



*cartographic perspectives*

Number 42, Spring 2002

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This special issue of *Cartographic Perspectives* chronicles the sessions of the first NACIS Practical Cartography Day, held at NACIS XXI in Portland, Oregon in October of 2001. The long promised write-ups of the how-to tutorials and the informative presentations are contained herein.

We have a total of seven articles and I extend a warm thank you to those Practical Cartography Day participants who took the time to put their presentations into a written format. Some of the immediate impact and nuances of the presentations, made in a hands-on manner on a computer, may be lost but the overall value remains in seeing what cartographers are doing in a practical context.

Three articles come from the session on two- and three-dimensional topographic presentation. David Barnes evaluates the capabilities of ESRI ArcGIS to create relief shading and other basic topographic techniques and also adds

*(continued on page 3)*

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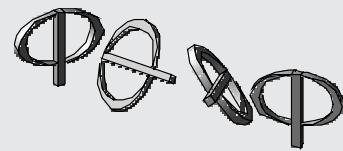
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*about the cover*



"The cover design was created by Lou Cross. Lou is a cartographer and graphic artist with the Florida Resources and Environmental Analysis Center at The Florida State University.

an advanced technique for preparing Swiss-style hill shading in Arc Spatial Analyst. I present a step-by-step guide to using the most common pixel-pushing graphic arts program, Adobe Photoshop, to create relief shading, hypsometric tinting and colored shadows and highlights. Tom Patterson leads the way in three-dimensional techniques with a tutorial for using Corel Bryce to drape a satellite image onto a digital elevation model.

From our session on special mapmaking techniques with drawing programs, Dick Furno presents his practical tips for dead-line map production at the Washington Post. The unique world of a daily publication provides important real world incentives for the practical cartographer to work quickly and accurately. Dick shows the advantages of combining database and drawing applications (Azimuth and Freehand) to maintain an accurate base map and produce publication quality maps.

Our final three articles are from the session on using geographic data. Brandon Plewe examines the practical cartographer's dilemma of living without the perfect cartographic software. He provides a valuable evaluation of the needs of the professional cartographer and abilities and liabilities of the current software used for mapmaking. Ted Florence provides little known tips and techniques for using Avenza MAPublisher and being the company president, he knows some excellent tricks. A particularly practical tip is how to create an ASCII file with your own lat/long coordinates for mapping. Finally, Mapthematics GeoCart software author Daan Strebe looks at appropriate projections for globes. This unique cartographic problem requires careful planning and projection selection to minimize distortions.

I hope these articles give NACIS members who were not at Practical Cartography Day a sampling

of the content of the presentations and a view of what the day was like. I would also like to take this opportunity to relate the activities surrounding an event that many of us hope will become a NACIS tradition.

When I first pestered my friends in NACIS about having more sessions and workshops devoted to the activities of the working cartographer, every one of them nodded enthusiastically and said "yes, that would be great, what do you propose?" This got me thinking and talking more and more as Milwaukee led to Williamsburg and Williamsburg led to Knoxville and before I could help myself I was on the NACIS Board and had volunteered to be lead organizer for the first Practical Cartography Day.

There was a devoted crew of fellow practicing cartographers who had also been buzzing for more hands-on cartographic topics at NACIS and they eagerly volunteered to help. We began organizational discussions in early Spring of 2001. Because we planned for a small, intimate gathering of 30 or so, we figured a late starting date for organizing would work fine.

What transpired for Practical Cartography Day in Portland went far beyond our initial expectations. We had over 100 cartographers attend our intimate gathering. We held four sessions: 2d and 3d Topographic Presentations, New Media Maps, Special Techniques for Mapmaking in Drawing Software, and Using Geodata. These consisted of short presentations followed by "open mouse" time with each presenter at a computer for questions and answers.

Despite some computer/projector issues and a room that was a little small for a hundred practical cartographers, we had a very successful day. The presentations were highly engaging and many lauded the value of watching practical cartographers at work. The ques-

tion and answer time allowed for interaction between attendees and presenters. Though this "open mouse" set-up was constrained by the small room and a fifteen minute time limit, it proved to be animated and informative and the cartographic techniques were flowing in both directions.

Attendees of Practical Cartography Day I completed questionnaires about the event. The most consistent comment was that we should do it again. As we look to future Practical Cartography Days at NACIS Annual Conferences, the feedback we received in Portland is very valuable. We asked a variety of questions and as often occurs in a survey, many people criticized the very things others extolled: too big, too small, too long, too short, etc. Some desires for a Practical Cartography Day are highly individual!

Here are some of the comments people wrote about what they liked most about Practical Cartography Day:

"Seeing how other cartographers solve the same problems we have."

"I liked the open mouse time – the good sense of humor of the presenters."

"It shows that we are all still learning and adding to our skills."

"Meeting other cartographers—networking—synergy of ideas."

"Variety of topics and rapid pace."

"I liked being shown the tools and steps that are used to create map graphics."

"Seeing how techniques are applied to everyday cartographic work."

"Exposure to new techniques and software."

We also asked people to note areas where things didn't go as well:

"I couldn't ask questions of all the speakers in the time allotted."

"I didn't like the open mouse time."

"Needed more space, hard to

get to presenters when people crowded around during open question and answer time."

"Wanted more explanation of reasons for software choices."

"Open mouse time would have worked better with smaller groups." (This was a common comment and something to address for the future.)

Attendees gave suggestions for the future:

"Would have been good if we had computers to try out the stuff we saw "

"Need to have the how-tos and the presentations posted by conference time so people can go look at them right away."

"Wanted more detail on FLASH cartography, more how-to "

"More on web-based mapping, virtual reality, printing of maps "

A few common themes emerged from the comments. We needed a more time and smaller groups for the "open mouse" concept to be successful. Generally people thought there were too many presentations and they were a little too short (but, of course, several people thought the short presentations were just right—fast-paced and exciting). People universally said they would attend another day and I loved the comment someone wrote that they were "left wishing for more."

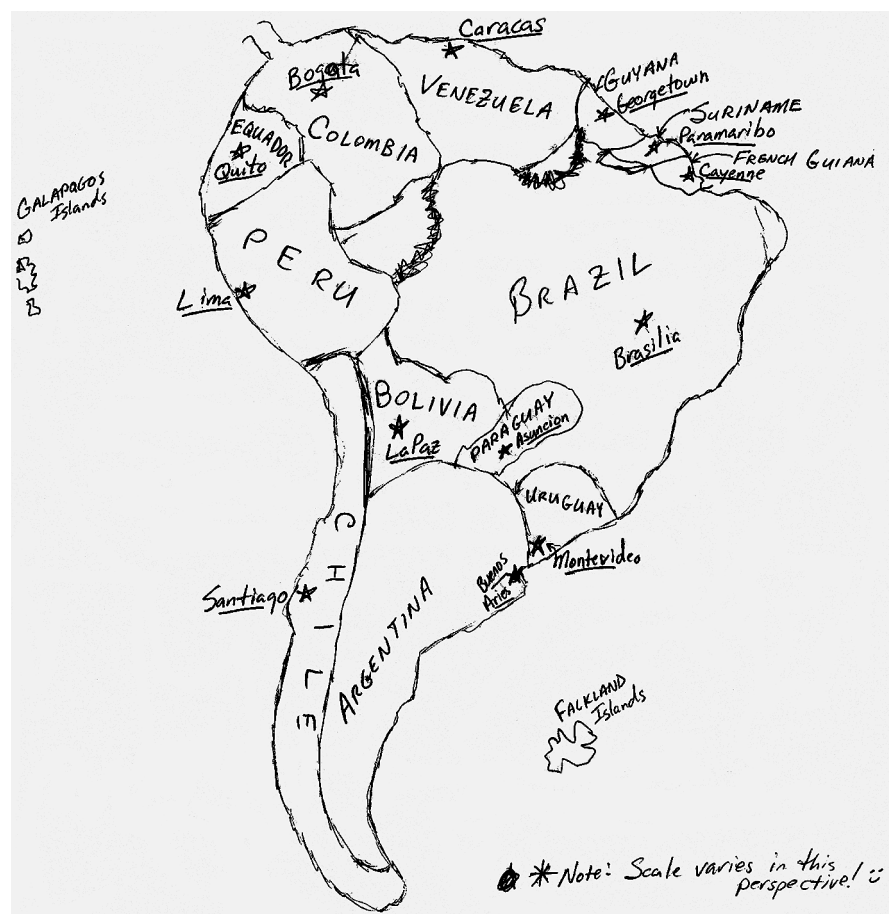
All in all, quite a satisfying experience for the participants and organizers and we will be doing it again. The next Practical Cartography Day will take place at the NACIS Annual Conference in Jacksonville, Florida, in October of 2003. We are gathering volunteers now to help with organizing and to be involved in preparing for the day. If you are interested in helping out or just in keeping up with what the organizing committee is up to, please email me at [tait@erols.com](mailto:tait@erols.com). We have an email LISTSERVE for the group and you are welcome to join in and contribute your ideas.

Alex Tait

## NACIS Practical Cartographer Award

As part of our questionnaire about Practical Cartography Day, we asked attendees to draw the outlines of all the South American countries and label them with their capital cities. We asked that the map be drawn from memory only and I was curious to see how the cartographers assembled would respond to this "practical" challenge. I didn't receive as many entries as I had hoped but those that came in ranged from amusing to astounding. Cartographers are indeed walking gazetteers sometimes.

The inaugural NACIS Practical Cartographer Gerardus Mercator Award (otherwise known as the "Gerry") for best map from memory goes to Sean Hayes of Land-Grafix, Inc. for his map of South America. The winning map below is remarkable for its completeness (all the names and capitals!) and its geographic verisimilitude.



# Using ArcMap to Enhance Topographic Presentation

*David Barnes*

The first part of this article discusses some of the basics of terrain representation using ArcMap. The last part goes into a little more detail about how to achieve a Swiss-style hill-shade effect using the Spatial Analyst extension.

## Preparing the grid

For display purposes if you want to mask out portions of a grid it is better to overlay polygon data rather than using the Workstation Gridclip command. This will help avoid grid cells showing along the edges between the masked and non-masked areas.

If you will be displaying the grid in a different coordinate system from the original it is best to reproject the grid in Workstation using the Project or ProjectGrid commands. This will speed up drawing in ArcMap as the grid will not have to be reprojected on the fly.

## Setting Symbology

Once you have opened ArcMap and added your raster layers you can adjust the symbology.

Right-click on the raster layer in the Table of Contents and select Properties.

Select the Symbology tab.

In the Symbology dialog you can choose one of the Renderer options. A Stretched renderer is good for terrain data. This produces smooth transitions of colors across the raster.

Next you can choose one of the built-in color ramps or edit one to suit your needs. For hill-shade grids it is best to use a monochromatic color ramp, but you don't have to be limited to grayscale. For example, a bathymetry hill-shade grid looks good with a blue color ramp, or try a warm color ramp for desert terrain. For hypsometry multi-hue color ramps often look best.

If you don't find any of the existing color ramps suited to your needs you can edit an existing ramp.

To edit a color ramp right-click on the ramp you want to edit in the dropdown list in the Layer Properties > Symbology tab and select Properties.

In the Edit Color Ramp dialog box you can delete individual color ramps from a multi-part color ramp, change the order of the individual color ramps in a multi-part color ramp, edit the properties of any existing individual color ramps, or add a new color ramp to the current color ramp (*Figures 1 and 2*). You will want to make sure the adjoining colors from two neighboring color ramps within a multi-part color

ramp are identical to ensure a smooth transition along the entire ramp. You might want to remove the first or last color ramp from a multi-part color ramp, for example to remove the white and light colors from the top of a ramp when the terrain you are mapping does not include any high snow-covered peaks.

### Setting Display Properties

You can also use Display properties to adjust the appearance of the terrain on your map.

Right-click on the raster layer in the Table of Contents and select Properties.

Select the Display tab.

The two main options you will want to use are the resampling methods and the transparency setting.

The bilinear resampling method works best for terrain. This method results in a smooth transition between pixels/cells across the entire surface. Nearest neighbor does very little smoothing and works best for discrete data. Cubic convolution doesn't smooth as much as bilinear and works best for imagery, such as satellite images and aerial photographs.



Figure 1. Dialog for editing multi-part color ramps

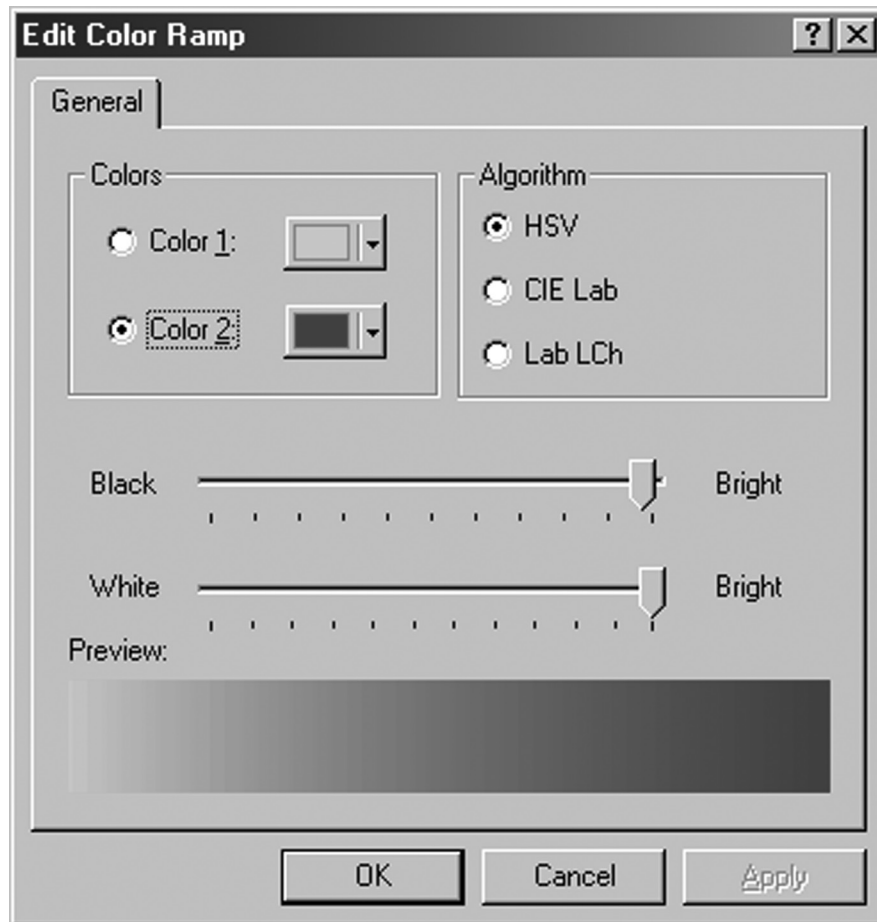


Figure 2. Dialog for editing algorithmic color ramps

Transparency can be used to allow underlying layers to show through, for example to show a hill-shade under a hypsometric layer. Transparency can also be used to tone down the intensity of layers, for example, to lighten the shadows of a hill-shade.

### Combining Multiple Rasters

You can combine multiple layers by using transparency to allow underlying layers to show through, as noted above. For example, you can place a hypsometric layer such as a DEM (digital elevation model) or a satellite image on top of a hill-shade layer, and then set a percentage of transparency on the uppermost layer. You can also reverse the order and put the hill-shade on top for different effects.

### Effects Toolbar

To open the Effects toolbar navigate to the View menu, select Toolbars, and select Effects from the list (Figure 3).

The Effects toolbar allows you to choose which layer any effects will be applied to, and also has controls for adjusting transparency, as well as contrast and brightness. The latter two controls only apply to raster layers and can be used to perform tasks such as heightening the contrast between light and dark areas of a hill-shade or to lighten the appearance of a raster layer without making it transparent.



Figure 3. Effects toolbar

### *Spatial Analyst*

Thanks to intern Stephan Geissler of ESRI for the examples and methods described below.

In addition to the standard ArcMap functionality described in the previous sections, the Spatial Analyst extension includes many useful tools for terrain representation. In particular, the raster calculator can be used to create new layers based on existing layers. You can use the raster calculator with a median filter on an existing hill-shade to produce a smoother hill-shade layer. Then you can combine the two hill-shade layers with another raster calculation to produce an effect similar to Swiss-style hill-shading as described by Imhof in *Cartographic Relief Presentation*.

### **Swiss-Style Hill-Shading with ArcMap and Spatial Analyst**

To do this you will start by adding your original hill-shade layer to ArcMap.

Next, in the Spatial Analyst toolbar click on the drop-down menu and select Neighborhood Statistics.

Set the Statistic type to Median, the Neighborhood to Circle, and the Radius to 4 cells.

Click Okay to create a temporary output grid. You can make this grid permanent later if you want.

The Median filter generalizes the terrain to emphasize the major geographic features, minimizes minor features, smoothes irregularities on the slopes, but maintains the rugged characteristics of the ridge tops and canyon bottoms.

The next step is to create another layer using the Raster Calculator.

Add your original DEM to the map.

In the Spatial Analyst toolbar click on the drop-down menu and select Raster Calculator.

In the Calculator use the following formula:

$[DEM]/5 + [Hill-shade]$

Where DEM = the name of the DEM from which the hill-shade was derived, and hill-shade is the name of the hill-shade layer

This simulates aerial perspective by making the higher elevations lighter and the lower elevations darker.



Now you have three raster layers, which you can combine with transparency to produce the desired effect. Place the layers in the following order, with the percentage transparency shown:

Front-most: original DEM, symbolized with a stretched renderer using a color ramp such as one of the elevation ramps, transparency around 55%

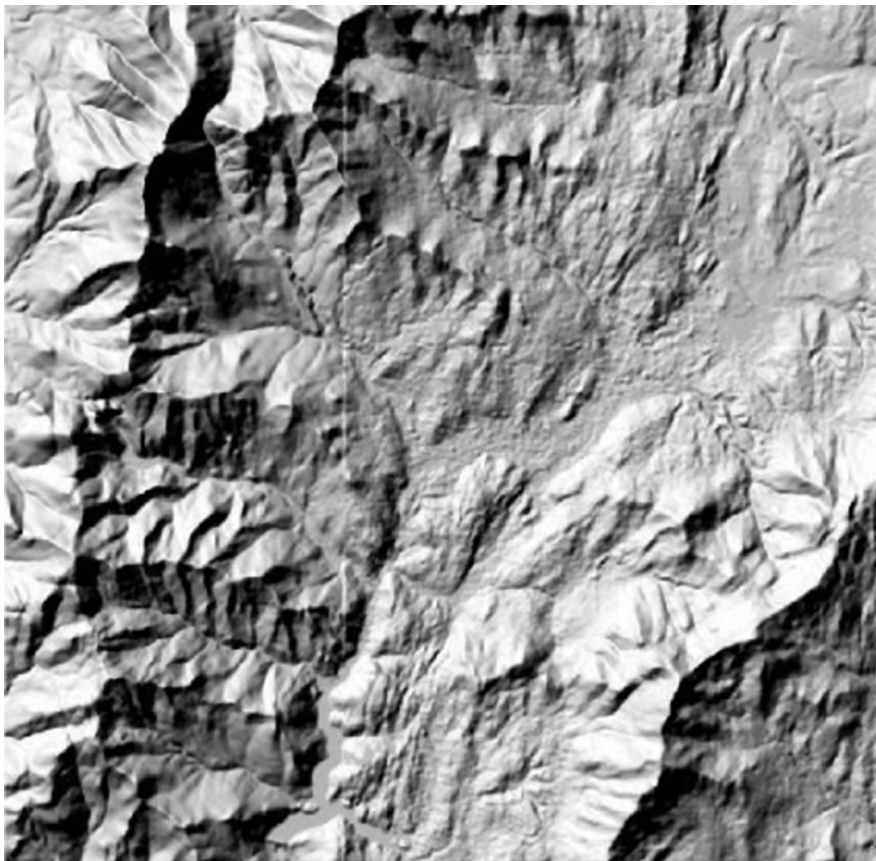
Middle: raster from neighborhood statistics with median filter, symbolized with a stretched renderer using a single hue color ramp such as grayscale ramp, transparency around 35%

Back-most: raster from raster calculator, symbolized with a stretched renderer using a single hue color ramp such as grayscale ramp, no transparency

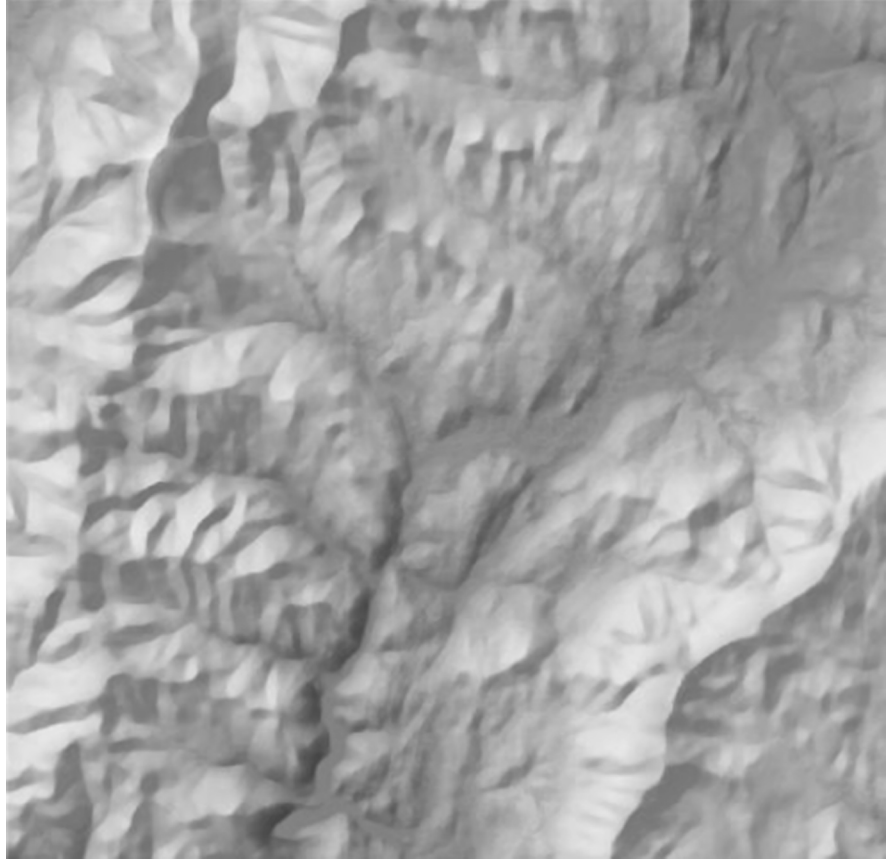
The numbers used in the above example are only suggestions. Feel free to experiment to find out what works best for particular terrain and effects. This method is most suitable to more rugged terrain, such as the Alps or the Rocky Mountains.

The following examples, in 2 dimensions and 3 dimensions, represent the same geographic area (*Figures 4, 5, 6, and 7*).

