



www.cedha.org.ar

The Uses of Satellite Imagery
Linking Human Rights and Environment

by Jorge Daniel Taillant and Romina Picolotti

Commissioned by the Center for International Environmental Law in a joint project with NASA

The Uses of Satellite Imagery: Linking Human Rights and Environment

by Jorge Daniel Taillant and Romina Picolotti¹

Introduction

The use of satellite imagery in everyday life is by no means a novelty. Since the first satellites dedicated to imaging land areas were placed in orbit in 1972 (Landsats), weather reports have become about the most recognizable by-product of humanity's optical dominance of the earth's atmosphere. The excitement and curiosity of viewing our planet from afar has recently led to propositions of sending satellites far into stellar orbit simply to have a live image of our planet. Anyone with a personal computer and modem can, in minutes, have a near-instant satellite image of almost any part of the globe. The rapid advances and accessibility of computer technology has placed satellite technology in millions of homes, cars, schools, and offices. The potential practical use of this technology by amateur and other non-technically expert institutions and individuals, is only now beginning to surface.

This essay elaborates a series of issues, legal, economic, social, and practical, which arise (or would arise) in the uses (or potential uses) of satellite imagery in the field of human rights. Given the limited experience to date with the application and use of satellite imagery for human rights promotion and protection, the work is exploratory and attempts to develop inroads to using satellite imagery in monitoring human rights conditions and enforcing international human rights legislation. The essay identifies theoretical and legal frameworks in which such use would occur, potentially interested parties, specific territorial issues, technological as well as financial implications which define the types of uses, general accessibility, etc.. As this is a new area of exploration, much of the material presented is hypothetical, and should be used as a guideline or framework for further research on this topic. It should not be viewed as definitive or exhaustive.

Linking Human Rights and Environment²

Probably the most obvious use of satellite imagery, or at least the one that comes most immediately to mind, is by its very nature, environmental. What we see from high above the earth, is indeed "the environment", our earth, our waters, our wildlife, our air, ourselves. Because, as a global society, we are evermore concerned with the transformations our planet is undergoing due to our own uncontrolled use of natural resources, we have become interested in monitoring our environment, identifying trends in resource depletion, and identifying problem areas. Space provides us a privileged

¹ Jorge Daniel Taillant is a specialist in subnational development and urban specialist. He is Development Director of the Center for Human Rights and the Environment, in Córdoba Argentina. Romina Picolotti is a Specialist on Human Rights and is Executive Director of the Center for Environment and Human Rights.

² See CEDHA, Center for Human Rights and Environment. XXXXX????

viewpoint, as it allows us to look at ourselves from a global or "biospherical" perspective, i.e. as a whole "natural" unit, the earth.³

Yet despite the generally accepted view that the environment is the critical framework for our sustainable development, we fail to include ourselves as a fundamental component of our environment. The environment is our habitat, and therefore, that which affects the environment, affects us directly. The environment, however, is largely and most commonly addressed as a natural habitat, comprising land, waters, and wildlife. We, humans, often see ourselves as somehow removed inhabitants of the environment, despite our inherently organic insertion into its ecology. The depletion of our natural resources affects our access to those resources. Contamination to our environment affects our habitat, and consequently affects our living conditions, and ultimately our rights as humans to a healthy environment and basic living standards. We are in the end, although we may not treat ourselves as such, an inseparable element that within our environment and affected by it. Abuses to our environment, hence, are abuses to ourselves and to our human rights.

The links between human rights and environmental rights merit some consideration before we proceed to examine the uses of satellite imagery in the area of human rights. As we will see, human rights are indeed closely interconnected to environmental rights and the uses of satellite imagery in one area, can in many cases be applied in the other. Few other contemporary international issues have occupied the international arena more prominently in the Twentieth Century more than human rights and environmental rights. Human rights and environmental rights are intimately related, and have been the common denominator of many world conferences towards to end of the century, including at the United Nation's Rio Summit in Rio de Janeiro (1992), Cairo 1994, the Second World Conference on Human Rights, Vienna (1993), Habitat II, Istanbul (1996).

