UNIVERSITÄT BERN

Vorlesung Open Data

Open Geodata

Termin 9, 18. April 2019

Dr. Matthias Stürmer

Dozentur Digitale Nachhaltigkeit
Institut für Wirtschaftsinformatik
Universität Bern

Terminübersicht Vorlesung

21. Februar 2019	Informationen zur Vorlesung, Einführung Open Data
28. Februar 2019	Open Government Data und das Impact Measuring Framework
7. März 2019	Digitale Nachhaltigkeit und Open Data
14. März 2019	Entstehung und Anwendung des Öffentlichkeitsgesetz
21. März 2019	Geistiges Eigentum und die Open-Bewegung
28. März 2019	Open Data Journalism
4. April 2019	Open Finance und Participatory Budgeting
11. April 2019	Open Transport Data
18. April 2019	**Open Geodata**
25. April 2019	Semesterferien
2. Mai 2019	Aid Transparency und Open Aid
9. Mai 2019	Linked Data und Semantic Web
16. Mai 2019	Open Corporate Data
23. Mai 2019	keine Vorlesung, am Nachmittag Abschlusspräsentationen Open Data Apps
30. Mai 2019	Auffahrt

Informationen zur Prüfung

- **Gleiche Prüfung** für MA und BA
- 1. Prüfungstermin: **Mittwoch, 5. Juni 2019** 14:15h-15:15h im HG 205
- 2. Prüfungstermin: **Donnerstag, 12. September 2019** 08:15h-09:15h im HG 114
- Anmelden auf **KSL** bis spätestens eine Woche vor der Prüfung
- **Aufgabenbeispiele aus der Vorlesung:**
  - *Nennen Sie fünf Voraussetzungen für digitale Nachhaltigkeit und erläutern Sie.*
  - *Welches sind die drei typischen Schritte bei einer Data Journalism Story? Beschreiben Sie sie und nennen Sie je ein technisches Tool, das dabei hilft.*
  - *Was sind die Kernaussagen der aktuellen OGD Strategie Schweiz des Bundesrats?*
- **Aufgabenbeispiele aus den Gastreferaten:**
  - *Nennen Sie drei Möglichkeiten, wie Behörden Anfragen über das Öffentlichkeitsgesetz «abwimmeln» können.*
  - *Was gibt die Creative Commons Attribution Share Alike Lizenz genau vor?*
  - *Für was dient die Schweizer Open Data Plattform des öffentlichen Verkehrs?*

Agenda

1. **Einführung Geodaten**
2. XML-basierte Datenformate für Geodaten
3. JSON-basierte Datenformate für Geodaten
4. OpenStreetMap und das OSM-Format

Geodaten

- Daten, die einen **Raumbezug** aufweisen und über den **Lagebezug** zur Erdoberfläche hergestellt werden
- Beschreiben Objekte, die durch ihre direkte Position anhand von Koordinaten oder durch Beziehung zu anderen **referenzierbar** sind
- **Grundlage** für Abfragen, Analysen und Auswertungen spezifischer Fragestellungen *(60%-80% der Entscheidungen haben Raumbezug)*
- Inhaltliche Unterteilung von Geodaten:
  - **a)** **naturbeschreibende Geodaten:** natürliche Zustände und Prozesse, z.B. hydrologische, hydrogeologische, bodenkundliche, atmosphärische, geologische und Bodendaten auf der Erdoberfläche
  - **b)** **artefaktbeschreibenden Geodate:** Resultate menschlichen Planens und Wirkens auf der Erdoberfläche, z.B. demographische, verkehrsgeographische, Wirtschafts- und Markt-, Raumordnungs- und Bauleitplanungs- sowie Landnutzungsdaten

Quelle: Damian Paderta «Open Data - Raumbezogene Daten» (2012) https://www.ssoar.info/ssoar/handle/document/36474

Qualität von Geodaten

Qualitätsparameter für Geodaten (DIN EN ISO 19113)

1. **Vollständigkeit (Completeness):** Präsenz oder Fehlen von Objekten, einzelner Attribute oder Beziehungen
2. **Logische Konsistenz:** Widerspruchsfreiheit der konzeptionellen, logischen und physikalischen Datenstruktur
3. **Positionsgenauigkeit (Positional Accuracy):** durchschnittlichen Positionsgenauigkeit der einzelnen Objekte
4. **Zeitliche Genauigkeit (Temporal Accuracy):** Korrektheit der Zeitangaben und zeitlichen Beziehungen
5. **Thematische Genauigkeit (Thematic Accuracy):** Korrektheit der Attribute

Quelle: http://de.wikipedia.org/wiki/ISO_19113

Geoinformationsgesetz GeoIG

- Seit 1. Juli **2008** in Kraft
- Rechtsgrundlage für alle Aktivitäten im Bereich der Information, des Austauschs und der Nutzung von **Geobasisdaten** des Bundesrechts
- "Dieses Gesetz bezweckt, dass Geodaten über das Gebiet der Schweizerischen Eidgenossenschaft den Behörden von **Bund, Kantonen und Gemeinden** sowie der **Wirtschaft, der Gesellschaft und der Wissenschaft** für eine **breite Nutzung,** nachhaltig, aktuell, rasch, einfach, in der erforderlichen Qualität und zu **angemessenen Kosten** zur Verfügung stehen."
- Verordnung: Geoinformationsverordnung, **GeoIV**

Bundesgesetz über Geoinformation (Geoinformationsgesetz, GeoIG) 510.62

vom 5. Oktober 2007 (Stand am 1. Oktober 2009)

Die Bundesversammlung der Schweizerischen Eidgenossenschaft,
gestützt auf die Artikel 60 Absatz 1, 63, 64, 75a und 122 Absatz 1 der Bundesverfassung[1],
nach Einsicht in die Botschaft des Bundesrates vom 6. September 2006[2],
beschliesst:

1. Kapitel: Allgemeine Bestimmungen

Art. 1 Zweck

Dieses Gesetz bezweckt, dass Geodaten über das Gebiet der Schweizerischen Eidgenossenschaft den Behörden von Bund, Kantonen und Gemeinden sowie der Wirtschaft, der Gesellschaft und der Wissenschaft für eine breite Nutzung, nachhaltig, aktuell, rasch, einfach, in der erforderlichen Qualität und zu angemessenen Kosten zur Verfügung stehen.

Art. 2 Geltungsbereich

[1] Dieses Gesetz gilt für die Geobasisdaten des Bundesrechts.

[2] Es gilt für andere Geodaten des Bundes, soweit das übrige Bundesrecht nichts anderes vorschreibt.

[3] Die Vorschriften für Geodaten gelten sinngemäss auch für geologische Daten des Bundes.

[4] Das dritte, vierte und fünfte Kapitel gehen abweichenden Vorschriften in anderen Bundesgesetzen vor.

Art. 3 Begriffe

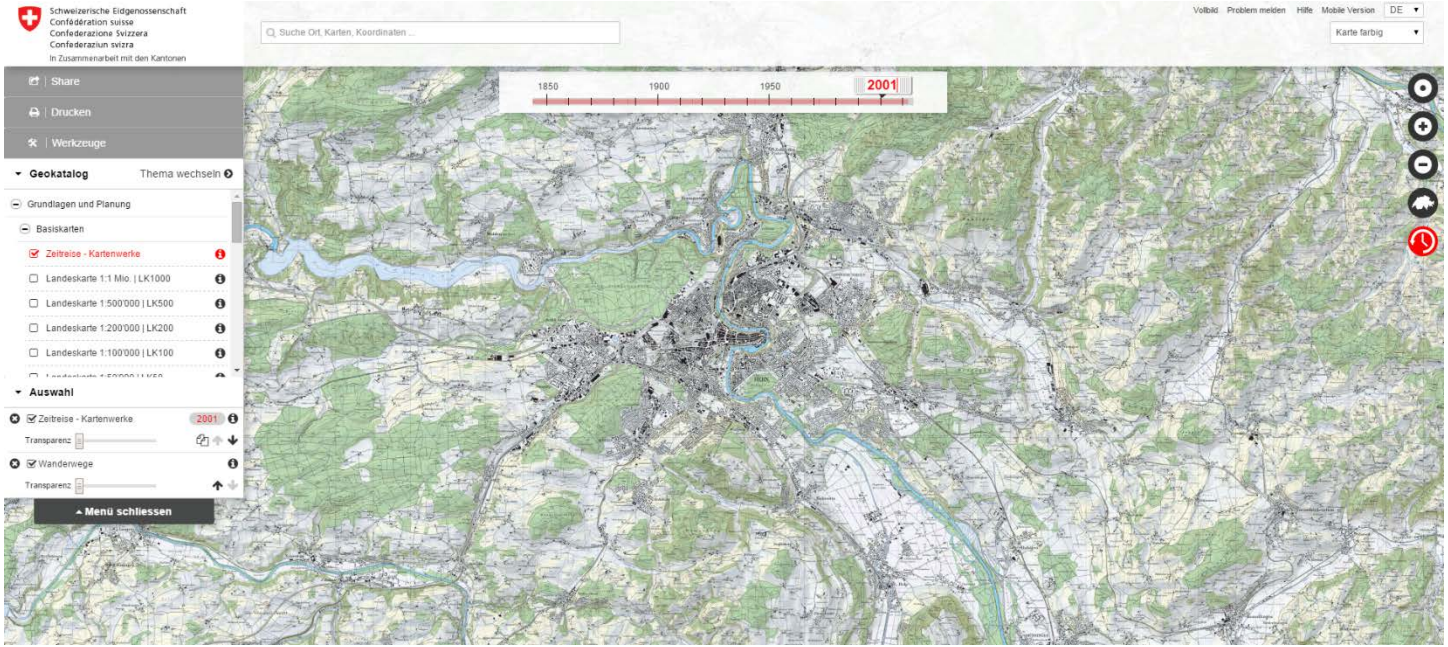
[1] In diesem Gesetz bedeuten:

a. *Geodaten:* raumbezogene Daten, die mit einem bestimmten Zeitbezug die Ausdehnung und Eigenschaften bestimmter Räume und Objekte beschreiben, insbesondere deren Lage, Beschaffenheit, Nutzung und Rechtsverhältnisse;

