

Create / distribute tiled map

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Notes (1/2)

- This presentation use some links to external resources
 - Please download the presentation from the link below

https://github.com/smellman/jica_2023

Notes (2/2)

- This presentation is written in Markdown
 - You can edit this presentation with any text editor
 - You can convert this presentation to PDF or PowerPoint, please see the README.md
 - You can download the presentation of auto generate versions from the link below
 - [PDF](#)
 - [PowerPoint](#)
 - [HTML](#)

Self introduction

- GIS Engineer at Georepublic Japan
 - Programming: Python, JavaScript, TypeScript, Ruby etc.
 - UNIX and Linux guru
 - GIS skill: Data processing, Tiled based Map
- Community
 - Director of [OSGeo.JP](#)
 - Director of [OpenStreetMap Foundation Japan](#)
 - Sub president of [Japan Unix Society](#)
 - [UNOpenGIS/7](#) volunteer
- Contact: taro@georepublic.co.jp / @smellman on Twitter

Today's agenda

- What is tiled map?
- Introduction of software and data in this presentation
- How to create your own tiled map
- How to design your own tiled map
- How to distribute your own tiled map

What is tiled map?

Tile technology

- Provide map image or data over the internet.
 - Map images are separated as tiles.
 - Zoom Level 0 = World
 - Each zoom level doubles in the dimensions.
 - Too many tiles use "Web Mercator" projection.



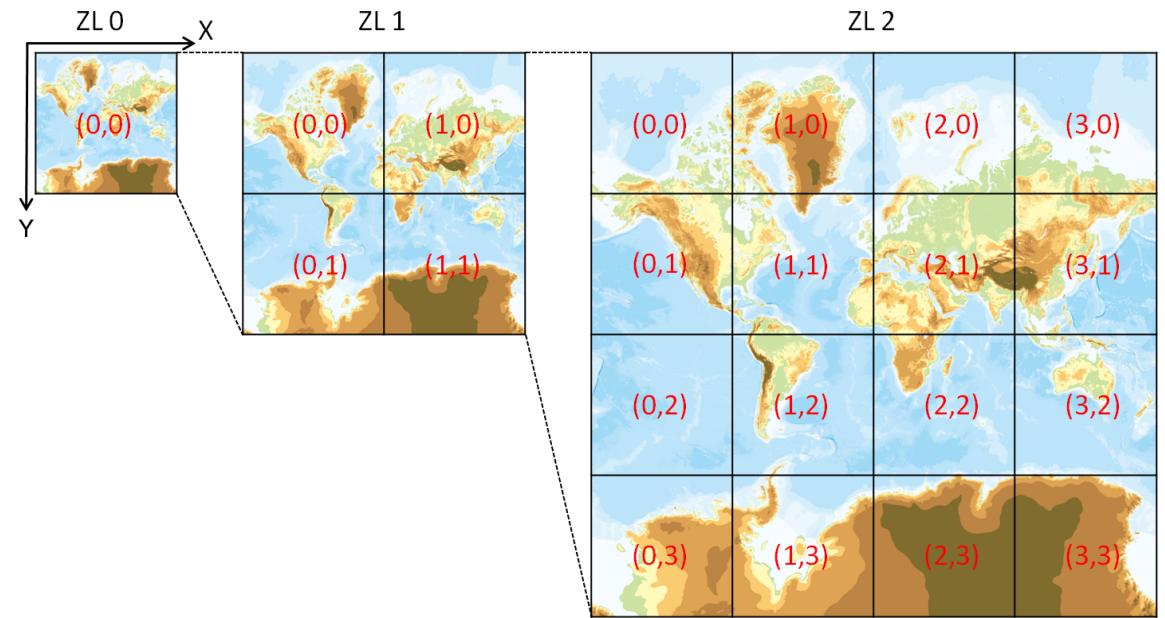
<https://a.tile.openstreetmap.org/0/0/0.png>

Useful to web

- Structure of tile is useful for web.
 - Enable to scroll map smoothly.
 - Enable to zoom up and zoom down map smoothly.
 - HTTP GET request.
- Tile become known for Google Maps.
 - Tile has existed from the late 1990s.

