

An Introduction to PROC SGMAP

Presenter

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Louise Hadden has been using and loving SAS since the days of punch cards and computers the size of a tiny house. She spends most of her time in support of health policy analytics at Abt Associates Inc. and loves a good SAS reporting challenge. She is an ardent life long learner and reads voraciously, loves photography and volunteers at the MSPCA Boston Adoption Center walking, training and photographing dogs.

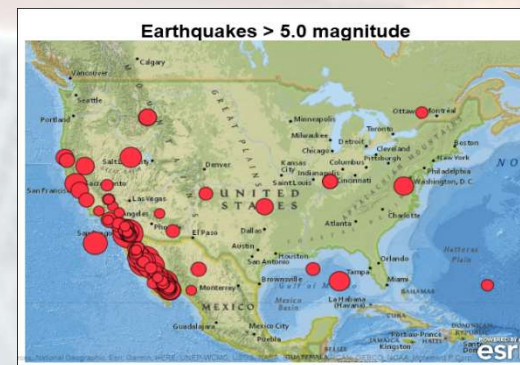
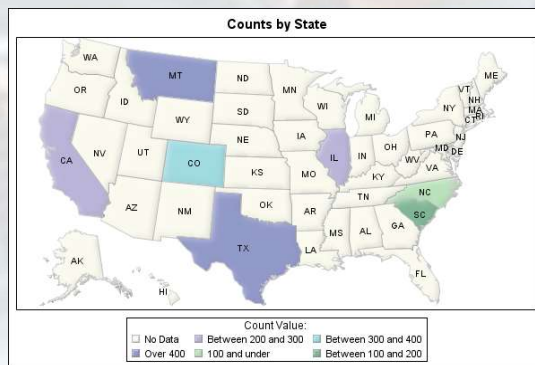
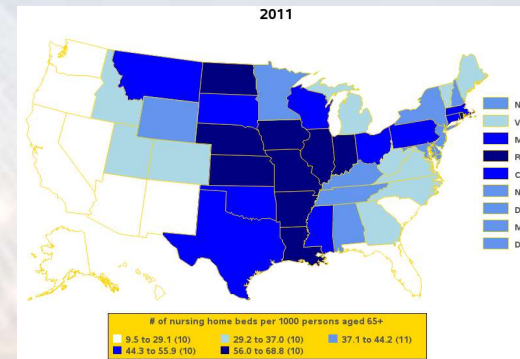
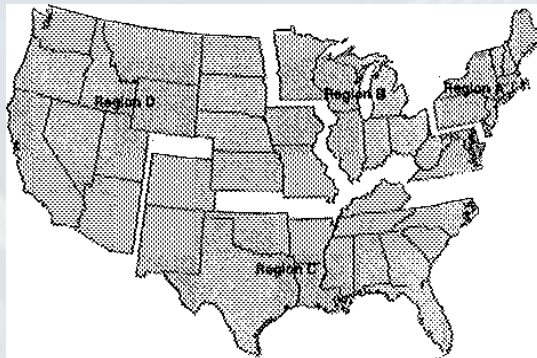


An Introduction to PROC SGMAP: Ushering in a New Era of Mapping with BASE SAS

Presented to BASUG, April 2018

Introduction

Mapping with SAS



Introduction

Resources for Mapping with PROC SGMAP

Creation of maps with BASE SAS® software

- Mapping resources
- Mapping concepts
- Procedures –Base SAS polygon plots in PROC SGPLOT, Base SAS PROC SGMAP
- Examples

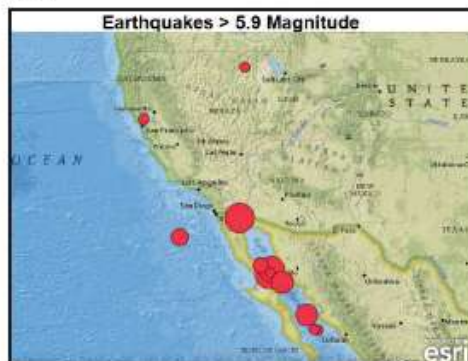
Mapping Basics

Resources – PROC SGMAP Tip Sheet

Procedure Tip Sheet

SGMap: Bubbles on Esri Map

```
data work.major_quakes;
  set sashelp.quakes (where=(magnitude>5.9));
run;
proc sgmap plotdata=work.major_quakes;
  esrimap
  url='http://services.arcgis.com/arcgis/
  rest/services/NatGeo World Map';
  title h=2 'Earthquakes > 5.9 Magnitude';
  bubble x=longitude y=latitude
  size=magnitude /
  fillattrs=(color=cx000000);
run;
```



PROC SGMAP Notes

- Map features are drawn in the order of the statements. A CHOROMAP, ESRIMAP or OPENSTREETMAP statement should precede BUBBLE, SCATTER and TEXT statements
- Map polygons drawn with CHOROMAP can be overlaid on Open Street Map and Esri background maps. Submit the CHOROMAP statement second to draw it on top.
- The CHOROMAP statement always uses the variables named X and Y in the map data set to draw the map polygons.
- All plot and map data locations *must* be in the same coordinate system.
- Both OPENSTREETMAP and ESRIMAP *require* unprojected latitude/longitude point locations in the plot data set. The map is sized to contain all the point data.
- If the SAS/GRAPH MAPSGFK library is not installed at your site, you can download the older MAPS library from SAS Maps Online. The MAPDATA= option and CHOROMAP can draw polygon maps with those.
- The MAPIMPORT procedure can import shapefiles for use with MAPDATA= and CHOROMAP to draw polygonal maps.

