

Discovering and cataloguing 3D city models with STAC

<https://catalog.open3d.city>

Hidemichi Baba + Hugo Ledoux

TU Delft



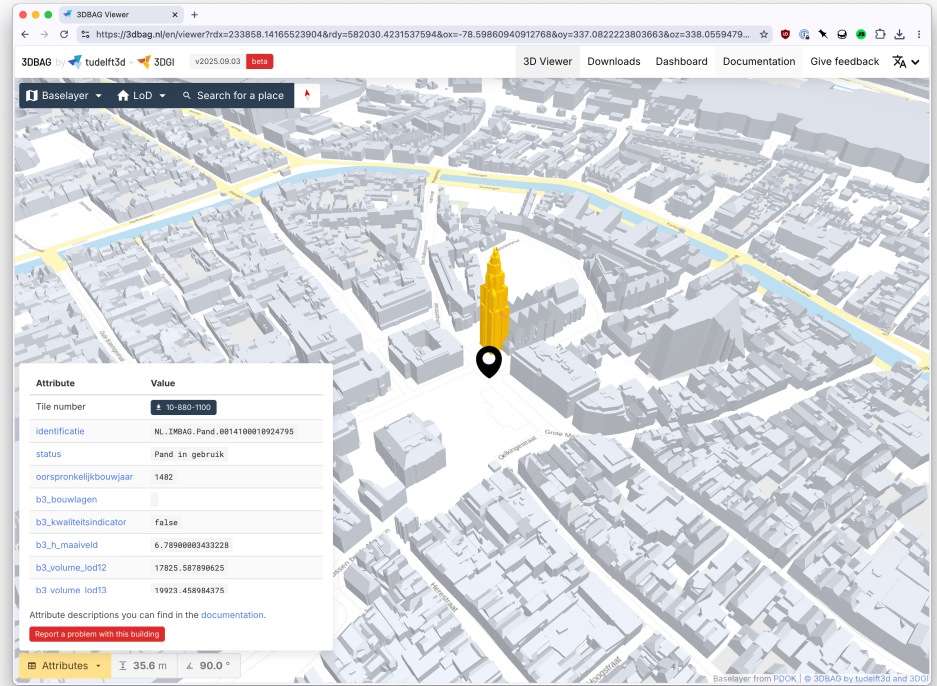
2026-07-09

FOSS4GNL · Groningen



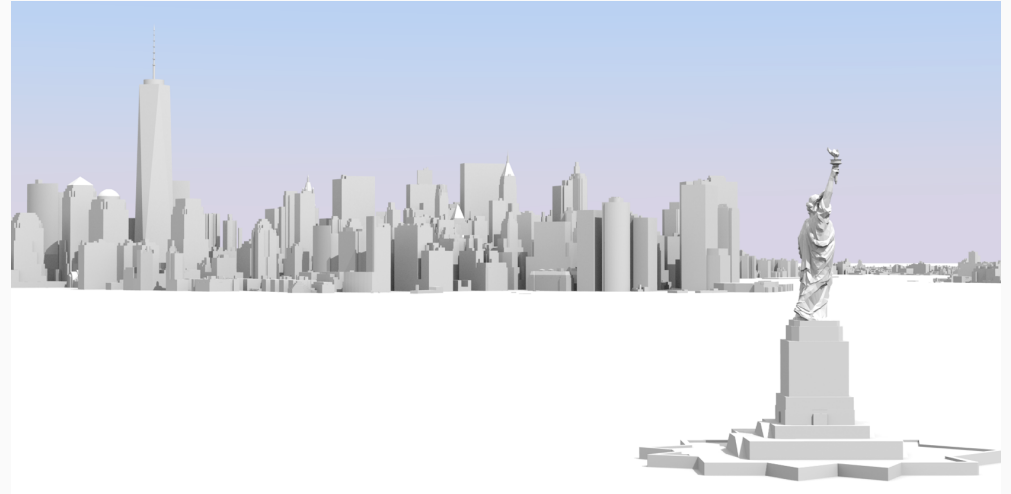
3D city models are now popular

- 3DBAG, Japan's PLATEAU, Helsinki, New York City, Montréal, Estonia, ...
- CityGML, CityJSON, FlatCityBuf
- No central registry → only hand-made lists