Zoom

- Zoom level 0 : 1 file
- Zoom level 1 : $2 \times 2 = 4$ files
- Zoom level 2 : $4 \times 4 = 16$ files
- ...
- Zoom level 18 : $2^{18} \times 2^{18} = 262,144 \times 262,144 = 68,719,476,736$ files



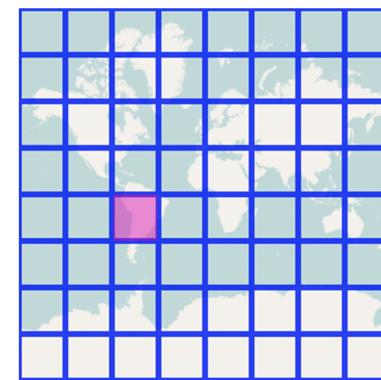
<https://maps.gsi.go.jp/help/image/tileNum.png>

GET Request

- Many services use REST API(GET Request).
 - <https://.../Z/X/Y.Format>
 - Z: Zoom Level
 - X: X coordinate
 - Y: Y coordinate
 - Format:
 - Raster image format(png, jpg, webp)
 - Vector data format(pbf, mvt)

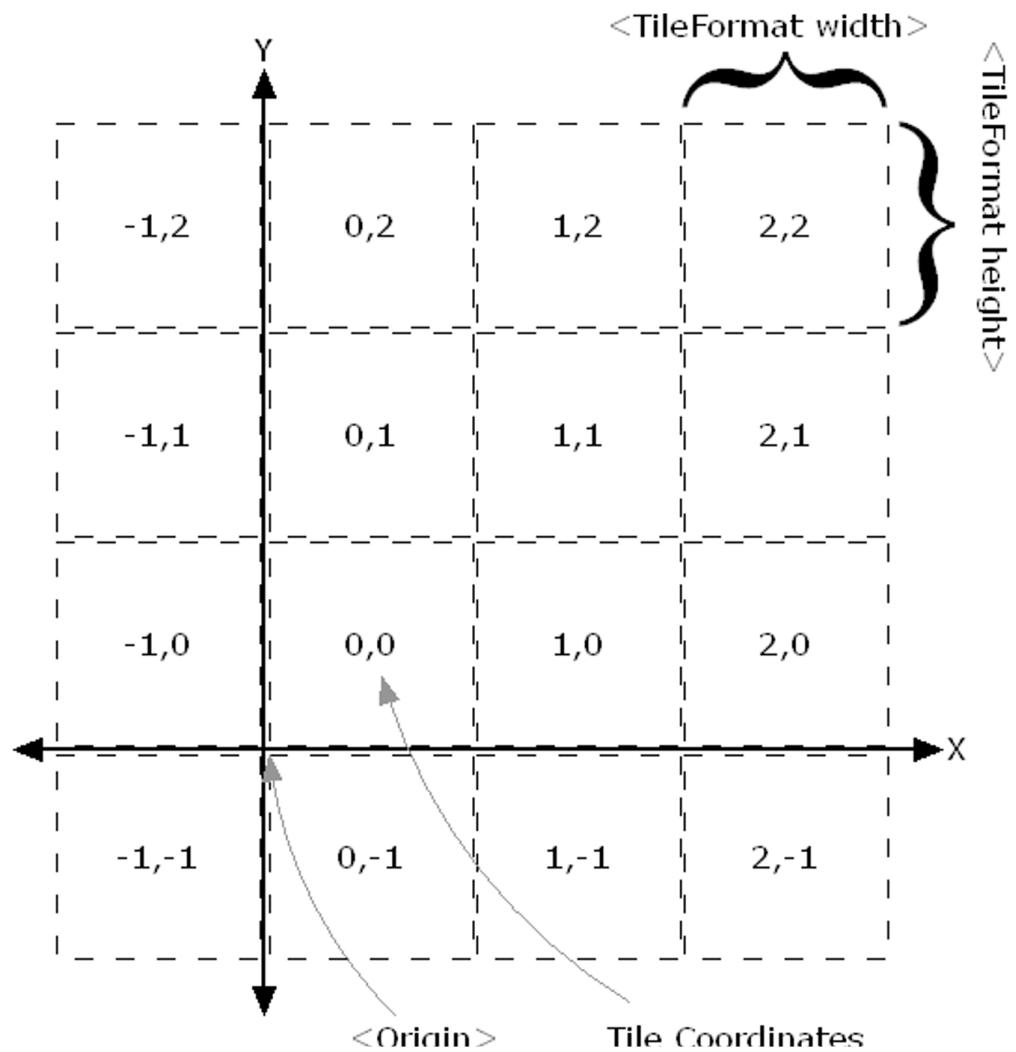
GET Request example

- <https://a.tile.openstreetmap.org/3/2/4.png>
 - Zoom = 3, X = 2, Y = 4,
format = png
 - X and Y coordinates start
with 0.

