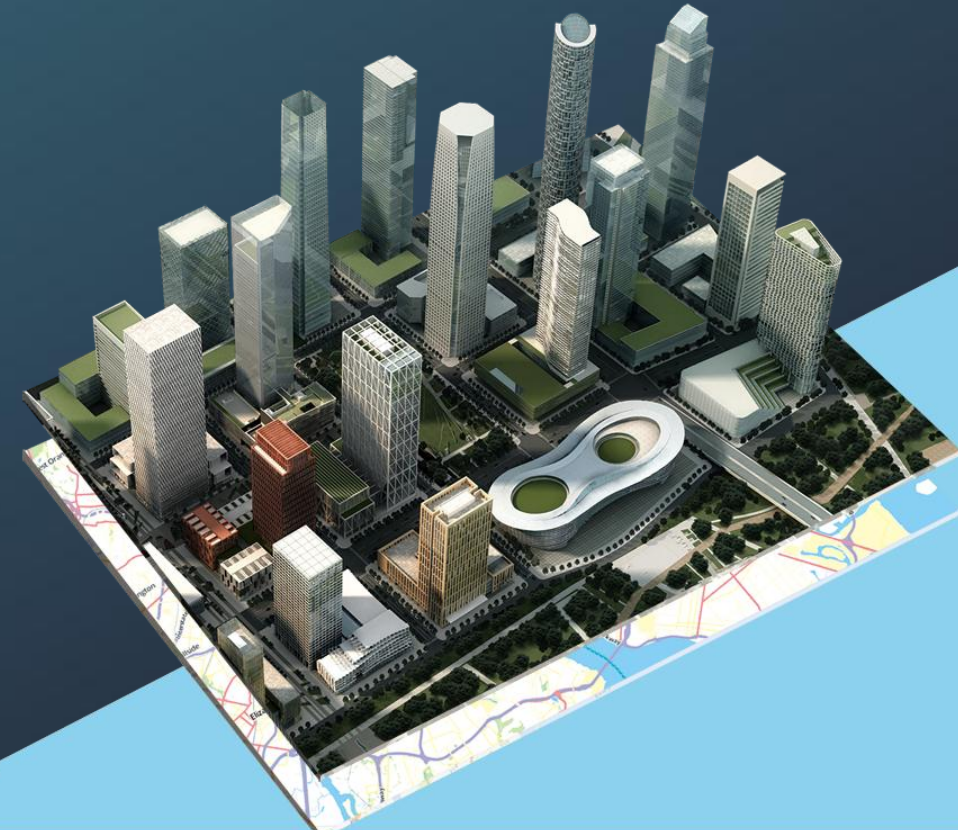


State of mago3DTiler & mago3DTerrainer

2025. 12. 05.

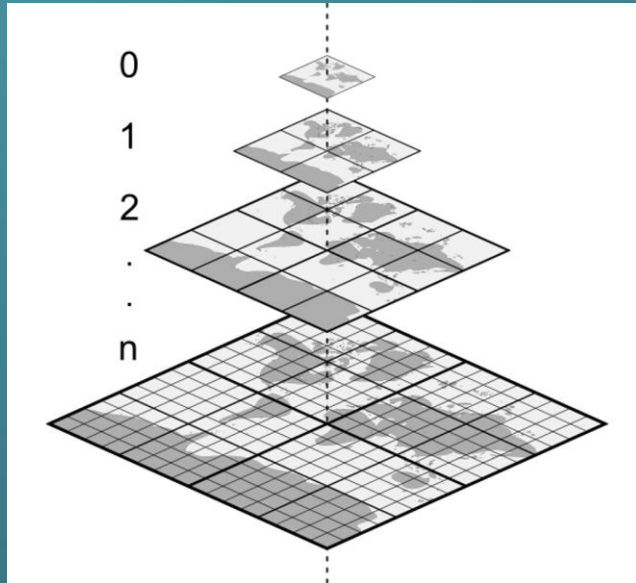
Sanghee Shin(shshin@gaia3d.com)
Jinho Kim, Sungdo Son, Hakjoon Kim
Gaia3D, Inc.



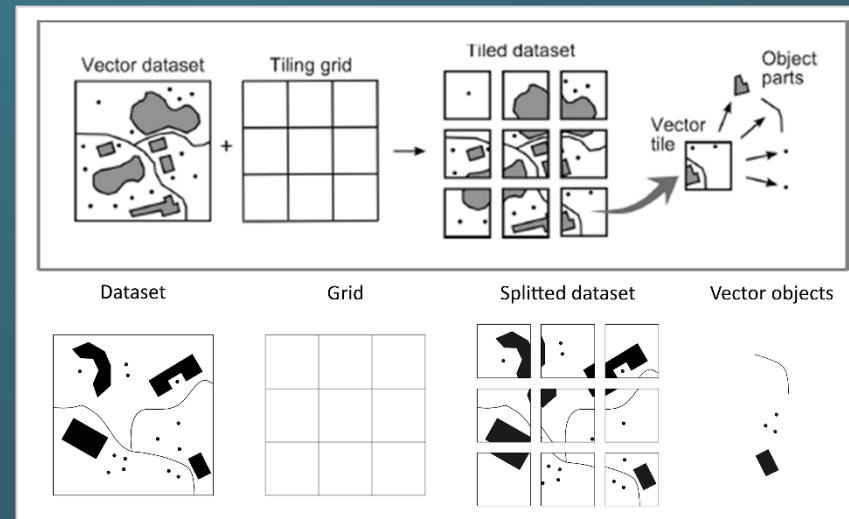
Contents

1. Before We Begin
2. Originally Supported Features
3. Newly Supported Features
 - Supporting OGC 3DTiles Version 1.1
 - 2D vector conversion
 - Improvement Realistic mesh
 - Improvement Point Cloud
 - ECEF Data Tiling
4. Things to Do Moving Forward
5. Q & A

