Determination of water by applying algorithms on remote sensing data

Ondertitel

Nelen & Schuurmans

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Introduction

Thomas Berends

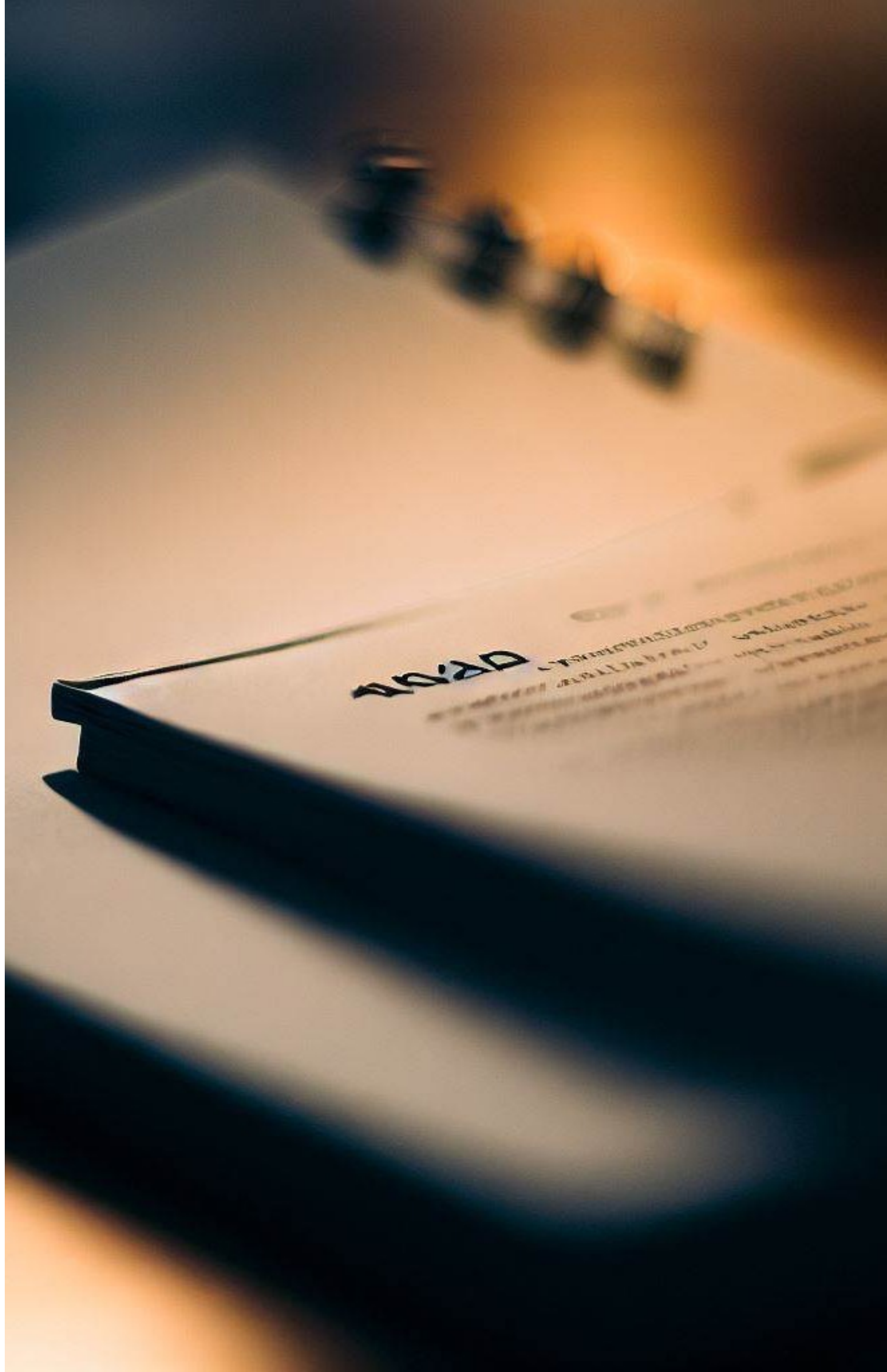
- Tu Delft
- Nelen & Schuurmans

Taj de Vries

- Nelen & Schuurmans

Agenda

- Problem description
- Goal
- Data inventory
- Method
- Results
- Conclusion & further development



