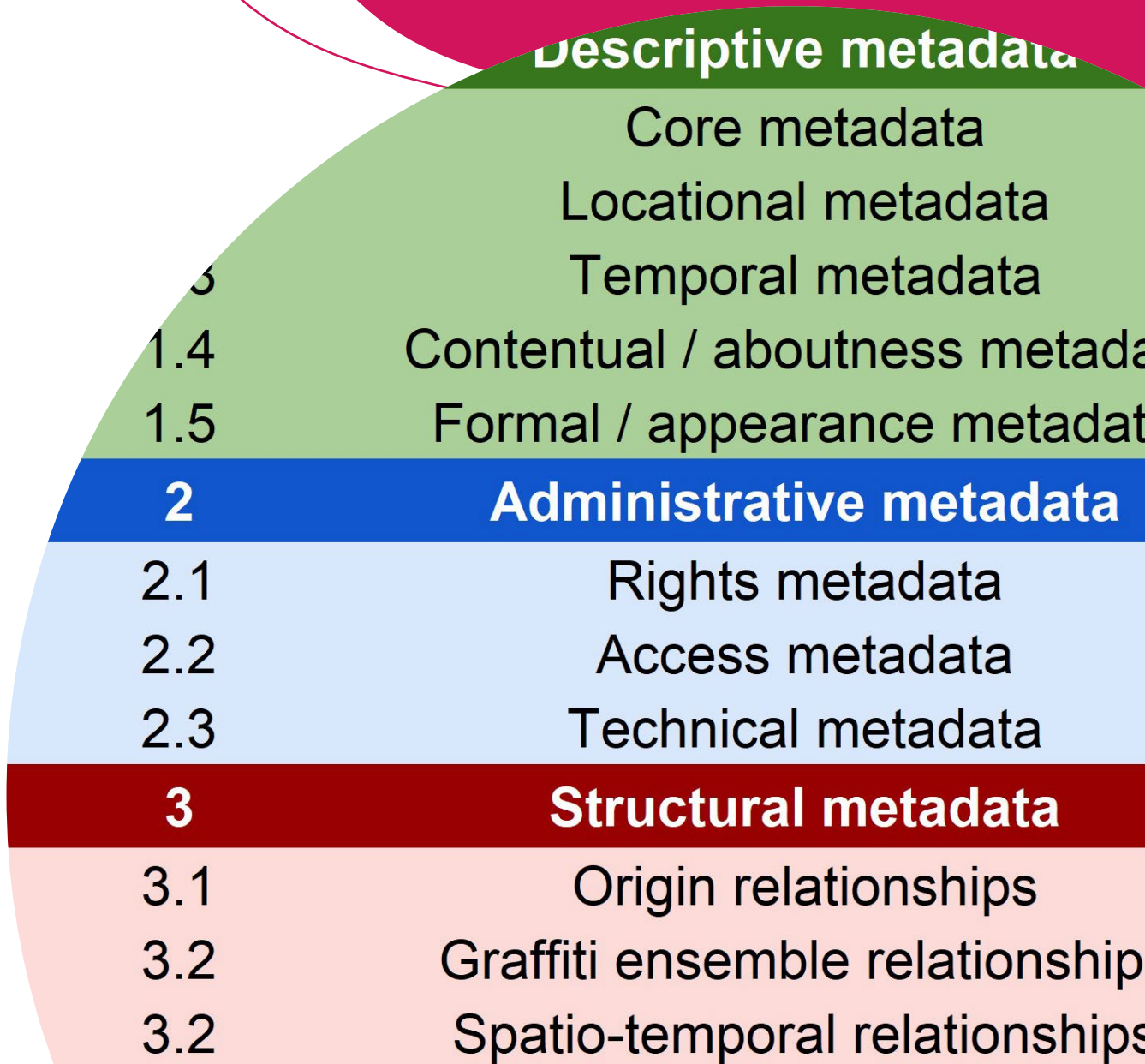
From Street to Schema:

The INDIGO Toolkit for Graffiti Documentation

Geert Verhoeven | *project coordinator*
projectindigo.eu

The INDIGO graffiti project was funded by the Heritage Science Austria programme of the Austrian Academy of Sciences (ÖAW)





graffiti are

unique
complex
short-lived
socially relevant



graffiti are

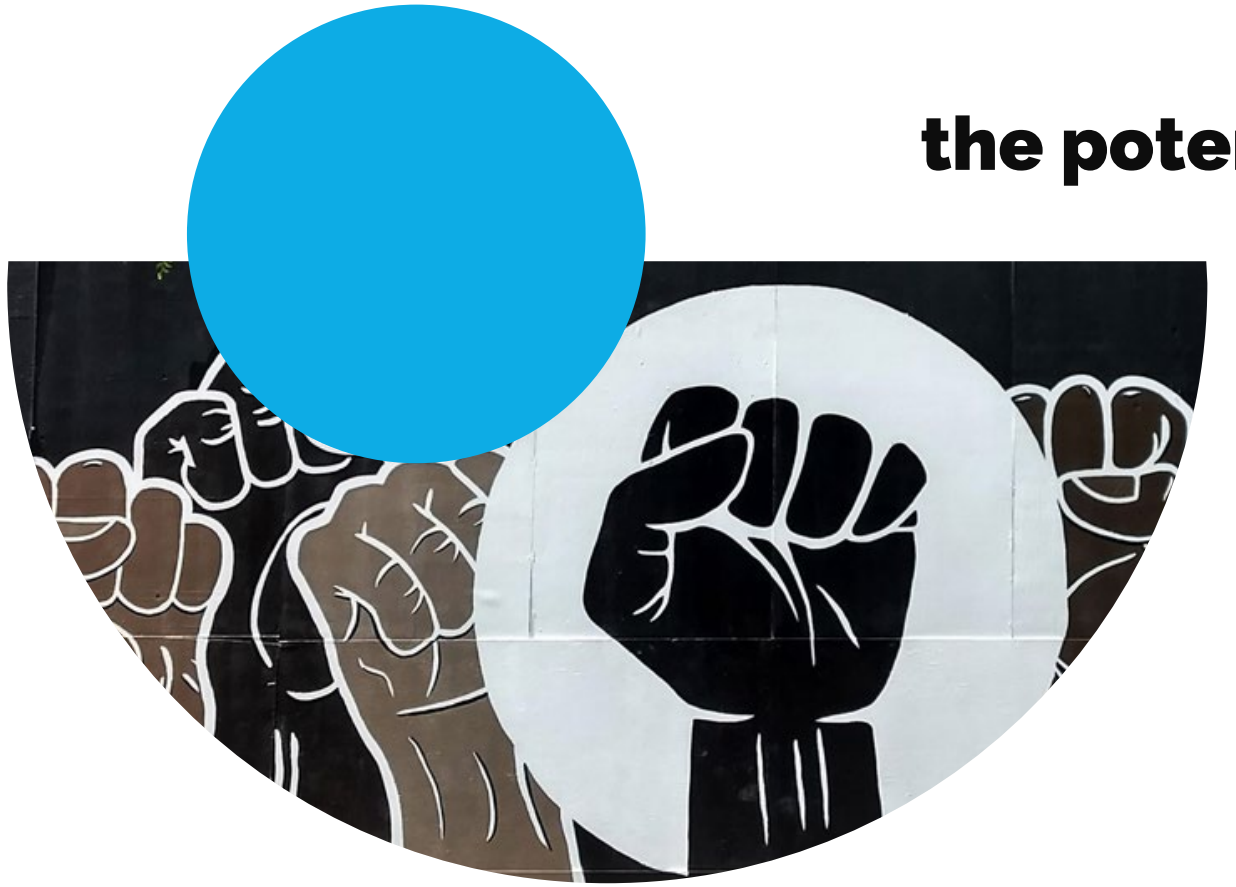
unique

complex

short-lived

socially relevant

cultural heritage



the potential
of graffiti
to understand
society
is under-exploited

indigo

Inventory and

disseminate

graffiti along the

d**o**naukanal

Inventory and

disseminate

graffiti along the

d**o**naukanal

WHAT

Inventory and

disseminate

graffiti along the

d**o**naukanal

WHAT

WHERE

inventory and

disseminate

graffiti along the

d**o**naukanal

WHAT

WHERE

WHY

digitally preserve

and

analyse

INventory and

DIsseminate

9raffiti along the

d**O**naukanal

WHAT

WHERE

WHY

digitally preserve

and

analyse

ÖAW dch

Universitat Politècnica de València

GiFLE

TU WIEN GEO

vr|vis

Stadt Wien

SPRAY CITY.AT

LUDWIG BOLTZMANN INSTITUTE
Archaeological Prospection and Virtual Archaeology

WHO

INventory and

DIsseminate

Graffiti along the

d**O**naukanal

WHAT

WHY

digitally preserve

and

analyse

WHERE

WHO

ÖAW

GiFLE

TU WIEN

GEO

virvis

Stadt Wien

LUDWIG BOLTZMANN INSTITUTE
Archaeological Prospection and Virtual Archaeology

SPRAY CITY.AT

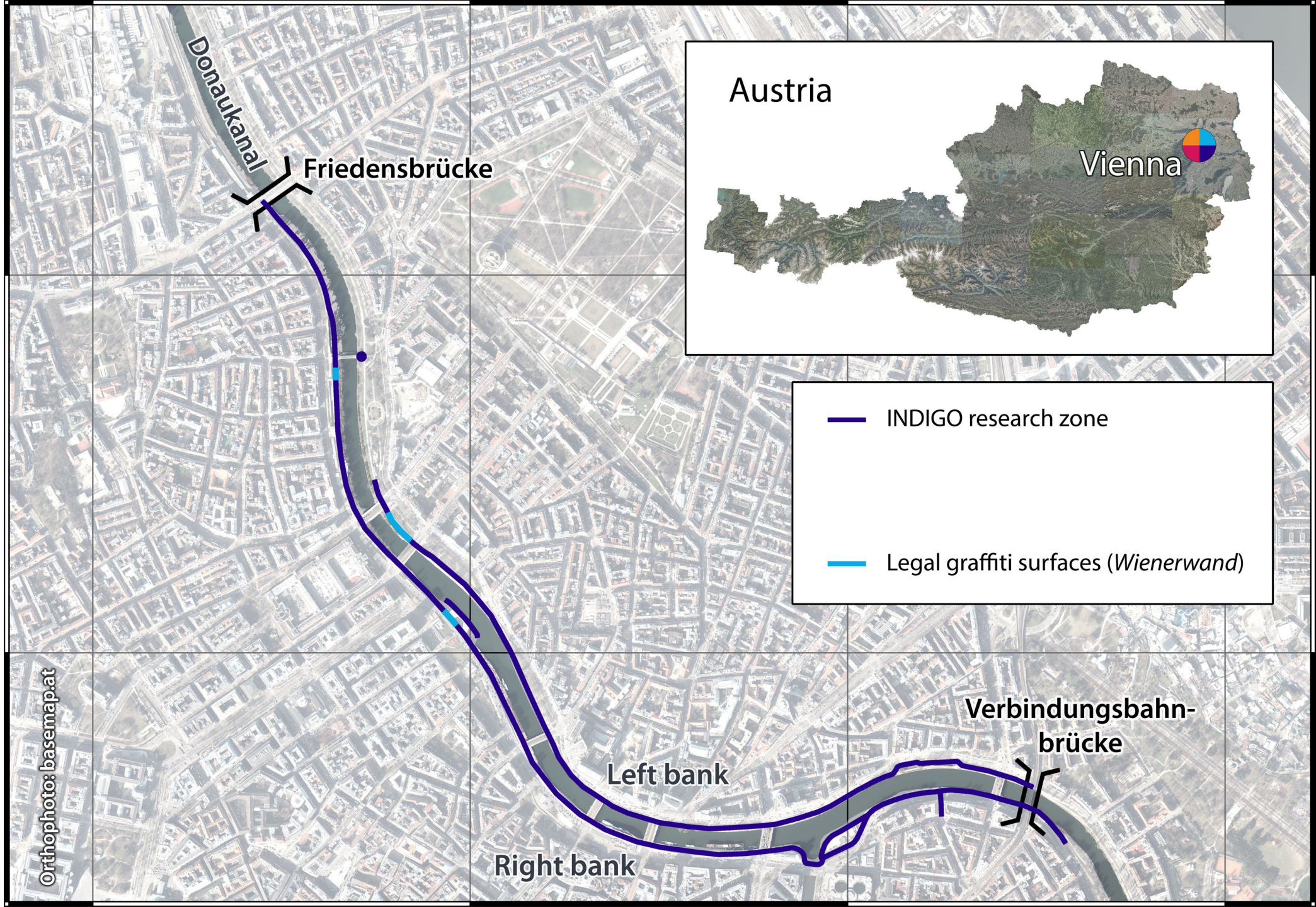
Heritage Science Austria programme | **€ 580 k** | **2** years

LEGAL SURFACES

0.3 km

MONITORED SURFACES

12.9 km











INTERACTIVE 3D
dissemination

archaeologists / art historians

sociologists / linguists

ethnographers / anthropologists

urban chameleon

INDIGO approach

5 research pillars

INDIGO approach

5 research pillars

creation



INDIGO approach

5 research pillars

creation



acquisition



INDIGO approach

5 research pillars

creation



acquisition



processing



INDIGO approach

5 research pillars

creation



acquisition



processing

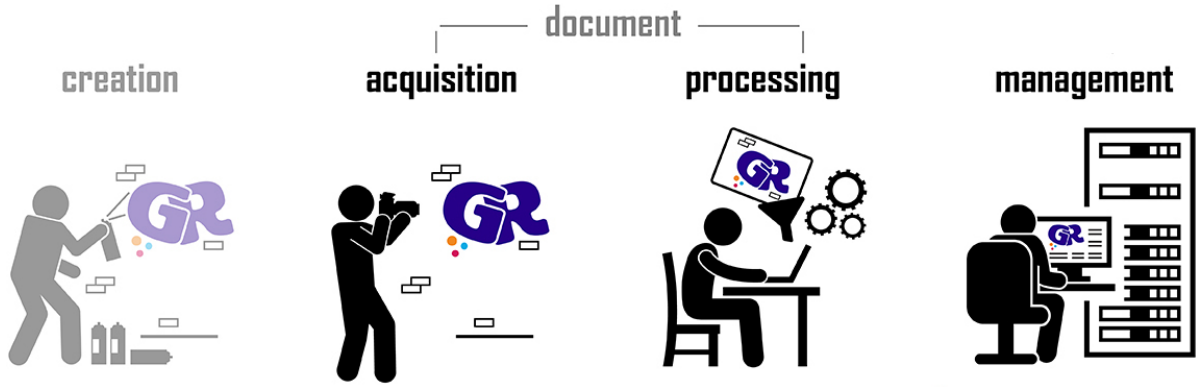


management



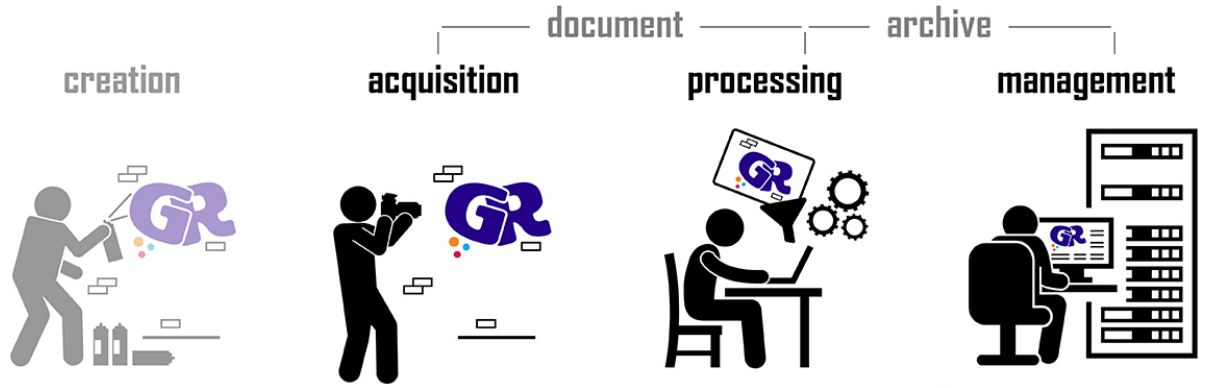
INDIGO approach

5 research pillars



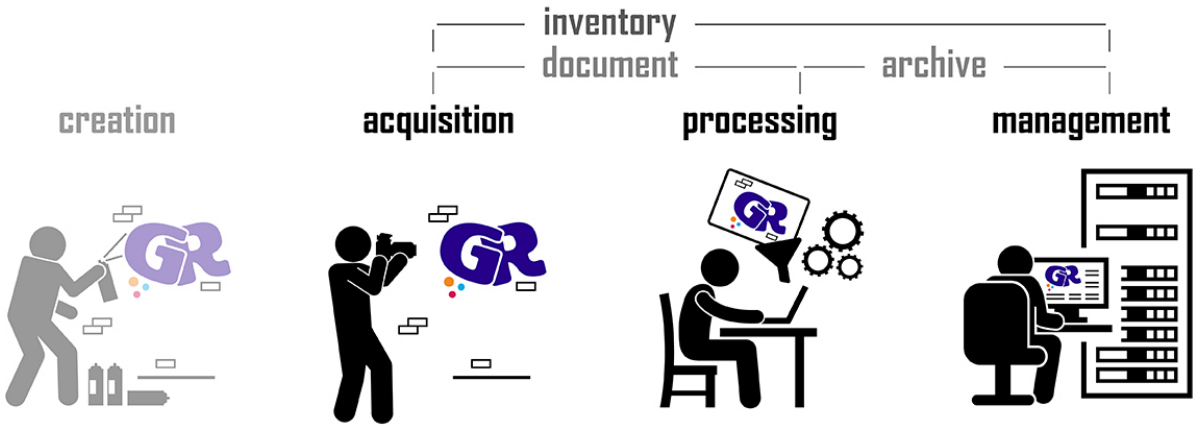
INDIGO approach

5 research pillars



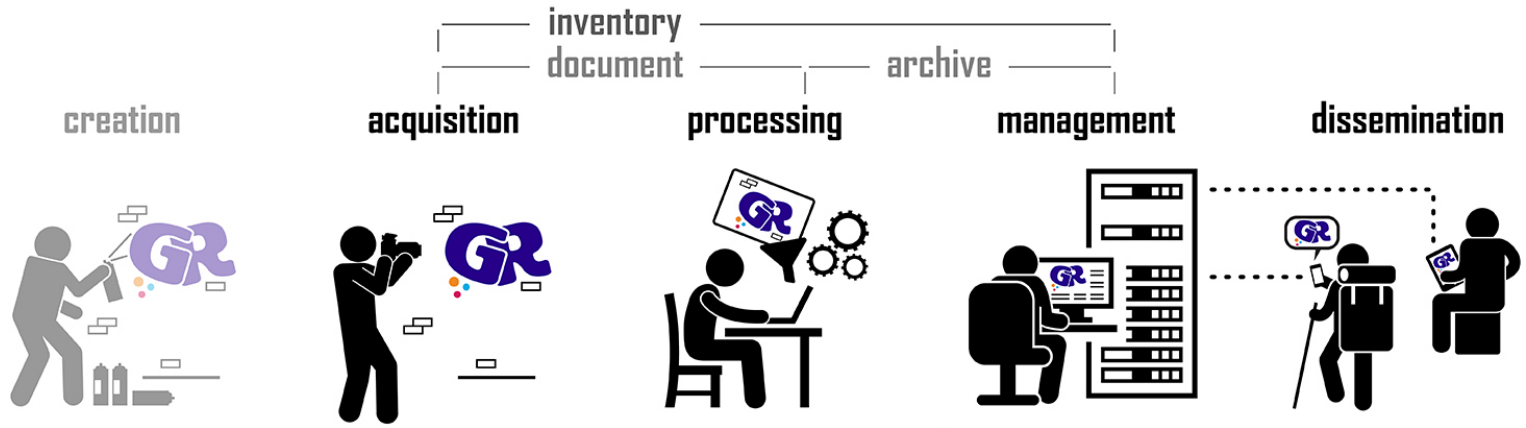
INDIGO approach

5 research pillars



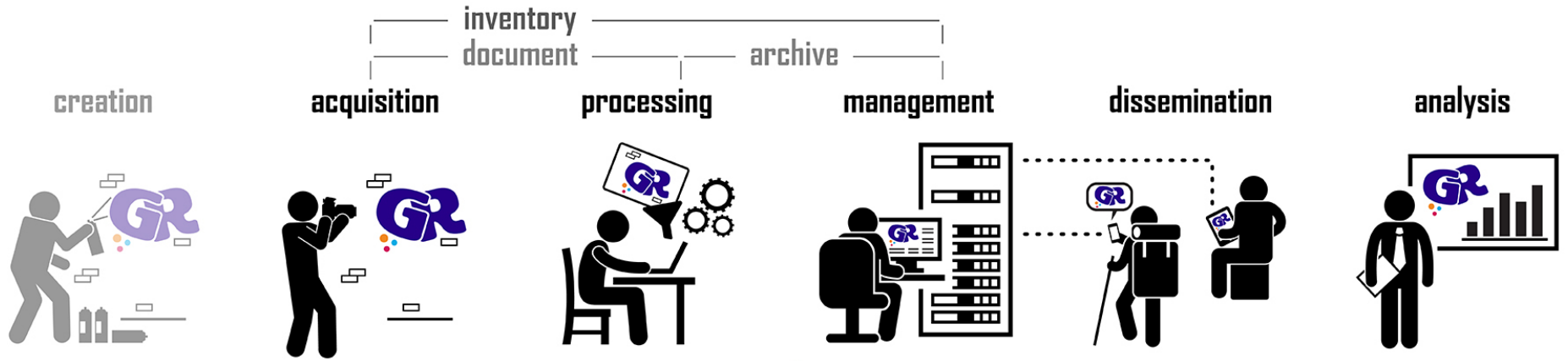
INDIGO approach

5 research pillars



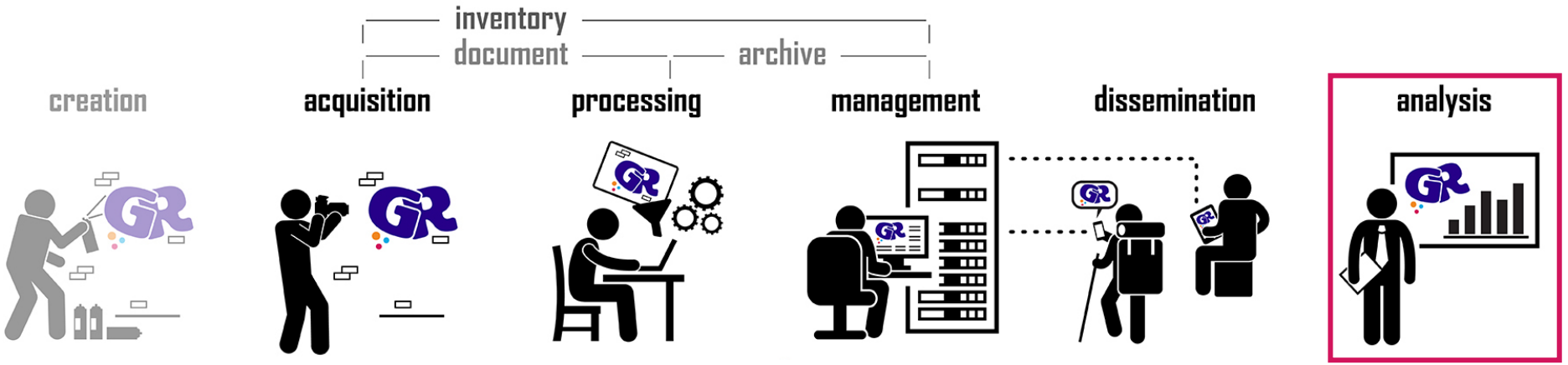
INDIGO approach

5 research pillars



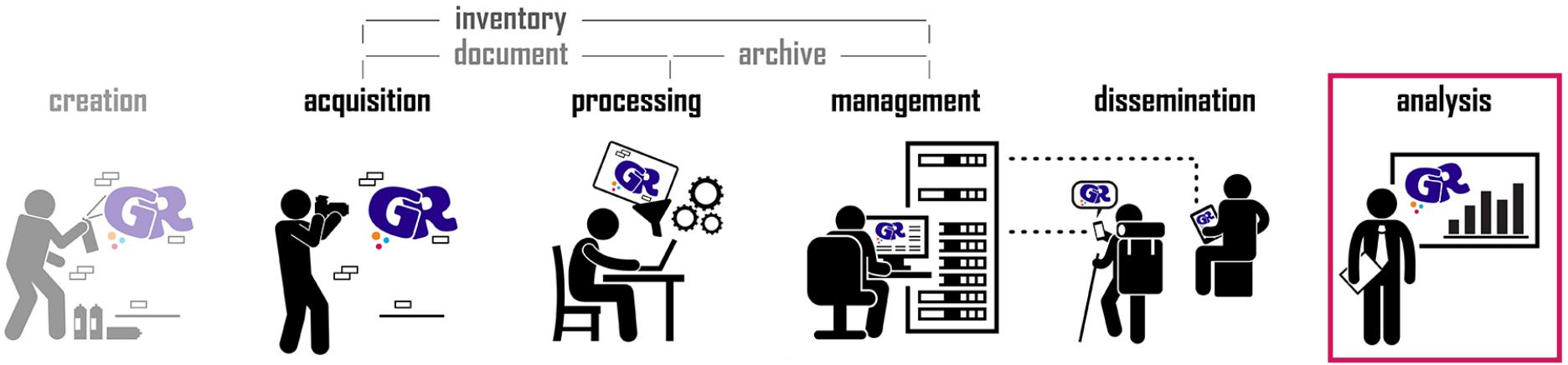
POTENTIAL questions

5 research pillars



POTENTIAL questions

5 research pillars



Along the Donaukanal,

where do aerosol wildstyle pieces occur,

which crews made them between 2021–2023,

and what are their main colours and typical size?

POTENTIAL questions

GRAFFITI *LOCATION*

Along the Donaukanal,

where do aerosol wildstyle pieces occur,

which crews made them between 2021–2023,

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POTENTIAL questions

GRAFFITI *LOCATION*

GRAFFITI *TEMPORALITY*

Along the Donaukanal,

where do aerosol wildstyle pieces occur,

which crews made them **between 2021–2023**,

and what are their main colours and typical size?

POTENTIAL questions

GRAFFITI *LOCATION*
GRAFFITI *TEMPORALITY*
GRAFFITI *TERMINOLOGY*

Along the Donaukanal,

where do aerosol wildstyle pieces occur,

which crews made them between 2021–2023,

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POTENTIAL questions

GRAFFITI *LOCATION*
GRAFFITI *TEMPORALITY*
GRAFFITI *TERMINOLOGY*
GRAFFITI *CHARACTERISATION*

Along the Donaukanal,

where do aerosol wildstyle pieces occur,

which crews made them between 2021–2023,

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POTENTIAL questions

GRAFFITI *LOCATION*
GRAFFITI *TEMPORALITY*
GRAFFITI *TERMINOLOGY*
GRAFFITI *CHARACTERISATION*

In Belgrade, ~~Along the Donaukanal~~,

where do aerosol wildstyle pieces occur,

which crews made them between 2021–2023,

and what are their main colours and typical size?

POTENTIAL questions

STANDARDS

- GRAFFITI *LOCATION*
- GRAFFITI *TEMPORALITY*
- GRAFFITI *TERMINOLOGY*
- GRAFFITI *CHARACTERISATION*

In Belgrade, ~~Along the Donaukanal~~,

where do aerosol wildstyle pieces occur,

which crews made them between 2021–2023,

and what are their main colours and typical size?

