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Sharing Space Data and Its Ethical Challenges^{*}

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Abstract: On the basis of presenting the status quo of space technologies and major national and international activities related to data policies, this paper analyses the characteristics of the existing data policies, and issues of sharing space data and its ethical challenges. Six key actions in the worldwide are suggested.

Key words: Outer space; Data policy; Ethics

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1 INTRODUCTION

At the historic moment as mankind farewells the 20th century and enters into the new millennium, we are very pleased to see that mankind has made unremitting efforts and tremendous progress in space activities over the last half century. As a direct consequence of this dramatic progress, tremendous data on our planet have been obtained. Currently, the data are still increasing by a Tbyte (terabyte) of information per day.

It is broadly believed and proved that these data are indispensable for the economic development of the world. Data obtained from outer space have not only been used successfully in farming, forestry, animal husbandry, sideline production, fishery, natural resources, industrial construction, regional economic design and various engineering projects, but also provided a scientific basis for addressing global issues such as environmental deterioration, resource depletion, prevention of desertification, flood and earthquake disasters, irrational exploration, and so on.

However, most of the developing countries are inaccessible to space technology and space data through their own technology, though these data are crucial to their de-

velopment. One question that should be posed is: should access to the data be based on equity and profit sharing? Before trying to find an answer based on ethical decision-making framework, it is necessary to recall the major efforts and related data policies that have been made by international communities in the past decades, to which ethical consideration for using space data has penetrated.

2 THE STATUS QUO

2.1 Space Technologies and Data Volume

Since the United Nations' Convention on Registration of Objects Launched into Outer Space entered into force in 1976, 3 977 space objects have been launched by its signatories, including: Argentina, Australia, Canada, China, Czech Republic, France, Germany, India, Italy, Japan, Mexico, Russian Federation, Spain, Sweden, Ukraine, the United Kingdom, the United States of America and ESA^[1]. Their ongoing satellites make or help to derive key global observations of the atmospheric structures and dynamics, sea-surface temperature, surface parameters, precipitation, land surface characteristics including biodiversity, and selected atmospheric chemical species. They are either geostationary platforms, such as GMS, GOES, GOMS, INSAT and

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METEOSAT, or polar-orbiting platforms, such as NOAA-AVHRR (US), Fengyun (China), CBERS (China/Brazil), IRS (India), LANDSAT (US), SPOT (France), Resurs-01 (Russia), Sich (Ukraine), Okean (Russia/Ukraine), International Priroda, TOPEX/Poseidon (France/US), TRMM (Japan/US), ERS (ESA), SIR-C/X-SAR-SRTM (US, Germany and Italy), JERS (Japan) and Radarsat (Canada). In the first decade of the new millennium, more than 30 new Earth observation satellites are projected to be launched^[2]. Meanwhile, the spatial and spectral resolutions of spaceborne sensors have been improved by around 100 times in the last 20 years. It is undoubted that these progressing space activities can provide an unprecedented capability of obtaining more valuable data from space.

With the advancement of these space activities, the size of Earth observation data archives has been increasing dramatically. On 31 December 1999, for example, there were 7 483 285 SPOT scenes of around 250 Tbytes in the SPOT Image central catalogue. ESA/ESRIN (European Space Agency's Centre in Frascati, Italy) has large volumes of Earth observation data; about 300—400 Tbytes to be maintained. NOAA currently has an archive of approximately 1 000 Tbytes of data from its major systems such as GOES, NEXRAD and DMSP. The archive will grow to approximately 9 000 Tbytes by the year 2010, and to approximately 14 000 Tbytes by the year 2014. NOAA estimates that it would take 80 years to copy its existing environmental data archives, and this estimation assumes extensive and rapid computing facilities. ESA/ESRIN, which is able to receive around 160 Gigabytes of Earth observation data per day, holds 86 000 high-density tapes in its archives, of which 42 000 have been transcribed and recycled more than once. If the transcription activity had not been performed, the actual number of tapes would have been around 160 000^[3].