As a society, we arrive, hence, to the end of the century with the understanding that human life is not possible without the existence of a healthy natural environment and of sustainable social and economic development. The alternative, that is, the projection of an unsustainable environment, is irreconcilable with our human right to life.

The relationship between human rights and environment is not limited, however, to the "right to life", since the existence of a healthy and sustainable environment is a condition *sine qua non* for the respect and exercise of other basic human rights. Just to name a few of such human rights which are closely linked to environmental rights:

- The right to health, cannot be exercised without a clean environment
- The right to property is both individually and collectively violated by environmental degradation (consider the effects of pollution on property value, or indigenous

³ See Davies, Hoban, and Penhoet, Moving Pictures: How Satellites, the Internet, and International Environmental Law can help Promote Sustainable Development. Center for International Law. Washington, DC. 1999

territories which are illegally violated for commercial exploitation of natural resources)

- The right to development in an environmentally sustainable manner
- The right to equality, violated by the disproportionate environmental degradation which occurs in certain vulnerable sectors of the population (environmental discrimination)
- The right to participate, necessary to all democratic societies to achieve sustainable environmental policy

In practice, when we speak and act on the defense of human rights, what comes to mind to most are strictly civil and political rights; we think of the right to life, free speech, political and religious freedom, freedom of movement, etc. We think of military abuses and illegal detention and interrogation. We rarely insist on, and even ignore, economic, social and cultural rights; the right to a clean environment, to health, to development, the right to food, etc., which are as important to our sustainable development as some of the other civil and political human rights our society has focussed on for the last several decades. Many of these rights are violated through environmental contamination and degradation.

Satellite imagery hence, while monitoring environment, can be used to defend human rights. We will see in this paper, that satellite imagery can be used in multiple forms and fashions to promote and defend economic and social rights, as well as civil and political human rights. At its onset, this paper was commissioned to help identify specifically human rights uses of satellite imagery. The position of the writer, as explained in this section is that human rights cannot be divorced from the environment. Other works related to this one, have postulated on specific uses of satellite imagery for the defense and promotion of a sustainable environment. For the sake of not repeating of other efforts, we will focus more closely on the human element of sustainable development and leave that which is strictly related to the protection of natural resources to the other contributors.

Earth Use and Satellite Imagery

Satellite imagery, beyond registering images of the natural earth, especially when these can be observed over a time series, registers a unique perspective on the use of natural resources, land, forest, waters, air, etc.. This use, which we will call "earth use" includes habitation patterns, (urbanization vs. ruralization) as well as natural phenomena, and the exploitation of natural resources which can be perpetrated by governments, companies, institutions, organizations, individuals, or wildlife. *Earth use*, sustainable or unsustainable, we know and agree, is of fundamental concern to environmental sustainability, and subsequently, of great concern to our basic human rights.

The way in which the earth is, or can be, potentially "used" is multifaceted, and involves many actors and interacting dynamics. For the purpose of analysis, we can examine *earth use* from a variety of optics, legal, economic, political, social, or moral (to name a few), each of which will shed light on a series of issues, affected or participating actors, arenas,

with corresponding and particular social and environmental consequences. *Legally* speaking, *earth use* may be legal or illegal according to local or international legislation. *Economically*, *earth use* may add or detract from economic productivity, improving or deteriorating human condition. *Politically*, *earth use* may be more or less politically viable, or a given political decision can influence how the earth is used. *Socially*, we may have ideas about how a given *earth use* can best benefit or harm a given sector of the population. *Morally*, as a society we may have opinions about how the earth should be exploited, at what cost, and just what *earth use* should or should not be allowed, beyond a mere legal reference. These optics are merely a reference to be used in approaching *earth use*, which can help us define parameters for assessing the consequences, and help the determine the stakeholders and their positions with respect to the *earth use* in question.

