Remote Sensing and Environmental Treaties: Building More Effective Linkages

Report of a Workshop

December 4 - 5, 2000
Woodrow Wilson International Center
Washington, DC, USA

Sponsored by the Socioeconomic Data and Applications Center
Center for International Earth Science Information Network (CIESIN)
Columbia University

In association with:
Environmental Change and Security Project
Woodrow Wilson International Center
IUCN-The World Conservation Union
MEDIAS-FRANCE

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The Center for International Earth Science Information Network (CIESIN) was established in 1989 as an independent non-governmental organization to provide information that would help scientists, decision-makers, and the public better understand their changing world. In 1998, CIESIN relocated from its original home in Michigan to become part of Columbia University's Earth Institute. From its offices at Columbia's Lamont-Doherty Earth Observatory in Palisades, New York, CIESIN continues to focus on applying state-of-the-art information technology to pressing interdisciplinary problems at the intersection of human and environmental systems.

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This report is available on the web at http://sedac.ciesin.columbia.edu/rs-treaties

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Abbreviations & Acronyms

AVHRR	Advanced Very High Resolution Radiometer
CBD	Convention on Biological Diversity (1992)
CCD	Convention to Combat Desertification (1994)
CEOS	Committee on Earth Observation Satellites
CIESIN	Center for International Earth Science Information Network
CITES	Convention on International Trade in Endangered Species (1973)
EC	European Commission
FCCC	United Nations Framework Convention on Climate Change (1992)
GHGs	Greenhouse Gases
GMES	Global Monitoring for Environment and Security
GOOS	Global Ocean Observing System
GTOS	Global Terrestrial Observing System
IGOS	Integrated Global Observing Strategy
IPCC	Intergovernmental Panel on Climate Change
IUCN	The World Conservation Union
LRTAP	Convention on Long Range Transboundary Air Pollution (1979)
MARPOL	International Convention for the Prevention of Pollution from Ships (1973/78)
MEA	Multilateral Environmental Agreement
Montreal Protocol	Montreal Protocol on Substances that Deplete the Ozone Layer (1987)
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
OES	Bureau for Oceans and International Environmental and Scientific Affairs of the U.S. Department of State
Ramsar	Ramsar Convention on Wetlands of International Importance (1971)
RS	Remote sensing
SAI	Space Applications Institute of the EC's Joint Research Centre
SEDAC	Socioeconomic Data and Applications Center of CIESIN
UNCLOS	United Nations Convention on Law of the Sea (1994)
Vienna Convention	Vienna Convention on the Protection of the Ozone Layer (1985)
WAO	World Agricultural Outlook
World Heritage	Convention Concerning the Protection of World Cultural and Natural Heritage

Executive Summary

The workshop on Remote Sensing and Environmental Treaties was organized by CIESIN's Socioeconomic Data and Applications Center (SEDAC) to address the growing needs for data and information to support the negotiation and implementation of multilateral environmental agreements (MEAs). Specifically, the workshop sought to explore the potential for enhancing the effectiveness of MEAs through the appropriate application of remote sensing data and technology. The workshop convened 68 professionals from the remote sensing community and MEA constituencies, including environmental NGO representatives, environmental lawyers, political scientists, and officials of the US State Department, for two days of lively discussions in plenary and breakout groups.

The rapid growth in the number of environmental treaties since the 1972 Stockholm Conference on the Environment has been an encouraging sign of international commitment to protecting the environment. Today, more than 240 global and regional environmental agreements address almost every conceivable aspect of the Earth's biophysical systems. This proliferation of MEAs has produced a new demand for environmental data and for better understanding of the socioeconomic processes and government policies that affect the environment. Remotely sensed data are critical to understanding Earth systems and human impacts on those systems, and can ultimately contribute to the design of improved policy instruments.

Conclusions

Remote sensing creates demand for better environmental law. Remote sensing is an unparalleled source of information that convey environmental changes in a visually compelling way. As a result, it is extremely useful for raising awareness and developing the political support necessary to strengthen MEAs and environmental laws at the national level.

Remote sensing data provide a synoptic view of many environmental trends. Remotely sensed imagery can provide both snapshots and data over time that address environmental issues at global, regional and national scales. It can provide these in consistent formats and in ways that complement national-level data collection efforts, which are often under-resourced and inconsistent from country to country.

Remote sensing can contribute to global assessments in support of MEAs. Remote sensing provides timely information on a large and growing number of environmental issues such as land-use/land-cover change, carbon-monoxide plumes, and the carbon density of ecosystems, which can significantly contribute to global environmental assessments in support of MEAs (e.g., the Intergovernmental Panel on Climate Change and the Millennium Ecosystem Assessment).

Remote sensing has the potential to contribute to compliance verification. However, for this to happen, developments need to occur in at least three areas:

1. The perception of environmental issues: Sovereignty concerns have taken precedence over enforcement of treaty provisions, and therefore contracting parties have traditionally been unwilling to accept external verification. Until global or regional threats from environmental change are perceived to significantly affect national interests, states are unlikely to accept strict enforcement of treaties by third parties.
2. The technology: Many treaty-specific remote sensing applications are still experimental; these applications need to be further refined before they will have the credibility necessary for use in compliance verification.
3. Data access: Issues such as guaranteed access to data by all parties, documentation of methodologies, and long-term data archiving need to be addressed.

Recommendations

Remote sensing instruments. There is a need to develop a coordinated suite of environmental monitoring instruments with long-term data continuity at appropriate spatial, spectral, and temporal resolutions. Some satellites, such as Landsat, already provide crucial data, and the continuity of the program needs to be maintained. Data archiving services should be developed in parallel. For MEA applications to become operational, the price of land-based remote sensing data would need to more closely approximate that of meteorological data, which have traditionally been available at low cost on an open-access basis.

Institutional arrangements. An international institution should be mobilized to promote coordination at three levels: among space agencies, among space agencies and value-added companies, and among these two groups and MEA constituencies. An existing institution, such as the Committee on Earth Observation Satellites (CEOS) or the Integrated Global Observing Strategy (IGOS), may be able to fill this role. This institution would also serve as a focal point for the development of the next generation of operational satellite systems (see point above). Given that the costs of such a system are likely to be beyond the means of any single country, a cooperative approach would serve to spread the costs among multiple providers.

Awareness raising and training. MEAs constituencies, including secretariats and contracting parties, need to be educated about the capabilities of current and future remote sensing instruments. They also need to receive training and capacity building in the use of remote sensing data for environmental monitoring.

It was agreed that the workshop represented the first step in a dialogue between the remote sensing community and MEA constituencies, and that further exchanges are needed. CIESIN will continue to foster that dialogue through the workshop web site (sedac.ciesin.columbia.edu/rs-treaties). Furthermore, in response to participants' recommendations, CIESIN will summarize case studies of treaty-specific remote sensing applications that can serve as a "state-of-the-art" in the field, and will also consult with convention secretariats about their remote sensing data needs. Reports on these activities, conference announcements, and information on the projects and programs of partner organizations will be available at the website.

Introduction and Background

The workshop on Remote Sensing and Environmental Treaties was organized by CIESIN's Socioeconomic Data and Applications Center (SEDAC) to address the growing needs for data and information to support the negotiation and implementation of multilateral environmental agreements (MEAs). More specifically, the workshop sought to explore the potential for enhancing the effectiveness of MEAs through the appropriate application of remote sensing (RS) data and technology. The workshop convened 68 professionals from the remote sensing community and MEA constituencies – including environmental NGO representatives, environmental lawyers, political scientists, and officials of the US State Department – for two days of lively discussions in plenary and breakout groups (see Annex 1 for the workshop agenda, and Annex 2 for the list of participants).

The rapid growth in the number of environmental treaties since the 1972 Stockholm Conference on the Environment has been an encouraging sign of international commitment to protecting the environment. The Earth Summit in 1992 provided added impetus to the establishment of multilateral environmental agreements (MEAs), with the formation of three major conventions: the Convention on Biological Diversity (CBD), the Convention to Combat Desertification (CCD), and the UN Framework Convention on Climate Change (FCCC). Today, more than 240 global and regional environmental agreements address almost every conceivable aspect of the Earth's biophysical systems.

