

Welcome to OpenStreetMap

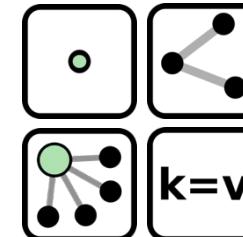


GIS Summer School 2014

Marcus Hudritsch

Agenda

- ▶ **Introduction to OSM:**
 - ▶ Quick Comparison with other Maps
 - ▶ History
 - ▶ Contributors
- ▶ **OSM Details:**
 - ▶ Elements & Tags
 - ▶ Reference System & Projection
 - ▶ Map Rendering (Tile or Vector based)
- ▶ **OSM Mapping Process:**
 - ▶ Collect & Upload GPS Data > Editing > Tagging > Viewing
- ▶ **Using OSM with Leaflet**
 - ▶ Leaflet Tutorial
 - ▶ Other Projects



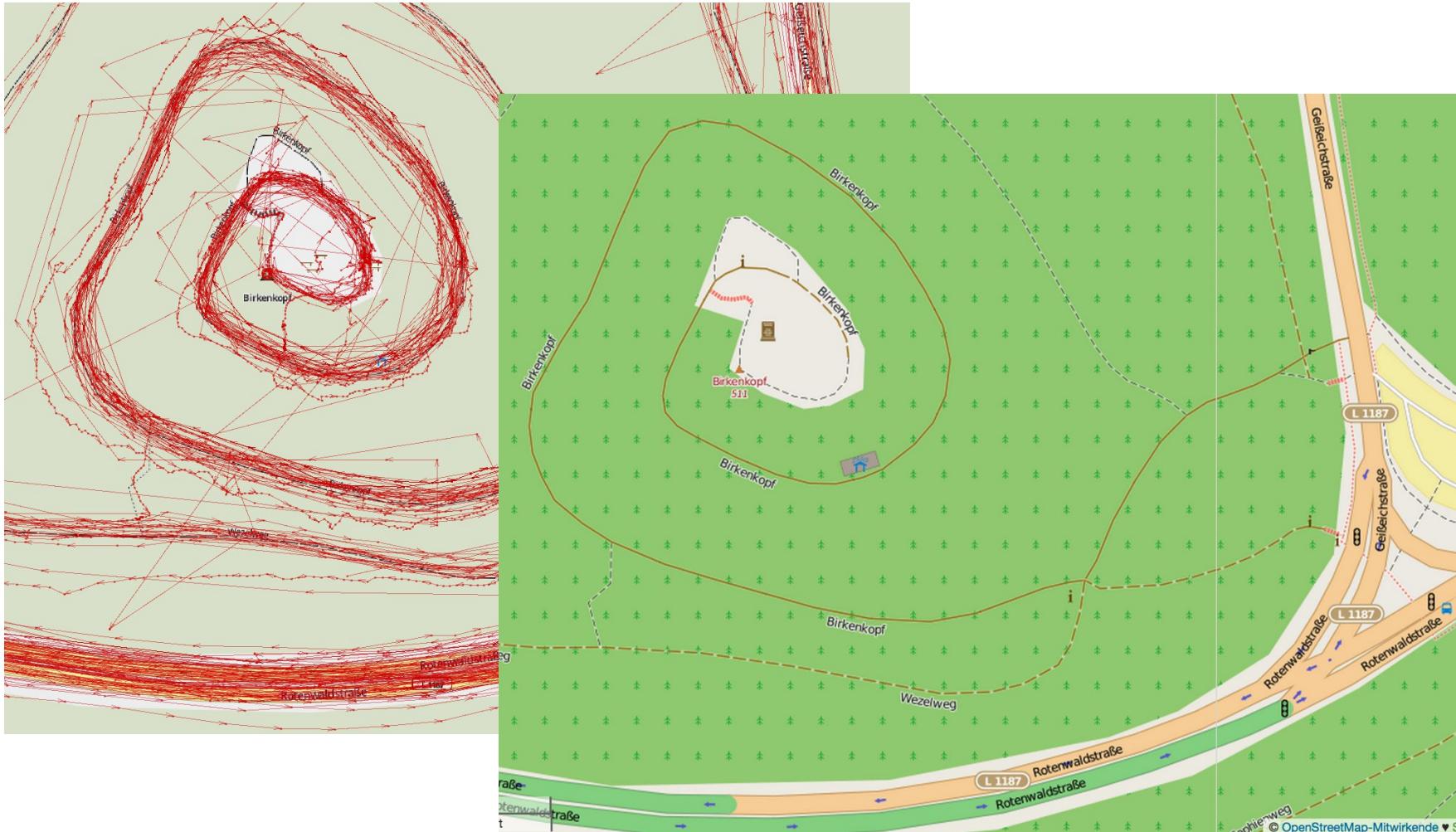
Introduction to OpenStreetMap (OSM)

- ▶ OSM is a collaborative project to create a free map of the world
- ▶ URL: <http://www.openstreetmap.org>



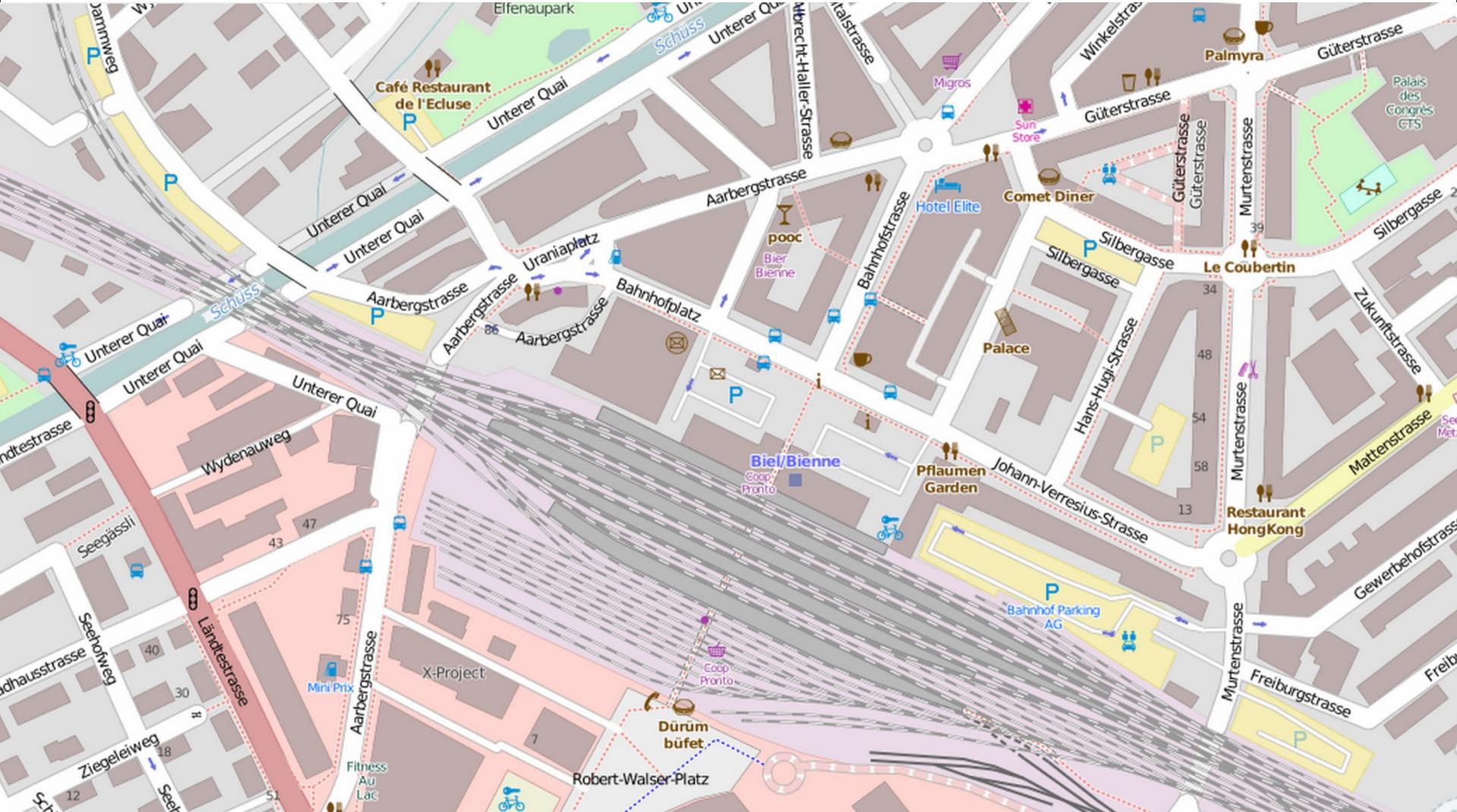
Introduction to OpenStreetMap (OSM)

- ▶ OSM is a collaborative project to create a free map of the world
- ▶ URL: <http://www.openstreetmap.org>



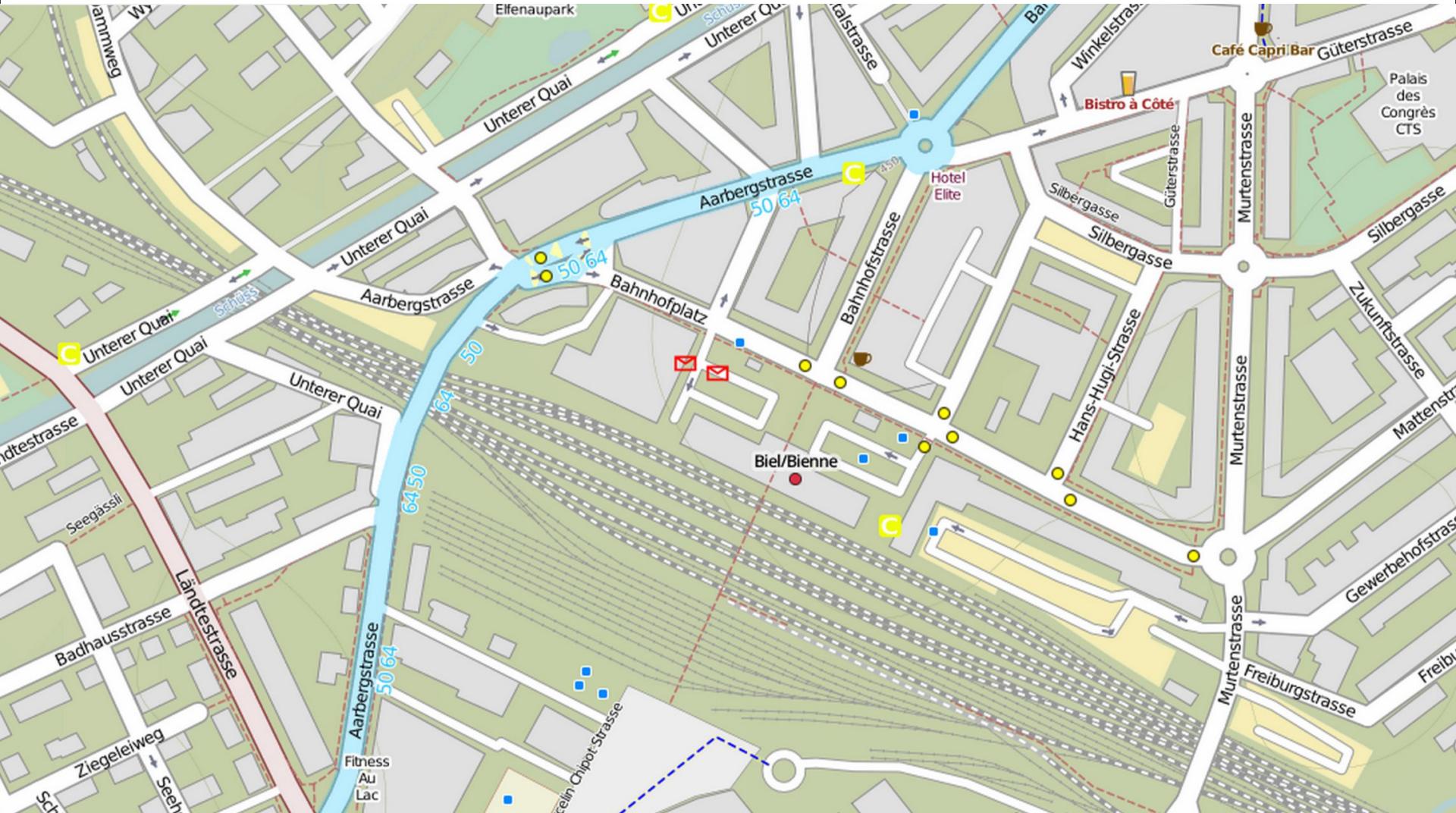
Introduction to OSM: Quick Comparison

OpenStreetMap: Standard Map



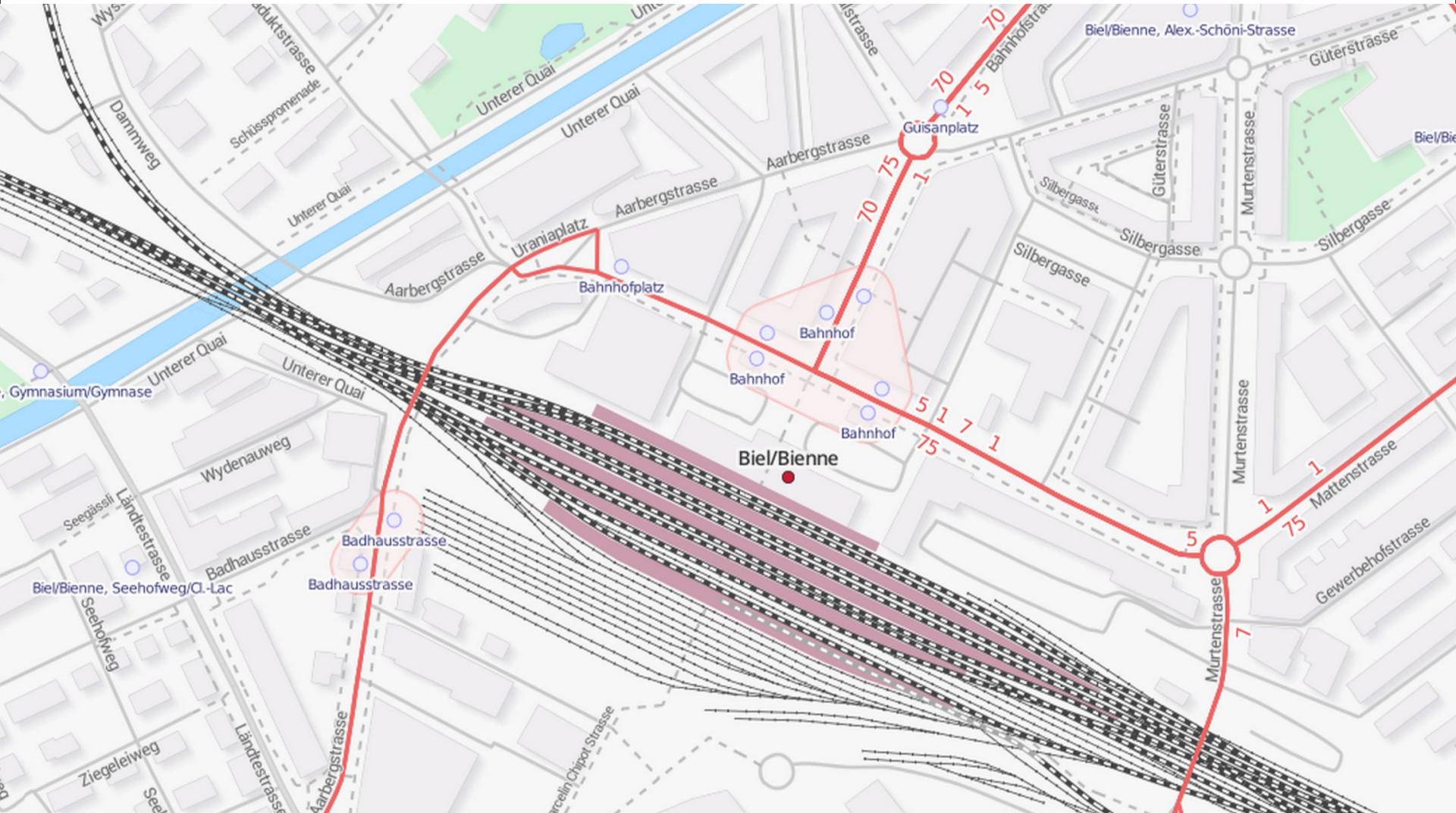
Introduction to OSM: Quick Comparison

OpenStreetMap: Bicycle Map



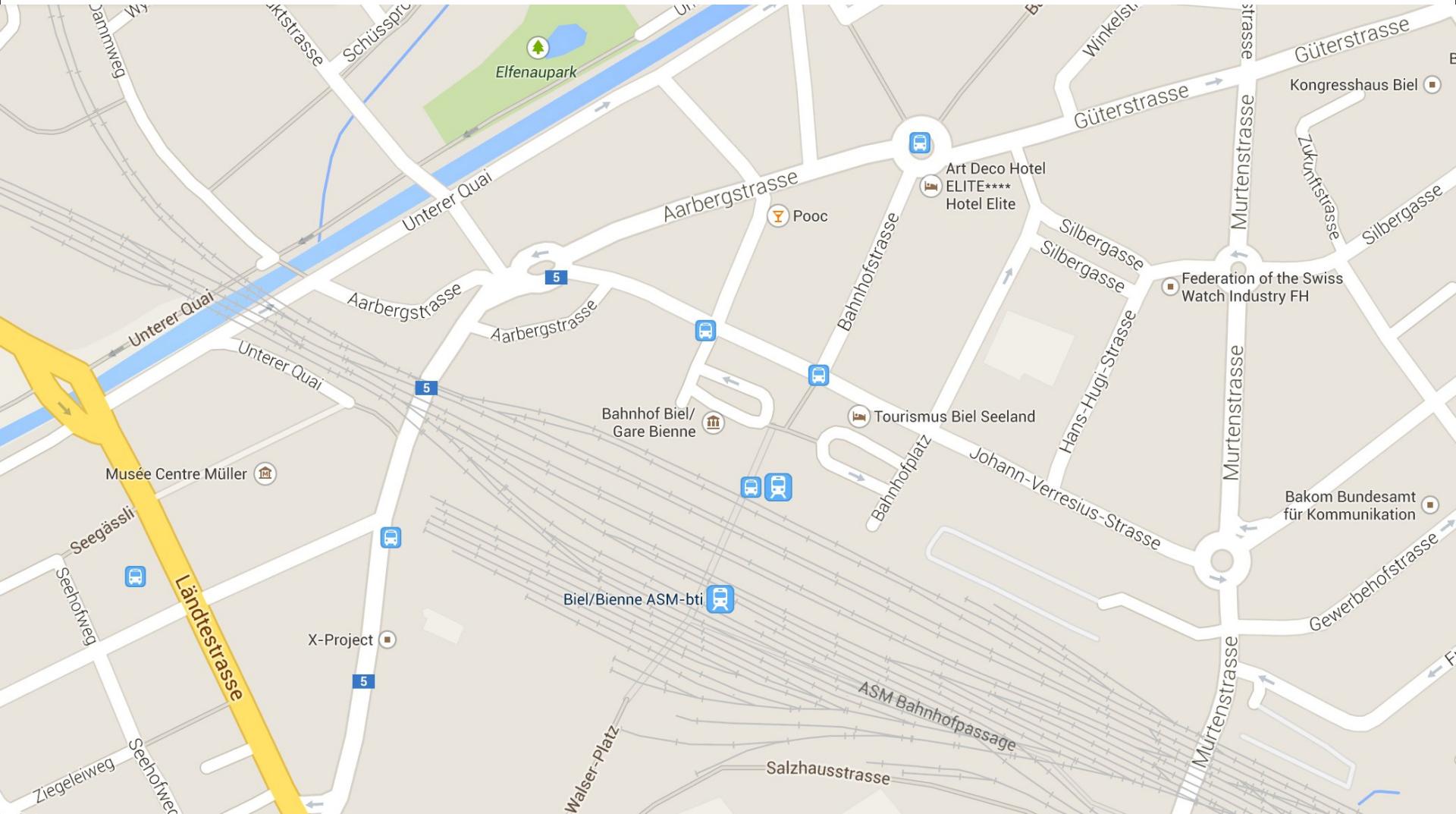
Introduction to OSM: Quick Comparison

OpenStreetMap: Public Transport Map



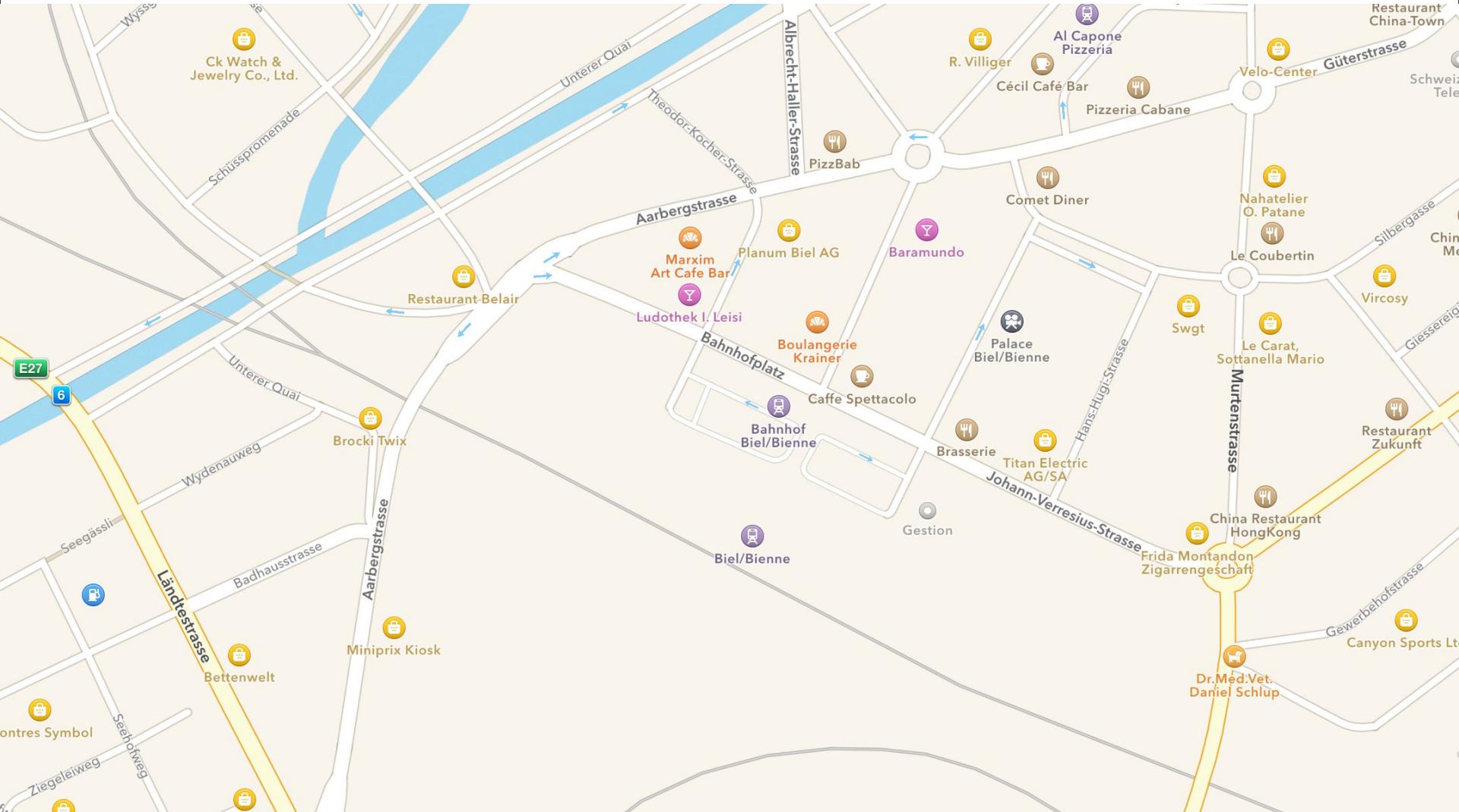
Introduction to OSM: Quick Comparison

Google Maps:



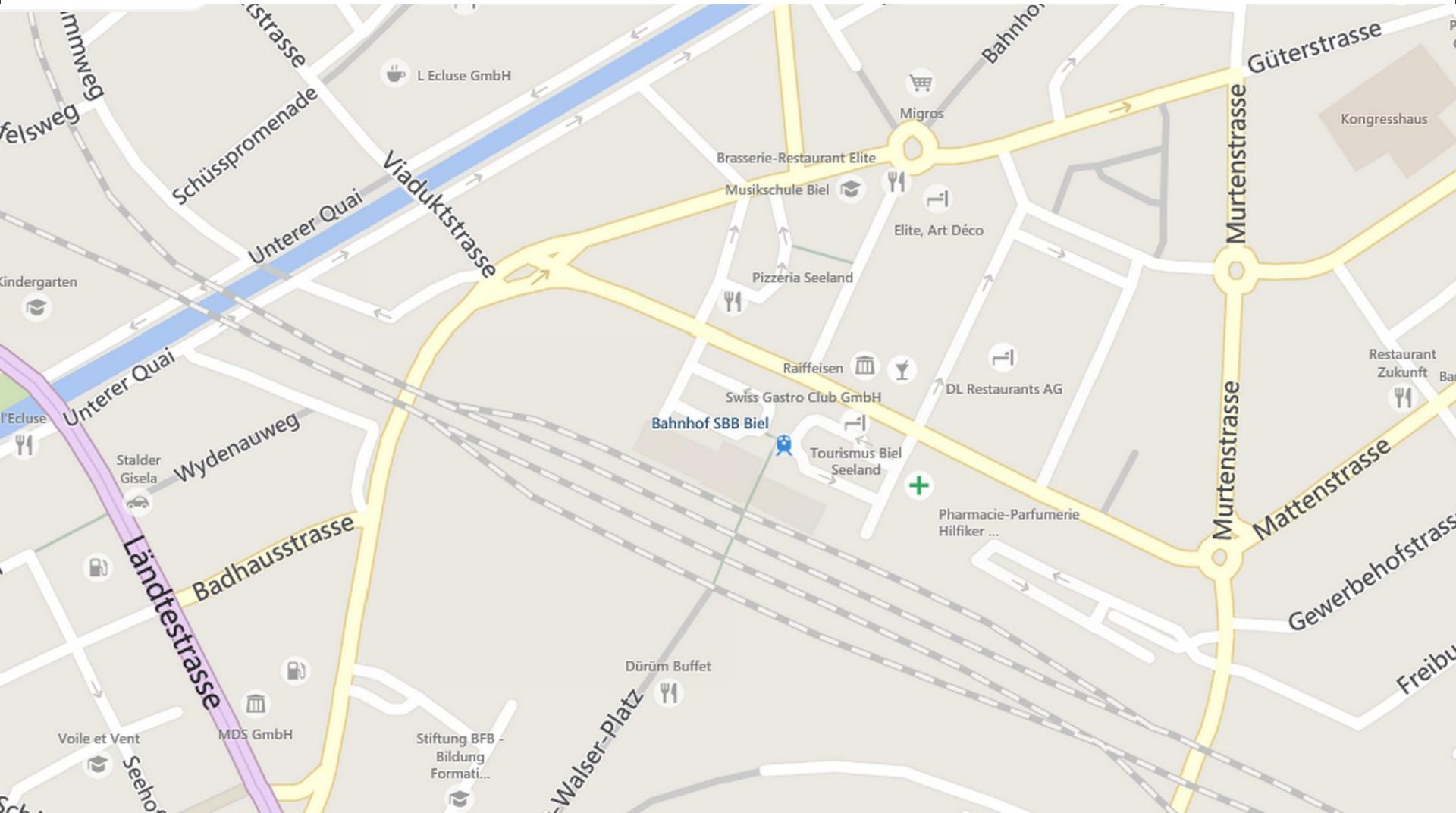
Introduction to OSM: Quick Comparison

Apple Maps (Mac OSX Application):



