Chapter 7

The Use of Commercial Satellite Imagery and Canadian Security Needs

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The development of a commercial satellite imagery (CSI) industry and its associated services is now commonly noted as a major element in the 'information revolution' sweeping the globe. (Commercial satellite imagery is here defined as unclassified satellite imagery publicly offered for a fee on a routine basis, whether by a public agency or a private firm.) Even without the Internet, access to such imagery by states that do not have their own satellite capabilities, by non-governmental organizations and by other private actors, is affecting the global political system by diffusing access to information. As both a consumer and a producer of imagery, and through its association with the United States, this development has varied and significant implications for Canadian security. This chapter is an effort to draw together and to consider many of these implications. It has two primary but overlapping foci: one is the broad security issues raised by CSI for Canada, particularly in the context of its relations with the United States, and the other is the potential for the use of CSI by the United Nations in support of its peacekeeping operations, or by states in support of such UN operations.

These two foci are to some degree distinct, yet they also overlap significantly. Canada's relations with the US are a cornerstone of our foreign and defence policies, but so, too, is our contribution to international security through activities such as peacekeeping. The use of CSI by the UN or in UN field operations raises a range of issues of significance in their own right, as well as in terms of Canadian support for the UN. At the same time, Canadian policy with respect to CSI has required a degree of co-ordination with the United States.[1] The two overlap as well in terms of Canadian defence requirements, in the question of whether and to what degree Canada responds to the so-called Revolution in Military Affairs (RMA)[2] and the extent to which peacekeeping either furthers or hinders this response. Finally, some of the questions which could arise with respect to UN use of CSI could also speak to concerns which Canada might face in any attempt to exploit the development of CSI in its own response to the RMA.

This chapter will first look in some detail at some issues concerning the UN, CSI and peacekeeping. It will then turn to some issues related to these which arise in the context of broader Canadian security requirements.

The UN, CSI and Peacekeeping

In 1983, the United Nations issued a study of the possibility for an International Satellite Monitoring Agency (ISMA), which would provide an international satellite remote sensing capability for verification, monitoring, early warning and peacekeeping.[3] The report suggested three phases for the development of ISMA: initially merely the acquisition and use of imagery from existing national sources; a second phase in which the agency would establish its own ground stations, and a third phase in which the agency would develop its own satellites, though not necessarily its own launch capability. While it recognized and built upon the established importance of national satellite reconnaissance and monitoring systems, this very ambitious proposal went no further. It did, however, help to establish the notion of an international remote sensing satellite capability, to be used by international organizations such as the United Nations. During the 1980s as well, interest developed in the use of satellite imagery by news media, including, as well, the possibility of a dedicated capability, 'Mediasat.'[4]

Neither proposal for a dedicated satellite imagery capability went anywhere. But this did not mean that satellite imagery remained simply the preserve of the governments of a few highly-capable states. Instead, a developing commercial satellite imagery industry – including not only satellite owners and imagery providers, but also service providers of various kinds – has effectively undercut the need for such expensive, centralized dedicated capabilities. Indeed, Gupta observed in 1995 that a centralized capability would seem neither necessary nor desirable, as '[t]he operational beauty of satellite imaging is that it does not require cooperation with anyone, neither friend nor foe': the politics of international organizations could thus be avoided.[5]

Others had already noted the potential security implications of the spread and the commercial availability of satellite imagery.[6] With the developing availability of CSI and attendant services, and the development of information technology more generally, the use of CSI has spread from a small group of technologically-capable states and certain industries to a much wider array of users. In 1990, analyzing the SPOT imagery catalogue, Peter Zimmerman noted that certain sites appeared to be significantly 'over-selected'; he inferred from this that SPOT was being 'heavily used' by intelligence services of states without their own satellite reconnaissance capabilities.[7] Such imagery has been used by the US in the Gulf War, by West Germany and Japan; it has been used as well by the news media (e.g. images of Chernobyl, Kyshtym, Dushanbe, Krasnoyarsk, Dimona, and of Saudi CSS-2 ballistic missile bases).[8] Tomas Ries and Johnny Skorve used LANDSAT imagery to examine Soviet military installations on the Kola peninsula.[9] Both the Federation of American Scientists and the Institute of Science and International Security have released CSI, and interpretations of the images, on their websites, and the Verification Technology and Information Centre has also used CSI.[10] Gupta and Pabian examined the possibility of combining CSI and 'open source' media information to investigate Indian nuclear testing.[11] The Australian Surveying and Land Information Group posted LANDSAT 7 images of East Timor, including of fires in Dili, in the turmoil following the independence referendum there.[12] More recently, Atlantis Scientific Inc. produced digital terrain elevation data of East Timor

