HUMANITARIAN CONGRESS

Between a Rock and a Hard Place:
Navigating war, politics and exploding needs through
principled humanitarian action

Sant'Anna School - Students' Working Papers

SATELLITES FOR HUMANITARIAN AID: WHICH IMPACT ON HUMANITARIAN ACCESS?

Matilde Sacchi

1 Introduction

The space sector is in expansion and the use of satellites is spreading also to commercial and humanitarian activities. On the one hand, satellites have great potential to favour humanitarian access by bridging crucial data gaps and by improving aid delivery's accuracy, timeliness and safety. On the other hand, elevated costs and other barriers to their diffusion preclude satellites' availability to many humanitarian organizations and populations in need, thus engendering imbalances and discriminations. Moreover, important actors in the satellite sector may pursue interests that diverge from humanitarian ones and risk to hamper humanitarian activities. To evaluate satellites' impact on humanitarian access, it is necessary to inquiry on who uses them, how and for what. To this end, this article provides a critical review of the literature and relies on insights from interviews with relevant actors, suggesting that satellites may favour humanitarian access if they do not accentuate or engender discrimination against certain humanitarian workers and people in need, and if their humanitarian use is clearly separated from the military one.

2 Making Room in Space

The 21st century is sometimes told to be the beginning of a post-Cold war "New Space" age.[1] Small and nanosatellites have revolutionized the space industry by providing an option for cost-effective space launches and by undertaking several specific tasks. SmallSats are spacecraft with a mass less than 180 kilograms, while nanosatellites are miniature satellites which are often in the standardized form of CubeSats, measuring 10x10x10 cm and weighing less than 1.33 kg. The size and weight of these satellites make them much cheaper to assemble and launch than traditional satellites. CubeSats can cost a few thousand dollars; SmallSats may be one hundred times more expensive, which is in any case much less than the multi-million or billion-dollar cost of a large satellite. Small satellites can

[1] Del Canto Viterale, Francisco. 2023. "Transitioning to a New Space Age in the 21st Century: A Systemic-Level Approach" *Systems.* 11(5): 232.

be launched from a variety of platforms, including through a rideshare multiple launch service[2], where many small satellites can be accommodated, thereby "piggybacking" on a same rocket and share the costs of the launch. Moreover, despite their small size they can be equipped with more sophisticated technology than traditional satellites, like high-resolution cameras and sensors, thus bringing forth custom-built solutions. Such a possibility for reduced costs and time of satellites' development and deployment turned the space in a very profitable economic sector, expanding the demand and attracting many public and private investors. According to the report "Expanding frontiers" issued by PwC and the UK Space Agency in 2023, over $47bn of private capital has been invested across the global space sector since 2015, growing on average 21% per year.[3]

The Small and CubeSat revolution both benefitted traditional space actors and made room in space for some new ones. On the one hand, traditional space entrepreneurs – namely, governments and national space agencies of certain states – diversified their systems, in such a way to make "more difficult for adversaries to knock down huge swathes of capability all at once". [4] On the other hand, small satellites increased both the number of space-capable actors within states and the overall amount of states with space capabilities. Since small satellites are easier to design, construct, and launch than conventional satellites, they are no longer exclusively employed by governments and the military, but also by the commercial sector, universities, small country space agencies, scientific organizations, start-ups, amateurs, and NGOs. Some CubeSats, launched by universities or private firms, have even been a country's first satellites.[5] This enlargement of the arena of satellites' producers and users is commonly referred to as "democratization of space".[6] It could bring several advantages

[2] To see more: https://www.esa.int/ESA_Multimedia/Images/2019/04/Rideshare_multiple_launch_service (last access: 27/08/2023)
[3] PwC, UK Space Agency. 16 May 2023. "Expanding frontiers: The down to earth guide to investing in space". Available at: https://www.strategyand.pwc.com/uk/en/insights/expanding-frontiers-down-to-earth-guide-to-investing-in-space.html (last access: 27/08/2023)
[4] Malisuwan, S. and Kanchanarat, B. 2022. "Small Satellites for Low-Cost Space Access: Launch, Deployment, Integration, and In-Space Logistics". *American Journal of Industrial and Business Management* 12(10): 122.
[5] *Ivi*.
[6] Baiocchi, Dave, and Welser, William. 2015. "The Democratization of Space: New Actors Need New Rules." *Foreign Affairs.* 94(3): 100.

for science and society[7], not only promoting exploratory, high-risk space research, but also improving human conditions on Earth. Among other things, in fact, satellites are also deemed to facilitate humanitarian aid and to help restore good conditions of life in territories disrupted by disasters or conflicts.

This paper questions whether satellites do indeed favour humanitarian access. The answer to such question is all but obvious and more in-depth analysis is needed to grasp the impact of satellites' democratization in the humanitarian sector. While the next paragraph underlines some circumstances in which satellite technologies can favour humanitarian access, the subsequent paragraphs invite to problematize such an optimistic view, highlighting some problems engendered by an indiscriminate application of satellite technologies to humanitarian activities.

A preliminary clarification of some key terms is warranted in order to better circumscribe this paper's problematique. First, when speaking about satellites technologies in this context we refer to the final products of satellite data gathering and management. Data gathering is performed by three types of satellite technology.[8]

- Earth Observation (EO) is the gathering of information about the physical, chemical, and biological systems of the planet via remote-sensing technologies. Remote sensing can be performed using not only images taken by optical sensors, but also those derived by radars. Optical sensors measure solar light reflected from the Earth's surface in the visible spectrum to produce easily interpretable images, similar to what human eyes see. Nevertheless, optical images are obstructed by darkness and clouds, while radar sensors provide images by emitting microwaves from an antenna towards a surface and by recording the intensity and delay of reflected waves. The lengths of these waves are much longer than those of visible light,

[7] Novak, A., Schuett, A., Parker, A., Bowser, A., Newbury, E. M. H., Goguichvili, S. Feb 7, 2022. "The Rise of Cubesats: Opportunities and Challenges". Wilson Center. Available at: https://www.wilsoncenter.org/blog-post/rise-cubesats-opportunities-and-challenges (last access: 22/07/23).

[8] The following definitions are mainly derived from the report: CaribouSpace and UKAid. August 2022. "Beyond Borders: Satellite Applications for Humanitarian Emergencies", p.5. Available at: https://space-economy.esa.int/article/177/beyond-borders-satellite-applications-for-humanitarian-emergencies (last access: 27/08/23).

making the sensors functional in all lighting conditions and able to penetrate through clouds and dust.[9]

- Global Navigation Satellite Systems (GNSS) are constellations of satellites providing positioning, navigation, and timing (PNT) signals from space. PNT signals are broadcast from a GNSS from space. These signals can be augmented by ground stations to improve accuracy.
- Satellite Communications (SatComms) provide voice and data/internet connectivity in regions that are not covered by terrestrial mobile networks or where such networks are not stable.

Then, satellite data management is indispensable in rendering satellite data intelligible and available when needed. Data streams deriving from satellites have to be refined and archived in order to extract valuable information from them. "Satellite data management" encompasses several different operations: image processing, detection, data integration and interpretation, platform and cloud services. On-demand cloud infrastructure enables all data analysis and product generation to be implemented in the cloud instead of the user's desktop. As for satellite applications, cloud providers allow users to conduct analyses that would otherwise require enormous resources to access, download, store, and analyze. Therefore, behind the word "satellites" there is a myriad of correlated technologies handled by different actors that need to be taken into account.

