



Leveraging Open-Source Tools for Creating 3D Tiles in the Urban Environment

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GeoSolutions

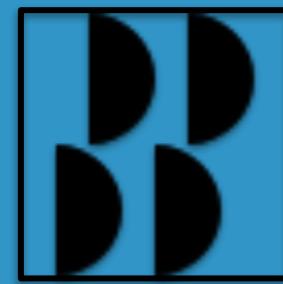


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Agenda



- **Digital Twin Toolbox** a brief overview
Let's briefly recap what the DTT is
- **Digital Twin Toolbox** an year in review
What was released for the Digital Twin Toolbox during the last year
- **Digital Twin Toolbox integration with geOrchestra**
Discovering interesting opportunities for 3D data processing in geOrchestra
- **Digital Twin Toolbox ongoing works**



Digital Twin Toolbox



Digital Twin Toolbox overview



Digital Twin Toolbox

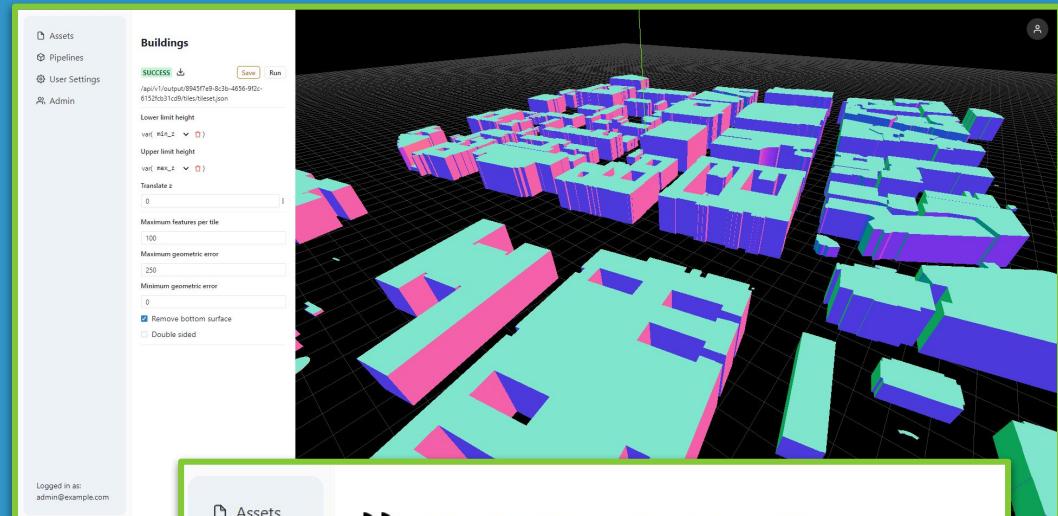
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Digital Twin Toolbox overview

The **Digital Twin Toolbox** borns with the aim to support with the conversion processes to 3D Tiles:

- Pipelines for **SHP** and **LAS** files
- Necessary tools for
 - inspecting datasets
 - assessing datasets
- Management of
 - classification
 - colorization
 - resampling ...
- Reliable tools for
 - tiling
 - CRS and georeferencing tuning
- and many more...



The screenshot shows the Digital Twin Toolbox's user interface. On the left, there's a sidebar with 'Assets', 'Pipelines' (selected), 'User Settings', and 'Admin'. Below it, a message says 'Logged in as: admin@example.com'. The main area has tabs for 'Buildings' (selected), 'Assets', 'Pipelines', and 'Map'. Under 'Buildings', there's a 'SUCCESS' message with a link to '/api/v1/output/8945f7e9-83b-4656-912c-6152b201cbfb/tiles/tileset.json'. It includes fields for 'Lower limit height' (set to 'var: \$d4_L_2'), 'Upper limit height' (set to 'var: max_L_2'), 'Translate z' (set to 0), 'Maximum features per tile' (set to 100), 'Maximum geometric error' (set to 250), 'Minimum geometric error' (set to 0), and checkboxes for 'Remove bottom surface' and 'Double sided'. To the right is a 3D visualization of a city model with buildings colored in various shades of purple, pink, and cyan.



