

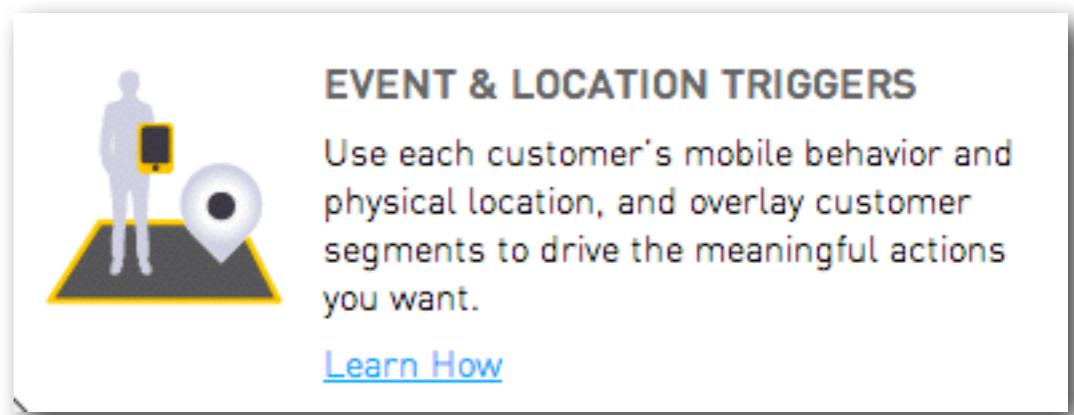
WebMapping: Base concepts

Christian Kaiser

Géovisualisation et traitement de l'information

Warning!

- .. The content of some slides is already outdated.
- .. Please beware of updates!
- .. Web mapping is a huge market.
- .. Location Based Services even more.
- .. And it's growing fast.
- .. Especially Location Based Advertisement...



Source: xtify.com (acquired by IBM on 3 October 2013)

The good news...

- .. Technology changes
- .. Principles don't change

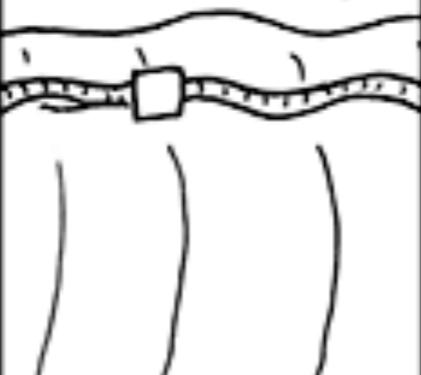
Why WebMapping?

WHEN AN EARTHQUAKE HITS,
PEOPLE FLOOD THE INTERNET
WITH POSTS ABOUT IT - SOME
WITHIN 20 OR 30 SECONDS.

ROBM163 HUGE
EARTHQUAKE HERE!



DAMAGING SEISMIC
WAVES TRAVEL AT
 $3\text{-}5 \text{ km/s}$. FIBER
SIGNALS MOVE AT
 $\sim 200,000 \text{ km/s}$.
(MINUS NETWORK LAG)



THIS MEANS WHEN THE SEISMIC
WAVES ARE ABOUT 100 KM OUT,
THEY BEGIN TO BE OVERTAKEN BY
THE WAVES OF POSTS ABOUT THEM.



PEOPLE OUTSIDE THIS RADIUS
MAY GET WORD OF THE QUAKE
VIA TWITTER, IRC, OR SMS
BEFORE THE SHAKING HITS.

WHOA!
EARTHQUAKE!



SADLY, A TWITTERER'S
FIRST INSTINCT IS NOT
TO FIND SHELTER.

