PHOS4DTOOLS:

Reconstructing the daylight conditions in an insula of antique Pompeii

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Goals



Overview

Preparation of model and software

Initialisation and simulations

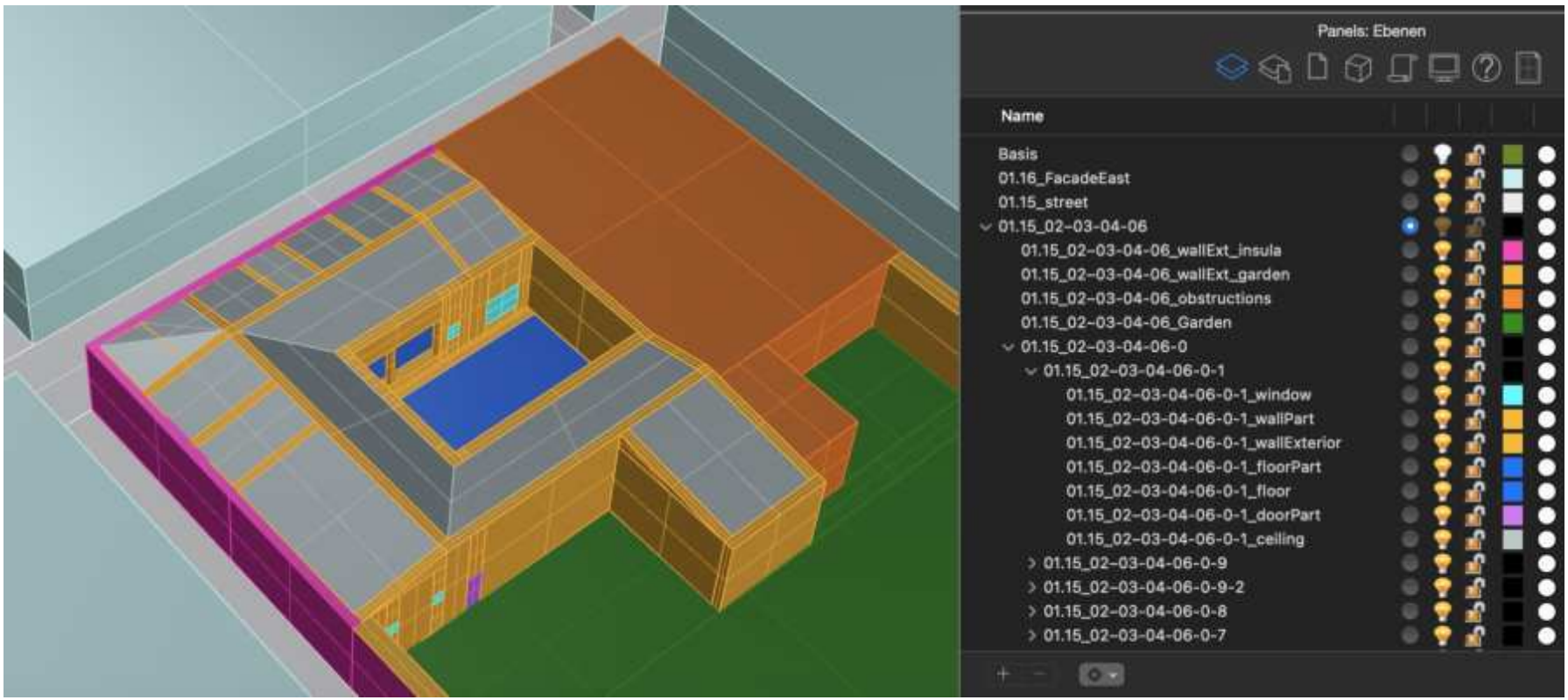
GIS import

Application of thresholds

Validation

Preparation of model and software

3D Model




```
1    planemod = .*(floor).*
```

3D Model

Resulting layer name in OBJ:

```
g 01_15_02_03_04_06 01_15_02_03_04_06_0 01_15_02_03_04_06_0_8 \
01_15_02_03_04_06_0_8_wallPart
```

Material definition:

```
#refs/materials.rad
void plastic wallPart
0
0
5        .35       .35       .35
         0         0
```

Get model data

```
1  git clone https://c4science.ch/source/CasaNaveEuropa.git
```

CasaNaveEuropa
- obj
  - CasaNaveEuropa.obj ..... Reconstruction model
- refs
  - basepoint.txt ..... Center
  - ITA_Napoli-Capodichino.162890_IGDG.epw ..... Weather file[1]
  - material.rad ..... Material definitions
- LICENSE.txt ..... CC BY-4.0 license

[1] IGDG file from `https://www.ladybug.tools/epwmap/`

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Install raytraverse and phos4dtool

```
    cd CasaNaveEuropa
    python3 -m venv env
    source env/bin/activate
    pip install --upgrade pip
    pip install raytraverse
    git clone https://igit.architektur.tu-darmstadt.de\
        /phos-4d/phos4dtools.git
    pip install ./phos4dtools
    deactivate
    source env/bin/activate
    phos4dtools --version
```

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Initialisation and simulations

Initialise, convert model, and set up zones

13
```
phos4dtool newdir
```

CasaNaveEuropa
- env — Virtual environment
- obj
- phos4dtools — From git
- RAD — For converted model
- refs
- LICENSE.txt
- results — For simulation results
- setup.cfg — Editable configuration

