

League of Geeks #23

Next Generation of (Web) Map Apps

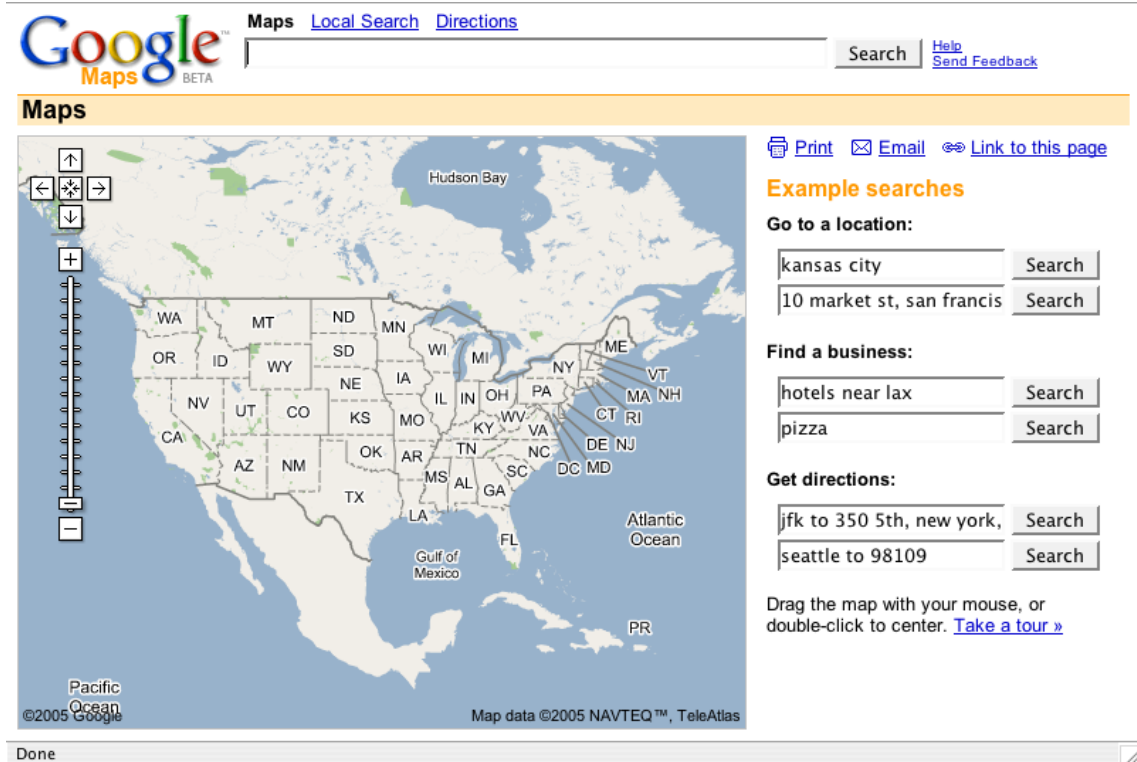
Markus Tremmel, 18.09.2019

About me



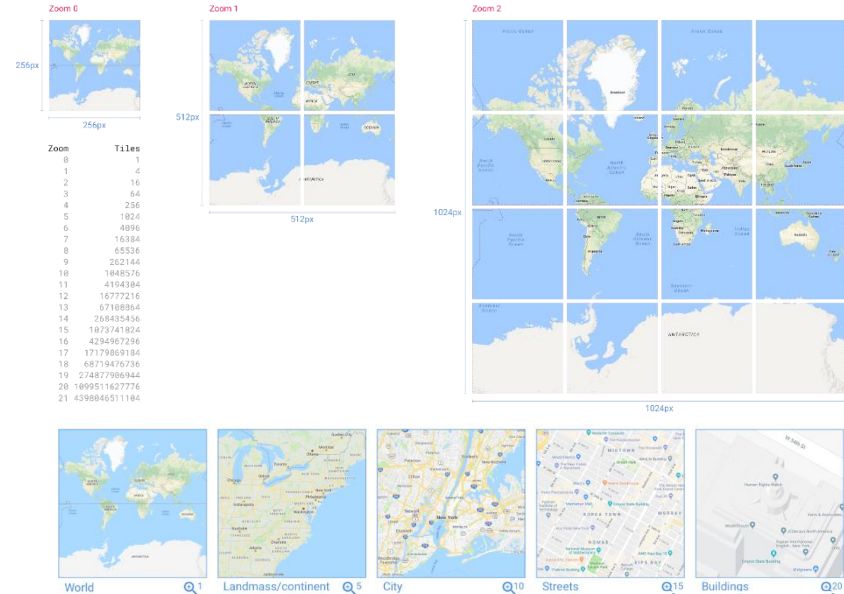
- Markus Tremmel
- Software Engineer at Rohde and Schwarz in Teisnach
- Main focus on developing map and GIS applications
- Contact: markus.tremmel23@gmail.com

When digital maps got mainstream ...



Raster Tiles

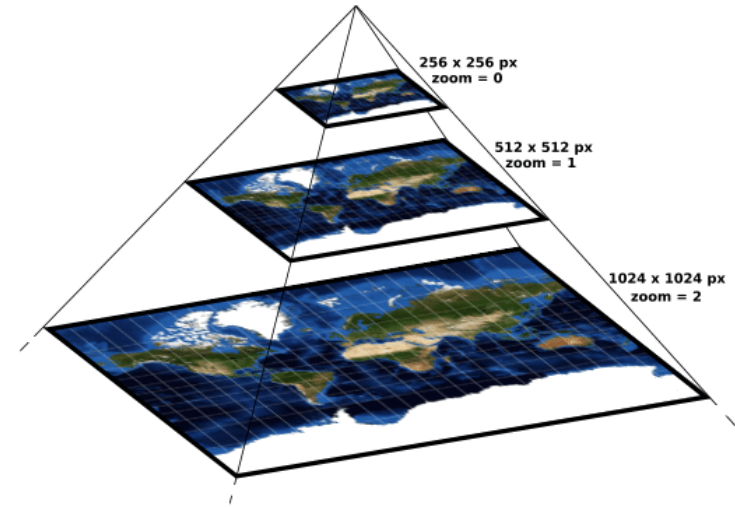
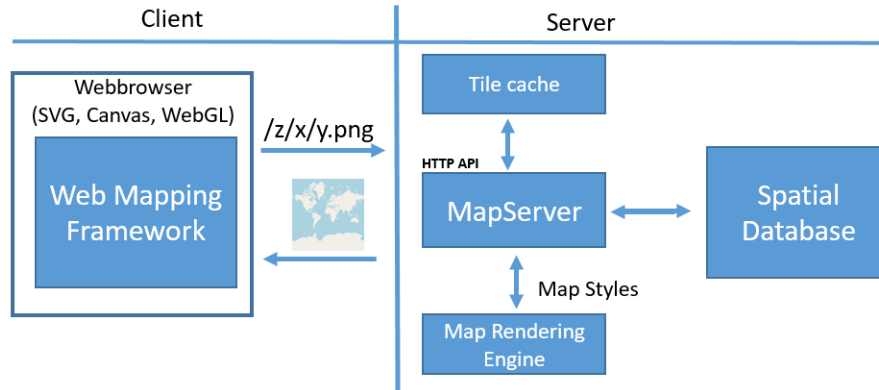
- A map of the entire world is too big to be directly displayed on a computer or mobile device
- Instead of making a single, huge image, a raster tile map will divide the image into several smaller images of a fixed size
- At the outer most zoom level 0, the entire world can be rendered in a single map tile (image)
- Each zoom level doubles in both dimensions, so a single tile is replaced by 4 tiles when zooming in
- The tile itself usually has an extend of 256 by 256 pixel (de facto standard), sometimes even 512 by 512 pixel if the tiles are set in high quality