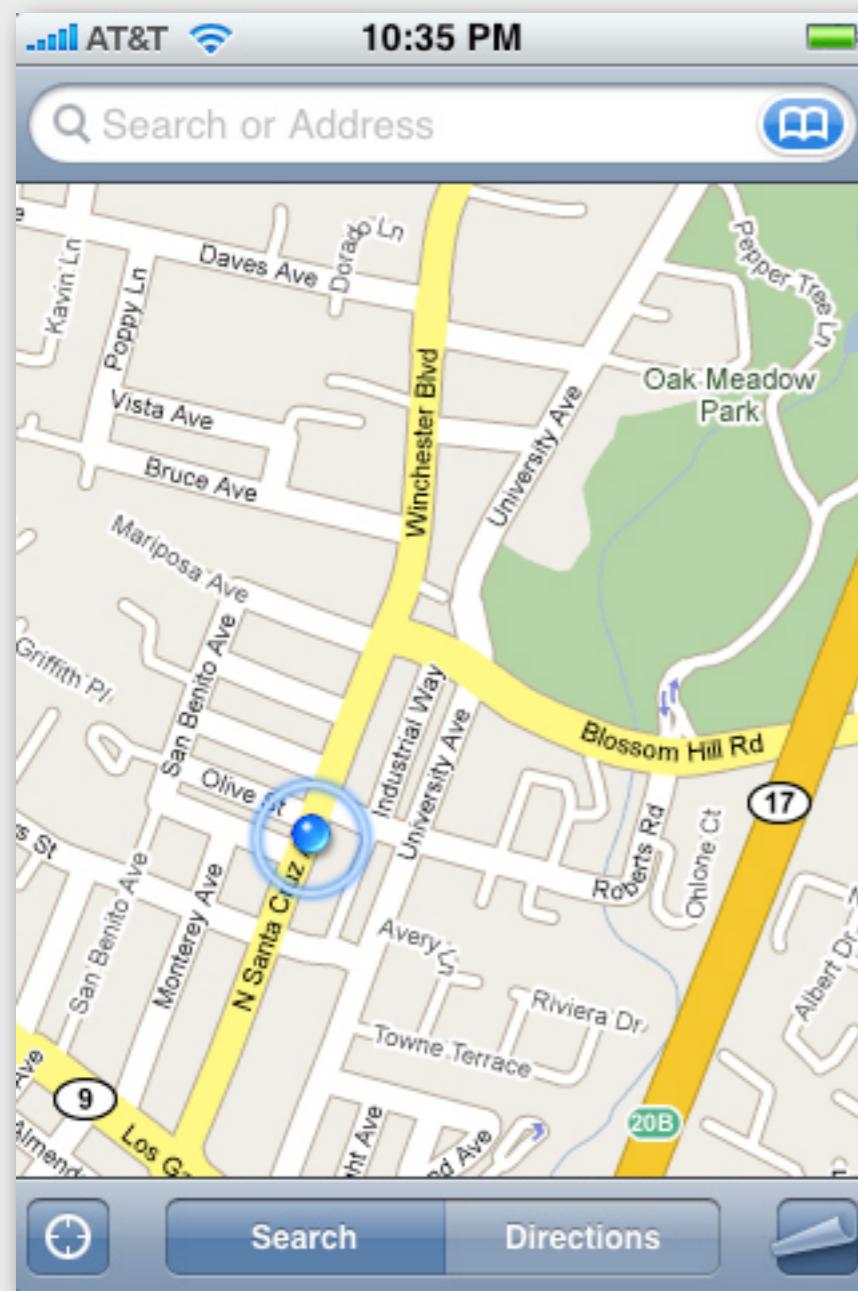
RT @ROBM163 HUGE
EARTHQUAKE HERE!



Why WebMapping?

- .. Great for easily accessing geospatial data from everywhere
- .. Great to interact with geospatial data
- .. Great for continuously changing data (easy to update)
- .. Great for community data, easy to share
- .. Easy to deploy on many different platforms (desktop computers, mobile devices, microwave, etc...)

WebMapping is changing...



<http://www.businessweek.com/news/2012-09-20/apple-maps-lose-way-with-iphone-app-victim-to-google-feud>

<http://www.lukew.com/ff/entry.asp?824>

People are using maps and
geospatial data everywhere
and at any time!

WebMapping

- .. Access to maps over the Web
- .. Distribution is cheaper,
content is more up to date
- .. But: life expectancy of maps on the Web is shorter
(«trashable maps»)

WebMapping

- .. Static maps: map as an image
- .. Interactive mapping: from view to manipulate
- .. Dynamic mapping: generated dynamically
- .. Webmapping and WebGIS

WebMapping = Google

Itinéraire Rechercher à proximité plus +
Essayez avec : Mustair à proximité de Sils im Domleschg

5 Hôtels à Mustair Profitez de nos offres spéciales ! Réservez votre hôtel en ligne. www.booking.com/Mustair-Hotels

Müstair

Années - Pourquoi cette annonce ?

5 Hôtels à Mustair Günstige Hotels in Val Müstair ! Testberichte lesen, günstig buchen. www.ciao.de/hotels_Val_Muestair

Années - Pourquoi cette annonce ?

Liens de Google Maps - Aide Google Maps - ©2012 Google - Conditions d'utilisation

<http://g.co/maps/96f6j>

Arrivée : 1 avr. Départ : 2 avr.

Hotel

Années - Pourquoi ces annonces ?

+140 000 Hôtels pas chers Un hôtel pour 1, 2 ou 3 nuits ? Hotels.com est la solution ! www.hotels.com/140000-Hotels

Votre chambre d'hôtel Pas de stress, que du bonheur ! Votre chambre d'hôtel à prix révélée www.ebookers.ch/hotels

Arrivée : 1 avr. Départ : 2 avr.

A Hotel Münsterhof AG Via Maistra 40, 7537 Mustair CHF 162 • 081 858 55 41 - muensterhof.ch Ce romantique hôtel est installé dans le parc national de Suisse. ... booking.com

B Hotel-Restaurant Chavalatsch Purtalstrasse 11, 7537 Mustair CHF 146 • 081 858 57 32 - hotel-muestair.ch Heinz met en garde que Hotel Chavalatsch à Mustair était complètement ... holidaycheck.fr

