ROBERT LATHAM & LISA WILLIAMS

Power and Inclusion

Relations of Knowledge and Environmental Monitoring in the Arctic

ABSTRACT This article is a critical study of the planning and design process of the Sustaining Arctic Observing Network (SAON). SAON, in its ambition to build a comprehensive, pan-Arctic monitoring system, seeks to integrate all relevant scientific and environmental monitoring sites in the Arctic, guided by an ethic of inclusion regarding the knowledge of indigenous Arctic peoples (KIAP). It is argued that the logics of inclusion in play, paradoxically, risks limiting the capacity for Arctic indigenous peoples to control their knowledge and its uses, to monitor the activities and outputs of SAON itself, and to appropriate the SAON system and its data for uses they control. This article also suggests an alternative approach: rather than place KIAP within SAON, it calls for planners to consider establishing knowledge relations between SAON and KIAP so that the distinct status of KIAP—in a position of exteriority to the comprehensive monitoring system—is acknowledged. Within these knowledge relations, differences in the production of knowledge can be effectively recognized, a site can be created for reviewing SAON's monitoring work by local communities and practices, and strategies for open, adaptable data systems for local users can be established.

KEYWORDS Arctic, monitoring, epistemology, environmental politics, science and technology, SAON

Introduction

A central locus of monitoring ambitions since the nineteenth century (see Levere 1993), the Arctic is now understood to be a crucial region for observing the effects of global climate change, including increases in temperature, melting sea-ice and glaciers, and shifts in terrestrial and marine life (*Arctic Climate Impact Assessment* 2005: 8).[1]

Accordingly, efforts are underway to organize the myriad Arctic observation networks into a comprehensive system-of-systems to improve the understanding of the Arctic (SAON 2008) and increase capacities for decision-making as part of Arctic environmental governance. This drive will materialize in the formation of the Sustaining Arctic Observing Networks (SAON).

This paper explores the logics of knowledge production involved in the planning of SAON and what is at stake in the effort to build SAON as a comprehensive monitoring system in the Arctic region. It argues that a comprehensive approach—one that integrates all the sites of knowledge production judged to be relevant to monitoring the Arctic, including the variety of knowledges of indigenous Arctic peoples (KIAP)—risks producing a system that limits the capacity for Arctic indigenous peoples to: a) control their knowledge and its uses; b) monitor SAON itself; and c) access SAON data and information in ways and for uses they control.

Through an analysis of documents released since 2007 that outline the fundamental plans for SAON, we will explore the attempt to be inclusive and comprehensive regarding forms and sites of knowledge produced and accessed in the Arctic. Even if SAON changes course (toward or even away from what is suggested here) or fails to be developed, this analysis remains relevant. This is because the process of planning SAON speaks to a particular way of thinking about building systems for mastering knowledge that remains prevalent in the realm of Western science, even a science that increasingly attempts to be inclusive of other forms of knowledge.[2] We critique the planned starting point for SAON not only because of what SAON may limit but also to point to the potential for an alternative starting point for engagement between knowledges.

As the focus of this paper is knowledge system-building and proposed ways of drawing KIAP into that system within the Arctic region, it will not address the actual knowledge practices of KIAP. Nor will it address how indigenous peoples are involved in community-based monitoring (as found for example, in knowledge produced by indigenous Arctic peoples in coastal Arctic communities about environmental and biological change found within the Bering Sea Sub-Network [BSSN], or the knowledge of reindeer

herding practices found with Ealát, the Reindeer Herder's Vulnerability Study, both of which are to be included within SAON; see Arctic Council Indigenous Peoples' Secretariat 2010).

Rather than assuming that KIAP will be included inside of (that is, integrated into) SAON as a source of information and knowledge about ecological conditions in a locale, we argue that KIAP should be explicitly recognized as standing outside the boundaries of the system, in a position of exteriority. But instead of treating this exteriority as the basis for exclusion or disregard of KIAP, we suggest that an information and knowledge system such as SAON can recognize the value of other knowledges without attempting to subsume them. Instead, SAON can approach itself and KIAP as complements and seek to establish relations of knowledge. We understand these relations as informal, loose, flexible, but obliging and responsive sets of relations of knowledge exchange. These relations of exchange should be open to renegotiation on a regular basis, with informal commitments and norms operating to ensure that this flexibility does not lead to a hierarchical relationship between SAON and KIAP.

What we suggest is that knowledge relations between SAON and KIAP need not be formal as they can rest on verbal understandings. Nor do they need to be tactical and strategic, but simply a function of mutual interest in cooperation and collaboration. Instead, knowledge relations between SAON and KIAP could be constructed where the KIAP is understood and acknowledged to be exterior to SAON such that indigenous peoples determine how their knowledge is used and on what terms it is drawn into SAON. This use and terms are to be continually open to renegotiation and resetting based on developments in local Arctic communities and the Arctic region, SAON, and the wider world. We envision this as a continual process of (re-) negotiation and trust-building in relations between indigenous and Western actors (Delgado & Strand 2010) and their knowledges. These processes could thus provide a framework for long-term relationships, which Horowitz (2010) argues is critical for building trust. The goals of the knowledge relations would also be open to negotiation as determined by KIAP but could broadly include the enrichment of Arctic environmental knowledge. More precisely, the objectives would include creating a space within which communications about inequalities in the production of knowledge could take place whilst avoiding appropriation by SAON, provide a site for reviewing SAON's monitoring work by local communities and practices, and encourage a system of data management that is appropriable for local users within Arctic communities.[3]

We begin by establishing the importance for investigating SAON, arguing that the current moment is crucial for interrogating SAON's plans. We

then go on to explore the comprehensive approach that is central to SAON's planning. We subsequently focus on the implications of establishing a comprehensive system. In doing so, we consider: what an all-encompassing system might mean for the status of KIAP; the possibility of independent, community-based monitoring and oversight of the SAON system itself; and the capacity of indigenous Arctic peoples to adapt the SAON system and its outputs to their own needs.

SAON. A System in Formation at a Crucial Moment

In general, the present juncture is a crucial moment in how knowledge can be produced, monitored, and synthesized. The advance in digital technologies is one reason special attention to the development of monitoring systems is urgent. We are at a point where such systems are possible and are in formation in many sectors (Latham 2006). In the Arctic region, these technologies have enabled the possibility for the construction of a large-scale system-of-systems such as SAON.

Formed in response to a call made at the 2006 Arctic Council's Ministerial Meeting in Salekhard, Russia, in anticipation of the 2007–2008 International Polar Year, SAON is unique in its ambition and potential to synthesize and integrate existing observation systems and their data into a large-scale observation network. SAON is designed to sustain Arctic environmental data, to improve the understanding of the Arctic environment (SAON 2008), and thereby increasing capacities for decision-making as part of Arctic environmental governance.

