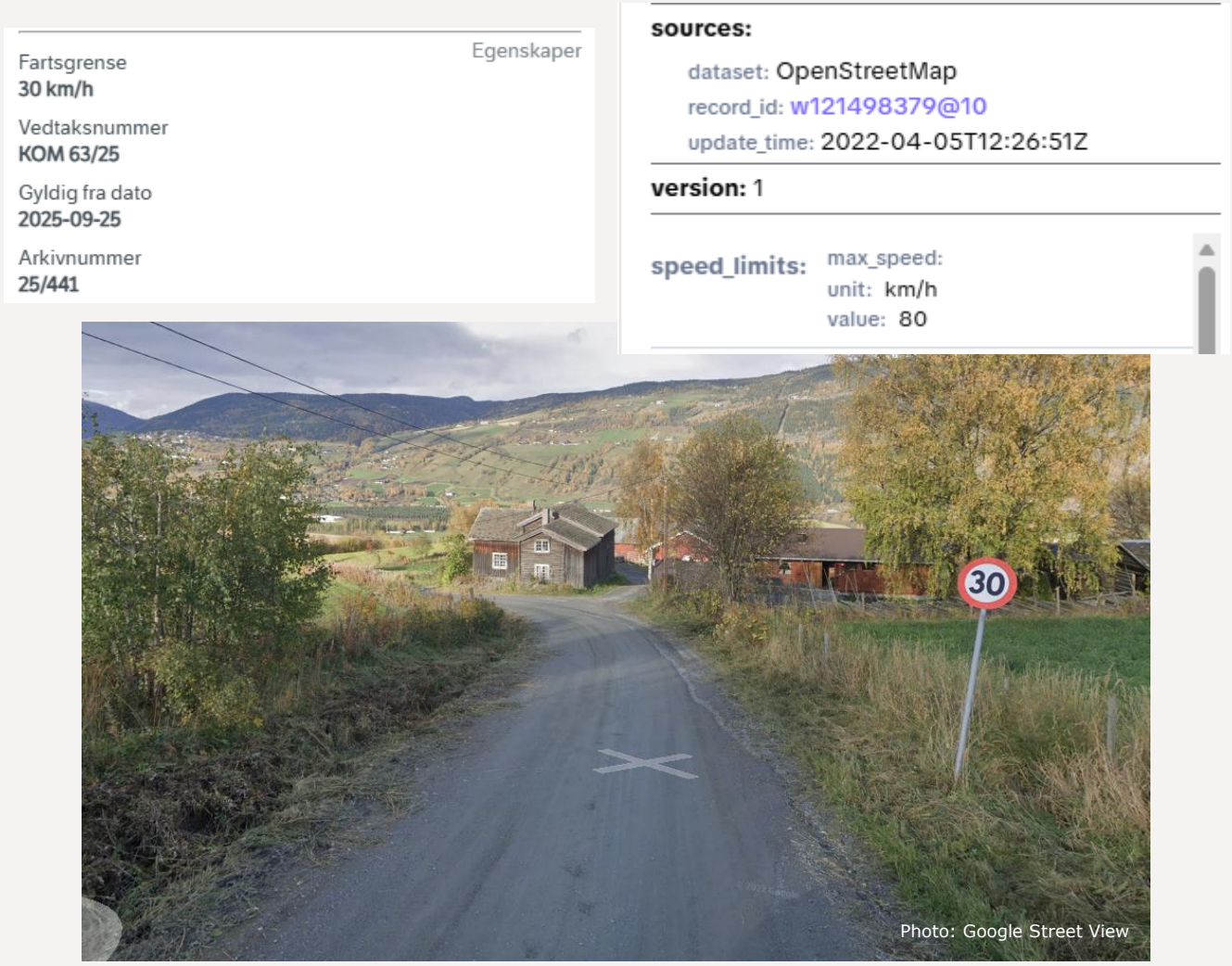
Comparing and Improving Authoritative and Open Geospatial Data Using Linear Referencing

Insights from a Systematic Cross-Dataset Analysis

Knut Jetlund[12]* and Bjørn Arild Godager[2]
[1] Norwegian Mapping Authority
[2] Norwegian University of Science and Technology

* knut.jetlund@kartverket.no



Kartverket

NTNU

MODI A LEAP TOWARDS SAE L4 AUTOMATED DRIVING FEATURES

Background:
Reliable Digital Infrastructure for Automated Transport

Automated transport depends on geospatial data

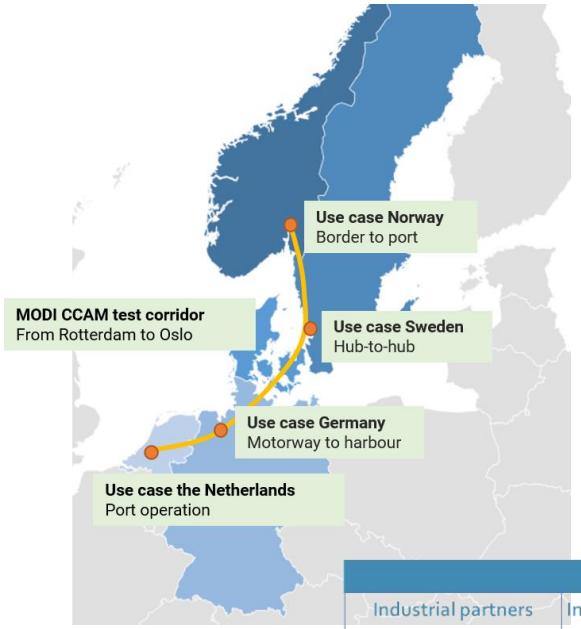
- Routing, navigation, driver assistance and automated driving systems
- Traffic regulations are safety-critical information
- Errors affect both operational performance and safety.

