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THE RIGHT TO SATELLITE REMOTE SENSE DATA: IMPACT OF MULTILATERAL COOPERATION ON INTERNATIONAL SPACE LAW

ABSTRACT

Access to satellite remote sense data has been problematic since the advent of satellite remote sense activity. The demands for a right to access have taken numerous forms and are expressed in a number of multilateral and regional arrangements dealing with remote sensing. The 1986 United Nations Principle On Remote Sensing declares an open, non-discriminatory access to remote sense data. However, the practice of remote sensing States and non-governmental has been a restrictive approach to access. Increasingly, there are restrictions to access based on issues of national security and foreign policy obligations. Yet there is determined effort by non-sensing States to ensure access to such data. This efforts manifest in the technological advances by developing countries not only to enter into multilateral arrangements to acquire satellite data, but in these countries launching and operating their own systems. These efforts provide an impetus to re-evaluating the current international regime for remote sensing.

A. INTRODUCTION

International cooperation is the cornerstone for the successful development and regulation of satellite remote sensing activities .[1] Remote sensing does not have territorial limitations: the nature and scope of satellite remote sensing (SRS) is international. [2] Only the earth-based downstream activity that can limit the extent of exposure of SRS data. [3] Hence, the law and regulation of SRS and must be extra -territorial in scope and application.

The overarching international legal framework for SRS, the 1986 UN Principles On Remote Sensing, is biased towards and is underpinned by the need towards international cooperation. The 1986 Principles are a result of international cooperation and reflect that concern. [4] While there was no remote sensing law ***stricto sensu*** to speak of pre-1986 UN Principles, the legal complexities surrounding having raging for a while which SRS resulted in a protected battle to get the legal framework declared. [5]

The 1986 UN Principles were adopted by the United Nations Committee On The Peaceful Uses Of Outer Space (UNCOPUOS) by consensus. [6] Despite the differences in approaches to SRS, both theoretical and practical, the 1986 UN Principles were adopted by consensus and adopted by the United Nation Assembly without a vote. [7] Yet, the consensus underpinning the 1986 UN Principles was a compromise to haunt the application of SRS.

A sizeable number of member States had misgiving and were not satisfied with the ambit and efficacy of the Principles, especially in relation to the rights to sensed State to the sensed data. (8) The extreme positions were mediated to produce a working compromise: the sensed State would be entitled to sensed data basis as soon as such data is received by the sensing State. [9]

Numerous factors and trends have unfolded post 1986 period. Economic, geopolitical and technological trends have provided such an impetus to SRS activities such that the impact of SRS calls for a re-examination of remote sensing legal framework. The non-discriminatory access and "reasonable cost" aspect governing the rights to SRS data have proved unworkable in practice and require new interpretation consistent with contemporary practice and uniform application at the international level. [10]

B. SATELLITE REMOTE SENSING AND INTERNATIONAL COOPERATION

1. Historical Context

Remote sensing developed from the needs of military for surveillance and reconnaissance purpose. [11] Aircraft were used for aerial photograph and collection platforms were specifically designed for overhead and stationery

platforms. [12] Satellites were commissioned for reconnaissance "to observe the Soviet Union and other potentially hostile nations ". [13] Civilian remote sensing unfolded in the 1970's with the launch of LANDSAT series, and included the processing and enhancement techniques of satellite imagery. [14] This capability to observe "all parts of Earth's land surface from orbit, using a US developed and operated satellite system provided foreign policy opportunity''. [15] This development attracted international demands that the US together with other earth observation systems, be subjected to "existing and emerging international obligations and principles related to remote sensing". [16]

2. Characteristics of Satellite Remote Sensing

Remote sensing refers to "the use of a mechanical recording medium" to gather data from a distance by a variety of means. The term "generally refers to the use of aerial sensor technologies to detect and classify objects on earth (both on the surface, and in the atmosphere and oceans) by means of propagated signals (***e.g*** electromagnetic radiation emitted from aircraft or satellites). [17]

Satellite remote sensing is a process where data is transmitted from a space craft in orbiting to receiving ground stations on earth. Such data is then analysed, processed, enhanced, stored or distributed. [18] The objective is to analyse the collected data and compare to topological features such as erosion, forestry, pollution, land use, etc.

