

MapCalc Interface and Display (design statement 7/00)

The MapCalc system contains many capabilities that are not available in most desktop GIS packages. The following presentation will describe MapCalc from a variety of perspectives...

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- [Import/Export and dBase Mgt](#)
- [Map Display and Summary](#)
- [User Interface and Macro Builder](#)
- [Spatial Statistics and Analysis Operations](#)
- [Future Directions](#)

● Import/Export and Database Management...

Import/Export and dBase Mgt

Vector

Analysis Frame

Grid

Map Properties - Elevation

Display	Title	Legend	Plot Cube	Units			
Data	Statistics	Equation	Source				
1	2	3	4	5	6	7	
25	500	500	500	500	500	500	
24	500	500	500	500	500	500	
23	500	500	500	500	500	500	
22	500	500	500	500	500	500	
21	500	500	500	500	500	500	
20	500	500	500	500	500	500	
19	500	500	500	500	500	500	
18	500	500	500	500	500	531	
17	500	500	500	500	520	569	
16	500	500	500	507	520	556	635

...the Analysis Frame provides the consistent "parceling" needed for advanced analysis of spatial relationships

Data listing for map stack... Drill-Down

Column Name	Value	Units
Latitude	40.345911	
Longitude	-104.071630	
Elevation	1.626	
Format	Dir Land	
Slope	46	
Aspect	Westely	
Index	1000/1000	
Covertype	Forest	
Forest	Good	
Soil	Lowland	
Soilclass	Class 2	
Roads	No Road	
Locations	0	
Housing	No Houses	
Water	1	
Roughness	9.15	

...stack of aligned Grid Layers for analysis within and among maps

(Berry) **Import/Export and Database Management.**

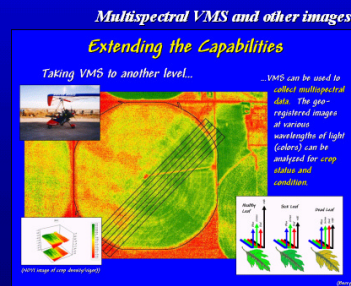
Traditional vector maps contain irregular polygons (e.g., discrete terrain contours) that assume the same response everywhere within a polygon. For example, map locations within a 500-700 foot contour polygon cannot be identified by their actual elevation values within that broad range. An analysis frame, serves as a "spatial sampling design" that carries a value for each sample location, termed a grid cell. A grid map forms a continuous spatial distribution of a map variable, such as an elevation surface. The consistent grid reference provides a structure that facilitates advanced analytical capabilities that cannot be performed using traditional vector maps.

Import/Export and dBase Mgt

Import/export modules enable exchange of data with most vector/raster GIS data formats, databases and spreadsheets...

- ArcView Shape files
- MapInfo Tab files
- X,Y,Z point files
- Bare matrix grid files
- ESRI Grid files
- Surfer grid files
- Standard dBase tables
- Standard Spreadsheet tables

Image registration, on-screen Digitizing and GPS link provide for direct encoding of maps.

