WHZ Westsächsische Hochschule Zwickau
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Visualization and analysis of OSM's public transport stop data with PTSA and ML based comparison to stop locations in aerial imagery (VeriBus project)

gauss.whz.de/ptsa   gauss.whz.de/veribus

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State of the Map Europe, November 15th, 2025

mFUND
Das Startkapital für die Mobilität der Zukunft

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Why PTSA (Public Transport Stop Analysis)? (1/3)

Visualize OSM's public transport data

difficult problem!

https://github.com/gravitystorm/openstreetmap-carto/issues/134
https://github.com/gravitystorm/openstreetmap-carto/issues/311
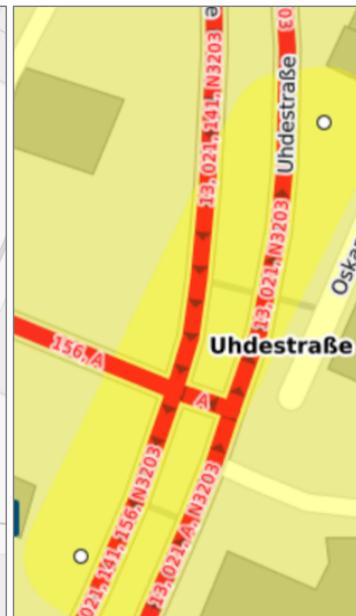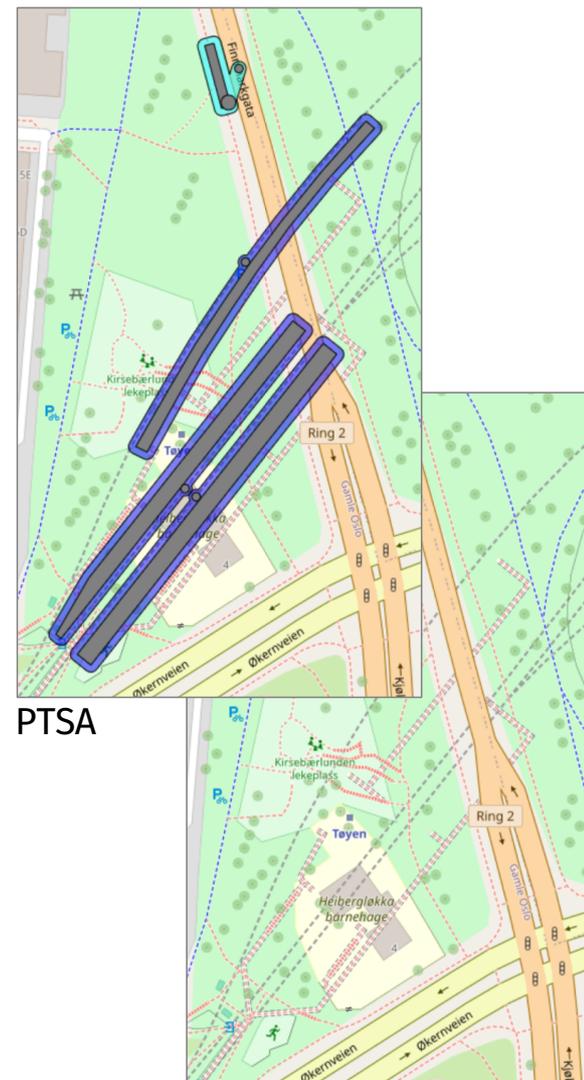https://github.com/gravitystorm/openstreetmap-carto/issues/435
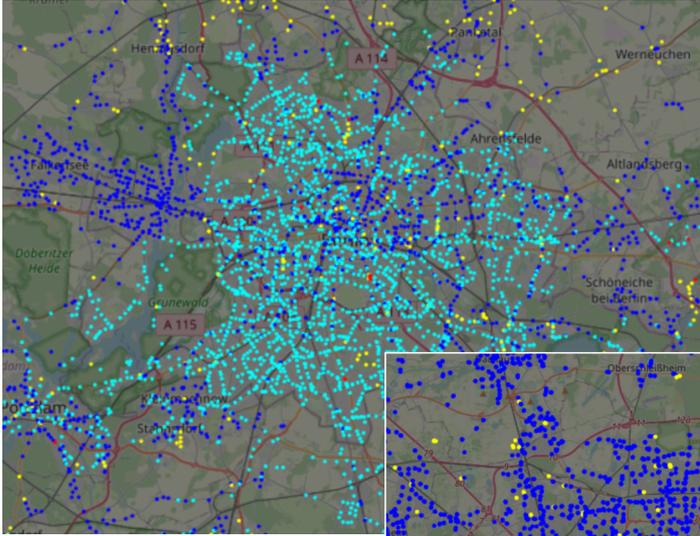

Carto

Transport Map

ÖPNVKarte

PTSA

PTSA
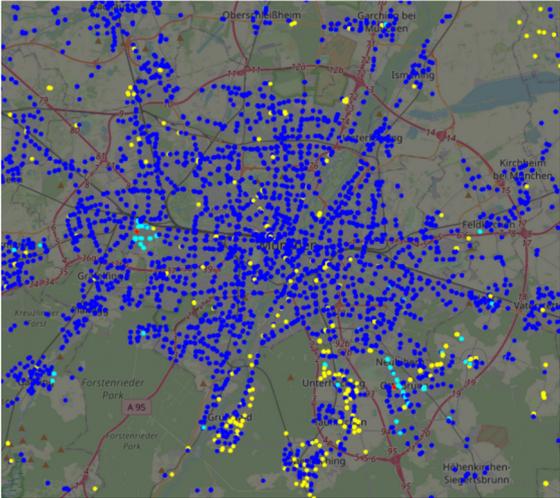

Carto

Why PTSA? (2/3)