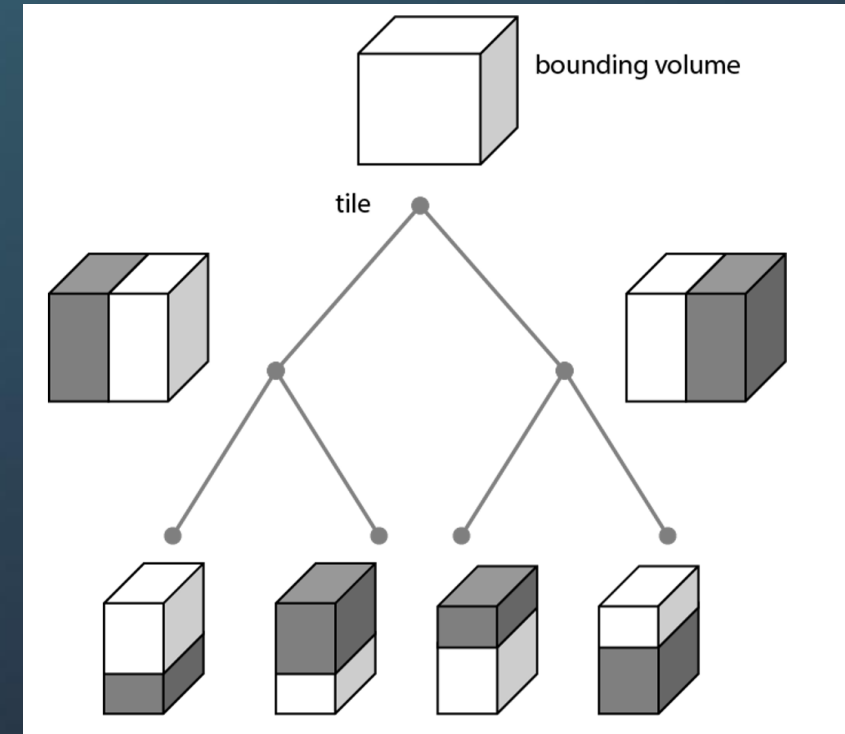
1. Before We Begin – 3D Tiles



<Tile Map Service>



<Vector Tile Service>



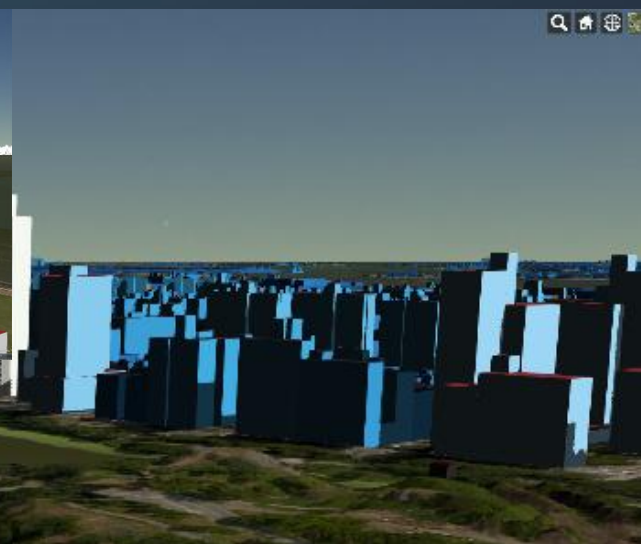
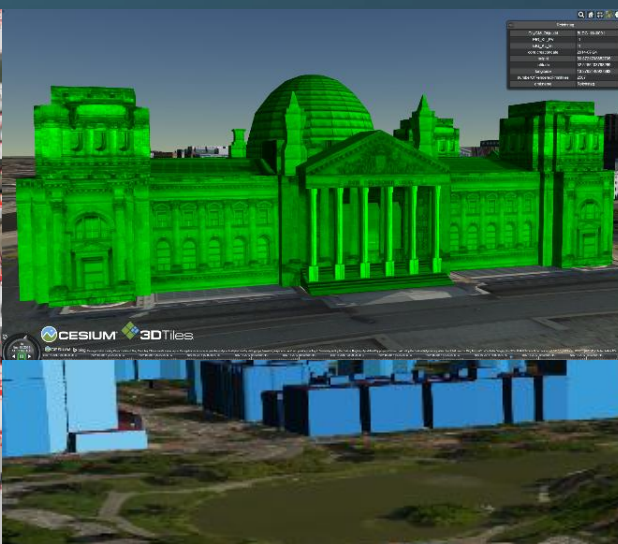
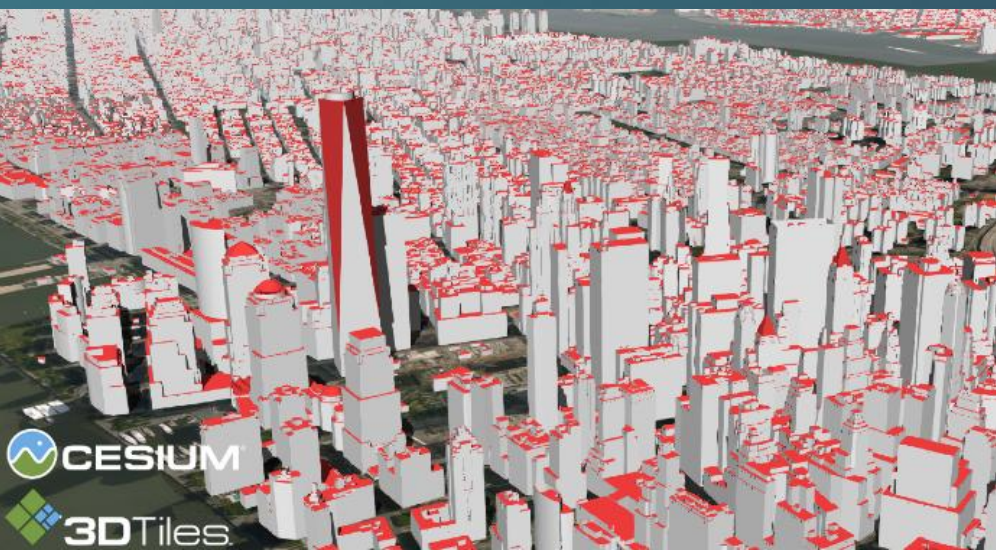
<3D Tiles>

1. Before We Begin – 3D Tiles

3D Tiles – OGC Community Standard

- Designed for streaming and rendering massive 3D geospatial content (3D Model, Points Cloud, Reality Mesh, etc.)
- Hierarchical data structure and a set of tile formats which deliver renderable contents

3D Tiles Specification



Originally Supported Features

2. Originally Supported Features

mago3DTiler

mago 3DTiler <https://github.com/Gaia3D/mago-3d-tiler>

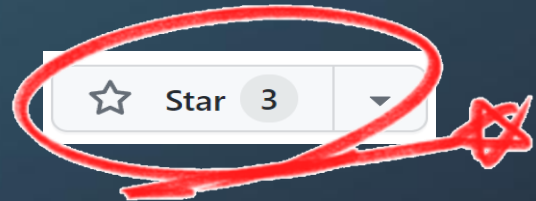
: Java based open source OGC 3D Tiles maker developed by Gaia3D

<https://github.com/Gaia3D/mago-3d-tiler>

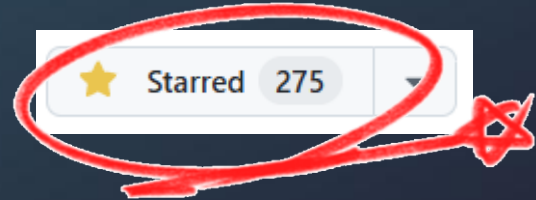


mago-3d-tiler Public			Edit Pins	Unwatch 15
main	6 Branches	21 Tags	Go to file	Add file >> Code
znkim Merge branch 'develop' ✓			b67c842 · 2 weeks ago	1,283 Commits
.github/workflows	build: version up to 1.11.7	6 months ago		
docs	docs: update java docs	2 weeks ago		
gradle/wrapper	build : Change gradle project to multiple project structure, a...	last year		
mago-common	chore: photogrammetry integral reMesh improved	2 weeks ago		
mago-io	docs: change subtree module docs	5 months ago		
mago-tiler-extension	hotfix: remove test code	2 weeks ago		
mago-tiler-non-extension	chore: integral reMesh improved by cellAveragePositions	2 weeks ago		
mago-tiler	Merge remote-tracking branch 'origin/develop' into develop	2 weeks ago		
.gitignore	build : change docker(jib) Authentication method	6 months ago		
LICENSE	Initial commit	2 years ago		
MANUAL.md	docs: update docs for 1.13.0-release version	4 months ago		
README.md	docs: update docs for 1.13.0-release version	4 months ago		

<December 2023>



<December 2025>



Latest Version: 1.14

2. Originally Supported Features

mago3DTiler

mago 3DTiler

<https://github.com/Gaia3D/mago-3d-tiler>

: Java based open source OGC 3D Tiles maker developed by Gaia3D

3D Tiles Specification



Open Source **No dependencies** on any specific company or technology

Portable & Scalable Offering excellent **interoperability, portability, and scalability** with other systems

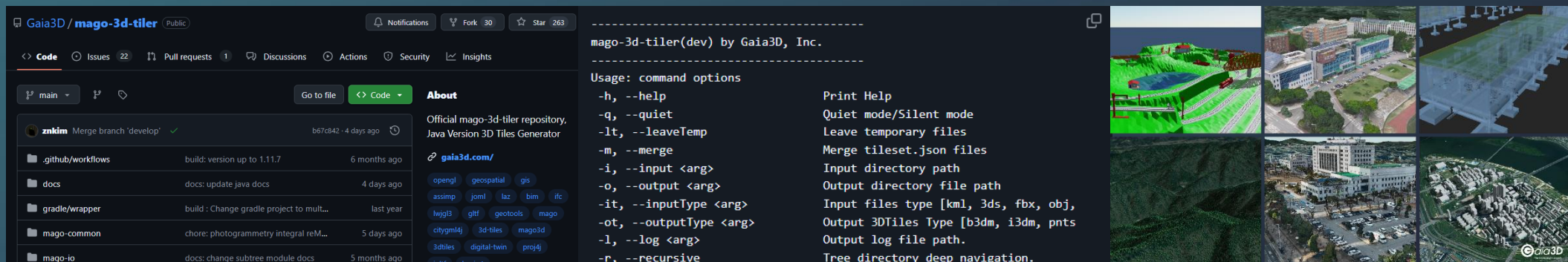
SRS Conversion **Real-time SRS transformation** during 3D Tiles making

Fast Speed Fast 3D Tiles making with parallel processing and fast rendering with data optimization

Model Extrusion Support **Extruded 3D Tiles making** from 2D SHP, GeoJSON using attribute

Various Formats Support 3DS, OBJ, FBX, IFC, CityGML, IndoorGML, LAS, LAZ, SHP, GPKG, and others

Enhanced Debugging Easy debugging through detailed exception handling and logging features



The screenshot displays the GitHub repository for Gaia3D/mago-3d-tiler. The repository page shows the 'Code' tab with a download button, a 'Fork' button (30 forks), and a 'Star' button (263 stars). Below the repository name, there are tabs for 'Code', 'Issues' (22), 'Pull requests' (1), 'Discussions', 'Actions', 'Security', and 'Insights'. The 'About' section describes it as the 'Official mago-3d-tiler repository, Java Version 3D Tiles Generator' and lists various supported formats like opengl, geospatial, gis, assimp, joml, laz, bim, ifc, hgt, gtl, geotools, mago, citygml, 3d-tiles, mago3d, 3dtiles, digital-twin, and proj4. To the right of the repository page, there is a terminal window showing the command options for mago-3d-tiler, including --help, --quiet, --leaveTemp, --merge, --input, --output, --inputType, --outputType, --log, and --recursive. Below the terminal window, there is a collage of six 3D tile visualizations showing various urban and natural scenes rendered as 3D tiles.

```
mago-3d-tiler(dev) by Gaia3D, Inc.

Usage: command options
-h, --help                Print Help
-q, --quiet                Quiet mode/Silent mode
-lt, --leaveTemp           Leave temporary files
-m, --merge                Merge tileset.json files
-i, --input <arg>         Input directory path
-o, --output <arg>         Output directory file path
-it, --inputType <arg>    Input files type [kml, 3ds, fbx, obj,
-ot, --outputType <arg>   Output 3DTiles Type [b3dm, i3dm, pnts
-l, --log <arg>           Output log file path.
-r, --recursive            Tree directory deep navigation.
```

Support for Various Formats

- 3DS, OBJ, COLLADA, IFC, FBX, PLY, Point Cloud(LAS, LAZ)
- All formats supported by ASSIMP (Open Asset Import Library, BSD3) can be theoretically supported.
- Polygon geometry + Height property described in SHP or GeoJSON formats is also supported.