The proliferation of MEAs has produced a new demand for environmental data and information, and for better understanding of the socioeconomic processes and government policies that affect the environment. This information contributes to the design of improved policy instruments. Remotely sensed data are critical to understanding Earth systems and human impacts on those systems. Although not the only tool for gathering such data, remote sensing (RS) complements *in situ* monitoring in the following ways: it provides accurate, objective and comparable data; it can provide snapshots of ecological regions of widely-varying scales; and because it is sensed from space it can present a wide range of relevant data synoptically and without directly infringing national sovereignty.

MEAs are evolving, open processes, which are continually reviewing implementation and developing new measures to improve effectiveness. Furthermore, there is no sign that the growth in the number of MEAs, especially at the regional level, will let up. Remote sensing can greatly contribute to the ongoing development and refinement of MEAs by assisting in problem definition and catalyzing action. It can also be used by researchers seeking to understand or evaluate regime effectiveness, and assist contracting parties in national reporting processes and other assessments related to implementation.

There is growing interest in the application of remote sensing technology to MEAs on the part of contracting parties to these treaties, convention secretariats, scientists, donors and environmental non-governmental organizations (NGOs). This interest has been sparked in part by the tremendous growth in the suite of observational data products that are now available from numerous long-running programs in the United States, Canada, Europe and Japan, as well as from developing country programs (Brazil, China, and India) and commercial satellite ventures. Efforts are under way on a small scale to test remote sensing applications in relation to MEAs, for example to monitor carbon sequestration under the Kyoto Protocol, or to examine land cover changes in the context of the CCD.

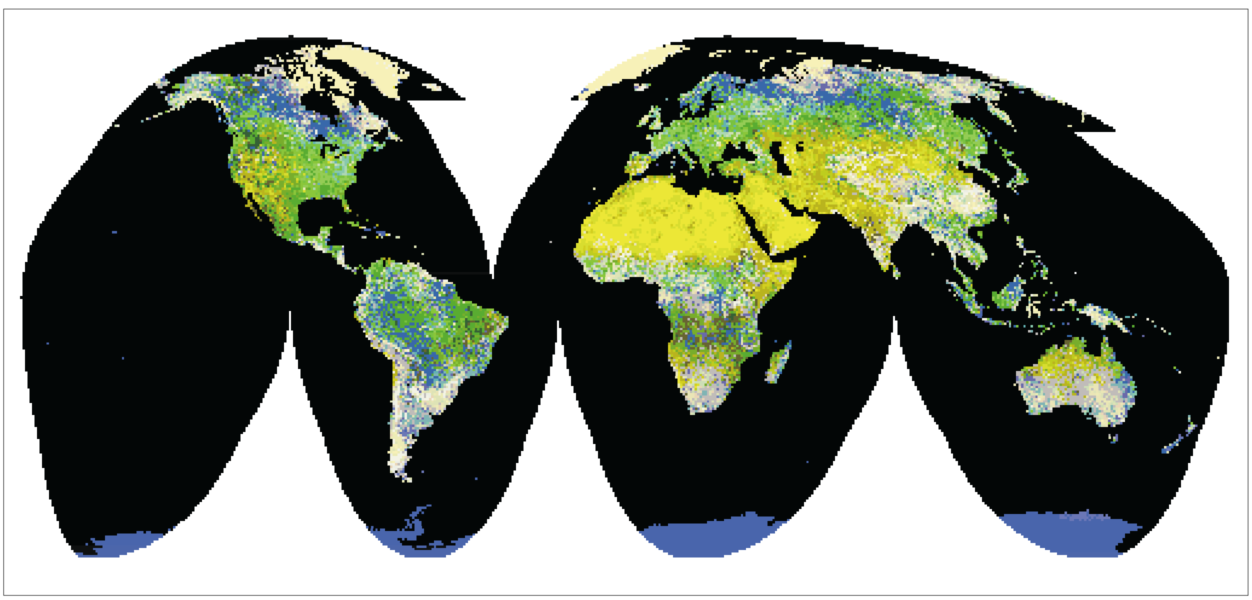
Yet the demand for tailored applications is potentially much larger. Participants at the Interlinkages conference in July 1999 called for a "harmonization of methodologies, procedures and formats for the gathering and analysis of information required of the Parties to environmental… agreements," and identified remote sensing as "an underutilized resource that should be focused more explicitly on MEA monitoring and implementation." Similarly, a report prepared for the Environmental Directorate (DG-XII) of the European Commission called for "greater dialogue between suppliers of earth observation data and services (principally space agencies and value-adding companies) and users of such information (e.g., parties to a treaty)…in order to make parties to treaties more aware of the detailed and tailored capabilities of satellite [earth observation] data and to inform suppliers of users' requirements."

CIESIN, in association with IUCN, MEDIAS France and the Woodrow Wilson International Center, organized the remote sensing and environmental treaties workshop in order to bring together actors from the aforementioned communities for a targeted and results-oriented discussion on the applications of remote sensing to enhance the effectiveness environmental treaties. The workshop's objectives were as follows:

- To increase awareness among MEA constituencies of the capabilities of, and the range of potential applications for, remote sensing technologies;
- To increase awareness on the part of the remote sensing community of the information needs of the contracting parties to MEAs;
- To form a network of individuals and institutions interested in expanding the application of remote sensing to MEAs; and
- To develop specific recommendations for the more widespread application of remote sensing data in treaty development, implementation, and monitoring.

This report provides a summary of the workshop discussions and results. Section II summarizes plenary presentations. Section III provides the principal conclusions and recommendations from the three breakout groups that addressed, respectively, biodiversity and ecosystem management, atmosphere and climate change, and institutional and remote sensing instrument design.

Source: USGS EROS Data Center web site.



AVHRR (Advanced Very High Resolution Radiometer) imagery such as this is useful for global and regional scale land cover change and environmental monitoring, and for selected meteorological and climatological applications.

II. Plenary Presentations

The workshop included four plenary sessions: a presentation on the European Commission's Global Monitoring for Environment and Security (GMES) initiative; a panel on the application of remote sensing to global environmental governance; a keynote speech by Mr. David Sandalow, Assistant Secretary of State for Oceans and International Environmental and Scientific Affairs at the U.S. Department of State; and a closing panel.

II.1 Global Monitoring for Environment and Security (GMES)

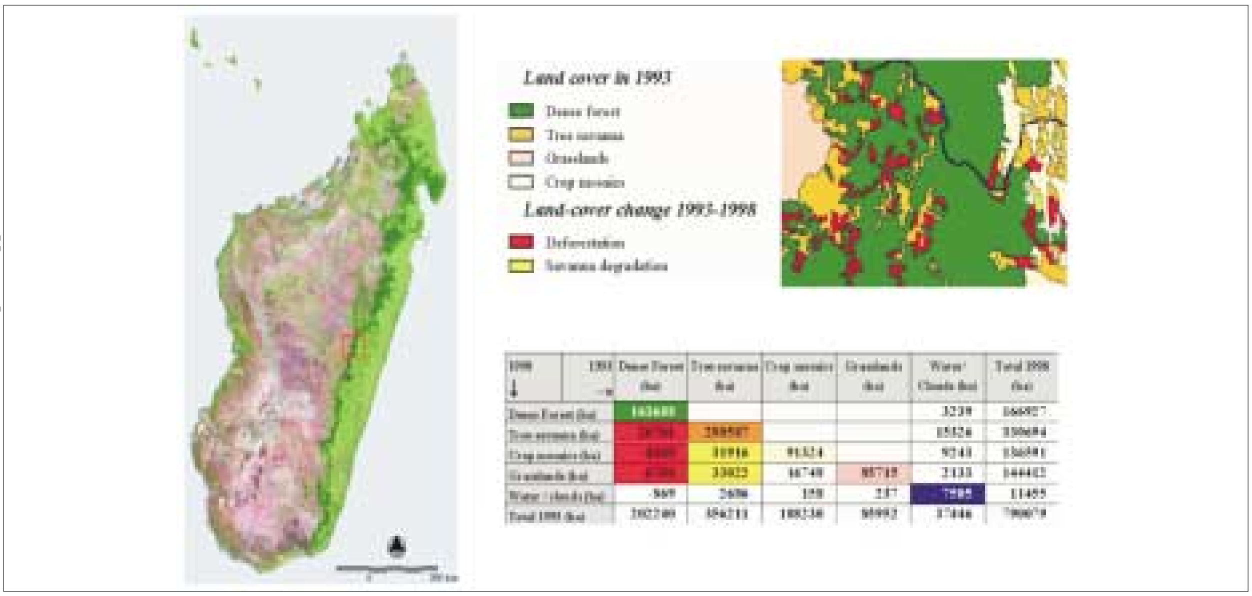
Dr. Jean Meyer-Roux, Deputy Director of the Space Applications Institute (SAI), Joint Research Center (Ispra, Italy), presented on this initiative, which is a collaborative effort between the European national space agencies and SAI.

