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INTERDISCIPLINARITY AND KNOWLEDGE NETWORKING: CO-PRODUCTION OF CLIMATE-AUTHORITATIVE KNOWLEDGE IN SOUTHERN SOUTH AMERICA

by

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Abstract: Interdisciplinarity and knowledge networking are at the core of current global, regional, and national initiatives concerning climate. Both scientific knowledge and public participation are essential to enhance the capacity of different sectors and governments to respond to challenges posed by climate variability and change. Exchange and bridge building among disciplinary domains are needed as well as involvement of governmental agents and a variety of stakeholders in knowledge networks and quality assurance processes, with the aim of producing authoritative, relevant, and usable knowledge. This article presents initial results of ongoing research on a recently launched Regional Climate Center for Southern South America (RCC-SSA) that is distinguished by close partnership and continuous interaction. The dynamics of cooperation in this innovative interdisciplinary, inter-institutional, and trans-sector network are being ethnographically documented and their epistemic and political features analyzed. Echoing the World Meteorological Organization, combining perspectives of the meteorological community with diverse interests, expectations, and needs of the many relevant "users" is a core challenge for climate services in the region. Because of the broad diversity of decisions and decision makers, multiple networks of organizations or actors seek involvement of the best available physical, biological, social science, and stakeholder knowledge. They ask not just for predictions but for "translation" of climate information into outcomes of adaptation/mitigation actions. Current collaboration efforts offer lessons on how to understand and conceptualize new trends in research and political practices, with scientists of all backgrounds participating in deliberations involving technical claims and decision making. These lessons underscore the complexity and multilayered nature of difficulties and obstacles involved in co-production of knowledge.

Keywords: interdisciplinarity, knowledge networking, co-production of climate knowledge, climate services, southeastern South America

I. Introduction

Integration of scientific knowledge and public participation are increasingly considered essential to enhancing the capacity of different sectors and governments to respond to challenges posed by climate variability and change. Feeding, sheltering, and improving the well-being of a growing urban population in environmentally, economically, and socially sustainable ways are now a major global concern (Swaminathan, 2006; Godfray et al., 2010). In the context of climate change, extreme events such as floods and drought, which are the costliest natural disasters, are expected to increase in frequency and severity, in addition to shorter-scale patterns of climate variability. These scenarios place pressure on many activities, especially food production and water provision systems that sustain large populations (IPCC, 2007). Recognition of irreducible scientific uncertainty and complexity in many policy issues has led to calls for revising current ideas on the role of science in developing and implementing policy (Wynne, 1992; Funtowicz & Ravetz, 1990, 1993; Nowotny, et al., 2001). Exchange and common understanding among disciplinary domains are needed as well as involvement of governmental agents and a variety of stakeholders in knowledge networks and quality assurance processes, aimed at producing authoritative, relevant, and usable knowledge. Thus, interdisciplinarity and knowledge networking are the core of current global, regional and national initiatives concerning climate.

Scholars in humanities as well as social, mathematical, and natural sciences accept the value of interdisciplinary research. Three indicators signal narrowing of older divides between the "social" and the "natural," the "pure" and the "applied," the "formal" and the "empirical":

i) Discussions of topics relative to interdisciplinary research are gradually increasing in academic journals;
ii) Hybrid fields are being institutionally recognized;
iii) Low and moderate levels of interconnectedness among academic disciplines are evident (Jacobs & Frickel, 2009).

However, interdisciplinary research does not emerge spontaneously. Active policies and efforts by science and technology agencies and universities are crucial to overcoming vague integrative intentions about grants, seed projects, training programs, and hiring positions (Klein, 1990, 2004).

