Highlight Article

The Global Land 1-KM AVHRR Project: An Emerging Model for Earth Observations Institutions

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Civil Earth observation programs are increasingly being defined by data distribution and access as well as on-orbit operations. This will be particularly true of NASA's Earth Observing System (EOS) and its terrestrial data and information system, the Earth Observation System Data and Information System (EOSDIS). Complex systems like EOSDIS create circumstances where more obstacles to successful missions are generated on Earth than in space.

In general, most satellite operating nations have mastered the space segment and can reasonably expect routine technological advancement to be an ongoing norm. However, the ground segment — where incompatible national policies, ambiguous laws, nonenforceable agreements, and resource and expertise disparities have hampered the evolution of the terrestrial networks necessary for long-term data collection and processing — fails to reflect this same degree of success. A key to increased ground segment success is utilizing an interdisciplinary definition of "ground segment" which includes legal, political, and technological agreements, facilities, and organizations. When considered as a whole, these elements form nascent institutional infrastructures.

This paper examines the *Global Land 1-KM AVHRR Project* (1-KM Project), an emerging Earth observations data network which has been catalyzed by the space segment. It is an evolving network whose participants deal with a spectrum of interrelated policy and technology issues, which, when addressed, create a web of agreements that continue to define the project's nature while advancing its goals. After 18 months of successfully gathering an ongoing global data set, the project's emphasis is shifting to product generation and user access. It appears poised to become operational and may serve as a model for EOSDIS.

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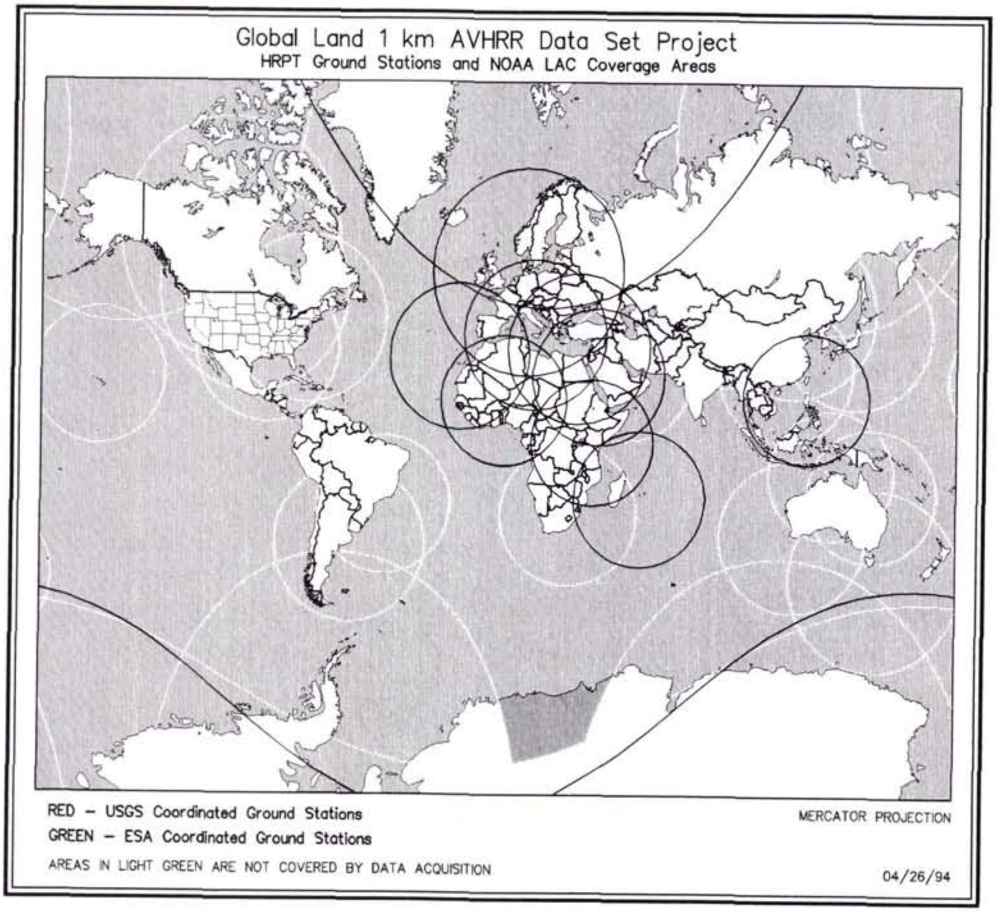
The object of the 1-KM Project is the acquisition and compilation of a global land 1-km resolution multi-temporal AVHRR data set.[1] In 1991, the four original major project partners were the National Aeronautics and Space Administration (NASA), the National Oceanographic and Atmospheric Administration (NOAA), the U.S. Geological Survey/EROS Data Center (USGS/EDC), and the European Space Agency/ European Space Research Institute (ESA/ESRIN). They were joined shortly thereafter by the Commonwealth Scientific and Industrial Research Organization of Australia (CSIRO). Combining NOAA's High Resolution Picture Transmission (HRPT) stations and its Local Area Coverage Recorder (LAC), ESA/ESRIN's AVHRR HRPT ground station network, the USGS/EDC ground station network, and key CSIRO Australian HRPT stations, the partners created a global data receiving network — in fact, a network of networks — consisting of approximately 29 active ground stations.[2] The first data was received and ingested by EDC on 1 April 1992.[3]

