CREATING NATURAL EARTH MAP DATA

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Natural Earth is a raster map dataset of the world introduced in 2005. It features land cover data merged with shaded relief. The idea of "cartographic realism" developed for the design of US park maps influenced the making of Natural Earth. Hal Shelton's hand-painted natural color maps produced during the 1950s and 60s were also influential. The digital production of Natural Earth hinges on Vegetation Continuous Fields, a land cover product with blended categories derived from MODIS satellite data. Three versions of Natural Earth are now available. Natural Earth I depicts contemporary land cover; Natural Earth II portrays potential vegetation; and, Natural Earth III is tailored to the needs of 3D artists and animators. A new version of the dataset enhanced for web mapping is now in production. The value of designing maps that incorporate realistic traits inspired by nature is a theme throughout the paper.

Natural Earth data are available free of charge at www.shadedrelief.com and www.naturalearthdata.com

INTRODUCTION

Natural Earth is raster data suitable for making maps of large regions, continents, and the world as a whole. It features shaded relief merged with land cover textures tinted as natural colors—colors that mimic on a map what people can see in nature, such as deep green forests, tawny deserts, and glistening white glaciers.

Since its release in 2005, Natural Earth has become a familiar backdrop on maps used in print media, television, and on the Web. That these data are available online for free has much to do with its popularity. Natural Earth also fills a niche. Before 2005, a cartographer who wanted to make a natural color map would have to do so by painting or airbrushing, manual skills that few possessed. The introduction of Natural Earth provided digital cartographers with the option of ready-to-use map data, or they could build their own natural color maps from scratch using methods similar to those employed for Natural Earth. In a few years, a map type that was once rare became commonplace.

This paper examines the making of Natural Earth, an idea with origins in the manual era that has become a full-fledged product in the Internet age. Three versions of Natural Earth data aimed at different types of mapping are now available, and work on a new version is underway. The following narrative is a cartographic story about this evolving dataset and cartographic realism, an approach for depicting physical environment on maps.

Cartographic realism

The making of Natural Earth, a part-time project done outside official duties, relates thematically to the author's work as a cartographer for the US National Park Service (NPS). The NPS mapping program faces a major challenge: catering to a large and diverse clientele—the 279 million people from around the world who visited US parks in 2011. When arriving at a park, a visitor decides in a matter of seconds whether or not to use the map. If it is too technical or difficult to read, they are presumably less apt to use it. One way the NPS attempts to ameliorate this problem is by designing maps that are less abstract and more realistic in their depiction of park landscapes. For example, because large numbers of visitors have difficulty reading contour lines, park maps use shaded relief instead. The interplay of light and shadows found on a shaded relief, resembling sun-splashed distant hills that people see as they go about their daily lives, depicts terrain with more realism than contours. A user manual (also known as the map legend) is not required to understand properly prepared shaded relief. To take this idea further, the three-dimensional terrain found on park panoramas is even more realistic than shaded relief, and research suggests that it is better suited to novice map users (Schobesberger and Patterson, 2008).

Cartographic realism is the term preferred by the author for the approach to designing maps with graphical elements inspired by observations of nature. This concept is hardly new to mapmaking, as evidenced by the many maps from centuries past with brown land and blue water. But never before in cartography have we had such powerful tools as today—geospatial data and graphical software—to pursue realistic map design almost without limit.

Given so much temptation, restraint is key to the success of cartographic realism. Glancing at a shaded relief map, the reader's reaction should be "of course" that is a mountain rather than "wow." Selectivity also is important. The goal is not an unfiltered portrayal of the landscape—as users of Google Earth well know, aerial photographs serve this purpose already—but to create maps that could plausibly pass for reality. They are a proposition of how the land viewed from above *might* look. Shaded relief, to use this example again, does away with the dark cast shadows and other superfluous detail typically found on aerial photographs, making the portrayal easier to comprehend. Other realistic traits used on NPS maps include embossed land cover textures, reflective water surfaces, surf lines along shores, minimal use of lines, treating rivers and water bodies similarly to shaded relief as background art, and, most important of all, natural color (Patterson, 2002).

A series of NPS maps made by the author during the early 2000s, including Crater Lake, Great Sand Dunes, and Kenai Fjords (see references for URLs), employed cartographic realism and set the stage for the creation of Natural Earth. The inspiration for launching the project was the natural color maps painted by Hal Shelton during the 1950s and 60s.

Natural Color Maps

Hal Shelton (1916–2004) was a scientific illustrator by training who worked for the US Geological Survey (USGS), eventually as head of the Shaded Relief Map Program. His importance to our discussion, however, did not involve the USGS, but his work as the freelance artist behind the Jeppesen Natural-Color Map Series. During the 1950s when air travel was first becoming common, the publisher of this series wanted to provide passengers with reference maps for use in flight that reflected the characteristics of the ground below. Shelton's solution was to paint base maps that merged shaded relief with land cover depicted with so-called natural colors. This was a radical departure from the hypsometric tints that then dominated small-scale physical maps, and which Shelton rejected for being "arbitrary" and misleading to readers. The average reader would surely see green, yellow, red, and white hypsometric tints not as representing elevation but land cover, Shelton argued (Patterson and Kelso, 2002).

