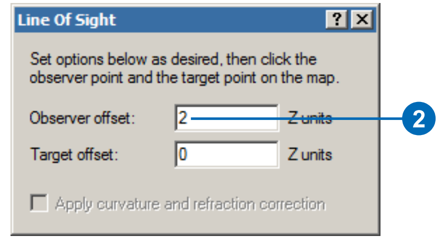
15. Click the Data View button to return to data view.

Creating a line of sight on the terrain

Another way of understanding the terrain is to create a line of sight. Lines of sight show what parts of a surface are visible and what parts are hidden along a line from an observer point to a target point.

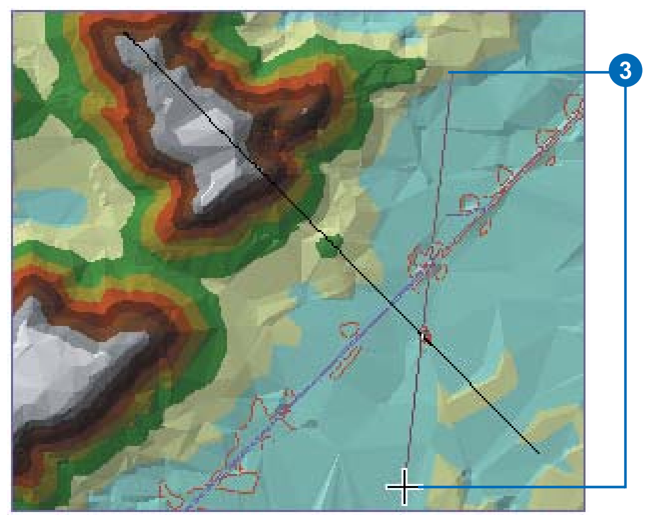
1. Click the Create Line of Sight button.

2. Type “2” in the Observer offset text box.

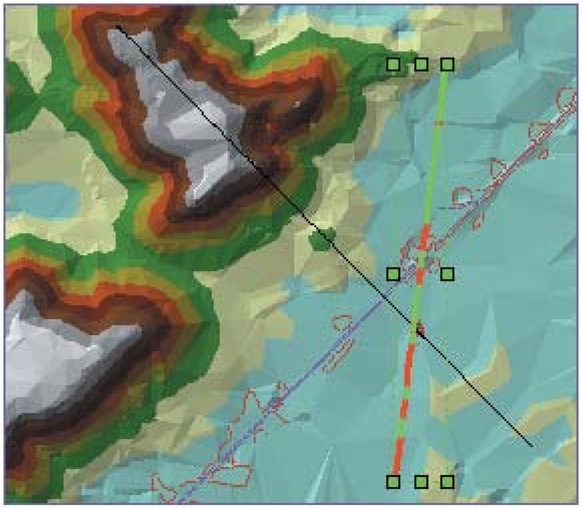


The line of sight will be calculated to show what is visible from the perspective of an observer two meters tall, as the z units for this scene are meters.

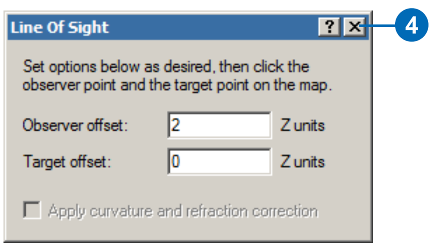
3. Click on the south slope of the higher land in the upper-right part of the TIN (the observer point), drag the line to the lower-right part, and release the mouse button (the target point).



The line of sight is calculated. The green segments show areas that are visible from the observer point; the red segments are hidden from the observer.

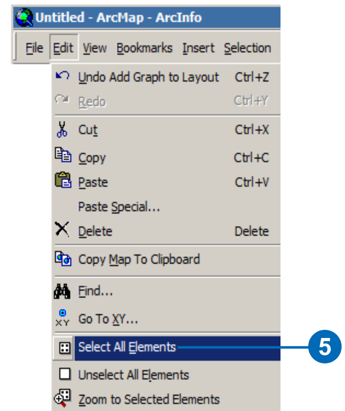


4. Close the Line Of Sight dialog box.



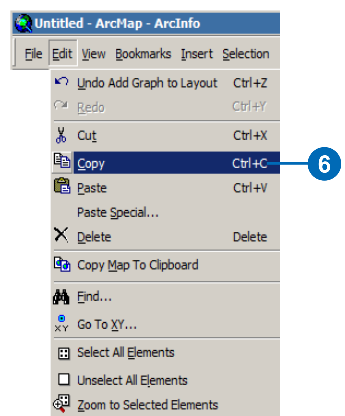
Lines of sight, like other graphic lines, can be copied from ArcMap to ArcScene. Now you will copy both the lines you've created into the scene.

5. Click Edit and click Select All Elements.

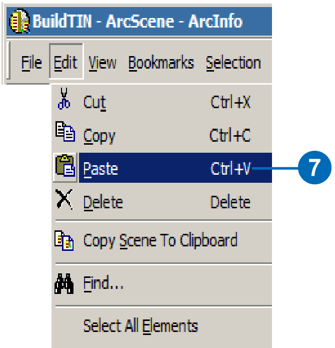


Both of the lines you created are selected.

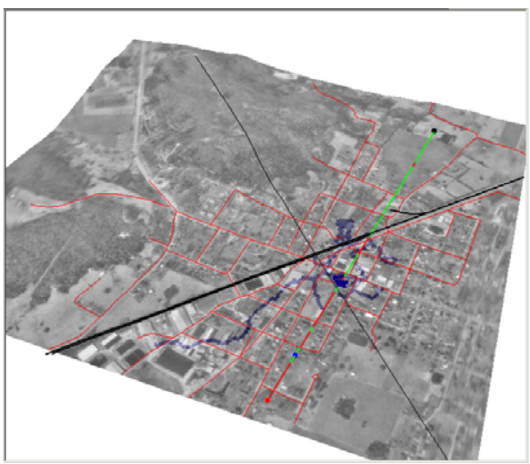
6. Click Edit and click Copy.



7. Click Edit in ArcScene and click Paste.



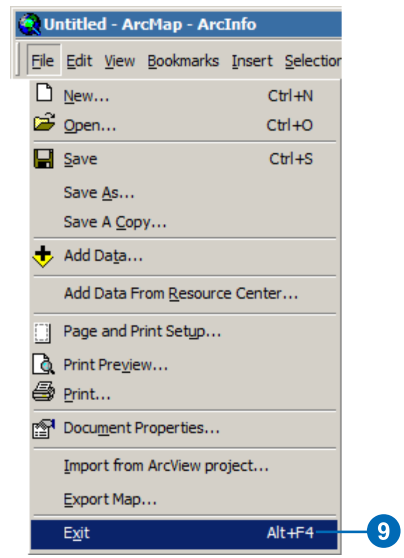
The lines are pasted into the scene.



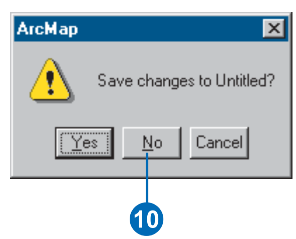
If necessary, to unselect the lines, click Selection from the Main menu and click Clear selected features.

8. Click the Save button in ArcScene.

9. Click File in ArcMap and click Exit.



10. Click No.



In this exercise you learned how to create and work with a TIN surface model using ArcScene and ArcMap. You discovered how to construct and symbolize a TIN dataset to accurately represent a 3D surface. Breaklines and polygons were added to additionally depict surface features, such as railroads and terrain elevation values. Further surface analysis was then conducted using aerial photography as a draped raster layer on the TIN. Finally, you completed the exercise conducting 3D surface analysis on the TIN model using the interpolate line and create profile graph tools in ArcMap.

Now that you've learned how to represent a surface using a TIN model, you can begin to explore other areas of the ArcGIS 3D Analyst extension. In the next exercise, you will learn how to create and work with animations in ArcGlobe.

Exercise 5: Working with animations

Imagine that you wish to create an animated sequence showing the flight of an object over a landscape. You've created a TIN and have draped images over it to show the area. You also have some data pertaining to a strange phenomenon that has been occurring in the region. You are interested in displaying all the data in a dynamic way, making an animation to tour points of interest, and showing how you made the surface. You would also like to model the phenomenon by moving a layer in the scene.

The tutorial data has already been assembled in the scene document named Animation.sxd. You will use animation tools in ArcScene to effectively convey the points you want to show.

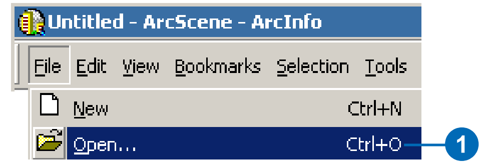
Data was supplied courtesy of MassGIS, Commonwealth of Massachusetts Executive Office of Environmental Affairs.

In this exercise, you will play an existing animation in an ArcScene document, Final Animation_A.sxd, and perform the tasks typically used to create the animation. Note that the majority of steps you'll perform in ArcScene to create the animation are also applicable in ArcGlobe.

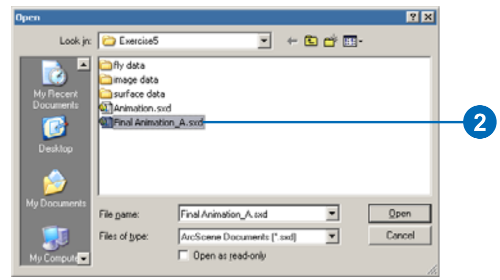
Opening the Final Animation_A scene document

In this section, you'll play an animation that demonstrates some effects you can create when you animate a scene.

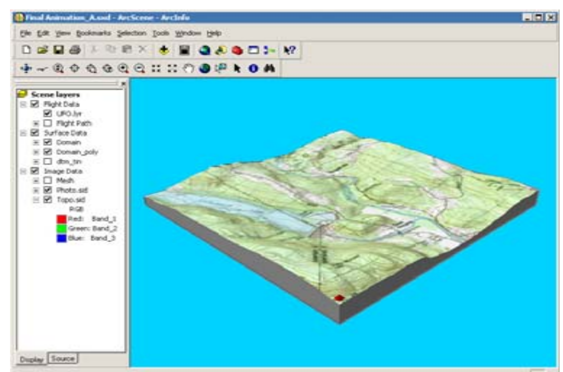
1. In ArcScene, click File and click Open.



2. Navigate to the Exercise5 folder and double-click Final Animation_A.sxd.



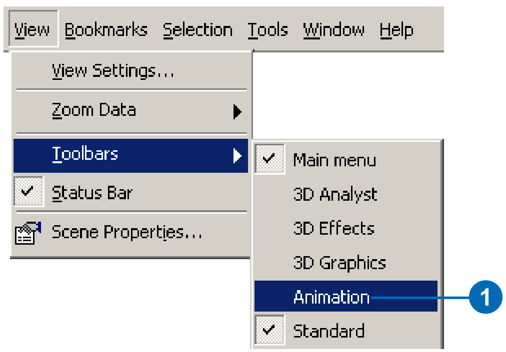
This scene contains geographic information and recorded special effects that have been combined to make an animation.



Playing the scene's animation

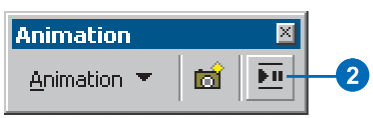
In order to view a scene's animation, you need to turn on the Animation toolbar.

1. Click View, point to Toolbars, and click Animation.



The Animation toolbar appears. Now you'll play the animation.

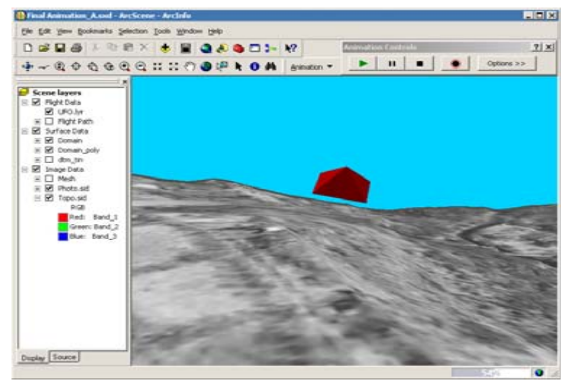
2. Click the Open Animation Controls button.



This animation shows the flight of a hypothetical unidentified flying object (UFO) over the terrain.

3. Click the Play button.

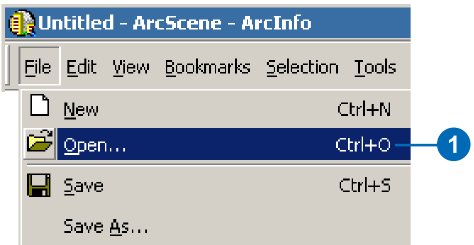
The animation plays, illustrating some of the effects you can use in an animated scene.



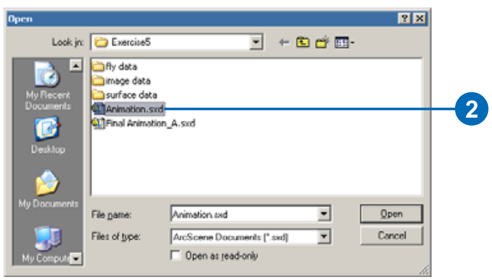
In the next section you will work through the steps used to make animations like this one.

Opening the Animation scene document

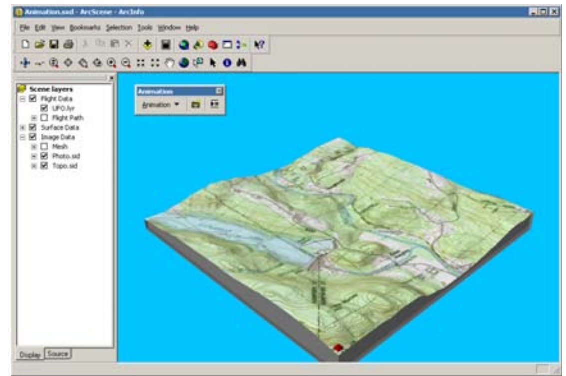
1. In ArcScene, click File and click Open.



2. Navigate to the Exercise 5 folder and double-click Animation.sxd.



The scene contains an ortho photo, a scanned topographic map, and other data you need to make your animation.



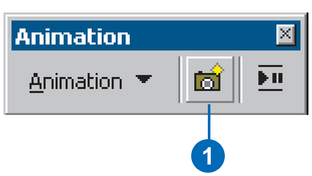
In this section, you'll use the animation tools to capture keyframes, import tracks, play back your animations, and save them to a scene document.

There are three types of keyframes that you can use to build animations. The first is a camera keyframe. A camera keyframe is a snapshot of the view you see in a scene. The second, a layer keyframe, is a snapshot of a layer's properties. The third type is a scene keyframe, which stores properties of a scene. In this section, you will create a simple animation from a set of camera keyframes.

Capturing perspective views as keyframes to make an animation

The simplest way to make animations is by capturing views to be stored as keyframes. The captured views are snapshots of camera perspectives in a scene at a particular time. The most fundamental element of an animation is a keyframe. Keyframes are used as snapshots to interpolate in between a track. You'll create a set of keyframes to make a camera track that will show an animation between points of interest in your study area.

1. Click the Capture View button to create a camera keyframe showing the full extent of the scene.

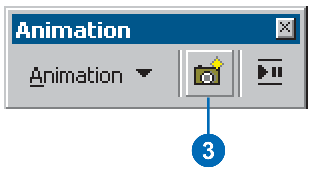


For a camera keyframe, the object is the virtual camera through which you view the scene. Navigating the scene changes camera properties that determine its position.

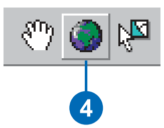
ArcScene interpolates a camera path between keyframes, so you'll need to capture more views to make a track that shows animation.

2. Right-click on UFO.lyr and click Zoom To Layer.

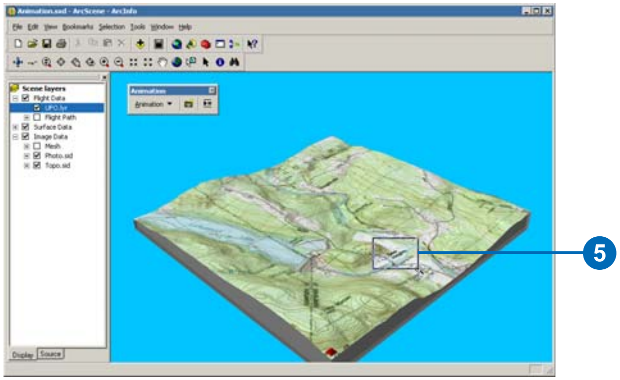
3. Click the Capture View button to create a camera keyframe showing the UFO layer.



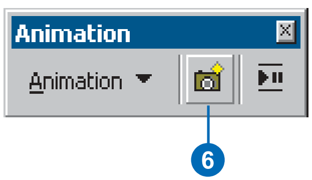
4. Click the Full Extent button to view all the data.



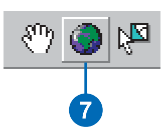
5. Click Zoom In on the Navigation toolbar and zoom to Goss Heights, located near the center of your view.



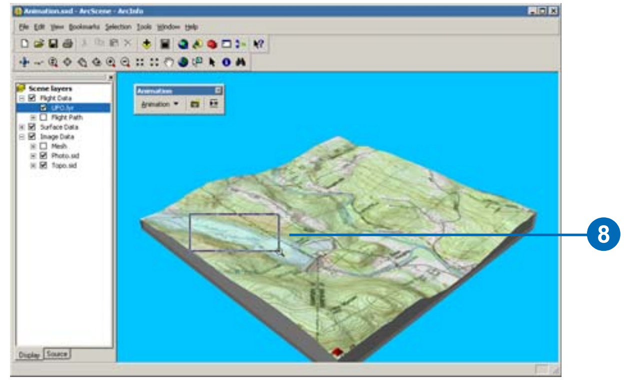
6. Click the Capture View button to create a camera keyframe of Goss Heights.



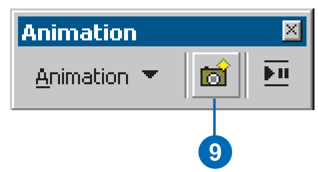
7. Click the Full Extent button.



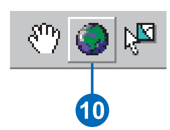
8. Zoom to Littleville Lake.



9. Click the Capture View button to capture a view of Littleville Lake.



10. Click the Full Extent button.



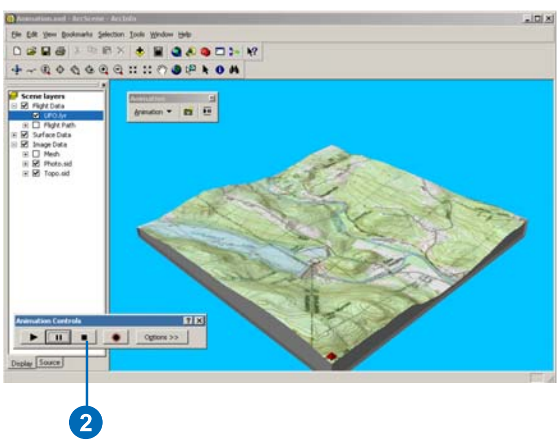
The captured views you just made are stored as a set of camera keyframes in a camera track. When the track is played, it shows a smooth animation between the keyframes. Next, you'll play your animation track.

Playing back your animation

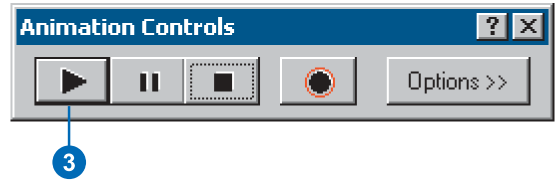
You will play back animations using simple tools that resemble the controls of a video cassette recorder (VCR).

1. Click the Open Animation Controls button.

2. Click the Animation toolbar and drag it to the lower-left corner of the scene so it won't block your view of the tools or data.



3. Click the Play button.



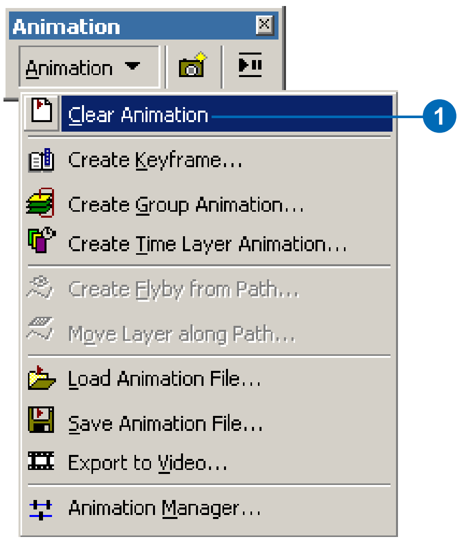
An animation is played back by interpolating the camera position between the keyframes in the track. In this case, the animation shows a virtual tour through the views you captured.

Clearing an animation

If you want to start over, you can erase all the tracks you created. In this section, you'll remove the tracks you just created so you can improve your animation.

1. Click Animation and click Clear Animation.

   All animation tracks are removed from the scene.

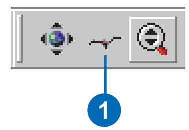


Recording navigation

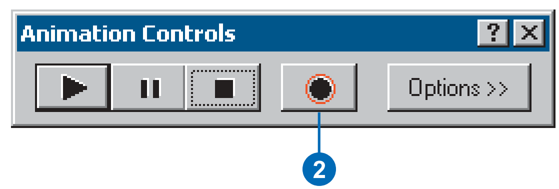
Another way to create a camera track for an animation is to record in real time while you navigate in a scene. In this section, you will record your view of the scene while you navigate using the Fly tool.

1. Click the Fly tool on the navigation toolbar.

   The Fly tool allows you to fly through your scenes.

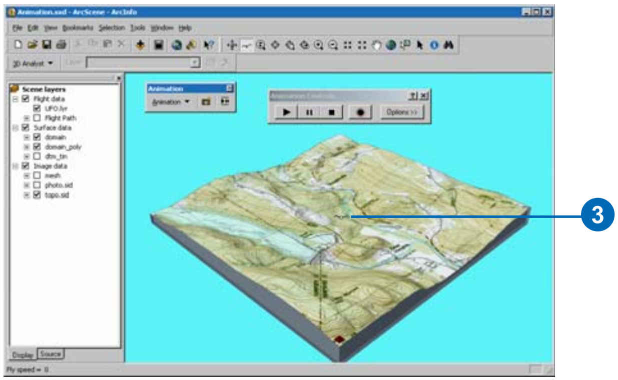


2. Click the Record button to start recording your navigation.



   ArcScene begins recording as soon as you click the Record button. If you don't navigate right away, your track will reflect this.

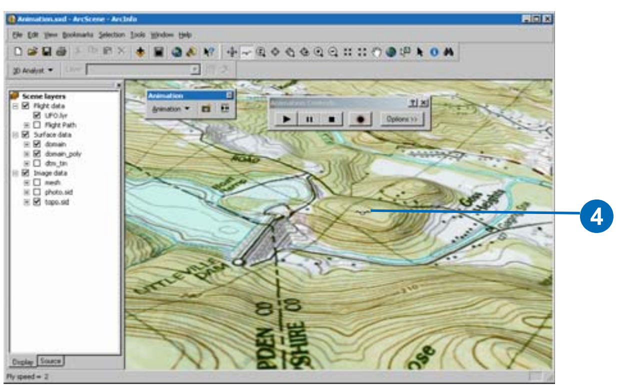
3. Click once in the center of the scene to activate the Fly tool. You start flying by entering into hovering mode.



In this mode your viewpoint follows the cursor. Point in the direction you wish to look.

4. Click once more to begin flying through the scene.

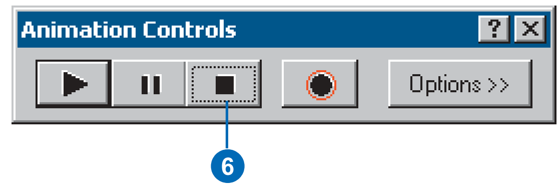
Point in the direction you want to move. Click again to increase your speed and right-click to decrease your speed. Your speed is indicated in the status bar in the lower-left corner of the ArcScene window.