for the Canadian Department of National Defence from satellite imagery, in support of a Canadian deployment there.[13] Eurimage provided CSI from LANDSAT and ERS of the Turkish earthquake at a reduced rate.[14] The possible uses of CSI are now being explored by various humanitarian organizations.[15] The International Atomic Energy Agency is moving steadily in the direction of using CSI to supplement its traditional safeguards.[16]

Wider use of satellite imagery, of course, also presents its dangers. Without trained interpretive capabilities, the information presented in an image may not be properly understood: it is one thing to be able to measure a building in an image and another thing to have the much broader knowledge base necessary to understand the significance of the building.[17] This may not, however, prevent the use of such imagery.[18]

The potential systematic acquisition and use of CSI in UN peacekeeping does not entail the development and deployment by the UN of a larger capability along the lines of the ISMA proposal. Gupta's suggestion that such an agency would not actually be needed or useful is thus adopted as a basic premise here. However, his observation on the non-utility of an ISMA-like concept did not address the possible use by the UN itself of CSI. Potential applications for various surveillance systems, not only CSI, have been studied by, among others, the Canadian Department of National Defence, the US Office of Technology Assessment, and the Center for Global Security Research.[19] Gupta and Bernstein, and Gupta and Harris have also studied the possibilities for CSI in a monitoring role.[20] In the Dayton negotiations, the ability of the US to produce and distribute maps based on imagery, showing locations of forces, boundary zones, terrain conditions, etc. was a factor. Aside from providing timely and detailed information for the negotiators, these maps also contained an implied threat: we know where you are, and we know what damage we can do to you.[21] Satellite imagery from various sources – National Technical Means as well as CSI – has been used at times on various UN peacekeeping operations: Smith notes that the UN's Situation Centre has purchased SPOT imagery; Dorn notes that UNEF was shown some US satellite images, and that there was some use of US imagery by UNPROFOR; and Berdal notes the use of LANDSAT imagery by the US 10th Mountain Division in Somalia.[22] At the moment, the UN is looking at the development of a United Nations Geographic Database, which would improve its mapping and data-representation capabilities.[23] This would, of course, link nicely to the availability and the use of CSI as a mapping tool, among other things.

The Brahimi report

With the end of the Cold War, the United Nations experienced an upsurge in the demand for peacekeeping operations. Initially, many of these involved the liquidation of Cold War-related disputes, and were handled with relative success. Then came the Gulf War and, in retrospect certainly, vastly and prematurely ambitious hopes for a UN role in maintaining international peace and security. There followed a series of highly-visible and large-scale failures – in Somalia, the former Yugoslavia and Rwanda in particular – which demonstrated both the larger and more complex demands being made on the UN in its peacekeeping operations, and its very considerable difficulties in meeting these demands. These gave rise to

predictable, easy condemnations of the UN as a particularly inefficient, ineffective and incompetent organization – to some degree justified but to some degree also scapegoating exercises which played to domestic political needs and opportunities, and ignored the role of states in setting the limits and shaping the processes of UN responses. There also followed, however, a series of studies, articles, reports and collections of recommendations attempting to analyse more closely the reasons for the difficulties faced in these missions and to suggest remedies.[24]

On March 7, 2000, United Nations Secretary-General Kofi Annan commissioned the most recent of this series of studies. Headed by Lakhdar Brahimi of Algeria, on August 21, 2000 the Panel on United Nations Peace Operations submitted its report, containing over 50 recommendations. While the term 'commercial satellite imagery' does not appear as such in the Report, a number of its recommendations have some bearing, whether directly or indirectly, on the possible use of CSI by the United Nations. Most directly, para. 251 (b) states that:

> Peace operations could benefit greatly from more extensive use of geographic information systems (GIS) technology, which quickly integrates operational information with electronic maps of the mission area, for applications as diverse as demobilization, civilian policing, voter registration, human rights monitoring and reconstruction.

