go indigo 2023

One polygon at a time trying to manage a graffiti-scape's spatio-tem ⧖ po ⧖ ra ⧖ li ⧖ ty

Geert Verhoeven
Jona Schlegel

projectindigo.eu

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

UNIVERSE
4-dimensional

UNIVERSE
4-dimensional

NEWTONIAN PHYSICS

↓

4D universe

UNIVERSE
4-dimensional

NEWTONIAN PHYSICS

↓

4D universe

“event” = location + time

UNIVERSE
4-dimensional

NEWTONIAN PHYSICS

↓

4D universe

“event”	**=**	**location**	**+**	**time**
		3D		1D
		(x, y, z)		t

UNIVERSE
4-dimensional

NEWTONIAN PHYSICS

↓

4D universe

“event”	**=**	**location**	**+**	**time**
		3D		1D
		(x, y, z)		t

~~**dimensional order**~~

more dimensions

UNIVERSE
4-dimensional

NEWTONIAN PHYSICS

↓

4D universe

“event”	=	location	+	time
		3D		1D
		(x, y, z)		t
		GIS		
		2D / 2.5D		

UNIVERSE
4-dimensional

NEWTONIAN PHYSICS

↓

4D universe

“event” = **location** (3D, (x, y, z)) + **time** (1D, t)

GIS

2D / 2.5D

3D

UNIVERSE
4-dimensional

NEWTONIAN PHYSICS

↓

4D universe

“event”	=	**location** 3D (*x*, *y*, *z*)	+	**time** 1D *t*
		GIS 2D / 2.5D 3D		time

UNIVERSE
spatio-temporal

NEWTONIAN PHYSICS

↓

4D universe

"event"	=	**location** 3D (*x*, *y*, *z*)	+	**time** 1D *t*
		GIS 2D / 2.5D		
INDIGO / UrbanChameleon		3D		time

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

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

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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

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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

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

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

between AD 41 & AD 79

16 June 2023 @ 10:25 CET

1963 years ± 19 years

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

MOMENTS of creation

12 days ± 2 days

between 02 & 06 June 2023

extended
temporal uncertainty

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

© Sophie Hay

between AD 41 & AD 79

16 June 2023 @ 10:25 CET

1963 years ± 19 years

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

temporal uncertainty
narrow

MOMENTS of creation

graffito creation
extended
temporal uncertainty

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

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
graffito creation

MOMENTS of creation

visibility (interrupted)
graffito creation
extended
temporal uncertainty

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

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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
graffito creation
visibility

INDIGO METADATA

real graffito
vs
digital derivatives

MOMENTS of creation

visibility (interrupted)
graffito creation
extended
temporal uncertainty

~~*related to temporal fuzziness*~~
photo | ~~graffito~~
creation event
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© Sophie Hay

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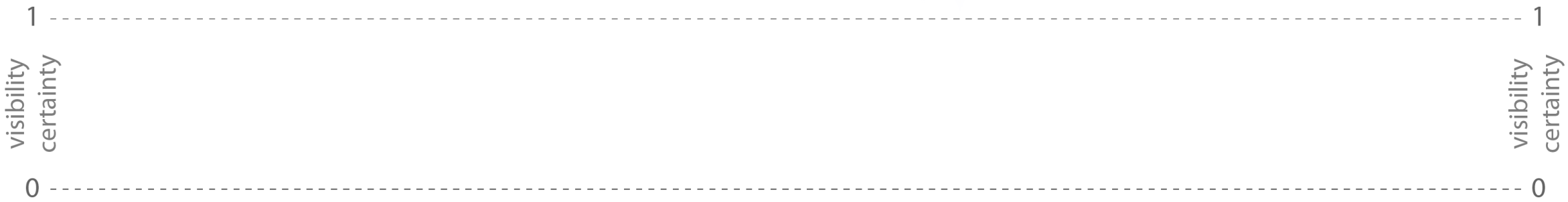
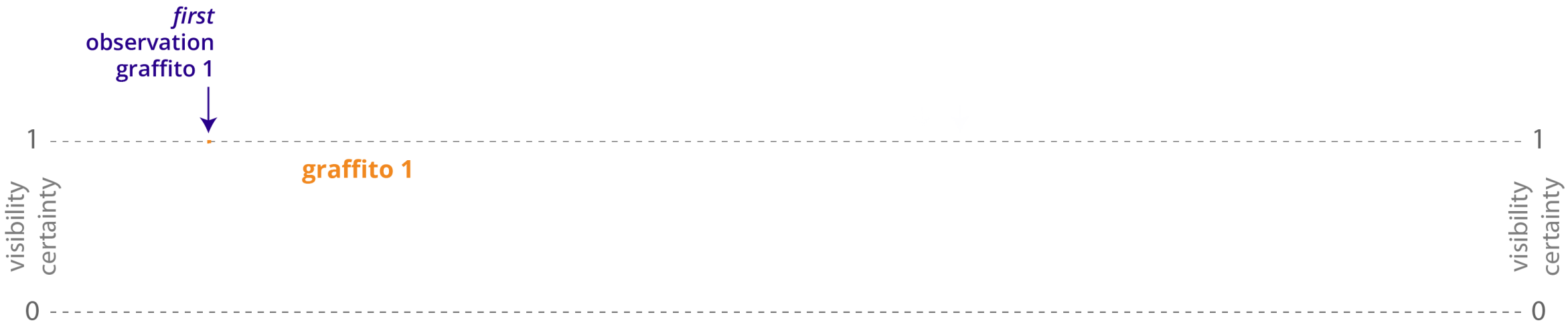
date + time
creation event
photo | ~~graffito~~
~~*related to temporal fuzziness*~~

temporal uncertainty
narrow
graffito creation
visibility

GRAFFITO observations



GRAFFITO observations



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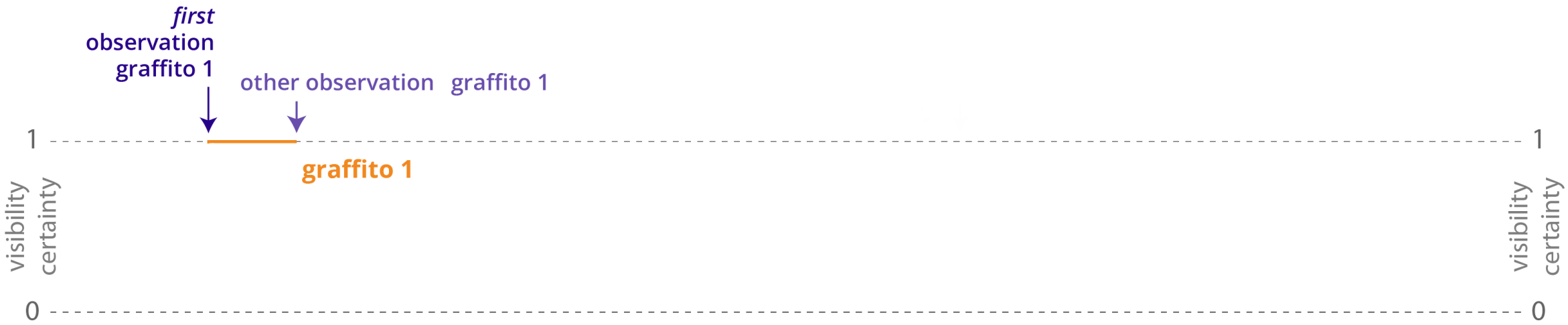

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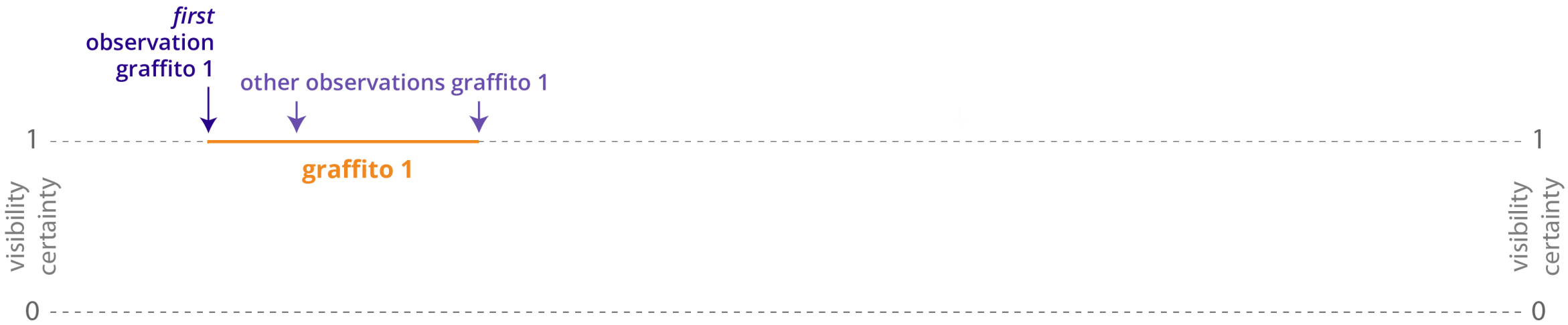

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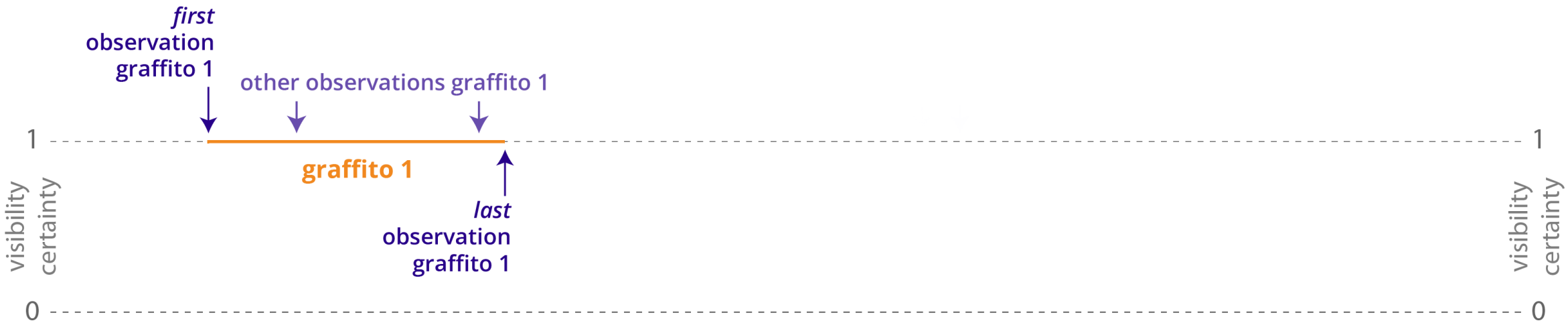
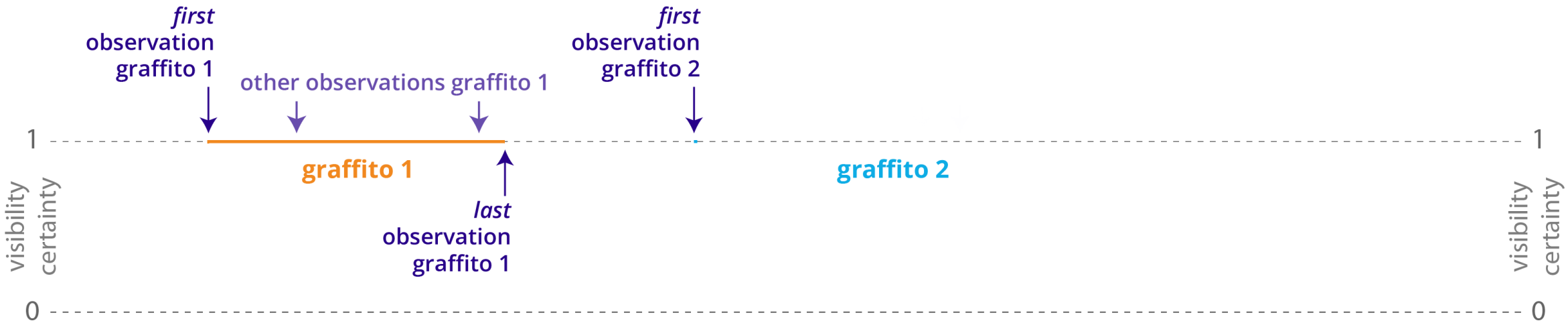


GRAFFITO observations



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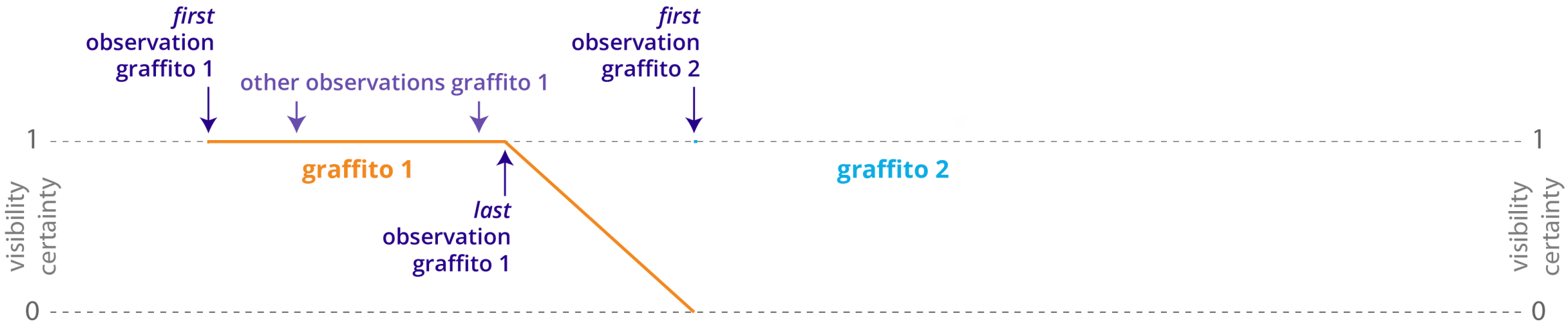
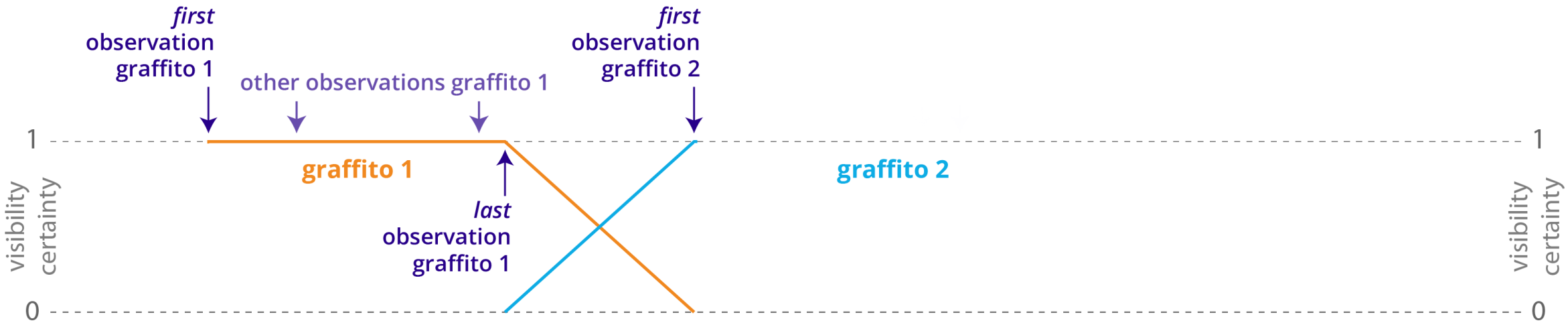
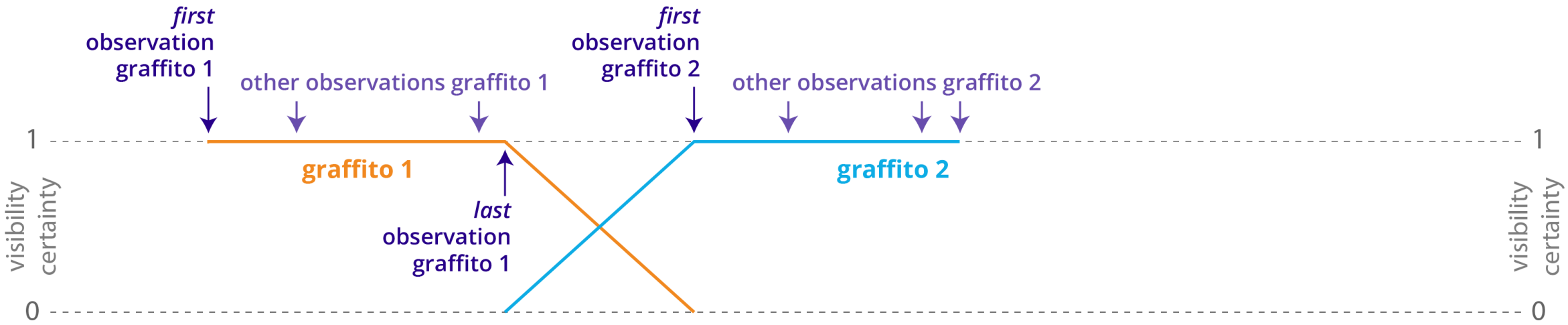


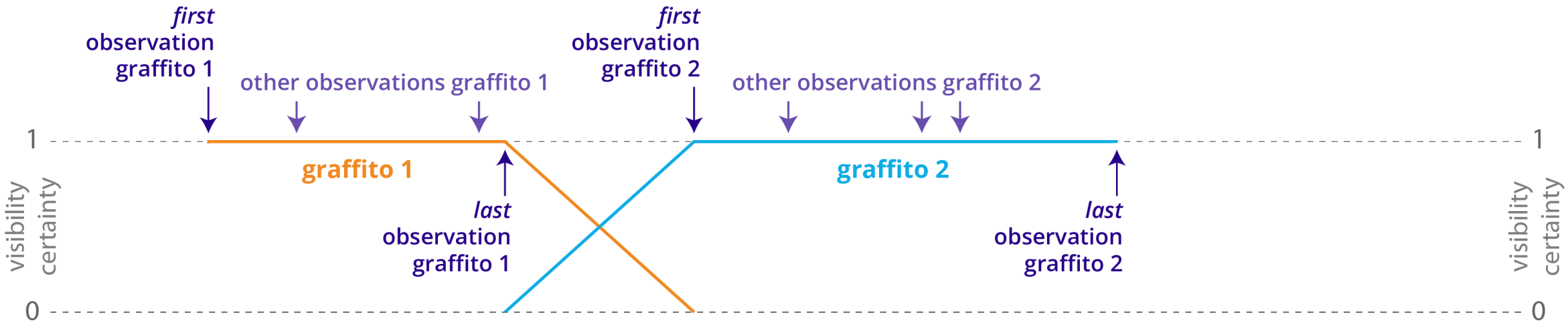
GRAFFITO observations



GRAFFITO observations



GRAFFITO observations



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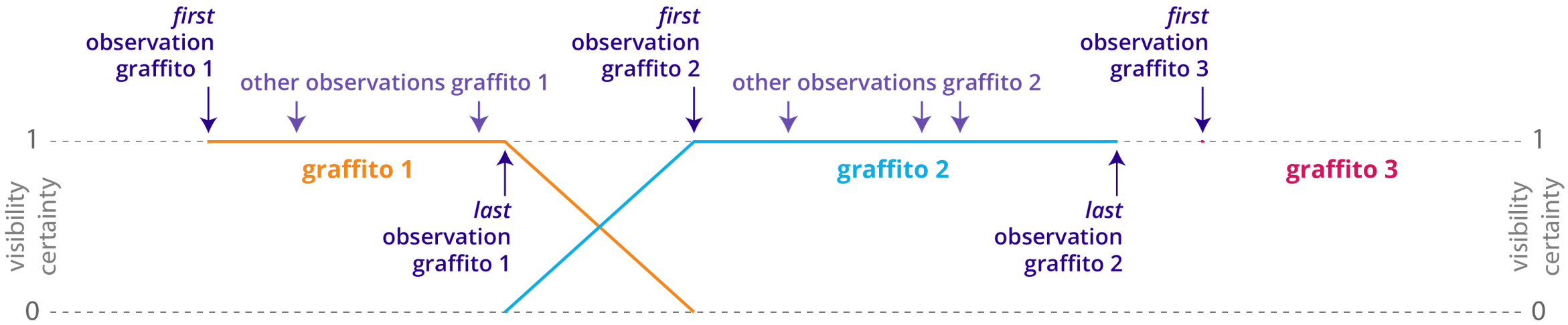

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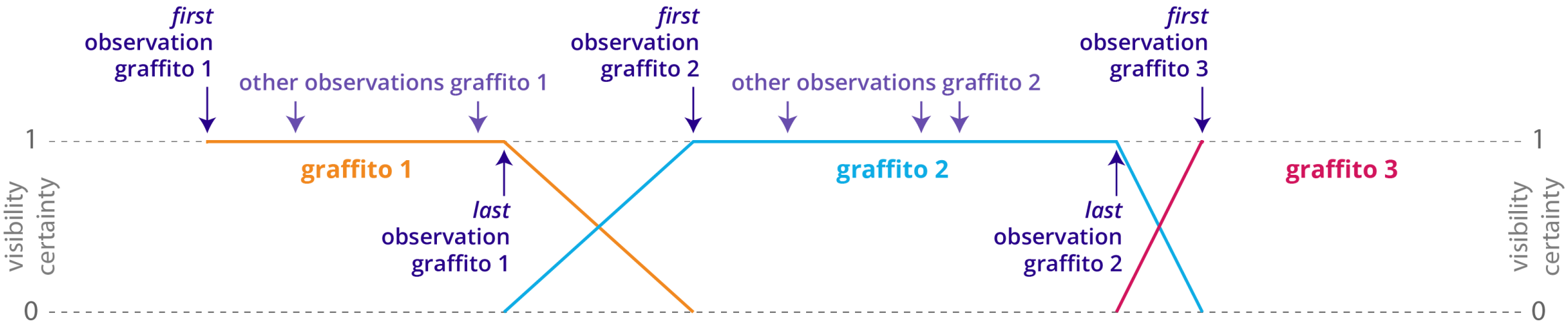
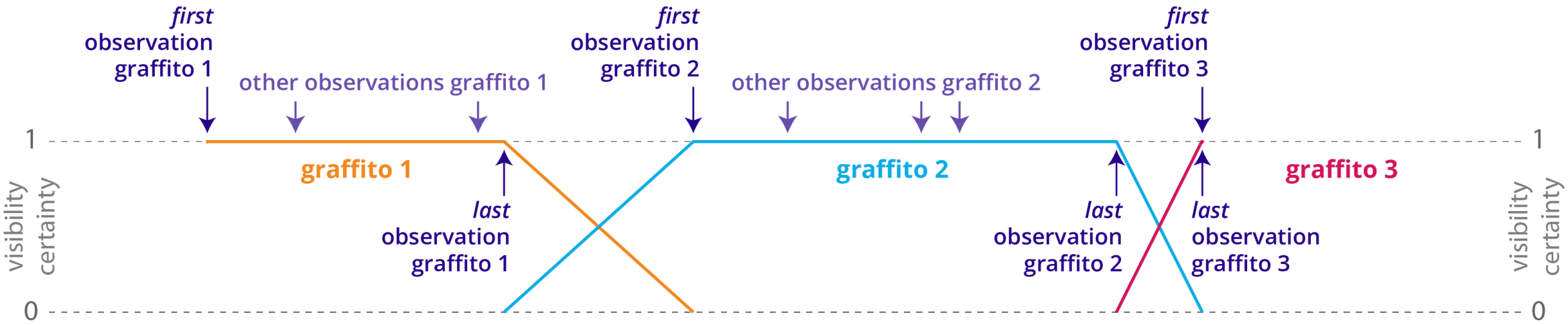
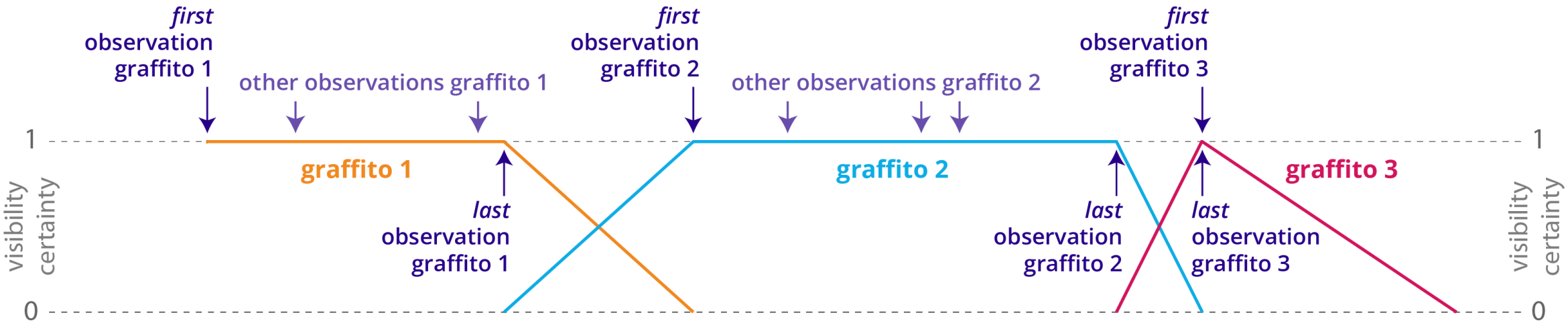


