

# Using ArcGIS<sup>™</sup> Tracking Analyst

**GIS by ESRI<sup>™</sup>**

Copyright (c) 2002 TASC, Inc. and its licensor(s).

All Rights Reserved.

Printed in the United States of America.

The information contained in this document is the exclusive property of ESRI. This work is protected under United States copyright law and the copyright laws of the given countries of origin and applicable international laws, treaties, and/or conventions. No part of this work may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying or recording, or by any information storage or retrieval system, except as expressly permitted in writing by ESRI. All requests should be sent to Attention: Contracts Manager, ESRI, 380 New York Street, Redlands, CA 92373-8100, USA.

The information contained in this document is subject to change without notice.

### **U. S. GOVERNMENT RESTRICTED/LIMITED RIGHTS**

Any software, documentation, and/or data delivered hereunder is subject to the terms of the License Agreement. In no event shall the U.S. Government acquire greater than RESTRICTED/LIMITED RIGHTS. At a minimum, use, duplication, or disclosure by the U.S. Government is subject to restrictions as set forth in FAR §52.227-14 Alternates I, II, and III (JUN 1987); FAR §52.227-19 (JUN 1987) and/or FAR §12.211/12.212 (Commercial Technical Data/Computer Software); and DFARS §252.227-7015 (NOV 1995) (Technical Data) and/or DFARS §227.7202 (Computer Software), as applicable. Contractor/Manufacturer is ESRI, 380 New York Street, Redlands, CA 92373-8100, USA.

ESRI, the ESRI globe logo, ArcView, ArcIMS, ArcGIS, GIS by ESRI, ArcCatalog, ArcEditor, ArcInfo, MOLE, the ArcGIS logo, ArcMap, and [www.esri.com](http://www.esri.com) are trademarks, registered trademarks, or service marks of ESRI in the United States, the European Community, or certain other jurisdictions.

This product includes software developed by the following organizations: Apache Software Foundation, Norken Technologies, Systementor AB, and DiscoverCast.

Other companies and products mentioned herein are trademarks or registered trademarks of their respective trademark owners.

# Contents

## Getting started

### **1 Introducing ArcGIS Tracking Analyst 3**

- Tracking temporal data 4
- Symbolizing temporal data 5
- Displaying data 6
- Charting temporal data 7
- Creating and applying actions 8
- Tips on learning Tracking Analyst 9

### **2 Quick-start tutorial 11**

- Exercise 1: Adding and symbolizing temporal data 12
- Exercise 2: Replaying temporal data 16
- Exercise 3: Applying actions 18

### **3 Working with temporal data 23**

- What is temporal data? 24
- Simple and complex temporal events 25
- Adding temporal data in ArcMap 27
- Adding a tracking shapefile from ArcView GIS 3.x 29
- Complex data 31
- Using temporal layer properties 33
- Displaying the most current temporal event 35
- Setting temporal offset for a layer 36
- Saving and exporting data in ArcMap 38

# Displaying data

## **4 Symbolizing temporal data 43**

- About symbolizing temporal data 44
- Symbolizing point data 49
- Symbolizing line data 55
- Symbolizing polygon data 57
- Symbolizing a track 59

## **5 Displaying temporal data 61**

- About displaying temporal data 62
- Displaying symbolized temporal data 65
- Using the Animation Wizard 67
- Labeling temporal data 70

# Interacting with data

## **6 Charting temporal data 73**

- About charting temporal data 74
- Using the Data Clock 76
- Using the Data Clock Manager 77

## **7 Creating and applying actions 79**

- Applying actions to temporal data 80
- Layer actions in ArcMap 81
- Applying filter actions in ArcMap 83

## **8 Working with real-time data 85**

What is real-time data? 86

Setting up a real-time connection in ArcCatalog 88

Setting properties for tracking connections in ArcCatalog 90

Setting properties for tracking services 91

Applying actions to real-time data 93

Applying custom VB actions in real-time 98

Adding real-time data in ArcMap 100

## **Glossary 101**

## **Index 105**





# Getting started

## Section 1





# Introducing ArcGIS Tracking Analyst

# 1

## IN THIS CHAPTER

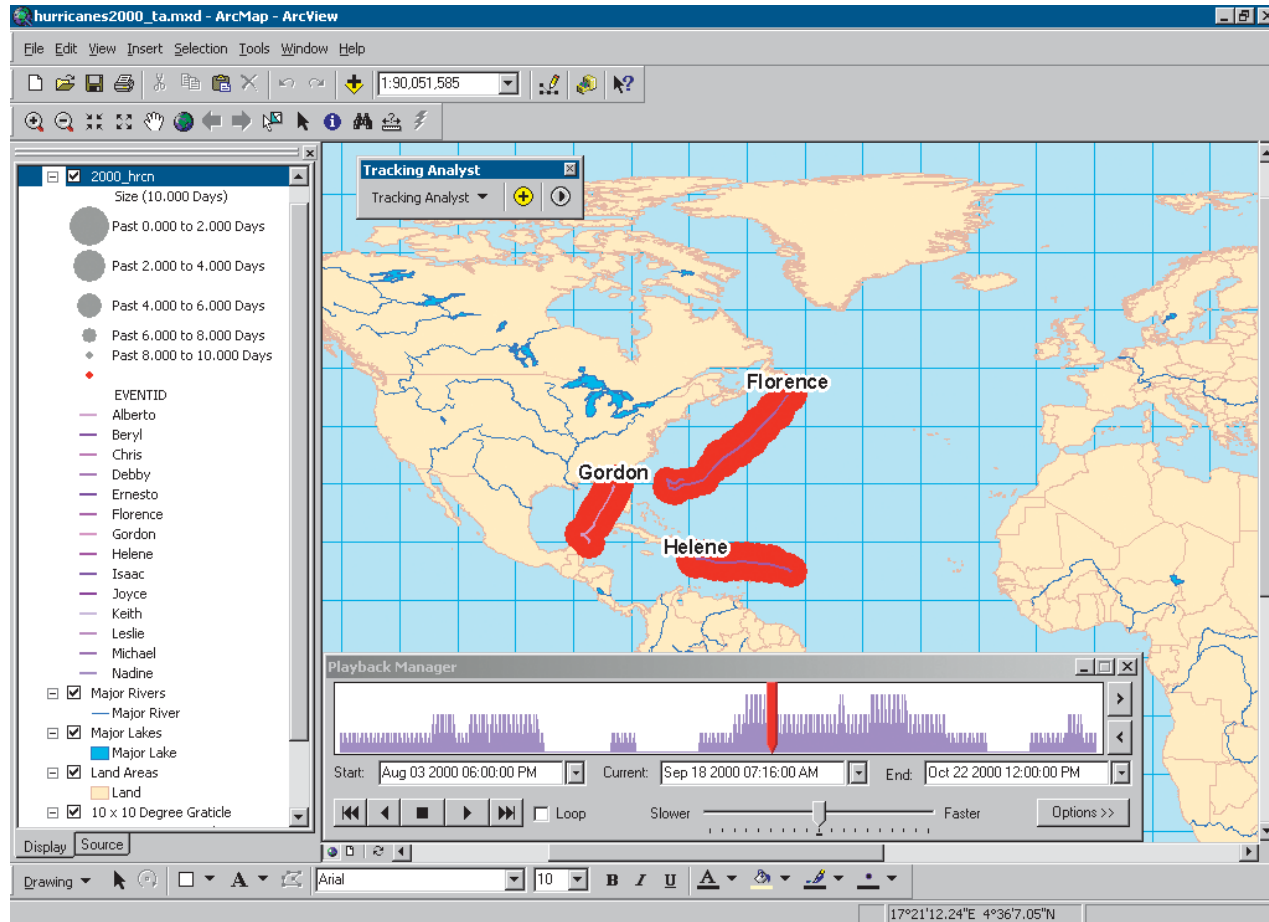
- **Tracking temporal data**
- **Symbolizing temporal data**
- **Displaying data**
- **Charting temporal data**
- **Creating and applying actions**
- **Tips on learning Tracking Analyst**

Welcome to ESRI® ArcGIS™ Tracking Analyst, the extension for mapping objects that move or change status through time. Tracking Analyst gives you the power to:

- **Track** temporal data from disk and in real time. Tracking Analyst supports network connections to global positioning system (GPS) units and other tracking and monitoring devices, so you can map your data in real time.
- **Symbolize** temporal data and change its appearance based on temporal components.
- **Display** real-time or fixed-time data from disk at any speed, forward or backward, using the Tracking Analyst Playback Manager.
- **Chart** temporal data using Tracking Analyst functionality to build and display a data clock.
- **Create and apply** actions on real-time and stored data.
- **Optimize** your use of Tracking Analyst.

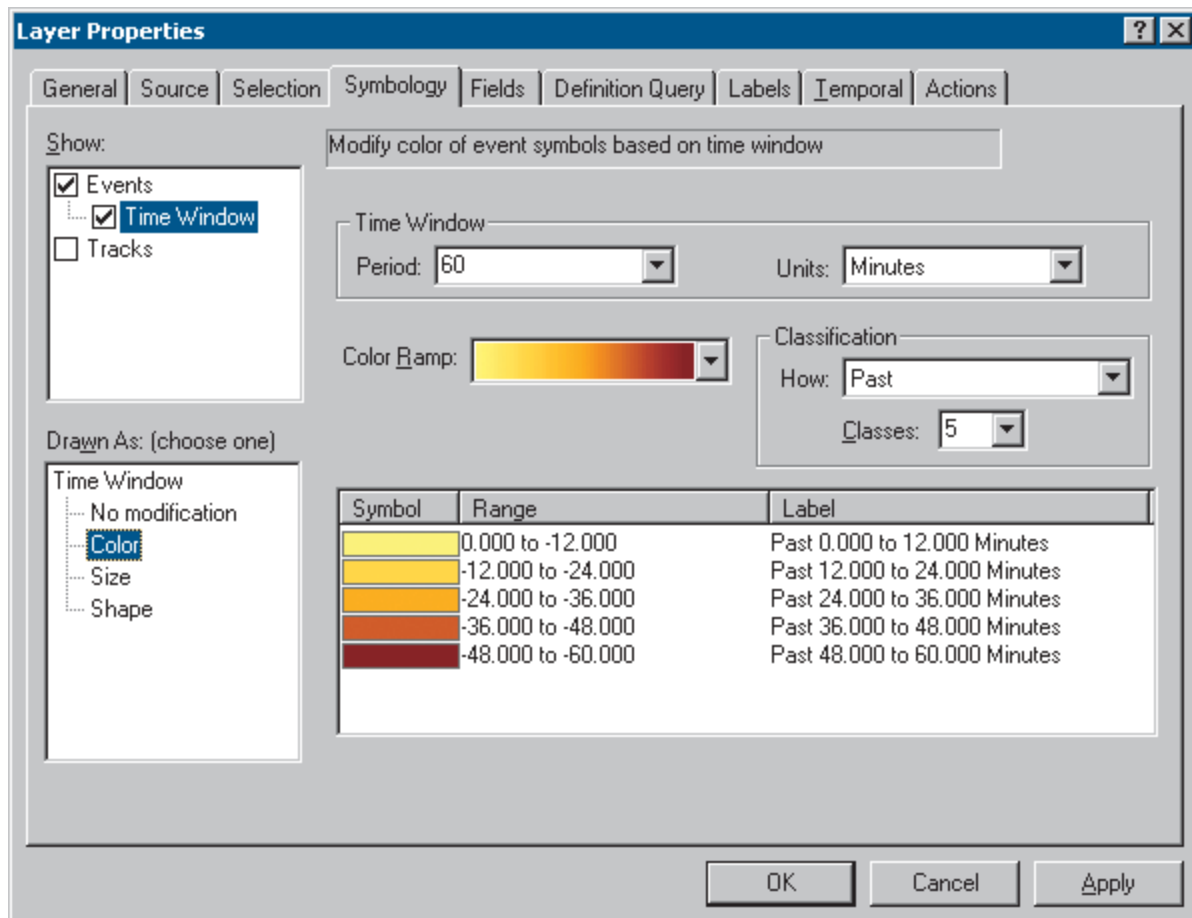
# Tracking temporal data

With the ArcGIS Tracking Analyst extension, you can create a new connection to a tracking service that can stream real-time temporal data to track events as they occur. Use ArcCatalog™ to set up the connection, and add data directly into ArcMap™, where you can play the data on a map background. You can also add and symbolize fixed-time data to play on the map.



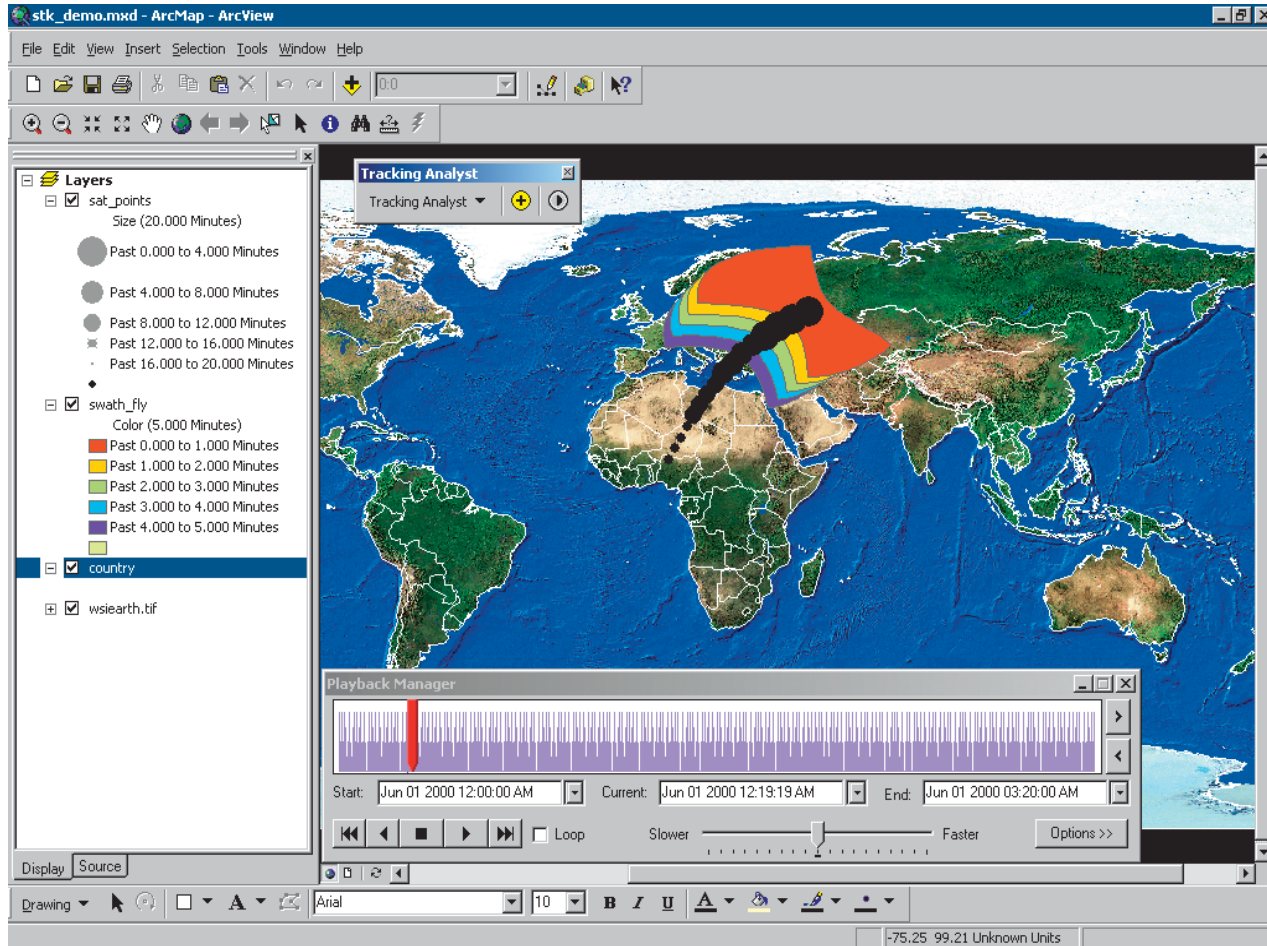
## Symbolizing temporal data

You can change the symbology of your temporal data by color, size, and shape from the Symbology tab in the ArcMap Layer Properties dialog box. Use Tracking Analyst customized settings to make changes and set preferences for the display of your data, including temporal tracks to identify individual entities. You can adjust time window settings, color and size ranges, and other temporal aspects of the display.



## Displaying data

Using the Tracking Analyst Playback Manager, you can replay real-time data messages or data from a disk. The Playback Manager allows you to set start and end times and replay data as it occurred—or as it is occurring—within that time frame, or *playback window*. You can play data backward or forward, change the playback speed, and adjust the playback window on the fly.



# Charting temporal data

Using Tracking Analyst charting tools, you can display the temporal distribution of data. You can determine what units and ranges you want to show, summarize the temporal information, and display your charts with legends and labels to help analyze your data more easily and efficiently. You can also manage data clock charts using the Data Clock Manager.

**Create Data Clock Wizard** [?] [X]

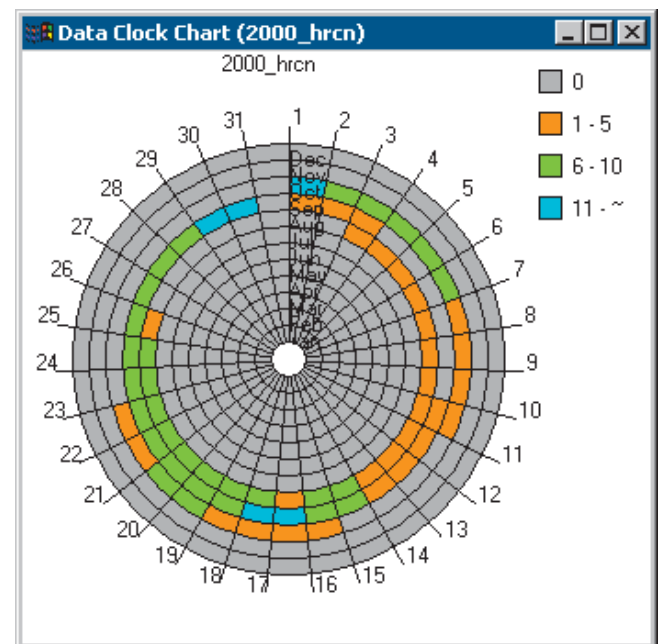
1. Choose layer to chart:  
2000\_hrcn

2. Choose summary method to create data clock:  
'Years' by 'Months'

3. Choose number of legend classes:  
6

4. Choose color scheme:

< Back Finish Cancel



**Data Clock Manager** [?] [X]

Data Clock Chart (2000\_hrcn)

Close

Open

Show on Layout

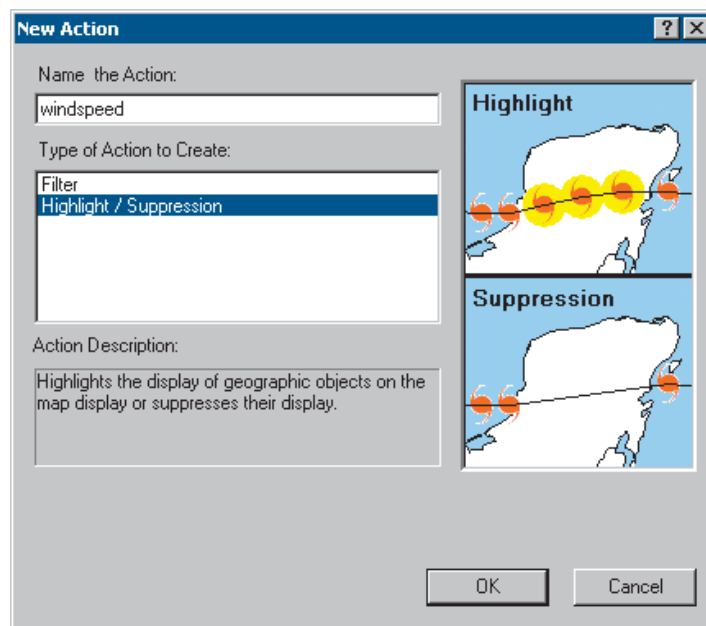
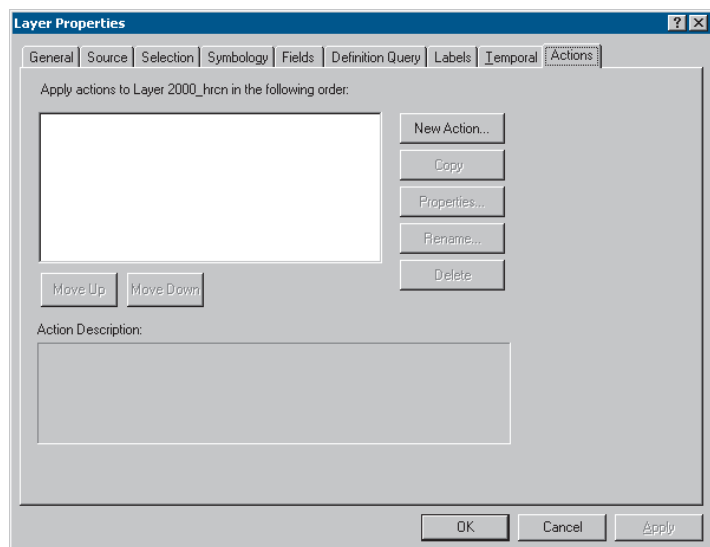
Remove

RemoveAll

= Data Clock is on layout

## Creating and applying actions

You can create and apply actions to alter your data, filter it, or perform some operation based on its contents, either in real-time data messages or in historical fixed-time datasets, depending on the type and location of the action. The Tracking Analyst Actions tab in the ArcMap Layer Properties dialog box allows you to create and apply actions to temporal data layers. You can also apply actions to the data itself as it comes in from the server using the Actions tab in ArcCatalog. You can apply actions to highlight and suppress data display, include or exclude data from a dataset using a filter, or convert a dataset's coordinate system reference. You can also create custom actions for real-time data using Microsoft® Visual Basic® for Applications.





## Tips on learning Tracking Analyst

A working knowledge of ArcGIS and the ArcMap 8.x interface is useful for learning the Tracking Analyst extension. If you are unfamiliar with ArcMap, it is suggested that you work through Chapter 2, ‘Quick-start tutorial’, in *Using ArcMap*.

### Finding answers to questions

Like most people, your goal is to complete your tasks while investing a minimum amount of time and effort on learning how to use software. You want intuitive, easy-to-use software that gives you immediate results without having to sift through pages of documentation. However, when you do have a question, you want the answer quickly so you can complete your task. That’s what this book is all about—getting the answers you need when you need them.

This book describes the temporal data tasks—from basic to difficult—that you’ll perform using ArcGIS Tracking Analyst. Although you can read this book from start to finish, you’ll likely use it more as a reference. When you want to know how to do a particular task, such as adding and symbolizing temporal data, just look it up in the table of contents or index. What you’ll find is a concise, step-by-step procedure to complete the task. Some chapters also include detailed information if you want to learn more about the concepts behind the tasks. You may also refer to the glossary in this book if you come across any unfamiliar terms or need to refresh your memory.

## Getting help on your computer

In addition to this printed documentation, Tracking Analyst also offers desktop and context-sensitive help as a valuable resource for learning how to use the software. To learn how to use help, see ‘Getting more help’ in the Tracking Analyst section of the ArcGIS Desktop Help system.

### Contacting ESRI

If you need to contact ESRI for technical support, see the product registration and support card you received with ArcGIS Tracking Analyst, or refer to ‘Contacting Technical Support’ in the ‘Getting more help’ section of the ArcGIS Desktop Help system. You can also visit ESRI on the Web at [www.esri.com](http://www.esri.com) and [support.esri.com](http://support.esri.com) for more information on Tracking Analyst and ArcGIS.

### ESRI education solutions

ESRI provides educational opportunities related to geographic information science, geographic information system (GIS) applications, and technology. You can choose among instructor-led courses, Web-based courses, and self-study workbooks to find education solutions that fit your learning style. For more information, go to [www.esri.com/education](http://www.esri.com/education).





# Quick-start tutorial

# 2

## IN THIS CHAPTER

- **Exercise 1: Adding and symbolizing temporal data**
- **Exercise 2: Replaying temporal data**
- **Exercise 3: Applying actions**

The best way to learn Tracking Analyst is to try it yourself. This chapter guides you through three exercises that will help you gain some basic skills in adding, symbolizing, and replaying fixed-time temporal data from disk in ArcMap, as well as how to apply actions to the data.

You'll be using data from hurricanes in 2000. You will add the temporal shapefile, customize how you want it to display on the map, and then play back the data. Then you'll use the Actions tab to apply a highlight to a hurricane when its winds reach or exceed a certain velocity.

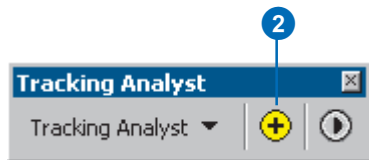
## Exercise 1: Adding and symbolizing temporal data

The scenario for the following exercises involves hurricane data from 2000. You'll add a shapefile of hurricanes containing temporal information to an existing ArcMap document (.mxd file) using the Add Temporal Data Wizard. Then you'll symbolize the data to indicate passing time. For procedures for adding real-time data, refer to Chapter 8, 'Working with real-time data'.

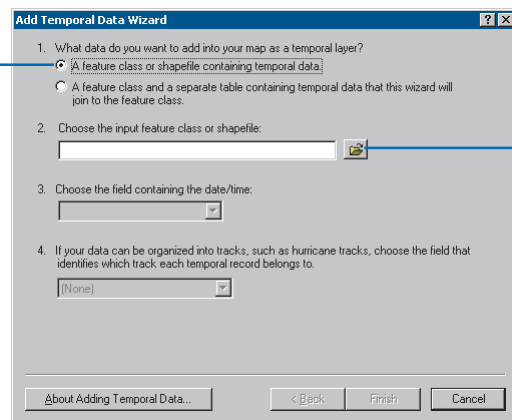
### Adding a shapefile or feature class

The following exercise leads you through the steps of adding a shapefile containing fixed-time data from disk. This shapefile contains simple temporal event data. For more information on simple and complex events, refer to Chapter 3, 'Working with temporal data'.

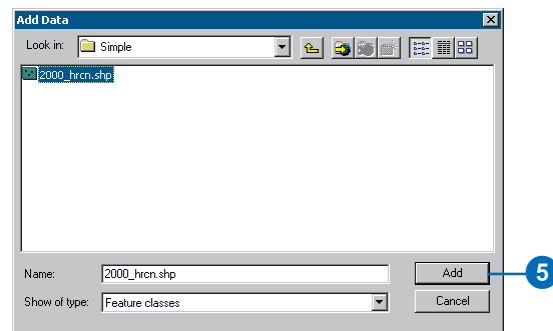
1. Start ArcMap and open the hurricanes2000.mxd file from your sample data folder.
2. Click the Add Temporal Data Wizard button on the Tracking Analyst toolbar. The wizard opens within the ArcMap window.



3. Leave the first button clicked to browse for a feature class or shapefile.
4. Click the Browse button to find the shapefile.

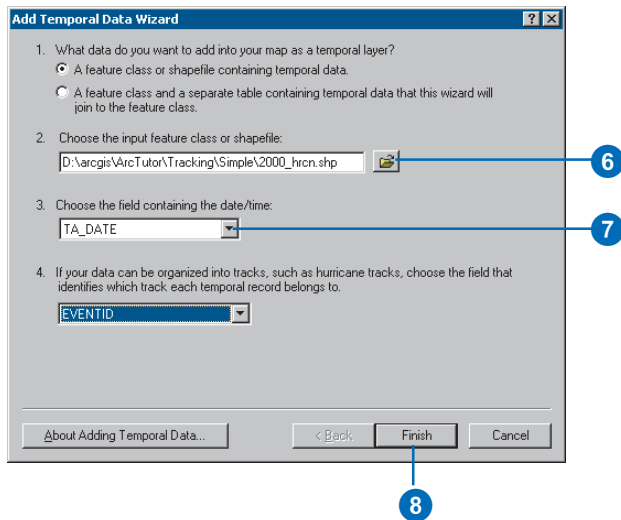


5. Click the 2000\_hrcn.shp shapefile in your sample data folder and click Add.



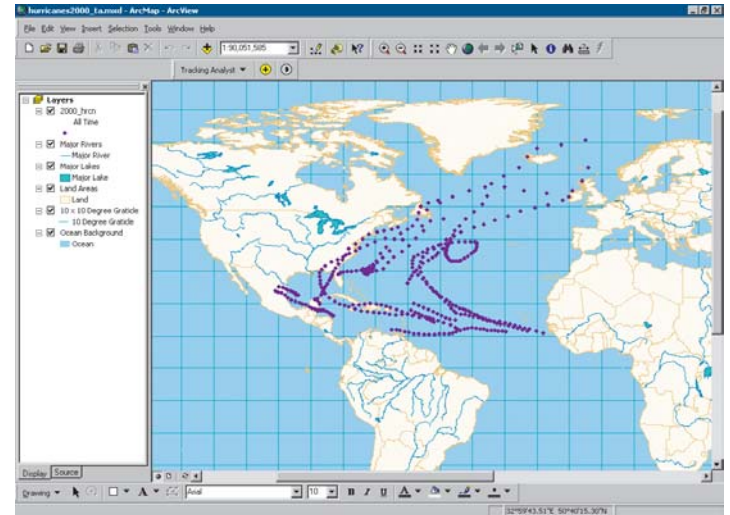
The file's pathname appears in the Add Temporal Data Wizard, and the two text boxes below it are enabled with default values.