DIGISHAPE
DATASCIENCE
FOR
DELTAS

Rijkswaterstaat
Ministerie van Infrastructuur en Milieu

hoogheemraadschap
Hollands
Noorderkwartier

Hoogheemraadschap van
Rijnland

Coöperation

WETTERSKIP
FRYSLÂN

Waterschap
Aa en Maas

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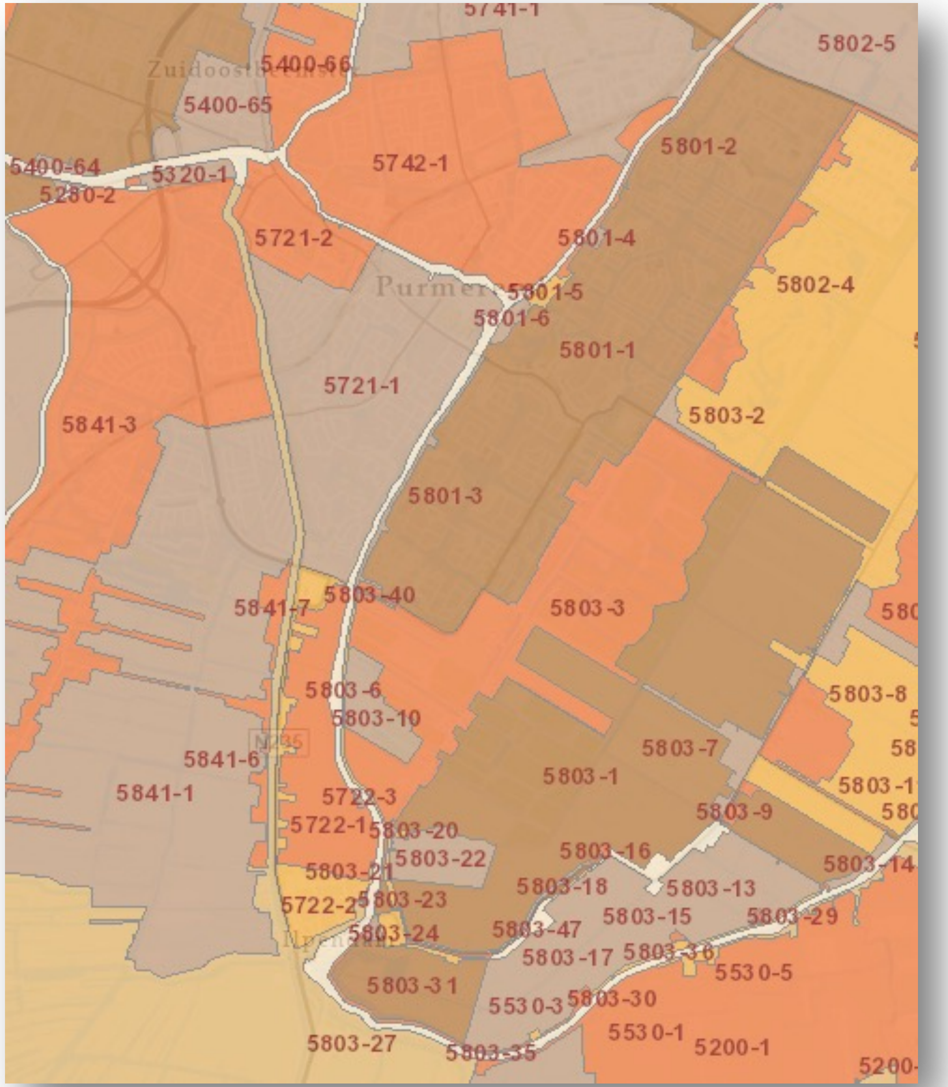
TUDelft

Problem statement

- Netherlands consist of a vast number waterways
- Waterway have a legally established target
- Assessment of target levels
  - By hand
  - Sensors
- Only 700/2600 fixed drainage level areas
- Labor intensive process



Oppertunities

- Increased use of remote sensing data
  - Measuring DEM (AHN)
  - Assessment of dikes (HHNK at Purmerend)
- Byproducts; measurement of water levels

