Earth Observation, Artificial Intelligence, Compliance Assurance and Environmental Crimes Protection

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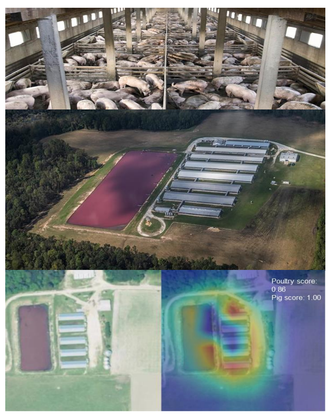
Environmental Compliance Assurance (ECA) getting close to new technologies: the first stimulus in using AI tecniques

New strategies are evolving on Environmental Compliance in European Union. A more integrated approach is proposed: promotion, inspection and checks, enforcement are seen as element of the same chain[1], and **the use of new technologies is strongly fostered**[2]. Earth Observation (EO) techniques are proven to be very successful to identify environmental non-compliance and crimes that produce alterations that are visible from the sky, but only the advent of Artificial Intelligence (ML) technique made the use of EO really available and suitable for the conduction of systematic surveillance programs, with the double scope of prevention and enforcement.

In its jurisdictional research activities, Fondazione Vittorio Occorsio studied the use of Artificial Intelligence in support to EO in infringements and crime detection through EO: the most relevant activities were developed in support to US Environment Protection Activities to tackle illegalities in poultry and pigs rearing, and in support to ARPA Lombardia (IT) in search of illegal wastes dump sites to prevent wastes fires.



US EPA in search of non authorized waste waters discharge origins[4]

ARPA Lombardia SAVAGER Project supported by Computer Vision techniques[3]

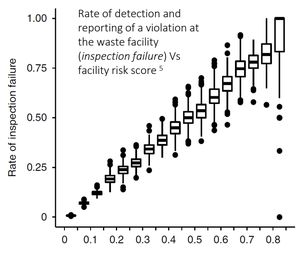
In particular, Italian studies enlightened the issues regarding the use of new technologies in crime tackling, with the need to respect some basic constraints referred to the management of criminal justice, and the linkages among different subjects involved in this type of procedures: specialized bodies, polices, prosecutors, administrative and sanitary authorities and judges.
It is to be noted that, in general, the strengthening of the relationships among all these authorities is a specific request of the art. 19 of new environmental crime directive (ECD) 2024/1203 on the protection of the environment through criminal law.

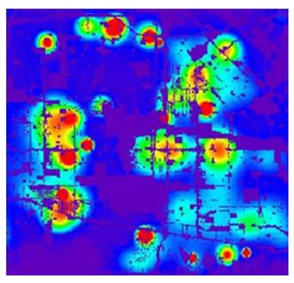
[1] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions EU: **Actions to improve environmental compliance and governance** {SWD(2018) 10 final}
[2] See **Regulation (EU) 2021/696** of the European Parliament and of the Council of 28 April 2021 establishing the Union Space Programme and the European Union Agency for the Space Programme and repealing Regulations (EU) No 912/2010, (EU) No 1285/2013 and (EU) No 377/2014 and Decision No 541/2014/EU, **which recognizes the role of space technologies and geo-spatial intelligence for environmental compliance assurance which is included now in the scope of the Copernicus Programme (Recitals 77, 78, Articles 49 (4) (b) and 51 (1) (a)).**
[3] **Machine Learning to Identify Illegal Landfills through Scene Classification in Aerial Images** - Torres, R.N.; Fraternali, P. - Remote Sens. 2021, 13, 4520. https://doi.org/10.3390/rs13224520
[4] **Study performed to test Deep Learning to map concentrated animal feeding operations** - Cassandra Handan-Nader and Daniel E. Ho: Stanford Law School and Department of Political Science, Stanford Unveristy - Stanford Institute for Economic Policy Research, Stanford, CA, USA On Deep learning to map concentrated animal Nature Sustainability 298 | VOL 2 | APRIL 2019 | 298–306 | www.nature.com/natsustain

Artificial Intelligence: not only Computer Vision - Other fields of use in ECA activities and perspectives

Being Artificial Intelligence used also in some police and jurisdictional fields, i.e. for profiling of subject from the point of risk of committing criminal offences, a search was made to see if this approach is used also in Environmental Compliance Field. Only few applications, apart than EO, were found.