Recent studies support Shelton's hunch that hypsometric tints are problematic in the way he suspected (Patterson and Jenny, 2010). For example, casual readers tend to associate green not only with lowlands but also with growing vegetation (Patton and Crawford, 1978). Although this finding bolsters the case for natural color mapping, they would nevertheless remain relatively rare for the next 50 years. Making them was slow, laborious, and required specialized skills. Any cartographic artist painting a map with natural colors had to take into account both accuracy and aesthetics. Lack of detailed land cover information was another factor limiting the widespread adoption of the technique. For example, Shelton worked with a team of academic geographers hired by the publisher who compiled the land cover data on Mylar sheets that then guided his painting (Shelton, 2004).

Shelton's natural color maps are exemplars of cartographic realism. He had the prescient ability to paint plausibly realistic looking maps of Earth before the advent of satellites. Nonetheless, a comparison of his work to recent satellite images reveals clear distinctions. Shelton's maps feature generalized shaded relief illuminated conventionally from the northwest; water bodies are free of sediments; land cover colors are lighter and brighter; and, clouds are absent (Figure 1). Shelton's goal was to transfer his mental image of a particular place to the reader as accurately and effortlessly as possible. Always an advocate for the untutored reader, he fervently believed that any map needing a legend was a failure (Shelton, 1985).

Figure 1. A 1965 Shelton natural color map *(left)* compared to a 2003 MODIS satellite image *(right)*. Map on left courtesy of Rand McNally & Company.

The US Library of Congress possesses the 33 original plates painted by Shelton for the Jeppesen Natural-Color Map Series. A viewing of this collection in 2003 spurred the author to make similar maps with land cover and digital elevation data.

Experiments with Land Cover Data

The first attempt at natural color mapping was a wall map of the contiguous US derived from downsampled National Land Cover Dataset (NLCD) and National Elevation Dataset (NED), both developed by the USGS. NLCD derived from Landsat was the key dataset for this effort. It employs a categorical classification system, whereby a pixel representing a point on the ground that is, say, 51 percent coniferous forest and 49 percent shrub, becomes entirely coniferous forest—winner takes all. NLCD has a two-level classification, broken into nine primary categories and 21 secondary categories of land cover (Anderson et. al., 1972). Default colors assigned by the USGS represent each of the 21 secondary categories.

Transforming raw NLCD into a natural color map required a change in thinking: treating land cover not as scientific data but as an artist's palette (Figure 2). This transformation attempts to interpret the natural world—a world that is non-linear, interrelated, and often ambiguous—in a similar "fuzzy" manner. Replacing the default USGS colors selected for maximum pattern recognition with subtler, more organic colors was the first step. Iconic landscape photographs found in coffee table books and calendars proved a helpful reference for selecting the palette. Like chips in a swatch book, similar land cover categories received variations of the same color. Transitional land cover categories, such as herbaceous wetland falling between woody wetland and open water, were blended. Finally, aggregating land cover categories not easy to distinguish from one another, such as types of cropland, further reduced the number of colors in the palette to 15.

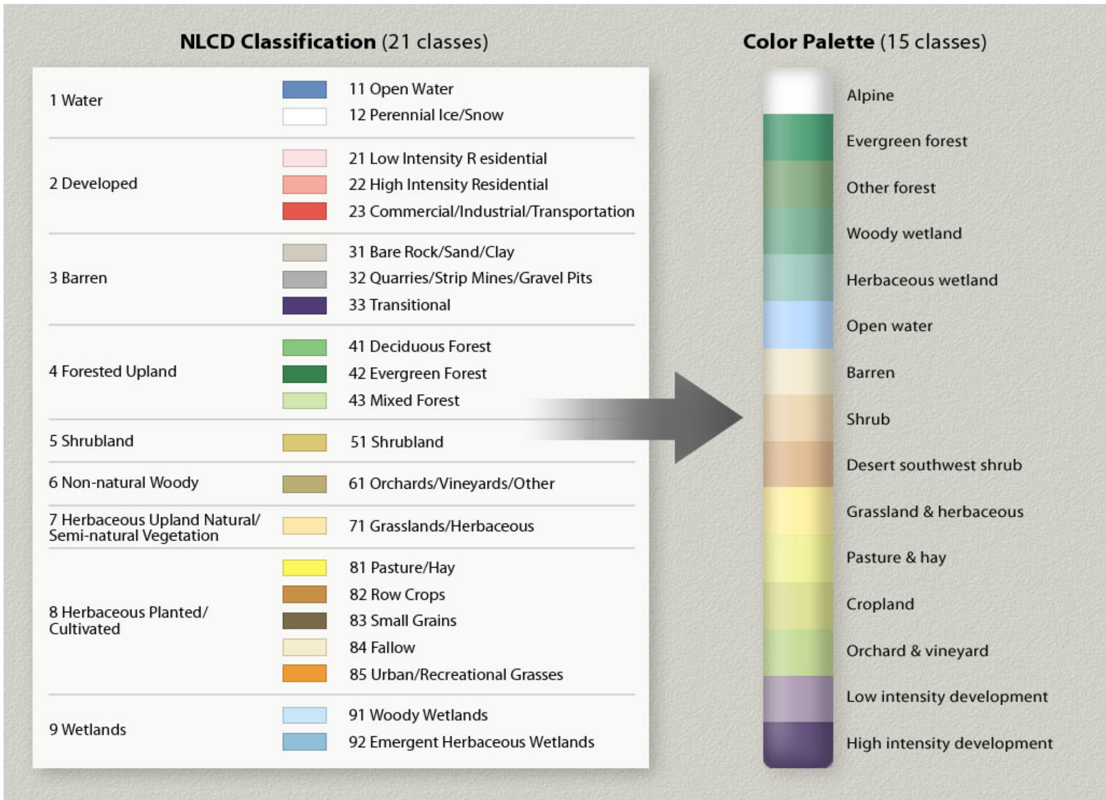

Figure 2. Transitioning from a land cover classification *(left)* to artist's palette *(right)*.