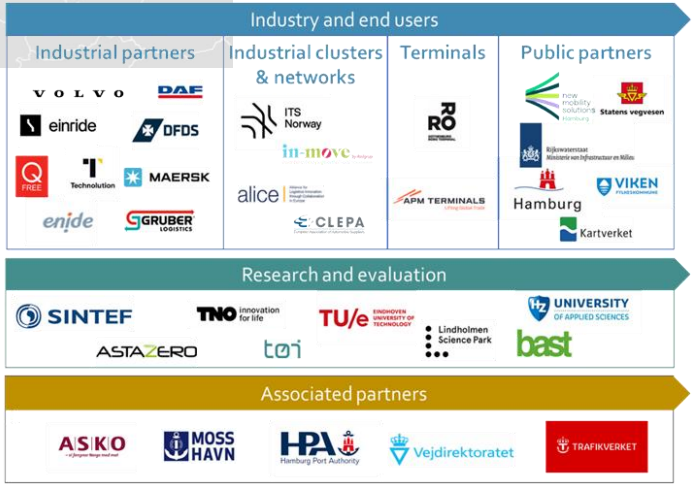
How can we ensure the quality and consistency of the road data used by future mobility systems?

Kartverket

MODI A LEAP TOWARDS SAE L4 AUTOMATED DRIVING FEATURES

MODI - A leap towards SAE L4 automated driving features





- Logistics corridor from **Rotterdam to Oslo**
- **Automated freight vehicles** at **SAE level L4** (no driver)
- **Confined areas** (ports and terminals) and **public roads**
- **Requirements** for **physical** and **digital infrastructure**

Key findings – requirements for the digital infrastructure:

- **Authoritative, high-quality digital road network and traffic regulations**
- **Interoperability across countries and systems**

A crucial and mandated role of road and mapping authorities

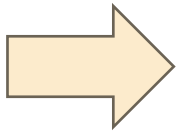
MODI

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them.

Co-funded by the European Union

Government and Open Geospatial Road Data

- **Government data - authoritative**
  - Road and mapping authorities
  - The ITS Directive, RTTI delegated regulation
  - Provide data, not HD map products
- **Open Geospatial Data - VGI**
  - OpenStreetMap
  - Overture Maps
  - Corporate contributions
- **Coexistence of authoritative and open datasets**
  - Need for systematic comparison and quality assessment



Research Questions

- How can authoritative and open road networks be linked and compared?
- How do the datasets compare in terms of content, coverage and quality?

Working hypothesis

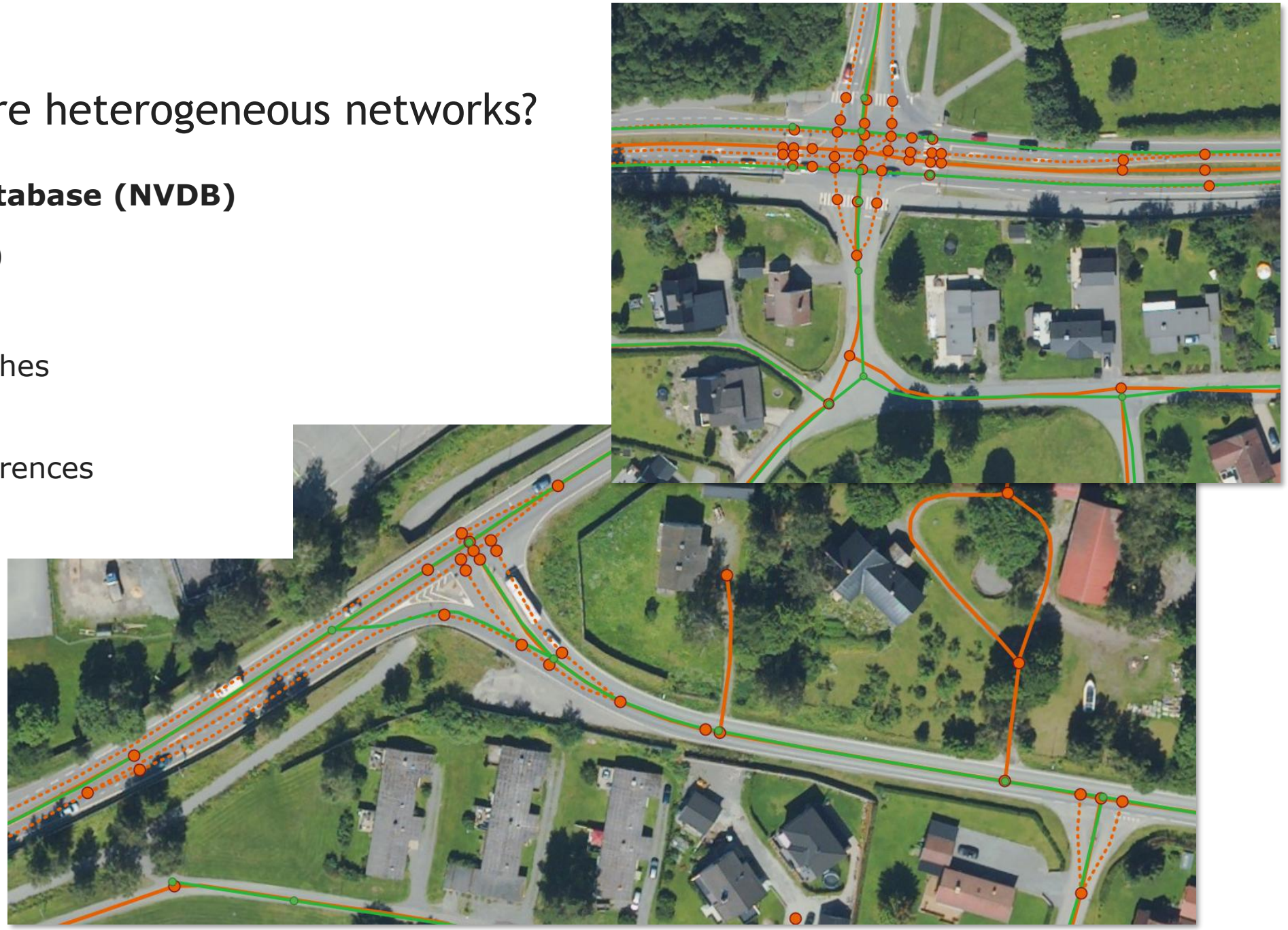
Authoritative data are generally more complete and consistent than VGI, but systematic comparison may reveal opportunities for mutual improvement.

