

## **Provision of Real Time Data and Analysis Tools to Research and Educational Institutions in Central and South America and the Caribbean**

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The Unidata Program Center (UPC) is currently involved in two separate yet parallel efforts aimed at providing near real time atmospheric science and related data and analysis and display tools to research and educational institutions located in Central and South America and the Caribbean. The parallel efforts are composed of:

- extending Unidata data delivery, software tools, and support services to a small number of universities in WMO Regions IV (Central America and the Caribbean) and III (South America)
- a joint, UCAR Office of Programs (UOP) funded, UPC and COMET pilot project, *MeteoForum*, whose goals are:
  - provide WMO Region III/IV Meteorological Training Centers (RMTCs) with access to advanced data sets and software (through the UPC), and educational materials (through COMET)
  - help RMTCs assume a more prominent role in their host country and region (joint UPC and COMET objective)
  - enable RMTCs to work more closely together on both basic education and continuing education (joint UPC and COMET objective)

Four out of the five Region III/IV RMTCs we are working with are closely associated and co-located with prominent national universities:

Argentina	- Universidad de Buenos Aires (UBA)
Barbados	- The University of the West Indies (UWI)
Brazil	- Universidade Federal do Para (UFPA)
Costa Rica	- Universidad de Costa Rica (UCR)

The intimate relationship between the RMTCs and universities simplifies the UPC's efforts since our primary mission is to assist universities in the acquisition and use of geoscientific data.

## History

Extension of Unidata services to educational institutions throughout WMO Region IV was endorsed by the Unidata Policy Committee in 1996:

“96.3: The Policy Committee resolves that Policy Committee Resolution 96.1 be amended to read: The Unidata Policy Committee resolves that the definition of those eligible to participate in Unidata include institutions of higher education within the United States and the World Meteorological Organization’s Region 4. Other criteria currently in use for qualification of institutions to be participants remains unchanged.”

The University of the West Indies in Barbados, and the University of Costa Rica are two of the Caribbean universities that joined the Unidata community as a result of this outreach and broadening effort.

In *Unidata 2008: Shaping the Future of Data Use in the Geosciences*, a funding proposal to NSF, we proposed to extend provision of data, tools and support to educational institutions in select nations in WMO Region III. As part of this outreach effort, we inaugurated delivery of near real time data to the Universidade Federal do Rio de Janeiro (UFRJ) in Rio de Janeiro, Brazil. Initially, feeding data to the UFRJ was fraught with problems mostly because of their satellite-based connection to the global Internet (through COMSAT) and because of long standing limitations in the underpinnings of the Unidata Internet Data Distribution (IDD) system, the Unidata Local Data Manager, Version 5. The only data that we were able to reliably provide to the UFRJ was NOAAPORT broadcast, world meteorological observations and select global model output. At that time, UFRJ was one of three institutions located outside of WMO Region IV receiving data through the IDD. The other remote IDD sites included the Hong Kong University of Science and Technology and the University of Melbourne in Melbourne, Victoria, Australia. All three of these sites continue as active IDD participants.

## Early Successes

Over the past two years, two different efforts have made it possible to move substantial volumes of data to remote IDD nodes in Brazil:

- Brazil’s connection to Internet-2 through the NSF-sponsored, Florida International University (FIU)/Global Crossing, American Pathways (AMPATH) project
- the modernization of the Unidata LDM to Version 6

The combination of these two advances allows the UPC and Unidata participating university IDD and THREDDS nodes to relay significant volumes of data to the UFRJ, including high resolution, GOES-12 satellite imagery with very small latencies (typically one to several seconds).

Even before reliable IDD connectivity was established, we approached the Unidata contact at the UFRJ, Dr. David Garrana Coelho, to see if his institution would be willing to act as a top level IDD

redistribution node first for Brazilian universities and then for the Universidad de Buenos Aires and beyond. We approached the UFRJ since their network connections are the closest of any university to the Internet-2 landing in Brazil (Guy Almes, Heather Boyles/Internet-2 personal correspondence). The UFRJ expressed an eagerness to act in this role on behalf of their fellow South America institutions by not only relaying data, but also by improving departmental networking/computing infrastructure if and when needed. The first institution that UFRJ is providing data to is the UFPA and its associate WMO RMTC. We have named this South American data distribution effort ***IDD-Brazil***.

As part of the ***IDD-Brazil*** effort, Dr. Garrana has proposed exposing Brazilian and South American universities to the benefits of participating in the IDD and in the usefulness of Unidata display and analysis systems by delivering a paper at the Brazilian Congress of Meteorology to be held next year. This summer, Dr. Elen Cutrim, currently a professor at Western Michigan University and former department chair and WMO RMTC head at UFPA, will be visiting several Brazilian universities (to visit former colleagues who are now department chairs) and demonstrating various Unidata offerings like data delivered by the IDD and data analysis and display using the UPC-developed Integrated Data Viewer (IDV). Dr. Cutrim will also be compiling an inventory of locally held datasets that investigators would be willing to share with their Brazilian counterparts and North American universities. Datasets that Dr. Cutrim will be investigating include local radar data from Amazonia, and long term rain gauge records from the UFPA.

