

SAMEN MAKEN WE
MORGEN MOOIER

OVAM

Asbestos suspect roofs from aerial imagery

AI4Copernicus Day 2022
May 3rd 2022

**DIGITAAL
VLAANDEREN**
Earth Observation & Data Science



**Vlaamse
overheid**



remote sensing



Flanders' aim: all buildings "asbestos safe" by 2040

- Only keep asbestos in good conditions
- Remove all other asbestos

Where to look ?



Inside/outside old buildings

How to build asbestos inventory on a regional scale ?



Looking at the outer shell of buildings

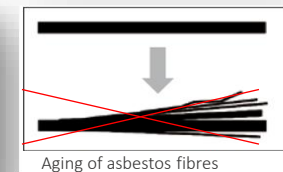
Automated detection of **asbestos roofs** through AI ?



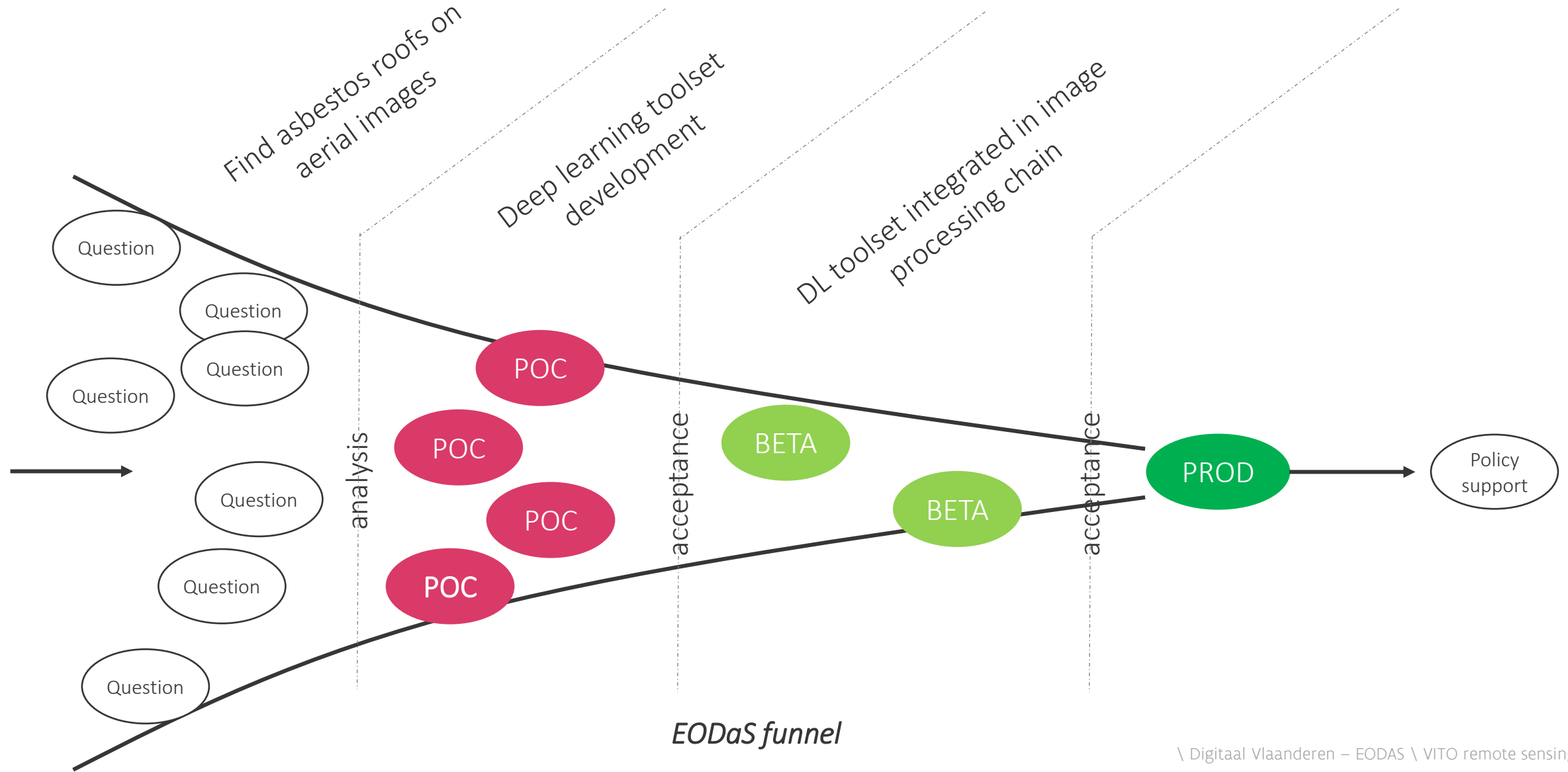
Try



by OVAM asbest



Asbestos suspected roofs through AI ?



Machine learning – deep learning: POC

Looking for asbestos roofs

- Define pattern
 - ▣ Build the reference (imagery)
- Learn to recognise and localise
 - ▣ Spectral angle mapper (SAM)
 - ▣ Object-based Decision Tree (ObDT)
 - ▣ Convolutional Neural Network (CNN)

corrugated roofs
+ slated roofs



Many positive samples



Calibration spectra

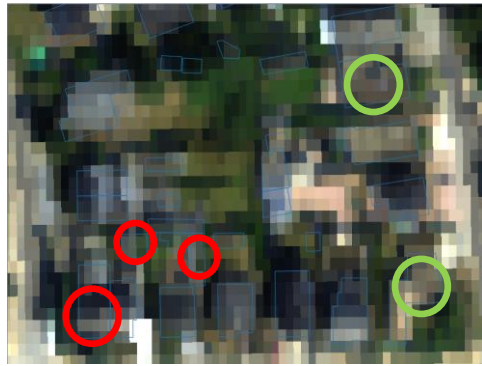
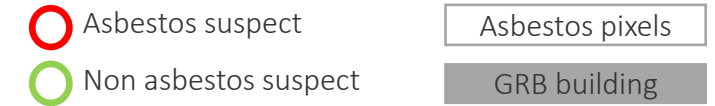


Many negative samples

Building a good training dataset is very time consuming but of utmost importance !!!

