Using "Materials and Textures" in Cartographic Presentations A.K.A. "Bump Mapping"

Jeffery S. Nighbert

Bureau of Land Management

Portland, Oregon

Cartographic "Realism" Movement

- Pictorial, Tactile, Iconic, Dimensional
- Uses GIS and digital imagery
- "Realistic" ("Cool-istic", "Cool-ism")
- Applies 3d animation and visualization concepts
- Noticeable application of dimensional "materials and textures"
- Artistic/scientific product

Cartographic "Realism" Advantages

- Better communication –
  - More universal language – wider audience
  - More efficient – less abstract and complexity of symbols
  - Better portrayal of complex geography
  - More Artistic, Beautiful and eye catching
- Advanced techniques and concepts
  - Three Dimensional Digital data, GIS and Imagery
  - Multiple views, animations, interactive

"Bumps, Materials & Textures

- Bump Mapping –
    - A catch all phrase for using materials, textures and surface perturbations in cartography, but includes other 3d functions and effects

- Material – What Things are made of…
    - Material Properties in 3d talk..
        - Pigmentation (reflected light)
            - Color – diffuse, ambient, specular, transparent, halo and volume
            - Pattern – Regular, random, etc
        - Texture – diffusion, ambience, specularity, metallicity, bumps (Affects light)
        - Finish – Transparent, Reflective, Refractive (light effects)

- Texture/Pattern
    - Real words in English used to describe surface characteristics or behavior

Landscape Bump Material

- Land Cover Materials – Each Type is an object
  - Pigmentation (reflected light)
    - Color – diffuse, ambient, specular, transparent, halo and volume
    - Pattern – Regular, random, etc
  - Texture or "Bump" (affected light and tactile surfaces)
    - diffusion, ambience, specularity, metallicity, bumps (Affecting light)
    - Pattern – Regular, random, etc
    - Bump height, density, pattern
  - Finish – Transparent, Reflective, Refractive (light effects)

- Use Imagery or Interpreted Imagery as Source

Land Cover Example

- Three Sisters Region of Central Oregon
- Beautiful Mountains of the Cascade Range
- Data:
  - 10 meter DEMS, 30 meter TM 1999 data,
  - 30 meter 10 class vegetation classification
- Software:
  - ArcGIS – ArcMap and ArcGrid
  - 3d Nature – Virtual Nature Studio
- Simplified Land Cover Theme
 - Water,Snow,Barren,Lava,Forest,Shrub,Grass

Land Cover Materials

- Water – Blue, smooth,transparent, reflective

- Snow – White, smooth, opaque,reflective

- Barren – Dark Gray, blocky,opaque

- Grass – Yellow, smooth, opaque

- Shrub – Sagebrush green, low height

- Forest – Forest green, varying height

- Lava – Ruddy, rough,varying height
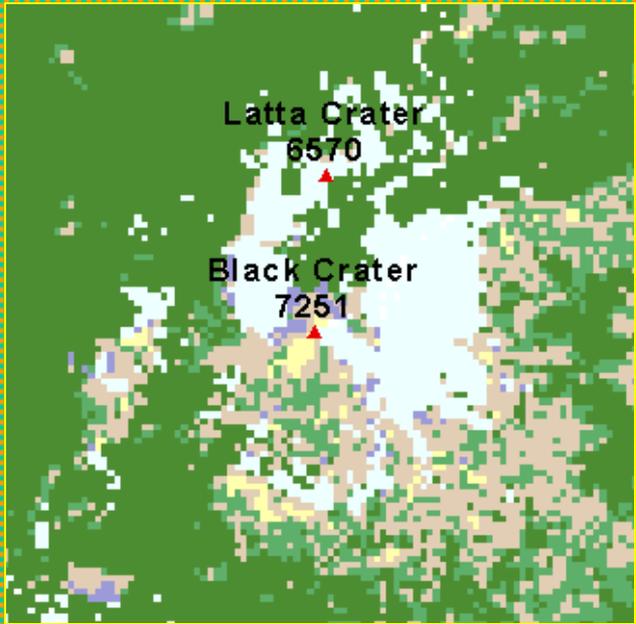
- GIS Systems use a different paradigm than 3d Visualization software
  - You must apply Surface Materials to The Terrain Surface!
  - You must "build" Materials and Textures from Thematic GIS data!
  - Some capabilities for this do exist!

