

# Geocoding and Mapping in SAS<sup>®</sup>

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# PROC GEOCODE

- How do you convert addresses into map locations? This is done through the process of geocoding.
- PROC GEOCODE was first included in SAS/GRAPH 9.2 to provide this capability.
- Street-level geocoding for the United States was later added to the third maintenance release of SAS9.2M3
- the new abilities to geocode international cities added in SAS 9.3M2 and Canadian street-level geocoding available in SAS 9.4
- you can now import free postal code data for Great Britain and Australia for geocoding in all releases of PROC GEOCODE
- With 9.4M5 PROC GEOCODE is now part of Base SAS

# PROC GEOCODE

- The geocoding process depends on lookup data with the necessary information to convert an address to a geographic location
- This data is the key to geocoding. Factors such as age and granularity of the lookup data determine the geocoding results.
- Granularity is another important consideration. Does the location need to be the actual house position, or will a more generalized location be close enough?
- Another factor to consider when choosing a geocoding method is your input data. What address components does it contain?

# PROC GEOCODE

## My SAS environment and a bit about me

- Viya 2023.5
- SAS Studio Engineer\*

NOTE: Even though I am using Viya, the code is 9.4. Viya runs SAS 9 code with little to no modification\*

- Twenty-six years at SAS specializing in ODS Statistical Graphics, SAS/GRAPH and SAS' Business Analytics interfaces including Enterprise Guide, the Add-In for Microsoft Office, Enterprise BI, Visual Analytics, etc.
- Eight years Geology/Geophysics – Oil and Gas
- Five years Geographic Information Systems (GIS)
- SAS Certified in Viya Programming, 9.4 Programming and as a Visual Business Analyst in Visual Analytics

# PROC GEOCODE

definition

Geocoding: the process of converting an address to a physical location

**Address**



**Location**

# PROC GEOCODE

What is geocoding?

**City**

**Address**

**Location**



# PROC GEOCODE

What is geocoding?

City

**ZIP Code**

**Address**

**Location**



# PROC GEOCODE

What is geocoding?

City

ZIP Code

**ZIP+4**

**Address**



**Location**



# PROC GEOCODE

What is geocoding?

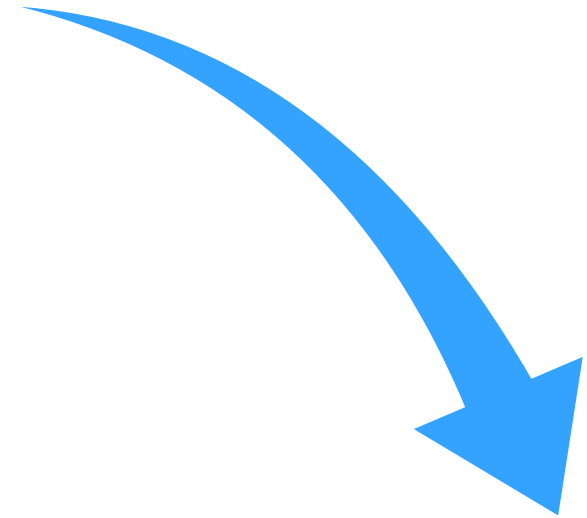
City

ZIP Code

ZIP+4

**Street**

**Address**



**Location**

# PROC GEOCODE

What is geocoding?

City

ZIP Code

ZIP+4

Street

**IP Address**

**Address**



**Location**

# PROC GEOCODE

What is geocoding?

City

ZIP Code

ZIP+4

Street

IP Address

**Custom**

**Region**

**Address**



**Location**

# PROC GEOCODE

## Mailing Address Component

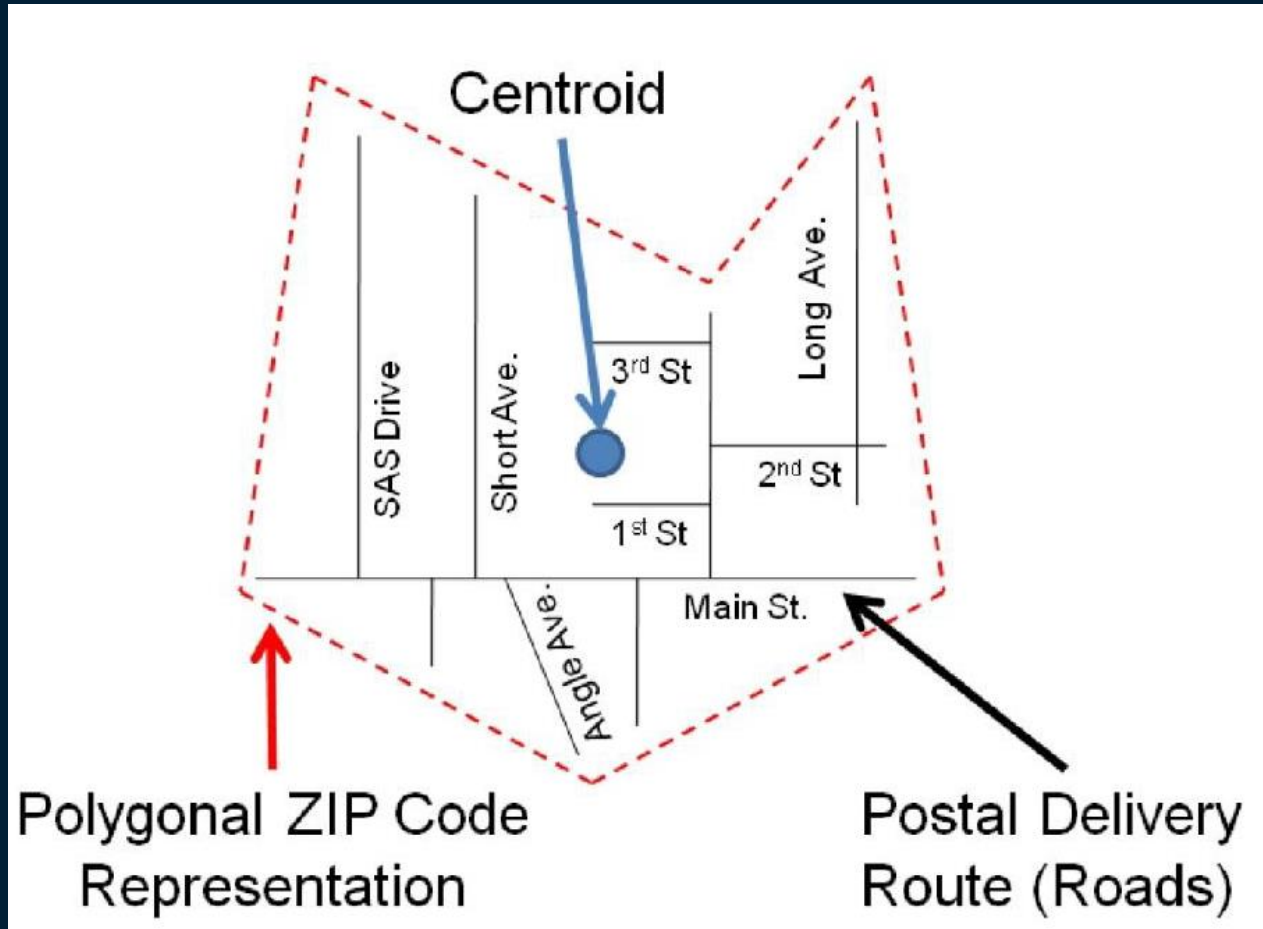
- City Center
- ZIP Code Centroid
- ZIP+4 Center
- Street Level

## Other

- IP Address
- Custom Region Centroid

# PROC GEOCODE

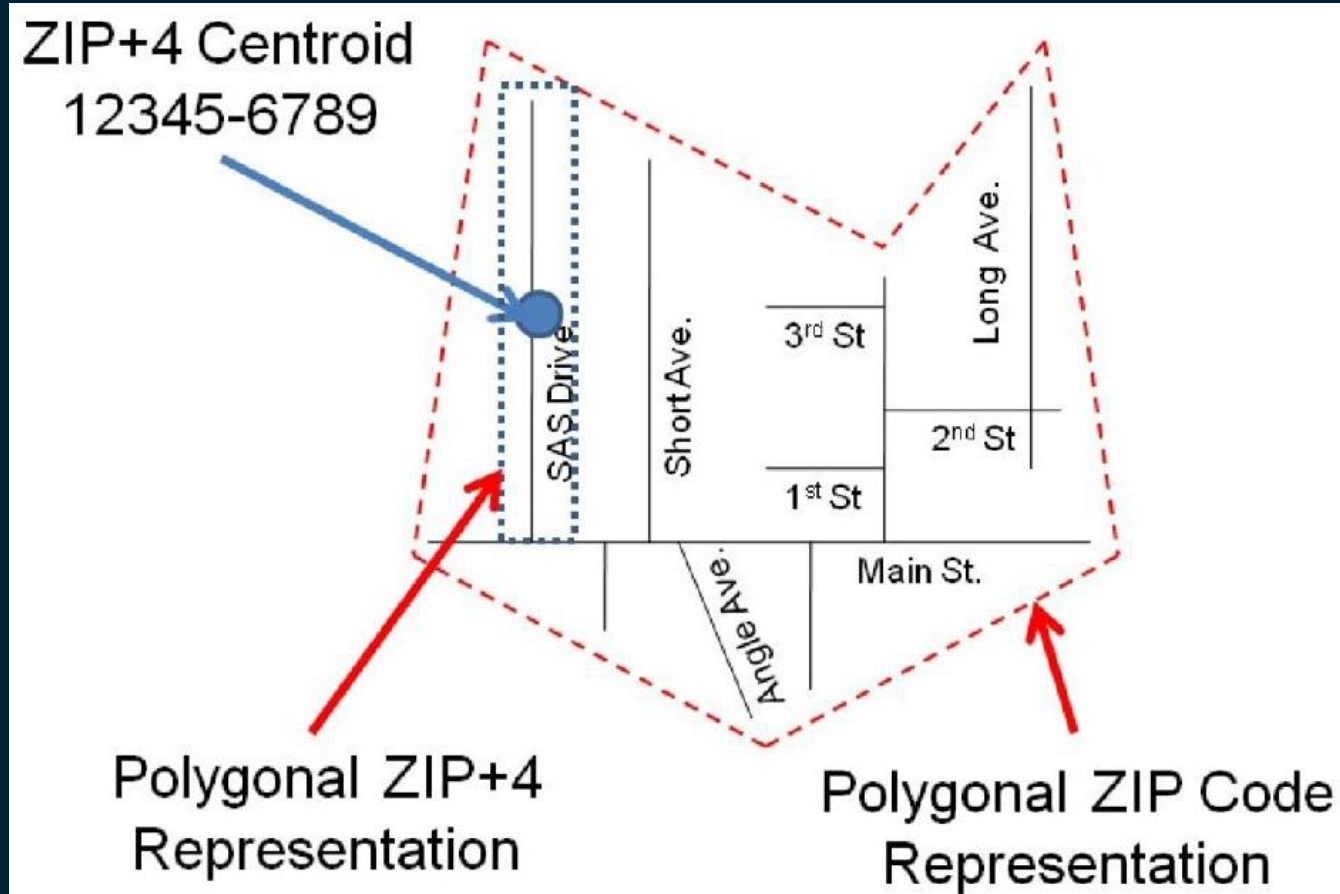
## Boundary Wraps Streets with Common ZIP Code