Remote sensing applications include environmental, monitoring, meteorology, disaster management, to the military reconnaissance, etc. [19] Satellite Remote Sensing provides a crucial data, even from dangerous places without easy access, such as the Arctic regions, steep mountainous areas, and conflicts-ridden areas. [20] The benefits derived from satellite remote sensing are therefore pervasive of modern life and recognised as such by international space law fora. [21] The advantages of satellite observation include the fact that an orbit satellite be controlled with ease and "can regularly revisit sites of interests". [22]

The resolution provided by a remote sensing system is central to the regulation of remote sensing because recently restriction to access to satellite imagery is

determined by the resolution as it determines the clarity of the sensed object in relation to the surroundings of that object. [23]

2. Historical Regulation of SRS

The genesis of regulation of remote sensing is found in the rationale of international law relating to "rights of states in and to the air-space above their territories." [24] Various treaties relating to over-flight came into effect with the overall recognition of the complete and exclusive sovereingty of subjacent state above their territory". Under this international legal regime, aerial surveillance by foreign aircraft required the consent of the over flown state. ([25]).

Satellite Remote Sensing is an activity occurring in outer space and is therefore subjected to the principles of international space law. [26] Historically, these principles are enshrined in the Outer Space Treaty of 1967. Effectively, all arguments related to satellite remote sensing were pitted against the principles established in the OST. Art 1 of OST decrees that outer space, including the Moon and other celestial bodies are free for exploration and use by all states without discrimination of any kind and on a basis of equality. Outer space must be used for the benefit of all states without any kind of discrimination. [27]

In practice, the ambit of international space law enabled satellites to pass over the territory of other states. Hence, when the argument for the regulation of satellite remote sensing ensued, the legal principles relating to use of space were broadly established. [28] As a space activity, Remote Sensing is also subjected to the requirement of other relevant outer space law treaties such as the Rescue and Return, Liability and Registration Conventions. [29]

3. The Need for Specific Remote Sensing Law

The practicalities surrounding the use of "space technology for acquiring earth data from space and the subsequent terrestrial activity including collating, processing and interpretation of such data" hastened the need for and development of remote sensing legal regime. [30] The benefits of SRS, including the processing and wide distribution of data, became more recognised, hence,

the practise, including those of private corporations, international organisations, and sovereign states had to be subjected to legal oversight. 31

The widespread use of the space remote sensing raised concerns and argument. Remote Sensing provided benefits difficult to ignore. Applications like better crop arrangement techniques, resource management, effective environment management, including locating deposits of new oil and mineral resources were now widespread. Strands to the argument involved two classes of nations, technically developed countries with remote sensing capabilities content with ***laissez faire*** environment, and the developing countries who perceived the control of their natural resources slipping away from their control. 32 Hence, the main consideration was the natural use of remote sensing data, ***i.e.*** whether it was a lawful and peaceful use? Conversely, was information about the natural resource an integral part of those resources, thus subjected to claim of sovereign rights? 33.

C. REMOTE SENSING AT UNCOPOUS: The 1986 UN PRINCIPLES

Remote Sensing was formally put on the agenda for international discourse of the 1968 UNISPACE I and subsequently at UNCOPOUS 34. Proposals for the regulation of remote sensing stated with a suggestion by Argentine in 1970, followed by the Soviet Union in 1973, an Argentina-Brazil draft in 1974 (co-sponsored by Chile, Mexico and Venezuela), followed by Austrian draft and in 1981 Mexico provided another proposal. 35 It eventually took almost 17 years to conclude a text of remote sensing principles in COPUOS and the UN General Assembly, without a vote, gave it unanimous approval to Resolution 41/65. 36

The Resolution continued the Fifteen Principles on Remote Sensing, a compromise reached as a result of the synthesis of the submitted proposals and negotiations spurred on by the practicalities that remote sensing is being implemented regardless COPUOS discussions of the legal regime on remote sensing. (37) COPUOS delegates had to “settle for a UN General Assembly Resolution declaring international policy on remote sensing” as opposed to an international treaty. 38 This reflected “the maximum level of agreement” that could be “achieved in a forum where consensus on all issues is required.” 39

The realisation of the enormous resources in space, and encouraged by the opportunities for sharing the benefits of remote sensing “resulted in the

elimination of some of the more strident restrictive proposals creating a spirit of accommodation and compromise which led to the adoption of UN GA Resolution 41/65." [40] Important compromises made it possible to adopt the UN Resolution which was "the achievement of a fair balance between the interests of the sensed States and States possessing the necessary space capabilities and the needs of the sensed states, many of them developing countries…" [41]

