



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Federal Office of Topography swisstopo

Spatial Data Infrastructure (SDI) development and maintenance

wissen wohin
savoir où
sapere dove
knowing where

Quanized-Mesh tile encoder/decoder for python

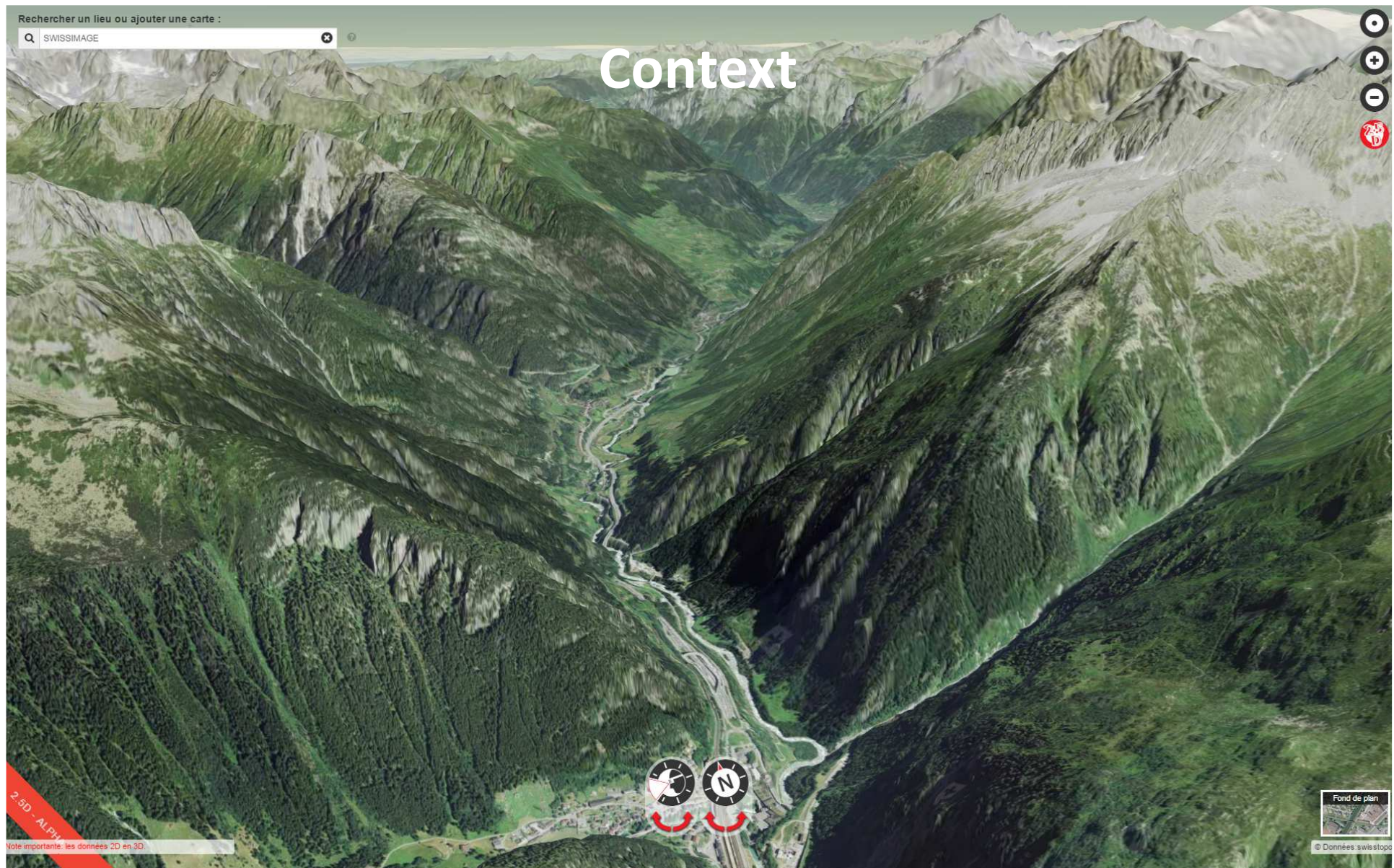


June, 20th 2016



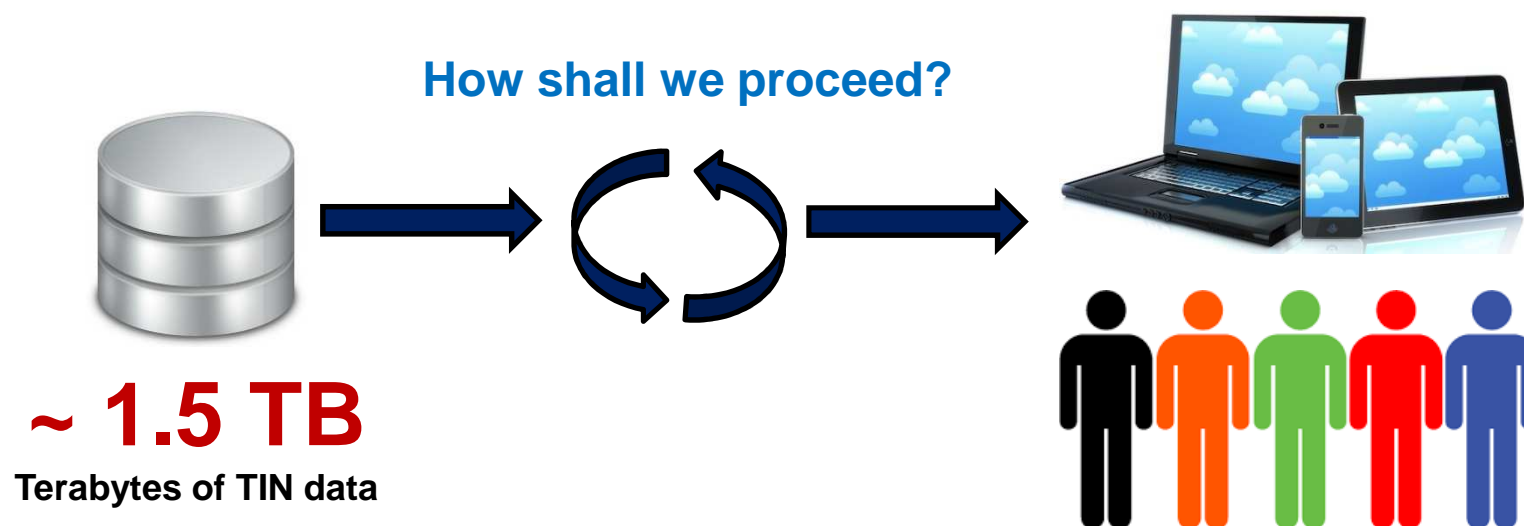
Presentation

- Context
- What are the open-source formats to represent terrain data in a browser?
- What is a quantized-mesh encoded tile?
- What do I need to create a terrain server?