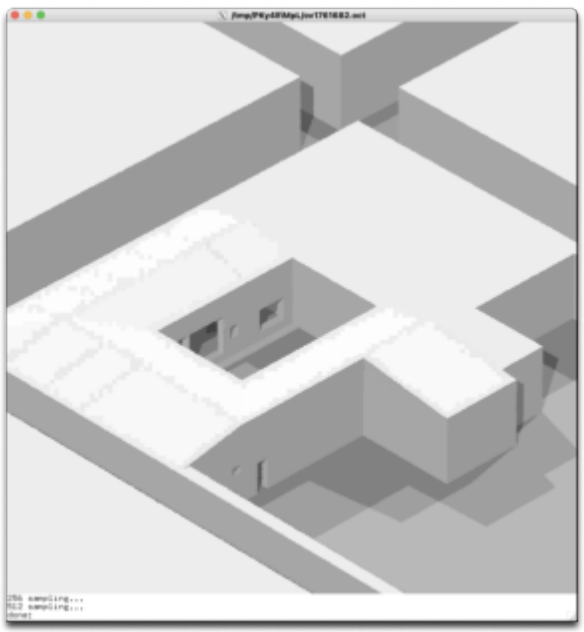
14
```
phos4dtools -c setup.cfg setup obj/CasaNaveEuropa.obj
```

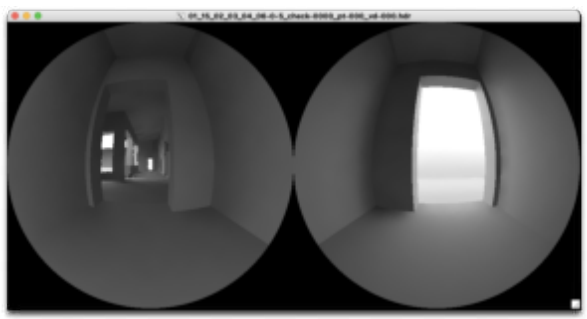
Initialised model structure

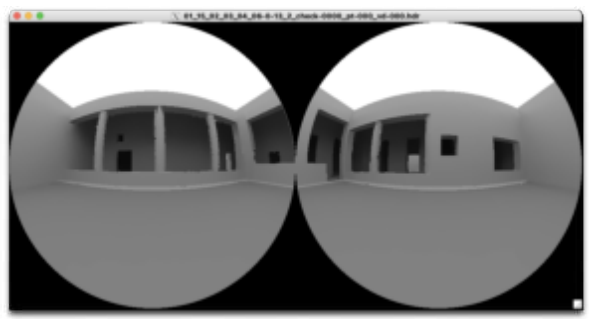
CasaNaveEuropa
- 01_ZONE — One zone per room
- 01_check.cfg — Configuration for test images
- check_sky.rad — Sky for test images
- env
- groups_for_debugging_setup.txt — Groups identified in obj
- obj
- phos4dtools
- RAD
  - 000_materials.rad — Copied from refs
  - 01.rad — Converted from obj
- refs
- LICENSE.txt
- results
- run_01_check.sh — Script to generate test images
- setup.cfg

Check the model

```
15    objview RAD/*
16    chmod ug+x run_01_15_02_03_04_06_check.sh
17    ./run_01_15_02_03_04_06_check.sh
18    ximage check_images/*
```







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Run simulation and export

```
19 phos4dtools -c setup.cfg run \
20     01_15_02_03_04_06_ZONE/01_15_02_03_04_06-0-13.rad
21 phos4dtools summarize "results/*.npz"
```

- This produces one tab-separated file per metric.
- '#' indicates comment lines.
- Each non-comment line comprises the zone name, the sample location, the represented area, and 144 columns of time-step data (12 months x 12 temporal hours).

```
1 # Each zone reduced to minimum 4 points a side [...]
2 # columns (times) are written as (month, day, period) [...]]
3 # zone   x   y   z   area   (1, 0, 1) [...] (12, 0, 12)
4 01_15_02_03_04_06-0-1   6.56333021   6.39218376   0.001
5     1.01539138   8.5368   28.12   56.753 [...] 12.143
```