SOME results

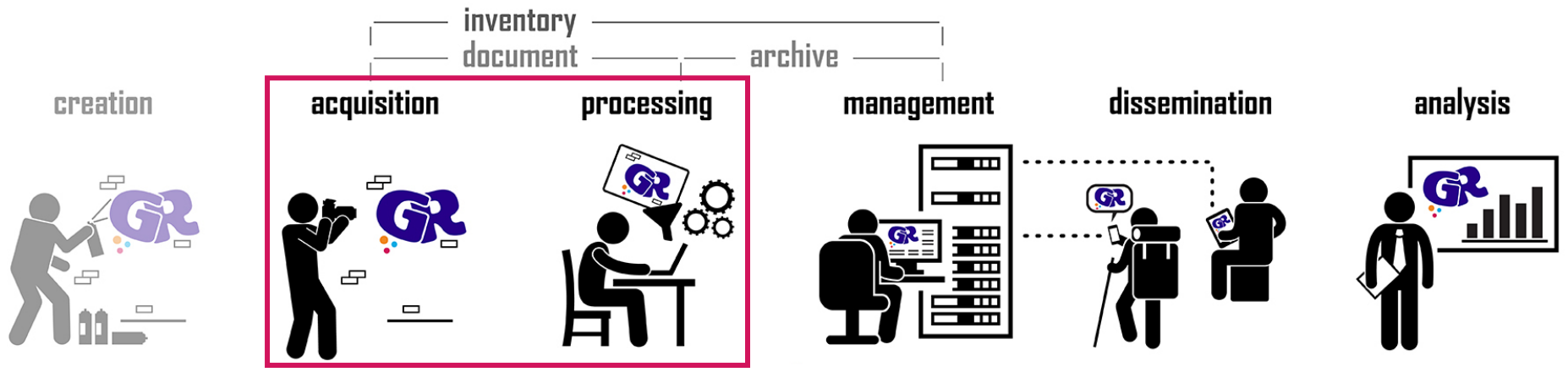
GRAFFITI *LOCATION*

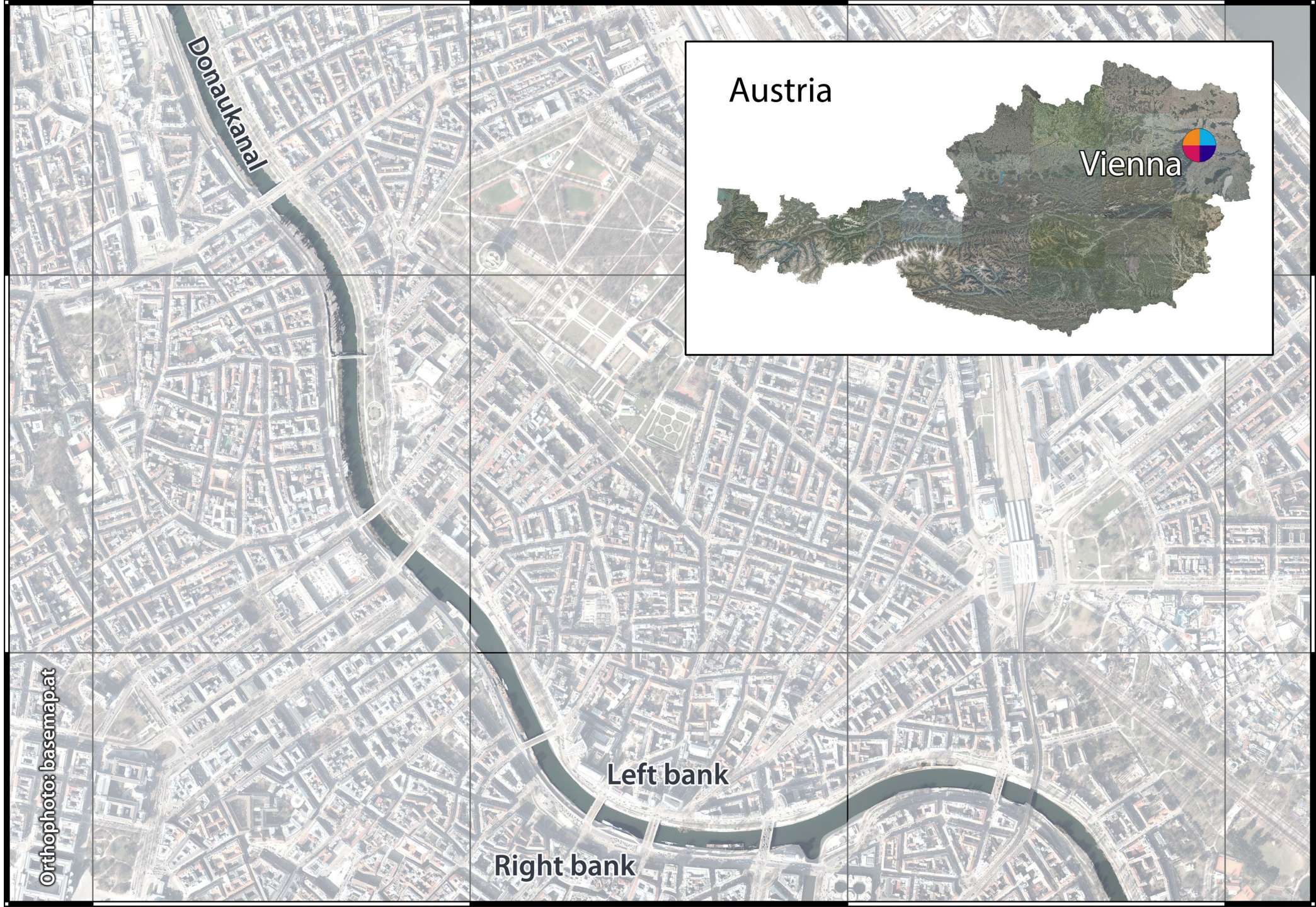
GRAFFITI *TEMPORALITY*

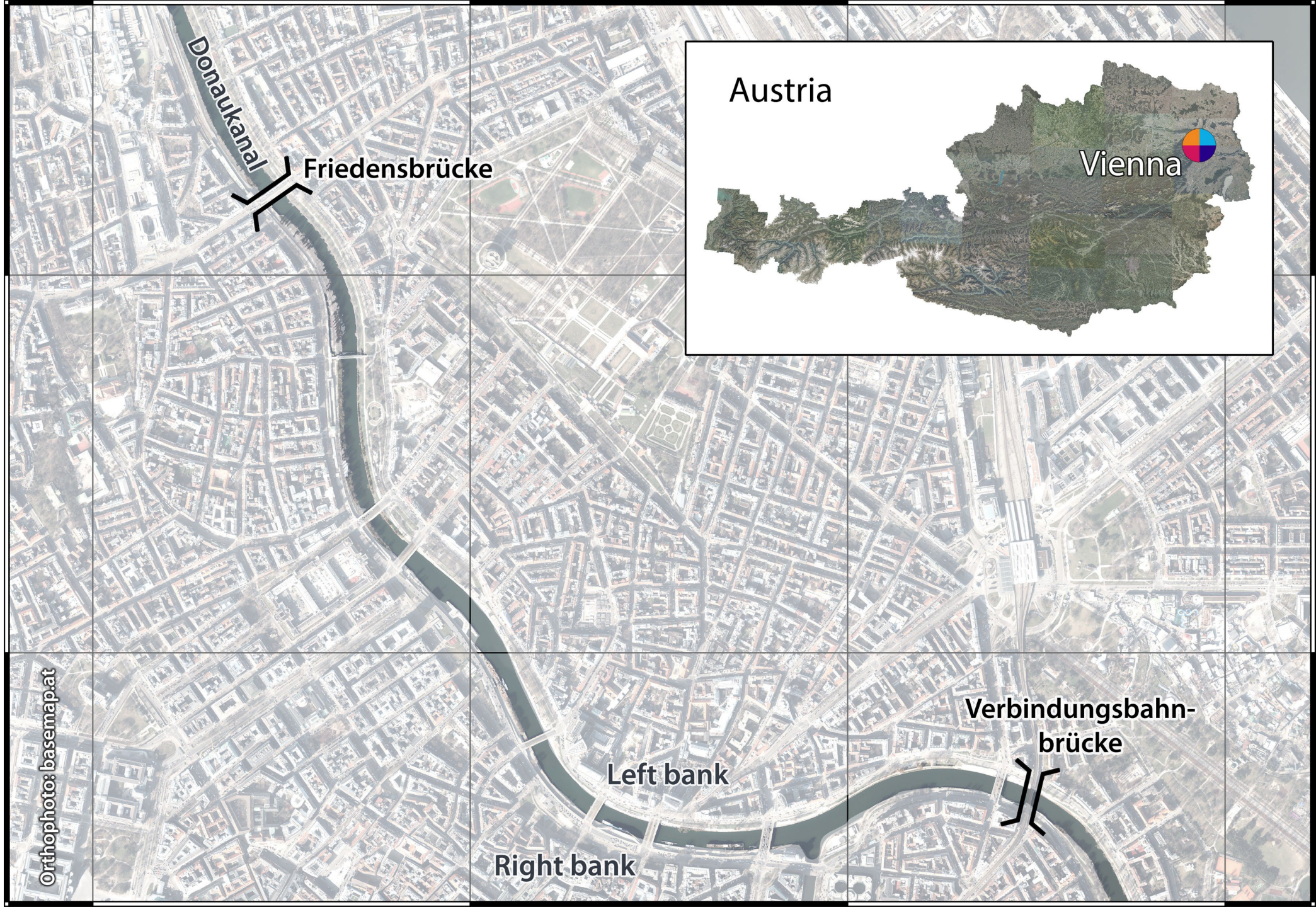
GRAFFITI *TERMINOLOGY*

GRAFFITI *CHARACTERISATION*

5 research pillars

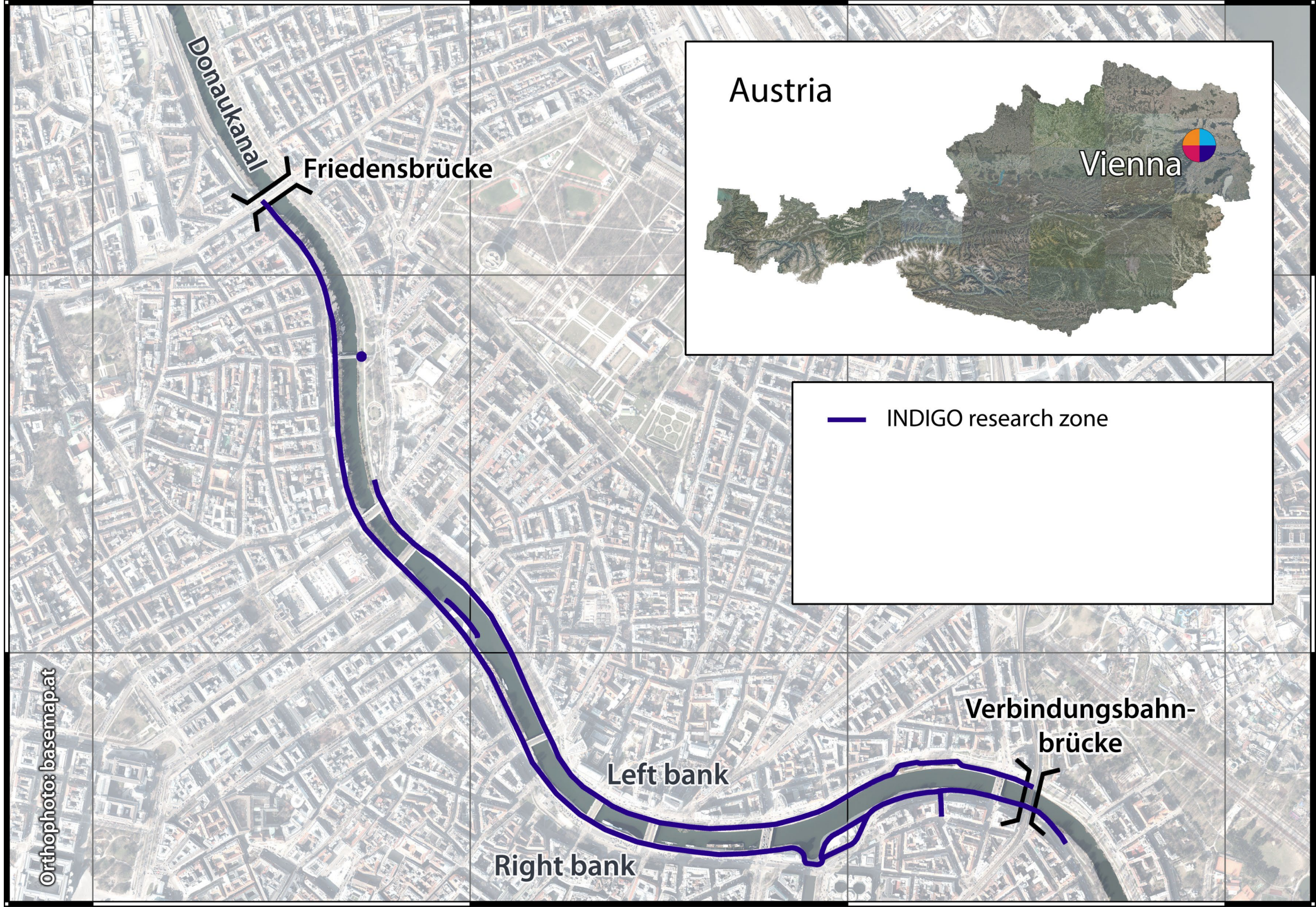



Donaukanal
Austria
Vienna
Left bank
Right bank
Orthophoto: basemap.at


Donaukanal
Friedensbrücke
Austria
Vienna
Orthophoto: basemap.at
Left bank
Right bank
Verbindungsbahn-
brücke

STRETCH

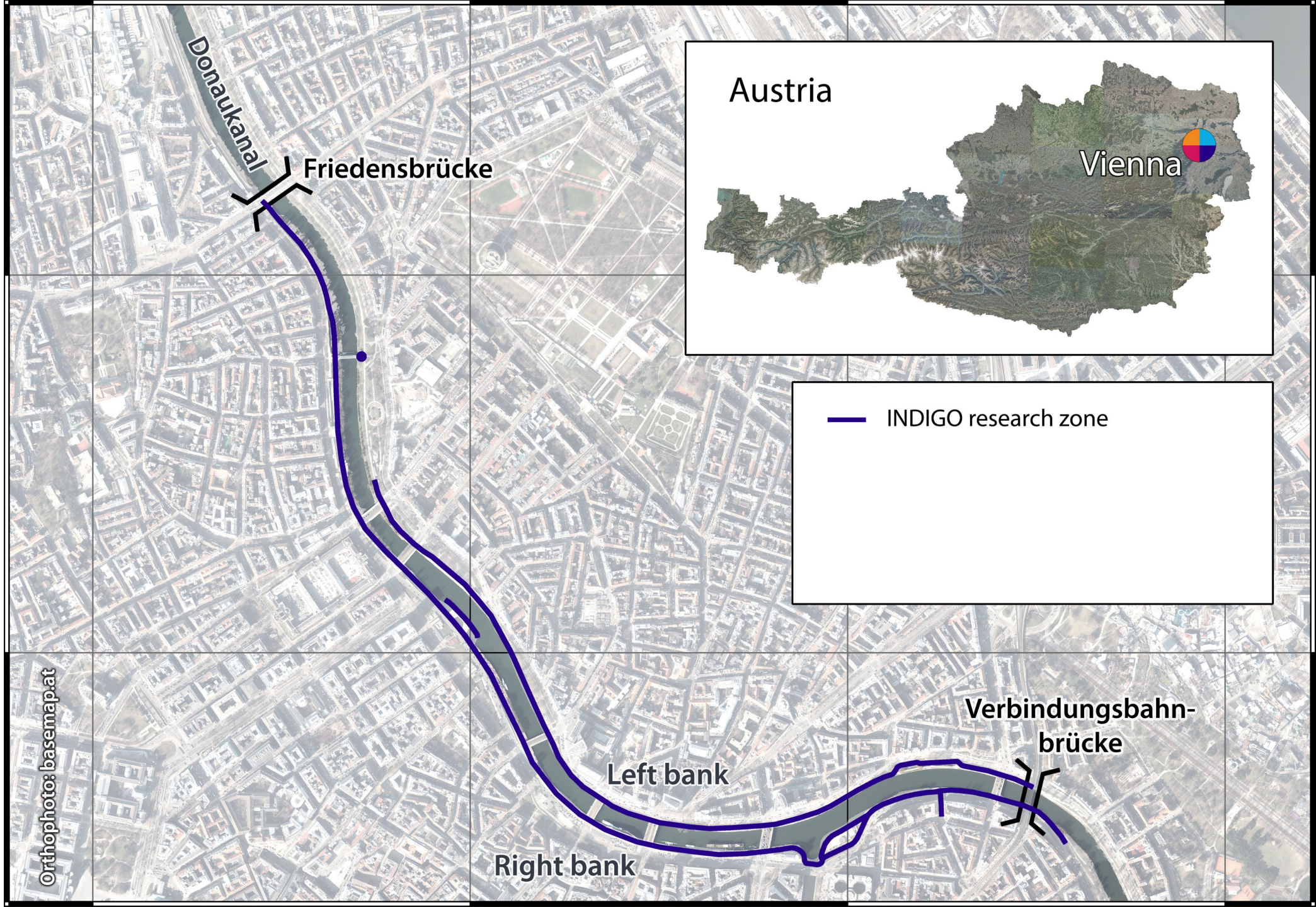
3.3 km



STRETCH

3.3 km

LEFT **RIGHT**



STRETCH

3.3 km

LEFT **RIGHT**



STRETCH

3.3 km

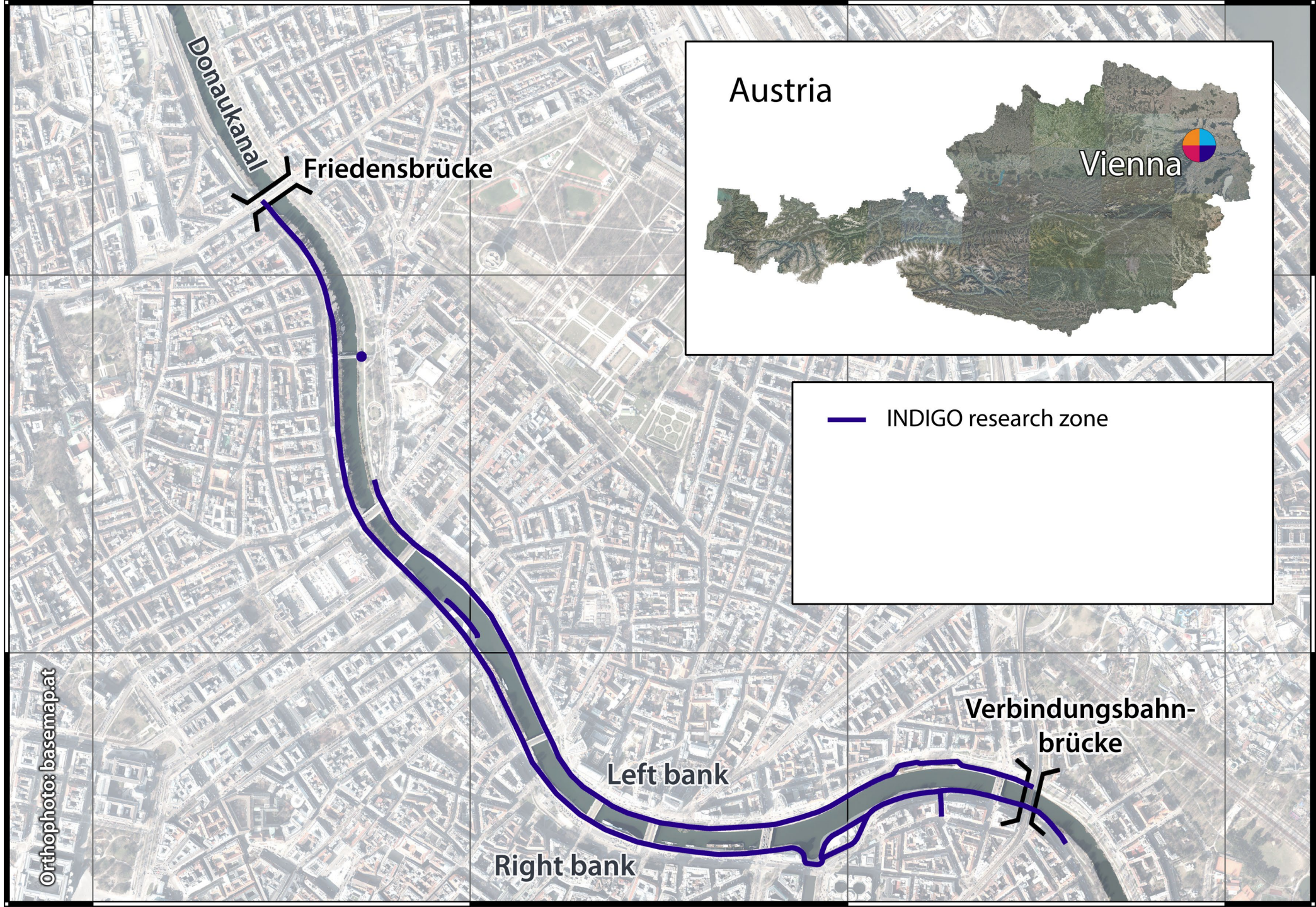
LEFT	RIGHT
UP	UP
DOWN	DOWN



STRETCH

3.3 km

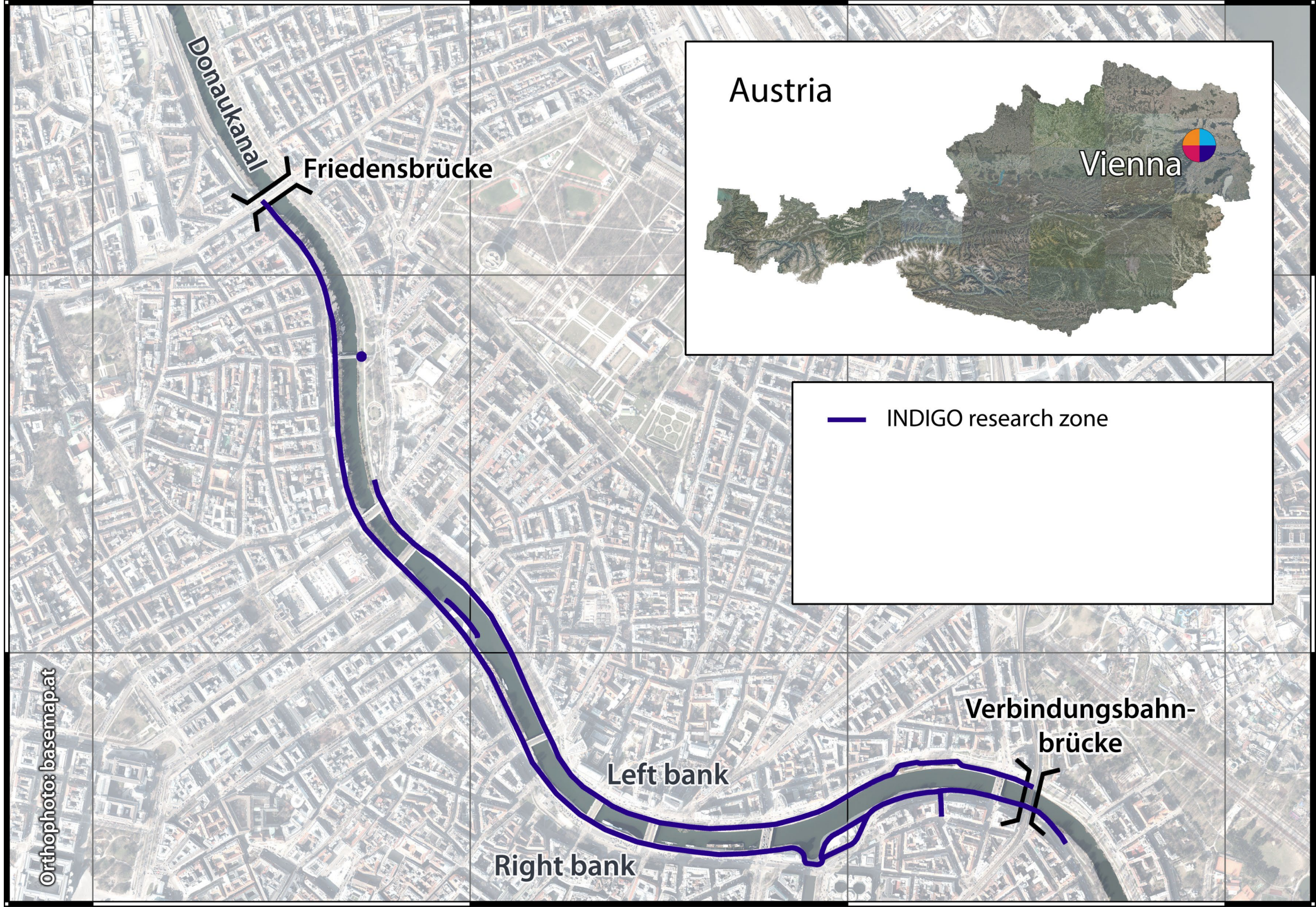
LEFT	RIGHT
UP	UP
3.2 km	5.3 km
DOWN	DOWN