Support for Various Coordinate Systems

- Supports all coordinate systems provided by PROJ

mago3DTiler

3D Tiles Specification



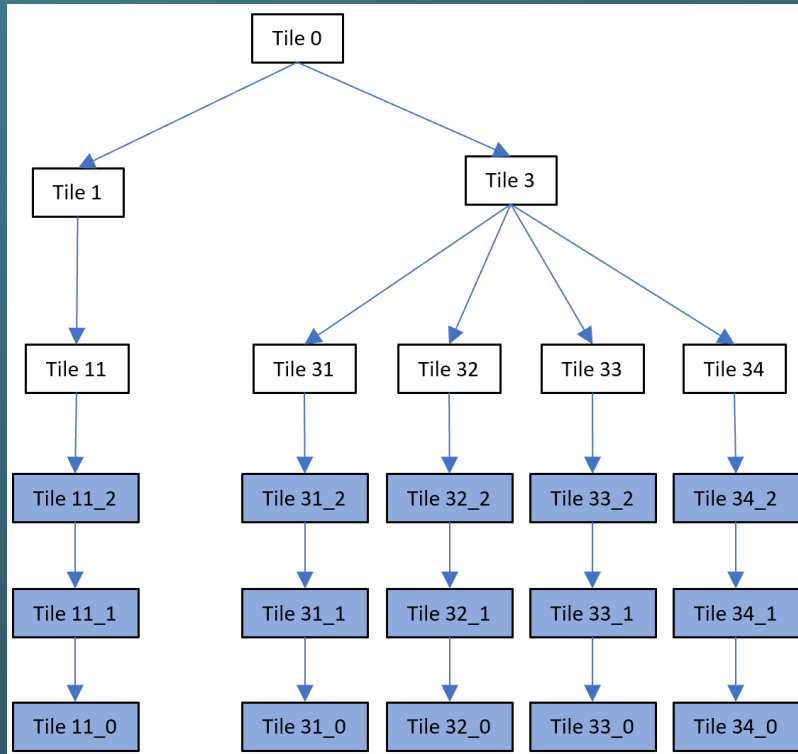
Open
Geospatial
Consortium

mago3DTiler

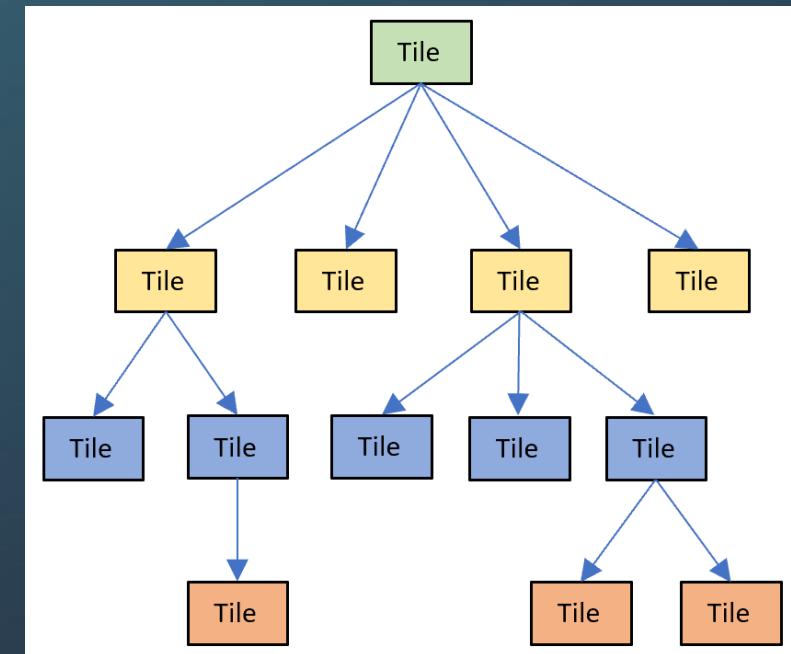
<https://github.com/Gaia3D/mago-3d-tiler>

: Java based open source OGC 3D Tiles maker developed by Gaia3D

>> ① Generate 3D Tiles with a more parent-child structure



<3D Tiles generated by other software>



<3D Tiles generated by mago3DTiler>

2. Originally Supported Features

mago3DTiler

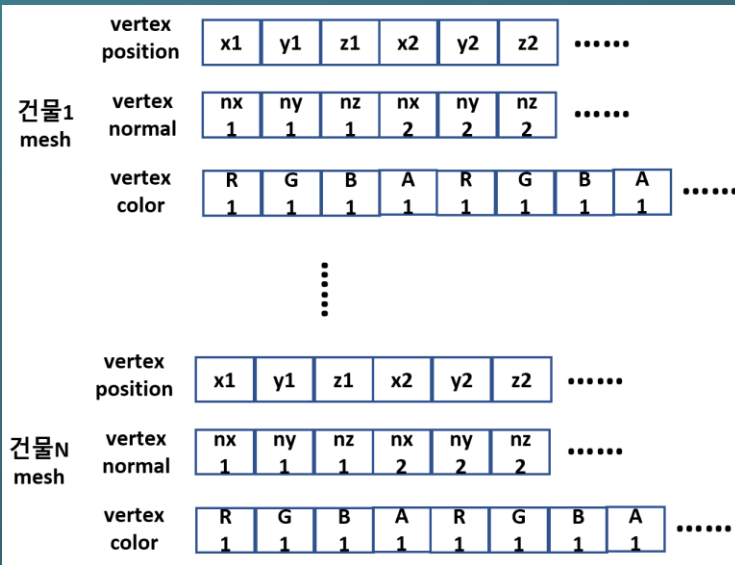


mago3DTiler

<https://github.com/Gaia3D/mago-3d-tiler>

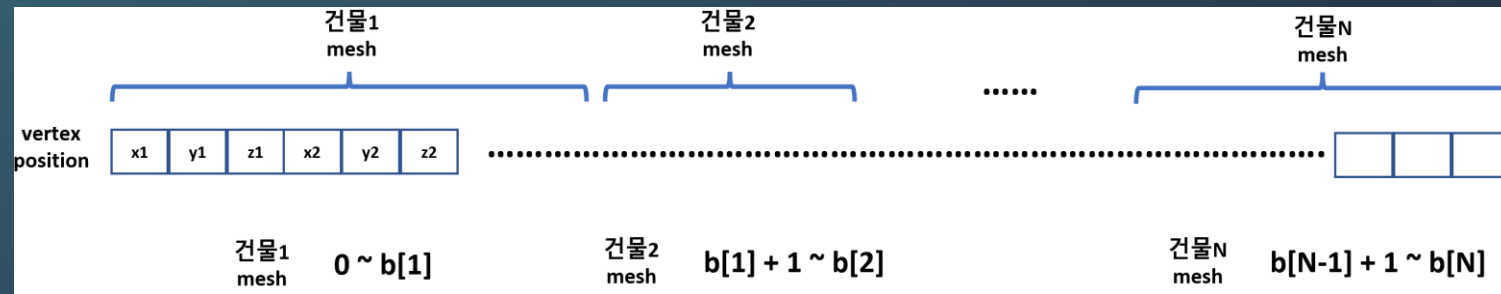
: Java based open source OGC 3D Tiles maker developed by Gaia3D