1. The 1986 UN Principles On Remote Sensing

The nature and application of the 1986 UN Principles has polarized the space community since their inception. The proponents argue that the Principles provide for an orderly regime that allow for consistent and "peaceful use of fact-gathering capabilities". [42] On the other hand, critics posit that the "Resolution does not represent substantial progress in the development of a remote sensing legal order". [43]

These conclusions are based on and reflect the fundamental theoretical positions advanced at the negotiations, ***viz*** the open and free fact-gathering framework favoured by States with remote sensing capabilities who argued for international cooperation in the acquisition and dissemination of remote sensing data in contradistinction the arguments of countries which emphasized the role of national sovereignty with its focus on the condition of national privileges." [44] Essentially, the debate is contest between sensing State and the non-sensing states, the latter compromising both the "have" and "have nots", developed and less developed countries. [45]

The thrust of the argument from the developing countries was that property ownership in natural resources included information regarding those resources and other states should not sense their resources without permission. "[46] The argument petered down to an exhortation that a sensed state is entitled to "priority rights" to satellite-acquired data of its territory" and as such data "as to one state should not be transferred or made available to others without its consent". [47]

On the other hand, it was that outer space was free for all to use, and such use included remote sensing. As such "prior constant with the implicit correlative right to forbid sensing was not consistent with that freedom". [48] Access to the

technology and preservation of technological advantage played in part with those debates. [49] The consensus on the principles reflected a compromise on these fundamental assertions, hence, there were "expression of dissatisfaction concerning the way in which both major and lesser issue had been treated". [50]

2. The 1986 UN Principles And International Cooperation

These are fifteen Principles contained in the 1986 UN principles. The Principles seek to accommodate the interests of all parties, both sensing and non-sensing state, with due consideration to the needs of developing countries. [51] There is a positive duty to conduct remote sensing for the benefit and in the interest of all countries irrespective of their degree of economic, social, scientific or technological development contained in Principle II which is in tandem with the international character of remote sensing activities.

Indeed the need for and requirement to conduct remote sensing on the basis of international cooperation permeates core and thrust the thrust Principles. But the Principles are narrowed to the "purpose of improving natural resources, management land use, and the protection of the environment". (Principle 1(a)). [52] They therefore do not cover all remote sensing, such as military use.

Principle 1 further defines and categorize data into three categories ***viz***, primary, processed, and analysed data. There is a duty to comply to conduct remote sensing in accordance with international law (Principle III); the requirement of adhere to OST Art 1, and respect for legitimate rights and interests of the sensed state, which is somehow inconsistent with the freedom of use of outer space (Principle IV).

Principle V specifically compels the States conducting remote sensing to promote international cooperation in remote sensing activities. States are encouraged to enter into agreements or other arrangements "in order to maximize the availability of benefits from Remote Sensing activities." (Principle VI). [53] Principle VII requires States having remote sensing capabilities to make available technical assistance to other interested states on mutually agreed terms".

Principle VIII stipulates that "the United Nations and the relevant agencies within the United Nations system shall promote international cooperation…" remote sensing activities. Principle X and XI require sensing States to make information on averting harmful phenomenon to the Earth's environment or useful to the States affected by natural disaster available to the affected states respectively.

Principle XII provides for access to data by sensed States. It provides that "as soon as primary data and the processed data concerning the territory under its jurisdiction are produced, the sensed State shall have access to them on a "non-discriminatory basis" and on "reasonable cost term". The sensed state shall also have access to the available analysed information concerning the territory under its jurisdiction and in the possession of any state participating in remote sensing activities on the same basis and terms, taking particularly into account the needs and interests of the developing countries." [54]

3. LEGAL CONCERNS RELATED TO 1986 UN PRINCIPLES

The 1986 UN Principles have been critisized as been too general [55], fail to cover all remote sensing activities, [56] data policies are left to domestic legal regime [57] liability issues are not adequately addressed, [58] the access and distribution of satellite imagery is the prerogative of the sensing State. [59] While sensing States pronounced their allegiance to the Principles, recent practice indicate policies and laws contrary to the tenor of the Principles, especially by making access to satellite imagery subject to their 'national security and foreign policy interests or international obligations ." [60]

The clear text of Principle XII provides that a sensed state shall have access to analyzed data concerning its territory in the possession of a sensing state on non-discriminating basis and on resources cost terms. Yet in practise, sensing states are withholding data on security concerns or the assertion that some organisation has bought all the data. [61]