STRETCH

3.3 km

LEFT	RIGHT
UP	UP
3.2 km	5.3 km
DOWN	DOWN
2.1 km	2.3 km



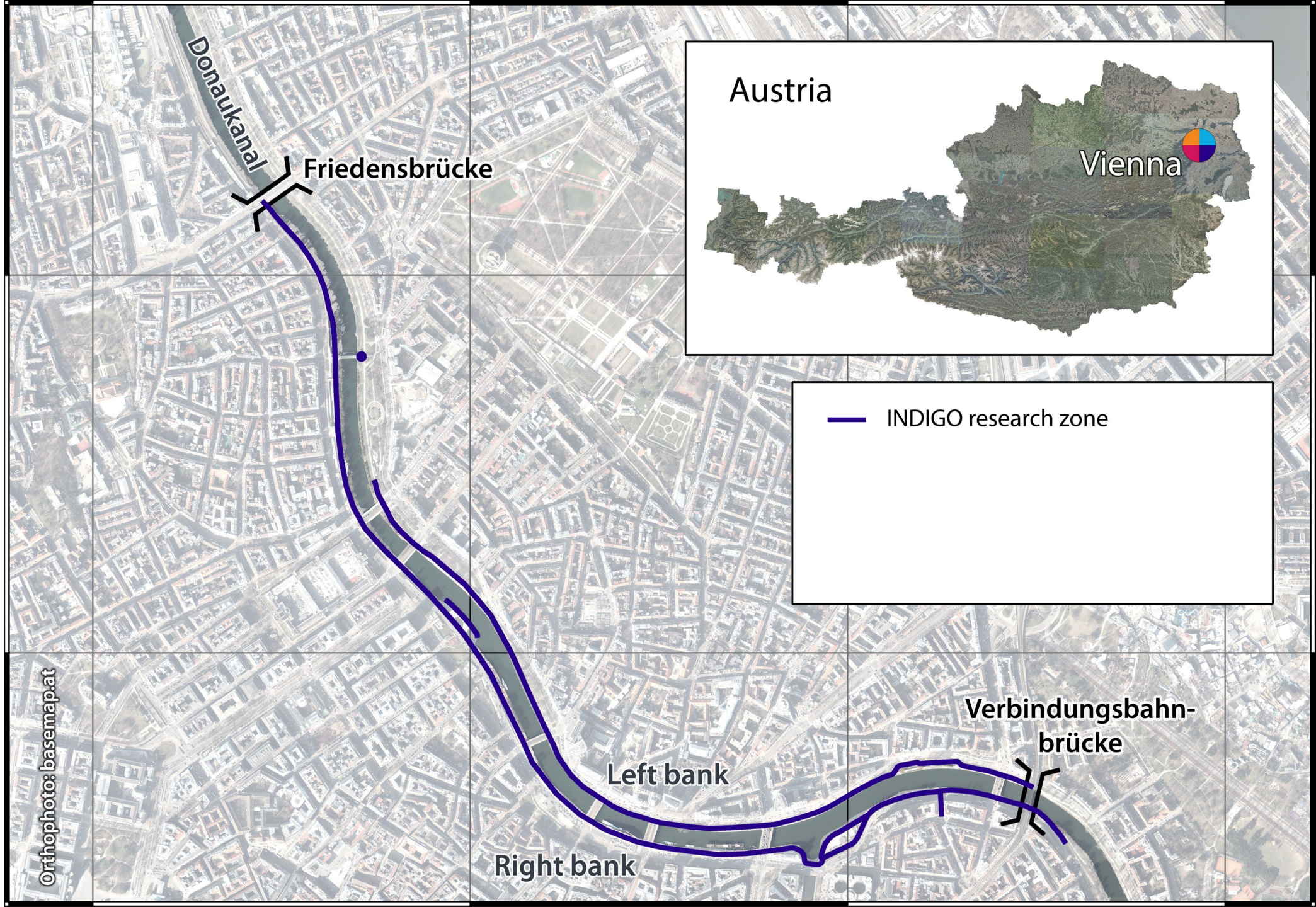
STRETCH

3.3 km

LEFT	RIGHT
UP	UP
3.2 km	5.3 km
DOWN	DOWN
2.1 km	2.3 km

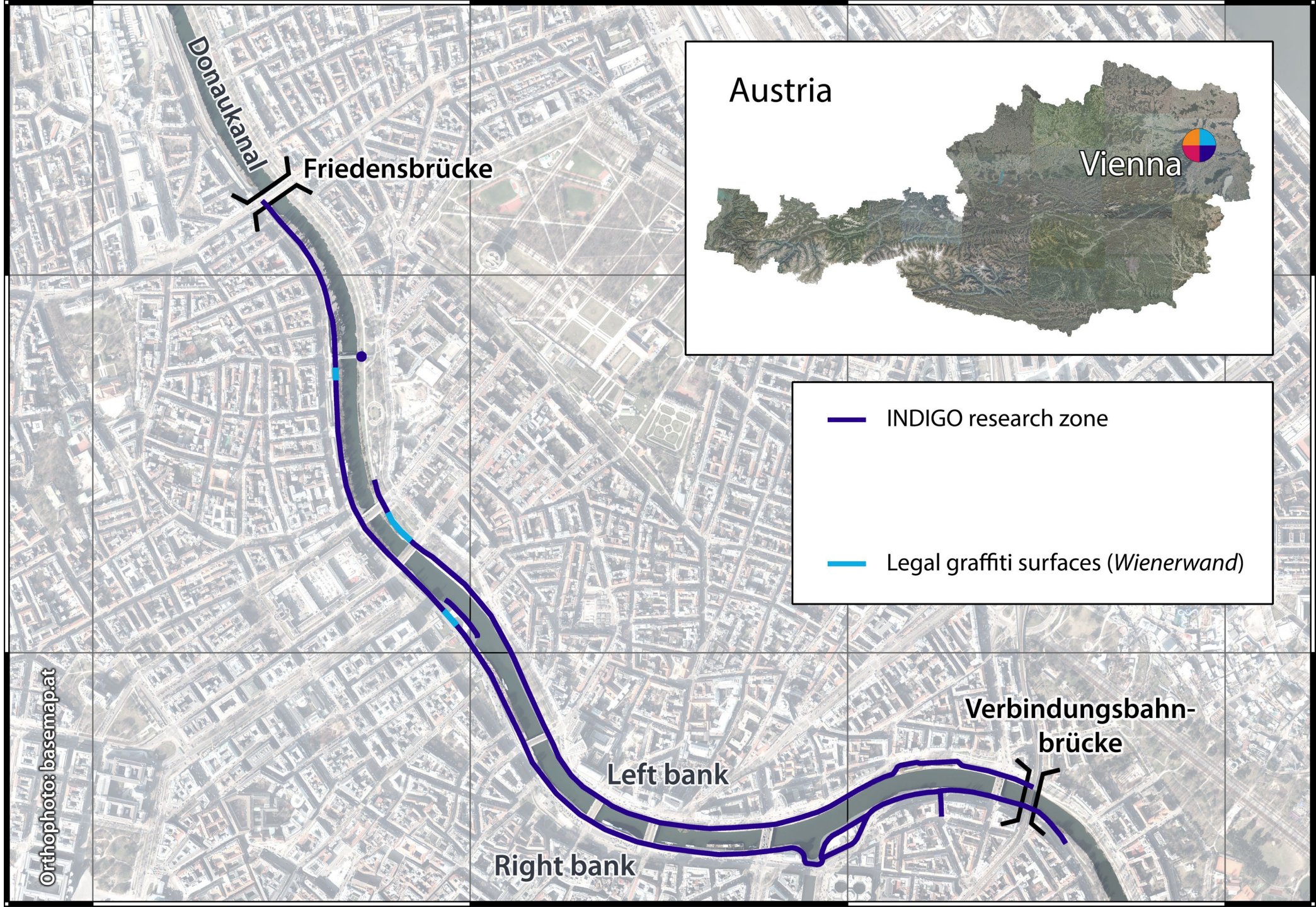
MONITORED SURFACES

12.9 km



MONITORED SURFACES

12.9 km

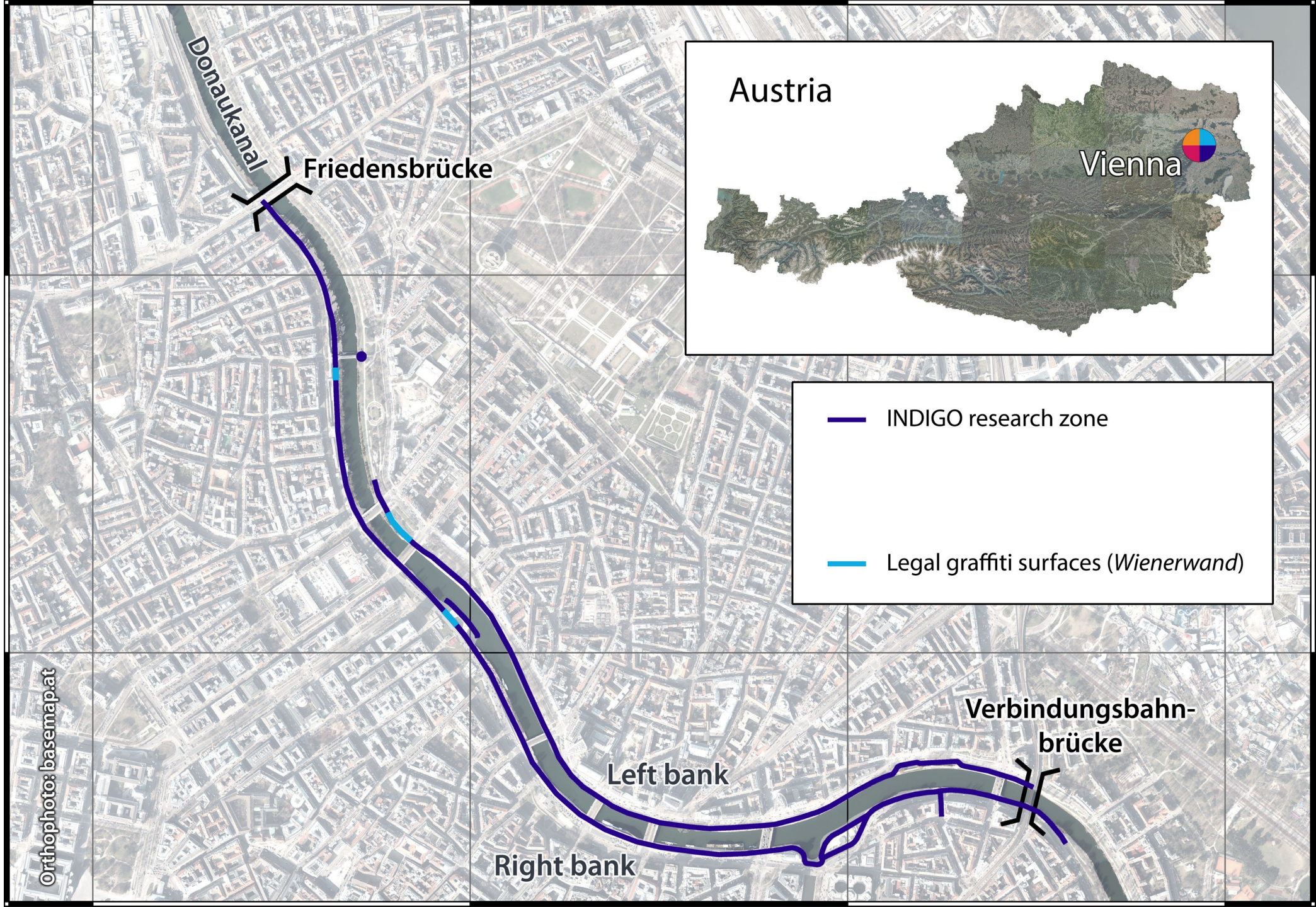


LEGAL SURFACES

0.3 km

MONITORED SURFACES

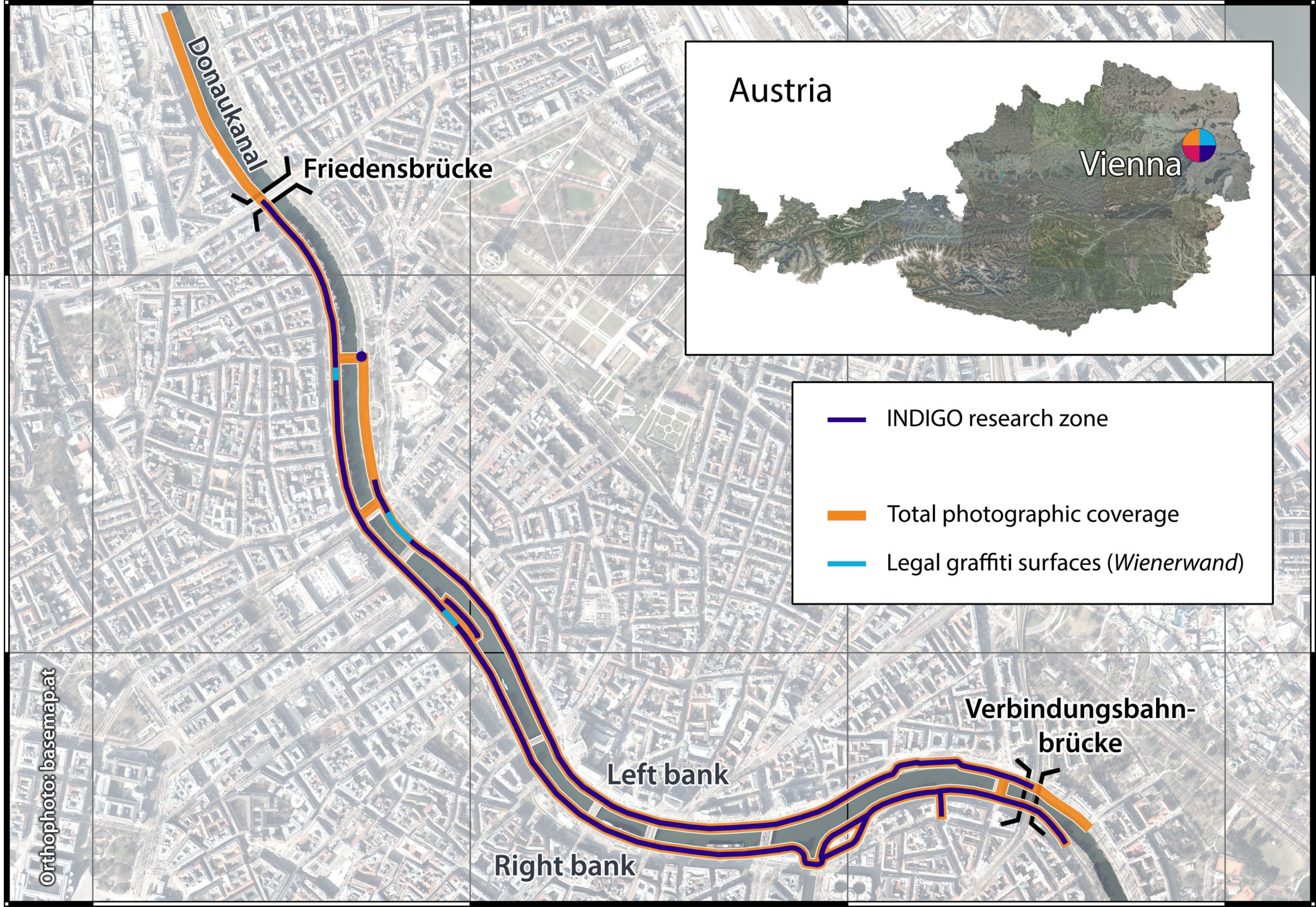
12.9 km



TOTAL COVERAGE
14.0 km

LEGAL SURFACES
0.3 km

MONITORED SURFACES
12.9 km



TOTAL COVERAGE

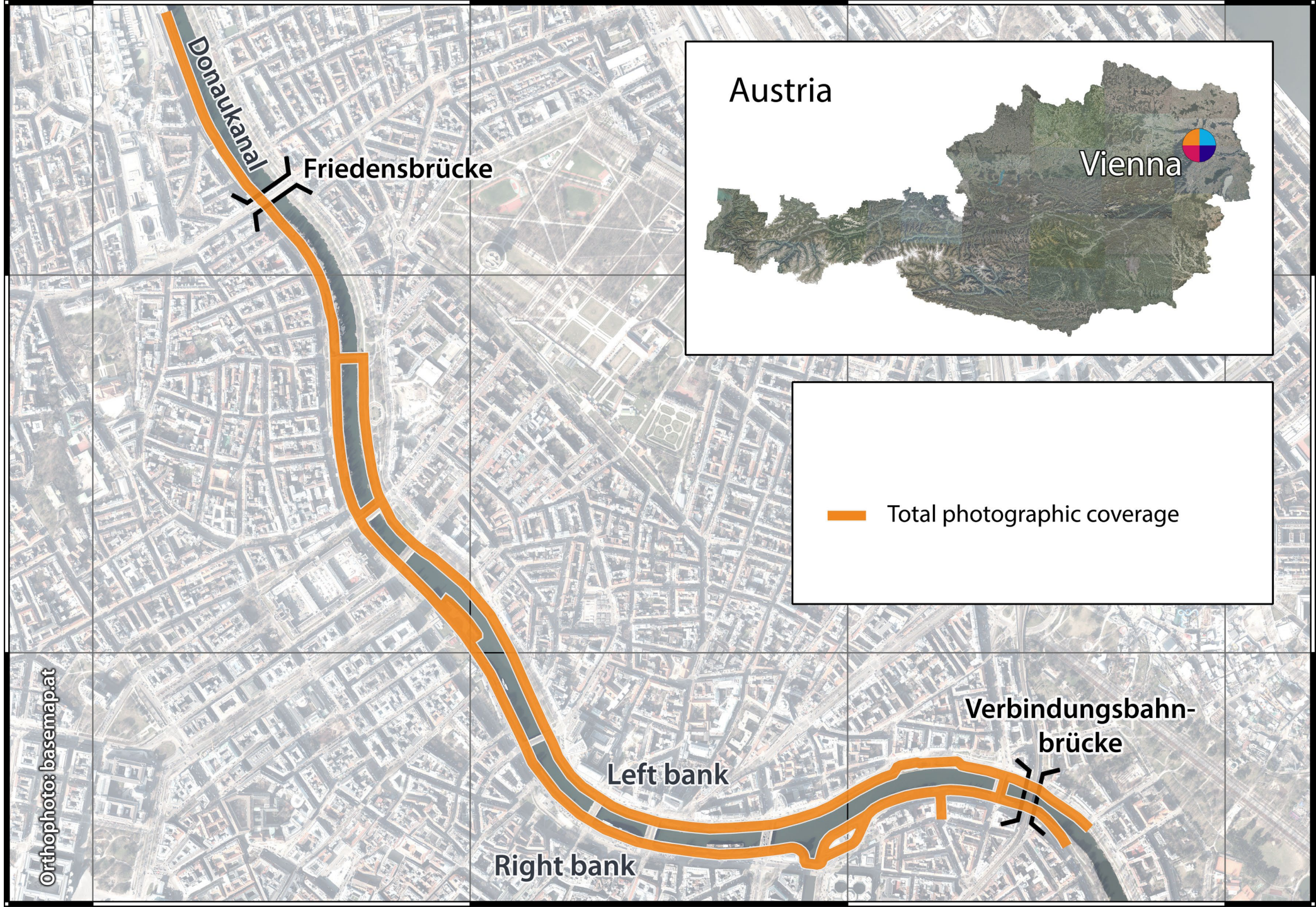
14.0 km

LEGAL SURFACES

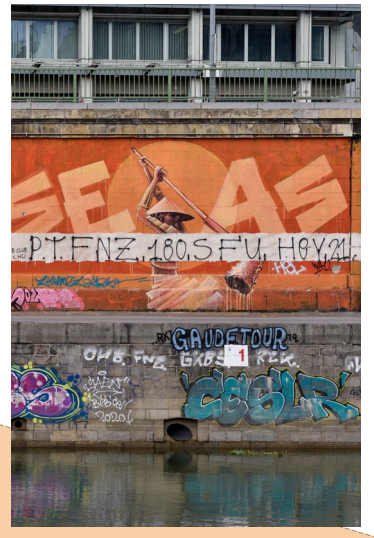
0.3 km

MONITORED SURFACES

12.9 km



TOTAL coverage



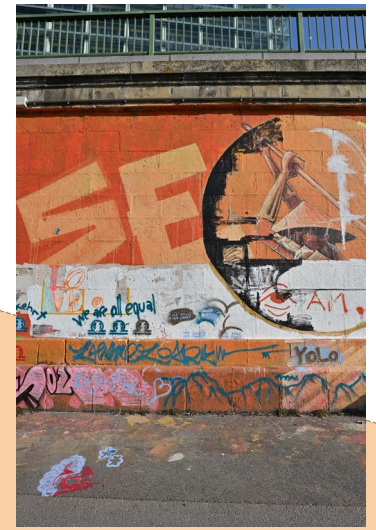
Date	Camera	Lens	Mean GSD	Acquisition time	Image count
30/09/2021 01/10/2021	Nikon D750 (24.2 MP p = 5.95 µm)	Nikon AF-S NIKKOR 85mm 1:1.8 G @ f/5.6	3.6 mm	3 h 45 min 3 h 20 min	2065 2544

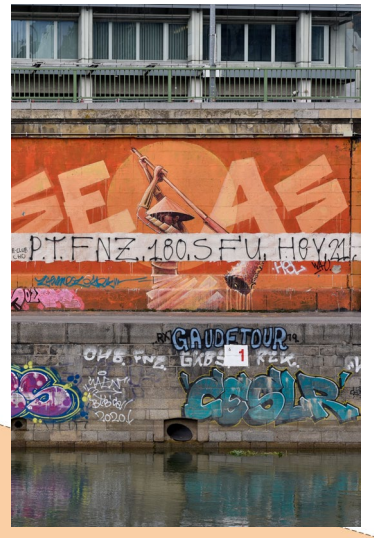
TOTAL coverage



Date	Camera	Lens	Mean GSD	Acquisition time	Image count
26/10/2021	Nikon Z 7II (45.4 MP p = 4.33 µm)	Nikon NIKKOR Z 20mm f/1.8 S @ f/5.6	0.9 mm	7 h	6042
27/10/2021				7 h 45 min	6591
28/10/2021				3 h 40 min	2856
29/10/2021				7 h	6608

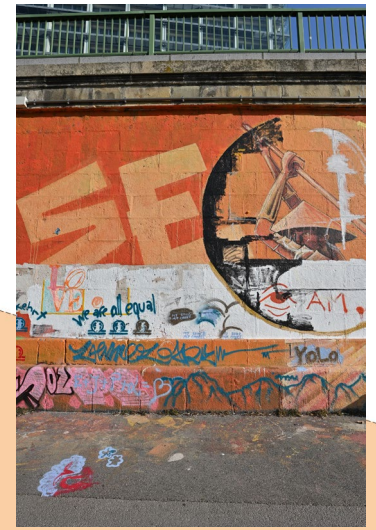
TOTAL coverage

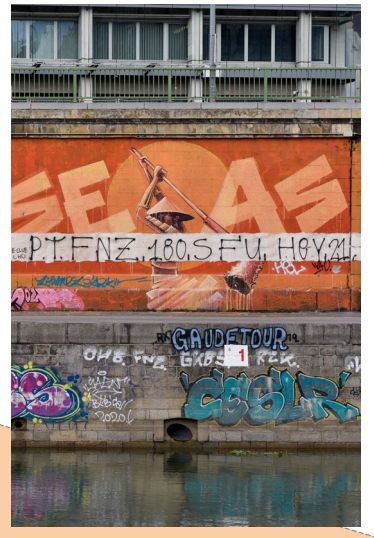




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28/10/2021				3 h 40 min	2856
29/10/2021				7 h	6608
			Total	**32 h 30 min**	**26706**

TOTAL coverage



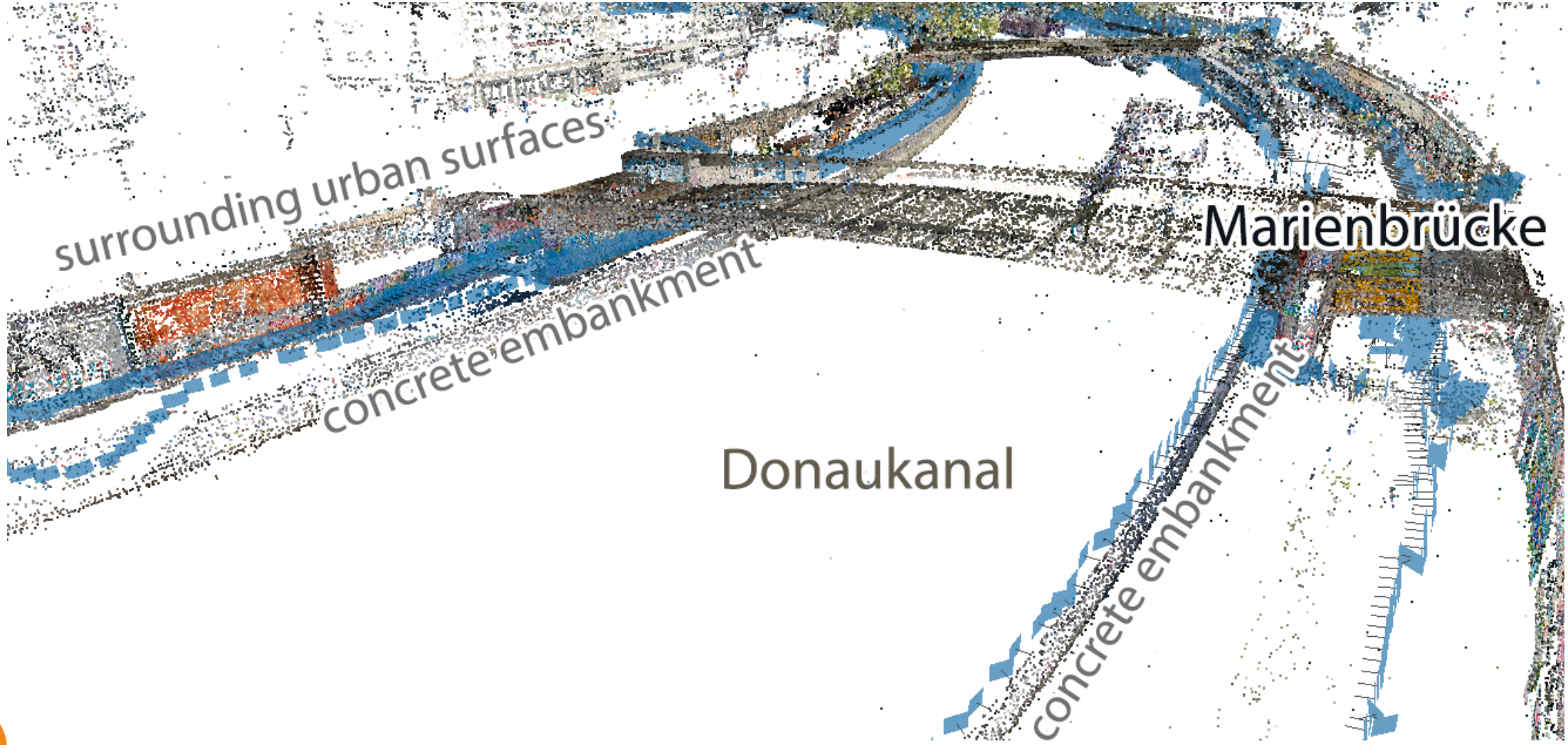


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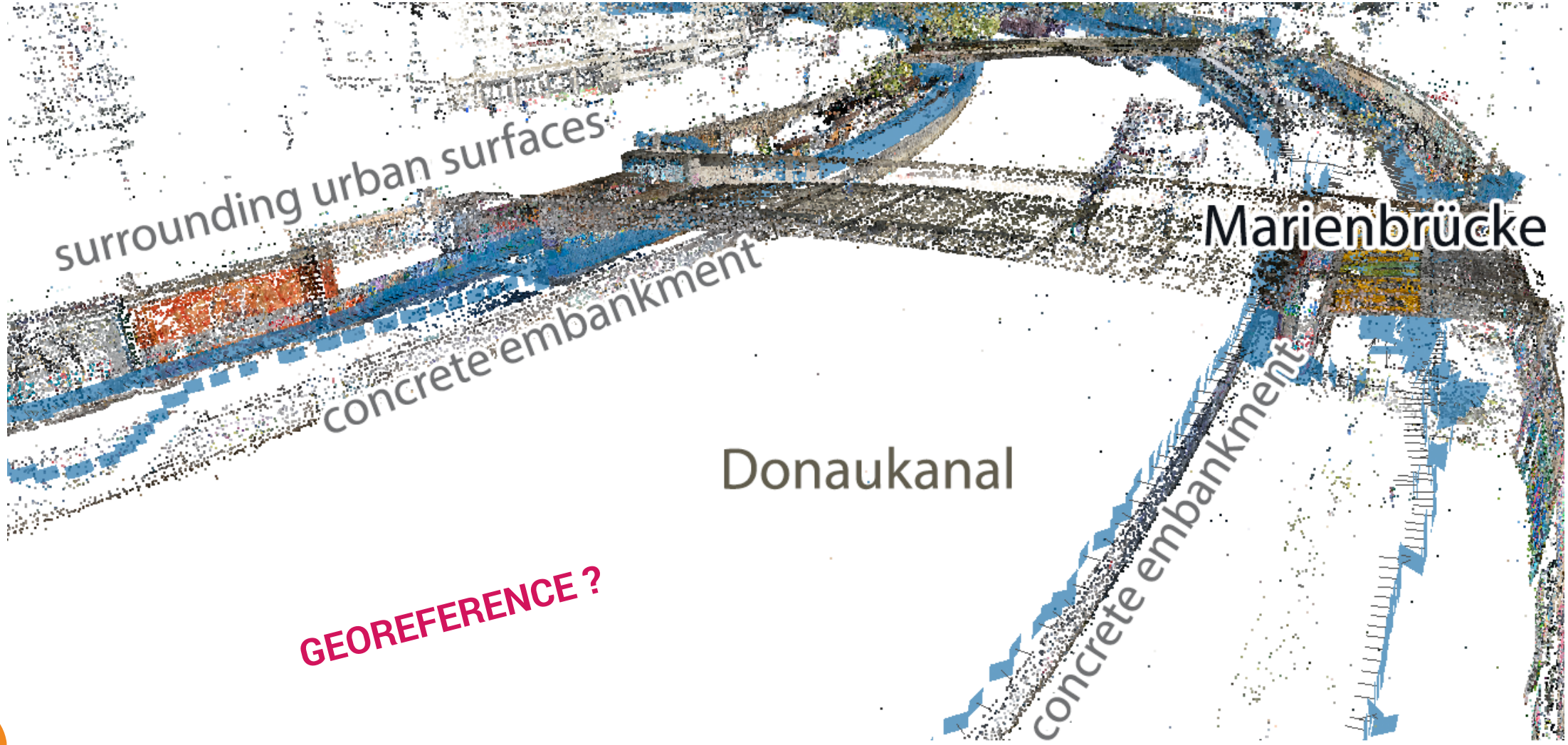
processing



CAMERA orientation



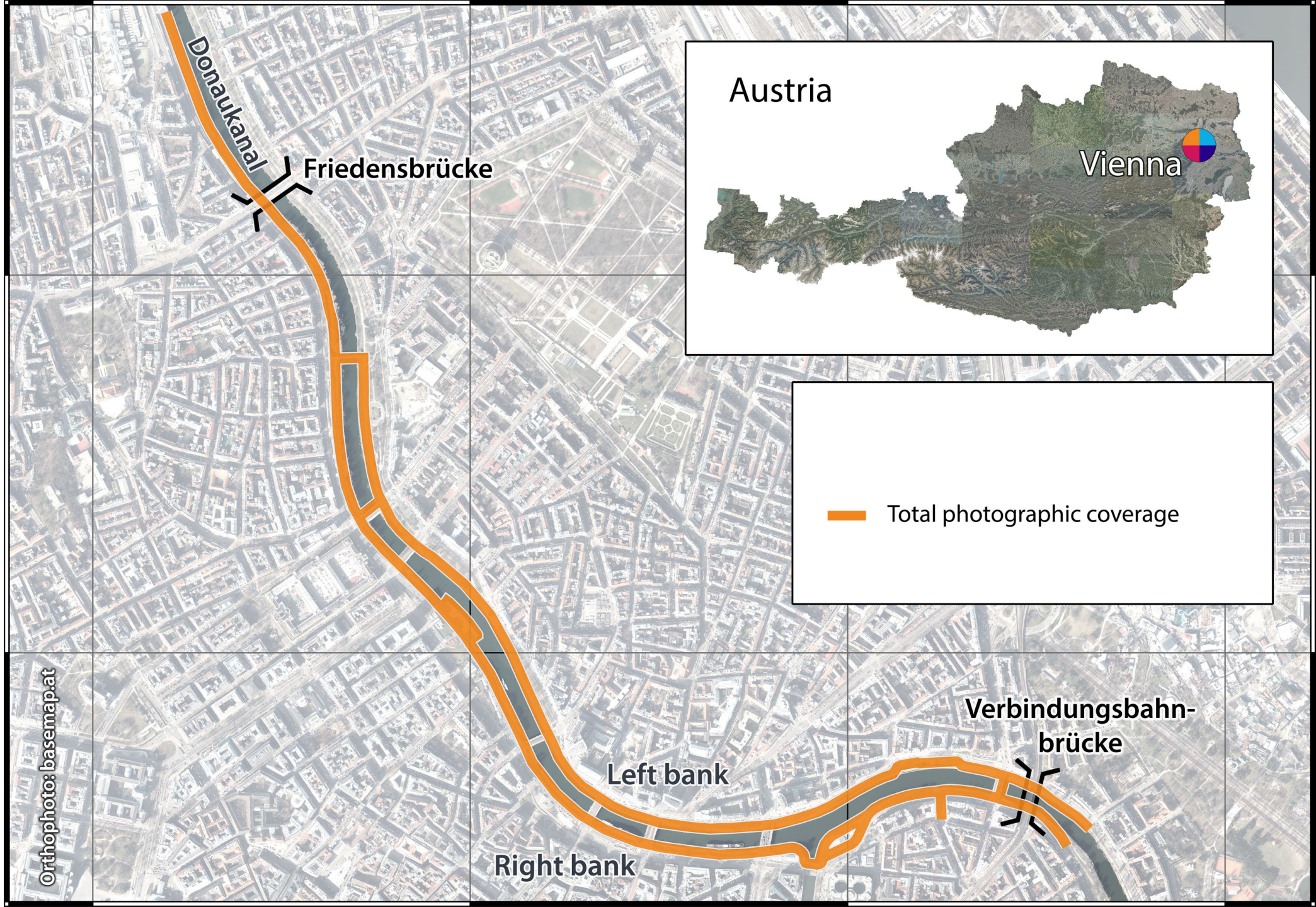
CAMERA orientation



GEOREFERENCE ?

TOTAL COVERAGE

14.0 km

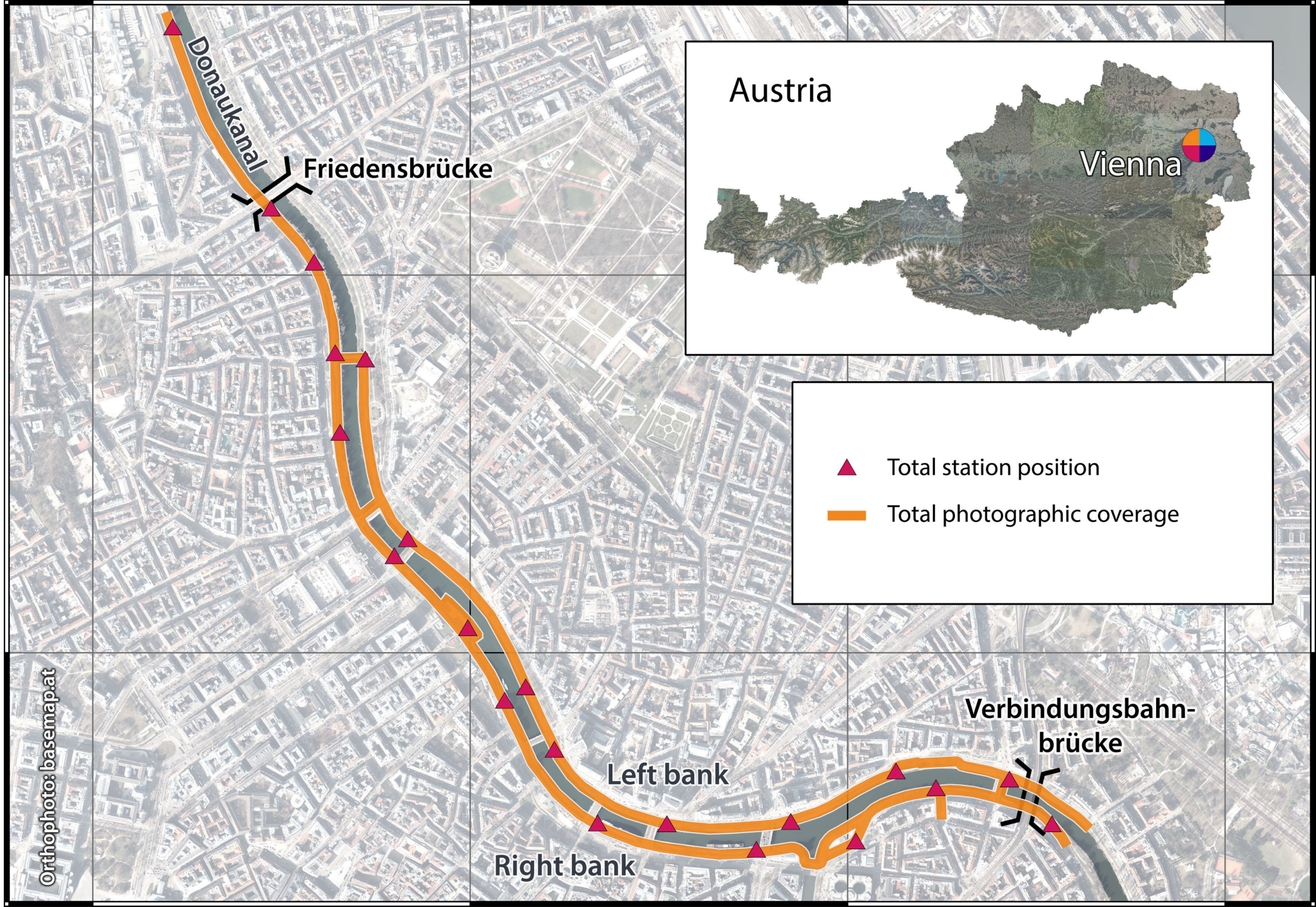


TOTAL COVERAGE

14.0 km

TOTAL STATION POSITIONS

21



TOTAL COVERAGE

14.0 km

TOTAL STATION POSITIONS

21



TOTAL COVERAGE

14.0 km

TOTAL STATION POSITIONS

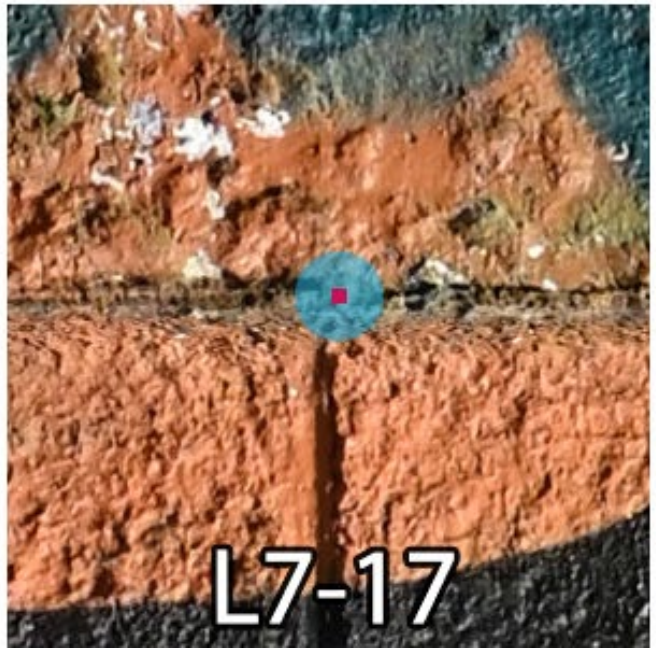
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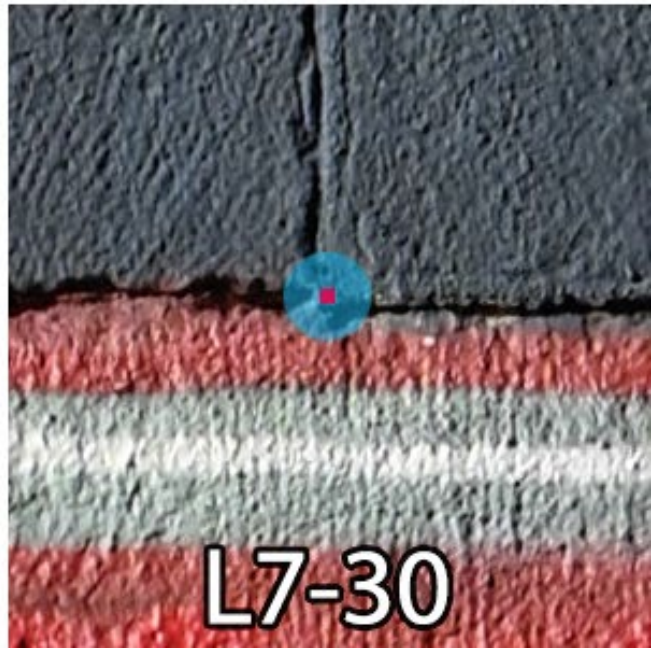
GRAFFITI-SCAPE POINTS

