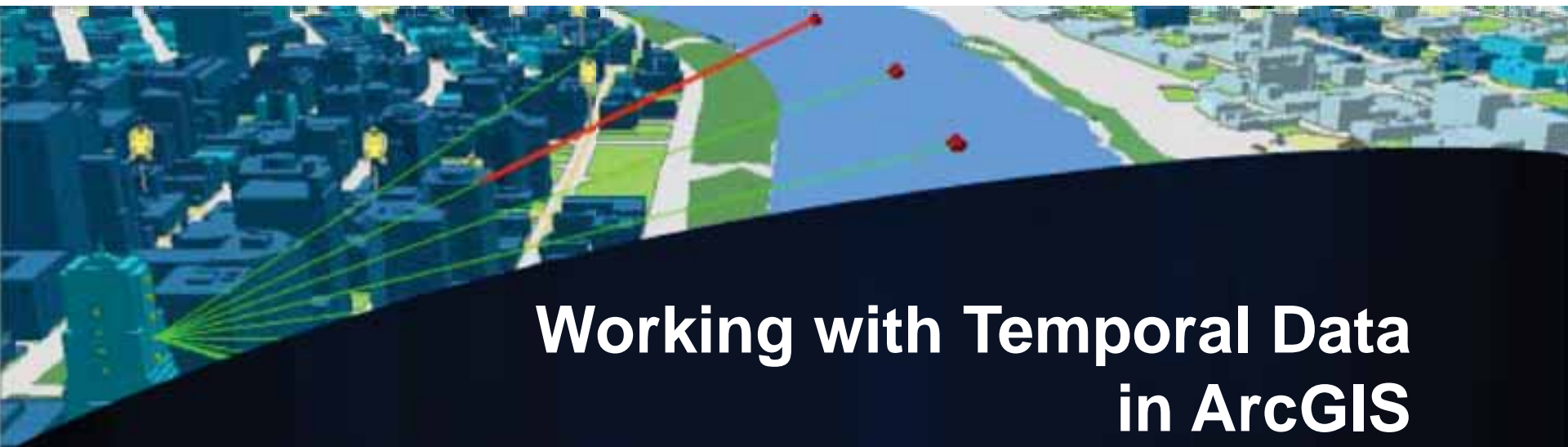


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Working with Temporal Data in ArcGIS



Agenda

It's about time!

- **Time and ArcGIS**
 - Solutions for working with temporal data
 - Time layers in ArcGIS 10
- **Working with time layers**
 - Temporal attribute tips
 - Visualization and animation
- **Sharing temporal maps and data**
- **Resources**

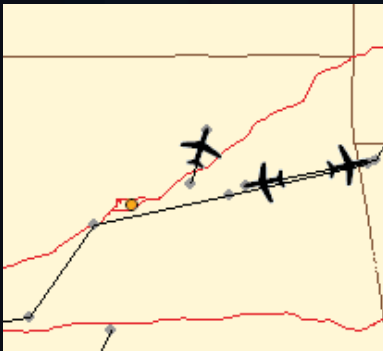


Time and ArcGIS

Space and time

Dynamic

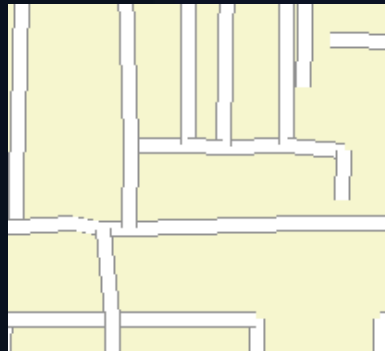
A feature moves or follows a path or track



- Planes
- Vehicles
- Animals
- Satellites
- Storms

Discrete

A feature “just happens”