This natural color palette when merged with shaded relief was not as successful as first anticipated. Although it bore a resemblance to Shelton's pieces, it had a harsher quality that functioned poorly as an unobtrusive base for general mapping (Figure 3). Much of the problem was due to the abrupt pixel boundaries that comprise NLCD, which do not disappear regardless of how soft the palette choices. It is the equivalent of "painting by the numbers" art, but with millions of pixels. Natural vegetation tends to transition gradually, as do the airbrushed and painted colors on Shelton's maps. Achieving this desired effect on a digital map would require a different type of land cover data.

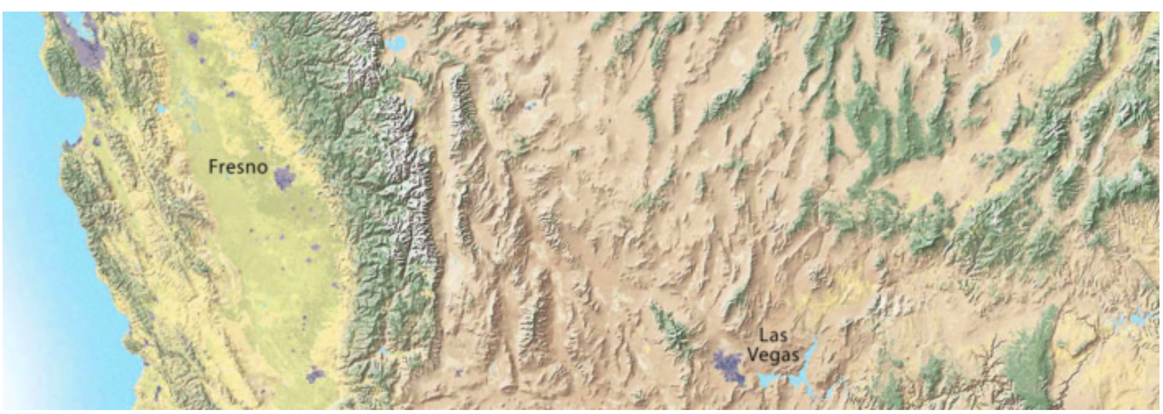

Figure 3. Excerpt of the natural color map of the contiguous United States produced from NLCD.

MODIS Vegetation Continuous Fields

The short answer to producing natural color maps is a land cover dataset with a long name: Moderate Resolution Imaging Spectro-radiometer (MODIS), Vegetation Continuous Fields (VCF). The University of Maryland, Global Land Cover Facility, produces VCF from monthly composites collected by NASA's MODIS satellite, mostly from near infrared bands. These data collected in 2000 and 2001 cover nearly all of Earth at 500-meter resolution.

MODIS VCF is comprised of three data classes, depicting woody vegetation, herbaceous vegetation, and bare areas. What makes VCF especially suitable for natural color mapping is how the data blend. Any given pixel representing a sample on Earth's surface can contain all three of the data classes in relative proportions adding up to 100 percent. For example, data for a pixel representing the African savannah will depict both woody and herbaceous vegetation. In drier areas of the Kalahari, a bare component enters this mix. By contrast, the Sahara is entirely bare (Figure 4).

