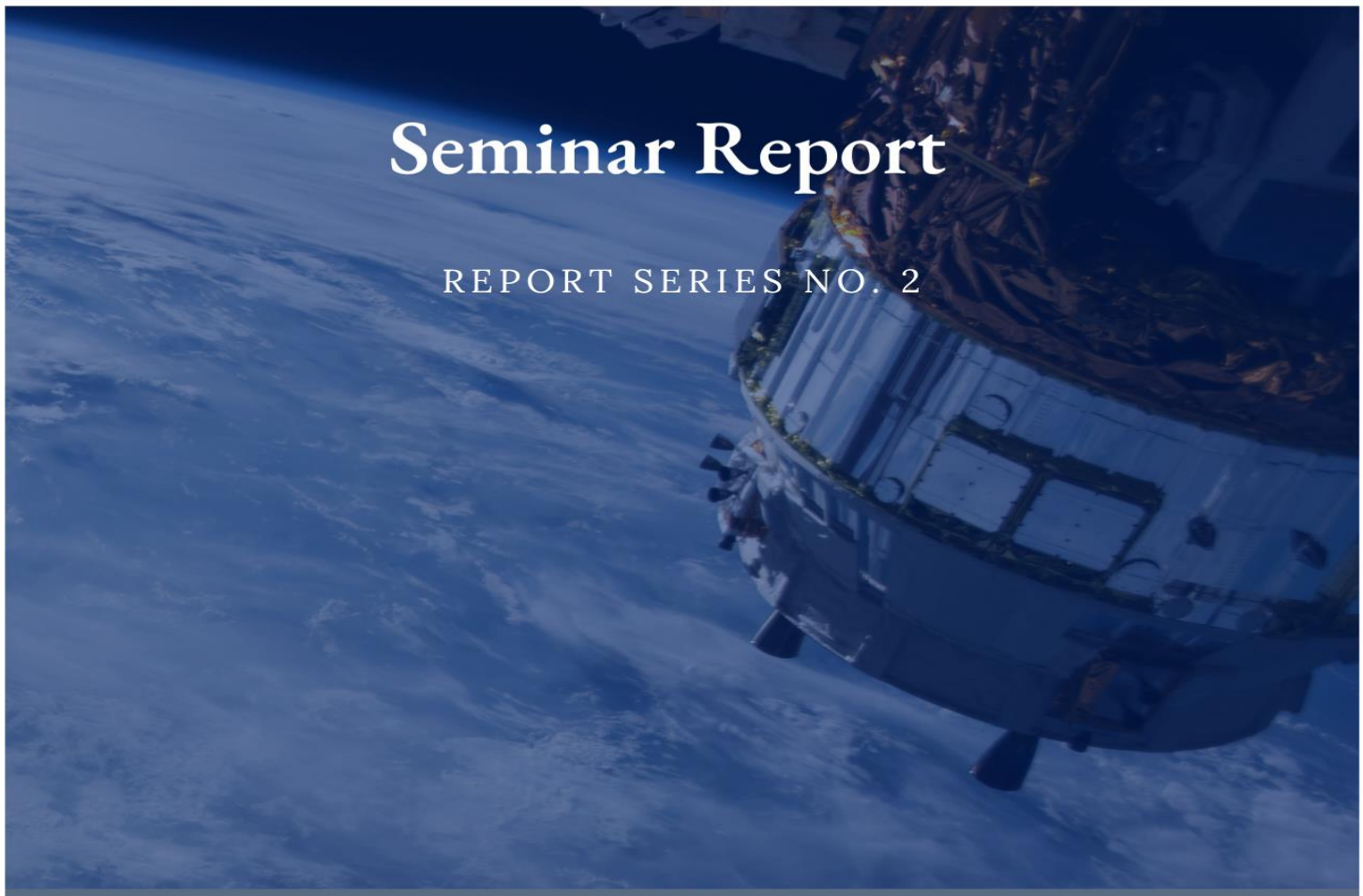

Seminar Report

REPORT SERIES NO. 2

The Optimisation of the Use of Satellite Information in the Humanitarian Domain: Legal and Space-Related Developments

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This report is based on the presentations from various scientists, technical and legal practitioners and international organisations during an academic session held on the 3rd of February 2023. The final responsibility for the content lies with Wim Ploeg who is the main publisher of the report.

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Introduction / Editorial

Several recent initiatives have attempted to assess and analyse the current use of satellite-based information in the humanitarian domain.[1] The results of those initiatives shed light on the current struggle to use this relatively new source of information in an optimal way. At the same time the uptake of the use of – applications based on – satellite information in other domains such as the environment, agriculture, and transport are growing rapidly. This development poses the challenge of how to bring the use in the humanitarian domain to that same level? What steps could private, public, and academic institutions take to organise this user domain for satellite information?

The results of the first exploration of the subject in this context are noted in the paper: "Beyond Reasonable Doubt; The Quest to Optimise the Suitability of Satellite Data for Monitoring Human Rights and International Criminal Prosecution."[2] The conclusions of this paper stated that important basic prerequisites were fulfilled that could form a basis for further research. Communication on the basis of this paper with relevant legal, technical and data related stakeholders learned that an interdisciplinary exchange of views and information could be a good basis for the further definition of a research project. This materialised in a seminar on "The Optimization of The Use of Satellite Information in The Humanitarian Domain" that took place on 3 February 2023 at the faculty of law of Leiden University. This paper contains an account and conclusions of the seminar.

The conclusions of the Paper and the Seminar showed that several legal, technical and data management related research questions should be answered before a more effective user domain could function. This process could then optimise the flow of information to the benefit of investigations and legal proceedings. The further definition of these research questions and the description of an interdisciplinary research project and the implementation thereof will be the next steps.

Contributions and ideas for the project are very welcome. Please use the email address: spaceforhr@gmail.com

Programme

The seminar held two thematic sessions. The speakers in Session A dealt with the significance of satellite information in supporting humanitarian initiatives[3] and the current challenges prosecutors face when assessing the data's reliability, credibility, and authenticity as evidence in accountability proceedings before international Courts and Tribunals. Following the break, Session B concentrated on satellite technical optimization, the current use of satellite

[1] Leiden Guidelines on the use of Digitally Derived Evidence (DDE); Berkeley Protocol on Digital Open-Source Investigations; The Harvard Signal Code: Ethical Obligations for Humanitarian Information Activities.

[2] W. Ploeg, Leiden, July 2022.

[3] This seminar focussed on the role of satellite information in international legal proceedings, demanding a very high level of trust. The project will also address other use such as inquiries to possible human rights violations.

information in humanitarian contexts, other underutilised satellite capacities, and the potential conflict of sophisticated data collection with privacy regulations.

Conclusions

Discussions with organisations working in the field of international justice, managing space programmes and space infrastructure and applications[4] led to conclusions below:

General Conclusions

- All actors acknowledged the value of better interaction between the legal and more technically oriented domains in order to bridge the gap between both disciplines;
- The sense of urgency and connected willingness to cooperate is broadly shared;
- It is expected that the main focus of this cooperation should be in preparing the legal and more technically oriented domains for an effective user consultation process;
- As further research will be needed after the definition of a dedicated project, the universities involved see opportunities for (international) research activities with possibilities for student participation;
- It's a non-negotiable that we should continue to use space technology, which is why we must address the issues that limit or prohibit access to this data, its use, and the dissemination of this data and its products.

Part A – Conclusions

- Satellites are an invaluable tool for courts to overcome the constraints imposed by State sovereignty in documenting evidence of international crimes and monitoring human rights violations;
- To use satellites to document evidence of human rights abuses and international crimes in proceedings before international courts and tribunals, technical operators must make

[4] International Criminal Court (ICC), European Space Agency (ESA), European Union Agency for the Space Programme (EUSPA), Kalshoven-Gieskes Forum for International Humanitarian Law (KGF), International Institute of Air and Space Law (IIASL), European Union Satellite Centre (SatCen), Geoscience and Remote Sensing Department of Delft University and the Netherlands Space Office (NSO).

provisions in their data collection, storage, and analysis procedures to assure the Court of the information's reliability, credibility, and authenticity;

- Agents can employ a practical technique to continuously collect evidence on and monitor a conflict-affected area by processing the data of numerous satellites simultaneously. Notably, the Court will attribute greater evidentiary weight if the data provider stores the original raw data from each satellite into an interface accessible to the Court so that it can confirm whether the incident in question was actually captured by the imaging satellite at the time it was supposed to have happened or to resolve any doubts about whether a malicious actor purposefully altered the data. Should an agent not be able to provide access to the raw data due to company policy, security measures, or for any other reason, the Court will attribute the same evidentiary weight to the image if other evidence corroborates the facts in the image, such as ground-based testimony of victims/actors in the affected area, complementary data from other satellites, etc.;
- Relevant data can be used to detect war crimes or to verify witness testimonies. Such data is contemporaneous to the events it purports to depict and is generally collected within a month of the incident's occurrence. Satellite operators should anticipate a need for such images by international courts and tribunals by collecting data in an early stage of a humanitarian crisis;
- The more information satellite operators and universities provide on the methodology used to generate satellite images, as well as industry standards and procedures for protecting and storing data, the more admissible and valuable the evidence;
- Forensic imaging experts can provide much needed assistance in image interpretation and ensuring that the maximum evidential value of the images is achieved;
- Focussed training with assistance of (technical) universities, satellite operators and the processing sector should be offered to Council Judges and other legal personnel so that they can better comprehend such evidence when presented;
- Strengthening methodologies and developing a standardized approach for the chain of custody and evidence authentication;
- Ingenuity and interdisciplinary collaboration among technical and legal practitioners in developing guidelines for optimizing satellite imagery for human rights and humanitarian purposes should be organized;
- Linking smaller satellites, such as Cube and Swarm satellites, to collect complementary data is a promising future development that can provide more temporal information than larger satellites at a lower cost. However, adequate archives must be built to overcome the more limited data volumes that individual small satellites can store or process;
- While the right to privacy does not yet preclude satellite imagery from being used in criminal proceedings, as image resolution increases, general principles should be developed to address privacy rights in light of the need to collect information;
- We are beginning to encounter privacy concerns on multiple levels as satellite groups and more powerful satellites are deployed. While there are fewer privacy concerns about what we can directly derive from satellite imagery due to resolution limitations, there are more concerns about the information generated by the fusion of multiple data

sets (mobile network, financial, and others). This solicits the question of how far the combination of different (satellite) datasets can be justified for humanitarian purposes?;

- Developing guidance material to make data collection more efficient and sensitive to privacy issues would be beneficial to all legal proceedings, including into International Criminal violations;
- National and EU agencies, such as SatCen, employ skilled image analysts who collect information from credible sources that can prove useful in judicial proceedings or other human rights initiatives. It is useful to investigate how this source of information could be used in a more optimal way.