Digital Twin Toolbox

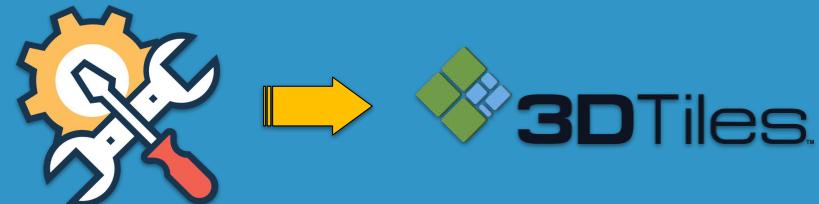
This project collects different tools/libraries and workflows inside a docker environment to generate 3D Tiles from common data sources such as Shapefiles and LAS files.

Extensive documentation about this project can be found in the [wiki](#) page (see the Table of Contents).



Main objectives are:

- Collect the best OS tools and libraries to process common data sources
- Provide workflows to orchestrate a well-driven set of processing chains and methodologies to
 - Inspect and evaluate data
 - Prepare/process data
 - Convert input data in 3D Tiles
 - Preview data step by step
- Provide an user friendly UI to facilitate the work



All in a Dockerized environment!



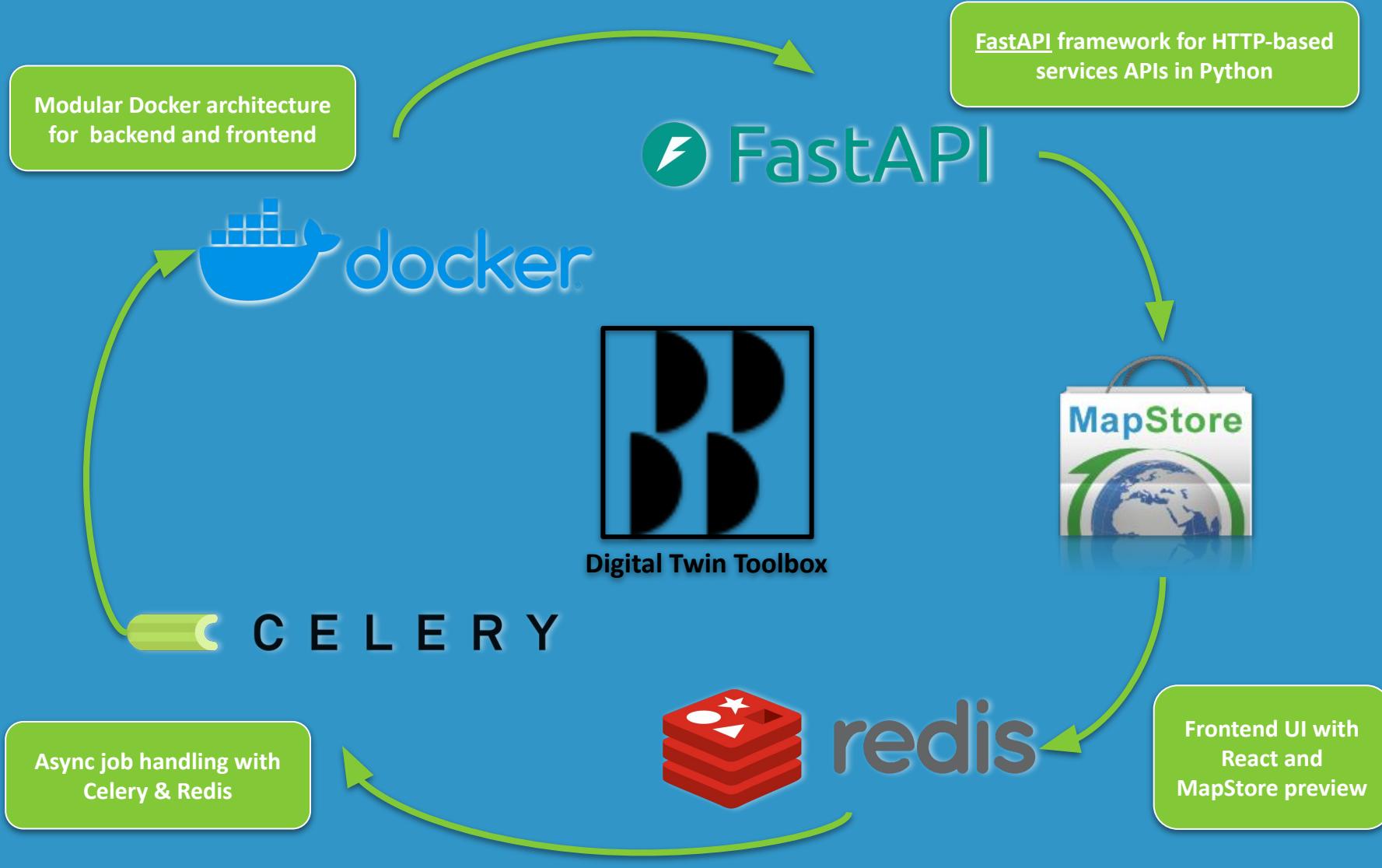
All using Open Source!



