

Road weather forecast for different customer systems in Switzerland

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Foreword

This presentation will be part of three presentations about the road weather service in Switzerland. The other two will be presented by Albert Mathis, road manager of the County of Lucerne, concerning the use of the daily road weather forecasts (reengineering winter road maintenance: Decision making process) and Willi Schmid, scientist at the Laboratory of the Atmospheric Physics at the ETH in Zurich. He will present the new system of nowcasting winter precipitation with radar.

Abstract

Switzerland is a mountainous country, highways lie in a range of altitudes extending from 200 m up to 1100 m. It is crucial to provide an accurate forecast for the maintenance staff of these highways.

At SMI a road forecast is carried out every morning in each linguistic part of Switzerland from the 1st of november until the 15st of april. The weather forecaster modifies data imported from a numerical model (SM) using the 'Road tool' program which has also been designed to deliver a forecast with different configuration according to the systems Vaisala, Vibrometer and Boschung (SWIS).

The Forecast

A forecast is produced every day between 11 am and 3 pm and is sent to users on different forms depending on different operating systems which are:

- Vibrometer

The parameters forecasted for this system are; the 2m temperature, the dew point depression at 2m, the total cloud cover, the precipitation intensity, the snowfall limit and the precipitation type. These parameters are given for each location every hour from 12 am on the forecasting day until 6 pm the following day.

- Boschung (SWIS)

The parameters forecasted for this system are; the total cloud cover (including fog), the 2m temperature, the dew point depression, the road temperature, the wind direction and speed, the quantity of precipitation, the type of precipitation, the snowfall limit and the state of the road. These parameters are averaged during a 3 hours period

from 1pm on the forecasting day until 10 am the following day. They are averaged on various section of roads at an average elevation. The data are sent by the Boschungs's communication system to PCs at the different maintenance centres where the staff can visualise these data graphically. Moreover, these data are used in a prognostic software BorrCast24. This software forecasts the state of the road (risk of frost, dampness, quantities of salt remaining) at each location using hydric and thermic balance and measurements near and on the road and the local characteristic of the road (bridge, ditch, hill etc...)

- Vaisala

The parameters forecasted for this system are; the 2m temperature, the dew point, the total cloud cover, the main cloud type (high, medium, low), the wind speed, the precipitation type and intensity. These parameters are given for 9 climatic locations every 3 hours from 12 am on the forecasting day until 12 am the following day.

For each road section the road surface temperature and state of the road are calculated automatically by the Vaisala energy balance model for the 24 hour period. Using the road surface temperature forecasted in correlation with the Vaisala's thermal mapping the minimum temperature can be forecasted for each location in the whole road network of Lucerne county.

Prognose Wigen

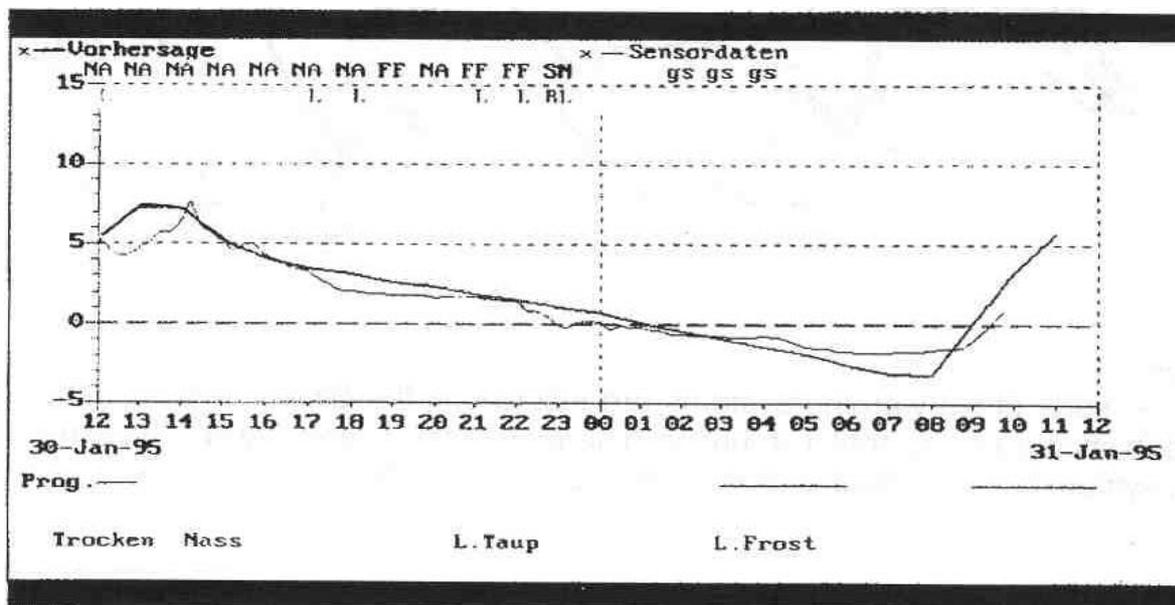


Figure 1:

24-hour forecast for Wigen in the Luzern county. The thick line displays the forecast, the thin line the actual road surface temperature. A small text appendix indicates the radiation type of the night (extreme, intermediate, damped) and the certainty of the forecast. The minimum temperature of this forecast is taken for the map generation. (

Distribution of the different systems in the Swiss highway network

The distribution of the different ice warning systems in Switzerland presents today the following:

23 maintenance centres are using the Boschung system, 8 the Vibrometer system and 4 the Vaisala system.

