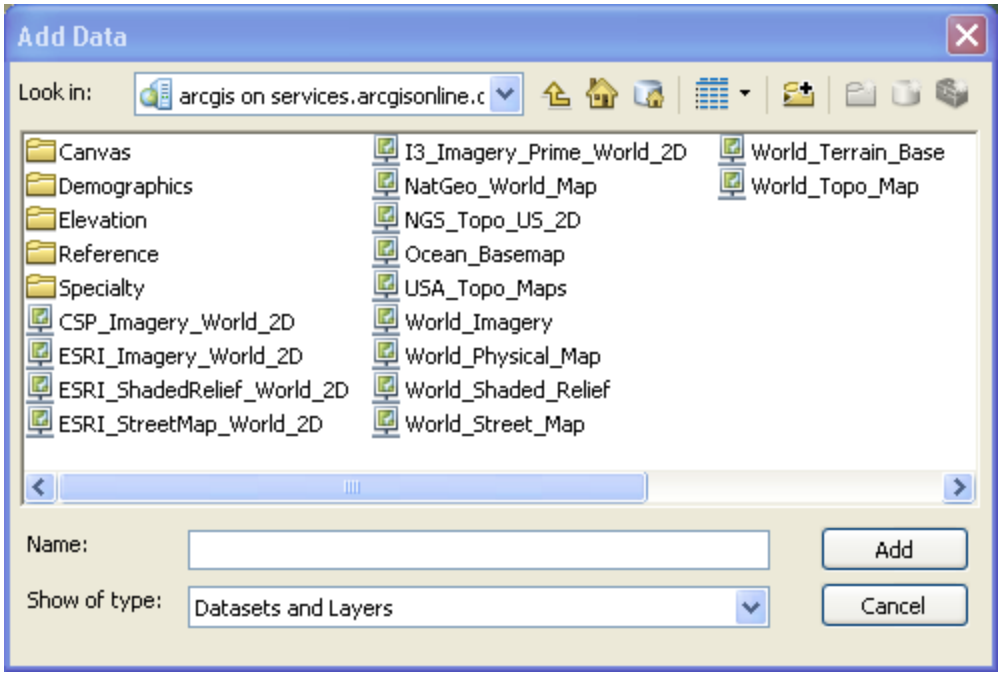
Data Set Projection Checklist

There are two projections/coordinate systems you must worry about:

1. That of your map. You can pick this to be whatever you want, and your GIS software should get all of the data into the correct location (reprojection on the fly), if the data has the correct metadata. This should probably be UTM, and definitely not GCS.
2. That of each layer in your project. You have no choice over this; it's part of the data. If you are lucky, the software will correctly identify it. If not, you must dig into the metadata and find it. If the software (or you) gets it wrong, the data will be in the wrong place and all of your analysis will be wrong. But it will probably be obvious because it will not align with your other data.

To check the projection for a data layer:

1. Open a new map, and define it to have the UTM projection for the correct zone. If you have a good reason, you might select another projection. For this course, there will not be a good reason to pick another projection.
2. Open an ArcGIS Online basemap. One way to to this is from the Add data button, in Look in, pick GIS Servers, then "arcgis on services.argisoline.com", and then pick a layer.



It does not matter which one you pick, as long as you will be able to see if you other data sets come in correctly. You may or may not want to keep this layer once you finish importing your data. The ESRI_Imagery_World_2D layer is a good choice for a large scale project of a small area. For a large scale map of a small area, ESRI_Imagery_World_2D would be a good choice. This obviously requires that you have a good connection to the internet.

This is the National Geographic base map in a UTM projection with a number of additional zones, and you probably want to zoom in quite a bit.

3. Open your data layer in ArcMap. By doing this in ArcMap rather than ArcCatalog, you will see your layer on the base map which you know is correct, and you can see the extent values. If you have to change/assign the projection/coordinate system for your data layer, you will then have to remove it from the map, and then open it in ArcCatalog.