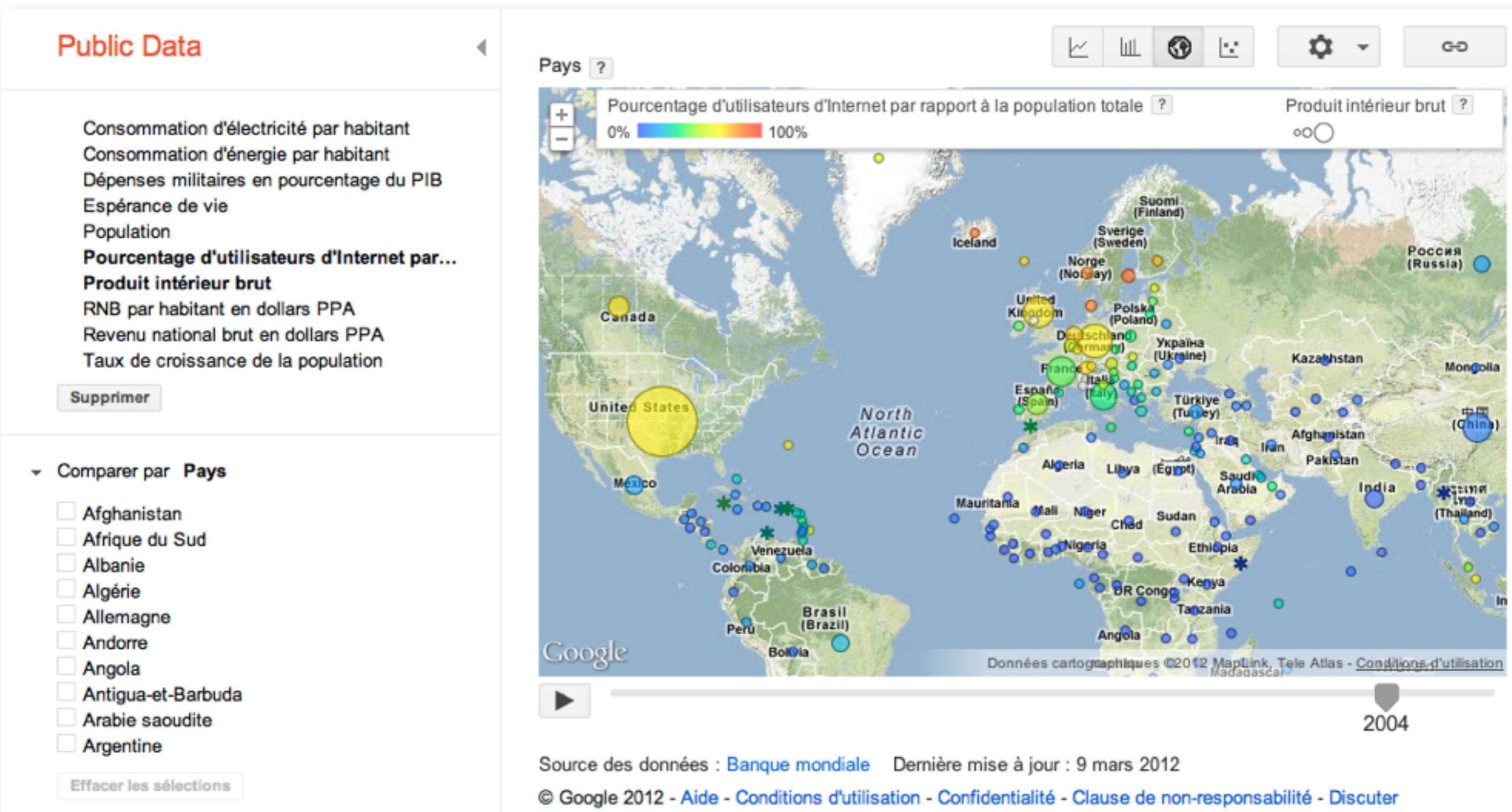
© 2012 CNES/Spot Image © 2012 Google © 2012 Google Earth © 2012 Cine Atlas