- No official ZIP code boundaries

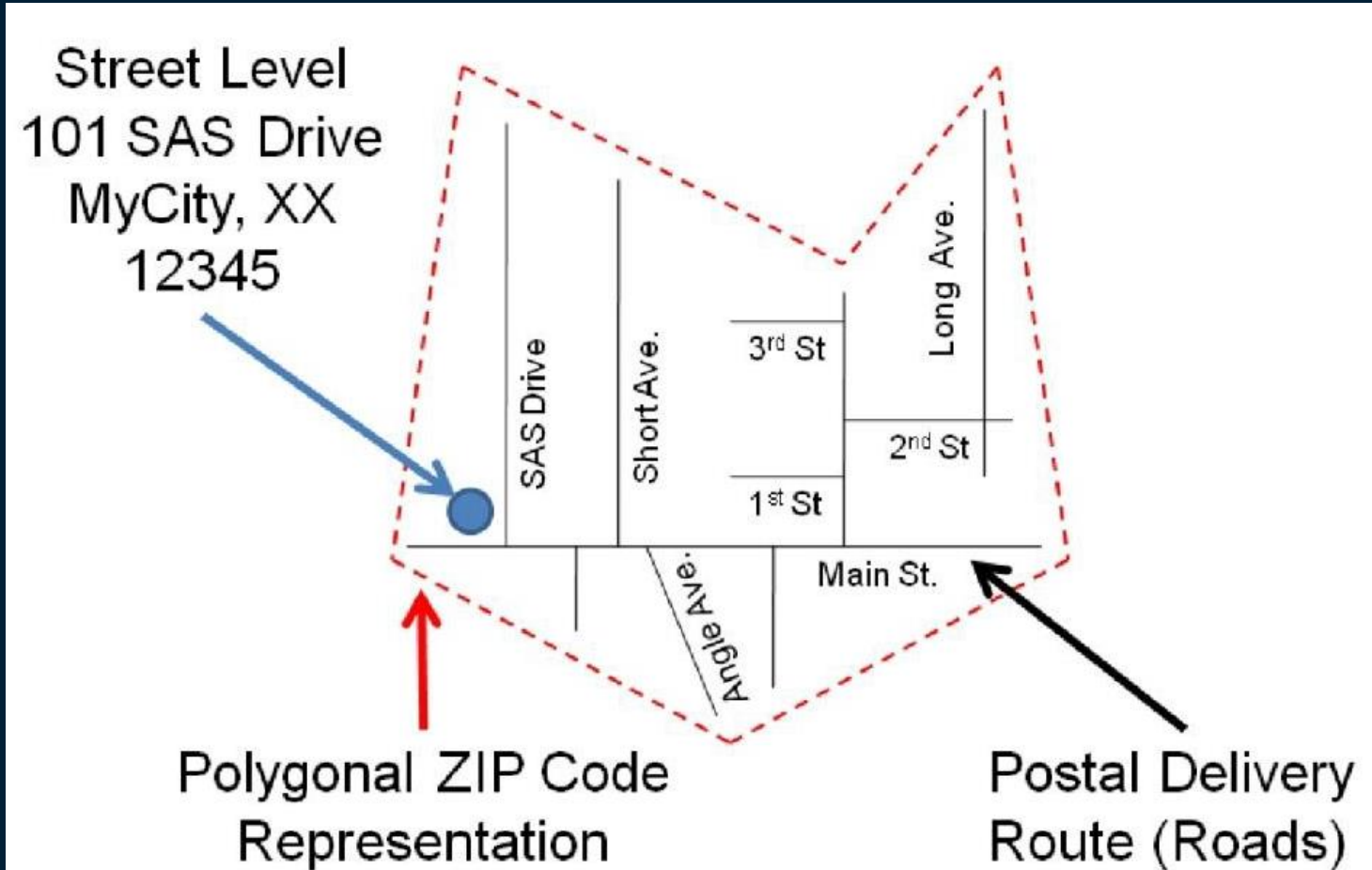
# PROC GEOCODE

ZIP+4 is a Portion of a ZIP Code



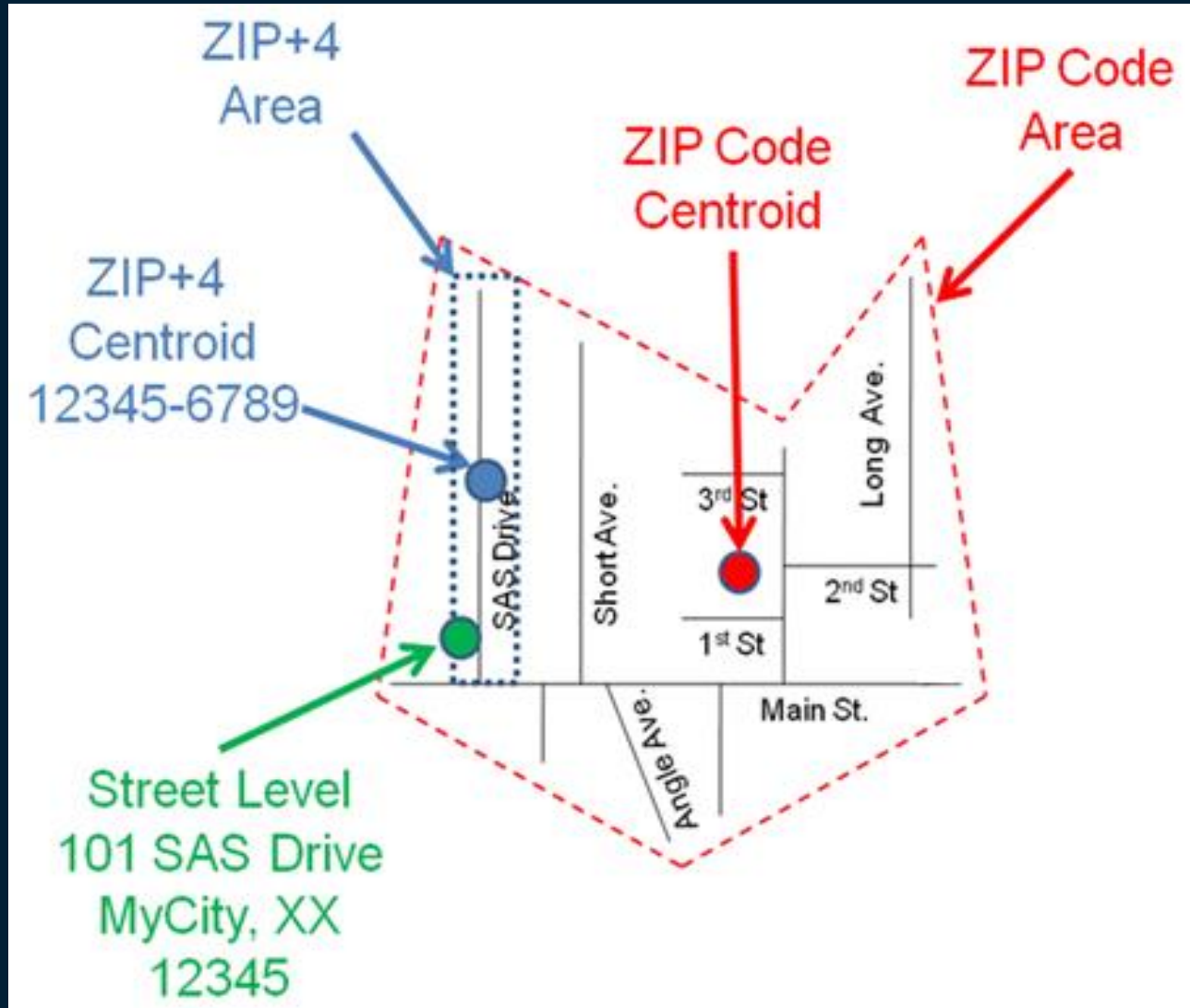
# PROC GEOCODE

Street-level Geocoding is Most Precise



# PROC GEOCODE

## Relative Precisions



MyCity Centroid



# PROC GEOCODE

## IP Address

- Non-mailing Parameter
- Ranges of IP Addresses are Clustered Geographically
- Precision Limited to Country or City Center
- Also Known as *Geolocation*

# PROC GEOCODE

## Custom Regions

- Non-mailing Parameter
- Any Data Having Specific Geographic Location
- Examples
  - Sales Regions
  - Telephone Area Code

# PROC GEOCODE

## Geocoding Method Selection Criteria

### 1. Geographic Extent

# PROC GEOCODE

## Geocoding Method Selection

1. Geographic Extent
2. Attribute Values Wanted

# PROC GEOCODE

## Geocoding Method Selection

1. Geographic Extent
2. Attribute Values Wanted
3. Location Precision

# PROC GEOCODE

## Geocoding Method Selection

1. Geographic Extent
2. Attribute Values Wanted
3. Location Precision
4. Address Components Present

# PROC GEOCODE

## Geocoding Method Selection

1. Geographic Extent
2. Attribute Values Wanted
3. Location Precision
4. Address Components Present
5. Lookup Data Availability

