# Training in Mapping Changes on an Archaeological Site

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ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

# FIG Com 2 – Professional Education

## Agenda

- EPFL – Swiss Federal Institute of Technology
- ENAC School “projeter ensemble”
- Archaeological site
  - Surveying
  - Mapping Changes
- Conclusions

# Ecole Polytechnique Fédérale de Lausanne

- Swiss Federal Institute of Technology = ETH Zürich + EPF Lausanne + dedicated labs.
- 13 study progr.
- 350 research labs
- ~10k students

# ENAC School – *Projeter ensemble*

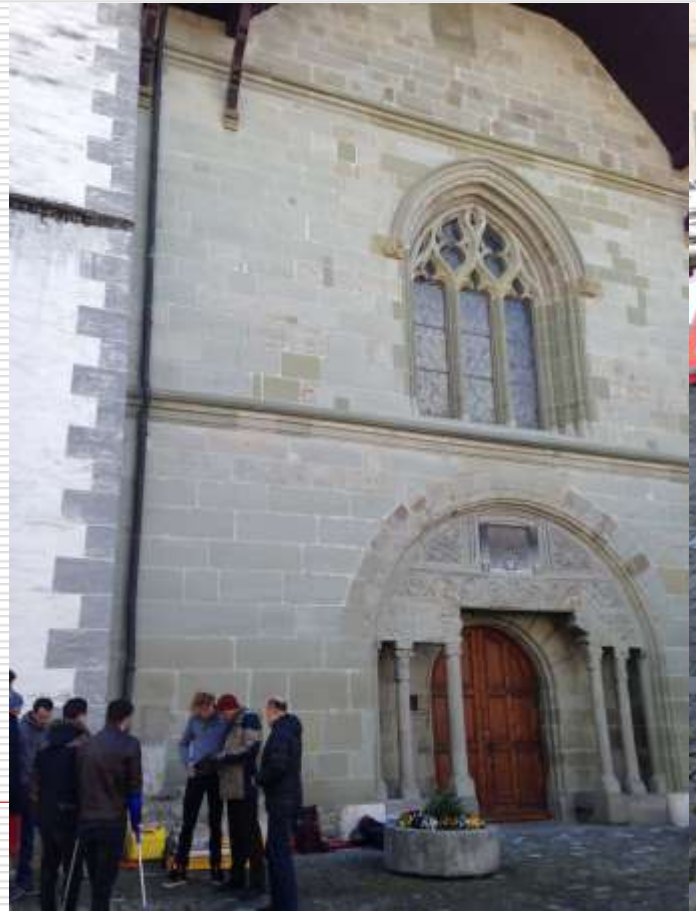
- ENAC: School of Architecture, Civil and Environmental Engineering
  - 3 institutes/sections (AR, GC, ENV)
  - ~70 faculty members
  - ~700 employees (professors, researchers, admin)
  - 1200 students (Bs, Ms)
  - 300 PhD students
- Concept *projeter ensemble* (design & build together)
  - To promote **the interdisciplinary approach** trough teaching activity: from joint courses to common projects.

# ENAC School – *Projeter ensemble*

- *Projeter ensemble* includes:
  - interdisciplinary courses from ENAC
    - architecture, civil & environmental engineering
  - pedagogical approach based on a mix of competences (students & teachers)
  - relevant topics: land management, transport & mobility, urban design, natural hazards, energy, …
  - team of teachers from 3 sections (AR, GC, ENV)
  - Mixed classes of students
- Opportunity to work together and to share knowledge

# ENAC week – 2nd year

- *Design together*



# ENAC - Teaching Unit - 3rd year, spring

- Focus on Teaching Unit
  - Weekly workshop (1/2 day/week) during one semestre
  - 2 – 3 teachers
  - Class of 15 to 25 students (balance between Archi. & Eng.)
- Combination of theory (concept) and practice (field, lab)
- List of topics proposed to students
  - Visualising future cities, architecture & solar energy, urban management in the South, mapping urban history, urban disctricts and sustainable management, …
- Our topic: Geotechnologies for mapping changes