Several steps have been taken to achieve higher levels of cooperation among practitioners of disciplines, institutions, regions, or nations. Collaborative arrangements take the form of networks or webs of researchers. Because complexity usually involves human dimensions of scientific problems, social scientists have also gained status in climate research. Correspondingly, scholars in humanities are more prone to accept the value of mathematical modeling (Epstein, 2006; Gilbert & Troitzsch, 2005; Kohler, 2000; Miller & Page, 2007). The bridges connecting human, natural, and formal dimensions of scientific problems are also widening, by incorporating stakeholders (mainly members of NGOs and GOs) as peers in interdisciplinary research projects. Despite these benchmarks of change, however, biases about hierarchies of knowledge and rights persist.

Integration requires overcoming biases towards particular subjects, different logics, and incumbencies. Extending the peer review community and including politicians and stakeholders are crucial, allowing them to scrutinize methodologies and to express their expectations, needs, and values while at the same time democratizing their own knowledge and policy decisions (De Marchi, 2003). A plurality of co-ordinated perspectives, each with its own value-commitments and framings, are needed. Engaging in dialogue, trying to understand others' positions and skills, and fostering mutual confidence are preconditions for translating everyone's knowledge and creating a new coherent whole. However, significant obstacles to achieving interdisciplinary collaboration remain (Jeffrey, 2003). They include:

- achieving consensus on a common problem or topic for study;
- building the "right" composition of a research team;
- overcoming language barriers and differences in research traditions;
- understanding different operations applied to data series;
- bridging tensions between applied and theoretical outcomes as well as different academic incentives, and publication requirements; and
- overcoming disciplinary biases, competition, and the "geopolitics" of knowledge, institutional, and personality differences.

Patience, empathy, and humility are needed throughout the process (Nicholson et al., 2002; Podestá et al., 2013). Greater expectations with stakeholder involvement and the resulting kaleidoscope of outcomes tend to emerge gradually and take time to become evident, pressuring teams with a multiplicity of demands to meet in a short time-frame (Hidalgo, et al., 2011).

The model of interdisciplinary integration presented in this article is an ongoing Collaborative Research Network (CRN3035) sponsored by the Inter-American Institute for Global Change Research (IAI). Reflection on co-production of climate knowledge in the region is neither normative nor grounded in a priori assumptions. It is based empirically on actual scientific and institutional practice. Although science is often recognized as an on-going cognitive and social process, understanding of the dynamics of contemporary knowledge production is often lacking. Static treatment of a subject is replaced by a focus on the process of participation, collaboration, and collective knowledge production (Hidalgo, et al., 2007, 2010, 2011). The research network is committed to providing climate services through a recently launched Regional Climate Center for Southern South America (RCC-SSA). The CRN3035 is also composed of a balanced team of investigators from physical, biological, and social sciences along with a wide range of stakeholders (governmental agencies and nongovernmental organizations) from Argentina, Brazil, Paraguay, and the USA. The project is entitled "Towards usable climate science: Informing sustainable decisions and provision of climate services to the agriculture and water sectors of southeastern South America."

Two main stages of the process illustrate the changing dynamics of knowledge production through a combination of interdisciplinary, inter-institutional, and trans-sector cooperation. Prior to the creation of RCC-SSA limitations for providing climate services stemmed from lack of articulating scientific information and expertise and regular communication among scientists, institutions, and stakeholders. With the evolution of new partnerships triggered by collaboration, other limitations also became apparent. Governmental and non-governmental institutions' roles in production, assessment, and synthesis of knowledge are not realized yet. Criteria for what counts as authoritative knowledge are not fully stabilized. Institutions still struggle to maintain their credibility and feel their independence is threatened.