An example of the use of profiling in ECA activities is the Inspection Plan of solid hazardous and non-hazardous wastes facilities drafted by US EPA prioritizing installations through ranking of non-compliance risk. The ML system, chosen through the test of 4 different Random Forest Algorithms, has been trained with a subset from 15 years of historical data regarding installations including tens of thousands of variables such as: facility characteristics (location, industry, shipments, etc.) and historical enforcement and compliance data.
Retrospective Test on a subset of installations extracted from historical data: the model could increase targeting accuracy by 47%, increasing the "hit rate" from 38% to 56%.

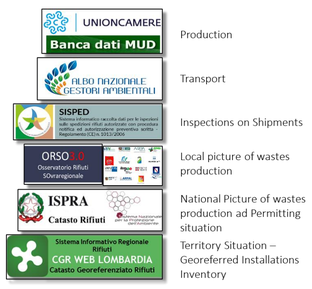




Predictive territorial policing: map of proability of crimes commission produced throug an AI System[6]

Prospectively, it could be investigated if some techniques of predictive policing, to prevent and tackle crimes through territorial crime probability distribution forecast, based on AI, could be used also in environmental field to prevent and enforce crimes such as illegal dumping or abandoning of wastes crimes, illegal discharges

Fondazione Vittorio Occorsio studied the possibility of the use of AI to extract from existing databases information useful to identify irregular situations, possible clue of criminal activity in wastes field



[5] From: Machine learning for environmental monitoring - M. Hino, E. Benami and N. Brooks - Nature Sustainability | VOL 1 | OCTOBER 2018 | 583–588 | www.nature.com/natsustain
[6] From: Smithsonian Magazine – Randy Rieland https://www.smithsonianmag.com/innovation/artificial-intelligence-is-now-used-predict-crime-is-it-biased-180968337/

Peer reviews as instrument to strengthen the compliance chain around the use of new technologies and AI: *an IMPEL initiative*

The use of new technologies and techniques, such as Earth Observation or Artificial Intelligence, may face practical use issues. The lack of knowledge in many public bodies often make complicate the use of new tools in administrative and justice activities, and the dialog among different ECA players is often not easy because the different, cultural orientation and habits of different state bodies.

IMPEL NPRI

Funded by the European Union

European Union Network for the Implementation and Enforcement of Environmental Law

The Actors of a National Network Peer Review and the actions flow chart

This condition endangers the benefit of use of new technologies in enviromnental illegalities fighting: to overcome this situation the entire Environmental Compliance Assurance actors need to be aligned on the basis of technical, administrative and judicial new aspects regarding the use of these technical innovations.
IMPEL decided to develop the well known Peer Review methodology to set up an instrument to manage at best the dialog inside Organizations and Networks composed by Authorities belonging to the Environmental Compliance Chain to solve the issues in place The project National Peer Review Initiative (NPRI)[8] at present is followed by 14 Countries and made possible dialog and decisions on improvement of procedures and of processes never faced before.
Among many other field of application, the Slovak Environmental Inspectorate (SEI) decided to implement an NPRI procedure to develop at best its Department for Technical Innovation, which scope is to put at disposal of its Regional Inspectorates new technologies and procedures that needs a specialized approach, in close connection with operational procedures already implemented and with the full awareness of the legal constraints they have to consider.

[7] IMPEL - European Union Network for the Implementation and Enforcement of Environmental Law (IMPEL) is an international non-profit association of the environmental authorities of the European Union Member States, acceding and candidate countries of the EU, EEA and EFTA countries and potential candidates to join the European Community. Currently, IMPEL has 56 members from 36 countries including all EU Member States, and some non EU states
[8] The NPRI approach, defined after the study of seven similar initiatives used by National, European, and Worldwide Organization has been used also,

IMPEL ARTIC

A project to support the use of Artificial Intelligence by the European Authorites involved in Environmental Compliance Assurance Activities

With the perspective of making easier the implementation of AI – ML in IMPEL Members (almost all of the permitting, inspection and enforcement Authorities in the EU), it has been proposed a project covering the period 2025 – 2027, at the moment under approval procedure at IMPEL General Assembly
The project has three main aims:

- To make an extensive survey at EU Countries Authorities involved in environmental compliance activities, including jurisdiction, about the present use of AI tools and on needs that could be satisfied through AI applications, to share experiences and launch applicative projects to set up AI tools of common interest.
- To investigate and identify legal constraints in the use of AI in ECA field
- To deliver literacy to officers belonging to EU Environmental Authorities that are, as active or passive subject, involved in the use of AI, fulfilling the request of the recent EU regulation «AI Act» (see next box).

