Cultural Heritage Through Time

Project Deliverable

Number	**D4.2**
Title	**Report on 4 D models in World Wide Web of all test areas**
Month	**M33**
Language	**English**

Revisions record

Rev. N.	*Author*	*Notes*	*Date*
0	Gabriele Guidi	Document framework	April 17, 2018
1	Beata Hejmanowska	Main document	May 30, 2018
2	Gabriele Guidi	Final form	June 8, 2018
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Introduction

In WP4 3D/4D model publication following objectives were defined:

- Analysis of existing tools for 4D models web publications
- Identification of needs and requirements of created models in the context of web publications
- Web sharing of created in the project 4D models

3D/4D model presentation is possible using ready open-source software, i.e. 2 following powerful tools:

- MeshLab http://www.meshlab.net/
- CloudCompare http://www.danielgm.net/cc/

The mentioned solutions have advantages: allow visualization of 3D models and point clouds (from laser scanning data but also point clouds form optic images) and read many formats. They have however significant disadvantage: integration with GIS data is not available.

Another option is creating own application using open-source JavaScript framework i.e. WebGL Earth or Cesiumjs or use other open-source software ie. Blender https://www.blender.org/.

Some tests were performed on Avila test site using MeshLab 2016.12 and ColudCompare. The results are presented in figure.

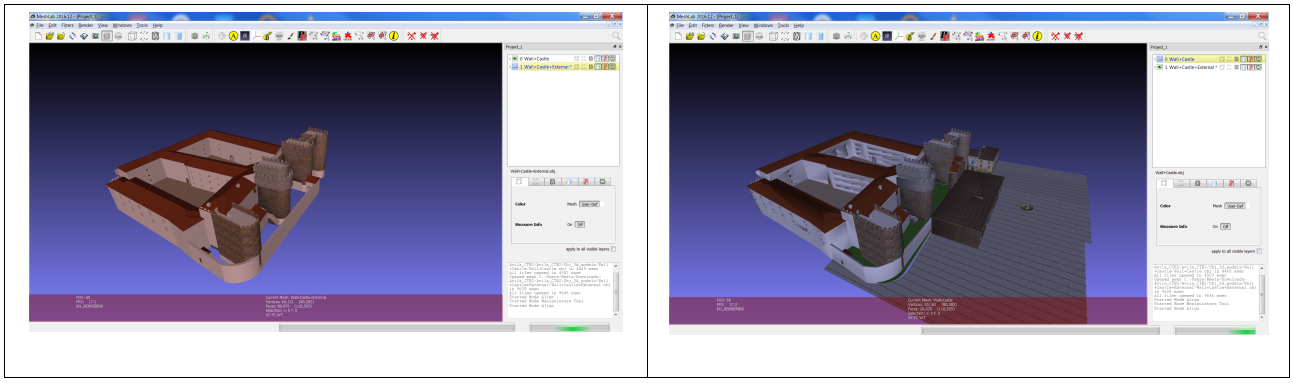


Figure 1 - Two stages of Avila test in MeshLab (on the left in legend is possible to switch on/off the selected stage)

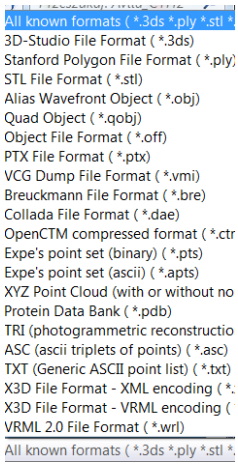


Figure 2 List of the input formats available in MeshLab

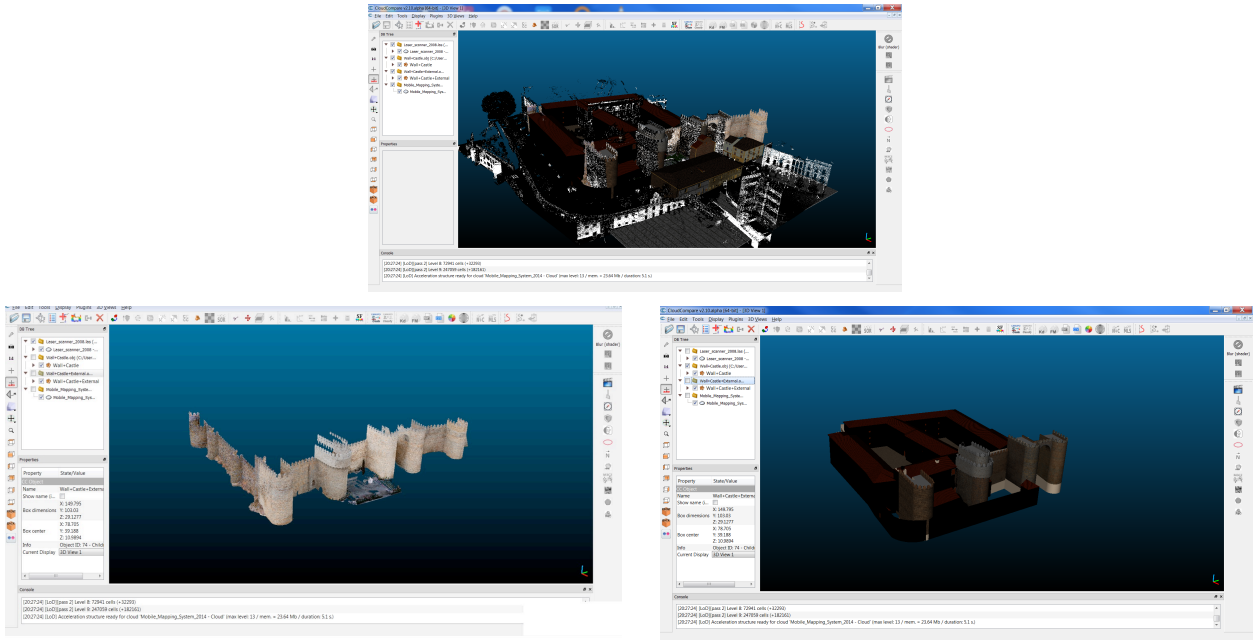


Figure 3 Integration of the models and point clouds is possible in CloudCompare

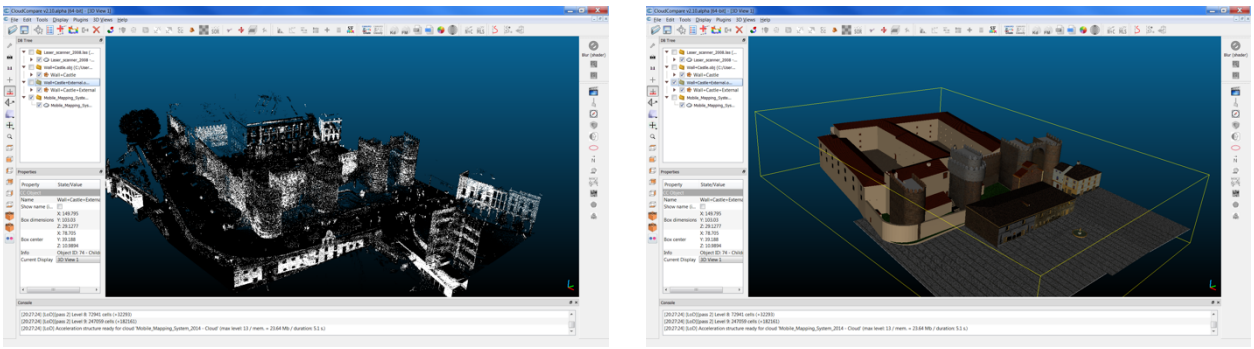


Figure 4 Mobile laser scanning point clouds (left) 3D model (right) in CloudCompare

One of the main aims of the project was to integrate presentation of 3D models through the time **with GIS data on web platform.** As a result of the state-of-the art studies following technologies for 3D/4D model publication were selected for testing:

- commercial Hexagon, CityEngine
- open source 3DHOP, Potree, X3D

For many years, 2 companies: Esri and Integraph (using Microsttaion as CAD platform) were the leaders in the GIS market. Therefore in the project they were also selected for testing. On the other hand, nowadays ready open-source solutions are also available especially on the achitecture, archeological, historical "market" and three of them were tesed: 3DHOP, Potree, X3D.

