

Optima (Road Weather Informations dedicated to road sections)

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Abstract

Optima is a global approach of data fusion and specific road weather algorithms implementation to obtain the best road weather information, according to the state of art, for the whole french road network. Thus, Optima is a tool for road managers to anticipate and follow in real time the meteorological situation on their road sections, especially when dangerous phenomena are concerning their roads.

Optima supplies real time meteorological qualifications for road sections (five kilometers resolution) of France between H and H+1h (about 250 000 km) at high temporal frequency (5').

The forecasted parameters inform on the weather conditions along the roads as well as on the state of the roadway.

Keywords : Meteorology/Road sections/Data fusion/Forecasts

1. INTRODUCTION

OPTIMA is a weather forecast data fusion approach, dedicated to the real time and the immediate forecast from H to H+one hour. The results are customized on the road network, with dedicated road weather algorithms.

To reach this result every pertinent data, observed or forecasted, are part of the system:

- Radar observed and forecasted imagery (updated every 5')
- Weather observations (every 5/6', or one hour)
- Forecast data base over the French territory, covering 36 000 towns, (to D+3, updated every 4h)
- Road Surface modelisation

Optima positions on the same field as nowcasting (H/H+1h) resulting from the observations with, as additional objectives:

- To discriminate the type of forecasted precipitations
- To forecast other parameters and specially those which could affect road traffic.

Optima positions between the "In situ" reality and the forecasts.

Thus, Optima makes it possible to synthesize the various informations coming from observations and forecasts in order to provide the best possible forecasts between H and H+1h .