Kartverket

MODI A LEAP TOWARDS SAE L4 AUTOMATED DRIVING FEATURES

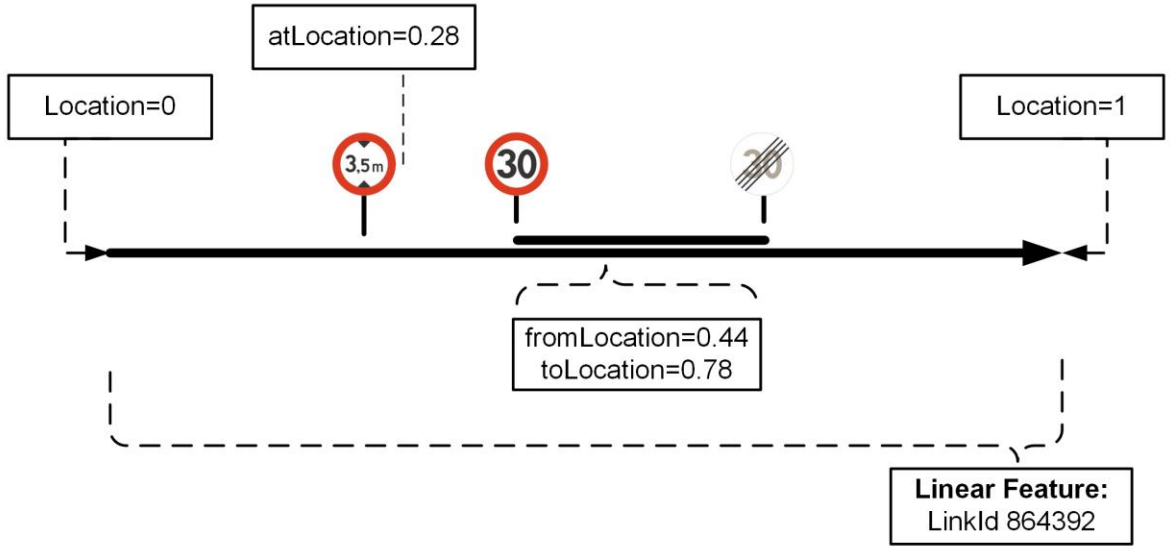
The challenge:
How do we compare heterogeneous networks?

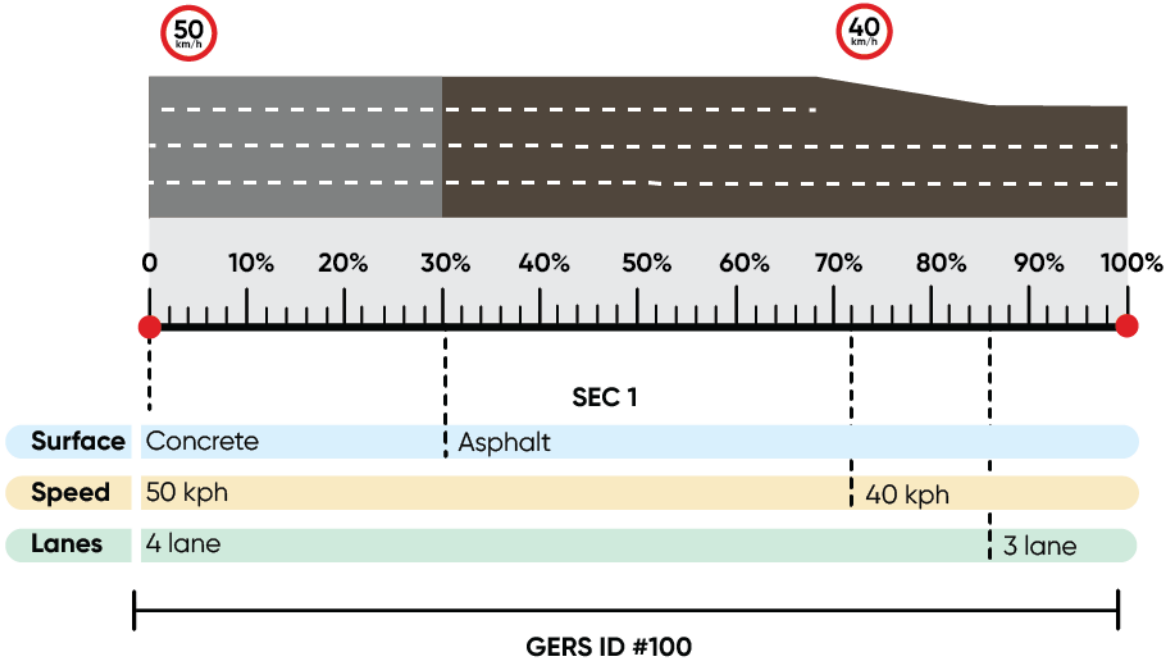
- **Norwegian Road Database (NVDB)**
- **Overture Maps (OM)**
- Heterogeneity
  - Structural mismatches
  - Inaccuracies
  - Segmentation differences
  - Levels of detail



