Designing Raster Base Maps with Photoshop

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ABSTRACT

The term "raster base map" is defined, the different types of raster base map are discussed along with the uses to which they can be put. An argument is developed for greater use of designer raster base maps – maps that are created specifically for use as base maps rather than the continued widespread use of orthophotos and scanned paper maps for this purpose. The development of a new custom raster base map dataset is described and discussed. This is not a scientific paper. It reflects the opinions of a practicing commercial cartographer and relates experiences gained in a commercial cartographic environment.

Keywords

relief – raster – land cover – base map – map design - Photoshop

INTRODUCTION

A raster base map can be defined as a bitmap, or image map or chart, showing certain fundamental information, used as a base upon which additional data of a specialised nature is compiled or overlaid. Raster base maps are commonly used as backdrops for additional land information. They contain basic information that provides both a reference frame and context for whatever is being added. This can make for more effective communication and it can also save the cartographer valuable time. A good raster base map can also add aesthetic appeal, improving the look and attractiveness of the composite map. Depending on their content, raster base maps can potentially also make effective textures to drape over terrain and display in an interactive dynamic virtual 3D environment

In terms of content, a relatively simple and effective raster base map in common use today is the greyscale hillshaded image. Many basemaps though provide a more complex picture, being either scanned paper maps or orthophotos processed from aerial photography or satellite imagery. This paper argues that neither orthophotos nor scanned maps make ideal base maps from a cartographic perspective. That to communicate effectively one should use a raster base map that is designed specifically for the purpose. The paper then goes on to describe the design objectives and workflow developed to compile a new custom raster base map dataset for New Zealand.

What is wrong with using orthophotos or scanned paper maps as raster base maps?

Orthophotos may be recently flown and high resolution, both being desirable attributes. However when used as basemaps they can produce overload. Orthophotos contain information on everything seen by the camera, and much of this may be irrelevant to what one is trying to communicate in a map. The display of transient objects like vehicles for example is more likely to detract from a map rather than enhance it. Additionally there can be issues such as spectral reflectivity, cloud cover, and shadow depth that may obscure important detail. And there can be variation in colour toning, the appearance of vegetation and shadow length where adjacent photographic sequences are captured at a different time of day or year.

Scanned paper maps are likely to be dated, and while they may offer some uniformity in appearance there will again be a tendency towards too much information. Few if any paper maps were designed to be scanned and then used as a raster base map.

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The case for designer raster base maps

- Designer base maps can be compiled by additive process where content is controlled and managed. Content in this case may be a single layer (e.g. greyscale hillshade). Alternatively it may consist of multiple layers (e.g. landcover). The hierarchal layering of thematic or feature layers onto (initially) a blank screen means we can display the information we want to display in the order we want it displayed. Unlike orthophotography or scanned paper maps, there is no clutter or extraneous information unless we choose to add it. This makes it easier to communicate the chosen content intuitively, so that map users can focus on any overlying cartographic artwork rather than have to think too much about the base map itself.
- Coverage can be seamless and consistent. Designer base maps will display constant shadow angle and depth, no clouds, and no temporal, climatic or seasonal variations in toning, brightness, contrast or exposure levels.
- Each and every thematic or feature layer can be displayed in a way that contrasts with its neighbours and with different but similar feature types. The ability to manage presentation is this way means that base maps can be customised and optimised for a specific purpose and for different presentation formats.

EXAMPLES OF EXISTING DESIGNER RASTER BASE MAPS: THE GEOGRAPHX NZ LAND COVER BASE MAP

There are of course existing examples. We (Geographx) have ourselves developed several such datasets, though none nearly as sophisticated as the one I am shortly going to describe. Another well-known example is the raster component of Natural Earth.

Geographx has recently completed the development of a new raster base map dataset covering all New Zealand – a tileset of raster landcover textures at 4m pixel resolution.