Part B – Conclusions

- The European Union Agency for the Space Programme provides services related to Galileo, EGNOS, and satellite communication to support the delivery of humanitarian aid, including through the EU Space for Ukraine initiative, which brings together innovators and small and medium enterprises to create solutions that can assist NGOs in the field and anticipate a humanitarian crisis. It should be feasible to extend these services to stimulate the delivery of information and products beyond humanitarian aid to human right's needs;
- International Space Agencies, such as the European Space Agency (ESA), might be institutionally limited due to their mandate as an research and development organization rather than an operational entity for investigating war crimes or crimes against humanity. Nonetheless, ESA can still provide support in other capacities; for example, ESA works closely with various entities, including the ICC, national prosecutors, and UN agencies, to build capabilities for using Earth observation in these investigations and developing methods for integrating information derived from satellite data with other relevant data streams to strengthen its value (e.g. mobile network data, commercial media and social media information, financial transaction data, vehicle telemetry data, data collected by NGOs etc);
- For international crimes that occur in a sequence of activities that take place over an extended period of time, the integration of Earth observation data with other data sources over an extended period can help to detect the components of criminal activities and put together a picture of how the illegal activity occurred. Such information can help to support the demonstration of connections between different contributing activities;
- There are two methods for using GNSS to authenticate forensic data. The first involves utilizing Galileo's open-service navigation message authentication, which provides a signal that can be used to prove that the metadata was received at a specific time, thus authenticating the image. The second and most secure method of proving that a signal was collected at a specific time involves creating a Genesis signature using a commercial company's capability of taking short-duration snapshots, around 100 milliseconds;

- The Netherlands uses satellite data to analyse the spectral profiles of various crops to detect farmers growing unregistered crops. Given that the evidence based on this data, the same techniques could be applicable to conflict areas to monitor widespread crimes, or to inform the effective delivery of humanitarian support;
- Storing data in blockchain is seen as a solution to overcome the major technological obstacles in using images in international criminal justice. Notably, in 2023, ESA will launch a dedicated set of activities to address this issue;
- Among the most exciting developments in space technology for the humanitarian and criminal justice domain is the possibility of launching swarms of satellites to monitor conflict areas, to which all speakers see opportunities if the management of the data processing and storage is properly organised and protentional conflict areas are defined.

Summary of the Session

PART A

Session A.1: Satellite Information and The Statute and Practice of The International Criminal Court

Speaker: Bas Jacobs

This session's speaker provided an overview of how space law creates opportunities for satellites to be valuable for documenting evidence in International Criminal Court proceedings. The speaker also discussed the reliability, credibility, and authenticity criteria that satellite data must meet to be admissible as evidence in international criminal proceedings, as well as the relevant circumstances defined in the ICC Rome Statute rules on Procedure and Evidence that may force the Court to exclude the collected data from the proceedings.

International space law guarantees States, private actors, and prosecutors an (almost) unrestricted means to use satellites to document evidence of international crimes occurring in high-risk, active military zones, irrespective of national borders. The 1969 Outer Space Treaty (OST) indirectly grants prosecutors in the territory of all State Parties to the Treaty this right under Articles I and II. Article I of the OST states that space "shall be free for all States for exploration and scientific investigation." While the terms 'exploration' and 'scientific investigation' are broad in scope, ample practice in outer space by States and private actors supports the existence of an *opinio juris*, or legal opinion, that prosecutors may use satellites for humanitarian purposes under the rights enshrined in Article I OST.

Furthermore, even if it is disputable whether Article I OST grants State and private entities the right to use outer space to document information about crimes occurring within the territory of a State that has not given its consent for such data collection, the affected States lack the authority to prohibit foreign actors from using outer space for this purpose. According to Article 2 of the OST, State sovereignty does not extend to outer space. Therefore, the true value of Earth Observation is that it allows the Court to collect intel contemporaneously, remotely, and independently as events occur and, thereby, document the widespread, systematic character, and long-term extent of reported violence. Those aspects can be indispensable to the ICC, particularly for gathering information in the early stages of an investigation.

Once the information is documented, the data must meet specific requirements to become eligible as evidence before the International Criminal Court and be assigned a high-probative

value (evidentiary weight) by the judges. Generally, the judges may rule on the admissibility and evidentiary weight of all evidence submitted to the Court. While making this evaluation, the judges follow two steps. Firstly, it does a positive assessment of whether certain criteria are met, looking specifically at Article 69(4). Secondly, the Court does a negative assessment to make sure the evidence wasn't collected in a prohibited way, looking at Articles 69(7).

To meet the condition in Article 69(4) of the Rome Statute, the evidence must be relevant and have a greater probative value than prejudicial effect.[5] Relevance means that the data must make a fact that is in question before the tribunal more or less probable by throwing light on the time, place, or circumstance of the incident. Relevant satellite information can be material or immaterial. Material elements refer to information pertinent to the crime committed, including which weapons an actor used, what damage they caused, or who the victims are. Immaterial matters provide information on the capacity of the accused, their broader role in an incident, or evidence of their intent (e.g., where the battalion was headed, what strategic areas are nearby, what is forcing a group to move in a particular direction). Notably, with satellite information, the main challenge is a temporal one. The longer the delay, the more likely evidence becomes available to the Court indicating that changes could have arisen between the event's occurrence and the time the satellite took the images. This, in turn, would place the Trial Chamber in a position where it can no longer establish beyond a reasonable doubt that what the data show is a consequence of the event under consideration. The ICC Trial Chamber held in *Prosecutor v Ntaganda* (Judgment) that "that images taken more than a month after an attack are of limited use to establish whether, and if so how, any destruction took place during the events that are subject to the charges."[6] Hence, for evidence to be relevant, the data collection must be taken within a month of an attack to be contemporaneous to the events it purports to be showing, and relate to the matters that are properly to be considered by the Trial Chamber.

Probative value means the extent to which evidence can prove the facts, which is compared to the evidence's prejudicial effect – when the information is unrelated to the core part of the case and affects the impartiality of the jury. As a general rule, three key criteria are used to measure probative value: reliability, credibility, and authenticity. In practice, these concepts overlap, and judges evaluate them simultaneously.

Reliability refers to the quality of the information. A satellite operator can make the evidence more reliable by corroborating the evidence with the data collected by other satellites. Credibility refers to the believability or trustworthiness of the information and depends on how well-recognized the methodology used to process and analyse the data is, as well as the reputation of the satellite operator. The evidence automatically becomes less credible if the operator has a history of distributing inaccurate data. Finally, authenticity requires proof the evidence has not been manipulated or tampered with. This criterion can be met by having access to the raw data and having detailed safety protocols in place to track the chain of custody

[5] Prejudicial effect refers to information that is not regarded as reliable, credible, or authentic and does not adequately relate to the specific incident under consideration by the Chamber.
[6] Leiden Guidelines on Digitally Derived Evidence - Aerial and Satellite Images, Section C3.

of the data at each step from the original collection by the satellite, processing by an analyst, and transference to the Court.

When a specific crime is submitted to the Court, evidence can be labelled to have a "prejudicial effect" if the data has only minimal probative value and does not adequately relate to the specific incident before the Chamber. For instance, if the Chamber is hearing a case concerning a soldier operating in battalion A, it is likely that evidence showing crimes committed by battalion B in a different territory is not relevant to the proceedings and will not prove the facts before the Court. However, such data might affect the impartiality of the judges to rule on the incident presented before them and can hence be labelled to have a "prejudicial effect."

When the satellite information meets the criteria in Article 69(4) of the Rome Statute, the evidence must also pass a second test in Article 69(7) Rome Statute. Substantively, the information collection, processing, and analysis process must not violate internationally recognized human rights in a manner that would be antithetical to and would seriously damage the integrity of the proceedings. Regarding satellite information, the principal concern is that the documentation of personally identifiable information, i.e., information that allows an entity to make conclusions about an individual's personal life, will violate their right to privacy under international law. Privacy violations do not automatically make the evidence inadmissible in proceedings before the Court. Only if the privacy violation affects the reliability of the evidence or is so severe that it would be antithetical to and seriously damage the integrity of the proceedings will the judges rule the evidence inadmissible.

It is currently unclear when a violation of privacy meets this high standard. However, as the resolution of Earth Observation improves and satellite operating systems and the data it can collect about people's lives become more sophisticated, these criteria will inevitably become an impediment for the Court in the future. Therefore, while optimizing satellites to document evidence of international crimes in accordance with the legal criteria outlined in the Court's Statute, the right to privacy should be carefully considered.

In conclusion, it is essential to think about what technical provisions can be made to meet the legal criteria outlined in the ICC Rome Statute to facilitate the admissibility of satellite data as evidence before the Court and increase the overall evidentiary weight. The more information available about the methodology used to generate satellite images, as well as the standards and procedures used to protect and store the data, the more admissible and valuable the evidence.

Session A.2: The Authentication, Reliability, and Interpretation of Image-Based Evidence with an Emphasis on Satellite Images

Speaker: Jonathan W. Hak, KC

Images, including satellite imagery, play a significant role in persuading courts and serving as evidence in international and domestic criminal prosecutions. Satellite imagery helps provide macro-level analysis of locations, such as permanent or semi-permanent landforms and architectural features, but also transitory features (vehicles, equipment, people, and things moving within a scene). In all types of image-based evidence, the key issues to ensure their admissibility in court concern their authentication, reliability, and interpretation.

Authentication is the process of proving that an image constitutes evidential proof in a case. To authenticate an image, the tendering party must establish four things:

1. The location the image shows,
2. The date the image was taken,
3. The time an image was captured, and
4. The integrity of the data/image and the process by which any information is derived .

Internally, the counsel can authenticate image-based evidence by demonstrating the technical soundness of the data and media content. External authentication can be accomplished by evaluating other reliable evidence, such as testimonial accounts. Finally, a third approach employs multiple sources to cross-reference and validate both the temporal and spatial narratives reflected in the media. Failure to authenticate an image using any of these methods may result in exclusion at trial.

Reliability is another important factor to consider when using image-based evidence. The reliability criteria concern whether the court can trust what the image depicts and whether the image can be used to establish a stated fact before the court. Judges must be assisted in their interpretation of the images through the use of expert witnesses. Furthermore, Counsel and judges should receive focused training on image-based evidence so that they can better comprehend such evidence when presented. Untrained viewers may misinterpret image content, leading to erroneous interpretations and sometimes unjust results. While suboptimal images may suffice for macro-level analysis, they might be unreliable for determining micro-details. To overcome doubt, ambiguity, and divergent interpretations, understanding the meaning of image-based evidence necessitates effort and, in many cases, expertise. In some cases, the court only needs contextual information to understand the meaning of the evidence. In other cases, the court requires content-based assistance from people with direct, relevant knowledge and expert testimony to interpret the images.

Interpretation of image-based evidence is crucial in criminal investigations and prosecutions. Pictures do not necessarily speak for themselves, despite the common view that they do. While

judges can understand images correctly without assistance in some cases, in others they require expert testimony to interpret the images correctly. Understanding the meaning of visual evidence requires effort and often expertise to arrive at sustainable interpretations. The value of forensic imaging experts is that they can confront images, dissect them, reconstruct them, and maximize their evidential value.

In conclusion, satellite imagery is a powerful tool in criminal investigations and prosecutions. However, the authentication, reliability, and interpretation of image-based evidence are crucial factors to ensure its admissibility and value in court. Forensic imaging experts can provide much needed assistance in image interpretation and to help ensure that the maximum evidential value of the images is achieved. Counsel and judges should receive focused training on image-based evidence so that they can better comprehend such evidence when presented.

Session A.3: Mobilising Satellite Data for International Accountability

Speaker: Sabrina Rewald

This session looked at the evidentiary benefits and challenges related to satellite imagery, and how we can apply the Leiden Guidelines on Digitally Derived Evidence (DDE), specifically the sub-guidelines on Aerial and Satellite Imagery, to start addressing these challenges. The Leiden Guidelines is a project of the Kalshoven-Gieskes Forum on International Humanitarian Law (KGF).[7]

The goal of the Leiden Guidelines is to outline the standards applicable to Digitally Derived Evidence (DDE) used in domestic courts, fact-finding missions, and international courts and tribunals. The Leiden Guidelines are an output of the KGF's DDE Project, the research of which has also covered the treatment of digital evidence in domestic courts and fact-finding missions, accessible at: https://leiden-guidelines.com/resources/downloads/.