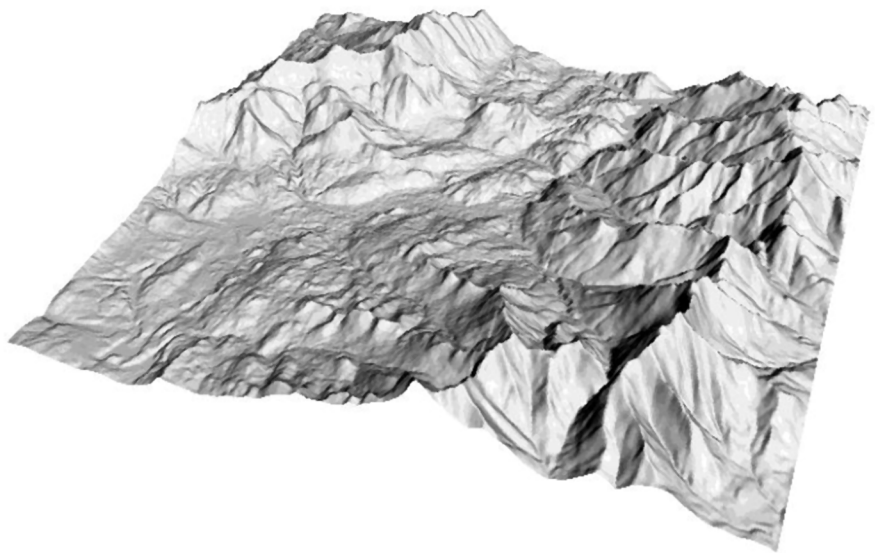
Other effects can be achieved by experimenting with the various Spatial Analyst tools and core ArcMap functionality.



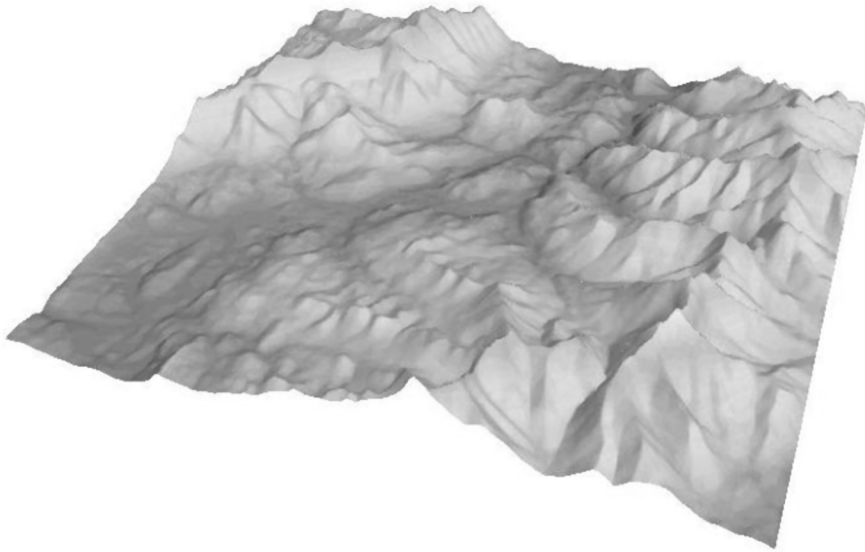
*Figure 4. Standard hill-shade*



*Figure 5. Swiss-style hill-shade*



*Figure 6. Standard hill-shade in 3-D*



*Figure 7. Swiss-style hill-shade in 3-D*

## Photoshop 6 Tutorial: How to Create Basic Colored Shaded Relief

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### INTRODUCTION

**A**dobe Photoshop is the graphic arts industry standard software for raster image manipulation. It can also very effectively be put into use by cartographers to render attractive shaded relief for maps.

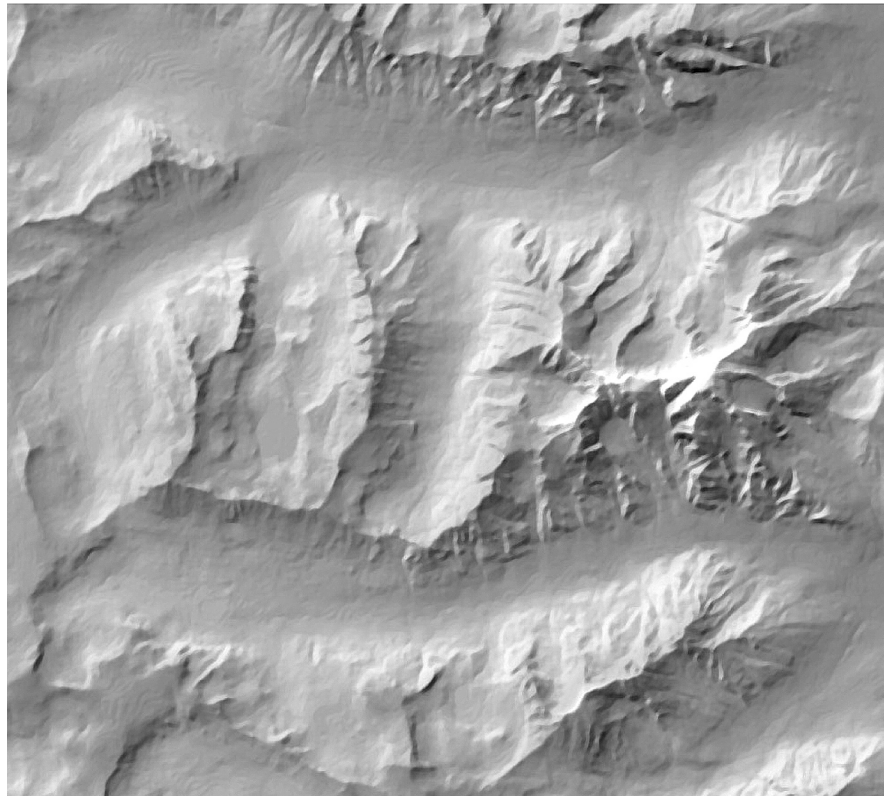


Figure 1. Terrain image of Mount Moran Quadrangle, Wyoming

*“One important advantage  
in using Photoshop to create  
shaded relief is that of  
familiarity.”*

One important advantage in using Photoshop to create shaded relief is that of familiarity. Most cartographers and graphic artists have Photoshop on their desktop and are skilled at using it for working with images. It is an extremely powerful image editing tool and a skilled cartographer can make many enhancements to a shaded relief map image once it is rendered.

### What you will need

- Adobe Photoshop 6 or 7 running in MacOS or Windows
- Digital elevation file converted to a “grayscale to height image” (for the

sample image used in this tutorial, go to [http://www.equatorgraphics.com/nacis/mt\\_moran\\_g2h.tif](http://www.equatorgraphics.com/nacis/mt_moran_g2h.tif))

### Grayscale to Height Preparation (optional)

To create relief in Photoshop you need first to get a grayscale to height image into the program. I will not go into details for this tutorial, I will simply use a grayscale image created using MacDEM, a remarkably powerful yet simple application that is a vital part of many a cartographer's toolbox (available at <http://www.treeswallow.com/macdem/>).

There are numerous other ways to bring in digital elevation data including opening some data files directly into Photoshop in RAW format. See Tom Patterson's excellent tutorials on working with GTOPO 30 data for an example: <http://www.nacis.org/cp/cp28/gtopo.html>.

### ELEVATION-COLORED SHADED RELIEF

Coloring physical terrain by elevation is known as hypsometric tinting. This is an effective way to portray terrain when combined with shaded relief. The primary part of this tutorial is a guide to combining these two techniques in Photoshop to render a dramatic mountain image.

#### Create hypsometric tinting

To begin your session,

1. Open the sample grayscale to height image in Adobe Photoshop
2. Name your base layer "hypso" by double clicking in the layers palette on the one layer you currently have and then typing in the name
3. Add a "gradient map" adjustment layer to this layer by clicking on the icon in the layers palette for adding such a layer (see Figure 2)
4. Click once in the colored area of the gradient map to open the gradient editor and start playing with the colors in the gradient. You can click on the presets to start with and then click on any of the color "stops" along the gradient to change color. You can slide the stops and the center point between stops to adjust many aspects of the gradient map. As you work you can watch your grayscale image change as Photoshop maps the different color schemes to it (be sure "preview" is checked). (see Figure 3)

To use the presets pictured below you can load the "mt\_moran.grd" settings here. (The file containing the settings is at: [http://www.equatorgraphics.com/nacis/mt\\_moran.grd](http://www.equatorgraphics.com/nacis/mt_moran.grd)).

Once you have chosen a color gradient you like click OK for the dialog boxes.

#### Create Shaded Relief

Now your file should have a layer for the grayscale to height image and an adjustment layer adding a color gradient. The next step is to create

*"Coloring physical terrain by elevation is known as hypsometric tinting."*

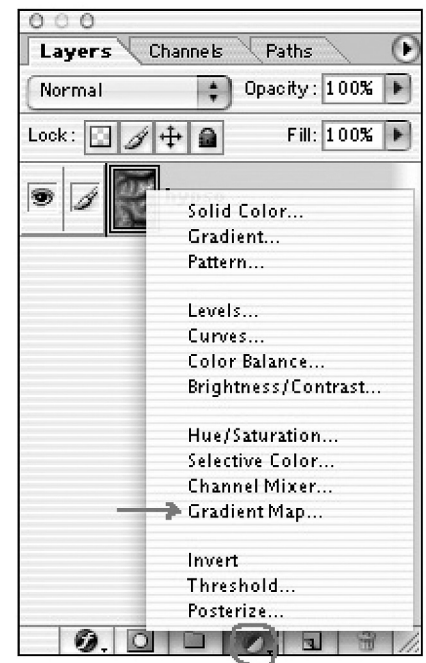


Figure 2.

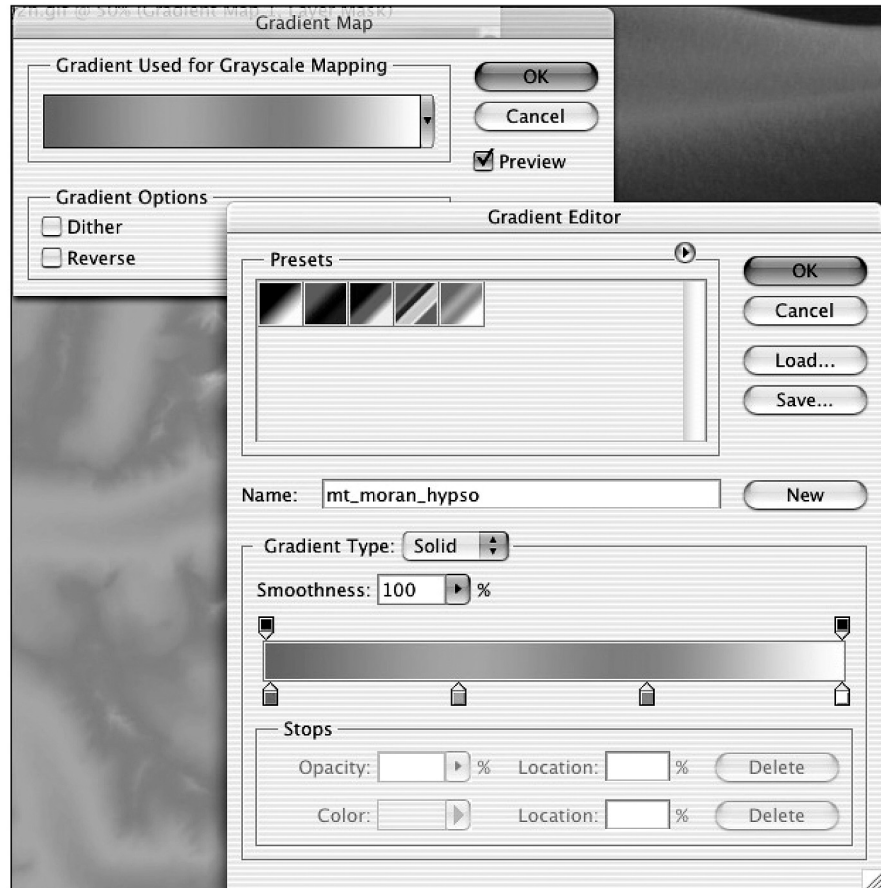


Figure 3.

shaded relief from the grayscale to height image and blend it into the colored elevation.

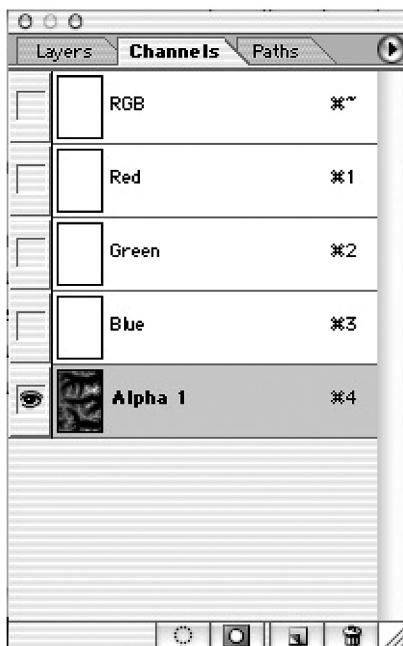


Figure 4.

5. Make a new layer (under the Layer menu) above the hypso and gradient map adjustment layers, name it "relief" and fill with white
6. Copy entire grayscale to height image into the clipboard by clicking on the "hypso" layer, selecting all, and copying
7. Move to the "channels" palette and create a new alpha channel and paste the grayscale to height info into the channel (see Figure 4)
8. Return to viewing your image (click on the RGB layer in the channels palette), click on the "relief" layer in the layers palette and go to Filters/Render/Lighting Effects menu item
9. In the dialog box make the following settings. Experiment to find better setting if you'd like, these work for me (you must have the Alpha 1 channel as your texture channel). The trickiest setting is the tether line in the preview image, it must be pulled about 2/3 to 3/4 of the way to the northwest of the image to get a traditional looking shaded relief. (see Figure 5)
10. Use Photoshop filters to enhance relief because it will look a bit stair-stepped and rough when you first render it. Try these filters:

- a. Blur/Guassain filter, set to 1.0
  - b. Noise/Median Blur filter (the magic relief generalizer), set to 2
  - c. Sharpen/Unsharp Mask filter, set to 75%, 1.0, 0
11. Combine relief with hypsometric tinting and tweak
- a. Multiply relief layer at 50–70% opacity
  - b. Adjust colors in gradient if necessary
  - c. Add Hue/Saturation adjustment layer to boost saturation and make other colors tweak, the adjustment layer is great because it can be undone and modified easily

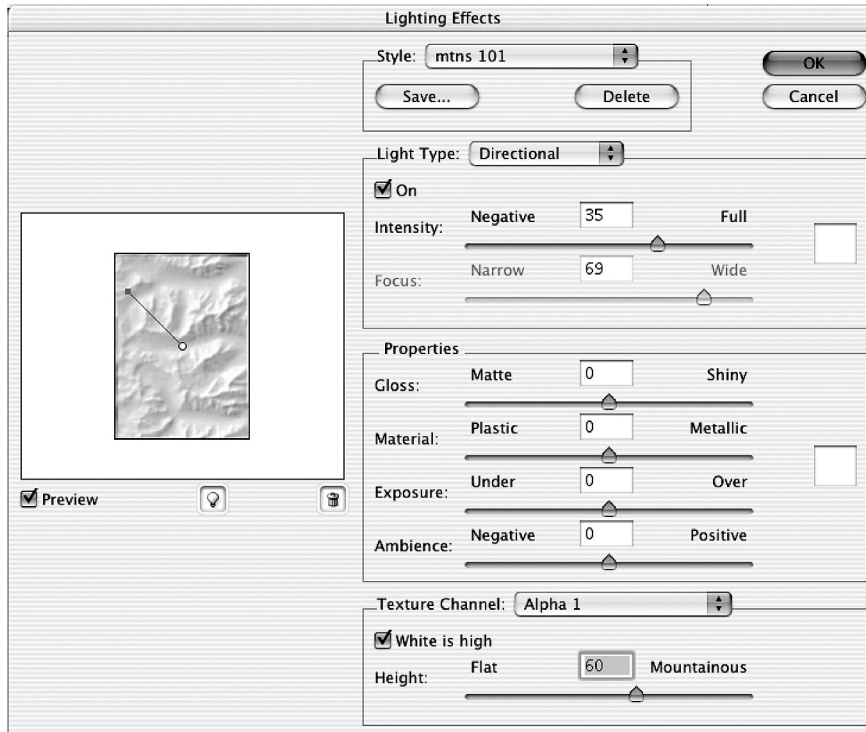


Figure 5.

### Add Colored Highlights and Shadows

To further enhance your mountain relief image you can add color tinting only to the shadows (e.g. purple) and other color tinting only to the highlights (e.g. red alpenglow).

12. Add Colored shadows
  - a. Add Solid Color (called Color Fill after created) adjustment layer above other layers
  - b. Choose color RGB = 110/92/175, click okay
  - c. Set layer blending to hue, set layer opacity to 65% (see Figure 6)
  - d. The Color Fill adjustment layer has a mask area built in, you will want to fill this with the inverse of the relief so that the purple will only color the dark areas of the relief
    - i. Click on relief layer, select all copy
    - ii. Option (or Alt) click on the mask for the Color Fill adjustment layer (this selects that mask)
    - iii. Paste

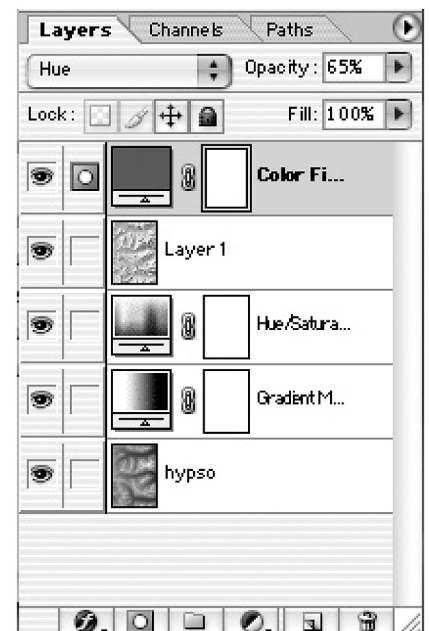


Figure 6.

*"Photoshop is a mighty engine if you know how to control it."*

- iv. Invert
  - e. Adjust levels for the mask to further emphasize the purples in the shadows, input levels to 100/1.00/190
13. Add colored highlights
    - a. Add another Solid Color adjustment layer
    - b. Choose color RGB = 201/69/23
    - c. Set layer blending to screen, set layer opacity to 75%
    - d. Copy relief into mask for the red Color Fill adjustment layer (as above) but do not invert
    - e. Adjust levels for the mask to input levels at 135/0.50/240
  14. As you are working, be sure that you know which layer and which mask are active when tweaking adjustment layers, colors, etc. Photoshop is a mighty engine if you know how to control it. Turn layers on and off to check your results and keep tweaking. You can download my complete Photoshop file at [http://www.equatorgraphics.com/nacis/moran\\_psd.zip](http://www.equatorgraphics.com/nacis/moran_psd.zip) (warning, this is a 8mb file). Here's a piece of my image:

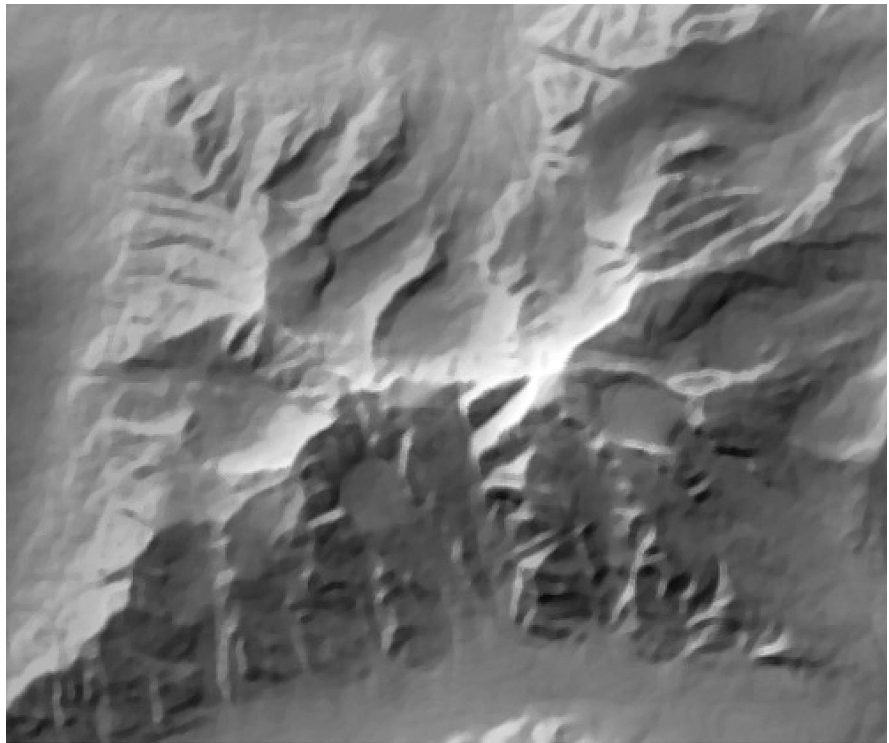


Figure 7.

## CONCLUSION

This is only a basic starter course in using Adobe Photoshop for creating and especially enhancing shaded relief. To be truthful, I don't usually render the lighting of the shaded relief in Photoshop, I use MacDEM or Bryce or Natural Scene Designer which all can use the full 16bit grayscale information and can open DEM formats more easily than Photoshop.



Additional tricks to play with are adjusting relief and coloring to elevations (use masks based on the grayscale to height image) and combination masks using both elevation and relief (slope aspect). Yet another tactic is to play with adjusting relief and coloring by the steepness of the slope. See new article at NACIS Shaded Relief Home Page (<http://www.nacis.org/cp/cp28/resources.html>) by Tom Patterson and Mike Hermann for more on using slope.

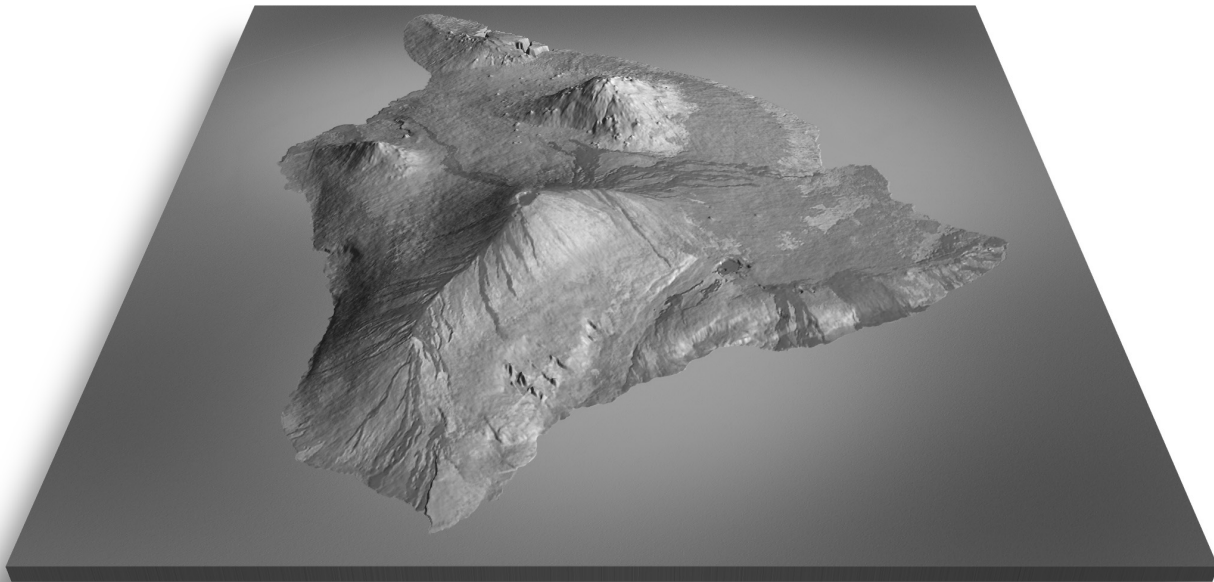
Without breaking out of flatland, all these techniques for using hue, saturation, and value can create a terrain image based on the hard data of the DEM but evincing the beauty of the mountain world.