This appeared as part of a larger strategy of improving the UN's information technology (IT) capability, both for Headquarters and for operations in the field, as "a key enabler" of UN objectives in peace and security. The Report emphasized the need for a properly planned and integrated IT structure, and suggested that an Information and Strategic Analysis Secretariat (EISAS), under the Executive Committee on Peace and Security (ECPS), could perform a significant supervisory role in this. It noted as well (para. 221) that the Department of did not have modern means to document ceasefire violations or to monitor these, or movements in demilitarized zones, or the removal of weapons from storage sites.

Other aspects of the Panel's report and recommendations also present potential implications for a United Nations CSI capability. These included the observation that:

> United Nations forces for complex operations should be afforded the field intelligence and other capabilities needed to mount an effective defence against violent challengers.[25]

Other recommendations of the Report touched on areas such as the formation of several coherent, brigade-size units ready for deployment within 30 days. The Report noted a recent tendency for Less Developed Countries to provide the bulk of troops for missions, instead of Developed Countries. There are problems arising from troops arriving in the field ill-equipped or untrained, or without common understandings of mission operations, or common training with other contingents. The development of "coherent brigade-sized forces" would provide troops who had worked together and could meet training, equipment and other standards. As well, the Report argued the need to strengthen support resources for peacekeeping operations in UN Headquarters, including an increase in the number of personnel at Headquarters, especially in the Department of Peacekeeping Operations.

These additional recommendations point to larger command and control issues within UN peacekeeping operations, which form a significant context for the consideration of the use of CSI by the UN. As UN missions become larger and more complex, are deployed in more hostile environments, and become more proactive, the demands for intelligence increase, but the 'fudged' command and control structures typical of UN operations become increasingly stressed. Meeting both the broader command and control needs and more specific intelligence needs of these missions become interlocking requirements.[26]

CSI and UN Peacekeeping

A variety of specific questions must be addressed in order to assess the potential for and the problems entailed in the use of CSI in support of UN peacekeeping.

An initial need is to clarify the current and developing capabilities in the satellite remote sensing field and in the technologies for the manipulation of the resulting information. Only a few years ago, CSI was available at best in the range of 5–10 meter resolution, which would provide some, but limited, usefulness. With the development of 1-meter resolution imagery (such as the IKONOS satellite), RADARSAT, and other sensor capabilities, the possibilities for use have expanded. It has been suggested that, of a fairly standard table of tasks and the necessary spatial resolution to perform them,

> [w]ith the advent of one-meter ground-sample distance (GSD) panchromatic sensors..., nearly 60 percent of the table's military intelligence tasks, and 85 percent of the targeting-related tasks can now be satisfied.[27]

At the same time, the development of communications technology and the hardware and software for imagery analysis, as a part of the larger information technology revolution, have led to both greater ease and greater sophistication of use. Applications in disaster relief are drawing increased attention in the NGO community, while the parallels between fighting forest fires – another potential application for imagery, whether airborne or satellite – and an armed enemy have also been noted.[28]

In approaching the matter of the use of CSI not simply in terms of the imagery itself but also as the centre of a broader system of communications and analytical capabilities, at least three things become apparent. First, there are at least some potential, if still limited, parallels between the demands of peacekeeping and those of managing other activities in which CSI could have applications. Second, the availability of commercial technology – even if it requires some adaptation to UN needs – could be a significant factor in cutting the costs for the acquisition and operation of such a capability. Baines, for example, argues that CSI, and associated interpretation costs, could be reasonably competitive with aerial surveillance.[29] At the same time, CSI presents legal, physical and other financial advantages over aerial surveillance. There is no need to apply for overflight rights over national territory, and satellites, unlike manned or unmanned aircraft, are not exposed to hostile fire and associated loss risks and replacement costs. Williams and Lind, on the other hand, note claims that use of 'commercial off-the-shelf" systems may be

cheaper considered individually than military systems, but suggest that they still face problems of compatibility and replacement.[30] Third, while a CSI-based capability may not be "state-of-the-art" as compared to the most highly-advanced militaries, it may still be extremely useful in and of itself.