The most important consideration for reaching consensus the 1986 Principles "was the expectation of advantage desired from the possession of data and information". [62] Developing countries grudgingly accepted some provisions with a view that a future opportunity to revisit the Principles and reinforce

those beneficial aspects will be arise “in order to buttress existing assurances and commitment.” [63]

The crucial issues in remote sensing still revolve around four thematic areas, sovereign rights, proprietary rights, freedom of information and privacy. [64] Thus, the principles were left deliberately general and nonspecific for states having control over remote sensing systems (to) have a large degree of flexibility in developing the rule of law. [65] This is so largely because “the proprietor state’s practices largely shape the remote sensing regime of the future.” [66] An example is the US sponsored Open Skies policy for remote sensing “now taking lead in setting forth a specific framework for private enterprise operations.” [67] In effect, practical consideration of economic commercial and security, concerns dominating mainly the United Sates, have dominated the development framework of satellite remote sensing legal regime.

D. INTERNATIONAL COOPERATION IN REMOTE SENSING

The UN requested Report on Remote Sensing emanated from the deliberation of UNISPACE I in 1968. [68] The need to establish a worldwide remote sensing system was identified as a possible mechanism to provide remote sensing data globally- including regional, bilateral, multilateral and international arrangements. Under this scenario, users would bear the costs for the development, production, launching and operation of the earth observation satellites. [69] One main central concern is that data is not available to the sensed State, but “available for commercial exploitation by another country.” [70]

1. BILATERAL APPROACH

The lack of a coherent international remote sensing legal regime and the imperative to acquire the remote sense data led to the conclusion of bilateral agreement between sensing and sensed countries. UNCOPOUS was called upon to assist in establishing multilateral agreement” to provide better international safeguards for equitable distribution of information… “[71] The efficacy of these instruments to define remote sensing has been questioned.

These instruments play an important role in “widening and specifying the rights and obligations among parties concerned, but they cannot, unless unanimous in their meaning, effect the precisions of an instrument having a universal character.” 72

The United States concluded this type of Agreements with numerous countries all over the world. These were the Landsat agreement concluded by National Aeronautics and Space Administration (NASA) with countries such as Argentina, Australia, Brazil, Canada, India, Japan, South Africa, and others. These agreements provided for the acquisition and processing of remote sensing data on a fee and cost-sharing basis. Recipient countries are required to pay for the ground receiving station mountain such at own cost, and pay NASA a certain sum per annum for the privilege. 73

The Landsat 7 system, the US civil land remote sensing satellite program, was trnasferrred to the United States Geological Survey (USGS) of the Department of Interior which is now the signatory to the Landsat Agreements. Under the Agreements, the USGS “reserve the right to curtail of terminate transmission of data-for reasons of US national security… or failure to pay cost-sharing fees.” 74 These fees were an initialization fee of $50, 000 US, and annual cost-sharing fee range is $250, 000.00 US for all land scenes to be received by the receiving site. The governing law under the MOU is the laws of the United States and recipient country respectively. There is no warranty for suitability of Landsat 7 data for any purpose. 75

Similarly, the French have a commercial entity, SPOT Image, which has a license for the worldwide “promotion, reproduction and sale of the data received from the SPOT satellite’” and is authorised under the said licence to sub-licence in turn.” 76 SPOT IMAGE undertakes to ***comply with 1986 UN principles by making SPOT Data available on a non-discriminatory basis***. Yet it provides the data on a commercial basis and grants sub-licences for the reproduction and distribution of SPOT data. There are prices, fees, and royalties to SPOT Image for remote sensing data. Transmission Rights costs 1,500,000 Euros per Operational cycle. Extraction fees range from 200 Euros for 600 Euros for 5m resolution for B&W products. The Licencee must pay to SPOT for any product sold. 77

Other agreements provide for similar terms and conditions. These terms and conditions, especially the costs, have proved onerous for users, especially from developed countries, and despite assertions to the country, are not consistent with the tenor of international cooperation provided for the 1986 UN Principles of remote sensing. [78]

2. Multilateral Approach

The second UNISPACE Conference made significant contribution to the discussion on the regulation of SRS. The contributions by the Group of 77 that an international agreement on the principles governing remote sensing be developed be developed was a reflection of the dissatisfaction with the status quo. The Group of 77 also insisted on having "timely and non-discriminatory access to primary data concerning their territories acquired through SRS." [79] The UN and its specialized agencies were tasked to investigate ways and means to harmonize the practical implementation aspect of remote sensing activities in the varied countries.

