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

Visualization

Sharing

Multi Dimensional Data (netCDF)

Temporal attributes
Transaction changes (History)

DBMS

Files

Simulation & Modeling

Real Time Sensor Networks

Mobile

Stationary
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?

Oil Spill: 15 June, 2010
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
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
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
Mosaic Datasets and Raster Catalogs

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

<table>
<thead>
<tr>
<th>OBJECTID</th>
<th>NAME</th>
<th>Shape</th>
<th>Raster</th>
<th>Date_Time</th>
<th>SHAPE_Length</th>
<th>SHAPE_Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Image1.gif</td>
<td>Polygon</td>
<td>Raster</td>
<td>1998-10-14 12:00:00</td>
<td>3068</td>
<td>522753</td>
</tr>
<tr>
<td>2</td>
<td>Image2.gif</td>
<td>Polygon</td>
<td>Raster</td>
<td>1998-10-15</td>
<td>3068</td>
<td>522753</td>
</tr>
<tr>
<td>3</td>
<td>Image3.gif</td>
<td>Polygon</td>
<td>Raster</td>
<td>1998-10-15 12:00:00</td>
<td>3068</td>
<td>522753</td>
</tr>
<tr>
<td>4</td>
<td>Image4.gif</td>
<td>Polygon</td>
<td>Raster</td>
<td>1998-10-16</td>
<td>3068</td>
<td>522753</td>
</tr>
<tr>
<td>5</td>
<td>Image5.gif</td>
<td>Polygon</td>
<td>Raster</td>
<td>1998-10-16 12:00:00</td>
<td>3068</td>
<td>522753</td>
</tr>
<tr>
<td>6</td>
<td>Image6.gif</td>
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<td>3068</td>
<td>522753</td>
</tr>
<tr>
<td>7</td>
<td>Image7.gif</td>
<td>Polygon</td>
<td>Raster</td>
<td>1998-10-17 12:00:00</td>
<td>3068</td>
<td>522753</td>
</tr>
</tbody>
</table>
Time field property

- Supported time field formats:
  - Strings, Numbers
  - DATE
- Tip: Using DATE data types will help make setting time properties easier
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” \(\rightarrow\) 03/21/2010
  - Converts custom string formats to a date field
    - e.g. “March 21, 2010” \(\rightarrow\) 03/21/2010

- Or Field Calculator expressions and manipulations
  - Learn Python or vbScript string manipulation functions!
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.
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
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
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
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!