# ENAC - Teaching Unit

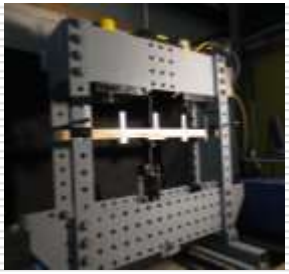
## Geotechnologies for mapping changes

- Objective: to study and to evaluate changes at different scales
  - part of a structure, small construction
  - building, bridge, archaeological site
  - territory, urban area, biotope
- The approach
  - Studying and understanding the «object»
  - Collecting appropriate data, capturing information
  - Analysis, visualisation and mapping

# ENAC - Teaching Unit

## Geotechnologies for mapping changes

- Measurement of structural deformation (beam), data processing and geometrical features analysis
- Surveying of a building with laser techniques, data processing, 3D modelling and 2D drawing (CAD), comparison with old maps
- Mapping of landscape changes based on remote sensing data at different epochs



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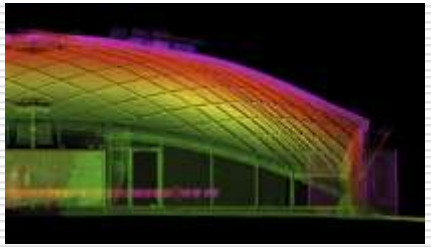

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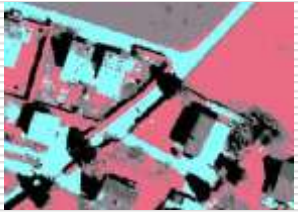


10-50 cm

# Teaching Unit – Archaeological Site

- Antique Theatre of Aventicum
  terrestrial and aerial mapping
- Objectives
  - To combine different sources of data.
  - To model a non-conventional built object.
  - To visualise a complex environment.

# Teaching Unit – Archaeological Site

Antique Theatre:
Avenches (CH)