624

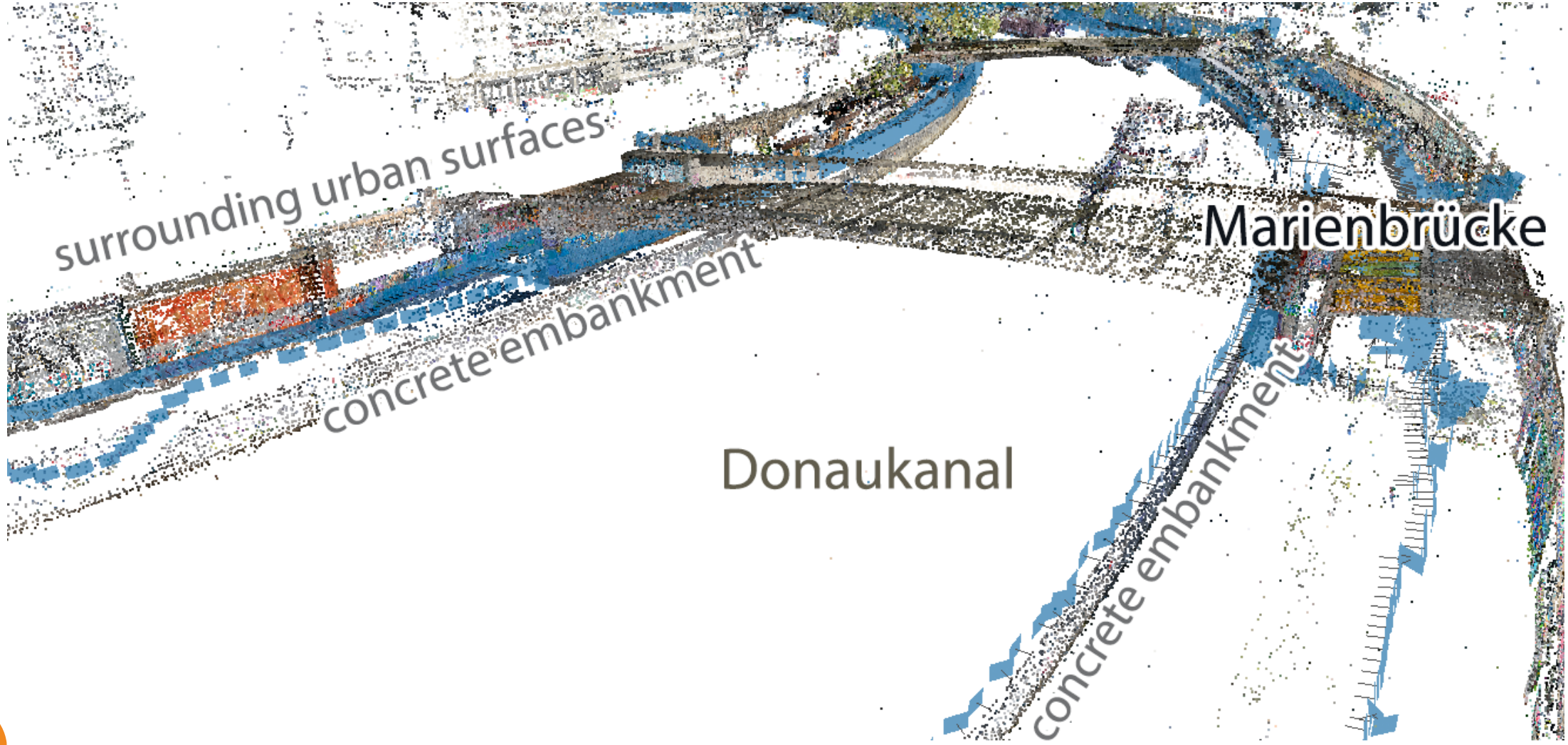




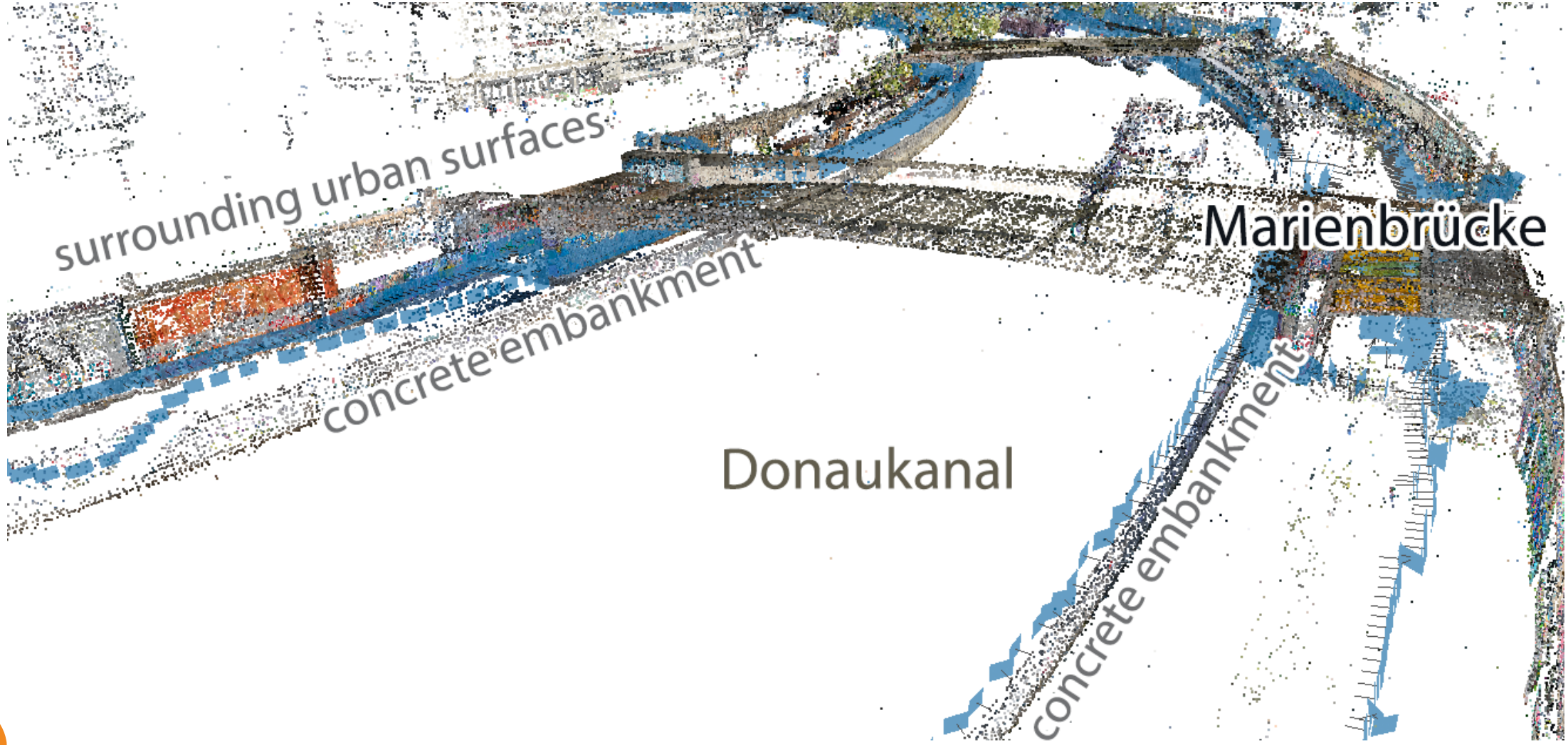




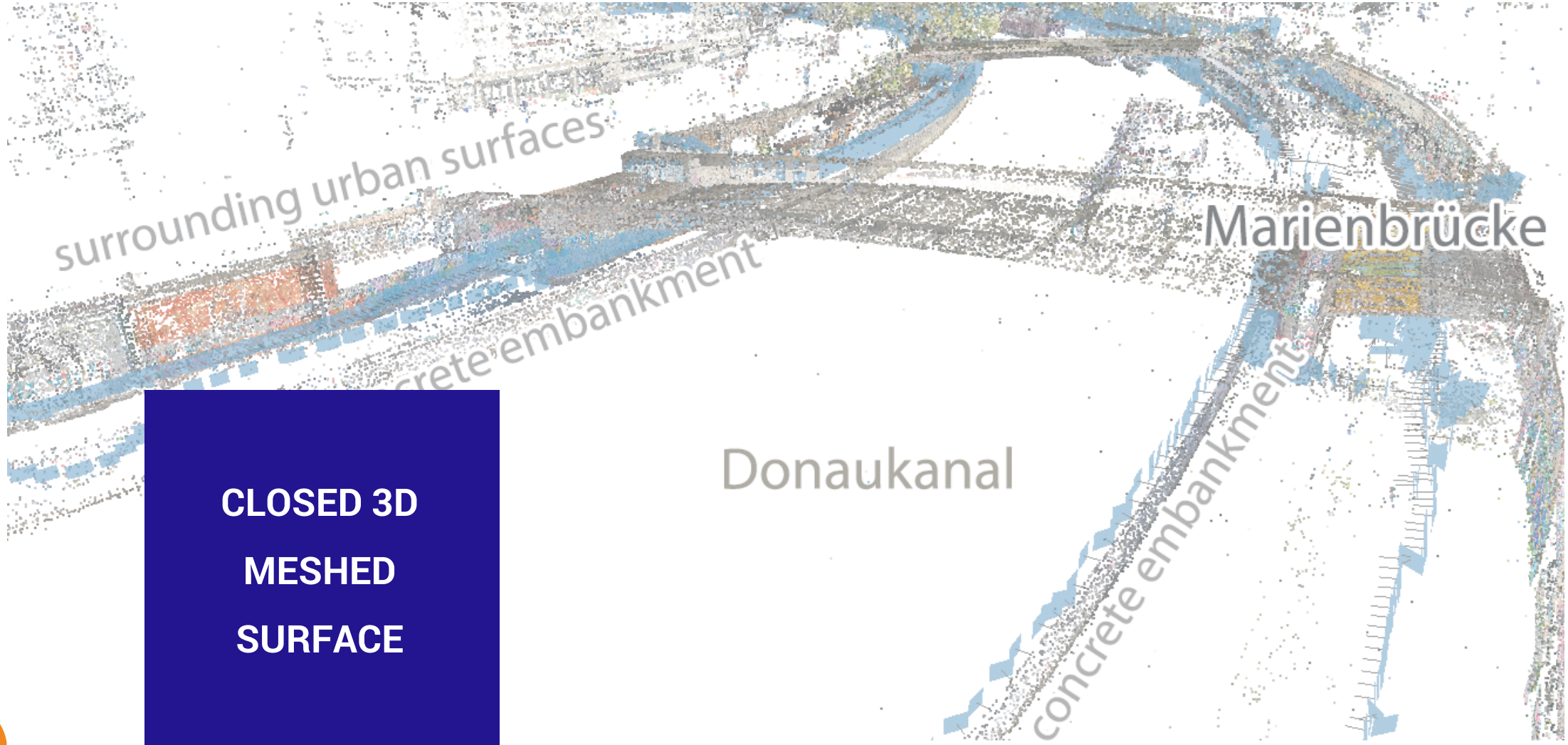
CAMERA orientation



THREE purposes

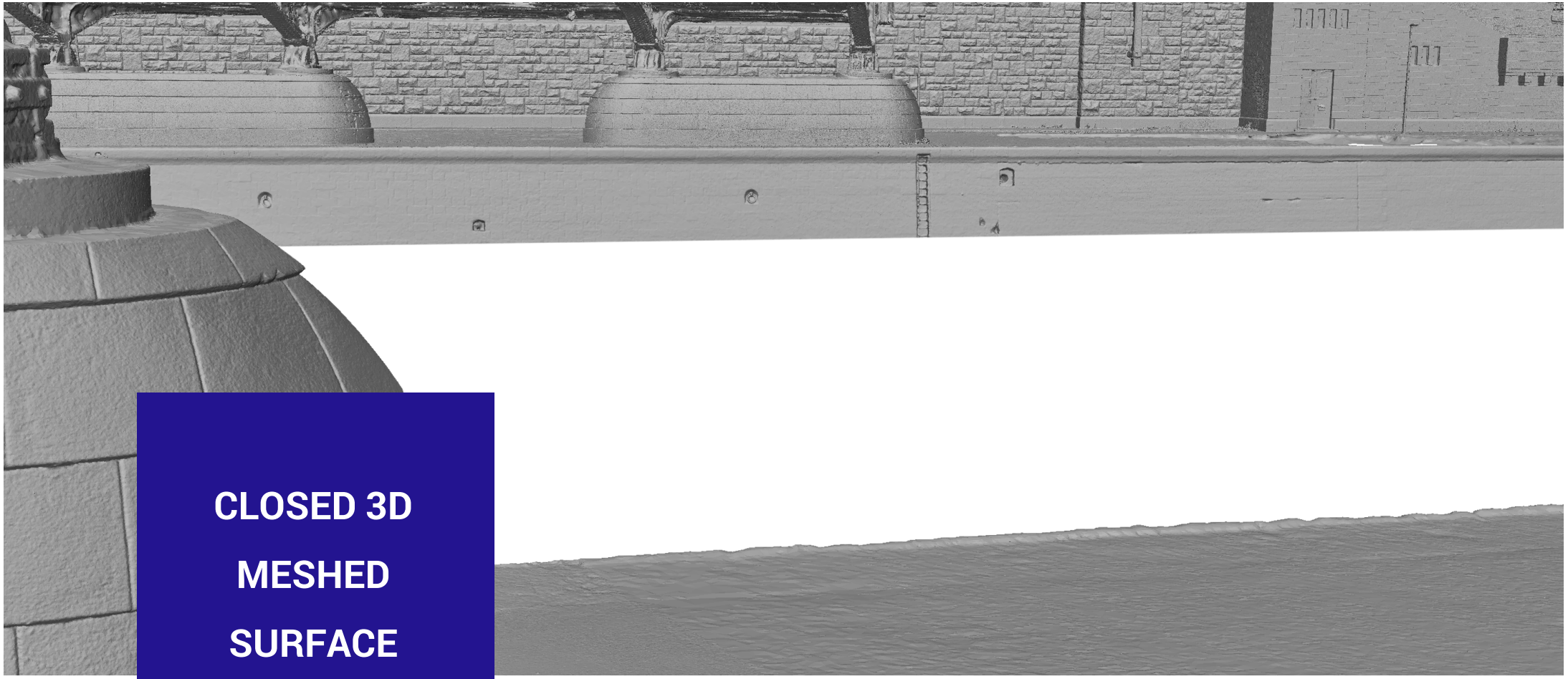


THREE purposes



CLOSED 3D MESHED SURFACE

THREE purposes

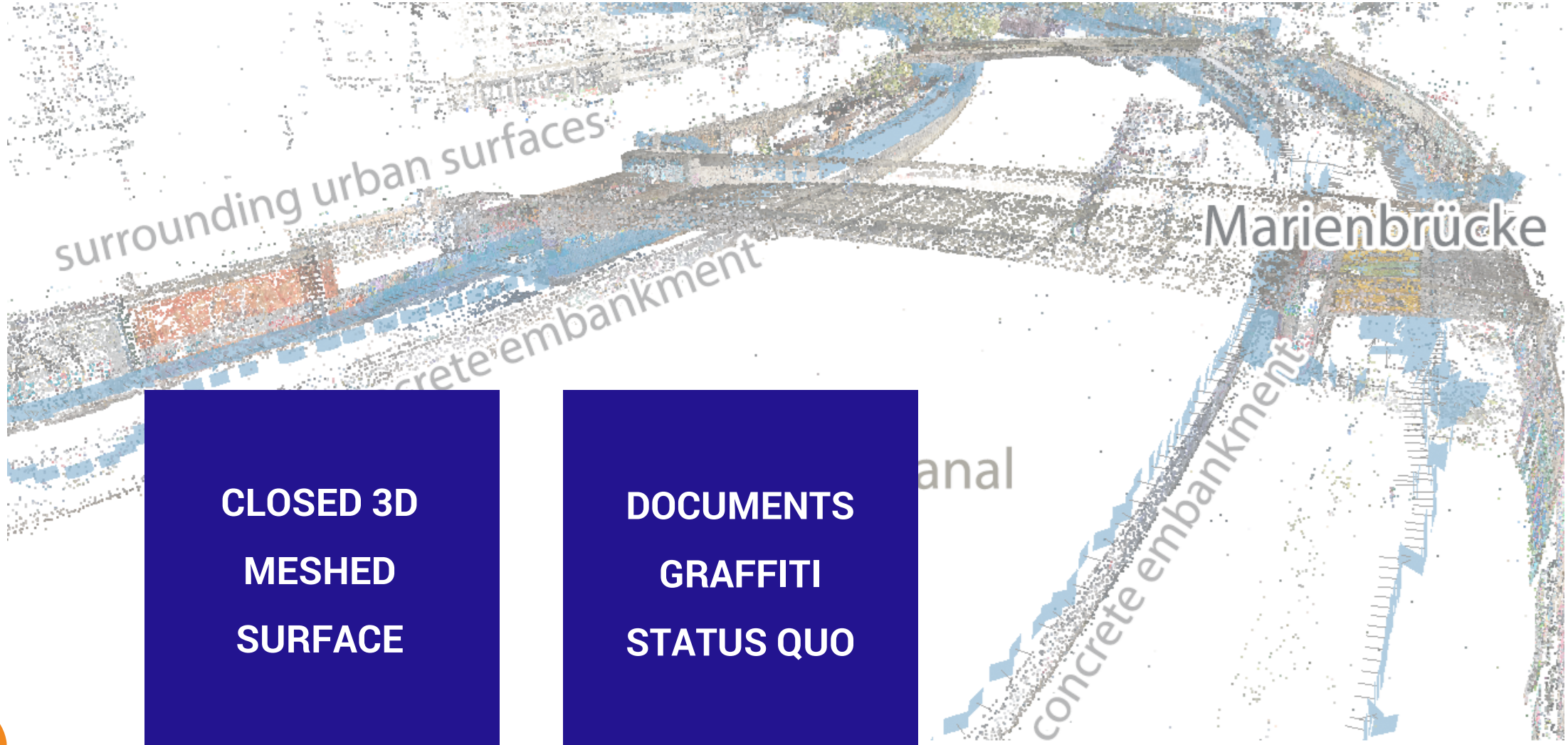


CLOSED 3D

MESHED

SURFACE

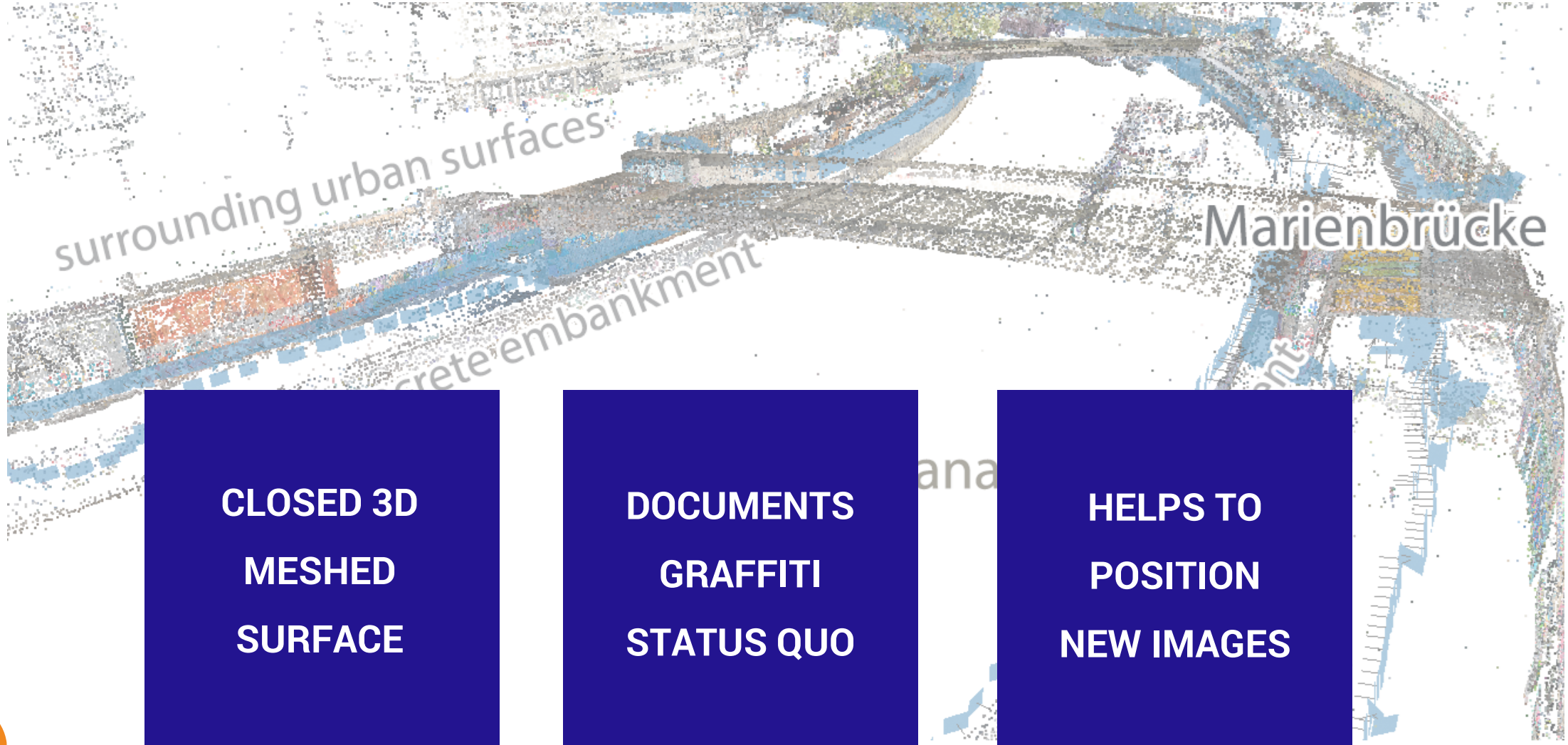
THREE purposes



CLOSED 3D MESHED SURFACE

DOCUMENTS GRAFFITI STATUS QUO

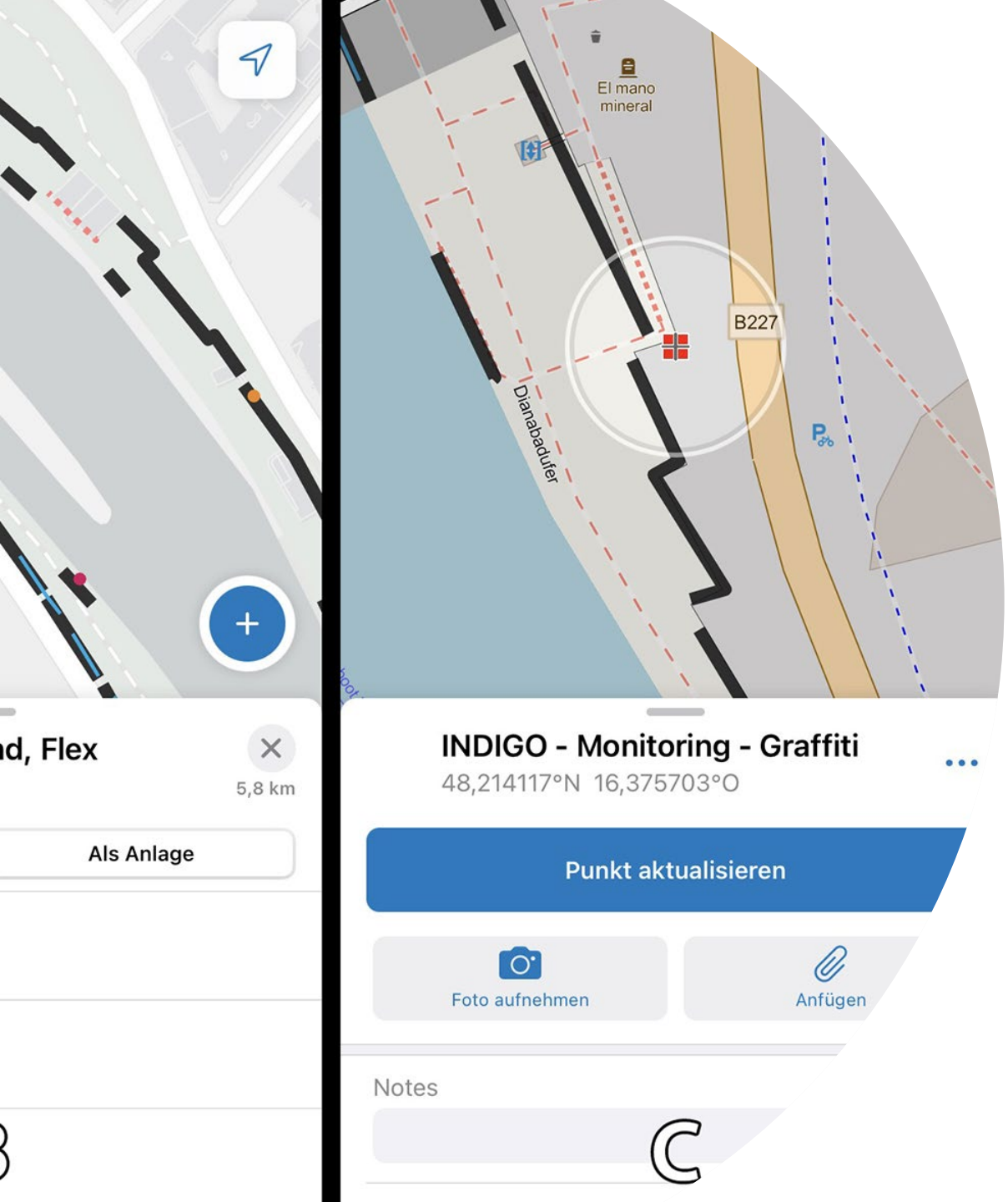
THREE purposes



CLOSED 3D MESHED SURFACE

DOCUMENTS GRAFFITI STATUS QUO

HELPS TO POSITION NEW IMAGES



FOLLOW-UP
photography

Instagram + monitoring app



FOLLOW-UP
photography

Instagram + monitoring app

2 photographers



FOLLOW-UP
photography

Instagram + monitoring app

2 photographers

2 cameras + 2 spectrometers + 2 tablets

identically programmed



FOLLOW-UP
photography

Instagram + monitoring app

2 photographers

2 cameras + 2 spectrometers + 2 tablets

identically programmed

fixed acquisition procedure

ACCURATE photo coordinates





ACCURATE photo coordinates



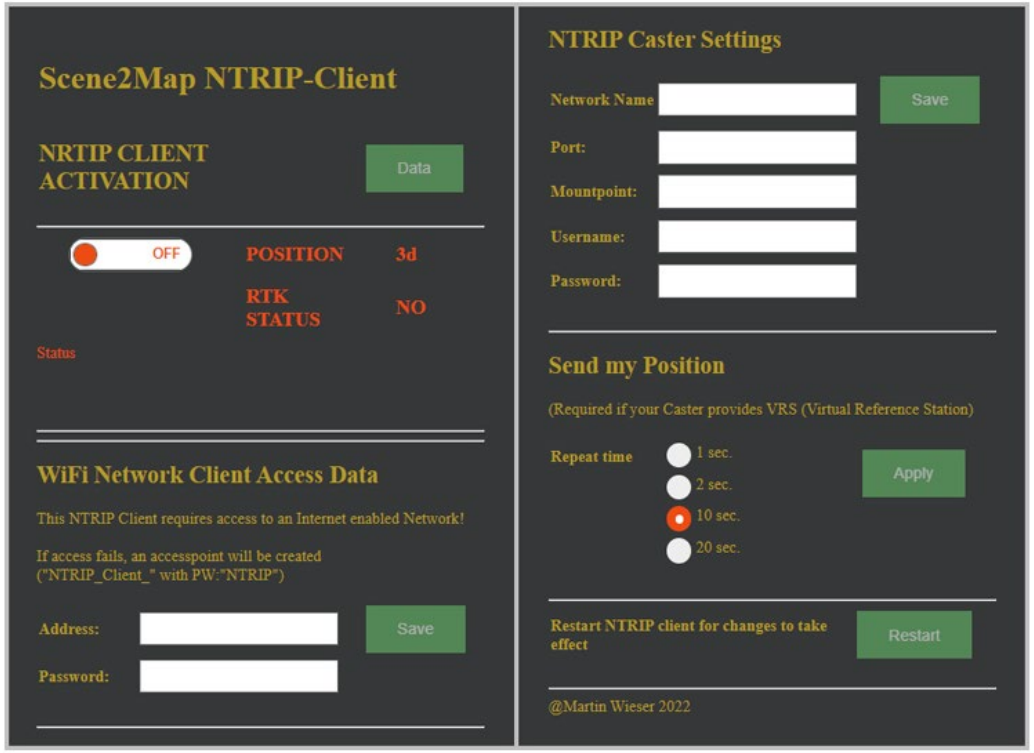


IMAGE positioning

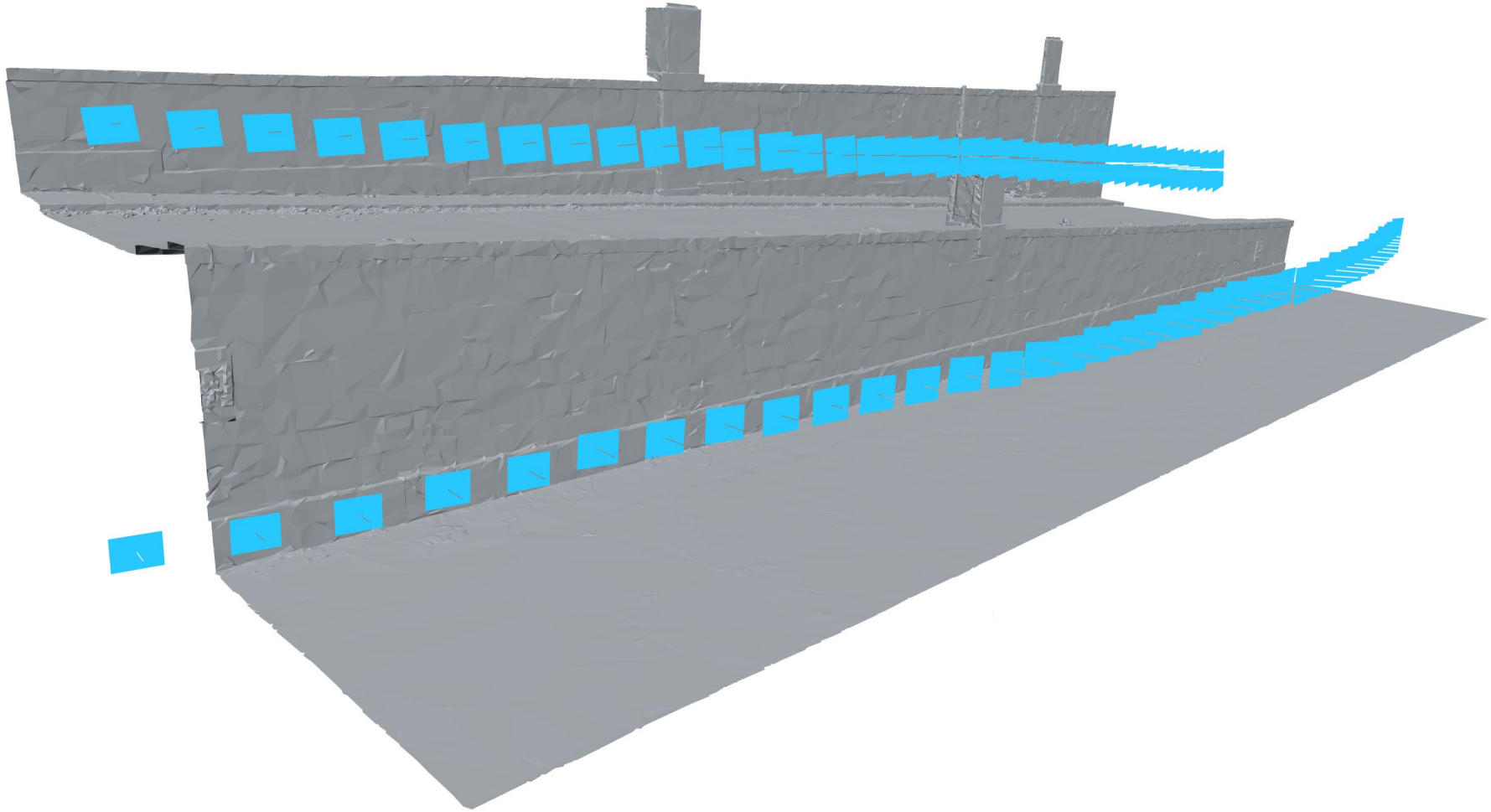


Illustration by Benjamin Wild

IMAGE positioning

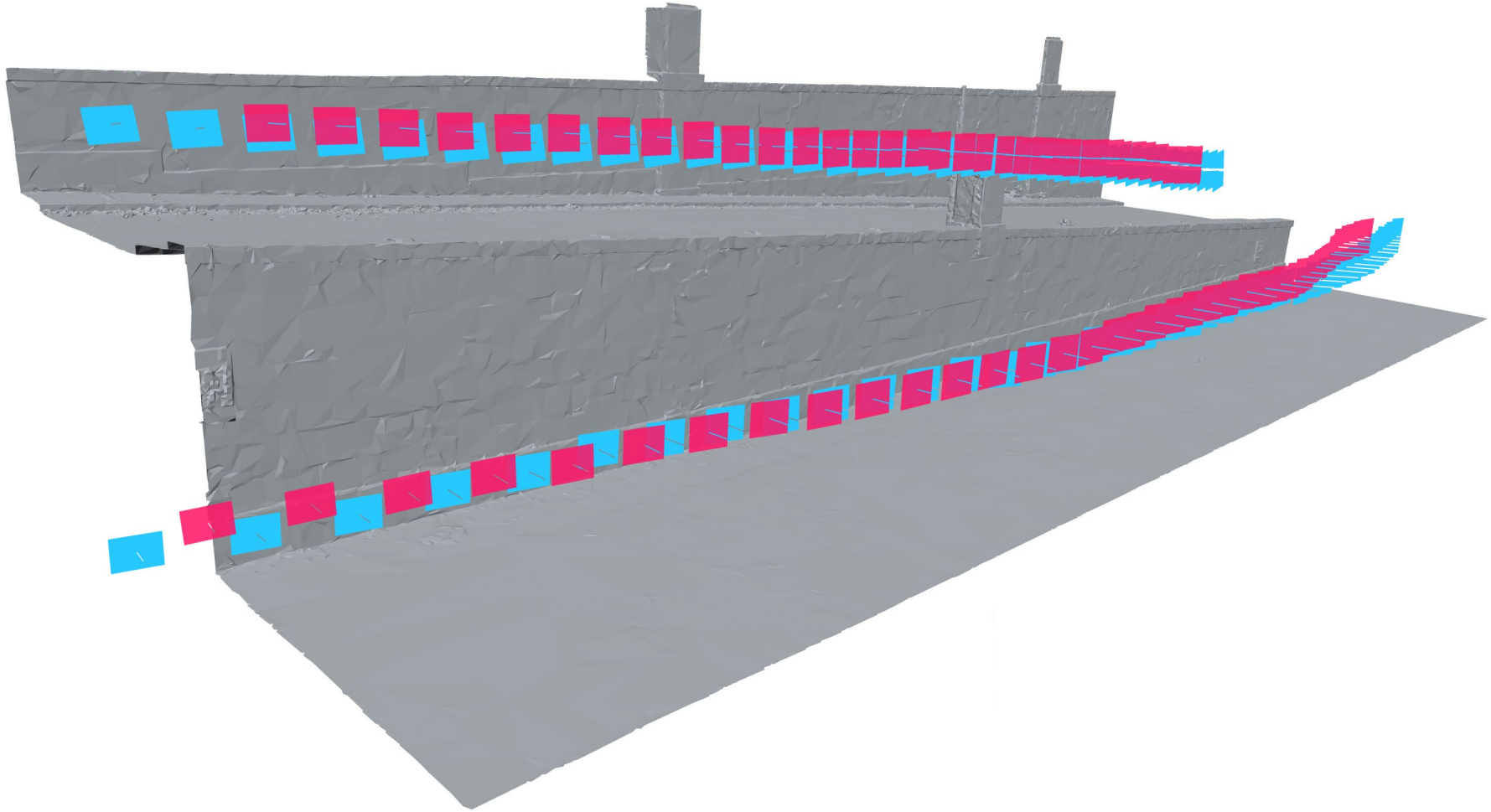


Illustration by Benjamin Wild

IMAGE positioning

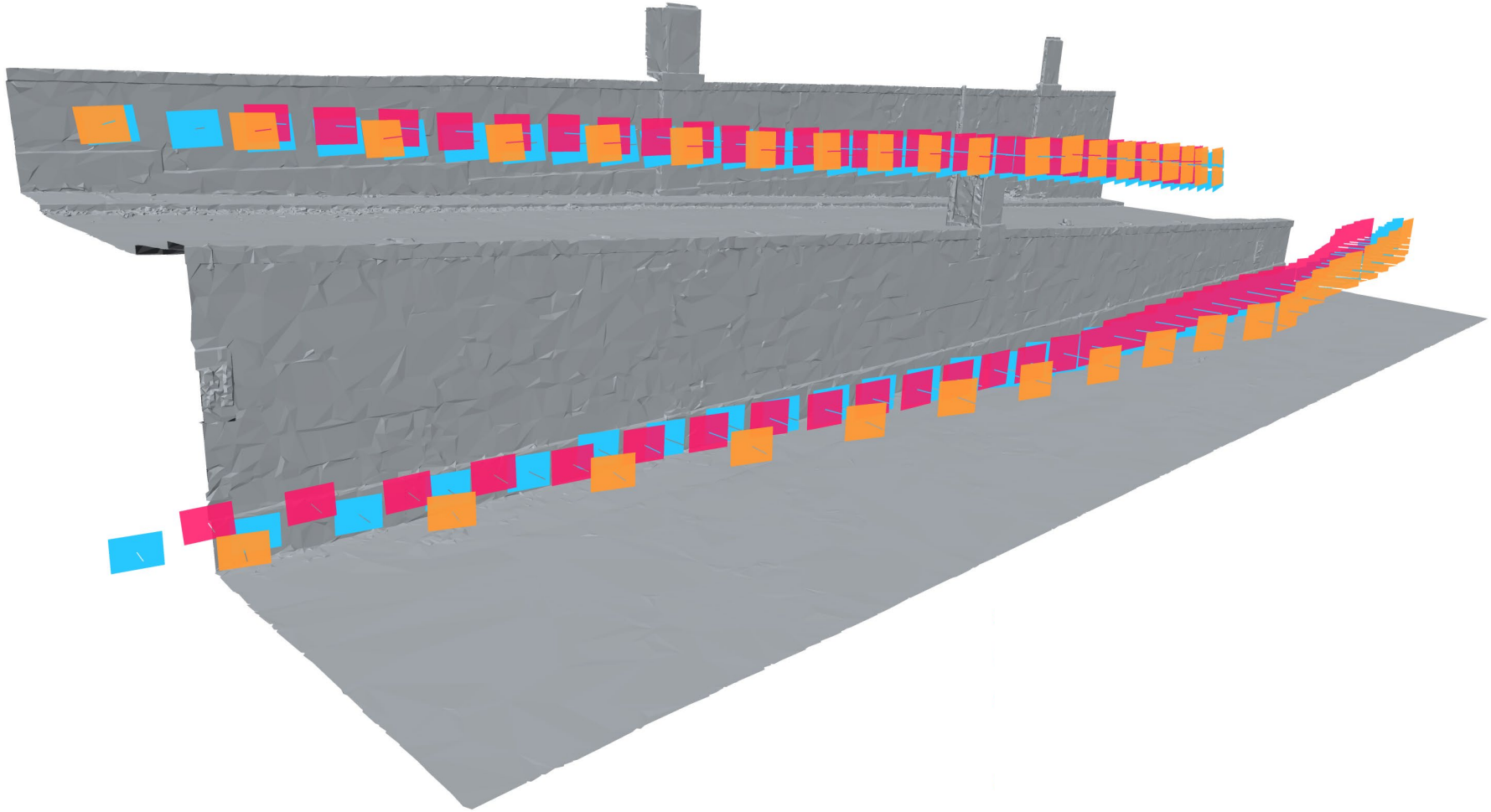


Illustration by Benjamin Wild

IMAGE positioning

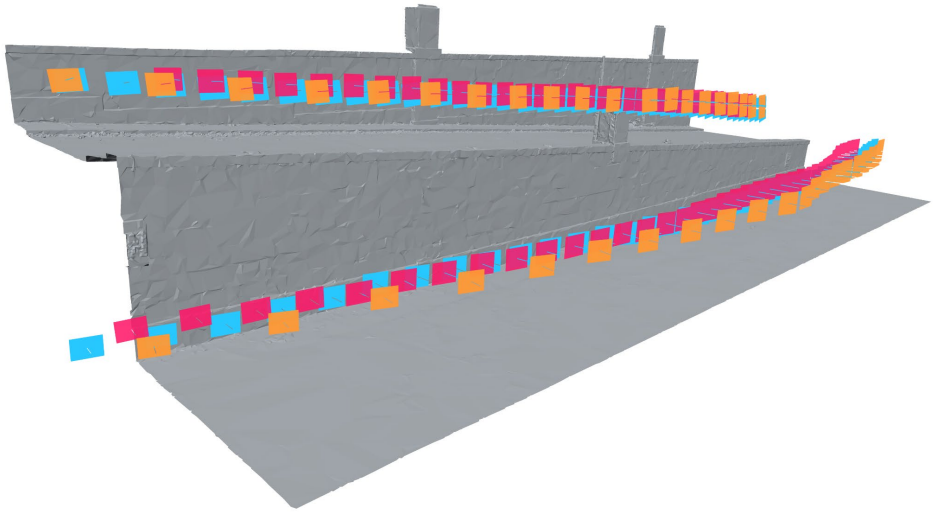


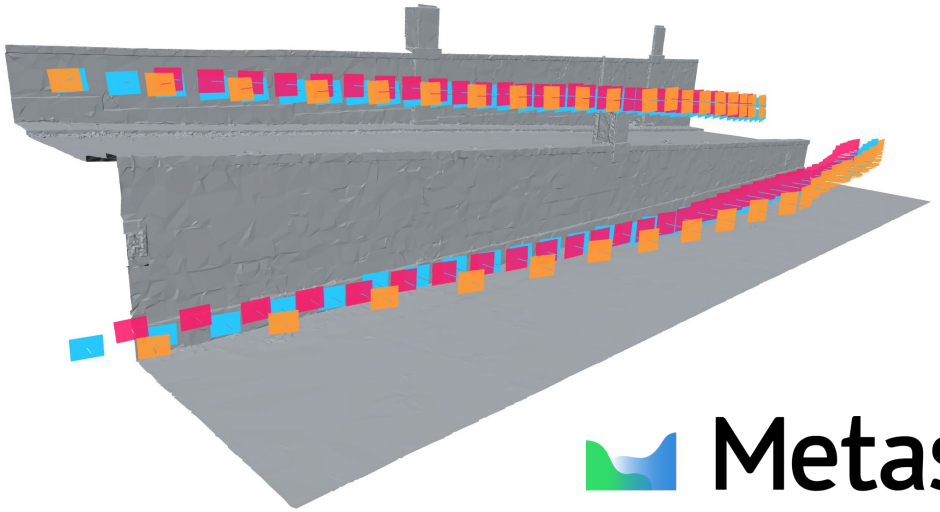






Illustration by Benjamin Wild

IMAGE positioning





Metashape





Illustration by Benjamin Wild

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GraffitiProjectINDIGO / AUTOGRAF Public

Notifications Fork 0 Star 6

Code Issues Pull requests Actions Projects Security Insights

main 1 branch 0 tags Go to file Code

bewild96 Update README.md	75d27bb 15 days ago	24 commits
Heritage_ClassificationResults	Add files via upload	2 months ago
images	Add files via upload	last month
src	Add files via upload	2 months ago
LICENSE	Initial commit	2 months ago
README.md	Update README.md	15 days ago

README.md

Short Description

AUTOGRAF (**AUT**omated **O**rthorectification of **GRAF**fiti photos) is an open-source python-based Metashape add-on which enables the automated orthorectification of graffiti photos at a specific site of interest. It employs state-of-the art photogrammetric computer vision techniques to allow highly accurate georeferencing and orthorectification of large numbers of photographs. A paper detailing AUTOGRAF's methodology will soon be submitted to Heritage (an MDPI journal).

AUTOGRAF is developed as part of the INDIGO project (In-ventory and DI-sseminate G-raffiti along the d-O-naukanal) carried out by the Ludwig Boltzmann Institute for Archaeological Prospection and Virtual Archaeology in close collaboration with the GEO Department of TU Wien University.

How to set up AUTOGRAF

Before AUTOGRAF can be used, the following preparatory steps [1-3] need to be performed:

1 - Install Agisoft's Metashape

About

AUTomatic Orthorectification of GRAFfiti photos