6. Click the date/time field dropdown arrow and click TA\_DATE. This tells ArcMap to look in this field for the temporal component of the data. Tracking Analyst Symbology settings will also use this field to determine how symbols will draw during playback.
7. Click the track identifier field dropdown arrow and choose EVENTID from the fields listed. The ID field identifies each object in the dataset. Tracking Analyst uses it to apply tracks to data and to join complex temporal events.
8. Click Finish to add the layer to ArcMap.



The layer appears in the table of contents with a default base symbol and a label of All Time, and the data appears on the map.

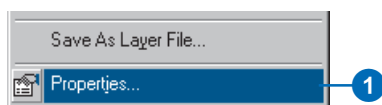
In the next procedure, you will modify the data's symbology to indicate the passage of time as the data occurred.



## Symbolizing temporal data

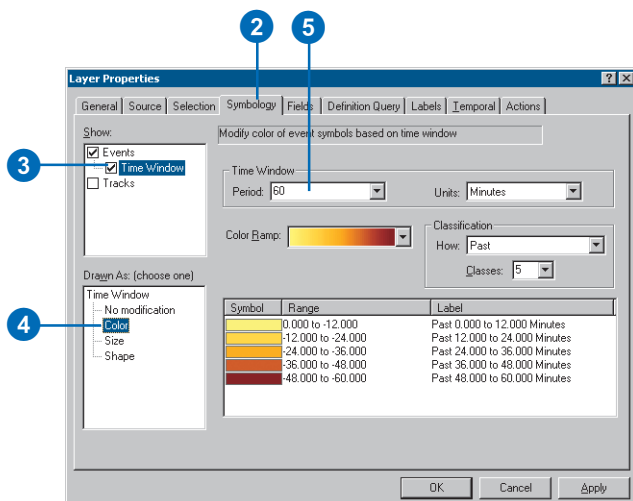
The Tracking Analyst extension allows you to set time-specific symbology so your data will display differently depending on its temporal components. Using the Symbology tab in the ArcMap Layer Properties dialog box, you can change color, shape, size, and time ranges.

1. Right-click the temporal layer you just added and click Properties.



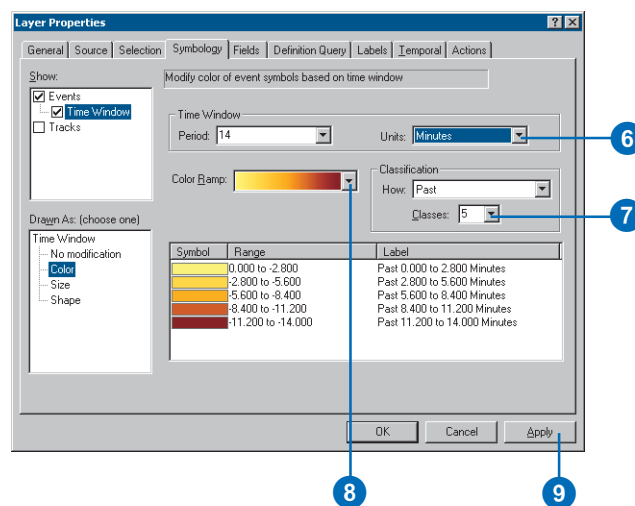
The Layer Properties dialog box opens.

2. Click the Symbology tab.
3. Click the Time Window check box in the Show panel.
4. Click Color in the Drawn As panel.
5. Click in the Period text box and type 14.

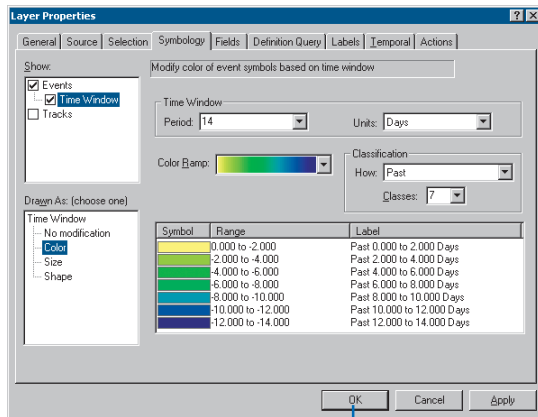


6. Click the Units dropdown arrow and click Days.
7. Click the Classes dropdown arrow and click 7 to divide the color range into seven classes of two days each.
8. Click the Color Ramp dropdown arrow and click on a color range that will show contrast when replaying data.
9. Click Apply to accept these changes, which now appear in the legend panel of the Symbology tab.

For more information on the settings in this dialog box, you can click the Help button on the title bar and click on the desired control to activate the Tracking Analyst context-sensitive help.

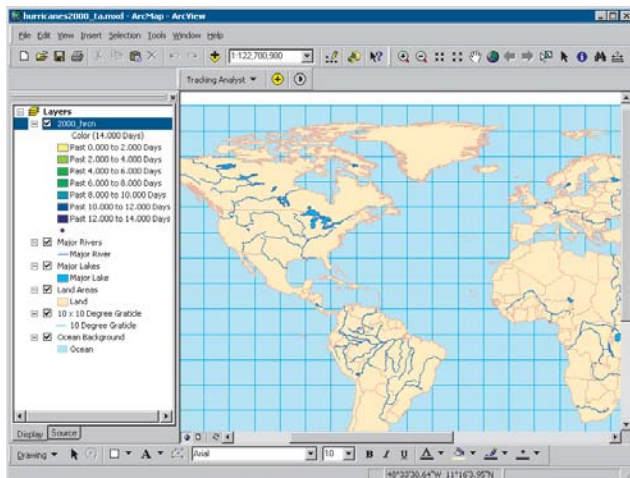


10. Click OK to accept changes and close the dialog box.



10

The new color range appears under the layer in the ArcMap table of contents. At this point, you will not see any data displayed on the map, because you have changed its temporal display properties. In the next exercise, you will display the data using the Playback Manager.





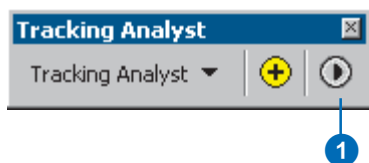
## Exercise 2: Replaying temporal data

You've already gone through the procedure for symbolizing data according to its temporal components, including setting time ranges to display, specifying classes, and viewing the new symbology in the ArcMap table of contents. The following procedure takes you through the steps of replaying the data using the Playback Manager.

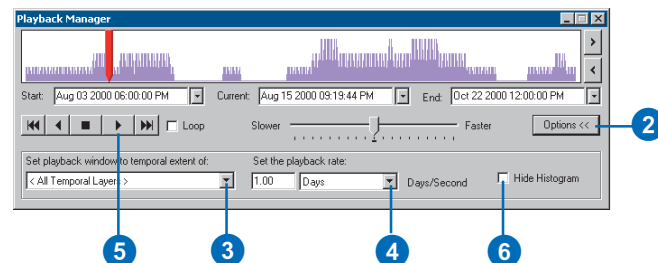
### Replaying symbolized temporal data

In the previous exercise, you've indicated that the data's color be modified according to its temporal components. Now you'll use the Playback Manager to replay the data as it occurred. In the Playback Manager, you can set start and end times, the playback window of data to replay, the speed of the playback, and whether you want the data to replay in a continuous loop. For more information on any item in the Playback Manager, you can click the question mark button and then the item to access Tracking Analyst's context-sensitive help.

1. Click the Playback Manager button on the Tracking Analyst toolbar. The Playback Manager opens.



2. Click Options to see a full view of the dialog box.
3. Click the Set playback window to temporal extent of dropdown arrow and click 2000\_hrcn, which is the temporal data layer you just added.



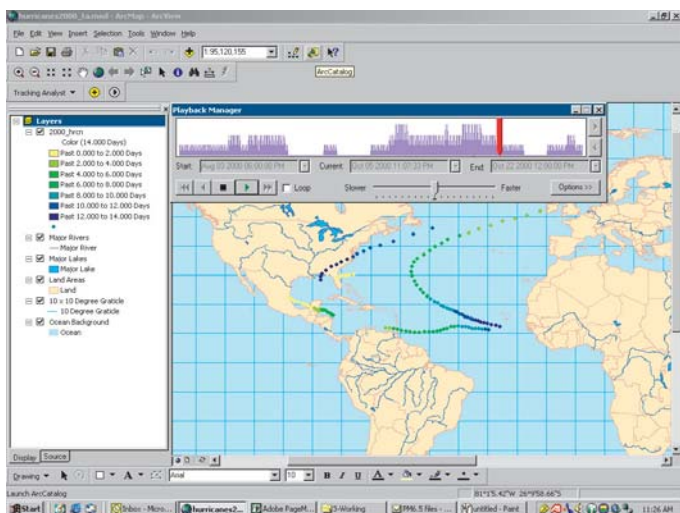
Note: This setting adjusts the start and end times of the playback window to include the temporal information for all data in the selected layer or layers. If you have added more than one temporal layer, you can set the temporal extent—start and end times—to all temporal layers, only those that are visible, or just a single layer.

4. Click the Playback Rate dropdown arrow and choose Days as the unit.
5. Click the Play button. The Playback Manager remains open, indicating progress of the playback, and the data begins to replay on the map.
6. If you want to condense the dialog box, you can click Hide Histogram to show the Playback Manager without the histogram.

You can speed up or slow down the playback rate by clicking and dragging the speed indicator in the center of the Playback Manager to the Slower or Faster setting. Click the Loop check box to play the data continuously.

The histogram at the top of the Playback Manager shows the amount of data available at a given time in the set temporal extent. You can change the Start, End, and





Current times by clicking the dropdown arrows beside those fields, or you can click in the fields to edit the date and time settings directly.

If you want to nudge the playback forward or backward while not playing data, you can click on the Next and Previous buttons to the right of the histogram. These buttons adjust the current date being displayed by a set increment, determined by the playback rate, plus any adjustments made to the speed using the slider bar. You can only use the Next and Previous buttons when not playing data.

You can also affect data display by clicking and dragging the time indicator or by clicking on the histogram at any point, which will set that point to the current time.

Note: If you have applied labels to a layer, they will not display on the map when you click and drag the time indicator in this manner for performance reasons.

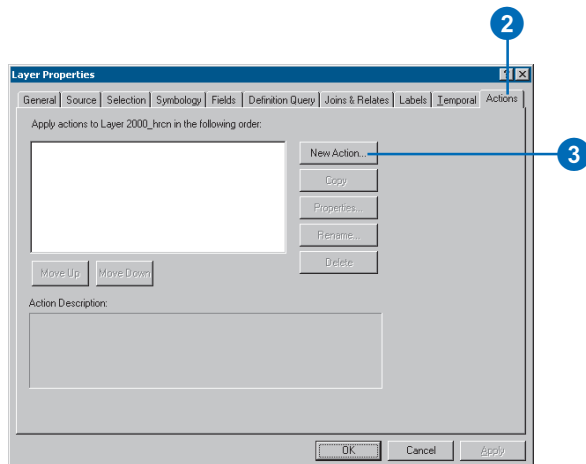
## Exercise 3: Applying actions

You can create and apply actions that will affect the data's display or properties. In the following exercise, you will apply a highlight action that will affect the display of the temporal data layer during playback. You will enter parameters in the Action Wizard to highlight a hurricane's path when it meets or exceeds a certain wind speed.

### Creating a highlight action for playback

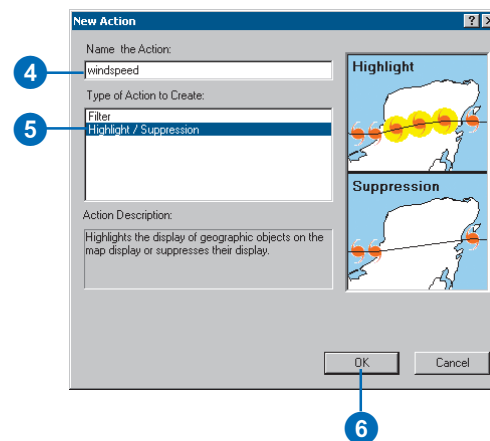
In the previous exercise, you replayed your symbolized data using the Playback Manager. In this exercise, you will add an enhancement to your playback by highlighting wind speeds of 75 mph and higher. You will use the Actions tab in the Layer Properties dialog box to apply the highlight.

1. Right-click the 2000\_hrcn temporal data layer in the table of contents and click Properties.
2. Click the Actions tab in the Layer Properties dialog box.
3. Click New Action.



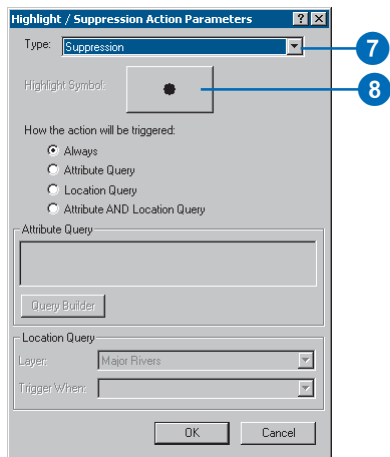
The New Action dialog box opens.

4. Click the text box and type "windspeed" as a name for the action.
5. Click Highlight / Suppression in the Type of Action to Create panel.
6. Click OK.

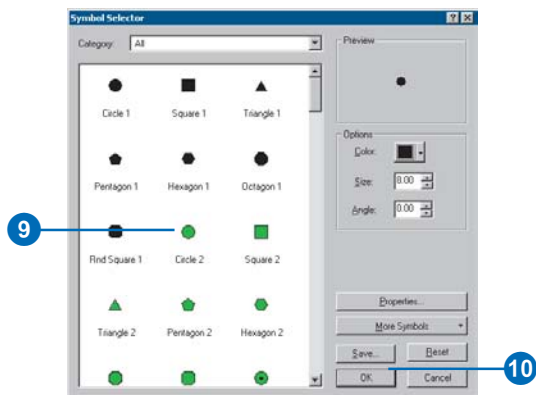


The Highlight / Suppression Action Parameters dialog box opens.

7. Leave the Type dropdown default of Highlight.
8. Click the Highlight Symbol button to open the ArcMap Symbol Selector dialog box.

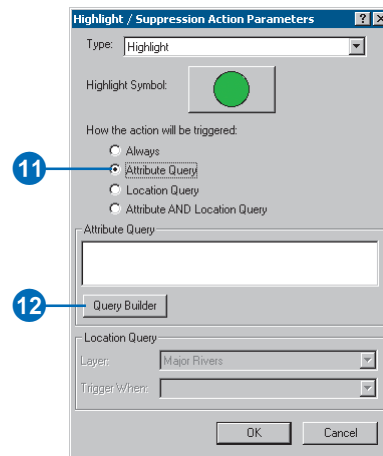


9. Scroll down and click the bright green circle symbol. Then adjust its size in the Options panel to the right.
10. Click OK.

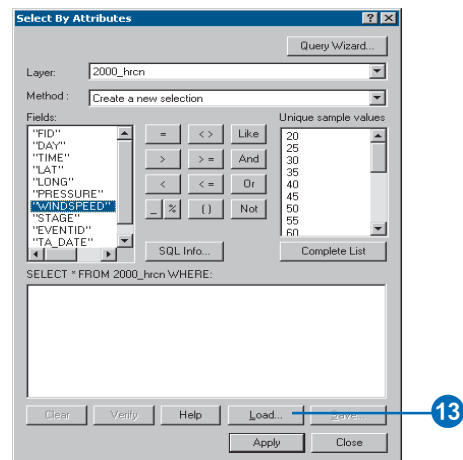


The symbol appears on the Highlight Symbol button in the Highlight / Suppression Action Parameters dialog box.

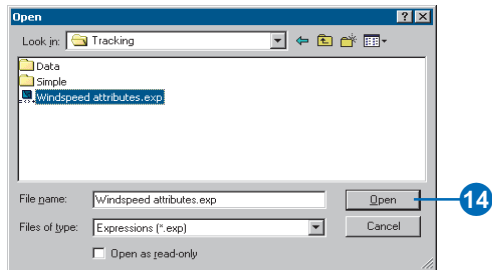
11. Click the Attribute Query button.
12. Click Query Builder.



13. Click Load to access the Open dialog box.

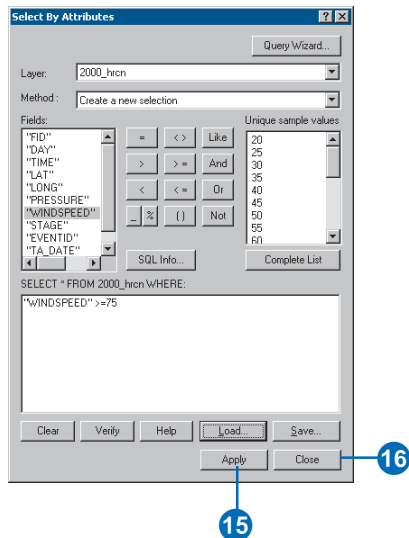


14. Click Windspeed attributes.exp in the sample data folder and click Open.



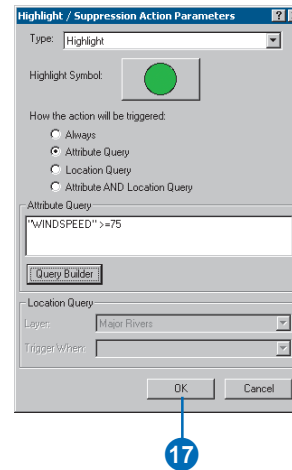
15. Click Apply to apply the new attribute query to the data layer.

16. Click Close.



Note: In this example, you're loading an existing expression. If an expression doesn't already exist, you can set up your own expression using the controls in this dialog box.

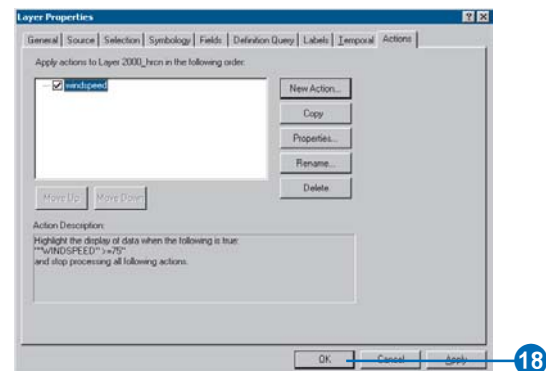
17. Click OK in the Parameters dialog box.



The new action appears in the list panel of the Actions tab.

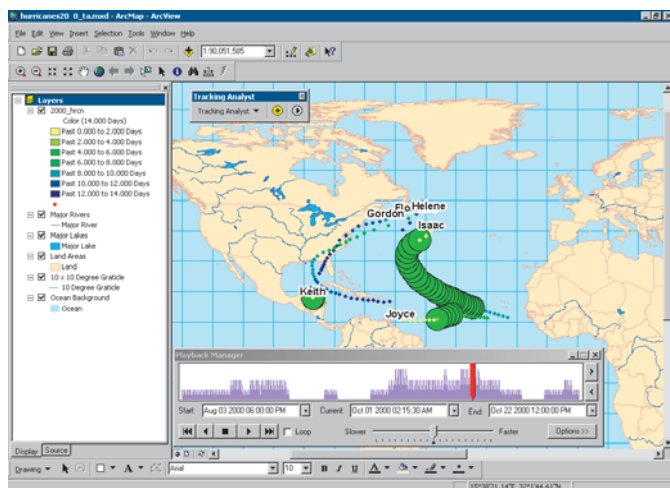
Note: You can highlight any action in the list panel to see more detail about it in the Action Description panel at the bottom of the tab.

18. Click OK.



19. Go through the steps of Exercise 2 to run the Playback Manager and view the changes you've made to the highlight setting.

In the example below, the highlight symbol is a bright green circle, which appears during playback but not in the table of contents. This circle indicates when a given hurricane reached a wind speed of 75 mph or higher.





# Working with temporal data

# 3

## IN THIS CHAPTER

- What is temporal data?
- Simple and complex temporal events
- Adding temporal data in ArcMap
- Adding a tracking shapefile from ArcView GIS 3.x
- Complex data
- Using temporal layer properties
- Displaying the most current temporal event
- Setting temporal offset for a layer
- Saving and exporting data in ArcMap

In this chapter you will learn the basics of working with temporal data using Tracking Analyst procedures in ArcCatalog and ArcMap. You will also gain conceptual knowledge about categorizing and structuring temporal events.

You will learn how to:

- Organize the concepts behind temporal data.
- Add temporal data in ArcMap.
- Set and change temporal layer properties.
- Save and export temporal data.



# What is temporal data?

*Temporal data*, also referred to as *tracking data*, can be included in an ArcMap document as an ArcMap layer using the Tracking Analyst extension. This data includes time- and date-specific information for geographic locations, which enables you to track real-time and previously documented observations, both discrete—such as lightning strikes—and continuous—such as trucking routes and flight paths.

You can add temporal data from a variety of sources in a variety of data structures, adding this data as a new ArcMap layer. Then edit the properties of this temporal layer based on the temporal component of the data. You can determine how much data appears at one time using time windows and alter symbology to display different aspects of your data.

## Data sources

The Tracking Analyst extension accepts stored temporal data referred to as *fixed-time* data, as well as real-time data sources, including the following:

Real-time sources

- ArcIMS® Tracking Server

Fixed-time sources

- Shapefiles
- Geodatabase feature classes

For more information on real-time data sources and structures, see Chapter 8, ‘Working with real-time data’.

## Data structures

Tracking Analyst accepts the following data structures from both real-time and fixed-time sources:

- Simple event
- Complex stationary event
- Complex dynamic event

## Date and time formats

ArcGIS Tracking Analyst depends on Windows®-based date and time formats. To view these formats, go to the Start menu, click Settings > Control Panel > Regional Options. This dialog box shows acceptable date and time formats for use in temporal datasets.

Note: Although the underlying architecture of ArcGIS Tracking Analyst supports milliseconds, there are some limitations in adding data with this time value.

# Simple and complex temporal events

Temporal data includes information about a *temporal event*, which describes an observation or set of observations through time of a particular object or group of objects. Therefore, the event includes information about the observation itself, such as when or where the observation took place, and what activity was observed, as well as identifying information about the object.

Tracking Analyst organizes this information into simple and complex temporal events. A *simple temporal event* contains all necessary information in one message or record, called the *temporal observation* component. A *complex temporal event* includes a second component, called the *temporal object*. In the case of fixed-time data stored on disk, these components appear as files or tables. Real-time data streams in—both simple and complex—from the ArcIMS Tracking Server, and components are automatically combined. For more information on real-time data structures, see Chapter 8, ‘Working with real-time data’.

## Using the track identifier field

Whether working with simple or complex temporal events, you will need to become familiar with the track identifier field, or ID field. The *ID field* contains an identifier for objects being observed through time. This value may be used to connect different observations of the same object for display and analysis purposes. For example, you may be tracking several trucks through a day’s work, each with its own ID value, and you can connect each truck’s activities, like connecting the dots. For U.S. citizens, social security numbers serve the same purpose. This field does not need to be called ID, but it is important to make sure it contains the appropriate identifying value.

The line connecting the dots, which you can apply on the Symbology tab, is called a *track*. Tracks can be applied to simple or complex temporal events when an ID field is set.

## Simple events

The temporal observation component is one part of the data information. It includes at least the date and time of the observation. If all the data is organized in one table, including the date and other attributes, the record—in fixed-time data—or message—in real-time data—is considered a simple event. This simple event contains in one component all elements necessary for Tracking Analyst to process and display it.

| ID | Time | Geometry | Status |
|----|------|----------|--------|
| 1  | T1   | X1,Y1    | Green  |
| 2  | T2   | X2,Y2    | Green  |
| 1  | T3   | X3,Y3    | Green  |
| 2  | T4   | X4,Y4    | Green  |
| 3  | T5   | X5,Y5    | Green  |
| 2  | T6   | X6,Y6    | Yellow |
| 4  | T7   | X7,Y7    | Green  |
| 1  | T8   | X8,Y8    | Green  |
| 1  | T9   | X9,Y9    | Red    |

## Complex events

Complex events include two components: an observation component and an object component. If the temporal observation component does not include all of the needed information for the object, additional information may be stored in a second component, called the *temporal object* component. The contents of this component will depend on whether the observed object is moving, static, or a discreet event—like a lightning strike. It will at least include certain static attributes and the ID field.

The merger of the temporal observation with the temporal object creates a complex event record or message. This merger uses one identical field in both tables—typically the ID field—to combine the two, yielding a full picture of each object’s information.

In the case of real-time data, this merger occurs automatically, so you will see the data message stream in with all of its necessary components already combined. For more information on real-time data, see Chapter 8, ‘Working with real-time data’.

A complex event may further be described as either stationary or dynamic.

## Complex stationary events

An example of a *complex stationary event* would be input from a traffic sensor. The sensor’s geographic location will not change, so its static coordinates or other location information are stored in the temporal object table. The temporal object component also includes the sensor’s ID and possibly other attributes. Because this information is stored in the object component, the temporal observation will include the ID, the date and/or time of the observation, and possibly other attributes—but not the locational information.

**Temporal Object Table**

| ID | Geometry | Type        | ... |
|----|----------|-------------|-----|
| 1  | X1,Y1    | Model # 200 |     |
| 2  | X2,Y2    | Model # 200 |     |
| 3  | X3,Y3    | Model # 300 |     |
| 4  | X4,Y4    | Model # 300 |     |

**Temporal Observation Table**

| ID | Time | Status   | Value |
|----|------|----------|-------|
| 1  | T1   | Active   | 100   |
| 2  | T2   | Active   | 80    |
| 1  | T3   | Active   | 100   |
| 2  | T4   | Active   | 110   |
| 3  | T5   | Active   | 90    |
| 2  | T6   | Inactive | 0     |
| 4  | T7   | Active   | 100   |
| 1  | T8   | Active   | 100   |
| 1  | T9   | Inactive | 0     |

## Complex dynamic events

An example of a *complex dynamic event* would be information from an airplane. Its geographic location is changing all the time, so that information would be stored in the observation component, in addition to its ID and the date and time of its observations. In this case, the temporal object table may include

information like the make and model of the aircraft, its pilot and crew information, and the age and capacity of the fuselage.

**Temporal Object Table**

| ID | Type | Airline  | ... |
|----|------|----------|-----|
| 1  | 747  | United   |     |
| 2  | 727  | American |     |
| 3  | 747  | United   |     |
| 4  | 767  | United   |     |

**Temporal Observation Table**

| ID | Time | Geometry | Status |
|----|------|----------|--------|
| 1  | T1   | X1,Y1    | Green  |
| 2  | T2   | X2,Y2    | Green  |
| 1  | T3   | X3,Y3    | Green  |
| 2  | T4   | X4,Y4    | Green  |
| 3  | T5   | X5,Y5    | Green  |
| 2  | T6   | X6,Y6    | Yellow |
| 4  | T7   | X7,Y7    | Green  |
| 1  | T8   | X8,Y8    | Green  |
| 1  | T9   | X9,Y9    | Red    |

*Table join for a complex dynamic temporal event*

## Adding complex events from fixed-time data

The procedures that follow include steps for adding fixed-time simple and complex temporal events as new layers in ArcMap. When you add complex events from fixed-time data, the Add Temporal Data Wizard will ask you for the two components described above. The wizard, however, uses different terminology—input feature class and input table—to define how and where the data is stored. Both the feature class and the table must reside in the same geodatabase.

The *input feature class* always contains at least the geographic features and the ID for the data you are adding. Its other contents depend on the type of event you’re adding—either dynamic or stationary. If dynamic, the input feature class will contain the dates and times of observations, but not static attributes. If stationary, the input feature class will contain the object’s static attributes, but not the dates and times of observations.

Likewise, the *input table* will contain at least the ID and attribute information. If the complex event is dynamic, the input table will contain static object information. If stationary, the input table will contain dates and times of observations.