The UN countries adopted a set of principles for international cooperation to, ***inter alia***, "facilitate the application of the principle that the exploration and use of outer space, including the moon and other Celestial bodies, shall be carried for the benefit and in the interest of all states, irrespective of their degree of scientific or scientific development." [80] States with relevant space capabilities are required to promote and foster international cooperation "on an equitable and mutually acceptable basis". (Article 3).

E. INSTITUTIONAL RESPONSES TO THE UN PRINCIPLES

The most visible expression at an institutional of the requirements of Remote Sensing principles are those efforts directed at environmental and disaster management. These institutional arrangements are a direct manifestation of the requirements contained in Principles X and XII of the 1986 UN Remote sensing as well as other international arrangements. [81] States are required to provide information on impending harm and offer assistance to those affected by such. These efforts increase access to SRS data globally.

1. Disaster Management

The recommendation of UNISPACE III included assessing "the feasibility of implementing and integrated, space-based global natural disaster management system." [82] This was a result of the realisation that many countries lack or had minimal access to the benefit of space system, no national focal points for facilitating access to space-based information and services, a gap between the user communities (disaster and risk management agencies) and space application provides, and difficulties in accessing achieved space-based data, mainly because it was not organized in a database." [83]

In 2006, the UN General Assembly established UN-SPIDER" to provide universal access to all countries and relevant international and regional organisations to all types of space-based information to support fuel disaster management cycle being a gateway to space information for disaster management support, serving as a bridge to connect the disaster management and space communities and being a facilitator of capacity building and institutional strengthening, in particular for developing countries". [84]

UN-SPIDER has activities coordinated through regional support offices and national focal points (usually National space agencies) and regional and international organisations such asIinternational strategy for Disaster Reduction (ISDR), the Group on Earth Observation (GEO), World Meteorological organization, UNDP, UNESCO, etc. The capacity building approach provide skills development programme to use space-based information for disaster management.

2. Disasters Charter

The Disasters Charter is an inter-agency agreement which puts together national space agencies with responsibility for remote sensing and international space system operators "who can usefully contribute to the purpose of the Charter." [85] Members make available information about their space systems, and make these systems available when disaster strikes. The objective is to "provide authorized users a unified system of space data acquisition and delivery so as to allow the anticipation and management of

potential crises, and reconstruction and subsequent operations." [86] Data is provided free of charge. [87]

3. Environmental Monitoring

Environmental monitoring is crucial for orderly planning and management of livelihood for States. The European Space Agency and the Commission of European communities (ECC) initiated a programme called Global Monitoring for Environment and Security (GMES). [88] GMES aims to "bring data and information provides together with users, so they can better understand each other and make environmental and security related information available to the people who need it through enhanced or new services." [89] Data from Remote Sensing is used by the national institutions "to anticipate, intervene and control in environmental and security matter" hence "remote sensing provides an important source of information and nodes international and procedures are crucial". [90]

4. Earth Observation

The Group on Earth Observation (GEO) was established at the Third Earth Observation Summit in February 2005 to carry out the Group on Earth Observation System of Systems (GEOSS) Ten-year implementation plan. Membership in GEO comprise 82 Governments, the 27 member European countries and 58 international organisations that have combined resources to build GEOSS . [91]

The objective of GEOSS is to utilize earth observation data for a better understanding of the earth system, including its "weather, climate, oceans, atmosphere, water, land, geodynance, natural resources, ecosystems and natural and human-induced hazards." [90] The plan "builds on and adds value to existing Earth Observation systems by coordinating their efforts addressing critical gaps, supporting their interoperability, sharing information, reaching a common understanding of user requirements and improving delivery of information to users". [92] The vision is to "realise a future wherein decisions and actions for the benefit of humankind are informed by coordinated, comprehensive and sustained Earth observation and information".

The purpose of GEOSS is set out in the implementation plan and includes, ***inter alia***, to meet the need for timely, quality long-term global information as a basis for sound decision-making, and will enhance delivery of benefits to society…" The areas of focus are identified as, reducing loss of life and property from natural and human-induced disasters, improving management of energy resources, climate change, water resource management, etc.

GEOSS seeks to facilitate "the development and position of common products such as maps of topography, bathymetry, river systems infrastructure, land cover and land use, and a goedetic frame for Earth Observation". (93) The functional components include addressing identified common user requirements, acquiring observational data, processing data into useful products, to exchange, disseminate, and achieve shared data, metadata and products and monitor performance.

