Exercise 4: Combining Raster & Vector Data

1. Review: put together an ArcGIS Pro project from scratch
   - Add data, group layers, export shapefiles to GDB, symbolize

2. Label features
   - Label style, labeling based on attributes & Map reference frame

3. Use point data to locate a polygon & attributes

4. Use measuring tool: Planar vs geodesic

5. Digitize polygons

6. Calculating areas in different projections
   - Geodatabases calculate areas based on projection
4. Combining Raster & Vector

**Review:** Putting it all together (use your notes as needed)

- Create a new ArcGIS Pro Project from scratch
  - All data will be used from Exercise_4_Moon_Data

1) Start Project without a template
2) Add folder connection to Exercise_4_Moon_Data (if needed)
3) Add New Map
4) From Moon_Raster_Data, add to Map: Lunar_LRO_LROC-WAC_Mosaic_global_100m_June2013.tif
   - Set: Brightness to 10, \( \gamma \) to 1.8 [or adjust to preference]

See if you can do this on your own!
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**Review:** Putting it all together (use your notes as needed)

5) Add a Group Layer to Contents, name it: Lunar Geology

6) From Moon_GeoDB.gdb, add: GeoUnits and GeoContacts to Contents. Drag files into Lunar Geology group layer

7) From Moon_GeoDB.gdb add Lunagrid_30x30 to top of Contents

8) Give the Lunagrid_30x30 a symbology of Black Outline (1pt), and change the line thickness to 0.4

9) Import symbology for GeoUnits & GeoContacts from the *.lyr files in LayerSymbology. Set GeoUnits to 50% transparent.

10) Save your Project in Exercise_4_Moon_Data as: Ex4_Moon

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Review: The map should look something like this:
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Labeling
- Attributes from point, line, or polygon data can be used to label features in the Map
- Add the MOON_nomenclature.shp file to the Map
- Select MOON_nomenclature in Contents, click Labeling from above the menu ribbon
- At the far left of the ribbon, click the Label icon. Make sure that the word “name” is in the Field text window. It might take a moment to load...

Blue highlight = on
Clear label icon = off
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Labeling (continued)

- That’s too many labels and points!
- Change the point symbol for MOON_nomenclature so that the Color is set to “No color” and the Outline Width = 0

- Next, set features > 300km to be labeled:
  - Click SQL Query in the Label Class area

- In the Label Class pane to the far right, click the +New expression box. This will bring up an expression form
  - SQL means: Sequenced Query Language. It builds word equations.
  - After the word “Where” select from the drop-down menu: diameter. This a column in the Attribute Table.
  - Select from the next drop-down menu: is greater than
  - In the last text box enter the number 300. Click Apply
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Labeling (continued)

- This is a more manageable number of labels
- In the Text Symbol part of the Labeling ribbon, set the font name and style to: **Arial, 10pt, Bold**
- Try zooming into the map.

Q: What happens to the labels?

- Keep the fonts, points & lines the same size relative to the map
- In the Map **Properties**, set the **Reference scale** to 2,000,000. Click OK.

Q: What happens to the fonts when zooming in and out now?

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Labeling (continued)

- Turn labeling off
- Either go back to the Label icon and click it again – OR –
- Right-click on MOON_nomenclature in Contents, and select Label
- Give MOON_nomenclature a symbol (e.g., sm. black circle)
Analysis: use an attribute from one dataset to locate a feature in another dataset

Q: What is the geologic unit that makes up Mare Crisium?

- Open the **GeoUnits** attribute table. Look at the headers. There are Unit ages and names, but no feature names.
- Open the **MOON_nomenclature** attribute table. Look at the headers. Name are listed, but not the geology.
- With **MOON_nomenclature** selected, activate the Menu ribbon and select the **Select By Attributes** icon.

Enter the values:
- Name
- is equal to
- Mare Crisium
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NOTE: Give the nomenclature layer a visible symbol

- With the Map menu selected:
  - Click on the ZoomTo icon
  - Click a few times to step in closer

Q: With the Reference Scale set for Map, what happens to the nomenclature point symbols when zooming in?

- Open the nomenclature attribute table and highlight the selected point for info
- Click in on the red unit associated with the point

Q: What is the UnitName?
To get info from feature layers in Contents:
- Set the layers that are selectable – OR –
- Turn off the layers above the one to be viewed

To clear selection:
- In Map menu
- Click the Clear button above the ZoomTo icon
- Turn off the nomenclature and Lunagrid layers

Set data layer in Contents to:
Make this the only selectable layer

Other options
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Measuring Tool

- In Map ribbon – measures lengths, area, and direction of surface features

Measures a straight line

Draw a polygon to get area

- In Measure drop-down, select Measure Distance
- Set measurement type
- Set units
Measuring Tool (continued)

- The Measure tool uses the **map projection** to calculate value
  - Planar = Projected 2D cartesian surface
  - Geodesic = 3D datum
- Near the equator, not much difference...
Measuring Tool (continued)

- At the poles, things get strange

- Try the same experiment by measuring the area

“De Sitter F” crater at 80° N
Calculate length and area in the GeoDatabase

Map Projections are a mathematical representation of a planetary surface in 2D.