A second general concern is to establish in greater detail some of the needs of peacekeeping operations themselves with respect to the sorts of information and the applications made possible through the use of CSI. If the demand for intelligence varies with the complexity and the proactive character of the mission, and with the hostility of the environment in which the mission must operate, there may then be variations in the requirements for information from CSI even if all mission types could have potential uses. As well, variation in needs for the phases of the mission and for the nature of the user must be taken into account. In the initial phases of mission planning and preparation, the information would be needed in the UN's New York headquarters. As the force deploys and carries out its mission, how would information needs develop (depending, of course, on the specific mandate of the force as well as mission phase)? Even observation missions could use imagery to map and to help monitor ceasefire lines and buffer zones. More complex missions, whether involving disaster relief, disarmament verification or other operations, could have more and in some cases stiffer requirements. Would CSI compare favourably to other methods for the gathering of imagery?

How such varied needs would be best satisfied raises a third group of concerns. Could the imagery and its analysis be obtained in a timely manner and at an acceptable cost? Would the basic acquisition and analysis be best done by a central unit which would then disseminate the data to commands in the field, or would theatre commands be of a size and have needs sufficient to justify a theatre capacity? What would be the minimum useful size for a CSI 'cell,' as compared, for example, to the size of a given UN operation, and what would be the associated capital and operating costs? What other problems might arise in operating such a unit, whether in the field or at UN headquarters?

The notorious sensitivity of the UN to "intelligence" might also raise problems: states might resist the development of a UN CSI capability in one form or another. This resistance could be either reduced or exacerbated by the connection between the development of such a capability and the broader question of the improvement of the UN's more general command and control capability. If such a CSI capability was politically tolerable, it would still have to be developed and applied within the limits of international law with respect to both remote sensing and the UN Charter.

A UN CSI capability: Better, but no magic bullet

The development of a UN-centred CSI capability is more than an issue simply of imagery. It would have to be linked to broader issues of technology in order to exploit the imagery in the first place: the full impact could not be achieved without this modern technology. As David B. Sandalow, an Assistant Secretary in the US Department of State, has observed,

> The ultimate value of satellite data comes from integration with other technologies of the global information age. Satellite data becomes more useful after it has been analyzed and

> fused with other geospatial technologies such as geographic information systems and the Global Positioning System (GPS). This allows for calibration, accuracy, verification and transformation into useful information products. Particularly important is the modeling capability made possible by the fusion of data streams from various sources.[31]

The question of such a capability thus bears on issues of hardware, software, communications equipment, information standards and compatibility, and a variety of other technical issues. These pose significant demands even within the scope of a national military organization.[32] The impact of CSI on the United Nations must therefore be assessed not only merely in terms of the imagery itself, but also in terms of the marriage of that imagery to modern information technology. CSI is of importance not only in itself but also as a platform or base for the use of spatially-represented data more generally. In this sense, the development of a modern CSI capability by the UN means, in essence, its participation in at least some aspects of the Revolution in Military Affairs which some military analysts see happening in at least the most modern armed forces in the world. One broad implication of the Brahimi Report more generally, and not just of the possibilities for the use of CSI, is the necessity of an upgrading of the UN's C4I (command, control, communications, computers and intelligence) capability. To think otherwise is equivalent to proposing to put a 4-cylinder engine on a hand mower.

At the same time, commercial satellite imagery and its associated technologies are not a 'magic bullet', a panacea for all the ills affecting United Nations peacekeeping operations. Information from human sources – HUMINT – is still by far the most important source of information, especially at the level of field operations. There are also significant military and political dangers that could arise from the use of CSI. For example, if it was perceived as a force multiplier, it might be used to justify reductions in peacekeeping manpower, reducing the vital physical presence of peacekeepers. Or, the increasing use of high-technology systems in UN peacekeeping operations – especially in the field – could raise difficulties by increasing the demand for troops capable of using such sophisticated systems.[33] The possible implications here are twofold. On the one hand, a number of states with less sophisticated forces, which might otherwise be quite willing to provide troops for UN operations, could find themselves less called upon, thus reducing in some senses the UN's potential manpower pool for at least some tasks. On the other, would developed states, more likely to have the required forces, be willing to provide them more generously? If they did, would this in turn be a source of concern to Third World states which might not find an outburst of First World peacekeeping activism to be entirely welcome in political terms?[34]

Both technologically and politically, the development of a significant United Nations capability to exploit CSI technology cannot itself address all the problems that the UN faces in its peacekeeping activities. Indeed, the development of such a capability is likely to raise a variety of potentially thorny problems. However, such a capability would mark, or could lead to, a significant improvement in the UN's peacekeeping capabilities more generally. Given that such capabilities are increasingly available in the private sector, to non-government actors, and even potentially to those whom UN peacekeepers might face in the field, there seems to be little point in denying them to the United Nations, and there seems to be much to be gained.