Satellite images, hence, assist us in mapping *earth use*, either at a given time or over a specific time interval. In terms of our optics, satellite images can help us categorize and value the various consequences of *earth use* at any given time or over a time period. Satellite images of earth use can act as a tool to monitor this use, linking the normative to the practical and cultural, helping us analyze, verify, and assure that, in practice, our *earth use*, is in line with our legal, social, economic, moral and political frameworks we have developed to make use of our natural resources and protect our human rights. And in the event our normative frameworks are hindering the promotion of a sustainable environment, satellite imagery may assist us to reconsider or reevaluate norms and regulations.

Uses of Satellite Imagery for Human Rights Defense and Promotion

To begin to address the uses of satellite imagery in promoting and protecting human rights, one must first technically understand just what these images provide in terms of pictorial definition, i.e. precisely what types of images are we taking about? While some geographic information systems (GIS) involving aerial photography taken by especially equipped airplanes, offer pinpoint accuracy, allowing a person to read a newspaper from a vantage point of up to many thousands of meters above the earth, most satellite images do not allow for such precision definition. Pixel definition (point resolution) can be from under a meter in width to well over thirty meters. That is, in the case of one-meter resolution, one point in the given image represents a meter of image, so that any part of the image of less than a meter in size, would not be recognizable in detail. Finer definition provided for by some GIS systems, might distinguish which finger on a hand has a gold ring on it, while others may only distinguish where one grove of trees ends and where another begins. To place our case for human rights uses of satellite imagery in perspective, a single "human", will likely not be identifiable via satellite imagery. This does not mean that lower resolution satellite imagery does not provide powerful data, but rather that the images that the vantage of the images it does provide lies in its ability to capture more macro data such as forest growth, general population displacements, movement of oil spills, etc..

Satellite images and other aerial photography is already widely used in Global Information Systems, such as in cadaster registrars, or in urban planning exercises. These

data are used to determine population shifts, natural resource use, water displacements, and other changing earth patterns. For the most part, the use of satellite imagery in terms of earth use, has been limited to monitoring environmental transformations, and in the case of urban planning, to land use in a strictly "urban" sense. Yet few cases exist where satellite imagery has been used specifically to explore the linkages of the changing environment to basic human rights. In order to bridge this gap, a greater social consciousness is necessary of the inherent links between our human rights and our habitat. Satellite imagery can serve as a measuring stick to monitor basic economic and social human rights.

Taken to the field of the defense and promotion of human rights, it might be difficult to identify bodily harm inflicted on an individual, but it may be quite possible to identify mass graves (GIS systems, although not satellite images but rather airplane imagery, has been successfully used to identify mass graves), monitor intrusion into indigenous territories, or track the persecution of a tribal community or other human mass across a determined land area.

Defending human rights from space implies difficult challenges in interpreting dynamic and ongoing change and action through the use of static single images. A single image, while potentially powerful (say a photograph of an oil spill or of mass graves), does not necessarily show causality, which is crucial in the legal sphere. A satellite image may merely bring a visible human rights issue to the attention of interested parties, and subsequently lead to investigation and eventual prosecution. If properly exploited, this propagandistic use of satellite imagery may indeed be a useful contribution to the defense of human rights. Yet the sequential images that may be had from a time series of images from a given geographical area, may nevertheless help shed light on the causality of events. The deforestation of a given area over time due to logging, clearly shows causality. That is, the causality of logging and the deforestation viewed over time in satellite images is clear in the mind of anyone and need not suffer severe legal questioning. Taking the example a step further, if the causality implied by the viewed deforestation can be linked to government or commercial policy, and not only to the physical action of cutting trees, a solid case might be made identifying the responsible policy and actors of the witnessed action, and such causality can subsequently provide substantive material to present in court.

