UNIVERSITY OF TWENTE.



GEDETAILLEERDE AHN EN BEELDMATERIAAL CLASSIFICATIE DOOR MET BGT GETRAINDE DEEP-LEARNING MODELLEN

NWO OTP PROJECT

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ITC FACULTY OF GEO-INFORMATION SCIENCE AND EARTH OBSERVATION

HET IDEE IN HET KORT

Start

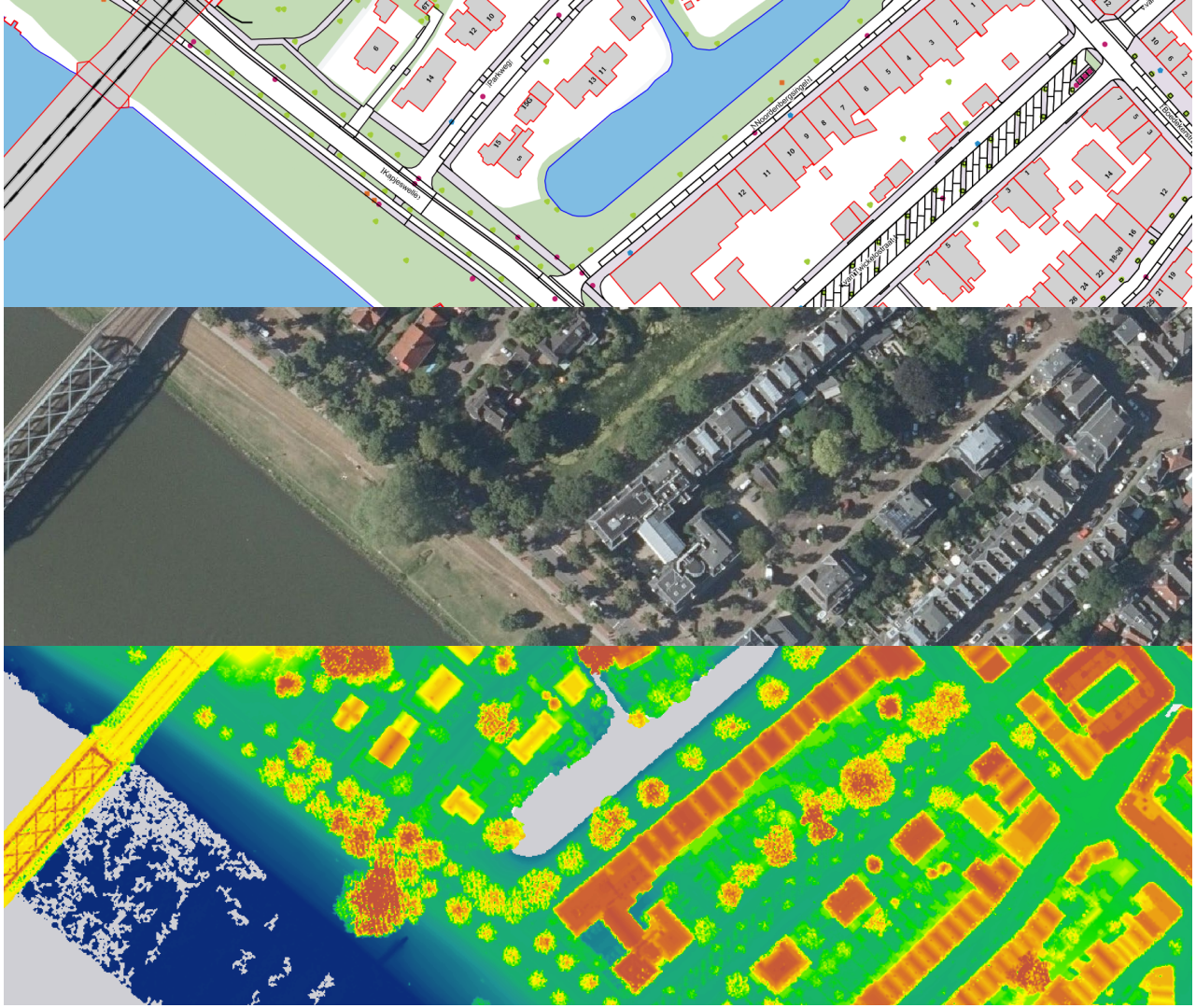
- De bestaande (“oude”) kaart is de leraar.
- De kaart bevat informatie over klassen en grenzen van heel veel objecten, landsdekkend.
- Dus als we de kaart fuseren met aerial sensordata (BM/AHN), levert dat training data op voor deep learning-netwerken.

Reis

- Eén netwerk om de aerial sensordata te classificeren (semantic segmentation).
- Eén netwerk dat leert om grenzen tussen objecten te genereren.

Finish

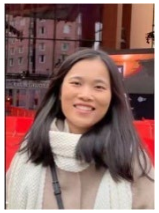
- Zodat we de kaart kunnen updaten of een nieuwe kaart kunnen maken.


Parkweg
Rotterdamsedijk
Noordvliet
Noordvliet

ONDERZOEKSPOSITIES









WP1 Postdoc	WP2 PhD1 Point cloud-/beeldclassificatie	WP3 PhD2 2D-kartering
Enorme hoeveelheden training data genereren		
Fusie van kaart- en sensordata	Wat doe je met enorme hoeveelheden training data?	Wat doe je met enorme hoeveelheden training data?
Training data beschikbaar maken (= open)	NL + benchmarkdata	NL + benchmarkdata
	Internationale data, Rode Kruis-situaties	Internationale data, Rode Kruis-situaties
	Change detection tussen kaart en sensordata	Kaart updaten

