Vol. 47: 41–45, 2011
doi: 10.3354/cr00959

CLIMATE RESEARCH
Clim Res

Published March 31

Contribution to CR Special 25 'Climate services for sustainable development'

Building sustainable regional climate information systems

Rodney Martínez Güingla*

Centro Internacional para la Investigación del Fenómeno de El Niño (CIIFEN), Escobedo 1204 y 9 de Octubre, PO Box 09014237, Guayaquil, Ecuador

ABSTRACT: Regionally oriented services will be key elements within the proposed Global Framework of Climate Services, the main outcome of World Climate Conference-3. Regional services may be substantially different from both global and national climate services. This paper elaborates on some of the conditions necessary to develop and deliver sustainable regional climate information systems and services. The proposed approach is mostly based on 7 yr of experience of the International Research Center on El Niño (CIIFEN) in the western coast of South America (WCSA). Those wishing to design, conduct, and sustain regional activities should first accept climate information as a regional public good. Following this premise, regional climate information systems should (1) improve capabilities within institutions through collective action, (2) share knowledge and experiences on nation-specific benefits, (3) contribute to the reduction of asymmetries among countries, (4) demonstrate that a regional climate service can be enhanced as a result of improving national components, and (5) agree upon regional coordination mechanisms. The WCSA region has been able to implement a regional climate database, a regional group on climate modeling, climate-agriculture risk mapping, and statistical and dynamical seasonal-forecast systems. The development and uptake of climate services has been enhanced within government institutions, community organizations, the private sector, local authorities, and the media. The experience of CIIFEN can be useful to those starting up regional climate information systems.

KEY WORDS: Regions · Climate · Services · Regional climate centers · Regional climate information systems · Regional public good · Western coast of South America

1. INTRODUCTION

Global Producing Centers (GPCs) and National Meteorological and Hydrological Services (NMHSs) can benefit from the presence of a regional interface to ensure a more effective climate information chain (Martinez et al. 2009a). Providing climate information services at the regional scale requires institutional, technological, and organizational arrangements. These critical considerations are also necessary to define the scope of regional climate services in a way that avoids potential conflict with their potential customers at the national level.

One paramount issue in establishing the infrastructure for delivering regional climate information is the sustainability of the operations. The main concern is how to maintain a complex interface that interacts with, and to a large extent depends on, global and national institutions.

In addition, regional climate information services should take into account the need to integrate capabilities, the need to optimize technological and financial resources, the exchange of lessons that have already been learned, and the mutual assistance among countries.

The Global Framework on Climate Services (GFCS), the main outcome of the World Climate Conference-3, aims to foster and improve the interaction between users and providers of climate information and products. The GFCS has a Climate User Interface Pro-

*Email: r.martinez@ciifen-int.org

gramme (CUIP), which was created to coordinate, facilitate, and oversee the development of such interactions (WMO 2009a).

At a regional level, the user interface will depend on the social and economical priorities identified and shared by countries. The Regional Climate Outlook Forum (RCOF) is a good example of what can be done in terms of addressing specific user sectors (WMO 2008).

The World Meteorological Organization (WMO) Regional Climate Centers (RCCs) are centers of excellence that assist NMHSs in a given region to deliver better climate services and products, including regional long-range forecasts, and to strengthen their capacity to meet national climate information needs. RCC responsibilities are regional in nature and do not duplicate or replace services produced by NMHSs. RCCs serve the regional level of a 3-tiered climate-related infrastructure: GPCs for long-range forecasts (global level), RCCs (regional level), and NMHSs (national level) (WMO 2003).

WMO (2010) defines RCCs as follows: 'Centres designated by WMO for the provision of regional long-range forecasts and other regional climate services, or groups of centres who collectively provide these forecasts and services in a distributed network, are called Regional Climate Centres (RCCs) or RCC-Networks, respectively.' Specifically, an RCC is required to perform the following functions: (1) operational activities for long-range forecasts and climate monitoring, (2) operational data services to support long-range forecasting and climate monitoring, and (3) training in the use of RCC products and services.