Actueel Hoogtebestand
Nederland

Goal: opportunities of byproduct

- Large amount of data available
- Hard to process
  - Large files
  - Technical knowledge
- Data enrichment
- Develop an easy & accessible method for processing

Data inventory

- Remote sensing data (.las/.laz files)
- Data received
- Not al data is processed yet

Organisation	Location	Point density (m2)
AHN (Public)	Netherlands	~8
RWS	Maas 2021	30-40
Wetterskip	Buitenpost	20-30
HHNK	Purmerend	200-300

Method: From .laz to water levels

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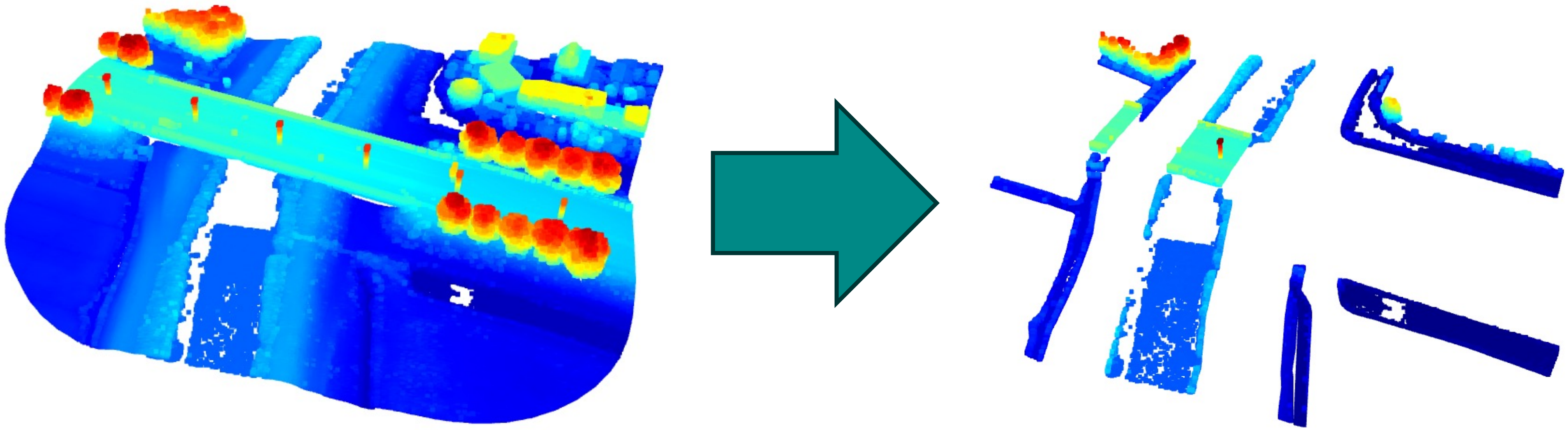
Method: Overview

- Point cloud in .laz files
- BGT-waterdelen: shapefile (.shp) with waterbodies in the Netherlands
- Unfiltered point cloud



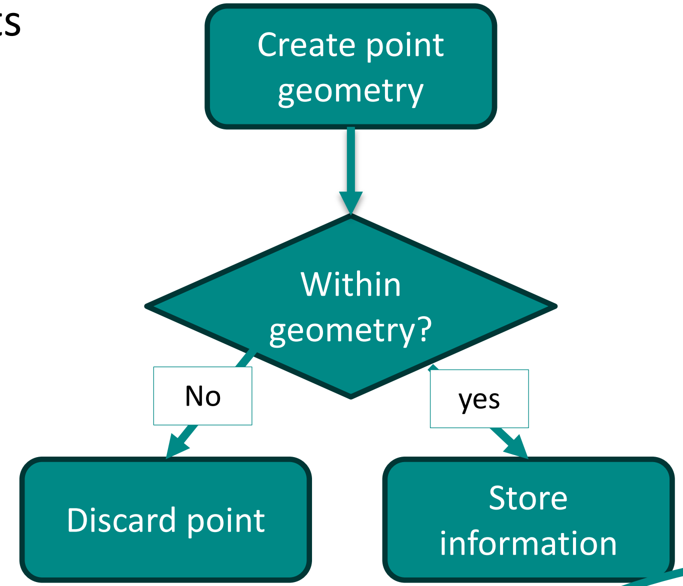
Method: STRtree -

- R-tree: data structure for storing spatial indexes
- Created at initilization
- 2 trees from input shapefiles
  - BGT-waterdelen
  - Fixed level drainage areas (peilgebieden)

```
tree = STRtree(waterbodies)
tree_pg = STRtree(peilgebieden)
print("Total points: ", len(las.X))
```