Digital Twin Toolbox overview



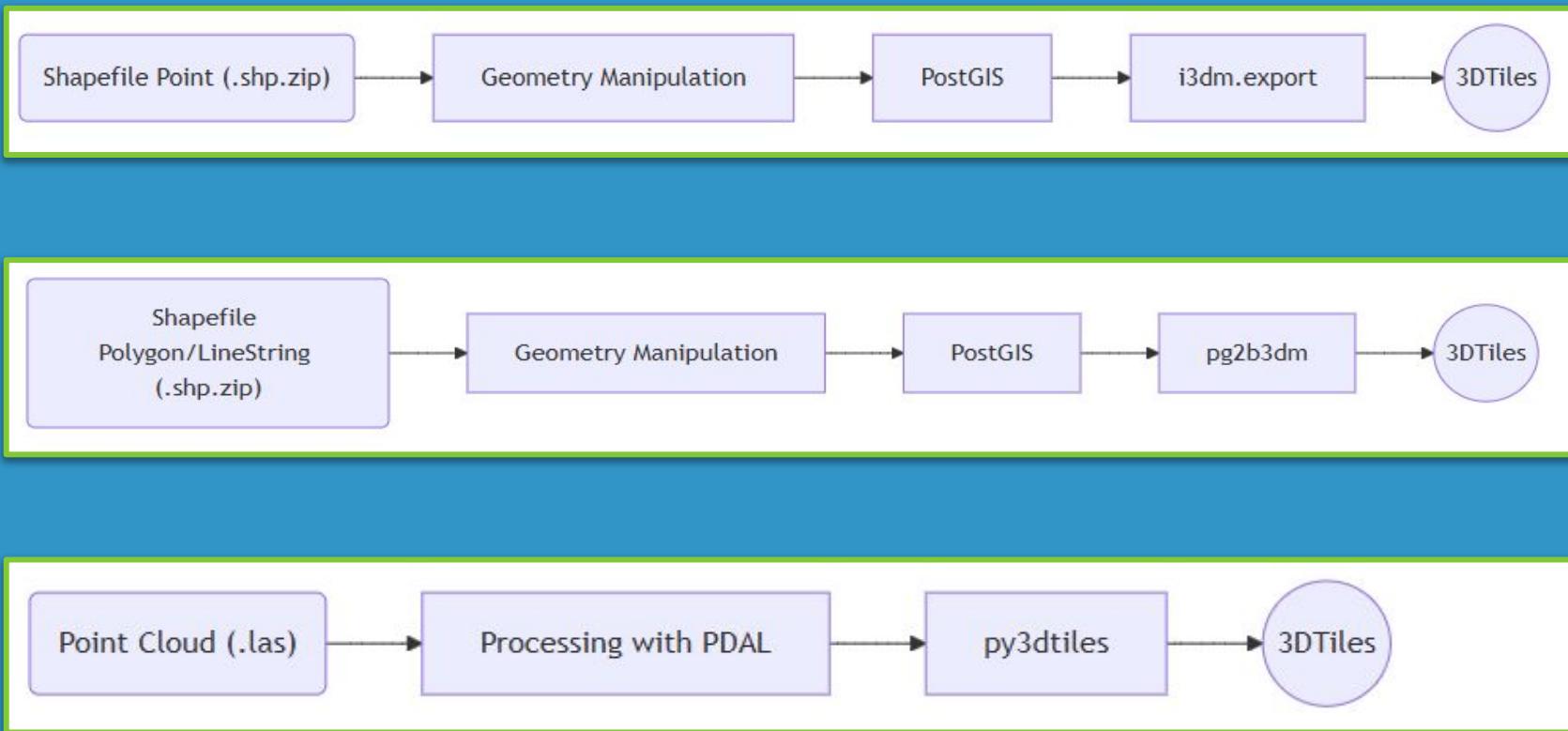
- Digital Twin Toolbox architecture overview



