Archaeology of contemporary graffiti

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)



iconic

GRAFFITI
diverse creations



iconic

GRAFFITI
diverse creations



multi-faceted

GRAFFITI
diverse creations

art <> vandalism

graphical <> textual

socio-political criticism <> entertaining

legal <> illegal

tangible <> intangible



multi-faceted

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multi-faceted

GRAFFITI
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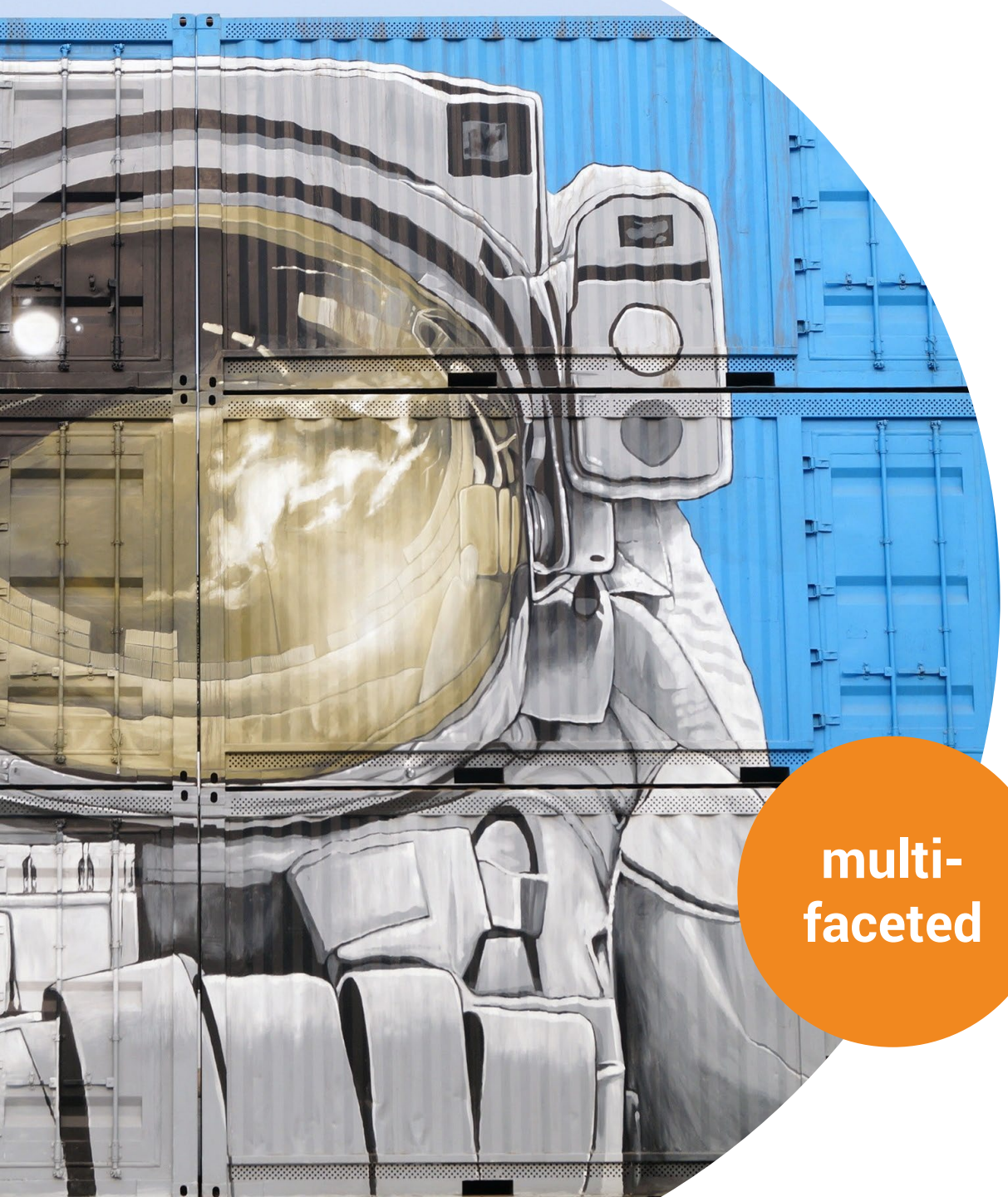
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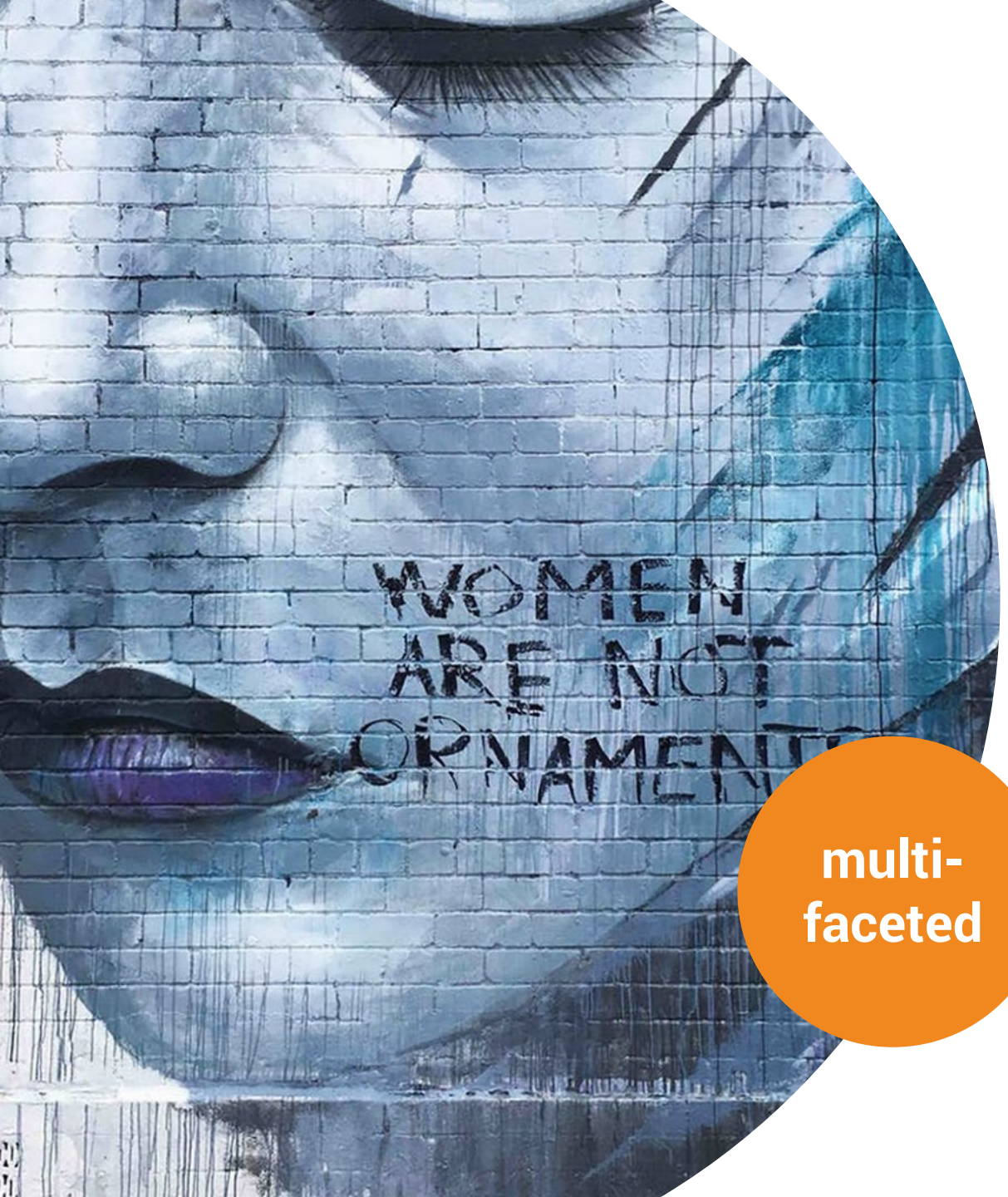
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graffiti are

unique
complex
short-lived
socially relevant



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unique

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short-lived

socially relevant

cultural heritage

ARTISTIC merit

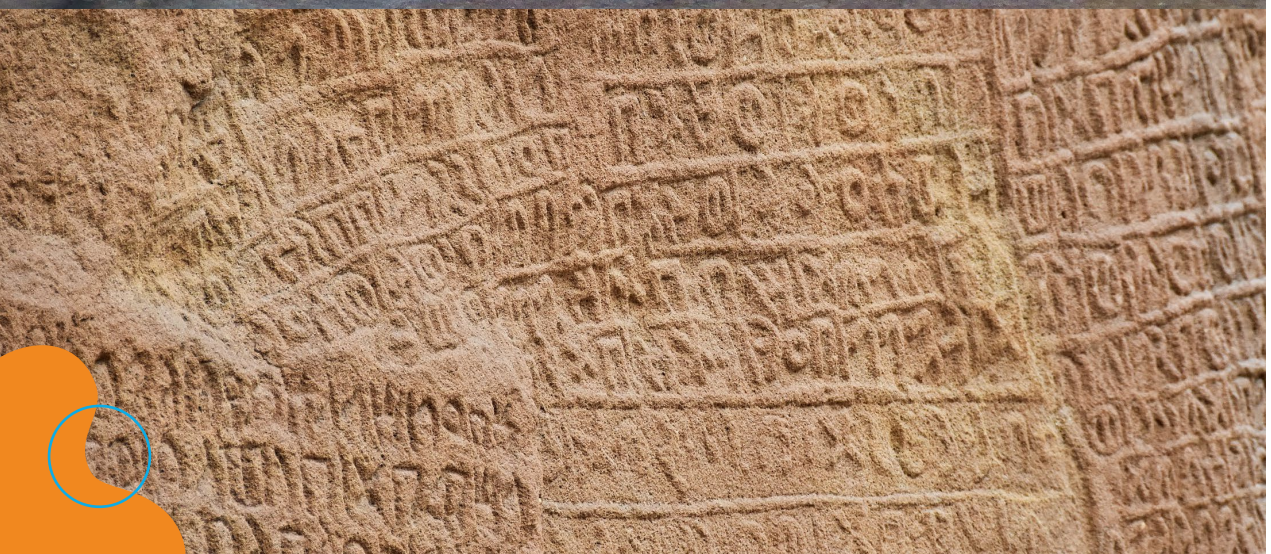
ARTISTIC merit



Marcel Duchamp
Fountain (1917)

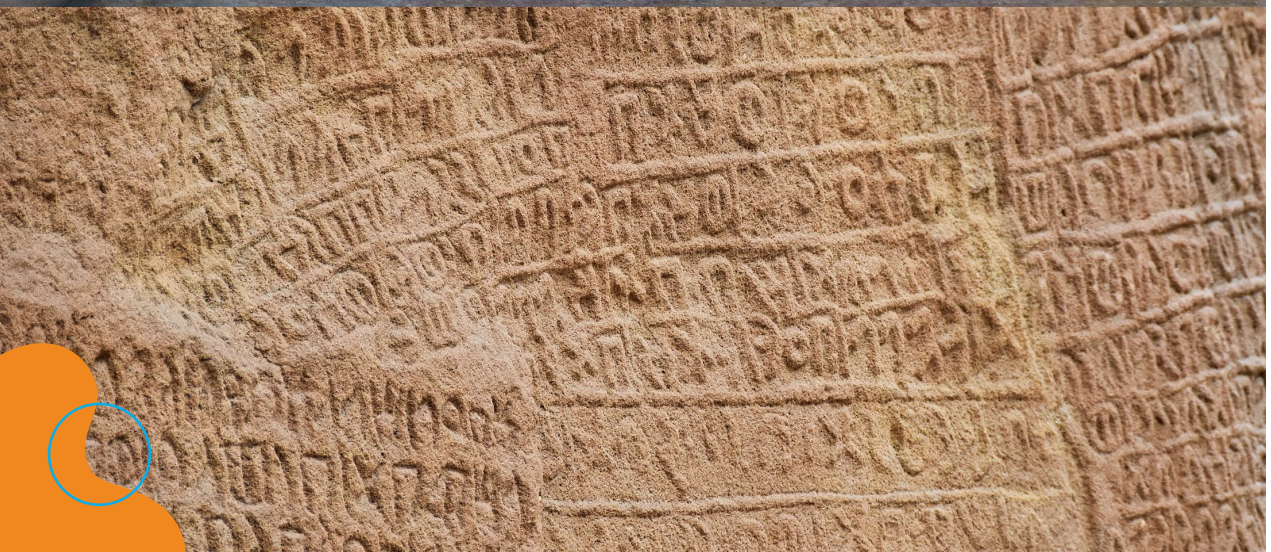
ARTISTIC merit





ARTISTIC merit



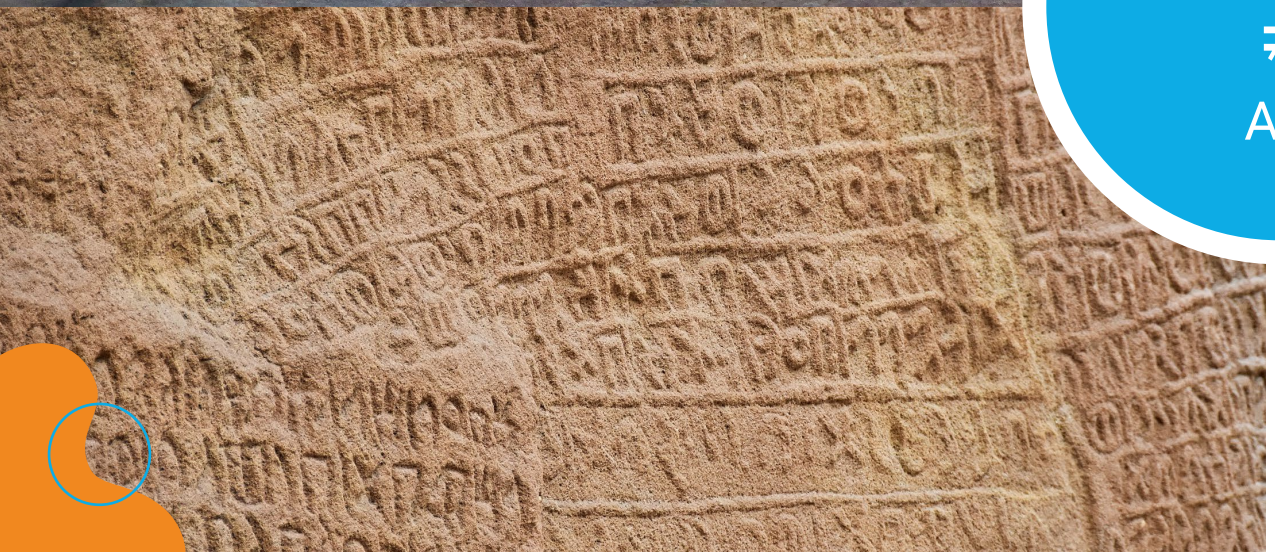






ARTISTIC merit





Cultural heritage

≠

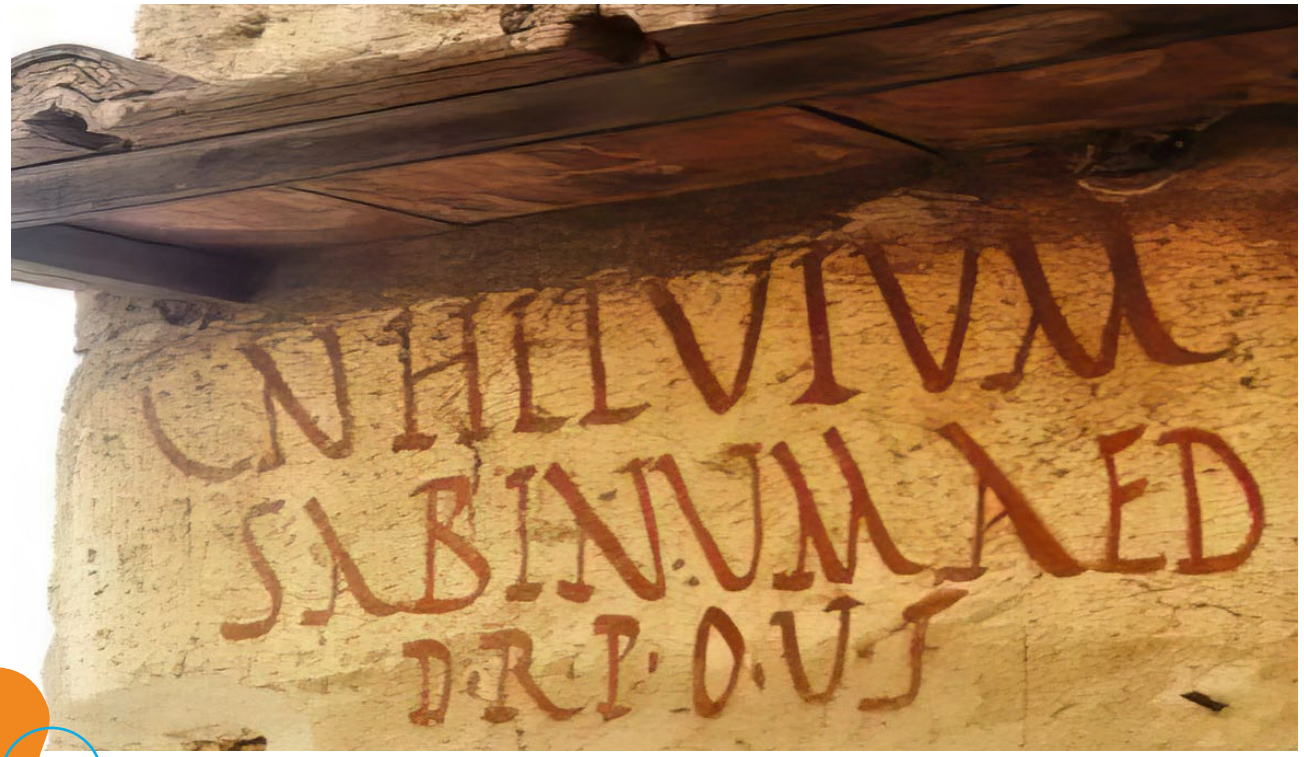
Art



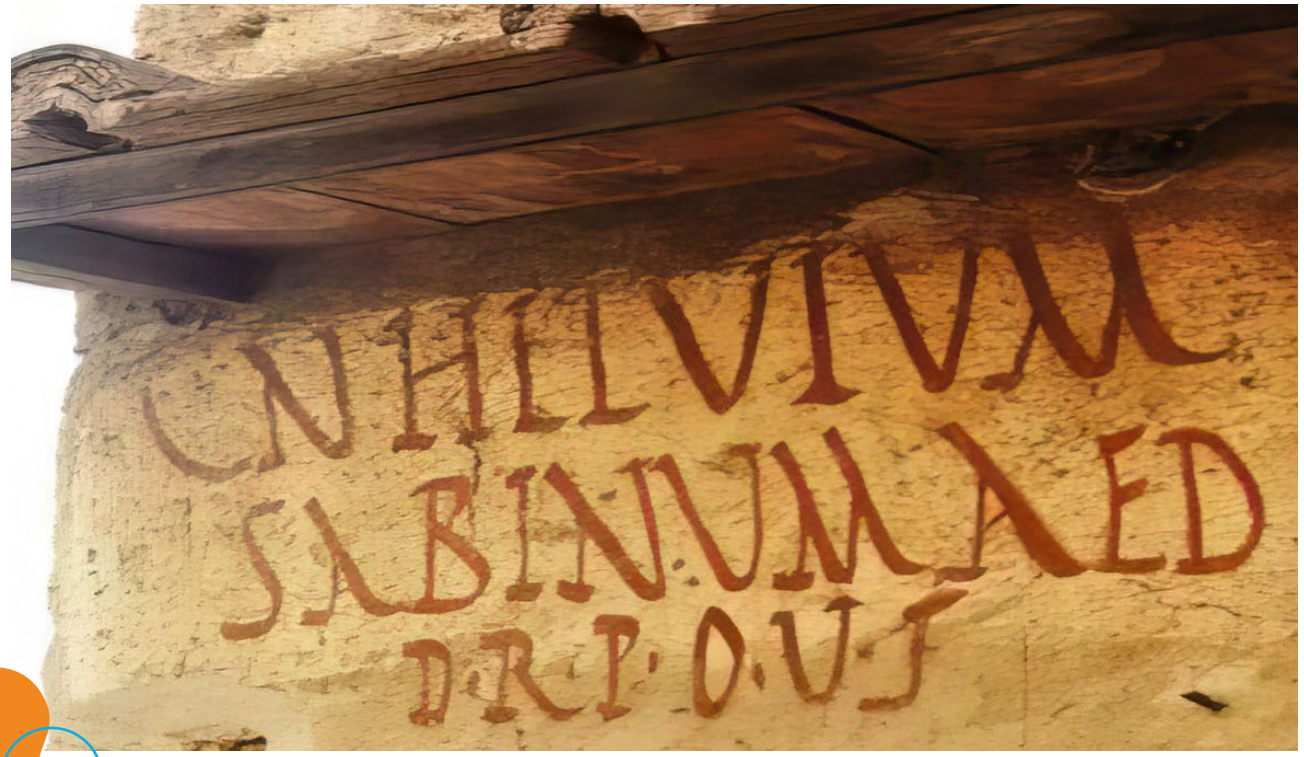


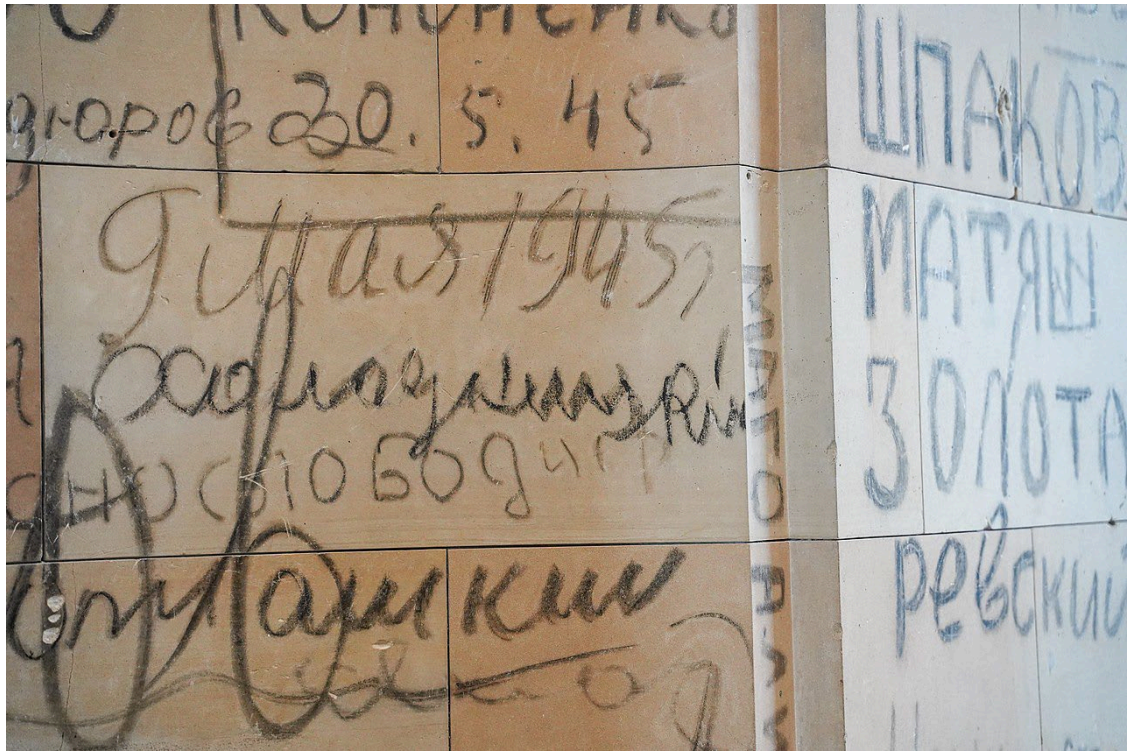
HISTORICAL | POLITICAL
relevance

HISTORICAL | POLITICAL
relevance



HISTORICAL | POLITICAL
relevance

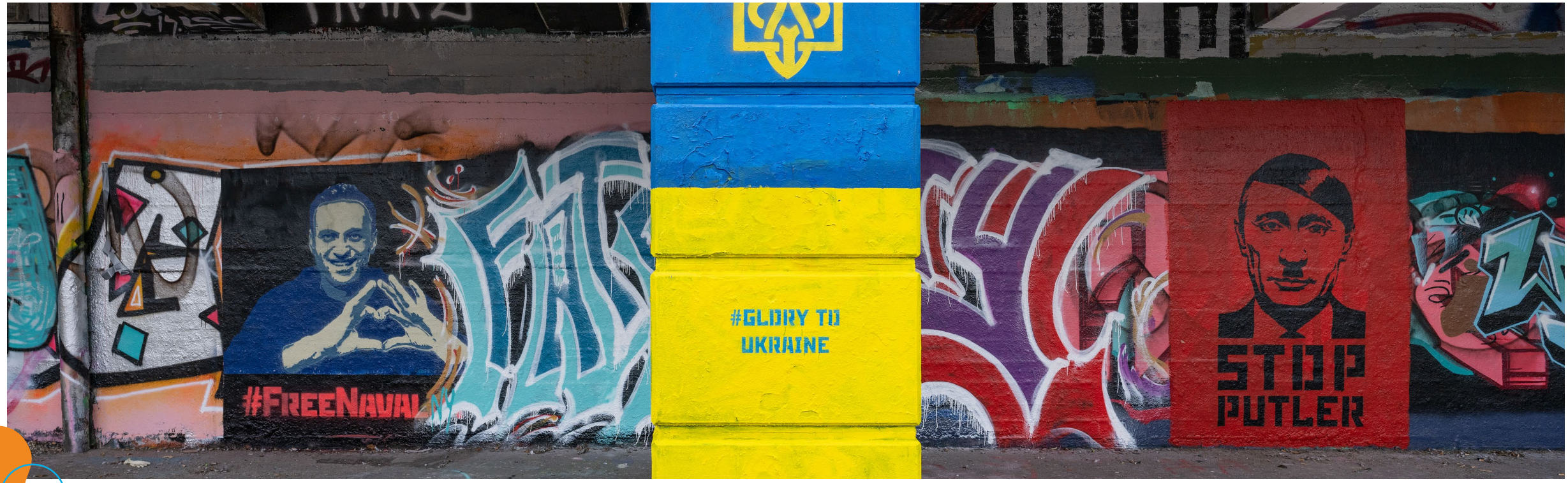




HISTORICAL | POLITICAL
relevance

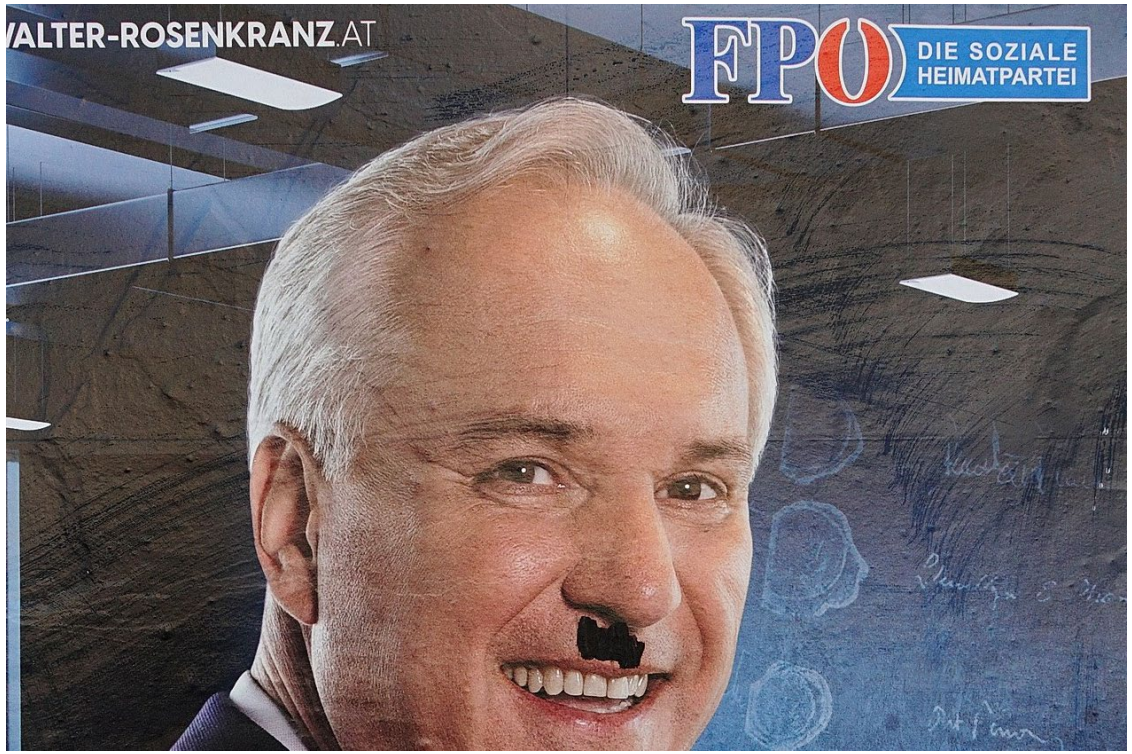


HISTORICAL | POLITICAL
relevance



HISTORICAL | POLITICAL
relevance

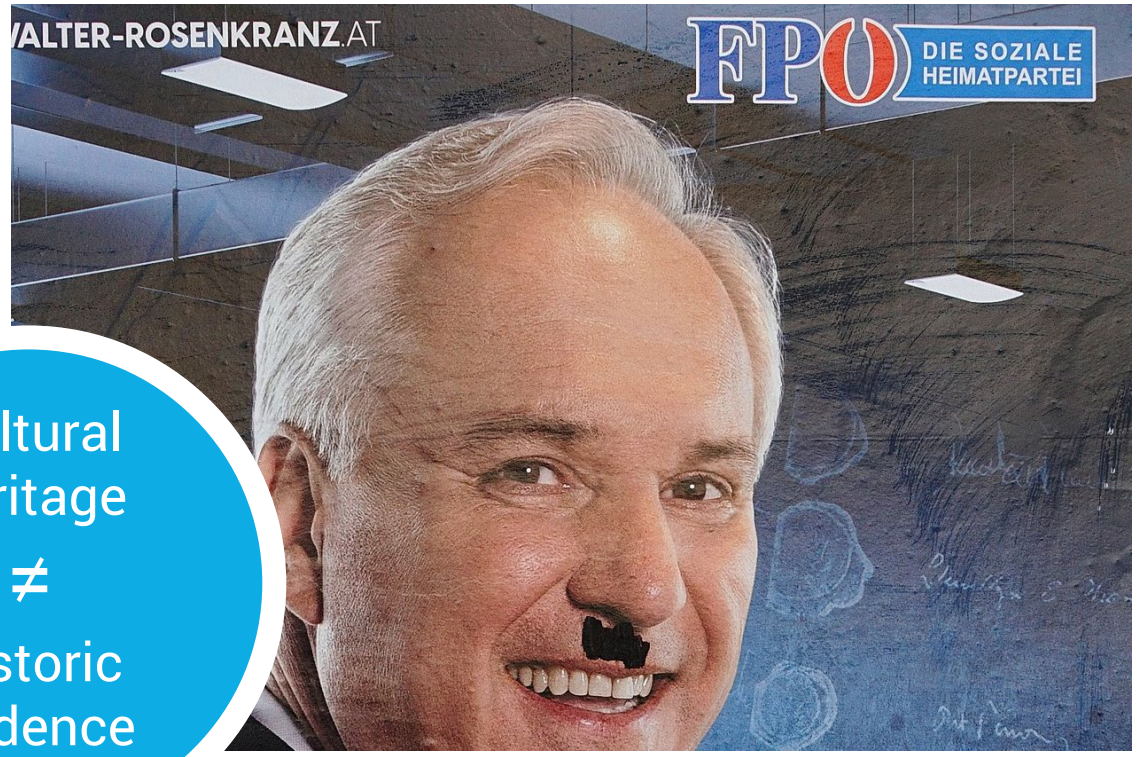




HISTORICAL | POLITICAL
relevance



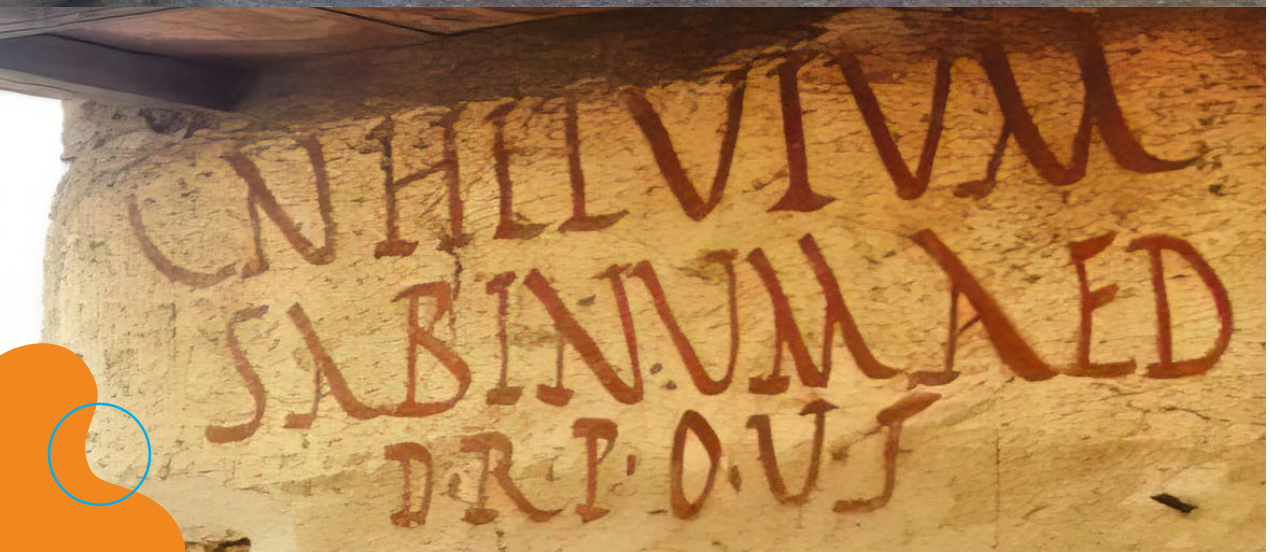
Cultural heritage ≠ Historic evidence



ANCIENT | contemporary









ANCIENT | contemporary

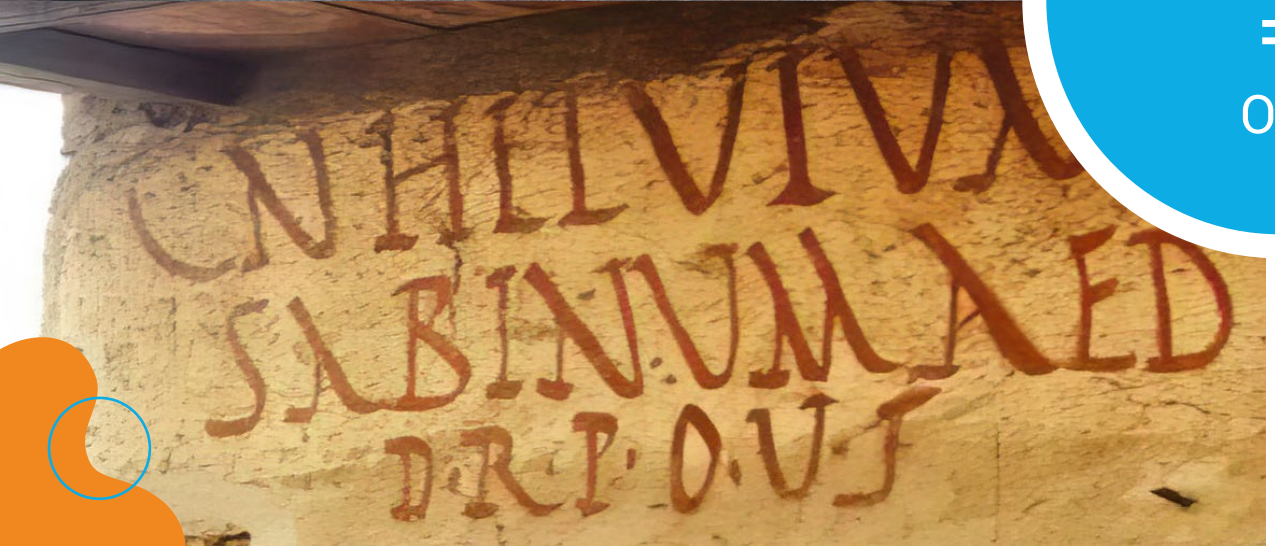




Cultural heritage

=

Old
















KOOER



graffiti are

unique

complex

short-lived

socially relevant

cultural heritage



NEEDING
academic rigour

“For as long as we are imprecise about the artworks we are discussing, our research will be rightfully seen as lacking scholarly rigor.“

de la Iglesia 2015





RECORDING

random

partial

inaccurate

NEEDING
academic rigour

“For as long as we are imprecise about the artworks we are discussing, our research will be rightfully seen as lacking scholarly rigor.“

de la Iglesia 2015





RECORDING

random

partial

inaccurate

DISSEMINATION

unstandardised

limited interaction

closed access

NEEDING
academic rigour

“For as long as we are imprecise about the artworks we are discussing, our research will be rightfully seen as lacking scholarly rigor.“

de la Iglesia 2015





RECORDING

random

partial

inaccurate

DISSEMINATION

unstandardised

limited interaction

closed access

ANALYSIS

descriptive

fragmentary

biased



NEEDING
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de la Iglesia 2015



RECORDING

random

partial

inaccurate

DISSEMINATION

unstandardised

limited interaction

closed access

ANALYSIS

descriptive

fragmentary

biased

SYNERGY

one-sided

partial know-how

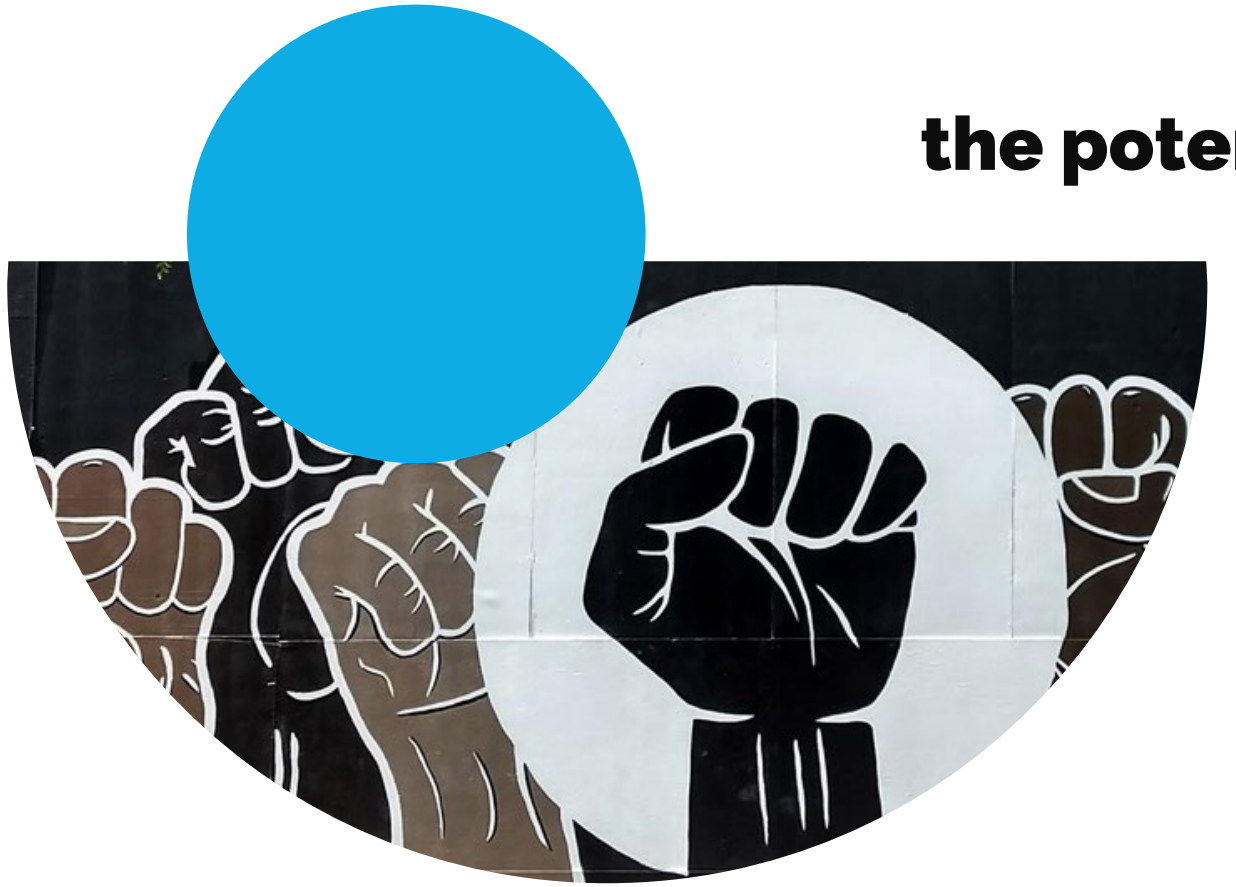
limited output



NEEDING
academic rigour

“For as long as we are imprecise about the artworks we are discussing, our research will be rightfully seen as lacking scholarly rigor.“

de la Iglesia 2015



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

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SPRAY CITY.AT

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

WHY

Inventory and

disseminate

graffiti along the

donaukanal

WHAT

digitally preserve and analyse

? HOW ?