## Adding temporal data in ArcMap

If you have temporal data stored on disk, or *fixed-time data*, you will use the Tracking Analyst Add Temporal Data Wizard to add the feature class or shapefile as a new layer in ArcMap. This procedure replaces the typical ArcMap procedure for adding data through the Add Data dialog box.

### Tip

#### Enabling the extension

If the Tracking Analyst toolbar appears in ArcMap with one or more of its buttons unavailable, you'll need to activate the Tracking Analyst extension. Click Tools and click Extensions to open the Extensions dialog box. Click the box beside ArcGIS Tracking Analyst.

### Tip

#### Accessing the Tracking Analyst toolbar

If the Tracking Analyst toolbar does not appear in your ArcMap window, click View and click Toolbars, then Tracking Analyst. Click Customize and add a new toolbar in the Customize dialog box. Then drag the Tracking Analyst tools from the dialog box.

## Adding a shapefile or feature class

1. Click the Add Temporal Data Wizard button on the Tracking Analyst toolbar.

On the wizard, the first button is selected by default, which will browse for a shapefile (.shp) or feature class. Leave it at the default setting.

2. Click the Browse button and choose the shapefile or feature class you want.
3. Navigate to the desired shapefile or feature class, highlight it, and click Add.

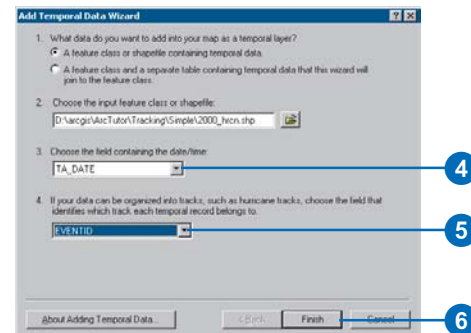
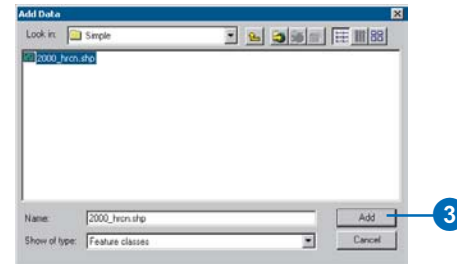
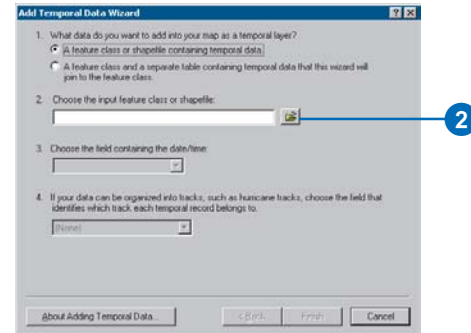
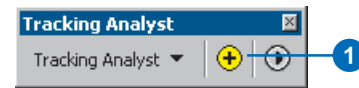
The file's pathname appears in the wizard. Default values appear in the Date/Time and Track ID text boxes.

4. Click the date/time field dropdown arrow and choose the appropriate field.
5. Click the track ID dropdown arrow and click the appropriate ID field from the list.

Note: Click None if you're adding discrete events such as lightning strikes.

An ID field is required if you want to apply tracks, labels, and the most current setting.

6. Click Finish to add the layer to ArcMap. ►



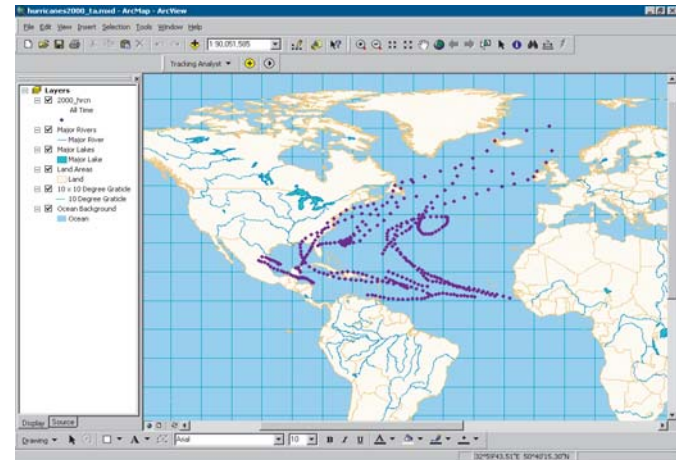
## Tip

### Adding temporal data as a layer file (.lyr)

*Instead of using the Temporal Data Wizard each time you want to add temporal data, you can save the layer as a .lyr file from ArcMap. Then use the regular Add Data dialog box to add the data to maps in the future, or drag the file into ArcMap from ArcCatalog.*

*Note: If you have applied actions to a temporal layer that you save as an .lyr file, these actions will be read-only in the resulting .lyr file.*

The layer appears in the table of contents with a default base symbol and an All Time label, and the data appears on the map.



## Adding a tracking shapefile from ArcView GIS 3.x

The procedure for adding a tracking shapefile is very similar to the one shown here. If you choose to add a shapefile from Tracking Analyst for ArcView® GIS 3.x, the Tracking Analyst Add Temporal Data Wizard will automatically detect it. The options in the wizard will change accordingly. The wizard will list the ID field automatically, recognizing that it has already been set up as a tracking shapefile.

The final option in the wizard requires you to save the shapefile as a feature class in a geodatabase. You must save the tracking shapefile to an existing geodatabase to add it as a layer in ArcMap. This step effectively converts the 3.x shapefile to a format compatible with the current version of ArcGIS Tracking Analyst.

### Adding a tracking shapefile from ArcViewGIS 3.x

1. Open a background .mxd file in ArcMap.
2. Click the Add Temporal Data Wizard button on the Tracking Analyst toolbar.
3. Click the Browse button to navigate to the tracking shapefile you wish to import.

Note: A tracking shapefile from ArcView GIS 3.x will already contain temporal and track identifier information. This procedure converts the file into a feature class to make it more compatible with ArcGIS Tracking Analyst.

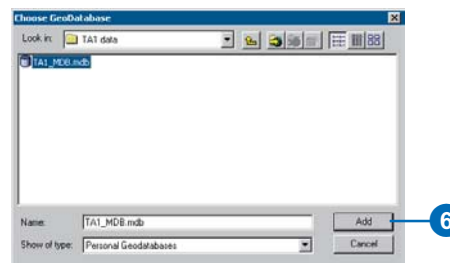
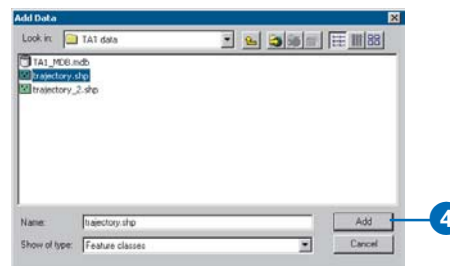
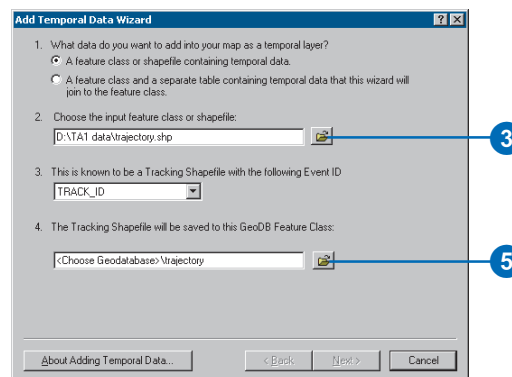
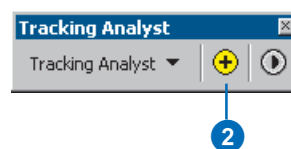
4. Navigate to the file you want, highlight it, and click Add.

The wizard changes to indicate the file's identifier field.

5. Click Browse to navigate to a geodatabase where the new feature class will reside.

Note: If a geodatabase doesn't already exist, you can create one in ArcCatalog. See *Using ArcCatalog* for more information.

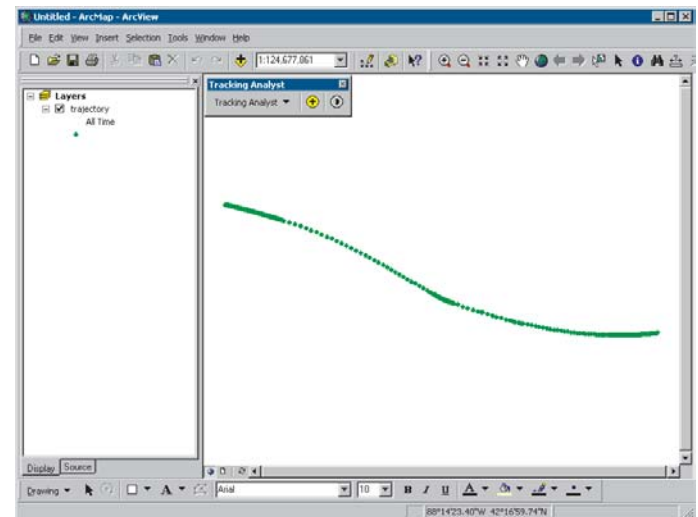
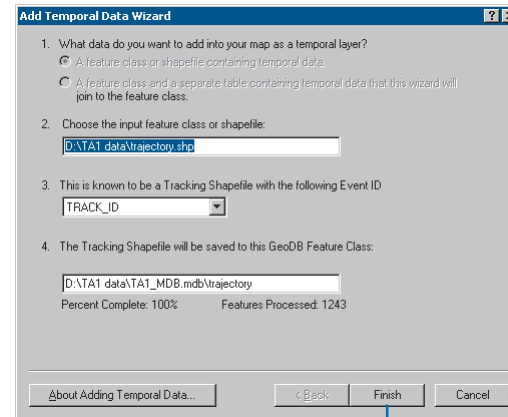
6. Click on the geodatabase you wish to contain the new feature class and click Add. ►



A progress bar appears at the bottom of the wizard, indicating the status of the file conversion.

7. Click Finish.

The new feature class appears in ArcMap as a new layer, both on the map and in the table of contents.





## Complex data

When you add a complex temporal event as a new layer in ArcMap, you will be merging, or joining, two components of data: temporal object and temporal observation, both described earlier in this chapter. For more information, see ‘Adding complex events from fixed-time data’ in this chapter.

For real-time data, ArcIMS Tracking Server manages the merging of the two components. For more information on real-time data, see Chapter 8, ‘Working with real-time data’.

### Tip

#### Creating a feature class

*If you have a shapefile or a table that you wish to make part of a complex temporal dataset, you can use tools in ArcCatalog to import the shapefile into a geodatabase as a feature class. See Using ArcCatalog for more information.*

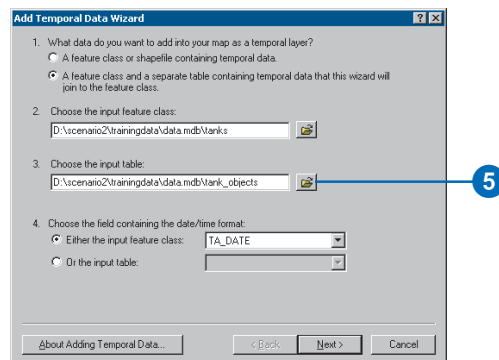
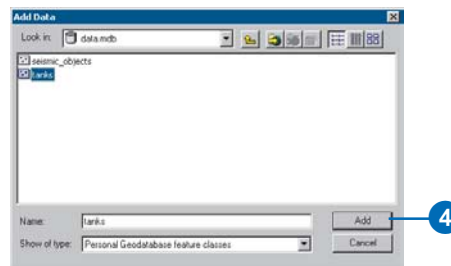
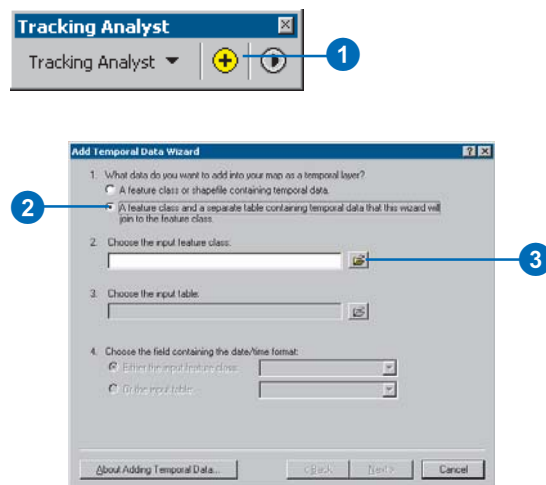
## Adding complex temporal data

1. Click the Add Temporal Data Wizard button on the Tracking Analyst toolbar.
2. Click A feature class and a separate table containing temporal data that this wizard will join to the feature class button.
3. Click the Browse button and navigate to the geodatabase (.mdb) you want. Click Add.
4. Highlight the input features component and click Add.
5. Click the Browse button and choose the input table.

Note: Make sure the table resides in the same geodatabase as the feature class you just selected.

6. Highlight the table you want and click Add.

Its path and filename appear in the wizard, and the Date/Time Format buttons and dropdown lists are enabled with default values. ►



## Tip

### Time Field for stationary and dynamic complex events

*If you are dealing with entities that change position through time, called dynamic complex events, the temporal information will appear in the input feature class. If the entities are stationary, the date and time will appear in the input table.*

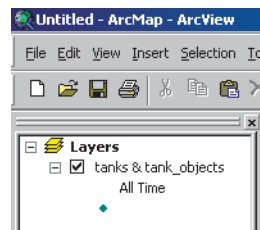
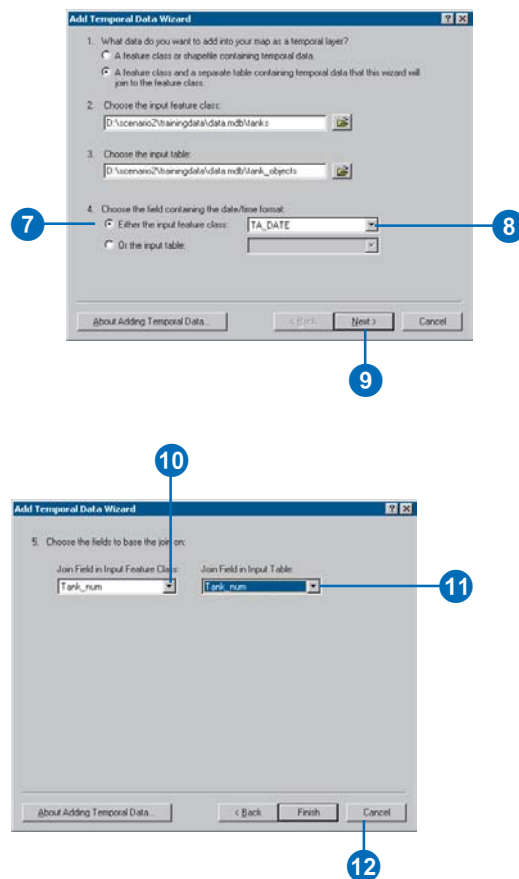
## Tip

### Using Join Field dropdown lists

*The fields you choose from the dropdown lists will contain the corresponding ID field contained in both the input feature class and the input table. These fields are not required to have the same name, but they must contain the same identifying information to join the files successfully.*

- Click the button beside the appropriate input file containing the date and time information—either the input feature class or the input table.
- Click the date/time format dropdown arrow to choose the appropriate date and time field if it does not appear automatically.
- Click Next.
- Click the Join Field in Input Feature Class dropdown arrow and choose the appropriate field to perform the join.
- Click the Join Field in Input Table dropdown arrow, and choose the appropriate field to perform the join.
- Click Finish.

A message appears on the wizard that the join completed successfully. The combined feature class appears as a new layer in ArcMap with a default layer name and a label of All Time.



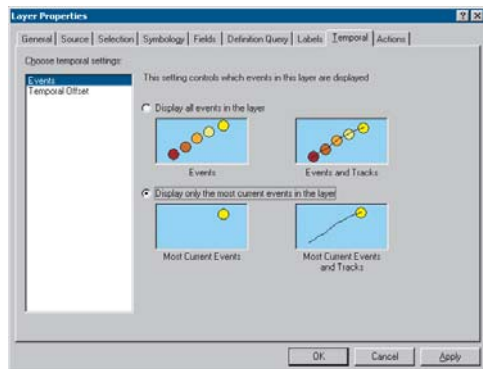
Once the new layer appears in ArcMap, you can edit the symbology .

# Using temporal layer properties

The Temporal tab in the ArcMap Layer Properties dialog box allows you to access specific Tracking Analyst settings for temporal data layers in ArcMap.

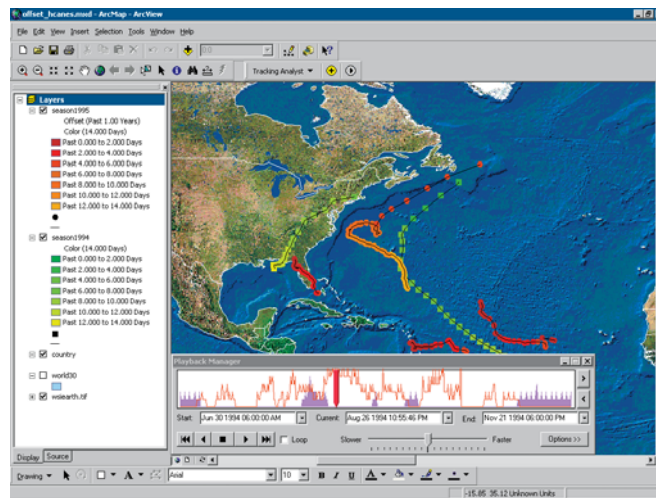
## Displaying the most current temporal event

You may decide to display only the most current temporal events in ArcMap. For example, if you're monitoring a trucking fleet, you may want to monitor only the trucks' latest location. The most current setting hides the display of previous events, and it can be enabled or disabled on the Temporal tab. It uses the ID field to determine each unique event to display. Click Events in the Settings panel and click the Display only the most current events in the layer button.



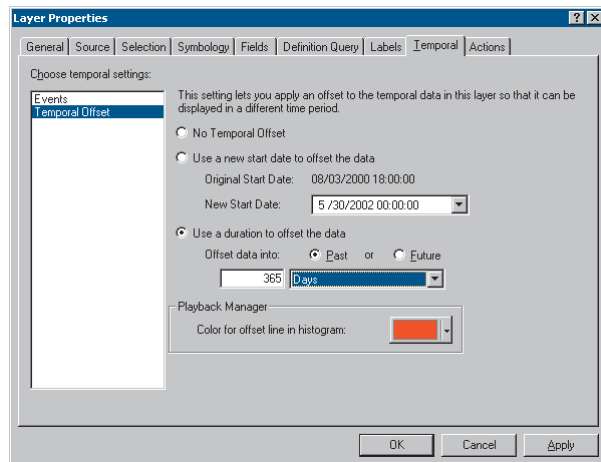
## Using temporal offset

The *temporal offset* feature of Tracking Analyst allows you to adjust the temporal display of data so that it replays at a user-defined date and time. The offset will not change the temporal component of the data itself, but it will allow you to display the data as if it were happening at a different time.



Temporal offset has two basic purposes: analysis and planning. First, you can use it to compare two or more sets of past temporal data and display them at the same time in ArcMap. This feature is useful if you want to analyze multiple sets of fixed-time data and look for temporal patterns within the data. For example, you can compare the hurricane seasons for two different years and determine if more storms occur in any given month. This analysis can help with weather predictions, travel planning, and other cases where these patterns would be helpful.

Another use for temporal offset is to help plan a mission or tour. A mission commander can plot several different scenarios for troop movement and plan time-sensitive steps of the operation using a fictitious time frame. If the need arises for the execution of such an operation, the commander can open one of the planned scenarios and adjust the temporal information to the current time using temporal offset.



offset to be played back. For more information on Playback Manager settings, see Chapter 5, ‘Displaying temporal data’.

Note: If you offset data into the future, you may need to change the end time before changing the start time. The Playback Manager will not allow you to enter a start time that is later than the end time.

Set temporal offset properties on the Temporal tab in the ArcMap Layer Properties dialog box using one of two methods. To use a date range for temporal offset, click Use a new start date to offset the data and type the desired date in the New Start Date text box. You can also click the dropdown arrow to choose a date from the popup calendar. The Start Date method is the most likely option if you’re using temporal offset as a planning tool. If you use duration for temporal offset, click Use a duration to offset the data. Then click either Past or Future and type the number value for the offset. Click the dropdown arrow and choose a unit. Use this method when using temporal offset to compare and analyze two or more sets of stored fixed-time data.

Once you’ve changed these settings, you can click the Color for offset line in histogram dropdown arrow and choose a color for the offset line. This line will appear in the Playback Manager histogram to indicate the offset data’s placement within the playback window. You may need to adjust the start and end date/time settings in the Playback Manager to allow data that has been

## Displaying the most current temporal event

The most current setting hides the display of previous events for each ID in a dataset, and it can be enabled or disabled on the Temporal tab.

The following procedure takes you through the steps of enabling the most current setting to show only the most recent event on the map for each record in the dataset.

### Tip

#### Using tracks with the most current setting

*If you have applied tracks to a dataset and then used the most current setting, the tracks still appear on the map. They will abide by the constraints of the time window if you have set one.*

*Temporal symbology will still change as the data ages. The color, size, or shape of the features will change, and a track will connect the features.*

### Tip

#### Setting an ID field

*If you do not set an ID field when adding temporal data, you will not be able to apply tracks, labels, or the most current setting.*

## Enabling the most current setting

1. Open an .mxd file and add the temporal data you want to display.

For more information on adding data, see 'Adding a simple shapefile or feature class' or 'Adding complex temporal data' in this chapter.

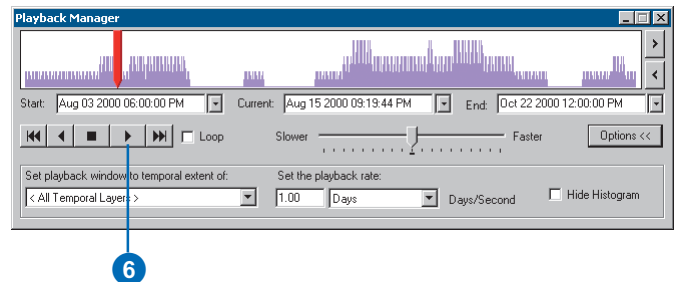
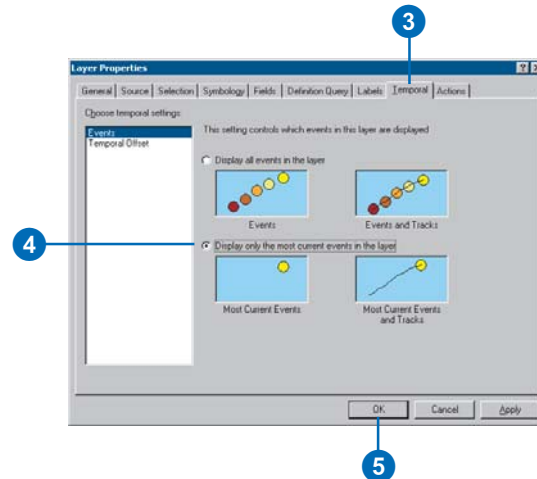
2. Double-click the temporal data layer you wish to display.
3. Click the Temporal tab in the Layer Properties dialog box.

Show is highlighted in the Settings panel.

4. Click Display only the most current events in the layer.

Note: This setting will display the most current event for each ID—that is, each unique object—in the dataset. Previous events for each ID will be hidden.

5. Click OK.
6. Use the Playback Manager to display the data with the new setting.



## Setting temporal offset for a layer

The following procedure takes you through the steps of offsetting the time display of one temporal layer so that it will display simultaneously with other temporal data.

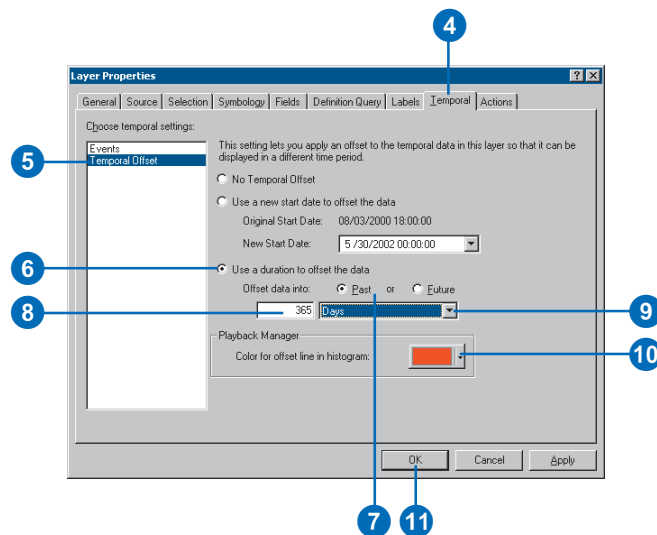
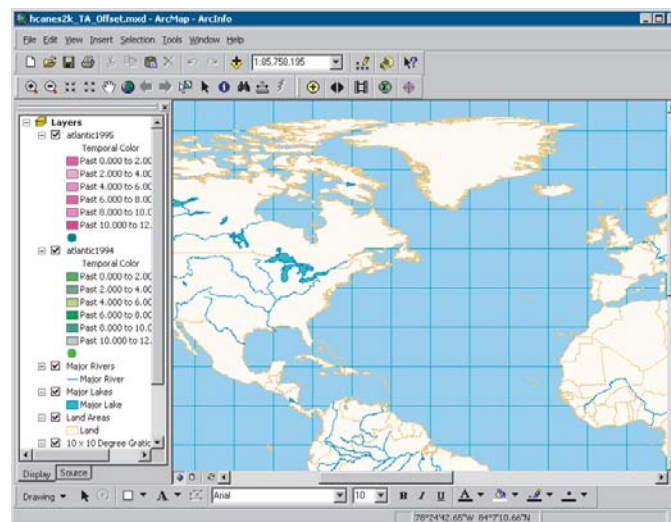
Here, hurricane data was added for 1994 and 1995—each year as its own layer. The two layers were symbolized to differentiate them on the map. In this example, you will apply a 365-day offset to the 1994 layer so that it will replay with the 1995 data.

## Setting temporal offset for a fixed-time temporal layer

1. Open an .mxd file and add the temporal data you want to offset.
2. Click the Symbology tab in the Layer Properties dialog box to apply temporal symbology to the layer.
3. Right-click the layer you want to offset and click Properties on the context menu.
4. Click the Temporal tab in the Layer Properties dialog box.
5. Click Temporal Offset.

Three buttons become active.

6. Click Use a duration to offset the data.
7. Click Past or Future for the offset.
8. Click the text box and type "365".
9. Click the dropdown arrow and choose Days for the units.
10. Click the Color for offset line in histogram button and choose a color for the offset line that will appear in the Playback Manager.
11. Click OK to accept changes and close the dialog box.►



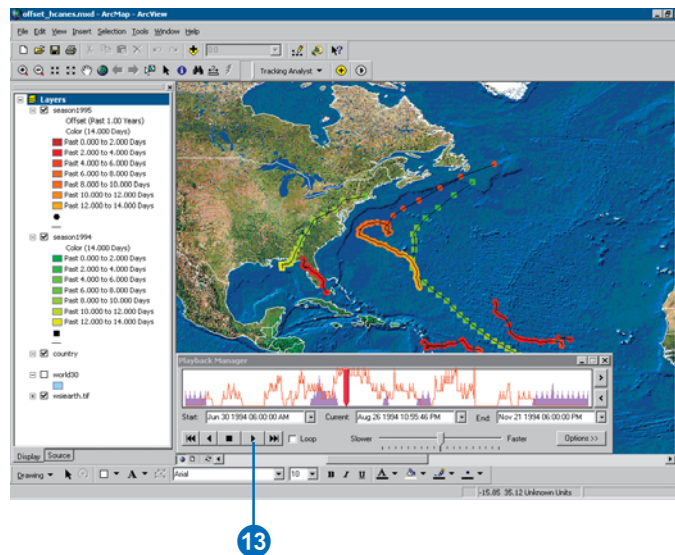
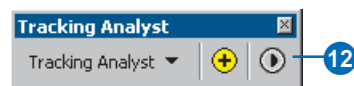
## Tip

### Adding and symbolizing temporal data

For more information on adding and symbolizing temporal data, see Chapter 3, 'Working with temporal data', and Chapter 4, 'Symbolizing temporal data'.

12. Click the Playback Manager button on the Tracking Analyst toolbar.

13. Change playback settings as desired and click the Play button to replay the data.





## Saving and exporting data in ArcMap

You can save temporal data in four ways within ArcMap: save the temporal layer or layers as a .lyr file or files, export the map as an image file, using a number of different image formats, export the temporal layer as a shapefile, or save the entire .mxd file.

