ArcGIS® GeoEvent Server

Introduction Tutorial

Lesson 6 – Spatial Processors

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The Real-Time Visualization & Analytics Team strives to update product tutorials and abstracts to reflect the latest release. Depending on the version of ArcGIS GeoEvent Server you are using, there may be inconsistencies between your environment and the illustrations or specific steps in exercises or videos bundled with the abstract. The concepts outlined, however, should be applicable across different versions of GeoEvent Server.

Contents

Tutorial overview

The Introduction to ArcGIS GeoEvent Server Tutorial is one of several tutorials that introduces you to the capabilities of ArcGIS GeoEvent Server. The tutorial contains six lessons, each complementing one another by exploring different capabilities. If you are new to GeoEvent Server, you are encouraged to start with Lesson 1 and then work through the remaining lessons. If you are familiar with GeoEvent Server, you can skip to any other lesson depending on your learning objectives, you do not need to complete each lesson in order. Later lessons will assume you have some familiarity with GeoEvent Server.

The lessons include a GeoEvent Server product configuration that you will import. Each includes configured items such as inputs, outputs, GeoEvent Definitions, and GeoEvent Services that support the lesson. Carefully review the information on what is included in the configuration, as it may reset items you created as part of previous lessons and product exploration.

This tutorial does not provide information on installing, deploying, or managing ArcGIS GeoEvent Server. For information about deploying ArcGIS GeoEvent Server, see Deployment considerations.

Access the other lessons here. If you have questions, comments, or feedback on this tutorial, start a discussion on the ArcGIS GeoEvent Server Community.

Tutorial prerequisites

Before getting started with the Introduction to GeoEvent Server Tutorial, review the following prerequisites.

- ArcGIS GeoEvent Server is installed, licensed, and configured in your organization. If not, see the following topics for your operating system to install GeoEvent Server:
    - GeoEvent Server (Windows) installation guide
    - GeoEvent Server (Linux) installation guide
- A managed relational geodatabase or ArcGIS Data Store is registered to ArcGIS Server. See Register an ArcGIS Server managed database for more information.
- ArcGIS Server must be licensed with the ArcGIS GIS Server and ArcGIS GeoEvent Server licensing roles.
- Exercises in this tutorial assume GeoEvent Server is installed on a single machine with ArcGIS Server. The exercises will leverage the **Default** connection to ArcGIS Server, accessible in **GeoEvent Manager** by navigating to **Site** > **GeoEvent** > **Data Stores**.

Lesson 6 overview

Lesson 6 builds upon the concepts of event processing presented in Lesson 4 and Lesson 5. Exercises in this lesson introduce spatial processors, these are more advanced processors that enable event monitoring and enrichment based on spatial proximity.

Once you complete the exercises in this lesson, you will be familiar with the processors below and how they are used in real-time analysis workflows:

- **Buffer Creator Processor**
- **Convex Hull Creator Processor**
- **Envelope Creator Processor**
- **Difference Creator Processor**
- **Symmetric Difference Creator Processor**
- **Intersector Processor**
- **Projector Processor**
- **Range Fan Calculator Processor**
- **Union Creator Processor**

Lesson 6 prerequisites

The prerequisite steps below must be completed before proceeding with the exercises in this lesson.

Prerequisite 1: Create a new folder on the GeoEvent Server machine

To complete Lesson 6, you will create a new folder on the GeoEvent Server machine. This folder will be used with the file-based outputs in GeoEvent Server. If you already created the folder structure in previous lessons, proceed to the next prerequisite.

1. On the GeoEvent Server machine, create the folder structure below:

   ```
   C:\GeoEvent\output
   ```

Prerequisite 2: Import a GeoEvent Server configuration

ArcGIS GeoEvent Server stores elements and settings in a configuration file (.xml). To complete this lesson, a GeoEvent Server configuration file is included to help get your GeoEvent Server environment configured with the required elements to complete the exercises below. For more information about working with GeoEvent Server configurations, see Manage configurations.

Importing the configuration for this lesson will create the following items:

GeoEvent Definition	input

Inputs	multipoint-url-poll-in point-url-poll-in point2-url-poll-in polygon-url-poll-in polygon2-url-poll-in polygon3-url-poll-in polyline-url-poll-in
Output	file-json-out
GeoEvent Services	Buffer Creator Convex Hull Creator Difference Creator Envelope Creator Intersector Projector Range Fan Calculator Symmetric Difference Creator Union Creator
Geofences	Arizona/.*

NOTE: *If an element with the specified names above already exists in your environment, importing this configuration will overwrite those elements. You will reset your GeoEvent Server configuration which will remove items you created previously and import only the items necessary for this lesson.*

Follow the steps below to reset and import the GeoEvent Server configuration for Lesson 6.

1. Open **GeoEvent Manager** and navigate to **Site** > **GeoEvent** > **Configuration Store**.
2. Click **Reset Configuration** and click **Yes** to confirm.

   NOTE: *If you have anything else configured on your GeoEvent Server machine, resetting the configuration will delete everything from your configuration.*
3. Click **Import Configuration**.
4. Click **Choose File** and browse to the …`\configuration` folder included with this lesson and select the **Lesson_6.xml** file and click **Open** and then **Next**.
5. Click **Next**, ensure **Import Configuration** is selected, and click **Import** to import the configuration.

   NOTE: *It is best practice to stop any inputs, outputs, and GeoEvent Services before exporting a GeoEvent Server configuration. When imported, a started element may begin processing event data before you are ready for it to do so, contend with another running element, or import in an error state when an externally hosted socket connection, for example, is not yet available for a client connection.*

Prerequisite 3: Add simulation data

In the GeoEvent Server installation directory there is an `assets` folder which can be used to simulate data coming from an API endpoint. You will put the JSON files included with this lesson into the `assets` folder and use them to simulate real-time data being sent from an API endpoint.

1. On the GeoEvent Server machine, navigate to the `assets` folder at:

   `<GeoEvent Installation Directory>\ArcGIS\Server\GeoEvent\assets`

2. Copy and paste the **multipoint.json**, **point.json**, **point2.json**, **polygon.json**, **polygon2.json**, **polygon3.json**, **polyline.json** files located in the `data` folder included with this lesson into the `assets` folder.

3. In **GeoEvent Manager**, on the **Manager** page, click ▶ to start the **multipoint-url-poll-in**, **point-url-poll-in**, **point2-url-poll-in**, **polygon-url-poll-in**, **polygon2-url-poll-in**, **polygon3-url-poll-in**, **polyline-url-poll-in** inputs as well as the **file-json-out** output.

   NOTE: *If for some reason your organization does not allow the machine to be accessed via localhost or the inputs counts are not increasing, perform the following steps to try to resolve the issue.*

   a. *Click to edit an input.*

   b. *For the **URL** parameter, replace `localhost` with your GeoEvent Server machine's name.*

   c. *Click **Save** to save the changes.*

You have now completed the prerequisites necessary to complete the exercises in Lesson 6.

Lesson 6 exercises

Complete the exercises below to familiarize yourself with key capabilities of the spatial processors available in GeoEvent Server.

Exercise 1: Buffer Creator Processor

The Buffer Creator Processor is used to dynamically produce a buffer around an event's geometry. The processor requires the event field containing the event's geometry to be specified. You can specify either the event field name or a tag applied to a field in a GeoEvent Definition that identifies the event's geometry field. You will use a Buffer Creator Processor to create 250-meter buffers around incoming vehicle point event records.

1. Open **ArcGIS GeoEvent Manager**, on the **Manager** page open the **Buffer Creator** GeoEvent Service.
2. From the **New Elements** menu, double-click **Processor** and specify the parameters as follows:
   a. For **Name**, type `Buffer Creator`.
   b. For **Processor**, select **Buffer Creator**.
   c. For **Geometry Field**, select **GEOMETRY**.

d. For **Replace Geometry**, select **Yes**.

e. For **Buffer Size Units**, select **Meter**.