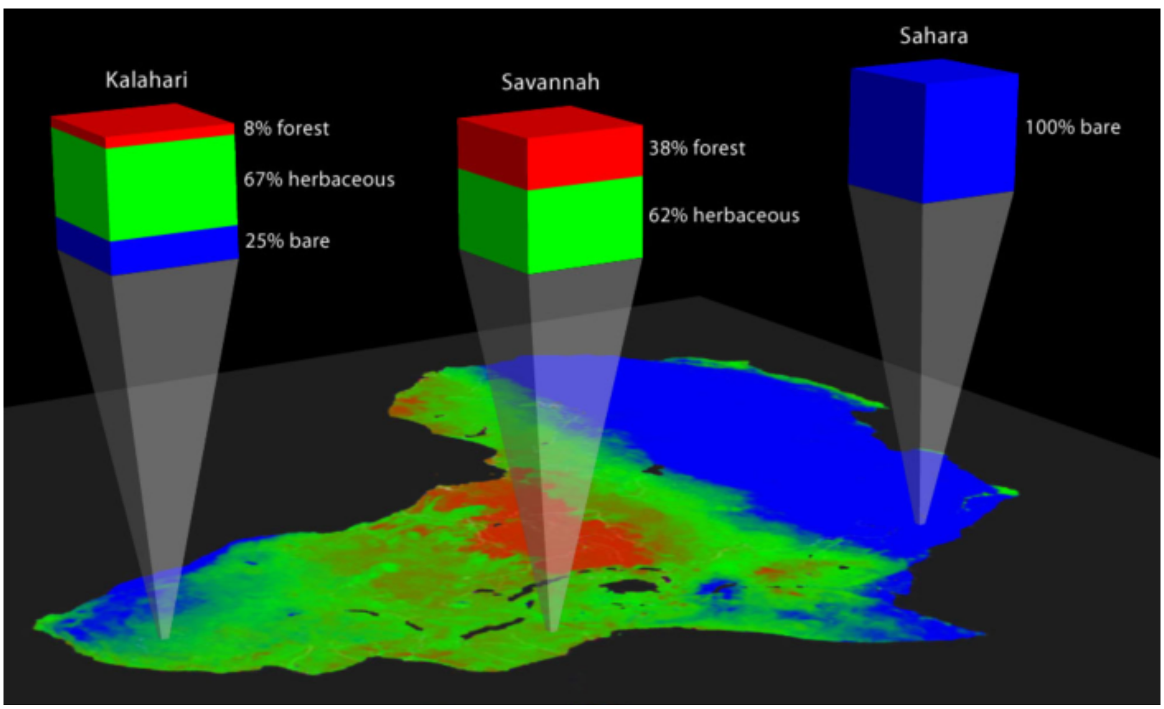

Figure 4. The three data classes of MODIS VCF add up to 100 percent for every pixel on Earth's surface.

An experiment (Patterson and Kelso, 2004), in which MODIS VCF data were imported as layer masks in Adobe Photoshop, yielded blended results similar to Shelton's painted maps (Figure 5). Identifying the right natural colors for each data layer proved difficult, however, especially the bare data layer that in desert areas, such as the Sahara, appeared uniformly bland. Swapping in a color-enhanced version of NASA's Blue Marble true-color global satellite image (see references for URL) for the flat color, masked by the MODIS VCF bare data, solved this problem (Figure 5, bottom layer). It also revealed a path for creating the dataset that was to become Natural Earth.

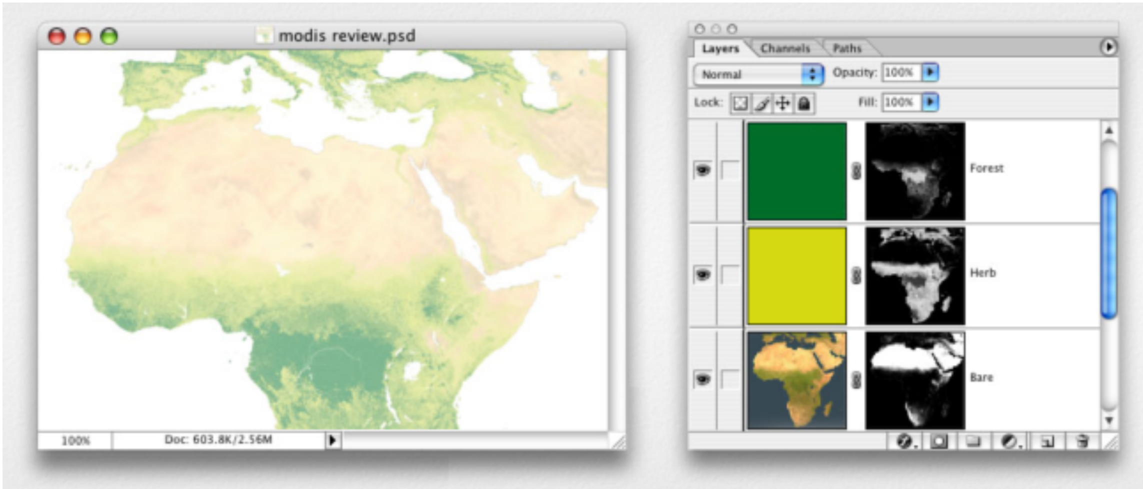

Figure 5. A natural color map *(left)* produced by compositing MODIS VCF in a layered Adobe Photoshop file *(right)*.

The following sections summarize the three versions of Natural Earth now available, and plans to create a fourth version.

NATURAL EARTH I

Creating the final version of Natural Earth I posed additional challenges. First among them was that MODIS VCF, with only three data categories, is insufficient for portraying the varied land cover of Earth. For example, the herbaceous category includes a wide range of landscapes from wheat farms to steppe grasslands to arctic tundra. Differentiating tundra from these other herbaceous areas involved a color adjustment in Photoshop based on climate data. For this case, the 10-degree Celsius isotherm for the warmest month of the year generally defines the polar limit of tree growth (Arno and Hammerly, 1982). Importing this natural boundary into Photoshop, feathering it, and changing the herbaceous color from yellow-green to light gray-green created the tundra. Because this color adjustment applied only to the herbaceous layer, boreal forests represented by the woody vegetation layer were unaffected. This adjustment created an accurate depiction of the discontinuous forest/tundra boundary.

High altitude areas also received special treatment in Natural Earth I. Above 3,000 meters, where the climate is generally cold regardless of latitude, the terrain gradually becomes gray-white. A digital elevation model used as a layer mask in Photoshop governed this transition. Borrowing a technique from hypsometric tints, the highest mountains receive a white frosting to help elevate them above their surroundings.

Because glaciated areas were absent from MODIS VCF, their extents derive from rasterized Digital Chart of the World data. The glacier textures found on Natural Earth I are a combination of a shaded relief given a blue-white tint, and re-colorized Blue Marble. The dataset accounts for recent ice shelf break offs reported in the news.