Hexagon

Hexagon Geospatial has two leading Hexagon Smart M.App products and Power Portfolio. *Platform Suite* allows to provide information via the mobile network (smartphone, androids). This line includes products from the WebGIS family of solutions: GEOME-DIA® WEBMAP, GEOSPATIAL PORTAL and GEOSPATIAL SDI.

Geospatial SDI extends-GEOMEDIA® WEBMAP websites using CSW standards (Catalog Serrvice for the Web). *Geospatial Portal* is an interoperable data infrastructure designed for for data providers who need to manage in an efficient way, safely transfer and license your data to clients based on the standards of webs. It is provided with OGC standards (Enhanced Open Geospacetial Consortium; consumer websites such as WMS, WFS and WMTS are directed directly to the portal user providing the highest level of interoperability), INSPIRE Infrastructure for Spatial Information in Europe) as well as ISO (International Standards Organization) for web sites and metadata compliance.
Working with geospatial data in *Geospatial Portal* is possible using mobile devices (applications available on iOS, Android and Windows). Geodata can be displayed in 3D mode, in a very realistic way by introducing a shade option. The browser uses WebGL by default (the ERDAS APOLLO ECW 3D plugin can also be used), which means that the map is displayed on a 3D globe, and the other 3D objects are rendered on the surface.

Preparing 3D model for Internet publication is not trivial taks. The proces is iterative and can be generalized to two steps:

- simplifying model geometry (3D model software),
- conversion of 3D models for steaming in Internet (mTransformer in Hexagon).

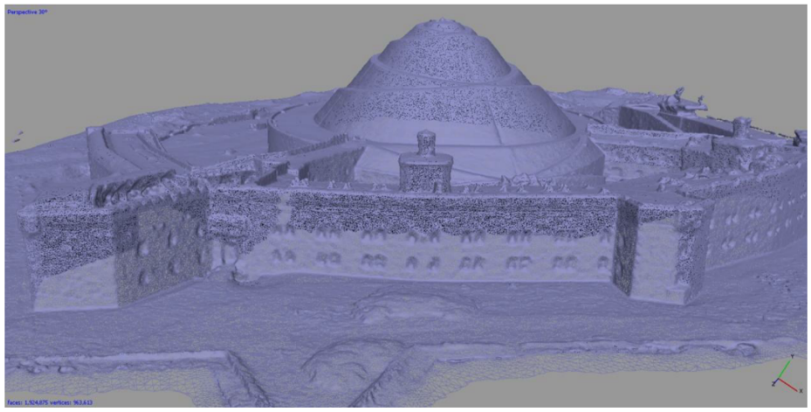


Figure 5 Original geometry – Fort Kosciuszko; ca. 2 mln polygons

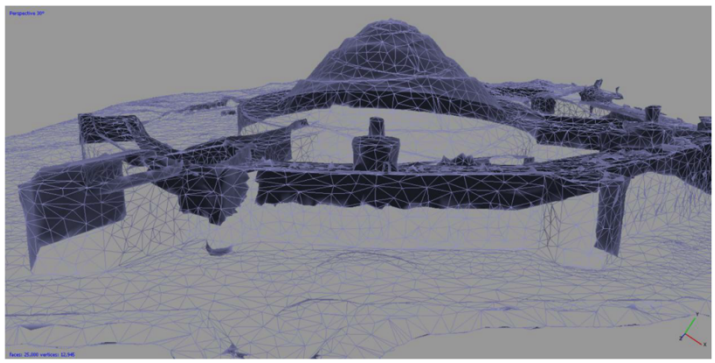
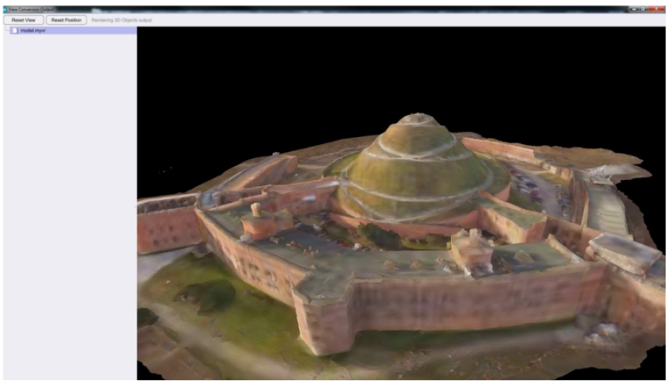
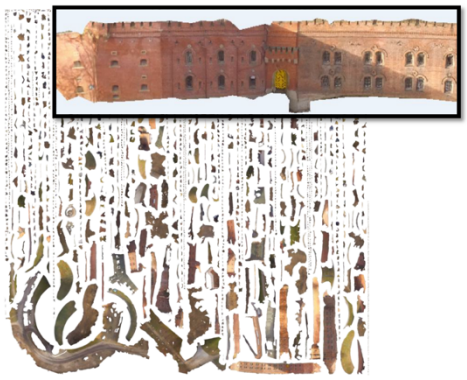


Figure 6 Simplified geometry – Fort Kosciuszko; 25 000 polygons

However, some problem appeared with texture.

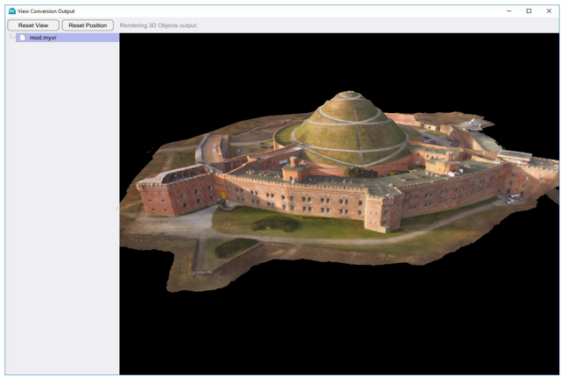


3D model texture in mTransformer



Texture atlas fom 3D modeling software (Photoscan) KMZ format

Texture atlas in mTransformer



3D model after manual corrections of xml mTransformer

Figure 7 Problems with textures

CityEngine

CityEngine from Esri transforms 2D GIS Data into Smart 3D City Models possible to share thought time in Internet. The solution, as grounded on GIS assumption has no problem with other geospatial data: vector, raster (DTM, ortophotomaps) etc. The main concept of CityEngine is a procedural approach to effective modeling. Encrypted procedure contains a number of commands regarding the geometry of the objects. Instead of the classic user operation who manually develops models, the task is described "abstract" in the rules file. CGE shape grammar is unique programming language with specification of generating objects architectural. The term CGE is an abbreviation of Computer Generated Architecture. The the idea is to define rules in CityEngine, which iteratively creates more and more details. After creating the 3D city model, model can be exported * .3ws, CityEngine format Web-Scene, and published in the Internet using free module CityEngine or on ArcGis Online platform.
Tests performed on one PL object: Fort Kosciuszko was successful, and the technology was chosen for next case studies.