>> ② Batching optimization



<3D Tiles generated by other software>

Array Buffer Optimization



<3D Tiles generated by mago3DTiler>

mago3DTiler

3D Tiles Specification



Open
Geospatial
Consortium

mago3DTiler

<https://github.com/Gaia3D/mago-3d-tiler>

: Java based open source OGC 3D Tiles maker developed by Gaia3D

>> ③ Texture Size Optimization

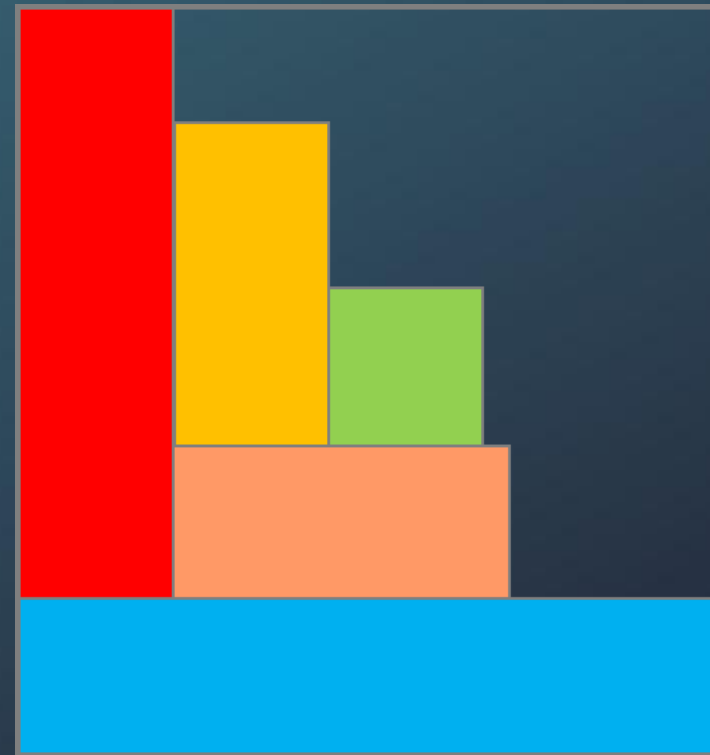
N Textures



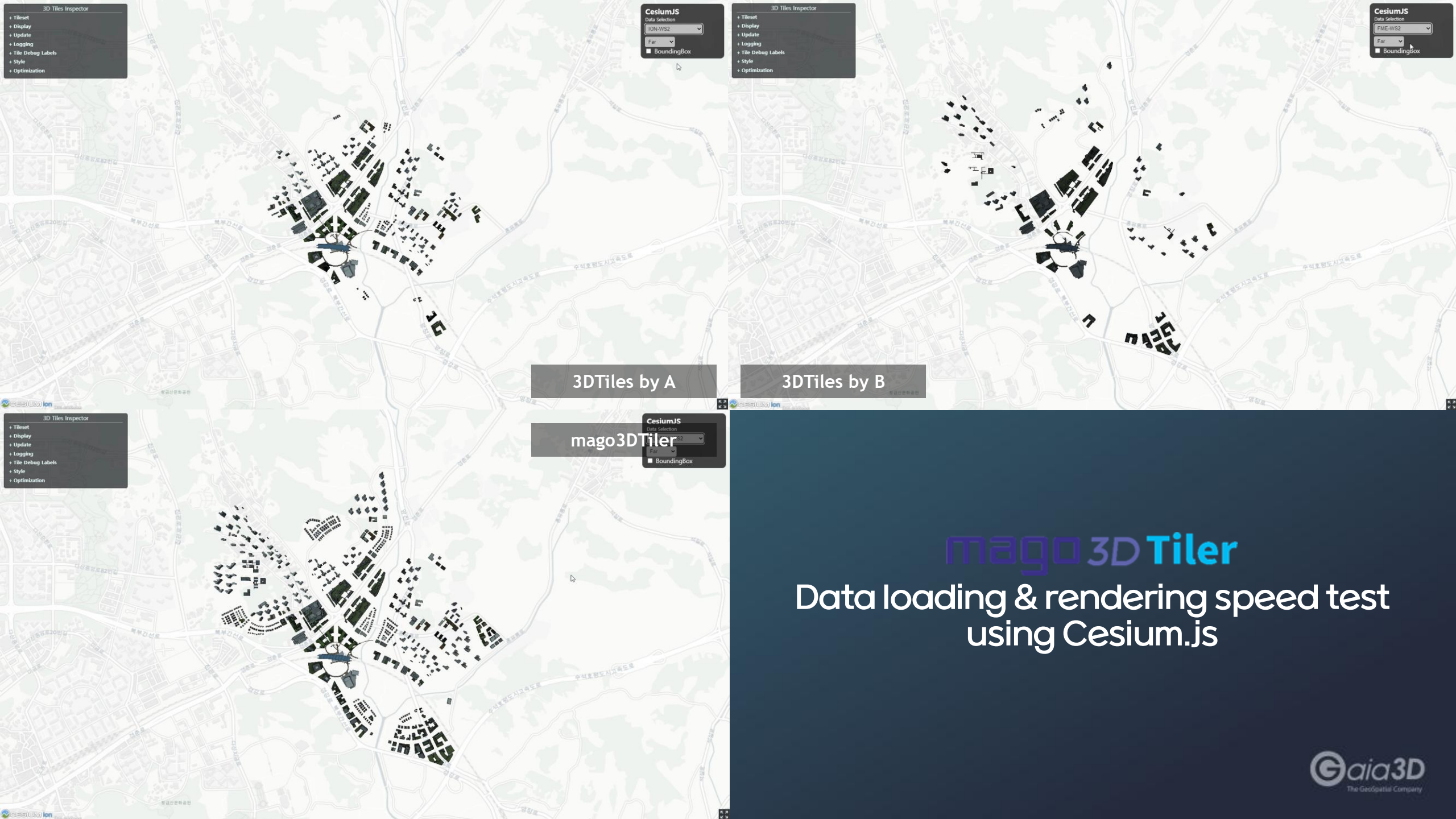
<3D Tiles generated by other software>



1 Texture



<3D Tiles generated by mago3DTiler>



3DTiles by A

3DTiles by B

mago3DTiler

mago3D Tiler

Data loading & rendering speed test
using Cesium.js

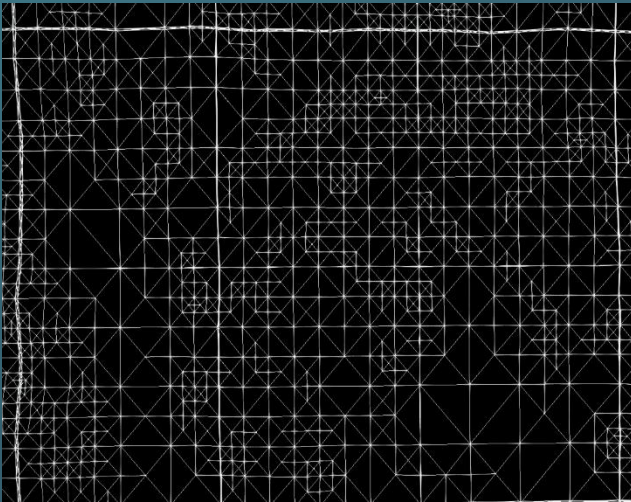
2. Originally Supported Features

mag3DTerrainer

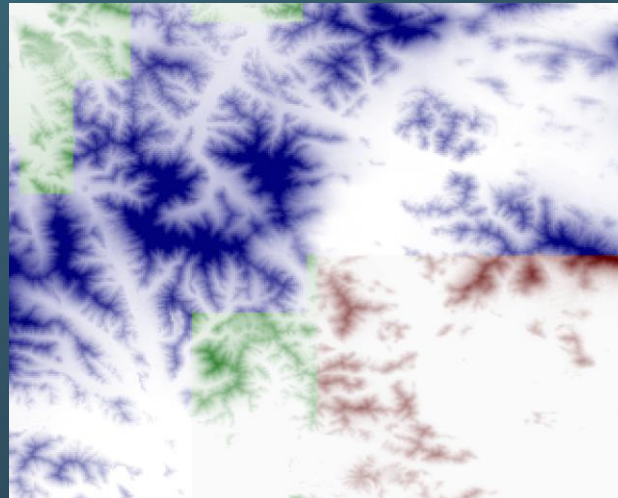
From Urban to Terrain — mag3DTerrainer

mag3DTiler focuses on urban and object-based 3D data, so **mag3DTerrainer** complements it for terrain data processing

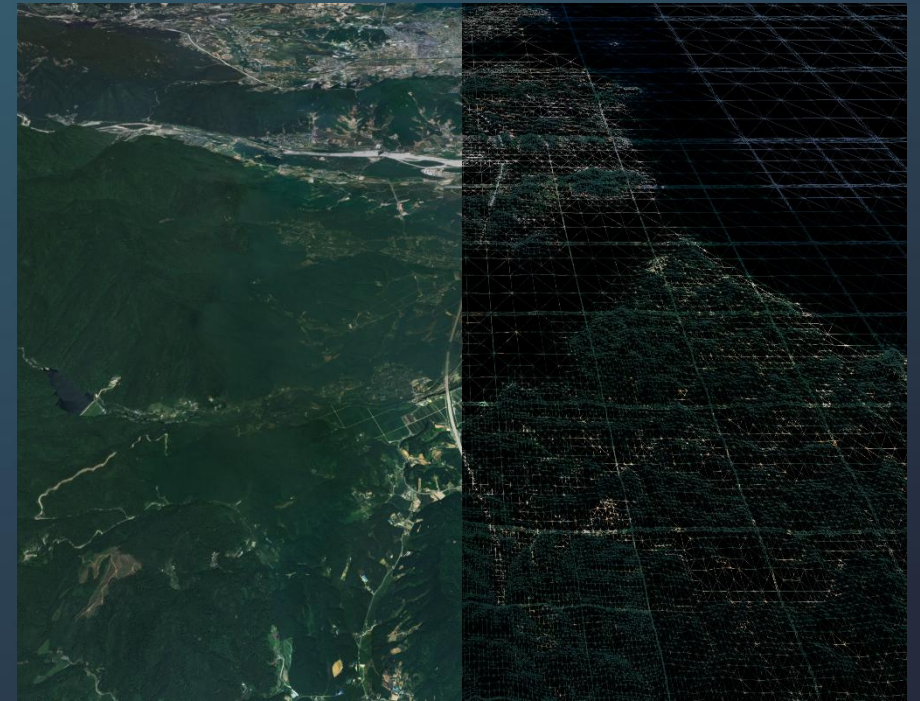
- Simple to use, fast DEM-to-Terrain conversion
- Supports multiple GeoTIFF inputs and multi-CRS handling via Proj
- **Prioritizes high-resolution data when mixing multiple datasets**
- RTIN-based terrain generation



<Wireframe Terrain>



<Multiple Resolution GeoTIFFs>



<Terrain Wireframe Comparing Screenshot>

2. Originally Supported Features

mago3DTerrainer

mago 3DTerrainer

<https://github.com/Gaia3D/mago-3d-terrainer>

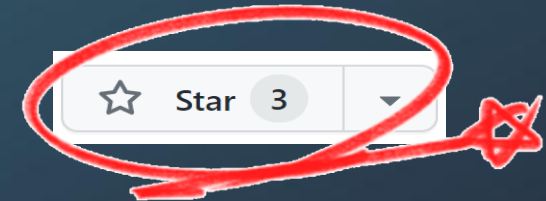
: Java based open source quantized-mesh terrain generator