Background: Europe has strong interests in global monitoring. However, there is no precedent for operational monitoring of environment and security issues in Europe. In order for this to occur, a common vision and implementation plan is necessary. Information from space contributes strongly to the "global" and the "monitoring" parts of environment and security issues. Current capabilities already exist to provide information of this type. Through the efforts of European space agencies, Europe has developed cutting-edge space technology capable of providing precise information on a wide range of global environmental parameters, from operational meteorology to terrestrial and marine resource assessment. Recognizing this, the European space agencies met in Baveno, Italy in 1998 and 1999 and agreed on the need for a common action. Since that time, there has been a drive to develop a response through growing co-operation between different actors in Europe.

The objective of GMES is to elaborate Europe's global monitoring role in the field of environment and security, showing how information from space can provide part of this role. GMES seeks to capture and focus existing industrial and political efforts, and thus to provide a common framework to bring activities together and develop common ownership of a strategy. The technical issues are being examined through three working groups, which examine support to a) Kyoto Protocol implementation and other environmental treaties, b) natural disasters (especially floods and forest fires), and c) environmental stress, population pressures and humanitarian aid.

In his comments, Dr. Meyer-Roux indicated that GMES began in 1998 as a technically driven initiative by the European space agencies. It has evolved into a politically accepted concept. What the GMES has succeeded in doing is federating user needs – that is, the needs of EU member governments and Norway – thereby providing a useful forum for interaction between the EC, government agencies involved in disaster preparedness or environmental negotiations, and the European space agencies. The GMES matches and tests those needs against the most appropriate technology. The arm of GMES that is most operational is the natural disasters group, headquartered at the SAI, which routinely responds to requests for maps and data related to floods and fires throughout Europe. The environmental treaties working group is conducting pilot analyses to see how remote sensing can be used in support of the Kyoto Protocol and the Convention to Combat Desertification. More information on GMES, including a sample set of product brochures, can be obtained on the web at http://gmes.sai.jrc.it.

In the question and answer period, Frederic Nordlund of the European Space Agency added that his agency's two main priorities are navigation by satellite utilizing the Galileo system, and GMES. Ronald Mitchell of Stanford University asked if Dr. Meyer-Roux felt that there was a need for brokers between the technicians and those who use the products. Meyer-Roux responded that we have the tools (the RS technology) and the instruments (agreements between countries for environmental management), and that a system needs to be in place to bring these two sides together. This costs money, and that is what the GMES is in place to do: to raise the political profile of environment and security issues so that the funds will be in place to respond to them. He added that generally we are not serious enough about the implementation of environmental agreements. Margaret Finarelli of the International Space University asked if other aspects of security, such as military and intelligence operations, were being included under the GMES rubric. Meyer-Roux responded that they were attempting to build consensus, and therefore it was determined that it would be better to leave those issues to one side. Marc Levy of CIESIN inquired about how the GMES came to focus on the rather narrow issue of technical specifications to meet the requirements of specific treaty texts, rather than taking a broader perspective of putting management systems in place for the environment. Meyer-Roux responded that if the GMES were to succeed, it needed to be seen as operational from an early stage, and so therefore it needed to be tailored to specific treaty requirements. Finally, there was some discussion about the private sector role in GMES. What Dr. Meyer-Roux emphasized was that if the public sector is going to pay for these systems, they must meet public needs, but that there was still a role for space industries in helping to meet the requirements for GMES.



Source: Space Applications Institute, JRC.

Illustration of a Global Monitoring for Environment and Security (GMES) analysis of land cover change from 1993 to 1998 in Madagascar. The image at left is a SPOT image and the table at bottom right is called a change matrix. It shows the amount of land that was converted from one land cover type to another between the two time periods. Such analysis is useful for assessing deforestation and, indirectly, biomass and biodiversity loss.

II.2 Panel on Remote Sensing for Environmental Governance

This panel was moderated by Dr. Gérard Begni of MEDIAS-FRANCE, and included presentations by Dr. Anthony Janetos of the World Resources Institute (WRI), Mr. Woody Turner of NASA Headquarters, Dr. Durwood Zaelke of the Center for International Environmental Law (CIEL), and Dr. Marc Imhoff of NASA's Goddard Space Flight Center.

Dr. Janetos led off by describing the Millennium Ecosystem Assessment. Just as the Intergovernmental Panel on Climate Change provides scientifically grounded assessment of the drivers, risks, and potential impacts of climate change to the Framework Convention on Climate Change (FCCC), the Millennium Assessment is intended to provide scientific guidance to the biodiversity related conventions (CBD and Ramsar in particular). Dr. Janetos indicated that the Assessment is a process designed to improve the management of ecosystems and their contribution to human development by helping to bring the best available information and knowledge on ecosystem goods and services to bear on policy and management decisions. The Assessment consists of a global scientific assessment as well as catalytic regional, national, and local assessments and has the aim of building capacity at all levels to undertake integrated ecosystem assessments and to act on their findings. According to Dr. Janetos, the Assessment will provide information to, and strengthen the capacity of, government agencies and NGOs, but it will not set goals or advocate specific policies or practices. He then reviewed a number of global land cover data sets, including one describing percent tree cover by the Global Land Cover Facility. He showed some images of deforestation in Brazil illustrating the distinct herring-bone pattern of deforestation along recently constructed roads. These data sets demonstrate current applications of RS for the monitoring of global ecosystems.

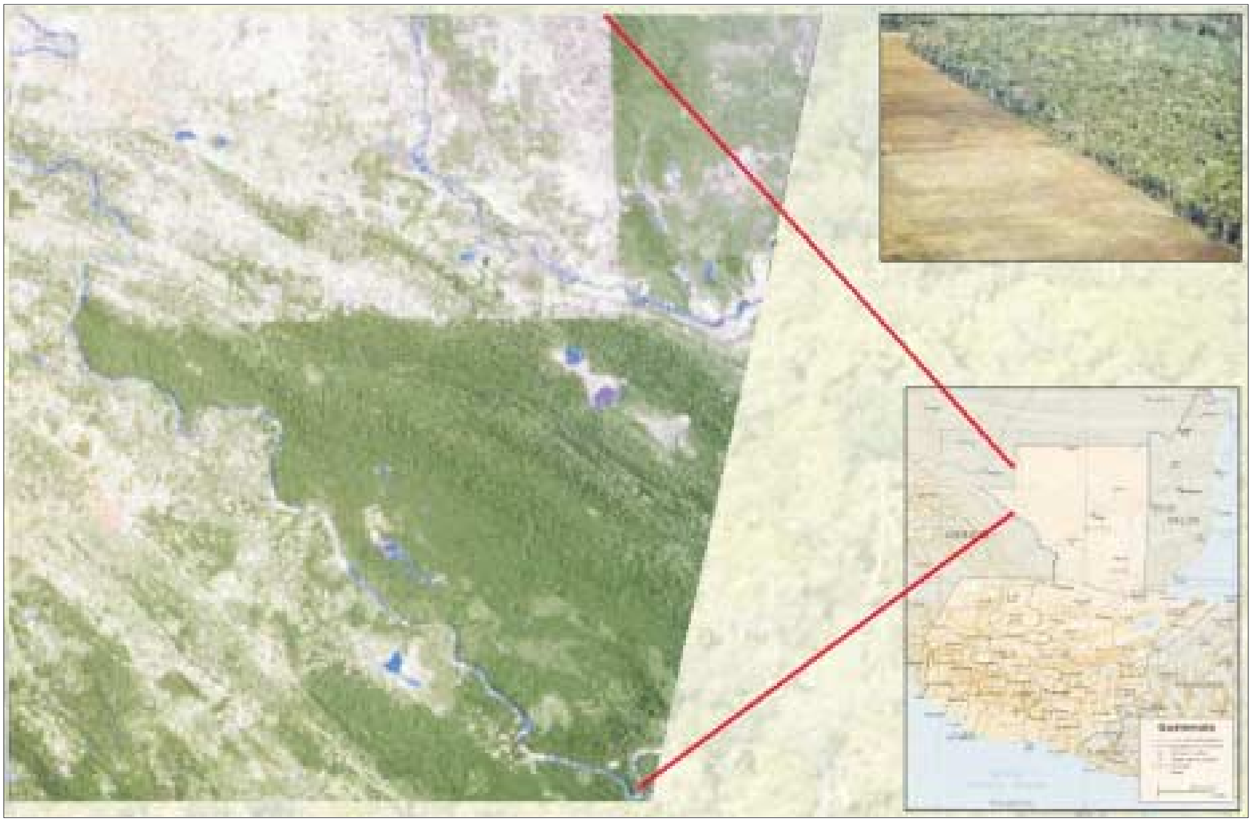
Although he believes that RS data can be of great utility to global environmental governance, Janetos ended his talk with four cautions:

1. RS often provides only proxy measurements for the parameters we are really interested in. If we would like to know about *changes in land cover*, particularly the change in area from one form of cover to another, RS does a good job of providing this information. However, if we are interested in *changes in carbon density* of specific ecosystems, the measures are not yet well developed.
2. RS data cannot be used alone. They need to be accompanied by selective ground-truthing, which is time and labor intensive. Furthermore, they need to be included in models if they are going to have any predictive power.
3. There are significant asymmetries in the utility and use of RS data between developed and developing countries. The financial barriers to RS data analysis are significant, and the availability of the analytical techniques is often limited to well-funded developed country institutions. Training and capacity building for developing countries *has* to be part of the equation if the data are going to be politically accepted in negotiation or compliance processes.
4. There is no clear commitment on the part of the United States to maintain its RS capacity and data in the public domain. For the Millennium Assessment, and for ecosystem management applications more generally, there is a need for higher resolution data than are currently available through the continuously operating meteorological satellites, whose data (such as the 1 Km resolution AVHRR) are in the public domain. However, there is no institutional commitment to keep the Landsat program operational, and to ensure that the data are widely and publicly available at a reasonable cost.

Mr. Turner's presentation focused on the Meso-American Biological Corridor agreement, and the RS activities in support of the agreement being undertaken jointly between NASA and the Central American Commission on Environment and Development (CCAD). The biological corridor is a combination of protected areas and managed landscapes that forms a continuous wildlife migration route from Panama to the Mexican ~~o~~ border. This is an area of rich biodiversity. Partly o~~O~~wing to its position between North and South America, Central America possesses7 to 8 percent of the Earth's species on less than one percent of its surface area. The region has suffered from armed conflicts, and the ecosystems are under stress from population growth, legal and illegal logging, slash and burn agriculture, and cattle ranching. In the late 1990s, the CCAD approached NASA for remote sensing technical support, and in 1998 an MOU was signed. Turner emphasized that the impetus for the MOU came from the Central American side; NASA did not go into the region looking for an application for its technology, but rather, owing to the rapid rates of land cover change in the region, the regional partners saw a need for it.

The project includes land cover/land use mapping, and seeks to develop techniques for change detection and metrics to measure fragmentation. NASA and project partners at the University of Maine are mapping forest distribution and status in order to develop and test biomass estimates using radar data. Utilizing a mosaic of Japanese JERS radar data as the baseline for mapping, and adding digital elevation data and optical remote sensing imagery for nine intensive study areas has allowed the project to bring a variety of remote sensing assets to bear on the challenge of understanding the status of landscapes within the corridor. Field work is being undertaken by Central American counterparts to validate the data. So far the project has developed a number of important data sets and a web site for data dissemination (http://ghrc.msfc.nasa.gov/ccad/), and it has carried out three training workshops for capacity building.

Source: NASA.



Landsat imagery depicting deforesation along the Mexican side of the border between Mexico and Guatemala raised concerns about the impact of land clearing on forest ecosystems, and provided some of the impetus for the development of the Meso-American Biological Corridor. This agreement among Central American states led to the creation of a biodiversity corridor running like a spine from Mexico to Panama, providing protected habitat for migrating species as well as economic opportunities through the sustainable use of forest resources.

Turner emphasized that RS data had helped to raise the profile of deforestation in the first place by alerting the public and decision makers to the scope of the problem. In 1988, a Landsat image was released showing the Mexican and Guatemalan borders in the Petén region of Guatemala~~,~~ with the Mexican side largely deforested and the Guatemalan side still largely under forest cover. The stark contrast at the border, clearly shown in this image, prompted one of the first meetings in decades between the Mexican and Guatemalan presidents to discuss management of border lands, and was probably a significant reason for the development of the Biological Corridor. In conclusion, Turner suggested that RS can:

- Change minds
- Build consensus
- Enhance understanding
- Enable monitoring over time
- Bring people together across boundaries to address common problems
- Provide a powerful tool for international cooperation

Dr. Zaelke of CIEL began his remarks by stating that international and national environmental law making is moving more slowly than the problems that the laws are seeking to address. Global environmental problems will get worse faster than the general public thinks, and this rapid worsening of environmental conditions will be accompanied by calls for better environmental laws. Through its involvement in the Environmental Law Information Service (ELIS) and other programs, CIEL hopes to be ready when the public and policy makers awaken to the need for better environmental laws and legislation. ELIS, for example, seeks to link digital earth science data to environmental law in an on-line information system (http://www.csee.umbc.edu/~elis/). With respect to international environmental law, Zaelke emphasized that it is heavily dependent on good scientific information. To develop agreements such as CBD or FCCC, there needs to be an acceptance at the political level that the scientific evidence points to a significant environmental problem.

Over time agreements are being negotiated and implemented more rapidly. The Law of the Sea took ten years to develop. Current agreements are being negotiated at a much faster pace. However, the agreements are still a long way from being entirely effective, and the secretariats are generally weak, lacking sufficient funds or personnel to carry out their missions. The agreements also need continuous monitoring. One development Zaelke would like to see take place is the inclusion of law in scenario building, such as that done by the Stockholm Environment Institute or World Resources Institute. He feels that if the scenarios are realistic enough, they could provide a strong message that greater strides are needed for improving international environmental governance. Zaelke, like the previous speakers, emphasized the need for capacity building among developing countries. He mentioned that many have difficulty simply with managing the legal aspects of international environmental negotiations. If they are to benefit from the use of remote sensing in support of these agreements, they will need training and financial assistance.

Dr. Imhoff of NASA Goddard Space Flight Center spoke about a number of new remote sensing instruments that have either been recently launched, or will be launched soon, and which could support the implementation of environmental agreements. One such instrument is MOPPIT, which can trace carbon-monoxide emissions, which is proxy for a number of greenhouse gases. A video clip showed detection of plumes of smoke from agricultural land clearing in West Africa and Central and South America, and industrial emissions in Europe and the northeastern United States, as they are blown by winds over neighboring regions. Merging this kind of data in a GIS can provide a very powerful analytical tool. Imhoff serves on the scientific committee of the Pathfinder program at NASA, which seeks to develop small, quick turn-around sensors that can fill important scientific data gaps. Pathfinder solicits proposals every three years, and he suggested that if audience members had specific pilot projects that could help to meet MEA related needs, *and* that answer important science questions, they should contact him for details on the proposal process. Pathfinder contrasts with the Earth Observing System (EOS), which develops large instruments covering longer time periods, with far larger budgets. Imhoff indicated that NASA's larger science projects are developed in response to needs identified by the National Science Council, the National Academy of Science, or the US Global Change Research Program. Instrument development is fairly interactive with the science community, but so far the process has not involved wider MEA constituencies such as convention secretariats, contracting parties or environmental NGOs. What gets built depends in large part on what is technically, technologically, and financially feasible.

