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Joint Workshop of the GOFC-GOLD SCERIN and MedRIN Networks

CIHEAM conference center, Chania, Greece, July 16 – July 19, 2024

Land Cover Change (LCC) and Extreme Events in the Context of Climate Change

Mediterranean Agronomic Institute of Chania
Region of Crete
Eratosthenes Center of Excellence, Cyprus University of Technology
Aristotle University of Thessaloniki
NASA LCLUC Program
GOFC-GOLD and START, USA

Municipal Solid Waste Landfill: Landscape Ecological Problem and Potential for Future

Subtitle: Remote Sensing Methods Applied for MSW Landfills

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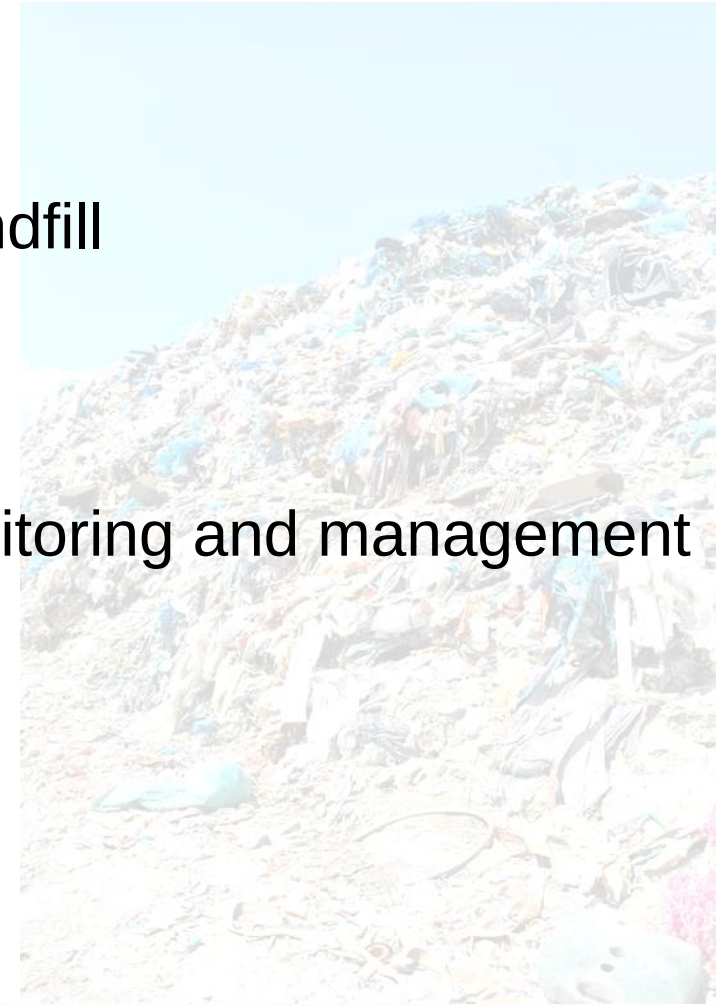
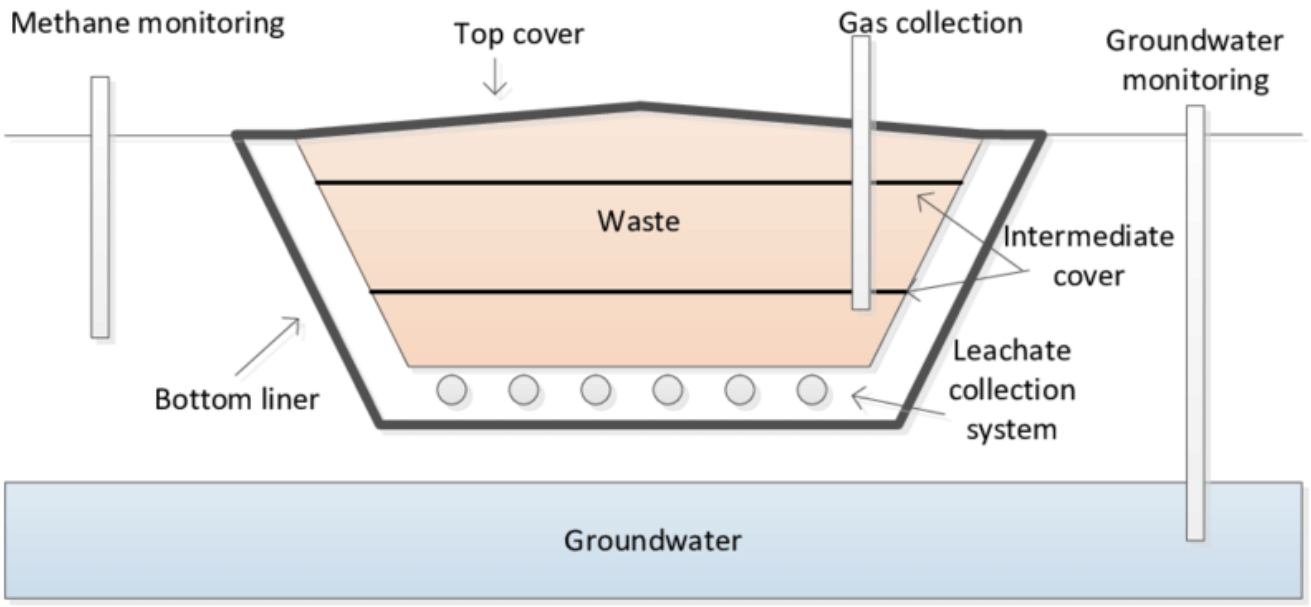
Overview

