

## Demo 08: Time in ArcGIS

In this demo you will gain an understanding of how to use temporal data in ArcGIS. We will work mainly with vector data (points and polygons), though I also include information on how to visualize raster-based temporal data (in the NetCDF format). We will also deal a little with how to add service layers from ArcGIS online into the desktop version of the software.

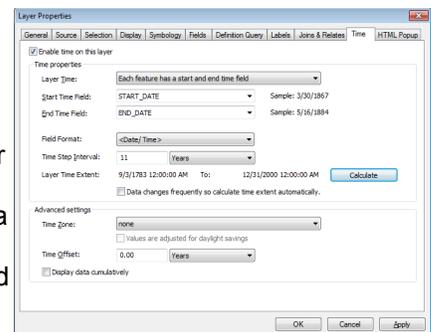
### I. First, prepare the demonstration data

- Download **Demo08\_Data.zip** from Sakai and extract it into a temporary folder
- Load ArcMap through the start menu
- Add the file **US\_HistoricalStates.shp**

### II. Time for Vector Data

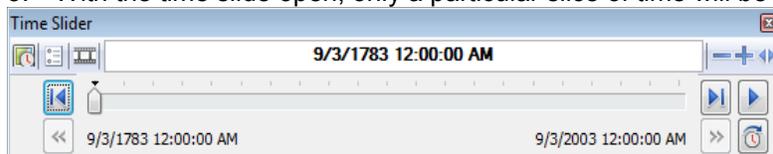
- Zoom back to the full extent and look at the US\_HistoricalStates layer
  - You can see that many of these features overlap
    - They are the various territories and states of the US coded for the time they became part of the country
- Open the Attribute table by right-clicking on the layer name and choosing Open Attribute Table
  - There is both a START\_DATE and END\_DATE field
  - This means that we can display these data temporally
- To access the time data go to the layer properties for US\_HistoricalStates by double-clicking on the layer name
  - Choose the Time Tab
    - Check **Enable Time on this layer** to get the other options
    - Change the Layer Time to *Each Feature has a start and end time field*
      - The default should be the correct fields
        - Start Time Field is **START\_DATE**
        - End Time Field is **END\_DATE**
        - Field Format refers to how the date is stores,
          - Here **<Date/Time>** is accurate because these fields are the datetime format. Others may just have a year or a time and will need to be customized.
        - Time Step Interval refers to how often the software sets a time step for visualization
          - Click the Calculate button to set a time interval based on the temporal extent
          - Here, specify 1 year because it will make a more smooth transition
      - Choose OK

FID	Shape	ID_NUM	NAME	ID	VERSION	START_DATE	END_DATE
0	Polygon	1	Alaska Department	ak_dept	1	3/30/1867	5/16/1884
1	Polygon	2	Alaska District	ak_district	1	5/17/1884	8/23/1912
2	Polygon	3	Alaska	ak_state	1	1/3/1959	12/31/2000
3	Polygon	4	Alaska Territory	ak_terr	1	8/24/1912	10/1/1959
4	Polygon	5	Alabama	al_state	1	12/14/1819	5/29/1820
5	Polygon	6	Alabama	al_state	2	5/29/1820	12/18/1820
6	Polygon	7	Alabama	al_state	3	12/19/1820	12/31/2000
7	Polygon	8	Alabama Territory	al_terr	1	3/3/1817	2/5/1818
8	Polygon	9	Alabama Territory	al_terr	2	2/6/1818	12/13/1819
9	Polygon	10	Arkansas	ar_state	1	6/15/1836	5/20/1840
10	Polygon	11	Arkansas	ar_state	2	5/21/1840	12/31/2000
11	Polygon	12	Arkansas Territory	ar_terr	1	7/4/1819	5/25/1824
12	Polygon	13	Arkansas Territory	ar_terr	2	5/26/1824	5/5/1828
13	Polygon	14	Arkansas Territory	ar_terr	3	5/6/1828	6/14/1836
14	Polygon	15	Arizona	az_state	1	2/14/1912	12/31/2000
15	Polygon	16	Arizona Territory	az_terr	1	2/24/1863	5/4/1866
16	Polygon	17	Arizona Territory	az_terr	2	5/5/1866	2/13/1912
17	Polygon	18	California	ca_state	1	9/9/1850	12/30/1959
18	Polygon	19	California	ca_state	2	12/31/1959	12/31/2000



