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AI-Based Geospatial Intelligence for Illegal Waste Detection in the European Union: Opportunities and Legal Considerations under the AI Act and Data Protection Laws

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Illegal waste disposal remains a persistent environmental and legal challenge in the EU, contributing significantly to pollution and climate change. This article explores the potential of AI-based geospatial intelligence, such as UAV-assisted aerial monitoring, to support the detection and inspection of illegal landfills by LEAs. The research aims to assess both the opportunities and the legal implications of such technologies. The study combines legal analysis with a case study of the EU-funded PERIVALLON project. The paper identifies and discusses the relevant EU legal frameworks in the fields of AI governance and personal data protection. It concludes that while AI-driven geospatial tools offer substantial potential for environmental law enforcement, their deployment must be carefully aligned with EU legal standards to ensure compliance.

Keywords: *Illegal waste disposal, artificial intelligence, geospatial intelligence, UAV, personal data protection*

1. Introduction

Every year, over two billion tons of waste are generated globally and without urgent action, this figure could rise to 3.8 billion tons by 2050 (UNEP 2024). Waste disposal, one of the greatest environmental challenges, heavily contributes to carbon dioxide and methane emissions and, thus, to human-induced climate change (Pata–Pata 2025). Landfilling is one of the most conventional and cost-effective waste disposal methods, with at least 17% of Europe's waste being landfilled (European Environment Agency 2024). However, it is also the most environmentally harmful option (Abubakar et al. 2022). Its negative impacts are exacerbated by illegal waste disposal, an ongoing global issue and multibillion-euro illegal business (Europol 2022).

To effectively combat illegal waste disposal in the European Union (EU), European authorities must act proactively (Lundh 2024). Advancements in digital technologies, such as Global Positioning System (GPS) tracking, remote sensing, and geographic information systems (GIS), offer opportunities for tackling waste crime, which often requires large-area monitoring (Isarin et al 2024a). Artificial Intelligence (AI)-based geospatial intelligence using unmanned aerial vehicles (UAVs) is being explored in the EU as an effective tool against environmental crimes (Youme et al. 2021). Such technology could help European law enforcement automatically detect, characterize, and inspect illegal landfills, tasks which are still often executed manually (Torres–Fraternalli 2021).

Nonetheless, the development of AI-based geospatial intelligence has specific legal implications in the EU. This paper provides a brief overview of the opportunities of

such technologies and identifies key legal considerations, specifically in the fields of AI governance and personal data protection.

The analysis draws on doctrinal legal research involving the review and interpretation of applicable legislation, non-doctrinal research encompassing the review of reports and other documents from UN and EU institutions and initiatives, a case study based on the EU-funded project PERIVALLON, and a literature review of published journal articles.

The study is divided into two sections:

- an overview of the current situation of illegal waste disposal in the EU and the potential of AI-based geospatial intelligence, and
- an analysis of the applicable European legal framework in the aforementioned fields.

The first part provides an overview of illegal waste disposal in the EU and examines the opportunities of AI-based geospatial intelligence for the detection, characterisation and onsite inspection of illegal landfills by law enforcement authorities (LEAs). To illustrate the practical application of these technologies, the EU project PERIVALLON, which is developing tools for automated analysis of aerial images for the detection and characterisation of illegal waste landfills and land pollutants, serves as a case study.

The second part provides a legal overview of the applicable European legal framework relevant for the development of AI-based geospatial intelligence tools. Particularly, given AI's significant role in intelligent threat detection tools for environmental crime prevention, and the unique personal data protection risks that they may pose, the legal analysis focuses on the EU AI Act (*Artificial Intelligence Act 2024*), as well as the General Data Protection Regulation (*General Data Protection Regulation 2016*) and the Law Enforcement Directive (*Law Enforcement Directive 2016*).