Potree

Potree http://potree.org is a free open-source WebGL based point cloud renderer for large point clouds, developed at the Institute of Computer Graphics and Algorithms, TU Wien.

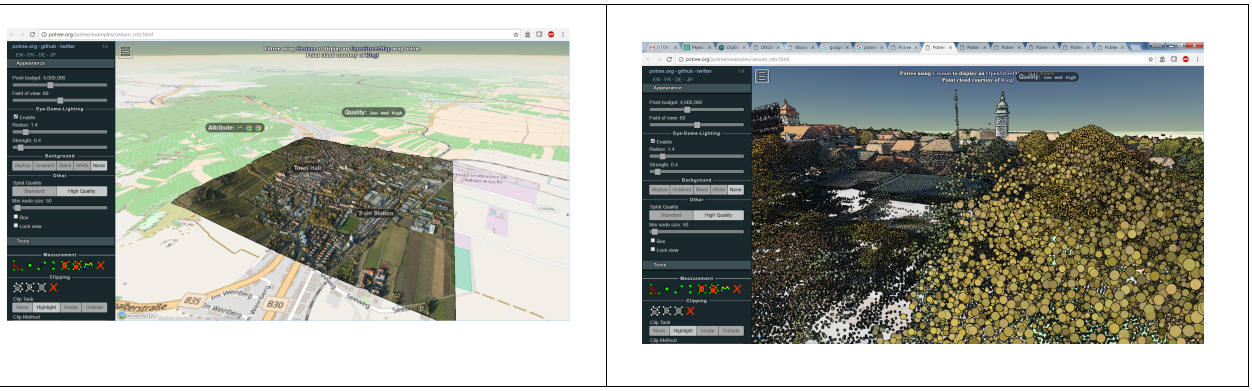


Figure 8 An example of Potree (http://potree.org/potree/examples/cesium_retz.html)

4D models in World Wide Web implementation

For WWW 4D models' presentation a special portal was prepared: http://cht2.eu. Main option is: ONLINE VISUALIZATION access now limited until formal decision about access to data (user: cht2, password: fgjn76wy).

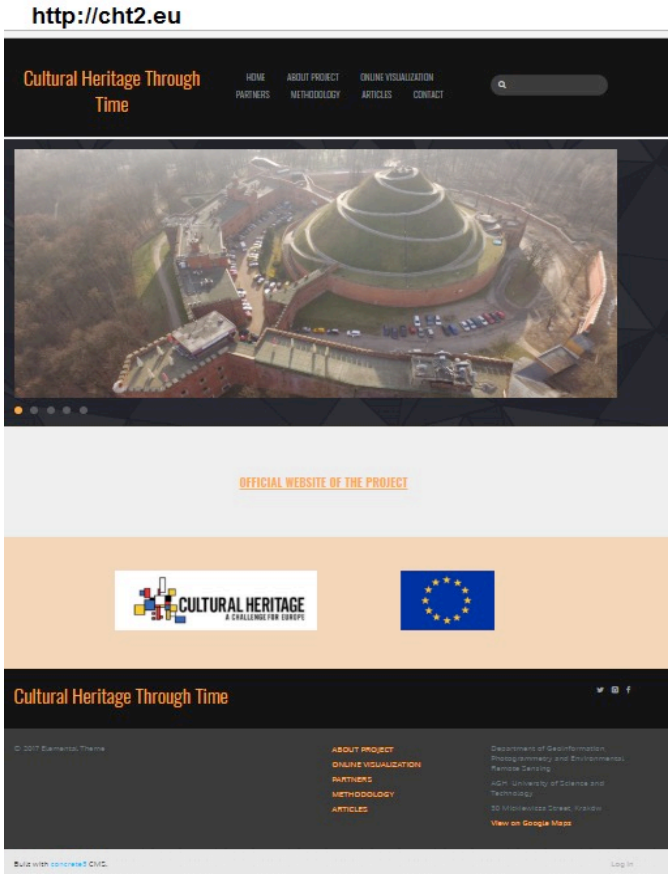


Figure 9 http://cht2.eu

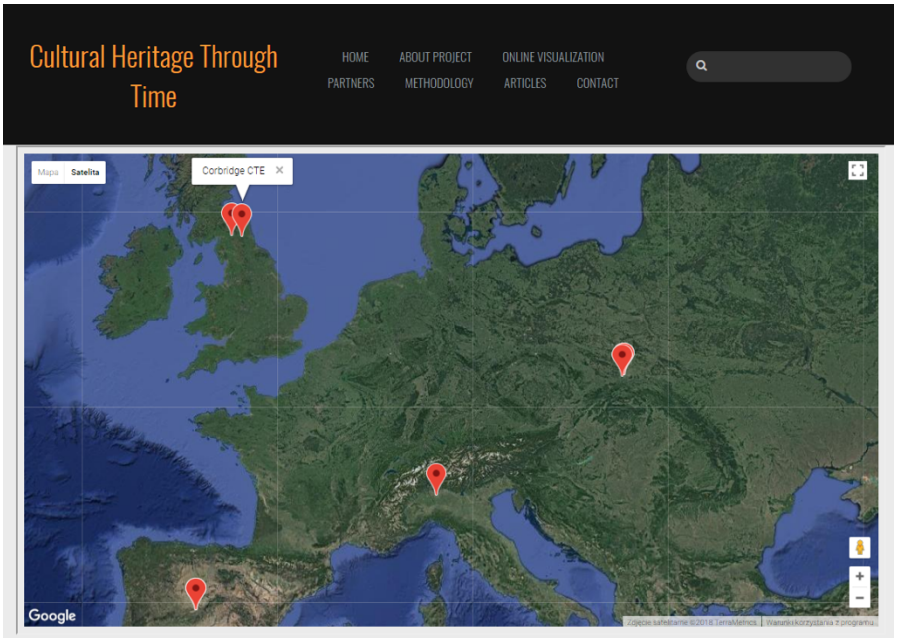


Figure 10 http://cht2.eu – ONLINE VISUALIZATION

Figure 11 http://cht2.eu – 4D models for all case studies using different technology; also movis are available