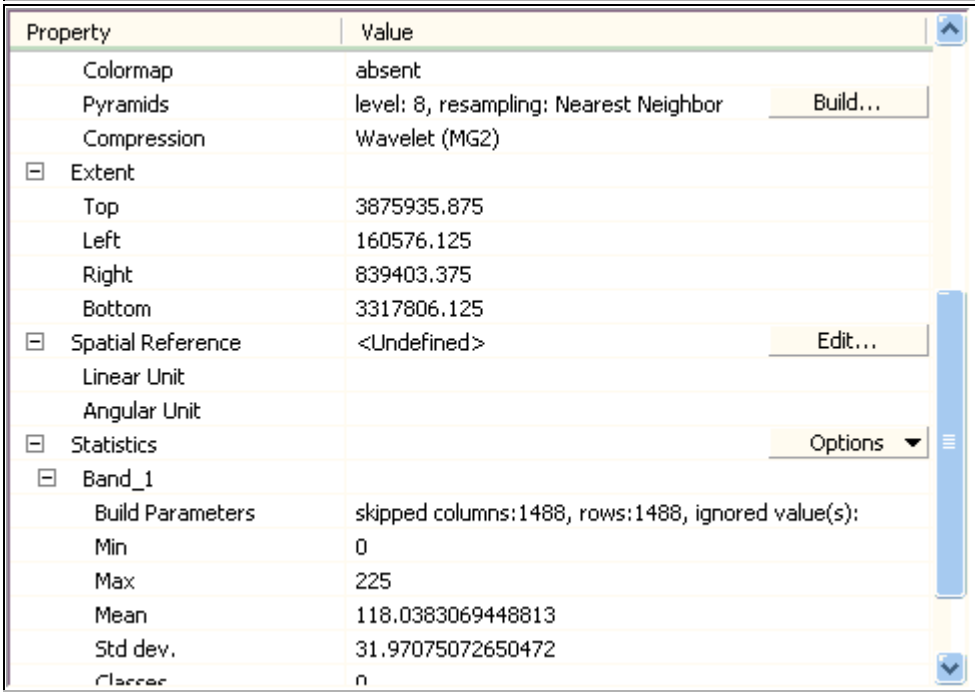
Note that in this case, the red faults in Afghanistan are plotting correctly inside the country. The data layer almost certainly has a correct projection assigned, and even if it is not UTM for this zone, Arc is correctly reprojecting on the fly. You should not have to do anything else with the layer. While it is possible to have problems that this will not reveal, almost all the student problems will have the data plotting far away from the correct location and it will be obvious on this map.

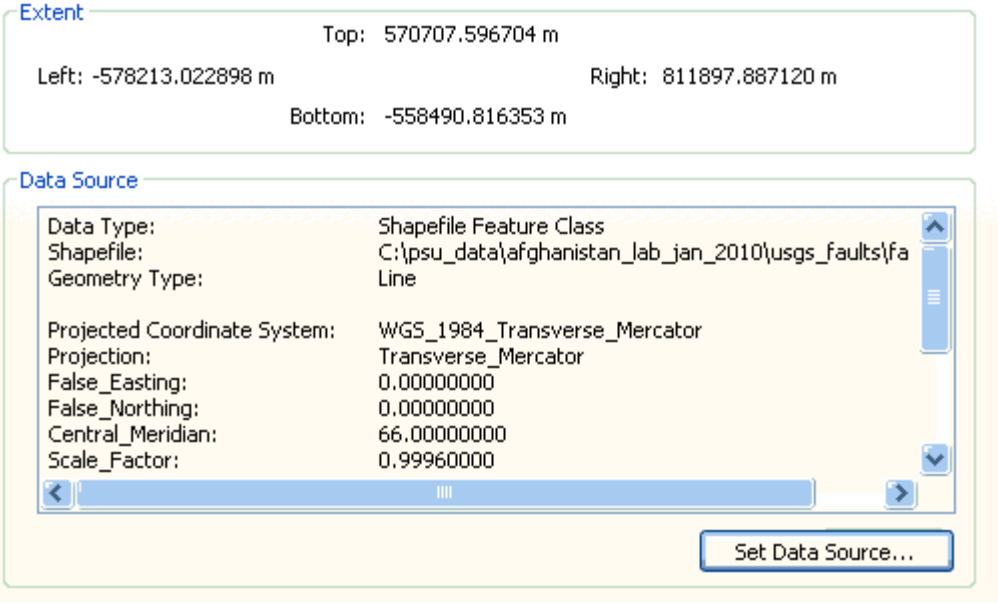
4. If there are problems, or you want to see the details of the data layer's projection, look at the dataset properties, source tab. This is particularly important if the layer does not overlie the other data for your project, which implies that one of the layers is either undefined or incorrectly defined. The use of the ArcGIS Online basemap immediately tells you which is the layer with the problems, and it won't be the data layer from ESRI.