Secondly, one needs to clarify what humanitarian access is. Humanitarian access is not explicitly defined in International Humanitarian Law (IHL), where it is understood as a precondition for effective humanitarian assistance. On the one hand, defining humanitarian access may not be an exclusive prerogative of IHL since the issue of humanitarian access emerges when any population is in need, for reasons that encompass but are not limited to an armed conflict, as it is the case with natural disasters. On the other hand, constraints to humanitarian access are frequently engendered by a lack of familiarity – on the part of states, non-state armed groups, and humanitarian relief

[9]To see more: https://www.esa.int/SPECIALS/Eduspace_Global_IT/SEMLT0G64RH_0.html (last access: 27/08/23)

organizations – with the existing legal framework[10] and implicitness does not help. Moreover, humanitarian access as a precondition for assistance has also to do with an institutional enabling environment which would be better developed in presence of shared definitions. For this reason, competent authorities have struggled to define it. UNGA resolution 46/182 describes it as a principled and negotiated endeavour, whereby humanitarians access people in crisis-affected areas and provide them with emergency assistance in accordance with the principles of humanity, neutrality, impartiality and independence.[11] Respect for these normative principles facilitates concrete negotiations with state and non-state entities to reach people in need. To further support everyday negotiations for humanitarian access, the United Nations Office for the Coordination of Humanitarian Affairs (OCHA) develops tools and provides guidance, such as the Access Monitoring and Reporting Framework. The focus of such definition on humanitarian operators' behaviour is helpful to the extent that it identifies a subject susceptible to act in accordance, and therefore responsible for compliance, with established principles and top-down guidance. Nevertheless, such approach ignores other relevant aspects of humanitarian access – like the endeavour of population in need and the empowering/depowering effects that deployment of humanitarian assistance can have on them. A more comprehensive conception is that of the Global Protection Working Group, according to which "humanitarian access should be understood both from the perspective of the affected population having access to protection and assistance, as well as the humanitarian actors having access to those requiring assistance and protection".[12] Instead of treating populations in need as mere passive recipients of material aid, such definition properly values their agency and their ability to promote their own rights. Therefore, the interpretation of humanitarian access as a two-way process will be

[10] Schwendimann, Felix. 2011. "The legal framework of humanitarian access in armed conflict. International Review of the Red Cross". 93. 994.
[11] Available at: https://www.unocha.org/humanitarian-access. (last access: 01/09/23).
[12] Global Protection Cluster Working Group (PCWG), "Handbook for the Protection of Internally Displaced Persons". Geneva: Global PCWG, December 2007. Available at: http://www.humanitarianreform.org. (last access: 03/08/23).

adopted in the following as it highlights the relevance of assisted persons' capacities to receive humanitarian aid.

The terminological clarification above reveals an intricate reality, where technological knowledge and capacities are unevenly distributed among a wide variety of actors, and coordination between providers, users and beneficiaries represents a remarkable challenge.

3 Methodology

This research is based on the collection and scrutiny of information coming from two main sources: the state-of-the-art literature on satellite technology and humanitarianism; and interviews with key informants. The literature review encompasses both the scientific literature and the grey literature, namely reports. The articles I consulted belonged mainly to the critical humanitarian studies and critical remote sensing studies strands of research. Reports are issued from state development agencies, international organizations and private research centers, so to grasp the point of view of both public and private actors on satellites' potential for facilitating humanitarian activities and, therefore, humanitarian access. Almost all those actors have their own satellites and issue annual reports to monitor their performance. Enriched with first-hand and up-to-date data, such reports are indispensable to understand the state of the art with regards to satellite services. Nevertheless, reports are usually focused on specific devices and lack a comparative perspective. Therefore, even if some reports specifically examine the potentials of satellite technology for the humanitarian sector, they usually fail considering all the alternative tools (also non-satellite ones) that humanitarian operators actually take into account while deciding how to conduct and coordinate their activities. This bias highlights the need to complement reports from the supply-side actors with interviews with humanitarian operators that practically decide which tools best fit their contingent needs. Between July and September 2023, I held four interviews: with a humanitarian NGO's male officer working as ICT coordinator; with two officers, a male and a female, from a humanitarian NGO specialized in

ship recognition models through satellite imagery; with a male manager from a spaceflight services company. During the interviews with some members of NGOs that operate in diverse settings and with different organizational models, many obstacles arose with regards to the use of satellite technologies. The array of technical difficulties emerging from reports was compound by problems deriving from the costs and conditions imposed by providers. I am aware that my institutional anchorage, non-technical profile and age may have influenced the information released during the interviews. Presenting myself as a young student of international security studies and being part of a project promoted by INTERSOS and the Sant'Anna School of Advanced Studies may have inhibited my interlocutors from delving deeply into the technical aspects of satellite technologies and from expressing critical opinions on humanitarian NGOs and academic institutions.This research makes use of some examples that illustrate the employment of satellite technologies in humanitarian contexts. Although the analysis is mainly conceptual, still concrete examples are very helpful in as much as they serve as useful illustrations of the research's findings. This work has no ambition to offer a generalizable understanding of neither the world of satellite technologies nor of humanitarian work nor a conjunction of the two, but simply attempts to problematize the way in which satellite applications can impact on humanitarian activities, namely regarding the problem of access.

4 Satellites for Good: Benefits to the Humanitarian Sector

According to the United Nations Office for Outer Space Affairs (UNOOSA), space-based technologies provide unique contributions to the international humanitarian system.[13] Protracted crises and large-scale population displacements require up-to-date information in many facets of humanitarian action support, from mission planning, resource deployment and monitoring, to nutrition and vaccination campaigns, camp plotting, damage assessment, etc. Yet such crucial data are often in short supply, even more so in conflict environments and fragile states. Satellites can

[13] See: https://www.unoosa.org/oosa/en/benefits-of-space/humanitarian-assistance.html (last access: 28/08/23).

exactly fill such data gaps and strengthen humanitarian action in all phases of crises management. In fact, not only gathering information is useful to disaster response, but also some predictive measures can be undertaken on the basis of data made available by satellites. For example, earth observations can be particularly powerful in supporting response activities, identifying damaged critical infrastructures or IDPs. Satellite-generated data can also serve predictive analytics for slow-developing crises, such as foreseeing weak crop yields months before the harvest season. Apart from potentially being a good solution, data derived from satellites are sometimes the only ones, as it is often the case in remote or conflict areas. To grasp a more precise idea of satellites' potential for humanitarian action, it is worth examining the specific functions that can be performed by different satellite technologies.

4.1 *Earth Observations*

For what concerns EO, the uptake of geospatial technologies within the humanitarian aid sector happened at an unprecedented rate over the last decade.[14] Geohumanitarian action, meaning the integrated usage of Earth observation and geoinformatics in support to planning and deploying of humanitarian aid, is a field where this technology can tap its full potential.[15] Compared to conventional field mapping, remote sensing is less time-consuming and can be conducted remotely and with the help of algorithms that automatically detect relevant features. Since a single high-quality map normally requires at least 6-8 hours of work if created manually[16], humanitarian operators usually prefer relying on satellite images made available by well-reputed providers, first of all the UN OCHA.[17] In the following paragraph, an example will be provided of how EO may be the only way to assess a situation of humanitarian crisis and to promote humanitarian access.

---

[14] Lang, S., Füreder, P., Rogenhofer, E. 2018. "Earth observation for humanitarian operations". In C. Al-Ekabi & S. Ferretti (Eds.), *Yearbook on Space policy 2016 "Space for sustainable development"*. Berlin: Springer. 217–229.

[15] Stefan Lang et al. 2020. "Earth observation tools and services to increase the effectiveness of humanitarian assistance", *European Journal of Remote Sensing*, 53(2), 67-85.

[16] Information available at: https://innovation.wfp.org/project/humanitarian-topographic-atlas (last access: 28/07/23).

[17] Interview with humanitarian NGO officer, done remotely, July 2023.

