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Employing cartographic principles to improve data graphics

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Abstract:

Teaching (geo)information visualization, I’ve observed that many students struggle when trying to go beyond simply representing the available data in graphical form. To some part, this may be due to tools that quickly transform data values in visual displays but often offer much less support for editing and improving the visualizations. Nevertheless, a host of guidance on improving data representations to create good data graphics and designing them to communicate messages exists. A key element is knowing or defining the message and making it clearly visible. While the message is in the focus, usually additional data or background information is displayed as well to put the message in context. This abstract explores the opportunities of employing cartographic (generalisation) principles, as for example applied on general reference maps, to organise the visual hierarchy of message and reference and to generally improve the legibility of data and communication graphics.

Figure 1. Data graphic comparing daily maximum temperatures of 2015 to the temperature of the ten previous years in Melbourne AU; top: line graph with 2015 highlighted on top of the data lines of the other years, bottom: aggregated reference years in the background.

For people with experience in using maps, especially frequently zooming through different scales on digital maps, the analogy or process of applying cartographic principles, such as for generalisation or labelling, to data visualization may give them some observed knowledge about how the methods work or at least how the results may look like. Additionally, this knowledge may help to improve the overall understanding that data graphics, like maps, communicate information about some real-world phenomena. When using maps, specifically general reference maps, we do not question that those maps inform us about the situation we will encounter in the real world.

Map generalisation has much in common with the processes described to create good data and communication graphics. However, there is no standard process that can be followed. For example, selecting what to represent and what not, i.e.,

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what supports the intended message and what can be left out, is an important first step for any representation. But after this step, we may still have detailed data that needs to be shown. Space is limited and showing every detail may not be necessary to grasp the main idea, neither on maps nor in data graphics. For example, on maps, forests normally do not represent every single tree, but they are aggregated to a symbolised area communicating “forest”. Robinson et.al. (1995) list classification, simplification, exaggeration, and symbolization as the four elements of generalisation. Slocum et al. (2009) list ten vector-based generalisation operations, i.e., simplification, smoothing, aggregation, amalgamation, collapse, merging, refinement, exaggeration, enhancement, and displacement. But often the separation of the methods is difficult and applying one method may influence another. Nevertheless, these approaches may be usefully applied to data graphics to reduce detail, clarify the visual hierarchy, and make the visualization easier to perceive but still show the essential characteristics (cf. Figure 1 bottom, with aggregated background). Illustration of how ‘cartographic’ methods can be applied to data graphics is supported by the abundant example material available in existing (general reference) map graphics (e.g., the Swiss National Maps) at different scales (cf. Figure 2, the main characteristics of a track field at different scales). These allow experiencing the generalisation approaches and results for a range of situations and scales. When using data graphics examples, we often only see one result and may not be able to learn how much generalisation was applied throughout the creation process.

This talk will discuss and illustrate selected cartographic (generalisation) principles and their potential application to data and communication graphics.

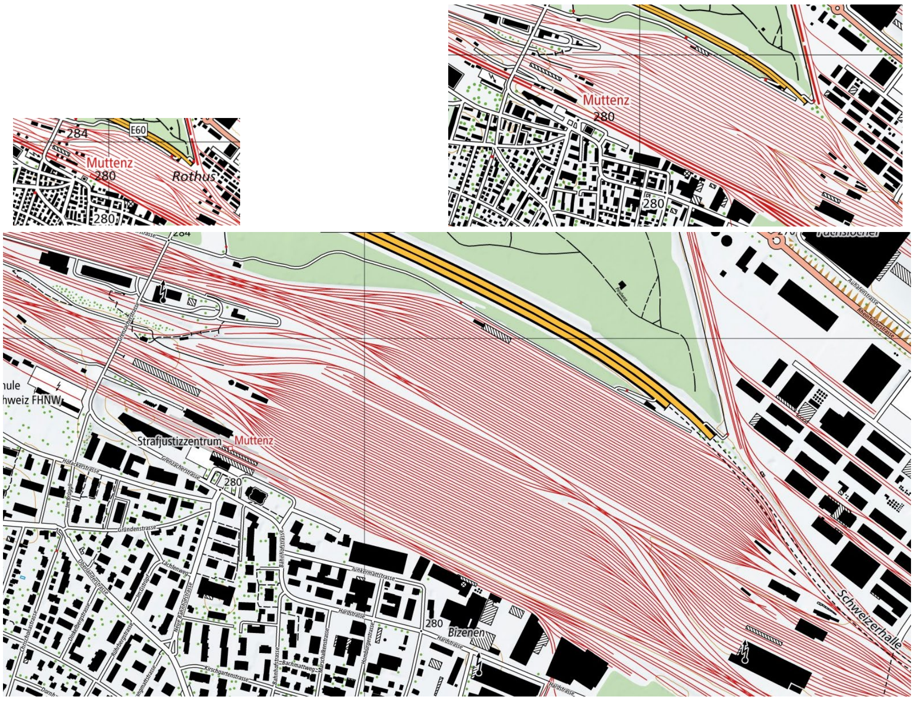

Figure 2. Example of map generalization as applied on the Swiss National Maps (swisstopo, map.geo.admin.ch). The track field in Muttenz with its main characteristics at different scales (approx., 1:50’000, 1:25’000, and 1:10’000).

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