- **Digital Twin Toolbox** input/output capabilities
 - Supported Inputs: **.shp, .las, .laz, .tif, .glb**
 - Output: 3D Tiles, ready for visualization
 - Integration with CesiumJS map for quick data preview
 - Integration with MapStore for previewing processed data



Available workflows and involved tools:



New workflows coming soon ...!



Digital Twin Toolbox an year in review



Digital Twin Toolbox

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- Digital Twin Toolbox releases summary:
 - v1.0.0-rc (Jun. 2024): providing basic processing workflows and rough UI for assessing and inspecting data
 - v1.0.0-rc2 (Sept. 2024): consolidating existing processing workflows with more advanced UI and controls on processing pipelines
 - v1.0.0-rc3 (Jun. 2025): bug fixing and further improvements for processing pipelines

Let's now review the main new features included during last year!





- Advanced User Interface for a really improved experience in managing resources and processing pipelines

The screenshot displays the Digital Twin Toolbox interface with several key components highlighted:

- Main Dashboard:** Shows a sidebar with links to Assets, Pipelines, Map, User Settings, and Admin. A central area contains a brief introduction to the project and a link to its documentation.
- User Settings Modal:** A modal window titled "User Settings" is open, showing tabs for My profile, Password, and Appearance. It displays user information: Full name (Tobia Di Pisa) and Email (tobia.dipisa@geosolutionsgroup....). An "Edit" button is present at the bottom.
- Users Management Section:** A table titled "Users Management" lists the current user (Tobia Di Pisa, YOU) with their email address (tobia.dipisa@geosolutionsgroup.com). A "+ Add User" button is available for adding new users.

Digital Twin Toolbox an year in review

- Consolidated existing processing workflows and included management of Assets for Data Processing

The screenshot shows the Digital Twin Toolbox's user interface. On the left, a sidebar menu includes 'Assets' (selected), 'Pipelines', 'Map', 'User Settings', and 'Admin'. Below the menu, it says 'Logged in as: tobia.dipisa@geosolutio...'. The main area is titled 'Assets' with a sub-header 'FILENAME', 'EXTENSION', and 'STATUS'. It lists several files: '1916.las' (.las, SUCCESS), '1916.tif' (.tif, SUCCESS), 'Building_Footprints_join_Building_3D_EPSG_26985.shp.zip' (.shp.zip, SUCCESS), 'cone.glb' (.glb, SUCCESS), and two more entries partially visible. A modal window titled 'Add Asset' is open in the foreground, prompting for a file to be chosen ('Choose File Urban_Forestry_Stre...EPSG_26985.shp.zip') and a checkbox to convert shp.zip files to ellipsoidal height ('Convert shp.zip files to ellipsoidal height').

