



# Map Projections, Tiles & Copyright

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# Goal

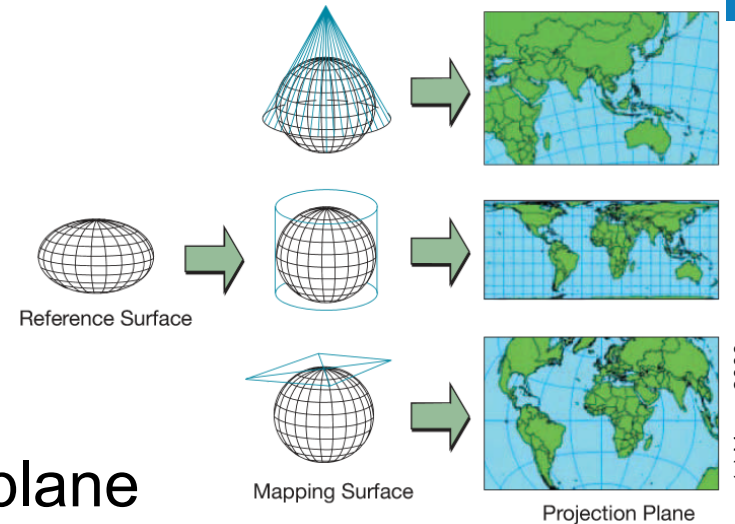
- Prepare data as tiled maps (similar to Google Maps) for integration into a Web Map Framework

## Learn / review

- ...what a map projection is
- ...the concept of zoom level (vs. map scale)
- ...what map tiles are needed for
- ...what is CartoCSS and TileMill
- ...why should we be aware of copyright

# Map Projections

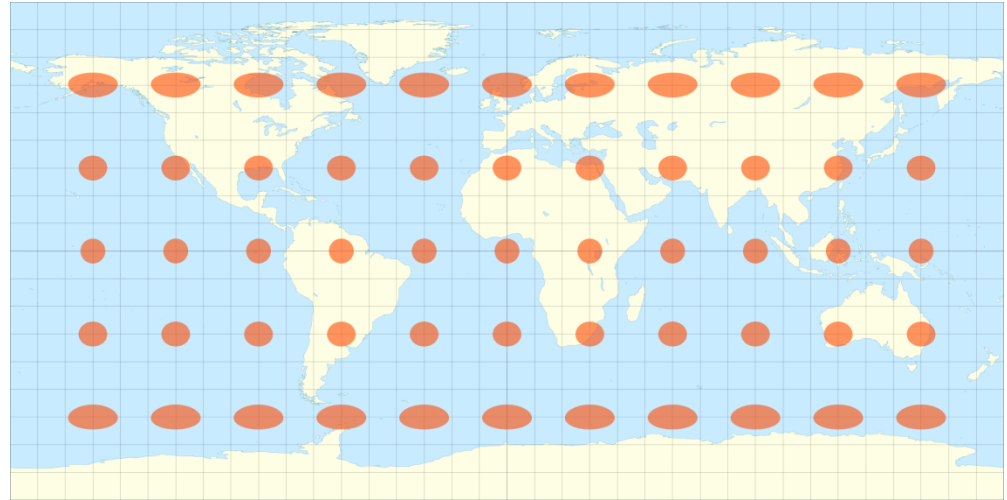
- Reference: sphere / ellipsoid
  - Distortions; e.g. WGS84, ETRS89
- Mapping surface: cylinder, cone, plane
  - Distortions
  - Aspect: orientation of the surface to the globe: normal, transverse, oblique
  - Tangent or secant to the sphere / ellipsoid
- Preservation of metric properties:
  - Conformal or orthomorphic: locally no angular distortion (e.g. Transverse Mercator)
  - Equivalent or authalic: locally equal-area properties
  - Partially equidistant
  - Others (compromise or error minimizing)



(c) Vosser 2003

# Plate Carrée

- Equirectangular projection
- North-South distances neither stretched nor compressed
- Neither equal area nor conformal
- The standard parallel is the equator
- De facto standard for global raster datasets
  
