

o h s o m e

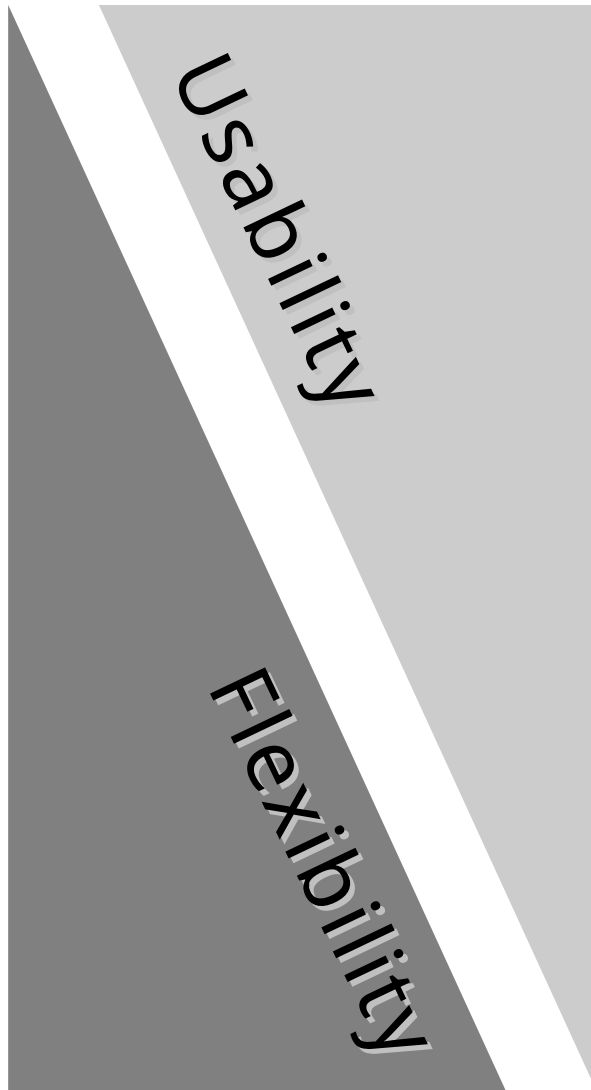
OpenStreetMap data quality analysis

Martin Raifer, Michael Auer, Lukas Loos, Rafael Troilo, Fabian Kowatsch,
Johannes Visintini & Alexander Zipf

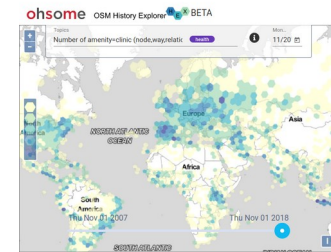
3rd International Workshop on Spatial Data Quality
Valetta (Malta) · 28.01. - 29.01.2020

ohsome platform

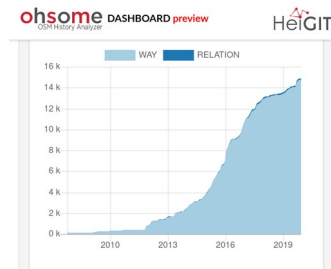
OpenStreetMap History Data Analyzing Platform



ohsome
OSM History
Explorer



ohsome
dashboard



ohsome
API



OSHDB
API



OSHDB



Agenda



ohsome

The logo for HeiGIT, featuring a red stylized network diagram above the text "HeiGIT".

HEIDELBERG INSTITUTE FOR GEOINFORMATION TECHNOLOGY



Prof. Dr. Alexander Zipf



UNIVERSITÄT
HEIDELBERG
ZUKUNFT
SEIT 1386





HEIDELBERG INSTITUTE
FOR GEOINFORMATION
TECHNOLOGY

Focus areas:



Smart Location-based
Services and Navigation



Geoinformation for
Humanitarian Aid



Big Spatial Data Analytics

Agenda



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What is OSM?



