# THE FRENCH NIVOLOGICAL WORKSTATION
## AN INTEGRATED SOFTWARE FOR REGIONAL SNOW DATA ANALYSIS

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ABSTRACT : For more than 20 years, the CEN (Snow Study Centre) has been developing operational software for snow data analysis including models for avalanche hazard forecast.

"Poste Nivologie" is now the daily working station of the "departmental" avalanche forecasters of Météo-France. All nivo-meteorological data (observations and forecast information) can be processed and displayed in various windows in order to help avalanche forecasters in snow cover analysis. All data of existent years can be accessed on line (since 1970 for many stations).

- This new application has been developed by the computing division of CEN. It is integrated in the new computing architecture of the Departmental Centres of Météo-France, based under client / server technology, Oracle database and Windows OS (WS2003-XP).
- Many recent tools have been used to improve it : Oriented Object Analysis method, Software Configuration Management, Object Programmation, COM / DCOM, …
- All developments have been done under a project structure named DOLMEN ("**D**éveloppement **O**pérationne**L** des **M**oyens d'**E**xpertise **N**ivologique") where all the actors of nivology in Météo-France were involved, from management committee to final users.

This application has been deployed for the autumn 2002 in the 11 Departmental Centres of Météo-France in charge of operational avalanche forecast. After several upgrades over two years, a major evolution was done in December, 2005, in order to integrate many innovations including the modeling chain Safran-Crocus-Mepra. New versions are yet planned until 2008 to access climatological data, to merge observations and forecasting, to produce commercial data and to connect "Poste Nivologie" to local application GELINIV.

KEYWORDS : nivological workstation, modeling, operational forecast.

## 1 – INTRODUCTION

For more than 20 years, the CEN (Snow Study Centre) has been developing operational software for snow data analysis and snow models for avalanche forecast : Safran (meteorological analysis) – Crocus ( snow model) – Mepra (avalanche hazard assessment).

"Poste Nivologie" is now the daily working station of the departmental avalanche forecasters of Météo-France, and for the first time, direct access to results of modeling is available.

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## 2 – "POSTE NIVOLOGIE"

All nivo-meteorological data (snow-weather observations, ram profiles, avalanche hazards, estimated snow depth, forecast information) are processed by the application. All data of existent years can be accessed on line (since 1970 for many stations).

The "Poste Nivologie"'s main screen shows a toolbar which allows access to all the functions, grouped by data type. The application and other software for meteorological forecaster, have the same "look and feel".

### 2.1 – Data entry

This function is available over massifs ( an area in average about four hundred square kilometers) of the responsibility zone. Many verifications are made to ensure good

quality of the local database. When an observation is stored on disk, an automatic transmission over the "Transmission Network" of Météo-France is processed.
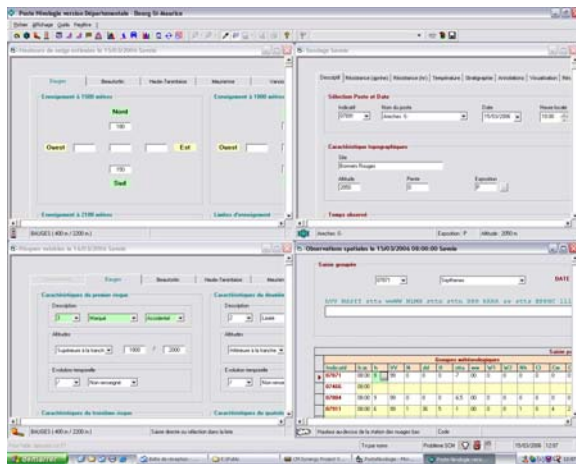


Figure 1: Four "sub-screens" for data entry : estimated snow depth, ram profile, avalanche hazard, observation.

### 2.2 – Visualizations

Many screens are available : detailed snowpit (with gradient of temperature, ratio between shear-stress and shear-strength), chronological snowpits, multi-location snowpits, temporal graphs for the main nivo-meteorological parameters, charts, grid and so on.

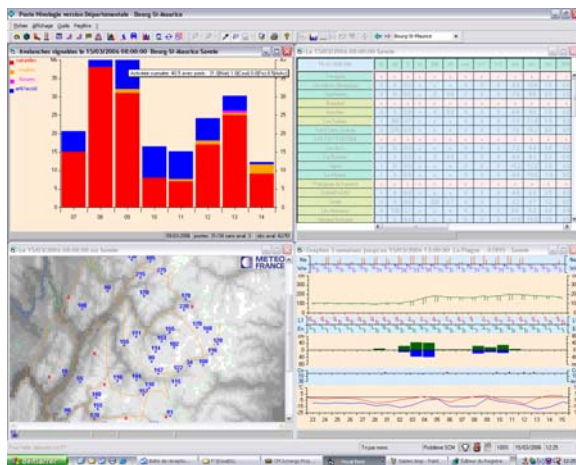Each forecaster can visualize data of his own department with neighbor massifs.