<http://g.co/maps/zcktv>

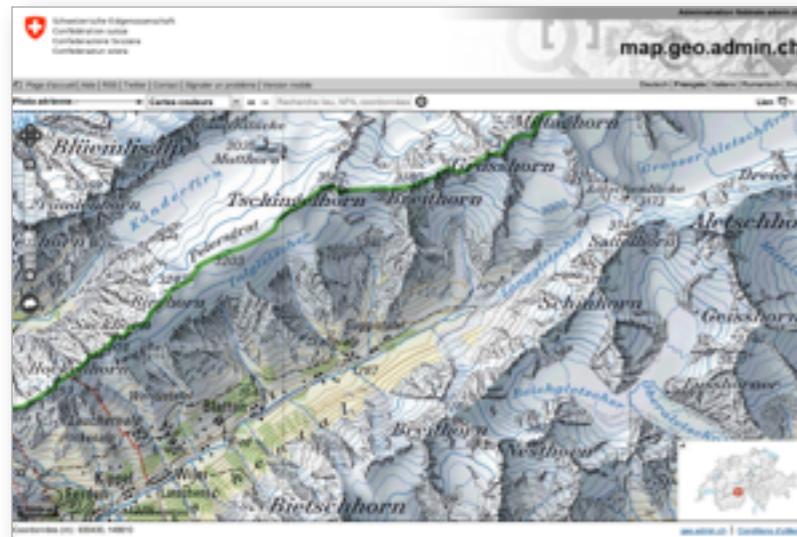


<http://g.co/maps/4hazp>

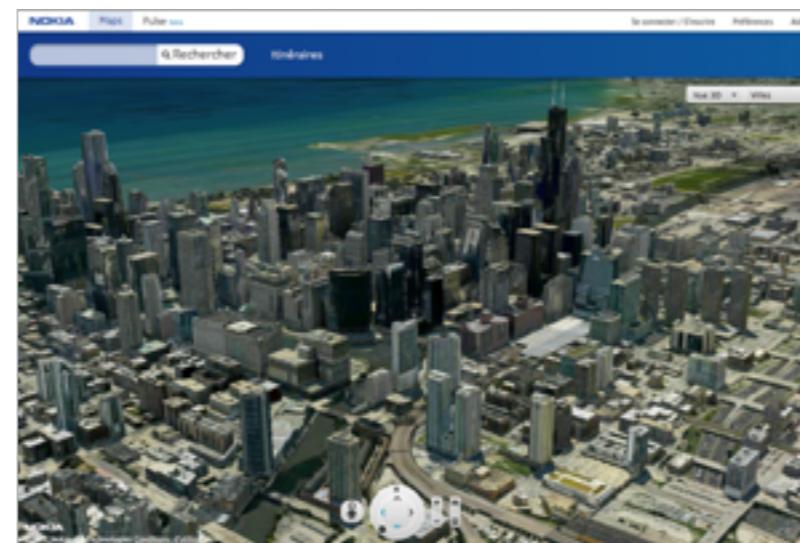
WebMapping = Google



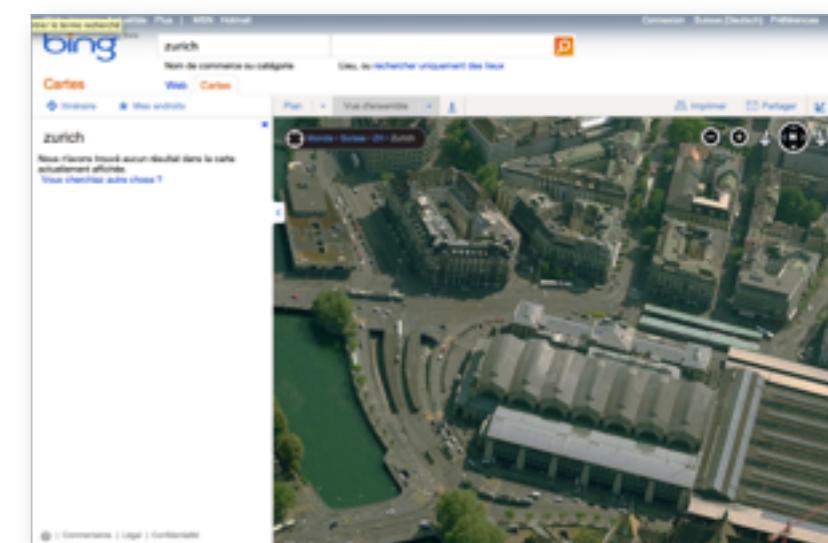
Webmapping > Google !



<http://map.geo.admin.ch/>



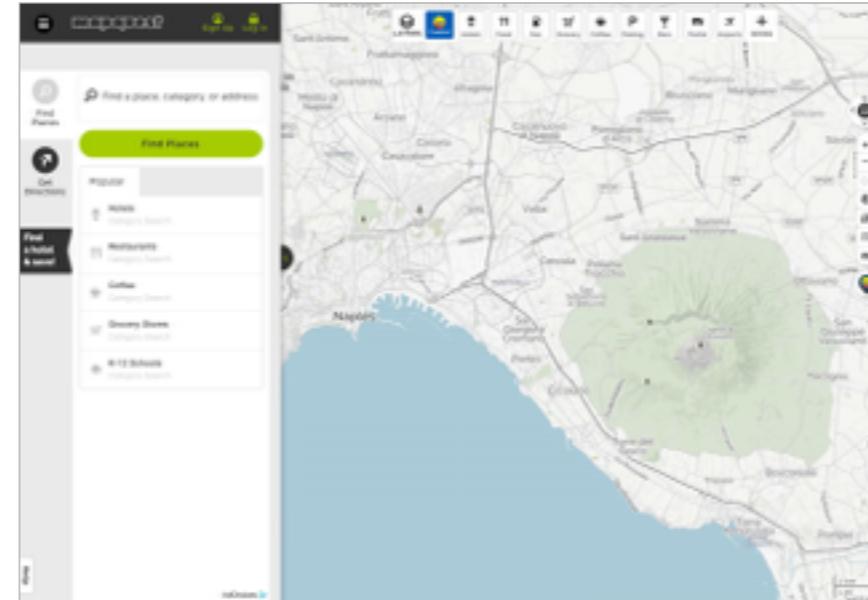
<http://here.com>



<http://binged.it/H0tUsH>



<http://de.viamichelin.ch>



<https://www.mapquest.com>

etc...