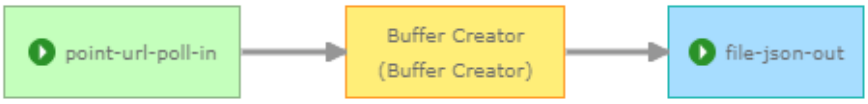
f. For **Buffer Size**, type 250.

g. For **Create Geodesic Buffer**, select **No**.

h. For **Processing Coordinate System WKID**, leave the default value at 3857.

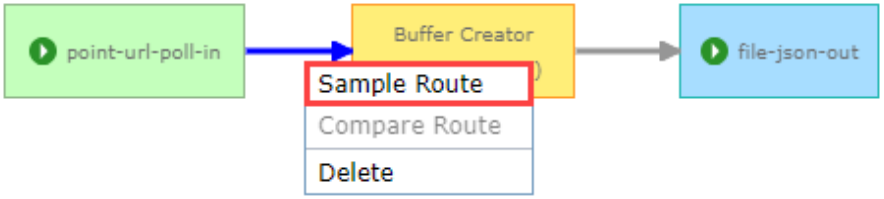
3. Click **OK** to save the new processor.

4. Configure the GeoEvent Service as illustrated below:

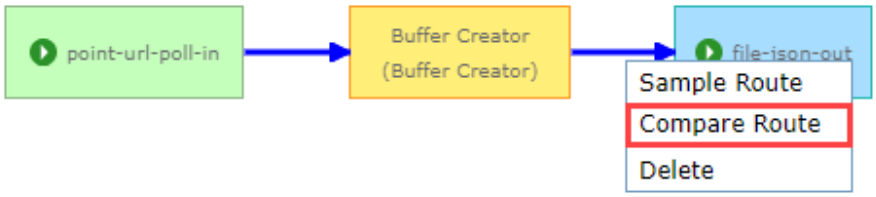


5. Click **Publish** to publish the GeoEvent Service.

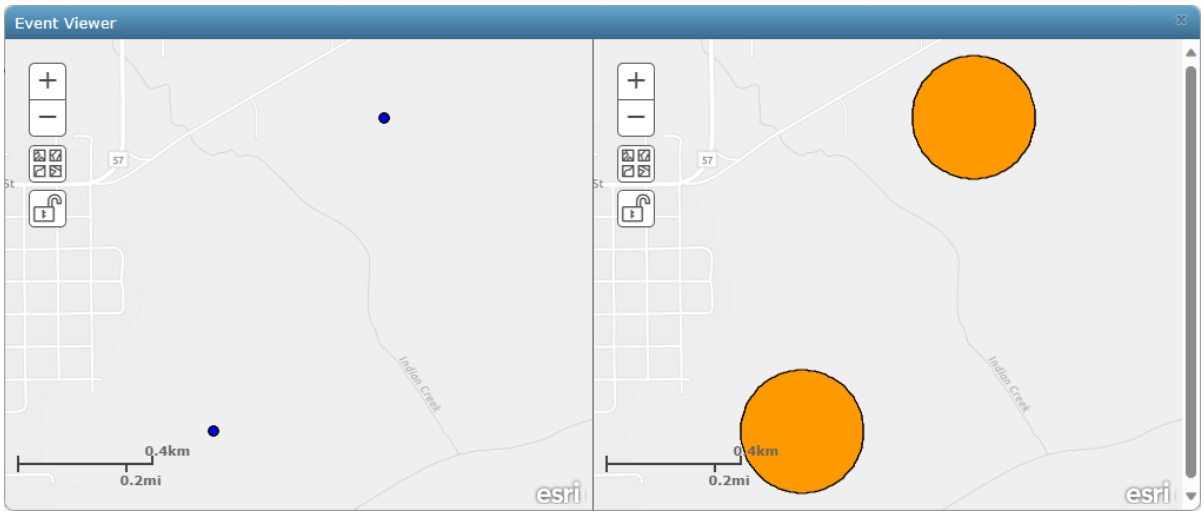
6. Right-click the highlighted route illustrated below and select **Sample Route**.



7. Right-click the highlighted route and select **Compare Route**.



8. In **GeoEvent Sampler**, click  to view the sampled event data in the **Event Viewer**.



Notice the two 250-meter buffers that were created around the vehicles in the map on the right.

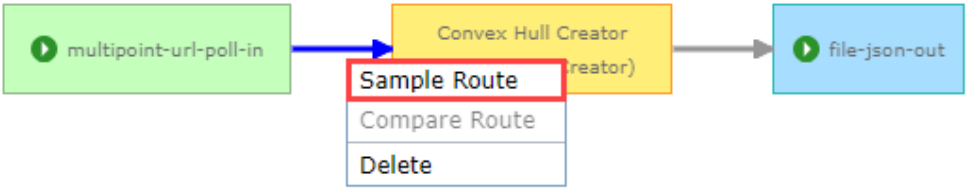
Exercise 2: Convex Hull Creator Processor

The Convex Hull Creator Processor is used to dynamically produce a polygon representing the smallest region or area enclosing an event's geometry. Conceptually, a convex hull is the shape a rubber band would take if it were stretched around an event's geometry.

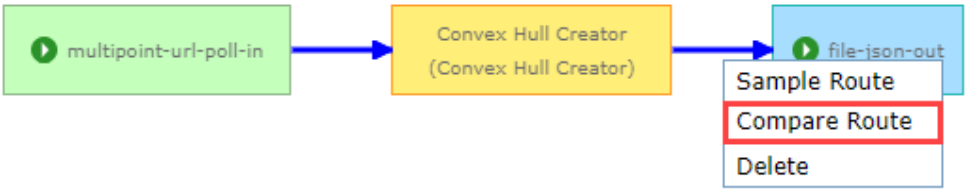
A Convex Hull Creator Processor requires that the event field containing the event's geometry be specified. You can specify either the event field name or a tag applied to a field in a GeoEvent Definition which identifies the event's geometry field.

1. In **GeoEvent Manager**, open the **Convex Hull Creator** GeoEvent Service.
2. Double-click **Processor** and specify the parameters as follows:
    a. For **Name**, type `Convex Hull Creator`.
    b. For **Processor**, select **Convex Hull Creator**.
    c. For **Geometry Field**, select **GEOMETRY**.
    d. For **Replace Geometry**, select **Yes**.
3. Click **OK** to save the new processor.
4. Configure the GeoEvent Service as illustrated below:

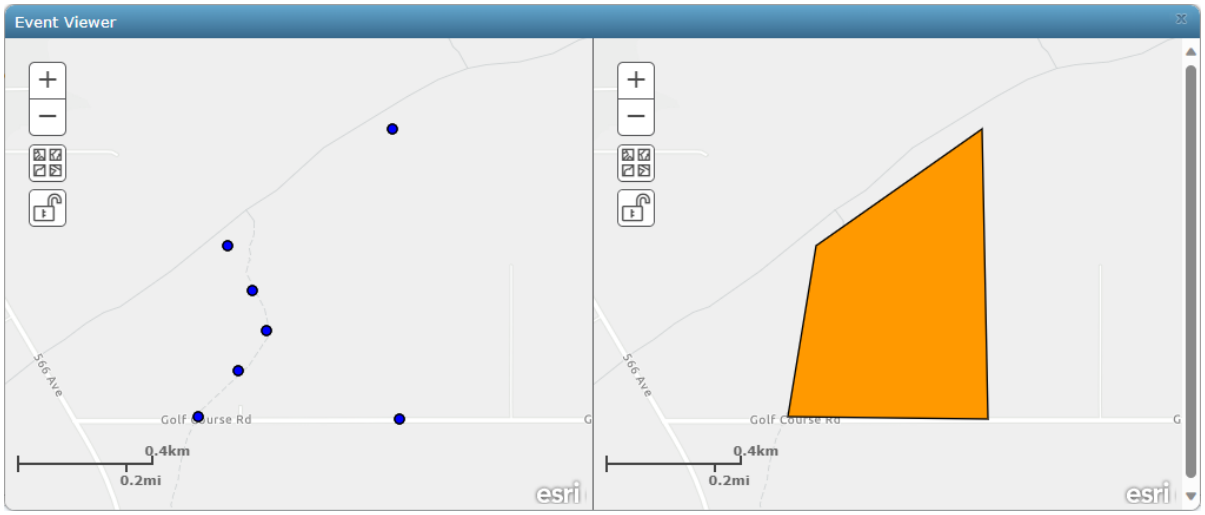
5. Click **Publish** to publish the GeoEvent Service.
6. Right-click the highlighted route illustrated below and select **Sample Route**.



