Using ArcGIS WebMaps in SAS Visual Analytics 8.2

Using the data-driven content feature offered in SAS Visual Analytics 8.2, users can add ArcGIS WebMaps to their reports and integrate the results of their SAS-based analysis as discrete map layers.

Figure 1 VA Choropleth Layer Added in a WebMap

What are ArcGIS WebMaps?

Esri is a world-wide supplier of mapping technology and a warehouse for frequently used geographic-based data (such as demographics and scientific information). Via their ArcGIS products, they provide their customers the means to assemble maps and merge the results with their data.

ArcGIS Web AppBuilder is ESRI's publicly accessible tool for constructing maps for viewing on the web both on the desktop and on web-capable devices. Using the AppBuilder, an ESRI customer can select a map background (a "basemap"). They can search for and integrate a wide variety of publicly accessible "layers" to appear above the background. And after acquiring an identifying key, they can publish their results online as a "WebMap."
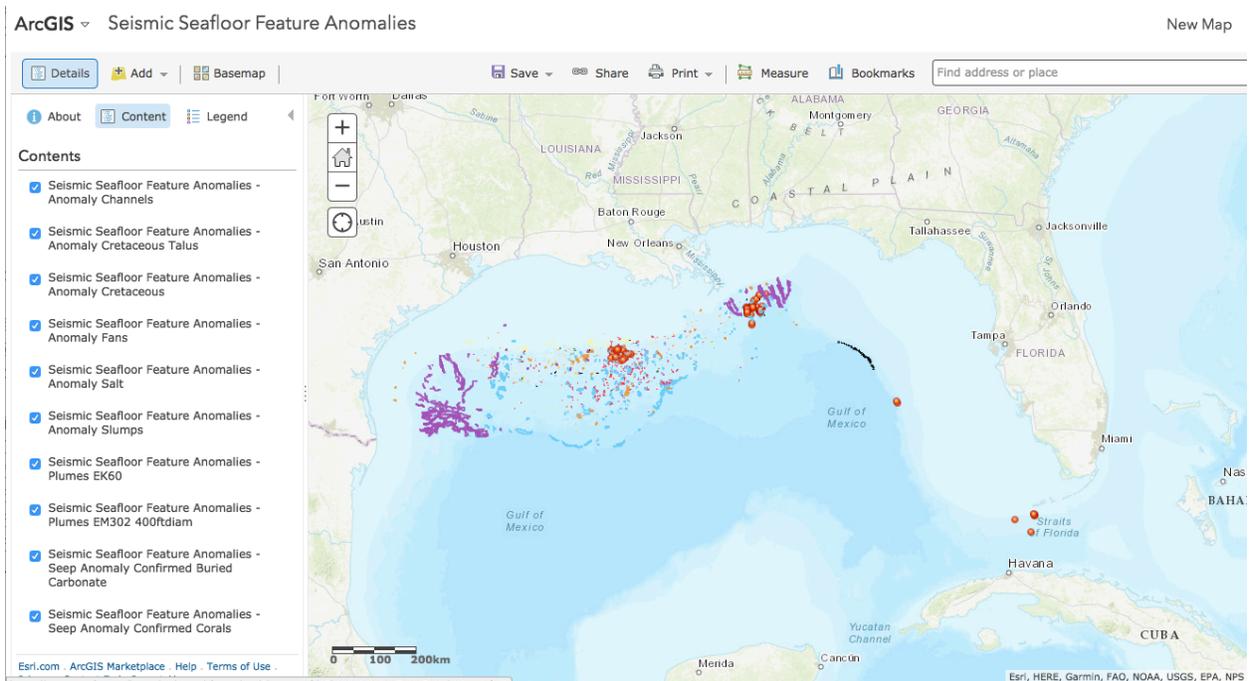
Figure 2 ArcGIS Web App Builder

WebMaps As Web Content in SAS VA

With the "web content" feature of SAS Visual Analytics, users have been able to include external web pages in their reports, and this ability has always included the use of ArcGIS WebMaps.

