

# Understanding elevation and derivative layers

ArcGIS makes it easy to work with elevation data by offering a dynamic world elevation service (TopoBathy) and a specific land elevation (Terrain). These services provide online access to elevation data.

## Build skills in these areas:

- ▶ Displaying world elevation and bathymetry
- ▶ Identifying various elevations of the world
- ▶ Displaying terrain
- ▶ Displaying and understanding slope
- ▶ Comparing slope to contour lines
- ▶ Displaying and understanding aspect
- ▶ Displaying and understanding hillshade

## What you need:

- ▶ Account required
- ▶ Estimated time: 30 minutes to 1 hour

## Scenario

You have been asked to provide an online experience introducing users to elevation services. You are to provide instruction in the use of the TopoBathy and USA elevation services. Derivatives produced from the elevation services are to be included in your explanations.

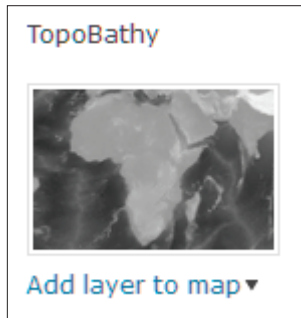
## World Bathymetry: Display

The TopoBathy image service combines topography (land elevation) and bathymetry (water depths) around the world. Heights are based on sea level = 0, and bathymetric values are negative downward from sea level. Once again, the unit of height of measurement is meters.

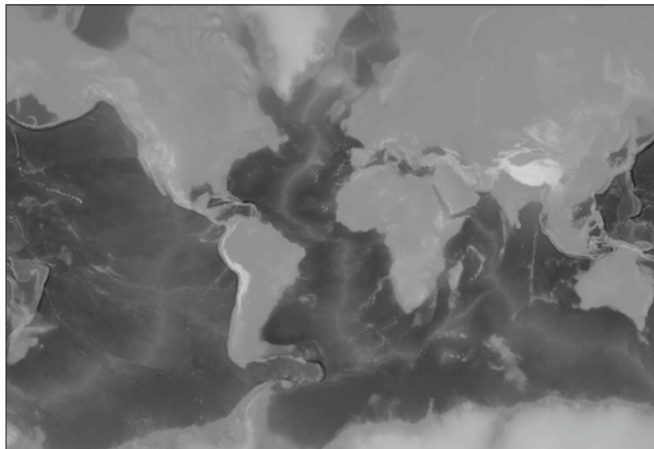
1. Sign into your organizational account at [ArcGIS Online](#)
2. Click Map on the top Ribbon.
3. Click Add and choose Browse Living Atlas Layers.

4. Search for TopoBathy and add to map.

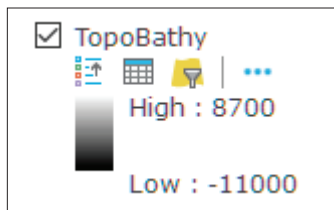
5. Click on the Back Arrow



6. Zoom all the way out to see the land elevation and water depth.

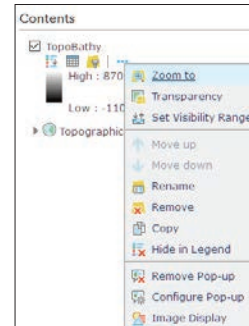


7. Uncollapse the legend in the contents pane.



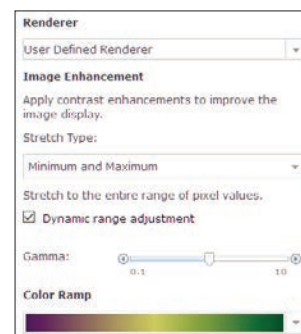
Q1 What is the lowest and highest elevation shown on the imagery server?

8. Right-click TopoBathy and go to Image Display.



9. Select the following parameters to the Image Display Menu:

- Renderer is User Defined Renderer.
- Stretch Type is Minimum and Maximum.
- Check Dynamic range adjustment.
- For Color Ramp choose Purple to Green, Diverging, Dark. This color ramp has been chosen so that the deepest place in the ocean is dark purple and the highest places on land is dark green.



