

## PERSPECTIVES ON INTERNET DATA DISTRIBUTION EXPANSION AND USE IN BRAZIL

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### 1. INTRODUCTION

Brazilian participation in the Unidata Internet Data Distribution (IDD) system began in the fall of 2001 at the Universidade Federal do Rio de Janeiro (UFRJ), the Universidade Federal do Pará (UFPA), and the Universidade de São Paulo (USP). Meteorological data were needed for research projects, and university personal searched for ways to get this access. By independent efforts, co-author David Garrana learned about real-time data availability through the IDD and installed the IDD data relay engine, the Unidata LDM, at the Laboratório de Prognósticos em Mesoescala (LPM) at the UFRJ.

At about the same time, personal of the Instituto de Astronomia, Geofísica e Ciências Atmosféricas (IAG) at the USP began writing scripts to FTP near real-time meteorological data from two North American university IDD participants, the State University of New York at Albany (SUNYA) and Florida State University (FSU). Following USP's lead, the Centro de Previsão de Tempo e Estudos Climáticos (CPTEC, a division of the Instituto Nacional de Pesquisas Espaciais (INPE)) began making use of these same IDD sites to acquire near real-time GTS data as a backup to their feed from a WMO regional center. The interesting aspect of this initial use of IDD-delivered data was that two Brazilian institutions had begun taking indirect advantage of the IDD without being aware of the IDD project that had been developed by the Unidata Program Center (UPC) or of the UFRJ's growing participation in that effort.

During 2002 and 2003 the CPTEC strengthened its data section by adding new personal and ideas, and embarked on a process of modernization of its

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systems. This effort resulted in an association with the UPC and a close cooperation with the UFRJ which was by then was actively participating in the **MeteoForum** pilot project being conducted by the University Corporation of Atmospheric Research (UCAR) COMET and Unidata programs (Spangler 2001, Laing 2002).

Thanks to these coordinated efforts, the **IDD-Brasil** project was inaugurated in January, 2004 with four nodes: the UFRJ, the UFPA, CPTEC and the USP (Yoksas, 2004). The UFRJ node was upgraded from a leaf node to a top-level data relay; the CPTEC began as a data relay; and the USP and the UFPA joined as leaf nodes. **IDD-Brasil** stress testing began in January, and the results were presented at the September XIII Congresso Brasileiro de Meteorologia (CBMET) held in Fortaleza, Ceará, Brazil (Almeida, 2004; Yoksas, 2004).

Comparisons of **IDD-Brasil**-conveyed data received at CPTEC and the same types received from the WMO Regional Center in Brazil demonstrated that the **IDD-Brasil** reliably delivered a higher volume data (all of which originates in the GTS) with comparably low latencies. Because of the favorable inter-comparisons, data received through the **IDD-Brasil** are now being incorporated into the data assimilation processes used to initialize the COLA global and South American ETA models run by CPTEC. In addition to providing more data more reliably, the IDD was found to be easier to configure for data ingest since there is no bureaucratic overhead for requesting data, or knowledge of exactly what data was need in advance. Receiving sites can request all data available from upstream sites, explore which data are most useful, and then reconfigure their requests to the subset they need (Almeida, 2004).

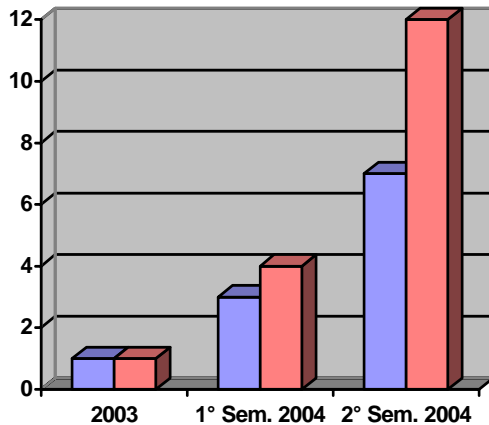
CPTEC demonstrated the capabilities available in the **IDD-Brasil** at the CBMET, and the system

attracted a lot of attention. Real-time *IDD-Brasil* received data was visualized by Unidata GEMPAK, and a set of accompanying information, like the *IDD-Brasil* web page (<http://solon.meteoro.ufrj.br>) that contains an installation guide for both the LDM and GEMPAK in Portuguese, was presented. The workstation running these packages was the most visited point in the entire congress, and the free access to meteorological data for education and research through the *IDD-Brasil* was major topic of discussion.