By accessing the "Objects" pane, they can drag the "Web Content" object onto their report area, and then, from the "Options" panel they can enter the web content URL, such as a link to a published web map.
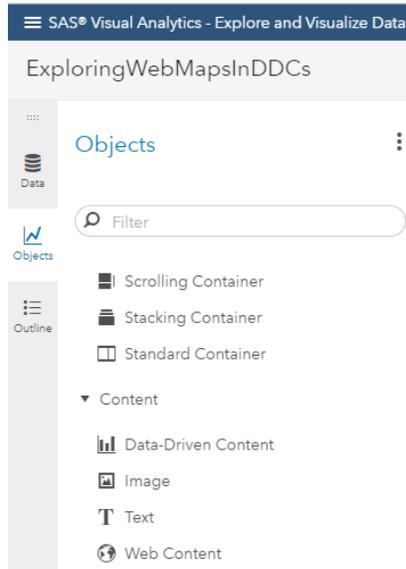
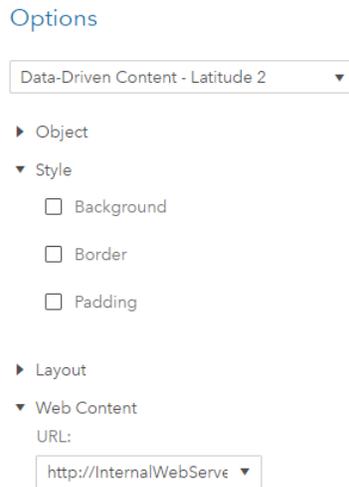*Figure 3 VA Objects Panel Showing Web Content Object*

Figure 4 VA Options Panel with Web Content URL

The VA report can include any web map with any of its features (such as 3D presentation) and external, Esri-supplied data.
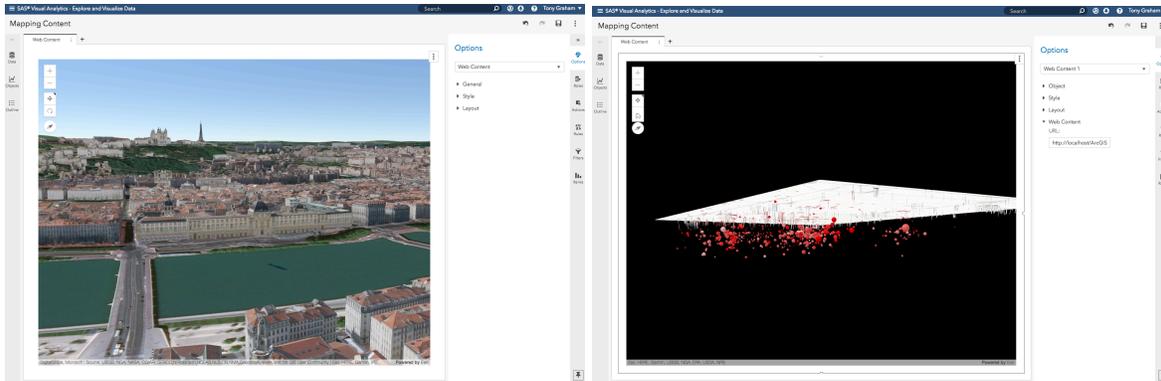
Figure 5 Custom ArcGIS Maps as Web Content

The disadvantage of web maps as "web content" is that they cannot take advantage of data generated from SAS analytics.

WebMaps As Data-Driven Content in VA

In version 8.2, Visual Analytics introduced the "data-driven content" feature, which enables web content to be supplied with report data.

As with the "web content" feature, users drag the "Data-Driven Content" object from the object panel onto their report area, and then, from the "Options" pane, they supply a URL.

Now, however, the user can also use the "Roles" panel to assign data columns. This data is transmitted to the data-driven content (via JavaScript window's postMessage API), allowing the content to consume the data and to participate in all report features, such as filters and interactions, as if it were a standard report object.