A concrete example may help clarify things. Due to the inaccessibility of wide areas of Nigeria to field surveys, the situation of cropland in the country could only be estimated by using geospatial analyses. Since the beginning of the Boko Haram insurgency, in conjunction with volatile climate conditions, the country has lived a situation of severe food insecurity. The cultivation of crops and breeding of livestock have been remarkably disrupted.[18] For this reason, in 2020 the World Food Programme requested the support of the Copernicus Emergency Management Service to assess the agricultural and food security situation of 57 Local Government Areas in the country[19]. Copernicus is the Earth Observation component of the European Union's space programme and the Copernicus Emergency Management Service (CEMS) provides geospatial products and analyses based on satellite imagery before, during and after a crisis occurs. Some of its performances are on-demand and can be activated by the Emergency Response Coordination Centre of the European Commission (ERCC), any local, regional, national entity/organisation dealing with disaster management, from countries participating in the EU Civil Protection Mechanism, and in the rest of the world through the EU Delegations, but also United Nations bodies such as the World Food Programme, as well as non-governmental organizations. In the case of Nigeria, the CEMS Risk and Recovery Mapping component provided an analysis of crop change between the two reference years of 2010 and 2019. Change detection of crop areas was performed using Normalized Difference Vegetation Index (NDVI) composite raster based on high resolution imagery data. NDVI is an indicator of the greenness of the biomes. Even though it is not a physical property of the vegetation cover, it is measured using the spectral reflectance in the near infrared and red wavebands, and it is it widely used for ecosystems monitoring as it indicates the presence of photosynthetic activity.[20] Compared to surrounding natural vegetation, cropland in Nigeria was identified by its high changes of NDVI values

[18] Information available at : https://emergency.copernicus.eu/mapping/ems/crop-change-detection-conflict-affected-areas-nigeria-2021 (last access: 28/08/23).
[19] Information available at : https://emergency.copernicus.eu/mapping/list-of-components/EMSN063 (last access: 28/08/23).
[20] Information available at: https://land.copernicus.eu/global/products/ndvi (last access: 28/08/23).

between the different phases of the vegetation period: photosynthetic activities of crops are low during the ploughing and sowing period, increase during the growing phase until reaching a maximum value right before the harvest. Once harvested, NDVI values should decrease drastically.[21] Therefore, CEMS Risk and Recovery Mapping service assessed cropland change, using high-resolution multispectral satellite imagery. Crop change status was then assigned per populated site, thus obtaining statistics on the portions of population affected by crop change across different periods.[22] The results of such analysis were then integrated by the WFP in the Cadre Harmonisé[23] and used to inform humanitarian response mechanisms, including strategic decision-making related in hard-to-reach areas.

4.2 *Global Navigation Satellite Systems*

GNSS is widely used for goods' distribution and tracking, as well as for the safety of field staff location. For example, up to date approximately 2 600 ICRC field vehicles have installed satellite tracking equipment[24] and custom satellite mobile apps are increasingly available on app stores for humanitarian operators on the ground. In case of lost people or vehicles, GNSS can help with search and rescue (SAR) operations. For instance, EU's GNSS Galileo has a service dedicated to that, which includes also a Return Link Service (RLS) that provides an automatic acknowledgement message back to the user informing them that their request for help has been received. Galileo has steadily increased its scope, being deployed to provide safety of life (SOL) navigation services to aviation, maritime and land-based users over most of Europe.[25] PNT satellite technology is also employed for

[21] Information available at: https://data.jrc.ec.europa.eu/dataset/d3550b3d-3499-43d2-8a96-5cd09fa19b28 (last access: 28/08/23).
[22] Information available at: http://www.copernicus.eu/en/news/news/observer-saving-lives-and-helping-most-vulnerable-how-copernicus-supports-humanitarian , p. 7. (last access: 28/08/23).
[23] "The Cadre Harmonisé is a unifying tool that helps to produce relevant, consensual, rigorous, and transparent analyses of current and projected food and nutrition situations". To see more: https://www.ipcinfo.org/ch (last access: 28/08/23).
[24] Zhou, Wen. 2023. "War, law and outer space: pathways to reduce the human cost of military space operations", *ICRC blogs: Humanitarian Law & Policy*, p.2. Available at: https://blogs.icrc.org/law-and-policy/2023/08/15/war-law-outer-space-reduce-human-cost-of-military-space-operations/ (last access: 28/07/23).
[25] Information available at: https://www.rheagroup.com/the-role-of-satellites-in-supporting-humanitarian-aid/ (last access: 28/08/23).

geo-tagging of relevant infrastructures. The democratization of digital mapping through smartphones has proven to be very useful in this sense. In fact, geo-tagged texts, pictures and videos help assessing the impact of the damages both from the humanitarian and financial (e.g. documentation for cost claims such as insurances) perspectives. Humanitarians can use smartphones to 'map' data and crowdsource information fundamental to situational awareness, such as logging of waypoints at the start and end of damaged road sections.[26] The usefulness of GNSS applications makes them more and more popular also for humanitarian purposes. According to the European Union Agency for the Space Programme (EUSPA) 2023 report, a significant increase in annual shipments of GNSS receivers is foreseen with more than 10 billion GNSS devices that will be operational by 2031[27].

4.3 *Satellite Communications*

Finally, SatComms are not a new entry in the humanitarian sector, satellite phones being a common tool for humanitarian aid delivery. The phones are especially useful in remote areas, where traditional cellular networks are often unreliable or non-existent or when a secure backup for other communication is absolutely needed.[28] Satellite phones provide a reliable connection that can be used to coordinate relief efforts and provide support to those in need. Unlike some other satellite-based technologies, using satellite phones is quite easy and does not usually require any specific training, thus favoring employment by non-technical personnel. Satellite communications systems provide connectivity to users equipped with compatible terminals to transmit and/or receive data/voice with another user or a system located in another area. Making possible two-way communication, SatComms are likely to promote humanitarian access as a two-way process, allowing also people in distress to express their own needs for more effective and need-based humanitarian aid. This, in turn,

[26] EUSPA. 2023. "Report on Emergency Management and Humanitarian Aid", p. 56. Available at : https://www.gsc-europa.eu/sites/default/files/sites/all/files/report_on_emergency_management_humanitarian_aid_user_needs_and_requirements.pdf (last access: 28/07/23).
[27] *Ivi*, p. 9.
[28] Interview with humanitarian NGO officer, done remotely, July 2023.

facilitates the respect of human rights – also those of vulnerable groups – in humanitarian aid. In fact, one of the most important factors determining the discrimination of vulnerable people in disaster response is the paucity of data on who needs what, where, and why. Since they promote the possibility of feedback on humanitarian aid, SatComms can help carrying on monitoring and evaluation activities.[29]

However, examining the functioning of specific technologies is not enough to account for all the advantages apported by SAT technologies in comparison with how humanitarian aid operations were deployed before satellites' introduction. In a comparative and incremental perspective, satellites apport some improvements to humanitarian activities, most notably by:

- Increasing predictability: Satellite technologies mitigate uncertainty through objective analytical tools that can predict outcomes, especially for low pace evolving events. The analysis of a large amount of satellite data, processed through certain methods (deductive, inductive or mixed) enshrined in specific algorithms, allows the prediction of patterns that are repeated over time in what are called series of events.[30]
- Protecting staff through remote management: Satellites make sometimes possible to remotely evaluate situations on the ground before the deployment of humanitarian activities, making humanitarian aid less vulnerable to volatile environments and promoting safety of humanitarian staff.[31]
- Automatizing and speeding up tasks: Satellites gather information in a timely, repeatable and cost-efficient manner, supporting continuous situational awareness and better decision-making.

[29]Bizzarri, Mariangela. 2012. "Protection of Vulnerable Groups in Natural and Man-Made Disasters", in A. de Guttry et al. (eds.), *International Disaster Response Law*. 382.
[30] Guida, Emilio. 2021. **"**The use of satellites in humanitarian contexts", NCHS paper, 4.

[31] Interview with humanitarian NGO officer, done remotely, July 2023.

- Promoting transparency: Methods to collect and process data are standardized and allow for more transparency and accountability across stakeholders. Satellites can also monitor and verify outcomes, providing regular feedback to humanitarians.

Nevertheless, such a description of the positive impact of SAT technology on humanitarian activities risks being too abstract for two reasons. First, it presupposes humanitarian organizations to be inseparable units, without explaining who exactly is benefited and who may be damaged within humanitarian organizations by the changes introduced by satellites. Secondly, it fails to consider that satellites – as any technological innovation – are not exogenous variables but are developed and adopted by specific entities according to their own interests. Therefore, careful considerations of these two conditions is needed to answer the research question.