- Crimes
- Lightning
- Accidents

Stationary

Same location but values change



- Weather Stations
- Traffic Sensors

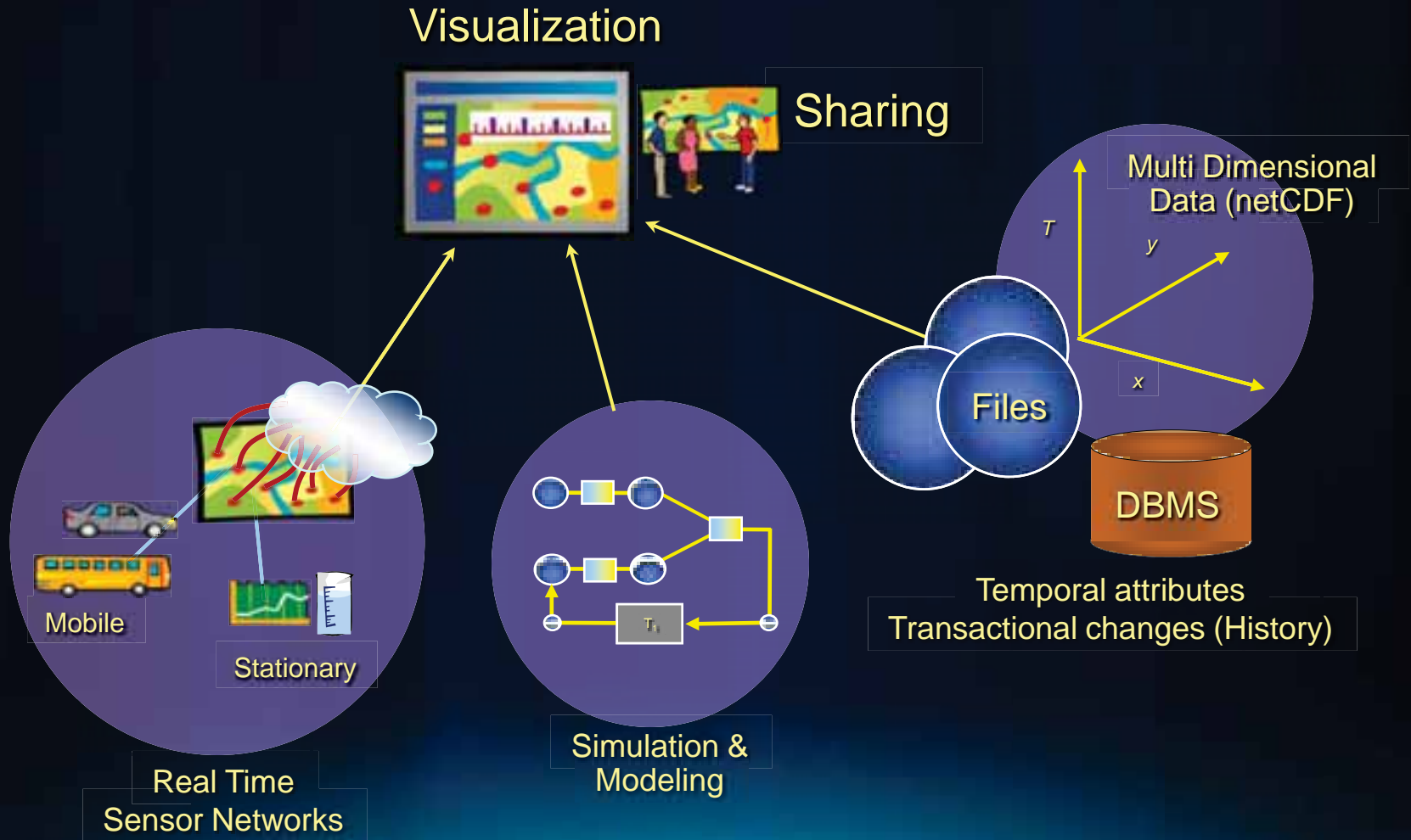
Change

Feature location and its values may change



- Wildfires
- Census updates

Integration of time and space

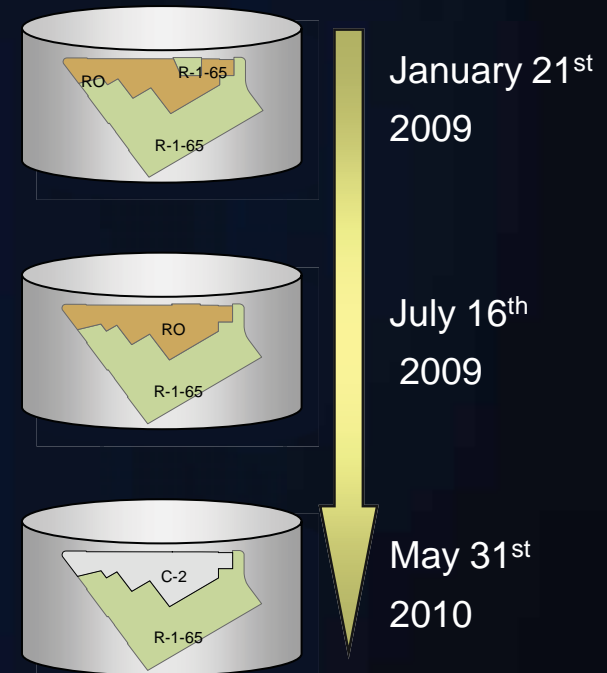


ArcGIS and time

- **Time layers**
 - Visualization of temporal attributes
- **Geodatabase History**
 - Transactional time
- **Tracking Analyst solutions**
 - Tracking, sensors, feeds, real-time

Geodatabase archiving

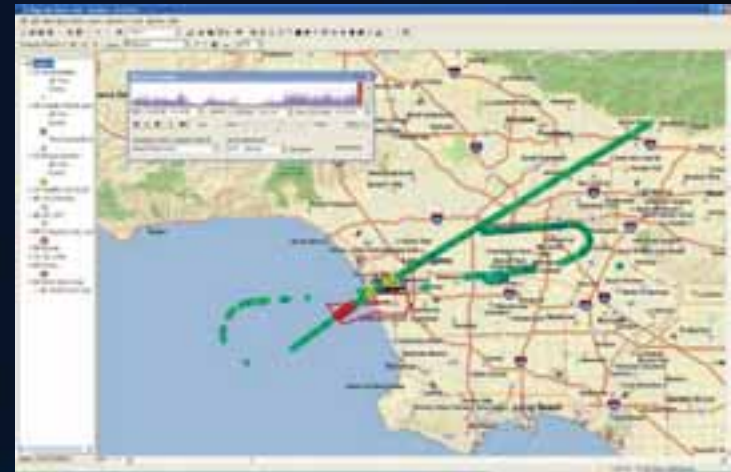
- Capturing, managing, and visualizing *data change*
 - Attributes & feature shapes
 - When those changes occurred
- Integrated into ArcGIS
 - Multi-user geodatabases only
 - Archive version
- Consider [ArcGIS Data Reviewer](#)



Valid time vs. transactional time?