Source: morphcode.com

Raster Tiles

- Different HTTP GET numbering schemes: XYZ, TMS, WMTS
- With XYZ images are served through a Mapserver with a URL like „<http://host/{zommLevel}/{x}/{y}.png>“
- To display a tiled map in a browser usually requires the support of a web mapping framework



Source: maptiler.com

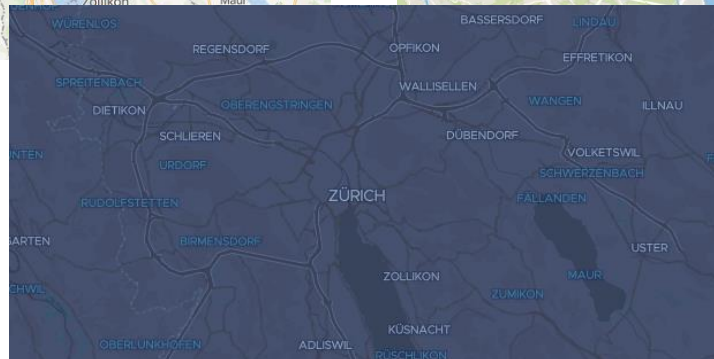
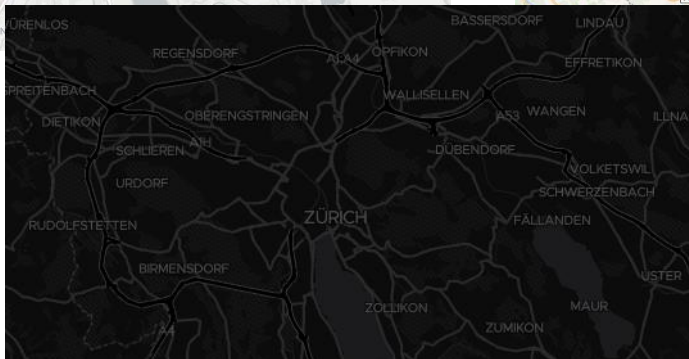
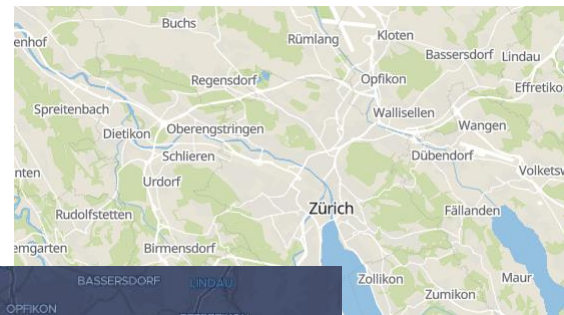
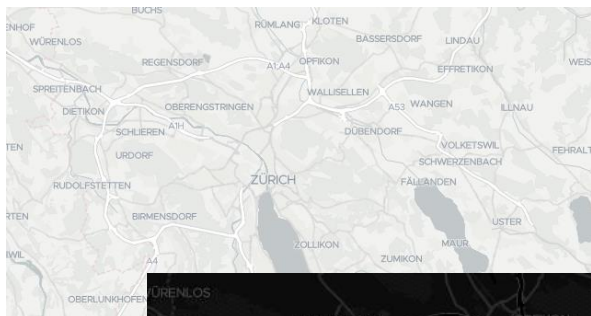
Vector Tiles

- Vector tiles are similar to raster tiles, but instead of raster images, the data is a vector representation of the features in the tile
- Rendering takes place on the client side via WebGL
- **Advantages over Raster Tiles**
 - Client (not the server) decides on styling
 - Vector tiles are smaller -> slim enough to fit the entire world onto a single USB stick
 - Rendering takes place in distributed GPU processors
 - Better user experience -> smooth zooming