2. PRESENTATION OF OPTIMA

2.1. Synthetic diagram

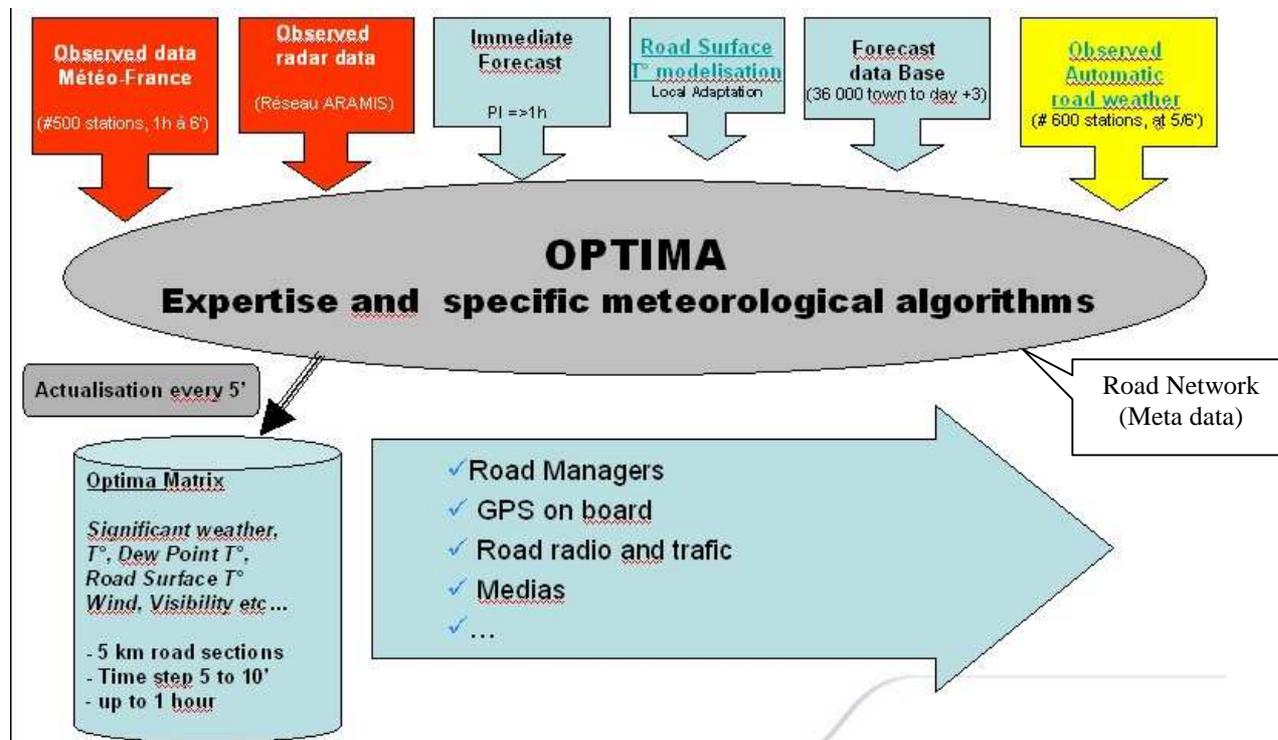


Figure 1 : Optima synthetic diagram

With the various sources of observed and forecasted data (cf figure 1), Optima provides forecasts as followed :

- Range of forecast : every 5' from H to H+30', every 10' between H+30' and H+1h.
- Updated every 5'
- Geographical precision : all the French road sections of 5 km
- Forecasted parameters :
 - Type of precipitations : icing rain, snow, rain-snow mixture, hail, rain, drizzle.
 - Intensity of precipitations (light, moderate, strong).
 - The quality of snow (density, temperature, water content...)
 - Snow potential (depending on the quality of snow and the air temperature) : snow height on the ground without accounting for melting effects
 - Air and dew point temperature
 - Road surface temperature
 - Rain/snow limit altitude
 - Wind and squalls
 - Visibility
 - Thunderstorm
 - *Road surface condition*
 - *Snow height*

At any parameter is associated a fiability index according to the quality, and the number of input sources. It is also the dialogue with the road owners which will allow, for specific parameters like the road surface condition, the improvement of the algorithms for the determenation of the future road surface condition knowing the current one.

2.2. The input sources

The input sources are :

- Observed data :
 - Observed data from Meteo-France every one hour or 6': approximately 500 stations
 - Observed data from road meteorological stations, every 5 or 6' : approximately 600 stations
 - Observed data from the radars which cover the whole France
 - Lightning impacts
 These data are taken into account in real time, as soon as they are available : every 5', 6' or one hour.
- Forecasted data :
 - 1 hour extrapolation of observed radar
 - Hourly forecasts resulting from the numerical models and appraised by the forecasters

2.3. Road weather data improvements

The more Optima will have of observed data on the roads, the better its forecasts will be.

Nowadays, we use road weather data for :

- Statistical adaptation especially for the road surface Temperature (models output)
- Local improvements of OPTIMA forecasts
- Archive and controls

Early 2012, nearly 200 stations are processed.

2.4. Treatments

First step :

We initialize the forecasted parameters with the best source of available weather forecasts :

- Observed data from radars, extrapolated on 1 hour for the parameter “precipitations”
- Weather forecasts appraised by the forecasters for the parameters Temperature, Dew Temperature, rain-snow boundary, Wind and Visibility
- Forecasts resulting from the specific road surface temperature model for the temperature of the surface of the road Ts completed by the local adaptations when exist.

Second step :

We improve the initial forecasts by taking into account the interactions between the various parameters and the environmental conditions :

- We discriminate between rain and snow according to the forecasted air temperature
- We evaluate the quality of snow and the snow potential (described in section 2.1)
- The forecast of freezing rain depends on the forecasts appraised by the forecasters, the occurrence of precipitations and the forecasted air temperature.
- If necessary, we correct the forecasted air temperature according to the altitude difference between the road section and the reference point of the forecast.

Third step :

We update the forecasts with available observations using specific algorithm for each parameter.

3. OPTIMA – VISUALISATION OF DIFFERENT PARAMETERS

The Optima’s visualisation interface allows us to visualize the one hour evolution of the following parameters : type of precipitations, air temperature, road surface temperature, squalls, visibility and the accumulation of the snow potential.

In the example below (Figure 2), rain is in green color, drizzle in yellow, snow in blue (the intensity of the color depends on the intensity of the precipitation) and icing rain in red. The road sections colored in grey have no precipitation.