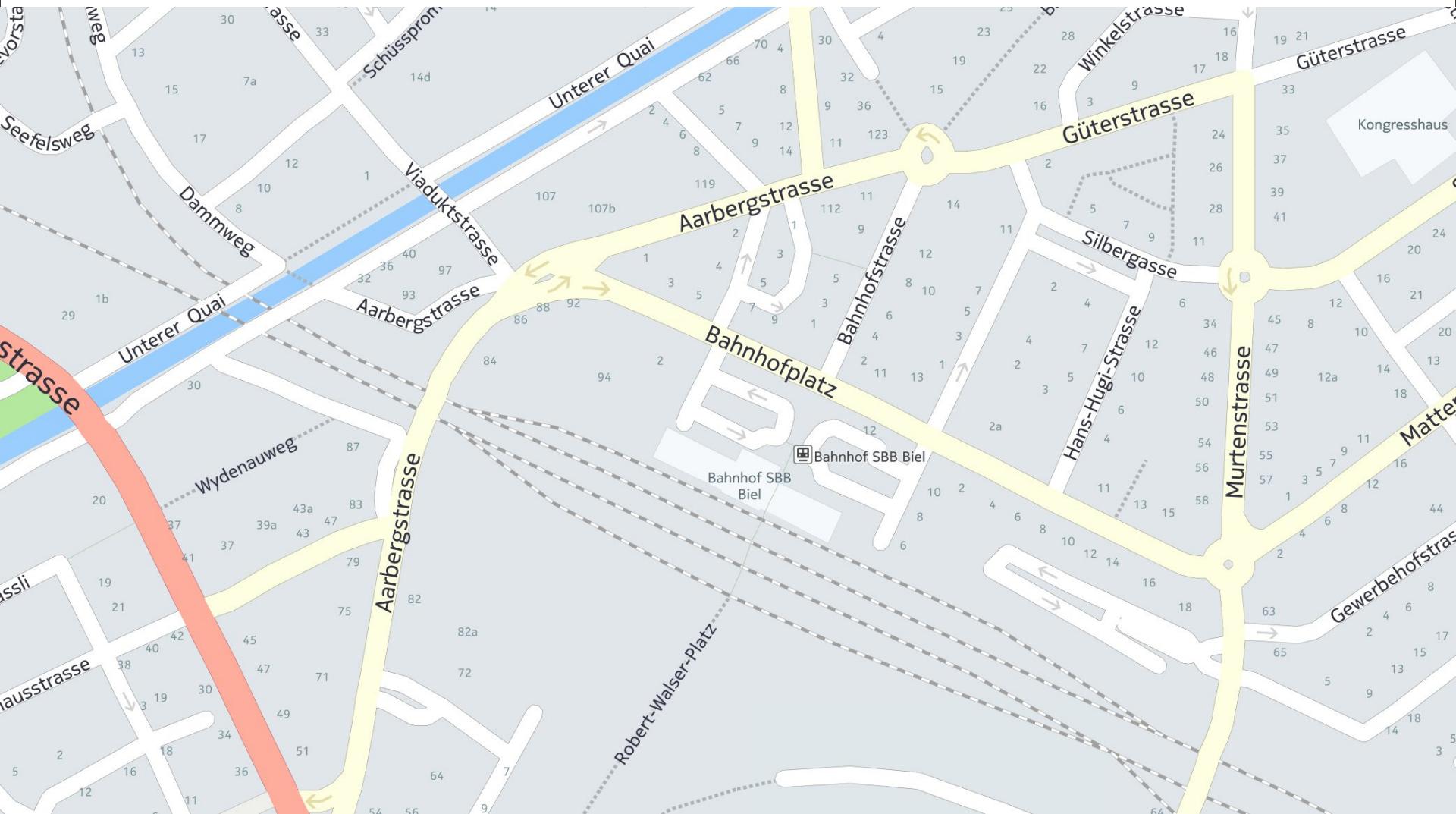
Introduction to OSM: Quick Comparison

Microsoft Bing Maps (Nokia):



Introduction to OSM: Quick Comparison

Yahoo Maps:



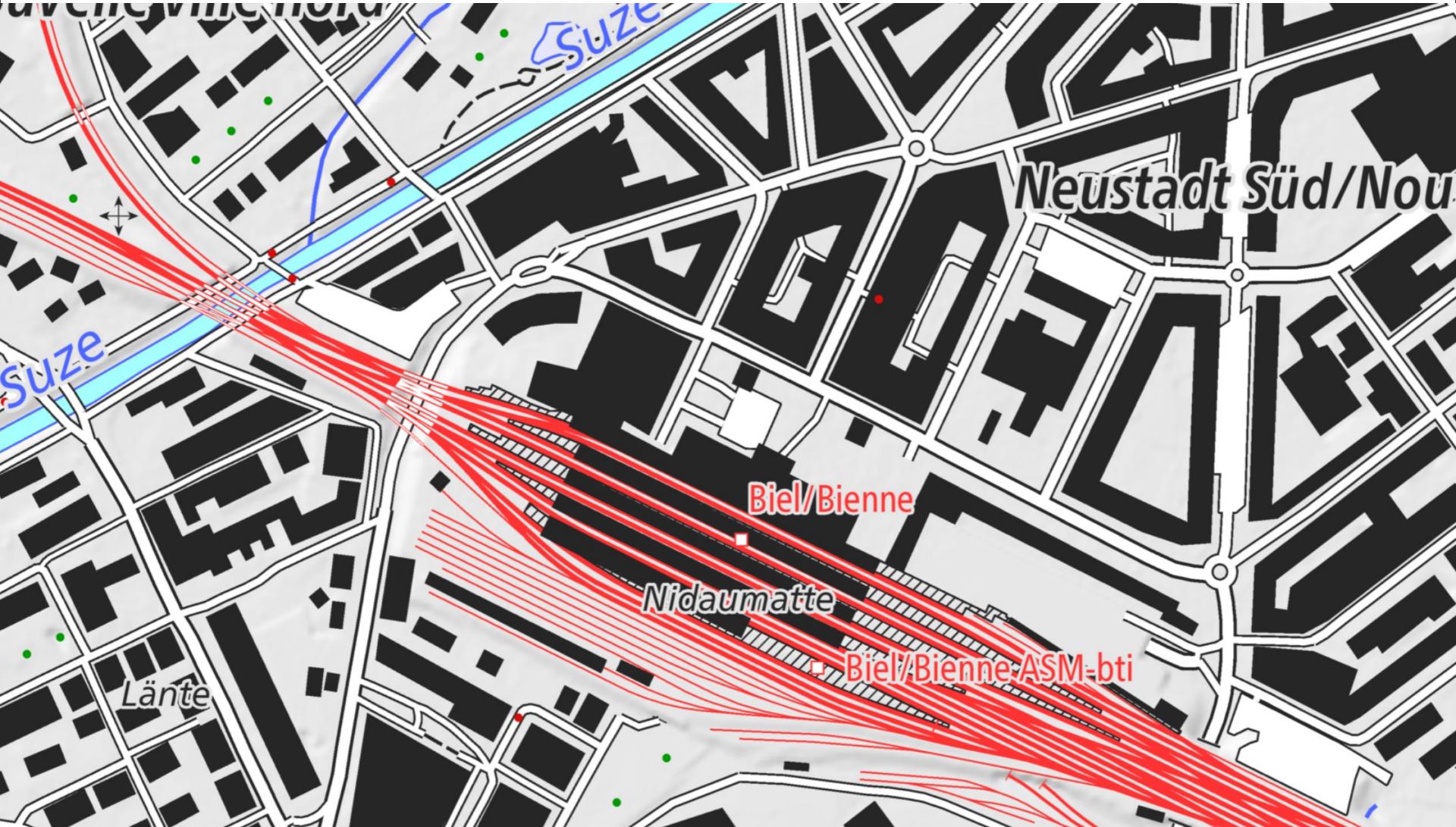
Introduction to OSM: Quick Comparison

Bing Satellite Image:



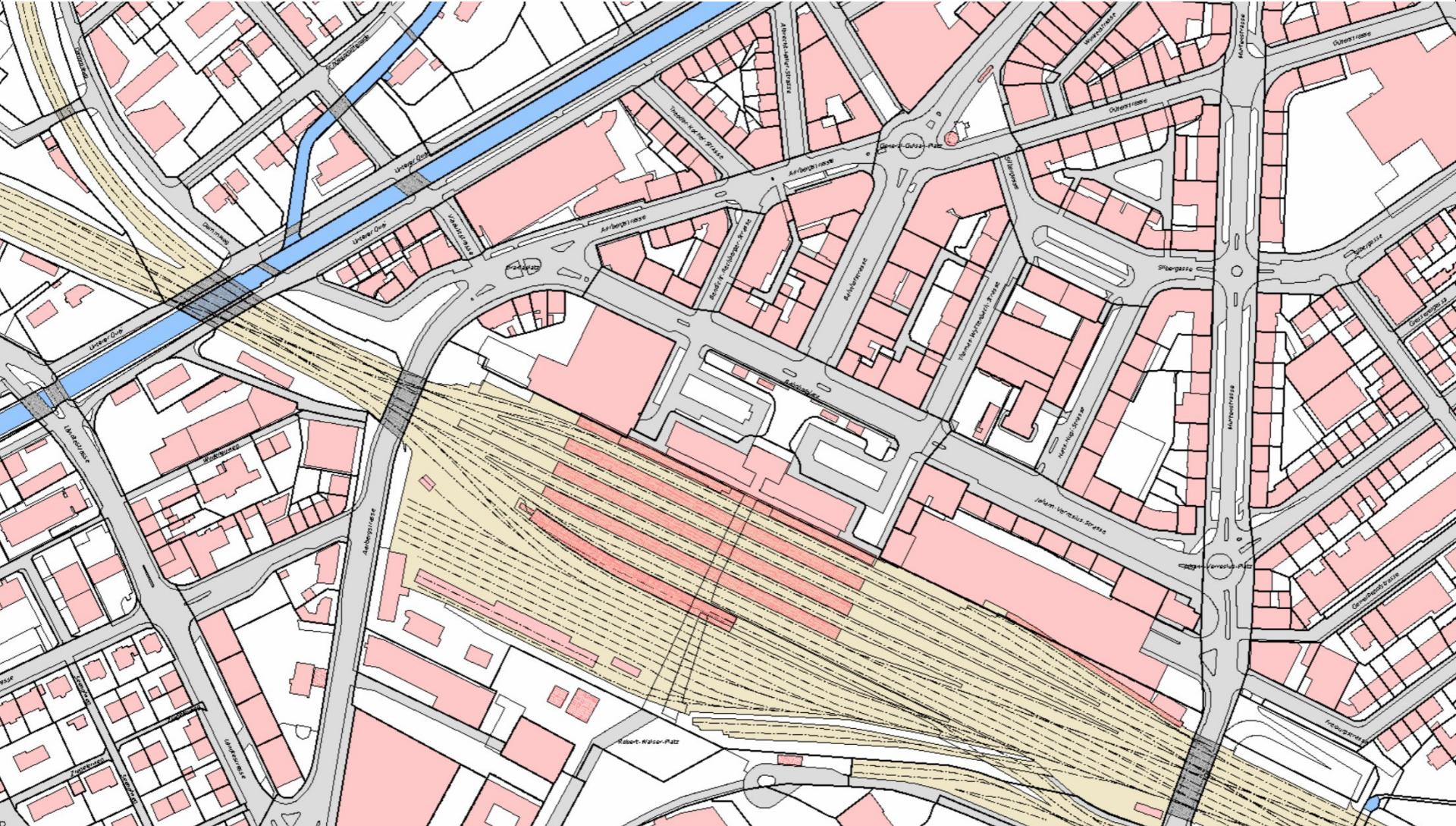
Introduction to OSM: Quick Comparison

SwissTopo: swissTLM Map



Introduction to OSM: Quick Comparison

SwissTopo: cadastralWeb Map



Introduction to OSM: History

- ▶ 2004: Founded by **Steve Coast** in UK
- ▶ 2006: Yahoo allowed the use of their **aerial photos**.
- ▶ 2007: Import of road data for **Netherlands, India, China & USA**.
- ▶ Annual conference **State of the Map** since 2007
- ▶ 2010: **Microsoft** allowed the use of aerial photos from **Bing Maps**
- ▶ 2012: **Pricing for Google Maps** led several prominent web sites to switch to OSM:
 - ▶ Apple uses now TomTom & OSM data



Introduction to OSM: History

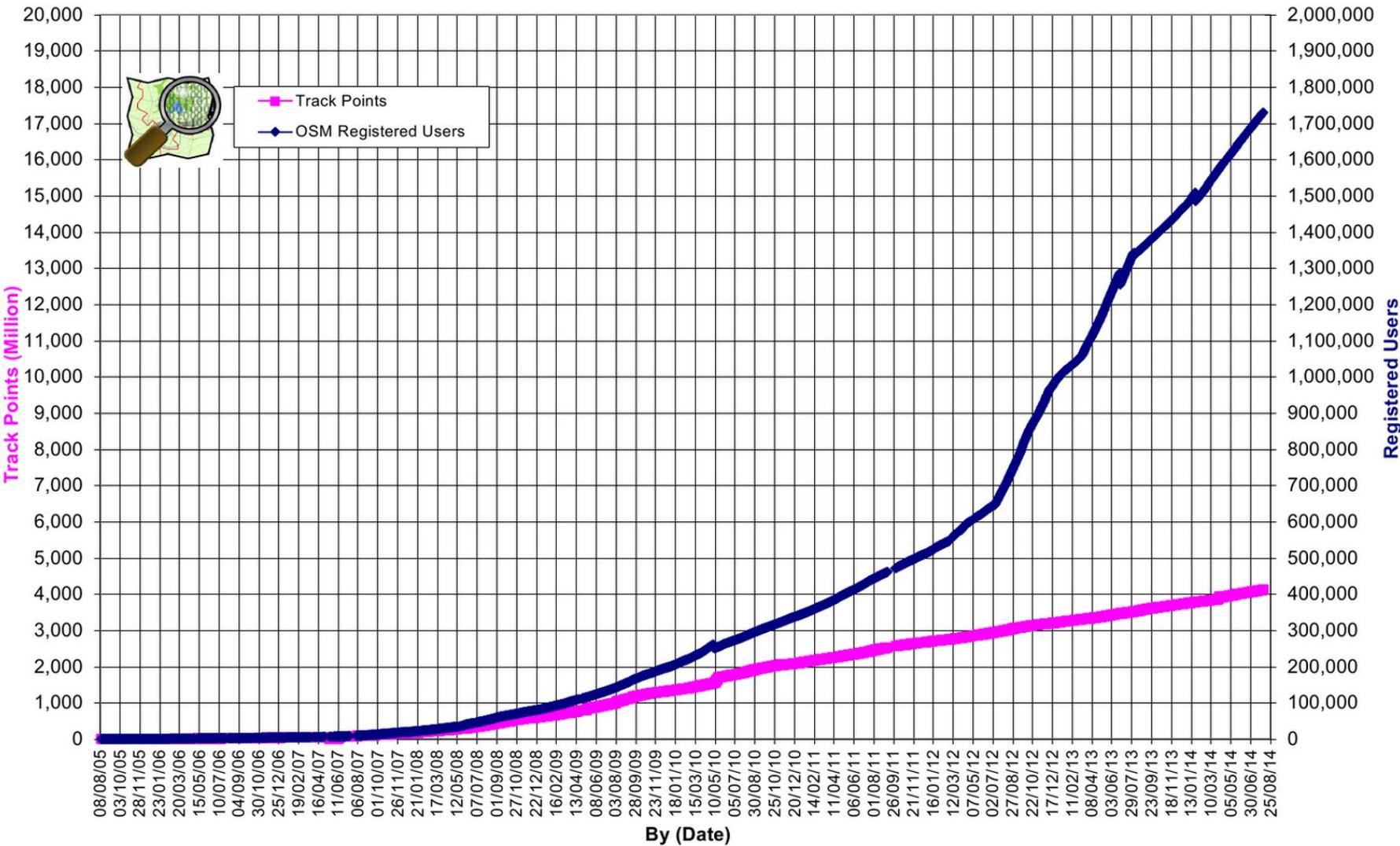
10th Anniversary Evolution Video on YouTube:



OpenStreetMap
Map data copyright
www.openstreetmap.org 1 Aug 2014

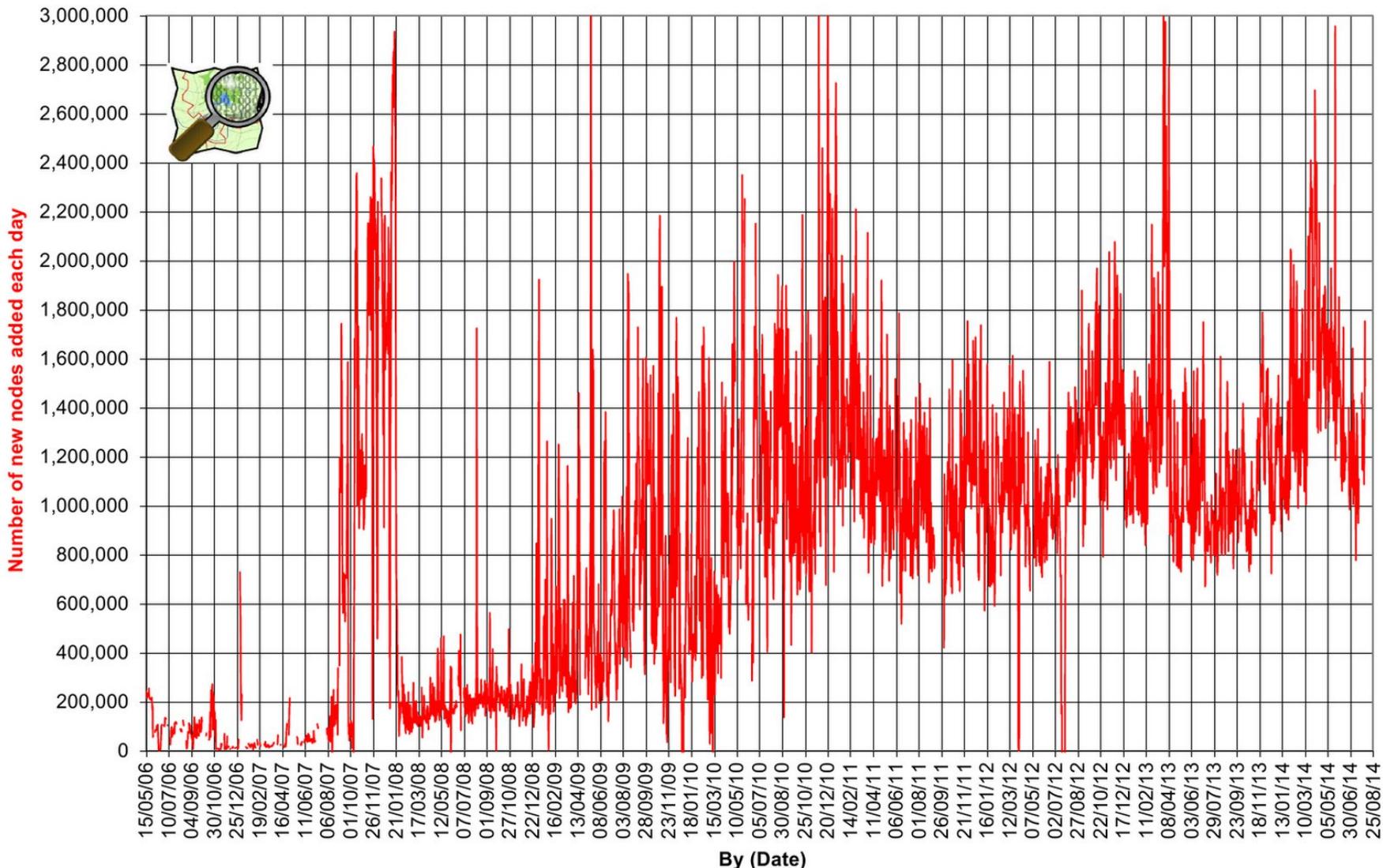
Introduction to OSM: History

OpenStreetMap Database Statistics
Users and User gpx Uploads (track points)



Introduction to OSM: History

OpenStreetMap Database Statistics
Number of nodes added each day



Introduction to OSM: History

% of total users contributing
(Node edits in last month)



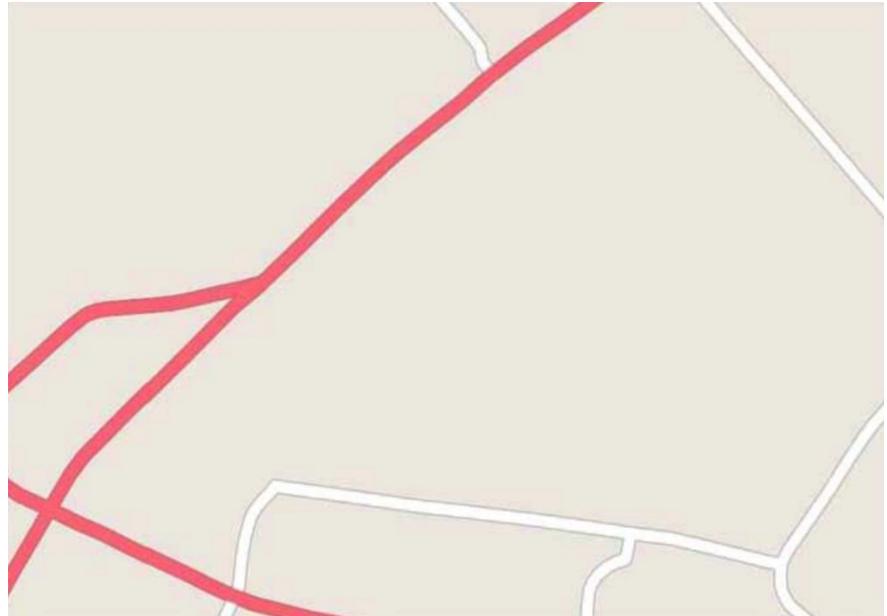
Introduction to OSM: History

Fast Disaster Response after Haiti Earthquake on January 12th 2010:

Mwen se carline pierre mw poko mori
mwen anba dekonb nan universite
caraibes ki sitye nan delma 29 la tanpri
map tann pou yo vini sove m.



My name is Carline Pierre **I'm not dead.**
I am under the rumbles in University
Caraibes, which is in Delmas 29.
Please come and get me!
I'm waiting for you.



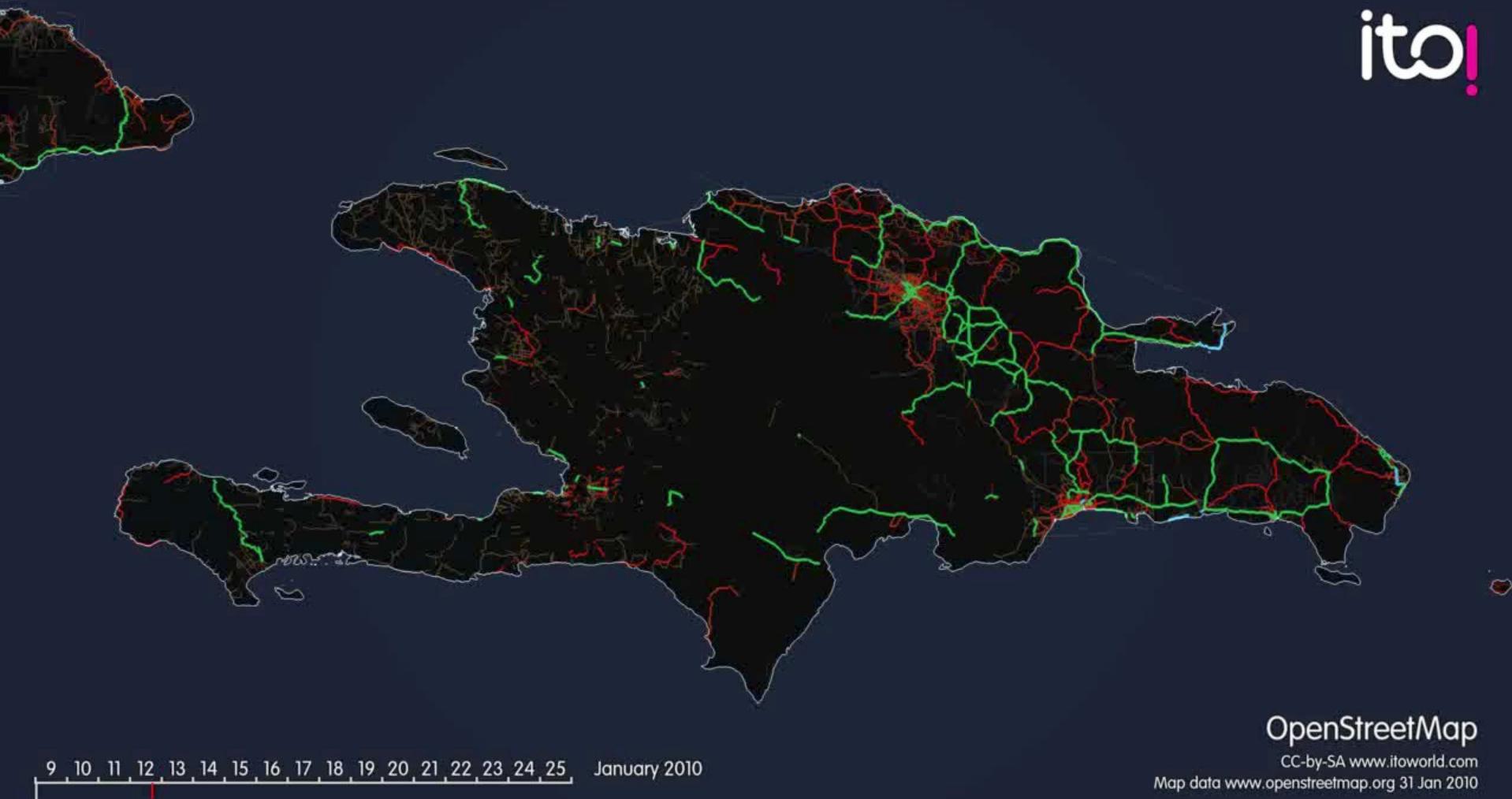
Introduction to OSM: History

Fast Disaster Response after Haiti Earthquake on January 12th 2010:



Introduction to OSM: History

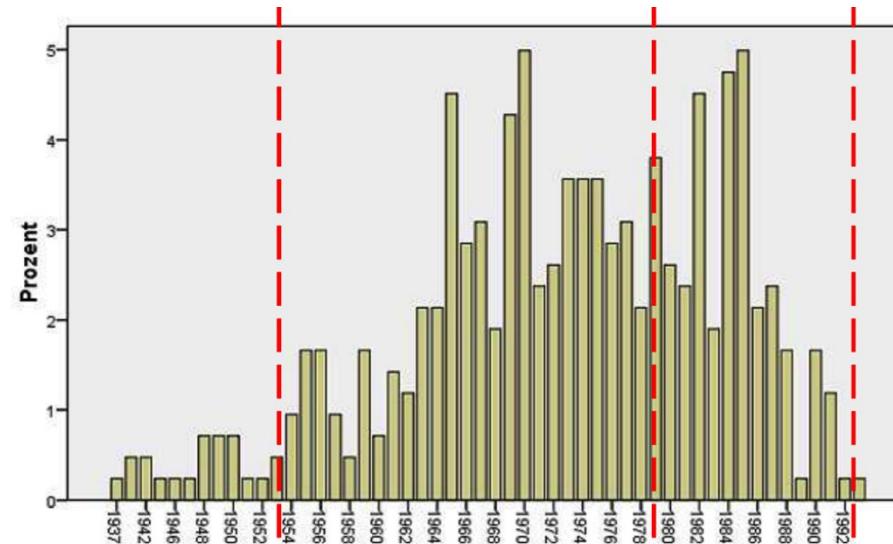
Fast Disaster Response after Haiti Earthquake on January 12th 2010:



Introduction to OSM: Contributors

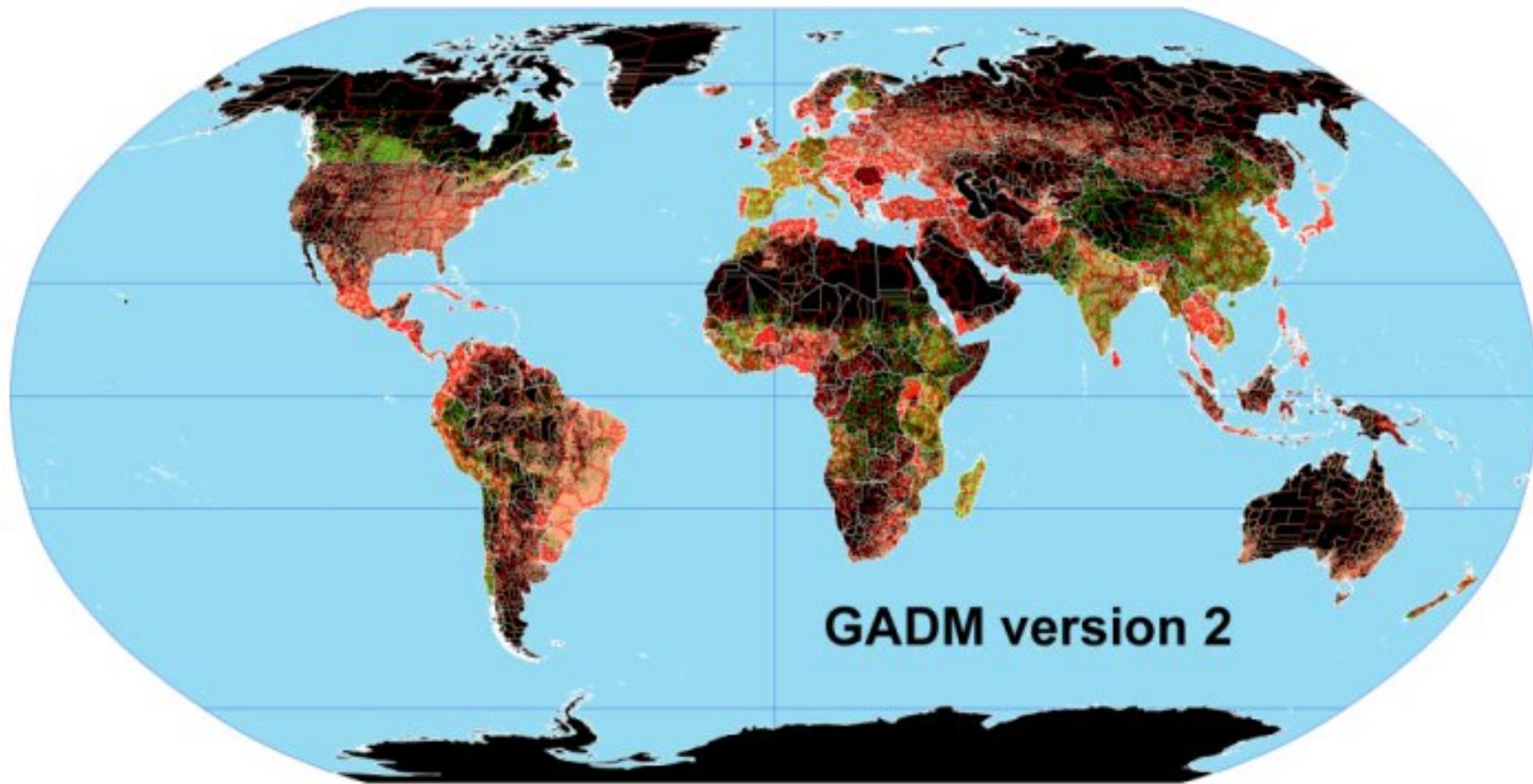
Registered Users:

- ▶ Web survey done by FHNW in 2009 in German language:
 - ▶ NO. of participants: 421
 - ▶ Gender: **95% Male - 5% Female**
 - ▶ Region: **60% Urban**
 - ▶ Education: **44% University, 24% College**
 - ▶ Profession: **34% Students, 32 CS, 21% Media**
 - ▶ Time per Week: **< 2h: 45%, 2-5h: 37%, 5-10h: 14%**
 - ▶ Contacts to others: **30% internet, 30% personal, 30% none**
 - ▶ Age:



Introduction to OSM: Contributors

- **Global Institutional:** <http://wiki.openstreetmap.org/wiki/Contributors>
 - **GADM: Global Administrative Areas:** <http://www.gadm.org>
 - Used for borders of: Turkey, Bahrain, Iran, Iraq, Ivory Coast, Jordan, Saudi Arabia, Sudan, and Syria

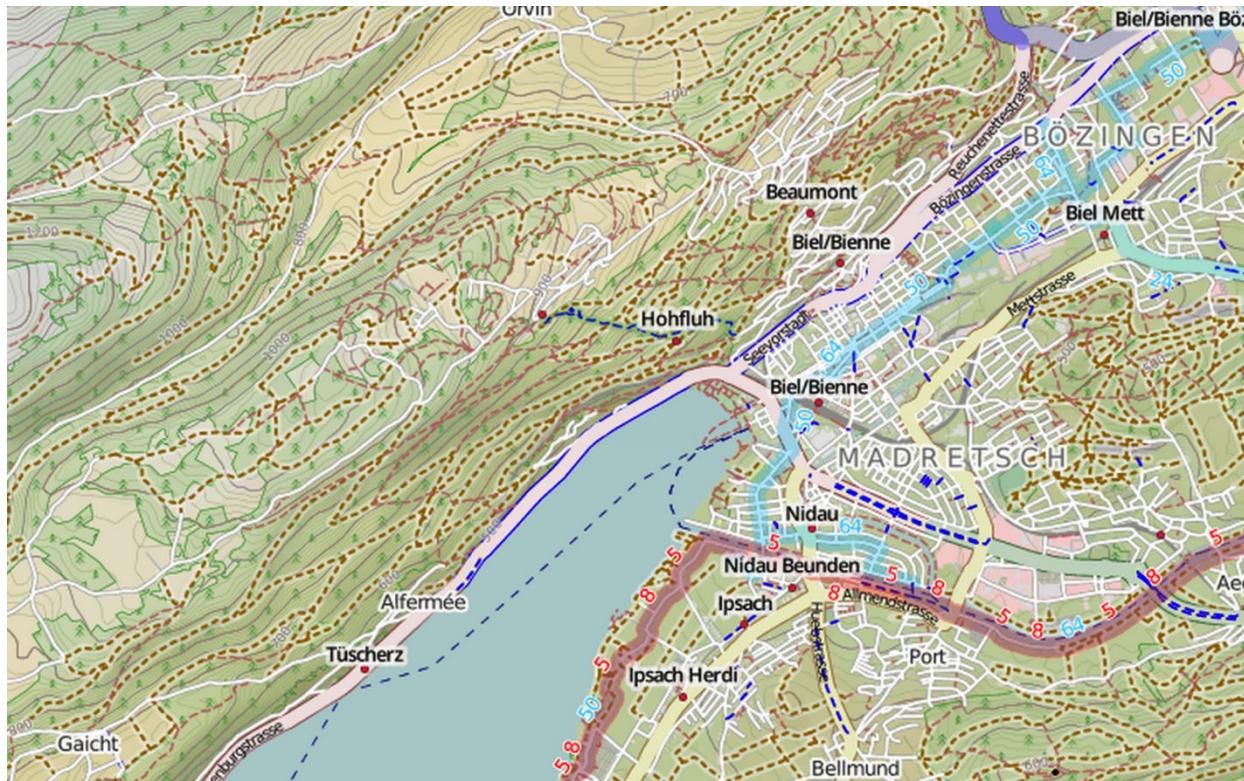


Introduction to OSM: Contributors

► Global Institutional:

► SRTM (Shuttle Radar Topographic Mission):

- <http://www2.jpl.nasa.gov/srtm>
- Resolution: 90m at equator, < 30m in the US
- Used in many OSM projects (e.g. in OpenCycleMap):



Introduction to OSM: Contributors

► National & Regional Institutional:

- A big step forward was the TIGER database import of the US:



Introduction to OSM: Contributors

► National & Regional Institutional:

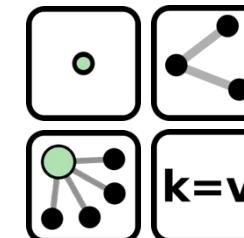
- ▶ Most western countries provided complete border coordinates.
- ▶ Many cities provided complete GIS information (house & street coordinates, street names & house numbers):
 - ▶ E.g.: Berlin, Bremen, Hamburg, Köln ...
- ▶ Contributions of Switzerland:
 - ▶ From SwissTopo: All borders communal borders
 - ▶ Canton Aargau: Aerial photos
 - ▶ Basel: House coordinates & house numbers

Agenda

- ▶ Introduction to OSM:
 - ▶ Quick Comparison with other Maps
 - ▶ History
 - ▶ Contributors



- ▶ OSM Details:
 - ▶ Elements & Tags
 - ▶ Reference System & Projection
 - ▶ Map Rendering (Tile or Vector based)



- ▶ OSM Mapping Process:
 - ▶ Collect & Upload GPS Data > Editing > Tagging > Viewing



- ▶ Using OSM with Leaflet
 - ▶ Leaflet Tutorial
 - ▶ Other Projects



OSM Details: Elements & Tags

Elements and **Tags** are the basic components of the data model:

► **Elements:**

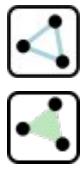
-  ► **Nodes** define a point on the earth's surface. They have an ID & Longitude & Latitude coordinates
-  ► **Ways** define linear objects and are built out of 2-2000 Nodes
-  ► **Relations** define relationships between elements or other relations

► **Tags (attributes):**

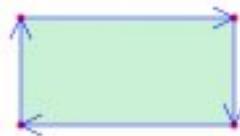
- All elements can have **tags to describe** the element
- All tags are **key = value pairs** e.g. highway=residential
- Keys & values are Unicode strings up to 255 characters
- There is no fixed dictionary but many conventions

OSM Details: Elements & Tags

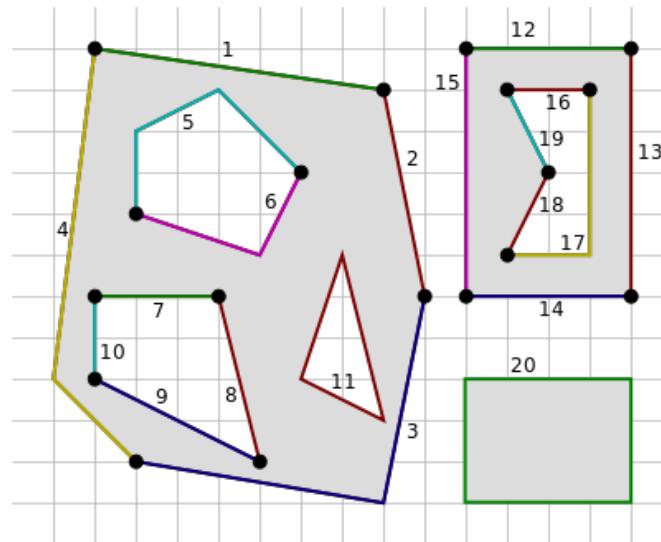
More on Elements:



- ▶ A way with the same start & end node is a “**closed way**”
- ▶ An **area** is a closed way with special tags (e.g. `area=yes`, `landuse=forest`, `building=yes`)



- ▶ **Areas with holes or areas with more than 2000 nodes** must be described with **multipolygon** relations:



OSM Details: Elements & Tags

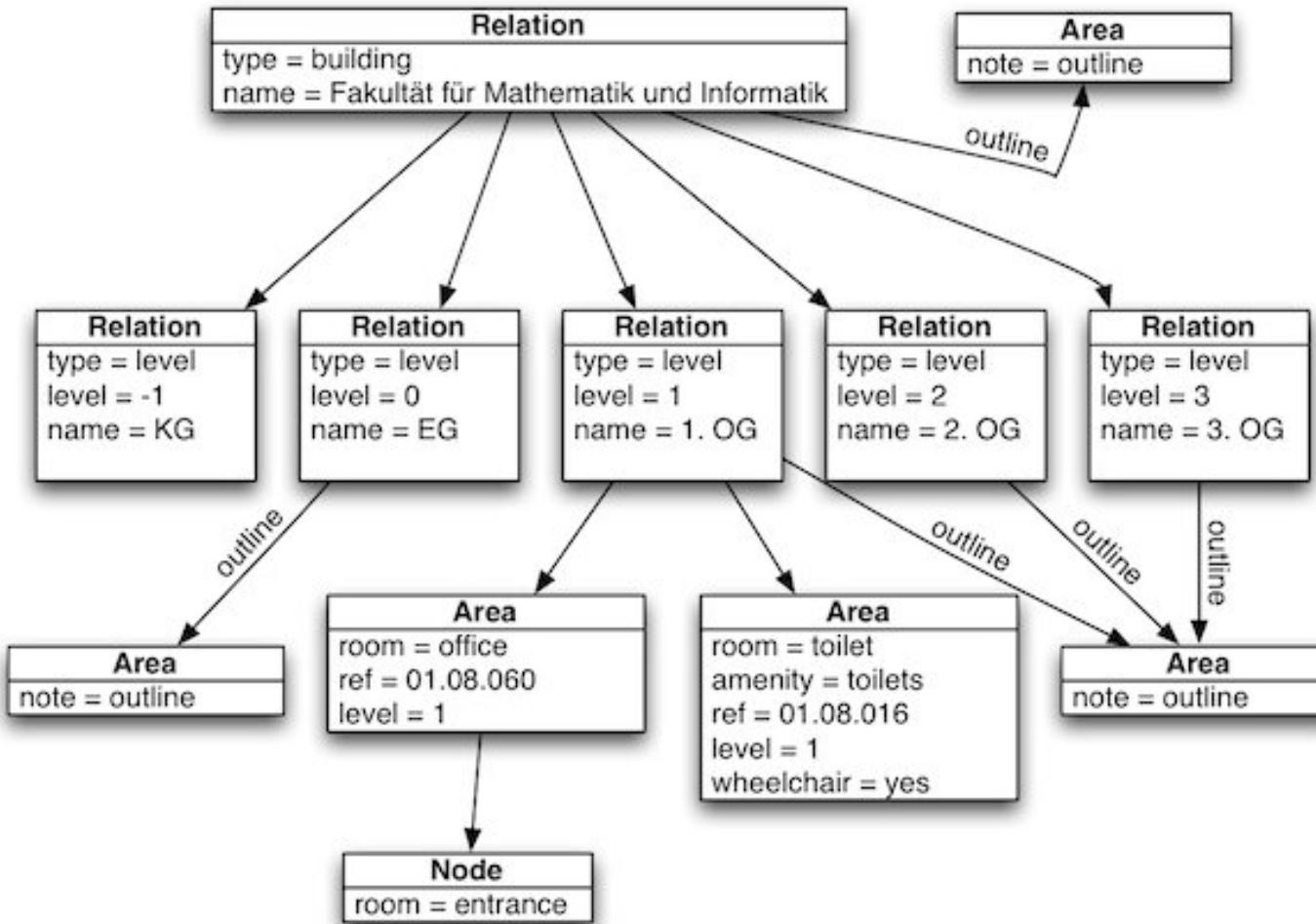
More on Relations:

- ▶ Relations are **groups of elements** (nodes, ways & relations)
- ▶ Elements of a relation have an **order to describe direction**
- ▶ Relations have **no location**
- ▶ All relations have the tag `type=*` to describe the **type of relation**:
 - ▶ **route**: Bus routes, hiking routes, highways, railways)
 - ▶ **border**: Closed ways with more than 2000 nodes
 - ▶ **multipolygon**: Courtyards of buildings, islands of lakes
 - ▶ **restriction**: Turn restrictions
- ▶ Relations are **not categories**:
 - ▶ Don't use relations to describe all shops of a brand
Use tags: `amenity=shop`, `operator=Migros`

OSM Details: Elements & Tags

More on Relations:

- ▶ Example of a proposed new relation type for indoor navigation:http://wiki.openstreetmap.org/wiki/Proposed_features/indoor



OSM Details: Elements & Tags

More on Tags:

- ▶ OSM uses a **free tagging system**:
 - ▶ It allows to use an **unlimited amount** of different tags
 - ▶ The community agrees on certain **commonly used tags**:
 - ▶ The **primary features** (keys) are:
Aerialway, Areaways, Amenity, Barrier, Boundary, Building, Craft, Emergency, Geological, Highway, Historic, Landuse, Leisure, Man, Made, Military, Natural, Office, Places, Power, Public Transport, Railway, Route, Shop, Sport, Tourism, Waterway
 - ▶ Example: http://wiki.openstreetmap.org/wiki/Map_Features
 - ▶ Statistics on tags:
 - ▶ <http://taginfo.openstreetmap.org>
 - ▶ Proposal Process for new tags
 - ▶ http://wiki.openstreetmap.org/wiki/Proposed_features

OSM Details: Elements & Tags

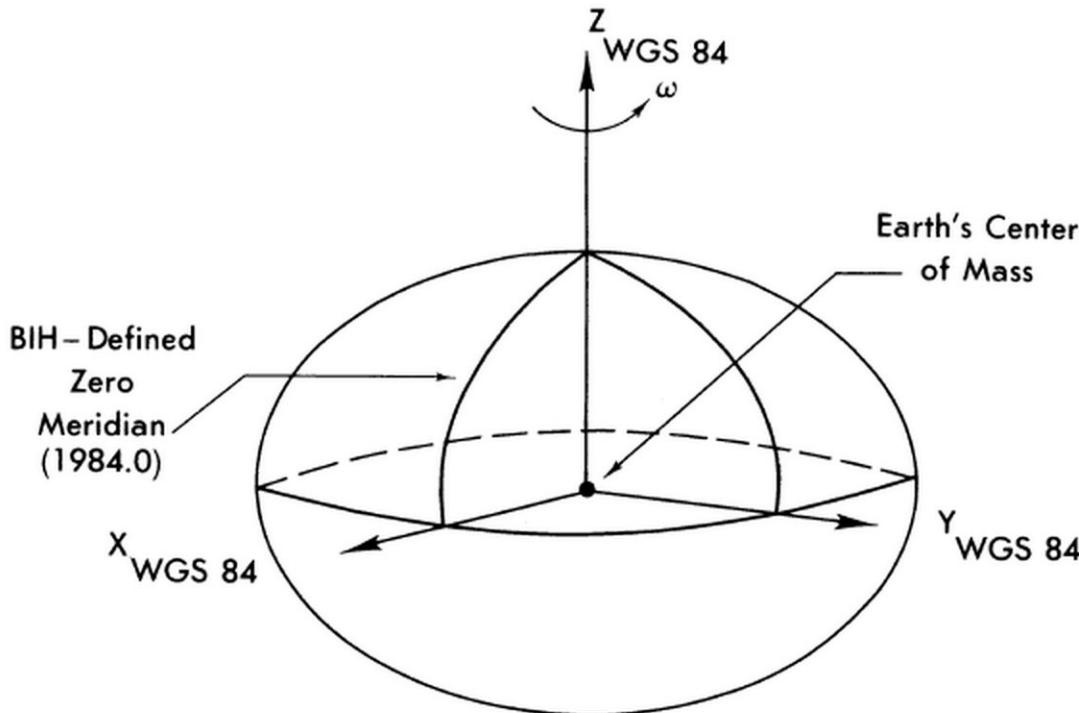
More on Tags:

- ▶ Some tags are automatically added:
 - ▶ id: ID of node
 - ▶ user: User name of last change
 - ▶ uid: User ID of last change
 - ▶ timestamp: Date & time of last change
 - ▶ visible: Flag if element was deleted
 - ▶ version: Integer version number
 - ▶ changeset: Change set version number
- ▶ Keys can have namespaces to group tags:
 - ▶ addr:street=Höhenweg 80
 - ▶ addr:city=Biel

OSM Details: Reference System

All geo locations in OSM use the **WGS84 reference system**:

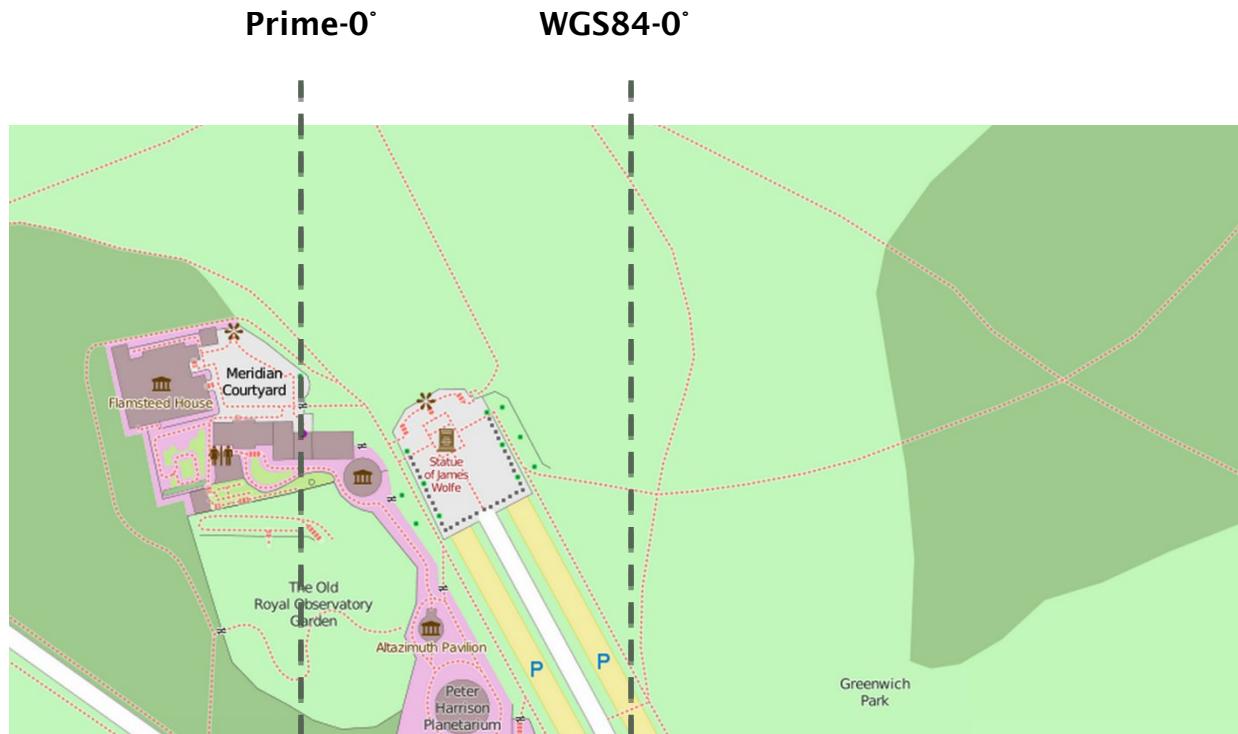
- ▶ WGS84 is also used by the **Global Positioning System (GPS)**
- ▶ WGS84 uses a **reference ellipsoid** to match the earth's shape best:
 - ▶ Major semi axis: 6'378'137.000000 m
 - ▶ Minor semi axis: 6'356'752.314245 m



OSM Details: Reference System

All geo locations in OSM use the **WGS84 reference system**:

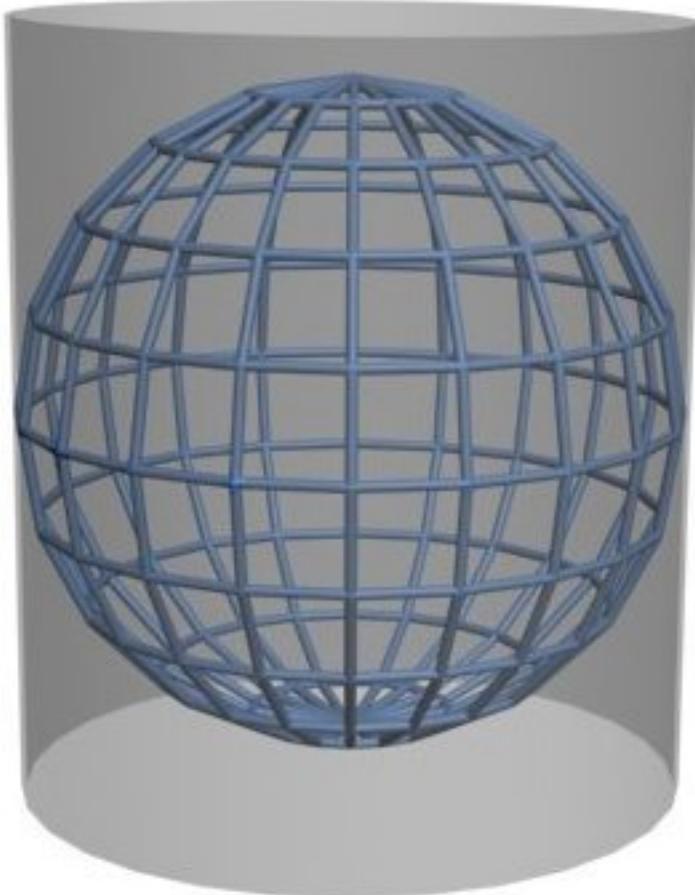
- ▶ The 0° meridian of the WGS84 is 100m east of the famous **Prime Meridian of the Royal Observatory in Greenwich** (gMaps)



OSM Details: Projection

The projection defines the mapping of 3D coordinates on a 2D map:

- ▶ There is **no perfect projection**
- ▶ OSM uses the **Mercator projection**, which is a cylindrical projection:

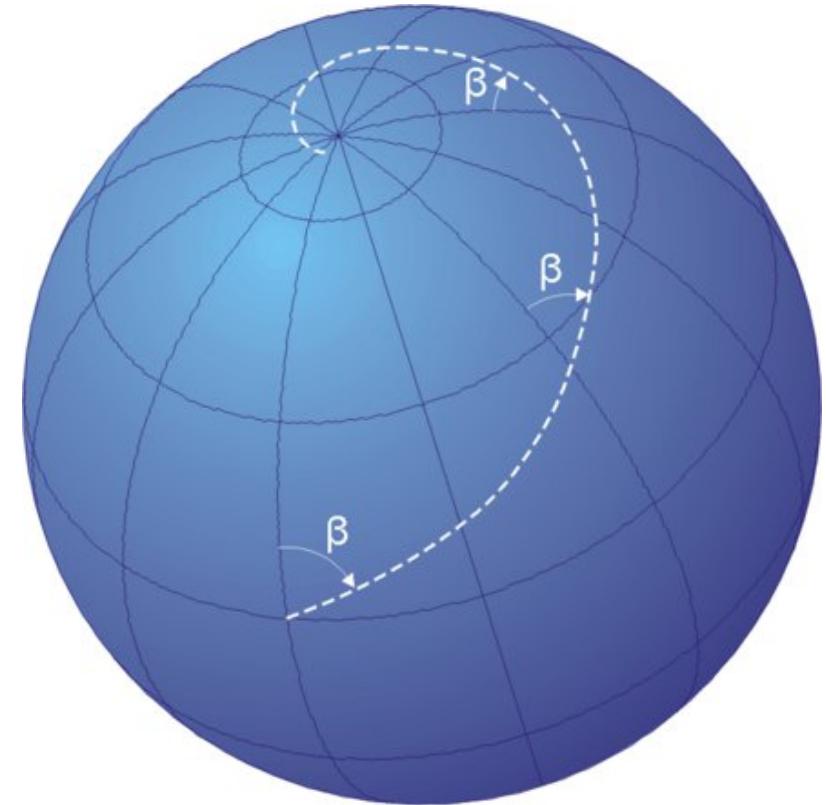


OSM Details: Projection

As every map projection the Mercator projection has **properties**:

► **Angles are preserved**

- This is the most important feature for maritime or aerial navigation!
- North is the same direction everywhere .
- Course lines (loxodromes) cross meridians under the same angle:



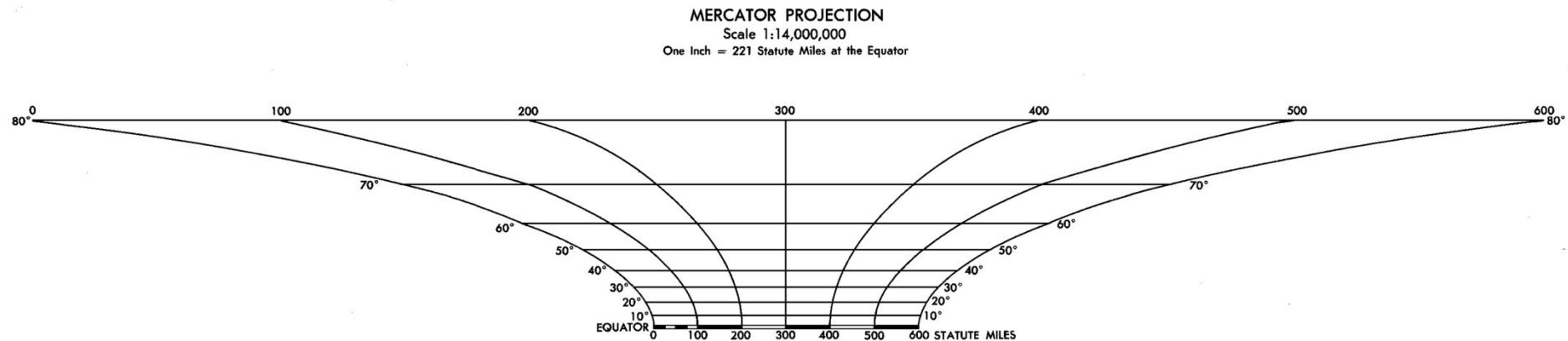
OSM Details: Projection

As every map projection the Mercator projection has **properties**:

- ▶ Angles are preserved
- ▶ Distances are NOT preserved:
 - ▶ Distances are only scaled the same in a small area



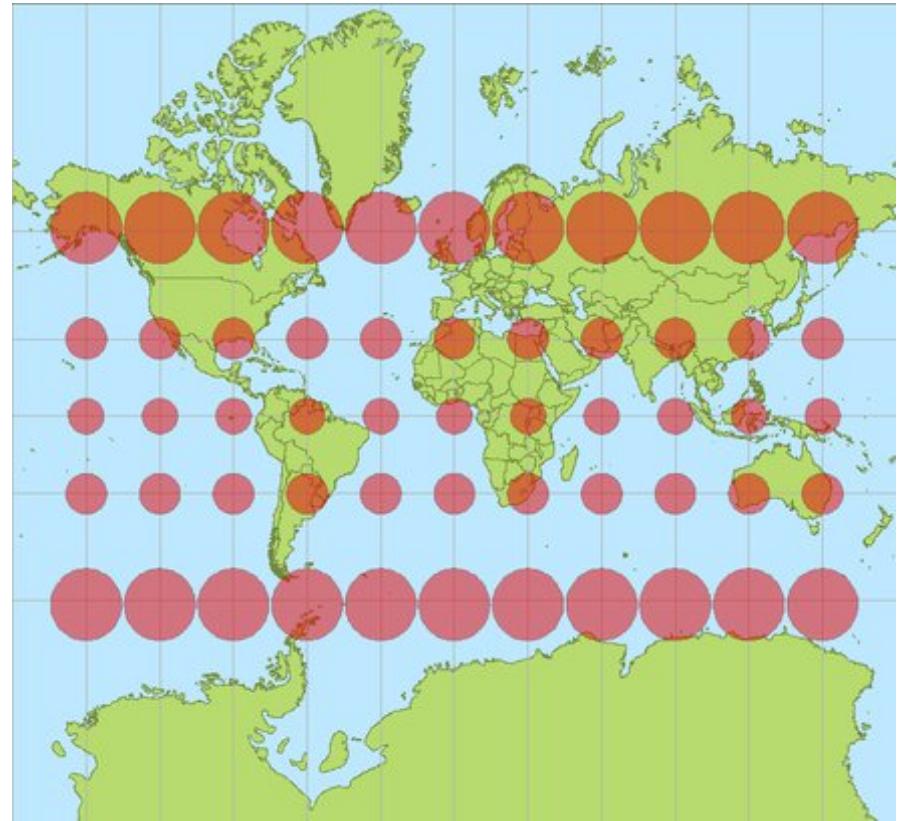
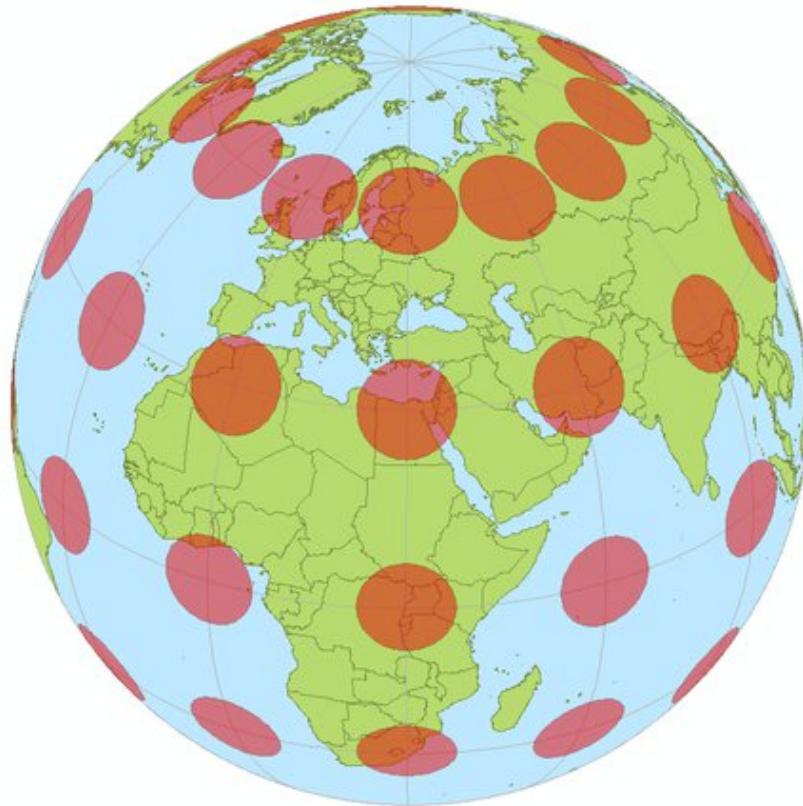
- ▶ Distances are only constant on the same latitude (Breitengrad):



OSM Details: Projection

As every map projection the Mercator projection has **properties**:

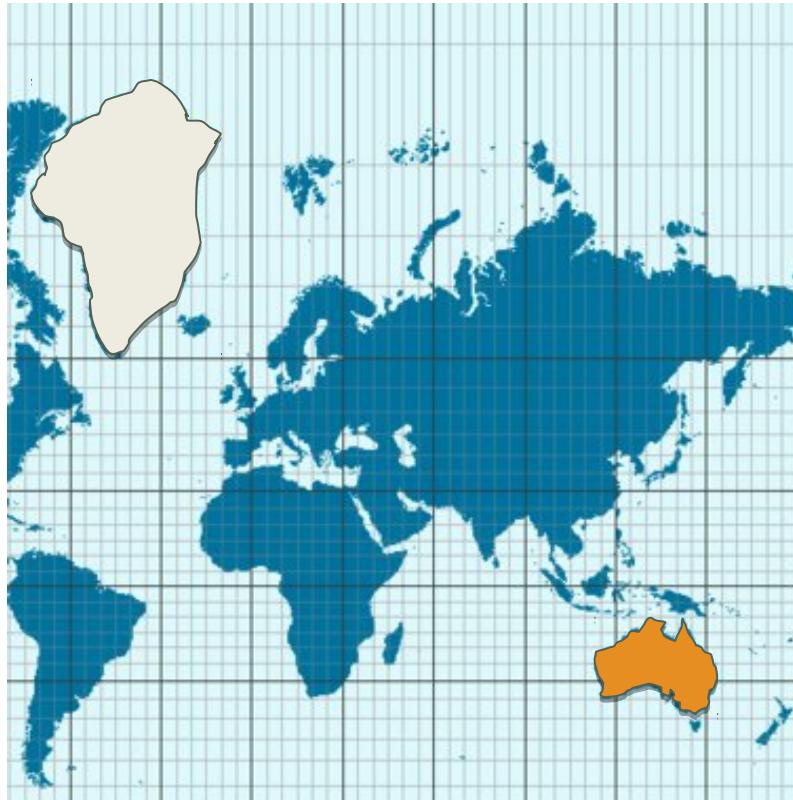
- ▶ Angles are preserved
- ▶ Distances are NOT preserved:
- ▶ Areas are NOT preserved:



OSM Details: Projection

As every map projection the Mercator projection has **properties**:

- ▶ Angles are preserved
- ▶ Distances are NOT preserved:
- ▶ Areas are NOT preserved: Compare Greenland with Australia:



OSM Details: Tile Rendering

The process of visualizing map data is called **rendering**:

► **Tile based rendering:**

- Tiles are 256x256 pixel images rendered & stored in advance.
- Tiles are rendered in 19 zoom levels.
- Tiles are displayed in browser as a slippy map
- The main render software is called Mapnik

► **Vector based rendering:**

- **Realtime 2D vector rendering:**
 - In desktop apps using OS dependent drawing techniques:
 - Java2D, OpenGL, Direct3D
 - In browser apps using drawing techniques from:
 - HTML5 Canvas, SVG, WebGL

OSM Details: Tile Rendering

Are tiles are 256 x 256 pixel PNG type images:

- ▶ Images have big advantage that they are **well supported everywhere**.
- ▶ **PNG compresses maximum** because tiles have only a few colors.
- ▶ OSM has tiles in **19 scale levels**:

zoom level	tile coverage	number of tiles	tile size in degrees
0	1 tile covers whole world	1 tile	360° x 170.1022°
1	2 x 2 tiles	4 tiles	180° x 85.0511°
2	4 x 4 tiles	16 tiles	90° x 42.5256°
n	$2^n \times 2^n$ tiles	2^{2n} tiles	$360/2^n \times 170.1022/2^n$ °
12	4096 x 4096 tiles	16 777 216	0.0879° x 0.0415°
16		$2^{32} = 4\ 294\ 967\ 296$ tiles	
17		17 179 869 184 tiles	
18		68 719 476 736 tiles	
19	Maximum zoom for Mapnik layer	274 877 906 944 tiles	

OSM Details: Tile Rendering

URL of standard OSM style: <http://tile.openstreetmap.org/zoom/x/y.png>

X goes from 0 (left edge is 180 °W) to $2^{\text{zoom}} - 1$ (right edge is 180 °E)

Y goes from 0 (top edge is 85.0511 °N) to $2^{\text{zoom}} - 1$ (bottom edge is 85.0511 °S) in a Mercator projection

<http://tile.openstreetmap.org/0/0/0.png>

<http://tile.openstreetmap.org/1/0/0.png>



OSM Details: Tile Rendering

URL of standard OSM style: <http://tile.openstreetmap.org/zoom/x/y.png>

- ▶ Formulas for x & y of a zoom level z from longitude & latitude:

$$x = \left\lfloor \frac{lon + 180}{360} \cdot 2^z \right\rfloor$$

$$y = \left\lfloor \left(1 - \frac{\ln \left(\tan \left(lat \cdot \frac{\pi}{180} \right) + \frac{1}{\cos(lat \cdot \frac{\pi}{180})} \right)}{\pi} \right) \cdot 2^{z-1} \right\rfloor$$

- ▶ Formulas for **longitude & latitude** from x & y of a zoom level z:

$$lon = \frac{x}{2^z} \cdot 360 - 180$$

- ▶ $lat = \arctan \left(\sinh \left(\pi - \frac{y}{2^z} \cdot 2\pi \right) \right) \cdot \frac{180}{\pi}$ | different languages.

See oms.wff.ch/calc.htm for an online calculator.

OSM Details: Tile Rendering

URL of standard OSM style: <http://tile.openstreetmap.org/zoom/x/y.png>

► See oms.wff.ch/calc.htm for an online calculator:

zoom

lon

lat

X

Y

<http://tile.openstreetmap.org/zoom/x/y.png>



OSM Details: Tile Rendering

- ▶ Pre-rendering all tiles would use around **54'000 GB** of storage
- ▶ Only **1.79%** of all tiles possible where viewed (until 2011)
- ▶ All stored tiles use **1'272 GB** (2012):
 - ▶ Zoom 0-16: 252 GB
 - ▶ Zoom 17-18: 1020 GB

Zoom	Tile view count	Maximum (4^{zoom})	% viewed
0	1	1	100
1	4	4	100
2	16	16	100
3	64	64	100
4	256	256	100
5	1,024	1,024	100
6	4,096	4,096	100
7	16,384	16,384	100
8	65,536	65,536	100
9	262,144	262,144	100
10	1,048,576	1,048,576	100
11	4,194,304	4,194,304	100
12	13,475,072	16,777,216	80.32
13	35,640,512	67,108,864	53.11
14	87,820,928	268,435,456	32.72
15	163,872,384	1,073,741,824	15.26
16	287,448,064	4,294,967,296	6.69
17	429,535,936	17,179,869,184	2.50
18	617,515,264	68,719,476,736	0.90
Total	1,640,900,565	91,625,968,981	1.79

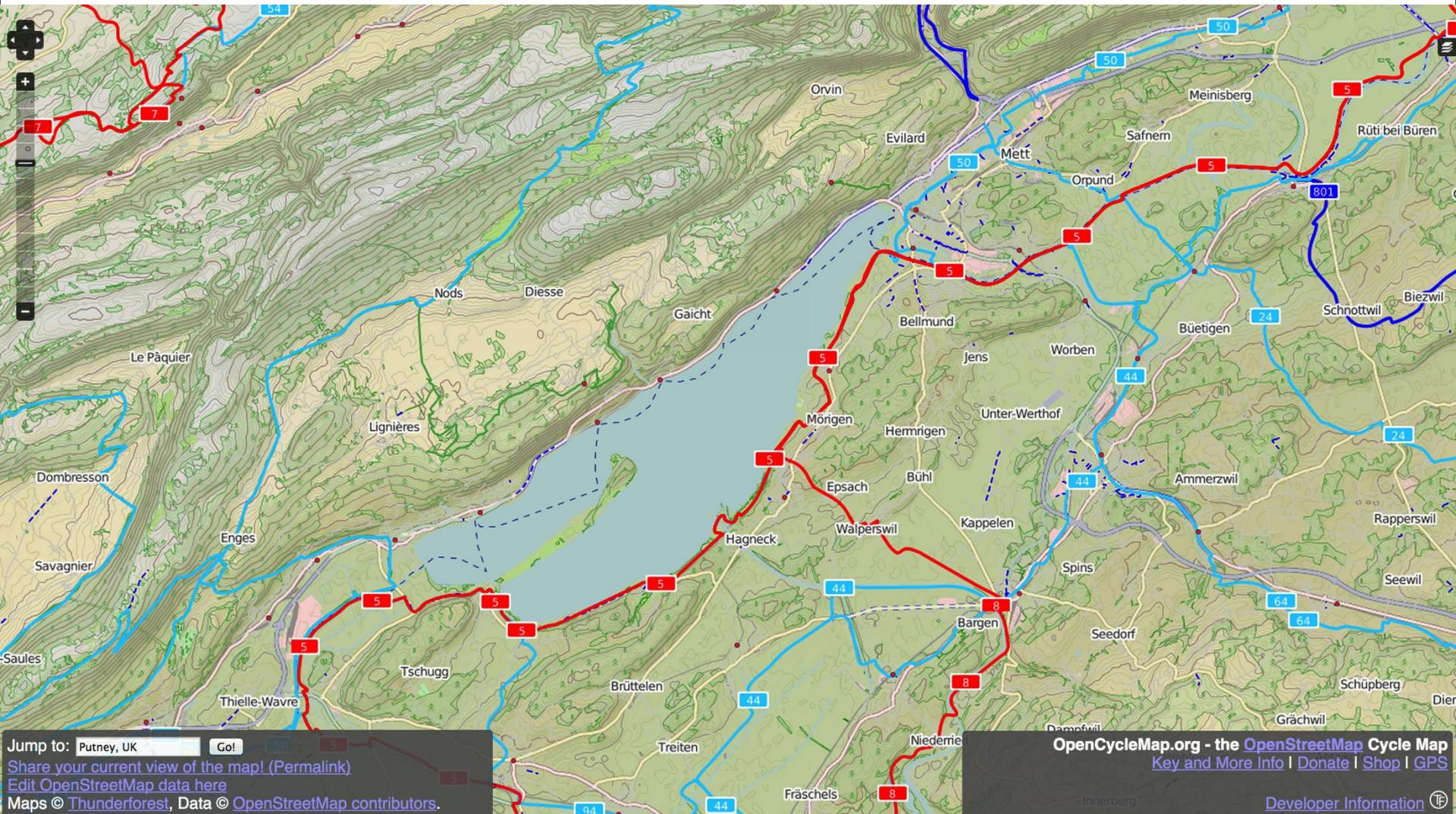
OSM Details: Tile Rendering: Special Maps

There are many **special maps** based on tile rendering for specific purposes:

- ▶ Hiking
- ▶ Biking
- ▶ Horse Riding
- ▶ Skiing
- ▶ Public Transport
- ▶ Wheelchair
- ▶ Vegetarian Restaurants
- ▶ ...
- ▶ Full list: <http://wiki.openstreetmap.org/wiki/DE:Anwender>

OSM Details: Tile Rendering: Special Maps

► Bicycle Route Map: opencyclemap.org



OSM Details: Tile Rendering: Special Maps

► Hiking & Biking Map: [komoot.de](#)

The screenshot displays the komoot.de website interface. At the top, there's a navigation bar with the komoot logo, a search bar, and links for "Tourenvorschläge" (Tour suggestions), "Tour planen" (Plan a tour), "Apps", and "Mein komoot". On the far right, there are links for "Anmelden" (Log in) and "Profil erstellen" (Create profile). Below the navigation bar, a central message reads "Find deine Tour mit der besten Wegbeschaffenheit" (Find your tour with the best route quality). The main content area features a detailed map of the Biel/Bienne region. The map shows a mix of green terrain and grey urban areas. A prominent yellow line represents a planned route, which starts in the green hills to the west and follows a path along a lake and through the city center. The map is labeled with various streets and locations such as "Route Principale Evillard", "Leubringen-Strasse", "Reuchenettestrasse", "Bözingenstrasse", "Längfeldweg", "Mett", "Geysriedweg", "Orpundstrasse", "Mettrisch", "Verwaltungskreis Biel/Bienne", "Ischlag", "Längholz", "Alte Baan", "Nidau", "Neuenburgstrasse", "Ponstrasse", "Bielstrasse", "Bärletwald", "Brügg", and "Brügg". To the left of the map, there's a sidebar with a "Sportart" (Sport type) section containing icons for "FAHRRAD" (Bicycle), "WANDERN" (Hiking), "MOUNTAINBIKE", and "RENNRAD". Below this are buttons for "Startpunkt" (Starting point), "3 Std." (3 hours), and a "Tour planen" (Plan a tour) button. A zoom control with a magnifying glass icon is also present. In the bottom right corner of the map area, there's a small note: "Powered by Leaflet — © Komoot — Map data © OpenStreetMap contributors, CC-BY-SA".

komoot nutzt Cookies. Mit der Nutzung von komoot stimmst du der Verwendung von Cookies zu. [Details](#) | [Schliessen](#)

OSM Details: Tile Rendering: Special Maps

► Horse Riding & Hiking Map: wanderreitkarte.de

**Reit- und
Wanderkarte**

1:54k z13

Legende **Hilfe**
Ortssuche **Vollbild**
Position merken

Kartenwerkzeuge

Routeneditor

Route laden...
Route löschen

Strecke: --
Routenvorschlag
Übernehmen

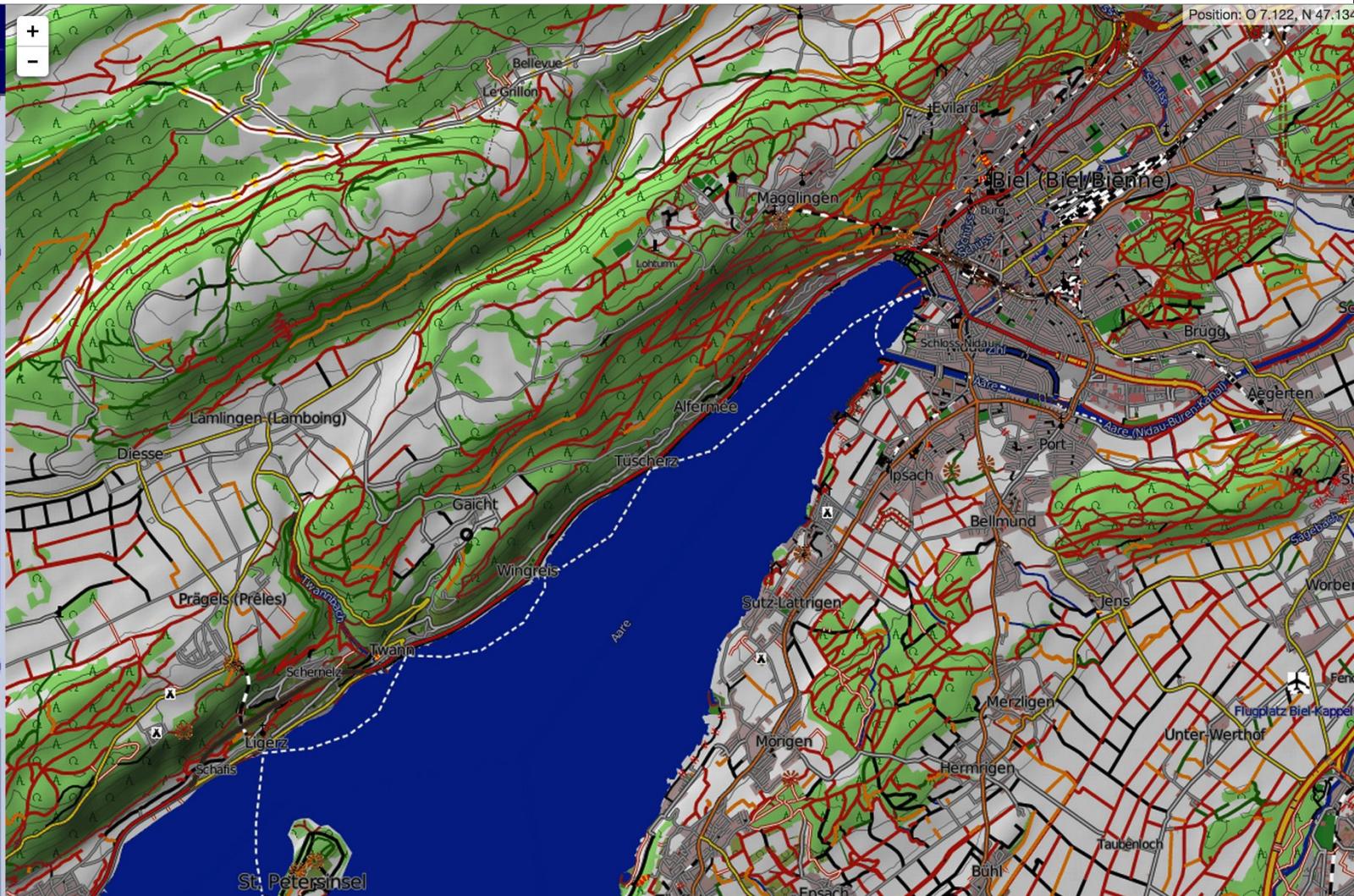
Route speichern...
Route drucken

Höhenprofil
Luftbild **Hilfe**

Informationen

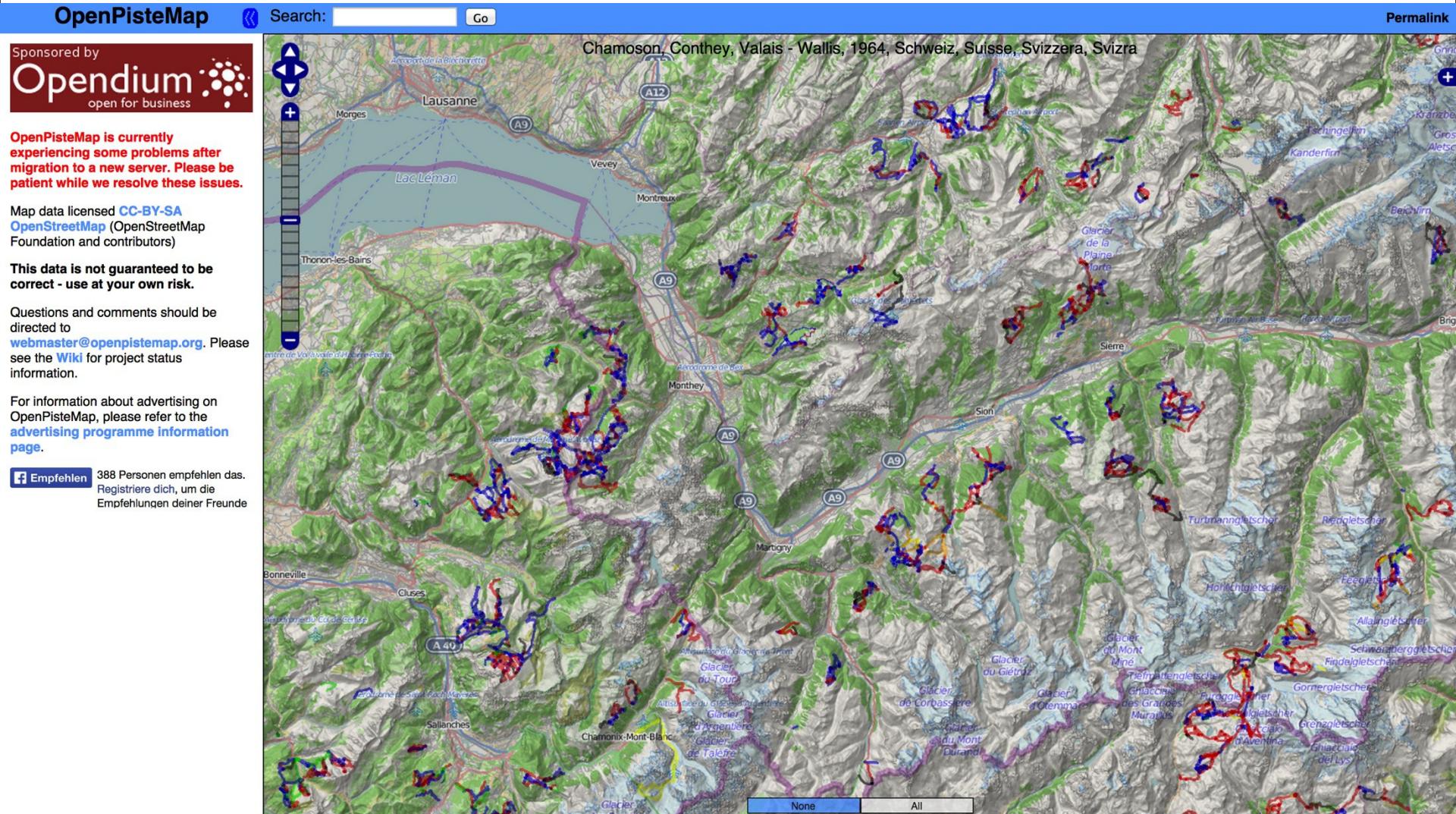
Infos anzeigen

Neuigkeiten (28.07.2014)
Informationen zur Karte
Garminkarten
Wandershop
FAQ
Forum
Gästebuch