USGS/NASA responsibilities include daily data acquisition directly from NOAA satellites and NOAA ground stations; establishment of agreements and technical plans with ESA and CSIRO to acquire and transfer data

GLOSSARY

ALRDC	Australian Land Research Data Center
AVHRR	Advanced Very High Resolution Radiometer
CEOS	Committee on Earth Observing Systems
CSIRO	Commonwealth Scientific and Industrial Research Organization of Australia
EDC	EROS Data Center
EOS	Earth Observation System
EOSDIS	Earth Observation System Data Information System
ESA	European Space Agency
ESRIN	European Space Research Institute
HRPT	High Resolution Picture Transmission
LAC	Local Area Coverage Recorder
LGSOWG	Landsat Ground Station Operations Working Group
LP-DAAC	Land Processes Distributed Active Archive Center
NASA	National Aeronatuics and Space Administration
NOAA	National Oceanogrpahic and Atmospheric Administration
USGS/EDC	United States Geological Survey/ EROS Data Center



to EDC; and to obtain commitments from the core network of ground stations and NOAA to acquire and transfer data to EDC. USGS/NASA is also responsible for processing and archiving raw data received; populating, maintaining, and providing worldwide access to an information system containing metadata and digital browse data; making microimage browse distribution available by subscription; and providing a basic data set and derived global data product preparation, generation, and distribution.[4]

ESA's responsibilities include obtaining commitments from its ground stations to acquire and transfer data to ESA/ ESRIN/Earthnet;[5] processing and archiving raw data received; establishing a letter of agreement with USGS/NASA to transfer data to EDC; populating, maintaining, and providing worldwide access to a metadata and digital browse data system; and providing a basic set of data products and derived global data product/set preparation, generation, and distribution.[6] As of August 1994, one-third of all collected data by the ESA network had been archived.[7]

NOAA's responsibilities include making its best effort to schedule daily data acquisition for areas uncovered by the AVHRR network or where individual ground stations are unable to meet project requirements; ensure satellite and ground station transfer of data to its operations control center; processing and archiving raw data received; serving as a backup archive to EDC for data acquired by its satellites and stations; authorizing EDC to distribute raw data; populating, maintaining, providing access to a metadata system; and providing preparation, generation, and distribution capabilities for a basic set of data products. [8]

CSIRO Australia's responsibilities include obtaining commitments from the Australian network of key ground receiving stations, archiving raw data acquired by or transferred to CSIRO; establishing an agreement and technical plan with USGS/ NASA to transfer data to EDC; populating, maintaining, and providing access to a metadata system; investigating product preparation, generation, and distribution capabilities for a basic set of data products.

The ground stations in the ESA and USGS networks are responsible for daily data acquisition; establishing agreements with ESA or USGS/NASA to acquire and transfer data to ESA or EDC; and to transfer raw data to the project. Data is gathered centrally for the ESA network by ESA/ESRIN in Frascati, Italy, and sent to EDC. In turn, EDC centrally gathers the data from its network and sends it to ESA.[9]

All four primary partners — ESA, NOAA, USGS/NASA, and CSIRO — have agreed to "provide/ distribute the raw and data derived products on a nondiscriminatory basis, at the marginal cost of processing the specific user request."[10] ESA, NOAA, and CSIRO[11] are also bound by their own data distribution and policy guidelines.[12]

The project was originally intended to continue for 18 months. However, satisfied that they were producing results, project participants agreed in April 1993 to extend the project for an additional 12 months until September 1994.[13] At that time, the participants again decided to continue their efforts, this time until at least 1998. Project products include seven composite global images and a total of 42,000 scenes acquired to date.[14]