GEBRUIKERSCOMMISSIE

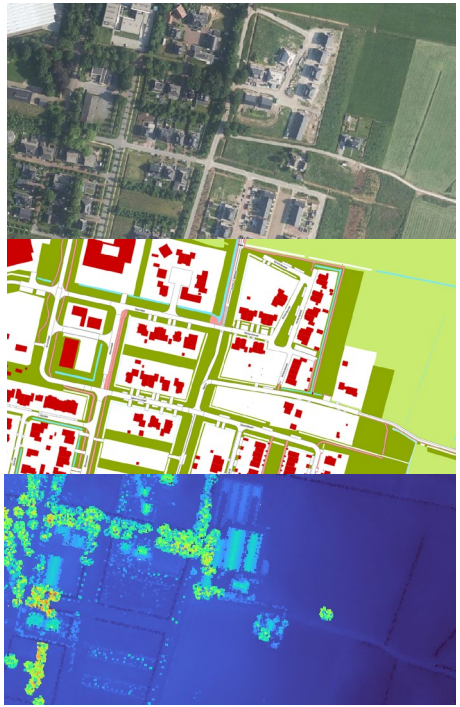
- NEO / Terramira: change detection, kaart updaten
- Miramap: kwaliteit sensordata t.o.v. BGT, dataclassificatie?
- Het WaterschapsHuis: point cloud classificatie + BGT updaten
- RVO: BGT change detection en updaten
- Red Cross 510 Global: vertaalslag naar internationale change detection, rapid mapping

“Oude sensor- en kaartdata”

“Gefuseerde sensor- en kaartdata”

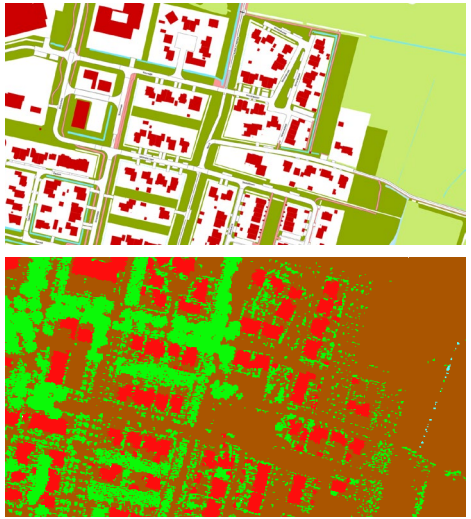
“Nieuwe sensordata”

“Geüpdatete kaart, geclassificeerde sensordata”









TRAINING DATASET GEPUBLICEERD

ELSEVIER

ISPRS Open Journal of Photogrammetry and Remote Sensing

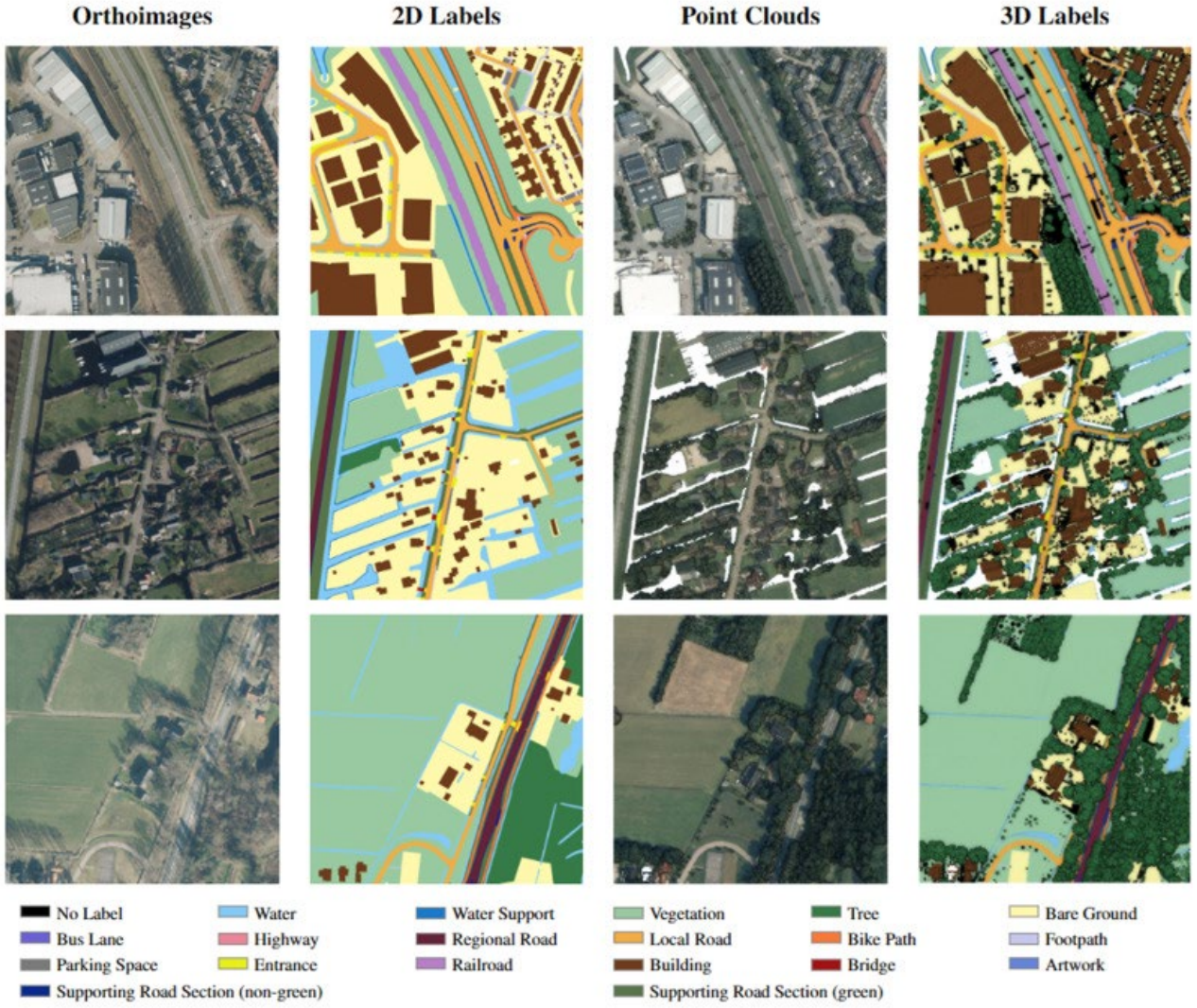
Volume 19, January 2026, 100112



Map2ImLas: Large-scale 2D-3D airborne dataset with map-based annotations

Geethanjali Anjanappa, Sander Oude Elberink, Abhisek Maiti, Yaping Lin, George Vosselman

