SCIENCE FOR POLICY BRIEF

Earth Observation against Environmental Crime

HIGHLIGHTS

- → There is growing demand for Earth Observation to help fight environmental crime and to assure environmental compliance more broadly.
- → Earth Observation can support environmental law enforcement in a growing number of ways, thanks to advances in the technology itself as well as in policies.
- → Despite success in specific domains, uptake of Earth Observation in combatting environmental crime remains limited in Europe.
- → Efforts are needed to bring together those responsible for environmental compliance assurance and those providing Earth Observation-based services, such as those in Copernicus, to match respective needs and capacities.

'An environmental rule of law technology-policy interface could enable environmental agencies and organizations involved in implementation of environmental law to better understand and take advantage of technology that already exists and to inform the future direction of technological development' - UNEP, 2023, Second EROL Report [1]

ENVIRONMENTAL CRIME IS ON THE RISE

Environmental crime is growing globally at 5% to 7% annually. According to World Bank estimates from 2019, global annual economic loss from wildlife trafficking, illegal logging and illegal fishing alone reached between 900 billion and 1.8 trillion euro [2].

Environmental crime can rarely be decoupled from conflict, climate change, poverty, and violations of human rights and indigenous rights. Fighting environmental crime thus has societal benefits that reach far beyond the protection of nature.

Environmental crime is linked to other crime

Environmental crime is often perpetuated by transnational criminal organizations that pose a significant threat to both the environment and society. These organizations frequently connect environmental crime to other illicit activities, including financial crime, threats to security, and corruption. This interconnectedness amplifies the urgency of addressing environmental crime through international cooperation that bridges legal systems and enforcement priorities. Such a coordinated response to environmental crime can benefit greatly from modern technologies, such as Earth Observation, to prove wrongdoing.

HOW CAN EARTH OBSERVATION HELP?

Remote sensing technology has been instrumental in monitoring natural resources for decades. Satellite and aircraft imagery offer a unique vantage point, especially for vast or inaccessible regions. Recent advancements have led to satellite-based sensors capturing images with greater detail that now rivals the precision previously only achievable using cameras on board aircraft. Furthermore, satellites are now often organized into constellations that make it possible to update images more frequently, sometimes even daily. This continuous stream of detailed imagery makes it possible to track activities such as vessel movements, waste dumps, mining operations, or resource exploitation in protected areas.

Unmanned Aerial Vehicles (drones) complement satellite imagery by providing highly detailed remote sensing data over smaller areas. Their ability to live-stream images directly to operators creates a real-time "eyes in the sky" perspective. Coupled with the rapid availability of satellite imagery, remote sensing can now reveal possible wrongdoing almost in real-time, allowing more efficient deployment of resources on the ground as part of inspections or law enforcement. When remote sensing is used in this way to tackle environmental crime, it can have a deterrent effect and remove a sense of impunity, which is particularly beneficial in remote areas where on-site data collection is otherwise difficult (Box 1).

Traditionally, very high resolution images were visually analysed by skilled experts. But as the amount of satellite remote sensing data keeps increasing, reviewing every image individually can form a new bottleneck for operational monitoring. To address this, automated image analysis techniques, like computer vision and deep learning, are being used to quickly process large volumes of data and identify potential issues that warrant further inspection**.**

New sensor technologies and miniaturization are further expanding the capabilities of remote sensing, increasing the availability of very-high-resolution, images, also through clouds and at night using radar, as well as thermal data and spectral data that can, for example, reveal poor air quality and sometimes the point sources responsible for them.

Box 1: Illegal deforestation in Brazil

In Brazil, the Institute of Environmental and Renewable Natural Resources (IBAMA) is responsible for monitoring compliance with environmental policies. They use remote sensing, including from Copernicus Sentinel 2 satellites, and geospatial database on land ownership to detect illegal deforestation and enforce administrative sanctions. These include placing illegally deforested areas under embargo, so that products originating from them can't be traded, and restricting bank credit to violators.

Illegally cleared forest in the Amazon region typically gets stocked with cattle. To make illegal deforestation less profitable, IBAMA confiscates livestock from these areas and donates them to social programmes. Drone-based imaging and computer vision based algorithms allow IBAMA to quickly count the cattle and organize the personnel and material necessary to gather and transport them.

QUICK GUIDE This brief is based on the envcrimes2024 workshop [3] that brought together professionals from the Earth Observation community and those charged with enforcing environmental law to jointly explore how Earth Observation can better be used in the fight against environmental law. The event was staged by ESA and the European Commission's Joint Research Centre who plan to organize follow-up meetings at major international conferences.

Box 2: The Commission's use of Earth Observation to assure Environmental Compliance

EU law is key to protecting the environment and in her political guidelines, the Commission President stressed the importance of implementing EU environmental law efficiently.

The Commission has already used remote sensing in infringement procedures related to EU environmental laws, such as the Nature Directives and the Industrial Emissions Directive, and is stepping up its use of Earth Observation, and geospatial intelligence in general, to assure environmental compliance. It also committed to supporting Member States to do the same.

The new Environmental Crime Directive strengthens the enforcement chain through provisions that require Member States to ensure sufficient human, financial, and technical resources and appropriate training for enforcers.