ArcGIS Tracking Analyst and Tracking Server

- **Collect and monitor real-time data**
- **Visually organize point data into track lines**
- **Analyze change over time**
 - Aging of color, size, shape
- **Per-feature analysis**
 - Geofencing
 - Filtering
- **Example**



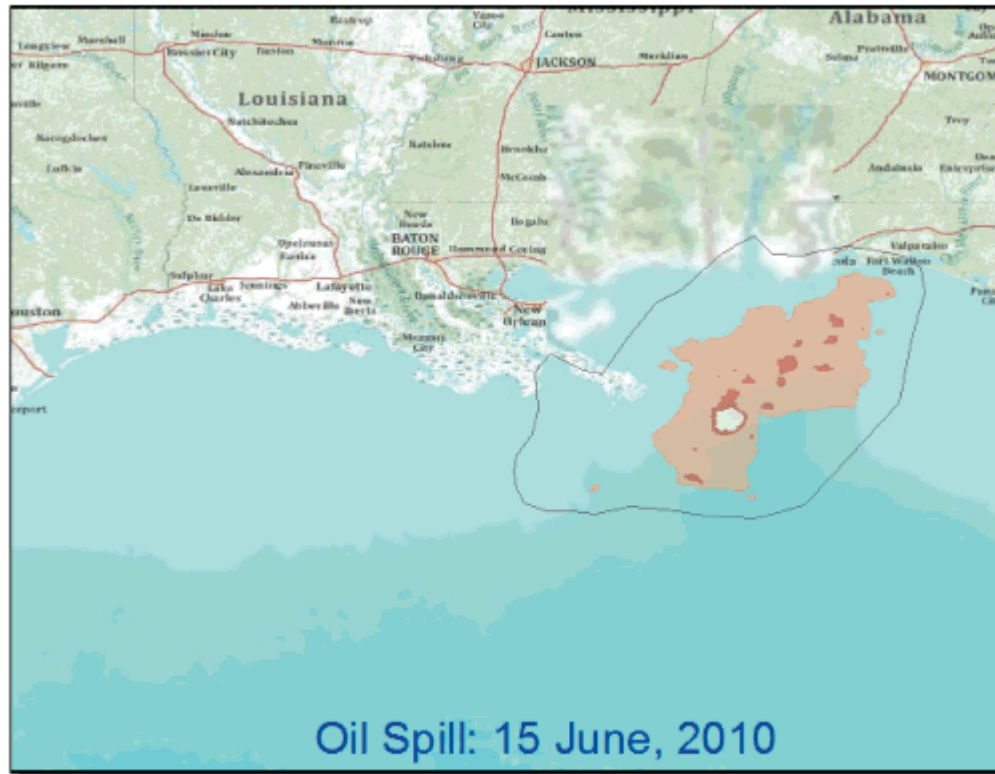
Enabling Real-Time Temporal GIS Solutions

Temporal mapping in ArcGIS 10

- The map is now time aware
 - Create, interact with and serve temporal maps
- Unified experience for time
 - Works the same in ArcMap, ArcGlobe and ArcScene
 - Part of Desktop, Engine, and Server



Why visualize data through time?



Analyzing crimes

Demo



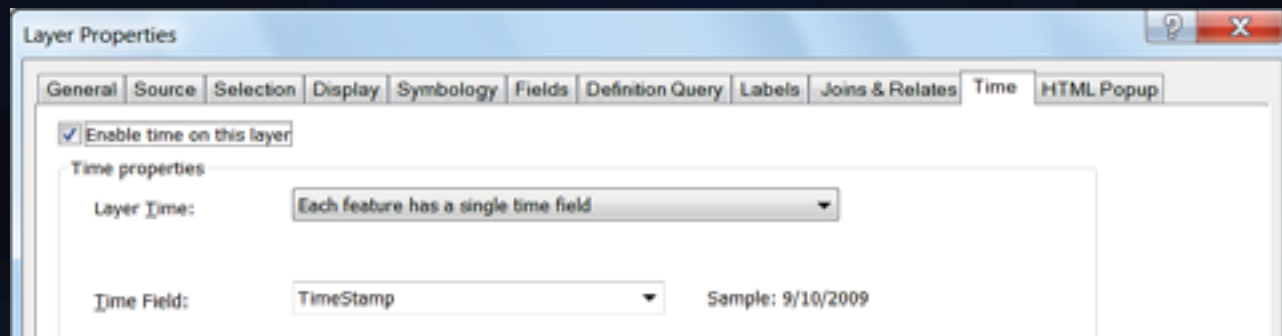
Working with time layers

Workflow

- Enable *time* property on layers or tables
 - Requires temporal attribute(s)
- Time Slider toolbar becomes enabled
 - Configure time properties
 - Interactively display map data through time
- Optional: Integrate with Animation tools
- Share

Supported data

- Feature Layers
- Data tables
- Mosaic Datasets & Raster Catalogs
- NetCDF (Raster, Feature, Table)
- Tracking Layers
- Network Layers



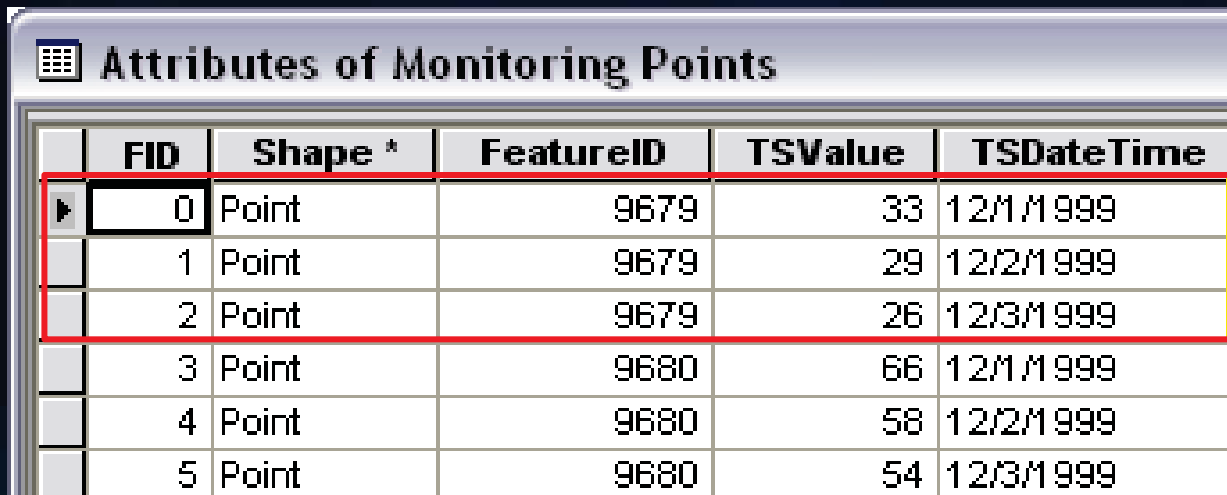
Discrete feature events

- **Most common scenario**
 - **Single field storing date/time values for each record in table**
 - **Observations (other attributes) often change based on date/time value**
 - **e.g. crimes, lightning strikes, inspections**