7. Right-click the highlighted route and select **Compare Route**.



8. In **GeoEvent Sampler**, click  to view the sampled event data in the **Event Viewer**.



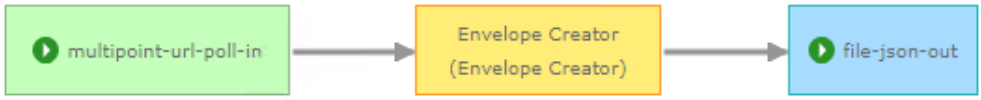
Notice that a convex hull was created around the multipoint geometry of the incoming vehicle event records.

Exercise 3: Envelope Creator Processor

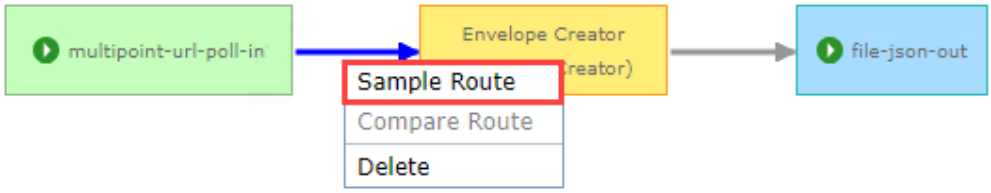
The Envelope Creator Processor is used to produce a simple rectangular envelope enclosing an event's geometry. Contrast this with a Convex Hull Creator Processor above which produced a polygon representing the smallest area enclosing an event's geometry – a convex hull will not necessarily be rectangular, whereas an envelope is always rectangular. A common use case for envelopes is to specify a map's extent.

The Envelope Creator Processor requires the event field containing the event's geometry to be specified. You can specify either the event field name or a tag applied to a field in a GeoEvent Definition which identifies the event's geometry field.

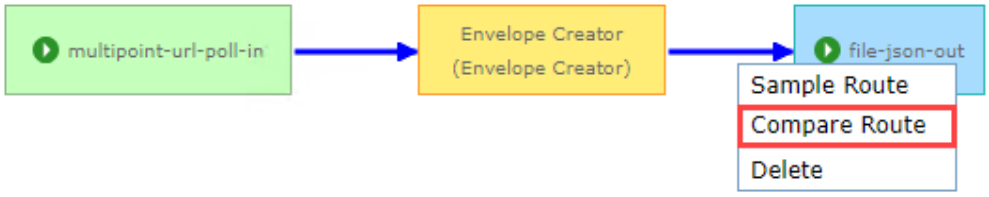
1. In **GeoEvent Manager**, open the **Envelope Creator** GeoEvent Service.
2. Double-click **Processor** and specify the parameters as follows:
    a. For **Name**, type `Envelope Creator`.
    b. For **Processor**, select **Envelope Creator** from the drop-down menu.
    c. For **Geometry Field**, select **GEOMETRY**.
    d. For **Replace Geometry**, select **Yes**.
3. Click **OK** to save the new processor.
4. Configure the GeoEvent Service as illustrated below:



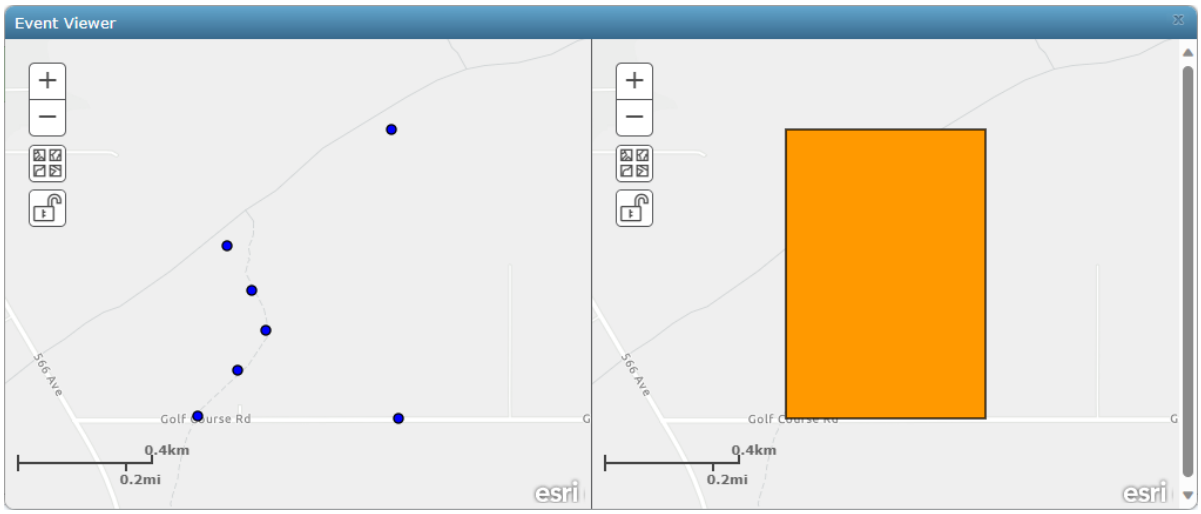
5. Click **Publish** to publish the GeoEvent Service.
6. Right-click the highlighted route illustrated below and select **Sample Route**.



7. Right-click the highlighted route and select **Compare Route**.



8. In **GeoEvent Sampler**, click  to view the sampled event data in the **Event Viewer**.



Notice the envelope that was created around the multipoint geometry from the incoming vehicle event records.

Exercise 4: Difference Creator Processor

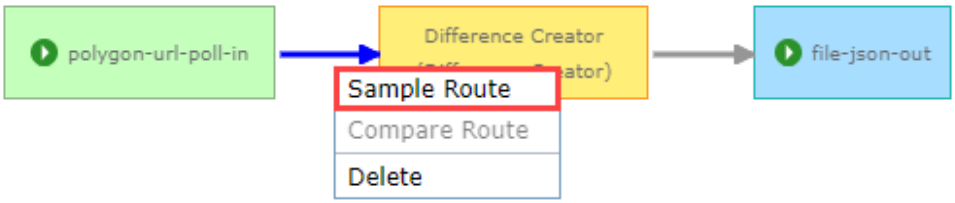
The Difference Creator Processor is used to determine the intersection between an event's geometry and a geofence, and then it clips or removes the portion of the geofence which intersects the event's geometry.

The **Arizona** geofences were included in the configuration file you imported in the prerequisites above. For information about creating geofences, refer to the *Filter based on spatial conditions* exercise in Lesson 3 and the Manage geofences help topic.

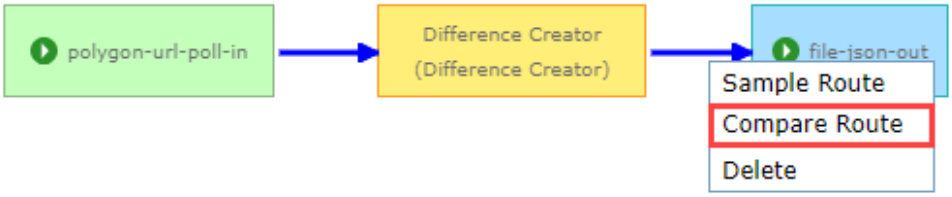
You will configure a Difference Creator Processor to remove the boundary of Maricopa County from the State of Arizona's boundary and create a polygon with the removed county boundary.