Data will be shared fully and openly within GEOSS at a minimum cost. Implementation is through partnership organisation and participating in the UN. Governance is through an elected Executive Committee Supported by a secretarial. Members bear the cost that they incur. Voluntary contribution are welcomed. 94

5. Committee on Earth Observation (CEOS)

The Committee on Earth Observation (CEOS) was established in 1984 under the aegis of the G7 Summit of Industrialized Nations Working Group on Growth, Technology and Employment. 95 The scope of CEOS is "international coordination of earth observation program and the maximum utilization of data, ranging from the development of detailed technical standards for data product exchange to the establishment of high level interagency agreements on common data principles." CEOS operates through a Plenary and has Working Groups supported by a Secretariat as a framework for coordination across CEOS agencies. 96

CEOS introduced a Data Democracy program as an international coordination project to maximize benefits to users of data product in response to challenges of access to data developing countries. The Data Democracy aims to strengthen the Earth Observation data utilization cycle by increasing data dissemination capabilities in developing countries. Data from most Remote

sensing systems is collected, processed and harmonized on a Portal accessible to all. Training on use of the developed software is provided to members. The portal is a simple intefrace for general use and an engine scope down result to data contributed by CEOS members only, thus saving time. 97

6 CHINA-BRAZIL EARTH RESOURCE SATELLITE (CBERS)

The CHINA Brazil Earth Resources Satellite (CBERS) is a joint program initiated by Brazil's Natural Institute For Space Research and China Association for Science and Technology (CAST) in 1988. The aim of CBERS is to develop a series of multipurpose remote sensing satellite and related ground facilities to supply both countries with earth remote sensing images. 98 Three satellite have been launched with two more nearly ready for orbit.

The technical scope of CBERS satellite "allows for imaging appropriate for diverse needs including urban planning, and which requires high resolution as well as application that need frequent, data such as agriculture and deforestation." 99 The CBERS agreement proclaim open access with data downloads licensed based per-minute basis. Data can be transferred free in some instances. 100 The CBERS system now include a number African countries including Angola, Mozambique and South Africa. CBERS imagery is free of charge on condition that such data is available to specified users in that footprint. 101

CBERS policy is informed by both countries domestic policies on access to space-based data. China holds that international space cooperation must be consonant with the Declaration on International Cooperation and "that outer space is the common wealth of mankind. (101) Brazil is plays a pivotal in Latin America and CBERS data is available free for all of Latin American countries. 102

F. IMPACT OF INSTITUTIONAL RESPONSES ON SRS LAW

The multitude of institutional efforts, both at a global scale (GEOSS), multilateral (UN-SPIDER) and regional arrangements (CBERS, etc) provides an impetus to the clarification and further refinement of international legal regime for remote sensing. These efforts address the thorny issue of access to space-based data. More remote sensing systems provide data free of charge.

This is as a result of geopolitical, economic and technological trends impacting earth observation system and operations.

1. Geopolitical Trends

The weakness identified in the 1986 UN Remote principles are steadily eroded by initiatives to form regional alliance in earth observation system as demonstrated by CBERS system, IBSA, others. The developing countries are actively participating in international efforts such as CEOS and GEO introducing new ethos to address access and discrimination to access of satellite remote sensing data.

The move towards providing free data for humanitarian purposes as demonstrated by the Disaster Charter, as well as the multilateral arrangement at UN level provide a positive framework to narrow the legal concerns surrounding SRS. The UNSPIDER programme, and the space-based data use by most UN agencies serve as a catalyst to breaking the barriers to access to data, thereby further obviating obstacles to a comprehensive legal framework for SRS. 103

2. Technological Trends

Many countries that did not have remote sensing capacity during the negotiations leading to the adoption of the 1986 UN principles now routinely launch and operate remote sensing satellites. 104 The advent of small and microsatellite is increasing the earth observation capacity.

3. Economic Trends

The remote sensing market is growing exponentially each year. In the Asian Pacific Satellite-based Earth observation market, the market earned revenues of over US $70.1 million and estimates this to reach US220.5 million in 2018 .105

Remote sensing satellite, related infrastructure and value added services have now become an integral part in the geographic information system industry. The importance of satellite to safeguard national security and further enhance socio-economic growth has spurred Asia-Pacific nations to seek to own their satellite. 106

E. Conclusion

Remote sensing can develop in consonant with the practices of states that had implemented earth observation systems. These were mainly the United States and few European countries, including the Soviet Union. The 1986 UN principles were a compromise informed by this technological superiority. However, changed circumstances have shifted the persuasive balance in favour of former developing countries. The practices of dominant countries such as China, Brazil and India allows for a cordial reconsideration of the principles governing satellite remote sensing.