II.3 Keynote Address by the Assistant Secretary of State for OES

Mr. David B. Sandalow, Assistant Secretary of State for Oceans and International Environmental and Scientific Affairs (OES), spoke during a lunchtime plenary on the second day. His full remarks can be found on the workshop web site.

Mr. Sandalow began by describing the work of OES, which is the arm of the US State Department responsible for monitoring and negotiating international agreements on environment, as well as civil science and technology issues. It is not difficult to document the proliferation of MEAs that has occurred in the past decade. OES's portfolio includes over 180 international treaties and conventions on environment, science, technology and health. Since the 1992 Earth Summit in Rio de Janeiro the number of negotiations, agreements and treaties OES supports has nearly tripled. Examples of the broad range of environmental topics that OES addresses through these agreements, include: the 1946 International Whaling Commission, the 1975 Ramsar Convention on Wetlands, the 1982 UN Convention on the Law of the Sea, the 1987 Montreal Protocol to The Vienna Convention for the Protection of the Ozone Layer, 1989 Basel Convention on the

Transboundary Movement of Hazardous Waste, the 1992 Convention for the Conservation of Anadromous Fish in the North Pacific Ocean, and the 1994 UN Convention to Combat Desertification.

Given these treaty-related responsibilities, Mr. Sandalow indicated that he has a particular interest in the application of remote sensing as a tool to develop and refine multilateral environmental agreements. This interest also is consistent with the State Department's ongoing commitment to enhance the use of science and technology assets in the formulation and implementation of U.S. foreign policy. He mentioned that many understand how this technology could play a role in the reporting and inventory of carbon stocks called for by Article 3 (on human-induced land use change and forestry) and Article 12 (on the Clean Development Mechanism) of the Kyoto Protocol to the UN Framework Convention on Climate Change. But few have fully explored how this same technology could be used to monitor and enforce environmental treaties that attempt to reduce land-based sources of marine pollution, transboundary movement of hazardous wastes, and overexploitation of fisheries. Perhaps, he speculated, in the not too distant future, governments will be able to use remote sensing data to routinely evaluate international regime effectiveness, verify national reporting practices, and assess treaty implementation.

With the rapid growth in the number of environmental treaties OES recognizes remote sensing as a potentially invaluable tool in developing, refining, and monitoring many of these agreements. But, Sandalow cautioned that many challenges remain. Both domestic and international policy makers need to clarify how this technology is to be effectively harnessed. Sandalow agreed with the authors of the workshop background paper (available on the workshop web site), which identifies some difficult issues that need to be addressed, such as:

- Demonstrating to the environmental diplomatic community the potential benefits and relevance of remote sensing tools.
- Identifying priority MEAs where remote sensing tools are already providing value added in either the development, implementation or monitoring of agreements.
- Fostering an active dialogue between remote sensing scientists and the foreign policy community.
- Identifying international guidelines for the development of remote sensing procedures, standards and data formats for its integration into the negotiation and implementation of environmental treaties.

He added that many of these questions will need to be resolved before these technologies can be fully incorporated into the OES diplomatic toolbox.

Sandalow concluded his speech by listing a number of initiatives that OES is presently engaged in that have a direct bearing on the topic of the remote sensing and environmental treaties workshop:

1. OES approached the National Research Council's Space Studies Board in June 2000 with a request to bring together experts from government, industry and academia to examine the emerging role of remote sensing in foreign policy development and implementation. A preliminary meeting was convened on November 3, 2000 to discuss the scope of this study. It is his hope that the results of the study will identify some of the hurdles that today prevent us from realizing the full potential of remote sensing technologies.
2. OES is working with the UN's Office of Outer Space Affairs to fund and develop a series of regional workshops in Africa, Asia, Latin America, and Eastern Europe for the promotion of space applications for sustainable development. These workshops will emphasize the synergy of satellite navigation information and geospatial techniques, to support a wide range of environmental applications.
3. OES is participating in the organization of a working group for the Sixth International Space Cooperation Workshop meeting in Seville, Spain, in March 2001. This group will discuss the "Contribution of Space Systems to the Implementation and Verification of International Environmental Agreements." It is co-sponsored by the American Institute of Aeronautics and Astronautics (AIAA) and the Confederation of European Aerospace Association (CEAS).

4. OES is working with NOAA on initiatives to promote the effective use of existing space technologies for the application and sharing of information to manage natural and industrial disasters. Specifically, OES is working with the Committee for Earth Observing Satellites (CEOS) Disaster Management Support Project. In addition, OES has been an active participant in the development of the Global Disaster Information Network (GDIN). Through GDIN, OES is engaged in an international effort to develop regional disaster information networks that facilitate timely dissemination of the right information in the right format to disaster managers in order to save lives and property.
5. OES has joined the Civil Applications Committee (CAC), an interagency committee that coordinates and oversees federal civil use of classified and unclassified information. The CAC facilitates imagery acquisition, provides applications support services to Committee members and coordinates remote sensing research and development. This will provide further venues for the State Department to engage technical agencies with remote sensing expertise.
6. OES hosted the MEDEA workshop in November 2000. MEDEA is a group of senior scientists, created by the government in 1994, to address the intersection of environmental science, national security and foreign policy. The objective of this workshop was to identify ways that MEDEA can better assist the Department of State with scientific issues; the discussion addressed how remote sensing can support the Department of State on key environmental agreements.
7. OES is co-sponsoring, along with the Bureau of Intelligence and Research (INR), the National Imagery & Mapping Agency and the DCI Environmental and Societal Issues Center a one-day workshop on December 15, 2000 entitled "Remote Sensing and Environmental Change: Implications for Diplomacy." The purpose is to educate and inform policymakers at the State Department and other agencies with whom OES collaborates on the relevance of this technology to environmental diplomacy.

II.4 Closing Panel: Conclusions and Next Steps

This panel was moderated by Mr. Marc Levy of CIESIN, and included presentations by Dr. Kal Raustiala of the UCLA Law School, Ms. Margaret Finarelli of the International Space University, Dr. Robert Harriss of the National Center for Atmospheric Research (NCAR), and Dr. Oran Young of Dartmouth College.

Dr. Raustiala of UCLA began his presentation by emphasizing that the most important barriers to integrating remote sensing data into MEAs are political and institutional. Though Mr. Sandalow stated that the major barriers to RS use were primarily institutional, Raustiala noted that there is evidence that the political barriers are also quite high. Many MEAs are not currently gathering, requesting or using scientific data to any noticeable extent, and it is not clear that RS data will be treated any differently. Reporting and review provisions are very weak in most MEAs, and attempts to improve them, and to make them more rigorous and data-rich, have largely failed. Programs on the remote sensing side, such as the Committee on Earth Observation Satellites (CEOS), Integrated Global Observing Strategy (IGOS), Global Ocean Observing System (GOOS), etc., are also not currently well integrated with MEAs. The Montreal Protocol is a major exception to this general rule, insofar as scientific data is being used extensively, but the political commitment is quite high and hence this exception seems to prove the rule.

Therefore, Raustiala cautioned that we need to be careful in targeting the use of RS data in MEA processes and take into account the political context. He noted that although treaty compliance received considerable attention in breakout group discussions, compliance is one area where governments are very sensitive and, apart from certain cases such as the Kyoto Protocol, the use of RS for compliance purposes is unlikely. And while the Kyoto Protocol is politically very important, its future is not clear. Biodiversity treaties might be a useful group to emphasize, particularly because there is already an interest in harmonization of the various reporting requirements and because RS is well-suited to terrestrial issues. Raustiala also suggested that there need to be more concrete pilot projects, such as the MesoAmerican Biological Corridor initiative, which can demonstrate the utility of RS data to MEA needs. In conjunction with clear lists of MEA provisions that are mapped onto relevant RS technology, such projects may help persuade governments and other stakeholders of the utility of RS for environmental cooperation. Finally, Raustiala suggested that RS could be useful for overall assessments of MEA effectiveness, which can then help in the development and refinement of MEAs. Because assessments are systemic in nature, rather than focused on individual governments or actors, the use of RS in assessments may be politically more palatable.