# PROC GEOCODE

Geocoding Method	Input Data	Lookup Data	
		Coverage	Source
CITY	City and state name	United States	MAPSGFK.USCITY_ALL
			SASHELP.ZIPCODE
		World	MAPSGFK.WORLD_CITIES
			WORLD_CITIES_ALL
ZIP	Postal code	United States	SASHELP.ZIPCODE
		Australia	Australian Bureau of Statistics
		England and Scotland	Ordnance Survey of Great Britain
PLUS4	ZIP code with ZIP+4	United States	MapsOnline
			Melissa Data
STREET	Complete mailing address	United States	MapsOnline
			Census TIGER shapefiles
		Canada	GeoBase National Road Network
RANGE	IP address	World	MaxMind
CUSTOM	User-defined region	n/a	User created



# PROC GEOCODE

## Geocoding Process – Example ZIP method

Input Data Set (Addresses)

Customer ID	Address	City	State	ZIP
456	1234 Smith St	Shelbyville	DE	19975
457	201 S 2nd St	Oxford	PA	19363



**PROC GEOCODE**

Lookup Data Set

ZIP	LONG	LAT
19975	38.4673	75.1976

Customer ID	Address	City	State	ZIP	_MATCHED_	LONG	LAT
456	1234 Smith St	Shelbyville	DE	19975	ZIP	38.4673	75.1976

Geocoded Output Data Set

# PROC GEOCODE

CITY Method: 9.2 – 9.3M1

- Only **U.S. Cities**
- Lookup Data: SASHELP.ZIPCODE
- Installed with SAS
- Updated Each Release
- Quarterly Updates on MapsOnline

# PROC GEOCODE

CITY Method: 9.3M2 – 9.4

- **Worldwide Cities**
- Lookup Data: MAPSGFK.USCITY\_ALL    MAPSGFK.WORLD\_CITIES
- Installed with SAS/GRAPH
- Updated Each Release
- Unabridged WORLD\_CITIES\_ALL Data Set Available on MapsOnline

# PROC GEOCODE

ZIP Method – available since 9.2

- Geocode by U.S. ZIP Codes
- Lookup Data: SASHELP.ZIPCODE
- Installed with SAS
- Updated Each Release
- Quarterly Updates on MapsOnline

# PROC GEOCODE

## ZIP Method

- Also Geocodes with British Postal Codes
- Free Lookup Data from Ordnance Survey Code-Point Open Product
- Import Program and Documentation on MapsOnline
- Coverage for England and Scotland

# PROC GEOCODE

## ZIP Method

- Also Geocodes with Australian Postal Codes
- Free Lookup Data from Australian Bureau of Statistics' Postal Area (POA) File
- Import Program and Documentation on MapsOnline
- POA Files Include Postcode Polygons

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## ZIP Method

- Postcode Centroids for Other Countries Available from Vendors
- Examples:
  - [www.zipcodedownload.com](http://www.zipcodedownload.com)
  - [www.allmapdata.com](http://www.allmapdata.com)
- SAS Technical Support can assist importing Third Party Data

# PROC GEOCODE

## ZIP+4 Method

- Geocode by U.S. ZIP+4 Codes
- Free Lookup Data on MapsOnline
- Contains ZIP+4 Values from 2006 (should be 2012 **TIGER** now)
- Update When ZIP+4 Returns to TIGER Files
- Current ZIP+4 Values Available in **Melissa Data** Geo\*Data Product
- Import Using %GCDMEL9 Autocall Macro – documented in doc.



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## STREET Method: 9.2M3 – 9.3M2

- Coverage includes U.S. with Puerto Rico and Virgin Islands
- Free National Lookup Data from **TIGER** Files
- Download prebuilt nationwide lookup data from MapsOnline
- Updated Each Annual **TIGER** Release
- Macro **TIGER** Import Program Available from MapsOnline

# PROC GEOCODE

## STREET Method: 9.4

- Added Coverage for Canada
- Free Lookup Data from GeoBase:  
[www.geobase.com](http://www.geobase.com)
- Download Files for Provinces
- Macro GeoBase Import Program Available from MapsOnline
- No Address Data for Newfoundland and Labrador
- No Postcode Values in GeoBase Data
- Can also use %GEOBASE2GEOCODE macro program to import files for specific provinces downloaded from **GeoBase**.

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## RANGE Method

- IP Address Geolocation
- Free Lookup Data from **MaxMind**:
  - **GeoLite** Country
  - **GeoLite** City
- Import Using %MAXMIND Autocall Macro

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## CUSTOM Method

- Any Geographic Data Can be Used
- Data Must Have Latitude/Longitude and **Third Variable for Lookup Key**
- User Builds Lookup Data
- SAS Technical Support can assist

# PROC GEOCODE

Procedure Syntax

```
PROC GEOCODE
```

```
    METHOD =
```

```
    DATA =
```

```
    LOOKUP =
```

```
options...
```

# PROC GEOCODE

## Example U.S. Input Address Data

Customer	Address	ZIP	ZIP+4	City	State	Revenue
J. Cheever Loophole	136 E. Water St	19901	3630	Dover	DE	\$985.33
Cuthbert J. Twillie	760 Moose Lodge Road	19934	2220	Camden	DE	\$2,533.25
Kaspar Gutman	4701 Limestone Road	19808	1927	Wilmington		\$33.44

# PROC GEOCODE

CITY Method Syntax:

```
proc geocode
  method = city          /* City method */
  data    = work.customers /* Address data to geocode */
  out     = work.geocoded /* Geocoded output data set */
  lookup  = sashelp.zipcode /* Default lookup data set */
  attribute_var = (msa areacode); /* Attribute values to add */
run;
```

# PROC GEOCODE

## CITY Method: 9.4

- Worldwide Cities
- Lookup Data: MAPSGFK.USCITY\_ALL MAPSGFK.WORLD\_CITIES
- Installed with SAS/GRAPH
- Updated Each Release
- Unabridged WORLD\_CITIES\_ALL Data Set Available on MapsOnline



# PROC GEOCODE

## U.S. CITY Method Syntax: 9.4

```
proc geocode
  method      = city      /* City method      */
  data        = work.customers /* Address data to geocode */
  out         = work.geocoded /* Geocoded output data set */
  lookupcity  = mapsgfk.us_city_all /* Default U.S. lookup data */
  attribute_var = (county_name); /* Attribute value to add */
run;
```

# PROC GEOCODE

World CITY Method Syntax: 9.3M2 – 9.4

```
proc geocode
  method      = city          /* City method          */
  data        = SASoffices    /* Addresses to geocode */
  out         = work.geocoded /* Geocoded data set    */
  lookupcity  = mapsgfk.world_cities /* Default world lookup data */
  addresscityvar      = city          /* Req'd. city name     */
  addresscountryvar  = countryID     /* Req'd. country name  */
  addressstatevar    = state         /* Optional state name  */
  attributevar       = (cttype);     /* Attribute value to add */
run;
```

# PROC GEOCODE



# PROC GEOCODE

ZIP Method Syntax: U.S. Postcodes

```
proc geocode
  method          = zip          /* ZIP method          */
  data            = work.customers /* Addresses to geocode */
  out             = work.geocoded /* Geocoded data set   */
  lookup         = sashelp.zipcode /* Default lookup data set */
  attribute_var   = (msa areacode); /* Attribute values to add */
run;
```

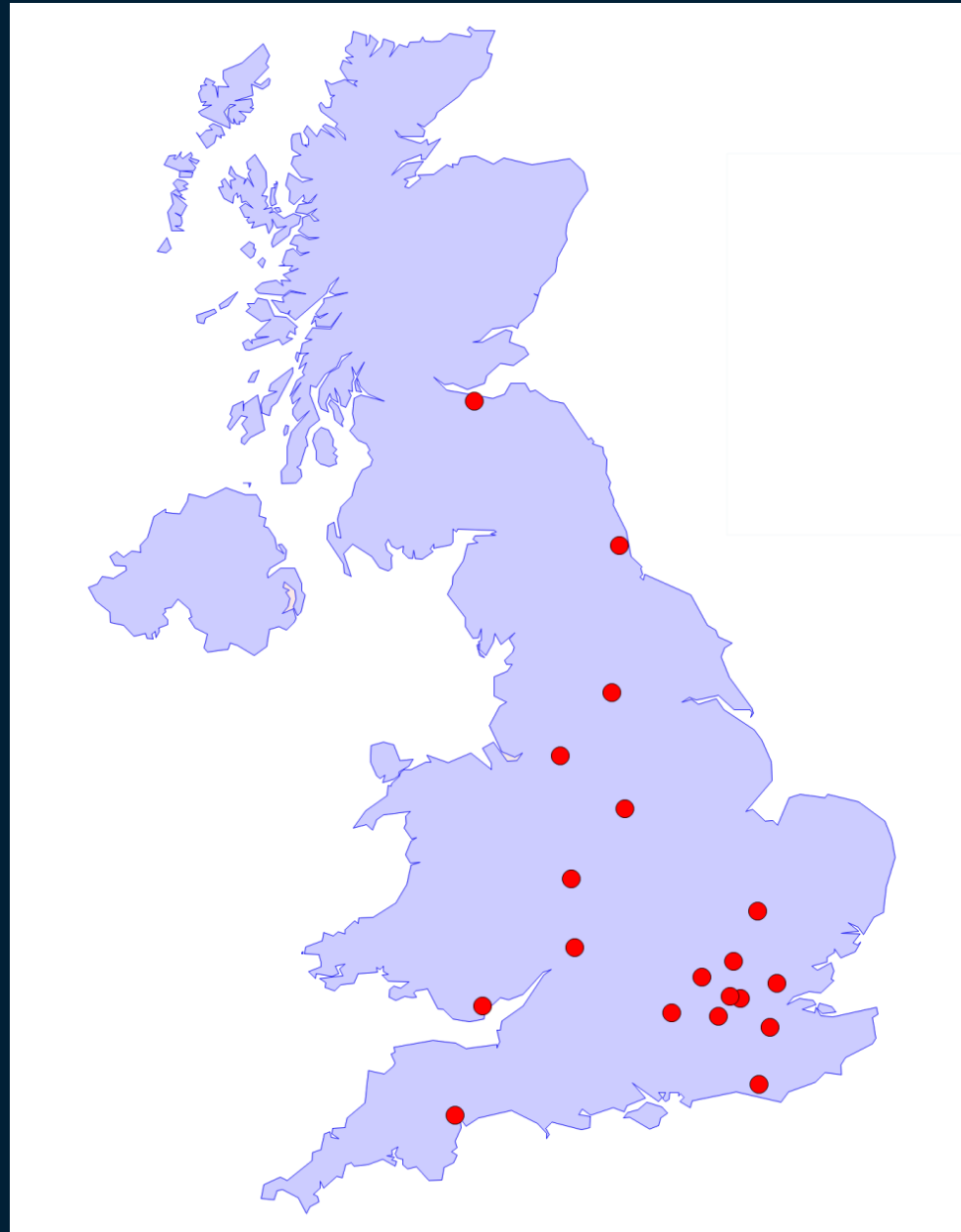
# PROC GEOCODE

ZIP Method Syntax: British Postcodes

```
proc geocode
  method = zip /* Method for postcodes */
  data = dealers /* Addresses to geocode */
  out = geocoded /* Geocoded data set */
  lookup = lookup.GBpostcodes /* Postcode lookup data */
  addresszipvar = postcode /* Address postcode var */
  lookupzipvar = pc /* Lookup postcode var */
  lookupxvar = Lon_WGS84_DD /* Lookup data X-variable */
  lookupyvar = Lat_WGS84_DD /* Lookup data Y-variable */
  nocity; /* Disable CITY method */
run;
```