- Guidelines to create my own terrain server?
- Debugging, what can I use?
- Terrain service for Switzerland



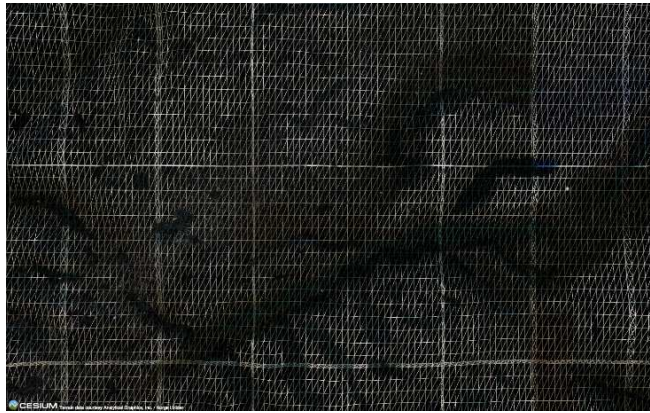


Context





What are the open-source formats to represent terrain data in a browser?



Heightmap-1.0

Data Source:

Digital elevations over a regular square grid. (65 x 65 vertices per tile)

Advantages:

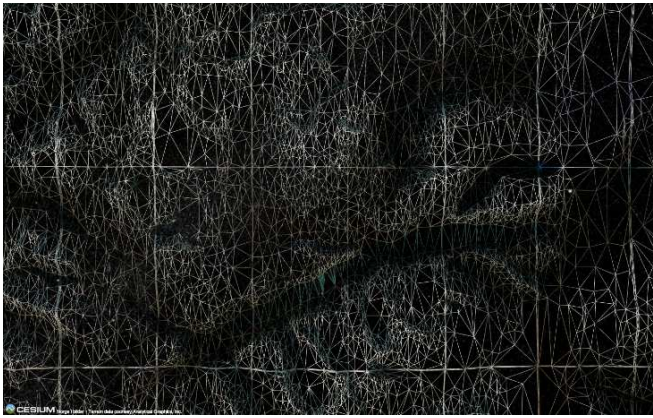
- Simple to produce and understand. (Use a GDAL supported DTM raster for instance)
- Free Open-Source terrain builder ready to use.