2. Illegal Waste Disposal and the Potential of AI-Based Geospatial Intelligence

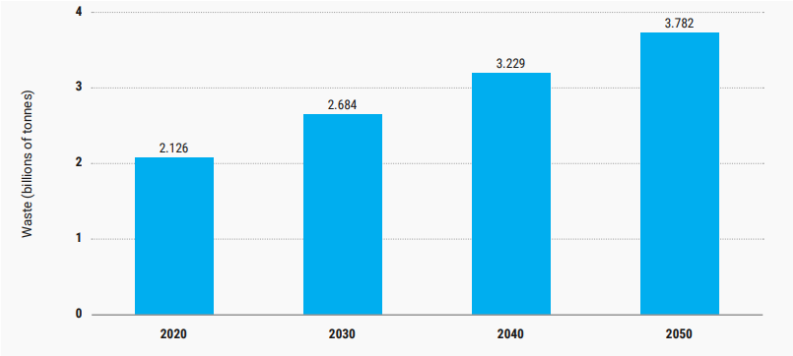
This chapter explores the challenge of illegal waste disposal in the EU and highlights the potential of AI-based geospatial intelligence to support monitoring, detection, and enforcement efforts by LEAs. It begins by outlining the scale and environmental impact of illegal dumping across the EU, followed by an examination of emerging technological solutions, particularly those involving AI and remote sensing. As a practical example, the EU-funded project PERIVALLON is presented as a case study.

2.1. The Scale and Environmental Impact of Illegal Waste Disposal in the EU

The challenge of waste management has become a defining issue of the 21st century, driven by rising populations, consumption patterns, and a predominantly linear economic model (Minelgaitė–Liobikienė 2019). Despite a global increase of policies and initatives encouraging transition to a circular economy, which supports reuse, repair and recycling of waste (Isarin et al. 2024a), over two billion tonnes of municipal waste

are generated annually across the world. This figure is projected to rise to 3.8 billion tonnes by 2050 if no urgent measures are adopted (Figure 1, UNEP 2024).

Figure 1. Projections of global municipal solid waste generation per year in 2030, 2040 and 2050 if urgent action is not taken



Source: UNEP (2024)

These figures primarily reflect municipal solid waste, originating from households, retail, small businesses, and public services, which represents only a (comparatively small) fraction of the total waste stream (UNEP 2024). However, beyond municipal solid waste, a wide variety of other waste types are generated through human activity. These can be classified in multiple ways, such as by material, product type, or source and include examples such as plastic waste, electronic waste and construction waste, all of which contribute significantly to the overall volume of global waste.

Although different types of waste have varying environmental impacts, all forms of waste, from hazardous to biowaste, affect the environment, as well as society and global economy, in different degrees. As a result, the EU has established a waste hiearchy, prioritizing prevention, reuse, and recycling over disposal, as the latter is considered to be the least desirable option (Figure 2, *Waste Framework Directive, Article 4*).

Figure 2. EU Waste hiearchy

Source: European Commission (2025)

With respect to the environmental impact, waste disposal counts as one of the greatest environmental challenges, heavily contributing to carbon dioxide and methane emissions and, thus, to human-induced climate change (Pata–Pata 2025). Yet, waste disposal remains widespread. Specifically, landfilling is one of the most conventional and cost-effective waste disposal methods worldwide, but also in Europe, where 306 kg of waste per EU citizen was landfilled in 2022 (European Environmental Agency 2024).

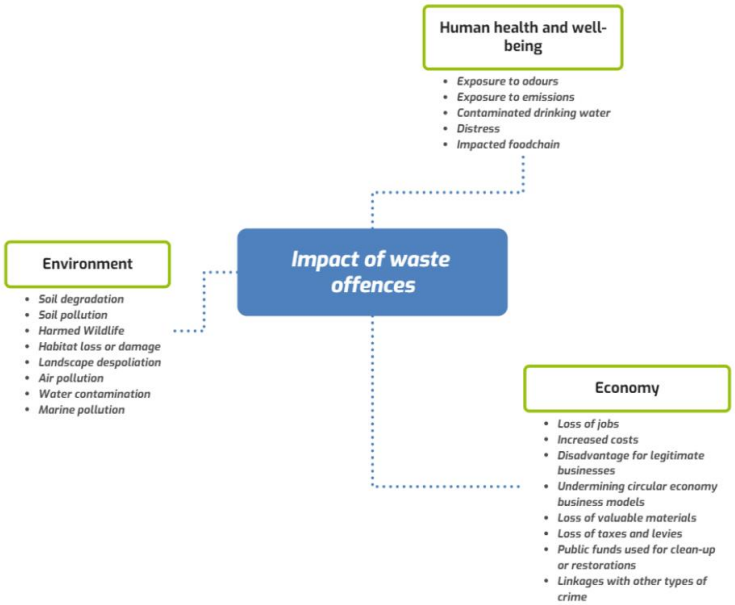
This paper therefore focuses on landfilling, which is the most environmentally harmful disposal method (Abubakar et al. 2022). While sanitary or controlled landfilling involves engineered facilities designed for regulated solid waste disposal, it still poses environmental risks. These are significantly worsened by illegal waste disposal, characterized by inadequate site selection, absence of containment barriers, lack of technology for gas or energy recovery, and insufficient security measures (UNEP 2024). According to estimates, 33% of solid waste is disposed of in illegal waste disposal site or unmonitored landfills (Kaza et al. 2018).