Customers have used this feature to populate their own reporting schemes and charts, using online libraries such as D3 and Google charts. And SAS provides open-source support for integrating these third-party visualizations (https://github.com/sassoftware/sas-visualanalytics-thirdpartyvisualizations).
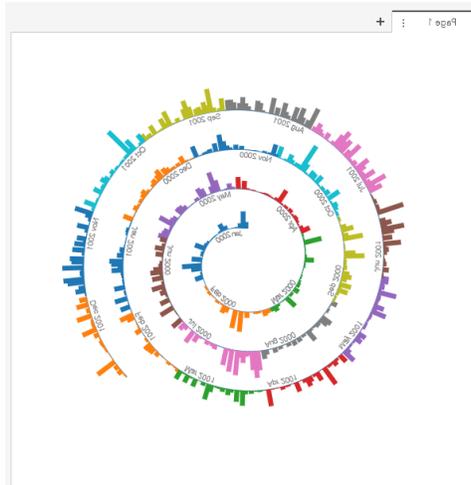
Figure 6 Data-Driven Content (D3) in VA

ArcGIS WebMaps are simply another kind of third-party visualization. And SAS is extending open-source support to help customers integrate them as well.
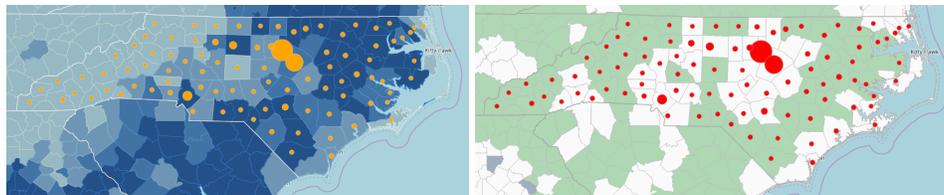

Figure 7 2016 In-State Enrollment NC Central Univ. (ArcGIS Layer in VA) over Diversity and Income Demographics

The key to connecting the report data to the WebMap is the ArcGISWebMapProvider source (https://github.com/sassoftware/sas-visualanalytics-geowebmap). By setting the data-driven content's URL to the ArcGISWebMapProvider in its public location, developers can see an example of how the integration could be accomplished, and they can download and deploy the code, along with any customizations, in order to maximize performance.

VA report designers need know only the URL to the deployment and how to alter that URL to control their web map settings. Those settings are used to identify the desired web map or, instead, to select from a list of Esri-supplied basemaps. They establish the type of the visualization that will be added as a map layer. And they control whether the result will be presented in 2D or 3D.

A Simple Scatter-Plot Map Layer

A VA report designer adds a "Data-Driven Content" object to their report. Since they want a scatter plot, they navigate to the "Data Roles" pane, and add variables for their geographic coordinates (here, "Latitude" and "Longitude").
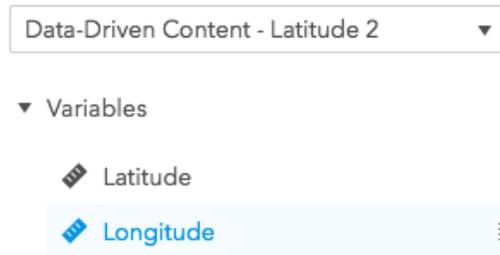
Figure 8 Roles Panel in VA with Columns Added

Next, from the "Options" panel, they set the content's URL. If they have deployed the ArcGISWebMapProvider project to their own web server (e.g., "InternalWebServer.com"), the base URL might look like the following:

```
InternalWebServer.com/ArcGISWebMapProvider
```

To specify that they want the "Latitude" and "Longitude" data to appear in a scatter plot, they would add the following (query string) parameters to the URL: *visualizationType* as "scatter", *x* as "Longitude", and *y* as "Latitude".

```
InternalWebServer.com/ArcGISWebMapProvider
?visualizationType=scatter&x=Longitude&y=Latitude
```