Digitized evidence combines two types of evidence that nevertheless can be reasonably similarly treated in the proceedings before criminal Courts and Tribunals: digital evidence, and digitised evidence. On the one hand, digital evidence is material that originates from a computer environment, which includes videos, modern photographs, intercepts, call data records, and satellite imagery. On the other hand, digitized evidence is analogue material that an entity transfers into a digital format or data that has been manipulated, stored, or communicated by or over a computer system. Some examples of digitised evidence are radio recordings transferred into a digital format or paper documents scanned digitally

[7] The KGF is a Forum embedded within the Grotius Centre for International Legal Studies at Leiden University. For the past 11 years, it has focused on the education, research, and dissemination of international humanitarian law. It also runs the Leiden International Humanitarian Law Clinic, offering practical international legal experience to select Leiden students in the Master of Law program.

A key evidentiary benefit of satellite imagery is that it is accessible without entering insecure or inaccessible areas or even another State's territory. As a result, it is challenging for perpetrators to undermine the collection thereof. Moreover, satellite imagery provides a great deal of information; for example, open-source investigation platforms like Bellingcat have highlighted researchers' use of NASA's fire data to heat track the conflict in Ukraine. Prosecutors can also use satellite imagery to document evidence of attacks against civilian objects, interference with humanitarian assistance, and intentional disturbances of the earth's surfaces - suggesting human activity such as mass graves.

How have some of these benefits been applied before accountability mechanisms? The ICTY used satellite imagery to identify mass graves. [8] Similarly, missions involving or exploring human rights violations and international crimes in the Occupied Palestinian Territories, Sri Lanka, Myanmar, Syria, and South Sudan, utilized satellite imagery as evidence.

While satellite imagery has many benefits, there are also many complexities to consider. A major challenge is the fragmentation of treatment across and within accountability fora, a problem that the Leiden Guidelines seek to ameliorate. Moreover, data manipulation in this deep fake era is becoming ever more complex and difficult to ascertain, so establishing the credibility of satellite imagery is paramount for accountability purposes but also increasingly challenging.

While developing the Leiden Guidelines, the KGF became aware of the need for technical experts and collaboration between private industry and justice mechanisms. Methodologies must be developed specifically to detect whether hostile actors have tampered with the data. It's ever more important to have experts with this ability, but also we need judges and fact finders to have basic data literacy and be able to understand the underlying technical issues. The ethical and human rights considerations that come into play regarding privacy, especially as Earth Observation becomes ever more high resolution, demand a high degree of technical competence on the Court's part to ensure fair trials.

The value of the Leiden Guidelines is that it provides prosecutors with a platform to access helpful tools to assess digitally derived evidence enabling investigators, lawyers, and judges to proceed with the most information possible. For instance, Guidelines C3 on Aerial and Satellite Images show that the evidence must be contemporaneous to the events it purports to portray. The advice in this guideline is based on the ICC Trial Chamber's ruling in the 2019 Nanganda case, wherein the Court identified that an image taken more than a month after an attack is of limited use to establish whether, and if so, how any destruction took place during the events that are subject to the charges.

In conclusion, due to the evidentiary value of the evidence, but also to the possibility that digital evidence is manipulated, tools like the Leiden Guidelines can offer a first step in establishing

[8] The International Criminal Tribunal for the former Yugoslavia.

objective and legally sound standards that legal professionals can use to assess the reliability, credibility, and authenticity of digitally derived evidence. However, the guidelines can only be developed so far by lawyers and human rights advocates. The question of how to optimise satellite imagery for human rights and humanitarian purposes remains riddled with white space, and it's prime for ingenuity. Indeed, the next evolution of the guidelines will significantly benefit from an interdisciplinary collaboration between technical and legal practitioners.

Session A.4: Legal Issues that May Hinder the Access to and Distribution of Satellite Data, Such as Privacy-Related Regulations, Intellectual Property, and Export Control

Speaker: Marco Beijersbergen

In this session, Marco Beijersbergen discussed a few trends he has noticed in his experience developing remote sensing instrumentation that are rapidly growing and what impact that might have on using satellite data in a legal context beyond just humanitarian law.

Marco started by showing an example of an instrument used on the International Space Station that takes night-time photographs and gives a lot of very different information from normal images. For example, the image shown during the presentation displayed light pollution in the Netherlands caused by greenhouse emissions.

Furthermore, a rapidly developing trend happening now is that, instead of having huge satellite missions that are very expensive and that there are only a few in orbit, we now go to much smaller satellites, which are becoming much more powerful these days. Such satellites might only weigh 1 kg and can take images in 45 wavelengths. While such satellites cannot provide the 5 cm resolution, for which you need big and expensive satellites, these smaller satellites provide much quicker and more varied types of information. The linkage of satellite groups allows for the collection of complementary data that gives much more temporal information and much more than just the visible images. In the legal context, the main benefit you can expect is that CubeSats can be deployed in lower earth orbit that can cover the entire earth with a resolution of around 5m from the ground.

Another new development is the deployment of instruments that can take active images from space using, for example, a laser pulse to measure the height of vegetation, the spread of deforestation, and detect the demolition of buildings.

Concerning the constraints on data collection, these images are not infinitely accessible. Moreover, the data is processed on board, so prosecutors cannot access the raw data. Hence, Courts will have to look at the images and how they are processed. Also, there is the challenge of data continuity and when data should and can be deleted.

Additionally, government and private entities may not make this data publicly accessible. As a result, only some have free and the same access to these data. Consequently, there will be a bias in the information available from this system. While there are many data providers, each will have its own strategic interest and data processing methodology, leading to authenticity issues. Hence, to be able to use this data in the legal context will require enhanced means for validating, verifying, and authenticating satellite images.

Finally, we can expect a lot of privacy problems because these observations make it possible to track objects, vehicles, and individuals simultaneously. Not only governments, but numerous actors, will have the ability to collect personally identifiable data and produce highly accurate conclusions regarding a person's life using AI models. Therefore, we should consider what kind of data we can actually use for humanitarian purposes and the option to launch special humanitarian satellites to document data that can hold up in Court.

Speaker: Dimitra Stefoudi

Beyond the use of satellite technology as evidence, all entities must consider the legal challenges associated with satellite information coming from outer space. Satellites enable wide coverage compared to other fact-gathering technologies and provide high-speed access to reliable information. Moreover, with the current state of technology, even if the data is not offered on an open basis, it is still becoming more affordable thanks to the commercialization of the space sector. As a result, we must discuss the legal issues that limit or prohibit access to this data, the use of this data, and the dissemination of this data and its products.

When we speak about space data, we usually refer to Earth Observation data. From the legal perspective, they fall under space regulations, given their connection to space activities, as well as information technology regulations, being information products. Space activities are regulated on a unique level because, unlike on the Earth, State sovereignty does not exist in outer space. As far as information technology law is concerned, one of the major concerns with space data is how to address the right to privacy, i.e., the right to be left alone. Privacy entails the duty to protect information that identifies or can identify people, such as satellite-enabled location and high-resolution remote sensing imagery. States adopt a wide range of measures, including data protection laws, such as the European General Data Protection Regulation (GDPR), which is binding for data controllers and processors in the EU.

Alongside the right of individuals to privacy, a question that arises is whether States have a right to privacy, which protects their territory from being observed from outer space. According to international law, States can exercise their sovereign rights in areas under their jurisdiction, such as within their borders, in their territorial water and in their airspace. There, States can regulate the information that is collected and distributed. For example, flying over the territory of a State in order to take pictures requires permission. However, outer space is an area outside the sovereignty of States where such a limitation does not exist, and States have the freedom

of exploration, use, and scientific investigation. This provision allows States to launch Earth observation satellites and conduct remote sensing activities without the permission of the sensed State.

Notably, since States know they will be observed from outer space, the discussion on privacy can become more nuanced. As satellite resolutions become more accurate, the lawfulness of Earth Observation will depend on the purpose of the collection of satellite images. Nevertheless, it is difficult to determine what that purpose is, since we collect remote sensing images specifically because we can use them for many different applications. Public interest purposes, such as humanitarian actions, may introduce some exceptions to the collection of personal data. The bottom line is that, given the benefits that we get from satellite data, we may have to reconsider how we treat data protection. It is a non-negotiable that we should continue to use space technology, including space data, the way we already do, if not more. At the same time, the legal issues are there. We cannot disregard them, but what we can be more transparent in the way we use satellite data. Some other information technology law and space law related issues regarding the collection, use, and dissemination of satellite images include intellectual property rights, which subjects data users to specific terms and conditions, and export regulations that limit access to sophisticated technology used to collect and process satellite data.

In conclusion, we need many more synergies among not only the public and commercial data suppliers and users, but other entities that can benefit from data, including criminal courts, local courts, and whoever else is going to use this data. While regulations seem desirable when it comes to cutting-edge technology, they are often difficult to adapt or at least to review whenever necessary. Instead, developing guidance material and considering satellite data as another layer of data in the general context of Information Society might be more efficient.

PART B

Session B.1: Opportunities That Can Foster User Uptake in The Specific Domain of Crimes Against Humanity

Speaker: Vasilis Kalogirou

Mr. Kalogirou from the European Union Agency for the Space Programme underlined the importance of the initiative to bringing the legal and space communities together. He presented on the Union Space Programme and its various components. He highlighted that Regulation (EU) 2021/696 of the European Parliament on 28 April 2021 established the Union Space Programme and the European Union Agency for the Space Programme,[9] and their roles in providing services related to Galileo, EGNOS, Copernicus, Space Situational Awareness and satellite communication. The agency also works on security accreditation, market development, downstream innovation, and user uptake of the Union space programme.

Mr. Kalogirou also talked about the agency's involvement in humanitarian aid through its initiative called EU Space for Ukraine, which aims to bring together innovators and small and medium enterprises to create solutions that can assist NGOs and response practitioners in the field. The agency is now in the demonstrator phase and plans to demonstrate some space solutions based on Galileo and/or Copernicus to NGOs. Additionally, the agency is also working on how to anticipate crises through its workshop on Copernicus for anticipatory humanitarian action in cooperation with the EU Joint Research Centre.

The presentation also touched on the Earth observation industry and its growth, which proliferated exponentially after the 1992 Land Remote Sensing Policy Act in the US. The industry has grown significantly, and there are now more instruments in orbit, including thermal and night-time ones, diverse data types, and better perspectives on observable events. However, besides these positive developments, Mr. Kalogirou further highlighted the risks associated with imagery intelligence craft and how images can be manipulated to support certain narratives and propaganda. He also discussed the importance of archives and frequent earth observations and their role in providing indicators of activities before, during and after events that can be connected to crimes against humanity. Mr. Kalogirou identified opportunities for collaboration with the community, including working with jurists and prosecutors to improve admissibility, working with the industry to safeguard images and data from manipulation, and addressing the issue of deep fakes.

Overall, Mr. Kalogirou's presentation provided an overview of the Union Space Programme and its various components, as well as its involvement in humanitarian aid and crisis. He addressed concrete aspects, such as frequent earth observations, to be further developed and talked about the risks associated with information provided by the Earth observation industry.