1. Acquiring information about an object of phenomenon without making physical contacts with the object, ***see***, ***e.g*** **Francis Lyall and Paul B. Larsen, Space Law: A Treatise, Ashgate, 2009 ("Lyall and Larsen").**

2. A remote sensing satellite gathers data of objects it sees in its footprints as it orbit the earth without being limited by political considerations.

3. I.H.Ph. Diedericks-Vershoor, An Introduction To Space Law, Wolters Kluwer, 2008.

4. UNCOPOUS, and the UN itself, is a model of international cooperation.

5. It took 17 years of hand negotiation in UNCOPOUS, ***see, e.g*** Carl Q Christol, Space Law: Past, Present and Future, Kluwer, 1991.("Christol")

6. ***Ibid***. The sensing States at that time admit that the remote sensing were adamant that they are implementing remote sensing despite of the objects of non-sensing state. The latter was apprehensive that their territories were being sensed with little benefit to them

7. Principles Relating to the Remote Sensing of the Earth from Outer Space, 3 December 1986; UNGA Res. 41/65. ("1986 UN Principles")

8. Glenn H Reynolds and Robert P. Merges, Outer Space: Problem of Law and Policy, Westview, 1997. ("Reynolds and Merges")

9. Http://www.wikipedia.org/wiki/remote_sensing. (U2/ TR-1, SR-71 and OV-1 were designed for the specific purposes of aerial photography.

10. Lyall and Larsen, ***supra*** note 1.

11. Ibid.

12. Reynolds and Merges, ***supra*** note 8.

13. Ibid.

14. ***See, eg***., **Lyall and Larsen** at p413

15. See, R Schott, Remote Sensing; The image Chain approach, 2007 (http://books .google.com) quoted in wikipedia, *supra. Note 9.*

16. **Lyall and Larsen**, *supra*,note 1 for a more comprehensive technical analysis of remote sensing.

17. Ibid.

18. *See, e.g*. JI Gabrynowicz, The Land Remote Sensing Laws and Policies of National Governments: A Global Survey, National centre for Remote Sensing, Air and Space Law, University of Mississippi school of law , www.olemiss,org_. ("A Global Survey")

19. **Lyall and Larsen**, *supra*,note 1.

20. ibid at p418.

21. Ibid at p.415: In balloon flights in 1890s, military officers found carrying cameras board "foreign" digirible balloons that just happened to overfly military notifications fuelled the debate.

22. Ibid at 416. This include the Convention on International Civil Aviation, Chicago, 7 December 1994 15 UNTS 295, http://www.icao.int/cgi)

23. Ibid at p 416. The Open Skies Treaty of 1992 allows overfly of other limitations AND CONDITIONS.

24. Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, 19 December 1966. The agreement related to SRS came much later.

25. Remote Sensing activity is also subjected to the requirement of Liability Convention, the Rescue Agreement and the Registration Conventions.

26. Christol, supra note 5. At p78.

27. Ibid.

28. Reynolds and Merges, supra note 5, Lyall and Larsen , supra note 1- p419- In the main most regarded such sensing as unwanted intrusion on their jealously guarded sovereignty.

29. Lyall and Larsen , supra.

30. Ibid. UNISPACE 1 recommended that a study be undertaken to assess the need for and viability of a worldwide remote sensing system.

31. Ibid.

32. Christol, supra at p73.

33. Ibid. UN. DOC. AC. 105/C.2/24.450 April 1986.

34. Ibid. H DeSassurre, Remote Sensing; The interaction of Domestic And International Law quoted Reynolds and Merges, supra. For more comprehensive analysis of the argument advanced at COPOUS, see also Christol, supra, Lyall and Larsen, supra.

35. Lyall and Larsen, supra, note 1 at p 421.

36. Ibid.

37. Reynolds and Merges, supra, at p197.

38. Christol, Sspra, note- at p74. (unanimous acceptance of GA Res 41/65 demonstrated that seemingly intractable positions could over time, be overcome".)

