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The Use of Geospatial Imagery in Myanmar for Mass Atrocity Prevention

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Introduction

In the last two decades, the purposes and potential of geospatial technologies have significantly increased, moving from the sphere of governments and large companies to smaller users, such as human rights and humanitarian organizations. In the past, satellite imagery was used for scientific purposes, to target enemy facilities, manage environments and monitor land-use change;¹ however, today, the different uses include evidence for prosecution in international criminal tribunal trials, humanitarian relief, UN peacekeeping operations and human rights activism.

Geospatial technologies have become one of the most valuable tools to collect and transfer potential evidence of human rights violations in contexts of limited access.² Geospatial technologies is a term used to define the variety of modern tools that contribute to the mapping and spatial study of the earth and human geography, which include satellite imagery, global positioning systems (GPS), and digital mapping software.³ Today we are facing scenarios where there are a diversity of people participating in human rights image creation and sharing.⁴ While this is can have a positive impact in documenting mass atrocities and monitoring areas with ongoing armed conflict and post conflict, this data cannot be used as evidence alone in prosecutions of international criminal justice⁵ and does not always prompt the international community to take action to prevent these human rights violations. The emergence of ethical dilemmas and concerns over the need of using this technology responsibly, to make sure to “do no harm,” is also a critical issue. Sometimes the release of information can show the locations of vulnerable populations and could enable the parties who are part of the conflict to target the people.⁶

This paper aims to explore to what extent the usage of geospatial imagery can serve as a tool to prevent mass atrocities in a context of armed conflict and post-conflict. To this end, it will focus on the use of geospatial imagery in the field of human rights by different non-state actors such as UN mechanisms, international tribunals, NGOs, media, and armed groups in the context of the Rohingya refugee’s crisis in Myanmar that began in August 2017. While most attention has been paid to the use of geospatial imagery to document mass

¹ Martin Dodge and Chris Perkins, “The ‘View from Nowhere’? Spatial Politics and Cultural Significance of High-Resolution Satellite Imagery,” *Geoforum* 40, no. 4 (2009), 497–501, accessed July 21, 2024, <https://doi.org/10.1016/j.geoforum.2009.04.011>.

² Christoph Koettl, “Sensors Everywhere: Using Satellites and Mobile Phones to Reduce Information Uncertainty in Human Rights Crisis Research,” *Genocide Studies and Prevention* 11, no. 1 (2017), 36–54, accessed July 21, 2024, <http://doi.org/10.5038/1911-9933.11.1.1440>.

³ Lars Bromley, “Eye in the Sky: Monitoring Human Rights Abuses Using Geospatial Technology,” *Georgetown Journal of International Affairs* 10, no. 1 (2009), 159–168, accessed July 21, 2024, <https://www.jstor.org/stable/43134201>.

⁴ Sam Gregory, “Ubiquitous Witnessing in Human Rights Activism,” in *Visual Imagery and Human Rights Practice*, ed. Sandra Ristovska and Monroe Price (London: Palgrave Macmillan Cham, 2018), 253–273.

⁵ Kamari Maxine Clarke and Sara Kendall, “‘The Beauty...Is That It Speaks for Itself’: Geospatial Materials as Evidentiary Matters,” *Law Text Culture* 23, (2019), 100, accessed July 21, 2024, <https://ro.uow.edu.au/cgi/viewcontent.cgi?article=1382&context=ltc>. As the authors explain, “geospatial technologies are deployed in order to supplement witness narratives and to document post-atrocity destruction at different scales.”

⁶ Susan R. Wolfenbarger, “Remote Sensing as a Tool for Human Rights Fact-Finding,” in *The Transformation of Human Rights Fact-Finding*, ed. Philip Alston and Sarah Knuckley (Oxford: Oxford University Press, 2016), 463–478.

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atrocities for advocacy and accountability purposes, less attention has attracted the potential of this technology as a preventive tool. In the case of Myanmar, a special interest is on how to advance the use of geospatial imagery to guarantee the safe return of the Rohingya refugees and internally displaced persons (IDPs) in the current fragile context after the *coup d'état* in 2021. Despite the potential of geospatial imagery, it is important to bear in mind its limitations, such as the costs, the need for expert analysis, and the possibility of misinterpretation of the imagery.

The Use of Geospatial Technologies in the Human Rights Field

The use of geospatial imagery has expanded considerably in the field of human rights, and NGOs such as Amnesty International and Human Rights Watch have used satellite imagery to denounce human rights violations and to call for action from the international community. Documenting and exposing atrocities is essential for advocacy groups and international organizations that aim at deterring violence and to change the conduct of perpetrators. The most well-known geospatial-oriented analysis of mass atrocities are the “Eyes on Darfur” project by Amnesty International,⁷ and the “Crisis in Darfur” by the US Holocaust Museum, a joint project with Google Earth⁸ launched in 2007 to cover the ongoing human rights violations in the region of Darfur in Sudan. The Amnesty International project consisted in monitoring 12 villages with high risk on an on-going basis and posting the satellite images on the internet. One of the aims was to pressure the Sudan’s government to allow the deployment of a UN peacekeeping operation in Darfur.⁹ Amnesty International used commercial satellite imagery from the companies Digital Globe, Geoeye, and Imagesat, to monitor selected villages at high risk in Darfur and Eastern Chad, with the purpose of analyzing and predicting which other villages may be at risk given studies of locations already attacked and the spatial patterns of the attacks.¹⁰

The Holocaust Museum partnered with Google to document the genocide in Darfur by bringing together satellite imagery with layers of data and multimedia from Google Earth.¹¹ The project website describes the novelty of using satellite imagery in human rights crisis:

With the imagery alone, it was next to impossible to locate the attacked villages. With the data alone the user could see the big picture of attacks in Darfur but had no understanding of the local impact on each village and settlement. When the two sets of data were combined, each became more powerful.¹²

The impact of this initiative on public perception is undeniable. The “Crisis in Darfur” project was covered globally by more than 500 media outlets in English alone, and more in other languages. More than a million people downloaded imagery from the museum’s website, and more than 100,000 visited the “What Can I Do?” page to find out how they might help.¹³

⁷ For an overview of the project, see generally, AAAS, “High-Resolution Satellite Imagery and the Conflict in Chad and Sudan,” accessed February 15, 2024, <https://www.aaas.org/resources/high-resolution-satellite-imagery-and-conflict-chad-and-sudan>.