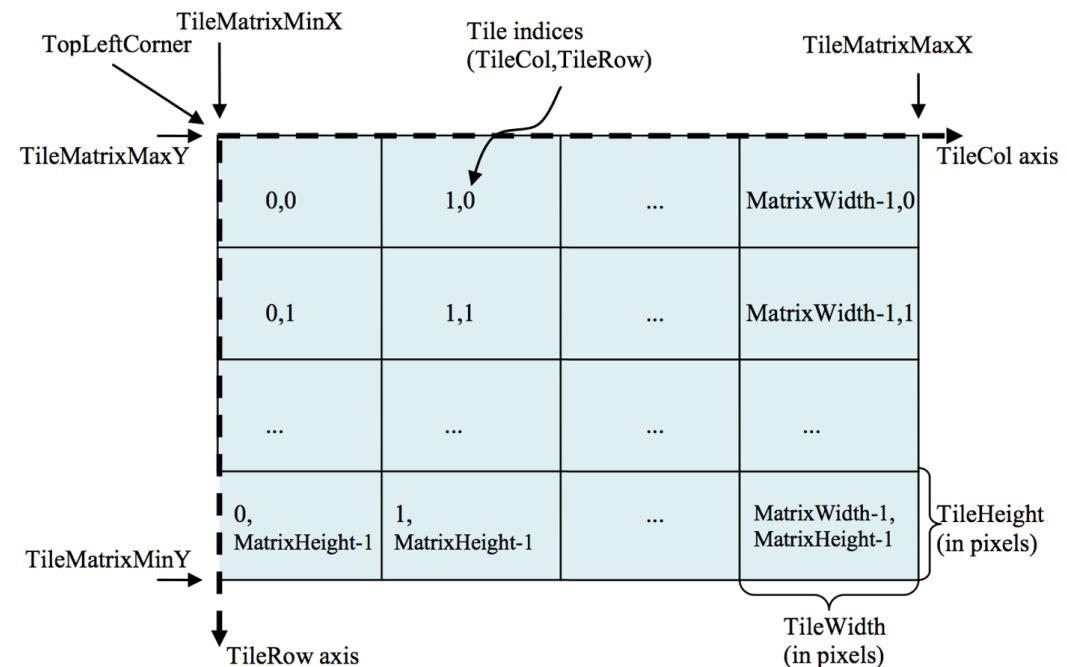


Specification

- Two tile service specifications are popular.
 - Tile Map Service(TMS)
 - Web Map Tile Service(WMTS)
- TMS is simpler than WMTS.
- TMS's X Y coordinate is started from bottom left.
 - Same as Cartesian coordinate system.
- WMTS's X Y coordinate is started from top left.
 - Same as Coordinate system of 2D computer graphics.