## 2. PRESENT *IDD-BRASIL* UTILIZATION

A number of Brazilian institutions are now participating in *IDD-Brasil* data sharing, and a greater number are interested in joining the growing IDD community in the next few months. The number of participating *IDD-Brasil* institutions presented in this paper for the second half of 2004 should be recognized as being incomplete since this work was prepared in October. Participation in the *IDD-Brasil* tripled in first 6 months of 2004 leading us to expect 9 participants at the end of the year.

Figure 1 shows the number of Brazilian institutions and individual IDD nodes reporting real-time data ingest statistics to the UPC at the end of October of 2004 (<http://www.unidata.ucar.edu>).



**Figure 1: Domains (blue) and machines (red) from *IDD-Brasil* reporting real-time statistics. The second semester does not include additions in November and December of 2004.**

The rapid growth of the *IDD-Brasil* has made Brazilian institutions the largest user of the Unidata IDD and display and analysis tools outside of the US. Table 1 lists the number of IDD domains and machine participants by country (<http://www.unidata.ucar.edu>).

Country	Domains	Sites
US	115	209
Brazil	8	12
Canada	3	3
Costa Rica	1	2
Hong Kong	1	1
Vietnam	1	1
Russia	1	1
<b>Total</b>	<b>130</b>	<b>229</b>

**Table 1: Number of domains and machines reporting real-time statistics in October of 2004 for each countries participating in the IDD.**

At the UFRJ the IDD is the meteorological data source used to initialize regional models (e.g., the MM5). The UFRJ is also a top data-relay and an IDD backup site. UFRJ was the first IDD site in Brazil, and it is one of the leading Brazilian meteorological research and education institutions.

The CPTEC, which acts as an institution of higher education by offering graduate courses in meteorology, now runs the fastest supercomputer (NEC SX-6 with 768 gigaflops) in the South Hemisphere. The CPTEC is a pioneer in global and regional numerical weather forecasting, being the only institution in South America that distributes output from a global model (COLA). The CPTEC helped pioneer modernization of Brazilian meteorology with the installation of Brazil's first supercomputer, a NEC SX-3, ten years ago. The CPTEC is continuing this tradition by acting as a top-level IDD data relay, by using data available in the *IDD-Brasil* to feed its meteorological database and in data assimilation schemes used for its numerical modeling efforts. CPTEC is currently purchasing new computing equipment so it can act as an even stronger IDD data relay site.

The IAG at the Universidade de São Paulo is one of the premier research and education institutions in South America. The USP MASTER laboratory

has developed several programs that have significantly contributed to Brazilian Meteorology advancement in last several years. The MASTER/IAG is one of three institutions that participated in the January, 2004 debut of the **IDD-Brasil** and continues to act as an IDD leaf node.

The Instituto Nacional de Meteorologia (INMET), which is the South America GTS regional center and controls over 400 WMO meteorological stations, is currently testing the LDM/IDD for use as a data delivery tool.

The Centro Federal de Educação Tecnológica (CEFETs) are among the best meteorological technical schools South America. Their campuses in Rio de Janeiro and Santa Catarina are using the **IDD-Brasil** to ingest real-time data for educational purposes as leaf nodes.

The Diretoria de Hidrografia e Navegação (DHN), which controls the Brazilian buoy and ship network, has recently begun participating in the **IDD-Brasil** in order to obtain data that will be used in data assimilation schemes for regional models runs (e.g., ETA).

### 3. PERSPECTIVES

Several institutions have shown great interest in the IDD, and may be online as new **IDD-Brasil** participants in the next several months. Examples of these include the Laboratório Nacional de Computação Científica (LNCC, a federal research institution), the Instituto Oceanográfico (IO) of the Universidade de São Paulo, and Federal universities that have undergraduate meteorology courses, like the Universidade Federal de Alagoas (UFAL), the Universidade Federal de Pelotas (UFPel) and Universidade Federal de Paraíba (UFPb). The use of the IDD at these institutes ranges from education to research: some use the system to disseminate their own products (e.g., the LNCC for regional model runs), and others to act as a host for sharing data servers (e.g., the IO/USP is interested in using DODS). Between the present participants, there is a process of strengthening the IDD structure: the CPTEC, for instance, is purchasing new equipment to bolster its IDD data relaying capability; is planning to host ADDE and DODS servers that will be accessible by Brazilian educational institutions; and is

planning to actively participate in the Unidata THREDDs project.

The **IDD-Brasil** can be a powerful tool for universities, research centers, state meteorological services and public companies that have private meteorological station networks whose data are not currently available on the GTS since it can be used to distributed data to interested sites. Some examples are: Universidade do Vale do Paraíba (UNIVAP); Instituto Agrônômico de Campinas (IAC); CEPAGRI/UNICAMP (Campinas State University Center for agricultural research); Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA, a federal research center); ON (National Observatory); SIMEPAR (Paraná state meteorological service); FUNCEME (Ceará State meteorological service); and FURNAS (a federal electrical company).