In the United States,

GROUND STATION NETWORK

Casey, Antarctica	66°17′ S	110°32′ E
Terranova Bay, Antarctica	74°25′ S	164°04′ E
Buenos Aires, Argentina	34°24′ S	58°18′ W
Darwin, Australia	12°23′ S	130°44′ E
Hobart, Tasmania, Australia	42°48′ S	147°18′ E
Perth, Australia	19°18′ S	115°53′ E
Townsville, Australia	19°18′ S	146°48′ E
Cachoeira, Paulista, Brazil	22°45′ S	45°00′ W
Prince Albert, Canada	53°12′ N	105°55′ W
Maspalomas, Canary Islands	27°46′ N	15°38′ W
Beijing, China	40°00′ N	115°00′ E
Urumqi, China	45°00′ N	85°00′ E
Guanzhou, China	25°00′ N	115°00′ E
Cairo, Egypt	30°00′ N	31°14′ E
La Reunion, (France)	20°52′ S	55°28′ E
Oberpfaffenhofen, Germany	48°03′ N	11°09′ E
Scanzano, Italy	37°54′ N	13°21′ E
Tokyo University, Japan	36°00′ N	140°00′ E
Nairobi, Kenya	01°15′ S	36°45′ E
Ulaan Baatar, Mongolia	48°00′ N	107°00′ E
Niamey, Niger	13°32′ N	02°05′ E
Tromsoe, Norway	69°39′ N	18°56′ E
Manila, Philippines	14°23′ N	121°02′ E
Dhahran, Saudi Arabia	26°13′ N	50°00′ E
Jeddah, Saudi Arabia	21°30′ N	39°12′ E
Hartebeesthoek, South Africa	25°53′ S	27°42′ E
Baton Rouge, Lousiana, USA	30°24′ N	91°10′ W
McMurdo Bay, Antarctica	77°50′ S	166°39′ E
Palmer, Antarctica	64°46′ S	64°04′ W
Uh Snug Harbor, Hawaii, USA	21°19′ N	157°15′ W
Sioux Falls, South Dakota, USA	43°44′ N	96°37′ W
Gilmore Creek, (Fairbanks), Alaska, USA	64°58′ N	147°30′ W
Wallops Island, Virginia, USA	37°52′ N	75°27′ W

the 1-KM Project has operated under the auspices of the *Land Processes Distributed Active Archive Center* (LP-DAAC), an EOSDIS node, through EDC and has been funded in large part by NASA through an EOSDIS line item. Since FY92, the total amount is approximately $2 million U.S.[15] ESA, identifying the project as noncommercial, has also contributed funds.[16] There has been no exchange of funds between the LPDAAC/EDC and ESA.[17] Contributed funds have been used to begin and coordinate project activities, including data processing at EDC. Partners and participating ground stations are expected to fund local operations. The basic form of exchange among network participants is data on a *quid pro quo* basis. That is, for each scene contributed to the project's data pool, a participant may receive a scene in return. The largest exchange to date is 2,000 scenes between the Chinese stations and EDC.[18] Supplemental forms of exchange include hardware, expertise, and software. These require additional negotiation on a case-by-case basis between the ground station and a major partner. Cash exchange is kept to a minimum for practical and political reasons. Funds are exchanged only between NASA and USGS/EDC with USGS/EDC directing NASA money to the ground stations, if and where necessary.[19] Increase in funds beyond a first-time basis requires strong justification and is atypical.[20]

Additional stations have continued to be added since the project's inception, raising the total number of participating ground stations. Each of the major partners is responsible for determining which stations to add or delete from their network. Using the concept of a "core network," a partner determines which stations ought to be included or excluded. "Core" is defined as any station or group of stations that presents the only available capability in a particular area and which is necessary in obtaining the project's goal: a complete global data set.[21] Redundancy is an important criterion in determining if a station is "core." But alone, is inconclusive.[22]

The addition of new stations is anticipated. With NASA assistance, Irkutsk will become operational in 1995 providing Siberian coverage.[23] A Costa Rican station and additional Asian and European stations would also be welcomed.[24]

In most cases, networks are, by nature, different than the entities attempting to create them. Generally governments, universities, and federal agencies are hierarchies. They are attempting to create something like themselves, and therefore a high possibility of failure in an innate element of the process. That is part of the reason why, as the world moves from hierarchies to networks at lightning speed, establishing Earth observations networks to acquire, disseminate, and archive global data is still elusive. This is evidenced by the 20-year-old *Landsat Ground Station Operations Working Group* (LGSOWG), which, despite the universally accepted importance of Landsat data,[25] has yet to coalesce into a true network that would ensure data continuity.