OBJECTID *	Shape *	REPORTDATE	OFFENSE	METHOD	BLOCKSITEA	DISTRICT	Date
8477	Point	4/30/2010 12:00:00 AM	THEFT F/AUTO	2	CONNECTICUT AVE NW & TILDEN ST NW	SECOND	4/30/2010
13846	Point	6/28/2010 12:00:00 AM	THEFT	2	CONNECTICUT AVE NW & R ST NW	SECOND	6/28/2010
11963	Point	6/8/2010 12:00:00 AM	STOLEN AUTO	STOLEN AUTO	CONNECTICUT AVE NW & PORTER ST NW	SECOND	6/8/2010
12270	Point	6/11/2010 12:00:00 AM	THEFT	2	CONNECTICUT AVE NW & L ST NW	SECOND	6/11/2010
9608	Point	5/12/2010 12:00:00 AM	THEFT	2	CONNECTICUT AVE NW & KALORAMA RD NW	THIRD	5/12/2010
7480	Point	4/18/2010 12:00:00 AM	STOLEN AUTO	STOLEN AUTO	CONNECTICUT AVE NW & I ST NW	SECOND	4/18/2010
1866	Point	1/26/2010 12:00:00 AM	STOLEN AUTO	STOLEN AUTO	CONNECTICUT AVE NW & ELLICOTT ST NW	SECOND	1/26/2010
9722	Point	5/15/2010 12:00:00 AM	ROBBERY	KNIFE	CONNECTICUT AVE NW & DUPONT CIR NW	SECOND	5/15/2010

Features that *move* through time

- Features repeat for each time stamp
 - Each time stamp often has a unique attribute value
- Commonly used for capture or playback of moving objects (tracking features)
 - e.g. Hurricanes, vehicles, animals



	FID	Shape *	FeatureID	TSValue	TSDateTime
▶	0	Point	9679	33	12/1/1999
	1	Point	9679	29	12/2/1999
	2	Point	9679	26	12/3/1999
	3	Point	9680	66	12/1/1999
	4	Point	9680	58	12/2/1999
	5	Point	9680	54	12/3/1999

Features and relates

- With two tables, if your table relationship is:
 - One to one
 - One to many
- Run Make Query Table Tool to perform an in-memory join
- Commonly used with fixed position samples, such as weather stations and other sensor networks

One-to-many

Stations feature class			Temperature table			
OBJECTID*	SHAPE*	StationID	OBJECTID*	StationID	Date_1	Temp
1	Point	43	1	43	1/1/2000	50
2	Point	55	2	43	1/1/2001	53
3	Point	21	3	43	1/1/2002	49
4	Point	15	4	43	1/1/2003	58

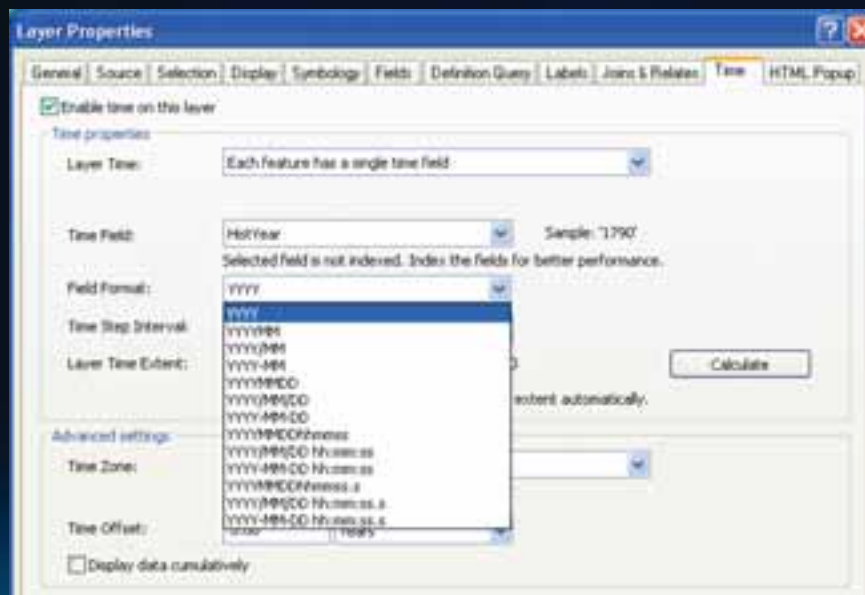
Mosaic Datasets and Raster Catalogs

- Use a date/time field
- Use an index field (i.e. ObjectID)

OBJECTID*	NAME	Shape*	Raster	Date_Time	SHAPE_Length	SHAPE_Area
1	Image1.gif	Polygon	Raster	1998-10-14 12:00:00	3068	522753
2	Image2.gif	Polygon	Raster	1998-10-15	3068	522753
3	Image3.gif	Polygon	Raster	1998-10-15 12:00:00	3068	522753
4	Image4.gif	Polygon	Raster	1998-10-16	3068	522753
5	Image5.gif	Polygon	Raster	1998-10-16 12:00:00	3068	522753
6	Image6.gif	Polygon	Raster	1998-10-17	3068	522753
7	Image7.gif	Polygon	Raster	1998-10-17 12:00:00	3068	522753

Time field property

- **Supported time field formats:**
 - Strings, Numbers
 - DATE
- **Tip: Using DATE data types will help make setting time properties easier**



Date fields

- **DATE is a special field type specific to time**
- **Geodatabase provides DATE**
 - Maps to RDBMS SQL 'DATE'
 - Not all databases support the same type and operators
- **If at all possible – use DATE type**
- **Tip: DATE field should be indexed for faster query performance**

What if the field is not a supported format?