# PROC GEOCODE

## Aston Martin Dealers In Great Britain



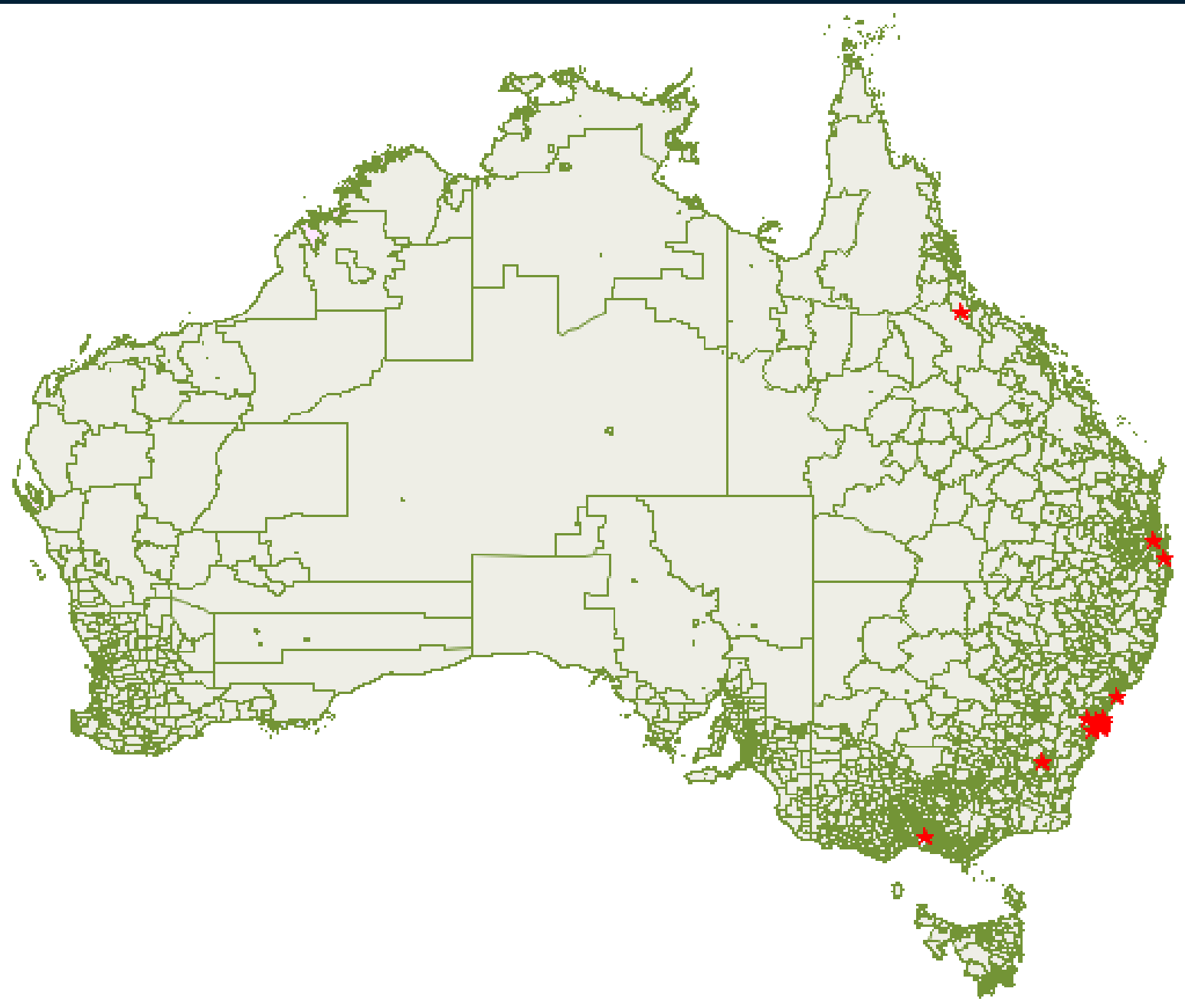
# PROC GEOCODE

## ZIP Method Syntax: Australian Postcodes

```
proc geocode
  method = zip /* Method for postcodes */
  data = NRL_stadiums /* Addresses to geocode */
  out = geocoded /* Geocoded data set */
  lookup = lookup.postcodes /* Postcode lookup data */
  addresszipvar = postcode /* Address postcode var */
  lookupzipvar = POA_code /* Lookup postcode var */
  nocity; /* Disable CITY method */
run;
```

# PROC GEOCODE

Australian Postal  
Areas  
and  
National Rugby  
League Stadiums





# PROC GEOCODE

## Zip 4 Example

### RESOURCES / FOCUS AREAS

#### FOCUS AREAS

- Analytics Life Cycle
- Base SAS
- Graphics
  - › Automatic Graphs
  - › Your Graphs
  - › Maps
    - **Maps Online**
    - SAS Bridge For ESRI
- Enterprise Management Integration
- Migration
- Scalability & Performance
- SAS for Containers
- Statistics & Operations Research

#### Welcome to SAS Maps Online

SAS Maps Online shows maps for areas throughout the world. You can easily locate and identify specific regions in each of the following categories: world maps, continents, countries, and maps of political groups.

SAS users will find:

- Archived maps from previous releases
- Sample programs
- Recent Mapping and Geocoding updates
- Geocoding examples, techniques and look-up data



Click on the World Image to go to MapsOnline

# PROC GEOCODE

## Zip 4 Example

### ZIP+4 Geocoding

- **Free ZIP+4 Data**

A file containing ZIP+4 centers from 2006 is available. These ZIP+4 locations are based on the 2006 Second Edition TIGER/Line files from the Census Bureau. That was the most recent TIGER/Line release which contained ZIP+4 values. This file will be updated when the Census Bureau replaces ZIP+4 values in a future TIGER release. As of the most recent TIGER release, the ZIP+4 values had not yet been restored. Download that 2006 ZIP+4 file: [ZIP4\\_GEOCODE\\_DATA-2006.zip](#)

- **Alternate ZIP+4 Data**

The GEO\*Data product containing current ZIP+4 locations can be purchased from [Melissa Data](#). The autocall macro %GCDMEL9 imports GEO\*Data files into lookup data for ZIP+4 geocoding with PROC GEOCODE. See the SAS/GRAPH documentation for details on this macro.

### IP Address Geocoding

Worldwide IP address geocoding is supported by all PROC GEOCODE releases. Lookup data is available from MaxMind in their free [GeoLite databases](#). The autocall macro %MAXMIND imports GeoLite files to create lookup data. See PROC GEOCODE in the SAS/GRAPH documentation for details on this macro.

# PROC GEOCODE

## Zip 4 Example

### SUPPORT / DOWNLOADS & HOT FIXES

#### SUPPORT

- [Manage Tracks](#)
- [SAS Administrators](#)
- [Security Bulletins](#)
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  - › [SAS DataFlux Software](#)
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  - › [Mobile Device Software](#)
  - › [Third Party Software](#)
  - › [Additional Products](#)
  - › [Hot Fixes](#)
- [Knowledge Base](#)

#### Downloads

##### Maps Online

Updated JANUARY 2019

January 15, 2019 Update - Zipcode and geocode files

To begin the download process, select the item in the table below which best meets your needs.

Maps Online				
Platform	Description	Request Download	Size	Release Date
All	SAS Files	<a href="#">ZIP4_Geocode_Data-2006.zip</a>	170.8 MB	2010-01

For questions you may have about this download, please [contact our Product Support Group](#)

# PROC GEOCODE

## Zip 4 Example

The screenshot displays the WinZip application window titled "ZIP4\_Geocode\_Data-2006 - WinZip". The interface is divided into several sections:

- Files:** Shows the current ZIP file, "ZIP4\_Geocode\_Data-2006.zip".
- Recent Zip Files:** Lists three recent ZIP files: "ZIP4\_Geocode\_Data-....zip", "Intro\_2\_SAS\_VA\_Rep....zip", and "disease\_managemen....zip", all located in the "Downloads" folder.
- Browse & Manage Files:** Includes "Frequent Folders", "I10c137" (51.8 GB free of 237 GB), "Network", and "Homegroup".
- File List:** Contains three items:
  - ImportCSVfile.sas** (Type: SAS File): Date modified: 6/2/2015 9:33 AM, Size: 2.87 KB → 1.13 KB.
  - ReadMe.txt** (Type: Readme Document): Date modified: 6/2/2015 9:34 AM, Size: 3.25 KB → 1.35 KB.
  - ZIP4.csv** (Type: Microsoft Excel Comma Separated Values File): Date modified: 6/1/2015 11:49 AM, Size: 1.14 GB → 170 MB.
- Actions:** Provides options for "Unzip All Files", "Convert & Protect Files" (with sliders for Encrypt, Reduce Photos, Convert to PDF, and Watermark), and "Save or Share Zip" (with buttons for Save as..., Email, and Instant messaging).

