

USE-CASES – Environmental Crimes

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1. INTRODUCTION

This document outlines the strategic use cases defined for the "Environmental Crimes" thematic call for proposals under the ACCESS Business Applications - Space Solutions (BASS) programme line. The Call for Proposals is underpinned by consultations between ESA and various stakeholders operating within the environmental management, policy, and compliance domains who have guided the identification of some of the most relevant challenges to be addressed.

The objective of this Call for Proposals is to support European industry in studying, developing, and demonstrating pre-operational, space-based commercial downstream services that empower organisations, enforcement bodies, and corporate users to proactively detect, monitor, and verify environmental crime risks across global operations. When writing the initial proposal, the applicant shall make clear which use case(s) or focus area their solution will address, if chosen from those listed here. The applicant may address other use-cases if adequately aligned with the overall theme of environmental crime.

2. FOCUS AREAS & USE CASES

2.1. Illegal Mining, Quarrying & Critical Raw Material Theft

The Challenges:

- Illegal and unpermitted mining activities can cause significant habitat destruction, landscape degradation, and environmental harm. At the same time, global demand for battery minerals and Critical Raw Materials (CRMs) continues to grow. Downstream buyers often lack independent visibility into the legitimacy of upstream extraction activities, which can expose them to supply chain risks and regulatory non-compliance.
- Downstream buyers and regulators often lack timely, independent verification of extraction activities. This is because ground audits at extraction zones are infrequent, costly, vulnerable to documentation errors or misreporting, and struggle to keep pace with rapid landscape modifications. Therefore, the verification of mining activities remains challenging.

The Opportunities:

- Where baseline services already exist, proposals should aim to enhance operational accuracy, lower service costs, or scale up existing capabilities by exploring areas such as:
 - Using satellite Earth Observation (SatEO) to map macro mining boundaries, open-pit expansions, and tailings facilities over time, cross-referencing these footprints with a supplier's declared production capacity to flag volume anomalies.
 - Integrating terrain data with weather and climate analytics to monitor environmental stressors (e.g., regional water scarcity, ground movement, or slope instability) near extraction sites to warn companies of sourcing bottlenecks and environmental degradation.

Target Users

- Corporate manufacturing compliance teams, electronics and automotive OEMs, commodity traders, mineral procurement, mining operators, sustainable extraction auditors, and national land management registries.

2.2. Industrial Pollution, CBAM Evasion & Waste Crimes

The Challenges:

- Under the Carbon Border Adjustment Mechanism (CBAM), heavy industrial operators importing materials (e.g., steel, cement, aluminium) from outside Europe face tariffs tied directly to production emissions. Because they do not typically possess independent access to information about the factories that produce the imported materials, the possibility of false representations of a material's carbon footprint is increased. In addition, many illicit waste disposal networks will attempt to circumvent taxation imposed on waste by transporting it illegally across international borders or

through other clandestine means such as dumping e-waste, expanding landfills without permits or releasing toxins into the air.

- Currently, waste crime and contamination monitoring approaches rely heavily on company self-reporting, which offers limited capability for independent verification. There is a strong business demand for independent tracking tools to check green claims and prevent legal issues. To be commercially viable, any service has to either measurably reduce the time taken for auditors to audit operations or otherwise serve as an independent "proof" against litigation.

The Opportunities:

- Rather than duplicating existing tracking platforms, proposals should focus on integrating fragmented capabilities or introducing new analytical layers, such as:
 - **Emissions & Contamination Risk-Scoring:** Utilising SatEO atmospheric and thermal parameters to observe global industrial facilities and active landfill footprints. Real-time thermal signatures, smoke plumes, and greenhouse gas markers can be evaluated to provide an independent look at operations before purchasing.
 - **Logistics Integrity & Dumping Countermeasures:** Tracking logistics assets (shipping containers, freight trains, waste trucks) via satellite navigation to verify route parameters and prevent "ghost" dumping or illegal hazardous waste exports, automatically flagging an anomaly if a cargo lock is breached.
- **Target Users:** Industrial operators, waste management companies, environmental protection agencies (EPAs), customs authorities, and logistics insurers. Industrial importing companies, commercial waste management contractors, supply chain logistics firms, customs brokers, corporate risk insurers, and environmental protection agencies (EPAs).