Open Street Map (OSM)



[http://www.openstreetmap.org/?
lat=51.5240442752838&lon=-0.1
33252143859863&zoom=16](http://www.openstreetmap.org/?lat=51.5240442752838&lon=-0.133252143859863&zoom=16)

Highway

Used to describe roads and footpaths. See [Highways](#) for further guidance and [Restrictions](#) for details of access limitations by vehicle type/ time/ day/ load/ purpose etc.

| Key | Value | Element | Comment | Rendering | Photo |
|---------|---------------|---------|---|-----------|-------|
| Roads | | | | | |
| highway | motorway | | A restricted access major divided highway, normally with 2 or more running lanes plus emergency hard shoulder. Equivalent to the Freeway, Autobahn, etc.. | | |
| highway | motorway_link | | The link roads (sliproads/ramps) leading to/from a motorway from/to a motorway or lower class highway. Normally with the same motorway restrictions. | | |
| highway | trunk | | Important roads that aren't motorways. Typically maintained by central, not local government. Need not necessarily be a divided highway. In the UK, all green signed A roads are, in OSM, classed as 'trunk'. | | |
| highway | trunk_link | | The link roads (sliproads/ramps) leading to/from a trunk road from/to a trunk road or lower class highway. | | |
| highway | primary | | Administrative classification in the UK, generally linking larger towns. | | |
| highway | primary_link | | The link roads (sliproads/ramps) leading to/from a primary road from/to a primary road or lower class highway. | | |

[http://wiki.openstreetmap.org/
wiki/Map_Features#Highway](http://wiki.openstreetmap.org/wiki/Map_Features#Highway)

Webmapping or WebGIS?

map+ by TYDAC

swisstopo

NEWS 19.03.2012

Relief Vue aérienne Vue hybride Routes

swisstopo maps
CLICK HERE

Coordonnées-CH 742918 175704

Longitude/Latitude 9.30816 46.7172

Recherche par adresse
NPA/Localité Rue No

Recherche par toponomie
Nom

Recherche locale par Google
Terme

Sport et informations d'hiver

- Stations de ski
- Toboggan
- Patinoires
- Téléphériques
- Webcams
- Fotos (Panoramio)
- Wikipedia
- Montagnes
- Hotels
- Restaurants
- Transport public
- Zones de tranquillité, chemins (GR)
- Zones de tranquillité (GR)
- Déclivité (Légende)

[http://www.mapplus.ch?
x=732212&y=175675&
z=12](http://www.mapplus.ch?x=732212&y=175675&z=12)

TYDAC Inc. - Optingenstr. 27 - 3013 Bern - Switzerland | Powered by Neopoljs Locator | Copyrights | Contact | [Login](#)

Geoportal

Vaud | Guichet cartographique cantonal

Accueil Thèmes RSS Contact Commande

Recherche et localisation

Rechercher

Choix des données

Thèmes

Thème : Localisation

Données de base

- Adresses
- Canton
- Districts
- Communes

Données cadastrales

- Propriété foncière
- Bâtiments

Orthophoto

Cartes Nationales (co)

Commune : Prangins
Bien-fonds : 606

Surface : 2941956 m²

Genre(s) de nature et bâtiment(s) :

| | |
|--------------|------------------------|
| Bâtiment | 17 m ² |
| Eau | 26'383 m ² |
| Forêt | 63'396 m ² |
| Habitation | 497 m ² |
| Habitation | 304 m ² |
| Place-jardin | 4'872 m ² |
| Pré-champ | 199'487 m ² |

Propriétaire(s) : Napoléon Bonaparte Alix-Mario

Registre Foncier (Service payant)

Note : la surface des bâtiments souterrains et des couverts n'est pas comptabilisée dans bien-fonds.

Interop RF version 1.7 / 11.07.2014

Ajouter d'autres données :

Rechercher des données...

Informations dépourvues de foi publique, © Etat de Vaud, géodonnées © Swisstopo 5704004385, OpenStreetMap

Échelle : 1 : 7'500

Biens-fonds

| N° commune cantonal | N° | Désignation | Lien |
|---------------------|-----|-----------------|----------------------------------|
| 247 | 606 | parcelle privée | Informations du registre foncier |

WebMapping: how it works...

- .. Client / server infrastructure
- .. Client: Web browser
 - .. Examples: Firefox, Internet Explorer, Chrome...
- .. Server: software sending files over HTTP.
 - .. Examples: Apache, Nginx
 - .. HTTP = common language (protocol)
 - .. Client sends file requests to server over HTTP
 - .. Server returns requested file

WebMapping: how it works...

Client



Server



GET photo.jpg



WebMapping: how it works...

Client



Server



**GET photo.php?
id=5&size=small**



Client: the browser

- .. A Web browser can handle some defined data formats:
 - .. HTML (HTML 4, hopefully HTML 5)
 - .. CSS (style sheets)
 - .. Images: PNG, GIF, JPEG
 - .. SVG except for some dinosaur browsers
(e.g. Internet Explorer 8)
 - .. sometimes WebGL (3D animations)
 - .. JavaScript (for manipulation of HTML, CSS, SVG)
 - .. Sometimes plug-ins: Flash, Silverlight, PDF, Java...