Ms. Finarelli of the International Space University spoke of two potential uses of RS data: a) to get environmental issues onto the public agenda, and b) to implement MEAs more effectively. The workshop primarily focused on the second, and there was a general agreement that activities such as the development of continuous data sets, insuring global public access to data, and training and education to increase the use of data are very expensive. However, RS data could also be utilized to pull MEAs in new directions and to increase public support. If more resources are to be allocated to MEAs, and MEAs are going to be stronger and more effective, there needs to be a strong level of commitment on the part of policy makers and the public to the environmental agenda. There needs to be a long-term commitment to MEAs, but the US policy agencies responsible for them, such as the State Department, have limited resources to fund RS-related activities, and scientific agencies such as NASA have no direct mandate to support MEAs. The near demise of the Landsat program illustrates the precariousness of sustained funding for ongoing environmental monitoring and assessment.

Ms. Finarelli went on to say that the costs of RS are quite significant. It cost $10 million to develop a full set of Landsat scenes for the coterminous U.S. for three different time periods. If such data sets are to be developed globally, the costs will be significantly higher, and ensuring global access to avoid differential enforcement of environmental agreements will be difficult. She distinguished low resolution meteorological data, which has generally been produced for free and public access, with medium to high resolution land-based data, which due to a legacy of national security considerations and the direct relevance of the data to valuation of natural resources, have generally been available only at significantly higher cost. In addition, she stressed that there is a difference between monitoring, on the one hand, and verification and enforcement, on the other. Verification is a political process. You need the political will to confront a violation. In the case of the Montreal Protocol there was good public consensus on the problem and what needed to be done, but with Kyoto it is very different. So the question, according to Finarelli, is how can RS be used to promote public awareness and understanding of environmental problems, so that it will lead to bigger budgets for MEAs and the development of necessary data resources in support of them?

Dr. Harriss of NCAR indicated that the panel on RS technologies and governance (see section II.2) had provided workshop participants with very good exposure to the development of new RS technologies at NASA, and that the breakout groups had fostered a fruitful exchange. He then provided four recommendations:

1. We need to look into existing and planned operational RS and resource information systems (as opposed to developmental RS systems). An example of a successful operational system that integrates RS (Landsat) data, weather model data, and human observations is the US Department of Agriculture/NOAA World Agricultural Outlook (WAO) program, which monitors and forecasts global agricultural yields. Also, the Famine Early Warning System (FEWS) uses AVHRR data in combination with weather data and ground-level observations to issue famine alerts. The WAO and FEWS operate on small budgets but produce extremely useful results.
2. We need to carefully study what NOAA and the Department of Defense are planning for in the future National Polar Observing Earth Satellite System (NPOESS). In this regard, the climate research community has been very assertive in making its voice heard within both these agencies.
3. We need to think deeply about what kind of educational tool kit is necessary for bridging the RS and international environmental policy worlds. Training will be vital for the next generation of leaders.
4. Advanced information technologies, especially digital library and computer-assisted

simulation tools, are ideally suited to the problem set addressed by the workshop. In addition, new Internet search capabilities are needed that are based on retrieval of all information for defined spatial coordinates. This will help national-level analysts to obtain digital Earth science information relevant to their specific geographic area of interest.

Dr. Oran Young of Dartmouth College had three “categories” of comments: the functions of RS data in relationship to MEAs, organizational and structural issues relating to the use of RS in connection with MEAs, and community building and next steps. In the first, he suggested that we steer away from issues of verification and compliance enforcement. Contracting parties will likely be reticent and possibly obstructionist. But, the systematic monitoring of MEAs or ecosystems would be very valuable. Part of the problem, according to Young, is that we don’t understand the problem. RS data could be useful for identifying the main problems. We need to demonstrate in a dramatic way the potential of RS data to contribute to environmental monitoring.

In the second category, he indicated that the organizational and institutional issues are significant. These are big issues where we need problem solving, credibility, continuity and commitment. There needs to be a dialogue between the two sides – e.g., IGOS (or an IGOS like remote sensing partnership) and MEA constituencies – to talk about the opportunities, but also the credibility issues, and to address issues of long-term continuity of data in support of MEAs. The Global Environmental Facility, World Bank or perhaps a consortium in the business community such as the World Business Council for Sustainable Development might be possible funding sources for this kind of initiative. Finally, in regards to community building, Young indicated that we need to get the right people together from the cutting-edge science-oriented agencies like NASA or the European, Japanese, Brazilian, and Indian space agencies, and the MEA community on the other, and encourage them to have a dialogue and to develop pilot projects. He mentioned two initiatives that are begging for data: the Arctic Climate Impact Assessment, and the International Coral Reef Initiative. Perhaps these could form the basis for pilot efforts.

The panel ended with a discussion of next steps. As a preliminary move to maintain the momentum from the workshop, it was agreed to maintain the workshop web site as a ongoing, high profile “portal” or bulletin board where people involved in this kind of activity can post information about what they are doing, and ideas can be exchanged. Other suggestions included development of an on-line news service. It was emphasized that it is very important to engage the MEA community, and particularly the secretariats and contracting parties, through these services.

III. Breakout Groups

A large portion of the workshop was dedicated to discussions in three simultaneous breakout groups on the following topics:

Biodiversity and Ecosystem Management
This breakout group addressed a range of issues related to biodiversity conservation and ecosystem management in terrestrial and marine environments. Specific topics included wetland and forest conservation, marine and coastal environmental protection, desertification, and endangered species protection through habitat conservation. The group looked at the CBD, Ramsar, CITES, World Heritage, CCD, MARPOL, and other marine-related conventions.

Atmosphere and Climate Change
This breakout group addressed issues related to atmospheric pollution, protection of the ozone layer, and climate change (especially mitigation strategies). The workshop focused on remote sensing applications related to regional air pollution, ozone hole monitoring, remote monitoring of land surface temperatures, and land-based carbon emissions and sequestration (sinks). The group looked at the LRTAP, the Vienna Convention and Montreal Protocol, the FCCC and Kyoto Protocol, among others.

Institutional and RS Instrument Design
This cross-cutting breakout group addressed aspects of institutional design across the wide range of MEAs, and issues related to the design of the next generation of instruments. It sought to address the following questions: How do we write new international environmental laws in such a way as to take advantage of RS data? How can political sensitivities be addressed so as to make the use of RS imagery more palatable to Contracting Parties for monitoring and compliance purposes? What opportunities are there to influence the design of new RS instruments so that useful data that are currently not available are produced in 5-10 years time?

Each group was provided a list of questions to guide their discussions (see Annex 3), but was free to diverge from that list. The following are summaries of their principal conclusions and recommendations.

III.1 Biodiversity and Ecosystem Management Breakout Group

This group was co-chaired by Durwood Zaelke of CIEL and Antoinette Wannebo of CIESIN. It reviewed a range of issues in relation to the topics listed above. In its report out, the group suggested that there is a need to transition from scientific or experimental uses of RS to an operational mode. To do this, MEA constituencies will need to see that the data are reliable, which entails a commitment to provision of standardized and "ready-to-use" data with 20-30 meter spatial resolution and high temporal frequency. Transparency is critical; all parties need to have uniform access to the raw data and the methodologies used to develop the processed data, or it is likely that the data will be subject to dispute. The group endorsed the Land Remote Sensing Act of 1992 and similar resolutions addressing data collection, management, access and archiving (see Box).

Selected Quotes from the Land Remote Sensing Act of 1992
United States Congress

"The continuous collection and utilization of land remote sensing data from space are of major benefit in studying and understanding human impacts on the global environment, in managing the Earth's natural resources, in carrying out national security functions, and in planning and conducting many other activities of scientific, economic and social importance;" "The cost of Landsat data has impeded the use of such data for scientific purposes, such as for global environmental change research as well as for other public sector applications;" and "It is in the best interest of the United States to maintain a permanent comprehensive Government archive of global Landsat and other land remote sensing data for long-term monitoring and study of the changing global environment."

