

Next-Generation Vector Tiles Cartography

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Abstract:

Modern web cartography has evolved from static images to dynamic, data-driven environments powered by advanced vector tiles technology. MapTiler has introduced a new generation of map styles that leverage refined data structures to provide detail and clarity across all scales. A critical component of this release is the underlying technical methodology rooted in advanced manipulation of the MapLibre Style Specification. Drawing on optimized JSON styling techniques and logic-driven expressions, these styles utilize complex data-driven styling. The Streets style, for instance, features localized highway shields tailored to national standards, and high-fidelity street-level details such as traffic lights, zebra crossings, and 3D buildings. These styles are optimized for a wide range of use cases, from urban navigation to minimalist data visualization.

Building on this foundation, MapTiler is currently developing AI-driven workflows for the Base map style. The goal of this research is to enable users to generate and refine custom cartographic themes through natural language prompts, effectively bridging the gap between professional GIS suites and intuitive, prompt-based design interfaces.

A significant breakthrough in terrain representation is found in the Landscape map style, which integrates hand-drawn hillshading. Inspired by the classic Swiss cartographic techniques of Eduard Imhof, MapTiler utilizes advanced machine learning algorithms to replicate the artistic finesse of hand-drawn relief. This technique applies careful vertical exaggeration and soft gradients to digital elevation models, creating expressive and naturalistic terrain visuals that transition seamlessly into classic relief at high zoom levels. Complementary innovations such as land gradients, coastal glows, and curved water labels further enhance the map's storytelling capabilities.

Pushing the boundaries of the third dimension, MapTiler's GeoSplats technology introduces photorealistic 3D maps using georeferenced Gaussian splatting. By using a unique Level of Detail (LOD) system and a high-performance WebGPU-based renderer, MapTiler enables streaming hundreds of millions of splats in real time. Unlike traditional 3D meshes, GeoSplats provide a photorealistic experience, allowing users to pan and zoom through large-scale models with incredible smoothness and no loss of detail. These innovations collectively represent a shift toward more immersive, accurate, and artistic digital cartography, providing practitioners with powerful tools to communicate complex spatial information.



Figure 1. Base map: San Francisco, Coit Tower.



Figure 2. GeoSplats: San Francisco, Coit Tower; Data source: V. Woo.