WHERE

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GiFLE

TU WIEN GEO

vrvis

Stadt Wien

SPRAY CITY AT

LUDWIG BOLTZMANN INSTITUTE
Archaeological Prospection and Virtual Archaeology

WHO

Heritage Science Austria programme | € 580 k | 2 years

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

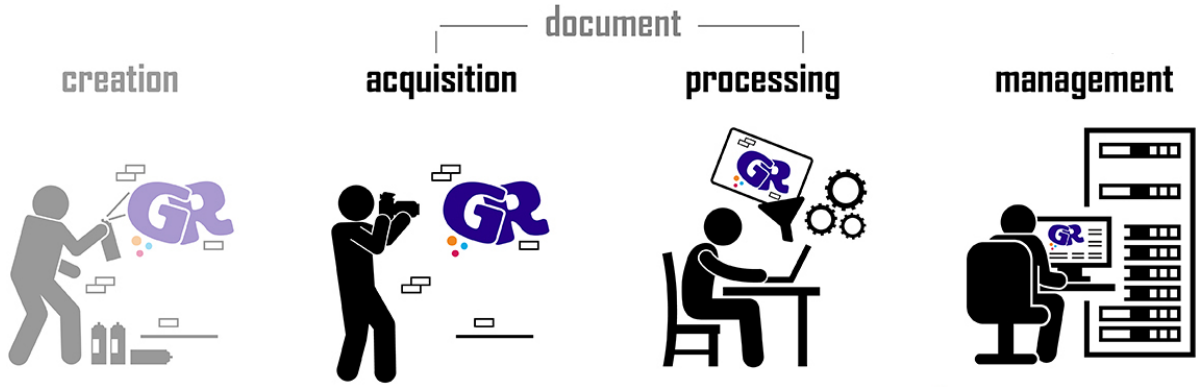


management



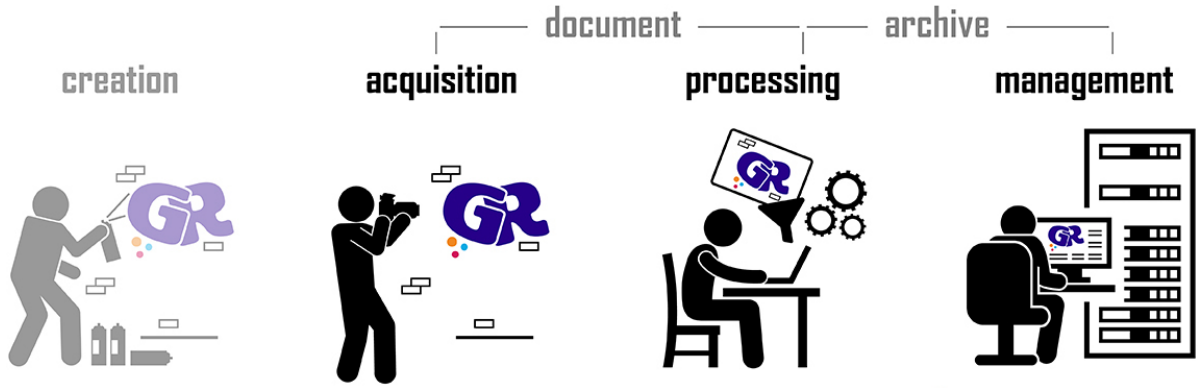
INDIGO approach

5 research pillars



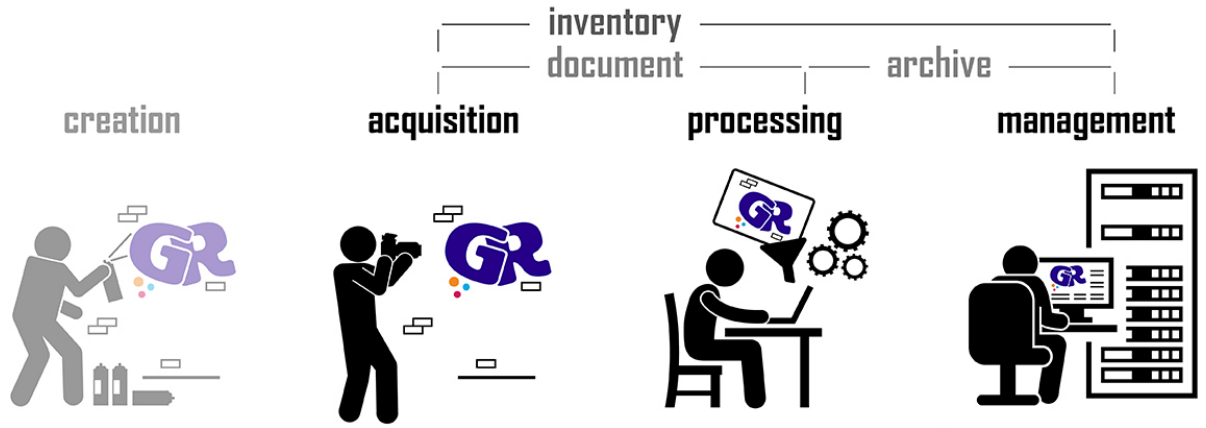
INDIGO approach

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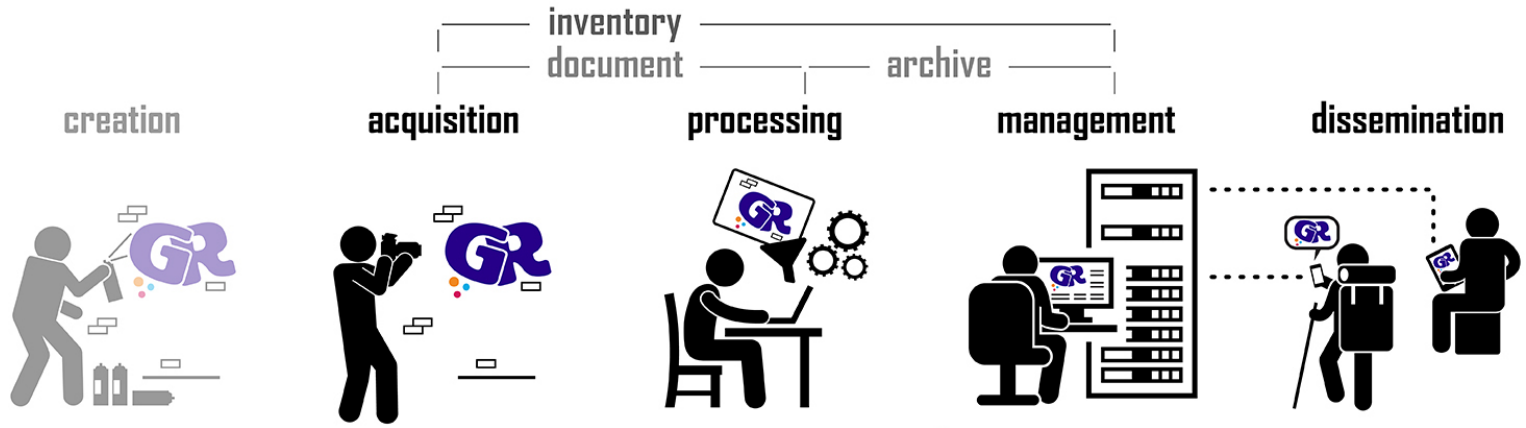
INDIGO approach

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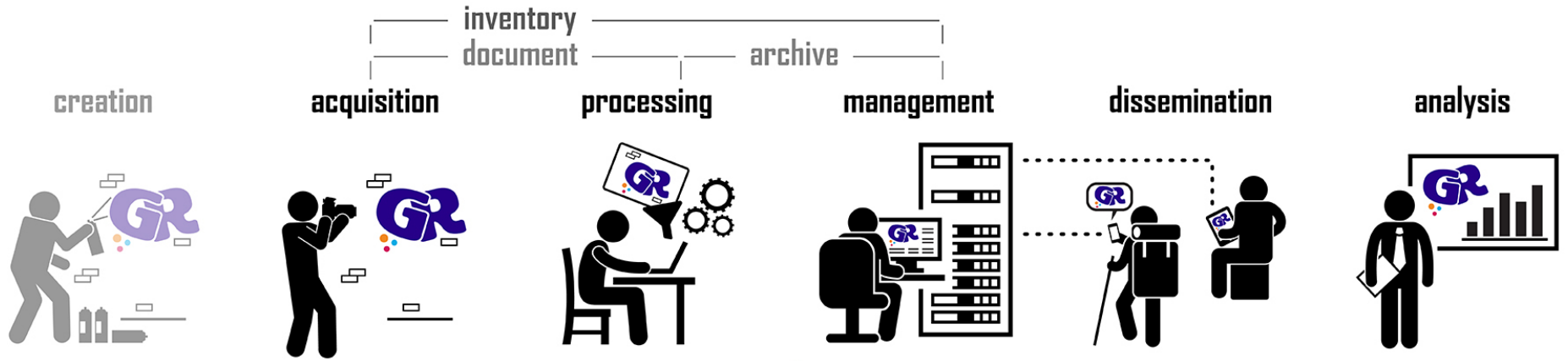
INDIGO approach

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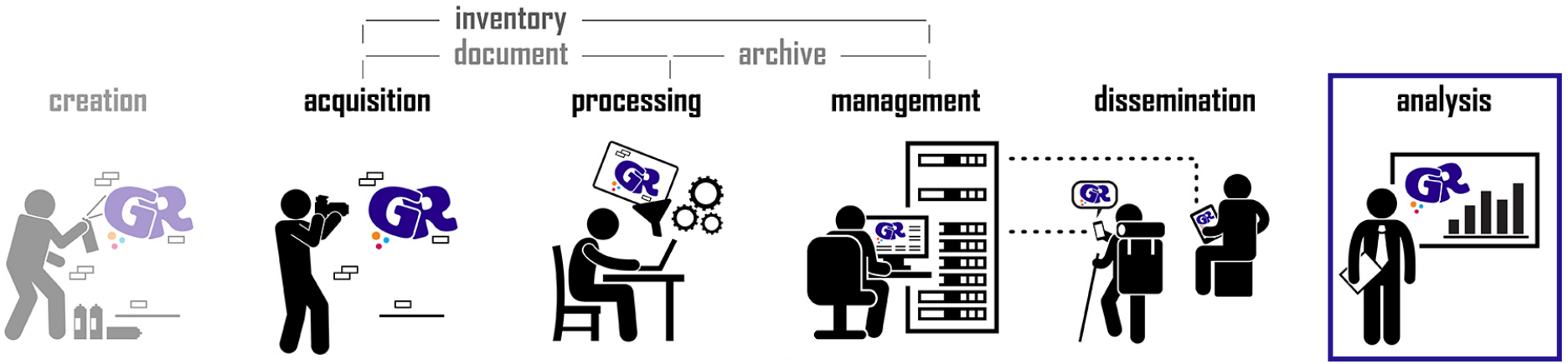
INDIGO approach

5 research pillars



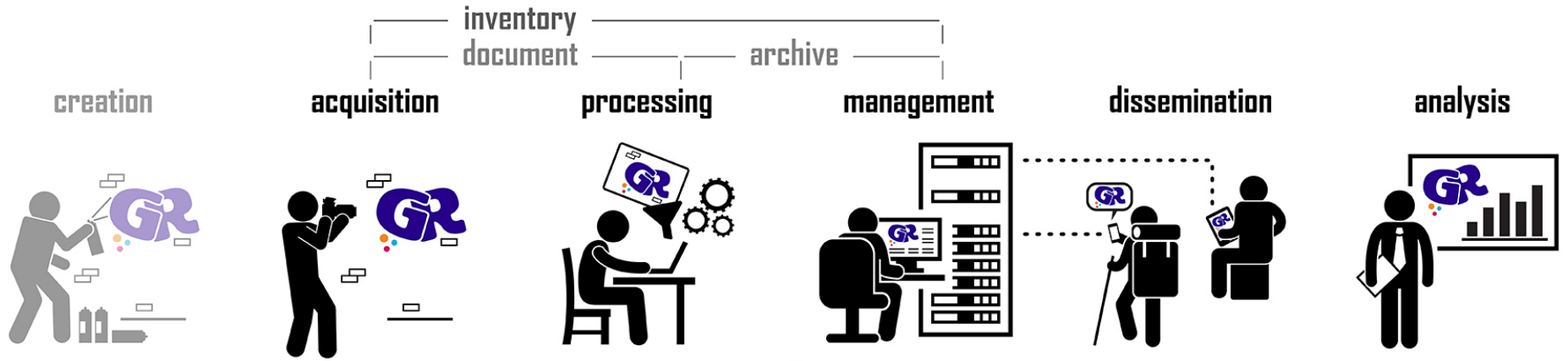
POTENTIAL questions

5 research pillars



POTENTIAL questions

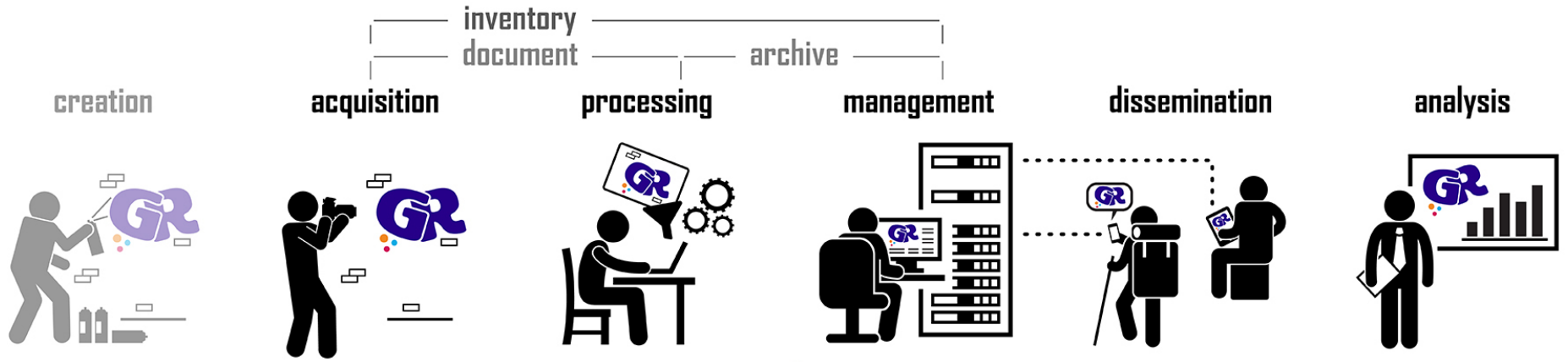
5 research pillars



When and where do political graffiti typically appear ?

POTENTIAL questions

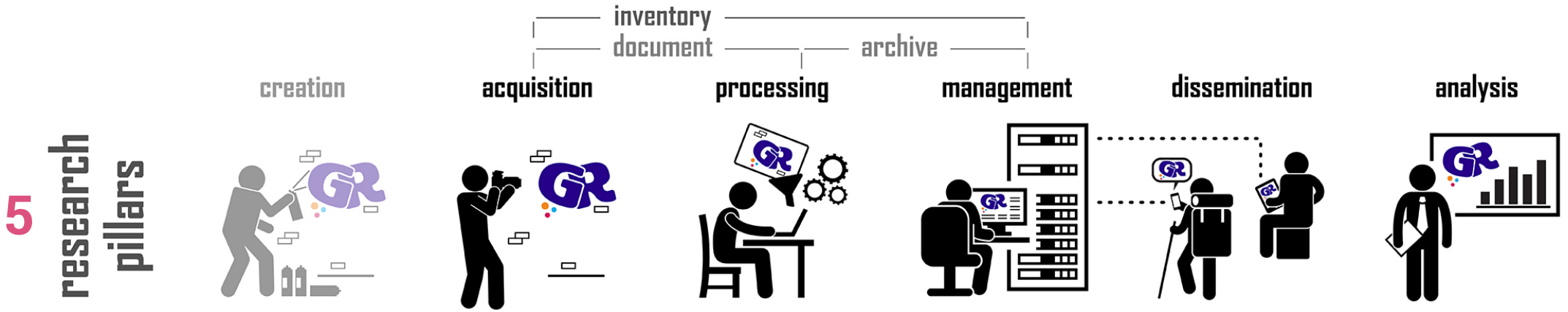
5 research pillars



When and where do political graffiti typically appear ?

What are the main styles and colours of those graffiti, and how long do they – on average – stay visible before they are (partly or entirely) covered ?

POTENTIAL questions



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What type of graffito commonly covers political messages ?

POTENTIAL questions

GRAFFITI *LOCATION*

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GRAFFITI *TEMPORALITY*

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GRAFFITI *LOCATION*

GRAFFITI *TEMPORALITY*

GRAFFITI *TERMINOLOGY*

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

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GRAFFITI archaeology

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

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GRAFFITI archaeology

ARTEFACT

LOCATION
TEMPORALITY
TERMINOLOGY
CHARACTERISATION

When and where do political graffiti typically appear ?

What are the main styles and colours of those graffiti, and how long do they – on average – stay visible before they are (partly or entirely) covered ?

What type of graffito commonly covers political messages ?

SOME results

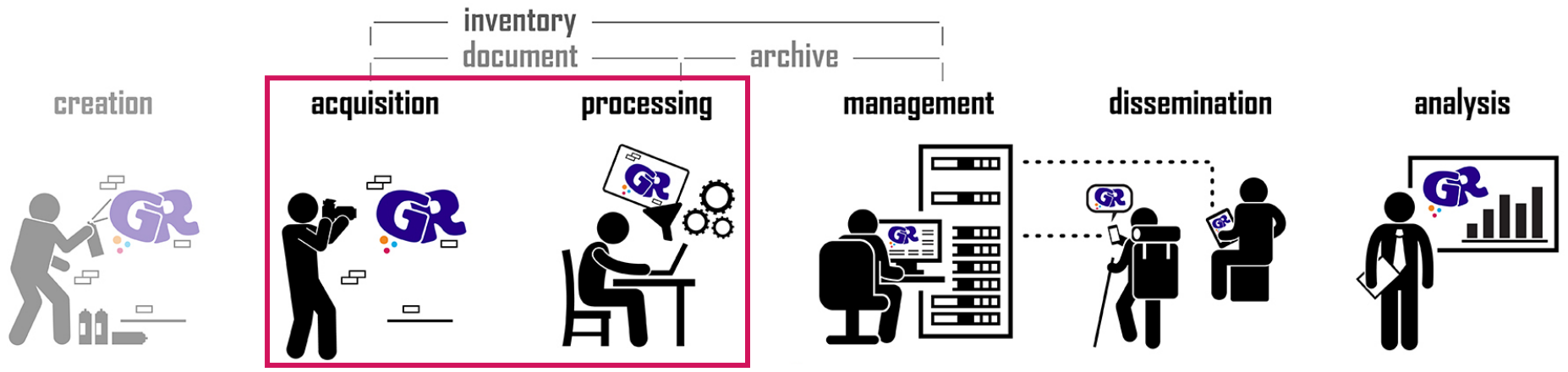
GRAFFITI *LOCATION*

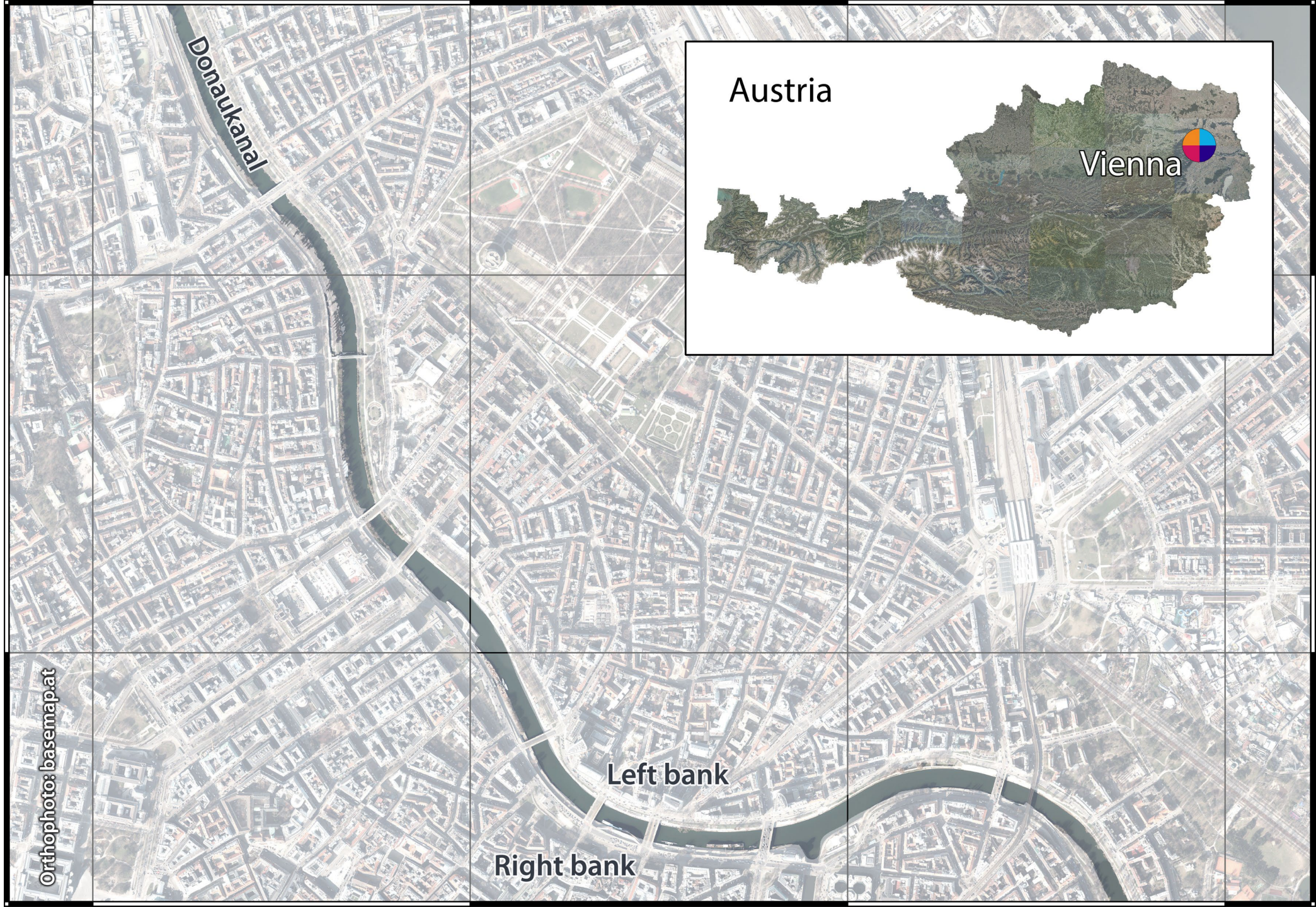
GRAFFITI *TEMPORALITY*

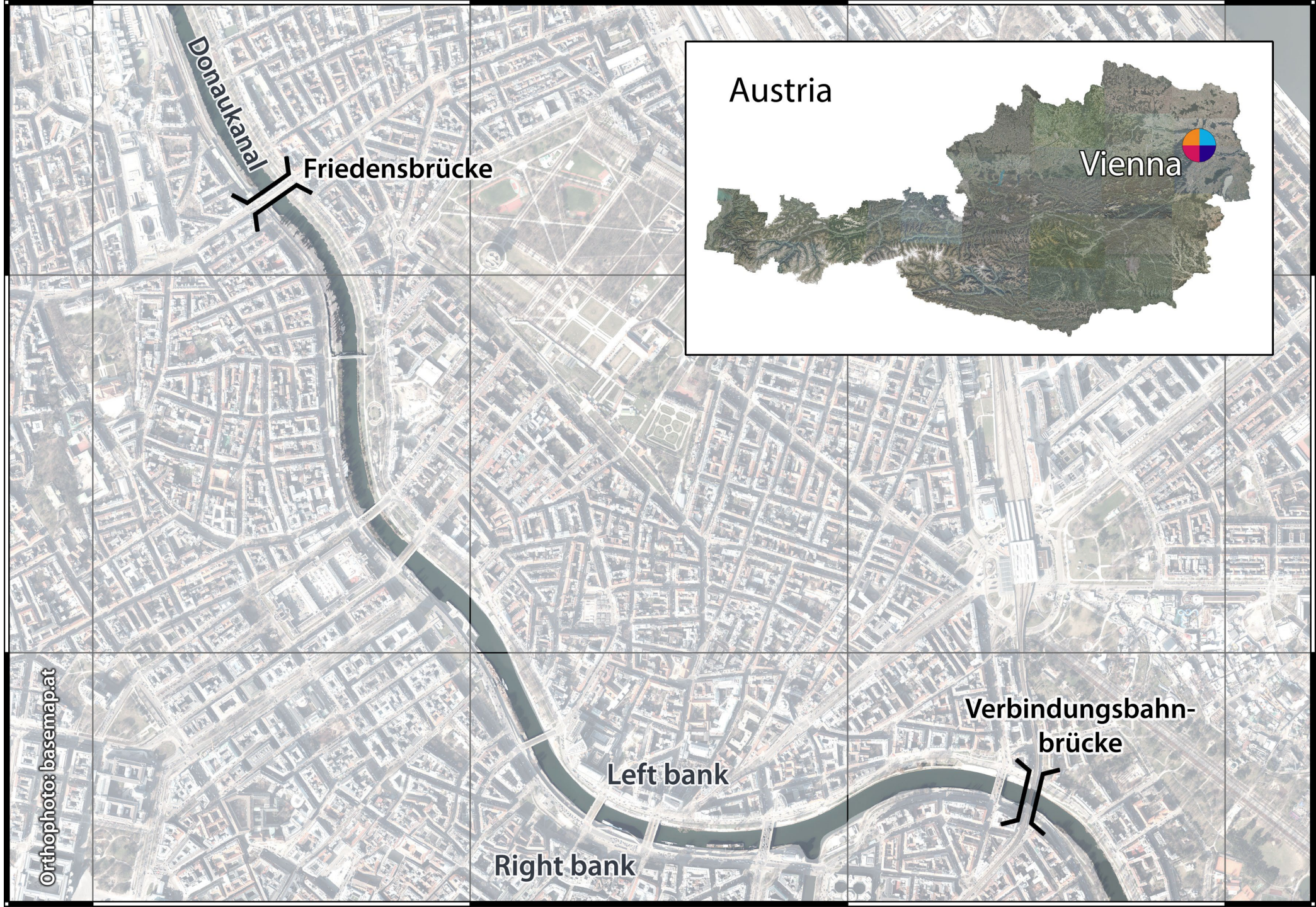
GRAFFITI *TERMINOLOGY*

GRAFFITI *CHARACTERISATION*

5 research pillars

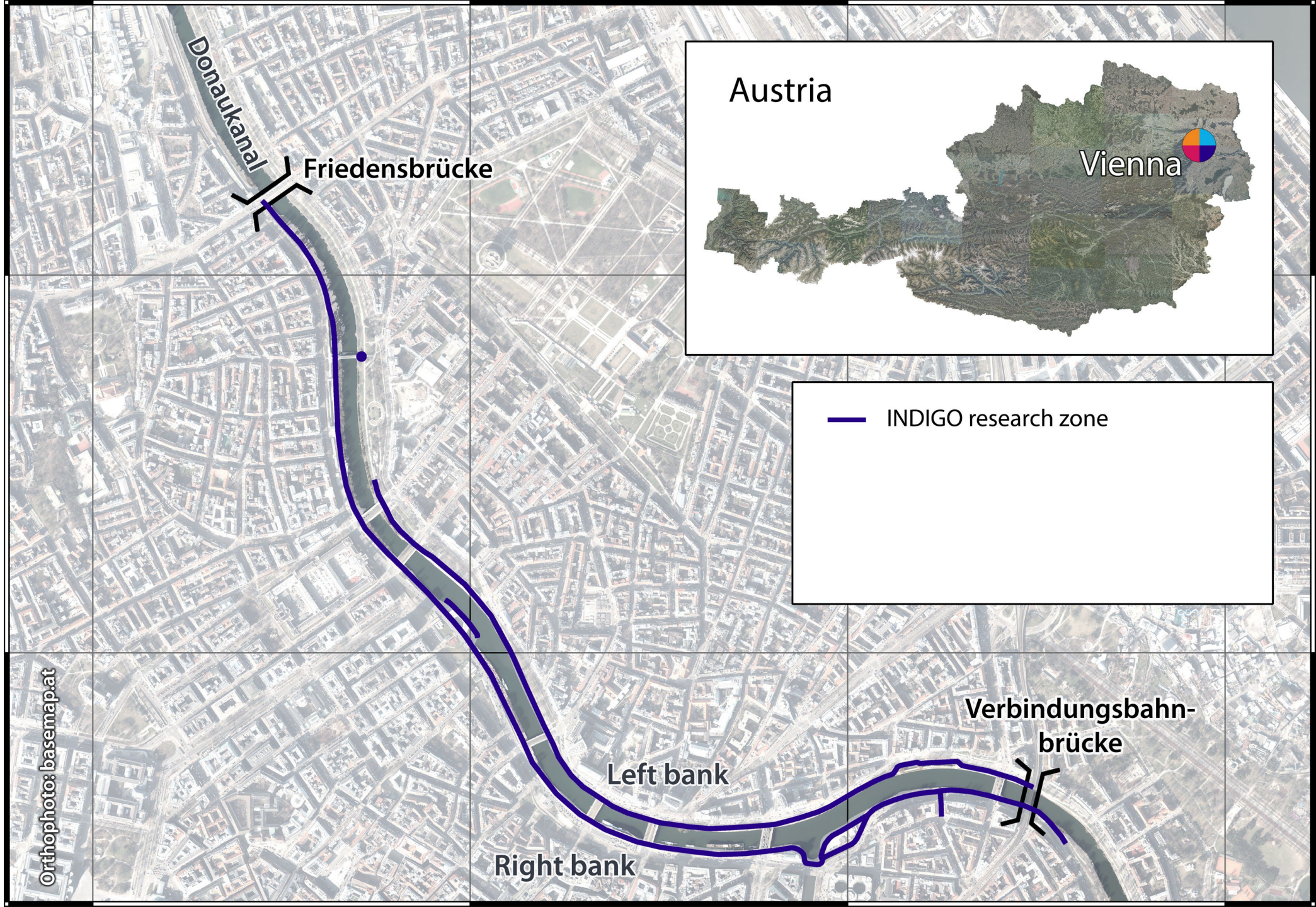



Donaukanal
Austria
Vienna
Left bank
Right bank
Orthophoto: basemap.at


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

STRETCH

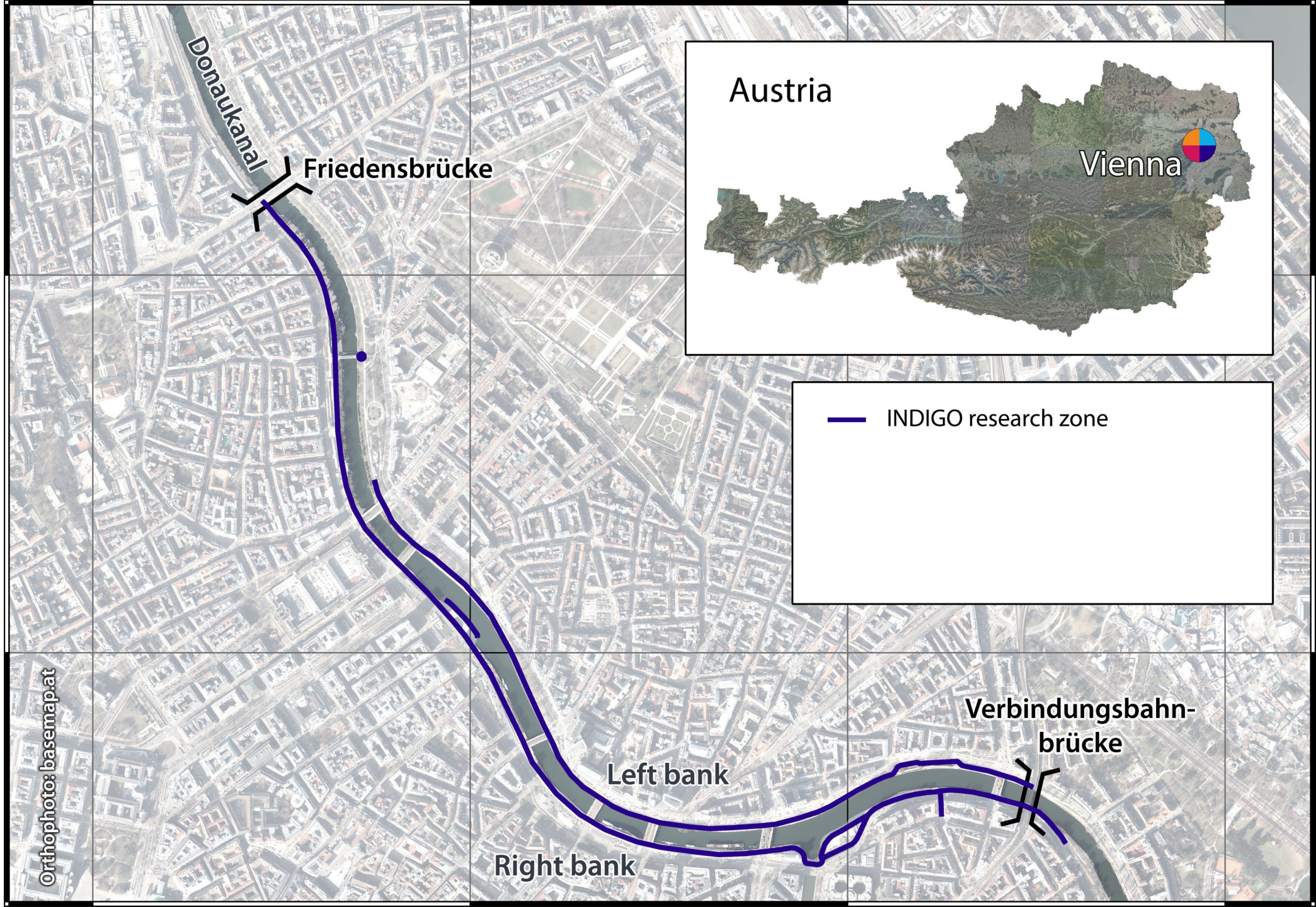
3.3 km



STRETCH

3.3 km

LEFT **RIGHT**



STRETCH

3.3 km

LEFT **RIGHT**



STRETCH

3.3 km

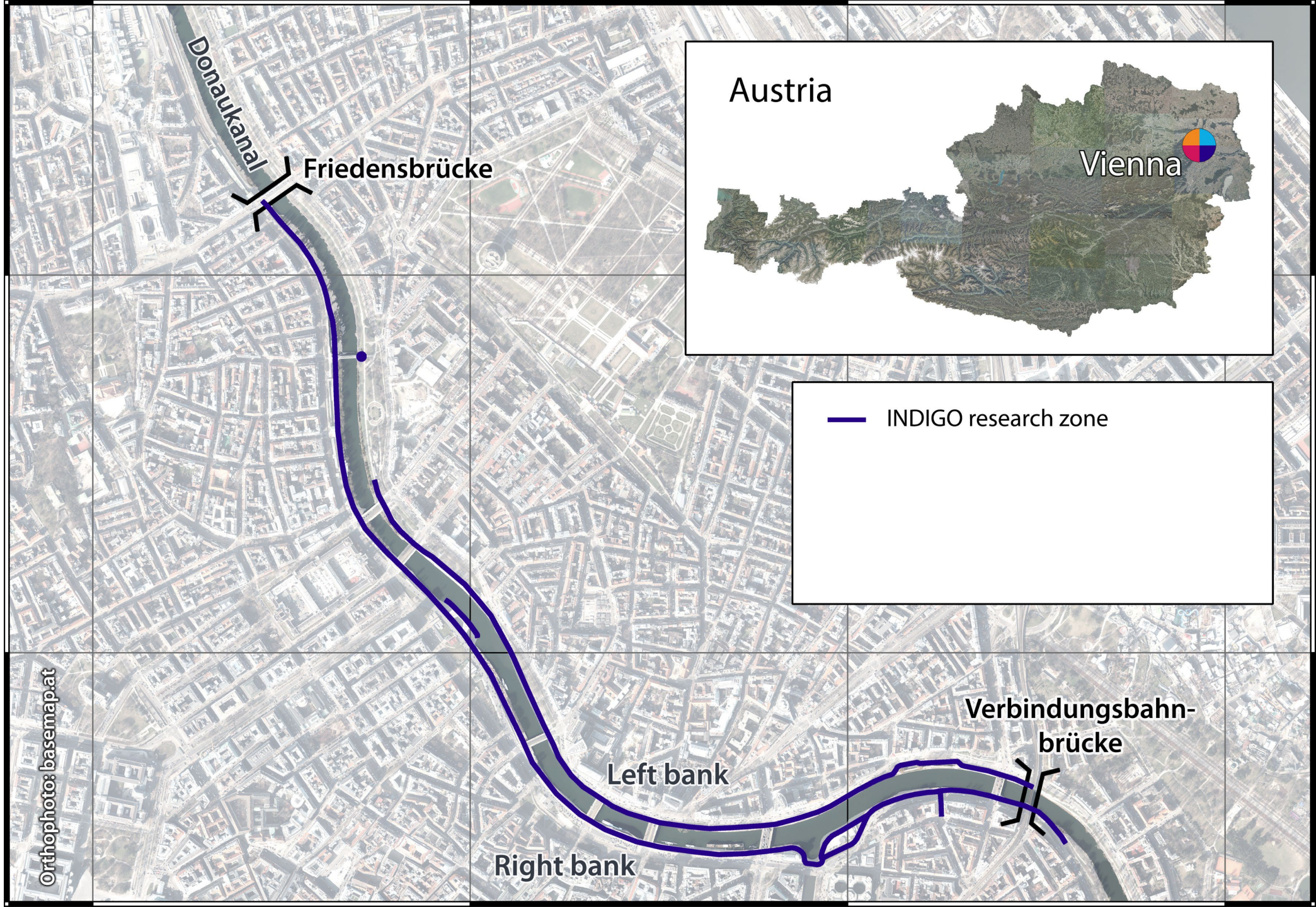
LEFT	RIGHT
UP	UP
DOWN	DOWN



STRETCH

3.3 km

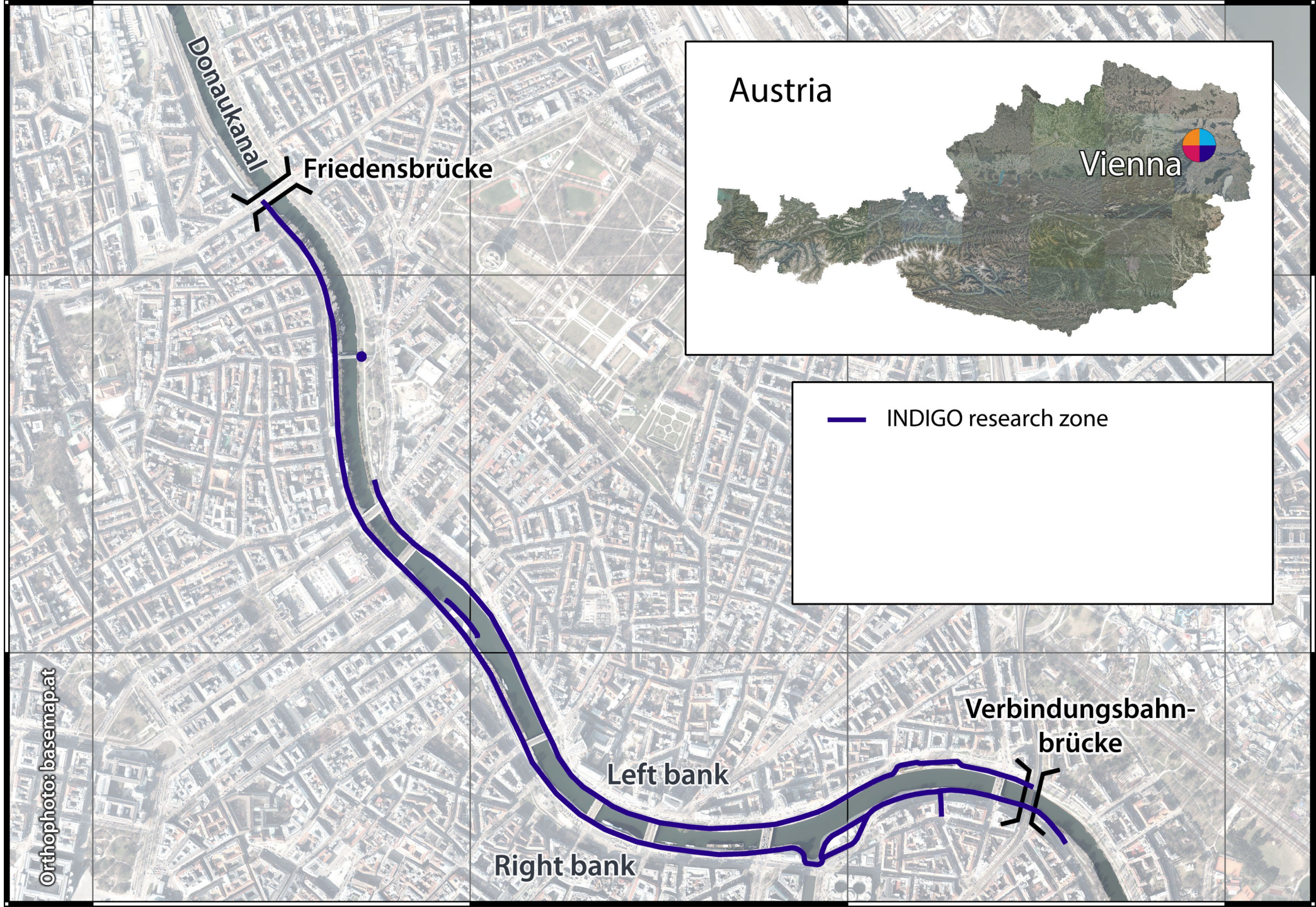
LEFT	RIGHT
UP	UP
3.2 km	5.3 km
DOWN	DOWN