5. Press Esc to stop flying.

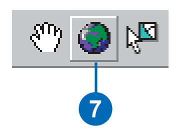
You can also stop flying by clicking until your speed is zero.

6. Click the Stop button to finish recording.

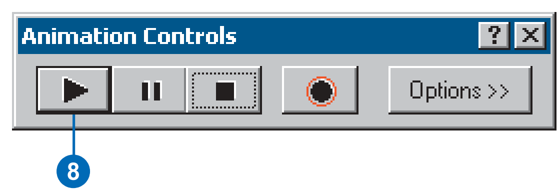


You have recorded your flight path through the scene as a new camera track that began when you clicked the Record button and ended when you clicked the Stop button.

7. Click the Full Extent button.

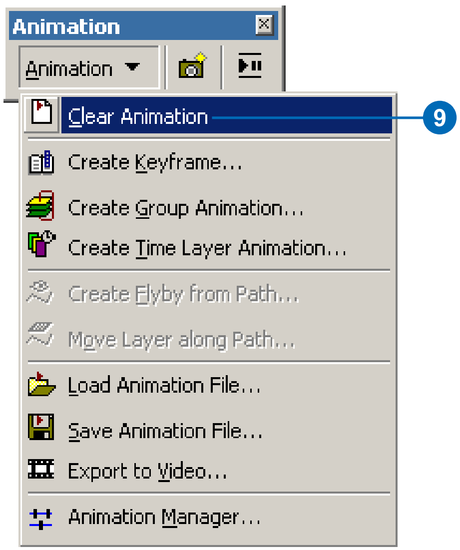


8. Click the Play button to see the animation you recorded.



When you are done viewing the animation you recorded, clear the track so you can make a better one in the next section.

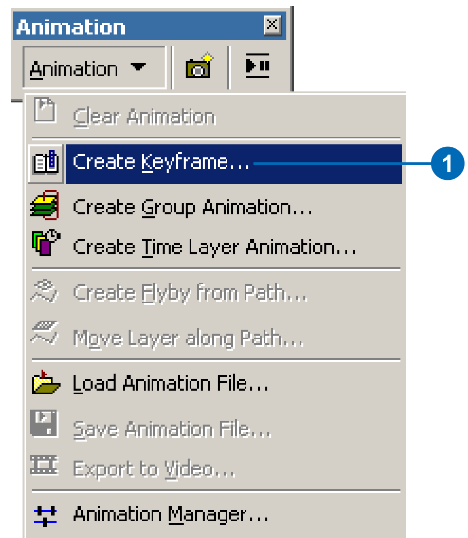
9. Click Animation and click Clear Animation.



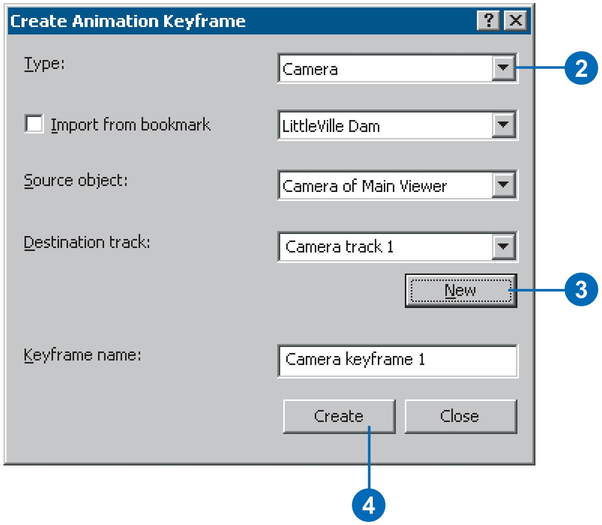
Making a camera track from 3D bookmarks

In the previous sections, you navigated in a scene and created keyframes to build a camera track. Another way to create the keyframes for a camera track is to import bookmarked perspective views of a scene. In this section, you'll create keyframes from 3D bookmarks.

1. Click Animation and click Create Keyframe.

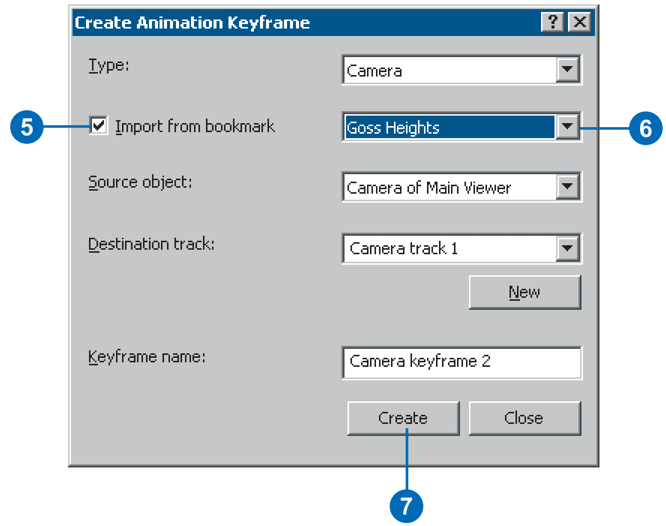


2. Click the Type drop-down arrow and choose Camera.
3. Click New to create a new track.
4. Click Create.



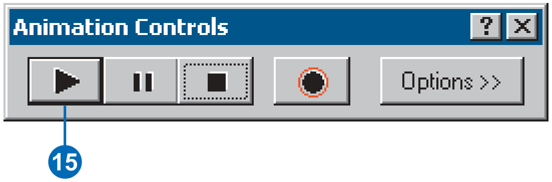
You've now created a camera track with one camera keyframe showing the full extent of your scene. You'll need to add more keyframes to your track so that it will show animation. Now, you'll import bookmarks to create the keyframes for the rest of the animation.

5. Check Import from bookmark.
6. Click the Import from bookmark drop-down arrow and click Goss Heights.



7. Click Create to make the second keyframe in your track.
8. Click the Import from bookmark drop-down arrow and choose LittleVilleDam.
9. Click Create to import this bookmark as a keyframe.
10. Click the Import from bookmark drop-down arrow and click Knightville.
11. Click Create to make the Knightville keyframe.
12. Click the Import from bookmark drop-down arrow once more and click Overview.
13. Click Create to import a keyframe showing all the data.

14. Click Close.
15. Click the Play button.

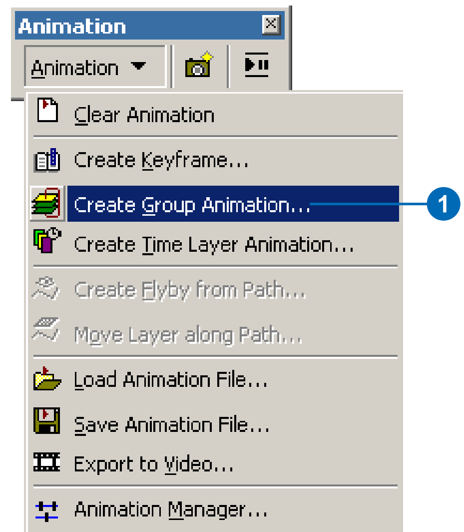


The camera track plays, moving the camera through the set of keyframes you imported from existing 3D bookmarks.

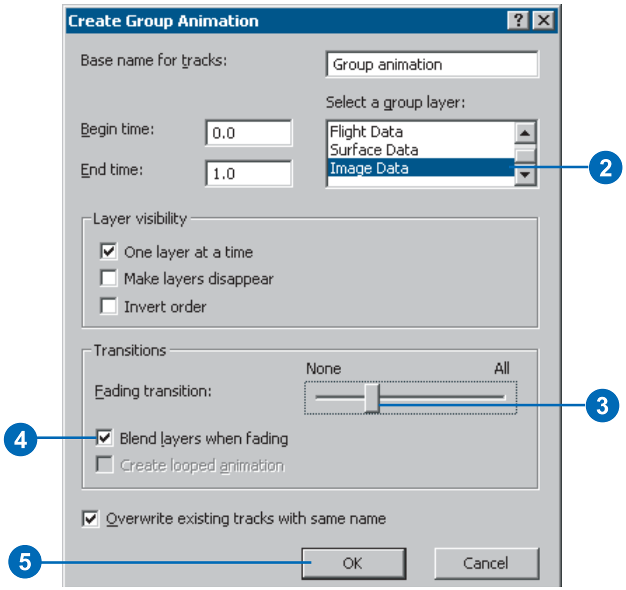
Switching the visibility between layers using a group animation

Now that you have explored some of the ways to create an animated camera track from keyframes, you'll learn how to change the way layers in a scene are displayed during animation. In this section, you will switch the layer that is draped over the terrain model to show different ways of representing the terrain.

1. Click Animation and click Create Group Animation.

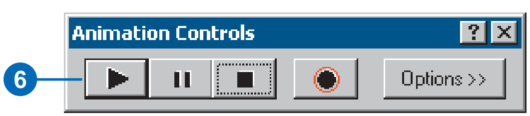


2. Select the group layer named Image Data.
3. Slide the Fading transition bar about a quarter of the way to the right.
4. Check Blend layers when fading.
5. Click OK.



The Layer track you just created toggles the visibility of successive layers to animate a progression between them. The transition settings you modified will show a smooth blending between the layers in the progression.

6. Click the Play button to watch your animation.

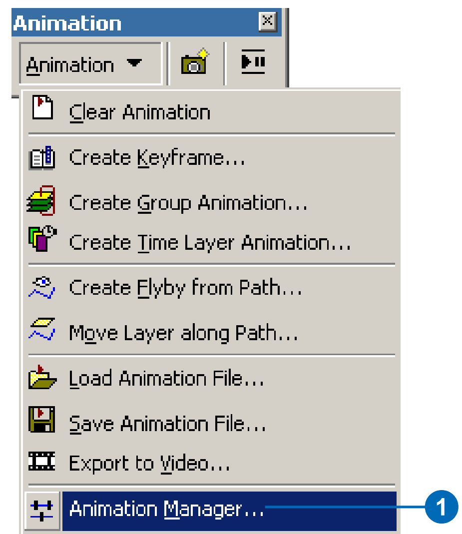


Since you didn't clear the animation track you made from the keyframes, it plays in addition to the layer tracks you just created. However, you can stop the camera track from playing. You'll do this next.

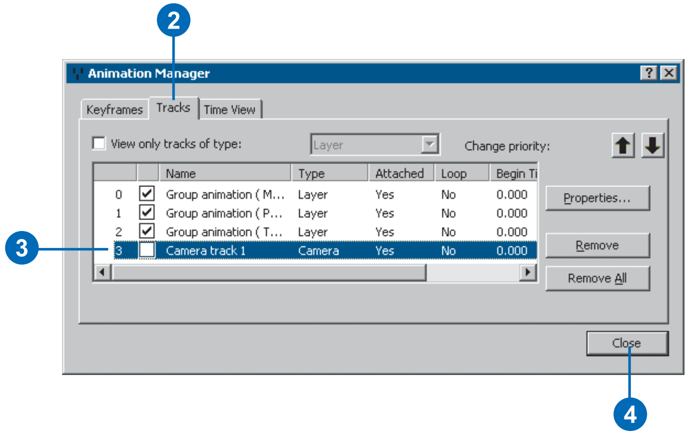
Using the Animation Manager to disable a track from playing

The Animation Manager allows you to control many properties of an animation. In this section, you'll use the Animation Manager to stop a camera track from playing.

1. Click Animation and click Animation Manager.

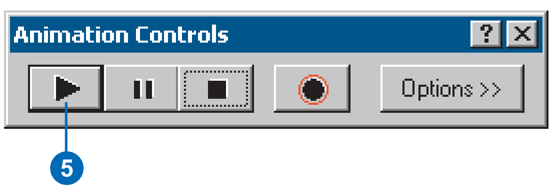


2. Click the Tracks tab.
3. Uncheck Camera track 1.
4. Click Close.



You have disabled the camera track. Now it will not play as part of the animation.

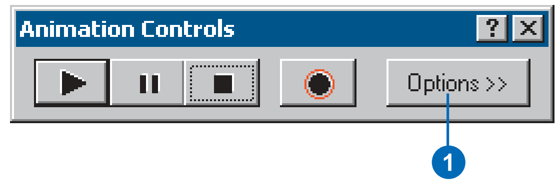
5. Click the Play button.



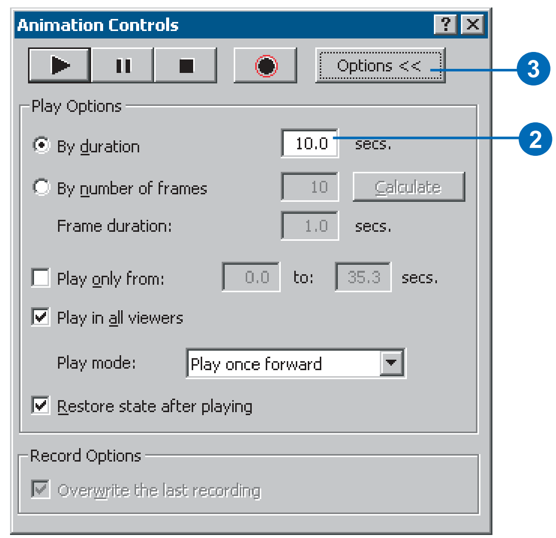
The animation plays again, only showing the layer tracks this time. It may now seem that the duration of the animation is too long. You can control the amount of time in which an animation is played.

Using Animation Controls to adjust the playback duration

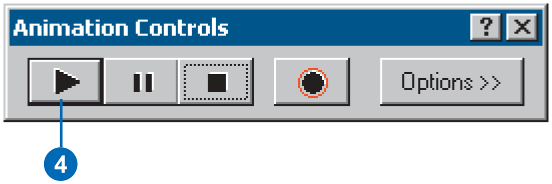
1. Click Options.



2. Type “10” in the Duration text box.
3. Click Options to close this portion of the dialog box.



4. Click the Play button.



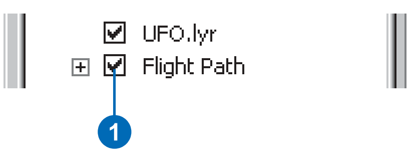
The animation now plays more quickly.

Moving an object along a predefined path

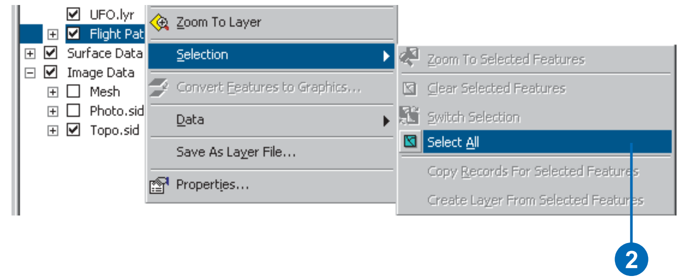
One of the things an animation allows you to do is move an object through a scene. You can add a layer containing a model vehicle and move it through the scene along a specified track. Note that this functionality is only available in ArcScene.

You can choose to move a layer along a selected line feature or graphic. The scene contains a graphic layer with a model UFO that was created using Visual Basic code. In the next set of steps, you'll fly the model UFO along a shapefile that shows its flight path.

1. Click Flight Path in the table of contents.

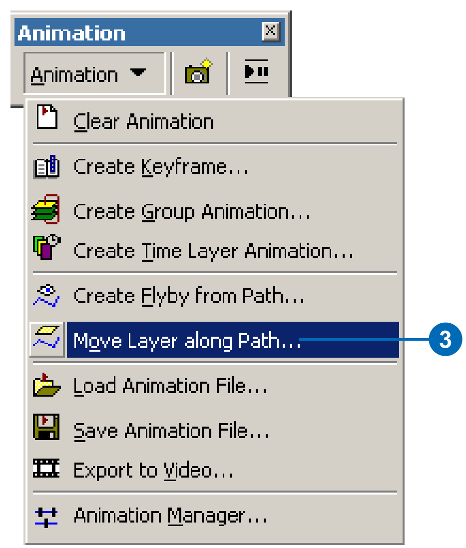


2. Right-click Flight Path, point to Selection, then click Select All.

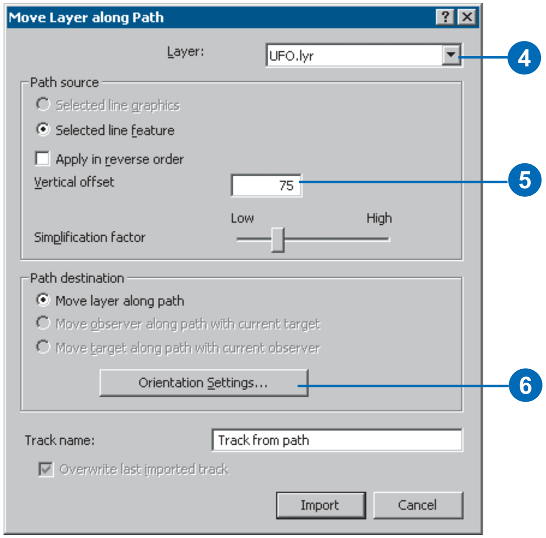


You can also use the Select Features or Select Graphics tools to select the path you want to use. A path is constructed from a single selected line feature or graphic.

3. Click Animation and click Move Layer along Path.



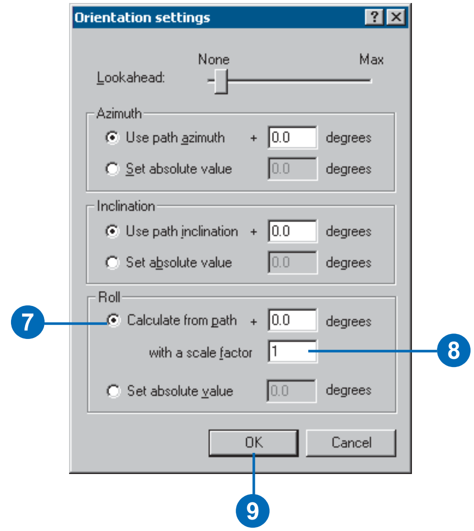
4. Click the Layer drop-down arrow and click UFO.lyr.



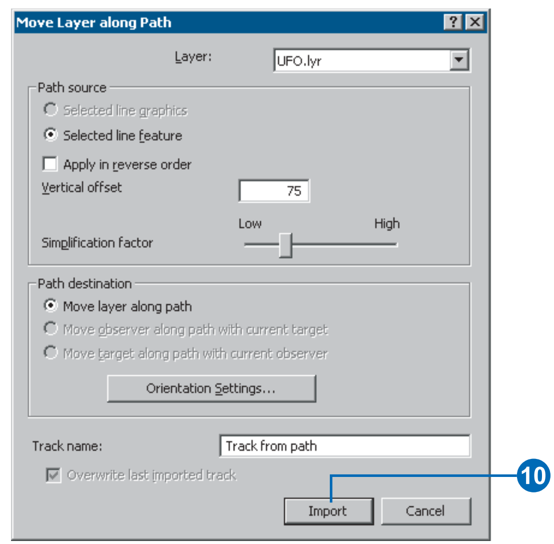
5. Type a Vertical offset of "75". This will make the object appear to fly above the surface.

   ArcScene can improve the simulation of flight of an object, such as an airplane, along a path by making the object point in the direction it is moving and by rolling it from side to side as if it were banking. In the next steps, you'll define a roll for the UFO layer.

6. Click Orientation Settings to modify the layer's position while it's animated.
7. Click Calculate from path to calculate the layer's roll based on the path's shape.
8. Type "1" as a scale factor.
9. Click OK.

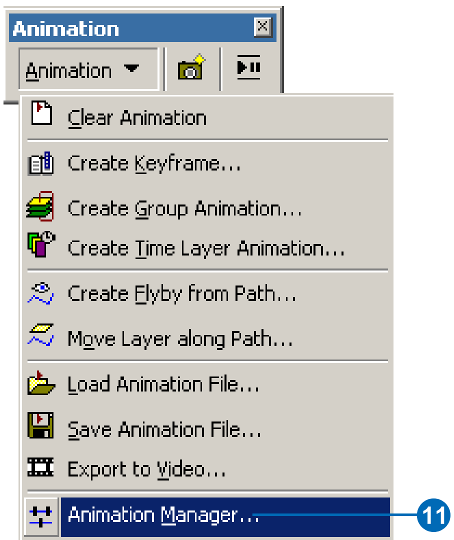


10. Click Import to import the selected line as a flight path.

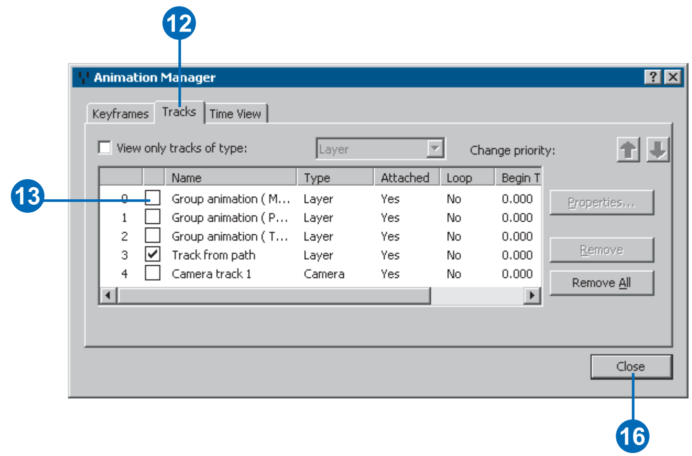


The UFO layer moves along the selected path. The movement is stored as a set of layer keyframes in a layer animation track. Now you'll disable the tracks you created previously so that just the UFO track is played.

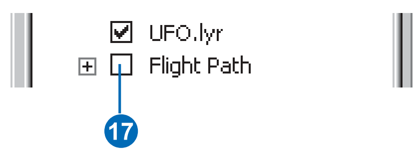
11. Click Animation and click Animation Manager.



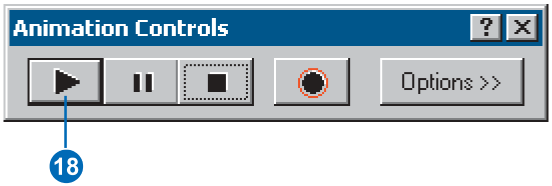
12. Click the Tracks tab.
13. Uncheck Group animation (Mesh).
14. Uncheck Group animation (Photo.sid).
15. Uncheck Group animation (Topo.sid).
16. Click Close.



17. Uncheck Flight Path to turn off the visibility of this layer.



18. Click the Play button.

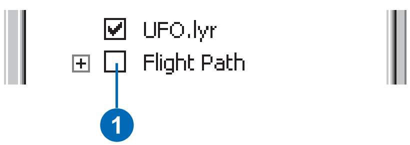


The UFO flies along the path you indicated. Next, you'll move the camera along a predefined path.

Creating a camera flyby from a path

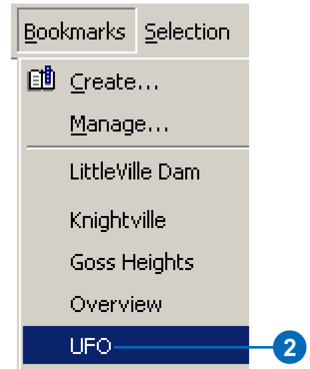
You can move a camera along a flight path in the same way you just moved a layer along a path. Next, you'll combine the track you made in the last step with one that will point the camera at the UFO as it flies.

1. Check Flight Path, make sure the line you chose for your path is still selected, then uncheck Flight Path.

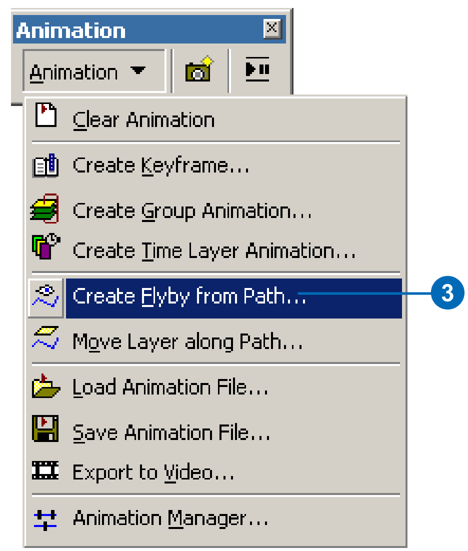


You'll move the camera location to a predefined location in the center of the scene that will give you a better vantage point from which to view the UFO layer as it is moved.