Saving a temporal layer as an ArcMap .lyr file or as a shapefile will save only that specific layer. The other two options allow you to either export or save the entire map as an image or .mxd file.

### Tip

#### Exporting a map

*You can export a map displayed in ArcMap as an image file, which can then be used in other applications or documents. Make sure to choose an image file format that suits your needs.*

### Tip

#### Exporting an AVI file

*You can also export temporal data as a video file (AVI format) or individual frames. See Chapter 5, 'Displaying temporal data', for more information.*

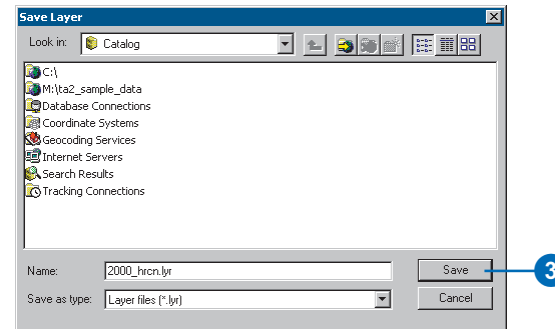
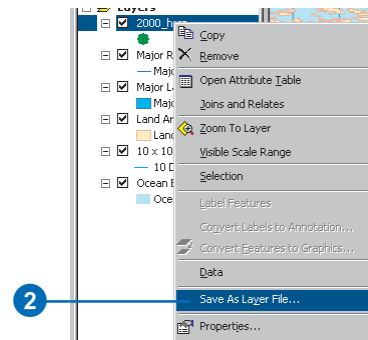
## Saving a temporal layer as a .lyr file

1. Right-click the layer you want to save in the table of contents.
2. Click Save As Layer File from the Context menu to open the Save Layer dialog box.
3. Navigate to the desired folder and click Save.

The file is saved with the layer name by default. You can type a different name if you prefer.

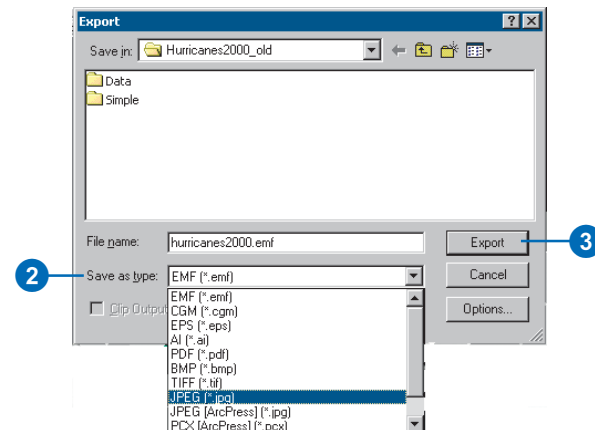
4. Add this layer to any map using the ArcMap Add Data button.

Note: If you have applied actions to a layer that you export as an .lyr file, the applied actions will be read-only in the resulting file.



## Exporting a map

1. Click File and click Export Map.
2. The Export window opens. Navigate to the folder where you want your image file and choose the file format you want to use from the Save as type dropdown list.
3. Click Export to save the image file.



## Exporting temporal data

1. Right-click the temporal layer in the Table of Contents and click Export Data on the context menu.

The Export Data dialog box opens.

2. Click the Export dropdown arrow and choose All features or All features In View Extent.

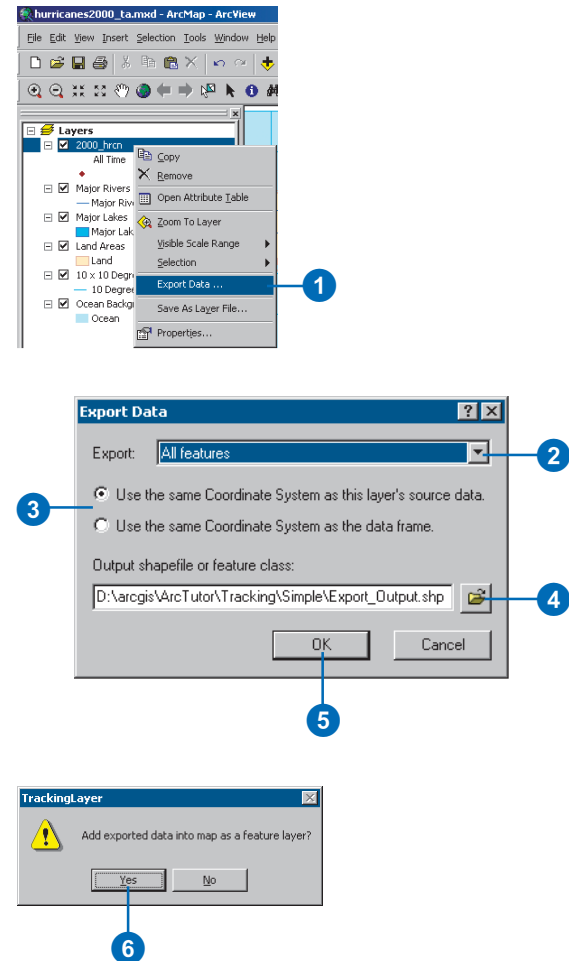
Note: If you have selected features in the layer, you can also choose Selected features.

3. Click the appropriate button to either use the same coordinate system as the layer's data source or use the same coordinate system as the data frame.
4. Click the Browse button and navigate to the destination folder for the output shapefile or feature class.
5. Click OK.

A message will appear, asking if you want to add the shapefile to the current map.

6. Click Yes to include the output shapefile in the current map document, or No to save it without including it on the map.

The new layer will be saved as a temporal layer.



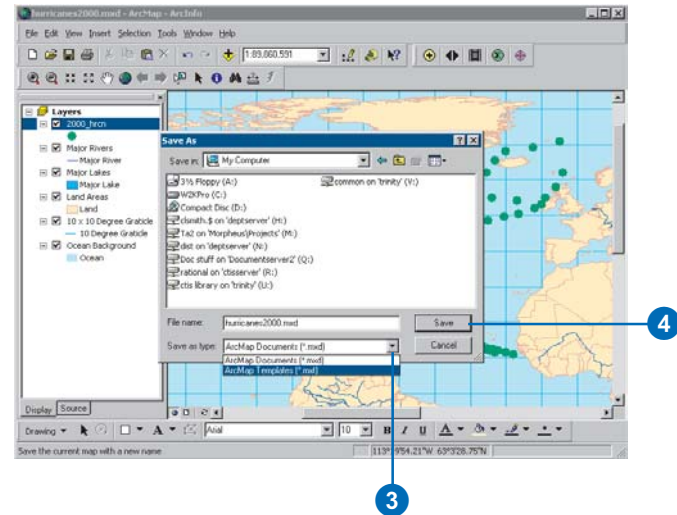
## Tip

### Viewing tabular data

*You can right-click on a temporal data layer and click Open Attribute Table to open a tabular view of the selected layer, though data editing is not supported.*

## Saving a map with temporal data as an ArcMap .mxd file

1. Click the Save button on the ArcMap Standard toolbar.  
**Note:** If the file has already been saved, it will automatically save the new information to the same filename. Otherwise, the Save As window appears.
2. Navigate to the folder where you want the finished .mxd file to reside.
3. Click the Save As type dropdown arrow, and choose to save the map as an ArcMap file (.mxd) or a template (.mxt).
4. Type a name for the file in the File name text box and click Save.



# Displaying data

## Section 2





# Symbolizing temporal data

# 4

## IN THIS CHAPTER

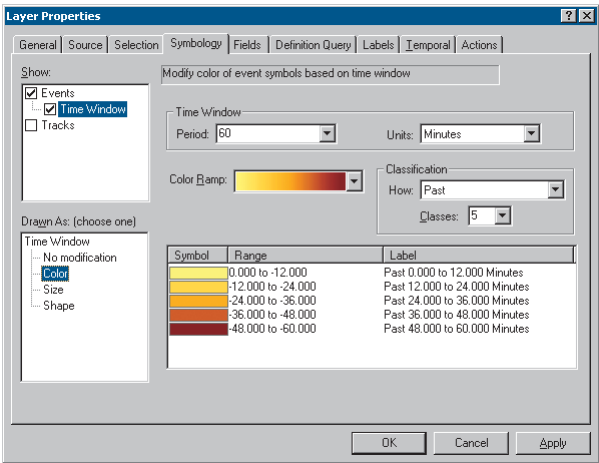
- About symbolizing temporal data
- Symbolizing point data
- Symbolizing line data
- Symbolizing polygon data
- Symbolizing a track

Symbology for temporal data changes through time. In addition to changing display attributes for regular discrete events, Tracking Analyst allows you to modify symbology color, shape, and size according to the age of the data. You can also symbolize data according to tracks and modify other display properties. In this chapter, you will learn to:

- Symbolize a temporal event.
- Modify symbology to depict the age of data.
- Symbolize a track.

# About symbolizing temporal data

The ArcGIS Tracking Analyst extension allows you to change the data’s symbology by individual layers. This enables you to differentiate symbology on the map and distinguish between different layers displayed on the map.



## Symbology tab settings

You can use the settings on the Symbology tab to customize the appearance of your data based on its temporal attributes. You begin with base symbology for events in the layer, which you can then modify based on the set time window. These modifications will change color, size, or shape, depending on the type of data you’re working with. For example, although point data can be symbolized by color, size, or shape, lines and polygons are limited to color modifications. You can also choose to display the data within the time window with no changes to its symbology by choosing the No modification option.

The following table shows what type of symbology modifications are available for each type of data.

| Data Type | Symbolize by... |      |       |                 |
|-----------|-----------------|------|-------|-----------------|
|           | Color           | Size | Shape | No modification |
| Point     | X               | X    | X     | X               |
| Line      | X               |      |       | X               |
| Polygon   | X               |      |       | X               |

## Setting base symbology

You can set a *base symbol*, or default symbol, for your data by clicking Events in the Show panel of the Symbology tab. The Drawn As panel will show you which settings are available for the base symbology. By default, the base symbology is a single symbol. Choose the best way to symbolize your data. The base symbology will change based on the temporal symbology options you choose.

## Modifying data’s symbology to depict its age

The display properties of temporal data differ from those of other data because you can change data appearance as time passes. The data’s symbology can age, or change through time, based on the temporal field specified in the fixed-time or real-time dataset. You can display these changes to visually enhance the data you’re viewing on the ArcMap display.

For instance, you can use a color ramp to indicate the aging of data. The data may appear yellow when it depicts an event less than 10 days old, green for 10–20 days, and blue up to 30 days. This change in the data’s display over time helps you to clearly define events—not only by where they occur, but also by when they occur.

When you check Time Window in the Show panel of the Symbology tab, the Drawn As panel below it changes to display your options for symbolizing temporal data. You can choose No modification, Color, Size, or Shape for points. For lines and polygons, options include No modification and Color.

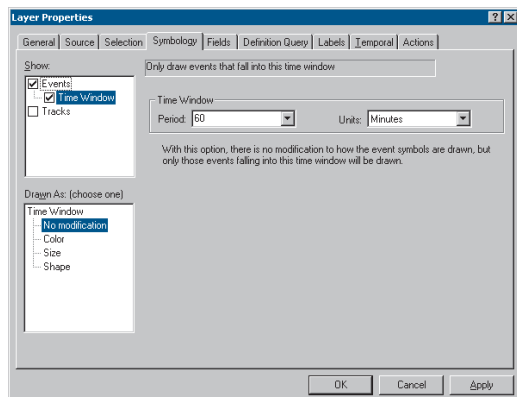


Note: Time window settings behave differently for real-time data than for fixed-time. With fixed-time data, the time window defines how much of the full temporal extent of the dataset displays on the map during playback. For real-time data, the time window limits the number of visible features as they stream in and as they're replayed in playback mode. For more information on these different display behaviors for real- and fixed-time data, see the section on time modes in Chapter 5, 'Displaying temporal data'.

Note: When you change the Drawn As settings described below, the layer's time window settings—Period and Units—will remain the same. Other settings will reset to their defaults.

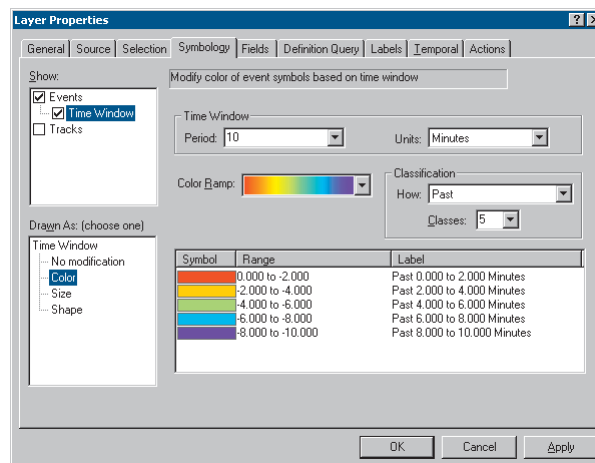
## No modification

The No modification option in the Drawn As panel allows you to change the time window settings to determine how much data will display. Any data outside the parameters you set here will not display on the map. Data within the time window will display using the base symbology. This option is available for point, line, and polygon data.



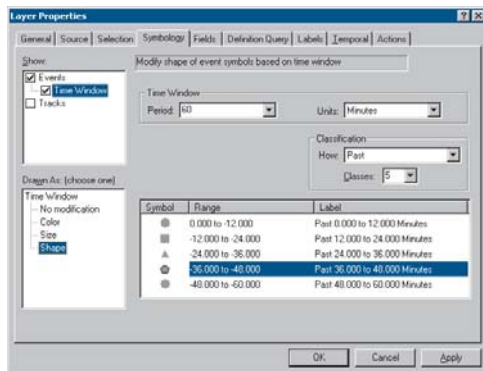
## Color

The Color option in the Drawn As panel allows you to change the appearance of data as it ages by color. Use the Color Ramp dropdown arrow to select the color gradation you want to display as time passes. The legend panel at the bottom of the tab updates with the colors you have chosen, dividing the color gradation into classes. This option is available for point, line, and polygon data.



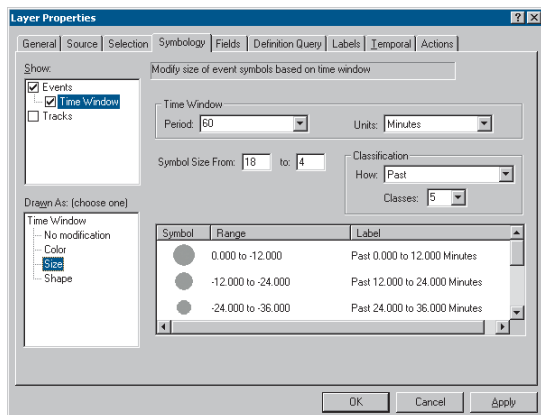
## Shape

The Shape option in the Drawn As panel allows you to change the way data appears as it ages by its shape. Double-click any shape in the Symbol column of the legend panel and choose the desired shape from the ArcMap Symbol Selector. You can do this individually for each class in the legend panel. This option will allow you to change only the shape of the symbol—not the size, color, or rotation, which are characteristics determined by the base symbology. This option is available only for points.



## Size

The Size option in the Drawn As panel allows you to change the way data appears as it ages by its size. Enter numeric integer values to determine the size range of the symbols you want to draw during playback. The symbols will change accordingly in the legend panel. With this option, type in From and To values for the symbol size. This option is available only for points.



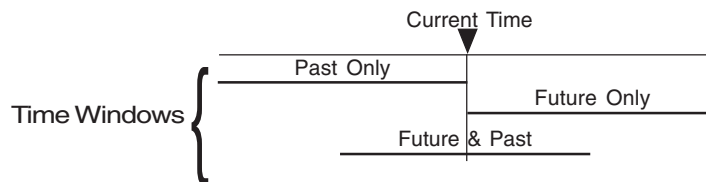
## Other display settings

**Period.** The Period dropdown list allows you to set the time window in which the data will display. Choose a value from the list or type in a decimal numeric value.

**Units.** The Units dropdown list allows you to set the time window units in which the data will display. Choose a unit from the list.

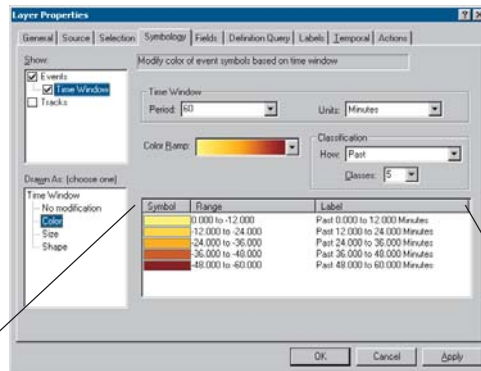
Note: You cannot enter a unit that does not appear in the list.

**Classification settings.** The Classification settings allow you to set how your data will display—past, past and future, or future—as well as the number of classes, or divisions, for the time window you want to display.



**How: Past and Future.** Tracking Analyst also allows you to set a time window that will display data in the past, future, or both—spanning the zero point of the present moment. Because real-time data can only be viewed in the present and past, as it streams in, you won't be able to view it in a Future time window. But the Future time window gives the user a lot of flexibility in viewing fixed-time data. The time line below illustrates the variety of time window options for the past and future.

For example, imagine you have a six-hour temporal window. You can set that window to show data from the present moment back in time to show the past six hours. Depending on the situation, you can also set the window to display data from the present



| Symbol | Range              | Label                         |
|--------|--------------------|-------------------------------|
|        | 0.000 to -12.000   | Past 0.000 to 12.000 Minutes  |
|        | -12.000 to -24.000 | Past 12.000 to 24.000 Minutes |
|        | -24.000 to -36.000 | Past 24.000 to 36.000 Minutes |
|        | -36.000 to -48.000 | Past 36.000 to 48.000 Minutes |
|        | -48.000 to -60.000 | Past 48.000 to 60.000 Minutes |

moment forward in time to show the next six hours. Or, if you wish, you can span the zero point and set the window to show the past three hours, the current time, and the next three hours.

**Classes.** The Classes dropdown list allows you to divide your time window into several ranges to delineate the passage of time. Choose a value from this dropdown list.

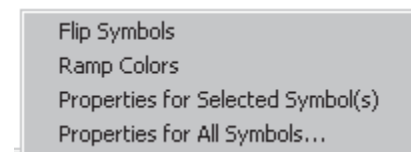
**Legend panel.** The legend panel gives you a preview of how the data will appear based on its age. This panel offers a preview of how your data will appear based on the settings you have indicated for temporal symbology. It shows the number of classes, how each class is divided—by color, size, or shape—the

range included in each class, and the label for each range that will appear in the ArcMap table of contents.

You can click in one of the legend fields to manually change a range or label. When you change a range manually, you can enter decimal numeric values for these ranges, which Tracking Analyst will truncate to three decimal places. Tracking Analyst will only allow you to change the end of a given range. If another range follows the one you've changed, it will update automatically based on your changes. If you edit the range to totally include the next range, the legend panel will automatically eliminate the following range and change the number of classes accordingly.

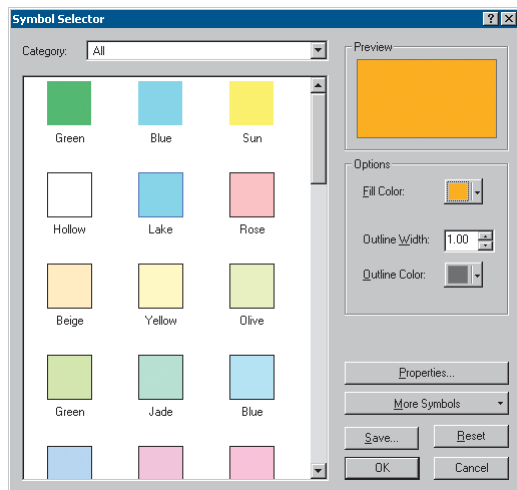
**Note:** All changes to ranges and labels in the legend panel will be overwritten if you go back to the time window and classification settings and make further changes there.

You can also access other options for changing symbology by right-clicking on the legend panel. The context menu that appears includes commands to Flip Symbols, Ramp Colors, and access Properties for All Symbols. Not all options are available for all types of temporal symbology.



- Flip Symbols will invert the order of the symbols for the ranges you have set up. For instance, if you have modified symbology by size, the range with the smallest symbol will have the largest, after using the Flip Symbols command. This command is available only if you've chosen to modify symbology by color or size—that is, not available for shape.

- Ramp Colors allows you to manually define a color ramp. Change the colors for the first and last classes, then use the Ramp Colors command to fill in the colors for ranges between the first and last classes. This command is available only if you've chosen to modify symbology by color.



- Properties for Selected Symbol(s) accesses the Symbol Selector dialog box, where you can change settings for the symbol or symbols you have highlighted in the legend panel.
- Properties for All Symbols accesses the Symbol Selector dialog box, where you can change the appropriate aspect of symbology. For instance, if you have modified symbology by color, the Symbol Selector will allow you to change only color. If you have modified by size or shape, the Symbol Selector will allow you to choose those symbols.

# Symbolizing point data

For the example shown in the following procedures, you'll be symbolizing a point dataset generated from simulated satellite information. This is fixed-time data stored on disk. You'll modify its display by color, size, and shape.

## Tip

### Modifying the time window

If you want to modify the time window but not the data's symbology, you can click *No modification in the Drawn As panel*. If you decide to change symbology—by color, shape, or size—at a later time, the time window settings—Period and Units—will remain the same.

## Tip

### All Time setting

If you decide not to apply a time window to the data layer, the setting of *All Time* will remain. All data in the layer with a date/time stamp earlier than the current system time will appear on the map.

## Tip

### Navigating through fields

Use the Tab key to move quickly from one field to another in the Layer Properties dialog box.

## Symbolizing point data by color

1. Open a background .mxd file and add the desired temporal data.

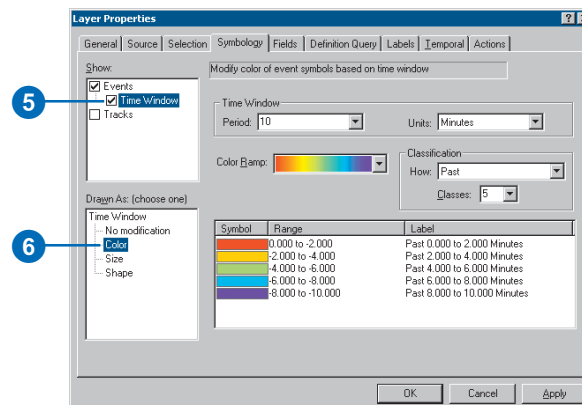
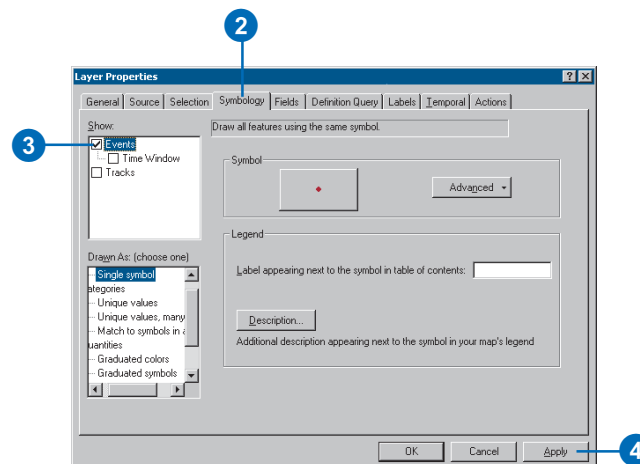
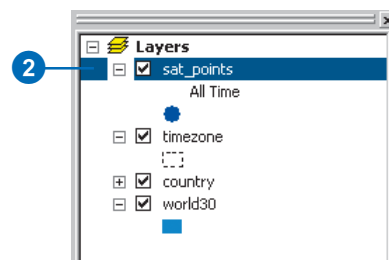
For more information on adding temporal data, refer to Chapter 3, 'Working with temporal data'.

When the temporal data is initially added, its default symbology appears in the ArcMap table of contents, showing default base symbology and a label of All Time.

2. Double-click the temporal data layer in the table of contents and click the Symbology tab of the Layer Properties dialog box.

The tab shows default base symbology, and the Events check box is checked in the Show panel.

3. Click Events in the Show panel and edit your base symbol shape if you wish.
4. Click Apply to accept changes and keep the dialog box open.
5. Click the Time Window check box in the Show panel.
6. Click Color in the Drawn As panel to activate the color ramp and other fields.



## Tip

### Setting period and classes

The settings for period and classes depend on each other for accurate display of temporal data. For instance, if you choose a period with a lower numeric value than the number of classes, you will receive an error message. The period you choose must have a higher numeric value than the number of classes you have chosen, so that Tracking Analyst can divide that period into the appropriate number of classes.

If you receive this error, choose a different unit that will allow a higher number of classes. For example, instead of using 1 month, you can set the period to 30 days.

## Tip

### Using MOLE symbology

You can also add Military symbology (2525B) using the Military Overlay Editor (MOLE) extension to ArcMap. When MOLE™ symbology is enabled, you can access symbols by clicking Events in the Show panel. Then scroll to the top of the Drawn As panel and highlight Military. The Symbology tab will update with MOLE symbol options.

7. Click the Period dropdown arrow and choose a numeric value from the list or type a numeric value in the field.
8. Click the Units dropdown arrow and choose a unit from the list.
9. Click the Color Ramp dropdown arrow and choose an appropriate color range.
10. Click the How dropdown arrow under Classification and choose a display option for the data: Past, Future, or Future & Past.

11. Click the Classes dropdown arrow and choose a number of time ranges from the list.

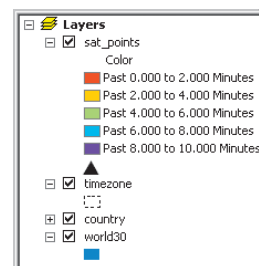
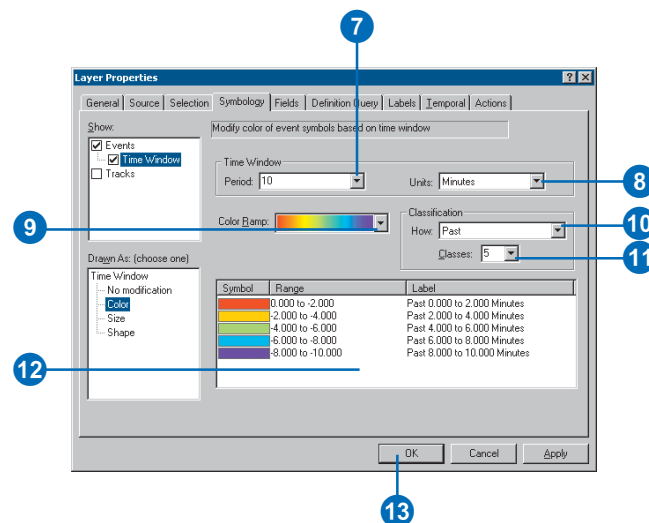
The legend panel updates with each new setting.

12. Click in any of the Range or Label fields in the legend panel to manually change values.

Note: Any manual changes will be overwritten if you continue to change display settings on the tab.

13. Click OK.

The table of contents shows the temporal and base symbology for the data layer.



## Tip

### Symbolizing points by size

The procedure for symbolizing temporal point data by size is very similar to that used for symbolizing for color. The Symbology tab will change slightly, activating fields where you can enter a range of size values.

## Tip

### Editing the legend manually

You can click in a range or label field in the legend panel to change values manually. The table will allow you to edit only the end of a range, but the next range, if there is one, will update automatically. Manual changes will be lost if you continue to alter other display settings in the dialog box.

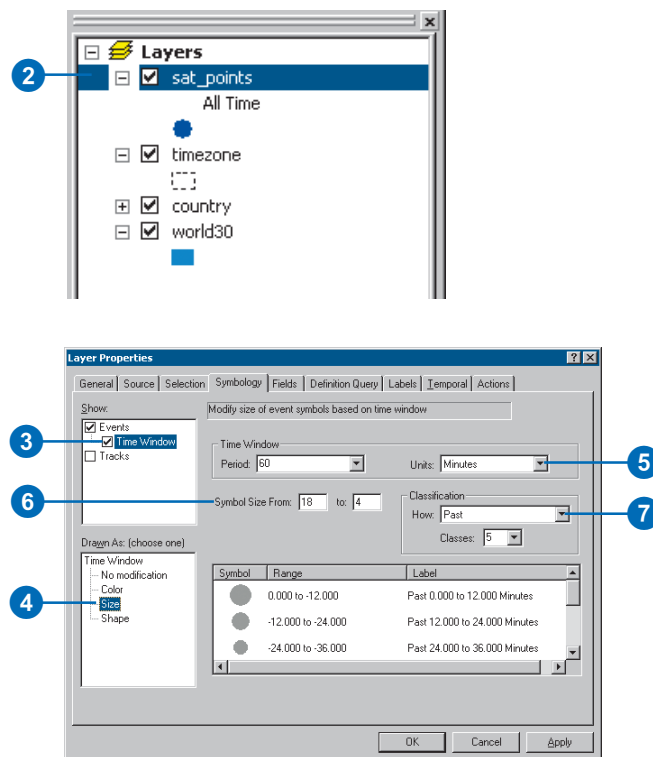
## Symbolizing point data by size

1. Open an .mxd file and add the desired temporal data.

For more information on adding temporal data, refer to Chapter 3, 'Working with temporal data'.