*“Yet another tactic is to play with adjusting relief and coloring by the steepness of the slope.”*

## Bryce 5 Tutorial: How to Drape a Satellite Image Onto a DEM

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Few other programs can match the ease of use, affordability, graphical quality, and creative special effects of Bryce for depicting 3D cartographic landscapes. This tutorial introduces an easy technique for draping raster geo-images onto DEM surfaces in Bryce 5. Using a pre-registered 1,024 x 1,024 DEM and satellite image of the Island of Hawaii, you will be shown how to make a photorealistic 3D landscape visualization similar to the image below. It is just a matter of knowing which buttons, arrows, knobs, and widgets to click in Bryce's unique graphical user interface.



### What you will need

In addition to Bryce 5 for Mac 9.x, Mac OSX, or Windows, you will need to download sample data from the companion website at:

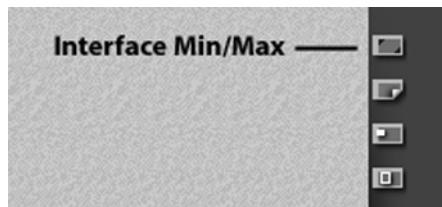
[www.nps.gov/carto/silvretta/drape/index.html](http://www.nps.gov/carto/silvretta/drape/index.html)

The data includes a DEM of Hawaii in Portable Grayscale Map (PGM) format and a registered satellite image in Photoshop (PSD) format. Mac users can also download the Bryce 5 file of Hawaii used to make the scene shown above (unfortunately, Mac and PC Bryce 5 files are not interchangeable).

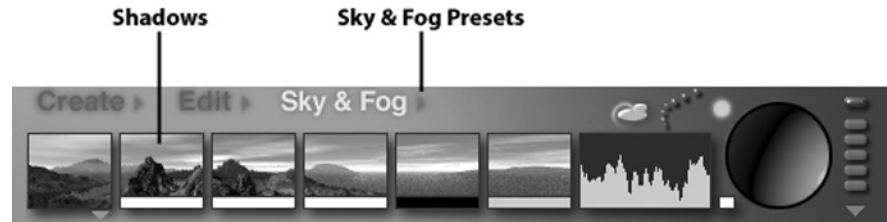
## Initial Bryce setup

The default settings in Bryce 5 assume that you work on a 13 inch monitor and use the application for creating artistic landscapes from low elevation views. These need to be reconfigured before making 3D maps viewed from higher elevations:

1. After launching Bryce, delete the default infinite plane, which appears as a wireframe grid at the bottom of the scene. Do this by selecting the infinite plane (click on it once; it will turn red when selected) and press the delete key.
2. The cramped default Bryce Graphical User Interface (GUI) can be expanded to completely fill larger monitors by clicking on the Interface Min/Max icon at the right side of the desktop (see the illustration below). Since the Bryce GUI completely takes over your desktop anyway, there is no advantage in using the smaller size.



3. The Bryce project window (the hairline rectangle within which the scene is constructed and rendered) is preconfigured to 540 x 405 pixels. You can give yourself a larger size and/or a different format by going to File/Document Setup. I generally find 800 x 600 pixels to be a good starting point.
4. Bryce opens with default sky and fog settings turned on, which, although great for making artistic landscapes, need to be disabled for cartographic work (at least initially). The following steps will yield a plain vanilla Bryce environment with a white background and white illumination, and without clouds, atmospheric haze, or cast shadows:
  - A) At the top of the Bryce desktop click the Sky and Fog label to activate the Sky and Fog palette (see illustration below).
  - B) Click on the small triangle next to the Sky and Fog label to enter the Sky and Fog Presets. Choose "Simple White Background" from the scrolling list.
  - C) To remove cast shadows from the scene, click-drag to the left in the Shadows window until the numerical amount reads 0 (displayed at the lower left corner of the Bryce desktop as you click-drag).



### DEM importing and editing

DEM importation in Bryce 5 is a snap providing that the DEM is quadratic-sized and in Portable Grayscale Map (PGM) format. The sample DEM of Hawaii just so happens to meet these requirements:

Note: For an online tutorial about DEM importation in Bryce go to: [www.nps.gov/carto/silvretta/bryce\\_dem/index.html](http://www.nps.gov/carto/silvretta/bryce_dem/index.html)

DEM import procedure:

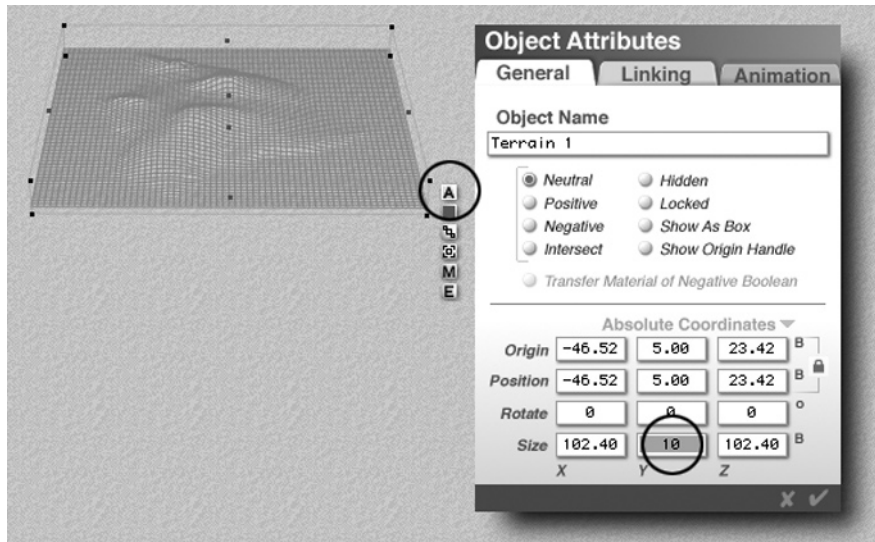
1) In the drop menu, go to File/Import Object and select the hawaii.pgm file that you downloaded earlier. When imported, the DEM will appear as a wireframe terrain object at the bottom center of the Bryce project window.

You will undoubtedly notice the excessive vertical exaggeration on the imported DEM. This can be diminished by two methods:

METHOD 1 - With the DEM selected, in the Edit palette (see the illustration below) click-drag the upper Y axis of the Resize icon to the left until the topographic vertical exaggeration looks about right. Although unscientific, this method is quick and effective for making visual adjustments.



METHOD 2 - For the numerically inclined, click on the tiny "A" next to the selected DEM to activate the Object Attributes dialog (see illustration below). Lessen the Y size at the bottom of the dialog. (Note: sizes are indicated in Bryce units, a somewhat arbitrary unit of measurement unrelated to real world elevations or percent vertical exaggeration, but nevertheless useful for making relative adjustments to vertical scaling). In general, high elevation views require more vertical exaggeration than low elevation views of the same area. Experiment.

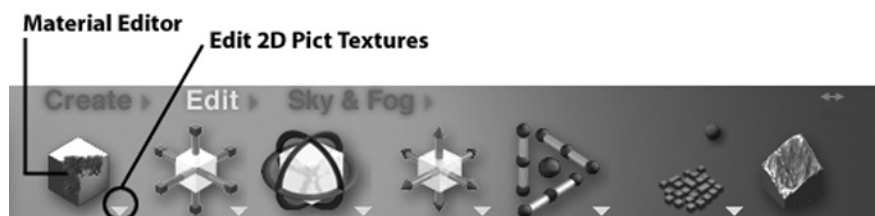


## Image draping

In Bryce, as with all 3D landscape software, the image and the DEM upon which it will be draped must register to one another perfectly. Although DEMs in Bryce must conform to quadratic sizes, a draped image can be a square of any size, quadratic or otherwise. I usually prefer that the image used for draping have a resolution at least twice that of the DEM beneath—for instance, draping a 8,192 x 8,192 image on top of a 4,096 x 4,096 DEM, to show surface features with utmost detail and sharpness. However, this approach translates into huge file sizes. In the interest of download time, the tutorial satellite image of Hawaii is a modest 1,024 x 1,024 pixels, the same resolution as the DEM upon which it will be draped.

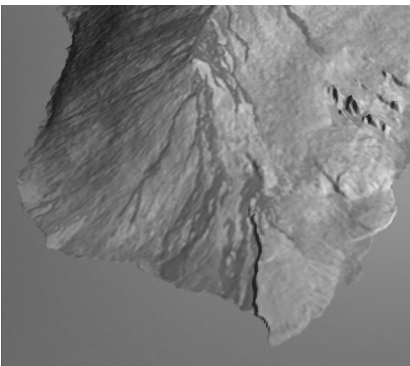
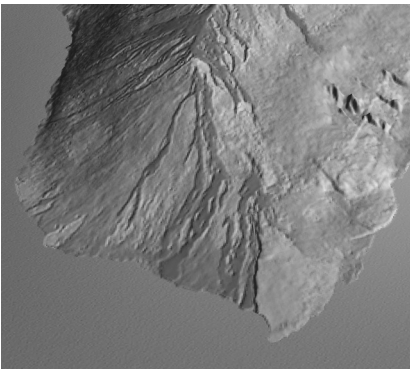
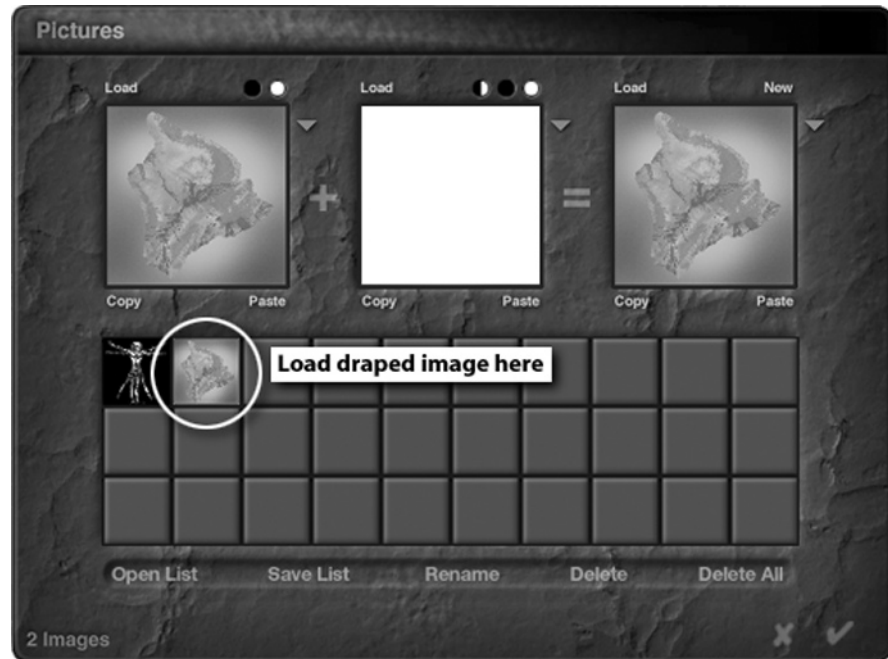
Draping procedure:

1. In the Edit Palette, click on the small arrow to the right of the Material Editor icon (see the illustration below) and choose the Edit 2D Pict Textures option.



2. The Pictures library then appears (see the illustration below). Load the satellite image of Hawaii into the Pictures library by clicking the empty square to the right of Leo, the default Bryce picture of a da Vinci-like human figure. In the open dialog box that appears, choose the downloaded satellite image named drape.psd.

3. Close the Pictures library by clicking the check mark “okay” at the lower right.
4. In the main Bryce window click the render button (the lowest ball on the left side of the desktop) to render the draped satellite image and DEM. Congratulations, you are done.

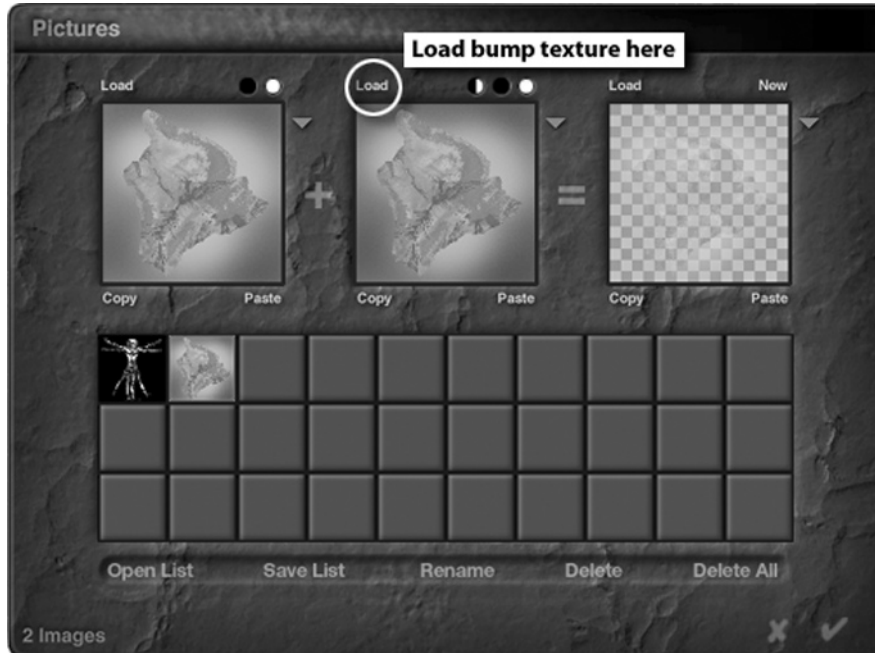


### Bump mapping

Images draped onto DEMs sometimes can appear stretched and blurred, especially in steep areas when large amounts of vertical exaggeration is used. Bump mapping is a technique that counteracts this tendency, giving landscapes a more natural appearance by depicting subtle light and shadow detail, or bumps, on terrain surfaces. Although bump mapping is more often created from procedural (algorithmic) textures, in this case we will use the draped satellite image itself as the bump map data. Illumination within the 3D scene reacting with contrast information contained within the image, such as forest and lava flow boundaries, will cause these edges to appear embossed. The illustration to the left shows Hawaiian lava flows rendered with bump mapping (top) and without (bottom).

**To load the satellite image as a bump map texture:**

1. With the DEM selected, go to the Pictures library using the procedure described previously.
2. Click the load label above the middle preview square (see the illustration below). Choose the file named `drape.psd`. Exit the Pictures library.



3. Now you must enter the daunting world of Bryce's main Material Editor by clicking the Material Editor icon in the Edit palette (it is on the far left side). The following instructions will guide you through the maze:
4. In the matrix at the center of the Material Editor, click the empty circular depression where the Bump Height row and A column intersect. A glass-like button will appear where you just clicked (see #4 below).
5. Next, enter a value by pulling the Bump Height slider bar to the left (see #5 below). Alternatively, numeric Bump Height values can be entered by clicking directly on the number field. Restraint is advised when assigning bump height values; too much will give the satellite image a coarse appearance.
6. Exit the Material Editor and then render the final bump mapped image.



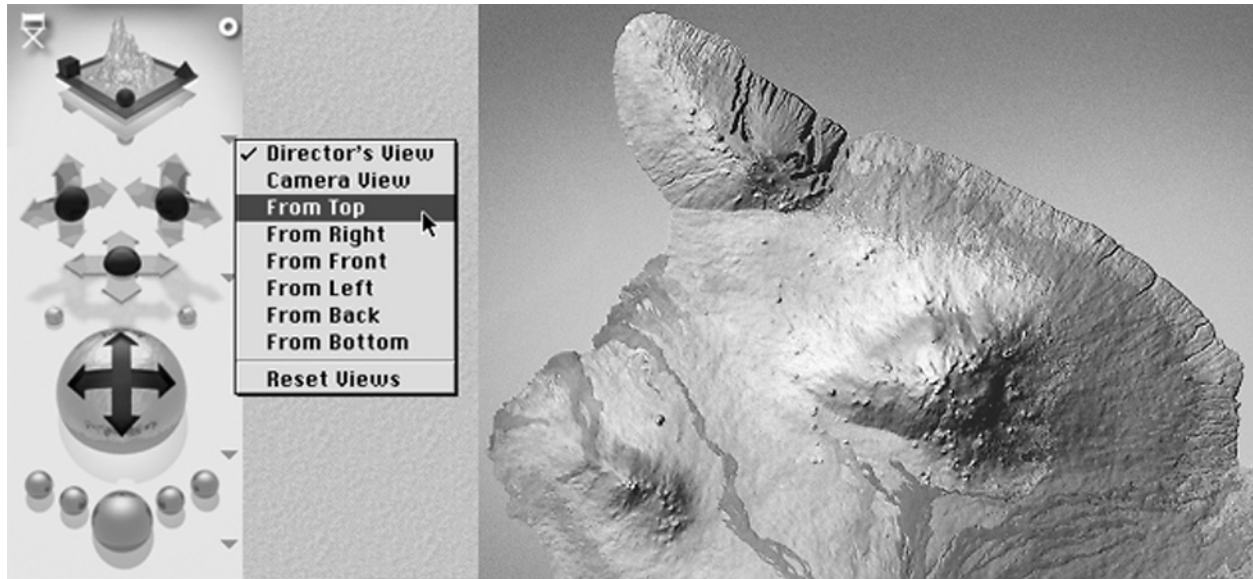
Additional comments about bump mapping:

- Bump mapping effects are non-permanent. To adjust or turn off bump mapping, simply go back to the Materials Lab.
- Custom bump map textures can be created by modifying a duplication of the original satellite image in Photoshop, and then loading the modified image as the bump map texture in Bryce. For example, using Photoshop, green forest areas could be selected and given a light application of the noise filter and, perhaps, a touch of Gaussian blur, which would translate to a lumpy forest canopy when used as a bump map. Conversely, diminishing 2D image contrast diminishes the effects of 3D bump mapping--a useful technique for applying variable amounts of bump map texture locally within an image.
- In Bryce, bump map textures are read as 8-bit grayscale data, so there is no qualitative penalty for preparing custom bump map textures in grayscale color mode.



## Shaded relief

Shaded relief can be rendered in Bryce 5 by choosing “top” from the view control menu (see illustration below).



Shaded relief hints:

- The illumination direction works best in top view when “Link Sun to View” is disabled in the Sky and Fog palette (click the options arrow on the lower right side of the palette).
- Resizing the Y dimension (which controls vertical exaggeration) in the Object Attributes dialog has a dramatic effect on shadow intensity and the overall appearance of three dimensionality.
- Simple gray shaded relief can be created by assigning flat gray or white color to the terrain. Look for these in the Material presets in the Edit palette under the simple and fast category.

## Conclusion

This tutorial only hints at the creative possibilities in Bryce 5. As you use Bryce’s powerful graphical tools using a GUI that invites exploration, you will, undoubtedly, discover new and innovative techniques for visualizing geo-data.

## Afghanistan Maps

Richard Furno

*“... though the map had the same basic underlying relief map, the overlaid information varied enormously, sometimes showing major roads, sometimes minor roads as well, sometimes towns, or the extent of the Northern Alliance, or provinces, etc.”*

*“For us the gains of CAD outweigh the loss of most, but certainly not all, GIS features.”*

*“Digitizing and deprojecting traced vectors and points is a straightforward process that can be done within deadline constraints.”*

After September 11, and the beginning of the US action in Afghanistan, The Washington Post Art Department had to publish maps of Afghanistan on a regular basis. Almost daily, we created a map containing the events of that day. But usually, though the map had the same basic underlying relief map, the overlaid information varied enormously, sometimes showing major roads, sometimes minor roads as well, sometimes towns, or the extent of the Northern Alliance, or provinces, etc.

We knew from the start that we should construct a map with recorded parameters so that all new information could be projected to fit the original. As the war evolved, we had to keep information up to date and in geographic position, and more data had to be generated and registered to the map accurately.

Among our stable of geographic applications, we use Azimuth to store our geographic data and generate the vectors that appear on our maps. It is a plug-in to a full-featured CAD application called VectorWorks. Using VectorWorks, Azimuth gains considerably from the CAD interface, however, it also lacks much of the functionality of a full-featured GIS. As the author of the plug-in, working for the art department of The Washington Post, I fashioned Azimuth to fit the particular needs of cartographers working within a graphic environment. It stores data on a layer in a VectorWorks document scaled to latitude and longitude. Data can be selected in the standard graphic method, click and drag, etc., and plotted according to selected parameters. The plotted map appears in a layer or layers above the data layer. The standard GIS is aimed at technical output, engineering, marketing, etc. For us the gains of CAD outweigh the loss of most, but certainly not all, GIS features. Because of the extensive GIS databases, we need to convert GIS data and store them in Azimuth documents, by no means a direct, simple process.

Production of our Afghanistan database illustrates the importance of Azimuth's and VectorWorks CAD interface. It is typical for us to generate a wide variety of data on subjects for our news maps. We digitized and converted information for the Afghan permanent database. Digitizing and deprojecting traced vectors and points is a straightforward process that can be done within deadline constraints. In doing so, VectorWorks CAD functionality was important using Snap to point, Clip, Add and Intersect Surfaces. We can then modify our data by moving, adding and subtracting vertices as well as adding lines, polygons, symbols and text right into the data layer. We did much of this for both temporary and permanent data. Because data bases are visual, appearing as drawn elements on a data layer, we can edit visually or we can make changes in an Object Info palette as exact coordinates.

To produce each of our maps for the day's edition of the paper, here are the typical kind of steps we took. We selected the proper database or bases. Then the appropriate "Classes" of data were turned on or off, comparable to ArcView functionality. If data in one Azimuth data base document was needed in another document, the data was selected and, using VectorWorks "Paste in Place" feature, placed the other document in exact geographic position. Vectors were then projected and exported as EPS vector files and brought into Freehand or Illustrator. For our various versions of Afghanistan maps, we generated a relief plate from DEMs,

and noted in the Freehand document the exact projection and parameter settings used in Azimuth to produce the map. So, using those Azimuth parameters we can open the map any time in the future and be able to create new, matching vector information. Most important, this avoids the attempt to copy vectors from a one Freehand document and try to force it to fit to another map. Settings can also be kept within the Azimuth document. So any data can be replotted, to match an existing map.

The large map of Afghanistan that we used for maps that ran anywhere from one-third the width of a page to the full width is shown here (Figure 2). Our relief plates were converted to our chosen projections using either Geocart or Morph but these two methods are not discussed here. Once the projection was chosen for the relief, the plate was produced and ready for vector overlays.

At this point, the relief was imported into Freehand and made note of the projection parameters of the relief plate 9 (Figure 3) (I also use the "File Info" feature of Photoshop to record the projection parameters and DEM files used in the relief document itself).

This gave us all the information we needed to produce any additional vector overlays. As our data bank grew for the Afghanistan area we continued to project and add more overlays for our Afghan map.