2. Click Bookmarks then click UFO.

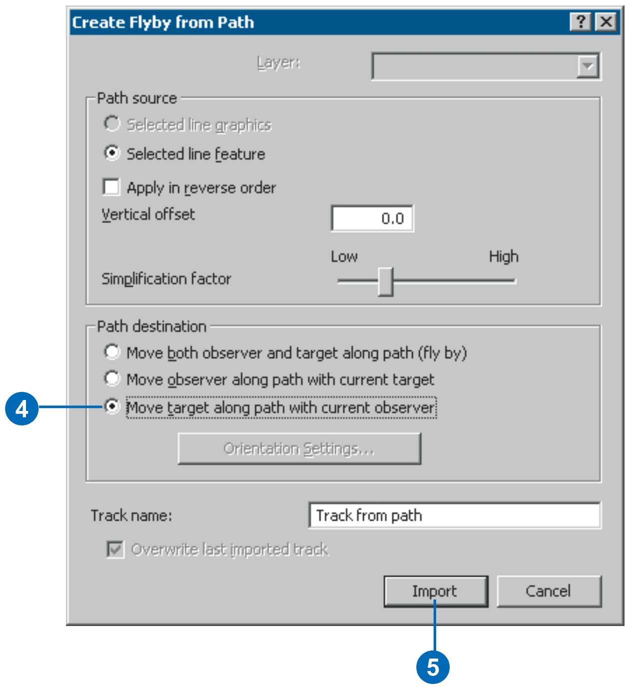


3. Click Animation and click Create Flyby from Path.

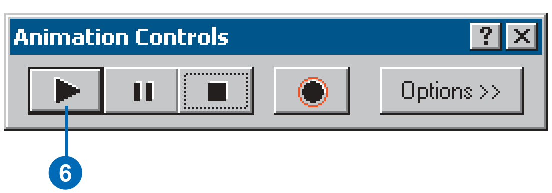


4. Click the third path destination option.

   This option lets you observe the UFO as it moves along the path.

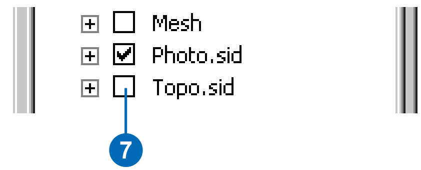


5. Click Import.
6. Click the Play button.



Both tracks play. The UFO layer moves, and the camera follows its movements.

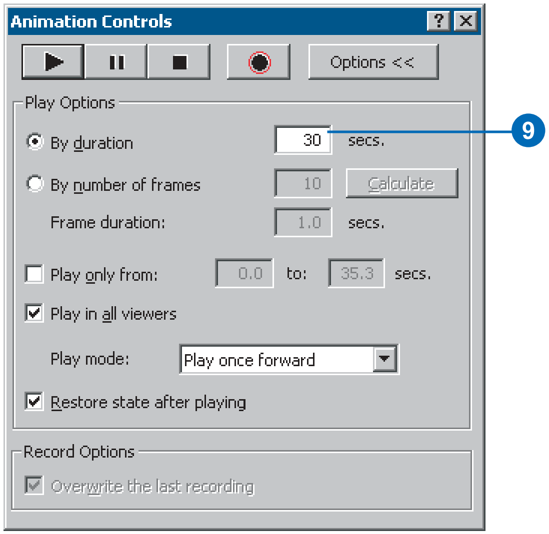
7. Uncheck the Topo.sid check box to make the ortho photo visible.



The animation is playing too quickly. Next, you'll learn how to adjust the duration that the animation is playing to enhance the visual effect.

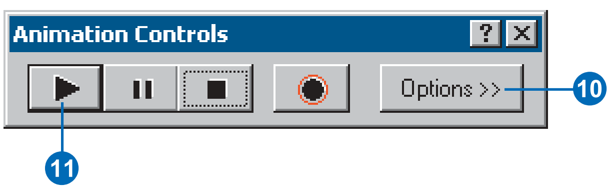
8. Click Options.

9. Type “30” in the Duration text box.



10. Click Options to minimize the dialog box.

11. Click the Play button.

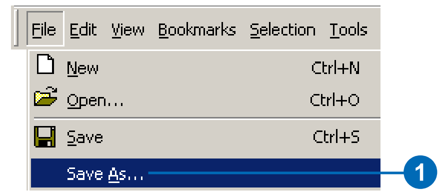


Now the animation plays more slowly as the UFO flies over the terrain.

Saving an animation in a scene document

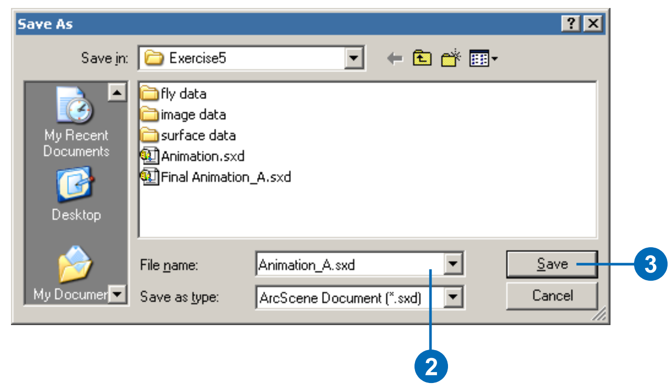
You can save animation tracks in a scene document. In the next step, you’ll save the animation you made in a scene document.

1. Click File and click Save As.



2. In the File name text box, type “Animation_A.sxd”.

3. Click Save.



The new scene document is created, storing the animation tracks.

In this exercise you learned how to create and save simple animations that help you better visualize 3D data. This exercise focused on creating animations in ArcScene, but the majority of steps can also be performed in ArcGlobe.

Note that the Animation toolbar is also available in ArcMap, meaning that animations can be created in this application. A 3D Analyst license is not required to animate data in ArcMap. You can capture the view to create a map view track (the ArcMap equivalent of a camera track in ArcScene or ArcGlobe) that captures the display extent. This allows you to create an animation where you are zooming in and out, and panning the display. You can also create a map layer track (the ArcMap equivalent to the layer track in ArcScene or ArcGlobe) to create an animation where you are altering layer visibility or transparency.

In ArcMap, ArcScene, and ArcGlobe, you can create an animation through time, by creating a time layer track. Feature, netCDF and raster catalog layers can be animated through time in all three applications. The information in a table can be animated through time in a graph in ArcMap only. For more information on animating through time, see the Animation in ArcMap tutorial. ArcMap is used as the application for this tutorial, but the steps performed can be applied to ArcScene and ArcGlobe as well.

In the next exercise you'll learn some basic fundamentals to working with ArcGlobe.

Exercise 6: ArcGlobe basics

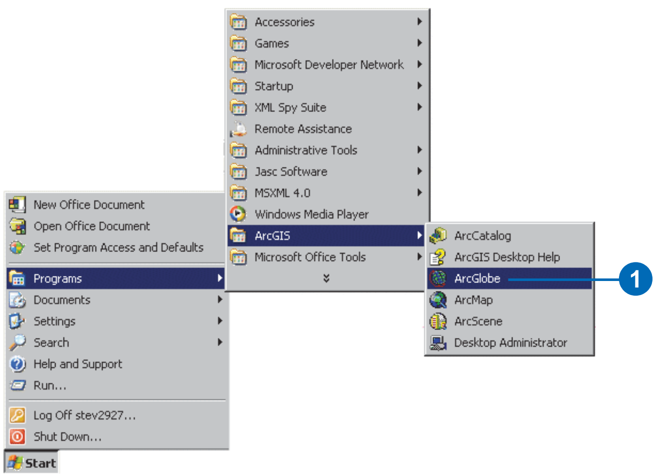
Navigating in ArcGlobe lets you explore your data and teaches you how to accomplish fundamental tasks that you'll use later.

In this exercise, you'll learn how to use the ArcGlobe navigation tools and set properties that enhance your viewing experience. This exercise assumes that you are using ESRI-supplied default layers.

Examining the default layers in ArcGlobe

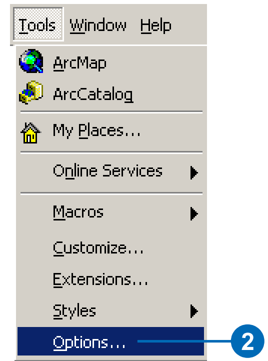
First, you'll start ArcGlobe and learn what kind of data is included by default.

1. Click the Start menu, point to Programs, then ArcGIS, and click ArcGlobe.



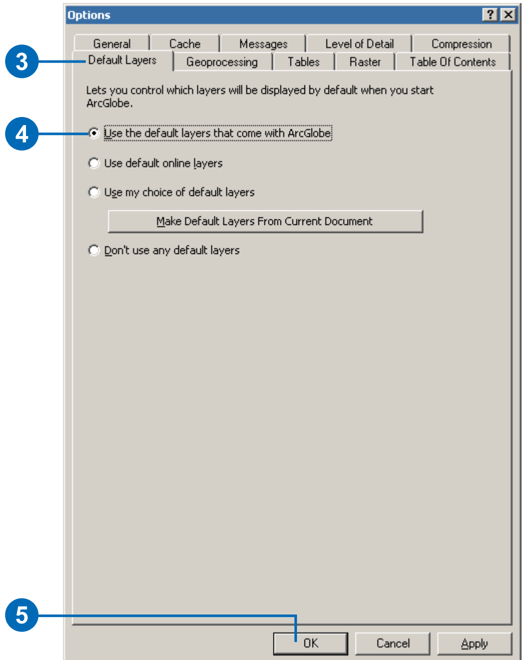
ArcGlobe starts and its default layers are loaded. Notice which layers are loaded in the globe by looking at the list in the table of contents.

2. Click Tools and click Options.



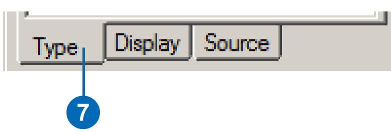
3. Click the Default Layers tab to view all start-up layer options for ArcGlobe.
4. Check Use the default layers that come with ArcGlobe.

   This data is installed locally with ArcGIS and includes a world image layer and a continents layer. Therefore, rather than using online source data for this exercise we will use the default data that comes with ArcGIS.



5. Click OK.
6. Click the New Globe File button to refresh the globe view with the new layers.

7. Click the Type tab in the table of contents.



ArcGlobe categorizes layers according to their type. Layers are classified as either elevation, draped, or floating. Elevation layers provide relief to the globe's surface. Draped layers use the globe surface as the source of their base heights. Floating layers display independently of the globe surface and can be draped on discrete surfaces or derive their elevation from attributes or a constant value.

Now, look how the default layers are categorized - they are both listed as draped layers and therefore display directly on the globe surface.

Adding more layers

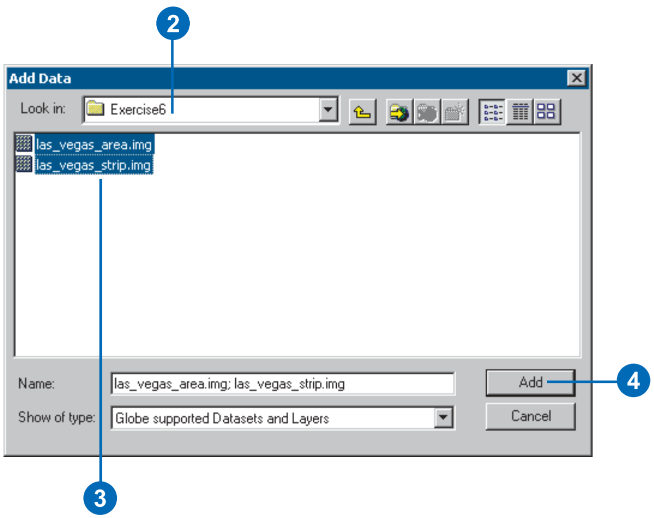
Default layers serve as a background to any data that you want to add to ArcGlobe. Next you'll add some local data for the Las Vegas area.

1. Click the Add Data button.

2. Navigate to the location of the Exercise 6 tutorial data folder.
3. Click las_vegas_area.img, press Shift, and click las_vegas_strip.img.

   The multiple layers are selected.
4. Click Add.

   The image layers are added to ArcGlobe as draped layers. You'll explore them later in this exercise.



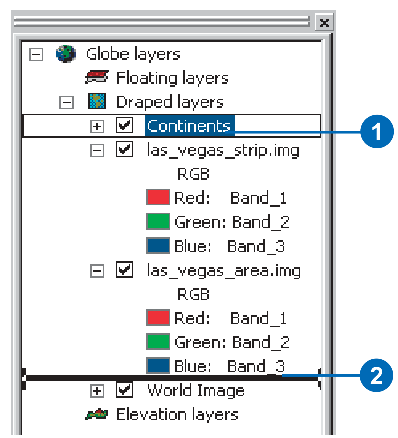
Changing a layer's drawing priority in the table of contents

Draped layers that have overlapping extents need to have a drawing priority set so one layer gets drawn on top of the other. ArcGlobe makes some assumptions to accomplish this, using criteria such as the cell size of a raster layer. Occasionally, you'll need to override the ArcGlobe default drawing priorities. One way to do this is to change the order of draped layers as they appear in the Type page of the table of contents.

1. Click the Continents layer and drag it so it's just above the World Image layer.

   A black line indicates where the layer will be placed.
2. Release the mouse pointer to drop the layer in its new position.

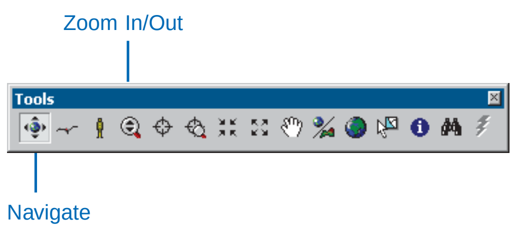
   The drawing priority is now set so las_vegas_area.img and las_vegas_strip.img get drawn on top of the Continents layer.



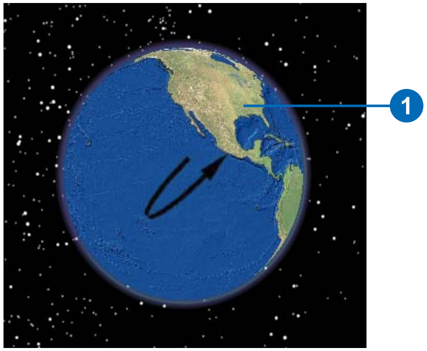
Navigating in Globe mode

ArcGlobe has two viewing modes: Globe and Surface. Globe mode allows you to navigate your data in the realm of the whole globe and sets the camera target to the center of the globe. Surface mode lets you work with your data at a lower elevation, allows additional perspective viewing characteristics, and sets the camera target on the surface of the globe. You'll learn how to navigate in Globe mode first, then in Surface mode.

The Navigate tool is active when you start ArcGlobe. You can see the names of other tools on the Tools toolbar by hovering the pointer over the tool.

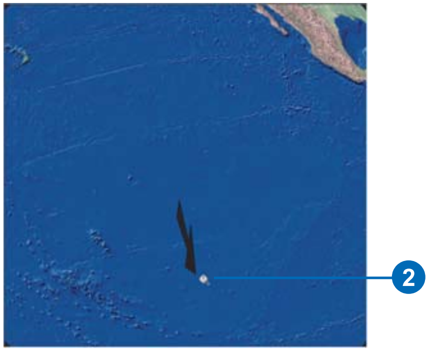


1. Click the globe, slowly drag up and to the right, then release the mouse pointer.



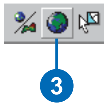
The globe rotates and the view angle lowers, so you gain a different vantage point.

2. Right-click and drag down.



The pointer changes to the Zoom In/Out pointer, and the view zooms in on the globe. To zoom out, right-click the globe and drag up.

3. Click Full Extent.

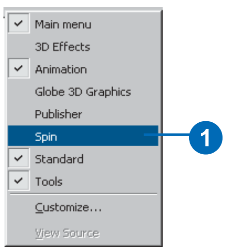


The globe displays at full extent.

Turning on the Spin toolbar

You can use the Spin toolbar to automatically spin the globe clockwise or counterclockwise at any speed you wish.

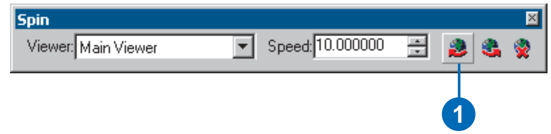
1. Right-click the menu area and click Spin.



The Spin toolbar appears as an undocked toolbar.

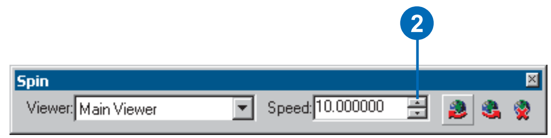
Using the Spin tools

1. Click the Spin Clockwise button.



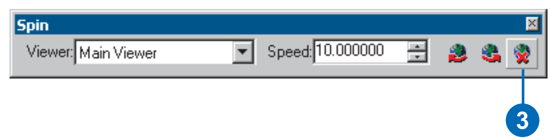
The globe continuously spins clockwise around the z-axis. You can change the speed at which it spins.

2. Click the Up arrow on the Speed text box to increase the rate at which the globe spins.



Continued clicks will incrementally increase the spin rate. You can also type in a value. Click the Down arrow to decrease the rate.

3. Click the Stop button to stop the globe from spinning.

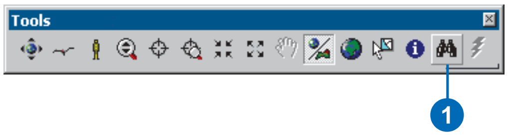


You can also press Esc to stop the globe from spinning.

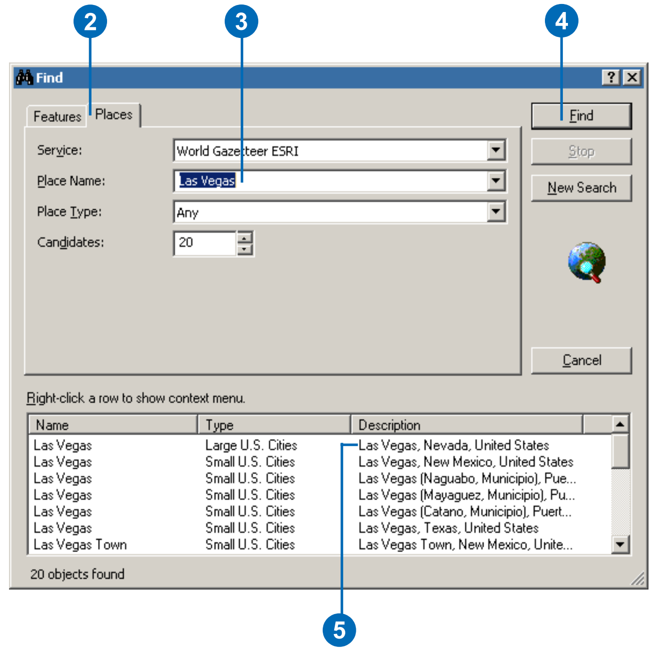
Finding places on the globe

If you have an Internet connection, you can find world locations by using the ESRI Online Place Finder in the Find dialog box.

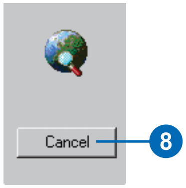
1. Click the Find button.



2. Click Places.
3. Type “Las Vegas” in the Place Name text box.
4. Click Find.
5. Right-click Las Vegas, Nevada, United States, and click Create Bookmark.
6. Right-click Las Vegas, Nevada, United States, and click Zoom To.



7. Click Cancel to close the Find dialog box.



The Find tool is an easy way of locating almost any place in the world. Use it to locate points of interest, then use bookmarks to save perspectives of these places.

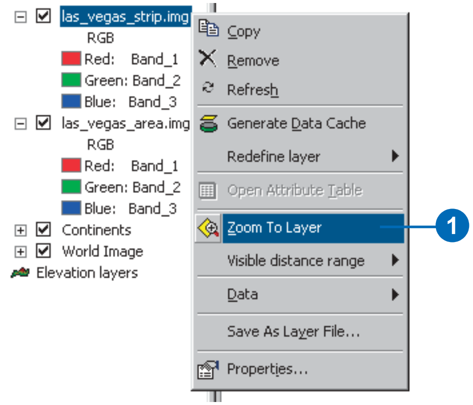
Now that you're zoomed close to the globe surface, you'll learn how to navigate in Surface mode.

Navigating in Surface mode

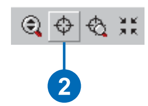
When you zoom in close to your data, you can switch to Surface mode to make your navigation apply more correctly to your new environment. Switching to Surface mode places the camera target on the globe surface and gives you a sense of 3D perspective while you navigate your data.

1. Right-click las_vegas_strip.img in the table of contents and click Zoom To Layer.

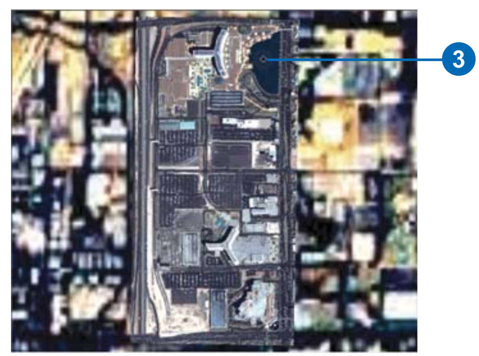
   The display zooms to the Strip area of Las Vegas.



2. Click the Center on Target button.

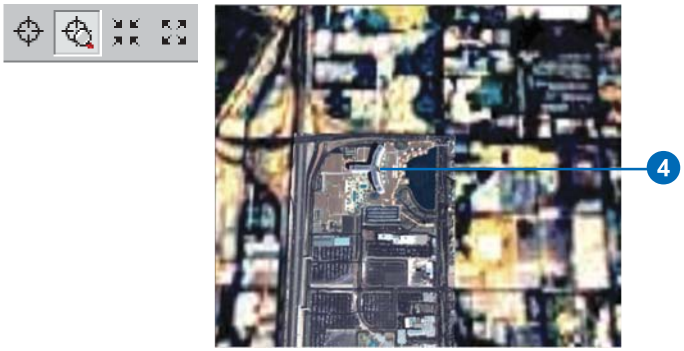


3. Click the center of the Fountains of Bellagio.



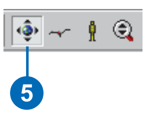
The point you clicked is moved to the center of the display. Centering on a target sets a target on the globe surface and switches to Surface mode.

4. Click Zoom to Target and click the central dome of the Bellagio.

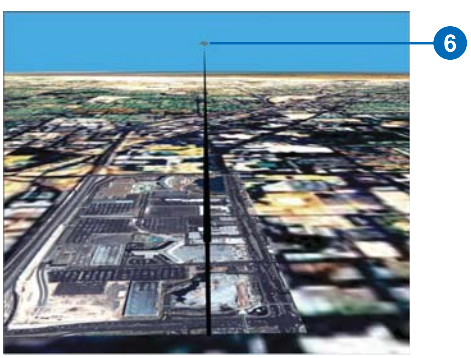


A new target is centered and the display is zoomed to it.

5. Click the Navigate button.

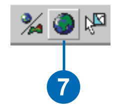


6. Click the bottom of the display and slowly drag up.



The globe rotates, and the viewing angle lowers. The horizon becomes visible with a light blue background, and you view the globe in a new perspective.

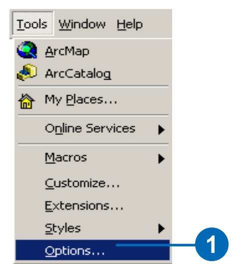
7. Click the Full Extent button to return the globe to its full extent position.



Setting some preferences

You can modify the way ArcGlobe functions at both the application and globe levels. First, you'll explore some application-level options.