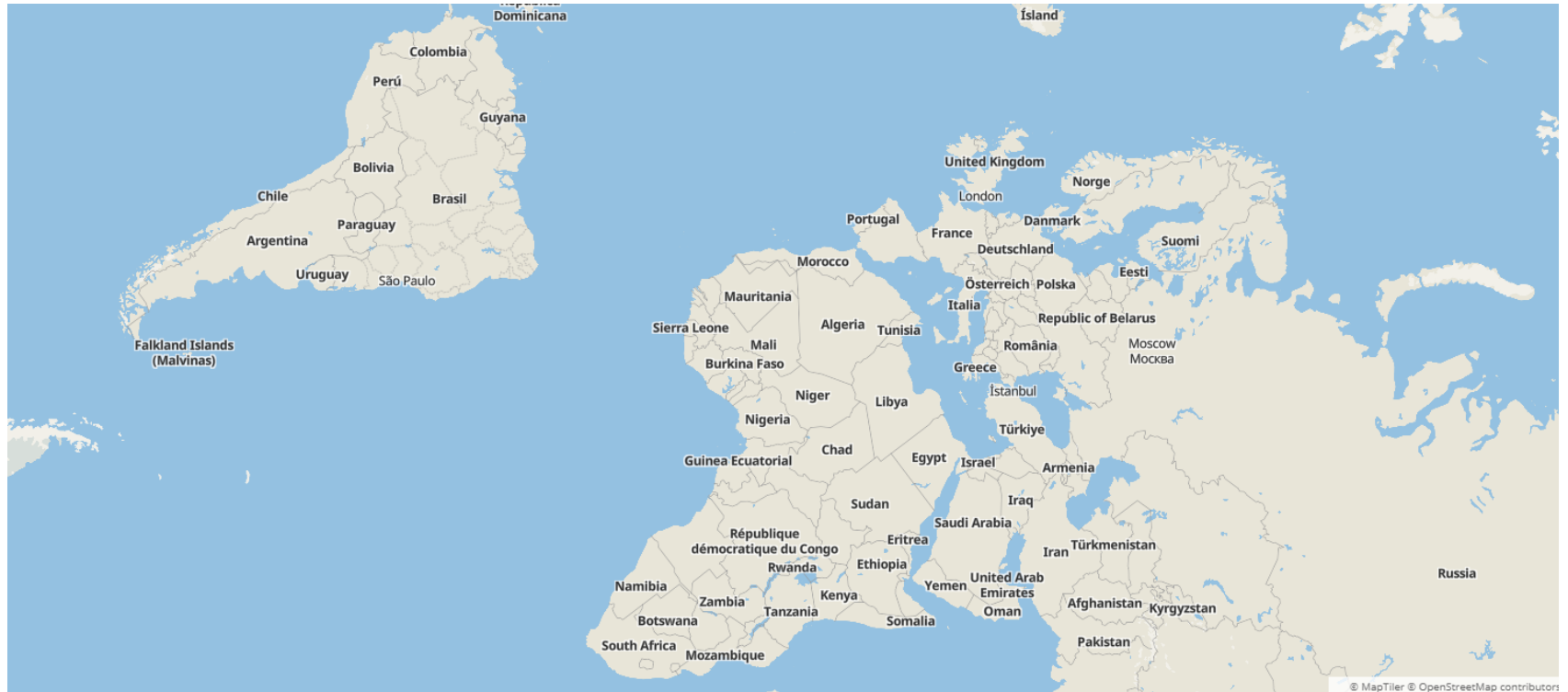
Source: mapzen.com

Dynamic Styling



Source: OpenMapTiles

Smooth zooming → better user experience



Smaller Size → offline capable maps

Raster Tiles



...