At the bottom of the file list, it indicates "3 item(s)" and "Zip File: 3 item(s), 170.85 MB".

# PROC GEOCODE

## Zip 4 Example

```
ReadMe.txt - Notepad
File Edit Format View Help
Summary
-----

The zip archive 'ZIP4_Geocode_Data-2006.zip' contains a
comma-separated values (CSV) file to create a SAS data set.

The data set is used by PROC GEOCODE for ZIP+4 geocoding of U.S.
mailing addresses. See the PLUS4 geocoding method for PROC GEOCODE in
the SAS/GRAPH documentation.

The ZIP+4 values and locations were computed using the 2006 SE
TIGER/Line files. In 2007 the U.S. Census Bureau changed from their
Record Type (RT) format ASCII files to shapefiles and did not include
the ZIP+4 values. Their original intent was to restore the ZIP+4 values
in a future TIGER shapefile release, but as of the 2014 TIGER/Line
release they had not yet done so.

So be aware that the ZIP+4 values in this CSV file are from 2006 and
should be used with caution. Up-to-date ZIP+4 values can be obtained
from Melissa Data (www.melissadata.com) in their Geo*Data product.
See the PROC GEOCODE documentation on using the GCDMEL9 autocall
macro to import Geo*Data files.
```

# PROC GEOCODE

## Zip 4 Example

```
ReadMe.txt - Notepad
File Edit Format View Help

Metadata
-----
Source       : U.S. Census Bureau TIGER/Line files
Release      : 2006 SE
Data set name : ZIP4
Product      : SAS/GRAPH, PROC GEOCODE, PLUS4 geocoding method
Support      : SAS Institute, http://support.sas.com

Zip Archive Contents
-----
ImportCSVfile.sas .... SAS program to import the ZIP4.csv file into a SAS data set
ReadMe.txt ..... This text file
ZIP4.csv ..... Comma-separated values file for the ZIP4 data set

Instructions
-----
1) Download the 'ZIP4_Geocode_Data-2006.zip' archive.
2) Unzip the archive using your system's unzip utility.
3) Open 'ImportCSVfile.sas' in a text editor.
4) Modify the PATHIN and PATHOUT macro variables as described in its comments.
5) Submit the modified program in SAS to create the lookup data set
   and index used in PLUS4 method geocoding.
6) Check log for errors.
7) See the PROC GEOCODE PLUS4 method in the SAS/GRAPH
   documentation to geocode with this data set.
8) If desired, the downloaded zip archive and unzipped ZIP4.csv file
   can be deleted or moved offline to recover disk space.
   They are not needed for geocoding.
9) If assistance is needed, please contact SAS Technical Support:
   http://support.sas.com
```

# PROC GEOCODE

ZIP+4 Method Syntax

```
proc geocode
  method = plus4          /* ZIP+4 method          */
  lookup  = lookup.zip4   /* Lookup data set       */
  data    = work.customers /* Addresses to geocode  */
  out     = work.geocoded /* Geocoded data set     */
  attribute_var = (tract) /* Attribute value to add */
  nocity;                 /* Disable CITY method    */
run;
```

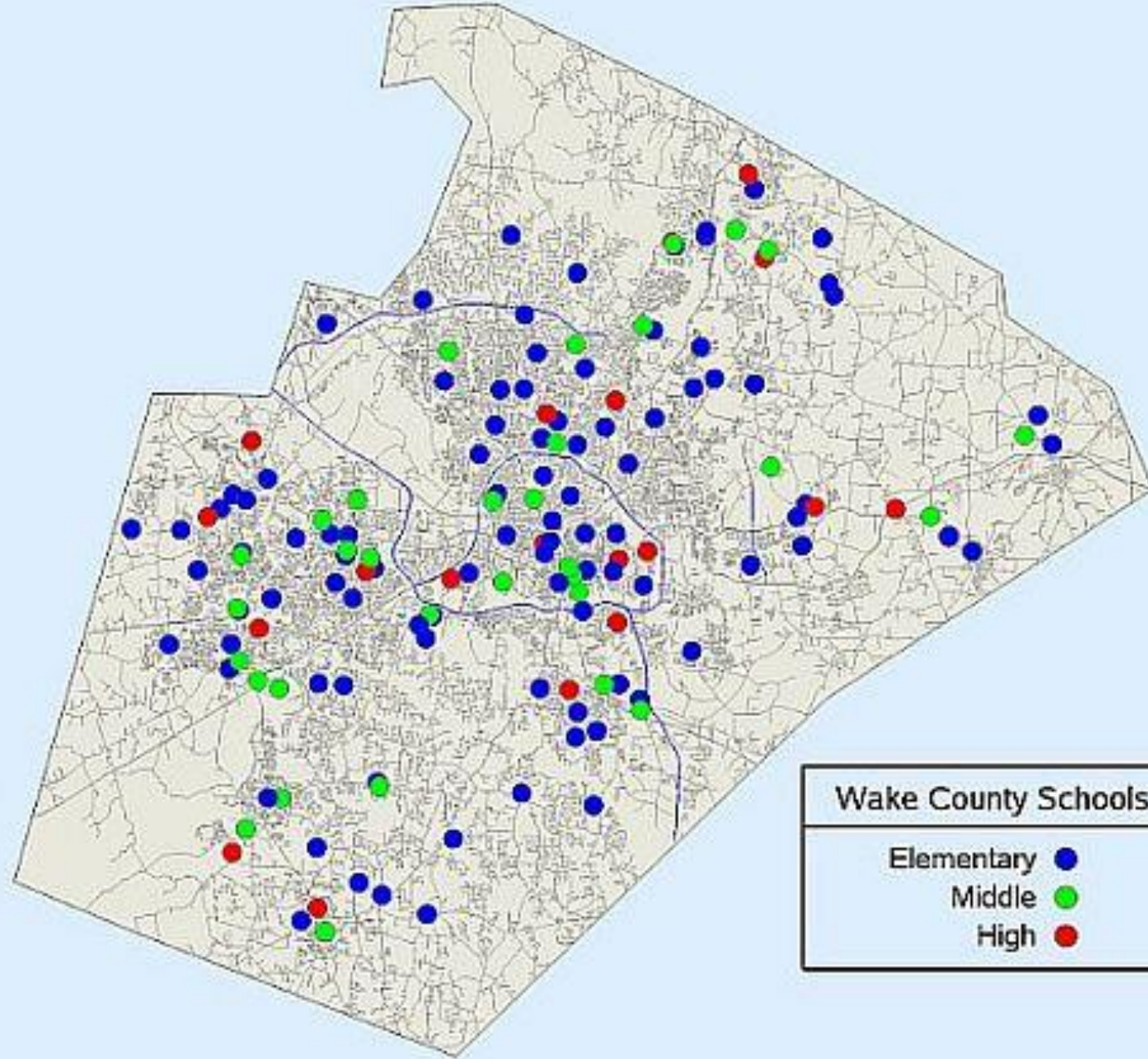
# PROC GEOCODE

STREET Method Syntax: U.S.

```
proc geocode
  method = street          /* Specify method          */
  data    = work.schools   /* Addresses to geocode    */
  out     = work.geocoded  /* Geocoded data set      */
  lookupstreet = sashelp.geoexm /* Lookup data set       */
  attribute_var = (tractce00); /* Attribute value to add */
run;
```



# PROC GEOCODE



# PROC GEOCODE

```
proc geocode
  method      = street          /* Specify method      */
  data        = work.inns       /* Addresses to geocode */
  out         = work.geocoded   /* Geocoded data      */
  lookupstreet = lookup.canada_m /* Lookup data set    mapsOnline*/
  direct      = lookup.gcdirect_can /* Direction names   */
  type        = lookup.gctype_can /* Street type names  */
  addresscountryvar= country    /* Country names     */
  addressstatevar= province    /* Province names    */
  addresscityvar= city        /* City names*/
  nozip;
run;
```

# PROC GEOCODE

- Canadian street lookup available on MapsOnline
- JAVA MapApplet with OpenStreetMap background



# PROC GEOCODE

## RANGE Method Syntax

```
proc geocode
  method      = range          /* Geocoding method */
  data        = work.addresses /* IP address input data */
  out         = work.geocoded  /* Geolocated data set */
  addressvar  = IPaddress      /* Address var in input data set */
  rangedata   = lookup.cityblocks /* Range data set */
  beginrangevar = startipnum    /* Begin range variable */
  endrangevar  = endipnum       /* End range variable */
  rangekeyvar  = locid          /* Link variable in range data */
  lookup       = lookup.citylocation /* Lookup data set from MAXMIND */
  lookupkeyvar = locid          /* Link variable in lookup data */
  lookupyvar   = latitude       /* X variable in lookup data */
  lookupxvar   = longitude      /* Y variable in lookup data */
  attributevar = (city, country); /* Attribute values to add */
run;
```

# IP Addresses

## Locations by PROC GEOCODE with MaxMind Data



# PROC GEOCODE

← → ↻ dev.maxmind.com/geoip/legacy/geolite/

**MAXMIND** Dev Home minFraud GeolIP FAQ Main Site Site Map

English  
简体中文

**Search**  
Search

**Table of Contents**

- Databases
  - IP Geolocation
  - Autonomous System Numbers
- Support
- License
- Downloads

**Links**

- System Status

## GeoLite Legacy Downloadable Databases

**New Database Format Available:** This page is for our legacy databases. For our latest database format, please see our [GeoLite2 Databases](#).

### Databases

#### IP Geolocation

The GeoLite databases are our free IP geolocation databases. They are updated on the first Tuesday of each month. These databases are offered in the same [binary](#) and [csv](#) formats as our subscription databases. Any code which can read the subscription databases can also read the GeoLite databases.

IP geolocation is inherently imprecise. Locations are often near the center of the population. Any location provided by a GeoIP database should not be used to identify a particular address or household.

We publish [accuracy statistics for GeoLite City](#).

#### Autonomous System Numbers

We offer free databases that map IPv4 and IPv6 addresses to Autonomous System Numbers (ASN), including the names of each Autonomous System. The databases are updated every month.