*"As our data bank grew for the Afghanistan area we continued to project and add more overlays for our Afghan map."*

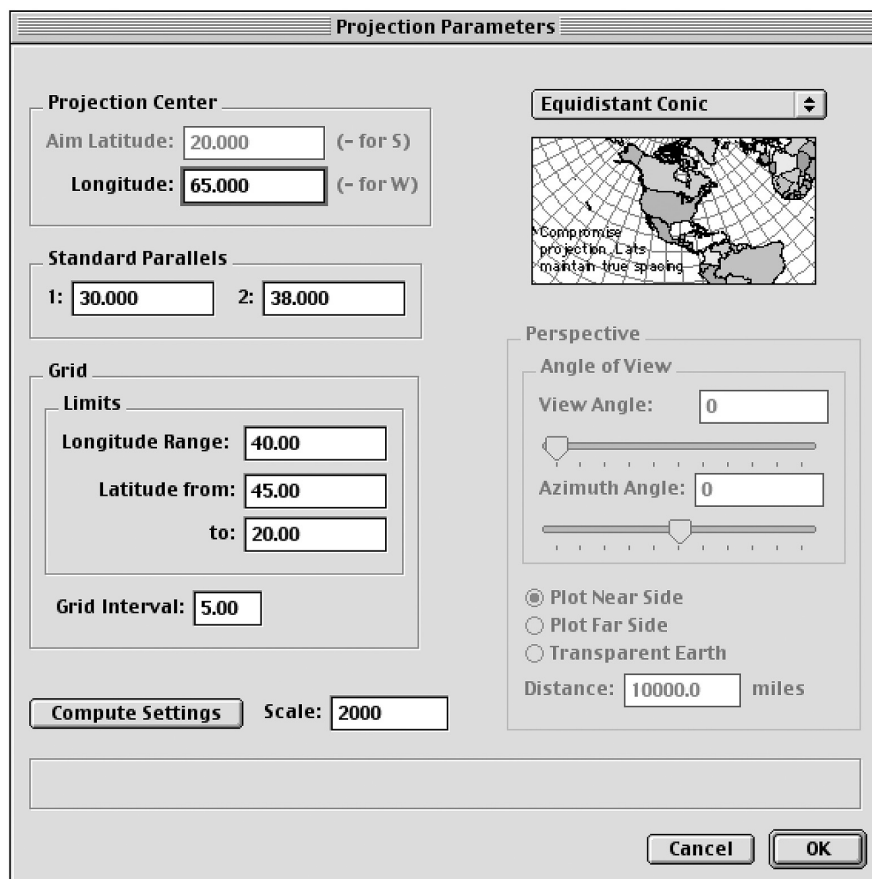


Figure 1. The Set Projection dialog contains all the information needed to reproduce the map such as these settings for the Afghanistan map.

All of our data for areas around the world accumulate by this same method. Maps for the newspaper often don't correspond to the kind of information found in GIS data banks. When we do use such standard GIS

vectors, we see the familiar problem of unconnected vectors, the often-encountered mass of points, one on top of another and the unfortunate unclosed polygons. Again, we make use of VectorWorks CAD tools to convert the data to a more useful form for our databases. By doing this once and integrating it within the Azimuth document, it never needs to be done again for subsequent documents, Afghanistan or otherwise.

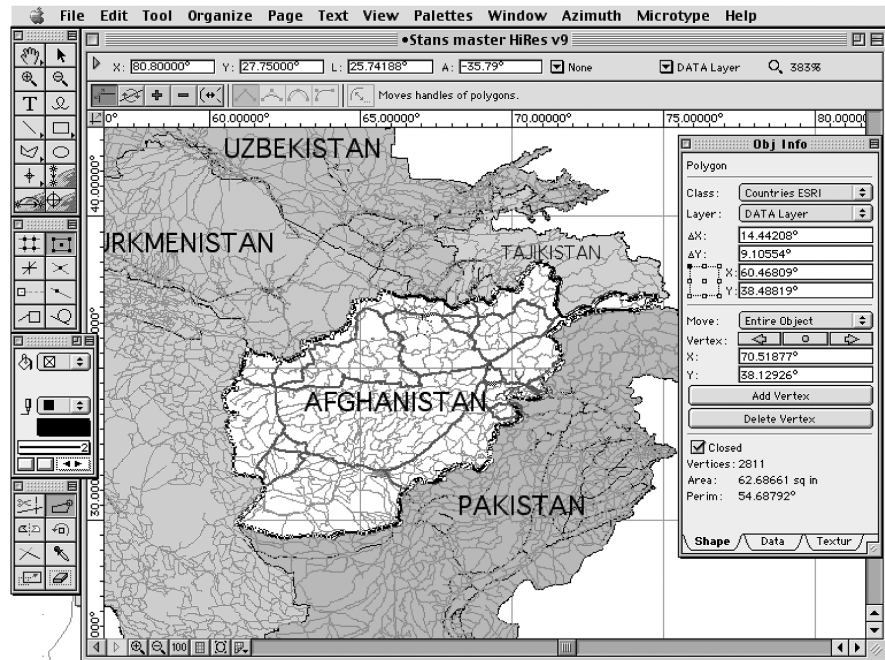


Figure 2. This is the Data Layer in Azimuth containing our "Stans master HiRes" data. The Afghanistan border is selected to show the information in the "Obj info" palette. Note the lat/long rulers and readout.

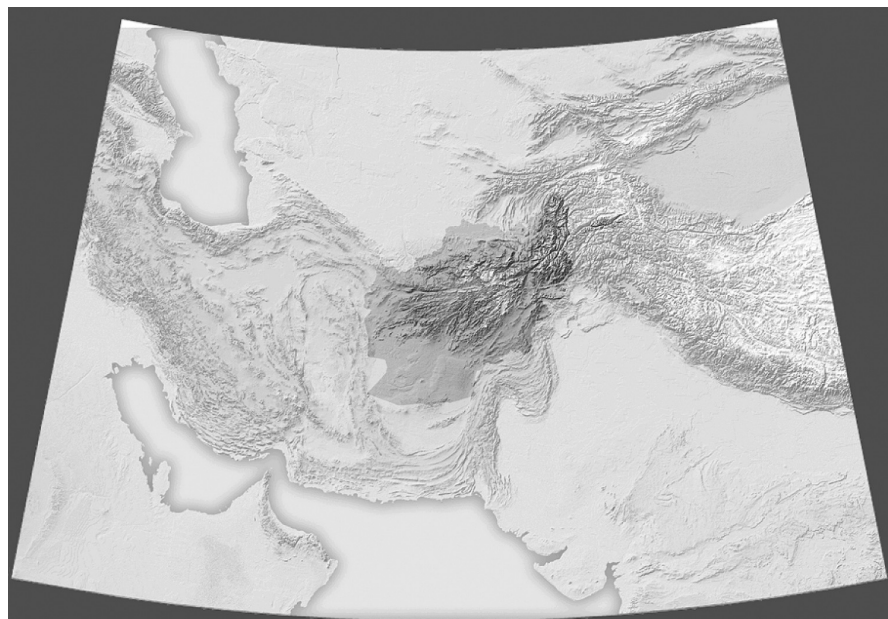


Figure 3. Here is the relief plate we used for maps for Afghanistan capable of being inclusive of all of Pakistan, Iran and much of the Soviet republics.

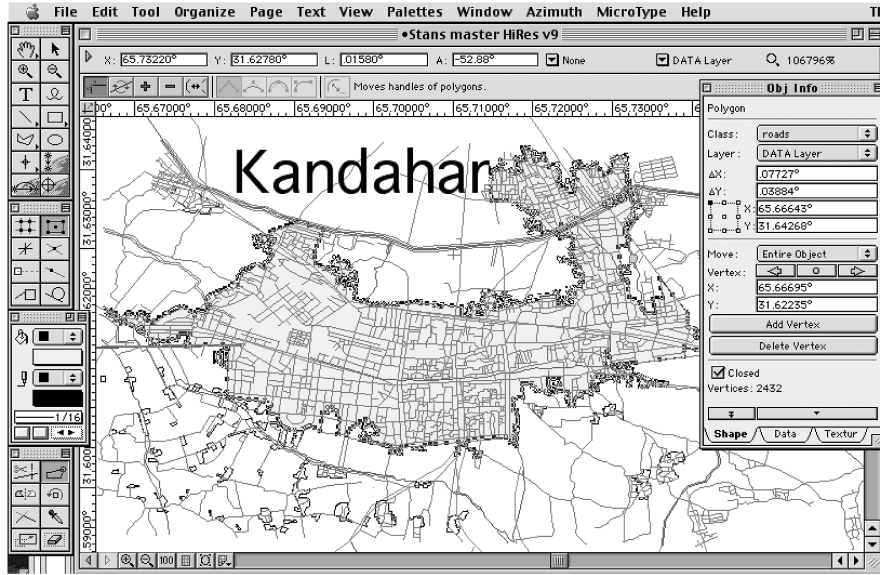


Figure 4. Zooming into Kandahar in the same database and selected is the outline of the city built up area.

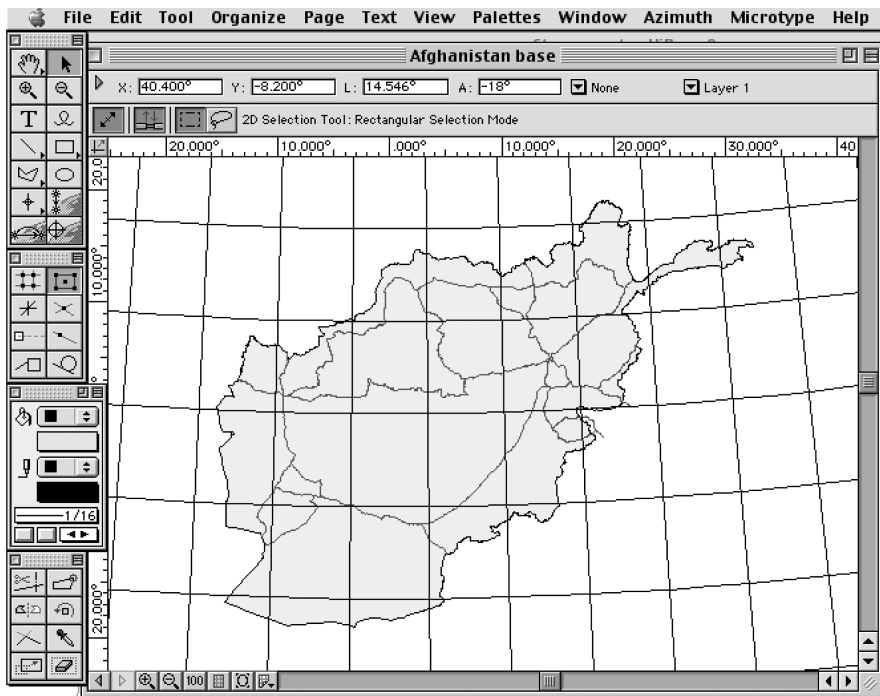
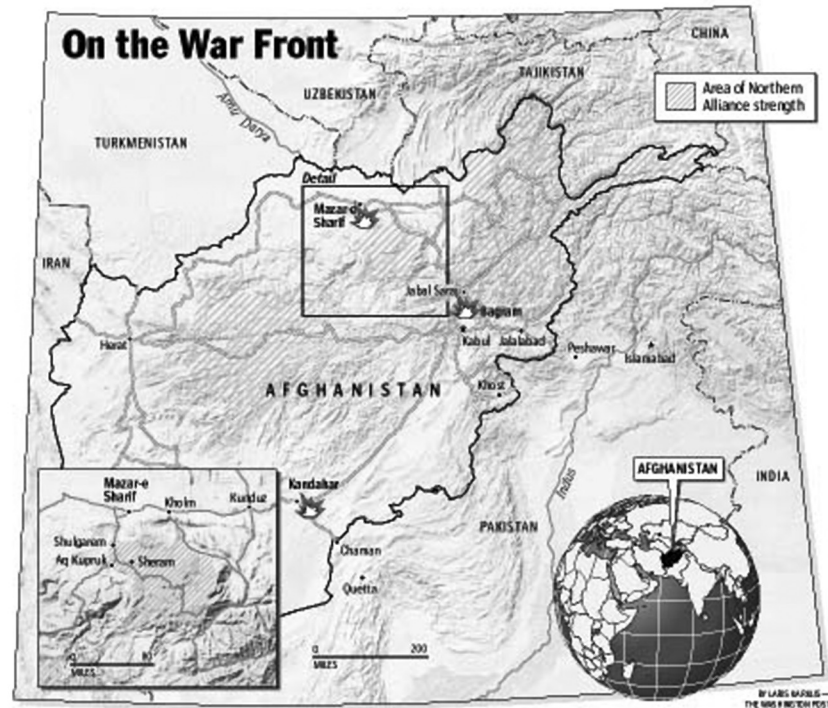


Figure 5. A plotted map of Afghanistan, its major roads and a 2-degree grid.



#### Mazar-e Sharif

■ After taking control of several nearby villages, the Northern Alliance opposition said its forces were about to launch an attack to capture Mazar-e Sharif. Taking the city would be crucial for the opposition to gain control of northern Afghanistan.

#### Kabul

■ Opposition leaders said they would await the outcome of the battle for Mazar-e Sharif before moving on Kabul, the capital. U.S. planes continued to bomb Taliban front lines near Bagram.

#### Bombing yesterday

■ Taliban positions outside Kandahar came under heavy U.S. bombardment.

■ U.S. bombers again pounded Taliban lines 20 to 30 miles from Mazar-e Sharif.

Figure 6. Final published map.

## MAPublisher – Little Known Tips and Tricks

The following is a summary of the brief presentation given at the NACIS XXI conference in Portland, OR on October 3, 2001.

**A**s many of those present were either already users of MAPublisher or were familiar with it in one way or another, it was decided that a short presentation outlining a few useful tips and tricks would serve everyone well. All data files used in these examples can be found at [ftp://ftp.avenza.com/pub/misc/NACIS\\_XXI\\_files.zip](ftp://ftp.avenza.com/pub/misc/NACIS_XXI_files.zip)

- 1. Importing Multiple GIS Data Files Individually to Scale to a Pre-defined Page Size** – When a GIS data file is imported to Illustrator or FreeHand using MAPublisher, MAPublisher calculates a scale for the map layer which will best fit the data onto the current page. Problems can result when layers of different extents, which cover roughly the same geographic area, are imported separately, such that the layer with the greater extents falls outside the Illustrator or Freehand page. The trick to making sure that all layers import and line up properly and that no data falls outside the page is to import the layer with the largest extents first. Subsequent layers can then be imported using the “Same as” option with the initial layer selected. To demonstrate this, create a new page in Illustrator or FreeHand using the landscape orientation. Be sure to set the rulers to 0,0 at the lower left corner. This example uses the railroad and county layers for King County, WA. The railroads do not fully extend to the county boundary so if the rail file is imported first MAPublisher will calculate a scale based on the rail layer. Then, when the county boundary file is imported, portions of it will fall outside the page in order to ensure that it registers with the rails layer. Start by importing the kingWARails.shp file using the “Defaults” option. The file will be imported and the railroad lines will extend to the edge of the page. Now import the kingWABoundary.shp and select the “Same as” option, referencing the kingWARails layer. The boundary file will import at a scale that matches the rails layer but in so doing the county boundary will fall outside the page. This is the situation we wish to avoid. Now start a new page and repeat the above procedure importing the boundary file first. Notice that after the railroad layer is imported both layers fall inside the page and are registered to each other as desired. Note that with MAPublisher 4.0 multiple data files can be imported at one time such that the scale is set by the file with the greatest extents.
- 2. Importing With a Grain** – Frequently it is desirable or necessary to “thin” a GIS file upon import. This is particularly the case with very complex area files that exceed the points-per-path limits set by Illustrator and FreeHand or with large files that exceed your computer’s processing ability. In this example we will see how the MAPublisher “Grain” function is used to import a complex polygon layer. This example uses the outline of Norway (norway.mif) file. Start by creating a new page in landscape orientation. Be sure to set the 0,0 point

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*“Problems can result when layers of different extents, which cover roughly the same geographic area, are imported separately, such that the layer with the greater extents falls outside the Illustrator or Freehand page.”*

*“Frequently it is desirable or necessary to ‘thin’ a GIS file upon import.”*

to the lower left corner. Now import the norway.mif file using the "Defaults" function and without entering a grain value. The file will import, however you should notice there has been a truncation of the line work of the main Norway polygon resulting in two points being joined by a straight line and a number of points not being joined at all. This is obviously incorrect and can be addressed by re-importing using the "Grain" function. Rename the "norway" layer to "norway-nograin" in your layers palette. Now re-import the norway.mif file. If you are using Illustrator be sure to check the "grain" box **before** selecting the norway.mif file. After the norway.mif file appears in the import list you will be able to enter a value for the grain in the row corresponding to this file. Enter a value of 0.0225 in the cell corresponding to the grain value for the norway.mif file. Now complete the import using the "Defaults" option and the file will import correctly and overlay the original "no-grain" import. You can now compare the difference between the two import processes by selecting one of the Norways and moving it to a blank portion of the page so both outlines can be seen at the same time. You can also open the norway-both.ai and norway-compare.ai files that have been included with the accompanying data.

*"... you may desire to plot some points on your map using world coordinates where such a point GIS file is not available."*

3. **Creating Your Own ASCII Point File** – From time to time, you may desire to plot some points on your map using world coordinates where such a point GIS file is not available. In this example we will see how to create a point file using a text editor that will enable points to be placed in their correct geographic locations on an existing FreeHand or Illustrator MAPublisher map. To start, open the westcoastUSA.ai file or import the westcoastUSA.mif file to a new page. This file will form the base for the points we wish to plot. In this case we will create a file that will place points for 3 major cities on the US west coast. Now open Notepad, SimpleText or another text authoring program and create a new document and enter the following 4 lines of text:

```
Lat,Long,City
45.565,-122.86,Portland
47.45,-122.38,Seattle
37.70,-122.49,San Francisco
```

The first line is optional. We have included it in this case and will use it as the header line when we import the file. As the base map (westcoastUSA.mif) is in lat/long coordinates we will use lat/long values to plot our points. The Lat value is the latitude and the Long value is the longitude. All other values will be used to construct the attribute table for the points. In this case there is only one, City, however you can have as many as you'd like. **An important thing to remember here is to perform a hard carriage return after the last line.** Save the file as cities.txt or some other reasonable name. Now choose a font and point size of 10 and open the MAPublisher Import Points dialog. Select the text file you just created as the file to import and complete the fields in the rest of the dialog by choosing the Long column for the X coordinates, the Lat column for the Y co-ordinates and a symbol to use for the points. Select the "Same as" option under Page Scaling Information and reference the westcoastUSA layer. Check the "use first line as header" box if your file has a header line like ours does. Now click OK and the points will



be imported to a new layer called cities with the points placed according to the lat/long values we used in the text file. The attributes table will also be constructed and can be viewed using the "Show Map Attributes" function. Files such as our cities.txt file can also be made using common spreadsheet programs such as Microsoft Excel using the export as comma-delimited option.

4. **Dropping Columns** – Removing unnecessary data columns from the MAPublisher attributes table is a very easy and handy way of improving the overall performance of your map file. GIS data files often include many columns of data that are entirely unnecessary for cartographic construction and end up causing slow "Select by Attribute" and "Draw Legend" routines and can make files larger than need be. For example, the US counties file (counties.shp) contains 12 columns of data of which we may only need the single column that contains the county name. Import the counties.shp file to a new Illustrator or FreeHand page, select one or two features, and open the MAP Attributes window to view all the columns of data. Now let's remove a few columns that we don't need. Illustrator users should click the MAP Columns tab, select one or more of the column names they wish to delete and then click on the trash can symbol at the bottom right of the window. FreeHand users must open the "Show MAP Columns" window, select one or more columns to delete and then select Options->Delete column within the "Show MAP Columns" window. Now try this again with the az\_deci(partial).txt point file or with your own data file.
  
5. **Joining Arcs** – Map files can also be made smaller and easier to work with by joining similarly attributed linear features together to form single longer lines. The end result is a new line layer with much fewer line features, each with only a single attribute column, hence faster redraws, searches and selections. Joining arcs is also useful prior to labeling using MAPublisher's "Feature Text Label" tool. Try this using the toronto-streets.mif file. After importing this file open the MAPublisher Selection Statistics window and notice that the toronto-streets layer has 1197 lines on it and using the MAP Attributes window notice the number of data columns for each line feature. Now using the MAPublisher "Join Arcs" function, join all the lines by selecting toronto-streets as the layer, Street as the column and entering 0.0001 as the proximity value. Name the output layer toronto-streets-joined. After the join is complete select the toronto-streets-joined layer and using the MAPublisher Selection Statistics window you should notice that there are now only 289 lines present yet the map looks identical. The MAP Attributes window will reveal only a single attribute column for that layer. Now the original unjoined layer can be deleted if no longer required.
  
6. **MAP Tagger Tool vs Feature Text Label** – MAPublisher offers two methods of labeling using the attributes table of an imported GIS file. The "MAP Tagger" tool is used for labeling individual features of a map by clicking on each feature, whereas the "Feature Text Label" function is used for labeling multiple items at a time. To demonstrate the appropriate usage of each tool, start by importing the quad250.e00 file to a new document. Now after choosing an appropriate font and point size select the "MAP Tagger" tool from the tools palette and choose an appropriate column

*"Removing unnecessary data columns from the MAPublisher attributes table is a very easy and handy way of improving the overall performance of your map file."*

*"Map files can also be made smaller and easier to work with by joining similarly attributed linear features together to form single longer lines."*

*"MAPublisher offers two methods of labeling using the attributes table of an imported GIS file."*

*“One of the most overlooked functions in MAPublisher 4.0 is its ability to generate an accurate index for labeled features.”*

*“A little known feature of MAPublisher’s indexing function is the ability to generate an index from an un-georeferenced or non-MAPublisher created map.”*

for labeling. Then begin clicking within each of the polygons and place a few labels. As you will quickly imagine, labeling this map that way or perhaps one with 100’s or even 1000’s of elements can be a tedious and time-consuming process. Now delete the labels you have just placed. Select either all the features on the layer or only a few that you wish to label and select “Feature Text Label” from the menu of MAPublisher functions. Complete the entries in the ensuing dialog and after clicking OK all the selected features will be labeled at once. This quickly illustrates the power of “Feature Text Label” over “MAP Tagger” but what about the converse? Start a new document and import the toronto-streets.mif file. This is an unjoined line file and can be used to demonstrate when the “MAP Tagger” tool is more appropriate. Using the “Feature Text Label” function on such a layer will result in multiple labels being placed for each road, given that each road is comprised of several segments, each with the same name. However, one can quickly label the roads using the “MAP Tagger” tool. In such a case only the lines that have been clicked on will receive labels. This affords greater precision in labeling files of this nature by allowing you to click only the segments you want labels on.

7. **Make Index** – One of the most overlooked functions in MAPublisher 4.0 is its ability to generate an accurate index for labeled features. Try this by opening the world.ai file or importing the world.mif file. Now label a few countries using the “MAP Tagger” tool. Create a new layer and name it ‘grid’. Use the MAPublisher “Add MAP Parameters” function to assign a scale and coordinate system to the grid layer using the “Same as” world layer function. Open the MAPublisher “Grid Generator” dialog and enter the following values:

- check the “generate index labels” box and select the options you desire for the grid labeling for index purposes
- select page units
- set columns to 11 and rows to 6
- set UR X to 792 and UR Y to 400
- “cell size” next to the “Calculate” button and click the calculate button

Now click OK and the grid will appear complete with alphanumeric labels along its axis or within each cell depending upon the option you chose earlier. Now open the MAPublisher “Make Index” dialog. Select “Text Objects” and set the layer to world and grid layer to grid. Select the output options you desire for the resulting index formatting and click “Save As” and name your index text file when prompted. Your index will now be saved to the file and location you just named and can be copied and pasted or placed into your map document.