The project is open to the collaboration of EU and non EU scientific entities and it will strive to get also in touch with non EU authorities that are already using AI tools in Environmental Compliance Activities

Use of advanced instruments in Environmental Compliance Assurance and Criminal Jurisdiction: potentials and constraints – The *AI Act*

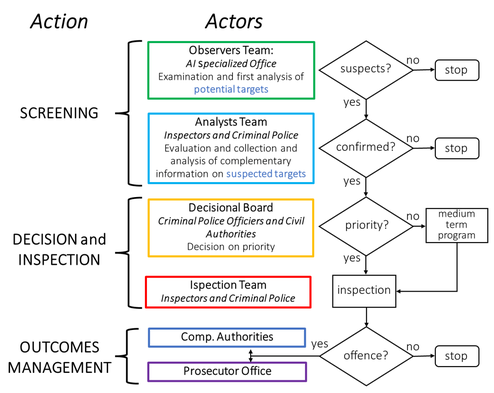
The use of Earth Observation (EO) techniques, also assisted by Machine Learning systems, in the case of environmental compliance assurance and for criminal prosecution, has proven to be highly effective in many situations.

When applied to Earth observation, AI can make it easier and faster to identify situations of environmental non-compliance, including criminal ones. Earth observation, enhanced by computer vision tools, also becomes a very powerful tool for preventing and combating all illegal actions that involve changes in the morphology of the territory that can be detected from the sky. Examples of this are the search for illegal waste dumps, spills, production facilities or illegal interventions on the natural environment.

Without going into the merits of many examples, that are the subject of this Workshop, we recall the experiences conducted by ARPA Lombardia probably one of the firsts in Europe (2018 – ongoing), with the *SAVAGER project*, and by US EPA, briefly illustrated in the box.

However, such generalized non-compliance and criminal investigations may, in various legal systems, pose a problem of legal framework. This activity is also extraneous to administrative police actions, which are essentially aimed at controlling the correct exercise of authorized activities. The issue has been resolved, in specific situations of environmental crisis, as in the case of the crisis relating to fires in waste deposits in Lombardy (2017 – 2019) with delegations or specific agreements between all the competent authorities, but there is no stable general solution.

A similar problem could also arise for the use of Artificial Intelligence for the systematic analysis of databases in search of inconsistencies that can lead to the detection of environmental crimes, without a clear mandate given to technical structures by a competent authority.

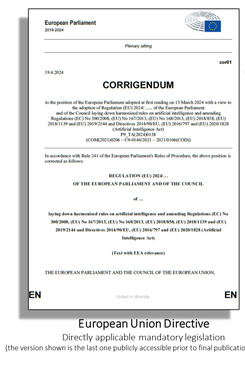


The management of Earth Observation outcomes.
A possible scheme also applicable to highly productive environmental surveillance tools such as **Artificial Intelligence Systems**

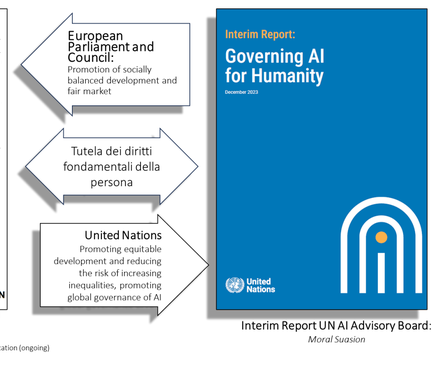
However, the applications of Artificial Intelligence in criminal proceedings can be considered as a facilitator, guidance or initiator of targeted investigations, which, however, must then be carried out with traditional techniques by human operators. There is a structural reason for this: the inferential logic on which AI applications are based is not considered admissible, at least in the European Union's judicial system, as an exclusive tool on which to base a criminal judgment, as clearly recalled in various passages of the AI Act[9].

Automated systems, in including AI, to search for potentially illegal situations starting from the analysis of images of the territory or databases can lead to the identification of suspicious cases that require confirmation and the definition of investigative and enforcement priorities.

As a result, in real situations an agreement between the various components of the "environmental compliance chain" has proved to be indispensable and effective, involving the technicians assigned to the initial analysis of suspicious cases identified by AI systems, the staff able to assess the criminal relevance and environmental and health importance of the cases identified and, finally, the competent administrative and/or judicial body with decision-making power for the activation of criminal prosecution or administrative action.



European Union Directive
Directly applicable mandatory legislation
(the version shown is the last one publicly accessible prior to final publication (ongoing)



Interim Report UN AI Advisory Board:
Moral Suasion

This Act is adopted by the European Union for the purpose of protecting its citizens from the improper use of Artificial Intelligence also in the field of criminal jurisdiction.