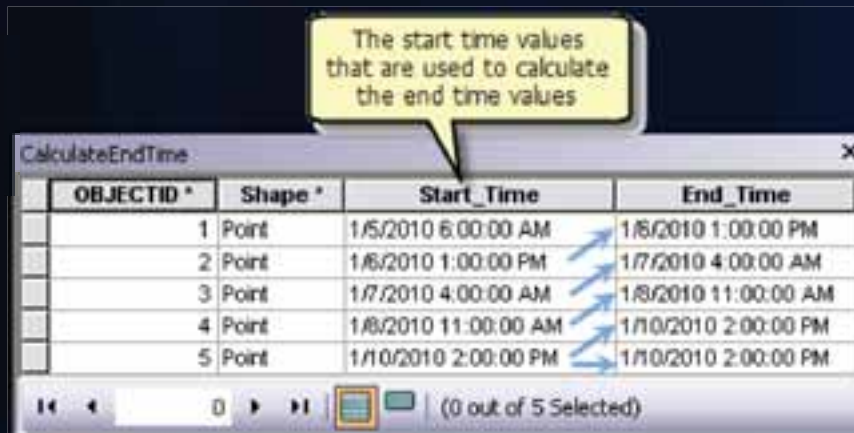
- Use the Convert Time Field tool
 - Converts numeric & string formats to a date field
e.g. "20100321" → 03/21/2010
 - Converts custom string formats to a date field
e.g. "March 21, 2010" → 03/21/2010
- Or Field Calculator expressions and manipulations
 - Learn Python or vbScript string manipulation functions!

Input time field with time values stored in the custom format
MMMM d, yyyy HH:mm:ss

OBJECTID *	Shape *	Input_Time	Output_Time
1	Polygon	January 21, 1988 17:12:57	1/21/1988 5:12:57 PM
2	Polygon	August 28, 1998 00:01:01	8/28/1998 12:01:01 AM
3	Polygon	August 10, 2001 19:56:30	8/10/2001 7:56:30 PM
4	Polygon	September 7, 2002 5:00:00	9/7/2002 5:00:00 AM
5	Polygon	July 31, 2003 13:45:00	7/31/2003 1:45:00 PM
6	Polygon	August 23, 2009 17:30:00	8/23/2009 5:30:00 PM
7	Polygon	July 18, 2010 11:00:00	7/18/2010 11:00:00 AM

Representing time span with two fields

- Sometimes there is a need to imply that a duration existed between each instant in time feature
- Populate the End time field with the next successive records Start time
 - The last instance will not have a duration as the End time and Start time will be the same



The screenshot shows the 'Calculate End Time' tool interface. A yellow callout box points to the 'Start Time' column, stating: 'The start time values that are used to calculate the end time values'. The table below shows the data for five records. The 'End Time' for each record is the 'Start Time' of the next record, except for the last record where it is the same as the 'Start Time'.

OBJECTID *	Shape *	Start Time	End Time
1	Point	1/5/2010 6:00:00 AM	1/6/2010 1:00:00 PM
2	Point	1/6/2010 1:00:00 PM	1/7/2010 4:00:00 AM
3	Point	1/7/2010 4:00:00 AM	1/8/2010 11:00:00 AM
4	Point	1/8/2010 11:00:00 AM	1/10/2010 2:00:00 PM
5	Point	1/10/2010 2:00:00 PM	1/10/2010 2:00:00 PM

The Calculate End Time tool can create this end date field for you.

What if time is stored in columns?

- ArcGIS works with time stored in records, not columns
 - Need to transpose data in columns into records
 - Reformat table with Transpose Fields tool