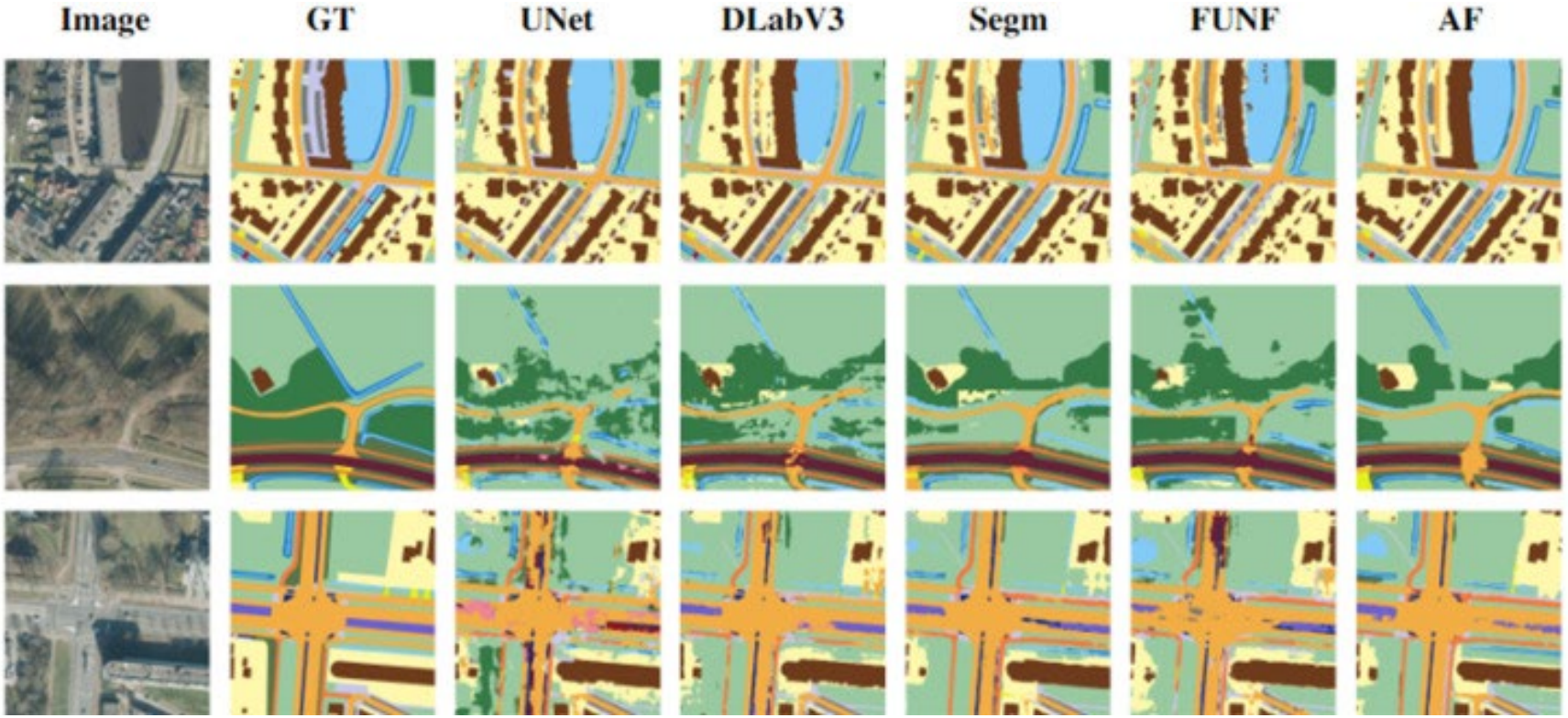
https://doi.org/10.1016/j.ophoto.2025.100112


Orthoimages
2D Labels
Point Clouds
3D Labels
No Label
Water
Water Support
Vegetation
Tree
Bare Ground
Bus Lane
Highway
Regional Road
Local Road
Bike Path
Footpath
Parking Space
Entrance
Railroad
Building
Bridge
Artwork
Supporting Road Section (non-green)
Supporting Road Section (green)

