

EMPRESS MET: THE METEOROLOGICAL DATABASE MANAGEMENT SYSTEM CURRENT & FUTURE DEVELOPMENT

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ABSTRACT

EMPRESS MET, the EMPRESS Meteorological Database Management System, is a layered software implementation of the standard EMPRESS RDBMS (Relational Database Management System), additional meteorological data types and operators, meteorological based front ends, as well as interactive media, tools and data interchange to make met data more widely accessible. The layered toolkit architecture provides the met community with easy to use, intuitive and reliable access to met data on a world-wide basis.

This paper describes the current and future technology of EMPRESS MET in the following areas:

- enhanced data types and operators both in the core EMPRESS MET engine and in user defined libraries
- standardized distribution of bulk or pre-processed data via electronic or physical media
- archival and multi-level staged storage for large volumes of data
- hypertext management subsystems (HTML toolkit) for managing text and graphic information about the base data and the meta data descriptors
- standardized formats and data interchange to provide maximum access to Met data
- database linkage to the WWW to provide international access to weather data and its descriptors

1. INTRODUCTION

Empress is a relational database management system (software) for managing almost any kind of meteorological data that can be stored in the computer ranging from satellite images to 3D grids to sensor outputs.

Empress Software Inc. was founded in 1979 by John Kornatowski and Ivor Ladd two researchers in relational database management systems at the University of Toronto. The company's market philosophy has been in database development software for scientific and engineering applications. The Empress product had been sold worldwide to discriminating and knowledgeable developers especially to the weather forecasting community for use on engineering workstations such as Sun, SGI, HP, DEC, IBM as well as 64 bit super computers such as Cray.

2. EMPRESS & THE METEOROLOGICAL WORLD

In 1990 the meteorological research paper entitled, "Environmental Database For The Naval Environmental Operational Nowcasting System" stated that:

"A database that handles a wide variety of meteorological and oceanographic data has been described. This system is "user-friendly" in terms of providing a simple and logical access to diverse data types from application programs as well as interactive browse. New environmental data are easy to add because of the use of generic storage types. Storage volume and I/O time is minimized by data packing. The in-house software effort is reduced and portability enhanced by the use of a mainstream commercial data-management system." (Jurkevics et. Al., 1990)

The commercial database management successfully used in that meteorological research project was Empress. Since then, Empress had evolved to keep up with the sophisticated demands of meteorological applications.

The meteorologist today is faced with an overwhelming volume of data that must be processed, viewed to make a forecast decision. The data need to be stored and archived for future references and research purpose. More important, the data should be interchangeable since local weather is affected by what has happened remotely, local information is no longer sufficient for weather prediction (Figure 2-1).

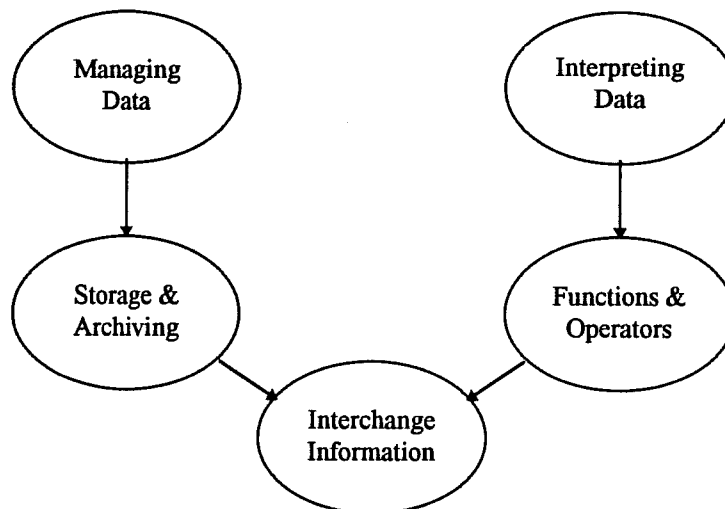


Fig. 2-1 Meteorological Data Processing & Archiving

This paper outlines the current functionality and the future development of Empress related to the data processing needs in the Meteorological World.

3. FEATURES FOR METEOROLOGICAL APPLICATIONS

This section describes the features of Empress that provides meteorologist power to managing and interpreting the vast amount of meteorological data. The features for managing data include: (1) Heterogeneous Distributed Database Management, (2) Support for Large Number of Tables and Attributes and (3) Binary, BLOB, Multimedia and Bulk Data Handling. The features for interpreting data include: (4) User-Defined Functions and Operators, (5) Updatable Complex Views and (6) World Wide Web Hypermedia Toolkit.