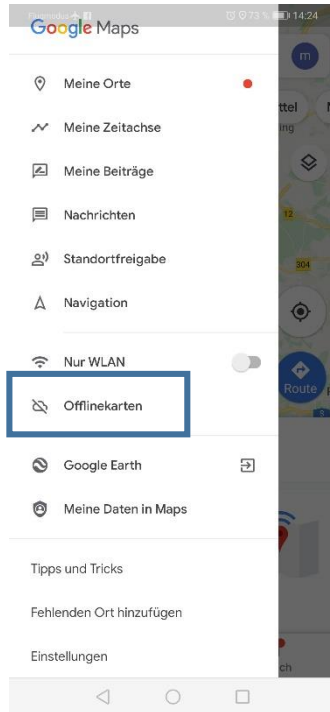
World Zooml. 18 :
Approx. **55 TB** / 100 bn Tiles

Vector Tiles

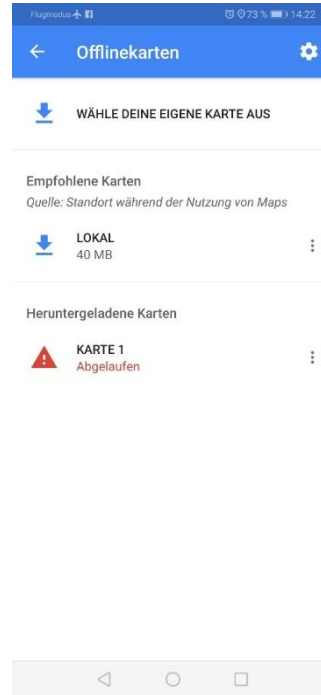


World:
Approx. **50 GB**

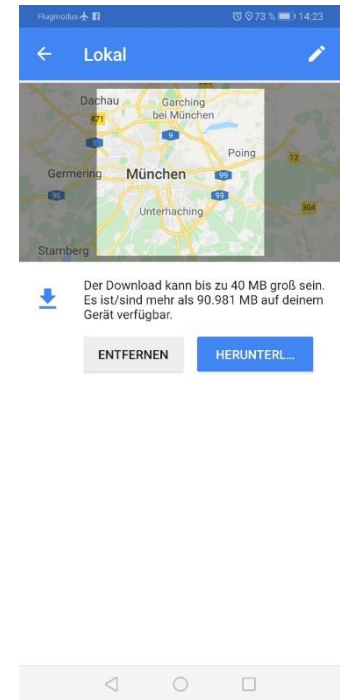
Google Maps offline maps



18.09.2019

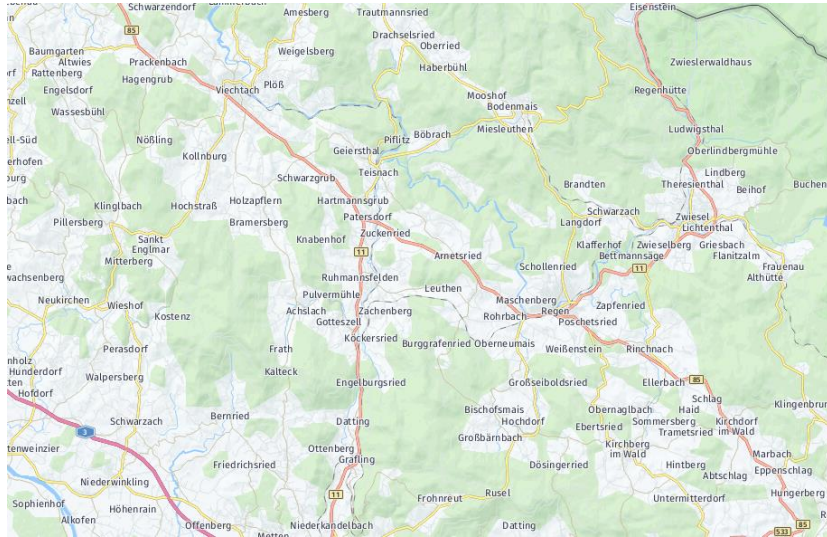


Next Generation of Map Apps



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What the map industry calls state-of-the-art



... and what the game industry does



3D Mapping Applications

- Lidar and digital photogrammetry generates rich 3D content
- With a combination of a virtual globe, terrain data and 3d models we can see the world as from a birds eyes
- More than just a pretty pictures -> New ways to analyse data for city planning, flood simulation, transmitter towers site planning, ...
- Why is 3D hard?
 - Large scale big data
 - Rendering