SAON is planned to become *the* pan-Arctic informational system dedicated to coordinating the observational data of over 44 already operational monitoring systems referred to as "building blocks" (SAON 2008: 11). These building blocks are organized into three levels of observation systems: research observing within scientific communities, operational observing from government agencies, and local observing by Arctic residents and communities (SAON 2007: 2). Each of these systems are planned to cover as much Arctic observational data and information as possible. The three levels are to function under the wide remit to strengthen connections between "research and observing activities and associated data/information management services, and the societal benefits and needs from Arctic observing" (SAON 2008: 12). Scientific research and education, data products and technology, and the development of forecasting and prediction capabilities are the proposed benefits that will feed into decision-making and the development of policy by the Arctic Council and SAON participants (SAON 2008: 12).

Co-ordinated by the International Arctic Science Committee (IASC) and the Arctic Council, SAON's founding members included the Arctic Council, European Polar Board-Global Ocean Observing System, Indigenous Peoples' Secretariat, and the National Science Foundation (USA). SAON subsequently began its planning process, coordinated by the Sustained Arctic Observing Networks Initiating Group (SAON IG), formed in 2007. Tasked with developing a set of recommendations on how to "achieve long-term Arctic-wide observing activities that provide free, open, and timely access to high-quality data that will realize pan-Arctic and global value-added services and provide societal benefits" (SAON 2012), workshops were organized in Stockholm, Sweden, Edmonton, Canada, Helsinki, Finland, and St. Petersburg, Russia from 2007–2008. The outcome of these workshops was published into the Report "Observing the Arctic" (SAON 2008), which concluded that

> Arctic observing sites did not adequately cover the Arctic region, observing data are fragmentary and not easily available, and only a part of the Arctic observing is funded on a long term basis. (SAON 2008: 1.)

SAON is now planning for its implementation by a Steering Group, comprised of members of the Arctic Council states, indigenous people's organizations who are Permanent Participants at the Arctic Council, the IASC and the World Meteorological Association (WMO) (SAON 2012). Once implemented, SAON will be a massive, transnational monitoring effort designed to facilitate, coordinate and collaborate amongst existing monitoring networks, data, and information systems (SAON 2008: 11).

    With this background in mind, the first reason why the present moment is such a crucial one for investigating SAON and its proposed approach to knowledge relations stems from the sense of urgency to respond to global climate change. According to the SAON Initiating Group, superior, more synthesized, and better-organized knowledge about climate change is needed (SAON 2008: 2). SAON is meant to provide an opportunity to systematize and expand Arctic observations in order to build

> understanding of the impacts of environmental change and human activities on the marine and terrestrial ecosystems of the Arctic so that ecosystems can be better managed and sustained to maintain and to improve the quality of life both for Arctic residents and all peoples who are connected to the Arctic. (SAON 2008: 4.)

According to SAON planners and potential participants, climate change necessitates the construction of networks and linkages in monitoring data to

"facilitate improvements in Arctic observing, and related data and information management services" (SAON 2008: 13; SAON 2009*a*: 1), which in turn will guide environmental governance regarding decisions made by the Arctic Council, IASC, and WMO. As climate change is not limited to the Arctic, SAON also plans to be interoperable with other systems, such as the Global Earth Observation System of Systems (GEOSS) (SAON 2008).[4] SAON can therefore offer another resource for understanding climate change not only for the IASC and Arctic Council but also for other systems and governance structures outside of the Arctic region.

The current moment is also important because SAON is at a critical juncture in its formation, with its Steering Group looking towards implementation. On the one hand, SAON's component parts are already in place and producing observations. For example, many of SAON's networks and much of SAON's proposed design and organization will be based on the Arctic Observation Network (AON) (see SAON 2009*a*; AON 2010), an American initiative of the National Science Foundation. For its part, AON is significant for its efforts in gathering long-term data based upon observations about the Arctic's atmosphere, ocean and sea ice, hydrology/cryosphere, terrestrial ecosystem, and human dimension from numerous projects (AON 2010). The data and information based upon these observations are to improve knowledge about environmental change and inform the American Study of Environmental Arctic Change (SEARCH) program (AON 2010). What is of concern is the ability to use AON, an U.S. national initiative, as a template for SAON, an international effort that would ostensibly require more time, resources, and ability to gather and concentrate Arctic data and information than its American counterpart.

On the other hand, it must also be kept in mind that SAON is not operational as a system-of-systems. At this moment, SAON is not locked in with regards to its particular design. It is therefore the moment to ask questions about stakeholders (such as government agencies, scientists and research centres, and local communities in the Arctic) and the potential distribution of benefits from the knowledge flowing through SAON. It is also timely to query the application of SAON-based knowledge (for example, in monitoring and controlling fisheries) and the organization of SAON's data and information, and to question the nature and consequences of the comprehensive system that SAON's designers are planning. These issues need to be raised and such questions asked now, as once locked in, such a comprehensive system will be even more difficult to change than one that operates on a smaller scale.

These issues and questions might be asked of any infrastructure in formation. Infrastructures (such as cyberinfrastructures) can be

sites of intense conflict, through which the identity and status of relevant stakeholders, the distribution of benefits, and losses, and the general rules of the game are all being worked out simultaneously. (See Jackson *et al.* 2007: 6–7.)

The identification and naming of actors as winners or losers and the articulation of who gets what and when (Jackson *et al.* 2007: 6–7) are choices about the allocation of power. These issues make the processes in SAON's formation especially crucial.[5] Thus, decisions about how networks are included and what information is involved in SAON (which would affect what is disseminated through the system) are of great consequence, as are decisions about what constitutes the "gaps" in Arctic knowledge that SAON is designed to fill as part of the benefits of the proposed system (see SAON 2008).

The valuations of the knowledge SAON plans to sweep into its proposed system and the ways in which this information is transformed and used through technologies will also become imbued with power relations. How knowledge, data, and information that SAON selects to incorporate into its structure would position SAON decision-makers (within SAON's Steering Committee, the IASC, and Arctic Council) in a determining role over other (scientific, governmental, and community-level) actors who submit their data and observations. These decisions can recast, reframe, and render the Arctic, its ecologies, and its peoples in particular ways by controlling the production and dissemination of knowledge about the Arctic through SAON. Specifically, this could be done through technologies within SAON's system design and administration (such as its data management, information portal and interoperability mechanisms with other systems), practices and logics which underlie them (such as decisions about protocol for observation networks and building blocks and distribution of information), and grammar (choice and use of language and terminology to describe and frame problems) (Latham 2010).