CSI and Canadian Security Interests

Having identified at least some of the issues and problems to be dealt with in developing a UN capability to use commercial satellite imagery, we might then ask how they could be best resolved. In particular, from a Canadian perspective, several additional considerations come into play. First, Canada has an interest in the strengthening of UN peacekeeping, and has declared its general support for the Brahimi Report. Second, we are also interested in the use of satellite (and aerial) imagery and related systems in the context of NATO operations. Third, Canada is an imagery provider, in the instance of RADARSAT, and an imagery service provider. Fourth, Canada is an ally of the United States, and is co-ordinating its policies with those of the US with respect to the availability of CSI.

Canada's ability to address UN requirements and possibilities depends, therefore, not only on technical matters, including its capabilities, but additionally on issues of policy. How far ought Canada be willing to support the development of an autonomous UN CSI capability? If Canada chooses to support such a capability in the UN, how might it best do this? Would a satisfactory or even a superior alternative to the development of a capability lodged within the UN be the development and deployment of a CSI or similar capability located in a national unit on peacekeeping duty? If Canada developed a CSI-related capability, it would be less dependent on US imagery from its National Technical Means. Would this be a necessary or desirable development for at least some purposes, or simply a complication both technically and in our relations with the US? As a producer and a consumer of CSI, how would it deal with issues of 'shutter control'?

The capabilities of the Canadian Armed Forces as such also arise as an issue in the context of the Revolution in Military Affairs. The RMA includes, but is not limited to, increased intelligence and surveillance – broadly, 'battlespace awareness' – capabilities: it also applies to precision weaponry, C4I, and power projection.[35] Some of the questions which the UN might face in the development of its own CSI capability could, however, touch on some RMA-related issues, as is obvious from our discussion thus far. To that extent, the question of a solution for the UN could also be instructive for states less capable than the US.

A further set of considerations arises from the complex intersection of the RMA and low-intensity operations such as peacekeeping. First, commentators have warned that high-technology systems, including intelligence systems, may have limited uses in such operations. The importance of HUMINT in peacekeeping has already been noted.[36] Second, the possibility that such low-intensity operations may be the most frequent form of mission therefore suggests the limited utility of RMA technologies in a common type of operation. Third, this raises a potential tension between the desire of the Canadian Forces to have interoperability with American forces, and its peacekeeping employment, including resource and effort allocation problems between RMA investment and peacekeeping deployments.[37] Fourth, however, just as the US might fear becoming technologically incompatible with 'backward' allies,[38] so increasing the C4I capabilities of the UN to permit it to take advantage of CSI could open an analogous gap between relatively high-technology and low-technology contributors to peacekeeping. 'Medium-technology' states such

as Canada could potentially find themselves on both ends of the problems which the RMA poses for multinational operations.

Finally, however, because the Revolution in Military Affairs embraces a range of issues and technologies, there is no inherent reason to believe that all technologies are uniformly problematic for all applications. Overlaps between civilian and peacekeeping applications, and the Brahimi Report itself, suggest that there could be at least some relevance of some technologies and some associated issues to peacekeeping and similar operations. Whether on a technical, organizational, doctrinal or conceptual basis, consideration by Canada of the questions raised by the possibility of a UN CSI capability of some sort could possibly help it avoid, reduce or at least clarify some matters raised by the RMA. There may be no inherent contradiction, within the context of Canadian security interests, between some aspects of the RMA, Canadian peacekeeping and Canadian CSI policy. There may even be some potential for mutual support.

Notes

1 Government of Canada *News Release* No. 153, 'Canada and United States Sign Agreement Concerning Operation of Commercial Remote Sensing Satellite Systems,' June 16, 2000; Barrie McKenna, 'Canada, U.S. strike deal on spy satellite,' *The Globe and Mail*, June 16, 2000, p.B3.

2 See, e.g., Elinor Sloan, 'Canada and the Revolution in Military Affairs: Current Response and Future Opportunities,' *Canadian Military Journal*, Vol. 1, 2000, pp.7–14.