GIS import

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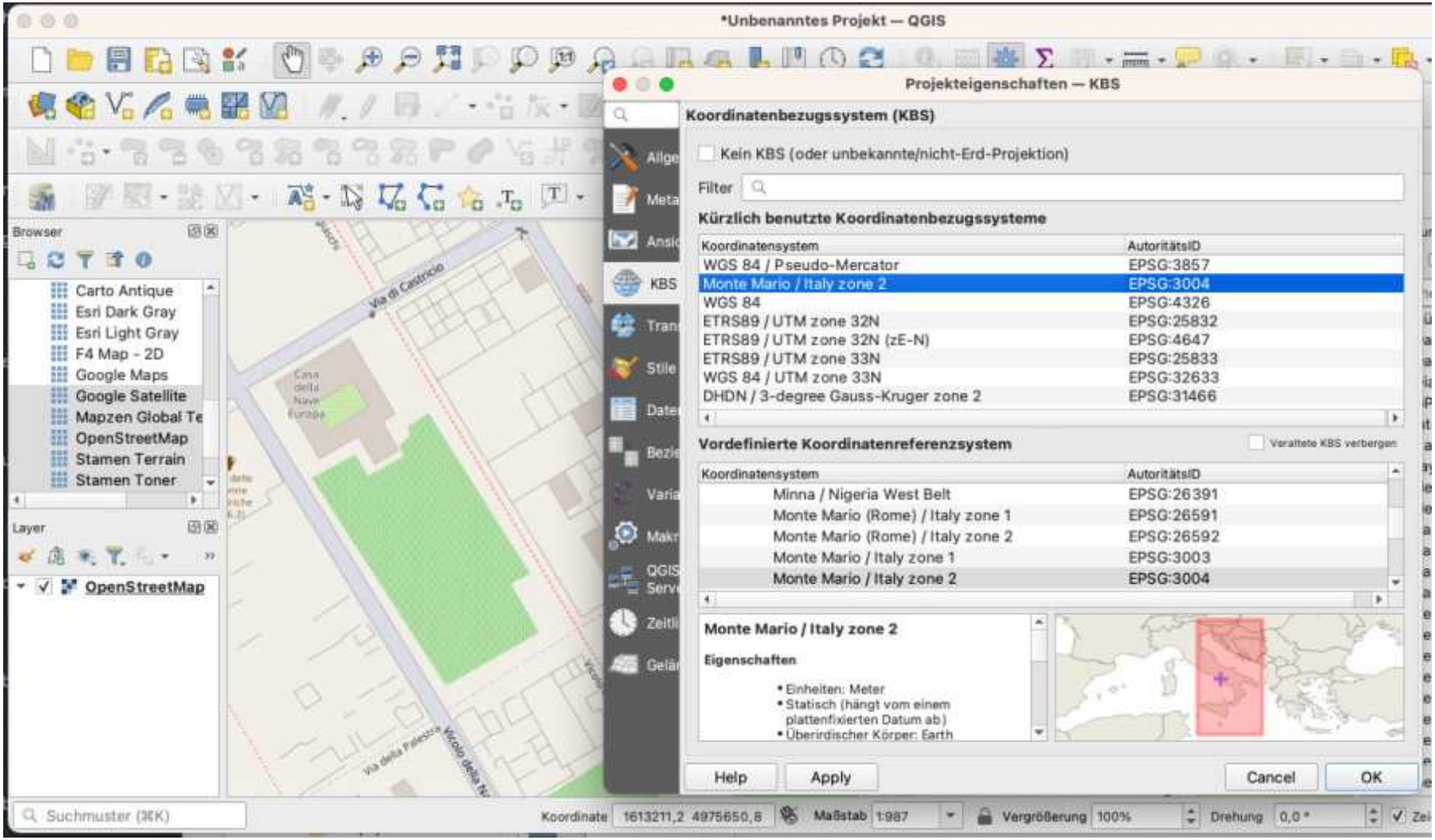
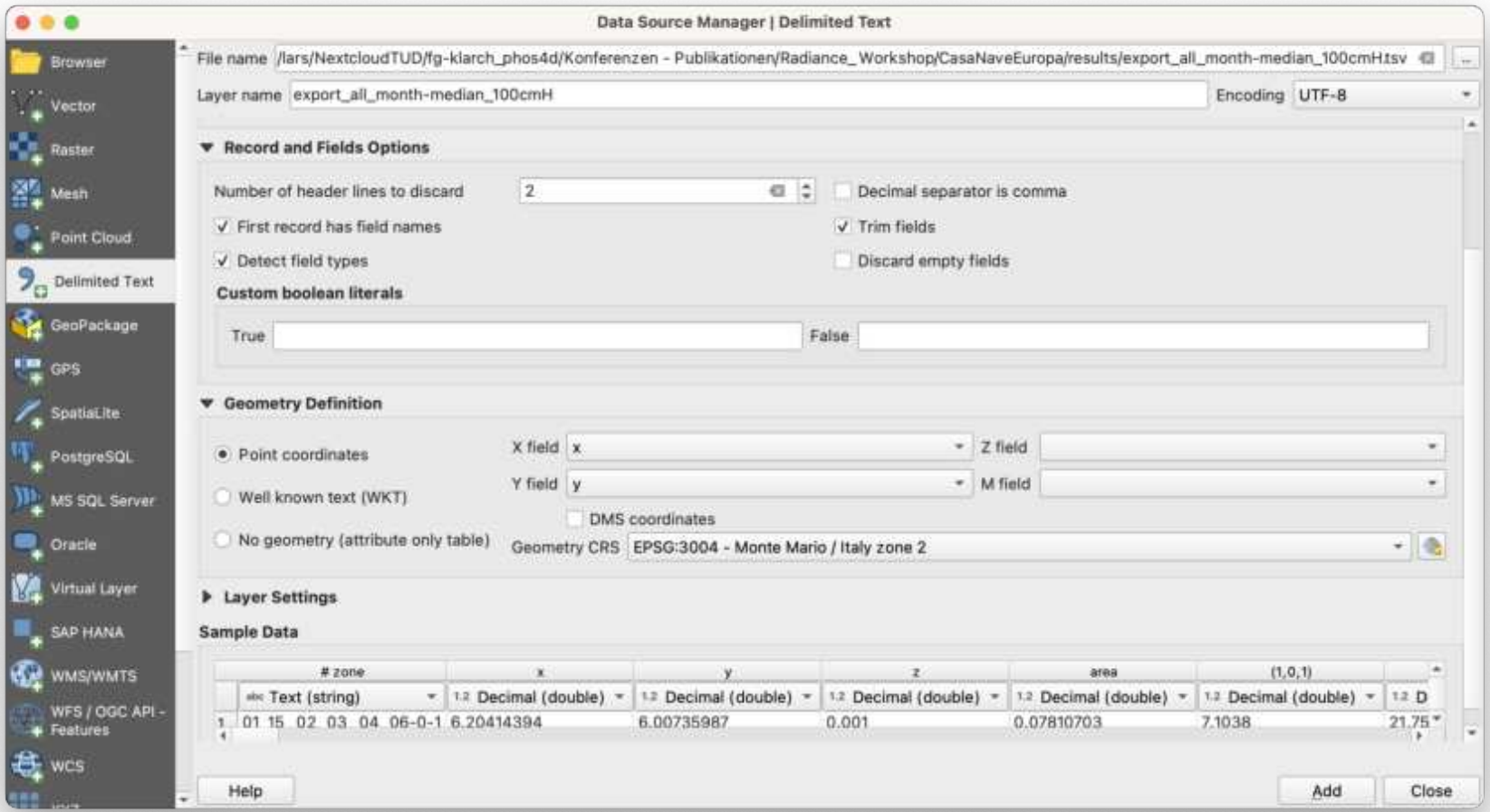
Set up the project in QGis