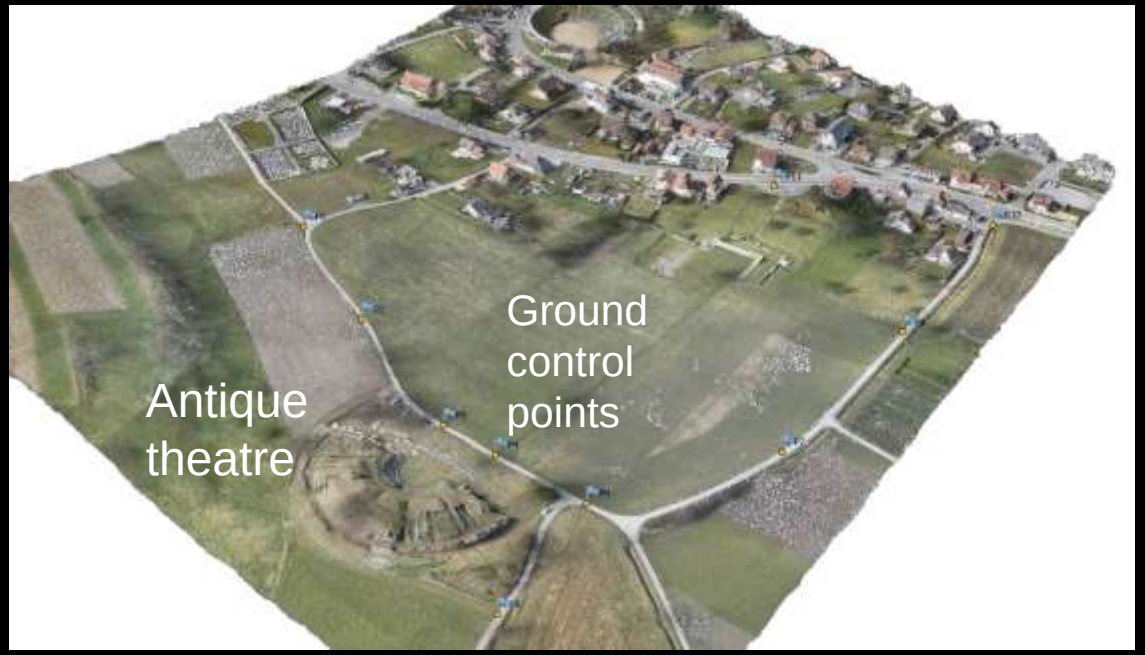
# Archaeological Site: Data Acquisition


Terrestrial laser scanning: capturing 3D point clouds

Total station: surveying of Ground Control Points

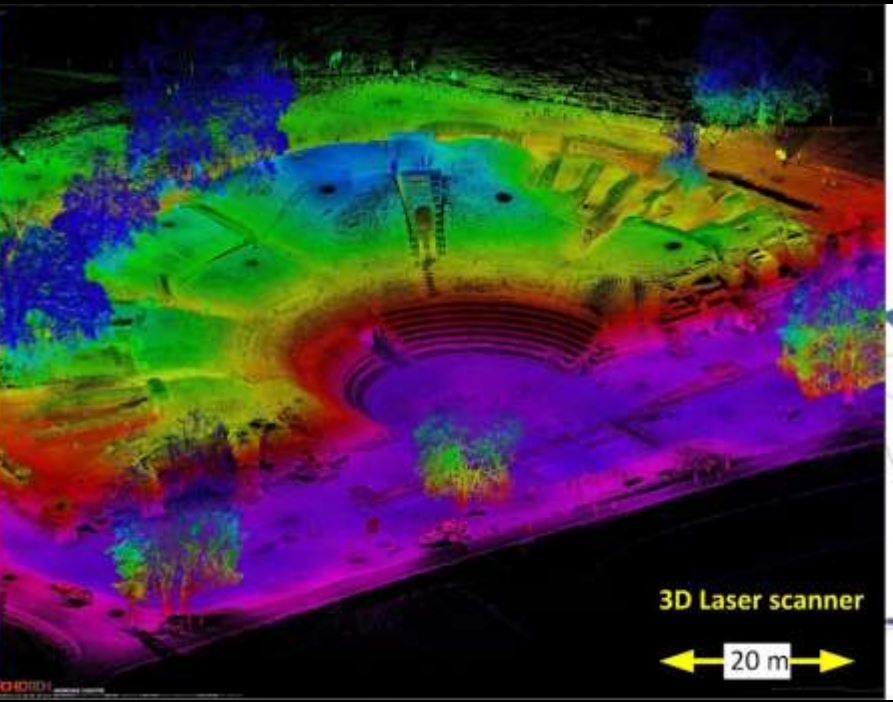
# Archaeological Site: Data Acquisition

Aerial photogrammetry




Mapping with drones: overview of Avenches