<https://github.com/Gaia3D/mago-3d-terrainer>

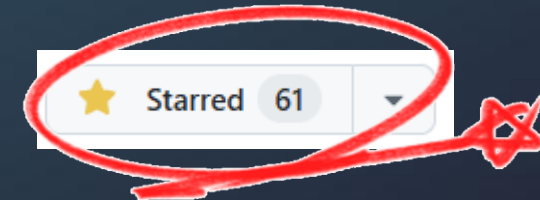


mago-3d-terrainer Public			Edit Pins	Unwatch 9
main	2 Branches	4 Tags	Go to file	Add file Code
znkim	test: add test codes	d16a6d6 · last month	1,378 Commits	
.github/workflows	build : fix word	6 months ago		
docs	refactor : improve build scripts	6 months ago		
gradle/wrapper	refactor : refactoring project	last year		
mago-common	Merge commit '0847a664b2b562bd86ed2f183c393a715469...	5 months ago		
mago-terrainer	test: add test codes	last month		
src/main/java/com/gaia3d/basic/marchingcube	Merge remote-tracking branch 'common/main' into develop	6 months ago		
.gitignore	build : change docker(jib) Authentication method	6 months ago		
LICENSE	doc : fixed korean manual, readme	11 months ago		
MANUAL.ko.md	refactor : improve build scripts	6 months ago		
MANUAL.md	refactor : improve build scripts	6 months ago		
README.ko.md	refactor : improve build scripts	6 months ago		
README.md	build : fix test, update readme	6 months ago		

<May 2025>



<December 2025>



Latest Version: 1.10

2. Originally Supported Features

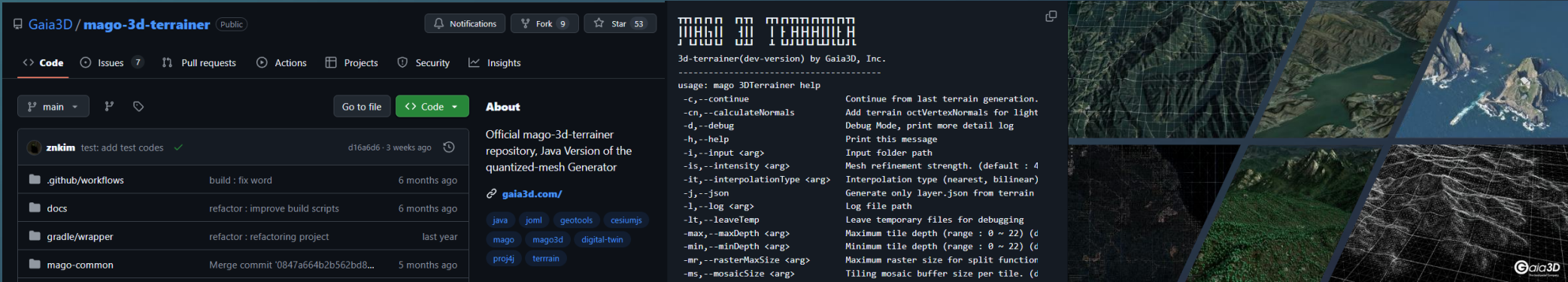
mag3DTerrainer

mag 3DTerrainer

<https://github.com/Gaia3D/mago-3d-terrainer>
<https://github.com/CesiumGS/quantized-mesh>

: Java based open source quantized-mesh terrain generator

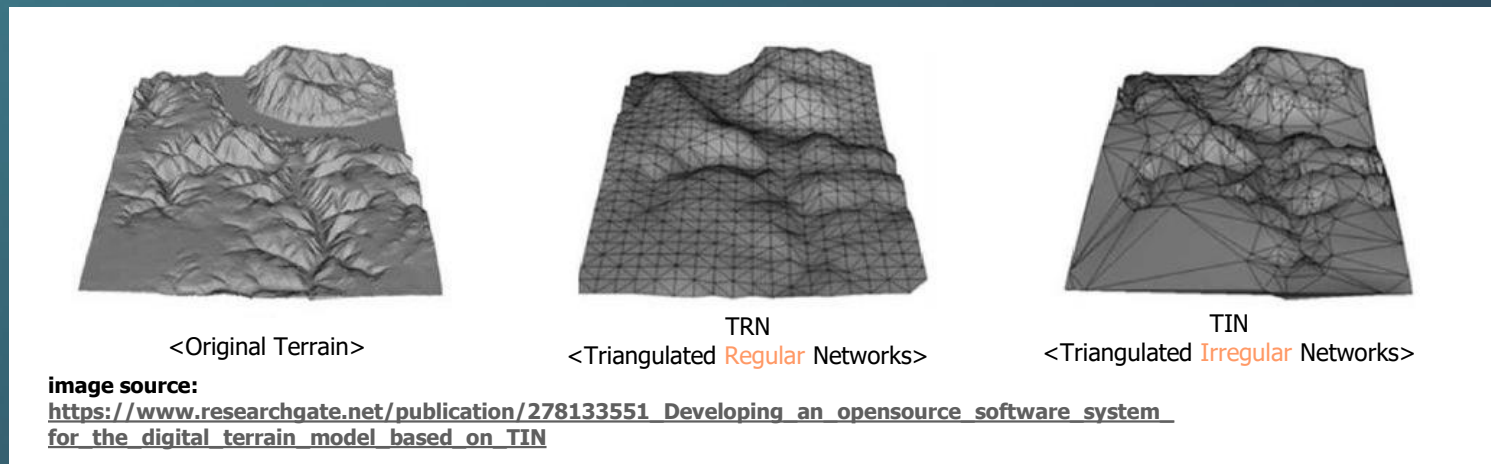
Open Source	No dependencies on any specific company or technology
Portable & Scalable	Offering excellent interoperability, portability, and scalability with other systems
SRS Conversion	Real-time SRS transformation during 3D Tiles making
High accuracy	Generate quantized-mesh data with high accuracy.
Multiple data conversion	Convert multiple GeoTIFF data at once.
Customizable options	Provides various customization options such as min/max tile depth, tile raster max size, tile mosaic size, tile generation strength, interpolation method, etc.



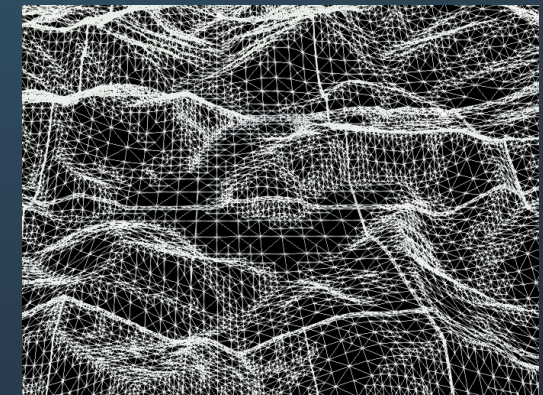
Why we use RTIN(Right-Triangulated Irregular Network Type)?

We adopted the **RTIN-based method** as our primary terrain generation approach.

- RTIN provides an efficient **balance** between TIN and traditional terrain grids
- It captures terrain features accurately while keeping the mesh lightweight
- The refinement process allows flexible control over detail levels
- Because refinement can be adjusted, LOD generation becomes much easier and more efficient



<Terrain Mesh Types>



RTIN
<Right-Triangulated Irregular Network Type>

2. Originally Supported Features

License

- mago3DTiler, mago3DTerrainr are released under the **MPL 2.0 license** (<https://www.mozilla.org/en-US/MPL/2.0/>)
- If you do not wish to disclose the modified code under the **MPL 2.0 license**, you may opt for a commercial license. In this case, please contact us at sales@gaia3d.com

*"It's a work
in progress"*



*"Good things
take time!"*

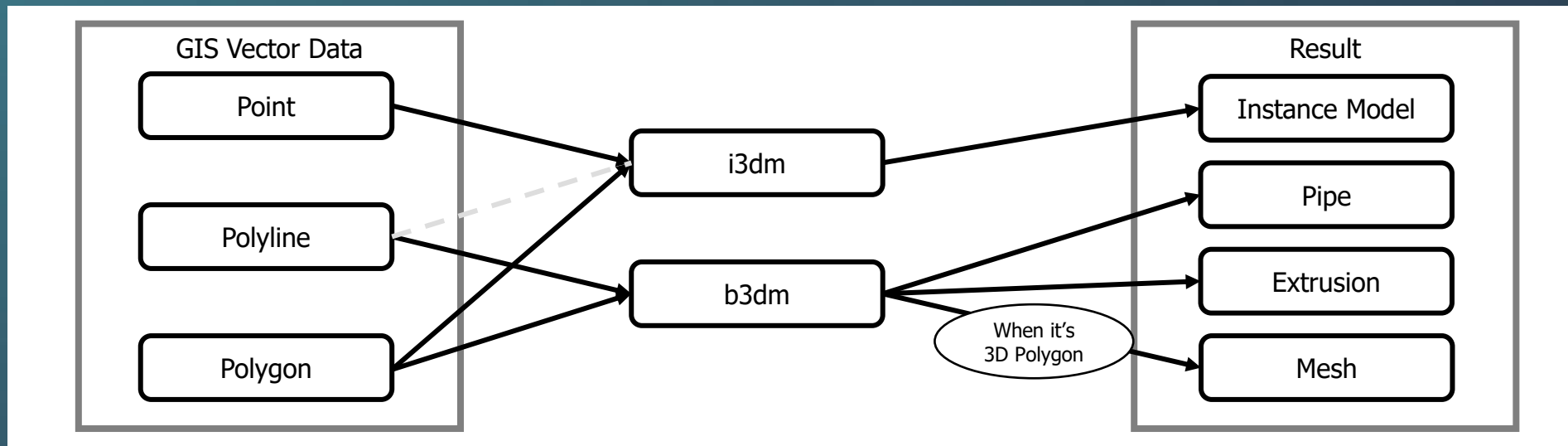
Newly Supported Features

(mago3DTiler)

3D Tiles Making from 2D Map

More flexible 2D map conversion features

- Enhanced 2D map data conversion for more flexible use, including extrusion and underground pipe generation features.
- It's not just about converting point-type data to i3dm—it also enables generating random instances within polygons.