- Definition of municipal solid waste (MSW) landfill
- Ecological problems of MSW landfills
- Relevance to use RS methods in landfill monitoring and management
- Examples from our experience



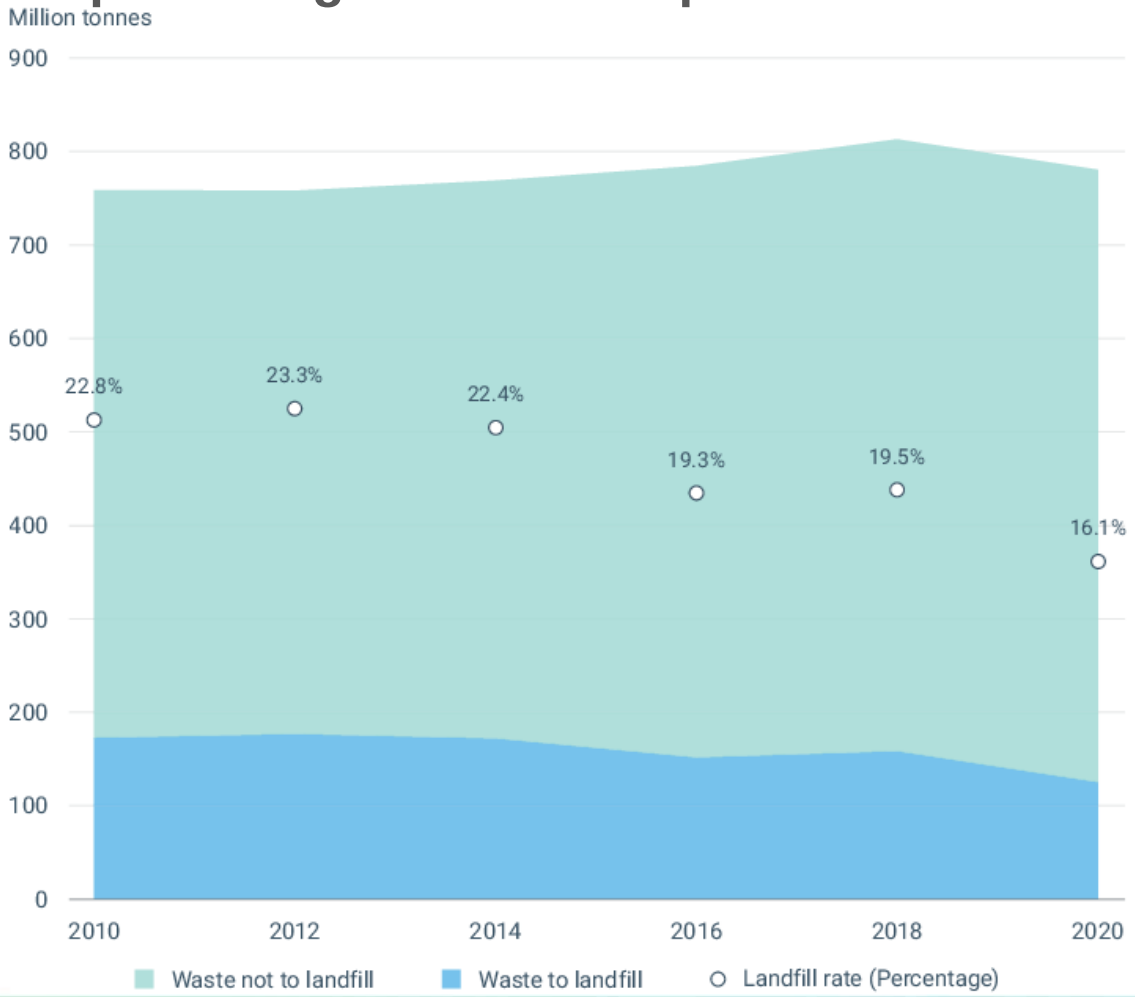
What is a municipal solid waste (MSW) landfill?