When the temporal data is initially added, its default symbology appears in the ArcMap table of contents, showing default base symbology and an All Time label.

2. Double-click the temporal data layer in the table of contents and click the Symbology tab in the Layer Properties dialog box.
3. Click the Time Window check box in the Show panel.
4. Click Size in the Drawn As panel.
5. Change the settings for Period and Units as needed.
6. Click in the fields for Symbol size and enter numeric values to define the size range for the symbols.
7. Click the How dropdown arrow and choose Past, Future, or Future & Past. ►



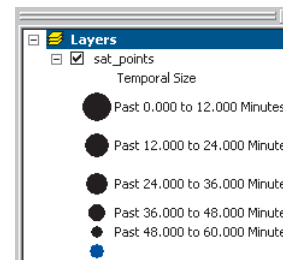
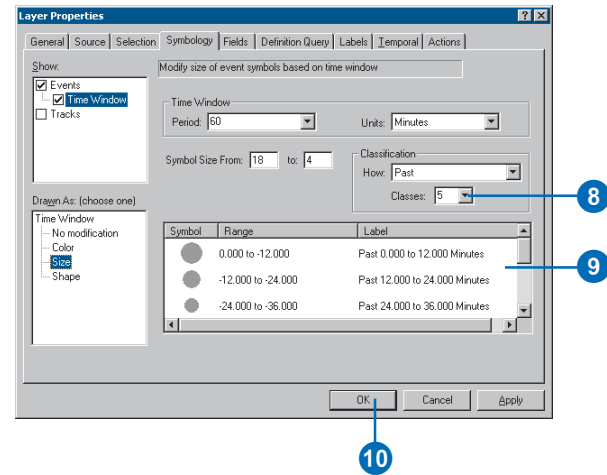


8. Click the Classes dropdown arrow and choose a value.

9. Edit values in the legend manually if you wish.

10. Click OK.

The table of contents in ArcMap updates with the changes you've made.



## Tip

### Adjusting the size of shape-symbolized temporal points

When modifying temporal points by shape, you will not be able to define point size at the same time. To adjust point size for a shape-symbolized data layer, click Events in the Show panel, and change the size of the base symbol.

## Tip

### Editing ranges and labels manually

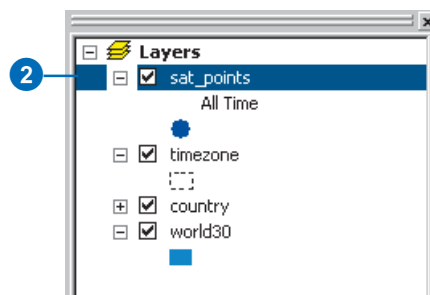
You can click in a range or label field in the legend to change values manually. The table will allow you to edit only the end of a range, but the next range, if there is one, will update automatically. Manual changes will be lost if you continue to alter display settings.

## Symbolizing point data by shape

1. Open a background .mxd file and add the desired temporal data.

For more information on adding temporal data, refer to Chapter 3, 'Working with temporal data'.

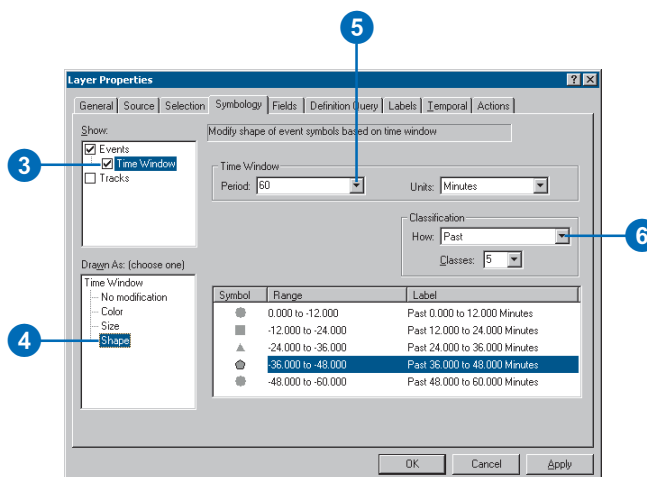
When the temporal data is initially added, its default symbology appears in the ArcMap table of contents, showing default base symbology and a label of All Time.



2. Double-click the temporal data layer in the table of contents and click on the Symbology tab in the Layer Properties dialog box.

The tab shows default base symbology, and Events is checked in the Show panel.

3. Click the Time Window check box in the Show panel.
4. Click Shape in the Drawn As panel.
5. Click the Period and Units dropdown arrows to choose desired values for these settings.
6. Click the How dropdown arrow and choose Past, Past & Future, or Future. ►



- Click the Classes dropdown arrow and choose the number of classes to appear in the legend panel.

- Double-click a symbol in the legend panel to open the Symbol Selector dialog box.

- Scroll down and click the shape you want, then click OK.

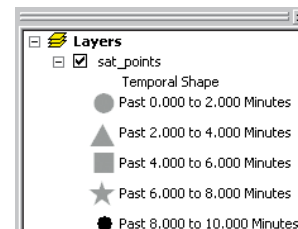
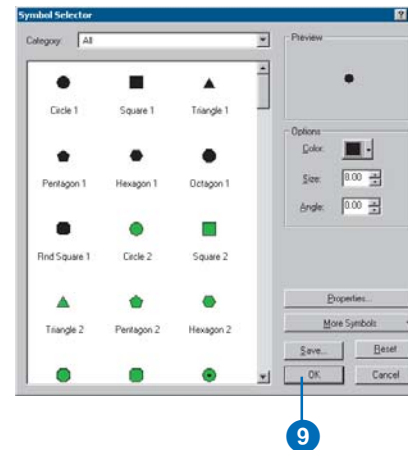
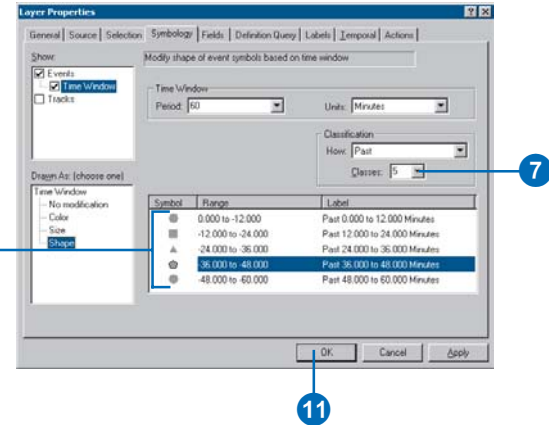
The new symbol appears in the legend panel.

- Repeat steps 8 and 9 for each range whose symbol you want to change.

If you change any other display setting, your symbols will reset to the default.

- Click OK.

The table of contents updates to show the changes you have made.



# Symbolizing line data

For the example shown in the following procedures, you'll be symbolizing a line dataset by changing its color as time passes.

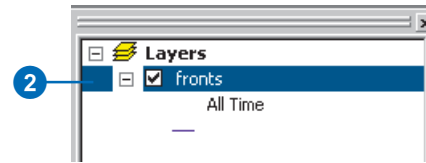
Note: Because line data cannot be modified by size or shape, these items will not appear in the Drawn As panel of the Symbology tab. Some steps will be very similar to the ones you used for modifying other symbology by color.

## Symbolizing line data

1. Open a background .mxd file and add the desired temporal data.

For more information on adding temporal data, refer to Chapter 3, 'Working with temporal data'.

When the temporal data is initially added, its default symbology appears in the ArcMap table of contents, showing default base symbology and a label of All Time.



2. Double-click the temporal data layer in the table of contents to open the Layer Properties dialog box.

3. Click the Symbology tab.

The tab shows default base symbology, and Events is checked in the Show panel.

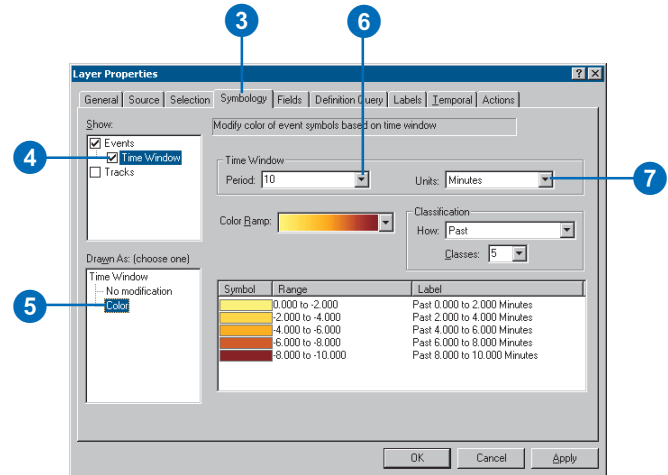
4. Click the Time Window box in the Show panel.

The No modification and Color options appear in the Drawn As panel.

5. Click Color in the Drawn As panel.

6. Click the Period dropdown arrow to select a numeric value for your time window.

7. Click the Units dropdown and choose a unit for the time window. ►

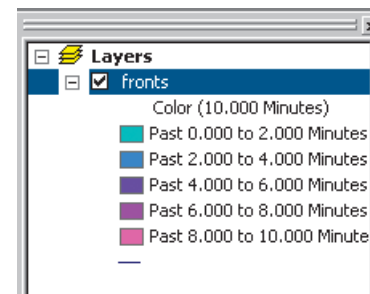
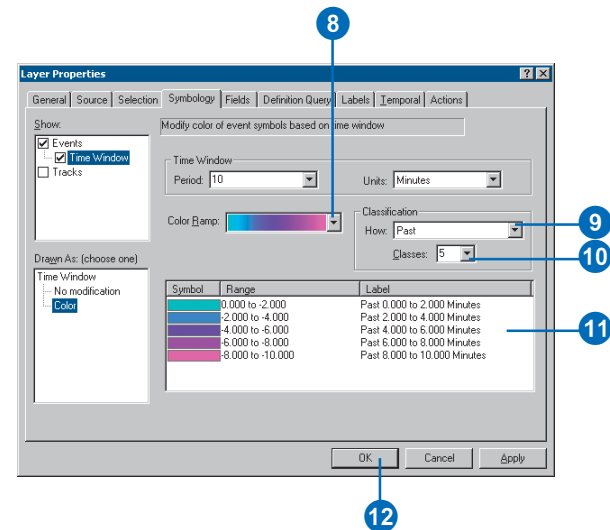


8. Click the Color Ramp dropdown to choose a color scheme.
9. Click the How dropdown arrow and choose to display the data in a time window that includes past, future, or both.
10. Click the Classes dropdown arrow and choose the number of classifications you want for the data.
11. Click in the legend panel and manually change any ranges or labels if you wish. If you change the value of a range, the subsequent ranges will update automatically.
12. Click OK.

Note: Any manual changes to these values will be lost if you return to other settings on the Symbology tab.

The table of contents will update with the new symbology information you have entered.

Note: After you have applied a time window, data will not appear on the map until you open the Playback Manager.



## Symbolizing polygon data

For the example shown in the following procedure, you'll symbolize a polygon dataset from the same satellite information used to symbolize the point data in previous procedures.

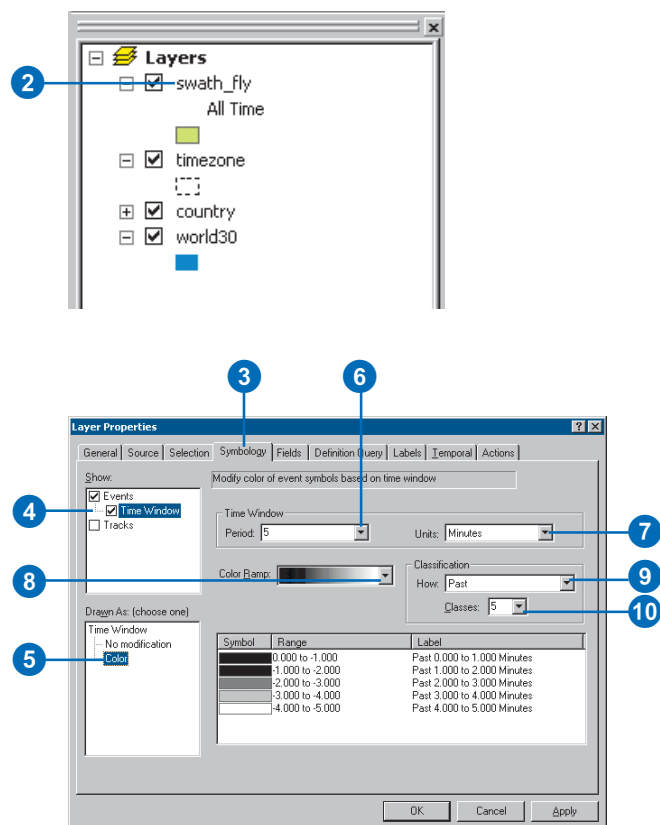
Note: Like line data, polygon symbology can only be modified by color.

## Symbolizing polygon data by color

1. Open an .mxd file in ArcMap and add a temporal data layer.

For more information on steps for adding temporal data, refer to Chapter 3, 'Working with temporal data'.

2. Double-click on the temporal data layer in the table of contents to open the Layer Properties dialog box.
3. Click the Symbology tab.
4. Click the Time Window check box in the Show panel.
5. Click Color in the Drawn As panel.
6. Click the Period dropdown arrow and choose a numeric value from the list, or type a value in the field.
7. Click the Units dropdown arrow and choose a value from the list.
8. Click the Color Ramp dropdown arrow and choose an appropriate color range.
9. Click the How dropdown arrow and choose Past, Future, or Future & Past from the list.
10. Click the Classes dropdown arrow and choose an appropriate value. ►

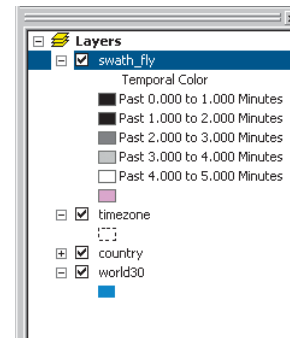
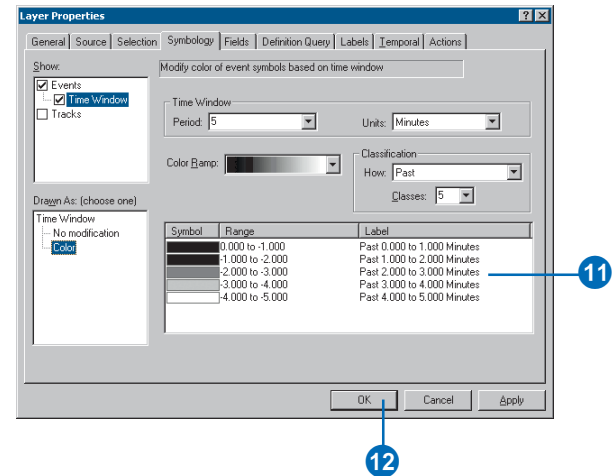


11. Click in any of the legend fields to change ranges or labels manually.

Note: Manual changes will be lost if you continue to alter display settings.

12. Click OK.

The table of contents updates with the temporal modifications you have made.





# Symbolizing a track

A *track* is a line that connects observation points that share a common object identifier, or ID field. For instance, if you are monitoring the movements of a surveillance vehicle, you can apply a track to connect the dots, so to speak. The track would link the observations of the vehicle through time.

Symbolizing tracks is very similar to defining symbology for line data. The following procedure includes steps for choosing track symbology.

## Tip

### Using a single symbol to designate tracks

You can also use a single symbol to apply tracks to temporal data symbology in ArcMap. Follow the steps for symbolizing a single symbol on the Events panel of the Symbology tab. For more information, see Using ArcMap.

## Tip

### Setting an ID field

You can choose *None* as the ID field if you're working with discrete events such as lightning strikes. Tracking Analyst will use a default feature ID field to apply labels, tracks, and the most current setting.

## Symbolizing tracks using unique values

1. Right-click the temporal data layer you want to symbolize in the ArcMap table of contents and click Properties.

2. Click the Symbology tab.  
The tab appears with default settings and no temporal capabilities.

3. Click the Tracks check box in the Show panel.

4. Click Unique values in the Drawn As panel.

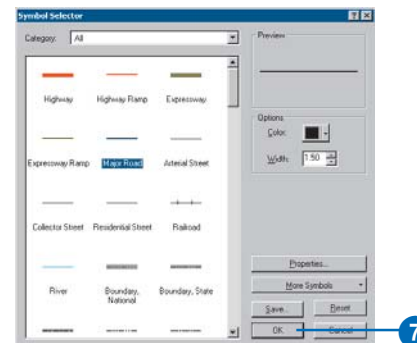
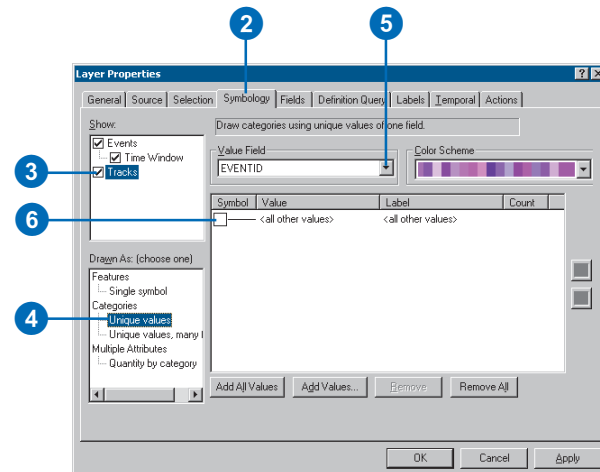
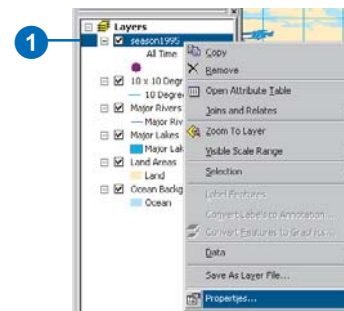
Note: Even though tracks connect features with the same ID, you can symbolize unique values on any field in the dataset.

5. Click the Value Field dropdown arrow and choose the field for which you want unique values displayed.

6. Double-click the line symbol in the center panel.

The Symbol Selector dialog box opens.

7. Click the type of line you want to use for the track and click OK.



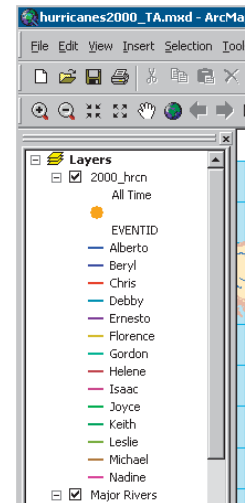
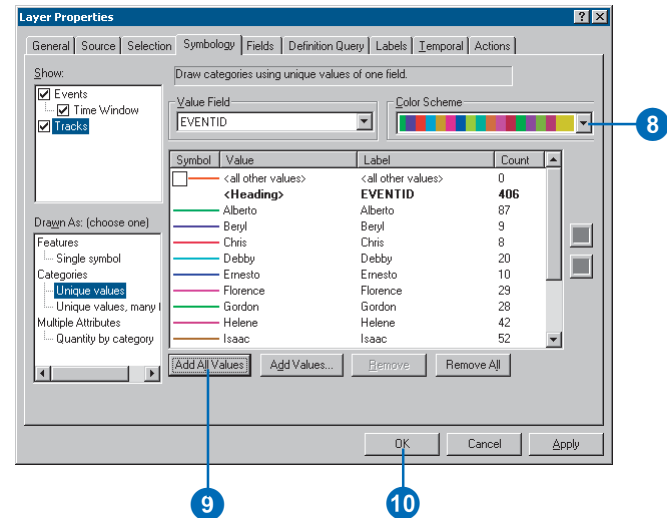
8. Click the Color Scheme dropdown arrow and choose a color range for the tracks.

9. Click Add All Values.

The center panel will update with the layer's values for the specified field, including their new symbology.

10. Click OK.

The table of contents updates with the track symbology you have added.



# Displaying temporal data

# 5

## IN THIS CHAPTER

- **About displaying temporal data**
- **Displaying symbolized temporal data**
- **Using the Animation Wizard**
- **Labeling temporal data**

Once you have chosen your temporal data, added it, and set its display properties, you can display it in ArcMap using the Tracking Analyst Playback Manager. In this chapter, you will learn about Tracking Analyst time modes, the Playback Manager dialog box, different playback settings, and how to display fixed-time and real-time temporal data. You'll also learn how to use the Tracking Analyst Create Animation dialog box.

# About displaying temporal data

## Time modes

In Tracking Analyst, you can use one of two *time modes* to view temporal data: *real-time mode* and *playback mode*. In real-time mode, temporal data appears on your map as soon as a tracking service receives it. Real-time mode is based on your current system clock.

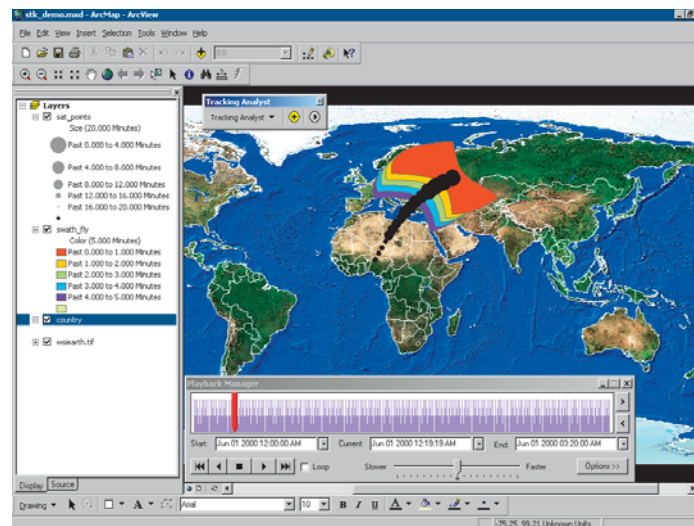
In playback mode, you can define the display of temporal data using the Playback Manager. Opening the Playback Manager automatically puts Tracking Analyst into playback mode. You can replay real-time and fixed-time data. You can also use playback mode to display data that is in the future.

If you receive real-time data from a tracking service, going into playback mode lets you display all of the data within the time window up to the instant that you opened the Playback Manager. Real-time data received while the Playback Manager is open is placed in system memory, and the temporal data layer is updated when you exit playback mode by closing the Playback Manager.

## Using Playback Manager

The Tracking Analyst Playback Manager allows you to control settings for displaying fixed-time and replaying real-time temporal data. The Playback Manager helps you monitor changes in your data. Because the data is temporally enabled, you can change its display to indicate time passing in the time window you define.

Real-time data is temporarily stored in memory as it streams in, and you can replay it using the Playback Manager. Its time window and temporal symbology are determined by settings on the Symbology tab, though your settings may differ with the rate of the data stream.

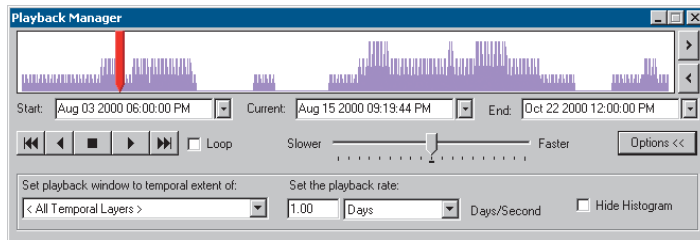


## Playback rate

Pay close attention to the temporal characteristics of the data you have added. Its time window will determine an appropriate playback rate for the Playback Manager. For instance, if you have a time window of one year, you can display the data at one month per second. This setting would not work, however, if you had a two-hour time window.

## Temporal extent dropdown list

This dropdown list allows you to choose a layer or layers whose temporal extent will be used to define the start and end times of the playback window. The *temporal extent* of a dataset encompasses the earliest and latest information for the data.



## Using the playback histogram

The histogram panel at the top of the Playback Manager indicates how much data is available at a given time in the time range you have specified.

You can use the play buttons, the time indicator, and the Next and Previous buttons, to the right of the histogram, to change the point in time that will display on the map. Next and Previous can only be used when you're not playing data. If playing data, click the Stop button first before using these buttons.

You can also click a point on the histogram with your mouse to move the time indicator to that point in time. Like the Next and Previous buttons, this method works only when not playing data.

Note: If you adjust the time by clicking and dragging the time indicator on the histogram, any labels you have applied to the layer will not appear on the map for performance reasons. Labels will reappear after you have released the mouse button.

## Start, current, and end times

The first time the Playback Manager is opened, the start time defaults to the earliest time of the temporal layers in your view, and the end time defaults to the latest time of the tracking layers in your view. The Playback Manager recognizes the temporal extent of the dataset or datasets you have initially added.

Current time changes as the Playback Manager steps through the time sequence from start to end. To jump to a specific time, enter it into the current time text box. The Playback Manager shows a date and time (mmm dd yyyy hh:mm:ss) in each of the three text windows. The date portion of the string is formatted as a three-character month, two-digit day, and four-digit year—Aug 13 1997. Tracking Analyst will not recognize the full spellings for months. The time portion of the string that follows the date is formatted in 12-hour time with AM and PM indicators. Time includes two digits for hours (01–12), two digits for minutes, and two digits for seconds—12:42:18.

| June 2000        |     |     |     |     |     |     |
|------------------|-----|-----|-----|-----|-----|-----|
| Sun              | Mon | Tue | Wed | Thu | Fri | Sat |
| 28               | 29  | 30  | 31  | 1   | 2   | 3   |
| 4                | 5   | 6   | 7   | 8   | 9   | 10  |
| 11               | 12  | 13  | 14  | 15  | 16  | 17  |
| 18               | 19  | 20  | 21  | 22  | 23  | 24  |
| 25               | 26  | 27  | 28  | 29  | 30  | 1   |
| 2                | 3   | 4   | 5   | 6   | 7   | 8   |
| Today: 8/23/2002 |     |     |     |     |     |     |

Another way to enter dates is to click on the dropdown arrow beside the start, current, and end time fields, below the histogram, to open a calendar widget. The calendar allows you to choose a date to begin and end your time window. If you wish to enter a specific time for a chosen date, you can click in the field itself and enter the desired time.

If you accidentally enter an invalid date or time for any of these fields, Tracking Analyst rejects the value and returns the previous value for that field. The start and end times can be adjusted into the past and the future. Any changes that you make to the start and end times are saved in the Playback Manager. If you edit time values and close the Playback Manager for a view, the values will still be there when you next open it for that view.

Note: The start and end times are set for the first time Playback Manager is opened. If you subsequently add temporal layers outside this range or receive real-time data, the playback window will not update automatically. To reset the playback window, click Options and choose the appropriate layer or layers from the Temporal Extent dropdown list.

Note: You must adjust the end time before changing the start time. The Playback Manager will not allow you to enter a start time that is later than the end time.



# Displaying symbolized temporal data

In the Playback Manager, you can set start and end times, the extent of the data to display, the speed of the playback, and whether you want the data to display in a continuous loop. This example uses satellite data from a simulated dataset. It includes two datasets: one with point data and one with polygons.

