

An aerial photograph of a lush, green forest. A winding river or stream flows through the center of the forest, its water appearing brownish-tan. The forest is dense with various shades of green, and some bare tree trunks are visible. The overall scene is a natural, undisturbed landscape.

# The Use of Open Source Investigation Methods in Tracking Environmental Harms

The University of California  
Digital Investigations Network



## UNIVERSITY OF CALIFORNIA DIGITAL INVESTIGATIONS NETWORK



Dolores Huerta  
**RESEARCH CENTER  
FOR THE AMERICAS**  
UC SANTA CRUZ

**HUMAN  
RIGHTS  
CENTER**

UC Berkeley School of Law



**UCLA** School of Law  
**The Promise Institute  
for Human Rights**

**The UC Digital Investigations Network** is comprised of the Human Rights Center at the UC Berkeley School of Law, the Dolores Huerta Research Center for the Americas at UC Santa Cruz, and The Promise Institute for Human Rights at the UCLA School of Law. The Network trains a diverse cohort of students from across the three campuses to conduct digital open source investigations, and to support the training of human rights professionals throughout the Americas through training and other forms of support.

**Cover image:** An overflight conducted by Greenpeace and Instituto Socioambiental spotted four excavators near an illegal road discovered inside the Yanomami Indigenous Land, one of the most endangered Indigenous lands in the country. The over 150 km long road in the Catrimani River basin is making way for heavy machinery to enter the land, like hydraulic excavators, for the first time, which could increase between 10 and 15 times the illegal gold mining destructive potential in the area. The road also threatens an isolated Indigenous people, crossing the forest at a 15 km distance to a village of the Moxihatëtëa people, in volunteer isolation inside the Yanomami Indigenous Land. Image by Valentina Ricardo, May 12, 2022.



**With thanks to the Public Interest Technology - University Network and the Oak Foundation for their generous support.**

**This report is also available in Spanish and Portuguese.**

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# Preface

In January 2023, the University of California Digital Investigations Network (UC Network) received a Public Interest Technology University Network grant to institutionalize and expand the UC Network to support frontline environmental defenders. During the first phase of the project, in collaboration with Cultural Survival, an organization that advocates for Indigenous Peoples' rights and supports Indigenous communities' self-determination, cultures and political resilience, students in the UC Network conducted an open source investigation (OSI) into the deaths of 13 murdered Indigenous land defenders in Brazil, and produced a report documenting the circumstances surrounding their deaths (also available in Portuguese).

During the second phase of the project, we focused on developing a broader understanding of how OSI methods can be used to document environmental harms globally, and how OSI is being used in environmental harm research, advocacy and litigation. We conducted a literature review and case law analysis, and convened a meeting with leading several experts who are using OSI in their work, and conducted individual consultations with others. This brief report is an outcome of phase two of our project.

In addition, environmental exploitation often goes hand in hand with human exploitation. Indigenous communities are at the forefront of land defense worldwide as their land is often targeted by state and corporate actors through agriculture, fishing, logging, and mining and the extraction of other resources. For example, the Brazilian human rights group Conselho Indigenista Missionario reported the killing of 795 Indigenous land defenders between 2019 and 2022 under former president Jair Bolsonaro.

Those engaged in seeking accountability for environmental harms should consider the use of OSI tools to complement more traditional research methods and thoroughly document the ways in which land, peoples and communities have been impacted by extractive, pollutive, and degrading practices.

*Aerial view of runoff from iron and gold mine bordering rainforest land 50 miles southeast of Parque Nacional Motanhas do Tumucumaque, 90 miles northwest of Macapa, Brazil.*

*Image by Daniel Beltrá for Greenpeace. April 2, 2017.*

## The Human Impact of Environmental Harm

Environmental harms disproportionately impact a range of vulnerable communities and lead to the degradation of natural environments. Social and economic factors, such as ethnicity, country of origin, gender, age, migrant status, income, education, access to health care, and housing, affect populations' experiences with environmental harm and climate change. For example, a report from the International Centre for Criminal Law Reform and Criminal Justice Policy in Canada illustrates how the global supply chains of resource-exploited countries expose vulnerable communities in various countries — especially those with pervasive government corruption — to environmental harms.



## The UC Digital Investigations Network

The Network has collaborated on numerous projects including documenting the killing of Indigenous land defenders in the Brazilian Amazon, investigating violence against immigrants traveling through Mexico, and live-monitoring election disinformation on social media.