⁸ Andrew Hollinger, “United States Holocaust Memorial Museum: Crisis in Darfur,” *Google Earth* (webpage), accessed February 15, 2024, <https://www.google.com/earth/outreach/success-stories/united-states-holocaust-memorial-museum/>.

⁹ Michelle Nichols, “Amnesty Keeps an Eye on Darfur with Satellite Images,” *Reuters*, updated August 9, 2007, accessed February 15, 2024, <https://www.reuters.com/article/us-sudan-darfur-amnesty-idUSN0530427120070606>; Amnesty International, “Darfur: New Evidence of Attacks on Villages,” November 17, 2009, accessed February 15, 2024, <https://www.amnestyusa.org/darfur-new-evidence-of-attacks-on-villages/>.

¹⁰ Lisa Parks, “Digging into Google Earth: An Analysis of ‘Crisis in Darfur,’” *Geoforum* 40, no. 4 (2009), 535–545, accessed July 21, 2024, <https://doi.org/10.1016/j.geoforum.2009.04.004>.

¹¹ Hollinger, *Crisis in Darfur*.

¹² *Ibid.*

¹³ *Ibid.*

Some authors consider that these projects had a deep impact not only on public perception of the crisis, but also on policymakers at both the domestic and international level.¹⁴ Others, however, view these site's efficacy as public advocacy tools but with limited impact to motivate external actors to take action against the genocidal regime.¹⁵ In the context of the "Eyes in Darfur" project, Grant Gordon's analysis concludes that Amnesty International's program had in fact negative effects as it increased violence in the monitored villages in Darfur, not only during the duration of the project, but also in subsequent years.¹⁶ The Holocaust Museum itself recognized that the use of Google Earth as a tool to prevent genocide still remains limited.¹⁷ In practice, although the projects contributed to awareness raising about the violence in Darfur, violence continued to happen.¹⁸ This may be one of the reasons why the Holocaust Museum has not replicated the project in other conflict areas afterwards. For instance, in its 2017 report¹⁹ on Burma, geospatial imagery was only used as evidence to corroborate "eyewitness testimony describing how Myanmar authorities and others razed Rohingya-owned homes and properties throughout northern Rakhine State, destroying hundreds of villages and entire village tracts" and, in the 2015 report, there was no reference to satellite imagery.²⁰

More recently, organizations specialized in technology such as Belling Cat²¹ or Forensic Architecture,²² use geospatial imagery combined with other types of resources and technologies, as evidence to analyze a specific event, such as genocide committed against the Mayan *Ixil* in Guatemala between 1981 and 1983,²³ the destruction of infrastructure in Cameroon,²⁴ international coalition airstrikes in Syria affecting hospitals,²⁵ and destruction of cultural heritage in Gaza.²⁶

Within the United Nations, Fact-Finding Missions established by the Human Rights Council to investigate human rights and international humanitarian law violations in a specific context, have included satellite imagery as a source for information gathering. This is the case of

¹⁴ James R. Walker, "The Rise of GEOINT: Technology, Intelligence and Human Rights," in *Visual Imagery and Human Rights Practice*, ed. Sandra Ristovska and Monroe Price (London: Palgrave Macmillan Cham, 2018), 67–88.

¹⁵ Matthew Levinger, "Geographical Information Systems Technology as a Tool for Genocide Prevention: The Case of Darfur," *Space and Polity* 13, no. 1 (2009), 69–76, accessed July 21, 2024, <https://doi.org/10.1080/13562570902781249>.

¹⁶ Grant Gordon, "Monitoring Conflict to Reduce Violence: Evidence from a Satellite Intervention in Darfur," December 22, 2015, accessed February 15, 2024, http://cega.berkeley.edu/assets/miscellaneous_files/Gordon_Monitoring_Conflight_to_Reduce_Violence_WGAPE.pdf.

¹⁷ Hollinger, *Crisis in Darfur*.

¹⁸ Parks, *Digging into Google Earth*.

¹⁹ United States Holocaust Memorial Museum, "They Tried to Kill Us All: Atrocity Crimes against Rohingya Muslims in Rakhine State, Myanmar," *Bearing Witness Report*, November 2017, accessed February 15, 2024, <https://www.ushmm.org/m/pdfs/201711-atrocity-crimes-rohingya-muslims.pdf>.

²⁰ United States Holocaust Memorial Museum, "Burma: Bearing Witness Trips," 2015, accessed February 15, 2024, <https://www.ushmm.org/genocide-prevention/countries/burma/burma>.

²¹ Bellingcat (webpage), accessed July 28, 2024, <https://www.bellingcat.com>.

²² Forensic Architecture (webpage), accessed July 28, 2024, <https://forensic-architecture.org>.

²³ Forensic Architecture Team, "Genocide in the Ixil Triangle," *Forensic Architecture* (webpage), February 1, 2014, Accessed February 15, 2024, <https://forensic-architecture.org/investigation/environmental-violence-and-genocide-in-the-ixil-triangle>.

²⁴ Benjamin Strick, "Geolocation of Infrastructure Destruction in Cameroon: A Case Study of Kumbo and Kumfutu," *Bellingcat*, November 21, 2018, accessed February 15, 2024, <https://www.bellingcat.com/resources/case-studies/2018/11/21/geolocation-infrastructure-destruction-cameroon-case-study-kumbo-kumfutu/>.

²⁵ Brian Perlman and Sophie Timmerman, "Could Coalition Airstrikes Have Hit Medical Facilities in Syria? A Review of Open Source Data," *Bellingcat*, September 30, 2020, accessed July 16, 2024, <https://www.bellingcat.com/news/mena/2020/09/30/could-coalition-airstrikes-have-hit-medical-facilities-in-syria-a-review-of-open-source-data/>.