5 Winners and Losers: SAT Technology as a "Difference Multiplier"

Who is concretely affected by the changes apported by SAT technologies? Who uses satellite data and for what? Neither a description of what satellites can do, nor a comparative analysis of satellite-enabled performances with the status quo ante can explain the changes that satellites can bring forth in the relationships among humanitarian workers, as well as among beneficiaries. Until now, we have considered only the impact of satellites on the performances of ideal-typical "humanitarian workers" and "people in need", as if they were internally cohesive groups. Nevertheless, both are indeed internally heterogeneous groups composed of distinct populations and organizations. Moreover, each population and organization is made of people with different roles and capabilities. Since humanitarian access is about real people's lives, only considering these two concrete distinctions we can better grasp the effect of satellites on humanitarian access in terms of the "relational output" they produce. Therefore, the impact of SAT technologies can be further analyzed by considering these other two levels of specification. The first is the one in which satellites are available for some

humanitarian organizations (or for some populations in need), but not for others. The second is the one in which satellites are available for some actors within the same humanitarian organization (or the same population in need), but not for others. Each of the two scenarios is twofold and, therefore, the cases to be considered are four.

The first case is when a satellite technology is sold on the market and proposed to a plethora of humanitarian organizations. Although there are several free services made available by public national and international institutions, many humanitarian NGOs may prefer buying private services, and procurement of satellite services for humanitarian organizations is a frontier in expansion for some private providers.[32] In fact, relying only on open access data of public providers requires total adaptability of one's own activities to the timing and modalities of the public programme at stake, while private providers offer solutions that are more tailored on NGO's specific needs with regards to the quality of images, the area of coverage and the frequency of the service. Moreover, NGOs might want to be independent from existing governmental and international programmes and conduct unhindered operations. As a result, many humanitarian NGOs now acquire agreements and data access permissions, even if offered at reduced rates, from private providers who make no clear distinction between humanitarian and non-humanitarian clients. [33] Consequently, the cost of satellite services remains relatively high.[34] Moreover, small humanitarian NGOs mainly stipulate contracts not directly with SatComms providers, but with local providers to which the set up of SatComms hardware is delegated.[35] Intermediairies may, in turn, raise the price of the service. This is why, for many NGOs, the use of SatComms and other satellite applications is strictly limited to emergencies. Thus, economic barriers persist, impacting the accessibility of satellite technologies for humanitarian organizations, particularly those that are small and located in economically disadvantaged regions,

[32] Interview with member of a satellite provider, done remotely, September 2023.
[33] Interview with member of a satellite provider, done remotely, September 2023.
[34] Interview with humanitarian NGO officer, done remotely, July 2023.
[35] Interview with humanitarian NGO officer, done remotely, August 2023.

especially in the global South. Beyond economic constraints, there are also non-economic obstacles related to the knowledge and proficiency required for effective utilization of satellite technologies and the interpretation of satellite data. In fact, small and local NGOs, unlike their larger and international counterparts, do not usually possess dedicated training programs for satellite technologies.[36] Moreover, even when free training initiatives are available, they are mainly addressed to governmental organizations. For example, in 2020 the United Nations Satellite Centre (UNOSAT), which is part of the United Nations Institute for Training and Research (UNITAR), delivered 16 learning-related events, 6 of which were web-based and 10 of which took place face-to-face (4 in the Pacific, 4 in Africa, 2 in Asia), to 471 beneficiaries consisting mostly of government officials.[37] Consequently, although free satellite services and training opportunities exist worldwide, local humanitarian NGOs may still remain excluded from reaping their benefits. Such economic and educational constraints risk hindering the localization turn in the humanitarian sector, intended as the empowerment of local responders in affected countries to lead and deliver humanitarian aid. Local NGOs are often attributed the role of first responders when reacting to a humanitarian crisis and are considered more effective due to their proximity to the geographical and sociocultural reality of the target population. Nevertheless, in practice they are subject to numerous structural barriers which constrain their space in the economy of aid.[38] Expensive and hard-to-manage satellite services may not subvert the subordination of local responders, and excluding local NGOs from the satellite revolution in the humanitarian sector for economic and training constraints means impeding localization.

The second case is when a satellite technology is made available for humanitarian purposes, but it is not straightforward that all populations in need around the world will take advantage of it. In fact,

[36] Interview with humanitarian NGO officer, done remotely, July 2023.
[37] Information available at: https://unitar.org/about/news-stories/news/unosat-2020-year-review (last access: 11/10/23).
[38] Richmond, Oliver P., ”Beyond local ownership in the architecture of international peacebuilding”, Ethnopolitics 11(4), pp. 354-375.

deployment of SAT technologies only in some war or disaster settings - and not in others – may exacerbate issues of double standards and unequal repartition of humanitarian aid. Some crises attract more than others the attention of the media, donor governments, organizations, and the public. The "CNN effect" and the political priorities of donors drive aid allocation, much more than the number of people affected by the conflicts or the levels of mortality.[39] For example, unlike people suffering from other conflict around the world, Ukrainians benefitted from Elon Musk's SpaceX free access to its Starlink internet service, suspended from the payment of fees. Following this initiative, many tech companies have offered support in the form of internet connectivity to Ukrainians: for example, Airalo, a US-based eSIM company, ensures refugees and their families are kept connected wherever they, offering free SIM cards with internet in any country in the world for Ukrainians.[40] Not only the deployment of satellite technologies may be subject to the logic of double standards, but it might also apport visibility to some crises to the detriment of others. Satellites usually facilitate the observation and collection of information on conflict and disaster settings, potentially creating the perception that those settings are more manageable in comparison to others. Such perception might influence the allocation of humanitarian aid to areas where satellite technologies are employed, possibly disadvantaging other regions in need of assistance.

The third case is the one in which the introduction of satellite technologies in the activities of a humanitarian NGO facilitates the work of some humanitarians to the detriment of others, producing discriminations within the organization itself. Since SAT technologies usually require technical expertise, humanitarian workers with such competences can be advantaged compared to others. In fact, a division of tasks can be conducted on the basis of such skills, bringing to an uneven distribution of risk. Since tasks in the field are usually riskier than those remotely fulfillable, remote management

[39]Colombo, Sandro. "Are death and suffering in Ukraine different than in Yemen, Afghanistan or Ethiopia? Double standards in humanitarian assistance". *Epidemiologia&Prevenzione*. 46(3). 130.
[40] Information available at: https://www.dw.com/en/tech-firms-provide-free-internet-for-ukrainians/a-6136446 (last access: 12/08/23).

can secure some humanitarian staff but not all of it. Indeed, it can simply transfer security risk from non-local to local staff or sub-contractors, where non-local staff is usually the most trained and prepared.

The fourth case is the one in which, when assisting a certain population in need by means of SAT technologies, such technologies can be useful in providing assistance to some people – but not others - to express their needs, as well as in detecting only some specific needs. Not all vulnerable people are able to access and use satellite technologies in the same way. For example, although satellite phones are not difficult to use even for very young people, they may still be out of reach for ill people or the elderly, thus producing discriminations even between vulnerable groups. Moreover, not all specific needs are easier to detect thanks to satellite technologies. For instance, while earth observations can signal damaged infrastructures and indirectly point to the needs of disabled people, it is more difficult to deduct psychological needs by satellite data.

To sum up, any assessment on the impact of SAT technologies on humanitarian access cannot prescind from the acknowledgment of imbalances – caused or reproduced by satellites - between and within the groups involved in emergencies. Such evaluation of the "relational output" of satellites reveals that some humanitarian organizations and disrupted populations have more chances to benefit from satellites than others. Moreover, some specific humanitarian workers and persons in need may take advantage of them to the detriment of others. Therefore, SAT technology highlights existing differences and produces new ones, thus working as a "difference multiplier". Without denying all the qualities of satellite applications as described in the previous paragraph, still it is necessary to consider that someone could be excluded from those benefits. Although satellites might in principle favor humanitarian access, most disadvantaged humanitarian workers and people in need may still remain excluded and existing differences be exacerbated. Therefore, the problem of humanitarian

access through satellites includes that of "access to access", namely the problem of unequal access to technologies that might favour access to humanitarian aid.