A Comprehensive System

The plans to have SAON coordinate and integrate the numerous, already-existing systems and "strengthen the linkages between research and observing activities and associated data/information management services" (SAON 2008: 12) are directed towards creating a comprehensive system. This is not a totalizing project. There is no ambition to integrate and draw into its network *all* information and knowledge about the Arctic region in order to generate a totalized field of social power, or totalistic information and knowledge matrix over this space.[6]

As a comprehensive—as opposed to totalizing—system SAON would seek to draw together the known set of discrete systems of observations operating in or over the Arctic. From the perspective of Western knowledge, it may appear self-evident that there is value in this comprehensiveness, as SAON is tasked with developing as complete a body of observations about Arctic conditions as possible. But what is at stake in this logic is the positioning SAON as the overarching context for Arctic knowledge and information, with KIAP as merely one form of knowledge production. And thus pronouncements on conditions in the Arctic become the authority of SAON, with KIAP left to the role of information source and knowledge subaltern.

There are two noticeable sites for the articulation of SAON's comprehensive logic. One is its proposed structure. As specified by the IASC and Arctic Council, SAON is meant to become the Arctic regional informational system. It will be dedicated to coordinating observational data from the 44-plus building blocks which engage in research observing within scientific communities, operational observing from government agencies (SAON 2008: 11) and local observing by Arctic residents and communities, the latter which includes KIAP. It bears repeating that these different levels of observation will cooperatively work to cover as much Arctic observational data and information as possible. Further, in keeping with SAON's express desire to cooperate with and include indigenous actors and knowledge (evidenced by the inclusion of the Indigenous People's Secretariat [IPS] of the Arctic Council in SAON's Initiating Group and Permanent Participants [PPs] of the Arctic Council in its Steering Group), all levels of observation—including community-based monitoring projects that are based on KIAP—are conceptualized as having equal status in SAON's plans (see SAON 2008: 3).[7] This means that community-based monitoring projects based on KIAP, such as the Sanikiluaq Sea Ice Project that is part of the Exchange for Local Observations and Knowledge of the Arctic (ELOKA) initiative would have equal status to those projects based on Western science, such as the WMO's Global Ocean Observing System's (GOOS) Argo project. Part of the proposed value and benefit of SAON is that research, operational, and local observing levels are to function under a wide remit to strengthen connections between "research and observing activities and associated data/information management services, and the societal benefits and needs from Arctic observing" (SAON 2008: 12). Scientific research and education, data products and technology, and the development of forecasting and prediction capabilities are the proposed benefits that will feed into decision-making and the development of policy by the Arctic Council and SAON participants (SAON 2008: 12).

A second articulation of SAON's comprehensive aspirations is the role

and identity SAON will adopt. SAON would become the collector of Arctic ecological data and knowledge, in order to become the sole organizer and disseminator of Arctic ecological information. As such, SAON will become an observational system that coordinates and concentrates the input of data. It will also become an information system that provides data output to end-users in support of "Arctic and global value-added services and so-cietal benefits," that is, the provision of Arctic ecological knowledge and a means of coordinating it. In turn, the system is designed to be interoperable with global systems and systems working outside of the Arctic (see SAON 2009*a*: 1).

According to the information available, the SAON plans include the design of a singular data portal, in which observational data and informa-tion will be stored and organized. The rationale for creating the data portal reinforces the notion that SAON will assume a comprehensive role, because SAON will act to sustain existing Arctic observational networks as a "leg-acy" for the 2007–2008 International Polar Year. This contribution to the legacy of knowledge indicates that SAON wishes to be a long-term, compre-hensive repository of Arctic observations.[8]

SAON's Comprehensive Desires ... with Unexpected Consequences

As argued above, in order for SAON to approach its comprehensive goals, it has to follow a logic of incorporating and concentrating Arctic environmen-tal knowledge. This knowledge comes from local communities, and means that KIAP-based projects will be brought into SAON to form trans-local networks. In turn, these trans-local networks will bind together commu-nities and link diverse actors. By concentrating and incorporating commu-nity-based monitoring and observations into its system (SAON 2008: 12), SAON may create unintended consequences for KIAP. In the logic of its collection of as many observational networks as possible, SAON may risk producing an unbounded system that has no exterior from which local communities can control their knowledge in relation to SAON, as they will become outflanked by SAON. Further, in integrating all sites that SAON deems relevant to Arctic monitoring, indigenous Arctic peoples will not be able to monitor SAON from an outside position, which could potentially reduce the quality of information and data that would circulate through SAON.[9] Finally, by aiming to become comprehensive, SAON's plans do not indicate that it will be a system that will allow its data to be used and ap-propriated by those outside of its system in creative and unanticipated ways. Below, each of these possibilities is examined in turn.

Exteriority and Control over Knowledge

The creation of SAON as a massive information and data system risks rendering indigenous Arctic peoples unable to establish and control the boundaries and applications of their knowledge. This would not be on account of malice on SAON's part, or a desire to marginalize or absorb KIAP. Rather, it would be because SAON is committed to comprehensiveness and the inclusion of KIAP.

First, a loss of control over KIAP becomes a real possibility given the large proposed amount of observation networks, data, and information that SAON plans to digests (see SAON 2008: 11). Some building blocks claim to collaboratively use Traditional Ecological Knowledge (TEK) and Western scientific knowledge in their observation systems (for example, the Circumpolar Biodiversity Monitoring Program and the Centre for Inuit Health and Changing Environments).[10] While this may initially seem positive, the idea that these building blocks are rooted in both TEK and Western knowledge can be problematic, as knowledge framed and cast as TEK may easily be appropriated and swept away by SAON. This is because TEK is a broad, ambiguous term that lacks much of the specificity needed for it to become the basis of power or resistance practices, a quality that would greatly improve by emphasizing locality and/or indigeniety (see Nadasdy 1999; Martello 2001).[11] Furthermore, when framed vis-a-vis Western knowledge systems (which historically have represented themselves as universal and solely legitimate compared to other epistemologies), TEK can easily be integrated and misappropriated, extracted, and altered in the service of Western science (Nadasdy 1999). SAON has not indicated how it would take specific steps to avoid this.

Returning to the composition of knowledge that will flow into SAON through the building blocks, it is notable that at this time, few of SAON's named building blocks are devoted exclusively to KIAP. Many more, including Developing Arctic Monitoring and Observing Capabilities for Long-term Environmental Studies (DAMOCLES) and the Global Ocean Observing System (GOOS) are of the Western-scientific variety (see SAON 2008: 13). Because of the number of observation systems based on Western knowledge and SAON's desire to provide a comprehensive system by incorporating KIAP, it would be difficult indeed to avoid crowding-out and displacing KIAP—if only because of the overwhelming proportion of non-local, non-KIAP projects.

