Map Projections, Tiles & Copyright

Ionuț Iosifescu

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 Surface

Mapping Surface

Projection Plane

(c) Voser 2003

- 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)
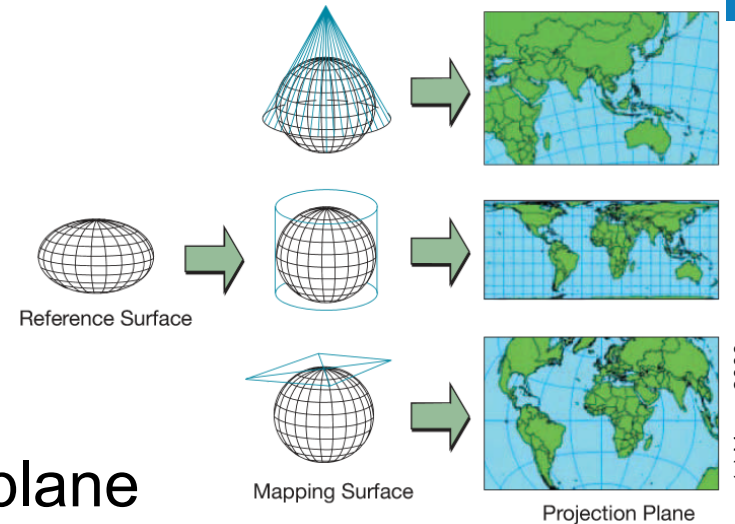
Plate Carrée

- 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
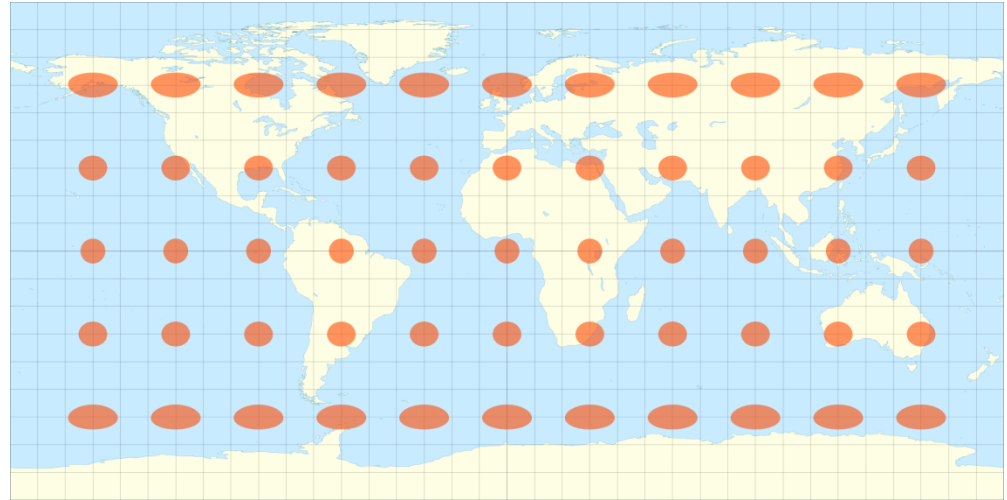
EPSG

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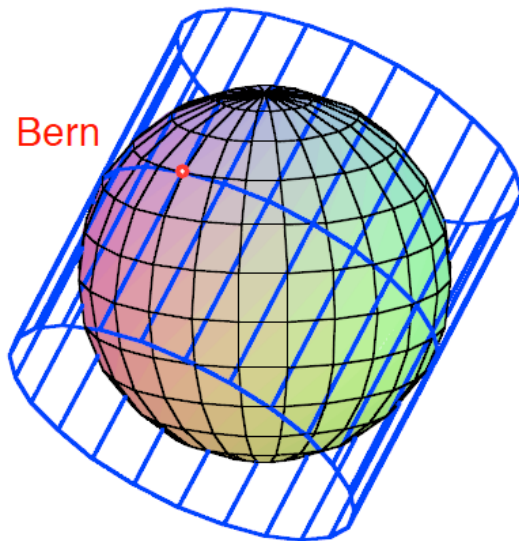
- oblique conformal cylindrical (Mercator) projection
- reference Bessel ellipsoid 1841

ETH_zürich_

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
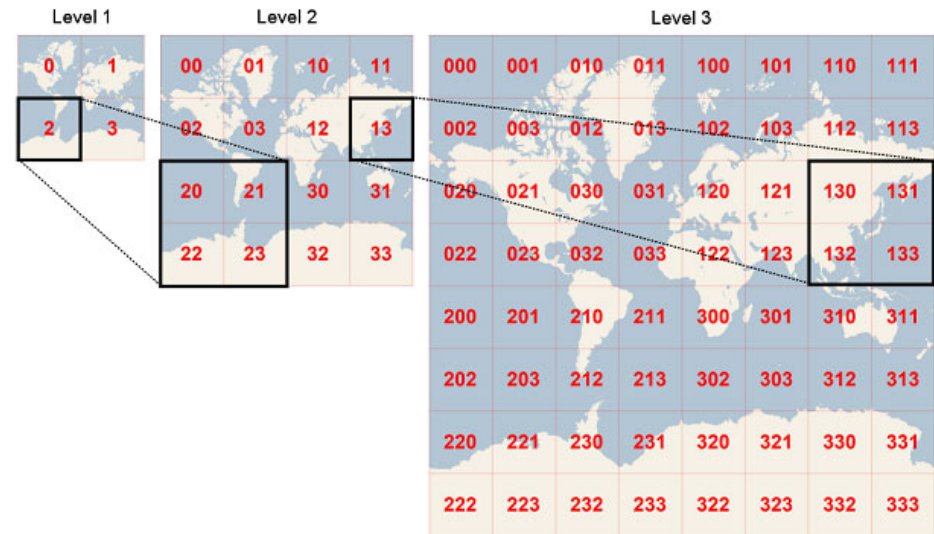
ground resolution (meters/pixel) =
*cos(latitude * pi/180) * earth circumference / map width*

