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Digitizing historical Swiss railway data for interactive presentation in the Atlas of Switzerland

Christian Wohlert [a,*], Andreas Neumann [a], Lorenz Hurni [a]

[a] *ETH Zurich, Institute of Cartography and Geoinformation – {cwohlert, andreas.neumann, lhurni}@ethz.ch*

* Corresponding author

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Abstract:

Railways play a special role for transport in Switzerland. On average, the Swiss travel almost 2,500 kilometers per person per year [https://www.bfs.admin.ch/]. The Swiss railway network is considered to be one of the most punctual and safest in Europe. Prominent train infrastructure, such as train stations, railway viaducts or spiral tunnels contribute to the cultural heritage of Switzerland. Those are just some of the reasons why the topic of railways has repeatedly found its way into the Atlas of Switzerland (AoS), the national atlas of Switzerland. In the course of the technical reorientation away from a desktop-based atlas application towards a web version, the topic of railways is also undergoing a general overhaul. While the focus of the work is on current information on the railway network, route and technical equipment, the historical development of the Swiss railway network is also to be examined in more detail for the first time in the AoS.

While the current state of the Swiss railway network is available in a number of different spatial data sets, the situation is very different for historical route information. Highly generalized data are often used to visualize the historical development of the rail network, whereas there is no widely available digital data basis for more detailed information. In the AoS, due to combinations with our other themes and base maps, we have higher demands on the accuracy of both spatial and temporal information. As a result, we have focused on collecting and digitizing historical data ourselves, based on various partially non-connected data sources.

The development of the railway network in Switzerland began around the middle of the 19th century with the first railway lines from Strasbourg (France) to Basel in 1844. Around the same time, the first nation-wide topographical map of Switzerland was produced, the so-called Dufour Map at a scale of 1 to 100,000. A few decades later, in 1870, the first map sheets of the Siegfried Map were published, a national topographic map series at scales of 1 to 50,000 and 1 to 25,000 with an overall positional accuracy of approximately 30 meters. In the latter map series, the route-by-route development of the Swiss railway network can be traced in detail. The map sheets of the Siegfried Map therefore serve as the primary spatial data basis for this project.

At present, computer-aided methods are mainly used for the automatic extraction of spatial information from (historical) maps, cf. Xia et al. (2023). However, these methods often yield limited results in terms of informative value or temporal accuracy since they rely almost exclusively on maps. Historical national survey maps, updated in multi-year cycles, result in data with imprecise temporal resolution. To improve this, written sources providing chronological details on line openings, relocations, or closures are used alongside maps. The authors primarily reference Wägli (2010), a comprehensive record of the Swiss railway network's development. The combination of these written records and cartographic representations allows for the accurate attribution of temporal information to the digital spatial entity delineated on the map. A similar approach can be found in Morillas-Torné (2012), who also used written documentation as an additional source of information for the development of a European historical railway GIS. However, due to our role as a national atlas as well as the special topography and the importance of the railway in Switzerland, highly detailed final data are needed for a rich visualization of historical developments. This means that in addition to the opening and closing years of rail connections between certain cities, changes to the track layout should also be traced in detail. This approach is unique in its attention to detail and unprecedented for a national historical traffic geodata set. To ensure consistent data quality throughout the digitization process, and to account for the changing map symbology over time, the decision was made to perform the digitization manually (Figure 1).

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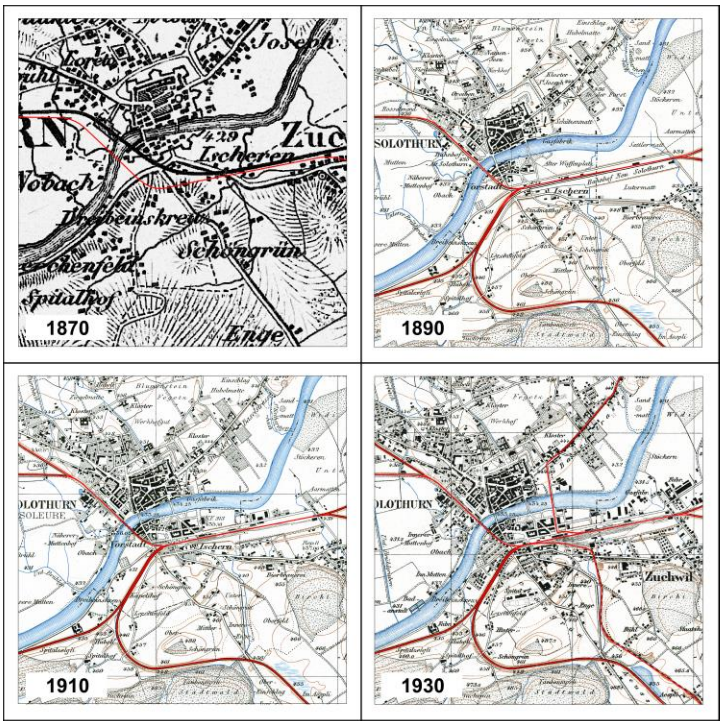

Figure 1. Historical development of the railway network (red) around Solothurn. Base layers are the Dufour map (1870) and the Siegfried map (1890 – 1930). © swisstopo.

After digitization, the data is visualized in the AoS, influenced by the technical capabilities of its new web version and the historical context of "Infrastructure Switzerland." Among other things, an interactive animation is planned to make the spatial and temporal dynamics of the development more tangible. Users will also be able to analyze specific points in time and view detailed maps highlighting events like route changes or major openings. The AoS is set to expand in the medium to long term to encompass visual storytelling as a way to enhance the information value as well as to address a broader user base (cf. Sieber and Hurni 2022). Furthermore, the innovative combination of visualization approaches should enable the atlas user to freely explore the evolution of infrastructure over time as well as to be editorially guided through interesting steps of railway development in Switzerland.

Special attention is given to the creation of historical base maps to accompany the rail network data. Today, historical data is often presented on contemporary background maps that allow comparisons with today's conditions, but do not reflect past conditions, making it difficult to understand historical developments. Ideally, the map context—features like rivers, forests, and settlements—should align with the time period of the thematic content. This requires extracting information from historical national survey maps and visualizing it as independent historical base layers. In this regard, computer-aided methods can be an effective means of achieving a compromise between accuracy, whether in terms of spatial or temporal precision, and the associated workload, leveraging the expertise of ETH Zürich's Institute of Cartography and Geoinformation in AI-supported spatial data extraction (cf. Xia et al. 2023).

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