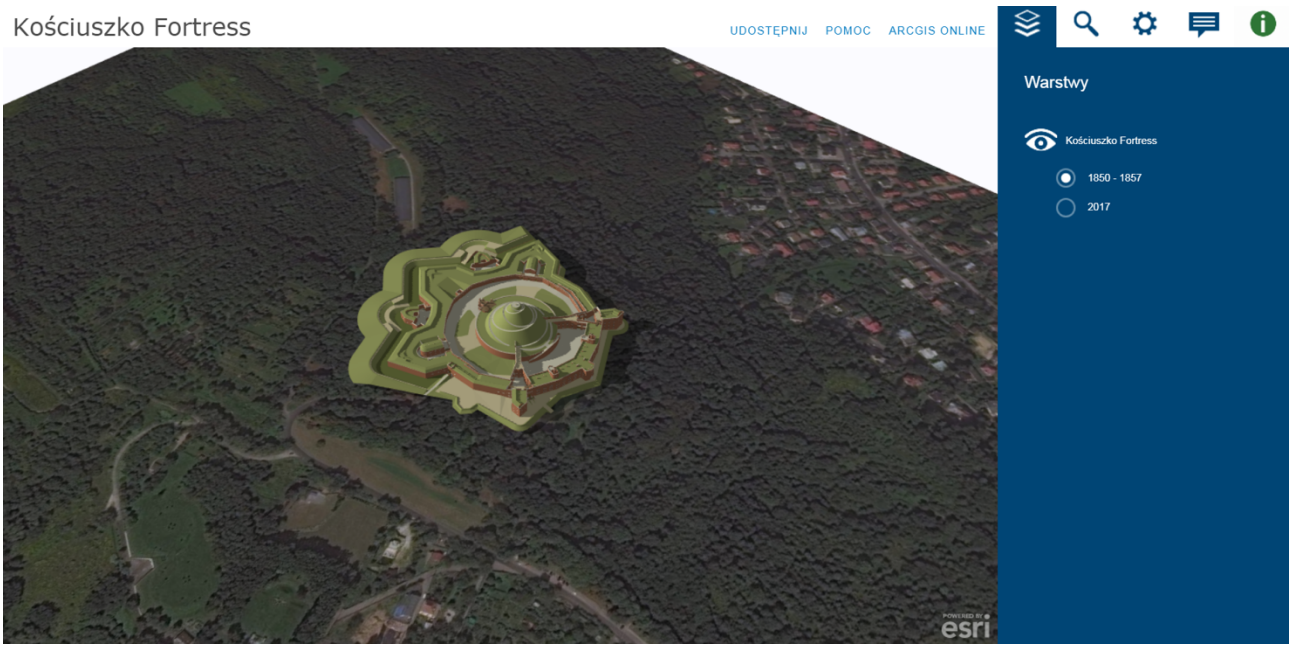


Figure 12 Fort Kosciuszko – CityEngine Web Viewer

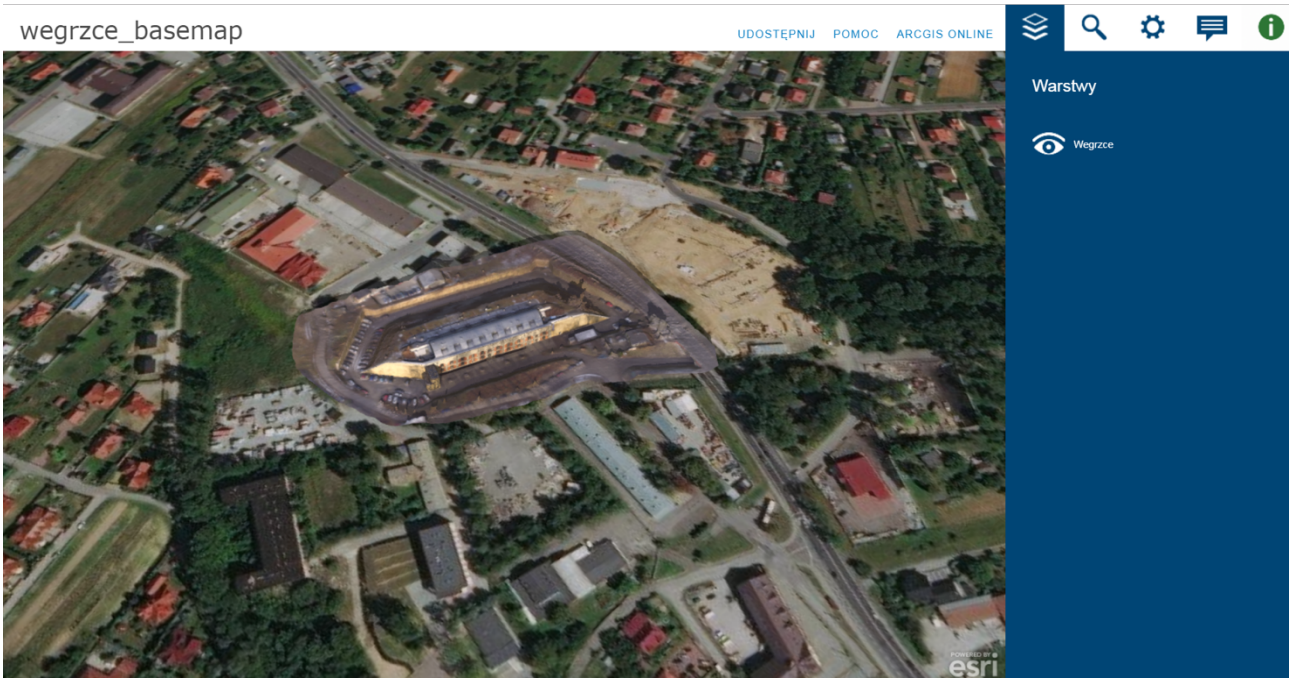


Figure 13 Fort Wegrzce – CityEngine Web Viewer

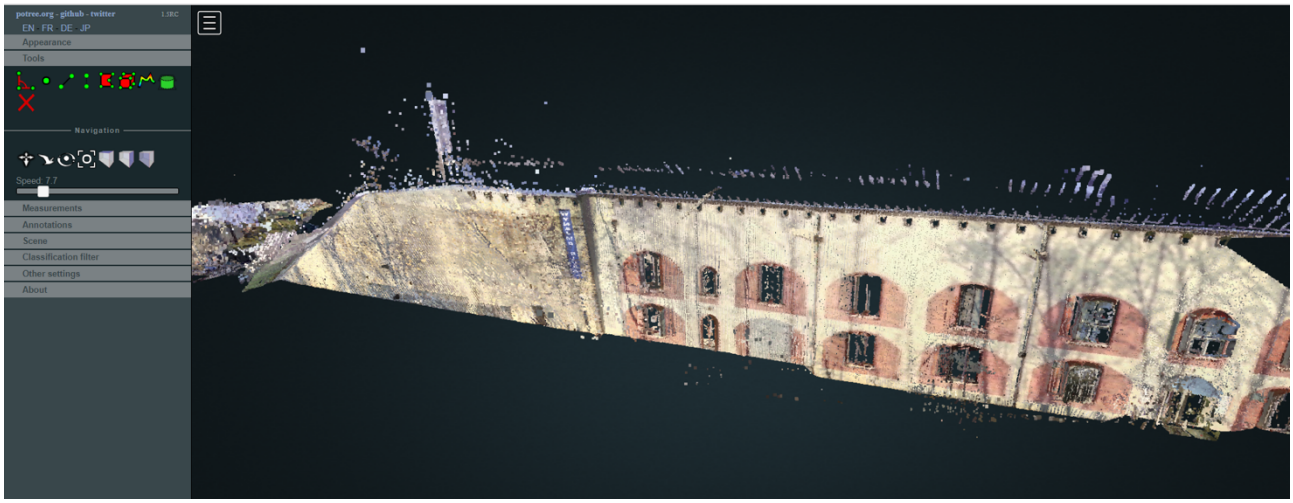


Figure 14 Fort Wegrzce – Potree

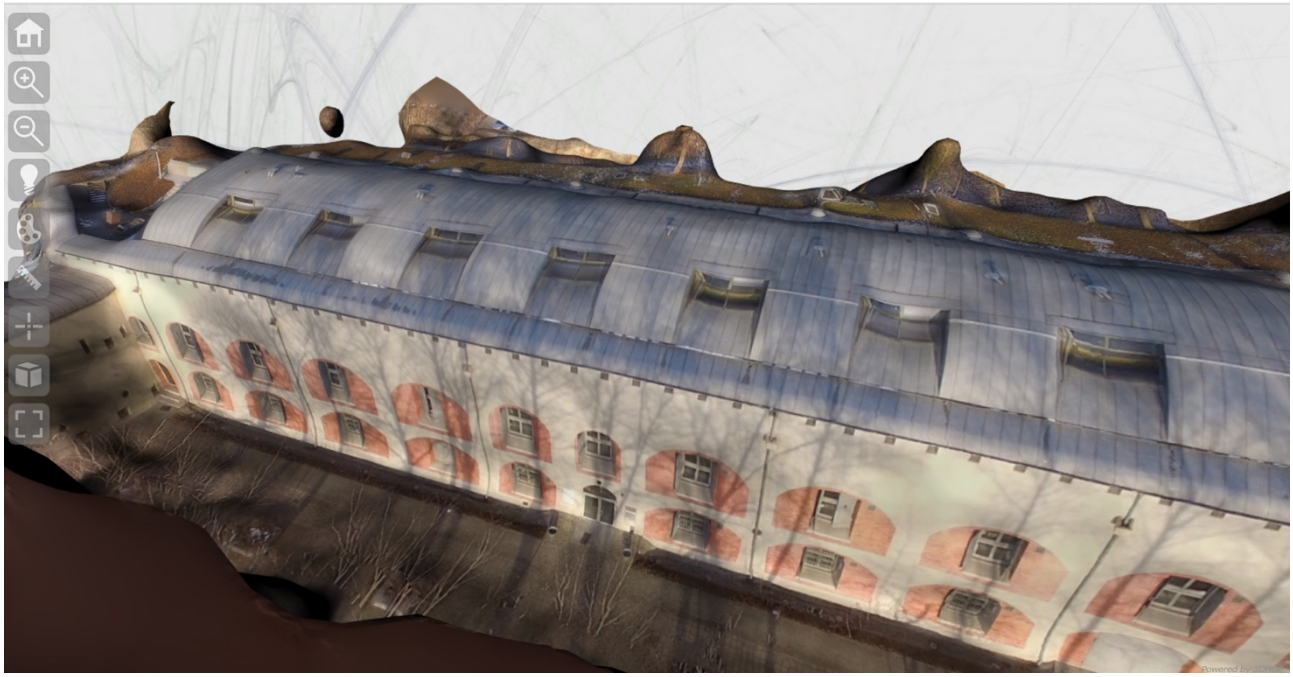


Figure 15 Fort Wegrzce – 3DHOP

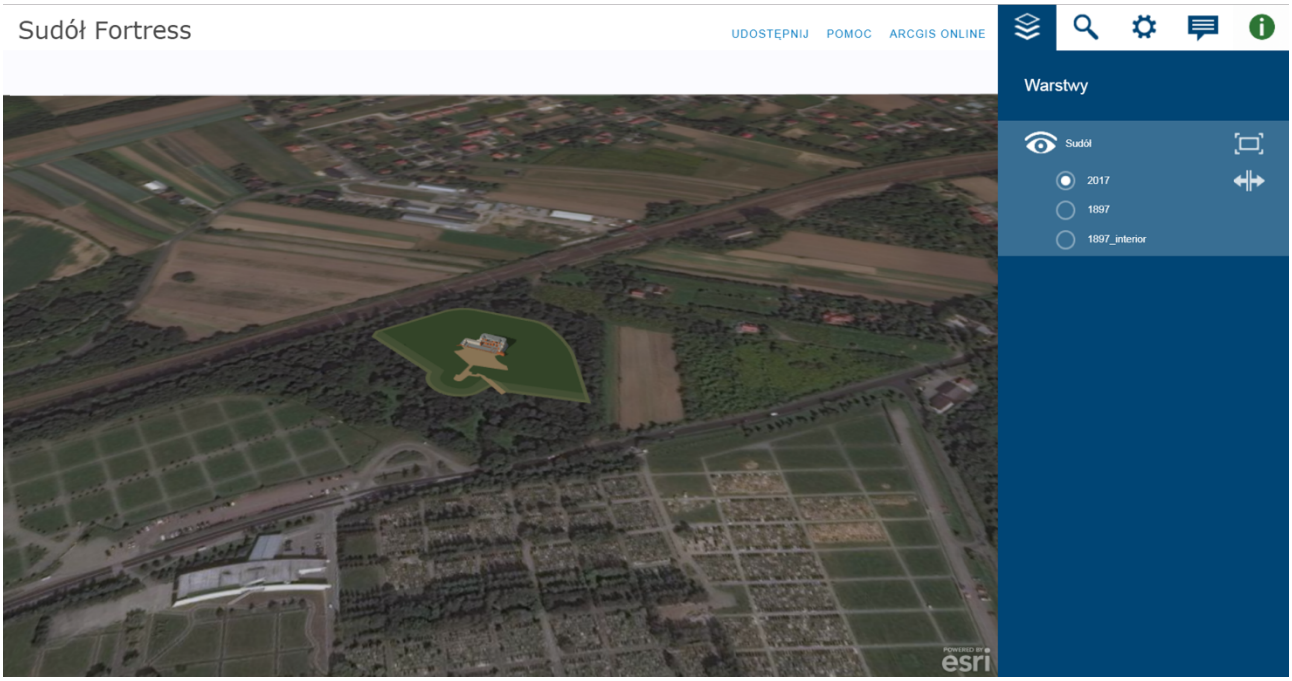


Figure 16 Fort Sudol – CityEngne Web Viewer

Figure 17 Alcazar Gate – Avila – CityEngine Web Viewer