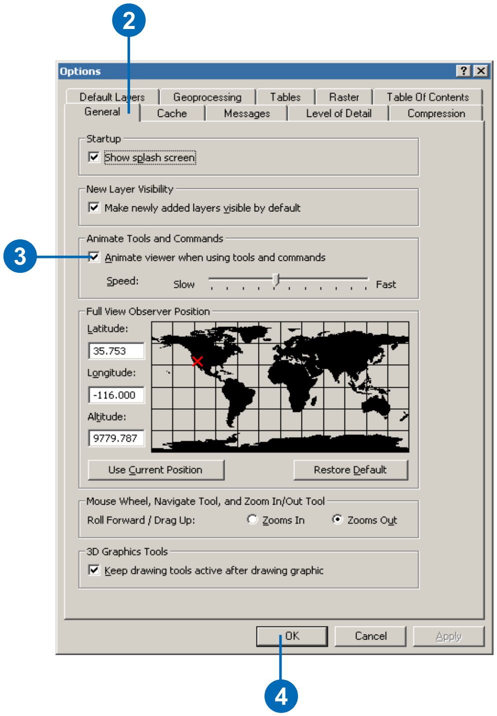
1. Click Tools and click Options.



The Options dialog box is where you set application-level preferences. The settings will be preserved in all instances of ArcGlobe.

2. Click General.

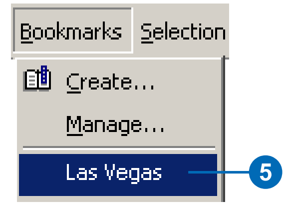
3. Check Animate viewer when using tools and commands.



This option shows smooth transitions from one view to the next when you use tools that change your perspective. This will be the standard behavior every time you start ArcGlobe until you turn off the option.

4. Click OK.

5. Click Bookmarks and click Las Vegas.

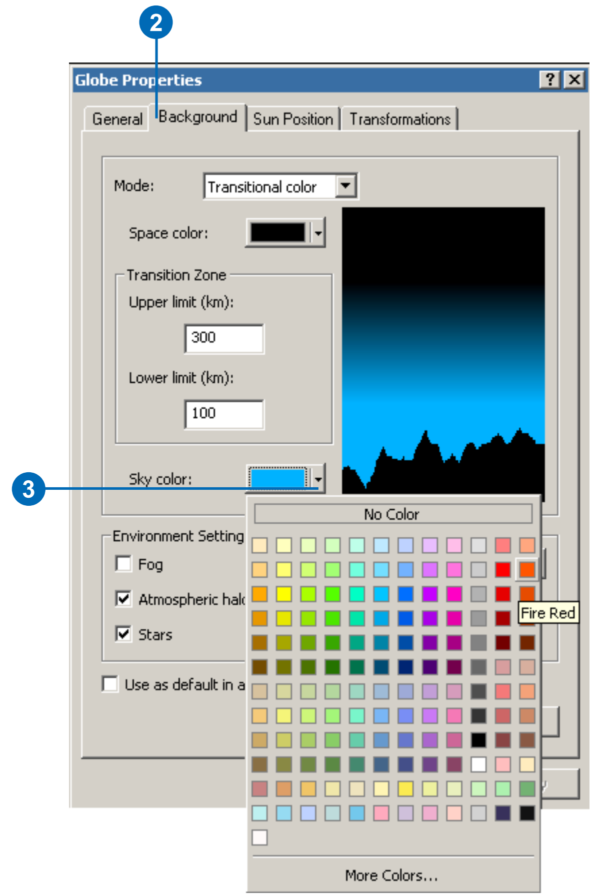


The display moves to the Las Vegas bookmark in a smooth, animated transition. Next, you'll examine a document-level option.

Setting a document-level option

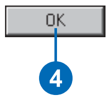
1. Double-click Globe Layers in the table of contents.

2. Click the Background tab.
3. Click the Sky color drop-down arrow and click a color of the morning or evening sky.



Sky color is the color of the background when you zoom in close to your globe as defined by the lower limit of the transition zone.

4. Click OK.



If you switch to Surface mode and lower the viewing angle, you'll notice the background color changing to the color you indicated.

In this exercise you learned how to differentiate between ArcGlobe layer types, navigate in Globe and Surface modes, find places, and set some application and globe properties. Now that you've learned some fundamentals, you can begin to explore other areas of ArcGlobe. In the next exercise, you'll learn how to use data as different layer categories.

Exercise 7: ArcGlobe layer classification

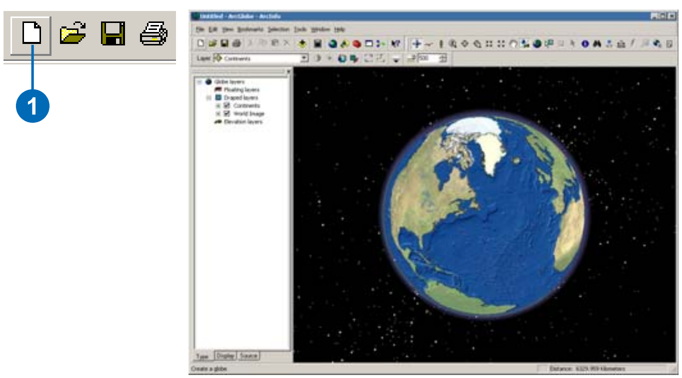
ArcGlobe classifies layers into three types to help you manage them: elevation, draped, and floating. In this exercise, you'll learn how to use the classifications to help layers provide the right information to your documents. This exercise assumes that you are using ESRI-supplied default layers.

Adding elevation layers

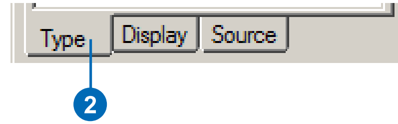
Elevation layers provide height information to the globe surface. You'll use rasters with height source information to provide topography to the surface of the globe and making it look more realistic.

1. With ArcGlobe already open, click the New Globe File button to create a new globe surface.

   ArcGlobe starts, and its default layers are loaded.

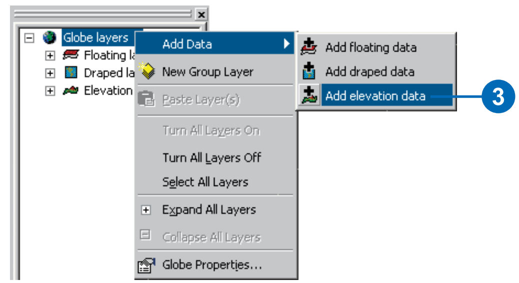


2. Click the Type tab in the table of contents to show the default layer classifications.

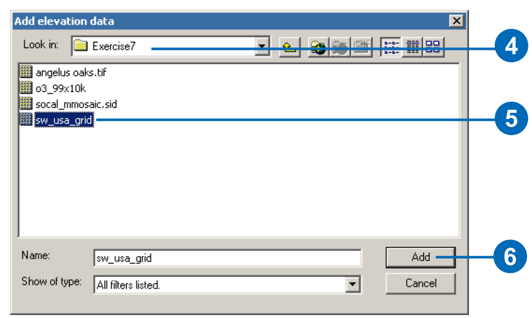


3. Right-click Globe layers, point to Add Data, and click Add elevation data.

   This indicates that you want to add a specific type of data to that layer category.



4. Navigate to the location of the Exercise7 folder.
5. Select sw_usa_grid.
6. Click Add.

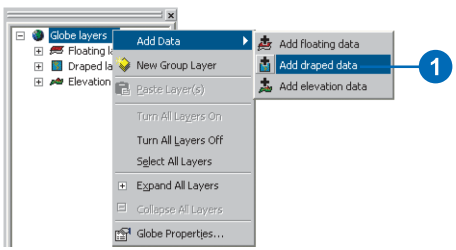


The raster is added to the elevation category and will be used as a source of elevation for the globe surface.

Adding draped layers

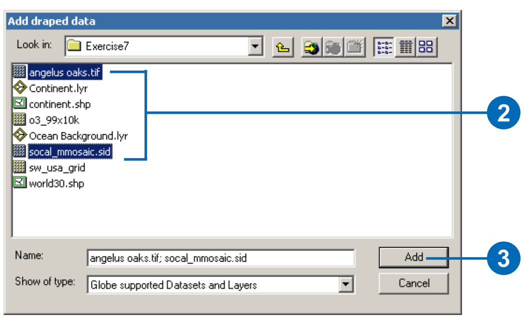
Draped layers are placed on the globe surface and use any elevation data present to show base heights. Next, you'll add images that will be draped on the globe surface in the area you added elevation data.

1. Right-click Globe layers, point to Add Data, and click Add draped data.



Layers you will now add will follow the globe surface.

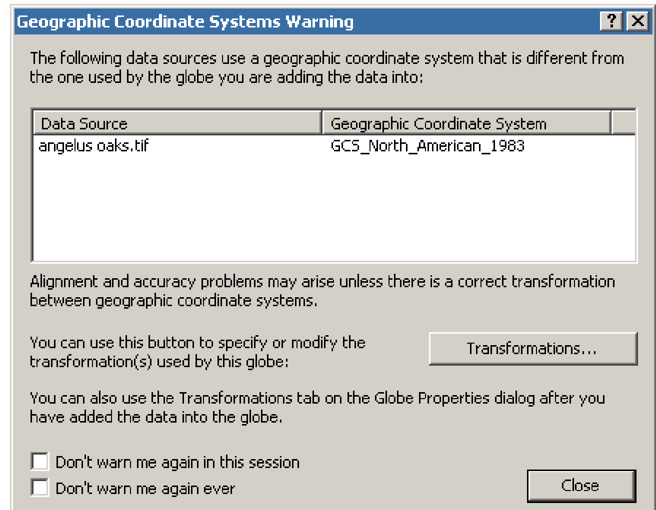
2. Click angelus oaks.tif, press Ctrl, and click socal_mmosaic.sid.



Both layers are selected.

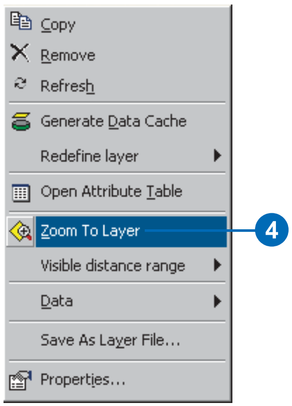
3. Click Add.

   If prompted, close the Geographic Coordinate Systems warning message box. The data will be projected to ArcGlobe's currently set Geographic Coordinate System.



4. Right-click angelus oaks.tif and click Zoom To Layer.

   The display zooms to the extent of the layer. A few moments will pass before the layer is shown at full resolution as the on-demand cache is built. Once the cache is built, you'll be able to revisit the area and display the layer quickly.



The Angelus Oaks imagery appears washed out due to the Continents layer being drawn with a higher drawing priority. Next, you'll learn how to change the drawing priority of a draped layer.

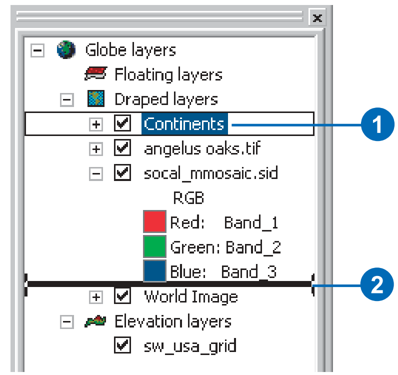
Changing the drawing priority of a layer in the table of contents

Draped layers that have overlapping extents need to have a drawing priority set so one layer gets drawn on top of the other. ArcGlobe makes some assumptions to accomplish this, using criteria such as the cell size of a raster layer. Occasionally, you'll need to override the ArcGlobe default drawing priorities. One way to do this is to change the order of draped layers as they appear in the Type page of the table of contents.

1. Click the Continents layer and drag it so it's just above the World Image layer.

   A black line indicates where the layer will be placed.

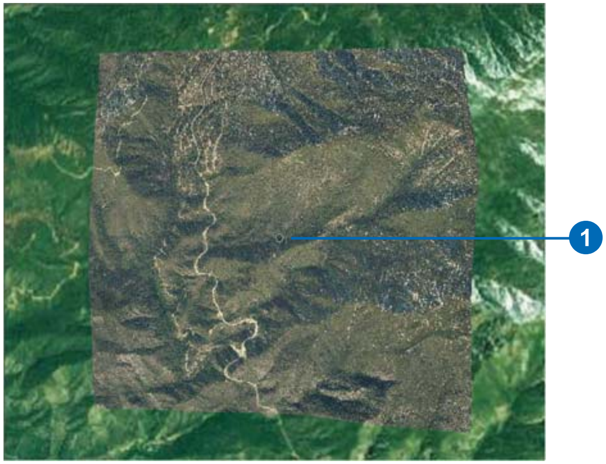
2. Release the mouse pointer to drop the layer in its new position.



The drawing priority is now set so angelus oaks.tif and socal_mmosaic.sid are drawn on top of the Continents layer.

Setting a target to initiate Surface mode

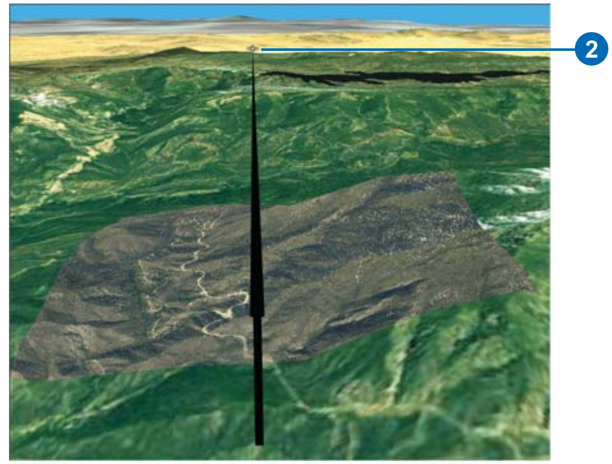
1. Press Ctrl and click the middle of the display.



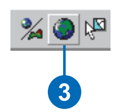
You've initiated Surface mode and set a target at the location on the globe surface where you clicked.

2. Click the bottom of the display and slowly drag up.

   The globe terrain you created becomes discernible as you investigate the imagery you added.



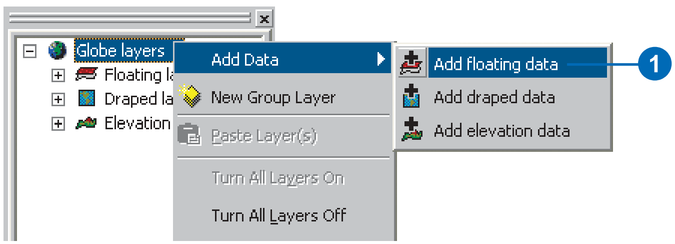
3. Click the Full Extent button to return the display to the original view.



Adding floating layers

Floating layers are layers that float independently of the globe surface. Next, you'll add a raster as a floating layer and set it to elevations not connected with the globe surface.

1. Right-click Globe layers, point to Add Data, and click Add floating data.

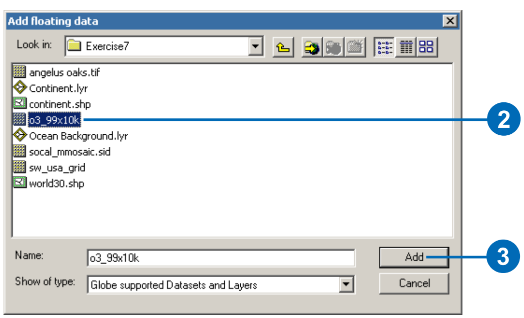


2. Click o3_99x10k.

   o3_99x10k is a raster showing average annual ozone concentration for 1999 in California.

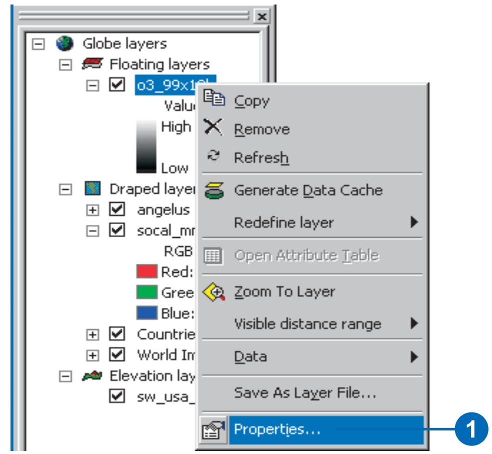
3. Click Add.

   The layer is added to the floating category.



Setting elevation properties of floating layers

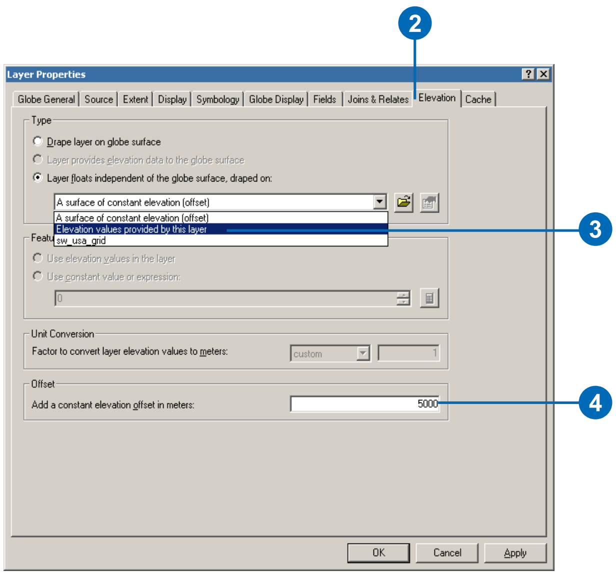
1. Right-click o3_99x10k and click Properties.



2. Click the Elevation tab.

3. Click Elevation values provided by this layer in the Layer floats independent of the globe surface, draped on drop-down menu.

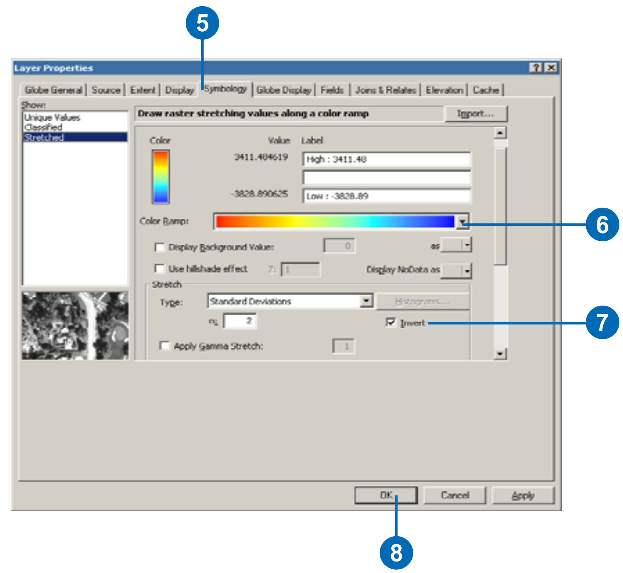
4. Type “5000” in the Add a constant elevation offset in meters text box.



5. Click Symbology.

6. Select the red to blue color ramp in the Color Ramp drop-down menu.

7. Check Invert.



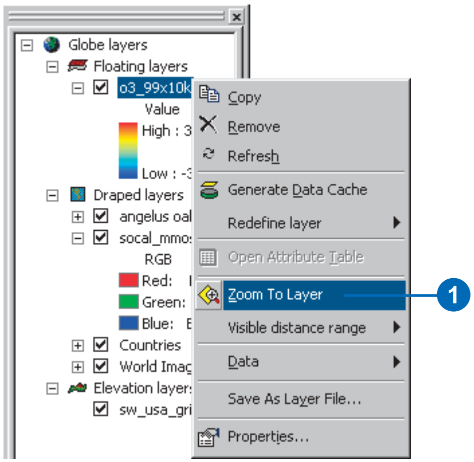
This inverts the color ramp so that high values will be displayed as red, low values as blue.

8. Click OK.

You’ve set the raster to use its own values as a source of base heights, offset those heights 5,000 meters from the globe surface, and symbolized the concentration values with color. Next you’ll take a look at how this appears in the display and set a vertical exaggeration to accentuate the elevation.

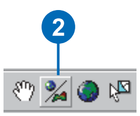
Setting a vertical exaggeration factor for floating layers

1. Right-click o3_99x10k and click Zoom To Layer.

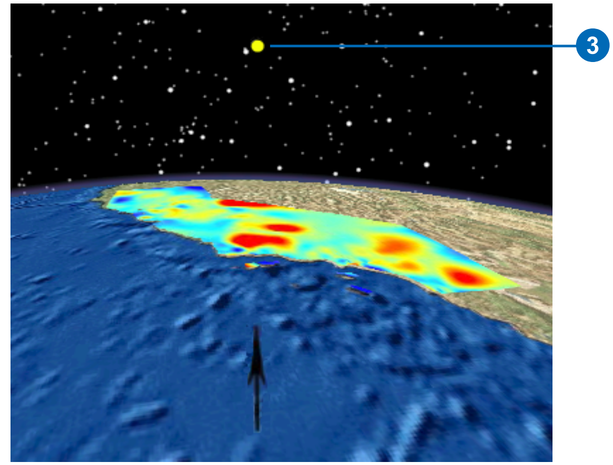


The layer is displayed in the view.

2. Click the Navigation Mode button to change the mode to Surface navigation.



3. Click the bottom of the display and slowly drag the mouse pointer up.

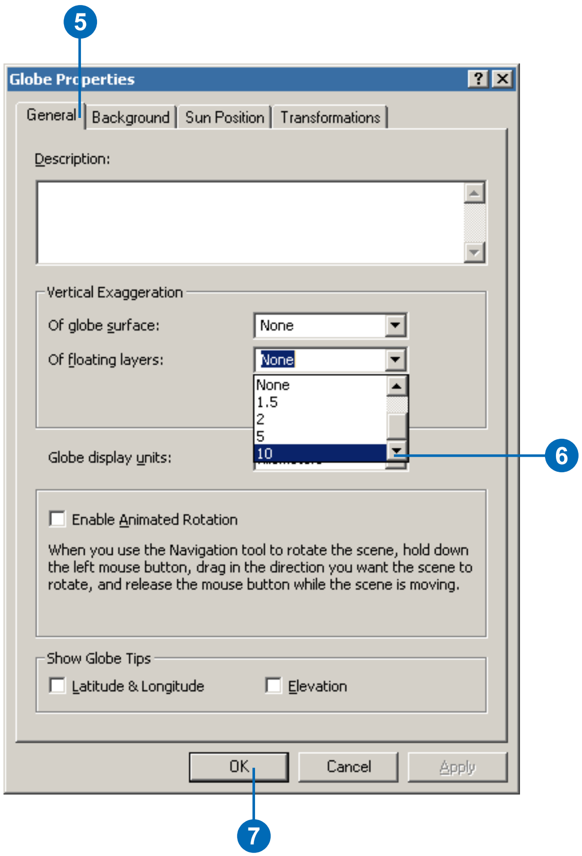


This allows you to see the effect of changing the vertical exaggeration.

4. Double-click Globe layers.

5. Click the General tab.

6. Select or type a value of “10” in the Vertical Exaggeration Of floating layers drop-down menu.



The floating layer will be exaggerated by a factor of 10.

7. Click OK.

Examine the floating layer you created. You’ll see a 3D raster showing average ozone concentrations in California in 1999. The layer floats above the state of California and is a surface that is different from the terrain below.

In this exercise, you learned how to differentiate layer types in ArcGlobe, saw the effect they have on the globe, and set properties to improve their display. Explore Exercise7.3dd globe document in the Exercise7 folder to discover additional ways to enhance your globe documents. The document contains layers saved with custom settings, bookmarks, globe lighting, and animation tracks.

Exercise 8: Creating and using a terrain dataset

A terrain dataset is a multiresolution TIN-based surface derived from measurements stored in one or more feature classes in a geodatabase.

In this exercise, you will use geoprocessing tools to load surface data into a geodatabase, construct a terrain dataset, and use the terrain inside ArcMap and ArcGlobe.

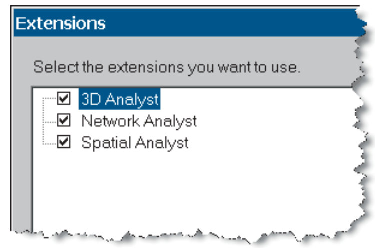
Loading surface feature data into a geodatabase

In this scenario, you have LIDAR points and photogrammetric breaklines stored in two separate ASCII text files. This data will be used to construct your terrain dataset. To accomplish this, you need to import them into feature classes that reside in a feature dataset. The terrain will be generated in the same location as the source data.