Seven key design requirements

- source data – the ability to integrate data from multiple sources
- appearance – familiar, easily interpreted natural look
- special effects – to enhance visual representation
- pixel resolution – as high as the source data will realistically allow
- updates – to allow for addition of new or amendment of existing feature layers
- scripted processing – to streamline production
- non-destructive processing – to allow easy customisation

Source data

The dataset is built entirely from vector map source data. The primary source is the national 1:50,000 topographic dataset, Land Information New Zealand's (LINZ) Topo50. All the vegetation feature layers in Topo50 have been replaced with vegetation data from the Landcare landcover database v3.0 (LCDB3), which boasts more feature classes, more detailed attribution and more recent sampling. We are considering too incorporating elements from the Landcare Potential Vegetation database to provide more subtle variation in forest canopy appearance, ecosystem information from Land Environments New Zealand (LENZ) and possibly even physical land resource information from the now rather dated NZ Land Resource Inventory (NZLRI). Some feature layers (e.g. industrial port areas) we have created in-house. Geographx also created the 8m digital elevation model used to add hillshading to the base maps. The elevation model is derived from vector LINZ topo50 contours and height point source data.

Software

Only 64 bit applications have been used to build the new base maps. Manifold System is currently our preferred GIS platform for the collation, organisation and preparation of source data. GlobalMapper is used extensively to batch the rendering of height maps, hillshading and feature type layer masks. However the primary software application for base map processing is Adobe Photoshop.

Tile and dataset specifications

New Zealand is covered by 116 tiles, each measuring 2^{14} (16384) pixels square. At 4m pixel resolution this gives a tile coverage of 65.5 km square, or 4290 sq. km. We archive these tiles as large format Photoshop (psb) files, each around 3.6 Gb filesize. The complete dataset held in this format is 420 Gb filesize totalling in excess of 31 billion pixels.

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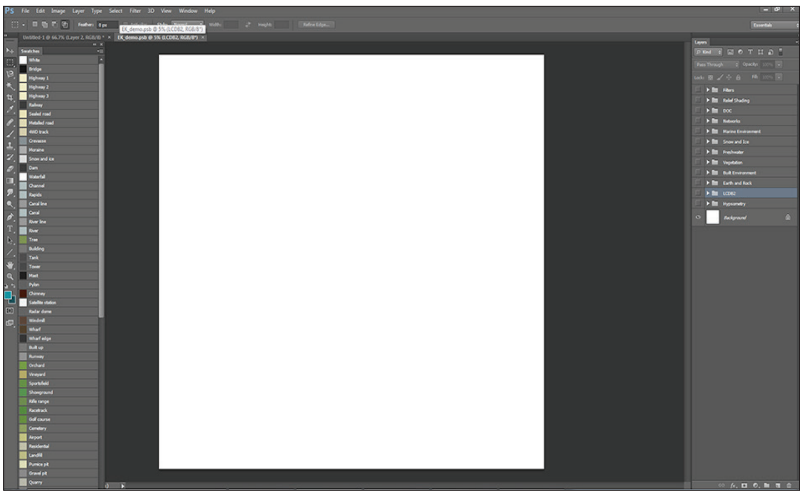

Figure 1. The tile in Photoshop.

The Photoshop workflow *(demonstrated live)*

Each tile starts in Photoshop as a blank page (Figure 1). Up to 100 different feature layers are then progressively added. Each tile takes around 8 minutes to generate, following a single button script call.

The pre-processed data called on by the script consists of:

- a height map and hillshade for each tile
- a raster mask for each of the thematic or feature type layers to be added (the raster mask defines the areas on each tile where the feature type is either present or absent).

The script first loads the relevant height map into Photoshop and applies hypsometric colour toning. The raster masks for each different feature type are then called in sequential order. The base layers are those we classify as "earth and rock". Next the script calls "vegetation" raster masks, followed by those for the "built environment", "freshwater", the "marine environment" and finally the raster masks for feature type layers classified under "networks". On top of the raster masks one or more hillshading layers is loaded.

Next the script refers to a custom palette and applies an appropriate colour swatch to each feature or thematic type layer. This is followed by the application of styling and effects, where different layers are individually textured, styled or have patterns applied. Some of these effects are relatively sophisticated. The script for instance automatically applies transitional colour blending where rivers exit lakes, and where rivers enter the sea. Then there is a snowfall slider that allows the user to intervene in the process and instantly generate snow cover down to any prescribed level.