[9] For EUSPA information see: https://www.euspa.europa.eu/

Session B.2: SatCen and Copernicus: Satellite Imagery Analysis for Humanitarian Aid

Speaker: Denis Bruckert

Denis Bruckert, Head of the Copernicus Unit (SatCen), presented how the Copernicus Service in Support to EU External Action (SEA) can support humanitarian aid. SatCen is an EU agency located near Madrid, Spain that provides geospatial intelligence to support the decision making and actions of the European Union in the field of Common Foreign and Security Policy (CFSP), in particular Common Security and Defence Policy (CSDP). SatCen analyses satellite imagery to provide valuable information on what is happening on the ground, supporting the EU External Action Service, Member States, and relevant EU Agencies including FRONTEX for the Border Surveillance. The agency is also assessing whether it can submit SatCen geospatial data for use in judicial proceedings.

When linked to security events outside the EU, Copernicus SEA service implemented by SatCen can help to support EU humanitarian aid. Copernicus SEA primarily focuses on EU security and not on disaster management though in cases of sensitive or specific requests SEA can also provide services for humanitarian aids needed following disasters. Among the data that SatCen provides is data concerning refugee camps. In this case, SatCen is usually asked to analyze the camp's details and to provide data on the number of dwellings, morphology, and other specific elements to dimension humanitarian aid required.

SEA also conducted conflict damage assessments outside EU, identifying the extent and type of damage to villages and local infrastructure by using satellites to monitor conflicts and confrontations between military and opposition armed groups. SEA products can also advise on the suitability and serviceability of infrastructures such as a hospital or local airport in a given area for a specific humanitarian operation.

Overall, SatCen has, through Copernicus SEA, fully operational tools to support humanitarian aid delivery. Its skilled image analysts gather information from verified and trustworthy sources that may be useful in human rights initiatives. All in all, SatCen's use of geospatial intelligence provides critical support for EU humanitarian aid efforts in security-affected areas.

Session B.3: Experience of Integrating Satellite Data to Support Investigations of Crimes Against Humanity

Speaker: Gordon Campbell

Mr. Gordon Campbell, from the European Space Agency,[10] delivered a presentation on the integration of satellite data to support the investigation of crimes against humanity. The presentation highlighted that while the European Space Agency is an R&D organization and not an operational entity for investigating war crimes or crimes against humanity, it works closely with various entities, including the International Criminal Court, national prosecutors, and UN agencies, to build capabilities for the use of satellite Earth observation in these investigations.

Mr. Campbell emphasized that the satellite Earth observation data alone is limited in its utility, and its effective integration with other data sources, such as witness statements, mobile network data, financial transfer information, social media data, and others, is fundamental to achieving the maximum value out of satellite-derived information. He added that integrating satellite Earth observation data with other data sources can help to correlate different anomalies and put together an overall picture of the crime being committed. According to Mr. Campbell, crimes against humanity and war crimes are not instantaneous activities, but rather, they occur in a sequence of activities that take place over an extended period. Therefore, the integration of satellite Earth observation data with other data sources over an extended period can help to detect the components of criminal activities and put together a picture of how the illegal activity occurred.

The presentation also highlighted the value of satellite information in situations where there is a lack of security for collecting information in hostile operating environments and in corroboration with witness statements. Mr. Campbell provided some examples of how satellite Earth observation data have been used in actual investigations and cases in the past. These analyses were executed in close cooperation with relevant national and international law enforcement/criminal investigation entities. For example, satellite data were used to detect anomalies in the agricultural practices (ground movement) of a region during a time of year when that type of agricultural practice is not expected, in this case corroborating witness statements in the investigation. In another case, satellite data was used to verify alternative sources of information, such as the movement of military assets proving state involvement in particular activities. Mr. Campbell also discussed the current limitations of satellite data, such as the limited overpass and updates, which are being progressively addressed to investigate crimes committed in the future. He mentioned current research to bring satellite information more into earlier activities in the investigation model.

In summary, Mr. Campbell's presentation focused on how the European Space Agency is playing a vital role in supporting law enforcement and developing technical capacity within

[10] For ESA see: https://www.esa.int/

Member State institutions to make more use of satellite imagery and satellite-derived information in investigations and analysis of war crimes and crimes against humanity. He provided insight into how ESA has been able to provide customized support to individual Member State prosecutors or cooperating entities in exceptional cases where the routine satellite image analysis was not sufficient. Finally, the presentation emphasized the importance of integrating satellite data with other data sources to get the maximum value out of the satellite-derived information.

Speaker: Rafael Lucas

Mr. Rafael Lucas, from the Directorate of Navigation at the European Space Agency, presented on the use of GNSS for authenticating forensic evidence.

He highlighted the importance of authenticating not only satellite images but also images taken by smartphones and social media platforms. The speaker pointed out that although smartphone cameras record the date and time when a picture is taken, it is difficult to prove the authenticity of the metadata. To address this problem, Mr. Lucas suggested two methods of image authentication. The first method involves using the open service navigation message authentication provided by Galileo, the European Global Navigation Satellite System (GNSS). Galileo can provide a signal that can be used to prove that the metadata was received at a particular time, thus authenticating the image. The second method involves taking snapshots of short duration, around 100 milliseconds, which represents de-facto a very effective GNSS signature that can be verified off-line as this signature depends on the time and locations where the snapshot weas recorded. Several companies have already started to develop commercial applications of this method. The advantage of this method is that at any given time, there are around 100 to 110 satellites visible, transmitting 24 hours a day, seven days a week. Therefore, this method provides a very strong proof that the signal or evidence was collected at a particular time. The metadata can then be verified by an external authority, which also has access to the data from its own monitoring networks.

The speaker noted that this method of image authentication is not only useful for commercial companies, but also for institutional organizations such as insurance companies that need to prove the authenticity of evidence related to accidents. Additionally, the speaker emphasized that Galileo, with its 24 satellites in orbit, is the European GPS and can be used for image authentication. Mr. Lucas's presentation provided valuable insights into the methods that can be used to authenticate images and the methods suggested by the speaker, using Galileo's open service navigation message authentication and exploiting commercial companies' capabilities of processing snapshots, can provide strong and safe proof of the authenticity of the evidence.

Session B.4: How Satellite Data Can Assist The Humanitarian Domain, The Role of The Netherlands Space Office

Speaker: Wim Looijen

Mr. Wim Looijen from the Netherlands Space Office (NSO)[11] gave a presentation on the use of satellite data in assisting the humanitarian domain and the role of NSO in achieving this. NSO is a governmental space agency for the Netherlands that advises and executes a national space policy on four specific subjects. The primary aim of the NSO is to maximize the societal benefit of space for the Netherlands, with a focus on the humanitarian domain, which is a benefit for everyone in general. The speaker highlighted the trends of forced displacement, violent conflicts, food security, and climate change, all of which result in a rising need for humanitarian assistance. Mr. Looijen highlighted that the United Nations Office for the Coordination of Humanitarian Affairs (OCHA) has indicated that one in every 23 people needs some form of humanitarian assistance.

Mr. Looijen discussed the role of satellite data in the humanitarian domain and emphasized that satellite data alone cannot provide solutions to all problems; it must be used in conjunction with other data, such as witness statements, mobile networks, or other geo-information. He noted that satellites offer daily repetitive coverage with resolutions down to 30 centimetres and that more and more satellites are being launched, which will increase the possibility of daily coverage in the future. However, optical imagery, which is commonly used for monitoring, can be hampered by clouds, so other data types like radar or LIDAR could be used instead.

The speaker stressed that collecting evidence is crucial, and satellite data can be useful in assessing damages, particularly in the event of flooding, fires, or other natural disasters. He shared an example of how satellite data can be used to collect evidence in a completely different domain, such as agricultural subsidies. In the Netherlands, satellite data has been used to measure the spectral profiles of different crops for a long time, enabling farmers to be caught if they report growing one crop while growing another. He highlighted that a lot of cases in the agriculture sector are brought before the court because they concern a high monetary exchange.

The speaker noted that the same techniques could be applied to monitor crimes against humanity or humanitarian action, discussing what needs to be done differently in the usage of satellite data for cases before the ICC as compared to data collection for agricultural cases.

The NSO's role in this domain is to work collaboratively with partners to provide relevant satellite data and to develop the necessary software and expertise to interpret it. NSO does not develop tools and technologies but facilitates these through the Netherlands contribution to ESA projects and programmes and by national innovation budgets.

[11] For NSO see: https://www.spaceoffice.nl/

In the context of disaster management, the International Charter on Space and Major Disasters is an important agreement to provide free and unrestricted access to satellite data for emergency response efforts. In this context, international organizations like the European Space Agency and the United Nations Platform for Space-Based Information for Disaster Management and Emergency Response (UN-SPIDER) are working to develop tools and technologies to assist in disaster response efforts.

In conclusion, Mr. Looijen emphasized that satellite data can be a valuable tool in conjunction with other data types and interpreted by experts. He highlighted the importance of collecting evidence and how satellite data can be used in this regard. The humanitarian domain could benefit from experience in agriculture, where satellite information is used in court cases. He also discussed the NSO's role in working collaboratively with partners to provide satellite data and develop software and expertise to interpret it.

Session B.5: Advanced Satellite Data Analysis and Defining Future Missions at GRS

Speakers: Peter Hoogeboom & Ramon Hanssen

The last speakers for the symposium, Mr. Hoogeboom & Mr. Hanssen from TU Delft,[12] explained how the geoscience and remote Sensing Department is able to contribute to this domain. They briefly introduced TU Delft's geoscience and remote sensing section (GRG), mentioning that the department focusses on technical research related to climate change, climate analysis, remote sensing, and geography.

Mr. Hoogeboom displayed an image showing a dike, which can be seen as unstable with the help of radar. He explained how millimetric deformation could be observed from space with satellites and how this could be relevant from a humanitarian perspective or from a disaster perspective, as the collapse of the dyke could lead to heavy flooding. However, when it comes to research, it is useful to have a sequence of such images over time to see the evolution of the structure of the dyke, and evaluate the causes of its instability over time.

He then discussed the current missions involving the Netherlands, including 'Harmony', an ESA Earth Explorer mission, for which the Netherlands provides the principal investigator. It is an international project making use of the Sentinel-1 radar to improve the ability to investigate air-sea interaction, glaciers, and land change. He also spoke about the Dutch project SwarmSAR, where small CubeSat radars cooperate to deliver exponential performance increase. These would provide high image quality akin to large satellites, but at a fraction of the cost. He discussed the challenges related to the same, particularly with respect to licensing, liability and illegal activities, emphasizing the need for cooperation and adherence to international law.

Mr. Hoogeboom also discussed Alticubes, a constellation of CubeSat altimeters aiming to improve the operational capability of altimeters enormously in terms of revisit time and spatial coverage. He commented that this is a project undertaken under the auspices of the Netherlands Knowledge Network on Radar Instruments and Applications (NL-RIA), a group set up with NGOs and other stakeholders involved in radar analysis and radar sensors. He commented that the use of such data is much more than what one would expect, displaying the logos of participants of NL-RIA, including TU Delft, Airbus, Hermess, NLR, and Metasensing, among others.

In conclusion, Mr. Hoogeboom and Mr. Hanssen provided concrete technical developments in projects that could also be relevant for improving the satellite information for the humanitarian domain. They see possibilities for cooperation concerning the legal environment for implementing the groundbreaking technical developments as well as for technical developments on the basis of judicial needs.