# Archaeological Site: Data Acquisition



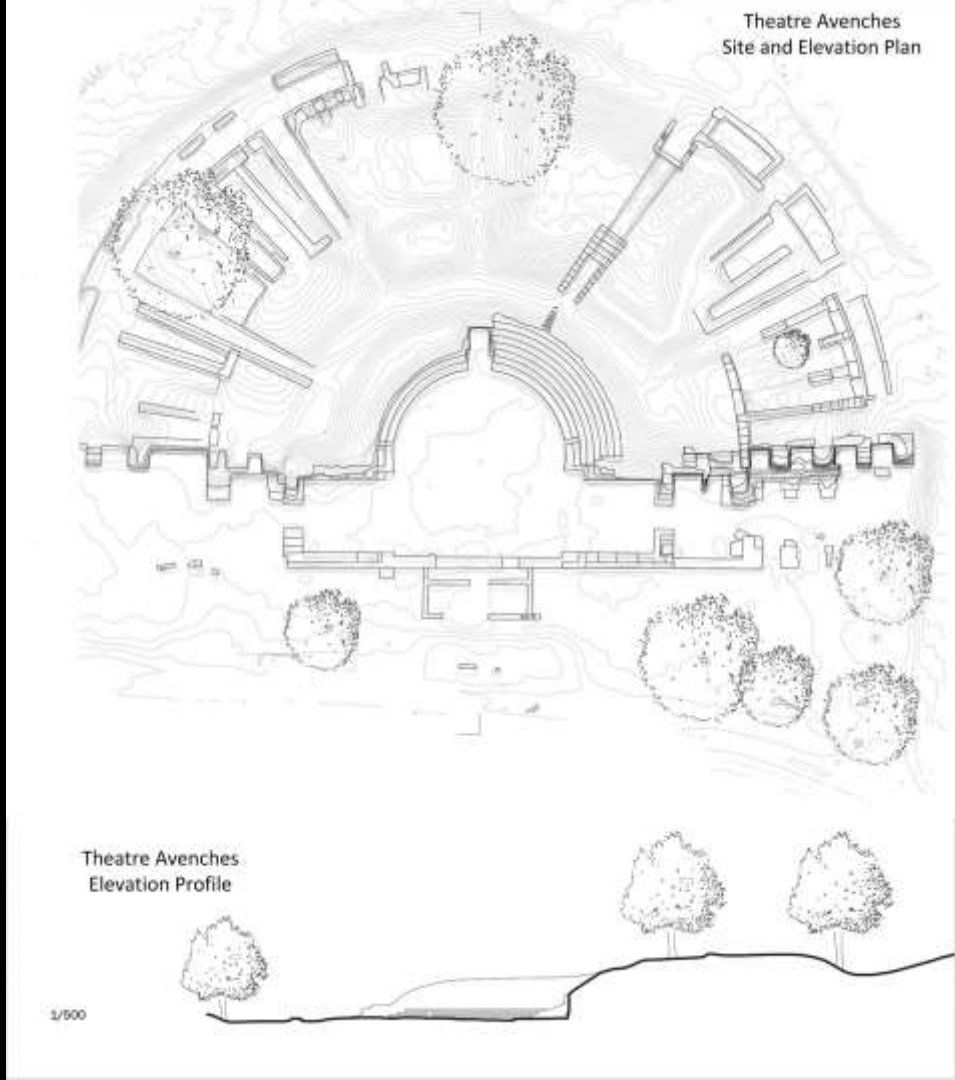

Terrestrial laser scanning:
raw point clouds


Mapping with drones

# Archaeological Site

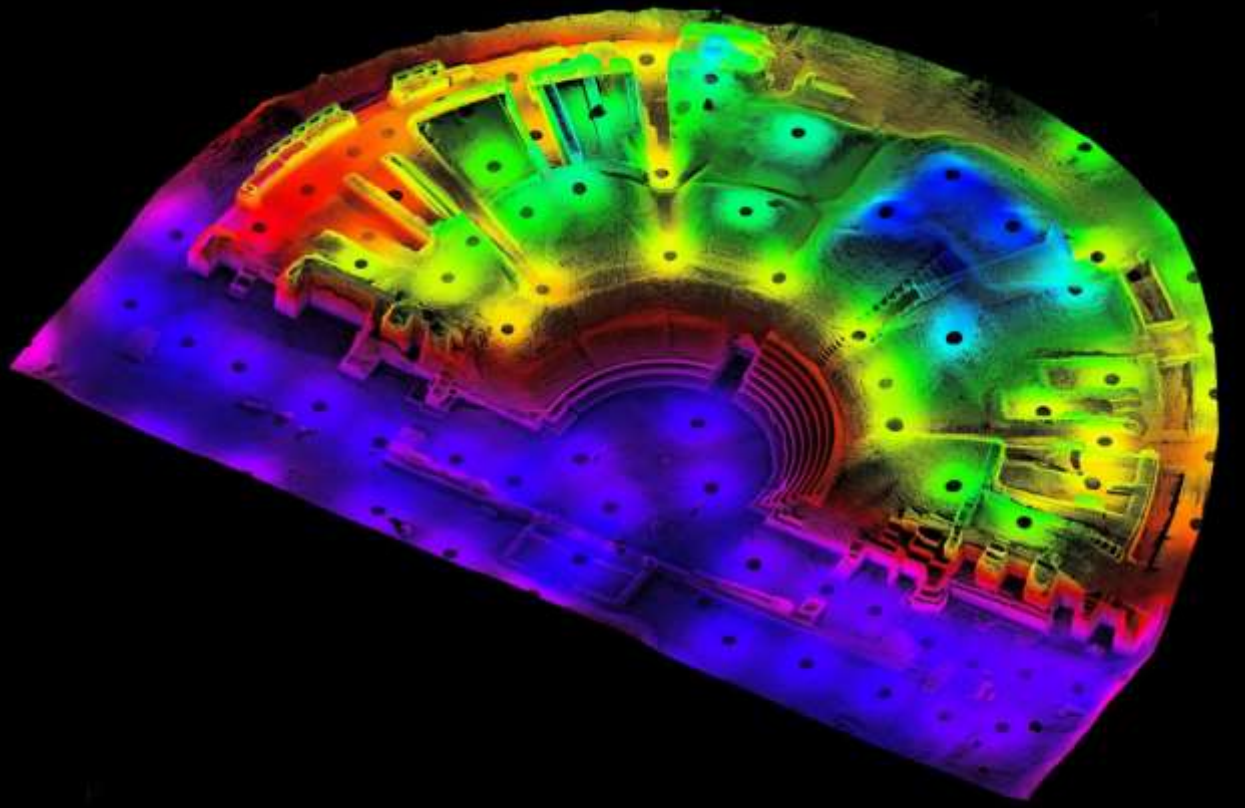
- Modelling
  - Creation of 3D models based on PC
  - Extraction of profiles
  - 2D drawing
  - PC based comparison between epochs