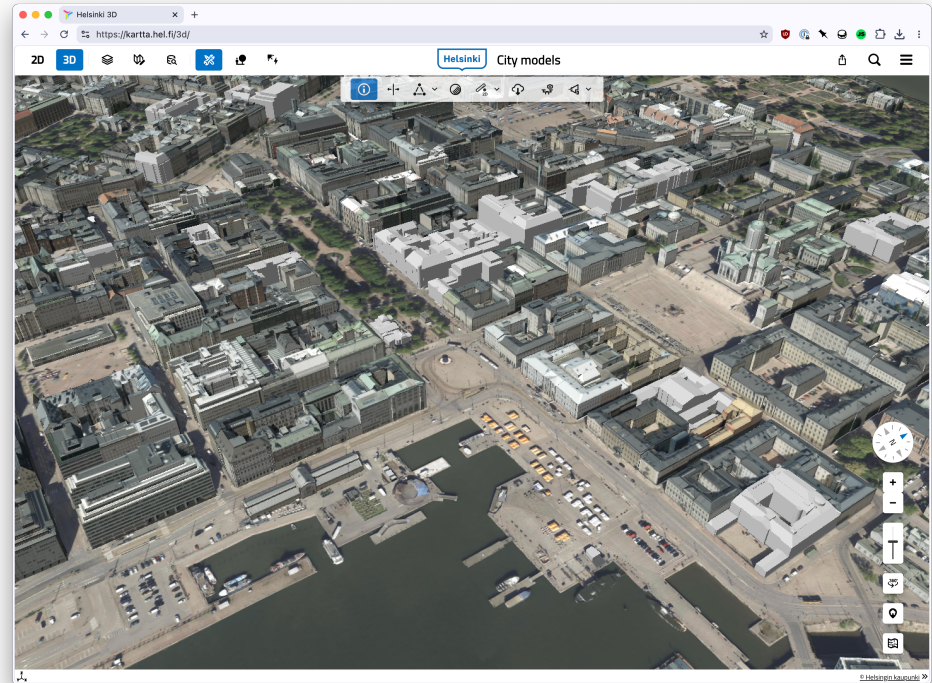
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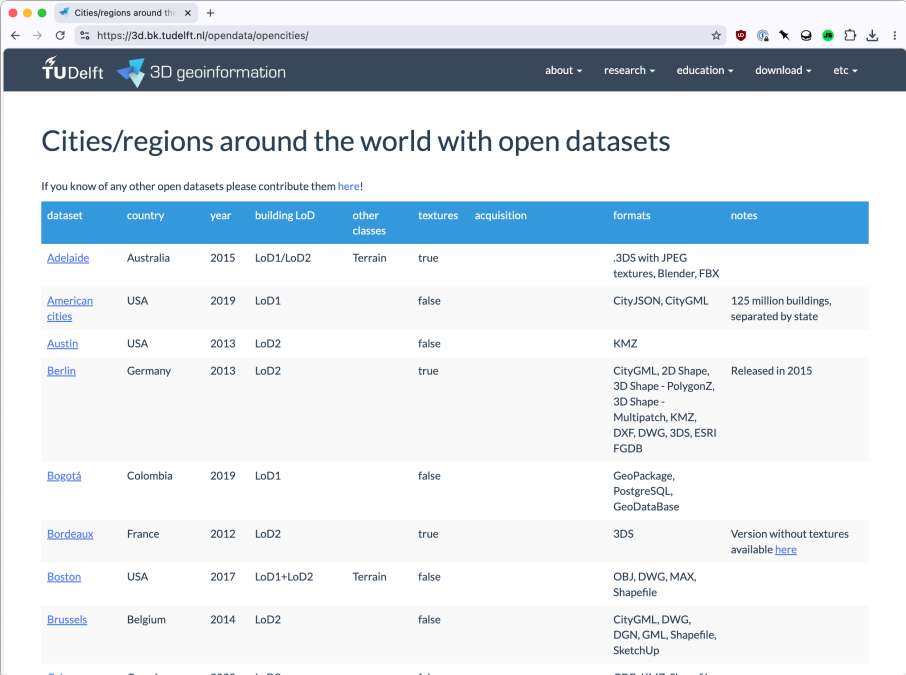
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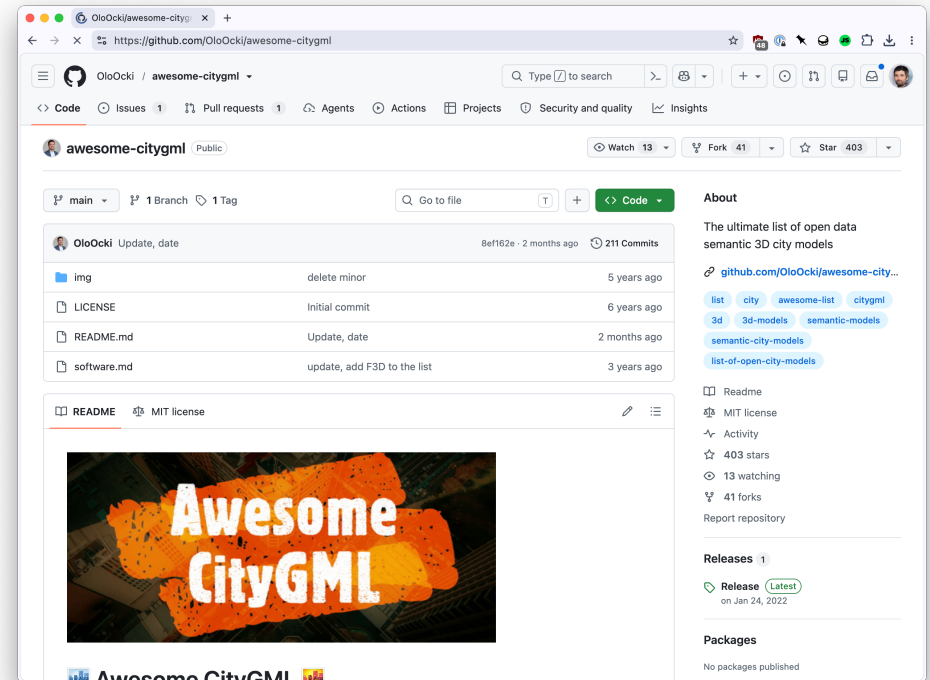