Method: Filtering

- Loop through points
- Store information

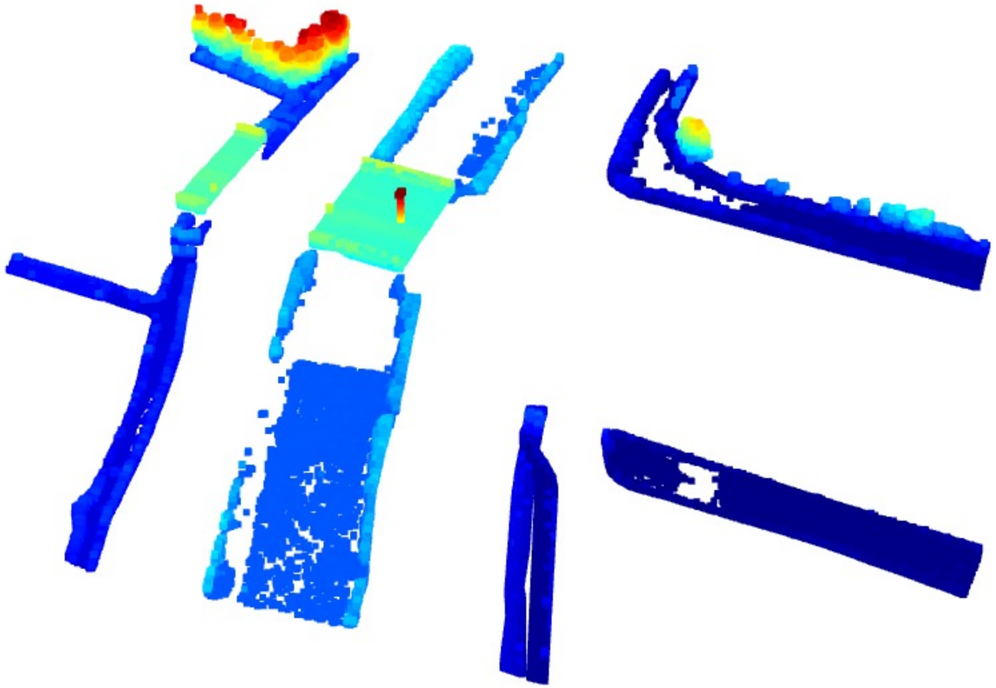



```python
# main loop
for i, point in enumerate(las.X):
    point = Point(las.X[i] / 1000, las.Y[i] / 1000) #
    if tree.query(point, predicate="within").any():
        new_row = [las.X[i] / 1000,
                   las.Y[i] / 1000,
                   las.Z[i] / 1000,
                   las.intensity[i],
                   las.number_of_returns[i],
                   las.gps_time[i],
                   las.classification[i],
                   i,
                   tree_pg.query(point, predicate="within")[0]]
        df_las.append(new_row)
    if i % 100000 == 0:
        print(f"{i} points checked")
```