The group also recommended that better linkages be developed between the data providers and the data users. They suggested a particular focus on the needs of remote sensing users (MEAs), and the ability of data providers to meet those needs (in terms of the spatial, spectral and temporal resolution and cost issues). For MEAs that are currently being negotiated, it is important to consider data needs up front. For existing MEAs, it was recommended that an analysis be conducted of ongoing uses of RS data. In line with these recommendations, the group proposed four action items:

A review of case studies and literature to document past successes and failures in the use of RS directly in relation to MEAs, or in applications that are directly relevant to MEAs.

The creation of a joint team of data providers and users to study and apply remote sensing to meet specific needs of a subset of MEAs. Research questions and key obstacles would be highlighted, and a matrix of MEAs and relevant data products would be developed.

Involvement by the joint team in ongoing activities such as those of the Millennium Ecosystem Assessment, Conservation International, and the Ramsar Bureau.

Active outreach to promote findings of this workshop and the above activities at international agencies, MEA secretariats and among scientific and technical bodies advising environmental conventions.

III.2 Atmosphere and Climate Change Breakout Group

This group was co-chaired by Craig Dobson of the University of Michigan and Susan Subak, a AAAS Fellow at the U.S. Environmental Protection Agency. Although the group did address atmospheric pollution and depletion of the ozone layer to some extent, the central focus was on the issue of land-based carbon sinks and emissions as addressed under the Kyoto Protocol.

The group gave a few examples of how RS had been used in assessment and awareness raising. For example, the Tropospheric Ozone Mapping Satellite (TOMS) was instrumental in creating the public awareness and outcry about the ozone hole that led to the Montreal Protocol, and continues to be used to raise awareness of ozone depletion. RS imagery also has contributed to concern over deforestation and biomass burning, particularly in the tropics. The IPCC indirectly made use of RS data on deforestation and land cover (e.g. methane from rice paddies) when citing estimates of land-based emissions and sequestration of carbon. Finally, RS has been used in FCCC pilot projects in Costa Rica and Bolivia. Costa Rica has used Landsat imagery of forest area to determine whether landowners are eligible to take part in the country's carbon sequestration incentive program. Remote sensing was used in Bolivia's Noel Kempff Project to develop a vegetation stratification map of the area, and work is ongoing to investigate the potential application of high resolution aerial videography and laser altimetry for annual monitoring of selected logging concessions. The only direct application of RS data to an MEA that the group was aware of was one instance of syntetic aperture radar (SAR) data being used to track an oil spills to a particular ship in the Straights of Malacca under the MARPOL convention.

The group determined that RS has not been used more often because the data are often unavailable for the needed times, or in the formats, that MEAs require. Sensors may not be turned on, data may not be archived, or the data may simply have been lost. Awareness of existing data among MEAs is probably limited, and even where it is available, the motivation to use it may be small.

Should the Kyoto Protocol enter into effect, the group determined that there are several systems currently in place in either operational or experimental modes that could meet its data needs. First, there are coarse, moderate and fine resolution passive optical systems that are sensitive to surface chemistry (via pigmentation) and this data can be used to infer other surface conditions (i.e., land cover class). There are also experimental airborne LIDAR (Light Detection and Ranging) systems that can measure canopy height; the most advanced systems record the full wave return and can also provide information on surface height and the vertical distribution of vegetative material. In addition, there are microwave (radar) satellite systems that can measure moisture and structure (for above ground biomass). However, LIDAR and radar systems were not on satellites for the Kyoto baseline period of 1990. A number of satellite radar systems have been put into service by the international community (notably Japan, Europe and

Canada) during the 1990s, though none of these are particularly well-suited for collecting data that can be used to estimate above-ground biomass on a global basis, nor have they been tasked to do so.

Experts in the breakout session agreed that many practical obstacles exist to using these data tools to generate accurate estimates of above-ground carbon or even biomass stocks. These challenges include the potential cost of coordination, standardization and conversion of optical, radar and LIDAR data through common empirical models to yield the quantities of interest. It must also be noted that the integration of these data requires accurate digital elevation models of topography that today are only locally available (though this should be remedied over the next year given the recent success of the NASA/NIMA Shuttle Radar Topography Mission). Finally, in most cases, remote sensing does not provide a single source solution to information needs; rather it serves to extend an ongoing and healthy program of *in situ* observations. Within this context, the promise of remote sensing is to allow the development of more robust and efficient ground sampling strategies and to subsequently extrapolate from such *in situ* measurements in both space and time.

For Kyoto, there is a need for a number of GHG measurements that can be obtained wholly or partly via RS. These include methane and nitrous oxide emissions, which are related to land cover features such as inundated areas (rice paddies), soil moisture, and temperature. There is an interest in land cover type, height, and above ground biomass (woody vegetation). Existing RS technology may be more readily used for estimating carbon sequestration on agricultural lands than in forested areas because tillage practices and crop types can be identified through optical imagery alone.

Land cover comes up repeatedly as a data requirement, not just for the Kyoto Protocol, but for a host of other MEAs. For example, among atmosphere-related MEAs, land use/land cover information can be helpful in estimating the quantity and spatial distribution of emissions of persistent organic pollutants, acid rain precursors, and other pollutants subject to agreements such as LRTAP. Among atmospheric MEAs, RS also offers the ability to measure atmospheric concentrations of GHGs, aerosols, particulates and other regionally or globally important air pollutants through the air column. Such measurements require side-looking sensors.

In the future, it is possible to envisage a suite of tools that could support MEAs such as Kyoto. The RS component would include a constellation of optical, LIDAR and radar instruments, flying roughly in formation, that would collect data simultaneously over the same land areas. These would need to be operational, with a commitment to long-term data provision. These would be linked, in turn, with *in situ* observations (for ground-truthing), improved estimates of biomass stocks, and to models that would integrate the RS data and provide some predictive capacity regarding future land-use changes and their relationship to emissions and concentrations of GHGs.

In terms of institutional infrastructure, the group recommended that an IGOS-like international coordinating body address issues of scientific research, funding, infrastructure development, operations, and access to/archiving of RS data. On the MEA side there need to be reporting and compliance monitoring structures, and some coordination among the MEAs to link data to treaty-specific applications.

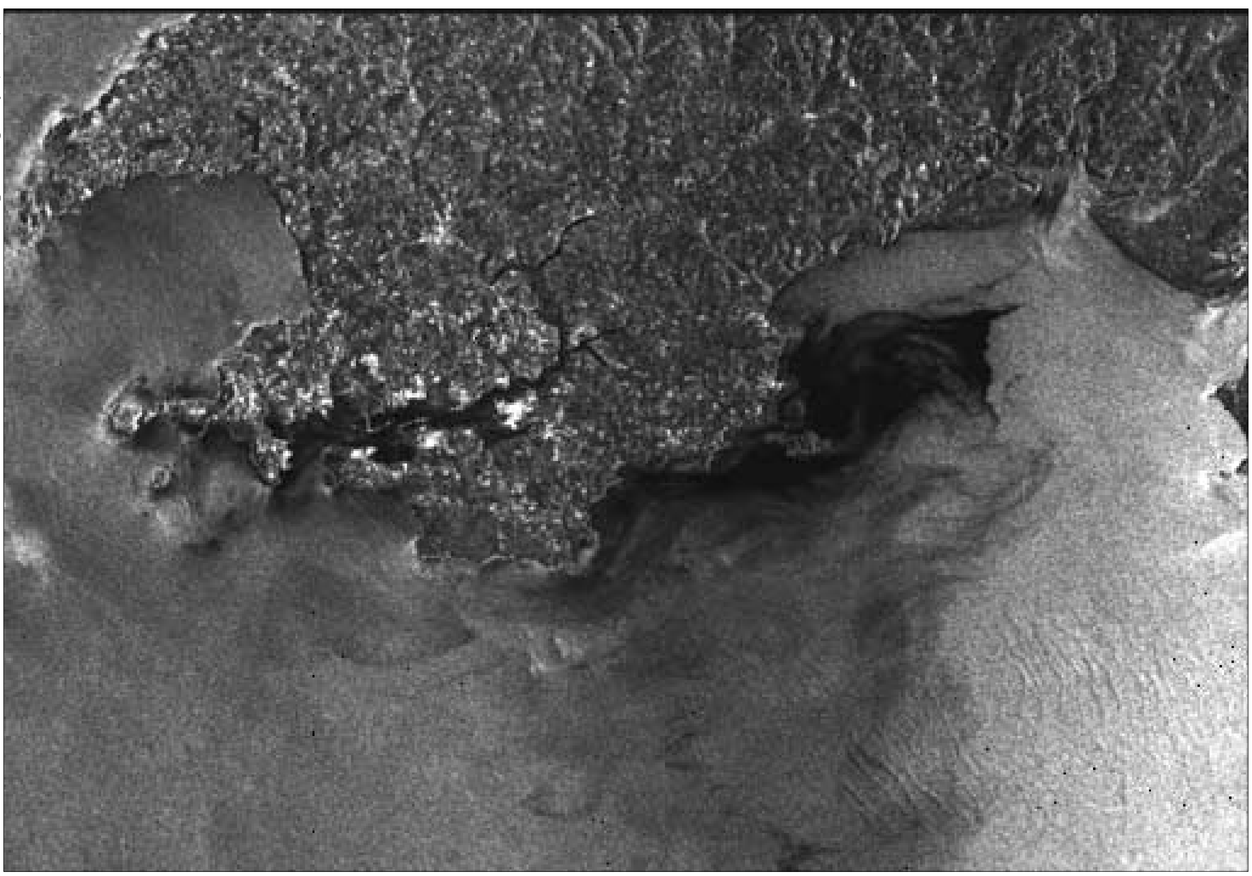
III.3 Institutional and RS Instrument Design Breakout Group