AS **2008** 2793
1 SR **101**
2 BBl **2006** 7817

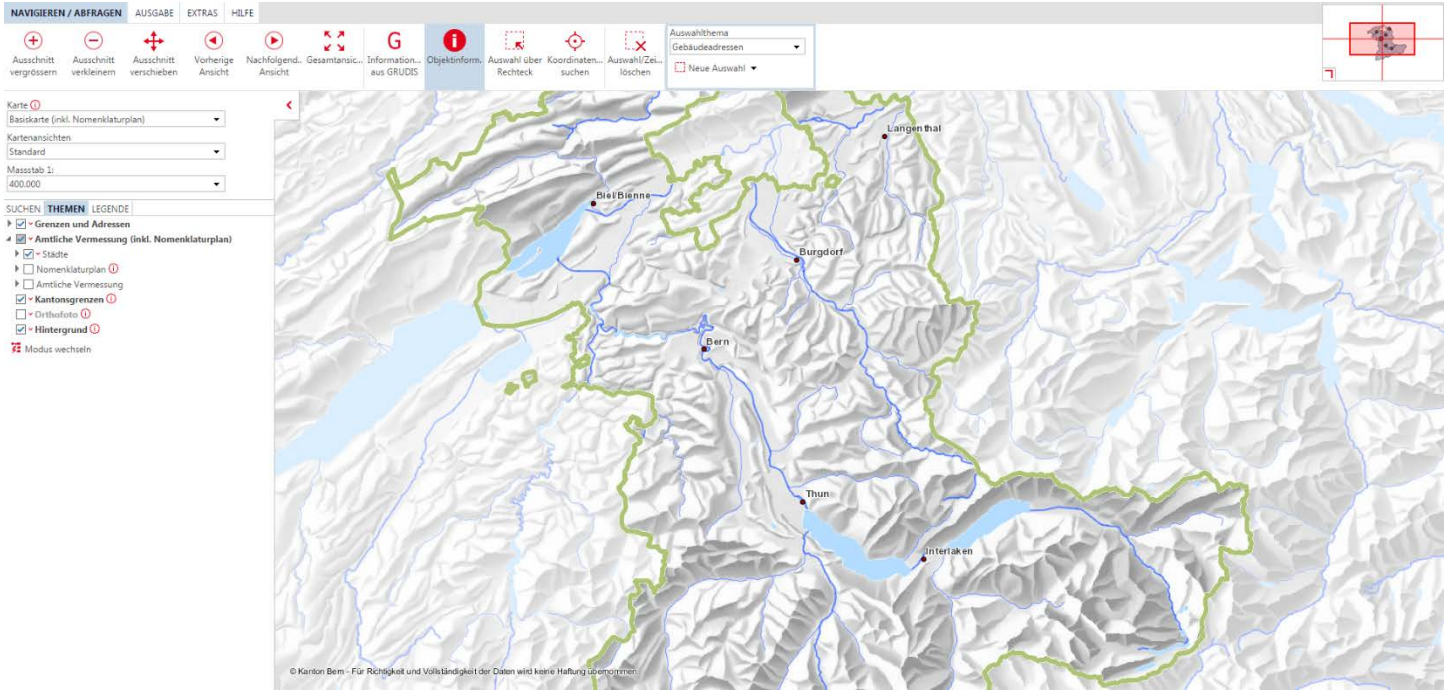
1

Geoportal Bund



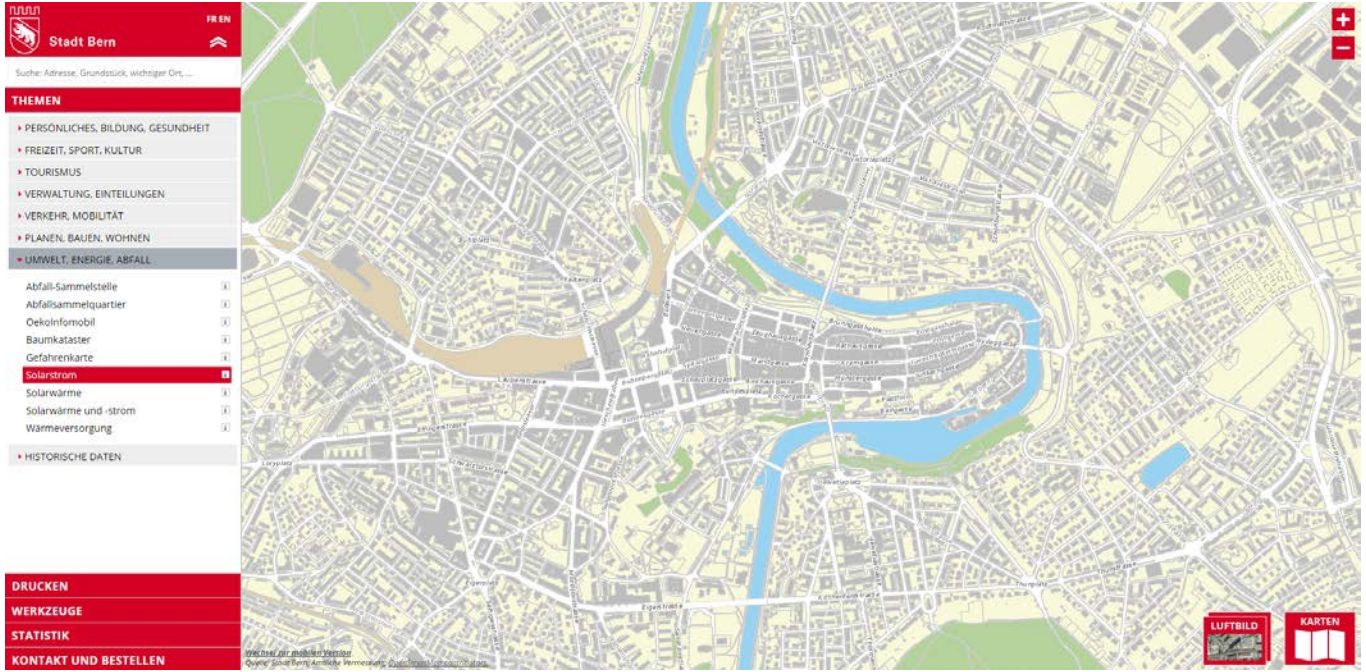
Quelle: http://map.geo.admin.ch

Geoportal Kanton Bern



Quelle: http://www.map.apps.be.ch/pub/synserver?project=a42pub_basis&userprofile=geo&language=de

Geoportal Stadt Bern



Quelle: http://map.bern.ch/stadtplan

Agenda

1. Einführung Geodaten
2. **XML-basierte Datenformate für Geodaten**
3. JSON-basierte Datenformate für Geodaten
4. OpenStreetMap und das OSM-Format

Dateiformate für Geodaten

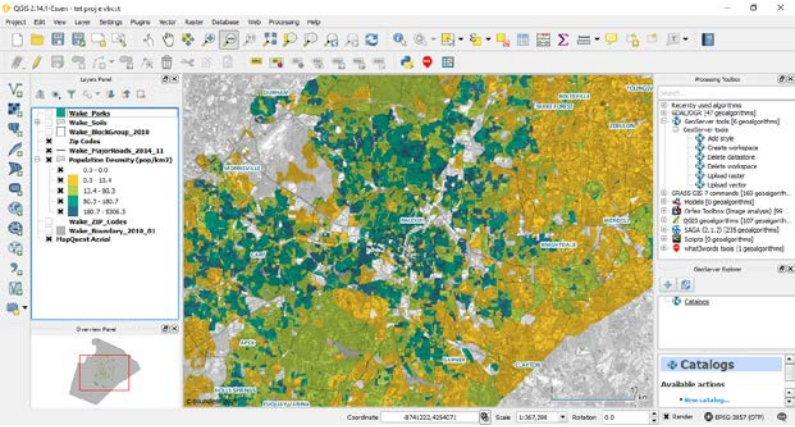
Maschinenlesbarkeit, Verfügbarkeit der Spezifikationen und Offenheit:

Geodaten/CAD	maschinen-lesbar	Spezifikationen verfügbar	offenes Format
Geography Markup Language (.gml)	+	+	+
GPS Exchange Format (.gpx)	+	+	+
Keyhole Markup Language (.kml)	+	+	+
Drawing Interchange File Format (.dxf)	+	+	-
Autodesk Drawing Format (.dwg)	+	-	-
ESRI Shapefile Format (.shp, .shx, .dbf)	+	+	-
Enhanced Compression Wavelet (.ecw)	+	-	-
MrSID Format (.sid)	+	-	-
Normbas. Exchangeinterface (NAS)	+	+	-
Unified Database Interface (EDBS)	+	+	-
BGRUND (Geospital agency BaWü)	+	+	-
WLDGE-Format (.wld)	+	+	-
Scalable Vector Graphics (.svg)	+	+	+

Quelle: Damian Paderta «Open Data - Raumbezogene Daten» (2012) https://www.ssoar.info/ssoar/handle/document/36474

QGIS: Open Source GIS Applikation

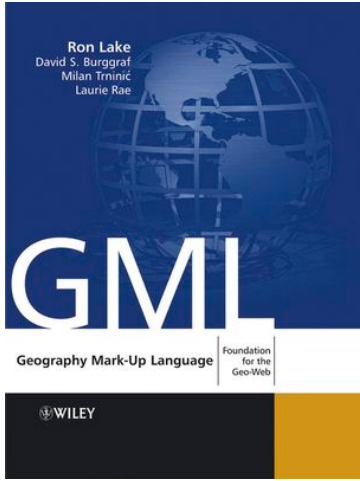
- **QGIS** (Quantum-GIS) gegründet 2002
- Open Source Applikation für **Geoinformationssysteme (GIS)**
- **Importieren,** Analysieren, Bearbeiten und **Exportieren** von Geodaten
- Verfügbar für **Windows, MacOS X, Linux und Android**
- Weltweit im Einsatz, auch bei **Schweizer Behörden**
- Kennt alle relevanten **Geodaten-Formate**



Quellen: https://www.qgis.org https://www.qgis.ch

Geography Markup Language GML

- Daten-Standard für **räumliche Objekte** mit Attributen, Relationen und Geometrien
- Von **Open Geospatial Consortium** (OGC)
- Offizieller Standard: **ISO 19136:2007**
- Basiert auf **XML-Standard**
- Enthält **Elemente** wie:
  - Objekt (feature)
  - Geometrie (geometry)
  - Koordinatenreferenzsystem (coordinate reference system)
  - Zeit (time)
  - dynamisches Objekt (dynamic object)



Quelle: http://www.opengeospatial.org/standards/gml

Geography Markup Language GML

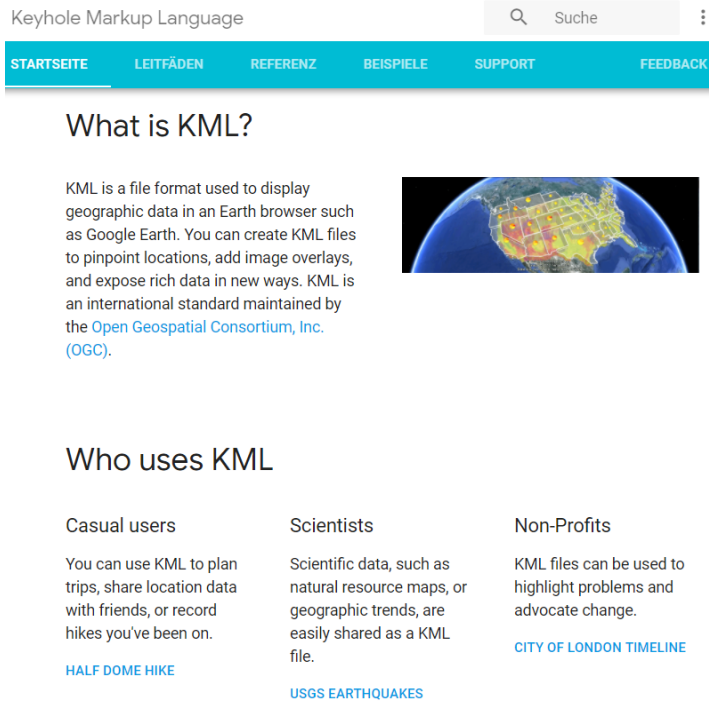
Beispiel-Daten in GML:

```
<gml:Polygon>
    <gml:outerBoundaryIs>
            <gml:LinearRing>
                    <gml:coordinates>0,0 100,0 100,100 0,100 0,0</gml:coordinates>
            </gml:LinearRing>
   </gml:outerBoundaryIs>
</gml:Polygon>
<gml:Point>
   <gml:coordinates>100,200</gml:coordinates>
</gml:Point>
<gml:LineString>
   <gml:coordinates>100,200 150,300</gml:coordinates>
</gml:LineString>
```

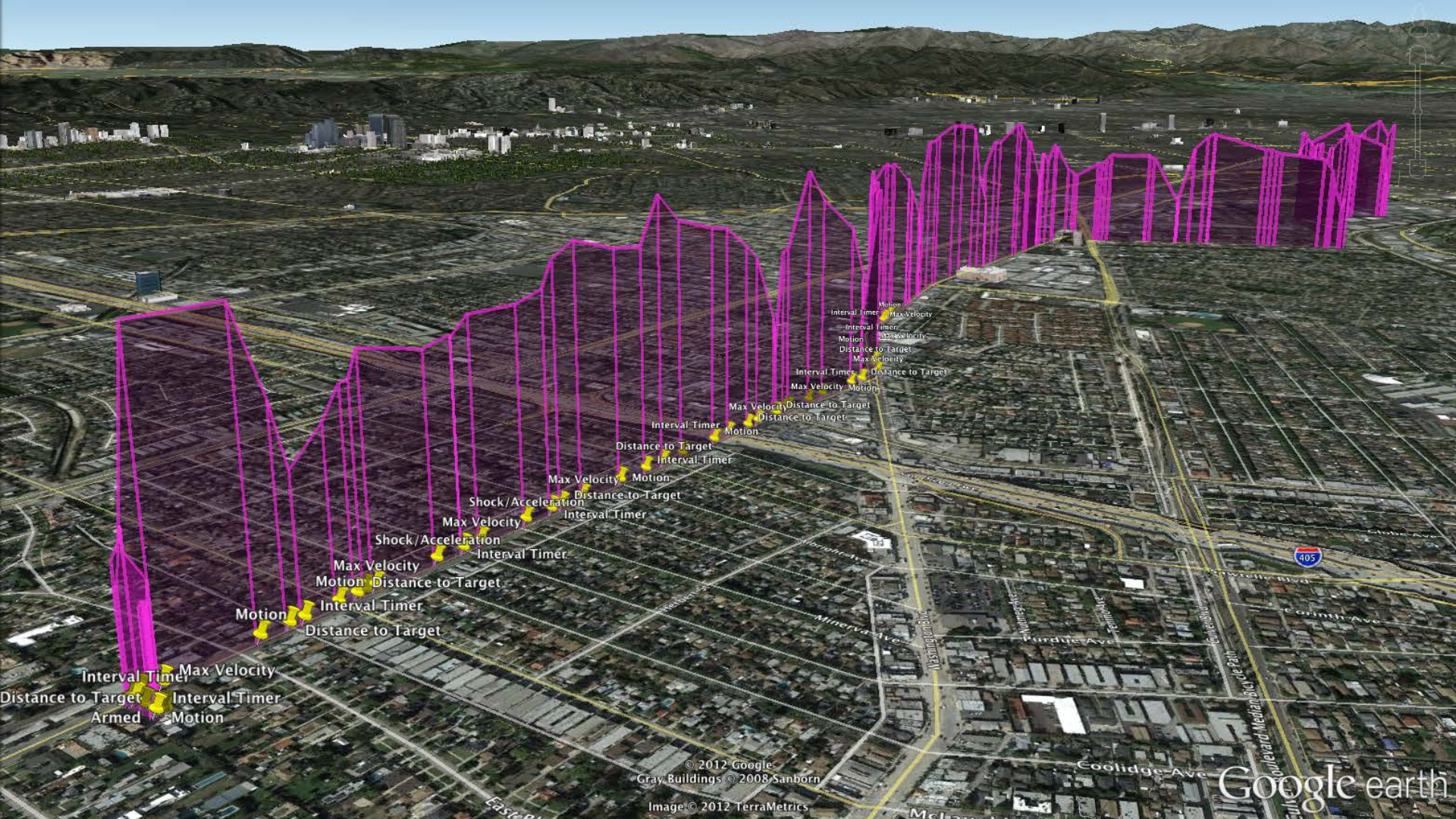
Quelle: http://en.wikipedia.org/wiki/Geography_Markup_Language

Keyhole Markup Language KML

- **Auszeichnungssprache** zur Beschreibung von Geodaten
- Bekannt durch die Anwendung in **Google Earth**
- **Google** entwickelte KML weiter bis zur Version 2.2
- Seit April 2008 Standard von **Open Geospatial Consortium**
- Format **KMZ** ist datenkomprimierte KML-Datei im ZIP-Format



Quelle: http://de.wikipedia.org/wiki/Keyhole_Markup_Language https://developers.google.com/kml/