Figure 2: Four "sub-screens" for observations visualization : avalanches bar chart, observations grid, chart and historical graph.
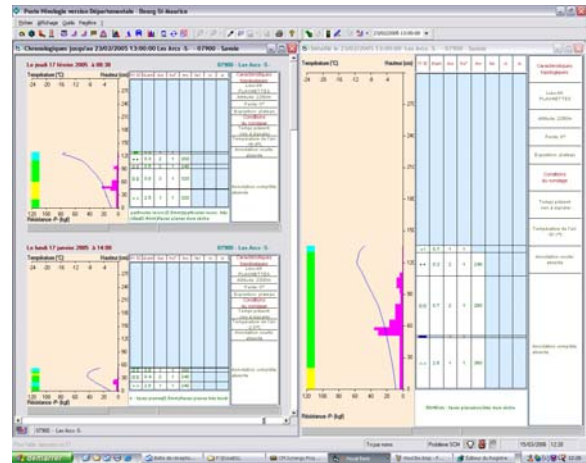


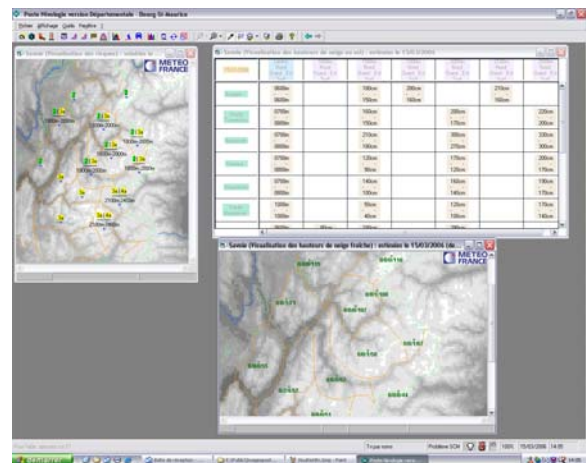Figure 3: Three "sub-screens" for ram profiles visualization.



Figure 4: Three "sub-screens" for snow depth and avalanche hazard visualization : charts and grid.

### 2.3 – Modeling

Safran-Crocus-Mepra is explained in the next chapter.

The "nearest neighbor program Astral" is totally integrated to the application with a fine looking interface. It is available for each ski resort of the department (with good quality data only). Data can be observed or estimated by forecaster ; fast changes allow many results.

### 2.4 – Utilities

The configuration of application is easy. Many options for the user can be defined.

Characterization of locations are synchronized from the national database of Météo-France located at Toulouse.

Other utilities are available : data accounts, export functions (to ASCII files and to GELINIV files), printing, database management.

## 3 – MODELING SAFRAN-CROCUS-MEPRA

The chain "Safran-Crocus-Mepra" is both a research product used by CEN, and an "operational" software for avalanche forecasters located in each mountainous department. It has been used since 1994.

These forecasters were able to access only a few number of typical results (text an graphics) by the way of a mini web site. The computing environment of this chain, based on own computing resources of CEN, a research centre, couldn't be fully operational.

So a national project of Météo-France, named DOLMEN ("**D**éveloppement **O**pérationne**L** des **M**oyens d'**E**xpertise **N**ivologique"), was created in 2004 to develop full operational functioning of this modeling and integrate in "Poste Nivologie" a friendly access to all results of the chain in each departmental centre.

### 3.1 – Safran

Safran is now implemented on the central computing centre of Météo-France in Toulouse. Four daily runs provide results (hourly interpolation and 24h analysis) which are encoded in BUFR (international codification of WMO) and transmitted over RETIM2000 (French meteorological diffusion network by satellite).

There are "analysis run" and "forecast run up to 48 hours".

A special control panel is generated and transmitted to the forecaster (ratio of data used by category, type of model (Arpege, Aladin), observations rejected, …).

### 3.2 – Crocus-Mepra

In each departmental centre of Alps, Pyrenees and Corse, the computer server processes first acquisition and decoding of these messages. Then the two models Crocus-Mepra run over a geographical zone limited to the department ant its neighbor massifs.

All results are stored one year, from August the first to July the 31 of the year after).

### 3.3 – Visualizations

By use of "Poste Nivologie", his daily working station, the forecaster can visualize many graphical representations : charts, pies, snow profiles, historical display, … of all the parameters.