SGMAP Procedure Tip Sheet

This tip sheet is a quick reference guide for frequently used information on the SGMAP procedure introduced in SAS 9.4M5.

SGMAP is the latest addition to the SG procedures in Base and is available in the SAS University Edition.

The SGMAP procedure allows you to easily plot data onto a map. The base map can be polygons from a SAS map data set or a background map from Esri™ or OpenStreetMap® (OSM).

You can also overlay SAS map polygons onto an OSM or Esri background map. The polygons can be outlines or display response values.

Mapping Basics


Resources – SAS® Blog Posts and Social Media

- Sanjay Matange's Blog Posts and Web Page
- Robert Allison's Blog Posts and Web Page
- SAS Communities
- LinkedIn
- Google
- Github
- Regional and Specialty Groups

Mapping Basics


Resources – SAS® Blog Posts and Social Media

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ODS Graphics

[Programming Tips](#)

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Working with SGPLOT - Part 12 - Loess Plot

Statement in PROC SGPLOT finds a fit function while making decisions about the parametric form of the regression function.

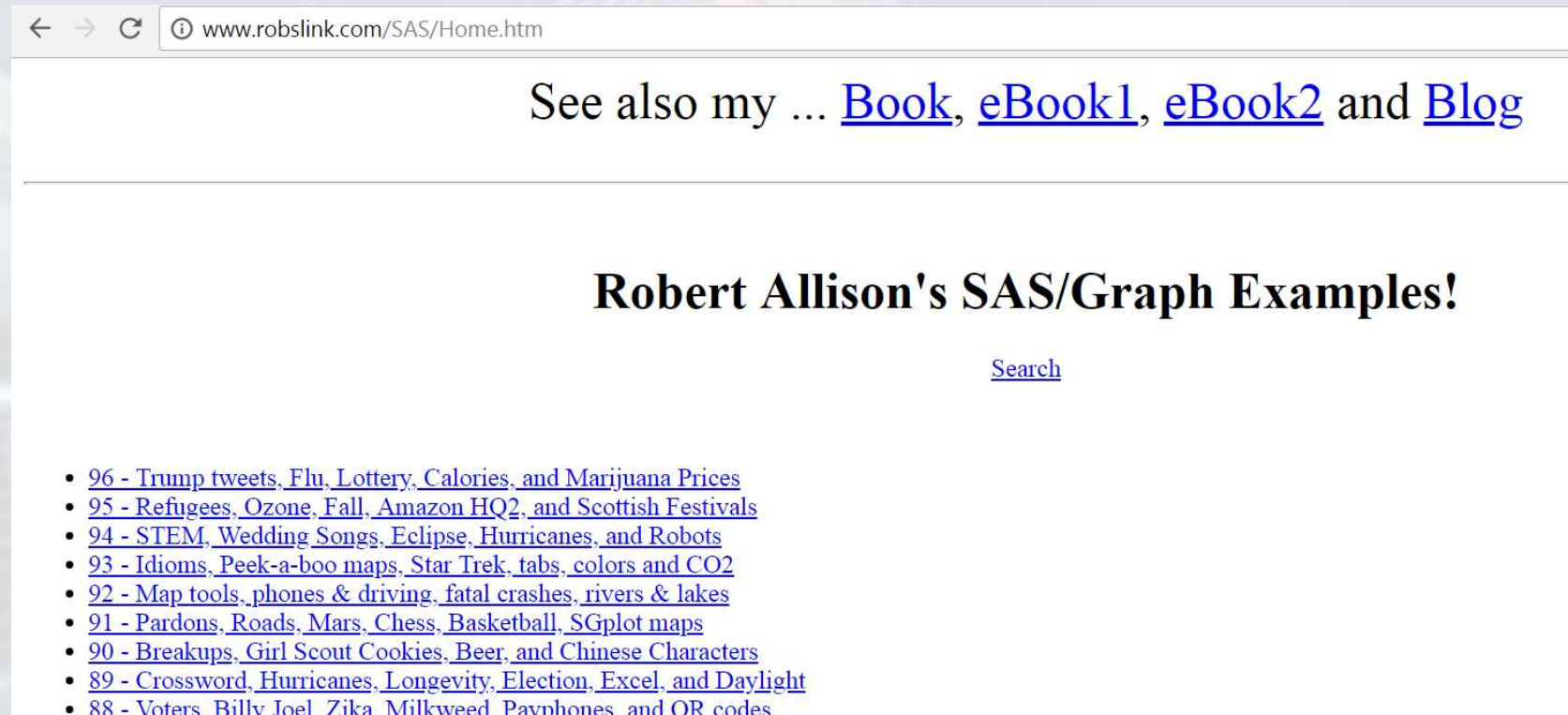
About this blog

Welcome to Graphically Speaking, a blog by Sanjay Matange focused on the usage of [ODS Graphics](#) for data visualization in SAS. The blog will cover topics related to the Statistical Graphics procedures, the Graph Template Language and the ODS Graphics Designer.

