AN INTERNATIONAL REMOTE SENSING SYSTEM: A POSSIBILITY

by

Adigun Ade Abiodun

Office for Outer Space Affairs, United Nations, New York, N.Y. 10017

ABSTRACT

There have been growing national capabilities in the observation of Earth from space and a corresponding increase in the global awareness of environmental problems. In response, within the past decade, a number of regional and international alliances, agreements and cooperation programmes have emerged - these include UNISPACE-82, the Principles of Remote Sensing from the United Nations, USA-led Earth Observing System (EOS), the International Geosphere-Biosphere Programme (IGBP) and the June 1992 United Nations Conference on Environment and Development (UNCED); the latter was convened "to lay the foundation for a global partnership between developing and more industrialized countries, based on mutual needs and common interests, to ensure the future of the planet." An international remote sensing system that is user-driven may be the next logical step.

1. FROM IGY TO ISY

The International Geophysical Year (IGY) quickened the pace of human understanding of many solar and terrestrial phenomena. Propulsion technology, manifested through a large number of experimental rockets and satellite launchings, culminated in the successful launch of SPUTNIK-1 on 4 October 1957. The interest of the international community became focused on geophysical studies and space exploration, and for the first time, a large part of the international scientific community felt really connected.

1.1 Global Concerns

In the intervening years, and through progressive advances and developments in space science and technology, aggressive competition dominated the space frontier. This posture was shared, if not publicly articulated or admitted, by most in the forefront of the technology. Fear of domination from outer space, by a few, preoccupied the attention of those "outside" the space science and technology circle. The Space Treaty adopted by the United Nations General Assembly on 13 December 1966 provided some shelter; it affirmed the use of outer space by and in the interest of all, encouraged international cooperation, provided for open inspection on the basis of reciprocity, rejected national appropriation by claim of sovereignty, of occupation or any other means, and it disavowed space militarization, particularly with weapons of mass destruction; it did not address the crucial issue of air/outer space boundary.

Before the necessary signatures could be firmly penned on the Space Treaty, those "outside" felt an urgent need for a world congress that would focus, not only on the science and technology of outer space, but also on the political and legal aspects of this new soon-to-become global preoccupation. Accordingly, in the last two decades, the United Nations has convened two (1968 & 1982) major international conferences dedicated in part to (i) the promotion of the awareness of the immense promise of space, including the possibility of international cooperation, (ii) an assessment of new developments in the technology, and (iii) an assessment of the adequacy and effectiveness of institutional and cooperative means of realizing the benefits of space technology.

1.2 Sewing the Seeds of International Cooperation

Between 1972, when the first dedicated civilian remote sensing satellite (LANDSAT-1) was launched, and 1992, the International Space Year, humanity has gained a prodigious knowledge of how to observe the Earth and its environment from outer space, a feat made possible by a variety of Earth observation satellites launched by a few nations. Although initial efforts in this arena were undertaken to exploit national investments in research and development, today, such national passions are gradually being replaced by collaborative efforts that are addressing regional and global concerns. In the process, we have discovered the global nature of our environmental problems, the oneness of our destiny on this planet, and the vitality of a unified effort to solve these problems.

Today, regional and international collaborative efforts, manifested in part by ERS-1 of the European Space Agency (ESA) and the Earth Observing System of USA, in cooperation with ESA, Canada and Japan, has become a reality. Within the scientific community, IGBP, an initiative of the International Committee of Scientific Unions (ICSU), strives to describe and understand the interactive physical, chemical and biological processes that regulate the Earth system. The

International Space Year (ISY-1992), with its theme of "Mission to Planet Earth," represents the latest significant effort to achieve international cooperation in the space frontier. Just as it did in 1957 in respect of IGY, the international scientific community has embraced the idea of stressing, in 1992, a better human understanding of the complex interactions within the Earth system with the aid of Earth observation satellites.