6 Orbiting the world of interests behind SAT technology

The second issue regarding the use of SAT technologies to enhance humanitarian action, and access in particular, is that satellites should not be conceived as inert, neutral artifacts, since they are produced and adopted by specific actors and therefore convey an array of diverging interests. Among those actors, the military deserves great attention as one of the main producers and users of space technologies. The relevance of military actors and interests in this field has remarkable implications, such as the risk of delays and obstacles to the spread of SAT technology also in the civil and humanitarian sector, or the issue of dual use, which runs the risk of undermining the key principles of humanitarian action, such as discrimination, neutrality and impartiality. Moreover, when using satellites, even aid providers may inadvertently uphold interests other than purely providing relief.

6.1 *Barriers to diffusion*

Although a democratization of space technologies is currently ongoing, still openness and availability of satellite data is limited. Governmental and international agencies have sometimes access to satellite data in an exclusive or preferential way. According to a study conducted by UKAid, 42% of satellite services are only for government-type users, while much lower usage is recorded by first responders to emergencies and by the affected public[41]. Some obstacles to the diffusion of SAT technologies to the humanitarian sector could be linked to the relevance of the military in the development and use of such technologies.

[41] Note 7, p. 61, figure 17.

In the early stages of space technologies development, the primary focus of the two most active states in this domain – USA and URSS – was military, with military satellite launches accounting for three-quarters of the total during the Cold War[42] and many key satellite applications, like the GPS[43], being developed in military environments. Nowadays, the military still plays an important role in the development of space capabilities. In China, the management of both civil and military space activities is entrusted to a single structure under military control. In other countries, the link between civil and military programs takes place at the level of the board of directors of civil space agencies, where a place is reserved for a representative of the armed forces, as is the case, for example, in France for CNES and in Italy for ASI.[44] Therefore, SAT technology is still frequently developed by taking account, first and foremost, military purposes, and the average time gap that exists between military and commercial use of such technologies is of five to ten years.[45] Moreover, the transfer to civil uses may require significant additional investments in R&D.[46]

Today, although the percentage of exclusively military satellites has decreased, due to increasing commercial satellites, military use of space has not. In fact, some dual-use satellites are used by the military or carry military payloads.[47] To date, armed forces have used space systems in a range of applications, such as navigation of military aircraft, precision targeting and weapon systems, advance warnings of missile attacks, surveillance, and reconnaissance.[48] Space is increasingly militarized and perceived as an "operational domain"[49] and the use of the outer space for predominantly peaceful purposes seems quite far. The relevance of the military in both the development and exploitation of satellites may explain the delays and barriers to the spread of SAT technologies in the humanitarian

[42] Aoki, Setsuko. 2017. "Law and military uses of outer space". In R. Jakhu & P. Dempsey (Eds.), *Routledge handbook of space law*. New York, NY: Routledge. 197.
[43] For a brief history, see: https://aerospace.org/article/brief-history-gps (last access: 19/08/23).
[44]Available at : https://www.ispionline.it/en/publication/new-space-race-risks-and-opportunities-32060 (last access: 23/08/23).
[45] Note 29, p.6.
[46] Molas-Gallart, J. 1997. "Which way to go? Defence technology and the diversity of 'dual-use' technology transfer". *Research Policy*, 26(3). 372.
[47] Khan, A. R., 2017. "Space wars: Dual-use satellites". *Rutgers Journal of Law and Public Policy*, 14 (314). 5.
[48] Note 23.
[49] See: Hanneke Weitering, *New U.S. Space Command Will Launch Next Week, VP Pence Says*, SPACE.COM (Aug. 20, 2019), available at: https://www.space.com/space-command-launches-august-2019.html (last access: 09/08/23).

sector and, therefore, their employment to favour humanitarian access. As long as cutting-edge satellite technologies primarily remain within the military domain before being gradually disseminated to the humanitarian sector, it is likely that humanitarian employment of these technologies will persistently carry the risk of dual use.

6.2 *Dual use*

Military entrepreneurship in the space sector alongside the commercial one brings forth the issue of dual use. Satellites can be operated by the military to provide services to civilians, and be operated by civilian or commercial actors to carry out military functions, since militaries can sometimes outsource certain services, particularly for satellite communications and remote sensing. Dual use allows for exploitation for both military and civilian/humanitarian purposes and can give rise to some legal problems. Dual use is not exclusive to SAT technologies: not only the issue is already addressed by international law for some terrestrial infrastructures (e.g. power plants)[50], but also other satellite enabling services are susceptible to dual use. For example, several states have already expressed concerns[51] about enabling services that are developed for objectives of an entirely benign nature—such as on-orbit servicing and refueling, or active debris removal—that could nevertheless be repurposed to harm other space objects because of their characteristics and capabilities, such as robotic arms, harpoons or lasers[52]. Those worries go hand in hand with the increasing development of counterspace capabilities to target dual use space objects.[53]

[50] Shue H. Wippman D. 2002. "Limiting Attacks on Dual-Use Facilities Performing Indispensable Civilian Functions", *Cornell International Law Journal*, 35(7). 558-579.
[51] UNGA/RES/76/77, 13/07/21, available at: https://documents-dds-ny.un.org/doc/UNDOC/GEN/N21/118/94/PDF/N2111894.pdf?OpenElement (last access: 09/08/23).
[52] Almudena Azcárate Ortega. June 5, 2023. "Not a Rose by Any Other Name: Dual-Use and Dual-Purpose Space Systems", *Lawfare*. Available at : https://www.lawfaremedia.org/article/not-a-rose-by-any-other-name-dual-use-and-dual-purpose-space-systems (last access: 09/08/23).
[53] See: Secure World Foundation, "2023 Global Counterspace Capabilities Report". Available at: https://swfound.org/counterspace/ (last access: 09/08/23).

First, it is necessary to explore what "dual use" means in different contexts. The term is often used in arms control and disarmament discourse, where it denotes objects and technologies that can - even only hypothetically - be used for both military and nonmilitary applications. To this extent, dual use is a synonym of "dual capable". From an international humanitarian law perspective, "dual use" holds a different meaning. An object that is used for both military and civilian purposes could be lawfully targeted if it is considered to be a "military objective", provided that conditions enshrined in article 52(2) of AP I are met. According to such article, which reflects customary international law[54], an object's qualification as military objective is determined by its nature, location, use, or purpose and its total or partial destruction, capture or neutralization must offer a definite military advantage. When conducting such assessment, there is no such a thing as a dual-use object, as dual use cannot imply dual status: an object is either a military objective—which could be lawfully attacked—or it is not.[55] The criterion of "use"[56] , in this context, refers to objects that are actively being used for a military function at the relevant time, rather than having a potential military use.