Sanjay is author of the following SAS Press books :

Mapping Basics

Resources – SAS® Blog Posts and Social Media



The screenshot shows a web browser window with the address bar displaying "www.robsslink.com/SAS/Home.htm". The main content area has a white background and contains the following text:

See also my ... [Book](#), [eBook1](#), [eBook2](#) and [Blog](#)

Robert Allison's SAS/Graph Examples!

[Search](#)

- [96 - Trump tweets, Flu, Lottery, Calories, and Marijuana Prices](#)
- [95 - Refugees, Ozone, Fall, Amazon HQ2, and Scottish Festivals](#)
- [94 - STEM, Wedding Songs, Eclipse, Hurricanes, and Robots](#)
- [93 - Idioms, Peek-a-boo maps, Star Trek, tabs, colors and CO2](#)
- [92 - Map tools, phones & driving, fatal crashes, rivers & lakes](#)
- [91 - Pardons, Roads, Mars, Chess, Basketball, SGplot maps](#)
- [90 - Breakups, Girl Scout Cookies, Beer, and Chinese Characters](#)
- [89 - Crossword, Hurricanes, Longevity, Election, Excel, and Daylight](#)
- [88 - Voters, Billy Joel, Zika, Milkweed, Payphones, and QR codes](#)

Mapping Basics

Resources – SAS® Blog Posts and Social Media

Author



Robert Allison 

The Graph Guy!



Robert has worked at SAS for over 25 years, and is perhaps the foremost expert in creating custom background is in Computer Science, and he holds a BS, MS, and PhD from NC State University. He won a few graphic competitions, and has written a book (SAS/GRAPH: Beyond the Basics).

Morning Rush Hour in the U.S.
When Americans Leave Home to go to Work

16%



Data Visualization | Programming Tips

March 26, 2018

Avoiding rush hour traffic!

Mapping Basics

Resources – SAS Software

- Map Data Sets provided by SAS
 - Traditional Map Data Sets
 - LIBNAME MAPS (MAPSSAS);
 - GfK Map Data Sets
 - LIBNAME MAPS (MAPSGFK);
 - SASHelp Data Sets
 - SASHELP.ZIPCODE, etc.
 - External Map Data Sets SAS can access (ESRI shapefiles, OpenStreetMap, etc.)

Mapping Basics

Resources – SAS Doc

The screenshot shows a web browser window displaying the SAS/GRAPH 9.4: Mapping Reference documentation. The browser's address bar shows the URL: <https://support.sas.com/documentation/cdl/en/grmapref/69722/HTML/default/viewer.htm#titlepage.htm>. The SAS logo and tagline "THE POWER TO KNOW." are visible in the top left. Navigation links for Home, Support, Learn, and Connect are present. A search bar is located in the top right. The main content area is titled "SAS/GRAPH® 9.4: Mapping Reference" and includes a small blue square icon. Below the title, a text box states: "Provides a comprehensive reference to all the features and options available with SAS/GRAPH mapping software. It includes complete information on each SAS/GRAPH mapping statement and procedure. Each statement description includes example programs designed to show you the capabilities of the statement and its options." A left-hand navigation pane lists various topics, including "What's New in SAS/GRAPH 9.4: Mapping Reference", "About This Book", "SAS/GRAPH Mapping Concepts", "Introduction to SAS/GRAPH Mapping", "Overview", "Components of SAS/GRAPH Mapping Software", "Producing Maps", "Enhancing Graphics Mapping Output", "About the Sample Library", "Examples and Resources on the Web", "Using Run-Group Processing", "SAS/GRAPH Mapping Statements and System Options", "SAS/GRAPH Mapping Statements", "SAS System Options Used by SAS/GRAPH Mapping", "SAS/GRAPH Mapping Procedures", "GEOCODE Procedure", "GINSIDE Procedure", and "GMAP Procedure".

Go to Documentation Home

SAS/GRAPH® 9.4: Mapping Reference

★ Tell us... How satisfied are you with SAS documentation?

Search this document

SAS/GRAPH® 9.4: Mapping Reference

Provides a comprehensive reference to all the features and options available with SAS/GRAPH mapping software. It includes complete information on each SAS/GRAPH mapping statement and procedure. Each statement description includes example programs designed to show you the capabilities of the statement and its options.

PDF

Contents **About**

- What's New in SAS/GRAPH 9.4: Mapping Reference
- About This Book
 - SAS/GRAPH Mapping Concepts
 - Introduction to SAS/GRAPH Mapping
 - Overview
 - Components of SAS/GRAPH Mapping Software
 - Producing Maps
 - Enhancing Graphics Mapping Output
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 - Examples and Resources on the Web
 - Using Run-Group Processing
 - SAS/GRAPH Mapping Statements and System Options
 - SAS/GRAPH Mapping Statements
 - SAS System Options Used by SAS/GRAPH Mapping
 - SAS/GRAPH Mapping Procedures
 - GEOCODE Procedure
 - GINSIDE Procedure
 - GMAP Procedure