Disadvantages:

- Bad representation of sudden changes in terrain heights.
- Flat areas display as many vertices as steep, rough areas.
- No light extension support.



What are the open-source formats to represent terrain data in a browser?



[1]

Quantized-Mesh-1.0

Data Source:

Terrain formed from a triangulated irregular network of points.

Advantages:

- Good representation of detailed terrain objects (a road, river, damn...).
- Less triangles to represent flat surfaces.
- Optimized lighting extension available.

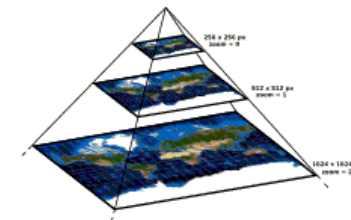
Disadvantages:

- No open-source tool to produce this format to until now.
- Complex, hard to debug.
- Harder to produce the input data.



What is a quantized-mesh encoded tile?

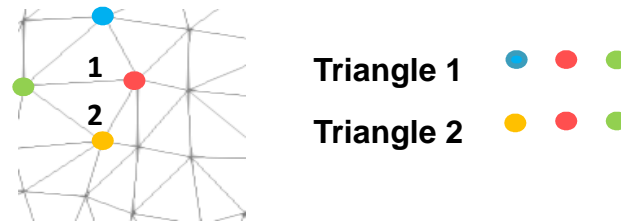
- It's a tiled format optimized to display mesh-based terrain (or TIN data) in a browser.
- Uses TMS (Tile Map Service) layout global-geodetic profile.
- Works exclusively in WGS84 EPSG:4326. ([Wiki OSGEO](#))
- A terrain server or terrain tileset represents a multi-resolution quadtree pyramid of terrain tiles.
- Finally, terrain tiles are binary files served gzipped and use the .terrain file extension.





What is a quantized-mesh encoded tile? (Data structure)

- Principle: Optimized OK but how?
- ➔ Use the characteristics of a triangulated irregular network of triangles to minimize bandwidth usage.
- We're only dealing with triangles.
 - Several triangles are sharing the same coordinates.
 - Because we know the tiling scheme we can get the extent of a tile.

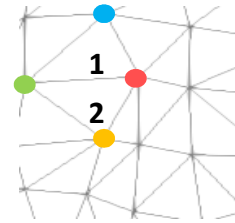




What is a quantized-mesh encoded tile? (Data structure)

- Representation in of 2 triangles in GeoJSON

```
[{
  type: Feature,
  geometry: {
    type: Polygon,
    coordinates:
      [[[31.351227273247478, 38.08185684148686, 215.9789151932048], [35.85376364749596,
45.0, 206.3408660888672], [39.9093445291757, 45.0, 212.1094958474486],
[31.351227273247478, 38.08185684148686, 215.9789151932048]]] }
},
{
  type: Feature,
  geometry: {
    type: Polygon,
    coordinates:
      [[[35.85376364749596, 45.0, 206.3408660888672], [31.351227273247478,
38.08185684148686, 215.9789151932048], [[21.146312171926024, 45.0,
282.2915329718519], [35.85376364749596, 45.0, 206.3408660888672]]] }
}]
```