Another consequence of the comprehensiveness built into SAON's system-design plans is that the spatial dimensions of knowledge production will be reconfigured. It will be scaled up from locally monitored sites to the

(pan-Arctic) regional level and, through interoperability with global obser-
vation systems, to global levels (via the global observation systems men-
tioned above). For example, during SAON's Stockholm workshop in No-
vember 2007,[12] a noted priority was to "recognize transition from regional
observation systems to pan-Arctic observation network" (SAON 2007: 25).
Additionally, global scaling will be achieved by linking with global moni-
toring systems such as GEOSS (see LeDrew 2008; SpecNet/NORTHSTAR
2008).[13]

Another example of rescaling KIAP follows from a document released
by SAON's Steering Group regarding community-based monitoring. The
document discusses SAON's creation of an inventory of community-based
monitoring and observation networks as reported through national repre-
sentatives, and stressed the importance of identifying all relevant commu-
nity-based monitoring and observation projects (SAON 2009b: 2), ostensi-
bly to avoid having national representatives miss or ignore KIAP projects
and their observations in scaling knowledge up to the national level. This
suggests that KIAP is already being subject to the process of collection and
inventory-taking, with national representatives identifying the networks
that are deemed relevant and ultimately how they may connect with oth-
er local and to transnational and global networks. Thus, in this scaling-up,
KIAP is being embedded in local, national, regional, and global hierarchies
not of their choosing.

The organization of the networks being drawn up into SAON and the
management of their data means that key actors within SAON will act as
collectors of knowledge. This risks SAON becoming an information-broker:
distributing Arctic environmental knowledge and ensuring that its knowl-
edge—and preferred "building blocks" that support such knowledge—are
sustained and not subject to scrutiny. In such a process, control over the
content and use of KIAP is transferred into SAON; as SAON, not indige-
nous Arctic peoples, will be the brokers of Arctic ecological knowledge and
thereby determine the content and application of the knowledge that they
distribute.

Also, SAON planning ignores the risk that system managers will draw
out only selected observations and information from the wider contexts
of local knowledge production; in Nilsson Dahlström's words, "picking the
cherries out of the [indigenous] cake" (Nilsson Dahlström 2009: 54). The
effect is de-contextualizing, and therefore devaluing to indigenous knowl-
edge (Nadasdy 1999; Simpson 2001; see also Nilsson Dahlström 2009: 52),
allowing its nuances to disappear (Harding 2008: 148). All the while SAON
is making a claim of inclusivity (of KIAP) as a part of planning its compre-
hensive system, while ignoring that, as a part of Western science, it too is

embedded in a local context (Watson-Verran & Turnbull 1995). Further, in planning a comprehensive system that works by collecting as much knowledge as possible, SAON would set the parameters and context of knowledge and thereby might subject KIAP to SAON's own standards of precision and measurement (see Adas 1989: 203). Moreover, even if SAON were to make efforts to incorporate the broader context associated with KIAP into its system design, the process of sweeping it up into its system would still present the possibility of devaluing it. This is because power would not be in the hands of local actors to organize knowledge within the system or determine the ways in which the produced knowledge would flow through the system (in terms of design, inputs, synthesizing, and end-use).

These concerns and possibilities about KIAP's loss of control because of SAON's comprehensive aspirations are not addressed within the available documents and information about SAON. The available texts are vague about these concerns, despite SAON's espousal of "coordination, collaboration and communication" (SAON n.d.: 3) amongst its monitoring sites and networks. Seen in this light, the stakes for knowledge are high: control by Arctic indigenous peoples over KIAP's nascent relationship with an emerging, dominant knowledge system could be lost, even though SAON claims that it includes this knowledge and requires it to fill gaps in observational knowledge.

Finally, perhaps the most self-evident way that SAON could limit KIAP's control over its relations with SAON is through resources. KIAP-directed, local observation sites and systems simply do not have the same sort of funding as their larger, state and research-institute based counterparts (who would provide more funding to SAON). Larger networks (like DAMO-CLES for example), the dominant building blocks within SAON, will bring with them far more funding and visibility than smaller projects based on KIAP. Thus far, SAON has yet to propose a compensatory strategy. Further, it is natural to expect that resources will be directed towards efforts that facilitate the development and creation of SAON. Will applicants for funding have to position themselves as contributors to SAON's system-building efforts, as opposed to contributing to their own knowledge needs? Without an explicit commitment to fund Arctic-monitoring projects based on KIAP, the building of SAON *per se* might easily absorb a majority of resources. The concentration of files, organization of data portals, and the organizational and bureaucratic power that SAON will require will be difficult to resist in funding decisions, so long as SAON conceptualizes itself as offering a comprehensive system with no exterior. The consequence could arise that KIAP projects will not receive the same level of funding.

Regardless of the purposes of funding, will indigenous Arctic peoples'

projects be forced to join SAON, in order to have KIAP broadly disseminated to other communities or policy-makers? While participation in SAON is voluntary, it may only be in name only. Without the SAON imprimatur, would KIAP voices be heard outside of indigenous Arctic peoples' communities? Faced with the possibility of an asymmetrical distribution of resources, KIAP would have little choice but to join a system that wants to be comprehensive.

Taken together, SAON's claims of including KIAP as a part of its comprehensive plan means that it offers no boundaries to delineate what is inside/outside the system. Instead, the relations of knowledge (as described above) would position KIAP as an exterior site. As suggested above, SAON's comprehensive and inclusive approach to KIAP fails to recognize the status of the later as exterior to the system. We contend that such recognition should follow from the establishment of relations between SAON and KIAP (as described above). This means that KIAP, whether organized into observational systems or occurring on an ad-hoc basis, would constitute this outside and be recognized as subject to its own meanings and own control. This site of KIAP would be recognized as setting its own terms of involvement of SAON and Western science, a relationship that would be constantly negotiated and reconsidered with indigenous actors determining which KIAP would be shared and/or integrated and scaled up into SAON, should they choose to do so.[14] KIAP could also retain the option to stabilize and normalize the relationship should it also choose to do so. What would therefore be unique in this situation is that SAON would acknowledge that its own knowledge has boundaries and has relations with KIAP as something outside of itself, not included within its system. This exteriority of KIAP would not render it an "Other" understood as subjugated in comparison to SAON and Western science, rather it would consciously recognize that influences and effects on KIAP by Western science and science systems are very real and powerful.

Knowledge relations would therefore be understood as comprising lateral, not hierarchical exchanges. KIAP would also then have the chance of avoiding being swept up into a comprehensive system and outflanked, decontextualized, or outdone by other observational systems with more resources. To be sure, the local site of knowledge would be outdone in terms of resources. However, if kept within the context of continually negotiated, lateral relationships, KIAP has a better chance of avoiding being fully outflanked within the confines of a comprehensive system. Questions about inequality between forms of knowledge and decontextualization of KIAP could also be asked through these relations of knowledge.