Common regulatory violations include illegal disposal, open burning, improper waste categorization and inadequate storage or recycling conditions (Isarin et al. 2024b, UNEP 2024). Once illegally disposed waste reaches its destination, often via illicit trafficking routes, it typically ends up in unauthorized landfills or storage sites, contaminating soil, groundwater, and marine ecosystems (UNODC 2021). Such activities are usually associated with organized crime and can be highly lucrative, thus remaining an ongoing global issue and multibillion-euro illegal business (Europol 2022). Dumping of waste, refering to indiscriminate disposal (littering) and to the accumulation of waste at uncontrolled dumpsites, was the dominant disposal choice globally until the middle of the last century (Cristóbal et al. 2022, Alao et al. 2023, UNEP 2024).

Both waste generation and its management have signifcant negative environmental impacts, contributing to climate change, biodiversity loss and pollution. Namely, transporting, processing and disposing of waste generates CO2 and other greenhouse gases and airborne pollutants that contribute to climate change (Figure 3). Furthermore, indiscriminate waste disposal practices can introduce hazardous chemicals into soil, water bodies and the air, causing long-term, potentially irreversible damage to local fora and fauna, negatively impacting biodiversity, harming entire ecosystems, and entering the human food chain (UNEP 2024).

A significant proportion of dumpsites are on or near coastlines, where they may leak toxic, long-lasting chemicals, plastics, and other waste into the environment. Additionally, illegal landfills are also prone to fires that may burn underground for months and are extremely difficult to extinguish. The pollution from such fires is hard to measure accurately, as it depends on the waste type and burning temperature, but studies show that these fires expose millions of people to dangerous pollution levels. Moreover, illegal waste sites often pose landslide risks, with several deadly incidents reported each year (Ospanbayeva–Wang 2020, UNEP 2024).

Figure 3. Impact of waste offences



Source: Environmental Compliance Assurance Guidance Documents – Combating Environmental Crimes and Related Infringements, European Commission (2021) modified; UNEP (2024)

Given the scale and complexity of illegal waste disposal as one of the main activities encompassed in the environmental crime (Rabbi 2024) and its environmental consequences, there is an urgent need for more effective monitoring and enforcement mechanisms. AI-based geospatial intelligence technologies show considerable promise, particularly for detecting and characterising illegal landfills. The next section explores these technological opportunities in more detail, specifically in the EU.

2.2. Technological Opportunities for Monitoring and Enforcement

Efforts to combat waste crimes have so far primarily focused on digitalizing data and facilitating information exchange among authorities, rather than directly transforming such data into actionable enforcement measures. Current digital tools include online platforms that integrate compliance and enforcement information, as well as electronic databases that collect and verify waste-related data. Some governments employ integrated approaches leveraging these tools to enhance compliance monitoring, and respond effectively to regulatory violations (Isarin et al. 2024a).

However, despite the severe environmental impacts of illegal waste disposal, monitoring vast territories using aerial images from satellites and UAVs remains largely manual and dependent on expert analysis (Torres–Fraternalli 2021). Advanced applications of AI to detect waste and pollutants from aerial imagery, possibly combined with GIS data, are still rare, and public datasets to train such machine learning models are scarce (Youme et al. 2021).

While AI is rapidly advancing and gaining traction in various industries, including waste management (Abdallah et al. 2020), its use in combating illegal waste activities remains limited. Greater connectivity of digital tools and application of AI could leverage predictive analytics, integrating deep learning to improve satellite imagining, and inform compliance monitoring and responses to non-compliance (Isarin et al. 2024a). Nonetheless, challenges persist. Most notably, the lack of comprehensive data on waste crime, which hinders governments' ability to detect patterns and effectively allocate enforcement resources.

To tackle these challenges, the EU is, among other endeavors, supporting projects that apply AI and geospatial tools to fight environmental crime. An example of such initative is the PERIVALLON project.