1. In **GeoEvent Manager**, open the **Difference Creator** GeoEvent Service.
2. Double-click **Processor** and specify the parameters as follows:
    a. For **Name**, type `Difference Creator`.
    b. For **Processor**, select **Difference Creator** from the drop-down menu.
    c. For **Geometry Field**, select **GEOMETRY**.
    d. For **Replace Geometry**, select **Yes**.
    e. For **Geofence**, type `Arizona/Maricopa`.
3. Click **OK** to save the new processor.
4. Configure the GeoEvent Service as illustrated below:

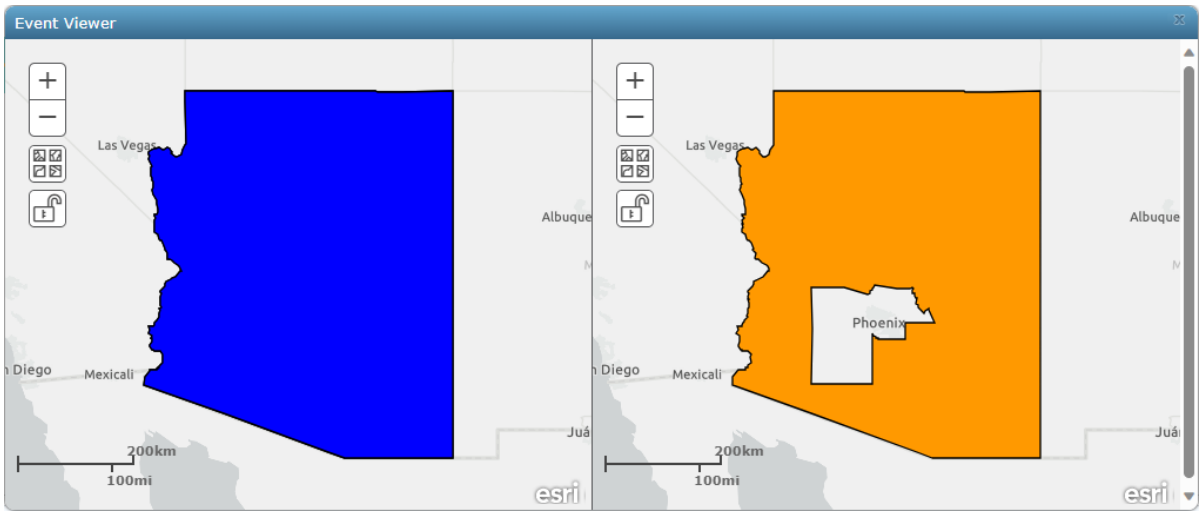
5. Click **Publish** to publish the GeoEvent Service.
6. Right-click the highlighted route illustrated below and select **Sample Route**.



7. Right-click the highlighted route and select **Compare Route**.



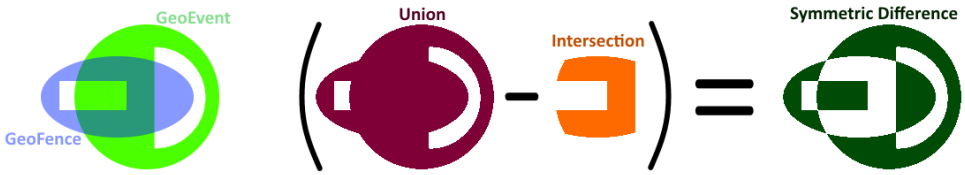
8. In **GeoEvent Sampler**, click  to view the sampled event data in the **Event Viewer**.



Note that a polygon was generated based on the intersection of the Maricopa County boundary and the State of Arizona boundary.

Exercise 5: Symmetric Difference Creator Processor

The Symmetric Difference Creator Processor is used to clip or remove the intersecting portion of an event's geometry and a geofence from the union of the two geometries. The symmetric difference of two geometries is essentially an exclusive OR.

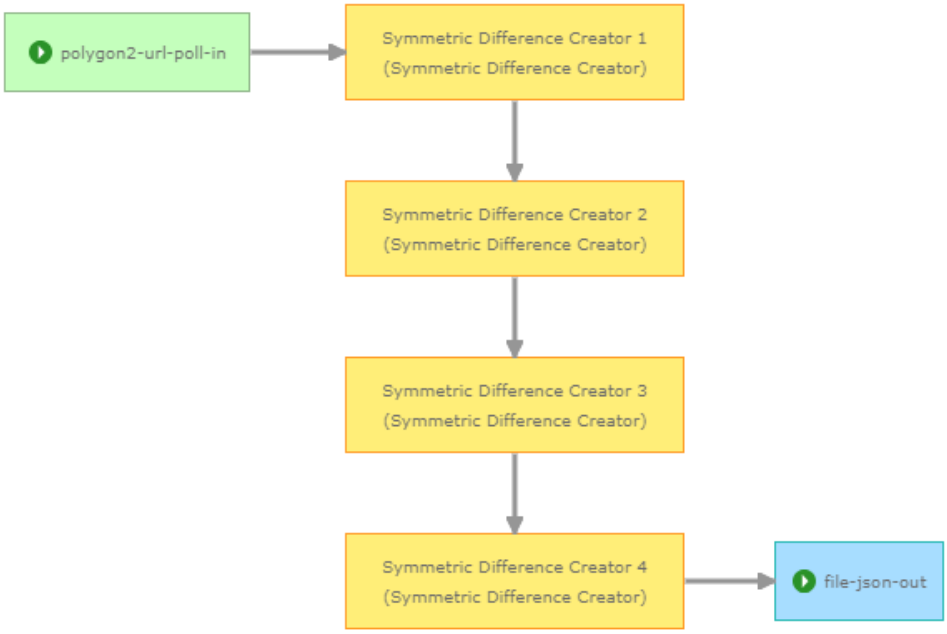


For this exercise, the input simulates a severe weather feed which provides polygon estimations of storms. You will configure a Symmetric Difference Creator Processor to identify specific areas of concern rather than defaulting to countywide alerts.

