epa Research

Report No. 438

The Use of Earth Observation and Machine Learning for Industrial and Waste Crime Identification and Prevention

Authors: Zane Ferch, Steve Coughlan, Charlotte O'Kelly and Sinead McGlynn

Identifying pressures

Waste crime and environmentally damaging forms of industrial non-compliance or negligence are damaging to the environment and human health, have an impact on an area's aesthetics, and are often extremely costly to clean up. These crimes are often carried out because they are easy to commit and can be very profitable for the perpetrator, who can be hard to catch . Waste crime can occur anywhere and at any scale, from a roadside bin bag left by a single person to the pollution of entire waterbodies by industrial actors.

Figuring out when, how frequently, or if an environmental crime has occurred at all, is not simple. This means that perpetrators may be left to commit waste crimes for extended periods of time, and waste crime sites may grow bigger and more difficult to remediate. The effects of pollution may also linger in the environment and have an impact on human health for as long as the waste is left in situ. Therefore, enforcement authorities have incentives to minimise waste crime and industrial non-compliance by detecting and reacting to it as quickly as possible.

Informing policy

Detecting and reacting to potential waste and environmental crime and industrial non-compliance as quickly as possible has large financial and societal implications for enforcement authorities. The damage that these relatively easy-to-commit crimes can incur on human and environmental health, and the costs associated with remediating these issues, represent a problem that becomes more difficult and more costly to resolve the longer that it is left unaddressed.

Currently, waste crime and industrial non-compliance is discovered either through public complaints or site visits by inspectors. These are, and will always remain, essential tools for enforcement authorities, but they have limitations.

Public complaints are ineffective in remote or hard-to-access areas where the public may not be aware of an issue. Site inspections are the primary tool for gathering evidence for cases of waste crime or industrial non-compliance, but they are administered either randomly, to sites with known issues, or to sites where complaints are made.

This research aims to provide enforcement authorities with another way of generating reports for more efficient inspections of key sites.

Developing solutions

Three service recommendations were proposed, aimed at different user groups with various funding capabilities. The most comprehensive recommended service would utilise both publicly and commercially available Earth observation data in conjunction with records of previous waste crime and industrial non-compliance incidents to build a machine learning algorithm for detecting such crimes at a national scale.

Additionally, when a potential waste crime is detected in publicly available satellite data, a report would be made available detailing the confidence of the machine learning model and any commercially available satellite imagery that may be useful for a deeper analysis of the area. This provides enforcement authorities with the opportunity to react to potentially unknown waste crimes in near real time, or allow them to gather more information on waste crime.

Finally, commercial data have higher spatial and temporal resolution, giving enforcement authorities the opportunity to go back through the archive to detect exactly what happened at a specific site, when and where. Validation of the model, either by deeper analysis or by site visits by personnel, are used to further improve the model's future performance.

Rialtas na hÉireann
Government of Ireland

EPA Research | **Webpages:** www.epa.ie/our-services/research
LinkedIn: www.linkedin.com/showcase/eparesearch/ | **Twitter:** @EPAResearchNews
Email: research@epa.ie | **Web:** www.epa.ie