Kartverket

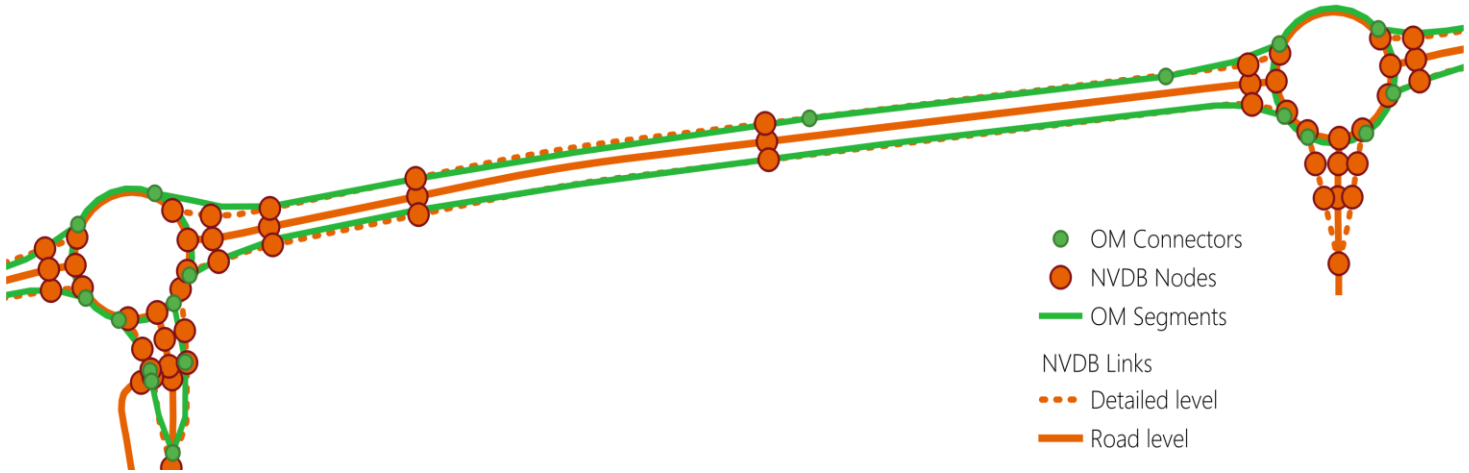
Methodology:
Exploiting linear referencing

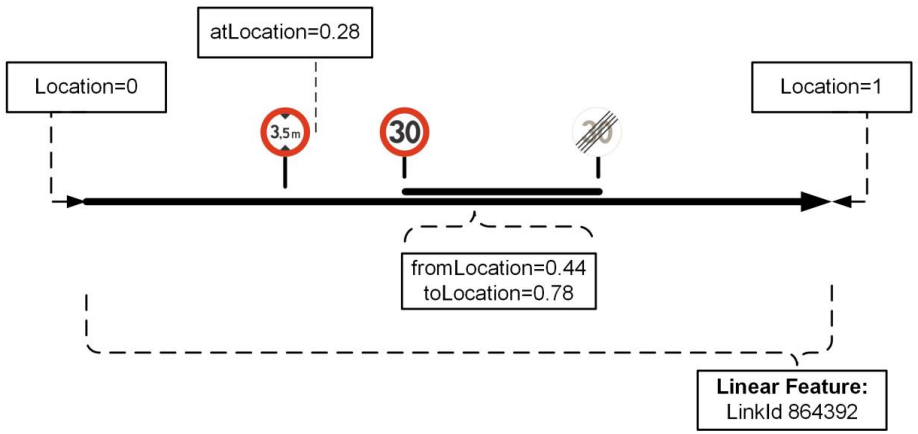




Kartverket

Methodology:
Linking two road networks through linear referencing





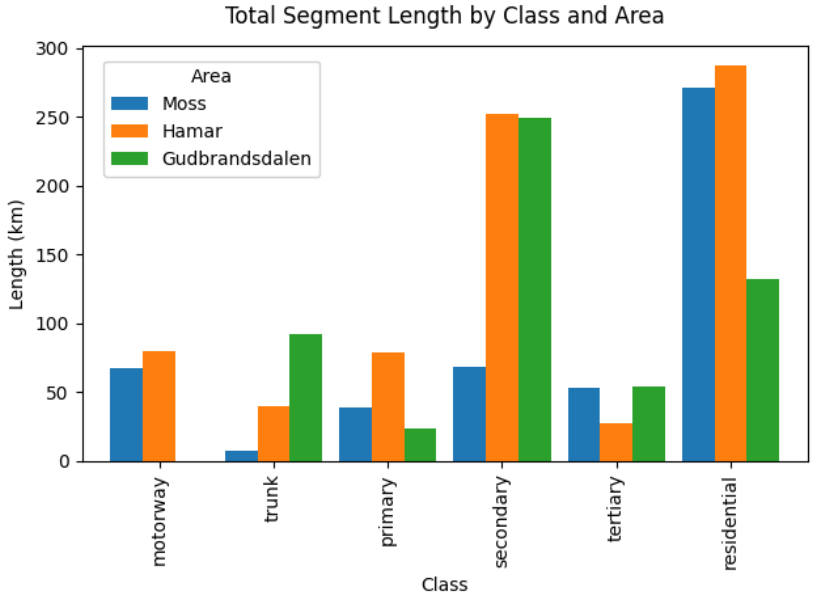
1. Segment matching by connectors and segment directions
2. Mapping of linear positions
3. Combine to common segments
4. Compare properties through linear positions