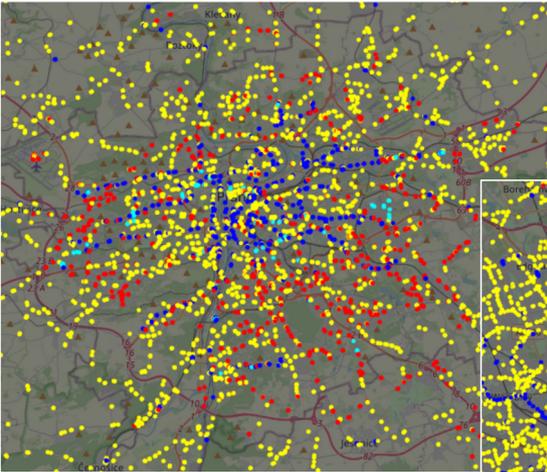## Visualize regional tagging habits
large regional differences!
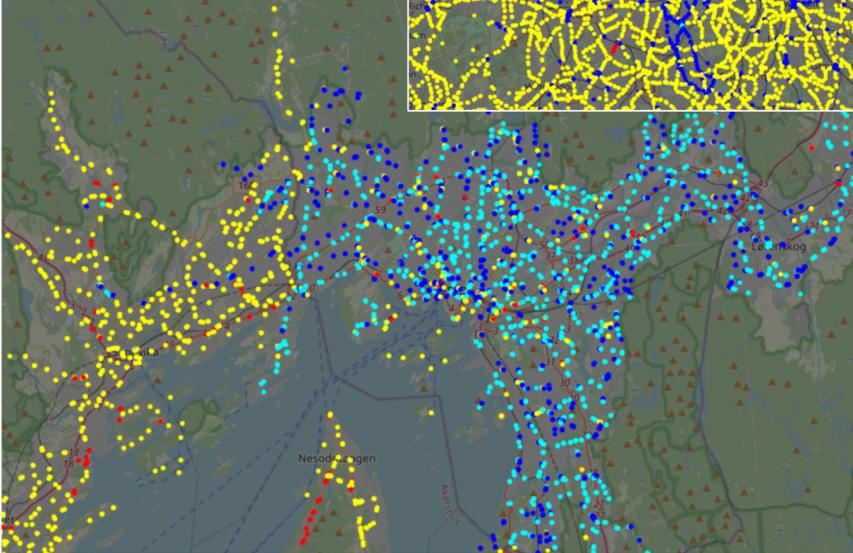

Prague

London

Oslo

Berlin

Munich

3
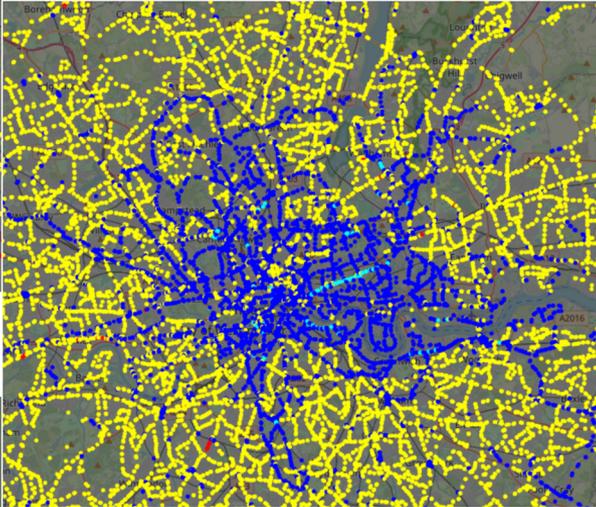
Why PTSA? (3/3)

Visualize OSM's public transport data, find and visualize errors
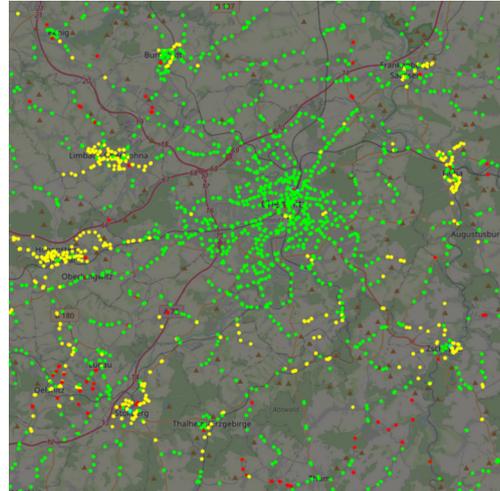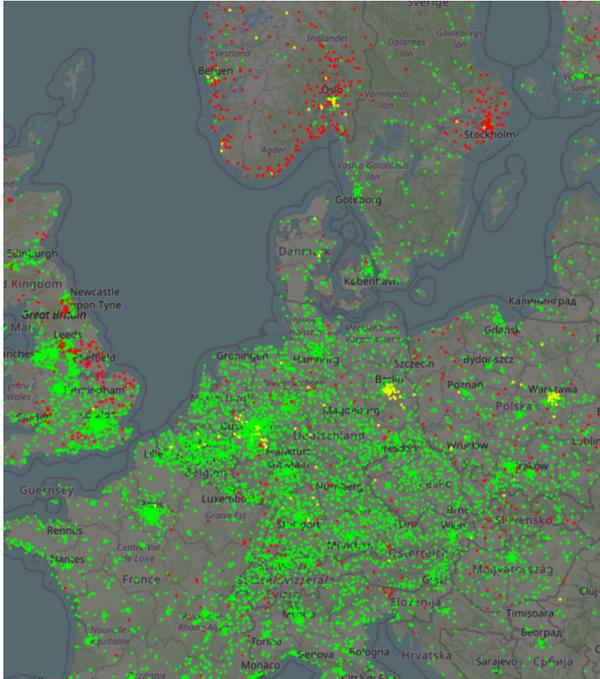
PTv1 or PTv2 or mixed?