²⁶ Forensic Architecture Team, "Living Archeology in Gaza," *Forensic Architecture* (webpage), February 23, 2022, accessed February 15, 2024, <https://forensic-architecture.org/investigation/living-archaeology-in-gaza>.

the missions of Gaza (2009),²⁷ Sri Lanka (2014),²⁸ and Myanmar (2017).²⁹ The use of this technology is relevant specially in those cases where the access is limited or denied to independent experts. The use of satellite imagery to document mass atrocities by these independent commissions of inquiry may be used to support investigations and accountability, both at the state and individual level, and in international courts, like in the case of Myanmar. Satellite imagery can also be an important tool to uncover serious human rights violations in countries with very limited access to information, such as the Xinjiang camps in China.³⁰

Moreover, geospatial imagery has been used by international criminal courts to prosecute international crimes such as war crimes, crimes against humanity, and genocide. In the 1990s, the Prosecutor of the International Criminal Tribunal for the former Yugoslavia used satellite imagery provided by US intelligence as evidence of the mass graves of Srebrenica in Bosnia and Herzegovina that occurred during the Balkans conflict.³¹ Likewise, the International Criminal Court has relied on geospatial imagery for the case of Thomas Lubanga as evidence of child soldiers' movements to training camps,³² and others cases such as the case against Ahmad Al-Mahdi in which the satellite imagery showed the cultural heritage buildings before and after the destruction.³³ At a regional level, the Inter-American Court of Human Rights has used satellite imagery to map land use and deforestation patterns of land of indigenous communities,³⁴ and the European Court of Human Rights has relied on satellite imagery to show internal displacement in the countries of origin as a risk for immigrants in deportation proceedings.³⁵ Therefore, geospatial technologies can document massacres, mass graves, and widespread burning and destruction of villages, in addition to providing a timeframe of the events and corroborate witness testimony, even if the crimes occurred some years ago.³⁶

In the humanitarian field, geospatial technology also offers new opportunities for prevention, response, and resource mobilization for humanitarian actors and affected communities, both in natural disasters and armed conflicts. In a context of reduction of humanitarian space due to the difficulty of access to crisis locations and the dangerous environment for humanitarian workers, technology is perceived as an instrument for remote

²⁷ United Nations Human Rights Council, *Report of the United Nations Fact-Finding Mission on the Gaza Conflict*, 25 September 2009 (UN Doc. A/HRC/12/48); UNITAR Operational Satellite Applications Programme, *Satellite Image Analysis in Support to the United Nations Fact Finding Mission on the Gaza Conflict*, July 31, 2009, https://www.ohchr.org/sites/default/files/Documents/HRBodies/HRCouncil/SpecialSession/Session9/UNITAR_UNOSAT_GFFM_UNOHCHR_31July2009.pdf.

²⁸ United Nations Human Rights Council, *Report of the OHCHR Investigation on Sri Lanka*, 16 September 2015 (UN Doc. A/HRC/30/CRP.2).

²⁹ United Nations Human Rights Council, *Report of the Independent International Fact-Finding Mission on Myanmar*, 12 September 2018 (UN Doc. A/HRC/39/64), para. 7.

³⁰ Alison Killing et al., "Blacked-Out Spots On China's Maps Helped Us Uncover Xinjiang's Camps," *BuzzFeed News*, August 27, 2020, accessed February 15, 2024, https://www.buzzfeednews.com/article/alison_killing/satellite-images-investigation-xinjiang-detention-camps.

³¹ See, among others, ICTY, *Prosecutor v. Blagojević & Jokić (IT-02-60)*, 17 January 2005. The Court uses the terminology "aerial imagery" to refer to satellite imagery.

³² ICC, *Situation in The Democratic Republic of The Congo in The Case of The Prosecutor v. Thomas Lubanga Dyilo, Decision on The Use of Visual Aids*, No.: ICC-01/04-01/06, 2 December 2008.

³³ ICC, *Situation in The Republic of Mali in The Case of The Prosecutor v. Ahmad Al Faqi Al Mahdi, Decision on the Confirmation of Charges Against Ahmad Al Faqi Al Mahdi*, No.: ICC-01/12-01/15, 24 March 2016, para. 33.

³⁴ IACtHR, *Saramaka People v. Suriname, Judgment*, November 28, 2007; *Sawhoyamaya indigenous Community v. Paraguay, Judgment*, March 29, 2006.

³⁵ ECtHR, *Sufi and Elmi v. the United Kingdom*, Application Nos. 8319/07 and 11449/07, November 28, 2011. The applicants were two Somalis that were the object of deportation for committing offences in the UK and feared ill-treatment if they were returned to Somalia.

³⁶ AAAS Scientific Responsibility Human Rights and Law, *Geospatial Evidence in International Human Rights Litigation* (New York: American Association for the Advancement of Science, 2018).

management in restricted access areas.³⁷ Moreover, UN Peacekeeping operations have also started to incorporate new technologies to improve operational effectiveness, with The UN Stabilization Organization in the Democratic Republic of Congo (MONUSCO) being the first peacekeeping mission to actively engage the use of remote sensing technology.³⁸

The Use of Geospatial Imagery in the Rohingya Refugee's Crisis in Myanmar

The fleeing of more than 700,000 refugees from Myanmar to Bangladesh was prompted by the violent reaction of Myanmar military forces (*Tatmadaw*) since August 25, 2017 when attacks by the Arakan Rohingya Salvation Army (ARSA) on security posts began.³⁹ Since then, nearly one million refugees have been housed in Cox's Bazar in Bangladesh, joining almost 200,000 refugees that were there following previous waves of displacement. Nearly 1.2 million Rohingya live in refugee camps in Cox's Bazar.⁴⁰ The burning and destruction of villages and operations of clearance was a method used on a large scale by the military in Rakhine State that affected mainly the Muslim Rohingya minority community.⁴¹ As a Muslim minority group in a predominantly Buddhist country, the Rohingya have suffered decades of ethnic and religious persecution.⁴² In the light of the military coup in Myanmar in 2021, and the reluctance of the government to solve the issues of citizenship and recognition of Rohingya as a minority, their return home seems unlikely.⁴³