2.3. IUU Fishing, Maritime Crimes & Illegal Marine Activities

The Challenge:

- Illegal, Unreported, and Unregulated (IUU) fishing, dark vessel manoeuvres, and maritime bilge dumping (the unauthorised discharge of oily wastewater at night to bypass port treatment fees) threaten ocean biomes and impact coastal economic sustainability.
- Maritime tracking relies heavily on cooperative transponder systems like the Automatic Identification System (AIS) and Vessel Monitoring Systems (VMS), which non-compliant crews intentionally switch off when entering restricted Marine

Protected Areas (MPAs). Traditional coast guard patrol ships are constrained by slow transit speeds and extreme fuel costs.

The Opportunities:

- Given that baseline tracking tools are widely deployed, proposed solutions should demonstrate high added value, improved latency, or unique sensor combinations, focusing on:
 - **Dark Vessel Multi-Sensor Tracking:** Fusing wide-area satellite AIS tracking with radar imagery (SAR) to identify "dark vessels", exposing illegal fishing and illicit mid-sea transshipments.
 - **Automated Bilge Dump Detection:** Utilising radar satellite imagery to spot oil slicks in real-time, pairing the data with hydrographic drift models to detect the source of each slick prior to it dissipating and subsequently isolate and attribute each oil slick to the offending vessel.
- **Target Users:** Commercial seafood wholesalers, maritime fleet operators, supermarket procurement divisions, marine insurance underwriters, commodity shipping lines, coast guards, and fisheries authorities.

2.4. Illegal Logging and Deforestation

The Challenge

- Logging syndicates are operating in unauthorised areas within the restricted forest reserve; they have been logging mature (old growth) canopies for valuable timber. Once extracted, the illegally obtained timber is then mixed with certified or legal logs that pass through regional consolidation hubs before being sold to downstream corporate buyers.
- Manual forest grid sampling and traditional ranger patrol methods are often hampered by extreme remoteness, dense jungle canopy, harsh weather conditions etc. Traditional ground-based inspection methods also may be susceptible to localised corruption and reporting fraud.

The Opportunities

- Rather than re-inventing basic deforestation alert systems, bidders are encouraged to enhance existing services by bridging real-time ground alerts with wide-area space baselines, looking at:
 - **Automated Boundary Tracking:** Utilising satellite radar (SAR) change-detection to map canopy loss and unauthorised access road clearing in near-

real-time. These visual baselines can serve as objective verification layers to check against supplier declarations.

- **Off-Grid Acoustic Routing:** Deploying low-cost satellite communications (SatCom) to connect remote ground sensors capable of picking up chainsaw frequencies or heavy vehicle engine signatures at night, instantly alerting field teams of active logging boundaries.
- **Target Users:** Consumer goods manufacturers, timber trading corporations, commercial forestry management firms, raw material compliance auditors, land registries, and forestry ministries.

2.5. Poaching and Wildlife Trafficking (Flora and Fauna)

The Challenge

- The illicit trade of protected animal species and endangered flora impacts biodiversity and creates substantial black-market revenue. Trafficking syndicates frequently cross remote international borders and use online marketplaces to distribute wildlife products away from physical border controls.
- The wildlife protection sector frequently operates under tight budget constraints and prioritises low operational costs. Basic animal tracking metrics and migratory routes are already widely available on an open-source basis. Therefore, commercially viable services must deliver significant added value beyond what an organisation can already execute in-house, focusing on actionable field integration or automated predictive intelligence.

The Opportunities

- Proposals must build upon existing baselines or open-source data streams to deliver complete operational value-adds, targeting areas such as:
 - **Resilience Satellite-Linked Field Alerts:** Connects wilderness cameras and sound sensors using low-power satellite IoT. This sends instant alerts and GPS coordinates about suspicious vehicles or activity directly to rangers, completely bypassing areas without mobile phone signal
 - **Black-Market Context Linkage:** Cross-referencing open-source intelligence (OSINT) aggregated from online black markets with spatial change-detection alerts (e.g., automated habitat tracking or fresh route clearings) to project localised poaching risk scores, predict localised poaching hotspots, and trace illegal wildlife products back to their geographic source.