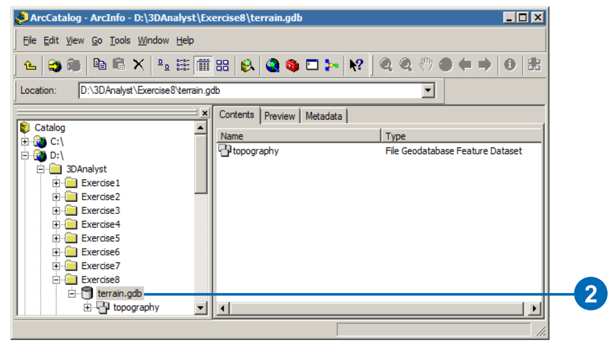
You've been provided a file geodatabase with a feature dataset. It contains two polygon feature classes: one is for lakes, the other to delineate the study area. The initial step will be to import the two ASCII files into the feature dataset as feature classes: one feature class will delineate the photogrammetric breaklines, while the other feature class will contain the LIDAR points.

1. Start ArcCatalog.

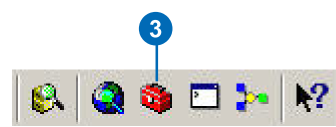
   Make sure the 3D Analyst extension is enabled via the Tools>Extensions dialog box.



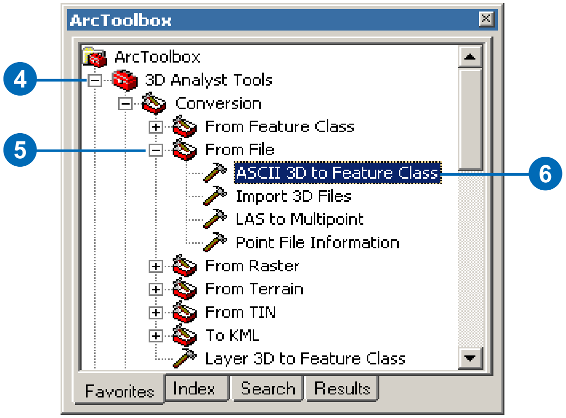
2. Navigate to the Exercise 8 folder and click terrain.gdb to open the geodatabase. Double-click the topography feature dataset to open it.



3. Open ArcToolbox by selecting Show/Hide ArcToolbox Window from the Main menu.



4. In the ArcToolbox window, choose the plus sign next to the 3D Analyst Tools to expand the tools located in the 3D Analyst toolset.



5. From the 3D Analyst toolset, expand the Conversion tools, then the From File tools.

6. Double-click ASCII 3D to Feature Class to open the geoprocessing tool.

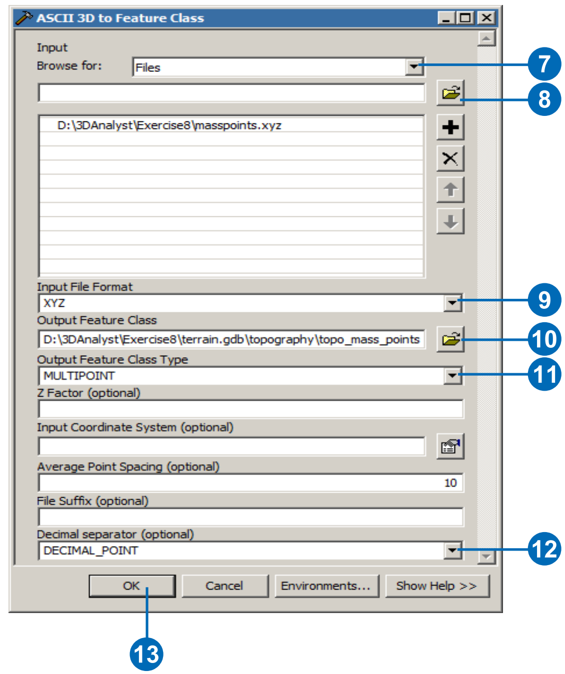
Next you'll convert the ASCII points from a simple text file in XYZ format into a multipoint feature class. These points only define surface geometry. The attributes only contain x,y, and z values.

A multipoint feature class stores one point per line, and the coordinates are separated by spaces. Since there is no attribution associated with these points, dedicating a database row for each is wasteful and inefficient. Instead, you'll combine them into multipoints.

A multipoint can store many points per shape or row, saving storage space and improving read–write performance.

7. In the ASCII 3D to Feature Class tool, make sure the Browse for drop-down list is set to Files.

8. Click the Browse button next to the Input dialog box, navigate to the Exercise 8 folder, and choose the masspoints.xyz file as input.



9. Make sure the Input File Format to XYZ.

10. Click the Browse button next to the Output Feature Class dialog box and navigate to the topography feature dataset.

Name the output feature class topo_mass_points and save it inside the topography feature dataset.

11. If not already, set the Output Feature Class Type to MULTIPOINT.
12. Set the Average Point Spacing to 10.

    The point spacing represents the average distance between measurement points. Sometimes this is referred to as nominal point spacing. This is given in the xy units of the data.

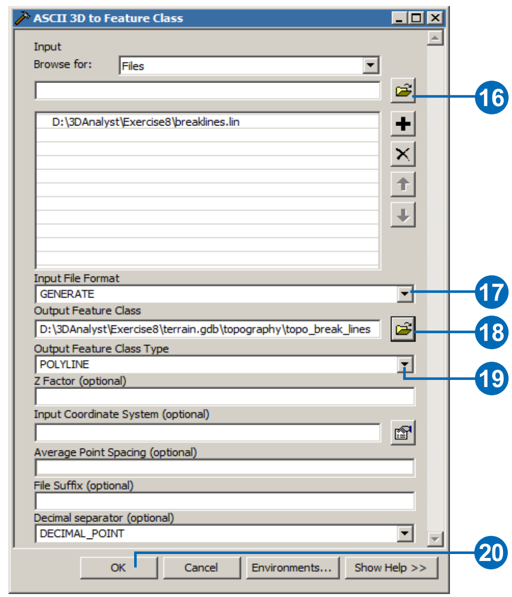
    The average point spacing option is only available when the Output Feature Class Type parameter is set to MULTIPOINT. It facilitates the clustering of points so that each output multipoint is made from points that are relatively close to one another.
13. Accept all other defaults and click OK to execute the geoprocessing tool.

In the next step, you'll use the same ASCII 3D to Feature Class tool to import the ASCII breakline data.

Breaklines are linear features, such as roads and water body shorelines, which need to be represented on the surface. The breaklines are provided in the 3-D GENERATE format—an ASCII format similar to XYZ but more appropriate for line and polygon data.

You can find a detailed description of the GENERATE format in the help. To find it, click the Learn more about link located at the top of the help page for the ASCII 3D to Feature Class tool.

14. Double-click ASCII 3D to Feature Class to open the geoprocessing tool.
15. Make sure the Browse for drop-down list is set to Files.
16. Click the Browse button and choose the breaklines.lin file as input.

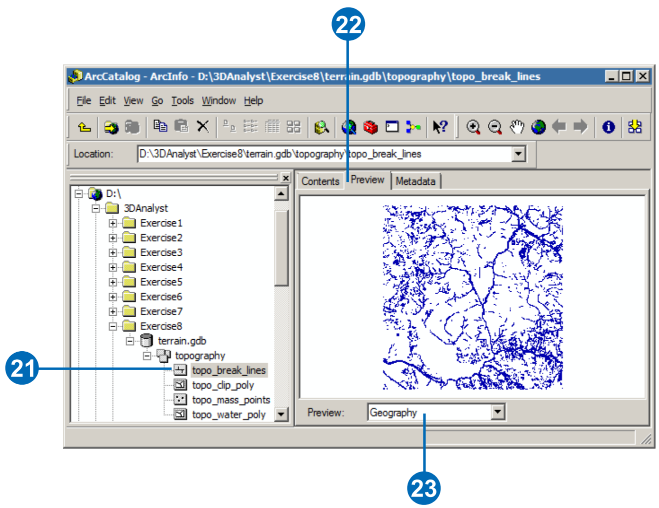


17. Set the Input File Format to GENERATE.
18. Click the Browse button for the Output Feature Class and browse to the topography feature dataset. Name the output feature class topo_break_lines.
19. Set the Output Feature Class Type to POLYLINE.
20. Click OK to execute the geoprocessing tool.

In ArcCatalog confirm the breaklines have been created correctly.

21. Click to select the topo_break_lines feature class in the catalog tree.

22. Click the Preview tab to view the breakline data.



23. Make sure the preview type is set to Geography. The preview should resemble the breakline data displayed in the above image.

Now you've loaded the mass points and breaklines from which a terrain dataset will be built. The LIDAR points came in XYZ format and the photogrammetric lines in 3-D GENERATE format. Both are ASCII formats for simple 3-D data and are read using the same tool, ASCII 3D to Feature Class.

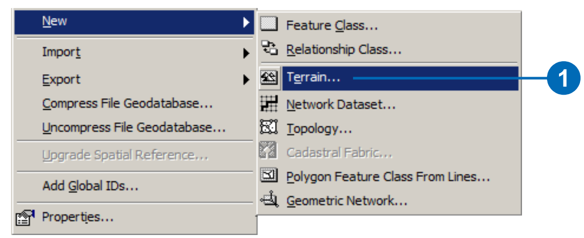
If you need to process a large collection of LIDAR points, consider using the LAS format instead of XYZ. LAS is an industry-standard format for LIDAR data. It's more efficient because it's binary. It also has more information stored in the file about the data.

There's a separate tool to import LAS format files, LAS to Multipoint, that's located in the same toolset as the ASCII 3D to Feature Class tool.

Building a terrain dataset from features

Next you will use the Terrain wizard in ArcCatalog to define and build a terrain dataset.

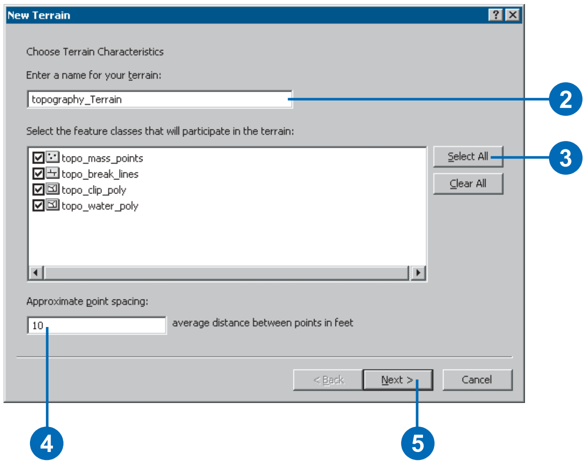
1. In ArcCatalog right-click the topography feature dataset and select New>Terrain from the context menu.



Terrains are located in feature datasets. Terrains, and the feature classes used to build them, must reside at the same location. One benefit of using the feature dataset as a container is that it ensures all the data used to build a terrain has the same spatial reference. In an SDE database, it's also the organizational level at which data gets registered as versioned for editing.

2. Accept the default name for the terrain dataset.

3. Click Select All to check on all the feature classes that are in the feature dataset.

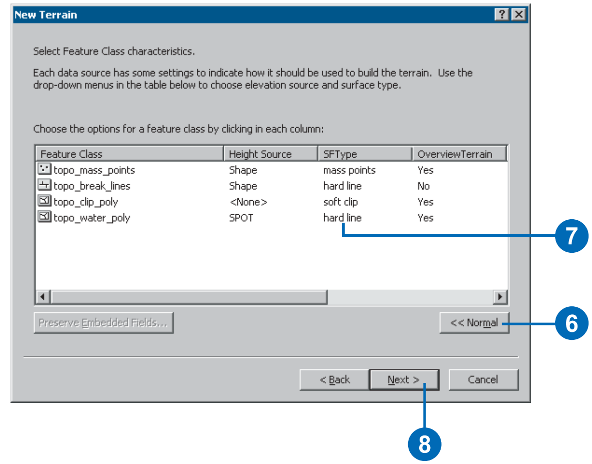


4. Set the Approximate point spacing to 10.

5. Click Next and indicate how each feature class will contribute to the terrain.

6. Click the Advanced button to expand the list of columns.

7. Set the Surface Feature Type (SFType) to hard line for the topo_water_poly Feature class.



The features of the topo_water_poly feature class should be incorporated into the surface as hard lines.

Since the mass points and breaklines have z-values, which will be used to define the terrain surface, so the height source for them is set to Shape. This means that z comes from the shape geometry.

The topo_clip_poly feature class contains a 2D polygon. It defines the horizontal extent of the surface and minimizes interpolation artifacts around the surface perimeter.

Clip polygons work best when they're smaller than the extent of the data that is being used to provide z-values. The water polygons are represented by 2D geometry but have the height attribute SPOT. Each polygon can have its own height, but that height is constant. For lakes, this is fine, since they're flat. With this data, there are no measurements inside the lake boundaries that contradict the lake SPOT values, so you can add the boundaries as breaklines; otherwise, they'd be added as replace polygons to ensure their areas get flattened.

Everything but the breaklines are used for the terrain's overview representation. The overview is a generalized representation of the terrain, similar to a vector-based thumbnail. The breaklines are too detailed for the overview, but all the other information is needed to produce a reasonable looking overview.

8. Click Next to determine the terrain pyramid type.

Defining the pyramid for the terrain dataset

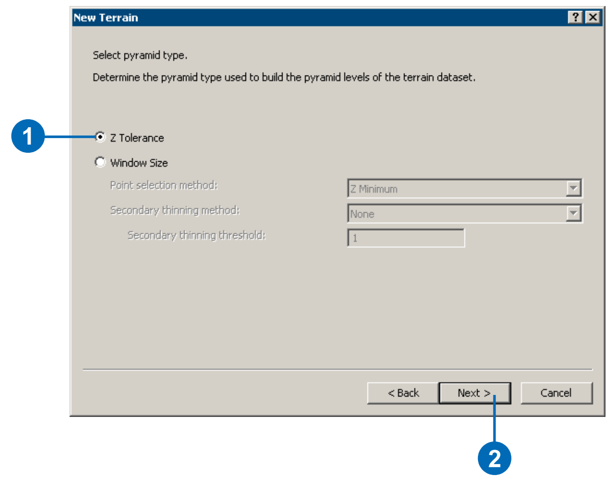
Terrain pyramids are used to create multiresolution surfaces. They're similar to raster pyramids in concept (that is, coarser pyramids are used for display at smaller scales to improve display performance), but there are differences. The most significant are that they're composed of vector-based measurements and they can be used for analysis as well as display.

Two types of pyramids can be used to build a terrain dataset: z-tolerance and window size.

Z-tolerance pyramiding thins points to produce surfaces that are within an approximate vertical accuracy relative to the full resolution data.

The window size pyramid type thins points for each pyramid level by partitioning the data into equal areas (windows) and selecting just one or two points from each area as representatives. Selection is based on one of the following criteria: the minimum, maximum, mean, or both the minimum and maximum z value.

1. Click the radio button next to the z-tolerance pyramid type.

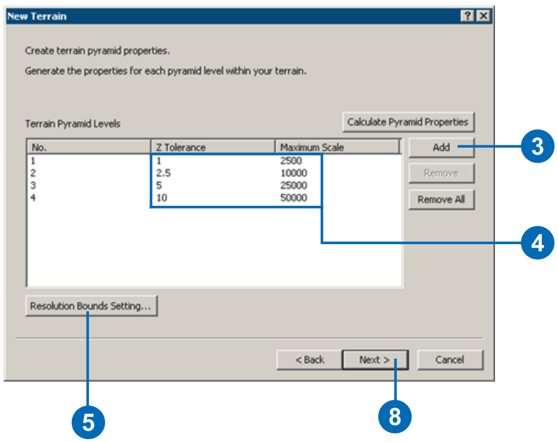


The z-tolerance pyramid type is defined using two factors: z-tolerance and reference scale.

The z-tolerance of an individual pyramid level represents its approximate vertical accuracy relative to the full resolution data. The reference scale of a pyramid level defines the display scale at which it becomes active.

2. Click Next to define the terrain pyramid levels.

3. Click Add four times. This populates the table for you to customize the properties.
4. Manually reset the values for Z Tolerance and Maximum Scale by clicking the values inside each column. Use the values specified in the following graphic.



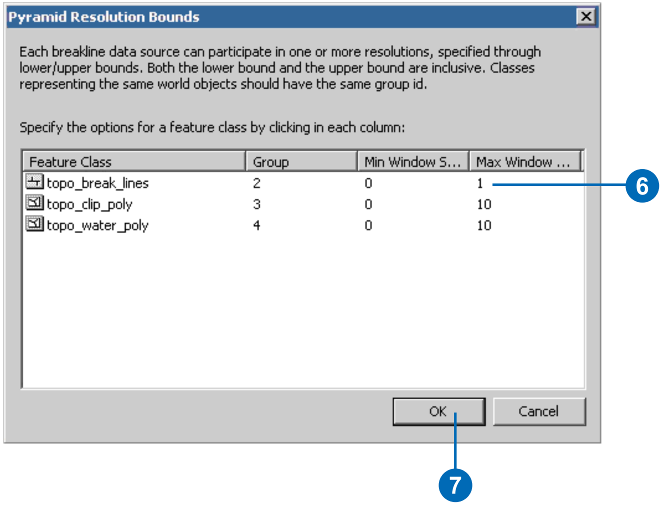
Using these settings, the full resolution data is used in map displays up to a scale of 1:2,500. Between display scales of 1:2,500 and 1:10,000, only the data necessary to achieve an approximate vertical tolerance of 1.0, relative to the full-resolution data, is used. Between 1:10,000 and 1:25,000, a tolerance of 2.5 is used. Between 1:25,000 and 1:50,000, a tolerance of 5 is used. For any scale smaller than that, a tolerance of 10 is used.

Tolerances and scales used to define a terrain pyramid need to be specified based on application requirements. One approach is to mimic the accuracy requirements of a contour map series. A generally accepted rule is that contours should be accurate to within one-half of their interval. For example, if a 1:24,000 scale map within your study area uses a 5-foot contour interval, then the vertical accuracy should be 2.5 units RMSE. Base the pyramid on the scales and contour intervals appropriate for a map series of the terrain.

While breakline vertices are used where needed through all pyramid levels, the actual line enforcement can be restricted to occur in a subset of these levels. For example, road curbsides need not be enforced as triangle edges in a terrain at scales smaller than 1:24,000. You control enforcement via the Pyramid Bounds dialog box.

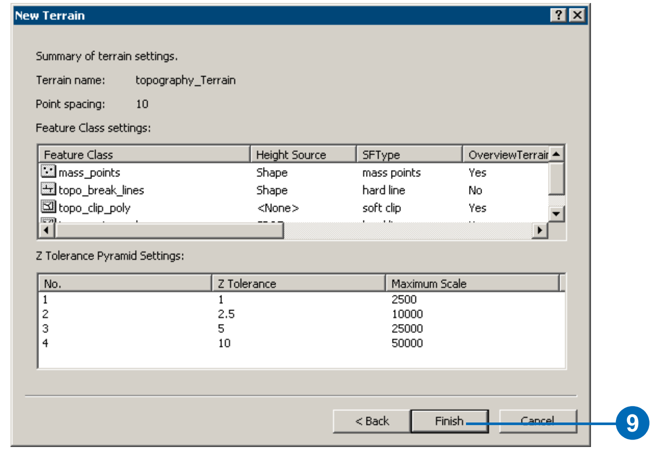
5. Click the Resolution Bounds Setting button to open the Pyramid Resolution Bounds dialog box.
6. Set the Max Z Tolerance for the topo_break_lines feature class to 1. Accept the defaults for the others.

In the Resolution Bounds dialog box, z-tolerances indicate at which pyramid levels the enforcement is to take place. Using the given values, the breaklines will be enforced for pyramid levels with z-tolerances >= 0 and <= 1.0. This translates into the breaklines being enforced only at scales larger than 1:10,000. The water and clip polygons are enforced through all scales. This ensures the data boundary is always correct and water bodies remain flat.

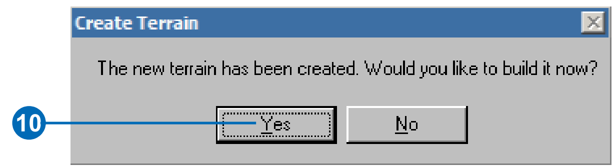


7. Click OK to dismiss the Pyramid Resolution Bounds dialog box.
8. Click Next to reach the summary panel.

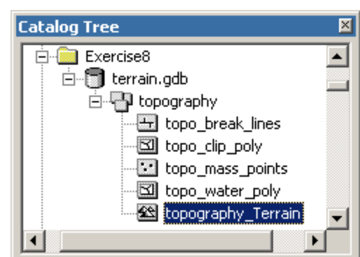
   Review your settings.
9. Click Finish.



10. You're now asked if you want to build the terrain. Select Yes to initiate the terrain build process.



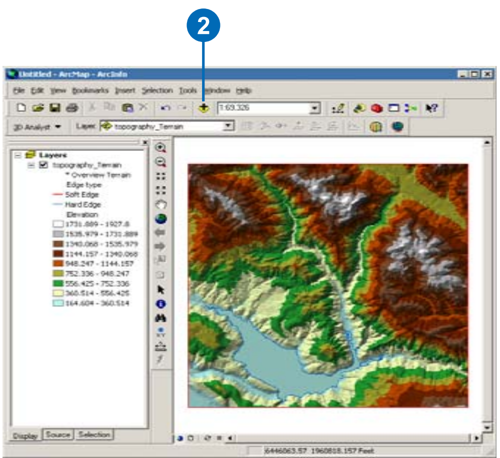
When the terrain build process is complete, the new terrain is added to the Catalog Tree inside the feature dataset. Right-clicking the new terrain dataset will expose the properties. You can preview the terrain dataset in ArcCatalog.



Viewing a terrain in ArcMap

Now that you have created a terrain dataset, adding it as a layer in ArcMap can be used to conduct further visualization and analysis. You can turn it on and off in the table of contents (TOC). As well, it has a Layer Properties dialog box to control display parameters. The Symbology tab on this dialog box is identical to TIN layers.

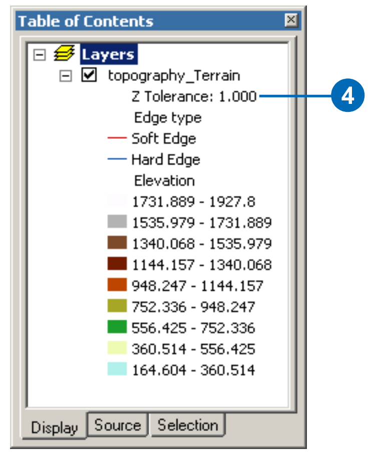
1. Start ArcMap.
2. Click the Add Data button.



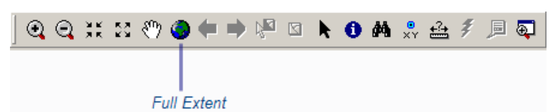
3. Browse to topography_Terrain from the Exercise 8 folder, add it to the map, then make sure its visibility is turned on.

The terrain will retrieve measurements from the database for the pyramid level associated with the current display scale. The measurements are triangulated on the fly and drawn to the screen. When going from coarser pyramid levels to more detailed levels, only the additional measurements needed to get to the higher-detail pyramid level are retrieved and added to the triangulation.

4. Zoom in on the display. Note how the vertical tolerance associated with the current display is listed in the map's Table of Contents.



5. Zoom to the full extent of the layer by clicking the Full Extent button from the Tools toolbar.



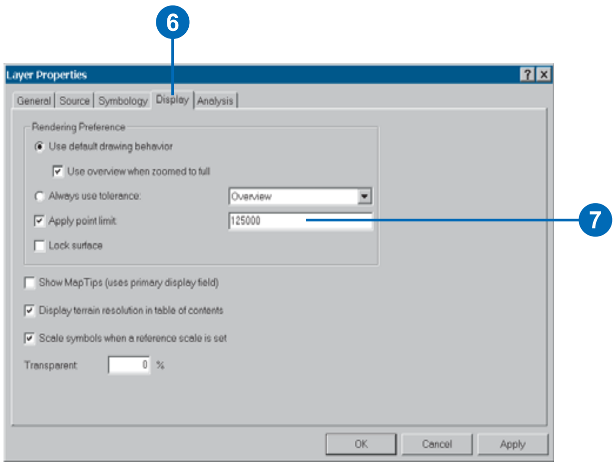
Note that Overview Terrain is listed in the Table of Contents.