3D Map Tiles

- 3D Tiles are an open specification (OGC standard) for streaming massive heterogeneous 3D geospatial datasets
- The foundations for 3D Tiling were created by the movie and game industry -> 3D tiles brings these techniques to geospatial
- 2D Tiling has limited use in 3D -> Ok for imagery and terrain but not for massive 3D models like buildings
- 3D Tiles Features
 - Spatial data structure with level-of-detail
 - Geometry and texture simplification for non-leaf tiles
 - Quick to offload to GPU (GLTF) -> ready to render, fast decoding



Hierarchical Level of Detail (HLOD)

- The foundation of 3D Tiles is a spatial data structure that enables Hierarchical Level of Detail (HLOD) so only visible tiles are streamed
- 3D requires multiple LODs in the same view
- Reduce an object's complexity when it contributes less to the scene
- An object in the distance may be rendered with less geometry and lower resolution textures than the same objects if it were close to the viewer

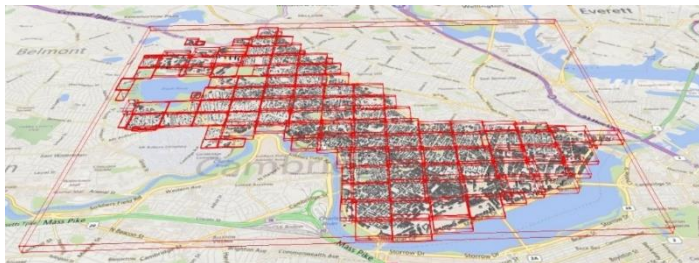





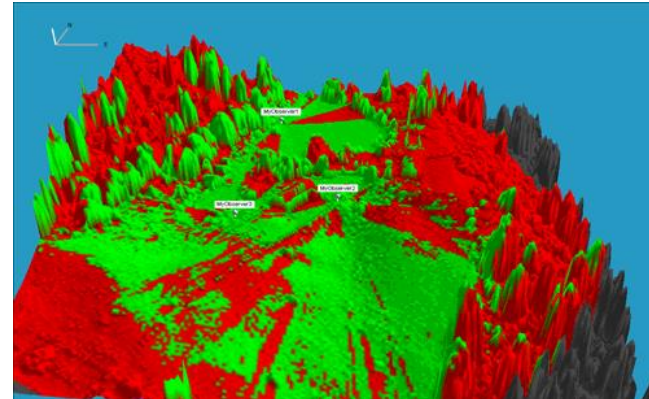
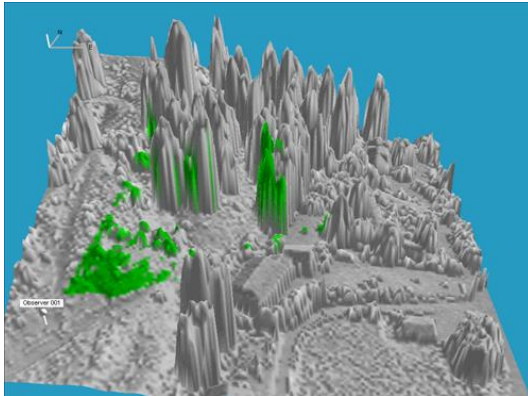


Image					
Vertices	~5500	~2880	~1580	~670	140
Notes	Maximum detail, for closeups.				Minimum detail, very far objects.