photographs graffiti orthorectification

Readme
GPL-3.0 license
6 stars
1 watching
0 forks

Releases

No releases published

Packages

No packages published

Contributors 2

bewild96
BeyondConventionalBoundaries Geert ...

Languages

Python 100.0%

AUTOGRAF

position-accurate pixels

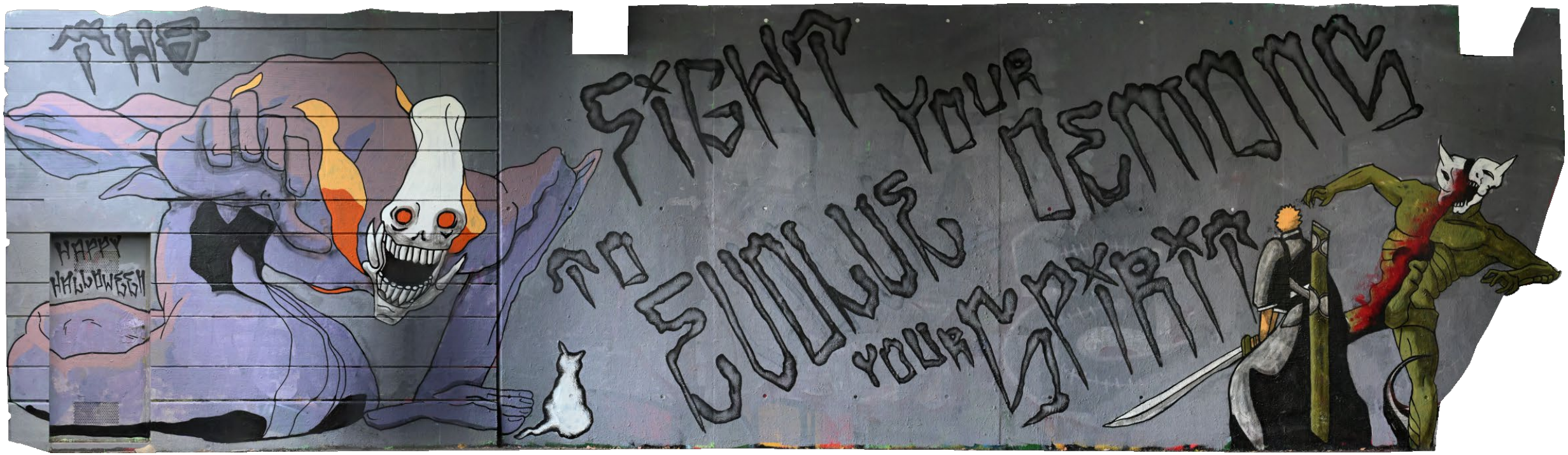
AUTOGRAF

position-accurate pixels



AUTOGRAF

position-accurate pixels



COLLECTED photos



COLLECTED photos



TOTAL COVERAGE

2

COLLECTED photos



TOTAL COVERAGE

2

TC PHOTOS

26.7 k

42.0 k

COLLECTED photos



TOTAL COVERAGE

2

FOLLOW-UP

106

TC PHOTOS

26.7 k

42.0 k

COLLECTED photos



TOTAL COVERAGE
2

FOLLOW-UP
106

TC PHOTOS
26.7 k
42.0 k

FU PHOTOS
94.6 k

SOME results

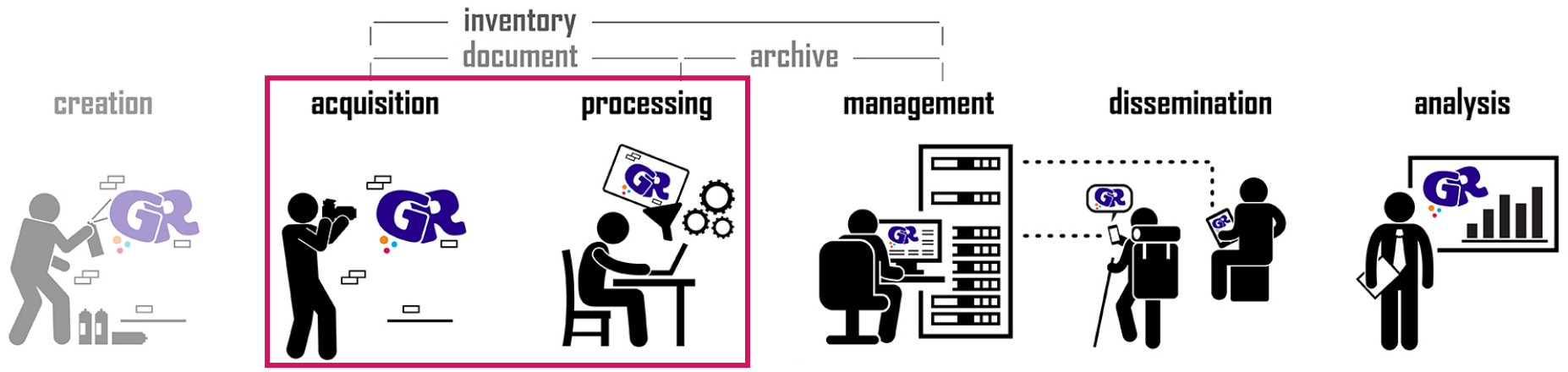
GRAFFITI *LOCATION*

GRAFFITI *TEMPORALITY*

GRAFFITI *TERMINOLOGY*

GRAFFITI *CHARACTERISATION*

5 research pillars



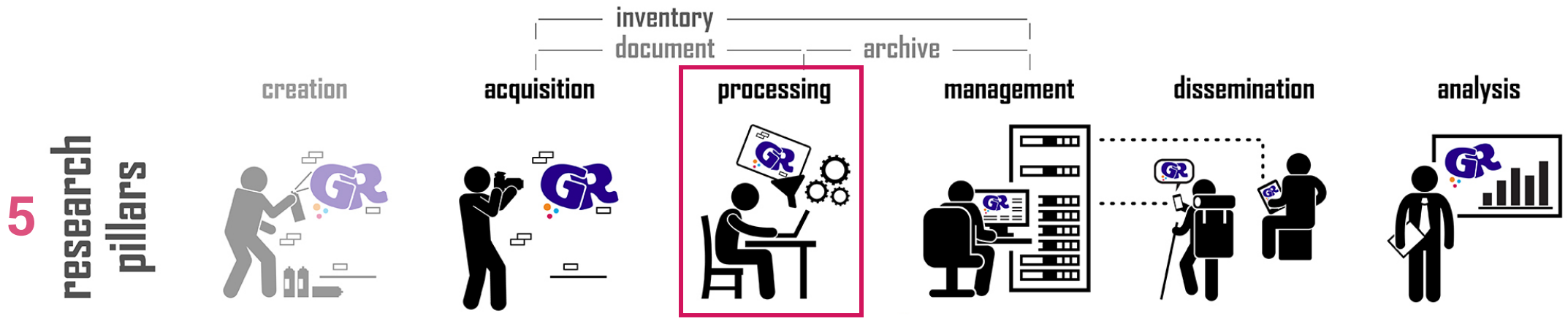
SOME results

GRAFFITI *LOCATION*

GRAFFITI *TEMPORALITY*

GRAFFITI *TERMINOLOGY*

GRAFFITI *CHARACTERISATION*



MOMENTS of creation

16 June 2023 @ 10:25 CET

MOMENTS of creation





16 June 2023 @ 10:25 CET

MOMENTS of creation





16 June 2023 @ 10:25 CET



© Sophie Hay



MOMENTS of creation



16 June 2023 @ 10:25 CET



date + time



© Sophie Hay



date + time

MOMENTS of creation

creation event
date + time



© Sophie Hay



16 June 2023 @ 10:25 CET





date + time
creation event

MOMENTS of creation

photo | ~~graffito~~
creation event
date + time



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16 June 2023 @ 10:25 CET





date + time
creation event
photo | ~~graffito~~

INDIGO METADATA

real graffito
vs
digital derivatives

MOMENTS of creation

photo | ~~graffito~~
creation event
date + time



© Sophie Hay



16 June 2023 @ 10:25 CET



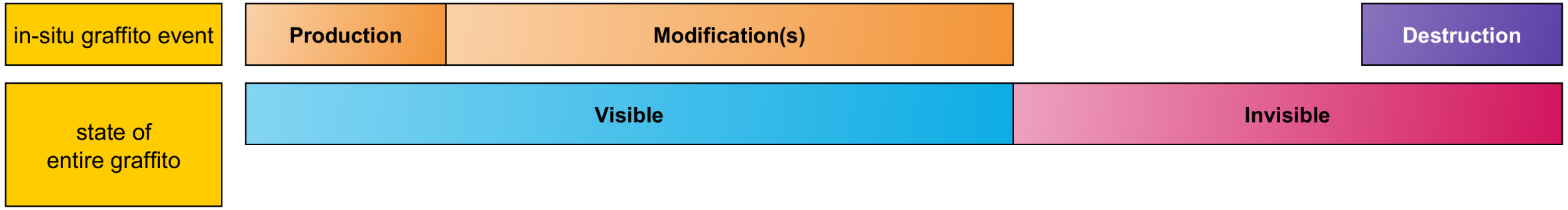


date + time
creation event
photo | ~~graffito~~

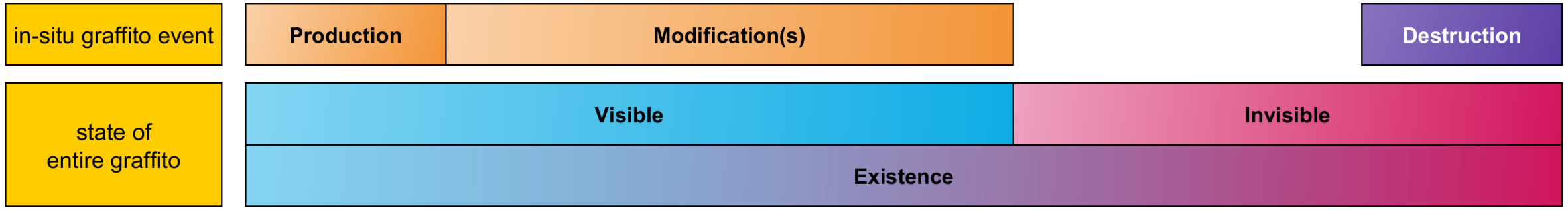
STORING time



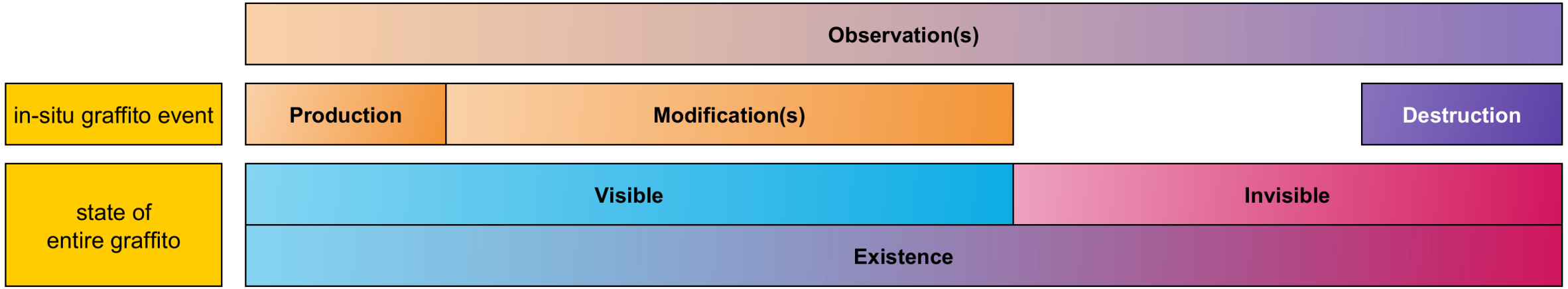
STORING time



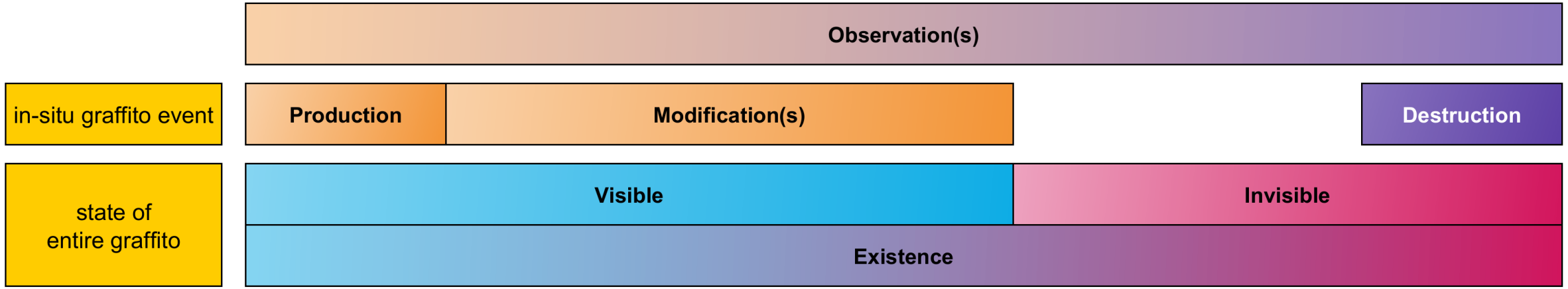
STORING time



STORING time



STORING time




```
"type": "Feature",
"properties": {
  "polygon_ID": "INDIGO_2023-03-16_Z7ii_0016 + string made by GRAPHIS",
  "polygon_state": "initial or derived",
  "polygon_creation": "manual, semi-automatic or automatic",
  "graffito_ID": "INDIGO_20230316_G0016",

  "observation": {···
  },

  "production": {···
  },
```

```
  "modification": [···
  ],

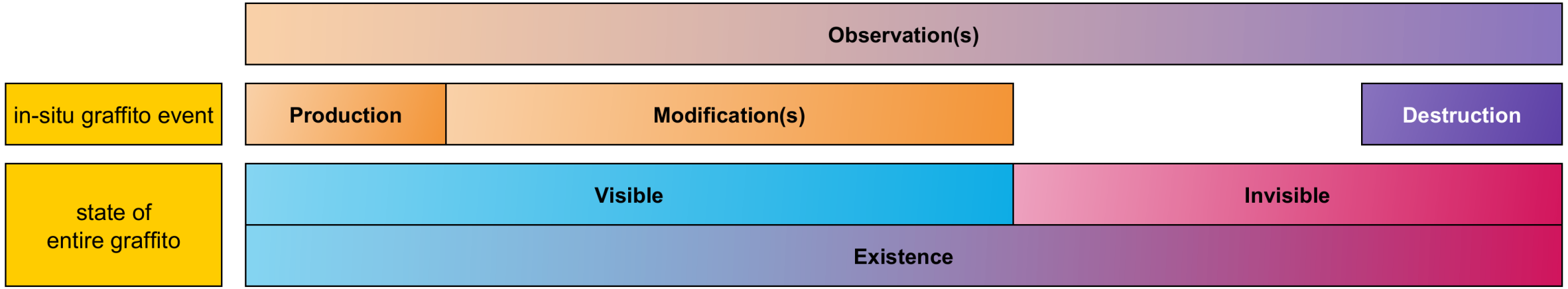
  "destruction": {···
  },

  "visible": {···
  },

  "invisibile": {···
  },

  "existence": {···
  }
```

STORING time




```
"type": "Feature",
"properties": {
  "polygon_ID": "INDIGO_2023-03-16_Z7ii_0016 + string made by GRAPHIS",
  "polygon_state": "initial or derived",
  "polygon_creation": "manual, semi-automatic or automatic",
  "graffito_ID": "INDIGO_20230316_G0016",

  "observation": {···
  },

  "production": {···
  },
```

```
  "modification": [···
  ],

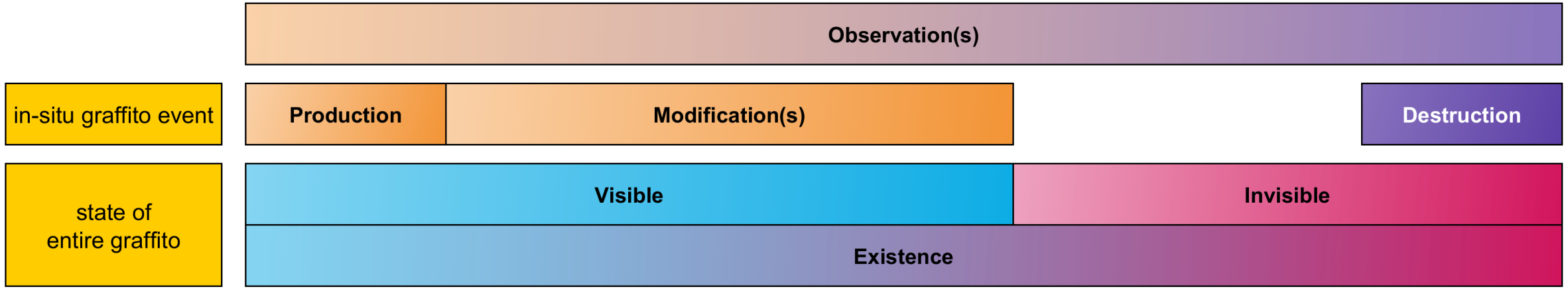
  "destruction": {···
  },

  "visible": {···
  },

  "invisibile": {···
  },

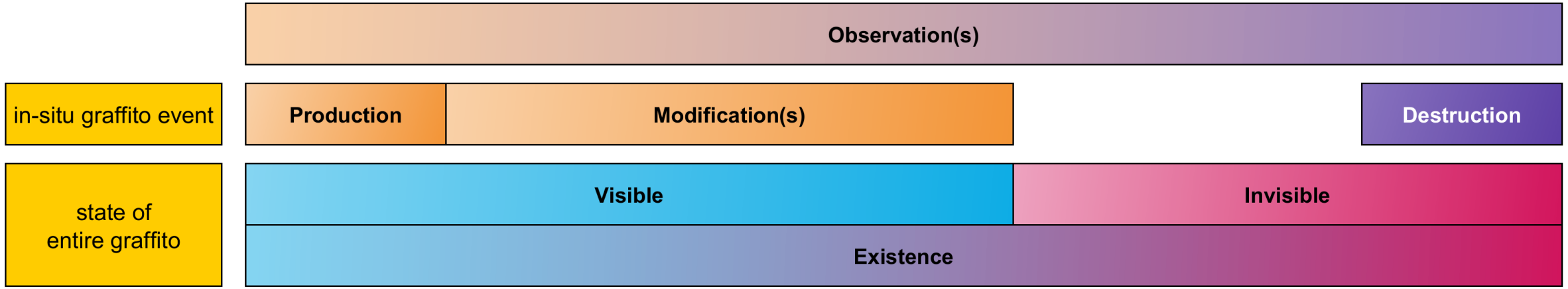
  "existence": {···
  }
```