Vesilind et al. (2002)

Municipal Solid Waste (MSW) includes all items from homes and businesses that people no longer have any use for. These wastes are commonly called *trash* or *garbage* and include items such as **food, paper, plastics, textiles, leather, wood, glass, metals, sanitary waste in septic tanks, and other wastes**

Amounts and percentage of waste deposited in landfills in the EU

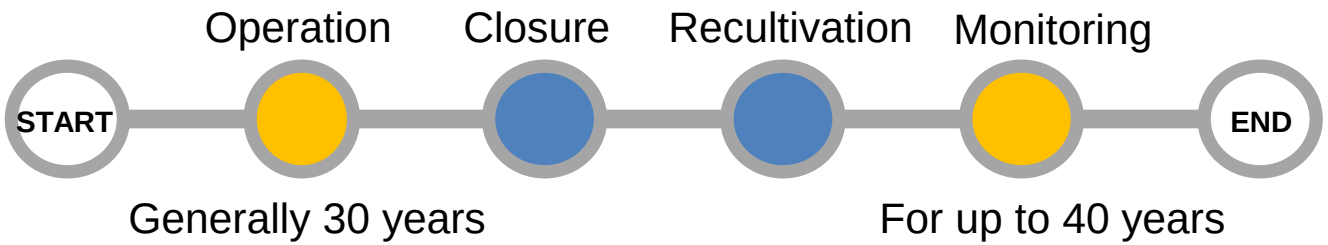


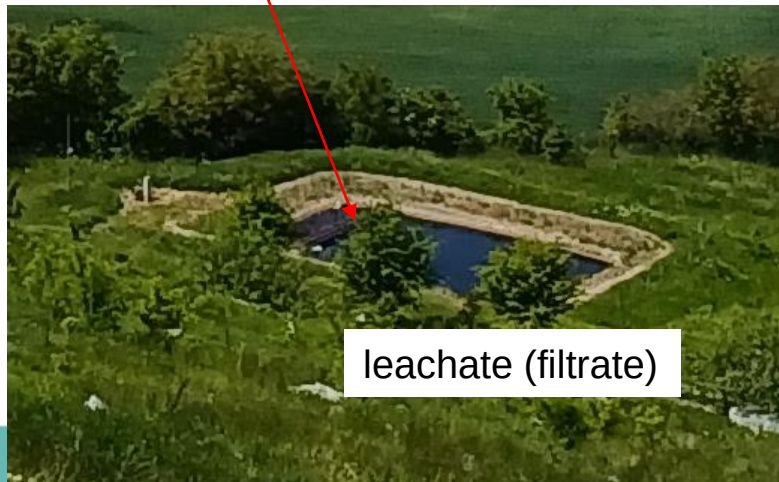
The key waste category landfilled is municipal solid waste.