Unlike LGSOWG, the network established by the 1-KM Project has yet to be exposed to major domestic and international political forces and the hierarchies that generate them. Therefore, given the project's initial success, this is a particularly opportune time to assess which of its attributes have contributed to that success, and which of its characteristics will present ongoing challenges. The next section identifies some of the network's most successful features and some of the areas that will require continued attention.

Network Successes

Asymmetrical Law and Policy

Agreements of all sorts exist between partners and among participants. They range from high-level written agreements between partners like the USGS and ESA/ESRIN and NASA and ESA,[26] to verbal agreements among partners and participants.[27] The primary characteristics of all 1-KM Project agreements are that they are asymmetrical, organic, responsibility-focused, and equity-based. Value is exchanged through data, money, expertise, supplies, and in-kind contributions — the quality and quantity of which is based on the ability to contribute and what is fair under the circumstances. The nature of the task to be accomplished gives rise to what the agreement encompasses. Notable also is that unlike conventional contracts, network agreements are silent regarding penalties for abrogation, relying instead on a common understanding that each participant's actions affect all other participants, the network, and the ultimate product. Enforcement is left to an interplay of complex forces: reputation, public opinion, entwined and vested interests, and cost-sharing incentives.[28] The agreement between NASA and ESA specifically waives all claims and rights of action arising out of project activities, except in the case of willful misconduct.[29]

The heart of project agreements is the project *Ops Plan*. Its most extraordinary aspect is that it exists.[30] The first version of the plan dates back to May 1991, and has constantly changed over time.[31] The original impetus for a written plan came from participants' requests that responsibilities be defined.[32] The plan began as more of a working document for EDC's guidance, but became useful for all participants to follow. It is a hub of agreements from which other agreements emanate. The *Ops Plan* is heavily supplemented by oral agreements and manifestations of agreements: data received, requisition of payment, and images exchanged. The Plan's existence demonstrates that the memorialization of responsibilities is necessary to inform and guide. But, unlike traditional contracts which stress rights and liability for every possible event that could go wrong and which often inhibits innovation, the *Ops Plan* is the legal case of less is more, allowing actions to clarify ambiguity and experimentation with growth and change over time.

the Ops Plans is the legal case of less is more

Scientific Consensus to Validate the Network's Purpose

A crucial aspect of the 1-KM Project's success is that it was acknowledged by the scientific community to have value.[33] Historically, data collection has been given little, if any, priority in funding satellite missions.[34] Although there are many complex reasons for this, chief among them is the frequent lack of cogent, scientific mandates to fund data collection and preservation. In political terms, scientific consensus makes it more likely that establishing the network itself will become a goal on par with obtaining, launching, and maintaining the space segment. Scientific consensus also makes it more likely that geographical logic — rather than political and economic — will guide the network node selection and maintenance process.

Reinforcing the Network

The Project's success is also attributable to the fact that it is relationship-centered, depending on the actual people involved and their interactions. Deciding to have regular, in-person, operators' meetings was the Project's most important organizational strategy.[35] This enabled the ground station operators to have the direct experience that progress was being made providing them and sponsors in their home nations with the incentive to continue participation.

Relationships among project members are defined within the context of network participants rather than as members of groups like users or providers. Although determining status may be necessary to ascertain if a participant has the authority to enter into agreements and the ability to take part, group identification as a condition for participation is unnecessary.[36] Instead, members focus on producing a global data set which results in the product, the network and a new identity of "network participant" concomitant with any other identity that the participant brings to the project.

Meeting Local Interests to Create Regional Structures

Participation by the Australian partner was begun by the *Australian Land Research Data Center* (ALRDC), a small unit within CSIRO. The 1-KM Project is one of its "principle functions."[37] The project's requirements "[p]rovide a common archive point for receiving stations in the Australian region."[38] Desiring to achieve its vision of being a regional partner,[39] ALRDC activities expanded to include other Australian states which has resulted in internal domestic organization and full continental coverage. ALRDC's coordination has extended to six stations, including the CASEY, Antarctica ground station which ships data to the Center by boat.

Similarly, although regionalization was beyond the original motive of the Chinese participants, all three Chinese stations—Beijing, Urumqi, and Guanzhou—are now better coordinated among themselves, creating a more coherent regional structure, as a result of participating in the 1-KM Project.[40]

Ongoing Necesities

Fostering Equilibrium

Equilibrium in an Earth observations data network is threatened when an economic or political issue arises in the horizontal organizational structure of the network which is noticed by one of the sponsoring hierarchies — a government, an agency, a university — and considered to be within its traditional jurisdiction. If deemed important enough, the issue is appropriated and makes its way up the hierarchy to the appropriate decisionmaking level. This process emphasizes the political and economic forces that presented the issue and causes the logic of politics and/or economics to overwhelm the logic of geography in the decisionmaking process.

