A COMPARISON OF GRAPHICS PACKAGES USED WITH THE GEOECOLOGY DATA BASE

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ABSTRACT

The Geoecology Data Base represents a unique compilation of computerized county-level environmental data for research and development. The data base contains selected data from extant sources on terrain and soils, forestry, vegetation, agriculture, land use, wildlife, air quality, climate, water resources, natural areas, and endangered species. The Statistical Analysis System (SAS) is used for data storage, retrieval, analysis and display.

Visual output such as maps, graphs, and charts are very effective in conveying information. The benefits of computer-generated graphics for scientific analysis are enhanced by convenience, flexibility, ease of interfacing with analysis and data management systems, high quality resolution, multi-color capabilities, and rapid turnaround. Historically, several mapping programs were needed to display results of studies using the Geoecology Data Base. SAS's GMAP procedure combines many features of these mapping packages with its own capabilities. Data from the Geoecology Data Base will be utilized to evaluate the usefulness of GMAP in lieu of other mapping packages.

INTRODUCTION

The Geoecology Data Base of the Oak Ridge National Laboratory (ORNL) was developed to assist with regional analyses of man's impact on the environment, particularly related to energy use and development. The national county-level information in the data base is organized around environmental themes defined in the abstract (Olson et al. 1980). The Statistical Analysis System (SAS) (Barr et al. 1980) is used for information storage, retrieval, management and now graphic display.

Geographic display of the data is used in several ways. It is particularly valuable in editing data because spatial aberrations often indicate coding errors or other problems with the data (Nungesser and Olson 1980). Graphic display is a valuable means of communicating information to researchers and decision makers. Most of the graphics used with the Geoecology Data Base are in the form of cartographic displays because regional patterns in the data are more easily identified with the aid of a map.

MAPPING

We presently use three software packages for cartographic data display. A comparison of their mapping features appears in Table 1, and three maps (Figures 1-3) are shown using each of these cartographic packages. The data are average annual precipitation as reported by the National Weather Service (Webb 1976).

Figure 1 is a line printer map that was generated with SYMAP (Dougenik and Sheehan 1975), the geographic display package we used originally. A value is mapped for each line printer position rather than for each county. The algorithm uses a smoothing function between data points. This gives a good presentation for continuous variables. Vor discrete county-level data, however, county polygons are preferable.

Figure 2 is a map produced by EZMAP (Coleman 1978) on an electrostatic plotter. This software has been used most frequently with the Geoecology Data Base. EZMAP plots polygons with shading or places numeric values within each polygon. We use county polygons but others are available. The disadvantage of both SYMAP and EZMAP is that these programs are external to SAS and use disparate job control.

Finally, Figure 3 is a map generated on a pen and ink plotter by a test version of SAS's GMAP procedure. Its color capabilities are a definite advantage in regional analysis (Waterhouse et al. 1981) because potentially more information can be communicated by combining colors and shading patterns. Other specific advantages of GMAP are its direct access
TABLE 1. COMPARISON OF SELECTED FEATURES OF COMPUTER MAPPING SOFTWARE

<table>
<thead>
<tr>
<th>SOFTWARE</th>
<th>PROCEDURE</th>
<th>GMAP</th>
<th>EZ-MAP</th>
<th>SYMAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>STANDARD POLYGONS</td>
<td>US: STATES</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>COUNTIES</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BEA (BUREAU OF ECONOMIC ANALYSIS)</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CANADA: PROVINCES</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>USER-DEFINED</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>OUTPUT</td>
<td>PAPER COPY</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CRT</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>MULTI-COLOR</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SINGLE COLOR</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>CARTOGRAPHIC FEATURES</td>
<td>VARIABLE PROJECTIONS</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SCALING</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>USER-CONTROLLED SHADING</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PATTERNS</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TITLES ON MAP</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>FOOTNOTES ON MAP</td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

Since many agencies routinely collect county-level data, there is a growing need for county-oriented display methods. Participants of the Integrated County-Level-Data User's Workshop held in October in Reston, Virginia, included representatives of governmental, industrial, and academic institutions. They recommended standardizing spatial units, identifiers, and cartographic mapping techniques (Olson 1981). SAS uses the county identifiers and county polygons that were suggested as standards.

RECOMMENDATIONS AND CONCLUSIONS

The mapping capabilities of SAS meet many of our cartographic needs. There are, however, several improvements that would greatly enhance GMAP's

Figure 1. Total annual rainfall, interval limits in centimeters and in inches: 1) less than 63.5(25); 2) 63.5-88.9(25-35); 3) 88.9-114.3(35-45); 4) 114.3-139.7(45-55); 5) greater than 139.7(55). Map produced on a line printer by SYMAP.
TOTAL ANNUAL RAINFALL
BASED ON 30 YEAR, MONTHLY AVERAGES FOR THE PERIOD 1941-1970
INTERNAL LIMITS IN CENTIMETERS AND INCHES

Figure 2. Total annual rainfall. Map produced on an electrostatic plotter by EZMAP.

Figure 3. Total annual rainfall in centimeters. Map produced on a pen and ink plotter by SAS's GMAP procedure.
versatility. They include

1. User option to specify scale for hard copy output (i.e. 1:7,500,000)
2. Continuous color mapping for bivariate maps
3. Polygon labelling
4. Point labelling (i.e. cities)
5. User option to specify a latitude-longitude window
6. Associate one pattern with a specific category irrespective of the order specified
7. Plot state boundaries and only selected counties rather than all or no counties.

Geographic display of data is a very important component of regional analysis at the Oak Ridge National Laboratory. Computer mapping capabilities allow quicker visual analysis of spatial data than with traditional output, and much more rapid map production than through traditional means. SAS's mapping features provide us with new and useful display capabilities through interactive display, color capabilities, and access within a SAS program.

REFERENCES


Coleman, P. R. 1978. Input for EZMAP. Unpublished Memo. Geographic Systems Group, Computer Sciences Division, Union Carbide Nuclear Division, Oak Ridge, TN.