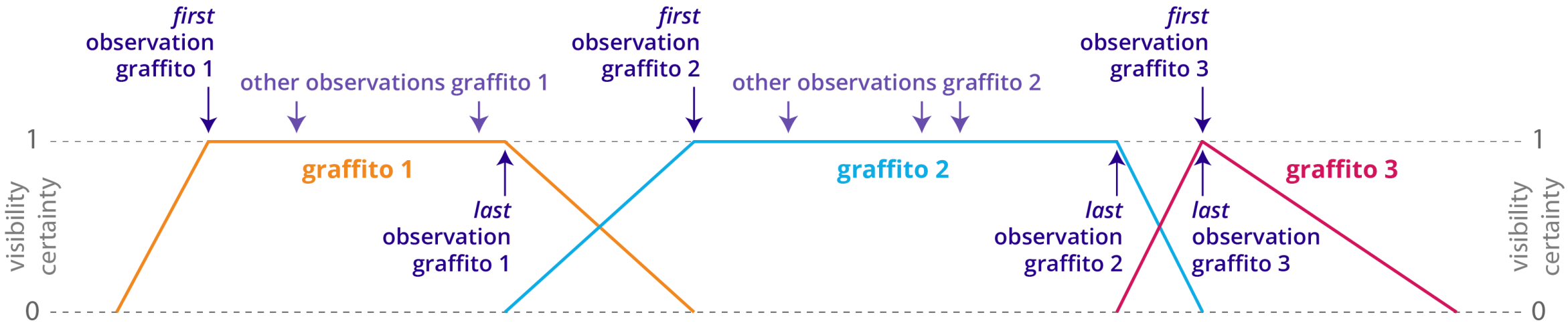
GRAFFITO observations



GRAFFITO observations



GRAFFITO observations



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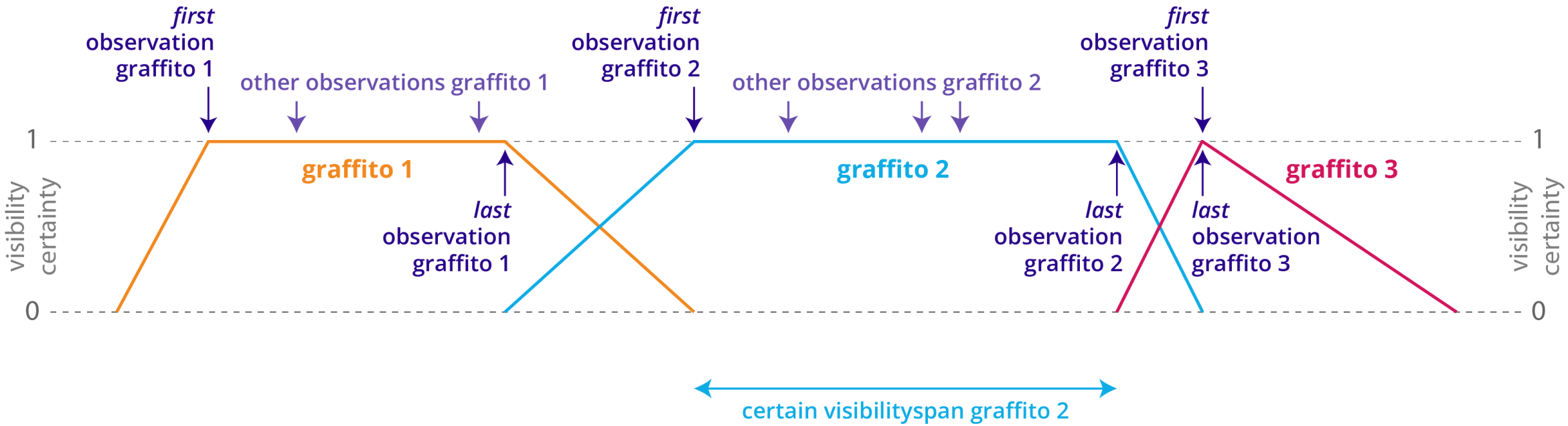

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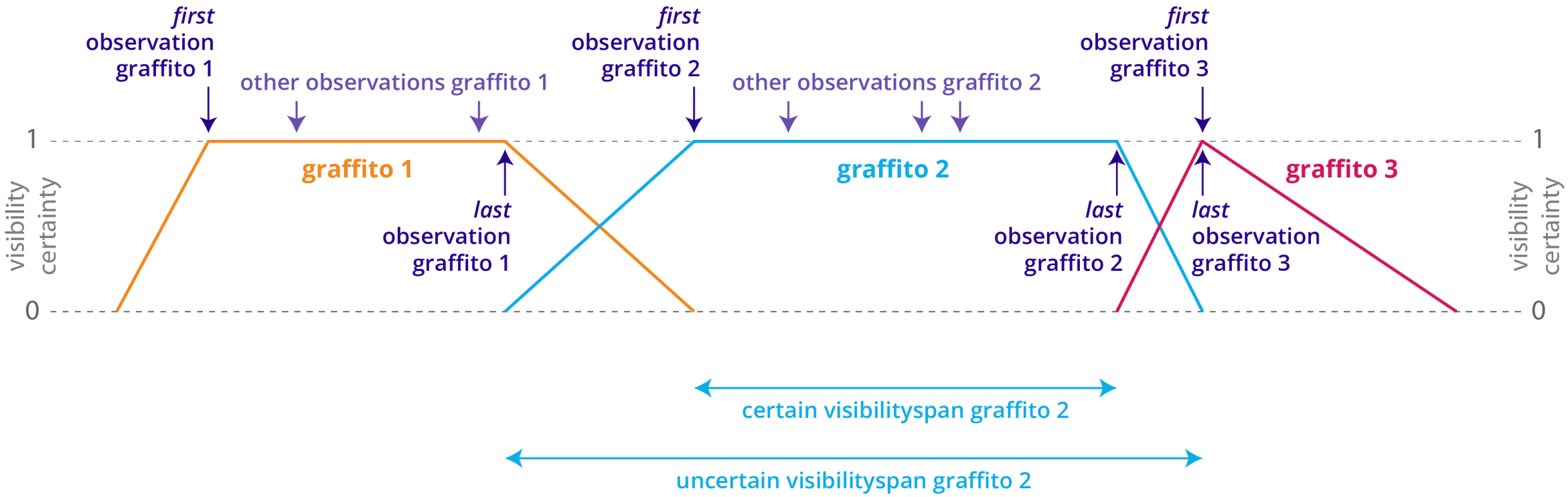

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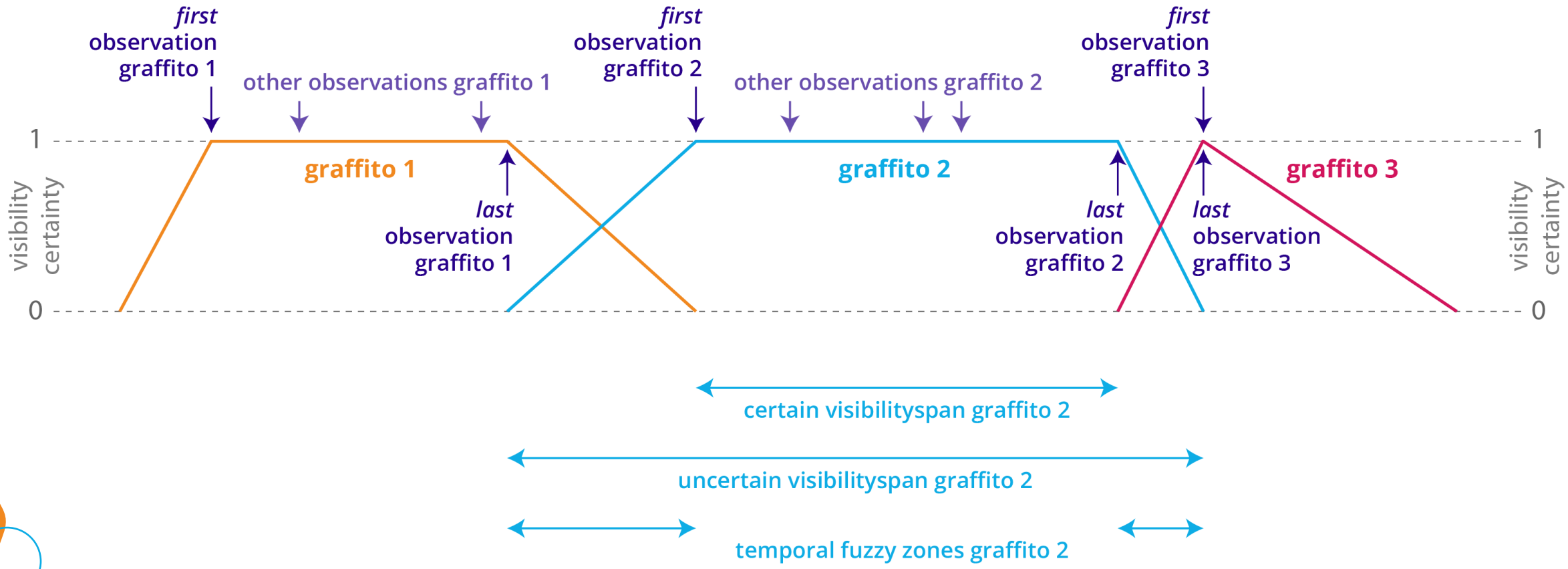

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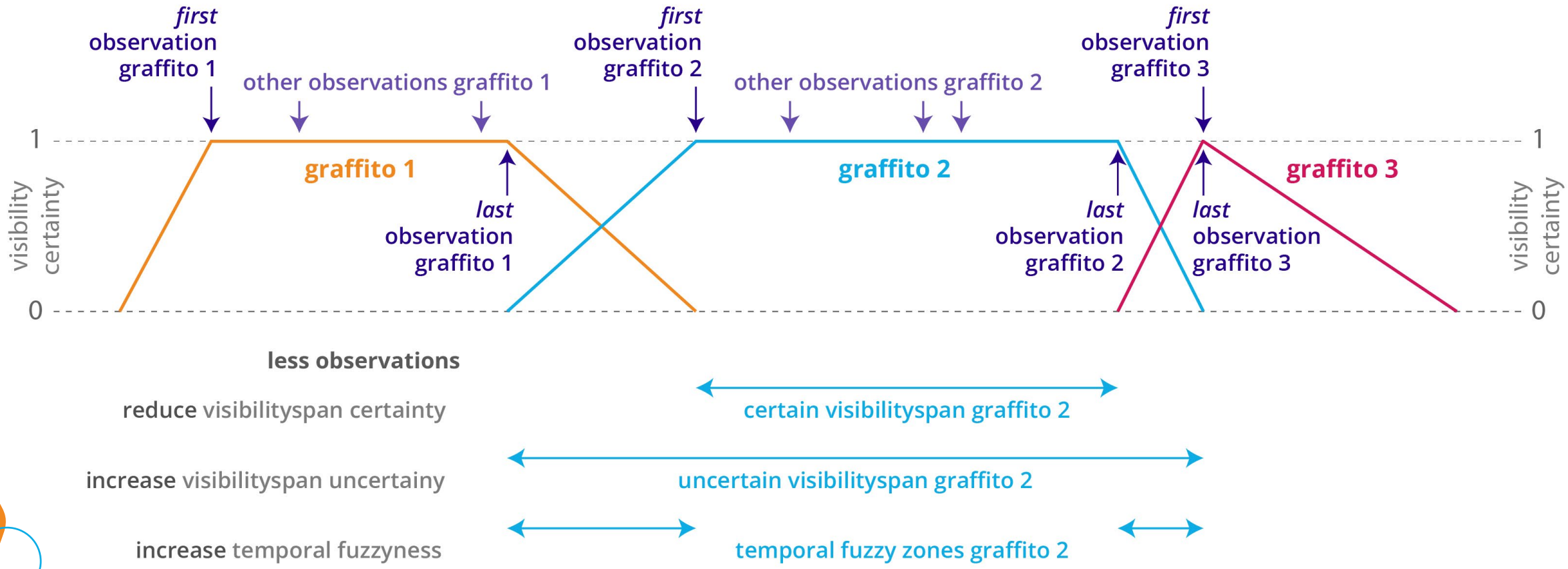

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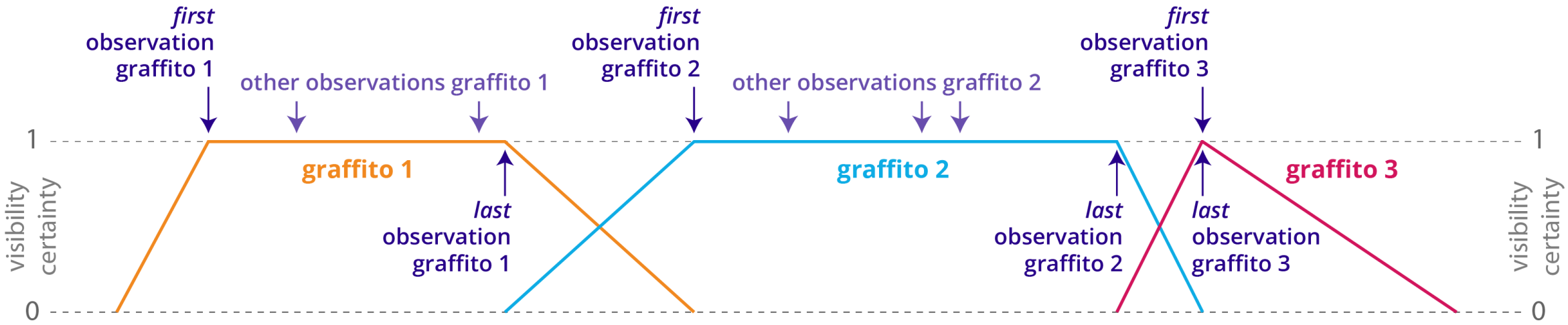


less observations

reduce visibilityspan certainty

increase visibilityspan uncertainty

increase temporal fuzzyness

more observations

increase visibilityspan certainty

reduce visibilityspan uncertainty

reduce temporal fuzzyness

certain visibilityspan graffito 2

uncertain visibilityspan graffito 2

temporal fuzzy zones graffito 2

GRAFFITO observations

less observations

reduce visibilityspan certainty

increase visibilityspan uncertainty

increase temporal fuzzyness

certain visibilityspan graffito 2

uncertain visibilityspan graffito 2

temporal fuzzy zones graffito 2

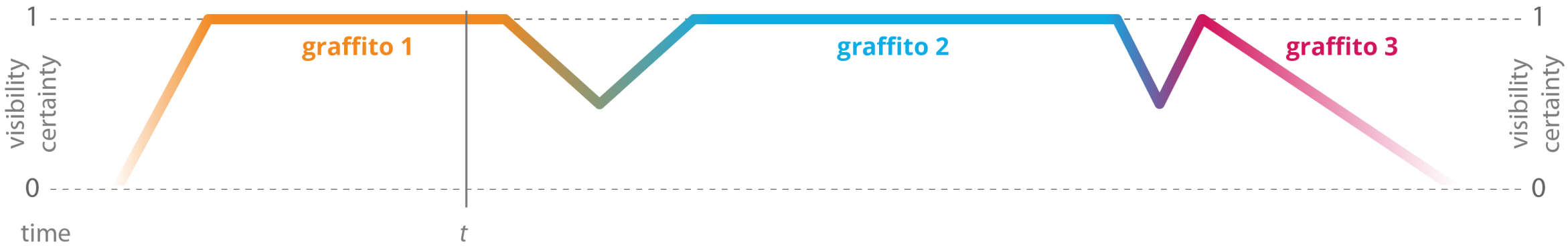
more observations

increase visibilityspan certainty

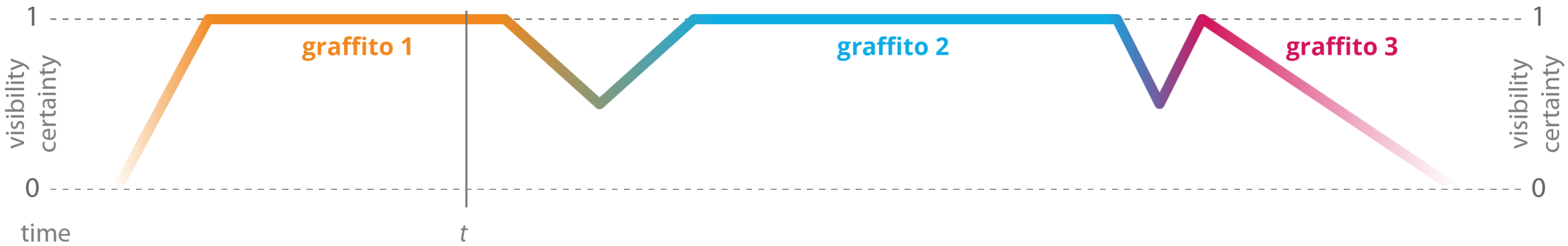
reduce visibilityspan uncertainty

reduce temporal fuzzyness

GRAFFITO observations



GRAFFITO observations

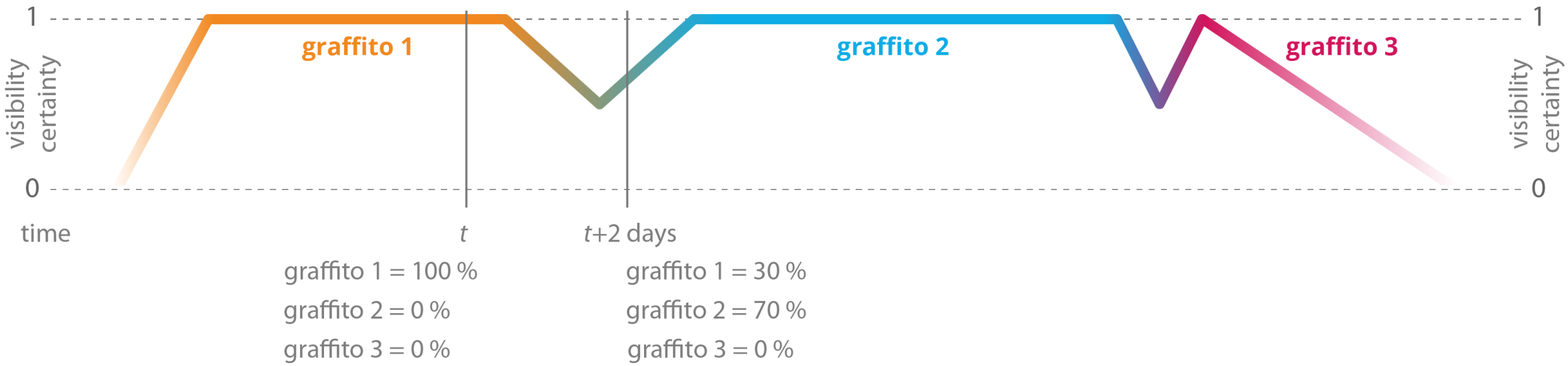


graffito 1 = 100 %

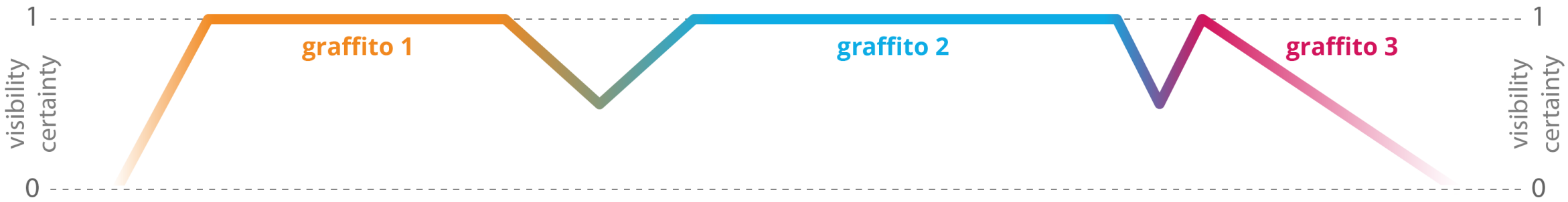
graffito 2 = 0 %

graffito 3 = 0 %

GRAFFITO observations



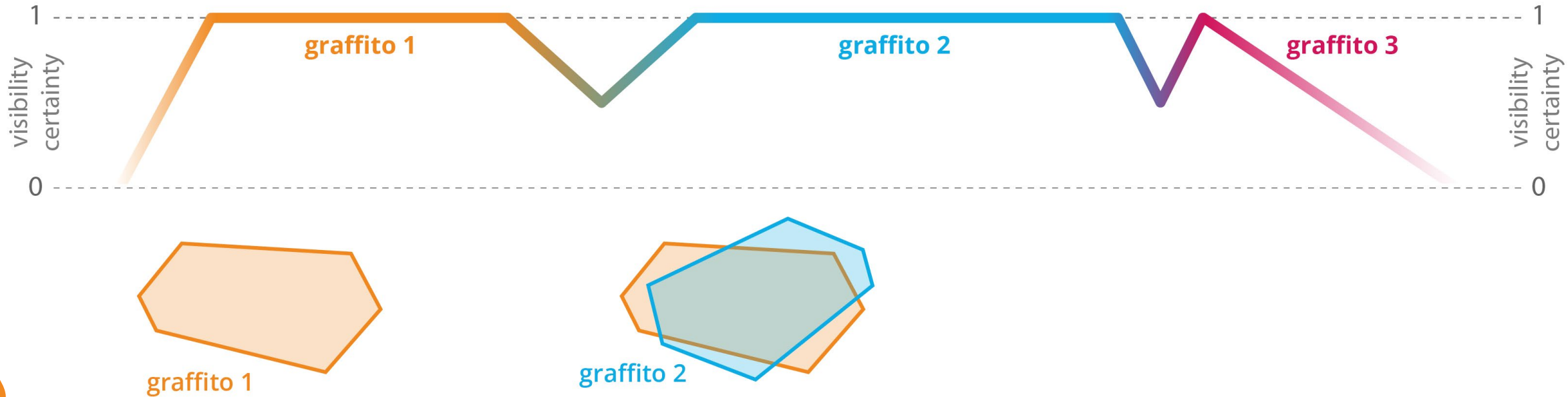
GRAFFITO observations



GRAFFITO observations

graffito 1

GRAFFITO observations



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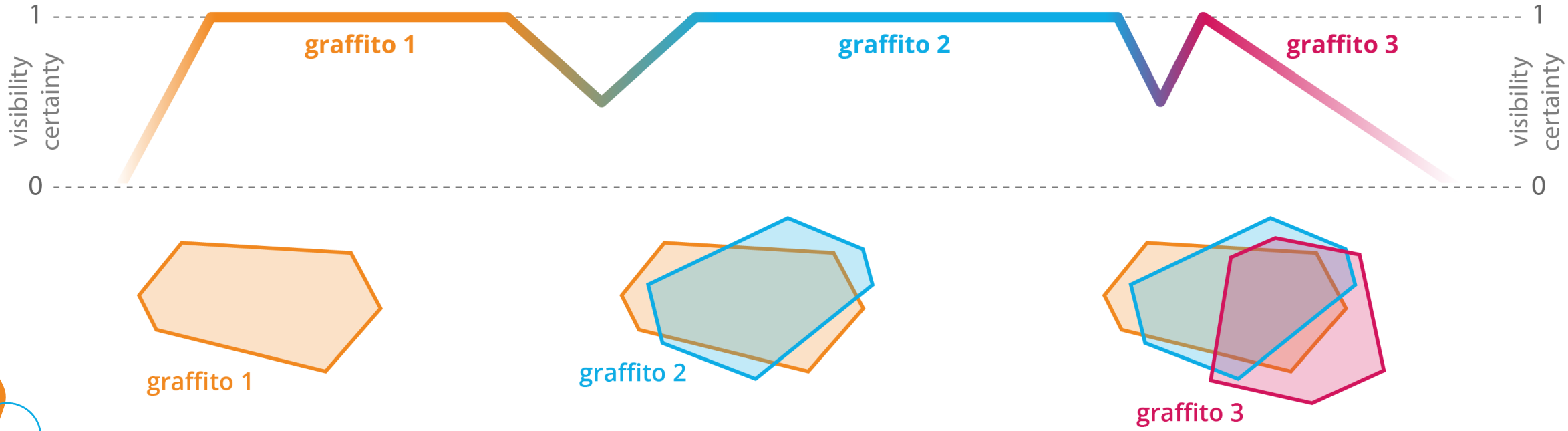