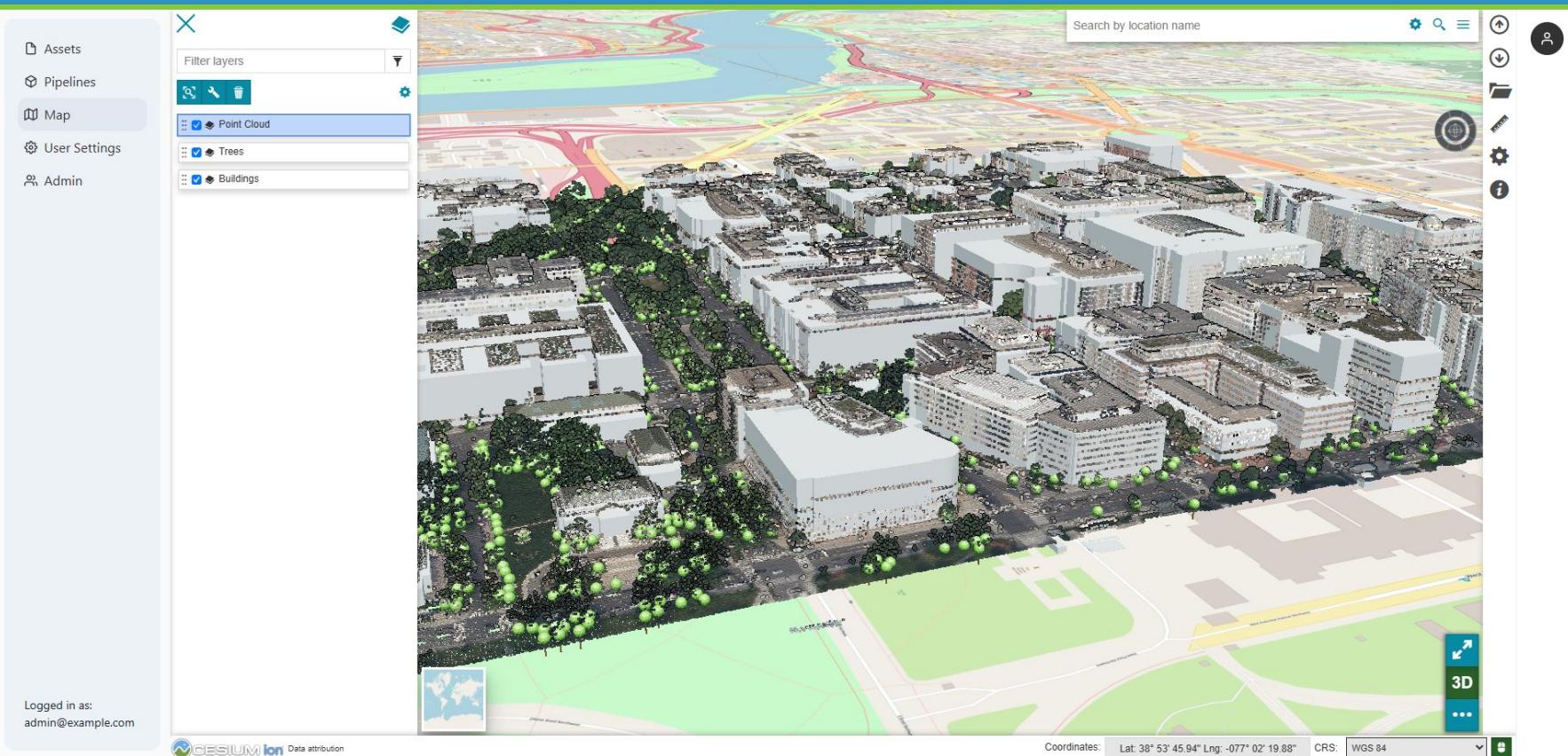


- Better handling of workflows with management of multiple asynchronous processing pipelines and state control

The screenshot displays the Digital Twin Toolbox interface. On the left, a sidebar lists navigation options: Assets, Pipelines (selected), Map, User Settings, and Admin. The main area shows a table titled "Pipelines" with three rows:

TITLE	STATUS	Actions
Buildings	SUCCESS ↗	trash
Point Cloud	PENDING	trash
Trees	SUCCESS ↗	trash

Below the table are buttons for Previous, Page 1, and Next. A modal window titled "Add Pipeline" is open in the foreground, containing fields for "Asset" (Building_Footprints_join_Building_3D_EPSG_26985) and "Title" (Building). It includes "Save" and "Cancel" buttons. To the right, another modal window titled "Point Cloud" is partially visible, showing settings for "Sample radius" (empty input field), "Image for colorization" (dropdown menu showing 1916.tif), and checkboxes for "Convert to ellipsoidal height" (checked) and "Ground classification" (unchecked).



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Digital Twin Toolbox integration with geOrchestra



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- What does this integration offer and what are the advantages?