Rendered in Carto?

	mods	ref:IFOPT	ref	local_ref	ref_name	name	layer	level	score
platform (edit in iD)			2/3			Taucha (Leipzig)			-
stop position 1 (edit in iD)	yes		1	1		Taucha (bei Leipzig)			-0.6616128958661196
stop position 2 (edit in iD)	yes		2	2		Taucha (bei Leipzig)			-0.5478764602522126
stop position 3 (edit in iD)	yes		3						-1.5476014614537612

Tagging mistakes?

Public transport stops in OSM

OSM objects for PT stops:
- platforms (way or area next road/rails/...)
- poles (platform mapped es node)
- stop positions (node on road/rails/...)
- stop areas (relation for grouping all objects of a stop)

tagging schemes:
- PTv1 (highway=bus_stop, railway=halt,...)
- PTv2 (PTv1 or public_transport=... or both)
- some uncontrolled proliferation, PTv3 (proposal),...

problems:
- stop position only or platform/pole only or both or all three?
- no grouping of single objects to stops!

PTSA yields this grouping
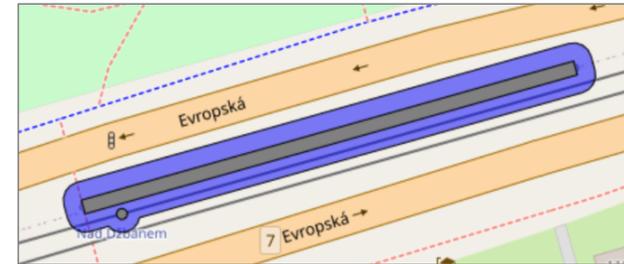
Problems for users of OSM data

We cannot deduce stop positions directly from OSM!

Not every stop in OSM has a stop position or a pole.

Have to look at platforms, too.

Are there two stops or is it one stop made of two OSM objects?

…

bahnhof.de/zwickau-sachs-hbf/karte
12 stops, 24 icons

How many stops?
3 poles, 4 platforms,
5 stop positions

How to use PTSA

"pole" = point-like (node) waiting position for passengers

"platform" = 1d (way) or 2d (area) waiting position for passengers

"plole" = waiting position for passengers, consisting of a node and/or a way/area
(matching done by PTSA)

"stop position" = point-like waiting position for vehicles
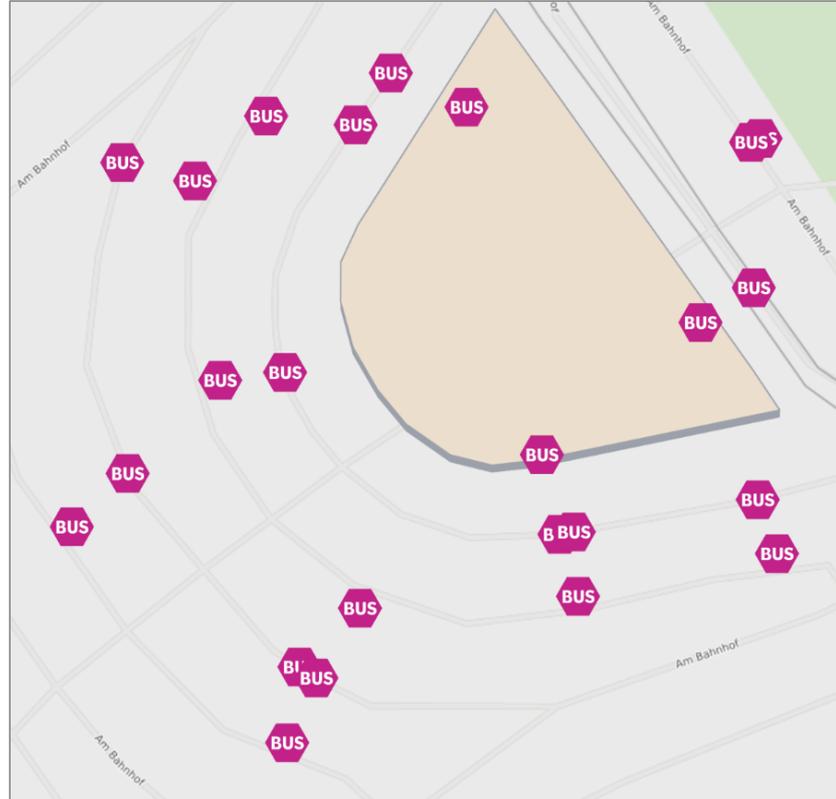
"stop" = plole + stop position
(or plole only or
stop position only)

PTSA = map
+ plole details
+ CSV export

Demo 1, 2, 3

PTSA - Public Transport Stop Analysis for OSM

Data | Help | Imprint | Data Privacy | Accessibility

toggle sidebar my location

☐ ● dubious objects

Modalities
☑ bus   ☑ monorail
☑ trolleybus   ☑ subway
☑ share taxi   ☑ funicular
☑ tram   ☑ ferry
☑ light rail   ☑ aerialway
☑ train   ☑ none