STRETCH

3.3 km

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



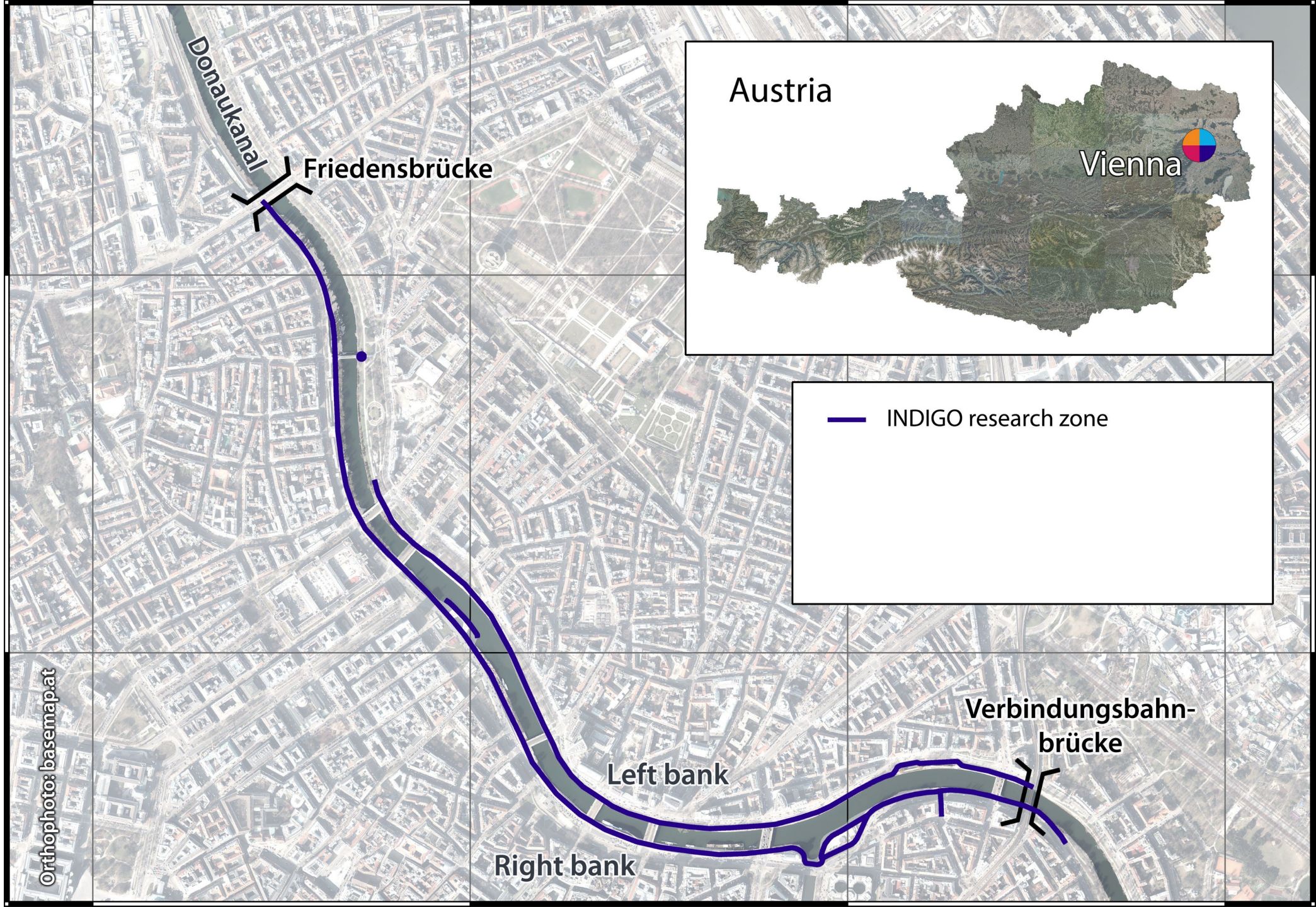
STRETCH

3.3 km

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

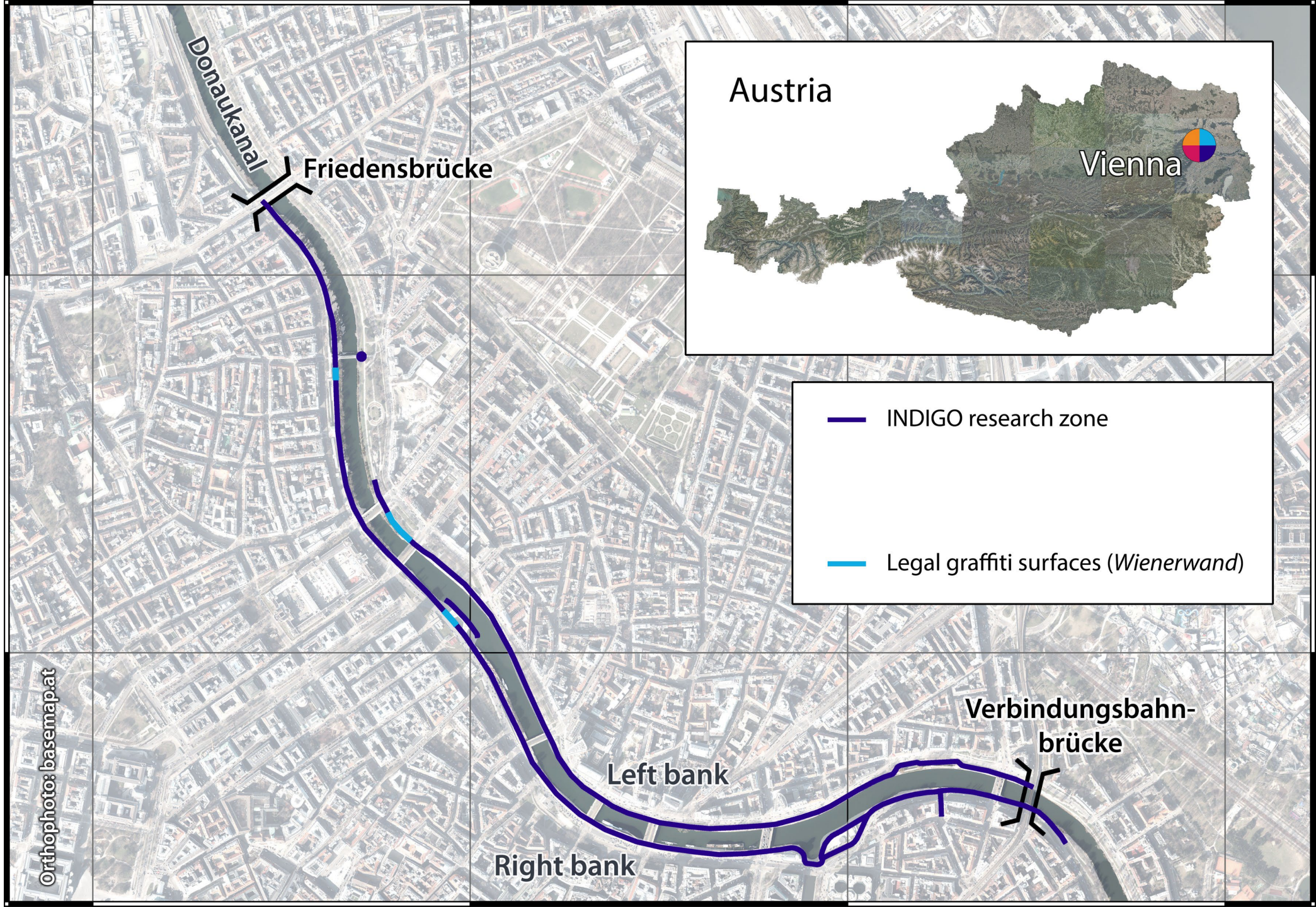
MONITORED SURFACES

12.9 km



MONITORED SURFACES

12.9 km

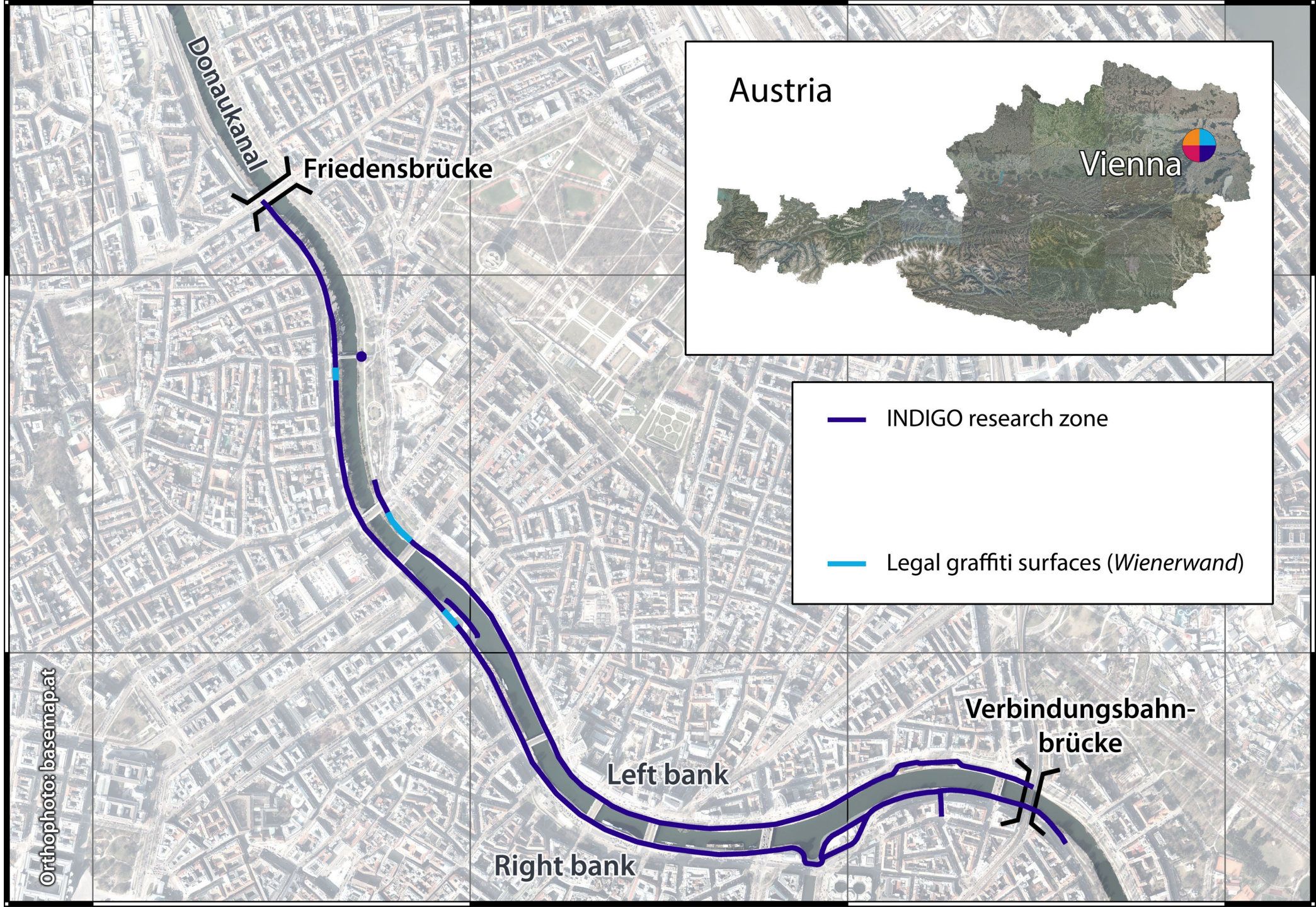


LEGAL SURFACES

0.3 km

MONITORED SURFACES

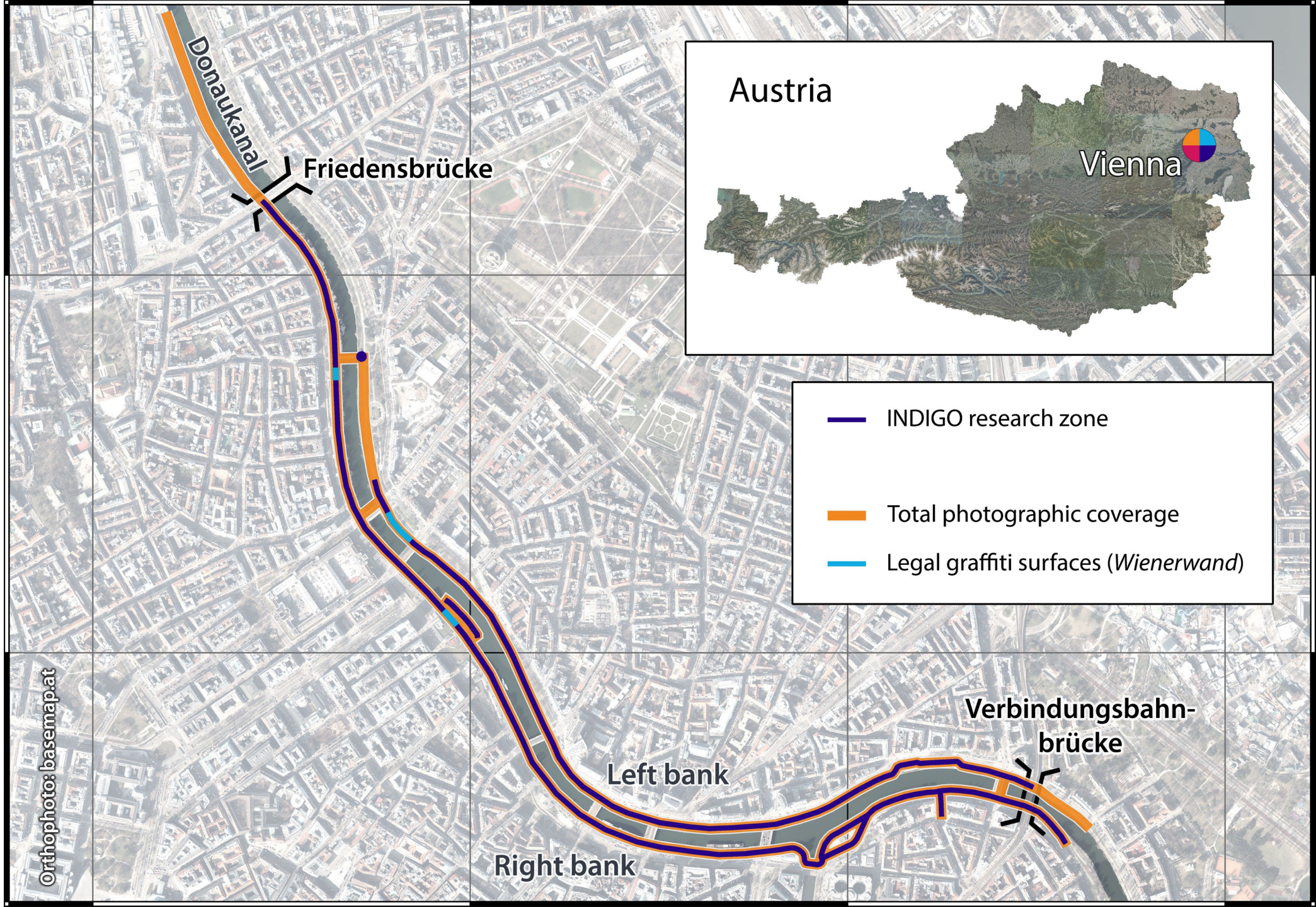
12.9 km



TOTAL COVERAGE
14.0 km

LEGAL SURFACES
0.3 km

MONITORED SURFACES
12.9 km



TOTAL COVERAGE

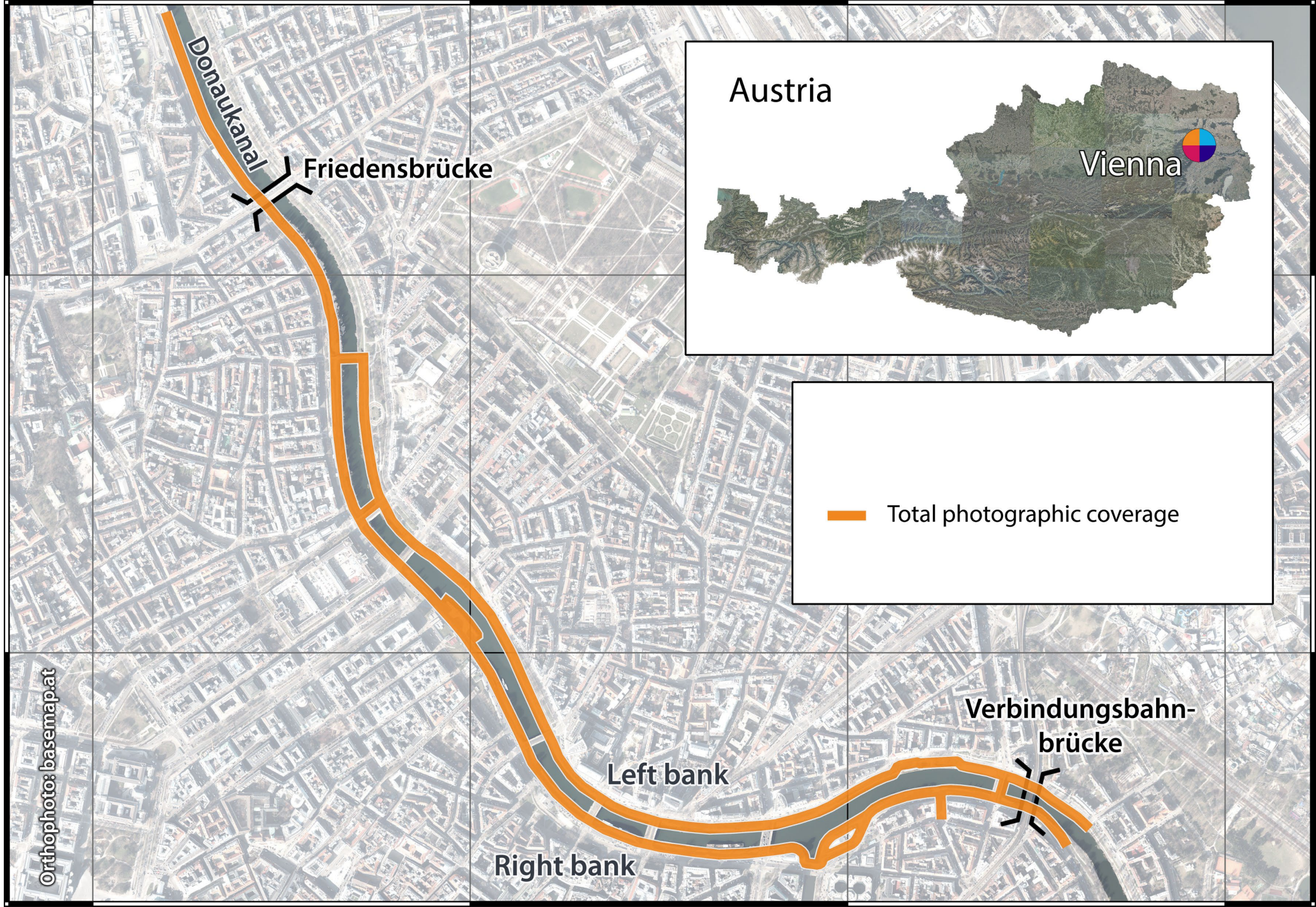
14.0 km

LEGAL SURFACES

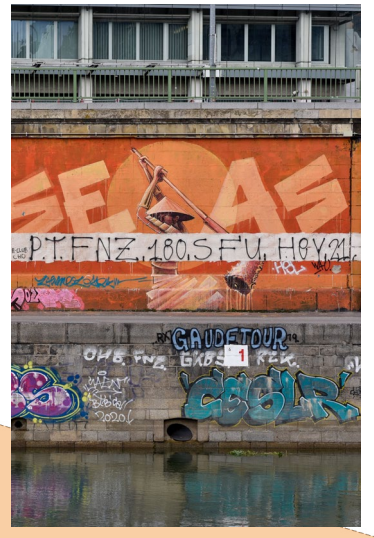
0.3 km

MONITORED SURFACES

12.9 km



TOTAL coverage



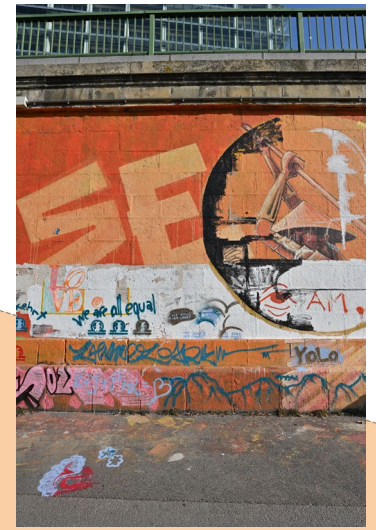
Date	Camera	Lens	Mean GSD	Acquisition time	Image count
30/09/2021	Nikon D750 (24.2 MP p = 5.95 µm)	Nikon AF-S NIKKOR 85mm 1:1.8 G @ f/5.6	3.6 mm	3 h 45 min	2065
01/10/2021				3 h 20 min	2544

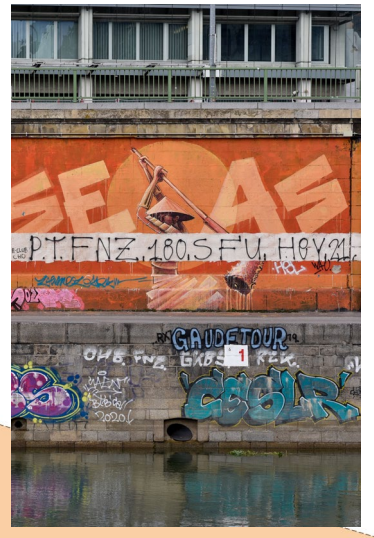
TOTAL coverage



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

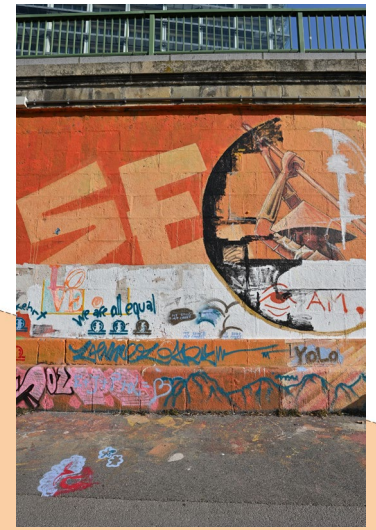
TOTAL coverage

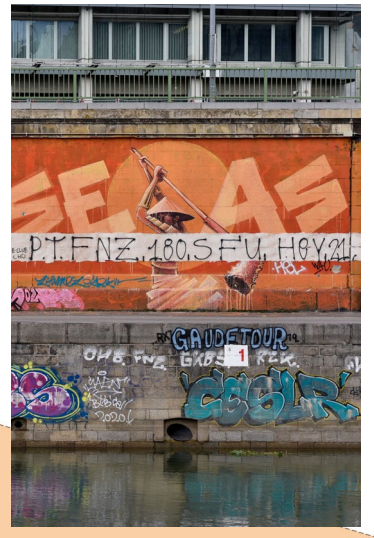




Date	Camera	Lens	Mean GSD	Acquisition time	Image count
30/09/2021	Nikon D750 (24.2 MP p = 5.95 µm)	Nikon AF-S NIKKOR 85mm 1:1.8 G @ f/5.6	3.6 mm	3 h 45 min	2065
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27/10/2021				7 h 45 min	6591
28/10/2021				3 h 40 min	2856
29/10/2021				7 h	6608
			Total	**32 h 30 min**	**26706**

TOTAL coverage



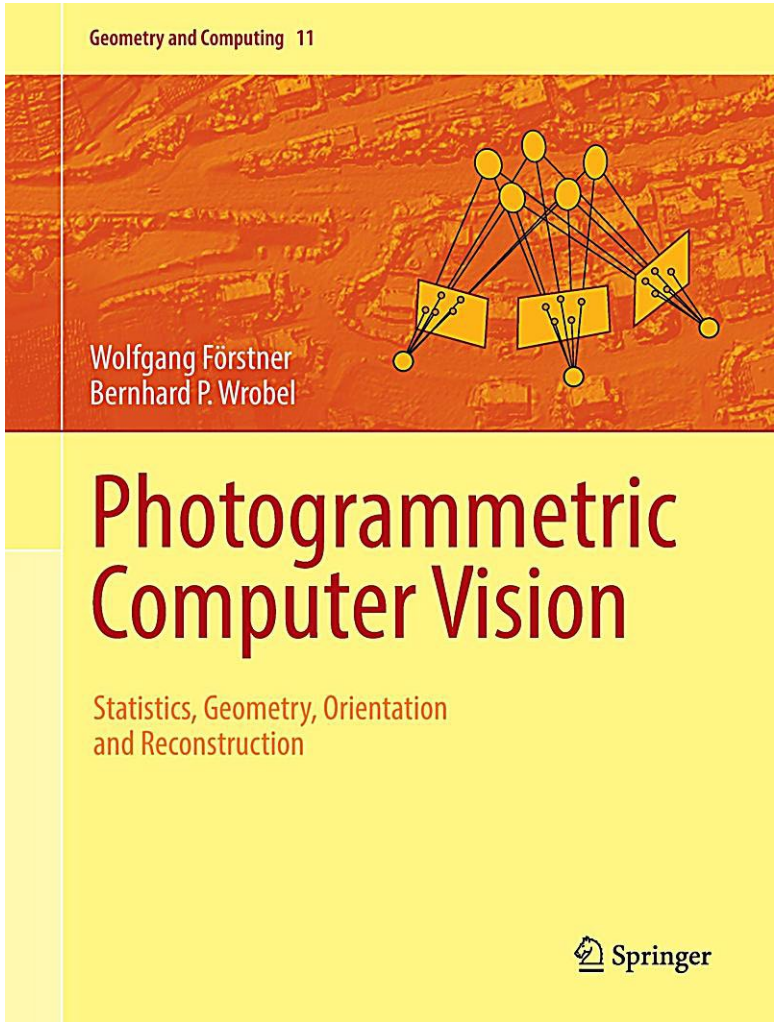


Date	Camera	Lens	Mean GSD	Acquisition time	Image count
30/09/2021	Nikon D750 (24.2 MP p = 5.95 µm)	Nikon AF-S NIKKOR 85mm 1:1.8 G @ f/5.6	3.6 mm	3 h 45 min	2065
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27/10/2021				7 h 45 min	6591
28/10/2021				3 h 40 min	2856
29/10/2021				7 h	6608
			Total	**32 h 30 min**	**26706**

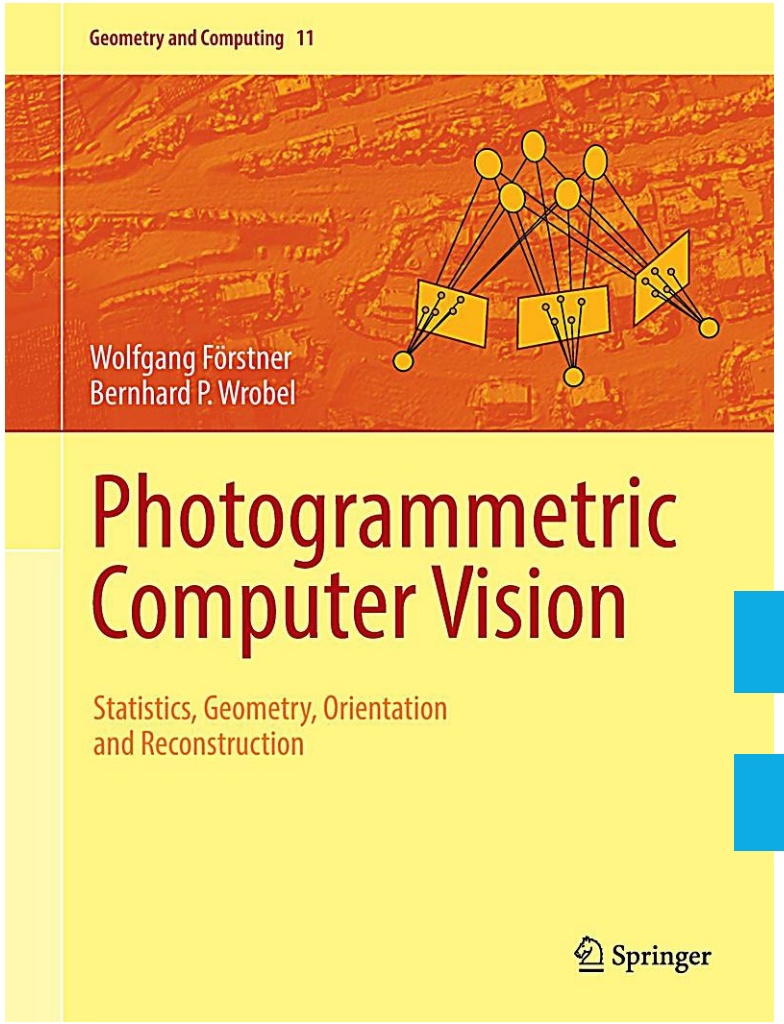
processing



PHOTOGRAMMETRIC computer vision



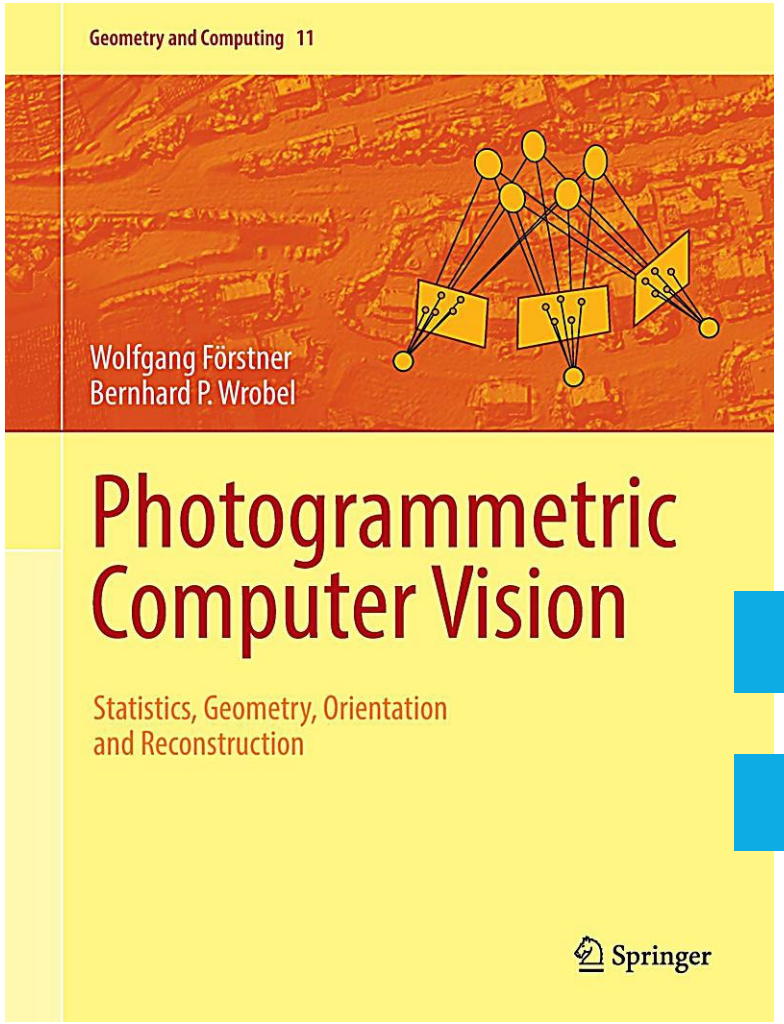
PHOTOGRAMMETRIC computer vision



Structure from Motion

Multi-View Stereo

PHOTOGRAMMETRIC computer vision

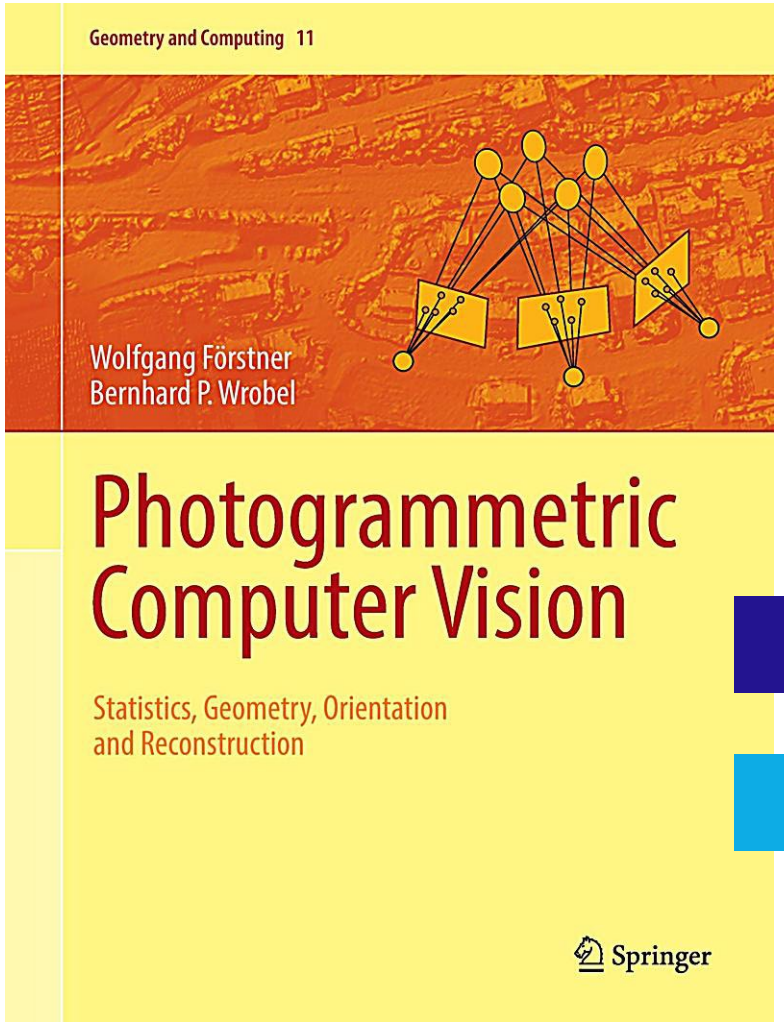


Metashape

Structure from Motion

Multi-View Stereo

PHOTOGRAMMETRIC computer vision



Metashape

Structure from Motion

Multi-View Stereo

STRUCTURE from motion







STRUCTURE from motion







DETECT *FEATURES*

STRUCTURE from motion







DETECT *FEATURES*

STRUCTURE from motion







DETECT *FEATURES*

STRUCTURE from motion

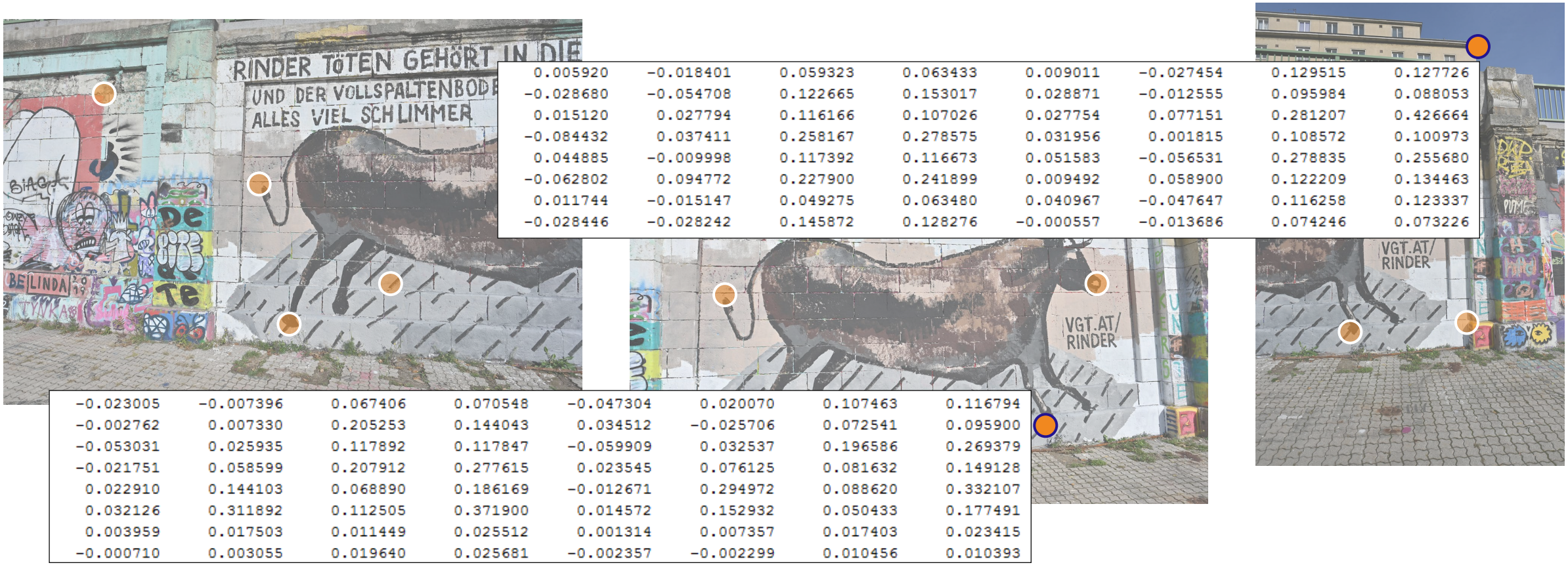






DESCRIBE *FEATURES*

STRUCTURE from motion



0.005920	-0.018401	0.059323	0.063433	0.009011	-0.027454	0.129515	0.127726
-0.028680	-0.054708	0.122665	0.153017	0.028871	-0.012555	0.095984	0.088053
0.015120	0.027794	0.116166	0.107026	0.027754	0.077151	0.281207	0.426664
-0.084432	0.037411	0.258167	0.278575	0.031956	0.001815	0.108572	0.100973
0.044885	-0.009998	0.117392	0.116673	0.051583	-0.056531	0.278835	0.255680
-0.062802	0.094772	0.227900	0.241899	0.009492	0.058900	0.122209	0.134463
0.011744	-0.015147	0.049275	0.063480	0.040967	-0.047647	0.116258	0.123337
-0.028446	-0.028242	0.145872	0.128276	-0.000557	-0.013686	0.074246	0.073226

-0.023005	-0.007396	0.067406	0.070548	-0.047304	0.020070	0.107463	0.116794
-0.002762	0.007330	0.205253	0.144043	0.034512	-0.025706	0.072541	0.095900
-0.053031	0.025935	0.117892	0.117847	-0.059909	0.032537	0.196586	0.269379
-0.021751	0.058599	0.207912	0.277615	0.023545	0.076125	0.081632	0.149128
0.022910	0.144103	0.068890	0.186169	-0.012671	0.294972	0.088620	0.332107
0.032126	0.311892	0.112505	0.371900	0.014572	0.152932	0.050433	0.177491
0.003959	0.017503	0.011449	0.025512	0.001314	0.007357	0.017403	0.023415
-0.000710	0.003055	0.019640	0.025681	-0.002357	-0.002299	0.010456	0.010393

