TOOLS AND TECHNIQUES TO INTEGRATE AND MAP GEOGRAPHIC DATA USING SAS/GRAPH SOFTWARE[1]

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Jay Jacob Wind, American Environmental Institute[2]
Bernard Rene Baum, Agriculture Canada[3]
Chapman Gleason, U.S Environmental Protection Agency[4]

INTRODUCTION

This paper covers three topics:

- o Using Basic SAS/GRAPH mapping tools
- o Mapping for Scientific Publications
- o Distributing Maps and Other Graphics via Internet

We have presented related papers at previous SUGIs and regional SUGs.[1]

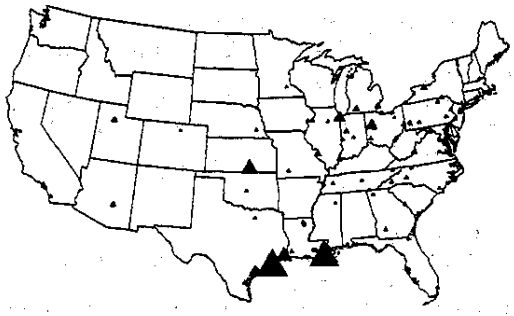
USING BASIC SAS/GRAPH MAPPING TOOLS

SAS provides many mapping tools: **GMAP, GPROJECT, G3D, GPLOT, GCONTOUR, GREMOVE, GREDUCE,** and **G3GRID.**

SAS can map boundaries, e.g., countries, provinces, states, counties; points by latitude-longitude; lines, e.g., rivers or streets; gradients, e.g., elevation or temperature; and measurements for any of these.

This section covers tools to build thematic maps; convert between coordinate systems; calculate distances between points; orient a map using a bounding rectangle; add shapes, sizes, and symbols to show locations; use data in a footnote; enclose a map in a reference frame with tickmarks for the latitudes and longitudes; and download graphics into WordPerfect.

1989 TRI Releases+Transfers
Suspected Carcinogens, Top 100 Facilities



Symbols Represent Totals. Maximum: 206,533 Thousand Pounds

An Example

US EPA presented the map above at the 1992 international conference of the Organization of Economic Co-operation and Development (OECD) in Vienna. It illustrates tools we discuss in this paper. The map excludes Alaska and Hawaii; is reduced in detail; is pinned to its bounding rectangle to eliminate outliers; is projected to represent equal areas nationwide; is annotated with symbols; and uses data in its footnote.

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1 SAS and SAS/GRAPH are registered trademarks of SAS Institute.

2 611 South Ivy Street, Arlington, Virginia 22204. (703) 920-5193

3 Principal Research Scientist, Centre for Land and Biological Resources Research, Agriculture Canada, William Saunders Building, Ottawa, Ontario, Canada K1A0C6. (613) 996-1665

4 Environmental Statistics and Information Division, 401 M Street SW, Washington, DC 20460. (202) 260-9006

Building A Thematic Map

Thematic maps use shades or patterns to show values of a variable by nation, province, state, or county. SAS provides maps for **US**, **STATES**, **COUNTIES**, **COUNTIES**, **USCENTER**, **USCITY**, **USCOUNTY**, **AFRICA**, **ASIA**, **EUROPE**, **NAMERICA**, **SAMERICA**, **WORLDMAP**, **WORLDPRJ**, **CANADA**, and more than 80 countries. For a list, use this tool:

```
PROC CONTENTS DATA=MAPS._ALL_; RUN;
```

How SAS Stores Boundary Data

Boundary files contain an **ID**, e.g., **STATE** Federal Information Processing Standard (FIPS) (1=Alabama, 2=Alaska, etc.); a series of **X,Y** pairs for longitude and latitude; and **DENSITY** on a 1-to-6 scale (1 = most important).