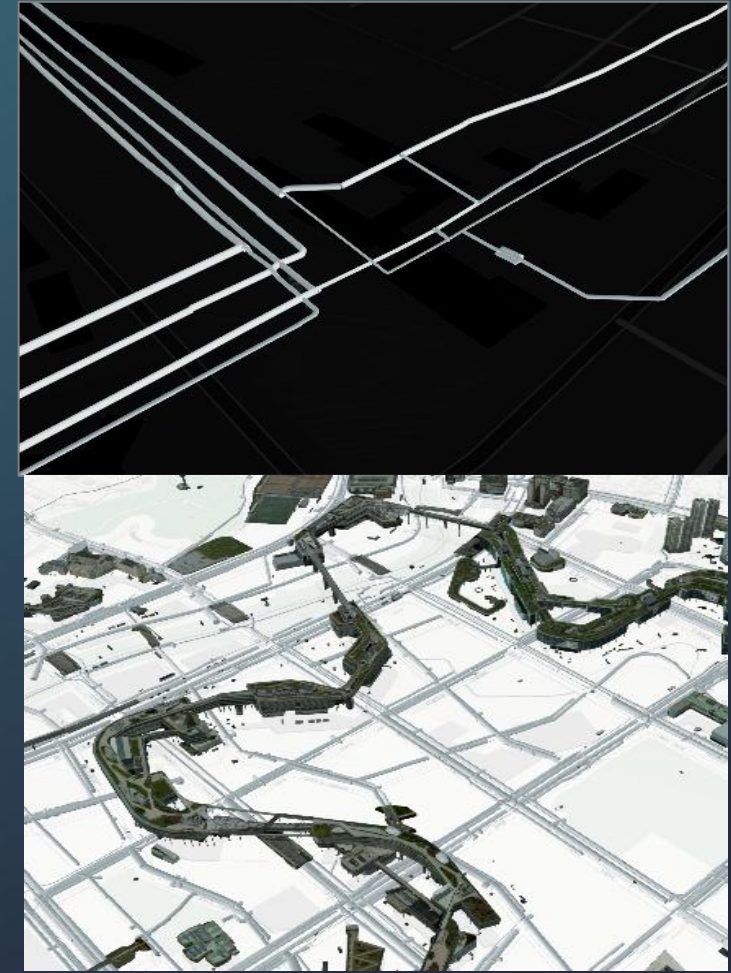
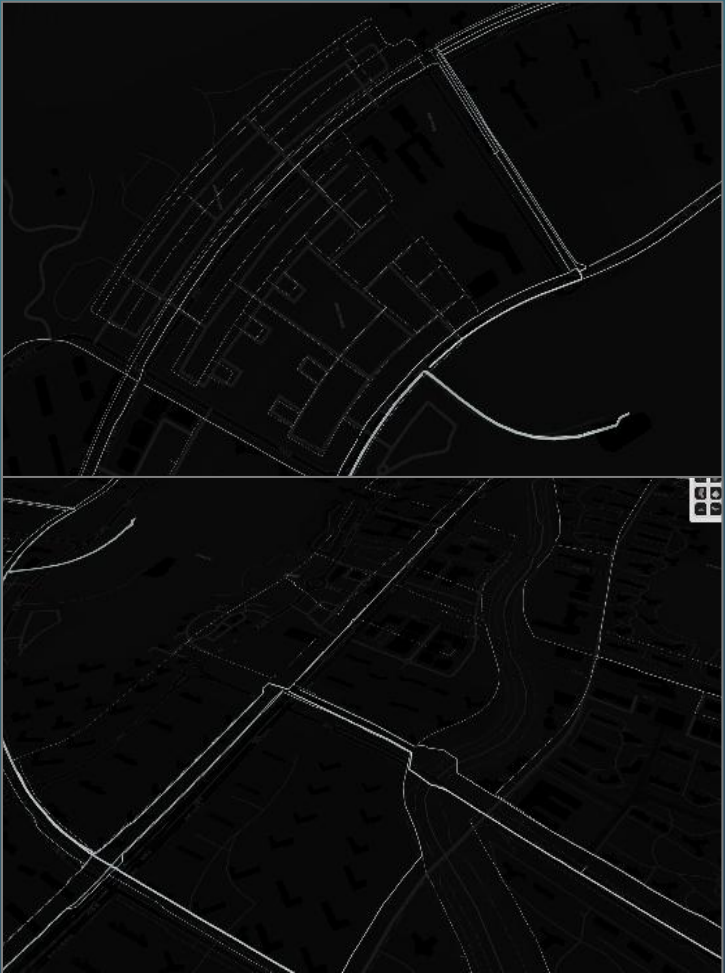


<3D Tiles Conversion Flow from 2D Map>

3D Tiles Making from 2D Map

Underground Facility Support

- Use underground drawings or maps in SHP format (linestring)
- Use specific attributes as diameter and node depth

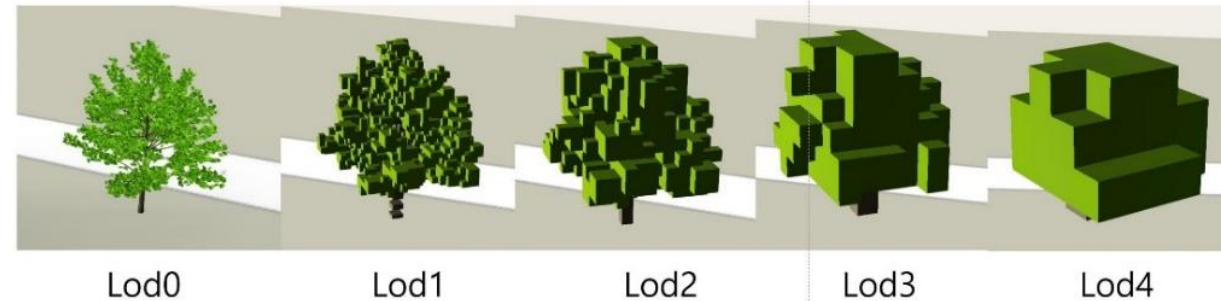


3D Tiles Making from 2D Map

Multi-LOD I3DM Support

- I3DM that allows for easy reuse of the same model, like a cookie-cutter molds
- If the model has a large file size, create LOD-specific cookie-cutter molds from the original model

Street tree I3DM using large-scale tree models

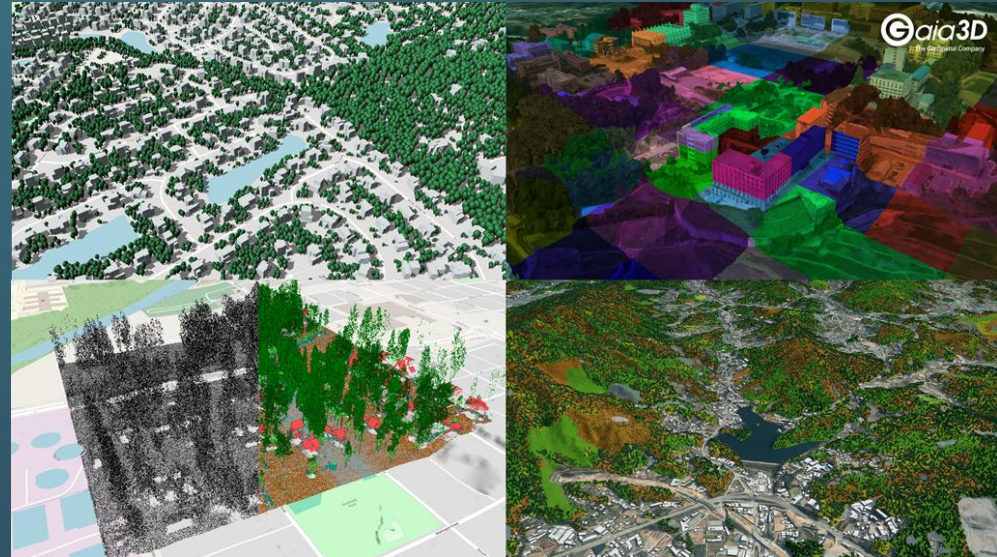
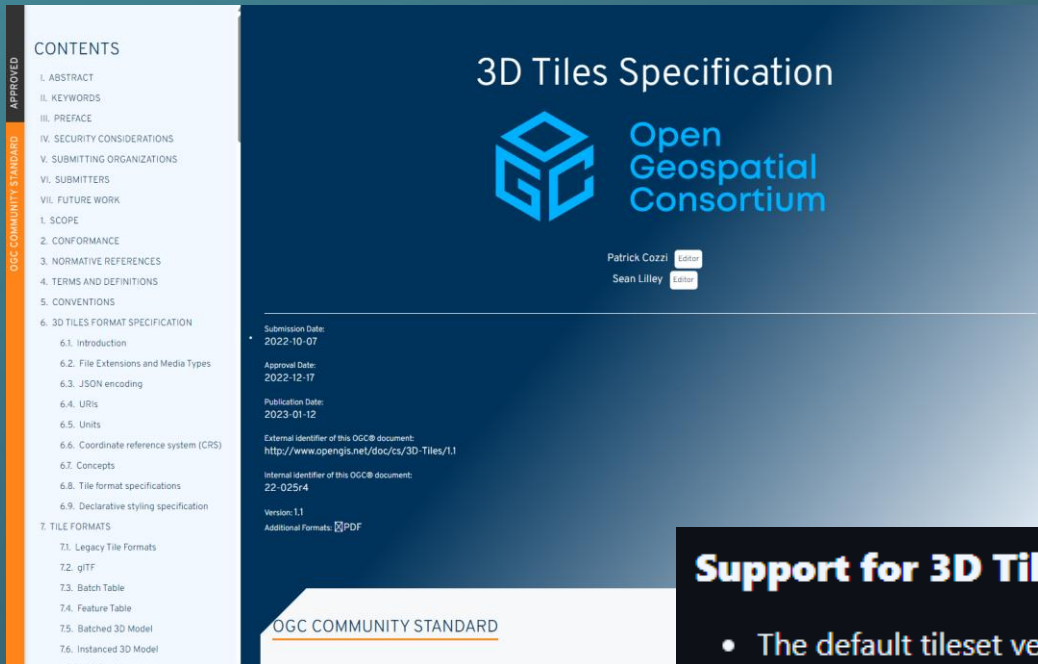