#### Support

MaxMind does not provide customer support for free GeoLite databases. If you have questions on how to use these databases, we suggest asking on [Stack Overflow](#).

#### License

The GeoLite databases are distributed under the [Creative Commons Attribution-ShareAlike 4.0 International License](#). The attribution requirement may be met by including the following in all advertising and documentation mentioning features of or use of this database:

1 This product includes GeoLite data created by MaxMind, available from  
2 <http://www.maxmind.com>

We also offer [commercial redistribution licensing](#).

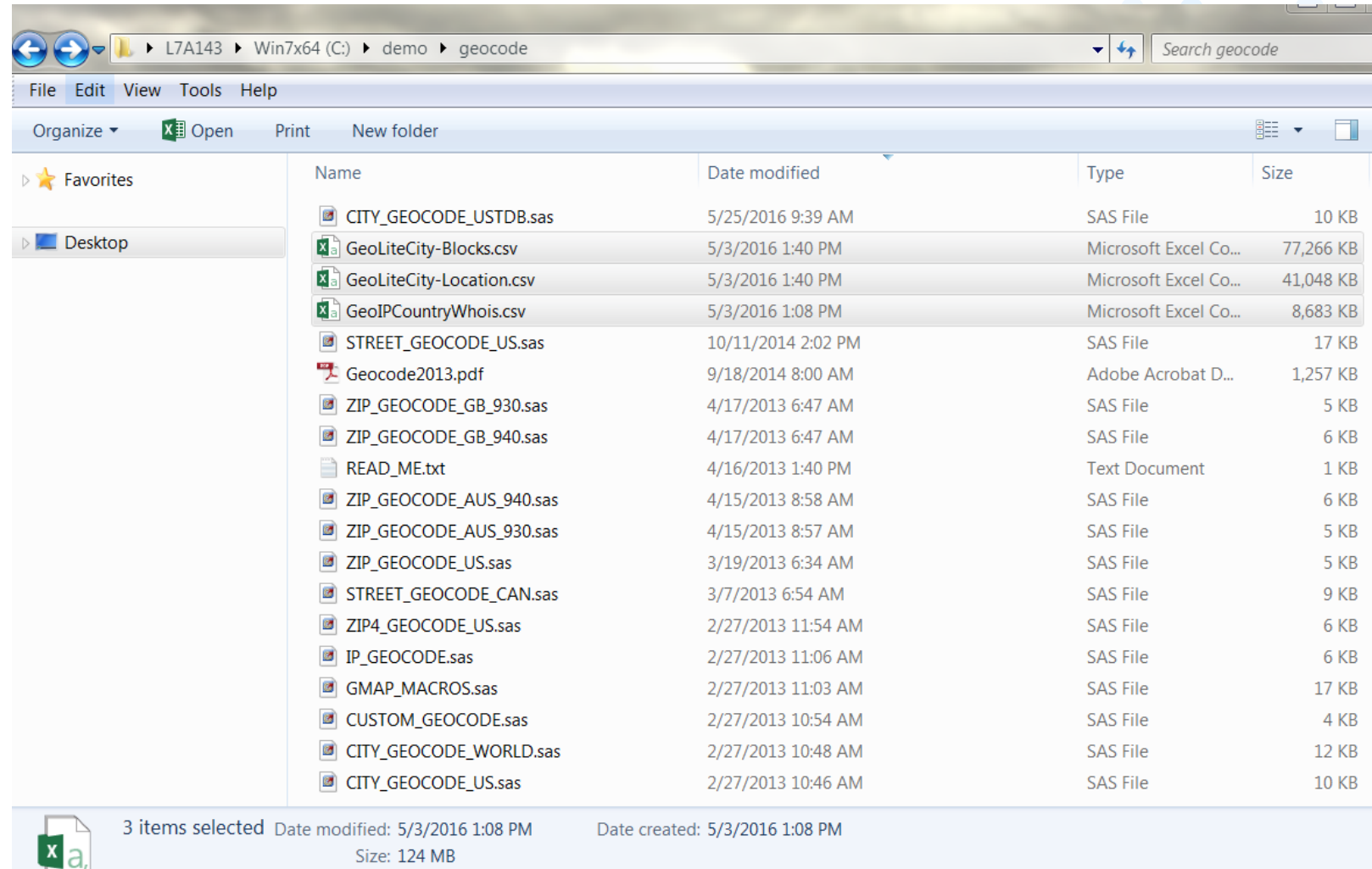
### Downloads

Database	Download links				
	Binary / gzip	Binary / xz	CSV / gzip	CSV / zip	CSV / xz
GeoLite Country	<a href="#">Download</a>	Gzip only	Zip only	<a href="#">Download</a>	Zip only
GeoLite Country IPv6	<a href="#">Download</a>	Gzip only	<a href="#">Download</a>	Gzip only	Gzip only
GeoLite City	<a href="#">Download</a>	<a href="#">Download</a>	Zip and xz only	<a href="#">Download</a>	<a href="#">Download</a>
GeoLite City IPv6 (Beta)	<a href="#">Download</a>	Gzip only	<a href="#">Download</a>	Gzip only	Gzip only
GeoLite ASN	<a href="#">Download</a>	Gzip only	Zip only	<a href="#">Download</a>	Zip only
GeoLite ASN IPv6	<a href="#">Download</a>	Gzip only	Zip only	<a href="#">Download</a>	Zip only

The GeoLite Legacy databases may also be downloaded and updated with our [GeoIP Update program](#).

# PROC GEOCODE

## Downloaded files



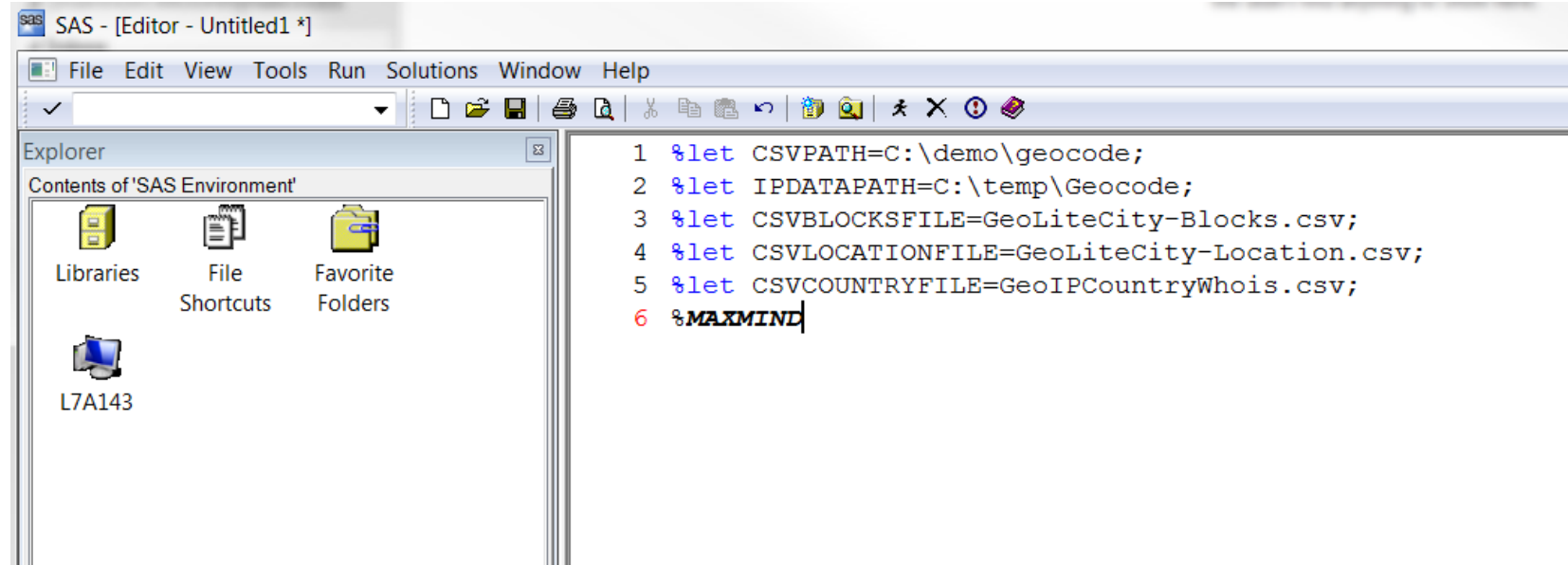
The screenshot shows a Windows File Explorer window with the address bar set to 'L7A143 > Win7x64 (C:) > demo > geocode'. The window displays a list of files and folders. The 'Favorites' pane on the left shows 'Desktop'. The main pane shows a list of files with columns for Name, Date modified, Type, and Size. Three files are selected: 'GeoLiteCity-Blocks.csv', 'GeoLiteCity-Location.csv', and 'GeoIPCountryWhois.csv'. The status bar at the bottom indicates '3 items selected', 'Date modified: 5/3/2016 1:08 PM', and 'Size: 124 MB'.