II. "Climate Services": What's in a name?

The U.N. World Meteorological Organization (WMO) has recommended strengthening climate services to enable "incorporation of science-based climate information and prediction into planning, policy, and practice." It has also produced a guideline for national and regional agendas, the Global Framework for Climate Services (GFCS). The central goal of GFCS is to enable more effective management of risks and opportunities arising from climate variability and change, especially in vulnerable sectors. Five main components characterize the framework. Four are familiar to climate scientists: i) Observations and Monitoring, ii) Research, iii) Modeling and Prediction, and iv) Capacity Development. A fifth–a "User Interface Platform"–underlies the centrality now assigned to achieving sustained interaction between producers and users of climate information. "Regional Climate Centers" are an important component of the design of the Global Framework for Climate Services. They produce regional climate products in support of regional and national climate activities, while building new organizational models that support climate information services by National Meteorological and Hydrological Services (NMHSs). This initiative has created exciting opportunities, novel partnerships, and organizational arrangements for provision and societal use of climate services, generating dynamism to overcome older limitations.

The WMO considers combining perspectives of the meteorological community with diverse interests, expectations, and needs of the multiple "users" to be a core challenge. The best available formal, natural, and social science knowledge is not in itself sufficient: Advances in climate knowledge must be matched with better understanding of how science can inform climate-resilient decisions and policy (Stainforth, 2007; Harrison, 2008). To be able to support adaptation decisions, provide straightforward estimates of uncertainty, and meet the needs of climate-sensitive sectors (NRC, 2001), an emerging approach to research is gaining ground. It implies collaboration among researchers of all relevant disciplinary backgrounds, stakeholders, and outreach specialists who do more than gather scientific contributions and sustain deliberations. They also renew holistic appreciation of relationships among knowledge, nature, and society. In this new approach interdisciplinary studies and capabilities are considered a must to address societal needs. To increase support for interdisciplinary climate studies, applications, and education is seen as crucial "to foster both the capacity for making and the ability to beneficially use climate products that are based on data, information, and knowledge from many disciplines (e.g., combining physical, chemical, biological, and societal stressors to yield products that explore climatological variability and societal impacts)" (National Research Council, 2001, p. 19).

Given the inadequacy of a single institution to generate and provide climate service, exploration of organizational models conducive to interdisciplinary, inter-institutional, and trans-sector work has become crucial. While meteorological, hydrological, and climate institutions provide the backbone of climate services, decision making and efforts towards sustainability can only succeed by involving other scientific disciplines and climate sensitive sectors. Driven by the broad diversity of climate-affected decisions and decision makers, multiple networks of organizations or actors are emerging aimed at more consistent involvement of the best available physical, biological, social science, and stakeholder knowledge in "translation" of climate information into predictions or projections of regional climate as well as outcomes of adaptation/mitigation actions. The concept of climate services adopted by the WMO is now widely used and articulates agendas of scientific and operational institutions on a global scale. The U.S. National Research Council's Board on Atmospheric Sciences and Climate has defined "climate services" as "the timely production and delivery of useful climate data, information, and knowledge to decision makers" (National Research Council, 2001, p. 14).

The concept of climate services is rooted in the operational bias of meteorological and hydrological governmental agencies, recovering the idea of a "service." At the same time, however, it stresses the need for research to improve the scientific quality of climate information, modeling, and prediction. In doing so, it also expresses a new interdisciplinary perspective on socio-environmental systems and strengthens the will to produce a new type of knowledge that could negotiate needs and expectations of different profiles of actors and climate-sensitive sectors. Social scientists are called to participate, to advance long-term initiatives promoting incorporation of "human dimensions" and social needs of adaptation and mitigation to global change. Previously they were called upon to provide accounts of changes in land use and soil coverage or social vulnerability. A brief review of main initiatives launched since the late 1970s reveals slowly but steadily growing consideration in articulating social and environmental knowledge. Several initiatives have appealed to concepts of vulnerability, mitigation and adaptation.[1] In addition, joint efforts are being made to achieve scientific credibility, independence, social inclusion, and equity.