Triangle 1 ● ● ●

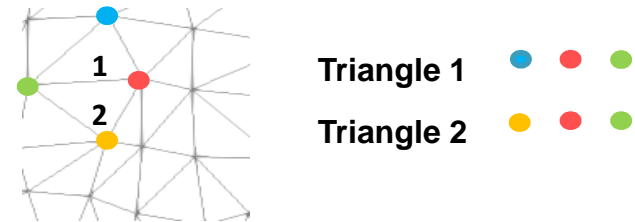
Triangle 2 ● ● ●



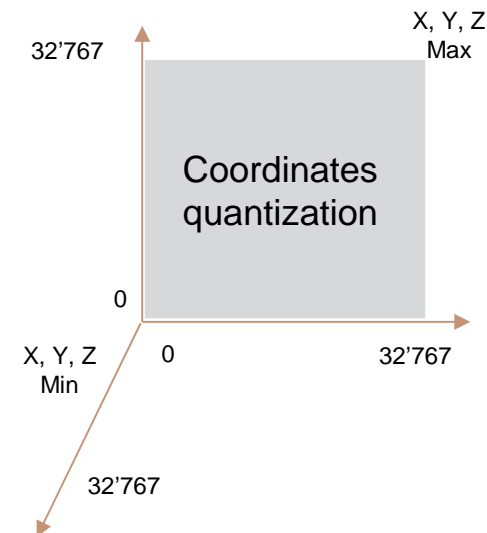
What is a quantized-mesh encoded tile? (Data structure)

- Representation of 2 triangles in quantized-mesh.

```
{  
X: [21075, 25034, 28600, 12102],  
Y: [26684, 32767, 32767, 32767],  
Z: [543, 0, 325, 4279],  
IndexData: [0, 1, 2, 1, 0, 3]  
}
```

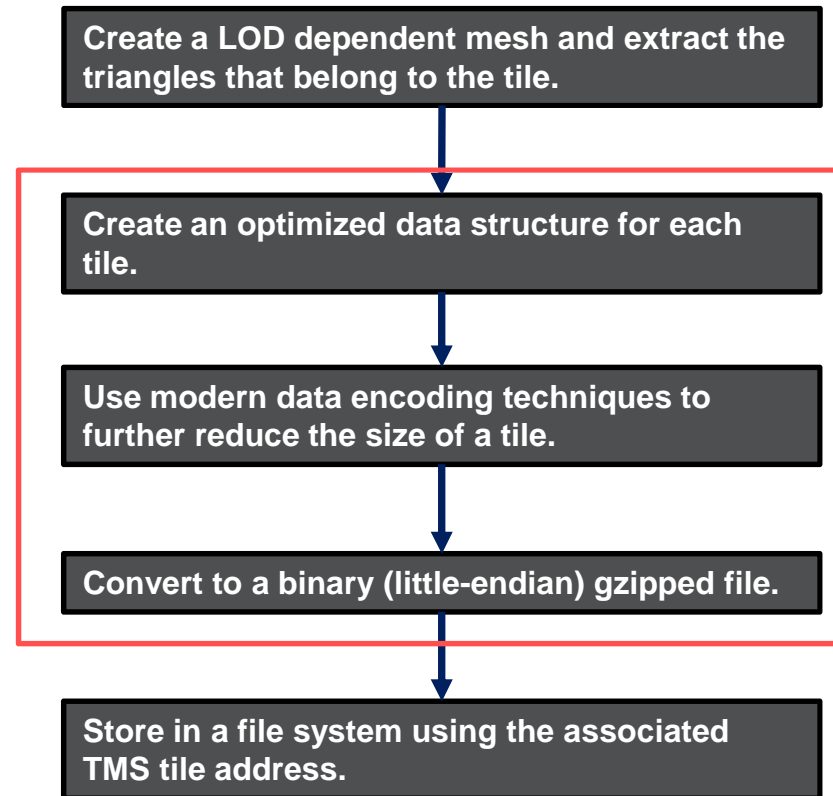


- Each vertex is defined only once.
- Index data read 3 by 3.
- Coordinates quantization.





What do I need to create my own terrain server?



What can
now be
addressed.



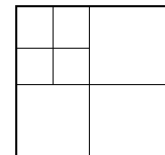
What do I need to create my own terrain server?

- You need to be able to create your own mesh and adapt its vertices density according to the level of detail.
- Once you have the triangle soup contained within a tile.
- You can use the [quantized-mesh encoder for python](#).