- WGS84, EPSG: 4326

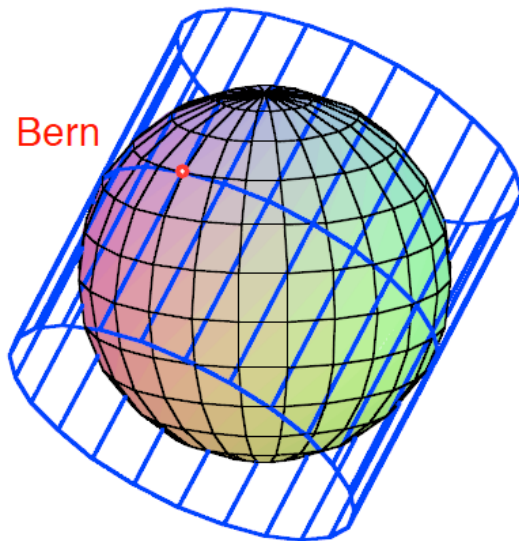


# EPSG

- The EPSG Geodetic Parameter Dataset is a structured dataset of Coordinate Reference Systems and Coordinate Transformations
- The geographic coverage of the data is worldwide
- Maintained by the Geodesy Subcommittee of the International Association of Oil and Gas Producers (IOGP) Geomatics Committee

<http://spatialreference.org/ref/epsg/>

# The Swiss Projection EPSG: 21781



- oblique conformal cylindrical (Mercator) projection
- reference Bessel ellipsoid 1841

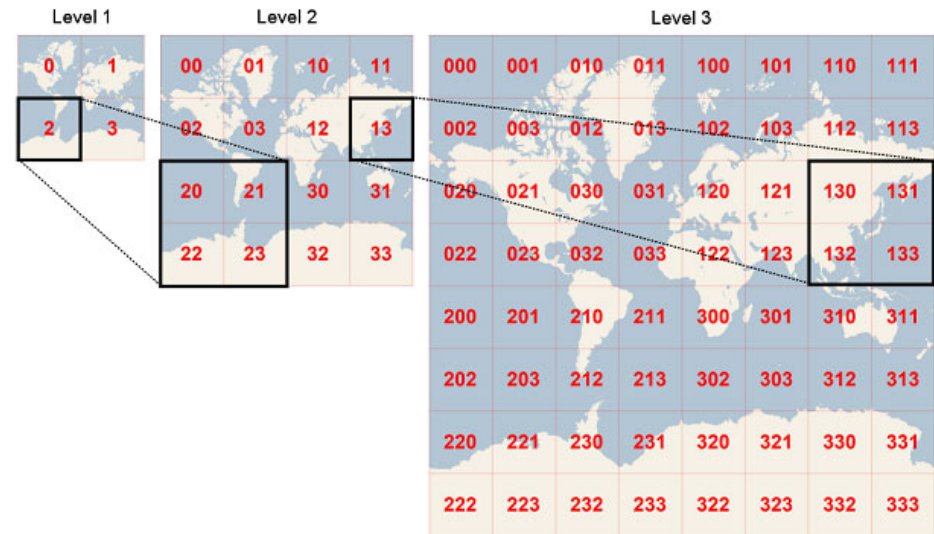
# The «Google» Projection EPSG: 3857

- A Spherical “Web” Mercator projection (Pseudo-Mercator)
- Popularized by web services such as Google and OpenStreetMap
- Distorted in the North-South direction
- Not conformal
- Reference WGS84
- $R=a$  (R is the spherical Radius, a is the semi-major axis of the WGS84 ellipsoid)
- US Dept. of Defense: “unacceptable for any official use”

<http://www.hydrometronics.com/downloads/Web%20Mercator%20-%20Non-Conformal,%20Non-Mercator%20%28notes%29.pdf>

# Zoom level

Level of Detail	Map Width and Height (pixels)	Ground Resolution (meters / pixel)	Map Scale (at 96 dpi)
1	512	78,271.5170	1 : 295,829,355.45
2	1,024	39,135.7585	1 : 147,914,677.73
3	2,048	19,567.8792	1 : 73,957,338.86
4	4,096	9,783.9396	1 : 36,978,669.43
5	8,192	4,891.9698	1 : 18,489,334.72
6	16,384	2,445.9849	1 : 9,244,667.36
7	32,768	1,222.9925	1 : 4,622,333.68
8	65,536	611.4962	1 : 2,311,166.84
9	131,072	305.7481	1 : 1,155,583.42
10	262,144	152.8741	1 : 577,791.71
11	524,288	76.4370	1 : 288,895.85
12	1,048,576	38.2185	1 : 144,447.93
13	2,097,152	19.1093	1 : 72,223.96
14	4,194,304	9.5546	1 : 36,111.98
15	8,388,608	4.7773	1 : 18,055.99
16	16,777,216	2.3887	1 : 9,028.00
17	33,554,432	1.1943	1 : 4,514.00
18	67,108,864	0.5972	1 : 2,257.00
19	134,217,728	0.2986	1 : 1,128.50
20	268,435,456	0.1493	1 : 564.25
21	536,870,912	0.0746	1 : 282.12
22	1,073,741,824	0.0373	1 : 141.06
23	2,147,483,648	0.0187	1 : 70.53