This breakout was co-chaired by Ronald Mitchell of Stanford University and Marc Imhoff of NASA Goddard Space Flight Center. The report out emphasized that the group had independently come to many of the same conclusions as the first two groups. The group indicated that RS can function in a number of modes. It can prompt new agreements, influence behavior under existing agreements, and evaluate past performance and effectiveness. However, there are a number of significant problems. These include lack of consistency and standardization of data sets, lack of infrastructure for access to/use of data, and differences in the goals between the collectors and users of the data. There are also “disconnects” between providers and users: the users don’t understand the capacity of RS to meet certain information needs, and the creators don’t understand the needs of MEA constituencies. Other major problems include issues of sovereignty, the high costs of data, and lack of communication or “linkages” between the two groups.

To address "linkage" issues, the breakout group recommended:

1. Annual meetings between MEA and RS people, including attendance of MEA representatives at major RS meetings;
2. More effective utilization of organizations such as CIESIN or the World Conservation Monitoring Centre;
3. Meetings such as those being organized by OES (see section II.3) and CIEL on Digital Earth Applications in Environmental Law;
4. Integration of RS and socio-economic data sets; and
5. Exploring how scientific research needs can be reconciled with requirements for operational, ongoing monitoring.

The group recommended demonstration projects, and in particular it was suggested that the Clean Development Mechanism pilot projects under way in Costa Rica and Bolivia be evaluated. Product creation, such as that underway through GMES or the MesoAmerican Biological Corridor, could help to sell MEAs on the capacity of RS to meet needs. This would generate demand for further applications of the data. The group recommended the development of a matrix, such as that proposed by breakout group 1, listing MEA needs and RS assets. Finally, there is need for a demonstration project on biodiversity and ecosystem management that would meet the collective needs of the biodiversity conventions. In the area of training, the group recommended a summer workshop bringing together MEA representatives and RS experts, and particularly drawing on environmental professionals in developing countries.



A Radarsat Synthetic Aperture Radar (SAR) image picks up an oil spill along the coast of Wales. The only known instance of remote sensing imagery being used in a compliance verification mode was the case of an oil spill in the straights of Malacca near Singapore under the MARPOL convention.

Annex 1. Workshop Agenda

Day 1: December 4

8:30 Welcome, The Honorable Lee Hamilton, Director, Woodrow Wilson Center

8:35 Welcome and Introductions, Dr. Roberta Balstad Miller, Director, CIESIN

9:00 A Worked Example: Global Monitoring for Environment and Security – A European Perspective
Introduction: Dr. Oran Young, Director, Institute on International Environmental Governance, Dartmouth College, and co-chair, workshop organizing committee
Presenter: Dr. Jean Meyer-Roux, Deputy Director, Space Applications Institute, Joint Research Centre, Italy

9:45 **Discussion**

10:00 Workshop Overview and Breakout Group Instructions
Dr. Robert Harriss, Director, Environmental and Social Impacts Group, National Center for Atmospheric Research, and co-chair, workshop organizing committee

10:15 Question & Answer

10:30 Coffee Break

11:00 Parallel Breakout Sessions
Remote sensing applications to assist in the negotiation, implementation and review of treaties in the following areas:
1. Biodiversity and Ecosystem Management
2. Atmosphere and Climate Change
3. Institutional and Remote Sensing Instrument Design

12:30 Lunch

1:30 Parallel Breakout Sessions (Continued)

3:00 Coffee Break

3:30 Preliminary Progress Reports from Breakout Groups

4:00 Panel Discussion: Remote Sensing for Global Environmental Governance
Moderator: Dr. Gérard Begni, MEDIAS France
Dr. Anthony Janetos, Sr. Vice President, World Resources Institute, USA
Dr. Marc Imhoff, Biospheric Sciences Branch, NASA Goddard Space Flight Center
Mr. Woody Turner, Coordinator for Scientific Assessments and Biological Initiatives, Office of Earth Science, NASA Headquarters
Dr. Durwood Zaelke, President, Center for International Environmental Law

5:30 Wine and Cheese Reception

Day 2: December 5

9:00 Parallel Breakout Sessions (continued)

12:00 Keynote: Remote Sensing and Environmental Agreements – A U.S. Perspective
Mr. David B. Sandalow, Assistant Secretary of State for Oceans and International Environmental and Scientific Affairs

1:00 Lunch

1:30 Reports of Breakout Groups to Plenary

3:00 Coffee Break

3:30 Closing Panel
Moderator: Mr. Marc Levy, CIESIN
Dr. Kal Raustiala, Associate Professor of International Law and Politics, University of California-Los Angeles Law School
Ms. Margaret Finarelli, Vice President for North American Operations, International Space University
Dr. Oran Young, Director, Institute on International Environmental Governance, Dartmouth College, USA
Dr. Robert Harriss, Director, Environmental and Social Impacts Group, National Center for Atmospheric Research

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Annex 3. Questions for Breakout Groups

What are examples of actual treaty-relevant applications that are being undertaken at present, using which instruments, and in which geographic areas?

How appropriate are the current instruments and measurements to the principal monitoring or information needs of the relevant MEAs?

What are the advantages of using RS vis-à-vis other methods of information collection? (e.g., synoptic view, consistency and comparability, ability to monitor remote areas, cost effectiveness, etc.)

What are the disadvantages of using RS vis-à-vis other methods of information collection? (e.g., cost considerations, capacity to process and analyze the data, misinterpretation of imagery, etc.)

What institutional components must be in place to link "raw RS data" to "useful MEA-relevant knowledge"? Where might this kind of activity be located (e.g., global centers, regional institutions, national institutes, or some combination thereof)?

What is the potential for more widespread application of the technology in the following areas:

- Identification and framing of important environmental issues
- Negotiation of treaties
- Implementation review
- Compliance and dispute resolution (in light of sovereignty concerns)
- Environmental assessment
- Utilization by NGOs and MEA constituencies for awareness raising

What are the needs of the relevant MEAs for trend analysis, analysis or archiving of historical data, and more broadly, data management?

What are the needs among MEA constituencies (Contracting Parties, secretariats, and environmental NGOs, particularly in the developing world) for awareness raising and capacity building in the domain of remote sensing?

What are some new or emerging RS data products that may contribute to MEAs in the area under consideration? What kind of sensors are not currently available or under development but would nevertheless be useful to MEAs?

How might the design of MEAs need to be modified in order to accommodate the use of more remote sensing imagery?

In cases in which an MEA is using RS well, what explains their success? In those which have access to RS but are using it poorly, what explains their failure?

What would constitute a good process for taking maximum advantage of existing RS capabilities while also making future RS capabilities more useful to MEAs?

Groups are encouraged to develop specific recommendations and strategies for how to make remote sensing more useful to MEAs addressed in each thematic area, and how MEAs might adopt remote sensing technology to improve their effectiveness.