European Environment Agency

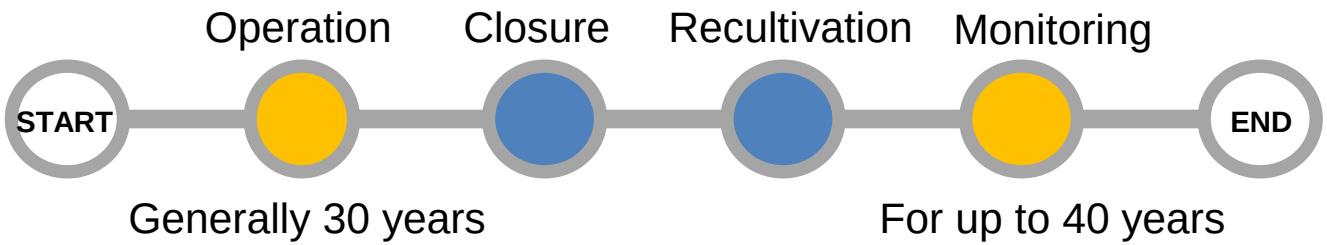
https://www.eea.europa.eu/en/analysis/indicators/diversion-of-waste-from-landfill

Ecological problems of a landfill



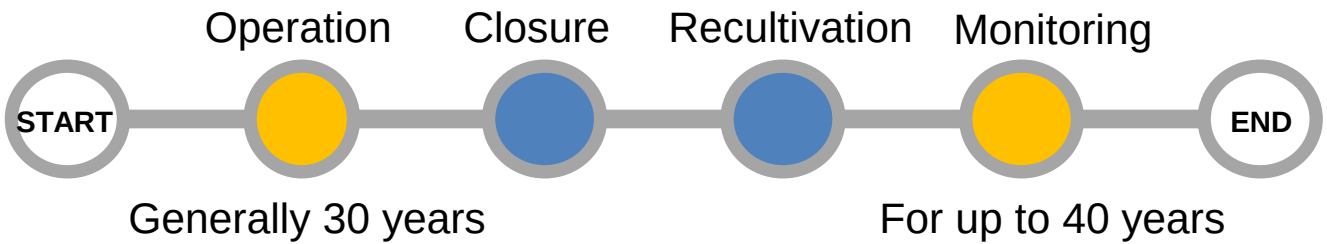


Ecological problems of a landfill



Discharge of leachate from landfill body

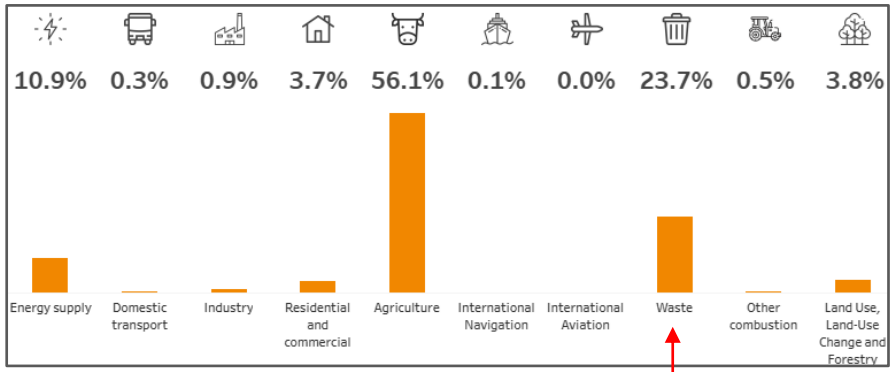
Ecological problems of a landfill



Discharge of leachate from landfill body

Release of methane from landfill surface

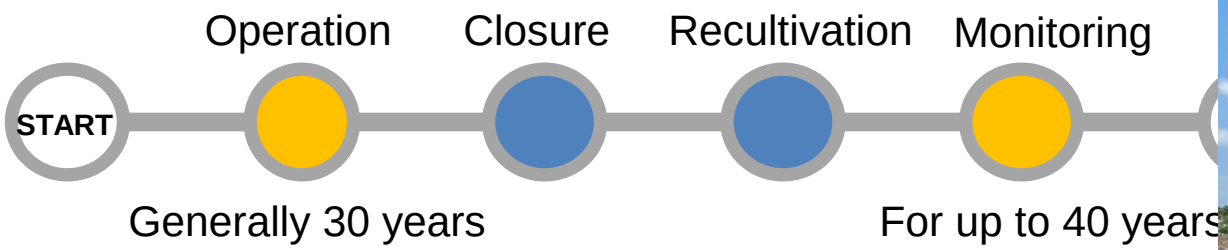
Methane emissions by sector in 2022 in EU (as percent of total methane emission)



https://climate-energy.eea.europa.eu/topics/climate-change-mitigation/greenhouse-gas-emissions-inventory/data