Therefore, in IHL the category of "dual use objects" is a descriptive category with no direct normative implications on the status of objects. In fact, it does not contradict the dualistic system enshrined in the principle of distinction, as it merely remarks the possibility that objects can "transit" from one category to another according to their contingent use. In principle, according to IHL, any person or object can change status, but "dual use" objects are named as such because the only shifting parameter that makes the difference in a status assessment is that of use. For example, the nature (technical), location (in orbit), and purpose (e.g. observing a portion of earth surface) of a satellite are less telling of its legal status than its actual use. *Ceteris paribus*, actual use makes the difference. Therefore, actors are asked to carefully consider contingent uses when conducting their assessments on such

[54] Rule 8, ICRC, IHL database. Available at: https://ihl-databases.icrc.org/en/customary-ihl/v1/rule8 (last access: 09/08/23).
[55] Note 48.
[56] Commentary 1987, API Commentary, para. 2022.

objects. Nevertheless, a use is contingent inasmuch as it is referred to one specific situation. While traditional technologies usually pertain only to one context at a time, this is not true for satellites. In fact, since they are placed in space, they can be employed in more than one context at a time and, within each context, play either a military or a non-military function. For example, it is possible that a satellite constellation providing data communication has simultaneously a civilian use in a site and a military use in another site many kilometers away but still within its area of coverage. Satellites do not pose problems with regards to their status according to the principle of distinction, but they demand complex targetability assessments in the respect of proportionality rules. In fact, according to such rules all foreseeable incidental harm to civilians and civilian objects in outer space and on earth must be considered, including the consequences for civilians of impairing the dual use space object's civilian use. To sum up, if in a certain context they serve military functions, satellites can be considered military objectives, but they can be legitimately targeted only if careful consideration is given to civilian uses in other contexts where they are operative at the same time, according to the proportionality principle. On the one hand, this makes it very difficult to justify targeting of satellites. On the other hand, it is also difficult to demonstrate the exclusive non-military use of satellites. This entails two remarkable risks for humanitarian organizations relying on SAT technologies.

The first one is that their satellites may be attacked and damaged. This implies losing all benefits apported by satellites and involving civilians as eventual collateral damages, thus worsening humanitarian crises and overloading humanitarian activities. According to some authors[57], one way could be that of identifying space systems serving specifically protected persons and objects by means of registration. The special protection accorded by IHL to humanitarian personnel and objects applies in all circumstances, including when armies carry out military operations against space systems which are necessary for humanitarian activities.[58] If a space object is serving specifically protected persons

[57] Note 23.
[58] Article 71(2) Additional Protocol I; Article 18(2) Additional Protocol II; Rule 31, ICRC Customary IHL Study.

and objects or is exclusively dedicated to civilian use, the state of registry should register it as such, clearly indicating its protected status under IHL under the voice "general function of the space object", according to Article IV(I)(e) of the "Convention on Registration of Objects Launched into Outer Space".[59] Nevertheless, exclusive civilian or humanitarian use of satellites is not only practically difficult to verify, but also impossible to state *a priori* its applications in wartime and discretion is always left to the commander. In fact, the actual use referred to in article 52(2) AP I may not coincide with the "general function" of the Convention. However, it should be noted that in case of doubt, Article 53(3) of Additional Protocol I provides that an object shall be presumed to be civilian and therefore protected from legitimate targeting. How this rule will apply to satellites where identification is so problematic given the preponderance of nonvisual data raises many practical issues. For all such difficulties, it is hard to totally preserve benefits apported by dual use satellites involved in humanitarian aid against any military operation.

The second risk is compromising humanitarian workers' reputation and impairing their activities. If the same tools are used for both humanitarian and military actions, humanitarian operators' neutrality could be questioned. According to the definition provided by the ICRC, neutrality means not to take sides in hostilities or engage at any time in controversies.[60] Humanitarian workers can be deemed to favour a party to a conflict if it takes advantage of structures and technologies that are set up for humanitarian aid. Of course, when humanitarian organizations intentionally share their assets with one party to a conflict, they could be accused of violating neutrality. But what about unintentionally sharing satellites services? In fact, especially private satellite operators can sell their products to whomever they want and can have a very heterogeneous range of clients including both humanitarian NGOs and militaries. Here the problem is neither that of a contingent diversion of civil objects for

[59] Annex to UNGA/RES/29_3235E.
[60] See: https://www.icrc.org/sites/default/files/topic/file_plus_list/4046-the_fundamental_principles_of_the_international_red_cross_and_red_crescent_movement.pdf or https://www.icrc.org/en/doc/resources/documents/article/other/57jncv.htm (last access: 02/09/23).

military purposes, nor that of destruction, theft and looting of objects used for humanitarian relief by warring parties. Indeed, the problem is that of services employed for humanitarian relief operations being simultaneously and legitimately used also by the military. Although military organizations usually have much higher budget than humanitarian ones and, therefore, can buy more and better services and do not need to rely on satellite data occasionally produced for the humanitarian sector, it is not impossible that commercial satellite providers sell their images and data to as many buyers as they can to maximise their profit. The United Nations Office for the Coordination of Humanitarian Affairs (OCHA) has already issued guidelines for private companies to distinguish clearly between their commercial and humanitarian activities [61], but such recommendations have remained widely unattended as prices for humanitarians are as high as for any other customer and, therefore, humanitarian activities are still used by private providers for commercial gain. The lack of transparency on the interplay between satellite operators, military clients and humanitarian clients can seriously compromise the security and reputation of the latter. Moreover, it is hard for humanitarian workers to obtain information about the other activities of their providers. Many small humanitarian NGOs do not stipulate contracts with the actual satellite operators directly, but with local sub vendors who set up hardware.[62] Therefore, even if some NGOs require their suppliers to meet some admissibility criteria, such a screening is conducted on intermediators and not on the big satellite providers. Non-neutrality can, in some circumstances, provide an excuse for warring parties to turn down offers of relief. In fact, doubts on the capacities of providing "assistance in a principled manner" can constitute a ground for withholding consent to the deployment of humanitarian aid[63] and, therefore, significantly hamper humanitarian access.

[61] Private sector actors' "collaborative efforts with the humanitarian community to alleviate human suffering should not be used for commercial gain". Principle 7, "Guiding Principles for Public-Private Collaboration for Humanitarian Action", UNOCHA, World Economic Forum, 2007.
[62] Interview with humanitarian NGO officer, done remotely, July 2023.
[63] Akande D. and Gillard E.C. 2016. "Arbitrary Withholding of Consent to Humanitarian Relief Operations in Armed Conflict". Available at: https://iow.eui.eu/wp-content/uploads/sites/20/2016/12/Akande-Gillard_ILS_Nov_2016-1-1.pdf (last access: 01/09/23).

6.2.1 Starlink

To illustrate the above contentions, the use of Starlink during the ongoing war in Ukraine well displays the dilemmas linked to dual use satellite technologies. Starlink is Elon Musk's company Space X internet access service provided through low-altitude satellites. Since 2019, Mr. Musk has sent SpaceX rockets into space nearly every week that deliver dozens of sofa-size satellites into orbit. The satellites communicate with terminals on Earth, so they can beam high-speed internet to nearly every corner of the planet. Today, more than 4,500 Starlink satellites are in the skies, accounting for more than 50 percent of all active satellites.[64] Starlink services are contracted directly with Space X, allowing to bypass governmental control: activists in Iran and Turkey have sought to use the service as a hedge against government controls. Nevertheless, such technology has also attracted the interest of the military: The U.S. Defense Department is a big Starlink customer, while other militaries, such as in Japan, are testing the technology. Starlink use during the war in Ukraine revealed many of the problems related to the dual use of such technologies. On February 2022 Starlink responded by activating country-wide service, and the first shipment of terminals for a country-wide service to Ukraine were activated as a response to requests by the Minister of Digital Transformation of Ukraine directly to Elon Musk[65], to replace Internet services destroyed during the war. Since then, Starlink's internet access has been used for both military and civilian/humanitarian purposes. On the one hand, it became indispensable to coordinate drone attacks[66] and intelligence gathering. On the other hand, civilians are also heavily using the technology "to keep in touch with the outside world and tell loved ones that they are alive".[67] The official positions of the company regarding this double use have been unclear. For example, the

[64] Available at: https://www.nytimes.com/interactive/2023/07/28/business/starlink.html (last access: 10/10/23).
[65] Available at: "@elonmusk while you try to colonize Mars — Russia try to occupy Ukraine! While your rockets successfully land from space — Russian rockets attack Ukrainian civil people! We ask you to provide Ukraine with Starlink stations and to address sane Russians to stand". *Twitter*. February 26, 2022.
[66] Available at: "Specialist Ukrainian drone unit picks off invading Russian forces as they sleep". *The Times*. ISSN 0140-0460. Archived May 9, 2022.
[67] Available at: "How Elon Musk's Starlink satellite internet keeps Ukraine online". *The Kyiv Independent*. September 3, 2022.