The screenshot shows a web browser window with the URL <https://3d.bk.tudelft.nl/opendata/opencities/>. The page title is "Cities/regions around the world with open datasets". Below the title, there is a link: "If you know of any other open datasets please contribute them [here!](#)". The main content is a table with the following columns: dataset, country, year, building LoD, other classes, textures, acquisition, formats, and notes.

dataset	country	year	building LoD	other classes	textures	acquisition	formats	notes
Adelaide	Australia	2015	LoD1/LoD2	Terrain	true		.3DS with JPEG textures, Blender, FBX	
American cities	USA	2019	LoD1		false		CityJSON, CityGML	125 million buildings, separated by state
Austin	USA	2013	LoD2		false		KMZ	
Berlin	Germany	2013	LoD2		true		CityGML, 2D Shape, 3D Shape - PolygonZ, 3D Shape - Multipatch, KMZ, DXF, DWG, 3DS, ESRI FGDB	Released in 2015
Bogotá	Colombia	2019	LoD1		false		GeoPackage, PostgreSQL, GeoDataBase	
Bordeaux	France	2012	LoD2		true		3DS	Version without textures available here
Boston	USA	2017	LoD1+LoD2	Terrain	false		OBJ, DWG, MAX, Shapefile	
Brussels	Belgium	2014	LoD2		false		CityGML, DWG, DGN, GML, Shapefile, SketchUp	