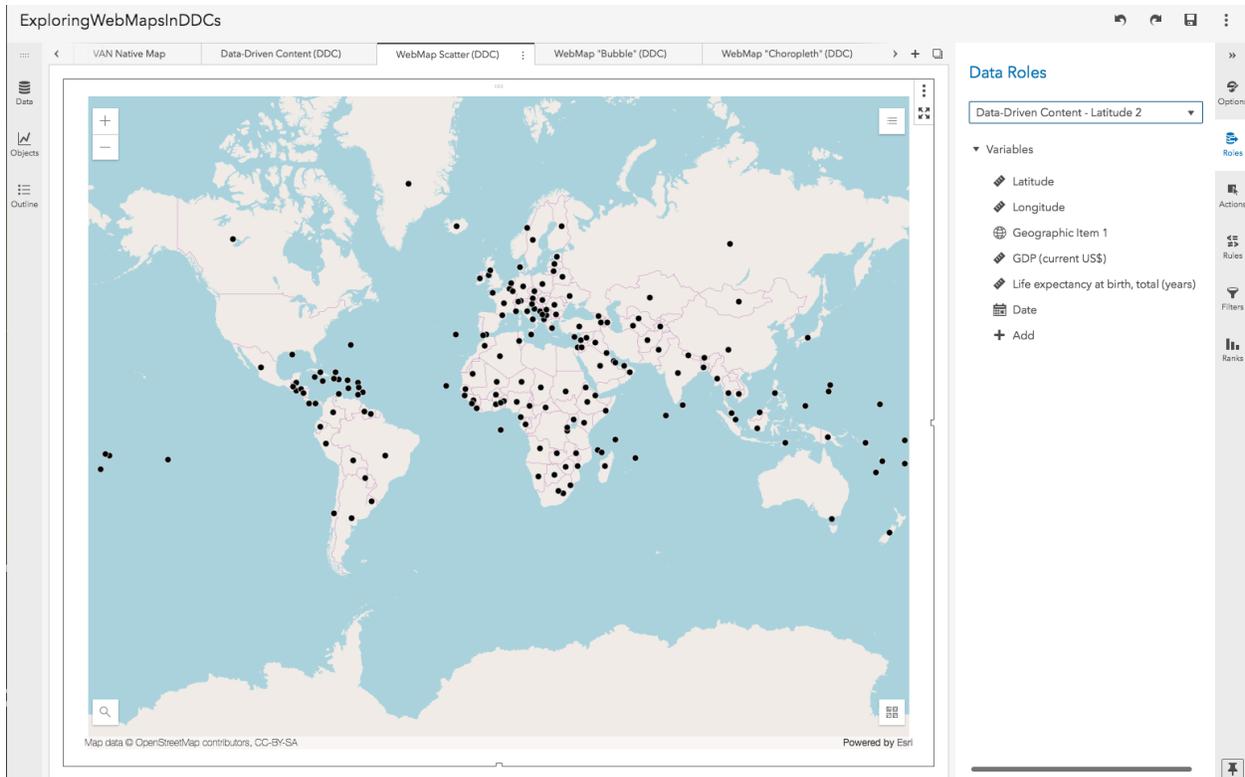Setting this as the content's URL produces the following plot:

Figure 9 Scatter Plot of the "WorldCombined" Dataset (ArcGIS Layer in VA)

(A better alternative to using the "Latitude" and "Longitude" columns directly would be to create a VA "Geographic Item" for them. See "A Note Regarding Aggregation" later in this document.)

A Bubble-Plot Map Layer

The same principle applies for a bubble-plot, except that additional data is required for "size" and "color" (here, "GDP (current US$)" and "Life expectancy at birth, total (years)").