In this context of armed conflict, geospatial imagery has been used by different actors to document human rights violations against the Rohingya and other ethnic minorities in Myanmar from 2017, such as forced displacement and unlawful destruction of property. The United Nations established in 2017 an independent international Fact-Finding Mission (FFM) on Myanmar⁴⁴ "to establish the facts and circumstances of the alleged recent human rights violations by military and security forces, and abuses, in Myanmar, in particular in Rakhine State," with the aim to "ensuring full accountability for perpetrators and justice for victims."⁴⁵ The FFM relied on different sources in its reports, including satellite imagery, and concluded that "satellite imagery and first-hand accounts corroborate widespread, systematic, deliberate and targeted destruction, mainly by fire, of Rohingya-populated areas."⁴⁶

The geospatial imagery used by the FFM was provided by the United Nations Institute for Training and Research-Operational Satellite Applications Program (UNITAR-UNOSAT). UNOSAT produced information and evidence related to widespread destruction in Buthidaung, Maungdaw, and Rathedaung Townships of Rakhine State in Myanmar from August 2017 and

³⁷ Kristin Bergtora Sandvik et al., "Humanitarian Technology: A Critical Research Agenda," *International Review of the Red Cross* 96, no. 893 (2014), 219–242, accessed July 21, 2024, <https://international-review.icrc.org/sites/default/files/irrc-893-sandvik-jumbert-karlsrud-kaufmann.pdf>.

³⁸ Walker, *The Rise of GEOINT*.

³⁹ Human Rights Watch, "Burma: Satellite Imagery Shows Mass Destruction," September 19, 2017, accessed February 15, 2024, <https://www.hrw.org/news/2017/09/19/burma-satellite-imagery-shows-mass-destruction>.

⁴⁰ Shazwanis Shukri, "The Rohingya Refugee Crisis in Southeast Asia: ASEAN's Role and Way Forward," *Journal of International Studies* 17 (2021), 239–263, accessed July 21, 2024, <https://doi.org/10.32890/jis2021.17.10>.

⁴¹ Chris Beyrer and Adeeba Kamarulzaman, "Ethnic Cleansing in Myanmar: The Rohingya Crisis and Human Rights," *Lancet* 390, no. 10102 (2017), 1570–1573, accessed July 21, 2024, [https://doi.org/10.1016/S0140-6736\(17\)32519-9](https://doi.org/10.1016/S0140-6736(17)32519-9).

⁴² Nehginpao Kipgen, "Myanmar's Perspective on the Rohingya Crisis," *International Journal on World Peace* 37, no. 1 (2020), 43–70, accessed July 21, 2024, <https://www.jstor.org/stable/26906542>.

⁴³ Antje Missbach and Gunnar Stange, "Muslim Solidarity and the Lack of Effective Protection for Rohingya Refugees in Southeast Asia," *Social Sciences* 10, no. 5 (2021), 166–180, accessed July 21, 2024, <https://doi.org/10.3390/socsci10050166>.

⁴⁴ United Nations, *Human Rights Council Resolution 34/22 Situation of Human Rights in Myanmar*, March 24, 2017.

⁴⁵ *Ibid.*, para. 11.

⁴⁶ United Nations Human Rights Council, *Report of the Independent International Fact-Finding Mission on Myanmar*, para. 42.

subsequent months, using high-resolution optical satellite imagery and fire detection data.⁴⁷ The purpose of the satellite imagery was to: (1.) identify the settlements damaged and destroyed; (2.) assess post-conflict debris clearance and construction activities in the affected villages; and (3.) review the data on fires detected by satellites during the period in question. UNOSAT used high-resolution satellite imagery from Digital Globe and the fire detection data from US Government satellites, as well as GIS software by UNOSAT analysts. The report of UNOSAT confirmed the patterns of destruction, debris clearance, and subsequent reconstruction in the towns monitored between August 25, 2017, and March 18, 2018. The geospatial imagery showed that 392 settlements had been affected and 37,700 structures were destroyed. Of these settlements, 214 were partially destroyed while 178 were completely or almost destroyed during that period.⁴⁸ The analysis of the satellite imagery also identified new constructions on previously cleared areas that could be new villages or resettlement camps, as well as security infrastructure and fences around these new constructions.⁴⁹ In the 2019 report, the FFM affirmed that “according to satellite imagery and witness testimony about the construction of new camps for displaced Rohingya refugees, the Government seems to be continuing its plan to keep the Rohingya off their lands to further segregate them from the rest of the population.”⁵⁰

The findings of the FFM that were based on satellite imagery, have been used to support the opening of an investigation by the Office of Prosecutor of the International Criminal Court on the situation of Bangladesh/Myanmar in 2019 for crimes against humanity (deportation, persecution, and other inhuman acts) perpetrated against the Rohingya during the 2017 wave of violence.⁵¹ Furthermore, in 2019, Gambia requested to the International Court of Justice the application for provisional measures to Myanmar to prevent genocide against Rohingya. Gambia claimed that the “clearance operations” perpetrated by the *Tatmadaw* and other security forces, were intended to destroy the Rohingya as a group, “by the use of mass murder, rape and other forms of sexual violence, as well as the systematic destruction by fire of their villages, often with inhabitants locked inside burning houses” and that such genocidal acts continued on a more massive and wider geographical scale after August 2017.⁵² Additionally, the Gambian application, based on the satellite imagery information provided by the FFM and UNOSAT, concluded that “satellite imagery reveals that wherever the Tatmadaw carried out a ‘clearance operation’ on a mixed ethnicity village or village tract, only the Rohingya settlements were targeted. Ethnic Rakhine people and habitations remained untouched.”⁵³

At the civil society level, both Amnesty International⁵⁴ and Human Rights Watch have relied on geospatial imagery to denounce human rights violations against Rohingya during the crisis in 2017.⁵⁵ The use in this case has been not only to document the destruction of villages in the Rakhine state, but also to pressure the international community and to request an impartial investigation to determine the responsibility for the mass destruction of Rohingya villages,

⁴⁷ United Nations Institute for Training and Research, *UNOSAT Analysis of Destruction and Other Developments in Rakhine State, Myanmar*, September 7, 2018, UN Doc. A/HRC/39/64, accessed September 5, 2024, <https://www.ohchr.org/EN/HRBodies/HRC/MyanmarFFM/Pages/ReportoftheMyanmarFFM.aspx>.

⁴⁸ *Ibid.*, 7.

⁴⁹ *Ibid.*, 11.