2.2 Major International Activities Related to Space Data Policies

Facing rapidly growing data along with the progress of space technology, maximizing their use is becoming a fundamental objective for both data suppliers and international bodies. There are three categories of key issues that affect the problem: technical issues, data policy issues, and ethical issues. Technical issues cover problems such as catalogues, archives, formats, integration, and any things that provide technological exchange/sharing mechanism or methods for space data. Data policy issues relate

to problems like the sensed state's rights, copyright protection, sui generis protection, ownership, price and so on. Ethical issues, in making a decision of data policy, refer to the ethical considerations, for example, on moral principles of action, concepts of risk and acknowledgment of sensed states based on respect for all human beings. They may also touch on such considerations as the general relationship between morality and economic profit, the balance between individual and collective interests, and that between ownership protection and access right, etc. Ethics for exploiting space data should be a basis for defining guiding principles of data policies for the development and use of such data.

In fact, international communities and many countries have, as shown in the annex, drafted and ratified their own data policies. Since 1961, the United Nations General Assembly has repeatedly adopted resolutions stating that *space must remain at the service of humanity as a whole*, which has set up an ethical basis for using space technology and space data. The UN adopted on 11 December 1986 by consensus a set of 15 Principles Relating to Remote Sensing of the Earth from Outer Space in its Resolution 41/65^[4].

At the Twelfth Meteorological Congress in 1995, for example, the World Meteorological Organization (WMO) adopted Resolution 40 on the policy and practice for the exchange of meteorological and related data and products, including meteorological satellite data. In March 1996, the European Parliament and Council agreed a Directive on the legal protection of databases. The objective of the Directive is to afford an appropriate and uniform level of protection of databases as a means to secure the remuneration of makers of databases. The Directive proposes protection of databases by either copyright protection or by a sui generis protection.

3 CHARACTERISTICS OF EXISTING DATA POLICIES

An ethical reflection in making space data policies or in using space data does not necessarily result from the needs of maximizing the use of growing space data. Ethical reflection is a perpetually renewed process, a constant questioning of the whys and wherefores of our acts related to space activities. As data policies can effectively affect the development of the earth observing systems and the use of space data, an ethical reflection should precede

and guide data policies, which are usually in the form of a legal instrument. In the field of outer space, especially for space data, difficulties and complexities for establishing a widely acceptable ethical code do not prevent human beings from introducing their ethical viewpoints in various space data policies, as shown in the annex, where human ethical reflection in a quasi-full dimension is dispersed by some means or other.

On Rights of Sensed State

The UN Principles cover the freedom of the sovereignty of nations, the conditions of access to Earth observation data by a sensed state and the control of private Earth observation data companies by their national governments^[5].

On Developing Countries

Special attention is given in the UN Principles to the needs of developing countries, but not in others.

On Equity Access

Non-discriminatory access is a firm term in the Principles of UN, ESA, NASA and the World Data Centers respectively. As Intergovernmental Oceanographic Commission states: "full and open sharing of a wide spectrum of global international data sets for all ocean programmes."

On Copyright

The Directive of the European Commission provides protection of databases by either copyright or a sui generis protection, or both. Copyright provides protection based on the selection or arrangement of the database, and sui generis provides protection based upon the content of the database. Copyright protection under sources other than the Directive will continue to apply where appropriate.

On Particular Use

By the UN principle on remote sensing, the members of UN should provide on a free and unrestricted basis essential data and products that are necessary for the provision of services in support of the protection of life and property and the well-being of all nations, particularly those basic data and products in space required to accurately describe and forecast weather and climate. CEOS agreed a set of satellite data exchange principles in support of global change research^[6].

On Data Category

Little attention is given in the existing data policies to distinguish space data category, even though many data policies were drafted for a specific sort of satellite data. It is impossible to establish a reasonable and feasible data

policy without taking into account of data category. Besides the importance of the difference between raw data and processed data mentioned in the UN principle on remote sensing, the value of space data depends largely on their up-to-dateness and their spatial or spectral resolution. SPOT, for example, has the following profile of sales from its archive: 62 per cent of requests are for data less than 1 year old, 82 per cent of requests are for data less than 3 years old and 88 per cent of requests are for data less than 5 years old^[7, 8]. Also, the prices for data of higher spatial resolution could be ten times expensive as those of lower spatial resolution.

Space data policies cannot develop in isolation. It is important to acknowledge that most space data are used in conjunction with other complementary data (for example, land use, topography, population, etc.), so policies for these data will have an impact on the use of space data.

4 ETHICAL CHALLENGES

4.1 In Political Aspect

Outer space is widely regarded as a common heritage of mankind. So it is acceptable, as an ethical standard, that its exploration and use, including space data, must be effected for the good and in the interests of all countries, regardless of the situation of their economic and scientific development. Noting the political upheavals resulting from the dissolution of cold war, informatisation and globalisation do not disperse the geographical boundaries between different countries where peoples with common interests agglomerate. National obligations and nationalism will continue to challenge the desire in which the Earth is considered as a global village without any boundaries, and the ethics in which the interests of all peoples should be respected in equity.