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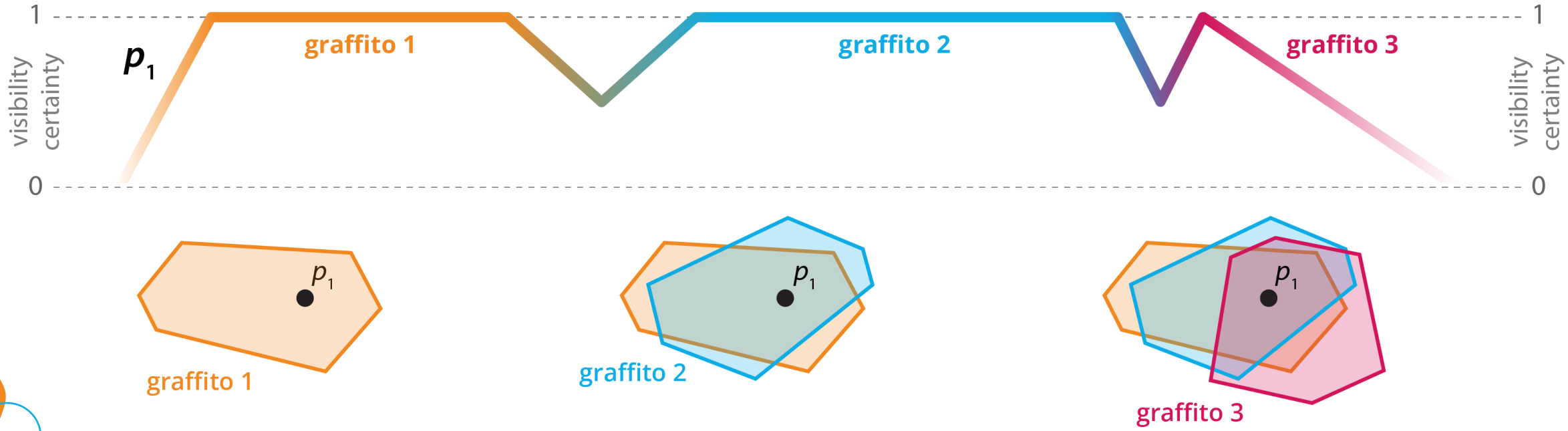
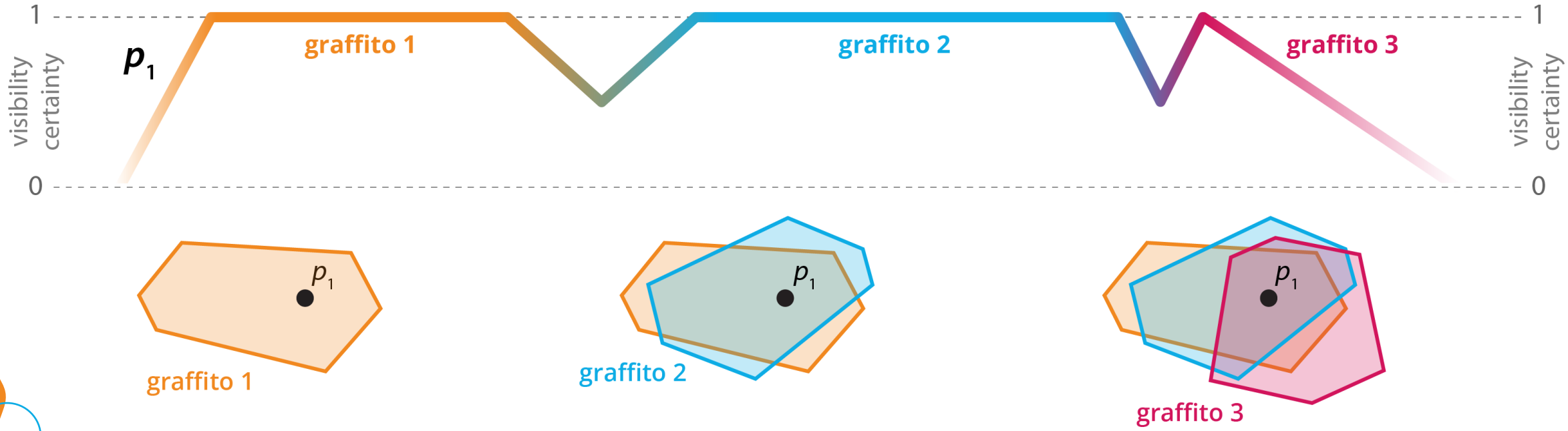
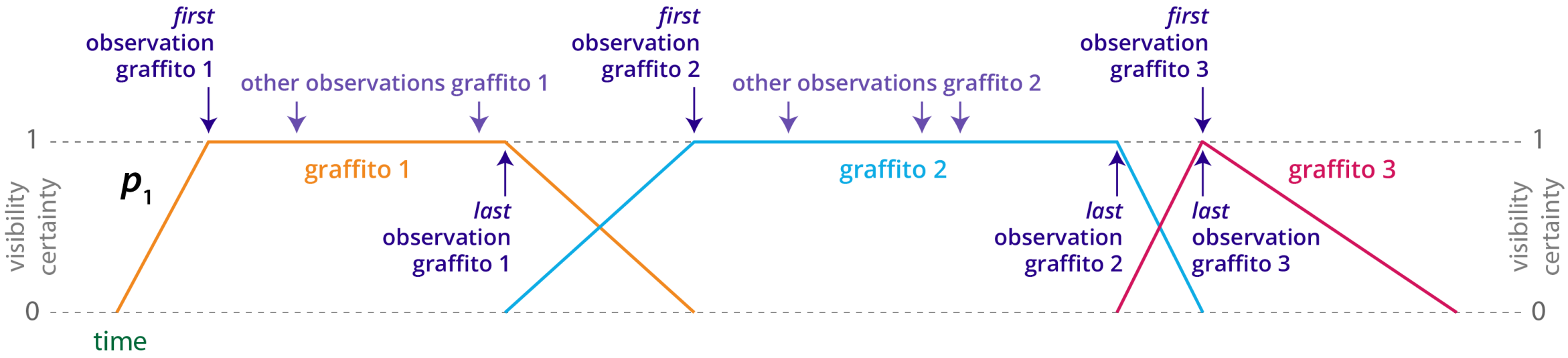


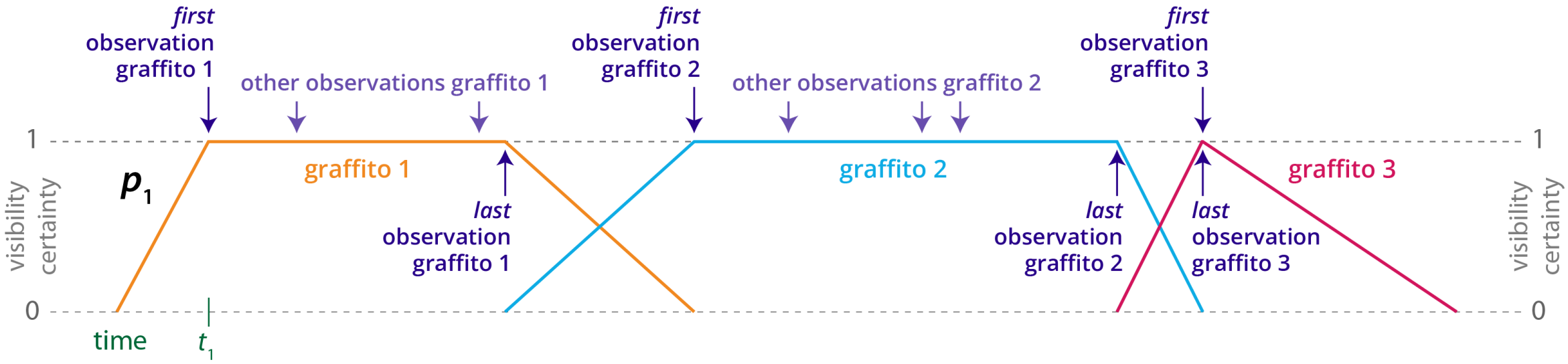
TOWARDS polygons



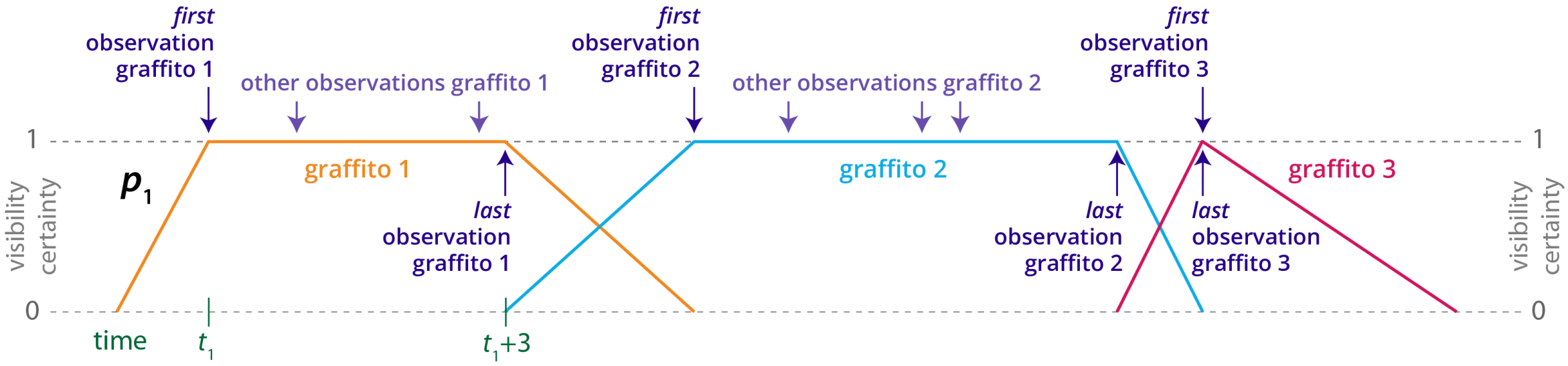
TOWARDS polygons



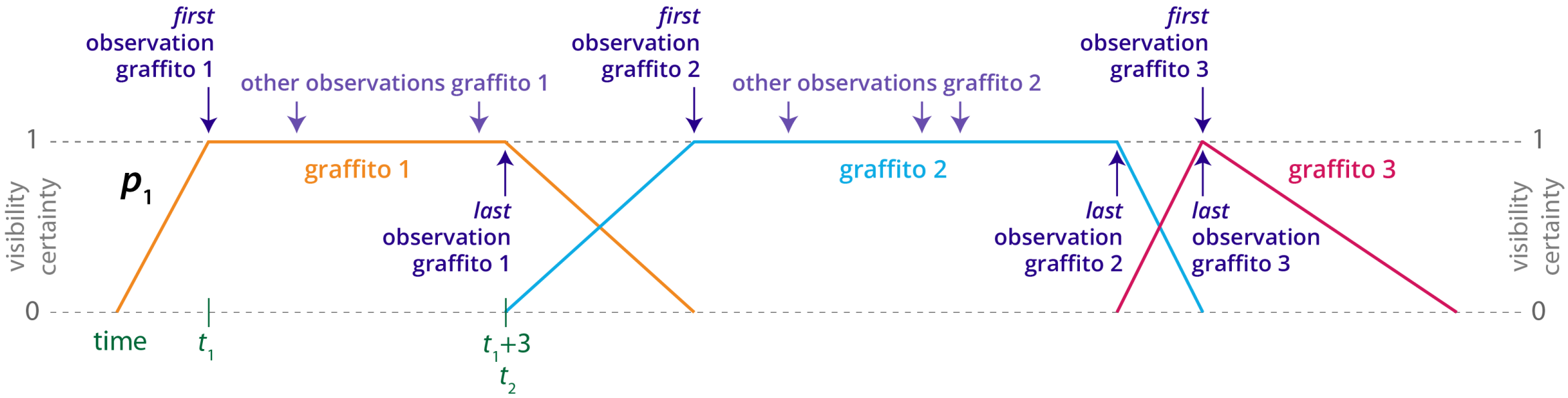
TOWARDS polygons



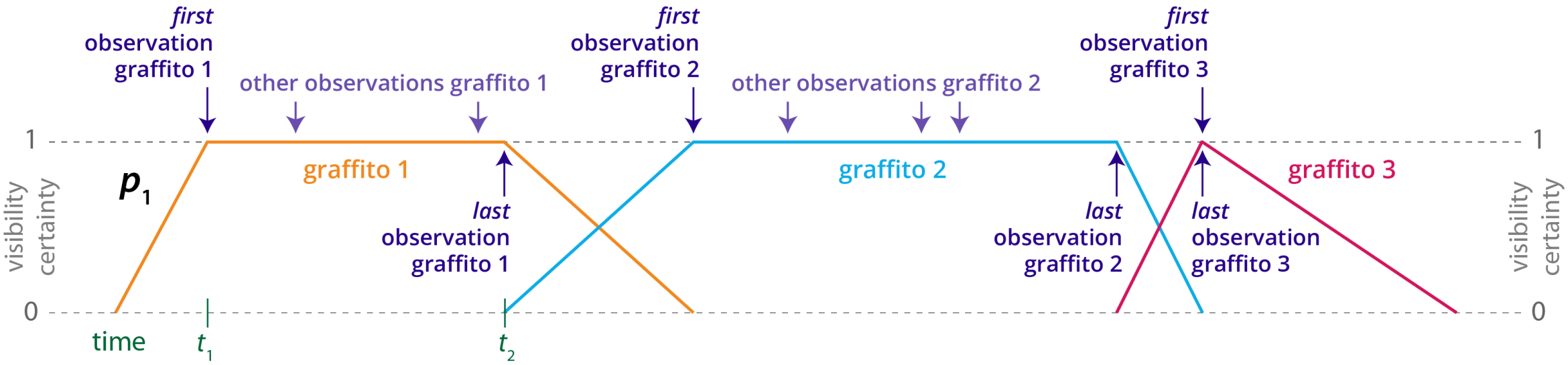
TOWARDS polygons



TOWARDS polygons



TOWARDS polygons



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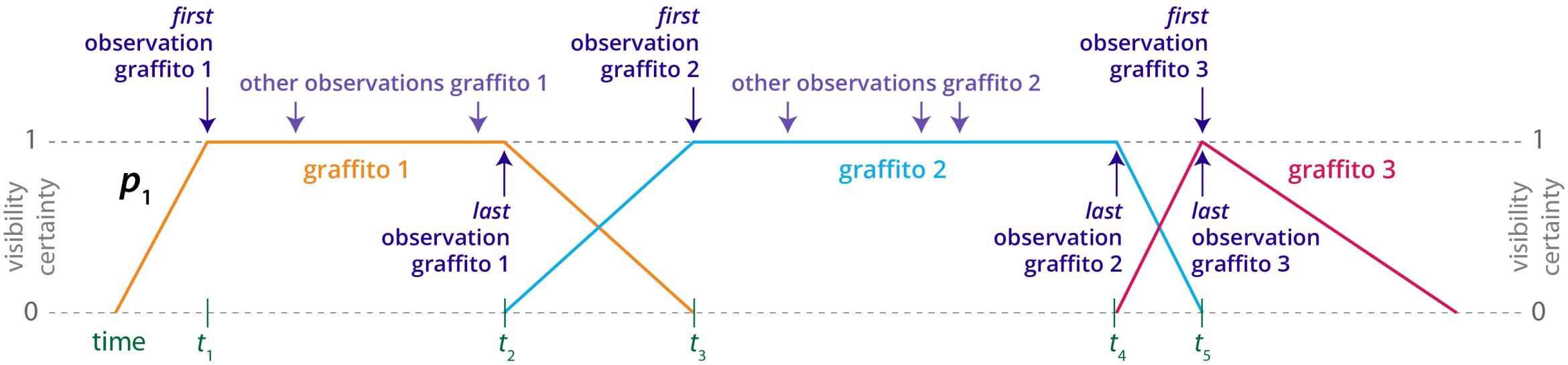

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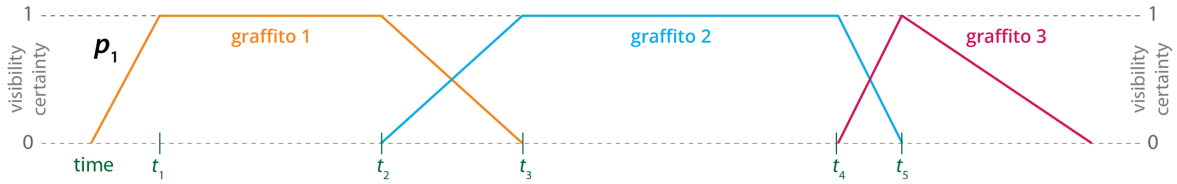

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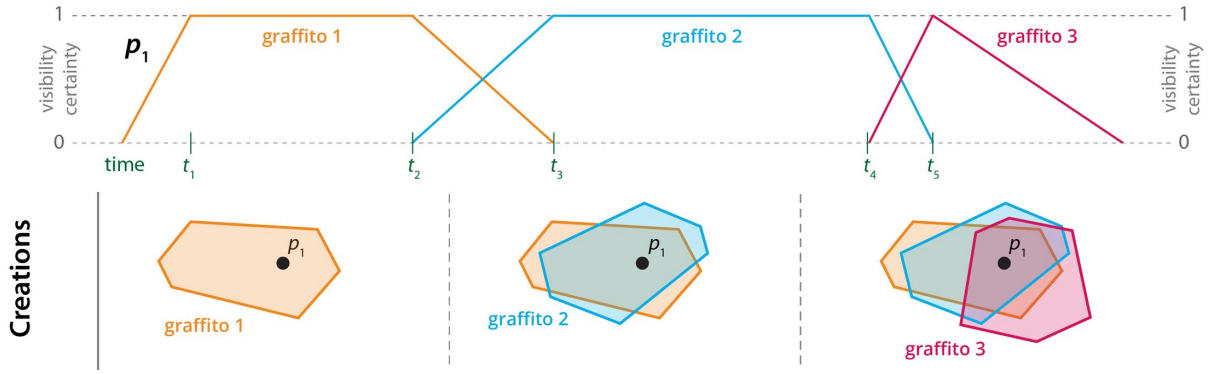

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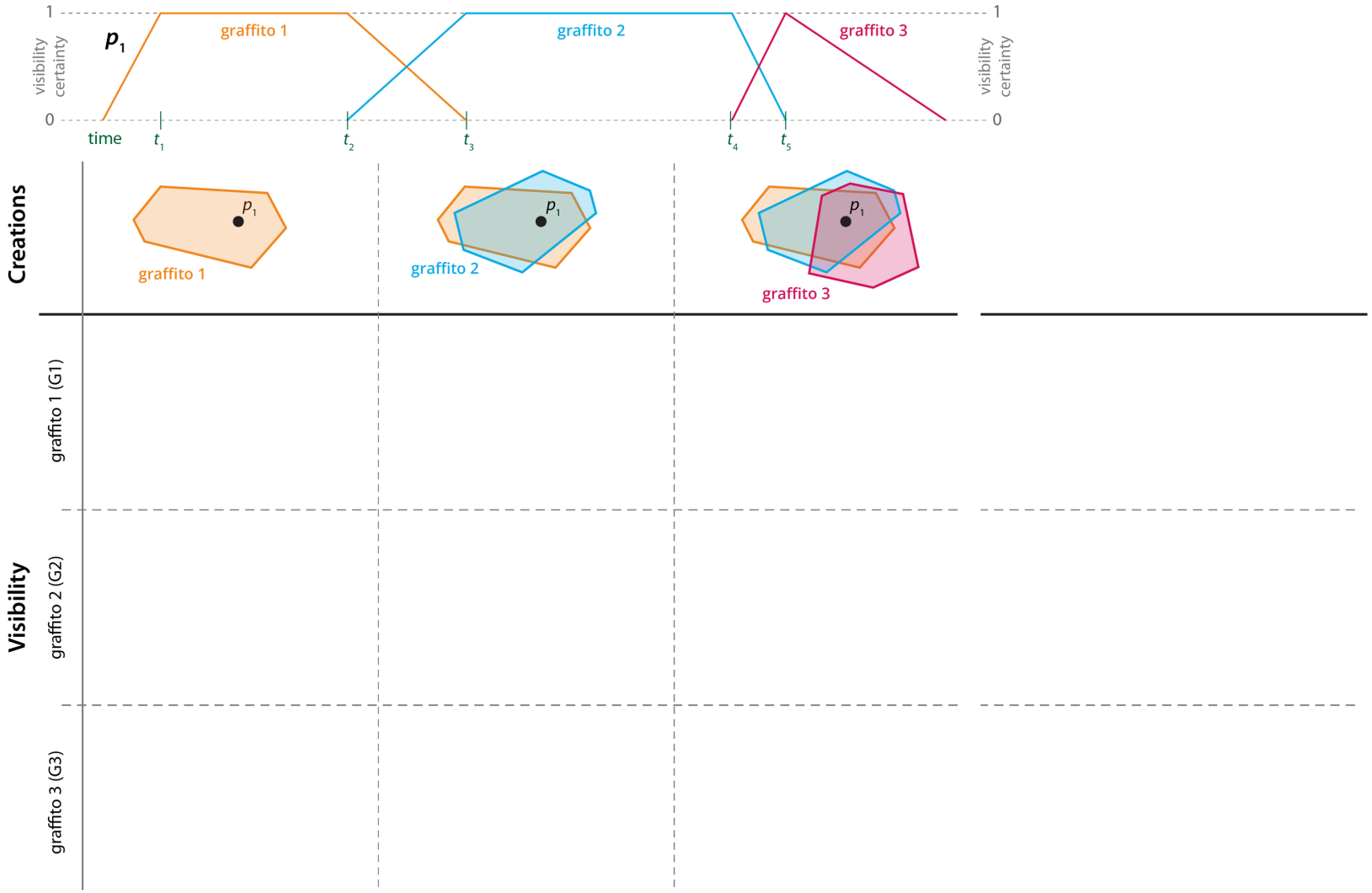

