



Emerging Issues Facing the Use of Remote Sensing Evidence for International Criminal Justice

Dr. Patrick Kroker
Fellow, Harvard Humanitarian Initiative

Remote sensing (RS)ⁱ can provide unique, sometimes otherwise unavailable, information about human rights violations occurring in non-permissive environments, over large geographic areas, and across long and multiple timeframes. The evidentiary potential of RS analysis currently appears not to be fully exploited by international criminal justice mechanisms. The purpose of this paper is (A) to illustrate the nature of RS analysis and its evidentiary potential and limitations, (B) to identify the key, repeating factors across regional and cultural contexts and types of crimes that influence its limited use in court, and (C) to explore steps and strategies for overcoming the challenges.

A. Nature of Remote Sensing Analyses

Remote sensing analyses are based on data, derived from electromagnetic energy, sensed by satellites and converted into a comprehensible document, mostly an image, by the satellite carrier. High-resolution imagery is by far the most promising when it comes to documenting human rights violations. The majority of RS analyses of alleged crimes are performed by third party analysts who are not affiliated with a specific court or prosecutor's office (see "Reliance on third parties" on p. 2 below). Before acquisition of the image, the analyst defines the target, temporal and spatial resolution, methodology, relevant indicators and specific research aims. Before and during analyses the original satellite image is manipulated and adjusted, e.g. by the use of multispectral bands for analysis, orthorectification, and changes to the image's original size and resolution. During and after the analysis, the visual information is aligned alongside complementary information – witness testimony, reports and newspaper articles or information gathered by crowdsourcing platforms. The result is published in a report, which can be offered as evidence. Remote sensing analyses are hence processed by a number of systems and individuals before submitted to court.

Evidentiary Potential and Limitations

With these features, RS evidence can provide critical crime-based and circumstantial evidence. Types of documentable phenomena include cratering consistent with indiscriminate artillery or aerial bombardment,ⁱⁱ the intentional destruction of civilian dwellings, targeting of humanitarian, religious and other forms of internationally protected infrastructure,ⁱⁱⁱ the locations, size, and composition of displaced persons camps^{iv} or excavations consistent with mass graves.^v

The following limitations apply to the evidentiary potential of RS analysis: (1) It is unlikely that a specific fact in issue can be proven on the basis of RS analyses alone. In most instances, corroborating evidence is needed. This evidence can sometimes be integrated into the analysis, if it is available. (2) The ability to provide for direct and (specifically useful) linkage evidence is limited. (3)

Only a relatively small number of elements of international crimes can be shown, typically including the widespread or systematic character of an attack.

Due to the ability to illustrate the spatial component and the extent of violence, RS analysis can be very helpful to provide a narrative of the crime/conflict and to give a general overview of the case, however. It can also be useful in corroborating other evidence.

B. Aspects Influencing the Use as Evidence

The role RS evidence plays in international legal venues today is to a large degree influenced by the practical framework in which such evidence is currently collected.^{vi} As these parameters also affect the legal issues surrounding the use of RS as evidence (which are discussed on p. 3 below), they need to be solved if any advancement in the use of RS evidence in courts is to be achieved.

Reliance on Third Party Investigators

Because international justice venues lack the capacity and the expertise to conduct remote sensing analysis of alleged international crimes on their own, it is mainly performed by independent third party analysts. They include humanitarian and human rights advocacy NGOs, academic research institutions, and UN and other international agencies.^{vii} This means, that the courts must currently rely on charitably external organizations, non-governmental or intergovernmental institutions, many of them operating under a restricted budget regime, to conduct investigations. Economic factors and limitations generally shape and constrain the capacity, and thus the contributions of third party analysis.

Limited Availability

The availability of appropriate high-resolution imagery of an area during the critical time-period is negatively affected by several factors, the most crucial one being the inconsistency between the timeline of court proceedings and the extreme time-sensitivity of satellite surveillance: Commercial providers only collect high-resolution imagery when it is of current or potential future value. Whether imagery of a specific situation is relevant for a criminal investigation is only decided months, sometimes years, later. Hence commercial providers have a low economic incentive to routinely collect areas where mass atrocities are allegedly occurring. Third party investigators have low economic capacity to task or purchase imagery of these areas or to create economic incentives for collection of these areas. Only in exceptional circumstances can civil society or research institutions afford to proactively acquire near real-time imagery in order to document human rights abuses.^{viii} Once the critical moment to acquire timely imagery is passed, there is an almost insurmountable barrier to data access and much potential evidence is regularly lost.