Machine learning – deep learning: POC

Relevant aerial imagery – algorithm combinations



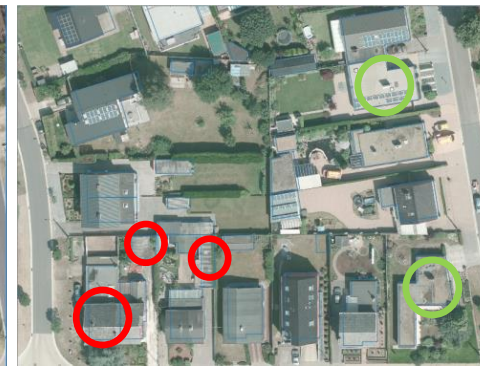
APEX 200 cm



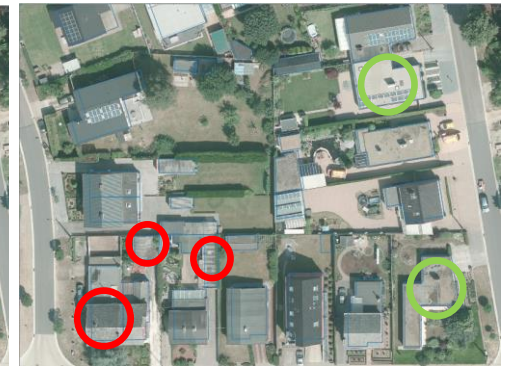
RGB 10 cm



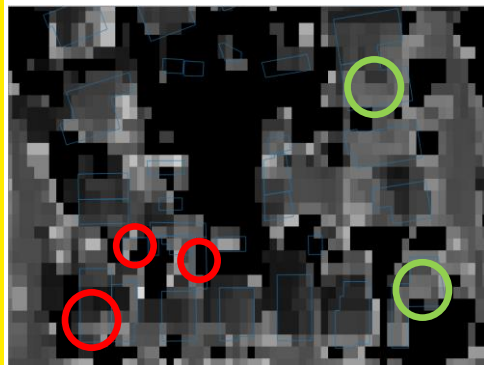
RGB 10 cm



RGB 5 cm