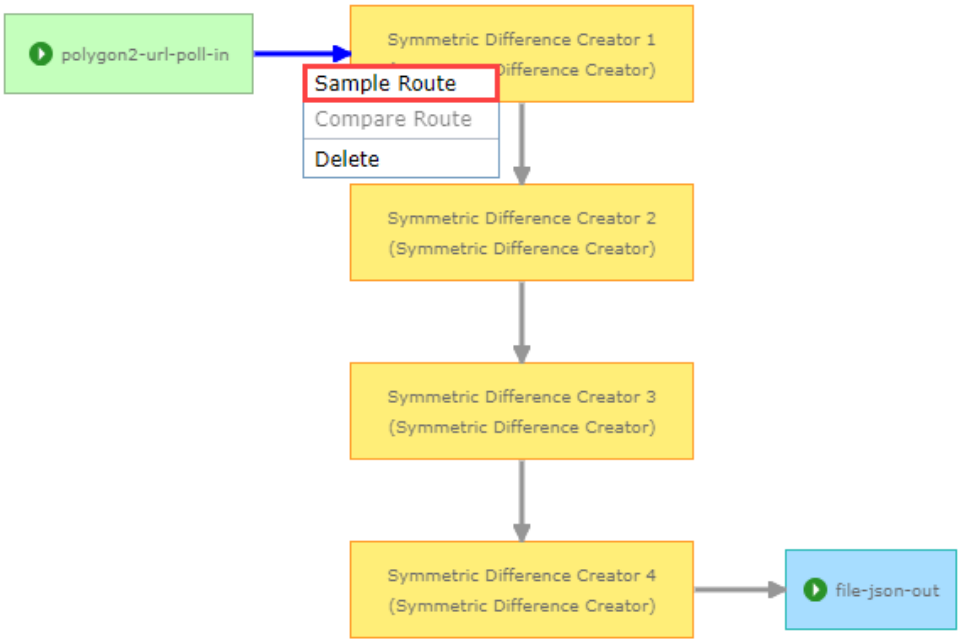
1. In **GeoEvent Manager**, open the **Symmetric Difference Creator** GeoEvent Service.
2. Double-click **Processor** and specify the parameters as follows:
    a. For **Name**, type `Symmetric Difference Creator 1`.
    b. For **Processor**, select **Symmetric Difference Creator**.
    c. For **Geometry Field**, select **GEOMETRY**.
    d. For **Replace Geometry**, select **Yes**.
    e. For **Geofence**, type `Arizona/Yavapai`.
3. Click **OK** to save the new processor.
4. Double-click **Processor** and specify the parameters as follows:
    a. For **Name**, type `Symmetric Difference Creator 2`.
    b. For **Processor**, select **Symmetric Difference Creator**.
    c. For **Geometry Field**, select **GEOMETRY**.
    d. For **Replace Geometry**, select **Yes**.
    e. For **Geofence**, type `Arizona/Maricopa`.
5. Click **OK** to save the new processor.
6. Double-click **Processor** and specify the parameters as follows:
    a. For **Name**, type `Symmetric Difference Creator 3`.
    b. For **Processor**, select **Symmetric Difference Creator**.
    c. For **Geometry Field**, select **GEOMETRY**.
    d. For **Replace Geometry**, select **Yes**.

e. For **Geofence**, type `Arizona/Gila`.

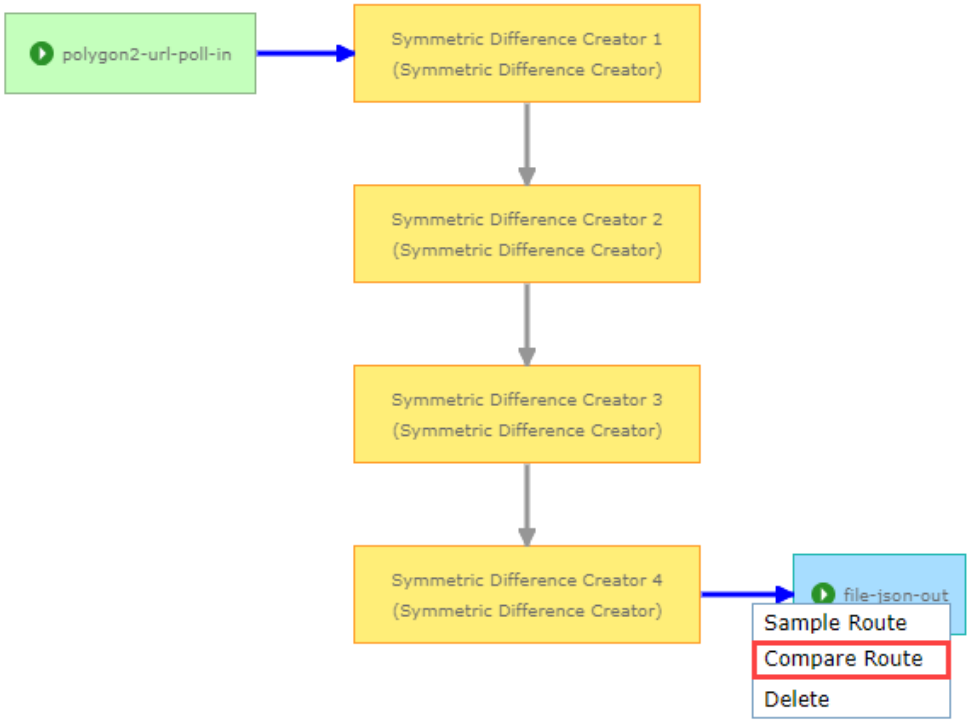
7. Click **OK** to save the new processor.
8. Double-click **Processor** and specify the parameters as follows:
    a. For **Name**, type `Symmetric Difference Creator 4`.
    b. For **Processor**, select **Symmetric Difference Creator**.
    c. For **Geometry Field**, select **GEOMETRY**.
    d. For **Replace Geometry**, select **Yes**.
    e. For **Geofence**, type `Arizona/Coconino`.
9. Click **OK** to save the new processor.
10. Configure the GeoEvent Service as illustrated below:



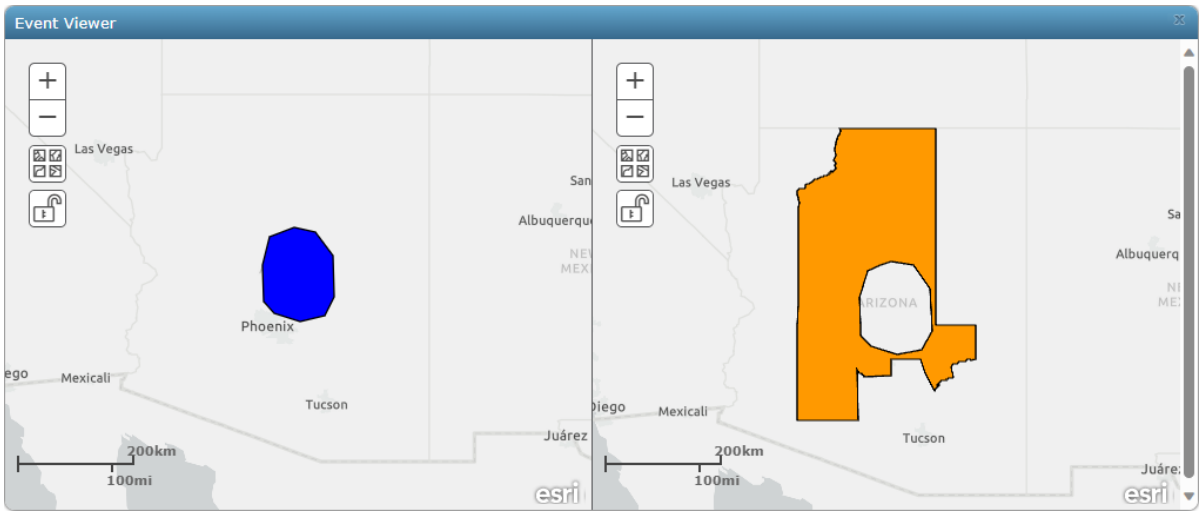
11. Click **Publish** to publish the GeoEvent Service.
12. Right-click the highlighted route illustrated below and select **Sample Route**.



13. Right-click the highlighted route and select **Compare Route**.



14. In **GeoEvent Sampler**, click  to view the sampled event data in the **Event Viewer**.



Notice that the storm system is represented by the polygon on the left. A geometric union of the geofences representing Yavapai, Maricopa, Gila, and Coconino counties was created by the Symmetric Difference Creator Processors. The intersection of the geometry was removed from the union, leaving a hole identifying the area of each county expected to be affected by the severe weather.

Exercise 6: Intersector Processor

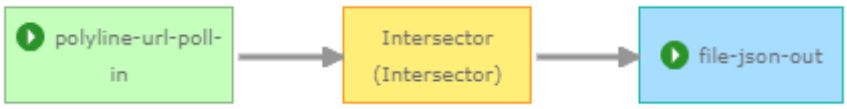
The Intersector Processor is used to generate a geometry representing the intersection between a geofence and an event's geometry. The event geometry is considered the base – the geofence is the geometry being evaluated to determine if an intersection exists.

The Intersector Processor requires two discrete geometries. For example, you cannot use a regular expression to specify several different geofences and obtain the intersection of each geofence with the geometry associated with the event being processed.