This will likely remain the dominant paradigm in the future even if the steps suggested in this paper are taken. The growing number of smaller satellites (known as “micro satellites”) being launched by companies new to the remote sensing field may one day improve the tempo of collection and reduce the cost for investigators seeking to monitor specific areas. Currently however, their number is limited, and they will have to prove to be economically sustainable. Although governments might increasingly release commercial imagery of alleged mass atrocity events to civil society groups,^{ix} RS analysts will most likely still have to turn mainly to commercial providers to acquire images of critical events in in the foreseeable future.

Even if timely imagery is acquired and analyzed, analysts often lack the knowledge of the admissibility criteria for criminal trials. Trying to meet these standards would render the work of

analysts more cumbersome, lengthy and hence expensive. Because of the uncertainty concerning the future evidentiary value of their analysis, they might be reluctant to try to meet these standards, even where they are aware of them in general terms.

Other factors that can negatively impact on availability are unfavorable weather conditions and government restrictions. Policies that limit the maximum resolution in which civilians are allowed to view imagery of certain areas are commonplace. Hence a ‘resolution gap’ exists between the resolution level of imagery available to civilians and that available to government intelligence agencies.

Cognitive Bias & Different Focus

Institutions who autonomously seek to collect evidence often have their own focus and agenda that rarely matches the evidentiary needs of courts. They sometimes operate under cognitive bias, pre-select information or prioritize certain events, in line with their own perspective and funding scheme, which can affect the reliability of the evidence they collect. Further, they often do not collect incriminating and exonerating material equally and are often reluctant to provide the defense with their material. Moreover, third party investigators often focus on establishing a historical record or on elements within a regime – such as its army or secret police – in order to influence policy decisions or public opinion and hence have a tendency to focus on scale. Investigations by international prosecutors are focused on individuals and on establishing individual responsibility.

Lack of Forensic Criminalistics

Despite the growing number of RS-analysis of human rights violations, there is little formal pedagogy specific to this field and hence a lack of professionalization and standardization of methods. Analysts currently operate without an accepted forensic standard for remote sensing of alleged mass atrocities.^x

Presentation and Evaluation of Evidence

RS analyses, unlike photographs, do not “speak for themselves”, but are results of a complex technical and methodological process based on the division of labor. Familiarity with the processes of RS enables them to better evaluate its reliability and probative value. Only when judges understand the underlying techniques and methods are they able to determine, whether the methods employed are scientifically established, to evaluate the expertise of expert witnesses, to detect possible technical errors, and to consider the possibility of alternative interpretations of events. Because of the current lack of knowledge of RS techniques, judges’ ability to independently assess reliability and probative value is limited.

It is hence important that the introduction of the evidence into the trial by the expert witness makes the results reached in the analysis comprehensible for the judges. The in-court presentation would ideally make the analysis replicable. The current practice of presenting images and findings in pdf-printouts or on the in-court computer screens might not satisfy this need for comprehensibility of the analysis.^{xi}

Legal Aspects Affecting the Use of RS Analysis as Evidence

From the characteristics of RS analyses follows that different evidentiary categories apply to them. They will be considered as documentary and digital evidence. For this reason and because of their complex and technical nature, they will most likely have to be introduced by an expert witness into the trial. They are also likely to be considered as hearsay evidence. This does not necessarily affect their admissibility but they might be attributed limited evidentiary weight. In any case, the analyses must be shown to be relevant and reliable and to not be obtained in violation of the Rome Statute or

internationally recognized human rights. Relevance means that the evidence can be rationally linked to a fact in issue (materiality) and that it is making the existence of the contended fact more or less probable (probative value).^{xii} Because of the digital and technological nature of RS it is particularly important to establish its accuracy, objectivity, and authenticity in order to satisfy the requirement of reliability. Further, the chain of custody of the data must be preserved.

It has to be kept in mind that criteria for admission and evaluation of evidence in ICL are not used in a consistent and systematic manner. Definite conclusions concerning admissibility of RS can only be drawn once more case law on the subject is available.

Accuracy

Judges must be able to verify that what the analysis shows is an accurate representation of the facts. For this reason, the functional characteristics of sensors must be demonstrated. An important element to establish accuracy is by showing that the sensor has been properly calibrated.^{xiii} Further, the reliability and capability of the computer hardware, software, and of the final presentation have to be established. For these reasons, it is important that institutions acquire data from reliable partners, who can certify that proper, accepted digital imagery processing techniques were employed and that the satellite images were produced by the data processor in a routine way. Further, it should be combined with meta-data, allowing verification of the time and the coordinates of the satellite image. Institutions should pay attention to only work with highly qualified experts with (proven) experience in the field, who meet criteria for expert witnesses.