The terrain overview is the coarsest representation of the terrain. It's coarser than the lowest level of detail (LOD) pyramid specified when the terrain was defined.

The overview is used by default when the layer is zoomed out to full extent or beyond. This is used to speed up rendering. Use of the overview representation can be turned on and off from the Display tab of the terrain's Layer Properties dialog box. You can also apply a point limit from this tab.

The use of a point limit tells the terrain layer to further downgrade its display resolution if the current environment (i.e., display extent, scale, and pyramid definition) would require too many measurement points. This helps maintain display performance at the cost of not always honoring the terrain's original pyramid display definition. When the resolution has been downgraded, an asterisk is displayed next to the terrain layer's name in the TOC. By default, a point limit of 800000 is used.

6. Double-click the terrain layer to open the Layer Properties dialog box and click the Display tab.
7. Change the point limit from 800000 to 125000 and click OK to close the Layer Properties dialog box.



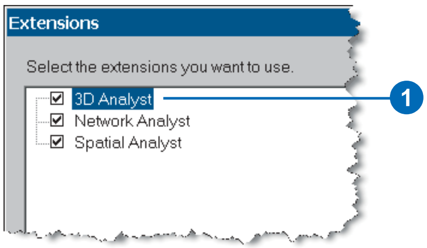
From the map display, zoom in and out, then pan around.

The display should be consistently fast because the layer is adjusting which pyramid levels gets used to keep the point count below the 125000 limit.

Using the interactive surface analysis tools in ArcMap

Now you'll use the 3D Interactive tools to complete some surface analysis.

1. Make sure the 3D Analyst extension is enabled by clicking its check box in the Tools>Extensions dialog box.

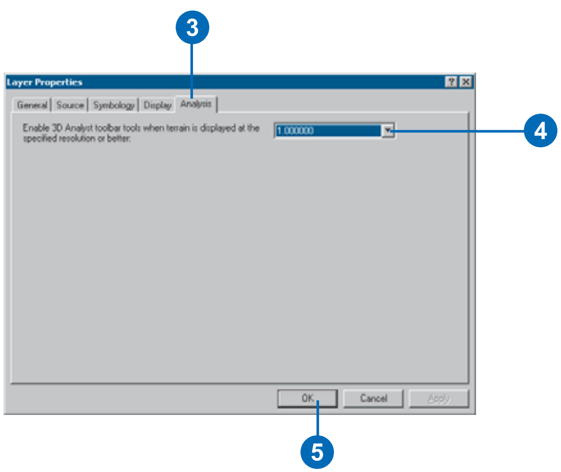


2. Add the 3D Analyst toolbar from the View>Tools menu, if not already displayed. The terrain is displayed in the Layer combo box on the toolbar.

If you aren't zoomed in far enough, the tools on the toolbar are disabled. By default, they're only enabled when the terrain is displayed at full resolution. Based on how the terrain's pyramid was defined, this will occur at display scales of 1:2,500 or larger.

You can enable the tools at lower resolutions from the Analysis tab of the terrain's Layer Properties dialog box. When you enable the tools at LODs lower than full resolution, the accuracy is also decreased. Interactive tools always operate at the current display resolution. This is useful if the full-resolution terrain is oversampled for the requirements of the analysis.

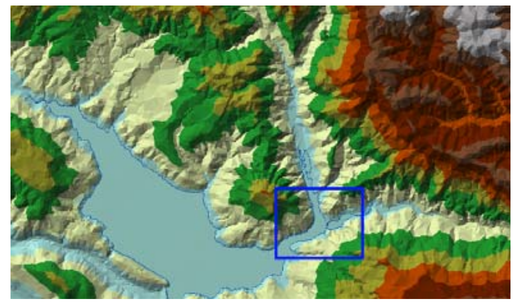
3. Double-click the terrain layer to open the terrain Layer Properties dialog box and click the Analysis tab.



4. Set the resolution threshold for the 3D Analyst tools to 1.0 from the drop-down menu.

5. Click OK.

6. Zoom in on the terrain until the display scale is larger than 1:10,000.



The 3D Analyst interactive tools on the 3D Analyst toolbar should now be enabled.

Now you'll conduct a Line of Sight analysis on the surface.

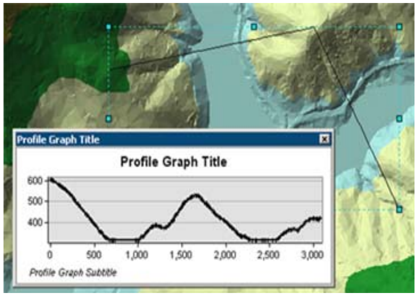
7. Click the Create Line of Sight tool. Set the Observer offset to 5 and the Target offset to 2. Digitize two points on the surface to reveal the line of sight analysis.

8. Now you'll interpolate a 3D line on the surface. Click the Interpolate Line button and digitize two points on the surface.

   The resulting graphic line will automatically be selected.

   A selected 3D polyline enables the Create Profile Graph tool.

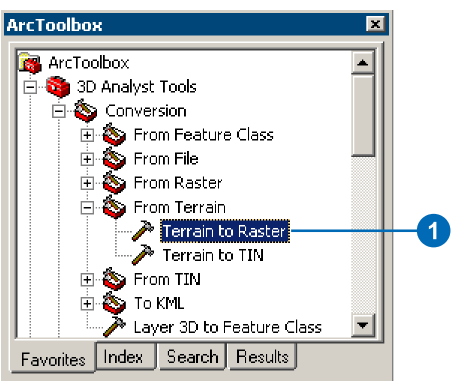
9. Click the Create Profile Graph tool to graph the 3D line.



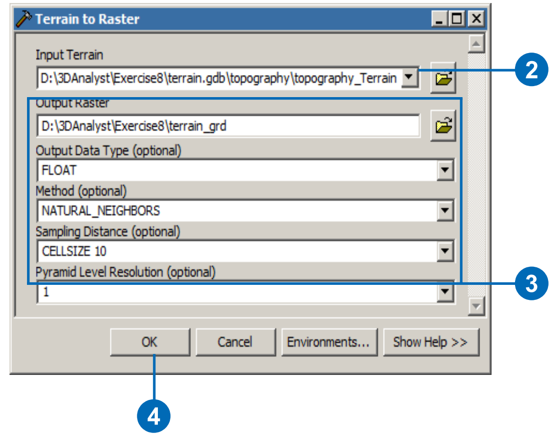
Rasterize a terrain using a geoprocessing tool

Terrain datasets can be rasterized based on any extent, cell size, and vertical tolerance. You can choose between linear and natural neighbor interpolators. A natural neighbor interpolation method generally produces higher quality results but at the expense of processing time. Rasterization is performed using the Terrain to Raster geoprocessing tool.

1. Open the Terrain to Raster tool from the ArcToolbox window. It's located in the 3D Analyst Tools>Conversion>From Terrain toolset.



2. Choose the terrain in the Input Terrain drop-down box.
3. Set the other values to match the graphic below.



4. Click OK to execute the geoprocessing tool.

   Keeping the Output Data Type as FLOAT will preserve vertical precision.

Changing the interpolation Method to NATURAL_NEIGHBORS will take a little longer than LINEAR but it adds some smoothness everywhere except across hard breaklines where sharp discontinuities are supposed to occur.

Setting an explicit Sampling Distance lets you know exactly what the output cell size will be.

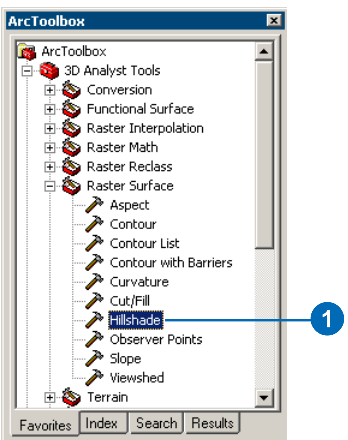
Since this terrain dataset was made with a z-tolerance pyramid type, the pyramid resolution represents the z-tolerance of the desired pyramid level. In this terrain, the pyramid level with a resolution of 1.0 has the breaklines enabled.

This surface will be somewhat generalized relative to the full-resolution data but not by much, and this process will run faster because it's using a thinned version of the data.

5. Zoom to full extent once the geoprocessing tool has completed. Turn off the layers except the raster to view the results.

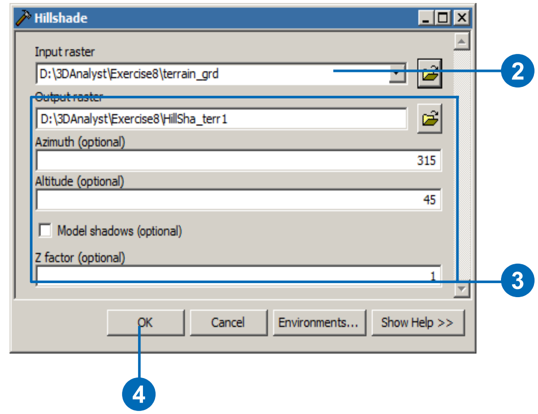
To see the morphology of the derived raster surface, generate a hillshade image. A hillshade representation of a surface can greatly enhance the visualization of a surface for analysis or graphical display, especially when utilizing the transparency setting.

1. Open the 3D Analyst Tools>Raster Surface>Hillshade geoprocessing tool.



2. Browse to the Exercise 8 folder to specify the input raster.

3. Confirm all other values match the graphic below.



4. Click OK to execute the tool, and examine the resulting hillshade layer.

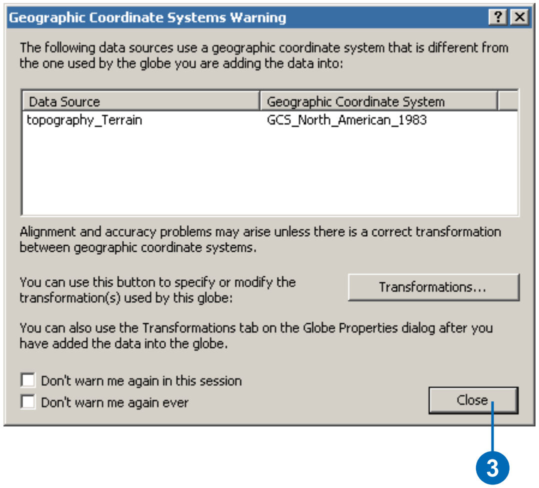
Using a terrain as an elevation layer in ArcGlobe

Terrain datasets can be used in ArcGlobe as either elevation or draped layers contributing to the definition of the globe surface.

1. Start ArcGlobe.

2. Right-click the Globe layers from the Table of Contents, then point to Add Data, and click Add elevation data to add the terrain dataset as an elevation layer.

3. If prompted, close the Geographic Coordinate Systems Warning message box.



The data will be projected to ArcGlobe's currently set Geographic Coordinate Systems.

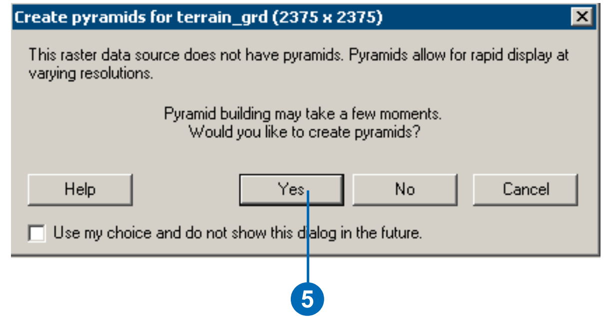
The terrain dataset will be added as an elevation source in the Table of Contents of ArcGlobe. It will not be visible if it is used as an elevation surface to drape additional surfaces on.

4. Add the rasterized terrain as a draped layer.

   Right-click on Globe layers from the table of contents, then point to Add Data, and click Add draped data.

   Browse to the rasterized terrain and click Add.

5. A dialog box may appear requesting to build raster pyramids. Click Yes.



If prompted, close the Geographic Coordinate Systems Warning message box.

6. Repeat steps 4 and 5 to add the hillshade raster as a draped layer.

   Right-click on Globe layers from the table of contents, then point to Add Data, and click Add draped data.

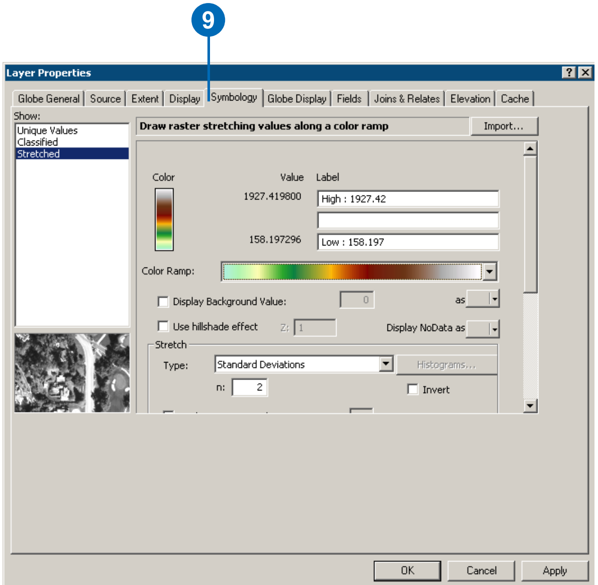
   Browse to the hillshade raster and click Add. A dialog box may appear requesting to build raster pyramids. Click Yes.

7. Click and drag the rasterized terrain until a line appears above the hillshade indicating the new location. Release the mouse once this line appears.

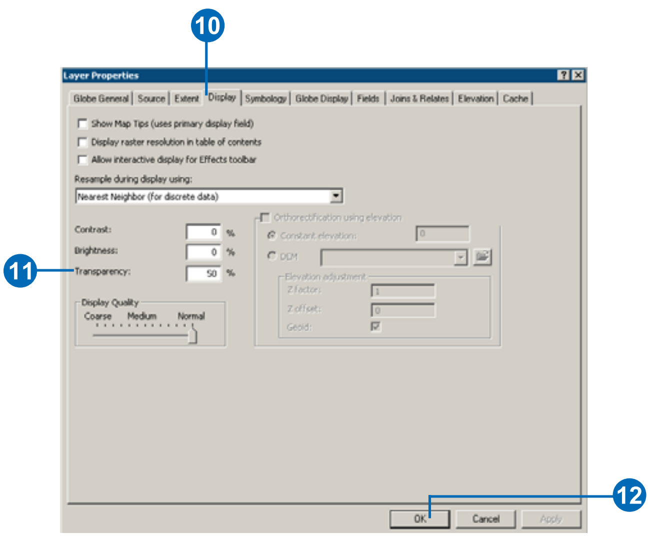
8. Right-click the rasterized terrain and click Properties.

9. Click the Symbology tab.

   Symbolize the rasterized terrain using an appropriate elevation color ramp.

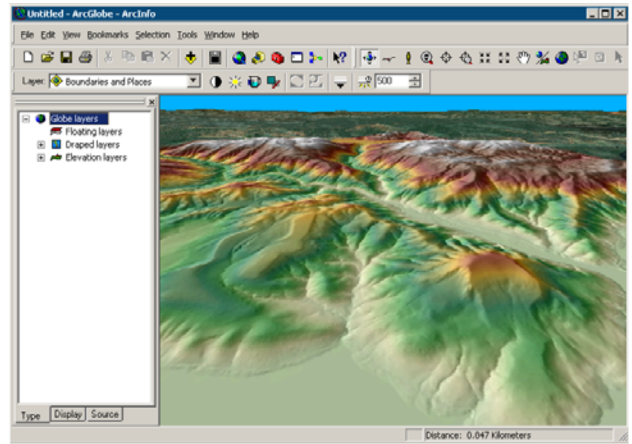


10. Click the Display tab.



11. Assign a transparency setting of 50%.

12. Click OK to close the Layer Properties dialog box.



The hillshade raster can be seen through the rasterized terrain using this transparency setting, revealing a 3D morphological surface of the terrain dataset.

Optimizing display settings in ArcGlobe

For high-quality display, you can do several things. Go to the Cache tab on the terrain's Layer Properties dialog box and uncheck the option to compress to 16 bits. This will eliminate the possibility of the surface geometry looking stair stepped when zoomed in very close.

You can also set both the draped layers to use bilinear renderers. These will draw a smoother picture. Also, the hillshade raster should not use any stretch. The default, using standard deviations, is not appropriate for this data.

As an alternative to viewing draped rasters derived from the terrain dataset, you can add the terrain directly as a draped layer.

To do this, right-click on Globe layers from the table of contents, then point to Add Data and click Add draped data, then choose the terrain.

Exercise 9: Creating a realistic 3D view

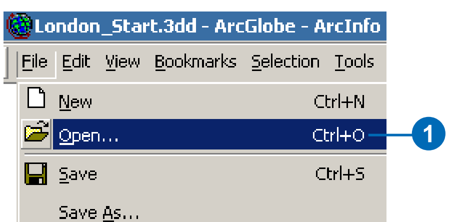
Imagine that you are an urban planner and are interested in constructing a realistic 3D model of a neighborhood. The staff of the planning and transportation departments have created GIS datasets for the building footprints, street lights, trees, and sample vehicles for this area. You also have imagery of the area, and an architect has supplied a set of photorealistic building models.

You want to combine the GIS data with the image and the building models in ArcGlobe to develop a realistic urban model. This model will help decision makers visualize proposed buildings and their associated view. Such models can also be used to study spatial awareness, or to simulate urban features, landscapes, landmarks, or tourist attractions for students or tourists.

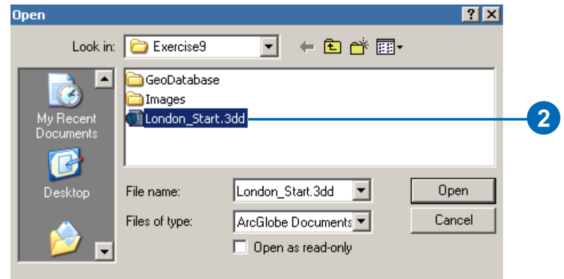
This is an advanced exercise illustrating how to use 3D symbology and 3D graphics tools to create a realistic looking view of a study area in London.

Opening the London Globe document

1. Start ArcGlobe, then click File and click Open.

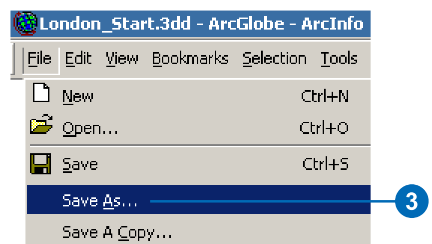


2. Navigate to the Exercise9 folder and double-click London_Start.3dd.

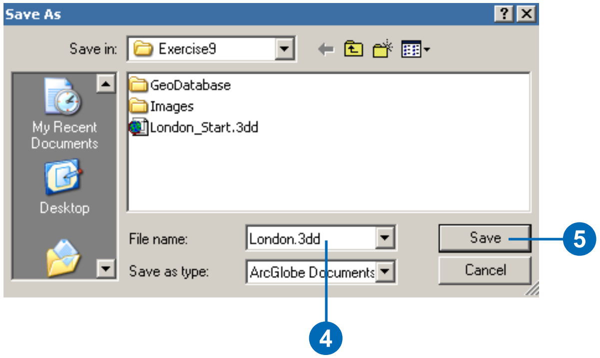


The ArcGlobe document contains two high resolution images (courtesy of DigitalGlobeQuickBird™), one 3D feature dataset symbolized with tree symbols, and one 3D textured multipatch dataset representing the buildings in the study area.

3. Click File and click Save As.



4. Type London.3dd for the name of the globe document.



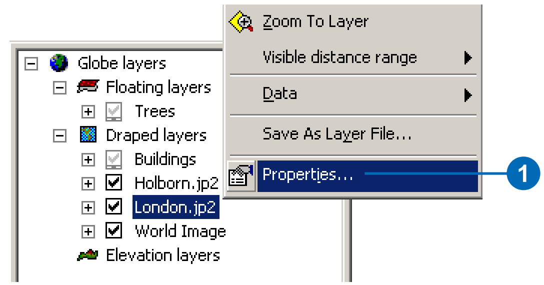
5. Click Save.

Setting the visible distance range of a layer

You can optimize the performance of an ArcGlobe document by setting an appropriate visibility distance for each layer. Specifying the visibility distance range lets you control when a layer becomes visible as you zoom in or out. You can either set the minimum and maximum distance for an entire layer, or you can base the layer visibility on individual tile distances.

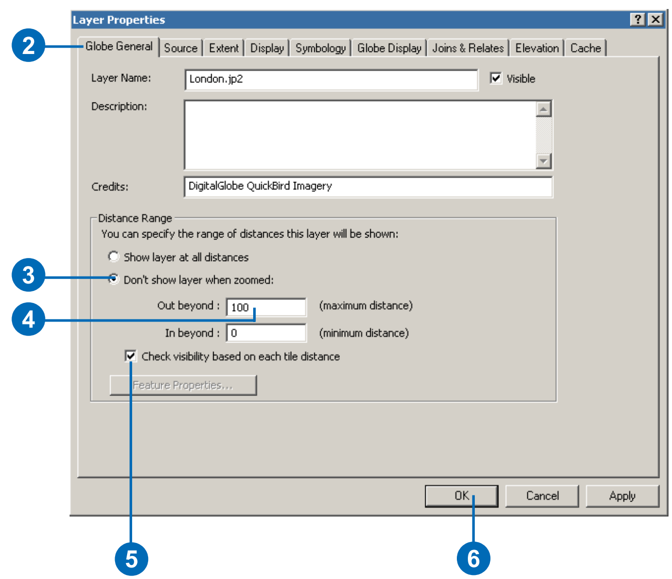
The checked box beside the Buildings layer is grayed out in the Table of Contents. This means the display currently exceeds the layers maximum visibility distance. You will change the maximum visibility distance for a couple of other layers later in this exercise.

1. In the Table of Contents, right-click the London.jp2 layer and click Properties.



2. Click the Globe General tab.

3. Click Don’t show layer when zoomed.



4. Type “100” in the Out beyond text box.

   The units used for this distance are kilometers.

5. Click Check visibility based on each tile distance to enable distance visibility for discrete parts of the layer.

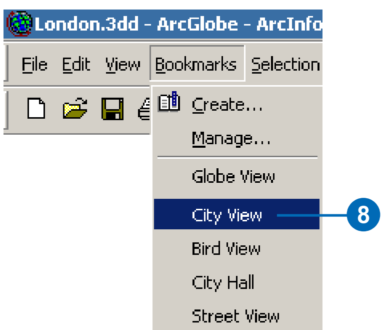
   This setting, although not enabled by default, further improves performance. When enabled, discrete tiles of data appear visible when navigating near their layer’s distance threshold.

6. Click OK.

   The layer will be visible between the minimum and maximum distance.

7. Repeat steps 1 through 6 for the Holborn.jp2 layer. Type “5” for the maximum distance for this image.

8. Click Bookmarks and click City View.



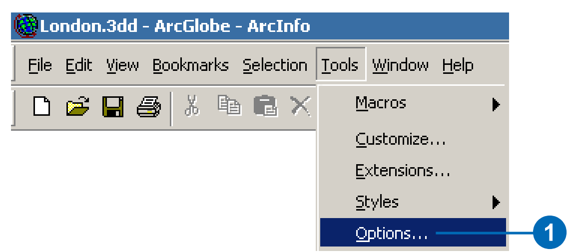
The display is now repositioned to the City View bookmark. All of the datasets are now visible because you are within the visibility distance range of all layers at this scale.

A layer’s visibility range can also be set according to current display distances. Right-click a layer in the Table of Contents, point to Visible distance range, and use the Set Maximum Distance and Set Minimum Distance commands to capture display distances.