The finishing touch to Natural Earth I was the addition of shaded relief. Applying it involved two layer masks in Photoshop. The first mask printed only shadowed slopes with all grayscale values removed from flat areas. The second mask lightened the illuminated slopes and also did not contaminate flat areas. Doing this better preserved the land cover colors, making for a brighter and lighter map overall. When viewed from a distance the first impression that Natural Earth gives is of broad swaths of color representing world environments. The shaded relief reveals itself fully when viewed at closer range. Taken together, Natural Earth I presents an idealized portrait of our planet created with the needs of general mapmaking in mind.

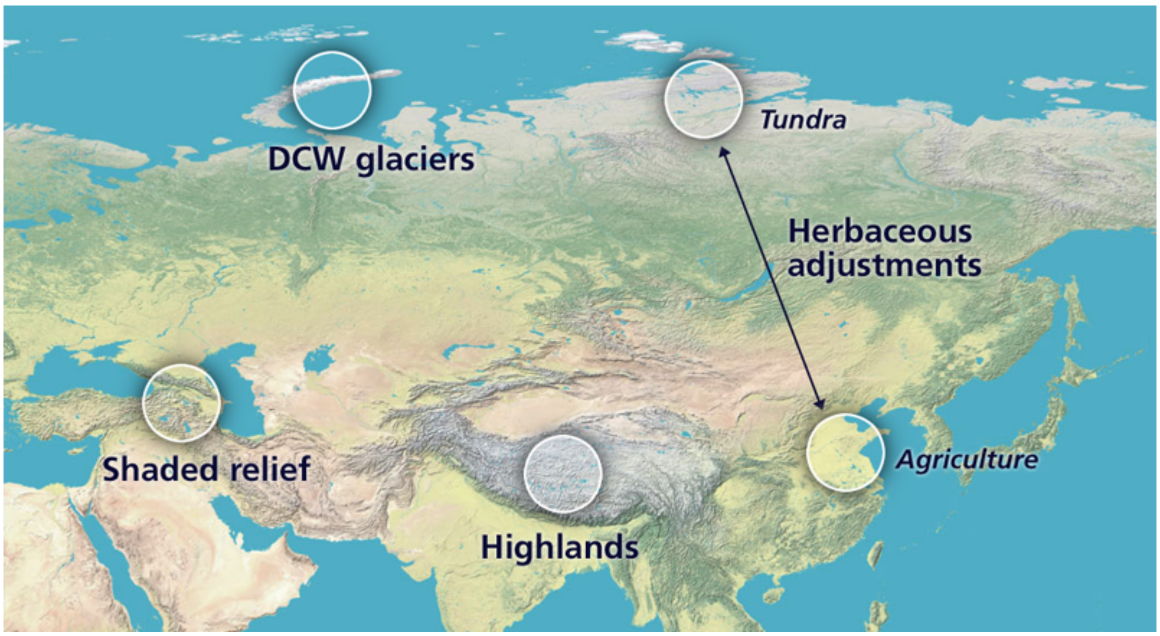

Figure 6. Enhancements needed to finalize Natural Earth I.

Natural Earth I was prepared as a GeoTIF in the Plate Carrée projection. It is available at several resolutions. Users also have the option of versions with and without embedded shaded relief, drainages, water bodies, and bathymetry.

NATURAL EARTH II

Natural Earth II is a modified version of Natural Earth I that was inspired by the relief art painted by Tibor Tóth for National Geographic Society (Tóth, 2008). In 1971, after consulting with Hal Shelton at his studio in Colorado, Tóth developed a unique new natural color map type. Instead of painting existing land cover, as Shelton did, Tóth painted potential natural vegetation—the floristic associations that would characterize regions if human disturbance were not a consideration. For example, northern Europe that is today a patchwork of forest, agricultural land, and built-up areas would revert entirely to primeval forest as depicted on Tóth's maps. The green tint covering, say, Denmark, informs readers that this place has a humid environment that supports forest cover, even though today most of the trees are gone. Tóth mapped an idea. Or, in the view of some critical cartography scholars, his maps would present an *argument* or *proposition* about the world that has no relationship with representing reality (Wood and Fels, 2008).

To guide his painting, Tóth referred to potential-vegetation maps compiled by bio-geographer A.W. Küchler in the 1950s and 60s. The "climax" vegetation mapped by Küchler assumed that if left undisturbed by humans, plant cover would eventually reach a state of equilibrium for a given environment. Barring natural catastrophes, little change would occur with the passage of time. Although we now know that plant communities are less stable than once thought, potential vegetation is still nevertheless a useful model for natural color mapping at continental scales. Any changes to vegetation at such scales and over the lifetime of anyone reading this article are likely to be barely noticeable.

For natural color mapping, potential natural vegetation offers advantages over land cover depiction. On historical maps before the modern era and the explosive growth of human population, they more accurately reflect what the landscape actually looked like. The Mediterranean region at the time of the Phoenicians was more verdant than today. A more important advantage has to do with cleaner graphical presentation. For example, a consistent green background throughout northern Europe is less noisy than the camouflage pattern created by the intermingling fields and forests found in contemporary land cover. As a result, labels and other overprinting information on base maps depicted with potential natural vegetation remain relatively easy to read.