2.3. Case Study: The PERIVALLON Project

PERIVALLON is an EU funded project which started in 2022 and which is projected to end in 2025. It aims to enhance the intelligent visualisation of organised environmental crime and develop effective tools for its detection, prevention, and for conducting comprehensive environmental impact assessments. The project leverages geospatial intelligence, remote sensing, online monitoring, risk assessment, and predictive analytics, combined with cutting-edge AI, computer vision, and multimodal analytics. These technologies will support improved investigation methodologies and insights through the project's environmental crime observatory (PERIVALLON 2023).

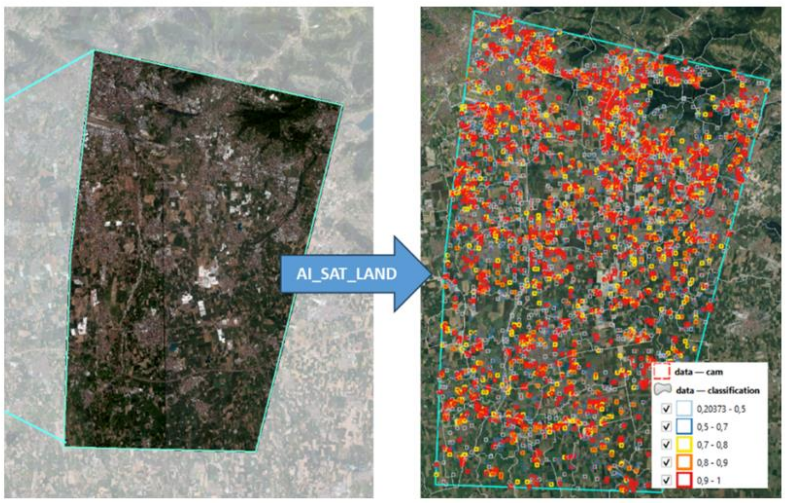
One of the main objectives of the PERIVALLON project is to develop AI-based geospatial intelligence solutions and apply them to earth observation imagery captured by satellites to detect activities potentially related to environmental crimes, particularly those related to illicit waste management. In the context of illegal waste disposal, PERIVALLON aims to build a geospatial intelligence platform for the automatic detection, characterisation and onsite inspection of landfills. The environmental crime monitoring centre of the PERIVALLON platform will enable the relevant authorities to navigate the entire lifecycle of geospatial intelligence, from monitoring, to mission planning and execution, to the update of the knowledge encoded in the AI models (PERIVALLON 2023).

Like other EU-funded projects, PERIVALLON includes pilot use cases to test its planned real-world applications. One such case focuses on detecting illegal waste disposal. According to the scenario, an environmental agency aims to use high-resolution satellite imagery to detect illegal landfills across a large area. Currently, such authorities rely on expert personnel to manually analyse aerial images, identify potential illegal sites, and tag them with metadata on threat level, site extent, waste type, and inspection priority. This process is time-consuming and costly, limiting large-scale applications. The integration of AI technologies, allowing for more frequent and comprehensive monitoring, could help overcome these challenges.

Accordingly, PERIVALLON is developing a geospatial intelligence platform for automated landfill detection, characterisation, and inspection. Expert interpreters will help build training datasets for advanced models that can identify various waste types, based on European waste codes in diverse imagery with high precision. These

models will process heterogeneous inputs, including satellite, UAV and GIS data, to detect waste at multiple scales. Detection will occur both offline and in real-time. A 3D reconstruction feature will enable volumetric analysis of waste. The platform's environmental crime monitoring centre will support the full geospatial intelligence cycle, from monitoring and mission planning to model updates. With PERIVALLON, environmental agencies can expect to significantly cut monitoring time, reduce personnel costs, and improve detection accuracy (PERIVALLON 2023). An example of preliminary results is shown in *Figure 4,* which displays outputs from a test model applied to the full imagery dataset of the area of interest, highlighting squared tiles where the algorithm detected waste, classified by confidence level.

Figure 4. Outputs from a test model applied to the whole imagery dataset available in the area of interest



Source: DigitalGlobe, Inc. (2024), provided by European Space Imaging; PERIVALLON (2024)

The case of PERIVALLON illustrates the potential of AI-driven technologies in addressing illegal waste disposal and strengthening the broader fight against environmental crime. Yet, the development and operational use of these emerging intelligent solutions must align with a complex and evolving EU legal landscape. The next section outlines key legal instruments relevant to such applications, focusing on the EU AI Act and relevant personal data protection law, namely the GDPR and the LED.