8. **Indexing a Non-MAPublisher Map** – A little known feature of MAPublisher’s indexing function is the ability to generate an index from an un-georeferenced or non-MAPublisher created map. This can be very useful if you wish to index a map you made before you began using MAPublisher. To illustrate this, open the index2.ai file or simply create a basic new document containing a few lines or polygons and associated text elements or labels. Now “Add MAP Parameters” to the layer you wish to index, using all the default values in

the “Add MAP Parameters” dialog. Then select all the text you wish to be indexed and “Add Text Defaults” to it. Then, by following the steps outlined in the previous example you will create an index for the index2.ai file or whichever one you happened to create in this example.

Questions regarding this presentation, the data files or any other MAPublisher-related issues can be sent to [support@avenza.com](mailto:support@avenza.com).

## The Perfect Cartography Software, and How We Live Without It

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*"Unlike many other art forms, cartographers must produce quality despite constraints in medium, symbology, and the necessary ties to the real world."*

*". . . new technologies can actually introduce new problems."*

Cartographers have a proud tradition of finding new solutions to difficult problems. According to Keates (1996, 211), design is all about using creativity to balance conflicting demands and overcome obstacles. Unlike many other art forms, cartographers must produce quality despite constraints in medium, symbology, and the necessary ties to the real world. The ever-improving technology of Cartography has provided one means to improving map design and production.

We are rarely the creators of new technology, but have been very adept at adopting the latest available tools, and finding ways to use them to make good maps (Monmonier 1985, 11). Maps have been among the first applications of new printing technologies, from the earliest woodcuts, to copperplate, to photolithography, to color laser copiers, and even the Internet (Plewe 1997, 6). We have quickly adopted new production technologies, whether they were peel-coats, typesetters, PostScript, or GIS. These technologies have given the professional (and casual) cartographer a set of tools for producing increasingly better maps in less time at less cost.

However, professional cartography today is still not in an ideal situation. It may seem paradoxical, but as life seems to get better, the number of "problems" and "obstacles" always seems to stay the same. There are several reasons for this. Our hopes and dreams quickly become our basic expectations, and the lack thereof is deemed a failure. Small issues that we didn't have time to worry about yesterday turn into major roadblocks to reaching "the next level." In addition, new technologies can actually introduce new problems.

This paradox has certainly happened in Cartography. The issues that professional and academic cartographers worry about today would be completely foreign (and probably trivial) to Ortelius, Mercator or the Blaeus. While the technology available for cartographic design is much more powerful and efficient than it once was, we are more keenly aware of what we lack. We can accomplish great things, but we always have some idea of how it could be better.

This paper looks at the relationship between professional cartographers and the available design technology. What are our expectations from software? What are our ideals for future technology? How do we make do with what we have now? The Practical Cartography Day at the 2002 meetings of the North American Cartographic Information Society showcased a number of tools, techniques, and tricks that we are using to produce high-quality maps; but the very existence of these tricks attests to the fact that current technology is not ideally suited to cartography.

This paper focuses on the "small-shop" cartographer, whether a freelancer, in a small cartography businesses, or as part of a GIS operation. Large map publishers have the resources to develop software solutions specialized to their operations, while small shops must rely on off-the-shelf solutions with only minor specialization. Also, large publishers tend to have standardized designs in which interactive design tools are not as crucial, while small-shop cartographers spend most of their time doing custom design.

## Cartographic Projects

To develop an idea of what the perfect cartography software would look like, we should first understand how it would be used. The typical small-shop cartographer is asked to do a variety of projects, which fall into three basic types:

1. **The One-off.** The request is unique, in terms of source information and product. The cartographer enters data specifically for this project, designs a custom map, and delivers it. The file is not intended to ever be used again.
2. **The Cartographic Database.** For many reasons, cartographers tend to specialize in certain regions and certain themes (e.g., street maps of Cincinnati, recreation maps of Idaho). Over time, a common collection of data is developed and maintained, from which a variety of maps may be produced for various purposes and clients.
3. **The Permanent Map.** Some clients, whether they be customers or employers, have recurring requests. A map may be designed once, but then every so often, it must be updated and redelivered.

Each of these projects requires many capabilities of cartographic tools. Some requirements are unique to a particular type, but many are shared. In addition, some projects make use of more than one type. For example, a cartographic database is often used to support one or two permanent maps as well as several one-off maps. Therefore, a successful cartography shop needs to have the tools necessary to meet the requirements of all three projects.

## The Ideal Solution

To develop an idea of what the perfect cartography software would look like, we should first understand how it would be used. This program would be easy to use, but also very powerful. It would need to support all three phases in the process of digital cartographic production (Robinson *et al* 1995, 18): data collection, map design, and output. Each type of project dictates many capabilities that are needed in tools of each phase.

### 1. Data Collection Tools

Cartographers need to enter new geographic data, import data from existing sources, and store those data permanently in a cartographic database that can be used for a variety of map layouts and designs. Several specific requirements are listed below:

**Data Entry:** support for digitizer tablets; image display for heads-up digitizing; tools for easy editing of existing datasets; able to replicate final map symbologies so that the final appearance of items can be previewed as they are entered; automated label placement; automated generalization, at least line simplification.

**Data Import:** support for many common national and international data formats; transfer from GPS units; connection to live web-based data services (such as ESRI Geography Network and OGC's Web Feature Server).

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*“The primary advantage of digital design tools is that they automate many of the repetitive and computational tasks.”*

*“Cartography today is about much more than flat paper maps.”*

*“Creative design happens best in an interactive environment, in which the cartographer can experiment with new ideas and see results immediately.”*

- **Database Structure:** support for raster and vector data; keeps data georeferenced to any projection or coordinate system; stores annotation (including curved text) and other “nongeographic” map elements; able to store different representations of each feature, such as for different scales; support for a variety of geometry types, such as spline curves; able to store and manipulate attributes of features for categorical symbolization.
- **Data Storage:** a stable platform so that data is not lost; scaleable to support data of many themes for many regions (several million records); modular so that a project doesn’t tax the system by loading unnecessary data; conversion between projections and coordinate systems; versioned so that updates can be managed and reported.

## 2. Design Tools

The digital cartographer then uses these stored data to create maps. The primary advantage of digital design tools is that they automate many of the repetitive and computational tasks. The best tools should do this without adding significantly to file sizes (which are large enough already with all of the features on the map). Some of the tools and capabilities are listed below:

- **Integrated with Cartographic Database.** Changes to features are often made late in the design process, when “tinkering” with drafts. These changes should be stored in the original database, either as updates to the original feature or as alternative versions of the feature.
- **Graphic Techniques.** Some of the capabilities needed include: transparency, lines and fills with composite patterns (e.g. railroad hatching, cased roads), point symbols, controlled blocking behind text, text controls such as kerning.
- **Controllable Display Order.** Certainly should have layers, and ordering within layers, but the latter should be able to be controlled parametrically (e.g., “show all major highways on top of minor streets”); also, one should be able to make exceptions, either manually or parametrically, so that roads could go over bridges over other roads, or boundaries could go under small lakes but over large ones.
- **Advanced Visualizations.** Cartography today is about much more than flat paper maps. We must be able to produce three-dimensional views, animations, interactive websites, and spatializations of non-geographic phenomena.
- **User Interfaces.** Creative design happens best in an interactive environment, in which the cartographer can experiment with new ideas and see results immediately. This is crucial for new maps. However, when designs become standardized, the process works best if the design implementation (layer and feature selection, symbolization, layout, etc.) can be automated, using either templates created during an interactive session or high-level program scripts.

### 3. Output Tools

The third phase of production is to deliver the finished design to its intended audience. This final product can have many forms, each of which makes its own requirements of cartography software:

- **Personal Printer.** The vast majority of digitally produced maps are destined for a laser or ink-jet printer, producing only a few copies to be used by a limited audience. The most difficult obstacle here is not the printer hardware—it is matching the monitor image to the printed image. There are many tools to assist in this matching, even though a perfect match is physically impossible.
- **Press.** Traditionally, a map intended for a large audience would be sent to the press. While other forms discussed here have grown at its expense, there are still a lot of maps that are mass-printed. To support this, cartographic software must include extensive pre-press capabilities, including separations, registration, trapping, reliable text sizing and spacing, and of course the color control mentioned above, with support for several color processes (4-color and 6-color process, spot, and various color matching systems such as Pantone).
- **Other Software.** Frequently, cartographers work with other design professionals, as maps are often one part of a broader product (such as an advertisement or a telephone book). Thus, the map needs to be sent out as a digital file capable of being read *and altered* using graphic design software with as little translation loss as possible. This means more than just EPS; a good program would be able to export maps in the native formats of programs such as FreeHand, Illustrator, Quark Express, and Corel Draw with all the layering and other graphic tricks intact.
- **Digital.** When maps are dynamic or interactive, or when they need to reach a large audience inexpensively, the best medium may be digital, usually either CD-ROM or the Internet. To support these, cartographic software would need to export maps in the *de facto* and *de jure* standards of those media, including raster formats such as JPEG, PNG, and GIF, but also in vector formats such as PDF, Flash, and SVG. It would also be nice if the software could assist in building the entire interactive interface, which one may consider as part of the map.

Together, these three phases result in a rather large wish list of capabilities. However, none of these is a pie-in-the-sky dream (that would be a much longer list). All of the capabilities above are currently available in one program or another. The question is whether they can be effectively collected to complete a cartographic project.

#### The Current Solution

Needless to say, the perfect specialized cartography software, a single program that seamlessly integrates all the above capabilities, does not currently exist. Probably the closest product to this ideal is Mercator S/A from Barco Graphics ([www.barcographics.com](http://www.barcographics.com)), but even it does not meet all the standards, and it is priced out of the range of most small cartography shops. In fact, the perfect software will probably not appear for a long time, if ever. The main reason is that cartography is a relatively small

*“Needless to say, the perfect specialized cartography software, a single program that seamlessly integrates all the above capabilities, does not currently exist.”*

market; developing a new program that combines the relevant features of GIS and Graphics software would be a very expensive process. Therefore, cartographers have to use general-purpose software to create maps for the foreseeable future.

Our current toolkit includes four basic kinds of software: Geographic Information Systems, such as MapInfo ([www.mapinfo.com](http://www.mapinfo.com)) and ESRI's ArcView ([www.esri.com](http://www.esri.com)); graphic design programs, such as Adobe Illustrator ([www.adobe.com](http://www.adobe.com)), Macromedia FreeHand ([www.macromedia.com](http://www.macromedia.com)), and CorelDRAW ([www.corel.com](http://www.corel.com)); specialized cartographic production software such as Mercator S/A and MAPublisher from Avenza ([www.avenza.com](http://www.avenza.com)); and specialized tools, such as Bryce and World Construction Set for 3-D visualization or any number of web design tools. The specialized products will not be discussed herein because they are designed for a specific task rather than general cartography.

GIS software and graphics software operate in very different ways; this has a profound influence on what they can and cannot do with maps. GIS software uses an "include-by-reference" philosophy, in which the map layers are references to data files, stored permanently and separately from the map itself, and often filtered by attribute and/or spatial criteria. Symbolization, layout, and such are displayed on-the-fly, without modifying the underlying data. Graphics software uses an "object collection" philosophy, in which data are entered (drawn or imported) into one single file, and subsequently modified to select and symbolize objects, and compose the map layout. Once they are brought in, the graphics objects maintain no link to the source data. MAPublisher is an add-on to graphics software that does not change this mode of operation, but extends the import, selection, and symbolization capabilities. Mercator S/A works in much the same way as graphics software with MAPublisher, except that it has the ability to store each map layer as a separate file.

Each type of software has its advantages. The GIS model enables easier update, since changes to a dataset are immediately reflected in any maps that use it. The graphics model is more flexible (e.g., displacement generalization is okay because it doesn't tamper with the original data) and easier to transfer, since everything is contained in a single file. The specialized software has features that are designed specifically for cartography. However, each of these software genres also has its own problems for cartography.

Tables 1, 2, and 3 show how well each of the above types of software supports each of the requirements listed earlier.

The tables show that none of the standalone packages comprises a complete cartographic software solution. Each is lacking in at least one vital area. Mercator seems to meet the most requirements, but is still lacking some data management capabilities, and is very expensive. For the GIS software, the largest holes are in design and output capabilities (although recent software such as ArcGIS 8 have significantly improved the former). For the graphics software, the greatest obstacle is in data processing, although MAPublisher helps somewhat.

Does this matter? In some situations these holes are not crucial, such as when a cartographer is in a GIS department where quality and distribution of maps is not a high priority; or in a small cartography business that produces one-off maps exclusively, in which permanent data management is not a concern. Certainly, some capabilities are a higher priority than others. However, a cartography shop needs almost all these capabilities to serve the full range of requests from a wide range of clients. This can be accomplished to some degree with the available software in two ways.

*"Our current toolkit includes four basic kinds of software: Geographic Information Systems, graphic design programs, specialized cartographic production software, and specialized software."*

*"GIS software and graphics software operate in very different ways . . ."*



Table 1: Data Management Requirements

Capability		Low-end GIS (e.g. ArcView)	High-end GIS (e.g. ArcGIS 8)	Graphics (e.g. FreeHand)	Graphics w/ MAPublisher	Mercator S/A
Data Entry	Digitizer support	3	3	0	0	0
	On-screen digitizing	2	3	3	3	3
	Editing tools	2	3	3	3	3
	Editing map display	2	2	3	3	3
	Label placement	1	2	0	1	0
	Generalization	1	2	2	2	2
Data Import	GIS data import	2	3	0	2	2
	GPS transfer	2	2	0	2	0
	Web data services	0	2	0	0	0
Data Structure	Raster/Vector	3	3	2	2	3
	Georeferenced	2	3	0	3	0
	Annotation	1	2	3	3	3
	Multiple representations	1	1	0	0	0
	Complex geometrics	1	1	3	3	3
	Attributes	3	3	0	2	2
Data Storage	Stable	3	3	3	1	3
	Scaleable	2	3	1	1	2
	Modular	2	2	1	1	2
	Re-projection	2	3	0	2	0
	Versioning	1	3	1	1	0

*Code meanings: 3=strong support: exactly what we hope for  
 2=some support: it can be done, but could be easier to use or more powerful  
 1=either there is no coherent support, but it can be done manually or using extra add-ons, or there is support, but performance does not meet basic standards  
 0=not possible*

Table 2: Map Design Requirements

Capability		Low-end GIS (e.g. ArcView)	High-end GIS (e.g. ArcGIS 8)	Graphics (e.g. FreeHand)	Graphics w/ MAPublisher	Mercator S/A
2-Way database-design integration		3	3	1	2	2
Graphic Techniques	Complex line symbols	1	3	1	1	3
	Complex fill symbols	1	3	2	2	3
	Complex point symbols	1	2	0	2	3
	Text controls	1	1	3	3	3
Display Order	Layers	3	3	3	3	3
	Intralayer control	1	1	1	1	2
	Interlayer control	0	1?	0	0	2
Visualization	3-D Views	2	2	0	0	0
	Animation	1	1	1	1	0
	Website design	1	2	2	2	0
	Spatialization	1	1	0	0	0
Interface	Interactive	3	3	3	3	3
	Automated	1	2	1	0	2

Table 3: Output Requirements

Capability		Low-end GIS (e.g. ArcView)	High-end GIS (e.g. ArcGIS 8)	Graphics (e.g. FreeHand)	Graphics w/ MAPublisher	Mercator S/A
Printed Output	Color Matching	1	1	2	2	3
	Text Matching	1	1	3	3	3
	Pre-press controls	0	1	3	3	3
File Export	Graphics software	1	2	3	3	2
	Web formats	1	2	3	3	2

The first solution is the “patch” approach, developing custom tools and techniques for filling in the holes in one of the standalone solutions. Many of the presentations at 2001 Cartography Day showed the great accomplishments that cartographers have made in this regard. There are shareware and freeware programs for processing GIS data without a full GIS, such as GeoCart (for projection) and MicroDEM (for terrain analysis). Many cartographers have written macros in graphics programs, or developed manual procedures, for handling some of the data processing tasks. For example, MAPublisher can be considered a significant patch for graphics software.

Patch macros can also be written in GIS software to improve its capabilities for output and other current weaknesses. For example, I am currently developing SVG exporters for ArcView 3.x and Oracle Spatial, and shareware scripts are available for managing annotation in ArcView. The main problem with this approach is that there are still holes in each product that cannot be so easily filled, such as the color control in GIS, or the permanent data management in graphics software. Also, as the number of patches multiplies, the software can become quite cumbersome to use and manage.

Alternatively, the two kinds of software can be combined to form a “hybrid” solution. GIS and graphics software are quite complimentary; where one side is lacking, the other side is typically very strong. If one can integrate both sides, almost all the needs are met. Currently, that means managing the permanent cartographic database in GIS, then importing selected datasets into a graphics program to produce a map. This is a process I frequently use for my own map projects. The difficulty with this approach is that the integration is weak, and in only one direction. That is, one cannot make changes back to the permanent database (in the GIS) during the design phase (in the graphics software). Also, since only raw datasets are imported, the design process has to start anew every time (with a few shortcuts such as styles and templates). Even specialized cartography software such as Mercator S/A has this one-way workflow, although it does have tools for automating a standard design. Another problem is that many cartographers and graphic designers are based on the Macintosh platform, for which no robust GIS is available.

Thus, neither the patch nor the hybrid solution is as powerful as a single, well-designed cartography program could be. The greatest weaknesses of each approach for the three types of projects are summarized in the table below. Major weaknesses, those that would keep most people from using the tool for that purpose, are shown in bold.

As can be seen in Table 4, the current toolset is not equally satisfactory for all types of projects with all software solutions. Graphics software tends to do fairly well for one-off maps (especially simpler ones), and GIS can be effectively used (with some tweaking) to manage a permanent cartographic database. The Hybrid and Mercator solutions make the permanent map possible, but they are cumbersome at best.

### The (Near) Future Solution

As mentioned above, a specialized, low-cost, powerful cartography program is not likely to appear soon. If not, then what can we expect (or hope) to see in the near future?

One possible next-best solution is to further extend (or patch) graphics software to provide a complete solution. Vendors such as Adobe, Macromedia, and Corel are not likely to spend much time fulfilling the requests of such a small group. Third-party vendors such as Avenza and

*“GIS and graphics software are quite complimentary; where one side is lacking, the other side is typically very strong.”*

*“One possible next-best solution is to further extend (or patch) graphics software to provide a complete solution.”*

Table 4. Shortcomings of Current Solutions

Method	One-off	Cartographic Database	Permanent Map
GIS w/patches	<b>poor pre-press, text control, few export formats</b>	transforming management-oriented GIS data	<b>same as one-off</b>
Graphics/MAPublisher/other patches	instability	<b>no data management</b>	<b>updates difficult</b>
GIS > MAPublisher > Graphics hybrid	instability	same as GIS	<b>1-way workflow, re-symbolizing updates</b>
Barco Mercator S/A alone	<b>Complex</b>	<b>no data management</b>	1-way workflow
GIS > Mercator S/A hybrid	<b>Complex</b>	same as GIS	1-way workflow

the many programmers in the cartography community itself have brought us a lot closer, and will continue to fill in the gaps. However, even these developers admit that there are inherent limitations in graphics software structures that prohibit them from imitating the best features of GIS. For example, changing categorical symbology (e.g., choropleth maps) in ArcView or GeoMedia is a one-step procedure. Since this approach cannot be implemented in the API's of FreeHand or Illustrator, MAPublisher requires a lengthy procedure to accomplish the same result.

Another possibility is for GIS vendors to solve their cartographic shortcomings. Many GIS vendors have recognized the need for high-quality cartography in recent years, and are adding more high-end capabilities that used to only be in graphics software. In fact, in some cases the GIS features are better, such as ArcMap's impressive tool for building composite line and fill patterns or GeoMedia's interactive classification tool. There do not appear to be any inherent structural limitations that would preclude them from filling in the rest of the holes in the chart above, although some additions (e.g., more export formats) are more likely than others (e.g., prepress tools like trapping and separations). As these capabilities are introduced, they are likely to initially appear in high-end software or as optional extensions, thus increasing the cost. Also, it would be helpful to have a GIS package for the Macintosh platform to allow a large segment of the custom cartography community to have this approach available at all.

*"Another possibility is for GIS vendors to solve their cartographic shortcomings."*

A third solution would be to improve the hybrid approach. One way to do this would be to design the map in the GIS, then export the finished map (not raw datasets) to graphics software for final preparation for the press or combination with other graphics materials. This would take advantage of the inherent connection to live source data (a great advantage for the permanent map and cartographic database) and the increasingly powerful symbolization tools in GIS. The one-way workflow would not be a problem, since no permanent editing would be done with the graphics file. However, it would require that the GIS software have high-quality export tools, that preserve layers, styles, attributes, etc., not just graphics, and that the results (esp. colors and text) be reliable.

Another way to improve the hybrid approach would be to create a streamlined automated production system from the graphics software.

One would store all the data (including annotation) in the GIS. Then one would use an interactive graphics tool to design the map, associating styles or procedures with attribute values, and creating a layout of the map and other pieces. This would generate a template for that map design. Then all one would have to do is start a small program, load the template and hit "Make Map," and a few seconds later, out pops a complete graphics file, or process separation negatives, or website. This is not the elusive "Automated Cartography:" the cartographer is the one doing the complete design; the computer is simply automating the application of that design to the source data. This is the approach of the high-end cartographic production software from Barco Graphics and some GIS vendors, but they are too expensive for the small shop, and too cumbersome for the variety of custom cartography projects.

As in the first approach, the one-way flow would not be a problem. There is no need to tinker with the final graphic file (and worry about how to make the tinkering permanent); if a change is needed, it can be made to the original data or the template, and the graphics file can be easily regenerated. This solution could be reached in future versions of Mercator, or if some kind of scripting or parameterization capability could be added to MAPublisher.

The advantage of many of these augmentations of the current approach is that if necessary, we can do much of this ourselves. Both Graphics and GIS software have built-in high-level scripting environments, although some are simpler than others. Many of these extensions could be written by cartographers with moderate programming skills.

Although the perfect cartography software is not likely to appear soon, there is hope that the existing situation will improve. Fortunately, we as cartographers are not dependent on others to solve our problems for us. The 2001 Practical Cartography Day showed that cartographers are creating solutions. We should continue to leverage (and increase) our inherent creativity and talents to build the ideal tools for cartography.