Interval Timer
Max Velocity
Distance to Target
Interval Timer
Armed
Motion
Motion
Distance to Target
Interval Timer
Motion
Max Velocity
Shock/Acceleration
Interval Timer
Max Velocity
Shock/Acceleration
Interval Timer
Max Velocity
Distance to Target
Interval Timer
Max Velocity
Motion
Distance to Target
Interval Timer
Motion
Max Velocity
Distance to Target
Interval Timer
Max Velocity
Motion
Distance to Target
Max Velocity
Distance to Target
Interval Timer
Motion
Max Velocity
Interval Timer
Motion
Max Velocity
Distance to Target
Max Velocity
Interval Timer
Distance to Target
Max Velocity
Motion
Max Velocity
Distance to Target
Distance to Target
Interval Timer
Motion
Max Velocity
Distance to Target
Interval Timer
Max Velocity
Shock/Acceleration
Interval Timer
Max Velocity
Motion
Distance to Target
Interval Timer
Motion
Distance to Target
Interval Timer
Max Velocity
Distance to Target
Interval Timer
Max Velocity
Motion
Distance to Target
Max Velocity
Distance to Target
Interval Timer
Motion
Max Velocity
Interval Timer
Motion
Max Velocity
Distance to Target
Max Velocity
Interval Timer
Distance to Target
Max Velocity
Motion
Max Velocity
Distance to Target

Keyhole Markup Language KML

Beispiel-Daten in KML:

```xml
<?xml version="1.0" encoding="UTF-8"?>
<kml xmlns="http://www.opengis.net/kml/2.2">
<Document>
  <Placemark>
    <name>Zürich</name>
    <description>Zürich</description>
    <Point>
      <coordinates>8.55,47.3666667,0</coordinates>
    </Point>
  </Placemark>
</Document>
</kml>
```

Quelle: http://de.wikipedia.org/wiki/Keyhole_Markup_Language

GML and KML

- **KML complements GML**
- **GML** is a language to encode **geographic content for any application**, by describing a spectrum of application objects and their properties (e.g. bridges, roads, buoys, vehicles etc.)
- **KML** is a language for the **visualization of geographic information tailored for Google Earth.**
- KML can be used to **render GML** content, and GML content can be **“styled” using KML** for the purposes of presentation.

Quelle: http://en.wikipedia.org/wiki/Geography_Markup_Language#GML_and_KML

GPS Exchange Format GPX

- GPX (the GPS Exchange Format) is a light-weight XML data format for the **interchange of GPS data** (waypoints, routes, and tracks) between applications and Web services on the Internet.
- GPX has been the de-facto XML standard for lightweight interchange of GPS data since the initial **GPX 1.0 release in 2002.**
- GPX is being used by dozens of software programs and Web services for **GPS data exchange, mapping, and geocaching.**
- GPX is **simple enough** to learn in an hour, yet **powerful enough** to describe complex geographic objects.
- GPX is an **open standard.** Anyone may use it, and there are no fees or licensing involved. → **EXIF metadata**

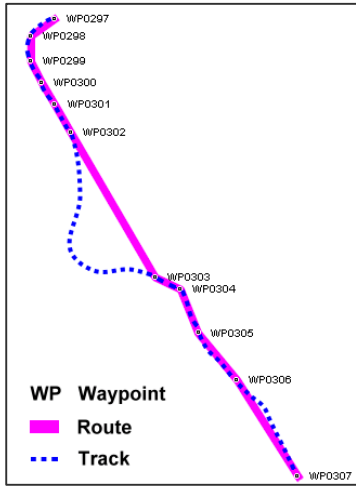
Quelle: http://www.topografix.com/gpx.asp

GPS Exchange Format GPX

UNIVERSITÄT BERN

Beispiel-Daten in GPX:

```
<?xml version="1.0" encoding="UTF-8" standalone="no" ?>
<gpx xmlns="http://www.topografix.com/GPX/1/1" version="1.1" creator="Wikipedia"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.topografix.com/GPX/1/1 http://www.topografix.com/GPX/1/1/gpx.xsd">
 <!-- Kommentare sehen so aus -->
 <metadata>
  <name>Dateiname</name>
  <desc>Validiertes GPX-Beispiel ohne Sonderzeichen</desc>
  <author>
   <name>Autorenname</name>
  </author>
 </metadata>
 <wpt lat="46.9466" lon="7.44412">
  <time>2011-12-31T23:59:59Z</time>
  <name>Bundeshaus (Bern)</name>
  <sym>City</sym>
 </wpt>
```



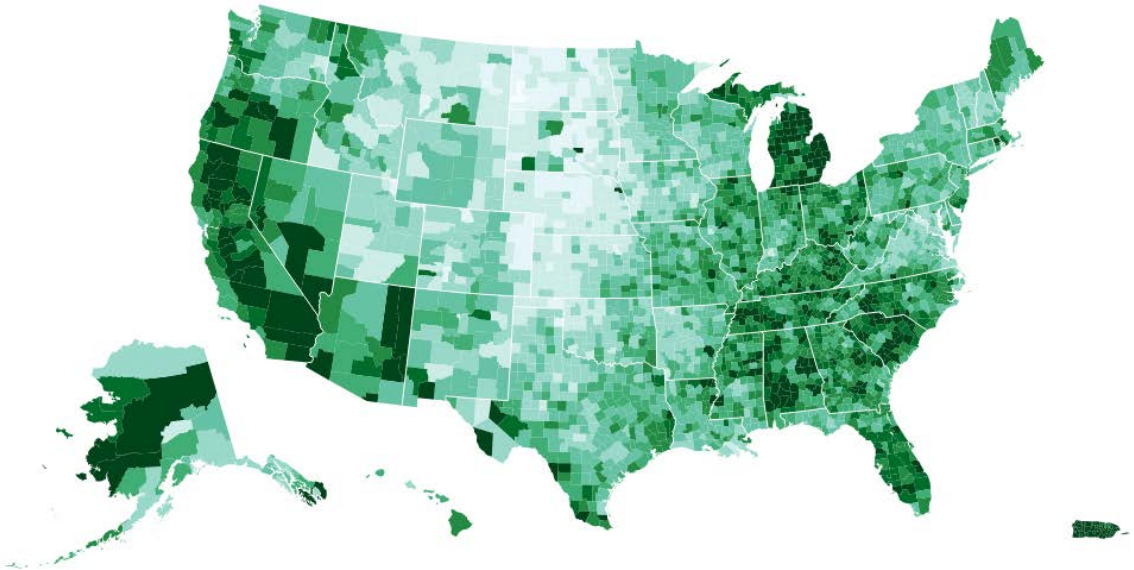
Quelle: http://de.wikipedia.org/wiki/GPS_Exchange_Format

Agenda

1. Einführung Geodaten
2. XML-basierte Datenformate für Geodaten
3. **JSON-basierte Datenformate für Geodaten**
4. OpenStreetMap und das OSM-Format

Geodatenformate für D3.js

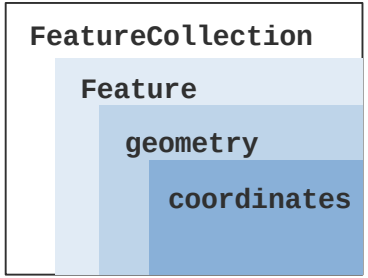
Choropleth-Visualisierung mit GeoJSON bzw. TopoJSON



GeoJSON

GeoJSON: JSON-based standard for encoding geodata for web applications (very specific use of JSON, **one giant JavaScript object)**

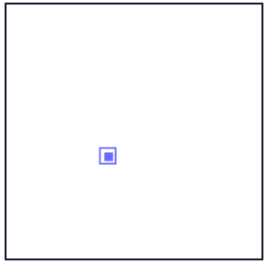
```
{ "type": "FeatureCollection",
  "features": [
     {
       "type": "Feature",
       "id": "01",
       "properties": { "name": "Alabama" },
       "geometry": {
         "type": "Polygon",
         "coordinates": [[[-87.359296,35.00118],
           [-85.606675,34.984749],[-85.431413,34.124869],
           [-85.184951,32.859696],[-85.069935,32.580372],
           [-84.960397,32.421541],[-85.004212,32.322956],
           [-84.889196,32.262709],[-85.058981,32.13674] …
          ]]
       } }
```



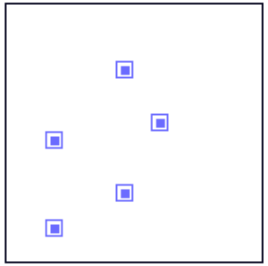
Quelle: https://raw.githubusercontent.com/alignedleft/d3-book/master/chapter_12/us-states.json

GeoJSON geometry types

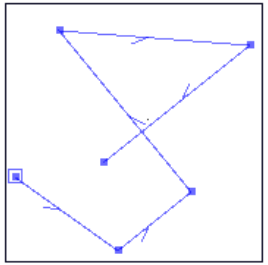
Point



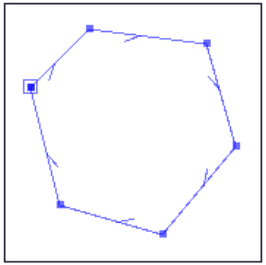
MultiPoint



LineString

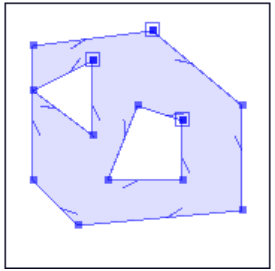


LinearRing (not in D3.js)