⁵⁰ United Nations, Human Rights Council, *Report of the Independent International Fact-Finding Mission on Myanmar*, para. 84.

⁵¹ ICC, Office of the Prosecutor, *Situation in The People’s Republic of Bangladesh/Republic of The Union of Myanmar*, ICC-01/19, 4 July 2019. See paras. 107–109, 158–159.

⁵² ICJ, *Republic of The Gambia V. Republic of The Union of Myanmar*, Application Instituting Proceedings and Request for Provisional Measures, November 11, 2019, para. 6.

⁵³ *Ibid.*, para. 90.

⁵⁴ “Myanmar: ‘We Will Destroy Everything’: Military Responsibility for Crimes Against Humanity in Rakhine State,” *Amnesty International*, June 27, 2018, accessed February 15, 2024, <https://www.amnesty.org/en/documents/asa16/8630/2018/en/>.

⁵⁵ Amnesty International, “Mapping Myanmar’s Atrocities Against the Rohingya,” accessed February 15, 2024, <https://mapping-crimes-against-rohingya.amnesty.org/>.

property and land. In this context, both organizations have a strong voice at the international level and have used satellite imagery in previous humanitarian crisis such as Darfur. Besides, the information provided by NGOs based on geospatial imagery had been echoed by various media such as *The Guardian*,⁵⁶ *The New York Times*,⁵⁷ the *BBC*,⁵⁸ among others.

In Myanmar, armed groups such as the Arakan Army have used satellite imagery to dismiss and to deny attacks that the Myanmar's military attributes to them.⁵⁹ While generally armed groups use the internet to claim for acts, the Arakan Army uses the Web to prove that the attacks were committed by the *Tatmadaw* by using geospatial imagery as well the testimonies from army deserters that are under their custody. However, the Myanmar military seems to use drone images to accuse the Arakan Army of the destruction of villages of Rohingya.⁶⁰

Consequently, in the context of the Rohingya refugees' crisis in Myanmar, different non-state actors are using geospatial imagery to document the ongoing destruction and burning of villages, clearance operations, and new construction in the Rakhine State. These efforts have contributed significantly to help collect, preserve, and analyze evidence of international crimes committed in Myanmar. The UN Independent Investigative Mechanism for Myanmar (IIMM) has collected nearly 3,000,000 pieces of information, including interviews, documentation, videos, photographs, geospatial imagery, and social media material.⁶¹ To be able to process all of this material, the IIMM has created an integrated mapping tool with the capacity to deal with the huge quantities of data collected, which is stored in a secured, cloud-based platform. Combining different types of information sources, such as geospatial imagery with more recent photographs and video footage taken during the clearing operations in Myanmar, has allowed the IIMM to geolocate and corroborate evidence.⁶²

These "satellite forensics"⁶³ are currently supporting international legal proceedings to determine international criminal accountability for crimes against humanity and state responsibility for genocide against the Rohingya community. While advocacy and accountability initiatives are contributing to post-conflict justice prominently, the application of geospatial imagery to conflict-prevention efforts has yet to reveal good results.⁶⁴ The most skeptical consider that the goal of preventing atrocities is likely to remain out of reach of this technology.⁶⁵ While including these new methodologies can constitute "pockets of hope" for

⁵⁶ Hannah Ellis-Petersen, "Satellite Images Reveal Scale of Myanmar's Rohingya Crisis," *Guardian*, July 24, 2019, accessed February 15, 2024, <https://www.theguardian.com/world/2019/jul/24/myanmars-rohingya-crisis>.

⁵⁷ Sergio Peçanha and Jeremy White, "Satellite Images Show More Than 200 Rohingya Villages Burned in Myanmar," *New York Times*, September 18, 2017, accessed February 15, 2024, <https://www.nytimes.com/interactive/2017/09/18/world/asia/rohingya-villages.html>.

⁵⁸ "Rohingya Crisis: Satellite Images of Myanmar Village Burning," *BBC*, September 14, 2017, accessed February 15, 2024, <https://www.bbc.com/news/world-asia-41270891>.

⁵⁹ Arakan Army, "Clarification of True Instances and Disclaimer of Fictitious Facts," last updated May 21, 2020, accessed February 15, 2024, <https://www.arakanarmy.net/post/clarification-of-true-instances-and-disclaimer-of-fictitious-facts>.

⁶⁰ Office of Commander-in-Chief of Defense Services of Myanmar, May 17, 2020, accessed February 15, 2024, <https://cincds.gov.mm/node/7543>.

⁶¹ United Nations, Human Rights Council, Report of the Independent Investigative Mechanism for Myanmar, July 12, 2022 (UN Doc. A/HRC/51/4).

⁶² *Ibid.*, paras 31–34.

⁶³ Parks, *Digging into Google Earth*.

⁶⁴ Francesco Mancini and Marie O'Reilly, "New Technology and the Prevention of Violence and Conflict," *Stability: International Journal of Security & Development* 2, no. 3 (2013), 1–9, accessed July 21, 2024, <https://doi.org/10.5334/sta.cp>.

⁶⁵ Frank D. W. Witmer, "Remote Sensing of Violent Conflict: Eyes from Above," *International Journal of Remote Sensing* 36, no. 9 (2015), 2326–2352, accessed July 21, 2024, <https://doi.org/10.1080/01431161.2015.1035412>.

atrocities prevention, there is still the paradox of having too much data and only little expertise to analyze all this information.⁶⁶

The Use of Geospatial Imagery for Atrocity Prevention

Geospatial imagery can be a powerful tool to counter government denial and narratives; however, it is not evident that these technologies have an impact on the decisions of the governments or serve as a deterrent for committing human rights violations. Although the war in Ukraine “has brought satellite imagery (...) to the forefront in a way it hasn’t been used before,”⁶⁷ in many cases irrefutable visual evidence may go unnoticed when there is an over-exposure of data of human rights violations, like in the case of Syria.⁶⁸ Therefore, technology-driven information does not always enable proper action and often decision-making processes at the international level remain disengaged from early warning and conflict-prevention mechanisms.⁶⁹