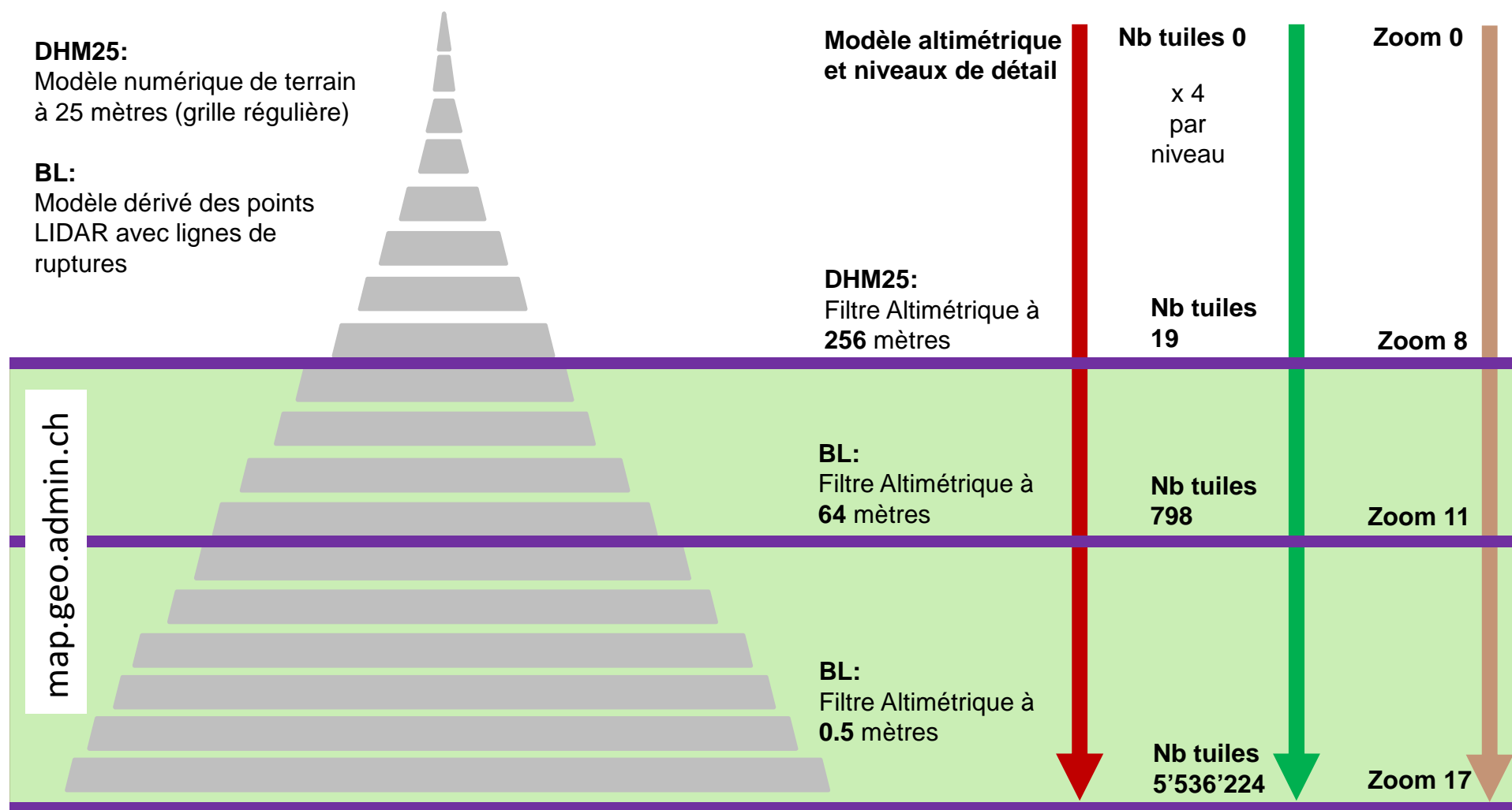
Guidelines to create my own terrain server?

- Tiles at low LODs are always loaded and these tiles should be extra light very generalized.
- The further the level of detail increase the bigger the tile can be.
- Try to never exceed 50Kb per tile or around 4'000 vertices max per tile.
- Based on TMS quadtrees → vertices density should be divided by 4 (at least) after each zoom level.
- Don't start at 0 if you're mapping a small country.