# OSI Methods to Document Environmental Harms

Investigators are increasingly using OSI methods to expose environmental harms. As the technology evolves and researchers become familiar with the toolkit of available resources, these tools are proving incredibly effective in complementing traditional investigative methods. For example, OSI tools that provide access to satellite imagery, or information aggregated from social media, can be used to complement ground-level observations. In addition, according to public health researchers, “The rise of open-source information investigation techniques has created an important opportunity to collect data and develop warnings and indicators of potential human health risks caused by environmental pollution or damage to the natural and built environment during conflict.”

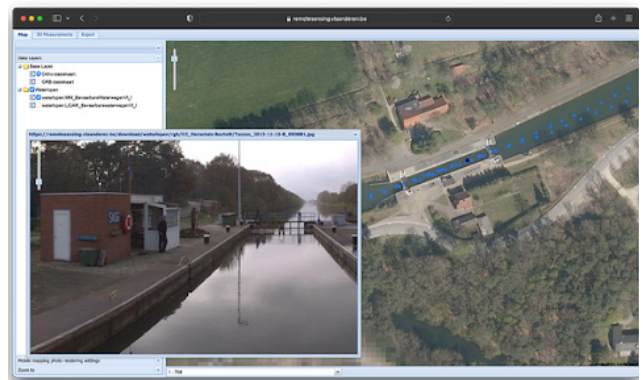
OSI tools can heighten the visibility of environmental harms in conflict zones and offer critical ways to document and monitor these environmental harms, ensuring effective and real-time mapping of such issues. For example, open source methodologies integrated with traditional climate impact assessments have enabled researchers to discover novel and more comprehensive insights into the effects of climate change. There are many categories of tools being used to track environmental harms in different contexts around the world. Below, we touch on each category of tool, providing at least one example from within that category:

## Documentation and Data Collection Tools

The first category of tools is composed of those that aid in documentation and data collection. For example, Mapeo is a tool, designed specifically for environmental defenders, that can organize and visualize ‘field evidence’ of environmental harms, such as photographs or GPS coordinates of critical locations. Co-designed with Indigenous communities challenging environmental threats like illegal mining and industry-caused pollution, the tool empowers activists to document the abuses they encounter, facilitate the reporting of crimes, and initiate advocacy campaigns. Accessible in multiple languages and in both online and offline environments, Mapeo is designed to meet defenders’ unique needs in the field. Its versatile applications span from territory and ancestral mapping to environmental monitoring and the identification of vulnerable populations.

## Environmental Databases

The Global Atlas of Environmental Justice is an interactive, “work in progress,” online database that documents global social movements and conflicts related to environmental issues. The database highlights specific regions, culpable sectors, and affected communities to help foster more responsive environmental policies. The data is collected by hundreds of collaborators and social activists across the world. The Atlas visualizes communities’ stories of resistance and enables its collaborators to document the environmental harms that they witness. The purpose of this OSI tool is to collect the stories of those at the forefront of the fight for environmental justice, increasing the visibility of environmental defenders’ mobilization for corporate and governmental accountability.



*A screenshot of Mapeo, a tool, designed specifically for environmental defenders, that can organize and visualize ‘field evidence’ of environmental harms, such as photographs or GPS coordinates of critical locations.*

*Screenshot from Mapeo.*

## Remote Sensing and Geospatial Analysis

Following the 2022 Russian invasion of Ukraine, the “OSINT Forest Area Tracker” was designed to assess the environmental damage caused by war, with an emphasis on remote sensing, such as use of satellite imagery. Hosted through the Google Earth engine, the tool employs data from the Sentinel-2 satellite, which captures near-infrared and shortwave infrared bands to detect changes in forest health. The tool’s interactive features empower investigators to use custom date ranges and preset geographic areas. Importantly, the tool reminds users of the need to corroborate any preliminary findings by drawing evidence from other sources in order to determine the causes of any forest disturbances.



This tool is valuable for environmental NGOs, research institutions, human rights organizations, and government agencies reviewing the impacts on conflict-affected areas, aiding in monitoring ecological impact for disaster response and open-source research. Journalists and geospatial analysts can benefit from the ability to visualize and analyze environmental changes based on remote sensing data.

### 3D and Photogrammetric Modeling

In an investigation into the aftermath of an explosion of the port in Beirut, Lebanon on August 4, 2020, the Febrayer Network and Forensic Architecture employed sophisticated OSI methods and tools, particularly focusing on 3D modeling and photogrammetry, to analyze and reconstruct the event. The explosion resulted from the improper storage and detonation of a large quantity of ammonium nitrate, causing widespread devastation.