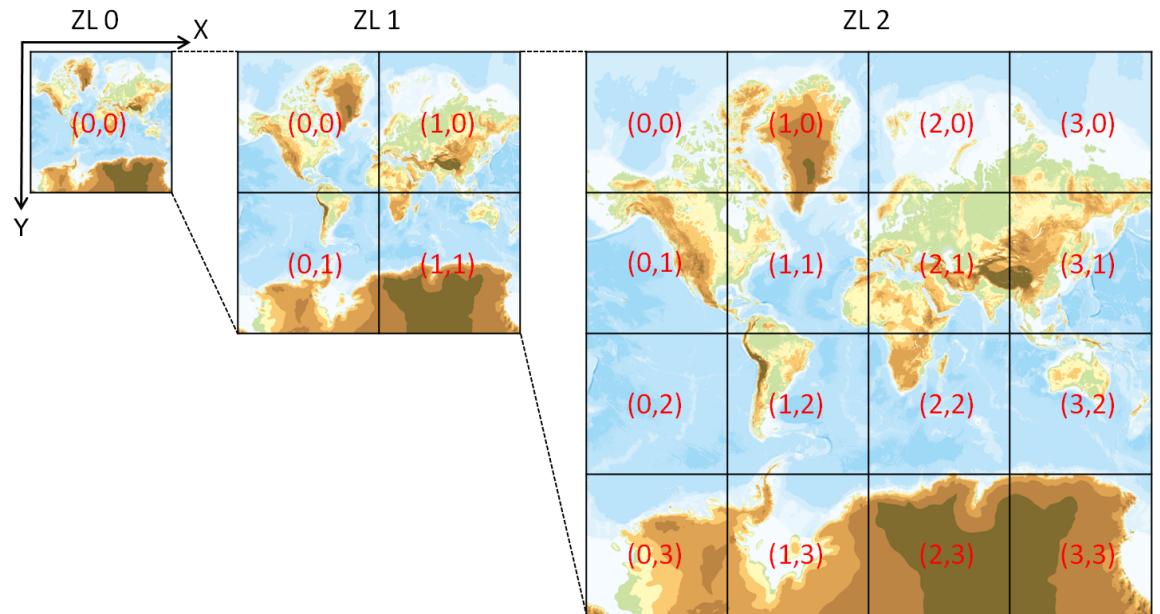
TMS



WMTS

The Y coordinate flipped

- OpenStreetMap use TMS like protocol but Y coordinate is numbered from top.
 - OpenStreetMap call "Slippy Map".
 - We call xyz tile.
 - $\{z\}/\{x\}/\{y\}.png$
 - Also we call zxy tile.



<https://maps.gsi.go.jp/help/image/tile>

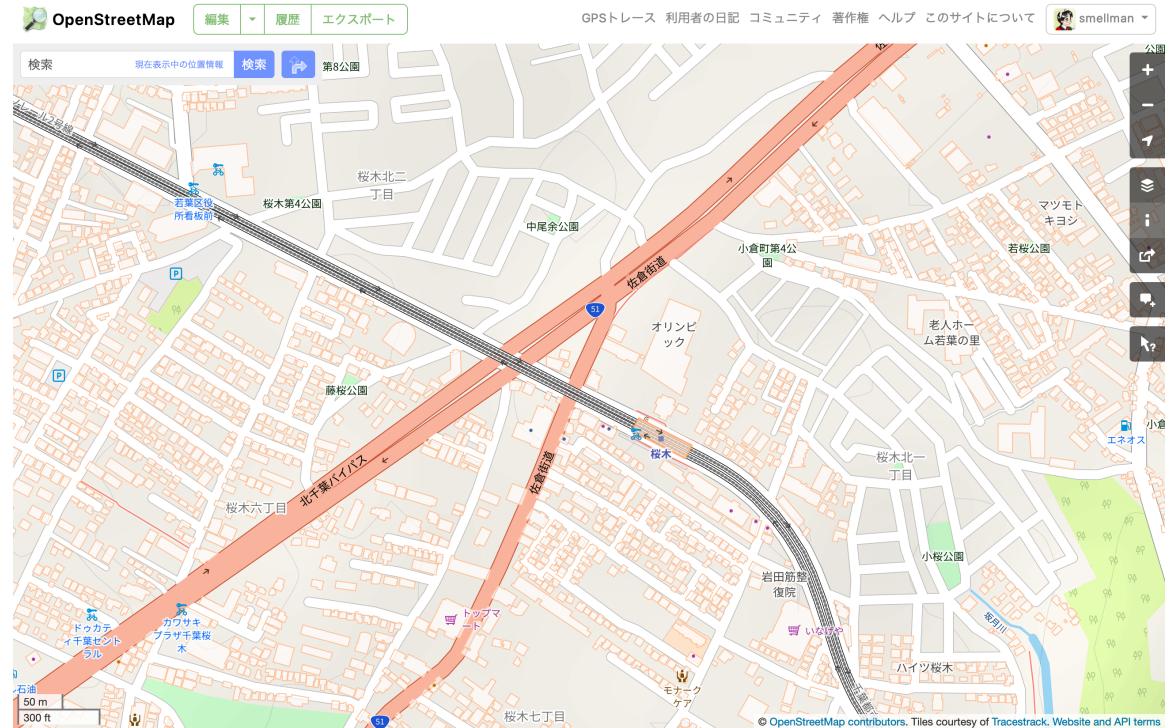
Num.png

XYZ tile

- De facto standard of tiled map.
 - Web Mercator projection
 - Y coordinate flipped TMS
 - Provide REST API
 - `{z}/{x}/{y}.{format}`
 - Anyone provide "Specification"
- Too many libraries support XYZ tile.
 - Leaflet, OpenLayers, Maplibre GL JS, Google Maps API etc.