Creating Data For A Thematic Map

Make a dataset with each state's code (**ST**), e.g., **MD** or **VA**, and a variable, e.g., **SALES**. To translate **ST** into FIPS codes, use this tool:

```
DATA ONE; SET MY.DATA;
  STATE=STFIPS(ST); RUN;
```

County Names

A county dataset contains FIPS state and county codes and a response variable. For a list of FIPS county codes, use this tool:

```
PROC PRINT DATA=MAPS.CNTYNAME;
  VAR STATE COUNTY COUNTYNM; RUN;
```

How SAS Links Data And Map Files

PROC GMAP automatically links data and map files. Both must contain **X**, **Y**, and the ID. Use this tool:

```
PROC GMAP DATA=ONE MAP=MAPS.US ALL;
  ID STATE; CHORO SALES; RUN;
```

How SAS Controls Map Detail

Use **DENSITY** to filter out high-detail points. **MAPS.US** (by state) and **MAPS.USCOUNTY** (by county) don't include **DENSITY**, but **MAPS.STATES** and **MAPS.COUNTIES** do. For state maps with just 30% of the detail, use this tool:

```
DATA MAP; SET MAPS.STATES;
  IF DENSITY LE 3; RUN;
```

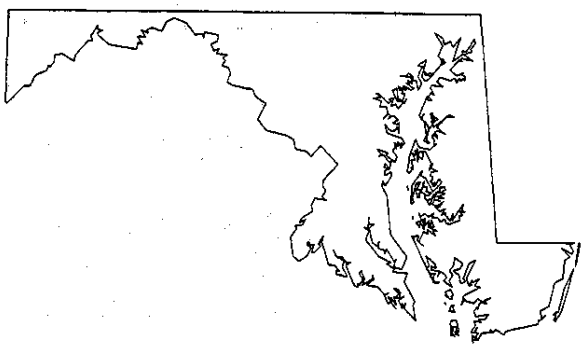
For county maps with just 16% of the detail, use this tool:

```
DATA MAP; SET MAPS.COUNTIES;
  IF DENSITY LE 3; RUN;
```

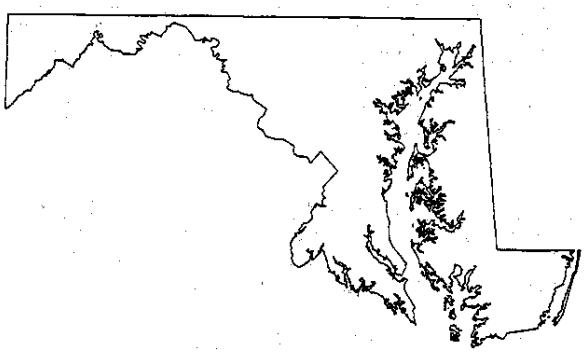
Examples

The two maps of Maryland on the right illustrate **DENSITY** levels of 3 and 6.

Map of Maryland at DENSITY LE 3



Map of Maryland at DENSITY LE 6



Adjusting for the Earth's Curvature

Earth is round, not flat. Latitude degrees are the same distance worldwide, but longitude degrees converge as you approach the poles. To adjust for Earth's curvature to make map areas correspond to actual areas, use this tool:

```
PROC GPROJECT DATA=MAPS.STATES
  OUT=MAP; ID STATE; RUN;
```

Then you can use:

```
PROC GMAP DATA=MAP=MAP ALL;
  ID STATE; CHORO STATE; RUN;
```

Projected vs. Unprojected Map Files

MAPS.STATES, **MAPS.COUNTIES**, **MAPS.CANADAx**, and **MAPS.WORLDMAP** use X and Y as actual lat-longs. You can annotate those maps with other lat-long data. **MAPS.US**, **MAPS.USCOUNTY**, **MAPS.WORLDPRJ**, and most country maps use pre-projected X and Y, i.e., "unrolled" onto a flat sheet of paper. You won't be able to annotate those maps with other lat-long data.