The *time factor* of satellite imagery, that is the sequential images that may be taken over a given period of time (logging), versus the instantaneous image of a particular incidence (oil spill), reveals very different methodological uses and application of satellite imagery for protecting and promoting human rights. Cases of abuses requiring *urgent action* related to a specific incident, such as oil spills, fires, waste dumping, etc. can be buttressed by instant imaging, while sequential imaging can be used for *prevention purposes* by monitoring change in earth use, bringing evidence to build cases against purported violators of human rights and environmental abuses, and to enforce legislation or even review or reconsider the impacts of legislation.

Below are some examples of instances or issues in which satellite imagery may contribute to the defense and promotion of human rights. In some cases satellite imagery or other GIS systems may already be used to promote human rights. In others, the examples are hypothetical. This list aims to explore possibilities and offer suggestions of just how the world of human rights and environment can be addressed through earth use imaging. The list is by no means exhaustive.

- **Mass Graves.** Perhaps the first case that comes to mind in using aerial images for human rights issues is mass grave recognition. In the aftermath of the Bosnian genocide, it has been shown how aerial photography can be used to identify recent land tilling from more compact land. The limitations of such use depend clearly on the terrain and the optical results of overturned lands and subsequently on the pixel quality of the satellite data in question. A low resolution of such data (which may be the case for satellite imaging), depending on the terrain, would probably not provide useful images.
- **Indigenous Communities/Land Delimitation.** Indigenous communities, more than any other societal group, interconnect cultural practices and human rights to their natural environment. Indigenous communities are also disproportionately systematic victims of unlawful exploitation of their natural territories and stand perhaps to gain the greatest benefit from the availability of time delimited satellite imagery of their changing habitat. Reviewing satellite data of changing forest cover, waterways, and other natural resources, and comparing these to time-specific state sponsored land and commercial policy, or to physical intrusion by into indigenous territories, and advances and declines in quality of life of indigenous communities is one possible use of satellite imagery to defend human rights.
- **Monitoring Crisis.** Growing access to information and the expansion of communications and media coverage, has helped bring ethnic conflicts across the globe closer to the attention of the international community. Crisis often escalate in a matter of days or even hours, requiring up to date information on physical human location. The ability of satellite imagery to track human population movements on a minute by minute basis, or the ability to review population movements over longer time intervals can shed light on the complexities of ethnic conflicts, helping us immediately address the human rights issues therein contained.
- **Policy Analysis and Design Tool.** A sole earth image such as of a forest, or population settlement at a given time, may not clarify much about how a society or given natural resource is changing over time. However, a set of images of a single study group or variable, say the rural inhabitants of a determined forested area, over time, may provide very useful information on the settlement patterns and natural resource base of this community. If these images can be linked to time-specific government land use policy or time-related to commercial exploitation of natural resources of the area, we can begin to build a story showing causality of events that determine population movements, resource depletion, or other dynamic changes responding to policy or to commercial activity (more on causality below).

Governments, or other interested parties could use satellite imagery to track variable changes over time, such as the impact of national forestry laws or policy on wildlife population.