*ground resolution (meters/pixel) =*

$$\text{cos}(\text{latitude} * \text{pi}/180) * \text{earth circumference} / \text{map width}$$

$$\text{map scale} = 1 : \text{ground resolution} * \text{screen dpi} / 0.0254 \text{ meters/inch}$$

*Based on the documentation provided for Microsoft Bing Maps by J. Schwartz,*

<https://msdn.microsoft.com/en-us/library/bb259689.aspx>



# TileMill

The screenshot displays the TileMill web map editor interface. On the left, a map of Europe is shown with various countries color-coded. A red flag of Switzerland is highlighted over the country. On the right, a code editor window titled "Geography Class" shows CSS code for styling the map. The code includes comments and rules for different zoom levels, such as [ScaleRank<2][zoom=2] and [ScaleRank<3][zoom=3].

**Teaser**  
Shows the flag of the country when hovered over with the mouse

**The Map**  
Shows how the final map will look like. You can zoom and pan.

**Legend**  
You can create a legend using HTML

**CartoCSS**  
These files use CartoCSS to style the map. style.mss contains basic style information for water bodies, labels.mss styles the country names and rainbow.mss applies different colors to the countries.

```

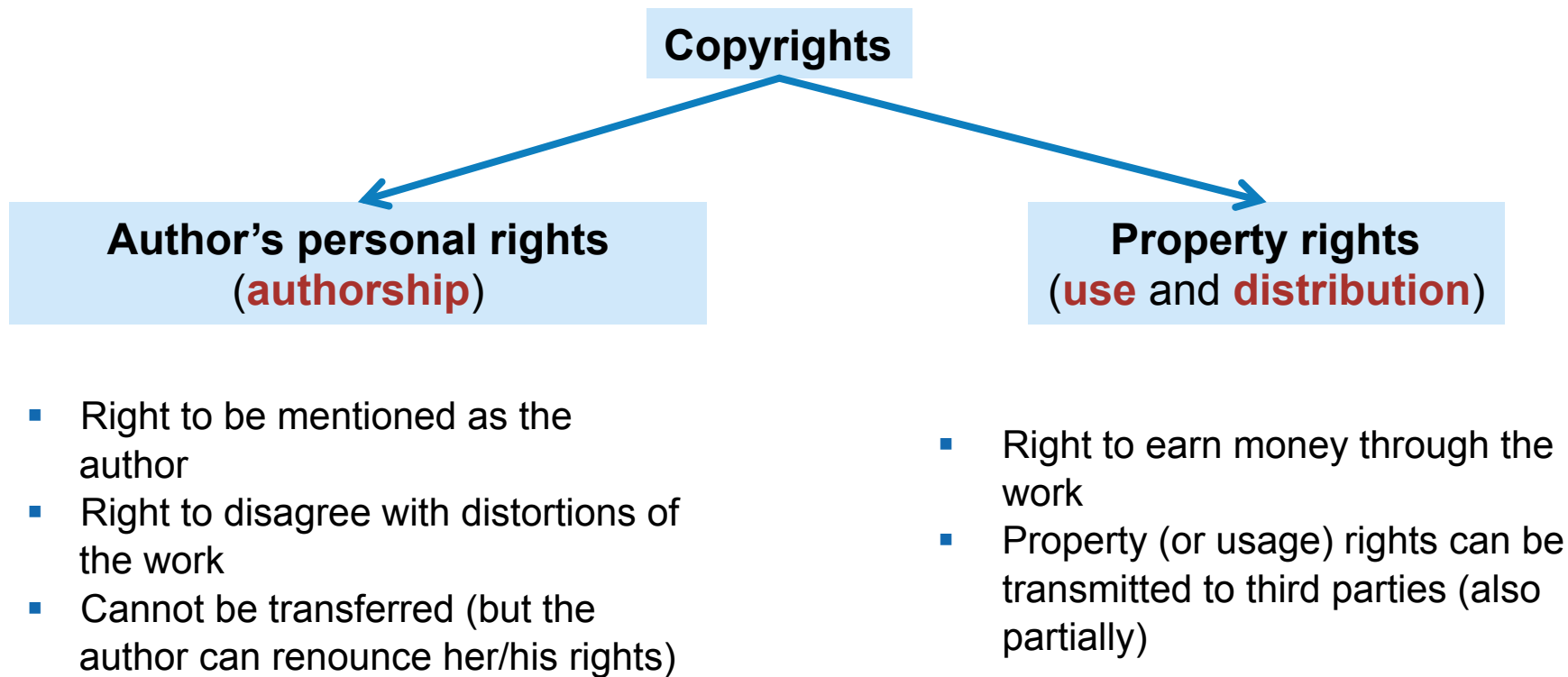
1 /* Fonts and font sizes can be assigned to variables. The first font
2 will be preferred, and fall back to subsequent fonts for characters
3 that are not available, or if the entire font is not available to
4 Mapnik. */
5 @futura_m ... Medium", "Ubuntu Regular", "Trebuchet
6 @futura_i ... ction Pro Medium Italic", "Ubuntu
7 @futura_b ... old", "Ubuntu Bold", "Trebuchet M
8
9 /* --- C
10 #country-
11 text-fa
12 text-fi
13 text-si
14 text-transform:uppercase;
15 text-halo-fill:rgba(255,255,255,0.5);
16 text-halo-radius:1;
17 text-line-spacing:1;
18 text-wrap-width:20;
19 text-name:""; /* hackish? */
20
21 [ScaleRank<2][zoom=2] {
22   text-name: "[ABBREV]";
23 }
24 [ScaleRank<3][zoom=3] {
25   text-name: "[ABBREV]";
26   text-size:10;
27 }
28 [ScaleRank<4][zoom=4] {
29   text-name: "[NAME]";
30   text-size:11;
31 }
32 [ScaleRank<5][zoom=5] {
33   text-name: "[NAME]";
34   text-size:12;