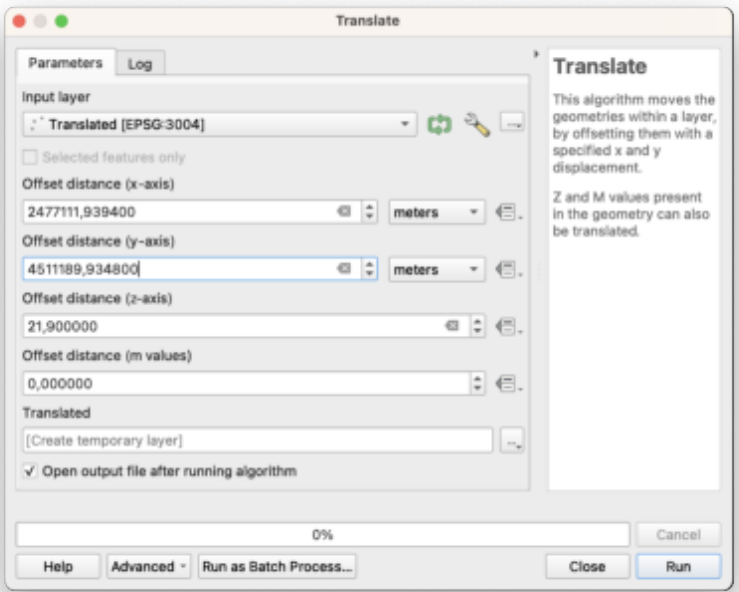


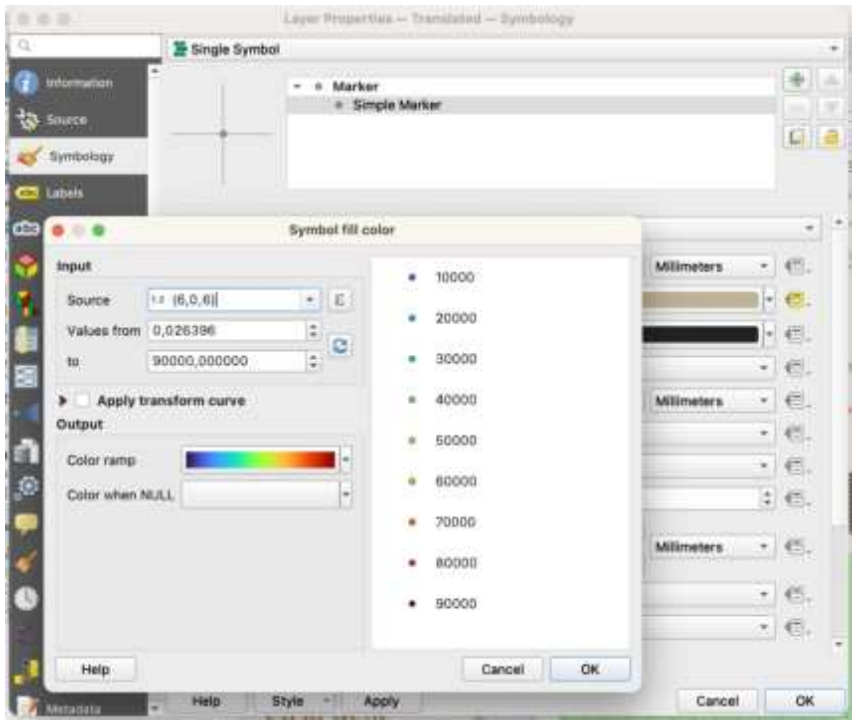
Load data into GIS

Import by adding a new ”delimited text” layer, EPSG:3004

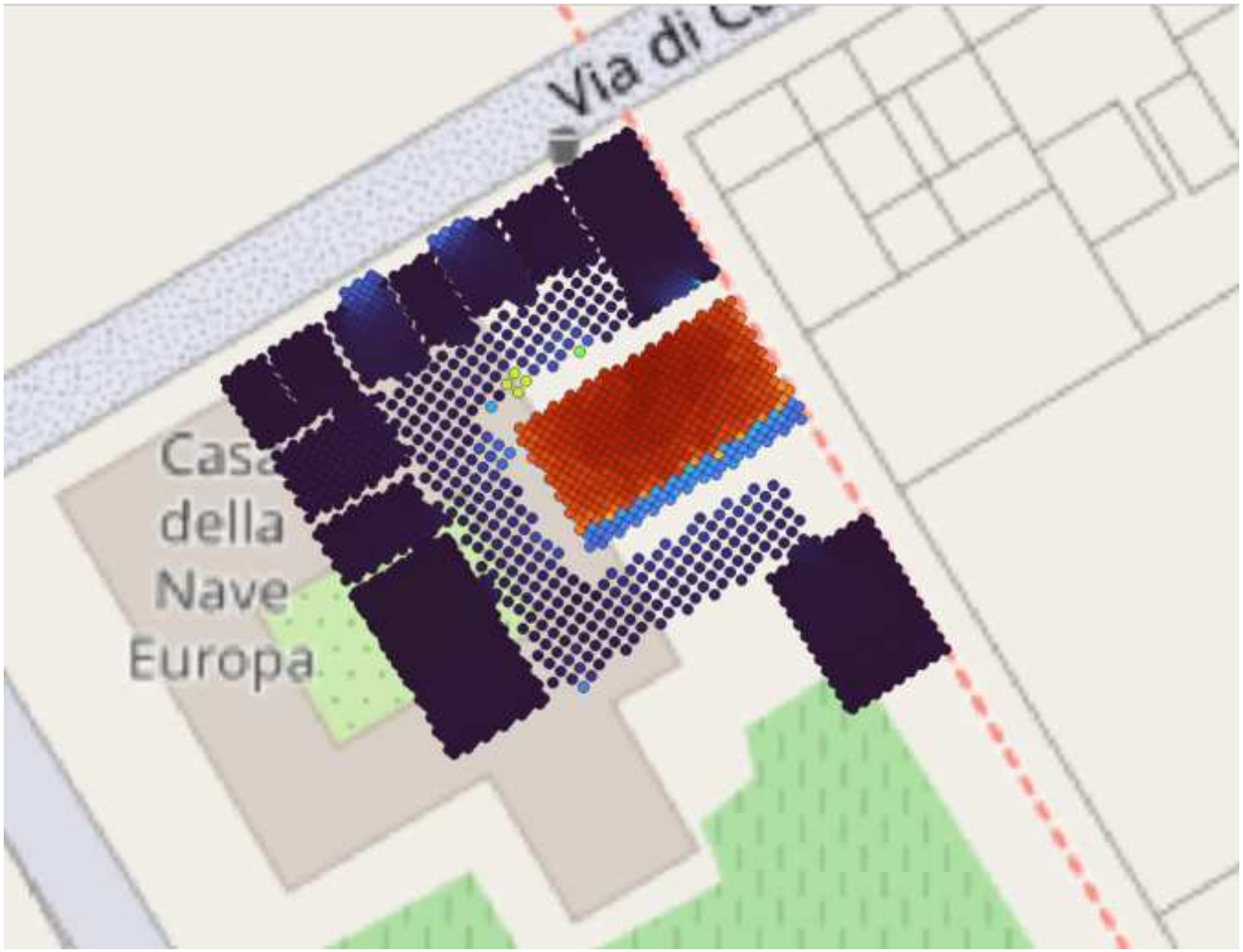


Translate and visualize data





Visualize one time step



Application of thresholds

Python helper functions 1

Add some Python snippets for filtering and data-reduction.

```
from qgis.core import *
from qgis.gui import *
from qgis.utils import iface
import statistics

def calcColumnns(startMonth, endMonth, startHour, endHour):
    indices=[]
    for monthIdx in range(startMonth-1, endMonth):
        for hourIdx in range(startHour-1, endHour):
            indices.append(monthIdx*12+hourIdx+5)
    return(indices)
```