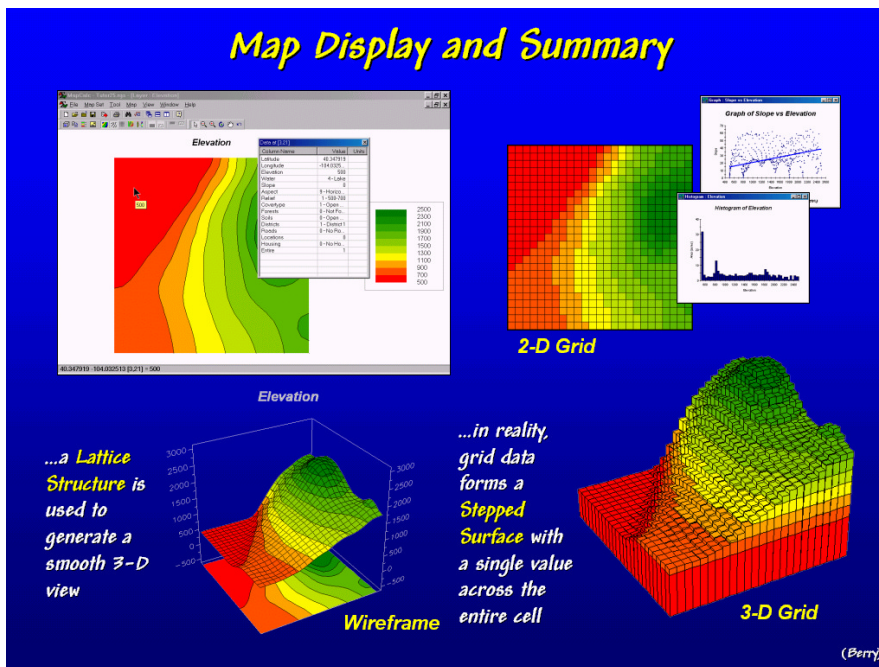


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Import/Export and

Database Management. MapCalc can exchange data in a variety of standard formats and contains tools for direct encoding of maps. Research into integrating Red Hen System's video mapping device (Multimedia Mapper) is underway. The device can be used to collect digital multispectral imagery that becomes additional grid layers for analysis in MapCalc.

Map Display and Summary...



Map Display and

Summary. MapCalc provides four types of map display for grid surfaces...

- ü **2-D Vector** – traditional “color-fill contour” maps composed of line segments defining boundaries,
 - ü **2-D Grid** – each grid cell is assigned a color that corresponds to its stored value (interval range),
 - ü **3-D Vector** – commonly referred to as “wireframe maps” that connect lines to the center of each cell raised to the height of its stored value, and
 - ü **3-D Grid** – each grid cell is raised to the height of its stored value (extruded).
- Vector displays provide smoothed renderings of map surfaces while grid displays show the actual appearance of the stored data. Summary statistics and charts, such as histograms and scatterplots, are easily generated from grid data.

Map Display and Summary

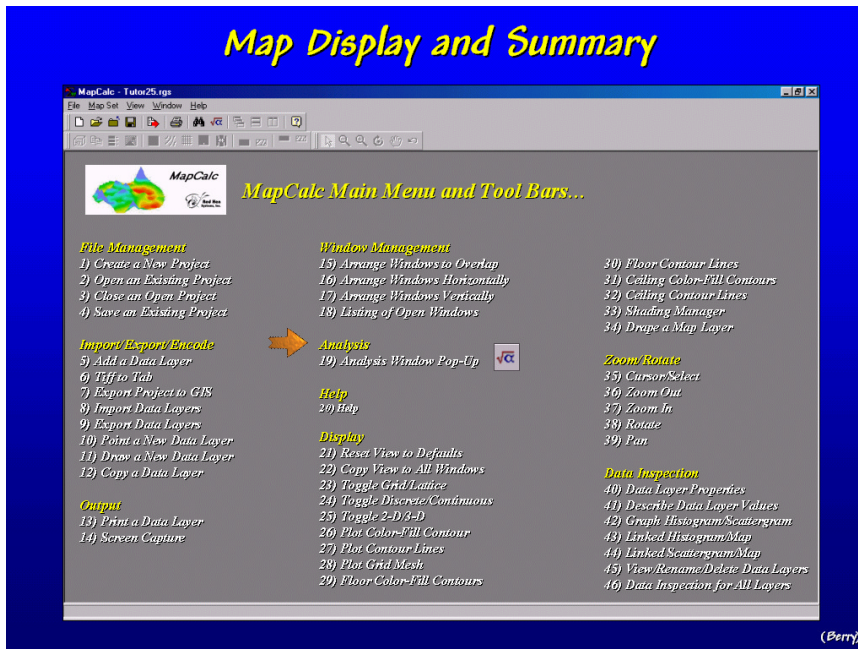
The Shading Manager controls the color steps used in any of the four types of map display. In this example the 3-D Wireframe display was toggled and ten Equal Ranges were specified. The color pallet was set to range from red through green with an inflection at the fourth interval (yellow).

Additional interval calculations, summary statistics, histogram and stored color pallets are available.

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Summary. MapCalc’s Shading Manager sets the contour intervals and color pallet for all four of the display types.