Challenges to using Earth Observation

Fighting environmental crime is an integral part of enforcing environmental law, and assuring compliance more broadly, which also comprises compliance promotion and monitoring. The interest to use Earth Observation to help assure environmental compliance is growing in Europe [4]. There are, however, great differences in capacity and experience among those charged with inspecting, policing, prosecuting, or adjudicating environmental crime. So, while there is often eagerness among individuals to integrate Earth Observation into compliance assurance workflows, more capacity-building is required.

Remote sensing data are quickly available nowadays but, by themselves, are insufficient to prove an environmental offence (Box 2). To do this, the observations need to be interpreted in a legal perspective alongside other contextual information, e.g. on ownership or permits. Unless investigators have easy access to such contextual information, they will struggle to take full advantage of the large volumes of observations that remote sensing provides nowadays for faster and more proactive crime fighting.

There is little literature on the use of Earth Observation in the fight against environmental crime leaving fundamental questions open; these questions relate to finding appropriate remote sensing data, assuring the authenticity of images, the admissibility of remotely sensed images in court, and protecting privacy when collecting very high-resolution images, particularly from drones.

Copernicus, the Earth Observation component of the European Union's Space programme, operates six services that provide information on the atmosphere, marine domain, land, climate change, security and emergencies. All these services shall include activities for the generation of value-added information to support environmental monitoring, reporting and compliance assurance (Box 3)

Copernicus has built a user community for its services when it comes to Maritime Surveillance, Emergency Management, and Security, among others. By providing these communities dedicated fora, the Copernicus services collect user needs and feedback to improve their products. However, when it comes to environmental compliance assurance, a Copernicus user community does not yet exist. Bringing stakeholders together would help tailor new remote sensing techniques further towards operational use and foster uptake.

Box 3: Environmental Compliance Assurance in the Copernicus services

Copernicus operates six services that provide information on the atmosphere, marine domain, land, climate change, security, and emergencies.

The European Maritime Safety Agency (EMSA) is entrusted with the Copernicus Maritime Surveillance (CMS) Service that combines uses Earth Observation with vessel traffic information to support law enforcement. EMSA also operates CleanSeaNet which monitors oil spills and detects vessels to fight marine pollution to comply with the MARPOL convention. CleanSeaNet delivers products in quasi-real-time (within 20 minutes of satellite acquisition).

The Copernicus Service on Support to EU External and Security Actions (SESA) can provide evidence of infringements of environmental laws and help assess environmental damage based on high-resolution images. Critically for law enforcement, however, the service does currently not allow their results to be used in judicial proceedings.

The Copernicus Emergency Management Service (CEMS) provides information for emergency response and disaster risk management. It has occasionally been activated to document, with the help of high-resolution images, environmental damage and its result have been used to hold perpetrators accountable, also in court.

The Copernicus Land and atmospheric Monitoring service provide geospatial products that typically cover the entire globe or a continent at spatial resolutions upward of 10 m. Despite their wide coverage, their lack of spatial detail makes them inherently less suited for most environmental crime investigations.

Box 4: The satellite imagery market

The global space economy is developing fast; access to space is getting cheaper which means that also smaller companies can now deploy satellites and sell the data they collect.

The Copernicus programme provides its services access to selected commercial satellite data through its Copernicus Contributing Missions programme. Purchasing satellite data is becoming easier in general. Traditionally, one had to request a tailored quote from vendors, and data would come with proprietary licenses that placed restrictions on sharing and redistribution. Nowadays, sales models also include generic pay-per-view or pay-per-download models, as well as quota-based subscriptions, offering greater flexibility to users. Some companies now also sell their satellite data under a Creative Commons License.

HOW TO INCREASE THE UPTAKE OF EARTH OBSERVATION AGAINST ENVIRONMENTAL CRIMES?

Building Earth Observation competences and skills throughout the environmental compliance assurance community is not trivial. Nor is it straightforward to familiarize remote sensing specialists with the specific needs of those responsible for enforcing environmental law. Both communities rely on their own jargon and procedures that form barriers to outsiders.

Besides training, there is a need to identify, share and discuss best practices, success stories, and lessons learned, also from failed attempts to use remote sensing to fight environmental crime. These exchanges should capture the range of experiences across jurisdictions and distinguishing between administrative and criminal law enforcement.

The findings of research projects that are evaluating or testing methods to use Earth Observation in environmental compliance assurance should be actively disseminated [5]. Methods that hold greatest promise will then require mechanisms to upscale them from the research realm to the operational one, so that the law enforcement community can get access to reliable and transparent Earth Observation-based evidence.

Along with it, there is a need for guidelines and specific training on particularly disruptive technologies such as the use of artificial intelligence (AI) to analyse remote sensing data, and the risk of falsifying data with AI. Sustained research on these topics should produce guidelines for the law enforcement community.

REFERENCES

[1] UNEP, 2023. Second Environmental Rule of Law Report.

[2] World Bank, 2023. Illegal Logging, Fishing, and Wildlife Trade: The Costs and How to Combat it.

[3] envcrimes2024.esa.int/

[4] ENPE, IMPEL, EUFJE, EnviCrimeNet, 4 Networks Conference 2023

[5] e.g. https://perivallon-he.eu/

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