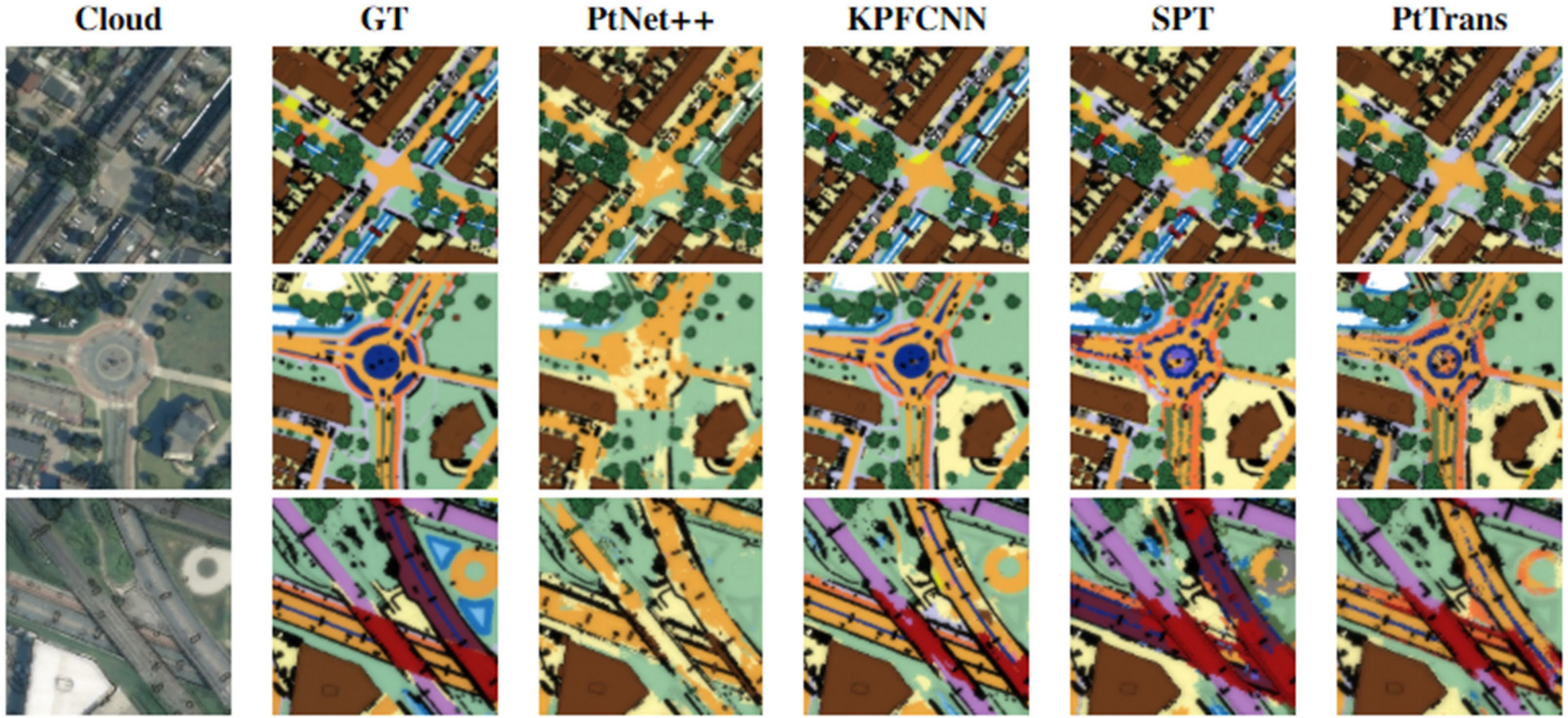
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RESULTATEN VAN DE BASELINE-METHODE OP DEZE DATA



RESULTATEN VAN DE BASELINE-METHODE OP DEZE DATA



(a) Experiment 1: Without RGB

WAT TUSSENRESULTATEN VAN LOPEND WERK



Semantic segmentation of 2D/3D data



Vectorization of buildings from images

WORKFLOW 2D/3D MET LABEL FUSION

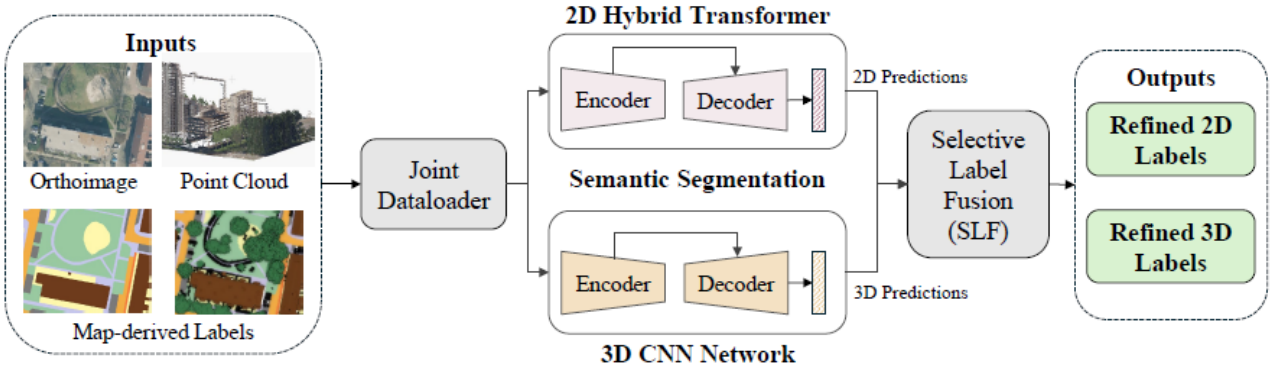
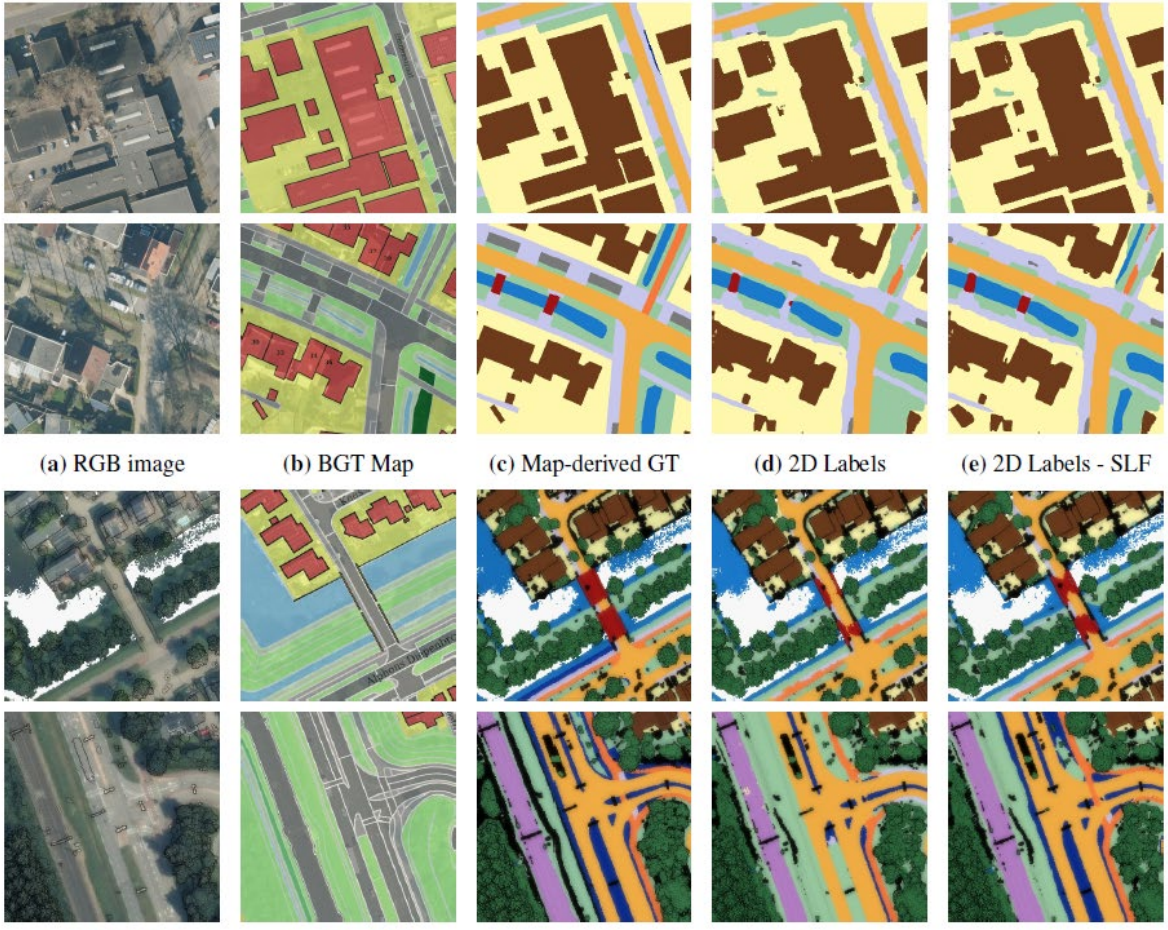