DESCRIBE *FEATURES*

STRUCTURE from motion







MATCH *DESCRIPTORS*

STRUCTURE from motion

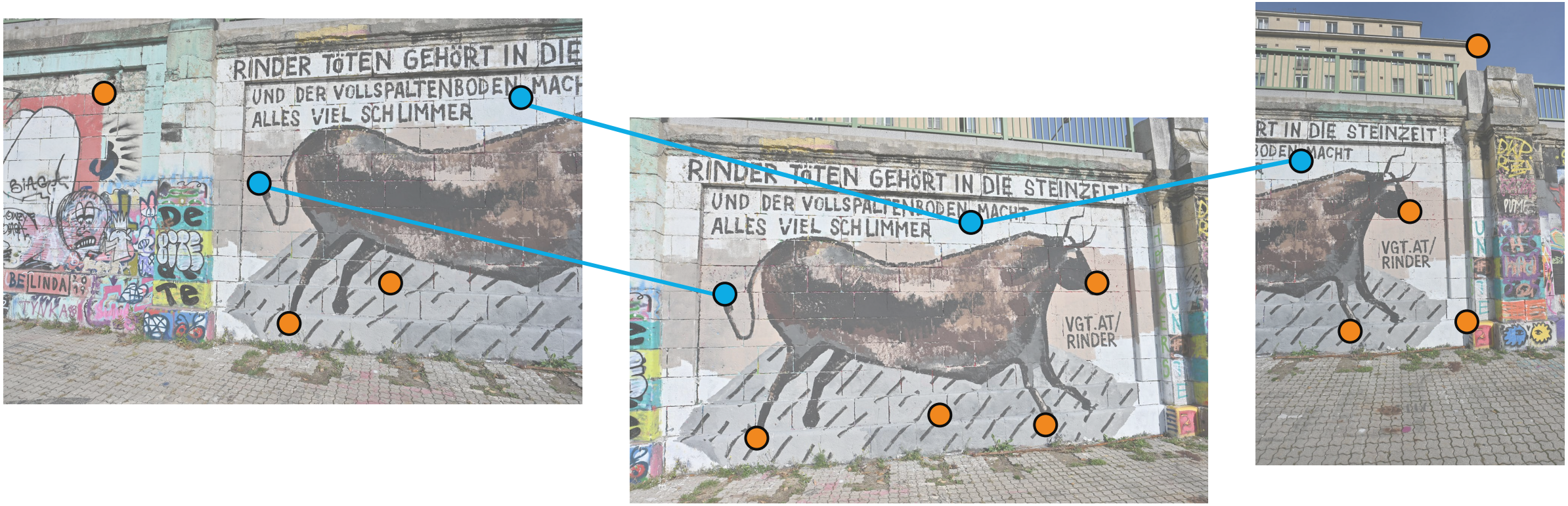






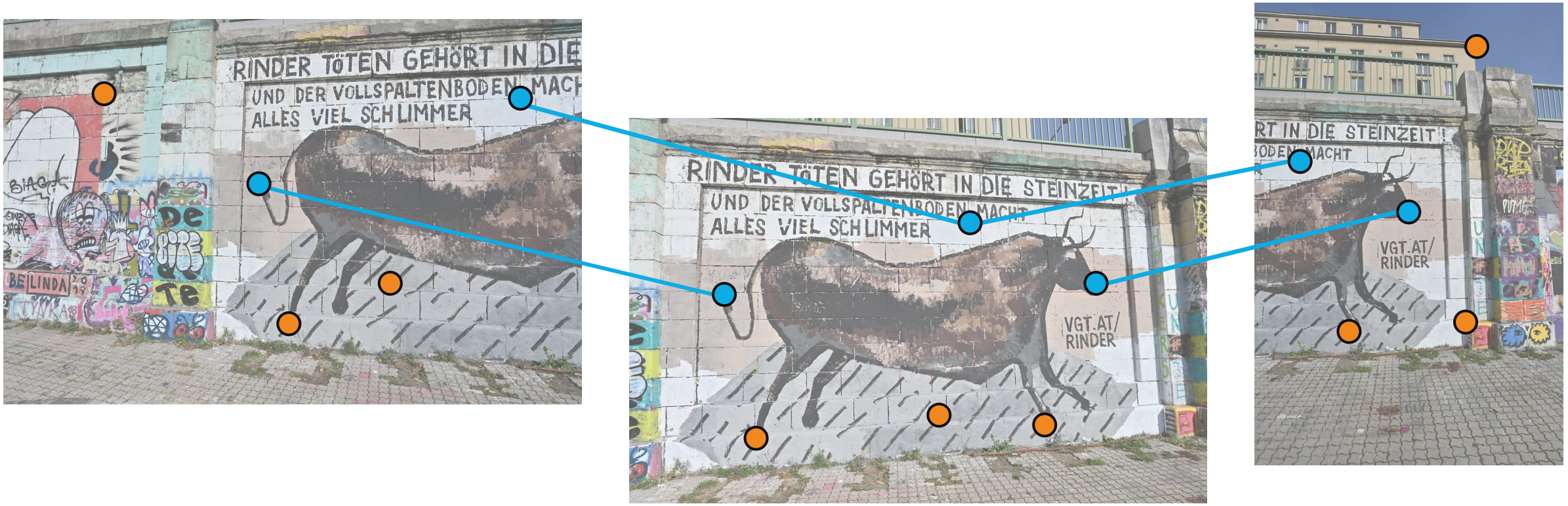
MATCH *DESCRIPTORS*

STRUCTURE from motion



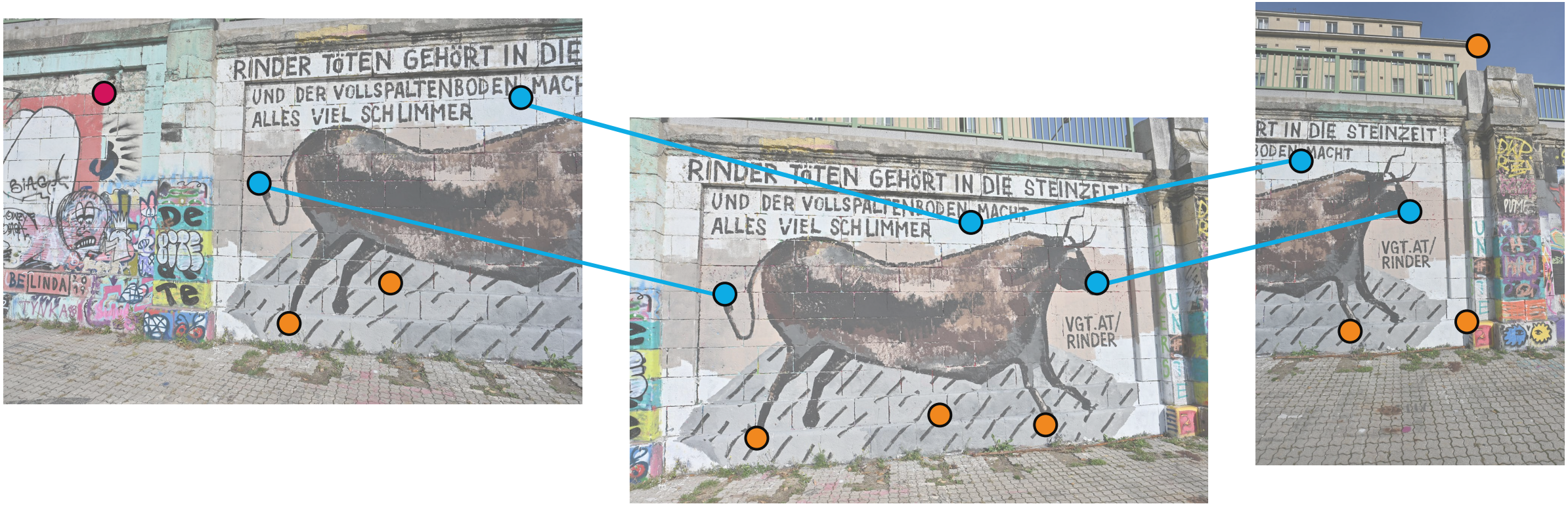
MATCH *DESCRIPTORS*

STRUCTURE from motion



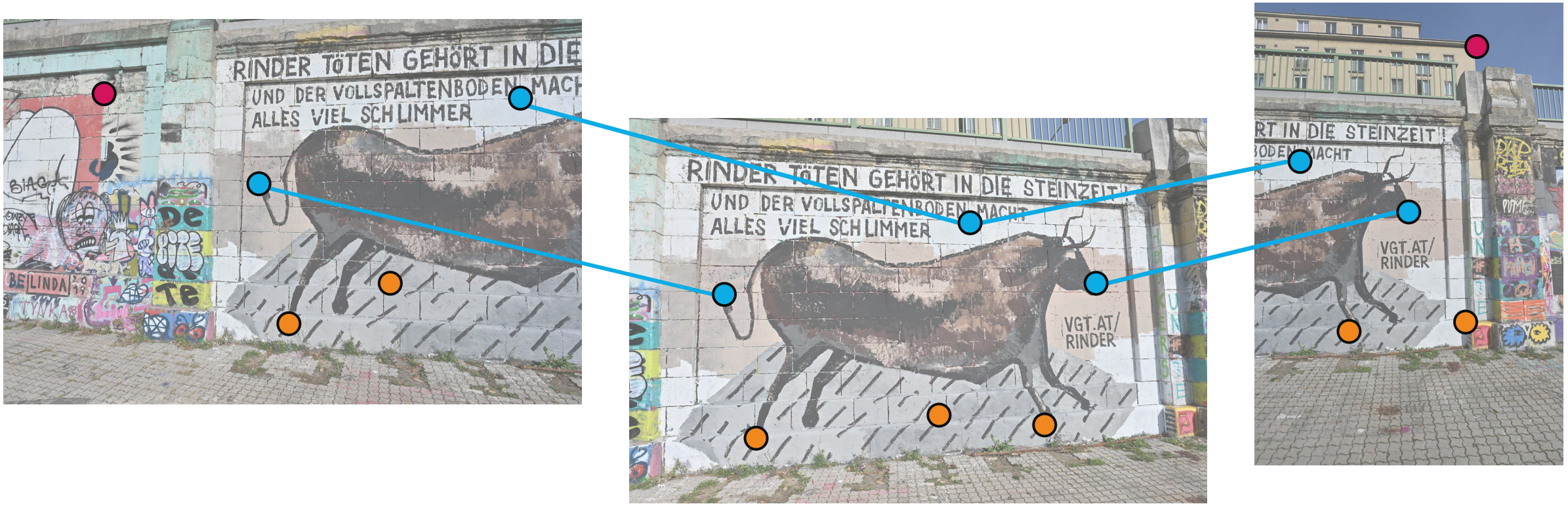
MATCH *DESCRIPTORS*

STRUCTURE from motion



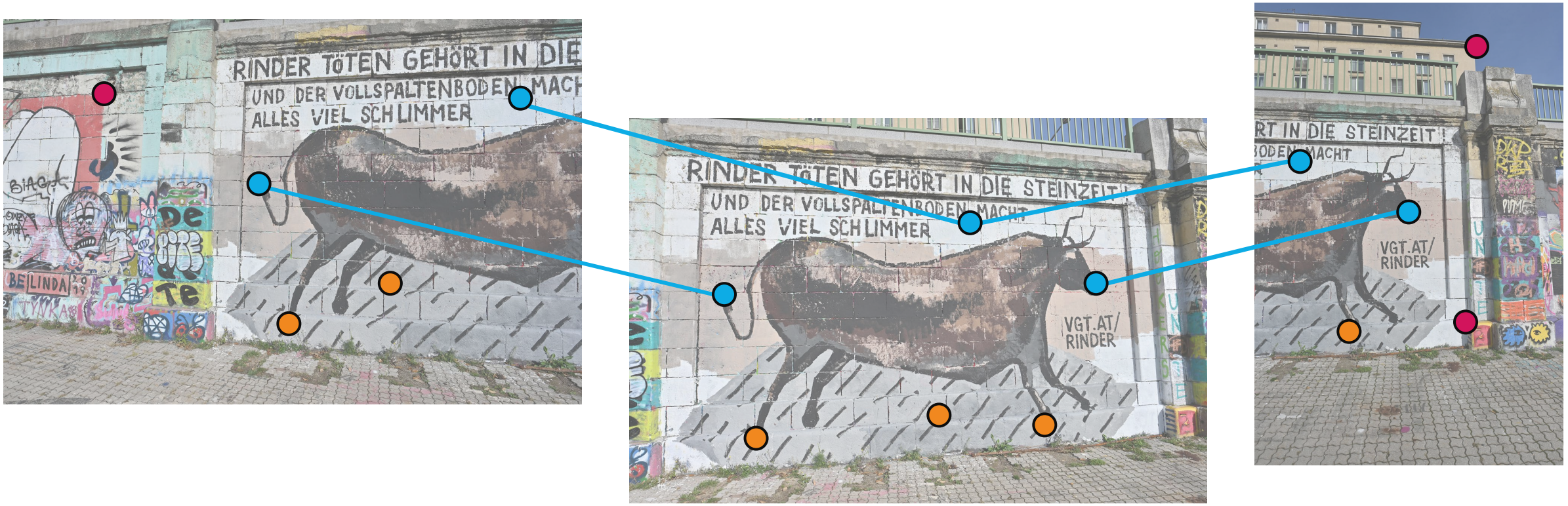
MATCH *DESCRIPTORS*

STRUCTURE from motion



MATCH *DESCRIPTORS*

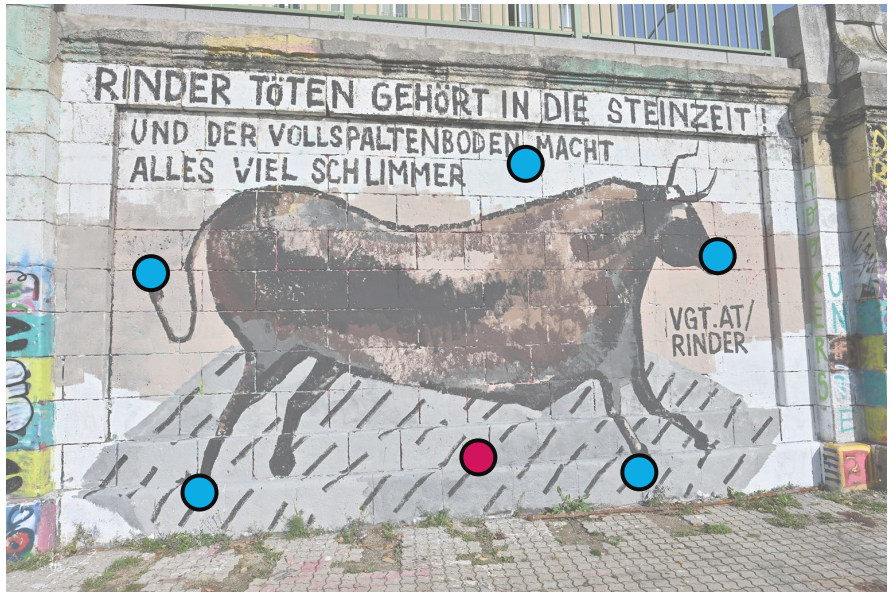
STRUCTURE from motion



MATCH *DESCRIPTORS*

STRUCTURE from motion





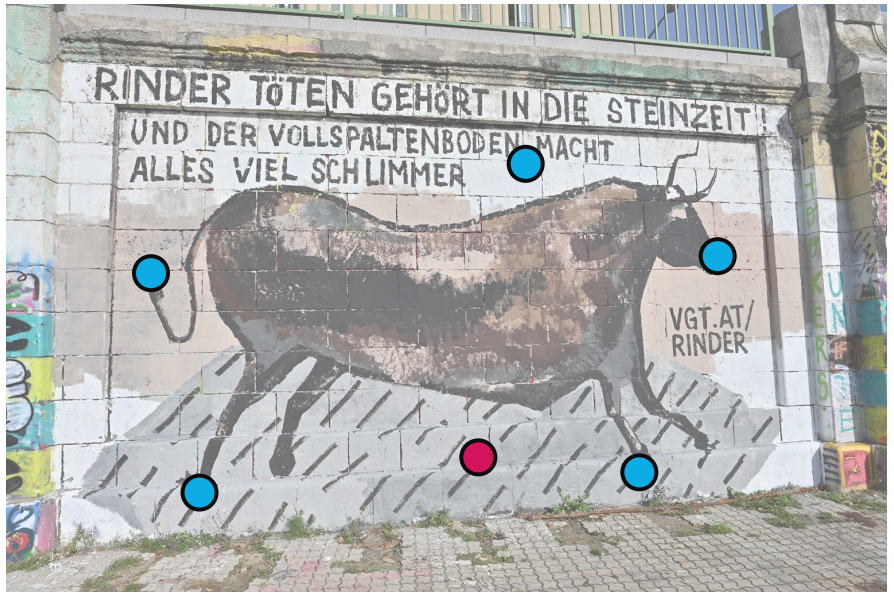


MATCH *DESCRIPTORS*

STRUCTURE from motion



TIE POINTS



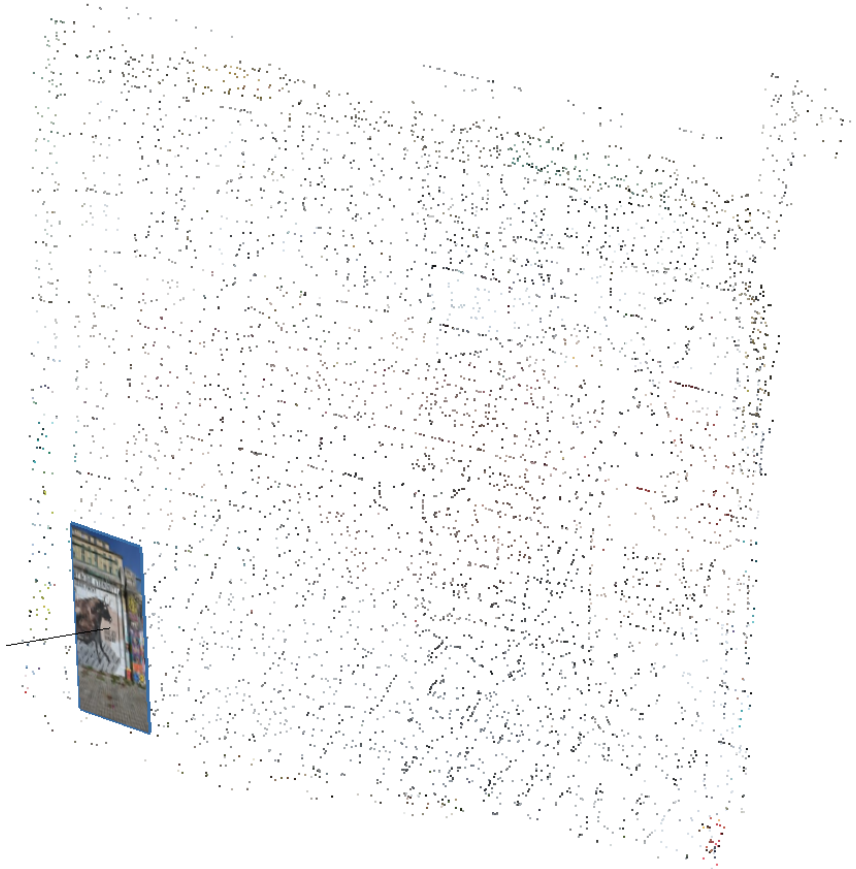


STRUCTURE from motion



TIE POINTS





ESTIMATE *CAMERA EXTERIOR ORIENTATION*

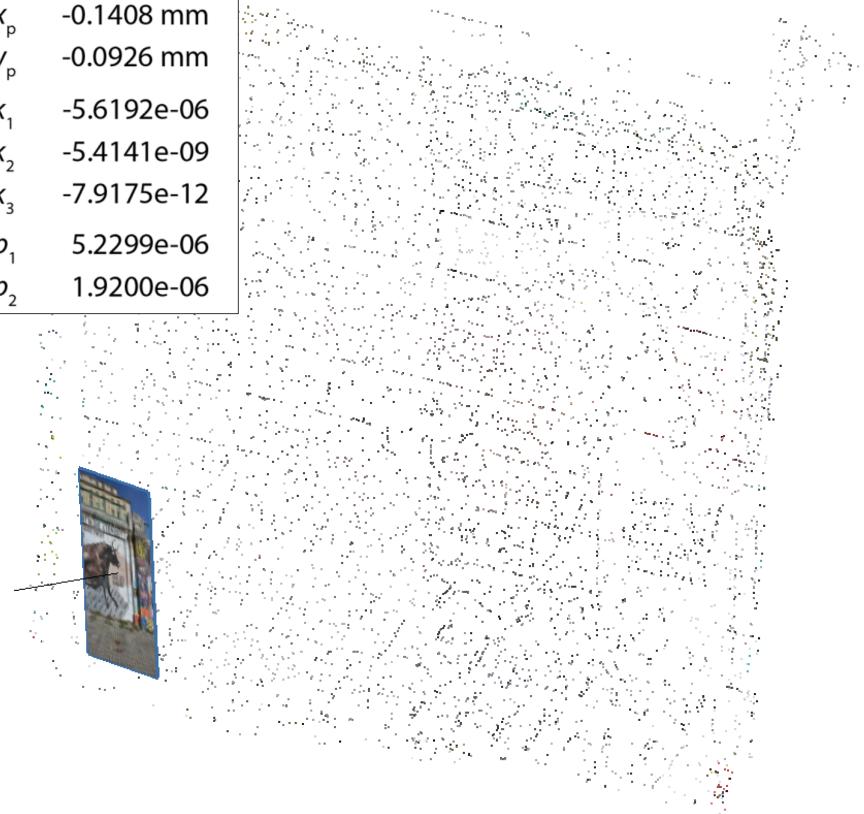
STRUCTURE from motion



TIE POINTS

principal distance	c	20.1546 mm
principal point location	x_p	-0.1408 mm
	y_p	-0.0926 mm
radial distortion parameters	k_1	-5.6192e-06
	k_2	-5.4141e-09
	k_3	-7.9175e-12
decentring distortion parameters	p_1	5.2299e-06
	p_2	1.9200e-06





ESTIMATE *CAMERA EXTERIOR ORIENTATION*

ESTIMATE *CAMERA INTERIOR ORIENTATION*

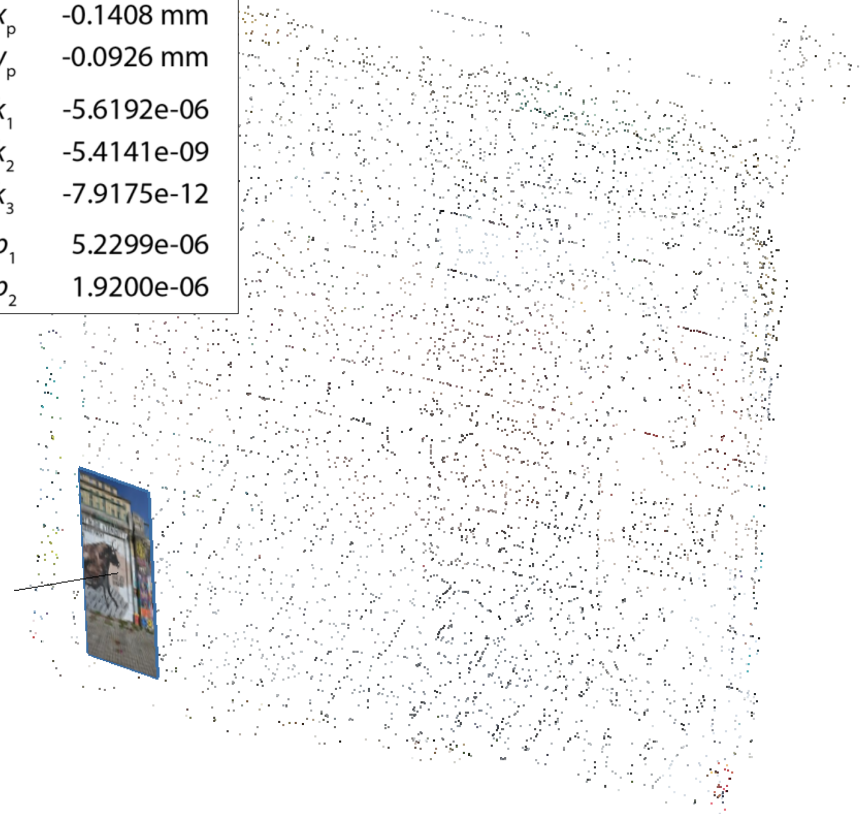
STRUCTURE from motion



TIE POINTS

principal distance	c	20.1546 mm
principal point location	x_p	-0.1408 mm
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radial distortion parameters	k_1	-5.6192e-06
	k_2	-5.4141e-09
	k_3	-7.9175e-12
decentring distortion parameters	p_1	5.2299e-06
	p_2	1.9200e-06





3D POINTS

ESTIMATE *CAMERA EXTERIOR ORIENTATION*

ESTIMATE *CAMERA INTERIOR ORIENTATION*

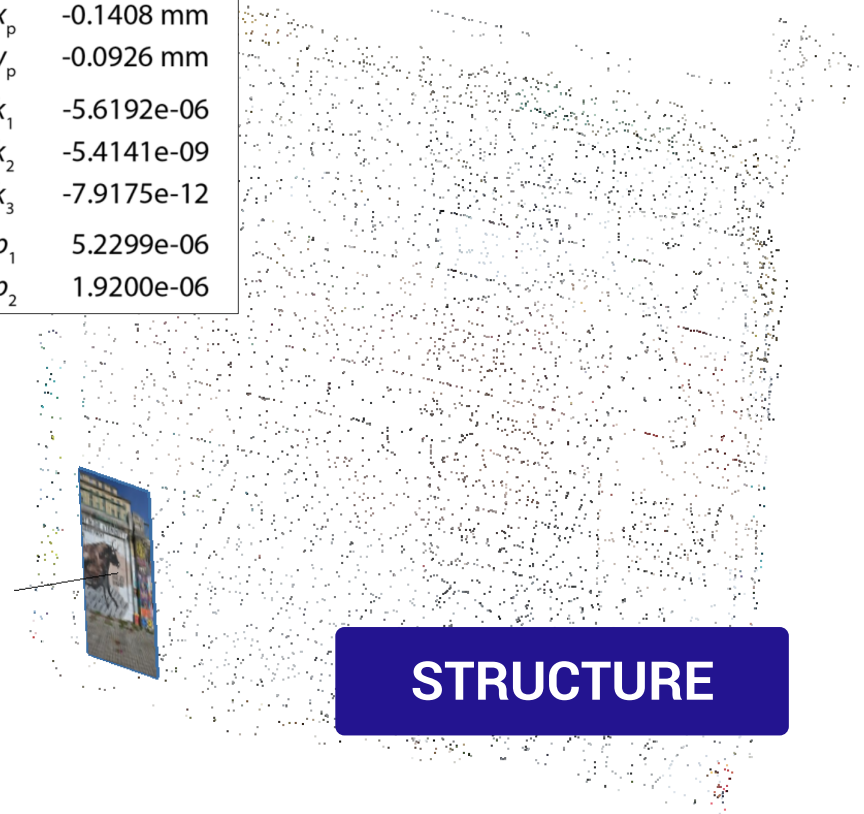
STRUCTURE from motion



TIE POINTS

principal distance	c	20.1546 mm
principal point location	x_p	-0.1408 mm
	y_p	-0.0926 mm
radial distortion parameters	k_1	-5.6192e-06
	k_2	-5.4141e-09
	k_3	-7.9175e-12
decentring distortion parameters	p_1	5.2299e-06
	p_2	1.9200e-06





STRUCTURE

3D POINTS

ESTIMATE *CAMERA EXTERIOR ORIENTATION*

ESTIMATE *CAMERA INTERIOR ORIENTATION*

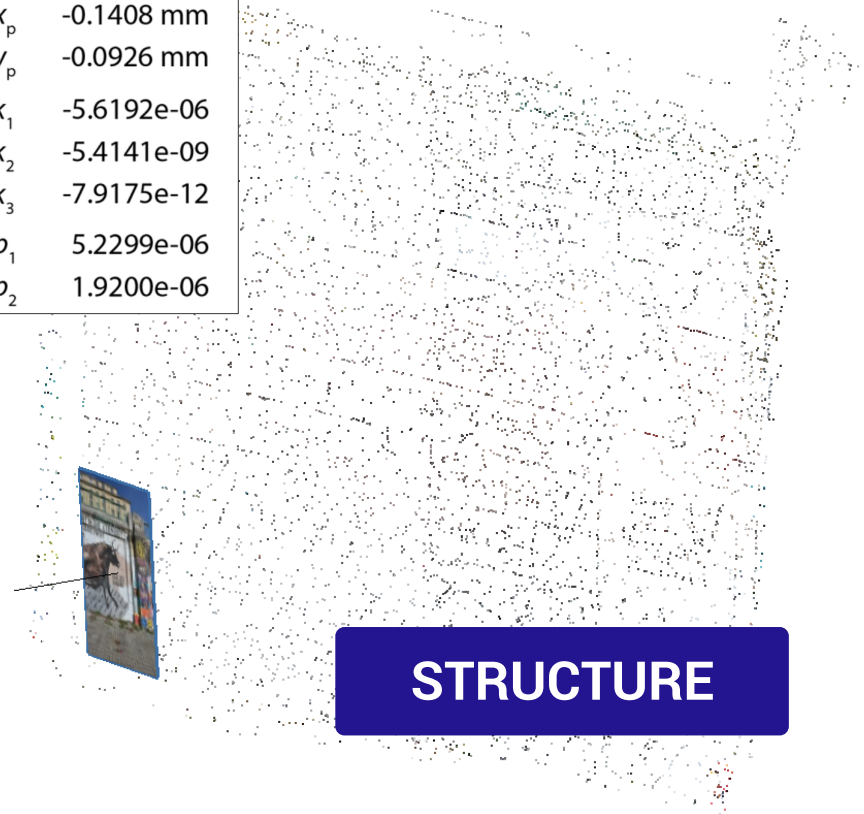
STRUCTURE and from motion



TIE POINTS

principal distance	c	20.1546 mm
principal point location	x_p	-0.1408 mm
	y_p	-0.0926 mm
radial distortion parameters	k_1	-5.6192e-06
	k_2	-5.4141e-09
	k_3	-7.9175e-12
decentring distortion parameters	p_1	5.2299e-06
	p_2	1.9200e-06





STRUCTURE

3D POINTS

ESTIMATE *CAMERA EXTERIOR ORIENTATION*

ESTIMATE *CAMERA INTERIOR ORIENTATION*

STRUCTURE from motion







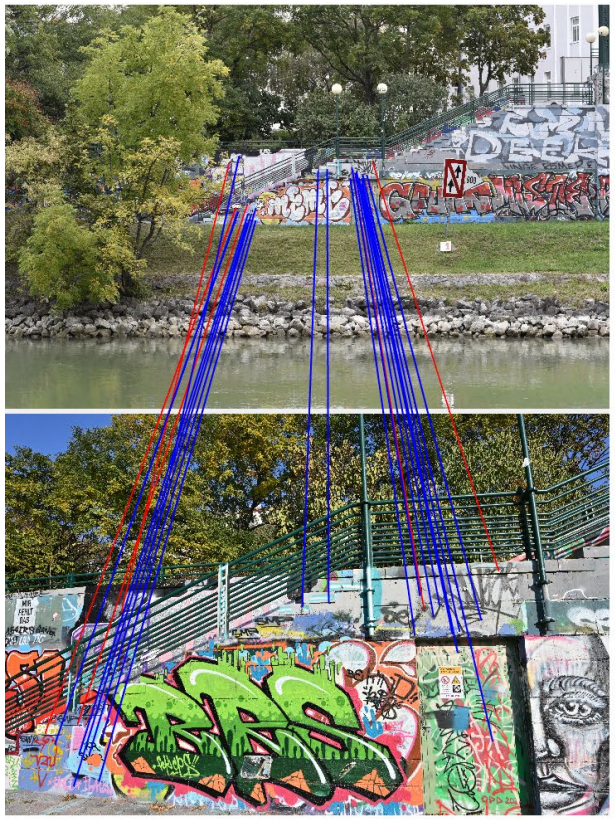
CAMERA EXTERIOR ORIENTATION

CAMERA INTERIOR ORIENTATION

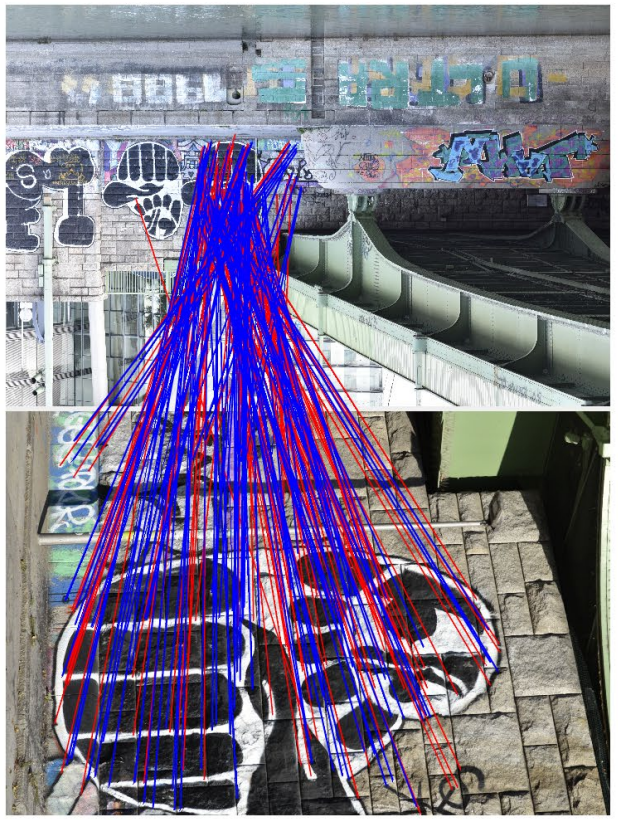
3D POINTS

CAMERA orientation

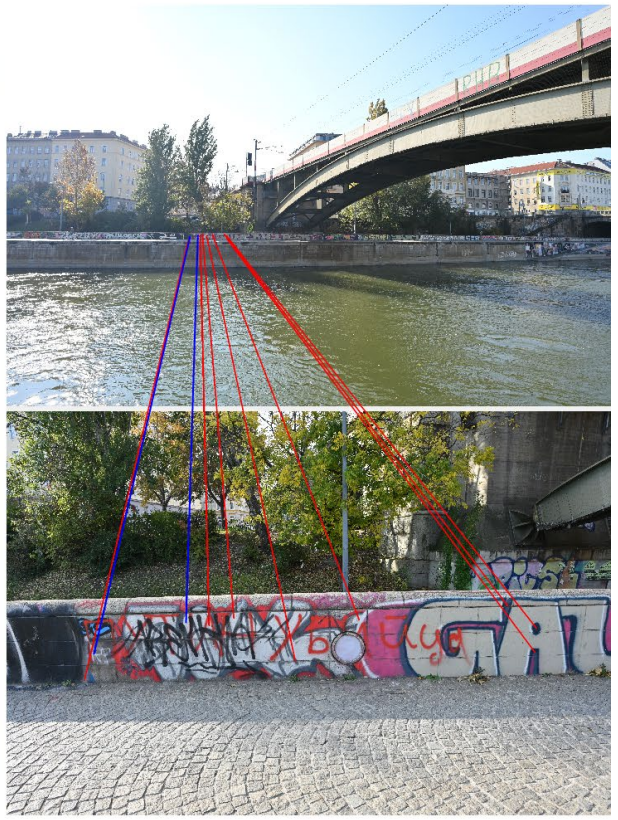
Nikon D750 + 85 mm
30-09-2021



Nikon D750 + 85 mm
30-09-2021



Nikon Z7 II + 20 mm
28-10-2021

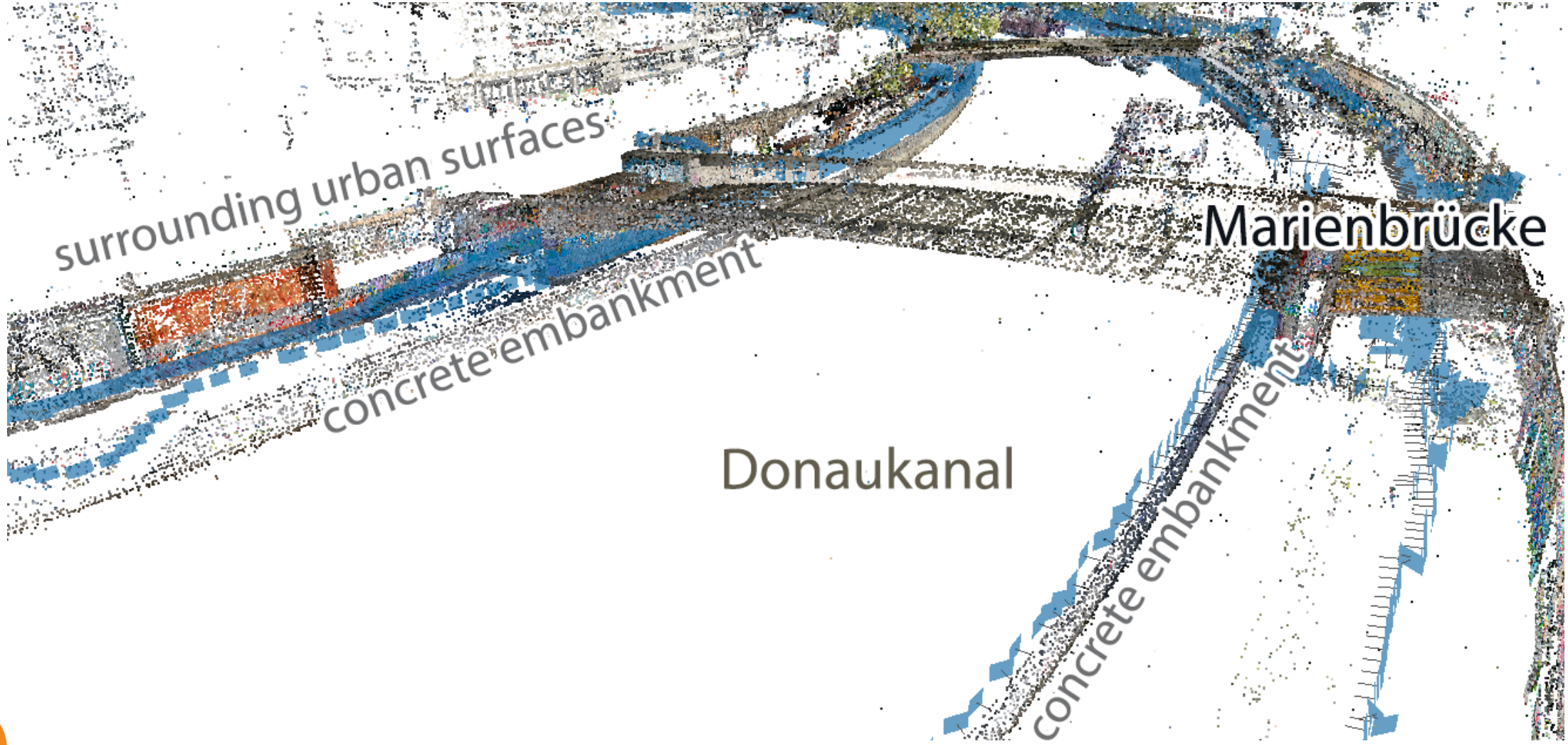


Nikon Z7 II + 20 mm
29-10-2021

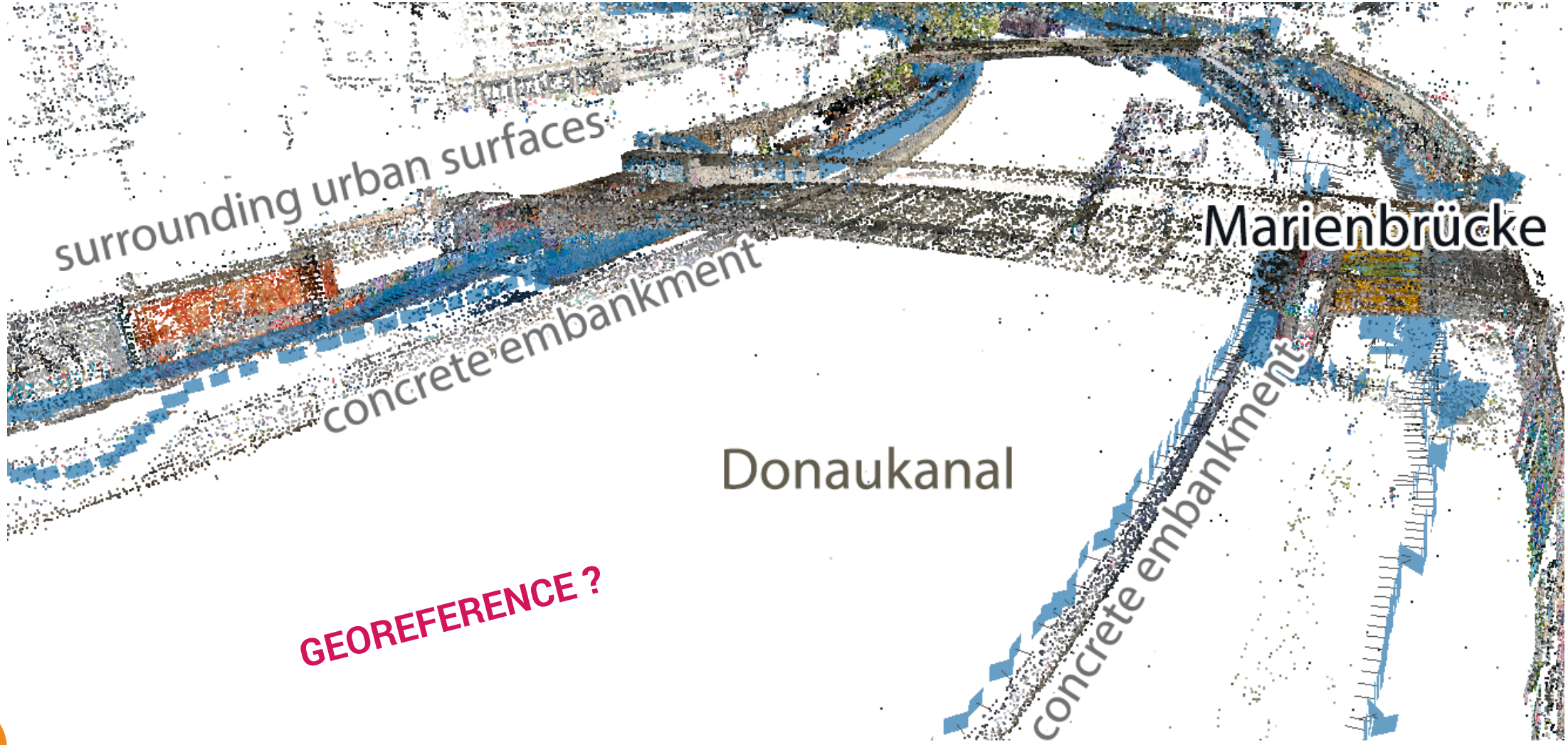
Nikon D750 + 85 mm
01-10-2021

Nikon Z7 II + 20 mm
26-10-2021

CAMERA orientation



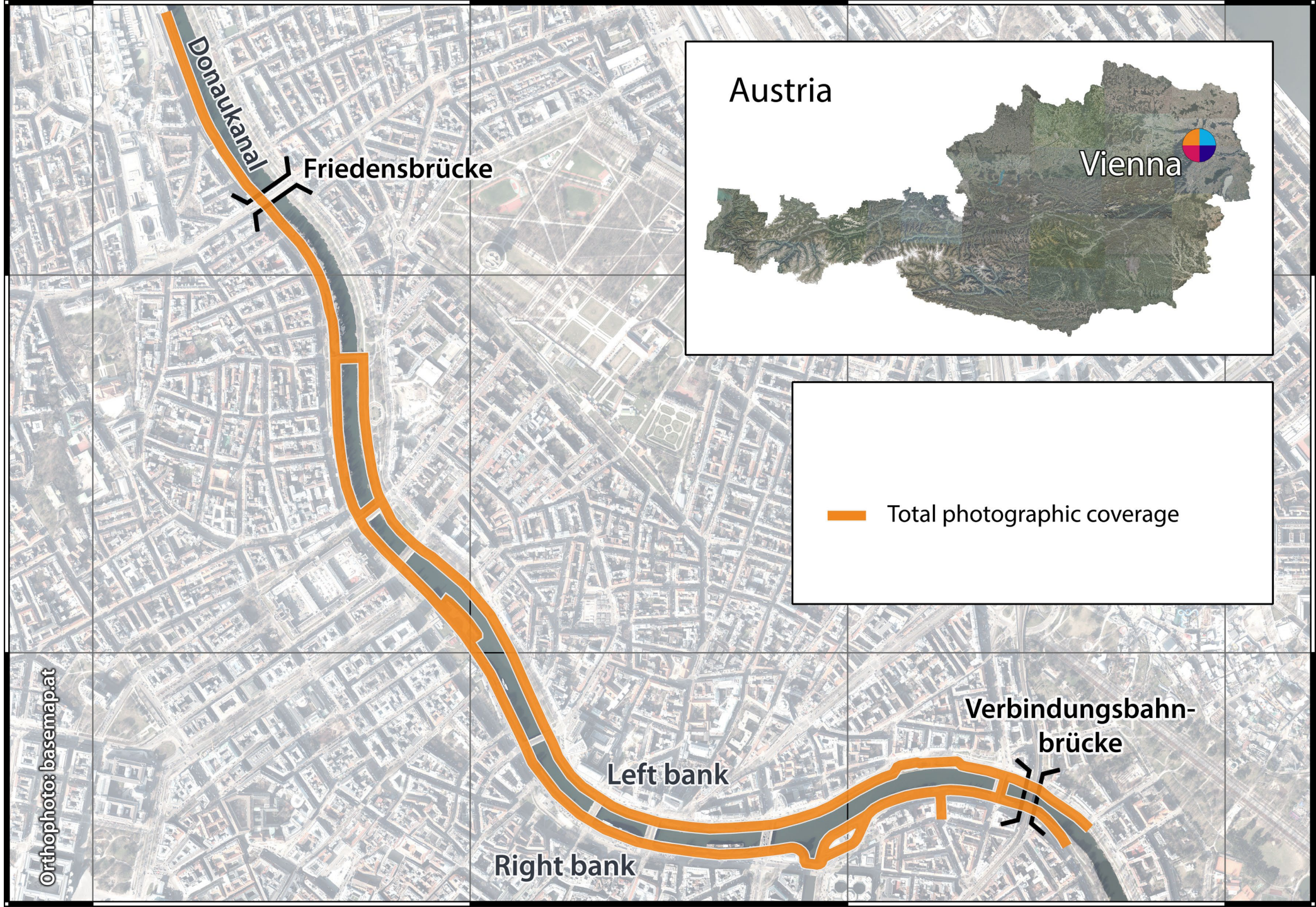
CAMERA orientation



GEOREFERENCE ?