https://www.eea.europa.eu/publications/methane-emissions-in-the-eu

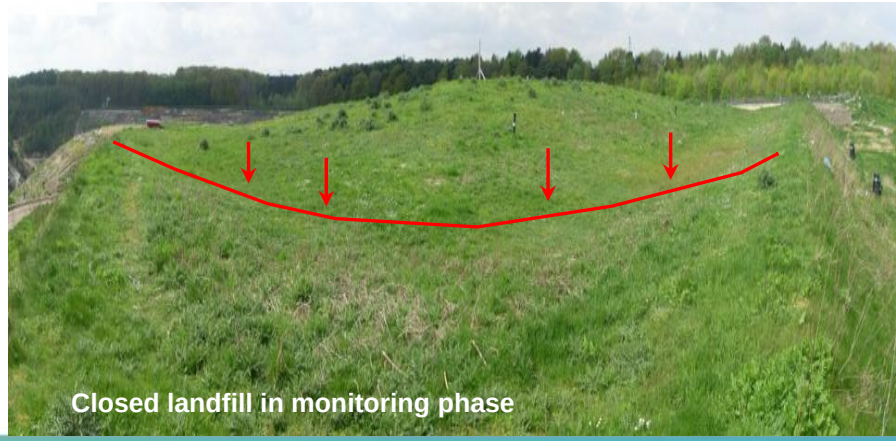
Ecological problems of a landfill



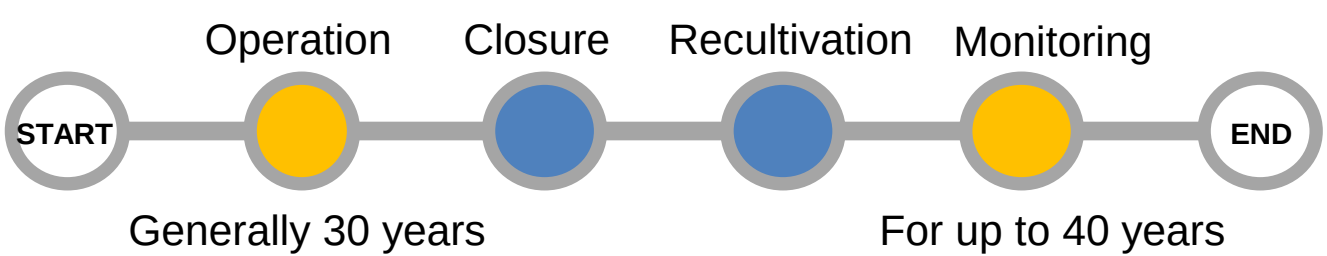
Discharge of leachate from landfill body

Release of methane from landfill surface

Landfill settlement



Ecological problems of a landfill



Discharge of leachate from landfill body

Release of methane from landfill surface

Landfill settlement

Spread of invasive plant species

RS methods in landfill monitoring

UAS

- detailed surface mapping (1 cm);
- detailed nDSM creation;
- thermal imaging to detect hotspots on landfill body;
- MS imaging to identify leachate seeps.

