Earth Observation
Artificial Intelligence
Use Cases Digitaal Vlaanderen

Earth Observation Data Science (EODaS)

Artificial Intelligence for NMCA’s
(27-28 October 20232)
Earth Observation: basis for mapping, monitoring, change detection, ...

or the recognition of objects and/or changes in the landscape for Mapping Agencies

- based on various sources, data and images
- use of various algorithms such as Machine learning
- Integration of sources with different spatial and temporal resolution,
- ...

Satellite images Sentinel
Spatial resolution: circa 10m
Temporal resolution: circa 3 days

Aerial images
Spatial resolution: circa 5-25cm
Temporal resolution: yearly, ...

Drone/UAV
Spatial resolution: circa 1-5
Temporal resolution: ad hoc, ...

2019 @ 10 m

25 cm
Agenda

USE CASES

• Satellite images
• Aerial images and LiDAR (DHMVII)
• LiDAR (DHMVI en DHMVII)

• inventarisation
• monitoring
• policy control
• change detection
The use of Satellite Images

SENTINEL-1 EN SENTINEL-2 TIME SERIES ANALYSIS > PROOF OF CONCEPT PROJECTS

EC+ESA: long-term guaranteed global availability of raw images.
Data continuity > 2023
Images: specifications

Aerial images:
- 25cm resolution
- 1x year

Sentinel-2:
- 10m resolution
- Via terrascope-Cropsar 1X day (fusion S1 + S2 day)
Triggers of changes

- Request of S1 & S2 time series via web-services
- No download necessary
Triggers of changes

SEASONALITY ➔ FREQUENCY DOMAIN

Zeer duidelijke 3de golffunctie verbonden aan een periode van 365 dagen, de 6de golffunctie corresponderend met een periode van 182 dagen wordt naar de achtergrond verdrongen (duidelijk verschil met landbouwvelden).
Agency Nature and Forest (ANB) : landuse/land cover maintaining permanent grasslands

Standard : monthly

Twice a week : March – May, September - Oktober
Policy Development and legal Support Department environment: Controll imperviousness

Operational scenario: monthly delivery of GIS layers reporting the changes to be verified
Step 1:
The LRD administrative layer is base for further segmentation, mean area 10-20 Sentinel pixels (1000 – 2000 m²)

Step 2:
Request for the Terrascope-Cropsar S1/S2 fuses time series of the “green index” for each parcel

Step 2:
Time series analysis makes it possible to investigate changes in land-use / land-cover. Changes are embedded in GIS-dataset.
RESULTS NEGATIVE CHANGES

Mostly negative
Mostly in the arable, grassland, forest/nature classes. These classes are easy to detect, so the vast majority will indeed be "Truly Negative". In a time series analysis across all field segments in a search region, more than 90% of the field segments will fall into this category by default. This has an impact on the "Confusion Matrix" as a statistical measure: we are dealing with "unbalanced classes": all plot segments have to be followed, but the changes we are interested in are sparse. This can lead to high accuracy, but still with poor correctness and completeness.

False negative
Frequently occurs when construction works start on areas that were virtually unvegetated or where the surface area of the (re)construction works is small compared to the area of greenery.
Digitaal Vlaanderen: GRB GBG/GBA change detection

RESULTATEN POSITIVE CHANGES

Really positive
When structures cause a substantial change in green cover, these are easy to detect.

False positive
Many false positive reports in agricultural/open areas due to, among other things: headlands, manure storage, storage, cultivation techniques (vegetables, long fallow). In urban areas there are many false positives because the Terrascope-CropSAR S1/S2 data fusion sometimes creates artifacts here, which in turn result in false positives.
Digitaal Vlaanderen : GRB GBG/GBA change detection

RESULTS S1/S2 BASES TIME SERIES ANALYSIS

• Algorithmic decisions using only the Terrascope-CropSAR S1/S2 service are not always clear and for now mainly useful in non-urban areas

• The S1/S2-based time series method only meets the requirement of “rapid detection”. Viewed across all plot segments, the method can be said to be accurate (good for general rapid screening), but not very precise for the types of changes the GRB tracking process is interested in. OK for quick trigger function.

• Additional methods are needed to also take into account geometric change parameters, in order to increase the “correctness/precision” of the reports.
TERRASCOPE – platform

**SIGNAL changes > Parcel inspector Flanders**

- Sentinel-1 + Sentinel-2: very powerful to detect indicative changes over time for Flanders.

- Plots with mixed land use: additional high-resolution data (better than 50 cm) needed throughout the year to visually/computer vision/AI detect the context for the change.

- Platform technology necessary to tailor technology/data to specific use cases and user needs.

Aerial images & LiDAR

INVENTARISATION, MONITORING, CHANGE DETECTION ... PARCEL, OBJECT, TERRAIN, ...

High quality requirements for raw data: in consultation with the contractors

High quality requirements derived information and its use: in consultation with the stakeholders

DATA

Open Backends

download.vlaanderen.be/
terrascope.be/
geoport.be/

Commercial imagery

Data integration
Data fusion + processing
Reporting (triggers)

Processing workflow

Decision Workflow
From trigger to action

Internal databases

DATA SCIENCE and AI

DATA

TRIGGERS

ACTIONS

POLICY

Industry

Agriculture

Infrastructure

Circular economy

Water

Interest and investigation for new Technics

EODaS & AI - Use Cases Digitaal Vlaanderen 27-28/10/2022
Aerial images & LiDAR

INVENTARISATION, MONITORING, CHANGE DETECTION, ... PARCEL, OBJECT, TERRAIN

Applicaties en algoritms are depending sensor, spatial en temporal resolution,

- Multispectral images winter: time series 2008 – 2022
- Multispectral images summer: time series 2009 – 2021
Agency for Care and Health

DETECTION OF ALL COOLING SYSTEMS (LEGIONELLA CONTAMINATION RISK)

Positive examples

Negative examples
DETECTION OF COOLING SYSTEMS (LEGIONELLA CONTAMINATION RISK)
VMM / Flemish environmental agency: inventarisation potential water channels

- Channels/didges are important water system and object in GRB (large scale Reference database of Flanders (LRD))
- But diverse &
- not all present in LRD!
> Need for update
VMM: inventarisation

Existing Water channels

deep learning ‘gracht’ probability (black = high chance)

The making of a first database of water channels

candidate channels – interpretation, connected, ...
VMM: inventarisatie

Study area (Zemst) – water channels as drainage system

Existing watercourses are well found +
New candidate water channels are found.
> Validation required

Dataset Water Channel
Info and Feedback

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