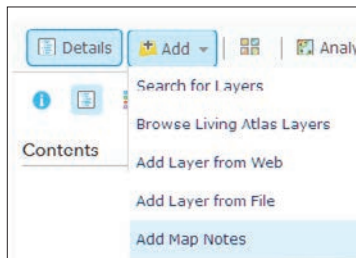
10. Click APPLY.

11. Click CLOSE.

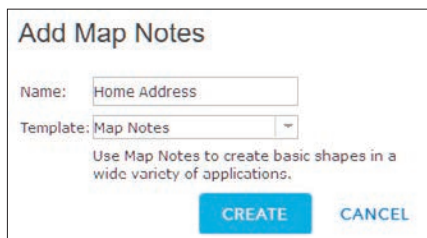
## World Bathymetry: Structures

Using the TopoBathy image service you will now identify and mark various elevation structures on the map. All the following structures will be identified by searching and adding a map note marker. To learn how to add a map note, start by adding to the location where you live.

1. In the upper right corner, type your address and press Enter to go to a map of the designated location.
2. On the upper ribbon click Add and Add Map Note.



3. Click Add Map Notes:  
Name is Home Address.  
Template is Map Notes

A screenshot of a dialog box titled 'Add Map Notes'. It contains a text input field for 'Name' with the value 'Home Address' and a dropdown menu for 'Template' with the value 'Map Notes'. Below the input fields, there is a small text box that says 'Use Map Notes to create basic shapes in a wide variety of applications.' At the bottom of the dialog, there are two buttons: 'CREATE' and 'CANCEL'.

4. Click CREATE.

5. Pick the Pushpin and click the location. Use the following parameters:

- Title is Home Location.
- Description is Where I live.

6. Click CLOSE.

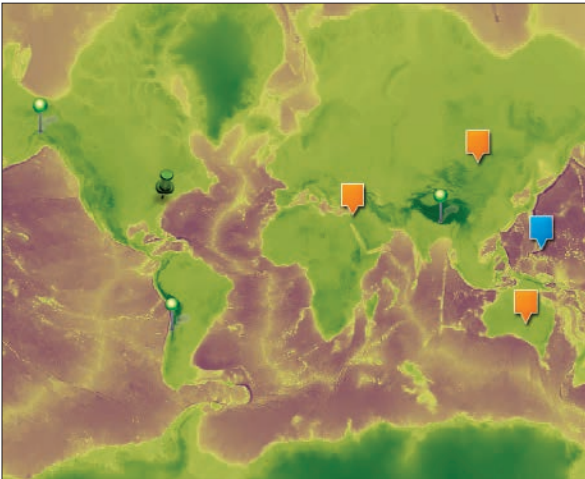
7. Repeat the process for the Highest Structures using a different type of map note.

8. Repeat the process for the Lowest Structure in the Ocean using a different type of map note.

9. Repeat the process for Structures Below Sea Level on Land using a different type of map note.

- Highest Structures
  - Mount Everest, Nepal
  - Aconcagua, Mendoza, Argentina
  - Denali, Alaska
- Lowest Structures in the Ocean
  - Mariana Trench, Northern Mariana Islands
- Structures Below sea level on land.
  - Dead Sea, Jordan
  - Lake Baikal, Russia
  - Lake Eyre, Australia

10. Click Save on the upper ribbon.



11. Complete the documentation for your map. Use the following parameters:

- Title - Elevations Around the World
- Tags: elevation, bathymetry, your initials
- Summary: Location of High and Low Elevations Around the World.

### Save Map

Title:

Tags:   
Add tag(s)

Summary:

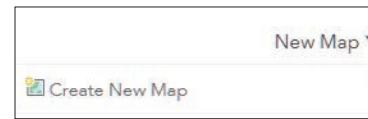
Save in folder:

12. Click SAVE MAP.

### Derivatives of elevation: Slope, aspect, and hillshade from terrain

Using the dynamic surface Terrain, you can access elevation values for use in analysis with slope, aspect, and hillshade.