Map Display and Summary



(Berry) *Map Display and Summary*

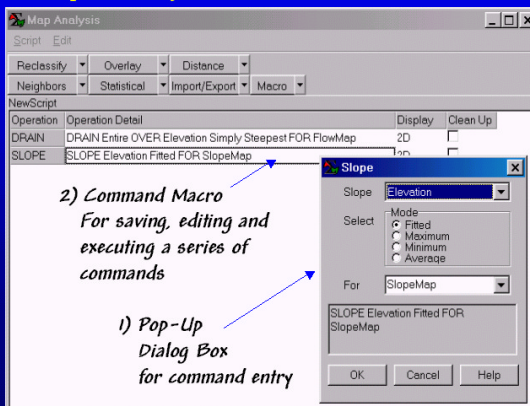
Summary. An extensive set of data handling, map display and summary tools are available... all within a “point-and-click” interface. Comprehensive “online help” is available for each operation.

User Interface and Macro Builder...

User Interface and Macro Builder

... all user interaction with the software is “point-and-click”

MapCalc Analysis Window...



1) An intuitive **Graphical User Interface** provides direct access to individual operations through familiar dialog boxes with Window standard pull-down lists, command buttons, slider bars, text boxes, icons and context help.

2) A powerful **Macro Builder** enables users to easily generate, edit and reuse command sequences for spatial modeling. As commands are specified through a dialog box, a macro language automatically creates and store recognizable English sentences or encrypted spatial models.

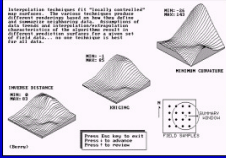
(Berry) *User Interface and Macro Builder*

Macro Builder. The analytical operations are specified through interactive **Dialog Boxes**. Completed commands are written to a **Macro Builder** that provides storage, editing and reuse of command sequences (scripts). The easy to use interface enables the development of GIS models that address a wide variety of applications.

Spatial Statistics Operations...

Spatial Statistics Operations

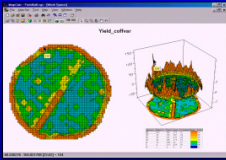
Descriptive Statistics • Normality Tests • Point Density Maps • Geographic Trend Analysis • Spatial Interpolation
 Spatial Autocorrelation • Residual Analysis • Error Mapping • Coincidence Statistics • Change Surfaces
 Comparison Tests • Spatial Correlation and Dependency • Multivariate Regression • Clustering • Map Similarity



Surface Modeling— spatial interpolation of point data (Nearest Neighbor, Inverse Distance Weighted, Kriging, Iterative Smoothing)

Univariate Statistics— For example, derive a map of localized yield variability by calculating the coefficient of variation within a two-cell radius of each map location...

$$(Coffvar = ((stdev/mean) * 100)$$



Multivariate Statistics— For example, derive a map of the average yield for each soil type within the field (coincidence summary)

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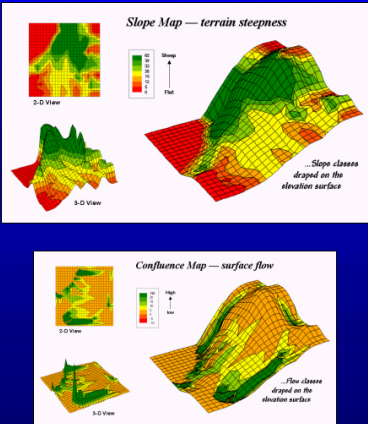
Operations. MapCalc analytical operations can be divided in Spatial Statistics and Spatial Analysis. **Spatial Statistics** involves techniques that mathematically summarize the spatial distribution of data and the relationships among maps...

- ü **Surface Modeling** – interpolation of point samples for continuous map surfaces
- ü **Univariate Statistics** – summarize patterns within a single map
- ü **Multivariate Statistics** – summarize the coincidence and relationships among two or more maps.

Spatial Analysis Operations

Geographic Search • Weighted Proximity Analysis • Slope & Aspect • Visual Exposure • Optimal Path
 Local, Regional & Map-Wide Overlay • Nearby Neighbor Summary • Edge, Shape & Pattern Characterization
 Narrowness • Logical, Ranking, Rating & Mathematical Combination • Confluence Surfaces • Probability & Propensity

"Map-matics"