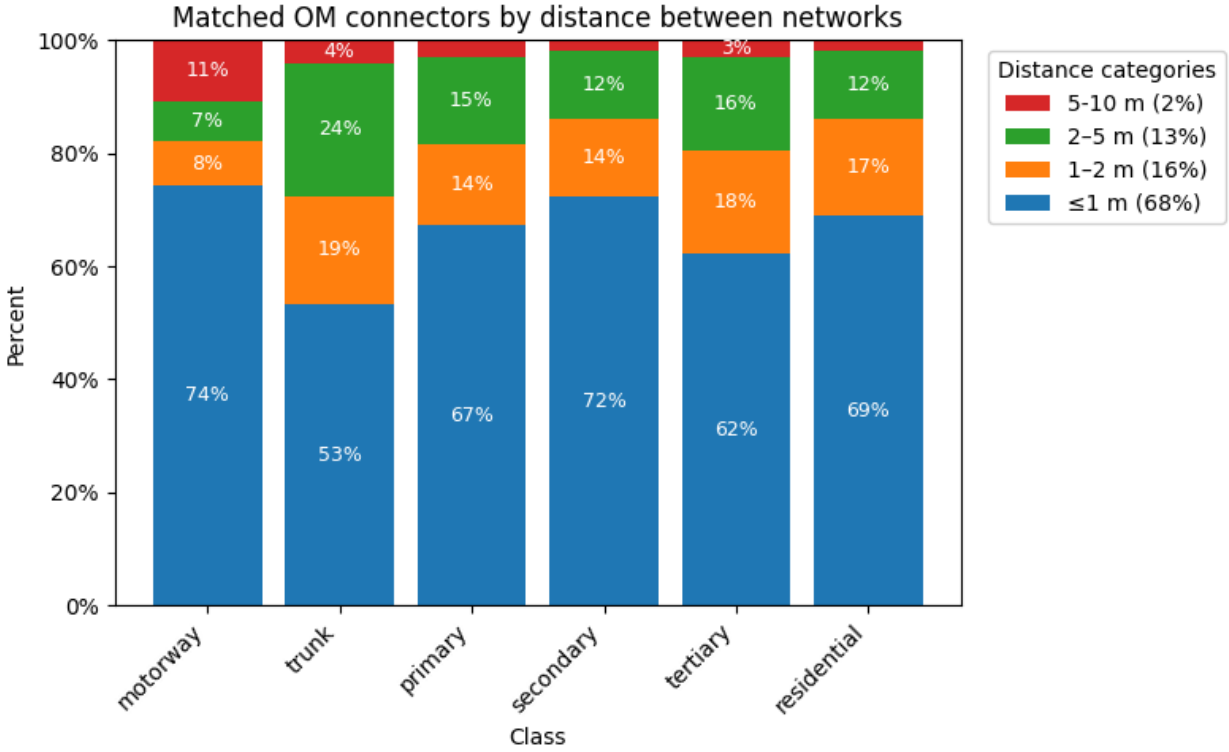
OM segment_id = b6750cfe-92e9-4b69-8d0a-2d97ef2304d7

OM from	OM to	NVDB linksequenceId	NVDB from	NVDB to
0	0.0288	2823434	0	0.0237
0.0288	0.0793	2823434	0.0237	0.0723

Results:
Network matching

- 3 test areas with different road networks
  - Urban, peri-urban and rural areas
- **99.2%** matched network length
- **98.1%** matched connectors
- Heterogeneity in OM
- Robust methodology despite different structures and levels of detail
- Solid basis for comparing LR-positioned properties