Patterns

By default, **PROC GMAP** divides responses into five groups by rounding up the top value and dividing it by five. Also by default, **PROC GMAP**'s legend prints only group midpoints. To overcome these defaults, use **PROC FORMAT.** Assume you have sales of $100,000 - $800,000 per county, and you want four groups. Use this tool:

```
PROC FORMAT; VALUE S
  LOW-200000='UNDER $200K'
  200000-400000='$200K-400K'
  400000-600000='$400K-600K'
  600000-800000='$600K-800K';
PROC GMAP DATA=ONE MAP=MAPS.US;
  ID STATE; CHORO SALES/DISCRETE;
  FORMAT SALES S.; RUN;
```

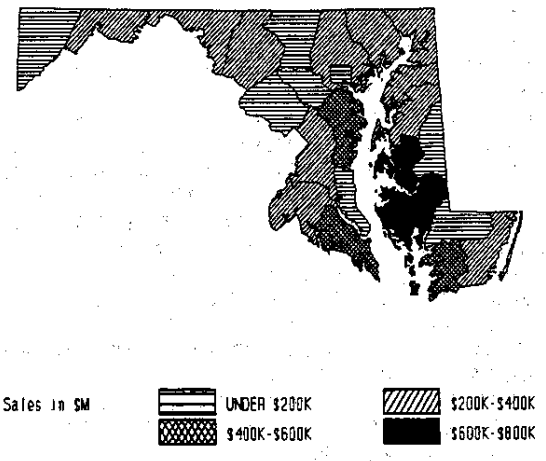
How to Control Patterns

After years of research, we know the four best patterns. Use this tool:

```
PROC GMAP DATA=ONE MAP=MAPS.US;
  ID STATE; CHORO SALES;
  FORMAT SALES S.;
PATTERN1 V=M3N00; PATTERN2 V=M4N45;
PATTERN3 V=M4X45; PATTERN4 V=MS;
RUN;
```

The map of Maryland below shows our favorite patterns.

Our Favorite Patterns



More About Patterns

Maps in SAS can have 1,802 different patterns. Map patterns include MEMPTY, MSOLID, M1N0-M1N359 ... M5N0-M5N179, and M1X0-M1X179 ... M5X0-M5X179. If you omit the prefix "M," SAS uses a default pattern.

Converting Between Coordinate Systems

Most non-SAS map files store lat-longs in degrees. Some use decimal degrees, e.g., 38.5=38½ degrees; others use degrees, minutes, and seconds (DDDMMSS). If you encounter DDDMMSS format, use this tool:

```
DEGREES=SUBSTR(DDDMMSS,1,3)
  +SUBSTR(DDDMMSS,4,2)/60
  +SUBSTR(DDDMMSS,6,2)/3600;
```

Radians

SAS map files, however, use RADIANS, not degrees. 1 radian=180/PI degrees ≈57.3 degrees. For PI, use this tool:

```
PI=ARCOS(-1);
```

To convert DEGREES to RADIANS, use:

```
X=LONG*PI/180; Y=LAT*PI/180;
```

For RADIANS to DEGREES, use:

```
LONG=X*180/PI; LAT=Y*180/PI;
```

UTMs and Other Systems

Some databases use Universal Transverse Mercator coordinate systems or state grids. Contact the authors for algorithms to convert UTMs and state grids into lat-longs.

Calculating Distances Between Points

Since Earth's is about 25,000 miles around, 1 degree at the equator ≈ 69.4 mi. (25,000 mi./360 degrees).

Latitude distance is constant, but longitude varies from 1 degree ≈ 69.4 mi. at the equator to 0 mi. at the poles. Longitude distance decreases with COSINE(Latitude). To figure miles between **LONG2**, **LAT2** and **LONG1**, **LAT1** (in radians), use this tool:

```
DISTANCE=
  69.44 * SQRT ((LAT2-LAT1)**2
  + (COS(LAT1)*(LONG2-LONG1))**2);
```

Orienting A Map In A Rectangle

Frequently, databases contain outliers beyond their reported area. To exclude points outside the rectangle bounding an area, e.g., for Maryland, use this tool:

```
DATA MAP; SET MAPS.STATES;
  IF FIPSTATE(STATE)='MD';
PROC SUMMARY DATA=MAP MISSING NWAY;
  VAR X Y; OUTPUT OUT=ANNO
    MIN=MIX MIY  MAX=MAX MAY;
DATA fixed;
  RETAIN PI MIX MAX MIY MAY;
  SET original;
  IF _N_=1 THEN DO;
    PI=ARCOS(-1); SET ANNO;
  END;
  X=LONG*PI/180; Y=LAT*PI/180;
  IF MIX<=X<=MAX AND MIY<=Y<=MAY;
```