- **Toxic Waste identification/documentation.** Toxic waste dumping is of growing international concern, and considering it often violates the rights of marginal and vulnerable groups, and of developing countries in particular, at the very least it is a clear violation of the right to a healthy environment. While the identification of toxic waste is not always possible from aerial imagery, it may be used in some specific circumstances. Transport vehicles carrying wastes can be monitored, or particular contaminants can be identified, such as oil spills, and other solid waste dumps. Monitoring toxic waste patterns and development can provide important information to protect vulnerable communities from potential or further contamination. Toxic waste dumping identification via satellite imagery will be more difficult in densely populated areas, due to the more difficult identification of detail, while in more remote rural areas, dumping may be more easily recognizable via the use of satellite imagery.
- **Civil Society.** Non Governmental Organizations (NGOs) and other civil society actors play an important role as monitors of compliance by local and international firms, government and individuals, with regulations, local laws, and international treaties regarding human rights. They can also help monitor the effectiveness of norms and regulations to comply with human rights and environmental objectives. Local civil groups and local and international NGOs are usually behind the effort to protect and promote respect of human rights, and hence, access by these groups to earth use imagery can be an important contribution to the effort of monitoring abuse. Especially since these groups and organizations are often best suited to identify local problems and needs. The use of satellite imagery by civil society and NGOs would be driven entirely by demand, and would hence be more directly focussed at local problem areas which more global or national programs risk overlooking.
- **Monitoring tool and instrument to influence international law.** Satellite imaging can be a practical way of monitoring compliance with environmental and other international treaties related to the respect of human rights and environment. The potential growth in earth use-monitoring thanks to the readily available use of satellite imagery, will undoubtedly result in civil society and other institutional pressures to bring human rights and environmental earth use-related issues to the forefront. These pressures will surely find their way into the relevant media channels and consequently into development discussions and debates. International organizations and interested country governments will likely be receptive promoters of the many issues brought to international attention by earth-use monitors.
- **Monitoring Urban Sprawl.** Urban sprawl is the physical distribution of humans in given geographical territory. The way in which we settle our habitat forces us to consider land use, examining where we live, where we eat, where we get our drinking water, what we do with our waste, how we move from one place to another, and

many other aspects of our physical daily lives. The physical distribution of persons in a given area, whether voluntary or not, has direct impact on the quality of life of those persons, and subsequently, on the rights of those persons. Human rights include the right to live healthy lives in healthy conditions, with some basic or minimum living standards, the right to mobility and many other quality of life related rights. Urban agglomerations in developing countries often present very difficult and extreme living conditions for population living with less than minimum basic standards. The monitoring of urban sprawl through satellite imaging can shed light on a number of issues that directly affect human rights.

- **Crime.** Crime can be monitored geographically using satellite imaging. Information about the geophysical movement of crime over time can reveal important information about localized security problems, crime corridors, and general safety concerns of communities, also basic living standards.

Participation in the Use of Information as a Right: Actors and Interested Parties

Most of the actors presently involved in human rights and environmental promotion and protection stand to benefit from access to satellite *earth use* imaging technology. Satellite imaging can serve as a tool to assist those actors in the activities and work programs they already address. We have already covered *urgent action* and *prevention* uses of satellite imagery, and discussed the benefits of obtaining such time-specific information about particular earth uses. Access to satellite imagery of earth use (participation or access to information) will expand the knowledge base of NGOs, local and grassroots community leaders, representatives of indigenous peoples, human rights attorneys, international observers, policy makers, journalists, and other interested non-governmental parties to invaluable information about the environment and the use of natural resources, facilitating and improving the information they presently access to accomplish their objectives.

Participation, in the form of access to information is a basic right, treated by many nations directly in constitutional law. Access to information is one the most important determinants of the ability of individuals to defend themselves against the abuses of their rights. At the state level, international law regulates the obligatory transfer of satellite technology information between governments that have with governments that do not have such technology at their disposition. The international legal regime for remote sensing focuses strongly on technology transfer obligations. Article 1 of the Outer Space Treaty mentions both the right of developing countries and the right of all mankind to the benefits derived from space technology.⁴ At a society level, this can be considered participation in the use of available information. At the individual level, the right of access to information may appear in many facets in local legislation.

⁴See Davies, Hoban, and Penhoet, *Moving Pictures: How Satellites, the Internet, and International Environmental Law can help Promote Sustainable Development*. Center for International Law. Washington, DC. 1999, p. 1108.

The potential value of facilitating access of satellite imagery to the general population should not be underestimated. Localized and personal use of satellite imagery can have as many manifestation as there are earth-use problematics. Individual participation and access to satellite data should be viewed as the universal right to know about ones' own habitat.