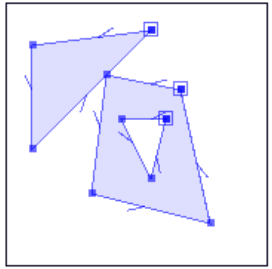


MultiLineString

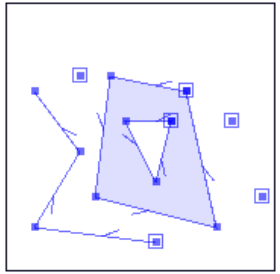
Polygon



MultiPolygon



GeometryCollection



Source: http://www.vividsolutions.com/jts/discussion.htm

GeoJSON feature collection objects

- A GeoJSON object with the type **`FeatureCollection`** is a **feature collection object.**
- An object of type **`FeatureCollection`** must have a member with the name **`features`**. The value of **`features`** is an **array.** Each element in the array is a **feature object**

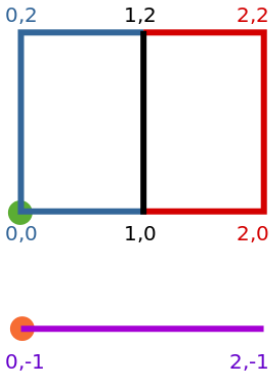

```
{"type":"FeatureCollection","features":[
{"type":"Feature","id":"01","properties":
{"name":"Alabama"},"geometry":
{"type":"Polygon","coordinates":
[[[-87.359296,35.00118],[-85.606675,34.984749],
[-85.431413,34.124869],[-85.184951,32.859696],
[-85.069935,32.580372],[-84.960397,32.421541],
[-85.004212,32.322956],[-84.889196,32.262709],
[-85.058981,32.13674],[-85.053504,32.01077],
[-85.141136,31.840985],[-85.042551,31.539753],
[-85.113751,31.27686],[-85.004212,31.003013],
[-85.497137,30.997536],[-87.600282,30.997536],
[-87.633143,30.86609],[-87.408589,30.674397],
[-87.446927,30.510088],[-87.37025,30.427934],
[-87.518128,30.280057],[-87.655051,30.247195],
[-87.90699,30.411504],[-87.934375,30.657966],
```

Source: http://geojson.org/geson-spec.html http://geojsonlint.com

TopoJSON

- TopoJSON is an **extension of GeoJSON** that encodes topology.
- Rather than representing geometries discretely, geometries in TopoJSON files are stitched together from shared line segments called arcs.
- **Arcs** are sequences of points, while **line strings** and polygons are defined as sequences of arcs.

```
Origine_Point
    "coordinates": [0,0]

Under_Point
    "coordinates": [0,-1]

Under_LineString
    "arcs": [3]

Left_Polygon
    "arcs": [[0,1]]

Right_Polygon
    "arcs": [[2,-1]]

"arcs":[
    [[1,2],[0,-2]],
    [[1,0],[-1,0],[0,2][1,0]],
    [[1,2],[1,0],[0,-2],[-1,0]],
    [[0,-1],[2,0]]
]
```



- Each arc is **defined only once,** but can be referenced several times by different shapes, thus **reducing redundancy and decreasing the file size.**

Source: https://en.wikipedia.org/wiki/GeoJSON#TopoJSON

GeoJSON vs. TopoJSON

TopoJSON ist rund 3x kleiner als GeoJSON:


```
{"type":"FeatureCollection","features":[{"type":"Feature","id":"01","properties":{"name":"Alabama"},"geo-
metry":{"type":"Polygon","coordinates":[[[-87.359296,35.00118],[-85.606675,34.984749],[-85.431413,34.124
869],[-85.184951,32.859696],[-85.069935,32.580372],[-84.960397,32.421541],[-85.004212,32.322956],[-84.88
9196,32.262709],[-85.058981,32.13674],[-85.053504,32.01077],[-85.141136,31.840985],[-85.042551,31.539753
],[-85.113751,31.27686],[-85.004212,31.003013],[-85.497137,30.997536],[-87.600282,30.997536],[-87.633143
,30.86609],[-87.408589,30.674397],[-87.446927,30.510088],[-87.37025,30.427934],[-87.518128,30.280057],[-
87.655051,30.247195],[-87.90699,30.411504],[-87.934375,30.657966],[-88.011052,30.685351],[-88.10416,30.4
99135],[-88.137022,30.318396],[-88.394438,30.367688],[-88.471115,31.895754],[-88.241084,33.796253],[-88.
098683,34.891641],[-88.202745,34.995703],[-87.359296,35.00118]]]}},{"type":"Feature","id":"02","properti
es":{"name":"Alaska"},"geometry":{"type":"MultiPolygon","coordinates":[[[[-131.602021,55.117982],[-131.5
69159,55.28229],[-131.355558,55.183705],[-131.38842,55.01392],[-131.645836,55.035827],[-131.602021,55.11
7982]]],[[[-131.832052,55.42469],[-131.645836,55.304197],[-131.749898,55.128935],[-131.832052,55.189182]
,[-131.832052,55.42469]]],[[[-132.976733,56.437924],[-132.735747,56.459832],[-132.631685,56.421493],[-13
2.664547,56.273616],[-132.878148,56.240754],[-133.069841,56.333862],[-132.976733,56.437924]]],[[[-133.59
5627,56.350293],[-133.162949,56.317431],[-133.05341,56.125739],[-132.620732,55.912138],[-132.472854,55.7
80691],[-132.4619,55.671152],[-132.357838,55.649245],[-132.341408,55.506844],[-132.166146,55.364444],[-1
32.144238,55.238474],[-132.029222,55.276813],[-131.97993,55.178228],[-131.958022,54.789365],[-132.029222
,54.701734],[-132.308546,54.718165],[-132.385223,54.915335],[-132.483808,54.898904],[-132.686455,55.0467
81],[-132.746701,54.997489],[-132.916486,55.046781],[-132.889102,54.898904],[-132.73027,54.937242],[-132
.626209,54.882473],[-132.675501,54.679826],[-132.867194,54.701734],[-133.157472,54.95915],[-133.239626,5
5.090597],[-133.223195,55.22752],[-133.453227,55.216566],[-133.453227,55.320628],[-133.277964,55.331582]
,[-133.102702,55.42469],[-133.17938,55.588998],[-133.387503,55.62186],[-133.420365,55.884753],[-133.4970
42,56.0162],[-133.639442,55.923092],[-133.694212,56.070969],[-133.546335,56.142169],[-133.666827,56.3119
55],[-133.595627,56.350293]]],[[[-133.738027,55.556137],[-133.546335,55.490413],[-133.414888,55.572568],
[-133.283441,55.534229],[-133.420365,55.386352],[-133.633966,55.430167],[-133.738027,55.556137]]],[[[-13
3.907813,56.930849],[-134.050213,57.029434],[-133.885905,57.095157],[-133.343688,57.002049],[-133.102702
,57.007526],[-132.932917,56.82131],[-132.620732,56.667956],[-132.653593,56.55294],[-132.817901,56.492694
],[-133.042456,56.520078],[-133.201287,56.448878],[-133.420365,56.492694],[-133.66135,56.448878],[-133.7
10643,56.684386],[-133.688735,56.837741],[-133.869474,56.843218],[-133.907813,56.930849]]],[[[-134.11593
6,56.48174],[-134.25286,56.558417],[-134.400737,56.722725],[-134.417168,56.848695],[-134.296675,56.90894
1],[-134.170706,56.848695],[-134.143321,56.952757],[-133.748981,56.772017],[-133.710643,56.596755],[-133
```