Mapping Counties Only With Data

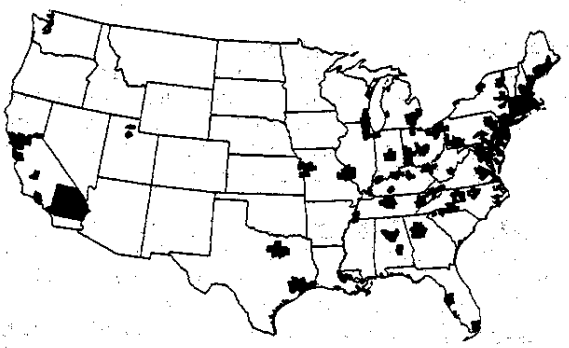
To map counties only where data actually appears, use this tool:

```
PROC FREQ DATA=MYDATA;
   TABLES STATE*COUNTY/NOPRINT OUT=ONE;
DATA MAP2;
   MERGE ONE (IN=ONE) MAPS.COUNTIES;
   BY STATE COUNTY; IF ONE;
DATA MAP; SET MAPS.STATES MAP2;
PROC GPROJECT DATA=MAP OUT=MAP;
   ID STATE COUNTY;
PROC GMAP DATA=ONE MAP=MAP ALL;
   ID STATE COUNTY; CHORO SALES;
```

Example

US EPA uses maps like the one below to identify counties exceeding Ozone standards.

Ozone Non-Attainment, 1987-89



Using PROC GPLOT as a Mapping Tool

Occasionally, you need to check map data against reference lines. Use this tool:

```
   DATA ONE; RETAIN FLAT FLON; SET MAP;
     BY ID SEGMENT; IDS=ID*100*SEGMENT;
     LAT=Y*180/ARCOS(-1);
     LONG=-X*180/ARCOS(-1);
     IF FIRST.SEGMENT THEN DO;
       FLAT=LAT; FLON=LONG;
     END;
     OUTPUT;
     IF LAST.SEGMENT THEN DO;
       LAT=FLAT; LONG=FLON;
       OUTPUT;
     END;
   PROC GPLOT DATA=ONE;
     PLOT LAT*LONG=IDS;
     SYMBOL1 V=NONE I=JOIN;
```

Adding Symbols, Shapes, and Sizes

The best symbol is **TEXT'L' STYLE'SPECIAL'** (▲). You can also use **TEXT'J' STYLE'SPECIAL'** (■) and **TEXT'K' STYLE'SPECIAL'** (●) if you use COLOR.

For **SIZE**, use minimum 1, maximum 8. Sort to find maximum, divide each value by maximum, then multiply each fraction by 8 and adding minimum of 1.

To display sites, you need each site's lat-long. Create an **ANNOTATE** file with variables: **X, Y, XSYS, YSYS, TEXT, SIZE, COLOR, STYLE, FUNCTION, POSITION.**