Mapping Basics

Resources – SAS software

- SAS documentation (support.sas.com)
<https://support.sas.com/documentation/cdl/en/grmapref/69722/HTML/default/titlepage.htm> (HTML) and
<https://support.sas.com/documentation/cdl/en/grmapref/69722/PDF/default/grmapref.pdf> (PDF)
- SAS Maps Online
 - Your primary resource for SAS map data sets and other important information
- SAS Tip Sheets

Mapping Basics

Resources – Recommended Reading

The screenshot shows a web browser window displaying the SAS support page for Mapping Basics. The URL in the address bar is <https://support.sas.com/documentation/cdl/en/grmapref/69722/HTML/default/viewer.htm#p1mqv3c037qjnin16cc9r8a1wi30.htm>. The page has a left-hand navigation menu with sections like 'Contents', 'About', 'What's New in SAS/GRAPH 9.4 Mapping Reference', 'About This Book', 'SAS/GRAPH Mapping Concepts', 'Introduction to SAS/GRAPH Mapping', 'Using Run-Group Processing', 'SAS/GRAPH Mapping Statements and System Options', 'SAS/GRAPH Mapping Procedures', and 'Recommended Reading'. The main content area is titled 'Recommended Reading' and lists various SAS publications and resources. At the bottom, there is contact information for SAS Books.

Previous Page | Next Page

Recommended Reading

Here is the recommended reading list for this title:

- [SAS/GRAPH: Beyond the Basics](#)
- [SAS/GRAPH: Network Visualization Workshop User's Guide](#)
- [SAS/GRAPH: Reference](#)
- [Base SAS Procedures Guide](#)
- [Base SAS Utilities: Reference](#)
- [Maps Made Easy Using SAS](#)
- [Output Delivery System: The Basics and Beyond](#)
- [The How-to Book for SAS/GRAPH Software](#)
- [SAS Data Set Options: Reference](#)
- [SAS Formats and Informats: Reference](#)
- [SAS Functions and CALL Routines: Reference](#)
- [SAS Language Reference: Concepts](#)
- [SAS Statements: Reference](#)
- [SAS System Options: Reference](#)
- [Statistical Graphics Procedures by Example: Effective Graphs Using SAS](#)
- [Statistical Graphics in SAS: An Introduction to the Graph Template Language and the Statistical Graphics Procedures](#)
- SAS offers instructor-led training and self-paced e-learning courses to help you get started with SAS/GRAPH. For more information about the courses available, see [sas.com/training](#).

For a complete list of SAS publications, go to [sas.com/store/books](#). If you have questions about which titles you need, please contact a SAS Representative:

SAS Books
 SAS Campus Drive
 Cary, NC 27513-2414
 Telephone: 1-800-727-0025
 Fax: 1-919-677-4444
 Email: sasbook@sas.com
 Web address: [sas.com/store/books](#)

Mapping Basics

Resources – SAS MAPS Online

The screenshot shows a web browser window displaying the SAS Maps Online Knowledge Base. The browser's address bar shows the URL `support.sas.com/rnd/datavisualization/mapsonline/index.html`. The page features the SAS logo and tagline "THE POWER TO KNOW." at the top left, with the text "Providing software solutions since 1976" below it. A navigation bar includes links for `support.sas.com`, `Knowledge Base`, `Support`, `Training & Books`, `Store`, and `Support Communities`. A search bar is located on the right side of the page. The main content area is titled "KNOWLEDGE BASE / FOCUS AREAS" and includes a "Welcome to SAS Maps Online" section. This section explains that SAS Maps Online shows maps for areas throughout the world and lists categories: world maps, continents, countries, and maps of political groups. It also lists what SAS users will find: Archived maps from previous releases, Sample programs, Recent Mapping and Geocoding updates, and Geocoding examples, techniques and look-up data. Below this text is a world map. At the bottom of the page, there are three columns of links: "Connect" (Feedback, Contact SAS, Make a Software Suggestion, SAS Users Groups, Careers, About SAS), "Get Help" (Open a Track with Technical Support, Resource Center, SAS Contracts Support, Sign Up for Training, Buy a Book), and "Account Management" (Maintenance Releases and Upgrades, Manage Installation Sites, Request Software Updates, Request a License Extension, Find Your Site Number). The footer includes social media links (Facebook, Twitter, LinkedIn, YouTube, RSS) and a privacy statement.

KNOWLEDGE BASE / FOCUS AREAS

FOCUS AREAS

- Base SAS
- Graphics
 - 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

Connect






- > Feedback
- > Contact SAS
- > Make a Software Suggestion
- > SAS Users Groups
- > Careers
- > About SAS

Get Help

- > Open a Track with Technical Support
- > Resource Center
- > SAS Contracts Support
- > Sign Up for Training
- > Buy a Book