STORING time



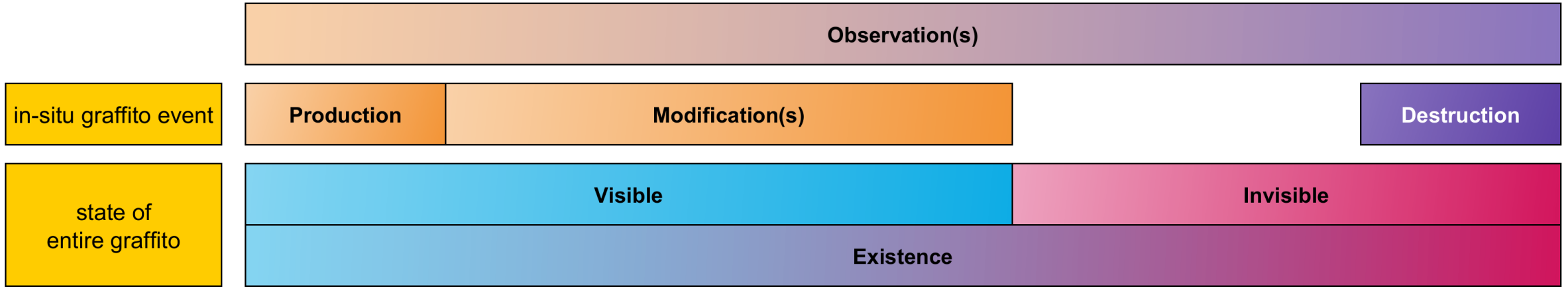

```
"visible": {
  "start": {                    "end": {                    "span": {
```

STORING time



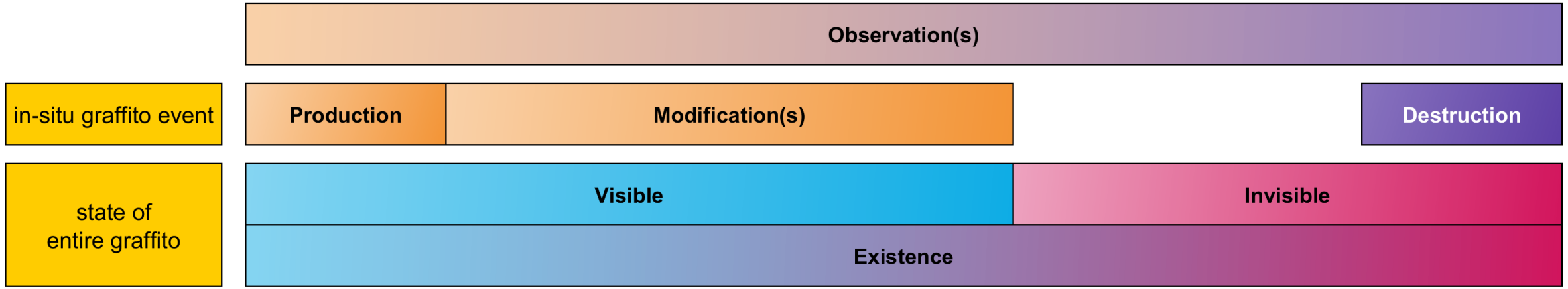

```
"visible": {
  "start": {                    "end": {                    "span": {
    "earliest":
    "earliest_source":
    "latest":
    "latest_source":
  },
```

STORING time




```
"visible": {
  "start": {
    "earliest":
    "earliest_source":
    "latest":
    "latest_source":
  },
"end": {
  "earliest":
  "earliest_source":
  "latest":
  "latest_source":
},
"span": {
```

STORING time




```
"visible": {
  "start": {
    "earliest":
    "earliest_source":
    "latest":
    "latest_source":
  },
"end": {
  "earliest":
  "earliest_source":
  "latest":
  "latest_source":
},
"span": {
  "minimum":
  "maximum":
}
```

STORING time




```
"visible": {
  "start": {
    "earliest":
    "earliest_source":
    "latest":
    "latest_source":
  },
```

```
"end": {
  "earliest":
  "earliest_source":
  "latest":
  "latest_source":
},
```

```
"span": {
  "minimum":
  "maximum":
}
```

STORING time






```
"visible": {
  "start": {
    "earliest":
    "earliest_source":
    "latest":
    "latest_source":
  },
```

```
"end": {
  "earliest":
  "earliest_source":
  "latest":
  "latest_source":
},
```

```
"span": {
  "minimum":
  "maximum":
}
```

STORING time








```
"visible": {
  "start": {
    "earliest":
    "earliest_source":
    "latest":
    "latest_source":
  },
"end": {
  "earliest":
  "earliest_source":
  "latest":
  "latest_source":
},
"span": {
  "minimum":
  "maximum":
}
```

STORING time




```
"visible": {
  "start": {
    "earliest":
    "earliest_source":
    "latest":
    "latest_source":
  },
"end": {
  "earliest":
  "earliest_source":
  "latest":
  "latest_source":
},
"span": {
  "minimum":
  "maximum":
}
```

STORING time




```
"visible": {
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    "earliest":
    "earliest_source":
    "latest":
    "latest_source":
  },
"end": {
    "earliest":
    "earliest_source":
    "latest":
    "latest_source":
  },
"span": {
    "minimum":
    "maximum":
  }
```

STORING time




```
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    "latest_source": "photoTour"   "latest_source":
  },                            },
```

STORING time




```
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    "earliest": "2022-09-05T10:20",     "earliest":                       "minimum":
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    "latest": "2022-09-12T12:36",       "latest":                       }
    "latest_source": "photoTour"        "latest_source":
  },                                  },
```

STORING time




```
"visible": {
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    "latest_source": "photoTour"
  },
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                      "latest":
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                    },
                                        "span": {
                                          "minimum":
                                          "maximum":
                                        }
```

STORING time




```
"visible": {
  "start": {
    "earliest": "2022-09-05T10:20",
    "earliest_source": "photoTour",
    "latest": "2022-09-12T12:36",
    "latest_source": "photoTour"
  },
  "end": {
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    "earliest_source": "photoTour",
    "latest": "2022-09-21T17:05",
    "latest_source": "photoTour"
  },
  "span": {
    "minimum":
    "maximum":
  }
```

STORING time




```
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    "latest": "2022-09-12T12:36",
    "latest_source": "photoTour"
  },
                    "end": {
                      "earliest": "2022-09-14T09:45",
                      "earliest_source": "photoTour",
                      "latest": "2022-09-21T17:05",
                      "latest_source": "photoTour"
                    },
                                        "span": {
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                                          "maximum":
                                        }
```

STORING time




```
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    "earliest_source": "photoTour",
    "latest": "2022-09-12T12:36",
    "latest_source": "photoTour"
  },
"end": {
    "earliest": "2022-09-14T09:45",
    "earliest_source": "photoTour",
    "latest": "2022-09-21T17:05",
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  },
"span": {
    "minimum": "PT45H9M",
    "maximum": "PT390H45M"
  }
```

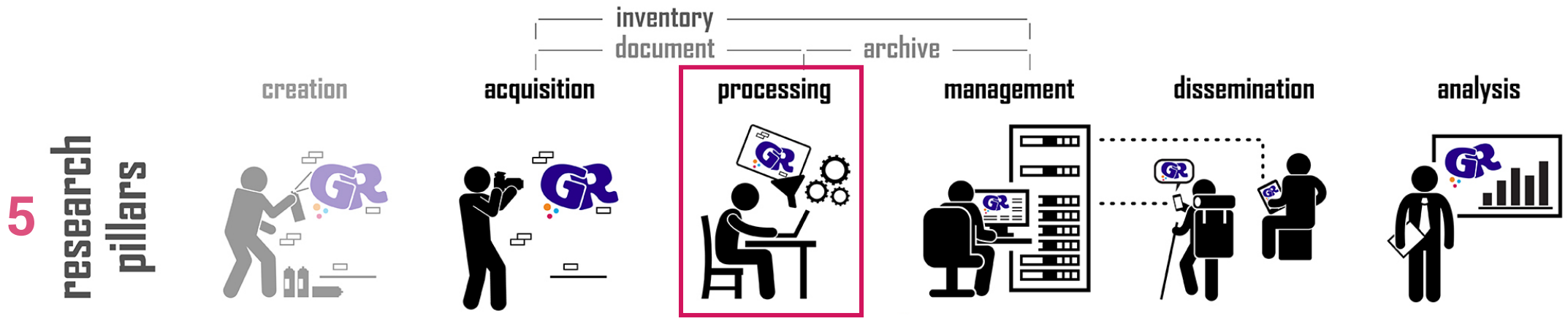
SOME results

GRAFFITI *LOCATION*

GRAFFITI *TEMPORALITY*

GRAFFITI *TERMINOLOGY*

GRAFFITI *CHARACTERISATION*



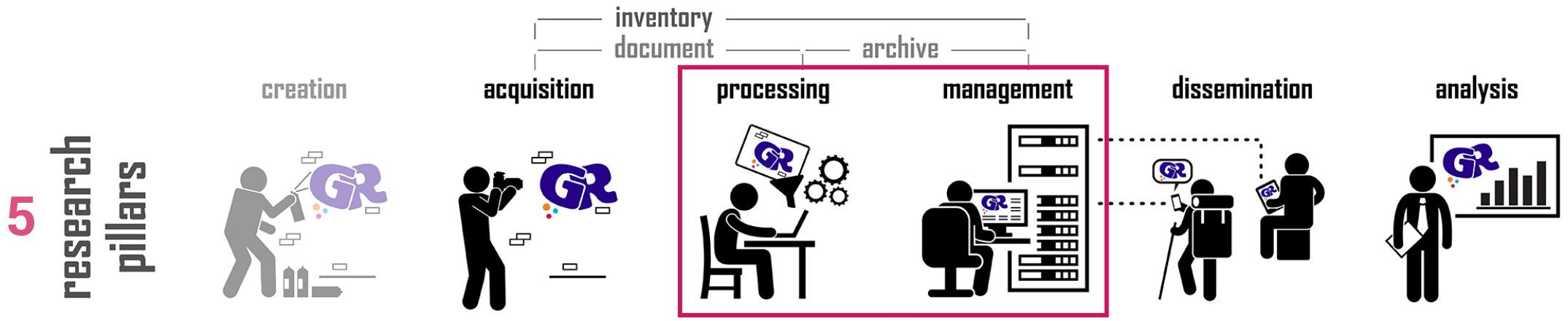
SOME results

GRAFFITI *LOCATION*

GRAFFITI *TEMPORALITY*

GRAFFITI *TERMINOLOGY*

GRAFFITI *CHARACTERISATION*



COOLPI

COOLPI

colour-accurate pixels



GraffitiProjectINDIGO / COOLPI Public

Notifications Fork 1 Star 4

Code Issues Pull requests Actions Projects Security Insights

main 1 branch 0 tags Go to file Code

amolada Add files via upload 0bbf6c3 on Oct 20, 2022 155 commits

dist	Add files via upload	9 months ago
docs	Add files via upload	9 months ago
graffiti_image_processing	Add files via upload	9 months ago
notebooks	Add files via upload	10 months ago
src	Add files via upload	9 months ago
tests/coolpi-gui-test	Add files via upload	10 months ago
wpp_data	Add files via upload	10 months ago
LICENSE	Initial commit	last year
LICENSE.txt	Add files via upload	9 months ago
MANIFEST.in	Add files via upload	9 months ago
README.md	Add files via upload	9 months ago
pyproject.toml	Add files via upload	9 months ago

README.md

COOLPI

Description

COlour Operations Library for Processing Images (COOLPI) is an open-source toolbox programmed in Python for the treatment of colorimetric and spectral data. It includes classes, methods and functions developed and tested following the colorimetric standards published by the Commission Internationale de l'Éclairage (CIE, 2018).

The COOLPI package has been developed as part of the INDIGO project (IN-ventory and DI-sseminate G-raffiti along the d-O-naukanal) carried out by the Ludwig Boltzmann Institute for Archaeological Prospection and Virtual Archaeology in close collaboration with the GEO Department of TU Wien University.

The achievement of colour-accurate digital images is one of the primary research topics within the INDIGO project. Therefore, the COOLPI package also includes specific procedures for digital image processing and colour correction, particularly from images in RAW format.

About

COlour Operations Library for Processing Images

Readme
GPL-3.0, GPL-3.0 licenses found
4 stars
0 watching
1 fork
Report repository

Releases

No releases published

Packages

No packages published

Contributors 2

amolada Adolfo Molada Tebar
BeyondConventionalBoundaries Geert ...

Languages

Jupyter Notebook 98.1% Python 1.9%

COOLPI

colour-accurate pixels

COOLPI

HUEnique
colour determination

HUEnique



HUEnique
colour determination

HUEnique



HUEnique
colour determination

HUEnique



HUEnique
colour determination

HUEnique



HUEnique
colour determination

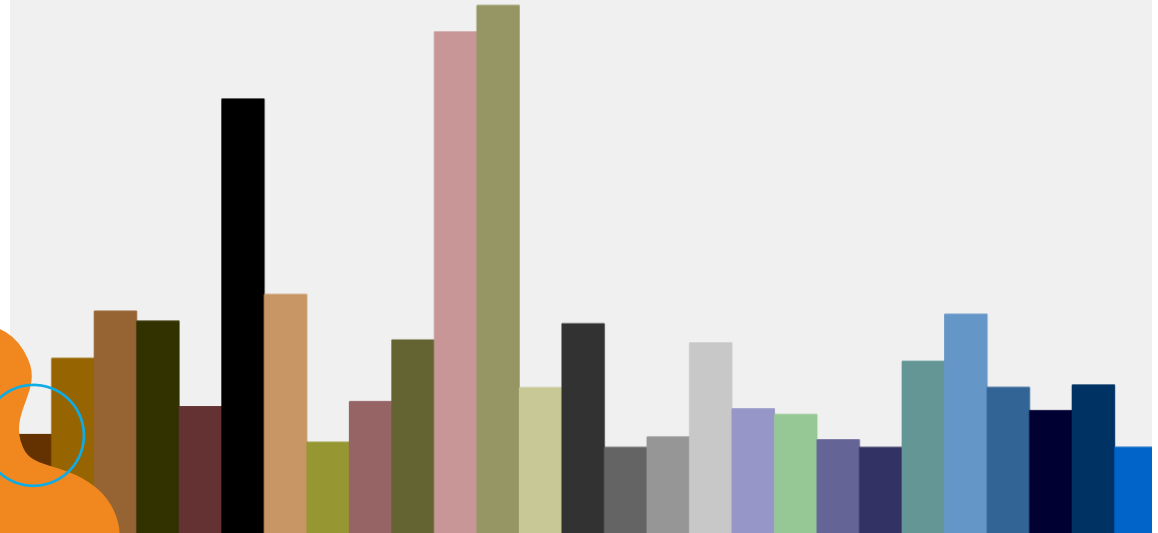
HUEnique



HUEnique
colour determination

HUEnique





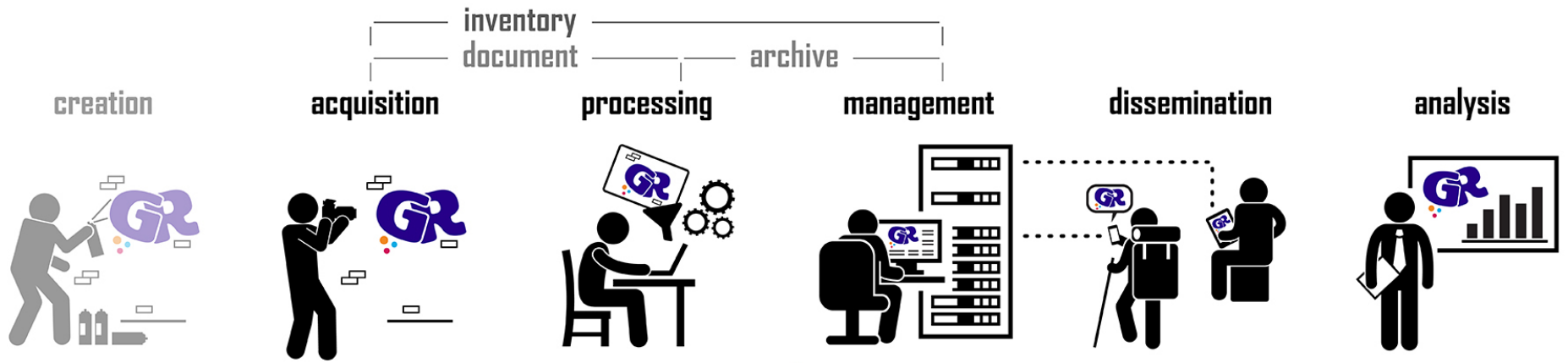
HUEnique
colour determination

HUEnique

GRAFFITI metadata

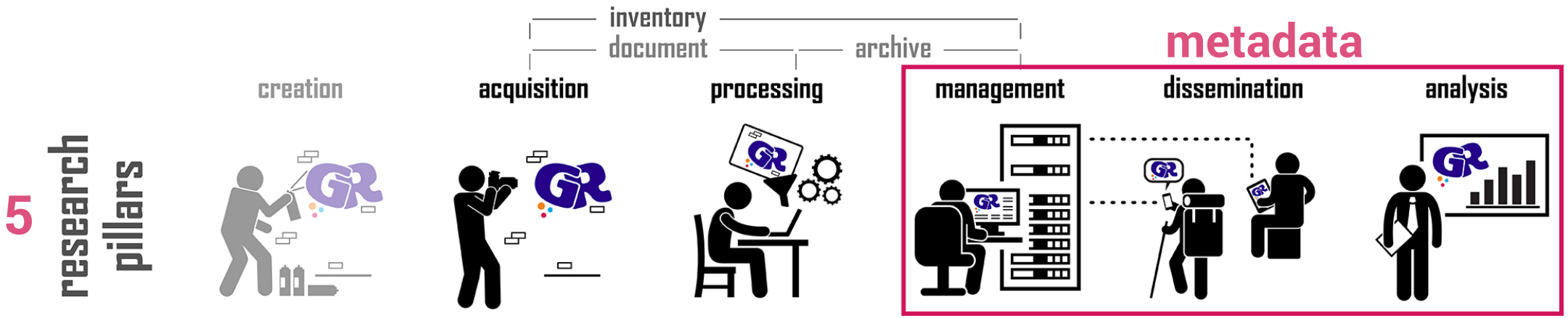
GRAFFITI *LOCATION*
GRAFFITI *TEMPORALITY*
GRAFFITI *TERMINOLOGY*
GRAFFITI *CHARACTERISATION*

5 research pillars



GRAFFITI metadata

GRAFFITI *LOCATION*
GRAFFITI *TEMPORALITY*
GRAFFITI *TERMINOLOGY*
GRAFFITI *CHARACTERISATION*



INDIGO METADATA

real graffito
vs
digital derivatives

GRAFFITI metadata



16 June 2023 @ 10:25 CET



photo | ~~graffito~~
creation event
date + time



© Sophie Hay



date + time
creation event
photo | ~~graffito~~

INDIGO METADATA

real graffito
vs
digital derivatives

GRAFFITI metadata

author

photo | ~~graffito~~
creation event
date + time



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date + time
creation event
photo | ~~graffito~~

author

INDIGO METADATA

real graffito
vs
digital derivatives

GRAFFITI metadata

location

author

photo | ~~graffito~~
creation event
date + time



© Sophie Hay



16 June 2023 @ 10:25 CET





date + time
creation event
photo | ~~graffito~~

author

location



INDIGO
core division



INDIGO
core division

real graffito
physical resource



INDIGO
core division

real graffito
physical resource

approximations
digital resources



INDIGO
core division

real graffito
physical resource

approximations
digital resources

digital photos

textured 3D models

orthophotographs

polygons



INDIGO
core division

real graffito
physical resource

approximations
digital resources

digital photos

textured 3D models

orthophotographs

polygons

metadata

metadata



INDIGO
core division

real graffito
physical resource

approximations
digital resources

digital photos

textured 3D models

orthophotographs

polygons

metadata ⇦ metadata



INDIGO
core division

real graffito

digital resources

digital photos

textured 3D models

orthophotographs

polygons

metadata



INDIGO
core division

real graffito

digital resources

digital photos

textured 3D models

orthophotographs

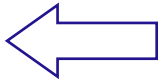
polygons

metadata

database

GRAFFITI metadata

INDIGO metadata (physical graffito)	
Category Level	**Category Name**
1	**Descriptive metadata**
1.1	Core metadata
1.2	Locational metadata
1.3	Temporal metadata
1.4	Contentual / aboutness metadata
1.5	Formal / appearance metadata
2	**Administrative metadata**
2.1	Rights metadata
2.2	Access metadata
2.3	Technical metadata
3	**Structural metadata**
3.1	Origin relationships
3.2	Graffiti ensemble relationships
3.2	Spatio-temporal relationships



metadata

GRAFFITI metadata

***graffito*-level**

***image*-level**



GRAFFITI metadata

graffito-level

identifier = INDIGO_2023_000512



image-level

identifier: INDIGO_2023-04-12_Z7ii-B_0685.jpg

GRAFFITI metadata

graffito-level

identifier = INDIGO_2023_000512
author: WOX INK



image-level

identifier: INDIGO_2023-04-12_Z7ii-B_0685.jpg
author: Stefan Wogrin

GRAFFITI metadata

graffito-level

identifier = INDIGO_2023_000512
author: WOX INK
creation date: between 2023-04-05T10:34
and 2023-04-12T11:55



image-level

identifier: INDIGO_2023-04-12_Z7ii-B_0685.jpg
author: Stefan Wogrin
creation date: 2023-04-12T11:55

GRAFFITI metadata

graffito-level

identifier = INDIGO_2023_000512
author: WOX INK
creation date: between 2023-04-05T10:34
and 2023-04-12T11:55
location: 48.21886° N, 16.37085° E (EPSG:4326)



image-level

identifier: INDIGO_2023-04-12_Z7ii-B_0685.jpg
author: Stefan Wogrin
creation date: 2023-04-12T11:55
location: 48.21882° N, 16.37079° E (EPSG:4326)

GRAFFITI metadata

graffito-level

identifier = INDIGO_2023_000512
author: WOX INK
creation date: between 2023-04-05T10:34
and 2023-04-12T11:55
location: 48.21886° N, 16.37085° E (EPSG:4326)



image-level

identifier: INDIGO_2023-04-12_Z7ii-B_0685.jpg
author: Stefan Wogrin
creation date: 2023-04-12T11:55
location: 48.21882° N, 16.37079° E (EPSG:4326)

GRAFFITI metadata

graffito-level

identifier = INDIGO_2023_000512
author: WOX INK
creation date: between 2023-04-05T10:34
and 2023-04-12T11:55
location: 48.21886° N, 16.37085° E (EPSG:4326)
technique = aerosol painting
style: angel character with slogan and tag
colours = black, yellow, grey, white



image-level

identifier: INDIGO_2023-04-12_Z7ii-B_0685.jpg
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creation date: 2023-04-12T11:55
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image-level

identifier: INDIGO_2023-04-12_Z7ii-B_0685.jpg
author: Stefan Wogrin
creation date: 2023-04-12T11:55
location: 48.21882° N, 16.37079° E (EPSG:4326)
camera: Nikon Z7ii
shutter speed: 1/200 s

GRAFFITI metadata

graffito-level

identifier = INDIGO_2023_000512
author: WOX INK
creation date: between 2023-04-05T10:34
and 2023-04-12T11:55
location: 48.21886° N, 16.37085° E (EPSG:4326)
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image-level

identifier: INDIGO_2023-04-12_Z7ii-B_0685.jpg
author: Stefan Wogrin
creation date: 2023-04-12T11:55
location: 48.21882° N, 16.37079° E (EPSG:4326)
camera: Nikon Z7ii
shutter speed: 1/200 s
graffito depicted: INDIGO_2023_000512

GRAFFITI metadata

graffito-level

identifier = INDIGO_2023_000512
author: WOX INK
creation date: between 2023-04-05T10:34
and 2023-04-12T11:55
location: 48.21886° N, 16.37085° E (EPSG:4326)
technique = aerosol painting
style: angel character with slogan and tag
colours = black, yellow, grey, white

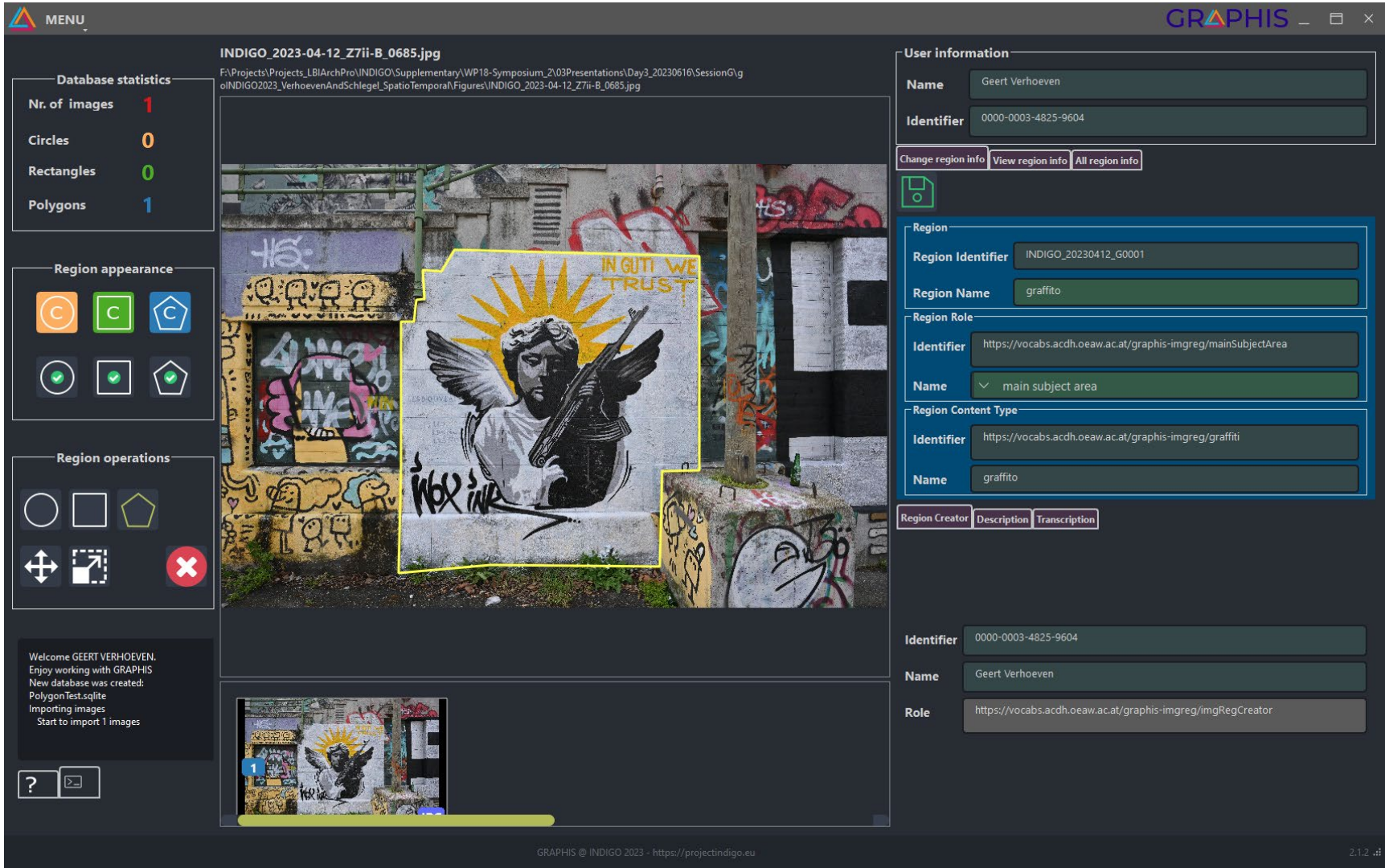


image-level

identifier: INDIGO_2023-04-12_Z7ii-B_0685.jpg
author: Stefan Wogrin
creation date: 2023-04-12T11:55
location: 48.21882° N, 16.37079° E (EPSG:4326)
camera: Nikon Z7ii
shutter speed: 1/200 s
graffito depicted: INDIGO_2023_000512

GRAFFITI metadata

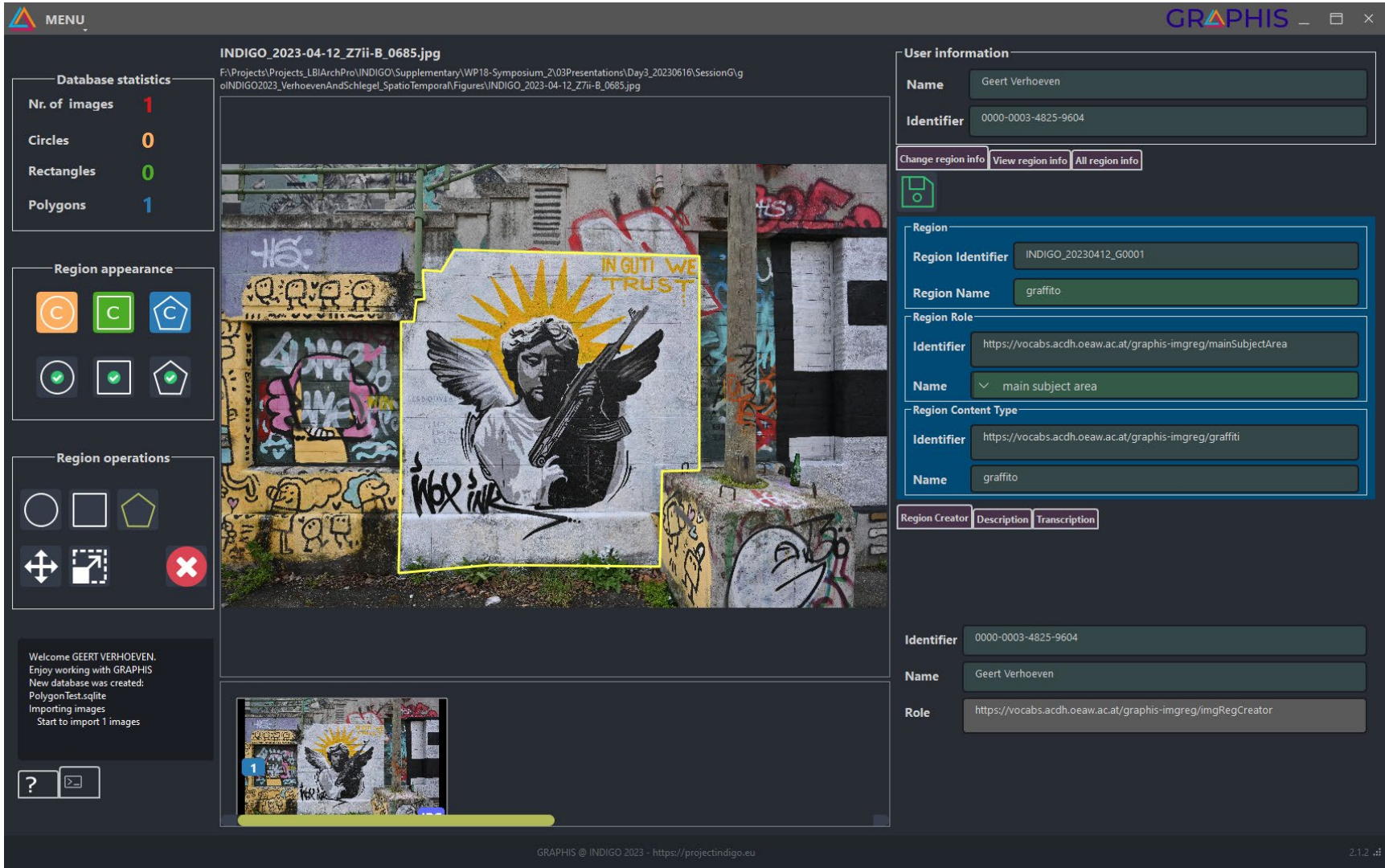
GRAPHIS



GRAFFITI metadata

GRAPHIS

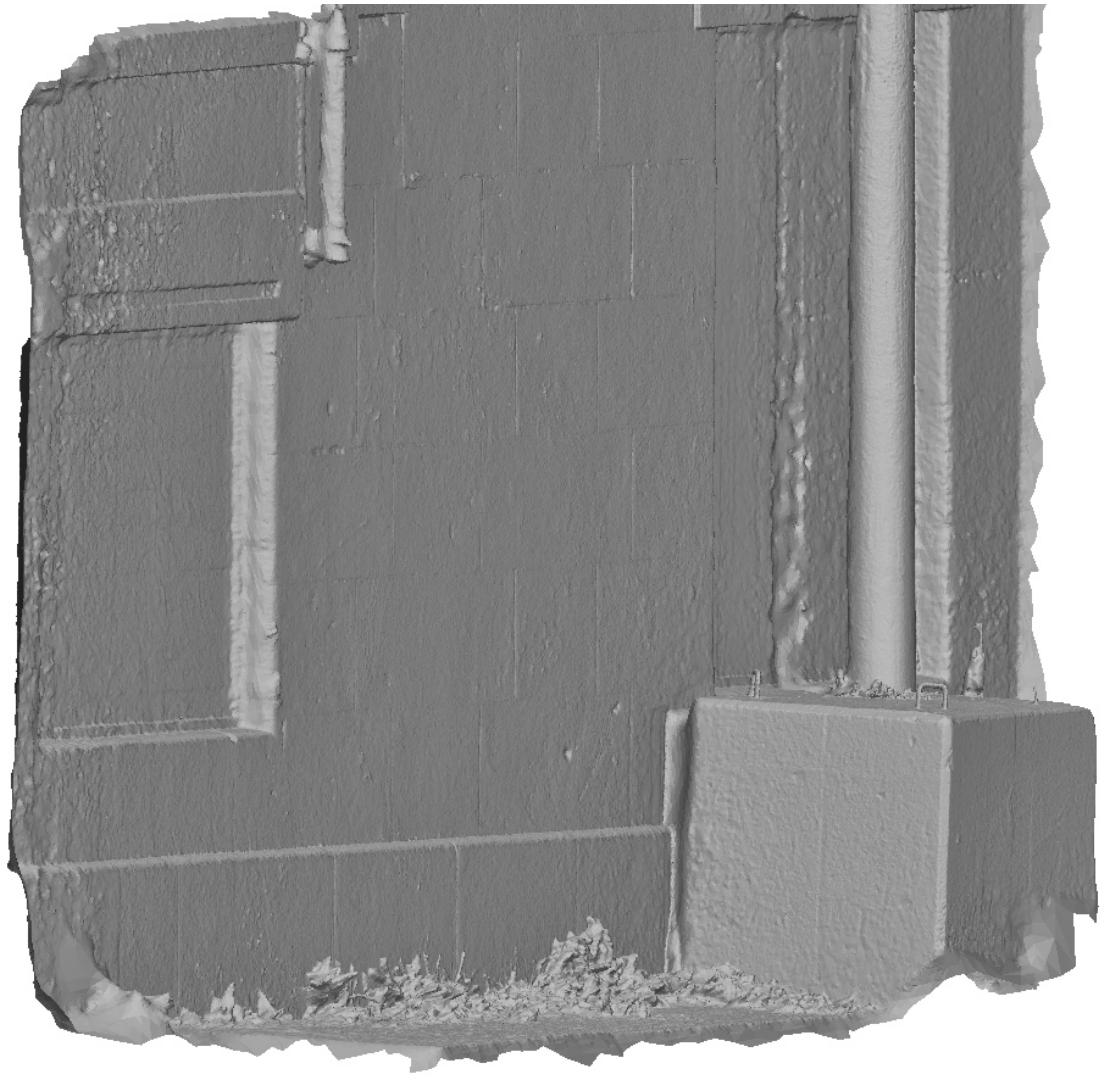
2D polygon (pixel coordinates)