Posing these questions about KIAP and relevant relationships of power

and knowledge does not preclude the possibility of developing aspects of the knowledge relations that would allow for KIAP to "travel." Technical devices allowing for connections between forms of knowledge and the mobility of knowledge such as maps and observations lists (Watson-Verran & Turnbull 1995: 117) would be shared to allow knowledge to be located out of its time and place without becoming decontextualized and swept into a hierarchical relationship.

To summarize, our concerns about SAON do not stem from the judgment that its planners intend to capture and colonize KIAP through their network of networks, in the end helping undermine it. Our apprehension is that SAON's starting point of inclusivity and comprehensiveness—regardless of intent—fails to recognize the difference that is constituted by KIAP. In consequence, KIAP would be treated as a component of a unitary, Western science-centred system in the Arctic region, rather than a knowledge system in its own right that may or may not be part of SAON—a choice to be left to Arctic communities, not SAON planners. Even if the choice is not to join SAON, a community could still provide relevant monitoring information on terms it chooses and settles with SAON. While the stakes of SAON's comprehensive approach may not directly impact the existence and status of KIAP for Arctic peoples *per se*, these stakes may affect the possibilities of Arctic peoples to ensure that there are "audible" and recognized voices speaking about the ecology of the Arctic based on legitimate knowledge practices from somewhere, institutionally, other than within the relatively massive system—one whose future governance and uses are not ultimately known.

Comprehensiveness Obviates the Need for Exterior Monitoring

Elinor Ostrom has pointed out that in the absence of a centralized governance system operating with complete information, monitoring is most effective as a cooperative endeavor, where actors in a given sphere of activity are supplying information and monitoring themselves and others (Ostrom 1990: 94–100). While SAON's scope and range is profoundly broad relative to the limited spheres that Ostrom focuses on (such as local fishing waters), there is no inherent reason why the value of a cooperative approach to monitoring cannot still apply. That is, unless, there is no exterior from which others can monitor it. This is precisely the case with SAON: it will be a comprehensive system that has no exterior from which local communities can monitor SAON itself, eliminating the possibility for a cooperative approach by obviating the need for external monitoring. Another approach to

cooperative monitoring is what can be labeled distributed monitoring (see Latham 2006). With distributed monitoring, not only is monitoring capacity and agency distributed among different actors, but also these actors are operating from distinct, exterior, institutional positions. Distributed monitoring capacity already exists to some degree in various national and international sectors. Consumer watch dog groups, human rights organizations, fair trade advocates, and environmental activists are among the actors—in addition to independent research institutes—that challenge official data and assessments with their own in various sectors regarding issues such as product safety, free speech, poverty, and environmental degradation.

SAON's designers are silent on the question of whether or not there will be any channels for distributed monitoring.[15] This suggests that the possibility of facilitating oversight and monitoring of SAON (and thereby contestation of its operation) by Arctic indigenous peoples is not being considered as a fundamental dimension of strategic planning for SAON. In other words, there is no discussion of putting in place capacities and relations to monitor SAON's monitoring work, once SAON is operational. Without monitoring from a space outside of SAON's boundaries, forms of local opposition to SAON's knowledge production become unlikely given the lack of resources in communities, especially in the face of the large-scale monitoring system of systems SAON is intended to be. For SAON, the opportunity for less powerful local actors (in terms of resources and access to decision-making structures) to participate not only in the supply of observational data and information, but also the monitoring of others' activities, are crucial to ensure that Arctic environmental governance has beneficial outcomes for all of the Arctic's peoples.

SAON's logic of comprehensiveness means that there is no built-in requirement for monitoring SAON's activity from the outside, because *there is nothing to be recognized outside of its boundaries of knowledge*. Not only would its knowledge be seen as comprehensive, but also official, carrying with it the weight and authority of the Arctic Council, IASC, WMO, and SAON's constituent building blocks. However, the existence of bodies of knowledge located outside of SAON can become a good in itself if it challenges official data and information to be more inclusive, accurate, and transparent (Latham 2006). This is an especially important feature given the close proximity between science and positions of economic and political power, and science's ability to produce new elites (see Jasanoff (ed.) 2004: 5) who may articulate particularistic, perhaps even parochial interests.

It could be argued that monitoring SAON from an exterior position is not necessary. The comprehensive nature of SAON's plans means that SAON itself would provide the solution: coordinating and collaborating

data inside SAON to eliminate or improve poor monitoring practices and/or outlying results.

Assuming that SAON's comprehensiveness would lead to effective self-monitoring within the boundaries of its own knowledge raises questions that need to be addressed: what if the very knowledge and information that needs to be challenged comes from projects undertaken by larger networks, projects backed by nation-states, or building blocks whose produced knowledge support hegemonic groups such as decision-makers and private firms? How specifically would this monitoring/or oversight take place and how would accountability be structured?[16]

Should KIAP be integrated into SAON without creating a space for monitoring that exists outside of SAON (beyond oversight by its controlling actors and institutions), then it is difficult to conceptualize who or what will challenge SAON's official data. Because this data is legitimized by structures as diverse as the IASC, Arctic Council member States, the Global Ocean Observing System and National Science Foundation, there is a clear need for SAON to be more explicit about its commitments to how its monitoring operations will be monitored and how KIAP and indigenous Arctic peoples will be accounted for in such a plan.

We suggest that the relations of knowledge conceptualized above are a useful starting point for outside monitoring. Such a relation provides the initial recognition that there is something existing exterior to SAON that has the knowledge and capability to monitor the data and information that SAON produces. This sort of relation would ensure that there is something existing exterior to SAON which has the knowledge and capability to monitor the data and information that SAON produces, while engaging in a lateral relationship with SAON on its own terms. Within these spaces, KIAP would not just participate in monitoring, but have a clear and self-defined role and capacity to monitor the monitoring. Positioning KIAP as outside of SAON yet entering into a knowledge relation with lateral exchanges means that indigenous Arctic communities could monitor and potentially challenge SAON's work, working towards limiting the repression of local, indigenous knowledge that subverts Western logic and science (see Cruikshank 2005; Tester & Irniq 2008). Monitoring SAON's work therefore involves knowledge-based contestation, an opportunity to challenge claims based on Western scientific experience, and a positing of alternative knowledge claims that could be incorporated and represented within the knowledge relations, with control over this KIAP continually residing with indigenous Arctic peoples.

KIAP's exteriority in turn relates to another advantage that a system designed relations of knowledge offers: that the position of knowledge out-

side SAON and the ability for KIAP to monitor SAON (and itself) could enrich the knowledge produced both by SAON and local observations standing outside of it. Comparison of observations about the atmosphere, ocean and sea ice between SAON and KIAP external sources for example, would deepen knowledge about these areas for both sides. While this incorporation of KIAP is already underway within SAON's observation systems, the difference between what is planned by SAON and the relations of knowledge conceptualized herein cannot be overstated: the lateral, locally-self determined relationships permanently in-process of (re-)negotiation shape knowledge production in ways that are dramatically different than in systems that are planned around comprehensive status.