Airplane

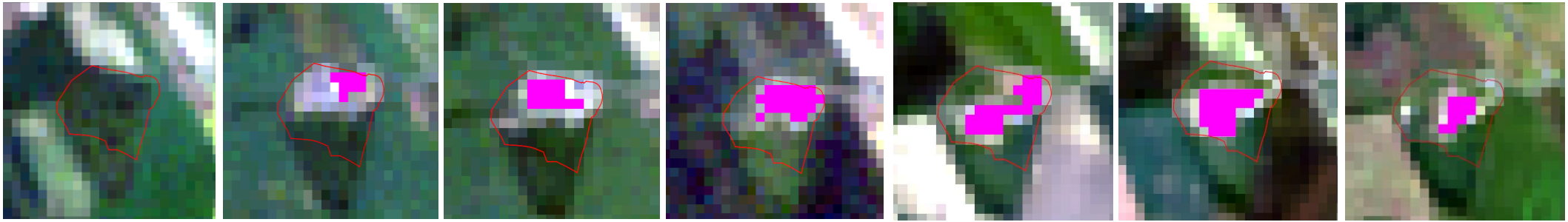
- airborne LiDAR for monitoring landfill volume and detecting subsidence;
- HS SWIR sensor to detect methane emissions;
- HS VNIR and SWIR data for vegetation monitoring.

Satellite

- consistent long-term data collection, enabling the analysis of changes over time;
- access to historical data for the assessment of landscape evolution;
- thermal imaging to identify large-scale heat anomalies;
- SAR data to detect ground movements.

Mapping changes in the active part of the landfill

Changes in the active part of the landfill (pink) using a **retrospective analysis** of Landsat 5 (1991, 1996, 2001, 2008) and Landsat 8 (2013, 2018, 2023) **satellite data**.



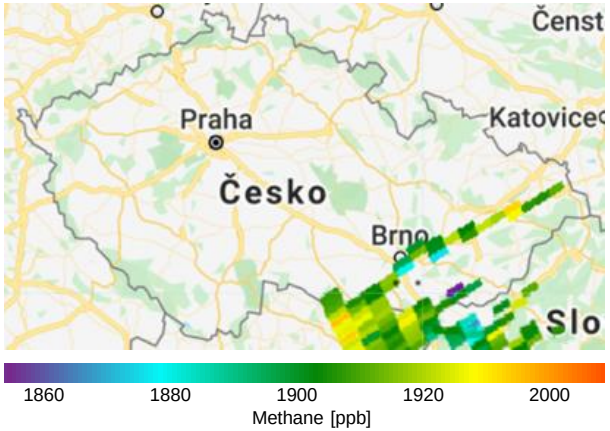
1991 1996 2001 2008 2013 2018 2023

In 1991, the landfill had not yet been established. The red line defines the boundary of the landfill area.