Enriches
geOrchestra with
native 3D processing
capabilities

Docker-based
portability for easy
testing and
deployment

geOrchestra

Leverages robust
processing from the
DTT for geOrchestra
Administrators

Provides a simple extension
for loading processed 3D
Tiles in the MapStore
geOrchestra viewer



- Main objectives of the integration Proof of Concept
 - Connect the Digital Twin Toolbox to the geOrchestra stack via Docker
 - Provide a working but essential integration with existing geOrchestra modules with no users/roles management
 - Provide a shared volume for storing processed 3D Tiles
 - Provide a simple MapStore extension for loading DTT 3D Tiles in the geOrchestra map viewer



Digital Twin Toolbox





Digital Twin Toolbox integration with geOrchestra

- Sample workflow #1 - Login and access

The screenshot shows the geOrchestra web application interface. On the left, there is a sidebar with links for Assets, Pipelines, and Map. The main content area features a purple header with the text "Digital Twin Toolbox". Below the header, there is a brief description of the project and a link to the wiki page. A large central box contains a login form with fields for Username and Password, and buttons for Sign in, Forgot password?, and Register. To the right of the login form, a navigation bar includes links for Apps, Services, Import, Administration, Catalogue, Viewer, Users, and Digital Twin Toolbox. The "Digital Twin Toolbox" link is highlighted with a green box.



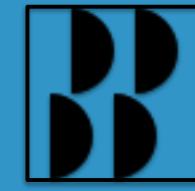
Digital Twin Toolbox integration with geOrchestra

- Sample workflow #2 - Loading the needed assets

The screenshot shows the geOrchestra web application interface. On the left, there's a sidebar with 'Assets', 'Pipelines', and 'Map' options. The main area is titled 'Assets' and lists three files:

FILENAME	EXTENSION	STATUS
020101_un.vol.shp.zip	.shp.zip	SUCCESS
1916.tif	.tif	SUCCESS
centro_storico_unesco.shp.zip	.shp.zip	SUCCESS

A modal window titled 'Add Asset' is open in the foreground, prompting for a file to be chosen. The file '1916.las' is selected. There's also an unchecked checkbox for 'Convert shp.zip files to ellipsoidal height'. At the bottom of the modal are 'Save' and 'Cancel' buttons.



Digital Twin Toolbox





Digital Twin Toolbox integration with geOrchestra

- Sample workflow #3 - Creating the pipeline

The screenshot shows the geOrchestra web application interface. At the top, there is a navigation bar with links for Catalogue, Viewer, Apps, Services, Import, Administration, and a user account for Test ADMIN. The main area is titled "Pipelines" and contains a table with one row:

TITLE	STATUS
Point Cloud	READY

Below the table are buttons for Previous, Page 1, and Next. A modal dialog box titled "Add Pipeline" is displayed in the foreground. It has fields for "Asset *" (set to "1916.las") and "Title *" (set to "Point Cloud"). At the bottom of the dialog are "Save" and "Cancel" buttons. The entire "Add Pipeline" dialog is highlighted with a thick green border.

In the bottom right corner of the slide, there is a graphic element consisting of a purple circle with a white "geOrchestra" logo, a black square with a white "B" logo, and a green plus sign (+).



- Sample workflow #4 - Managing the process

The screenshot shows the geOrchestra web application interface. On the left, there's a sidebar with navigation links: Assets, Pipelines, and Map. The main area features a 3D point cloud visualization of a terrain, colored in shades of purple and blue. A small green line segment points from the top-left workflow panel to a specific feature in the 3D point cloud. Below the visualization is a large green box containing a second workflow history panel.

Point Cloud

PENDING

Cancel

Sample radius

Image for colorization: 1916.tif

Convert to ellipsoidal height

Ground classification

Geometric error scale factor: 1

Point Cloud

SUCCESS

Save Run

/dtt-api/api/v1/output/40e0de5b-d746-4b4c-ba50-057fd08cc865/tiles/tileset.json

Sample radius

Image for colorization: 1916.tif

Convert to ellipsoidal height

Ground classification

Geometric error scale factor: 1

Digital Twin Toolbox + **geOrchestra**



- Sample workflow #4 - Final preview using MapStore

The screenshot illustrates the integration of the Digital Twin Toolbox with geOrchestra. On the left, the Digital Twin Toolbox interface shows a 'Point Cloud' section with a 'SUCCESS' message and a download link: /dtt-api/api/v1/output/40e0de5b-d746-4b4c-ba50-057fd08cc865/tiles/tileset.json. A green arrow points from this link to a callout text: 'Click to preview or to download the 3D Tiles!'. Below this, a large 3D map of a city area is displayed. On the right, the geOrchestra interface shows a catalog entry for 'Point Cloud' with the same URL. A green arrow points from the geOrchestra catalog to the 3D map, indicating the preview or download of the 3D tiles.