Account Management

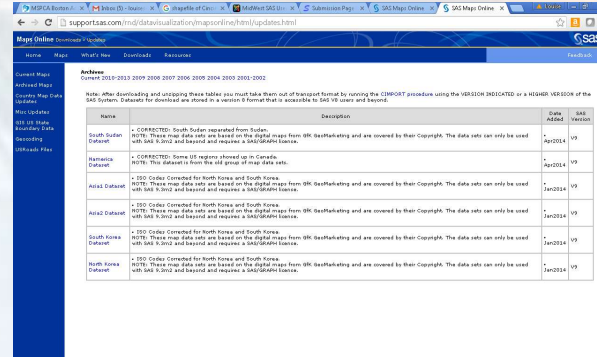
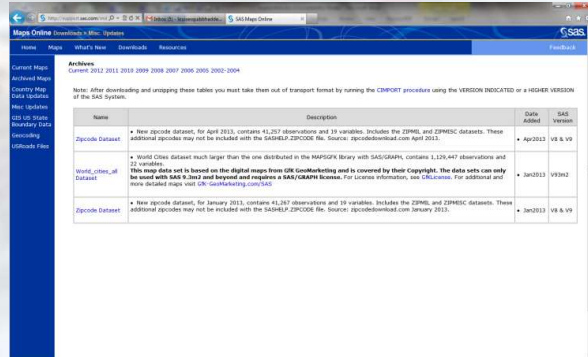
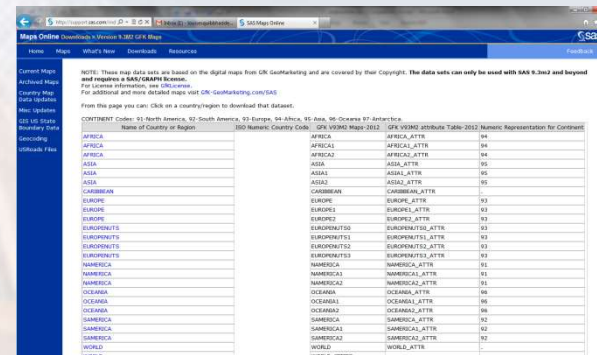
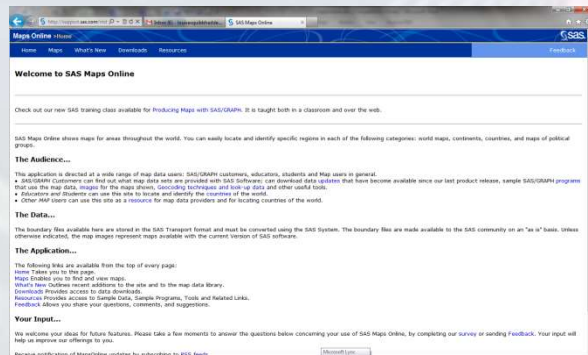
- > Maintenance Releases and Upgrades
- > Manage Installation Sites
- > Request Software Updates
- > Request a License Extension
- > Find Your Site Number

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Mapping Basics

Resources – SAS MAPS Online



Mapping Basics

Resources – SAS® Software

- Macros, Functions and Formats, Oh My
 - Macros: %sganno, %centroid, %geodist
 - Geographic Functions: ZIPCITY, ZIPSTATE, ZIPNAME, ZIPNAMEL, ZIPFIPS, ZIPCITYDIST() and GEODIST()
 - SASHELP.MAPFMTS

Mapping Basics

Resources – Mapping Macros

- %sganno
- %sgimage
- %centroid
- %geodist

Mapping Basics

Resources – Mapping Macros

```
/* calculate the distance between two zip code  
centroids */  
%macro geodist(lat1,long1,lat2,long2);  
  %let pi180=0.0174532925199433;  
  7921.6623*arsin(sqrt((sin((&pi180*&lat2-  
  &pi180*&lat1)/2))**2+  
  cos(&pi180*&lat1)*cos(&pi180*&lat2)*  
  (sin((&pi180*&long2-&pi180*&long1)/2))**2));  
%mend;
```


Mapping Basics

Resources – Geographic Functions

- ZIPCITY('02138') returns 'Cambridge, MA'
- ZIPSTATE('02138') returns 'MA'
- ZIPNAME('02138') returns 'MASSACHUSETTS'
- ZIPNAMEL('02138') returns 'Massachusetts'
- ZIPFIPS('02138') returns 25 (FIPS state code for Massachusetts)

Mapping Basics

Selected SAS® procedures related to mapping

- Some BASE SAS procedures that create a map
 - PROC GMAP – SAS/GRAPH
 - PROC SGPLOT with a POLYGON statement – BASE SAS
 - PROC SGMAP – BASE SAS
- Other selected important graphics procedures
 - PROC MAPIMPORT, PROC GREDUCE*, PROC GREMOVE*, PROC GPROJECT*
- Important geography-related procedures
 - PROC GEOCODE, PROC GINSIDE**, PROC GREPLAY***