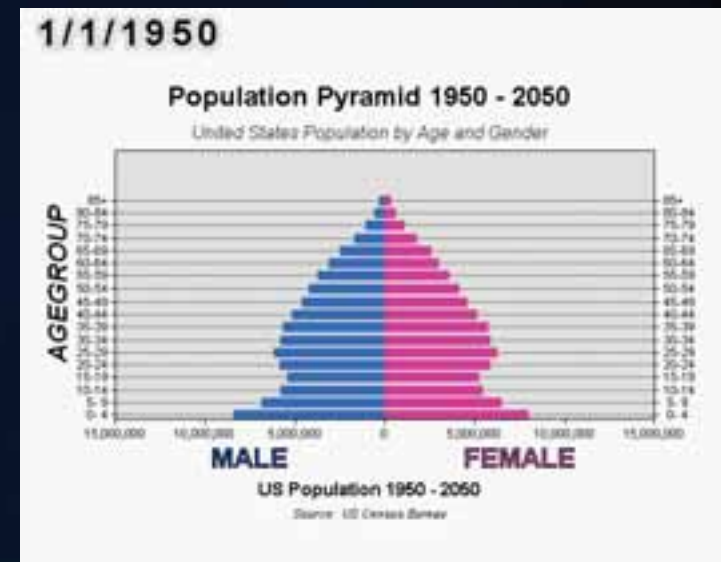
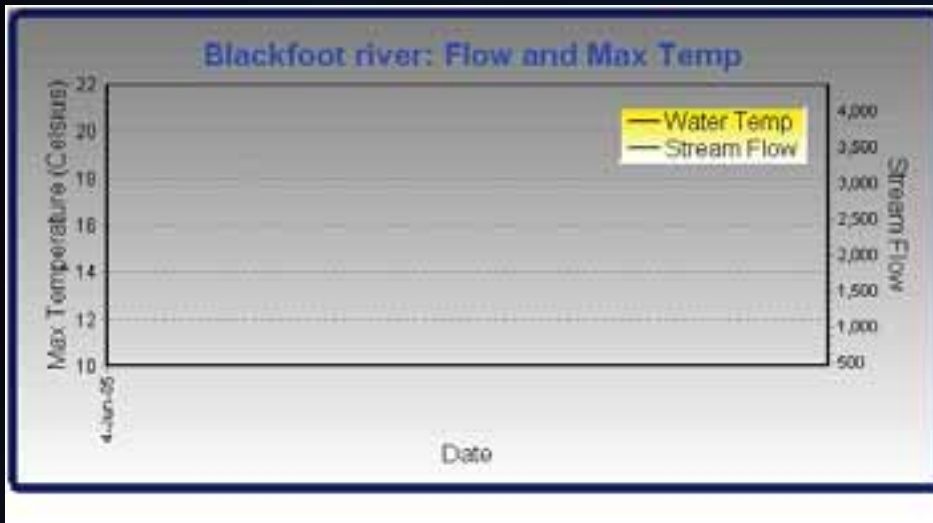
The image shows two data tables side-by-side in an ArcGIS interface. The left table, titled 'Counties_Census_History', has columns for NAME and census years (HIST1890, HIST1900, HIST1910, HIST1920, HIST1930). The right table, titled 'Census_History_Counties_Tran', has columns for NAME, Date, and Population. A green arrow points from the 'HIST1890' column of the first table to the 'Date' column of the second table, illustrating the transposition of data.

NAME	HIST1890	HIST1900	HIST1910	HIST1920	HIST1930
Gallatin	6246	9553	14079	15064	16124
Monroe	18786	18006	21583	19550	13624
Kalaheo	0	1177	795	667	605
Kauai	0	20582	23744	29247	35808
Honolulu	0	50504	81993	123496	166887
Mauai	0	25418	28823	38080	46887
Hawaii	0	46043	55302	64095	73325
Lane	15188	19604	33783	38168	54493

NAME	Date	Population
Durleson	HIST1970	9999
Grant	HIST1970	9999
Durke	HIST1930	9990
Miller	HIST1940	9998
Monroe	HIST1000	9997
Mason	HIST1940	9997
Polk	HIST1000	9995
Charles Mix	HIST1970	9994

Graphs and time

- Create a Graph using a layer or table
 - Open Graph window or insert on layout
- Table properties
 - Time tab
- Time Slider affects graphs, too



Working with time layers

Demo

Summary of best practice recommendations

- **Use DATE field type whenever possible**
- **Database Index on the DATE field**
- **UTC (or GMT) for time zone**
- **Use Standard Time – avoid Daylight Savings (DST)**
- **Use Data Conversion tools to convert to supported field types and storage formats**