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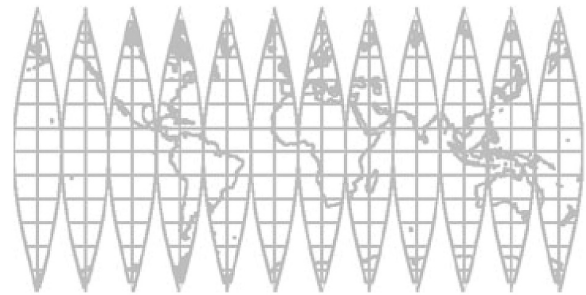
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*"Although the perfect cartography software is not likely to appear soon, there is hope that the existing situation will improve."*

*"We should continue to leverage (and increase) our inherent creativity and talents to build the ideal tools for cartography."*

## The Design of Globe Gores

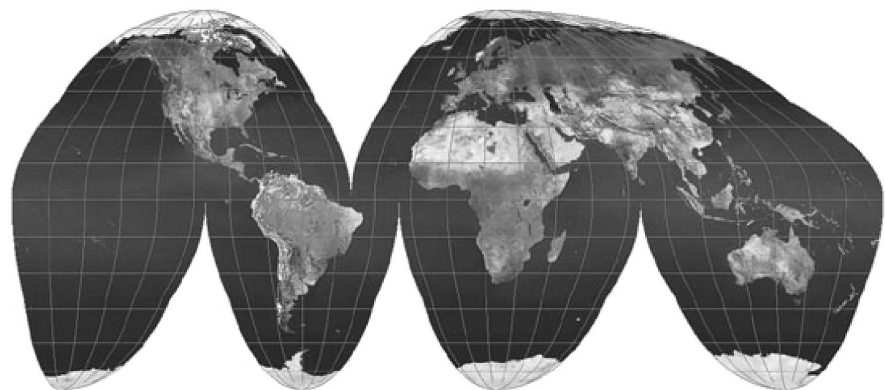
*Daan Strebe  
Mapmathematics LTD*



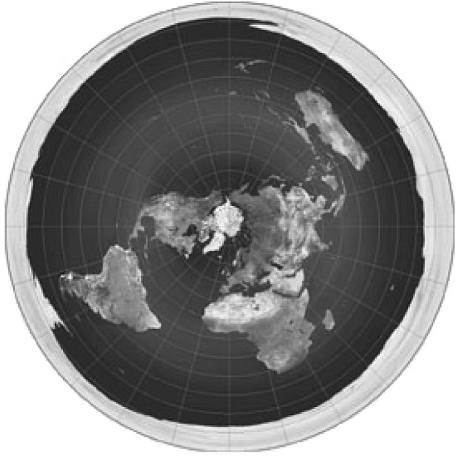
Why globe gores?

It's one our most common inquiries.  
Little recent literature.

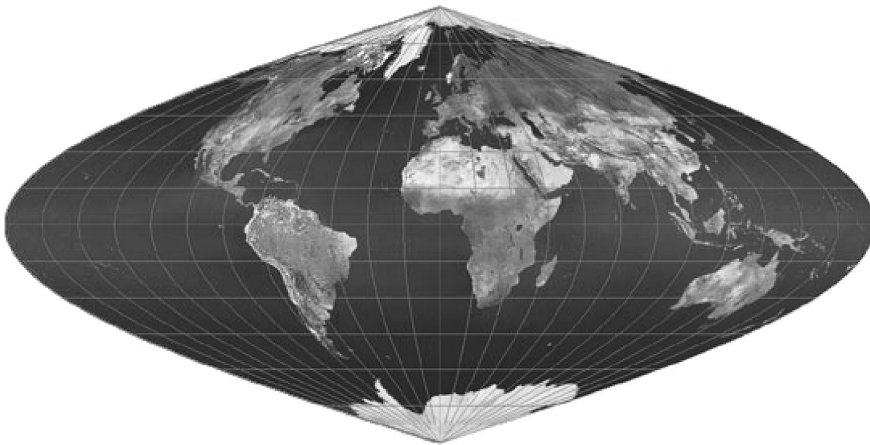
Globe gores are interruptions.  
What are interruptions?



Every world map is interrupted at least at one point.



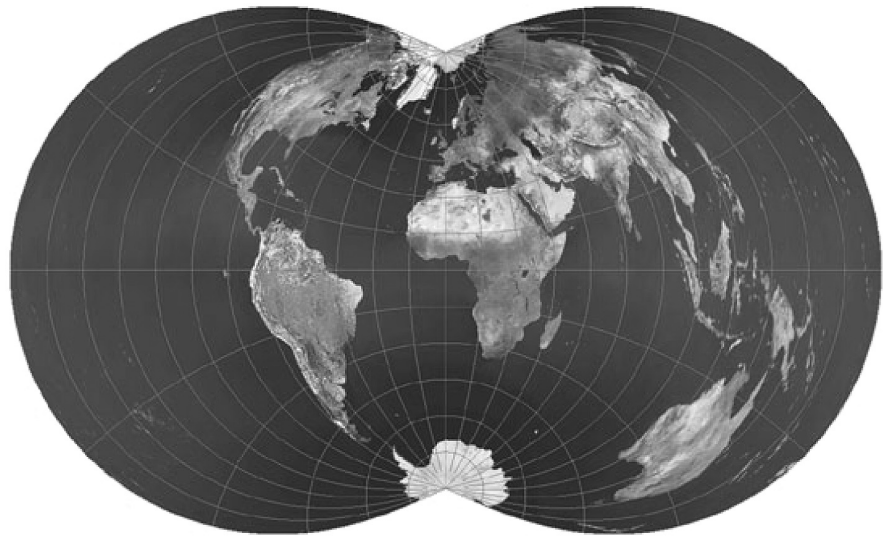
Most world maps are interrupted at least along one meridian. The more interruptions, the lower the shape or area distortion can be driven.



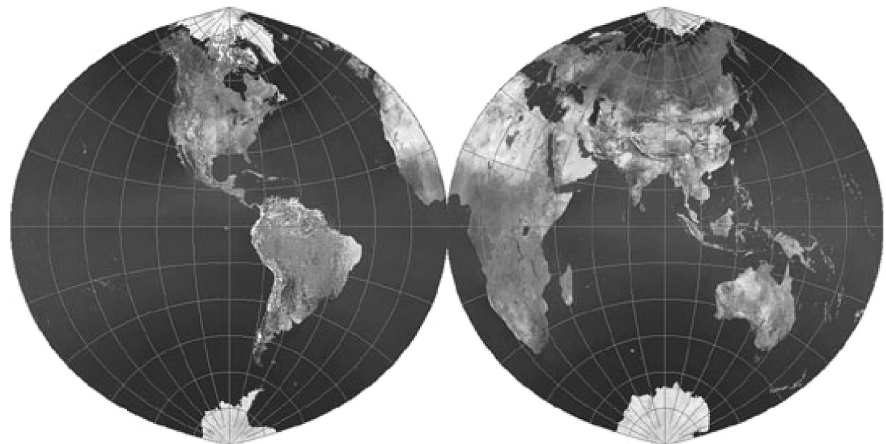
The more interruptions, the lower the distortion can be driven.

Notice the improvement in the following sequence:

Rectangular polyconic  
Standard parallel at equator  
One interruption

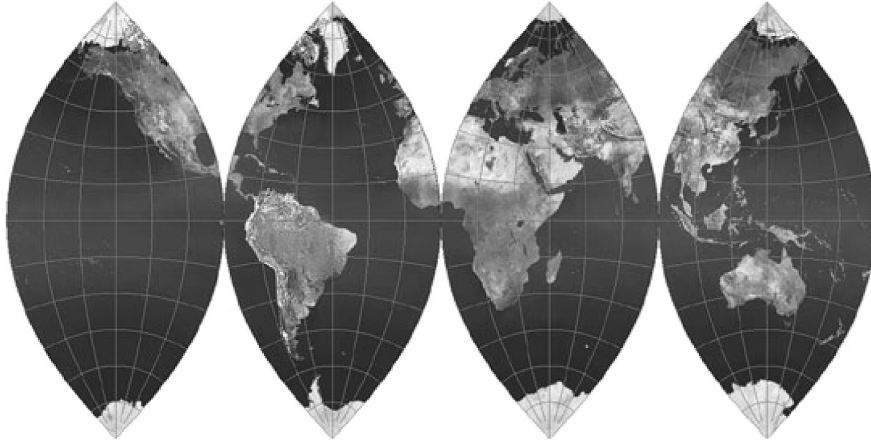


Rectangular polyconic  
Standard parallel at equator  
Two interruptions

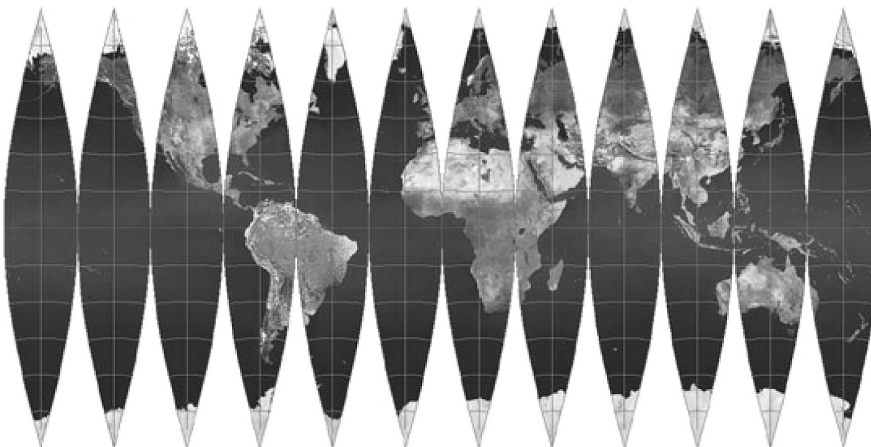




Rectangular polyconic  
Standard parallel at equator  
Four interruptions



Rectangular polyconic  
Standard parallel at equator  
Twelve interruptions

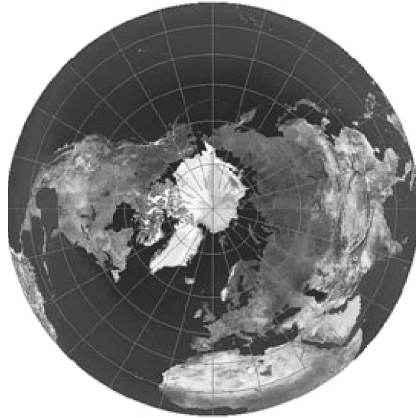


How are globes made?

Technology to print on curved surfaces is limited

Two methods:

- 1) Print gores, cut them, and paste onto sphere.
- 2) Print on malleable surface and extrude.



What is the best projection for globe gores?

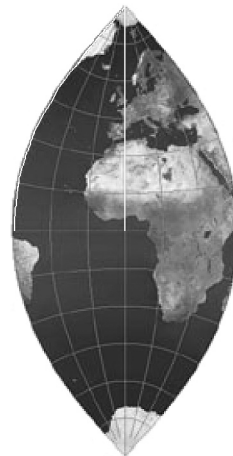
There is no best

Two fundamental reasons there is no best:

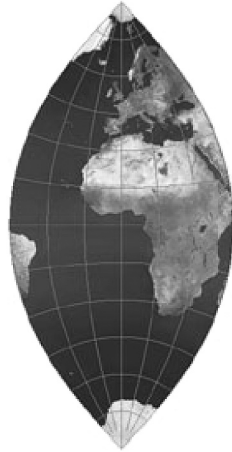
- 1) Mathematical: you must choose compromises;
- 2) Mechanical: stress properties of the medium vary.

What mathematical compromises are there?

Meridians should converge to the poles. But if they do, then the meridians can't all have the same length.



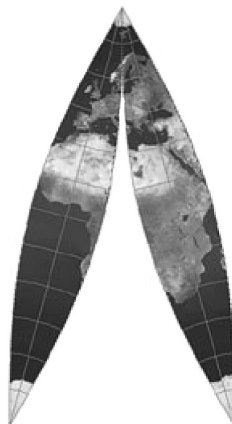
Parallels should meet meridians at right angles so there are no links in the seams between gores. But if parallels curve to meet the meridians at right angles, then the distance between parallels cannot remain constant.



What mechanical problems are there?

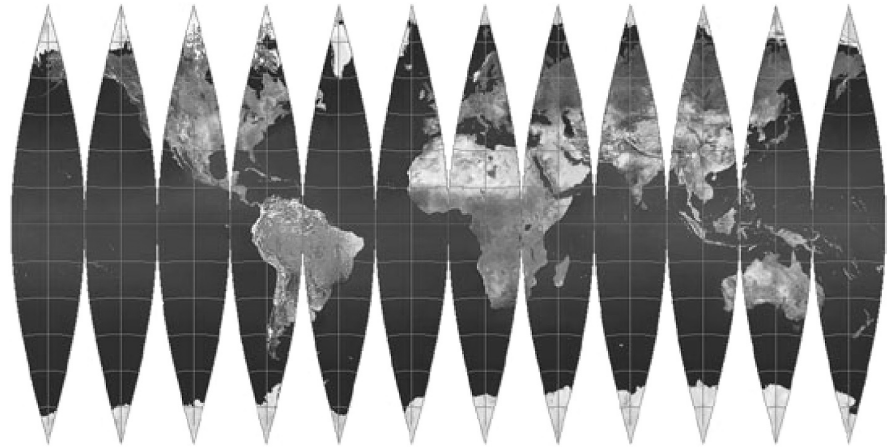
Flat media will buckle when adhering to a surface curved in more than one dimension when the curvature exceeds the medium's ability to distort. Wider gores require less production work but stress the medium more. Narrower gores stress the medium less but increase the number of seams, each of which is problematic.

How thick or thin a gore segment must be at each point along the seam meridian in order to avoid overlap or gaps depends on how the specific medium spreads. It varies from medium to medium; hence what projection is best varies from medium to medium.



A good basic gore:

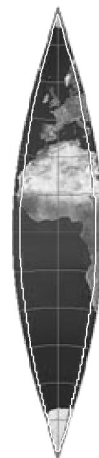
Rectangular polyconic with  $0^\circ$  standard parallel.  
Meridians meet parallels at right angles, so it's suitable for  
gores of any width.



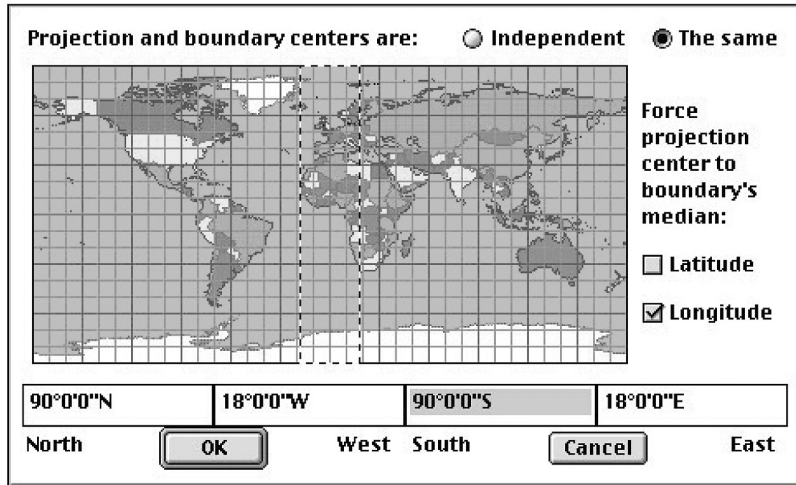
In order for a projection to be interrupted easily in a general way, spacing of meridians must be constant along the equator. Most of those projections are pseudocylindrical. Pseudocylindrical projections have straight parallels, so they do not meet the meridians at right angles. Hence, pseudocylindrical projections are not suitable for globe gores. Projections suitable for gores are rare.

The problem of bleeds

Rectangular polyconic has sound mathematics, but in practice you must print beyond the seam meridian in each gore to prevent gaps. This excess is called "bleed".

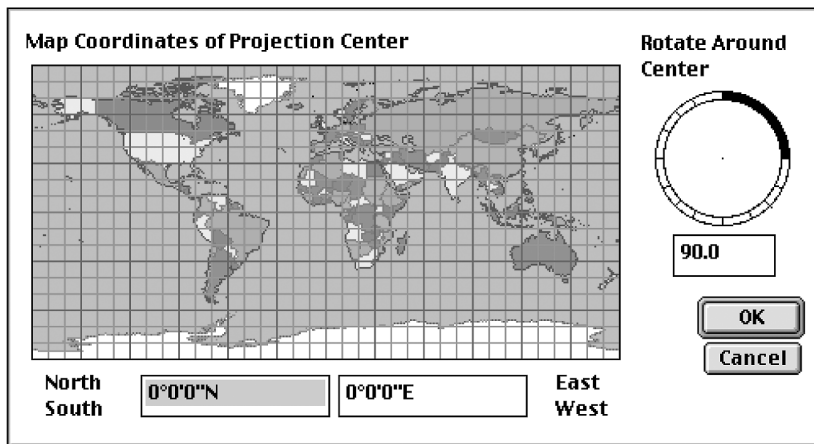


You can't use a stock interruption for bleeds; you must print each gore individually.  
 Set the projection center to the central meridian of the gore segment. Repeat for each gore.



Use transverse aspect for a variety of gores

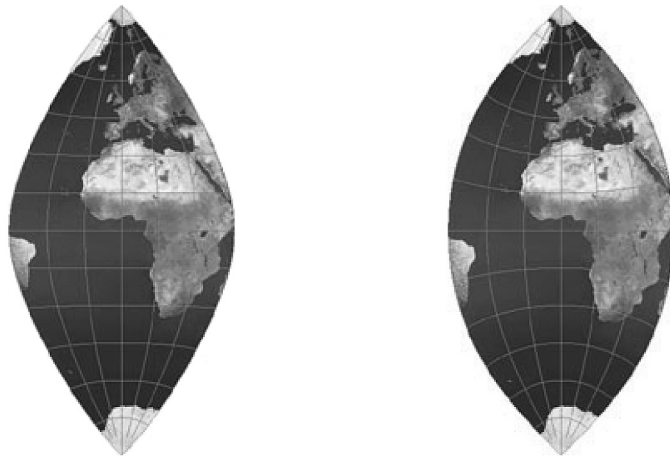
Set projection center just like a regular gore.  
 Rotate 90° around center for transverse aspect.  
 Render each gore separately.



Many pseudocylindrical projections are suited to globe gores in transverse aspect because the equal spacing of meridians translates to equal spacing of parallels along the central meridian of the gore.

Also, parallels tend to meet meridians at close to right angles because the same is true close to the equator on equatorial aspects of pseudocylindricals.

Compare the sinusoidal on the left as one extreme;  
The plate carrée on the right as the other extreme.  
Choose something in between to accommodate the properties of the medium.



**CUAC Minutes**

**CARTOGRAPHIC USERS  
ADVISORY COUNCIL (CUAC)  
2002 MEETING MINUTES  
May 3, 2002**

**CUAC Representatives:**

- Janet Collins, Western Washington University (WAML)
- Mike Furlough, University of Virginia (MAGERT)
- Donna Koepp, University of Kansas (GODORT)
- Clara P. McLeod, Washington University (GIS)
- Bruce Obenhasu, Virginia Tech (SLA G&M)
- Daniel T. Seldin, Indiana University (NACIS)
- Paul Stout, Ball State University (NACIS)
- Christopher J. J. Thiry, Colorado School of Mines (WAML)
- Mark Thomas, Duke University (MAGERT)
- Linda Zellmer, Indiana University (GIS)

**Presenters:**

- Betsy Banas (NFS)
- Dan Cavanaugh (USGS)
  - Howard Danley (NOAA)
  - John Hebert (LC)
  - Betty Jones (GPO)
  - Jim Lusby (NIMA)
- John Moeller (FGDC)
- Richard H. Smith (NARA)
- Timothy Trainor (Census)
- Doug Vandegraft (F&WS)

**Attendees:**

- Susan J. DeLost (NFS)
- Wil Danielson (GPO)
- Mark Flood (NFS)
- Robin Haun-Mohamad (GPO)
- Vi Moorhouse (GPO)

**Agenda**

8:30-8:40	Welcome and Introductions
8:40-9:30	CUAC Presentation Preservation and Archiving Issues Roundtable Discussion Led by Donna Koepp University of Kansas Government Documents and Map Library
9:30-10:00	Library of Congress, John Hebert
10:00-10:20	Break
10:20-10:50	National Archives and Records Administration, Richard Smith
10:50-11:20	US Government Printing Office, Betty Jones
11:20-11:50	Federal Geographic Data Committee, John Moeller
11:50-1:00	Lunch
1:00-1:30	Forest Service, Betsy Banas
1:30-2:00	Census, Tim Trainor
2:00-2:30	US Geological Survey, Dan Cavanaugh
2:30-2:45	Break
2:45-3:15	NIMA, Jim Lusby
3:15-3:45	NOAA National Ocean Service, Howard Danley
3:45-4:15	Fish and Wildlife Service, Doug Vandegraft
4:15-4:30	Wrap-up and Closing Remarks

**Preservation and Archiving  
Issues Roundtable Discussion**  
*Facilitated by Donna Koepp,  
University of Kansas, Government  
Documents and Map Library*

*Introduction (Donna Koepp, CUAC)*  
Our biggest concern is the preservation of cartographic and spatial data, especially what is born digital and we never see in paper. We are concerned about having

snapshots in time for data that is constantly being updated, so that we have historical records. Libraries are not set up to preserve that data mainly because of file size. Are the agencies preserving snapshots of their data? If not is there some roll that libraries can play, similar to what we do with paper documents? GPO does some preservation of text documents, but is not preserving maps – GPO is referring users to USGS and other agencies because the files are so large. Libraries have some capacity to work with government agencies to do this in partnership to preserve these datasets.

*John Moeller (FGDC)* encouraged our participation and representation in FGDC. A specific opportunity is with the Historical Data Working Group of FGDC chaired by Bruce Ambacher from the National Archives and Records Administration (NARA). They developed the policy and guideline statement “Managing Historical Geospatial Data Records: Guide for Federal Agencies” in 1997. Tools in place that can be used include the metadata standard for documentation, a final draft of an international metadata standard should be approved by the end of this calendar year, and the spatial data transfer standard.

*Donna Koepp (CUAC)* asked if John knew of any agency that was preserving all of its cartographic data.

*John Moeller (FGDC)* replied that he did not know of any. He knows that the Earth Resources Observation System (EROS) data center has an extensive archive of imagery and Bureau of Land Management (BLM) has a policy for preserving all information including digital information.

*Donna Koepp (CUAC)* mentioned the special problems with BLM’s decentralization. State and local offices are not necessarily following the same rules.

*Chris Thiry (CUAC)* pointed out users often want historical data. People are doing historical studies, examples include the history of land management and growth areas, and this is why we are so interested in having snapshots of the data. We may lose this history and end up with a period of time where we don't have the documentation.

*Richard Smith (NARA)* hopes it is a comfort to know that federal statutes require records maintenance, control and disposition schedules, for materials of enduring or permanent value, regardless of format. Sometimes there is a snapshot provision. The Electronic Records Archive of NARA is charged with preserving many different electronic records formats including maps and cartographic data sets independent of software and hardware. Currently in a pilot project, the Electronic Records Archives is supposed to be up and running by 2004. The Archives has a plan for collecting and preserving digital datasets.

*Donna Koepp (CUAC)* mentioned the NARA definition of records management and found it comforting that their definition of records includes maps.

*Bruce Obenhaus (CUAC)* brought up issues of when do we take snapshots and how much change is worth identifying? What is of enduring value? These are hard questions that might not have answers currently.

*Richard Smith (NARA)* added that the National Archives has appraisal archivists that are familiar with electronic records. They are hammering out agreements with agencies on the maintenance, use and final disposition of these files. That's the law and nearly the practice. Archives has schedules for USGS electronic records, as an example. Archives will likely preserve only a small (2-3% of paper is now preserved and we presume electronic data will be

similar) percentage of the data actually collected. This is a shared responsibility between NARA and the originating agencies.

*Donna Koepp (CUAC)* asked what is included in NARA? Is it similar to Federal Depository Library Program (FDLP)? NARA keeps records of the agency, FDLP keeps the publications of the agencies. These are different types of material.