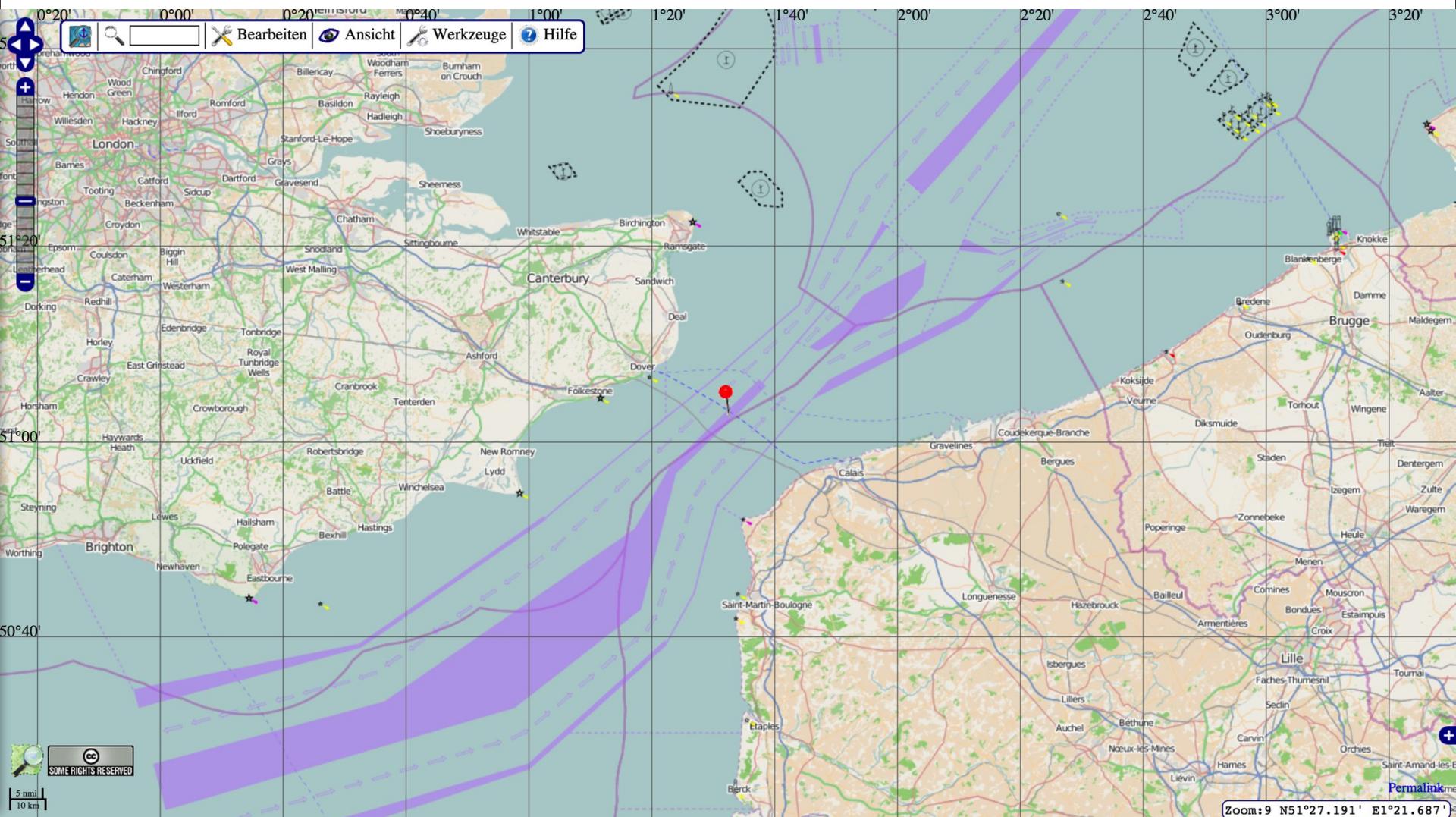
OSM Details: Tile Rendering: Special Maps

► Ski Run Map: openpistemap.org



OSM Details: Tile Rendering: Special Maps

► Maritime Navigation Map: openseamap.org



OSM Details: Tile Rendering: Special Maps

► Mauerkarte: mauerkarte.de

Mauerkarte

Informationen

Impressum

Legende



Grenzübergang



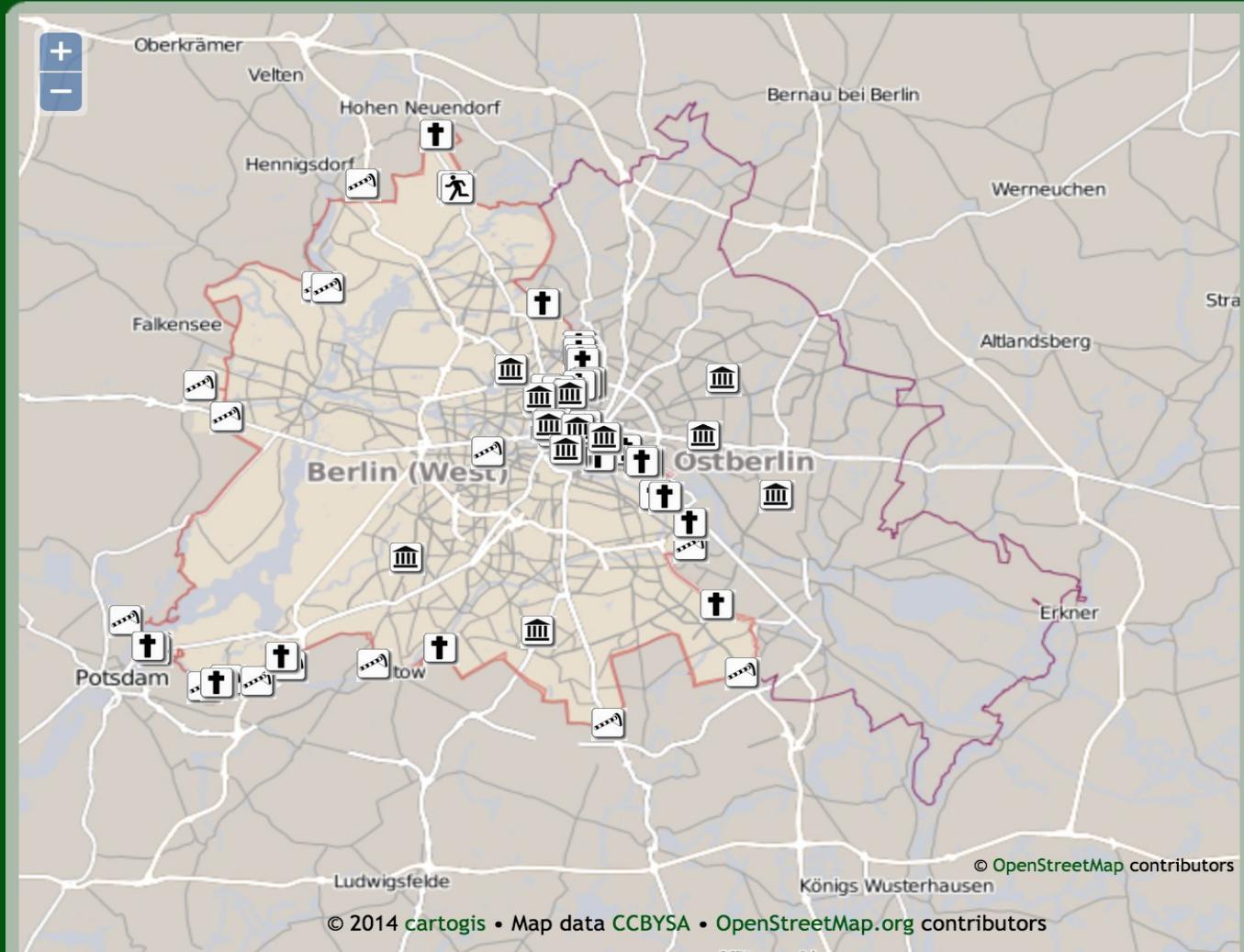
Fluchtversuch



Maueropfer



Mauermuseum



OSM Details: Vector Rendering

Advantages of vector based rendering:

- ▶ The transferred data **could be reduced**.
- ▶ The render application knows the **semantic of elements**:
 - ▶ Display information on demand
 - ▶ Highlight relation based information
 - ▶ Change style on demand
 - ▶ Google, Apple & Yahoo Maps use vector rendering since 2013

Disadvantages of vector based rendering:

- ▶ Rendering needs a **lot of hardware resources**
 - ▶ Rendering is **slow without GPU** acceleration
 - ▶ HTM5 canvas, Java2D or SVG rendering are not accelerated.
 - ▶ GPU acceleration exists almost everywhere,
but the **WebGL standard** is not yet available on mobile platforms

OSM Details: Vector Rendering

Vector data is mostly delivered in [vector tiles](#):

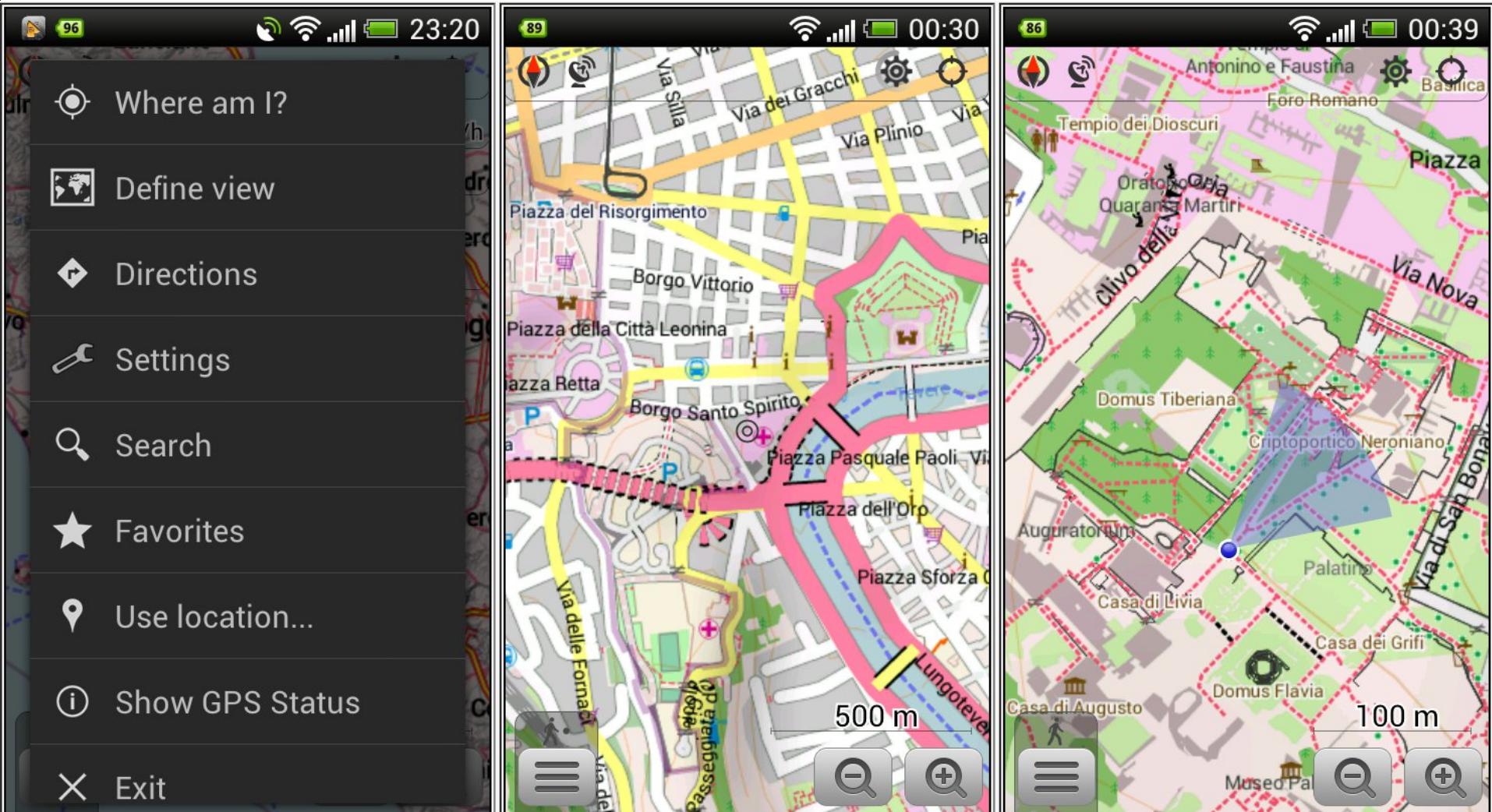
- ▶ [Mapnik renderer](#) can also produce vector tiles. It supports:
 - ▶ [GeoJSON](#) text format
 - ▶ [MVT](#) (Mapnik Vector Tiles) zlib compressed format
- ▶ Vector tile access uses the same logic as for image tiles:
 - ▶ <http://tile.openstreetmap.us/vectiles-highroad/zoom/x/y.mvt> or .json
 - ▶ <http://tile.openstreetmap.us/vectiles-highroad/17/68173/46030.json>
- ▶ Size comparison:
 - ▶ PNG: 20.2 KB
 - ▶ JSON: 15.4 KB (maybe not all info in it)
 - ▶ MVT: 29.4 KB
- ▶ Conclusion:

Tiling increases data again!



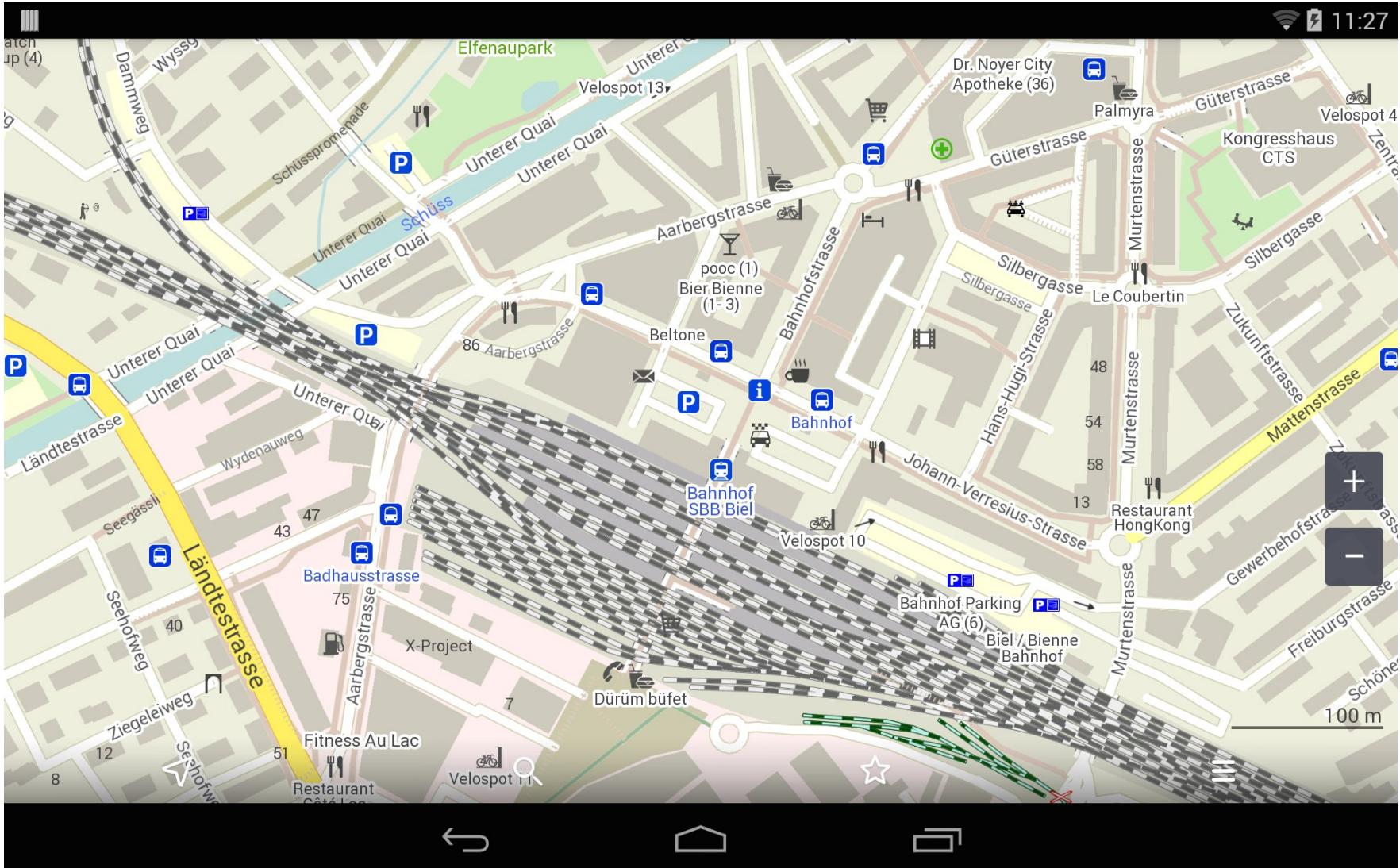
OSM Details: Vector Rendering: Apps

► OSM 2D Vector Map & Navigation for Android: osmand.net



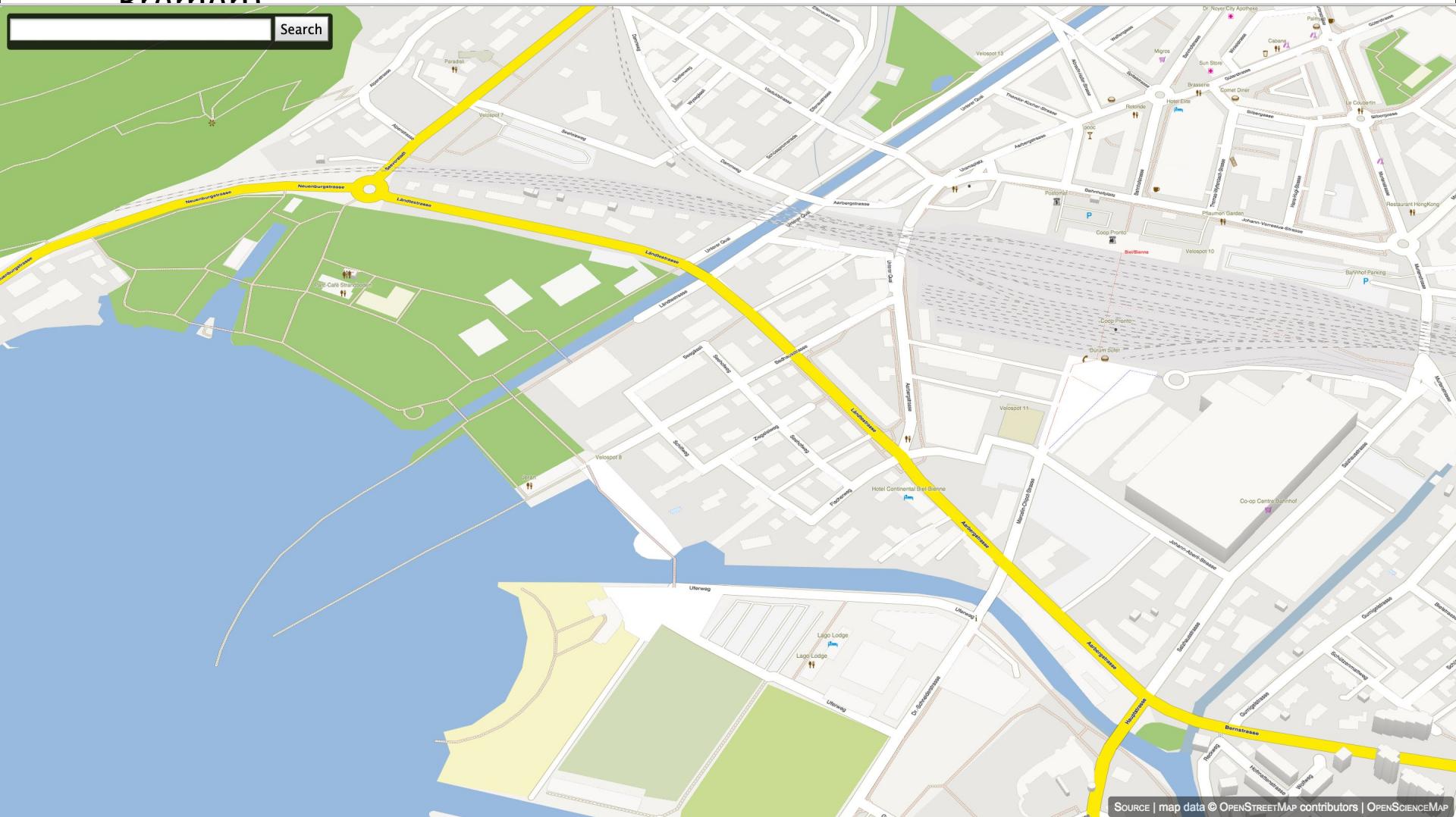
OSM Details: Vector Rendering: Apps

► OSM 2D Vector Map for offline viewing for iOS & Android: maps.me



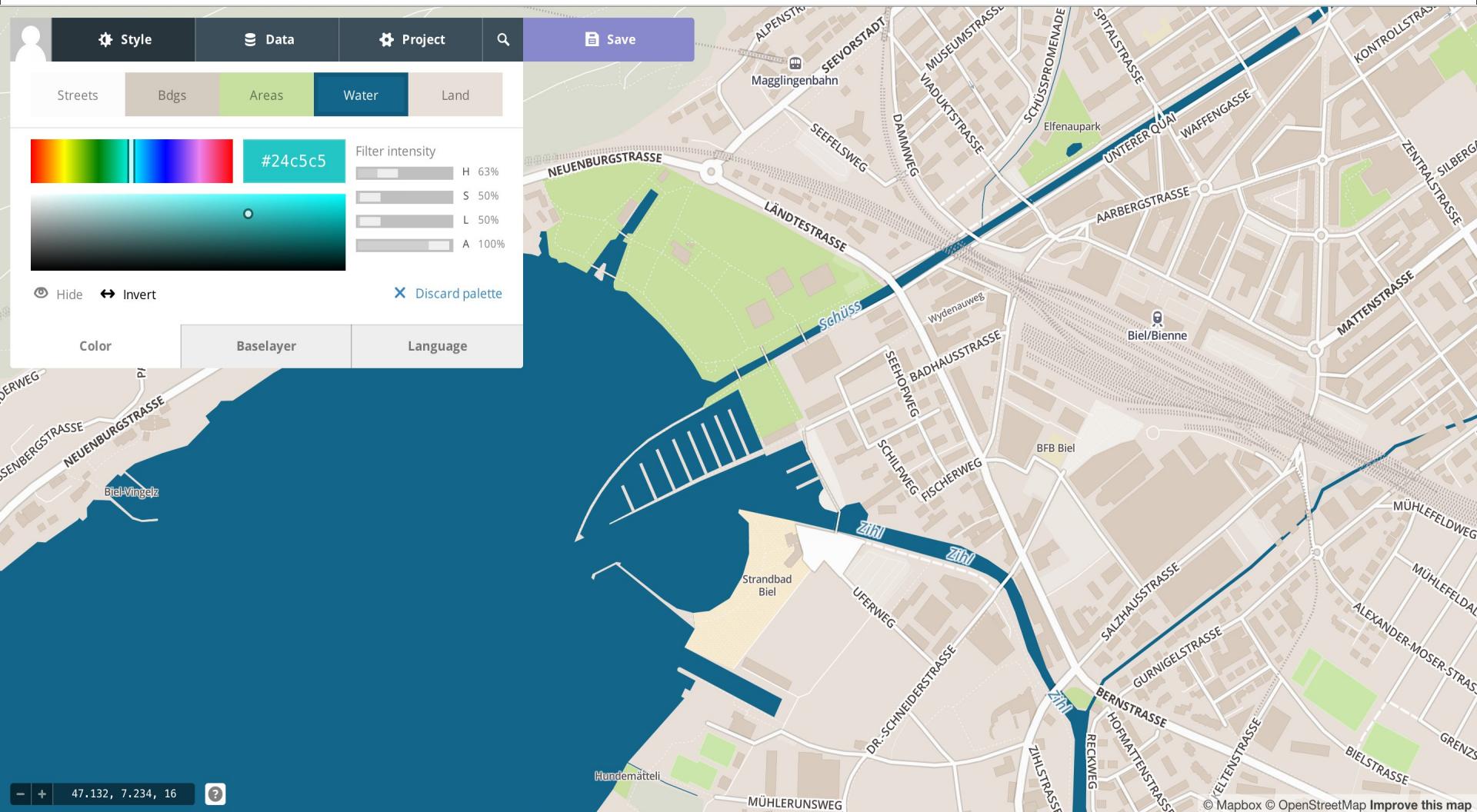
OSM Details: Vector Rendering: Apps

► OSM 2D & (3D) Vector Rendering: opensciencemap.org (Univ. of Bremen)