Once the colour swatches, the effects, styling and hillshading are applied, the image undergoes fine-tuning with applied filters and colour adjustments. A colour profile is prescribed, and the image flattened and writ-

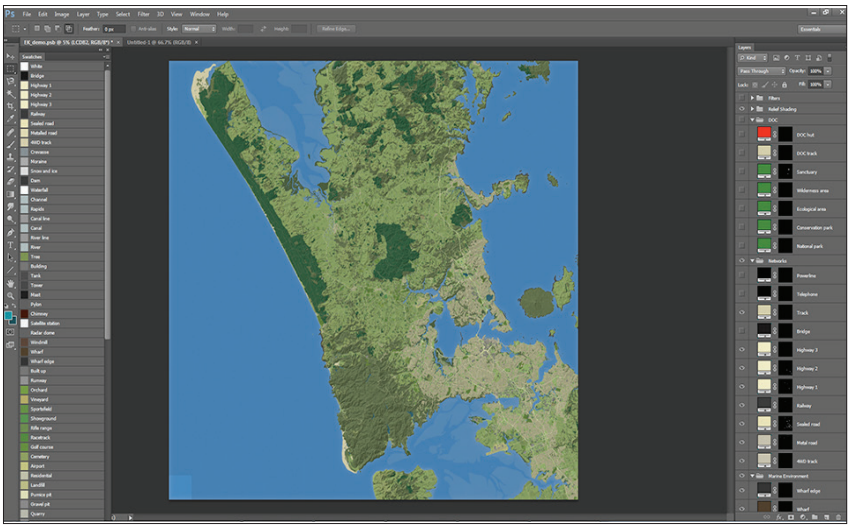

Figure 2. A completed layered tile file of the Auckland area in Photoshop.

Figure 3. A close-up of part of the image above. It zooms in on the Whangaparaoa Peninsula, on the east coast.

ten to whatever raster format the customer may require (usually geotiff, ecw or png). Figure 2 shows a completed tile of Auckland city and the area immediately to the north. Figures 3 and 4 show some zoomed-in examples.

Georeferencing

The key to managing registration of tiles lies in the initial preparation of data. All source data is georeferenced to start with and it is simply a case of preserving that quality throughout the entire process. All raster masks, height maps and hill shade images are precision cut to the exact pixel. So long as we are careful not to compromise image size or resolution during the Photoshop processing the output registration will be exactly the same as the input data registration.

3D visualisation

Designer base maps like these make ideal textures for draping over terrain and viewing in virtual 3D. The output can be easily customised to meet any particular requirements. For example a simple change to the script will allow the generation of base maps without embedded hillshading. Figures 5 and 6 show screenshots of NZ South Island base map data viewed in the 3D Skyline Terra Explorer.