LOD processing of the original instance

3DTiles 1.1

Supporting OGC 3DTiles Version 1.1

<https://docs.ogc.org/cs/22-025r4/22-025r4.html>



Support for 3D Tiles 1.1 Specification

- The default tileset version is now **1.1**.
- You can still generate tiles in the **1.0** format by using the option:

```
--tilesVersion 1.0
```

- Legacy tile formats (**b3dm** , **i3dm** , **pnts**) have been replaced with glTF (**.glb**) based structures.
- Extension handling has been updated to use both Tileset and glTF extensions as specified in the 1.1 standard.

3D Tiles Making from 2D Map

Applying Remeshing Techniques to LOD

- ✓ We generated South Korea's forest i3dm data using a Forest-Type based on polygons.
- ✓ We created realistic forest data by using forest **density**, **tree species**, **tree height**, and random heading.

You can now create i3dm using Polygon.

--densityColumn <arg> : Polygon instance generation density relative to area

--scaleColumn <arg> : Instance size

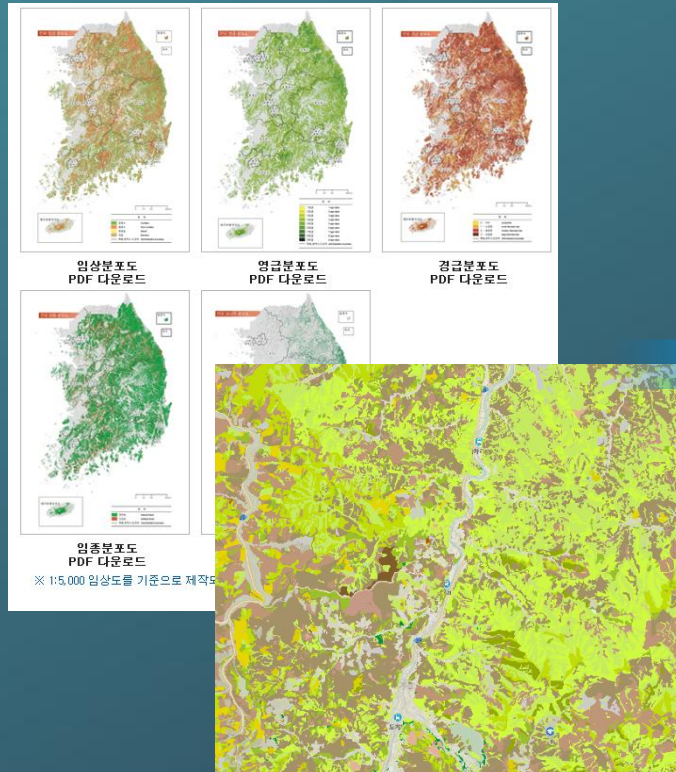
--AttributeFilter <arg> : Feature attribute filter