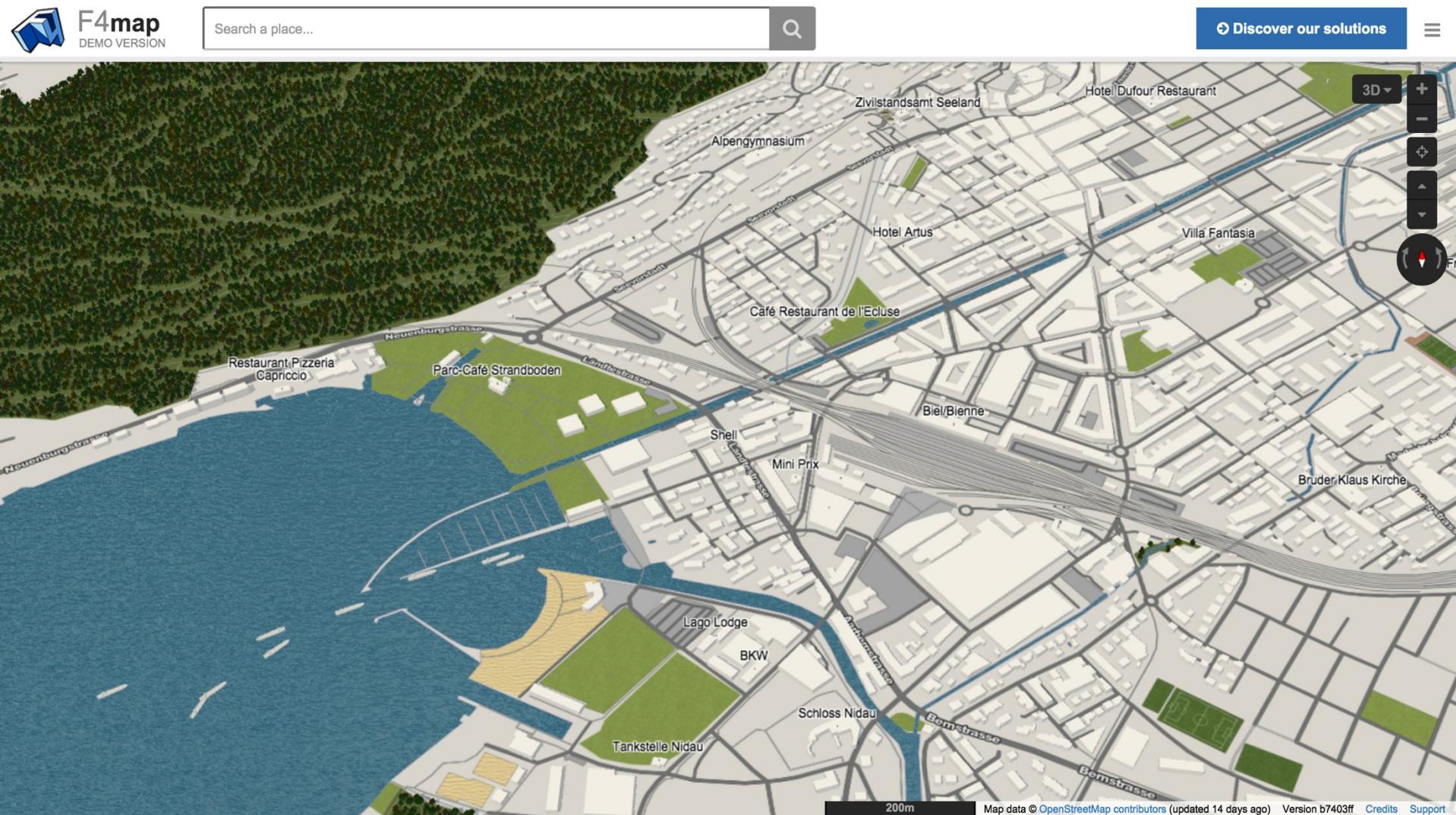
OSM Details: Vector Rendering: Apps

► OSM 2D Vector interactive map (commercial): mapbox.com



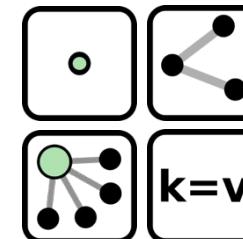
OSM Details: Vector Rendering: Apps

► OSM 2D & 3D Vector Rendering with Animations: demo.f4map.com



Agenda

- ▶ Introduction to OSM:
 - ▶ Quick Comparison with other Maps
 - ▶ History
 - ▶ Contributors
- ▶ OSM Details:
 - ▶ Elements & Tags
 - ▶ Reference System & Projection
 - ▶ Map Rendering (Tile or Vector based)
- ▶ OSM Mapping Process:
 - ▶ Collect & Upload GPS Data > Editing > Tagging > Viewing
- ▶ Using OSM with Leaflet
 - ▶ Leaflet Tutorial
 - ▶ Other Projects

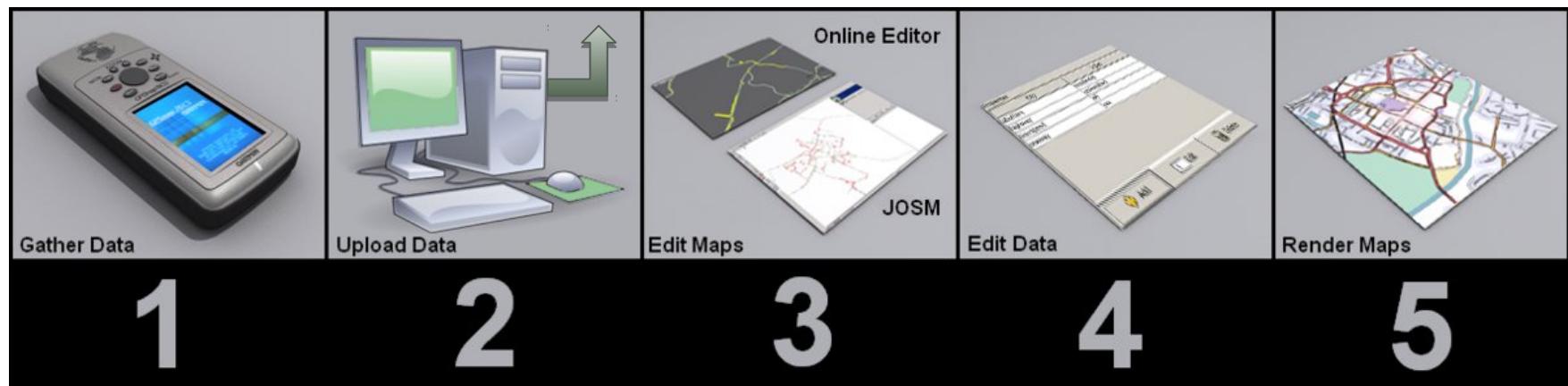


OSM Mapping: Beginner's Guide

Adding new Elements to OSM is fairly simple:

Create a **free OSM account** on: www.openstreetmap.org

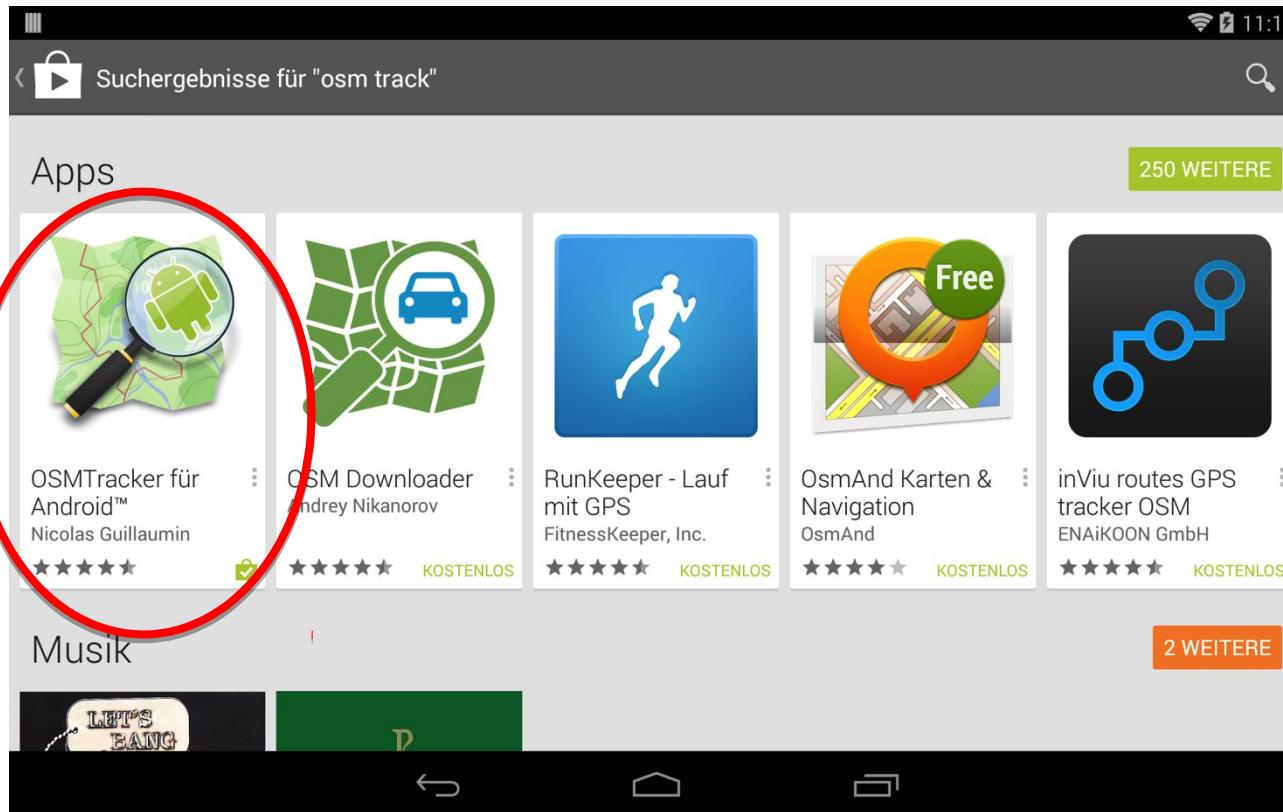
- 1. Collect GPS data**
- 2. Upload GPS data**
- 3. Editing the Map in an Editor**
- 4. Tagging the Map Elements**
- 5. View the updated map**



OSM Mapping: 1. Collect GPS Data

The goal is to **collect constantly the position** with a GPS enabled device:

- ▶ You can use almost any **iOS** or **Android Device** to create GPS Tracks
- ▶ See wiki.openstreetmap.org/wiki/GPS_Reviews for detailed reviews
- ▶ Search for “GPS tracker”, “GPS logger” or “OSM track” in your app store:



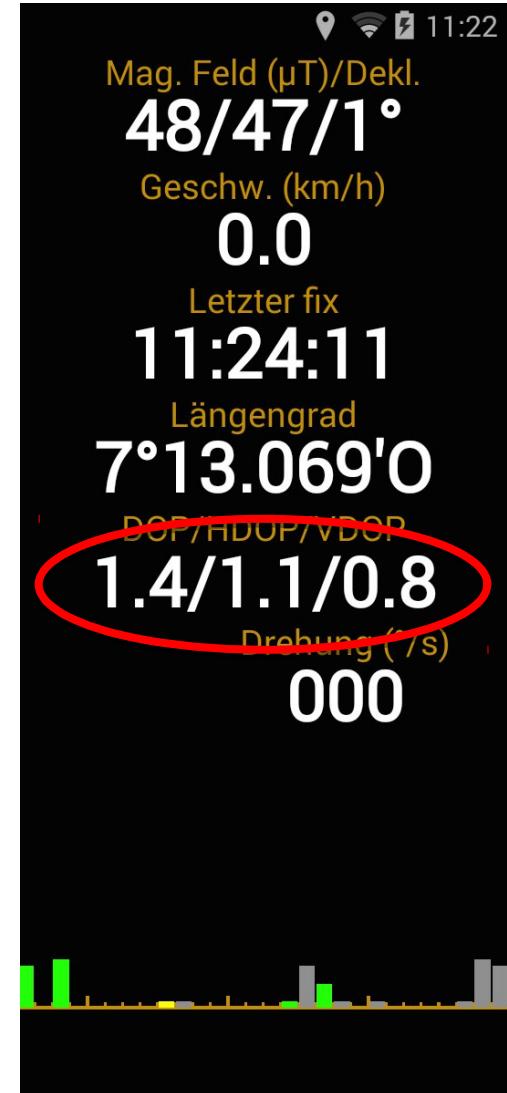
OSM Mapping: 1. Collect GPS Data

- Be sure GPS is enabled & that you have more than 4 satellites:



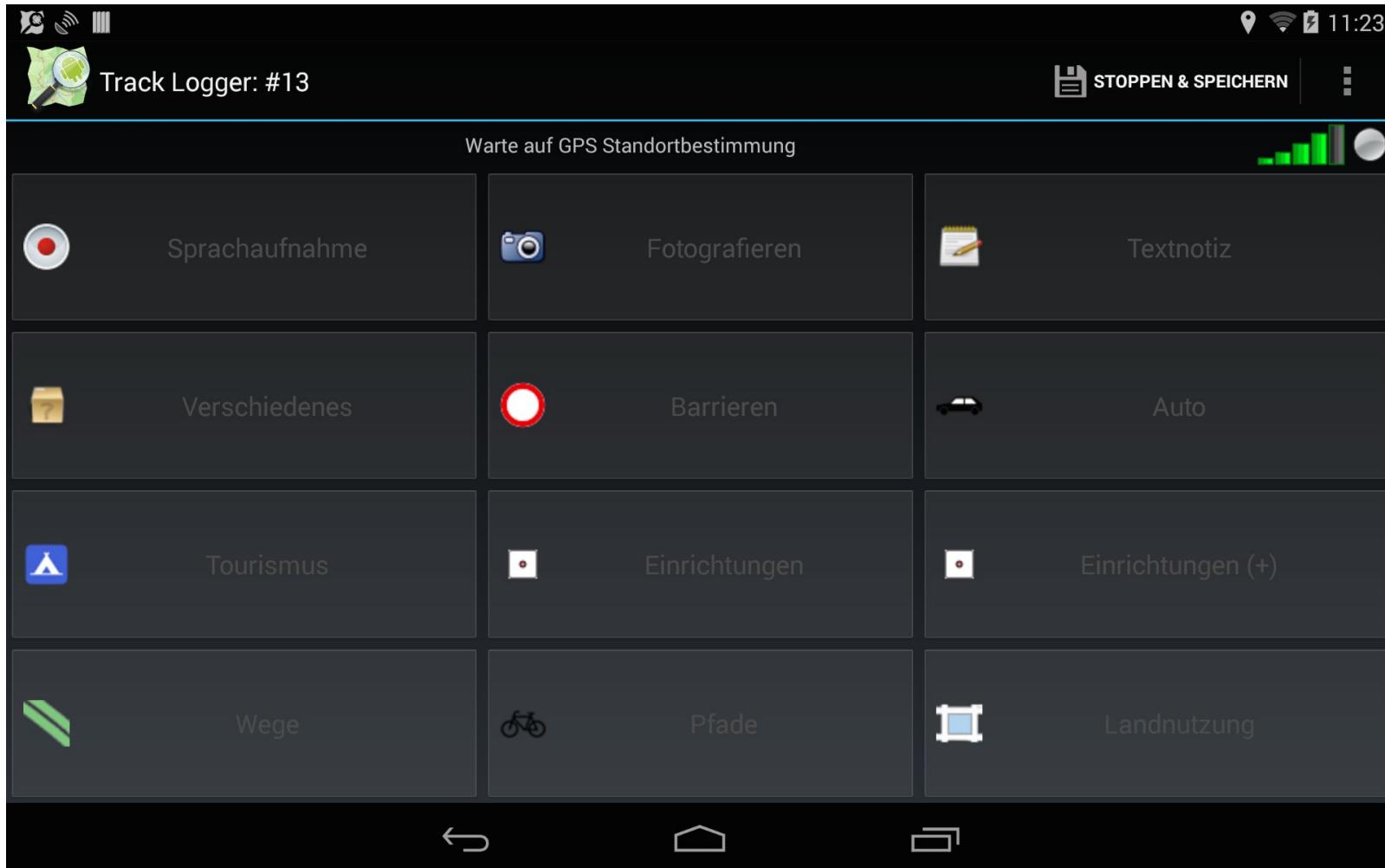
OSM Mapping: 1. Collect GPS Data

- ▶ A DOP Value (Dilution of Precision) below 4 is good enough for tracking.
- ▶ A DOP Value below 2 will give a very good fix.
- ▶ Only use GPS-Devices outdoor.
- ▶ The wider spread the satellites are the higher will be the precision:



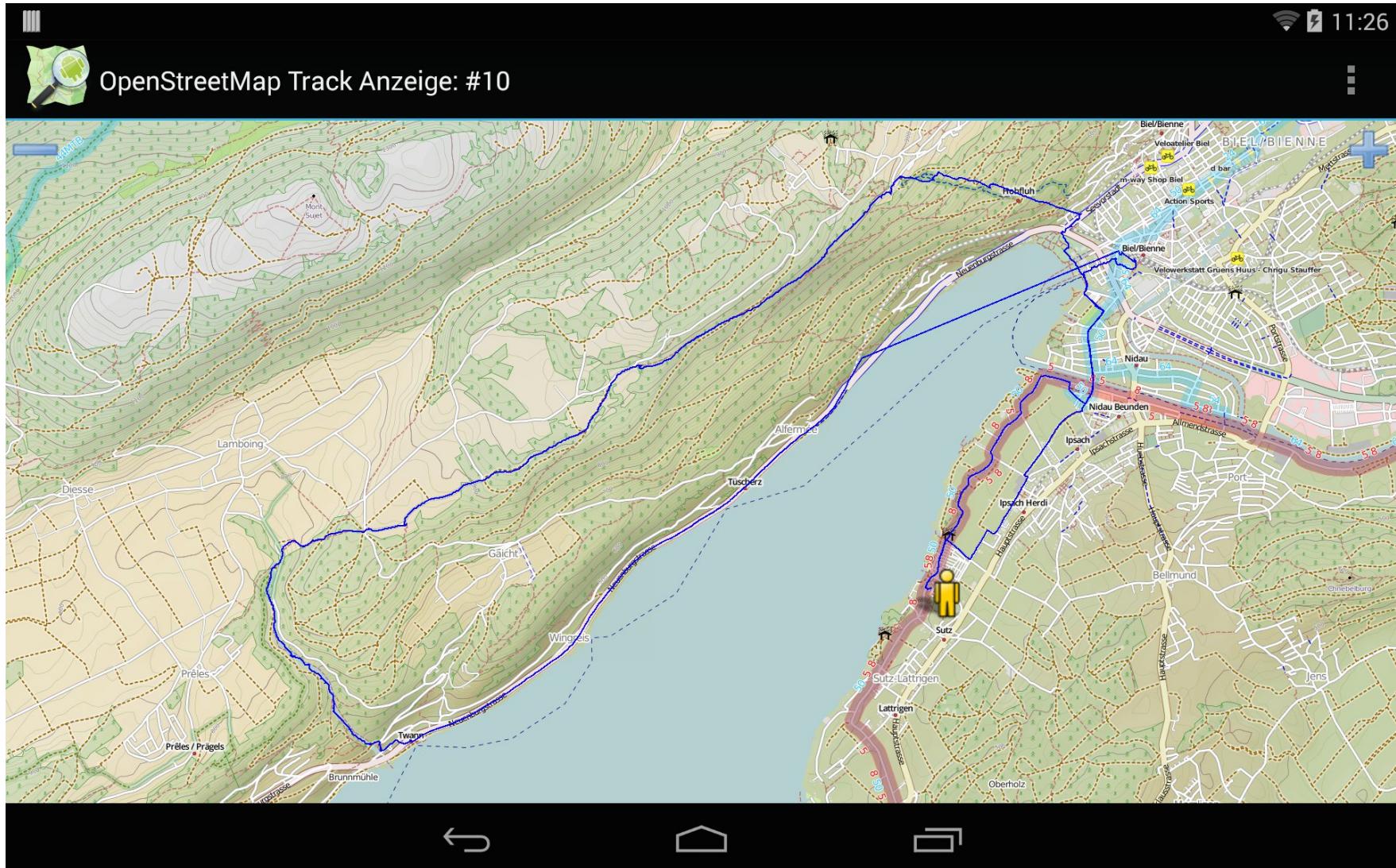
OSM Mapping: 1. Collect GPS Data

- ▶ Create a new track & put the device in your bag
- ▶ You could add comment, photos & tags on the way:



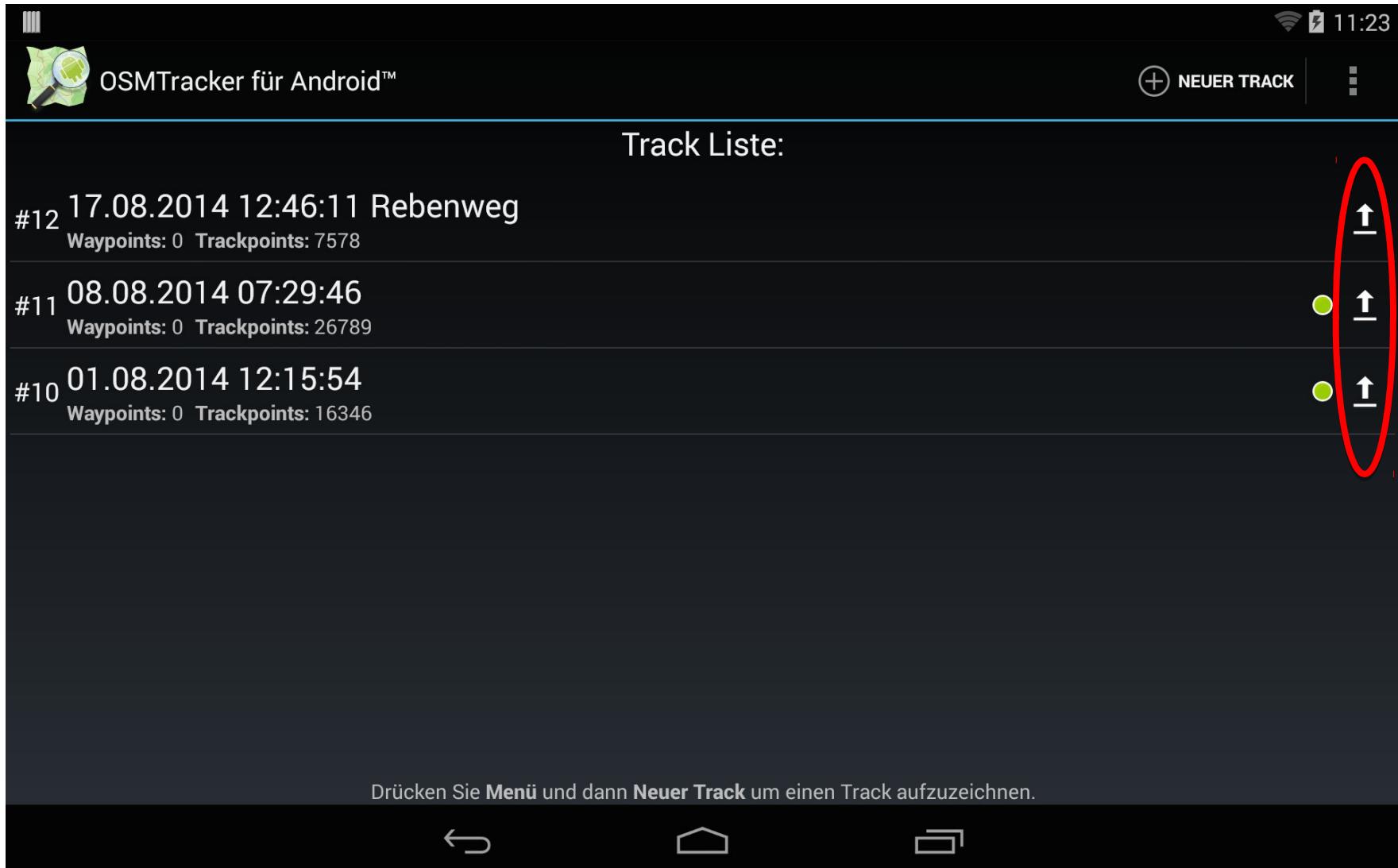
OSM Mapping: 1. Collect GPS Data

You don't need mobile internet if you **preload your map at home**:



OSM Mapping: 2. Upload GPS Data

At home you can upload your tracks to OSM:



OSM Mapping: 3. Editing the Map

When logged in, go to **GPS-Tracks**, **My Tracks**, **Details & Edit**:

The screenshot shows the OpenStreetMap website interface. At the top, there is a navigation bar with links for "Bearbeiten", "Chronik", "Export", "GPS-Tracks" (which is highlighted with a red circle), "Benutzer-Blogs", "Urheberrecht", "Hilfe", and "Über". Below the navigation bar is a search bar with "Suchen" and "Wo bin ich?", a "Los" button, and a map view. A user profile for "hudrima1" is shown on the right.

Below the main navigation, there is a secondary navigation bar with "Bearbeiten", "Chronik", "Export", "GPS-Tracks" (highlighted with a red circle), "Benutzer-Blogs", "Urheberrecht", "Hilfe", and "Über". The "GPS-Tracks" link here also has a red circle around it. A large arrow points from the "GPS-Tracks" link in the first navigation bar down to this second one.

The main content area is titled "Öffentliche GPS-Tracks" (Public GPS-Tracks). It includes a search bar for "Letzte GPS-Track-Uplists durchsuchen", a "Lade einen GPS-Track hoch" (Upload a GPS Track) button, and a "Meine Tracks ansehen" (View my tracks) button (highlighted with a red circle).