3 United Nations, Department for Disarmament Affairs, *The Implications of Establishing an International Satellite Monitoring Agency*, New York: United Nations, 1983. The ISMA study originated in a 1978 French proposal. In the early 1980s, Canada developed the PAXSAT concept. This, rather than being geared to an overarching, multi-use verification organization, focused on the development of satellite systems for specific treaties. See, e.g., Canada, Department of External Affairs, 'PAXSAT Concept: The Application of Space-based Remote Sensing for Arms Control Verification,' *Verification Brochure* No. 2 Ottawa: Department of External Affairs, n.d.

4 See, e.g., Robert A. McDonald (ed.), *Space Imagery and News Gathering for the 1990s: So What?* Bethesda, Md.: American Society for Photogrammetry and Remote Sensing, 1991.

5 Vipin Gupta, 'New Satellite Images for Sale,' *International Security*, Vol. 20, 1995, pp.124–125.

6 E.g., Ann M. Florini, 'The Opening Skies: Third-Party Imaging and U.S. Security,' *International Security*, Vol. 13, 1988, pp.91–123; Hugh de Santis, 'Commercial Observation Satellites and their Military Implications: A Speculative Assessment,' *The Washington Quarterly*, Vol. 12, 1989, pp.185–200.

7 Peter D. Zimmerman, 'The Uses of SPOT for Intelligence Collection: A Quantitative Assessment,' in Michael Krepon et al. (eds.), *Commercial Observation Satellites and International Security*, New York: St. Martin's Press, 1990, pp.74–77.

8 Michael Krepon, 'The New Hierarchy in Space; Peter D. Zimmerman, 'Remote Sensing Satellites, Superpower Relations, and Public Diplomacy;' Jeffrey T. Richelson, 'Implications for Nations Without Space-Based Intelligence Collection Capabilities,' Zimmerman, "Uses of SPOT;" in Krepon et al., *Commercial Observation Satellites*, pp.16–32, 33–48, 55–73 and 74–77 respectively. A.V. Banner and A.G. McMullan, "Commercial Satellite Imagery for UNSCOM," in Steven Mataija and J. Marshall Beier

(eds), *Multilateral Verification in the Post-Gulf Environment: Learning from the UNSCOM Experience*, Toronto: Centre for International and Strategic Studies, York University, December 1992, p. 155. Florini, "The Opening Skies," pp.103, 111–112.

9 Tomas Ries and Johnny Skorve, *Investigating Kola: A Study of Military Bases using Satellite Photography*, London: Brassey's, 1987.

10 Respectively, http://www.fas.org and http://www.isis-online.org. See also Ann M. Florini and Yahya Dehqandzada, 'Commercial Satellite Imagery Comes of Age,' *Issues in Science and Technology Online* (Fall 1999), http://www.nap.edu/issues/16.1/florini.htm.

11 http://www.auslig.gov.au/acres/referenc/dili.htm. Note that this is found on an Australian government site.

12 Vipin Gupta and Frank Pabian, *Investigating the Allegations of Indian Nuclear Test Preparations in the Rajasthan Desert: A CTB Verification Exercise Using Commercial Satellite Imagery*, Sandia National Laboratories, July 1996; available at http://www.ca.sandia.gov/casite/gupta/index.htm. In 1998, the Canadian government published a bibliography, containing 562 entries, on the use of CSI in verification. Canada, *Security-Related Applications of Commercial Remote Sensing Satellites: A Bibliography, 1955–1997*, Ottawa: Department of Foreign Affairs and International Trade, July 1998.

13 http://www.atlsci.com/news/040200_East_Timor1.html.

14 http://www.eurimage.com.

15 E.g., Einar Bjorgo, 'Digital Imagery in Global Disaster Information, *Bulletin of the American Society for Information Science*, Vol. 26, 1999, http://www.asis.org/Bulletin/Oct-99/bjorgo.html. See also: the United States Institute for Peace 'Virtual Diplomacy' project, http://www.usip.org; the Carnegie Endowment for International Peace 'Transparency and Civil Society' project, http://www.ceip.org; the Nansen Environmental and Remote Sensing Center, http://www.nrsc.no; the ReliefSat project, http://www.nrsc.no/reliefsat; and the ENVIREF project, http://www.enviref.org.

16 On the feasibility of this, see, e.g., Christer Andersson, *Ph 2 Final Report: IAEA Safeguards: Implementation Blueprint of Commercial Satellite Imagery*, SKI Report 00:11, Stockholm: Swedish Nuclear Power Inspectorate, January 2000. See also James F. Keeley and Jason K. Cameron, 'The Need to Know: Commercial Satellite Imagery and IAEA Safeguards,' in Peter Gizewski (ed.), *Non-Proliferation, Arms Control and Disarmament: Enhancing Existing Regimes and Exploring New Dimensions*, Toronto: Centre for International and Security Studies, York University, 1998, pp.13–33.