Land Cover Texture Program

```
if (sis10 ge 9)
texture1 = 10
else if (sis10 == 7 & sisrand > 15) /* dark lava
texture1 = 70
else if (sis10 == 8 & sisrand > 15) /* light lava
texture1 = 70
else if (sis10 == 1) /* water
texture1 = -10
else if (sis10 == 6 & sisrand gt 30) /* small trees
texture1 = 65
else if (sis10 == 5 & sisrand gt 50) /* medium trees
texture1 = 85
else if (sis10 == 4 & sisrand gt 70) /* large trees
texture1 = 100
else if (sis10 == 3 & sisrand gt 90) /* shrub
texture1 = 30
else if (sis10 == 2 & sisrand gt 99) /* grass
texture1 = 10
else texture1 = 0
endif
merge1 = merge(rivers * -10,roads_1 * 10,texture1
hill_tex = hillshade((merge1 * .25) + sisters_dem * 3.2,345,65)
```
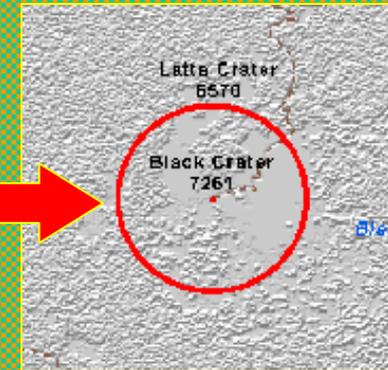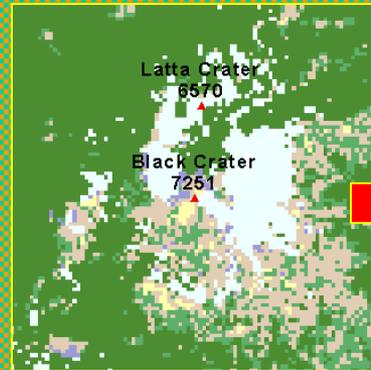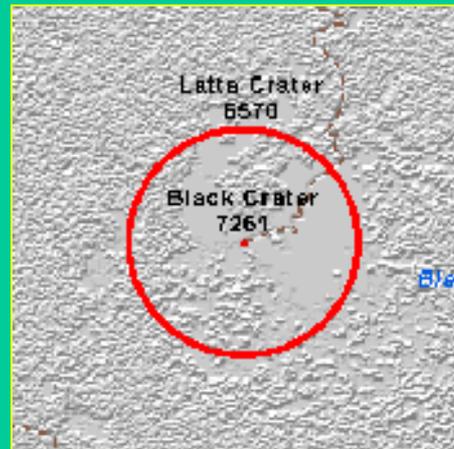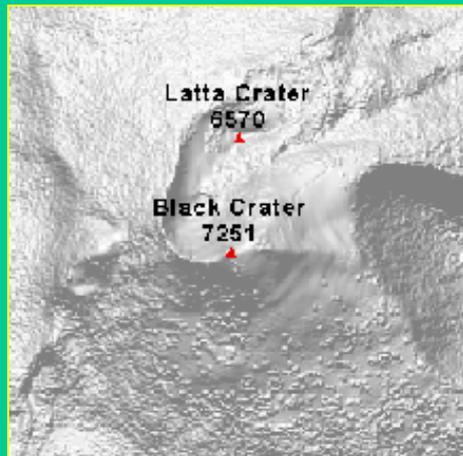
- Base Terrain – Surface object
  - Hillshade Function
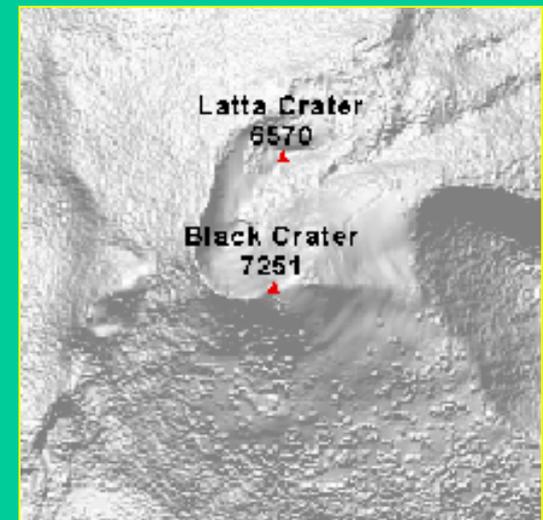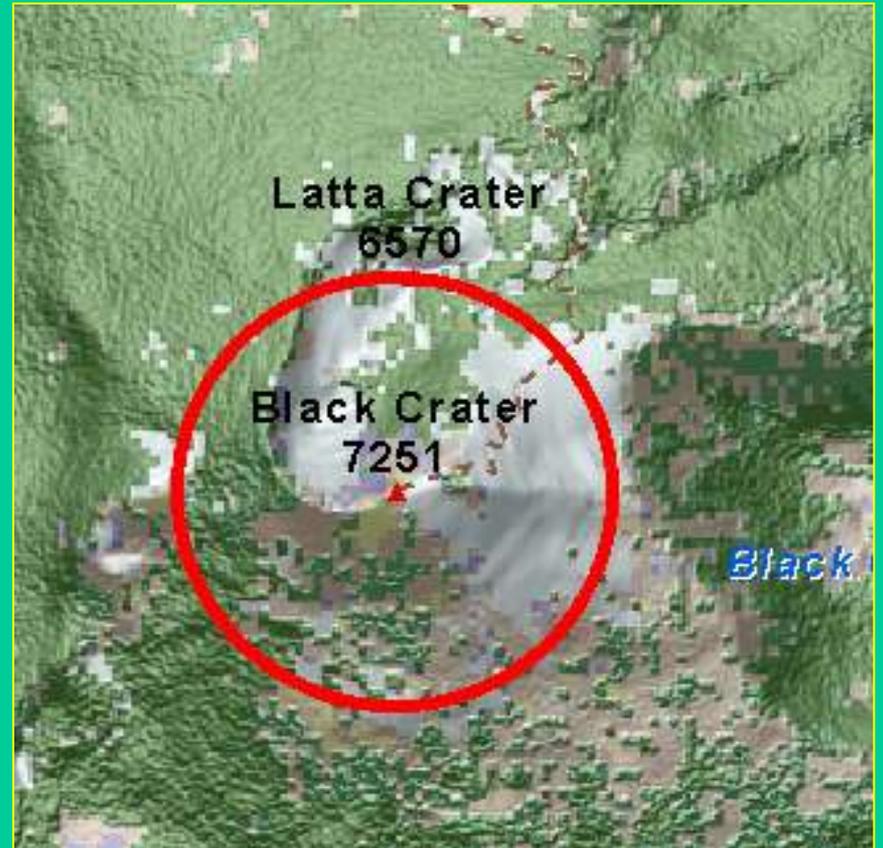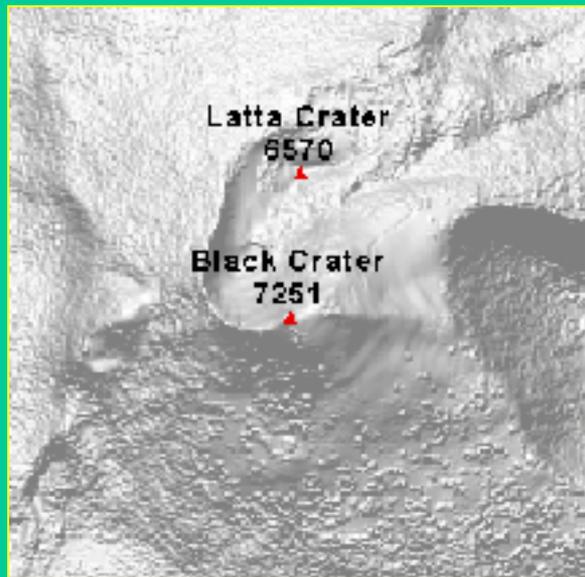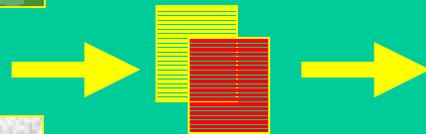   - Not dynamic,one color,single light, not atmospheric
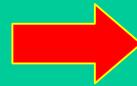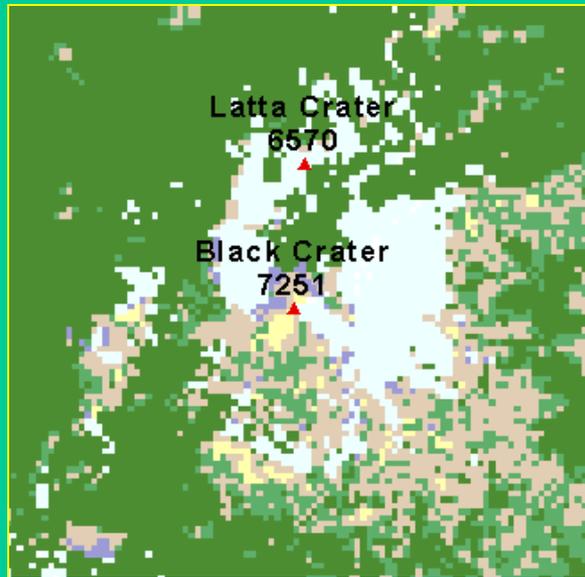

