International Cartographic Association
Association Cartographique Internationale

View-adaptive implementation of hypsographic tinting for interactive web maps

Pyry Kettunen [a,*], Antti Järvenpää [b], Olli Sirkiä [c]

[a] *Finnish Geospatial Research Institute (FGI) in the National Land Survey of Finland (NLS), pyry.kettunen@nls.fi*
[b] *Terrasolid Ltd, antti.jarvenpaa@terrasolid.com*
[c] *National Land Survey of Finland (NLS), olli.sirkia@nls.fi*

* Corresponding author

Keywords: hypsographic tints, elevation, adaptive, interactive, web map

Abstract:

Hypsographic tinting is a traditional cartographic method applied to illustrate terrain elevations on maps, particularly on small-scale maps covering large geographic areas (see Imhof, 1965). Despite the common misinterpretation of hypsographic tints as a depiction of land cover (see Patterson and Jenny, 2013), they are a highly efficient visualization method for communicating distribution of elevations over country-, continent- or world-wide extents. Especially, hypsographic tints make it easy to compare elevations in locations of a map view that are remote from each other.

One primary problem of hypsographic tinting in the modern digital cartography is the conventional paper-born way of generating the tinting into a static form for a selected region. When panning on screen maps in larger scales, static hypsographic color zones are not often detailed enough to represent topographic variation of the map view that is visible on the screen at once. Instead, a few color zones fill major parts of the view leading to a very low informational content about the distribution of elevations in the area (Figure 1a).

To overcome this dilemma of resolution of hypsographic tint intervals in interactive maps, we developed an adaptive hypsographic tinting into a web map software. The implementation essentially utilises free and open-source OpenLayers web map library. The implementation reads the minimum and maximum elevations of the current map view and rescales the utilised color palette evenly between the elevations (Figure 1b,c). This function is repeated each time after finishing a zooming or panning action in the user interface, which makes the visualization adapted to the region in the view in real time.

Readability of elevation information on topographic maps is known to enhance with slope shading (Putto et al., 2014). Therefore, slope shading was also added on top of our adaptively tinted hypsographic layer. For experimenting with shading parameters, both dynamically- and pre-calculated shadings were inserted.

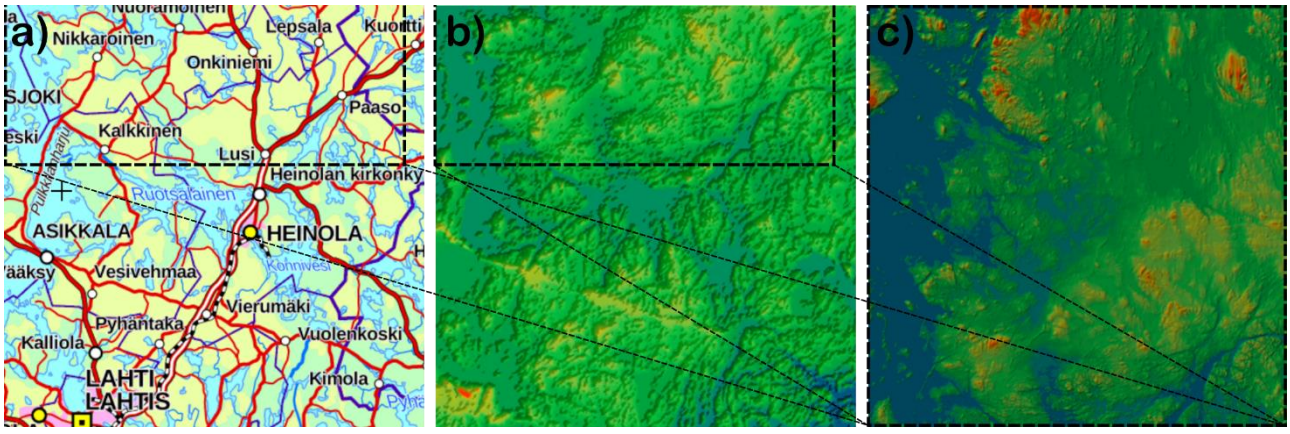

Figure 1. Traditional static hypsographic color zones (a; ©NLS) miss topographic details when zoomed in whereas adaptive coloring (b; c) scales a color palette over the elevations covered in the changing map view.

Abstracts of the International Cartographic Association, 10, 144, 2025
32nd International Cartographic Conference (ICC 2025), 17–22 August 2025, Vancouver, Canada.
https://doi.org/10.5194/ica-abs-10-144-2025

The non-conventional blue-to-green-to-red color palette for the demonstrator was brought from earlier elevation data exploration tests of the National Land Survey of Finland for maximizing the color contrasts of the map view. In the future, more conventional palettes, such as green-to-yellow-to-brown, and ones with less possibility for confusion with land cover, such as greyish-green-to-brown-to-white are to be tried for further improving the communicativeness of the adaptive hypsographic tints. Furthermore, usability evaluations are to be conducted on readability and efficiency of the developed and traditional methods of rendering hypsographic tints.

Acknowledgements

Thanks to the student group Ronja Hiironen, Lauri Nyholm, and Eino Yrjänäinen for advancing the implementation in their coursework. Thanks to Sami Mäkinen and Jukka Rahkonen from the National Land Survey of Finland for advising the coursework and to Jussi Nikander from Aalto University for inviting this topic to his GIS project course.

References

Imhof, E., 1965. *Kartographische Geländedarstellung*. Walter De Gruyter & Co.

Patterson, T. and Jenny, B., 2013. Evaluating Cross-blended Hypsometric Tints: A User Study in the United States, Switzerland, and Germany. *Cartographic Perspectives*, 75, Article 75. https://doi.org/10.14714/CP75.578

Putto, K., Kettunen, P., Torniainen, J., Krause, C. M. and Sarjakoski, L. T., 2014. Effects of Cartographic Elevation Visualizations and Map-reading Tasks on Eye Movements. *The Cartographic Journal*, 51(3), 225–236. https://doi.org/10.1179/1743277414Y.0000000087