- Sample workflow #5 - Preview using the MS extension to load 3D Tiles from shared volume

The screenshot shows the geOrchestra viewer interface with the Digital Twin Toolbox extension integrated. A green arrow points from the 'dtt-integration' context in the left sidebar to the main map area. Another green arrow points from the 'Digital Twin Toolbox' button in the bottom right corner of the main map area to a callout box in the bottom right. The callout box highlights the 'Digital Twin Toolbox' button and the '3D' button. The main map displays a 3D point cloud of a city area, with a legend on the right side showing 'Point Cloud'.

Digital Twin Toolbox integration with geOrchestra

- Involved components and online resources
 - Forked and customized:
 - **georchestra/docker** (branch **dtt-24.0**)
<https://github.com/geosolutions-it/georchestra-docker/tree/dtt-24.0>
 - **georchestra/header** (branch **dtt-24.0**)
<https://github.com/geosolutions-it/georchestra-header/tree/dtt-24.0>
 - **georchestra/htdocs** (branch **dtt-24.0**)
<https://github.com/geosolutions-it/georchestra-htdocs/tree/dtt-24.0>
 - Integration documentation and quick start:
<https://github.com/geosolutions-it/georchestra-docker/blob/dtt-24.0/README.md>
 - MapStore extension to load 3D Tiles from the DTT:
<https://github.com/geosolutions-it/DigitalTwinToolboxCatalog>



- What's still missing for a complete integration?

A few ideas:

- Integration with the geOrchestra users/roles management system
- Handling permissions for processed 3D Tiles
- Better streaming performances of 3D Tiles served from geOrchestra
- Integrated 3D Tiles upload to the cloud
- Improved DigitalTwinToolboxCatalog extension
- Other ?

Check-out the integrated DTT to have a try in geOrchestra!



Digital Twin Toolbox ongoing works



Digital Twin Toolbox

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Digital Twin Toolbox ongoing works

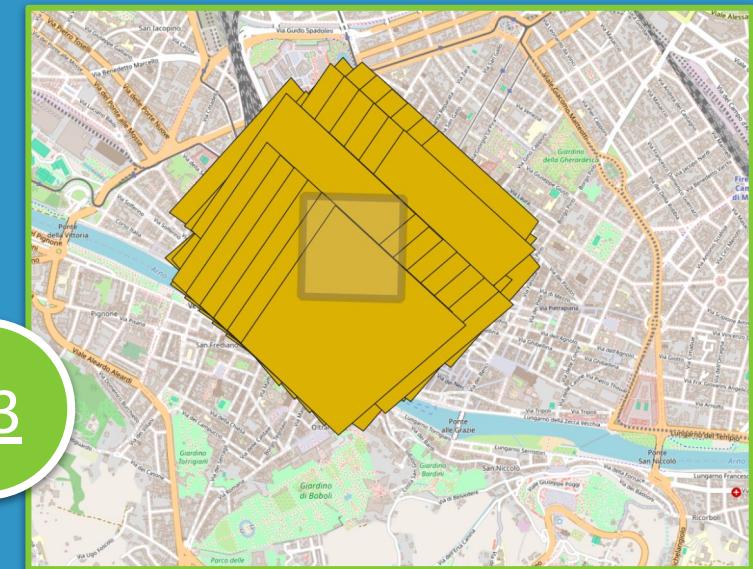
- Ongoing work to integrate support for extensive 3D Tile Mesh processing pipelines

Main objectives:

- Metadata extraction, inspection and photogrammetry outline
- Sparse & Dense Point clouds generation from images
- 3D Mesh generation
- Texturing
- Tiling strategies for the purpose

Main challenges:

- Use Open Source tools
- HW capabilities and costs
- Find balance between quality and processing time
- Performing result