The fact that satellite imagery allows monitoring of human rights violations in ongoing armed conflicts without having to deploy people on the affected area, is an important advantage and at the same time cost-effective.⁷⁰ As geospatial imagery covers large areas and large-scale violations more accurately, it enables persons to track events or determine patterns and evaluate the scale of seriousness of atrocities. Gathering information in conflict areas continues to be very difficult, especially in countries in which governments deny access to humanitarian and human rights organizations to avoid the documentation of their conduct. Therefore, using satellite imagery circumvents the obstacles of collecting information from the ground and the need of authorization of the governments concerned to access conflict areas.⁷¹

Moreover, geospatial technology can present knowledge in a context of decision-making and offer critical information and analysis to prompt action. Beyond advocacy efforts, geospatial imagery can have value for conflict analysis and early warning by helping organizations performing on the ground to coordinate their responses.⁷² Also, the capacity of geospatial imagery to protect is related to its user’s ability to understand the context in a constantly changing environment, and its use needs to be combined with other types of sources such as video, footage, photos, GIS data, news sources, and ground informants. For a long time, satellite imagery has been provided by certain states (such as the US government) on a need-to-know basis, while commercial satellite imagery has made this technology more accessible in a timely and cost-effective manner. Still, to improve the impact of this technology, especially in the prevention of human rights violations, there is a need “to move from outdated still images to dynamic near real-time reconnaissance to achieve current situational awareness and immediate operational effect.”⁷³

⁶⁶ Kristina Hook, “The Information Revolution and New Opportunities for Multitrack Diplomacy in High Violence Situations: The Increasing Importance of Data Organization and Local Input for Policy Shaping,” *Ottawa Dialogue*, no. 2 (Ottawa: University of Ottawa, June 2021), accessed July 21, 2024, <https://doi.org/10.20381/ruor-28550>.

⁶⁷ Marisa Torrieri, “How Satellite Imagery Magnified Ukraine to the World,” *Via Satellite*, October 24, 2022, accessed February 15, 2024, <https://interactive.satellitetoday.com/via/november-2022/how-satellite-imagery-magnified-ukraine-to-the-world/>.

⁶⁸ Gregory, *Ubiquitous Witnessing*.

⁶⁹ Mancini and O’Reilly, *New Technology*.

⁷⁰ Andrew J. Marx, “A New Approach to Detecting Mass Human Rights Violations Using Satellite Imagery,” (Washington, DC: United States Holocaust Memorial Museum, October 2013), accessed July 21, 2024, <http://www.ushmm.org/m/pdfs/20130912-marx-cpgfellow-satellite-imagery-report.pdf>.

⁷¹ Gordon, *Monitoring Conflict*.

⁷² Matthew Levinger, “Geographical Information Systems Technology as a Tool for Genocide Prevention: The Case of Darfur,” *Space and Polity* 13, no. 1 (2009), 69–76, accessed July 21, 2024, <https://doi.org/10.1080/13562570902781249>.

⁷³ United Nations Peacekeeping, “Final Report of the Expert Panel on Technology and Innovation in UN Peacekeeping” (New York: United Nations, 2014), accessed February 15, 2024, <https://peacekeeping.un.org/en/final-report-of-expert-panel-technology-and-innovation-un-peacekeeping>.

A combination of constant observation of satellite imagery of the affected area, alongside adequate spatial resolution, is required to use this technology as a tool for prevention of human rights violations.⁷⁴ For instance, access to almost real-time satellite imagery would allow peacekeeping missions to keep up with the events on the ground in rapidly changing circumstances and improve operation effectiveness if peacekeeping missions are deployed in conflict and post-conflict contexts.⁷⁵ However, although commercial satellites have made geospatial technology more accessible, high-resolution satellite imagery is still expensive.⁷⁶

In the context of Myanmar, geospatial imagery has shown that the safe return of the Rohingya refugees to their land, house, and property in dignified conditions is not possible yet.⁷⁷ Due to international pressure, the government created, in 2018, the Union Enterprise for Humanitarian Assistance, Resettlement and Development (UEHRD) to respond to humanitarian and development needs in the Rakhine State. The government announced the construction of 3,500 housing units in resettlement villages for refugees and IDPs; however, geospatial analysis provided by UNOSAT showed that these new constructions were built in previously destroyed villages or cleared lands, and that these resettlement camps had “signs of security build up” and “new security structure.”⁷⁸ In addition to these new structures, for the Rohingya to return in safe conditions, discriminatory laws against them should be repealed and their citizen status granted. This seems unlikely according to the UN “in the light of the continuing persecution of remaining Rohingya, the legal conditionalities placed on return and the unacceptable living conditions that await returnees, the mission regards these statements [of the Government of Myanmar] and associated measures as lacking sincerity.”⁷⁹

Placing the civilian population at the center of the analysis of geospatial imagery by monitoring the implementation of the Memorandum of Understanding (MoU) between the government of Myanmar and UNHCR can constitute a tool of prevention of human rights violations. For instance, tracing the refugees and IDPs with satellite imagery provides humanitarian organizations information about internal and cross-border flows of people, as well as sites, camps, transit points and places of resettlement, and the conditions of infrastructure and livelihoods.⁸⁰ If the UN can use satellite imagery near real-time, the information provided can enhance cooperation between the UN and the Myanmar Government to make sure that the Rohingya refugees can return to their lands in safe and dignified conditions. While access to the area by UN personnel can be difficult since the armed conflict is ongoing, the use of geospatial imagery can give information on the humanitarian needs, and on whether there is a conducive environment for the voluntary, safe, and dignified return of refugees, and for their full enjoyment of human rights.

In addition, geospatial imagery can also be a useful atrocity prevention tool, countering genocide denial narratives and serving as a guarantee of non-repetition of human rights violations. Guatemala suffered an internal armed conflict between 1960 and 1996, leading to about 200,000 people dead and 45,000 disappeared. The Commission of Historical Clarification of Guatemala concluded that State agents, within the framework of the counterinsurgent operations, carried out acts of genocide against the Mayan people, resulting in the killing of at

⁷⁴ Andrew J. Marx and T. V. Loboda, “Landsat-Based Early Warning System to Detect the Destruction of Villages in Darfur, Sudan,” *Remote Sensing of Environment* 136, (2013), 126–134, accessed July 21, 2024. <https://doi.org/10.1016/j.rse.2013.05.006>.

⁷⁵ *Ibid.*, 132.