The 3D model reconstructs an “accurately measurable model” of the explosion’s aftermath. This involved utilizing drone footage from August 6, 2020, along with photogrammetry techniques applied to the Beirut port silos and the surrounding area. The methodology encompasses the collection and examination of images and videos sourced from online platforms, offering valuable insights into the protracted fire’s growth at the base of the ammonium nitrate storage silos. By skillfully combining these elements, investigators created a detailed and comprehensive 3D model of the silos, fostering a deeper understanding of the events leading to their collapse. This OSI-driven approach plays an important role in understanding the mismanagement of the site, and reveals the structural changes, interventions, and contributing factors that led to the tragic incident – processes that could be used to similarly deconstruct and analyze other environmental disasters.

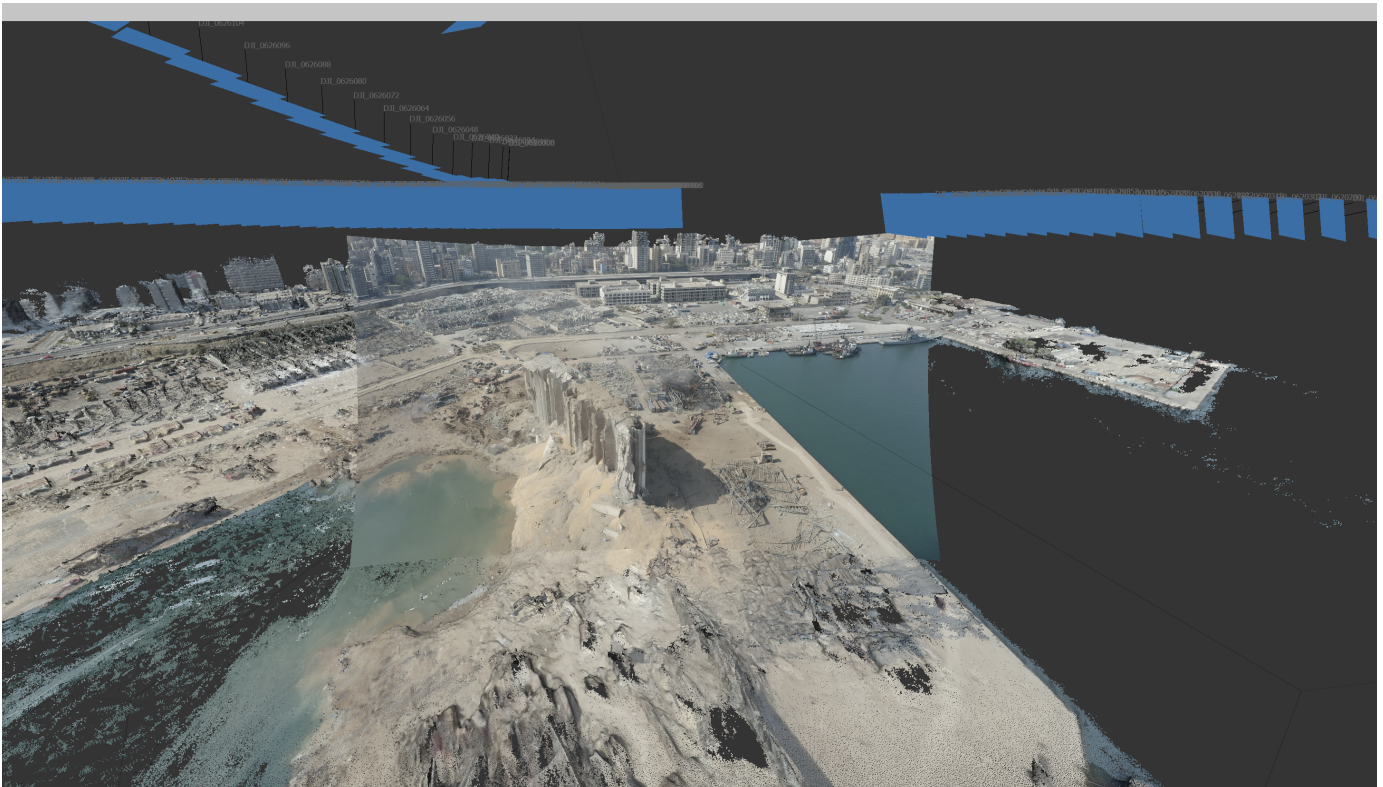
# The Use of OSI in Environmental Advocacy and Litigation

One objective of this project was to identify litigation from jurisdictions around the world in which open source tools are being utilized in the courtroom to provide evidence of environmental harms, and to identify some best practices. However, this was a much more difficult task than anticipated. Our intuition is that open source information is being introduced in court, but in many jurisdictions the evidentiary record is not publicly available. In addition, judgments do not always refer to sources of evidence, making it difficult if not impossible to know if or how data gathered from open sources was used in decision making.