[12] For Delft University GRSD see: https://www.tudelft.nl/citg/over-faculteit/afdelingen/geoscience-remote-sensing

Session B.6: Discussion and Further initiative

Moderator: Tanja Masson-Zwaan

The Q&A session was moderated by Dr. Tanja Masson-Zwaan. Responding to a question on whether the restrictions in General Data Protection Regulation[13] could be applied to satellite imagery for humanitarian purposes. Ms. Stefoudi discussed the possibility of including satellite data under existing regulations, such as GDPR, until technology changes require a new regulation. Another question was raised about government-owned or affiliated satellite imagery providers and the possibility of manipulated images. Mr. Campbell stated that there is currently no standard way to determine if an image has been manipulated and that the development of such mechanisms is underway. Finally, there was a question about whether EUSPA would organize a consultation with users relevant to humanitarian actors this year. Mr. Kalogirou responded that they would like to have a consultation and involve the community, most likely in October.

Mr. Hanssen made an intervening remark, reminding the audience that satellites acquire bits and bytes, and most companies or agencies that collect the data are not the ones who spread the images later. Therefore, if we want to know if something is fake or not, we can always go back to the source, which is the binary data. Secondly, the discussion focuses on the resolution of satellite imagery, and the speaker suggests that in the legal way of talking about data, we should avoid distinguishing between high-resolution and low-resolution data because the problems we want to solve are not necessarily directly related to resolution. When asked about the biggest challenges in the use of satellite imagery in international criminal justice, Mr. Beijersbergen emphasized the importance of transparency and capacity building and suggested that putting data in blockchain could be a solution. Finally, the discussion touched upon the possibility of launching swarms of satellites to monitor conflict areas in the future, to which the speakers see only possibilities.

In conclusion, Dr. Masson-Zwaan opined that the session provided valuable insights into the current issues and developments in the field of space law and satellite imagery. She thanked Mr. Ploeg for orchestrating this insightful event and extended gratitude to the speakers for enlightening the audience. She highlighted that this seminar managed to bring together several communities, not only from the two universities and different departments of the universities, but also from various governmental and international organizations and the industry. It also showed the broad interest from the different communities in the subject and this seminar is a good starting point for future collaboration and projects in this area.

[13] See Regulation EU 2016/679 and national regulations

APPENDIX

Annex 1: Seminar Overview

1.1 Invitation

KGF
KALSHOVEN-GIESKES FORUM
ON INTERNATIONAL HUMANITARIAN LAW

Universiteit Leiden

IASL
INTERNATIONAL INSTITUTE
OF AIR AND SPACE LAW

Invitation
for a seminar (hybrid) on

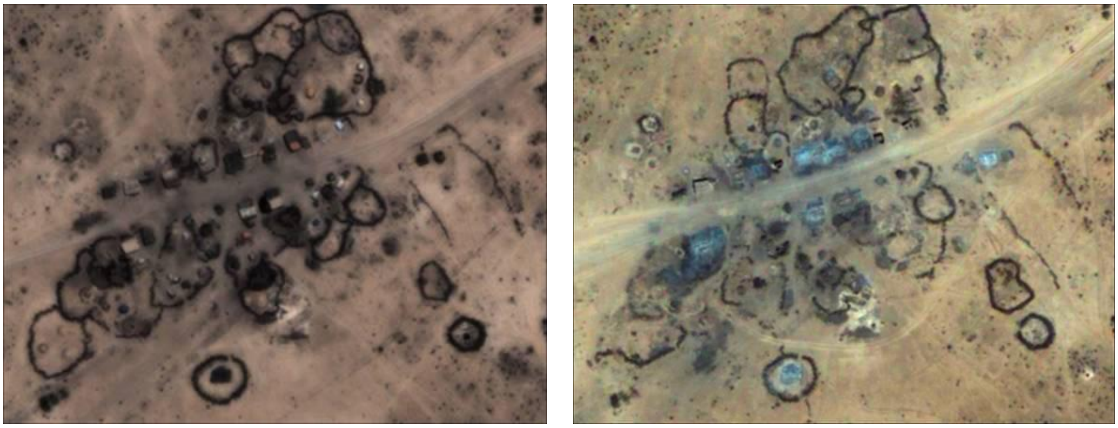
The optimization of the use of satellite information in the humanitarian domain

legal and space related developments

Organized in cooperation with the Kalshoven-Gieskes Forum on International Humanitarian Law and the International Institute of Air and Space Law of Leiden University.

Date/time: 3 February 2023, 14.30 - 17.30 hrs.
Location: Lorentz Lecture Hall, Faculty of Law, Leiden University, Steenschuur 25, Leiden.
Zoom link: Please register for the link.

Registration required via e-mail: spaceforhr@gmail.com



Example image - attacks on minority population detected in high resolution optical satellite imagery

1.2 Programme

Moderator: Assistant Professor Tanja Masson-Zwaan

14.30 : Opening by Wim Ploeg

14.40 : Associate Professor Robert Heinsch/Sabrina Rewald
'Mobilizing satellite data for international accountability'
14.55 : Bas Jacobs
'Satellite information and the Statute and Practice of the International Criminal Court'
15.05 : Jonathan Hak
'The Authentication, Reliability, and Interpretation of Image-Based Evidence with an Emphasis on Satellite Images'
15.15: Denis Bruckert
'SatCen and Copernicus: Satellite Imagery Analysis for Humanitarian Aid'
15.20 : Questions and discussion

15.35 : Coffee/tea break

15.45 : Professor Marco Beijersbergen/Dimitra Stefoudi
'Legal issues that may hinder the access to and distribution of satellite data, such as privacy-related regulations, intellectual property, and export control'
15.55 : Vasilis Kalogirou
'Opportunities that can foster user uptake in the specific domain of crimes against humanity'
16.05 : Gordon Campbell
'Experience of integrating satellite data to support investigations of crimes against humanity'
16.15 : Wim Looijen
'How satellite data can assist the humanitarian domain, the role of the Netherlands Space Office'
16.25 : Peter Hoogeboom
'Advanced satellite data analysis and defining future missions at the Geoscience and Remote Sensing department'

16.30 : Questions and discussion

16.45 : Closing remarks and further initiatives

16.55 : Drinks and informal discussions

17.30 : End of the seminar

1.3 Speakers

Marco Beijersbergen studied physics and Leiden resulting in a PhD in quantum optics at Leiden University in 1996. He worked for several years as scientist and technology development manager at ESTEC, The Research and Technology Centre of the European Space Agency. In 1998 he founded the company cosine which develops optical instrumentation for remote sensing and astronomy and is a major supplier of miniaturized remote sensing instrumentation for space. cosine consists of 50 scientists, engineers and technicians, and has offices and cleanrooms for manufacturing and assembly, integration and testing of optics and instruments in the Netherlands, Germany and Italy. For the development of this instrumentation Marco has worked on a wide variety of remote sensing technologies including spectral and infrared imaging and applications including water management, disaster management, agriculture, transport and security. Since 2005 Marco is also unremunerated professor at the physics department of Leiden University, teaching advanced optics, space instrumentation and entrepreneurship. He participates in several organizations that promote and organize collaborations in science and technology, chairing the roadmap Advanced Instrumentation in the Dutch Topsectoren program and the route Measuring and Detecting of the Dutch National Science Agenda.

Denis Bruckert is the Head of the Copernicus Unit at the European Union Satellite Centre (EU SATCen) since 2004. His work is principally focused on the definition and implementation of the EU SatCen role(s) in the EU Copernicus Space Programme. In addition and always related to Copernicus, he is also in charge of other SatCen Capability Development activities such as maritime Surveillance and Border Surveillance in cooperation with the EU Commission. Mr. Bruckert holds a Ph.D. in Remote Sensing obtained at Strasbourg University in 1996.

Gordon Campbell is Head of Enterprise section in EO Science, Applications and Climate Department, European Space Agency, working on EO application developments for more than 20 years. Working with European private and public sector stakeholders to develop methods to better integrate information derived from civilian satellite data into a range of law enforcement and security domains including environmental crime, crimes against humanity, proliferation, trafficking/organized crime. Also working with international stakeholders (eg UN, Interpol, ICC etc) in this area. Also working to develop improved accessibility, flexibility and content of EO derived information.

Jonathan W. Hak, KC is a barrister and solicitor who served as a Crown Prosecutor for over thirty years, a specialist in international imagery evidence law who teaches in several countries, and a PhD Candidate in the Faculty of Law at Leiden University. He is the author of Image-Based Evidence in International Criminal Prosecutions: Charting a Path Forward to be published by Oxford University Press in 2023. He obtained his legal education in Canada, the US, the UK, and the Netherlands.

Robert Heinsch is an Associate Professor of Public International Law at the Grotius Centre for International Legal Studies of Leiden University, and is the Director of its Kalshoven-Gieskes Forum on International Humanitarian Law at Leiden University and the founder of the Leiden IHL clinic. From 1 April 2018 to 28 February 2019 he held the DAAD Guest Chair for International Humanitarian Law, International Criminal Law and Applied Legal Theory at the Institute of Peace and Armed Conflict (IFHV) of Bochum University in Germany. During his time at the IFHV he successfully created the Bochum IHL Clinic. He has published numerous articles in the field of international criminal law and international humanitarian law, including a monograph on the jurisprudence of the Yugoslavia and Rwanda War Crimes Tribunals and its impact on the development of IHL. Previously, he has worked as a Legal Advisor in the IHL Department of the Red Cross Headquarters in Berlin, and as a Legal Officer in the Trial Chamber of the International Criminal Court in The Hague.

Peter Hoogeboom and Ramon Hanssen: Peter is emeritus professor Radar Earth Observation, Ramon is full professor Geodesy and Satellite Earth Observation. In our department Geoscience and Remote Sensing satellite data are used in a wide range of studies on climate(change), oceans, atmosphere, infrastructure (including radar interferometry). Also new applications with existing satellite data are developed. Finally GRS is involved in several new satellite missions, e.g. in the ESA Harmony mission for detailed ocean studies. The Principal Investigator, Paco Lopez-Dekker works at GRS.

Bas Jacobs is currently pursuing an advanced LL. M in Air and Space Law at Leiden University, recently graduated *cum laude* from Leiden University's LL. M program in Public International Law, and holds a B.A in International Justice with an emphasis on European and Public International Law from Leiden University College. He also worked alongside his masters as a student assistant at the Kalshoven-Gieskes Forum on International Humanitarian law.

Vasilis Kalogirou, is a Space Downstream Research & Innovation Officer at the EU Agency for the Space Programme (EUSPA). He is contributing in the definition and management of the Agency's R&I portfolio, as well as the market development in the area of Emergency Management and Humanitarian Aid. Dr. Kalogirou obtained his MSc in Remote Sensing from the University College London (UCL) and his PhD in Geoinformation from the University of Rome - Tor Vergata.

Wim Looijen, studied Geodetical Engineering in Delft and worked as a project manager in various positions in space, before becoming a freelancer in geo-informatics. Since April 2022 he is the programme manager for the stimulation of the use of space data in the Netherlands.

Eya Macauley (unfortunately unable to attend) specialized in Geographic Information Systems (GIS) and graduated from the University of Amsterdam and from the International Institute for Aerospace survey and Earth Sciences. He is extensively involved in the use of geospatial technologies to address a wide range of issues related to the environment, natural resource management and applications related to solving crimes against humanity. His current position as GIS/Remote Sensing Analyst is in the Office of the Prosecutor of the ICC. His primary focus is on the use of scientific evidence-gathering techniques in geospatial technologies to support human rights litigation. Opportunities provided by technologies related to Remote Sensing (RS) and Geographic Information Systems (GIS) are now widely used for the documentation of human rights violations, including forced displacement and mass killings.