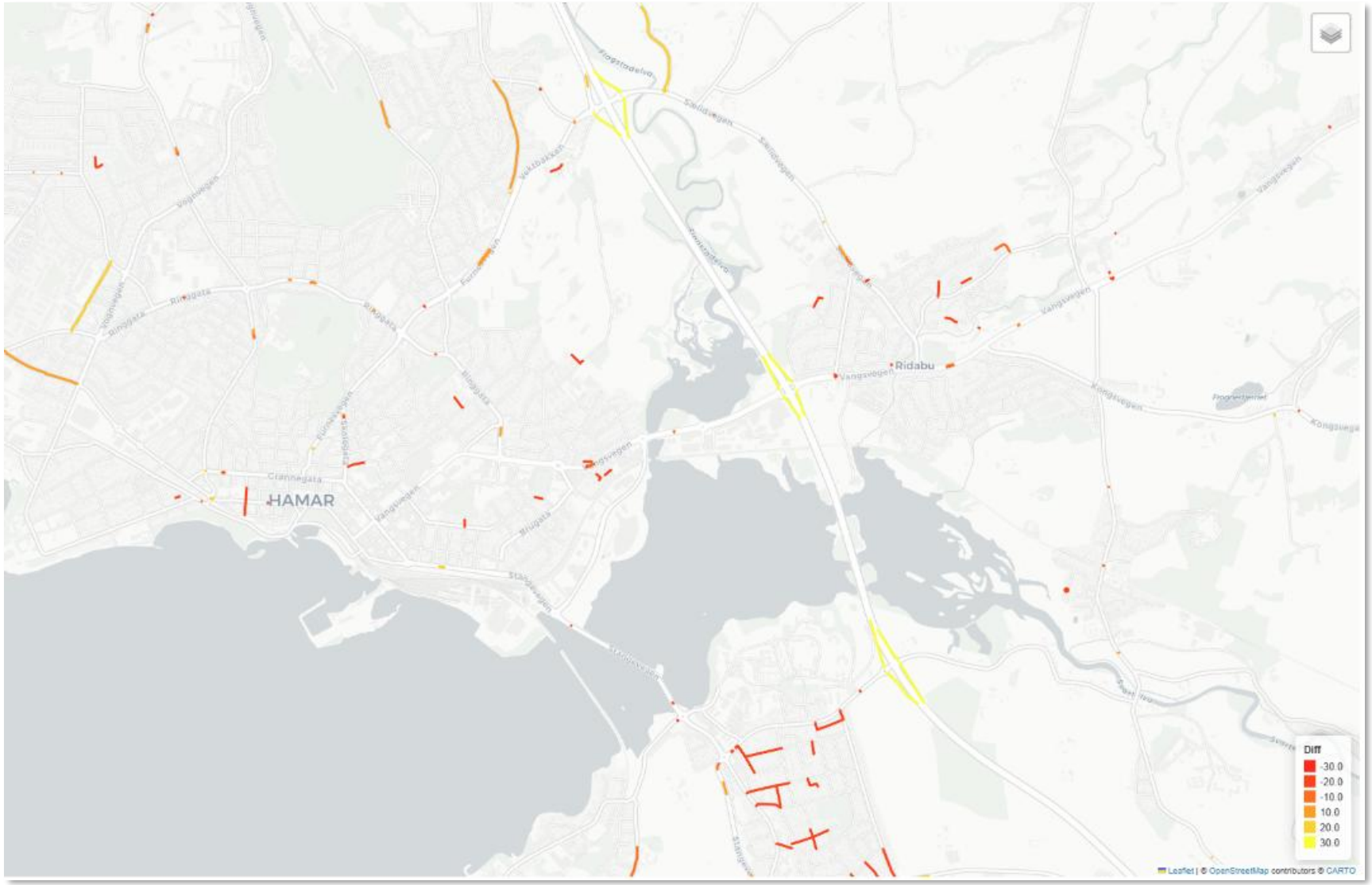


Kartverket

Property comparisons in numbers

- **Speed limits**
  - 20,1% missing in OM
  - 6,2 % deviation
  - 69.3% OM>NVDB
  - 30.7% NVDB>OM

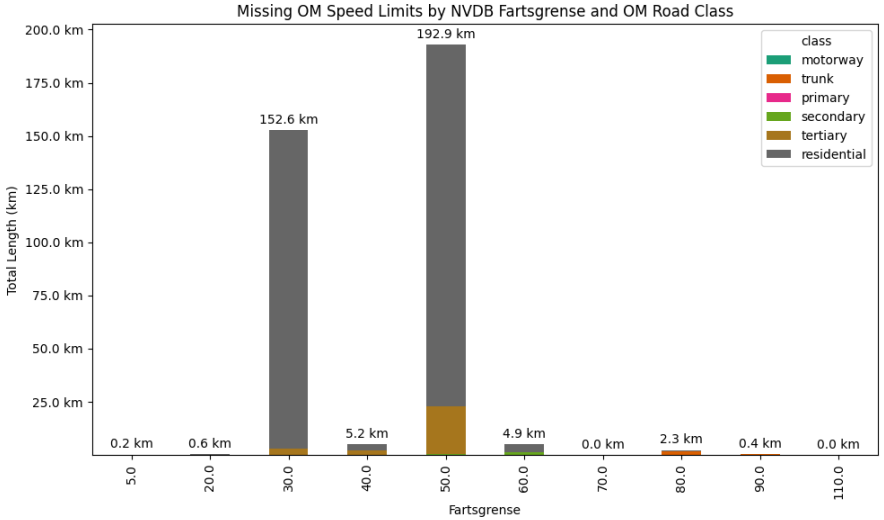
  - Short urban roads
  - Longer rural roads
  - Motorway ramps