Figure 10 Roles Panel in VA with Columns Added

And the URL would look like the following:

```
InternalWebServer.com/ArcGISWebMapProvider
?visualizationType=bubble&x=Longitude&y=Latitude&size=GDP
(current US$)&color=Life expectancy at birth, total (years)
```
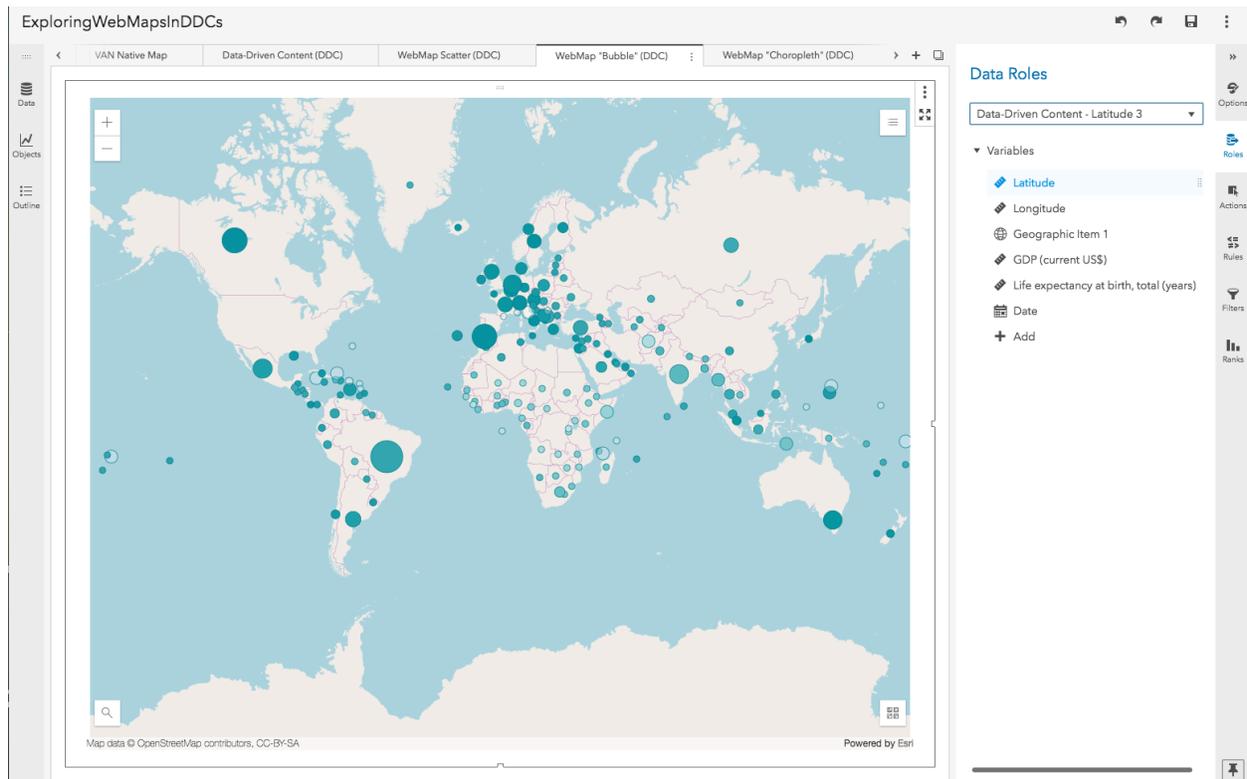

Figure 11 Bubble Plot of the "WorldCombined" Dataset (ArcGIS Layer in VA)

A Choropleth

A choropleth draws regions onto a map, usually to color those regions by some measure. To produce a choropleth, more work is involved to identify the kind of regions that the report designer wants to draw (e.g., national borders or internal divisions). And the regions identified in the data must exactly match those that identify the regional shapes.

The region identified in the report data is identified as its "geoId".

The regional shapes are obtained from Esri. Esri provides data for many different kinds of regions over the web. Users must know the URL for the regions that they wish to use (the "featureServiceUrl"), and they must know the name of the attribute that the Esri service uses to identify the regions (the "featureServiceGeoId").

A useful feature service URL is the one for world borders:

https://services.arcgis.com/V6ZHFr6zdgNZuVG0/ArcGIS/rest/services/World_borders/FeatureServer

It uses the "NAME" attribute to identify the full name for each country.