4.2 In Economic Aspect

Space activities usually need huge budgets, accessible mostly to the wealthiest countries. It seems reasonable that, in order to maximize scientific and commercial value, the space sector might tolerate the presence of private funds in space activities. Once this phenomenon becomes more widespread, the "commercial logic" and conflict of interests could strongly challenge the ethical reflection in access to data based on equity and profit sharing, particularly in environmental protection and prevention of major risks. Cost-benefit analysis, generally used as

“commercial logic”, weighs alternative actions in terms of such consequences and is not suited for consideration of consequences such as the loss of moral integrity. It should be convinced that data sharing in equity is beneficial not only for all users, especially for those who are not able to access space, but also for space data suppliers who invest and hold space technology^[9].

4.3 In Technological Aspect

While the spatial resolution of space data has been improved dramatically (by around 100 times in the last 20 years) and everything is photographed or captured from space in a way as clearly as taking a photo of a swimming man in his home pool from a position of around ten meters high, free access to such kind of information for everyone should fiercely challenge some more general ethical principles such as respect for individual interest and privacy protection.

4.4 In Data Ownership Aspect

When a photographer takes one photo for his customer, that is a response to the demand of the customer, and the customer will become the owner of this photo after performing payment for it. Then if the photo should be used by any other purpose, it can be taken only with the permission of the customer or even with some payment to the customer. But at present, this is not the case in the space data sector. Firstly, any state or region is passively sensed at any time without its permission. Secondly, when the state or region gets its sensed data after it has paid as much as others do, the sensed data of the state or region can still be re-sold, once again without the permission of the sensed state or region. So there arise such questions: Is the sensed state or region a partial owner of these data? What are the rights of a sensed state in space activities? Ethical relativism in the 20th century should face challenges by a sort of such questions.

4.5 In Ethical Aspect

Without various intellectual innovations, Earth observation data could not have been obtained, and could not have become valuable information. An over-emphasised obligation or pretext for protecting the related intellectual property or copyright could conflict with some ethical principles such as non-discriminatory access, the rights of developing countries and the rights of a sensed state, which have been emphasized in many data principles.

5 SUGGESTIONS

After making the above analyses, it is reasonable for us to reach suggestions as follows:

(1) It is necessary to establish a code of ethics, which should be designed and clearly accepted by all involved organisations in space activities to harmonize elaboration of data policies and their practices.

(2) It should continue to respect and follow up the ethical principles established by the UN and other organisations that act as an ethical basis for all actions in the field of exploration of outer space, including the space data sector.

(3) The archived data being relatively old with lower spatial resolution should be free and accessible to any people or country for the use of environmental protection or disasters monitoring which are crucial issues for the whole world.

(4) It is imperative to establish an Internet system for managing space data for critical issues such as global warming, climate change, human health and sustainable development.

(5) In the process of making data policies, more attention should be paid to the needs of developing countries, the rights of sensed states and the respect for the sovereignty of these nations, based on the equity and profit sharing principles.

ANNEX: EXTRACTS OF SPACE DATA POLICIES

CEOS (Committee on Earth Observation Satellites)

At its sixth plenary meeting held in London in December 1992, members of CEOS agreed a set of satellite data exchange principles in support of global change research. Subsequently, CEOS members agreed a preliminary resolution on the principles of satellite data provision in support of operational environmental use for the public benefits in Washington D. C. in April 1994.

ECSEL/ESA (European Center for Space Law/European Space Agency)

“On one side, in respect of the widest availability of data to all interested users each of whom has access to the data on an open and non-discriminatory basis. In doing so, we wish to conform and set a practice of conformity to the spirit of the well known “principles relating to remote sensing of the earth from outer space” approved in the

united nations framework in 1986”.

ENVISAT/ESA (European Space Agency)

“ENVISAT data shall be available in an open and non discriminatory way, in accordance with the united nations principles on remote sensing of the earth from space (United Nations resolution 41/65, 3 December 1986). The ENVISAT distributing entities shall provide services to users in a fair and non discriminatory way”.