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[1] Several initiatives have appealed to the concepts of vulnerability, mitigation and adaptation in their attempts to bridge the gap between the social and the natural. It is worth mentioning, among others, the evaluation process being developed by the IPCC-Intergovernmental Panel on Climate Change. Not without difficulties, and complementary to a growing interaction between natural and social scientists, recent initiatives such as Future Earth-Research for Global Sustainability launched in June 2012 Rio+20 (www.icsu.orgfuture-earth) exhibit a shift into interactive and horizontal forms of research. This new program in construction emphasizes the need to integrate not only social scientists, but also young scientists and people in underdeveloped countries, as well as social actors and decision-makers in climate research projects.

III. Co-producing Climate Services

Two main connotations of co-production play an important role in current accounts and revisions of relationships between science and society, human and natural systems that are triggered by new trends (Jasanoff, 2004; Lemos, 2005). One focuses on articulation of talents, perspectives, and values needed to produce new types of knowledge, the other on intertwined transformations of identities, institutions, languages, and discourses that characterize the workings of science and technology within society. In the first sense, in particular, co-production is linked with interdisciplinarity, collaborative networks, and stakeholder participation. Production of relevant and usable climate information requires thorough understanding of dynamics of target sectors and of the economic, social, and cultural contexts in which adaptation and mitigation decisions are embedded.

A single scientific discipline is not sufficient to address related challenges, not even from the perspective of science, because it reduces value commitments and framings. Many epistemic barriers must be overcome, including styles of thought, research traditions, techniques, and language that are difficult to translate across domains. Sustained dialogue among stakeholders and scientists trained in diverse disciplines, and among climate information producers and users, are main conditions for an extended peer community able to create a democracy of expertise (Funtowicz, 2001, 2006; Funtowicz & Hidalgo, 2008).

Achieving collaboration is simultaneously fascinating and tricky. It is fascinating because stakeholders and users may enhance the quality of scientific results as they become critical of the strength and relevance of scientific framings and evidence, and as they assess politicians´ arguments and decisions. It is tricky because despite enthusiasm and commitment to common goals, a plurality of legitimate cognitive perspectives with their own value-commitments and framings coexist. Thus, cognitive and pragmatic obstacles reappear continuously in subtle ways. The analysis of research efforts aiming to integrate knowledge, address complex problems, and involve the participation of a varied range of stakeholders is not a novelty in interdisciplinary literature. Reflections located at <td-net> (http://www.transdisciplinarity.ch/) or displayed in volumes like the *Handbook of Transdisciplinary Research* (Hirsch Hadorn, et al., 2008) are exemplary. In our case the regional scope of the RCC-SSA adds new difficulties to the challenges already identified, owing to differences in national styles of regulation, political and scientific cultures, availability of data, resources, and timing.

In order to co-produce climate services, scientific and operational institutions must change in the direction of relevance and robustness (Lempert & Groves, 2010). Improvement is mandatory in the way climate information and knowledge are analyzed, assessed, synthesized, communicated, and merged with the needs, procedures, and decision protocols of climate-sensitive sectors of society. The depth of changes needed to address effective provision of usable knowledge becomes apparent in the following four main targets that capture the attention of scientists in a way that also fosters interdisciplinary, inter-institutional, and trans-sector cooperation.

(1) Not just production but interpretation, assessment, and synthesis of diagnostic and forecast climate information on multiple time scales:
Reliable data and derived information on climate are of basic importance. But, to develop diagnostic descriptions of climate conditions that support decisions about needs of diverse users (Carbone, et al., 2008), scientists and stakeholders have to define together the most relevant aspects to monitor and test. If the aim is to mitigate unwanted impacts or, alternatively, take advantage of favorable conditions, production of climate forecasts also requires a major change of focus, namely placing emphasis on the assessment and translation of seasonal forecasts.