Tips on allocating memory cache

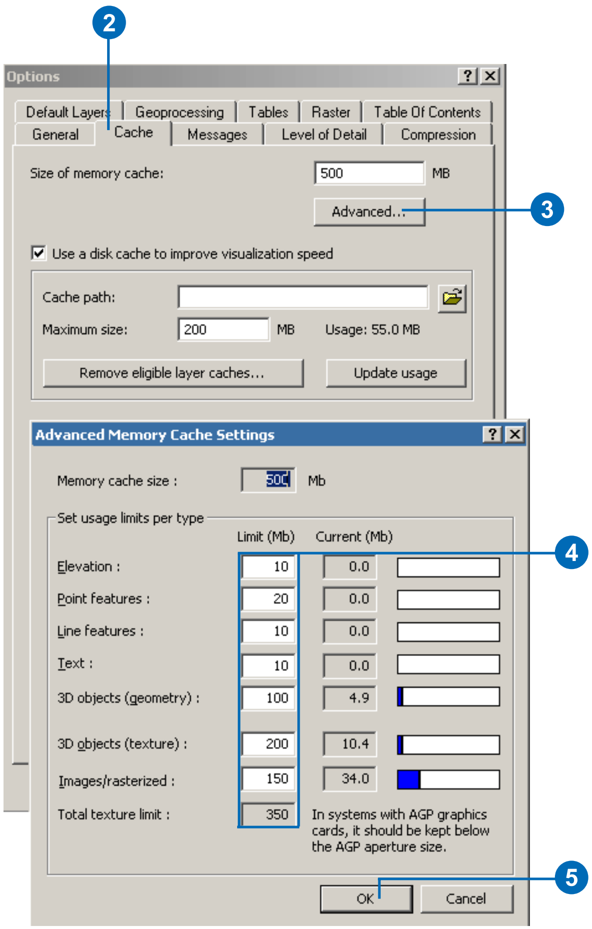
Often, an ArcGlobe document that is performing poorly can be made interactive through a well defined memory cache. This is a specified amount of physical memory (RAM) dedicated for exclusive use by ArcGlobe to improve performance. For optimum performance, the memory cache can be fine-tuned according to the individual data types used. As this exercise uses many 3D textured objects and raster images, your next step will be to allocate a greater percentage of the memory cache to improve handling these data types.

1. Click the Tools menu and click Options.



2. Click the Cache tab.

3. Click the Advanced button.



4. Type the following memory allocation values, in megabytes, for each of the following memory types:

- 3D objects (geometry): 100
- 3D objects (texture): 200
- Images/rasterized: 150

If necessary, reduce the amount of memory allocated for other data types to prevent the size of the memory cache from exceeding your available physical memory (RAM).

Each data type's current memory usage as an absolute value and as a percentage of its allocated size is detailed in the text box and horizontal graph to the right of each item.

5. Click OK to confirm changes and close the Advanced Memory Cache Settings dialog box.

6. Click OK to confirm changes and close the Options dialog box.

The total memory cache size is automatically calculated as the sum of the individual data type settings. This total cannot exceed the amount of physical memory (RAM) installed on your machine.

These values will apply to all future ArcGlobe sessions, so you should consider all ArcGlobe documents you will be working with when specifying memory cache settings.

ArcGlobe will not automatically balance the allocation of memory used for each data type. If you allocate a small amount of physical memory (RAM) to a particular data type and subsequently create a document that makes extensive use of this data type, it will start paging the data to disk well before physical memory is exhausted, leading to reduced performance.

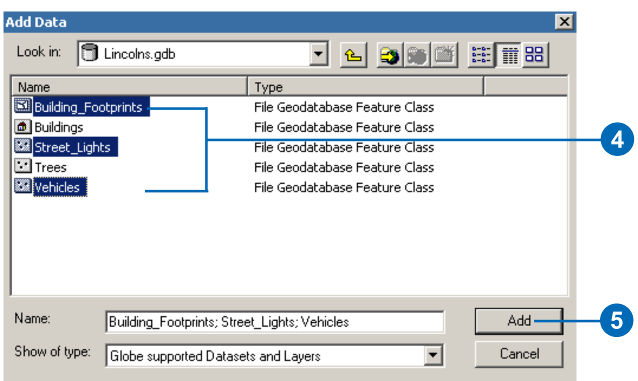
Adding feature data

In order to create 3D objects on your model, you will add some local data to the London area.

1. Click the Add Data button.

2. Navigate to the location of the Exercise 9 tutorial data folder.
3. Open the Geodatabase folder, and double-click the Lincolns.gdb geodatabase file.
4. Holding down the Ctrl key, click the Building_Footprints, Street_Lights, and Vehicles feature classes.

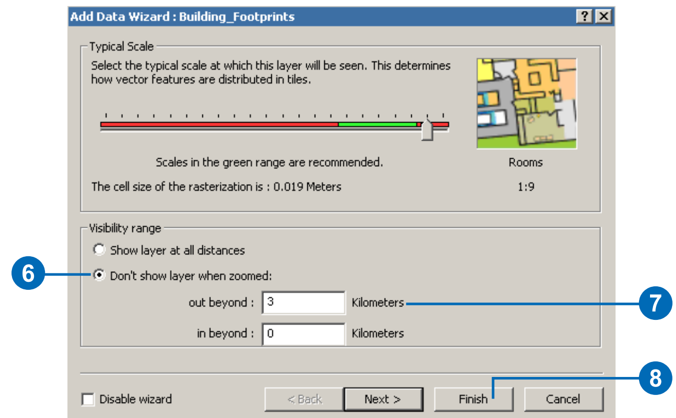
   Holding down the Ctrl key lets you select multiple items.



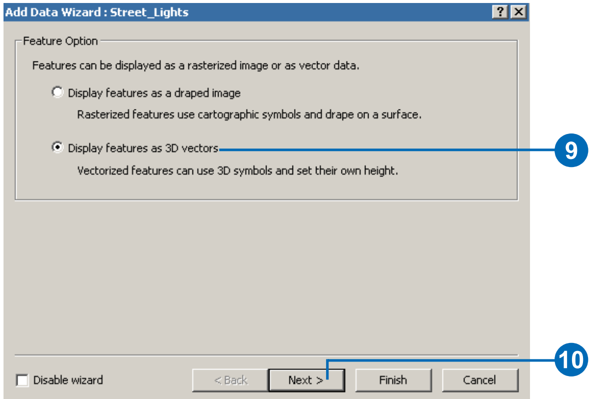
5. Click Add.

A sequence of three Add Data Wizards will appear for each feature layer beginning with Building_Footprints.

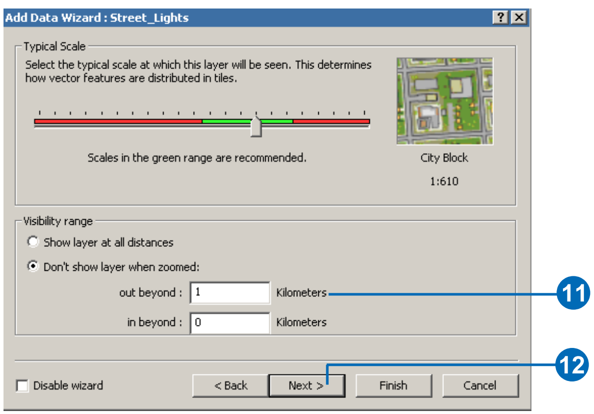
6. Click Don't show layer when zoomed to apply the distance visibility range.
7. Type "3" in the out beyond text box, and leave the in beyond text box set to the default value of "0".



8. Click Finish.
9. Click Display features as 3D vectors when the Add Data Wizard appears for Street_Lights layer.
10. Click Next.

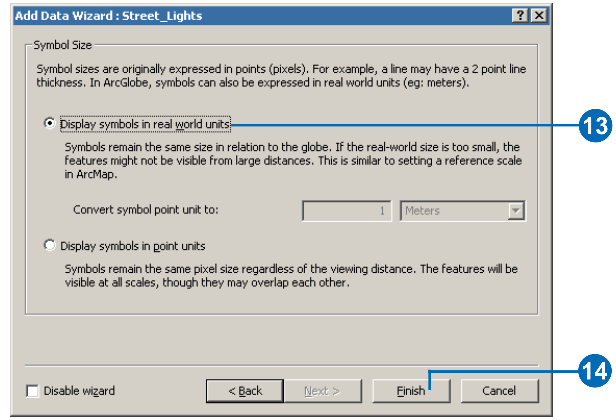


11. Click Don’t show layer when zoomed to apply the distance visibility range. Then type “1” and “0” in the distance range text boxes.



12. Click Next.

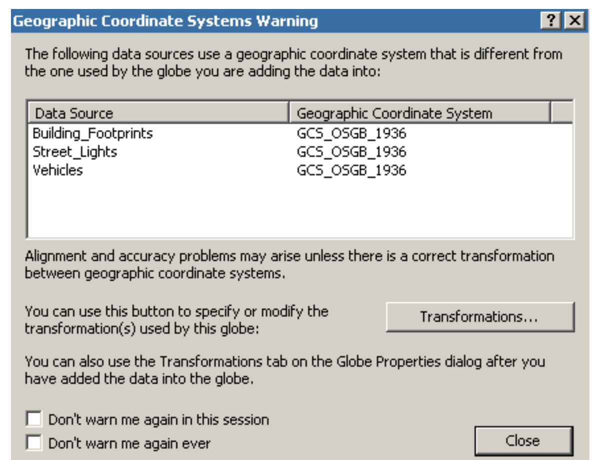
13. Select the typical scale at which this layer will be seen.



14. Click Finish.

15. Repeat steps 9 through 14 for the Vehicles layer.

If prompted, close the Geographic Coordinate Systems Warning message box. The data will be projected to ArcGlobe’s currently set Geographic Coordinate System.



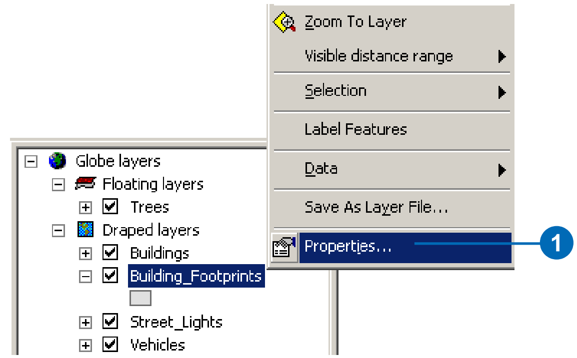
16. Click Bookmarks and click Bird View.

    Now you can see all the layers you have added to the study area. The Table of Contents indicates that these feature layers have been added as draped layers in the scene.

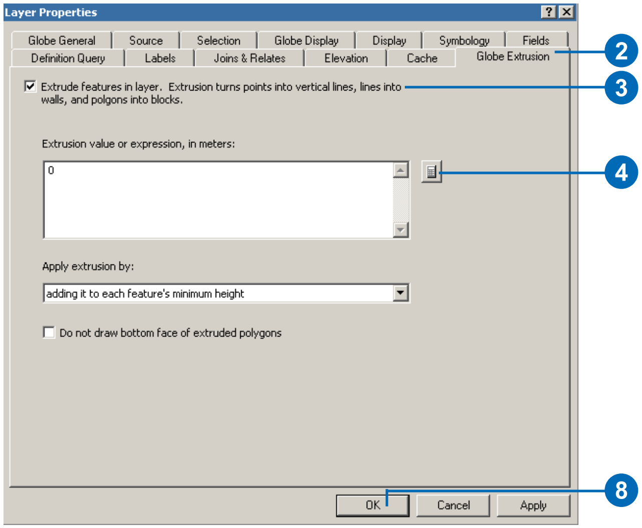
Extruding buildings

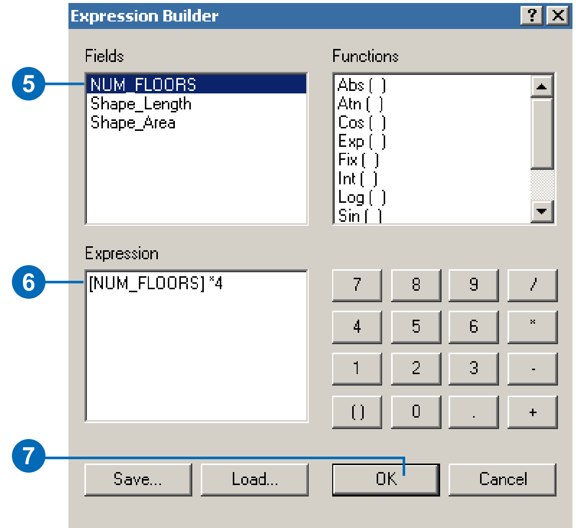
Features in a two-dimensional data source can be projected into a three-dimensional representation through a process known as extrusion. A 2D building footprint, for example, can be extruded into a 3D block representation of that building. In this exercise, you will extrude building polygons according to a height value governed by the number of floors and average height per floor to create realistic 3D building shapes.

1. In the Table of Contents, right-click Building_Footprints layer and click Properties.



2. Click the Globe Extrusion tab.
3. Check Extrude features in layer.
4. Click the Calculate Extrusion Expression button to open the Expression Builder dialog box.





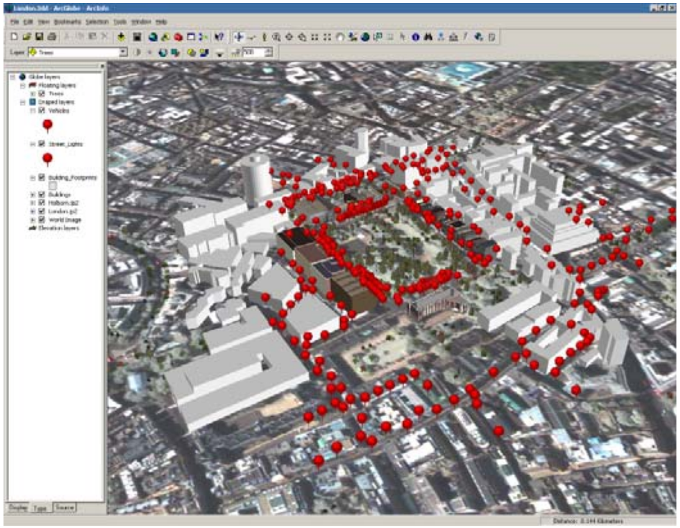
5. Click the attribute “NUM_FLOORS” to add it to the Expression text box.
6. Assuming that each floor has a height of 4 meters, you can calculate the height of each building by multiplying the number of floors in each building by 4.

   Set the expression to [NUM_FLOORS] * 4 to reflect the following graphic.
7. Click OK.
8. Click OK to close the Layer Properties dialog box.

   The 2D building footprints features are now extruded into 3D blocks.

   Optionally, to increase performance you can choose not to draw the bottom faces of extruded polygons.

   Navigate around the display to view your results.



Symbolizing features

1. In the Table of Contents, right-click the Street_Lights layer and click Properties.

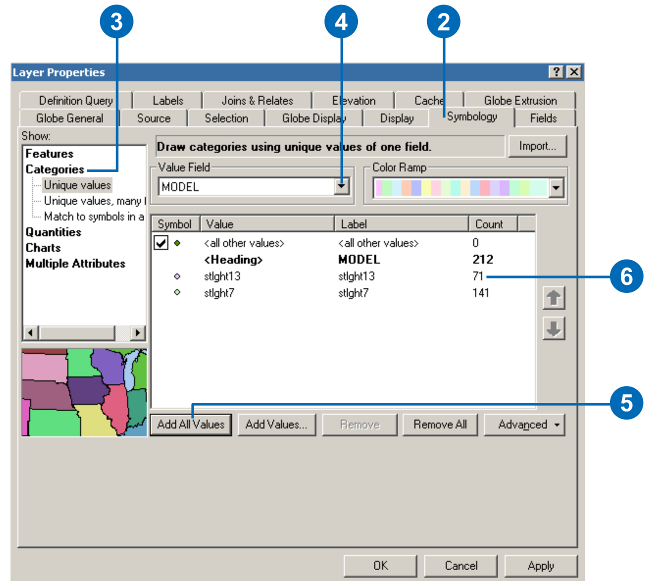
   You can also open the Properties dialog box by double-clicking the layer.

2. Click the Symbology tab.
3. Click Categories.

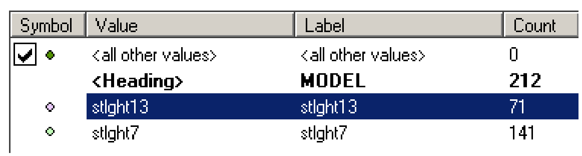
   ArcGlobe automatically selects the Unique values option.

4. Click the Value Field drop-down arrow and click MODEL.
5. Click Add All Values.

   This adds all unique values to the list. You could also have clicked the Add values button to choose specific Model values to display.

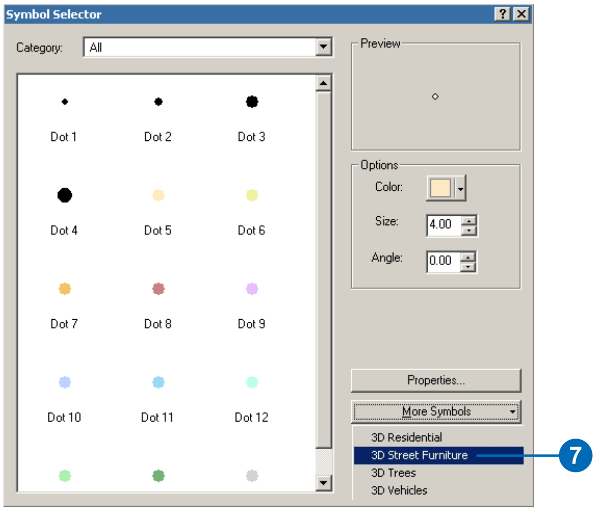


6. Double-click the symbol for “stlght13”.



Symbol	Value	Label	Count
☑	<all other values>	<all other values>	0
	<Heading>	**MODEL**	**212**
	stlght13	stlght13	71
	stlght7	stlght7	141

7. In the Symbol Selector dialog box, click the More Symbols button, and in the list click the 3D Street Furniture style from the list.



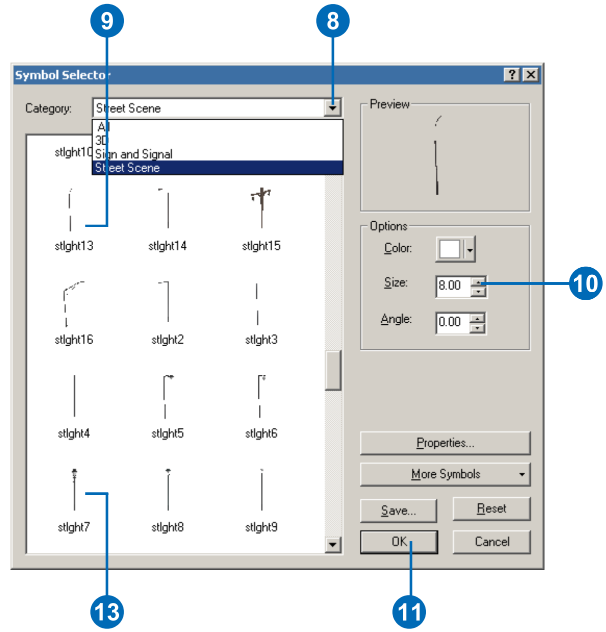
8. Click the Category drop-down list and click Street Scene.

This will show only those symbols in the Street Furniture style, so that you don't have to scroll through all visible symbols in the Selector list.

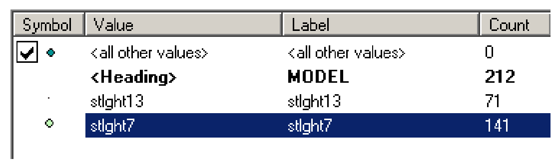
9. Click the "stlght13" symbol.

10. Type "8" in Size text box.

11. Click OK.



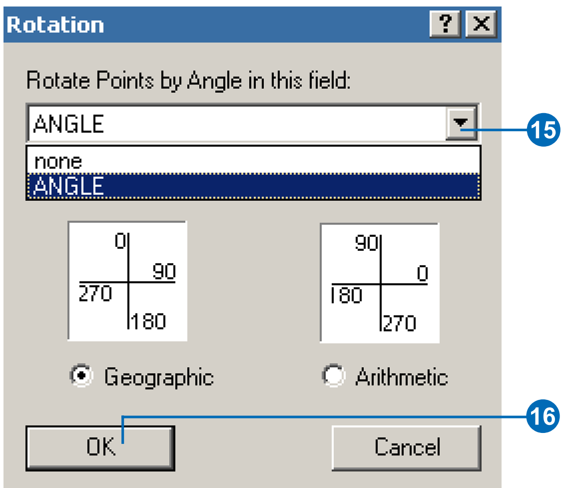
12. Double-click the symbol for "stlght7".



13. Repeat steps 8 through 11, type "5" for the size, and assign "stlght7" for another street light symbol.

14. In the Layer Properties dialog box, click the Advanced button and click Rotation.

15. Click Rotate Points by Angle in this field drop-down list and click Angle.



16. Click OK.

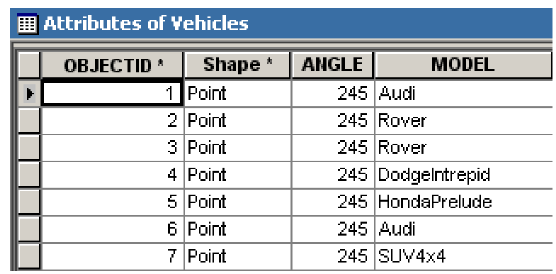
17. Click OK on the Layer Properties dialog box when you have finished.

Matching symbols in a style

The symbols in a style have names. If your features have values that match these names, you can automatically associate a particular symbol with each matching feature. If your features use a different set of names, you can edit the names in the style to match them.

1. In the Table of Contents, right-click Vehicles layer and click Open Attribute Table.

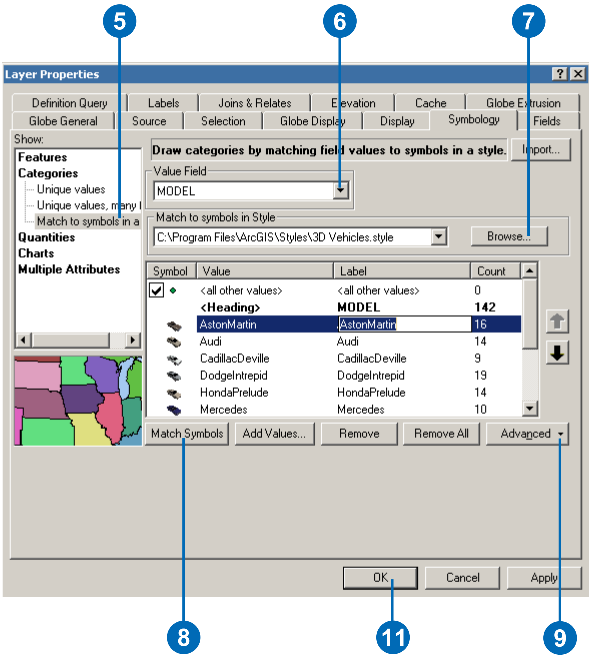
   In the Attribute table window, notice the Model column. Each vehicle type listed corresponds to a symbol with the same name.


Attributes of Vehicles

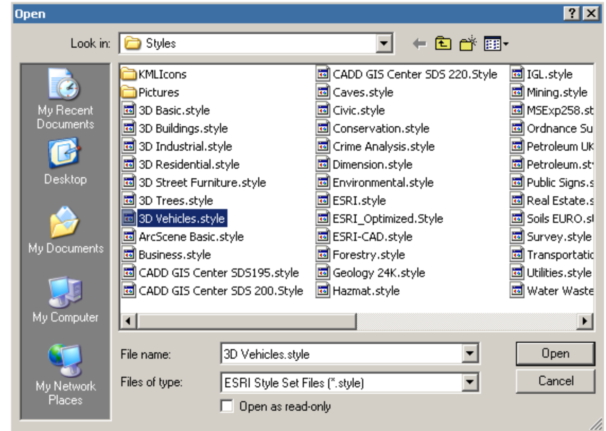
OBJECTID *	Shape *	ANGLE	MODEL
1	Point	245	Audi
2	Point	245	Rover
3	Point	245	Rover
4	Point	245	DodgeIntrepid
5	Point	245	HondaPrelude
6	Point	245	Audi
7	Point	245	SUV4x4

2. Close the Attribute table.
3. Double-click the Vehicles layer to open the Layer Properties dialog box.
4. Click the Symbology tab.
5. Under Categories, click Match to symbols in a style.