PC: Point Cloud

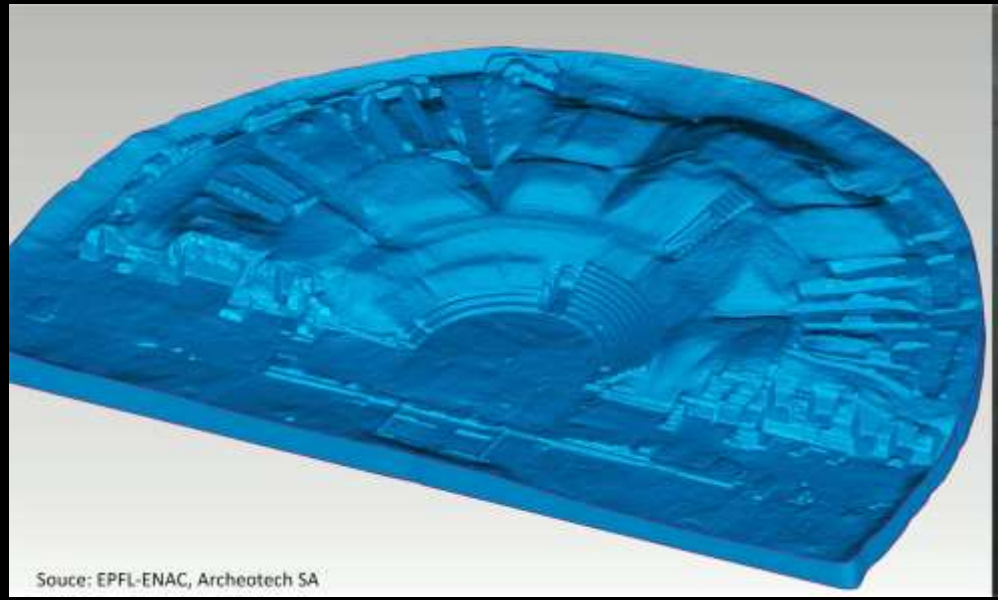


# Archaeological Site - Modelling

- 3D point clouds
- Digital surface model
- All the objects above ground are removed before extracting a mesh model.