In the 1-KM Project, deference to disparate economic contributions and political status is reflected by the distinction between project "partners" and "participants." An example of this was affording Australia "partner" status because its coordination activities spanned two continents.[41] As the number of partners and participants increase, this distinction will have to be carefully balanced with sustained attention to the many forms of contributions and needs of all the network members to prevent a polarization along economic and political lines which is antithetical to the network's nature.

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Maintaining Ground Station Interest and Exchange of Value

There is a critical period between the time when a ground station operator identifies a motivating interest to join the network and the time when that interest has become part of the network itself. When the initial interest becomes part of the network's routine operations, then the station has a long-term reason to keep the network viable. The initial motive can be a variety of things: money, technology, data, software, media, prestige, expertise. From the perspective of creating stable relationships that preserve the network, which of these incentives works best depends entirely on the context of each trade. Value is subjective to the traders dictated by specific needs. A network must be flexible enough to facilitate all forms of value exchange so that stations' initial interests are met increasing the interdependence between their, and the network's interest.

The promise of money does provide a strong, attractive interest. It may, literally, make participation possible for some stations. However, it may also necessitate having one or more of the participant continually provide funds, increasing the chances of a participant's eventual withdrawal if the funds become unavailable or a station's monetary needs become too high. Alternatively, money, if spent by a station to support its own network participation, strengthens a station's commitment to the network.

Similarly, obtaining or exchanging technology or software can catalyze a station's interest to participate. Technology and software barter has the advantage of bestowing prestige and obviating eviscerating exchange rates and politicized fiscal procedures. It also facilitates technology transfer enabling the network, as a whole, to function more efficiently and effectively. At the same time, complex trade and technology transfer regulations have pitfalls of their own. And, like money, the cost of providing technology or software can cause a disproportionate burden on some network participants.

Data also provides a strong incentive to join a network. Since local stations can exist by serving local needs with local data, motivating a station to incur the additional cost of collecting and maintaining data to serve a global need requires a corresponding incentive. Access to — and being a local distributor of — a global data set provides the incentive. The station also gains prestige as the source for a regional or global product. Additionally, the local, regional, and global data sets provide raw material for value-added products.

Because all forms of exchange involve local costs, value-added activities are particularly important. They provide the means to generate revenue to offset the costs while raising stations' participation above the local level.

Tempering Control

Satellites — manifestations of the Cold War values of national power and prestige as much vehicles for cooperation and science — are the objects of high international politics. They are subject to the ultimate control of the proprietary sovereign, who, through control of the space segment (satellite design, orbital parameters, data collection priorities) can dictate the development of the ground segment. This, perhaps, presents the greatest challenge to the evolution of Earth observation data networks. Absolute control is antithetical to a network's dynamic nature and if pursued, will ultimately destroy it.

The distributed networks necessary to carry out the data side of the new generation of Earth observations missions is incompatible with cold war style domination and control. Incentives to temper control are presented by the continually rising scientific and economic value of data and decreasing national budgets. These now require that control sufficient enough to protect a national investment be balanced with effective ground segment institutional evolution to provide demonstrable reasons to continue funding satellites. That the 1-KM Project has received the full endorsement of the Committee on Earth Observing Systems (CEOS)[42] - an association of governmental organizations responsible for operating civil space-based Earth observations programs, and which makes recommendations for coordinating national and international satellite programs[43] — indicates movement toward meeting post cold war conditions.

Establishing Long-Term Institutional Mechanisms

The technical problems that were the early concerns of the project are now giving way to the financial and policy problems of establishing network longevity and cohesiveness. If, and when, participants make a long-term commitment to make the 1-KM Project operational, many of the reasons for its short-term success, a focused community of users; noncommercial, noncompetitive objectives; initial low cost; a narrow range of international requirements; and specific goals for the data set — may be the very things that change.