GRAFFITI metadata

GRAPHIS

2D polygon (pixel coordinates)



AUTOGRAF

GRAFFITI metadata

GRAPHIS

2D polygon (pixel coordinates)



AUTOGRAF



GRAFFITI metadata

GRAPHIS

2D polygon (pixel coordinates)



AUTOGRAF



GRAFFITI metadata

GRAPHIS

2D polygon (pixel coordinates)

AUTOGRAF

3D polyline (real-world coordinates)



GRAFFITI metadata

graffito-level

identifier = INDIGO_2023_000512
author: WOX INK
creation date: between 2023-04-05T10:34
and 2023-04-12T11:55
location: 48.21886° N, 16.37085° E (EPSG:4326)
technique = aerosol painting
style: angel character with slogan and tag
colours = black, yellow, grey, white
area: 3.5 m²



image-level

identifier: INDIGO_2023-04-12_Z7ii-B_0685.jpg
author: Stefan Wogrin
creation date: 2023-04-12T11:55
location: 48.21882° N, 16.37079° E (EPSG:4326)
camera: Nikon Z7ii
shutter speed: 1/200 s
graffito visible: INDIGO_2023_000512

GRAFFITI metadata

graffito-level

identifier = INDIGO_2023_000512
author: WOX INK
creation date: between 2023-04-05T10:34
and 2023-04-12T11:55
location: 48.21886° N, 16.37085° E (EPSG:4326)
technique = aerosol painting
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image-level

identifier: INDIGO_2023-04-12_Z7ii-B_0685.jpg
author: Stefan Wogrin
creation date: 2023-04-12T11:55
location: 48.21882° N, 16.37079° E (EPSG:4326)
camera: Nikon Z7ii
shutter speed: 1/200 s
graffito visible: INDIGO_2023_000512

SOME results

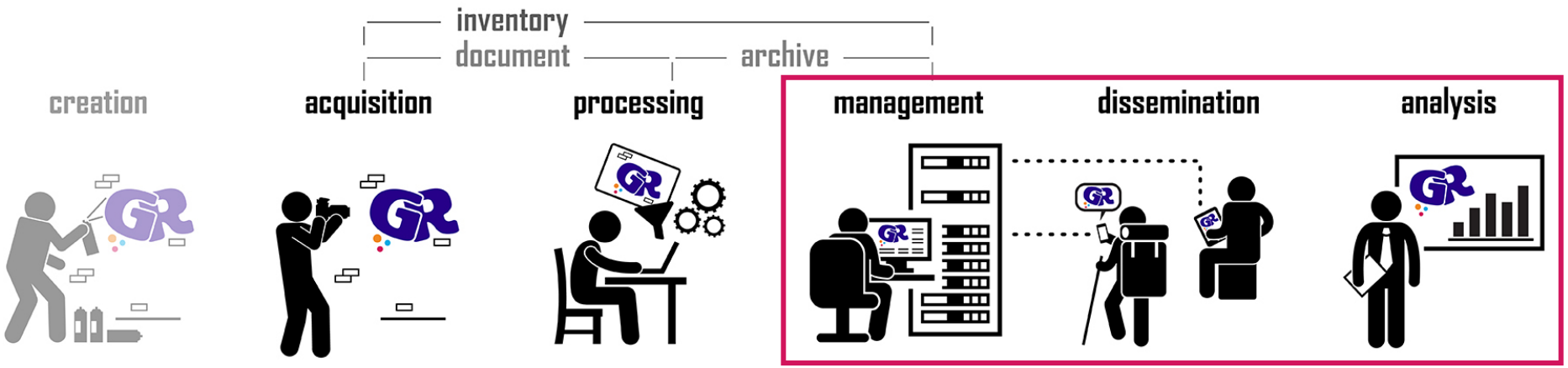
GRAFFITI *LOCATION*

GRAFFITI *TEMPORALITY*

GRAFFITI *TERMINOLOGY*

GRAFFITI *CHARACTERISATION*

5 research pillars



UNIFORM terminology

TERMINOLOGY & HIERARCHY



UNIFORM terminology

TERMINOLOGY & HIERARCHY

Graffiti ? Street Art ?



UNIFORM terminology

TERMINOLOGY & HIERARCHY

Graffiti ? Street Art ?



UNIFORM terminology

TERMINOLOGY & HIERARCHY

Graffiti ? Street Art ?



UNIFORM terminology

TERMINOLOGY & HIERARCHY

Graffiti ? Street Art ?

Graffiti
|___ Street Art



UNIFORM terminology

TERMINOLOGY & HIERARCHY

Graffiti ? Street Art ?

Graffiti
|___ Street Art

Street Art
|___ Graffiti



UNIFORM terminology

TERMINOLOGY & HIERARCHY

Graffiti ? Street Art ?

Graffiti
|___ Street Art

Street Art
|___ Graffiti

Graffiti | Street Art



UNIFORM terminology

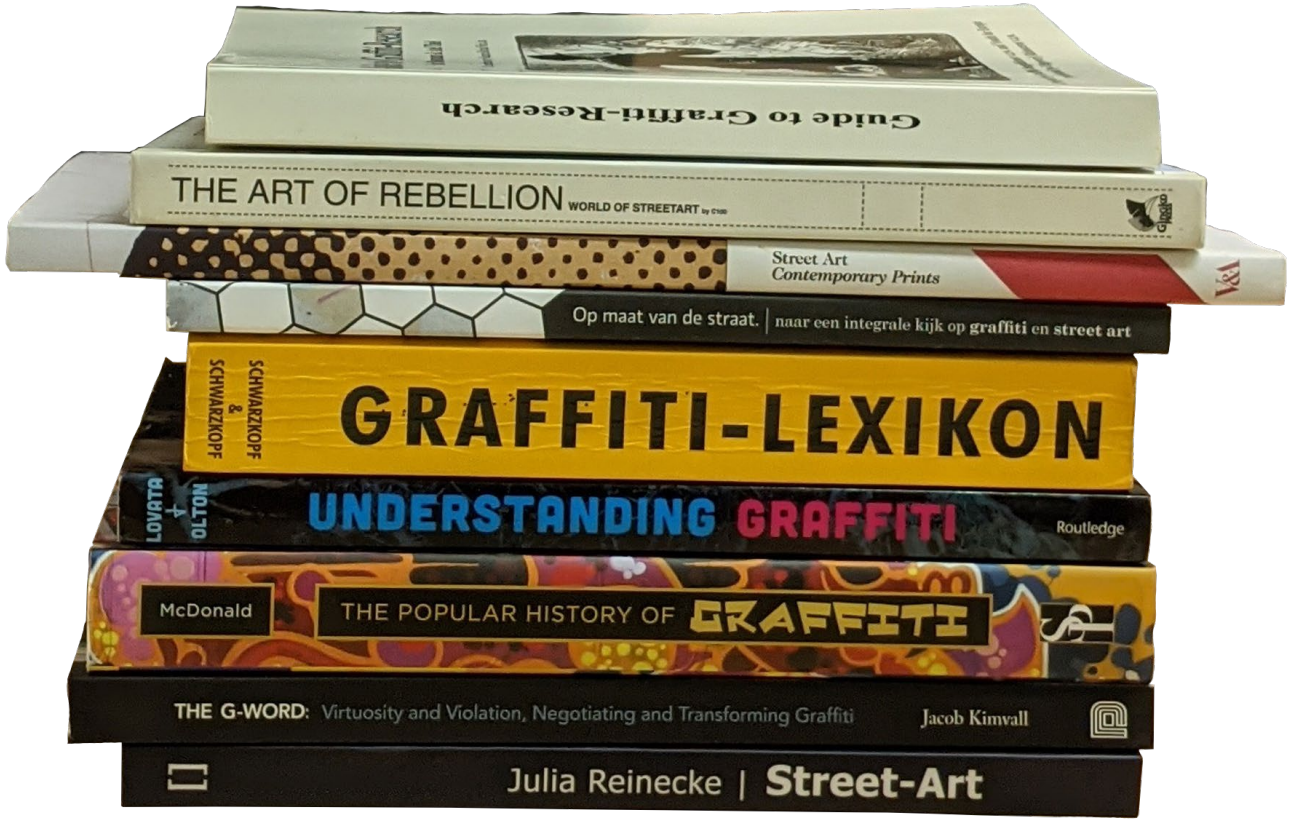
TERMINOLOGY & HIERARCHY

Graffiti ? Street Art ?