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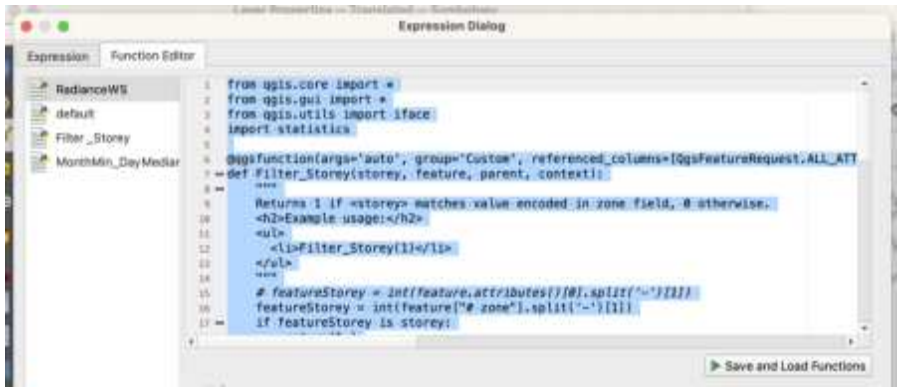
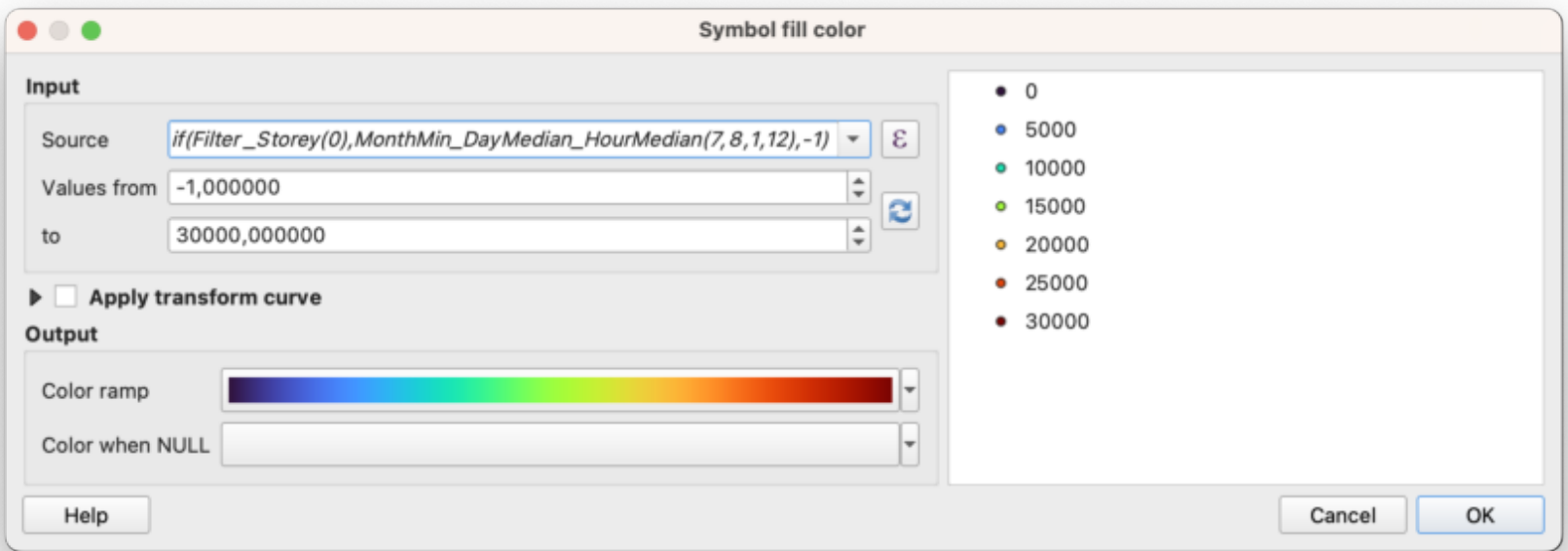
Python helper functions 2

```
12 @qgsfunction(args='auto', group='Custom',
13         referenced_columns=[QgsFeatureRequest.ALL_ATTRIBUTES])
14 def MonthMin_DayMedian_HourMedian(startMonth, endMonth, startHour,
15         endHour, feature, parent, context):
16     indices=calcColumnns(1, 12, 1, 12) # fill with all values
17     hourlyVals=[feature.attributes()[idx] for idx in indices]
18     monthIndices=range(startMonth-1,endMonth)
19     monthlyMinima=[]# for each hour min monthly value
20     for hourIdx in range(startHour-1, endHour):
21         monthVals=[] # monthly values for one hour
22         for monthIdx in monthIndices:
23             monthVals.append(hourlyVals[monthIdx*12+hourIdx])
24         monthlyMinima.append(min(monthVals))
25     med=statistics.median(monthlyMinima)
26     return(med)
```

QGis expression



Add some Python snippets for filtering and data-reduction.



Visualize thresholded data

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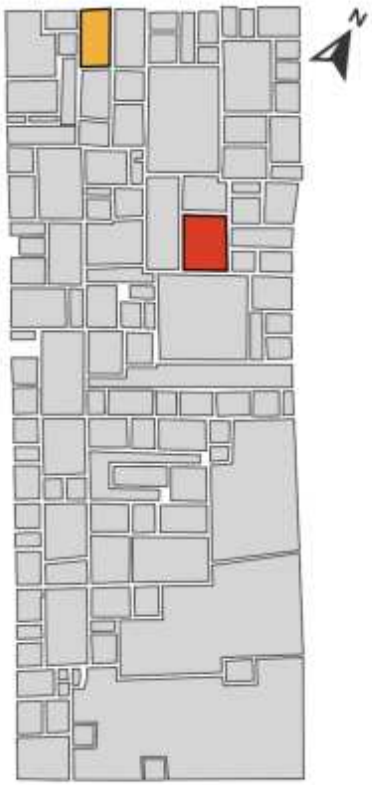
Validation