Barriers to Appropriable Data and Information

Recognizing KIAP as situated outside the boundaries of SAON would require SAON to communicate and make accessible and useable its knowledge to local communities as an equal partner (as opposed to integrating KIAP into its structure). It would be nice to believe that information technology offers a straightforward solution and that linking SAON's website and networks to other sites and networks that are based on KIAP and are exterior to SAON. In principle this practice could build up relations between SAON and the outside, and also allow for comparisons and mutual use of SAON and non-SAON data.

However, in its proposed design, SAON would limit the ability of local users from creatively appropriating and manipulating its data. This is because SAON seems intent on allowing access to its data and information only within the parameters of its own system, controlling which observation sites in the Arctic, networks, and data sets/areas of concern (such as biotic/abiotic data, cryosphereic, data etc.), can be accessed. By articulating KIAP's use of data as a matter of "free, open, and timely access to high-quality data that will realize pan-Arctic and global added-value services and provide societal benefits" (SAON 2008: 5), SAON manages to constrain use to the existing parameters and context of SAON itself.

In this case, open means to convey that access is available to all parties. But another meaning of openness relates to the practices of open source software development, where being open means being able to appropriate elements of the system so that they can be configured differently to fit needs and logics not otherwise intended by system designers. Anthropologists articulate similar logics with the concept of counterwork, which describes how non-Westerners appropriate knowledge and practices from Western systems and relocate and re-transpose them within their own knowledge systems (see Parkin 1995; Arce & Long 2000; Escobar 2008).

Because SAON is not-yet fully operational, the inability of users to appropriate its data can only be assumed at this juncture. SAON's lack of stated commitment to the importance of appropriating data suggests that it is justified to be skeptical about its understanding of end-use. First, SAON has yet to release a statement regarding the importance of a system that can easily be manipulated by users who can shape SAON's cyberinfrastructure to their own self-defined ends. In the absence of a clearly defined statement to build appropriation into the system, SAON is not only precluding the creative and innovative use of data and information to take place, but it is also excluding actors who would not use the data in the "templated" way, which ostensibly would privilege scientists and government.

Second, SAON will likely base its data portal on the data portal presently used by AON, the Cooperative Arctic Data and Information Service (CADIS).[17] As mentioned above, AON is an already-operational, U.S. initiative of the National Science Foundation that incorporates numerous observation projects in the Arctic. For the information and data produced by AON's projects, CADIS already provides a

> web-based service that enables data discovery, access and use by providing a metadata archive and portal for data discovery, a data and products archive, and tools for data manipulation and analysis. (AON 2010.)

For SAON to use (or at least build upon) CADIS makes sense, as few networks-of-networks exist, and there cannot be many options for cyber infrastructure that are able to answer the informatics challenge of coordinating and integrating existing networks into one cyberinfrastructure. CADIS may be the closest system available to organize SAON's metadata. Therefore, it seem likely that SAON will decide to use AON, for the very reason that it offers a massive comprehensive organization of networks, and SAON needs a ready cyber infrastructure to handle all its data and information. Moreover, there is no publicly-available information provided by SAON that directly addresses the possibility that they will develop their own cyber infrastructure.

Concern about the usability of AON stem from the fact that the AON/CADIS platform does not appear to allow for the appropriation of data by end-users. AON's search fields include geographic bounding, principle investigator, discipline, instrument, platform, location and projects. At first glance, these appear to provide a wide variety of applications for users. However, the system appears to be oriented to scientists, rather than local users. These fields narrow the opportunities users have to think about the ways that they would like to define and use the data. Creative use is there-

fore limited and more likely, excluded. Further, while users can contribute and edit metadata and data, they must sign up for an account and be subject to an approval process, to determine which data sets users will be editing, with the consequence that access is not as free or as open as first appears. Instead, local users need to be able to determine what their data/informational needs are and what is required from AON in terms of accessing data. Overall, if SAON will depend, to a large part, on the AON/CADIS system and model, and does not articulate a commitment to a versatile and meaningfully open system, it will head towards a brittle construction that is not easily appropriated by community users.

Alternatively, a system that is appropriable is one in which the users could design their own logics of use and access. In turn, users can contribute to the system itself, becoming producers of technology and observational data and information through appropriation (Eglash 2004). Systems that have creative appropriation designed into them include the Barrow Area Information Data Base-Internet Map Server (BAID-IMS). Through BAID-IMS, indigenous Arctic peoples are creatively using GIS technology in unanticipated ways to distribute sea ice information via BAID-IMS to

> better understand and survive in an extreme environment, which is seeing the impacts of climate change in terms of coastal erosion, flooding, permafrost melting, increased intensity of storm events, and so forth. (BAID-IMS 2010.)

Indigenous Arctic peoples also contribute to systems knowledge about the ice and the BAID-IMS system is flexible enough to adapt around new knowledge. BAID-IMS offers but one example of a system that allows users to appropriate technology for their own needs, and enables them in turn to shape this technology in terms of how it is used and the knowledge it draws upon.

In sum, by creatively appropriating information and data, KIAP is not reified or seen in a pure sense within the relations of knowledge proposed in this study, because it is assumed to be in a state of interaction with other forms of knowledge outside of its own boundaries. By bearing this in mind and revisiting its design plans, SAON could design a system that draws on an open-source model whereby users continually re-shape and re-define not only publicly-available data, but how data is used (often in unanticipated ways) and modified by users to suit their own needs. Such as system, modeled along the lines of the Linux operating system or Mozilla Firefox web browser, would be both pliant and versatile for SAON and its potential users, and could provide a model for other data and information systems designed in the future.

Conclusion

Large-scale systems have their place in knowledge production if the boundaries which define what knowledges they include/exclude are permeable and shift and are resistant to absorbing and colonizing knowledge which stands outside of it. Attempting to make SAON a comprehensive system means that now useful knowledge can exist outside of its boundaries. Instead, its claims to being all-inclusive—no matter how well-intentioned—should be re-evaluated against the possibility of generating negative consequences for KIAP. These include the loss of control over the relations between KIAP and a large-scale system-of-systems like SAON, by limiting opportunities for local communities to be able to monitor knowledge-production in their world, and by closing off opportunities for local communities to generate and use data in ways that they deem appropriate for their uses.

An alternative approach is one in which SAON engages in relations of knowledge with KIAP, with KIAP defining its own relationship with SAON, and both forms of knowledge respecting the lateral boundaries between them. To do this requires not only a top-level commitment by SAON's architects and potential decision-makers, but also willingness amongst sub-systems, scientists, and state representatives. In doing so, the content and practice of environmental monitoring, as well as the relationship between forms of knowledge, could potentially be recast and set up as a model for other regions beyond the Arctic. Whatever the fate of SAON, the preceding analysis speaks to a particular way of thinking about knowledge production and system building that is evident in the SAON process and remains prevalent in the world of Western science.