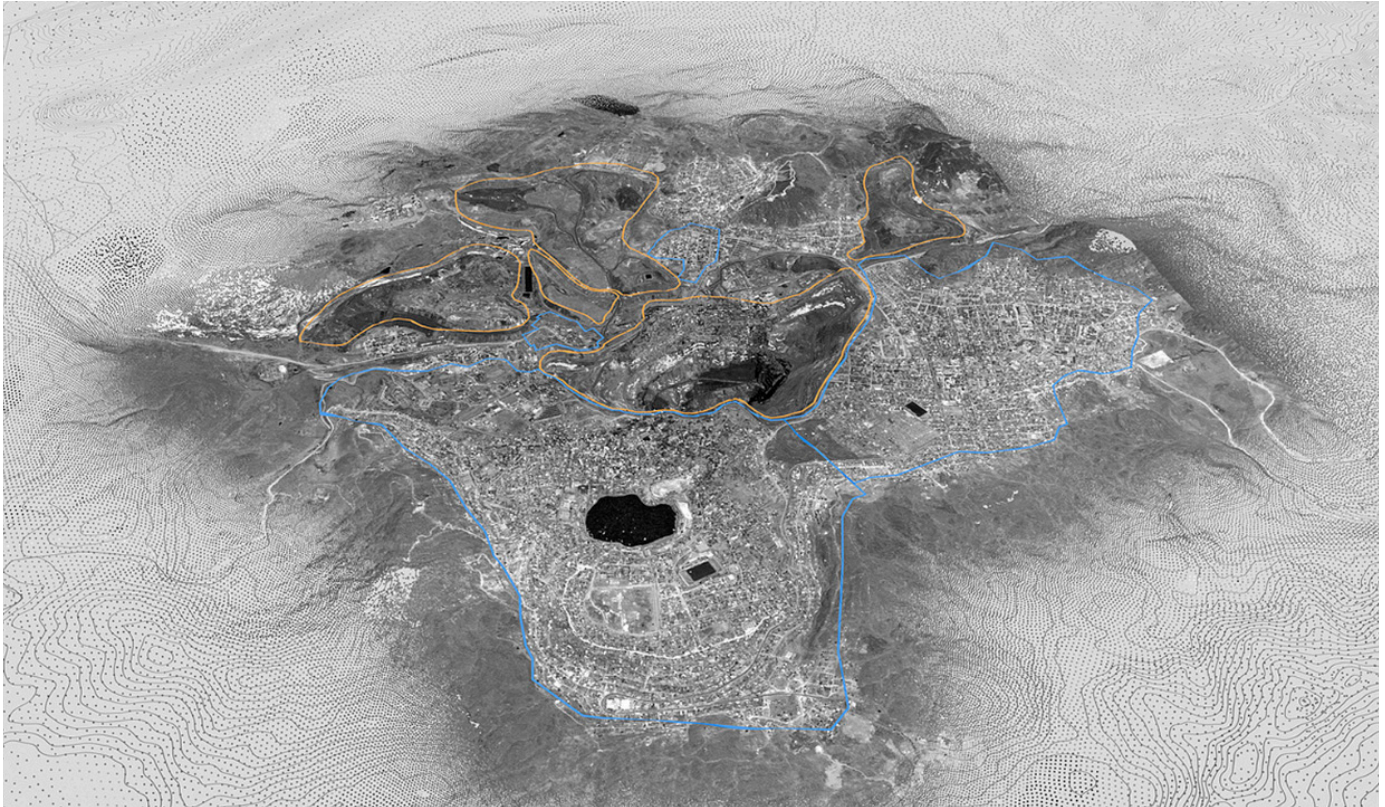
#### Port of Beirut

*Below, from ‘The Beirut Port Explosion: Destruction of Destruction,’ an accurately measurable model of the Beirut silos put together by Forensic Architecture and Febrayer using drone footage taken on August 6, 2023, two days after the explosion.*

*Rendering by Forensic Architecture and Febrayer.*







#### Cerro de Pasco, Perú

*SITU Research integrated the findings of multiple scientific studies to combine all the datasets within a cohesive geospatial framework. This analytical data was then layered on top of a composite 3D model of Cerro de Pasco and its environs, which combines data at multiple different resolutions to achieve an accurate and immersive representation of the city. Above, Pointcloud information is shown at multiple densities, determined by distance from the mining pit and the city center.*