What is OSM? A Map

OSM

© OpenStreetMap contributors

Bing

© OpenStreetMap contributors

© HERE

HERE

© 2020 HERE, Deutschland

Google Maps

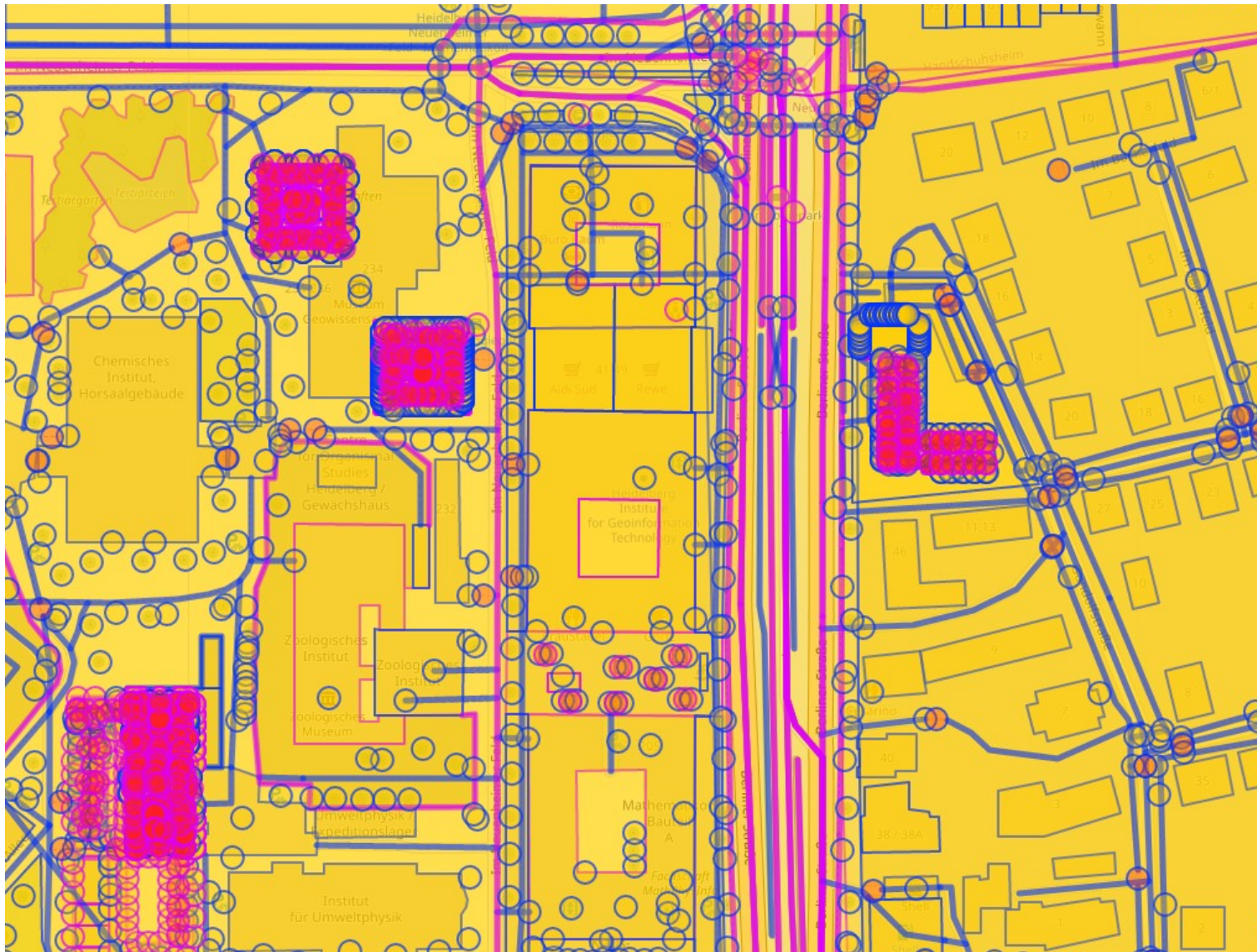
© 2020 Geobasis-DE/BKG

(© 2009), Google



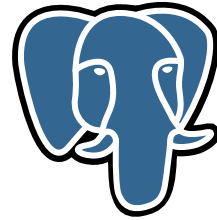
What is OSM? Data

OSM Data fetched from
Overpass Turbo
© OpenStreetMap contributors





What is OSM? An SDI



PostgreSQL
PostGIS

January 2020

5700 million nodes
635 million ways
7 million relations

Download server
Current OSM
Full History



Web API
Map Tiles
Data
Metadata



WIKI

Documentation

maps • • • editors

https://www.openstreetmap.org/stats/data_stats.html

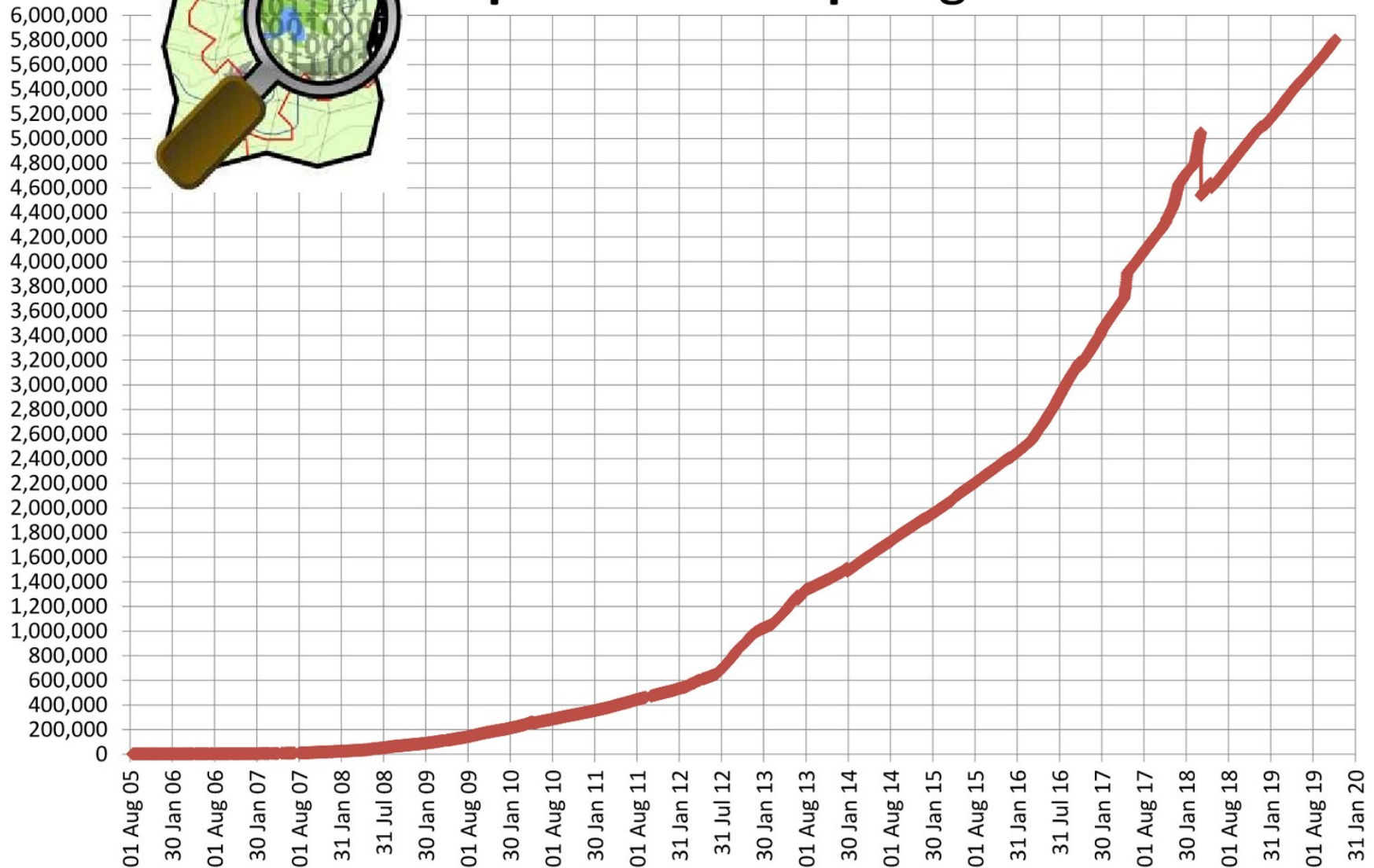
info@heigit.org