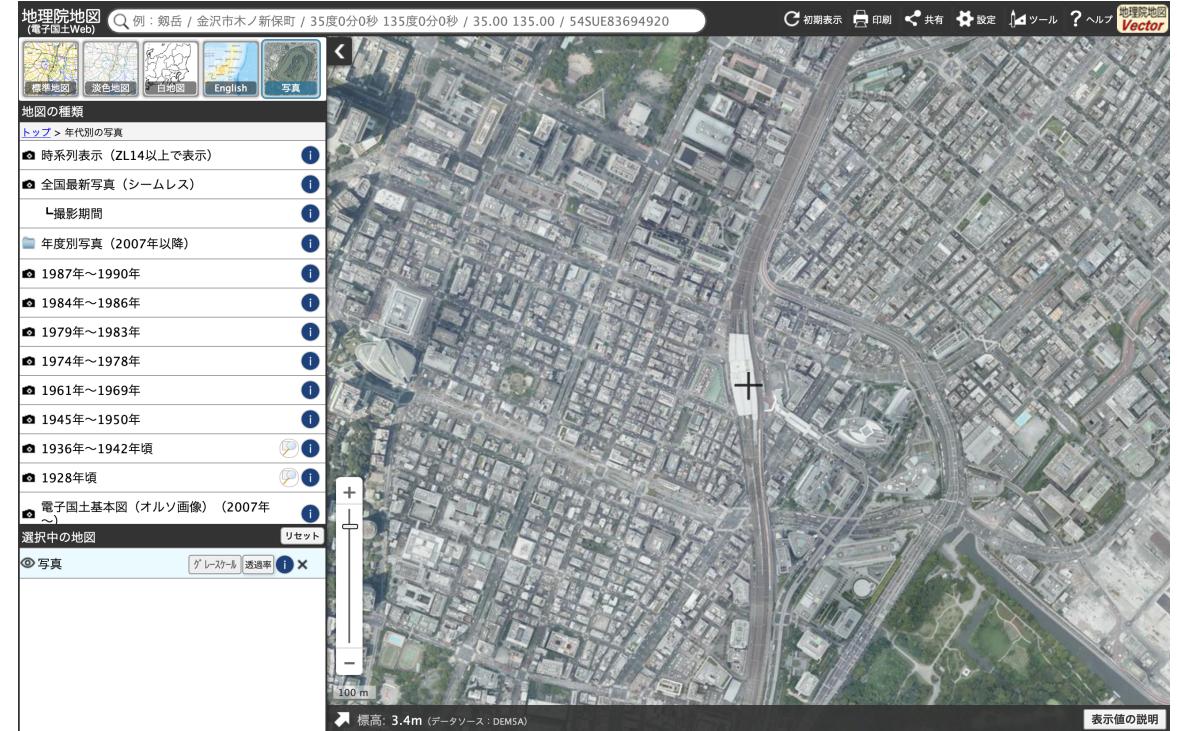
Raster tile (1/3)

- Provides "rendered image"
 - The image doesn't have any "data".
 - Focus to visualization.



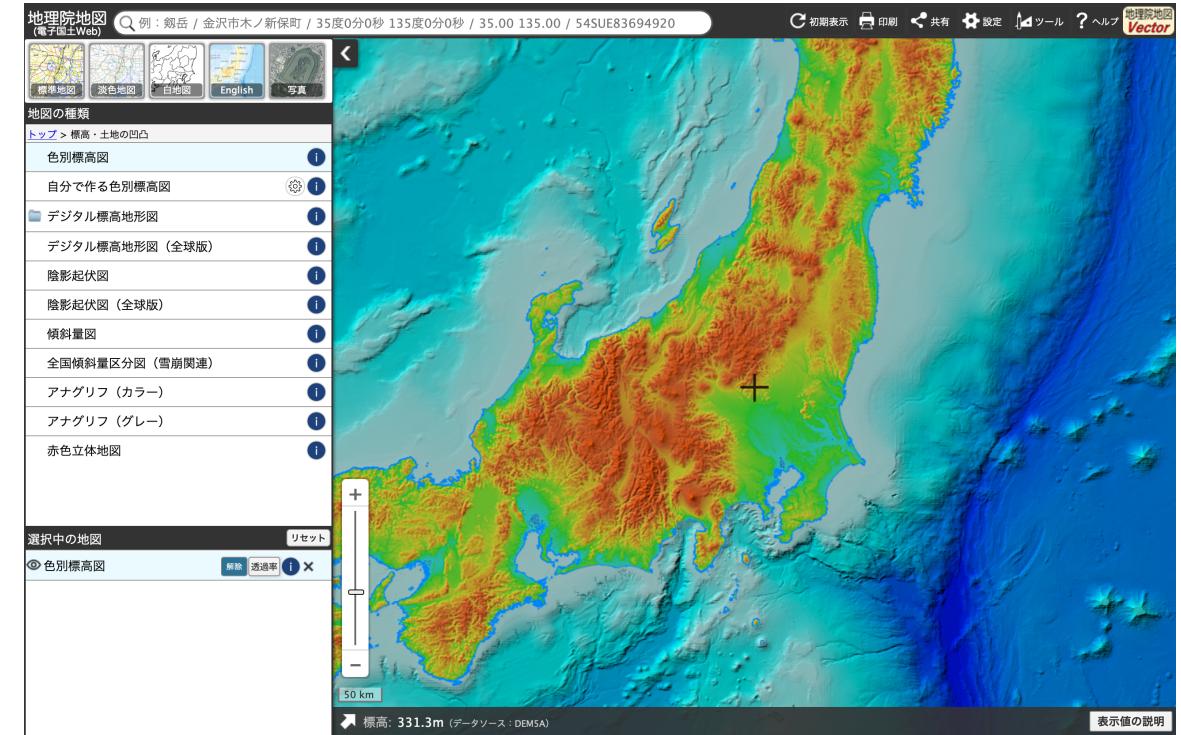
Raster tile (2/3)