An RCC is expected to play a supportive role in climate information services provided by NMHSs in a specific area through the provision of relevant climate information, and to transfer technical knowledge to NMHSs so that they can tailor information operationally. In other words, an RCC is meant to be one of the interaction mechanisms for supplying climate information and predictions, and facilitating communication among NMHSs at regional levels. The primary clients of an RCC are NMHSs and other RCCs in the region and in neighboring areas (WMO 2009b).

The evolution of the RCC concept started after the intensified El Niño event during 1997 and 1998. An Intercommission Task Team on RCCs elaborated the first framework for WMO RCCs (WMO 2001). The influential milestone was the Meeting on Organization and Implementation of RCCs, which provided the first guideline document on the establishment of RCCs (WMO 2003). Supported by activities in the WMO regional associations (RAs), especially RA II (WMO 2007) and RA VI (WMO 2006), as well as by discussions and resolutions by the Executive Council (WMO-EC), World Meteorological Congress (WMO-Congress), Commission for Climatology (WMO-CCl), and Commission for Basic Systems (WMO-CBS), the establishment of RCCs as well as the designation of the Beijing Climate Center of the China Meteorological Administration (BCC/CMA) and the Tokyo Climate Center of the Japan Meteorological Agency (TCC/JMA) as multifunctional RCCs in RA II was authorized at WMO-EC in June 2009. Also in RA II, Russia, India, and Iran expressed their intention to be nominated as RCCs.

Every region possesses particularities and underlying factors that need to be taken into account in all the components of the system when designing and implementing climate services. For example, the European Climate Support Network (ECSN) was created in 1997 to organize improved cooperation of its members in the field of climate and related activities in order to expand their capabilities to support the European user community through enhanced provision of high-quality climate data and products and services and advice based on the members' climate expertise. To fulfill its objectives, ECSN makes use of the expertise and facilities of its members through an appropriate sharing of tasks and resources. Another example is the Climate for Development in Africa (ClimDev) program, which has been under development since April 2006. Its scope has expanded from solely addressing the need for greatly improved climate information for Africa, to also strengthening the use of such information for decision-making, improving analytical capacity, knowledge management and dissemination activities, and implementing pilot projects that demonstrate the value of mainstreaming climate information into development. This came about after a realization that information alone would not lead to effective policies. The criteria for this regional initiative were non-rivalry, non-excludability of public interest, multi-country involvement, strategic alignment, catalytic and upstream role, and higher developmental impact in cooperating (AUC/ECA/AfDB 2009).

The present paper explores some of the principles that will help ensure the implementation of effective regional climate services, and to elaborate on sustainability strategies that are currently in place as a result of the 7 yr of experience of the International Research Center on El Niño (CIIFEN) working with the NMHSs in the western coast of South America (WCSA).

2. REGIONAL CLIMATE INFORMATION IN THE WESTERN COAST OF SOUTH AMERICA

One important starting point for the integration of NMHSs from the WCSA region has been the RCOF. Since 2003, the WCSA-RCOF has been coordinated by CIIFEN with the support of the WMO and the NMHSs

from Bolivia, Chile, Colombia, Ecuador, Peru, and Venezuela. The seasonal forecast is the main achievement of this regional mechanism. It is produced on an operational monthly basis. All of the members share a common methodology; therefore, several parameters have been agreed upon and are now being improved year by year (Martinez & Mascarenhas 2009). The discussion and review of the final statement about the regional forecast is done by email. The seasonal forecast is then widely disseminated through email to >15 000 users across Central and South America and to contacts on other continents.

Based on this continuous exchange and partnership, the region started the implementation of a project entitled 'Regional information system for climate risk management in the agriculture sector in the Andean countries', which was funded by the Inter-American Development Bank (IADB).

In order to implement a regional climate information system in WCSA, CIIFEN applied the principle of 'regional public good'. Although there are several definitions for a regional public good, mostly used by financial and economical institutions (Bezanson & Sagasti 2001, Barrett 2002, Sandler 2002; IADB), for the purposes here the following definition (see http://idbdocs.iadb.org/wsdocs/getdocument.aspx?docnum=2003519) was adopted:

> A Regional Public Good is a basic product, normative system, or policy regime produced with public resources, which generates common benefits to participant countries as a result of concerted actions between them.

The CIIFEN approach is therefore based on the premise that climate information is a regional public good. NMHSs are the national members of the delivery system. The regional climate information system would, it was agreed, fulfill 5 principles under the 'regional public good' premise. These principles and the way in which they were applied is described next in Sections 2.1 to 2.5.