charitable intentions behind the first donation of terminals for humanitarian purpose seemed to crawl down when, in October 2022, Musk announced that SpaceX could no longer bear the costs and asked the Pentagon to take over as financers[68]. SpaceX warned the Pentagon that unless the US military contributes tens of millions of dollars per month, it may cease funding the service in Ukraine. According to a letter reported by the CNN[69] and then confirmed by the NYTimes, the company estimated the cost at nearly $400 million over 12 months. The fact of asking a military institution to be the official contractor with SpaceX slipped the perception on the neutrality of the company and on the actual uses of its technology. Nevertheless, on February 8, 2023 Gwynne Shotwell, President of Starlink, announced that the company had taken measures to prevent the use of Starlink service to control combat drones, affirming that Starlink was "never meant to be weaponized"[70], as the contract was intended for humanitarian purposes such as "providing broadband internet to hospitals, banks and families affected by Russia's invasion"[71]. Such fears were probably fed by several statements made by Russia that it could target US commercial satellites deployed in Ukraine, although Starlink was not explicitly mentioned[72]. Russia has the capability to target satellites kinetically, as demonstrated by its direct-ascent anti-satellite mission (DA-ASAT) in November 2021.[73] Probably for fear of accuses by Russia, in September 2023, Musk acknowledged to have refused the request for activation of the service in Crimea for military purposes.[74] The lack of transparency by the side of the satellite operator about the military and humanitarian uses of its technology arose the issue of its targetability. The Starlink constellation is a lawful military

[68] "operation has cost SpaceX $80 million and will exceed $100 million by the end of the year". Available at: https://twitter.com/elonmusk/status/1578433482757271552 (last access: 30/08/23).
[69] Available at: https://edition.cnn.com/2022/10/13/politics/elon-musk-spacex-starlink-ukraine/index.html (last access: 30/08/23).
[70] Available at: https://www.reuters.com/business/aerospace-defense/spacex-curbed-ukraines-use-starlink-internet-drones-company-president-2023-02-09/ (last access: 30/08/23).
[71] *ibidem*
[72] Available at: https://www.wsj.com/articles/russia-says-it-could-target-u-s-commercial-satellites-in-ukraine-war-11666882614 (last access: 03/09/23).
[73] Available at: https://www.spacecom.mil/Newsroom/News/Article-Display/Article/2842957/russian-direct-ascent-anti-satellite-missile-test-creates-significant-long-last/ (last access: 03/09/23).
[74] Available at: https://edition.cnn.com/2023/09/10/europe/ukraine-starlink-not-active-crimea-intl-hnk/index.html (last access: 10/10/23).

objective but, as for Russia targeting it, a kinetic attack levied against an entire constellation would be of such a scale that it is difficult to imagine the attack would not run afoul of the principle of proportionality.[75] In fact, kinetic attacks against space objects risk causing far more debris than many other space activities, which might damage or destroy in an unpredictable manner other space objects. All feasible precautions must be taken to avoid, and in any event to minimize, incidental civilian harm, including by choosing, whenever feasible, a non-debris producing alternative when planning an attack against a military objective in space. However, jamming, sproofing or destroying terminals on Earth are still viable options. Moreover, Ukraine's military use of Starlink has indirectly delegitimized claims that the service is fundamental for humanitarian operations. Although Russia has not yet contested Stralink's humanitarian uses, some others have. Last September, Musk's detractor Iam Brenner posted on X that "the idea that starlink was being used for humanitarian purposes was always a fiction"[76], indirectly accusing humanitarian workers in Ukraine which are using Starlink of being partial, if not liars. Therefore, the case of Starlink concretely demonstrates that dual use satellites are susceptible to be attacked and can impair the credibility of humanitarian activities.

7 Conclusion

The application of satellite technologies to humanitarian activities is an outcome of a relatively recent "democratization of space", and it has to be assessed whether satellites do favour humanitarian access as a two-way process. On the one hand, satellites have great potential to favour humanitarian access by bridging crucial data gaps and by improving aid deliverance's accuracy, timeliness and safety. On the other hand, satellites are not yet available to everyone, and their uneven accessibility can engender imbalances among and even within different humanitarian organizations and populations in need. In

[75] Available at: https://lieber.westpoint.edu/can-starlink-satellites-be-lawfully-targeted/#:~:text=The%20civilian%20use%20of%20Starlink,obligation%20to%20take%20precautionary%20measures. (last access: 03/09/23).
[76] Available at: https://twitter.com/ianbremmer/status/1700526367446544709 (last access: 11/10/23).

fact, it affects especially local humanitarian NGOs and workers, thus hampering the localization turn, while it also gives visibility only to some humanitarian crises and to some vulnerable people's specific needs, to the detriment of others. Moreover, satellite technologies are developed and used by specific actors to pursue their interests, that can diverge from that of purely proving relief. Potential dual use – both military and humanitarian - of satellite technologies constitutes a risk for humanitarians, as it allows for satellite services that are critical for humanitarian activities to be targeted and damaged, as well as it may undermine the neutrality of humanitarian organizations. The analysis conducted until now highlighted two problematic aspects in the use of satellite technologies for humanitarian action, that can hamper widespread and stable humanitarian access: the problem of discrimination, both on the side of humanitarian organizations and on that of people in need, and that of distinction of uses, actors and scopes. To conclude, satellites may favour humanitarian access only if the conditions of non-discrimination and of distinction are met.

To mitigate unequal availability of satellites and promote clear distinction of their uses, more efforts in space regulation and in international cooperation may be needs. In the case of satellites, humanitarian access is truly a multi-way process, since the positive impact of satellites on the deployment of humanitarian assistance does not depend only on the capacities of humanitarian workers and people in need to use them, but also on the enabling international cooperation. The analysis presented in this paper is not exhaustive of all the challenges that humanitarians face in adopting space technologies, and further research on them and on the means to overcome such difficulties is needed.

BIBLIOGRAPHY

ACADEMIC ARTICLES

Aas, K. F., and Gundhus, H. O. I. 2015. "Policing humanitarian borderlands: Frontex, human rights and precarious life". *British Journal of Criminology*, 55(1), 1–18.

Akande D. and Gillard E.C. 2016. "Arbitrary Withholding of Consent to Humanitarian Relief Operations in Armed Conflict". Available at: https://iow.eui.eu/wp-content/uploads/sites/20/2016/12/Akande-Gillard_ILS_Nov_2016-1-1.pdf. Last access: Sep 1, 2023.

Azcárate Ortega, Almudena. June 5, 2023. "Not a Rose by Any Other Name: Dual-Use and Dual-Purpose Space Systems", *Lawfare*. Available at : https://www.lawfaremedia.org/article/not-a-rose-by-any-other-name-dual-use-and-dual-purpose-space-systems. Last access: Aug 9, 2023.

Andreas, Peter. 2003. "Redrawing the Line: Borders and Security in the Twenty-First Century." *International Security* 28, no. 2: 78–111.

Aoki, Setsuko. 2017. "Law and military uses of outer space". In R. Jakhu & P. Dempsey (Eds.), *Routledge handbook of space law*. New York, NY: Routledge. 197–224.

Baiocchi, Dave, and Welser, William. 2015. "The Democratization of Space: New Actors Need New Rules." *Foreign Affairs* 94, no. 3: 98–104.

Balibar, Etienne. 2009. "Europe as Borderland". *Environment and Planning D: Society and Space*, *27*(2), 190–215.

Bizzarri, Mariangela. 2012. "Protection of Vulnerable Groups in Natural and Man-Made Disasters", in A. de Guttry et al. (eds.), *International Disaster Response Law*, 381-414.

Bjorgo, E. 2000. "Refugee camp mapping using very high spatial resolution satellite sensor images". *Geocarto International*, 15(2), 79–88.