- **Target Users:** Global shipping companies, e-commerce platform compliance, private wildlife reserve operators, eco-tourism operations, corporate sustainability risk managers, customs authorities, and wildlife law enforcement bodies.

2.6. Integrity Crimes, Corporate Greenwash & Environmental Fraud

The Challenge

- The environmental sector faces vulnerabilities from unsubstantiated carbon offsets, false eco-label claims, falsified environmental certifications, and manipulated sustainability performance data. Organisations may purchase credits or certify supply chains that do not correspond to verified ecological benefits on the ground.
- Similar to the industrial waste sector, there is a powerful market demand for completely independent assurers of environmental measures. Verifiable, unalterable performance claims are required by both consumers and government enforcement bodies operating under strict policy frameworks.

The Opportunities

- Bidders should seek to combine existing audit techniques with objective space assets to elevate data integrity, focusing on:
 - **Baseline Verification Layer:** Using SatEO and spaceborne LiDAR/radar to map historical and active environmental baselines, biomass density, and vegetation health. This provides an independent audit layer to validate forest conservation assertions, verify soil carbon sequestration claims, and confirm renewable energy generation footprints.
 - **Continuous Compliance Auditing:** Tracking material flows and environmental parameters from source to market to expose false recycling, fraudulent waste diversion claims, or greenwashing in product marketing. These datasets are integrated into screening dashboards to give auditors, insurers, and banks scale-ready verification tools.
- **Target Users:** Carbon offset credit registries, institutional asset managers, corporate sustainability verifiers, compliance software developers, commercial banks, supply chain risk management companies, and government regulatory auditors.

3. ROLE OF SATELLITE TECHNOLOGY AND DATA

Satellite technology and data must be essential to the provision of the proposed services. Satellite capabilities are expected to enable downstream services through the provision of the following non-exhaustive capabilities:

- **Satellite Earth Observation (SatEO):** Earth Observation data – such as multi- and hyper-spectral imagery – can be used for analysis of land cover, soil, and vegetation parameters, identifying anomalies, hotspots, or landscape scars across broad regions. Satellite-based radar (SAR) may support vegetation and terrain changes through night, cloud cover, or heavy canopy. SAR is also essential for detecting surface disturbances and monitoring physical terrain baselines. SatEO data can also provide observations of atmospheric instability, tracking greenhouse gas footprints, smoke plumes, and trace gases. Additionally, it can map forest canopy structures to build unalterable environmental baselines. Finally on-board automated algorithms can be explored to dramatically reduce data retrieval latency. Bidders must demonstrate how they strategically balance wide-area screening data with targeted Very-High-Resolution (VHR) imagery to ensure commercial viability at scale.
- **Satellite Communications (SatCom):** SatCom options - including narrowband IoT (NB-IoT), Direct-to-Device (D2D) communications, and Low-Earth Orbit (LEO) broadband – can enable robust connectivity to in-situ sensing devices, automated cameras, drones, and heavy equipment deployed in regions with poor or absent cellular coverage. Narrowband solutions may be complemented by novel edge processing or compression algorithms to optimise bandwidth requirements over remote terrains. This is highly relevant for security sensors, machinery geofencing loggers, cargo integrity pings, or environmental threat sensors operating off-grid. In well-connected urban areas, systems should logically prioritise terrestrial infrastructure.
- **Global Navigation Satellite Systems (GNSS / SatNav):** GNSS data is critical for the continuous time-stamping and high-precision georeferencing of data collected across logistics chains, field rangers, and automated tracking platforms. Bidders can explore advanced authentication mechanisms (such as Galileo OS-NMA) in cases where it makes business sense to provide robust anti-spoofing protection and create legally binding provenance records for court-ready environmental evidence. Applications may utilise navigation data to cross-examine transit histories, verify container route boundaries relative to protected ecosystems, or manage active geofencing workflows. The bidding team should clarify the technical approach for maintaining data integrity during expected signal blackouts (such as transit through dense urban areas or under cargo rows on major maritime vessels).