It is important to notice that the interface makes possible to visualize the past situation, from H to H-3h. That is to say it is easy to understand the weather evolution over four hours, from the past (H-3h) to H+1h. So that the progression of the major events (Frozen rain, snow, high snow potential etc...) are well seen.

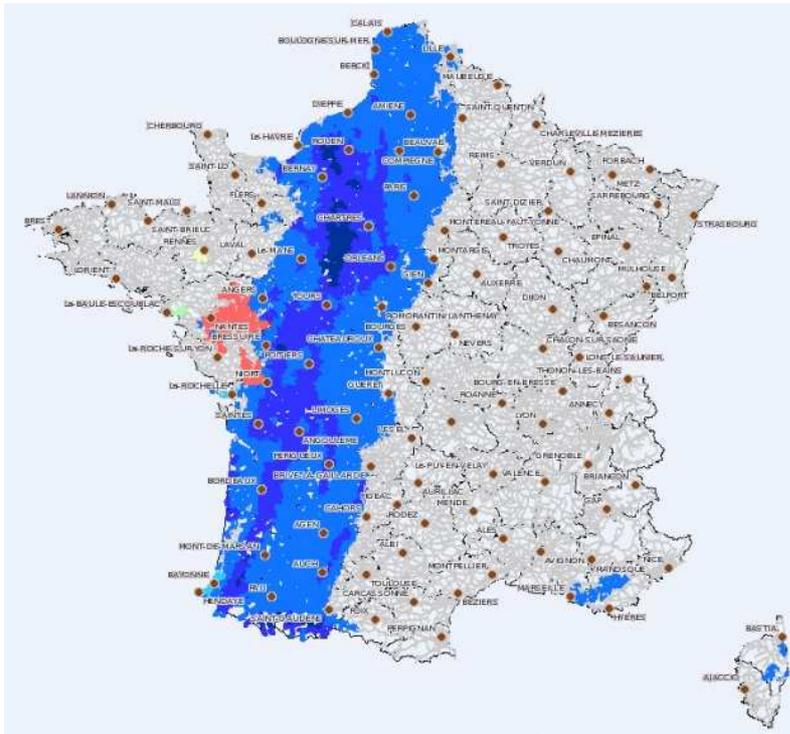


Figure 2 : Meteorological situation of February 5th, 2012 at 06h50 am.