us-states.min.geojson: 88'285 bytes


```
{"type":"Topology","objects":{"collection":{"type":"GeometryCollection","geometries":[{"type":"Polygon",
"id":"01","arcs":[[0,1,2,3,4]]},{"type":"MultiPolygon","id":"02","arcs":[[[5]],[[6]],[[7]],[[8]],[[9]],[
[10]],[[11]],[[12]],[[13]],[[14]],[[15]],[[16]],[[17]],[[18]],[[19]],[[20]],[[21]],[[22]],[[23]],[[24]],
[[25]],[[26]],[[27]],[[28]],[[29]],[[30]],[[31]],[[32]],[[33]],[[34]],[[35]],[[36]],[[37]],[[38]],[[39]]
,[[40]],[[41]],[[42]],[[43]]]},{"type":"Polygon","id":"04","arcs":[[44,45,46,47,48]]},{"type":"Polygon",
"id":"05","arcs":[[49,50,51,52,53,54]]},{"type":"Polygon","id":"06","arcs":[[55,-47,56,57]]},{"type":"Po
lygon","id":"08","arcs":[[58,59,60,61,62,63]]},{"type":"Polygon","id":"09","arcs":[[64,65,66,67]]},{"typ
e":"Polygon","id":"10","arcs":[[68,69,70,71]]},{"type":"Polygon","id":"11","arcs":[[72,73]]},{"type":"Po
lygon","id":"12","arcs":[[74,75,-2]]},{"type":"Polygon","id":"13","arcs":[[76,77,-75,-1,78,79]]},{"type"
:"MultiPolygon","id":"15","arcs":[[[80]],[[81]],[[82]],[[83]],[[84]]]},{"type":"Polygon","id":"16","arcs
":[[85,86,87,88,89,90,91]]},{"type":"Polygon","id":"17","arcs":[[92,93,94,95,96,97]]},{"type":"Polygon",
"id":"18","arcs":[[98,99,-95,100,101]]},{"type":"Polygon","id":"19","arcs":[[102,-98,103,104,105,106]]},
{"type":"Polygon","id":"20","arcs":[[107,108,-60,109]]},{"type":"Polygon","id":"21","arcs":[[110,111,112
,113,-96,-100,114]]},{"type":"Polygon","id":"22","arcs":[[115,116,117,-52]]},{"type":"Polygon","id":"23"
,"arcs":[[118,119]]},{"type":"MultiPolygon","id":"24","arcs":[[[120]],[[121,-71,122,123,124,125,-74,126,
127]]]},{"type":"Polygon","id":"25","arcs":[[128,129,130,131,-68,132,133,134]]},{"type":"MultiPolygon","
id":"26","arcs":[[[135,-102,136]],[[137]],[[138,139]],[[140]]]},{"type":"Polygon","id":"27","arcs":[[141
,-107,142,143,144]]},{"type":"Polygon","id":"28","arcs":[[-4,145,-116,-51,146]]},{"type":"Polygon","id":
"29","arcs":[[-97,-114,147,-55,148,-108,149,-104]]},{"type":"Polygon","id":"30","arcs":[[150,151,152,-86
,153]]},{"type":"Polygon","id":"31","arcs":[[-105,-150,-110,-59,154,155]]},{"type":"Polygon","id":"32","
arcs":[[-89,156,-48,-56,157]]},{"type":"Polygon","id":"33","arcs":[[-119,158,-135,159,160]]},{"type":"Po
lygon","id":"34","arcs":[[161,-69,162,163]]},{"type":"Polygon","id":"35","arcs":[[164,165,166,-45,-62]]}
,{"type":"Polygon","id":"36","arcs":[[167,-133,-67,168,-164,169,170]]},{"type":"Polygon","id":"37","arcs
":[[171,172,-80,173,174]]},{"type":"Polygon","id":"38","arcs":[[-144,175,-151,176]]},{"type":"Polygon","
id":"39","arcs":[[177,178,-115,-99,-136,179]]},{"type":"Polygon","id":"40","arcs":[[-149,-54,180,-165,-6
1,-109]]},{"type":"Polygon","id":"41","arcs":[[-90,-158,-58,181,182]]},{"type":"Polygon","id":"42","arcs
":[[-163,-72,-122,183,-178,184,-170]]},{"type":"MultiPolygon","id":"44","arcs":[[[-130,185]],[[186,-65,-
132]]]},{"type":"Polygon","id":"45","arcs":[[187,-77,-173]]},{"type":"Polygon","id":"46","arcs":[[-176,-
143,-106,-156,188,-152]]},{"type":"Polygon","id":"47","arcs":[[189,-174,-79,-5,-147,-50,-148,-113]]},{"t
ype":"Polygon","id":"48","arcs":[[-53,-118,190,-166,-181]]},{"type":"Polygon","id":"49","arcs":[[191,-63
,-49,-157,-88]]},{"type":"Polygon","id":"50","arcs":[[-160,-134,-168,192]]},{"type":"MultiPolygon","id":
```


us-states.min.topojson: 27'748 bytes

Agenda

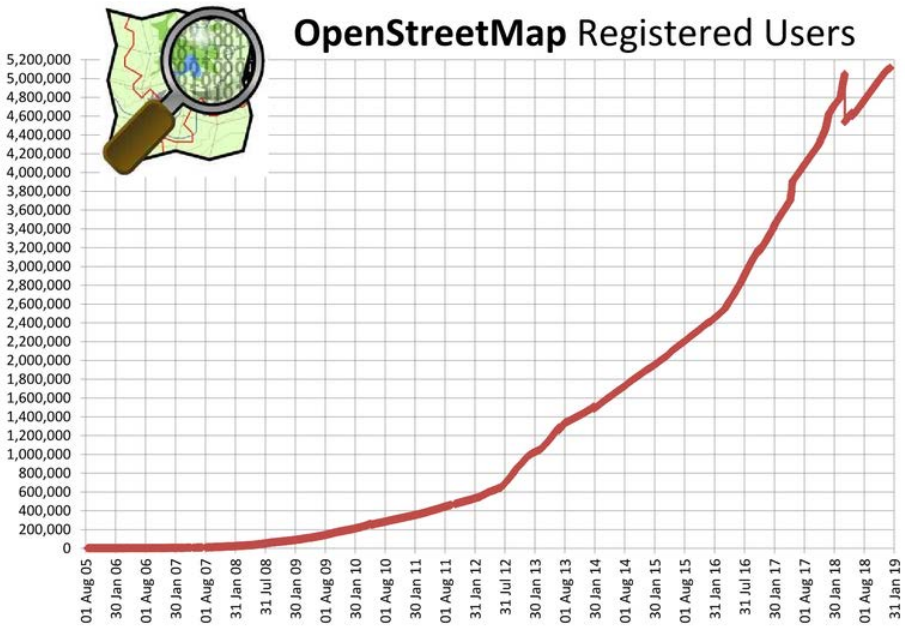
1. Einführung Geodaten
2. XML-basierte Datenformate für Geodaten
3. JSON-basierte Datenformate für Geodaten
4. **OpenStreetMap und das OSM-Format**

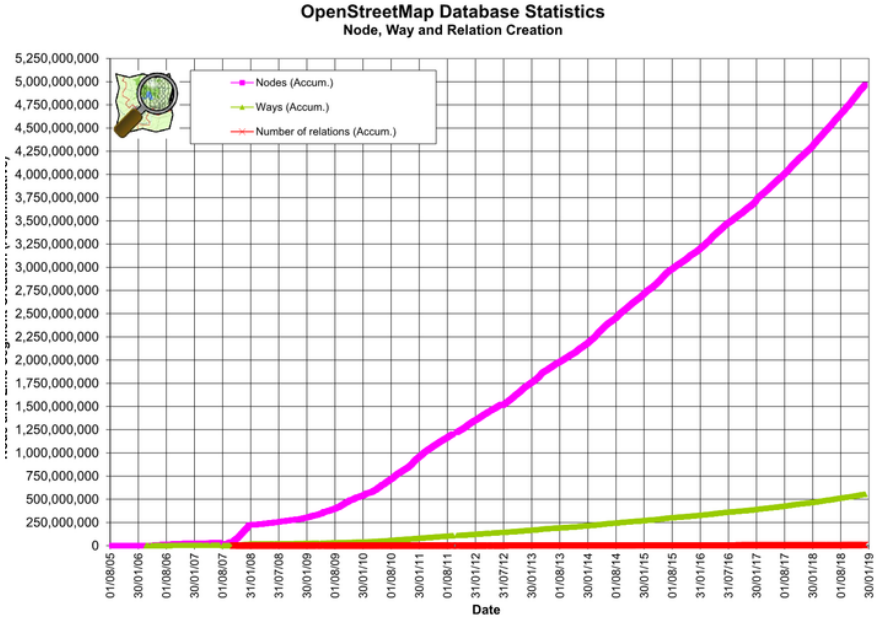
OpenStreetMap

- OpenStreetMap ist ein **Crowdsourcing-Projekt,** das frei nutzbare Geodaten sammelt (Open Data)
- Gegründet 2004 in UK durch **Steve Coast**
- Alle Daten unter der offenen **Open Data Commons Open Database Lizenz (ODbL)** verfügbar
- In über **50 Sprachen** übersetzt
- **OSM Statistiken vom 17.04.2019 / 26.04.2018 / 26.04.2017 / 11.05.2016:**
  - Number of users: 5’343’381 / 4’588’655 / 3’674’325 / 2’654’260
  - Number of uploaded GPS points: 7’252’014’384 / 6’141’164’745 / 5’652’844’408 / 5’190’844’897
  - Number of nodes: 5’146’034’710 / 4’469’117’947 / 3’855’262’773 / 3’356’387’699
  - Number of ways: 574’213’537 / 488’978’312 / 407’905’375 / 347’347’874
  - Number of relations: 6’675’686 / 5’775’898 / 4’942’334 / 4’203’813