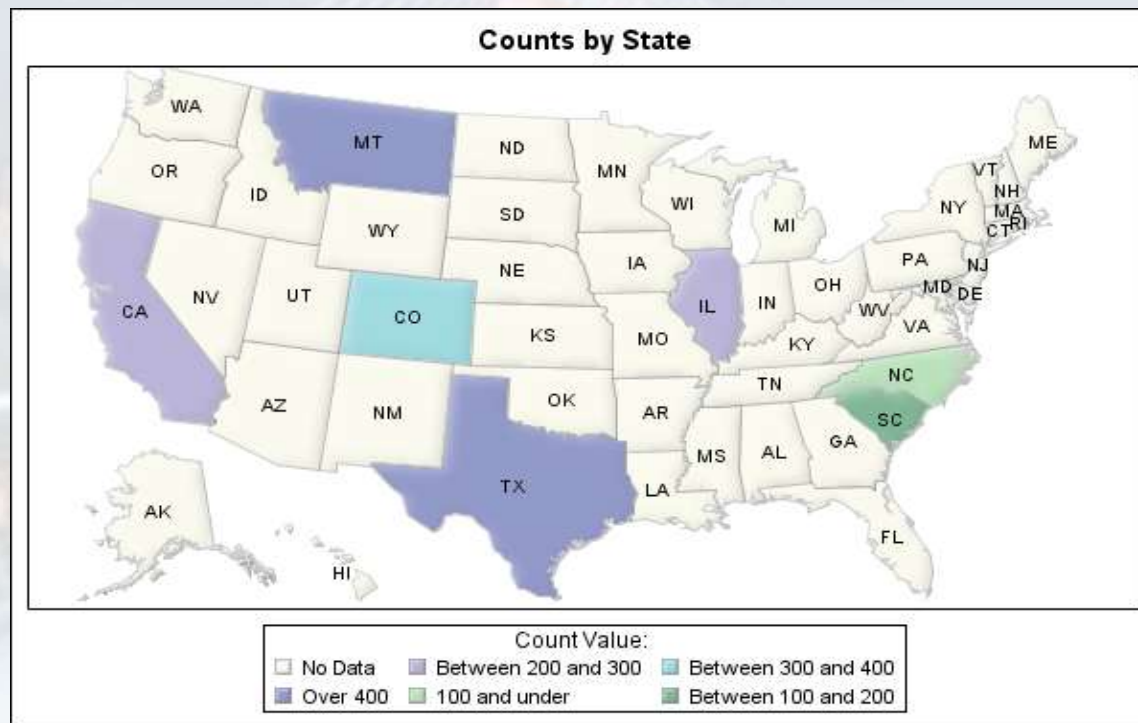
Mapping Basics

Mapping Concepts for Creating Maps with Base SAS

- Map data sets
- Outputting maps
 - Devices, ODS and style templates
- Annotation
- Graphics editing (GTL)

Examples

PROC SGPLOT with a Polygon Statement



Examples

PROC MAPIMPORT

Basic syntax for PROC MAPIMPORT:

```
PROC MAPIMPORT
```

```
  OUT=map-data-set
```

```
  DATAFILE='path-to-shapefile '
```

```
  <CONTENTS>
```

```
  <CREATE_ID_> ;
```

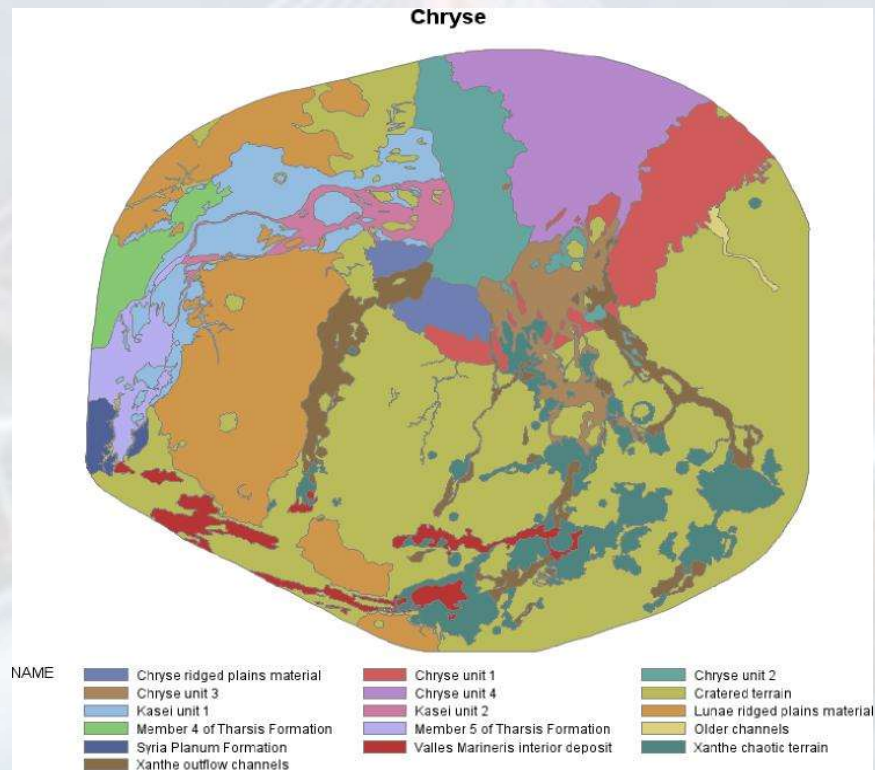
```
  <SELECT> 'field-identifier(s)';
```

```
  <EXCLUDE> 'field-identifier(s)';
```

```
RUN;
```


Examples

PROC MAPIMPORT



Examples

SASHELP.ZIPCODE

- The SASHELP.ZIPCODE file is a SAS data set containing ZIPCODE level information for the United States
- The file is indexed on ZIPCODE to facilitate processing
- The source of the zip code data in the file is <http://www.zipcodedownload.com/>
- Updates are free to licensed SAS users as a SAS transport file through SAS MAPS Online.