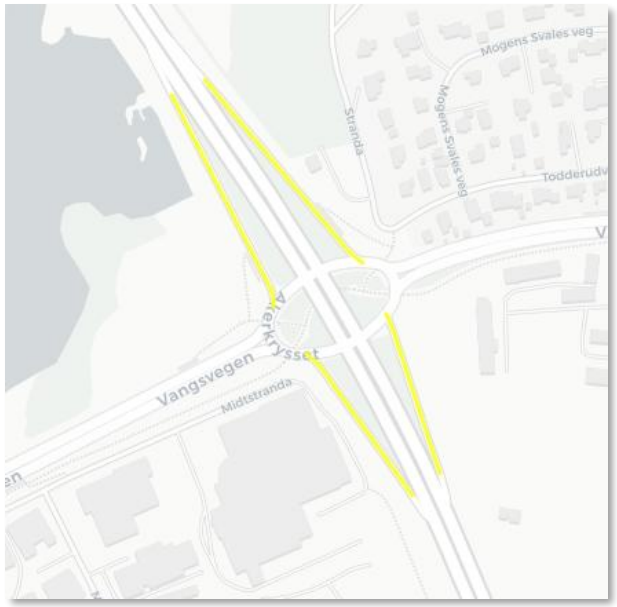


Kartverket

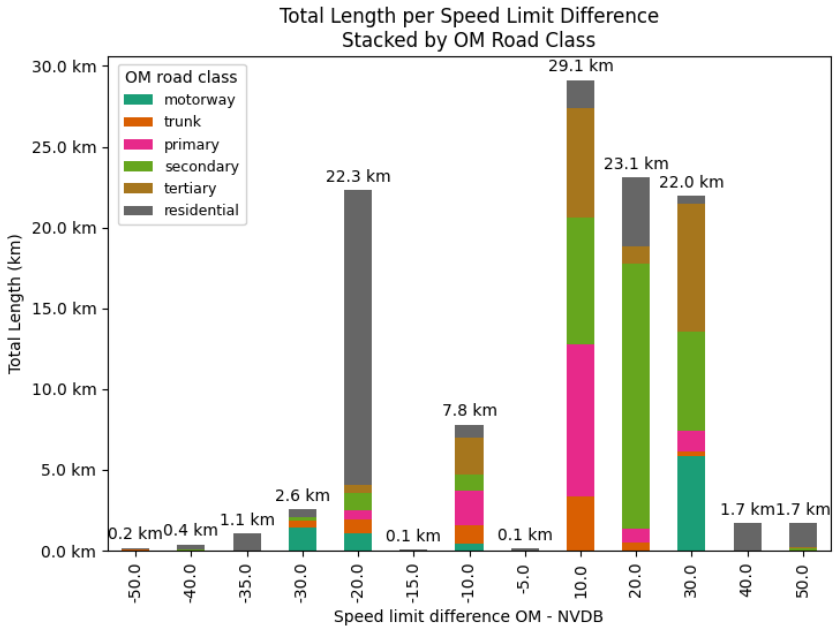
Property comparisons in numbers

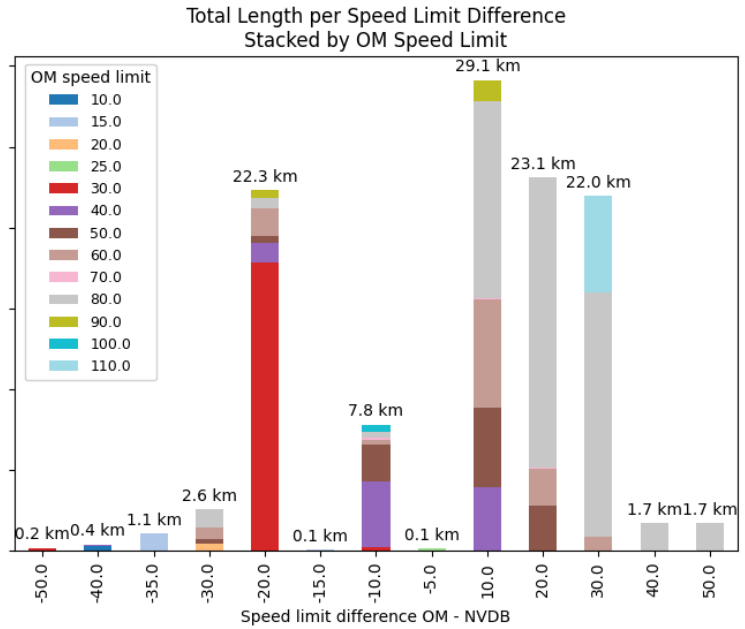
- **Speed limits**
  - Urban roads NVDB 50 km/h ↔ OM 30 km/h
  - Rural roads OM 80 km/h ↔ NVDB 50-70 km/h
  - Motorway ramps OM 110 km/h ↔ NVDB 80 km/h
  - Missing OM on residential roads





Speed Limit Discrepancies - Length by OM Road Class vs OM Speed Limit





Kartverket

Property comparisons in numbers

- **Traffic flow direction**
  - 92,1 % agreement
  - 4.3% OM only
  - 3.6% NVDB Only

  - Inconsistent representation of detailed road structures
  - Delayed updates on municipal roads

Kartverket

Beyond the numbers

Surprising findings

- Errors in both data sets
- **Authoritative data – NVDB**
  - Better but not good enough
  - Failing maintenance routines across administrative levels
  - Need improvement to maintain trust
- **VGI – OM**
  - Better than assumed
  - Good on freshness
  - Lack of homogeneity
  - Property discrepancies in urban areas

Implications

- The methodology provides a practical basis for targeted quality improvement across data sets
- Authority data can enrich VGI
- VGI comparison can detect errors in authoritative data
- Shared standards and interoperability mechanisms are required

How can the methodology be implemented in maintenance routines?

Kartverket

From research to operational quality management

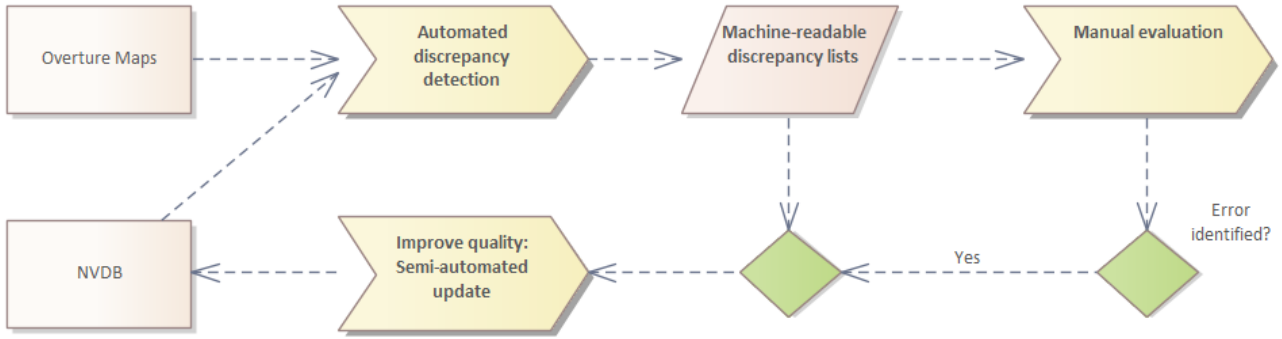
OPEN2AUTH

Funded by the Norwegian Research Council

Goal: Operationalise the methodology to support continuous quality improvement of authoritative road data.