RGB 5 cm



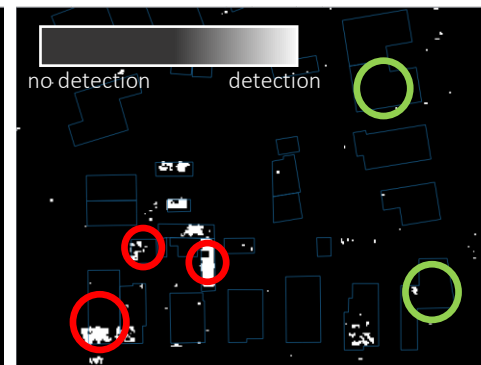
SAM

corrugated
+ slated



ObDT

corrugated



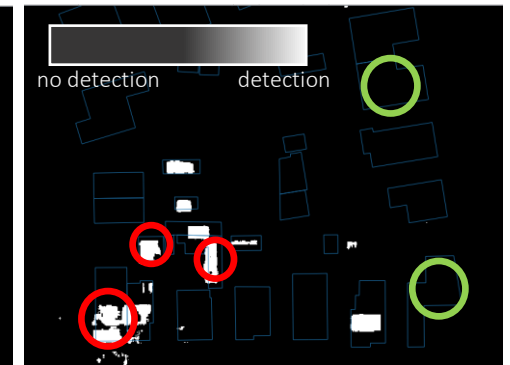
CNN (prob. thr. 99%)

corrugated
+ slated



ObDT

corrugated



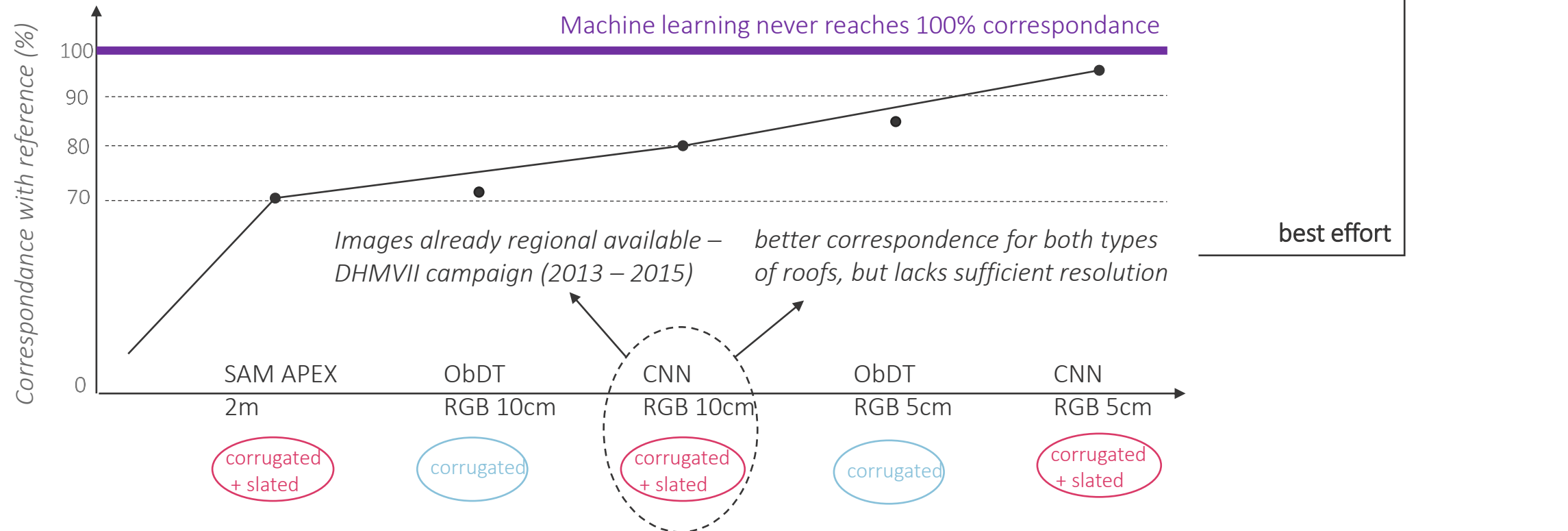
CNN (prob. thr. 99%)