What is OSM? Contributors



OpenStreetMap Registered Users



https://www.openstreetmap.org/stats/data_stats.html



What is OSM? Community ^{HeiGIT}



Humanitarian
OpenStreetMap
Team



**MISSING
MAPS**

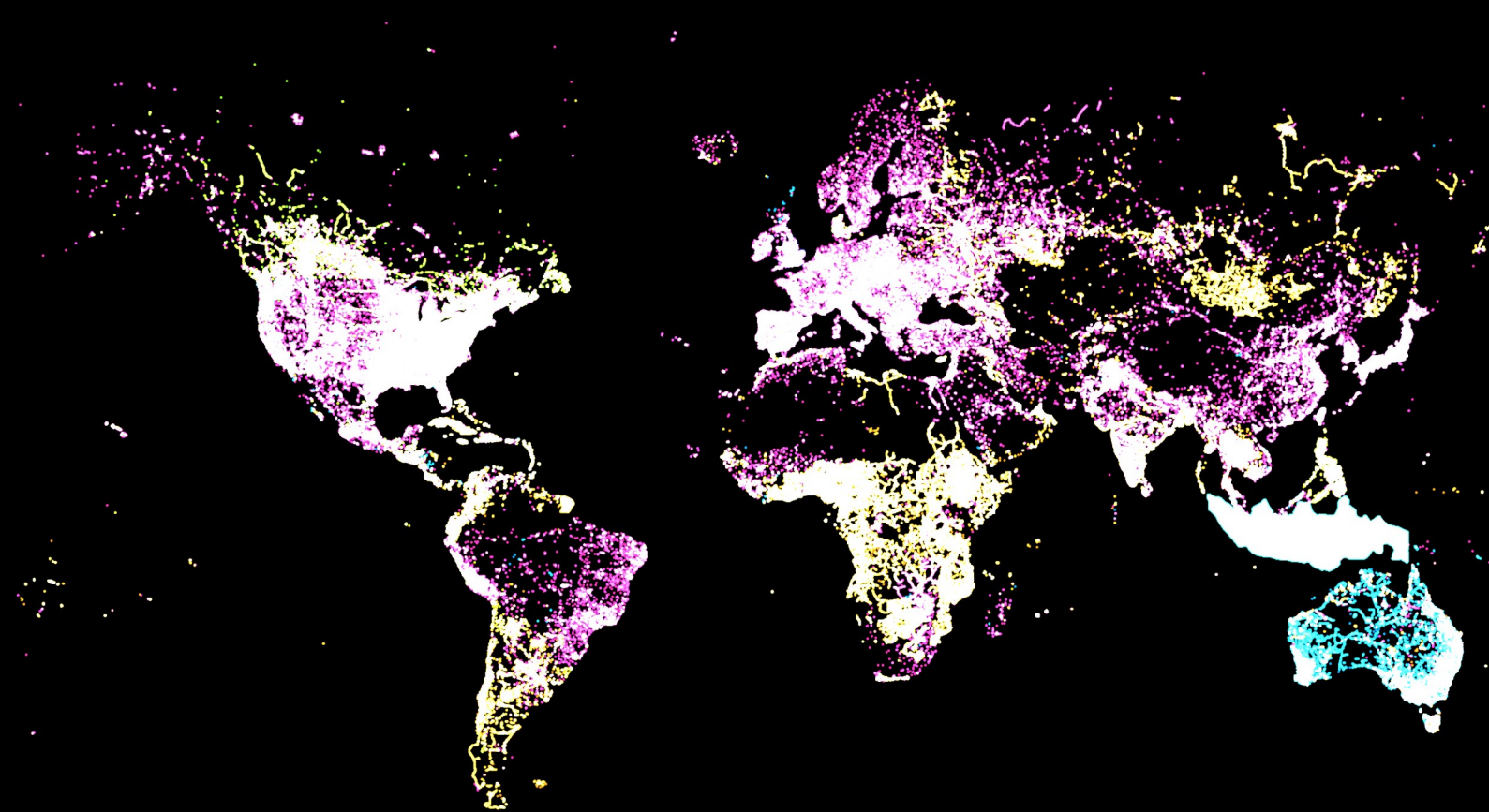


youth mappers



What is OSM? Business

Global Footprint of Corporate Contributions to OpenStreetMap



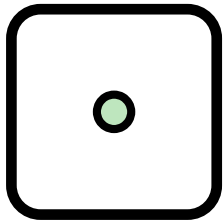
Corporations

-  Telenav
-  Kaart
-  Apple
-  Facebook
-  Mapbox
-  Devseed
-  Amazon
-  Microsoft
-  Grab
-  Uber

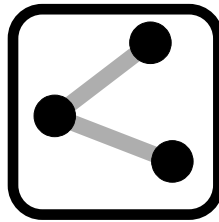
Anderson, Sarkar, & Palen 2019

Anderson, J.; Sarkar, D.; Palen, L. Corporate Editors in the Evolving Landscape of OpenStreetMap. ISPRS Int. J. Geo-Inf. 2019, 8, 232