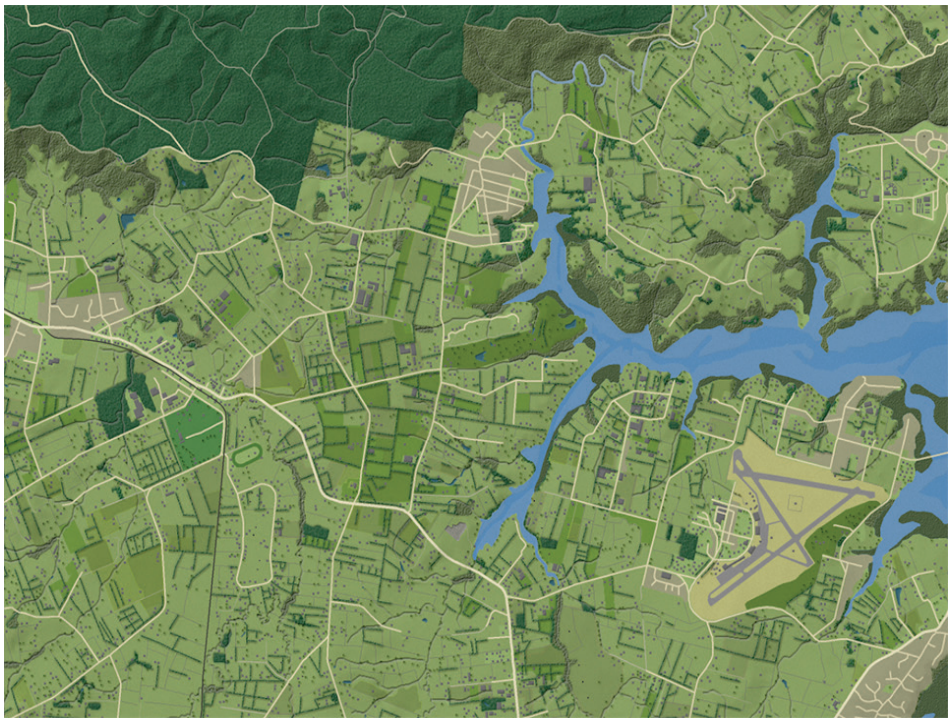

Figure 4. Zoomed-in map of the Huapai – Whenuapai area, which is located immediately below the central forest in the same tile.

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Figure 5. Screenshot of base map data viewed in Skyline Terra Explorer – here looking up a braided river (the Waitaki) on the East Coast of the South Island. The base map is draped over the Geographx 8m terrain model (DEM).

CONCLUSION

Designer raster base maps can be used to add value to or improve maps, GIS output and delivery, geoportal presentation and virtual 3D environments. They have the potential to be more effective in communicating base level information to end users than commonly used substitutes such as orthophotos or scanned paper maps. Designer base maps are versatile in how they can be used and can be easily customised to suit a particular situation or any special requirements. They can help save cartographers and GIS professionals time and money.

The Geographx landcover raster base map data is, we believe, a unique and valuable addition to the wealth of land information currently available in New Zealand. We plan regular updates, the timing of which will be dictated by the revision cycles of key source

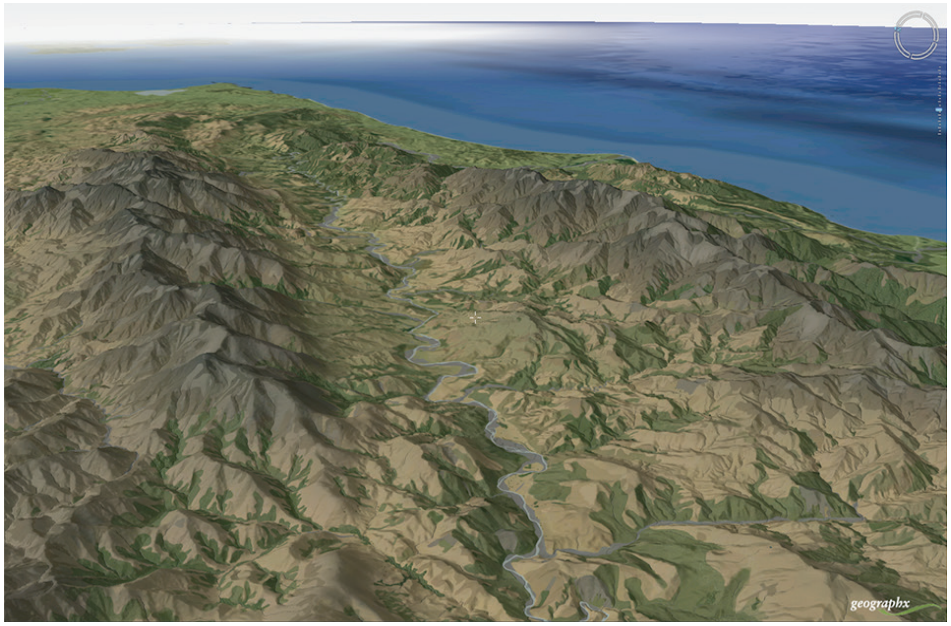

Figure 6. Terra Explorer image looking north east over the Clarence River and the Kaikoura Mountains, also on the East Coast of the South Island.

data. The current expectation is that base maps will undergo updating at approximately six month intervals.

The development of the Geographx raster base map data has showcased the enormous power and potential of Adobe Photoshop, which is, in our opinion, is currently much under-rated and under-utilised as a processing tool by the geo-spatial industry. This is illustrated by the fact that we can now push a single button to render off the entire 420 Gb dataset in a little over 24 hours.

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