If a report's data includes the full name for each country in its CountryName column, then a report designer could plot a choropleth of population by country with the following URL:

```
InternalWebServer.com/ArcGISWebMapProvider
?visualizationType=choropleth&geoId=CountryName&color= GDP
(current
US$)&featureServiceUrl=https://services.arcgis.com/V6ZHFr6zdgNZu
VG0/ArcGIS/rest/services/World_borders/FeatureServer&featureServ
iceGeoId=NAME
```
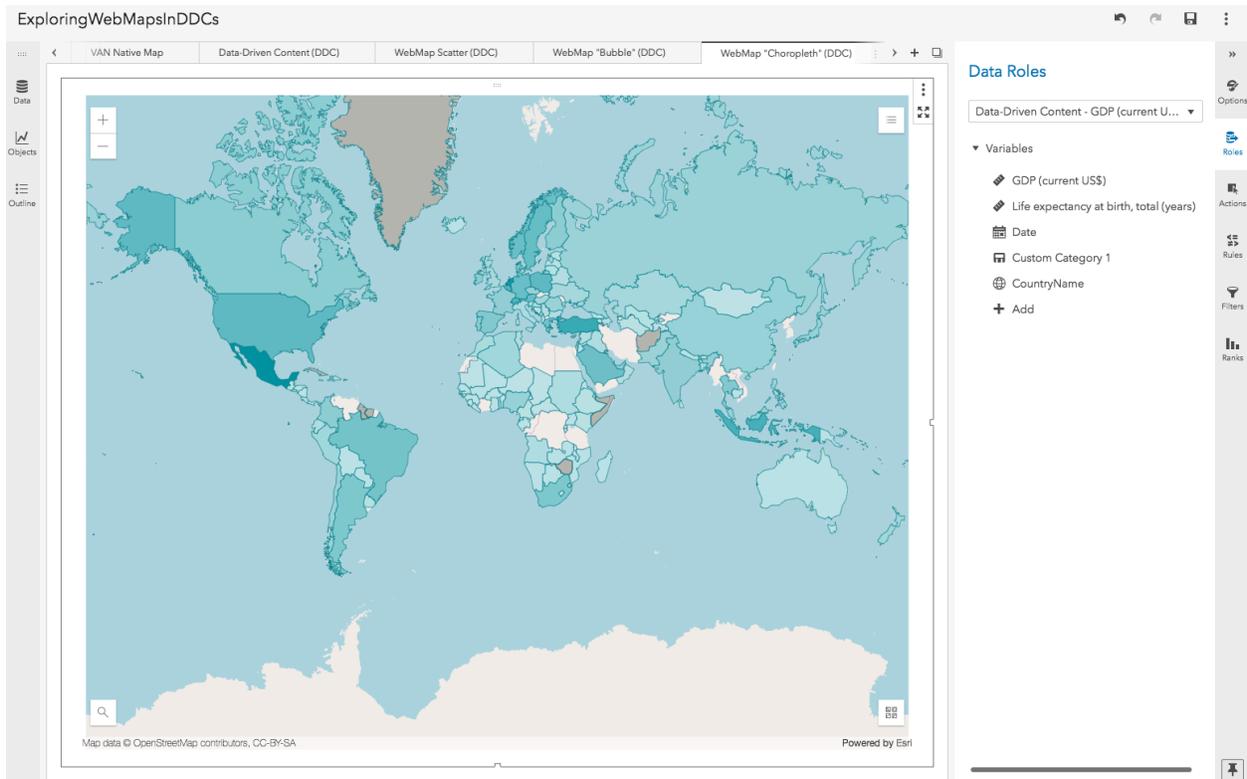

Figure 12 Choropleth of the "WorldCombined" Dataset (ArcGIS Layer in VA)

Layer Options

Following is a complete list of options for the SAS VA data layer:

Argument	Description
visualizationType	Optional. Possible values include "scatter", "bubble", or "choropleth". If unspecified, the value will be inferred from other arguments or left as "scatter".
x	The label of the column containing longitude expressed in the same terms as the basemap. Defaults to "Longitude". Required for scatter and bubble visualizations.
y	The label of the column containing latitude expressed in the same terms as the base map. Defaults to "Latitude". Required for scatter and bubble visualizations.
size	The label of the column containing the size measurement. Required for bubble visualizations.
color	The label of the column containing the color measurement. Optional for bubble and choropleth visualizations.
animation	The label of the column containing the date used when animating through the data. Optional. Animations are not currently supported in choropleths or 3D views, and they should be considered experimental. Acceptable date formats include RFC2822 and ISO formats.
colorMin	A hex, rgba, or named color for the minimum value of the range. Defaults to "#bfe4e7".
colorMax	A hex, rgba, or named color for the minimum value of the range. Defaults to "#00929f".
outline	A hex, rgba, or named color for an outline on drawn shapes. Defaults to "#007E88".
geoId	The label of the column containing the geographic identifiers for the areas to be drawn. Required for choropleth.
featureServiceUrl	The url to the Esri feature service containing the shapes of the geographies identified by the geoId. Required for choropleth.
featureServiceGeoId	The name of the attribute in the Esri feature service that will match values found in the geoId column of the VA data. Required for choropleth.
featureServiceWhere	A where clause to be provided to the Esri feature service that filters results. Optional.
portalItemId	The ID for a web map served at arcgis.com. Optional. Defaults to basemap "osm" (OpenStreetMap).
baseMap	The ID for a basemap from arcgis.com (e.g., "streets", "satellite", "hybrid"). Optional. Defaults to basemap "osm" (OpenStreetMap). Ignored if portalItemId is set.
use3D	Set to "true" to display the map in a 3D SceneView. Defaults to false.
title	The title of the layer that includes VA data. Optional. Defaults to the geoId, if available, or to "SAS VA Layer", if not.
zIndex	The index of the layer that includes VA data. Optional. Use "0" to insert the layer below all others. Defaults to the top-most level.

period	Defines the interval used to subdivide the animation date. Valid values are units of time such as "millisecond", "day", "month", "year", etc. Defaults to "year".
useSampleData	Set to "true" to load data from SampleData.json instead of VA. Useful for testing. Optional.

A Note Regarding Aggregation

Data-driven content aggregates report data.

Users should remain mindful of this when including location coordinate information, which is required for scatter and bubble plots. The default aggregation method for numeric columns is "sum", and summing coordinates (e.g, latitude and longitude) will produce values that cannot be geographically located.

For example, following is Australia's CO_2 emissions (kt), with latitude and longitude, for 2006 and 2007:

Country	Emissions (kt)	Latitude	Longitude	Year
Australia	371000	-38.902565	147.20554669	2006
Australia	347000	-38.902565	147.20554669	2007

Dragging these columns onto a data-driven content object will aggregate not only the emissions data for the two years (which may be desirable) but also the latitude and longitude (which is not).

Country	Emissions (kt)	Latitude	Longitude
Australia	718000	-77.80513	294.411093

The result (above) would not be successfully plotted.

For latitude and longitude, users can either switch their aggregation type to something less disruptive (such as "average") or take other steps to ensure that there is only one category value per location, so that no aggregation of their coordinates will occur.

An easy and safe solution is always to use VA's "Geographic Item" along with the latitude and longitude. A user can create a geographic item from a category, set its data type to "custom coordinates," and then associate that item with latitude and longitude items in their data. Wherever a Geographic Item is used, its coordinates are automatically protected against inappropriate aggregation.

Conclusion

Data-Driven Content objects can be used to introduce SAS data layers onto new and existing ArcGIS maps. And once in the map, they behave as a normal layer, participating with all the ArcGIS features, allowing the toggling of visibility, switching out the underlying basemap, and searching by location, while, at the same time, they also participate with VA report features such as filtering and interactions.