Quelle: http://www.openstreetmap.org/stats/data_stats.html

Anzahl Mappers und Nodes auf OpenStreetMap





Quelle: http://wiki.openstreetmap.org/wiki/Stats

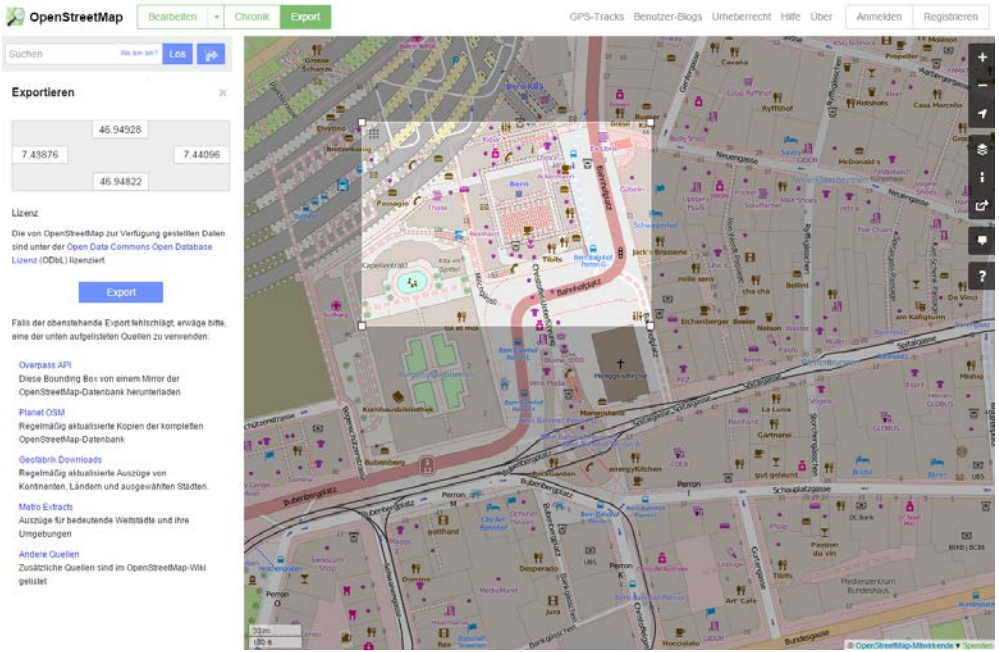
Export der Daten von OpenStreetMap

Einfacher Export sämtlicher Daten im **OSM** (OpenStreetMap) Format

OSM basiert auf **XML**

Format entwickelt von **JOSM** (Java OpenStreetMap Editor) Gründer

Diverse Konvertierer bspw. von OSM zu GML etc.



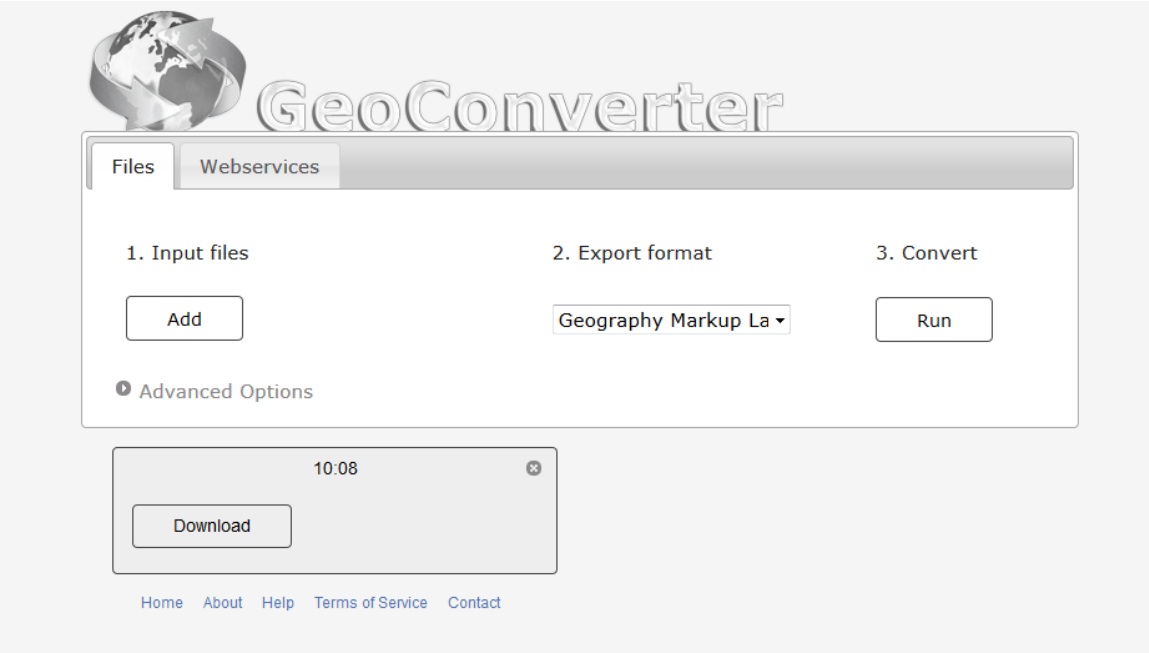
Quelle: https://wiki.openstreetmap.org/wiki/OSM_XML

OSM-Beispiel


```xml
<?xml version="1.0" encoding="UTF-8"?>
<osm version="0.6" generator="CGImap 0.3.3 (28211 thorn-02.openstreetmap.org)" copyright="OpenStreetMap and contributors" attribution="http://www.openstreetmap.org/copyright" license="http://opendatacommons.org/licenses/odbl/1-0/">
 <bounds minlat="46.9482200" minlon="7.4387600" maxlat="46.9492800" maxlon="7.4409600"/>
 <node id="3920930" visible="true" version="6" changeset="22994255" timestamp="2014-06-17T21:56:26Z" user="hugi" uid="65044" lat="46.9486042" lon="7.4407326">
  <tag k="highway" v="traffic_signals"/>
 </node>
 <node id="14384529" visible="true" version="13" changeset="24715793" timestamp="2014-08-13T05:25:20Z" user="hugi" uid="65044" lat="46.9492564" lon="7.4405236">
  <tag k="crossing" v="traffic_signals"/>
  <tag k="highway" v="crossing"/>
 </node>
 <node id="21550280" visible="true" version="2" changeset="5219841" timestamp="2010-07-14T17:31:57Z" user="samot" uid="46071" lat="46.9495277" lon="7.4388677"/>
 <node id="276034795" visible="true" version="5" changeset="16471638" timestamp="2013-06-08T17:47:15Z" user="hugi" uid="65044" lat="46.9487135" lon="7.4474653"/>
 <node id="276058643" visible="true" version="3" changeset="22991920" timestamp="2014-06-17T19:52:52Z" user="hugi" uid="65044" lat="46.9492927" lon="7.4403525"/>
 <node id="32606772" visible="true" version="10" changeset="22884266" timestamp="2014-06-12T07:59:27Z" user="hugi" uid="65044" lat="46.9491688" lon="7.4410422"/>
 <node id="443715524" visible="true" version="3" changeset="4319631" timestamp="2010-04-04T07:14:01Z" user="samot" uid="46071" lat="46.9467899" lon="7.4328486"/>
 <node id="443715525" visible="true" version="7" changeset="24330403" timestamp="2014-07-24T13:18:22Z" user="hugi" uid="65044" lat="46.9469296" lon="7.4341043"/>
 <node id="279803191" visible="true" version="3" changeset="1912312" timestamp="2009-07-23T08:38:56Z" user="Mike Lehmann" uid="127903" lat="46.9487499" lon="7.4405589">
  <tag k="amenity" v="taxi"/>
  <tag k="capacity" v="10"/>
  <tag k="name" v="Hauptbahnhof"/>
 </node>
 <node id="275976183" visible="true" version="5" changeset="22991920" timestamp="2014-06-17T19:52:51Z" user="hugi" uid="65044" lat="46.9491774" lon="7.4394638"/>
 <node id="443806334" visible="true" version="4" changeset="22991920" timestamp="2014-06-17T19:52:51Z" user="hugi" uid="65044" lat="46.9491310" lon="7.4390013"/>
 <node id="452996239" visible="true" version="4" changeset="27669528" timestamp="2014-12-24T12:46:46Z" user="hugi" uid="65044" lat="46.9481073" lon="7.4473106"/>
 <node id="29760182" visible="true" version="9" changeset="5214084" timestamp="2010-07-14T06:02:05Z" user="samot" uid="46071" lat="46.9483028" lon="7.4399619"/>
 <node id="275974884" visible="true" version="5" changeset="5214084" timestamp="2010-07-14T06:02:06Z" user="samot" uid="46071" lat="46.9485106" lon="7.4406933"/>
 <node id="275974885" visible="true" version="6" changeset="20369473" timestamp="2014-02-04T10:50:15Z" user="hugi" uid="65044" lat="46.9483749" lon="7.4401341">
  <tag k="crossing" v="traffic_signals"/>
  <tag k="highway" v="crossing"/>
 </node>
 <node id="286918440" visible="true" version="10" changeset="26781131" timestamp="2014-11-14T17:03:37Z" user="hugi" uid="65044" lat="46.9474098" lon="7.4397479"/>
 <node id="276038020" visible="true" version="5" changeset="26998921" timestamp="2014-11-24T14:56:05Z" user="hugi" uid="65044" lat="46.9479724" lon="7.4473098"/>
 <node id="443715523" visible="true" version="3" changeset="5096606" timestamp="2010-06-28T11:04:35Z" user="samot" uid="46071" lat="46.9466935" lon="7.4327868"/>
 <node id="516059609" visible="true" version="2" changeset="22863787" timestamp="2014-06-11T05:41:31Z" user="hugi" uid="65044" lat="46.9463417" lon="7.4478644"/>
 <node id="516059566" visible="true" version="2" changeset="22158798" timestamp="2014-05-06T05:37:51Z" user="hugi" uid="65044" lat="46.9462367" lon="7.4477977"/>
 <node id="516059661" visible="true" version="7" changeset="29270524" timestamp="2015-03-05T16:32:36Z" user="hugi" uid="65044" lat="46.9463708" lon="7.4483249"/>
 <node id="452996240" visible="true" version="4" changeset="16471638" timestamp="2013-06-08T17:47:15Z" user="hugi" uid="65044" lat="46.9489148" lon="7.4475233"/>
 <node id="565072324" visible="true" version="1" changeset="3127921" timestamp="2009-11-15T22:41:03Z" user="guggis" uid="40577" lat="46.9475659" lon="7.4390292"/>
 <node id="565072355" visible="true" version="4" changeset="23091053" timestamp="2014-06-22T23:02:42Z" user="hugi" uid="65044" lat="46.9483705" lon="7.4389767">
  <tag k="natural" v="tree"/>
```


Link: http://www.openstreetmap.org/export#map=18/46.94813/7.44073

OSM to GML



Link: http://geoconverter.hsr.ch/

Chronik

Link: http://www.openstreetmap.org/history

Präzision der Daten auf OpenStreetMap

Founder: OpenStreetMap Already As Good Or Better Than Google Maps

Greg Sterling on May 21, 2014 at 2:57 pm

Steve Coast founded OpenStreetMap (OSM) in the UK in 2004. It's 10 years old this year. He was inspired by the Wikipedia model and compelled by a lack of available map and location data in the UK at that time.