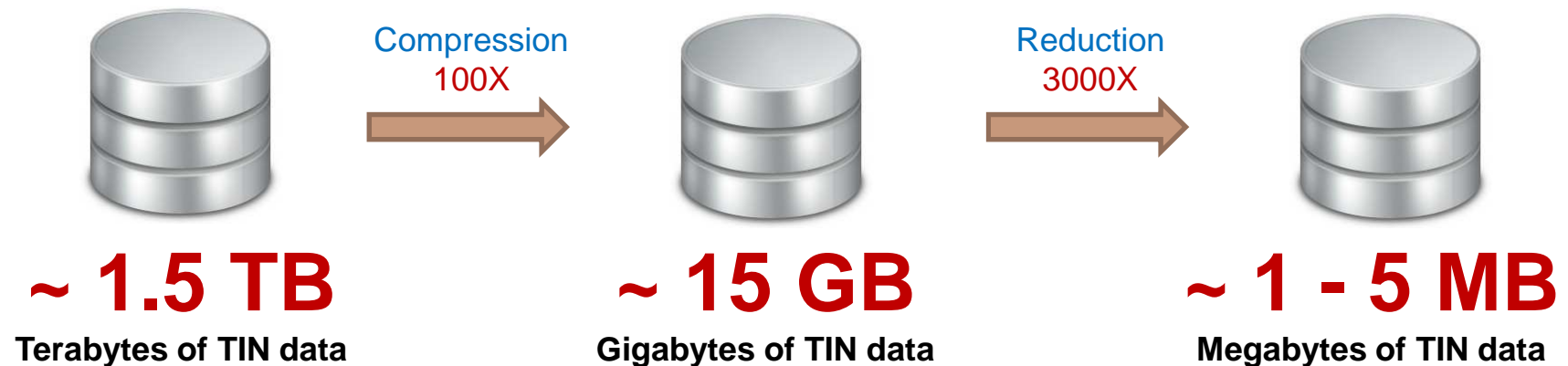
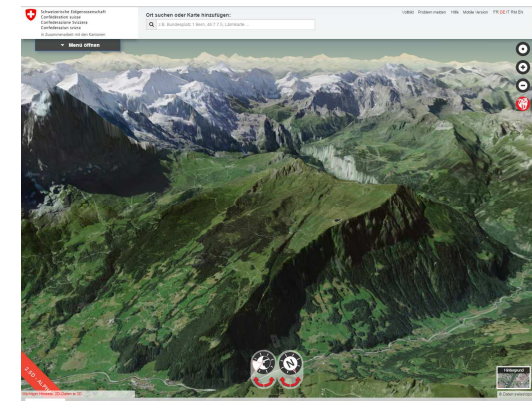
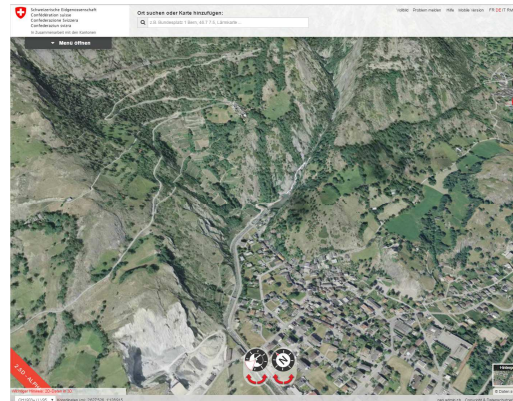
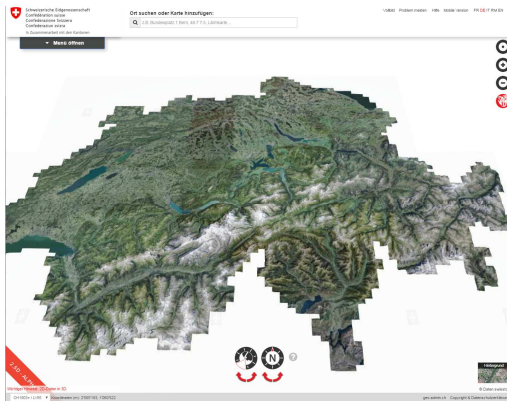


Guidelines to create my own terrain server?





Data Transfer to the client





Debugging, what can I use?

- [Single tile visualization.](#)
- [Cesium Debugger.](#)
- Use decoder to analyze the values, write a file in a different format.



... Echange / Communauté

FORUM

<http://groups.google.com/group/geoadmin-api>

www.geo.admin.ch

map.geo.admin.ch

api.geo.admin.ch

info@geo.admin.ch

Twitter: **@swiss_geoportal**

[http://www.**slideshare**.net/swiss_geoportal/](http://www.slideshare.net/swiss_geoportal/)