The data sharing capabilities inherent in the IDD/**IDD-Brasil** will foster new collaborations between Brazilian meteorological centers and universities thereby strengthening research and education throughout Brazil today and eventually throughout South America. There is a long list of data that can be shared by all participating centers, universities and institutes. Data gathered from a mesonet operated by CPTEC will be among the first new data to be shared through the **IDD-Brasil** and IDD, as well as the numerical output from CPTEC models like the COLA global forecast model and the South American regional ETA, satellite imagery and derived satellite imagery products like cloud drift winds and sounding profilers. Other important sets are from UFRJ, IAG/USP, LNCC and INMET, that will be able to share their regional model runs. The WMO network in South America is sparse, but there are several smaller networks that can be an IDD source of station data from FURNAS, IAC, EMBRAPA, SIMEPAR, FUNCEME, and so on.

### 4. CONCLUSIONS

With the establishment of two top-level IDD relay nodes at CPTEC and at UFRJ, the Unidata North American IDD was extended to Brazil through a project known as the **IDD-Brasil**. **IDD-Brasil** grew rapidly in the first half of 2004, and promises to continue its rapid growth into the foreseeable future.

The collaborative nature of the IDD is beginning to change ideas and practices in Brazilian meteorology. The data sharing capabilities inherent in the IDD/**IDD-Brasil** is fostering new collaborations between meteorological centers and universities thereby strengthening research and education throughout Brazil today and eventually throughout all of South America.

The main attraction of the IDD/**IDD-Brasil** is the easy access to real-time meteorological data which can be used by the data analysis and visualization tools available from Unidata, a very strong point in a country where resources are scarce. Soon Brazilian institutes will be ingesting their own datasets, from numerical models to mesonets and automatic reporting station networks. This will be a very important advancement since WMO synoptic reporting stations are sparse in Brazil to the point where many large regions have no coverage. Data gathered from a mesonet operated by CPTEC will be among the first new data to be shared through the **IDD-Brasil** and IDD.

## 5. REFERENCES

- Almeida, W. G. et al: *Testes no Brasil com o sistema de distribuição de dados meteorológicos pela Internet (IDD). Proceedings of the XIII Brazilian Meteorological Congress, August 2004, Fortaleza.*
- Almeida, W. G., Ferreira, S. H. S. and Carvalho, L. A.: *"Comparação entre o fluxo de dados do GTS e IDD para o CPTEC" Unpublished technical report, April 2004, Cachoeira Paulista, Brazil.*
- Domenico, B., S. Bates, D. Fulker, 1994: Unidata Internet Data Distribution (IDD), *Proceedings Tenth International Conference on Interactive Information and Processing Systems for Meteorology, Oceanography, and Hydrology, J15-J20.*
- Davis, G. P., and R. K. Rew, 1994: The Unidata LDM: Programs and Protocols for Flexible Processing of Data Products, *Proceedings 10<sup>th</sup> International Conference on IIPS for Meteorology, Oceanography, and Hydrology, 131-136.*
- Chiswell, S. R. and L. Miller, 1999: Toward Expanding Model Data Access Through Unidata's Internet Data Distribution System, *Preprints, 15<sup>th</sup> International Conference on IIPS for Meteorology, Oceanography, and Hydrology, 441.*
- Laing, A. G., L. Miller, T. C. Spangler, D. Fulker, 2002: **MeteoForum**: A Pilot Project for Advanced International Meteorological Training Centers, *Preprints, 18<sup>th</sup> International Conference on Interactive Information and Processing Systems for Meteorology, Oceanography, and Hydrology, 326-327.*
- Spangler, T. C., D Fulker: **MeteoForum** – *An International Network of Meteorological Training Centers for the 21<sup>st</sup> Century*, A Pilot Proposal developed jointly by the COMET<sup>®</sup> and Unidata Programs of the University Corporation for Atmospheric Research, Boulder, CO, U.S.A., March 2001.
- Yoksas, T. et al: **MeteoForum** – *Initial Successes in Data Sharing Leading to the Creation of the IDD-Brazil. 20<sup>th</sup> International Conference on IIPS for Meteorology, Oceanography, and Hydrology, Seattle, WA, 2004.*
- Yoksas, T. et al: *Proceedings of the XIII Brazilian Meteorological Congress, August 2004, Fortaleza, Ceará, Brazil.*