Key ideas:

- Use open data as **independent quality indicators**
- Detect **errors, omissions and delayed updates** in NVDB
- Integration **into municipal maintenance workflows**



Key question

Can open data become part of the routine quality management of authoritative road databases?

Kartverket

From dataset quality to system consistency

CONSIST

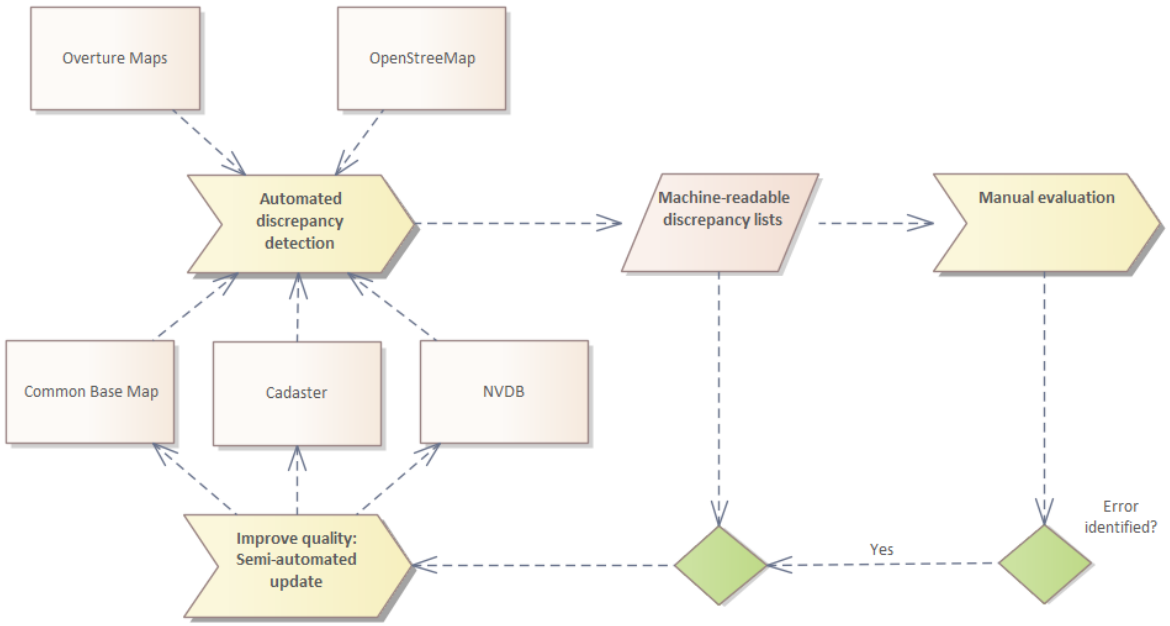
Research and innovation **proposal** to the Norwegian Research Council

Towards System-Level Quality Management of Authoritative and Open Geospatial Transport Data

Roads • Addresses • Buildings

- How can heterogeneous geospatial datasets be linked?
- How can **system consistency** be measured?
- How can open data **improve** authoritative data?

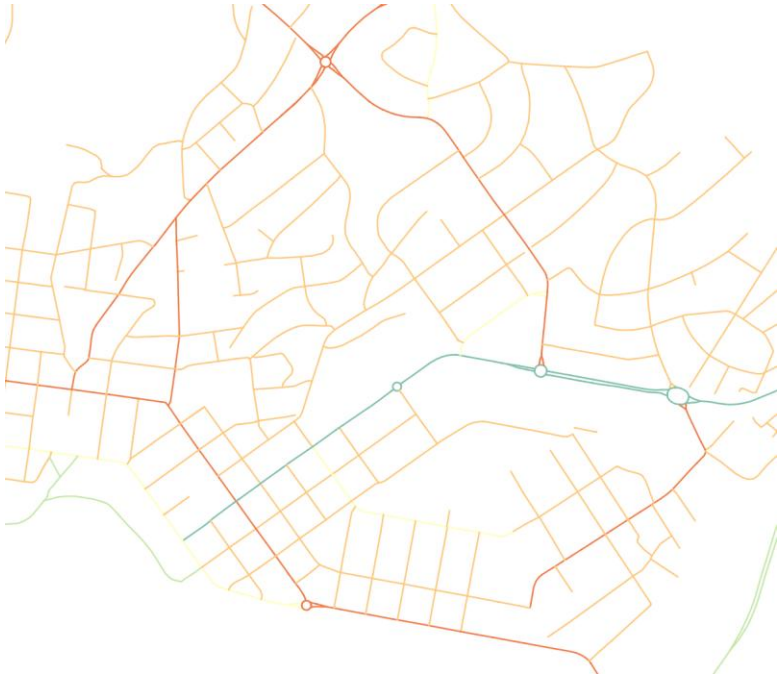
From evaluating datasets individually to managing **quality across geospatial ecosystems**.



Kartverket NTNU Statens vegvesen Norwegian Public Roads Administration

Take-home messages

1. Robust comparison is possible
   - Linear referencing enables systematic comparison of authoritative and open road data.
2. Open and authoritative data can improve each other
   - Authoritative data remain the most complete and consistent source.
   - Open data can reveal errors, omissions and delayed updates.
3. The next challenge is system consistency
   - Moving from dataset quality towards quality management across interconnected geospatial ecosystems.



Further information:
Jetlund & Godager: Comparing and Improving Authoritative and Open Geospatial Data Using Linear Referencing Manuscript submitted for publication.

Kartverket

NTNU

MODI A LEAP TOWARDS SAE L4 AUTOMATED DRIVING FEATURES

Questions?

→ Knut Jetlund

→ knut.jetlund@kartverket.no

Kartverket

NTNU

MODI A LEAP TOWARDS SAE L4 AUTOMATED DRIVING FEATURES