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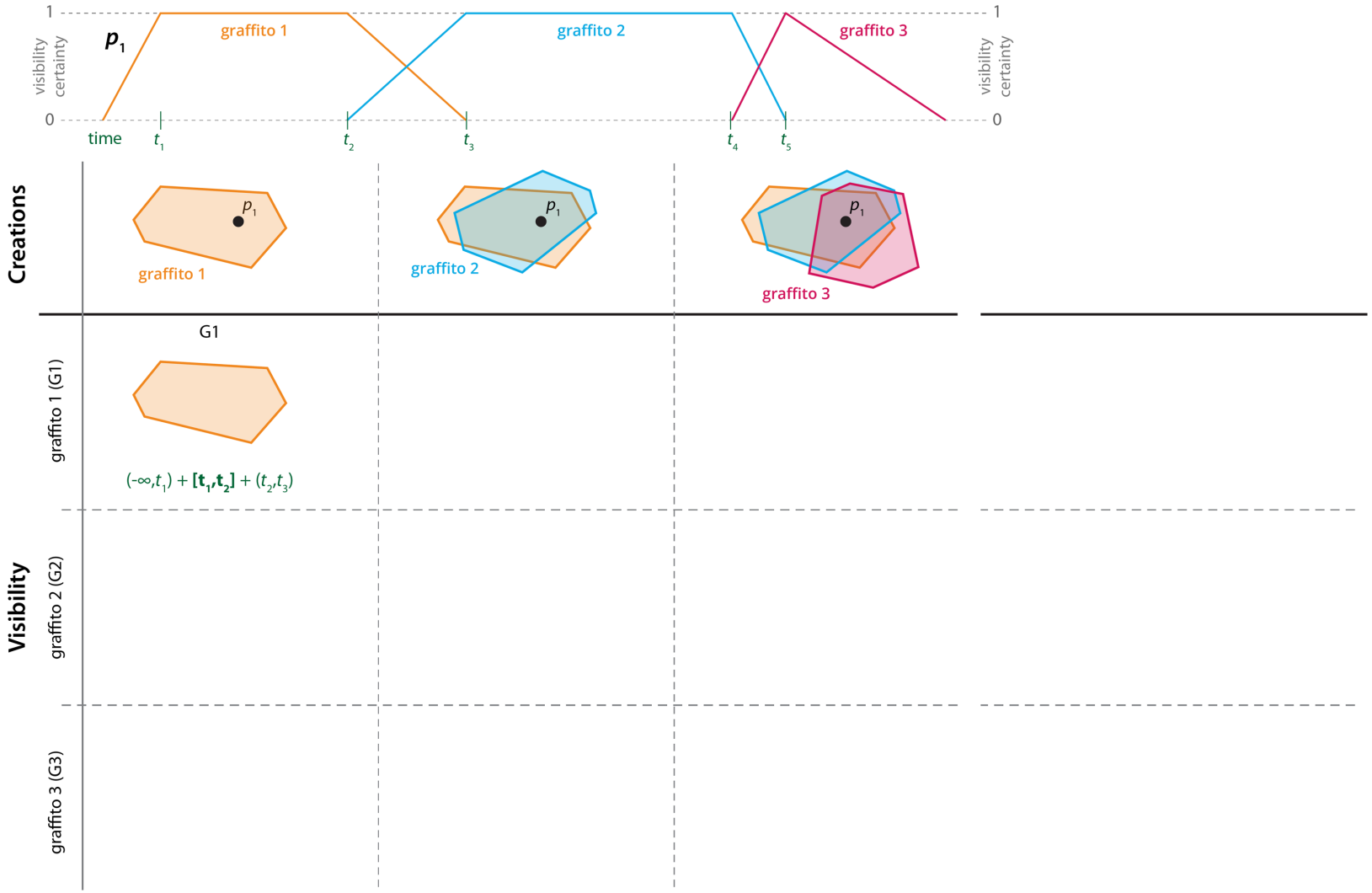

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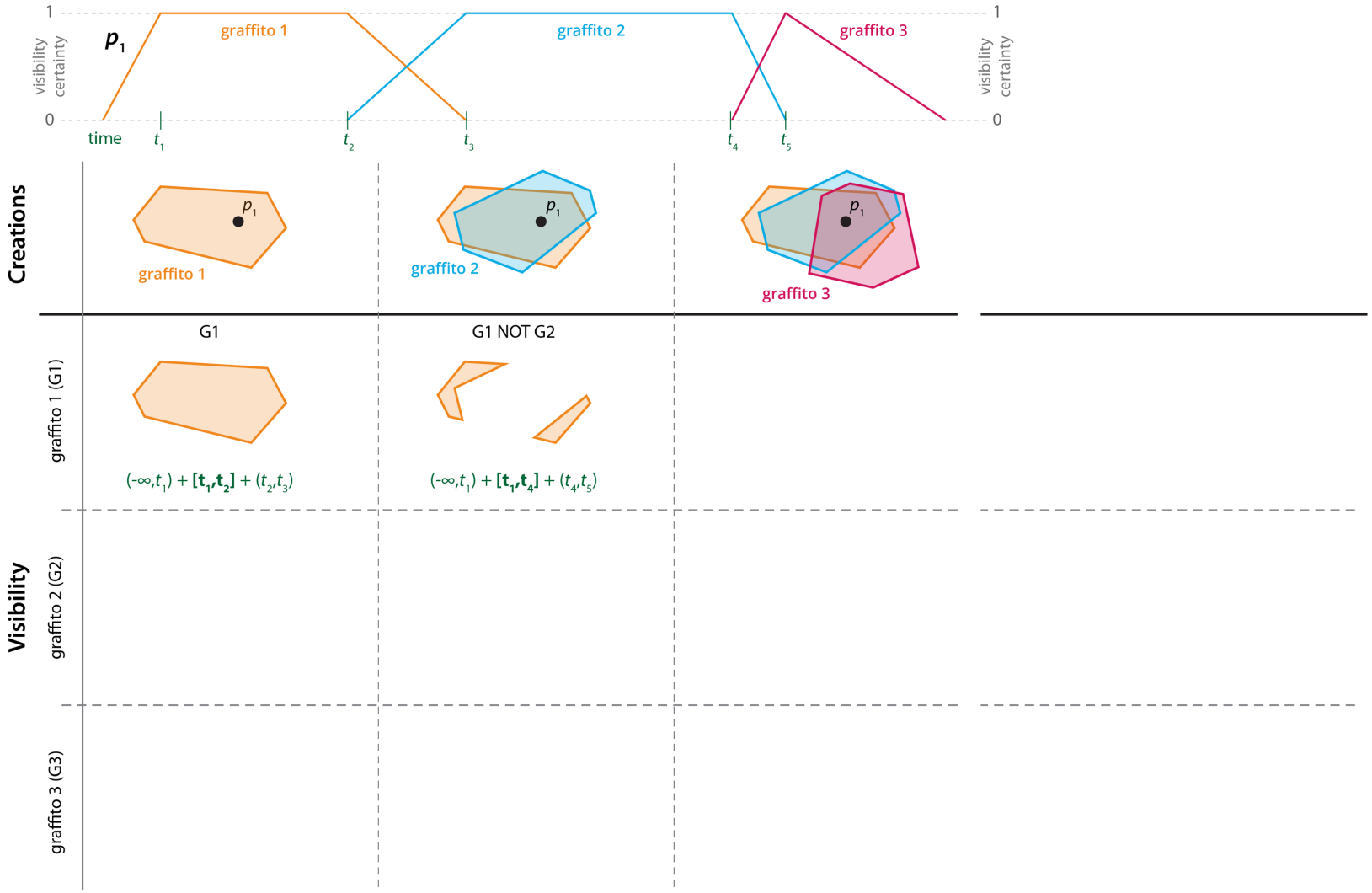
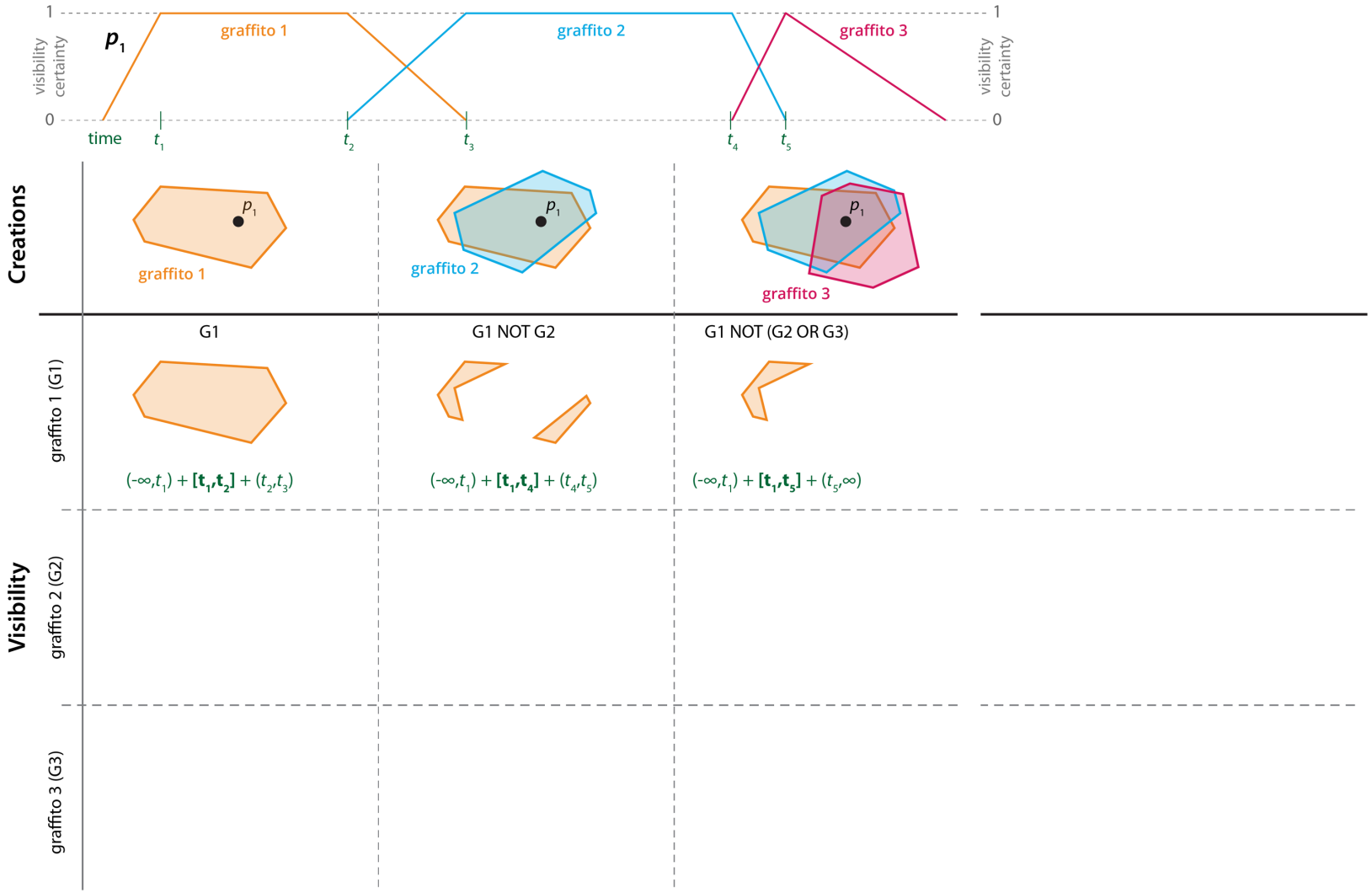
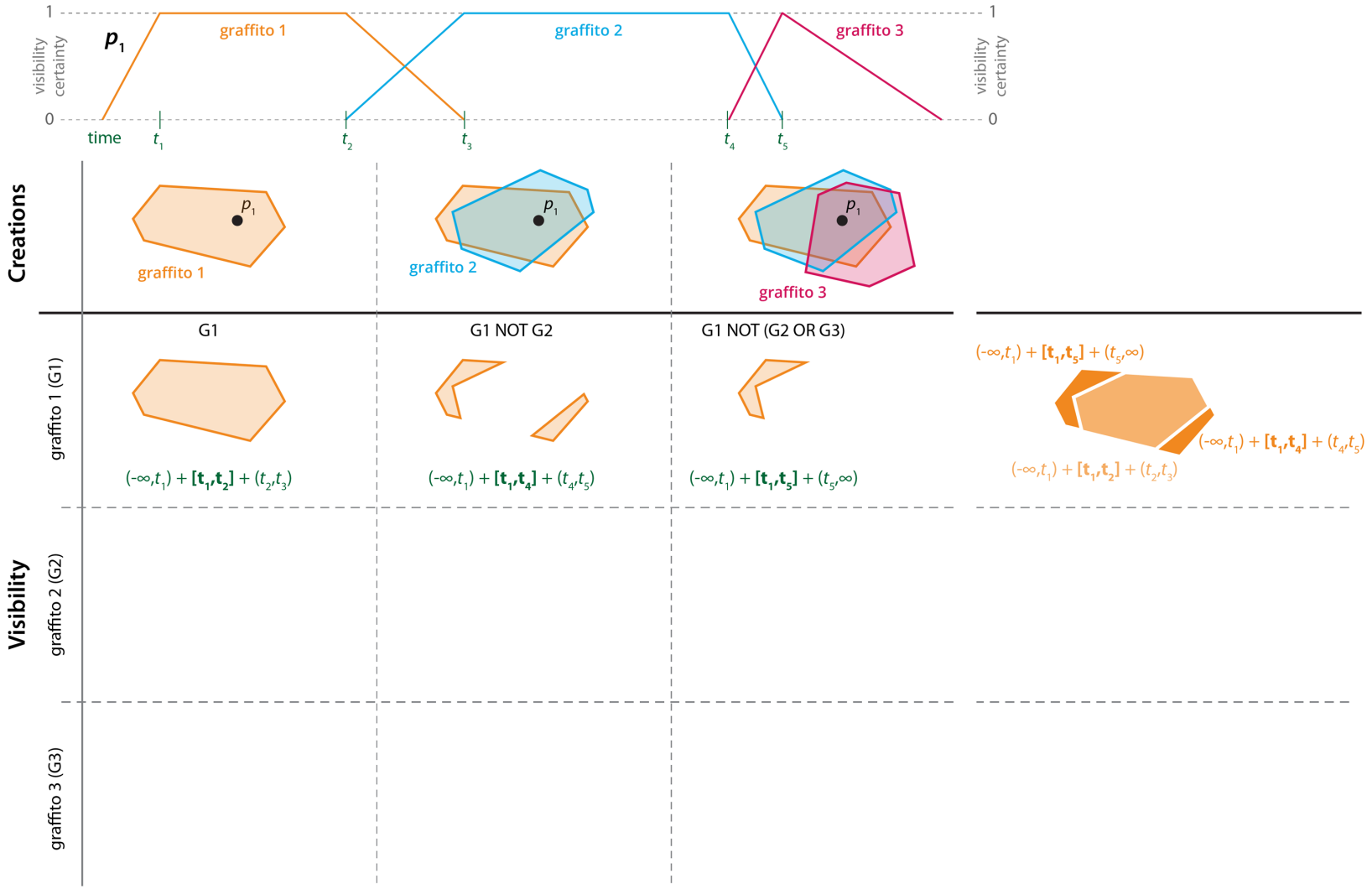