Legal Implications and Admissibility of Satellite Imagery in Court

Like standard computer language, satellite images come in the form of 0s and 1s. If we were to look at crude satellite data, most of us would not be able to distinguish one image from another. This data is processed and converted into recognizable images by a computer-generated interpretive process. That is, the 0s and 1s are read by a computer program which in turn relates them to physical elements and translates them into commonly recognizable images. In this fashion, a specific grouping of 0s and 1s becomes a mountain, while another set of numbers, becomes a tree or lake, or people. In the legal realm, the validity of interpretive data, or of photography specifically, in some countries is entirely inadmissible in court. Satellite imagery, as any other photographic medium has hence, a limited interpretive value. Any professional photographer will tell you that every picture is subjective, or put in the negative sense, no picture is entirely objective. What we see in print is only a subjective interpretation of reality. The real legal value, hence, of satellite imagery is not absolute. This should be taken into account when considering using satellite images in the legal process. The use of satellite imagery should be treated as a single step in the gathering of evidence. Without supporting evidence, and the validation of the interpretive results of the data, the use of satellite images to defend human rights, may be very limited. Images themselves are not necessarily a smoking gun for the defender of human rights, but their contribution in the legal process can be an important one if used properly.

Forms of Use/Methodology for Use of Data and Costs.

The practical use of satellite imagery for the non-expert in satellite technology depends largely on the interpretive process it undergoes from the moment the image is registered by the satellite to how it is represented by the image-generating program. Satellite imaging, as it is available today, is not easily processed, and quite expensive. In fact, satellite data needs to undergo very costly processes to derive usable images for the non-expert. One image can require significant human resources and several thousand dollars to produce. Furthermore, the processes by which satellite imaging can provide useful information about a given area depends on the output desired. Information can come in various formats, showing forest cover, heat emissions, rock formations, and many other geological formations and phenomena. Unless the interested party knows exactly what they are looking for, and also understands the graphic significance of the images presented, images may not reveal much to the untrained eye.

A human rights defense lawyer, seeking information about the changing natural resource base of a given community, will likely need significant training and assistance in

interpreting the images obtained from a given download of data. Hence the format, understanding of the presentation, and a trained eye are key to the usefulness of the data.

A question that will need to be answered if satellite imaging is made generally available to all interested parties to promote human rights and the environment, is in what manner and in what format these parties will be able to obtain the information, what training resources will be made available to non-experts in order that they be able to interpret the data available, and at what cost.

The availability of satellite imagery via the internet offers enormous potential, and in some cases, is already a reality. Weather reports with up to the hour satellite images are available to anyone with a computer and modem. Extending other imaging resources to the web, however, may not be a simple task.

Conclusion

The potential uses of satellite imaging for the defense and promotion of human rights and the environment are numerous. Firstly, however, a broader understanding and interpretation of the linkages between the environment and human rights is necessary in order to fully benefit from the technological resources available through this medium. Satellite imagery captures *earth use*, which in turn, tells us about the environment we live in; our rights as humans are greatly affected by the deterioration and abuse of this environment. How we use our earth reveals much information about our living conditions, whether we define them ourselves or whether they are imposed by others. Satellite imagery offers a tool to monitor, prevent, study, reconsider, and react against practices that deteriorate or abuse our environment and human rights. Satellite imagery can offer information about time-specific incidents, or information over time about the uses of the earth. Satellite imagery can be used to defend civil and political rights as well as economic, social and cultural rights. The use of satellite imagery can be difficult to interpret, which means that access to the data offered through this medium needs to be accompanied by some form of technical assistance to interpret, understand and use the data. Further, satellite data is costly to obtain and process. The high cost of the data may make its use limited to those institutions which can afford to pay to access, while excluding those who cannot. What is certain is that satellite imagery offers enormous and powerful information, to be applied to human rights and environmental protection. Its use should be encouraged and the difficulties of use and the high cost should be studied to make this valuable human resource available to the public.