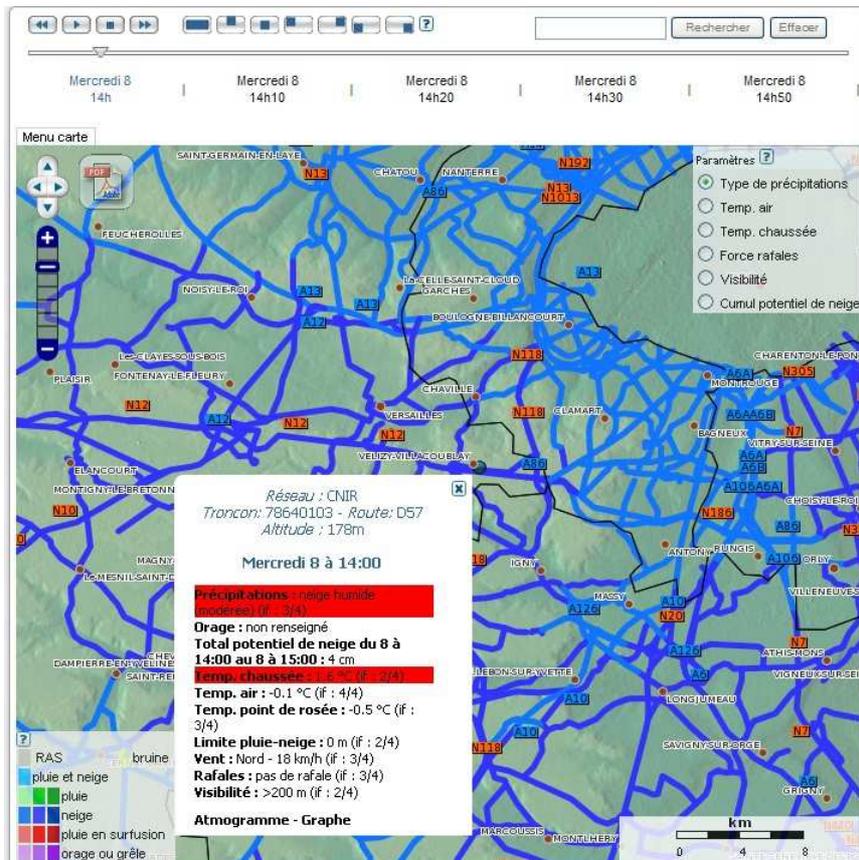


Figure 3 : Meteorological situation of December 8th, 2010 at 02h00 pm, in the south of Paris on road D57

In this situation we have forecasted a snow potential of 4 cm in the hour. Such a potential corresponds, for road managers, in a “limit situation” : it becomes very difficult, and often impossible, to clear the roads especially at the hour of knocking-off time. In this situation, we attended big traffic jams, many road users had to left their car

and walked back home. So the anticipation of the areas of “huge” potential is crucial, and the evolution from H-3 to H+1 is fundamental.

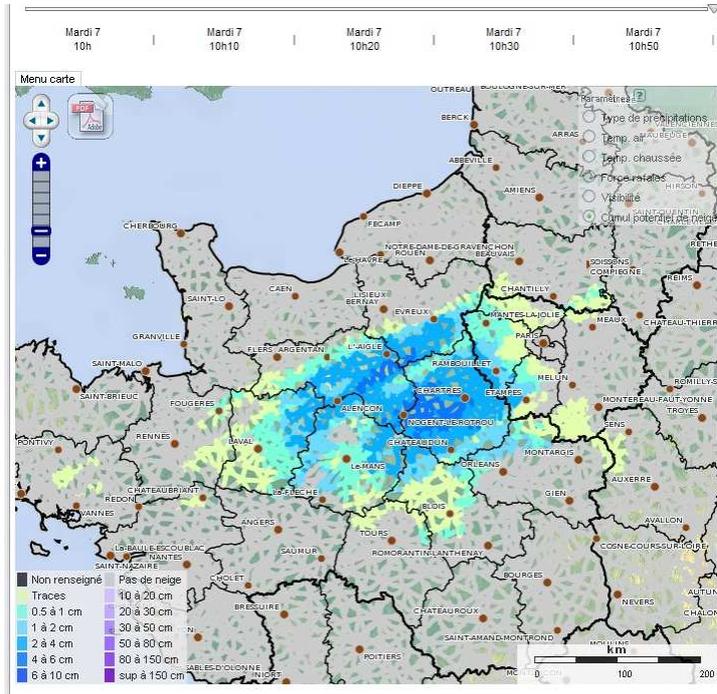


Figure 4 : We see on this figure the accumulation of the snow potential between 10h and 11h. It is around 4 cm in the South-West of Chartres.

