

Vegetation Map of South Africa, Lesotho and Swaziland

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Cartographic challenges and lessons learnt during the production of the wall map and an A4-sized atlas in both analogue and digital formats.

The *Vegetation of South Africa, Lesotho and Swaziland* [1], published by the South African National Biodiversity Institute (SANBI), is the product of more than ten years of botanical research and contributions by more than 100 people. The map [2], published at a scale of 1:1 000 000, showing 435 vegetation types with 17 796 polygons, is by far the most comprehensive and detailed map of the region's vegetation and replaces all former official vegetation classifications.

Colour scheme

One of the major challenges faced during the production of the vegetation map was the development of a colour scheme that adequately differentiates the 435 vegetation types. The use of hatching schemes was not a cartographic option due to the complex shapes and small sizes of many vegetation polygons.

Consequently, the choice of colour for each individual vegetation type was vital to ensure that adjacent vegetation types, or vegetation types within close proximity to one another, can be discriminated 'at a glance'. A further complicating challenge was to design the colour scheme so that vegetation types from each biome (of which there are nine in the region) are complementary yet distinctive – allowing biomes to be coherently recognisable.

Because the discriminability of colour reduces rapidly as the number of colours in a scene increases [3] and due to the gamut constraints of printers, only a limited number of unique colours could be employed. The development of an appropriate palette started with the assignment of nine highly distinctive colours (i.e. primary and secondary colours) to each biome.

These 'anchor colours' were then used as central hue values to mathematically generate the required number of discernable colours for the vegetation types related to each biome. In total 250 distinct colours were generated in the hue saturation lightness (HSL) colour space.

Being restricted to a palette of 250 colours meant that many of the colours had to be reused. To prevent confusion in terms of vegetation type (and biome) identification, duplicate colours were assigned to vegetation types that are not in close proximity (in geographical space). This process was simplified by carefully assigning biome anchor colours so that they allow enough room (in colour space) to adequately accommodate the vegetation types of each biome and to minimise overlap between biomes.

Another measure to ensure that duplicate colours were not used in close proximity to one another was to assign contrasting hues (i.e. complementary colours) to anchor colours of adjacent biomes. To further enhance the contrast between biomes, the most distinctive colours within each biome's colour range were allocated to vegetation types occurring along biome borders.

Once allocated to the appropriate vegetation types, the HSL colours had to be converted to its corresponding, printable (i.e. within gamut) CMYK (cyan, magenta, yellow, key) colour. This process turned out to be a major challenge due to technical problems admitted to exist within the GIS software used (ArcGIS 9.2). Consequently, the colour scheme had to be exported to Adobe InDesign CS2 for conversion. This process was further