Blount, P. J. 2012. Targeting in outer space: Legal aspects of operational military actions in space. *Harvard National Security Features*, *3*.

Checchi, F., Stewart, B.T., Palmer, J.J., & Grundy, C. 2013. Validity and feasibility of a satellite imagery-based method for rapid estimation of displaced populations. *International Journal of Health Geographics*, 12(4), 1–12.

Colombo, Sandro. "Are death and suffering in Ukraine different than in Yemen, Afghanistan or Ethiopia? Double standards in humanitarian assistance". *Epidemiologia&Prevenzione*. 46(3). 130-133.

Del Canto Viterale, Francisco. 2023. "Transitioning to a New Space Age in the 21st Century: A Systemic-Level Approach", *Systems* 11, no. 5: 232.

Elia, A., Balbo, S., Boccardo, P. 2018. "A quality comparison between professional and crowdsourced data in emergency mapping for potential cooperation of the services". *European Journal of Remote Sensing*, 51(1), 572–586.

Guida, Emilio. 2021. **“**The use of satellites in humanitarian contexts”, NCHS paper (1), 1-17.

Hanneke Weitering, *New U.S. Space Command Will Launch Next Week, VP Pence Says*, SPACE.COM (Aug. 20, 2019). Available at: https://www.space.com/space-command-launches-august-2019.html. Last access: Aug 9, 2023.

Jinyuan, Su. 2023. “Outer Space: From Sanctuary to Warfighting Domain?”, *Chinese Journal of International Law*, 22(2), 263-305.

Kelly, C. 1998. “Bridging the gap: Remote sensing and needs assessment—A field experience with displaced populations”. *Safety Science*, 30, 123–129.

Khan, A. R., 2017. “Space wars: Dual-use satellites”. *Rutgers Journal of Law and Public Policy*, 14 (314).

Kirk W., Ehrenfreund P., Ricco A., Hertzfeld H. 2011. “Cubesats: Cost-effective science and technology platforms for emerging and developing nations”. *Applied ScienceDirect*. 47: 663.

Lang S., Füreder P., Rogenhofer E. 2018. “Earth observation for humanitarian operations”. In C. Al-Ekabi & S. Ferretti (Eds.), *Yearbook on Space policy 2016 “Space for sustainable development”*, Berlin: Springer. 217–229.

Mabrouk, Elizabeth. Feb 26, 2015, “What are SmallSats and CubeSats?”, Last updated: Aug 7, 2017. Available at: https://www.nasa.gov/content/what-are-smallsats-and-cubesats. Last access: Jul 23, 2023.

Malisuwan, S. and Kanchanarat, B. 2022. “Small Satellites for Low-Cost Space Access: Launch, Deployment, Integration, and In-Space Logistics”. *American Journal of Industrial and Business Management* 12(10).

Madianou M. 2019. “Technocolonialism: digital innovation and data practices in the humanitarian response to refugee crises”. *Social Media+Society* 5 (3): 1-13.

Mogiani, Marco. 2023. “Studying Borders from the Border: Reflections on the Concept of Borders as Meeting Points”. *Geopolitics* 28(3). 1323-1341.

Molas-Gallart, J. 1997. “Which way to go? Defence technology and the diversity of ‘dual-use’ technology transfer”. *Research Policy*, 26(3). 367-385.

Mosteshar, S. 2019, May 23. “Space Law and Weapons in Space”. *Oxford Research Encyclopedia of Planetary Science.* Available at: https://oxfordre.com/planetaryscience/view/10.1093/acrefore/9780190647926.001.0001/acrefore-9780190647926-e-74. Last access: 26 Aug. 2023.

Novak, A., Schuett, A., Parker, A., Bowser, A., Newbury, E. M. H., Goguichvili, S. Feb 7, 2022. “The Rise of Cubesats: Opportunities and Challenges”. Wilson Center. Available at: https://www.wilsoncenter.org/blog-post/rise-cubesats-opportunities-and-challenges. Last access: Jul 22, 2023.

Nishat, Awan. 2016. “Introduction to Border Topologies”. *GeoHumanities* 2(2), 279-283.

Pallister-Wilkins, Polly. 2022. “Humanitarian borders. Unequal Mobility and Saving Lives”. London. Verso.

Pelton, Joseph. 2004. “*Satellite Security and Performance in an Era of Dual Use”*, *Online Journal of Space Communication*. Last update: Available at: http://spacejournal.ohio.edu/issue6/perspectives1.html#top. Last access: Jul 27, 2023.

Rumford, Chris. 2008. Introduction: Citizens and borderwork in Europe. *Space and Polity, 12*(1), 1–12.

Rozzelle G, 8 April 2022. “Whose suffering counts? A discussion looking at crisis coverage beyond Ukraine.” *The New Humanitarian*. Available at: https://www.thenewhumanitarian.org/opinion/2022/04/08/event-crisis-coverage-beyond-Ukraine. Last access: Aug 22, 2023.

Shue H. Wippman D. 2002. “Limiting Attacks on Dual-Use Facilities Performing Indispensable Civilian Functions”, *Cornell International Law Journal*. 35(7). 558-579.

Schwendimann, Felix. 2011. “The legal framework of humanitarian access in armed conflict. International Review of the Red Cross”. 93.

Stefan Lang et al. 2020. “Earth observation tools and services to increase the effectiveness of humanitarian assistance”, *European Journal of Remote Sensing*, 53(2), 67-85.

Van Reekum, R. 2016. “The Mediterranean: Migration corridor, border spectacle, ethical landscape”. *Mediterranean Politic.* 21(2), 336–341.

Walters, W. 2011. “Foucault and frontiers: Notes on the birth of the humanitarian border”. In U. Bröckling, S. Krasmann, & T. Lemke (Eds.), *Governmentality: Current issues and future challenges*.New York: Routledge. 138–164.

Williams, J. M. 2015. “From humanitarian exceptionalism to contingent care: Care and enforcement at the humanitarian border”. *Political Geography, 47*(1), 11–20.

Zhou, Wen. 2023. “War, law and outer space: pathways to reduce the human cost of military space operations”. *ICRC blogs: Humanitarian Law & Policy*. Available at: https://blogs.icrc.org/law-and-policy/2023/08/15/war-law-outer-space-reduce-human-cost-of-military-space-operations/ Last access: Jul 28, 2023.

REPORTS

CaribouSpace and UKAid. August 2022. “Beyond Borders: Satellite Applications for Humanitarian Emergencies”. Available at: https://space-economy.esa.int/article/177/beyond-borders-satellite-applications-for-humanitarian-emergencies. Last access: Aug 27, 2023.

European Commission – Joint Research Centre Directorate Space, Security and Migration, Feb 2020, “EMSN-063 Crop change detection conflict areas, Nigeria Final Report”. Available at: https://emergency.copernicus.eu/mapping/download/179319/EMSN063_Final-Report_v1.pdf?redirect=list-of-components/EMSN063 Last access: Jul 28, 2023.

EUSPA. 2023. “Report on Emergency Management and Humanitarian Aid”. Available at : https://www.gsc-europa.eu/sites/default/files/sites/all/files/report_on_emergency_management_humanitarian_aid_user_needs_and_requirements.pdf. Last access: Jul 28, 2023.

Global Protection Cluster Working Group (PCWG), “Handbook for the Protection of Internally Displaced Persons”. Geneva: Global PCWG, December 2007. Available at: http://www.humanitarianreform.org. Last access: Aug 3, 2023.

NASA Aeronautics Research Institute (NARI), June 2021, “NASA ARMD WILDFIRE MANAGEMENT WORKSHOP”. Available at: https://www.nasa.gov/general/nasa-reports-and-transcripts/ Last access: Sep 3, 2023.

PwC, UK Space Agency. 16 May 2023. “Expanding frontiers: The down to earth guide to investing in space”. Available at: https://www.strategyand.pwc.com/uk/en/insights/expanding-frontiers-down-to-earth-guide-to-investing-in-space.html . Last access: Jul 22, 2023.