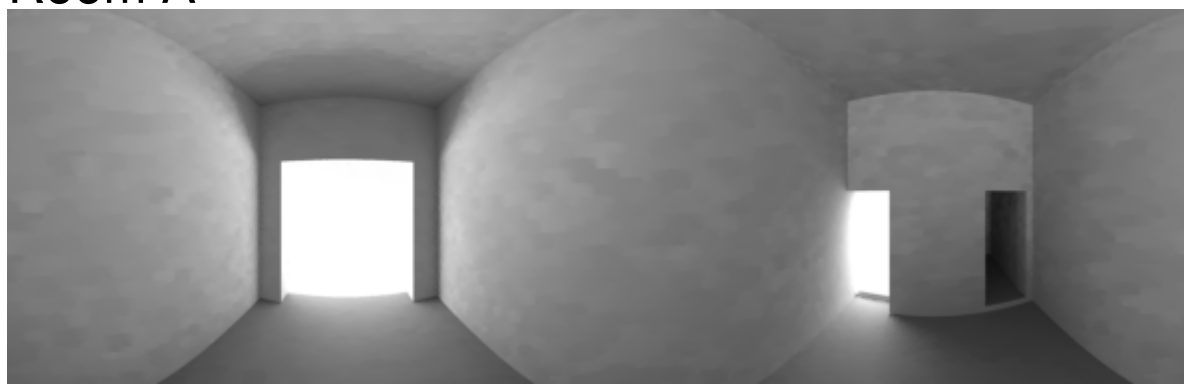
Objectives and chosen data

1. Sufficient parametrization by phos4dtool (convergence)
2. Comparability with conventional Radiance simulation (plausibility)