Coloring
○ warnings, comments
   ☑ ● has warnings
   ☑ ● has comments
   ☑ ● no warnings/comments
○ Carto rendering (bus only)
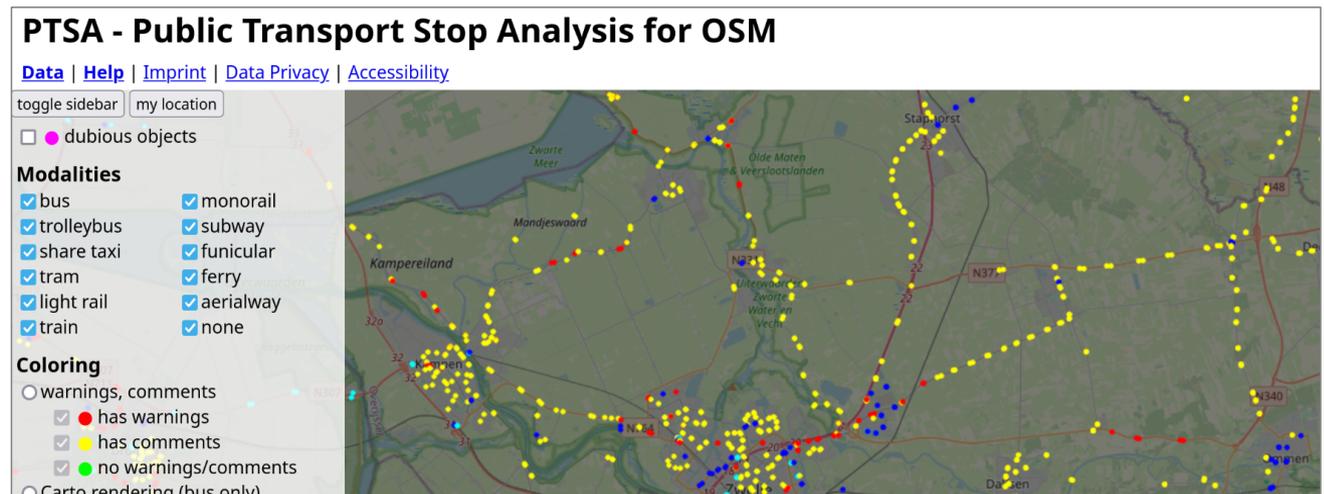
Data export and regions

Stops (groups of OSM objects) can be downloaded in CSV format.

One file per region according to OSM `admin_level` boundaries.

Size of regions depends on distortion of the associated map projection.

Details on map projections:
- arXiv-Preprint:
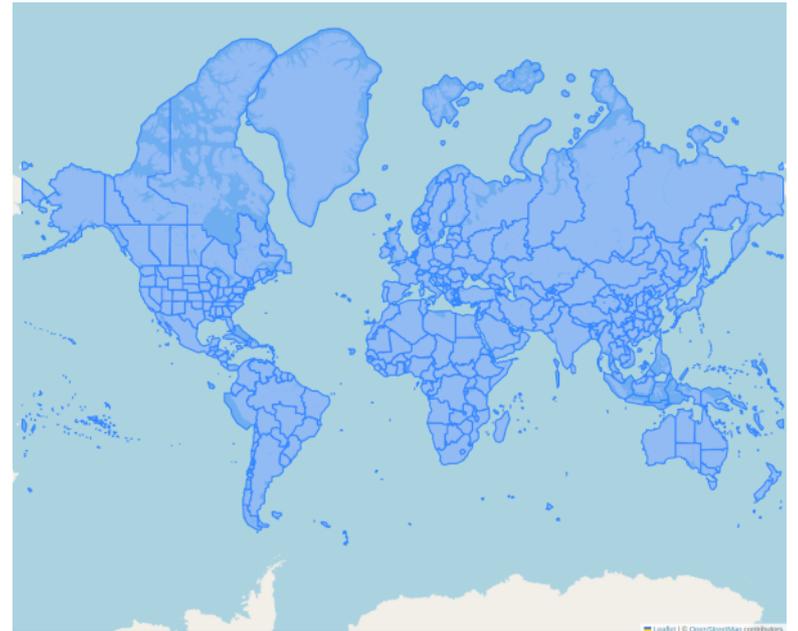 A simple linear time algorithm for smallest enclosing circles
  on the (hemi)sphere
- regions and projection parameters download:
  Administrative units/azimuthal equidistant projections datasets
- code for generating regions of suitable size:
  div4aep Python script

Further subdivision of Germany to keep
Overpass API queries small enough.

TODO

Code: github.com/jeflem/ptsa

From time to time new situations that PTSA should handle better.
Please send me any hints on "strange" stops!
(mail oder GitHub issue or OSM forum thread)

Currently unsolved problems:
- multi-object platforms (bridges/tunnels!)
- consider `layer=*` for better rendering
- consider further relevant tags
  (`public_transport=pole`)

Cross connections to other projects (PTNA,…)

Maybe someday a beautiful (!)
public transport map from OSM data
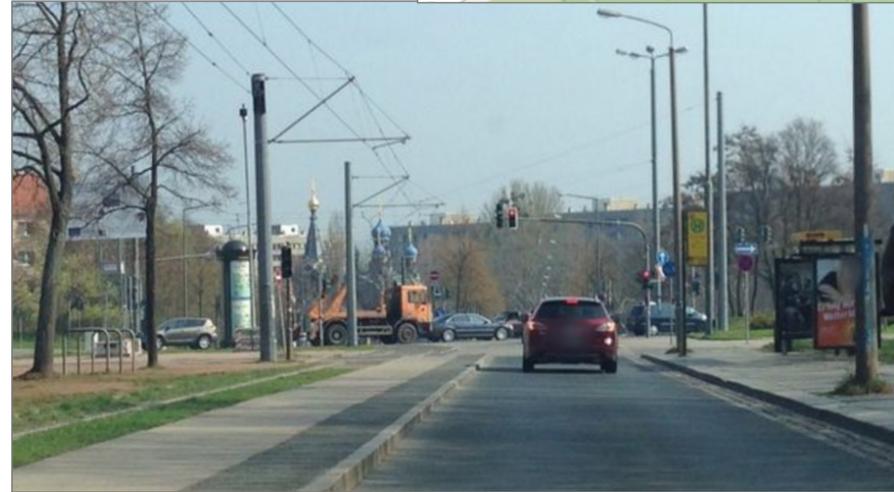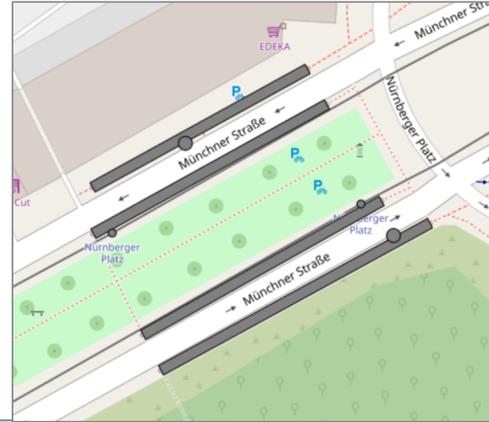
mappilary.com, thomersch, CC BY-SA