- Length and area are automatically calculated in GDB based on the projection of the data
- Look at the Attribute Table for GeoUnits: \textbf{AREA\_GEO} and \textbf{Shape\_Area}

Q: Why aren’t they the same value? Are they both right?

### GeoUnits Table

<table>
<thead>
<tr>
<th>OBJECTID</th>
<th>Shape</th>
<th>UnitSymbol</th>
<th>UnitAge</th>
<th>UnitName</th>
<th>AREA_GEO</th>
<th>Shape_Length</th>
<th>Shape_Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Polygon</td>
<td>Et</td>
<td></td>
<td>Crater Unit</td>
<td>1419058689.525654</td>
<td>838512.778405</td>
<td>16937623293.223201</td>
</tr>
<tr>
<td>2</td>
<td>Polygon</td>
<td>l2</td>
<td></td>
<td>Upper Crater Unit</td>
<td>35078103.932929</td>
<td>44732.250501</td>
<td>99718366.894456</td>
</tr>
</tbody>
</table>
Calculate length and area in the GeoDatabase (continued)

- Create a new polygon layer in Moon_GeoDB.gdb:
  1. In Catalog, r-click on Moon_GeoDB.gdb select New > Feature Class
  2. Set Name and Alias to: **Craters**
  3. Set Feature Class Type to: **Polygon** (uncheck Z Values)
  4. Set Spatial Reference to: SimpleCylindrical_MOON

- Digitize polygons of 3 large craters: at the Equator, near 50° N, and at >80° N
  1. Edit menu > Create
  2. In Create Features pane, click: Craters
  3. Then select Polygon icon

- When the three craters are digitized, save your work:
  Edit menu: Save icon
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Calculate length and area in the GeoDatabase (continued)

- Example of three craters and the attribute table

Give unique color symbols

Give unique name to each polygon
Calculate length and area in the GeoDatabase (continued)

- Add new attribute column
  - Click the Add tab
  - For the new field, enter:
    - Field Name: Name
    - Alias: Name
    - Data Type: Text
    - Length: 20

Once done,
- Give unique names to Crater features
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Calculate length and area in the GeoDatabase (continued)
- Enter new value in attribute
- Highlight cell in field
- Type in value, then Return
- Do for each field
- Click Save icon in Edit ribbon
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Calculate length and area in the GeoDatabase (continued)

- Give each crater a unique symbol
  - Select Craters in Content, then click Feature Layer above ribbon
  - Click Symbology drop-down, select Unique Values
  - In Symbology pane, select Name for Field 1
  - Choose unique color under Symbol

Double-click square to change color
Calculate length and area in the GeoDatabase (continued)

- Add new attribute column
  - Click the Add tab
- For the new field, enter:
  - Field Name: Area_km_gdc
  - Alias: Area km gdc
  - Data Type: Double
  - Number Format (default is ok)

Save to add column
Calculate length and area in the GeoDatabase (continued)

- Make sure **no features are selected**!
- Calculate area of the new field:
  - R-click on column header, select: Calculate Geometry

Form should look like this:

Make sure Property is set to Area (geodesic)
Calculate length and area in the GeoDatabase (continued)

Q: How similar are the calculated areas?

Try reprojecting the Crater data and see how the Shape_Area is calculated differently

For m to km, divide by 1,000,000
Reproject the Map frame

- ArcGIS Pro can reproject all the datasets on the fly
- The Map frame controls the appearance and organization of Contents
  - R-click on the Map frame, select Properties
  - In the new form, select Coordinate Systems
  - Add new coordinate system by clicking on the Globe down-arrow
Reproject the Map frame (continued)

- Navigate to Exercise_4_Moon_Data > Projection and select Sinusoidal_Moon.prj
- This is a pre-made projection file.

- Click OK. The form will close and the new coordinate system will replace the previous one.
- Click OK to apply the changes.
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Reproject the Map frame (continued)

The entire map looks something like a top

- Zoom to Full Extent, if needed
- Despite the strange shape, this is a good projection for calculating area
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Reproject the Map frame (continued)

- The final step is to export the Crater layer to a new file based on the new projection of the Map frame

- R-click on Craters in the Contents pane, and select Data > Export Features
Reproject the Map frame (continued)

- Set the Parameters & Environments of the Export Features
  - Save the file in the GDB with the name **Craters_sinu**
  - Set the Output Coordinate system to the Current Map
  - Click OK to apply

- Give the file a name
- Make sure to save to **Moon_GeoDB.gdb**
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Reproject the Map frame (continued)

- The new Craters_sinu layer is automatically added to Contents
- Open the Attribute table
- Compare the Area_km_gdc values calculated earlier with those in the new file
Exercise 4 Summary:

- Tested your knowledge: generated a new ArcGIS Pro project and new GeoDatabase
- Added labeling and set to a Reference Scale
- Used Measure Tool (planar vs geodesic)
- Added new fields to an attribute table
- Calculated feature area based on Map projection