NOTES

[1] The nineteenth and twentieth centuries witnessed a remarkable transformation in governance: states in the West gained new capacities in the monitoring of their populations and made such capacities central to policy-making across an ever expanding and deepening range of social and economic life within a territory (Scott 1998: 90–102). The logics of monitoring were increasingly applied transterritorially through organizations such as the World Meteorological Organization with the aim of monitoring phenomena on a global scale (Edwards 1997).

[2] See, for example, Nadasdy 1999; Mignolo 2000; Eglash 2004; and, especially, Delgado & Strand 2010, which explores the problems of inclusion in two cases in Latin America and Scandinavia.

[3] We acknowledge that the term *local user*s is problematic insofar as it cannot capture the range of subjectivities located in Arctic communities (including indigenous and non-indigenous populations).

[4] The construction of the Global Earth Observation System of Systems (GEOSS) should be completed by 2015, according to the Group on Earth Observations (GEO). With up-

wards of 100 founding government and institutional members, GEO was established in 2005 following the World Summit on Sustainable Development with the goal of forming GEOSS as a global system that will systematize and synthesize observing networks and the information and data that they provide (see GEO 2010).

5 It is beyond the scope of this essay to fully elucidate the identification of winners and losers, though the arguments that follow incorporate these issues in an implicit manner.

6 A thoughtful description of a totalizing field of social power, associated with the colonizing culture of the modern capitalist state in the Arctic is in Tester & Irniq 2008: 51: "We have used the concept of totalization, after Sartre (1991), in reference to a process whereby attempts are made to bring all aspects of life (spatial, temporal, social, and economic) into line with a dominant or overarching logic: in the case of Canada, that of a modern capitalist state committed to 'the idea of progress.'"

7 For clarity, these statements are to engage SAON's representation of KIAP and are not meant to imply that SAON's inclusion of indigenous actors in its planning process or the stated equality between levels of observation are actually equal.

8 Martello (2001: 126) incisively explores the tensions surrounding the issue of storage of traditional and local knowledge within databases. The rationale for this storage is to preserve knowledge, to ensure that it is not abandoned or lost, on account of its "low economic value, the inferior status of women who use traditional knowledge, and perceptions that 'modern' knowledge and technology are superior to 'traditional' forms". Drawing on Agrawal (1995), Martello discusses how databases represent local and indigenous knowledge as therefore "frozen in time" (Martello 2001: 126), yet proponents of these databases also articulate that knowledge of the world is constantly in flux, questioning how "assumptions that traditional knowledge is extractable, portable, and amenable to preservation can be reconciled with claims that traditional knowledges are dynamic, open to many interpretations, and embedded in people and places" (Martello 2001: 127).

9 To this end, there has been much controversy over the study of climate change. Audits are underway within both the Royal Society of London and the InterAcademy Council regarding climate science.

10 For a list of networks and programs that utilize KIAP, see SAON 2009*b*.

11 For a discussion of how knowledge can also be a resistance practice, see Tester & Irniq 2008.

12 The Stockholm workshop brought together representatives from Arctic national governments as well as non-state governmental actors (such as Lars Anders Baer, President of the Swedish Sami Parliament and Lene Kielson Holm of the Inuit Circumpolar Council) representing indigenous peoples' communities and interests, scientists representing various projects and research centres (including the Stefansson Arctic Institute and the National Science Foundation) to discuss user needs, identify presently operating observation networks and the spatial, disciplinary, and temporal gaps that exist between these networks (SAON 2007: 5).

13 This is not to privilege the local scale but to question the scaling-up envisioned by SAON. See Engel-Di Mauro (2009) for an exploration of what is at stake in the choice of scale in analysis, and Zulu (2009) for an analysis of the politics of scale in relationship to community-based knowledge practices.

14 As these knowledge relations would be based upon control of KIAP by indigenous actors, it against the thrust of this paper and beyond its scope to determine which indigenous actors (indigenous peoples' organizations and actors such as Permanent Partici-

[15] pants in the Arctic Council) or current governance structure would engage with SAON as representative of KIAP.

[15] Certainly, this may change as SAON proceeds apace with its formation. Even with a clear articulation of a monitoring capacity, these observations remain pertinent as they comment on a particular logic that underlies system building that will likely remain relevant as more and more Western science systems are constructed.

[16] Taking a hypothetical example, one of SAON's possible components or building blocks, SIZONet (Seasonal Ice Zone Observing Network), which is part of the ELOKA (Exchange for Local Observations and Knowledge of the Arctic) project, carries out ice observation in Alaskan communities in order to track sea ice change "from a user perspective" (ELOKA 2011). What if their data and information clash with that of another potential SAON component, the USGS (US Geological Survey)? In this hypothetical situation, SIZONet would be seriously limited in its ability to challenge and contest the data that the USGS produces in the event of a conflict over the meaning and application of data and information. The possibility that local communities and smaller, more participatory networks could be outflanked in challenging the methods, results, and applications of information found in larger SAON projects is disturbing. Without something situated outside of SAON, how would knowledge then be contested?

[17] SAON's Helsinki Workshop data management breakout group, which met in October 2008 to discuss data centers and portals already in use in Arctic observing bodies and the need to develop a data portal, indicated that SAON will not consider AON/CADIS exclusively (SAON. Helsinki Data Management Breakout Group 2008: 2). However, there is yet to be any sort of committed statement about the specific alternatives to CADIS that SAON would consider.

REFERENCES

Adas, M. (1989). *Machines as the Measure of Men. Science, Technologies, and Ideologies of Western Dominance*, Ithaca: Cornell University Press.

Agrawal, A. (1995). "Dismantling the divide between indigenous and scientific knowledge," *Development and Change*, 26, pp. 413–439.

Arce, A. & Long, N. (2000). *Anthropology, Development, and Modernities. Exploring Discourses, Counter-Tendencies, and Violence*, London: Routledge.

Arctic Climate Impact Assessment (2005). Cambridge: Cambridge University Press.

Arctic Council Indigenous Peoples' Secretariat (2010). "Monitoring. Arctic Peoples;" www.arcticpeoples.org/backgrounders/monitoring; access date 26 September 2010.

AON (Arctic Observation Network) (2010). AON-CADIS Homepage; www.aoncadis.org/; access date 17 September 2010.

BAID-IMS (Barrow Area Information Data Base-Internet Map Server). (2010). Homepage, www.baidims.org/; access date 20 April 2010.

Cruikshank, J. (2005). *Do Glaciers Listen? Local Encounters, Colonial Knowledge, and Social Imagination*, Vancouver: University of British Colombia Press.