HTML: language of the browser

The screenshot shows a code editor window with the following details:

- Title Bar:** Shows the file name "index.html".
- Code Area:** Displays the following HTML code:

```
1 <html>
2   <head>
3     <title>Document title</title>
4   </head>
5   <body>
6     <h1>My HTML document</h1>
7     <p>Paragraph in my HTML document</p>
8   </body>
9 </html>
```

The code is color-coded: blue for tags like <html>, <head>, <title>, <h1>, <p>, and </html>; brown for attributes like <title>Document title</title>; and orange for text content like "My HTML document" and "Paragraph in my HTML document".
- Status Bar:** At the bottom, it shows "Line: 7 Column: 45" and "HTML" in a dropdown menu.
- Toolbar:** Includes icons for file operations (New, Open, Save, etc.) and a "Soft Tabs" setting.

Maps in the browser

- .. Ways to bring a map into a Web browser:
 - .. As an image (PNG, JPEG, GIF)
 - .. As vector graphics (SVG) for decent browsers
 - .. As Flash if the plug-in is installed and supported
 - .. As WebGL
 - .. As HTML5 on a Canvas element (with Javascript)
- .. Use Javascript for more interaction and fun!

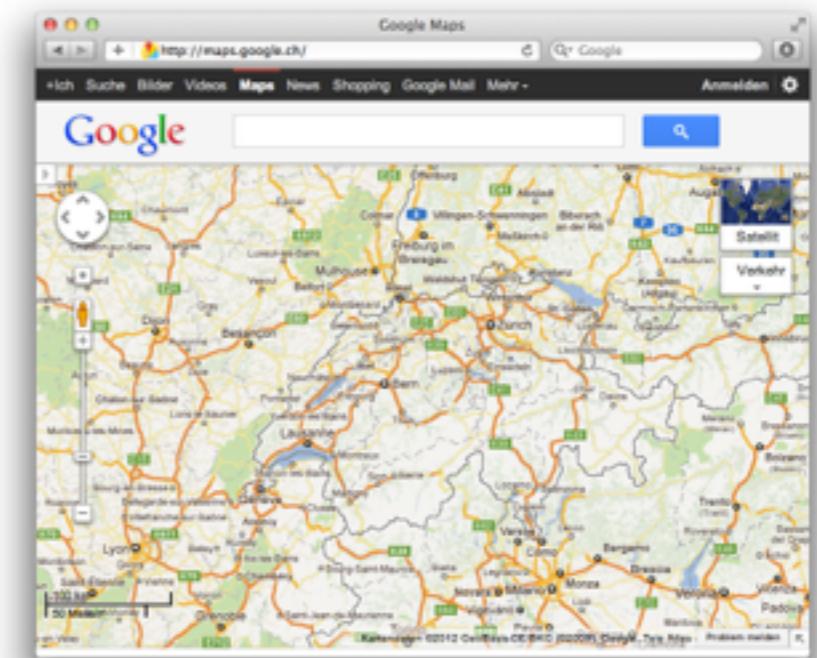
Image in the browser

- .. A simple static image in the browser
- .. Example: www.swissgeo.ch



Image in the browser: be smart!

- .. Many static images in the browser
 - .. Example: maps.google.com
- .. How to be smart?
 1. Divide your map into many small images (tiles)
 2. Place your images side-by-side
 3. Write some Javascript to move all images around, and to load the tiles that we currently need



Build Google Maps in 6 steps

1. Map tiles: typically 256x256 pixels (regular grid)
2. Limit the number of zoom levels: ~20–25
3. For each zoom level, we produce the whole set of map tiles in advance!
4. We put the images in folders on the server:
`http://my.map.com/X/Y/Z.png`
with X=grid column, Y=grid row, Z=zoom level
5. Add some Javascript for pan & zoom
6. Call the marketing department!

Vectors in a browser

- .. SVG = Scalable Vector Graphics
- .. Vectors = lines + polygons: discrete objects
- .. Geometries are defined by coordinates
- .. SVG is built on top of XML format:
stand-alone or embedded in HTML
- .. SVG is an official Web standard
- .. Supported by all modern Web browsers

SVG: how it looks...

```
<?xml version="1.0" standalone="no"?>
<!DOCTYPE svg PUBLIC "-//W3C//DTD SVG 1.1//EN"
"http://www.w3.org/Graphics/SVG/1.1/DTD/svg11.dtd">

<svg xmlns="http://www.w3.org/2000/svg" version="1.1"
width="200px" height="300px">

    <circle cx="100" cy="150" r="40" stroke="black"
        stroke-width="2" fill="red" />

</svg>
```

SVG: how it looks...

```
<html>
<body>

<svg xmlns="http://www.w3.org/2000/svg" version="1.1">
    <circle cx="100" cy="150" r="40" stroke="black"
        stroke-width="2" fill="red" />
</svg>

</body>
</html>
```

SVG: who uses it?

- .. Nobody?
- .. Everybody!
 - .. Mostly through a Javascript library
(with fallback for IE < 9)
 - .. Google Maps → Get directions
 - .. OpenLayers → Draw a polygon or vector
- .. Use of SVG directly possible also
 - .. Mostly through d3 (d3js.org)

SVG: what else?