Results are available twice a day in the past (06h and 12h) and every 3 hours for the day and up to 48 hours in forecast.
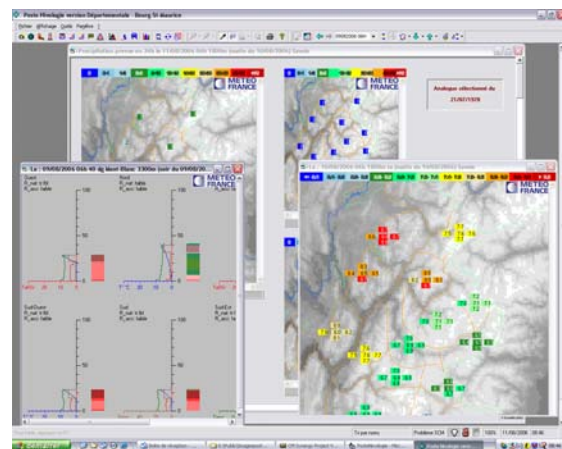


Figure 5: Three "sub-screens" for SCM results: charts of forecast precipitation, snow profiles and chart of temperature (with five expositions for each massif).
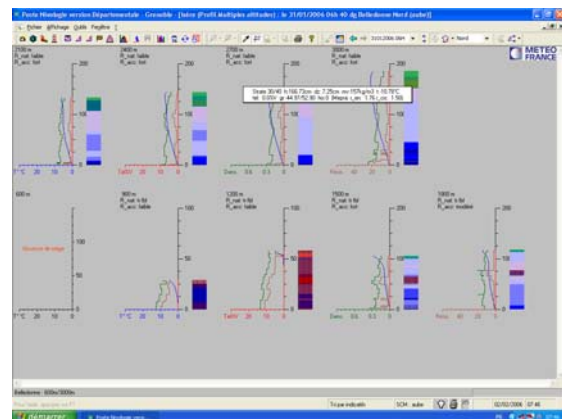


Figure 6: Multi altitudes snow profiles simulated for a massif, a date, an altitude and an exposition.

By the way of the control panel of Safran, the user can supervise the analysis process.
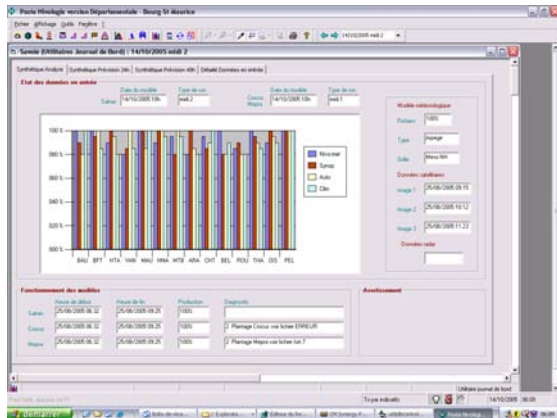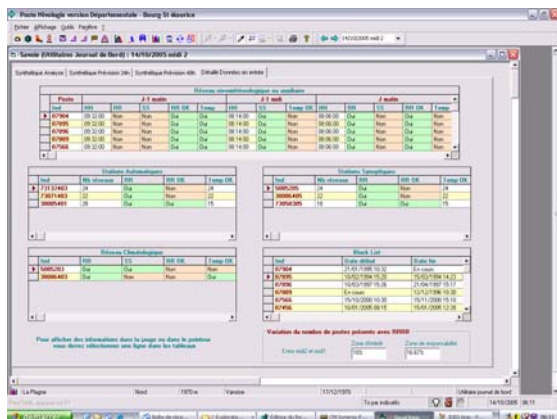


Figure 7: Control panel of models



Figure 8: Detailed control panel of input data of Safran

4 – DEVELOPMENT ORGANIZATION

All developments have been done under a national project structure, DOLMEN, where all the actors of nivology in Météo-France were involved : management committee, functional responsible, final users committee, regional operational team, and of course the technical project team.

This technical project team is made of 8 persons, 5 located in CEN (Computing division) and 3 located in Toulouse (Central Computing Division).

Many recent tools have been used for quality development : Oriented Object Analysis method, Software Configuration, Management,

Object Programming, COM / DCOM technology, Visual C++, Fortran 90, …..

5 – INSTALLATIONS AND THE FUTURE

"Poste Nivologie" has been deployed in its first version at the autumn 2002 above the 11 departmental centres of Météo-France in charge of operational avalanche forecast. After several upgrades over two years, a major evolution was done in December 2005 in order to integrate many new products, especially modeling chain Safran-Crocus-Mepra.

New versions are yet planned until 2008 to access climatological data, to merge observations and forecasting, to produce commercial data and to connect "Poste Nivologie" to local application "GELINIV" (referenced below) in order to minimize manual data entry.

In the same time, many training course will be organized for avalanche forecasters with the aim of acquiring detailed knowledge of these news tools.

6 – REFERENCES

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