Through the Space Agency Forum for ISY (SAFISY) 29 countries and 10 international organizations are channelling their talents and resources to take a new look at our fragile planet in order to gain a better understanding of the dynamics within its environment and the risks and changes to which it is exposed. Through "Mission to Planet Earth," internationally coordinated space-based programmes will chart pollution, deforestation, the greenhouse effect, ozone depletion and other threats to the Earth's environment. Of equal importance is UNCED which was convened in Rio de Janeiro in June this year, to lay the foundation for a global partnership in order to ensure the future of planet Earth.

2. ENGINES OF INTERNATIONAL COOPERATION

It is now universally accepted that our planet Earth is a unified system with events such as a volcanic eruption in one geographical location having repercussions in other parts of the world. Thus, a global effort to acquire necessary information through an international remote sensing system that could be used to resolve issues that affect our common destiny, such as environmental pollution, deforestation, food security and natural disasters, is a logical step.

Because of the need for such unified efforts, it would become increasingly difficult, in a short while, to justify, solely in the interest of national sovereignty, the solo-development and launching of orbiting Earth observation satellites that would retrace the tracks of or duplicate the services being rendered by similar existing systems. Thus, collaboration with others to enhance existing capabilities might become the norm. Similarly, the high cost of undertaking space business, including the corresponding inability of most states to single-handedly shoulder the financial burdens such ventures entail, would inevitably bind the global community together to evolve an internationally acceptable Earth observation system that would meet its demands.

Furthermore, international cooperation in the acquisition and use of environmental and natural resource information has become inevitable partly because an increasing number of countries are becoming "space-capable", thus enhancing the possibilities of such a cooperation.

3. INTERNATIONAL REMOTE SENSING SYSTEM (IRSS)

3.1 Existing Proposals

A remote sensing satellite called ENVIROSAT[1] has been proposed for the international community. The technical parameters of a dedicated spacecraft in an orbit similar to Landsat 1, 2 & 3, and operating as a mapping and monitoring system that could serve the international community have also been suggested[2].

A proposal titled PEACE mission, with six payloads and ground components, was presented to SAFISY in 1989. The six PEACE candidate payloads are for "Land and Ocean Monitoring (PLOM), Global Ozone Monitoring Radiometer (GOMR), Passive Doppler Wind Sensor (PDWS), Measurement of Air Pollution from Satellites (MAPS), Stratospheric Aerosol measurement II (SAM II) and Space Environmental Monitor (SEM)." The proposal envisages the realisation of a remote sensing project including the launching of an appropriate environmental satellite, through international cooperation that would include both developed and developing countries.[3]

The concept of an internationally coordinated satellite observation system that can provide daily observations for coping with fast transient environmental phenomena has matured into an initiative of the Society of Japanese Aerospace Companies (SJAC) in collaboration with the Government of Japan and other space agencies around the world. The proposal, known as World Environment and Disaster Observation System (WEDOS), foresees a global, around-the-clock monitoring of the Earth's environment and the disasters that are occurring therein[4]. The space segment of WEDOS consists of a constellation of thirty-two satellites: 26 Earth observation satellites over medium altitude sun synchronous and Earth circular orbits, and 6 Data Relay Satellites at the geostationary orbit. SJAC hopes that WEDOS could eventually be an effective and realistic disaster mitigating space system.

3.2 Primary Elements of an IRSS

The programmes and events identified in Section 1.2 of this paper are a testimony to the feasibility of establishing a mechanism for an International Remote Sensing System (IRSS). The primary elements of such a system should consist of (i) a number of complementary Earth observation satellites, with no national identity, but with adequate capabilities to meet the environmental and natural resources information needs of the international user community, and (ii) a set of data receiving and processing ground stations. The system should be wholly managed by an international consortium.