Figure 2. Workflow of proposed method - synchronized inputs from dataloader are processed by 2D hybrid Transformer and 3D CNN networks, each including an encoder, decoder, and prediction head to generate 2D and 3D predictions, which are then refined with SLF.


(a) RGB image
(b) BGT Map
(c) Map-derived GT
(d) 2D Labels
(e) 2D Labels - SLF
(f) Point Cloud
(g) BGT Map
(h) Map-derived GT
(i) 3D Labels
(j) 3D Labels - SLF
No Data
Water
Vegetation
Tree
Bare Ground
Roadway
Bike Path
Footpath
Parking Space
Railroad
Building
Bridging Part
Supporting Road Section

EN NU

- In plaats van de output van twee verschillende algoritmes te fuseren, ontwerpen we een feature fusion-algoritme dat zowel 2D- als 3D-data als output geeft.
- Gevolgd door een change detection-stap tussen kaarten en semantic segmentation-resultaten

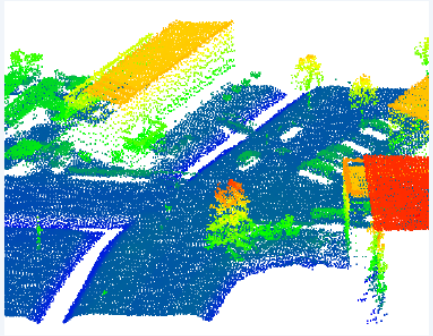
BI-FUSION NET

RGB-beelden - Kleur en textuur



Visuele kenmerken helpen klassen op vergelijkbare hoogte te onderscheiden.

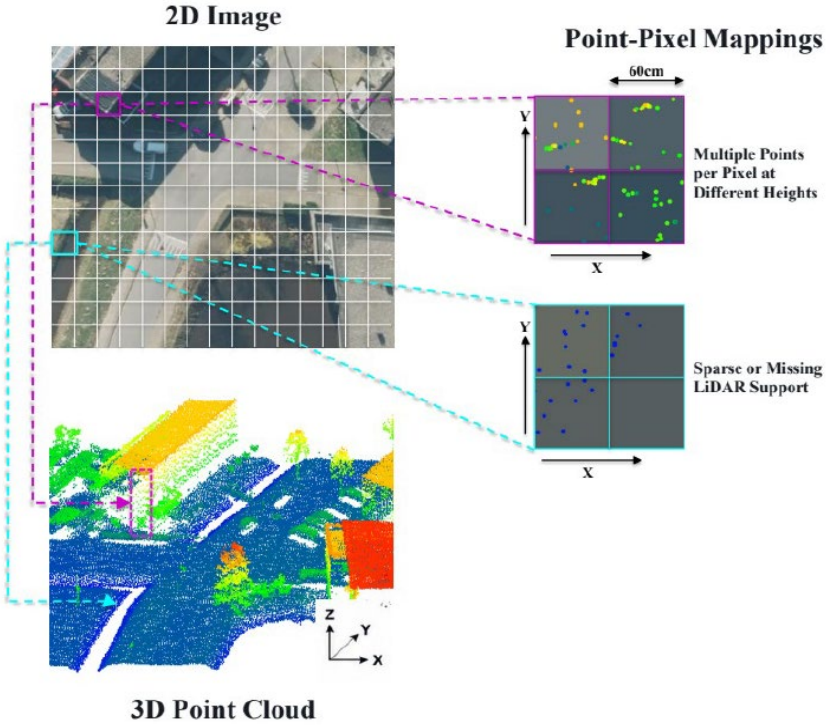
Point clouds - Hoogte en 3D-structuur



Hoogte helpt klassen te scheiden die er in het beeld hetzelfde uitzien.