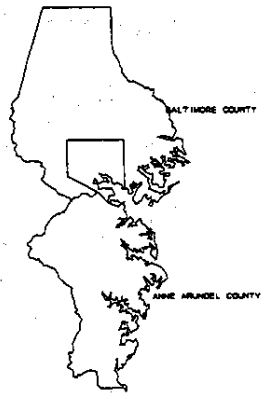
The front page map used this tool:

```
* Get the response data.;
PROC SUMMARY DATA=data MISSING NWAY;
   CLASS LAT LONG; VAR KLB;
   OUTPUT OUT=ONE SUM=;
PROC SORT DATA=ONE; BY DESCENDING KLB;
* Get the map data.;
DATA MAP; RETAIN MAP 1;
   SET MAPS.STATES; IF DENSITY LE 3;
   IF FIPSTATE(STATE)
     NOT IN ('RQ','HI','AK');
PROC SUMMARY DATA=MAP NWAY; VAR X Y;
   OUTPUT OUT=BOX
     MIN=MIX MIY MAX=MAX MAY;
DATA ONE; RETAIN PI MIX MAX MIY MAY;
   SET ONE; IF LAT AND LONG;
   IF _N_=1 THEN DO;
     PI=ARCOS(-1); SET BOUNDS;
   END;
   X=LONG*PI/180; Y=LAT*PI/180;
   IF MIX<=X<=MAX AND MIY<=Y<=MAY;
   N+1; IF N LE 100; STATE=N;
* Identify the maximum.;
PROC SUMMARY DATA=ONE MISSING NWAY;
   VAR LBY; OUTPUT OUT=MAX MAX=;
DATA _NULL_; SET MAX;
   CALL SYMPUT('K',PUT(KLB,COMMA9.));
   CALL SYMPUT('MAX',KLB); RUN;
   FOOTNOTE "Max: &K Thousand Lbs.";
* Create a bounding box.;
   DATA BOX; RETAIN MAP 2; SET BOX;
   X=MIX; Y=MIY; STATE=99001; OUTPUT;
   X=MAX; Y=MIY; STATE=99002; OUTPUT;
   X=MAX; Y=MAY; STATE=99003; OUTPUT;
   X=MIX; Y=MAY; STATE=99004; OUTPUT;
* Put them together and project.;
   DATA ONE; SET ONE TWO MAP;
   PROC GPROJECT OUT=ONE; ID STATE;
   DATA MAP; SET ONE; IF MAP=1;
DATA ANNO(DROP=DENSITY SEGMENT STATE);
   LENGTH FUNCTION $8;
   RETAIN WHEN'B' POSITION'5' TEXT'L'
     XSYS YSYS'2' FUNCTION'SYMBOL'
     STYLE'SPECIAL';
   SET TWO; IF MAP=0;
* Compute size of each triangle.;
   SIZE=1+8*KLB/&MAX;
* Generate the map.;
PROC GMAP DATA=MAP MAP=MAP ALL;
   ID STATE; CHORO STATE/LEVELS=1
   DISCRETE NOLEGEND ANNO=TWO;
```

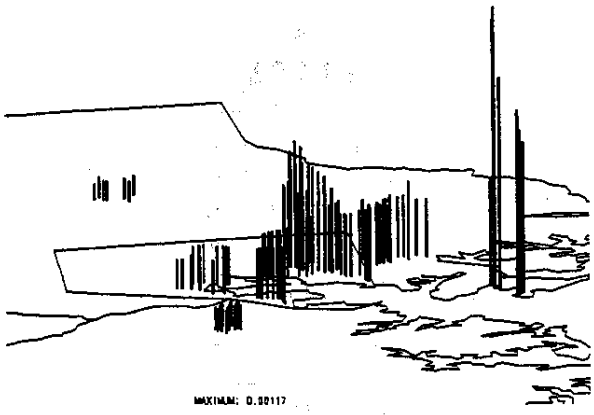
Using Boundary Data In Annotate Files

You can use boundary data in annotate files to take advantage of PROC GPLOT's SCATTER option. In 1986, US EPA studied air pollution health risk near Baltimore and used SAS/GRAPH to illustrate results, as below.

Baltimore and Anne Arundel Counties



Air Pollution Risk Near Baltimore
The Vertical Bars Represent Relative Estimated Excess 70-Year Cancer Risk From All Pollutants From All Sources At Various Urban And Suburban Sites



Trimming the Borders of a Map File

To take a subset of a map within a rectangular frame, you can use PROC GPROJECT without actually projecting. Use this tool:

```
PROC GPROJECT DATA=ONE OUT=ONE
  PROJECT=NONE
  LATMIN=y1 LATMAX=y2
  LONGMIN=x1 LONGMAX=x2; ID ID;
```

You may then add annotate data and reproject.