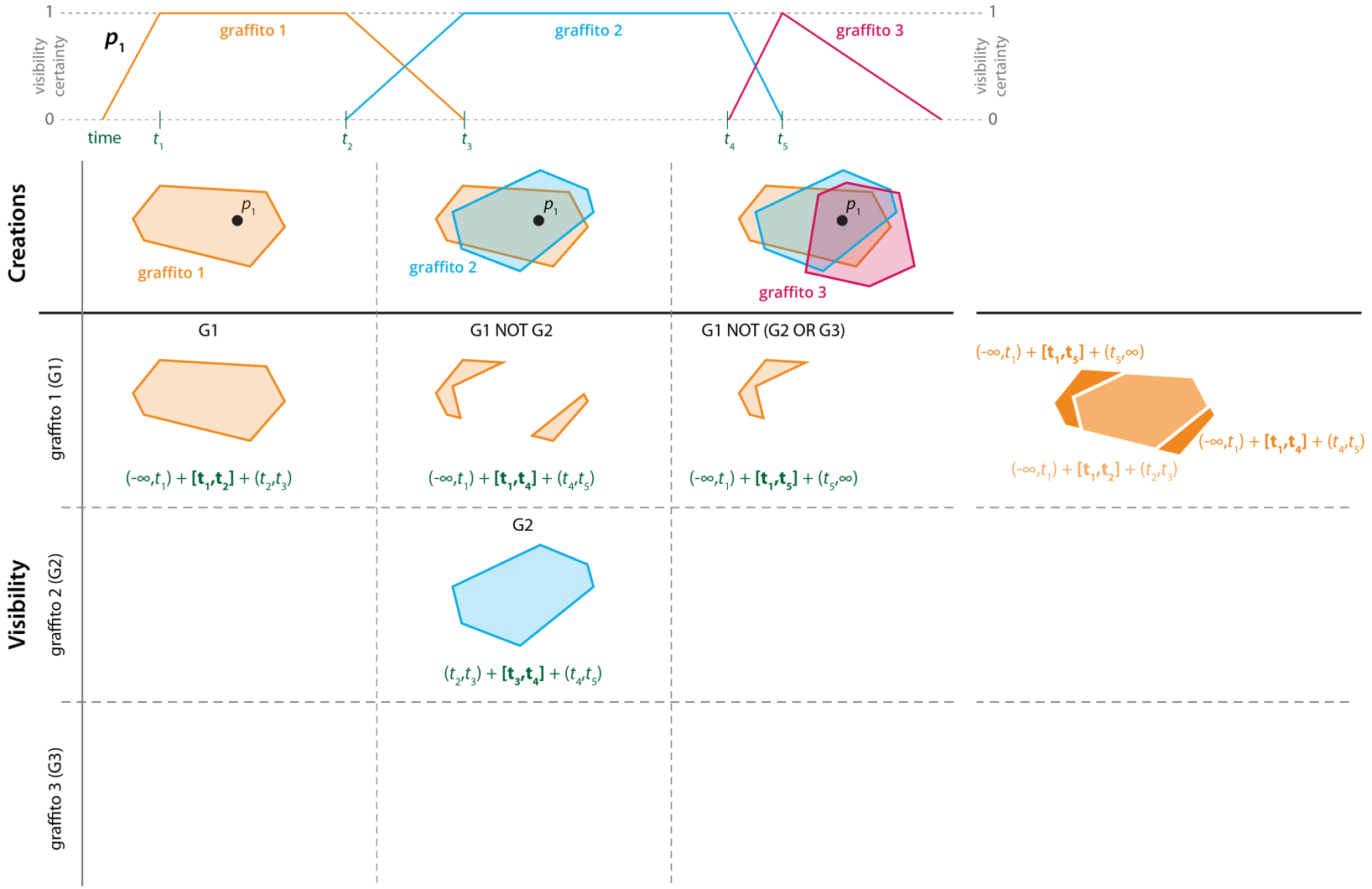
TOWARDS polygons



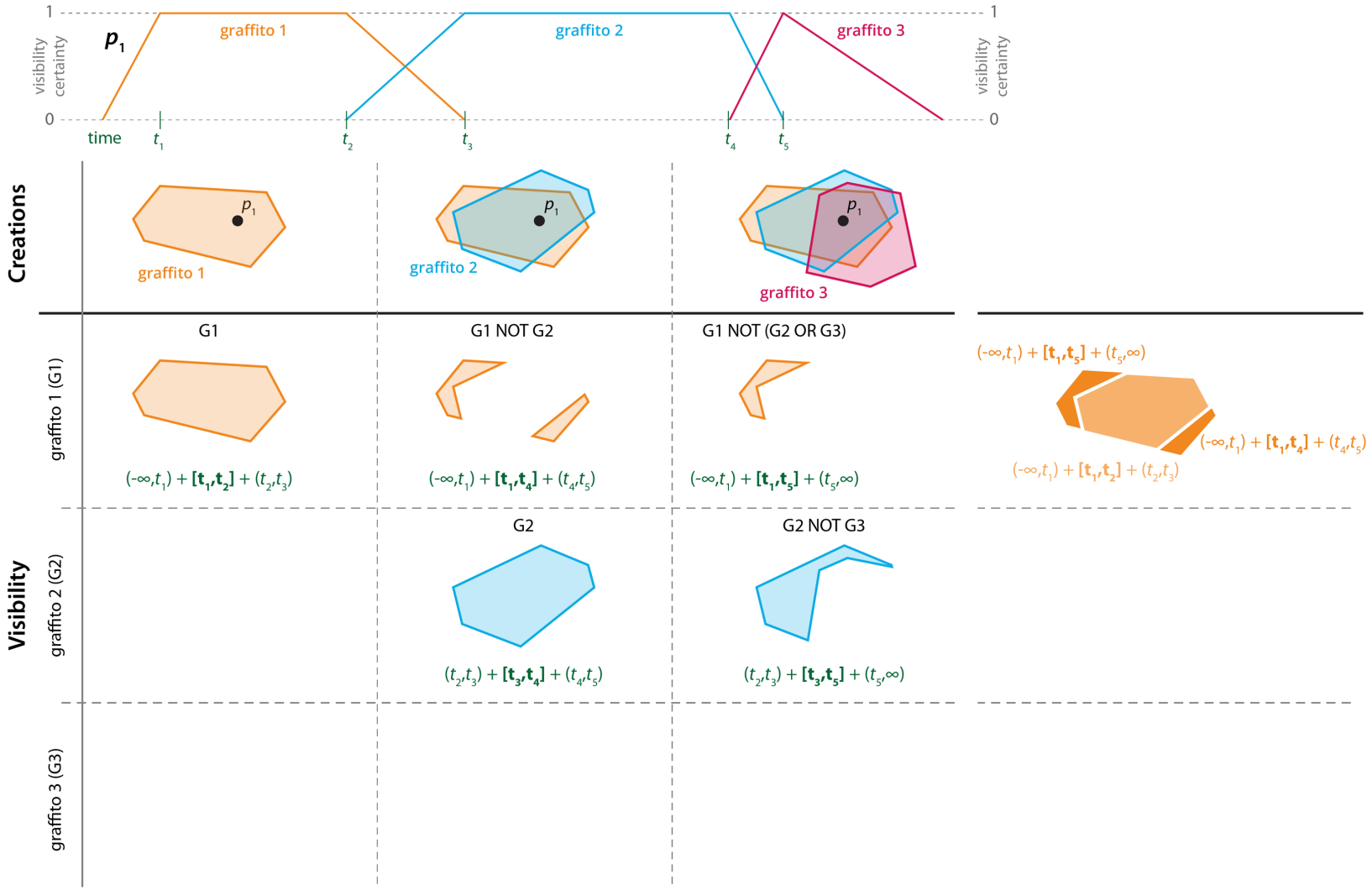
TOWARDS polygons



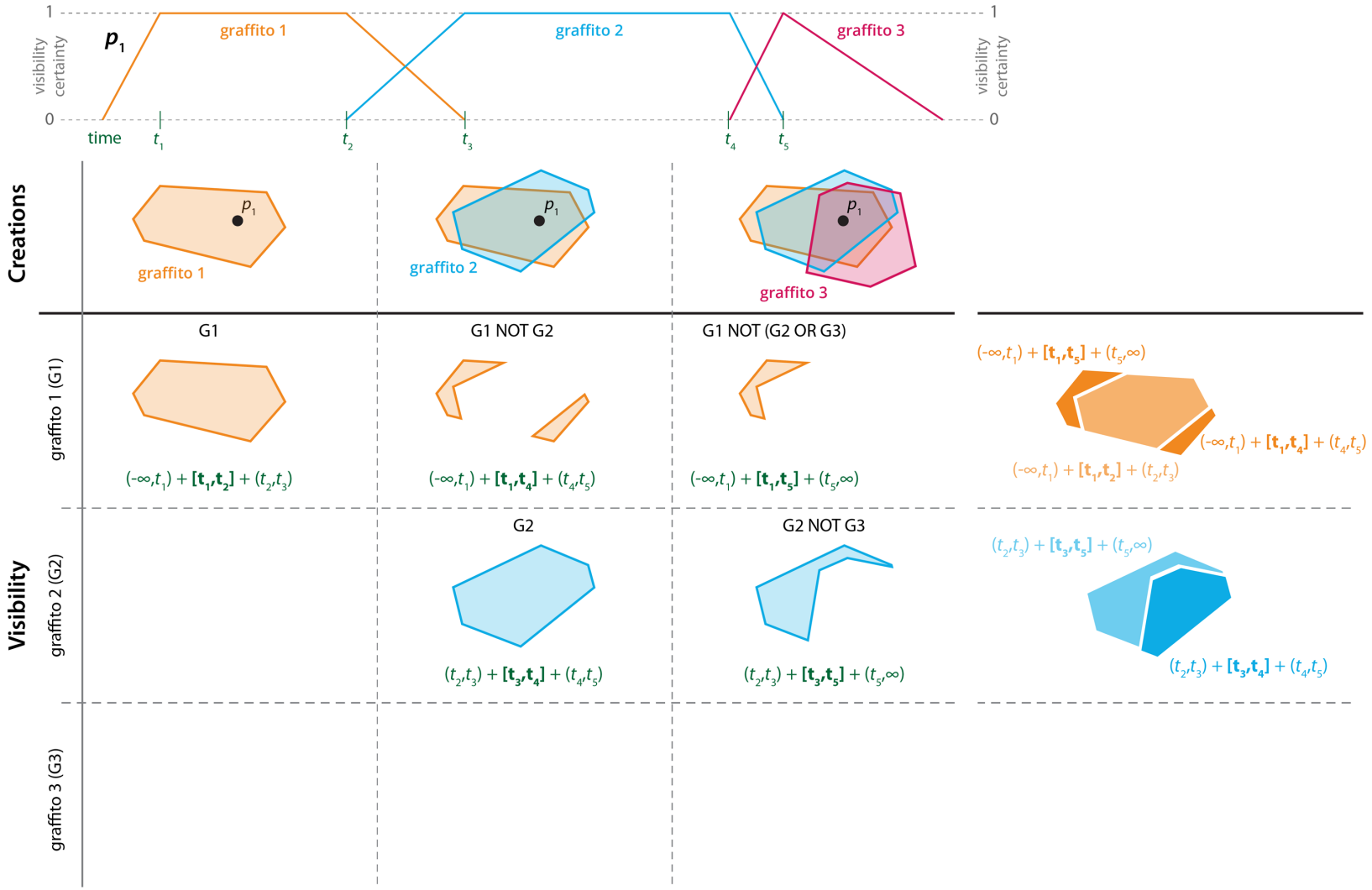
TOWARDS polygons



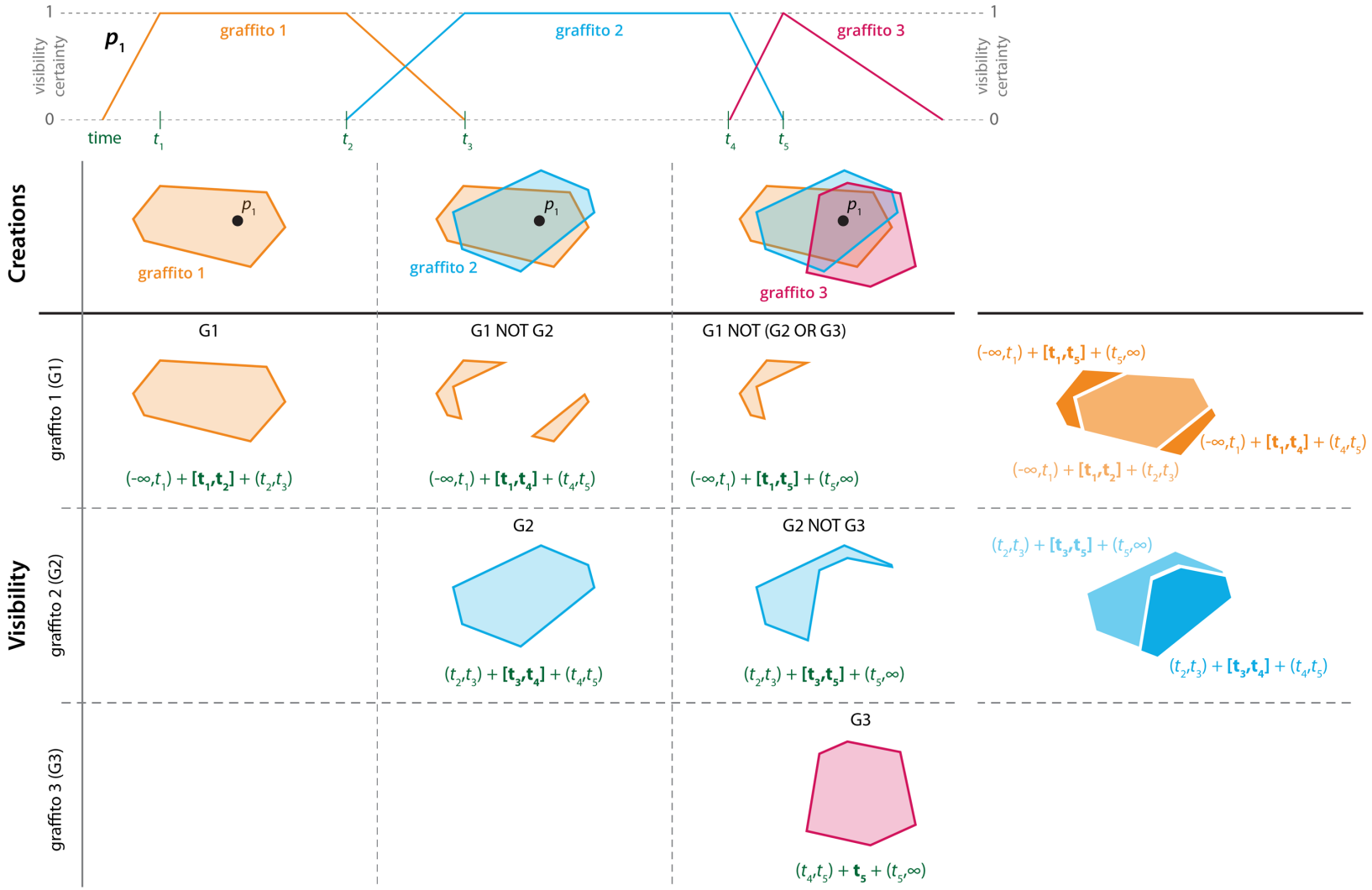
TOWARDS polygons



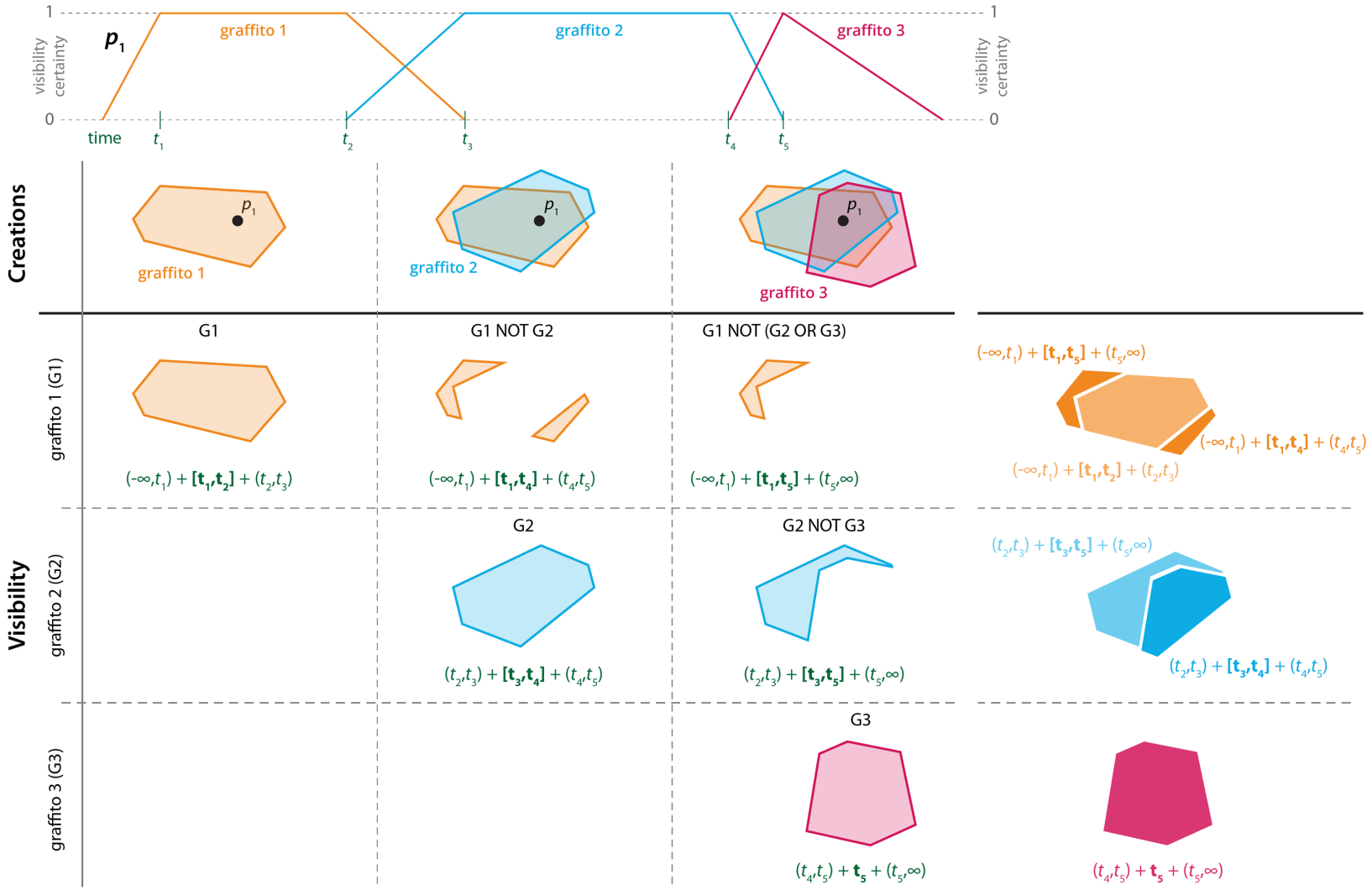
TOWARDS polygons



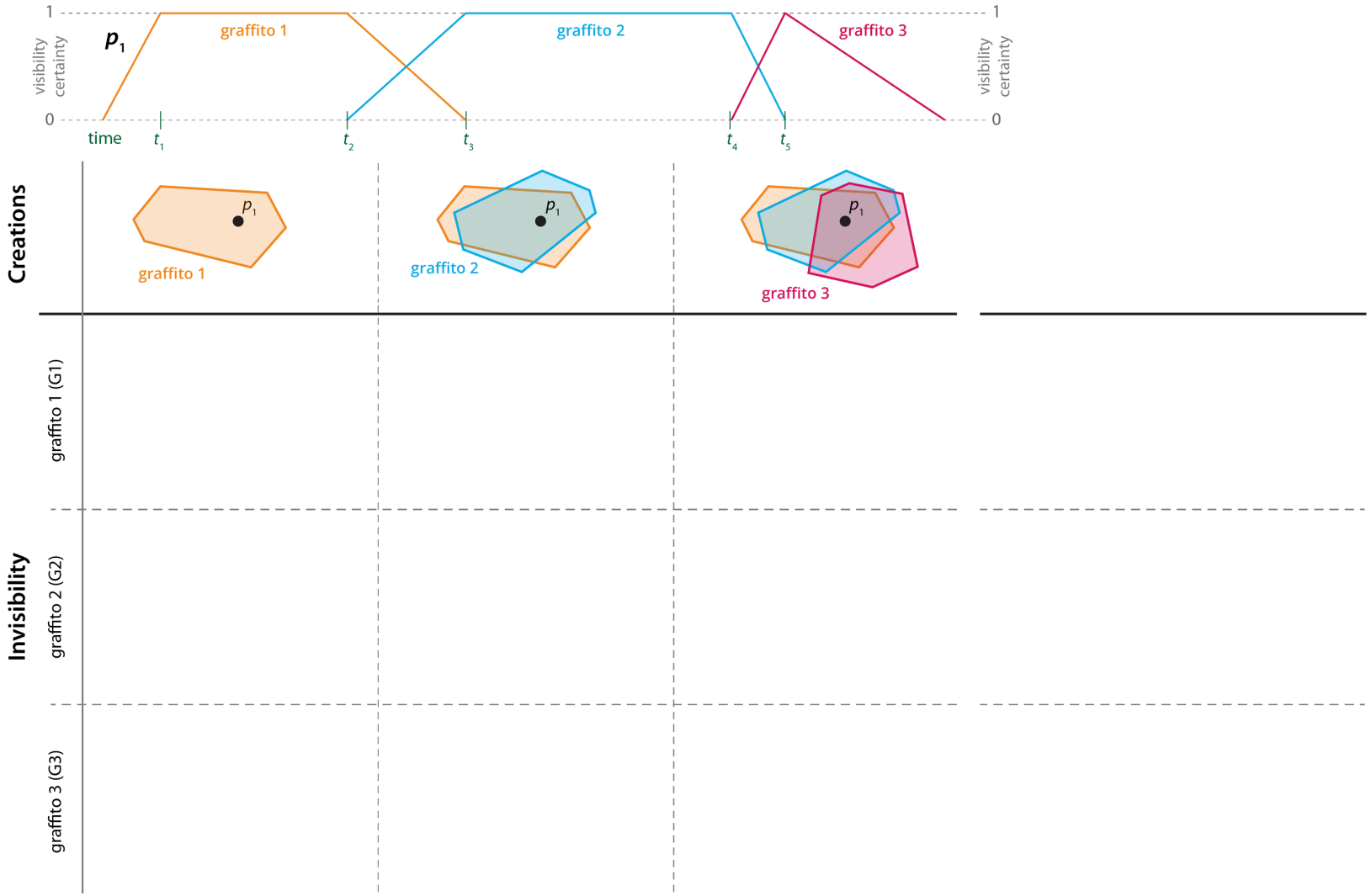
TOWARDS polygons



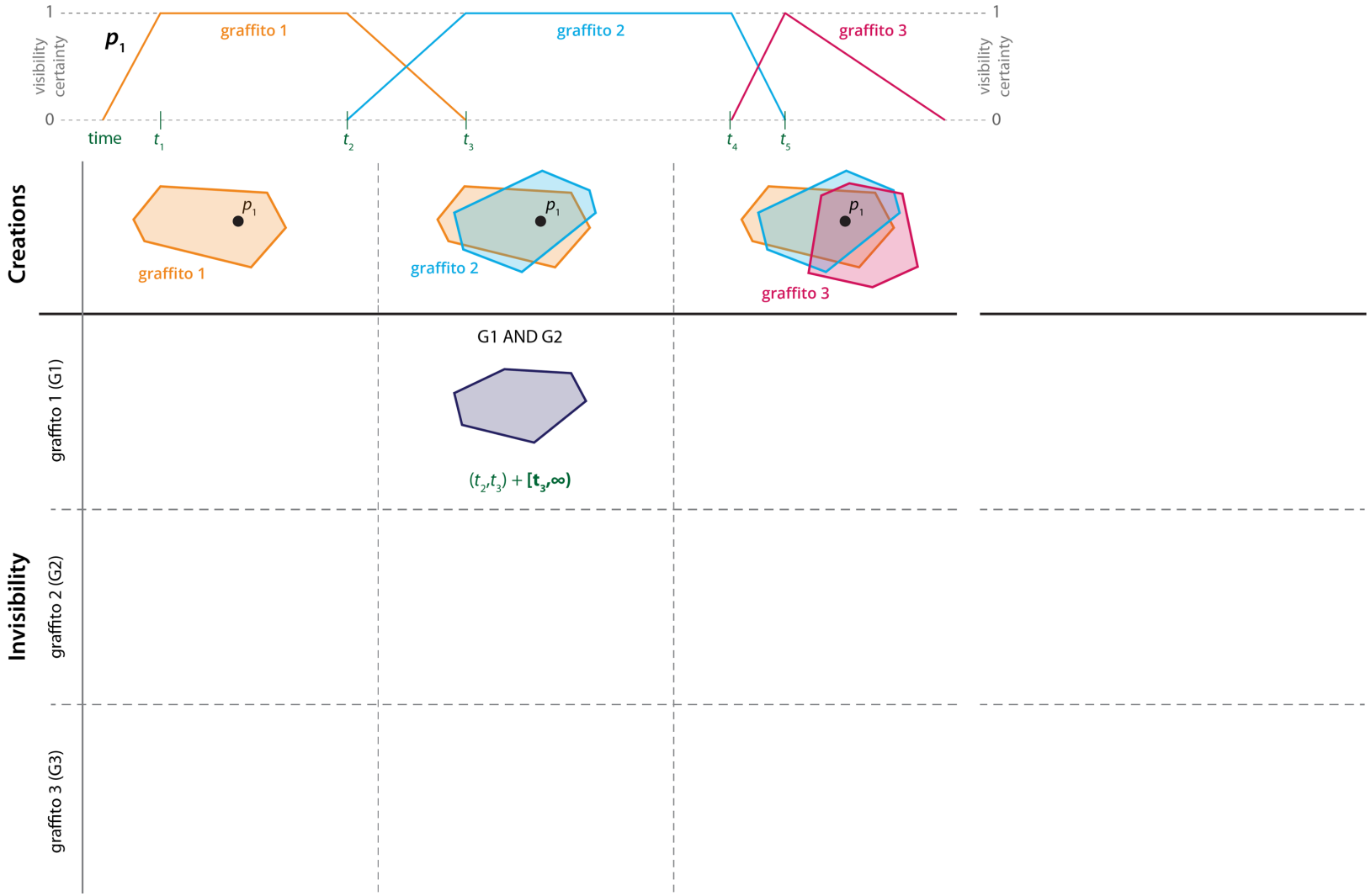
TOWARDS polygons



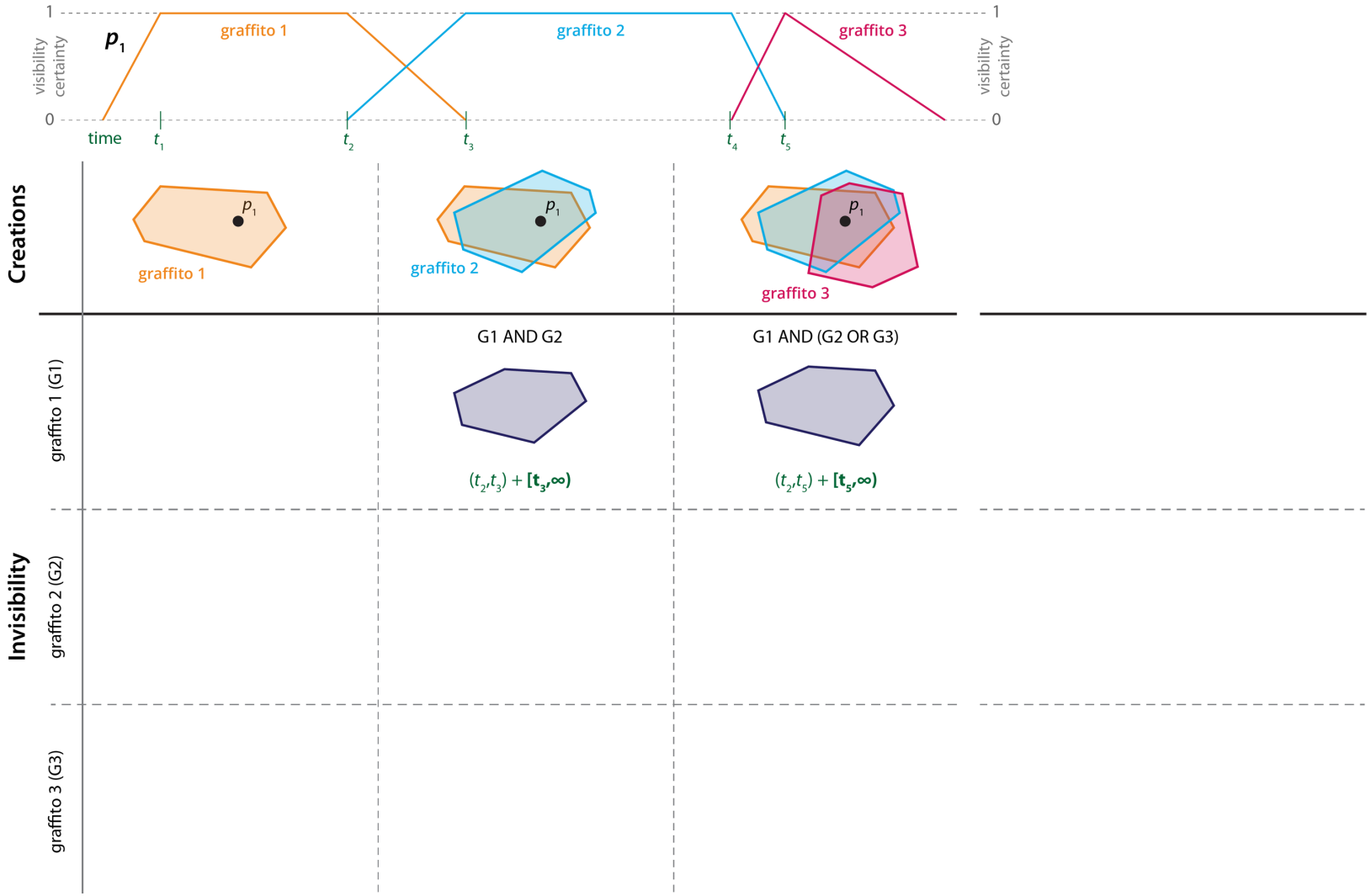
TOWARDS polygons



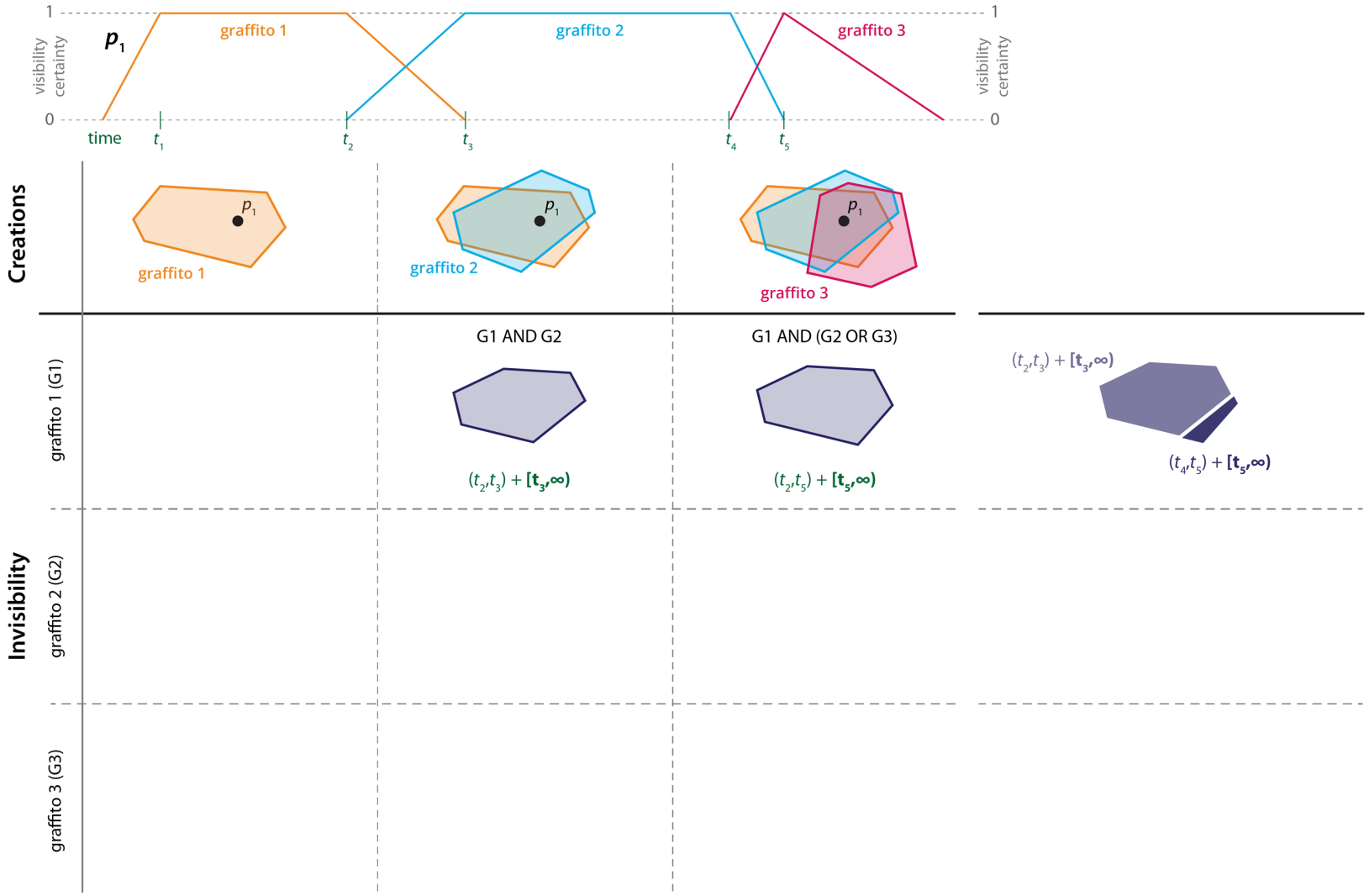
TOWARDS polygons



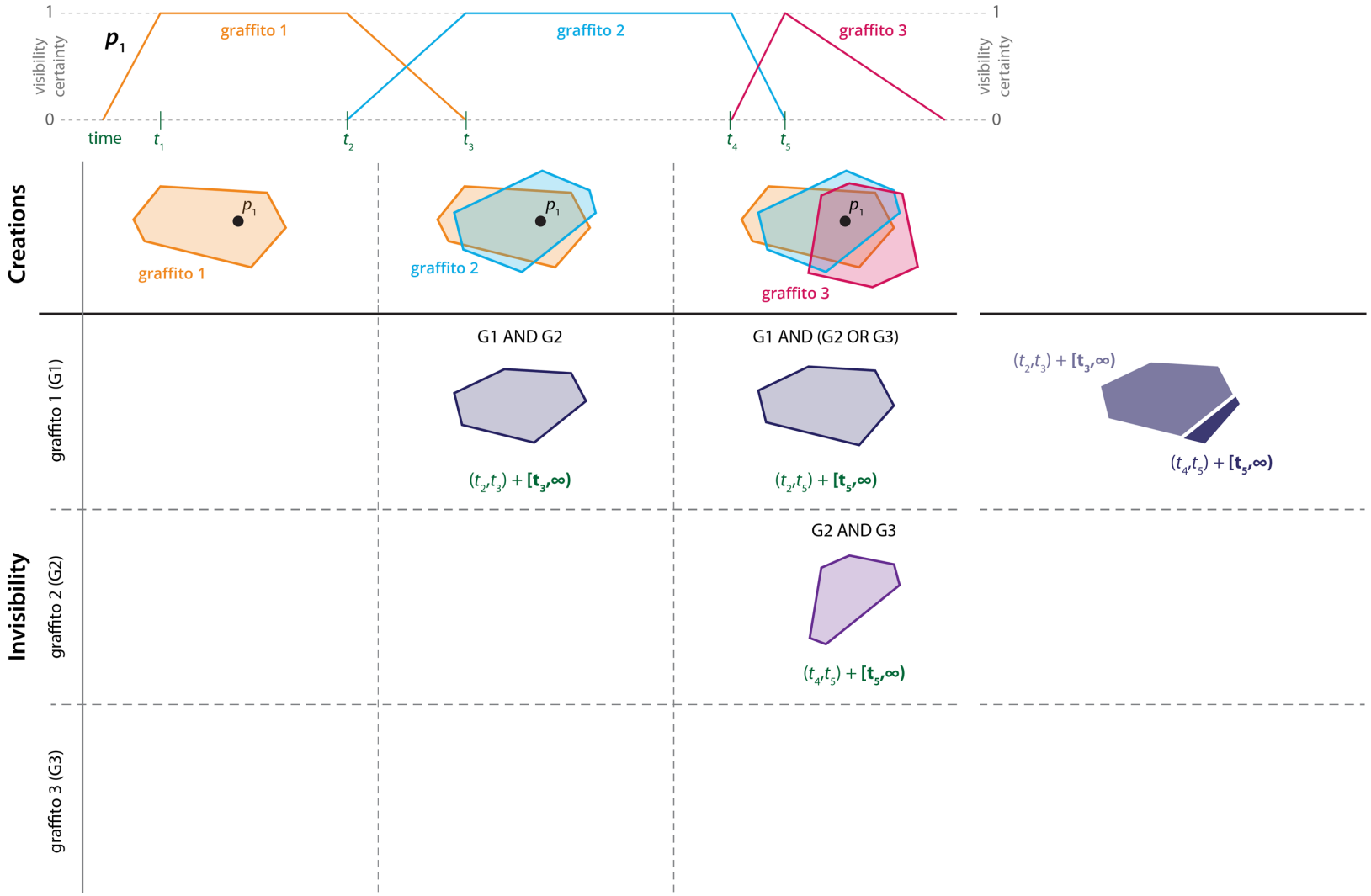
TOWARDS polygons



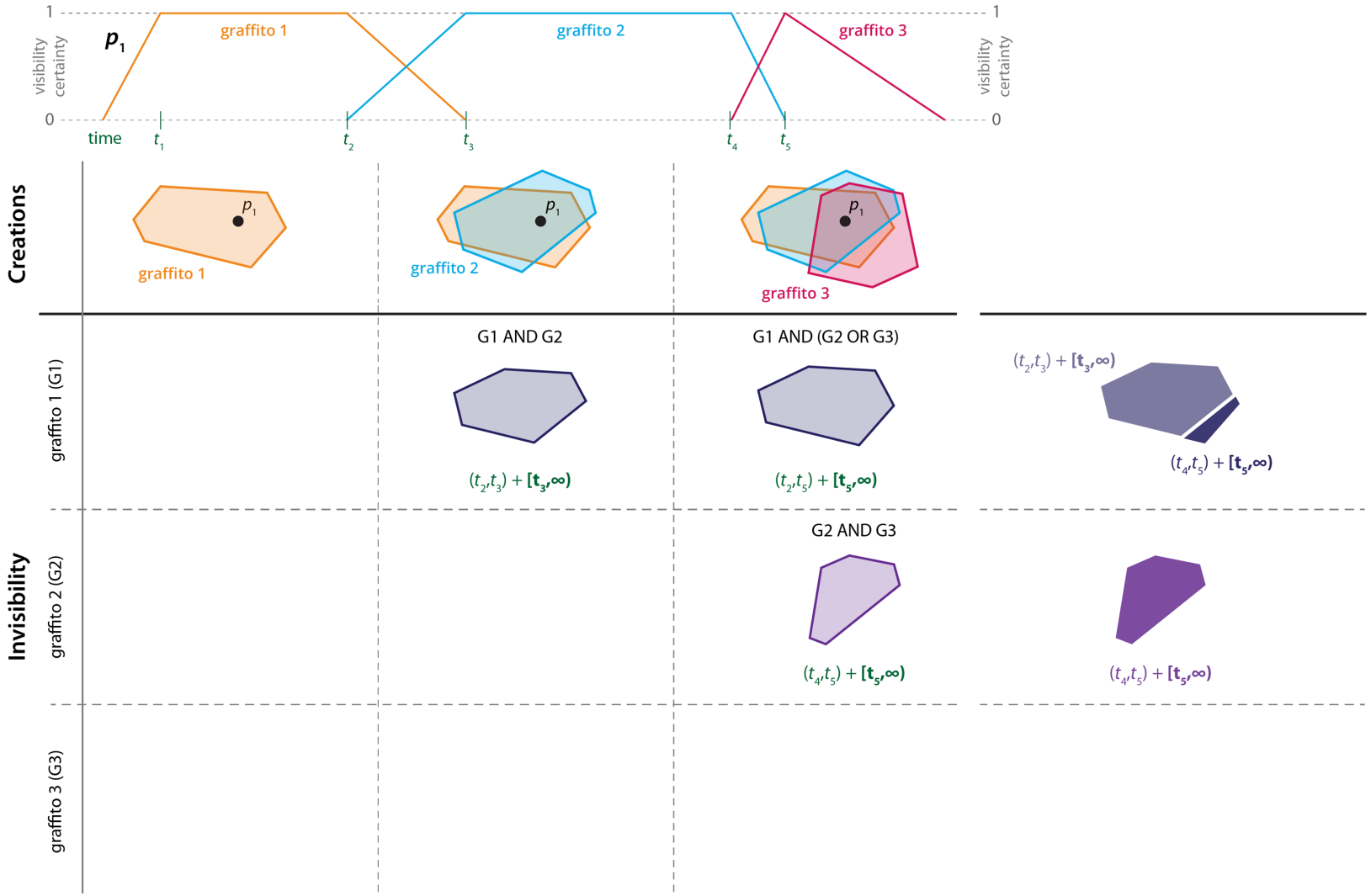
TOWARDS polygons

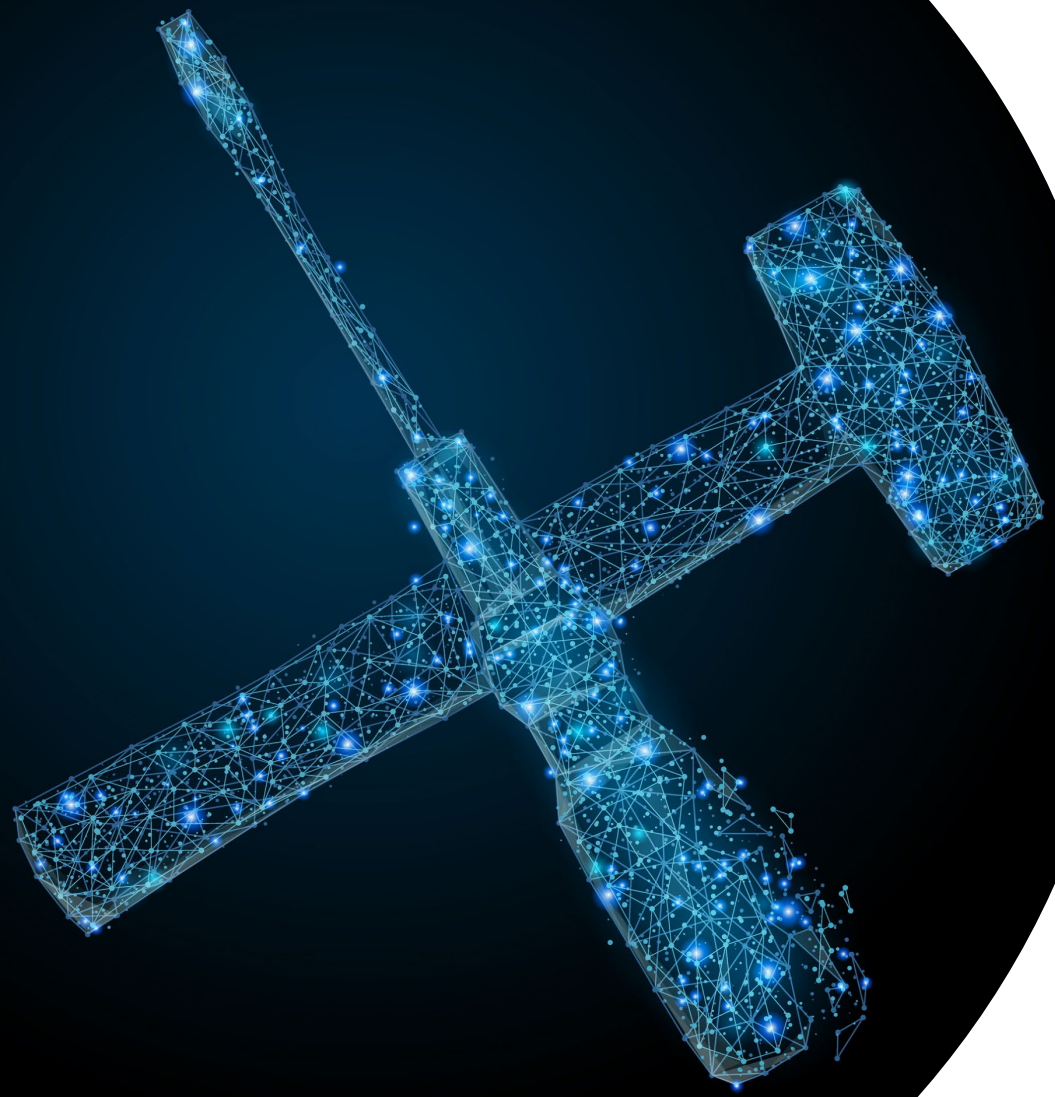


TOWARDS polygons



TOWARDS polygons





POLYGON
tools

POLYGON
tools

“event” = location + time

POLYGON
tools

“event” = location + time

GRAPHIS
AUTOGRAF

POLYGON
tools

"event" = location + time

GRAPHIS
AUTOGRAF

MATLAB

POLYGON
tools

"event" = location + time

GRAPHIS
AUTOGRAF

MATLAB

GeoJSON

POLYGON
tools

“event” = location + time

GRAPHIS
AUTOGRAF

MATLAB

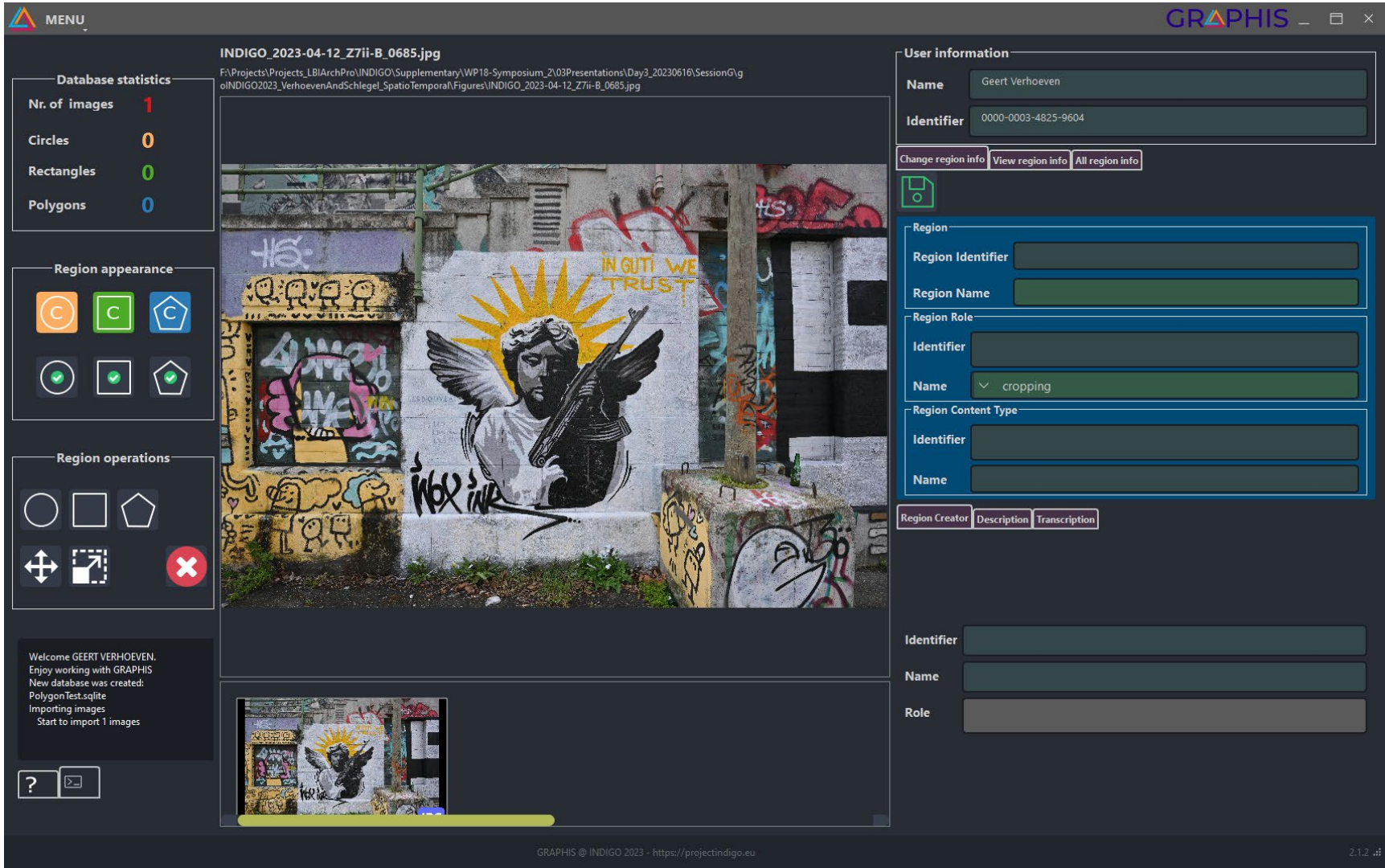
UrbanChameleon

GeoJSON

CREATING location

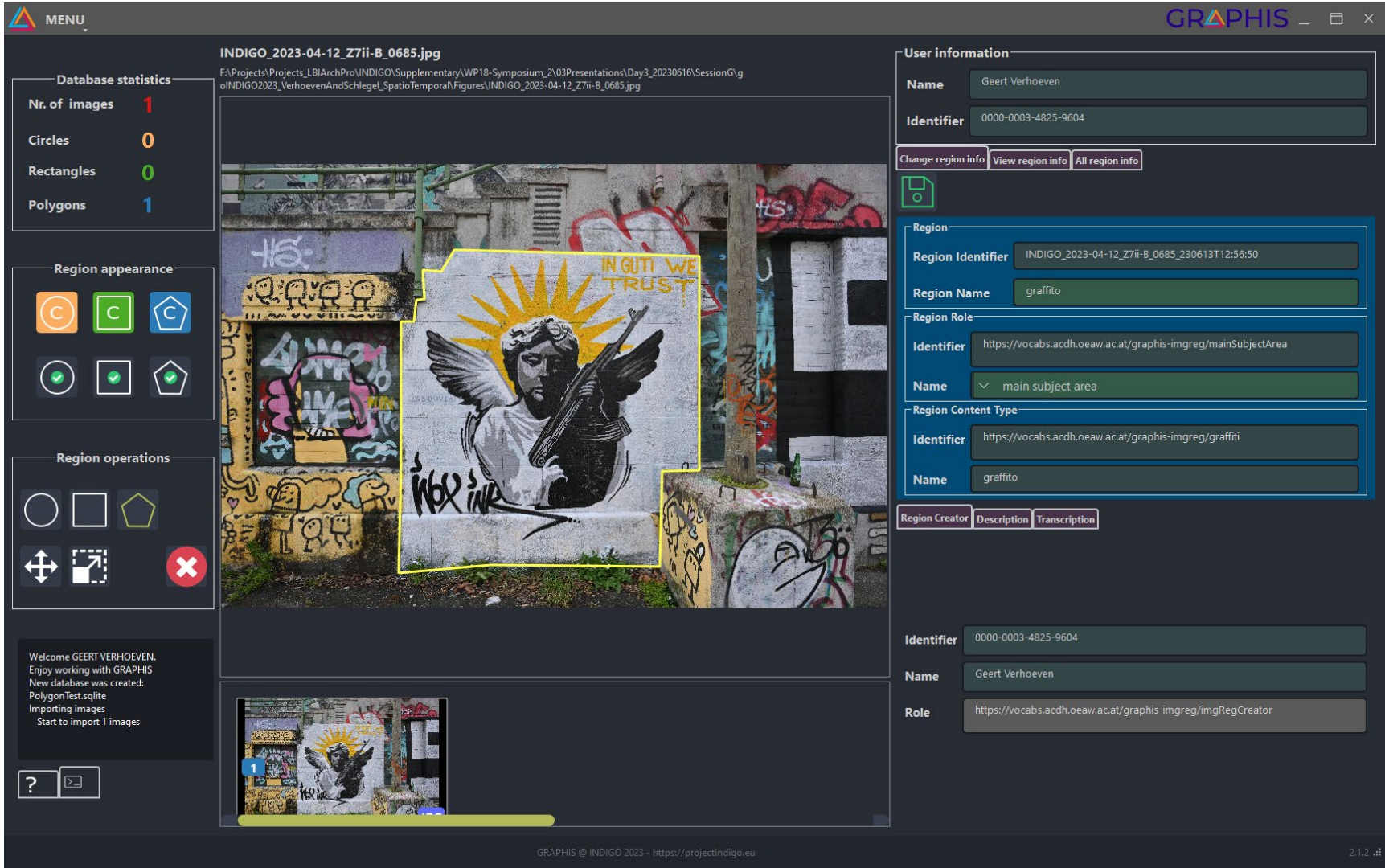
CREATING location

GRAPHIS



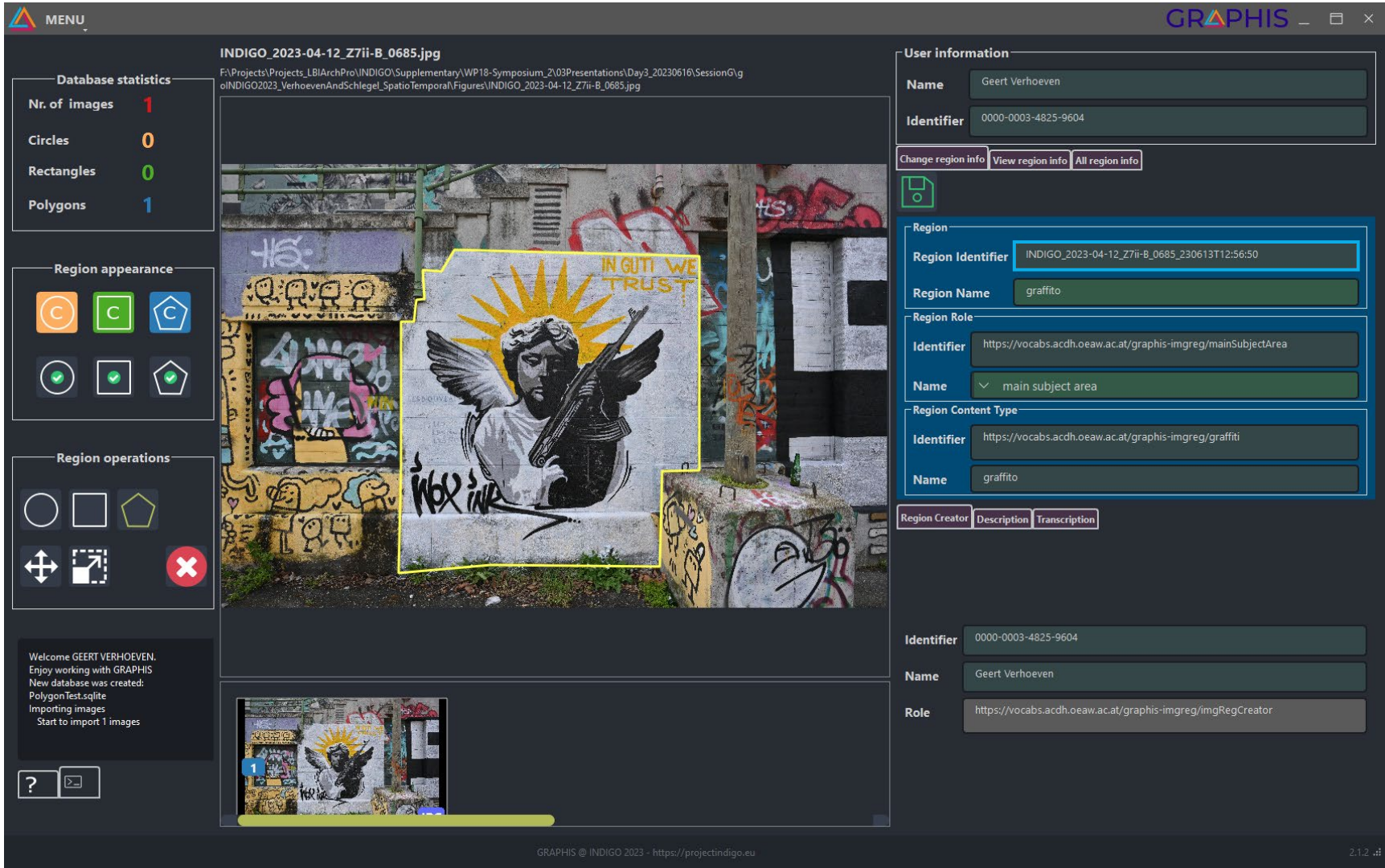
CREATING location

GRAPHIS



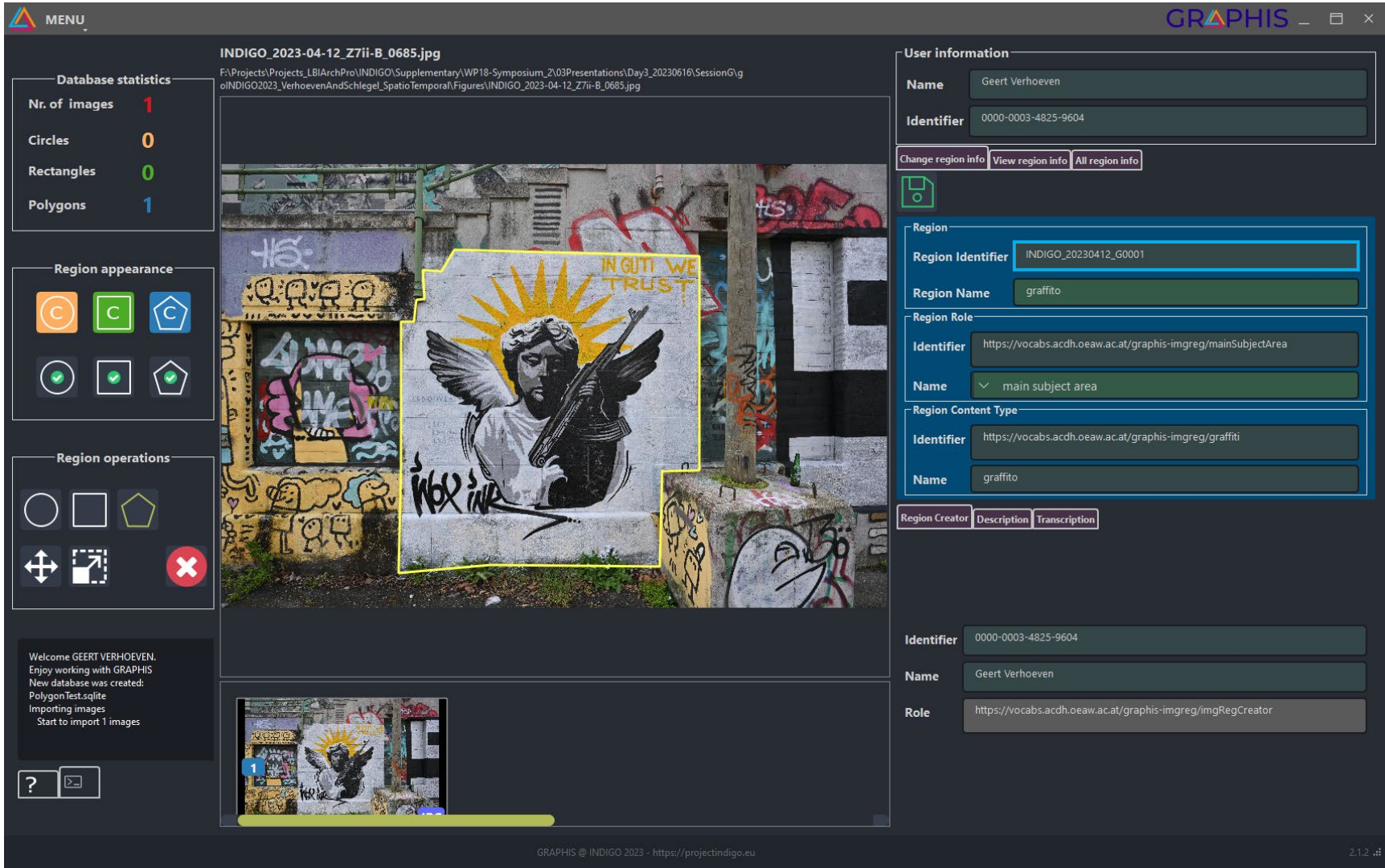
CREATING location

GRAPHIS



CREATING location

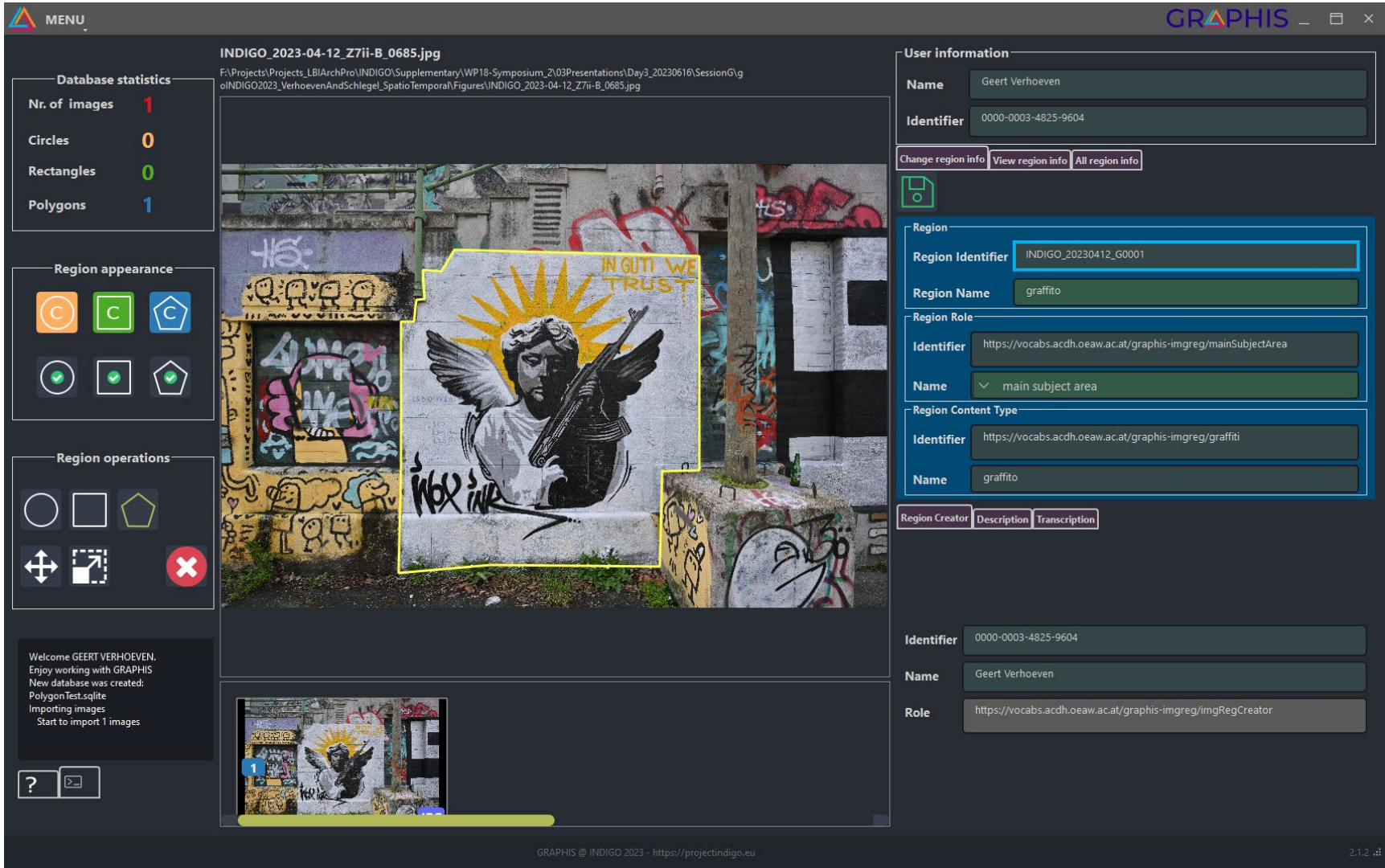
GRAPHIS



CREATING location

GRAPHIS

2D polygon (pixel coordinates)

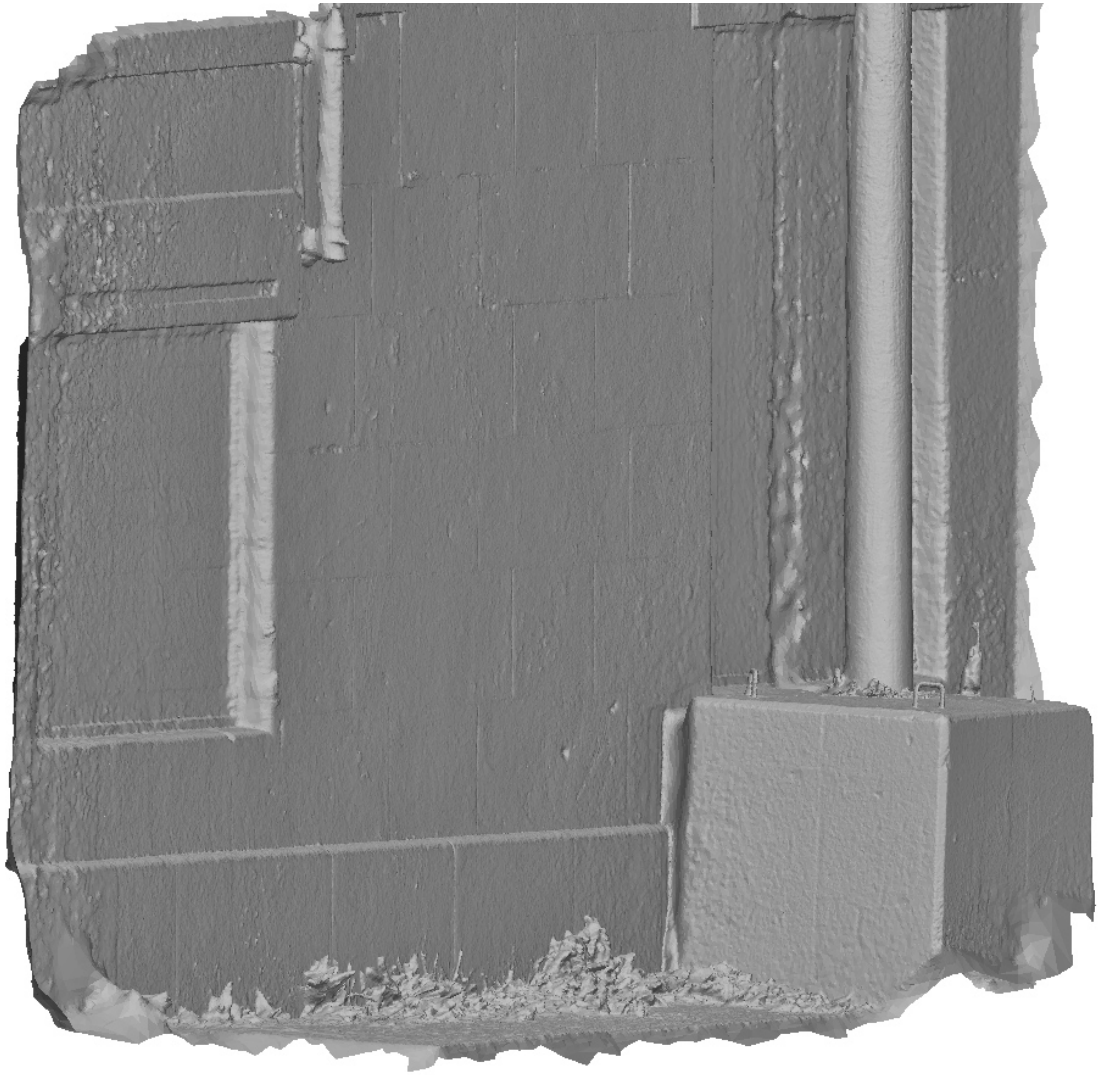


CREATING location

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)

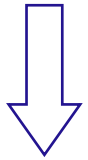
AUTOGRAF

3D polygon (real-world coordinates)

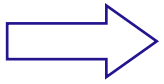
CREATING location

GRAPHIS

2D polygon (pixel coordinates)



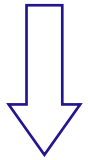
AUTOGRAF

3D polygon (real-world coordinates)  2D polygon (real-world coordinates)

CREATING location

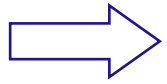
GRAPHIS

2D polygon (pixel coordinates)



AUTOGRAF

3D polygon (real-world coordinates)



2D polygon (real-world coordinates)

?

CREATING location

GRAPHIS