Delgado, A. & Strand, R. (2010). "Looking North and South. Ideas and realities of inclusive environmental governance," *Geoforum*, 41:1, pp. 144–152.

Edwards, P. (1997). *The Closed World. Computers and the Politics of Discourse in Cold War America*, Cambridge, MA: MIT Press.

Eglash. R. (2004). "Appropriating technology," in *Appropriating Technology. Vernacular*

Science and Social Power, eds. E. Eglash, J. L. Croissant & E. Chiro, Minneapolis: University of Minnesota Press, pp. vii–xxi.

ELOKA (Exchange for Local Observations and Knowledge of the Arctic) (2011). Homepage; http://eloka-arctic.org/index.html; access date 26 March 2011.

Engel Di-Mauro, S. (2009). "Seeing the local in the global. Political ecologies, world-systems, and the question of scales," *Geoforum*, 40:1, pp. 116–125.

Escobar, A. (2008). *Territories of Difference. Place, Movements, Life, Redes*, Durham, NC: Duke University Press.

GEO (Group on Earth Observations). (2010). Homepage; http://www.earthobservations.org/; access date 21 January 2011.

Harding, S. (2008). *Sciences from Below. Feminisms, Postcolonialities, and Modernities*, Durham, NC: Duke University Press,

Horowitz, L. S. (2010). "'Twenty years is yesterday.' Science, multinational mining, and the political ecology of trust in New Caledonia," *Geoforum*, 41:4, pp. 617–626.

Jackson, S. J. *et al.* (2007). "Understanding infrastructure. History, heuristics, and cyber-infrastructure policy," *First Monday*, 12:6; http://firstmonday.org/ojs/index.php/fm/article/view/1904/1786/; access date 17 April 2010.

Jasanoff, S. (ed.) (2004). *States of Knowledge. The Co-Production of Science and Social Order*, London & New York: Routledge.

Latham, R. (2006). "Knowledge and governance in the digital age. The politics of monitoring planetary life," *First Monday*, 11:9. http://firstmonday.org/ojs/index.php/fm/article/view/1398/1316; access date 19 November 2013.

— (2010). "Border formations. Subjectivity and security at the border," *Citizenship Studies*, 14:2, pp. 185–201.

LeDrew, E. (2008). "Data management and science in the IPY;" www.arcticobserving.org/index.php?option=com_content&view=article&id=48&Itemid=62; access date 5 April 2010.

Levere, T. H. (1993). *Science and the Canadian Arctic. A Century of Exploration, 1818–1918*, Cambridge: Cambridge University Press.

Martello, M. L. (2001). "A paradox of virtue? 'Other' knowledge and environment-development politics," *Global Environmental Politics*, 1:3, pp. 114–141.

Mignolo, W. (2000). *Local Histories/Global Designs. Coloniality, Subaltern Knowledges and Border Thinking*, Princeton: Princeton University Press.

Nadasdy, P. (1999). "The politics of TEK. Power and the 'integration' of knowledge," *Arctic Anthropology*, 36:1–2, pp. 1–18.

Nilsson Dahlström, Å. (2009). "The two-way appropriation of indigeous knowledge. Environmental management policies and the Laponia Process," *Journal of Northern Studies*, 3:2, pp. 39–57.

Ostrom, E. (1990). *Governing the Commons. Institutions for Collective Action*, New York: Cambridge University Press.

Parkin, D. (1995). "Latticed knowledge. Elimination and the dispersal of the unpalatable in Islam, medicine and anthropological theory," in *Counterwork. Managing Knowledge in its Diversity*, ed. R. Fardon, London & New York: Routledge, pp. 143–163.

SAON (2007). "Report from the SAON 1 Workshop, Stockholm, 12–14 November 2007;" www.arcticobserving.org/index.php?option=com_content&view=article&id=44&Itemid=56; access date 14 April 2010.

— (2008). "Observing the Arctic. Report of the Sustaining Arctic Observing Networks (SAON) Initiating Group;" www.arcticobserving.org/images/stories/saon_report

_final_web.pdf; access date 18 April 2010.

— (2009*a*). "SAON. Arctic Observing Forum. Draft terms of reference;" www.ipyeaso. aari.ru/Documents/SAON-AOF%20ToR%20draft%20January%202009.pdf; access date 20 April 2010.

— (2009*b*). "How to include community based monitoring and traditional knowledge into the SAON process. A proposal on ways forward;" www.arcticobserving.org/ images/stories/Preparatory/CBM/SAON_Community_Monitoring_---_Proposal _for_next_steps.pdf ; access date 10 April 2010.

— (2012). "The SAON Process;" www.arcticobserving.org/index.php?option=com_content &view=article&id=42&Itemid=52; access date 30 March 2012.

— (n.d.). "Sustaining Arctic Observing Networks-Initiating Group (SAON-IG)," www. arcticobserving.org/images/stories/saon_doc_final2.pdf; access date 18 April 2010.

SAON. Helsinki Data Management Breakout Group (2008). "Report from breakout group, 3rd IPY workshop on Sustaining Arctic Observation Networks;" www.arcticob- serving.org/index.php?option=com_content&view=article&id=51&Itemid=66; access date 12 April 2010.

Scott, J. (1998). *Seeing Like a State*, New Haven: Yale University Press.

Simpson, L. (2001). "Aboriginal peoples and knowledge. Decolonizing our processes," *Canadian Journal of Native Studies*, 21:1, pp. 137–148.

SpecNet/NORTHSTAR (2008). "SAON and cyberinfrastructure. General consider- ations;" www.arcticobserving.org/index.php?option=com_content&view=article &id=48&Itemid=62; access date 20 April 2010.

Tester, F. & Irniq, P. (2008). "Inuit Qaujimajatuqangit. Social history, politics and practice of resistance," *Arctic*, 1:1, pp. 48–61.

Watson-Verran, H. & Turnbull, D. (1995). "Science and other indigenous knowledge sys- tems," in *Handbook of Science and Technology Studies*, eds. S. Jasanoff *et al.*, Thou- sand Oaks: Sage Publications, pp 113–139.

Zulu, L. C. (2009). "Politics of scale and community-based forest management in southern Malawi," *Geoforum*, 40:4, pp. 686–699.

AUTHORS

Robert Latham is a professor in the Department of Political Science and Program on Com- munication and Culture at York University, Canada. He is also a fellow and acting direc- tor of the Centre for International and Security Studies. His publications include *Digital Formations. IT and New Architectures in the Global Realm* (2005) and "Knowledge and gov- ernance in the digital age. The politics of monitoring planetary life" (in *First Monday* 11:9, 2006).

rlatham1@yorku.ca

Lisa Williams recently completed her PhD in political science from York University, Canada, specializing in media and international relations in the Canadian Arctic. She is currently researching issues pertaining to knowledge production, foreign policy, and representational practices in the Arctic.

lwilliams1@gmail.com