https://gauss.whz.de/ptsa

VeriBus - overview

Funding
 - mFUND
 - grant no. - 19F1215A

Phase I - verification PT stops
 - via machine learning
     IN   - aerial images
     OUT - revised database

Phase II - additional information
 - via machine learning
     ADD - tactile paving
     ADD - roofing

Matching stops within search radius of 20 m

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1) Adding root database bus stop

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2) Defining initial radius, 2x search radius

VeriBus - overview

Funding
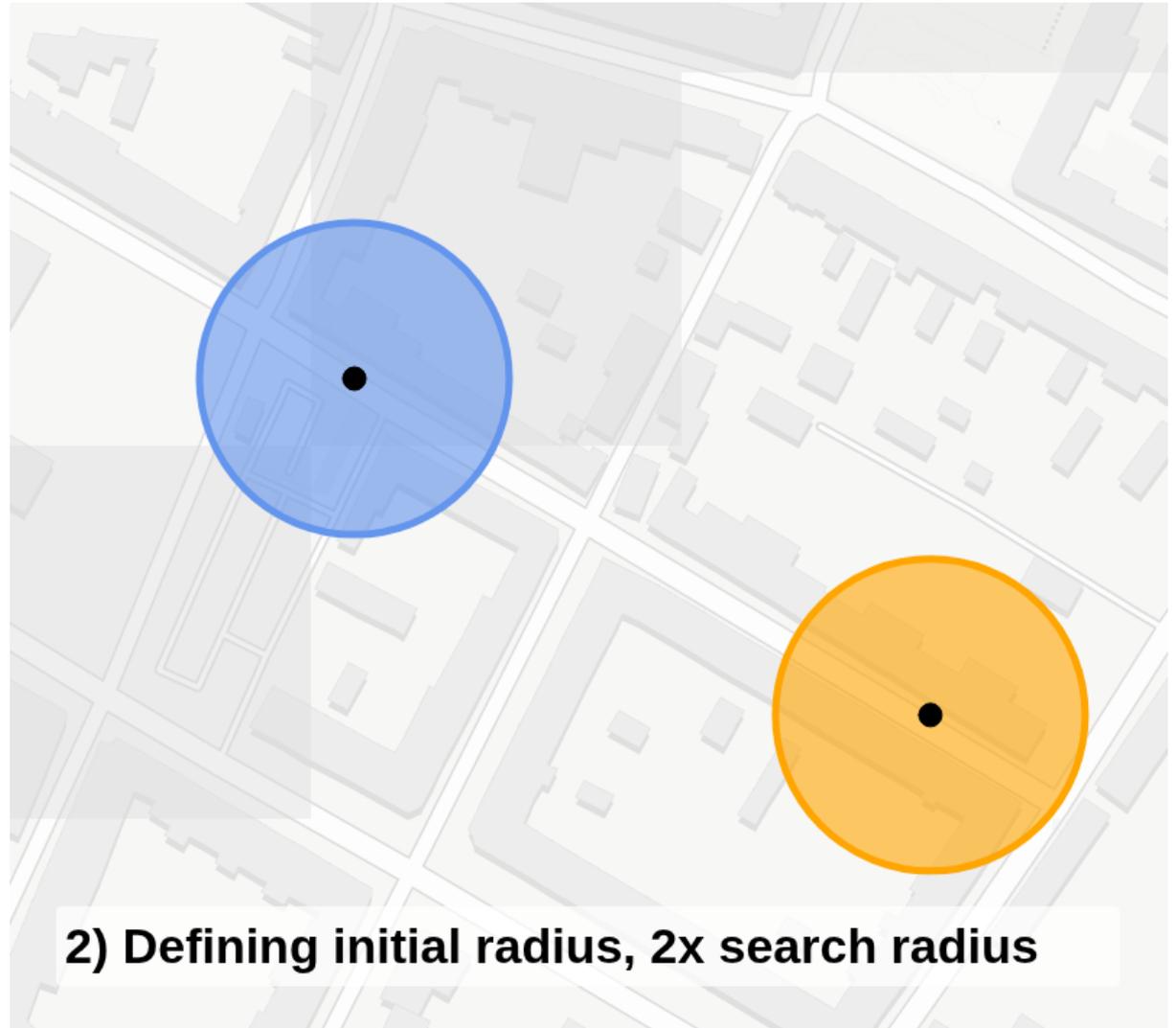 - mFUND
 - grant no. - 19F1215A

Phase I - verification PT stops
 - via machine learning
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      OUT - revised database

Phase II - additional information
 - via machine learning
      ADD - tactile paving
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3) Adding 2nd & 3rd database bus stop

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 - grant no. - 19F1215A

Phase I - verification PT stops
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      IN   - aerial images
      OUT - revised database

Phase II - additional information
 - via machine learning
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      ADD - roofing