```

# CartoCSS

- Like CSS, but for maps
- Style syntax for TileMill
- Convertible to Mapnik XML (default rendering engine for OpenStreetMap)
- 10 fundamental style types named **symbolizers**:
  - Line (for lines & polygons)
  - Polygon (for polygons)
  - Point (for points)
  - Text (for points, lines, and polygons)
  - Shield (for points & lines)
  - Line Pattern (for lines & polygons)
  - Polygon Pattern (for polygons)
  - Raster (for rasters)
  - Markers (for points, lines, & polygons)
  - Buildings

# What are Copy Rights?



(IGE|IPI, 2011)

# General Principles of Third-Party Data Use

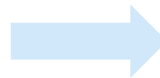
## (for Web Maps)

- Use of third-party material (e.g. maps, images, source code, data, ...)
  - Download
  - Private use
  - Commercial use
  - Publication without permission
- For every redistribution, public use and publication of a **protected work** only with **permission** (often under a license)
- The license specifies the conditions for using the work
- Possible uses without permission
  - **Private use ATTENTION**: it is very easy to leave the sphere of private use (school classes, work colleagues, Facebook friends, internet, etc. are examples where private use is not applicable)
  - **Schools** (education purposes)

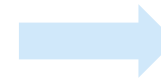
(IGE|IPI, 2011)

# Licensing Models

**All** rights reserved



**Some** rights reserved



**No** rights reserved

Everyone must ask for permission to:

- copy,
- use, and
- publish the work.

(The author makes special conditions for each request.)



The author determines the general conditions for the:

- copy,
- use, and
- publication of his work.



 **creative commons**

Everyone can:

- copy,
- use, and
- publish the work.

(public domain)



# Questions



## Exercise 3

- TileMill and CartoCSS:
  - Review the CartoCSS documentation
  - Create and export tiles with TileMill
  - Integrate the exported tiles into your Web map

# Exercise 4

- Interactive Web Mapping:
  - Display GeoJSON layer as overlay
  - Add attribute-based symbolization
  - Add additional interactive elements
    - Pop-up
    - Zoom-slider
    - Display coordinates



# TileMill

The screenshot displays the TileMill application interface. On the left is a sidebar with icons for Editor, Projects, Manual, Plugins, and Settings. The main area shows a map of Europe with a red box over Switzerland containing a white cross and the word "Switzerland". A large red box with the word "Demo" is overlaid on the map. A compass rose is visible in the bottom right of the map area.

Annotations on the map include:

- Teaser**: Shows the flag of the country when hovered over with the mouse.
- The Map**: Shows how the final map will look like. You can zoom and pan.
- Legend**: You can create a legend using HTML.

On the right, the "Geography Class" code editor is open, showing CSS code for styling the map. The code includes comments and rules for different zoom levels:

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