corrugated
+ slated

Machine learning – deep learning: POC

Test relevant aerial imagery – algorithm combinations

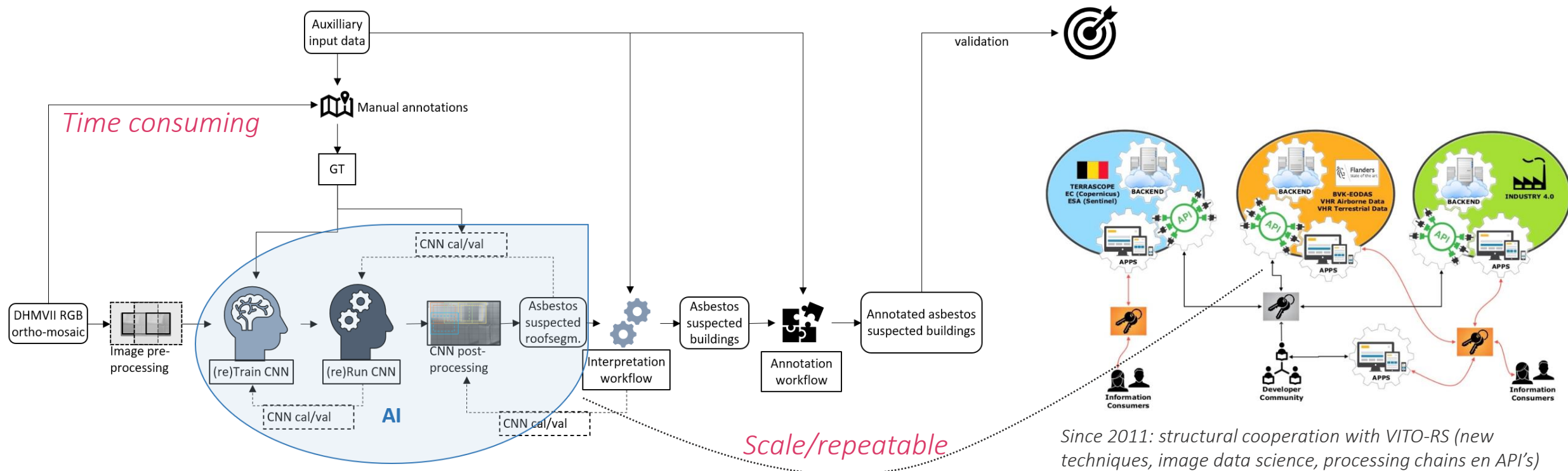
- RGB 10cm – CNN offers **regional opportunity**
- Good **regional reference set** is required !
- High to very **high resolution** is needed !



Machine learning – deep learning: BETA + PROD

Retrain and apply CNN on aerial RGB 10cm

- PASSwerk support for the regional reference dataset (<http://passwerk.be>)
- CNN integrated as part of the EODaS image processing chain



Machine learning – deep learning: BETA + PROD

Retrain and apply CNN on RGB 10cm

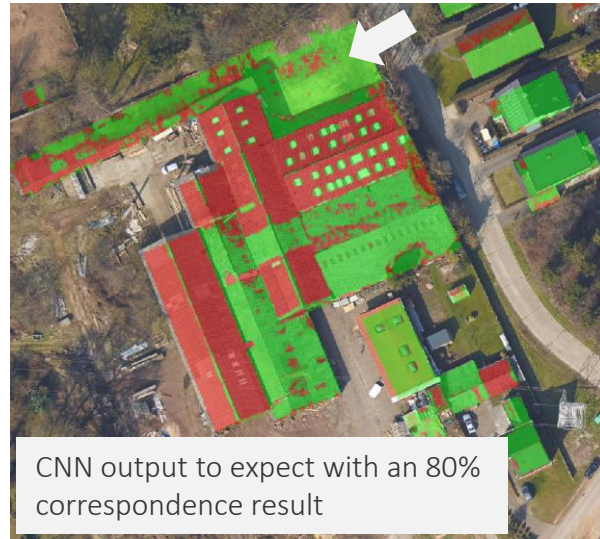
- Also deliver interpreted dbase/vector output for all Large Scale Reference Map buildings (GRB-gbg/gba)
- Each interpretation/workflow step **augments uncertainty !!**