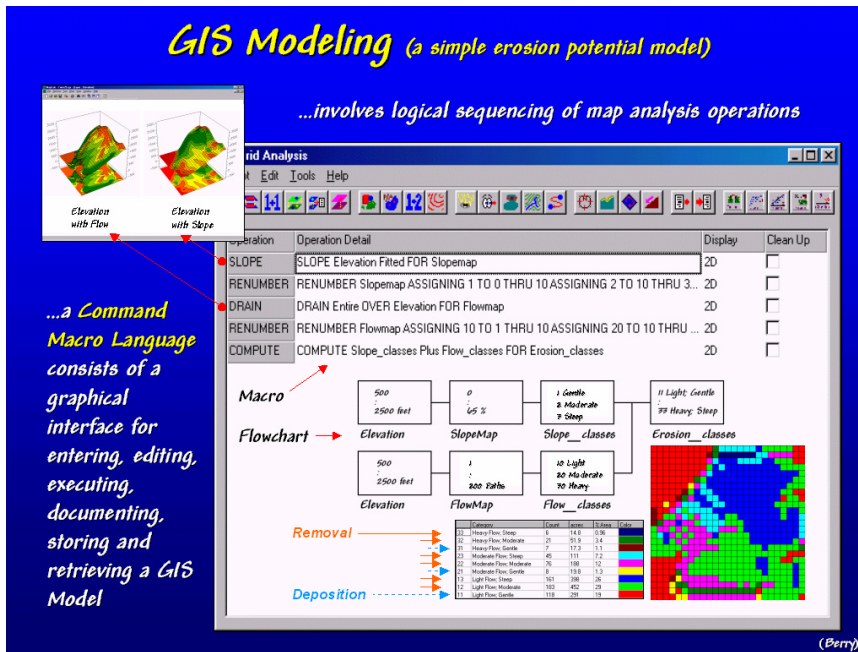
Characterizing Slope (and Aspect)
 A digital terrain surface is formed by assigning an elevation value to each cell in an analysis grid. The "slant" of the terrain at any location can be calculated— inclination of a plane fitted to the elevation values of the immediate vicinity.

Characterizing Surface Flow
 The procedure simulates a rain burst over the entire field then tracks the amount of water that passes through each grid cell. Higher values indicate locations with numerous uphill grid cells that pass water to them.

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Operations. Operations involving **Spatial Analysis** characterize the geographic context

of map features, such as distance, optimal paths, visibility, shape/pattern, and slope/aspect. In this example, terrain analysis is used to characterize the slope and surface flow for an area.



GIS Modeling. A

GIS Model can be thought of as a “big button” involving a logical sequence of operations. For example, the model in this figure uses the SlopeMap (terrain inclination) and FlowMap (relative water volume) to identify areas that surface materials (e.g., fine soil particles, organic matter, applied chemicals, etc.) are removed and subsequently deposited. While common sense suggests materials on steep slopes and heavy flows are transported to areas that have flat slopes and moderate to heavy flows, spatial science is needed to properly calibrate the model. Grid-based map analysis serves both the researcher’s development of GIS models and the land manager’s operational implementation.

Powerful Tools for Mapped Data Analysis...

Powerful Tools for Mapped Data Analysis



The *Map Analysis Calculator (MapCalc)* is a comprehensive set of grid-based tools for advanced analysis and display of spatial information.



Statistics

- Analyze
- Compare
- Correlate
- Regress
- Relate
- Cluster

Reclassify

- Clump
- Configure
- Renumber
- Slice
- Size

Overlay

- Composite
- Compute
- Cover
- Crosstab
- Intersect

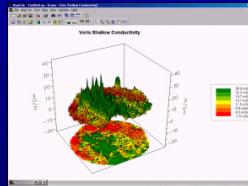
Distance

- Drain
- Radiate
- Span
- Spread
- Stream

Neighbors

- Orient
- Profile
- Scan
- Slope
- Interpolate

...integrated into an easy-to-use package with exceptional graphics and modeling capabilities



(Berry)

Powerful Tools for

Mapped Data Analysis. MapCalc contains basic and advanced analytical tools. While most desktop GIS packages contain procedures for viewing and querying mapped data, few can analyze spatial relationships without adding expensive and complex extensions with minimal integration with the basic system. MapCalc provides these capabilities in an easy to use environment. Future capabilities under consideration include...

- ü ...enhanced and extended features for existing data handling, analysis and display capabilities
- ü ...interactive links between spatial (maps) and numerical (scattergram) distributions
- ü ...integrated project manager and database design
- ü ...integrated model flowcharts and command macro builder
- ü ...enhanced remote sensing data links and image analysis capabilities
- ü ...integrated data mining module