Restoring forests

Natural Earth II portrays polar, desert, and highland environments nearly identically to those in Natural Earth I. These environments support relatively low human populations and, as a consequence, are little disturbed, or at least not in a way that is detectable on small-scale maps. Humid forest environments pose a different situation altogether. In these areas significant growth in human populations over the last two or three thousand years has resulted in major forest loss, which shows up clearly in small-scale maps. Converting the land cover of Natural Earth I to the potential vegetation was largely a matter of restoring these forests by spreading green pixels. This involved using painting techniques similar to those developed by Tóth more than 40 years ago, although applied with digital efficiency. Adobe Photoshop used with a Wacom tablet and stylus were essential tools.

Different methods and references guided the painting of potential forest extents. General geographic knowledge was most helpful. In the mid-latitudes, for example, eastern Asia, eastern North America, and northwestern Europe once supported dense forest. In drier, colder, and higher places, determining potential forest extent was not so easy (Figure 7). Useful references for these areas included the Köppen climate maps and Küchler potential vegetation maps obtained from a print atlas. For areas where doubts remained, consulting geo-tagged photographs online confirmed the existence or absence of trees.

Figure 7. Land cover of Natural Earth I *(top)* compared to the potential vegetation of Natural Earth II *(bottom)*. Differences between the versions are less apparent in the higher and drier western US.

Classification

Natural Earth II also uses subtle color variations to distinguish between different forest types. Tropical forest is a richer green than temperate forest that, in turn, is warmer than northern forest, which are dark blue-green. Mediterranean vegetation contains a hint of olive, and open savannah woodlands appear slightly yellow-green, to suggest the presence of grass. These colors blend together on the map just as vegetation does in nature. The point of using subtle colors was to depict these forest regions unobtrusively on a general base map.

The Natural Earth II legend contains only 12 basic categories to avoid overwhelming readers with too many colors (Figure 8). Using simple terms to describe these categories was another concern. For example, consider the world's largest forest encircling the globe across the northern reaches of Europe, Asia, and North America. Terms such as *boreal* and *sub-arctic* are unfamiliar to many general readers*;* and *coniferous, evergreen,* and *needle leaf* are not precise enough for a forest where aspen and birch trees are common. This category goes by the broadly descriptive name *Northern forest* in the legend.

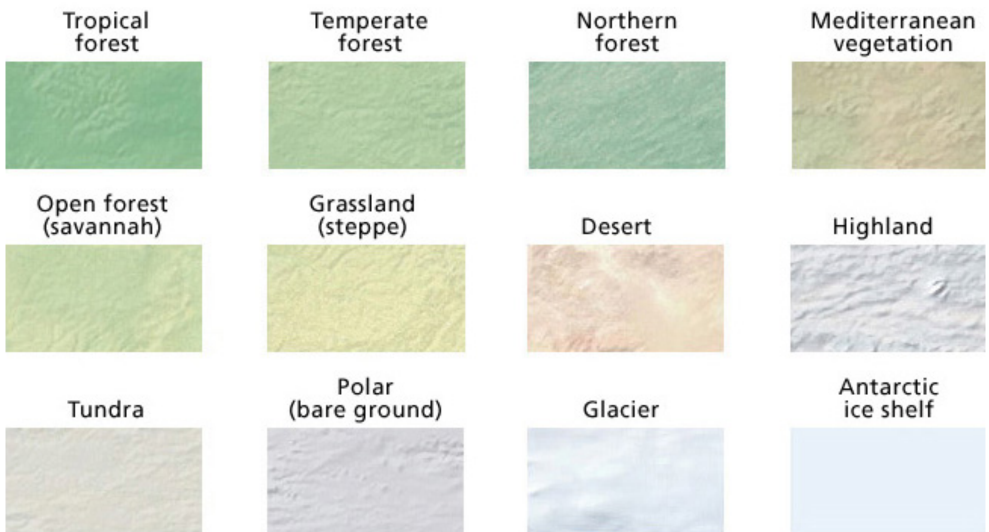

Figure 8. The Natural Earth II classification depicts a combination of potential natural vegetation *(top row)* and land cover.

Natural Earth II appeared online in 2007. A third version of the dataset followed in 2008, which had a purpose other than traditional mapping.

NATURAL EARTH III

The inspiration for creating Natural Earth III was not a person, as was the case with the first two versions of the dataset, but an iconic photograph. Astronauts on the Apollo 17 mission of 1972 snapped the "Blue Marble" image of Earth, a blue orb showing Africa and Antarctica beneath swirling clouds set against the blackness of outer space (see references for URL). Natural Earth III is a dataset for creating similar illustrations and animations of our planet, but with greater legibility. Compared to photographs of Earth taken from space, Natural Earth III offers brighter colors, fewer clouds over land areas, explicit environmental zones, distinctive mountains, and continuous rivers. It is a dataset suited more to the needs of 3D artists and animators than to the archetypical cartographer (Figure 9).