e.g. GRB mismatch errors on top of CNN uncertainty

Asbestos suspected roofsegments and asbestos suspected buildings



Aerial orthophoto mosaic, RGB10cm



CNN output to expect with an 80% correspondence result

CNN probability rasters, roofsegments scale

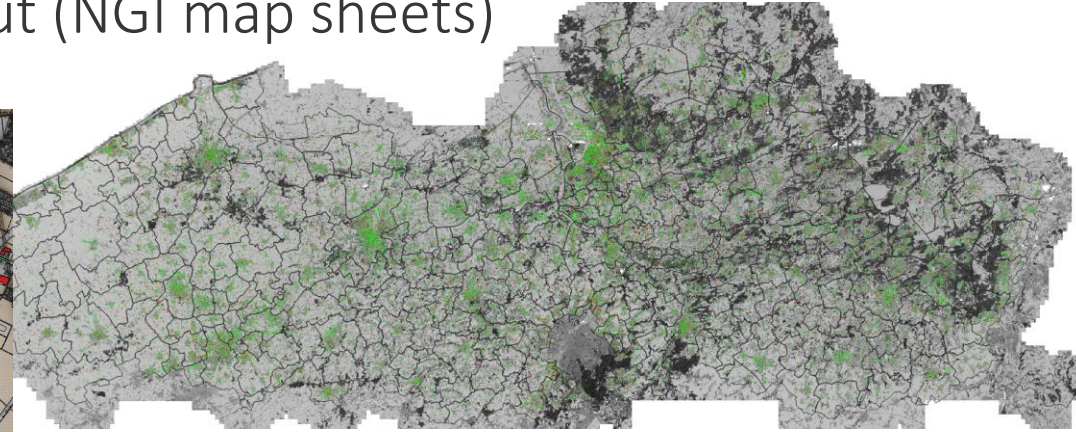


Interpretation uncertainty induced errors

Interpreted dbase/vector output, buildings scale

Machine learning – deep learning: Policy support

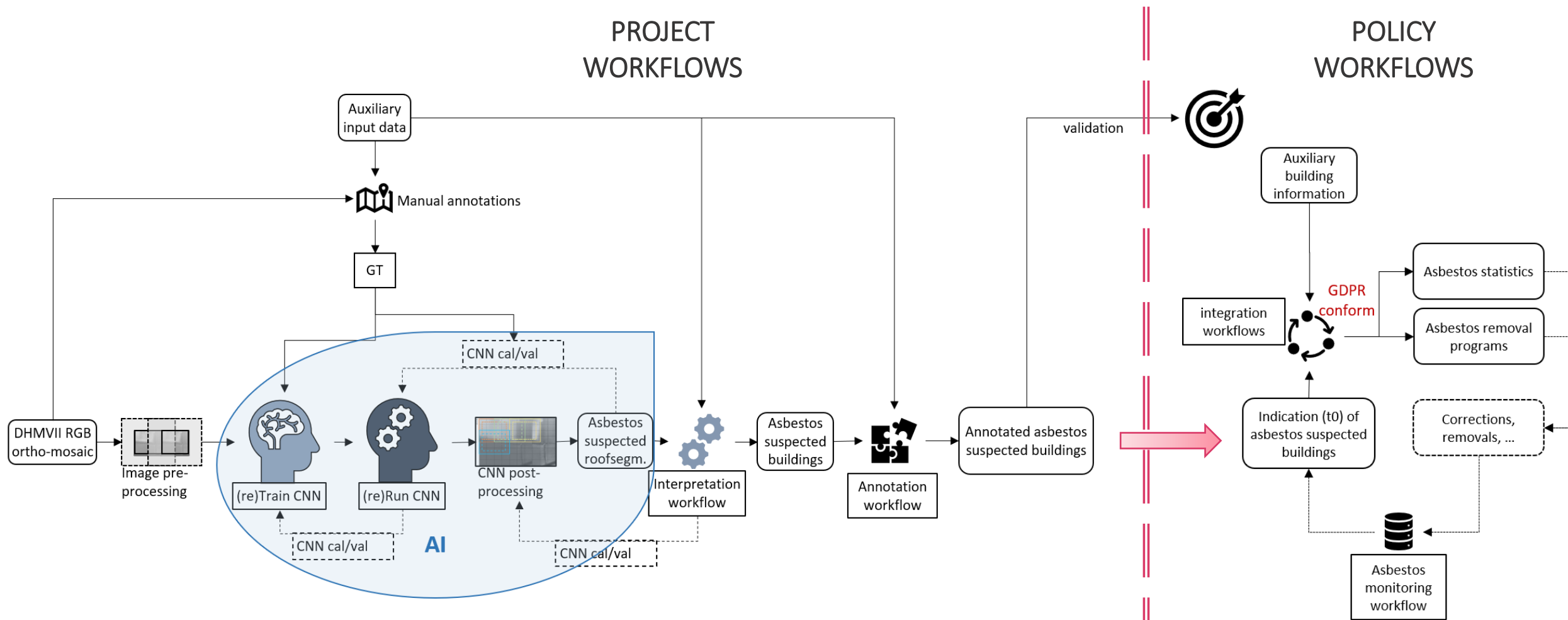
- Deliver regional CNN output probabilities (NGI map sheets)
- Deliver regional interpreted dbase/vector output (NGI map sheets)