- Row-wise appending for efficiency

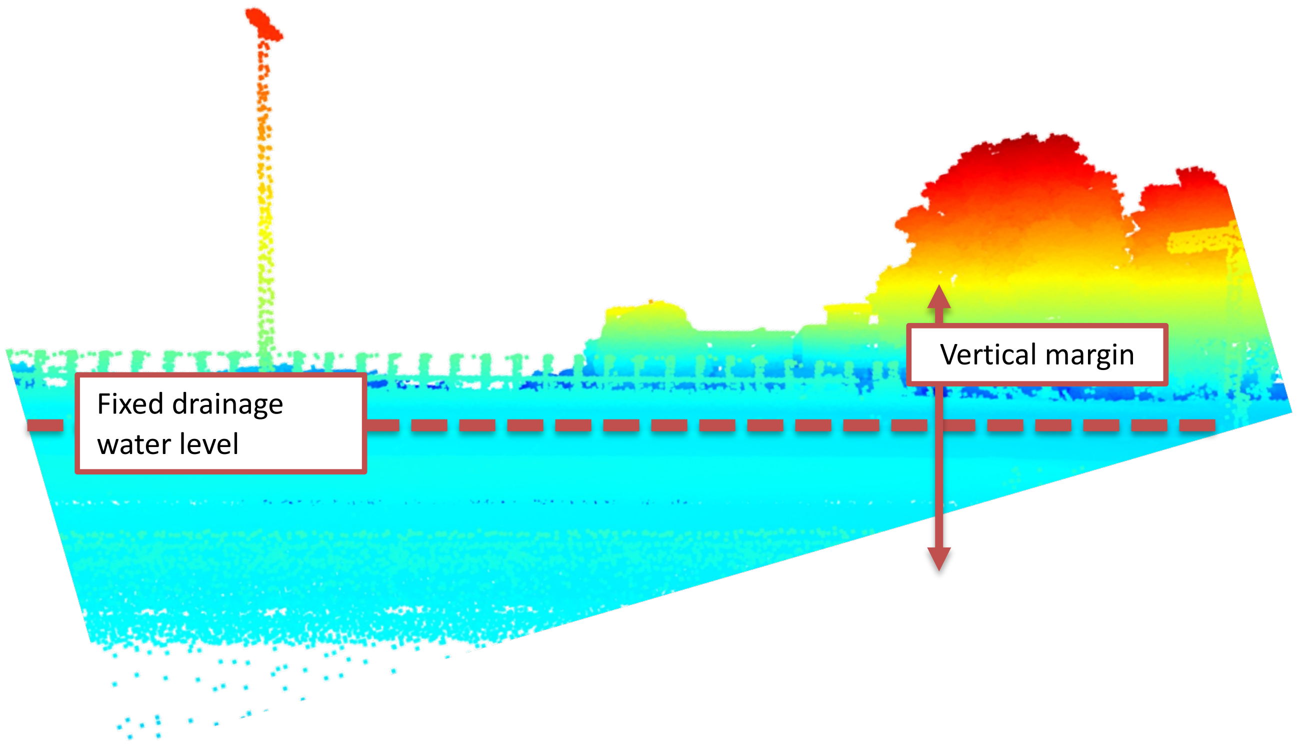
Results first filtration

- Filtered point cloud
- Lot of noise remains
  - Tree's;
  - Bridges;
  - etc.
- Further Filtering necessary



Additional filtering methods: 1. Vertical slicing

- Legally established fixed drainage water level
- Create upper and lower limit
- Only consider points between limits