- .. SVG supports animation also
- .. Possible to embed images
- .. SVG elements can be manipulated and created through JavaScript, just like standard HTML

Flash: vectors in a plug-in

- .. Flash can do everything SVG can
- .. But has video too
- .. Scripting through own language (ActionScript)
- .. Creation through GUI: Adobe Flash (.fla)
- .. Distribution in compiled & compressed format (.swf)

Flash versus SVG

- .. Advantages of Flash:
 - ⊕ Compact file format, includes everything
 - ⊕ No need to distribute source code
 - ⊕ Many people used to have Flash, it works on most browsers
- .. Disadvantages of Flash:
 - ⊖ Flash is deprecated
 - ⊖ Proprietary editor needed (Adobe Flash), no standard
 - ⊖ Flash Player not available on all platforms (e.g. iOS, Android)
 - ⊖ No interaction possible with other elements in page

Maps in the browser

- .. Ways to bring a map into a Web browser:
 - .. As an image (PNG, JPEG, GIF)
 - .. As vector graphics (SVG) for recent browsers
 - .. As Flash if the plug-in is installed and supported
 - .. As Vector Tiles, together with
 - .. WebGL
 - .. HTML5 on a Canvas element (using Javascript)
- .. Use Javascript for more interaction and fun!

What is the easy way to get a map in a browser?

- .. No free lunch!
 - .. Use a GUI program to prepare your map
 - e.g. Adobe Flash, Inkscape (SVG), ...
 - .. Use existing libraries
 - e.g. Google Maps, Leaflet, Swisstopo API, OpenLayers, d3, ...
 - .. Using an online service designed for mapping
 - e.g. Mapbox, ArcGIS Online, ...
- .. But: we still need to prepare the data
- .. Often some more advanced expertise needed (JS)

Using a Javascript library

- .. A library is a collection of functions and objects that we can use through a well-defined and hopefully documented API (Application Programming Interface)
- .. The data formats depend on the library
→ we need to adapt ourselves!

Using a JS mapping library

- .. Raster data:
 - .. XYZ tiles
 - .. WMS (Web Mapping Service)
 - .. WMTS (Web Mapping Tile Service)
- .. Vector data (geometry + attributes):
 - .. KML / KMZ
 - .. GeoJSON
 - .. WFS (Web Feature Service)
 - .. Mapbox Vector Tiles

GeoJSON format

- .. Format for geometries + attributes
 - .. Extension of JSON (JavaScript Object Notation), which is used a lot in Web sites with JavaScript
 - .. It basically contains simple JavaScript objects and variables
- .. Easy to read in JavaScript
(because it is JavaScript already)

GeoJSON: a closer look

```
{ "type": "FeatureCollection",
  "features": [
    { "type": "Feature",
      "geometry": {
        "type": "Point",
        "coordinates": [102.0, 0.5]
      },
      "properties": {
        "description": "a simple point",
        "temperature": 10.5,
      }
    }, { ... another Feature ... }, ...
  ]
}
```

GeoJSON format: how to create

- .. QuantumGIS
- .. PostGIS (`ST_AsGeoJSON`)
- .. `ogr2ogr` (command line utility part of GDAL)
- .. Using a script: many libraries around...
- .. ArcGIS: JSON toolset
- .. Online service (e.g. <http://2geojson.com>)

GeoJSON format: plus-minus

- .. Advantages:

- + Widely adopted (e.g. Twitter uses GeoJSON)
- + Easy to create programmatically, fast to parse
- + Human readable

- .. Disadvantages:

- Needs additional library for GoogleMaps
(e.g. GeoJason)
- No validation for data structure

TopoJSON: the brother of GeoJSON

- .. TopoJSON is an evolution of GeoJSON
- .. Smaller files, no redundant lines stored in file
- .. Supports generalization
- .. Easy to convert to GeoJSON on client

OGC Web services

- .. OGC is a consortium defining open geo-spatial data standards (\neq open-source !)
- .. OGC defines several Web services
 - .. A Web service allows retrieving data in a precise format through a URL-based API (request \rightarrow response)
 - .. OGC Web service responses are XML encoded data
- .. Generally, we only need to know the base URL of the service to use it

OGC Web services

- .. WMS = Web Mapping Service: for raster data
- .. WMTS = Web Mapping Tile Service: for raster data coming in tiles
- .. WFS = Web Feature Service: for vector data (geometries + attributes)
- .. Other less common services exist also (see www.opengeospatial.org)

OGC Web services

- .. We can use Web services also with traditional GIS software
- .. There are few reliable and fast Web services around
- .. Swisstopo provides some data as a WMS:
search for "Swisstopo WMS" in your favourite search engine (DuckDuckGo)