4 a) Validation with search radius

VeriBus - overview

Funding
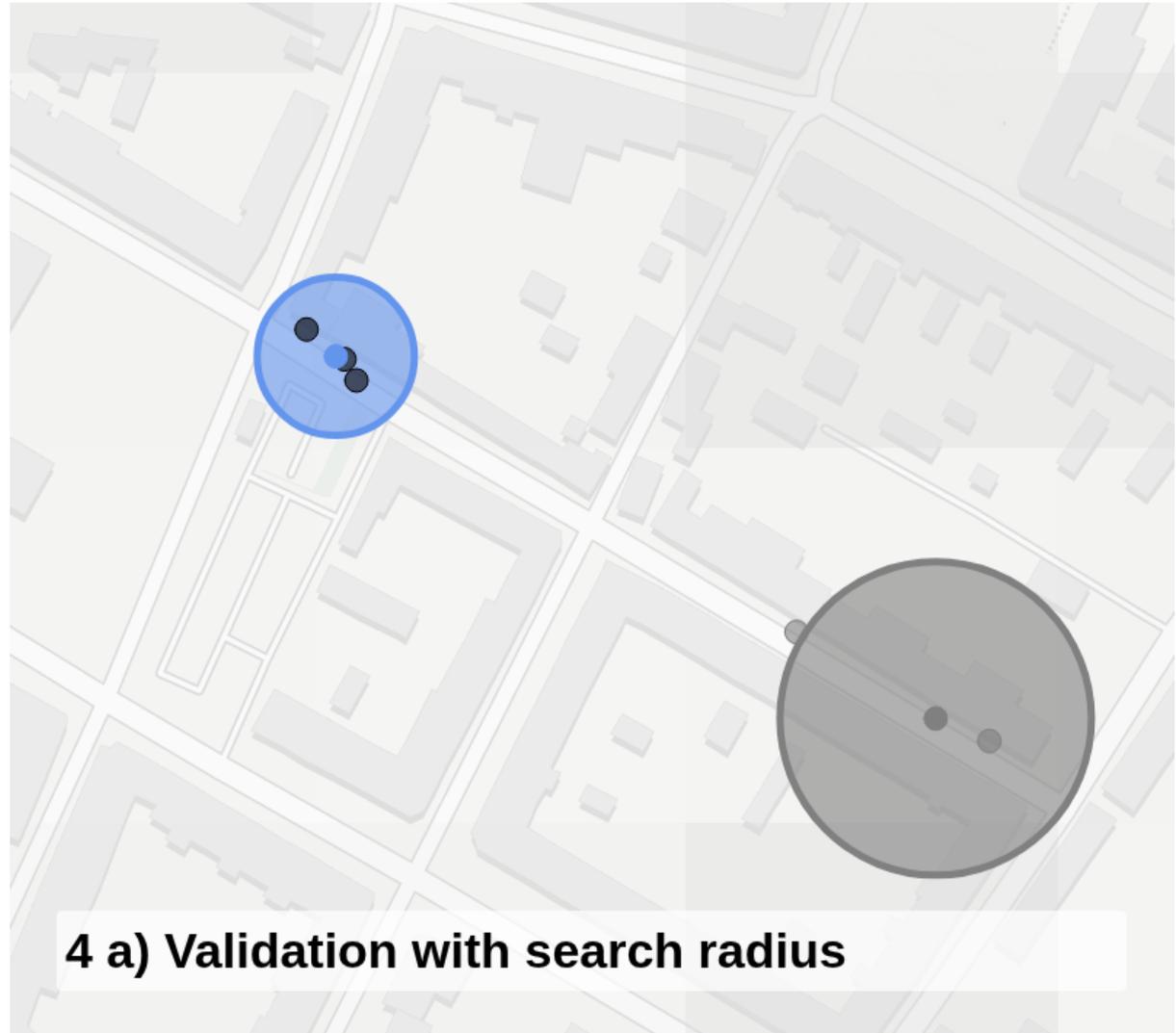 - mFUND
 - grant no. - 19F1215A

Phase I - verification PT stops
 - via machine learning
     IN   - aerial images
     OUT - revised database

Phase II - additional information
 - via machine learning
     ADD - tactile paving
     ADD - roofing