Over time, it can be expected that the 1-KM Project will interact with other networks; the data will have multiple applications, including commercial[44]; and distribution will expand. Potential changes particularly rife with possibly destructive policy issues are rising costs,[45] software availability and support,[46] and the commitment of the satellite to the network's long-term mission.[47] Each of these changes will increase the complexity of the network's operations which will, in turn, require institutional mechanisms for consistent decision-making, policy formulation, and conflict resolution.[48]

In the near-term, the USGS/ESRIN *Cooperation Agreement* provides a model for a flexible approach to making agreements and establishing controlling authority for activities generated by the Project's ongoing operations.[49] There will, however, come a time when the sheer number of additional agreements will turn this case-by-case approach to decisionmaking into an incoherent patchwork of *ad hoc* agreements. It will then be necessary to reconsider the Project's nature and its inherent institutional structure. Eventually, this means legal operating authority may have to migrate from individual participating entities to the network itself with the original institutional participants assuming an oversight role.

Examination of the 1-KM Project produces two important general principles and demonstrates one important conclusion. The first principle is that the ground and space segments are interdependent and constitute a *whole system*. The second principle is that acquisition of global data is a mission which *by nature* necessitates international cooperation. The conclusion demonstrated the Project is that a participant's capability for international cooperation is more important than the technological capability of any site.

The systemic and global nature of the 1-KM Project make it a model for coordinating large data collections characterized by global coverage and high volume data which require the distribution of work through regional and local participation. Applying the early lessons of the 1-KM Project to similar missions is an invitation to conduct international science and technology policy differently than has been done in the past. But then, the future is always different from the past.

About the Author

Joanne Irene Gabrynowicz is an attorney. She teaches graduate courses in space law and policy and remote sensing law and policy in the Space Studies Department at the University of North Dakota. The department's students include USAF Space Command officers and civilian students from around the United States and other countries.

Footnotes

1. EROS's Global Land 1 KM AVHRR Data Set Ops Plan, [Hereinafter, Ops Plan] August 1994, pg. 81.
2. Eidenshink, Jeff;Faundeen, John; Holm, Tom, telephone interview, 21 October 1994 [Hereinafter, Eidenshink, et al.].
3. 1-KM UPDATE!, EROS Data Center, December 1992, pg. 1.
4. *Ops Plan*, pp. 83-84 *supra*, note 1
5. The Earthnet program dates back to 1977, and acquires, processes, archives, and distributes remote sensing data from various satellites of many nations. Its central facility is based at the European Space Research Institute (ESRIN) in Frascata, Italy. ESRIN is one of ESA's four establishments and maintains direct telecommunications links among ESA member and nonmember ground stations.
6. *Ops Plan*, p. 84 *supra*, note 1.
7. However, ESA has just begun to address archiving the "stitched" orbit data products for which there is no current capacity. Giancarlo Pitella, ESA/ESRIN Earth Observation Division, Head of Third Party Missions Section, project review, EROS Data Center, Sioux Falls, SD, USA, August 1994.
8. *Ops Plan*, pp. 84-85 *supra*, note 1.
9. Eidenshink, et al. *supra*, note 2.
10. *Ops Plan*, p. 86 *supra*, note 1.
11. CSIRO's data center's "main clients are researchers and operational agencies...[it] aims at keeping data costs low...[and d]ata are not usually supplied for commercial use, but special arrangements can be made subject to agreement of the original data suppliers. [It] is guided by the policies of the Committee on Earth Observation Satellites at the international level, and by the Commonwealth Spatial Data Committee at the national level." Australian Land Research Data Centre, CSIRO Office of Space Science & Applications, GPO Box 3023, Canberra ACT 2602, Australia, January 1994. [Hereinafter, ALRDC.]
12. *Ops Plan*, p. 86 *supra*, note 1.

13. 1 KM UPDATE! EROS Data Center, July 1993, pg. 2.
14. Eidenshink, Jeff, personal communication, 21 November 1994.
15. Martha E. Maiden, Program Manager, Pathfinders and Product Generation, NASA Headquarters, Interview, Sioux Falls, SD, USA, 30 August 1994.
16. Pitella, *supra*, note 7.
17. Holm and Eidenshink, telephone interview, 27 September 1994, [Hereinafter, Holm, et al.]
18. Eidenshink, et al., *supra*, note 2.
19. Holm, et al., *supra* note 17. Fund limits are determined by a variety of complex factors beyond simple amounts available. They include procurement regulations, exchange rates, foretign economic and political institutions, and available communication systems.
20. Holm, et al., *supra* note 17.
21. Holm, et al., *supra* note 17.
22. For example, a second Japanese ground station which provided the same coverage as the first one to be included in the network was deemed redundant and outside of the "core." However, stations at Maspalomas and Niamey, while both providing coverage of the African Sahel, are considered "core" because the Niamey station has a high degree of unreliability and the Maspalomas station has a high degree of reliability. When taken together, Niamey's local position and Maspalomas reliability create a joint capability that provides coverage of an area critical to the global data base.
23. Jeff Eidenshink, Science Requirements and Project Extension Briefing, EROS Data Center, Sioux Falls, SD, 31 August 1994 [Hereinafter, *Briefing*].
24. *Briefing, ibid.*
25. *The U.S. Global Change Research Program: An Assessment of FY 1991 Plans*, National Academy Press, Washiangton, DC, 1990, p. 71.
26. *"Cooperation in the Mapping and Earth Sciences Between the United States Geological Survey of the Department of the Interior and European Space Research Institute of the European Space Agency,"* 4 April 1994. Among the subjects covered are activities, funding sources, and intellectual property [Hereinafter, *Cooperation Agreement*].