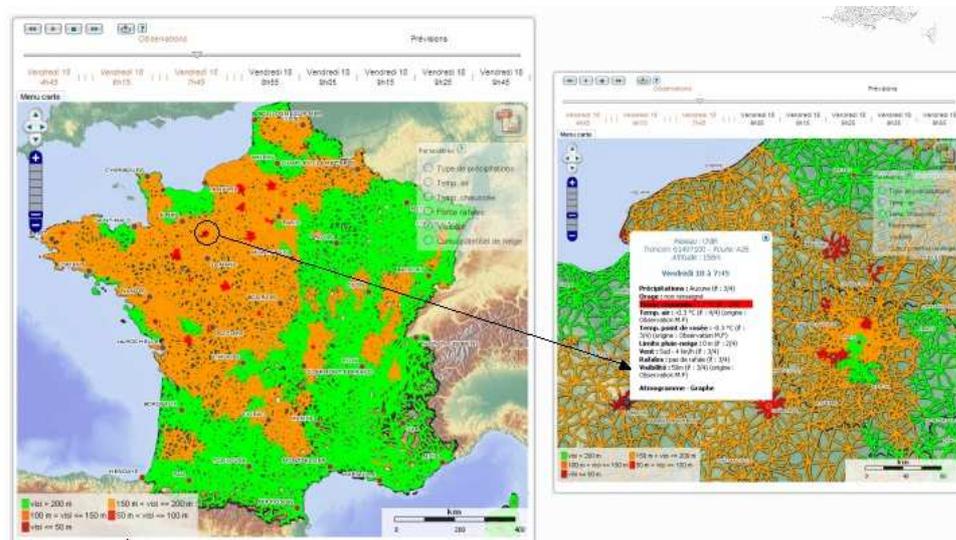


Figure 5 : Parameter “Visibility” with a correction of the initial forecast with an observation of 50 m of Visibility.

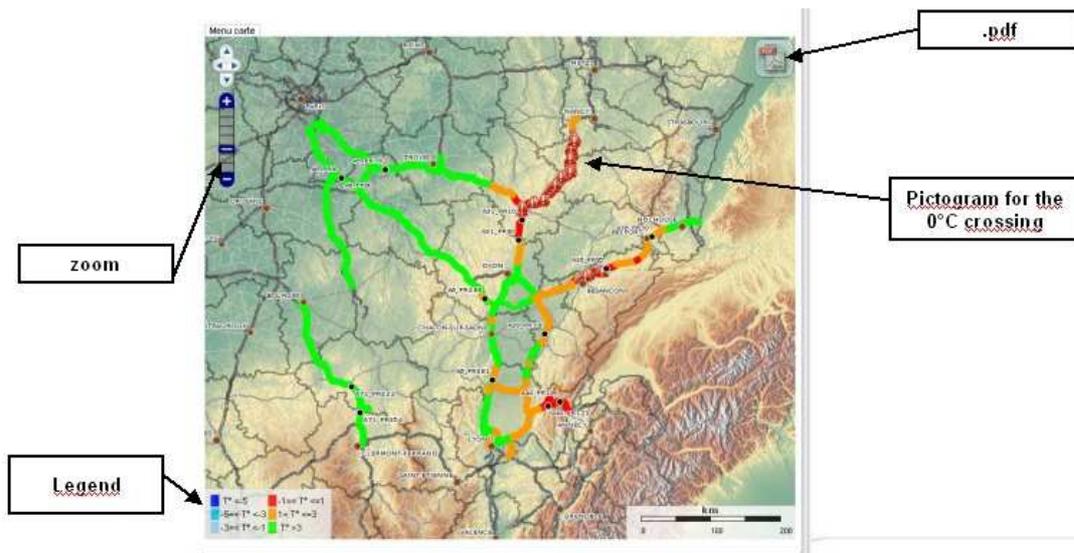


Figure 6 : Parameter “Road surface temperature”

4. OPTIMA – ROAD WEATHER RISK INTERFACE

On their network, road managers can define a list of alerts related to meteorological parameters in order to be aware of the overtaking of a threshold for one parameter or more.

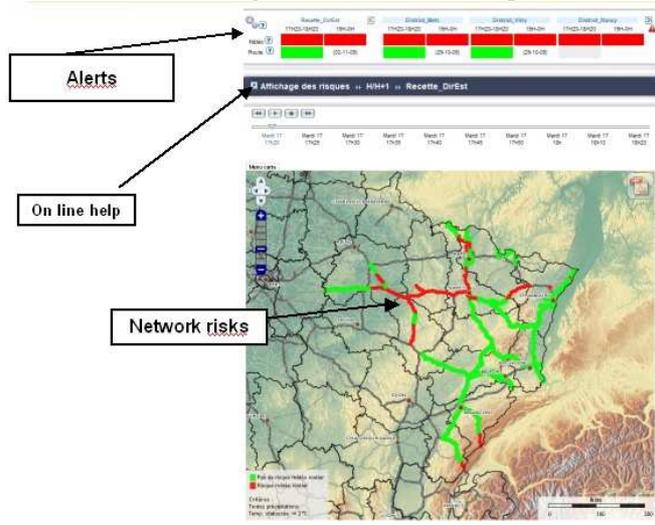


Figure 7 : Road weather risk interface (red : a threshold is exceeded, green : no risk)