(2) Tailoring, communication, and dissemination of that information:
Information and seasonal forecasts must be tailored more directly to variables of interest to regional users. User-centric definitions of climate service products and processes, as well as continuous improvement, are important aims of new partnerships. Research indicates iterative interaction between information producers and users is the most critical factor affecting adoption of climate information (Lemos, 2002). But interaction requires previous identification and recognition of "users," which is not always available. Many scientists ignore users, how they use results and products, and what they think about them. For these reasons, interdisciplinary interaction among scientists of different backgrounds proved easier than envisioning how to reach stakeholders and build relationships with them. Creating sustainable interactional spaces where different stakeholders can share experiences and contribute to framing issues and designing climate products was recognized as a crucial condition for success in providing climate services.

(3) Translation of climate information into plausible impacts and outcomes (including ranges of uncertainty or credibility) and taking viable adaptive actions in agricultural production and water management:
Potential outcomes of adaptation/mitigation actions are relevant to stakeholders. Thus, enhanced capacity is needed to "translate" climate information into distributions of outcomes for risk assessment and management (Hansen, 2006). The switch from isolated production of models, maps, and scientific reports occurs first in an enriched deliberation and then in co-exploration of outcomes relevant to decision making. Scientists are in a weak cognitive position for this shift when they lack answers based on consensual rules of evidence and inference.

(4) Exploration of institutional structures able to support this new type of co-production and co-exploration of usable, actionable knowledge:
A second sense of co-production becomes prominent when considering institutional structures to support providing usable knowledge around "climate services," a sense that has gained ground in the field of Science and Technology Studies influenced by Sheila Jasanoff´s work. It focuses on connections between the capacity to produce facts and artifacts that reconfigure nature and the ability to produce devices that order or reorder society, such as laws and regulations, experts, bureaucracies, financial instruments, interest groups, political campaigns, media representations, and professional ethics. Global processes of science and politics around providing climate services illustrate the second connotation of "co-production." The WMO, the GFCS, and all networks involved in regional climate centers are creating new *identities* in the form of new types of expertise and new collective identities differing from identities specific to a particular profession or research community. They are also creating new *institutions* because they require building institutional and human capacity and overcoming technological, financial, and cultural barriers. And, they are enunciating new *discourses* and *representations* in the form of new terms such as "climate services" or modification of old terms to find words for novel phenomena.

IV. Before and After Creation of Regional Climate Centers

A history of cooperation informed the baseline of interaction made possible by creation of the RCC-SSA Previously collaboration occurred mainly around maintaining and deepening circuits of production and interchange of meteorological, hydrological, and agricultural data and information, initially at a national and later a regional level. Limitations or barriers to developing, implementing, and providing climate services derived from two factors: 1) lack of articulation among the information and knowledge produced on climate by different disciplinary approaches and different institutions, and 2) lack of regular communication among scientists and institutions (mainly operational and governmental) of different backgrounds.

Relationships existed at a bilateral level and, as a network started to connect diverse nodes, each one contributed links toward establishing a consolidated group of governmental and academic partners on both national and international scales. Specific collaborative activities included scientists working in academia and agents of operational institutions trained at universities who managed to define common tasks. These activities involved:

- sharing observations collected by meteorological stations of each institution and developing information interfaces;
- creating recurrent inter-institutional communication channels to build mutual knowledge and trust, avoid duplication of efforts, and improve public accessibility to enlarged data bases;
- co-organizing panels, meetings, and training seminars;
- participating in research projects of mutual interest; sharing and exchanging of trained personnel; and
- creating several products, namely diagnostic reports, climate maps, forecasts for public information and special users, and climate modeling.

When the GFCS guidelines and the creation of the RCC-SSA became prominent in public and private agendas, additional limitations or barriers for developing, implementing, and providing climate services appeared, namely lack of knowledge about users and their understanding and use of climate products. Together they underscored the complexity of collaboration that spans not only academic disciplinary boundaries but also institutions and sectors of society. Exploration of channels of regular communication and innovative partnerships including stakeholders became a priority. Identifying and classifying "users" as well as discussing roles assigned to them to avoid repeating older research trends and mistakes became a new target and an axis of reflection. The classifications included being defined as active or passive, as consumers or citizens, as homogeneous and stable, or fractured and dynamic.