2D polygon (pixel coordinates)

AUTOGRAF

3D polygon (real-world coordinates)

2D polygon (real-world coordinates)

?

CREATING location

GRAPHIS

2D polygon (pixel coordinates)

AUTOGRAF

3D polygon (real-world coordinates)

2D polygon (real-world coordinates)

?

CREATING location

GRAPHIS

2D polygon (pixel coordinates)

AUTOGRAF

3D polygon (real-world coordinates)

2D polygon (real-world coordinates)

?

STORING location

GRAPHIS

2D polygon (pixel coordinates)

AUTOGRAF

3D polygon (real-world coordinates)

2D polygon (real-world coordinates)

STORING location

XMP metadata

GRAPHIS

2D polygon (pixel coordinates)

AUTOGRAF

3D polygon (real-world coordinates)

2D polygon (real-world coordinates)

STORING location

XMP metadata

GRAPHIS

2D polygon (pixel coordinates)

GeoJSON

AUTOGRAF

3D polygon (real-world coordinates)

2D polygon (real-world coordinates)

STORING location

XMP metadata

GRAPHIS

2D polygon (pixel coordinates)

GeoJSON

AUTOGRAF

3D polygon (real-world coordinates)

```
"type": "FeatureCollection",
"features": [
  {
    "type": "Feature",
    "properties": {
    },
    "geometry": {
      "type": "Polygon",
      "coordinates": [
        [
          [16.369211789142078, 48.220322928177943, 47.592282951099342],
          [16.369218883807932, 48.220332028088414, 49.952191243997014],
          [16.369262616499576, 48.220260963475802, 49.899587087985907],
          [16.369256646544585, 48.220262672660212, 47.281441048933353],
          [16.369211789142078, 48.220322928177943, 47.592282951099342]
```

2D polygon (real-world coordinates)

STORING location

XMP metadata

GRAPHIS

2D polygon (pixel coordinates)

GeoJSON

AUTOGRAF

3D polygon (real-world coordinates)

```
"type": "FeatureCollection",
"features": [
  {
    "type": "Feature",
    "properties": {
    },
    "geometry": {
      "type": "Polygon",
      "coordinates": [
        [
          [16.369211789142078, 48.220322928177943, 47.592282951099342],
          [16.369218883807932, 48.220332028088414, 49.952191243997014],
          [16.369262616499576, 48.220260963475802, 49.899587087985907],
          [16.369256646544585, 48.220262672660212, 47.281441048933353],