Detection of methane emissions from MSW landfill

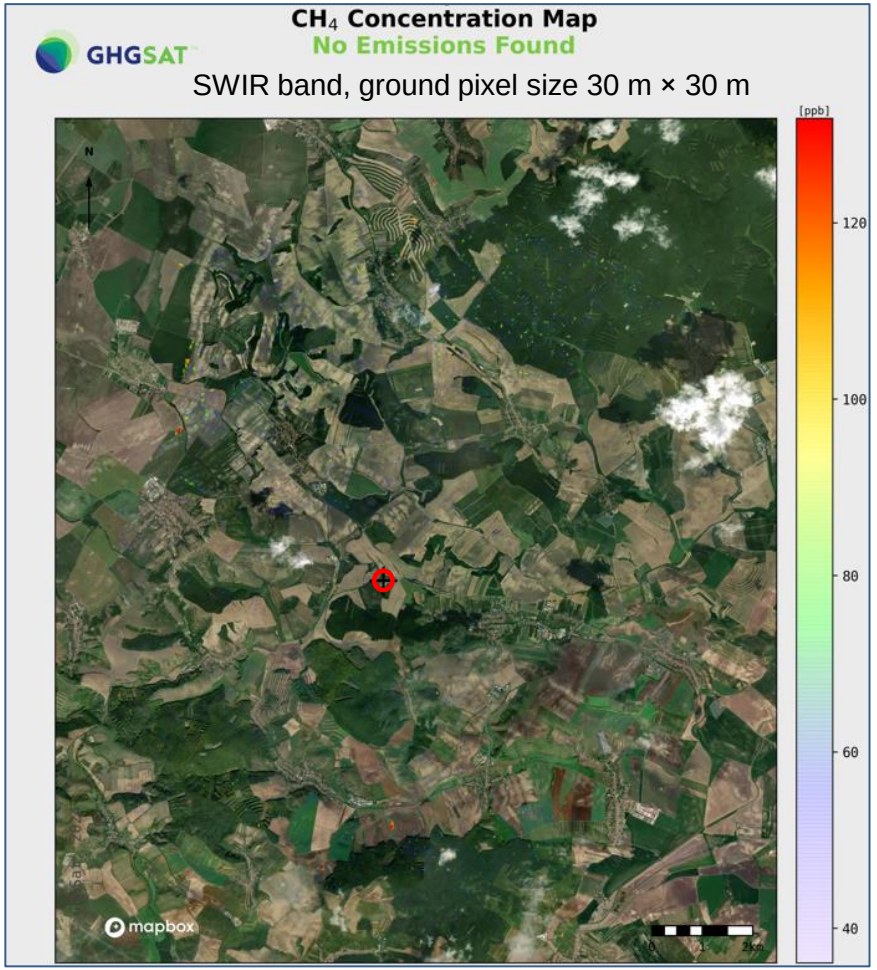
Satellites

Sentinel-5 Precursor, TROPOMI instrument,
Oxygen-A Band (760nm) and the SWIR range,
ground pixel size 7 km × 7 km



study object, landfill

EMIT, PRISMA, EnMAP
have not been studied in this research yet



GHGSat/ESA Earthnet - Project 96477

Airplane

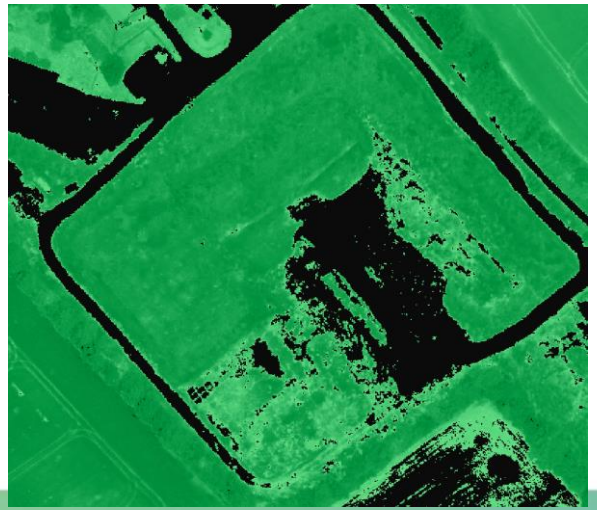
HS SWIR data,
ground pixel size 1 m × 1 m

Methane point sources from CH4 indexes

***In situ* CH_4 measurements:**
Min measured CH_4 concentration was **1980 ppb**
Max measured CH_4 concentration was **120600 ppb**