Discerning Map Data from Annotate Data

To map boundaries and annotate data together, you must GPROJECT them in the same plane. The example on the previous page used this tool:

```
DATA MAP;
  RETAIN MAP 1;  SET MAPS.xxx;
DATA ANNO;
  RETAIN MAP 0;  SET WORK.yyy;
DATA MAP; SET MAP ANNO;
PROC GPROJECT OUT=MAP; ID ID;
DATA ANNO; SET MAP; IF MAP=0;
DATA MAP; SET MAP; IF MAP=1;
PROC GMAP ...;
```

Excluding Alaska, Hawaii, Puerto Rico

MAPS.US and **MAPS.STATES** contain Alaska, Hawaii, and Puerto Rico. In **MAPS.US**, their coordinates are shifted to appear below California. In **MAPS.STATES**, their lat-longs are real. To exclude these three, use this tool:

```
DATA MAP; SET MAPS.STATES;
  IF FIPSTATE(STATE)
  NOT IN ('AK','HI','RQ');
```

Shifting Alaska, Hawaii, Puerto Rico

Use this tool:

```
IF ST='AK' THEN DO;
  LAT=(LAT-51.6)/4+44;
  LONG=(LONG-129.9)/8+124.5; END;
IF ST='HI' THEN DO;
  LAT=LAT+12.5; LONG=LONG-36; END;
IF STATE>70 THEN DO;
  LAT=LAT+22; LONG=LONG+11; END;
```

Downloading Graphics Into WordPerfect

You can use WordPerfect to view and print graphics. First, program them. Then create an 80-column or wider mainframe file to store a Computer Graphics Metafile (CGM).

Then use this tool:

```
FILENAME GSASFILE 'yourid.yourfile';
GOPTIONS DEVICE=CGMWP
  GACCESS=GSASFILE
  GSFNAME=GSASFILE GSFLEN=80
  GSFMODE=REPLACE HANDSHAKE=NONE;
PROC GMAP ...; RUN; QUIT;
```

GSASFILE now contains binary code. Download it, e.g., with Kermit, to a PC file named **GSASFILE**. To import into WordPerfect, use this tool:

```
* Use WordPerfect:  WP
* Invoke graphics:  <Alt>-<F9> 1 1
* Center graphics:  6 C
* Call a graphic:   1 GSASFILE <Enter>
* Wait, then view:  9
```

MAPPING FOR SCIENTIFIC PUBLICATIONS

The taxonomist, ecologist, biologist or anyone who describes and evaluates biodiversity almost always needs a map of some sort to plot localities of organisms, in varying details.

Of the two most common alternatives used to map distribution of organisms, contours and points, plotting points (localities) is preferred. Plotting points requires knowledge of the coordinates for each record, normally available in any serious work. To plot the distribution of two or more entities such as species or subspecies, races, etc., requires a symbol for each to retain the identity of the different entities. Plots of different entities on a map, each with its own symbol, enables you to make inferences on their distribution.

A map is not complete unless some of the latitudes and longitudes are marked on it. At least minimum and maximum latitude and longitude points are needed to relate the map to its location on the globe. Demarcation is indispensable for local maps, such as counties or relatively small areas, but essential for any map. Scientific journals with high standards will not accept maps without latitude and longitude marks.

It is important to have some sort of a program in SAS because SAS is an integrated, powerful, and flexible system. First, SAS allows a biologist to store data for documentation, such as maps. Second and most important, the same data can be analyzed and further incorporated in the documented study, without the need to use another specialized software. For instance, in addition to plotting distribution of points on a map, you may want to plot histograms of density distributions of populations and compare those across a given area. On a map like the one to the right, you can add various symbols or even histograms generated by SAS.

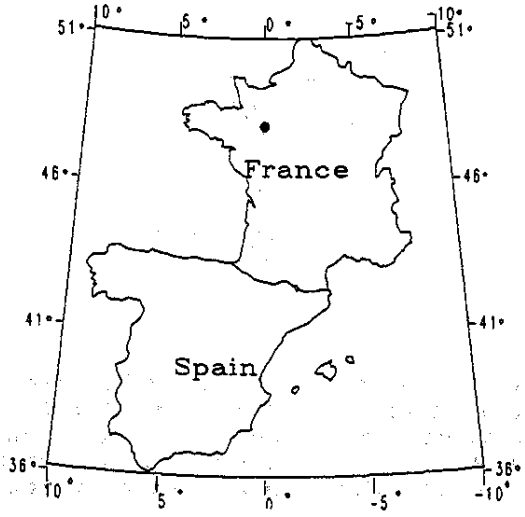
We have developed an interactive **MAPFRAME** macro to prompt for a plot dataset and a text dataset if any; a title; countries anywhere in the world; map boundaries -- east, west, south, and north; interval between ticks; country names not to appear on the map; and projection.[2]