GTOS (Global Terrestrial Observing System)

“GTOS data and information should be made available in timely and unrestricted fashion at zero (or minimum cost) GTOS data and information should be easily accessible in a variety of forms to meet the requirements of the user community.”

IEOS (International Earth Observing System)

IEOS agencies have produced a set of principles to guide their collaboration on data access and utilization. In developing the IEOS principles, the agencies envisaged the implementation of the principles to begin with the new Earth observation initiatives funded by governments during the late 1990s.

“All IEOS data will be made available for peaceful purposes on a non discriminatory basis and in a timely manner.”

IGBP (International Geosphere-Biosphere Programme)

“Full and open sharing of the full suite of global data sets for global change researchers is a fundamental objective.”

IGOS (Integrated Global Observing Strategy)

“Access to data is a continuing problem for many users. There are many reasons given for restricting or refusing access to environmental data, ranging from national sovereignty and military security to trade secrets and fear of criticism. In recent years, the demands for cost recovery, the growing commercialization of data providers and the spread of intellectual property rights to data that were once freely exchanged, have brought further complications. One component of IGOS will need to work on widely shared policies for data access and exchange that would allow the most effective use of environmental observations while respecting essential interests in the data.”

IOC (Intergovernmental Oceanographic Commission)

IODE statement on data management for global ocean programmes “full and open sharing of a wide spectrum of global international data sets for all ocean programmes is a fundamental objective of the IODE.”

NASA (National Aeronautics and Space Administration)

“For data from government-owned or funded systems, NASA will enforce a principle of non-discriminatory access so that all users within the same data use category will be treated equally. Preferential treatment for u. s. Government users and affiliates will be allowed only where expressly permitted by law.”

National Climatic Data Center

“Data are provided without restrictions at the cost of providing the service. Global data exchanged under the world meteorological organization (WMO) world weather watch (WWW) program and held

by NCDC are serviced according to the guidelines provided by WMO resolution 40”.

RADARSAT

“Radarsat-1 data are acquired for users on an open and non discriminatory basis, in compliance with the UN resolution 41/65 on the principles relating to remote sensing of the earth from outer space adopted by the general assembly on December 3 1986.”

United Nations Principles on Remote Sensing Principles

“As soon as the 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 terms. The sensed State shall also have access to the available analyzed information concerning the territory under its jurisdiction 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 developing countries”.

The highlight of UNISPACE III was that international recognition and agreement on space-based technology are fostered with a focus on global access, technology transfer to developing countries, spin-offs and commercial benefits.

USGCRP (The U. S. Global Change Research Program)

“Full and open sharing of the full suite of global data sets is a fundamental objective.”

World Data Center

“The data are provided to scientists in any country free of charge, on an exchange basis, or at the cost not to exceed the cost of copying and sending the requested data.”

World Meteorological Organization

WMO resolution 40; “as a fundamental principle of the world meteorological organization (WMO), and in consonance with the expanding requirements for its scientific and technical expertise, WMO commits itself to broadening and enhancing the free and unrestricted international exchange of meteorological products; adopts the following practice on the international exchange of meteorological and related data and products. Members shall provide on a free and unrestricted basis essential data and products which are necessary for the provision of services in support of the protection of life and property and the well being of all nations, particularly those basic data and products... required to describe and forecast accurately weather and climate, and support WMO programs”.

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空间数据共享及其面临的伦理挑战

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摘 要: 该文在总结空间技术以及关于空间数据政策的主要国际活动的现状基础上,分析了现有数据政策的特点和空间数据共享问题及其面临的伦理挑战,最后提出了相应的六点建议。

该文认为在太空领域人类通过不懈努力在过去半个世纪里已经取得了巨大进步,获得了大量的对地观测数据。现在这类数据每天仍以大约 1000 兆的速度不断增加。人们深信,同时大量事实也证明了这类数据对于世界经济的发展是必不可少的。如何在公平、互利的基础上共享空间数据是摆在人类面前的一个长期的棘手问题。该文从伦理视角,论述了共享空间数据将面对五个方面的挑战。建议应当继续尊重和遵循联合国及其它组织所制定的作为探测外层空间(包括空间数据领域)行为的道德基础的伦理原则;对相对过时的、低分辨率的空间数据免费提供给任何个人或国家,以用于环境保护或灾害预警;在公平和利益共享的原则上,在制定数据政策的过程中,对于发展中国家的需求、被观测国家的权利和国家主权的尊重等,应给予更多的关注。

关键词: 外层空间;数据政策;伦理