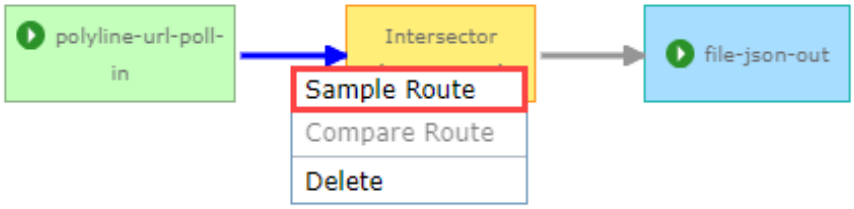
You will use the Intersector Processor to identify the intersection between the event record's geometry and a specified county, modeled as a geofence.

1. In **GeoEvent Manager**, open the **Intersector** GeoEvent Service.
2. Double-click **Processor** and specify the parameters as follows:
    a. For **Name**, type `Intersector`.
    b. For **Processor**, select **Intersector** from the drop-down menu.
    c. For **Geometry Field**, select **GEOMETRY**.
    d. For **Replace Geometry**, select **Yes**.
    e. For **Geofence**, type `Arizona/Pinal`.
    f. For **Output Geometry Type**, select **Highest Geometry Type Dimension of the Intersecting Pair**.

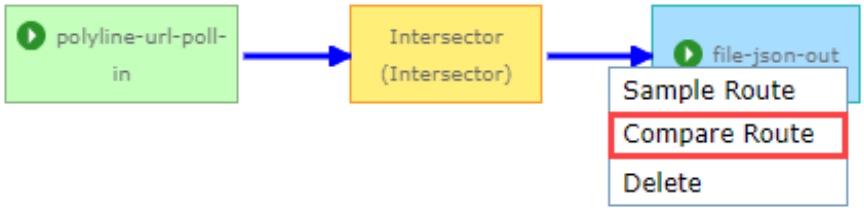
3. Click **OK** to save the new processor.
4. Configure the GeoEvent Service as illustrated below:



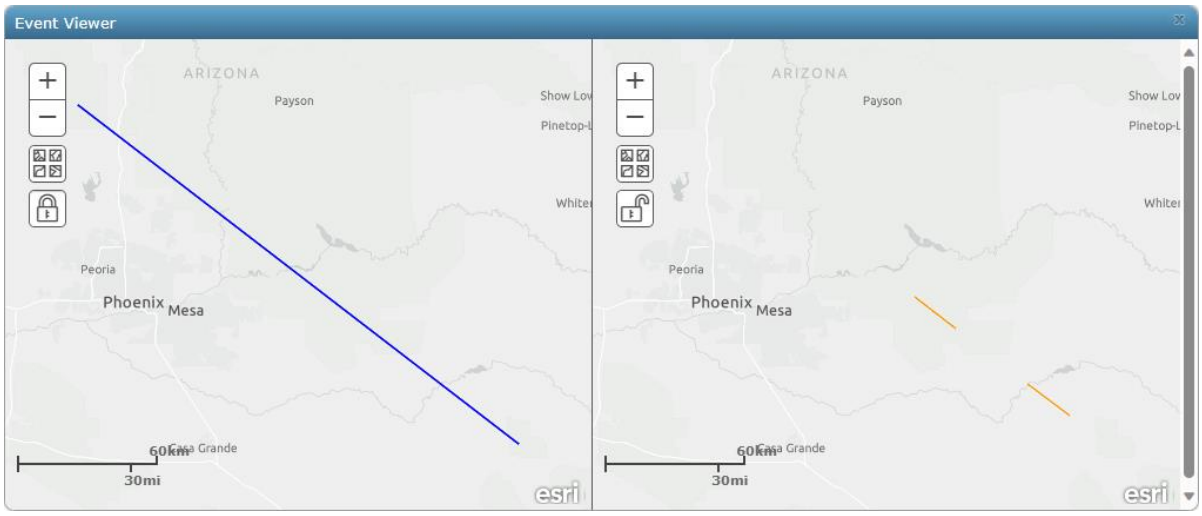
5. Click **Publish** to publish the GeoEvent Service.
6. Right-click the highlighted route illustrated below and select **Sample Route**.



7. Right-click the highlighted route and select **Compare Route**.

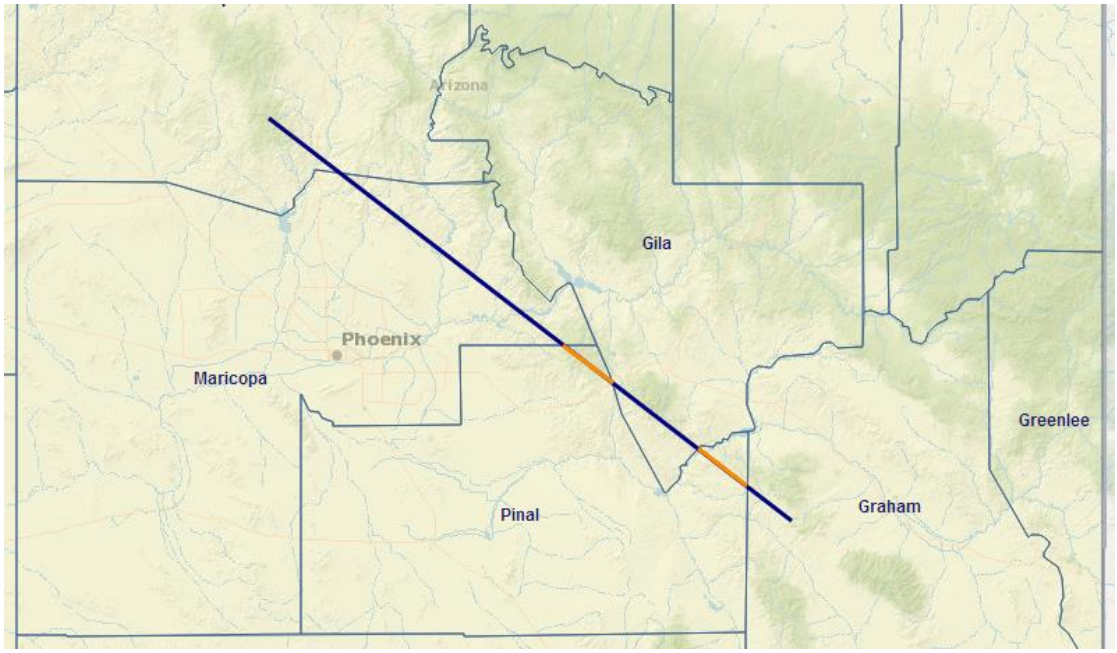


8. In **GeoEvent Sampler**, click  to view the sampled event data in the **Event Viewer**.



Notice the polyline defined by the sample JSON is symbolized as a simple blue line in the map on the left. The portion of the line which intersects Pinal County, the processed geometry, is a multipart polyline symbolized in orange in the map on the right.

Since the **Event Viewer** does not display the county boundary for Pinal County, below is an image for your reference.



Exercise 7: Projector Processor

Event data frequently expresses coordinate values in geographic space using latitude and longitude. The Projector Processor is used to project an event's geometry from its native coordinate system to another spatial reference. For example, you may want to explicitly project event data to review its coordinate values in the context of a particular coordinate system.

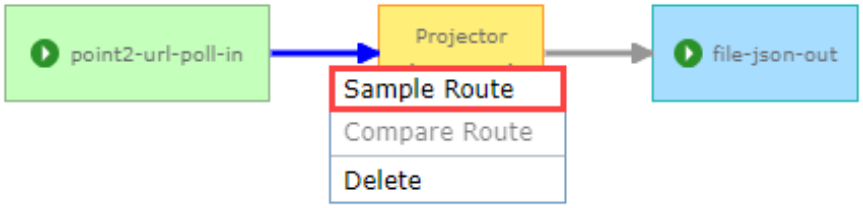
You will configure the Projector Processor to project incoming event records into NAD 1983 HARN Georgia East Meters State Plane.