Tanja Masson-Zwaan is Assistant Professor and Deputy Director of the International Institute of Air and Space Law at Leiden University, and President Emerita of the International Institute of Space Law (IISL). She serves as Vice President of the International Astronautical Federation (IAF) for science and academic relations.
Tanja advises the Dutch Government and other institutions on space law issues and was co-founder of the Hague International Space Resources Governance Working Group. She teaches at universities worldwide and is Global Faculty at International Space University (ISU). In 2020 she received a Royal decoration as Officer in the Order of Orange Nassau for her work in the field of space law.

Wim Ploeg *(LL.M)* studied Public International Law, European law, Humanitarian Law and International Relations at Leiden University and worked for an NGO and the Netherlands Government. Besides in bilateral relations he has specialized in the European and national Space Policy and Programmes. He was member of the Board of the European Union Agency for the Space Programme (EUSPA) and acted in national and ESA projects. Postdoc studies in international criminal law led him to take steps to realize a dedicated user domain for satellite information for Humanitarian purposes. He organized the current seminar as basis for an interdisciplinary research project between the legal, space and data related expertise.

Sabrina Rewald is a member of the Kalshoven-Gieskes Forum on International Humanitarian Law, where she has serves as a researcher and a Leiden IHL Clinic Supervisor. A key focus of her work is the supervision, maintenance and dissemination of the KGF's Digitally Derived Evidence (DDE) project and the Leiden Guidelines on DDE. Sabrina earned her advanced LL.M. in European and International Human Rights Law from Leiden University, during which time she was also a student researcher at the Leiden IHL Clinic. Prior to shifting to international law Sabrina worked in civil litigation and as a solicitor in Ontario, as well as in reproductive justice policy advocacy in Washington, D.C. and Atlanta, Georgia. Sabrina obtained her law degrees from the University of Windsor and University of Detroit Mercy Dual J.D. Program and is a licensed attorney in Michigan, U.S. and Ontario, Canada. She also holds a Bachelor of Arts in history and political science from the University of Toronto.

Dimitra Stefoudi is staff member of the International Institute of Air & Space Law of Leiden University and Adjunct Faculty at the International Space University. She focuses her research and teaching on space data policies, cybersecurity and privacy in space activities, space resources governance, and is writing her PhD on the "Legal and Policy Aspects of Space Big Data", with the support of the Netherlands Space Office and the European Space Agency. She holds an Adv. LL.M. in Air and Space Law from Leiden University, a master's in international business law from Tilburg University and a Bachelor in Law from the Law School of Athens. Dimitra participates often to international conferences and academic events and speaks frequently about space law in public events. She is member and Assistant Executive Secretary of the International Institute of Space Law, member of the European Center for Space Law, member of the Netherlands Space Society, and Advisory Board Member of the Space Court Foundation.

Annex 2: Information Sheets Presented During the Seminar

2.1 Bas Jacobs

Satellite Information and The Statute and Practice of The International Criminal Court

Bas Jacobs (LL. M) Public International Law, Student in Leiden's Adv. LL. M Air and Space Law

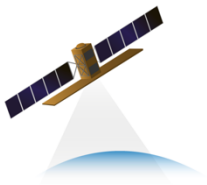
Contents

1. **Space Law and Collecting Satellite Information**
2. **Admissibility of Evidence under Rome Statute (Article 69 (4))**
3. **Philosophical Basis for the Exclusion of Evidence (Article 69 (7))**

Space Law and Collecting Satellite Information: Outer Space Treaty (1967)

Purpose: Governs the Activities of States in the Exploration and Use of Outer Space

- **Members:** 110 of 192 UN Member States are a Party to the Treaty
- **Article I :** Space shall be free for all States for exploration and scientific investigation



Space Law and Collecting Satellite Information: Outer Space Treaty (1967)

Article II: Outer space, including the moon and other celestial bodies, is **not subject to national appropriation by claim of sovereignty,** by means of use or occupation, or by any other means.

Admissibility of Evidence under the ICC Rome Statute

General Rule: The Chamber "shall freely assess all evidence submitted in order to determine its relevance or admissibility" (Article 64(9)/Rule 63)

Two-Step Process

1. **Positive Assessment:** Yes, the evidence meets requirements of Article 69 (4)
2. **Negative Assessment:** No, the evidence was not collected by the means in Article 69 (7)

Admissibility of Evidence under the ICC Rome Statute
Article 69 (4))

Legal Text: "The Court may rule on the **relevance or admissibility** of **any evidence**, taking into account, *inter alia*, the **probative value** of the evidence and **any prejudice** that such evidence may cause to a fair trial or to a fair evaluation of the testimony of a witness, in accordance with the Rules of Procedure and Evidence."

Prosecutor v Lubanga
Admissibility Formula for Article 69 (4)

Relevance + (Probative Value – Prejudicial Effect) = Admissibility

Parameters:
Relevance > 0
Probative Value ≥ Prejudicial Effect

'Relevance' under the ICC Rome Statute
Article 69 (4))

Relevance: throws light on the matter by reason of proximity in time, place, or circumstance

- **Material Matters:** Elements relevant to the crimes committed (E.g., Weapons, Damaged Buildings, victims)
- **Immaterial Matters:** Capacity of the accused, broader role in an incident, or their intent
- **Challenges:** Temporal Limitation
- **Key Criterion:** Must be contemporaneous to the events it purports to be showing and relate to the matters that are properly to be considered by the Trial Chamber.

'Probative Value and Prejudicial Effect'
Article 69 (4))

Probative Value: Reliability, Credibility, Authenticity

- **Reliability** = Quality of the information
- **Credibility** = Believability or trustworthiness of the information
- **Authenticity** = Proof the evidence has not been manipulated or tampered with

Prejudicial Effect: Evidence of minimal probative value that arouses emotions in the jury

Second Test – Exclusion of Evidence (Article 69 (7))

Evidence obtained by means of a **violation of this Statute** or internationally recognized **human rights** shall not be admissible if:

(a) The violation casts **substantial doubt on the reliability** of the evidence; or

(b) The admission of the evidence would be **antithetical** to and would **seriously damage the integrity of the proceedings**.

Conclusion

Technical provisions to meet the legal criteria will make it easier for satellite information to be admissible as evidence before the Court and increase the legal weight

The more information that is available about the methodology used to create satellite images, as well as the standards and procedures used to protect and store the data, the more admissible and valuable the evidence becomes

2.2 Jonathan W. Hak

THE AUTHENTICATION, RELIABILITY, AND INTERPRETATION OF IMAGE -BASED EVIDENCE

Jonathan W. Hak, KC
Barrister and Solicitor
PhD Candidate (Leiden)
Adjunct Associate Professor of Law

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THE AUTHENTICATION, RELIABILITY, AND INTERPRETATION OF IMAGE -BASED EVIDENCE

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Value of Images

- Tools of persuasion
- Method of proof
- Didactic role

Satellite Imagery and ICJ

- Macro analysis of locations
  - Permanent and semi -permanent features
  - Transitory features
  - Discerning changes

Key Issues

- Authentication
- Reliability
- Interpretation

Authentication

- Definition – establishing that the images are what the tendering party purports them to be
- Authentication is a positive action, not a state of being

Essential Elements

- Location
- Date
- Time (when precision matters)
- Image integrity

Three Approaches

- Establish technical soundness of metadata and content
- Corroboration via other evidence
- Circumstantial confirmation

Case Examples

- *Prosecutor v. Popović* (ICTY, 2010)
- *Prosecutor v. Tolimir* (ICTY, 2012)

Image Reliability

- Can the image be trusted for purpose intended by counsel?

Image Interpretation

- Pictures do not necessarily speak for themselves
- Images must be taught
- Semi-legible images – neither entirely legible nor impossible to understand
- Does the image stand for the proposition offered?

Image Interpretation Options

- Only context is required
- Testimony of content knowledge witnesses
- Expert testimony

Forensic Imaging Experts

- Confrontation
- Interrogation
- Interpretation

THE AUTHENTICATION, RELIABILITY, AND INTERPRETATION OF IMAGE -BASED EVIDENCE

Jonathan W. Hak, KC
Barrister and Solicitor
PhD Candidate (Leiden)
Adjunct Associate Professor of Law

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Email: jonathan@jonathanhak.com

2.3 Sabrina Rewald

Mobilizing Satellite Data for International Accountability

Lessons from the DDE Project

Assoc. Prof. Dr. Robert Heinsch & Sabrina Rewald, J.D., LL.M. (adv.)
(Kalshoven-Gieskes Forum on IHL, Leiden University)

3 February 2023

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Outline

I. Introduction to the KGF and the Digitally Derived Evidence (DDE) Project

II. Evidentiary Benefits and Problems

III. Applying the Leiden Guidelines on Aerial and Satellite Imagery

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About the DDE Project

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

The Leiden Digitally Derived Evidence (DDE) Project
Founded by KGF Director Dr. Robert Heinsch and Dr. Emma Irving

The Problem: Inconsistent approaches by the Courts & lack of common, international rules for DDE's collection, preservation, sharing, and treatment before accountability bodies.

The Goal: Outlining the ICL framework and extrapolating standards applicable to DDE in domestic courts, fact-finding missions, and international courts and tribunals.

DDE Project Outputs

- The DDE Database: Online repository
- The Leiden Guidelines on DDE: Final output at **leiden-guidelines.com**

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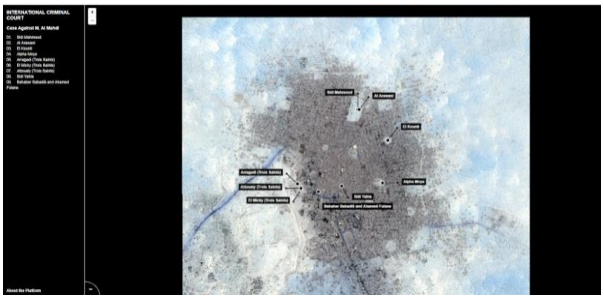
The Leiden Guidelines

Digital Evidence: Satellite Images



Al-Mahdi
Situ Research Platform

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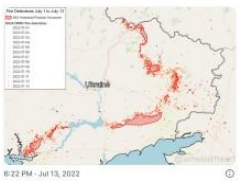
Key Evidentiary Benefits

- Accessible without entering unsecure / inaccessible area / State territory
- Challenging for perpetrators to undermine collection
- Provides a great deal of information, e.g.:
  - Heat tracking a conflict via NASA Fire Data
    Bellingcat, 'Scorched Earth: Using NASA Fire Data to Monitor War Zones', 4 Oct 2022, tweet by Amelia Smith dated 13 July 2022.
  - '*inter alia*: attacks against civilian objects, humanitarian assistance or peacekeeping missions; military infrastructure; and disturbances of the Earth's surfaces suggesting human activity, such as mass graves'.
    KGF, Fact Finding Missions (2020) at 13.



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Satellite imagery before accountability mechanisms

ICTY: Use of satellite imagery a gamechanger at the time, allowing for identification of mass graves.

UN Human Rights Fact-Finding Missions: OPT, Sri Lanka, Myanmar, Syria, South Sudan, etc.