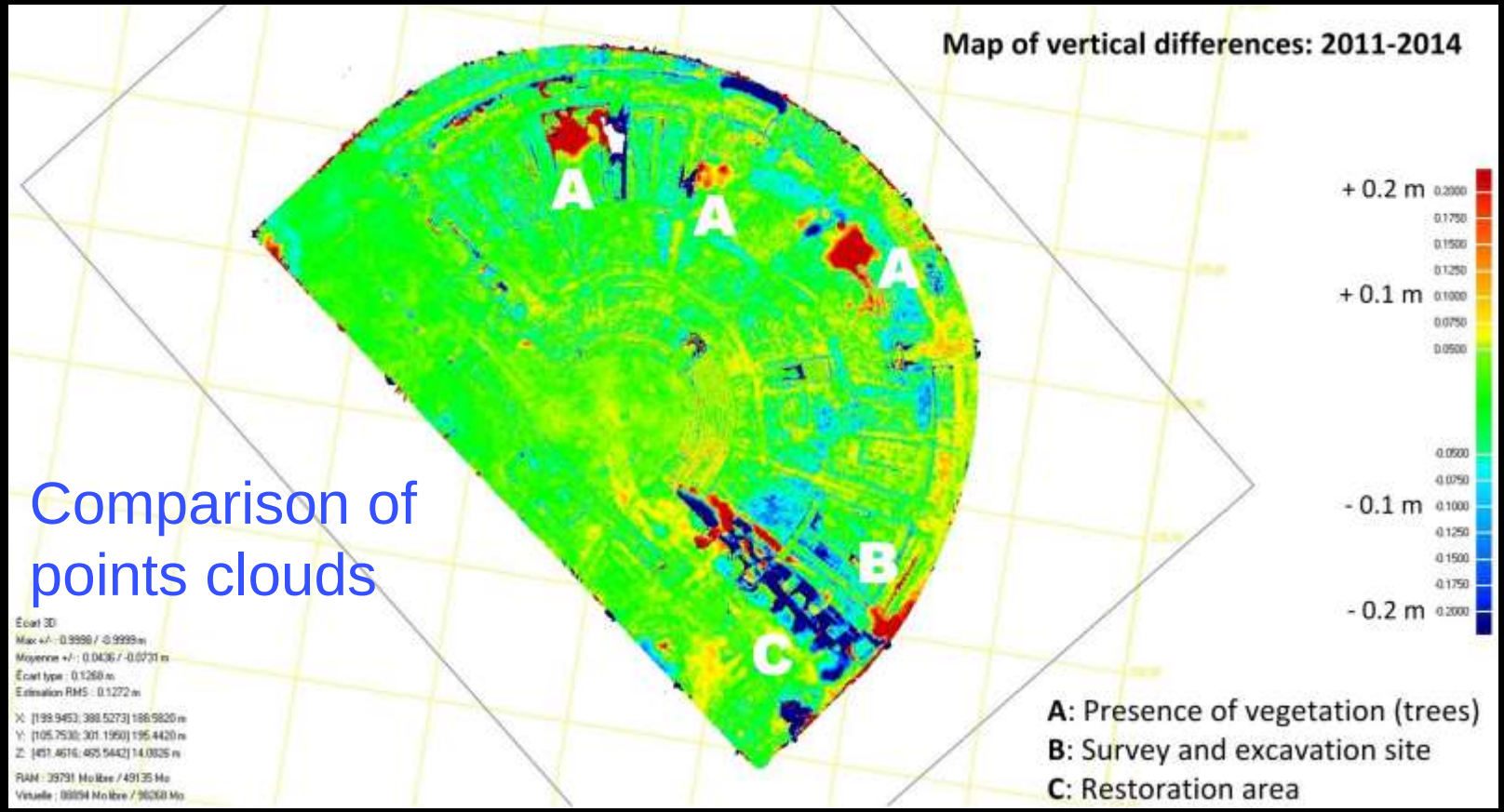
# Archaeological Site – Modelling



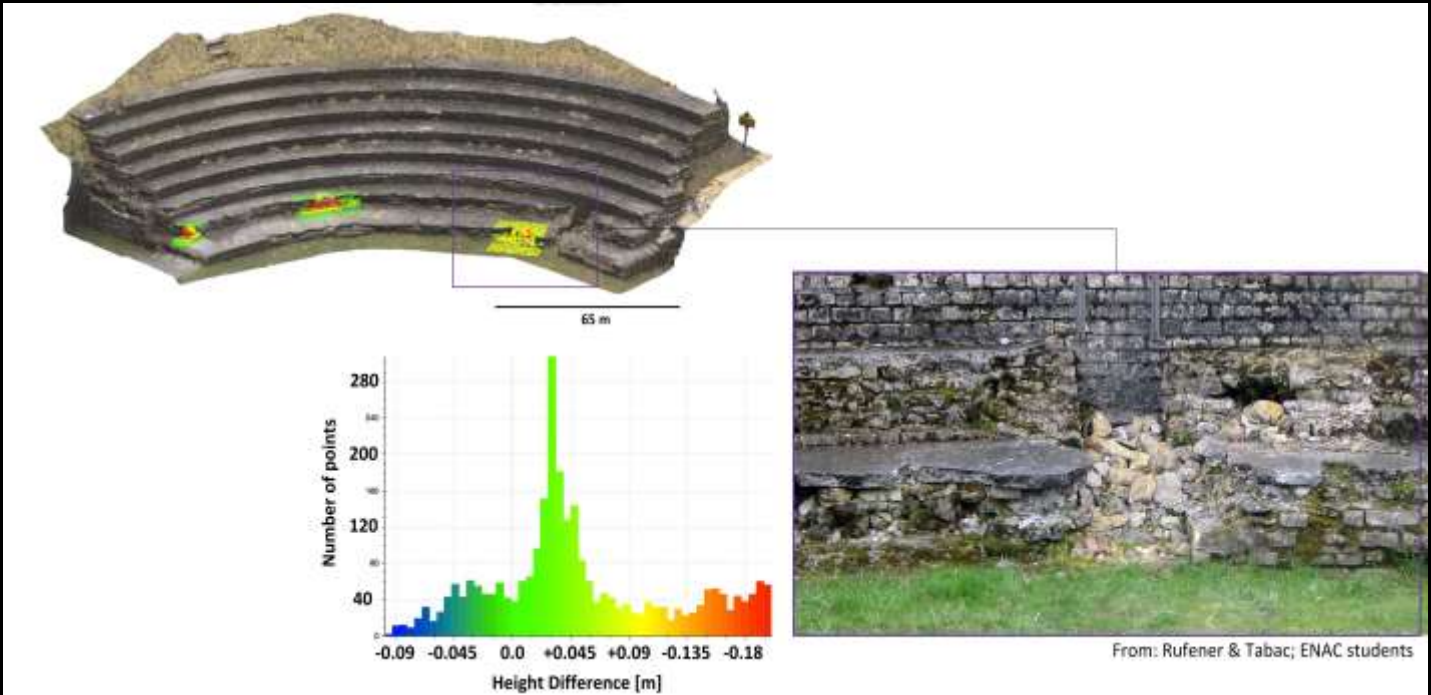

3D Mesh Model


3D Printing

# Archaeological Site – Mapping of Changes



# Archaeological Site – Mapping of Changes




- Height differences between 2010 and 2014
- Comparison of point clouds, erosion of steps

# Mapping of Changes

- Restoration
  - Comp. 2010-2016
  - new masonry (light brown)

dark red or blue means “big change”, e.g. reconstruction

Combined model: 2010 (white) – 2016 (brown)


Visualisation of changes: before (2010) and after restoration (2016)

# Conclusions

- Benefits of the teaching unit
  - Increase in motivation, strong implication of students
  - Practical work: necessity to ask appropriate questions
  - Combining approaches towards a common objective.
- Power of Mapping
  - From field observation to visualisation …
    … from raw data to information
  - Data capture is easy.
    Extracting the relevant information is another story.
  - Students had to think about the best way to compare epochs and to map the outcome.

# *Many thanks for your attention !*

# *Questions?*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