Filtering methods: 2. Modal

- Create grid cells based on

  1x1m raster cells

- Calculate value distribution

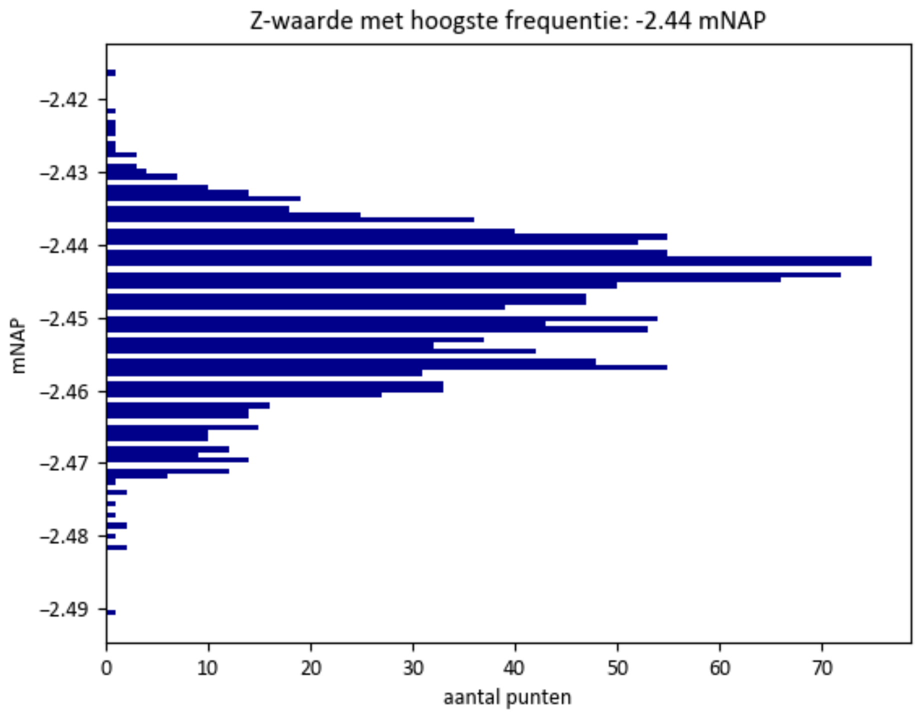
  for all points within raster cell

- Take modal/mean value

```
# remove duplicate indices by keeping the most frequent value
da = da.groupby(level=[0, 1]).agg(lambda x: x.value_counts().index[0])
```

Filtering methods: 3. point/polygon statistic

- Create a polygon
- Filter out points in point cloud
- Create point statistics
  - Mean
  - Modal
  - Distibution