The main obstacles to understanding and relevance for decision making about climate information among scientists and operational professionals reinforce the complexity of boundary crossing:

- limitations inherent in the climate system (e.g., variables that can be monitored or predicted, and spatial resolution and skills of prognostic information; that is, giving indications on the probable course of climate variables in advance.);
- technical aspects of information (e.g., formatting of uncertain information, timing its release in relation to decisions);
- cognitive factors that influence the way users perceive knowledge (e.g., communication, trust, credibility, accessibility, experience);
- institutional or procedural factors that constrain design and use of new knowledge (e.g., rigid operating protocols, pre-existent inertia of ways of working and framing problems); and
- structural factors that shape the capacity and willingness of different decision makers to use information (e.g., lack of access to knowledge, lack of choice in terms of alternative technologies, or policy change).

As willingness to produce real changes was reinforced by changing identities of collectives and networks of experts, reflection on process-oriented collaboration for climate products´ design, circulation, and reception were scrutinized. The main collaborative activities initiated were:

- re-elaborating climate products;
- creating spaces for dialogue and common work (i.e., seasonal consensual forecast meetings, dialogue tables with climate sensitive sectors) to evaluate usefulness of current products and to co-design new ones;
- constructing climate information platforms as public goods to guarantee accessibility and interoperability; and
- taking advantage of recurrent inter-institutional communication channels to develop and deploy early warning systems, thinking of impacts on farming outcomes, and avoiding misunderstandings of probabilistic information.

Calls for interdisciplinarity did not just focus on the enhancement of collaboration of social and natural scientists within the climate community. So that the work might help users to expand options and act on climate monitoring and forecasts, the need to reach a deeper articulation of data produced by natural scientists (namely meteorologists, hydrologists, and agronomists) was recognized. The priority of expanding observation networks with validated data was advanced with the promise to enlarge them with data from conventional and automated public and private stations, satellite and social information such as vulnerability maps, and cost-benefit analysis for socio-economic sectors.

As in all interdisciplinary collaborations, regular communication proved crucial. Barriers to developing, implementing, and providing climate services were tied to lack of regular communication between scientists and institutions of different backgrounds. They came to acknowledge, though, the gap concerning stakeholders' needs, expectations, and current use of climate products and services. Collective reflection on creation of new institutional structures and partnerships and its documentation also gained importance. Interviews and participant observation, consensus meetings, and other joint endeavors affirmed the importance of interactional spaces for success in providing climate services. These collaborative settings and the engagement of social scientists in the process continue to help accelerate cooperative process through systematic reflection. Definition of appropriate organizational and governance models for climate services institutions is another critical need for effective provision of climate knowledge.

Combining interests of an interdisciplinary climate science community with the diverse needs of many relevant climate-sensitive sectors remains a core challenge, though. A single institution generating products and information, such as "the Climate Service," is insufficient and inappropriate. Alternative models are being explored. While meteorological and climate institutions provide the backbone of climate services (currently the case for the RCC-SSA), real progress requires involving those who stand to benefit from use of climate information and knowledge. We envision the future structure of regional climate services as a broad knowledge network encompassing multiple overlapping sub-networks of institutions or actors targeting different constituencies or sectors. Energy, fluvial transportation and commercial companies, agricultural extension agencies, and farmers' associations can help connect to more distant nodes of the networks. Moreover, they provide an alternative to a linear, unidirectional model of transferring scientific information, facilitating instead *multi-directional* flow across institutions, scientists, and decision-makers (Cash & Buizer, 2005; Kirchhoff, et al., 2013). Given the "knowledge network" model, activities also involve tracking interactions among regional institutions and projects for producing climate and weather knowledge and information. Many different agents and agencies become committed with active climate studies in search of syntheses across disciplines and sectoral institutions' perspectives. These syntheses involve the creation of new mechanisms for designing, framing, and funding research, and the consequent support for interdisciplinary education and training, for research on developing applications across disciplines, and for identifying what products respond to an integrated vision of the problems.