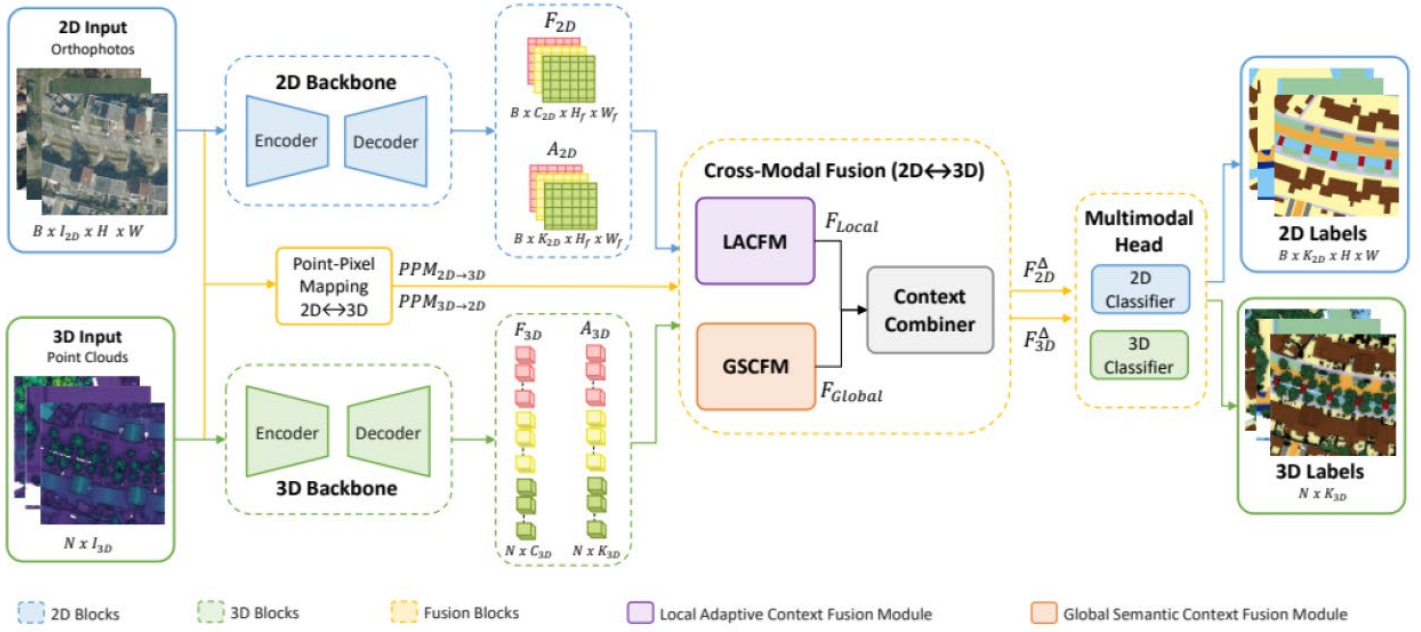
Door complementaire 2D- en 3D-features te combineren verbeteren zowel pixel-wise als point-wise semantic segmentation.

PUNTEN EN PIXELS MATCHEN



FEATURE LEVEL FUSION

Sterke unimodale backbones leveren high-level features. Cross-modale uitwisseling begint na de decoders.