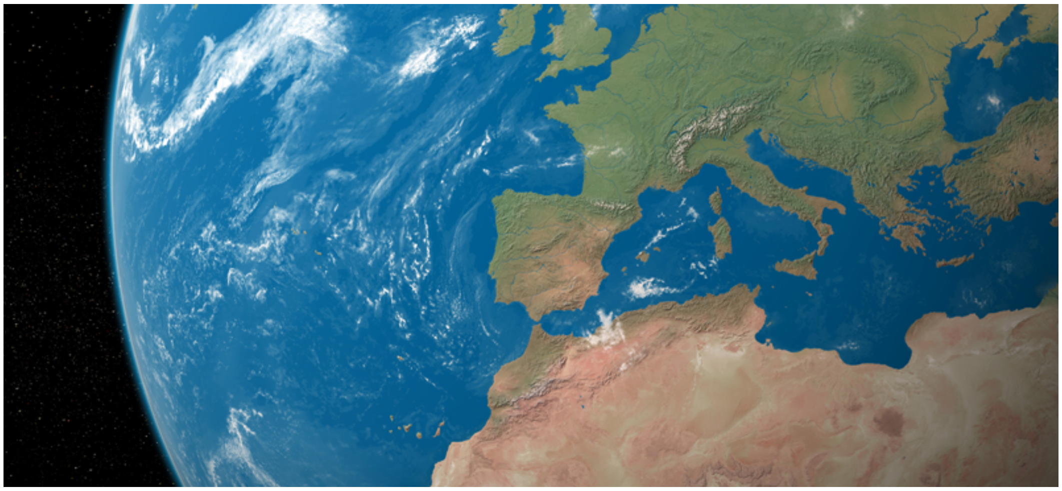

Figure 9. Natural Earth III includes textures, clouds, and a star field for rendering Earth-from-space visualizations.

Compared to Natural Earth II, the colors on Natural Earth III are darker and less contrasting to better match the appearance of Earth in photographs taken from space—up to a point. High altitude Earth photographs typically suffer from legibility problems. For example, humid regions with considerable vegetation (the places where many of us live) tend to be dark, drab, and lacking in detail. To remedy this problem, land on Natural Earth III is more colorful, and both the land and ocean are several shades lighter than photographs show them.

New features in Natural Earth III include coral reefs and sediment plumes extending into the ocean from major river mouths. The coral reefs, which appear pale blue against the dark blue of deeper adjacent waters, derive from manipulated SRTM30 Plus bathymetric data and indicate shallow water only a few meters deep in tropical seas. Sediment plumes come from NASA's Blue Marble dataset (named after the 1972 photograph referred to earlier) and include manual enhancements with the airbrush tool in Photoshop.

The Natural Earth III website offers a range of materials for producing visualizations of our planet in 3D software. These include texture maps—the term used in 3D production for images draped on objects—of Natural Earth III in several versions, including with and without cloud cover, and with polar sea ice. Another version depicts a night view of Earth with city lights. The city lights primarily originate from Earth's City Lights image, a product of NASA, combined with AVHRR (Advanced Very High Resolution Radiometer) urban land cover data to bring even more brightness to the centers of large cities. All texture maps are in the Plate Carrée projection. This rectangular presentation of the world with a 2:1 aspect ratio wraps perfectly around a spherical object in 3D software.

Cloud Maps

On any given day clouds, which are more prevalent over oceans and in the southern hemisphere, obscure two thirds of Earth (ISCCP, 2009). The chances are high that on a 3D rendering of Earth with clouds, the clouds will hide important land areas.

The Natural Earth III website addresses this problem by providing cloud maps edited selectively in Photoshop to remove clouds from continental areas. Users can combine the cloud maps with Natural Earth III texture maps to create custom views. For example, the cloud map for Australia removes most meteorological phenomena from that continent as well as over Indonesia and New Zealand. Moving toward the periphery of Earth cloud cover becomes normally abundant. By showing weather formations either approaching or soon after departing from Australasian shores, the cloud map imparts a sense of meteorological capriciousness—and luck, providing readers with a momentary clear view of familiar landmasses.

The Natural III cloud maps derive from a relatively small (8,192 x 4,096 pixels) cloud map that accompanied the original NASA Blue Marble dataset released in 2002. The origin of the NASA cloud map is unknown. A close inspection of it, however, reveals many small duplicate clouds over ocean areas, a sign of prior digital editing. Clouds on the NASA map nevertheless correspond with global weather patterns and look correct when viewed at small scale. For adding a final realistic touch to Earth-from-space visualizations, users can download a black background image sprinkled with multi-colored stars at varying densities.

It is ironic that the least cartographic version of Natural Earth is the most popular. Website visitors download Natural Earth III data four times more often than the other two versions of Natural Earth combined.

FUTURE PLANS

Following the release of Natural Earth III, the project took a dramatically different turn. In collaboration with dozens of cartographers from around the world, a new NaturalEarthData.com website was created (Kelso and Patterson, 2009). The North American Cartographic Information Society (NACIS) sponsors this website, which offers matching vector and raster data for making small-scale maps. Since the website launch, Natural Earth had become a brand, albeit in a non-commercial sense. Another related effort was the Natural Earth projection (Šavrič et. al., 2011). It is a pseudo-cylindrical projection intended for making physical world maps, such as those consisting of Natural Earth I and II data.

These projects are now finished, and a new raster version of Natural Earth is being developed.