- **2015 Commission of Inquiry on the Gaza Conflict** used satellite images to support allegations of the types of weapons used, i.e. destruction by 'laser guided air dropped munitions'.
  OHCHR, 'Report of the detailed findings of the Commission of Inquiry on the 2014 Gaza Conflict' at paras 224, 281.
- **2018 Myanmar Mission:** Through analysing satellite imagery and witness account, the Mission has established widespread, systematic, deliberate, organized and targeted destruction, mainly by fire, of Rohingya populated area across the three townships of northern Rakhine State'.
  OHCHR, 'Report of the detailed findings of the Independent International Fact-Finding Mission on Myanmar' at para 959.

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Satellite imagery before accountability mechanisms

Al Mahdi - Use of Digital Reconstruction Tech based in part on satellite imagery.

"[S]tarting with an interactive platform, the Prosecution will use satellite images, photographs, videos and other material gleaned from the Internet […] to show the situation of the mausoleums before, during and after the destruction, including the participation of the accused."

Prosecutor v. Admed Al Faqi Al Mahdi, Transcript Trial Hearing, ICC01/12-01/15-T-4-Red-ENG, T. Ch. VIII, 22 August 2016, at 41, lines 4-12; *Ibid.* at 47, lines 6-20.

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Applying the Leiden Guidelines: Satellite

C3. Aerial and satellite images should be contemporaneous to the events they purport to be showing.

Keywords

relevance; contemporaneity

Where there exists an extensive period of time between when the images were taken and when the events occurred, and where testimony of a witness acknowledges that changes could have arisen between the occurrence of the event and the time at which the aerial images were taken,[15] the ICC Trial Chamber in *Ntaganda* found that it is 'not in a position to establish beyond reasonable doubt' that what is shown on the image occurred as a result of the event under consideration.[16] The Trial Chamber determined that images taken more than a month after an attack are 'of limited use to establish whether, and if so how, any destruction took place during the events that are subject to the charges'.[17]

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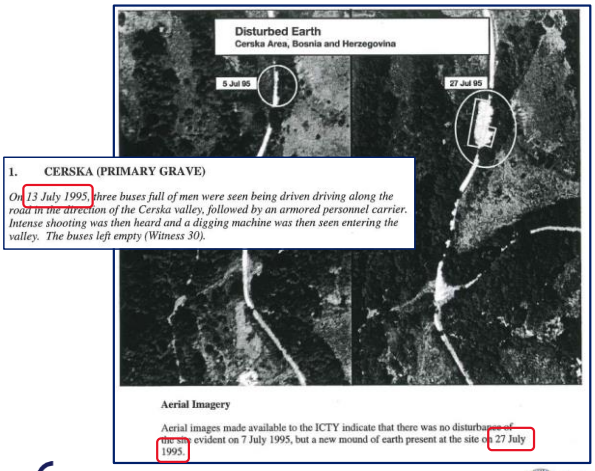

Dean Manning, *Srebrenica Investigation: Summary of Forensic Evidence Execution Points and Mass Graves* (16 May 2000) 00950901 -00951041, Annex A, 9.

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Applying the Leiden Guidelines: Satellite

C6. With adequate witness/expert corroboration, aerial and satellite images should be considered authentic and reliable and due weight should be accorded to them.

Keywords

probative value; relevance; testimony; corroboration; experts

Witness testimony can corroborate the interpretation or authenticity of aerial and satellite images.[29] Witness/expert corroboration is adequate if, for example, it establishes that the aerial and satellite images concerned could not be altered by anyone or it explains why dates have been added to or removed from them.[30] Adequate witness/expert corroboration also includes the testimonies of the investigators about the use of such images, or complementary forensic and anthropological reports.[31] As a result of expert identification and forensic analysis, the aerial images of the graves dug following the Srebrenica massacre were relied upon by the ICTY in *Blagojević and Jokić* to find that there had been attempts to move the graves to secondary sites.[32]

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Conclusion

- Considering the increasing quality of remote sensing technology and the relative ease of accessing digital evidence and satellite imagery compared to witness statements, the possibilities for investigators to build cases against perpetrators of international crimes have already and will continue to increase dramatically.
- However, this positive development also demands for investigators, prosecutors, and judges to be aware of the inherent dangers in relying on such evidence due to the possibilities of manipulation.
- Tools like the Leiden Guidelines can offer a first step in establishing objective and legally sound standards regarding DDE in international criminal proceedings …
- Yet, the question of whether it is possible to optimize the use of satellite imagery for human rights and humanitarian purposes remains riddled with white space and prime for ingenuity.

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2.4 Vasilis Kalogirou

Opportunities that can foster user uptake in the specific domain of crimes against humanity

03 Feb 2023

Vasilis Kalogirou, PhD, Space Downstream BI Officer

EUSPA's mission

Exploitation
- Management, operation, maintenance, improvement, evolution & protection of infrastructure
- Galileo and EGNOS services provision and 24/7 operations
- GOVSATCOM hub
- Space Surveillance and Tracking (SST) Front Desk as of 2023

Security
- Security Accreditation for all components
- Operational security of Galileo and EGNOS
- Operation of the Galileo Security Monitoring Center (GSMC)

Market development, communications, user uptake, applications, innovation
- Galileo, EGNOS, Copernicus, GOVSATCOM

2

EUSpace4Ukraine Initiative

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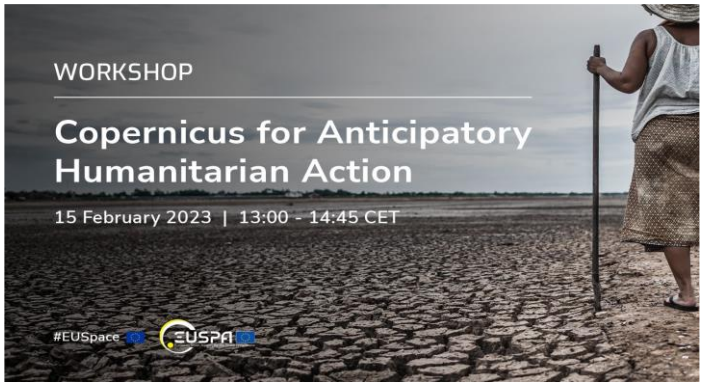
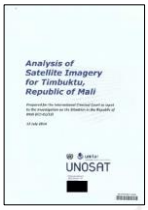


Crimes against humanity and EO

- Proliferation of VHR Data
- Industry has grown – diversification
- Used for supporting narratives and for propaganda



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Observables- examples

- cratering consistent with bombardment
- burning/destruction of civilian dwellings
- targeting of humanitarian and other forms of internationally protected infrastructure
- locations, size, and composition of displaced persons camps
- excavations consistent with mass graves etc

6

Opportunities for collaboration

- **Work with jurists** to improve admissibility of satellite data in courts. How can we improve this process ?
- **Work with industry,** to safeguard images/data from manipulation (i.e. deep fakes) and build trust in the chain-of-custody.
- **Work with researchers/academia** to monitor and analyse the use of satellite data for such applications

7

EUSPA Horizon Europe call of 2022 (HORIZONEUSPA2022SPACE)

Type of Action	Topic	Indicative budget (EUR mln)	Funding rate
IA	EGNSS applications for Smart mobility	9.5	70% (except for non-profit legal entities, where a rate of 100% applies)
PCP	Public sector as Galileo and/or Copernicus user	5.2	100 %
IA	**Copernicus downstream applications and the European Data Economy**	**9.6**	**70% (except for non-profit legal entities, where a rate of 100% applies)**
RIA	Large-scale Copernicus data uptake with AI and HPC	9.6	100%
RIA	Designing space-based downstream applications with international partners	5,1	100%
RIA	GOVSATCOM Service developments and demonstrations	9,1	100%
	TOTAL budget:	48,1	

Published: 03 Nov 2022
Deadline: 03 March 2023

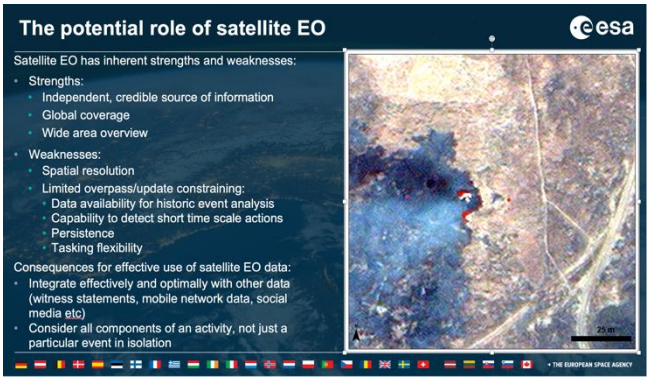
Innovation action (IA)

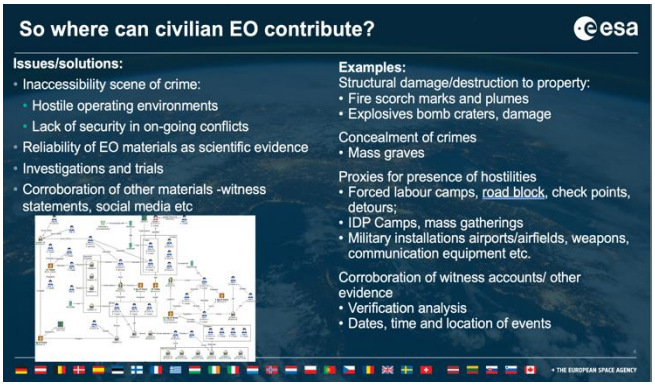
Activities to produce plans and arrangements or designs for new, altered or improved products, processes or services.

8

2.5 Denis Bruckert

2.6 Gordon Campbell





Characterizing extended activity – Uyghur Oppression

Objective
- Detection of urban sprawl and dynamics focusing on larger-scale settlement patterns to detect e.g. forced labour camps

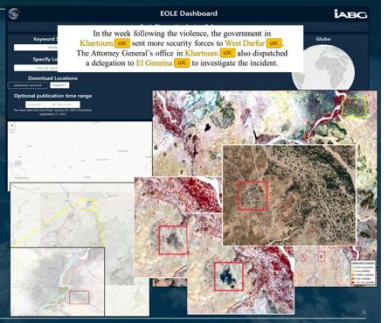
Added value/ impact
- Finding Hot Spots of changes in urban patterns
- In combination with on-the-ground information, these can serve as indicators for potential constructions of such camps
- Stakeholder awareness and uptake of new capabilities

Detecting state involvement - Deployment of armour

Fire detection in settlements

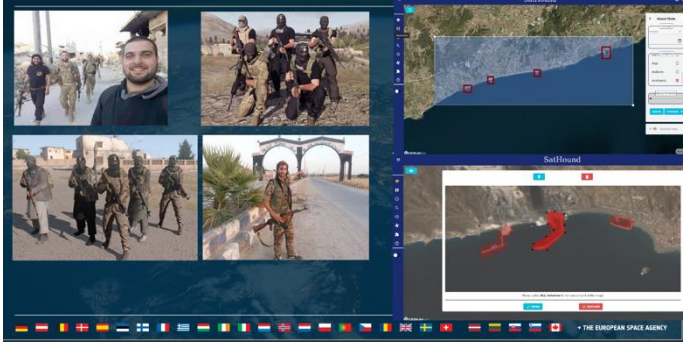
Objective
- Detection of burned down areas by combining various remote sensing technologies
- Probability estimation of areas of belonging to a settlement structure via GIS analysis including multiple geospatial data