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The discovery problem

“Retrieve all LoD2 buildings having semantic surfaces and textures”

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Metadata usually inside the data → download first

CityGML has no built-in metadata 🙀

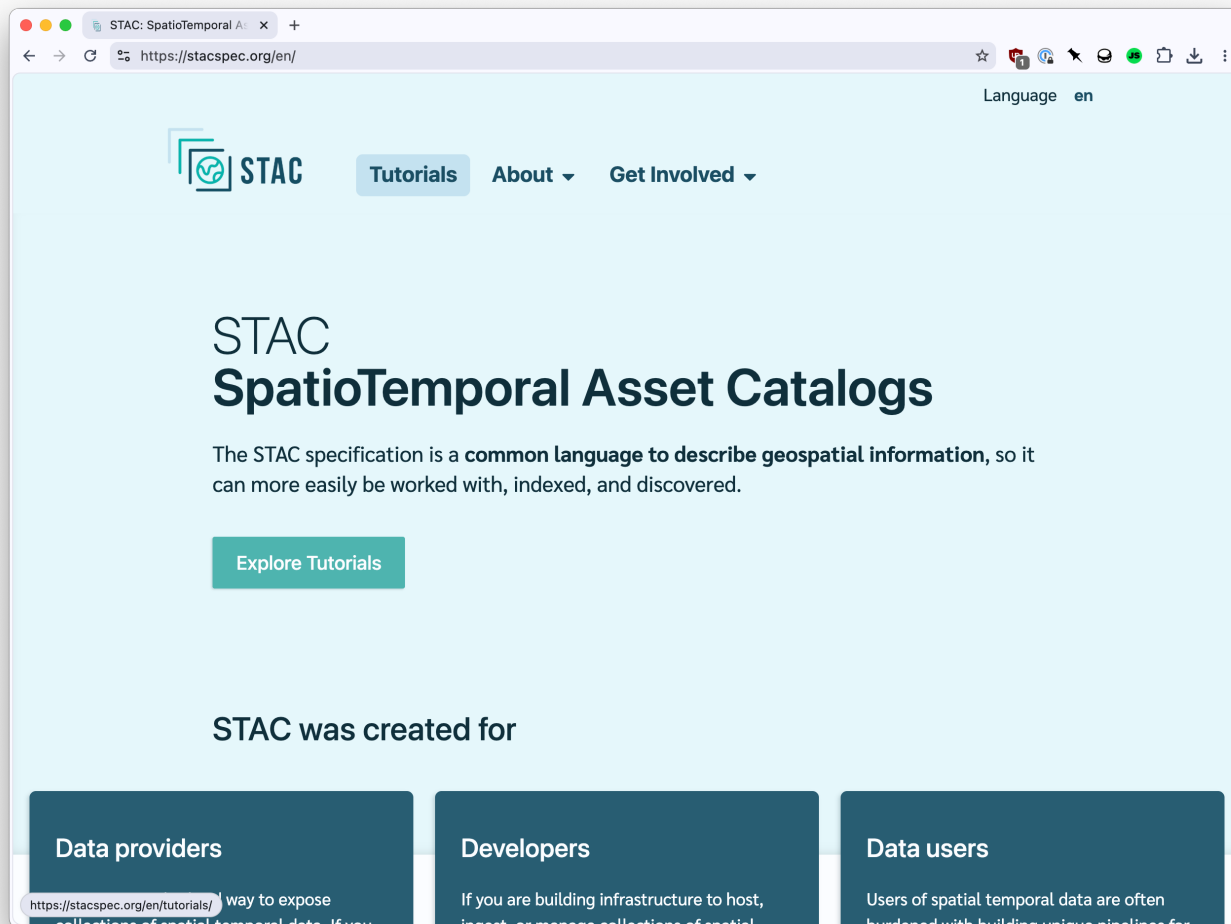
ISO 19115

- Verbose XML
- Too broad → compliance burden
- Cloud-unfriendly

Metadata ADE Labetski et al. (2018)