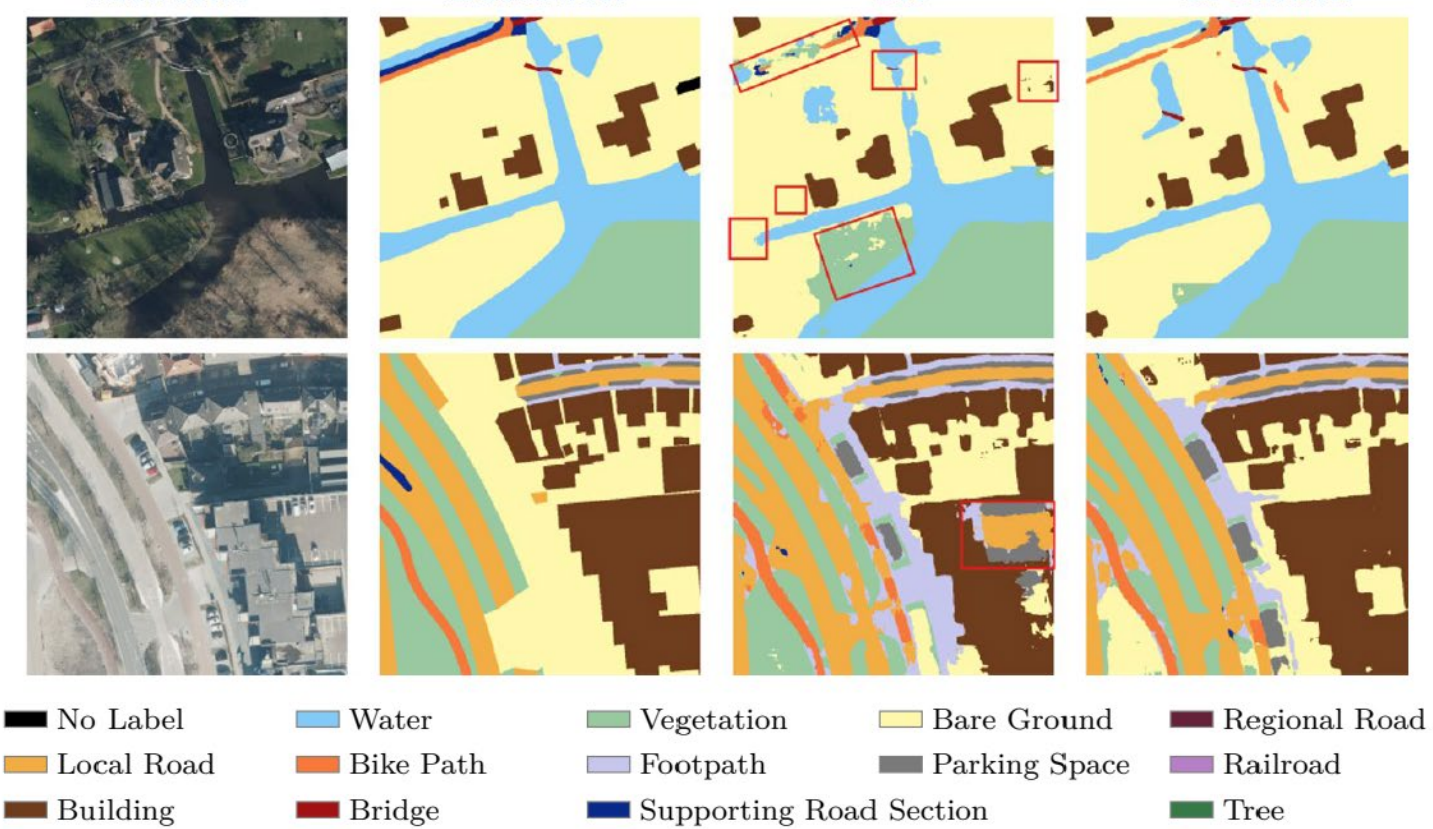


Standaard backbones: DeeplabV3+ voor 2D en KPFCNN (op basis van KPConv) voor 3D

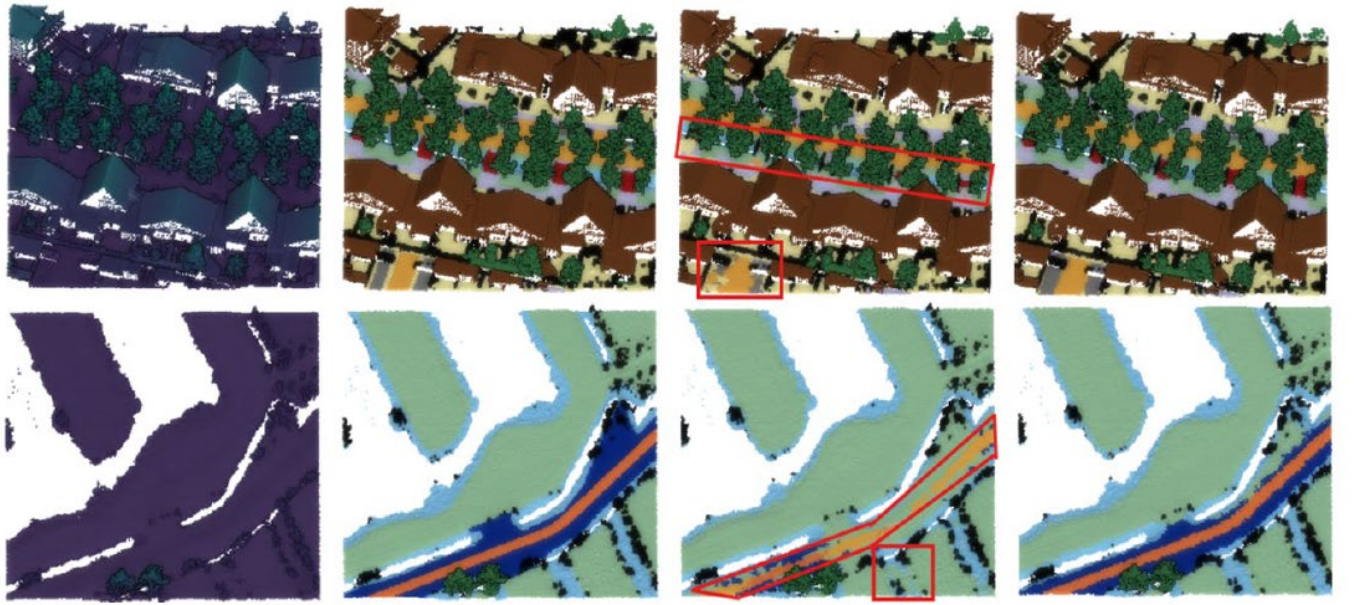
BI-FUSION NET

- Lokale fusion
  - Feature uitwisseling tussen pixels en punten
- Globale fusion
  - Cross-modal pool
    - Gebruik per modaliteit auxiliary logits om features te poolen tot prototypes.
  - Uitwisseling
    - Pixels richten attention op 3D-prototypes.
    - Punten richten attention op 2D-prototypes.

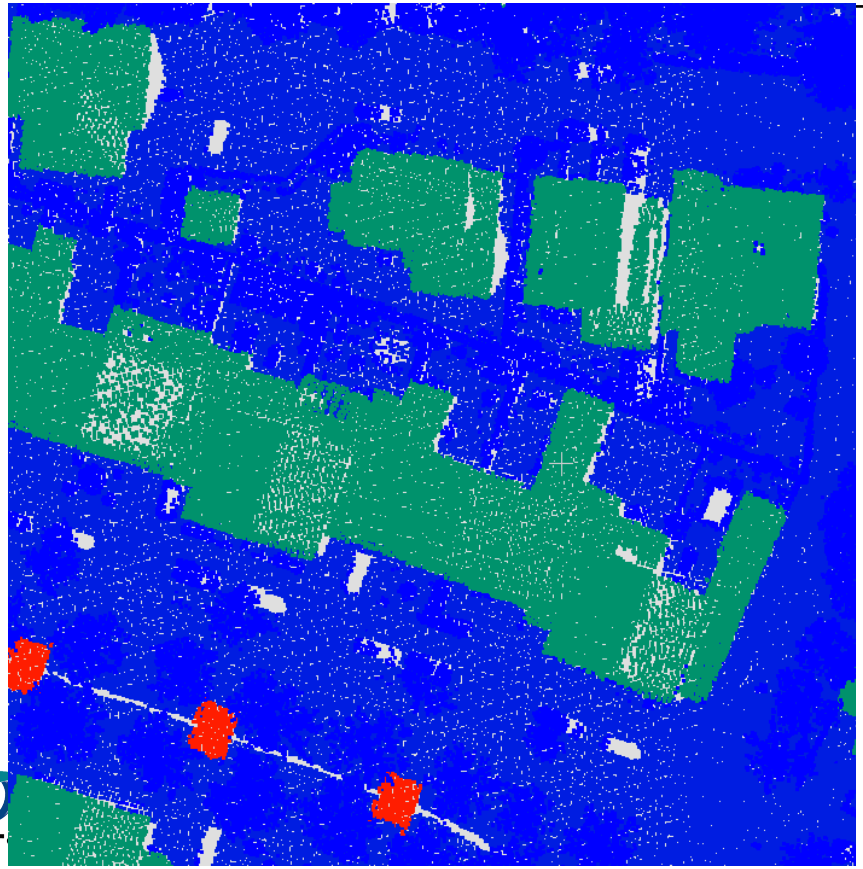
BM / BGT / BASELINE / BIFUSION



AHN / BGT-LABELS / BASELINE / BIFUSION



CURRENT AHN LABELS AND OURS





CURRENT AHN LABELS AND OURS



EN NOG WAT RESULTATION OVER DE OUTLINING



Semantic segmentation of 2D/3D data



Vectorization of map object from images

ACPV-NET, ALL-CLASS POLYGON VECTORIZATION

ACPV-Net: All-Class Polygonal Vectorization for Seamless Vector Map Generation from Aerial Imagery