1. In **GeoEvent Manager**, open the **Projector** GeoEvent Service.
2. Double-click **Processor** and specify the parameters as follows:
    a. For **Name**, type `Projector`.
    b. For **Processor**, select **Projector**.
    c. For **Geometry Field**, select **GEOMETRY**.
    d. For **Replace Geometry**, select **Yes**.
    e. For **Output Spatial Reference**, type `2780`.

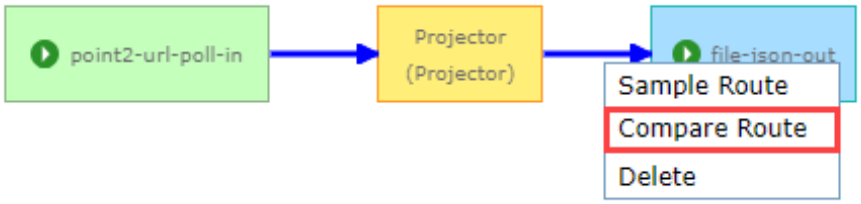
f. For **User Defined Transformations**, select **No**.

3. Click **OK** to save the new processor.
4. Configure the GeoEvent Service as illustrated below:

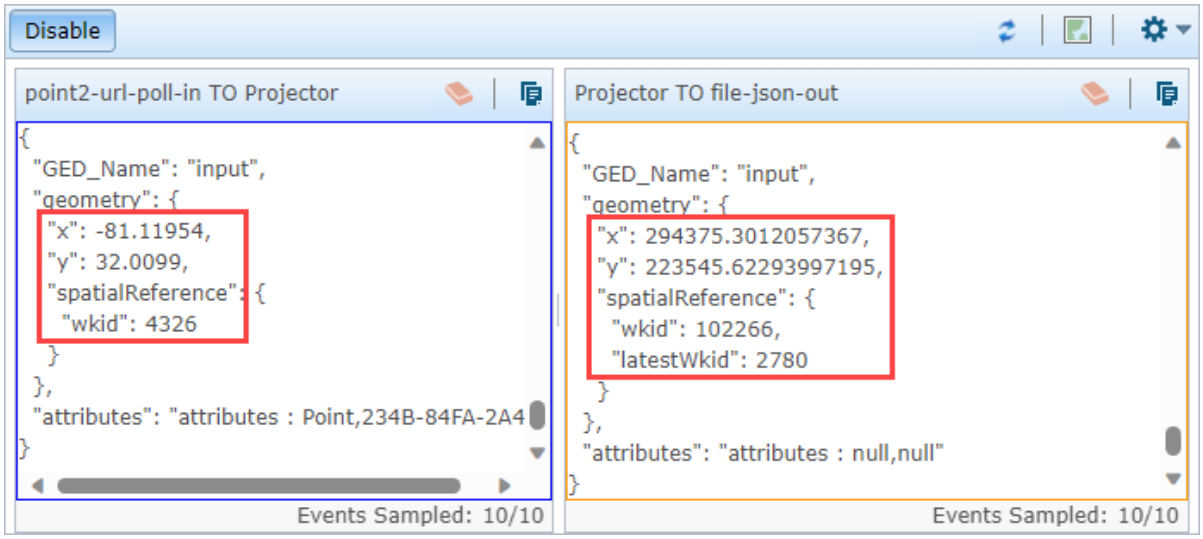
5. Click **Publish** to publish the GeoEvent Service.
6. Right-click the highlighted route illustrated below and select **Sample Route**.



7. Right-click the highlighted route and select **Compare Route**.



8. In **GeoEvent Sampler**, observe the highlighted items illustrated below.

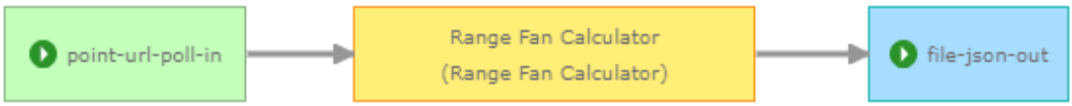


Notice that the coordinate values on the right are no longer expressed in decimal degrees and are now in meters, which is consistent with the requested coordinate system – *NAD 1983 HARN Georgia East Meters State Plane*. The coordinates system's WKID is included in each item's geometry.

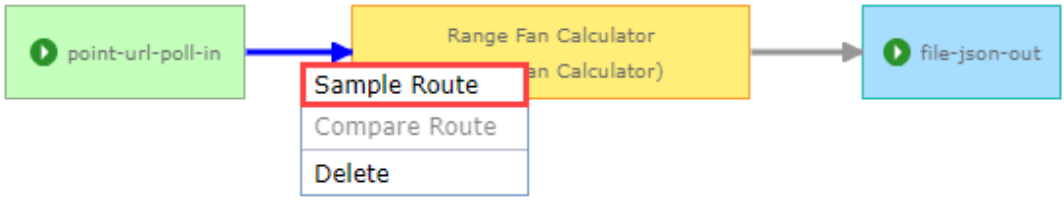
Exercise 8: Range Fan Calculator Processor

The Range Fan Calculator Processor is used to dynamically generate a range fan forward of an event record's point geometry. A range fan is effectively a two-dimensional feature in the shape of a wedge that can be used to represent a visual or contextual range of an event record. The processor calculates the range fan provided an event record's point geometry, range, bearing, and arc angle value.

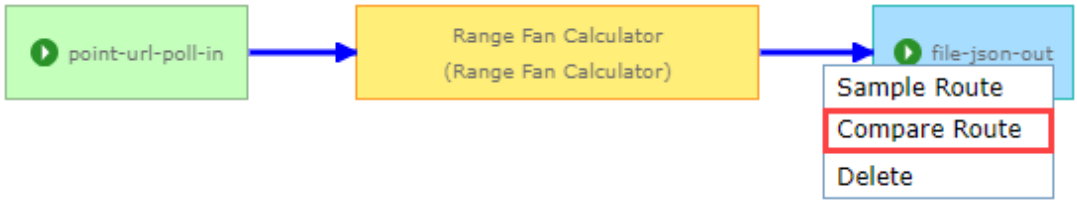
1. In **GeoEvent Manager**, open the **Range Fan Calculator** GeoEvent Service.
2. Double-click **Processor** and specify the parameters as follows:
    a. For **Name**, type `Range Fan Calculator`.
    b. For **Processor**, select **Range Fan Calculator**.
    c. For **Source GeoEvent Definition**, select **input**.
    d. For **Geometry Source**, select **Geometry Field**.
    e. For **Geometry Field**, select **GEOMETRY**.
    f. For **Range**, type `500`.
    g. For **Range Units**, select **Meters**.
    h. For **Bearing**, type **20**.
    i. For **Arc Angle**, type **90**.
    j. For **Replace Geometry**, select **Yes**.
    k. For **Processing Coordinate System WKID**, type `3857`.
    l. For **Output Coordinate System WKID**, type `3857`.
3. Click **OK** to save the new processor.
4. Configure the GeoEvent Service as illustrated below.