3. Applicable EU Legal and Regulatory Framework in the Fields of AI Governance and Personal Data Protection

3.1. The AI Act and Its Implications

The EU adopted the world's first comprehensive and standalone law on AI governance, i.e., the Artificial Intelligence Act (*Artificial Intelligence Act 2024*, AIA),

on May 21, 2024. The AIA governs the whole lifecycle of AI systems within the EU, from their development to their deployment on the market. This law aims to create a balance between innovation and safety and entered into force on 1 August 2024. It will be generally applicable to most AI systems on 2 August 2026 (Article 113 AIA), with some exceptions. The term "AI system" is defined by the AIA as

> "a machine-based system that is designed to operate with varying levels of autonomy and that may exhibit adaptiveness after deployment, and that, for explicit or implicit objectives, infers, from the input it receives, how to generate outputs such as predictions, content, recommendations, or decisions that can influence physical or virtual environments (Article 3 (1) AIA)".

AI-enabled analysis of geospatial images to detect and localize illegal waste disposal sites is an example of an AI system covered by the AIA.

It is to be noted that the AIA classifies AI into two distinctive groups: (1) general purpose AI models (GPAI) and (2) other AI systems which, unlike GPAI models, have an end-purpose. The latter group is particularly relevant in the context of the current analysis, as the considered AI systems used for AI-based geospatial intelligence are developed for a specific purpose, namely to automatically and thoroughly process geospatial data to inform law enforcement authorities actions.

Specifically, for AI systems having a predefined application, the AIA adopts a risk-based approach and categorizes AI systems into four risk categories: (1) AI systems presenting minimal risks, (2) AI systems presenting limited risks, (3) AI systems presenting high risks, and (4) AI systems presenting unacceptable risks. While the AIA prohibits AI systems classified as presenting "unacceptable risks" since 21 May 2024, it also introduces an array of legal obligations for high-risk and limited risk AI systems, which will be applicable starting August 2027 (Article 113 AIA).

AI systems presenting "high-risk" are authorized on the EU market if they comply with specific requirements provided by the AIA. On the other hand, AI systems posing "limited risk" only need to adhere to minimal transparency obligations, while AI systems presenting "minimal risks" are exempt from specific obligations. It is thus necessary, for each different AI system, to perform a thorough technical and legal analysis in order to classify said system in the according risk category introduced by the AI and, subsequently, to ensure the compliance with all relevant legal obligations.

It is to be noted that the AIA imposes important requirements, particularly for "high-risk" AI systems, which are deemed as having the potential to adversely impact people's safety or fundamental rights. The AIA provides classification rules for high-risk AI systems (Article 6 AIA) and specific requirement. These include (a) the obligation for the AI system to incorporate a risk management system (Article 9 AIA), (b) the requirement that the AI system includes a data governance and management system, ensuring it is trained and validated on datasets that meet specific quality criteria (Article 10 AIA), (c) the obligation for the AI system to be accompanied by technical documentation demonstrating its compliance with the AIA (Article 11 AIA), (d) the requirement that the AI system ensures thorough record-keeping, *i.e.*, the automatic recording of events (logs) over its lifetime (Article 12 AIA), (e) the

obligation that the AI system is designed to ensure sufficient transparency to enable deployers to interpret its output and use it appropriately (Article 13 (1) AIA), (f) the obligation for the AI system to be designed to provide necessary information to deployers (Article 13 (2) AIA) and to allow for comprehensive human oversight (Article 14 AIA), (h) the obligation that the AI system is developed to achieve an appropriate level of accuracy, robustness, and cybersecurity throughout its lifecycle (Article 15 AIA).

The AIA further introduces specific legal obligations for a number of stakeholders along the AI value chain, such as providers of high-risk AI systems (Articles 16 to 21 AIA) and deployers of high-risk AI systems (Articles 26 and 27 AIA). Notably, Article 27 AIA provides that if the high-risk AI system deployer is a public a body governed by public law, or a private entity providing public services, a fundamental rights impact assessment (FRIA) will be required prior to deployment (Article 27 AIA). Carrying out a FRIA will thus be required by law enforcement authorities (LEAs) before using a high-risk AI-based geospatial intelligent tool, as LEAs are public bodies. Under AIA, The AI Office is tasked with developing a template for a questionnaire to facilitate deployers in complying with their FRIA obligations (Article 27 (5) AIA). At the moment of writing, the FRIA questionnaire template has not yet been made available by the AI Office.