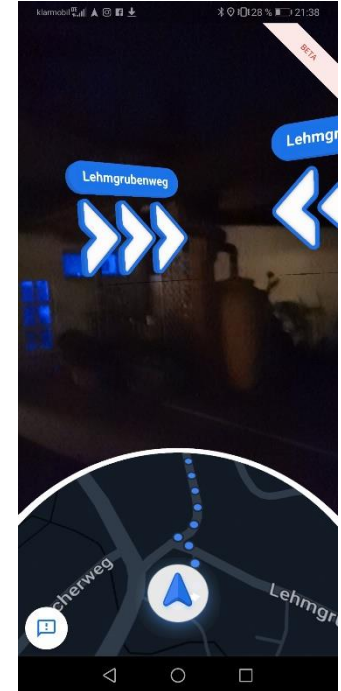
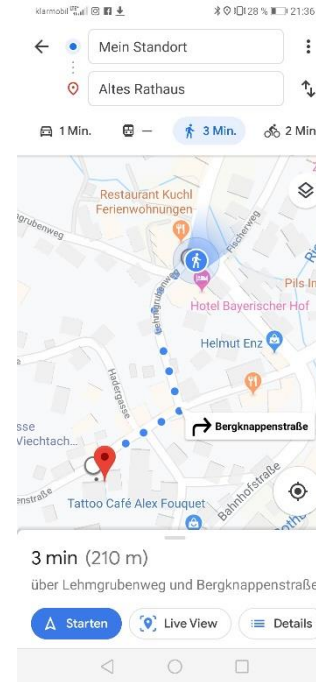
Viewshed Analysis

- Isovist, Viewshed and Viewdome means the same in different context
- Propagation area around some observer point
- Usage:
 - Visibility between two points
 - Site planning for transmitting towers



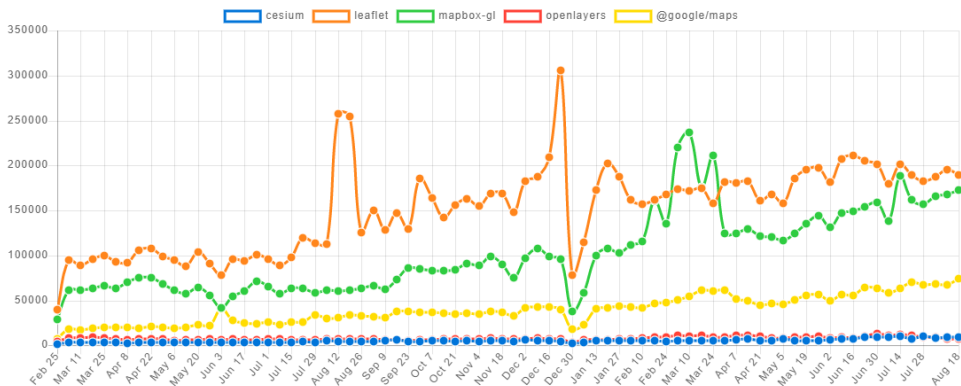
Current Trends

- HD maps
 - The maps on your mobile device only achieves meter-level precision, but self driving cars need a more detailed map
 - A high definition map enables the vehicle to achieve centimeter-level precision
- Augmented Reality (AR) apps
 - AR is an overlay onto the real world
 - AR navigation is now integrated in Google Maps (LiveView)



Popular Web Mapping Frameworks

Downloads in past 2 Years ▾



Stats

	stars 🌟	forks 🍴	issues 🚩	updated 🔄	created 🗓️	size 📦
cesium	4779	1863	986	Aug 22, 2019	Mar 2, 2012	bundlephobia timeout
leaflet	25522	4155	463	Aug 17, 2019	Sep 22, 2010	minzipped size 39.9 KB
mapbox-gl	4731	1132	664	Aug 22, 2019	Mar 7, 2013	minzipped size 171.0 KB
openlayers	5380	2010	98	Aug 22, 2019	Jun 20, 2012	minzipped size 151.7 KB
@google/maps	1809	452	10	Aug 5, 2019	Oct 21, 2015	minzipped size 6.2 KB

Cesium

- Cesium is a geospatial 3D mapping platform for creating virtual globes and visualizing dynamic data (Apache 2 license)
- Cesium uses WebGL for hardware-accelerated graphics and 3D Tiles for streaming 3D map data
- Cesium provides 3D, 2D, and 2.5D (Columbus View) through a single API





Demo