    Letter dated 9 July 1992 from Constance J. Carte, Acting Chief, NASA International Planning and Programs, International Relations Division to Jean Arets, Head of International Affairs, ESA and Letter dated 26 February 1994 from K. Barbance, International Affairs, ESA to Constance J. Carte [*Hereinafter, NASA/ESA Agreement*].
27. Bilateral negotiations. EROS Data Center, Sioux Falls, SD, 1 September 1994.
28. The dynamics between the network, ALRDC, and its relationship to the Manila ground station provides a practical example. Provision of network resources for ALRDC was premised on its promise to provide data to the network from the Manila station. This failed to occur despite ALRDC's payment to Manila for the data from funds provided by the network. Subsequently, the amount of network support to ALRDC was decreased commensurate with the amount of undelivered data. Because both the network and ALRDC's had already established interdependent interests, ALRDC's expulsion from the network was illogical and undesirable. Reducing ALRDC's support and allowing it to continue to participate made the remedy for the undelivered data and preservation of its reputation as a regional organizer ALRDC's responsibility with minimal adverse effects on the network.
29. NASA/ESA Agreement, *supra*, note 26, letter dated 9 July 1992, p. 2.
30. Holm, et al., *supra* note 17.
31. Holm, et al., *supra* note 17.
32. Holm, et al., *supra* note 17.
33. Townshend, John R.G., ed., *Improved Global Data for Land Applications: A Proposal for a New High Resolution Data Set, Global Change Report No. 20*, The International Geosphere-Biosphere Programme, Stockholm, 1992.
34. *NASA Is Not Properly Safeguarding Valuable Data from Past Missions*, Report to the Chairman, Committee on Science, Space, and Technology, House of Representatives, United States General Accounting Office, GAO/IMTEC-90-1, March 1990.
35. Holm, et al., *supra*, note 17.
36. *Ops Plan*, p. 80 *supra*, note 1.
37. ALRDC, *supra*, note 11.
38. "ALRDC Summary Report to the 4th Ground Station Operators Meeting," 30-31 August 1994, p. 1.
39. Maiden, *supra*, note 14.
40. Cheng, Liu, Deputy Director Engineer, Division of Operations and Service, Satellite Meteorology Centre, State Meteorological Administration, PRC, Interview, EROS Data Center, 31 August 1994.
41. Holm, et al., *supra* note 17.
42. *Ops Plan*, p. 81 *supra*, note 1.
43. CEOS 1994 Report, CEOS Terms of Reference, p. 7
44. The prospects of interacting with other networks and commercial applications have already emerged through a proposal by the French space agency, CNES, and the Institute for Remote Sensing Applications/Joint Research Centre, to interface the 1-KM Project with the SPOT 4 Vegetation System. 1-KM Project, presentation, Sioux Falls, SD, 31 August 1994.
45. Interagency conflicts over cost recovery are the stuff of daily politics. The most recent example of these issues being played out is among NASA, NOAA and the USGS regarding Landsat 7. Gabrynowicz, J., Remote Sensing Policy Deja Vu," *Space News*, 12 September 1994, p. 15.
46. The politics of software is particularly nettlesome because the very cohesiveness created by a uniform product commits the supplier to long-term expenses and responsibilities for follow-up, support, and updates. In the case of the 1-KM Project, because the primary partners are governmental entities, for one of them to provide software means committing a government to an ongoing cost not justified solely on domestic needs, a difficult position to advance in economically constrained times.
47. Due to a variety of reasons, the land cover community has been using AVHRR data from meteorological satellites for land mass observations. The Project currently acquires daytime land cover data from the 3.6-3.9μm AVHRR channel three. However, to better serve NOAA's primary meteorological mission, there are plans

to make channel three a dual-use channel with the data from two wavebands utilizing the space of one. This change, planned for the NOAA K-L-M satellites, would not occur for four to five years, or until a replacement for NOAA J is required.