Hillshade
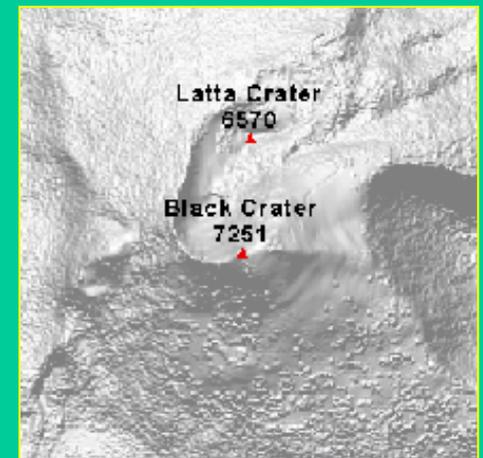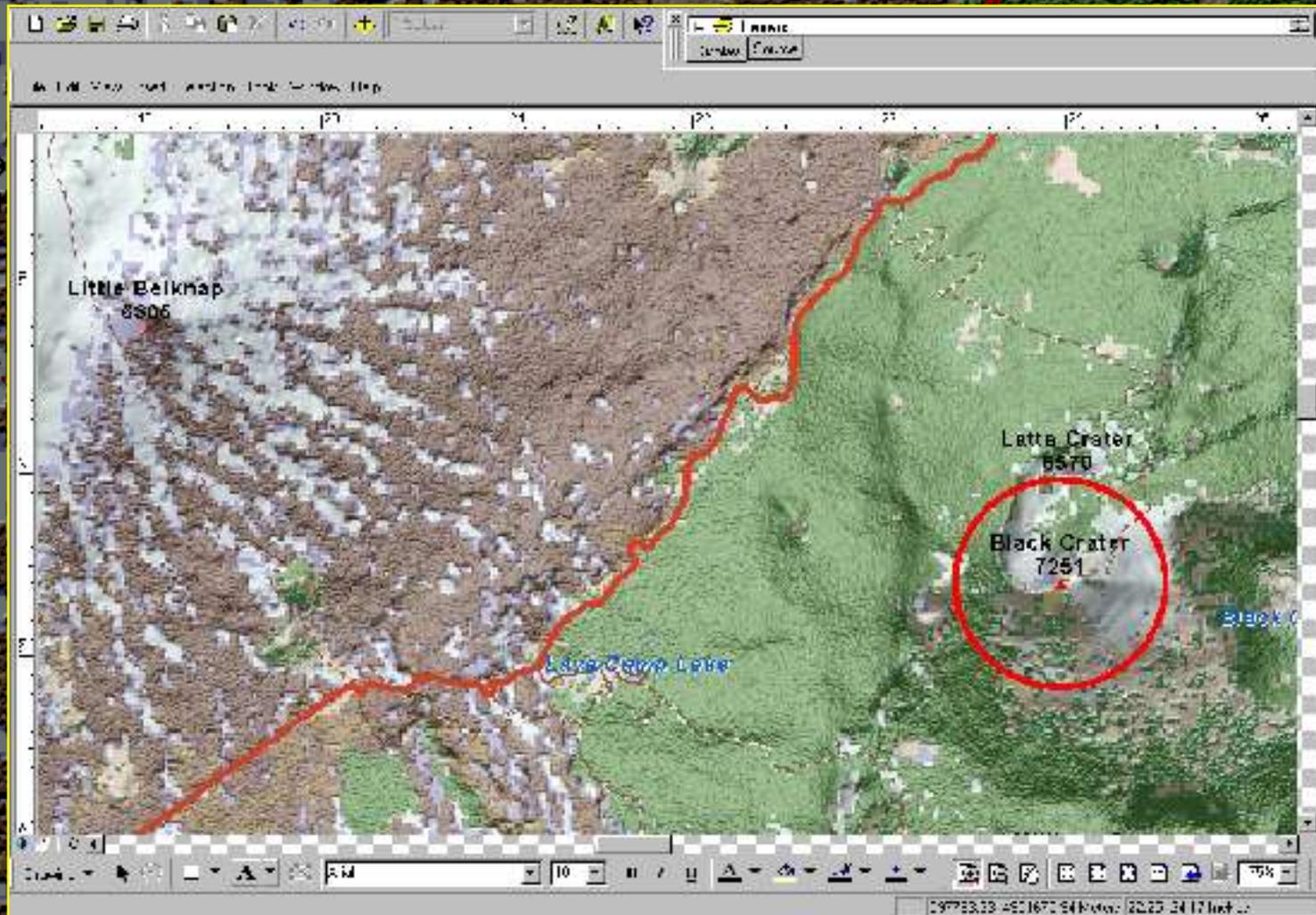
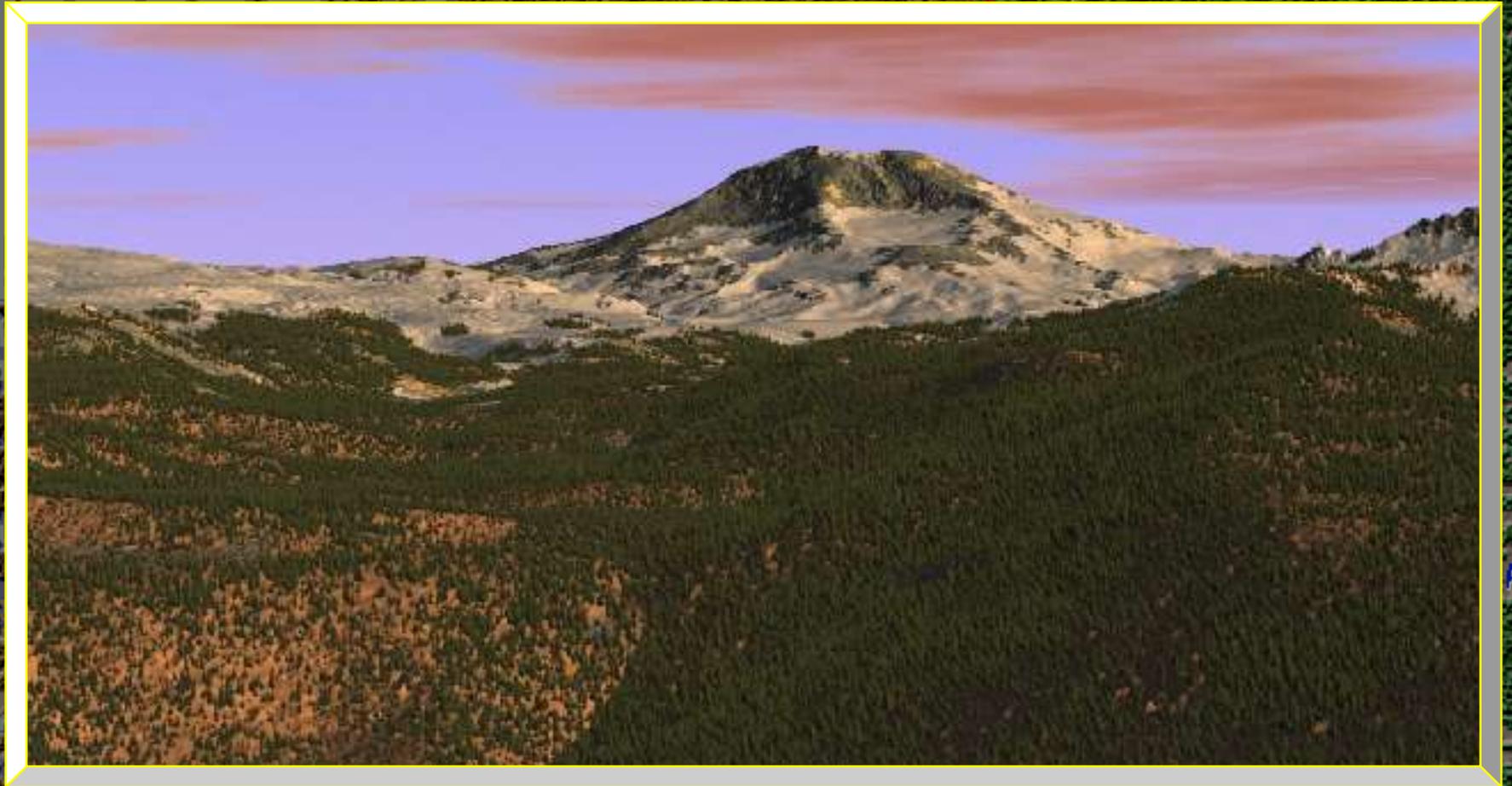# Integrate terrain and Bump Materials

Hillshade

Transparent Overlay

Final Product

The Map

Conclusion

"Bump Mapping" using materials and textures can bring life to your cartographic presentations by adding interest and dimension. It increases the options and richness of the graphical communication cartographers might use.

Bump Mapping can have the power to transform a bunch of tinted polygons into a vision of landscape realism and hidden intrigue.

Current Mapping and GIS software should begin to support materials and Textures, dynamic lighting, atmospheric effects and other tools needed to create "realistic" maps!

Contact:

Bureau of Land Management

Jeffery S. Nighbert

WWW.OR.BLM.GOV

Jnighber@or.blm.gov

503-808-6399

"Bumps Mapping"

Bump mapping is defined as a process that interprets changes in an object's surface luminance or color values and modifies elevations on the objects surface accordingly.

Satellite imagery, such as Landsat Panchromatic 15 meter data, is a good source for "bump mapping" vegetation and land cover themes, since the satellite measures the surface reflectance and texture of the Earth's surface materials.

Using the Spatial Analyst Extension, "bumps" can be created using satellite imagery with the hillshade function.

This data can then applied in Arcmap utilizing color transparency options to create a beautiful and interesting relief backdrops for cartographic presentations.

Process Review