Be aware of the uncertainties when integrating outputs into policy workflows !

Augment the regional indicative output :
→ additional (local) building information available for OVAM
(**building age**, owner, ...)
→ **agriculture** parcels

Machine learning – deep learning: Policy support



Machine learning – deep learning: Policy support

Flemish “Actieplan asbestafbouw”

- Inventory of all asbestos materials in buildings
 - From 2032 onwards all buildings will need an asbestos inventory certificate (“asbest attest”)

Estimated amount of asbestos in buildings (2019)



by OVAM asbest

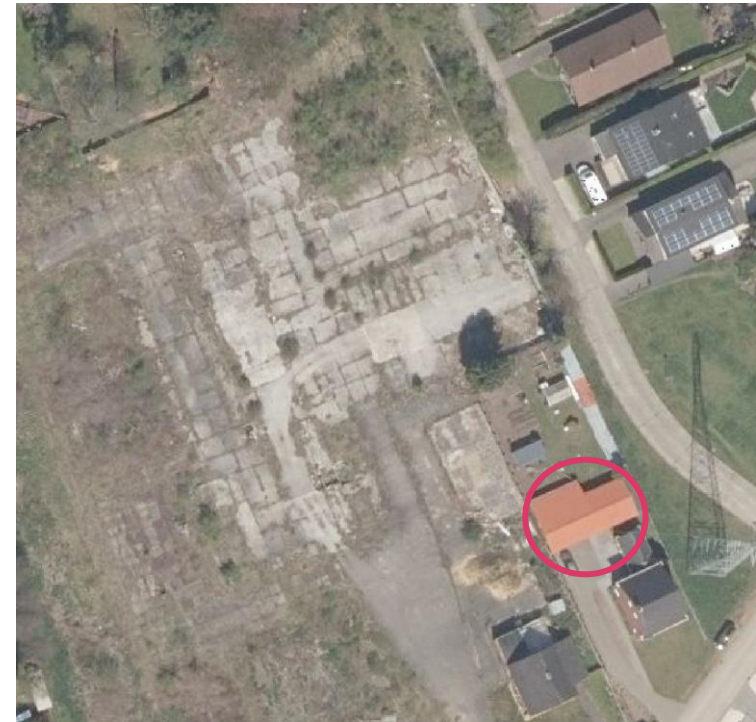
- Removal
 - Most hazardous (e.g. roofs/facades) by 2034 → encouragement by subsidies
 - All other in bad condition by 2040 (first governmental)
- Responsible management of asbestos materials in buildings obligated
- Enforcement