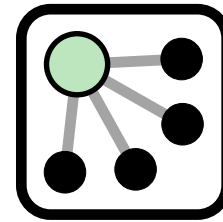
OSM Data Model



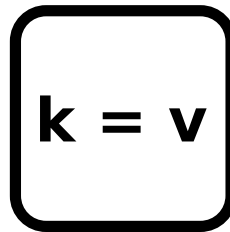
nodes



ways



relations



tags

Agenda



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Considerations

Scepticism

laymen's work

vandalism

imprecise

heterogeneous coverage



Considerations

TRUST

Positional

THEMATICAL

Accuracy

Completeness

Consistency



Considerations

2 complementing approaches

Extrinsic methods

Compare
OSM with reference
dataset

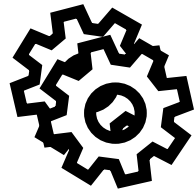
Intrinsic methods

Consider the **history** of OSM



Considerations

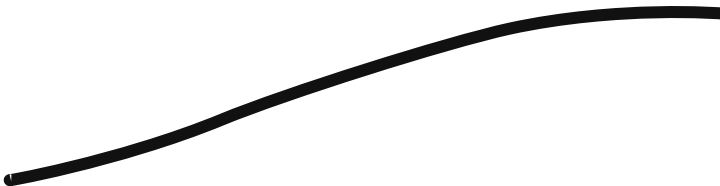
TRUST



Processes



Users



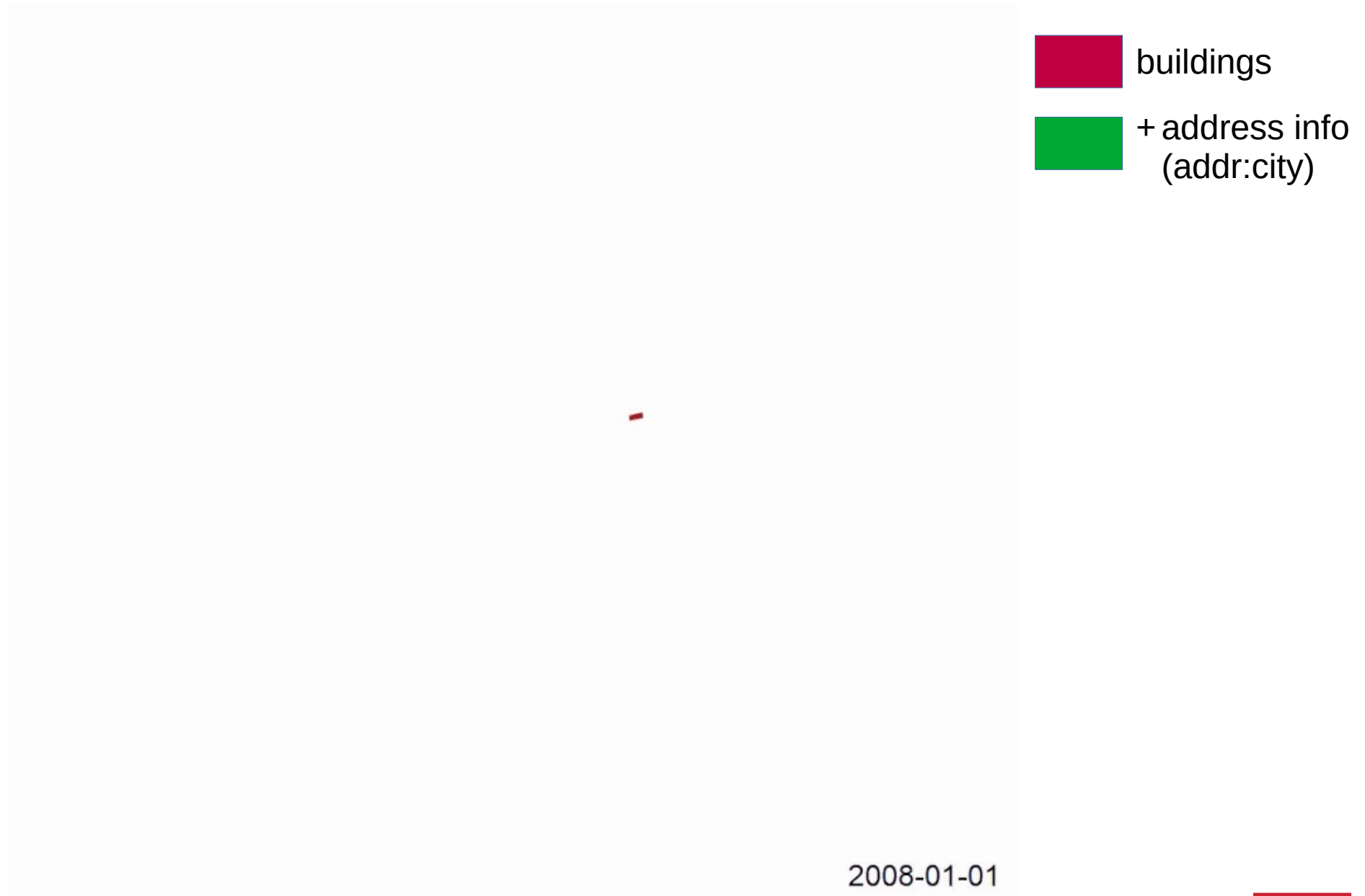
Data development

Agenda



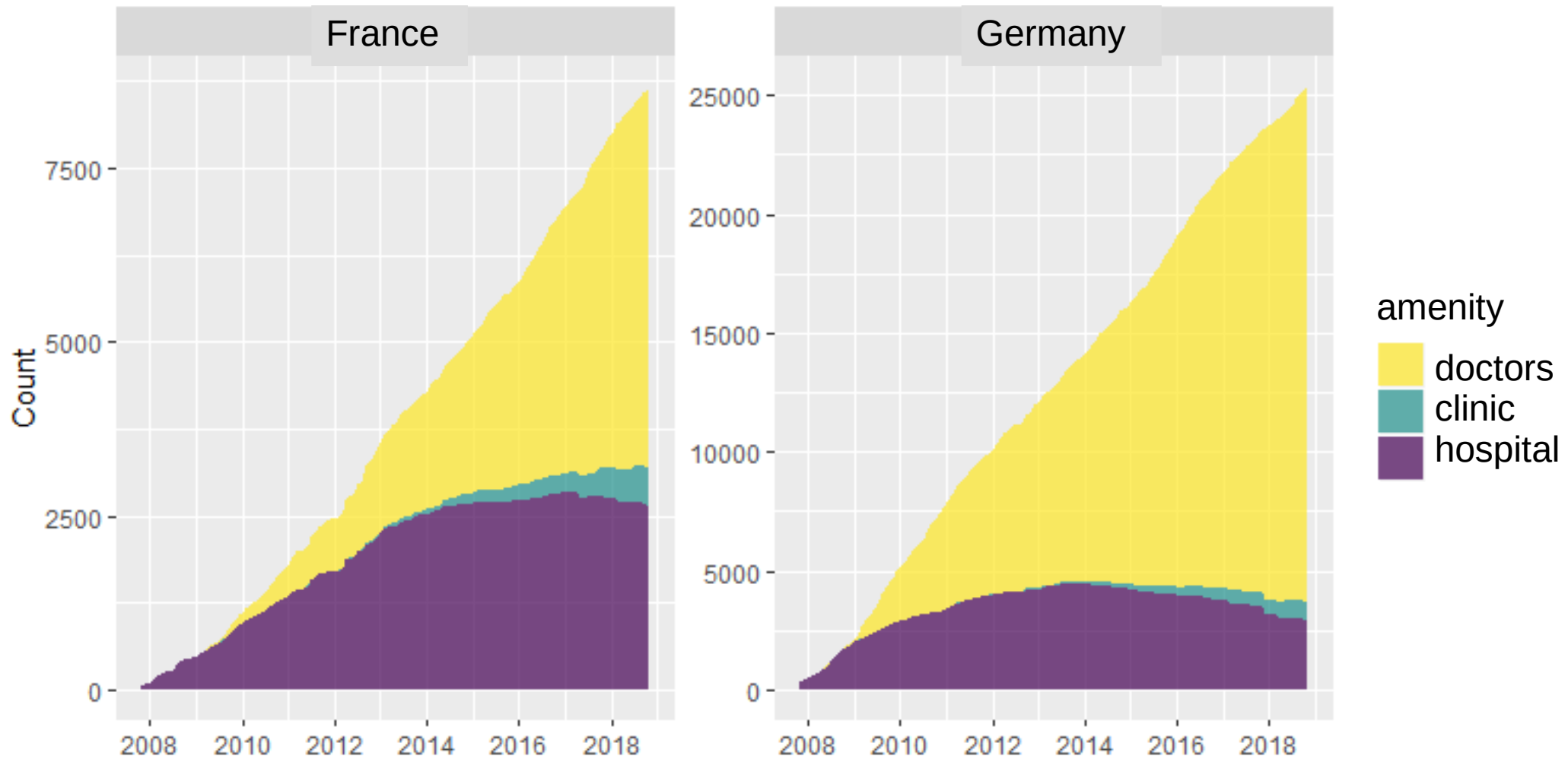
ohsome

Data Extraction: Heidelberg 2008-2018 HeiGIT



http://k1z.blog.uni-heidelberg.de/files/2018/12/buildings_addr:city-not-null.gif
info@heigit.org

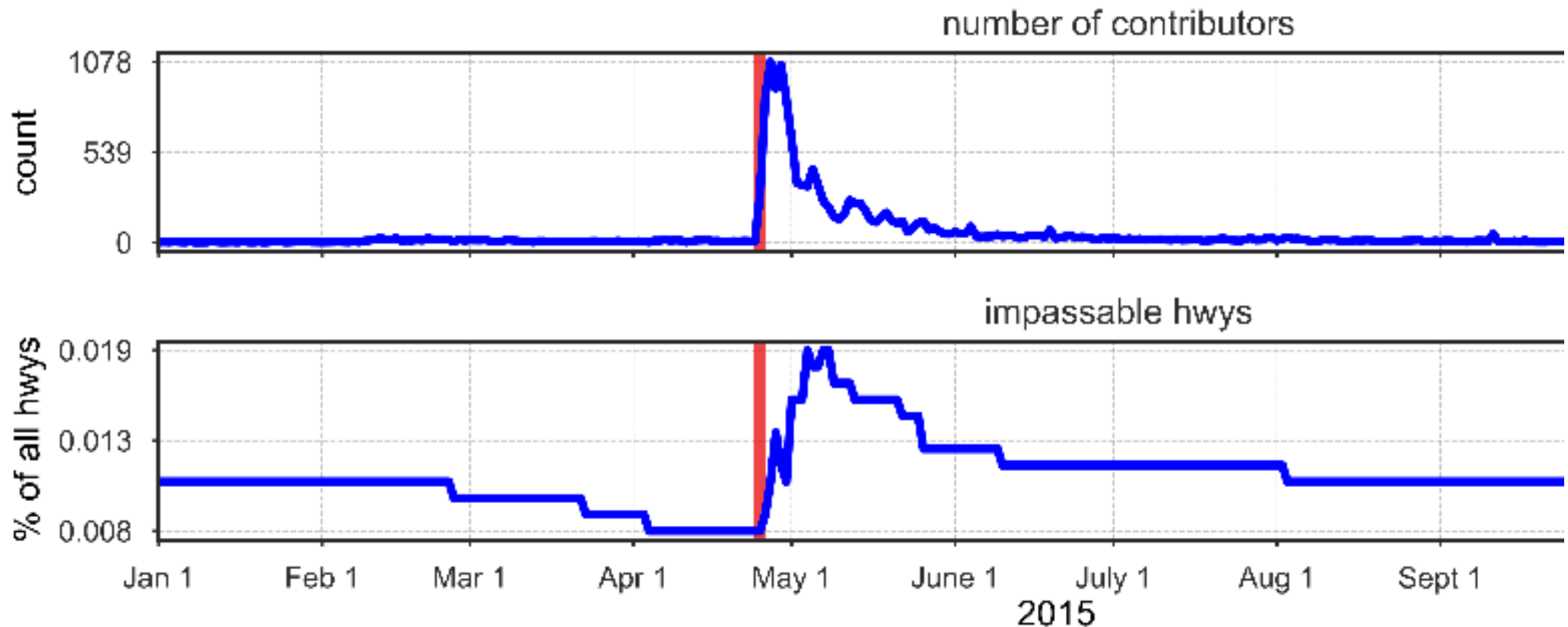
Aggregation: health facilities



<http://k1z.blog.uni-heidelberg.de/2019/05/16/exploring-osm-history-the-example-of-health-related-amenities/>

Strong community impact

Nepal Earthquake 2015



Auer et al. 2018: **Towards Using the Potential of OpenStreetMap History for Disaster Activation Monitoring.** *Proceedings of the 15th ISCRAM Conference – Rochester, NY, USA May 2018*

Central concepts

- Lossless
- Simple, but powerful
- High performance
- Levels of usability
- Flexible deployment: run it local or distributed

Aggregation

OSM Elements

Users (contributors)

Data extraction

Snapshots

Full History

OSM tag filter

Key	Value
highway	

(leave blank to query all values)

OSM type

 way x

Measure

☐ count
 ☒ length
 ☐ area
 ☐ perimeter

Group Results By ...