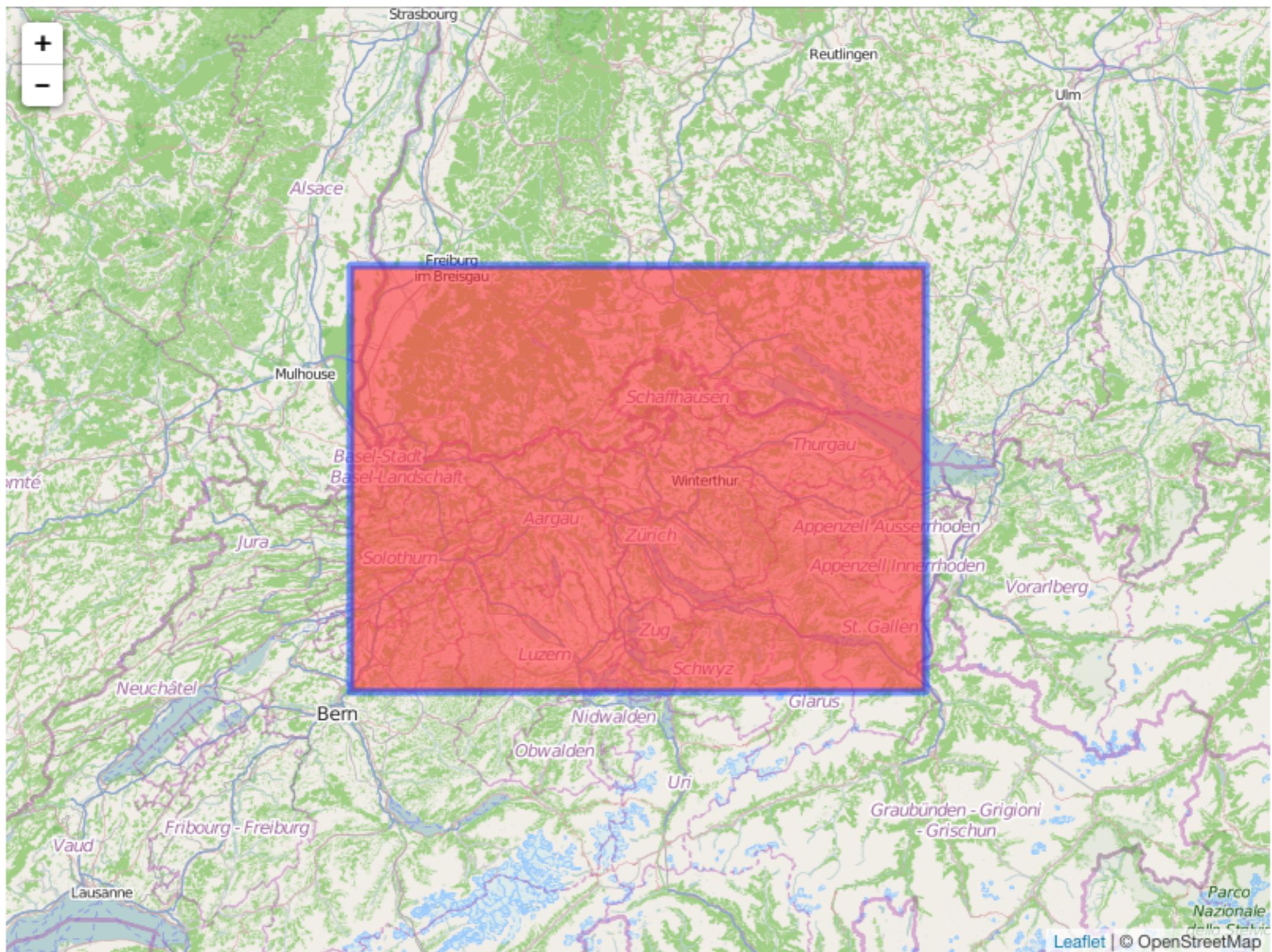
Mapbox Vector Tiles

- .. Cut vector data in regular tiles
- .. Efficient encoding for map data
- .. Rendering on client-side
- .. Fast!
- .. But not easy to implement...

Where to start?

- .. We start with the easy stuff, of course:
 - .. HTML page
 - .. Interactive map using Javascript library «Leaflet»
 - .. Layers to add in GeoJSON format

GeoJSON Example



Short Leaflet example

```
<html>
  <head>
    <link rel="stylesheet" href="leaflet.css" />
    <script src="leaflet.js"></script>
    <script src="script.js"></script>
  </head>
  <body onload="main()">
    <h1 id="title">GeoJSON Example</h1>
    <div id="map" style="background-color: #666;
                           width: 800px; height: 600px;"></div>
  </body>
</html>
```

```
function main() {
map = L.map("map").setView([8.5, 47.5], 8)
L.tileLayer("http://{s}.tile.osm.org/{z}/{x}/{y}.png",
{ attribution: "&copy OpenStreetMap" }).addTo(map);

var fc = {
  "type": "FeatureCollection",
  "features": [
    {
      "type": "Feature", "geometry": {
        "type": "Polygon",
        "coordinates": [[ [7.5, 47.0], [9.5, 47.0],
          [9.5, 48.0], [7.5, 48.0], [7.5, 47.0] ]]
      }, "properties": { "fid": 1 } }]
  };
L.geoJson(fc.features, {
  style: {fillColor: "#f33", fillOpacity: 0.6}
}).addTo(map);
}
```