VI. Conclusion

Creation of the RCC-SSA triggered a deliberate dynamic of cooperation explicitly oriented towards enhancing previous bonds and creating innovative institutional structures and partnerships. Bilateral linkages between many institutions in the region were strong, but the RCC-SSA network connected a greater variety of nodes, each contributing its own links towards consolidating a diverse group of governmental and academic partners, at both national and international levels. More systematic thinking about the processes in progress and previous identities (personal, institutional, and professional) propelled reorientation of concerns from truth to credibility and acknowledgment of a large gap between what scientists consider their responsibility and what the public thinks it is.

The appeal to interdisciplinarity proved mandatory but at the same time insufficient to fill all gaps. Shifting the image of a scientist as "information transmitter" to that of "information interpreter" contests the authority of scientific statements–whether disciplinary or interdisciplinary. Conservatism and low controversy proposals and inferences constituted the first defensive attitude and tended to prevail in diagnosis and forecasts. Nevertheless, in the RCC-SSA this attitude, its causes and consequences, are under study. This case study allows questioning the Manichaean thesis about asymmetries between scientists and experts on the one hand and ordinary people or legislators/politicians on the other. In new partnerships, patronizing attitudes of the former are questioned for lacking knowledge and criteria for acceptable framings, evidence, and inferences in decision making. On many occasions scientists and experts have felt their authoritative knowledge threatened, ignored, or contested. Yet, models of the public as deficient are not as acceptable as they were in the past. Governmental and non-governmental institutions are learning new roles around production, assessment, and synthesis of knowledge, recognizing they cannot fulfill them by themselves. Stakeholders are also experimenting with changes, gaining understanding of limitations of scientific knowledge and clarifying what questions can be asked and answered.

The lessons learned in this case study underscore the complexity and multilayered nature of difficulties and obstacles involved in co-production of knowledge. Although lessons concerning interdisciplinarity are varied and deep, scholars are finding a way to collaborate and take benefit from disparate disciplinary perspectives. Research funding agencies and universities are channeling resources to foster integration of knowledge, helping accelerate integration and synthesis. The larger challenges posed by broad knowledge networks that encompass multiple overlapping sub-networks of institutions or actors targeting different constituencies or sectors are harder to overcome. Involvement of boundary organizations such as academic, governmental research and resource-management institutions, and non-governmental organizations has been minimal, at least in the experience of the RCC-SSA. Their involvement purportedly exists and has resulted in memoranda of understanding with relevant institutions, but intentions have not been fully realized. Involving sectoral organizations and stakeholders in the RCC-SSA's activities is among the leading priorities for the Center's future. However, anxieties emerging from this priority are strong. New criteria for how to frame issues, what counts as evidence, and which types of inferences are relevant for decision making remain open questions. In this context scientific knowledge becomes just a component of an issue, although an important one. Quality assurance involves not only internal assessment practices such as peer reviewing but also the critical capacity of professionals working in operational institutions and the lay public.

The distance that remains to cover until climate science can provide an understanding of critical relations and feedbacks among climate, biophysical, and social systems is widely acknowledged. Interaction with users results in institutions committed to providing climate services in Southeastern South America struggling to maintain and enhance their credibility and independence. Scientists and experts are also aware they have to change. They have learned that science alone cannot give complete and definitive answers. New discursive choices and renewed ways of representation are being explored because the social context poses new scientific and democratic challenges, promoting rising consciousness of both cognitive and pragmatic obstacles to new positioning and aims. Stakeholders and politicians also admit they have to change, by participating in co-production of relevant knowledge, alleviating the enormous charge placed on science until recently, when interdisciplinarity was invoked as the panacea for solving the most urgent problems of our time.

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