TOTAL COVERAGE

14.0 km

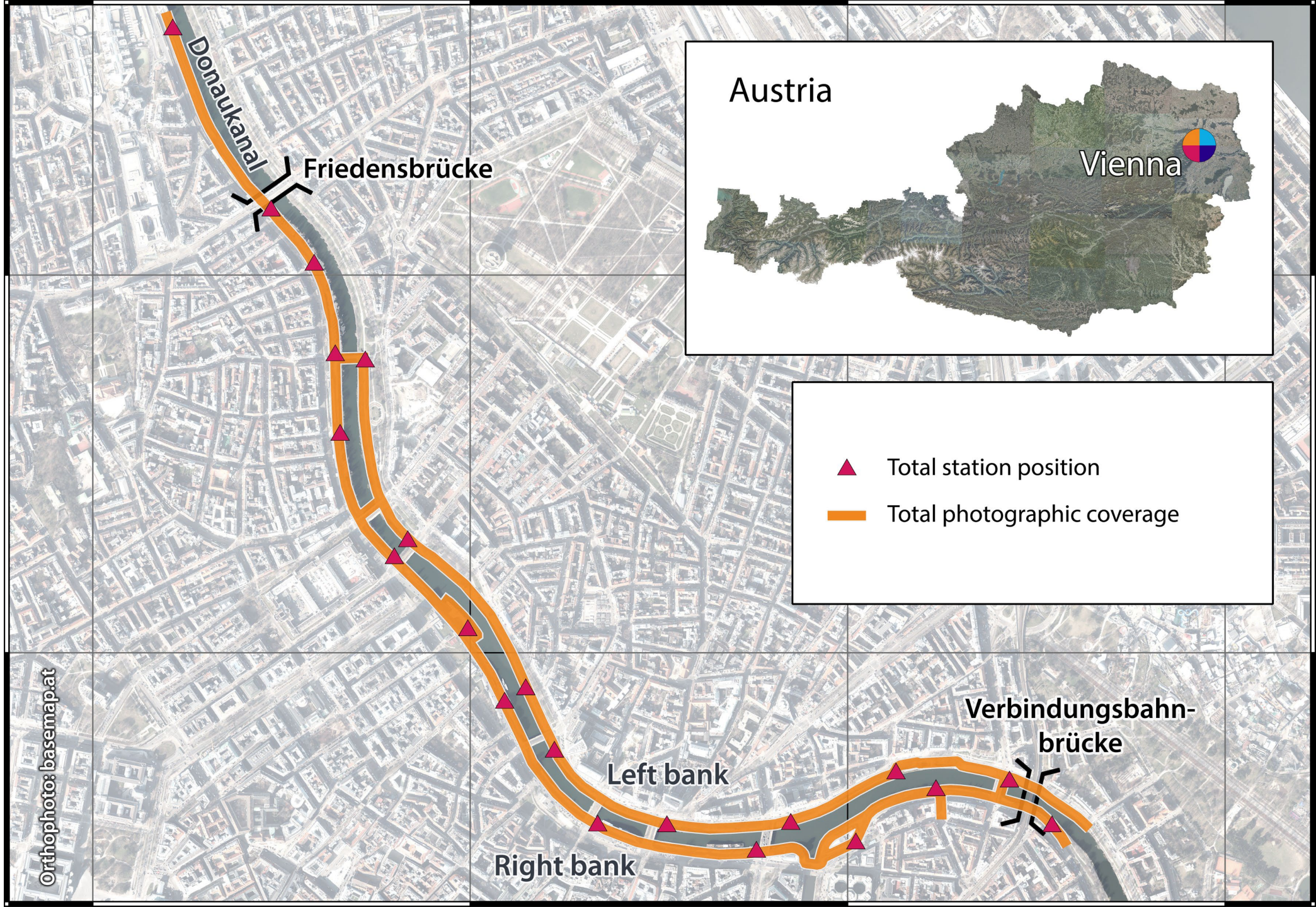


TOTAL COVERAGE

14.0 km

TOTAL STATION POSITIONS

21



TOTAL COVERAGE

14.0 km

TOTAL STATION POSITIONS

21



TOTAL COVERAGE

14.0 km

TOTAL STATION POSITIONS

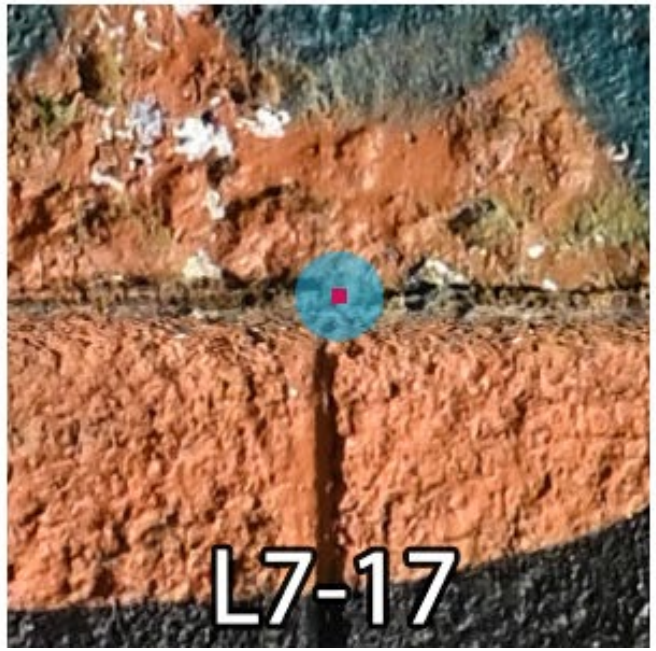
21

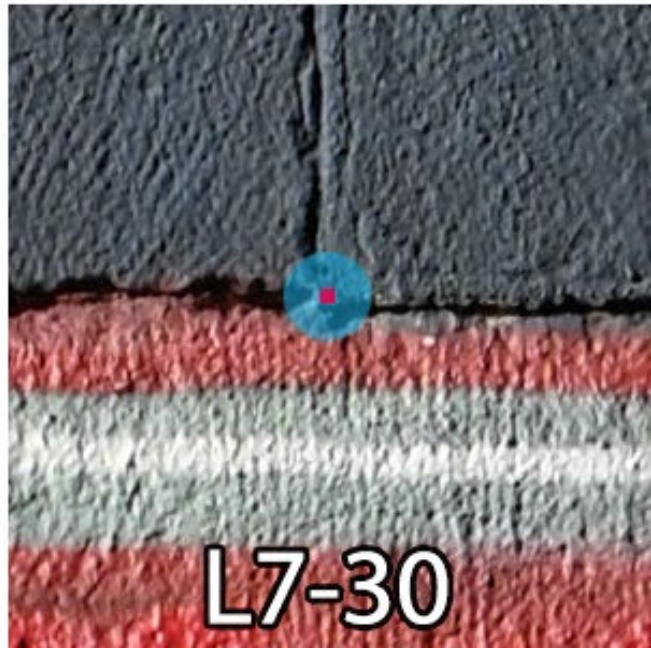
GRAFFITI-SCAPE POINTS

624

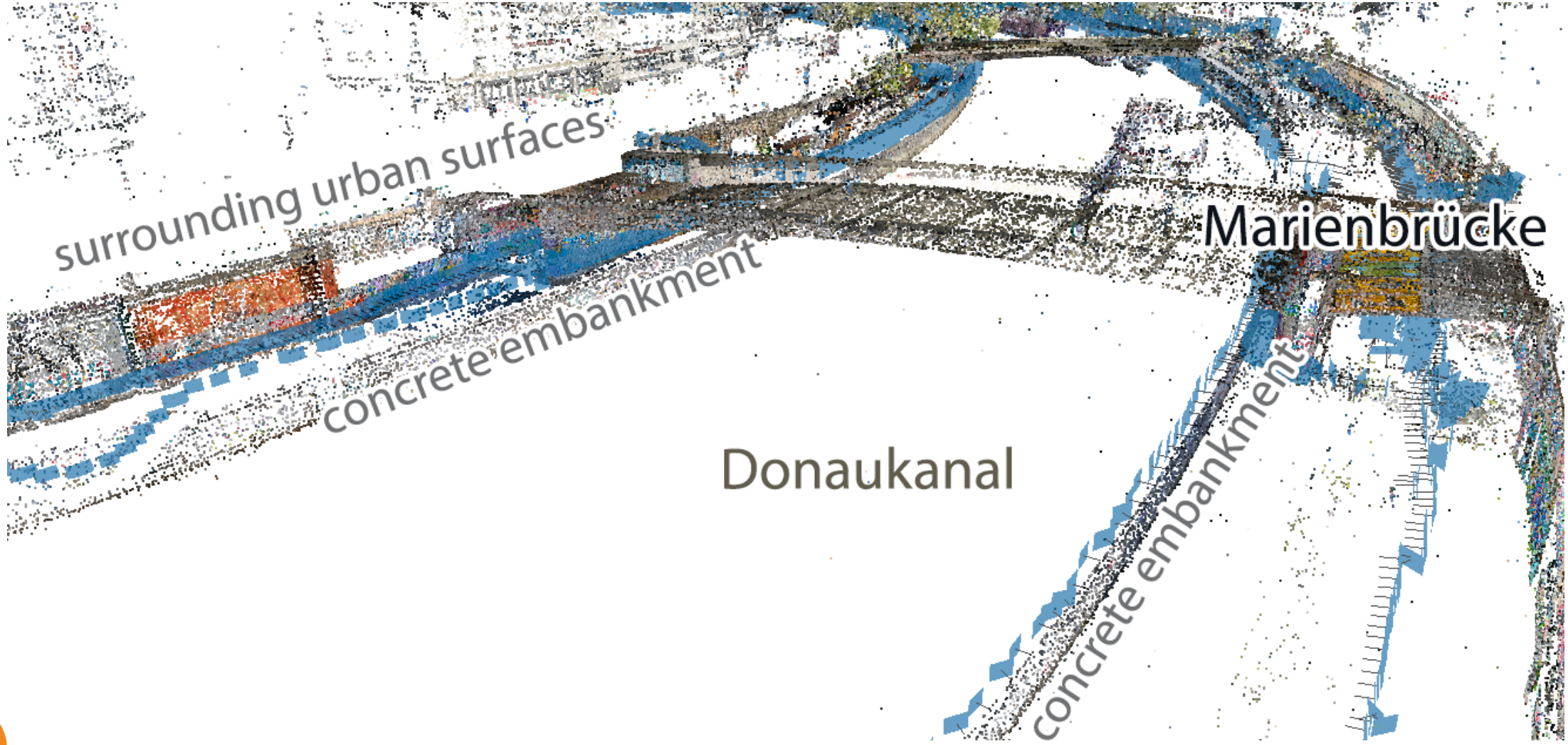




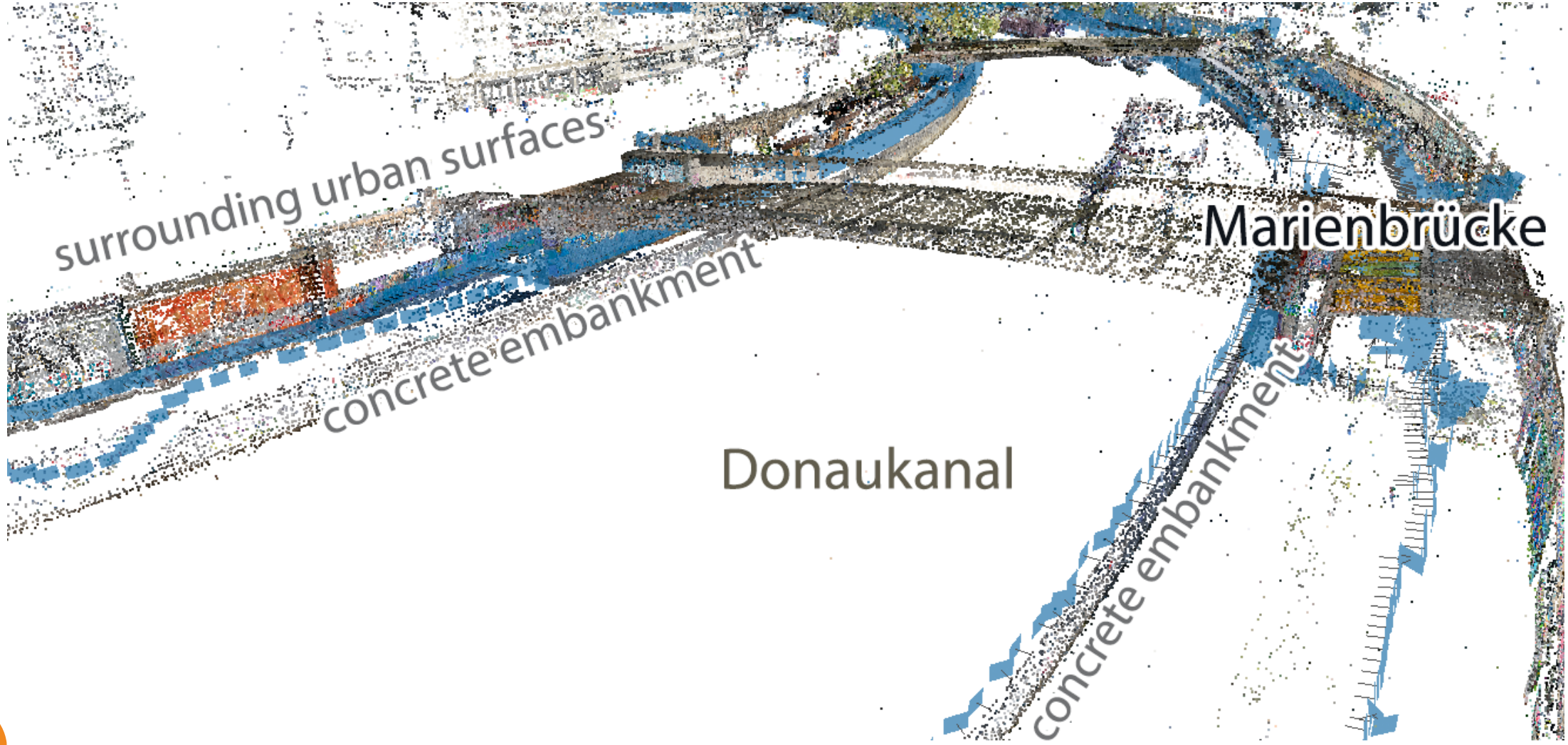




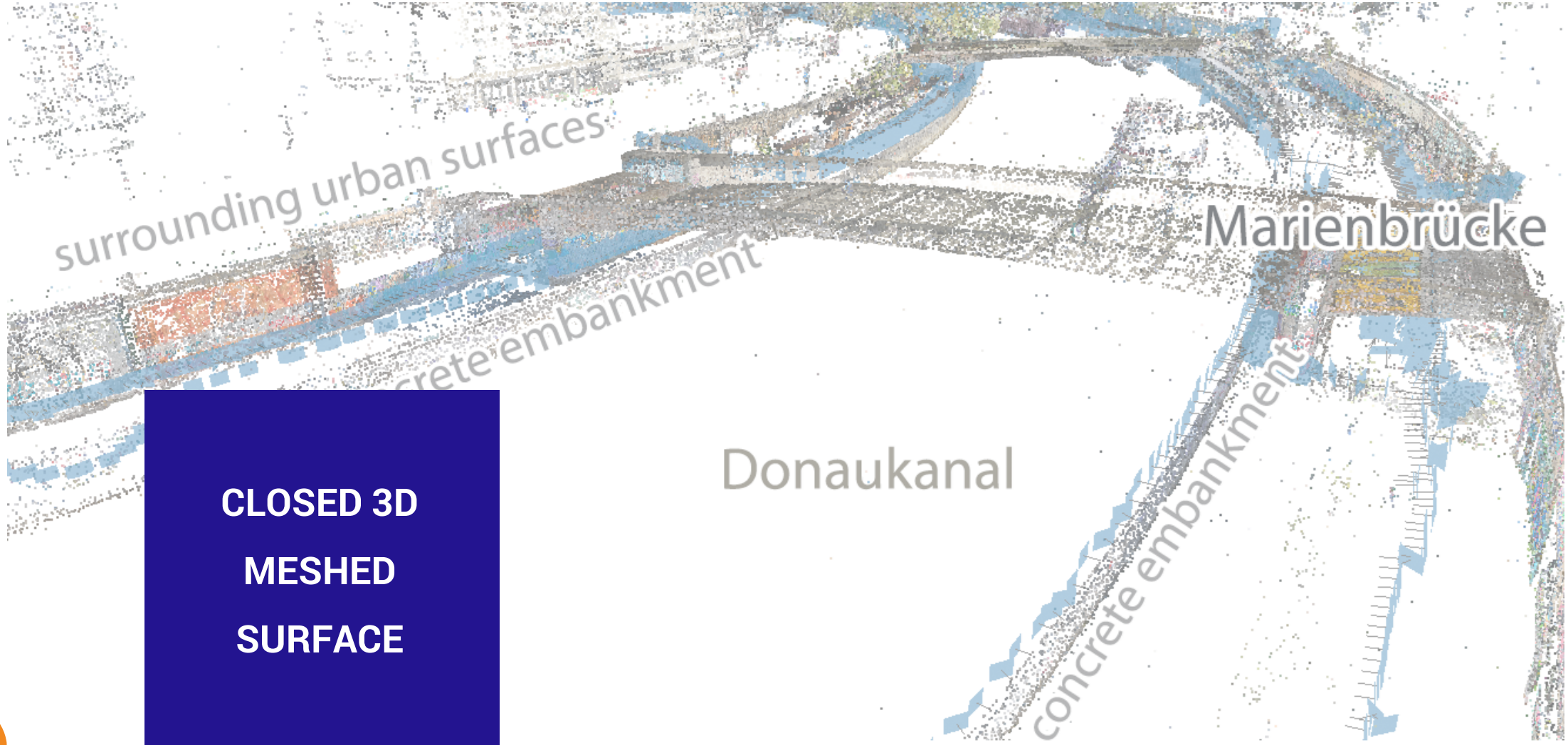
CAMERA orientation



THREE purposes

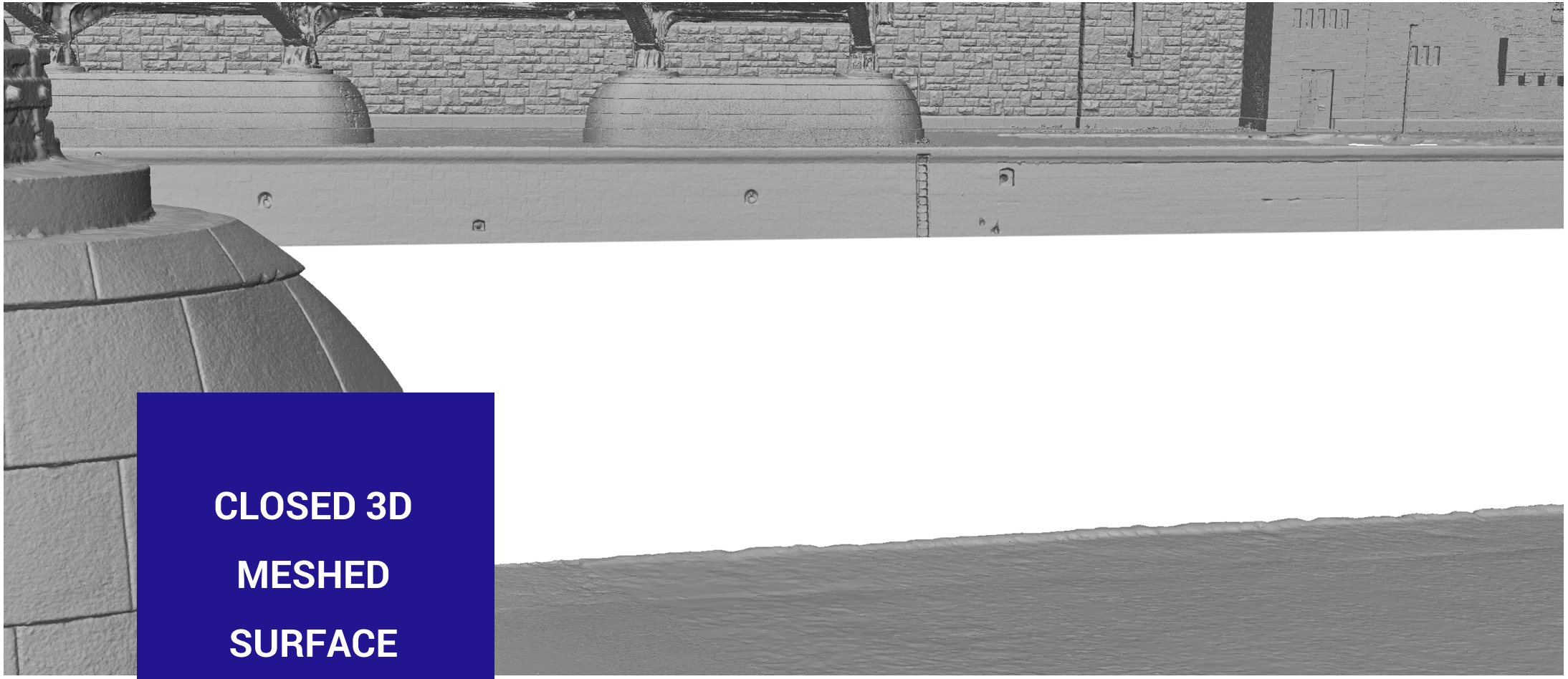


THREE purposes



CLOSED 3D MESHED SURFACE

THREE purposes

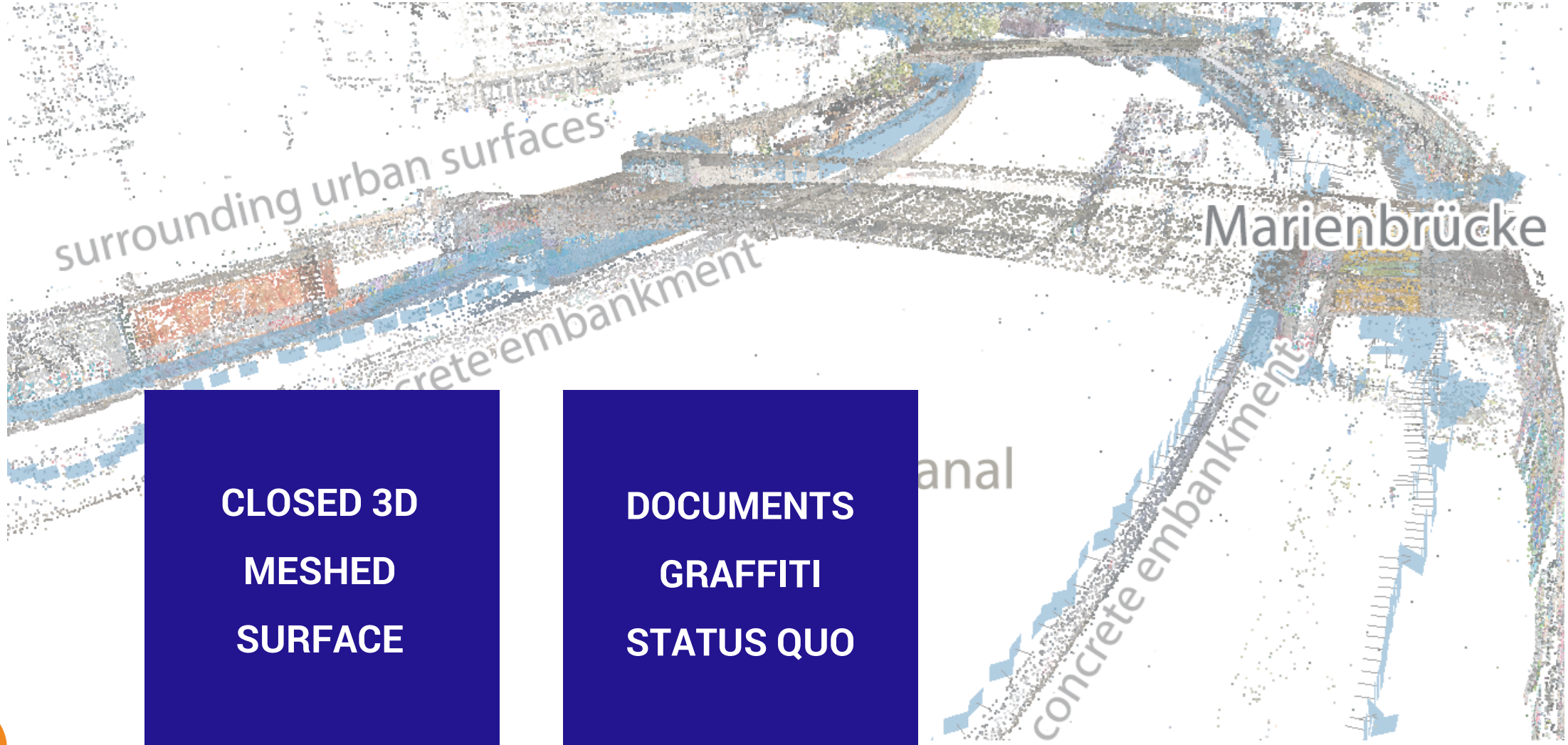


CLOSED 3D

MESHED

SURFACE

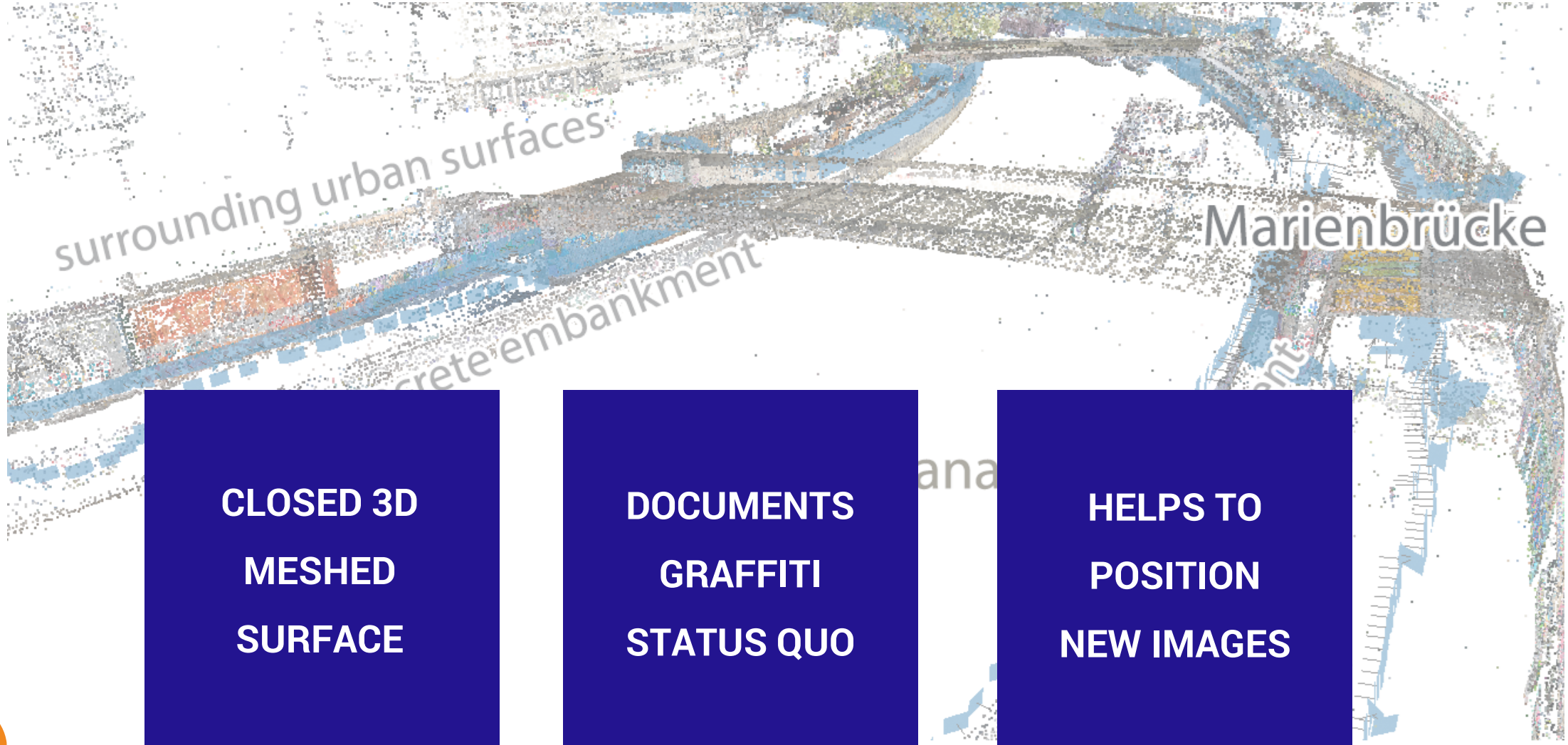
THREE purposes



CLOSED 3D MESHED SURFACE

DOCUMENTS GRAFFITI STATUS QUO

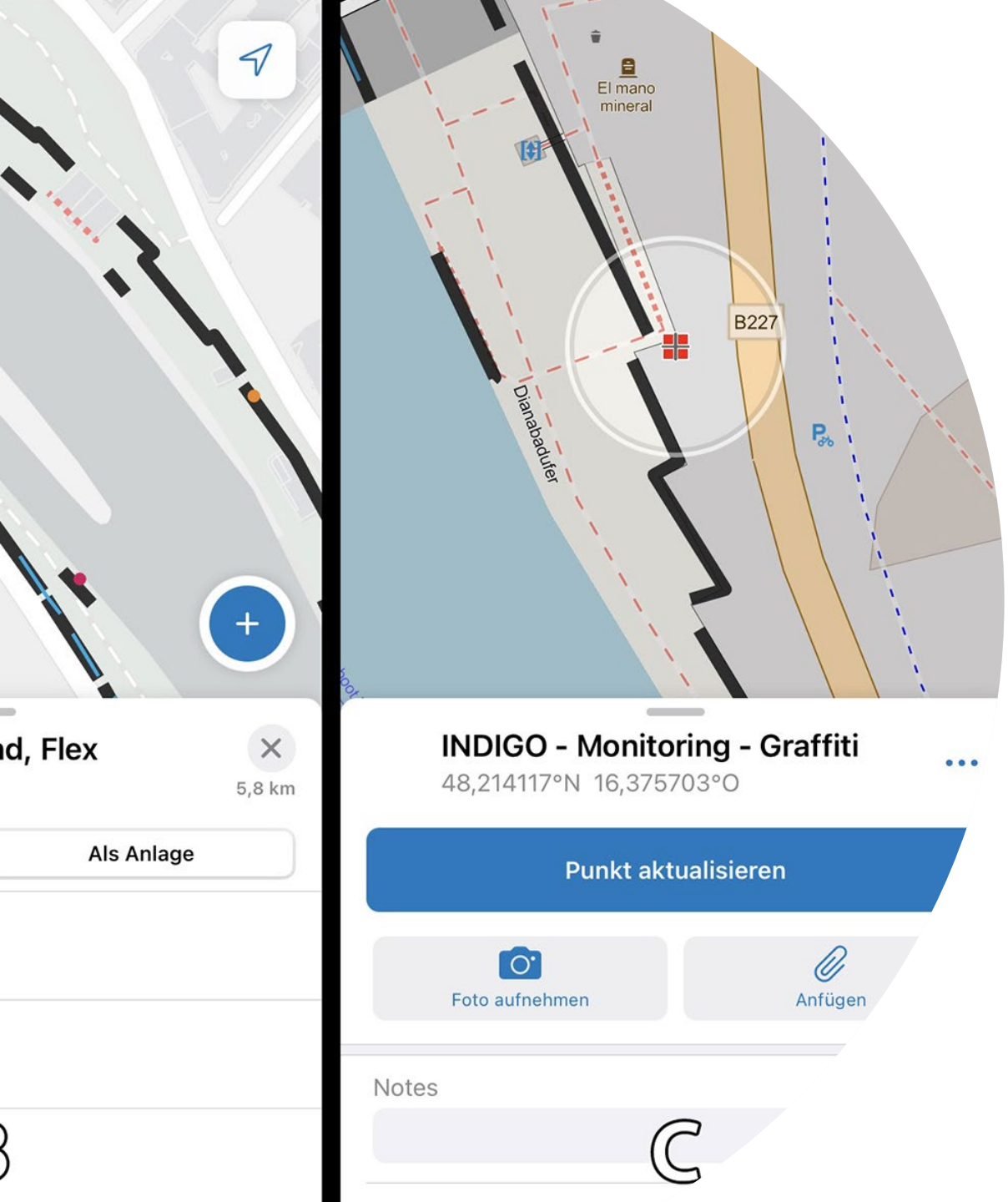
THREE purposes



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



RTK GNSS receiver

GPS & Galileo satellites
L1/L2/L5 multi-band
RTK

Position

ACCURATE photo coordinates



RTK GNSS receiver

GPS & Galileo satellites
L1/L2/L5 multi-band
RTK

Position

IMU

3-axis gyroscope
3-axis accelerometer
3-axis magnetometer

Rotation

ACCURATE photo coordinates



RTK GNSS receiver

GPS & Galileo satellites
L1/L2/L5 multi-band
RTK

Position

IMU

3-axis gyroscope
3-axis accelerometer
3-axis magnetometer

Rotation

Feedback

LEDs & status display

ACCURATE photo coordinates





ACCURATE photo coordinates



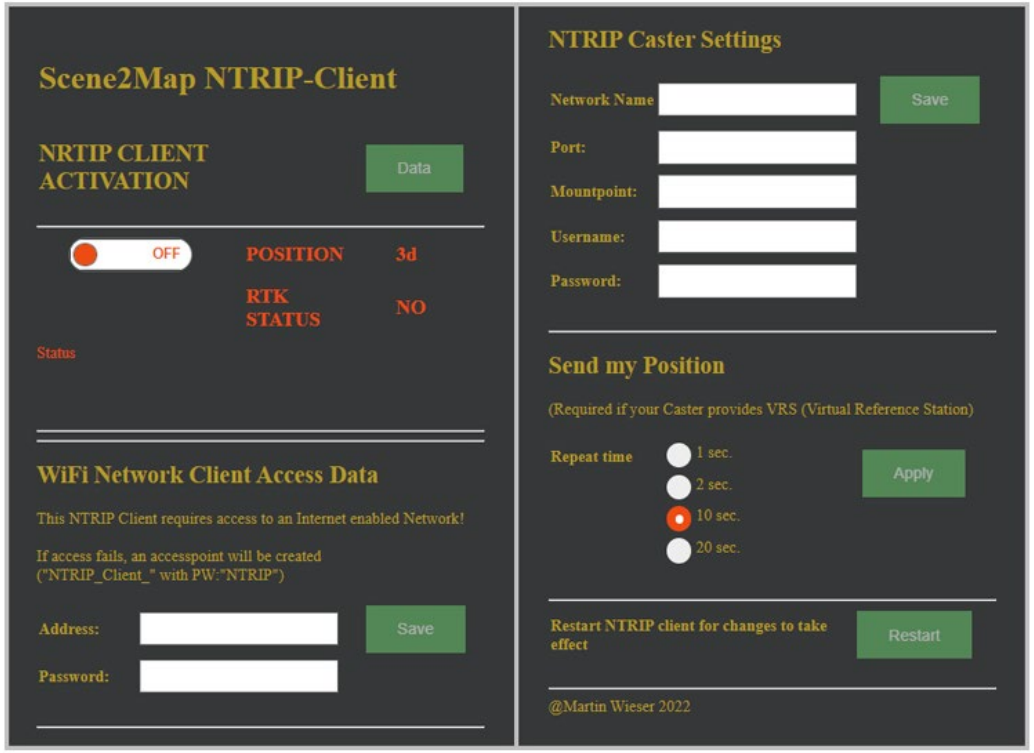


IMAGE positioning

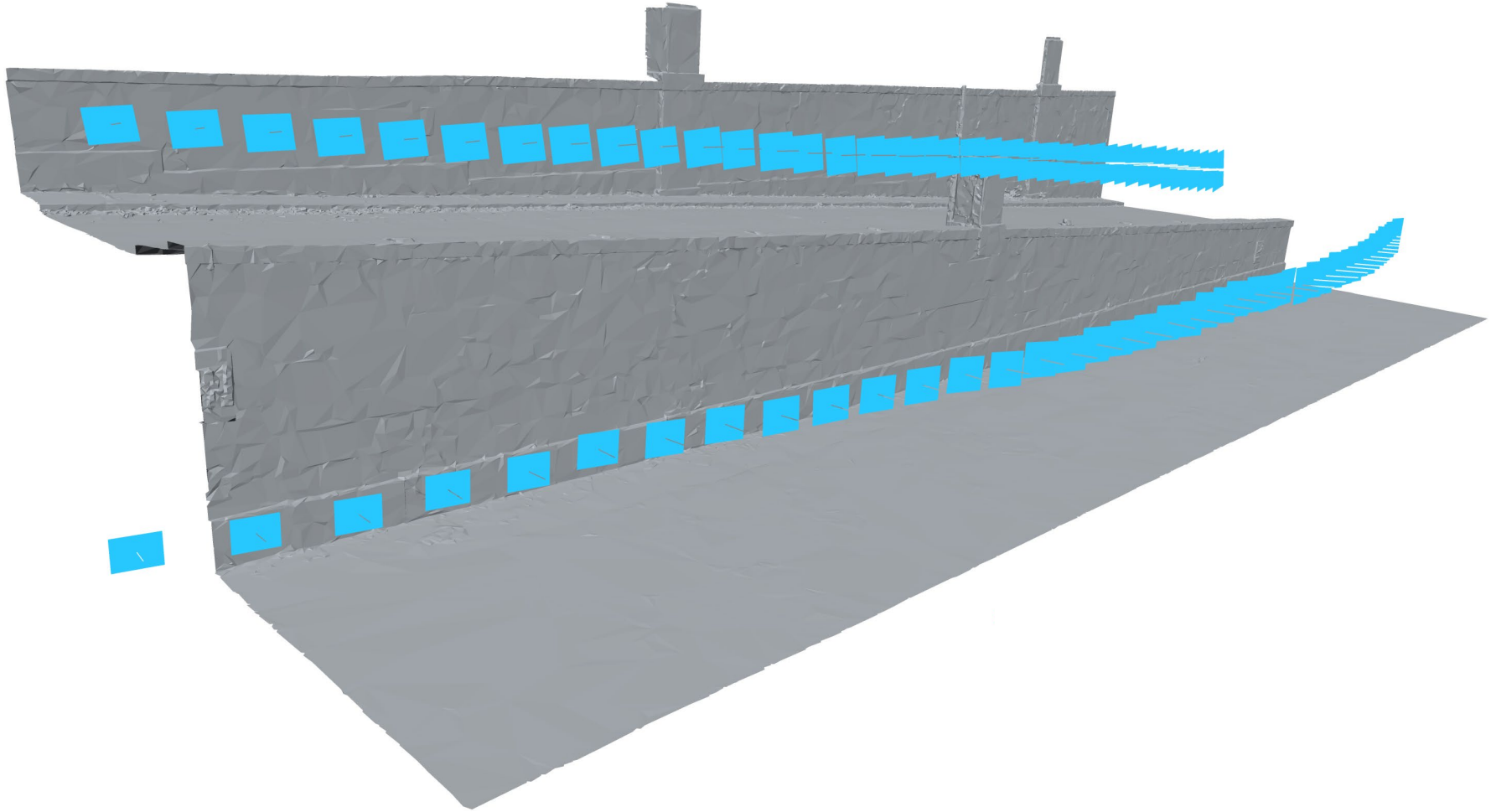


Illustration by Benjamin Wild

IMAGE positioning

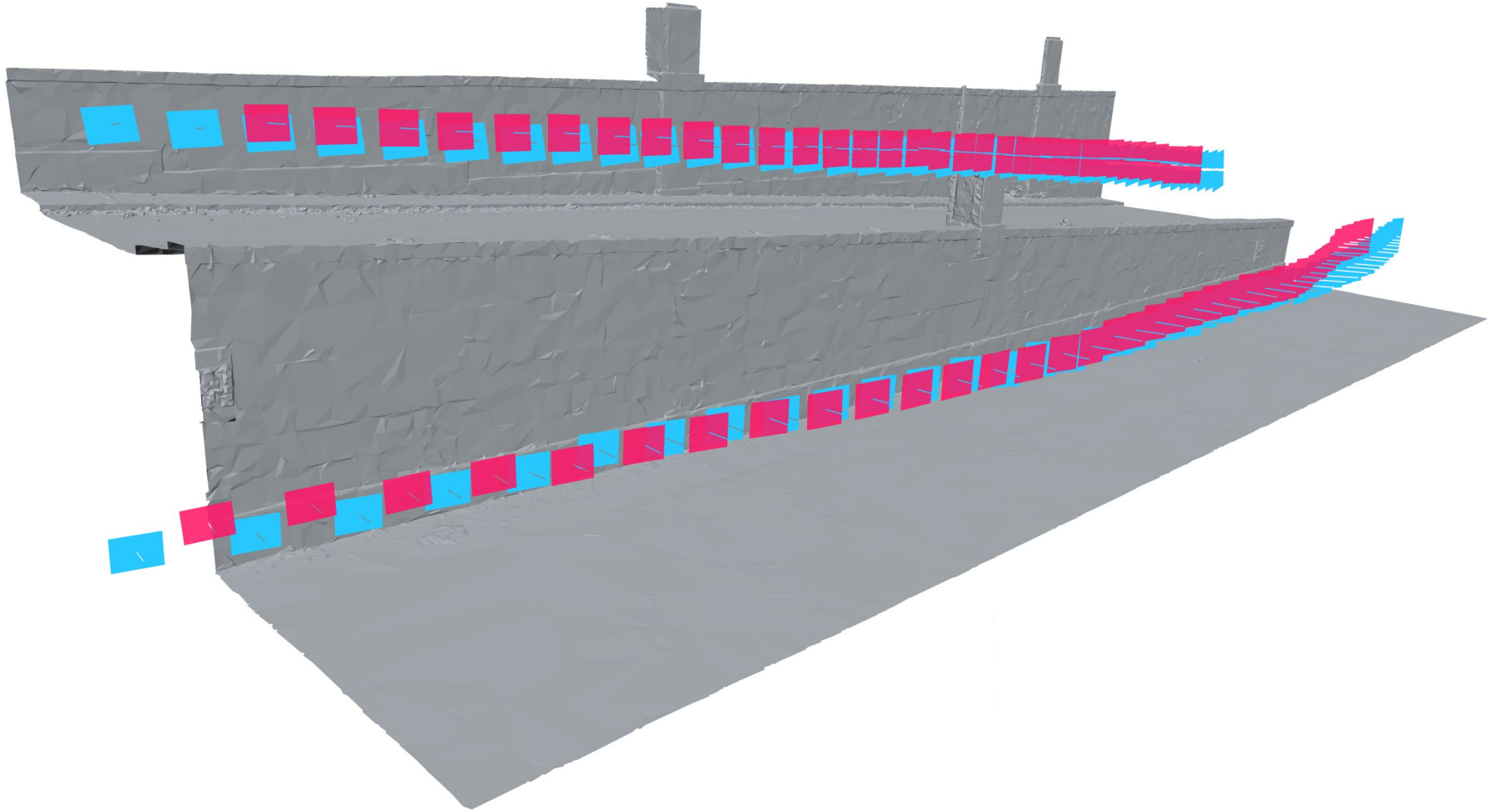
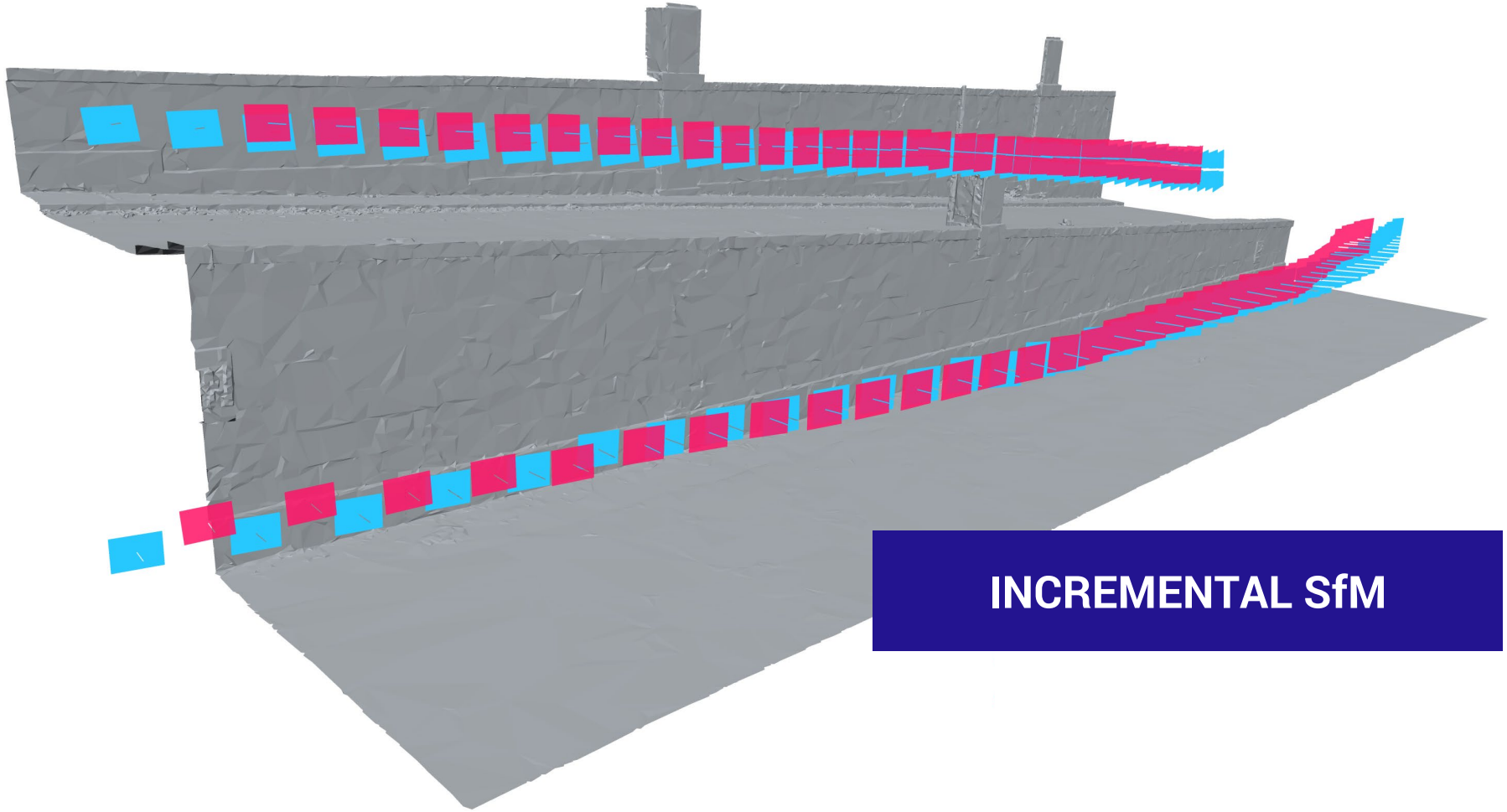


Illustration by Benjamin Wild

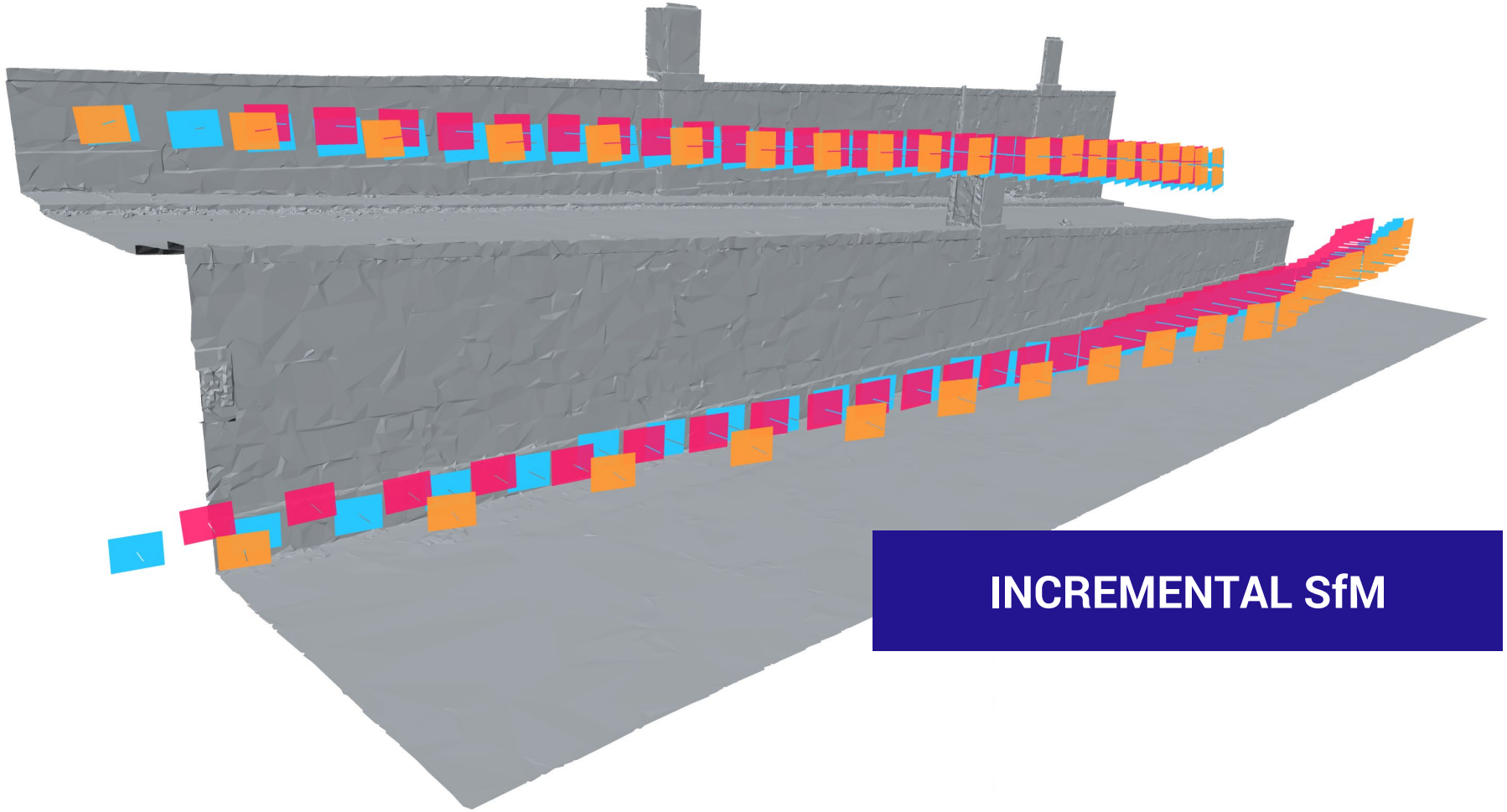
IMAGE positioning



INCREMENTAL SfM

Illustration by Benjamin Wild

IMAGE positioning



INCREMENTAL SfM

Illustration by Benjamin Wild

IMAGE positioning

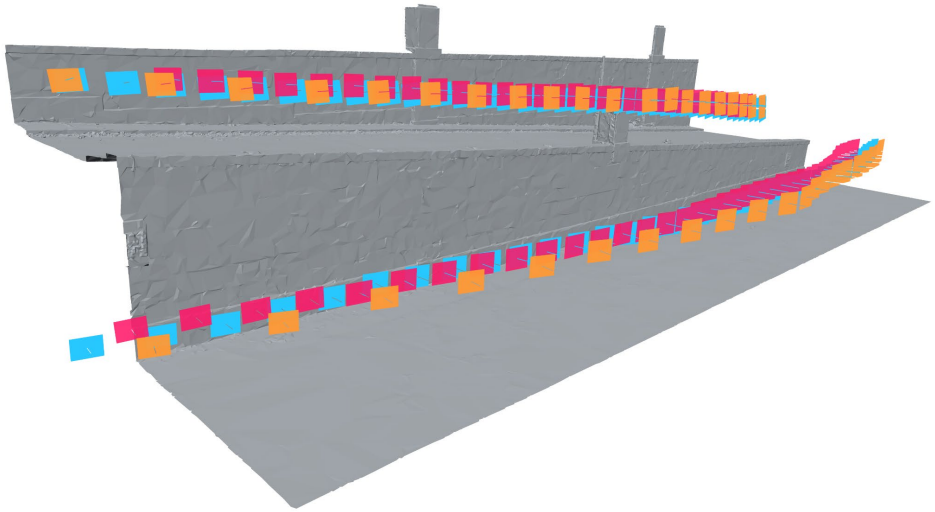


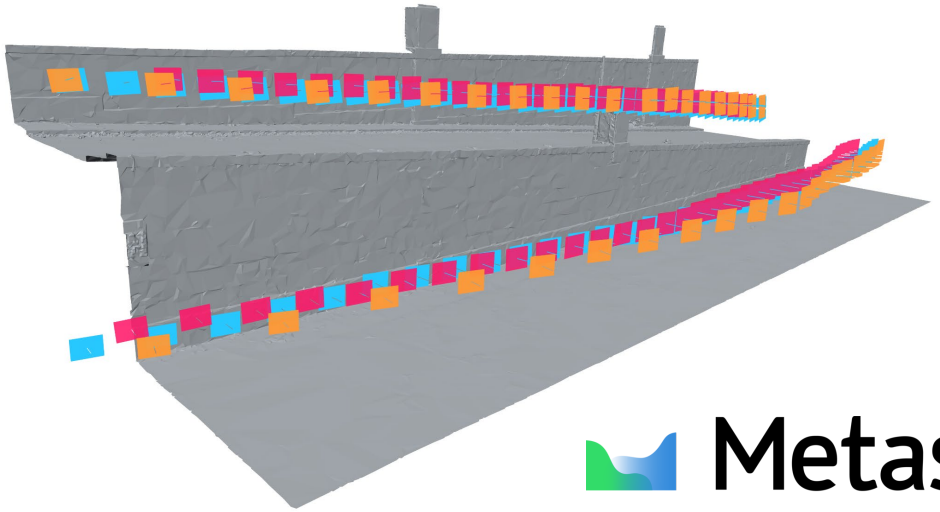






Illustration by Benjamin Wild

IMAGE positioning





Metashape

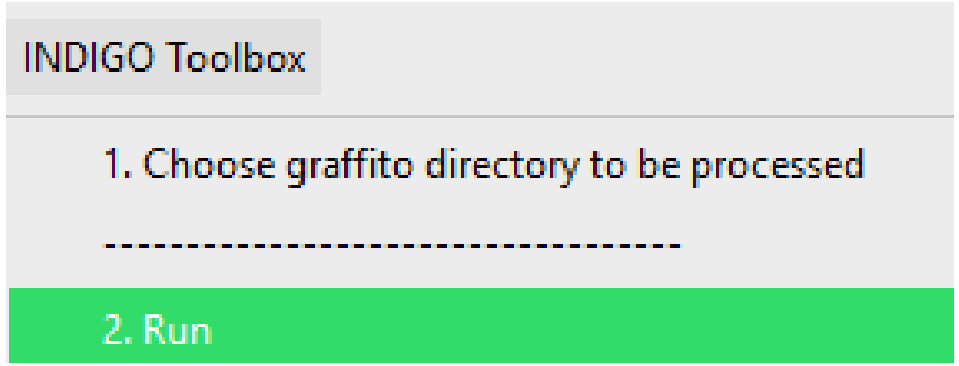




Illustration by Benjamin Wild

python™

Metashape



AUTOGRAF

position-accurate pixels

AUTOGRAF

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GraffitiProjectINDIGO / AUTOGRAF Public

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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

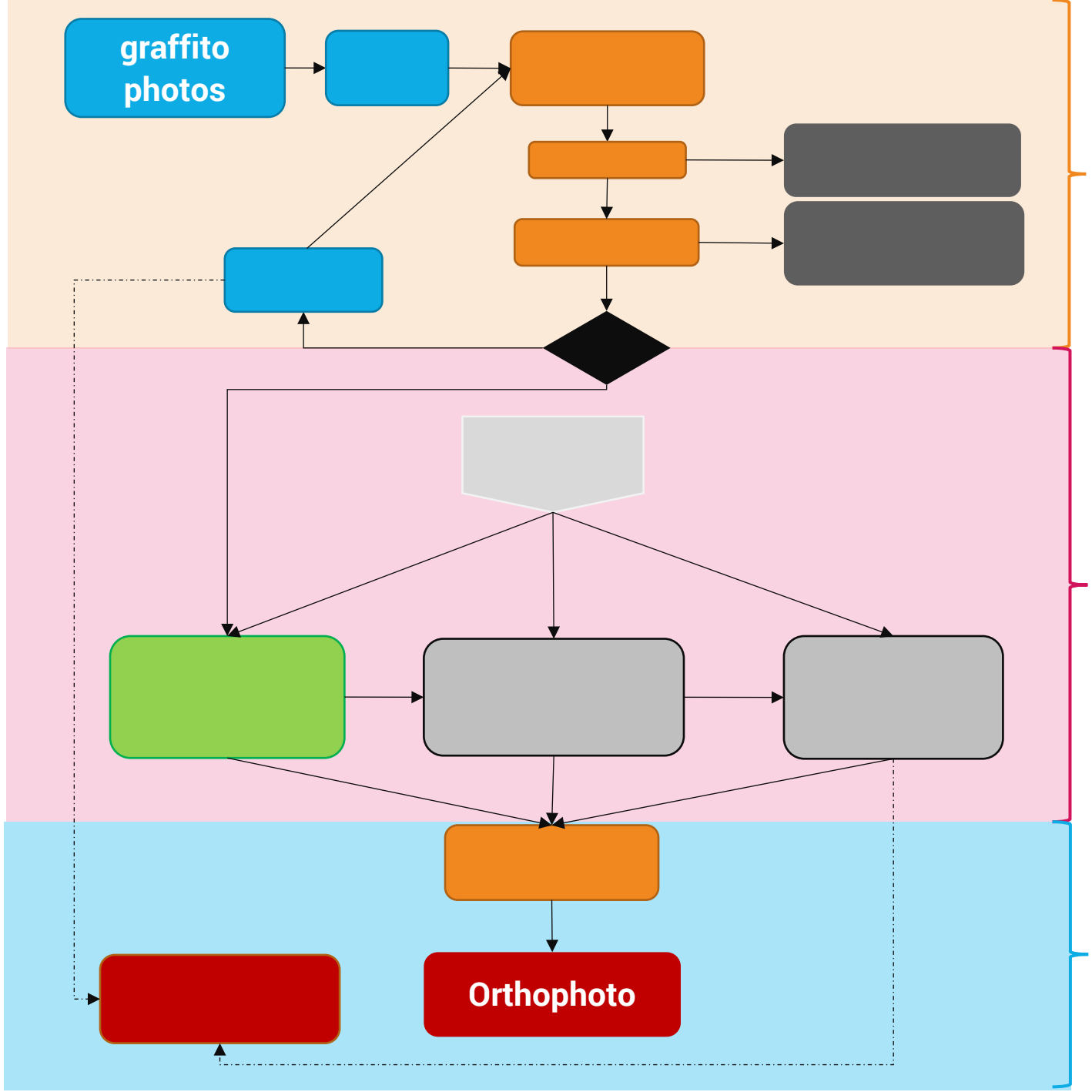
bewild96
BeyondConventionalBoundaries Geert ...