Examples

Zip Code Processing using SASHELP.ZIPCODE

```
DATA zip2msa (RENAME=(zipcode=start msacode=label));  
  RETAIN fmtname '$zip2msa' type 'c' hlo=' '  
  SET sashelp.zipcode END=last;  
  Msacode=PUT(msa,z4.);  
  Zipcode=PUT(zip,z5.);  
  IF last THEN hlo='h';  
RUN;  
PROC FORMAT LIBRARY=library CNTLIN=zip2msa;  
RUN;
```

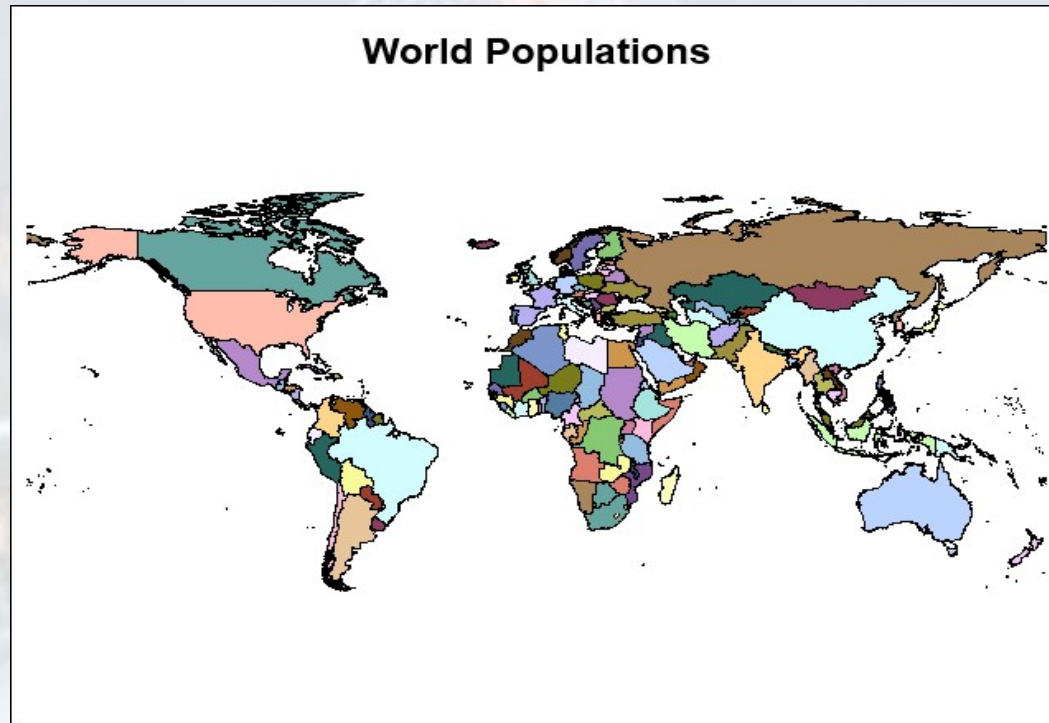
Examples

PROC SGMAP #1

```
PROC SGMAP MAPDATA=maps.world  
MAPRESPDATA=sashelp.demographics;  
    CHOROMAP popUrban / MAPID=id ID=id;  
RUN;
```