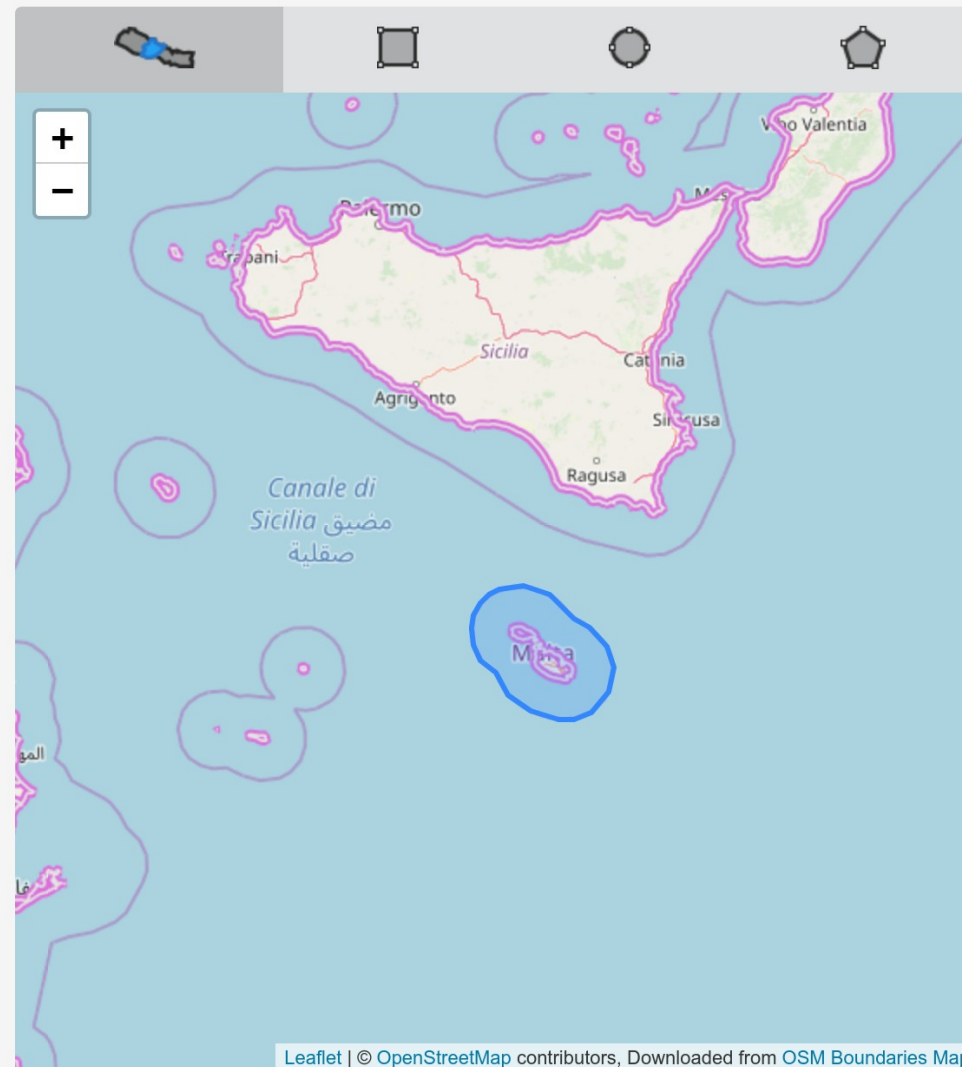
☒ none
 ☐ OSM type
 ☐ boundary
 ☐ tag
 ☐ key