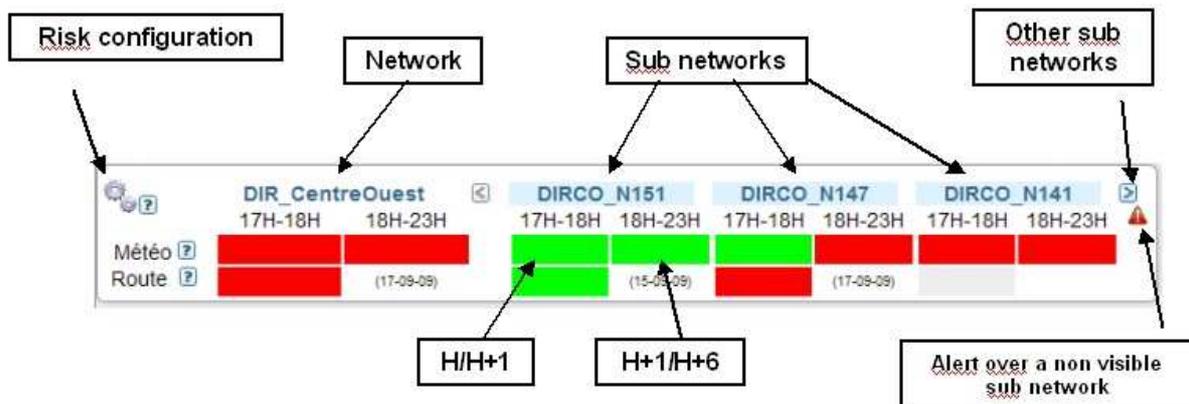


Figure 8 : The alerts are resumed in a banner on the top of the Optima’s interface

5. OPTIMA FOR ROAD MANAGERS

Optima is now available for all the major French road customers : most of the national Road Directions, highways managers, all the regional road informations Centers (CRICR + CNIR), departemental road managers and also on the crisis extranet sites.

For the real time follow-up of the meteorological situation on their network, the managers explained us that, until now, they looked both at the radar image and at the observations of their meteorological road weather stations in order to forecast the evolution of precipitations and type of precipitations (snow, freezing rain) in very short term : it is exactly what Optima does automatically (with a scientific approach) , every 5' and over the whole french road network.

The aim of Optima is not to replace the long range forecasts (from 1 to 7 days) helping the manager to proportion, in advance, the number of necessary persons to treat the roads but it completes the classic forecasts in particular for the real-time follow-up of the situation and the exact forecast of the return to normal conditions. With Optima, the manager of a network knows at any time, what is the meteorological situation on its network.

6. CONCLUSION AND PROSPECTS

The way Optima has been developed, will allow it to integrate all new developments concerning road weather information on the French territory. OPTIMA is a Road Weather Information System on France.

It will be able to take into account :

- Headways in nowcasting and weather forecasts : extension of the present limited range of one hour to two and three hours, improvement of the intrinsic quality of the forecasts, use of the data from the road meteorological stations etc...
- Headways in the determination of the slipperiness of the roadways. Météo-France works on it in partnership with reseach laboratories (project PALM[2]).

The geographical referencing of data opens way to taking into account descriptive data of road sections (type of road surface, environment, sunshine exposition etc...), and also the nature of the road treatments.

Thus, Optima is a useful tool to manage the third step of the anticipation of winter road risks (cf technical guide SETRA[1]) which is "Fine analysis of the risks on the road and decision of intervention".

7. REFERENCES

[1] Technical guide "Anticipation of winter road risks", elements of reflexion. February 2006. SETRA

[2] PALM: joint research project between Météo-France, the CETE and research laboratories (FSTARR, LRPC, CERTU...) on Forecasts and Alarms for degraded meteorological situations.