39. V. Kopall, Some Issues of Note Progressive Development of Space Law, quoted Dr. I.H.Ph Diedericks-Vershoor, supra.

40. Christol, supra at p74

41. Reynolds and Merges, supra, at p199.

42. Christol supra at p74. Ibid, see, also, R. Jakhu, International Law Governing the Acquisition and Dissemination of Satellite Imagery (2003) 29 J.Sp.L.65-91

43. Lyall and Larsen, supra, (a variant of the argument is remote sensing should not occur without the prior consent of the sensed state).

44. Ibid.

45. Ibid.

46. Ibid.

47. CQ Christol, supra, at p85

48. Principle IV (Remote sensing to be conducted on the basis of respect for the principles of full and permanent sovereignty)

49. For a thorough analysis of the principles and their application, see, Christol, supra,, CQ Christol, supra,

50. Such arrangement include “the establishment and operation to data collecting and storage stations and processing and interpretation facilities, particularly within the framework of regional arrangement or wherever feasible.

51. Reynolds and Merges, supra.

52. Lyall and Larsen, supra at p421 (aerial remote sensing and military)

53. Ito, IMPROVEMENT TO THE LEGAL REGIME FOR THE EFFECTIVE USE OF SATELLITE REMOTE SENSING DATA FOR DISASTER MANAGEMENT AND PROTECTION OF ENVIRONMENT, 34 J. Sp.L45.

54. R.Jakhu, supra.

55. Ibid.

56. Lyall and Larsen, supra.

57. Christol, supra.

58. Ibid.

59. Reynolds and Merges, supra.

60. Ibid.

61. Ibid.

62. Ibid.

63. Ibid.

64. Ibid.

65. Ibid.

66. IH Ph. Diedericks-Vershoor, supra.

67. Ibid, quoting comments of Prof V. Kopal on the 2006 Report of the ILA Space Law committee.

68. Ibid.

69. Term of MOU between the USGS for the Direct Reception and Distribution of Landsat 7 Data (on file with author)

70. Spot DATA RECEPTION AND DISTRIBUTION AGREEMENT 9on file with author).

71. See. e.g. UNISPACE III Report, UN DOC. A/CONF.101/10.

72. IH Ph. Diederiks-Verschoor, supra at p 76.

73. Declaration on International Cooperation in the exploration And Use of Outer Space for the Benefit and in the Interests of State, Taking into Particulars Account the Needs of Developing countries, Resolution 51/122, 13 Dec. 1996

74. See, Lyall and Larsen, supra. The Stockholm Declaration of 1992 and the Rio Declaration of 1992 deal with need for protection of human environment.

75. See e.g. UN DOC. A/AC.105/947 Capacity building strategy of the United Nations Platform. For Space-build information for Disaster Management and Emergency Response.

76. Ibid.

77. Ibid.

78. Lyall and Larsen, The Charter on Cooperation to Achieve Natural or Technological Disaster, 2000. www.disasterscgarter.org

79. Ibid.

80. Report of Inter- Agency on Outer Space Activities on the twenty-third session, January 2003, A/AC.105./791

81. Lyall and Larsen, supra.

82. Ibid, see, also, GMES IN AFRICA, www.africa/enterprise/policies.

83. See Overview: The Group on Earth observation (GEO) the Global Earth Observation system of systems (GEOSS), and ICEO in Earthzine, http:/www.earthzine.org/geossiceo-page/, visited on 30 July 2011.

84. The Global Earth Observation System of systems (GEOSS) www.geo 10 Year Implementation Plan , www.geo.org.

85. Ibid.

86. Ibid.

87. Ibid.

88. The CEOS Plenary- Rio de Janeiro-Brazil, 15 Oct. 2010

89. Ibid.

90. www.datademocracyportal.org.

91. www.earthzine.org /2011/05/20/ cbers. CBERS was established following the Protocol Joint Research Complimentary To The Framework Agreement Between the Government of the People's Republic of China and the Government of the Federative Republic of Brazil on Cooperation in Peaceful Application of Outer Space Science and Technology On the Cooperation of the CBERS Application System, 2004.

92. India- Brazil has also intends to launch with India and South Africa a series of EO satellite dubbed the IBSA system.

93. See e.g. A Global Survey, supra.

94. Ibid.

95. Ibid.

96. Ibid.

97. Ibid.

98. In Africa, Algeria, Nigeria, South Africa have launched Earth Observation satellite and are intending to form a series called the African Resource Management Constellation.

99. A Global Survey, supra.

100. http// www.earsc.eu/news/, visited on 04/08/2011. Siting a study by Frost of Sullivan.

101. Ibid.

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