*Image by SITU Research.*

However, while unable to do a systematic review, we learned of several cases where open source material has been used, which indicates that lawyers and activists are seeking to utilize these tools and data in the courtroom setting. These include satellite imagery used in the conviction of former Congolese army member, Chance Muhonya Koloko, in part for the illegal exploitation of natural resources in South Kivu, Democratic Republic of Congo; the use of Instagram photos in a recent Privy Council decision blocking the construction of an airstrip in Antigua and Barbuda over environmental concerns; and a civil case in Brazil where open source materials were used to prove the ongoing exploitation of land. In response to the work of numerous civil society organizations who have been documenting environmental crimes using open source investigative methods and sharing that information with the International Criminal Court, the Office of the Prosecutor is now creating a policy for investigating and prosecuting environmental crimes.

Outside of the courtroom, OSI methods are being used in advocacy to document and raise awareness of numerous wrong-doings related to the environment, from the trafficking of wildlife to illegal mining, with the goal of gathering critical evidence for court. For example, by using selective search terms and Virtual Private Networks to access publicly available websites in China, researchers from the Environmental Investigation Agency used OSI to investigate the illegal killing of leopards in Asia to provide bone for traditional medicine products.

In 2020, the Center for Climate Crime Analysis and SITU Research used OSI to conduct an in-depth examination of the impact of heavy metal extraction on the environment and human health in Cerro de Pasco, Perú, with support from Berkeley's Investigations Lab. In 2022, Forensic Architecture and the Climate Litigation Accelerator published a report criticizing the Brazilian government's support for illegal gold mining, uncovering attacks on Yanomami communities and reconstructing a 2021 attack on Palimiu village via 3D modeling. The report further documented attacks on Indigenous communities from miners by geolocating incidents using satellite imagery, geospatial data, and remote sensing.

The use of OSI in environmental advocacy and litigation is an evolving field. It holds increasing value in enabling stakeholders to share intelligence – within coalitions, NGOs, and the general public. Facilitating a shared understanding of environmental injustices allows practitioners and policymakers to make coordinated, environmentally focused decisions based on emerging technologies and crowdsourced information.



# Future Directions and Role of Standardization

As touched on above, digital open source investigative methods and tools are diverse and ever-expanding. For example, MetaOSINT — just one aggregator of tools that aid the open source research community — has curated hundreds of resources relevant to digital open source investigators. Given this breadth of resources and the fast rate of change, there are enormous gains to be had in identifying the methods and tools that may be particularly of value when starting a digital investigation into environmental harms. These range from techniques that aid with identification, analysis, verification, and visualization of digital open source information relevant to environmental harms (for example, videos and photos posted to social media, or satellite imagery, which can show changes to large geographic areas over specific time periods), to government or nongovernmental datasets that may hold critical information. These processes are increasingly being aided by machine-learning based technologies, which are rapidly improving in their ability to auto-detect various phenomena in photographs, videos and satellite imagery, and to potentially link disparate bits of data based on people, objects, and assets (such as email addresses and phone numbers).

What remains constant as environmental investigators increase their use of digital tools, regardless of source material or subject matter, is the need to follow internationally established guidelines like the Berkeley Protocol on Digital Open Source Investigations to ensure the quality of the analysis. This includes developing standard operating procedures and workflows that reflect the principles outlined in the Berkeley Protocol, as well as careful planning, including identification of resources that can be used to help meet investigative objectives. One particularly acute challenge is that this field of practice remains multidisciplinary and collaborative — various organizations may all be looking into similar or overlapping events or other phenomena. Harmonization in terminology; shared conventions for storing, coding and tagging data; and collaboration in reporting that data out to the world can help make this laborious work more efficient and impactful. In the months and years to come, tremendous gains can be made by bringing together researchers, journalists, and lawyers who use digital open source methods to research environmental harms, to further articulate and identify promising ways forward.

Gold is Brazil's second largest export. The advance of extractivism onto Indigenous Lands in Brazil has caught the attention of the international community. Pictured here is a strip mine for iron and gold 20 miles southeast of Parque Nacional Motanhas do Tumucumaque (5 miles northeast of Pedra Branch do Ampar'), Brazil.

Image by Daniel Beltrá for Greenpeace. January 20, 2017.



## Some Useful Resources for Environmental Defenders:

- [WITNESS Video as Evidence Environmental Defense Guide](#)
- [Sabin Center Climate Change Litigation Database](#)
- [Earth Defenders Toolkit Guide on Digital security for Earth Defenders](#)



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