Objectivity

Another issue affecting the credibility of evidence is the objectivity of its producer. This is especially relevant in the case of third party investigations. NGO reports have been viewed critically by the judges so far, and been attributed limited evidential weight^{xiv} because the organizations sometimes operate under a cognitive bias (discussed on p.3 above).

Authenticity

To establish authenticity of the data, the risk of manipulation should be assessed both at the raw data level and during processing. For the purpose of authentication, it will be indispensable that an expert witness introduces the RS analysis into the trial. The witness can aid in demonstrating authenticity by testifying about the method of analysis including all formulas, calculations, and assumptions used in defining and analyzing it, as well as to the functionality of the hardware and software involved in acquisition, processing and storage of information.

Chain of custody

Since RS analyses are outcome of a multi-stage production process, it is further crucial to establish a chain of custody during processing to show that the sources and the end product can be linked. All formulas, calculations, and assumptions used in defining and analyzing the data should be comprehensible for the judges evaluating the evidence. This means to be able to replicate each working step from the primary assumptions to data acquisition, storage, interpretation, integration of cross-reference data and visualization.

C. Recommendations

Research and Method Development

- ➔ Further research needs to be conducted to define the **standards for admission** and evaluation of RS evidence.
- ➔ A manual for **training lawyers on technology**, methods, potential and limitations of RS evidence should be compiled to increase familiarity with RS of defense lawyers, prosecutors and judges.

- ➔ The development of **standard methodologies for applying RS** by analysts across incidental and regional contexts would facilitate the demonstration of accuracy and objectivity of the analysis and hence improve its reliability and probative value. In this regard standard **forensic criminalistics** for specific types of crimes, cases, and contexts that may likely appear before an international justice venue should be developed.
- ➔ In order to enhance accuracy of the analysis, analysts should **identify variables** that can affect it and elaborate mechanisms for controlling them during analysis and evidence presentation.^{xv}
- ➔ The development of best practice **standards** among analysts for which **software and hardware platforms** are used would facilitate the demonstration of authenticity of the data. Further, it is necessary to address the technical question of standard version control during computer manipulation of the data.
- ➔ Data security standards need to be developed generally for all digital evidence. RS analysis would need to fit within that broader, missing architecture of standards and procedures.

Training

- ➔ Training of **third party investigators** in courts' jurisdictions, their evidentiary needs and the identified evidence standards could immediately increase relevance and reliability of their work.
- ➔ Training of **judges** on RS analysis would enhance their ability to independently evaluate reliability and probative value of RS-analyses. Such training should involve the presentation of examples of the specific types of data that can qualify as RS in a court context and show how technological and methodological characteristics influence the outcome.

Hardware

- ➔ To increase familiarity of judges with RS-evidence the creation of a **standard log** at a common source (i.e. website) for reviewing past admissible RS products and relevant RS evidence products that have not been part of a trial is recommended.
- ➔ Enhanced **courtroom technology** for the presentation of RS evidence by the expert would increase comprehensibility of the evidence.

Documentation & Review

- ➔ Documentation is important to establish the chain of custody and to show that other admissibility criteria are met:
 - In order to identify and prevent technical errors by **imagery providers**, a log should be developed to document, which people and systems (computers and relay stations) interact with an image before it reaches the analyst.
 - **Analysts** should document with which knowledge, assumptions mandates and hypotheses they **acquired** satellite imagery and began their analysis. During image interpretation, **alternative hypotheses** should be tested. Failure to establish one or more of the assumptions when beginning the work should be documented.
 - Further, **analysts** should document **methods and processes** by which the underlying data is transformed into RS analysis including the manipulations, and computer-assisted adjustments made to the original images.
- ➔ A **log** to document each working step should be created. **Cross-reference** data should be **catalogued** in a separate system in order to document its processing and integration into the analysis. All **internal communications** and working notes should be kept and stored separately.
- ➔ Analysts should establish **audit and monitoring** procedures for their analyses as well as **review** of the analyses by other experts, with no knowledge of working hypothesis.

Data Security

- ➔ Development and application of data-security standards for digital evidence (see on p.5 “method development”).
- ➔ All data should be kept in **closed network**, accessible by a limited number of people. Highest standards for network security and guarantees against manipulation should be upheld. These include hardware selection, cloud- or offline-storage options, and access codes to the data and individual analyst identification.