The general principles for the protection of citizens against the risks of AI, as well as for its promotion as a benefit to humanity, are also the subject of the activities of the Advisory Board specifically established by the United Nations.

Environmental Criminal Jurisdiction and AI Act

Artificial Intelligence is destined to influence many sides of the lives of European citizens, and, by consequence, the European Union has decided to erect protections to defend them against various risks associated with its use, while protecting and encouraging its legitimate uses, given the numerous benefits that can derive from it in many fields.

The primary objective of the AI Act is the protection of citizens' fundamental rights and particularly relevant in the field of inspection and justice, the protection of the right to be considered regardless of one's membership of population groups with specific characteristics and not to be evaluated through tools that may be subject to significant bias. For these reasons, the use of AI in the field of prevention, policing and justice is also considered in the AI Act as high-risk or is subject to the same prohibitions as any other sector, unless exceptions are allowed for cases of particular criminal relevance, including certain environmental crimes. It should be noted that the prohibitions, or at least the limitations, provided for by the AI Act are essentially aimed at the protection of natural persons, while its uses in the field of inspection, police and justice against legal entities are generally allowed.

In this case, in fact, there is no profiling of a subject on the basis of the presumption of his or her ability to commit offences, but it is a mere preventive identification of situations objectively at risk of environmental offences.

The AI-based activities probably of greatest interest for environmental protection activities are those of risk analysis and profiling, which can be used both in the preventive phase, for the definition of inspections programs, and in the jurisdictional phases of investigations and judgment.

In particular, it is forbidden: *"…. the use of an AI system for making risk assessments of natural persons in order to assess or predict the risk of a natural person committing a criminal offence, based solely on the profiling of a natural person or on assessing their personality traits and characteristics; this prohibition shall not apply to AI systems used to support the human assessment of the involvement of a person in a criminal activity, which is already based on objective and verifiable facts directly linked to a criminal activity"* (AI Act, art. 5, c. 1 (d)).

The prohibition is motivated by the *whereas* n. 42: *"In line with the presumption of innocence, natural persons in the Union should always be judged on their actual behavior. Natural persons should never be judged on AI-predicted behaviour based solely on their profiling, ……., without a reasonable suspicion of that person being involved in a criminal activity based on objective verifiable facts and without human assessment thereof. ….."*

It can be deduced that the prohibition does not apply to activities related to legal entities.

In the same *whereas* it is clarified that: *" …. In any case, that prohibition does not refer to or touch upon risk analytics that are not based on the profiling of individuals or on the personality traits and characteristics of individuals, such as AI systems using risk analytics to assess the likelihood of financial fraud by undertakings on the basis of suspicious transactions or risk analytic tools to predict the likelihood of the localization of narcotics or illicit goods by customs authorities, for example on the basis of known trafficking routes"*

Considering the examples used in the *whereas*, the use of techniques of investigation and predictive policing based on AI to tackle environmental crimes based on database analysis and territorial studies, as envisaged, should be considered as admitted by the AI act.

From another perspective, Directive 2016/680/EU of 27/04/2016 on the protection of natural persons with regard to the processing of personal data by competent authorities for the purposes of the prevention, investigation, detection or prosecution of criminal offences or the execution of criminal penalties, as well as on the free movement of such data, repeatedly refer, as recipient of the protection, to the natural person and, as a "ratio" of the discipline, to the protection of his personal data, thus indirectly admitting the non-applicability in all cases in which natural persons are not involved, naturally with the exclusions relating to the use of personal data in criminal proceedings.

An issue that is worth mentioning, as it is relevant from a criminal point of view, is the use of AI tools for the falsification of images included in documents produced by private parties in the context of environmental proceedings of various kinds. The potential of AI systems in the production of deep fakes will now have to be seriously considered in all cases in which public structures will be called upon to examine photographic documentation, including terrestrial images, present in administrative or judicial proceedings.

This issue opens up another front, which also concerns the use of any type of images, including those of the earth within judicial proceedings, for admissibility as evidence, even if presented by public officials: the certification of non-alteration after shooting. In addition to the testimony of the person presenting the images, other certification techniques are hypothesized that still need to be evaluated and approved, such as inclusion in block-chain-based systems.

[9] REGULATION (EU) 2024/… OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of … laying down harmonised rules on artificial intelligence and amending Regulations (EC) No 300/2008, (EU) No 167/2013, (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1139 and (EU) 2019/2144 and Directives 2014/90/EU, (EU) 2016/797 and (EU) 2020/1828 (Artificial Intelligence Act) – Approved, soon being published on EU Official Journal