⁷⁶ Wolfinger, *Remote Sensing*. According to the author, a single image printing cost from US\$350 to US\$2,000.

⁷⁷ Amnesty International, “Myanmar: Villages Burned, Civilians Injured and Killed as Rakhine State Conflict Escalates,” October 12, 2020, accessed February 15, 2024, <https://www.amnesty.org/en/latest/news/2020/10/myanmar-villages-burned-civilians-injured-rakhine-state-conflict/>.

⁷⁸ UNOSAT, *Analysis of Destruction*, 24.

⁷⁹ UN Doc A/HRC/39/64, para. 76.

⁸⁰ See, for example, IOM Displacement Matrix, which uses geospatial data for collecting and analyzing data about the mobility, vulnerabilities, and needs of displaced and mobile populations: <https://dtm.iom.int/about-dtm>.

least 1,771 Mayan *Ixil* under the Ríos Montt regime.⁸¹ Forensic Architecture was commissioned by a Guatemalan NGO, the *Centro para la Acción Legal en Derechos Humanos* (CALDH), to support them in gathering evidence for the genocide trial against former dictator Ríos Montt in 2013. Forensic Architecture used remote sensing pattern analysis, geolocation and fieldwork, and traced the intersections between military operations, population displacement and relocation, and transformations in the urban, agricultural, and forest areas of the *Ixil* between 1979 and 1983. The forensic organization concluded that:

Through massacres, forest and crop destruction, population displacement and transfer, closure of common lands, and psychological warfare, state security forces not only tightened their control over the rural population, but disrupted the political-natural connections between those communities and their land, in such a manner as to undercut the basis of the existence of the *Ixil* Maya as a distinctive culture.⁸²

Despite having the former Head of State Ríos Montt convicted for genocide by domestic courts, Guatemala's military and economic elites continue to deny that there was genocide during the internal armed conflict.⁸³ Having "objective" evidence, such as the one provided by Forensic Architecture, by using geospatial technology, can help counter these denial narratives in transitional justice settings and be used as a preventive tool and guarantee of non-repetition of the atrocities committed in the past.

However, this so-called "panopticon effect" of satellite imagery⁸⁴ (as God's eye) does not necessarily lead parties of the conflict to stop committing human rights violations, as seen in the case of Darfur.⁸⁵ Besides, there is an assumption that technology is objective and neutral⁸⁶ and that the imagery from satellite reveals the "truth,"⁸⁷ because images appear to be transparent and offer viewing without mediation.⁸⁸ The apparent "mirror-like" images of the territory are, in fact, a mirage, since satellite imagery is constructed out of different images from different times, which are integrated to create an artificial view of the territory.⁸⁹ For instance, the satellite imagery in Google Earth is a complex mosaic of thousands of photographs taken over the past years,⁹⁰ so it does not reflect an exact moment in time.

However, more important than the geospatial technology itself is the training and mentality of the personnel that apply the technology in the field.⁹¹ The use of geospatial imagery may have the potential of misinterpretation due to lack of a deep understanding of the

⁸¹ Comisión para el Esclarecimiento Histórico, *Guatemala Memoria del Silencio, Vol. III* (Guatemala: United Nations Office for Project Services, June 1999), 418–419, accessed July 21, 2024, <https://www.centrodememoriahistorica.gov.co/descargas/guatemala-memoria-silencio/guatemala-memoria-del-silencio.pdf>.

⁸² Forensic Architecture, *Genocide in the Ixil Triangle*.

⁸³ Rebecca Clouser, "Development and Denial: Guatemalan Post-Genocide Development Narratives," *Geoforum* 117, (December 2020), 93–102, accessed July 21, 2024, <https://doi.org/10.1016/j.geoforum.2020.09.010>.

⁸⁴ Levinger, *Geographical Information Systems*.

⁸⁵ Parks, *Digging into Google Earth*.

⁸⁶ Sandvik et al., *Humanitarian Technology*.

⁸⁷ Walker, *The Rise of GEOINT*.

⁸⁸ Dodge and Perkins, *The "View from Nowhere"?*.

⁸⁹ Ibid.

⁹⁰ Levinger, *Geographical Information Systems*.

⁹¹ Walker, *The Rise of GEOINT*.

context.⁹² Many times satellite imagery analysis “made us see what we wanted to see”⁹³; therefore, human rights and humanitarian organizations need to be aware of their bias and the need for external expertise for satellite imagery analysis. The lack of technical capacity is one of the biggest barriers that prevents human rights organizations from using satellite imagery more widely.⁹⁴ The use of military technology and intelligence for humanitarian purposes—“war dividend technology”—often implies a military mindset,⁹⁵ therefore it is essential to “decolonize” the data to prevent replicating the injustices of the past⁹⁶ and reproducing older colonial discourses of difference and exclusion.⁹⁷ For instance, one of the criticisms of the “Crisis in Darfur” project is the lack of contextualization of the imagery by omitting the history of the (post)colonial geopolitics of the region and the perpetuation of Western conceptions of the African continent as those countries that are “continuously in strife.”⁹⁸ Moreover, it is important to conduct a conflict sensitivity analysis in order to adopt a “do no harm approach”⁹⁹ and ensure that the use of satellite imagery does not increase violence or put at risk vulnerable populations by uncovering their location to armed groups.

Conclusions

One of the greatest advantages of the geospatial technology is the ability to monitor human rights violations in a large scale without violating the territorial integrity of the state. As governments often deny access to human rights and humanitarian organizations, the use of satellite imagery can overcome these barriers and unveil widespread human rights violations without deploying personnel on the ground. Additionally, satellite imagery can also be relevant to combat disinformation for past and ongoing atrocities. As the data of commercial satellite imagery is unclassified it can be easily shared and be used to combat official narratives, like in the event of Bucha in the Ukraine war.¹⁰⁰ In the context of past atrocities, like in Guatemala, satellite imagery can help counter the denial narratives of genocide in transitional justice settings and prevent future recurrence of serious human rights violations.