3.1 Heterogeneous Distributed Database Management

Due to the rapid advancement in the architecture and cost effectiveness of workstations and windowing technology, more and more meteorologist possess personal working environment, i.e. a dedicated workstation or PC. Most workstations or PC's have a local disk and provide an attractive price/performance throughput. Therefore, it makes sense to off-load data and database processing from the mainframe onto a network of workstations, and access and process the distributed data. The meteorologist can possess his or her own local data for viewing or analyzing by down loading the data from the mainframe or from several other resource pools. In addition, he or she can retrieve data from different resource pools on different locations simultaneously for viewing purposes without resident data in the local disk. Empress handles data conversion of different hardware architectures automatically. For example, data resides on Cray Super Computer can be accessed from Sun Microsystems workstations, Silicon Graphic workstations or others. Data residing on the Cray Super Computer can also be created in Sun Microsystems (or others) format if most of the data processing is from the Sun Microsystems workstations. This allows faster retrieval time. This feature allows the meteorologist to:

"Distribute vast amounts of meteorological data onto an optimum combination of mainframes, workstations or PC's and manage the data effectively."

3.2 Support Large Number of Tables and Attributes

For meteorological data to be useful, it must be archived to be easily accessible and efficiently retrieved in times of need. Empress provides such functionality and also the capability of storing large volumes of data and allowing the meteorologist to query data with efficiency. Empress is a database management system that spans multiple databases.

Empress has been tested with 25,000 tables created in one database. The system also has been tested with 20,000 attributes in one table. This feature allows the meteorologist to:

"Archive large volumes of different types of meteorology data so that it is easily accessible and efficiently retrievable in times of need."

3.3 Binary, BLOB, Multimedia and Bulk Data Handling

Empress has extended data types that allow users to store and manipulate variable-length binary data. The meteorologist can store weather charts, GRIB data, BUFR data and satellite imagery into the database. A benchmark has been conducted recently with excellent results on 10GB of binary data via 100 processes inserting 100MB binary data. This feature allows the meteorologist to:

"Operate on data in an object-oriented environment while preserving the relational model performance."

3.4 User-Defined Functions and Operators

Empress allows users to extend the range of Empress query language by adding User-Defined Functions and Operators that can greatly enhance the flexibility of database applications. User-Defined Functions can be written to do sophisticated pattern matching, statistical calculations, image and sound manipulation, as well as mathematical or lexical functions. Operating system provided Math libraries functions can also be dynamically linked into Empress and made available in the query language and C interface. This feature allows the meteorologist to:

"Enhance both data types and operators in user defined libraries."

3.5 Updatable Complex Views

When sharing data resources among meteorological sites, meteorologists would like to retrieve data from different sites simultaneously for viewing or processing. Empress allows the meteorologist to create logical tables (views) based on one or more tables that may be resident on multiple systems. Insert, update and delete operations are permitted on a large class of complex views if one has privileges to access the tables. This feature allows the meteorologist to:

"Promote sharing of software and data resources and help standardize formats and data interchange to provide maximum access to meteorological data."

3.6 World Wide Web Hypermedia Toolkit

As Internet usage has expanded rapidly, the World Wide Web (WWW) has played an important role within the Internet. The World Weather Watch on the World Wide Web will soon become a reality. Empress provides database linkage to the WWW via a hypermedia toolkit to provide international access to weather data and its descriptors. This toolkit consists of several tools that allow a WWW client or browser (such as Netscape or Mosaic) access to any kind of weather data residing in Empress databases. The toolkit conforms to the Hypertext Markup Language (HTML) Version 3 specification. This feature allows the meteorologist to:

"Take advantage of the World Wide Web for data resource sharing and information exchange."

4. FUTURE DEVELOPMENT

Future developments at Empress that are of particular interest to the meteorological community include (a) the addition of weather specific data types and operators and (b) the provision of spatial data extensions. (Empress, 1995)

5. CONCLUSION

The Empress Database Management System for meteorology provides features that allows the meteorologist to:

- distribute vast amounts of meteorological data onto an optimum combination of mainframes, workstations or PC's and manage the data effectively;
- archive large amounts of diverse meteorology data so that it is easily accessed and efficiently retrieved when needed;
- operate on data in an object-oriented environment while preserving relational model performance;
- enhance both data types and operators in user defined libraries;
- promote sharing of software and data resources and help standardize formats and data interchange to provide maximum access to meteorological data; and
- take advantage of the World Wide Web for data resource sharing and information exchange.

A major direction of the Empress corporate strategy is to provide and evolve high performance database management software for the Meteorological community.

6. REFERENCES

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