When implemented, the plan's result would be that during the day, 1.6-1.8μm data would occupy channel three space in the data stream and at night the current data of channel three would occupy the slot in the data stream. Opinion is mixed as to whether this would advance or impede the Project's activities. It does, nevertheless, raise the issue of long-term commitment of the satellite to a secondary mission and long-term plans for the Project. Kevin P. Gallo, Research Physical Scientist, NOAA/NESDIS, NOAA Representative to the 1-KM Project, Sioux Falls, 31 August 1994.

48. A possible model is the arbitration tribunal system provided in the ESA Convention. Annex I, Art. XXVI. It has been in place since 1975 and considered extremely successful in preventing conflicts before they begin. ECSL news, European Centre for Space Law/ESA, No. 7, June 1991, p. 3.

49. "Any activity carried out under this plan will be agreed upon by the Parties in writing in accordance with the Parties [sic] legal authority. Whenever more than the exchange of technical information or visits are planned, such activity will be described in an Annex to this plan which will set forth, in terms appropriate to the activity, an implementation plan, technical requirements, financial arrangements, and other responsibilities, oblications, or conditions not addressed in this plan. In case of inconsistency between the terms of this plan and the terms of a project Annex hereto, their terms of this plan will be controlling, unless the Annex specifically provides that it is intended to alter a provision of this plan." *Cooperation Agreement*, Art. VII.

Congress Threatens to Abolish U.S. Geological Survey and U.S. Bureau of Mines

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The U.S. Geological Survey and the U.S. Bureau of Mines are facing one of the most serious challenges in their history. Both agencies have been targeted for complete elimination according to an attachment to the *Contract with America*. The attachment identifies $176 billion in possible spending cuts over five years. Although many programs would be reduced, restructured, or frozen, the USGS and the USBM are among a handful of organizations that would be abolished.

"We are deeply concerned about the *Contract with America* proposal, because it reflects a lack of understanding about the broad range of scientific activities conducted by the U.S. Geological Survey, as well as our active role within all 50 states," says Gordon P. Eaton, director of USGS. "We serve as the archivist of this nation's Earth resources — monitoring the rivers, for example, and helping to maintain healthy water standards. Our geoscientists help citizens prepare for emergencies such as earthquakes and floods; and we address the challenges of sustainable development of our oil, gas, and minerals resources. In fact, the USGS touches the lives of every American citizen every day."

The geosciences would absorb a disproportionate share of spending cuts relative to other scientific disciplines, and the USGS and the USBM would take the most direct hits. Abolishing the USGS ranks as the fifth largest cut among all discretionary programs in the federal budget, and represents the largest single reduction for any science and technology program.

Congressional staff members indicate that abolishing the USGS might be accomplished by transferring some of its functions to other organizations. It is unlikely that other organizations would pick up these programs at no expense to the nation.

Rep. John R. Kasich (R-Ohio) is a key figure behind the proposal to abolish the USGS and the USBM. Last year, Rep. Kasich cosponsored an amendment that would have eliminated the two agencies. Although his amendment was rejected by the House of Representatives last year, Kasich is in a much stronger position to pass these measures now that he has become chairman of the House Budget Committee and Republicans control both the House and the Senate.

The Clinton Administration has made clear its support of the USGS and the USBM. Secretary of the Interior Bruce Babbitt has said, "The USGS is the nation's premier water and earth-science information agency, and its role is increasingly important at a time when we are facing many critical decisions on the environment." Last August, Secretary Babbit stated, "This Administration is firmly committed to maintaining a strong, viable U.S. Bureau of Mines in the Department of the Interior." In October, when Rhea L. Graham was sworn in as director of the USBM, she said, "I believe that the agency has a vital role to play in helping the nation solve its mineral-related problems — problems that involve our environmental and economic goals as well as basic human issues such as worker health and safety."

It is ironic that Congress is considering legislation to abolish the USGS and the USBM at a time when the United States is beginning to recognize its increasing vulnerability to earthquakes, floods, droughts, water pollution, volcanic eruptions, global environmental change, contamination from waste disposal, and reliance on unstable sources of foreign oil and minerals.

Geoscience research and information play vital roles in an ever-growing range of societal problems. Federal investments in geoscience research and information continue to pay enormous dividends. Although the rationale for supporting the USGS and the USBM remains strong, Congress and the public are not generally aware of their relevance to a broad range of national goals. Over 100 years ago, the USGS was established without fanfare — created by an amendment to another bill. Today, the agency stands in danger of being dismantled in much the same way it was created.

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