An Integrated Tool for Numerical Weather Models and Environmental Information Visualization

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Abstract

Since its beginning, Scientific Visualization has been extensively used in the field of Meteorology. There are currently tools for visualization and analysis of virtually all kinds of environmental data. However, in most cases, these tools focus only one type of data, forcing the meteorologists to use different tools in the decision-making process. With the popularization of personal computers and the appearance of the Internet, the amount of information available increased considerably, but the speed in which this data can be transferred is still limited. This work presents an application, named Metvis, suited for visualization and analysis of environmental data which can handle information of different natures, such as numerical weather models, satellite images and lightning data. The software has a distributed (client-server type) architecture. The role of the server is to store raw data and send to the client only the information to be visualized. The client part aims at being portable, capable of running in different operational systems. Metvis is already in use with good results by the meteorologists and researchers of SIMEPAR Technological Institute.

1. Introduction

Every day meteorological sensors all over the world collect a huge amount of information. This information is stored in databases of research centers and operational services in order to be used in weather forecast and research. Most of this information is accessible through the Internet, but is necessary the use of different tools, the same is true with the visualization.

This work objectives the development of a system that gives meteorologists the possibility of integrated visualization of the most important and recent meteorological information without the need to downloading them first.

2. Data Visualization In Meteorology

2.1. Numerical Weather Models

Numerical Weather Model data is composed of a set of four dimensional matrices, one for each variable [3]. For bi-dimensional visualization the matrices are too sparse to be treated as images, so the most used representations are isolines for scalar fields and streamlines or vectors for vectorial fields.

2.2. Meteorological Satellites

The data generated by meteorological satellites are infra red matrices. They can be treated as bitmap images colored by a scale composed by shades of gray.

2.3. Lightning

Lightning data is constituted mainly by the localization of the strokes and the moment they occurred. In meteorology this data is used indirectly for the detection of storms, so the punctual information information alone is not interesting.

The most used approach is the construction of a matrix whose cells represent a square area with the number of strokes detected in a period of time. This matrix then can be depicted as a bitmap where the pixels without strokes in then are transparent.

2.4. Surface Stations

Surface stations collect data that can be depicted in punctual form, by the use of annotated glyphs. It is also possible to interpolate a field to generate isolines representations.

2.5. Meteorological Radars

The raw data generated by meteorological radars are tree dimensional polar arrays which can be projected to horizontal planes and converted to bi-dimensional cartesian matrices. So the data can be depicted as images with the use of a convenient color scale.

3. Software Tools

In order to build a complex system with limited time and resources, the natural path to go is the extensive use of frameworks and toolkits.

3.1. NetBeans Platform

The NetBeans platform is a framework for building client applications [1]. The use of this tool makes constructing complex graphical interfaces an easier task.

3.2. VisAD

VisAD (Visualization for Algorithm Development) is a Java component library for interactive and collaborative visualization and analysis of numerical data [2].

3.3. GrADS DODS Server

The GrADS DODS Server, or GDS, is a data server that uses the Grads (Grid Analysis and Display System) tool for reading numerical models data and the DODS protocol for transmission of data in a easy readable format.

4. MetVis

As shown in figure 1, the Metvis architecture is composed by various types of servers due to the multiple kinds of data available. The server is responsible for storing the data and providing to the client the available data. The client is responsible for requiring the data to the server, to create visual representations and allow interaction with the user.

In figure 2 is shown the main Metvis display with a representation of two fields extracted from numerical model output. One is being displayed as white isolines and in the other the space between the isolines is filled by solid colors associated with a scale. The Metvis client also allows contrast of data by superposing or side by side visualization.

5. Conclusion

This work presented a system that provides integrated visualization for the main environmental data with meteorologial relevance. We are currently working on further improvements for the system but it is already being used at SIMEPAR institute.

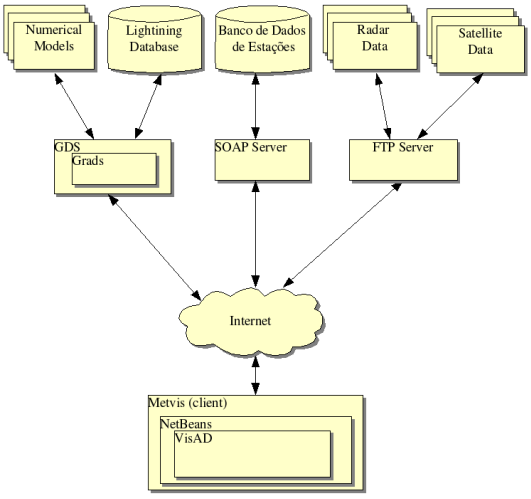

Figure 1. Metvis architecture.

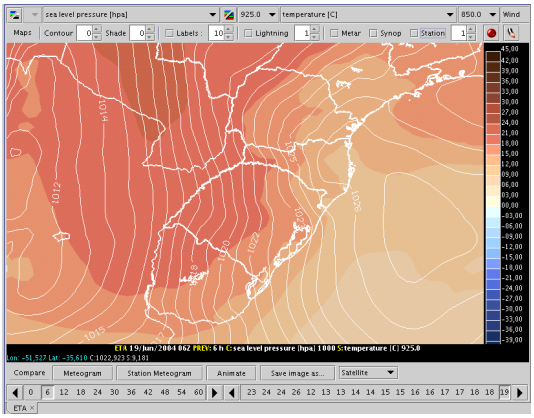

Figure 2. Metvis display.

References

[1] T. Bourdeau, J. Glick, S. Green, V. Spurlin, and J. Woehr. *NetBeans: The Definitive Guide*. O'Reilly, Sebastopol CA, 2002.

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[3] E. Kalnay. *Atmospheric Modeling, Data Assimilation and Predictability*. Cambridge University Press, Cambridge, UK, 2003.