Added value
- Gathering of evidence for the destruction of settlements due to warlike or criminal activities in inaccessible areas
- Timely and on-demand validation and verification of potential cases of destruction of settlement structures by arson based on independent remote sensing methodologies
- Coverage of large areas that are fully automatically analysed



Verification of open source information

Verification of social media information

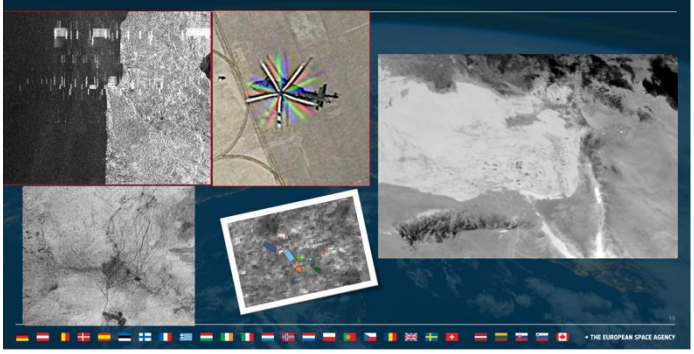


Additional analysis example – mass grave site suitability

Objective
- Predictive multi-criteria mass grave site model
- Combining GIS/EO-based landscape analysis and expert knowledge
- Assumption: selection of burial sites is subject to environmental and contextual conditions

Impact/benefit
- Narrowing down possible locations of mass grave sites to aid search efforts by delineating areas with higher suitability
- Subsequent highlighting of possible sites applying change detection algorithms using satellite data

Some Non-standard EO capabilities



Concluding points

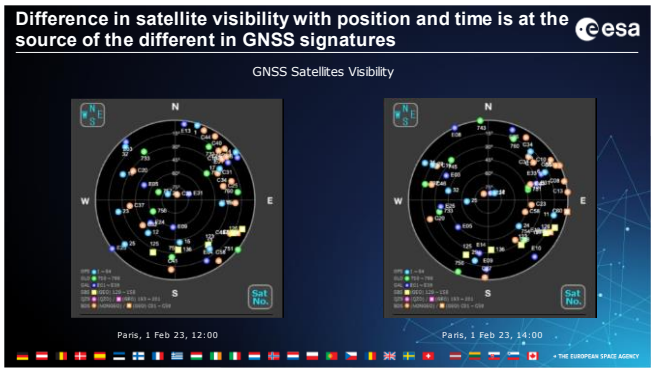
Satellite derived information may not directly detect short time scale activities but it can be used:
- To detect components of longer time scale processes
- To verify/counter witness statements
- To support/validate/enhance other information layers (eg social media)
- To detect contributing elements to support elaboration of an overall picture
- To provide contextual information

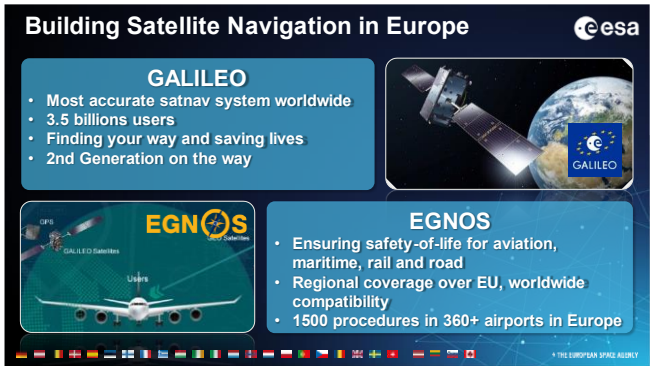
The contribution from satellite data can significantly increase due to continuous growth in the number and variety of satellite EO platforms eg:
- New data sets (hyper-spectral imaging, satellite video, RF signal detection, long wavelength SAR)
- Faster revisit and greater coverage (optical imagery, HR SAR imagery)

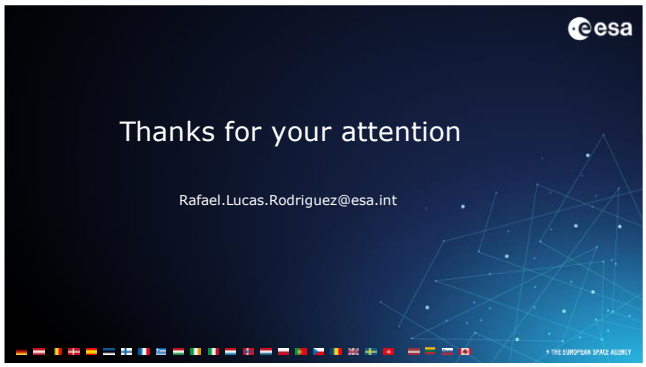
Additional developments are also creating the potential for increased impact from civilian EO:
- AI based feature extraction, image/video enhancement and multi-dataset fusion/correlation/anomaly detection
- On board processing for optimized tipping/cueing of satellite constellations

ESA has started a dedicated initiative to develop and verify new EO systems and processing resources optimized for addressing priority requirements for law enforcement and civil security

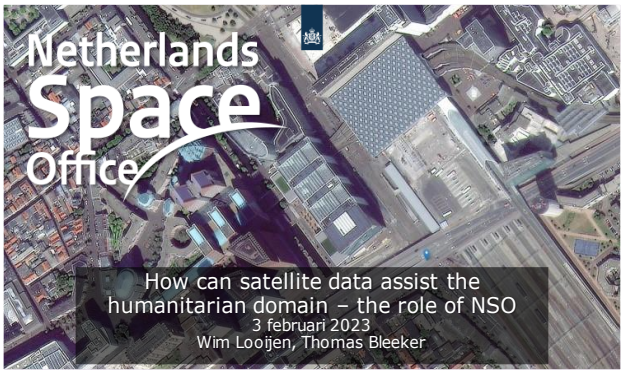
2.7 Rafael Lucas







2.8 Wim Looijen



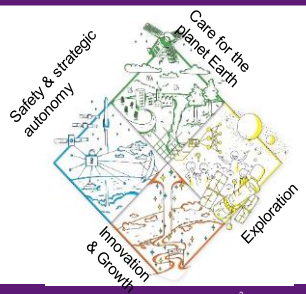
Agenda

- Introduction
- Characteristics of satellite data
- Collecting "evidence"
- Role of NSO
- Conclusions

Netherlands Space Office

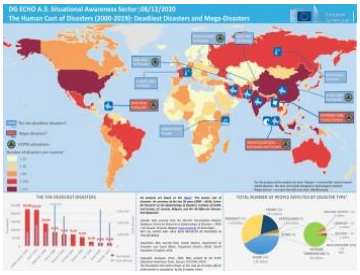
► NL Space Agency
► Task: advise and execute NL space policy
► Steering committee: EZK, OCW, IenW and NWO

Mission: To maximise the societal benefit of space for the Netherlands



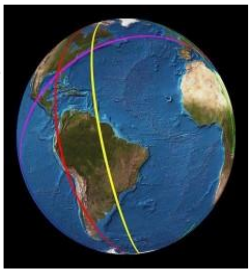
Introduction

- Trends
  - Forced displacements
  - Violent conflicts
  - Food security
  - Climate change
- One in every 23 people needs humanitarian assistance (OCHA 2022)
- Role of satellite data?

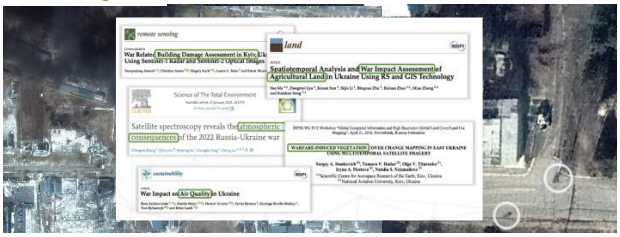


Characteristics of satellite data

- Repetitive – daily coverage possible
- Resolution – down to 30 cm
- Availability
  - Commercially – high resolution , costs
  - Open data – lower resolution, free
- Independent observation
- Clouds – use of radar data
- Processing – s/w, expertise



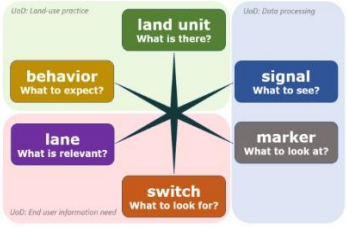
Collecting "evidence"



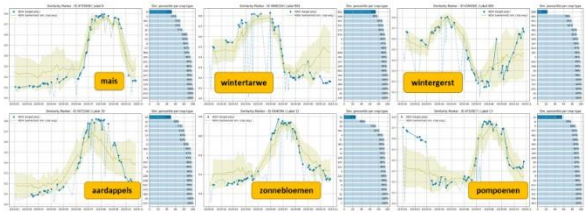
Collecting "evidence"

Collecting "evidence"

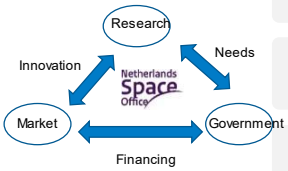
- Commission Implementin Regulation (EU) No 809/2014 of 17 July 2014 article 40a
  - Monitoring Agriculture by Remote Sensing
  - Agricultural subsidies



Collecting "evidence"



Role of NSO



Advise (e.g. at finding, purchasing and implementation)

NL: Facilitate data through satellietdataportaal

Global: Assisting in access to global databases

Support in innovative procurements

Ideas?

Contact us!

t.bleeker@spaceoffice.nl
w.looijen@spaceoffice.nl

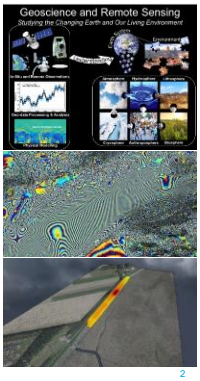
2.9 Peter Hoogeboom & Ramon Hanssen

Advanced satellite data analysis and defining future missions at GRS

Peter Hoogeboom, Ramon Hanssen
TU Delft, CiTG faculty, Geoscience and Remote Sensing department
p.Hoogeboom@tudelft.nl, r.f.hanssen@tudelft.nl

Ongoing studies at GRS

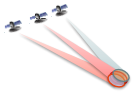
- Earth system science
  - Oceans, ice, atmosphere (climate change)
  - Sea level change
  - Hydrology
  - Land use
- Remote sensing
  - Synthetic Aperture Radar (interferometry)
  - Sustainable development
- Geodesy
  - Geodataprocessing (e.g. radar interferometry)
  - Gravity
  - Positioning systems
  - Vertical reference

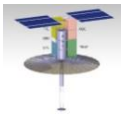


GRS involvement in new missions

- Harmony (ESA Earth Explorer mission)
  - 2 companions for Sentinel radar improve ability to investigate air-sea interaction, glaciers, land change
  - International project
- SwarmSAR
  - N small cube satradars cooperate to deliver N performance increase! Image quality like from the big birds at a fraction of the costs
  - Dutch project – legal aspects?
- Alticubes
  - A constellation of cubesat altimeters improves operational capability of altimeters enormously in terms of revisit time and spatial coverage
  - Dutch project under NL-RIA

Credits Paco Lopez-Dekker, IGARSS -21





NL-RIA: NetherLands knowledge network on Radar Instruments and Applications

- Goal
  - strengthen the international position of The Netherlands in the field of small spaceborne microwave remote sensing instruments, missions and applications
  - Network funded by NWO in an NSO program
- Participants:
- GRS manages NL-RIA, other faculties involved, e.g. Aerospace.
- Website: www.nl-ria.nl