- Provides "Satellite images" or "Aerial photograph"
 - Focus to photography.
 - The image doesn't have any "data" too.



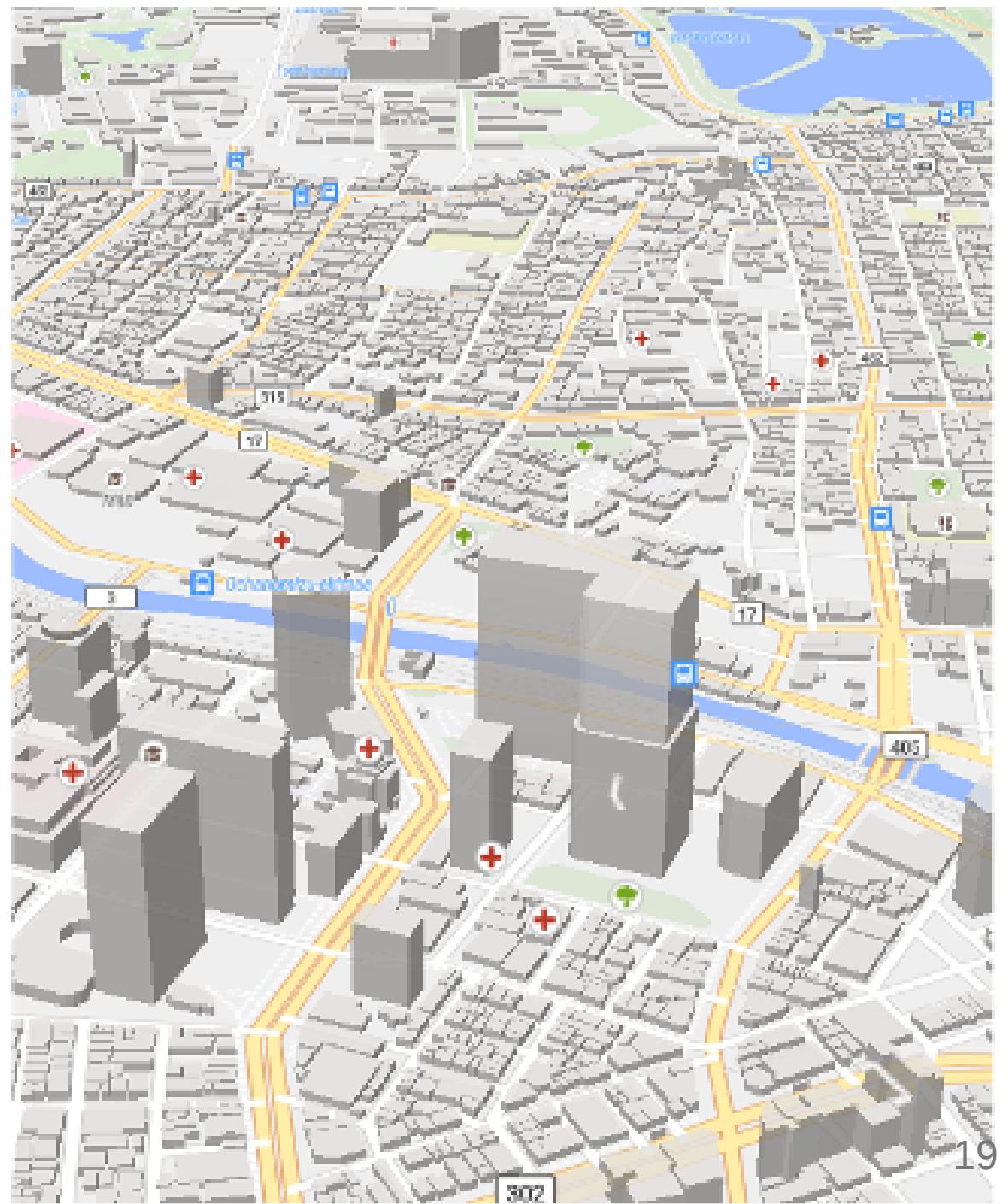
Raster tile (3/3)