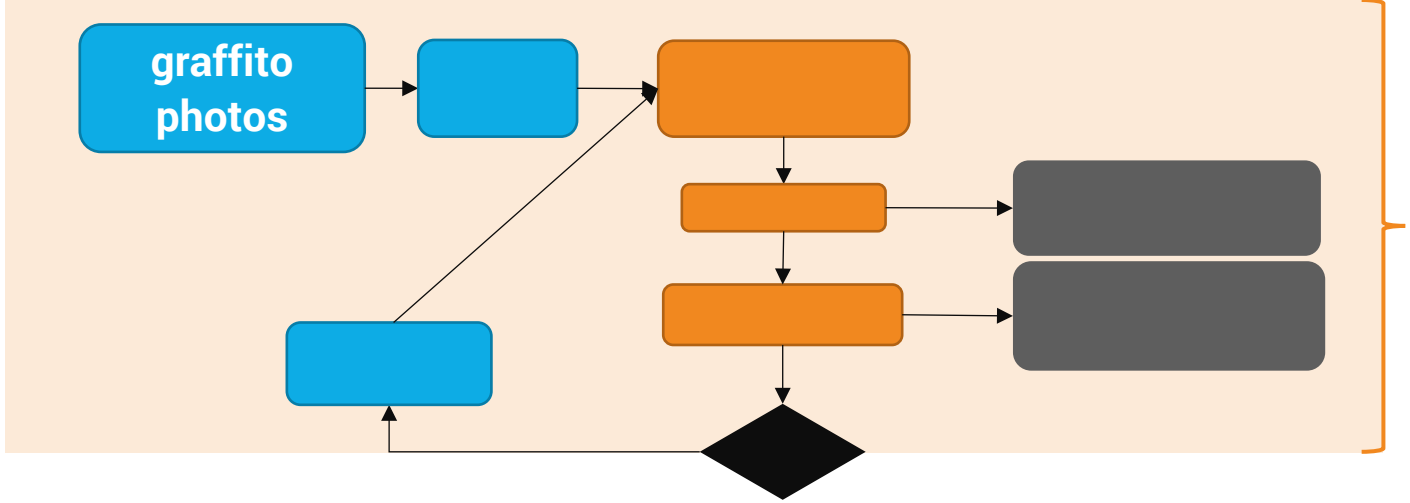
Languages

Python 100.0%

AUTOGRAF

position-accurate pixels


graffito photos
Orthophoto
Initial checks
Camera orientations
Incremental SfM
3D surface model
Orthophoto




INDIGO_2021-12-28_Z7II-B_0292.jpg


INDIGO_2021-12-28_Z7II-B_0293.jpg


INDIGO_2021-12-28_Z7II-B_0294 - Copy.jpg


INDIGO_2021-12-28_Z7II-B_0294.jpg


INDIGO_2021-12-28_Z7II-B_0295.jpg

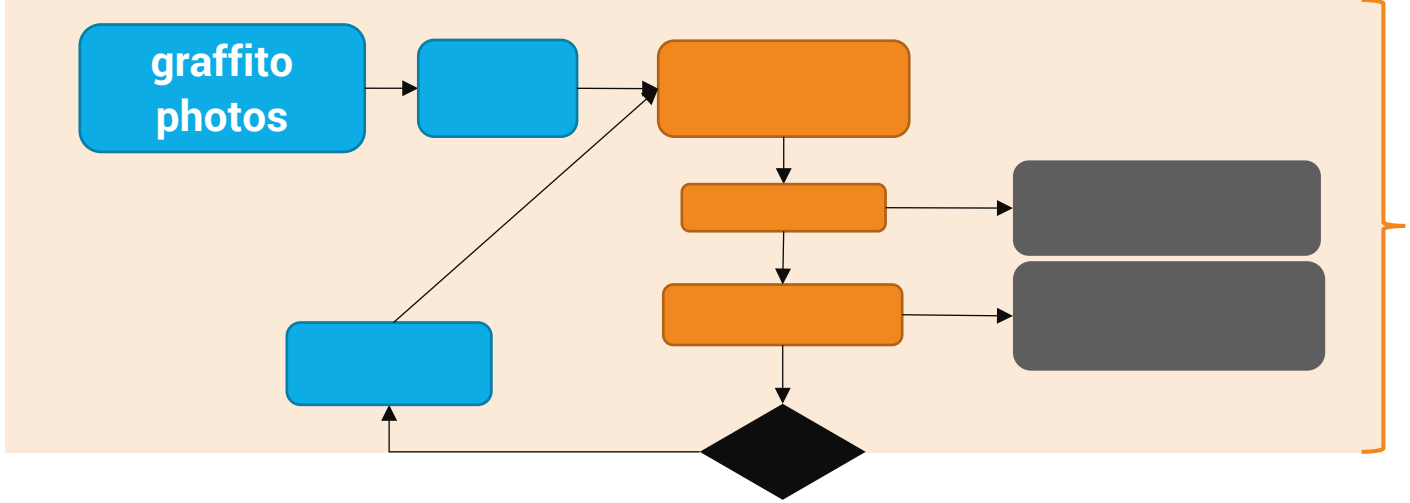

INDIGO_2021-12-28_Z7II-B_0296.jpg


INDIGO_2021-12-28_Z7II-B_0296a.jpg


INDIGO_2021-12-28_Z7II-B_0297.jpg


INDIGO_2021-12-28_Z7II-B_0298.jpg


INDIGO_2021-12-28_Z7II-B_0300.jpg



Initial checks


INDIGO_2021-12-28_Z7II-B_0292.jpg


INDIGO_2021-12-28_Z7II-B_0293.jpg


INDIGO_2021-12-28_Z7II-B_0294 - Copy.jpg


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INDIGO_2021-12-28_Z7II-B_0295.jpg

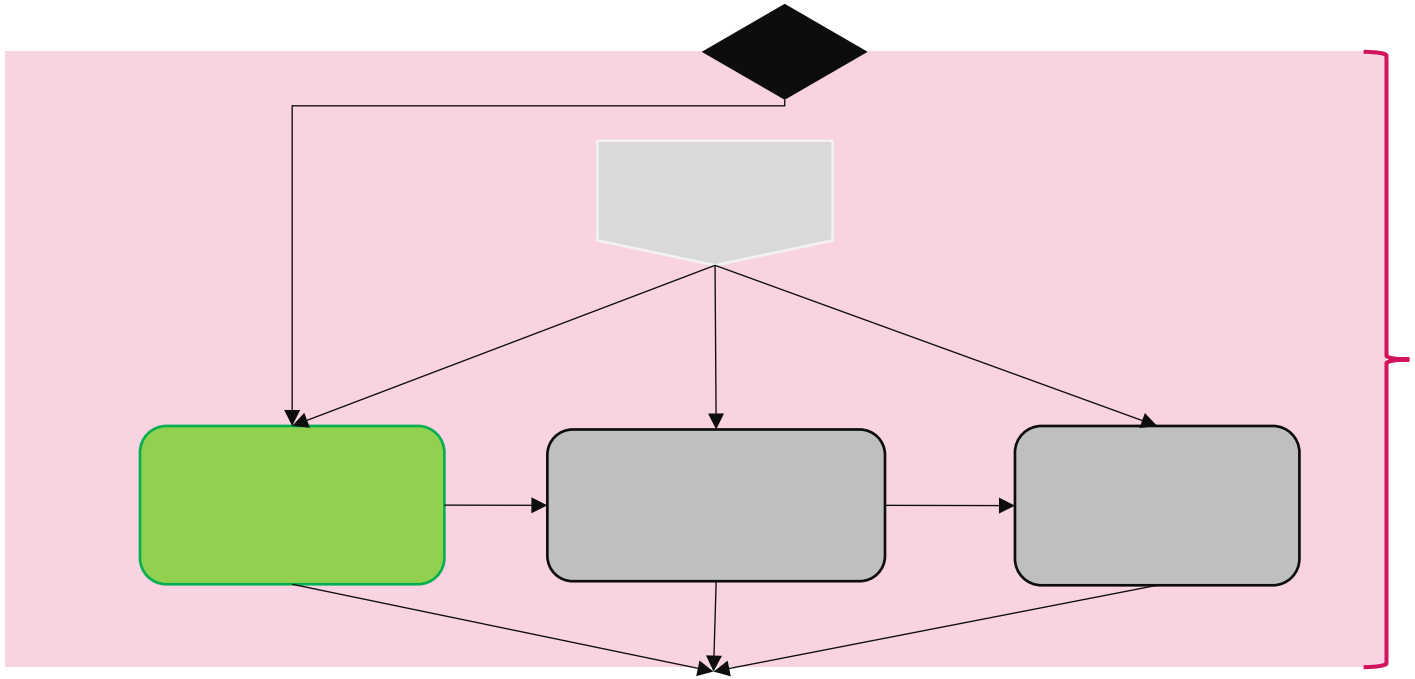

INDIGO_2021-12-28_Z7II-B_0296.jpg


INDIGO_2021-12-28_Z7II-B_0296a.jpg


INDIGO_2021-12-28_Z7II-B_0297.jpg


INDIGO_2021-12-28_Z7II-B_0298.jpg

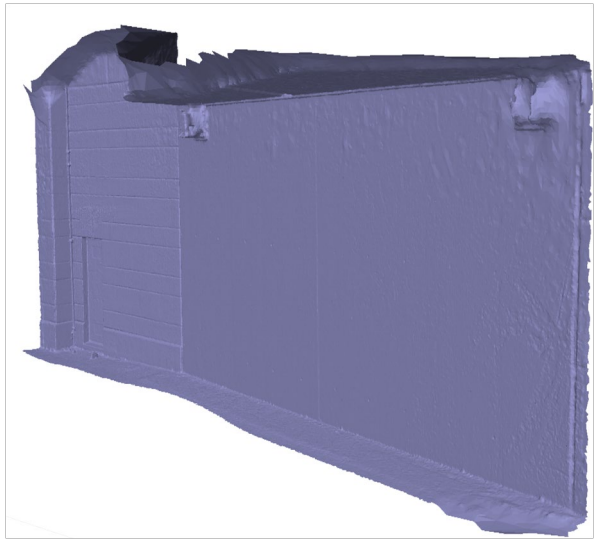

INDIGO_2021-12-28_Z7II-B_0300.jpg



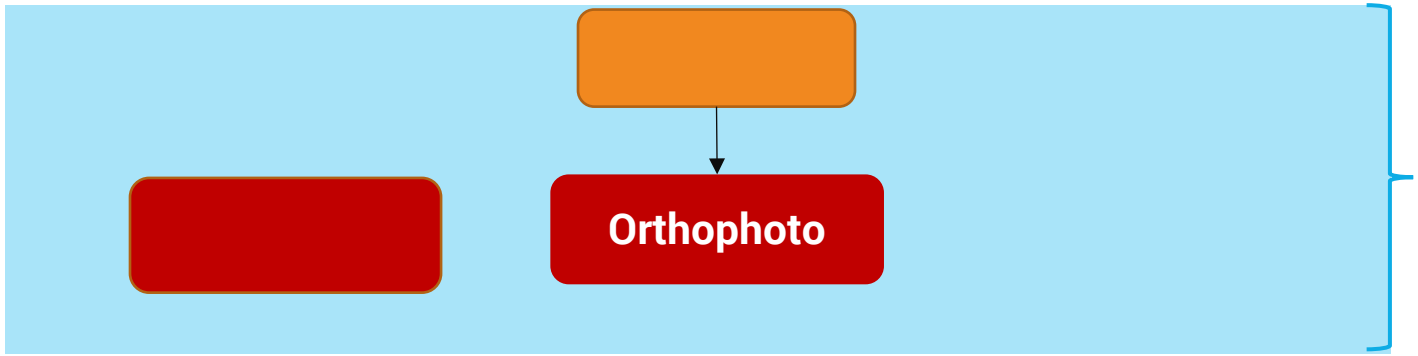
Camera orientations

Incremental SfM

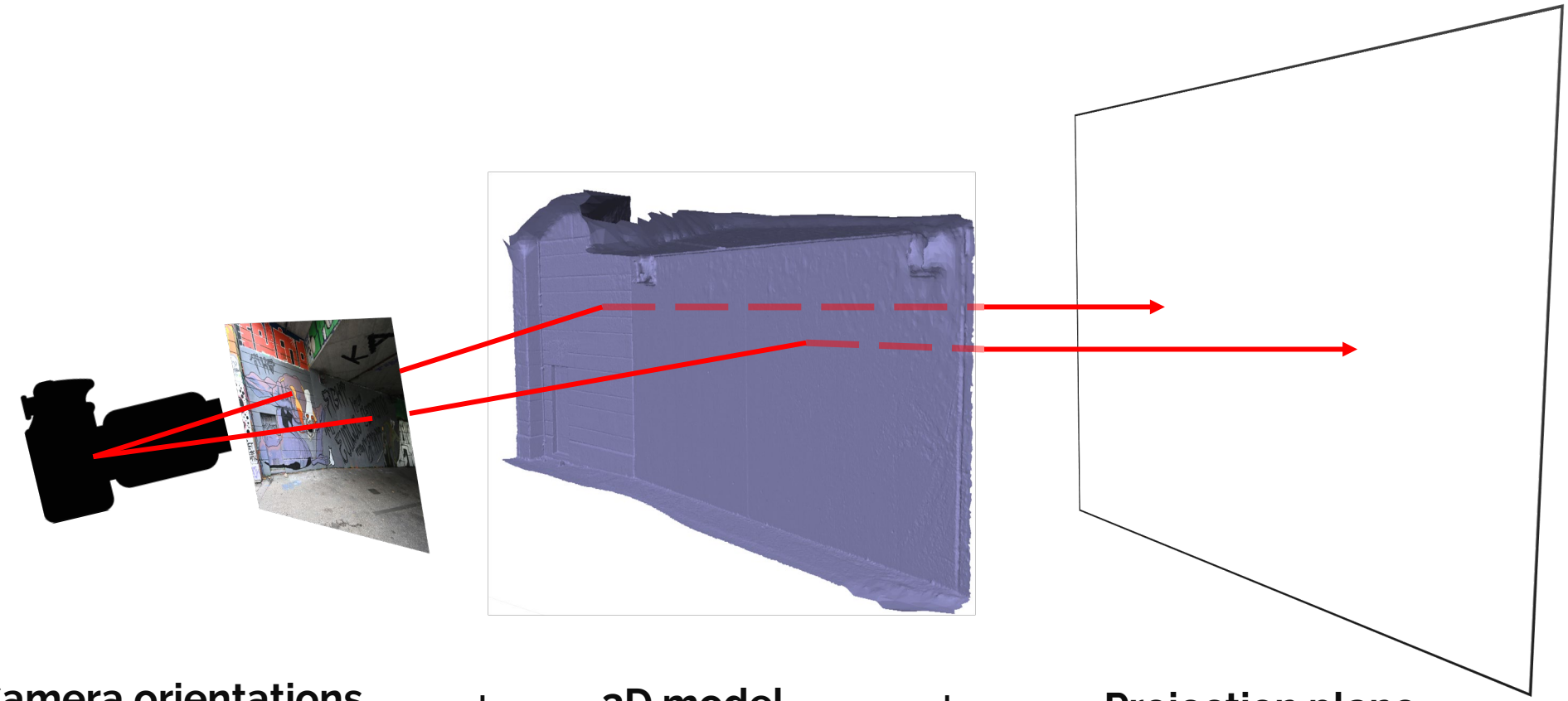




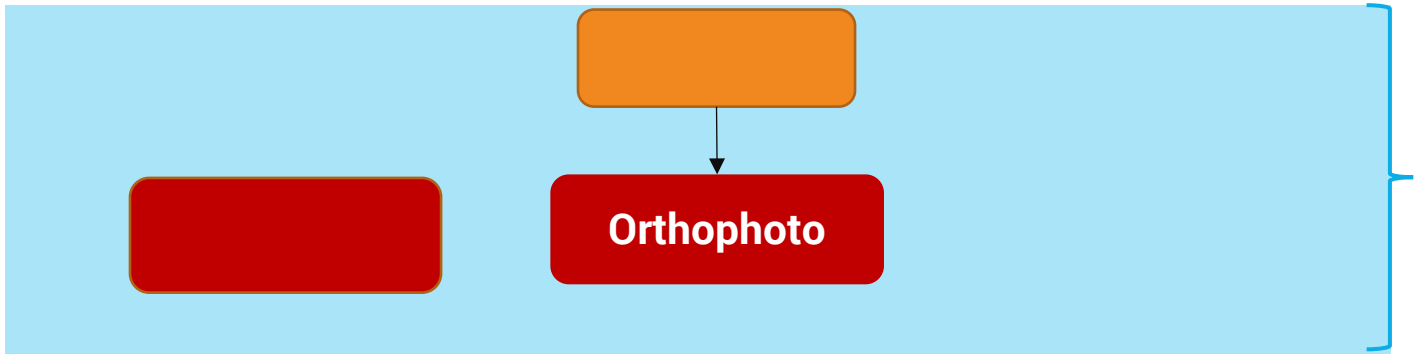
Camera orientations + **3D model**



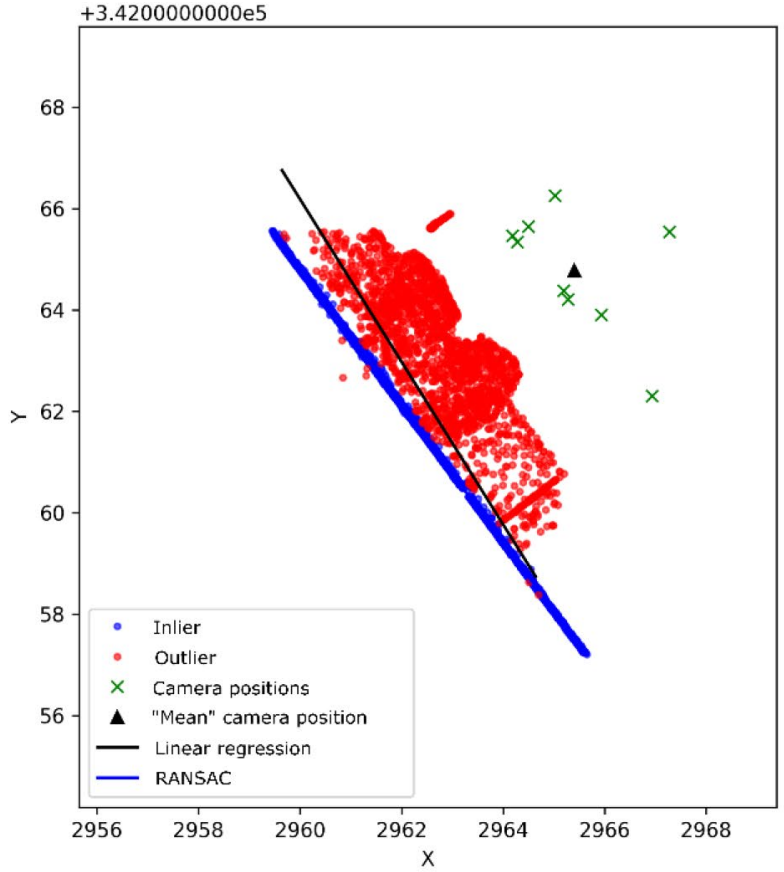
3D surface model
Orthophoto

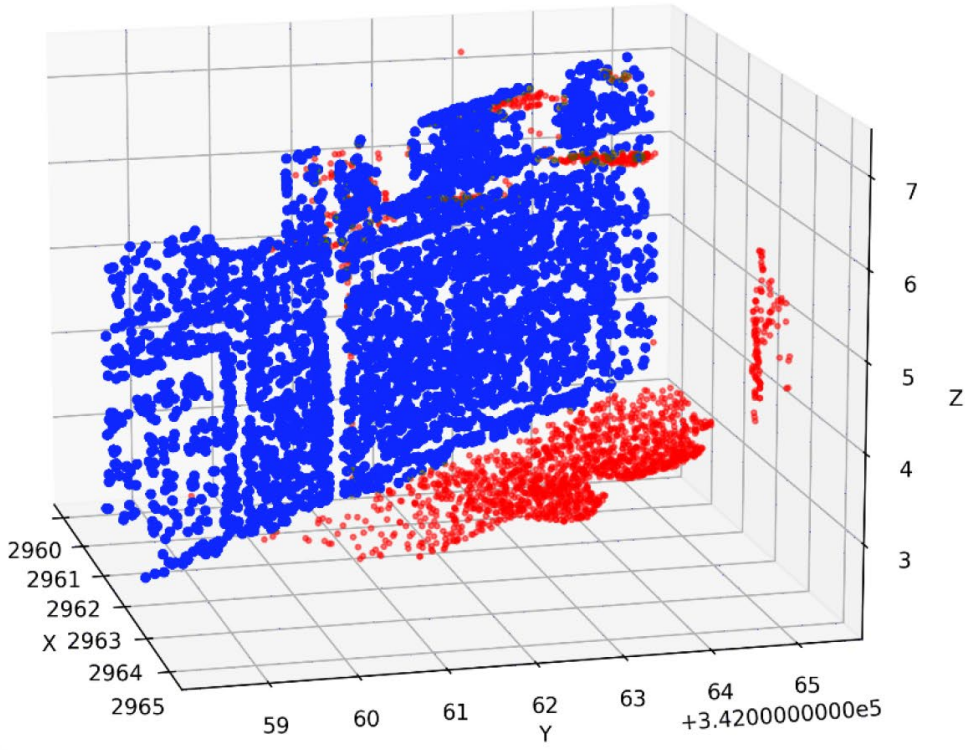


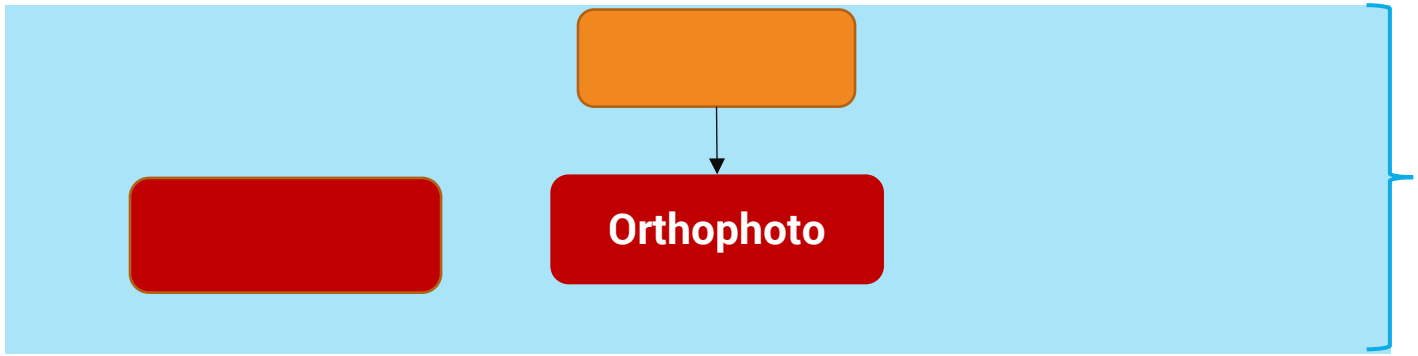
Camera orientations + 3D model + Projection plane



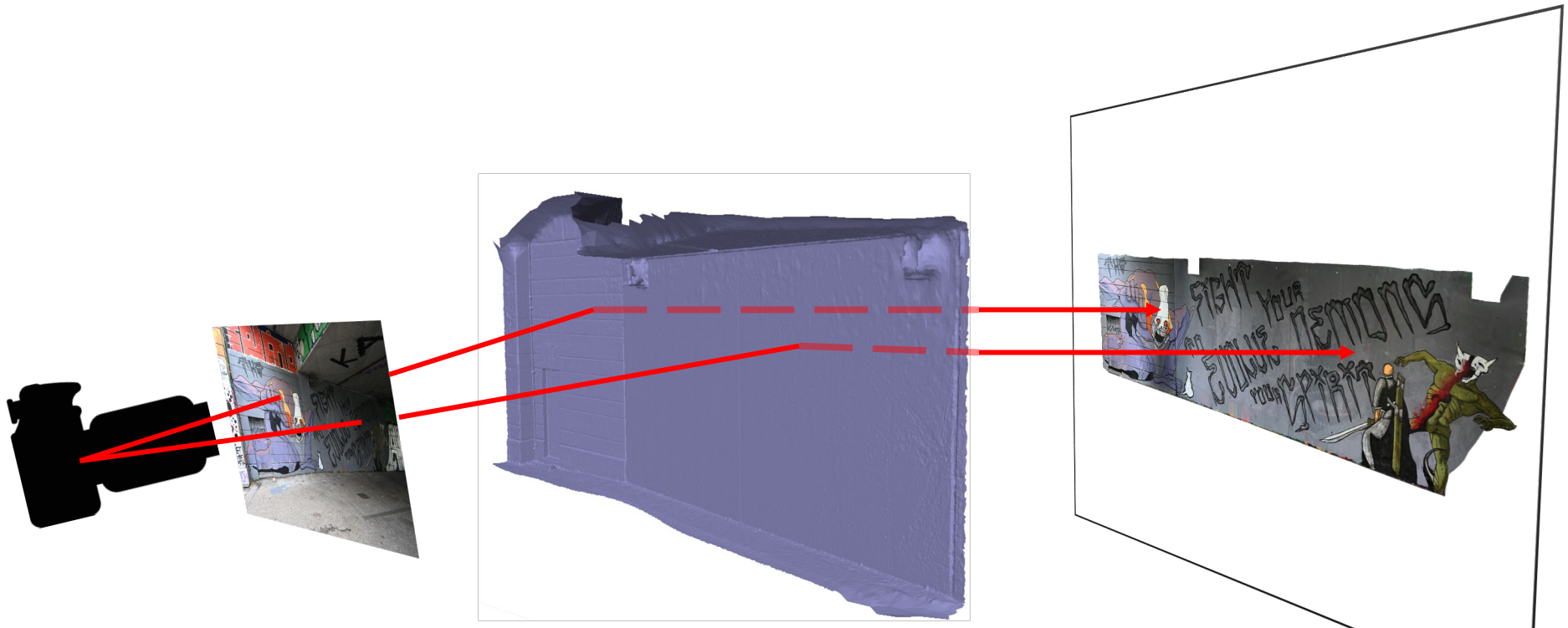
3D surface model
Orthophoto



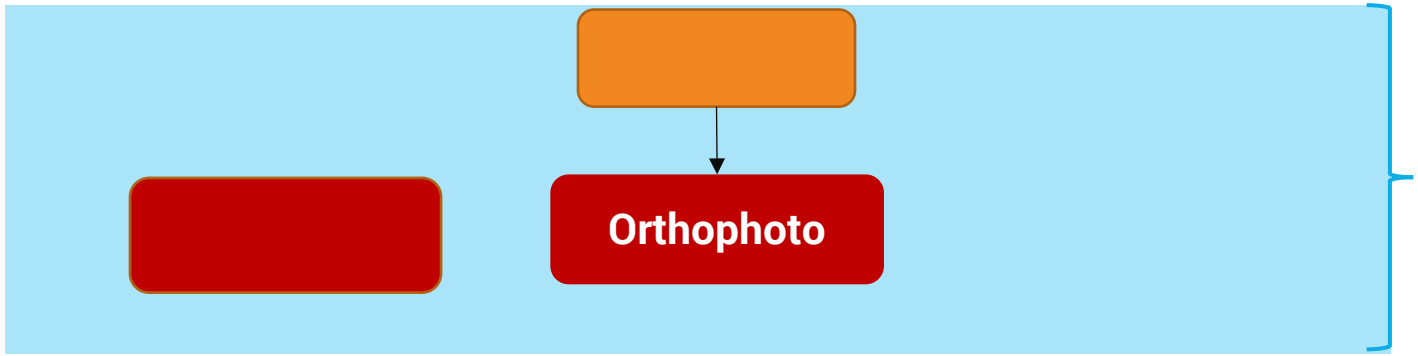




3D surface model
Orthophoto



Camera orientations + 3D model + Projection plane



3D surface model
Orthophoto

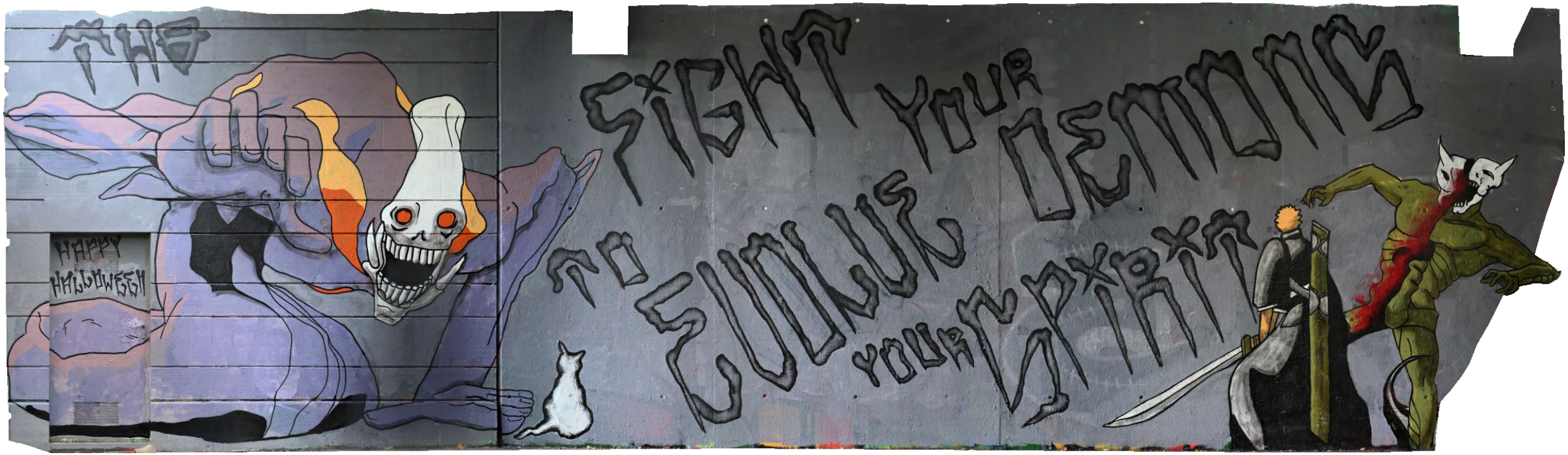
AUTOGRAF

position-accurate pixels



AUTOGRAF

AUTOGRAF
position-accurate pixels



GRAFFITI monitoring

GRAFFITI monitoring

BASEMAP

ESRI ArcGIS Field Maps

areas with overview photos

cloud-based | tablets



GRAFFITI monitoring

BASEMAP

ESRI ArcGIS Field Maps

areas with overview photos

cloud-based | tablets



MONITOR

check social media

memory

hashtags + form (unused)

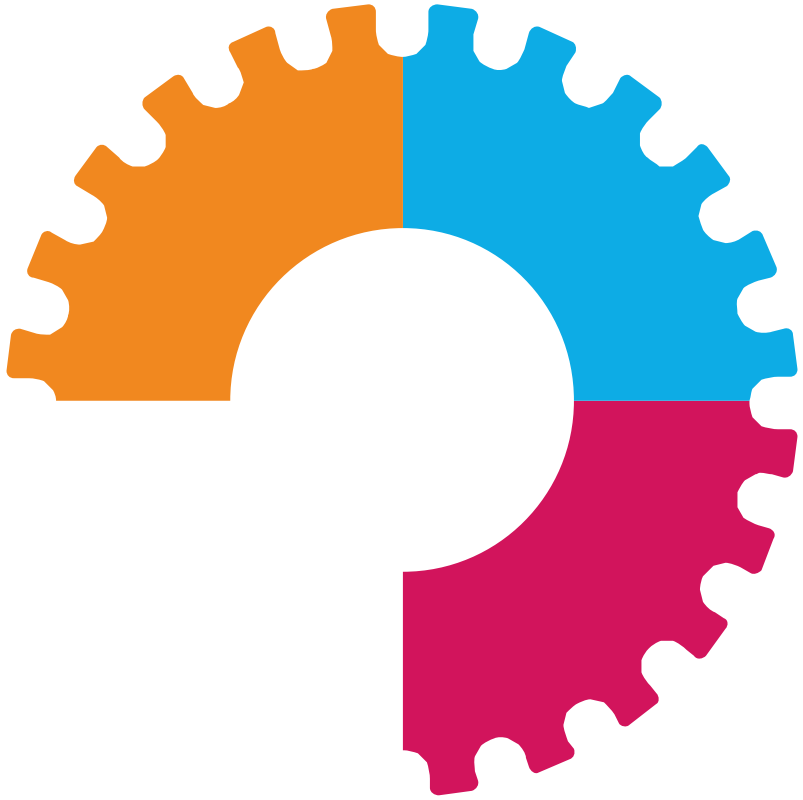
GRAFFITI monitoring

BASEMAP

ESRI ArcGIS Field Maps

areas with overview photos

cloud-based | tablets



MONITOR

check social media

memory

hashtags + form (unused)

ADD TO APP

point: “not photographed”

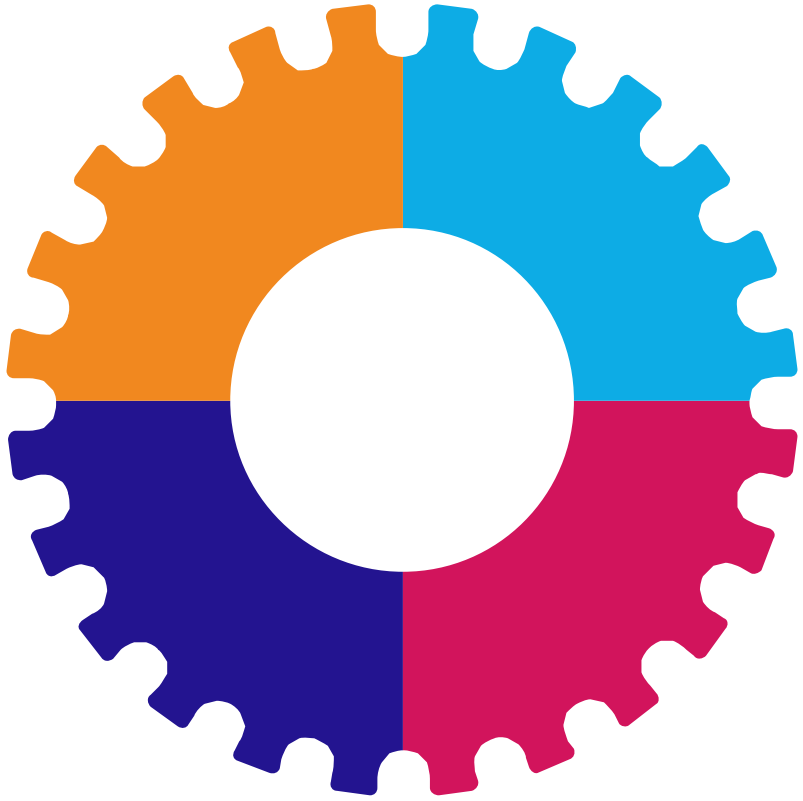
GRAFFITI monitoring

BASEMAP

ESRI ArcGIS Field Maps

areas with overview photos

cloud-based | tablets



MONITOR

check social media

memory

hashtags + form (unused)

DOCUMENT

± 10 photos

spectrometer reading

change status point

new overview photo

ADD TO APP

point: “not photographed”

CHANGE
detection



CHANGE
detection



CHANGE
detection

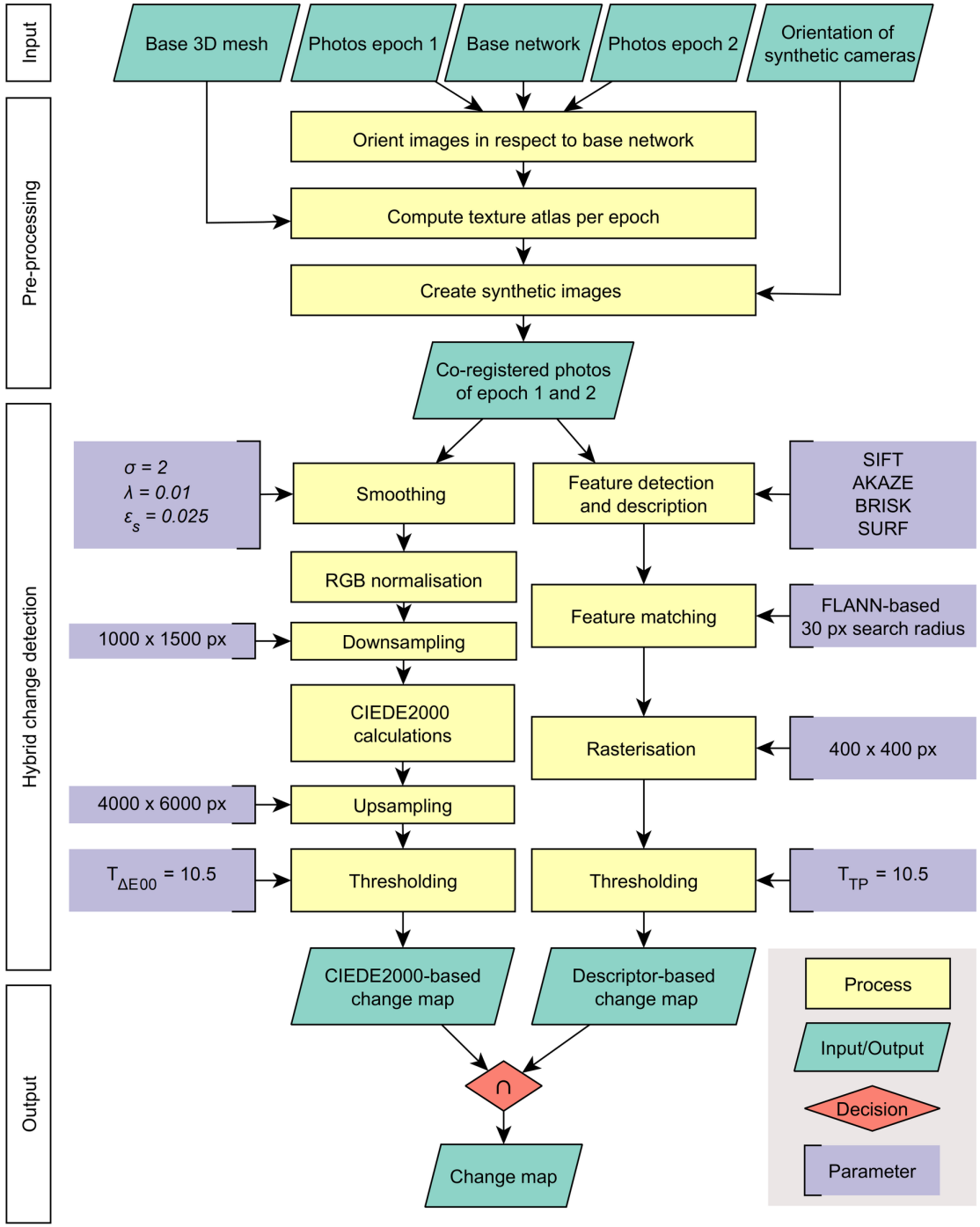






CHANGE
detection

CHANGE
detection







CHANGE
detection







CHANGE
detection









CHANGE
detection



CHANGE
detection



CHANGE
detection



CHANGE detection

Published October 11, 2023 | Version 1.0.0

Dataset Open

INDIGO Change Detection Reference Dataset

Wild, Benjamin[1]; Verhoeven, Geert[2]; Muszyński, Rafał[3]; Pfeifer, Norbert[1]

Show affiliations

Citation Style APA

Wild, B., Verhoeven, G., Muszyński, R., & Pfeifer, N. (2023). INDIGO Change Detection Reference Dataset (1.0.0) [Data set]. TU Wien. https://doi.org/10.48436/ayj4e-v4864

Description

The INDIGO Change Detection Reference Dataset

Description

This graffiti-centred change detection dataset was developed in the context of INDIGO, a research project focusing on the documentation, analysis and dissemination of graffiti along Vienna's Donaukanal. The dataset aims to support the development and assessment of change detection algorithms.

The dataset was collected from a test site approximately 50 meters in length along Vienna's Donaukanal during 11 days between 2022/10/21 and 2022/12/01. Various cameras with different settings were used, resulting in a total of 29 data collection sessions or "epochs" (see "EpochIDs.jpg" for details). Each epoch contains 17 images generated from 29 distinct 3D models with different textures. In total, the dataset comprises 6,902 unique image pairs, along with corresponding reference change maps. Additionally, exclusion masks are provided to ignore parts of the scene that might be irrelevant, such as the background.