2.1. Improving existing capabilities of NMHSs through collective action

Regional implementation is based on the national contributions to the system. To make this possible, climate forecasts in each country had to be enhanced. Statistical and dynamical downscaling tools were improved or installed in the NMHS partners of CIIFEN. NMHSs with better capacities served as reference groups, and lessons learned were shared. Training workshops with individual assistance were conducted in each institution. At the end of this process, statistical seasonal forecasts became operational at national and regional scales. In the case of numerical modeling for seasonal forecasts, all NMHSs are now at least in experimental mode, reducing considerably pre-existing weaknesses. The sustainability of statistical and numerical modeling is based mostly on the interest and motivation generated among members using new tools to improve their capabilities.

To sustain these developments, a regional working group on modeling was created and information resources were posted on a wiki site. This group shares experiences and consults frequently to maintain momentum towards the implementation of numerical model-based operational seasonal forecasts. While the group is self-driven and functions through informal but active exchanges between members, it is based on a formal agreement with CIIFEN.

2.2. NMHS experience to improve understanding and prediction of regional climate

The RCOFs and the different regional meetings promoted, through this process, the enhancement of dialogue and discussion between NMHSs about regional climate. Every month, a virtual discussion is held to produce the seasonal forecast. Each country in the region, mainly due to its geographical position along the long western coast of South America, has a particular strength to monitor, assess, and predict specific climate systems, features, or regions, e.g. the Bolivian Highlands, the South Pacific anticyclone, easterly waves, the Amazonian low-pressure system, Madden-Julian oscillations, or Niño 1+2 variability. The mutual learning of the impacts of these climatic drivers at national levels provides a better view of the potential effects that could exist at regional, transnational, and national levels. In turn, the opportunity to share experiences, particularities, and understanding from a regional climate perspective is also a good way to learn more about what is determining variations in the local climate. This exchange of information and expertise is highly motivating to members and supporters and helps to sustain the regional endeavor through a process of mutual learning.

2.3. Reduction of asymmetries among countries

Operational capacities among different NMHSs can vary substantially due to different causes. One of the main attractions of a regional system is the reduction of these asymmetries. For the stronger and the weaker institutions, the motivation to cooperate could lead to complementary outcomes. The stronger ones can use their leverage to assist a weaker institution in a specific operational field and hence promote progress, while simultaneously comparing and validating their own

capabilities in a different part of the region. The less-developed institutions are obviously motivated by the improvement in their operational capacities that will come from the collaboration. In the WCSA region, statistical and numerical climate modeling as well as climate risk mapping in the agriculture sector were activities where this principle was widely applied. The results are promising; we have seen leverage of some NMHSs as well as the progress of others. In the end, regional capacities are improved for the benefit of all.

2.4. Effectiveness of regional climate service improvements to national components

Through the establishment of CIIFEN, NMHSs have been able to improve their climate forecast capacities, with the regional forecasts being better than they were in the past. This fact is reflected in the continuing interest of NMHSs to being part of the regional system. One excellent example of this institutional commitment is the implementation of the first regional climate database for WCSA (http://www.ciifen-int.org/index.php?option=com_content&view=category&layout=blog&id=66&Itemid=62&lang=es). It contains >4 000 000 records of daily data from 170 stations along WCSA and is regularly updated. The regional database is managed by CIIFEN in accordance with a formal protocol agreed upon by the 6 NMHSs (Martínez et al. 2009b).

2.5. Agreeing upon a regional coordination mechanism

To maintain an effective regional climate information system, some form of coordination mechanism is necessary. In the case of WCSA, this role has been assumed by CIIFEN, which was agreed upon by NMHSs from the region. CIIFEN also coordinates the WCSA-RCOF and has promoted regional cooperation through planned meetings, training workshops, and continuous communications with national counterparts. CIIFEN's status has ensured continuity and consistency of regional activities as well as the harmonization of procedures, methodologies, and a common vision, which is necessary when designing regional projects. CIIFEN has worked in fundraising to support the consolidation of regional climate information systems with the active involvement of NMHSs. In doing so, CIIFEN has drawn support from intergovernmental organizations, mechanisms for international cooperation, financial entities, as well as individual partner governments so as to ensure the sustainability of the systems and services that have been developed and implemented.

