Aerial Perspective Effect on Shaded Relief

Bernhard Jenny, Monash University, Melbourne
Tom Patterson, US National Park Service (ret.)

ICA Mountain Cartography Meeting March 2022
Tom’s Photoshop technique

**Adjustment Curve**

**Elevation Mask**

**Original Shading**
1. Reduce contrast without changing grey tone of flat areas

$\Delta = 0$

$\Delta = \frac{1}{3} \cdot v_f$

$\Delta = \frac{2}{3} \cdot v_f$

$\Delta = v_f$

2. Blend contrast-reduced shading with original shading

$k = 0.5$

$k = 1$

$k = 2$

$k = 3$
No aerial perspective

Kurt Brassel, 1974

Bernie & Tom, 2021
No aerial perspective

Difference

Dark red indicates strong change of original brightness.

With aerial perspective
Aerial perspective for shaded relief
Bernhard Jenny and Tom Patterson

ABSTRACT
Aerial perspective is an essential design principle for shaded relief that emphasizes high elevation terrain using strong luminance contrast and low elevations with low contrast. Aerial perspective results in a more expressive shaded relief and helps the reader to understand the structure of a landscape more easily. We introduce a simple yet effective method for adding aerial perspective to shaded relief that is easy to control by the mapmaker.

1. Introduction
Through the use of illuminating and shadowing, shaded relief images show terrain as a continuous, three-dimensional surface on a flat map that is easy to understand for most map readers. Cartographers have developed a series of design principles for creating effective shaded relief images (Imhof, 1982). These design principles include using an illumination direction from the upper left to avoid the illusion of terrain inversion (Biland & Çöltekín, 2017), locally adjusting illumination to accentuate the shape of individual landforms (Brassel, 1974a; Veronesi & Hurni, 2014, 2015), adjusting brightness of major landforms (Kenelly & Stewart, 2006; Marston & Jenny, 2015), showing flat areas with a consistent gray tone (Jenny, 2001), and using aerial perspective to more clearly show the vertical distribution of distant topography, such as lowlands, is shown with reduced contrast. The result is a shaded relief image that emphasizes the three-dimensional effect and that clearly distinguishes between high and low elevations.

Our contribution is a simple algorithm for adding aerial perspective to grayscale shaded relief images. When developing this method, we had the following goals: (1) the user should be able to easily control the application through a minimum number of parameters that are simple to understand; (2) the algorithm should be simple to add to existing shading algorithms; (3) adding aerial perspective should not change the gray value of flat areas so as to maintain a uniform base color from which the terrain features rise up from or fall below; and (4) the method must be flexible in order to accommodate various shading methods, for example, methods that combine multiple illumination directions.

https://doi.org/10.1080/15230406.2020.1813052