- At the moment, nothing should have changed

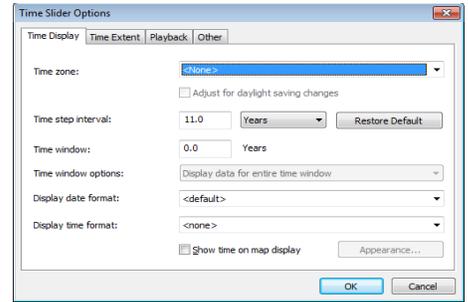
- Click the Time Slider button on the main toolbar ( )
- This should open the time slider.
- With the time slide open, only a particular slice of time will be displayed



- Every thing but the very

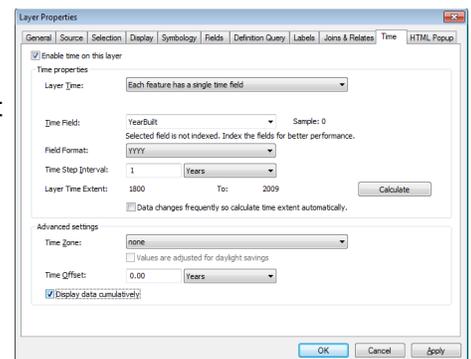
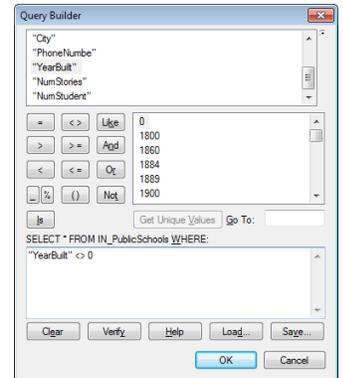
- earliest slice should have been removed from the previous view
- 5. You can drag the slider back and forth to control when is being displayed.
- 6. You can also manually set the time by entering it into the box

- f.  Enables or Disables time on the map
- g.  Opens the options window for controlling how the time is displayed and animated
  - 1. You could change the time zone or adjust for daylight savings if you needed to.
  - 2. More importantly, you can set the time interval that the slide will use.
    - i. This is especially important if you have different time layers in the same visualization
    - ii. Here, make sure it is set to 1 year
  - 3. The Time Window setting will display a moving window instead of a static date (think all of the features between July and October instead of each feature popping up when its date is up)
    - i. This is extremely useful for things that appear once and go away (like fires or crime)
    - ii. However, it does make things run much slower, so for now, we will leave it off.
  - 4. Our data are basically yearly, so change the Display Date Format to be 2015 (yyyy)
  - 5. And leave the Display Time Format as <none>
  - 6. Finally, check Check *Show time on map display*
- h. The *Time Extent* tab allows you to set a start and stop time or restrict it to a particular layer.
- i. *Playback* controls how fast the animation moves
- j. *Other* just controls the transparency of the time window
- k.  Will export the current setting as a video
  - i. This takes up a lot of memory, so be prepared for it to run slowly



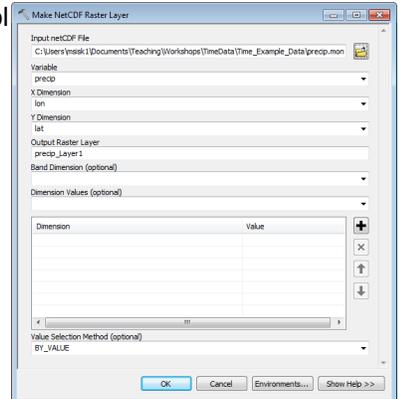
III. Another Example:

- a. Add in **IN\_PublicSchools.shp**
- b. Open the Attribute table
  - 1. There is a field called **YearBuilt**
  - 2. But most schools do not have this information recorded
- c. To visualize this layer temporally, go into the layer properties
  - 1. We will use the YearBuilt field to control when the schools appear on the map
  - 2. But all of those 0's need to be removed.
  - 3. To do this without creating a new file, go to the Definition Query tab
    - i. Create an equation to only include those records with a non-0 entry for YearBuilt
    - ii. "YearBuilt" <> 0
  - 4. Now if we return to the attribute table, we see that only 157 records remain
  - 5. Return to the Layer Properties and go to the Time tab
    - i. Enable Time on this layer
      - a. In this case *Each feature has a single time field: YearBuilt*
      - b. The Time Field is YearBuilt
      - c. It should automatically change the Field Format, but if not, it should be YYYY
      - d. Change the Time Step Interval to be 1 Years
    - ii. Under Advanced Settings, you want to check the box next to Display data cumulatively
      - a. This is because once the schools are built they should stay visible
        - 1. Otherwise, it is hard to catch the specific year you are interested in
  - 6. Now you should be able to visualize these data at the same time as the historical states

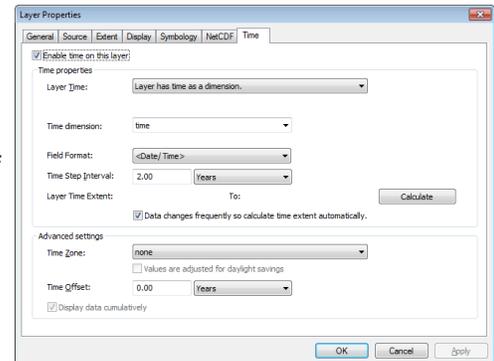


**IV. Time for Raster Data**

- a. Temporal visualizations are a little more difficult with raster data. This is largely because it is difficult to duplicate values consistently for time.
- b. It is more common that you will have one slice of raster data for one time and another for later
- c. One common work around for this is using a format called NetCDF, which has a separate layer for each time step.
- d. Go ahead and start a new Map Document by relaunching ArcMap
  - 1. Add in US\_Border.shp
    - i. This just gives us an idea of where we are in space
- e. ArcGIS does not natively support NetCDF files, so we need to use a toolbox tool to create a display version

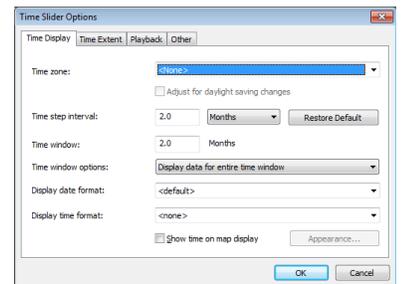


- 1. Access ArcToolbox by clicking on (  ) or going to **Geoprocessing** → **ArcToolbox**
- 2. This will bring up a new window which you can dock where you see fit
- 3. Within ArcToolbox you should select **Multidimension Tools** → **Make NetCDF Raster Layer**
  - i. Input netCDF File : **precip.mon.mean.nc**
  - ii. Everything else can be left as the default
  - iii. Choose OK
- f. You will now have what appears to be a regular raster image, but this is only one particular time
  - 1. Enable time by going into Layer Properties and choosing the **Time** tab
  - 2. Check **Enable Time on this layer** to get the other options
  - 3. Change the Time Dimension to Time
  - 4. Change the Time Step Interval to 2 Months
  - 5. Choose OK
- g. Follow the steps from before to make the Time Slide viable.
  - 1. In the Time Slider Options, make sure the time step matches that of layer