The technical parameters of such a space segment, including sensors, types and configurations, orbital inclinations, orbital repetition and altitude should meet the data requirements of those interested in the polar regions and others whose concern is the immediate environment of the equator with its cloud problems and its patterns of agriculture. The data receiving and processing ground stations should be practically located, equipped, staffed and operated to provide the data needs of the global community. Overlaps in the coverage areas of such stations should be absolutely miniminal and should be accommodated only if it is practically unavoidable. Necessary negotiations should result in a number of existing stations being integrated into this network.

4. WHICH MODEL TO ADOPT?

For any consortium to be accepted by the international community, it should be representative and inclusive in both structure and operations. While such a consortium could benefit from the experience of such worthy models as INTELSAT and INMARSAT[1], however, it should be recognized that a major prerequisite for its survival is that there should be an upper limit on the percentage of the share of the consortium that any given country can own or control.

4.1 Remote Sensing Task Force

In order to ensure an effective operational IRSS, an international study group should be established to determine its feasibility. Such a study group, hereafter referred to as Remote Sensing Task Force (RESTAF) could operate under the umbrella of an International Remote Sensing Council (IRSC). The establishment of the latter, recommended by the ISY Pacific Conference, stated that:

> "An International Remote Sensing Council (IRSC) should be created, perhaps under the auspices of the International Astronautical Federation. This non-profit commercial organization would provide coordination between remote sensing satellite builders, operators and data users."

The IAF accepted this challenge at its 38th Congress held in Brighton, England, in October 1987[1].

The tasks of RESTAF are many and varied, and they would require input from the satellite builders and operators, and from the international data user community. Among these tasks are the following:

1. A thorough assessment of data needs of the international user community;
2. The adequacy of existing remote sensing systems (both space and ground segments) in meeting the requirements identified in 1 above;
3. The definition of the parameters (both space and ground segments) of an IRSS that could meet the data requirements identified in 1 above;
4. The blue-print for an operational IRSS including layout, type of satellites, sensor systems capabilities and specifications, and ground segment network including proposals for their acquisition/lease and management;
5. The mechanism for raising necessary capitals;
6. The state of readiness/preparedness of the user community to effectively utilize data from Earth observation systems;
7. The economic viability and self-sustainability of an IRSS; and
8. Political and legal issues.

While reflecting on the proposed tasks of RESTAF, one is reminded that remote sensing is burdened with a number of unique problems. Paramount among these, today, are those relating to data accessibility, availability, compatibility, complementarity and ownership. In addition, the services being rendered by communication entities such as INTELSAT and INMARSAT have immediate economic appeal, with a large pool of global customers that do not require any specialized training or education to utilize their services. For the decision maker accustomed to a net gain on every investment, the cost-benefit ratio in communications technology is immediately apparent. Unfortunately remote sensing has not been that lucky with most decision makers; its many indirect benefits that are not easily amenable to cost-benefit analysis mask its true value and importance. For others, in spite of close to 35 years of space exploration, the idea of going to space to observe the Earth and its environment is still numbing.

4.2 Data Management

Irrespective of which model is adopted, such a model should institute an inviolable mechanism that would ensure (except in cases of emergencies such as natural disasters) rapid, non-discriminatory and non-discretionary acquisition, processing and distribution of data, and should forbid, under all circumstances, the auctioning of orbits to the highest bidder.

4.3 Economic Viability

To become an economically viable enterprise, the operation of a remote sensing system must generate products that are both needed and affordable. To be needed requires that it be user-driven. Globally, remote sensing is yet to achieve this status. Although producers of remote sensing products have consistently demonstrated annual gains in their market strength, however, the limited appreciation and knowledge of remote sensing and its capabilities, particularly in the developing countries, preclude the widespread demand for and applications of space acquired images and digitized data.