- Rich 3D fields
- Inherits ISO complexity
- → no adoption

SpatioTemporal Asset Catalog (STAC)



SpatioTemporal Asset Catalog (STAC)

- De facto geospatial catalogue standard – stacspec.org
- Static mode = JSON on storage, **no server**
- Imagery, raster, point clouds, ...
- GeoJSON reuse: **Catalog** → **Collection** → **Item**

SpatioTemporal Asset Catalog (STAC)

STAC is supported by these incredible organizations



Radiant Earth



Microsoft

Element 84



MAXAR
TECHNOLOGIES



cosmiQ
works®



WORLD BANK GROUP



UMBRA



PIXEL8



developmentSEED



Hydrosat



astræa



A Paul G. Allen Company



Google Earth Engine

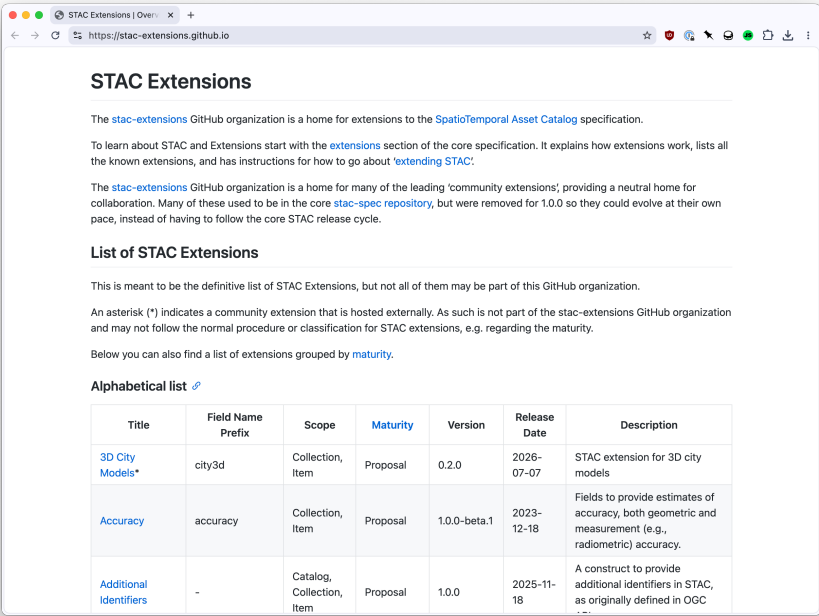
UP⁴²

TERRA²UE
Advancing Earth Science



STAC Extensions

- Minimal core + **extensions** for domain fields
- Registry: EO, SAR, point clouds, datacubes, ...
- Anyone can add a new domain



The screenshot shows a web browser window displaying the 'STAC Extensions' page on the GitHub organization's website. The page has a clean, white background with blue links and text. It includes an introductory paragraph about the organization's role in the SpatioTemporal Asset Catalog specification, followed by a section titled 'List of STAC Extensions'. Below this, there is a table listing three extensions: '3D City Models', 'Accuracy', and 'Additional Identifiers'. Each row in the table provides details on the title, field name prefix, scope, maturity, version, release date, and description.

STAC Extensions

The [stac-extensions](#) GitHub organization is a home for extensions to the [SpatioTemporal Asset Catalog](#) specification.

To learn about STAC and Extensions start with the [extensions](#) section of the core specification. It explains how extensions work, lists all the known extensions, and has instructions for how to go about [extending STAC](#).

The [stac-extensions](#) GitHub organization is a home for many of the leading 'community extensions', providing a neutral home for collaboration. Many of these used to be in the core [stac-spec repository](#), but were removed for 1.0.0 so they could evolve at their own pace, instead of having to follow the core STAC release cycle.