Monitoring of landfill vegetation

Vegetation cover

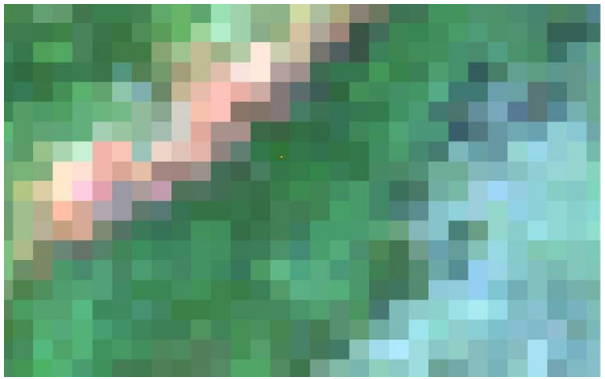


Vegetation structure and spreading of invasive species

Airplane 

UAS 

ground pixel size 1 m × 1 m

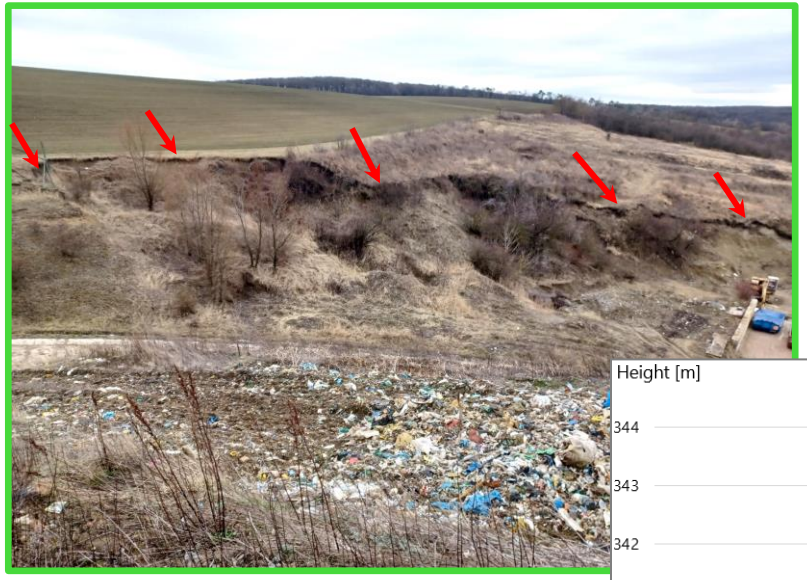


ground pixel size 0.1 m × 0.1 m

Municipal solid waste landfill, airborne campaign 28.5.2023

Detection of landfill slope movement

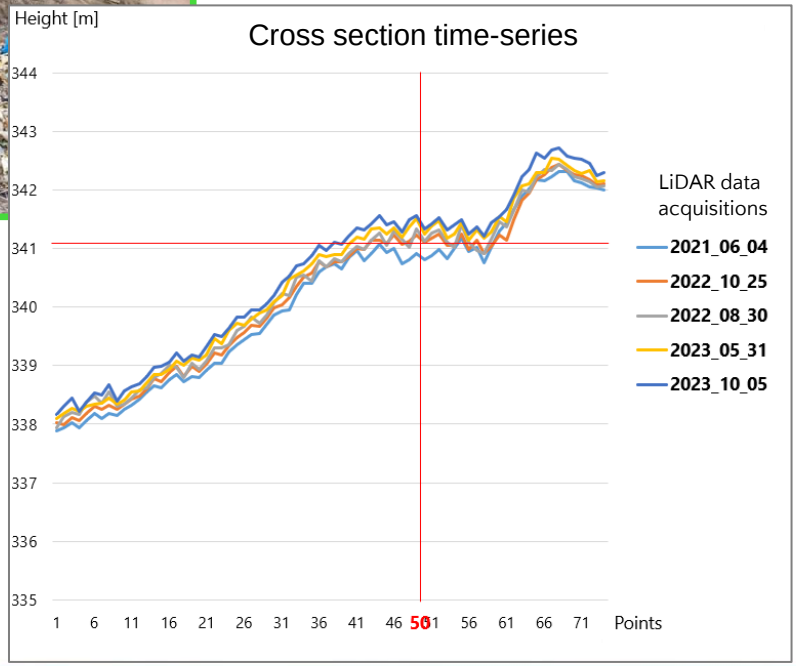
Airplane 



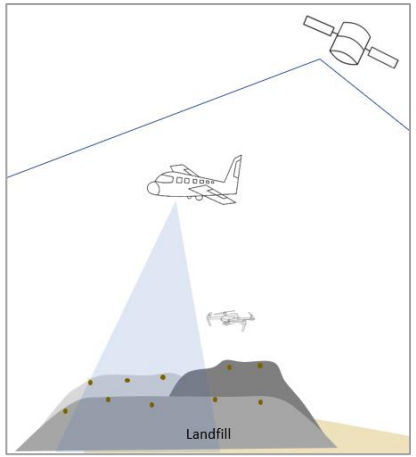
cross section

direction of slope movement

MaxDiff over 3 years is 68 cm
AverageDiff over 3 years is 40 cm



Thank you for your attention!



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