*Richard Smith (NARA)* The National Archives collects record sets from agencies. Archives has what he presumes FDLP libraries have and a lot of manuscripts to back up the publications.

*Mark Thomas (CUAC)* Now there is a blurring of published materials and electronic materials. With digital spatial data, maps are made on the fly, there is no permanent published version because the user makes maps for a specific purpose. The problem lies with saving the original data.

*Richard Smith (NARA)* Maps or records created by an agency may not have a permanent value to the agency and would not be preserved. When records are still important to an agency the agency keeps them until the use of the record dies down, at this point it will be transferred to NARA. Some records are deemed so important that the agencies keep them for many decades.

*Donna Koepp (CUAC)* There still are concerns with items that are not getting into the GPO distribution system, including the very special projects that may be sitting on agency shelves and we don't know exist because they have never been cataloged. This is also a problem with electronic items that never get into the system. It's a matter of getting information out there and sharing it. It's a matter of discovery.

*Mike Furlough (CUAC)* questioned to what extent NARA has already worked with cartographic data in electronic format? Cur-

rently statistical data is the bulk of the electronic data that NARA has archived.

*Richard Smith (NARA)* Only 4 groups of spatial files including the TIGER files are currently in NARA electronic archives, possibly 5% or less of what is out there. NARA is setting up schedules for the transfer of files but most have not been transferred to NARA because of the high rate of activity on the file. NARA may wait until files are 15-20 years old before they are deposited.

*Chris Thiry (CUAC)* Asked Mark Flood (NFS) – do you have data that you can no longer access for any reason?

*Mark Flood (NFS)* There has been problems accessing data collected 5-10 years ago because of changes in hardware and software. This is not as much a problem in maps yet because they have not been done electronically for a long period of time. This problem could be coming in the near future.

*John Hebert (LC)* Of concern to the Library of Congress is the ability to acquire increments of improvements in cartographic output. LC is much more global in acquisitions than NARA.

*Linda Zellmer (CUAC)* In asking federal agencies about archiving their data the answer was, "it is in the metadata". They are updating files but not including dates for updated fields in the metadata. Would like to see a temporal GIS, with dates when a field or feature was added.

*Susan DeLost (NFS):* National Forest Service is now developing feature level metadata. For each record there will be a metadata link attached to a particular record including a year when the field was added.

*Tim Trainer (Census):* From a producer and user perspective you will end up with more metadata than spatial data. That is something that we need to take another look at.



*Donna Koepp (CUAC)* thanked everyone for their participation and insights on the question of preserving and archiving cartographic data.

### **Library of Congress**

*John Hebert, Chief of the Geography and Map Division of the Library of Congress*

John Hebert, Chief of the Geography and Map Division of the Library of Congress, presented the LC update again this year. His presentation focused on the areas of acquisitions, staffing, scanning projects, general projects, the Phillips Society and the special project this past summer.

### Acquisitions

Of significance is the acquisition of the only known copy of a 1507 map, compiled by cartographer Martin Waldseemüller, to bear the name "America" and the first to depict a separate Western Hemisphere. Congress appropriated \$5 million for the purchase of the map and fund raising is still underway to secure an additional \$5 million. They have some pretty good leads for this money. There are several other items in the packet that came from Prince Johannes Waldburg-Wolfegg in which the library is very interested. They received from Census 130,000 sheets of census track materials for the 2000 Census. After September 11 there was a great deal of interest in holdings covering Southwest Asia. The Division put together a listing of what they hold and have tried to fill in gaps. LC continues to receive materials produced by the former USSR. They have completed most of the acquisitions of Soviet produced maps at 1:200,000 scale and are now acquiring the 1:100,000 scale series world wide. In addition they have sought nautical charts for the Arctic and Pacific coasts. LC has received what John believes will be

the final acquisition of paper state road maps, about 20,000 sheets, and expects future receipts from state highway departments will be digital.

### Staffing

The Geography and Map Division has a total of 55 employees. In the past year they have added 5 new technicians, and currently have a posting for two new catalogers. An assistant chief of the division and two new reference librarians will be advertised in the near future. They are adding one new person in the scanning and digital lab to replace one lost last year, bringing the staff back up to four. An additional digital specialist, a GIS person, is also being added. A new GIS initiative to create an "on demand" service for Congress is underway. Two geographer positions will be added for this initiative.

### Scanning Program

The Library has over 6,000 maps scanned. Cataloging is slowing the progress with as many as one third requiring original cataloging. They hope to recover some of the cost of the scanning and cataloging from sales of printed copies of the maps. The Waldseemüller map was scanned last fall, front and back. After they complete payment on the map, the question will be what to do with the scanned copies. LC probably will look to recover some costs by selling prints from the scanned copies and John wants it to be available online. They are currently completing the Civil War project, about 2,500 maps, Revolutionary War period maps, another 2000 maps, and are working on about 3000 sheets of British produced maps from the Revolutionary War era. New projects include scanning an early 19<sup>th</sup> century map of Japan which is divided into 214

sheets. Each sheet is about 5 by 5 feet. LC holds 207 sheets, 160 of which are not found anywhere else in the world.

### Projects

Professor Li from Beijing is coming to work at the Library this summer on the manuscript materials on China. Along with identifying and cataloging these materials they hope to scan many of them. Scanning could be problematic since many of them are scroll maps, some up to 60 feet long, that may take some creative work to complete. A continuing project is acquiring maps used in the field by soldiers and personal remembrances of those soldiers from World War II, Vietnam, and Korea. The hope is to produce an historical record of how maps are used in combat. Any help on locating veterans and maps would be appreciated. LC and the National Imagery and Mapping Agency (NIMA) are now in a cooperative cataloging project where NIMA is cataloging their set maps in Marc format to the sheet level. A Lewis and Clark exhibit, largely maps, is being planned with the kickoff to be in September 2003.

### Philip Lee Phillips Society

The Phillips Society is the Friends of the Geography and Map Division organization. There are currently over 200 members. This year's meeting is a joint meeting with the Texas Map Society in Arlington, Texas in October. The Society publishes newsletters and occasional papers.

### Special Project

Last year's summer project with five participants was a great success. They are not planning one this year. Instead, this summer the Library is hosting two librarians from tribal libraries in North Da-

kota and Minnesota. They expect to go back to the traditional summer project next year.

#### Sanborn Atlases

LC currently does not have a project to scan the Sanborn Atlases. Bell and Howell/Proquest developed a digital record of the black and white film but researchers are dissatisfied because it is black and white and because the film is not always a good copy. LC would like to scan the original color maps but lacks the resources to digitize all the maps and lacks permission from EDR Sanborn for those still under copyright.

LC is looking into the possibility of using some facilities at Fort Meade for remote storage.

#### **National Archives and Records Administration**

*Richard H. Smith, Senior Archivist, Cartographic Unit, Special Media Archives Services Division*

Dr. Richard Smith began by recounting the history of the Cartographic and Architectural Records Branch of the National Archives (web site [www.nara.gov](http://www.nara.gov)). Acquisition of maps and charts began in the 1930's. In the 1960's aerial photographs were added to the collection and in the 1970's through 1990's architectural and engineering plans were also added. Currently, they have just under 2.5 million maps, just over 2.5 million architectural and engineering drawings and 16 million aerial photographs. Not all acquisitions are in paper copy; the Archives also have materials on film and aperture cards. The cartographic unit has a staff of 14 who access, process, describe and make records available to the public in the Public Research Room. The Research Room is open six days a week and three evenings a week in the Archives II building

in College Park, Maryland. For more background on the Cartographic and Architectural Records Branch refer to General Information Leaflet No. 26 (<http://www.nara.gov/publications/leaflets/gil26.html>).

Records, as defined by federal statute include "all books, papers, maps, photographs, machine readable materials, or other documentary materials, regardless of physical form or characteristics, made or received by an agency of the United States Government under Federal law or in connection with the transaction of public business and preserved or appropriate for preservation by that agency or its legitimate successor as evidence of the organization, functions, policies, decisions, procedures, operations, or other activities of the Government or because of the informational value of data in them". (44 U.S.C. Chapter 33 Section 3301). Acquisitions are by records control schedules drawn up between the Archives and the originating agency. The Archives provides records life-cycle management guidance to all Federal agencies and conducts evaluations of Federal agency records management practices. Items come to the Archives after active use of the materials has diminished, the standard is about 30 years (after current administrative need for the materials is extinguished). Occasional offers of unique materials are made, but this is somewhat rare. Exceptions to the 30 year rule include receipt of a copy of most Federal agency maps at the time of printing. These records series are sometimes supplemented by annotated copies of maps and background files for published maps. Records are stored in record groups and kept in record series. The provenance of the materials is maintained. Appraisal and retention in the Archives is done on a series basis, not the individual piece.

Cataloging is done at the collection, series and record group level. Rarely is any item-level cataloging done.

Maintenance and preservation of the collections are major priorities. To minimize handling Archives creates reference copies in photocopy, microfilm or photographic reproductions for especially valuable items, but generally original maps or drawings are brought to the Research Room. A recent example is the color 35mm film of the 1930 Census enumeration district maps now available to accompany the 1930 census schedules released in April. This is the first time Archives has filmed the enumeration district maps. Paper maps are stored flat in map cases in acid free folders with occasional items in Mylar sleeve application. A scanning project, done under contract with a private company, has processed about 300 maps and 100 aerial photographs so far. We should also be aware of the Center for Electronic Records and their programs and the related Electronic Records Archive (<http://www.nara.gov/nara/electronic/>).

#### **Government Printing Office**

*Betty Jones, Chief of the Depository Administration Branch*

Betty Jones, Chief of the Depository Administration Branch, presented for the Government Printing Office (GPO). She has been in the position for less than one year.

#### Staffing Changes

On Friday, March 29, 2002, President Bush nominated Bruce R. James to be the Public Printer. Current Public Printer, Michael F. DiMario has been in the position since 1993. The Public Printer is the head of the U.S. Government Printing Office.

In the past year GPO has hired a chief of serials cataloging and a chief of monograph and map cataloging. They have also hired two new catalogers and made offers to two other candidates for cataloging positions. There are currently 14 catalogers with 6 positions still to be filled. In addition they have hired three program analysts and will hire an additional librarian in the Depository Administration Branch.

#### Budget: fiscal year 2002 appropriations

LPS received funding from Congress to modernize the automated library system. They are on the fast track to purchase a state of the art integrated library system (ILS). The current legacy systems made it through the Y2K transition. One persistent problem is the current systems do not allow for the easy transfer of information from one to the other. This is a major advantage of the ILS. GPO will be hiring a consultant to help with the transition. Any help or advice librarians outside GPO can provide would be greatly appreciated.

#### Recalls

On October 12, 2001, Francis J. Buckley, Jr., Superintendent of Documents, issued the recall of USGS Open File Report 99-248: *Source-Area Characteristics of Large Public Surface-Water Supplies in the Conterminous United States: An Information Resource Source-Water Assessment*. Mr. Buckley explained the Policies and Procedures for Withdrawing Documents from the FDLP in the November 15 *Administrative Notes*, and again March 14 in a letter sent to all depository library directors and coordinators (the letter was reprinted in the April 15 *Administrative Notes*). Since FY 1995, the GPO has distributed 230,019 tangible product (print, microfiche, and CD-ROM)

titles to depository libraries, and recalled just 20 (16 to be destroyed, 3 returned to the agency, 1 removed from shelves). GPO has not been asked to withdraw any electronic publication. Several agencies have taken electronic publications off their web sites.

#### Recommended Workstation Specifications

Betty presented copies of the 2002 Recommended Specifications for Public Access Workstations in Federal Depository Libraries and pointed out the "for cartographic data use" recommendations. This draft will be published in *Administrative Notes* and will supercede the recommended specifications dated June 2001 and become requirements on October 1, 2003.

#### Collections

GPO provided cataloging for 4,200 maps and map products this past year from USGS, Census Bureau, Department of Agriculture, NIMA, NOAA, CIA, and other agencies in paper, CD, DVD, and online. GPO will continue to disseminate maps in a tangible format whenever possible. Census track maps for the 2000 census will not be distributed in paper because of the prohibitive cost of production and distribution. They will be available on DVD. The Interagency Agreement with USGS expires this fiscal year. GPO does not foresee any major changes or any problems in renewing the Agreement.

#### **Federal Geographic Data Committee (FGDC)**

*John Moeller, Staff Director*

John Moeller, Staff Director of the FGDC, presented at the meeting for the first time. He primarily discussed policy; what the FGDC is, what tasks have been assigned to it and then generally about the National Spatial Data Infra-

structure (NSDI). The FGDC is an interagency and intersectional committee at the federal level. There are currently 17 cabinet and executive level agencies represented, and additional agencies/organizations are expected to become members, e.g., GPO and GSA. The FGDC has a Steering Committee, a Coordination Group, and a FGDC Secretariat staff. FGDC is under the leadership of the Department of the Interior. The Deputy Secretary of the Department of the Interior is the chair and the vice-chair is Mark Foreman, OMB Associate Director for Technology and Electronic Government. Within the Committee, there are 27 working groups or subcommittees that are organized on thematic categories, for example, the U.S. Forest Service for vegetation, the U.S. Fish and Wildlife Service for wetlands, and Census for cultural and demographic issues. Working groups deal with issues that cut across areas, such as a NARA lead working group for historical data and a recently established working group on homeland security with NIMA and USGS serving as co-chairs. FGDC's primary responsibility is determining among local participating agencies how activities for providing, collecting, and utilizing spatial information at the federal level can be better coordinated and to provide federal leadership for the National Spatial Data Infrastructure. A component of this goal is also to involve state, local and tribal governments, the academic community and the private sector.

John said that he directs the staff that supports the daily operations of the committees. The FGDC was organized in 1990 under OMB Circular A-16, which promotes "the coordinated use, sharing, and dissemination of geospatial data on a national basis". This establishes the federal information policies for the federal government. Regarding questions about the recent removal

of some government information off the Web, he stated that the government's policy still is to have federal information made available at the least cost to the widest dissemination with the least amount of restrictions as possible. In spite of September 11<sup>th</sup>, that policy has not officially changed, although the limitations of it have changed and there were plans to reassess OMB Circular A-130. At this time, there will probably be three categories of information, one being classified, another being open public domain, and the third being restricted information based on some criteria and protected for perpetuity in some cases and in some cases open access after a certain amount of time. Studies have indicated about 80% of government data has a spatial component. When managing business processes and decision processes in the federal government, geography can be used to better understand the entire environment. More and more, the geospatial component to information is being perceived by people as fundamental and we need to take opportunities for building the global spatial data infrastructure. There are about 50 or more countries that are either beginning to build this infrastructure or are planning to do so and the commonalities are many. FGDC is supporting these initiatives. A new kind of infrastructure to improve the use of geospatial resources across the country is needed. Currently, this is operated at the federal level under an OMB Circular A-16 and Executive Order 12906.

The components of the spatial data infrastructure are:

**Framework:** 7 layers have been identified to provide a consistent base for spatial location. The layers include imagery, elevation, cadastral, transportation, government units, geodetic and hydrographic.

**Metadata:** An explanation or textual description of the data

source. The FGDC has a metadata standard and federal agencies are required to use this. The expectation is that we will see greater implementation of the standard as more and more vendors begin to put it into their tools. In addition, there is the ISO standard that is being worked on by the ISO Geospatial Technical Committee 211. It should be in place by the end of the year. The federal government is committed to building a transition from the FGDC existing metadata standards to the ISO standards. There may just be one uniform standard for North America, including Canada, United States and Mexico.

**Clearinghouse:** A metadata catalog to ensure access to data that is already available to fit a user's needs. The catalogs are networked from county to country. For example, the United States, Canada and Australia have been networked. There are 26 or 27 countries that are now part of the global NSDI clearinghouse. The clearinghouse is expected to be at least 80-90% global in the future.

**Standards: Data and Technology.** 17 standards have been endorsed through the FGDC and another 20 or so are in some form of development by the subcommittees and workforce. The goal is to have interoperable data and specifications. They focus on data content and data classification. NIMA has been a big promoter of these products. The Open GIS Consortium is the primary organization providing guidance for the interoperable geoprocessing technology specifications.

**Geodata:** Available geographic data needed for community decision-making. The hope is to use descriptors, the clearinghouse, the standards and the other tools to make all geographic data more accessible and useable. The results will be that we will have the opportunity of finding geodata, understanding what is in a dataset,

using more and more consistent terminology and definitions of the data and having more tools available so that we can bring them together for decision making.

**Partnership:** Relationships for collaboration, sharing and policy deliberations. These are critical as 80% of the government data has a spatial component, cadastral data is only 1-2% at the federal level while 98% is at the local level, and only 5% of the biological spatial data is at the federal level. Thus the only way to build information relationships is through partnerships and collaborations.

John emphasized that the National Spatial Data Infrastructure (NSDI) is being developed for organizations to cooperatively produce and share geographic data. He cited several examples of geospatial data products where the use of standards has added to the understanding of the importance of interagency cooperation. A goal of the Infrastructure is to reduce duplication of effort among agencies and localities as well as to improve quality, increase availability and reduce costs related to producing and accessing geographic information.

John discussed the geospatial One-Stop E-Government initiative, which resulted from the government's desire to provide services to help other government entities, businesses and citizens to more effectively use electronic technology. A federal OMB task force was established to recommend profitable e-government initiatives and 24 initiatives were selected, one of which was the Geospatial Information One-Stop. This initiative was assigned to the Department of the Interior and the FGDC. Currently, FGDC is working with 11 federal partner agencies plus state, local and tribal governments. The vision of the Geospatial One-Stop is to spatially enable the delivery of government services and to provide a place where access to

individual information and access to combined information will be possible. The future model should provide fast, low-cost, reliable access to geospatial data needed for government operations via a government-to-government portal for this information. This will also facilitate the effective alignment of roles, responsibilities and resources for government-to-government geospatial interactions needed for vertical missions such as homeland security. Another goal is to have multi-sector input for standards which will create consistency in order to promote interoperability and stimulate market development of tools. The focus of the Geospatial One-Stop is to accelerate development and implementation of NSDI technology, policies and standards that support "one-stop" access. The outcome of the initiative should be that the infrastructure is accelerated, achieving better, faster, less expensive access to reliable data for use by citizens, to improve the use of resources for data acquisitions, partnerships, and reduce duplications, and to have all E-Government initiatives spatially enabled through data and functional capability.

In summary, John stated that an important goal is to create a multi-purpose program of procedures and technology with federal, state, local, academia, private sector and tribal governments to provide access to an enhanced geospatial one-stop portal that is enabled by standards and technology interoperability tools and is not vendor specific. The data will be based on standards and will be commercially available and technology driven so that it can be used in a whole variety of applications enabling geographic information use across the nation and the world. We are encouraged to provide output and representation from our communities, to give input by reviewing the standards and to recommend candidates to work on team proj-

ects to help further the Geospatial One-Stop initiative.

### **National Forest Service**

*Betsy Banas, Staff Cartographer, Geospatial Services Group*

Betsy Banas, National Forest Service (NSF) gave us an overview of the Service's mapping history, mapping programs, and digital mapping committees.

### History

Betsy began by noting the similarities between the mission statement of CUAC and that of the Forest Service. The Forest Service mission statement is "caring for the land and serving the people". Gifford Pinchot was the first Forest Service chief and the mission statement then was to "provide the greatest amount of good for the greatest amount of people in the long run". She noted the philosophical differences between Gifford Pinchot and John Muir in establishing "reserves" vs "preserves".

The Forest Service was created in 1905 to provide quality water and timber for the Nation's benefit. It originally had 60 forest reserves covering 56 million acres; now, it has 155 forests and grasslands covering 191 million acres. The Service is very decentralized, having 9 Regions, 1 through 10. Region 7 was absorbed into Regions 8 and 9 long ago. At the time that the Forest Service was organized, it was deliberately decentralized, as it was decided that decision makers needed to be right there, "on the ground" as they were most familiar with the public's needs at the local level.

The Forest Service is the largest forestry research organization in the world, having 20 research and experimental forests and other special areas. It also provides technical and financial assistance to state and private forestry.

Over the years, the public has

expanded the list of what they want from national forests and grasslands. Congress responded by directing the Forest Service to manage national forests for additional multiple uses and benefits as well as for the sustained yield of renewable resources such as water, forage, wildlife, wood, and recreation. Multiple use means managing resources under the best combination of uses to benefit the American people while ensuring the productivity of the land and protecting the quality of the environment.

The mapping and geospatial data programs have helped meet the Forest Service mission by aiding in fire management, forest planning, forest health protection, watershed restoration, ecosystem management and sustainability of our resources, and recreation. Initially mapping was done at the local level and it was a vital part of administering the land. The maps were made to the specifications and requirements of the particular forest. There was little standardization or consistency among Regions.

This changed during World War II. There was an effort to consolidate mapping for defense purposes. The Forest Service, at the time, had the equipment and expertise. During the War, NFS map programs worked out of Gettysburg, Pennsylvania, mapped areas of the U.S. along the Pacific Coast, and aided in making detailed maps of Japan.

Through the late 1960's regular Forest Service mapping business continued to be decentralized and non-standardized. But mapping technology began to change; new, costly equipment, computers, etc. required the centralizing of mapping operations. The Geospatial Service and Technology Center (GSTC) was founded in 1975 (then called Geometronics Service Center) and is located in Salt Lake City, Utah. Its intent was to bring

together the skills and resources needed to build and maintain a standardized base mapping program. The Center's program has since expanded to include production of digital data.

The Remote Sensing Application Center (RSAC) is co-located with GSTC in Salt Lake City. It provides technical support in evaluating and developing remote sensing, image processing, and how it relates to geospatial technologies throughout the Forest Service. It also provides project support and assistance with using remote sensing technologies, and technology transfer and training.

The Geospatial Service and Technology Center is more than maps. It provides geospatial services, data, training and awareness. These services and products support core Forest Service business needs including forest planning, watershed restoration, resources inventory, and transportation management. While NFS has a national program and centralized geospatial service and tech center in Salt Lake City, many mapping activities continue in the Regions. The Forest Service is developing a clearinghouse, this will be a FGDC and NSDI node. This will eventually provide all Forest Service geospatial data, and FGDC compliant metadata. Hopefully by September of this year, that node will be active.

#### Forest Service Maps

The Primary Base Series (PBS) maps of NFS have a scale of 1:24,000. They are topographic maps, used as an administrative product. The Forest Service started production in 1992 of the Single Edition Quad maps when they entered into an agreement with USGS. The Primary Base maps are produced by the Forest Service to USGS standards. This agreement has eliminated duplicative efforts. The maps are revised sooner with

partnerships than without partnerships, and show Forest Service data. USGS prints and distributes the maps for the Forest Service. The Forest Service is responsible for about 12,500 of the 55,000+ topographic sheets produced of the United States. They are mapping at a rate of 600 per year.

The Secondary Base Series is at a scale of 1/2 inch to the mile (1:126,720). The cartographic work is performed at GSTC. The base map is forwarded to Region/Forest where it is enhanced with photos, transportation guides and visitor information to become the standard Forest Visitor Map.

Forest Visitor Maps are being distributed by USGS through a relatively new agreement. Previously the maps were only available at Forest Visitor Centers. The new agreement provides for the sale of Forest Visitor Maps through a USGS vendor network, and provides customers with one stop shopping. The maps are available to vendors at volume discounts. This partnership has increased customer service. The maps are still also available at Forest Visitor Centers, Forest Supervisor and District Ranger Offices and can also be ordered from the various Forest Service websites – but only USGS provides the one stop shopping capability that vendors like because they receive a discount and can stock a variety of maps on their shelves.