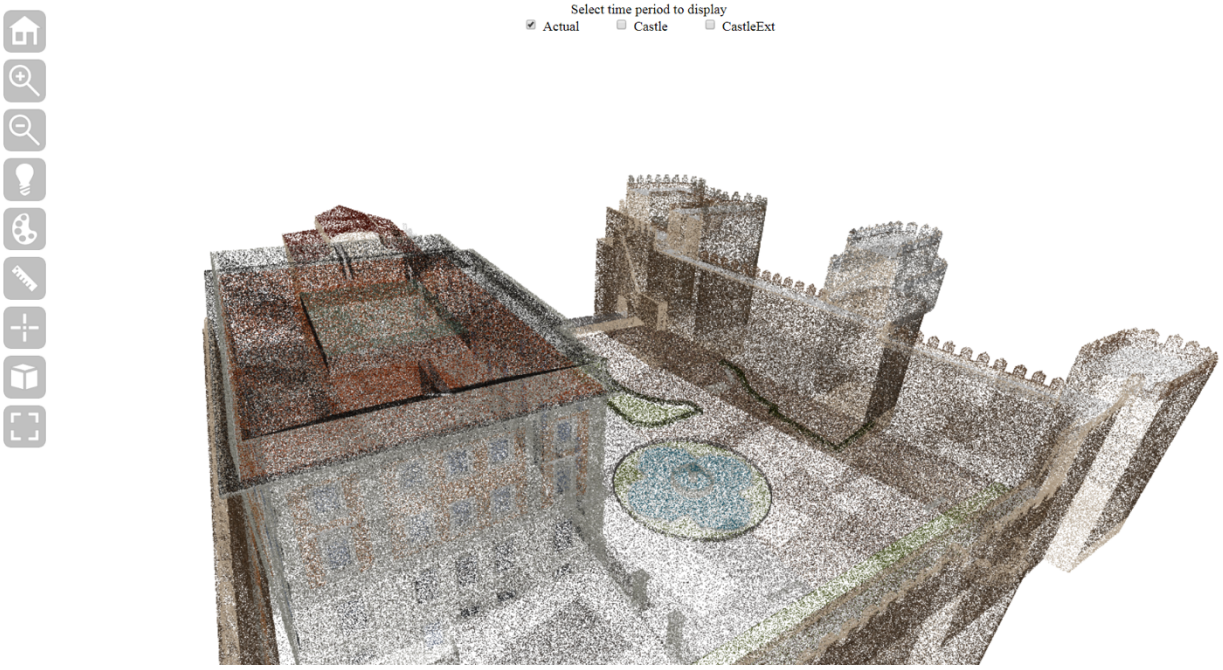


Figure 18 Alcazar Gate – Avila – 3DHOP

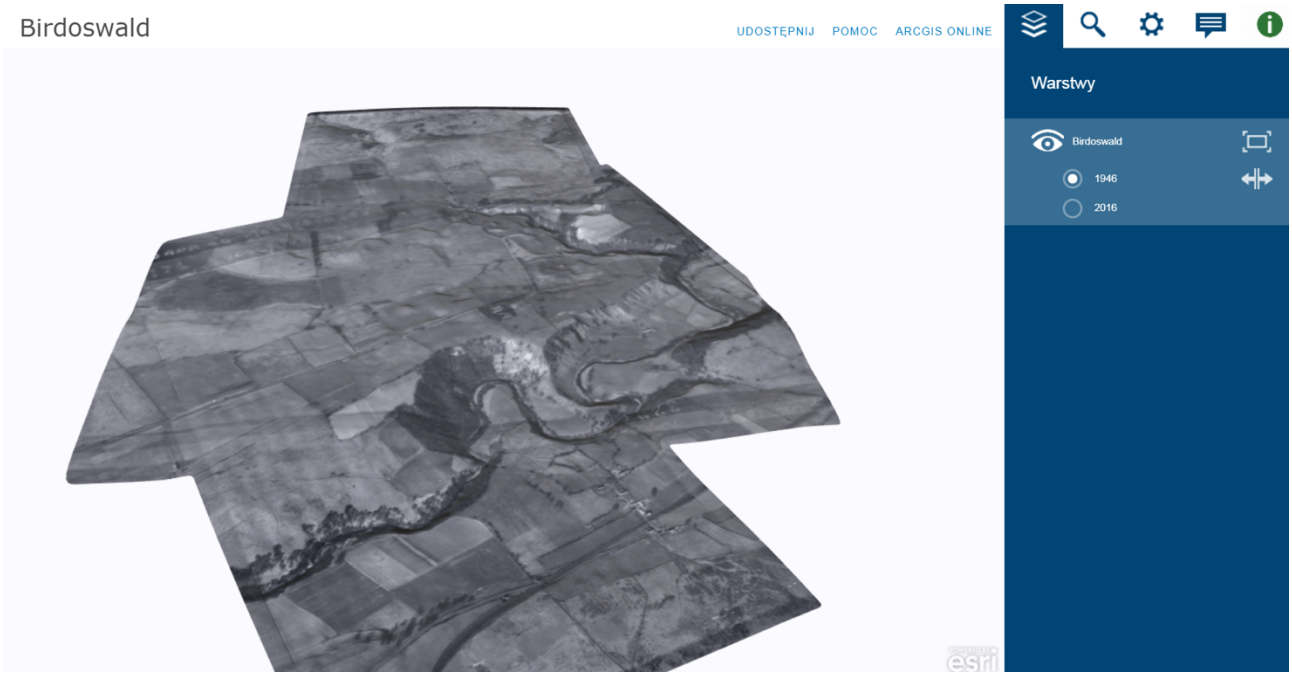


Figure 19 Birdoswald - CityEngine Web Viewer

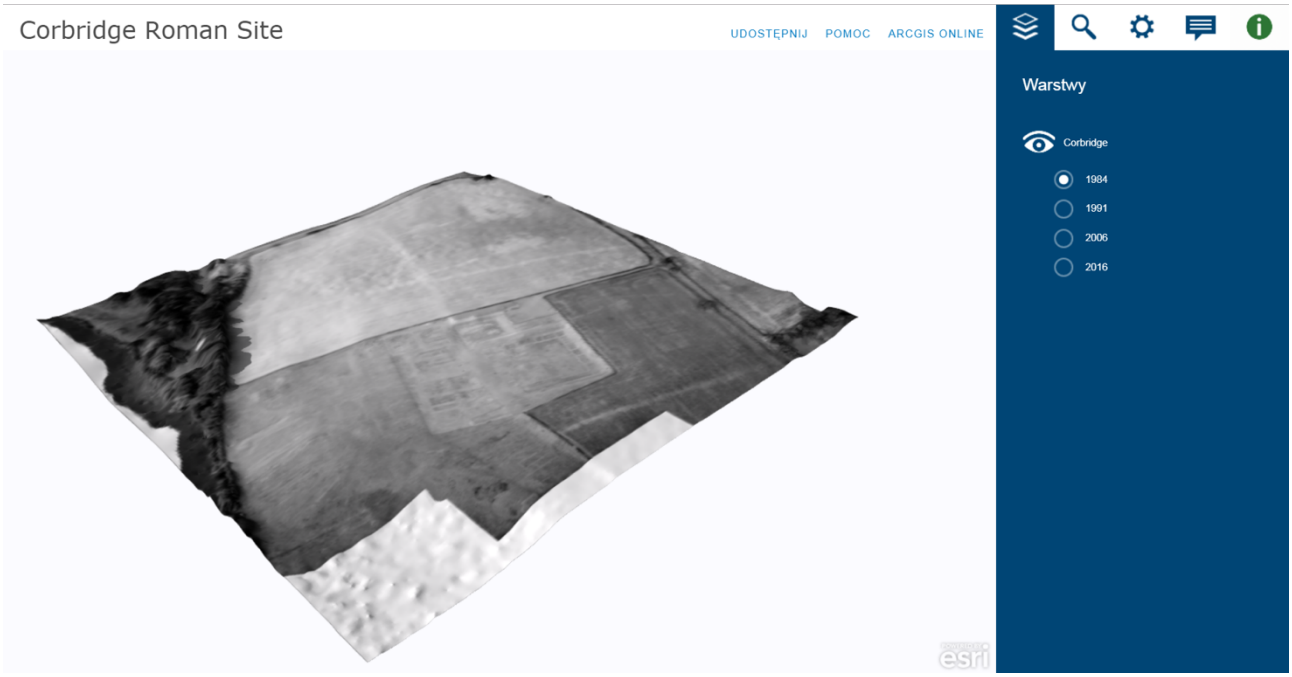


Figure 20 Corbridge Roma Site - CityEngine Web Viewer

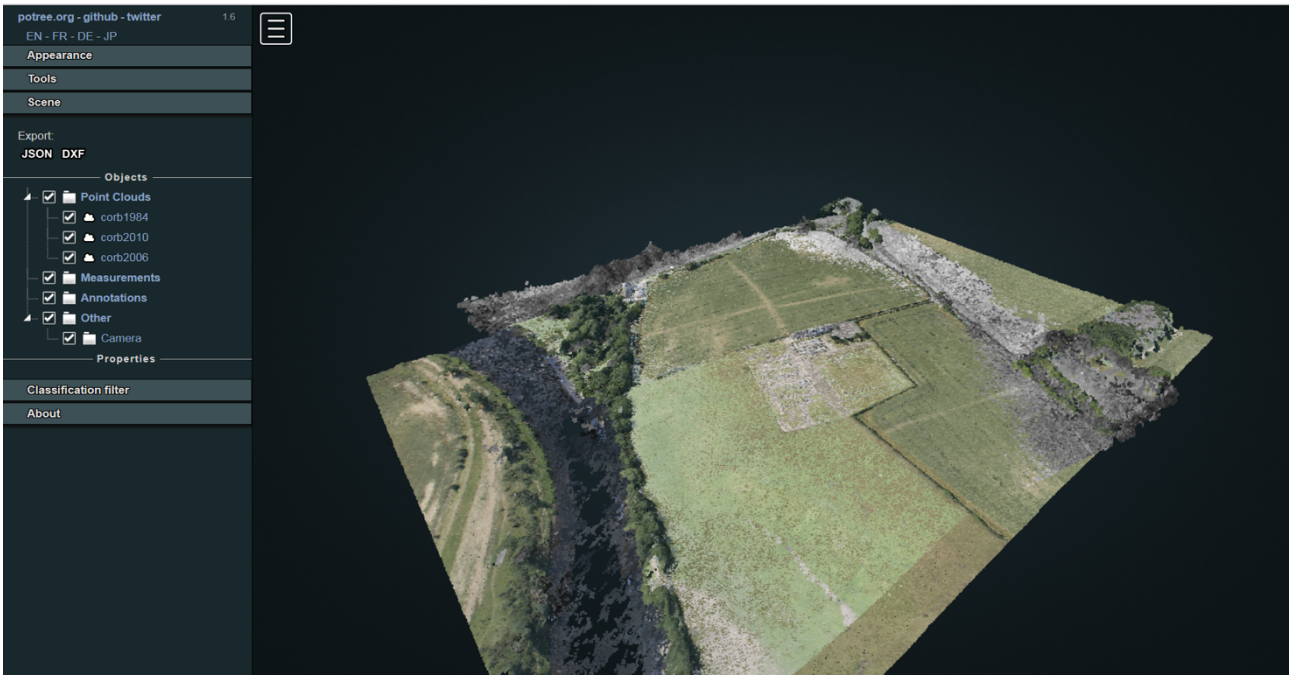


Figure 21 Corbridge Roma Site – Potree

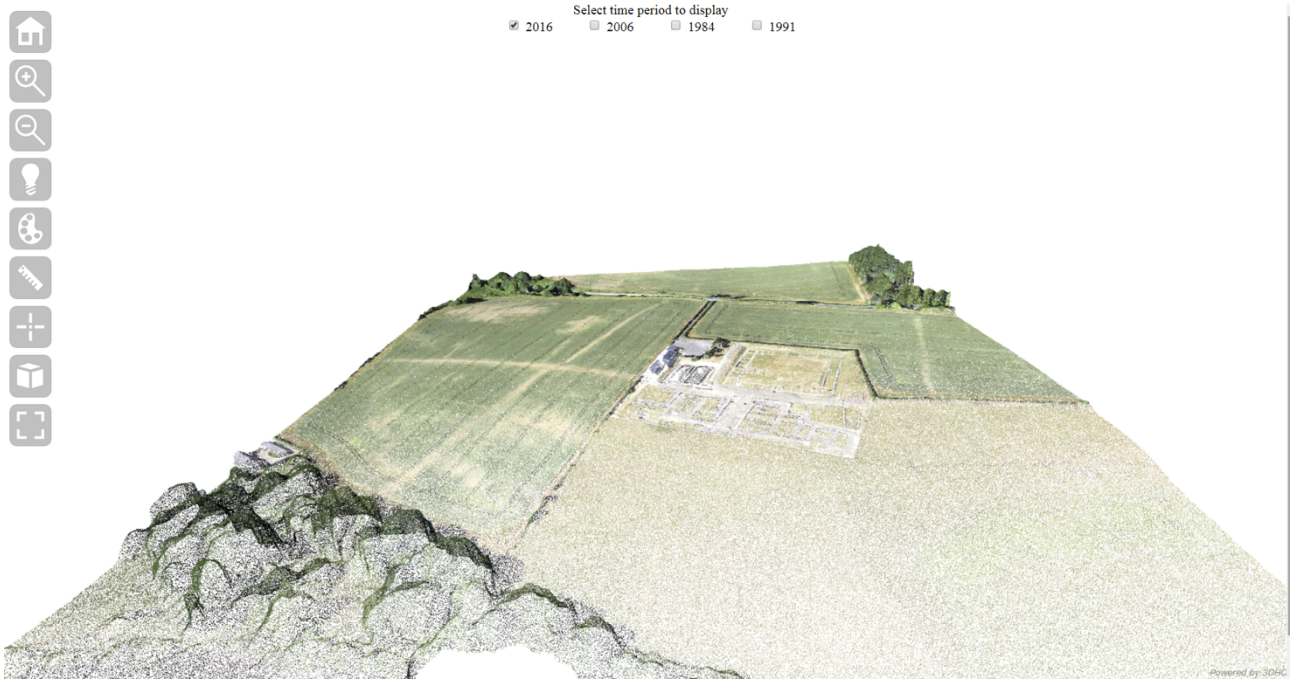


Figure 22 Corbridge Roma Site – 3DHOP

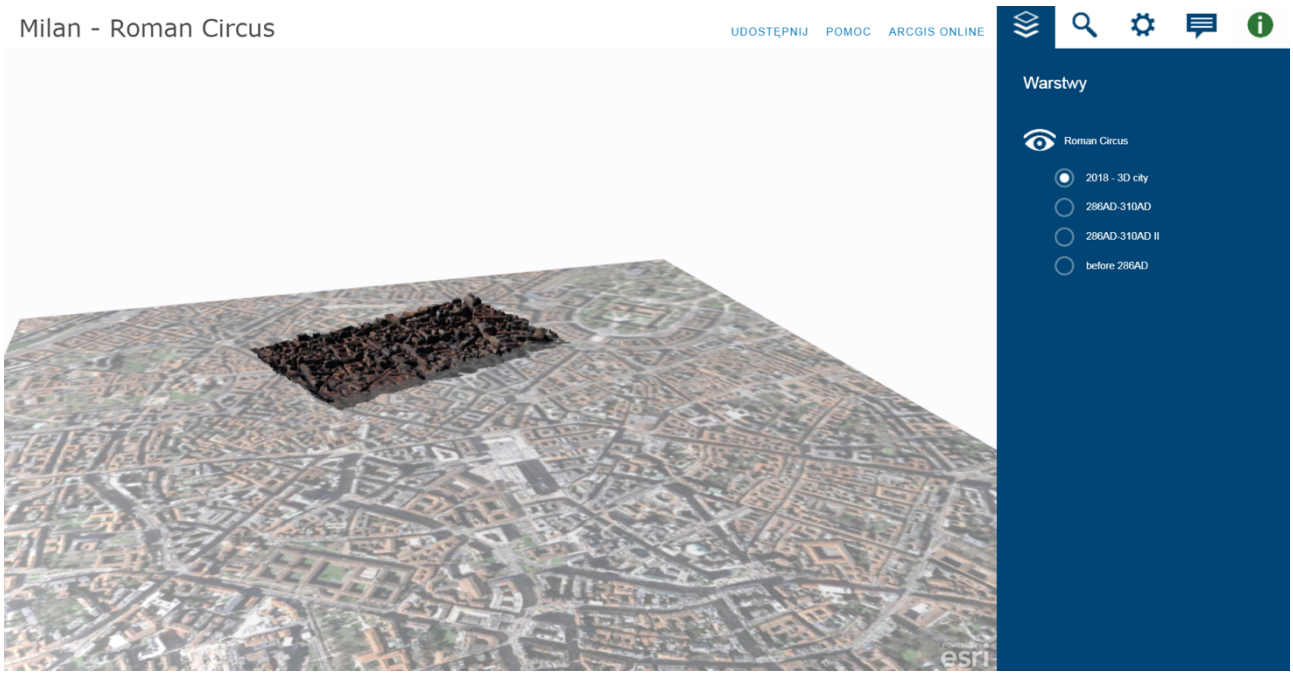