## Tip

### Using temporal offset during playback

*If you've applied temporal offset to one or more layers, the Playback Manager histogram updates its display with a colored line to indicate the offset data. You can set the color of this line on the Temporal tab in the Layer Properties dialog box.*

*The histogram indicates the amount of data at a given time in the time window. When you rewind and play the data, it will replay on the map according to the offset you indicated on the Temporal Layer tab. For more information on using temporal offset, refer to Chapter 3, 'Working with temporal data'.*

## Displaying symbolized temporal data

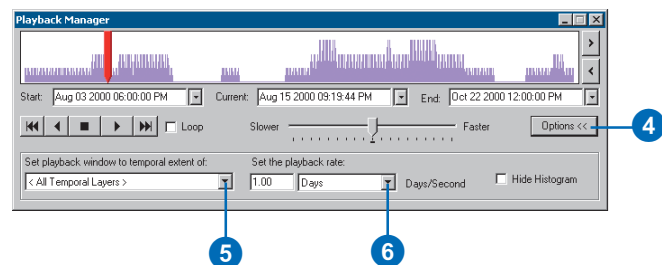
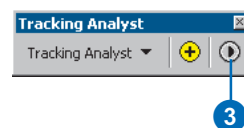
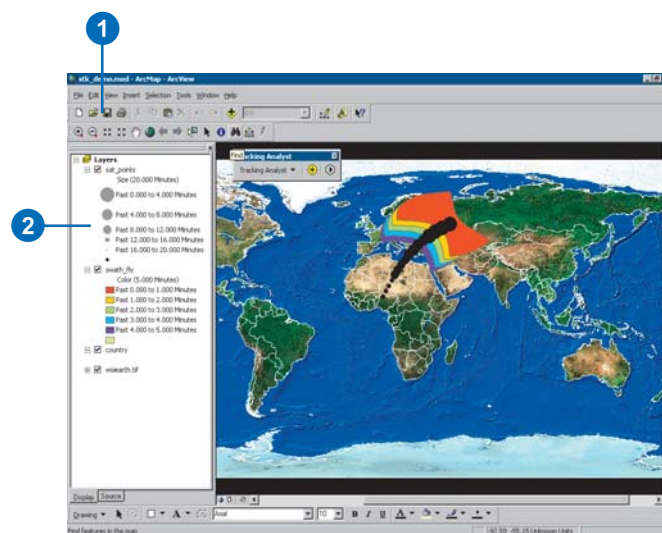
1. Click the Open button on the ArcMap toolbar and choose an ArcMap document (.mxd).
2. Add temporal data and edit its desired symbology and display properties.

For more information on steps to add and symbolize temporal data, refer to Chapter 3, 'Working with temporal data', and Chapter 4, 'Symbolizing temporal data'.

3. Click the Playback Manager button on the Tracking Analyst toolbar.
4. Click Options to see detailed settings in the dialog box.
5. Click the Set playback window to temporal extent of dropdown arrow and click the extent you wish to include in playback.

This setting defines the start and end times of the playback window to include all of the data in the selected layer or layers.

6. Click the Playback Rate unit dropdown arrow and choose the appropriate playback units from the list. ►

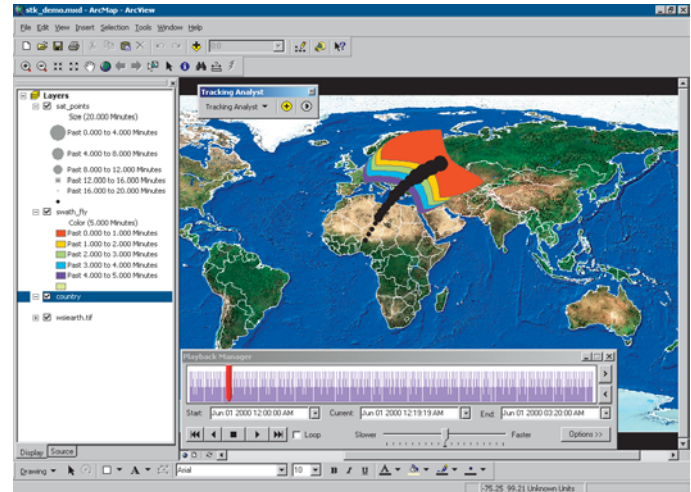
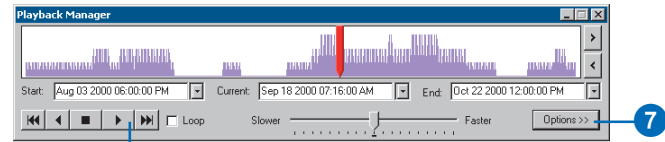




- Click Options to make the Playback Manager dialog box smaller.

- Click the Play button.

The Playback Manager dialog box remains open, indicating progress of the playback, and the data begins to display within the ArcMap window.



## Using the Animation Wizard

The Tracking Analyst Animation Wizard allows you to record playback information to save on disk as BMP frames—to use in your own animation program—or an AVI video file—to play in a media player such as Microsoft® Windows Media™ Player. You can also use plug-and-play functionality with your own animation engine.

The recording feature enables you to distribute the Tracking Analyst playback to different audiences without needing to install Tracking Analyst for them. For instance, you can post an AVI file on a Web site or attach it to an e-mail. This way, your audience can see the results without having to learn the software.

### Tip

#### Animation settings

*The Animation tool uses the settings from the Playback Manager as its default settings. You can change these settings using the Animation Wizard.*

## Using the Animation Wizard

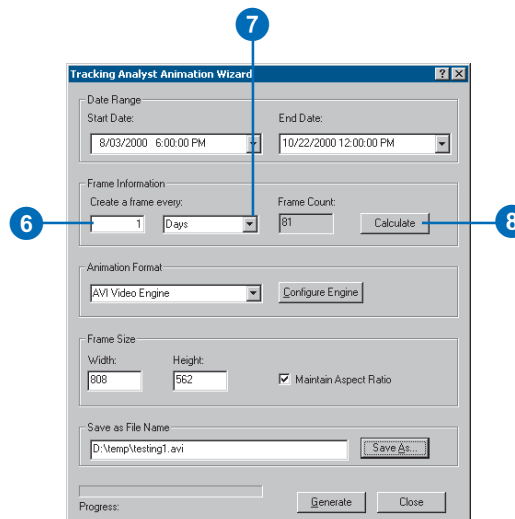
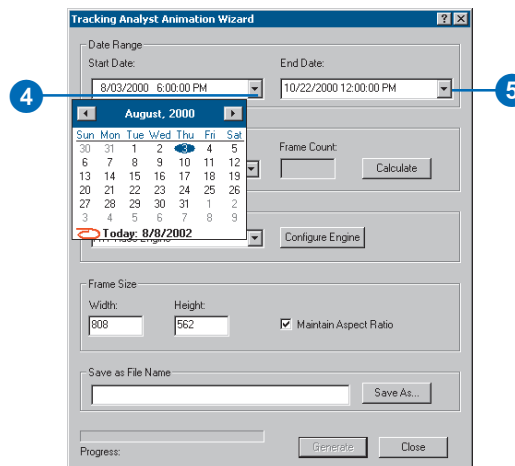
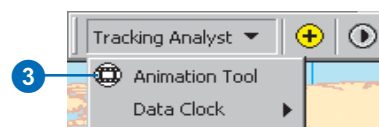
1. Open an ArcMap document (.mxd).
2. Add temporal data and edit its symbology as desired.

For steps to add and symbolize temporal data, refer to Chapter 3, 'Working with temporal data', and Chapter 4, 'Symbolizing temporal data', respectively.

3. Click Tracking Analyst from the Tracking Analyst toolbar, then click Animation Tool.

Note: The default settings in the Animation Wizard come from the Playback Manager.

4. Click the Start Date dropdown arrow and choose a date from the popup calendar, or type a start date and time in the text box.
5. Click the End Date dropdown arrow and choose a date from the popup calendar, or type an end date and time in the text box.
6. Click in the Create a frame every text box and type a number of units to include per frame.
7. Click the Create a frame every dropdown arrow and choose a unit from the list.
8. Click Calculate.



## Tip

### Minimizing AVI file size

To minimize file size for AVI output, you can reduce the number of frames by changing the start and end times or the frame frequency. You can also reduce the height and width of the output frames.

## Tip

### Saving output as individual frames

When you save output from the Animation Wizard as an AVI file, the AVI will be saved to the destination directory you indicate in the wizard.

If you choose to generate frame output, the individual JPEG files will be saved to the destination directory, with numbered suffixes on filenames.

Note: If the number of frames exceeds the system maximum, an error message will appear. You can change frame frequency or the start and end times to reduce the number of frames.

- Click the Animation Format dropdown arrow and choose the frame or AVI engine to generate the desired output.

- Click Configure Engine.

- Choose the type of frame compression you want from the dropdown list. Click OK.

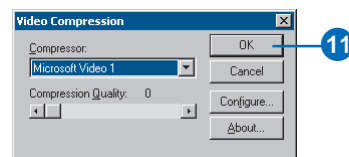
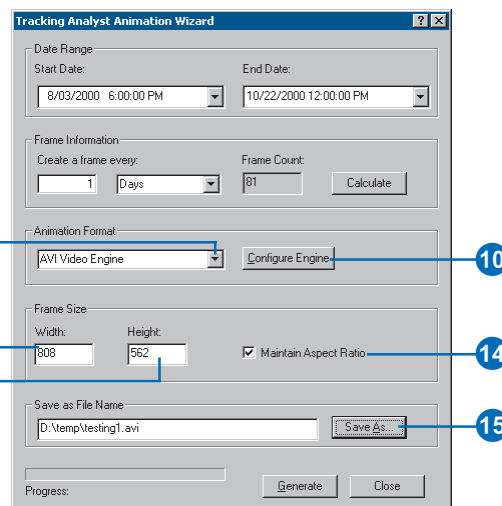
Note: The default engine is Full Frames (Uncompressed).

- Click in the Width text box and type a numeric value for the width of the frames.

- Click in the Height text box and type a numeric value for the height of the frames.

- Click Maintain Aspect Ratio to constrain the frame proportions.

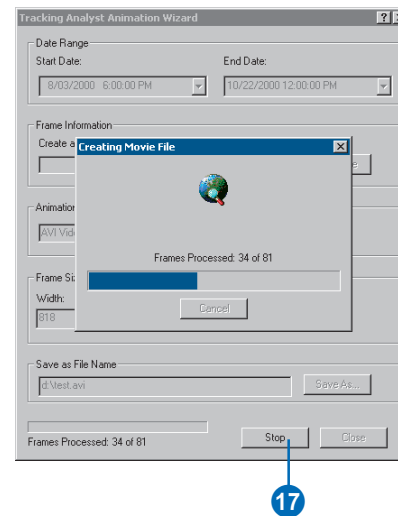
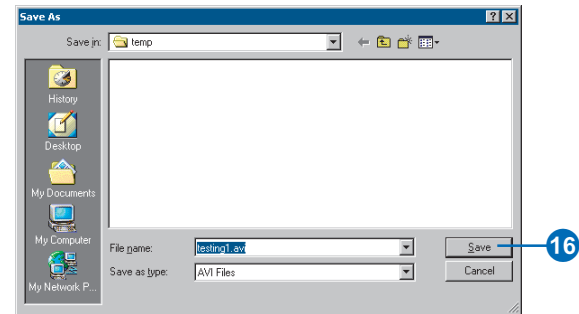
- Click Save As. ►



16. Navigate to the appropriate folder and type a filename. Click Save.

17. Click Generate.

As the Animation Wizard generates an output file, the Create Movie File dialog box shows progress.



# Labeling temporal data

Like other types of data in ArcMap, you can add labels to temporal data that will display on the map. You can apply labels using the Labels tab of the Layer Properties dialog box. The following procedure takes you through the steps of applying labels to a temporal data layer.

Note: Labels will appear with the most recent temporal event for each record in the dataset and are based on the ID field.

## Tip

### Labels during playback

*Due to performance issues, labels will not appear on the map when you click and drag the time indicator in the Playback Manager histogram. If you want labels to display during playback, use the play buttons in the dialog box, instead of manually moving the time indicator.*

## Tip

### Label placement options

*Depending on the type of data in the layer, you will see different placement options. For example, polygon and line data will allow you only to place the labels on the center of the feature.*

## Applying labels to a temporal data layer in ArcMap

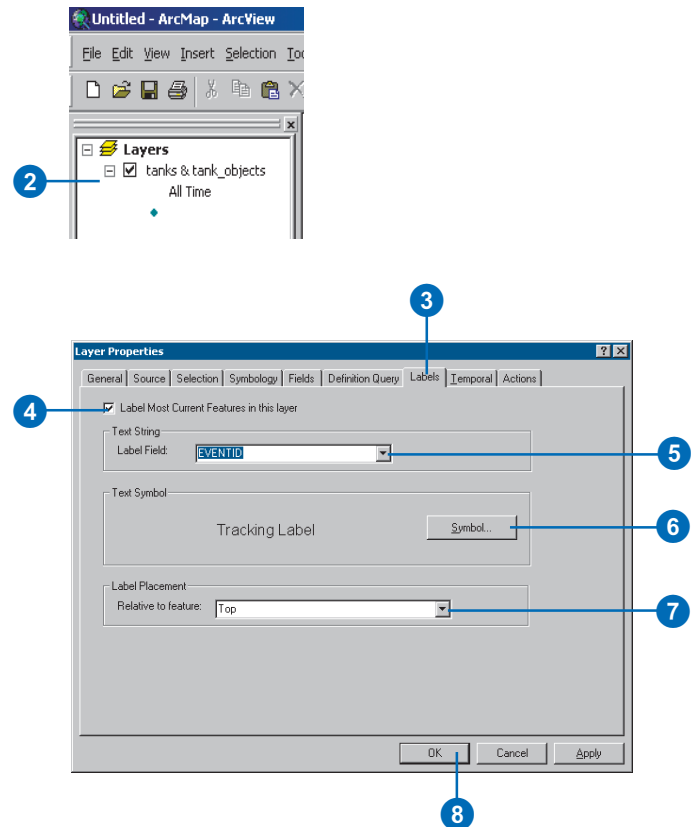
1. Open an .mxd file in ArcMap and add and symbolize temporal data as desired.

For steps to add and symbolize temporal data, see Chapter 3, 'Working with temporal data', and Chapter 4, 'Symbolizing temporal data'.

2. Double-click the temporal layer you want to label.
3. Click the Labels tab in the Layer Properties dialog box.
4. Click the Label Most Current Features in this layer check box.

This check box toggles label display.

5. Click the Label Field dropdown arrow and choose the field whose text you want to appear as the label.
6. Click Symbol to change the font and style of the label text.
7. Click the Label Placement dropdown arrow and choose where the label will display relative to the feature.
8. Click OK.



The background is a collage of various maps and terrain images in shades of orange and brown. It includes a topographic map of a mountainous region, a street map of a city, a map of India showing state boundaries, and a map of Europe. Large, semi-transparent circles are overlaid on the collage.

# Interacting with data

## Section 3





# Charting temporal data

# 6

## IN THIS CHAPTER

- About charting temporal data
- Using the Data Clock
- Using the Data Clock Manager

Charting temporal data can help you see patterns you may miss when viewing the data in a table or even on a map. Tracking Analyst provides charting methods that allow you to view and present these patterns and to help you analyze the data you have gathered. In this chapter you will learn:

- About charting temporal data
- How to create and manage data clocks

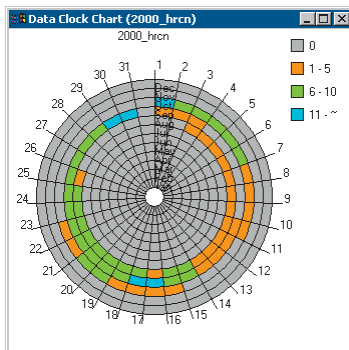
# About charting temporal data

When you view data in its attribute table, and even when you display it using the Playback Manager, you can't always delineate patterns to the data. That's why charting data is an important way to help you analyze temporal data. Charts such as the Tracking Analyst Data Clock help you to view temporal patterns in your data.

Imagine you have a dataset showing the occurrences of violent crime in a certain neighborhood over the last three months. The tabular data may give you specific times and places, and the Playback Manager may allow you to display the events in sequence. The data clock, however, can indicate a dramatic increase in crime observations, or hits, between 9 p.m. and 11 p.m. on weekends, for example. This pattern may not be apparent using other methods of data analysis.

## The Data Clock chart

The Tracking Analyst Data Clock Wizard produces a circular chart, which is a table divided into cells and wrapped around a center point. The cells are created using concentric lines, or rings, from the center of the chart outward. These rings are intersected by lines coming out from the center like spokes in a wheel, which divide the chart into wedges.



These cells represent units of time you wish to set using the Create Data Clock Wizard. The first unit of each option in the Charting Method dropdown list represents the division of the concentric rings, and the second unit represents the wedges—for example, the data clock shown above uses Months of year by days of month as its charting method option. This option divides and labels the rings by month, and it further divides the wedges into numerical dates.

## Data summary methods

Unlike other types of charts, such as bar graphs, the data clock allows you to modify the summary method for the data before displaying it. You can use the Set Summary Method dropdown list to define the data clock by days of the week or hours of the day or another option.

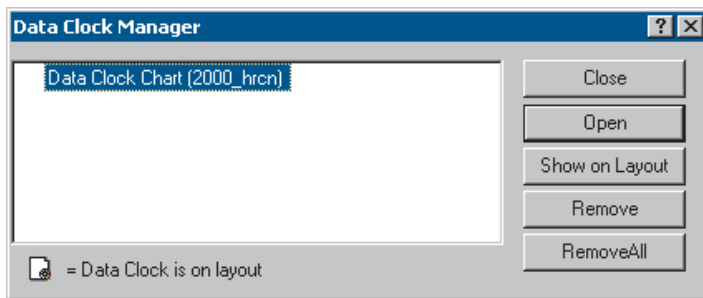
This flexibility allows you to interact with your data, dividing it into different classifications to most effectively illustrate certain temporal patterns in the data. For example, you may want to emphasize an increase in observations on a certain day of the week, or a certain day of the month, or a certain time of the day. Use the charting method that most clearly shows the pattern you wish to emphasize.

## Legend settings

The Create Data Clock Wizard allows you to define how you'd like the legend to appear on the data clock, specifying the number of classes, the colors used, and the display and placement of the legend itself.

## Data Clock Manager

Tracking Analyst provides a Data Clock Manager, which helps you keep track of multiple data clock charts you have created. With the manager, you can remove, rename, and edit data clocks you have already created. The following procedures introduce you to the capabilities of the Create Data Clock Wizard and the Data Clock Manager.



## Using the Data Clock

The Tracking Analyst Data Clock Wizard creates a circular chart of temporal data that you can use to analyze patterns in the data that you may miss when viewing the data in a table or on a map. You can modify the colors, number of classes, and legend settings to produce a temporal data chart that best suits your needs.

### Tip

#### Choosing a summary method

*The Set Summary Method dropdown list presents a number of options for dividing your data clock chart. The first item for each option refers to the way the chart is divided in concentric circles, or rings, from the center outward. The second item refers to the divisions around the circle, or wedges, beginning at the top of the chart and going around clockwise.*

*Depending on the option you choose here, you can show patterns in the data to highlight specific days, weeks, times of day, or months of the year when observations take place.*

## Creating a data clock

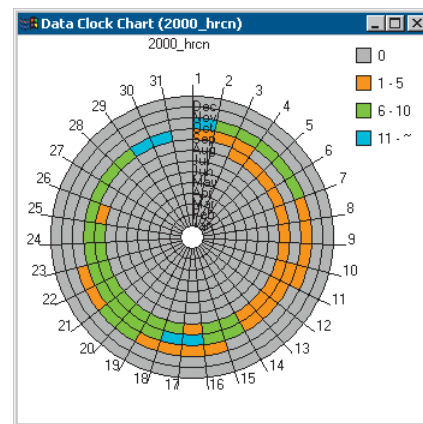
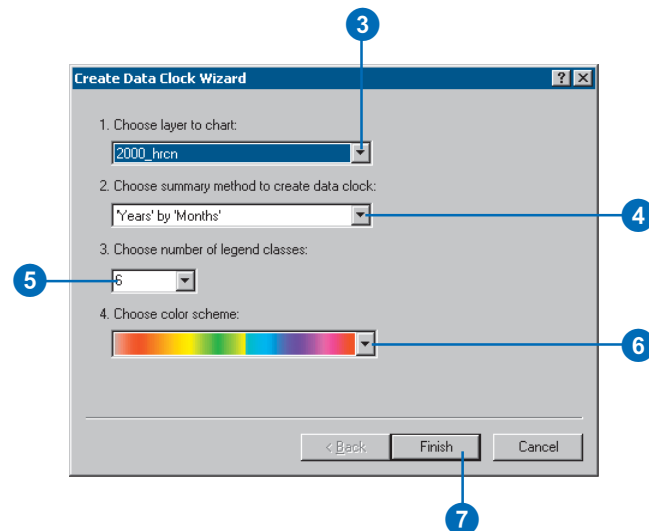
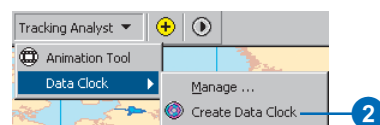
1. Open an .mxd file in ArcMap and add and symbolize temporal data.

For steps to add and symbolize temporal data, refer to Chapter 3, 'Working with temporal data', and Chapter 4, 'Symbolizing temporal data'.

2. Click Tracking Analyst on the Tracking Analyst toolbar. Point to Data Clock and click Create Data Clock.
3. Click the Choose layer to chart dropdown arrow and choose the temporal layer you want to include in the data clock.
4. Click the Choose summary method to create data clock dropdown arrow and choose the method by which Tracking Analyst will divide the data for the chart.

5. Click the Choose number of legend classes dropdown arrow and choose a number from the list.
6. Click the Choose color scheme dropdown arrow and choose the color range to include in the data clock.
7. Click Finish.

The data clock chart opens, showing the results of the settings you've changed in the wizard.



## Using the Data Clock Manager

You can rename, remove, and modify a data clock after you've created it using the Data Clock Manager. You can also use the Show on Layout button to place the data clock on your ArcMap document.

The following procedure takes you through the steps of modifying the properties of an existing data clock.

### Tip

#### Understanding the legend

The legend on the data clock shows color variations based on the number of observations made in a certain time frame. For example, you may have set up your data clock to show each day in a month. If you had 20 observations on a certain day, that day will appear on the chart with a certain color assigned to it. Refer to the legend to see if that color indicates 20 or more observations.

You can change the placement of the legend or turn its display on or off using the Data Clock Properties dialog box.

## Modifying an existing data clock

1. Open an .mxd file with temporal data already added and symbolized.

For steps to add and symbolize temporal data, see Chapter 3, 'Working with temporal data', and Chapter 4, 'Symbolizing temporal data'.

2. Click Tracking Analyst from the Tracking Analyst toolbar. Point to Data Clock and click Manage.

The Data Clock Manager opens, showing a list of data clocks you have created.

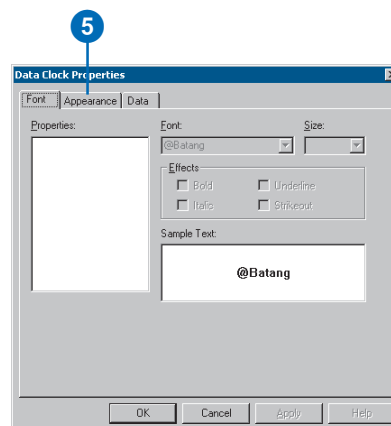
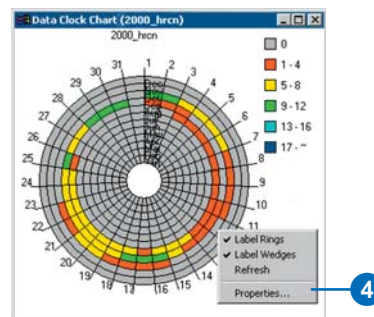
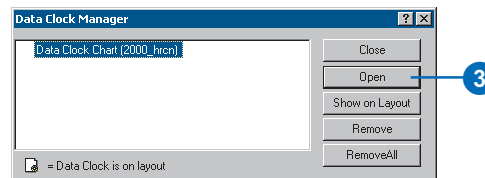
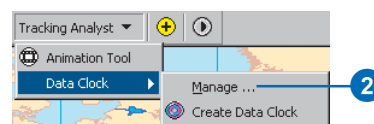
3. Click the data clock you want to modify and click Open.

The data clock chart opens.

4. Right-click anywhere in the chart window and click Properties.

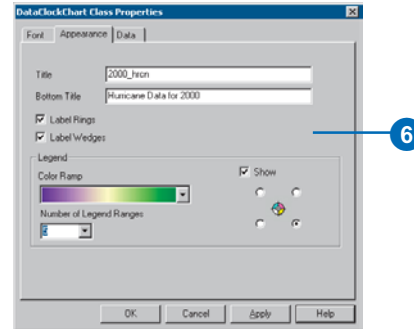
Note: You can also use this context menu to turn chart labeling on or off and to refresh the view.

5. Click the Appearance tab.



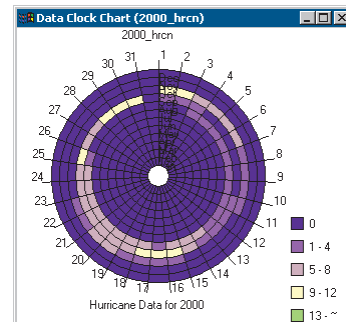
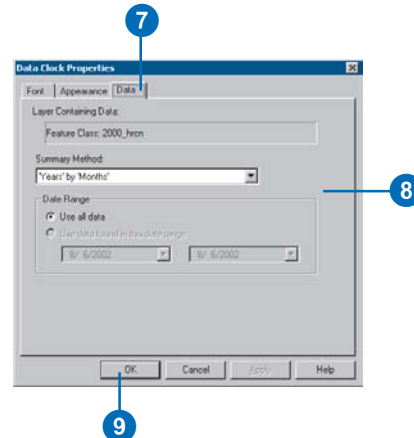
6. Change settings in the appearance to adjust the data clock chart title, the colors and legend classes used, and the placement and display of the legend.

Note: Changing the title on the Appearance tab will effectively rename the data clock in the Data Clock Manager.



7. Click the Data tab.
8. Make changes to the settings on the Data tab, including the charting method, as needed.
9. Click OK.

The data clock chart updates with the changes you have made.





# Creating and applying actions

# 7

## IN THIS CHAPTER

- Applying actions to temporal data
- Layer actions in ArcMap
- Applying filter actions in ArcMap

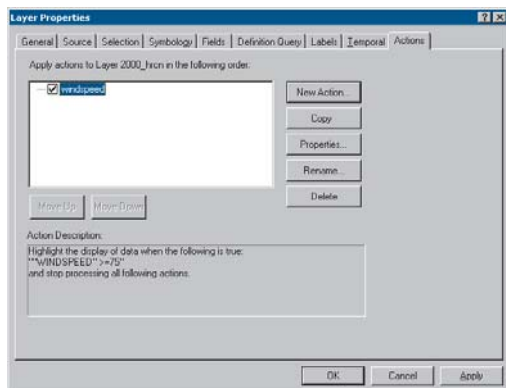
Tracking Analyst actions allow you to perform event-based operations on temporal data to enhance your data analysis capability. You can define certain criteria for the data, and any data that meets the criteria will have the action or actions applied. Location and attribute criteria can be used to apply filter features in a dataset from further action processing, highlight or suppress display of the data, change its coordinate system, or perform a custom action that you can design in Visual Basic (VB). In this chapter you will learn to:

- Apply actions to temporal data layers in ArcMap.
- Apply actions to temporal data in ArcCatalog.
- Set the order of actions.



# Applying actions to temporal data

Actions can be applied to temporal data at three different points in the data flow: at the layer, service, or server level. You can apply layer actions, such as highlight or suppression of display, to data layers in ArcMap; service actions, such as coordinate conversion, to tracking services in ArcCatalog; and server actions using the ArcIMS Tracking Server.



The following sections describe different actions you can build and apply in ArcMap. For more information about service-level actions, which are applied in ArcCatalog, see Chapter 8, 'Working with real-time data'. For more information about server actions, see *Using the ArcIMS Tracking Server*.

Note: A custom Visual Basic (VB) action, which can be created and applied to a real-time layer in ArcMap, is discussed in Chapter 8, 'Working with real-time data'.

## Layer actions

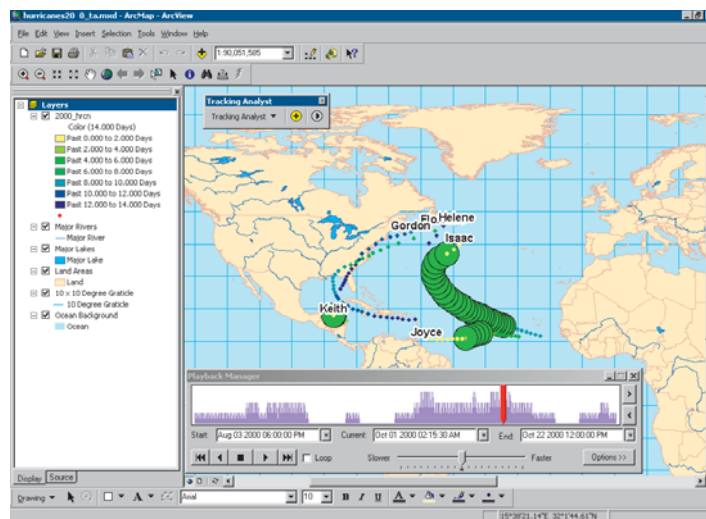
You can apply layer actions to a temporal data layer in ArcMap. These actions will not modify the data itself. You can access these actions—filter and highlight/suppression—through the Actions tab in the Layer Properties dialog box.