Following is an 3D ArcGIS map to which SAS VA has added a layer showing NOAA measurements (https://www.nhc.noaa.gov/data/tcr/index.php?season=2000&basin=atl) of the Atlantic hurricanes in 2000 sized by wind speed and colored by air pressure.
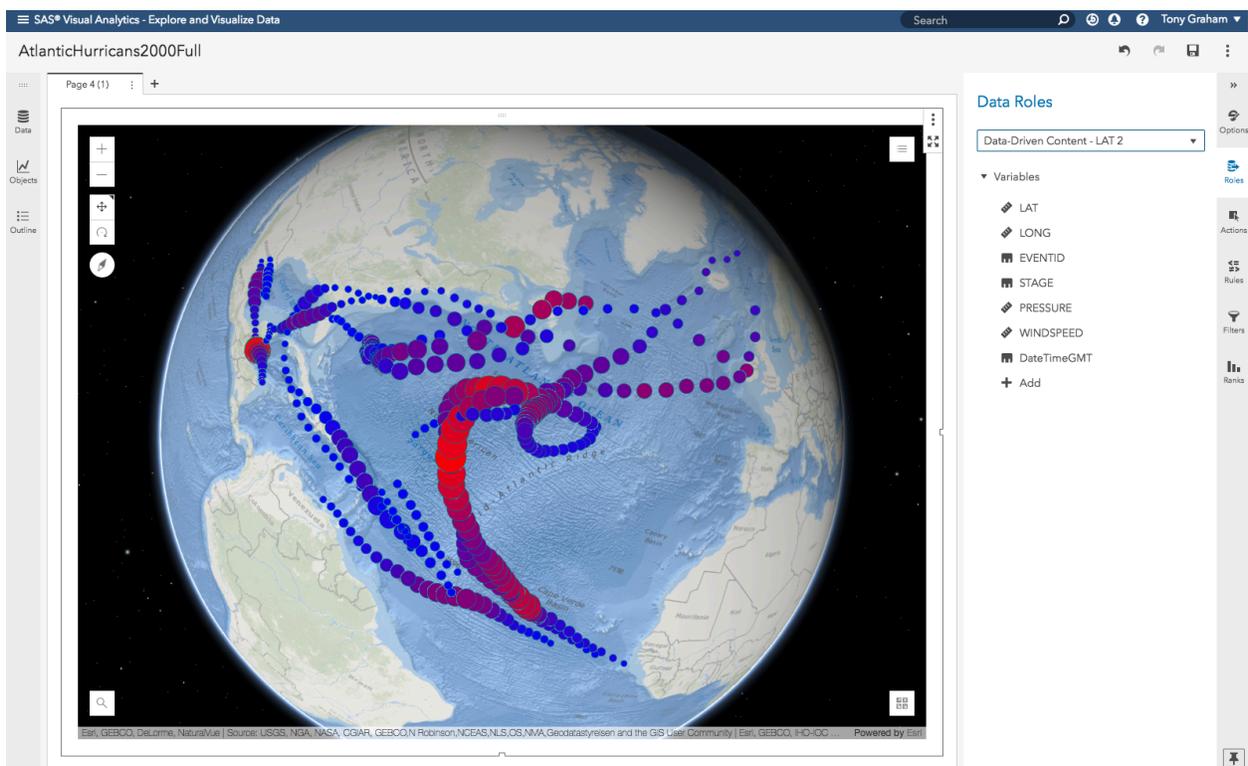

Figure 13 Atlantic Hurricane Paths in 2000 by Wind Speed and Pressure (ArcGIS Layer in VA)

For quick evaluation, users can reference a version of the ArcGISWebMapProvider directly by including in their reports the URL to the source location (https://rawgit.com/sassoftware/sas-visualanalytics-geowebmap/master/src/ArcGISVisualizationBridgeCDN.html).

For other uses, developers should download and build the source directly from project source (https://github.com/sassoftware/sas-visualanalytics-geowebmap).