17 I am indebted to J.P. Paquette for pointing out the difference between analysis and interpretation.

18 See, e.g., the controversy over some of the uses of CSI by the Federation of American Scientists, and some of the claims derived from those uses: Pat Eddington, "Orbital Snooping: Welcome to Amateur Hour," Space News, May 22, 2000, p.14, http://www.fas.org/eye/00052-sn.htm; 'A Response to Pat Eddington's "Orbital Snooping: Welcome to Amateur Hour"' http://www.fas.org/eye/00052-sn-r.htm.

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20 Vipin Gupta and Adam Bernstein, *Keeping and Eye on the Islands: Remote Monitoring in the South China Sea*, Sandia National Laboratories, May 1999; available at

http://gwis.circ.gwu.edu/~spi/title.htm. Vipin Gupta and LTC George Harris, *Detecting Massed Troops with the French SPOT Satellites: A Feasibility Study for Cooperative Monitoring*, Sandia National Laboratories, January 1999; available at http://www.cmc.sandia.gov/issues/papers/gupta2/index.html.

21 Richard G. Johnson, 'Negotiating the Dayton Peace Accords Through Digital Maps,"'Presentation at a Seminar, 'Virtual Diplomacy – Case Studies,' held by the United States Institute of Peace, Washington, DC, February 18, 1999. http://www.usip.org/oc/vd/vdr/rjohnsonISA99.html. See also Timothy L. Thomas, 'Virtual Peacekeeping: A Military View of Conflict Prevention Through the Use of Information Technology,' U.S. Army, Foreign Military Studies Office, http://call.army.mil/call/fmso/fmso.pubs/.

22 Hugh Smith, 'Intelligence and UN Peacekeeping,' Survival, Vol. 36, 1994, p.185; A. Walter Dorn, 'The Cloak and the Blue Beret: Limitations on Intelligence in UN Peacekeeping, *International Journal of Intelligence and Counterintelligence*, Vol. 12, 1999, pp.427, 428; Mats R. Berdal, 'Whither UN Peacekeeping? *Adelphi Papers* No. 281, October 1993, p.66.

23 Miklos Pinther, 'United Nations Geographic Database,' Presentation at 'Meeting on Cartography and Geographic Information Science,' United Nations, New York, March 28–30, 2000.

24 E.g., Berdal; Alex Morrison (ed.), *The Changing Face of Peacekeeping*, Toronto: The Canadian Institute of Strategic Studies, 1993; U.S. General Accounting Office, *U.N. Peacekeeping: Lessons Learned in Managing Recent Operations*, GAO/NSIAD-94-9, Washington: USGPO, December 1993; Canada, *Towards a Rapid Reaction Capability for the United Nations*, Ottawa: Government of Canada, September 1995; David Cox and Albert Legault (eds.), *UN Rapid Reaction Capabilities: Requirements and Prospects*, Clementsport, N.S.: The Canadian Peacekeeping Press, 1995; U.S. General Accounting Office, *United Nations: Limitations in Leading Missions Requiring Force to Restore Peace*, GAO/NSIAD-97-34, Washington, D.C.: USGPO, March 1997.

25 United Nations, *Report of the Panel on United Nations Peace Operations*, August 21, 2000, A/55/305-S/2000/809, p.x. Hereinafter cited as *Brahimi Report*.

26 Smith, pp.178, 181; Berdal, p.44; John Hillen, *Blue Helmets: The Strategy of UN Military Operations*, Washington: Brassey's, 1988, passim.

27 Lt Col Larry K. Grundhauser, USAF, 'Sentinels Rising: Commercial High Resolution Satellite Imagery and Its Implications for US National Security, *Airpower Journal*, 1998, http://www.usafa.af.mi./inss.

28 See, e.g., John K. Newton, *Autonomous and Remotely Guided Vehicle Market Study*, Edmonton, Alberta: Western Economic Diversification Canada, July 4, 2000, p.24. See also Brad Foster, 'REMSAT Revolutionizes Emergency Management,' *Earth Observation Magazine*, January 2000. http://www.eomonline.com.

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