1. Click Create New Map in the upper right corner.

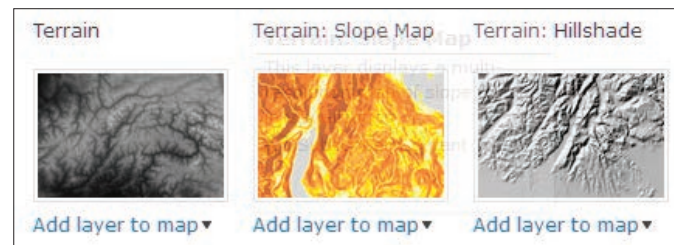


2. Click Yes Open the Map.

3. Go to Browse Living Atlas Layers.

4. Choose Elevation and add the following layers:

- Terrain
- Terrain: Slope Map
- Terrain: Hillshade
- Terrain: Aspect
- USGS National Map



5. Turn off all layers but Terrain.

6. Right click Terrain and zoom to.

7. Go to Image Display and select the following:

- Renderer is User Defined Rendered
- Stretch Type is Minimum and Maximum
- Color Ramp is Elevation #2

8. Click APPLY.

This rendition of Terrain gives you land elevation.

9. Turn on Terrain: Slope Map

The slope map provides a colorized representation of degree of slope. Flat surfaces are represented as gray, shallow slopes as light yellow, moderate slopes as light orange, and steep slopes as red-brown.

**Q2** *Where on the map is the greatest slope represented? Why?*

10. Zoom into Washington State in the United States.

**Q3** *What are the cone-like features?*

11. On the top ribbon, change basemaps to National Geographic.

**Q4** *What are the names of the cone-like features?*

12. Turn on the USGS National Map.

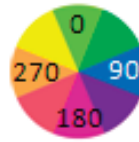
**Q5** *How do the contour lines represent the slope?*

13. Turn off USGS National Map and Terrain: Slope.

14. Turn on Terrain: Aspect.

The terrain layer provides a colorized representation of aspect, generated dynamically using the server-side aspect function of the terrain layer. The orientation of the downward sloping terrain is indicated by different colors, rotating from green (North) to blue (East), to Magenta (South) to orange (West). The numeric aspect values are represented by values from 0 to 359 degrees and the values are shown in the image below. Aspect is used in northern climates to show areas that would not receive as much sun and would, therefore, stay

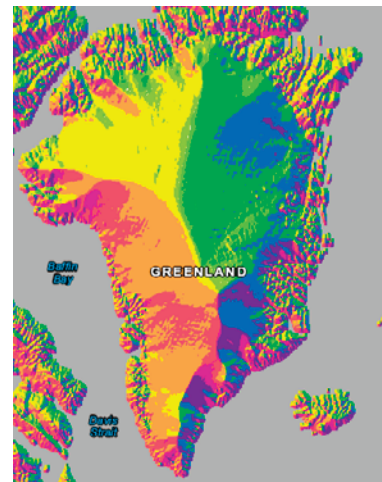
cold and icy longer. Aspect is also used in vineyard selection since a region's climate makes the aspect of the land important.



15. Zoom into any part of the land and identify by color which direction the land is facing.

Many places on the map will give you a numerical value for the aspect if you click on the map.

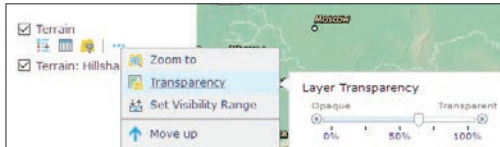
16. Zoom into Greenland since it is a good example of a landscape that shows distinct aspect.



17. Turn on Terrain: Hillshade. Hillshade is a grayscale 3D representation of a surface based on the sun's relative position.

This map provides a hillshaded surface based on a solar altitude angle of 45 degrees and solar aspect angle of 315 degrees. The map provides a quick indication of the shape of the terrain at a range of map scales.

18. Zoom to the West Coast of the United States.
19. Click and drag Terrain above Terrain: Hillshade.
20. Right-click Terrain and select Transparency.
21. Set the Transparency to 60 to give the Terrain layer a 3D look.



**Q6** Write a paragraph description of Terrain, Slope, Aspect, and Hillshade.