          [16.369211789142078, 48.220322928177943, 47.592282951099342]
```

2D polygon (real-world coordinates)

GeoJSON

STORING time

XMP metadata

GRAPHIS

2D polygon (pixel coordinates)

GeoJSON

AUTOGRAF

3D polygon (real-world coordinates)

```
"type": "FeatureCollection",
"features": [
  {
    "type": "Feature",
    "properties": {
    },
    "geometry": {
      "type": "Polygon",
      "coordinates": [
        [
          [16.369211789142078, 48.220322928177943, 47.592282951099342],
          [16.369218883807932, 48.220332028088414, 49.952191243997014],
          [16.369262616499576, 48.220260963475802, 49.899587087985907],
          [16.369256646544585, 48.220262672660212, 47.281441048933353],
          [16.369211789142078, 48.220322928177943, 47.592282951099342]
```

2D polygon (real-world coordinates)

GeoJSON

STORING time

GeoJSON structure

- make sense
- CIDOC CRM
- mathematically derivable

STORING time

in-situ graffito event

GeoJSON structure

- make sense
- CIDOC CRM
- mathematically derivable

STORING time

in-situ graffito event

Production

GeoJSON structure

- **make sense**
- **CIDOC CRM**
- **mathematically derivable**

STORING time

GeoJSON structure

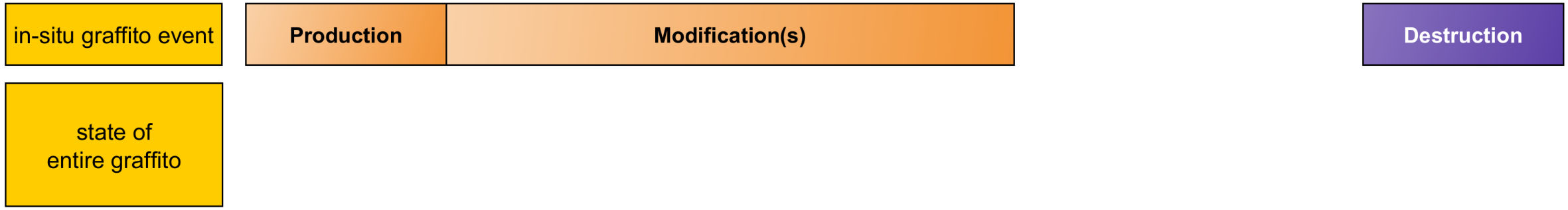
- make sense
- CIDOC CRM
- mathematically derivable

STORING time

GeoJSON structure

- make sense
- CIDOC CRM
- mathematically derivable

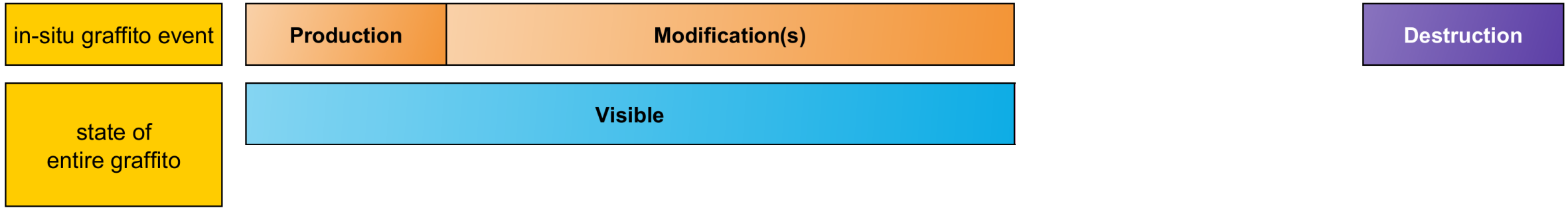
STORING time



GeoJSON structure

- make sense
- CIDOC CRM
- mathematically derivable

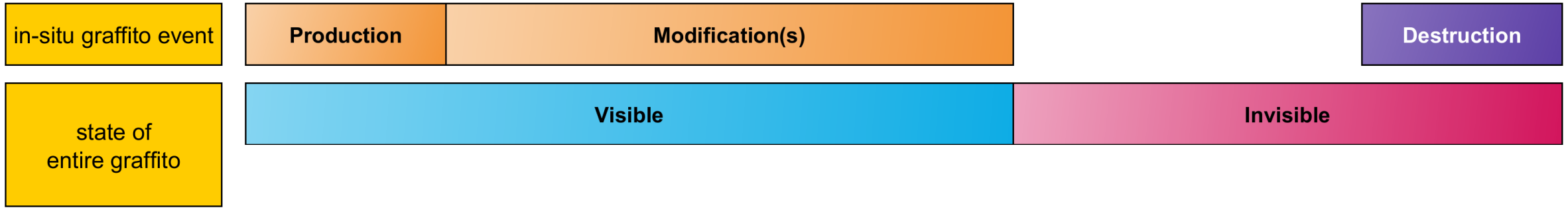
STORING time



GeoJSON structure

- make sense
- CIDOC CRM
- mathematically derivable

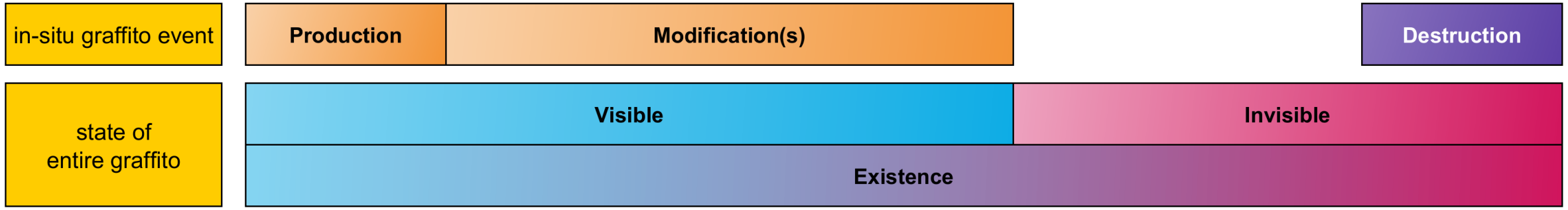
STORING time



GeoJSON structure

- make sense
- CIDOC CRM
- mathematically derivable

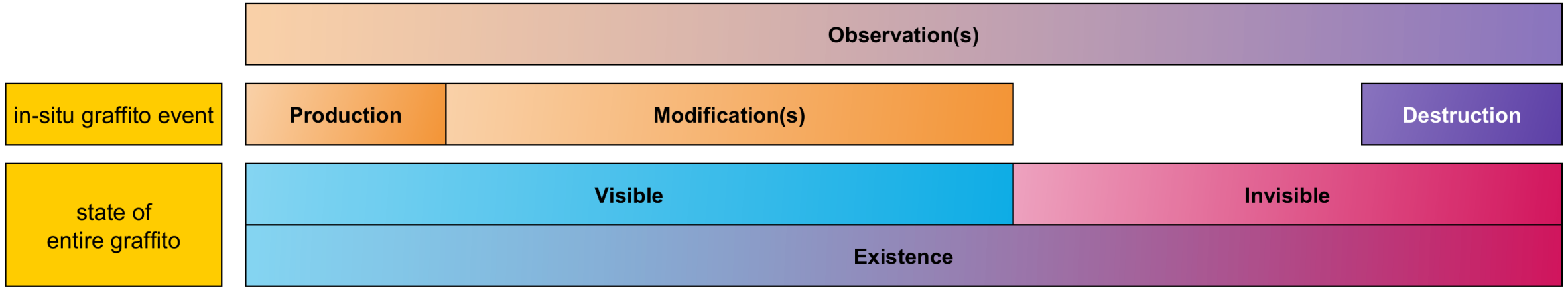
STORING time



GeoJSON structure

- make sense
- CIDOC CRM
- mathematically derivable

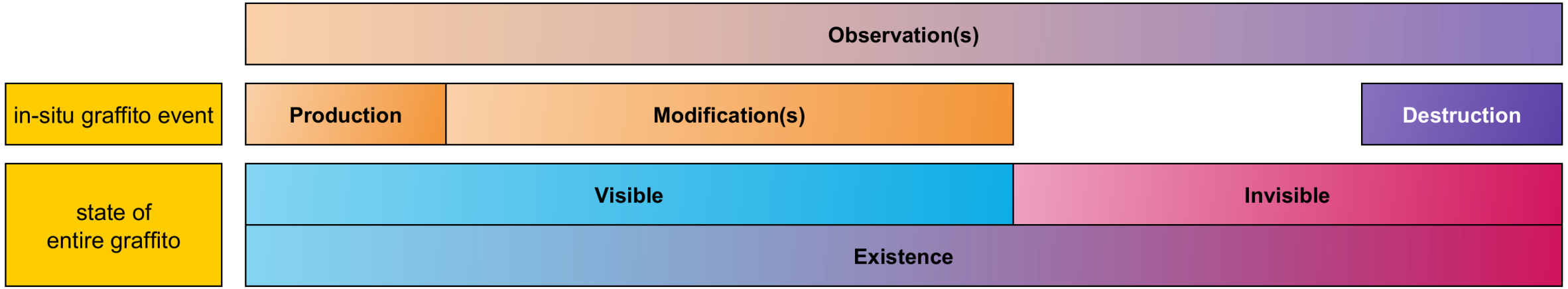
STORING time



GeoJSON structure

- make sense
- CIDOC CRM
- mathematically derivable

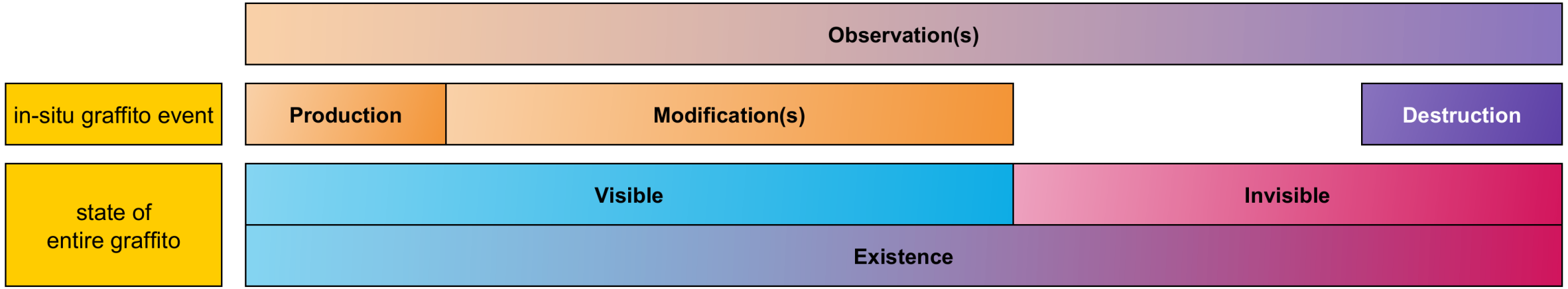
STORING time




```
"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": {···
  }
```