--headingColumn <arg> : Instance heading

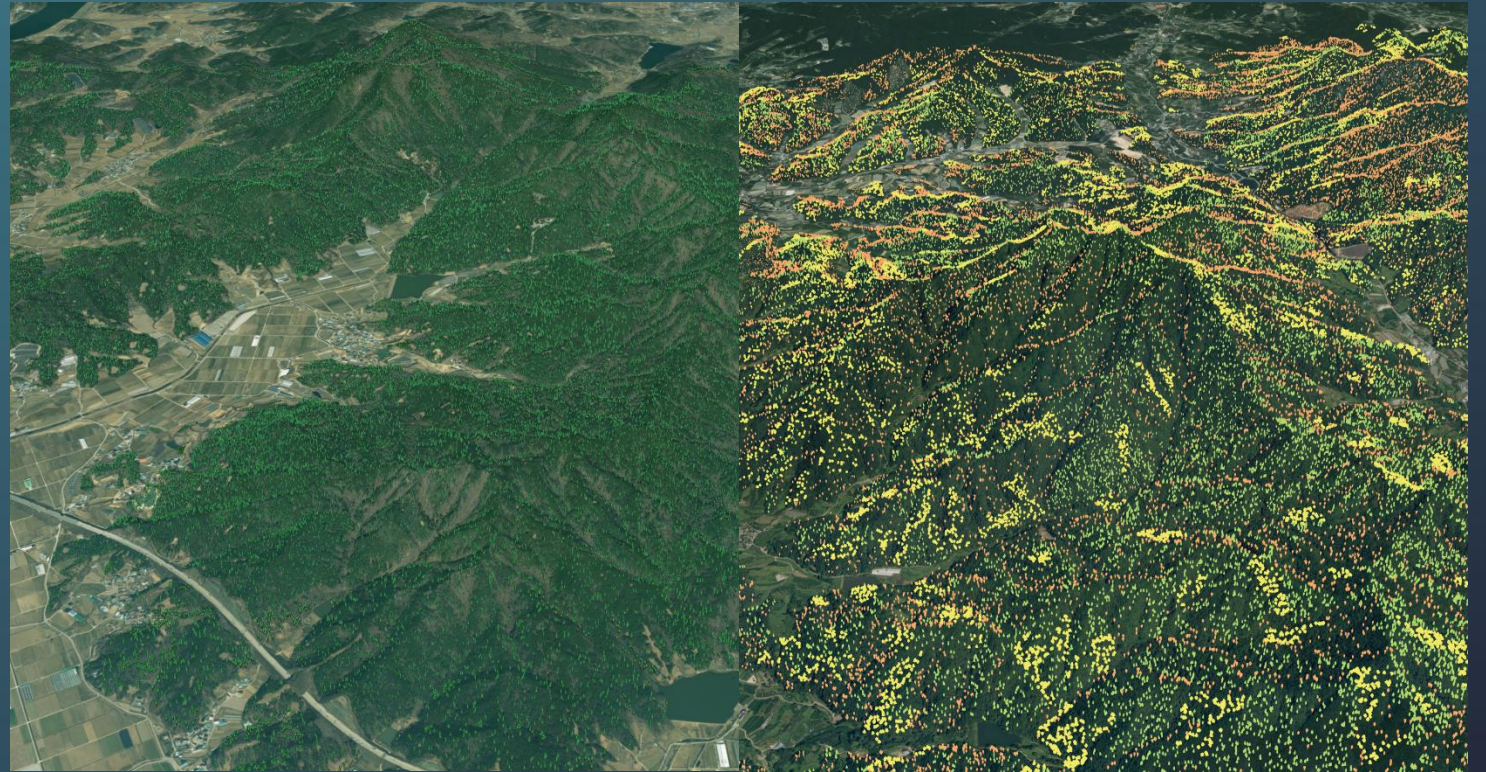


3D Tiles Making from 2D Map

Building a Forest with the i3dm Format



<Forest Maps from the Korea Forest Service>
2D Vector Polygon



<Generated Forest 3DTiles(i3dm)>

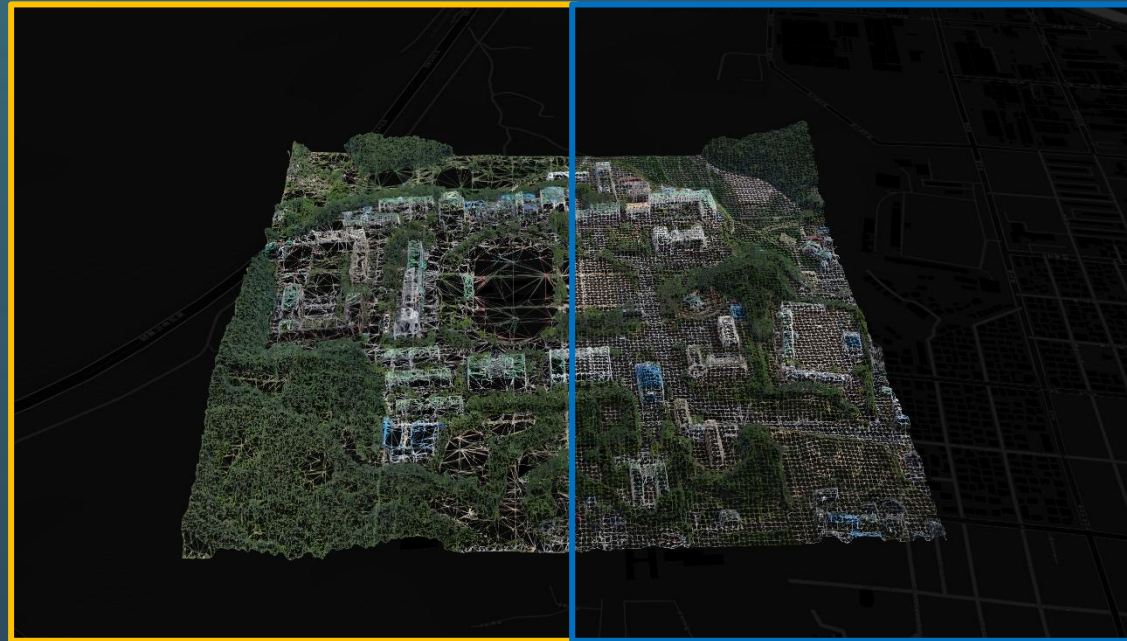
3D Tiles Making from 2D Map



Improvement of Reality Mesh Conversion

Visual Improvement and Size Optimization

- By applying mesh optimization techniques such as **remesh** and **decimate**, along with enhanced retexturing capabilities, we **minimized the visual gap between high LOD and low LOD** while reducing file size.
- applying glTF mesh quantization.



<L : Decimate, R : Remesh>

Improvement of Reality Mesh Conversion

Visual Improvement and Size Optimization



<Old Version>



<New Version>

Improvement of Reality Mesh Conversion

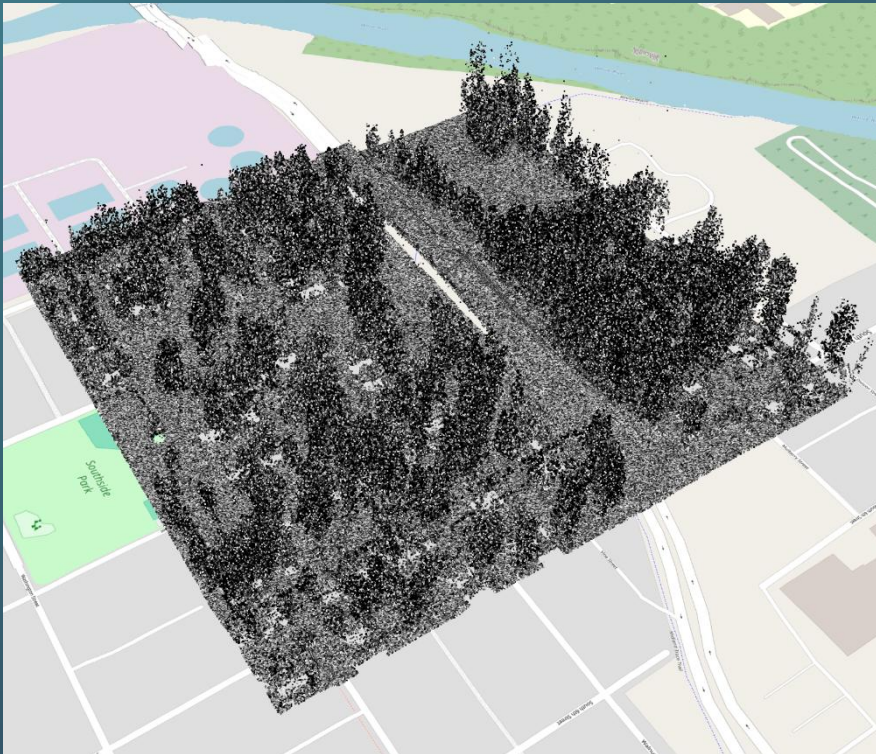


Improvement of Point Cloud Conversion

Support for **Intensity**, **Classification** in point clouds

Now, not only the **RGB** data from LAS files but also attribute information such as **Intensity** and **Classification** is included in 3DTiles.

They are included in the glTF's attributes, so they can be used through a custom shader.



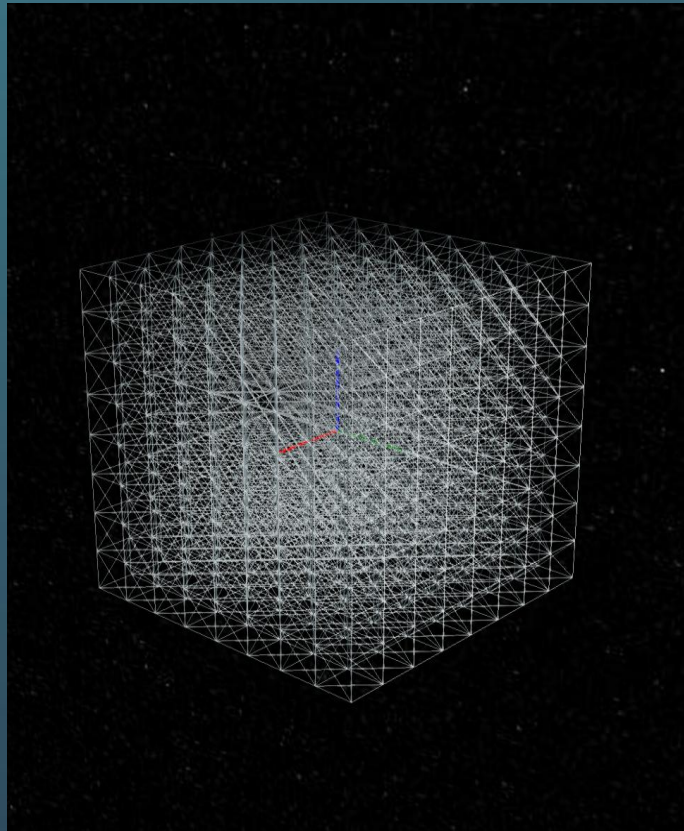
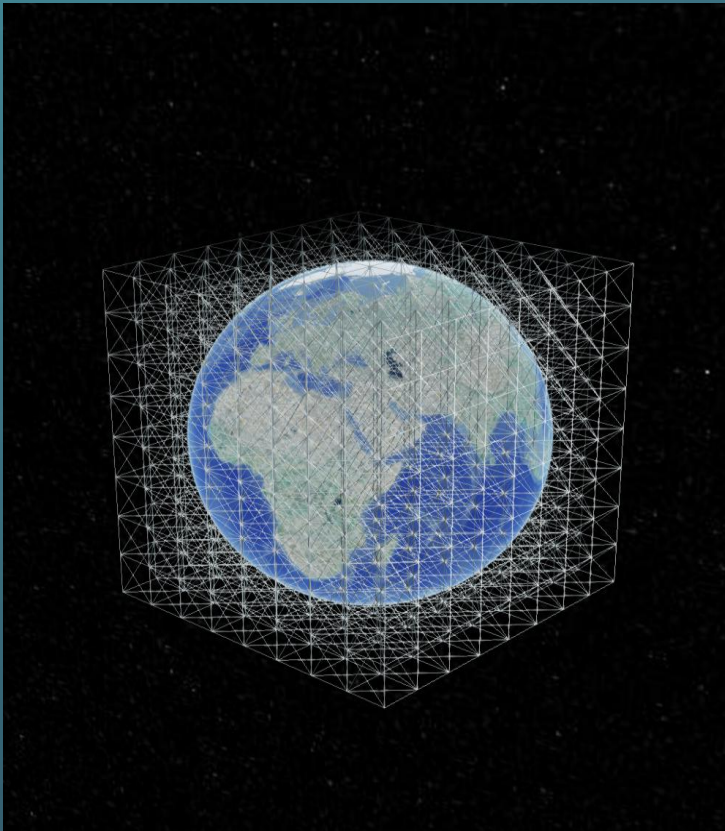
<Intensity>



<Classification>

ECEF coordinate system support

Support ECEF Coordinate System



4. Things to Do Moving Forward

There is still a long way to go

mago3DTiler

- Improve stability and performance of photogrammetry conversion
- Add automatic billboard LOD generation for i3dm outputs

mago3DTerrainer

- Expand input data types: TIN, irregular point sets, contour lines, etc.
- Support TIN-based terrain generation
- Enable generating terrain data directly as OGC 3D Tiles
- Add geoid correction
- Support additional tiling schemes: WebMercator (in addition to Geographic)

We have priorities, but your money can change the priority!

Show me the money, we'll show the code!!

Q & A

Thank you!

<https://github.com/Gaia3D/mago-3d-tiler>

<https://github.com/Gaia3D/mago-3d-terrainer>

Web: www.gaia3d.com

YouTube: <https://www.youtube.com/@mago3d890>

Facebook: <https://www.facebook.com/Gaia3d>

X(Twitter): <https://twitter.com/Gaia3D>