4.4 A Mutually Beneficial System

Furthermore, a successful operation of an international remote sensing system presupposes that it would be mutually beneficial for both the developed and the developing countries. For the latter, such a step will be an important one, since they will become active partners in a global venture on environmental monitoring through the modern techniques of space systems[3]. In addition, the related activities could provide additional impetus for the creation of new institutions and systems or the expansion of existing ones and subsequently facilitate the handling and use of space data as a part of an overall long-term development strategy in these countries.

Thus, a higher level of knowledge and expertise beyond that which exists today is needed by educators and research and application scientists in the developing countries in order that they can make significant contributions to the solution of global, regional and national environmental problems and thus become active partners in these global ventures. In particular, educators and scientists in the developing countries should participate in the definition of remote sensing instrument requirements, and in the investigation of the weaknesses and difficulties in current and future instrument design including the definition of techniques for their improvement. They should contribute to the development of calibration techniques for Earth observation data including the development of software for image assessment, the establishment of assessment criteria, and in the definition of calibration strategies with the aid of calibration targets and targets of opportunity. They should also contribute to the evaluation of Earth observation data and to the assessment of its value in various Earth science disciplines. These capabilities can only be acquired through long-term intensive education. A United Nations initiative to establish Centres for Space Science and Technology Education[5] in existing national/regional institutions in the developing countries should be of significant assistance in developing such capabilities.

These Centres shall be viable teaching and research institutions that are capable of high attainments in their development and transmission of knowledge. Given the global realities and concerns of our time, the initial emphasis of these Centres shall concentrate on in-depth education, research and applications programmes in remote sensing and satellite meteorology as part of the essential tools for environmental monitoring and natural resources management. These activities shall be carried out in two phases: (i) the development and transmission of knowledge and skills in the aforementioned disciplines for a period of nine months to educators and research and application scientists, particularly those in the natural and physical sciences at the universities, technical colleges and research institutions in the developing countries, and (ii) the execution of complementary follow-on projects, for a period of one year, by each participant, in his/her country, immediately after the conclusion of phase one above.

With the support of the governments of Canada and Spain, the evaluation mission in respect of the Centre in Latin America and the Caribbean was organized in late May this year. A host country will be identified after a careful study of the report of this mission. Three similar missions to Africa, Asia and the Pacific and the Arab countries are planned for the fourth quarter of this year. Each Centre will be inaugurated once the host country selection process has been completed.

4.5 United Nations Centres and the IRSS

Because these Centres will be regional in character and international in operation, and because of their initial focus, they will be well placed to manage a number of data receiving and processing ground receiving stations that will be a part of the IRSS network.

4.6 An IRSS Evolution Process

Although the first dedicated civilian remote sensing satellite (LANDSAT-1) was launched in July 1972, twelve of the first fourteen years after this satellite was launched were mired in unprecedented negotiations at the United Nations in order to evolve an internationally acceptable set of guidelines for the global operation of such satellites. What subsequently emerged in 1985 as a set of Principles on Remote Sensing[6] has been adopted with expressed reservations. Indeed, in the absence of any reservation, the negotiations would have been concluded with either a convention or a treaty. Thus, the evolution of an IRSS will require time.

5. CONCLUSION

Existing and growing capabilities in the acquisition and processing of environmental and natural resources information suggest that an international remote sensing system is feasible. However, these capabilities must be complemented by a committed effort not only to enlarge numerically the user community, but of equal importance is the need to enhance the capability of that community. The aforementioned Centres for Space Science and Technology Education stand ready to play such a role. Furthermore, the evolution of an IRSS will require patience; its social and humanitarian benefits outweigh any untoward benefit-cost analysis. An operational IRSS would certainly accelerate the pace at which the international community addresses its environmental problems; and in the process, remote sensing may even prove to be commercially viable. On the whole, an IRSS should enhance the professional contributions of most countries of the world to the solutions of global problems. Given the variety and depth of initiatives on Earth observation programmes that have surfaced in recent years, particularly through SAFISY and other entities, it is apparent that an IRSS is a logical follow-up to the International Space Year.

6. REFERENCES

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