Once you define the parameters for a certain action, it appears in a list box on the Actions tab. Additional actions are listed in this box as you create them. The actions applied to the data layer in their list order. Each layer's actions are defined separately in the ArcMap Layer Properties dialog box.

The Filter action will include or exclude data from further action processing based on criteria you define from the Actions tab. The filter does not affect the data's display on the map.

The highlight/suppression action allows you to set attribute and location conditions for the data. If the data meets these conditions, you can dictate whether it is highlighted with a symbol on the map or not displayed at all—that is, suppressed.

Note: If you have saved a temporal data layer as a layer file (.lyr), any actions you have applied to that layer will be read-only. You will not be able to edit actions in a .lyr file.



## Layer actions in ArcMap

On the layer level, you can build and apply actions to highlight or suppress the display of temporal data or create a filter for further action processing, given certain parameters. Use the Actions tab in the Layer Properties dialog box to access the query builder.

Actions can be applied to real-time data as it streams in, as well as to fixed-time data. For more information on applying layer actions to real-time data, see Chapter 8, 'Working with real-time data'.

In the following procedures, you can apply a suppression and a filter action to a fixed-time temporal data layer in ArcMap.

Note: Once you have saved a temporal layer as a .lyr file, its actions settings are read-only.

### Tip

#### Service actions

*You can apply service actions to data in ArcCatalog using the Actions tab in the Tracking Service Properties dialog box. These actions modify the dataset itself, applying coordinate conversion or a filter. For more information on applying service actions in ArcCatalog, see Chapter 8, 'Working with real-time data'.*

## Applying a suppression action to a layer

1. Right-click the desired temporal data layer in the table of contents and click Properties.

2. Click the Actions tab in the Layer Properties dialog box.

3. Click New Action.

The New Action dialog box opens.

4. Type a name for the action.

If you choose not to enter a name, the default, New Action 1, will be used.

5. Click Highlight / Suppression in the Type of Action to Create panel.

6. Click OK.

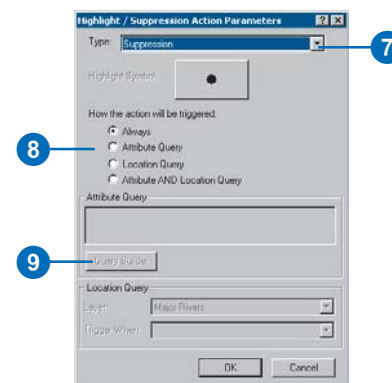
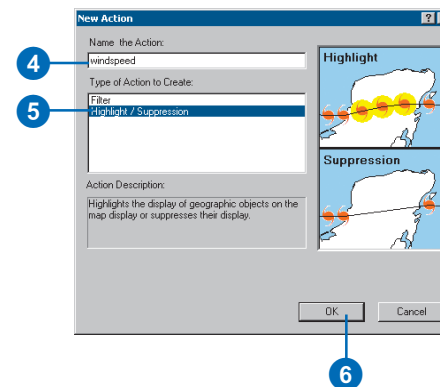
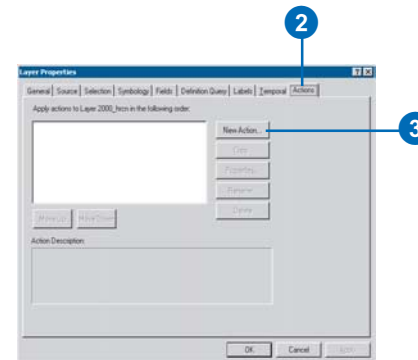
The Highlight / Suppression Action Parameters dialog box opens.

7. Click the Type dropdown arrow and click Suppression.

8. Click the button beside the type of query you want to use.

9. Click Query Builder.

Note: If Always or Location Query is chosen, the Query Builder button will be disabled. ►



## Tip

### Actions that stop further processing

The highlight/suppression and filter actions will stop the processing of actions for a single feature.

Highlight and suppression actions will not process any further actions if the condition that causes the feature to highlight or suppress succeeds. This prevents multiple highlights on a single feature or confusion in a case where, for example, a feature qualifies for both a highlight and a suppression action. The filter action is designed to stop processing further actions for a feature if it meets the filter conditions and is defined as excluded.

## Tip

### Using the filter action

Action processing can be time consuming. If you can eliminate features from further action processing by using a filter action, that may speed up the process. See 'Applying filter actions in ArcMap' later in this chapter.

10. Double-click a field in the Fields panel on the left side of the Query Builder dialog box to place it in the Expressions panel below.

11. Click the control or controls you wish to use to set the query conditions.

12. Enter a value for the field.

The query will look for this value in the field you have specified and perform the action on any feature meeting this criteria.

13. Click Apply.

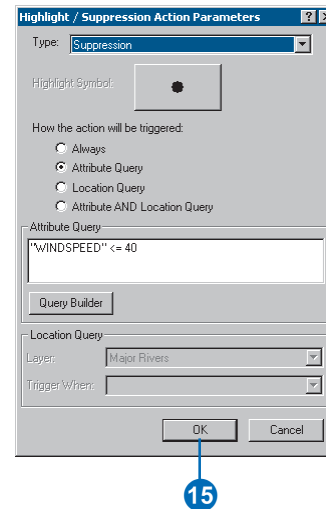
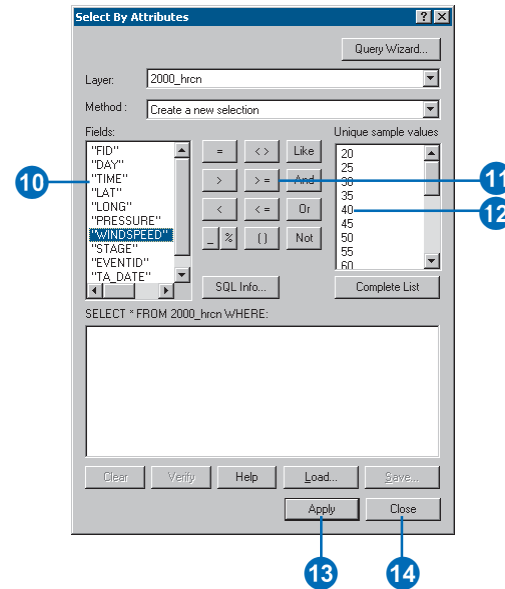
14. Click Close.

The Highlight / Suppression Action Parameters dialog box remains open, showing your attribute query expression.

15. Click OK.

The new action appears in the action list panel. You can continue adding new actions as you wish, editing the order in which to apply them using the Move Up and Move Down buttons.

Note: You can disable or enable any action in the action list panel by clicking its check box to the left.



## Applying filter actions in ArcMap

Tracking Analyst will allow you to apply a filter to data layers in ArcMap that will either include or exclude data from a dataset.

Applying a filter to a data layer in ArcMap will stop the processing of any subsequent actions for features that meet the filter criteria and are marked as excluded. The filter will not affect the display or inclusion of data on the map—unless it excludes features from a highlight or suppression action.

### Tip

#### Changing action order

*You can change the order of actions in the list panel by using the Move Up and Move Down buttons. For example, you may want to move a filter action to the top of the list to help reduce processing time for subsequent actions.*

## Applying a filter action

1. Right-click the temporal data layer you want to filter in the table of contents and click Properties.
2. Click the Actions tab.
3. Click New Action.
4. Click Filter as the Type of Action to Create.
5. Click in the text box and type a name for the filter action.

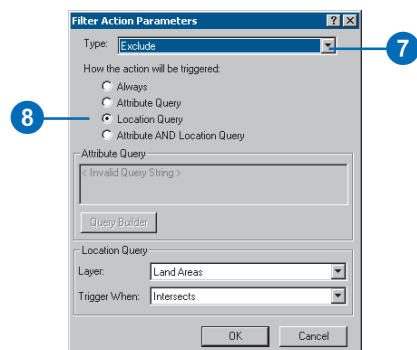
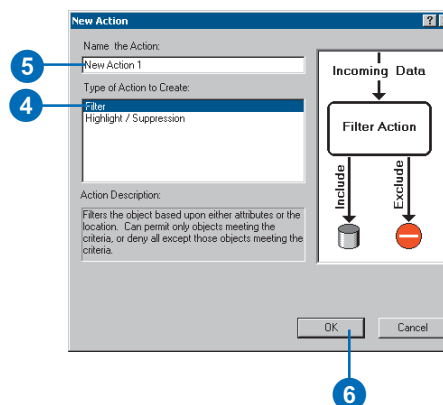
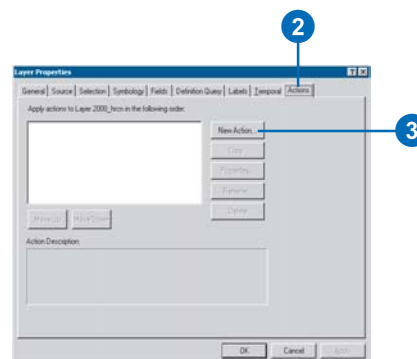
If you choose not to enter a name, the default setting of New Action will be used.

6. Click OK.
7. Click the Type dropdown arrow and choose Include or Exclude.

The Include filter will permit only data that meets certain location or attribute criteria and exclude all other features. Exclude will deny features that meet the criteria.

8. Click Always, Attribute Query, Location Query, or Attribute AND Location Query to set the type of action trigger.

This example uses a location query. For steps in creating an attribute query, see ‘Applying a suppression action to a layer’ earlier in this chapter. ►

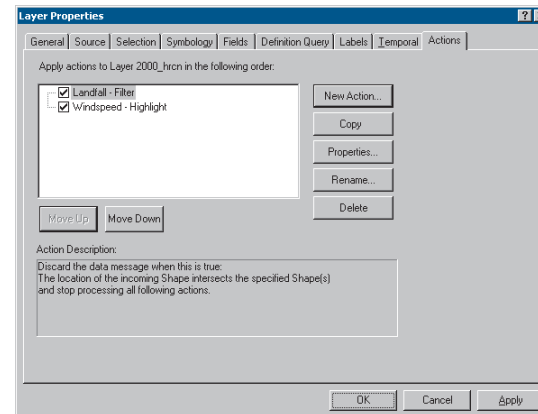
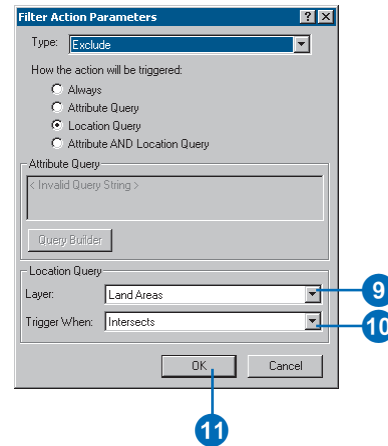


9. Click the Layer dropdown arrow and choose a layer whose location will somehow interact with the temporal layer you're working with.
10. Click the Trigger When dropdown arrow and choose a relationship between the layer you've chosen and the temporal layer—for example, Intersects.
11. Click OK.

The new action appears in the action list panel. If other actions appear in the list, you can use the Move Up and Move Down buttons to put them in the order in which you want to apply them to the data layer.

**Note:** You can enable or disable any action in the list by clicking on its check box to the left.

**Note:** Applying an action will stop processing of subsequent actions in the list for any feature meeting its conditions.



# Working with real-time data

# 8

## IN THIS CHAPTER

- What is real-time data?
- Setting up a real-time connection in ArcCatalog
- Setting properties for tracking connections in ArcCatalog
- Setting properties for tracking services
- Applying actions to real-time data
- Adding real-time data in ArcMap
- Replaying real-time data in ArcMap

In this chapter you will learn the basics of working with real-time data using Tracking Analyst procedures in ArcCatalog and ArcMap.

You will learn how to:

- Set up real-time connections in ArcCatalog.
- Set properties for tracking connections and tracking services.
- Apply actions to real-time data.
- Add and replay real-time data in ArcMap.



# What is real-time data?

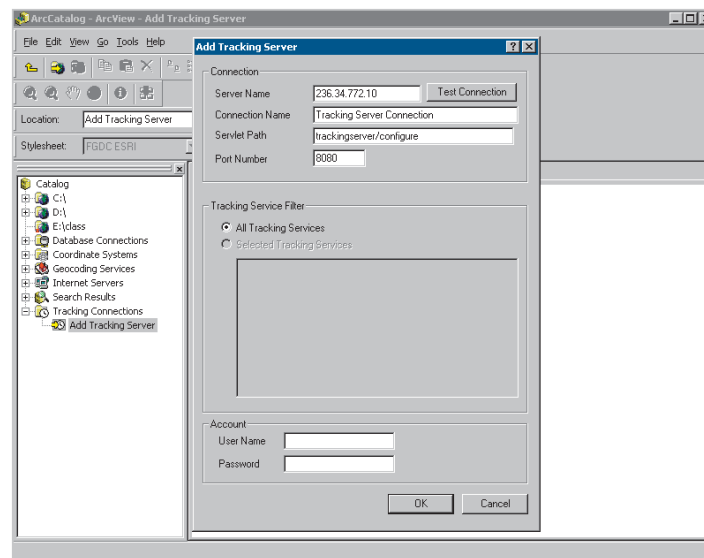
*Real-time data* is temporally enabled data that streams in from an ArcIMS Tracking Server connection. This information facilitates tracking of features as they occur in real time—or near real time. Specific needs for real-time tracking of data include emergency response systems, commercial and military fleet tracking, threat detection for defense and intelligence agencies, and satellite tracking systems.

The term real-time needs to take into account the route the data must travel from its input source through network connections and the Tracking Server before appearing in an end client viewer. Data rates will depend on the communication links to the data applications you're using, server speeds, and network speeds. The data you receive from the Tracking Server is as close to actual real-time information as possible given the above constraints.

Real-time data received in Tracking Analyst travels from the ArcIMS Tracking Server. Services are first defined in the Tracking Server using the Tracking Server Configuration Utility, allowing developers and administrators to configure connections to real-time devices. These devices communicate their messages to the Tracking Server, which in turn takes the data and creates a tracking service. Tracking services are managed through the Tracking Server Administrator. Only services enabled through this application are available to clients. Once data is collected and enabled as a service it will be available to clients.

## Using ArcCatalog to set up real-time connections

To enable real-time data output, you must first set up a connection to the Tracking Server using the Tracking Analyst Add Tracking Server dialog box in ArcCatalog. After setting up a connection to the Tracking Server, you can add the real-time service as a layer in ArcMap. The data displays on the map as it is received from the server.



The Tracking Server Connection Properties and Tracking Service Properties dialog boxes in ArcCatalog allow you to configure settings for the connection itself and the tracking services it contains.

## ArcIMS and ArcMap client viewers

Once you have set up your tracking connection and tracking services, you can view your real-time data in a variety of clients. The best client for you will depend on your operation's needs.

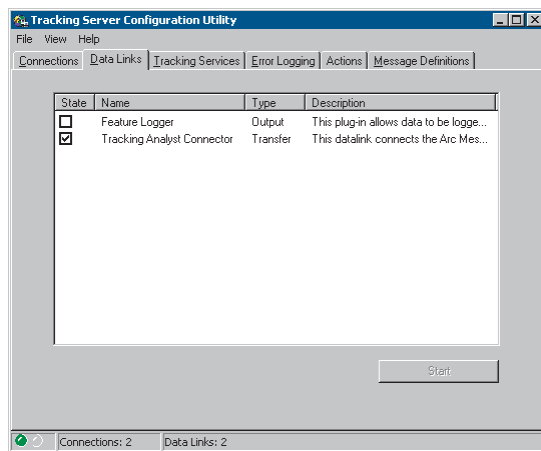
If your operation needs real-time data with powerful analysis capabilities, you will want to use the ArcGIS Tracking Analyst extension and ArcMap to view your data. This combination offers the most functionality for real-time display and analysis. However, the performance of the real-time throughput will be affected by the platform running ArcMap.



If you need a lightweight client without the complex analysis capabilities, you may want to use the ArcIMS Tracking Server Web client. This client uses ArcIMS images service and tracking services in a custom Web page, which you can modify to meet your needs, using the Tracking Server Author and Design tools, which are similar in functionality to the ArcIMS tools of the same names.

## About the Tracking Server

The ArcIMS Tracking Server includes tools—including a Configuration Utility and Administrator tool—that allow you to set parameters for the real-time data you wish to add to ArcMap. You can define what data service or services you wish to use, message definitions, actions, and other parameters. For more information on setting up the Tracking Server, see *Using the ArcIMS Tracking Server*.



## Setting up a real-time connection in ArcCatalog

Before adding real-time data to ArcMap, you'll need to create a connection to a tracking service that will provide the data. This procedure is accomplished in ArcCatalog, using the Add Tracking Server dialog box.

### Tip

#### Enabling the server utility

*You may need to set up the Tracking Server Configuration Utility before you create a real-time data connection in ArcCatalog. For more information on starting and configuring the Tracking Server, see Using the ArcIMS Tracking Server.*

### Tip

#### Testing the connection

*If an error appears when you click Test Connection, make sure you have the right name for the machine where the server resides, or type in the machine's Internet Protocol (IP) address.*

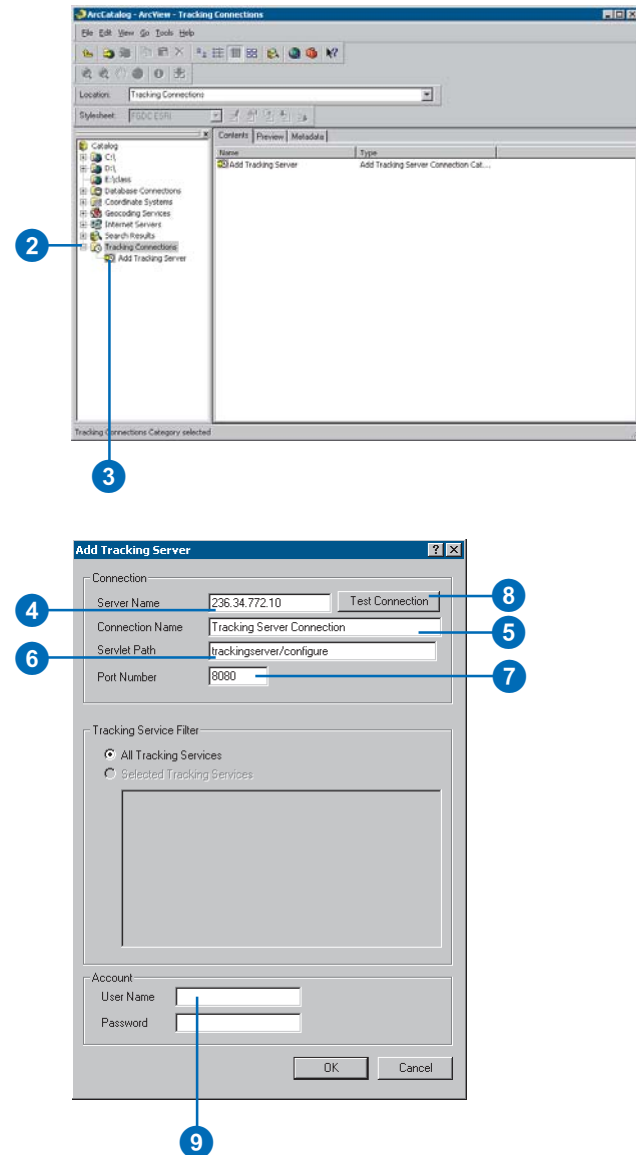
## Connecting to a tracking service in ArcCatalog

1. Start ArcCatalog from the Start menu or desktop icon.
2. Click the plus sign beside the Tracking Connections folder in the Catalog.

3. Double-click Add Tracking Server.

The Add Tracking Server dialog box opens, where you can enter information about the server and connection name, as well as the servlet path and port number.

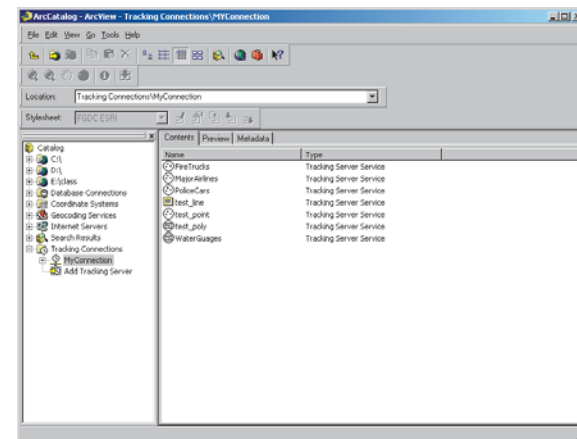
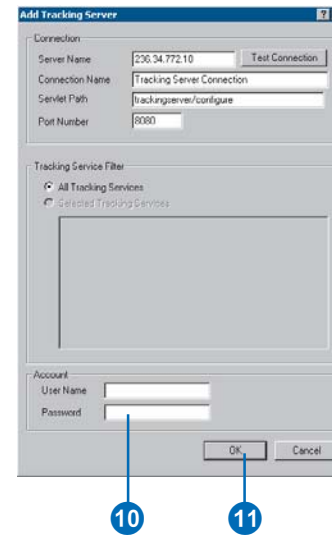
4. Click in the Server Name text box and type the name of the machine that hosts the Tracking Server.
5. Click in the Connection Name text box and type the name of the new connection.
6. Click in the Connection Name text box and type the name of the new connection.
7. Click in the Port Number text box and type the appropriate value.
8. Click Test Connection to make sure the information you have entered is correct.
9. Click in the User Name text box and type your system username. ►



10. Click in the Password text box and type your system password.

11. Click OK.

The new connection appears in ArcCatalog.



# Setting properties for tracking connections in ArcCatalog

You can set properties for each connection you add to ArcCatalog. These properties allow you to specify the server and connection names, as well as which services can be accessed in the connection to view in ArcMap.

## Tip

### Specifying tracking services

*If you click the Selected Tracking Services button in the Tracking Server Connection Properties dialog box, you can specify which services can be accessed within a connection. This is useful when you have many services set up and available but only want to access a few in ArcCatalog.*

## Setting tracking server connection properties

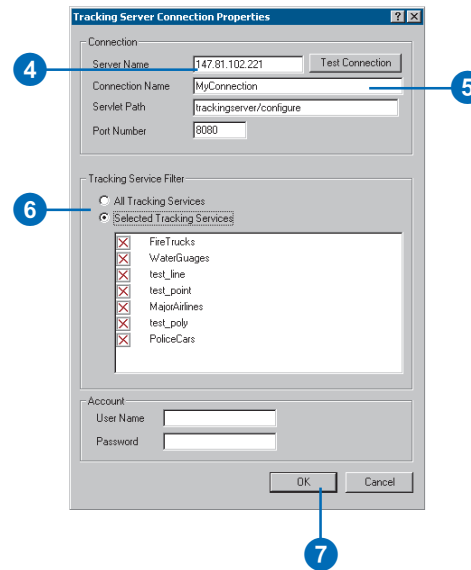
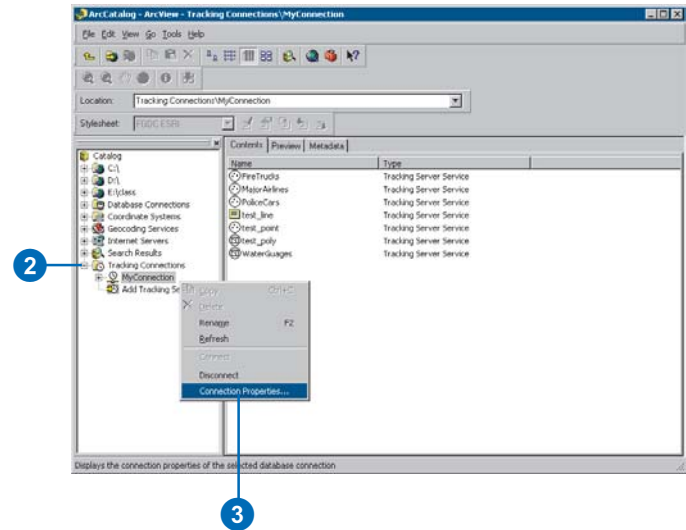
1. Start ArcCatalog from the Start menu or desktop icon.
2. Click the plus sign beside the Tracking Connections folder in the Catalog.
3. Right-click on the tracking connection you wish to edit and click Connection Properties.

The Tracking Server Connection Properties dialog box opens.

Note: If you have not yet created a tracking connection in ArcCatalog, see the previous section, 'Connecting to a message service in ArcCatalog'.

4. Click in the Server Name text box and make any necessary changes.
5. Click in the Connection Name text box and make any necessary changes.
6. Click the button beside the appropriate choice, to include all services or select specific services from the connection.
7. Click OK.

The dialog box closes and your new connection appears in the Catalog tree and Contents panel.



# Setting properties for tracking services

You can also define settings for individual tracking services in a tracking connection. These settings can help you define how long real-time data will remain in memory as it streams in, what fields are coming in, and what actions to perform on a given message service. For more information on performing actions on real-time data in ArcCatalog, see the procedure for Applying actions to real-time data, in this chapter.

## Tip

### Defining Auto Purge Settings

*The Auto Purge settings allow you to determine how many features you allow to stream into the data flow before starting to delete records. Once you reach the threshold you have entered, a percentage of the records currently in memory will be deleted. According to the default Purge Rule, the oldest records will be deleted first, until you reach the defined percentage.*

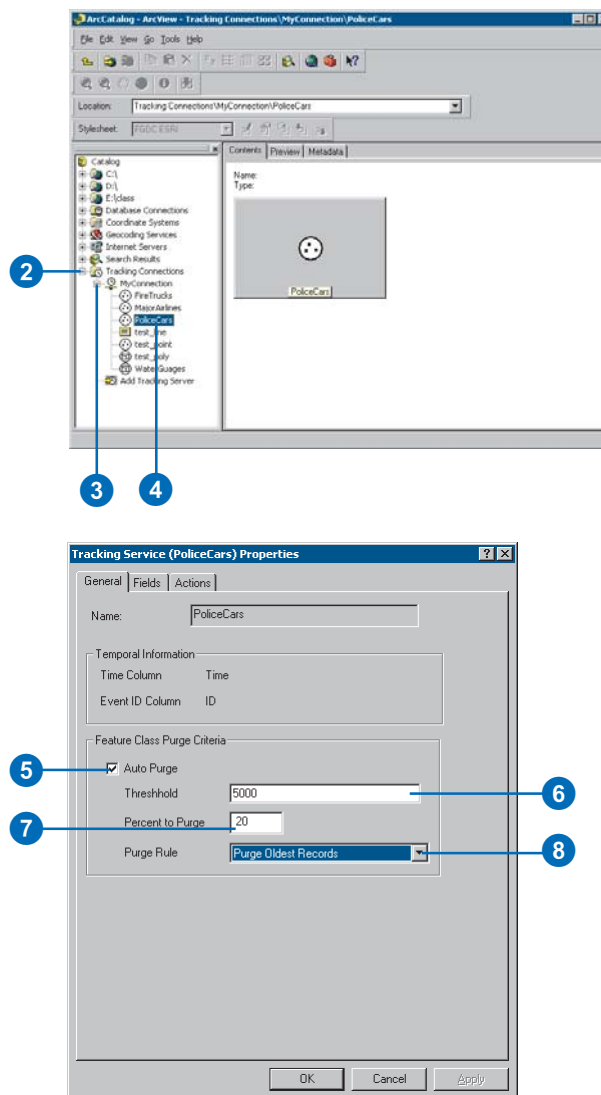
## Setting tracking service properties

1. Start ArcCatalog from the Start menu or desktop icon.
  2. Click the plus sign beside the Tracking Connections folder in the Catalog.
  3. Click the plus sign beside the connection you have created.
- A list of tracking services appears below the connection in the Catalog tree.

4. Right-click one of the services and click Properties.

The Tracking Service Properties dialog box opens, including the name of the service in the title bar, displaying the General tab by default.

5. Click the Auto Purge check box on or off to determine whether data will be thrown away once a certain threshold is reached.
6. Click the Threshold text box and type a maximum number of records to maintain in memory.
7. Click in the Percent to Purge text box and type a percentage of records to purge when the Threshold is met.
8. Click the Purge Rule dropdown arrow and choose a rule from the list. ►



9. Click the Fields tab.

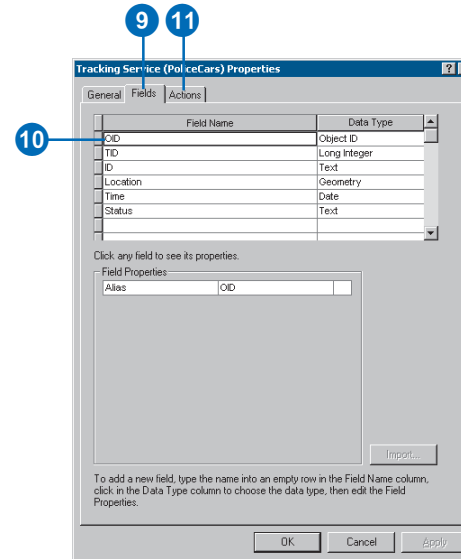
The Fields tab includes information about the fields in the tracking service.