Examples

PROC SGMAP #1



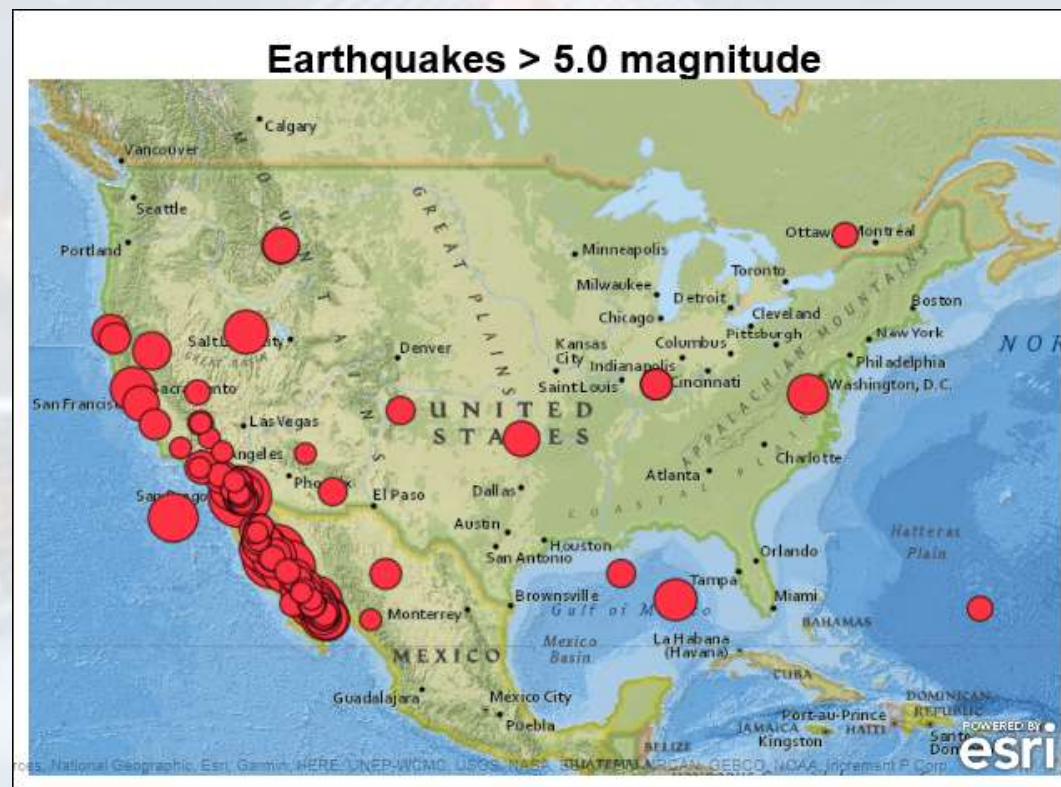
Examples

PROC SGMAP #2

```
DATA major_quakes;  
  SET sashelp.quakes (WHERE=(magnitude>5.0));  
RUN;  
PROC SGMAP PLOTDATA=major_quakes;  
  ESRIMAP URL='http://services.arcgisonline.com/  
    arcgis/rest/services/NatGeo_World_Map';  
  TITLE H=2 'Earthquakes > 5.0 magnitude';  
  BUBBLE X=longitude Y=latitude SIZE=magnitude /  
  FILLATTRS=(COLOR=cxff3344);  
RUN;
```

Examples

PROC SGMAP #2



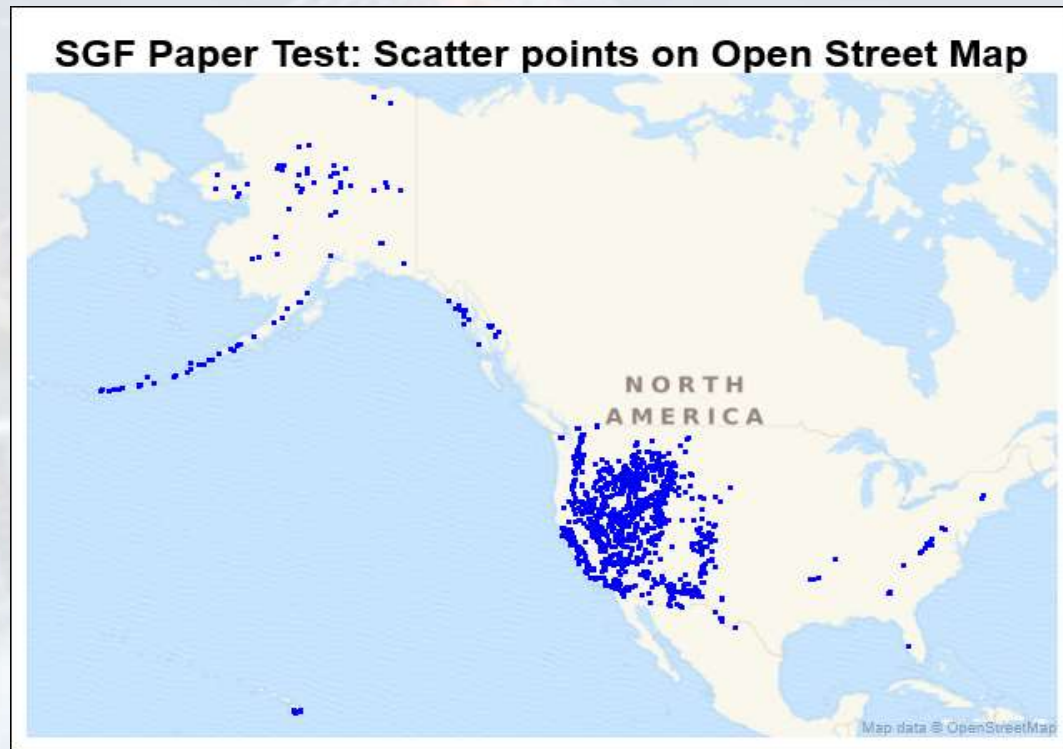
Examples

PROC SGMAP #3

```
PROC SGMAP PLOTDATA=sashelp.springs;  
TITLE H=2 'SGF Paper Test: Scatter points on Open  
Street Map';  
  OPENSTREETMAP;  
  SCATTER X=longitude Y=latitude /  
  MARKERATTRS=(COLOR=blue SIZE=3  
  SYMBOL=circlefilled);  
RUN;
```

Examples

PROC SGMAP #3



Conclusion

SAS has always been at the forefront of data visualization, from the days of SAS/GIS, ESRI bridge to SAS, SAS/GRAPH, and now with the SG procedures, SAS Visual Analytics, and SAS Viya. I feel privileged to have taken this journey with co-authors and my mentors. SAS has provided programmers with a vast array of tools to make beautiful maps – and those tools continue to evolve. I hope some of the examples in this paper inspire others to explore the unlocked potential of PROC SGMAP along with me.

Acknowledgements

- The author wishes to acknowledge Darrell Massengill (retired), Liz Simon and Robert Allison of SAS who work tirelessly to improve and facilitate the use of SAS/GRAPH and mapping with SAS and maintain the SAS MAPS ONLINE site; Ed Odom, Dan Heath, and Sanjay Matange who are ushering in a new era of mapping with base SAS and the SG procedures; Mike Zdeb and Barbara Okerson, extraordinary mapping gurus; and Rick Andrews of CMS.

Contact Information

Your comments and questions are valued and encouraged. Contact the author at:

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