Dr. Patrick Kroker is a lawyer and researcher who specializes in human rights and international criminal Law. As fellow with the Harvard Humanitarian Initiative, he examines the evidentiary value of remote sensing analyses in international criminal trials. His research is funded by a postdoc-scholarship from the German government's Academic Exchange Service (DAAD). Patrick is acting as pro-bono expert on international criminal Law for Amnesty International Germany. He formerly worked for victims' lawyers at the Extraordinary Chambers in the Courts of Cambodia. He lectured at the Freie Universität Berlin and the China-EU School of Law in Beijing and worked as research associate for Freshfields Bruckhaus Deringer LLP, the Universität Hamburg and the Hertie School of Governance in Berlin. Patrick holds a doctoral degree from the Universität Hamburg and law degrees from the University of Leipzig, Germany and Univerisdade Católica Portuguesa in Lisbon, Portugal.

ⁱ Remote sensing is defined as the process of gaining information about an object or phenomenon while at some distance and without any direct contact with it“ (Rychlak et al. J Space L 33 (2007), 195). In this paper

ⁱⁱ See e.g. on South Kordofan, Sudan: HHI, The Signal Program on Human Security and Technology: Sudan, Anatomy of a Conflict, 2013, 73; on Mogadishu, Somalia: AAAS, Human Rights Applications of Remote Sensing: Case Studies from Geospatial Technologies and Human Rights Project, 2013, 15.

ⁱⁱⁱ See e.g. for Kenya the presentation by Bromley (UNOSAT) before the ICC, TC V, Pros. v. Ruto and Sang, Transcript, 9 April 2014, ICC-01/09-01/11-T-109-ENG ET WT 09-04-2014; on Darfur, Sudan see AAAS (n 2), 41 and Prins, Intl J Rem Sen 29 (2008), 1207.

^{iv} For Kadugli, Sudan, see e.g. HHI, The Satellite Sentinel Project (SSP), Report from 19 June 2011; AAAS (n 2), 43.

^v Most famously the ones presented at the Security Council by Madelaine Albright in 1995, although some of these were air-, not spaceborne; see Kurgan, Close Up at a Distance: Mapping, Technology, and Politics (2013), 21 and Marx/Goward, The Geographical Rev 103 (2013) 104. See also ICTY, TC II, Pros. v. Tolimir, IT-05-88/2-T, Judgement, 12 December 2012, para 67 et seq., ICTY, TC, Pros. v. Kristic, IT-98-33-T, Judgement, 2 August 2001, para 222 et seq. For more recent applications see e.g. on Northern Afghanistan: AAAS (n 2), 33; on Kadugli, Sudan: HHI-SSP, Report from 14 July 2011.

^{vi} See for details: Wang et al, Stability: Intl J of Security & Development 2 (3) (2013).

^{vii} E.g. Human Rights Watch, UNOSAT, Amnesty International, Harvard Humanitarian Initiative, and AAAS.

^{viii} They can average as much as US\$40 per square kilometer. SSP operated by regularly ordering multiple shots averaging 130 x 80 kilometers, which were donated by DigitalGlobe. If consumers were to purchase such tasking at retail prices, its cost would be in excess of US\$400,000 per shot (see Wang et al (n 6), 5).

^{ix} See Raymond, Nathaniel A.; Card, Brittany L.; and Baker, Isaac L. (2013) "A New Forensics: Developing Standard Remote Sensing Methodologies to Detect and Document Mass Atrocities," *Genocide Studies and Prevention: An International Journal*: Vol. 8: Iss. 3: 33-48.

^x Ibid.

^{xi} See ICC, Trial Chamber V (n 3), 22.

^{xii} Klamberg, Evidence in International Trials (2013), 344 et seq.; see also ICC, TC II, Pros. v. Katanga et. al., Decision on the Bar Table Motion of the Defence of Germain Katanga, 21 October 2011, ICC-01/04-01/07-

3184, para. 16; ICC, PTC II, Pros. v. Ruto and Sang, Decision on the Confirmation of Charges, 23 January 2012, ICC-01/09-01/11-373, para. 66.

^{xiii} Calibration is the process of checking or adjusting the accuracy of an instrument by comparison with a standard or another instrument of known greater accuracy.

^{xiv} Buisman, J of Intl Human R 11 (2013), 55.

^{xv} These include weather, Nadir/Azimuth angles, ground phenomena, sensor error, and technical errors by imagery provider.