4 b) Averaged geolocation used for training

VeriBus - overview
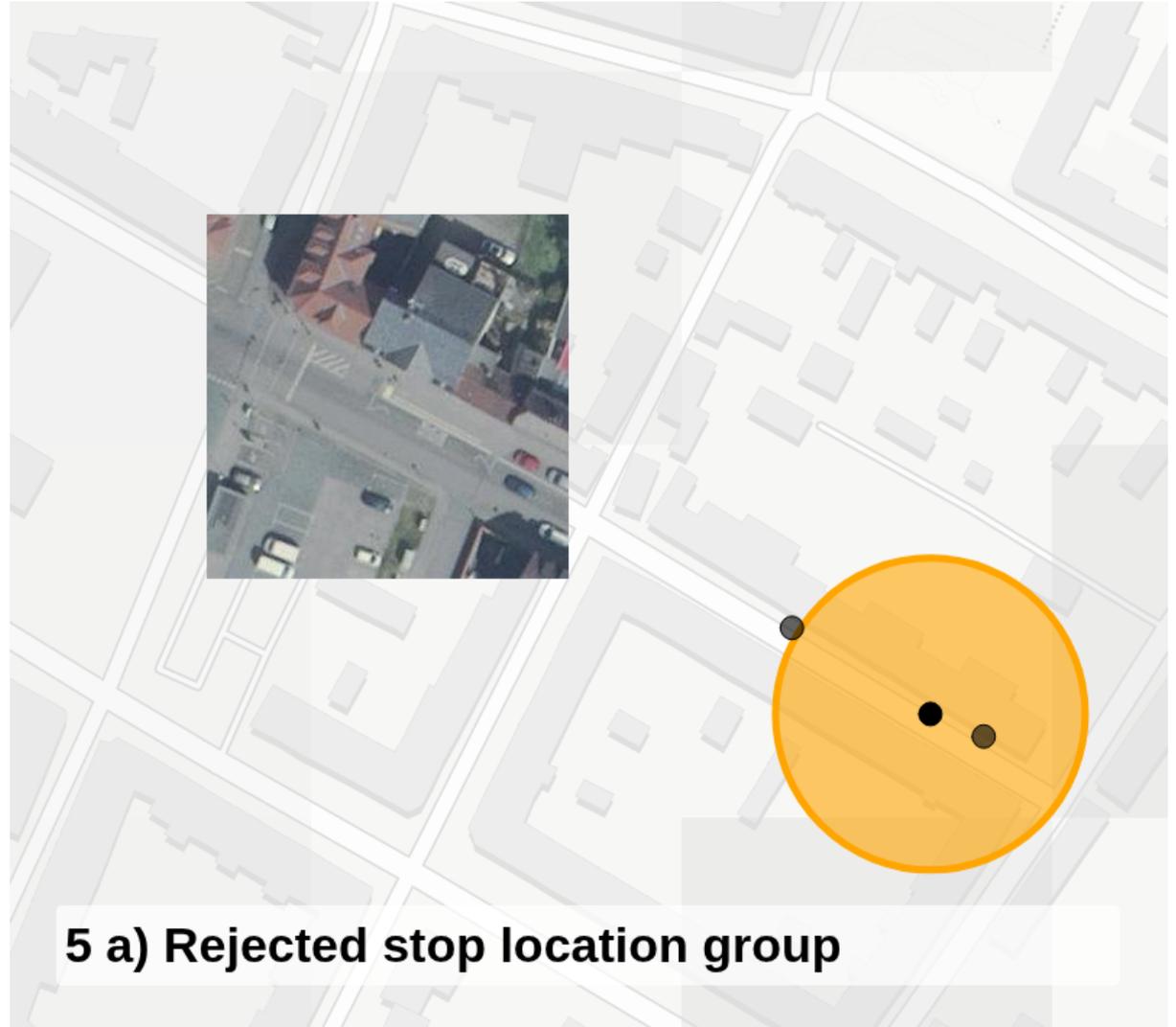
Funding
 - mFUND
 - grant no. - 19F1215A

Phase I - verification PT stops
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     OUT - revised database

Phase II - additional information
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     ADD - tactile paving
     ADD - roofing

5 a) Rejected stop location group

VeriBus - overview

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      ADD - roofing

5 b) Geolocation validation pending

VeriBus - current state

All code @ https://codeberg.org/openPTdata/PTstopsML
 - refactoring currently in progress

Trainings set
 - available @ https://mobilithek.info/offers/886611864201183232

Trained ResNet
 - 17h Bayesian opt + fine tune @ 300k samples per class
 - accuracy ~ 0.9 (G)
 - was tested on Norway (N) data ~ 0.74 accuracy
    std (G) = [69.21, 67.84, 63.80] ← → std (N) = [66.11, 62.16, 55.98]
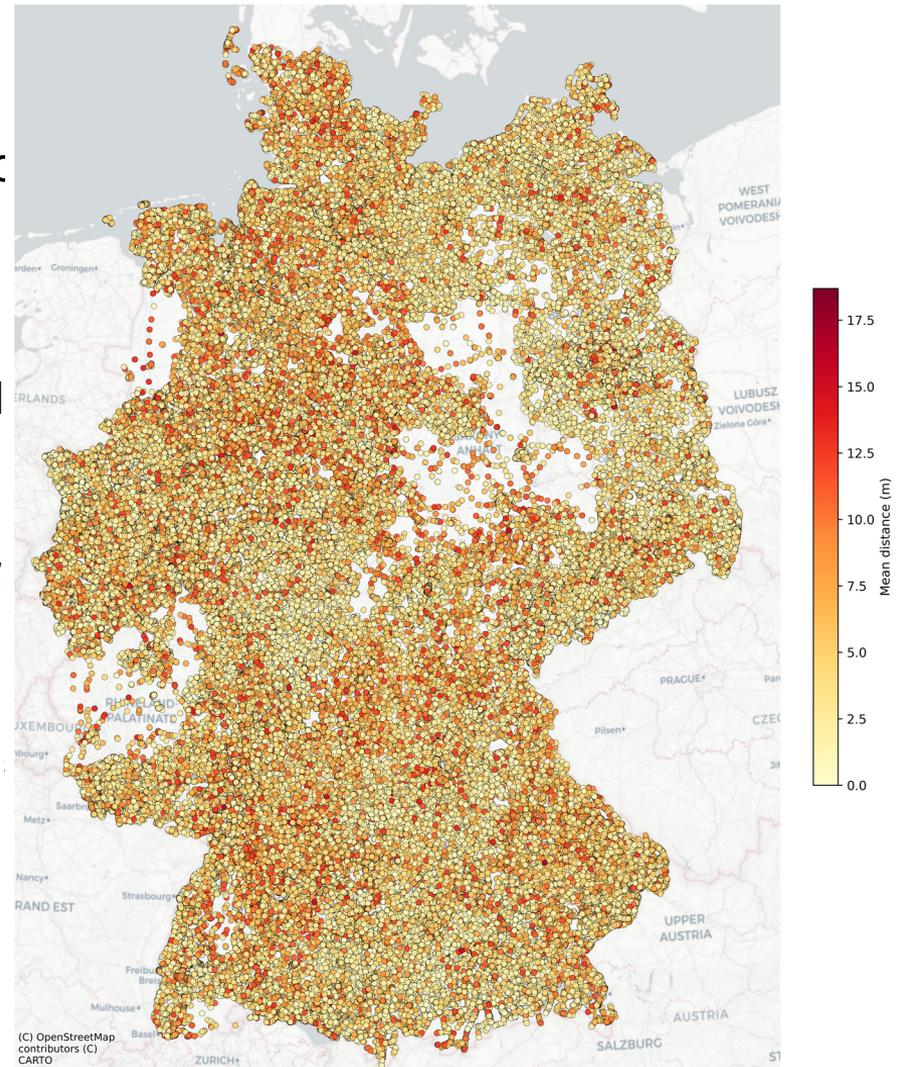   hists show small differences