10. Click any field to see its properties.

Note: Because field attributes are determined in the Tracking Server, they are not editable in this dialog box. For more information on defining real-time data messages, see *Using ArcIMS Tracking Server*.

11. Click the Actions tab.

The next section describes the procedures for creating and applying actions to real-time data.



## Applying actions to real-time data

When you're working with real-time data from a Tracking Server connection, you can apply actions to temporal data in ArcCatalog.

There are two real-time actions supplied out of the box with Tracking Analyst in ArcCatalog. These actions—the Coordinate Conversion and Filter actions—will affect the dataset itself, not merely its display as a layer in ArcMap.

### Tip

#### Changing action order

*If you'd like to apply another action to the same data layer, you can change the order in which they are applied to the data. Just highlight an action in the action list panel and click Move Up or Move Down until you have the actions in the desired order.*

*Note: The filter action will remove all data meeting the Exclude criteria from the incoming data stream. It will include all data that meets Include criteria. The excluded data will not appear in the dataset.*

## Applying a coordinate conversion action to data in ArcCatalog

1. Start ArcCatalog and navigate to the real-time connection you have set up in the Tracking Connections folder.

Note: For more information on setting up a real-time connection, see 'Connecting to a tracking service in ArcCatalog' in this chapter.

2. Right-click on the tracking service whose coordinate system you want to convert and click Properties on the context menu.
3. Click the Actions tab.
4. Click New Action.

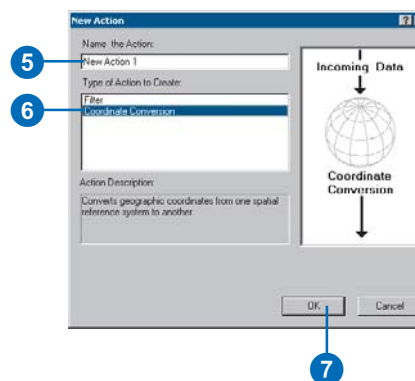
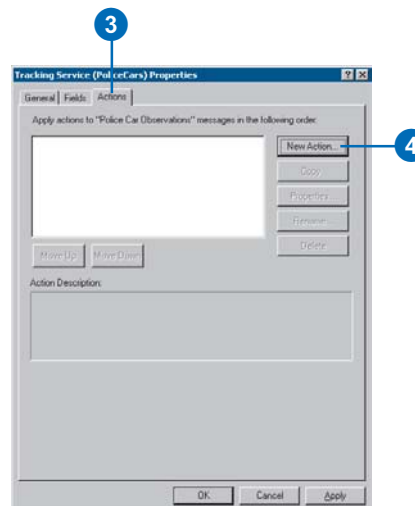
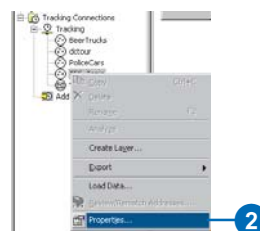
The New Action dialog box opens.

5. Click in the text box and type a name for the action.

If you choose not to enter a name, the default New Action 1 will be used.

6. Click Coordinate Conversion in the Type of Action to Create panel.
7. Click OK.

The Coordinate Conversion Action Parameters dialog box opens. ►





8. Click Select to browse for the desired spatial reference system.

The New Spatial Reference dialog box opens.

9. Click the button corresponding to the method you wish to use for the coordinate conversion.

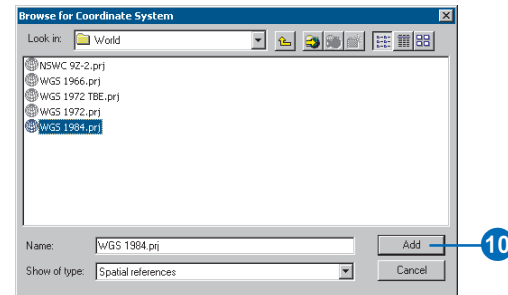
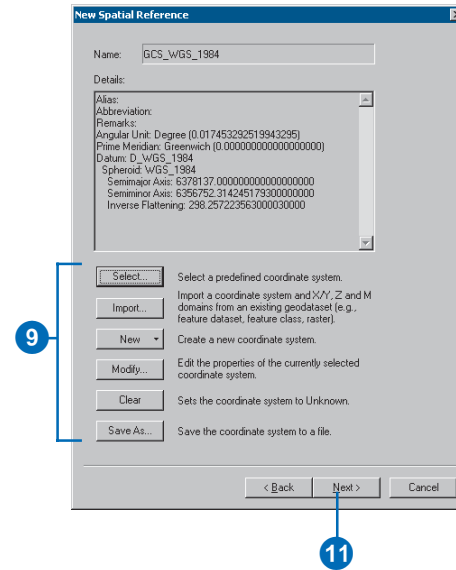
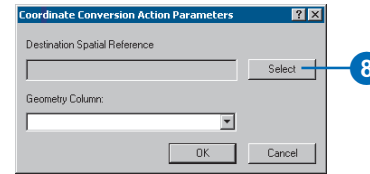
This example uses the Select button to choose a pre-defined coordinate system.

10. Navigate to the spatial reference system you wish to use and click Add.

The new spatial reference system appears in the New Spatial Reference dialog box.

11. Click Next.

The second panel of the New Spatial Reference dialog box appears. ►



12. Check the values in the text boxes and click Finish.

Note: If the values are incorrect, you can click Back to change previous options.

The new coordinate reference appears in the Coordinate Conversion Action Parameters dialog box.

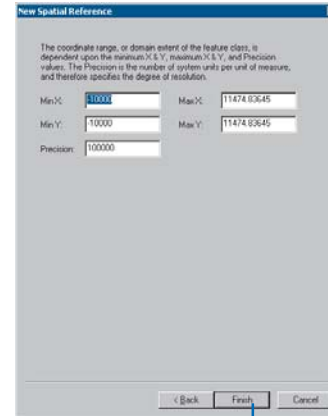
13. Click the Geometry Column dropdown arrow and choose the field that contains spatial reference information.

This field's contents will be converted to the new spatial reference system you have chosen.

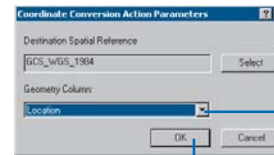
14. Click OK.

The new action appears in the Actions list panel, where you can click it to read its properties.

15. Click OK again to close the Properties dialog box.

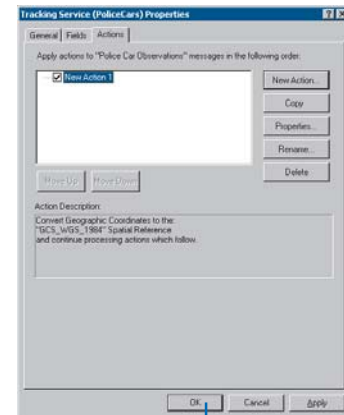


12



13

14



15

## Applying the filter action to data in ArcCatalog

1. Start ArcCatalog and navigate to the real-time connection you have set up in the Tracking Connections folder.

For more information on setting up a real-time connection in ArcCatalog, see Chapter 3, 'Working with temporal data'.

2. Right-click on the tracking service whose features you wish to filter and choose Properties from the context menu.

3. Click the Actions tab.

4. Click New Action.

The New Action dialog box opens.

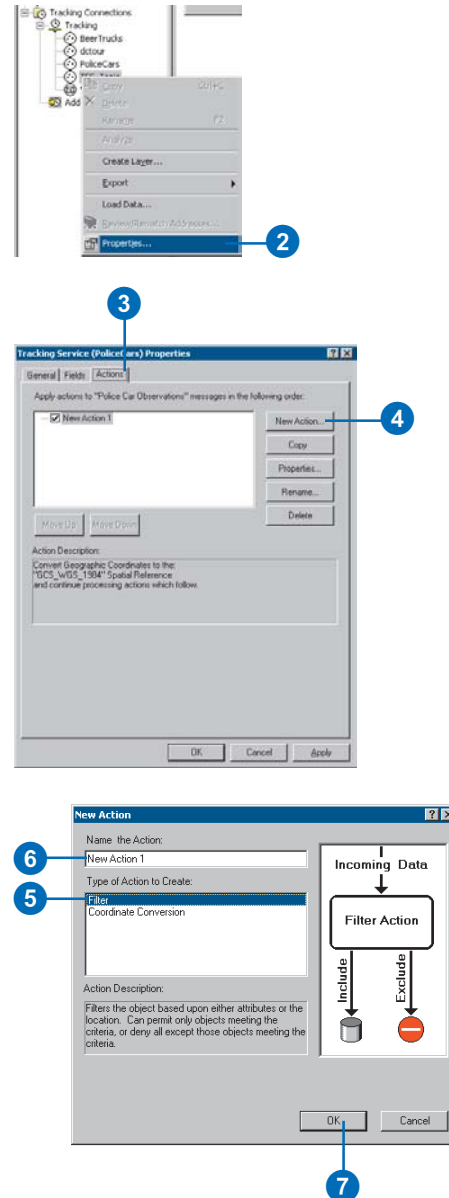
5. Click Filter in the Type of Action to Create panel.

6. Click in the text box and type a name for the action.

Note: If you choose not to type a name, the default New Action 1 will be used.

7. Click OK.

The Filter Action Parameters dialog box opens. ►



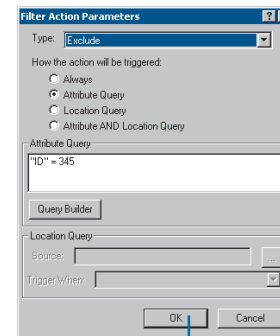
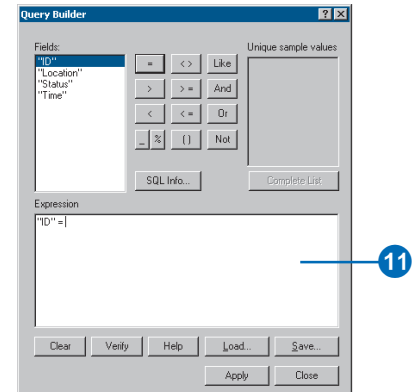
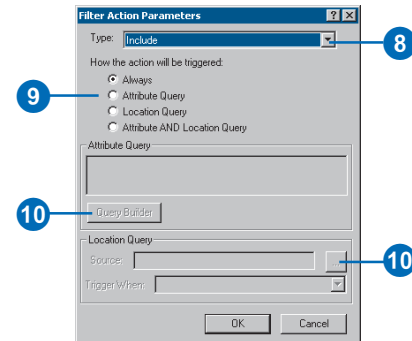
8. Click the Type dropdown arrow and choose Include or Exclude.

Exclude will drop all features in a dataset that meet the criteria you set in the Query Builder. Include will drop all features that do not meet the criteria.

9. Choose the appropriate type of query you wish to build.
10. Depending on the type of query you have chosen, you can either click Query Builder or the Ellipsis button beside the Source text box.
11. Define your query as needed.

Note: You will need to type a unique value in the Expression panel in the Query Builder dialog box.

12. Click OK.



## Applying custom VB actions in real-time

Tracking Analyst supports the use of custom Visual Basic (VB) actions with real-time data in ArcMap. These actions will apply to real-time data as it streams into ArcMap, but not to any existing data already in the layer prior to triggering the action.

You can access the Visual Basic Editor (VBE) from the ArcMap Main Menu to create this action. The following procedure takes you through the steps of applying a VB action to a real-time data layer as it streams into ArcMap.

For more information on applying actions to real-time data at the server level, see *Using ArcIMS Tracking Server*.

### Tip

#### Creating a macro

*You can create a macro that will be applied through the Tracking Analyst actions dialog boxes. Click Tools > Macros > Visual Basic Editor. For more information on using macros in ArcMap, see 'Creating, editing, and running macros' in the ArcMap section of the ArcGIS Desktop Help system.*

## Applying a custom VB action in ArcMap

1. Right-click the real-time data layer to which you want to apply the VB action in the table of contents and click Properties.
2. Click the Actions tab.
3. Click New Action.
4. Click in the Name the Action box and type a name for the action.

Note: If you choose not to enter a name, the default New Action 1 will be used.

5. Click Visual Basic as the Type of Action to Create.
6. Click OK.

The VB Action Parameters dialog box opens.

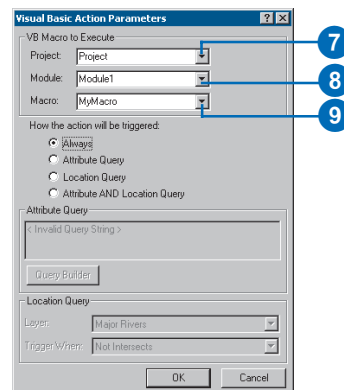
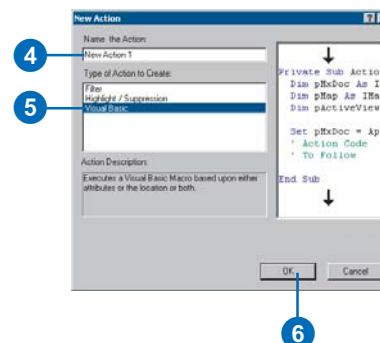
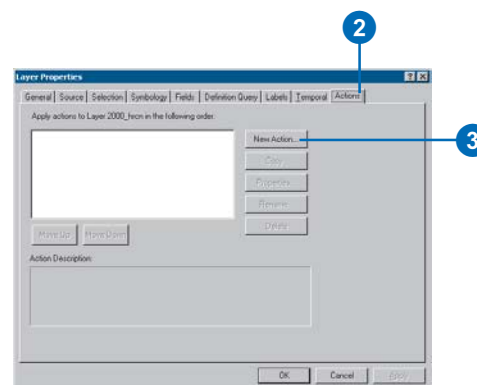
7. Click the Project dropdown arrow and choose Project or Normal.

Note: A macro in the Normal folder will affect all documents opened in ArcMap.

8. Click the Module dropdown arrow and choose the appropriate module for the macro.

The default module name in VBE is ThisDocument.

9. Click the Macro dropdown arrow and choose the name of the macro you wish to use. ►



## Tip

### Sample VB macro

*This is a very simple Visual Basic macro that can be used as an action:*

```
Public Sub  
MyMacro(ParamArray  
varArgs() As Variant)  
MsgBox varArgs(5)  
End Sub
```

*It takes the fifth argument in the list and presents it in a message box that appears on the screen. The message box will appear for every feature in the layer that meets the trigger criteria for the action. The number of the argument corresponds to the column number in the attribute table for the layer. The use of the ParamArray as the sole parameter to the macro provides you with the most flexibility; otherwise, all columns in the attribute table must be listed, and all data types must match.*

## Tip

### Minimizing processing time

*If you perform a lot of processing in a Visual Basic action, it may take a good deal of time for it to finish working on all features. The best approach is to develop and debug your macro on a very small set of data before using it on larger datasets. The filter action can help reduce the size of the dataset you're testing on.*

10. Click the appropriate button for the kind of query you want to use.

11. Click Query Builder to load or create a query for the action.

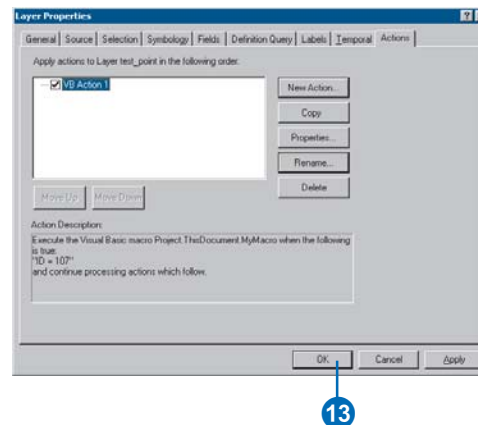
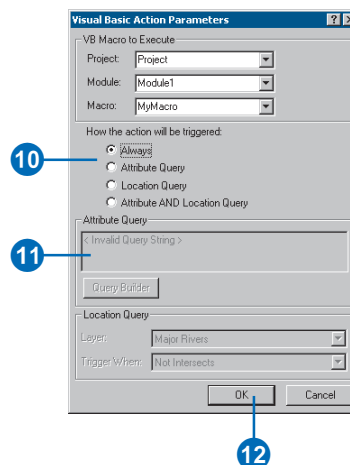
All features meeting the criteria defined in the query will be affected by the VB action you have created.

12. Click OK.

The new action appears in the list panel on the Actions tab.

13. Click OK to apply the new action to the specified layer and close the dialog box.

Note: Use a Visual Basic action with caution. For instance, if you used the example macro on a real-time data feed with thousands of records, and each of those records met the trigger criteria for the action, you would have to acknowledge a Message Box dialog box for each feature.



## Adding real-time data in ArcMap

The steps for adding real-time data as a new temporal layer are relatively simple. Once you have established a real-time connection in ArcCatalog, you can add a tracking service as a layer using the ArcMap Add Data function.

### Tip

#### Adding real-time data on the fly

If you haven't already established a real-time connection, you can do so through the ArcMap Add Data window. For more information, see Using ArcMap.

### Tip

#### Symbolizing real-time data

You can apply symbology to features in the real-time data layer using the Symbology tab.

### Tip

#### Showing future events

You can use the Display Future Events setting to make sure you include all real-time data as you receive it from the Tracking Server. Open the Layer Properties dialog box for the real-time layer in ArcMap, click the Temporal tab, click Most current, and click the Display Future Events check box.

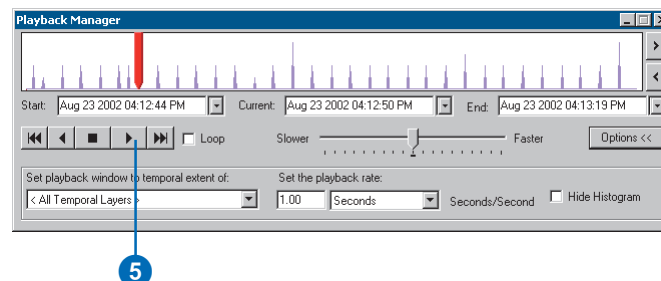
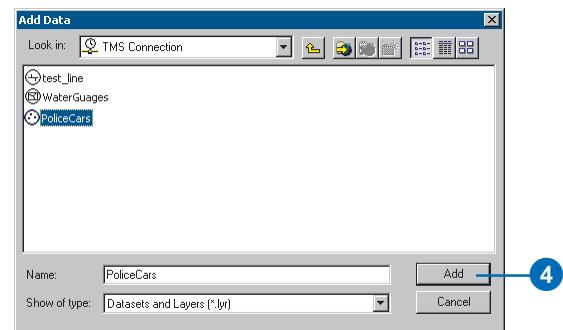
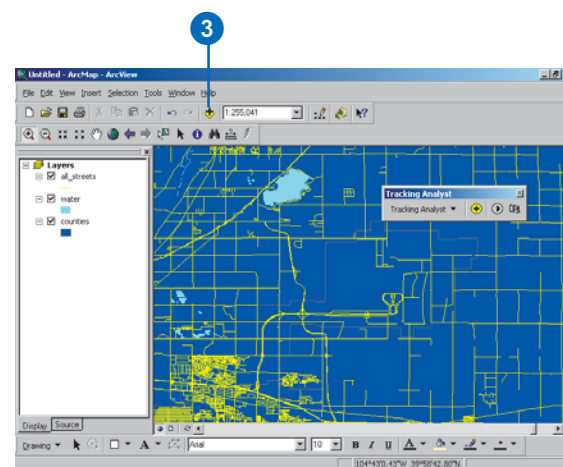
## Adding data from a real-time tracking service

1. Start ArcMap from your Start menu or desktop icon.
2. Open the desired .mxd file to display a background map for the new real-time temporal layer you will add.
3. Click the Add Data button on the ArcMap Standard toolbar—or click File and Add Data.
4. Click the tracking service you wish to add as a layer in the Add Data window from the Tracking Connections folder and click Add.

Note: At this point you may receive a warning message about potentially incompatible geographic projections.

- The new layer appears in the table of contents and features begin to appear on the map.
5. Open the Playback Manager to replay data stored in system memory once real-time data appears on the map.

The playback window for data stored in system memory will start with the time that data began streaming in and end with the time that you opened the Playback Manager.





# Glossary

## **base symbol**

The default symbol used to represent an event or a feature on the map.

## **complex dynamic event**

A complex temporal event, including two components, that involves a moving object, such as an airplane. The plane's geographical location changes through time, so its additional attributes are stored in the input table.

## **complex stationary event**

A complex temporal event, including two components, that involves a stationary object such as a traffic sensor. The sensor's geographical location will not change, so its location information is stored in the input feature class.

## **complex temporal event**

An event containing two components: one with persistent object information and one with observations of the object through time. The merger of the temporal observation with the temporal object creates a complex event record or message. There are two types of complex temporal event: dynamic and stationary.

## **event**

See temporal event.

## **fixed-time data**

Stored temporal data that can be viewed in past, future, and past-and-future time windows. This data is stored in a shapefile or as a feature class in a geodatabase.

## **ID field**

See track identifier field.

## **input features**

The component of a complex temporal event that includes shape and attribute information for a temporal event. The input features may or may not contain date and time information, depending on whether the event is dynamic or stationary.

## **input table**

The component of a complex temporal event that includes attribute information. The input table may or may not contain date and time information, depending on whether the event is dynamic or stationary.

## **most current event**

The most recent position of a feature as defined by the track identifier (ID field).

## **playback mode**

The time mode where data is displayed using the Playback Manager, replaying either real-time or fixed-time data.

## **playback window**

The span of time defined by the Start and End text boxes in the Playback Manager. You can set this window to include the temporal extent of one or more layers.

## **real-time data**

Temporal data that streams directly into Tracking Analyst from the ArcIMS Tracking Server.

## **real-time mode**

The time mode where data displays automatically on the map after being added. See *time modes*.

## **service**

A real-time data stream accessed via a tracking connection.

## **simple temporal event**

Contains all necessary information in one temporal data message—for real-time data—or record—for fixed-time data.

## **temporal data**

Includes time- and date-specific information for geographic locations that enables you to track real-time and future and past observations, which can be discrete such as lightning strikes, moving such as airplanes, or static such as traffic sensors.

## **temporal event**

Describes an observation—or set of observations—through time of a particular object—or group of objects. Also referred to as an event.

## **temporal extent**

Encompasses all temporal information, including earliest and last observations, of a data layer.

## **temporal object**

An object being observed through time.

## **temporal object table**

The component of a complex temporal event containing feature shape and attribute information.

## **temporal observation**

Data gathered for a given object through time.

## **temporal observation table**

Component of complex temporal event containing feature attribute information and possibly time and date information.

## **temporal offset**

A function that allows you to adjust the temporal display of data to play back as if it occurred at a user-defined date and time. The offset will not change the underlying data, but it will allow you to display the data as if it were happening at a different time.

**temporal window**

Time range within which to display data in Tracking Analyst. Temporal windows can be set at the layer level on the Symbology tab.

**time modes**

The two methods by which to display temporal data: real-time mode or playback mode. Time modes are determined by the use of the Playback Manager. If the Playback Manager is open, you will be in playback mode, where data stored in memory will be replayed. If you have a real-time data layer and Playback Manager is not open, you will be in real-time mode, where features appear on the map as they occur.

**track**

A connecting line between two or more temporal events that share a common track identifier (ID field).

**track identifier field**

A field containing a unique identifier for a given object or objects being observed. This field is used to join the components of a complex temporal event. Commonly referred to as the ID field.

**tracking connection**

A message or Internet connection whereby real-time data can stream into Tracking Analyst.

**tracking data**

See temporal data.



# Index

## A

- Actions
  - applying to temporal data 8
  - in layer (.lyr) files 38
- Adding
  - complex temporal events 31
  - fixed-time data 27
  - temporal shapefile 27
- Adding real-time data 100
- Animation Wizard 61
  - saving to AVI 67
- Applying actions
  - to a layer 80, 81
    - filter 83
    - suppression 81
  - to a tracking service 81
  - to real-time data
    - visual basic 98
- Applying actions to data 8, 80
- Applying coordinate conversion action 93
- Applying filter action to real-time data 96
- Applying labels 70
- ArcIMS Tracking Server 87
- AVI file
  - saving animation as 67

## B

- Base symbol
  - defined 101
  - setting 44

## C

- Changing
  - legend values manually 53
- Charting temporal data 74
- Complex dynamic event 26
  - defined 101

- Complex event 25
  - object component 25
  - observation component 25
- Complex stationary event 26
  - defined 101
- Complex temporal event 25
  - adding 31
  - defined 101
  - dynamic 26
  - stationary 26
- Connection properties
  - setting 90
- Coordinate conversion action
  - applying to tracking service 93
- Creating and applying actions 79
- Creating animation 67

## D

- Data clock
  - creating 76
  - modifying 77
  - using 76
- Data clock chart 74
- Data Clock Manager 7, 75, 77
  - using 77
- Data sources 24
- Data structures 24
- Data summary methods 74
  - choosing 76
- Displaying data 62
- Displaying temporal data 65
- Dropdown lists
  - Join field 32
  - Time field 32

## E

- Event
  - defined 101
  - temporal 25
- Exporting
  - maps 38
  - temporal data 39
- Exporting maps 39
- Extension
  - enabling 27

## F

- Feature class
  - adding 27
  - creating 31
- Filter action
  - applying to real-time data 96
- Fixed-time data 62
  - defined 101

## I

- ID field 25
  - defined 101
- Input feature 26
  - defined 101
- Input table 26
  - defined 102

## L

- Labeling temporal data 70
- Labels
  - applying 70
- Layer files
  - actions in 38
  - saving 38
- Legend values
  - modifying 53

## M

- Map
  - exporting 38, 39
  - saving 40
- Modifying
  - legend values 53
- MOLE symbology 50
- Most current event
  - defined 102
  - displaying 35
  - enabling setting 35

## P

- Period
  - setting 50
- Playback
  - options 65
  - setting window 63
- Playback Manager 6, 62
  - start and end times 63, 64
  - using 35, 37
- Playback mode
  - defined 102
- Playback rate 62
- Playback window 6
  - defined 102

## R

- Real-time data 61, 62, 85, 86
  - adding to ArcMap 100
  - applying actions to 93
  - defined 102
  - replaying 100
- Real-time mode
  - defined 102

## S

- Saving maps 40
- Saving temporal layers 38
- Service
  - defined 102
- Setting
  - classes 50
- Setting classes 50
- Setting period 50
- Setting playback window 63
- Setting tracking service properties 91
- Simple temporal event 25. *See* Temporal data:
  - adding simple event
  - defined 102
- Symbolizing
  - point data
    - by color 49
    - by shape 53
    - by size 51
  - points 49
  - using MOLE 50
- Symbolizing line data 55
- Symbolizing polygon data 57
- Symbolizing tracks 59

## T

- Temporal classes
  - setting 50
- Temporal data
  - adding
    - as a layer file 28
    - complex events 31
    - simple event 27
  - applying actions 8
  - applying actions to 80
  - charting 7, 73
  - data clock
    - summary methods 74

- Temporal data (continued)
  - date and time formats 24
  - defined 102
  - displaying 6
    - symbolized data 65
  - event 25
  - exporting 39
  - fixed-time
    - playing 62
  - in attribute table 40
  - real-time 85, 86
  - saving 38
  - saving as AVI 67
  - sources 24
  - structures 24
  - summary methods 74
  - symbolizing 5
    - about 44
    - base symbol 44
    - line data 55
    - points 49
    - polygon data 57
    - tracks 59
  - time modes 62
  - tracking 4
- Temporal event
  - defined 102
  - displaying most current 35
- Temporal extent
  - defined 102
- Temporal layer
  - offset 33, 36
  - properties
    - most current setting 33
    - offset 33
- Temporal object 25
  - defined 102
  - table, defined 102
- Temporal object component 25
- Temporal observation 25
  - defined 102
  - table, defined 102
- Temporal offset
  - defined 102
  - setting 36
- Temporal window
  - defined 103
- Time modes 62
  - defined 103
- Time window
  - classes 50
  - color 45
  - no modification 45
  - period 50
  - settings 45
  - shape 45
  - size 46
  - symbolology 46
- Toolbar
  - accessing 27
- Track
  - defined 103
  - symbolizing 59
- Track identifier field
  - defined 103
- Tracking connection
  - defined 103
- Tracking connections
  - setting properties 90
- Tracking data
  - defined 103
- Tracking Server 87
- Tracking service
  - choosing 90
  - creating connection 88
  - setting properties 91