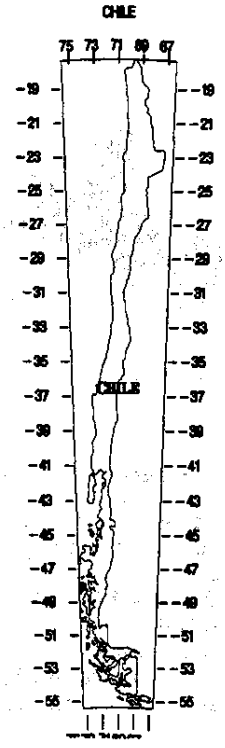
You may download this program, **mapframe.sasmacro**, via anonymous FTP from **IPC1.WAS.EPA.GOV**.

Our macro can produce Graphics Stream Files for slides, for hard copy on a laser printer, or for any other SAS-supported device. To produce slides for our presentation, we used a **QCR4X** driver, downloaded GSF files to the PC, and produced the slide using **MAESTRO** software.

Examples

France and Spain – with Tickmarks





DISTRIBUTING MAPS AND OTHER GRAPHICS VIA INTERNET

You can publish SAS graphics and other documents on Internet. Thus other users can access your data via File Transfer Protocol (FTP).

To use FTP, you log on to the public partition of a remote computer, under user ID "ANONYMOUS". Your password is your real ID @ your node ID. Anyone on Internet can log on, download files, and if authorized, upload files, at any FTP site world-wide.

For example, SAS Institute publishes some technical manuals via Internet. Try FTPing to FTP.SAS.COM.

US EPA will make its annual State of the Environment (SOE) report available via Internet, including tables, graphs, and maps of the status and trends of America's management of natural resources and waste. EPA will use SAS to generate CGM and PostScript files for SOE. EPA will then stores these files on a Unix computer connected to Internet. In addition, EPA will store indexes to SOE and other reports in EPA's Gopher and Wide Area Information Servers (WAIS). Thus full SOE text, graphs, and map will all be available for retrieval.

EPA's Public Access Task Force is developing policies for on-line information available to Internet.

What is FTP?

FTP is an Internet standard for file transfer between hosts. FTP software is available for most computers, including IBM and DEC VAX mainframes. Several PC vendors sell FTP software. FTP is provided as part of the base OS on most Unix workstations from Sun, HP, DEC and IBM. You need a telecommunications gateway to the Internet. If you have FTP available on a TCP/IP LAN, but no external connections to Internet, you should ask your telecommunications support personnel to request the appropriate class B or C network for your organization from the Internet network manager at:

Network Solutions, Inc.
Att: Network Information Center
14200 Park Meadow Drive
Suite 200
Chantilly, VA 22021
1-703-802-4535
Email: HOSTMASTER@NIC.DDN.MIL

Costs to connect to Internet vary depending on speed, telecommunications line costs, and whether you need a dedicated connection or a dial-up connection. See Internet: Getting Started for a detailed discussion of how to connect to Internet[3].

To use FTP, you first need something to go after. To find out where a particular file lives on Internet, use a package called ARCHIE. ARCHIE searches FTP archives to tell you the location of a particular file on a particular host on the Internet.

As an example of using Archie, consider the MAPFRAME macro. Below is an example of the output received from sending an Internet mail message to ARCHIE@ARCHIE.SURA.NET. In the body of the message, you specify what file you are looking for. Use this tool:

```
PROG MAPFRAME.SASMACRO
```

The file name need not be unique, but anything that restricts the search saves CPU time. Beware of generic queries to ARCHIE, e.g., PROG DOC, since generic queries will look up everything in the FTP archives with "DOC" anywhere in the file name.

The result of the query is a mail message telling you the location in the FTP archives of files:

```
From:     qarchie@sura.net
Thu Apr 15 13:38:20 1993
To:       your ID
Subject:  search mapframe.sasmacro
Reply-To: qarchie@sura.net

Host      ipc1.was.epa.gov
Location: /pub/sugi18
Apr 1 1992  mapframe.sasmacro
39528 bytes
```

Downloading from Internet: Example

The full text of this paper, in WordPerfect 5.1 format, including the graphics, is available via FTP from IPC1.WAS.EPA.GOV in the directory /PUB/SUGI18. In addition, the MAPFRAME macro described on the previous page, as is a CGM file produced using MAPFRAME.