3. DISCUSSION AND CONCLUSIONS

The success of applying regional public good principles is reflected in the continuity of the current regional climate information system for WCSA, even after the formal implementation phase of the project was completed. Despite the complexity of the national institutions collaborating in the project, the products and services are now routinely updated, and in some cases they have been improved or extended to other areas.

Several main conclusions can be drawn from the experience of implementing the WCSA regional climate information system, which was underpinned by the early establishment of CIIFEN. They are presented here in the form of strategies that will most likely lead to long-term sustainability of climate services delivery, and include the need to:

- Design and implement climate services based on the identified users' demand
- Generate sectoral climate services with public and private funding
- Assist in the generation of specific public policies regarding climate services
- Ensure alliances with private, public, and community media
- Foster the consolidation of multi-institutional frameworks
- Develop a resources mobilization plan
- Ensure the timely provision of training, web-based tools, and networks
- Ensure formal commitments and alliances.

LITERATURE CITED

AUC/ECA/AfDB (African Union Commission, Economic Commission for Africa, and African Development Bank) (2009) Climate for development in Africa (CLIMDEV-AFRICA). Economic Commission for Africa, Addis Ababa

Barrett S (2002) Supplying international public goods: how nations can cooperate. In: Ferroni M, Mody A (eds) International public goods: incentives, measurement, and financing. Kluwer Academic Publishers, Dordrecht, p 47–80

Bezanson K, Sagasti F (2001) International public goods: challenges, problems and the way forward. Submitted to Ministry of Foreign Affairs, Government of Sweden. Institute of Development Studies (IDS), Sussex

Martinez R, Mascarenhas A (2009) Climate risk management in western South America: implementing a successful information system. WMO Bull 58:188–196

Martinez R, Garanganga B, Kamga A, Luo Y, Mason S, Pahalad J, Rummukainen M (2009a) White paper on capability: regional climate information for risk management. Presented at: World Climate Conference-3, Geneva, 31 August to 4 September 2009. www.wcc3.org/sessions.php?session_list=WS-12

Martínez R, Mascarenhas A, Alvarado A (2009b) Technical guide for the implementation of a regional climate information system applied to agricultural risk management in

the Andean countries. International Research Center on El Niño (CIIFEN), Guayaquil, Equador
Sandler T (2002) Financing international public goods. In: Ferroni M, Mody A (eds) International public goods: incentives, measurement, and financing. Kluwer Academic Publishers, Dordrecht, p 81–118
WMO (2001) General summary of the session of the Inter-Commission Task Team on Regional Climate Centres, Geneva, 30 April to 3 May 2001. WMO-TD No. 1070, WCASP No. 52. WMO, Geneva
WMO (2003) Proceedings of the Meeting on Organization and Implementation of Regional Climate Centres, Geneva, 27–28 November 2003. WMO-TD No. 1198, WCASP No. 62. WMO, Geneva
WMO (2006) Abridged final report of the Commission for Basic Systems extraordinary session (CBS-Ext.(06)), Seoul, 9–16 November 2006. WMO Doc. No. 1017. WMO, Geneva
WMO (2007) Report of the meeting of the Working Group on Climate-Related Matters for Regional Association II, Beijing, 7–8 April 2007. WMO-TD No. 1382, WCASP No. 73. WMO, Geneva
WMO (2008) Regional Climate Outlook Forums review 2008. Int Expert Review Meeting on regional climate outlook forums, Arusha, Tanzania, 3–7 November 2008. www.wmo.ch/pages/prog/wcp/wcasp/documents/RCOFReview2008ConceptNote.pdf
WMO (2009a) Concept note on Global Framework for Climate Services, World Climate Conference-3. WMO, Geneva
WMO (2009b) Guidelines for the establishment and designation of WMO Regional Climate Centres (RCCs). WMO, Geneva
WMO (2010) How to establish and run a WMO Regional Climate Centre (RCC). WMO www.wmo.int/pages/prog/wcp/wcasp/seriespubs/documents/WCASP80_TD1534.pd

Submitted: May 7, 2010; Accepted: October 19, 2010

Proofs received from author(s): February 4, 2011