Time period

Start	End	Interval
2007-08-01	2019-12-31	monthly

Send Request

Area of interest



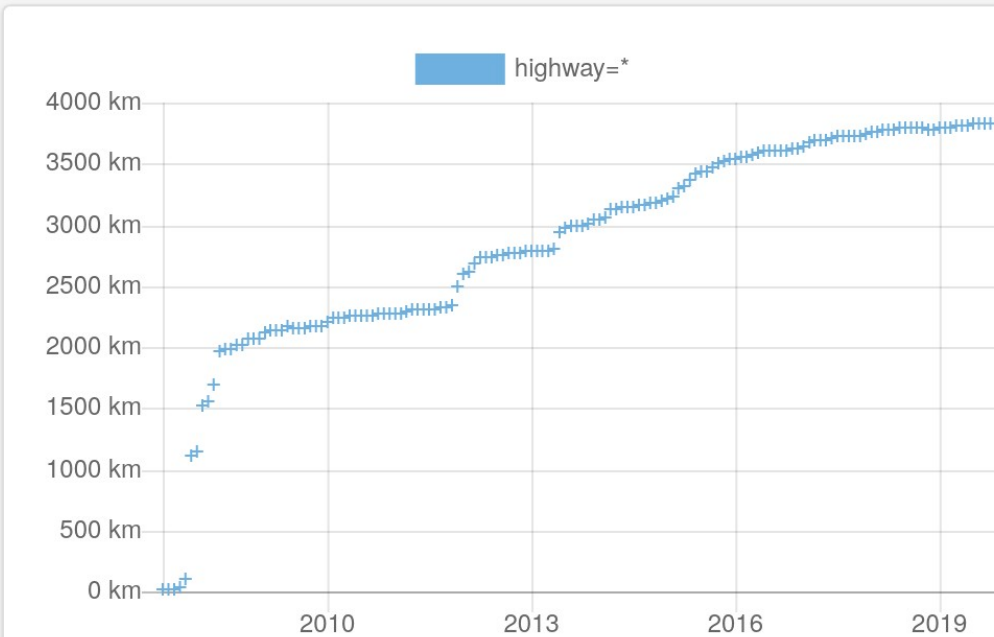
Selected areas

Malta

Result Log

highway = *   length ☐ Malta

Download 



13.1 KM
2007-08-01

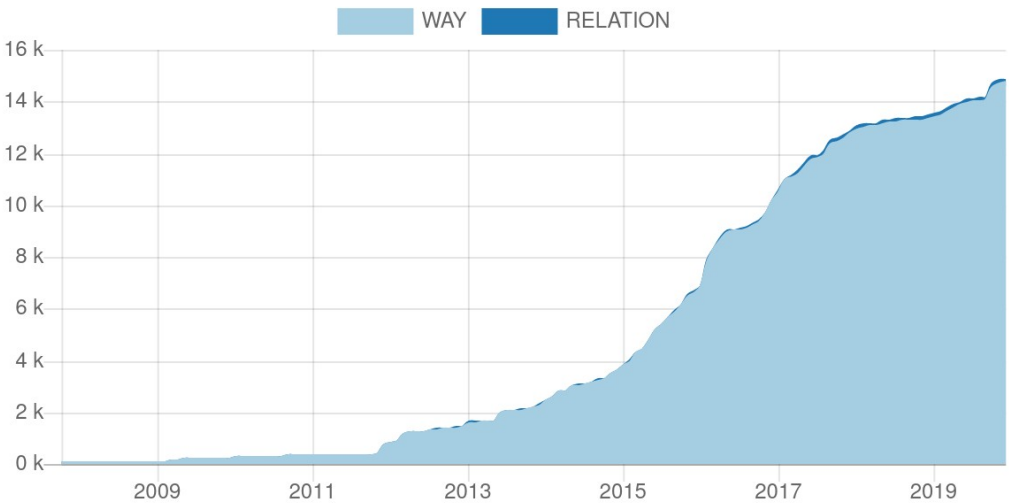
3838 KM
2019-12-01

↑ 29108 %
GROWTH RATE

Result Log

building = *    count  type ☐ Malta

Download 



NAME	2007-10-08	2019-12-08	GROWTH RATE
WAY	0.0	14.7 k	-- %
RELATION	0.0	109.0	-- %

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OSM History Explorer

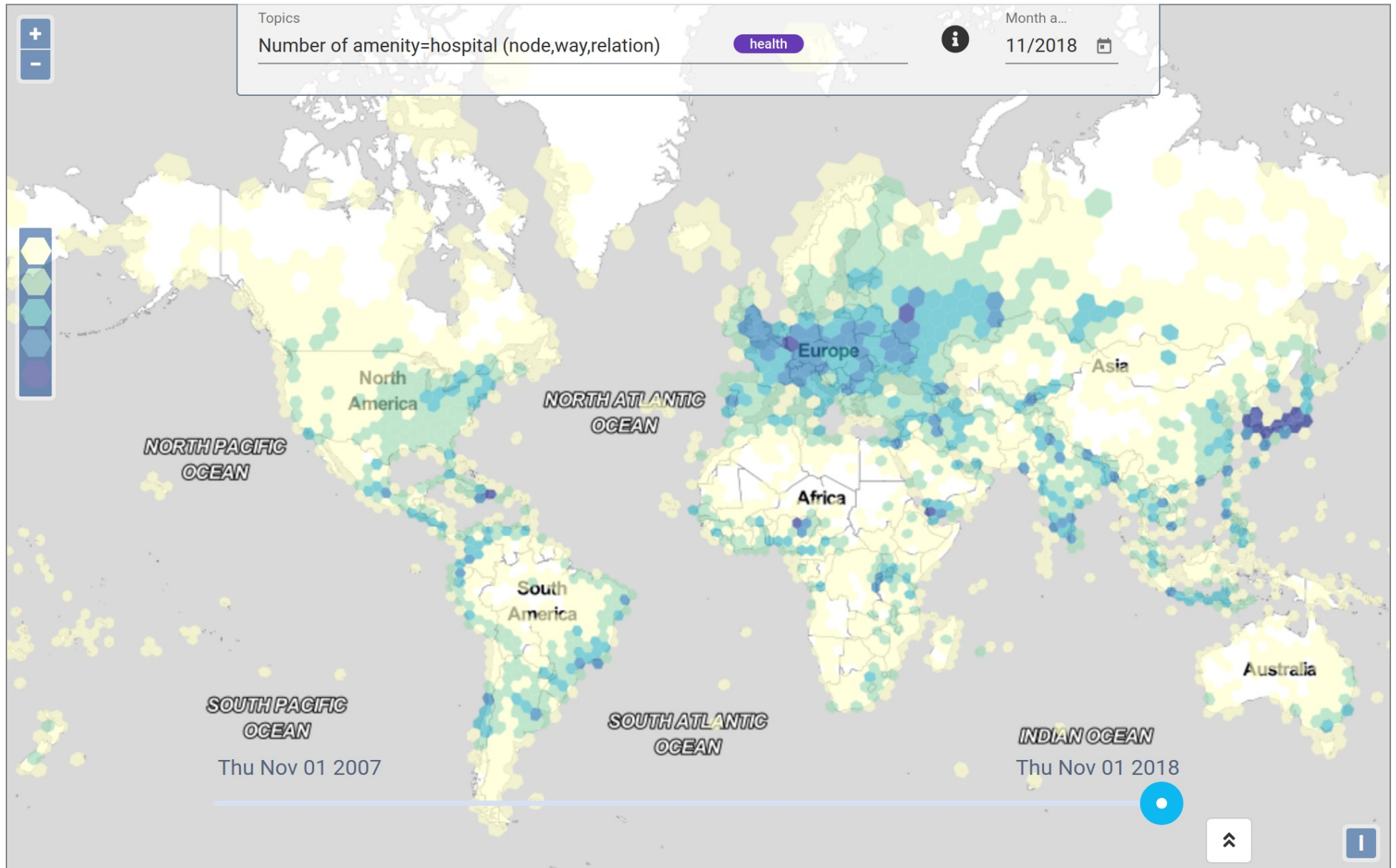


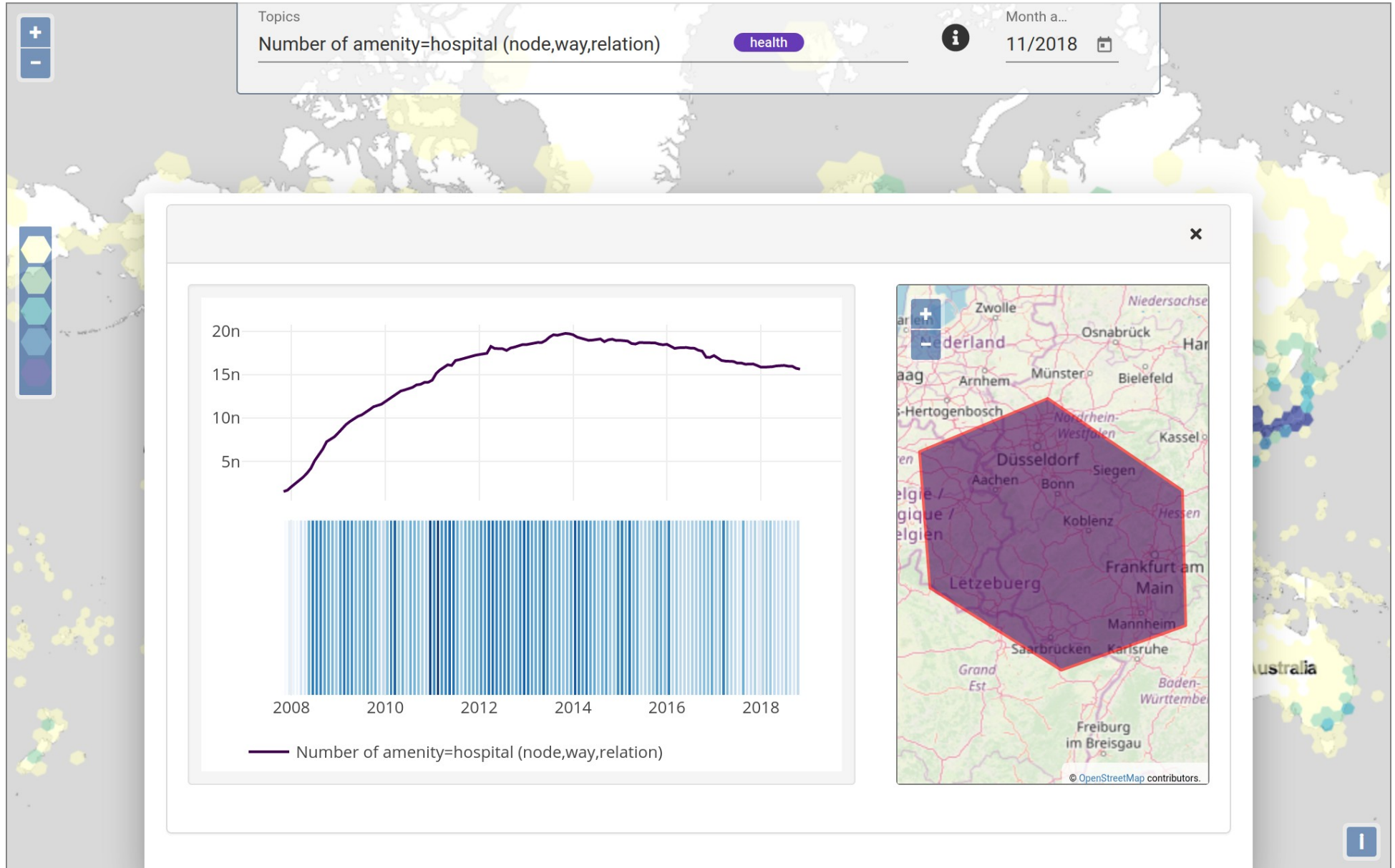
BETA

About



Klaus Tschira Stiftung
gemeinnützige GmbH





Topics

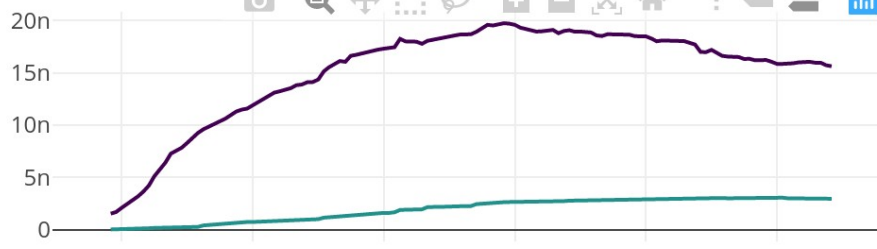
Number of amenity=hospital (node,way,relation)

health



Month a...