Other Forest Service maps include: wilderness area maps, wild and scenic rivers maps, "Pocket Guides," "Guide to Your National Forest," and other specialty products.

FSWEB site: <http://fsweb.r5.fs.fed.us/unit/puf/geometronics/> Other collaborative efforts include [www.recreation.gov](http://www.recreation.gov). This interagency initiative provides web-served recreation information to the public. It cuts across government boundaries. Outdoors America Map is a guide to recreation

opportunities on Federal Lands; 11 Federal Agencies are involved. The Forest Service is represented as a voting member on the U.S. Board on Geographic Names. Forest Service is responsible for their areas in the updating and maintenance of the Geographic Names Information System. The Forest Service is adding information to the National Atlas of the United States. There are other exchanges with USGS including Digital Elevation Models (DEMs), Digital Orthophoto Quads (DOQs), and the National Map. The Forest Service is working in Lake Tahoe Basin Management Unit on a pilot of the National Map.

#### FGDC and Geospatial Advisory Committee (GAC) Activities

Forest Service is participating in FGDC (Federal Geographic Data Committee). FGDC is trying to create Geospatial One Stop and I-Teams (which have to do with data sharing at the local level). John Moeller (who also spoke at CUAC) is FGDC Secretariat Staff Director and Project manager for Geospatial OneStop. NFS has taken the lead of the FGDC Vegetation Subcommittee. Vegetation Subcommittee activity had languished – initially a lot of effort had been put into trying to develop a vegetation data standard. No consensus on the elements of the standard could ever be reached, within NFS or among agencies on the subcommittee, so it stalled out. Alison Hill is new chair, and the Committee is reinvigorated. NFS is the Co-Lead for Sustainable Forest Data Subcommittee, active on Homeland Security Working Group, and Imagery and Remote Sensing Task Force.

The Geospatial Advisory Committee (GAC) was formed in 1999 to address advancing of Forest Service Geospatial Data Technologies. The geospatial community recognized the need to direct and coordinate geospatial data activ-

ity. GAC promotes awareness of geospatial data throughout Forest Service, and advises the Geospatial Executive Board (GEB). Its roles and responsibilities are to identify, monitor, and address issues regarding the state of NFS geospatial programs and activities. It also develops and makes recommendations concerning geospatial program execution to the Geospatial Executive Board. GAC communicates progress to NFS geospatial community and others. GAC emphasis areas are 1) standardized GIS data, 2) natural resource applications coordination, 3) geospatial training and awareness, 4) coordinate and share standardized GIS data, 5) cartographic publishing, and 6) technology architecture coordination. GAC's goals are to ensure NFS geospatial policy, programs are compatible and integrated, and to ensure programs are responsive to NFS business needs.

Forest Service Contact Information and Forest Service Home Page—[www.fs.fed.us](http://www.fs.fed.us)·GSTC Home Page—[www.fs.fed.us/gstc](http://www.fs.fed.us/gstc)

### **Bureau of the Census**

*Tim Trainor, Chief, Cartographic Operations Branch*

Tim Trainor began by discussing a couple of the Census Bureau's Geographic programs. The fifty State Data Centers (SDCs) participated in the Public Use Microdata Area (PUMA) Delineation Program. Tim spoke at some length about the Urbanized Area Delineation program, which culminated with a *Federal Register* notice on May 1, 2002 (71 FR 21961) listing the 466 areas defined as Urbanized Areas (UA) for Census 2000 (up from 405 in 1990). General criteria are that there must be a density of 500 people per square mile and a minimum population of 50,000. There is no grandfathering of urbanized areas: Cumberland, MD, was dropped from the UA list which qualified in 1990. The more

important detail is that the category has been expanded to include "urban clusters", with urbanized areas and urban clusters totaling 3,638 qualifying areas, so more areas will have data available. The smaller "Urban Cluster" (UC) is defined for areas of sufficient density from 2,500 to 50,000 inhabitants plus other characteristics. Detailed definitions and discussion of UA's and UC's may be found in a *Federal Register* announcement of March 15, 2002 (67 FR 11663). The concept of undevelopable areas adjacent to or within UAs (e.g., floodplains along a river) are now diplomatically being called "exempt" rather than "undevelopable." And of course, all of this information is available on the web.

Tim then reviewed several of the geographic products from Census. Some of these involve Zip Code Tabulation Areas (ZCTAs), in which each Census block is assigned a single Zip Code. This constructed geography will result in various special boundary files and tabulations. The TIGER 2002 files, which use 2000 geography, will be available soon on the web. Probably, at some point there will be maps but specifications have not yet been finalized.

2002 TIGER/Line files, based on Census 2000 Geography will be available to download by the end of this week. Based on Census 2000, many redistricting activities are underway in the states.

Pre-defined maps, mostly in pdf format, are available on the Internet. These are also available on DVD (CDs are used only if the files total less than 650 megabytes) and as on-demand plotted maps. Recommended specifications for plotters are on the web site. Tim has a national map showing locations of the State Data Centers, it is used internally, but possibly could be made available. It is constantly changing and has all of the different kinds of state data centers, in terms of their classifications.

Census 2000 block maps for every community in the country have been produced. They include the 130,000 maps sheets John Hebert referred to as recently accessioned at LC Geography and Map Division. Census has produced an additional 280,000 sheets, that are block maps for geographic levels above census tracts, such as places and county subdivisions.

For legal governments, maps have been sent to the entity's highest elected official and currently are available on the web. Six DVDs will be manufactured shortly that include regions of states. Unlike the 1990 county block maps, users can access a town or city of choice without having to acquire all of the maps for a county. Census tract outlines maps are available on one DVD and American Indian/Alaskan Native Areas and Hawaiian home land block maps are available on one CD-ROM.

Generalized boundary files are available on the web for most levels of geography in several popular ESRI formats: Arc/Info exports (.e00), ArcView shapefile (.shp), and Arc/Info ASCII format. Census 2000 boundary files are available in both high resolution and low resolution versions. They are re-doing the 1990 files so that nested geography share the same points.

As a result of user input, more printed reports than originally planned will be generated. County outline and subdivision outline maps will be produced. Page sized county maps by state, will be done by the end of summer. Metropolitan Areas will be redefined in 2003 based on new criteria.

The Bureau is still producing thematic maps. One recent map shows the center of population for each state. Another is the famous "nighttime" map, where white "light" on a dark background indicates population distribution, which recently had the biggest press run in Census history, of

1,500,000 sheets. Five copies were sent to every school in America. They are planning a 108<sup>th</sup> Congressional District Atlas for next year and have released a Census 2000 atlas based on the first seven questions of the census questionnaire.

This is the 100<sup>th</sup> anniversary of Census as an agency.

The Bureau realizes the acute need for modernization of its Master Address File (MAF) and the entire TIGER system. TIGER is old and technology has advanced significantly since being developed. (Most people don't know that Census still maintains the files in an internal format, not the ASCII format that it distributes.) Everyone knows that the positional accuracy of boundaries is inaccurate, and Census wants to move beyond relative accuracy and to true positional accuracy. One reason this will be imperative is that TIGER will form the transportation layer of The National Map. Updating can't wait: there are sixty-five committees already looking at Census 2010 planning, and to maintain the geographic standards of the ongoing American Community Survey, MAF and TIGER must stay updated and be improved. The goal is to get an enumerator to a housing unit 100% of the time.

There are many partnerships with other agencies and partners. Census maintains boundaries for most local governments on an annual basis.

The MAF/TIGER modernization is focusing on three important projects. One is to get existing files where they exist. Out of the 3,000 counties, about 1,000 of them have GIS files, of them a small number have really good GIS files. Census is evaluating that currently. A second strategy is to have contractors look at commercial sources that are available that can be used without restriction into the public domain. A third alternative is to use imagery where the previous two options are not possible as a

means to improve and maintain the spatial data.

### U.S. Geological Survey

*Dan Cavanaugh, Chief, Branch of Program Development*

Dan Cavanaugh, US Geological Survey (USGS) gave an update that focused on three themes: New Products, especially published maps, the National Atlas and the National Map.

#### New Products

USGS has released several maps that are different than they generally produce. They include a map of Lake Tahoe showing underground structure, and a *Tapestry of Time and Terrain* which depicts geology and physiography. There is also a new map of New England showing earthquakes between 1638 and 1998 (I-2737), which proved particularly timely given the recent earthquake there. Another recently published map, titled *Geographic Face of the Nation – Land Cover*, developed from the National Land Cover Data (NLCD), was jointly produced by USGS and the Environmental Protection Agency. A new relief map will be released similar to the Thelin & Pike map (late 70's, early 80's) titled *Geographic Face of the Nation – Elevation*. The new map will have fewer data artifacts than the previous edition.

USGS is continuing to forge partnerships, especially with the Forest Service. USGS Map Dealers (about 2000 of them) are now distributing Forest Service maps. Their goal is to distribute Forest Service maps for all 9 Forest Service regions. The map distributors are pleased about being able to obtain maps from one source (USGS), rather than having to deal with multiple agencies and regions. The USGS has also entered into partnerships with other agencies, such as the Library of Congress. This

partnership has resulted in reproduction of an 1894 map of Colorado. It is available from USGS (see <http://rockyweb.cr.usgs.gov/historicmaps/historicmapsfromlca.html> for more information). USGS is working with the National Park Service to produce geologic maps of the National Parks. They also continue to distribute National Imagery and Mapping Agency (NIMA) products. About 90-95% of the NIMA products that were available before September 11 are still available.

Some of the most popular products at USGS continue to be the booklets, such as the General Interest Publications, which are available for free. Dan indicated that just prior to our meeting, the Director of the Survey announced that the USGS will be getting out of retail sales (at the ESIC) by FY2004. It is uncertain if that is the beginning or end of FY04. Over the counter retail sales may cease at other USGS locations as well, and is probably a year or two away. A question was asked if there are other ESIC offices to be closed. Dave indicated that the Washington DC ESIC in Main Interior had closed this year due to budget cuts, and that the Spokane ESIC was closed last year to budget cuts. Remaining ESIC offices include Reston, Menlo Park, Denver, Anchorage, Rolla, and Sioux Falls, SD.

Dan was asked about the recently published maps of Utah and Colorado that came through FDLP. They are not a "national program". These maps were produced from the National Elevation Dataset by the Rocky Mountain Mapping Center, and are similar to the one of Pennsylvania that was issued several years ago. They will not be issued for the entire United States unless funding is made available. Dan was also asked if there were plans to revise or update *Maps for America*. The response was no, due to lack of funding.



### The National Atlas

The National Atlas continues to be one of the Geological Survey's most popular web sites. It is a cooperative venture between 21 partners and ESRI. There are presently 420 map layers available on the National Atlas web site. People can use it to make and print their own map. It also includes internal links to other web sites. For example, when a user clicks on a National Park, they are linked to sites with information on that park. The National Atlas web site receives 4.6 million hits per month, and links to 1900 other web sites. A new map is drawn every 1.5 seconds. Over 350,000 map layers have been downloaded from the site.

Through the National Atlas, the USGS has been able to produce hard copy products, such as the Federal and Indian Lands map, the elevation map of North America, the Forest Cover map, (produced with data from many Federal agencies), the Presidential Elections map, which includes insets showing the results of all Presidential elections since 1789, and the General Reference map, showing roads and county boundaries. This map will be revised to show Alaska at the same scale as the lower 48, in another words, one will be able to compare the land masses against each other and re-released. The National Atlas is viewed by some people as a small scale version of the more detailed National Map.

### The National Map

The National Mapping Division is now the Geography Discipline. The National Map is everything that the National Mapping Division used to do. There used to be three organizations under the National Mapping Division. They were Map and Data Collection, Earth Science Information Manage-

ment and Delivery, and Research. They are now known as Cooperative Topographic Mapping, Land Remote Sensing dealing with Landsat, and Geographic Analysis and Monitoring which equates to the research area.

The primary activity of the National Mapping Discipline is to compile the base data for the National Map. The vision of the National Map is to develop a current, continually revised, seamless, complete, consistent product that will reflect geographic reality, have positional and logical consistency, and have no cartographic offsets. It will be a temporal record, with metadata for both the data set and the features within it. The National Map will address 5 needs, to Map, Monitor, Understand, Model and Predict. The 7.5 minute topographic map is probably the USGS' most famous product. It is the only U.S. cartographic product that is comprehensive, trans-jurisdictional and border-to-border and coast-to-coast. Compiling it was an immense engineering feat that would cost over \$2,000,000,000 to replicate today. On average, the topographic map is 23 years old. U.S.G.S. is finding that they can not keep up with currency. Base data, such as aerial photographs, often show features that topographic maps do not.

Because topographic information has a variety of uses (scientific studies, planning, decision making, land and resource management, delivery of government services, economic activities, natural disaster relief, homeland defense), it will be the base of the National Map. There is presently some duplication of effort among and between geographic information sectors (federal, state and local governments and the private sector). Cooperation between these sectors (Cooperative Topographic Mapping) will provide the base information needed for the National Map. Partnerships will be built to

develop the base data, which will be accessible via the web 24 hours a day. Users will be able to specify the data and area of interest and print their map on demand. Cooperative Topographic Mapping will include activities such as acquiring, archiving, and disseminating base geographic data, maintaining and providing derivative products, including topographic maps, and conducting research to improve data collection, maintenance, access, and applications capabilities. The core data, which will include themes such as orthophotography, elevation, transportation, hydrography, structures, boundaries, geographic names and land cover, will be public domain, either collected by government agencies or made available through licensing agreements. Links to other data with higher resolution, enriched content and additional attributes will be available. These links may be to licensed data. This means that USGS' role will be changing from data producer to organizer responsible for awareness, availability, and utility. USGS will be the catalyst and collaborator for creating and stimulating data partnerships, a partner in standards development, and an integrator of data from other participants. When no other source of data exists, USGS will produce and own the data. There will be a temporal component or versioning, but the details have not been worked out yet. Data will be accessible 24 hours a day and will be in the public domain.

The National Atlas is an example of a small-scale implementation of the National Map. It has been developed through partnerships. USGS has integrated the content so that it is consistent nationwide. They have also developed the metadata and provided web access. USGS offers derivative products, such as the data layers and printed National Atlas maps.

There are currently 7 National

Map pilot projects underway in the United States (see <http://national-map.usgs.gov/nmpilots.html>) for more information. One in Delaware is currently the most complete and went live April 18 (URL: <http://www.datamil.udel.edu/nationalmappilot>). The events of September 11 illustrate the urgency for geospatial data and the National Map. September 11 has shown us that data must exist before, during and after an event, be readily accessible, and that partnerships among state, local, and federal agencies and the private sector are required. The events have illustrated that cartographic information is a national infrastructure, just like the Interstate Highway System. As a result of September 11, there is an emphasis to compile information, including high-resolution color imagery, high accuracy elevation data and critical infrastructure, for 120 major metropolitan areas in the United States. NIMA and other Federal agencies are partnering in this effort. Links with state and local agencies and "first responders" are also being developed.

### National Imagery and Mapping Agency

*Jim Lusby, NIMA Staff Officer, Disclosure and Release Division, Office of International & Policy*

Jim Lusby, represented National Imagery and Mapping Agency (NIMA) and provided an overview of the policy of Limited Distribution Products (LIMDIS) and an update on the distribution of Shuttle Radar Topography Mission Data.

NIMA has authority under U.S. law, Title 10, to restrict distribution of cartographic data if it is required to do so under international agreements, if disclosure would reveal sensitive methods for obtaining the data, or if disclosure would interfere with military or intelligence operations. Officially Limited Distribution (LIMDIS) is a caveat, not a security classifica-

tion, e.g., "Classified" or "Secret." It is still enforceable under law. Roughly 35% of NIMA's products fall under the LIMDIS category.

NIMA has 80,000 different line items, and of those, 30,000 are limited distribution. 20,000 are foreign produced and NIMA works in cooperation with the foreign governments.

Jim has worked to arrange exceptions to LIMDIS for academics and government agencies for an expressly noted purpose, e.g., to support disaster relief operations. Unauthorized re-distribution of LIMDIS data in such situations can result in agencies or contractors losing their ability to obtain future exemptions. Most requests for exemption require the agreement of a third party, such as the foreign agency responsible for supplying the data. NIMA evaluates all requests on a case by case basis, and tries to balance benefits and risks of exemptions.

NIMA also assists foreign countries with information in times of need. Jim mentioned NIMA and USGS efforts in assisting Honduras, Nicaragua, and El Salvador during "Hurricane Mitch". They are partnering with USGS, Census, Forest Service, and others.

Making NIMA products available to other government agencies can be a lengthy process. Criteria for approval of release is based on desired geographic location, the use, and justification for needing the material.

NIMA is working to make the process smoother by spelling out conditions of release during the initial data collection process with third parties, taking some internal steps to formalize LIMDIS policies and procedures, and by highlighting the issue to NIMA customers in forums such as CUAC. Is there a greater amount of risk to giving this product to someone to satisfy them? Are there other sources that will work? Is this is the only source and what kind of risk will have to

be weighed? What is the derived product coming out of it?

There are many multinational projects underway. NIMA works with "disclosure" or "release" restrictions. Disclosure is where someone can look at it and walk away or release where they can actually give someone the map. NIMA is trying to obtain more "disclosure" than "release" situations in working together.

Limited distribution is a caveat that restricts anyone from using it unless NIMA gives approval. Official use only means that you need that product for planning and you will use it only for that purpose.

Some products will be more easily available, others will be less. NIMA will be working on updating their "Memorandum of Understanding" (MOU's). They are trying to reduce the amount of LIMDIS information or make it classified and try to get out of the gray area.

Will Danielson from GPO asked Jim about maps received at GPO for FDLP cataloging that were marked with the LIMDIS caveat. Jim said that GPO/FDLP were indeed supposed to receive such items as they had been declassified. Jim explained that after printed materials are marked LIMDIS at the printer, a new press run can not be done to remove the LIMDIS caveat. Instead that marking is supposed to be removed or obliterated by the distributor.

Finally, Jim presented a revised schedule for release of the Shuttle Radar Topography Mission (SRTM) data products. This is the digital terrain data that librarians are hoping for. Alaska is not well represented. Having fallen behind after September 11, Jim cautioned that the schedule was subject to further change. Production of data for North and South America is expected to be complete by summer 2002, but distribution schedules and methods have not been determined. USGS through the

EROS Data Center with a joint agreement will be the data holder for the public. Public release data will vary in resolution, depending upon geographic area. USA data will be level 2 (30 meter resolution), non-USA areas will be level 1 (roughly 90 meters). By 2004, everything should be completed, elevation data for the world, and all the products done. It will be much better than anything they have had in the past and they are using additional information from others. 1,000 meter is available now.

**National Ocean Service - NOAA**  
*Howard Danley, Deputy Chief of the Navigation Services Division*

NOAA has 1037 paper charts for sale through the Distribution Division of the Federal Aviation Administration's National Aeronautical Charting Office. The National Aeronautical Charting Office also does the printing of the nautical charts. These are available through the FDLP. A private company, Maptech, sells raster images of the charts. On the web at maptech.com, thumbnails at 90 dots to the inch are available using MrSid compression.

There is great interest by graduate students in shoreline movement over the years, terrain, ports, and features. For the last four to five years, a selection of historical charts from the late 1800s to about 10 years in the past has been available on the NOAA web page. In cleaning out the warehouse, they discovered historical charts and scanned them. They can be downloaded. MrSid made this possible. These include hydrographic surveys. One can use "mapfinder" on the website: <http://mapfinder.nos.noaa.gov/> to find hydrographic surveys over time.

U.S. Coast Pilot is a supplement to the nautical charts. From the early to mid-1800s, this was a private publication. In the mid-1800s,

the Coast Survey purchased the publication. NOAA has contracted with a company in Beltsville, MD to scan the Coast Pilots starting with the oldest, a 1776 publication by the British Admiralty. These images will be placed on the Web, linked through the NOAA library. These online Coast Pilots will be searchable by chapter with an index in the back. Some of the older Coast Pilots had foldouts that are causing problems with scanning because they do not want the binding affected. Funding has been provided for about one-half of the project. Additional funding will be sought next year for finishing the project.

NOAA will be continuing to place electronic nautical charts on the Web in a vector format. There are about 150 charts with a browser available. They can be downloaded. They will be different from the printed charts; the symbology and detail are different. Current coast pilots are available on the web and can be downloaded. Electronic charts and Coast Pilots are considered "provisional" because they are not updated for navigation. These images have increased sales. Distances between Ports will go up on the web too.

Post September 11, NOAA has taken airflows, ship schedules and names from its web site, but decided to leave nautical data as it can be obtained elsewhere.

Questions about potential web products included: the early edition nautical charts of Alaska that had been classified because of the Distant Early Warning (DEW) sites; and the historical t-sheets. The T-sheets (topographic) date back to the mid-1800's and contain a tremendous amount of information including land use, land ownership, and place names. National Archives holds the t-sheet photographic negatives and the originals.

Paper charts will be around for an indefinite time, especially

for the recreation community. For large vessels, there will be a requirement for backup, in whatever form.

The print on demand program is still alive but going slowly. There are 876 charts of the 1,037 available through print on demand. The number of print on demand agents is now 40. 17,000 copies of charts were sold through print on demand last year.

**U.S. Fish and Wildlife Service**  
*Doug Vandegraft, Chief Cartographer*

Doug Vandegraft is the chief cartographer at Fish and Wildlife. The Fish and Wildlife Service (F&WS) has seven regional offices and about 25 cartographers throughout the United States.

Over the last year, his office has worked on digitizing the boundaries of the 538 wildlife refuges. They are three-quarters completed. Doug noted that 85% of refuge acreage is located in the state of Alaska.

In addition, they are working on a digital land status layer indicating F&WS land ownership. In other words, what lands they own within the wildlife refuges. They are always trying to acquire land to protect critters. Refuge boundaries are approved acquisition boundaries and within that boundary, they have decided that the habitat is worth saving.

Refuges date back to 1903, but the F&WS was not created until 1940. The Bureau of Biological Surveys was the first agency to manage wildlife refuges and in 1936, developed a template of what refuge maps should look like. They are still using the same format, but in 1980 ANILCA added 100 million acres in Alaska, and the format no longer worked well. The F&WS are experimenting with new ways of depicting wildlife refuges land status using the digital raster graphics (DRG's) and digital orthophotoquads (DOQ's). F&WS has new

refuges in the South Pacific and the agency is producing new maps of those areas. Doug indicated that they are currently working with USGS on a new refuge map to commemorate their Centennial. Alaska will be at the same scale as the lower 48.

The Yukon Delta refuge includes 26 million acres. F&WS has scanned about 500 of the original land status maps dating back to the 1920's. Originals will go to National Archives. Refuge boundaries are available on the web and they may be downloaded. It is important to recognize that there may be private in-holdings within the refuge boundaries depicted.

Work continues on the Real Property Database. The database provides information on tracts of lands owned by F&WS including price paid, parcel size, name of former owner, and additional information. Some information is not available due to its sensitivity. They are currently working on linking refuge boundaries to this database, which will be displayed in a web-based map-server environment. Ideally, there will be a photograph for each refuge. Doug indicated that the most important component of geographic information systems is the query capability. He provided some demo examples of how F&WS is hoping to use GIS with the Real Property Database. Doug is working on securing funding to pursue this project.