Figure 23 Milan – Roman Circus - - CityEngine Web Viewer

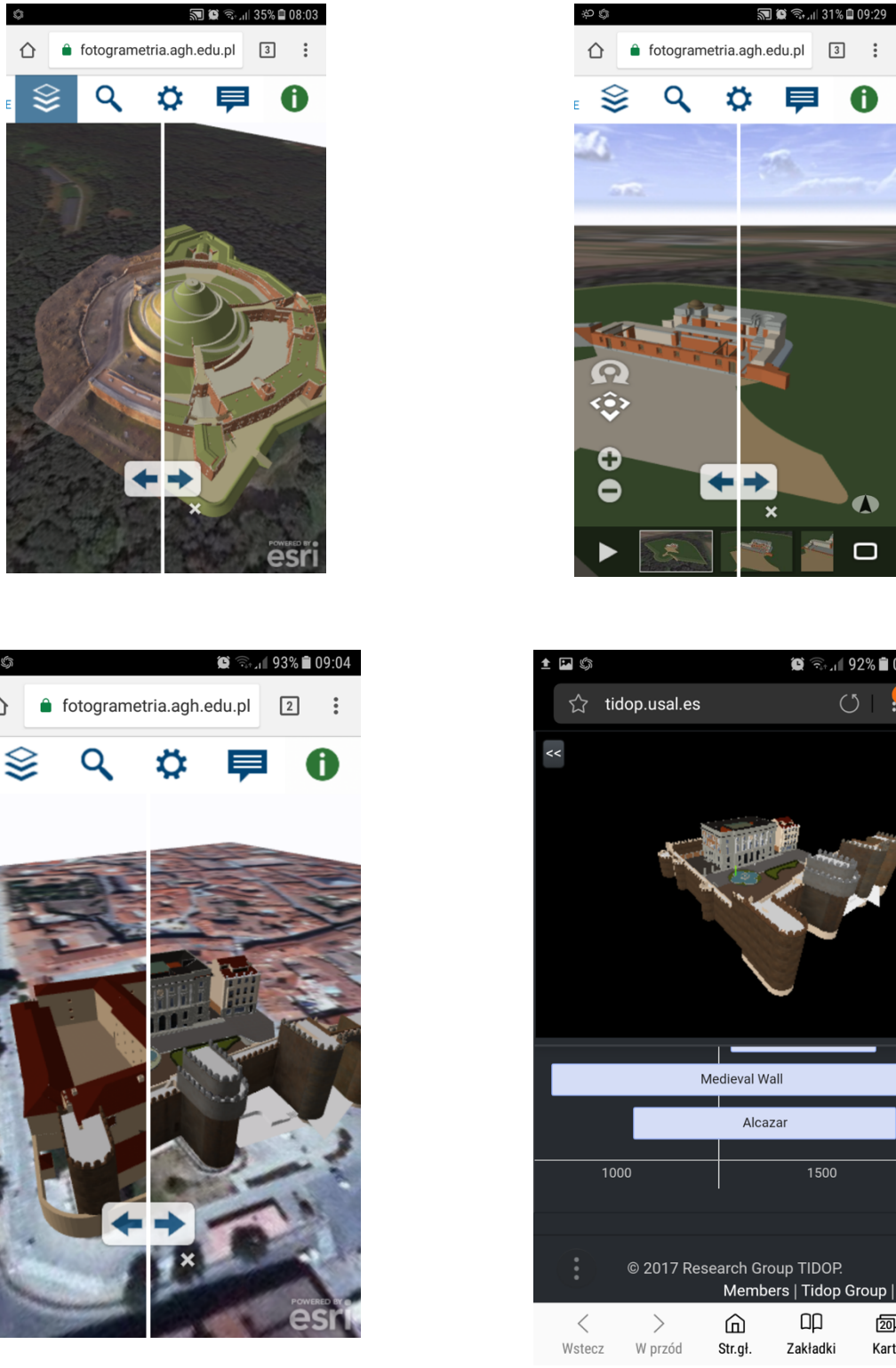


Figure 24 On mobile phone; 4D models – CityEngine Web Viewer – Fort Kosciuszko, Fort Sudol, Alcazar; lower right – TIDOP – application created by USAL (only Android)

Conclusions

1. Open-sources or free solutions for 3D/4D model and point clouds visualization are available as desktop application and also as web application
2. Web sharing of 3D models in time using GIS data is not common.
3. After testing commercial software Hexagon and Esri solution based on Esri – CityEnigine was chosen
    a. data preparation was easier
    b. there was no problem with texturing
    c. City Engine Viewer is free
    d. the solution works also on any mobile device
    e. very useful tool for 4D models comparison is available (screen is divided by two parts and user can shift the arrow loking at the 2 models parallel)
4. Two open source software for point clouds was deeply tested: Potree and 3DHOP
    a. after initial tests Potree seems to be more effective and supports GIS data
5. Application created by USAL: TIDOP based on Cesium JS, an open-source JavaScript library was also tested on desktop and on mobile device
    a. works on data from USAL very well
    b. on mobile is limited to Android
    c. needs special data preparation

More tests and some optimizing of the visualizations are planned. Visualization of SSSA and USAL are satisfactory but of POLIMI and NCL need some improvements.