Sharing temporal maps

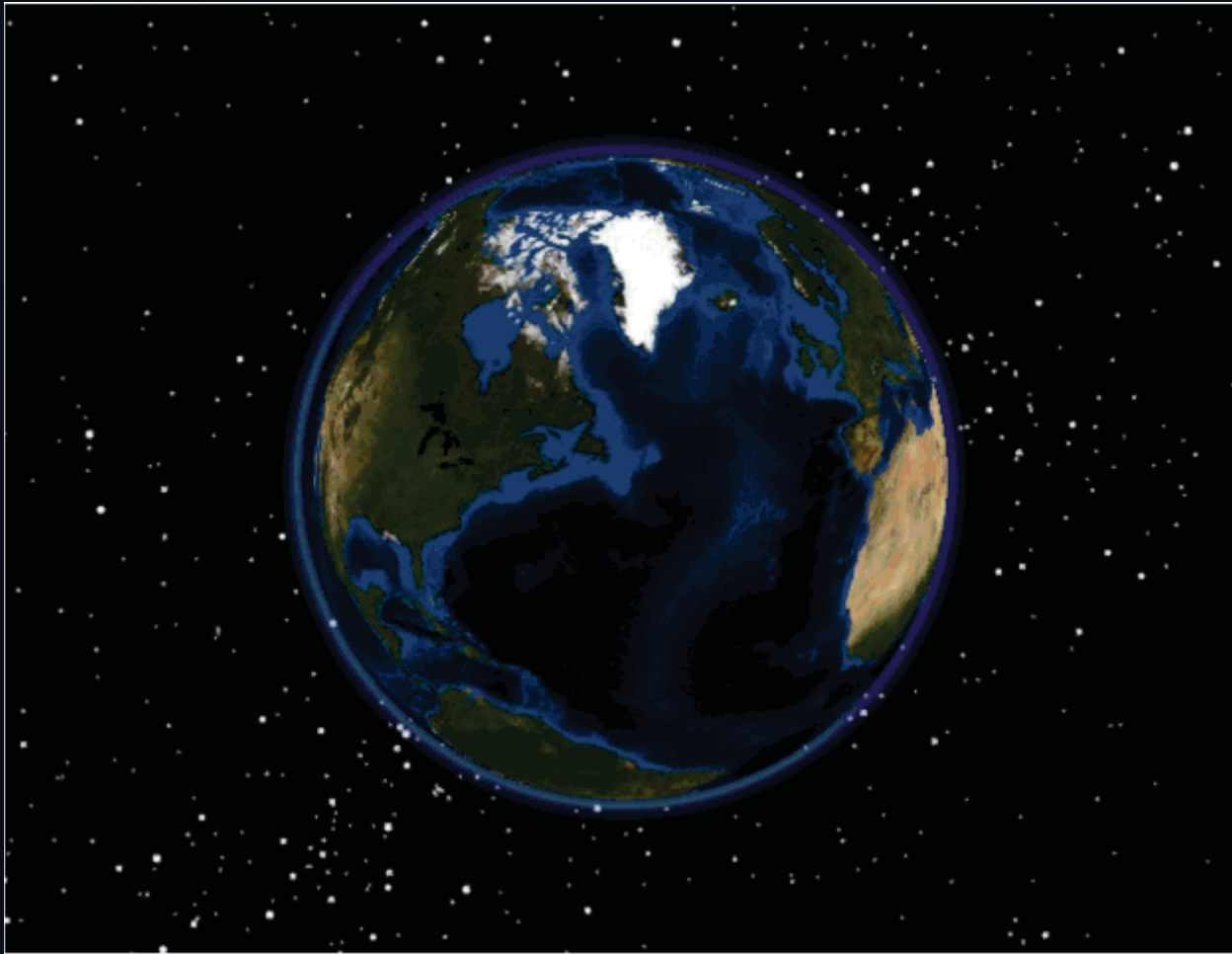


Sharing temporal maps and data with ArcGIS 10

- **Export videos or images**
 - Time slider
 - Animation controls
- **Included in layer and map packages**
- **Publish time-aware web maps**

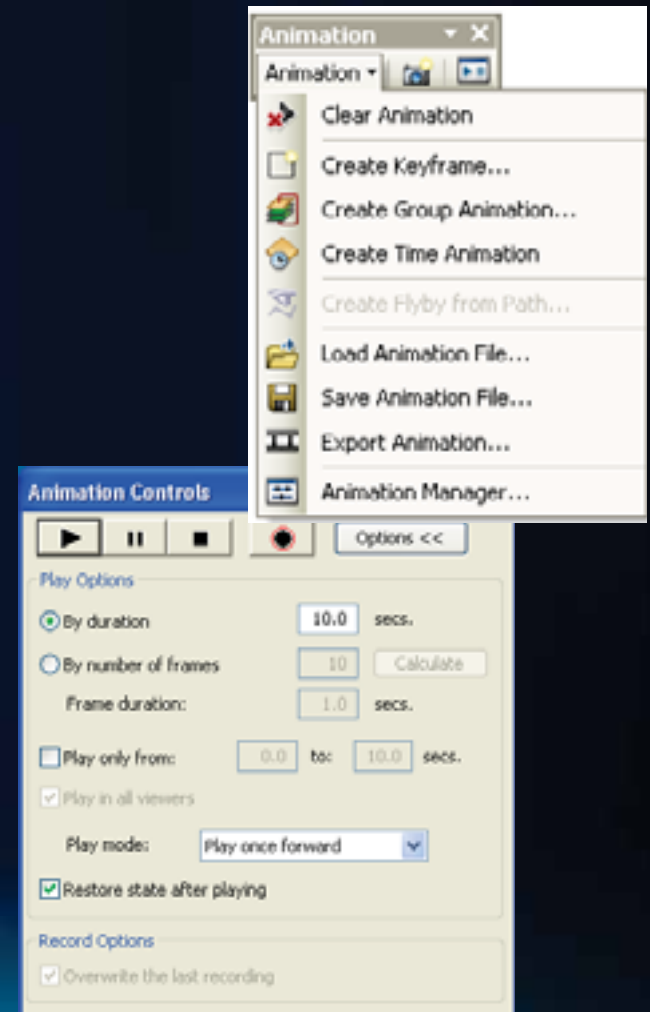


Time layers and “fly-overs”



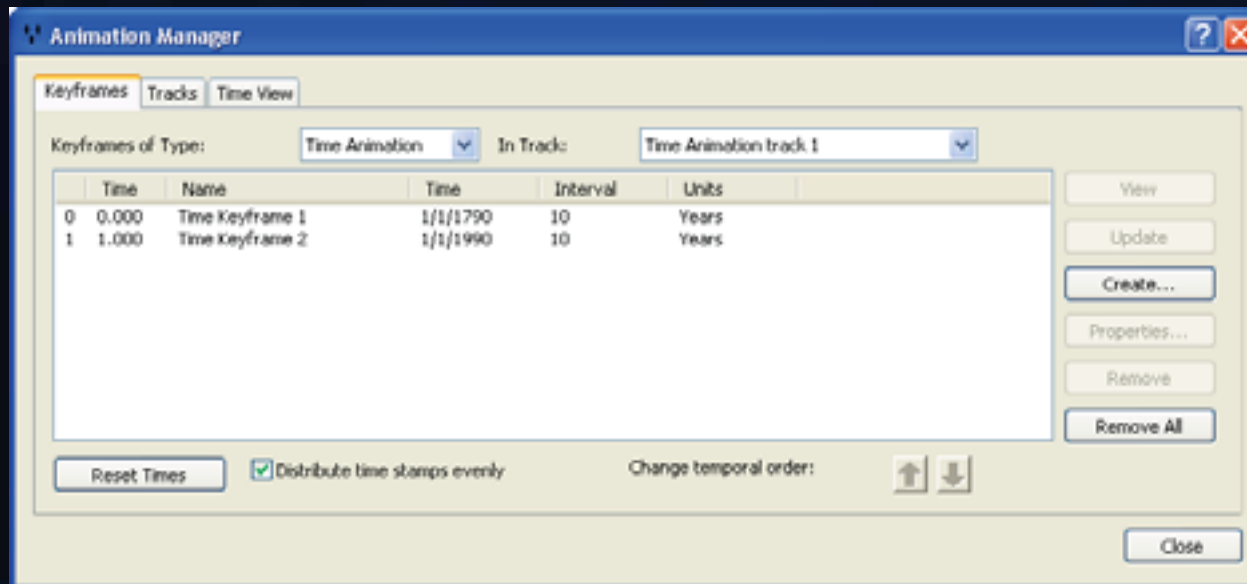
Time animations

- Use Time Animation for creating dynamic visual effects
 - Visualize temporal data while flying over an area
 - Fading in/out layers while visualizing temporal data
 - Visualizing time enabled layers at different time steps