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

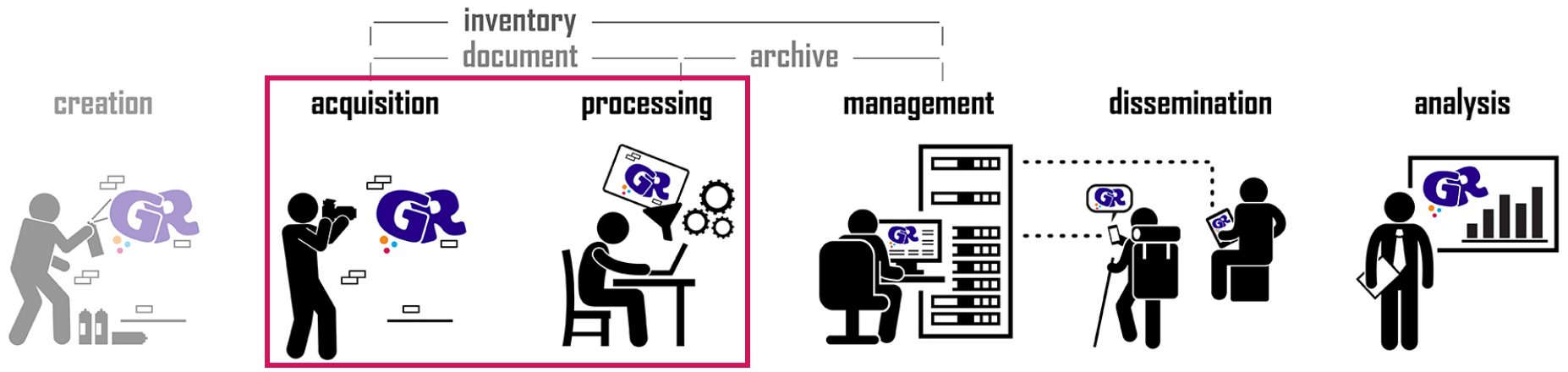
GRAFFITI *LOCATION*

GRAFFITI *TEMPORALITY*

GRAFFITI *TERMINOLOGY*

GRAFFITI *CHARACTERISATION*

5 research pillars



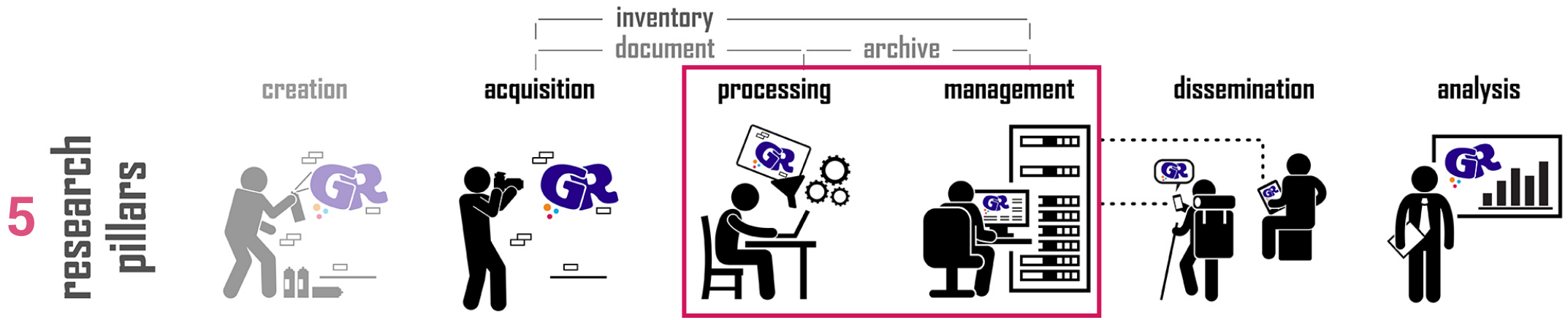
SOME results

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

date + time



© Sophie Hay



16 June 2023 @ 10:25 CET





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



© Sophie Hay



16 June 2023 @ 10:25 CET





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

MOMENTS of creation

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



© Sophie Hay



16 June 2023 @ 10:25 CET



between 02 & 06 June 2023



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

MOMENTS of creation

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



© Sophie Hay

between AD 41 & AD 79



16 June 2023 @ 10:25 CET



between 02 & 06 June 2023



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

MOMENTS of creation

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



© Sophie Hay

between AD 41 & AD 79

12 days ± 2 days



16 June 2023 @ 10:25 CET



between 02 & 06 June 2023



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

MOMENTS of creation

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



© Sophie Hay

between AD 41 & AD 79

1963 years ± 19 years



16 June 2023 @ 10:25 CET

12 days ± 2 days



between 02 & 06 June 2023



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

MOMENTS of creation

12 days ± 2 days

between 02 & 06 June 2023



~~related to temporal fuzziness~~
photo | ~~graffito~~
creation event
date + time



© Sophie Hay



16 June 2023 @ 10:25 CET



date + time
creation event
photo | ~~graffito~~
~~related to temporal fuzziness~~

between AD 41 & AD 79

1963 years ± 19 years

MOMENTS of creation

extended
temporal uncertainty

~~related to temporal fuzziness~~
photo | ~~graffito~~
creation event
date + time



© Sophie Hay

between AD 41 & AD 79

1963 years ± 19 years



16 June 2023 @ 10:25 CET

12 days ± 2 days



between 02 & 06 June 2023



date + time
creation event
photo | ~~graffito~~
~~related to temporal fuzziness~~

temporal uncertainty
narrow

MOMENTS of creation

visibility (interrupted)
extended
temporal uncertainty

~~related to temporal fuzziness~~
photo | ~~graffito~~
creation event
date + time



© Sophie Hay

between AD 41 & AD 79

1963 years ± 19 years



16 June 2023 @ 10:25 CET



12 days ± 2 days

between 02 & 06 June 2023



date + time
creation event
photo | ~~graffito~~
~~related to temporal fuzziness~~

temporal uncertainty
narrow
visibility

INDIGO METADATA

real graffito
vs
digital derivatives

MOMENTS of creation

visibility (interrupted)
extended
temporal uncertainty

~~related to temporal fuzziness~~
photo | ~~graffito~~
creation event
date + time



© Sophie Hay

between AD 41 & AD 79

1963 years ± 19 years



16 June 2023 @ 10:25 CET



12 days ± 2 days

between 02 & 06 June 2023



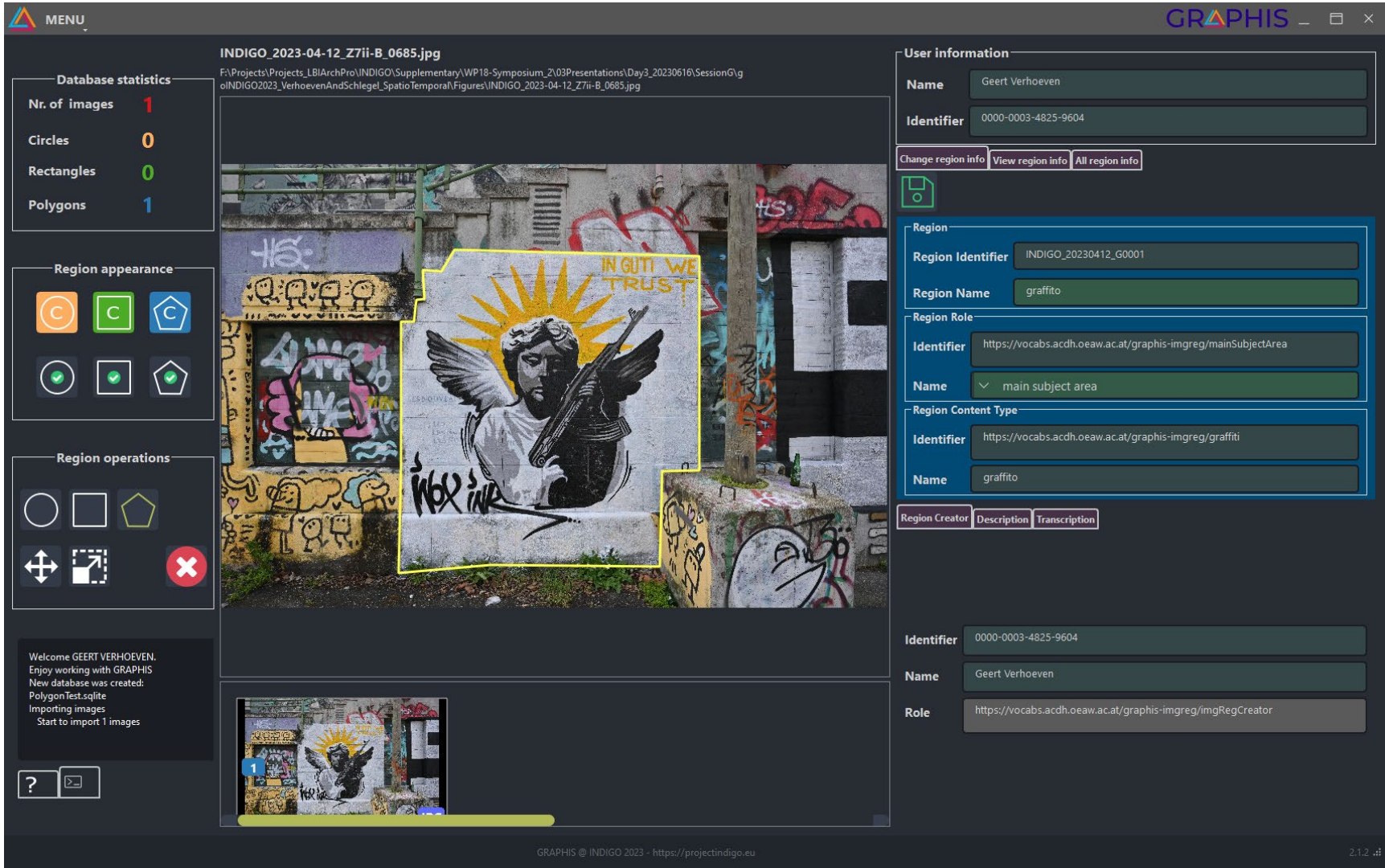
date + time
creation event
photo | ~~graffito~~
~~related to temporal fuzziness~~

temporal uncertainty
narrow
visibility

CREATING location

CREATING location

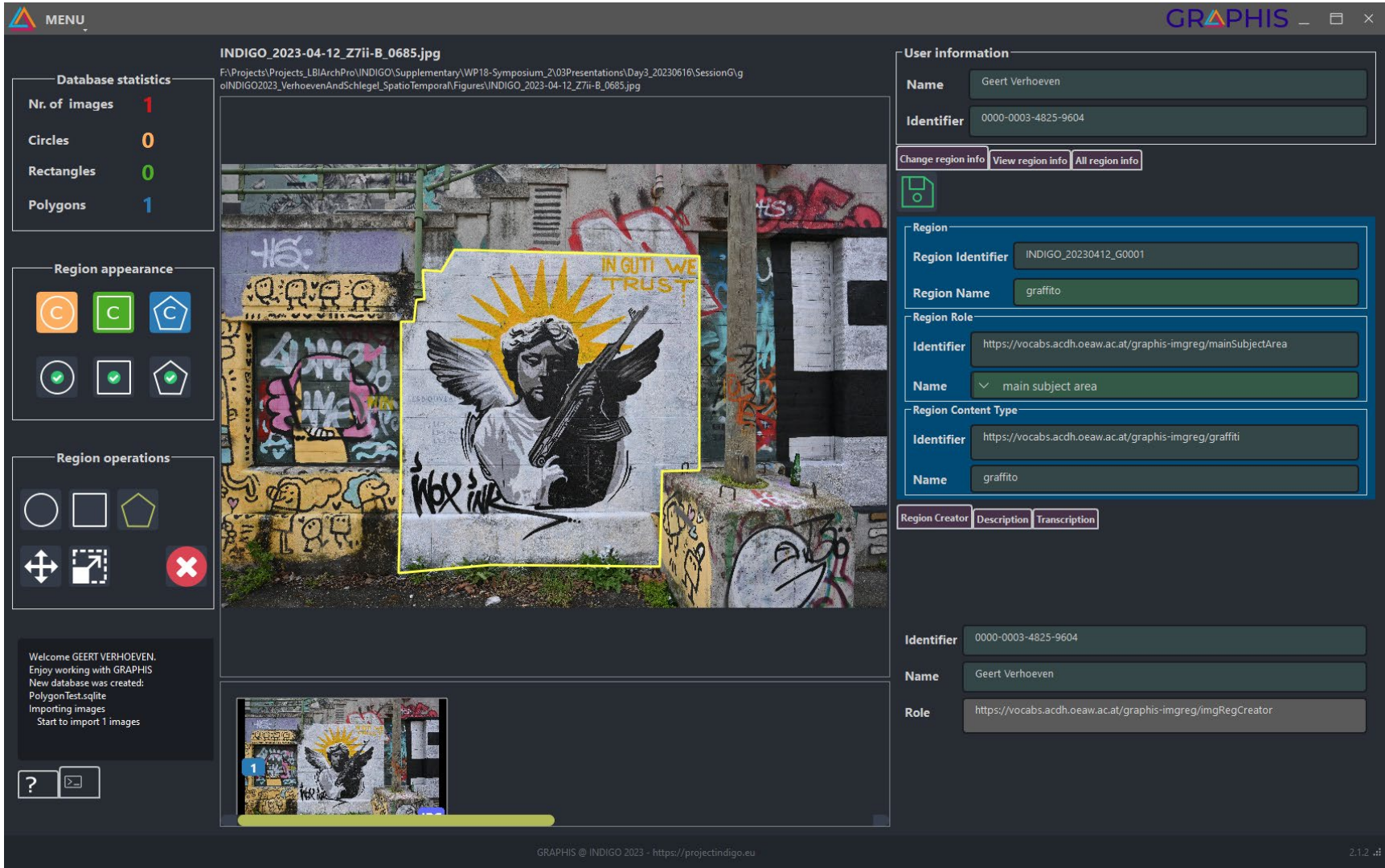
GRAPHIS



CREATING location

GRAPHIS

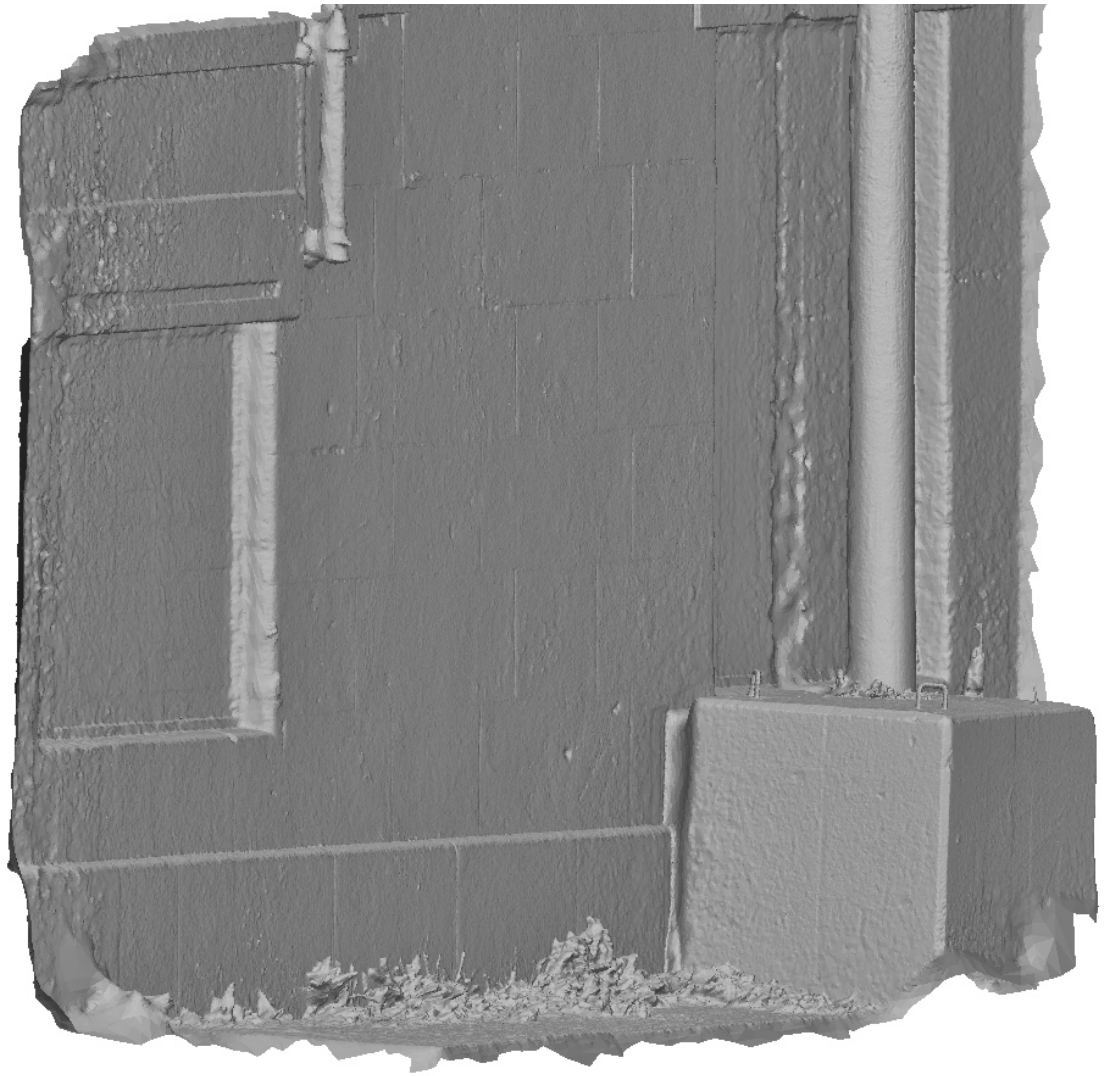
2D polygon (pixel coordinates)



CREATING location

GRAPHIS

2D polygon (pixel coordinates)



AUTOGRAF

CREATING location

GRAPHIS

2D polygon (pixel coordinates)

AUTOGRAF



CREATING location

GRAPHIS

2D polygon (pixel coordinates)

AUTOGRAF



CREATING location

GRAPHIS

2D polygon (pixel coordinates)

AUTOGRAF

3D polyline (real-world coordinates)



STORING location

XMP metadata

GRAPHIS

2D polygon (pixel coordinates)

AUTOGRAF

3D polyline (real-world coordinates)

STORING location

XMP metadata

GRAPHIS

2D polygon (pixel coordinates)

GeoJSON

AUTOGRAF

3D polyline (real-world coordinates)

STORING location

XMP metadata

GRAPHIS

2D polygon (pixel coordinates)

GeoJSON

AUTOGRAF

3D polyline (real-world coordinates)

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STORING time

XMP metadata

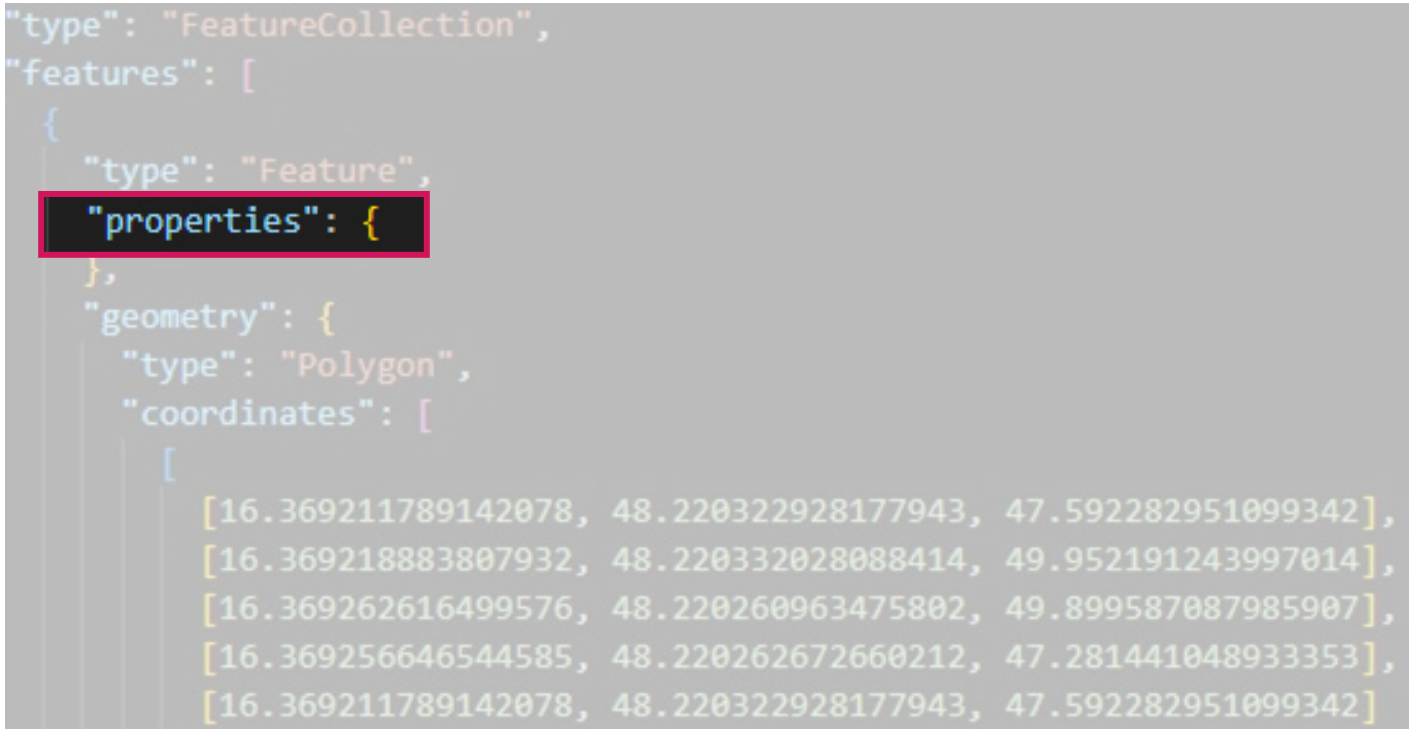
GRAPHIS

2D polygon (pixel coordinates)

GeoJSON

AUTOGRAF

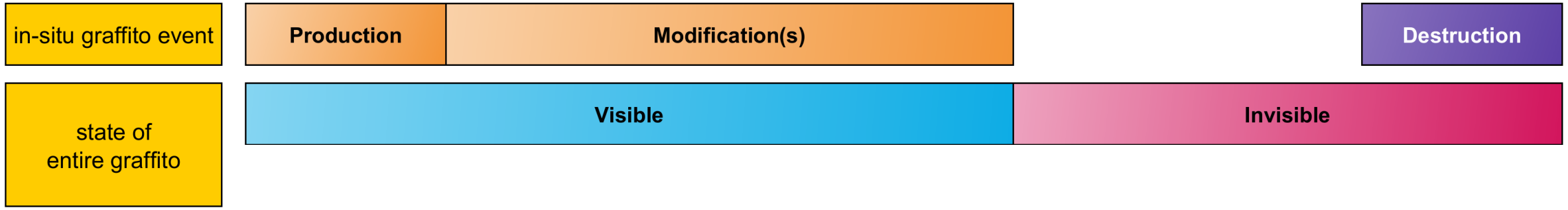
3D polyline (real-world coordinates)



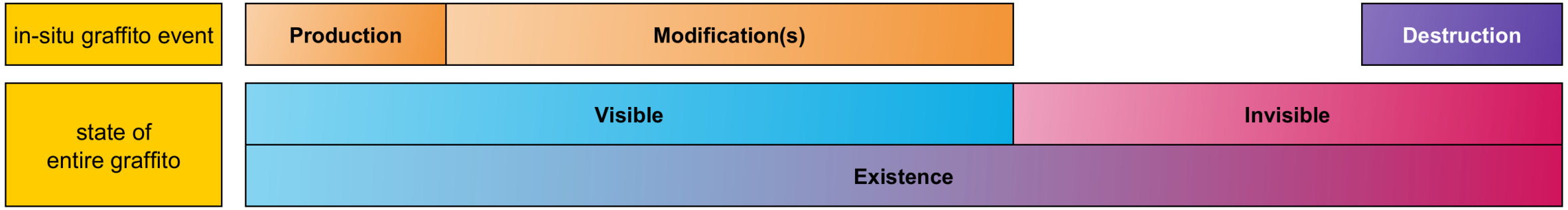
STORING time



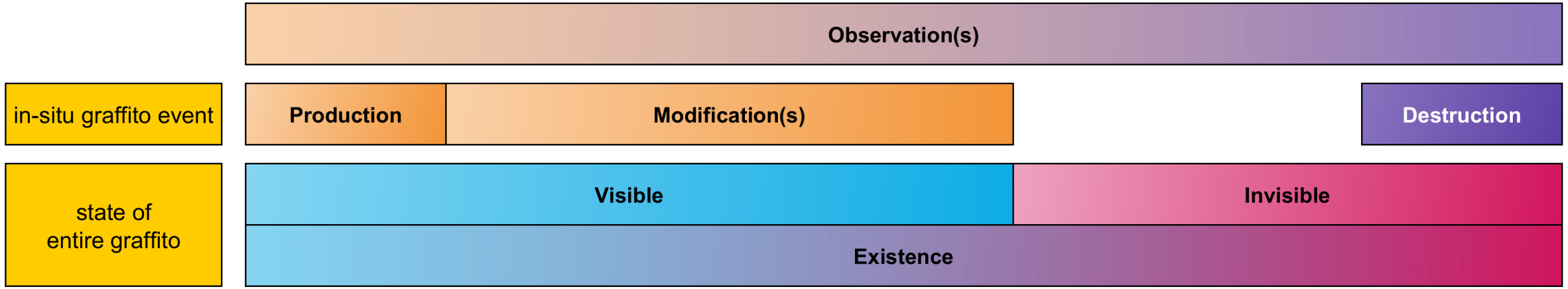
STORING time



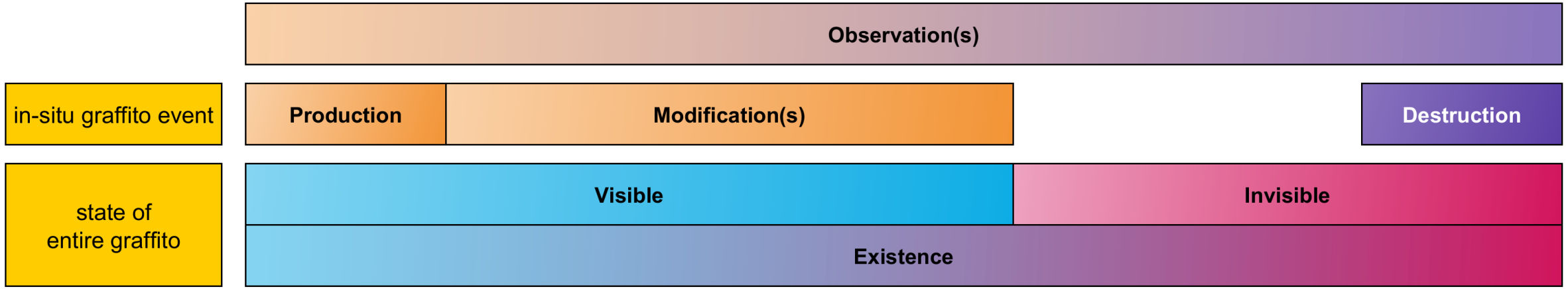
STORING time



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": […
  ],

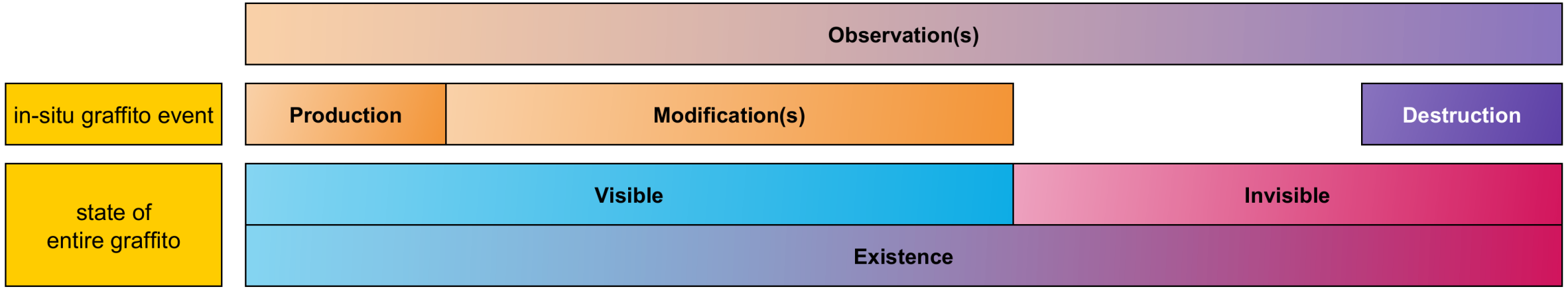
  "destruction": {…
  },

  "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": […
  ],

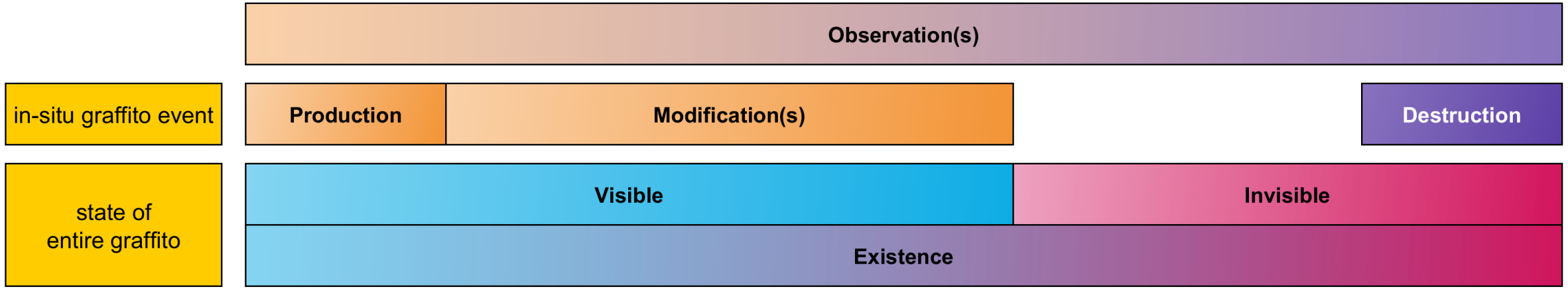
  "destruction": {…
  },

  "visible": {…
  },

  "invisibile": {…
  },

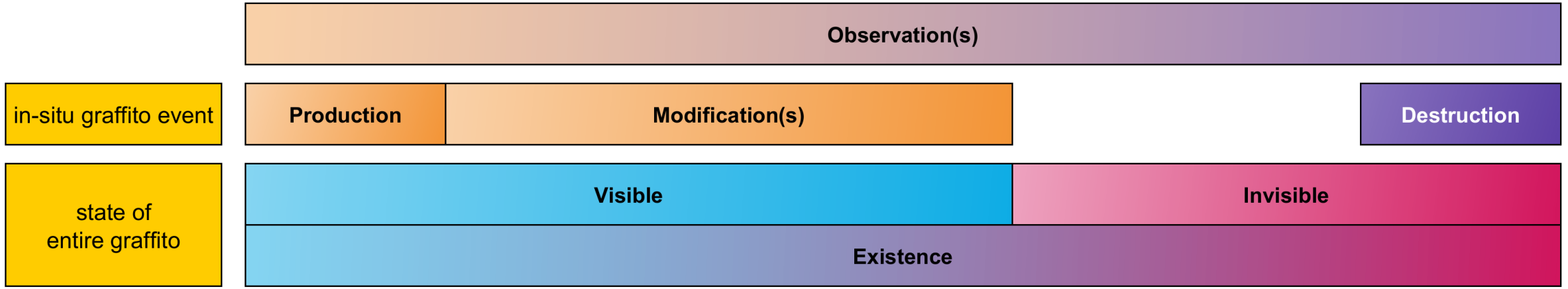
  "existence": {…
  }
```

STORING time



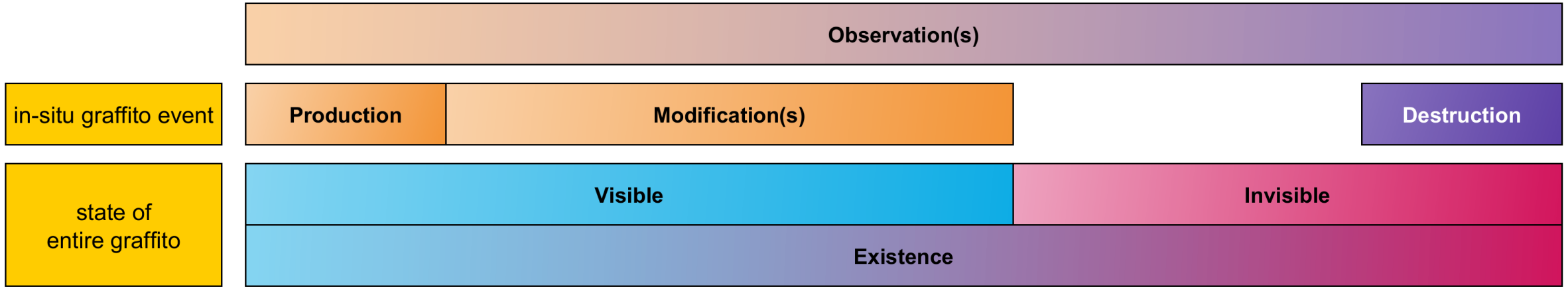

```
"visible": {
  "start": {                    "end": {                    "span": {
```

STORING time



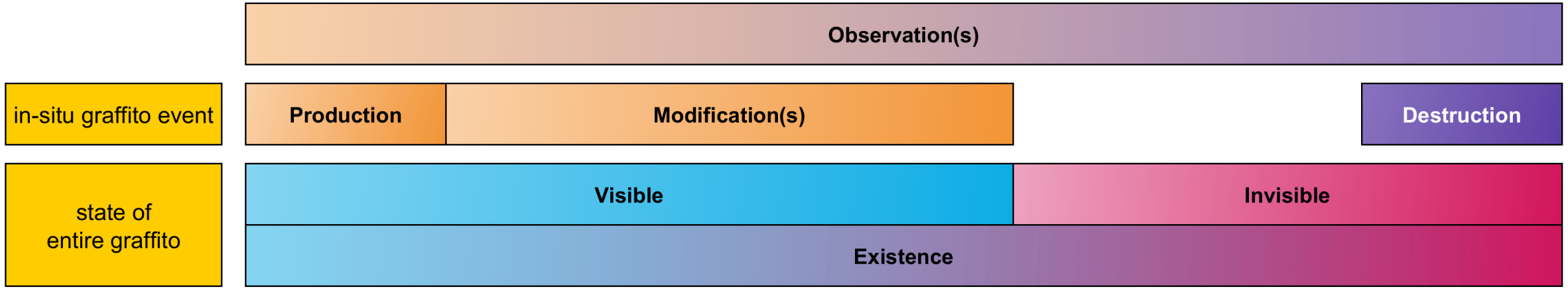

```
"visible": {
  "start": {                    "end": {                    "span": {
    "earliest":
    "earliest_source":
    "latest":
    "latest_source":
  },
```

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": {
  "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": "2022-09-12T12:36",
    "latest_source": "photoTour"
  },
```

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

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

STORING time




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

STORING time




```
"visible": {
  "start": {
    "earliest": "2022-09-05T10:20",
    "earliest_source": "photoTour",
    "latest": "2022-09-12T12:36",
    "latest_source": "photoTour"
  },
                    "end": {
                      "earliest": "2022-09-14T09:45",
                      "earliest_source": "photoTour",
                      "latest":
                      "latest_source":
                    },
                                        "span": {
                                          "minimum":
                                          "maximum":
                                        }
```

STORING time










```
"visible": {
  "start": {
    "earliest": "2022-09-05T10:20",
    "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",
    "latest_source": "photoTour"
  },
  "span": {
    "minimum":
    "maximum":
  }
```

STORING time




```
"visible": {
  "start": {
    "earliest": "2022-09-05T10:20",
    "earliest_source": "photoTour",
    "latest": "2022-09-12T12:36",
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  },
                    "end": {
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                      "latest": "2022-09-21T17:05",
                      "latest_source": "photoTour"
                    },
                                        "span": {
                                          "minimum": "PT45H9M",
                                          "maximum":
                                        }
```

STORING time




```
"visible": {
  "start": {
    "earliest": "2022-09-05T10:20",
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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"
  },
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    "maximum": "PT390H45M"
  }
```

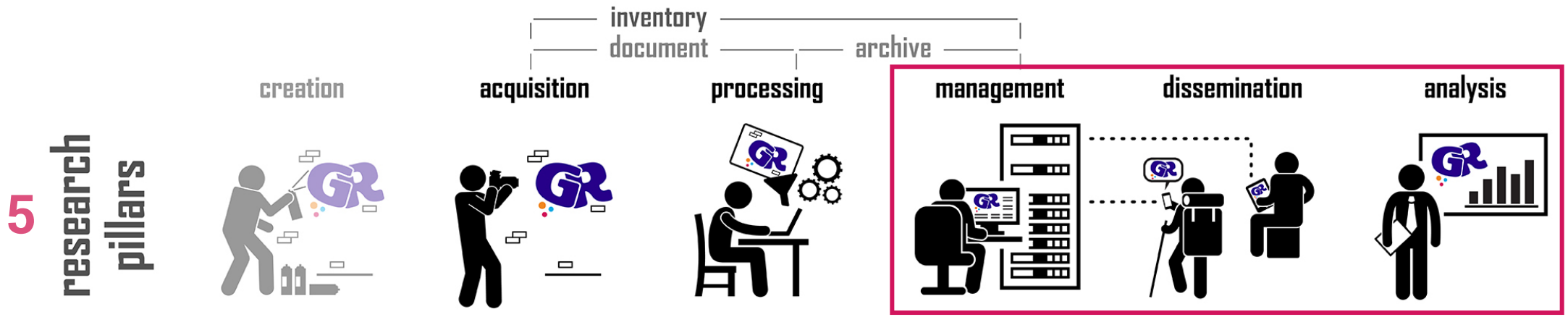
SOME results

GRAFFITI *LOCATION*

GRAFFITI *TEMPORALITY*

GRAFFITI *TERMINOLOGY*

GRAFFITI *CHARACTERISATION*



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

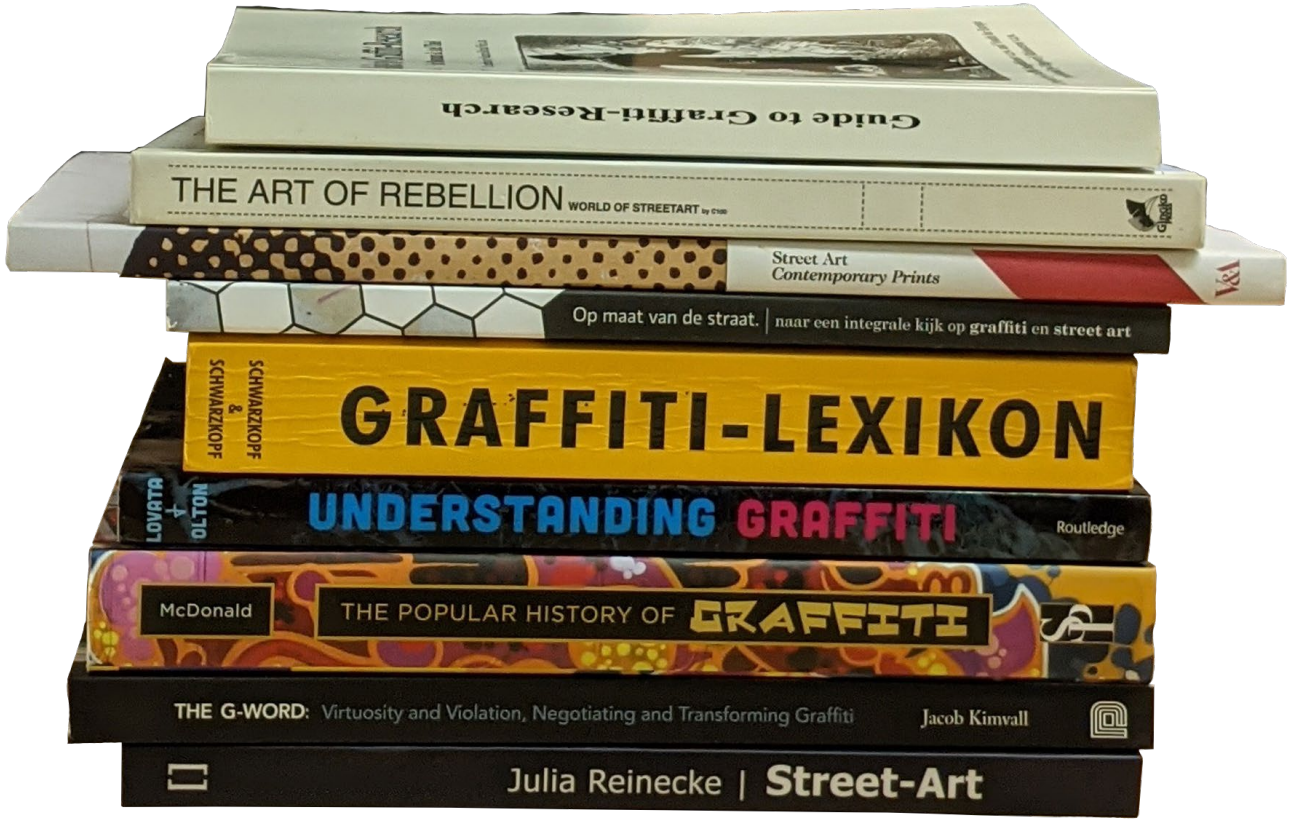
TERMINOLOGY & HIERARCHY

Graffiti ? Street Art ?