Machine learning – deep learning: Policy support

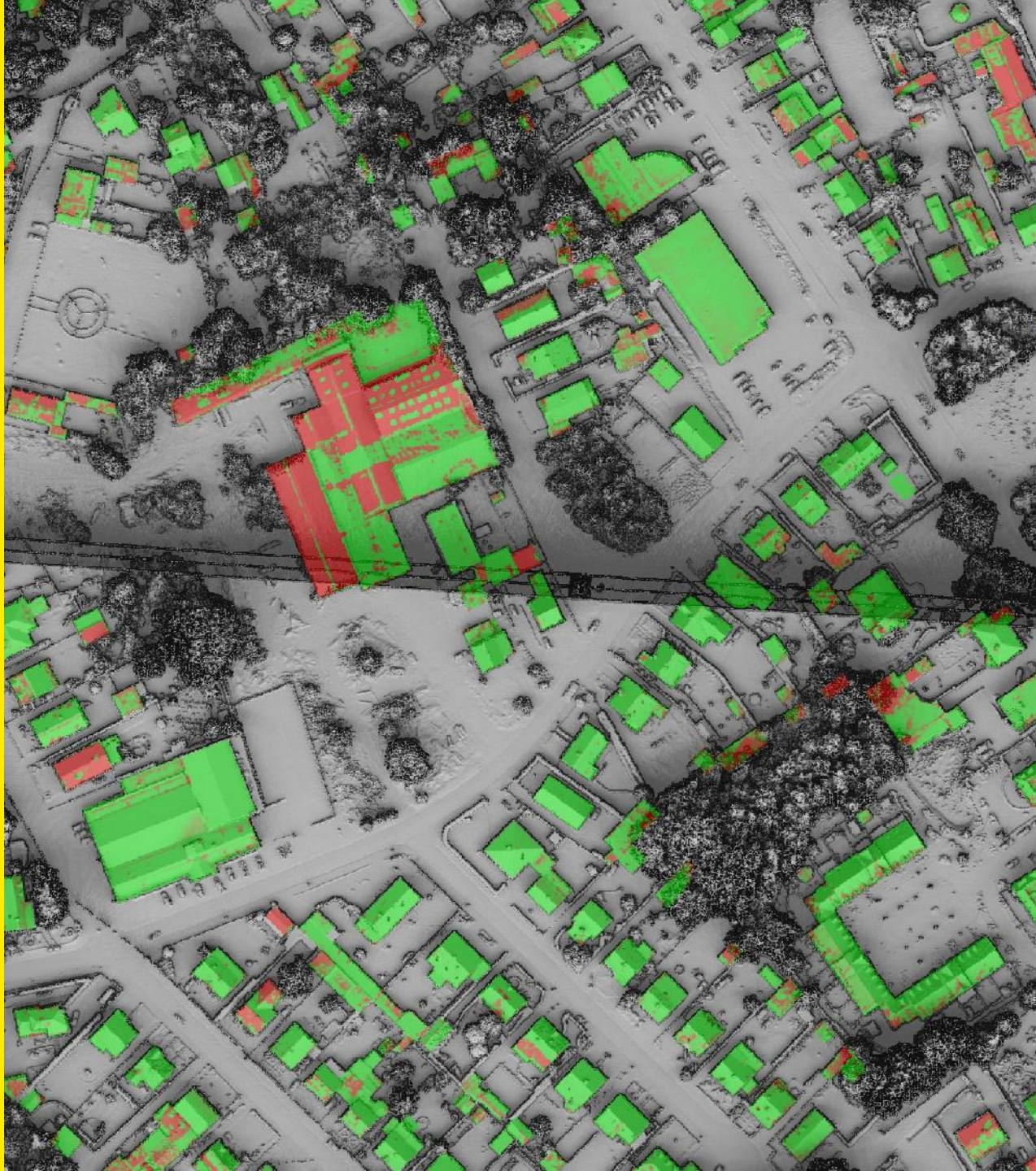
- Flemish “Actieplan asbestafbouw”
 - ▣ Removal



Aerial orthophoto mosaic, RGB10cm
(2013 – 2015)



Aerial orthophoto mosaic, RGB20cm
(2021)



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