11/2018



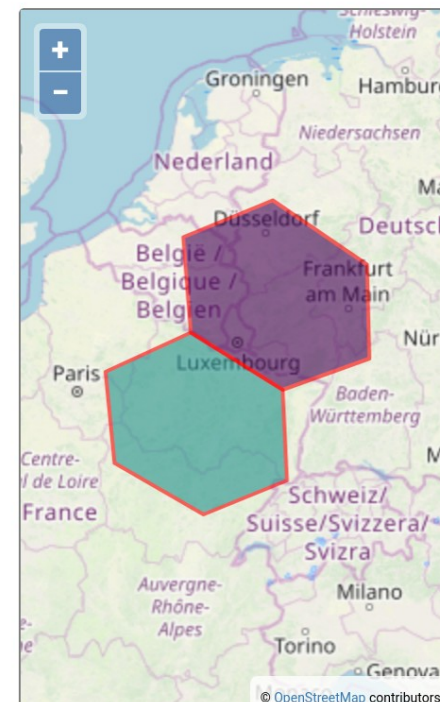
Number of Contributors for amenity_hospital_nwr: 4

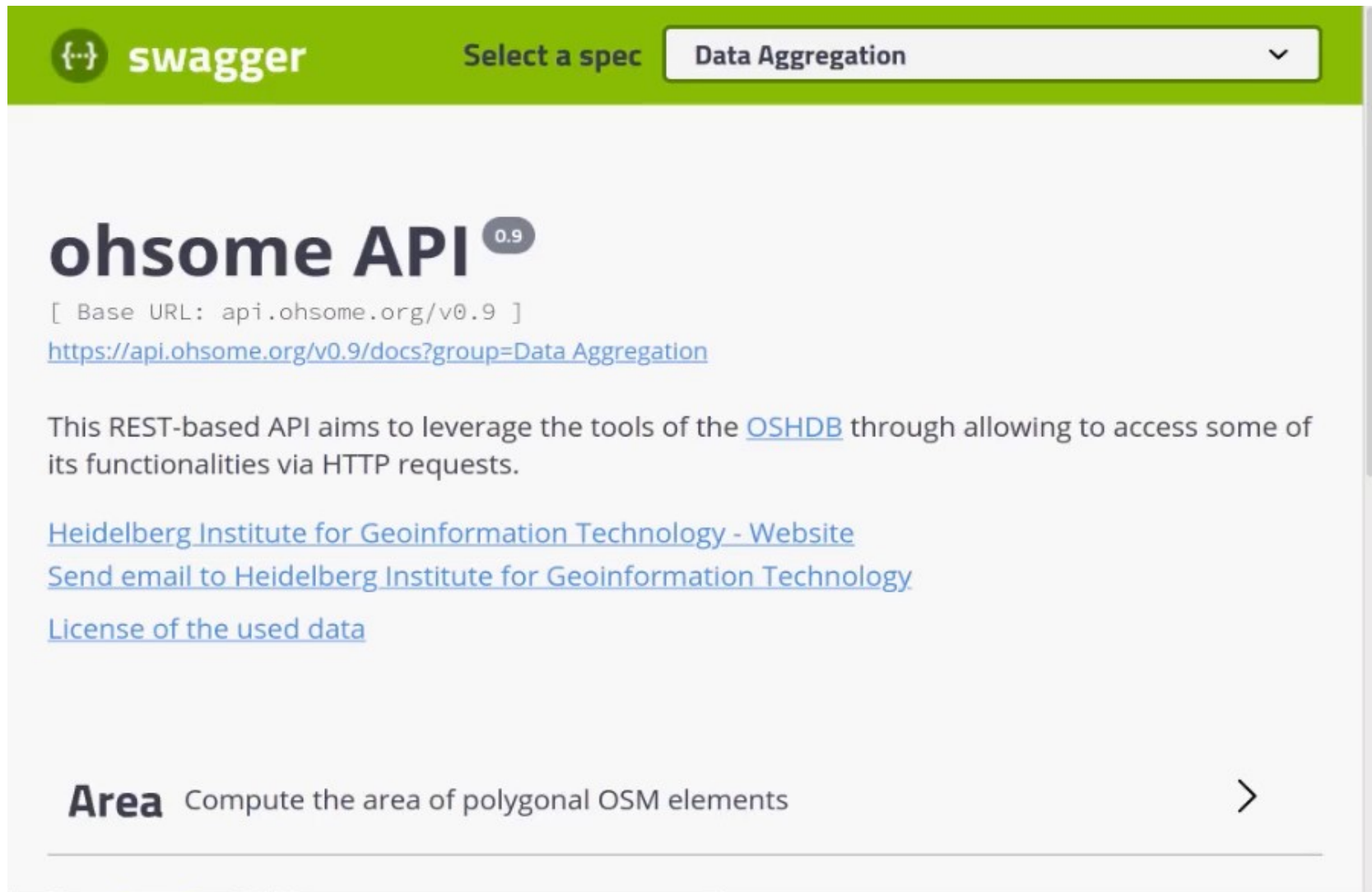
Number of Contributors for amenity_hospital_nwr: 59

2008 2010 2012 2014 2016 2018

— Number of amenity=hospital (node,way,relation)

— Number of amenity=hospital (node,way,relation)





The screenshot shows the Swagger UI for the ohsome API. At the top, there is a green header with the Swagger logo and the text "swagger". To the right of the logo is a dropdown menu labeled "Select a spec" with "Data Aggregation" selected. Below the header, the main content area has a light gray background. It features the title "ohsome API" in a large, bold, dark font, followed by a version number "0.9" in a small, dark circle. Below the title, there is a line of text in brackets: "[Base URL: api.ohsome.org/v0.9]". This is followed by a blue hyperlink: "https://api.ohsome.org/v0.9/docs?group=Data Aggregation". Below the link, there is a paragraph of text: "This REST-based API aims to leverage the tools of the [OSHDB](#) through allowing to access some of its functionalities via HTTP requests." Below this paragraph, there are three blue hyperlinks: "Heidelberg Institute for Geoinformation Technology - Website", "Send email to Heidelberg Institute for Geoinformation Technology", and "License of the used data". At the bottom of the visible area, there is a section titled "Area" in a bold, dark font, followed by the text "Compute the area of polygonal OSM elements". To the right of this text is a large, dark right-pointing arrow.

swagger

Select a spec Data Aggregation

ohsome API^{0.9}

[Base URL: api.ohsome.org/v0.9]

<https://api.ohsome.org/v0.9/docs?group=Data Aggregation>

This REST-based API aims to leverage the tools of the [OSHDB](#) through allowing to access some of its functionalities via HTTP requests.

[Heidelberg Institute for Geoinformation Technology - Website](#)

[Send email to Heidelberg Institute for Geoinformation Technology](#)

[License of the used data](#)

Area Compute the area of polygonal OSM elements



Recap

OSM has:

... Manpower, transparency of concepts, processes and technology

OSM is:

... Diverse, biased, heterogeneous, rich, poor

BUT: dynamic, thus, able to improve and capable to adapt and innovate

ohsome

... opens the OSM-History to be included in spatial data quality analyses

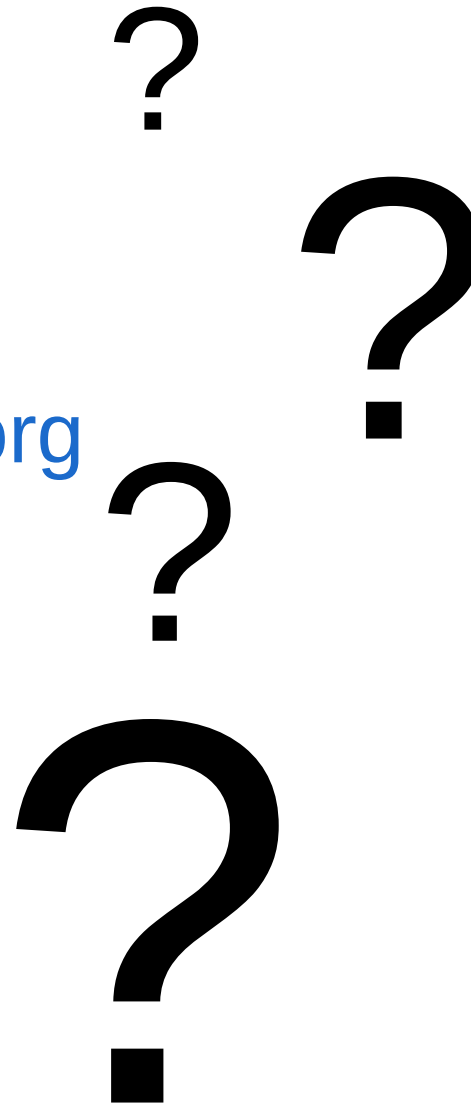
... can complement extrinsic approaches with novel intrinsic quality indicators

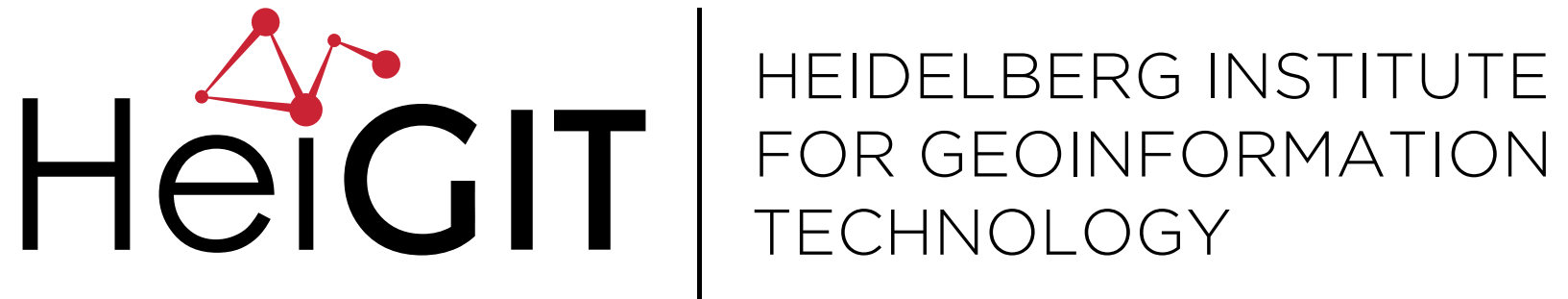
... can help you to find out if OSM is fit for your purpose

... can give you TRUST

Questions ?

<https://ohsome.org>





Leveraging the **Potential** of
Open Crowd-Generated Geoinformation and
innovative Geoinformation **Technologies**
for **Citizens** and **Environment**



HEIDELBERG INSTITUTE
FOR GEOINFORMATION
TECHNOLOGY

The Team



Dr. Michael Auer
PostDoc Researcher



Fabian Kowatsch
Research Associate



Lukas Loos
Research Associate



Martin Raifer
Research Associate



Rafael Troilo
Research Associate / System Administration



Johannes Visintini
Research Associate



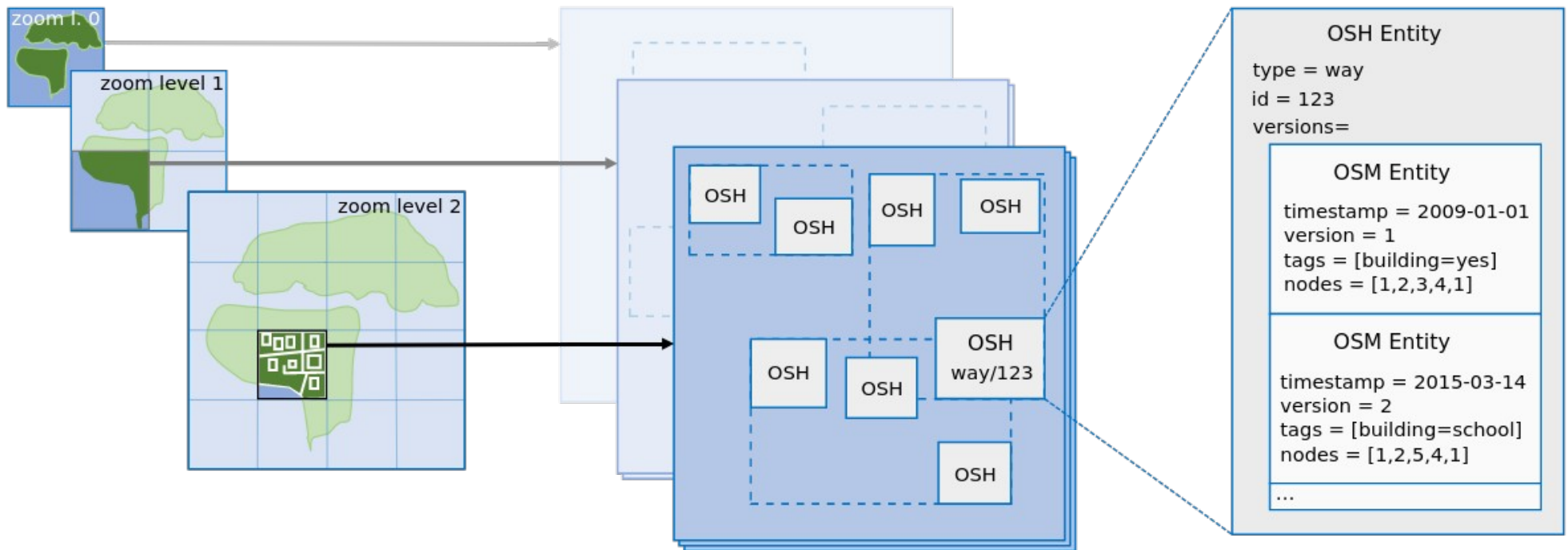
Big Spatial Data Analytics

Data model

Data partitioning

Grid cells with
local spatial index

OSH Data Entity



https://downloads.ohsome.org

o h s o m e 'ɔːsəm

Downloads

	Name	Last modified	Size
	Parent Directory		-
	africa/	2019-10-09 13:44	-
	asia/	2019-10-15 08:33	-
	europe/	2019-10-15 08:34	-
	events/	2019-10-09 13:44	-
	foss4g/	2019-10-09 13:44	-
	planet.oshdb.mv.db	2019-06-20 11:52	513G
	planet.oshdb.mv.db.md5	2019-07-03 15:08	36
	planet_2019-10-10T23:00Z.oshdb.mv.db	2019-10-15 13:13	541G

OSHDB Java API

```
OSHDBH2 db = new OSHDBH2("./data/oshdb/italy.oshdb");
```

```
SortedMap<OSHDBTimestamp, Number> result = OSMEntitySnapshotView.on(db)
    .timestamps("2008-01-01", "2018-01-01", Interval.MONTHLY)
    .areaOfInterest(new OSHDBBoundingBox(9.1308, 45.4239, 9.263, 45.5022))
    .osmTag("highway")
    .osmType(OSMType.WAY)
    .aggregateByTimestamp()
    .map(snapshot -> Geo.lengthOf(snapshot.getGeometry()))
    .sum();
```

```
result.forEach((timestamp, value) ->
    System.out.println(timestamp + "\t" + value)
);
```

ohsome query - aggregation



Entity Filter



Grouping



Transformation



Result Filter



Aggregation

ohsome query - aggregation

	Entity Filter		Area of Interest
			Timerange and resolution
			OSM type (node, way, relation)
			Thematic selection
			Custom filter
	Grouping		By timestamp / boundary / tag / key
	Transformation		Access to all properties (geom, tags, metadata)
	Result Filter		Optional, e.g. cleanup
	Aggregation		Count, average, sum, count unique, etc.