The development and deployment of AI systems for geospatial intelligence for illegal waste detection will require a thorough risk analysis to classify the AI system in its corresponding risk category according to the AIA. Article 6 AIA provides classification rules for high-risk AI systems and specifies that AI systems are considered as high risk if (a) the AI system is intended to be used as a safety component of a product, or the AI system is itself a product, covered by the Union harmonisation legislation listed in Annex I AIA (Article 6 (1) (a)) and (b) the product is required to undergo a third-party conformity assessment pursuant to the Union harmonisation legislation listed in Annex I (Art. 6 (1) (b)).

Regarding the condition (a), the AIA defines "safety component" as "a component of a product or of an AI system which fulfils a safety function for that product or AI system, or the failure or malfunctioning of which endangers the health and safety of persons or property" (Article 3 (14) AIA). Furthermore, point 20 of Annex I AIA may have implications in the context of AI-based geospatial intelligence using UAVs, as it refers to the EU Regulation on common rules in the field of civil aviation and establishing a European Union Aviation Safety Agency. In particular, the later targets the design, production, and placing on the market of unmanned aircraft, their engines, propellers, parts, and remote-control equipment (Annex I, 20 AIA). If both of these cumulative conditions are met, then the AI system will be classified as high-risk under the AIA.

In addition, article 6 (2) AIA provides that AI systems referred to in Annex III of the law shall be considered to be high-risk (Article 6 (2) AIA). Notably, this annex specifies on its point 6 that AI systems used for some specific uses in the area for law enforcement will automatically be considered as high-risk. These uses include victim risk assessment (Annex III, 6 (a) AIA), lie detection tools (Annex III, 6 (b) AIA), evidence reliability analysis (Annex III, 6 (c) AIA), offense risk prediction (Annex III, 6 (d) AIA), and criminal profiling of natural persons (Annex III, 6 (e)

AIA). Intelligent threat detection tools for environmental crime prevention are thus not covered by point 20 of the Annex III, nor, as a matter of fact, any other point in this section of the law.

In the event that an AI system used to process geospatial imagery for illegal waste site detection is embedded in the UAV and also performs safety functions such as object detection or threat classification, then it may qualify under article 6 (1) (a) AIA. If the concerned UAV is also required to undergo a third-party conformity assessment, then it will be classified as high-risk under the AIA, as both conditions under article 6 (1) AIA will be met. This is further supported by Recital 50 AIA, which specifically mentions aviation among the sectors where AI systems that are safety components of products or which are themselves products should be classified as high-risk when subject to third-party conformity assessment under relevant Union harmonisation legislation.

3.2. Data Protection Law

An additional legal area that is particularly relevant in the context of AI-based geospatial intelligence for illegal waste detection in the EU is data protection. The deployment of such technology, which relies on geospatial intelligence for automatic detection, characterisation and onsite inspection of landfills, may involve, even without intention, the processing of personal data by the end-user. Consequently, operators should be mindful about where they fly UAVs, as the simple presence of such a machine over someone's property may be perceived as, or cause, a violation of privacy (Scott et al. 2024).

As a general note, the concept of data protection comes from the right to respect for private and family life (the right to privacy), and is instrumental in preserving and promoting fundamental values and rights. Accordingly, the Charter of Fundamental Rights of the European Union (CFREU) stipulates that everyone has the right to the protection of personal data concerning them (Art. 8 (1) CFREU). In line with this, the protection of natural persons regarding their personal data is specifically regulated within the EU under the General Data Protection Regulation (GDPR) and the Law Enforcement Directive (LED).

Personal data is defined identically by these two regulatory texts, namely as:

> "any information relating to an identified or identifiable natural person ('data subject'); an identifiable natural person is one who can be identified, directly or indirectly, […] by reference to an identifier such as a name, an identification number, location data, an online identifier or […] factors specific to the […] identity of that natural person" (Article 4 (1) GDPR; article 3 (1) LED).