- Provides "data" as image.
 - Focus to data.
 - Population,
Temperature, Rainfall,
Elevation, etc.
 - The image has "data" as color.
 - Sample raster tiles contain the elevation value obtainable by calculating with RGB values.



Vector tile (1/2)

- Provides "Vector data"
 - Each tile contains "Vector data".
 - The tile like a data container.

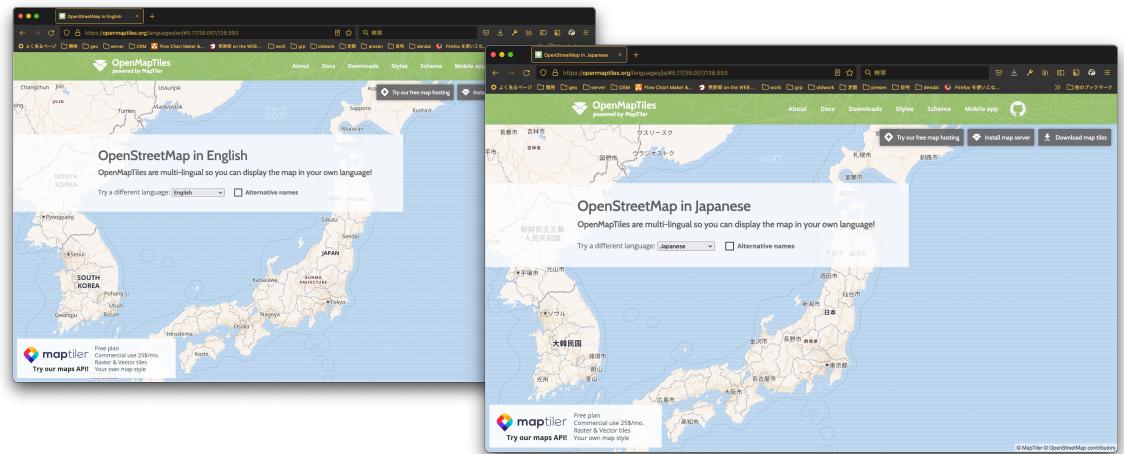


Vector tile (2/2)

- Vector tile doesn't have a style.
 - The client renders images with style settings.
 - Easy to rotation and bearing.
 - Supports 3D rendering.
- Programmable.
 - The client can change the style dynamically.