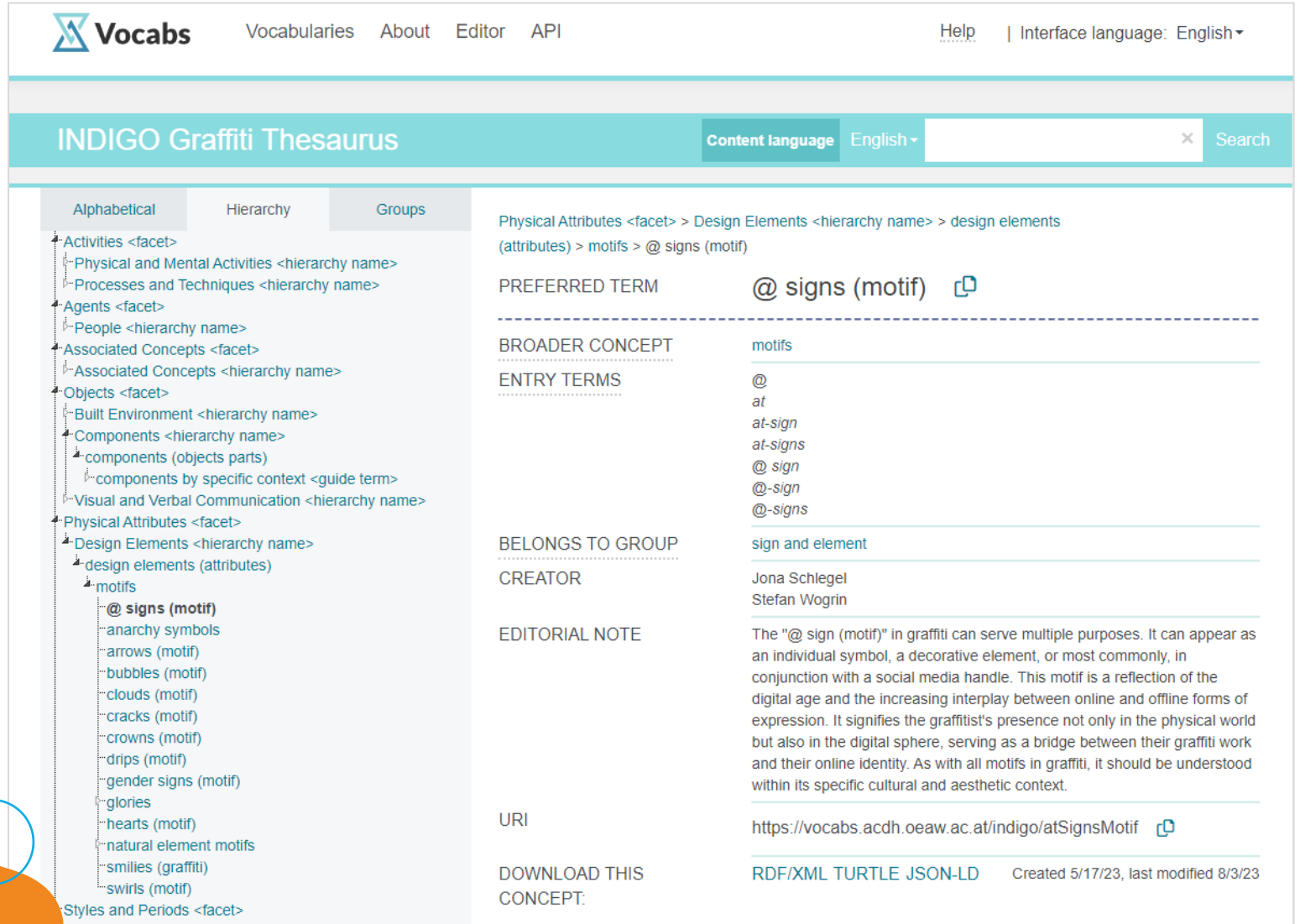
Graffiti
|___ Street Art

Street Art
|___ Graffiti

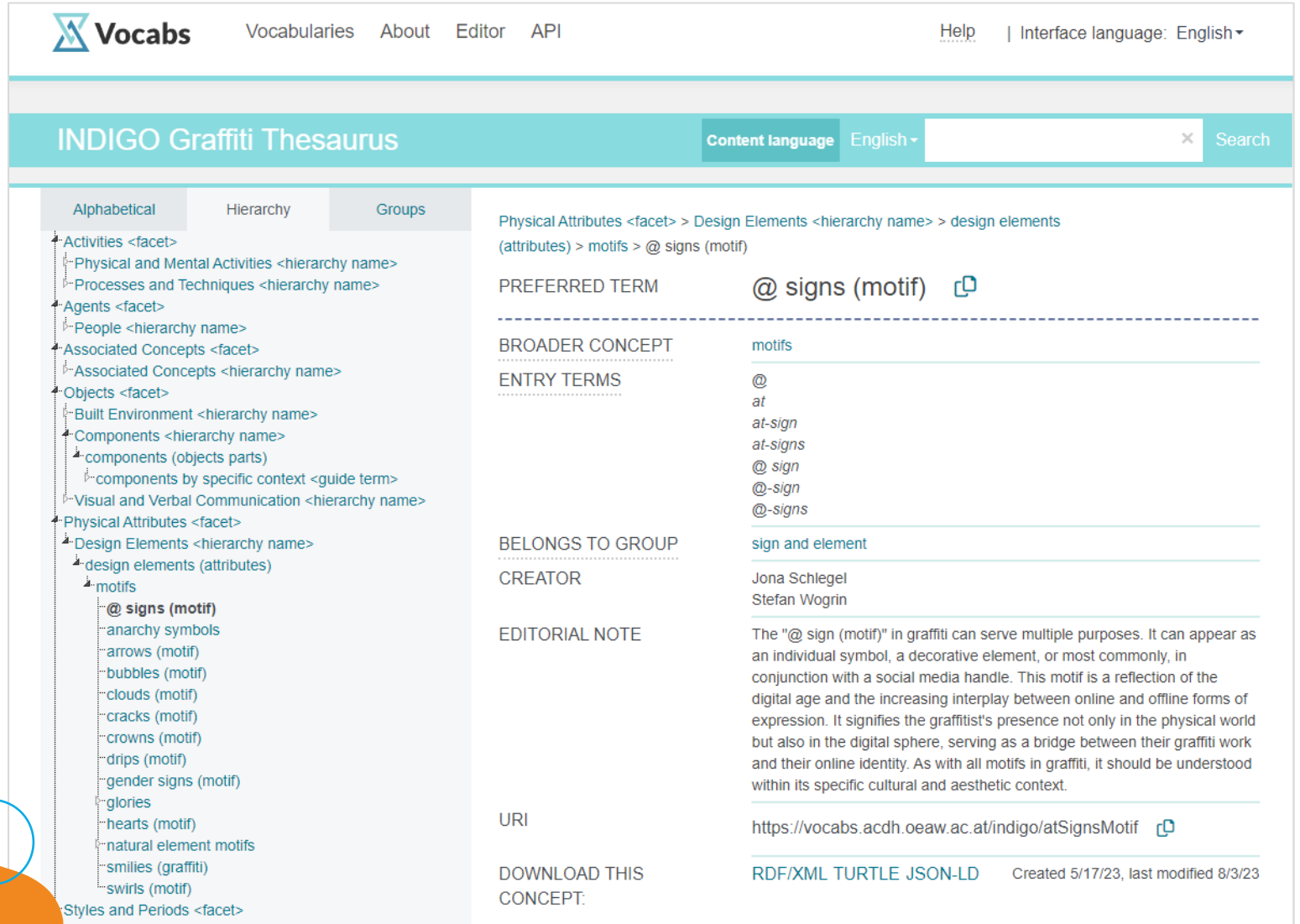
Graffiti | Street Art



GRAFFITI thesaurus

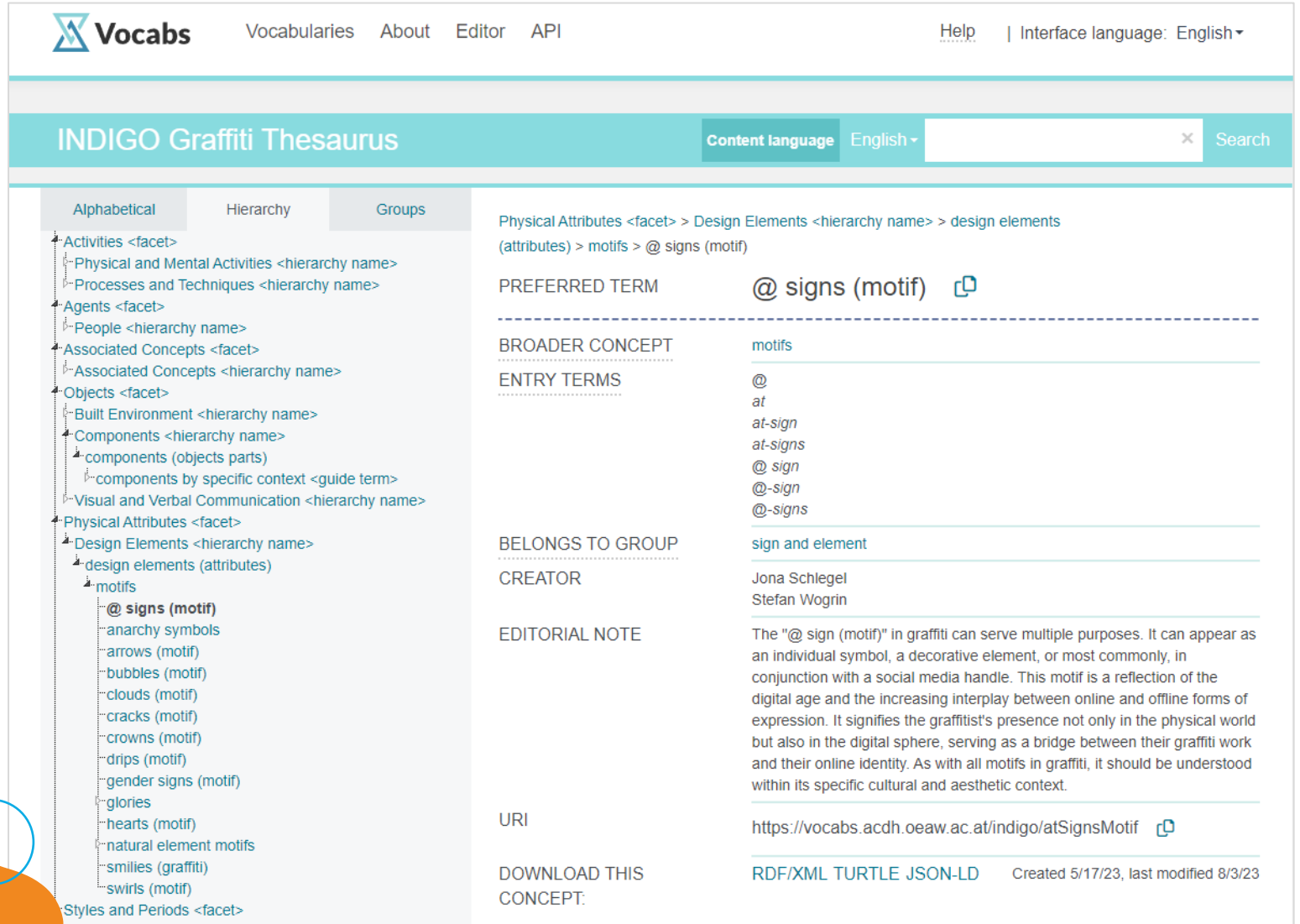


GRAFFITI thesaurus



Hierarchy

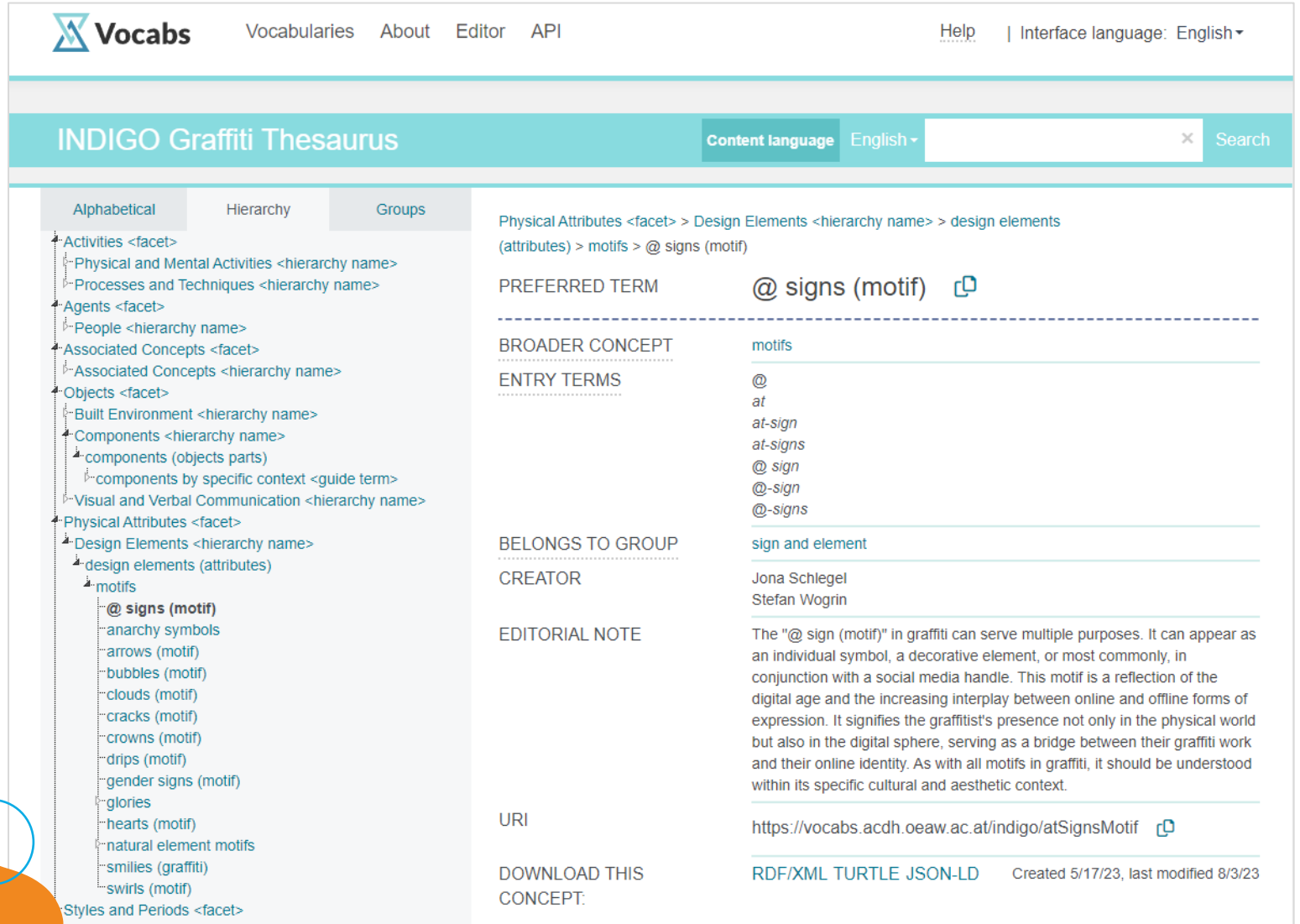
GRAFFITI thesaurus



Hierarchy

Synonyms & preferred terms

GRAFFITI thesaurus

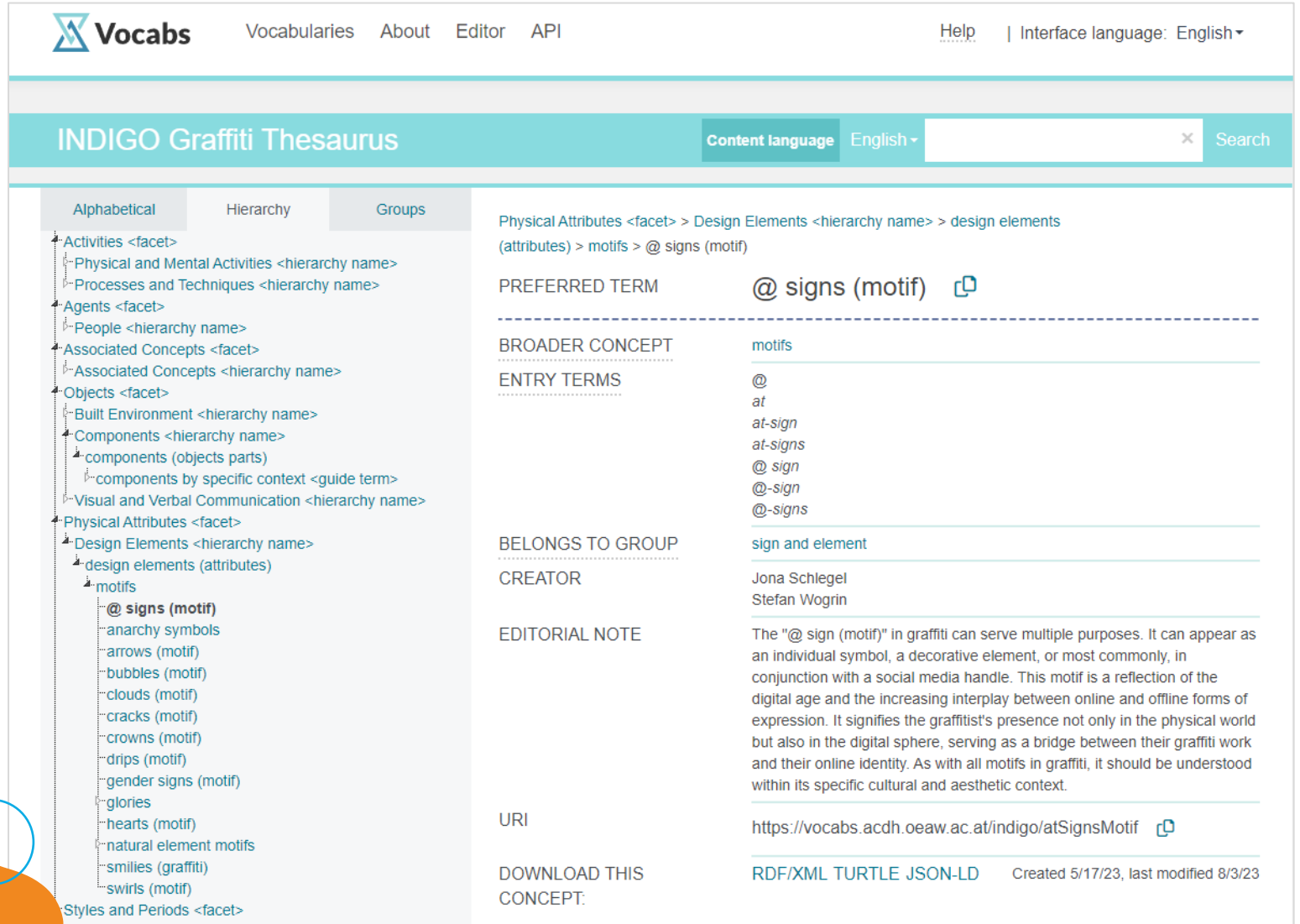


Hierarchy

Synonyms & preferred terms

URI

GRAFFITI thesaurus



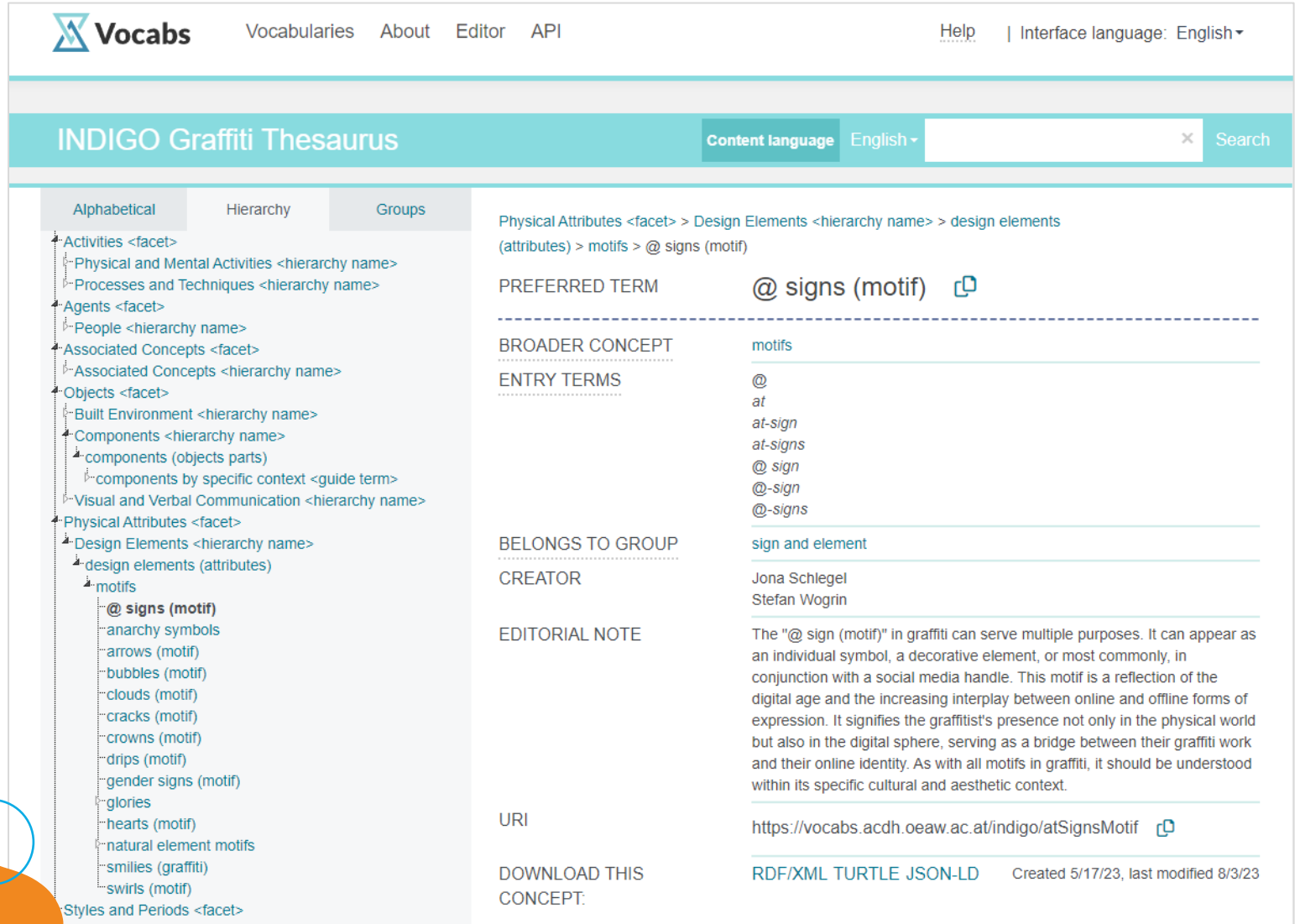
Hierarchy

Synonyms & preferred terms

URI

Semantic Web

GRAFFITI thesaurus



Hierarchy

Synonyms & preferred terms

URI

Semantic Web

Structure → Getty Art & Architecture Thesaurus

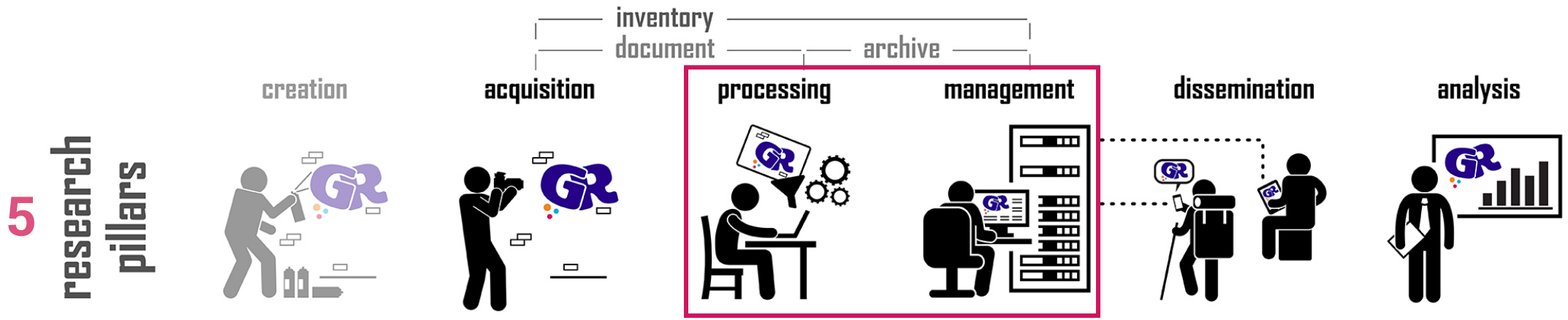
SOME results

GRAFFITI *LOCATION*

GRAFFITI *TEMPORALITY*

GRAFFITI *TERMINOLOGY*

GRAFFITI *CHARACTERISATION*



COOLPI

COOLPI

colour-accurate pixels



Product Solutions Open Source Pricing Search or jump to... Sign in Sign up

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

HUEnique
colour determination

HUEnique



HUEnique
colour determination

HUEnique



HUEnique
colour determination

HUEnique



HUEnique
colour determination

HUEnique



HUEnique
colour determination

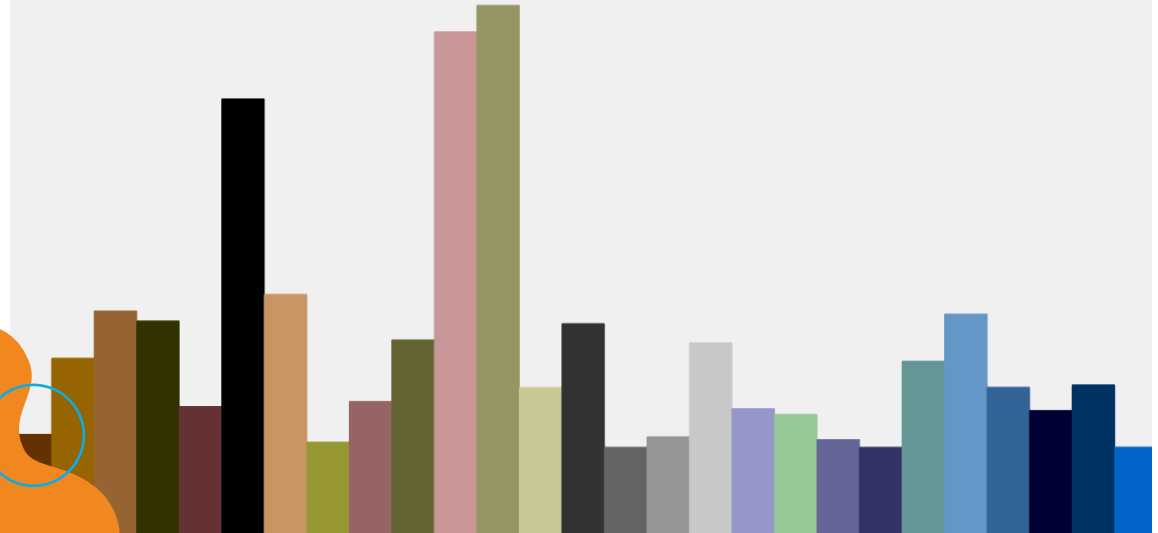
HUEnique



HUEnique
colour determination

HUEnique





HUEnique
colour determination

HUEnique

SOME results

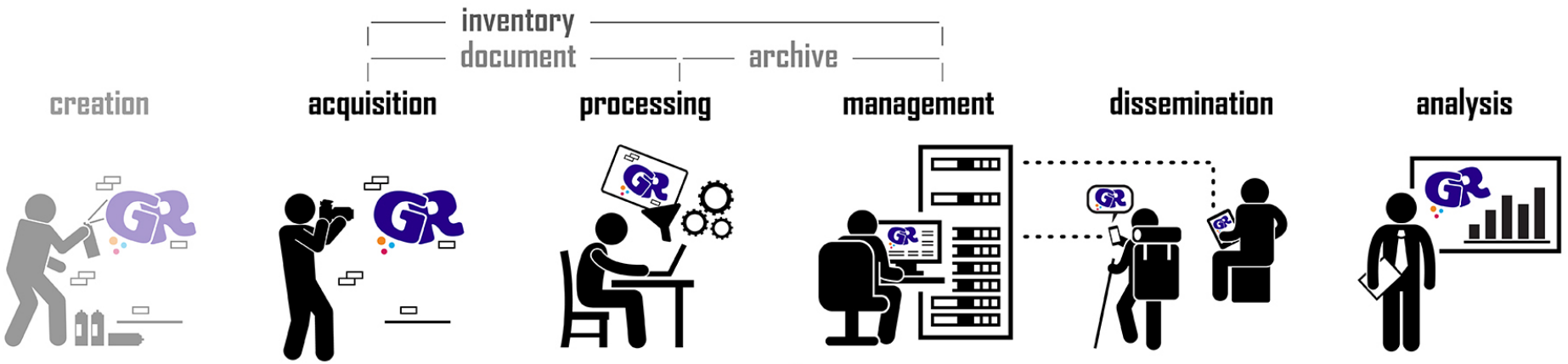
GRAFFITI *LOCATION*

GRAFFITI *TEMPORALITY*

GRAFFITI *TERMINOLOGY*

GRAFFITI *CHARACTERISATION*

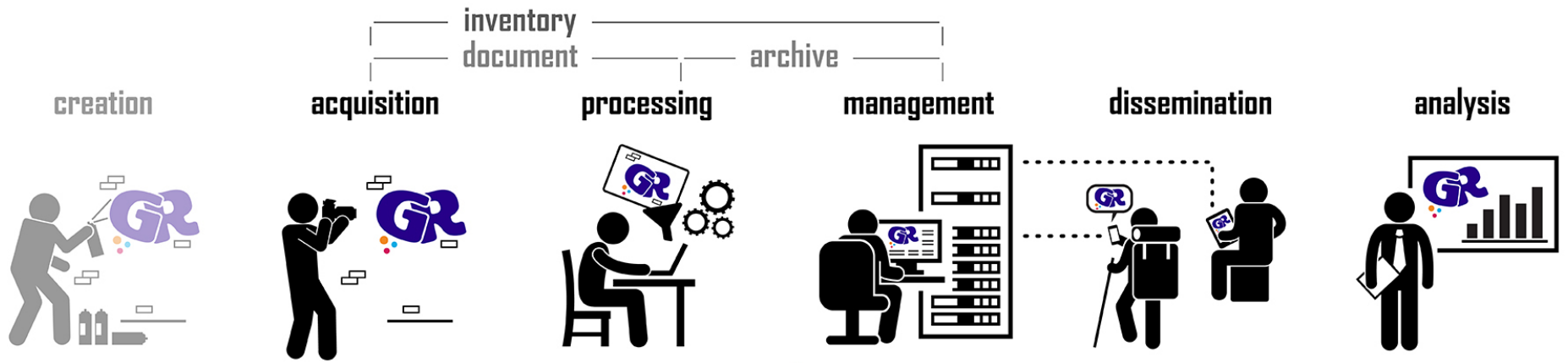
5 research pillars



GRAFFITI metadata

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

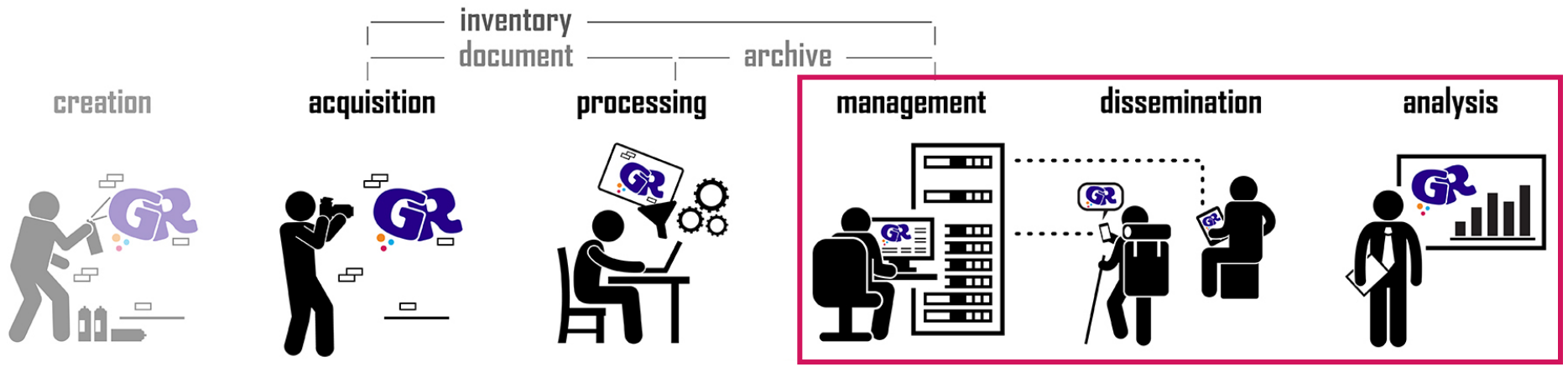
5 research pillars



GRAFFITI metadata

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

5 research pillars





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

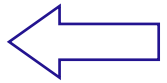
orthophotographs

polygons

metadata

GRAFFITI (meta)data

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

digital photos

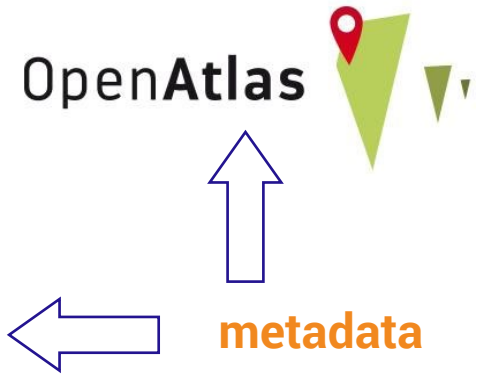
textured 3D models

orthophotographs

polygons

GRAFFITI (meta)data

INDIGO metadata (physical graffito)	
Category Level	**Category Name**
1	**Descriptive metadata**
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3	**Structural metadata**
3.1	Origin relationships
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3.2	Spatio-temporal relationships



digital photos

textured 3D models

orthophotographs

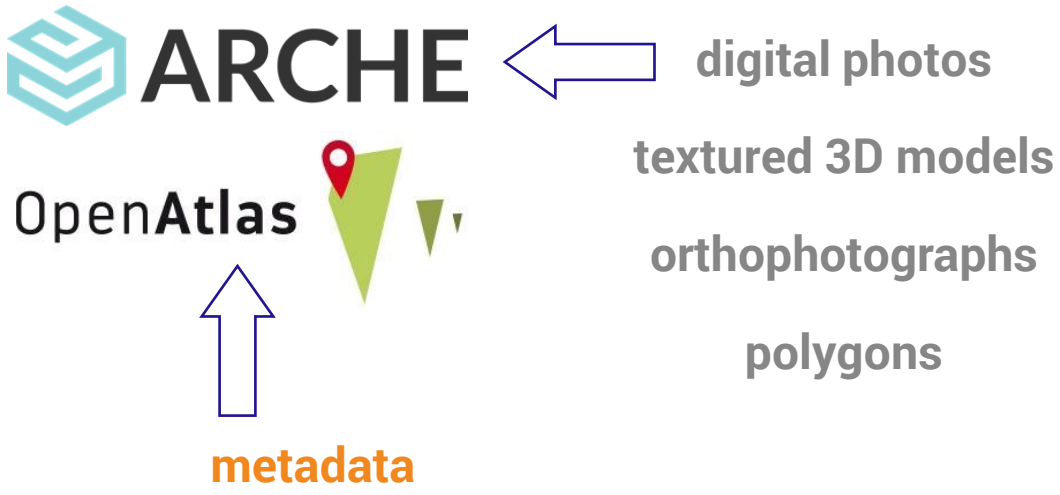
polygons

GRAFFITI (meta)data

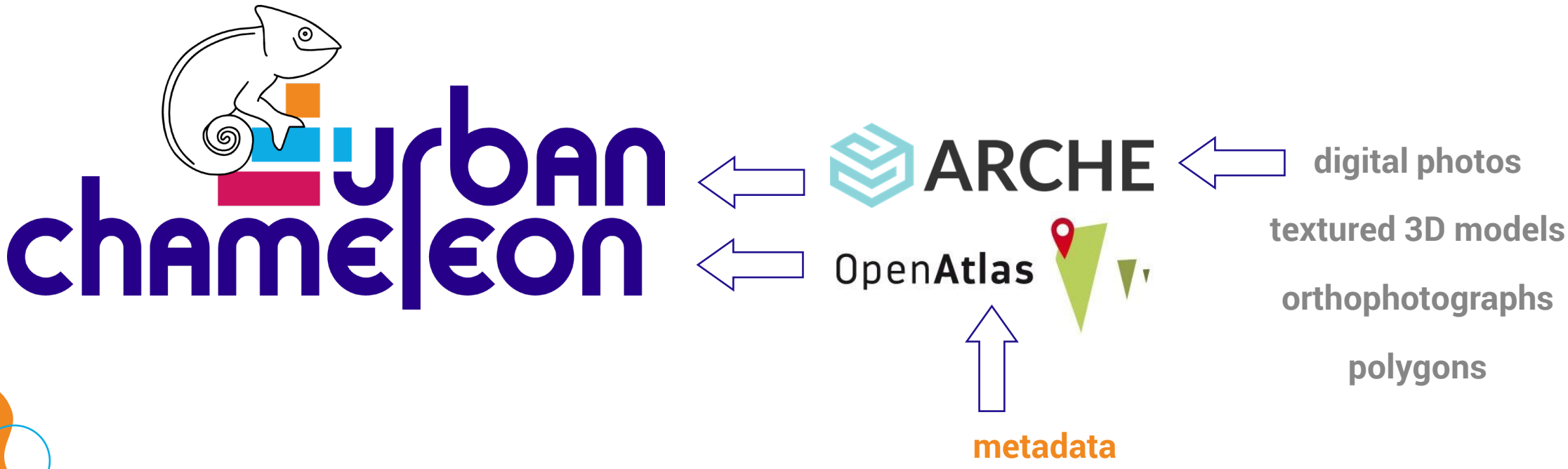
INDIGO metadata (physical graffito)	
Category Level	**Category Name**
1	**Descriptive metadata**
1.1	Core metadata
1.2	Locational metadata
1.3	Temporal metadata
1.4	Contentual / aboutness metadata
1.5	Formal / appearance metadata
2	**Administrative metadata**
2.1	Rights metadata
2.2	Access metadata
2.3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



FINAL goal

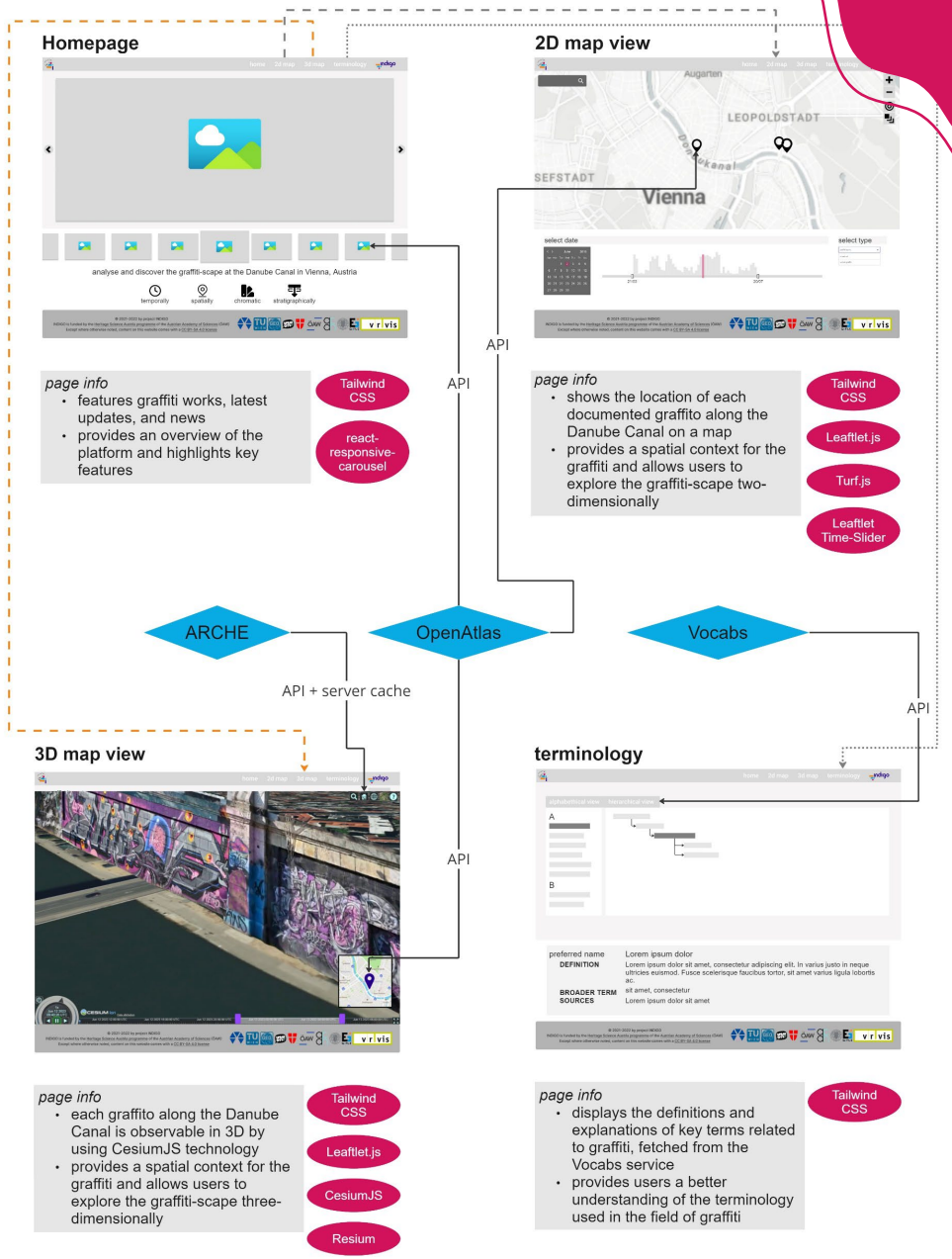

ARCHE
OpenAtlas
metadata
digital photos
textured 3D models
orthophotographs
polygons

FINAL goal


urban chameleon
ARCHE
OpenAtlas
digital photos
textured 3D models
orthophotographs
polygons
metadata

FINAL goal

urban chameleon





INTERACTIVE 3D dissemination

archaeologists / art historians

sociologists / linguists

ethnographers / anthropologists

architects / geographers



INTERACTIVE 3D dissemination

archaeologists / art historians

sociologists / linguists

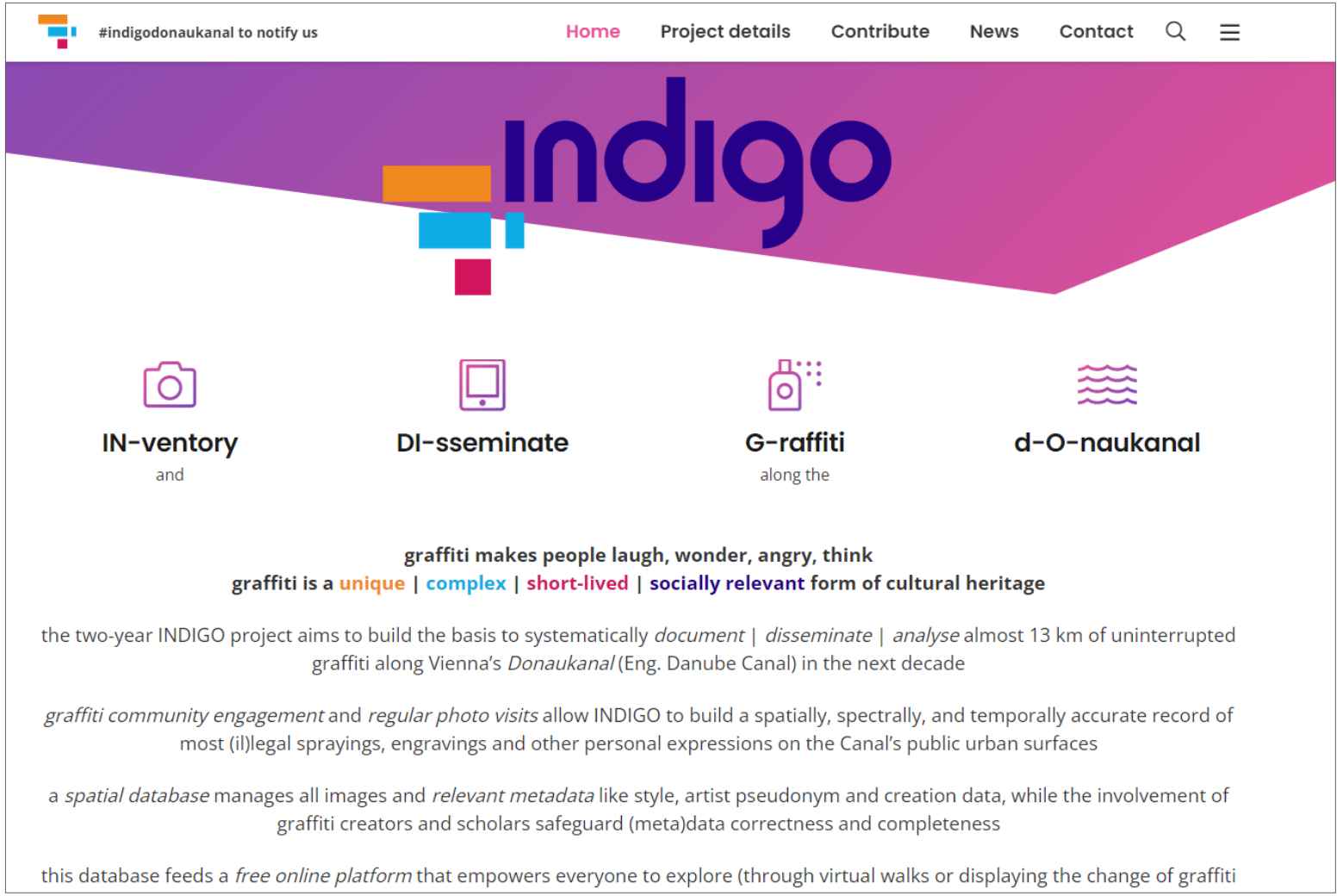
ethnographers / anthropologists

architects / geographers

ETHICAL + COPYRIGHT aspects

INDIGO website

https://projectindigo.eu

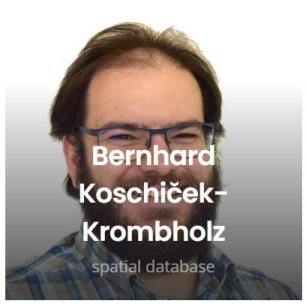


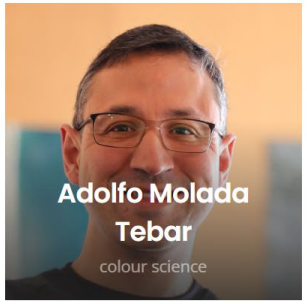
INDIGO team

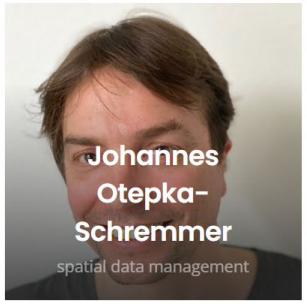


Geert Verhoeven



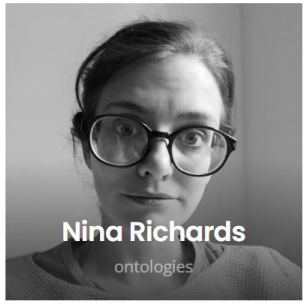


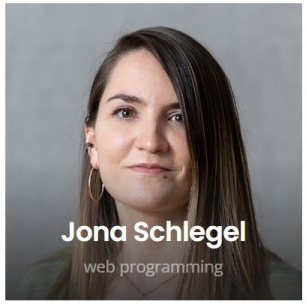






Norbert Pfeifer



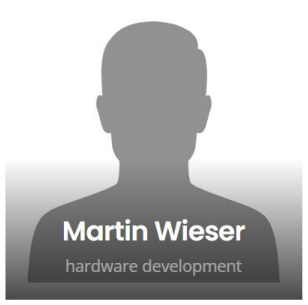


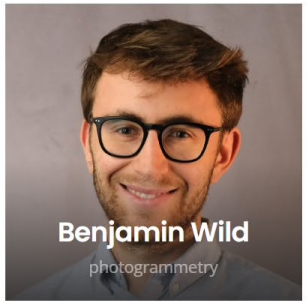






Stefan Wogrin





Archaeology of contemporary graffiti