VeriBus - current state

All code @ https://codeberg.org/openPTdata/PTst
 - refactoring currently in progress

Trainings set
 - available @ https://mobilithek.info/offers/88661

Trained ResNet
 - 17h Bayesian opt + fine tune @ 300k samples per
 - accuracy ~ 0.9 (G)
 - was tested on Norway (N) data ~ 0.74 accuracy
    std (G) = [69.21, 67.84, 63.80] ←→ std (N) = [66.11
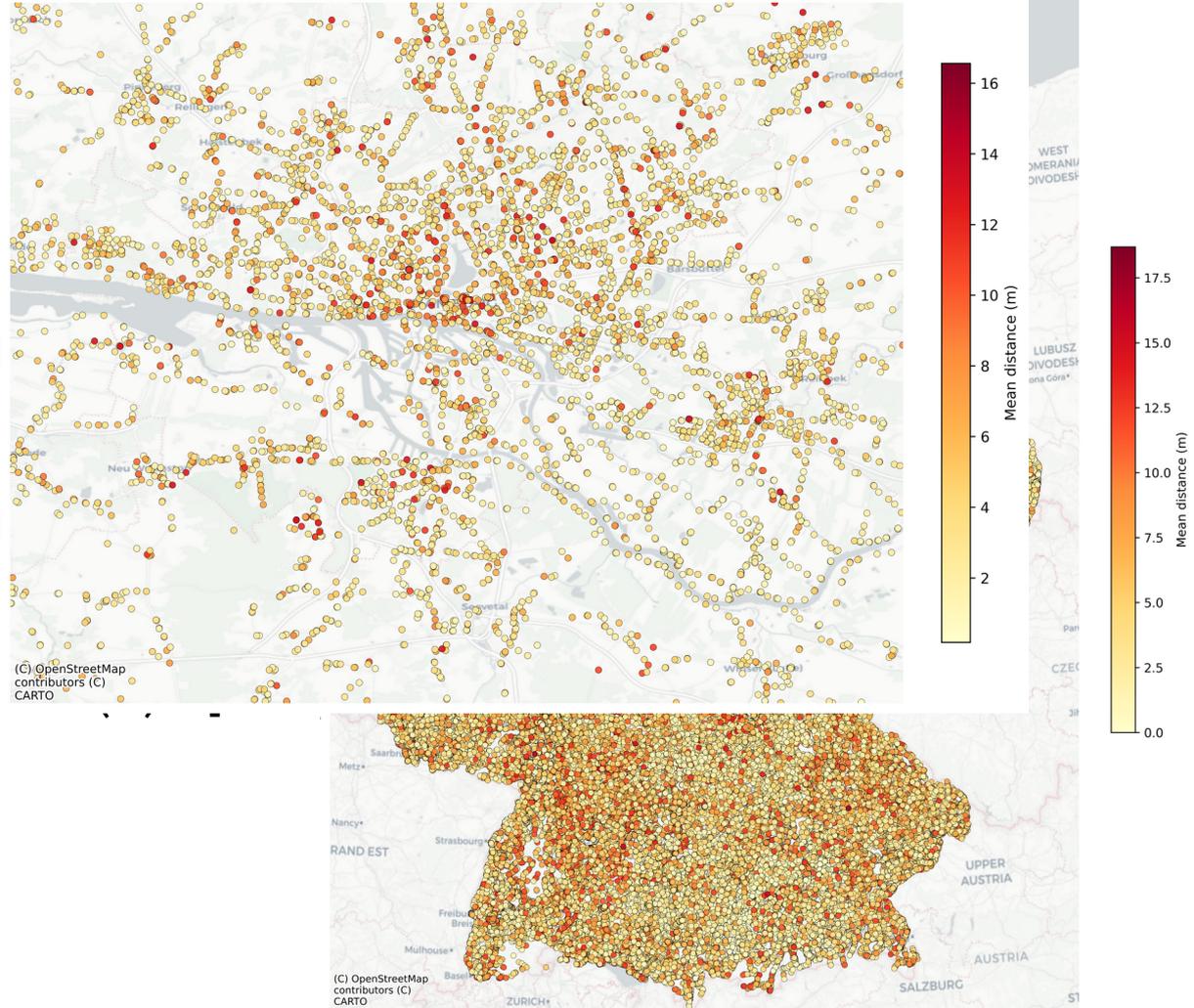   hists show small differences

VeriBus - current state

All code @ https://codeberg.org/op
 - refactoring currently in progress

Trainings set
 - available @ https://mobilithek.inf

Trained ResNet
 - 17h Bayesian opt + fine tune @ 30(
 - accuracy ~ 0.9 (G)
 - was tested on Norway (N) data ~ 0
   std (G) = [69.21, 67.84, 63.80] ←→
   hists show small differences

VeriBus - current state

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      std (G) = [69.21, 67.84, 63.80] ←→ std (N) = [66.11, 62.16, 55.98]
      hists show small differences

WIP / current work
 - other net structures
 - validation of rejected stops
 - nets for tactile paving / roofing

Thank you for your time

&

for doing the conference in Scotland

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