Beyond advocacy and accountability efforts though, geospatial imagery could be used more often for atrocity prevention. The capacity of geospatial imagery to protect is related to the ability to understand the context in a constantly changing environment, and its use needs to be combined with other types of sources such as video, footage, photos, and ground informants. Therefore, geospatial imagery can have a greater value for conflict analysis and early warning by helping organizations performing on the ground to coordinate their responses and therefore be used as a tool to prevent atrocities. The role of high-resolution commercial satellite imagery in the armed conflict of Ukraine and the international community response at various levels, is unprecedented.¹⁰¹ As commercial satellite imagery is improving its resolution and reducing its

⁹² Gregory, *Ubiquitous Witnessing*.

⁹³ Alberto Fittarelli, “Ghost in The Machine: From Chad, A Case Study on Why You Shouldn’t Blindly Trust Tech,” *Bellingcat*, July 17, 2020, accessed February 15, 2024, <https://www.bellingcat.com/resources/2020/07/17/ghost-in-the-machine-from-chad-a-case-study-on-why-you-shouldnt-blindly-trust-tech/>.

⁹⁴ Robin Pierro, “Satellite Imagery for Human Rights Monitoring,” *Engine Room Library* (webpage), August 2017, accessed February 15, 2024, <https://library.theengineroom.org/satellite-imagery-human-rights/>.

⁹⁵ Walker, *The Rise of GEOINT*.

⁹⁶ Erica Nelson, “Critical Cartography: The Subjectivity, Politics, and Power of Spatial Data,” Harvard Humanitarian Initiative, streamed live on November 5, 2020, YouTube video, 49:50, accessed February 15, 2024, <https://www.youtube.com/watch?v=Matpi4BhBTM>.

⁹⁷ Delf Rothe and David Shim, “Sensing the Ground: On the Global Politics of Satellite-Based Activism,” *Review of International Studies* 44, no. 3 (2018), 414–437, accessed July 21, 2024, <https://doi.org/10.1017/S0260210517000602>.

⁹⁸ Parks, *Digging into Google Earth*.

⁹⁹ Elizabeth Hume, “Peacebuilding Programs in the United States: First Do No Harm,” in *Building Peace in America*, ed. Emily Sample and Douglas Irvin-Erickson, (Lanham: Rowman & Littlefield Publishers, 2020), 75–91.

¹⁰⁰ Reality Check and BBC Monitoring, “Bucha Killings: Satellite Image of Bodies Site Contradicts Russian Claims,” *BBC*, April 11, 2022, accessed February 15, 2024, <https://www.bbc.com/news/60981238>.

¹⁰¹ Torrieri, *Satellite Imagery*.

costs, the advancements in data delivering and analysis will be crucial to become a real tool of prevention. Within the context of the Ukraine war, a “new” geospatial technology seems to be breaking barriers, called Synthetic Aperture Radar (SAR), which supersedes traditional satellite imaging which require daylight and clear skies to capture images.¹⁰² This new technology uses energy sensors and can capture images despite clouds, smoke, and fires. This technology is not only a step forward in terms of satellite imagery, but it is also much more accessible to private organizations and public. Improving rapid access to satellite imagery may have the potential to allow citizens all over the world to participate in monitoring areas at risk of serious human rights violations, and to strengthen organizations’ ability to act effectively.¹⁰³

In Myanmar, different actors have used geospatial imagery to document and collect evidence of the human rights violations against the Rohingya and this information has been used to initiate legal proceedings for crimes against humanity and genocide before international courts. However, this strong evidence of mass atrocities has not triggered the adoption of coercive measures by the UN Security Council, such as arms embargoes or economic sanctions, due to the veto of China and the Russian Federation. The UN Security Council has not referred the situation of Myanmar to the International Criminal Court to investigate international crimes, as it did with the crisis in Darfur, nor has it proposed the creation of a hybrid international criminal court for accountability of these crimes.¹⁰⁴ Moreover, it does not seem either that a deployment of a peacekeeping mission is being considered, although the Security Council visited the country after the Rohingya refugee crisis.

Tracing Rohingya refugees and IDPs and monitoring the conflict zone do not appear to have influenced or changed the behavior of the Myanmar junta in promoting the safe return of refugees to their homes. On the contrary, the increase of the military operations in Myanmar has prompted secondary displacement with “no foreseeable prospects for sustainable return for most parts of Myanmar” and internally displaced people do not have viable places to return or relocate.¹⁰⁵ As the conflict in Myanmar intensifies, the UN has requested Bangladesh to suspend the pilot project to return Rohingya refugees to Myanmar.¹⁰⁶ In this context, the use of geospatial technology to monitor compliance with the conditions for a voluntary, safe and dignified return of refugees in Myanmar can significantly contribute to preventing human rights violations and warn authorities about the risks to the return of refugees when the necessary conditions are not met.

The use of geospatial imagery in the field of human rights has often stayed on the “before and after” analysis using high-resolution imagery.¹⁰⁷ Regardless of having access to more sophisticated tools and methods to assist atrocity early warning, like the use of geospatial imagery, political will to intervene remains crucial to adopt measures to prevent mass atrocities. As it has been exposed, the overload of information on ongoing mass atrocities in different armed conflicts does not necessarily prompt action from the international community. The use of near real-time satellite imagery and technical expertise to monitor the conflict area can contribute to better inform decision making and be able to keep up with constantly changing circumstances on the ground to prevent mass atrocities.

¹⁰² Ibid.

¹⁰³ Hollinger, *Crisis in Darfur*.

¹⁰⁴ The ICC is only investigating the situation of the Rohingya refugees in Bangladesh, which is a State Party of the Rome Statute, but cannot investigate the situation in Myanmar because it has not ratified the Rome Statute.

¹⁰⁵ United Nations, *Situation of Human Rights of Rohingya Muslims and Other Minorities in Myanmar*, Report of the Secretary-General, August 14, 2023 (UN Doc. A/78/278), para. 61.

¹⁰⁶ Thomas Andrews, “Bangladesh Must Suspend Pilot Project to Return Rohingya Refugees to Myanmar: UN Expert,” *United Nations Human Rights Office of the High Commissioner*, June 8, 2023, accessed February 15, 2024, <https://www.ohchr.org/en/press-releases/2023/06/bangladesh-must-suspend-pilot-project-return-rohingya-refugees-myanmar-un>.

¹⁰⁷ Wolfenbarger, *Remote Sensing*.

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