Name	Date modified	Type	Size
CITY_GEOCODE_USTDB.sas	5/25/2016 9:39 AM	SAS File	10 KB
GeoLiteCity-Blocks.csv	5/3/2016 1:40 PM	Microsoft Excel Co...	77,266 KB
GeoLiteCity-Location.csv	5/3/2016 1:40 PM	Microsoft Excel Co...	41,048 KB
GeoIPCountryWhois.csv	5/3/2016 1:08 PM	Microsoft Excel Co...	8,683 KB
STREET_GEOCODE_US.sas	10/11/2014 2:02 PM	SAS File	17 KB
Geocode2013.pdf	9/18/2014 8:00 AM	Adobe Acrobat D...	1,257 KB
ZIP_GEOCODE_GB_930.sas	4/17/2013 6:47 AM	SAS File	5 KB
ZIP_GEOCODE_GB_940.sas	4/17/2013 6:47 AM	SAS File	6 KB
READ_ME.txt	4/16/2013 1:40 PM	Text Document	1 KB
ZIP_GEOCODE_AUS_940.sas	4/15/2013 8:58 AM	SAS File	6 KB
ZIP_GEOCODE_AUS_930.sas	4/15/2013 8:57 AM	SAS File	5 KB
ZIP_GEOCODE_US.sas	3/19/2013 6:34 AM	SAS File	5 KB
STREET_GEOCODE_CAN.sas	3/7/2013 6:54 AM	SAS File	9 KB
ZIP4_GEOCODE_US.sas	2/27/2013 11:54 AM	SAS File	6 KB
IP_GEOCODE.sas	2/27/2013 11:06 AM	SAS File	6 KB
GMAP_MACROS.sas	2/27/2013 11:03 AM	SAS File	17 KB
CUSTOM_GEOCODE.sas	2/27/2013 10:54 AM	SAS File	4 KB
CITY_GEOCODE_WORLD.sas	2/27/2013 10:48 AM	SAS File	12 KB
CITY_GEOCODE_US.sas	2/27/2013 10:46 AM	SAS File	10 KB

3 items selected Date modified: 5/3/2016 1:08 PM Date created: 5/3/2016 1:08 PM  
Size: 124 MB

# PROC GEOCODE

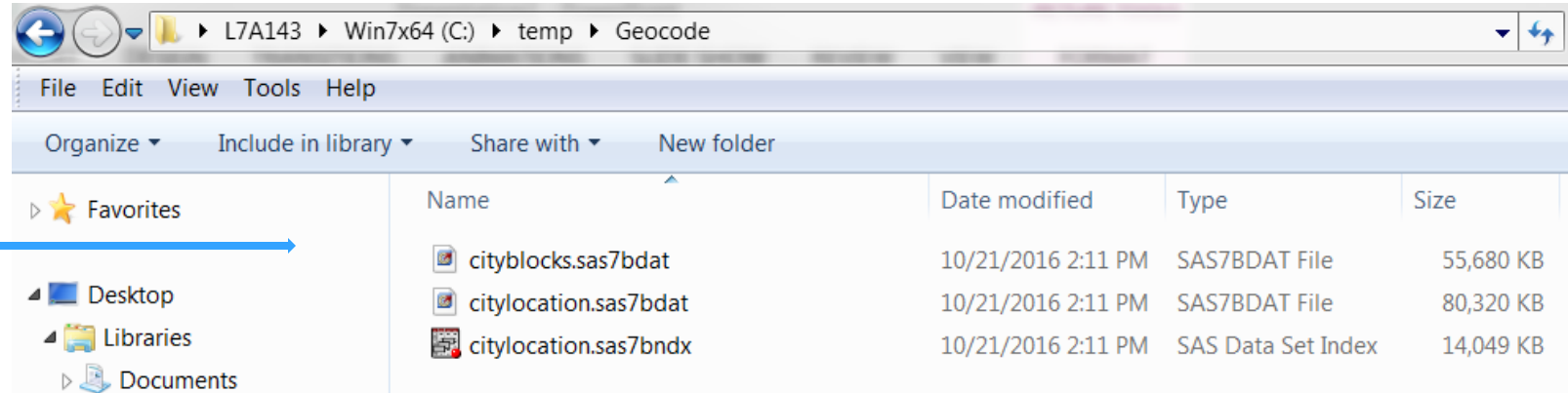
From  
documentation:  
How to create  
SAS datasets



```
SAS - [Editor - Untitled1 *]  
File Edit View Tools Run Solutions Window Help  
✓  
Explorer  
Contents of 'SAS Environment'  
Libraries File Shortcuts Favorite Folders  
L7A143  
1 %let CSVPATH=C:\demo\geocode;  
2 %let IPDATAPATH=C:\temp\Geocode;  
3 %let CSVBLOCKSFILE=GeoLiteCity-Blocks.csv;  
4 %let CSVLOCATIONFILE=GeoLiteCity-Location.csv;  
5 %let CSVCOUNTRYFILE=GeoIPCountryWhois.csv;  
6 %MAXMIND
```



# PROC GEOCODE



# PROC GEOCODE

## CUSTOM Method Syntax

```
proc geocode
  method          = custom          /* Specify method          */
  data            = work.customers  /* Input data set to geocode */
  out             = work.geocoded   /* Geocoded data set       */
  lookup          = work.areacodes  /* Lookup data set         */
  lookupvar       = areacode        /* Key variable in lookup data */
  Addressvar      = areacode;       /* Key variable in customer data */
run;
```

# PROC GEOCODE

## Summary

- Included with Base SAS
- Determines Location from Address
- Assigns Attribute Data to Locations
- Plot Locations on Map or Use in Calculations



# Mapping

# Mapping and Geocoding with SAS

- Mapping using SAS procedures
  - GMAP
    - Legacy
    - Part of SAS/GRAPH
    - Lots of examples from Dr Robert Allison's page
  - SGMAP
    - New with 9.4M6
    - Incorporates either OpenStreetMap or ESRI backgrounds to enhance maps
    - Similar but new syntax
    - Examples also on Dr Allison's page and SAS Communities

# SGMAP

- New with 9.4M6
- Part of Base SAS – ODS Graphics like the other SG procedures
- Can create a tile-based map that uses either the OPENSTREETMAP or ESRIMAP as a background
- Different syntax but straightforward

# SGMAP

## Procedure

PROC SGMAP

```
    MAPDATA=map-data-set | PLOTDATA=plot-data-set | MAPRESPDATA=response-data-set  
<options>;  
    STYLEATTRS </options>  
    CHOROMAP <response-variable> / </options>;  
    ESRIMAP URL='map-service';  
    OPENSTREETMAP;  
    BUBBLE X=variable Y=variable SIZE=numeric-variable </options>;  
    SCATTER X=variable Y=variable </options>;  
    SERIES X=variable Y=variable </options>;  
    TEXT X=variable Y=variable TEXT=variable </options>;  
    GRADLEGEND <"name-1" – "name-n"> </options>;  
    KEYLEGEND <"name-1" – "name-n"> </options>;
```

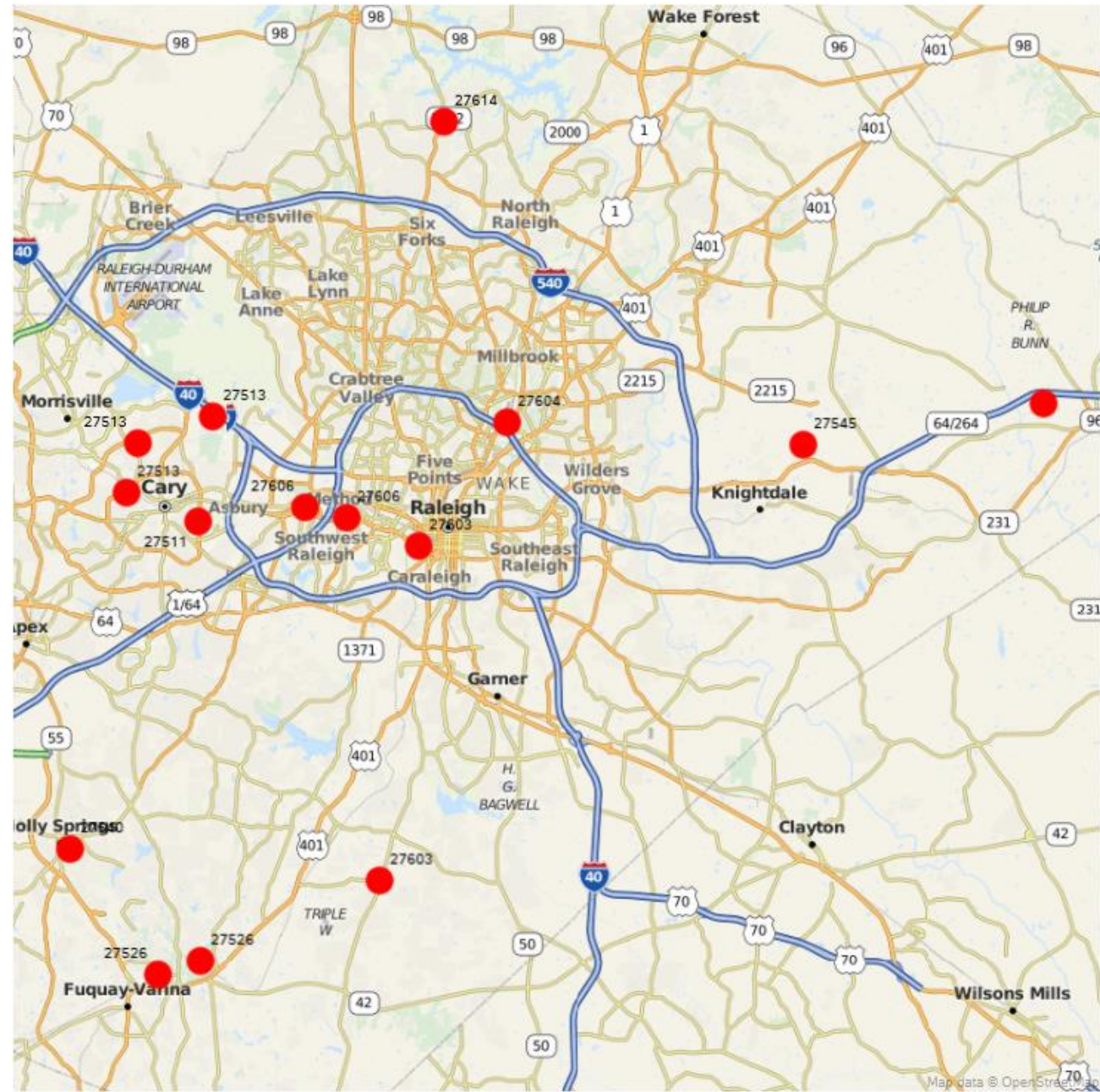
# SGMAP

## example

```
proc sgmap
  maprespdata=geocoded plotdata=geocoded noautolegend;
  scatter x=x y=y / datalabel=zip
  markerattrs=(color=red size=19 symbol=circlefilled);
  openstreetmap;
run;
```



```
proc sgmap  
  mapres  
  scatter  
  marker  
  openst  
run;
```