Web Map Tiles

This project underway for the US National Park Service will deliver park maps to the Web. When launched, this service will display customized Natural Earth II tiles at small scales, corresponding to zoom levels 0–8 on Bing or Google Maps. Starting off at the smallest scales, the user will see a lightened version of Natural Earth II with bathymetry. With increasing scale the Natural Earth II textures and bathymetry will transition with each successive zoom level to pale beige shaded relief and flat blue water (Figure 10). The point of fading to beige is to provide a neutral base map at intermediate scales that can accommodate a large number of labels, lines, and area colors representing parks and other administrative areas. At smaller scales where the Natural Earth II textures appear, overprinting information is less of an issue.

Figure 10. Fade to beige. As map scale increases the Natural Earth background image transitions to generic shaded relief.

Preparing NPS web-mapping tiles in the Web Mercator projection, a regrettable standard because of how it distorts parks in Alaska, presents challenges at high latitudes because of raster data stretching. The embedded glacier extents in Natural Earth II, for example, appear blurry in northernmost Greenland. To partially alleviate data stretching, all shaded relief will derive from SRTM Plus elevation data first transformed to the Web Mercator projection (from the Plate Carrée) before rendering.

Creating shaded relief with just the right amount of detail and prominence for each zoom level is another challenge. The objective at different zoom levels is to have the relief appear in a seamless continuum. A simple rule of thumb will guide the amount of detail: The number of height samples in the elevation data used to render a shaded relief will equal the final image size. For example, a Web Mercator world map at zoom level 6 measures 16,384 x 16,384 pixels and the elevation data would have the same number of height samples. To reduce visual noise, the data will receive one application of the “smooth terrain” feature in Natural Scene Designer Pro 6.0, the software slated for shaded relief rendering.

A factor controlling shaded relief prominence is the amount of vertical exaggeration that is applied. Vertical exaggeration will vary according to the zoom level. To present a smooth transition between zoom levels, reliefs rendered for the lowest zoom levels (i.e. smallest scales) will receive considerably more vertical exaggeration than those at higher zoom levels (Figure 11). Eventually as the scale increases beyond that of zoom level 8, the need for vertical exaggeration becomes unnecessary. Another factor affecting the prominence of shaded relief is how lightly or darkly it prints. Deciding on this option is a matter of personal taste and the function that the map serves. On the NPS Web map shaded relief is a secondary or even tertiary element, so it will print lightly.

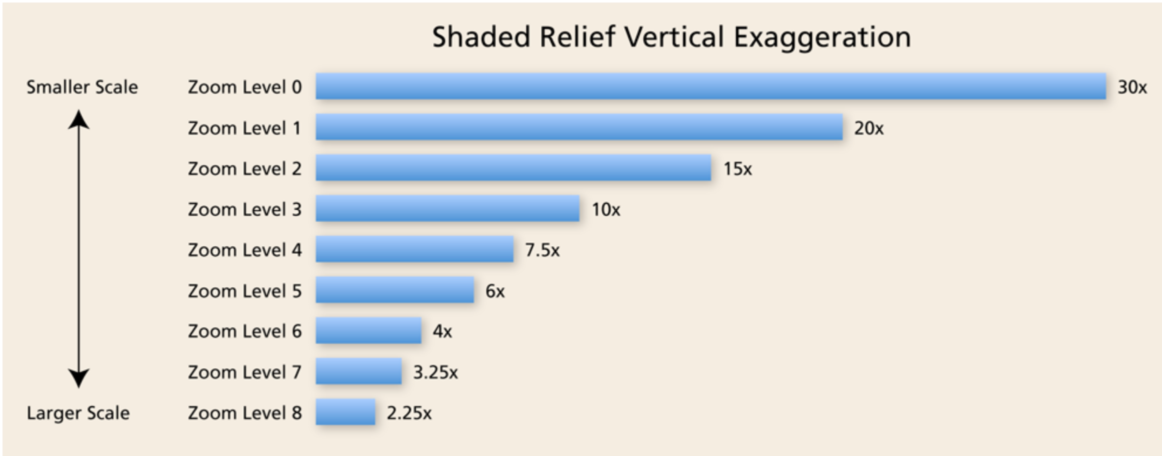

Figure 11. Shaded relief produced for NPS Web maps will receive different amounts of vertical exaggeration depending on the map scale.

The plan is to release NPS Web map tiles in late 2012. Whether to include "baked in" drainages, administrative boundaries, and other vector data in addition to the physical base map is still up for discussion.

CONCLUSION

What began as nascent ideas about cartographic realism on park maps and admiration of Hal Shelton's natural color maps from 50 years ago has developed into a series of products under the umbrella name of Natural Earth. A master plan did not guide the creation of these data; one thing just led creatively to another. That these products have proven popular with mapmakers indicates that a need existed for natural color maps, which the technology of the pre-digital era could not adequately fulfill.

Natural Earth provides a means for cartographers to colorize maps in a way that is presumably understandable to general readers without further explanation. Natural Earth reflects the "design for all" trend that seeks to rethink products and make them as accessible as possible to broad audiences. Yes, there is a superficial and even pandering aspect to this effort—looking good is important. On the other hand, it behooves cartographers to be pragmatic. What good are our maps if they are seldom read and even less understood?

Natural Earth is more than just a collection of pretty colors meant to attract readers, however. It gives a snapshot of the interrelatedness of world environments. As one moves north the deserts of Central Asia transition to steppe grassland that then becomes boreal forest and, finally, tundra. In presenting this change clearly, Natural Earth strives to bring order and understanding to the beautiful chaos of the natural world. At its essence: Natural Earth is a map.

Acknowledgements

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