The broad nature of this definition ensures a comprehensive protection of personal data, which also includes images or geolocation data that could identify individuals. Such data processing may result from the usage of AI-based geospatial intelligence for illegal waste detection, particularly in cases where UAVs are used. By contrast, personal data processing with satellite imagery still proves to be challenging

(Golej et al 2024), although technical advancements, such as in the field of AI, are expected to significantly improve the resolution and analysis of satellite imagery (Thangarasu et al 2025).The GDPR and LED are complementary, in the sense that the former provides overarching data protection principles and rights, while the latter provides specific rules and safeguards for the law enforcement sector, when the data processing is carried out for specific purposes explicitly listed in article 1 (1) LED. These include the prevention, investigation, detection or prosecution of criminal offences or the execution of criminal penalties, including the safeguarding against and the prevention of threats to public security. Should personal data be processed by LEAs for any other purpose, the GDPR will become applicable instead of LED (Article 9 (1) LED).

The LED further sets out rules for protecting personal data processed by competent authorities for preventing, investigating, detecting, or prosecuting crimes, enforcing penalties, and safeguarding public security (Article 1 (1) LED). Under the LED, competent authorities include police and other authorities with criminal law enforcement powers (Article 3 (7) LED). Furthermore, processing must be necessary for the performance of a task carried out by a competent authority for a law enforcement purpose, and based on Union or Member State law (Article 8 (1) LED). It must also be limited to what is strictly necessary and proportionate in a democratic society (Article 8 (1), recital 26 LED).

It is likely that the use of AI-based geospatial intelligence and UAVs for illegal waste detection by LEAs satisfies this necessity criterion, as it bolsters the detection and investigation of environmental crimes by the competent LEAs (i.e., those having the competence to carry out such law enforcement tasks). However, the assessment of the necessity and proportionality of using such instruments should be carried out by LEAs for each use case (Kurtpınar et al. 2024).

Accordingly, the deployment of AI-based geospatial tools by LEAs will fall under the LED if two conditions are met: (i) the end-users of such systems are LEAs, and (ii) the processing is for one of the specific purposes outlined in Article 1(1) LED.

If the LED does not apply, the GDPR governs the processing of personal data. This law provides that no personal data can be processed without the consent of the data subject or some other legitimate basis, as provided by the law (Article 5 (1) (a), recital 39 GDPR). Namely, these basis for processing include the following: (a) the data subject consents to the processing, (b) the processing is necessary for the performance of a contract, (c) for the compliance with a legal obligation, (d) in order to protect the vital interests of the data subject or of another natural person, (e) for the performance of a task carried out in the public interest or in the exercise of official authority vested in the controller, or (f) for the purposes of pursuing the legitimate interests by the controller or by a third party (Article 6 (1) (a) to (f) GDPR). For LEAs acting as public bodies performing tasks in the public interest, legal basis (e) may be particularly relevant, as it permits data processing necessary for tasks carried out in the public interest.

4. Conclusion

Illegal waste disposal remains a pressing and complex environmental issue in the EU, with serious consequences resulting in climate change, biodiversity loss and pollution. Traditional monitoring methods, such as manual inspection of illegal landfills, have proven insufficient in addressing the scale and sophistication of such illicit activities. As environmental crime grows more complex and transnational, innovative technological approaches are required to assist law enforcement and regulatory bodies. As demonstrated by the PERIVALLON project, AI-based geospatial intelligence, such as application of AI for UAV and satellite imagery analysis, can enhance environmental monitoring and support the detection of illegal waste disposal by enabling more efficient, accurate, and scalable detection and inspection of illegal landfills. Yet, the effective and responsible deployment of such technological solutions requires careful consideration of the applicable legal framework.

The analysis of the applicable EU legal and regulatory framework in the fields of AI governance and personal data protection highlights key legal considerations for the deployment of AI-based geospatial systems for waste disposal detection. In particular, the AI Act requires a thorough assessment to categorize AI systems according to the four risk levels defined in the law. In turn, this allows to determine (1) if the considered AI system is prohibited in the EU and, if not, (2) which legal obligations apply. As demonstrated by the authors analysis, AI-driven geospatial tools may be classified as high-risk, particularly in the context of AI systems embedded in UAVs and performing safety-related functions. This is important, as high-risk AI systems are subject to strict legal obligations such as transparency, documentation, and human oversight. In addition, for public bodies like LAEs, these obligations include conducting a fundamental rights impact assessment prior to the deployment of a high-risk AI system. Regarding personal data protection, the use of AI-based geospatial system may pose particular risks. In this context, the personal data processing must comply with either the GDPR or the LED, depending on the system end user's role and purpose. Specifically, LEAs processing personal data for law enforcement purposes will have to comply with the legal requirements provided by the LED, while other uses are governed by the GDPR. In both cases, personal data must be processed lawfully and with respect for fundamental rights.

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