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Faculty of Geo-Information Science and Earth Observation (ITC)
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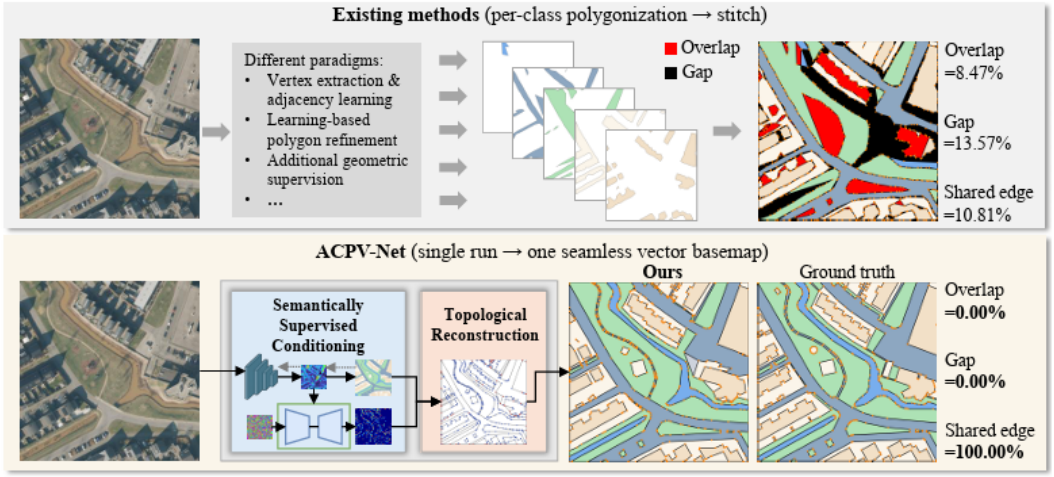


Figure 1. To generate an all-class vector basemap, existing single-class polygonization methods require per-class inference and stitching, resulting in gaps and overlaps across classes. **ACPV-Net** is the **first fully automatic framework** that produces a seamless basemap with **shared-edge consistency** and **avoids gaps and overlaps** in a single run.

EN NU

- Change detection
- Deep learning network, waarbij gegeven:
  - Bestaande BGT
  - Nieuwe sensor data
- Output: veranderde objecten (&outlining?)

BEST GAAF ☺, SEMANTIEK EN OBJECTGRENZEN

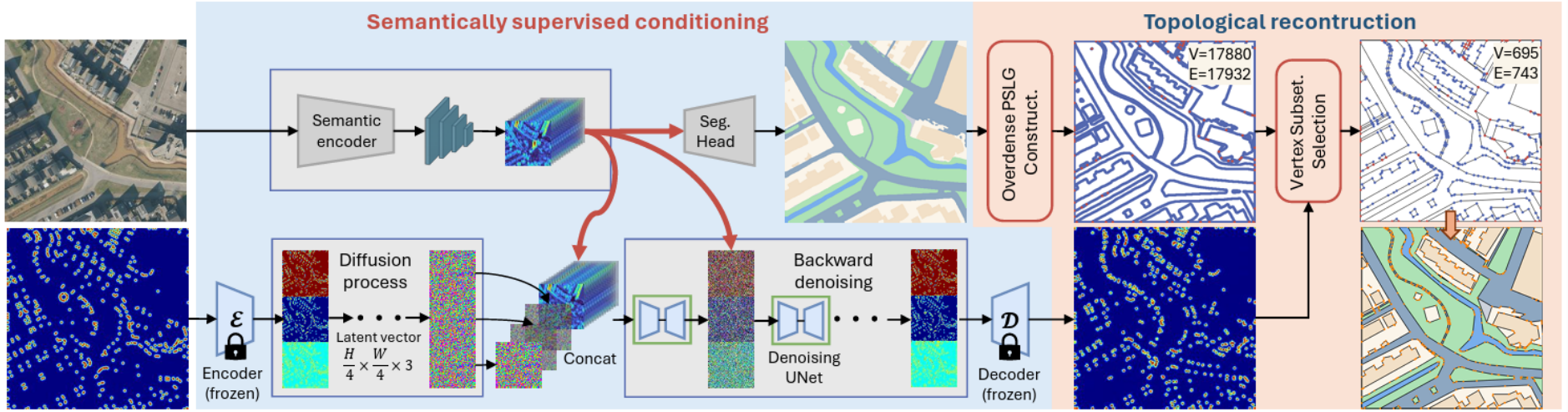


Figure 2. Overview of ACPV-Net. It unifies semantically supervised conditioning and proposition-driven topological reconstruction: the former produces coherent semantic–geometric evidence through diffusion-based vertex generation under semantic supervision, the latter deterministically reconstructs a topology-consistent vector basemap via overdense PSLG construction and vertex-guided subset selection.

OTP PROJECT LOOPT VOLGEND JAAR AF

- Goede band met de gebruikerscommissie
- Voortgang bijna volgens planning:
  - Methodes zijn innovatief
  - Nog niet toegepast op internationale datasets

- Meer info:
- Geethanjali Anjanappa (tot april 2027)
- Sander Oude Elberink of George Vosselman