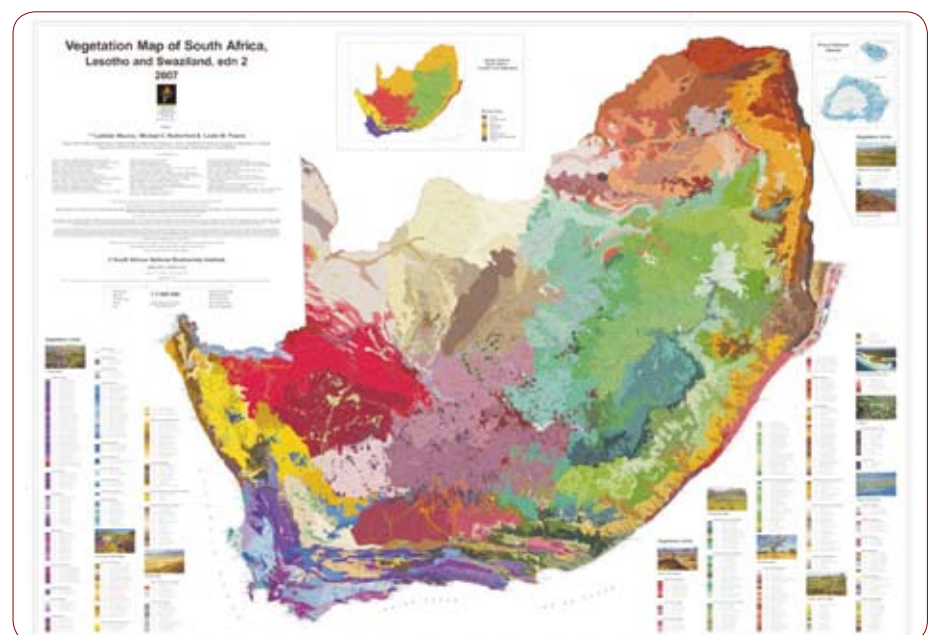


Fig. 1: *The Vegetation Map of South Africa, Lesotho and Swaziland (edition 2), 2007.*

complicated by the lack of colour management functionality in ArcGIS, which necessitated a trial and error approach using a colour-calibrated plotter and scanner.

Layout

The wall map was designed to fit onto four adjoining sheets of approximately A0 size, similar to the 1:1 000 000 topographical and geological map series of South Africa. An Alber's equal area projection, based on the Hartebeesthoek '94 datum, was used to ensure positional accuracy and compatibility with the *Geological Map of the Republic of South Africa and the Kingdoms of Lesotho and Swaziland* (dafs) [4].

In terms of layout, the biggest challenge was to fit the extensive and complex legend, biome map, insert maps and acknowledgements in the available page space in a functionally balanced and visually pleasing manner. Due to the large number of vegetation types, the legend items were automatically positioned and populated using specially developed software scripts, while the layout of the acknowledgements and other descriptive information was done in Adobe InDesign CS2 and imported into ArcMap.

Once the wall map was finalised, it was used as basis for creating the A4-format atlas edition [5]. As with most atlas designs, one of the major challenges was to create a page arrangement that will adequately represent the mapped area in the minimum number of pages. Another important consideration was the minimisation of scale distortions, which meant that each page (or page pair) had to be projected to a local projection. An adequate overlap between adjoining pages was also required to ensure that information on the page edges did not get lost. The optimal solution was a 31-page configuration consisting of 13 page pairs (i.e. adjoining pages in an A3 layout) and five individual pages.

Vegetation codes

The complexity and detail of the vegetation polygons necessitated the extensive use of vegetation type codes.

These code labels were not only used to help identify individual vegetation types, but to also show the location of inconspicuous (i.e. very small or narrow) polygons. Unfortunately, ArcMap's Maplex extension was unable to adequately label the almost 18 000 vegetation polygons and the majority of the labelling had to be done manually.

Another software limitation was encountered when the annotations in the geodatabase had to be reprojected for the atlas edition. The software considers each label as a line, which when reprojected, results in curved labels. As a workaround we converted the label centroids to point features before projecting. Automated labelling was then used to create unique annotation layers for each atlas page. However, much of the annotation had to be manually repositioned for the atlas edition to prevent discontinuities along page edges.

Printing

Because colour rendition and printing plate registration was a major concern, computer-to-plate technology was the only viable option for printing the maps. Fortunately, the firm USS Graphics, located in Cape Town, had large format computer-to-plate capability and was able to produce a high quality wall map. By making extensive use of colour profiles to ensure colour coordination, the atlas edition was printed in Thailand and also as part of the more than 800-page book titled *The Vegetation of South Africa, Lesotho and Swaziland* [1]. This book also contains the seamless electronic edition of the map, stored on a CD in a jacket at the back of the hardback bound publication [6].

Conclusions

In spite of the challenges faced, we are pleased with the visual appearance and quality of the end result. We conclude that modern map making is not only a combination of art and science, but has also become a technological contest of sorts. Although the technological advances in GIS have enabled much faster production of maps than in the past, their cartographic capabilities are still inadequate to produce high-quality maps. GIS software developers would

do well to incorporate some of the functionality of professional drafting software into their offerings.

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