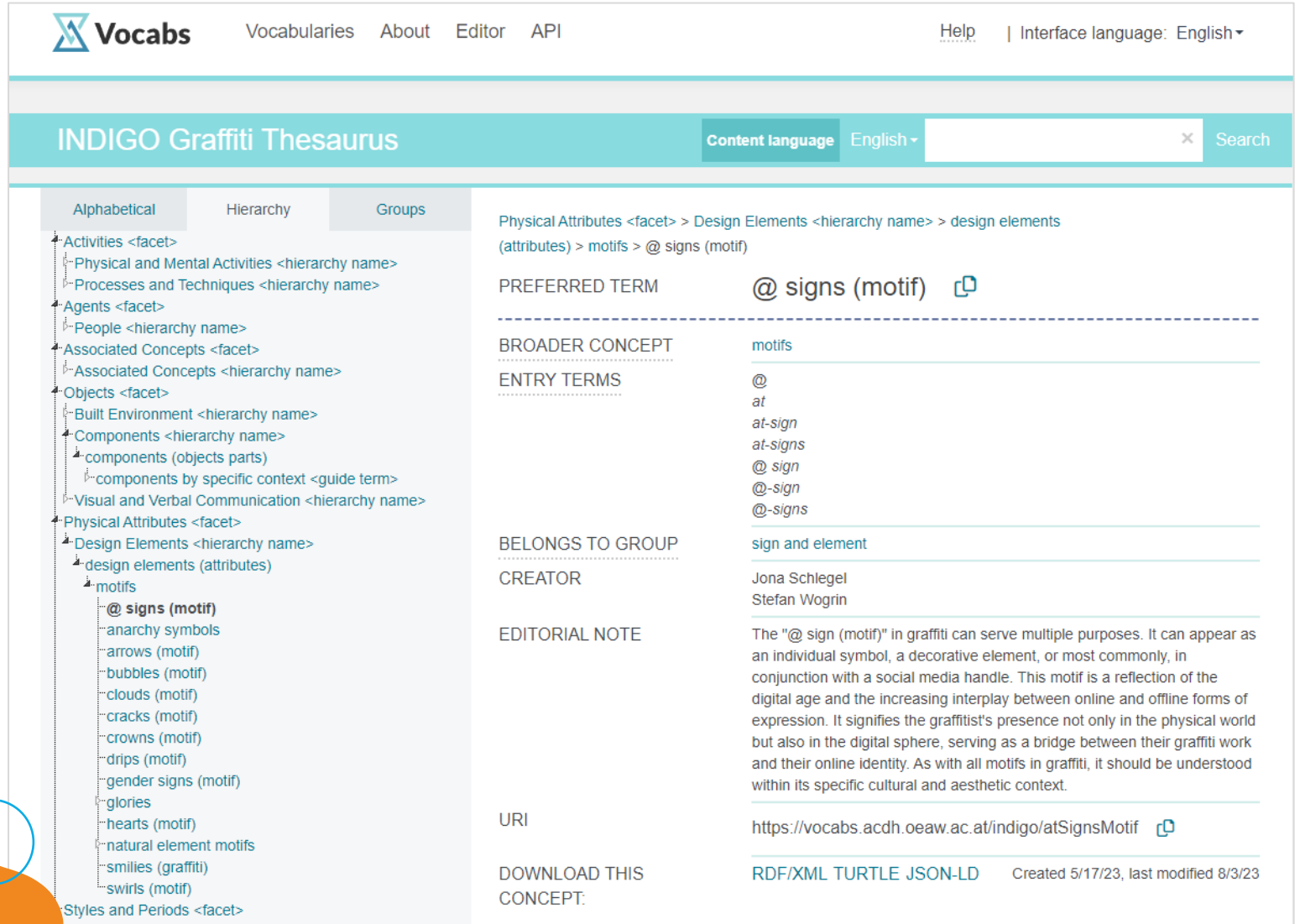
Graffiti
|___ Street Art

Street Art
|___ Graffiti

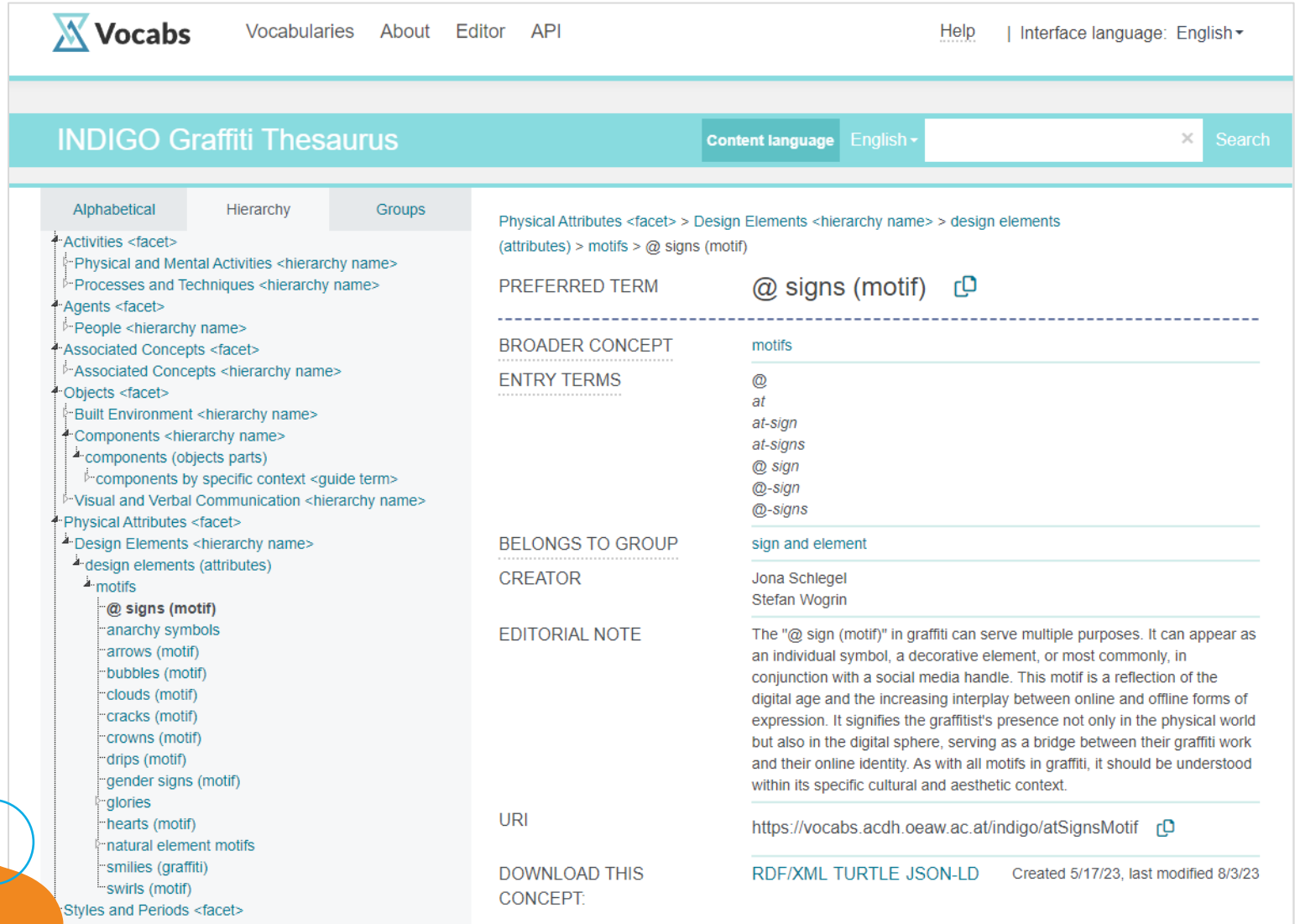
Graffiti | Street Art



GRAFFITI thesaurus

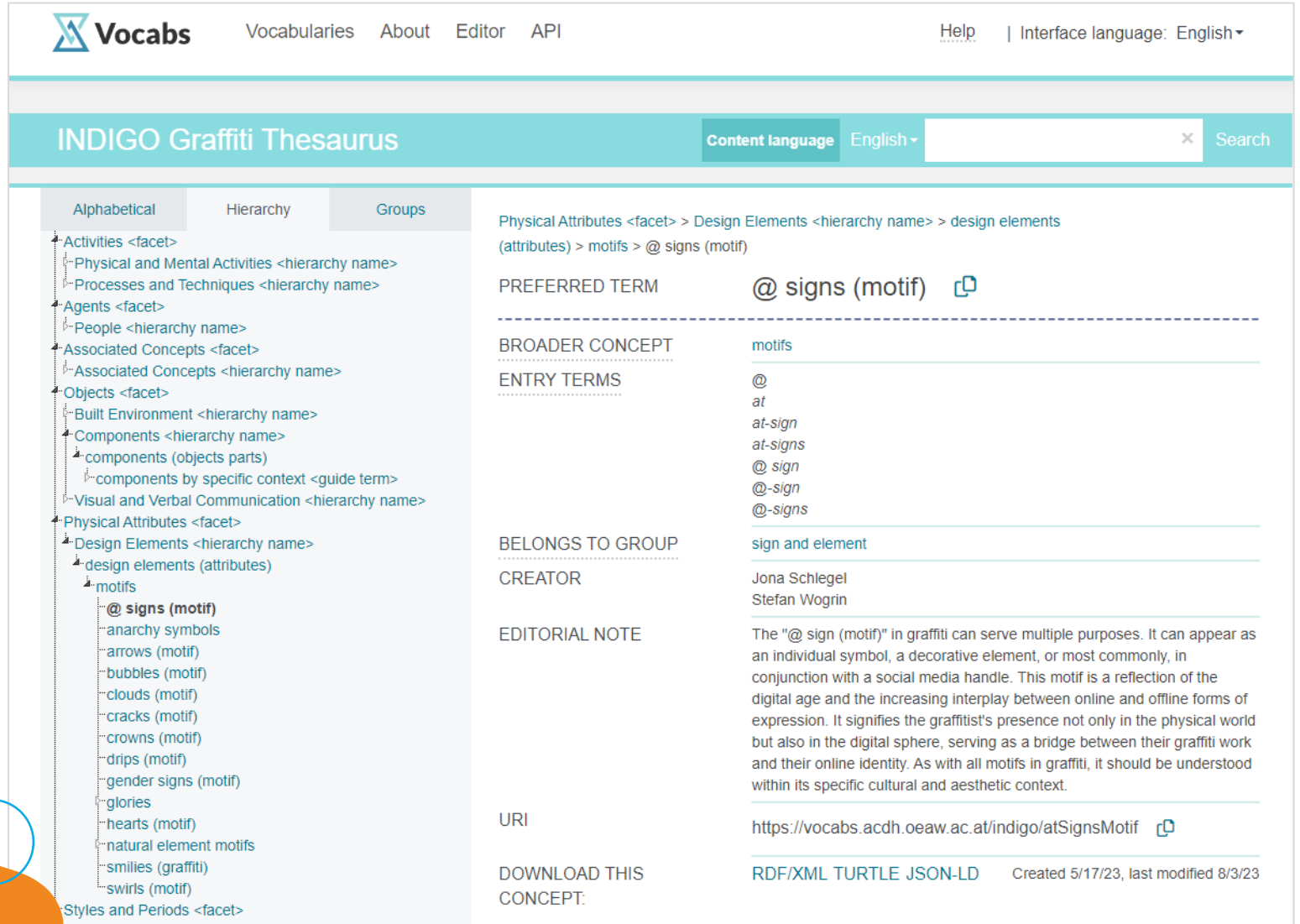


GRAFFITI thesaurus



Hierarchy

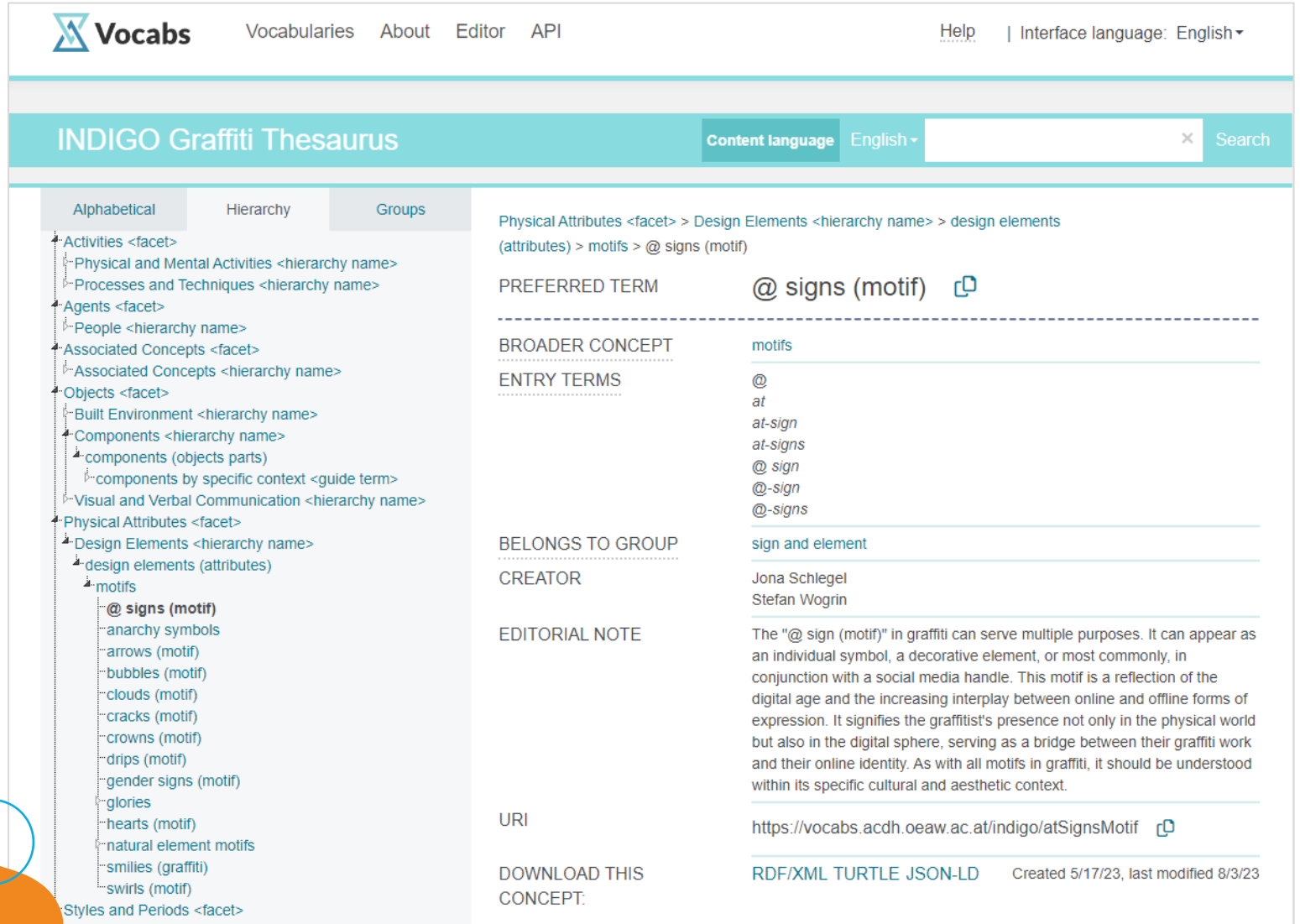
GRAFFITI thesaurus



Hierarchy

Synonyms & preferred terms

GRAFFITI thesaurus

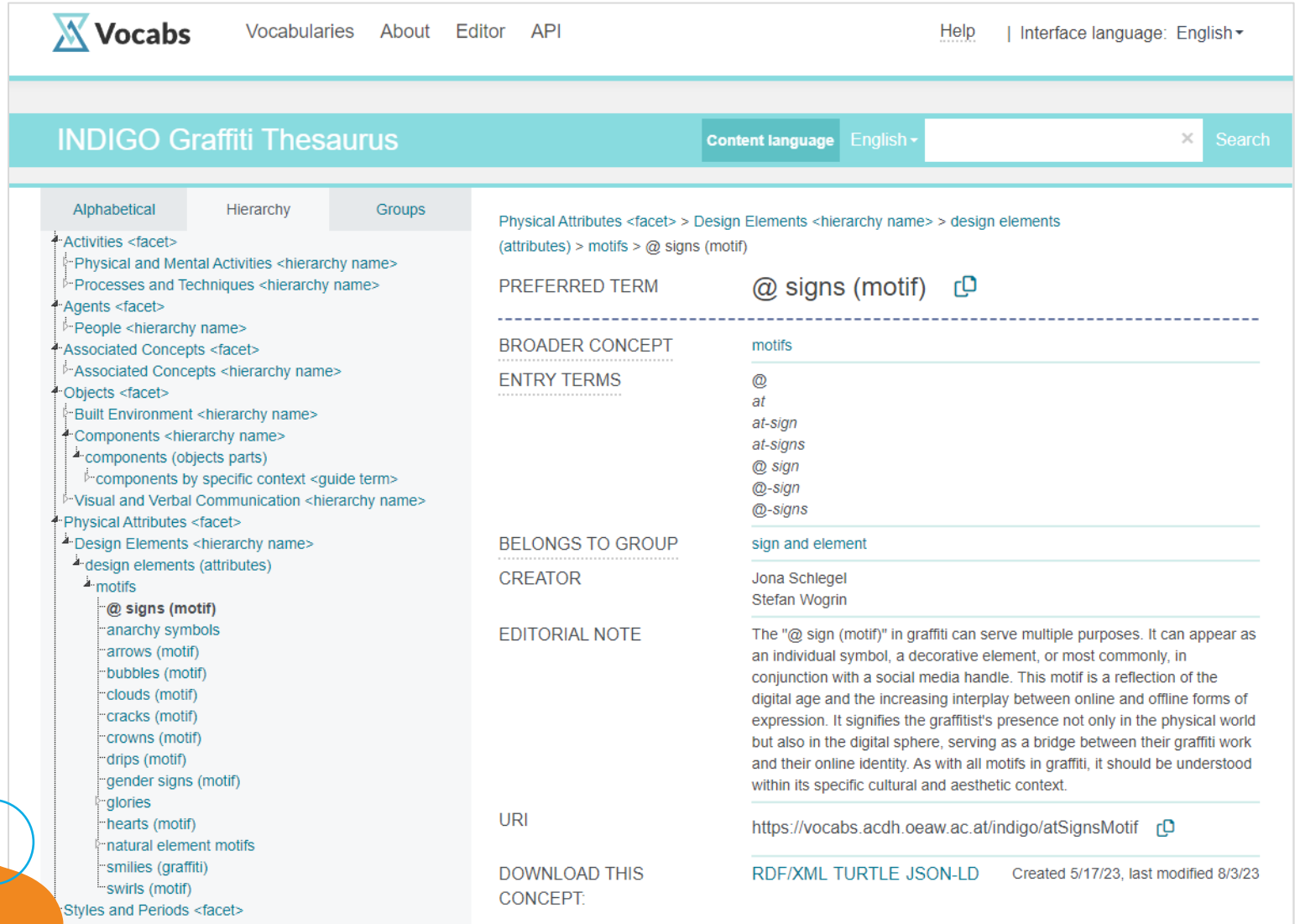


Hierarchy

Synonyms & preferred terms

URI

GRAFFITI thesaurus



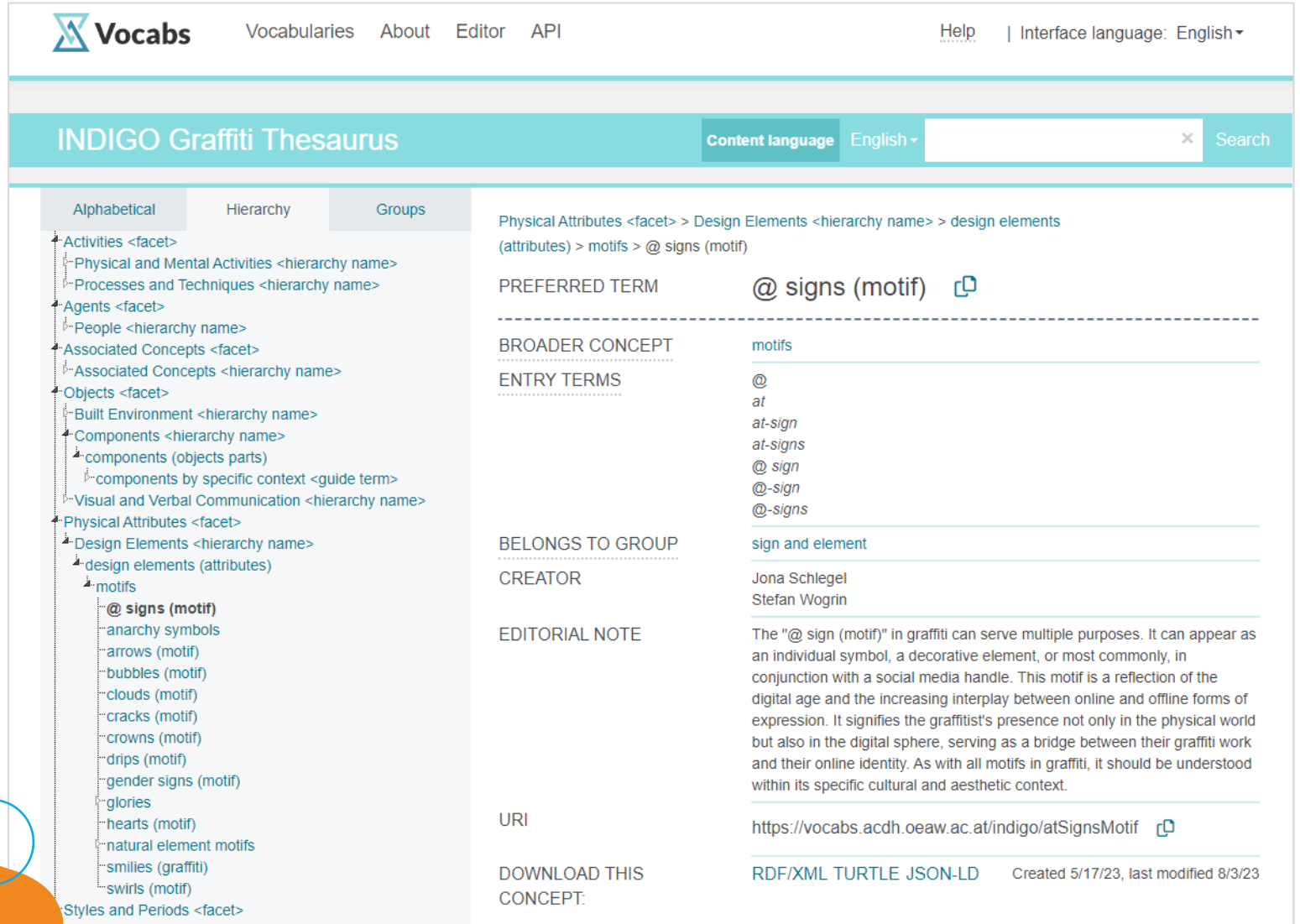
Hierarchy

Synonyms & preferred terms

URI

Semantic Web

GRAFFITI thesaurus



Hierarchy

Synonyms & preferred terms

URI

Semantic Web

Structure → Getty Art & Architecture Thesaurus

DISSEMINATION scientific audience

DISSEMINATION scientific audience

AUTOGRAF

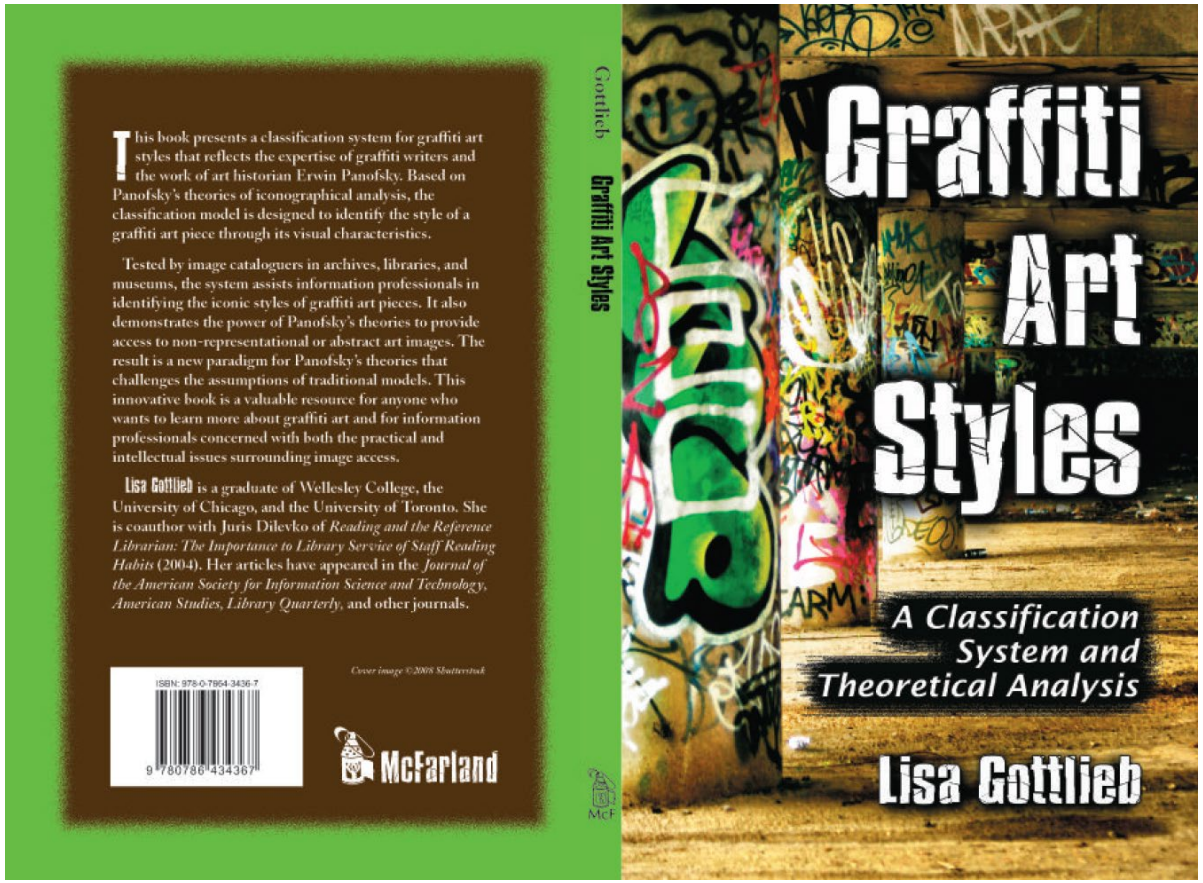
COOLPIR

GRAPHIS

SOFTWARE

3+

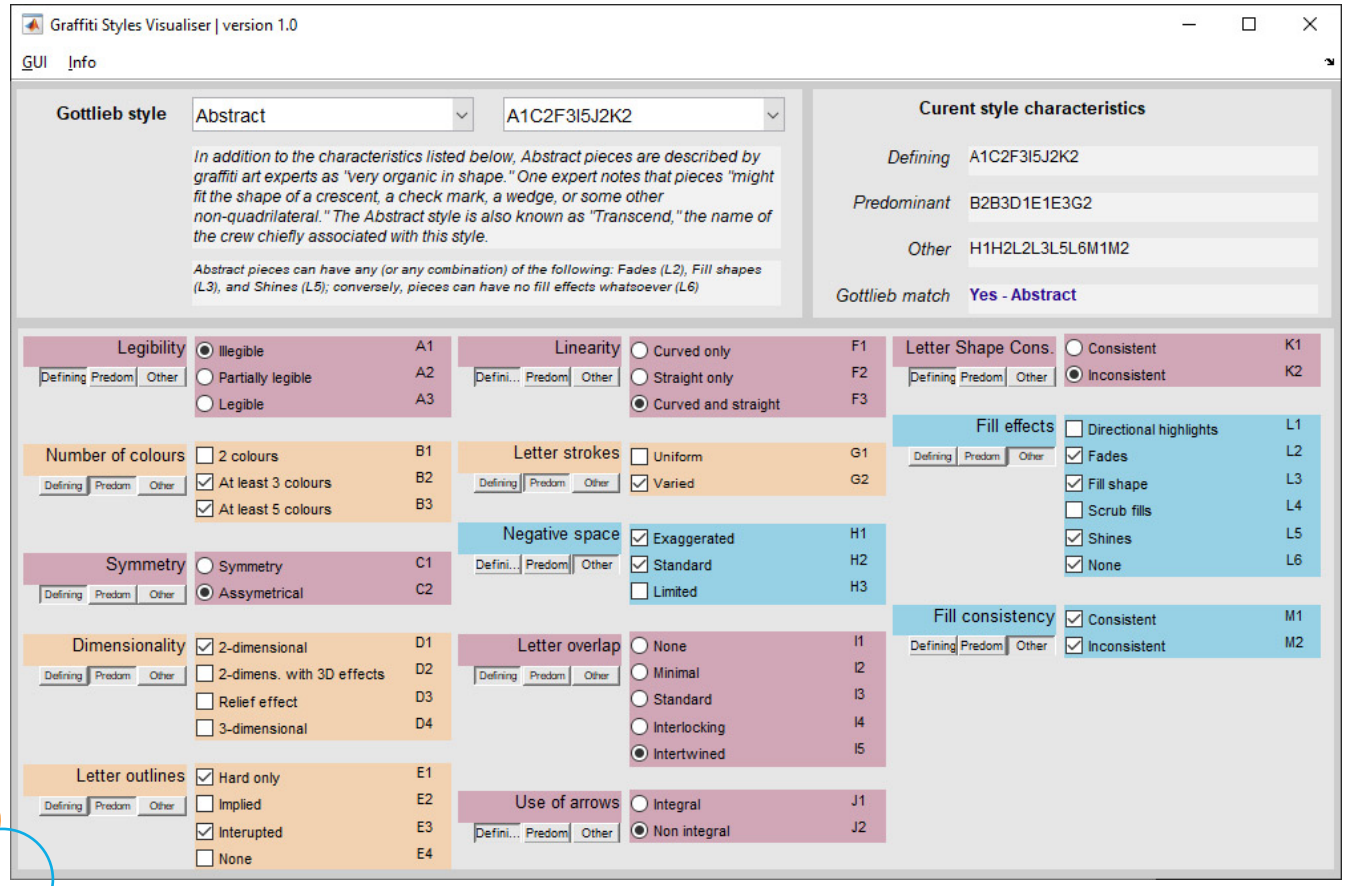
DISSEMINATION scientific audience



SOFTWARE

3+

DISSEMINATION scientific audience



SOFTWARE

3+

DISSEMINATION scientific audience



SOFTWARE

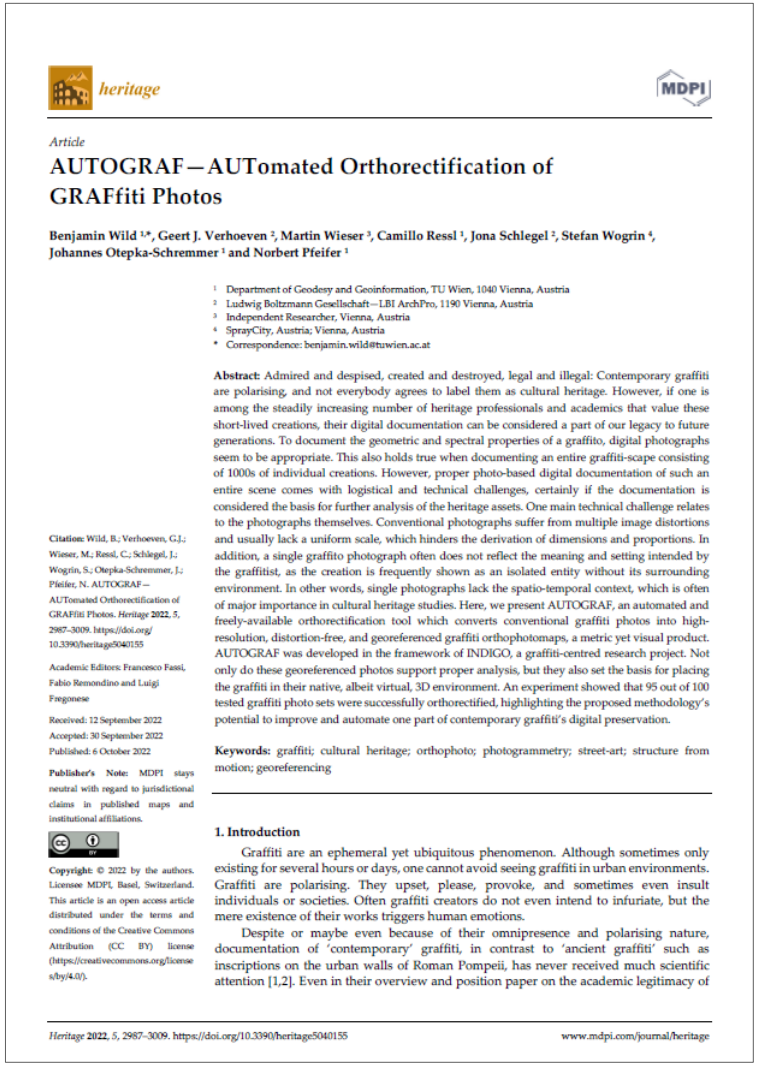
3+

HARDWARE

1

DISSEMINATION scientific audience

Heritage *[open-access]*



heritage

MDPI

Article

AUTOGRAF—AUTomated Orthorectification of GRAFfiti Photos

Benjamin Wild [1,*], Geert J. Verhoeven [2], Martin Wieser [3], Camillo Ressl [1], Jona Schlegel [2], Stefan Wogrin [4], Johannes Otepka-Schremmer [1] and Norbert Pfeifer [1]

[1] Department of Geodesy and Geoinformation, TU Wien, 1040 Vienna, Austria
[2] Ludwig Boltzmann Gesellschaft—LBI ArchPro, 1190 Vienna, Austria
[3] Independent Researcher, Vienna, Austria
[4] SprayCity, Austria; Vienna, Austria
* Correspondence: benjamin.wild@tuwien.ac.at

Abstract: Admired and despised, created and destroyed, legal and illegal: Contemporary graffiti are polarising, and not everybody agrees to label them as cultural heritage. However, if one is among the steadily increasing number of heritage professionals and academics that value these short-lived creations, their digital documentation can be considered a part of our legacy to future generations. To document the geometric and spectral properties of a graffito, digital photographs seem to be appropriate. This also holds true when documenting an entire graffiti-scape consisting of 1000s of individual creations. However, proper photo-based digital documentation of such an entire scene comes with logistical and technical challenges, certainly if the documentation is considered the basis for further analysis of the heritage assets. One main technical challenge relates to the photographs themselves. Conventional photographs suffer from multiple image distortions and usually lack a uniform scale, which hinders the derivation of dimensions and proportions. In addition, a single graffito photograph often does not reflect the meaning and setting intended by the graffitist, as the creation is frequently shown as an isolated entity without its surrounding environment. In other words, single photographs lack the spatio-temporal context, which is often of major importance in cultural heritage studies. Here, we present AUTOGRAF, an automated and freely-available orthorectification tool which converts conventional graffiti photos into high-resolution, distortion-free, and georeferenced graffiti orthophotomaps, a metric yet visual product. AUTOGRAF was developed in the framework of INDIGO, a graffiti-centred research project. Not only do these georeferenced photos support proper analysis, but they also set the basis for placing the graffiti in their native, albeit virtual, 3D environment. An experiment showed that 95 out of 100 tested graffiti photo sets were successfully orthorectified, highlighting the proposed methodology's potential to improve and automate one part of contemporary graffiti's digital preservation.

Keywords: graffiti; cultural heritage; orthophoto; photogrammetry; street-art; structure from motion; georeferencing

Citation: Wild, B.; Verhoeven, G.J.; Wieser, M.; Ressl, C.; Schlegel, J.; Wogrin, S.; Otepka-Schremmer, J.; Pfeifer, N. AUTOGRAF—AUTomated Orthorectification of GRAFfiti Photos. *Heritage* **2022**, *5*, 2987–3009. https://doi.org/10.3390/heritage5040155

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1. Introduction

Graffiti are an ephemeral yet ubiquitous phenomenon. Although sometimes only existing for several hours or days, one cannot avoid seeing graffiti in urban environments. Graffiti are polarising. They upset, please, provoke, and sometimes even insult individuals or societies. Often graffiti creators do not even intend to infuriate, but the mere existence of their works triggers human emotions.

Despite or maybe even because of their omnipresence and polarising nature, documentation of 'contemporary' graffiti, in contrast to 'ancient graffiti' such as inscriptions on the urban walls of Roman Pompeii, has never received much scientific attention [1,2]. Even in their overview and position paper on the academic legitimacy of

SOFTWARE

3+

ARTICLES

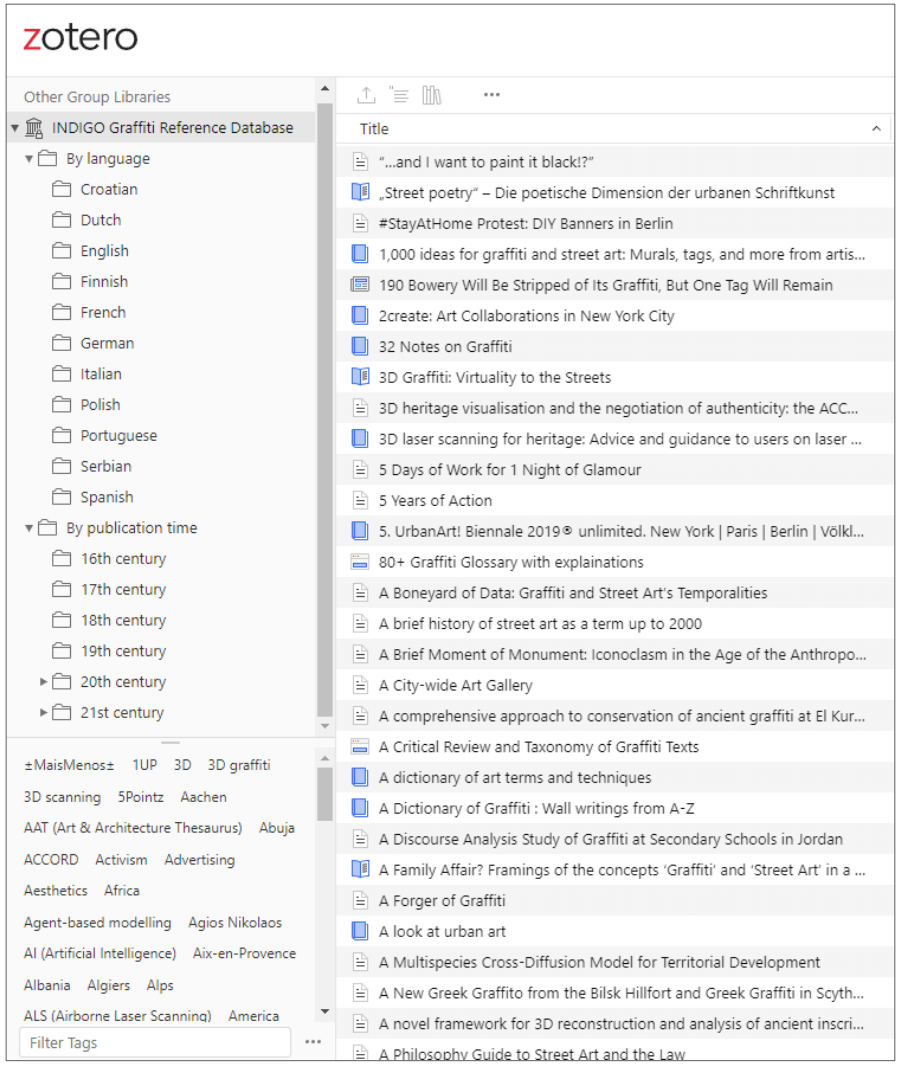
6+15

HARDWARE

1

DISSEMINATION scientific audience

Graffiti literature database



SOFTWARE

3+

ARTICLES

6+15

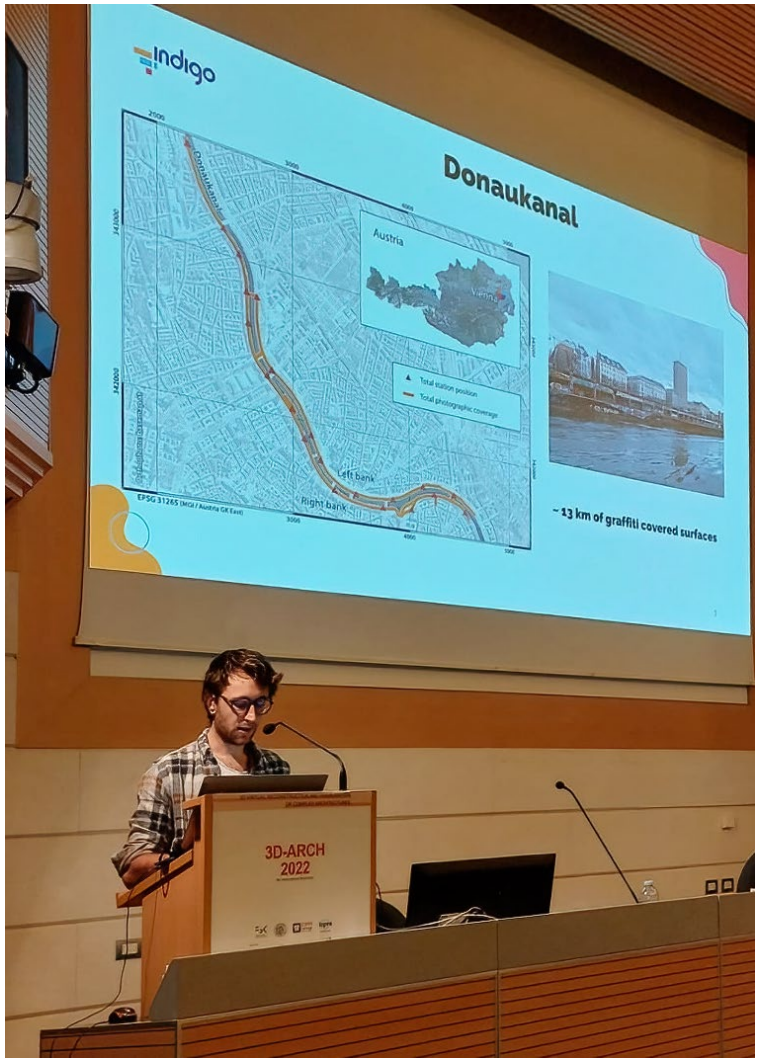
HARDWARE

1

DATA SETS

5 (+1)

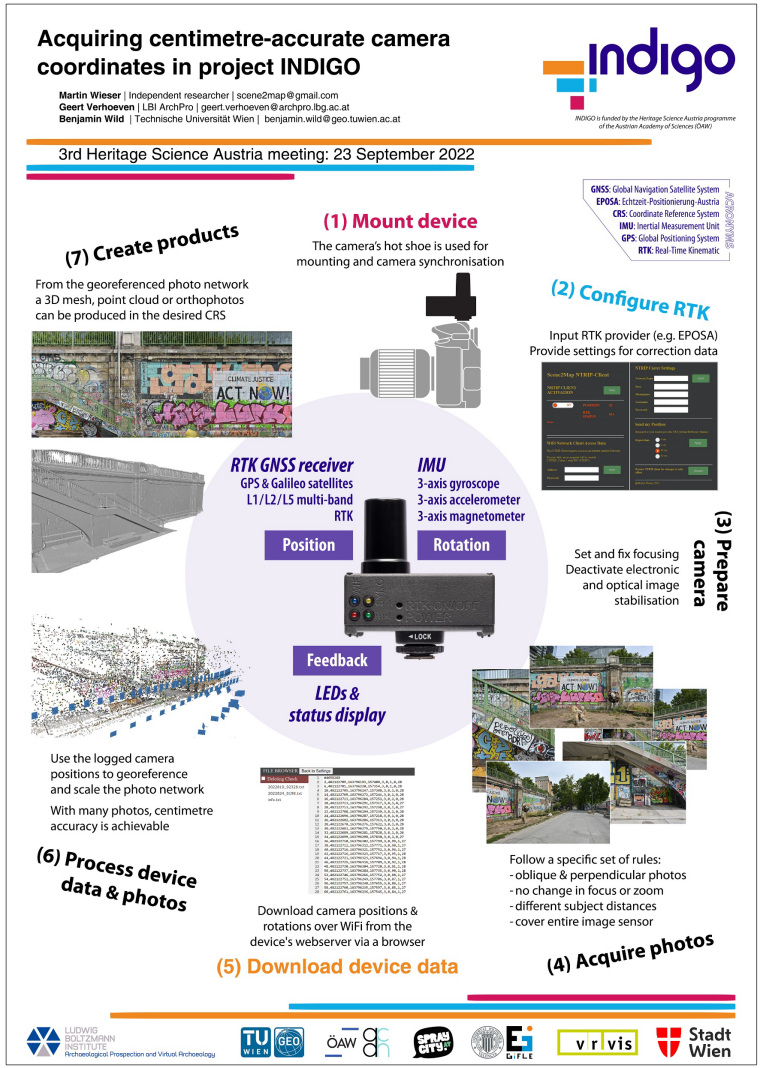
DISSEMINATION scientific audience



TALKS

29

DISSEMINATION scientific audience



TALKS

29

POSTERS

4

DISSEMINATION scientific audience



TALKS

29

SYMPOSIA

2

POSTERS

4

DISSEMINATION scientific audience



TALKS
29

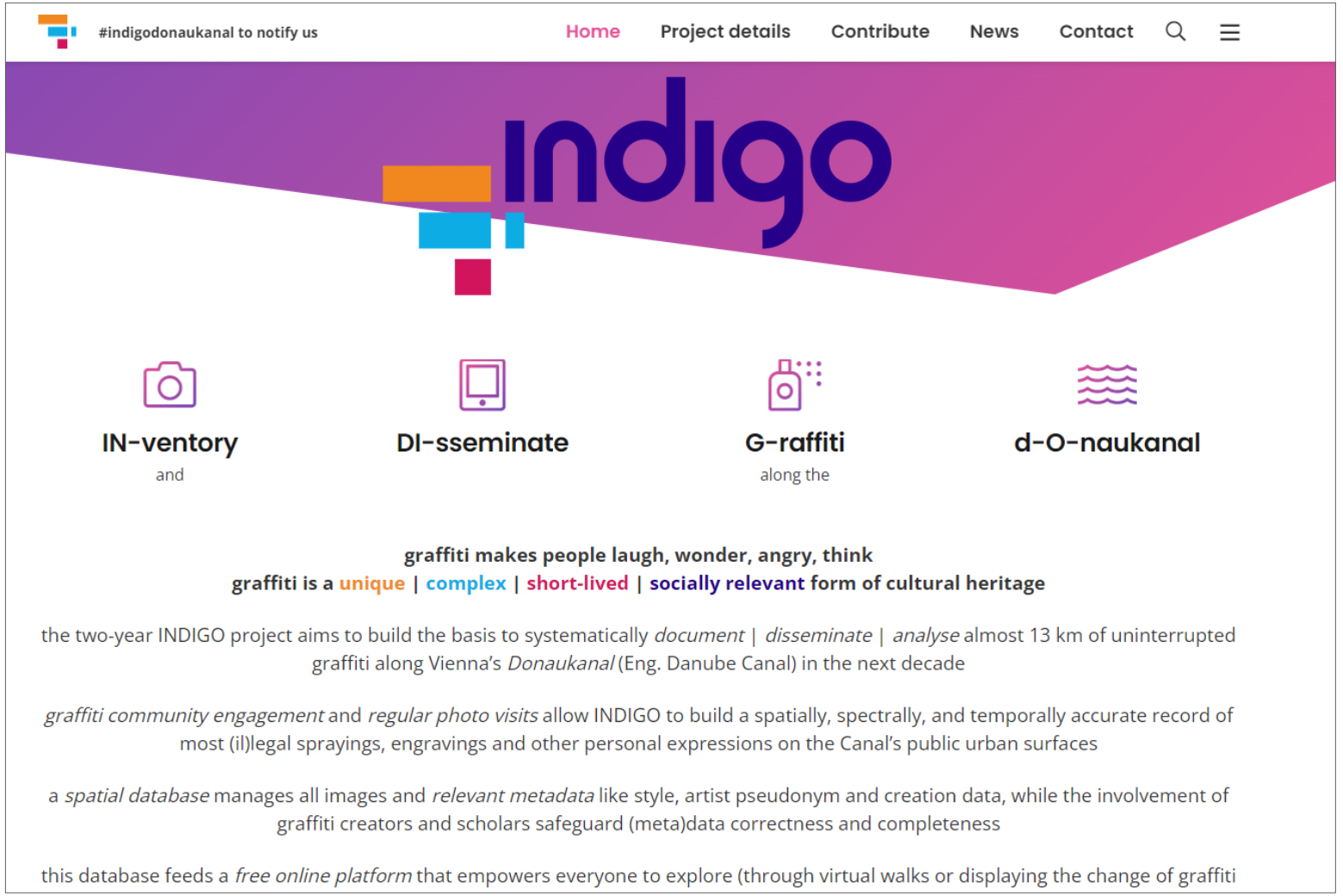
SYMPOSIA
2

POSTERS
4

PROCEEDINGS
2

INDIGO website

https://projectindigo.eu

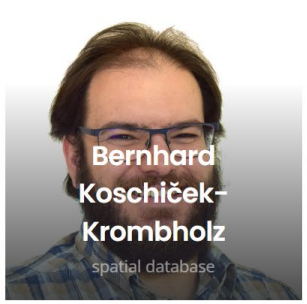


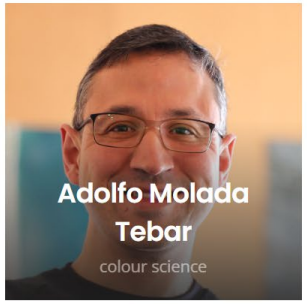
INDIGO team

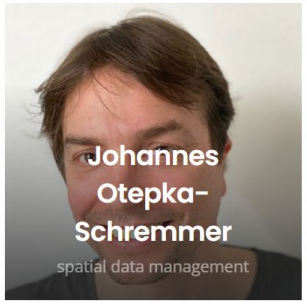


Geert Verhoeven



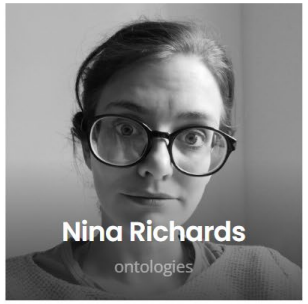


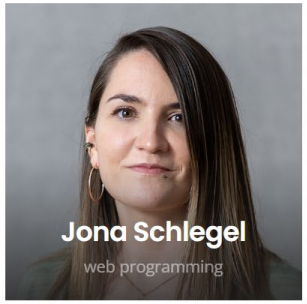






Norbert Pfeifer



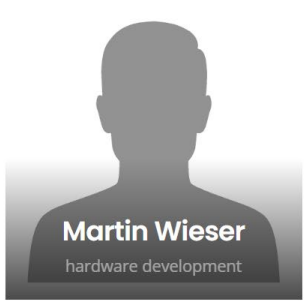


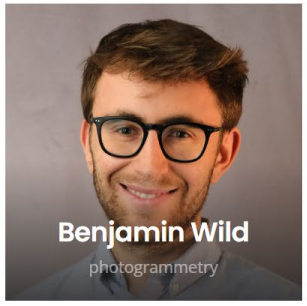






Stefan Wogrin





From Street to Schema:

The INDIGO Toolkit for Graffiti Documentation