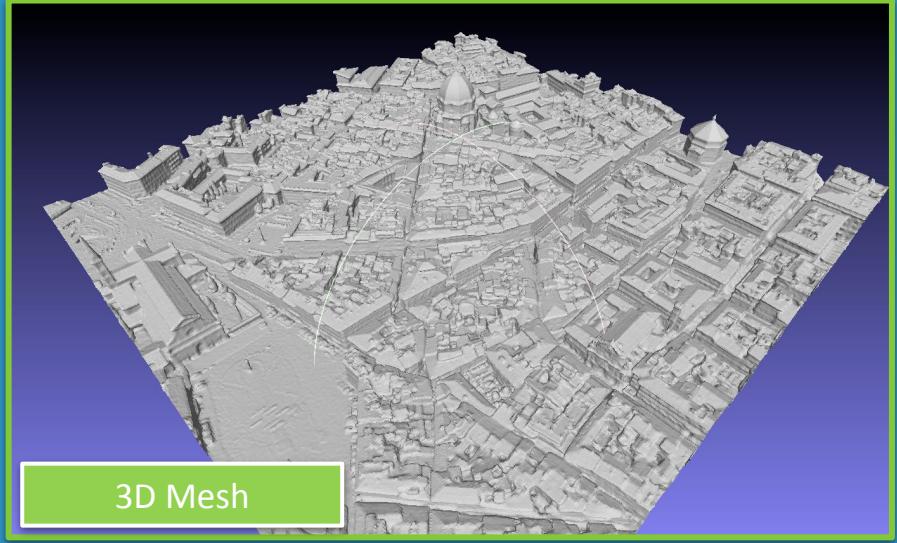


New RC in Autumn 2025!

Q3

Digital Twin Toolbox ongoing works

- Still work in progress but... **concrete first results!**



[Municipality of Florence case study](#)

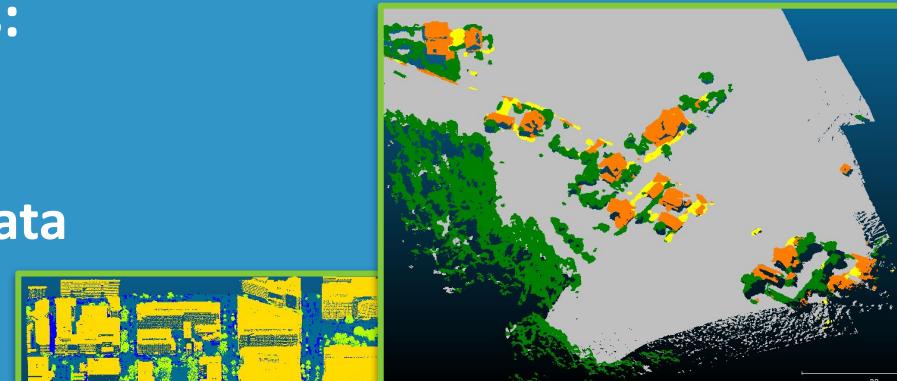




We have in plan also a bunch of other significant enhancements to enrich the toolbox capabilities:

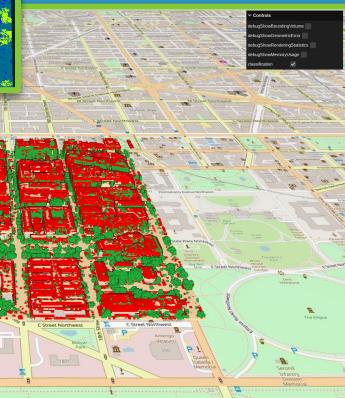
1. Finalizations of classification improvements for point cloud data started in 2024

Expected for **Q2 2026**



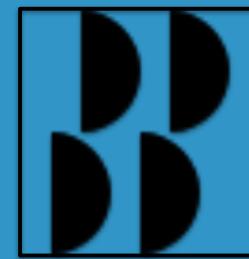
2. More support for LODs

Expected for **Q1 2026**



3. Support for other input data such as: **GeoJson, CityGML, IFC**

Expected for **Q4 2025**



Digital Twin Toolbox



Check it out on Github:

<https://github.com/geosolutions-it/digital-twin-toolbox>

Pre-Release at:

<https://github.com/geosolutions-it/digital-twin-toolbox/releases/tag/v1.0.0-rc3>

Online Documentation:

<https://github.com/geosolutions-it/digital-twin-toolbox/wiki>

Tutorials are also available in the WIKI:

<https://github.com/geosolutions-it/digital-twin-toolbox/wiki/Tutorials>

Check out the webinar on Youtube:

https://youtu.be/owQW-AUjk0U?si=yc1j_KTiJHsXwUCL



That's all folks!



Questions?

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