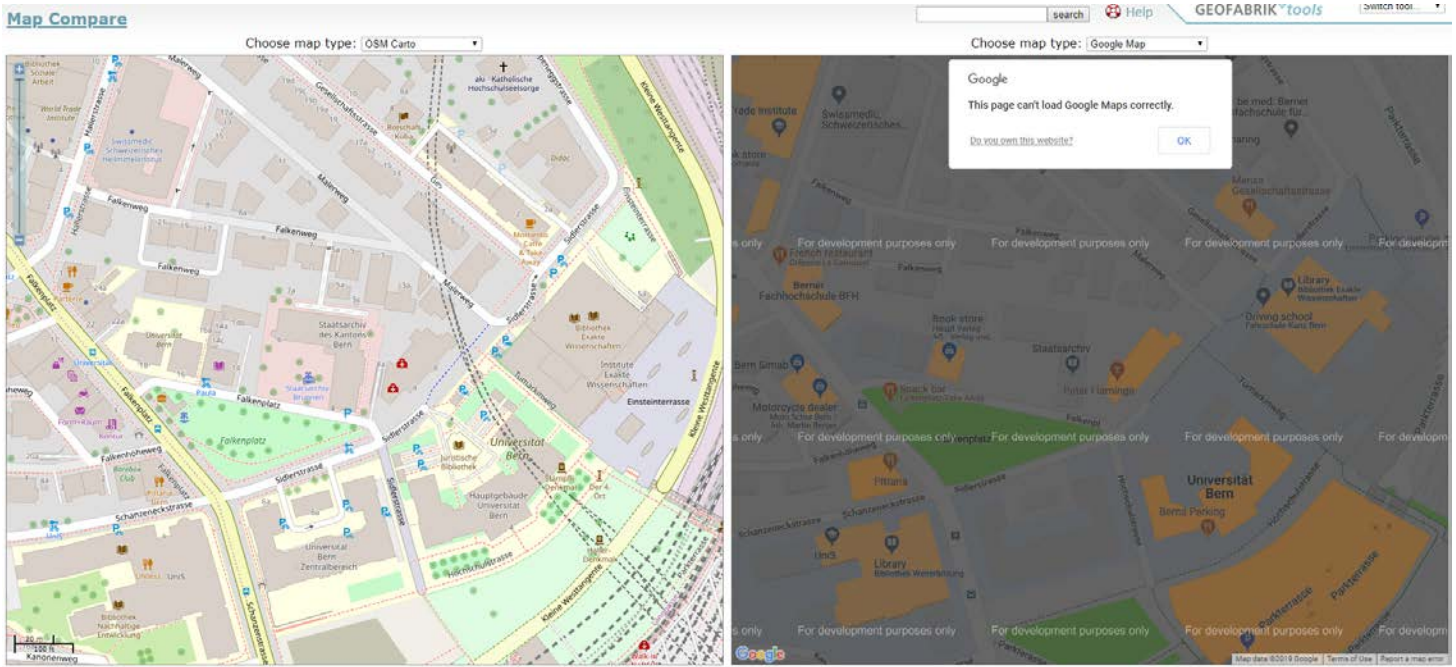
Coast now works for GPS navigation company Telenav, which owns location-based mobile ad network Thinknear. Not long ago Telenav also acquired Europe-based skobbler, which built a popular consumer-navigation app on top of OSM data. Telenav offers an equivalent, free consumer navigation/local search in Scout. The two apps are being merged later this year.

Earlier this week Telenav held a press day intended to discuss mapping and navigation and showcase the company's capabilities and products. The company also made several announcements, including that Scout navigation and routing in the US are now entirely built on top of OSM, indicating how much the latter has matured.

Several sessions and speakers spent time contrasting Telenav's mapping apps and capabilities with Google and Apple Maps.

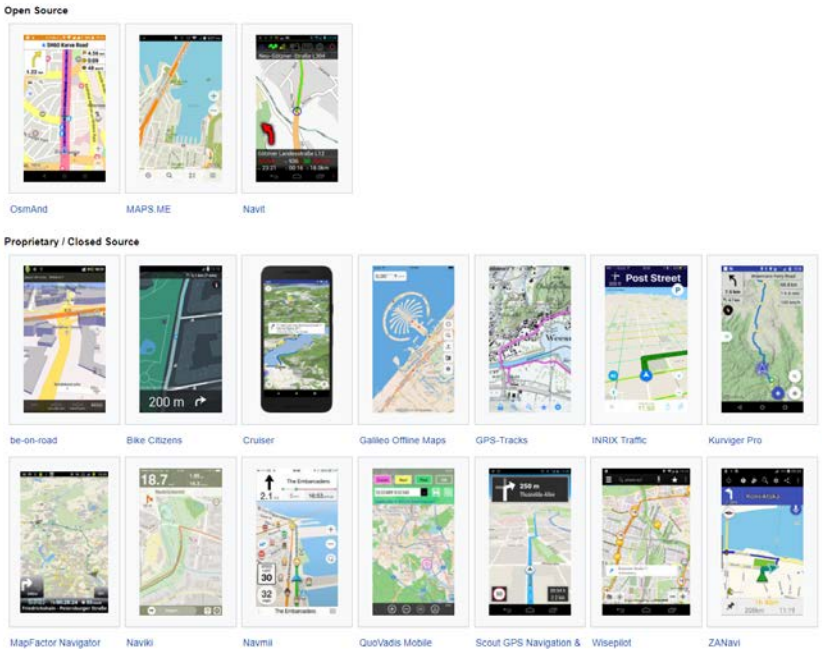
Quelle: http://searchengineland.com/founder-openstreetmap-good-better-google-maps-already-192089

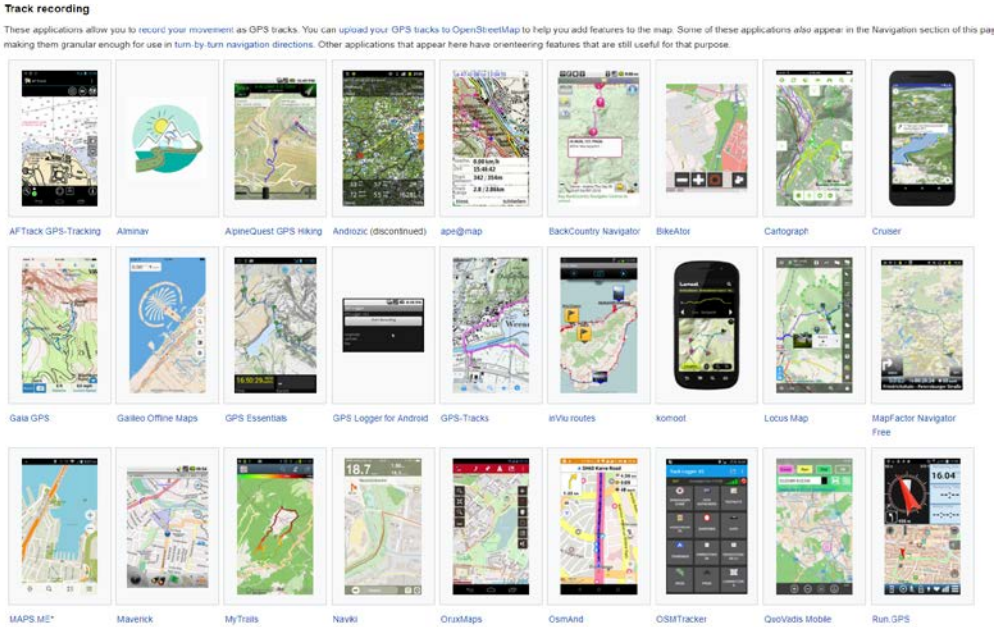
OpenStreetMap vs. Google Maps



Quelle: http://tools.geofabrik.de/mc/#18/46.9511/7.4372&num=2&mt0=mapnik&mt1=google-map

OpenStreetMap Applications





Quelle: https://wiki.openstreetmap.org/wiki/Android https://wiki.openstreetmap.org/wiki/Apple_iOS

OpenStreetMap Schweiz Community

Quelle: http://sosm.ch/de/