List of STAC Extensions

This is meant to be the definitive list of STAC Extensions, but not all of them may be part of this GitHub organization.

An asterisk (*) indicates a community extension that is hosted externally. As such is not part of the stac-extensions GitHub organization and may not follow the normal procedure or classification for STAC extensions, e.g. regarding the maturity.

Below you can also find a list of extensions grouped by [maturity](#).

Alphabetical list

Title	Field Name Prefix	Scope	Maturity	Version	Release Date	Description
3D City Models*	city3d	Collection, Item	Proposal	0.2.0	2026-07-07	STAC extension for 3D city models
Accuracy	accuracy	Collection, Item	Proposal	1.0.0-beta.1	2023-12-18	Fields to provide estimates of accuracy, both geometric and measurement (e.g., radiometric) accuracy.
Additional Identifiers	-	Catalog, Collection, Item	Proposal	1.0.0	2025-11-18	A construct to provide additional identifiers in STAC, as originally defined in OGC

... but no STAC for 3D city models

- Extensions for imagery, point clouds, vector, etc.
- But not 3D city models
- 3D discovery needs: CRS • LoD • object types • surfaces / textures / materials
- CityJSON datasets live in isolated repos

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So we built one 

Contribution 1 – the STAC 3D City Models Extension

STAC extension github.com/cityjson/stac-city3d

- **Minimal core** – discovery, not archival
- **Composable** – reuse Projection · File · Statistics
- **Format-neutral** – CityJSON · CityGML · CityJSONSeq · FlatCityBuf



The 3D-specific fields

`city3d:lods`

LoDs as strings – "1.2", "2.2"

`city3d:co_types`

Object types – Building, Bridge, Road

`city3d:city_objects`

Counts – {min, max, total}

`city3d:attributes`

Attribute schema – name, type

`city3d:semantic_surfaces`

`city3d:textures` • `city3d:materials`

Appearance flags

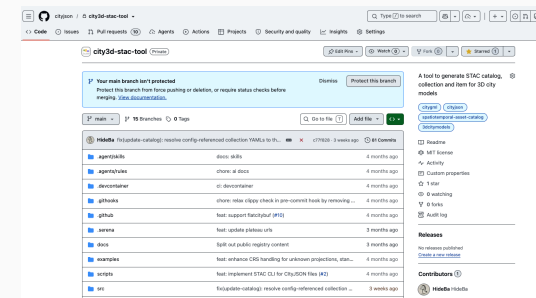
Contribution 2 – the city3dstac CLI

Rust crates.io/crates/city3d_stac

- Local files + remote URLs
- Simple YAML config
- STAC GeoParquet at scale

Four commands:

- item
- collection
- catalog
- update-*



github.com/cityjson/city3d-stac-tool

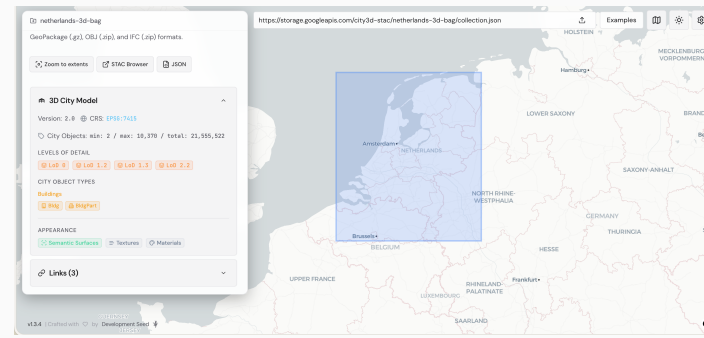
Demo with
city3d-stac

Contribution 3 – the 3D City Model STAC Registry

Open registry github.com/cityjson/city3d-stac-registry

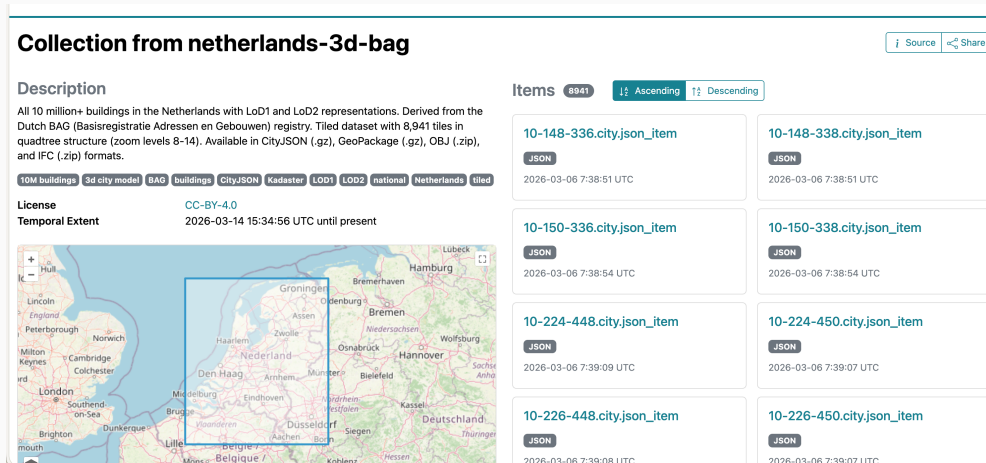
- 32 Collections
- 14,764 Items
- 3DBAG, PLATEAU, Estonia, NYC, and 25+ other cities – Contribution via GitHub PR → auto-published

Work-in-progress, still has errors!

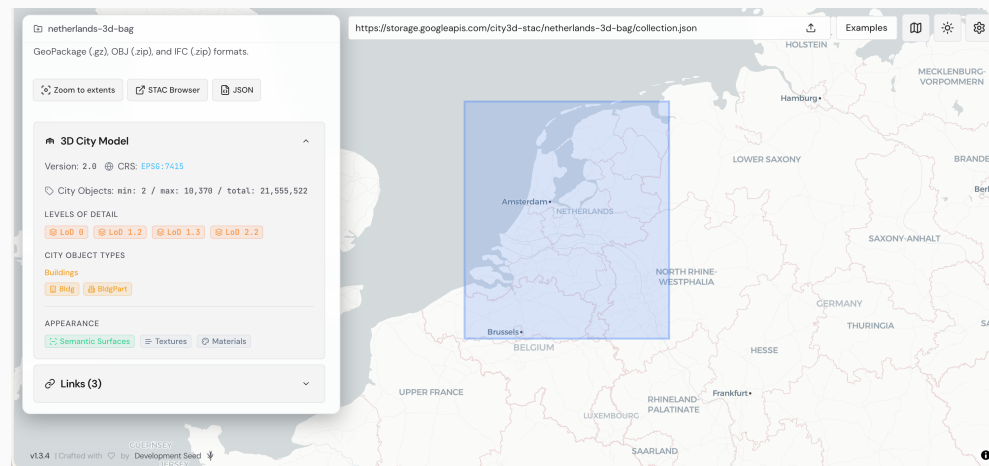


Forked STAC Map • cityjson.github.io/city3d-stac-map

Works with the existing STAC ecosystem



STAC Browser — unmodified



STAC Map — 3D filters

STAC conformance alone = plug into existing tools

- - TODOs

1. some cities have only a DBMS and a GUI → cannot fetch files?!
2. temporal dimension → for cities/regions having several versions
3. IFC, Rhino, 3D Tiles? I guess we might...
4. OGC API – Records?
5. automate the PR with GitHub Actions

Thanks for your attention

Project page	catalog.open3d.city
STAC Extension	github.com/cityjson/stac-city3d/
CLI	github.com/cityjson/city3d-stac-tool/
Registry	github.com/cityjson/city3d-stac-registry/
Hugo	3d.bk.tudelft.nl/hledoux
Hidemichi	3d.bk.tudelft.nl/hideba