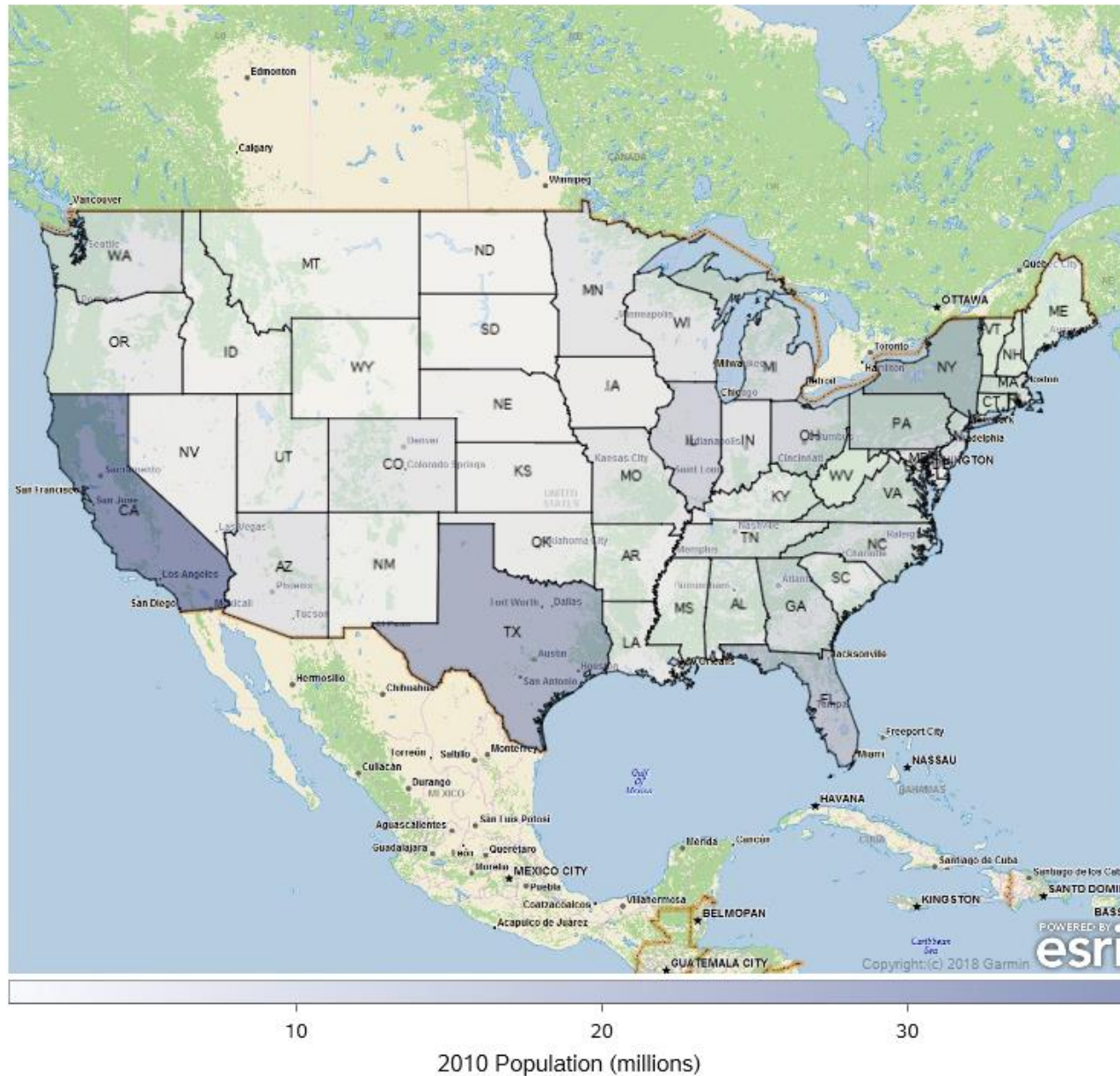
```
noautolegend;  
circlefilled);
```

# SGMAP

## example

```
title 'Population from 2010 US Census';
proc sgmap mapdata=states maprespdata=sashelp.us_data plotdata=plot_data;
  esrimap
  url='http://services.arcgisonline.com/arcgis/rest/services/Specialty/DeLorme_World_Base_Map';
  choromap population_2010 / mapid=state density=2 transparency=.4 name='choro';
  text x=long y=lat text=statename / textattrs=(size=6pt);
  gradlegend 'choro' / title='2010 Population' extractscale;
run;
```

## Population from 2010 US Census



```
title 'Population from 2010 US Census'
proc sgmap mapdata=states
  esrimap
  url='http://seamless.usa.gov/arcgis/rest/services/USA/MapServer/0'
  choromap popul
  text x=long y=lat
  gradlegend 'choro'
run;
```

```
Lorme_World_Base_Map';
choro';
```

**So that's all of SAS' map capabilities?**

**Nope. Visual Analytics has an ever-growing list of capabilities, many from our partnership with ESRI**

**Be sure to attend the session, "How Can I Create Custom Geo Maps in SAS<sup>®</sup> Visual Analytics?" on July 25<sup>th</sup> at 1pm EDT**

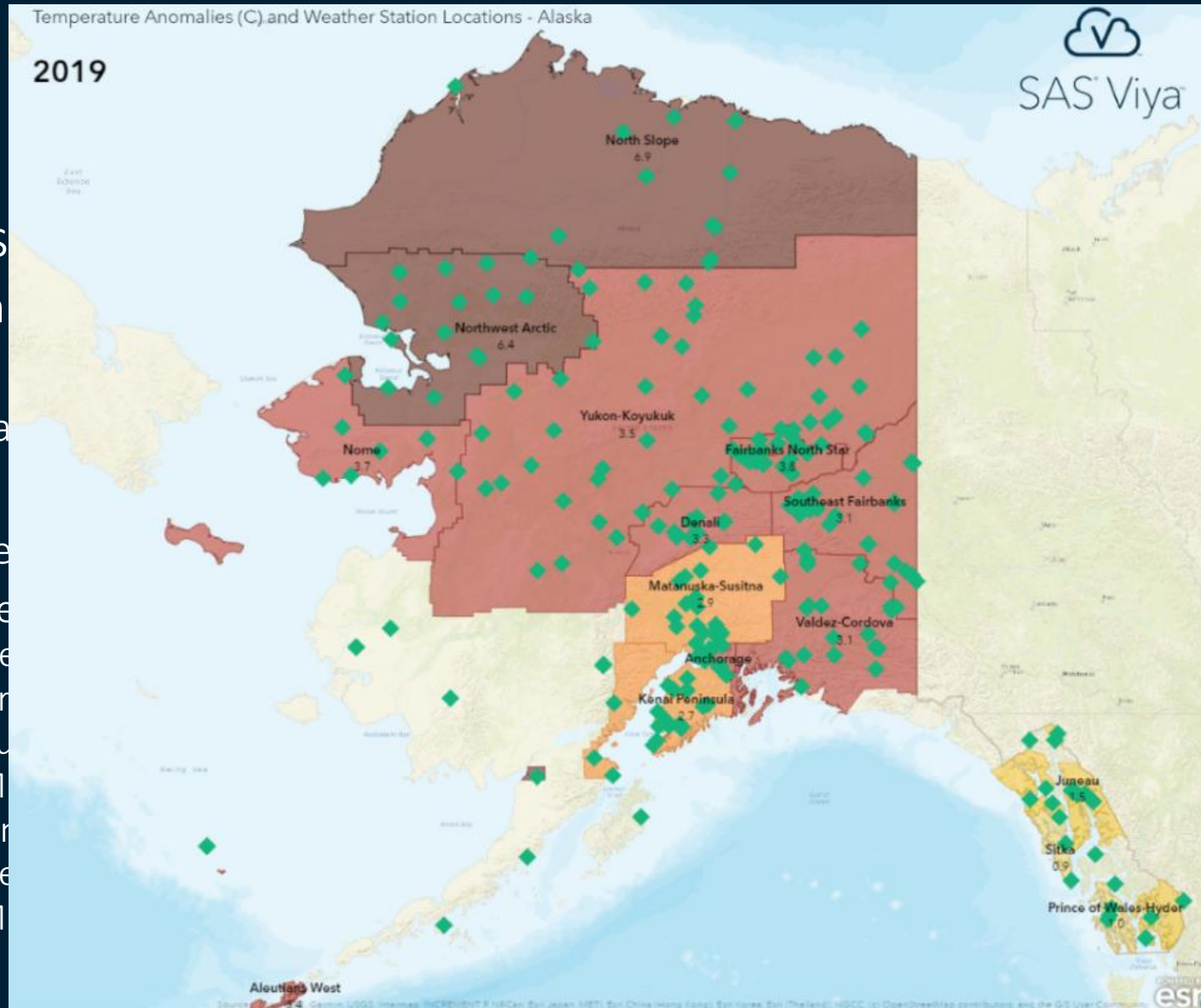
# Mapping and Geocoding with SAS

VA/Viya

- Mapping using SAS Visual Analytics
  - On 9.4 architecture
    - 7.5
    - Some enhanced capabilities
  - Viya
    - Basic and enhanced features
    - Tighter integration with ESRI
      - Geo-enrich your data by joining it with ESRI demographics data
      - Drop a pin and add geographic selection areas around your pins based on distance or travel time
      - Custom regions
      - Multiple map layers
      - Find optimal routes between points of interest or measure the straight-line distance between
      - Geocoding and direct import of shape files
      - Much more

# Mapping and Geocoding with SAS

- Mapping us
  - On 9.4 arch
    - 7.5
    - Some enha
  - Viya
    - Basic and e
    - Tighter inte
      - Ge
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      - M



Distance or travel time

Distance between

# PROC GEOCODE

[www.sas.com/mapsonline](http://www.sas.com/mapsonline)

SAS Maps Online

support.sas.com/rnd/datavisualization/mapsonline/index.html

Welcome Shannon [Log out] Edit profile My SAS

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  - Automatic Graphs
  - Your Graphs
  - Maps
    - Maps Online
    - SAS Bridge For ESRI
- Enterprise Management Integration
- Migration
- Scalability & Performance
- Statistics & Operations Research
- SAS AppDev Studio

**Welcome to SAS Maps Online**

SAS Maps Online shows maps for areas throughout the world. You can easily locate and identify specific regions in each of the following categories: world maps, continents, countries, and maps of political groups.

SAS users will find:

- Archived maps from previous releases
- Sample programs
- Recent Mapping and Geocoding updates
- Geocoding examples, techniques and look-up data



Click on the World Image to go to MapsOnline

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Stay safe and well!**

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