See the next page for instructions.

FTP sites store both text and binary files, such as compressed text, graphics, and WordPerfect documents. To connect to the FTP site where this paper, the MAPFRAME macro, and the graphic are stored, use this tool:

```
ftp ipc1.was.epa.gov
Connected to ipc1.was.epa.gov.
220 ipc1 FTP server (SunOS 4.1)
ready.
Name:      anonymous
331 Guest login ok,
send ident as password.
Password: realID@nodeID
230 Guest login ok,
access restrictions apply.
ftp>       ls -l
200 PORT command successful.
150 ASCII data connection
for /bin/ls (134.67.240.15,1505)
(0 bytes).
2 root    wheel    512 Sep  4  1992 bin
2 root    wheel    512 Sep  4  1992 etc
6 root    wheel    512 Apr  9 17:34 pub
226 ASCII Transfer complete.
remote: -l
189 bytes received in 0.19 seconds
ftp>       cd pub
250 CWD command successful.
ftp>       ls -l
200 PORT command successful.
150 ASCII data connection
for /bin/ls (134.67.240.15,1506)

2 root    wheel    512 Jan 19 19:39
chesapeake_bay
2 root    wheel    512 Mar 30 14:31
dos_programs
2 root    wheel    512 Mar 30 14:13
guide_to_environmental_stat
2 root    wheel    512 Apr 16 17:54
sugi18

226 ASCII Transfer complete.
remote: -l
296 bytes received in 0.17 seconds
ftp>       cd sugi18
250 CWD command successful.
ftp>       ls -l
200 PORT command successful.
150 ASCII data connection

1 root    wheel 23348 Apr 16 17:49
mapframe.cgm
1 root    wheel 39528 Apr 16 17:54
mapframe.sasmacro
1 root    wheel 1097009 Apr 16 18:54
   sugi18.wp51

226 ASCII Transfer complete.
remote: -l
```

To get the macro, use this tool:

```
ftp>       get mapframe.sasmacro
200 PORT command successful.
150 ASCII data connection
for mapframe.sasmacro
(134.67.240.15,1508)
(39528 bytes).
226 ASCII Transfer complete.
local: mapframe.sasmacro
remote: mapframe.sasmacro
40016 bytes received
in 0.54 seconds (72 Kbytes/s)
```

To get the CGM file, you must set the download protocol to **binary**. Use this tool:

```
ftp>       binary
200 Type set to I.
ftp>       get mapframe.cgm
200 PORT command successful.
150 Binary data connection
for mapframe.cgm
(134.67.240.15,1509)
(23348 bytes).
226 Binary Transfer complete.
local: mapframe.cgm
remote: mapframe.cgm
23348 bytes received
in 0.021 seconds (1.1e+03 Kbytes/s)
ftp>       quit
221 Goodbye.
```

If you have a Unix machine, to verify that these files exist on your machine, use this tool:

```
prompt%    ls -l mapframe*
1 chap         23348 Apr 16 14:51
mapframe.cgm
1 chap         39528 Apr 16 14:51
mapframe.sasmacro
```

If you have a DOS machine, use this tool:

```
DIR MAPFRAME.*
```

If you have an IBM mainframe under TSO, use this tool:

```
SPC MAPFRAME
```

Conclusion

You're done! MAPFRAME.CGM and MAPFRAME.SASMACRO are now on your machine, ready to use. Import MAPFRAME.CGM into WordPerfect using the tools described earlier, or use any other CGM viewer to display and print it.

References

1. J. Wind. "Using SAS/GRAPH to Map Geographic Data." Southeast SAS Users Group, St. Petersburg Beach, Fla., February, 1993.

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2. We wish to acknowledge Jude Redman of SAS Institute for her generous help completing this project.

3. Internet: Getting Started. SRI International, Network Information Systems Center, 33 Ravenswood Avenue, Menlo Park, CA 94025.