6. Click the Value Field drop-down arrow and choose MODEL.



7. Click Browse to navigate to the 3D Vehicles.style file in the ArcGIS\Styles folder and click Open. Match to symbols in a Style will now be populated with this style file.



8. Click Match Symbols.

This adds all unique values that have a matching symbol in the style.

Alternatively, by clicking Add Values, you can manually specify which unique values to display. You can also manually edit a label if you would like more descriptive labels to appear in the legend and the Table of Contents. This does not change the name in the attribute table.

9. Click the Advanced button and click Rotation.

10. Click the Rotate Points by Angle in this field drop-down list and click Angle.

11. Click OK.

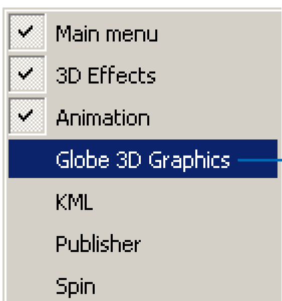
12. Click OK again to close the Layer Properties dialog box.

Navigate around the neighborhood to view the results.

Using the graphic tools

Sometimes you need to show something that isn't represented among your GIS features. You can add graphics to ArcGlobe and display them with the same realistic symbols that you use for features. You can digitize 3D graphics to represent points of interest, lines to delineate boundaries or roads, polygons that fill an open area, or text to name or describe places. In order to do so, you need to add the Globe 3D Graphics toolbar.

1. Click View, point to Toolbars, and select Globe 3D Graphics.



The 3D Graphics toolbar appears.

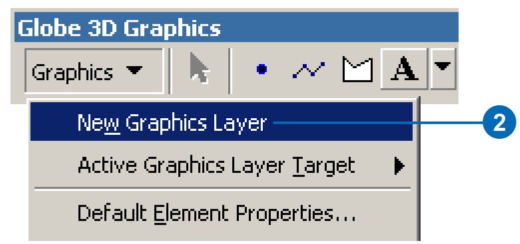
2. If you want to dock the toolbar along with other toolbars, simply drag it to the desired location.

You can also add/remove toolbars by right-clicking on a toolbar or in the gray area where toolbars appear. This opens the toolbar list. The visible toolbars are checked.

Creating a graphic layer

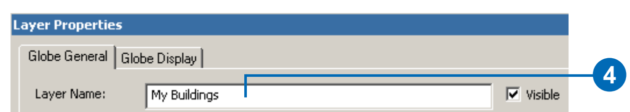
You can control the visibility of graphics by storing them in a named graphics layer. The graphics layer will be listed in the ArcGlobe Table of Contents, where you can turn it on and off like other layers.

1. Click Bookmarks and click City Hall.
2. On the Globe 3D Graphics toolbar, click Graphics and click New Graphics Layer.



The New Graphics Layer is added to the Table of Contents under Draped layers.

3. Double-click the New Graphics Layer to open the Layer Properties dialog box.
4. Type "My Buildings" in the Layer Name text box.

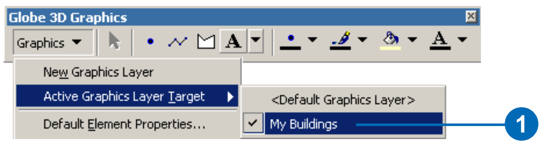


5. Check Don't show layer when zoomed.

6. Type “3” in the out beyond text box.
7. Click OK.

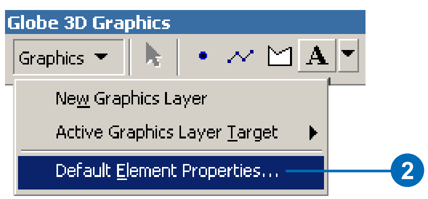
Setting the target layer and digitizing a 3D point graphic

1. On the Globe 3D Graphics toolbar, click the Graphics menu, point to Active Graphics Layer Target, then click My Buildings.



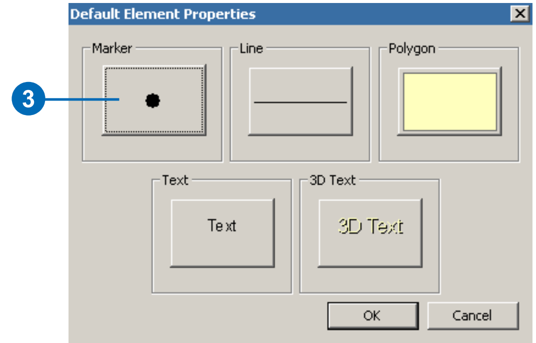
All new graphics will be added to this layer.

2. Click the Graphics drop-down menu and click Default Element Properties.

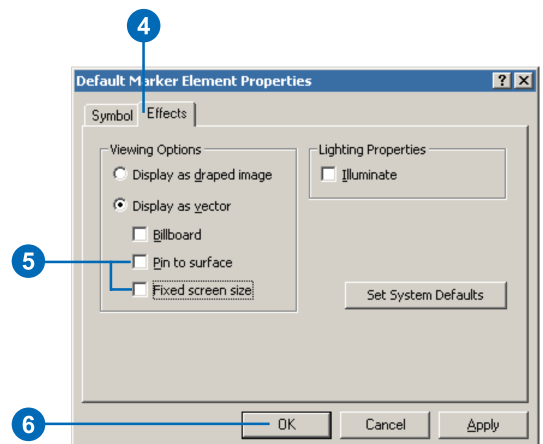


3. Click the Marker button.

The Default Marker Element Properties dialog box opens.



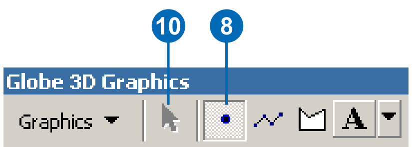
4. Click the Effects tab.
5. Uncheck Pin to surface and Fixed screen size.



Generally Pin to surface is selected by default to pin elements to the globe surface; however, for the purpose of this exercise it will not be used.

The fixed screen size option will not scale vector point graphic elements when you zoom in and out. We unchecked it here so the point graphic element will stay the same size in relation to the globe as you zoom in and out.

6. Click OK.
7. Click OK to close the Default Element Properties dialog box.
8. On the Globe 3D Graphics toolbar, click the New Marker tool.



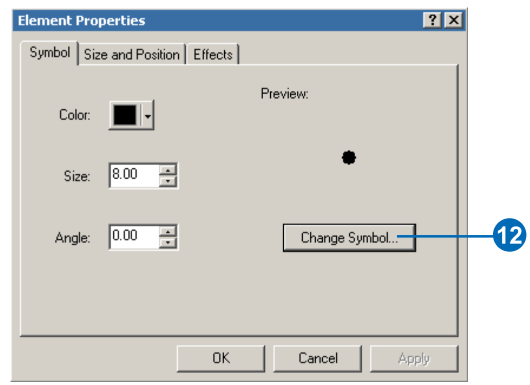
3D point graphics can be symbolized with 3D marker symbols. You can choose these symbols from existing styles. This is an easy way to add realistic objects to your 3D model without editing your GIS features. Now you will add a 3D symbol for the city hall in London.

9. Add a point as highlighted in the following graphic.

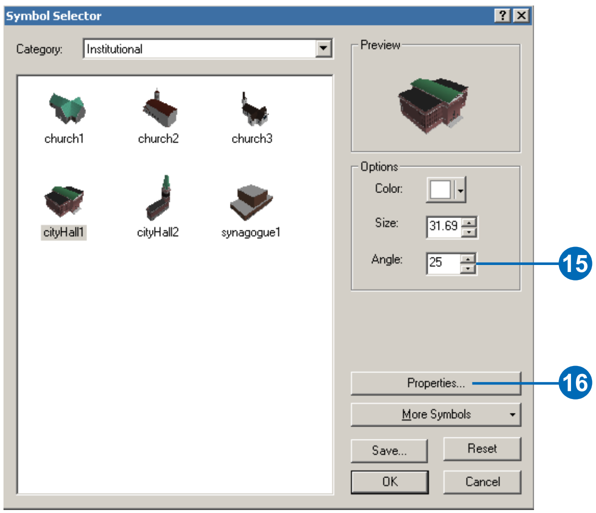
   A point graphic is drawn at the location you digitized.

10. Click the Select Graphics tool.
11. Right-click the point and click Properties.

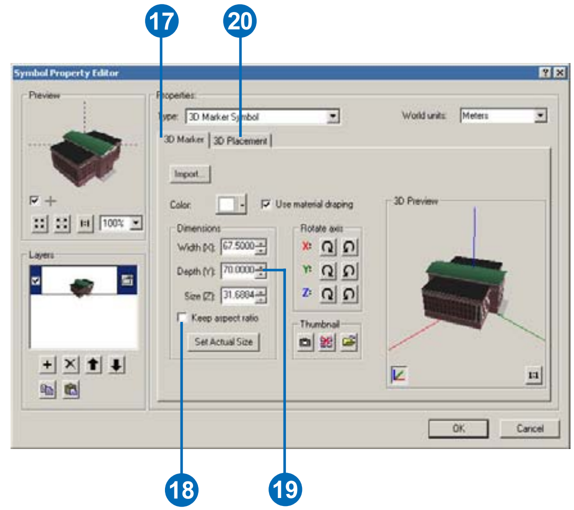
12. On the Symbol tab, click Change Symbol.



13. In the Symbol Selector dialog box, click the More Symbols button and click 3D Buildings style.
14. Click the Category drop-down list and click Institutional.
15. Click the “cityHall1”symbol, and type “25” in the Angle box.
16. Click Properties.

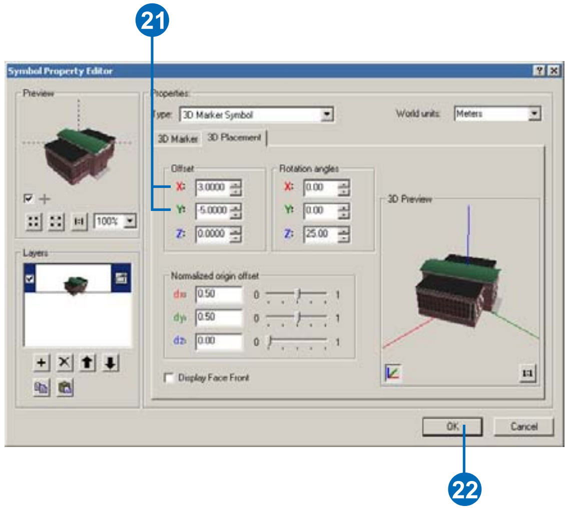


17. In the Symbol Property Editor, make sure that the 3D Marker tab is selected.
18. Uncheck Keep aspect ratio to allow the dimensions of the 3D symbol to be freely adjusted.
19. Under Dimensions, type “70” in the text box for Depth (Y).



The dimension of the cityHall1 symbol is modified in the 3D Preview window.

20. Click the 3D Placement tab.
21. Type “3” for the X offset, and “-5” for the Y offset.



The 3D symbol is offset in the XY plane, depending on the values supplied for X & Y values.

22. Click OK.
23. Click OK to close the Symbol Selector dialog box.
24. Click OK to close the Properties dialog box.
25. Unselect the city hall symbol and navigate around the display to view the result.

Digitizing text graphics

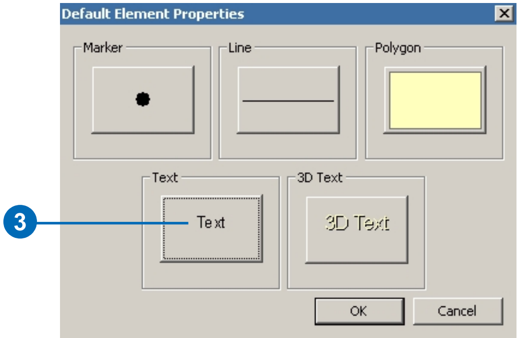
Once you have added the city hall symbol to the scene, you may find it useful to add a text annotation in the same view. The text graphic element allows one to digitize 2D or 3D text in the scene.

1. Click Bookmarks and click City Hall.

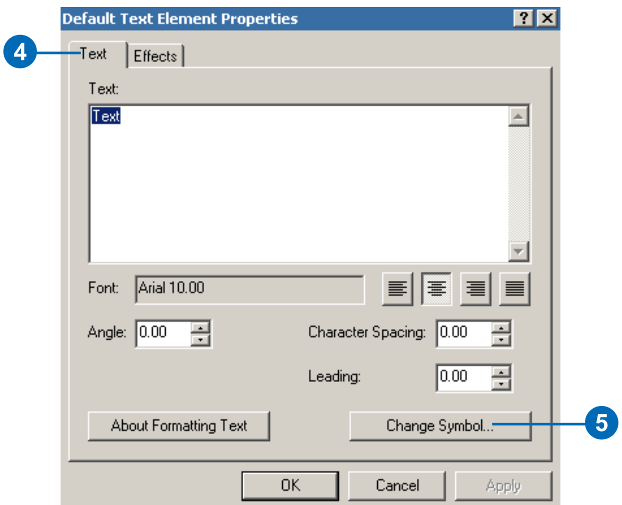
   Zoom in to the roof of City Hall.

2. On the Globe 3D Graphics toolbar, click the Graphics drop-down menu and click Default Element Properties.
3. Click Text button.

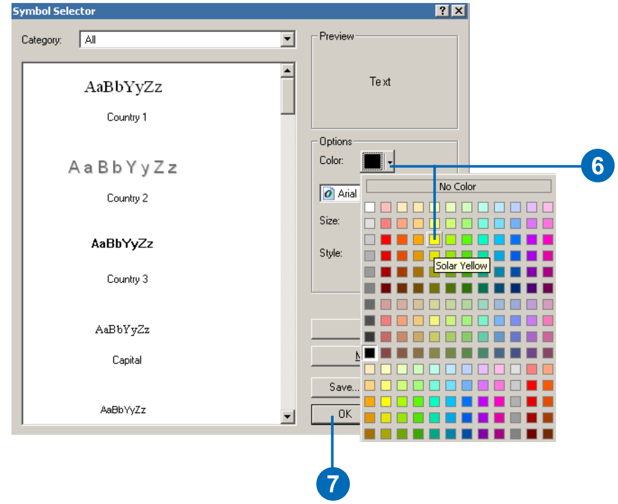
   The Default Text Element Properties dialog box opens.



4. Click the Text tab.



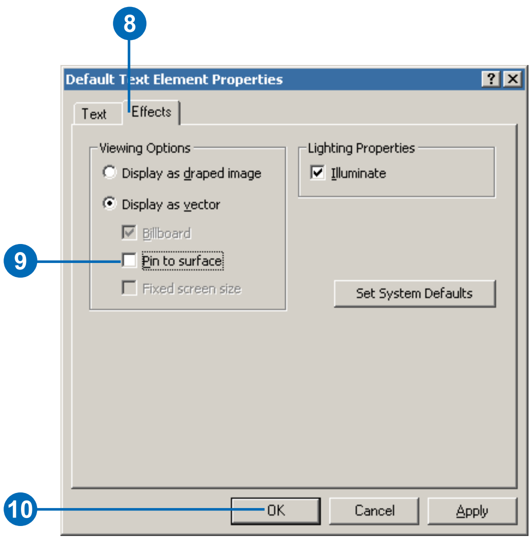
5. Click the Change Symbol button to open the Symbol Selector dialog box.
6. Click the Color drop-down arrow and choose Solar Yellow color from style palette.



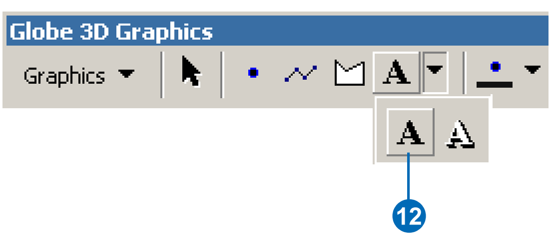
The mouse tip displays the color name in the style palette.

7. Click OK to close the Symbol Selector dialog box.
8. Click the Effects tab on the Default Text Element Properties dialog box.
9 Uncheck Pin to surface.

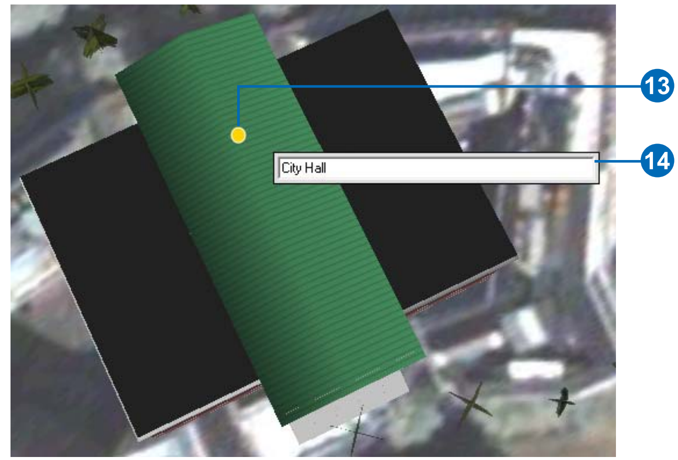
The Pin to surface option is useful if you want to fix the text graphic to the underlying globe surface. In this case, we want to digitize the text on the roof of the City Hall.



10. Click OK to close the Default Text Element Properties dialog box.
11. Click OK to close the Default Element Properties dialog box.
12. On the Globe 3D Graphics toolbar, click the New Text tool.



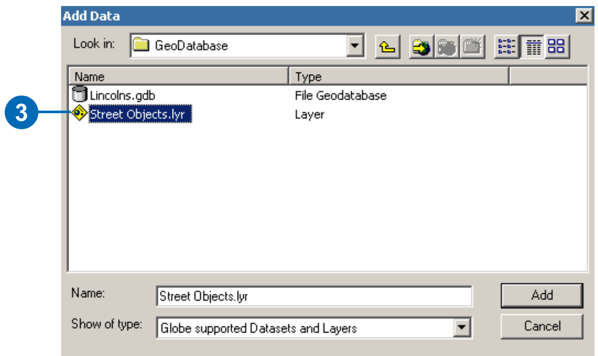
13. Click on the roof of city hall graphic.
14. Type “City Hall” in the text box and press Enter.
15. Unselect the text element and navigate around the display.



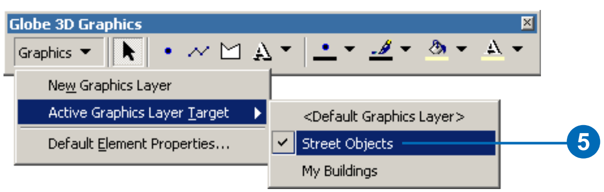
The text appears at the location you clicked.

Adding and modifying a 3D graphics layer

1. Click the Add Data button.
2. Browse to the Exercise9\GeoDatabase folder.
3. Double-click the Street Objects layer to add it to ArcGlobe.

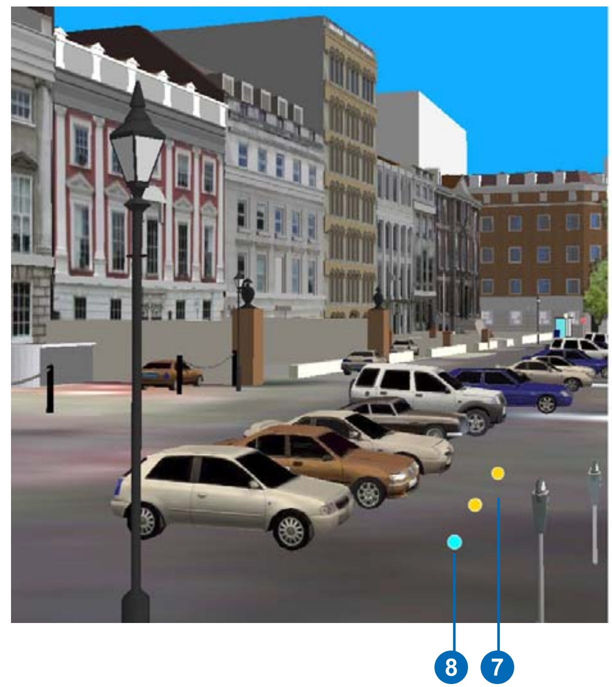


4. Click Bookmarks and click Street View.
5. On the Globe 3D Graphics toolbar, click the Graphics menu, point to Active Graphics Layer Target, then click Street Objects.



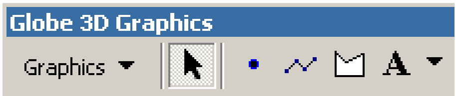
6. On the Graphics toolbar, click New Marker.
7. Click to add a marker in front of each of the first 3 cars as shown here. You will have to click the New Marker tool for each new marker.

   You can also choose to digitize multiple graphics while using any of the graphic tools by simply clicking Tools, then click Options and select the General Tab. Check the option to Keep drawing tools active after drawing graphic.



You will now assign each marker a 3D graphic symbol from the Street Furniture symbol style.

8. Click the Select Graphics tool and click the first marker. A selected marker will change color.



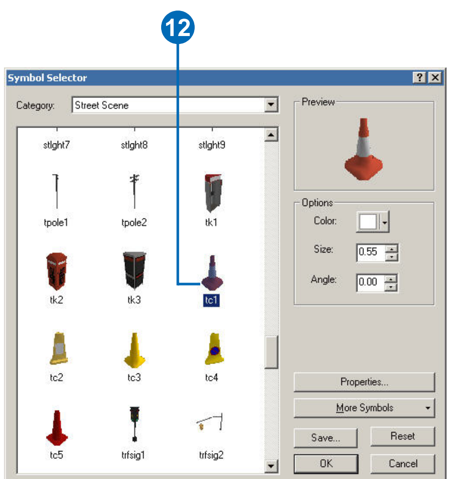
9. Right-click the selected marker and click Properties.

10. Click Change Symbol.

    Click More Symbols to verify that 3D Street Furniture is checked. If not, click 3D Street Furniture to add this style.

11. Click the Category drop-down list and click Street Scene.

12. Click the tc1 symbol.

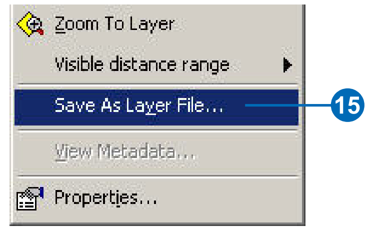


13. Click OK on the Symbol Selector dialog box.

14. Click OK on the Properties dialog box.

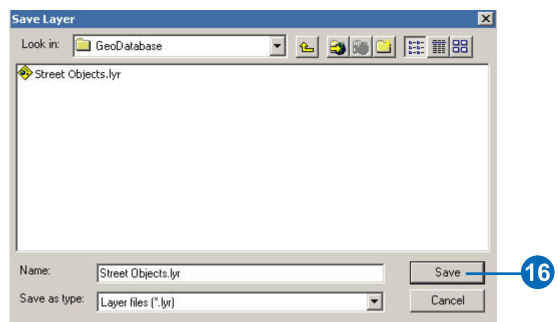
    Repeat steps 8 through 14 if you would like to symbolize the other point markers using one of the available 3D styles.

15. Right-click the Street Objects Layer in the Table of Contents, and click Save As Layer File.



16. Navigate to Exercise9\GeoDatabase, select the Street Objects layer file, and click Save.

    Click Yes if prompted to overwrite the existing file. The new markers you created are stored in Street Objects layer.



Final view

You have successfully created a realistic 3D view of small area within London. You can use one of the many navigation tools available such as navigate, pan, and zoom to browse the scene. You can also use the fly tool to fly over your city model.

In this exercise, you learned how to transform 2D feature datasets into realistic looking 3D data models. This exercise also focused on accessing symbol libraries for styles to match layer attributes. You can quickly personalize your scene with several symbol property options.

Finally, the 3D graphics toolbar is a host of many tools necessary to create and edit new 3D graphics layers and features. You are well on your way to adding realism to your 3D scene by using 3D graphics tools and symbology options available within ArcGlobe.