**V. Adding Vector Data on top of Raster Data**

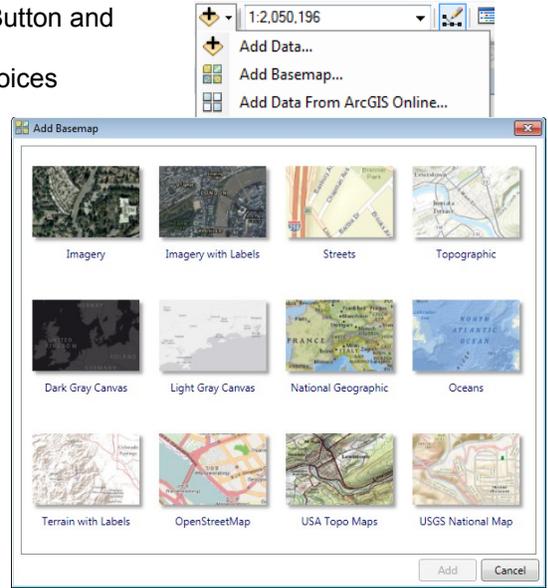
- a. With the same map document, add in US\_Fires.shp
  - 1. This is a record of major forest fires in the US over the same time period as the precipitation data
  - 2. Enable time on the US\_Fires layer
  - 3. There is only one Time Field : STARTDATED
- b. When you run the time slider, you should see very few fires coming up.
  - 1. This is because the time slider is showing only the fires who's time is right on the date that that slice is showing.
  - 2. To fix this, we need to go back into the Time Slide Properties and specify a Time Window of 2.0 Months
    - i. This will make it so that all of the fires from that interval are being displayed
- c. Spend some time looking though the data. Do you see any correlation between amount of precipitation and fires?



**VI. Using data from ArcGIS Online**

- a. ArcGIS has several premade base maps that you can use in your visualizations or final maps. Some of these are better quality than the imagery we have been dealing with, but the come with a few restrictions
  - i. You can do any analysis on these layers: They are just like Google Maps, an image that shows you the area you are interested in, but does not allow any manipulation
  - ii. These are licensed layers. Meaning that when you make a final map the copyright information must be preserved.
- 2. Start a new Map document and add in IN\_PublicSchools (or another Indiana layer if you prefer)

3. Add in a basemap using the dropdown next to the Add Data Button and choose Add Basemap..
4. This will bring up a new window with 12 different basemap choices
  - i. *Imagery and Imagery with labels*: Look like the satellite view in Google Maps and are made up of a lot of the same data
  - ii. *Streets*: Looks like the standard Google Earth or Apple Maps navigation
  - iii. *Topographic*: Is meant to look like a USGS Quad Sheet
  - iv. *Dark and Light Grey Canvas*: Are for making final maps with a high contrast overview
  - v. The others are either from particular data sources or are designed to show particular things.
5. Remember that these are base layers, we cannot do any analysis with the topography or run a filter on the imagery. They are static layers.
6. Here add in the Streets layer.
  - i. It may take a while to load
  - ii. Zoom in and take note of how the image changes based on the scale.
    - a. This is a big difference from a regular raster image.



- b. We also have access to a lot of layers that other researchers have hosted or indexed through ArcGIS online.
  1. Open the ArcGIS Online Search Window by choosing the third option under the add data
  2. Some of these are from ESRI, some are from state or national governments, some are from private individuals.
  3. Few are guaranteed in terms of quality or accuracy, but they can serve as an easy way to access a wide variety of data layers
  4. Layers with the **ESRI** tag are usually better, since ESRI provides them as part of ArcGIS
    - i. Though sometimes these will fail to add if you are not signed into an ArcGIS online account
      - a. These are free and in some cases you will be able to save them for your own work
  5. Try to add **USA Cropland**
    - i. If that does not work, try USA\_Countries
    - ii. Some times the servers are overwhelmed
  6. This is just like a regular vector layer, but it is huge.
    - i. Having it on a server means we can just load the small section we need at any given time
  7. Navigate around Indiana and take a look at some of the different crops we have using the Identify tool.
    - i. What are the dominant crop types?

