METEOROLOGICAL WORKSTATION SYSTEM LUNAIRS

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1. INTRODUCTION

Since 1985, Météo-France has been archiving radar data (local radar picture and composit one) and satellite data. But the protocoles used for getting the data back were not userfriendly and took a long time to work. In 1991, the Meteorological Central Service was decentralized. Since then, it settles in Toulouse where has been created a new subdivision called ARM (Models and Radar Archiving). One of its function was to develop a complete sofware in radar and satellite data management. Today, an interface called LUNAIRS is being developed in order to provide for users' needs. This application is functionally satisfactory but it will be gradually improved to satisfy the increasing users' requirements.

2. INTRODUCTION OF CBD IN METEO-FRANCE

CBD (Climatology and Data Bank) is a division of the national forecasting and analysis center(SCEM). CBD assumes the responsability of archiving, management and valorisation of climatological data. CBD is divided into 4 subdivisions:

2.1 **CCE(Branch for climatology coordination and marketing)**

This subdivision looks after the climatology coordination in Météo-France, follows up exceptional events, gives informations, makes special studies and publishes documents or meteorological statistics.

2.2 **EXP(Climatology operating service)**

This subdivision looks after french and overseas ground data's acquiring and management from the meteorological network or the climatology one. Upper-air data from the radiosonde are also archived in the data bank.

2.3 **DEV(Development)**

This subdivision makes statistical studies and elaborates interpolation methods and climatical zoning. DEV is also responsable for studies or validation of meteorological models.

2.4 **AGRO(Agronomy)**

This subdivision of CBD makes studies and statistics on agronomic subjects.

2.5 **ARM(Models and radar archiving)**

ARM is the new subdivision which was born with the decentralization of Météo-France. Its main work is to archive and administrate radar and satellite data. Its activities can be divided into 2 principal phases which are archiving and restitution.

2.4.1 *Archiving*

A software is used to get the radar and satellite data. These data are gathered and compressed before being sent to a specialised machine (Convex C220) where they are permanently kept.

2.4.2 *Restitution*

The data can easily be extracted from the data bank and visualised on a computer or printed on different supports (paper,diskettes ...).

3. ARM DATA BANK

From 1985 to 1991, radar and satellite data were archived from a CDC calculator (under NOS operating system), on magnetic tapes. This system had many disadvantages (pictures destruction during the transferts, problems in tapes management, difficulties for getting the data back ...).

From 1992, the archive has been entirely reorganized and realized on a specific system (Convex C220 under UNIX) and 2 silos STORAGETECK are used for the data's physical storage.
This system is really very reliable and can keep in line all the archived data which facilitates restitution's protocole.
For a whole year, the archival volume is approximatively 25 Go. This volume will probably increase according to ARAMIS network's evolution (ARAMIS: adaptation of the meteorological data for synoptic meteorology).
It is also planned to archive the data of numeric models. The volume of these data will represent about 400 Go/year.
The archived data are:

3.1 **radar pictures**

3.1.1 *local radar pictures*

They are produced by the 13 radar of the ARAMIS network. One picture is elaborated every 15 minutes.

3.1.2 *composit pictures*

Two composit pictures are archived. The swiss composit with a picture every 10 minutes and the french one which is made up with the 13 local radar, the Swiss composit and the english one (a picture every 15 minutes).

3.2 Satellite pictures

The archived pictures issuing from Meteosat satellite are extracted from the B nominal format, with a stereographic polar projection. These pictures are available into 3 channels (visible,infra-red and water vapour) and into 2 areas (France and streched Europe).
The pictures issued from the defiling NOAA satellite are also stored up in our data bank. Only one picture per day is elaborated.

3.3 archived data's catalog

On each file of this catalog is recorded the names of the data present in the data bank. There is a daily file for each kind of data.

3.4 Historic file

By a look at this file, it's possible to know the characteristics of the system (radar and transmission) which has produced the pictures, at any period of the archiving.

4. HOW TO ACCESS TO THE DATA BANK

The interface called LUNAIRS allows to get informations about the archive contents and about the historic of the measurement network. The user can extract data from the archive for future treatments. Supplementary activities are also provided like the combination with other data or the selection of pictures according to some criteria.

4.1 Technical environment

-Workstation with UNIX operating system.
-C standard language
-X/Motif (graphical user interface)
-ORACLE(on CDC 4680)
-TCP-IP protocole and the upper level of ISO.
-Archiving hardware CONVEX C220 using UNIX operating system and UNITREE (to manage the files in the silos).

4.2 Development method

LUNAIRS has been developed in a graphical and multitasking environment (X-Motif according to the standard OSF/Motif X11) where run programs coded in C standard language.
X-Motif brings a great choice of integrated facilities which make easier the implementation of menus, of interactive mode boxes and scroll bars. So, all these facilities provide an user friendly interface.
Moreover, in order to allow the best service of this product and also to make its development easier, all the main routines of LUNAIRS have been worked out as self-contained as possible. So it is for those following routines : Merger with other data and visualisation.
In the same way, each of the subroutines is itself written as modular as possible.
For the access to the Convex archiving system, the cnnection is supported by TCP-IP protocole and the well known FTP. To protect the data, the access is just read only.

So, LUNAIRS can answer to the following rules: user friendly, reliability, portability, access security and help at any level.

4.3 Workability

This software allows to extract radar and satellite pictures according to several criteria, to compare them with other data (rainfall, lightning), to consult the different catalogs (archive or equipment) and to visualise all these data.
First, we must define a period and choose a radar.Then, we can consult the archive's history.

We can also specify the request by giving a time step, a weather category, a quality code and a type of histogram for the chosen radar.
Finally, we can change the data format (BUFR into METEOTEL and reciprocally). METEOTEL is a french local format. We can overlay other kinds of data and visualise the pictures or change them into a graphical format in order to print them.
All these functions are easy to use because of the help which is provided at any time.

4.4 Merger option

The option called "Fusion" (merger) allows to analyse radar pictures with rainfall data or rainfall intensity data for the same period.

After having define a period and a radar, we can:

- visualise a radar picture
- produce an accumulated picture
- overlay different kinds of data
- get a reduced area of the picture
- have access to each pixel of the picture.
- make a zoom on the picture.
- add a correction to the whole or a limited part of the radar picture by applying masks picture, a correction factor or a new convertion formula .

At present, the formula used for the determination of the Z - R relationship is the Marshall-Palmer relation:

$$\underset{(mm^6.m^{-3})}{Z} = \underset{(mm/h)}{200.R^{1.6}} \qquad (1)$$

This relationship is just available for stratiform rainfall.

5. LUNAIRS FUTURE DEVELOPMENT

At the moment, the software LUNAIRS is satisfying for a great number of users. But, in the future, it will be completed by other functions like:

- drawing of rainfall isolines on radar pictures.
- superposition of satellite images on radar pictures.
- superposition of lightning data.
- making a computation of rainfall areas (evolution,direction).