map scale = *1 : ground resolution * screen dpi / 0.0254 meters/inch*

Based on the documentation provided for Microsoft Bing Maps by J. Schwartz,
https://msdn.microsoft.com/en-us/library/bb259689.aspx

TileMill

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?

Copyrights

**Author's personal rights
(authorship)**

**Property rights
(use and distribution)**

- Right to be mentioned as the author
- Right to disagree with distortions of the work
- Cannot be transferred (but the author can renounce her/his rights)

- Right to earn money through the work
- Property (or usage) rights can be transmitted to third parties (also partially)
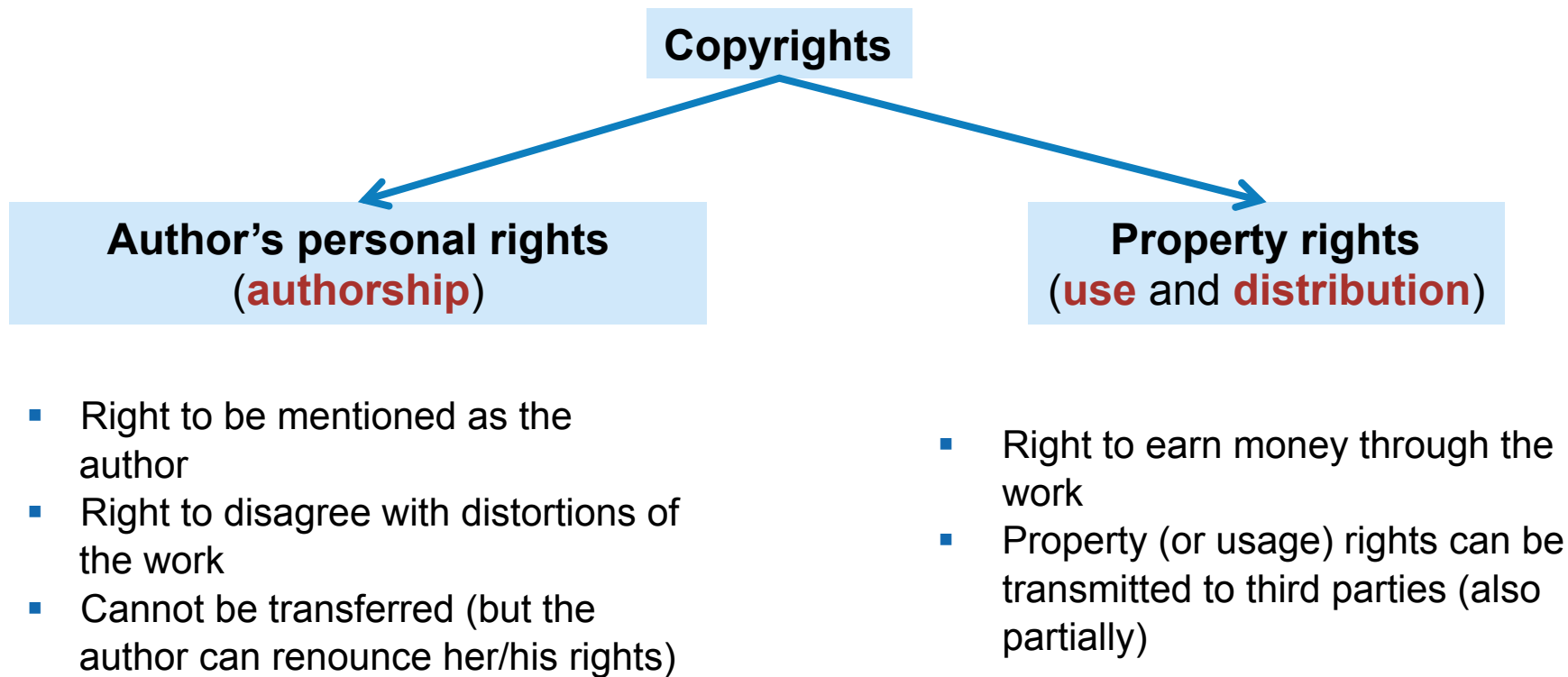
(IGE|IPI, 2011)

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 |
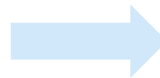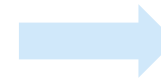
Everyone must ask
for permission to:
- copy,
- use, and
- publish the work.

(The author makes special
conditions for each request.)

The author determines
the general
conditions for the:
- copy,
- use, and
- publication of his
  work.

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