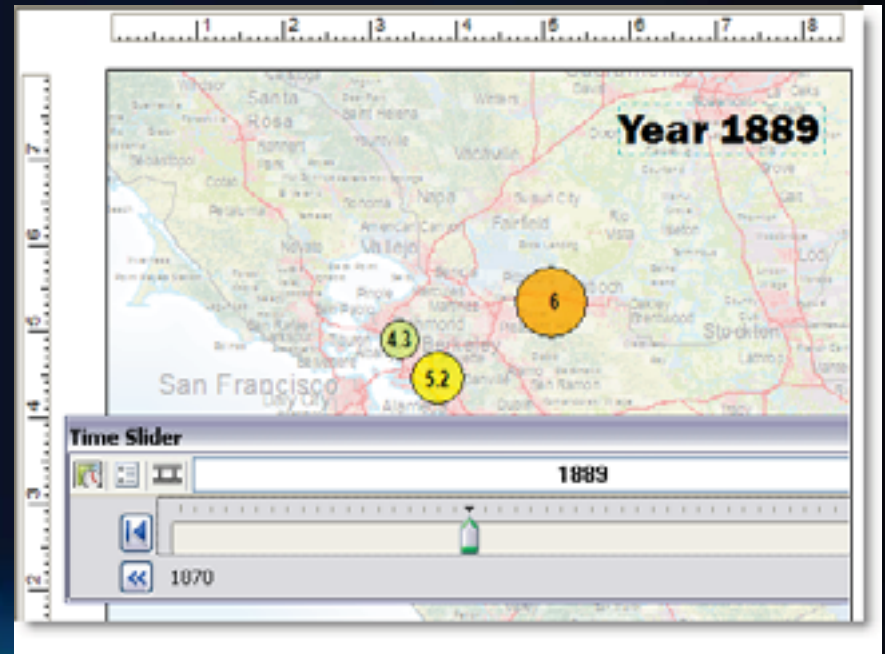
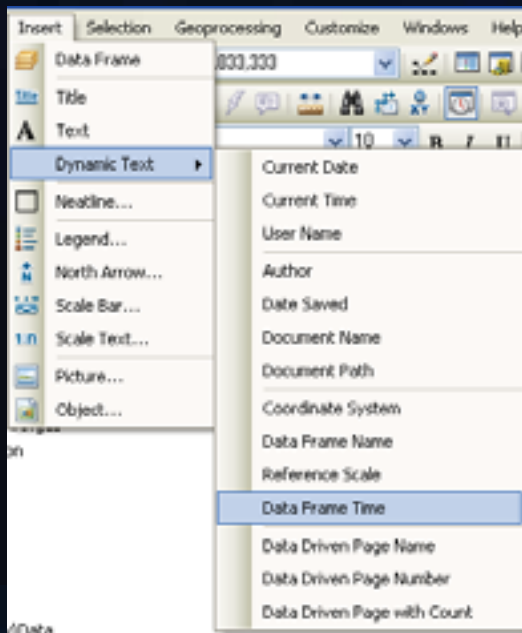
Animation manager

- **Manages animation effects between tracks**
 - **For example: Flying in and playing time layers or graphs**



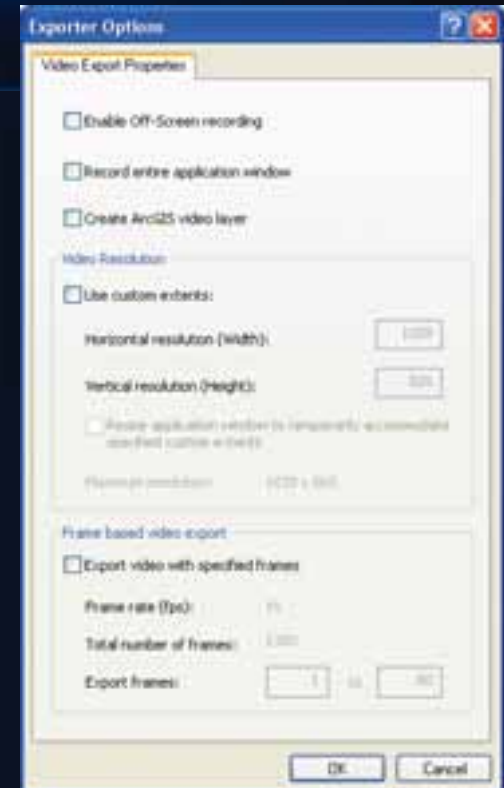
Additional effects

- Add “Time” to layout
 - Dynamic text
- Transparency on Time Slider



Creating videos

- **Time slider**
 - **AVI or Sequential images**
 - **For exporting simple time playback**
 - **Data frame or layout views**
- **Animation tools**
 - **AVI or Sequential images**
 - **Exports time, keyframe, and group animations**
 - **Data frame or layout views**



Web mapping and time

- **Author time aware layers in Desktop**
- **Publish map service**
 - **Supported with all web mapping API's (Java Script, Flex, Silverlight)**
- **Timeslider components to control play back in client**
 - **<http://help.arcgis.com/en/webapi/flex/samples/index.html?sample=TimeSliderPlayFeature>**

Sharing temporal maps

Demo

Resources

- Desktop Resource Center
- **Web mapping API tools & time-aware layers:**
 - ArcGIS API for Java Script
 - ArcGIS API for Flex
 - ArcGIS API for Silverlight/WPF



Questions?

Thank you!