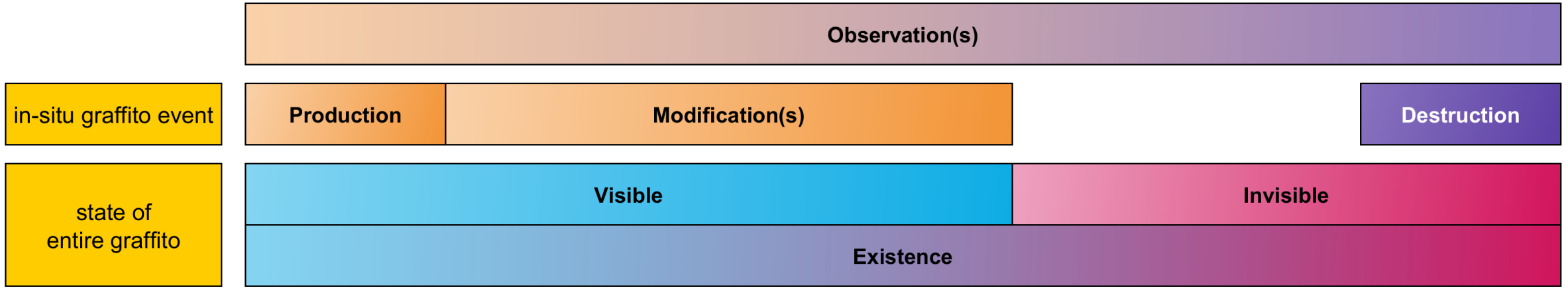
STORING time




```
"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": {···
  },
```

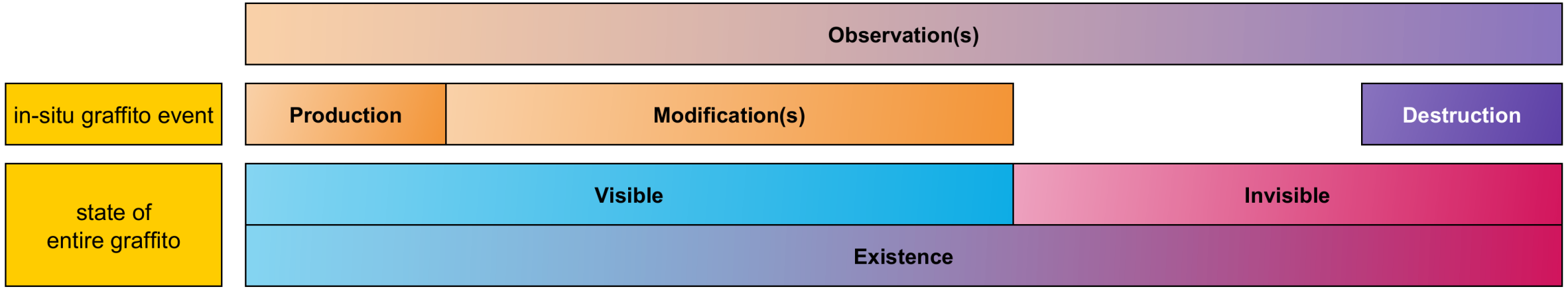
```
  "modification": [···
  ],

  "destruction": {···
  },

  "visible": {···
  },

  "invisibile": {···
  },

  "existence": {···
  }
```

STORING time



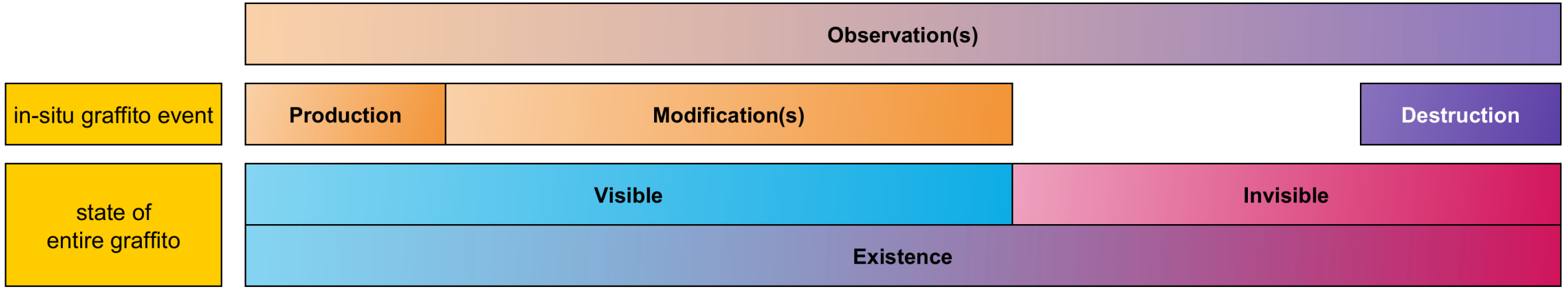

```
"visible": {
  "start": {                    "end": {                    "span": {
```

STORING time



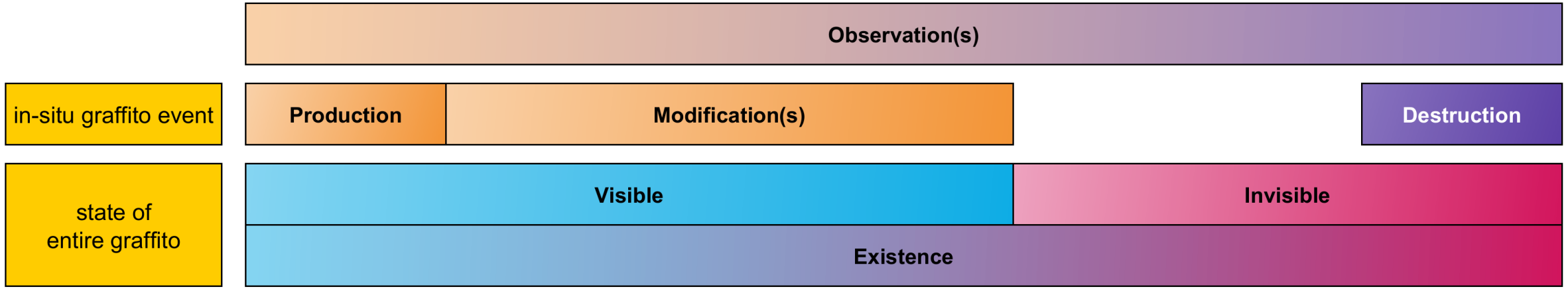

```
"visible": {
  "start": {                    "end": {                    "span": {
    "earliest":
    "earliest_source":
    "latest":
    "latest_source":
  },
```

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

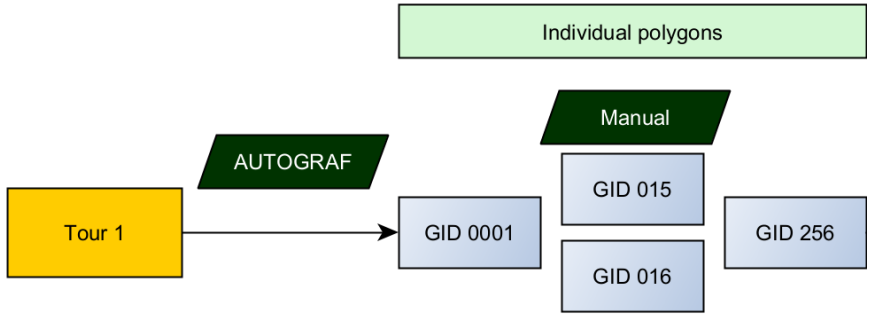
COMPUTING time


```
"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": "PT45H9M",
    "maximum": "PT390H45M"
  }
```

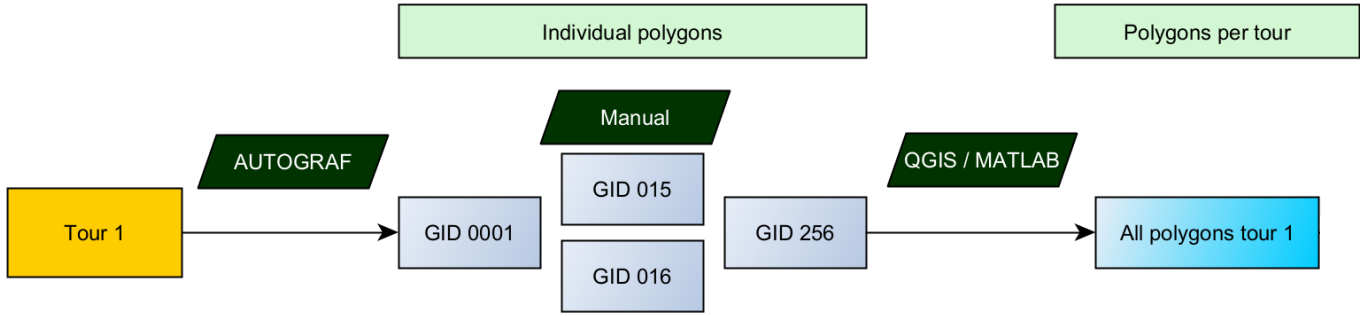
COMPUTING time

Tour 1

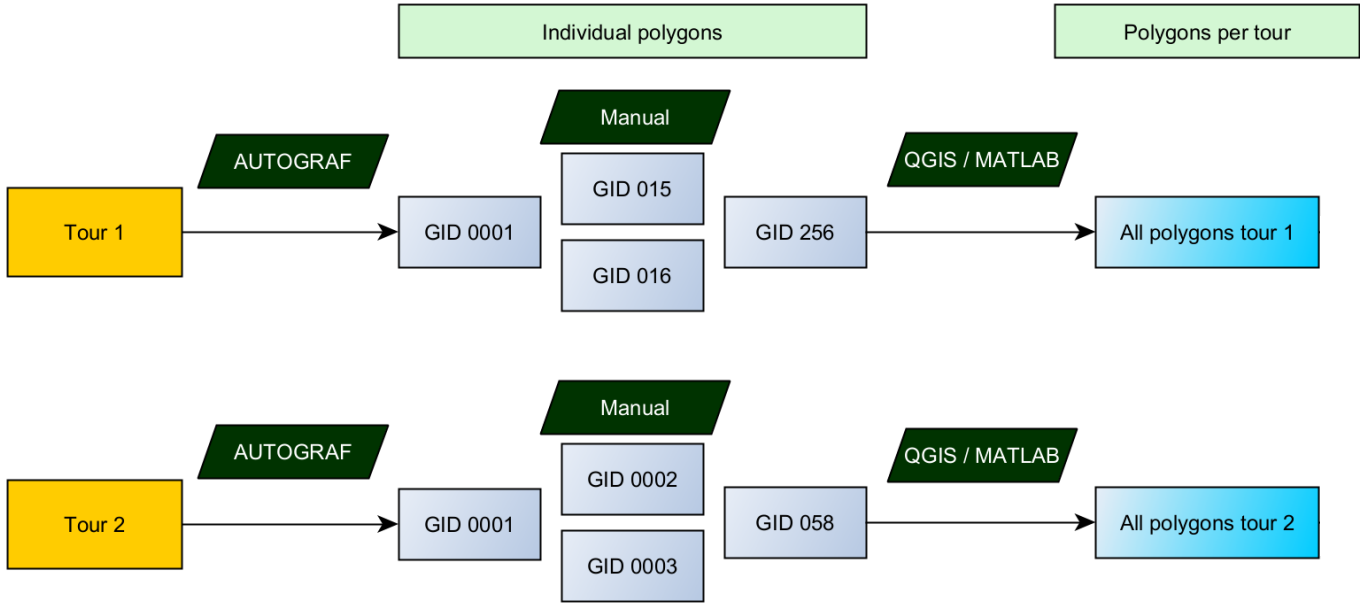
COMPUTING time



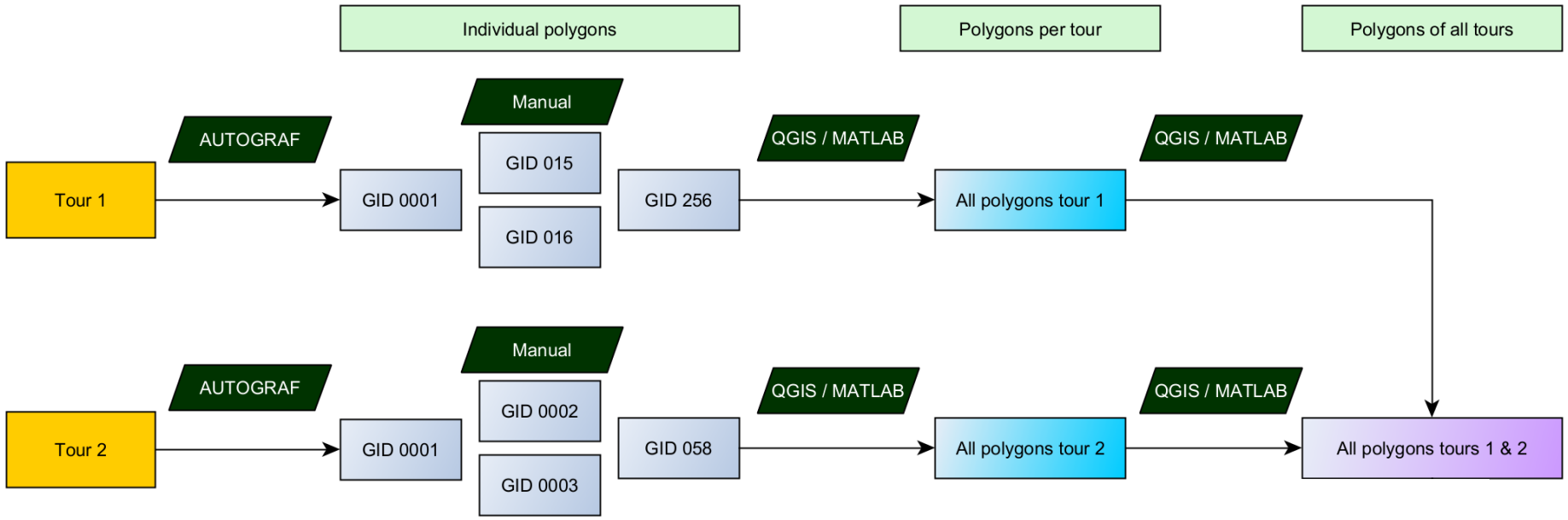
COMPUTING time



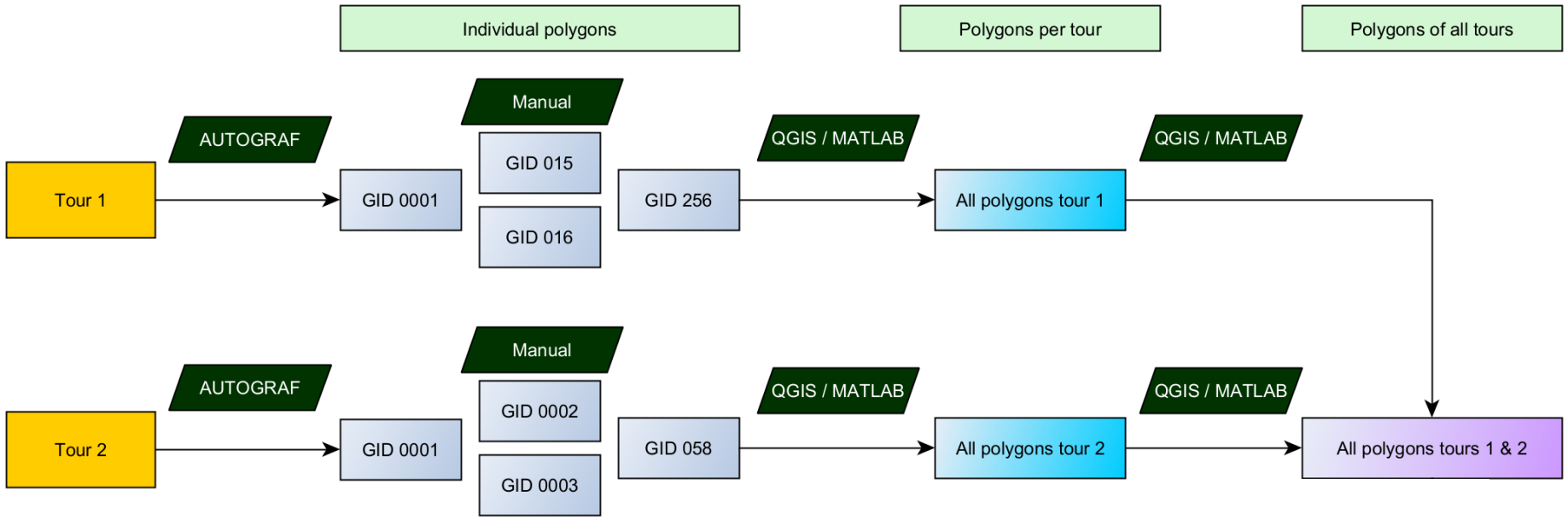
COMPUTING time



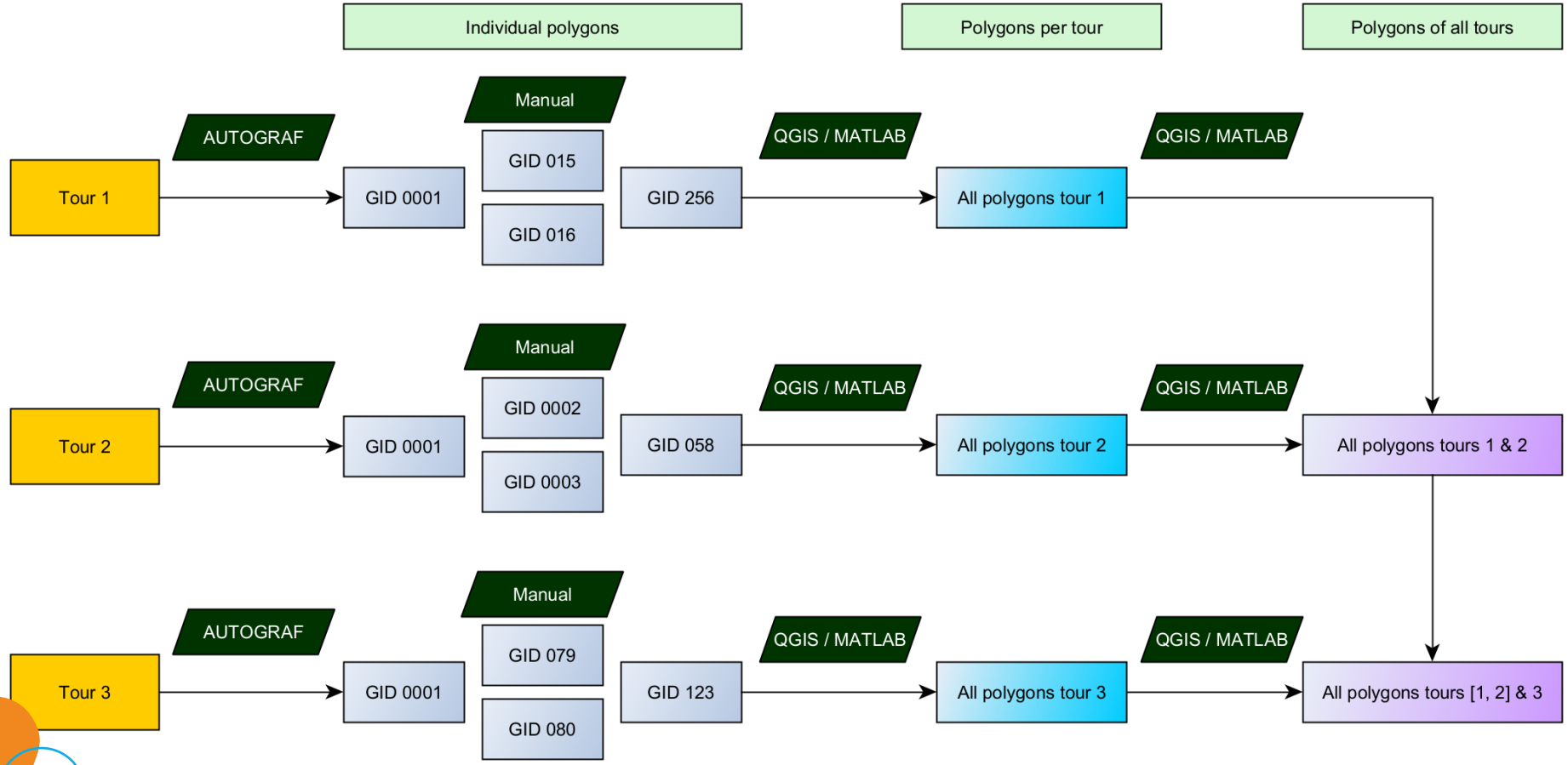
COMPUTING time



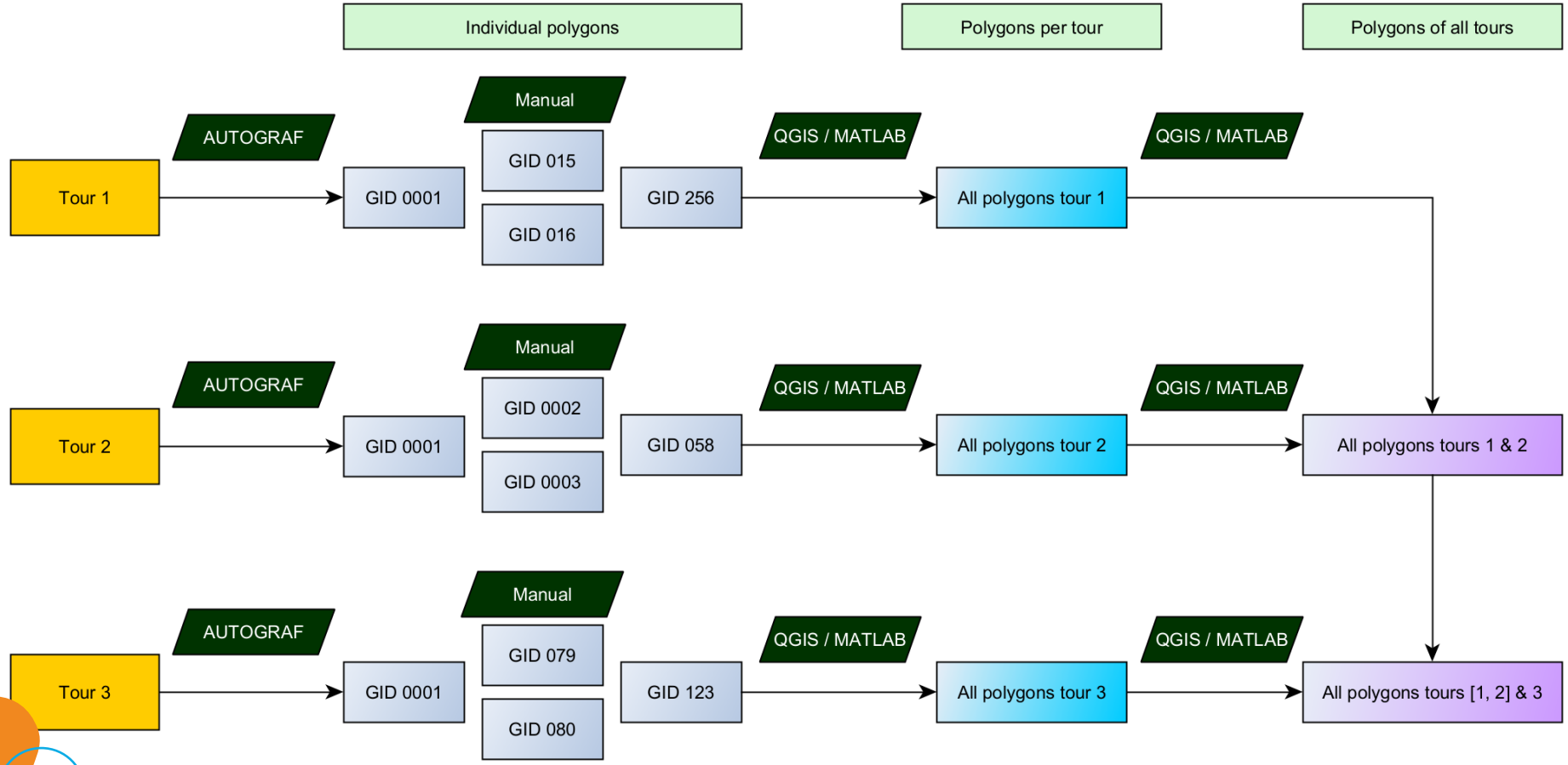
COMPUTING time



COMPUTING time



COMPUTING time



processing

STILL puzzling

trial and error

3D → 2D

polygons are subjective thresholds

STILL
puzzling

real graffito
physical resource

derivatives
digital resources

STILL
puzzling

real graffito
physical resource

derivatives
digital resources

polygons

STILL
puzzling

real graffito
physical resource

derivatives
digital resources

location

temporality

polygons

go indigo 2023

One polygon at a time trying to manage a graffiti-scape's spatio-tem ⧖ po ⧖ ra ⧖ li ⧖ ty

Geert Verhoeven
Jona Schlegel

projectindigo.eu

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