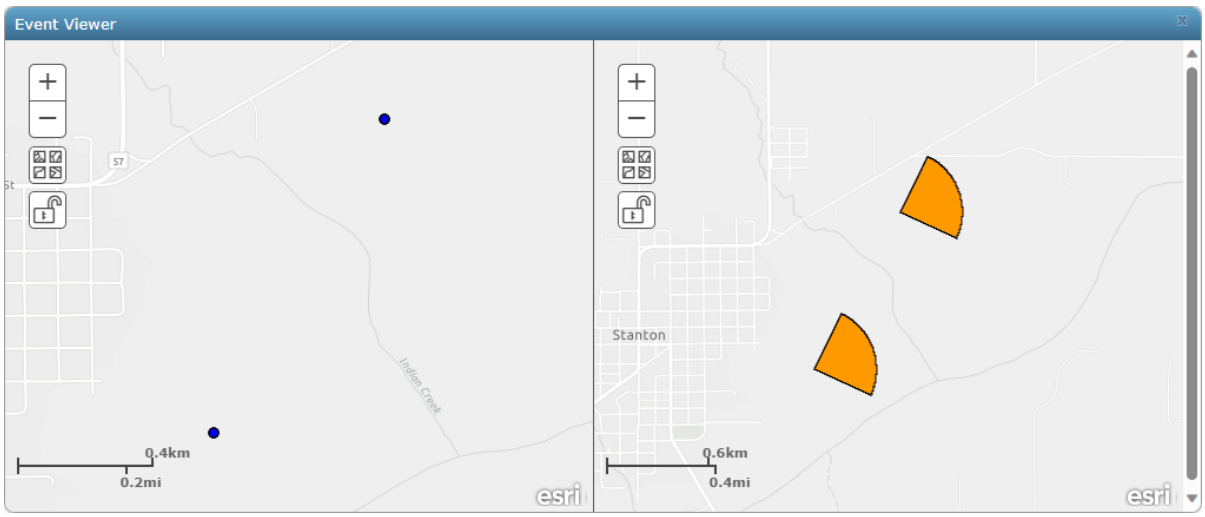
5. Click **Publish** to publish the GeoEvent Service.
6. Right-click the highlighted route illustrated below and select **Sample Route**.



7. Right-click the highlighted route and select **Compare Route**.



8. In **GeoEvent Sampler**, click  to view the sampled event data in the **Event Viewer**.



Notice that the range fans were created from the vehicles point geometry in the map on the right.

Exercise 9: Union Creator Processor

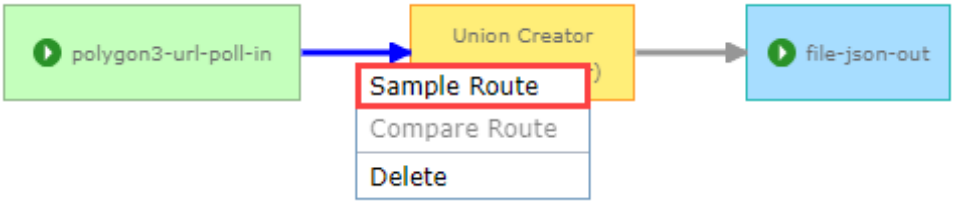
The Union Creator Processor is used to produce a geometric union of an event record's associated geometry with one or more geometries you have imported as geofences. The processor requires the event field containing the event's geometry to be specified. You can specify either the event field name or a tag applied to a field in a GeoEvent Definition which identifies the event's geometry field.

Unlike other processors such as the Difference, Symmetric Difference, and Intersector Processors which only operate with two discrete geometries, the Union Creator Processor accepts a regular expression allowing specification of several different geofences. Thus, you can obtain the union of a received event's geometry with one or more geometries that were imported as geofences.

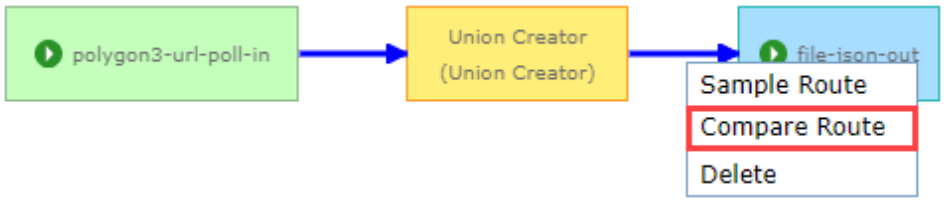
You will add and configure a Union Creator Processor to create a union of the incoming event record's geometry and the geofences for all counties in Arizona.

1. In **GeoEvent Manager**, open the **Union Creator** GeoEvent Service.
2. Double-click **Processor** and specify the parameters as follows:
    a. For **Name**, type `Union Creator`.
    b. For **Processor**, select **Union Creator** from the drop-down menu.
    c. For **Geometry Field**, select **GEOMETRY**.
    d. For **Replace Geometry**, select **Yes**.
    e. For **Geofences**, type `Arizona/.*`.
3. Click **OK** to save the new processor.
4. Configure the GeoEvent Service as illustrated below:

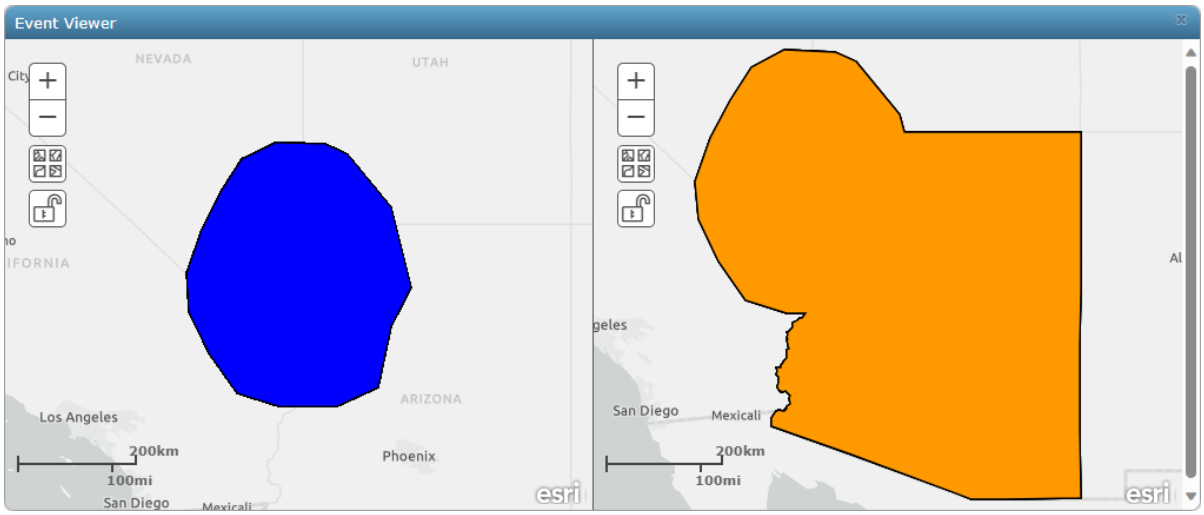
5. Click **Publish** to publish the GeoEvent Service.
6. Right-click the highlighted route illustrated below and select **Sample Route**.



7. Right-click the highlighted route and select **Compare Route**.



8. In **GeoEvent Sampler**, observe the highlighted items as illustrated below.



Notice that the incoming polygon event record's geometry was merged with the geofences which are all the counties in Arizona.

Lesson clean-up

With the lesson complete, you can now perform the following tasks to clean-up your GeoEvent Server machine, if necessary.

- Reset your GeoEvent Server configuration in **GeoEvent Manager** by navigating to **Site** > **GeoEvent** > **Configuration Store** and click **Reset Configuration**.
- Delete the files you added to the `assets` folder in the following directory, including **multipoint.json**, **point.json**, **point2.json**, **polygon.json**, **polygon2.json**, **polygon3.json**, **polyline.json**.

  `<GeoEvent Installation Directory>\ArcGIS\Server\GeoEvent\assets`
- Delete the files and folders at the following directory:

  `C:\GeoEvent\output`

Summary

By completing the exercises in this lesson, you learned how to add and configure the different spatial processors available with GeoEvent Server. You learned how the spatial processors can be used to buffer event geometry, create a convex hull, create an envelope encompassing event geometry as well as compute a simple geometric difference, a symmetric difference, and geometric intersection as well as simplified and projected event data received by GeoEvent Server.