Initial results

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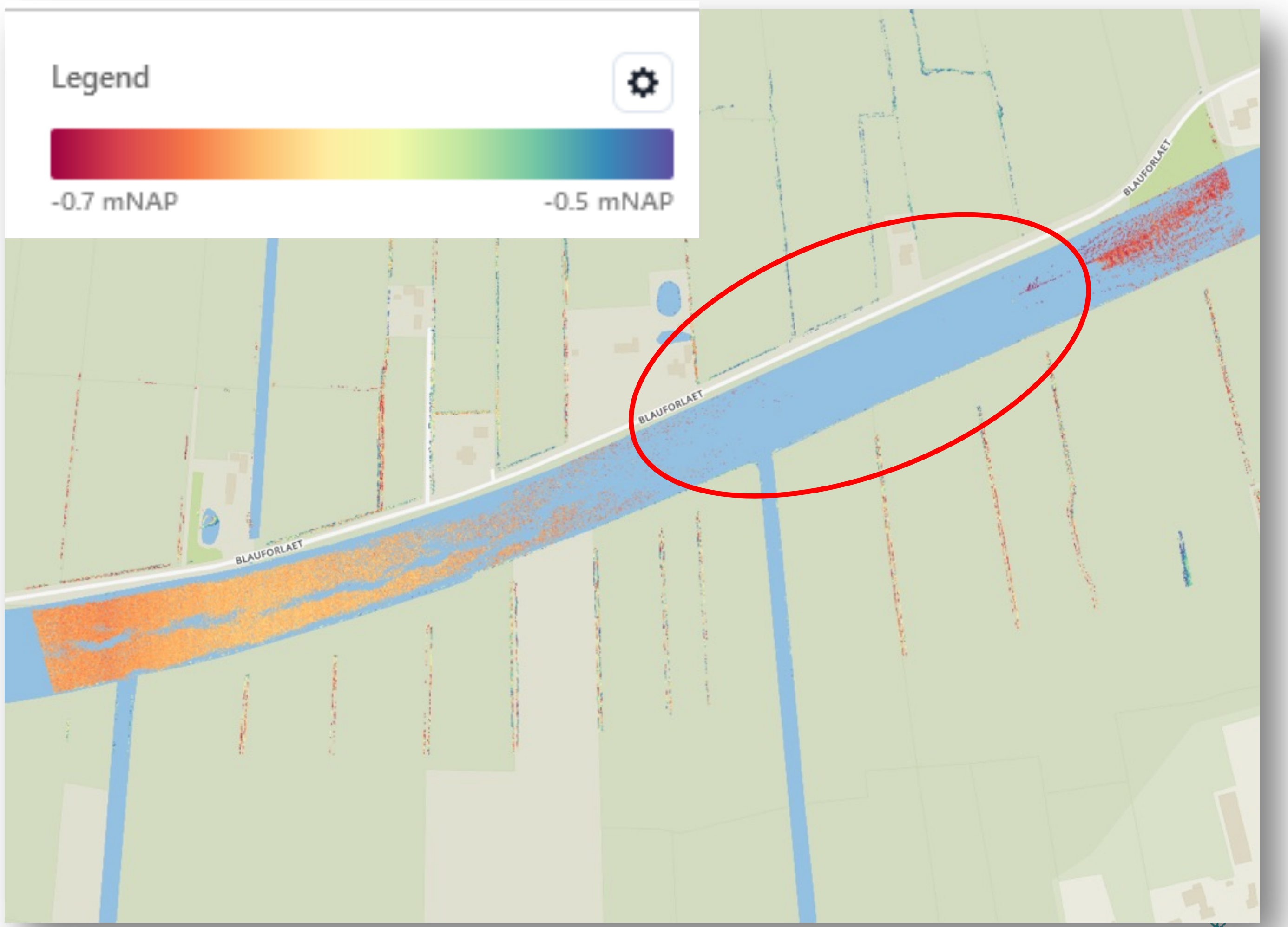
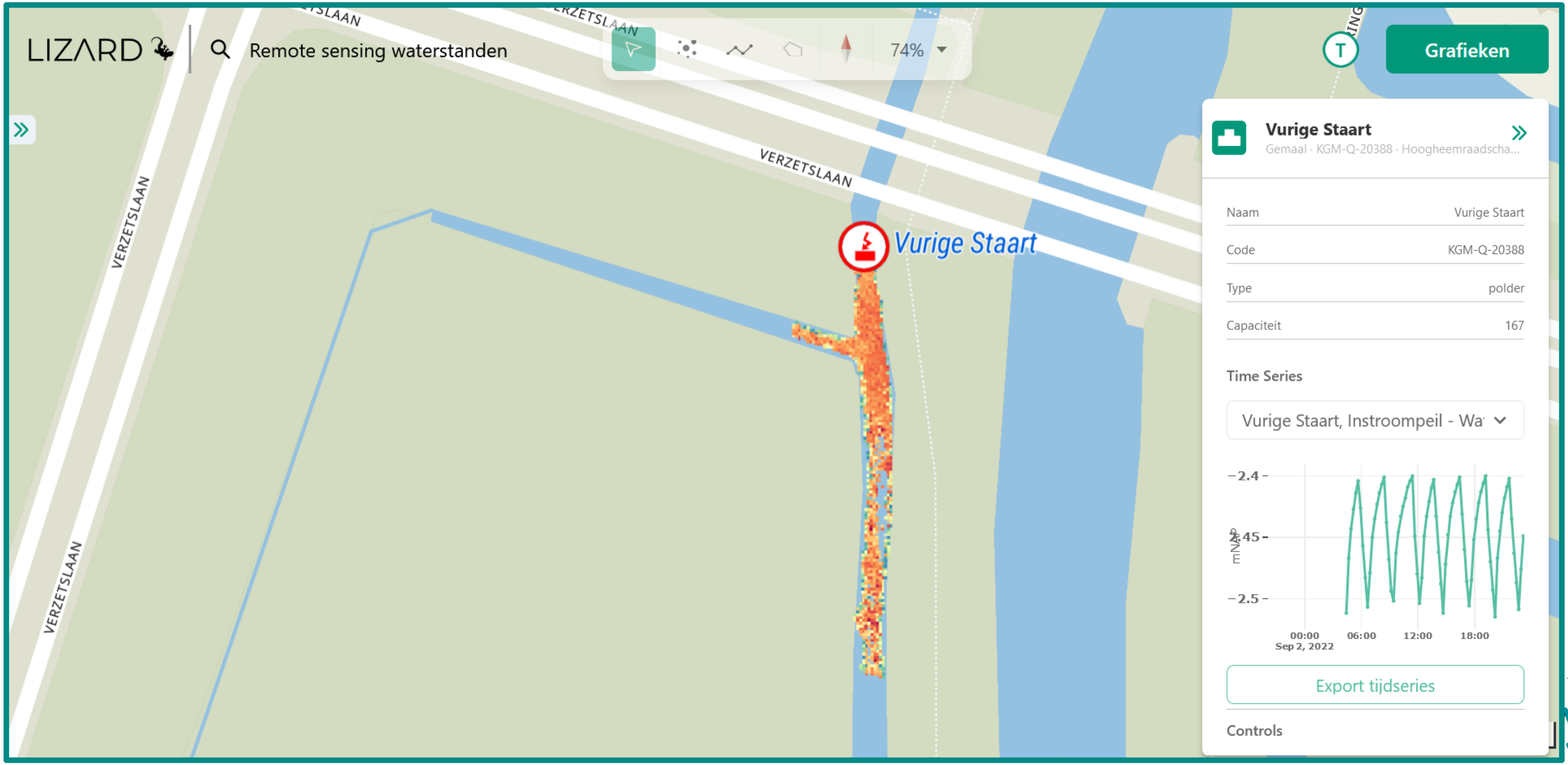
Results: Wetterskip