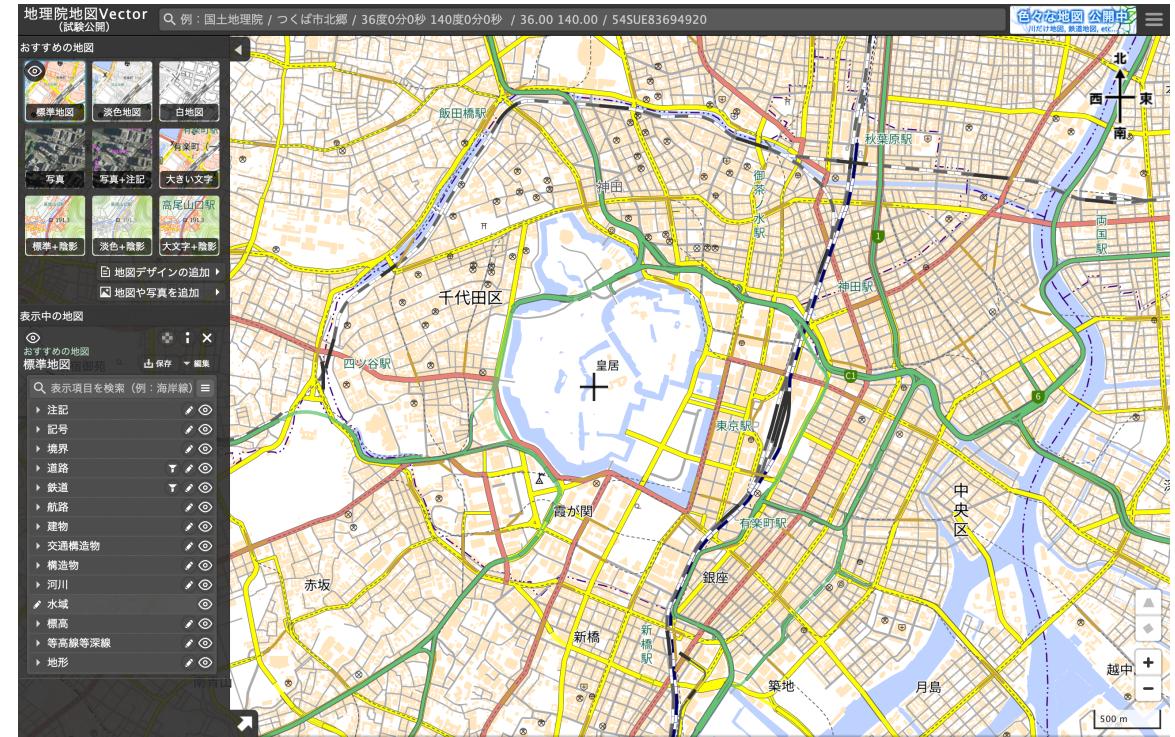
Vector tile example - Multilingual

- <https://openmaptiles.org/languages/>
 - Enable to change main language dynamically.



Vector tile example - Geospatial Information Authority of Japan

- <https://maps.gsi.go.jp/vector/>
 - GSI provides vector tile.
 - Enable to change style dynamically.



Mapbox Vector Tile

- De facto standard of vector tile.
 - Vector tile specification by Mapbox Inc.
- Specification
 - A tile encoded by Protocol Buffer format.
 - Desinged for Web Mercator projection.
 - Supports Layers and Features.

<https://docs.mapbox.com/data/tilesets/guides/vector-tiles-standards/>

Mapbox GL ecosystem and Style Specification

- Mapbox provides Mapbox GL JS(Web), Mapbox GL Native(Smartphone and Desktop application).
 - Mapbox provides specification of styling.
<https://docs.mapbox.com/mapbox-gl-js/style-spec/>



Note: Mapbox GL is proprietary software

- Mapbox GL became proprietary software from end of 2020.
 - Mapbox GL JS is OpenSource software until v1.5.
 - Mapbox GL JS over v2 must require mapbox service's token.
- MapLibre GL ecosystems are fork of mapbox OpenSource versions.
 - <https://maplibre.org/>
 - Highly recommend to use MapLibre GL JS now.

Tile support libraries - Javascript

- Leaflet
 - <https://leafletjs.com/>
 - Lightweight and easy to use.
 - Supports Mapbox Vector Tile with plugin.
- OpenLayers
 - <https://openlayers.org/>
 - Difficult to use but powerful.
 - Supports Mapbox Vector Tile.
- MapLibre GL JS
 - <https://maplibre.org/>
 - Easy to use for Mapbox Vector Tile.
 - Supports raster xyz tile too.

Tile support libraries - Android

- MapLibre GL Native
 - <https://maplibre.org/>
 - Easy to use for Mapbox Vector Tile.
 - Supports raster xyz tile too.
- Google Maps SDK
 - <https://developers.google.com/maps/documentation/android-sdk/overview>
 - Easy to use for raster xyz tile.

Tile support libraries - iOS

- MapLibre GL Native
 - <https://maplibre.org/>
 - Easy to use for Mapbox Vector Tile.
 - Supports raster xyz tile too.
- Mapkit
 - <https://developer.apple.com/documentation/mapkit>
 - Easy to use for raster xyz tile.

Desktop application

- QGIS
 - <https://qgis.org/>
 - Supports raster xyz tile.
 - Supports Mapbox Vector Tile.

Introduction of software and data in this presentation

Requirements

- This presentation requires Linux based OS.
- Also, you can use Raspberry Pi 4.
 - Raspberry Pi 4 is cheap and powerful.
 - Raspberry Pi 4 is ARM64 architecture.
 - Raspberry Pi 4 is easy to use for GIS.

Software

- GDAL/OGR
 - <https://gdal.org/>
 - GDAL/OGR is the most popular GIS library.
 - GDAL/OGR supports many GIS data formats.
 - GDAL/OGR supports raster xyz tile.