On the left, there is a list of public GPS tracks:

- 01.08.2014_12_15_54_2014_08_01_12_15_54.gpx ... (16,346 Punkte) ... etwa ein Monat her [Details / Karte / bearbeiten](#) **PRIVAT** (highlighted with a red circle)
- Twannbergewandern
von hudrima1
- 05.01.2014_14_47_45_2014_01_05_14_47_45.gpx ... (3,381 Punkte) ... 8 Monate her [Details / Karte / bearbeiten](#) **PRIVAT**
- Spaziergang Sutz
von hudrima1
- 01.01.2014_11_39_43_2014_01_01_11_39_43.gpx ... (11,530 Punkte) ... 8 Monate her [Details / Karte / bearbeiten](#) **PRIVAT**
- Riederalp
von hudrima1
- 30.12.2013_12_00_45_2013_12_30_12_00_45.gpx ... (12,296 Punkte) ... 8 Monate her [Details / Karte / bearbeiten](#) **PRIVAT**
- Fiescheralp
von hudrima1
- 29.12.2013_13_28_46_2013_12_29_13_28_46.gpx ... (5,326 Punkte) ... 8 Monate her [Details / Karte / bearbeiten](#) **PRIVAT**
- Bettmeralp
von hudrima1

On the right, a detailed view of the first track is shown:

Track 01.08.2014_12_15_54_2014_08_01_12_15_54.gpx ansehen

Datenname:	01.08.2014_12_15_54_2014_08_01_12_15_54.gpx (herunterladen)
Hochgeladen am:	1. August 2014 um 15:10
Punkte:	16,346
Startkoordinate:	47.106; 7.21802 (Karte / bearbeiten) (highlighted with a red circle)
Besitzer:	hudrima1
Beschreibung:	Twannbergewandern
Tags:	Keine
Sichtbarkeit:	PRIVAT (werden nur als anonyme, unsortierte Punkte ohne Zeitangaben gezeigt)

[Diesen Track bearbeiten](#) | [Diesen Track löschen](#)

OSM Mapping: 3. Editing the Map

You have **several possibilities to edit the OSM map:**

- ▶ **iD** in web browser made with JavaScript (standard since May 2013)
- ▶ **Potlatch2** in web browser made with Flash
- ▶ **JOSM** as a JAVA app has the most features but is more complex than iD
- ▶ **Merkaartor** as a native Qt4 application
- ▶ For more info & other editors see openstreetmap.org/wiki/DE:Editing

OSM Mapping: 4. Tagging the Map Elements

Tagging is **adding information** to new or existing elements:

- ▶ It is the most important part of the mapping process
 - ▶ Without information the elements are just graphics
 - ▶ **No logic such as navigation or special purpose maps** could be implemented
- ▶ See the [**Primary Feature page**](#) for most important tags
- ▶ See the [**recommended tagging schemes**](#) of countries: E.g. [Switzerland](#)

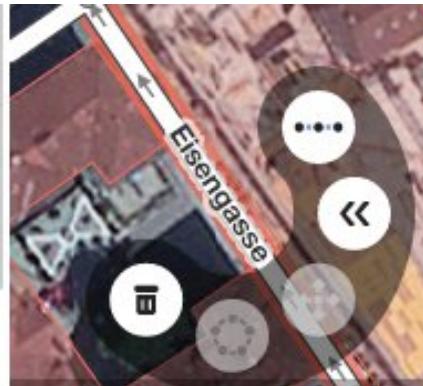
OSM Mapping: 4. Tagging the Map Elements

The most important features to add to OSM are:

- ▶ The ones that we need for **navigation!**
- ▶ Streets with correct **highway type value & street name**:

highway	residential		Straße an und in Wohngebieten , die keiner anderen Straßenklasse angehört (unclassified, tertiary, secondary, primary). Impliziert nicht maxspeed=30 . Bitte für Tempo-30-Zonen explizit maxspeed setzen.
name	benutzerdefiniert		Die allgemeine Bezeichnung
name:</lg>	benutzerdefiniert		Name in anderer Sprache Beispiel: name:en=Munich. Siehe auch: Bilingual_street_names (en)
alt_name	benutzerdefiniert		alternative Bezeichnung unter der das Objekt bekannt ist Beispiel: name=University Centre und alt_name=Grad Pad

highway	residential		
name	Eisengasse		
name:de	Eisengasse		
name:fr	Rue du Fer		
oneway	yes		



OSM Mapping: 4. Tagging the Map Elements

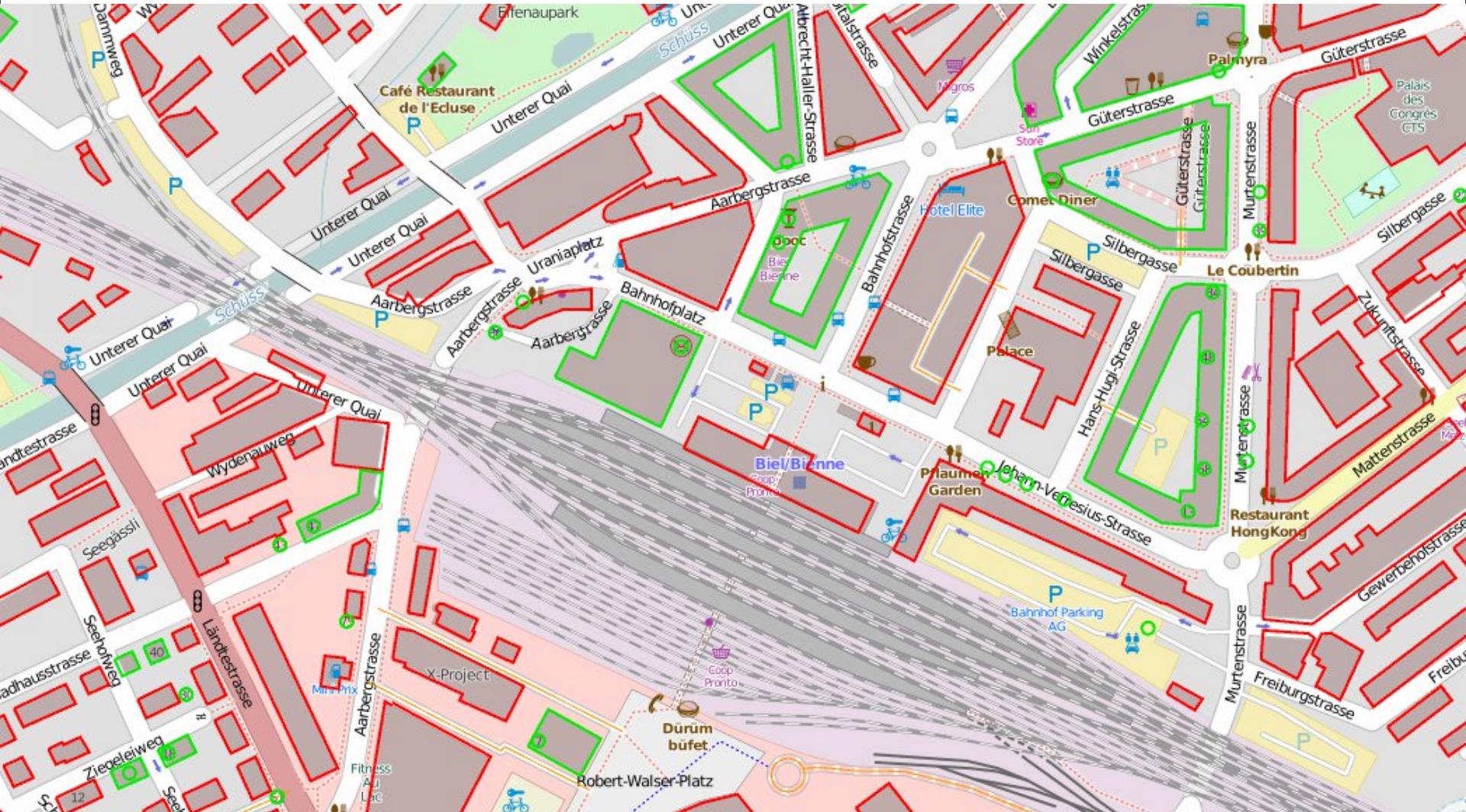
The most important features to add to OSM are:

- ▶ The ones that we need for **navigation!**
- ▶ Streets with correct **highway type value & street name**:
- ▶ Buildings with **street & house number**:

addr:housenumber	benutzerdefiniert		<p>Hausnummer (u.U. nicht nur Ziffern). Mehrere Hausnummern für einen Eintrag können mit Komma getrennt werden, z. B. "12b,12c". Bitte nicht nur <code>addr:housenumber=*</code>, sondern mindestens auch <code>addr:street=*</code> eintragen (oder die Straßenzugehörigkeit als Relation erfassen).</p>
addr:street	benutzerdefiniert		<p>Name der zur Adresse gehörenden Straße. Eine Straße mit dem angegebenen Namen sollte in der Umgebung existieren. Die Schlüssel <code>addr:housenumber=*</code> und <code>addr:street=*</code> sind prinzipiell die einzigen, für eine Adresse notwendigen Schlüssel, der Rest ist optional, wenn valide (d.h. fehlerfreie, geschlossene) Grenzpolygone vorliegen und die Werte passen. Wenn man sich nicht sicher ist, einfach zusätzlich Ort, Postleitzahl und Land angeben, was üblicherweise auch getan wird.</p>

OSM Mapping: 4. Tagging the Map Elements

See the Quality Assurance (QA) page for missing names & addresses:



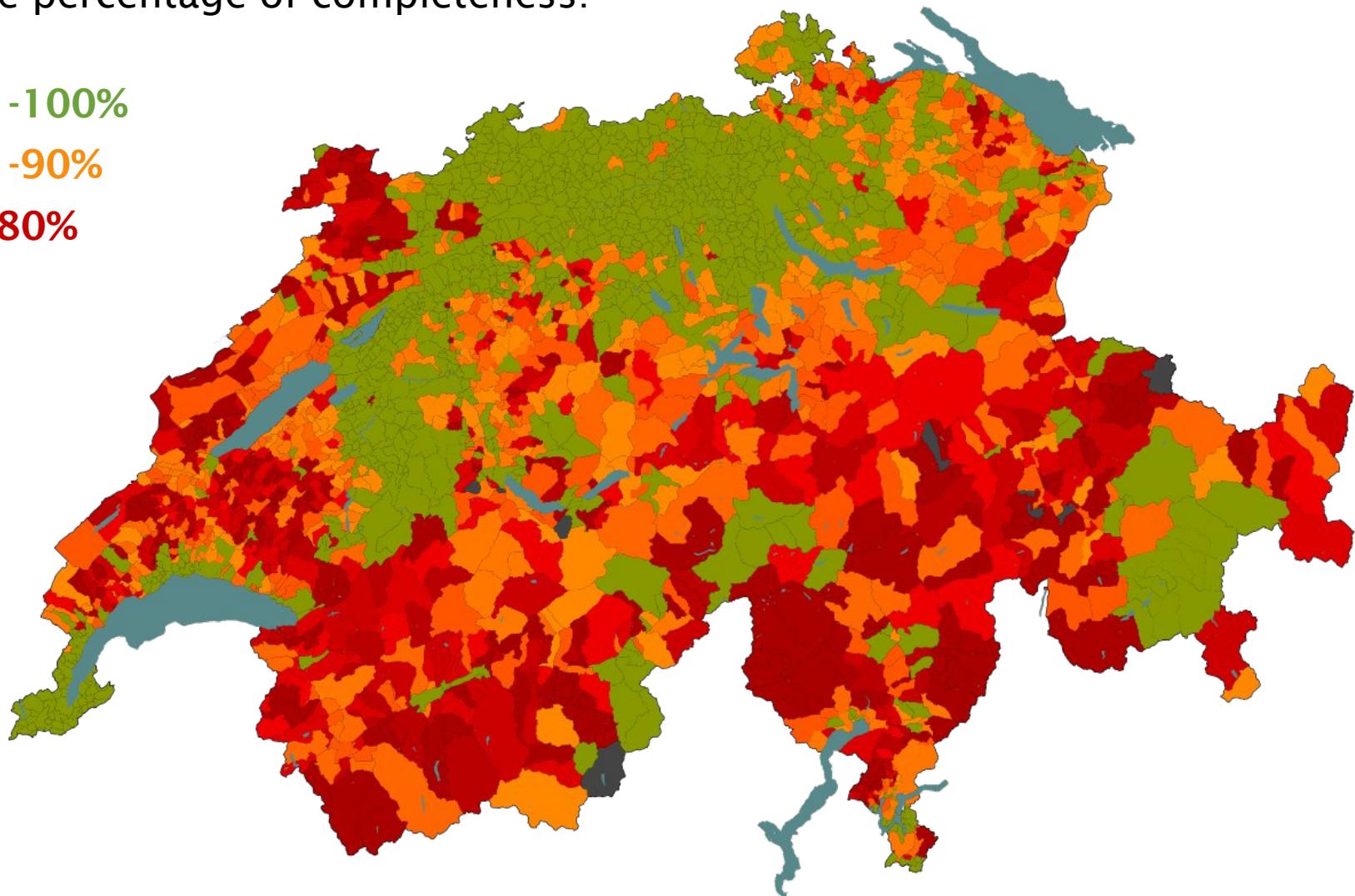
OSM Mapping: 4. Tagging the Map Elements

A daily comparisons with the “**Gebäude & Wohungsregister**” (GWR) shows the percentage of completeness:

91-100%

81-90%

< 80%



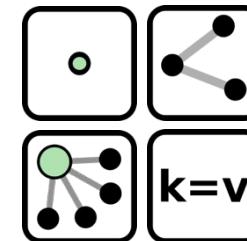
OSM Mapping: 5. Viewing the updated Map

When do I see my changes in OSM?

- ▶ The **rendering of the main map** should update within a **few minutes**, however, occasionally, it can take longer.
- ▶ Tiles are only marked to be re-rendered when people look at them
- ▶ For more info read [here](#)
- ▶ The full **Planet.osm** XML-file with all OSM data is released every week:
 - ▶ 498 GB uncompressed
 - ▶ 36 GB compressed

Agenda

- ▶ Introduction to OSM:
 - ▶ Quick Comparison with other Maps
 - ▶ History
 - ▶ Contributors
- ▶ OSM Details:
 - ▶ Elements & Tags
 - ▶ Reference System & Projection
 - ▶ Map Rendering (Tile or Vector based)
- ▶ OSM Mapping Process:
 - ▶ Collect & Upload GPS Data > Editing > Tagging > Viewing
- ▶ **Using OSM with Leaflet**
 - ▶ **Leaflet Tutorial**
 - ▶ **Other Projects**



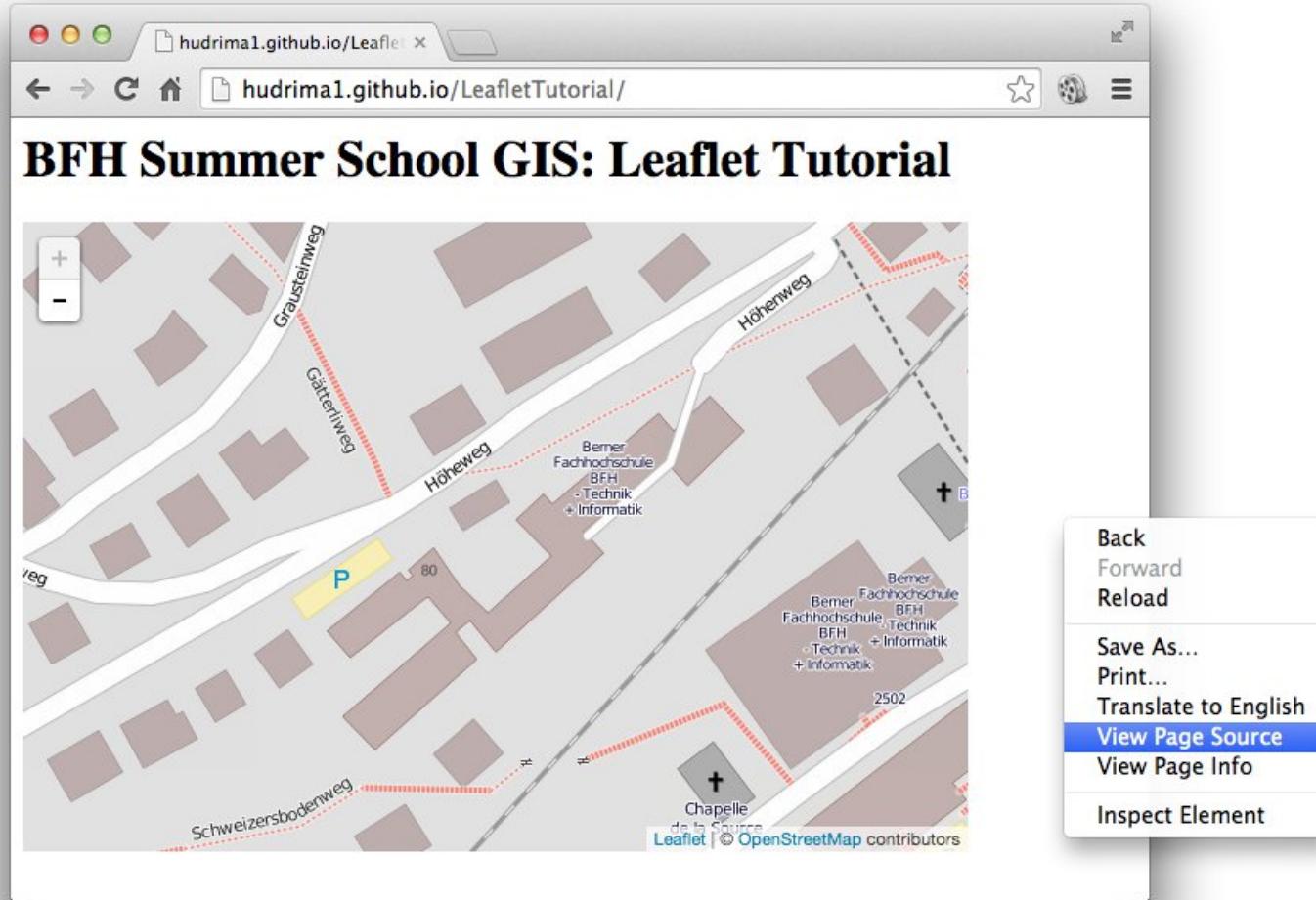
Using OSM with Leaflet



- ▶ **Leaflet** is a **JavaScript** library to create customized **slippy maps** in browsers.
- ▶ It allows to **integrate multiple GIS sources** including:
 - ▶ Tile layers
 - ▶ Vector layers
 - ▶ GeoJSON layers
 - ▶ Image overlays
 - ▶ ...
- ▶ Highly controllable interaction features.
- ▶ Optimized for mobile devices.
- ▶ Well documented: leafletjs.com/reference.html

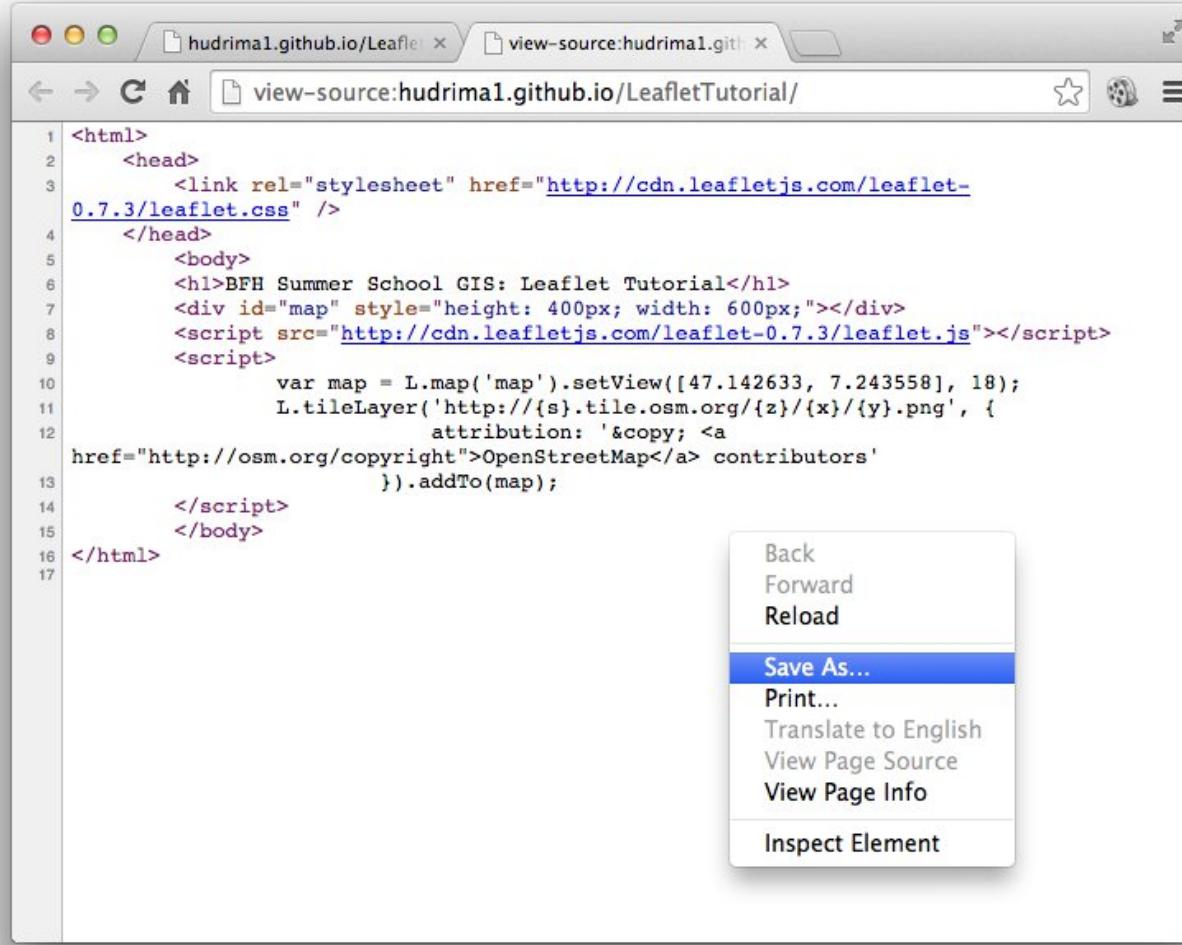
Using OSM with Leaflet: Tutorial

- ▶ Click on the link: <http://hudrima1.github.io/LeafletTutorial/>
- ▶ Right-click on the background (not the map) & choose View Page Source



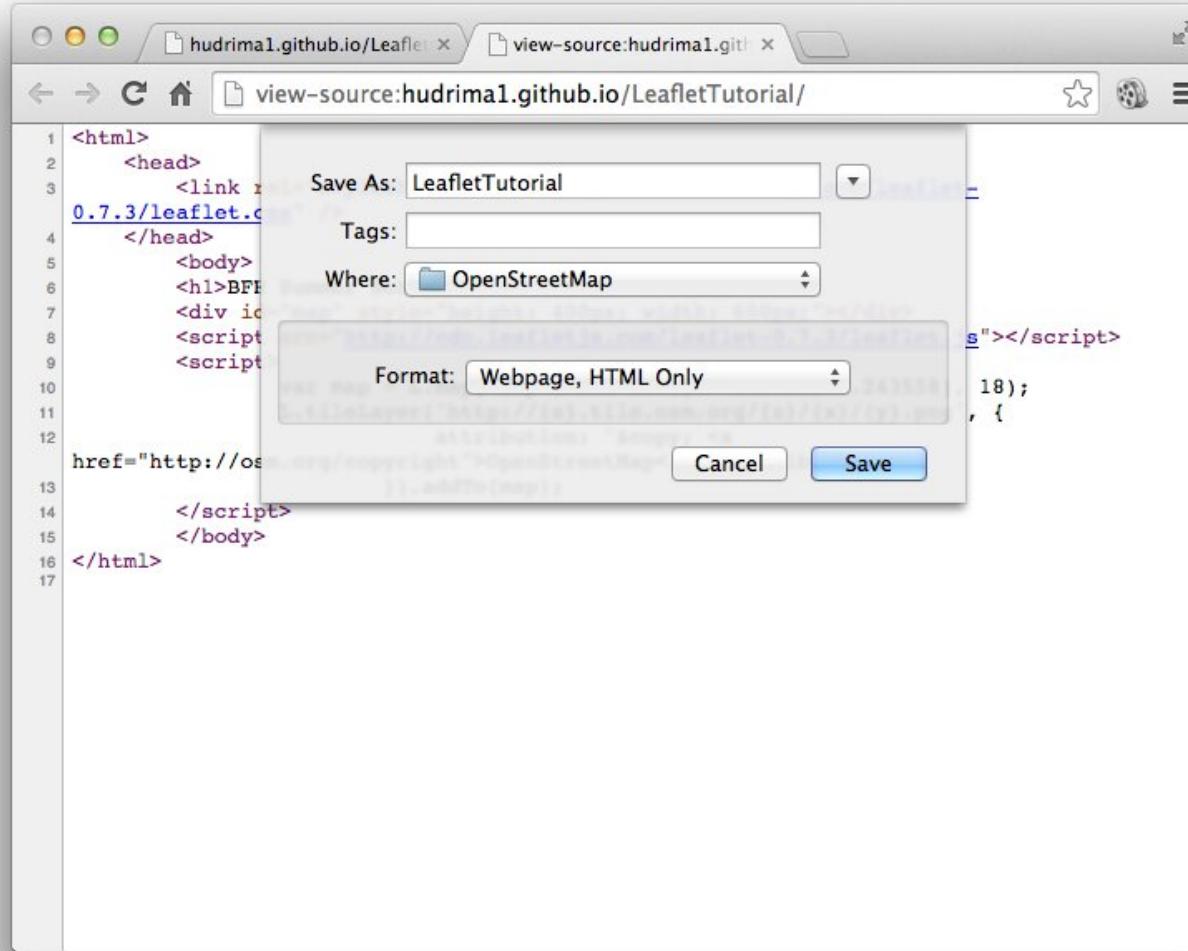
Using OSM with Leaflet: Tutorial

- ▶ Now you see the source code that produces the page
- ▶ Right-click on the background & choose Save As...



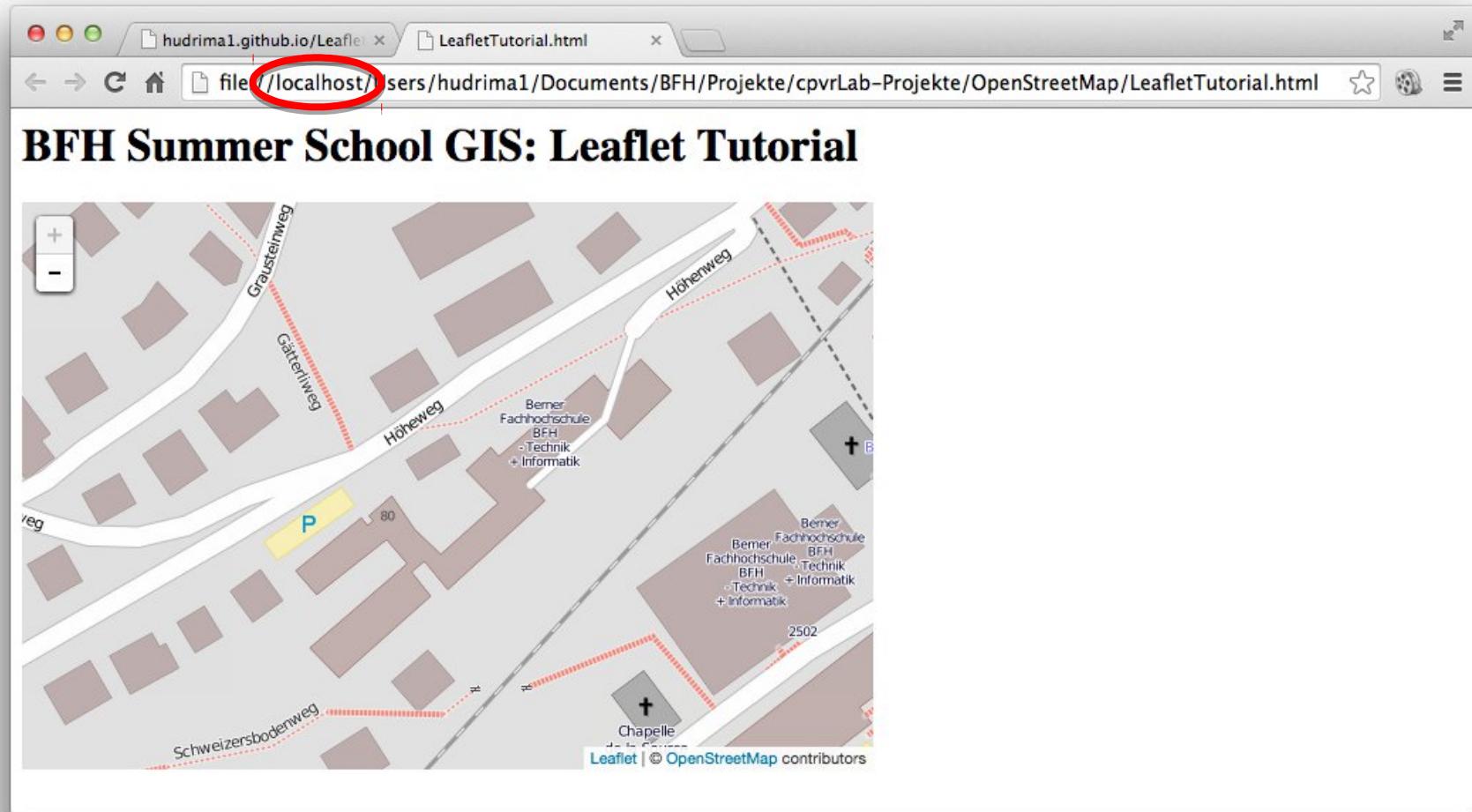
Using OSM with Leaflet: Tutorial

- Make sure that you **choose the format Webpage, HTML only & save it wherever you want**:



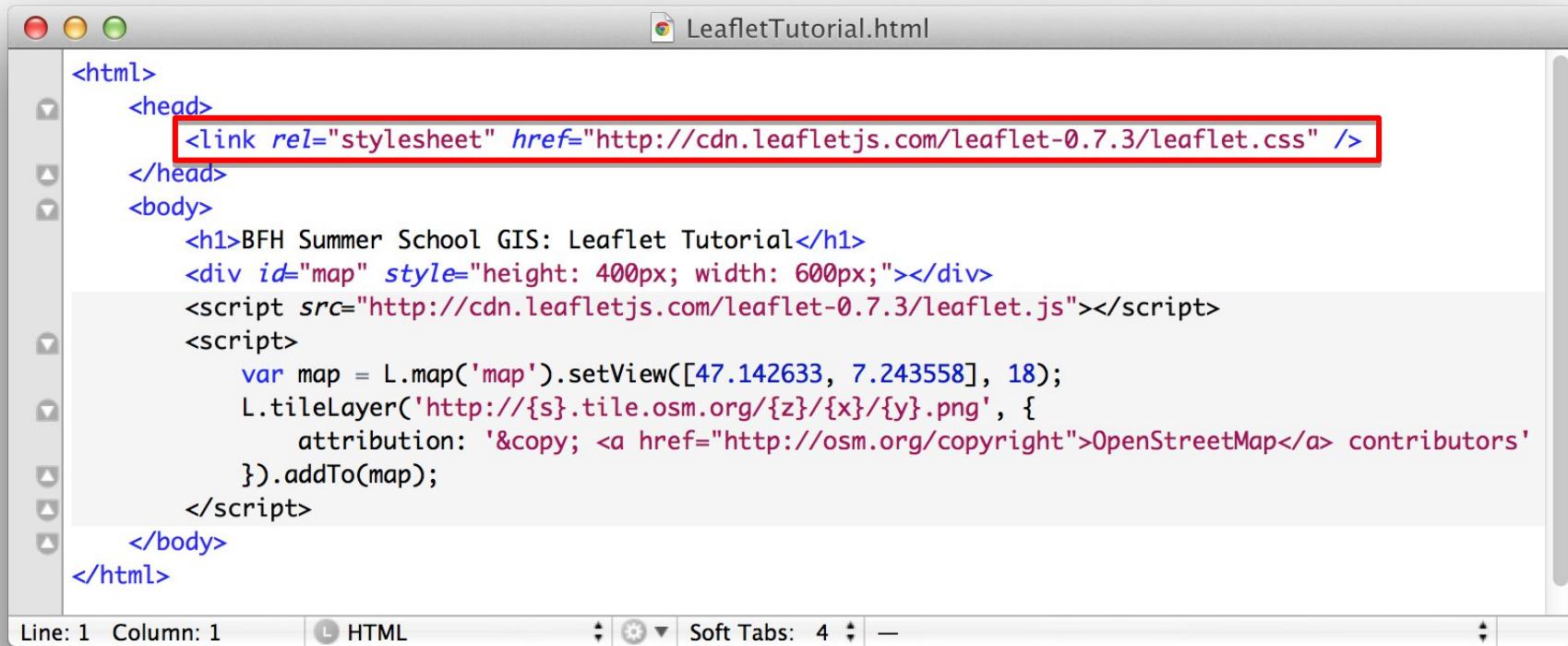
Using OSM with Leaflet: Tutorial

- ▶ Open now the saved file by **double clicking it**.
- ▶ It should be opened now with your default browser:



Using OSM with Leaflet: Tutorial

- ▶ Open now the saved file with a **text editor**:



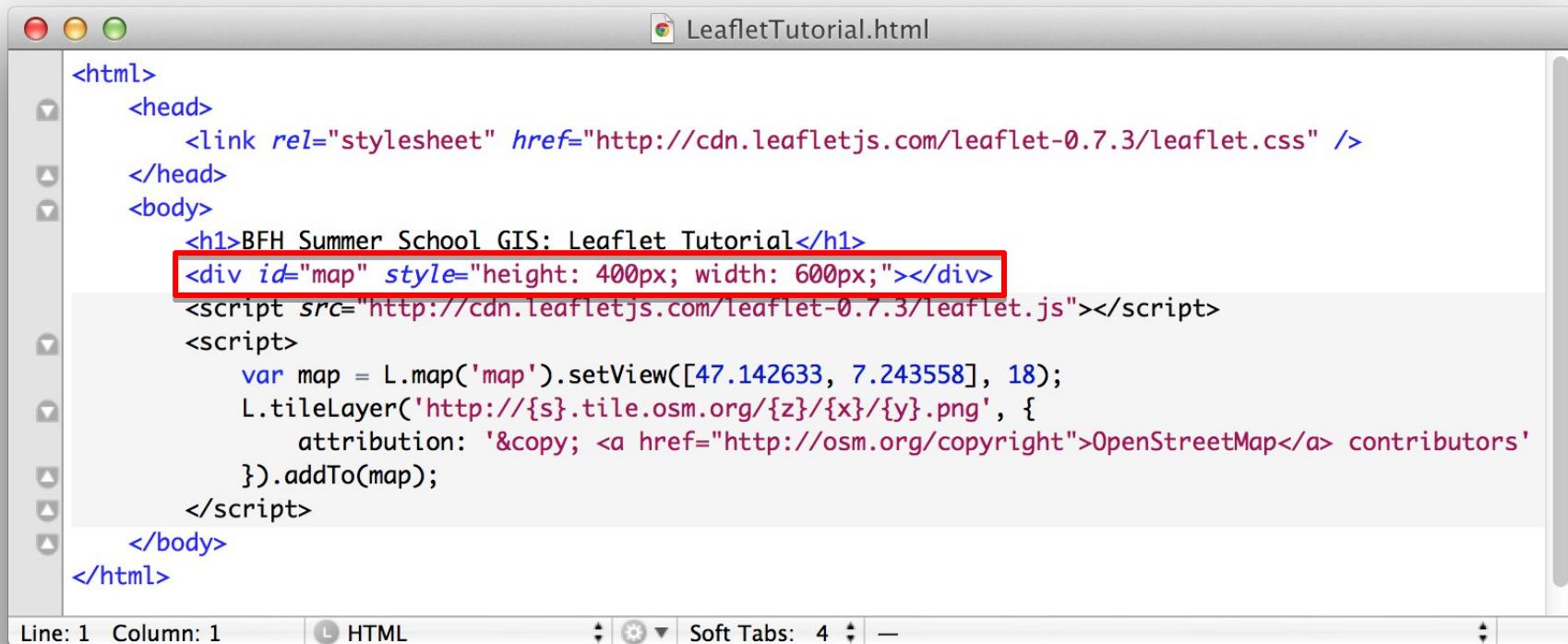
```
<html>
  <head>
    <link rel="stylesheet" href="http://cdn.leafletjs.com/leaflet-0.7.3/leaflet.css" />
  </head>
  <body>
    <h1>BFH Summer School GIS: Leaflet Tutorial</h1>
    <div id="map" style="height: 400px; width: 600px;"></div>
    <script src="http://cdn.leafletjs.com/leaflet-0.7.3/leaflet.js"></script>
    <script>
      var map = L.map('map').setView([47.142633, 7.243558], 18);
      L.tileLayer('http://{s}.tile.osm.org/{z}/{x}/{y}.png', {
        attribution: '&copy; <a href="http://osm.org/copyright">OpenStreetMap</a> contributors'
      }).addTo(map);
    </script>
  </body>
</html>
```

Line: 1 Column: 1 | HTML | Soft Tabs: 4 | —

- ▶ Inclusion of the Leaflet CSS (Cascaded Style Sheet) file

Using OSM with Leaflet: Tutorial

- ▶ Open now the saved file with a **text editor**:



The screenshot shows a Mac OS X-style text editor window titled "LeafletTutorial.html". The code editor displays an HTML file with the following content:

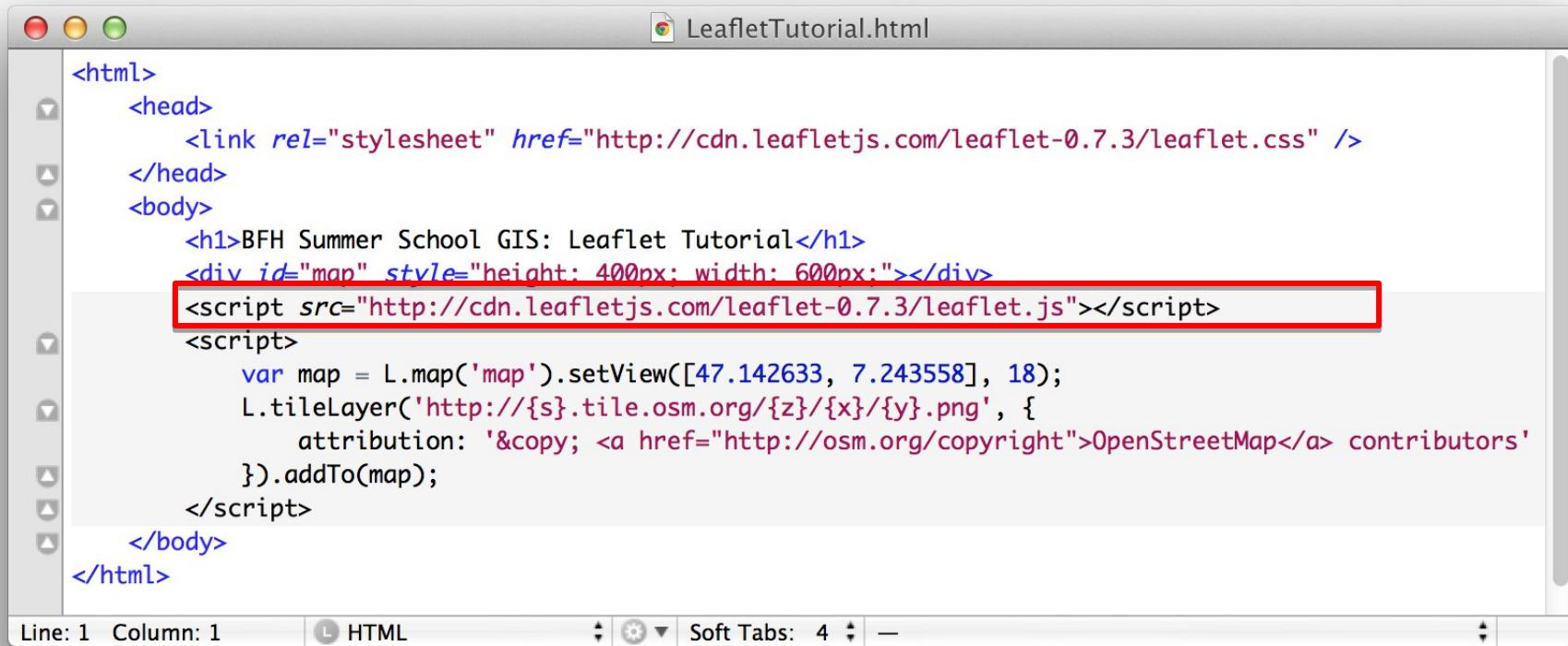
```
<html>
  <head>
    <link rel="stylesheet" href="http://cdn.leafletjs.com/leaflet-0.7.3/leaflet.css" />
  </head>
  <body>
    <h1>BFH Summer School GIS: Leaflet Tutorial</h1>
    <div id="map" style="height: 400px; width: 600px;"></div>
    <script src="http://cdn.leafletjs.com/leaflet-0.7.3/leaflet.js"></script>
    <script>
      var map = L.map('map').setView([47.142633, 7.243558], 18);
      L.tileLayer('http://{s}.tile.osm.org/{z}/{x}/{y}.png', {
        attribution: '&copy; <a href="http://osm.org/copyright">OpenStreetMap</a> contributors'
      }).addTo(map);
    </script>
  </body>
</html>
```

A red box highlights the `<div id="map" style="height: 400px; width: 600px;"></div>` line, which defines the placeholder for the map. The status bar at the bottom shows "Line: 1 Column: 1", "HTML", "Soft Tabs: 4", and other icons.

- ▶ Definition of the `<div>` tag placeholder where the map is rendered. It is important to set a height and the id.

Using OSM with Leaflet: Tutorial

- ▶ Open now the saved file with a **text editor**:



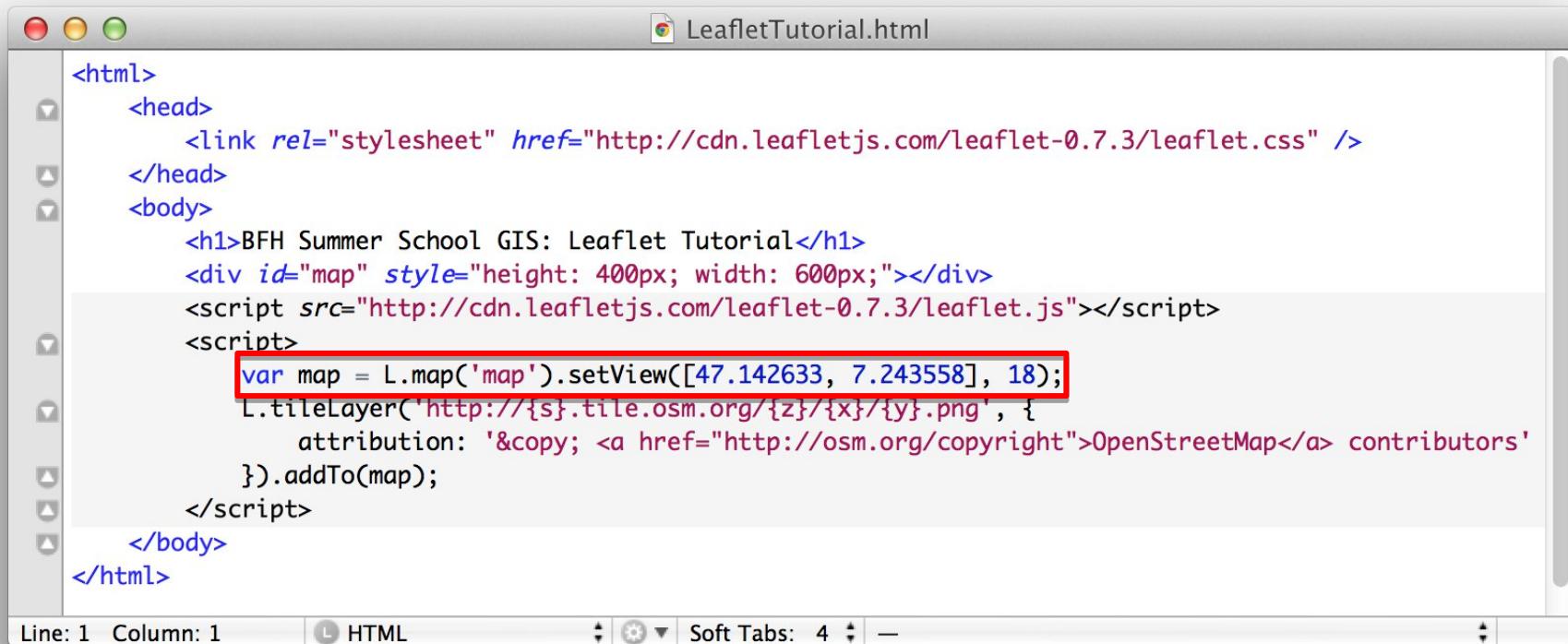
```
<html>
  <head>
    <link rel="stylesheet" href="http://cdn.leafletjs.com/leaflet-0.7.3/leaflet.css" />
  </head>
  <body>
    <h1>BFH Summer School GIS: Leaflet Tutorial</h1>
    <div id="map" style="height: 400px; width: 600px;"></div>
    <script src="http://cdn.leafletjs.com/leaflet-0.7.3/leaflet.js"></script>
    <script>
      var map = L.map('map').setView([47.142633, 7.243558], 18);
      L.tileLayer('http://{s}.tile.osm.org/{z}/{x}/{y}.png', {
        attribution: '&copy; <a href="http://osm.org/copyright">OpenStreetMap</a> contributors'
      }).addTo(map);
    </script>
  </body>
</html>
```

Line: 1 Column: 1 | HTML | Soft Tabs: 4 | —

- ▶ Inclusion of the Leaflet JavaScript library.

Using OSM with Leaflet: Tutorial

- ▶ Open now the saved file with a **text editor**:



The screenshot shows a Mac OS X-style text editor window titled "LeafletTutorial.html". The code inside the editor is as follows:

```
<html>
  <head>
    <link rel="stylesheet" href="http://cdn.leafletjs.com/leaflet-0.7.3/leaflet.css" />
  </head>
  <body>
    <h1>BFH Summer School GIS: Leaflet Tutorial</h1>
    <div id="map" style="height: 400px; width: 600px;"></div>
    <script src="http://cdn.leafletjs.com/leaflet-0.7.3/leaflet.js"></script>
    <script>
      var map = L.map('map').setView([47.142633, 7.243558], 18);
      L.tileLayer('http://{s}.tile.osm.org/{z}/{x}/{y}.png', {
        attribution: '&copy; <a href="http://osm.org/copyright">OpenStreetMap</a> contributors'
      }).addTo(map);
    </script>
  </body>
</html>
```

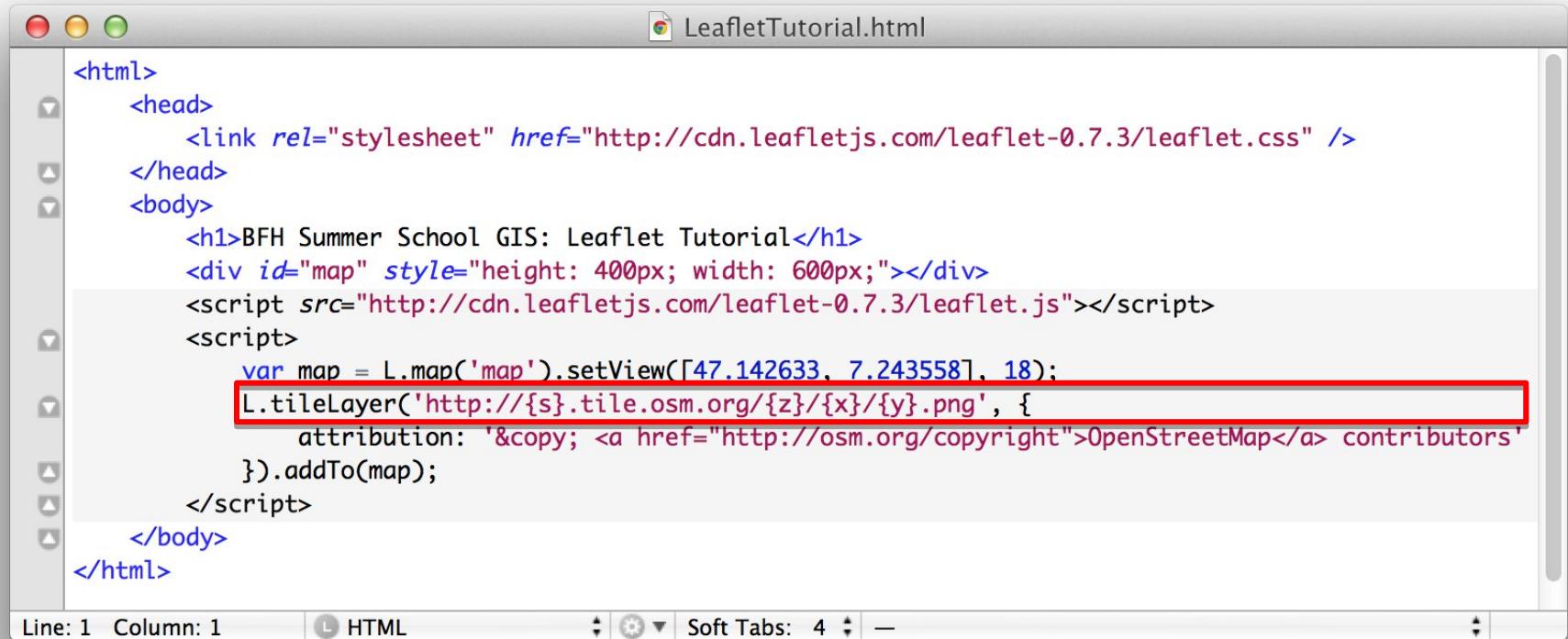
The line of code that initializes the map is highlighted with a red rectangle: `var map = L.map('map').setView([47.142633, 7.243558], 18);`

At the bottom of the editor, there are status bars showing "Line: 1 Column: 1", "HTML", "Soft Tabs: 4", and other interface elements.

- ▶ In the script the library is initialize on the `<div>` with id "map". At the same time the longitude, latitude and zoom level is set.

Using OSM with Leaflet: Tutorial

- ▶ Open now the saved file with a **text editor**:



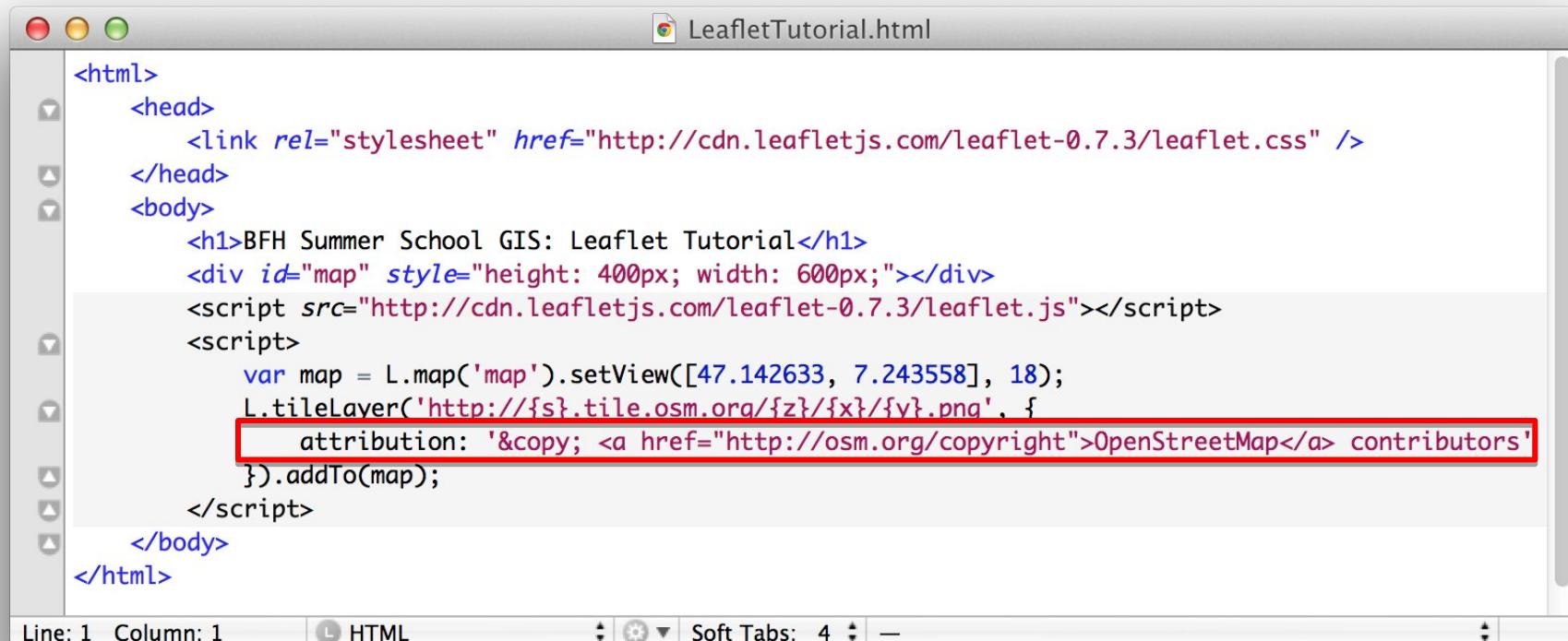
```
<html>
  <head>
    <link rel="stylesheet" href="http://cdn.leafletjs.com/leaflet-0.7.3/leaflet.css" />
  </head>
  <body>
    <h1>BFH Summer School GIS: Leaflet Tutorial</h1>
    <div id="map" style="height: 400px; width: 600px;"></div>
    <script src="http://cdn.leafletjs.com/leaflet-0.7.3/leaflet.js"></script>
    <script>
      var map = L.map('map').setView([47.142633, 7.243558], 18);
      L.tileLayer('http://[s].tile.osm.org/{z}/{x}/{y}.png', {
        attribution: '&copy; <a href="http://osm.org/copyright">OpenStreetMap</a> contributors'
      }).addTo(map);
    </script>
  </body>
</html>
```

Line: 1 Column: 1 | HTML | Soft Tabs: 4 | —

- ▶ The library function `L.tileLayer` passes first the URL of OSM tiles server for the map.

Using OSM with Leaflet: Tutorial

- ▶ Open now the saved file with a **text editor**:



```
<html>
  <head>
    <link rel="stylesheet" href="http://cdn.leafletjs.com/leaflet-0.7.3/leaflet.css" />
  </head>
  <body>
    <h1>BFH Summer School GIS: Leaflet Tutorial</h1>
    <div id="map" style="height: 400px; width: 600px;"></div>
    <script src="http://cdn.leafletjs.com/leaflet-0.7.3/leaflet.js"></script>
    <script>
      var map = L.map('map').setView([47.142633, 7.243558], 18);
      L.tileLayer('http://{s}.tile.osm.org/{z}/{x}/{y}.png', {
        attribution: '&copy; <a href="http://osm.org/copyright">OpenStreetMap</a> contributors'
      }).addTo(map);
    </script>
  </body>
</html>
```

Line: 1 Column: 1 | HTML | Soft Tabs: 4 | —

- ▶ The library function `L.tileLayer` passes as the second argument the copyright information.

Using OSM with Leaflet: Tutorial: Exercises

- ▶ Change the position of the map to your hometown.
 - ▶ <http://www.gps-coordinates.net/>
- ▶ Try other tile servers with other styles.
 - ▶ <http://{s}.tile.stamen.com/toner/{z}/{x}/{y}.jpg>
 - ▶ <http://{s}.tile.stamen.com/watercolor/{z}/{x}/{y}.jpg>
 - ▶ <https://{s}.tiles.mapbox.com/v3/examples.a4c252ab/{z}/{x}/{y}.png>
- ▶ Add the main train or bus station as marker to the map.
 - ▶ `var marker = L.marker([51.5, -0.09]).addTo(map);`
- ▶ Enhance the marker with a pop-up self describing the point.
 - ▶ `marker.bindPopup("Train station of <hometown>").openPopup();`
- ▶ Follow the following tutorial to change the appearance of the marker.
 - ▶ <http://leafletjs.com/examples/custom-icons.html>

Using OSM with Leaflet: Other Projects

- ▶ Compare different maps:
 - ▶ <http://mc.bbbike.org/mc/>
- ▶ MapBox.com - Company providing highly customizable design tiles:
 - ▶ <http://mapbox.com/design>
- ▶ Other cartographic projections for Leaflet with [Proj.4](#):
 - ▶ Example: <http://www.osm.ch/chlv95.html>
- ▶ Routing with [osm.ch](#)
 - ▶ <http://routing.osm.ch/>

Introduction to OSM: More Information

OSM is extremely well documented:

- ▶ Introduction: http://wiki.openstreetmap.org/wiki/Main_Page
- ▶ Features: http://wiki.openstreetmap.org/wiki/Map_Features
- ▶ Tag statistics: <http://taginfo.openstreetmap.org>
- ▶ Switzerland: <http://www.osm.ch>
- ▶ QA: <http://qa.poole.ch>
- ▶ FOSSGIS: <http://www.fossgis.de>



Berner Fachhochschule
Haute école spécialisée bernoise
Bern University of Applied Sciences

Questions ?

Thank you for your attention.

Marcus Hudritsch