- Large data gaps
- Lower point intensity
- Low water reflection
- No date of collection available for comparison



Initial Results HHNK



Results

- Comparison measures water level pump station
- Promising results

Name	Fixed drainage level[mNAP]	Analysis method	Value [mNAP]	Standard deviation [cm]	Difference [cm]
Vurige start	-2.42	measurement	-2.467		
		1	-2.443	2.4	-2.4
		2	-2.47	N.A.	-1.4
De Gors	-1.81	measurement	-1.803		
		1	-1.808	2.1	0.453
		2	-1.8025	N.A.	-2.4

Discussion

- Quality very dependent on data
- Method very situation dependent
- Method relatively slow

Method 1	Method 2	Method 3
Deterministic	Skewness in data	Low statistical value
Not able to catch deviations	Noise remains in data	

Further development

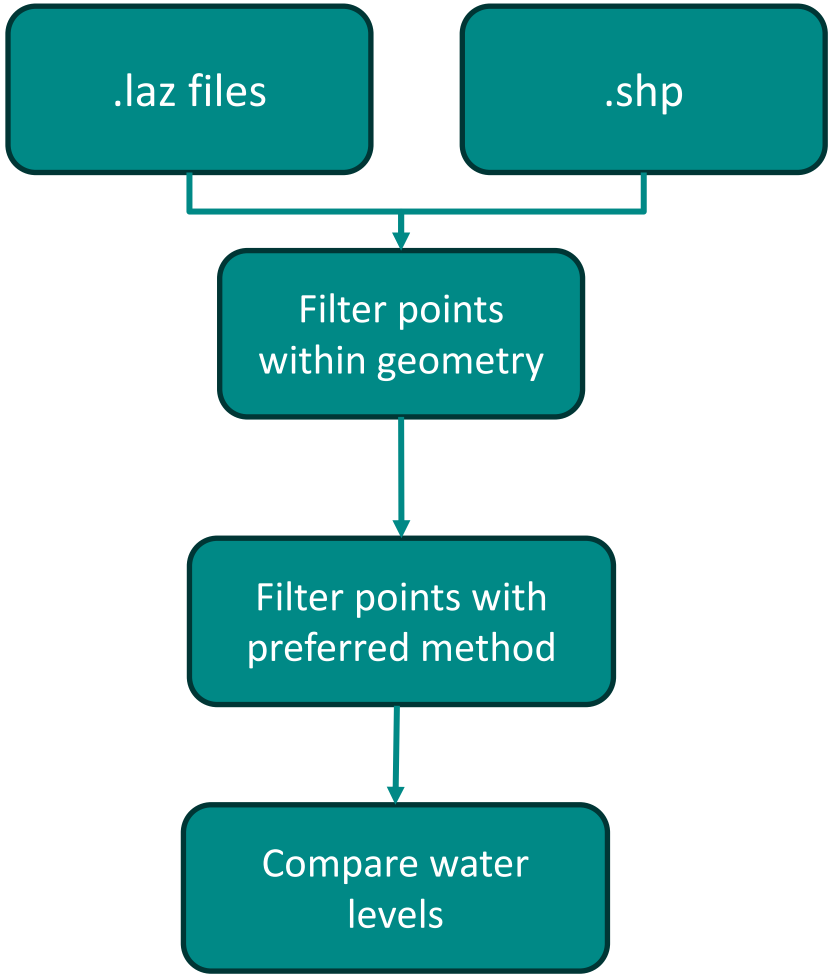
- Tool for easy processing
- Stepwise process
- Enrich already available data
- Optimize scripting process

Step 1: data inventory

Step 2: Initial filtering

Step 3: further filtering

Step 4: Assess results



Conclusion

- Good initial results
- Very dependent on input data
- Room for further development
- Could also be used for non-water polygons

Questions