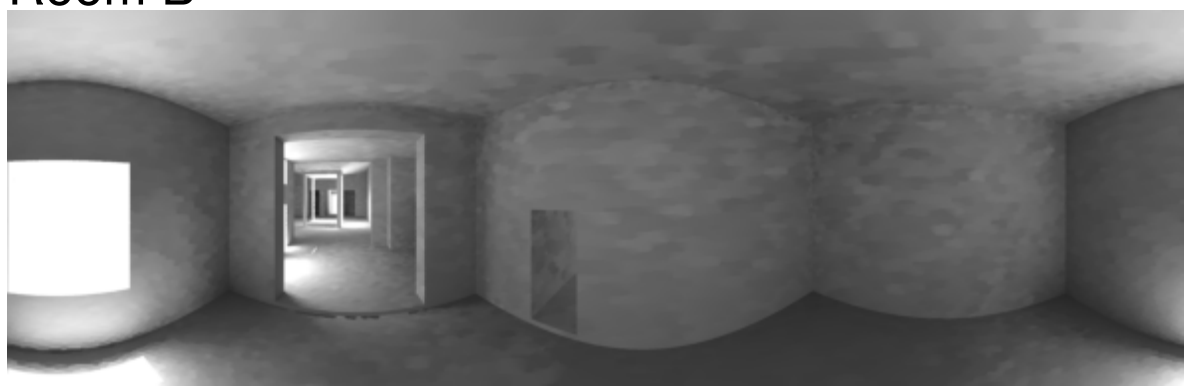
Parameter convergence



Room A



Room B

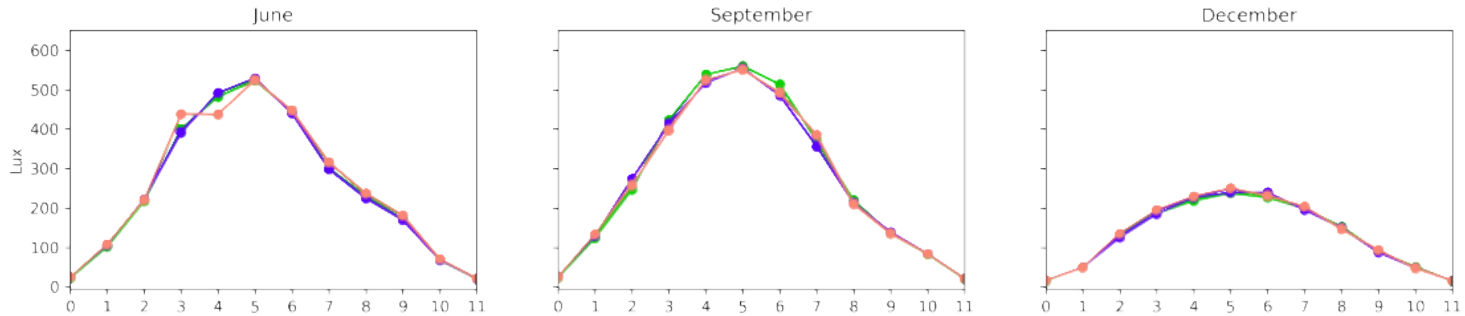


Parameter convergence

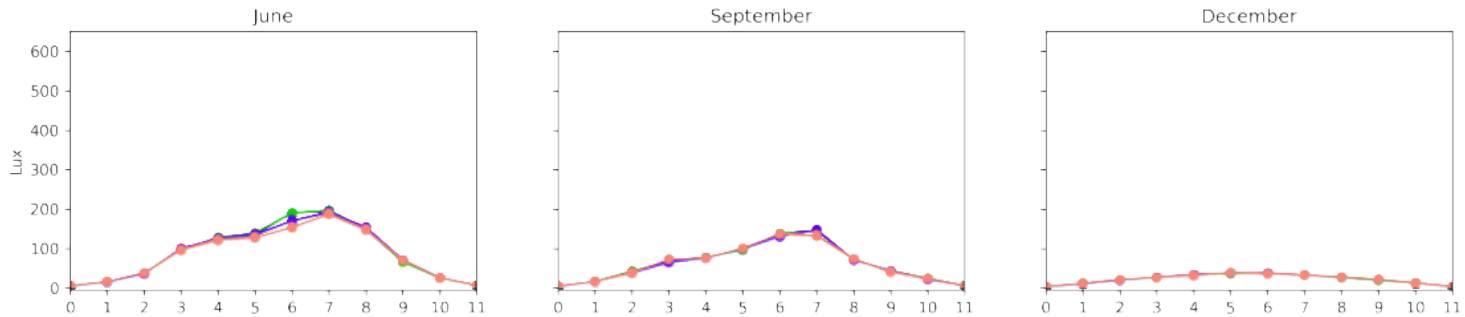
1. Room A: *phos4dtool* with *-ab 10000, -ab 40000, -ab 160000*
2. Room B: *phos4dtool* with *-ab 10000, -ab 40000, -ab 160000*

Parameter convergence

Room A



Room B

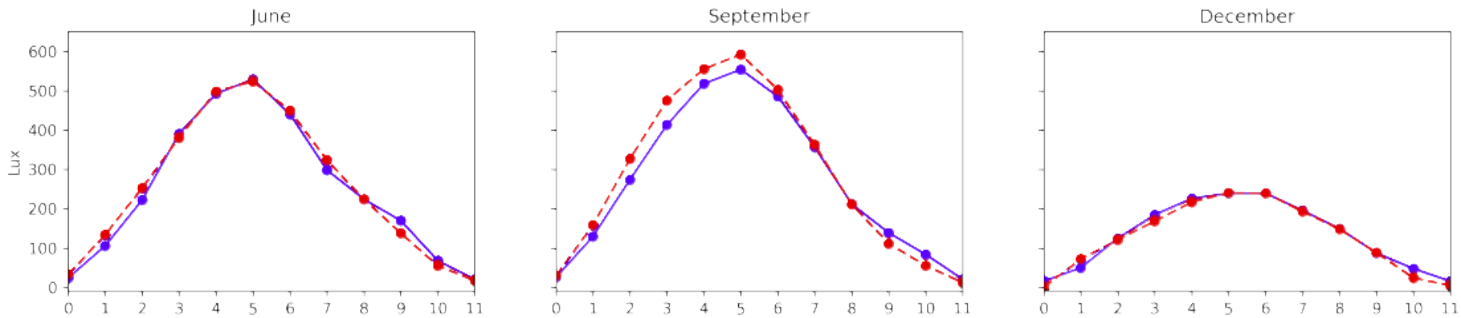


Plausibility

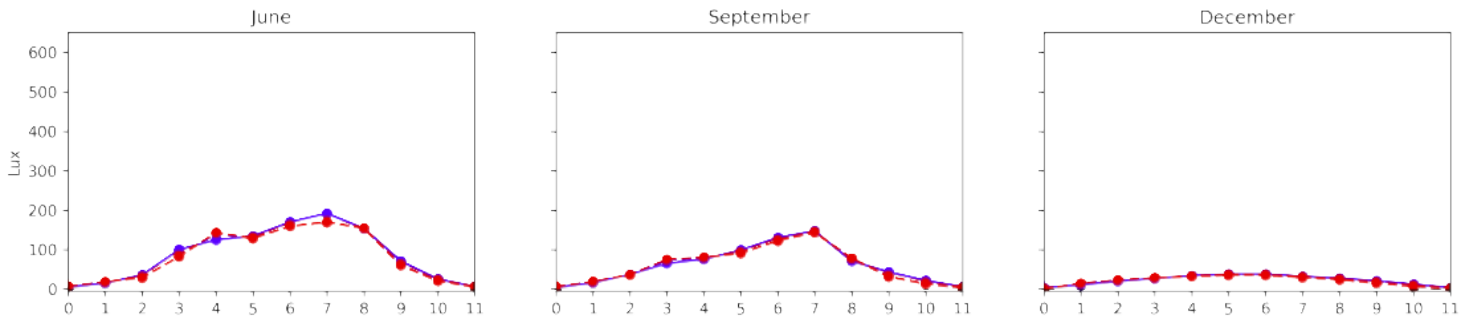
1. Room A: *phos4dtool* with *-ab 40000* vs gendaylit
2. Room B: *phos4dtool* with *-ab 40000* vs gendaylit

Plausibility

Room A



Room B



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Working Group Members:
Lars O. Grobe, Stephen Wasilewski, Juan M. Monteoliva Peralta, Andreas Noback (daylight research)
Claudia Mächler, Clemens Brünenberg (building history)
Julian Hollaender, Franziska Lang, Jane Kreiser (archaeology)
Roxana Kath, Charlotte Schubert (ancient history)

`https://www.archaeologie.architektur.tu-darmstadt.de/forschung_klarch`