Property	Value
Status	Permanent
⊟ Extent	
Top	3875935.875
Left	160576.125
Right	839403.375
Bottom	3317806.125
⊟ Spatial Reference	<Undefined>
Linear Unit	
Angular Unit	

Raster data set, projection information viewed in ArcMap. Key entries:

- Extent: note the magnitude of the entries. These numbers could be UTM (or SPCS or

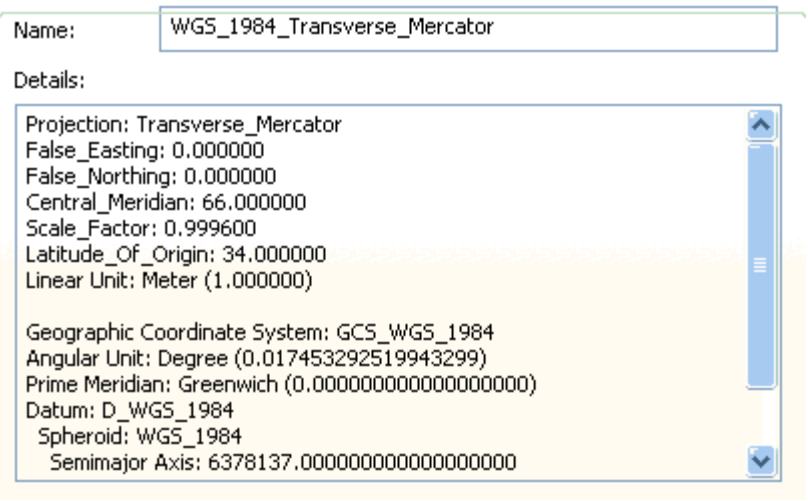
	some less common projections). It cannot be GCS because the extent values are too large. • Spatial reference: note that this one is undefined, so it is likely you could have problems. **You should define it, unless you want to live dangerously, and you have to check the metadata to see what it is.**
	Projection information viewed in ArcCatalog. This entry is for the same raster data set above. While it looks slightly different, all the same information on extent and spatial reference is present.



Vector data set, projection information viewed in ArcMap. This looks different from a raster. Key entries:

- Extent: note the magnitude of the entries. Note the negative values, which make it extremely unlikely that is is UTM. It also cannot be GCS because the extent values are too large.
- Spatial: note that this one is defined, because it has a name, and values for the parameters of the data set.
- Coordinate system: this tells you what the projection is for this data set.

If the values are defined, it is extremely unlikely they are not correct, unless someone (perhaps likes you) who did not know what they were doing attempted to assign a projection. This person could have been you, if you assigned or defined a projection blindly

	based on hope instead of the metadata. You should have a very good reason before you attempt to change a defined system.
	Projection information viewed in ArcCatalog for the same data set viewed above. This provides a different format, and does not show the data set extent. The name, Transverse_Mercator, differs from UTM. UTM uses 6 degree zones, but a Transverse Mercator can be optimized for any region, such as a country or state. The US SPCS uses Transverse Mercator projections for about half the states.

You can do two things for a projection of a data layer, which is completely different from your map's projection:

- **Assign or define the spatial reference**. This must be whatever the creator of the data set used. This tells Arc that you know what the projection is, and if Arc already had a projection assigned, you want to overwrite it. The data set is changed. It will probably now plot in a different location on your map. If the layer plots in the wrong location, you did not get the correct projection for the data layer.
- **Reproject the data set.** This creates a new data set, with the new projection, leaving the old one intact (the layers will overlie in Arc exactly, and you will be unable to detect any difference). If the defined spatial reference is wrong, the new data set will still be in the wrong location.

If you must **assign or define the spatial reference**, you will almost always select a predefined coordinate system. This must be done in Arc Catalog, and overwrites whatever is currently set. You should be extremely careful about doing this unless the value is undefined. There is only one correct answer, and it is not what you want, or what you want on your map, but what the data creator used. You will have two main choices:

- **Geographic coordinate systems**: this has a variety of names: lat/long coordinates, unprojected

coordinates, geographic coordinates, or GCS. The file names or metadata might include terms like "GEO" or "GEOG", or "DD" for decimal degrees. The extent in the x direction (left right) will be from -180 to 180 (or rarely, 0 to 360), and in the y direction (top-bottom) from 90 to -90. This will be essentially anything you get from NGA or the Census Bureau, and NED from USGS.

- **Projected coordinate systems**: There are a large number of these, but it is almost impossible to guess correctly.
    - UTM will have extent from 100,000 to 900,000 in false easting, with the false northing normally in the millions. There should not be any negative coordinates, unless data was deliberately extended into an adjacent zone. UTM is a standardized set of zones for the more general Transverse Mercator Projection. There are 60 zones, and you must know both the zone and hemisphere.
    - SPCS are special cases of Transverse Mercator and Lambert conformal conic, optimized for a state or part of a state. They should not have negative coordinates.
    - Transverse Merctator, Mercator, Lambert Conformal Conic, and Albers Conformal Conic are all seen more rarely, and might have negative coordinates.

If you want to **change the projection, you must do a reprojection**, in ArcToolbox. This will create a new dataset, leaving the original unchanged. This is not generally required, since Arc will reproject on the fly. GCS DEMs are a special case, and should be reprojected to UTM so that hillshades, slope and aspect maps, and viewsheds will work correctly.

PLG last revision 12/17/2012