In parallel with the establishment of ***IDD-Brazil***, the UPC approached the University of Puerto Rico at Mayaguez (UPRM) to enlist their help in relaying data to Caribbean and Central American universities. Like the UFRJ, UPRM was enthusiastic about playing an expanded role in the Unidata IDD. The UPRM has only been able to assume this role after their networking infrastructure was modernized by Puerto Rico's connection to Internet-2, again through the **AMPATH** initiative.

## **Benefits to the Unidata Community**

The need for full and open international exchange of environmental data has been articulated in many important documents. To understand the myriad complexities of the earth system and the way the different elements interact, it is crucial to collect, share and analyze environmental data from all parts of the world.

As Unidata strives to broaden its community, participation from international institutions will become increasingly important toward fulfilling its mission. As stated in the Unidata 2008 proposal, Unidata's reach already transcends international boundaries as exemplified by its involvement in the ***MeteoForum*** project, which is working with institutions in Barbados, Costa Rica, Brazil, and Argentina to set up real-time data feeds in those countries. In addition to exchange of data, such international collaborations and exchange of ideas are also becoming an indispensable part of research in environmental sciences.

The Unidata community recognizes the importance of access to environmental data from other countries, particularly those in the southern hemisphere, to enhance education and research

capabilities toward studying global problems like climate change, ozone depletion, and ENSO. A critical requirement for such research studies is the acquisition and assimilation of a complete spectrum of global meteorological, oceanographic and hydrological observations.

## Challenges

The ability and, therefore, willingness of both the UFRJ and the UPRM to more actively participate in the Unidata IDD were direct results of their connections to Internet-2. Unfortunately, not all of the Region III/IV universities affiliated with RMTCs are as fortunate as these institutions.

The Universidad de Buenos Aires in Buenos Aires, Argentina has long suffered from both poor connections to the global Internet and from substandard in-house network infrastructure. Recently, however, access to Internet-2 has been attained, at least, for a limited basis. In pursuit of upgrading departmental infrastructure, the Department of Atmospheric and Oceanic Sciences at UBA recently submitted a proposal to the Unidata Equipment Grants program. Their relatively modest proposal has asked for approximately \$12K, most of which is designed to upgrade aging and failing local area network equipment and to purchase computers for student education and research. The Equipment Grants evaluation committee, composed of Unidata-community and UPC representatives, stated that “support for this request is regarded as an opportunity to forge important connections for atmospheric sciences in the western hemisphere – a beginning of data sharing and collaborations between the Department of Atmospheric and Oceanic Science and the Unidata community. The panel recommends funding this proposal at a level to support the requested networking upgrade, upgrade for the servers, and acquisition of four computers for student educational use”.

The University of Costa Rica also finds itself in a position of currently being unable to actively participate in the Unidata IDD, even as a receive-only node. Recently, networking infrastructure upgrades within Costa Rica have allowed four universities to be able to intercommunicate at gigabit speeds. Still lacking, however, is a reliable, high-speed connection to the global Internet. Communications would improve dramatically if Costa Rica could connect to **AMPATH**. Such a connection would cost approximately \$100K per year (Ana Preston/Internet-2 and Julio Ibarra/**AMPATH** personal communications). The challenge is identifying funding sources within and outside of Costa Rica to secure this connection.

The RMTC in Barbados is in a similar position to Costa Rica. Their ability to participate in the Unidata IDD is limited by their exceedingly poor connection to the global Internet (currently, they use a dedicated 64 kilobit line). Their situation is different, however, in that there are existing high speed internet connections into the island of Barbados provided by the commercial firm, Cable and Wireless. The stumbling block is, like in so many cases, the recurring cost for service: \$477/month for a 1.544 Mbps downstream and 256 Kbps upstream link.

## Project Plans

Unidata anticipates playing an active role in establishing a robust IDD relay node for South America at the UFRJ. We also intend to investigate the establishment of an *IDD-Caribbean* by assisting, through information sharing and advocacy, universities and their associated RMTCs in establishing reliable networking at their sites. This goal is essentially what we do for our US university sites:

- enlist well configured sites to act as IDD relay nodes
- assist those sites with the initial installation and configuration of the LDM/IDD
- assist in troubleshooting as problems arise
- assist downstream sites in the use of the data they receive over the IDD through the provision of display and analysis software and support
- incorporating the sites into the greater Unidata community through active participation in email discussion groups and workshops
- encouraging sharing of locally held datasets that are of interest to the Unidata community