The distribution of road weather systems in Switzerland

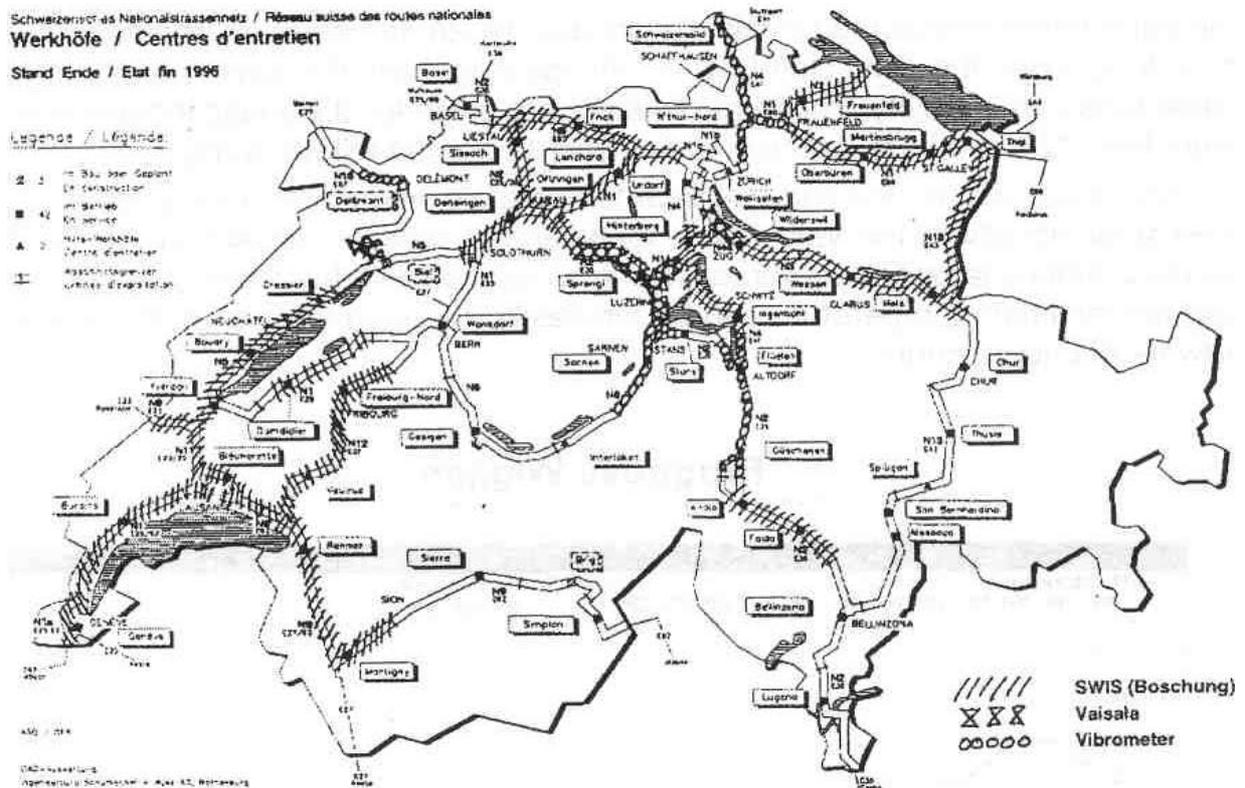


Figure 2: Three sorts of ice warning systems are installed in the Swiss highway network. The graph shows the regional distribution. There are a few counties which have a ice warning system but don't receive specialised forecasts on their system.

The Road tool program

The program developed by A.Rubli and P.Eckert (SMI), is written in an IDL code, it imports data from the SM (Swiss Model) numerical model. The SM model is fine mesh (14 Km grid length) with 31 vertical levels. It is centred over the Alps with boundary conditions given by the Europa model of the DWD. The SM provides a base on which the weather forecaster can produce a road forecast. He will modify the data from the model according to the local conditions.

Since the parameters and the format sent to the three systems (SWIS, Vibrometer and Vaisala) are fairly different the program consist of two parts:

BASIC

On that part, the forecaster makes a general forecast for a large area, for example Jura, western Alps, etc... The data are directly imported for the SM model output for locations corresponding to the location of automatic measuring stations (ASTA). For the 2m temperature and the dew point forecast, a Kalman filter is applied to the SM raw data. In order to produce a forecast for stretches of roads at various altitudes a second measuring station at the altitude for the same area is chosen.

For each parameter the weather forecaster modifies a time dependant diagram. The parameters to forecast are 2m Temperature, the dew point depression, the amount of low and medium clouds, precipitation intensity, snowfall limit, wind direction and wind speed. In case of stable conditions over more than 24 hours, it is also possible to import the day before forecast instead of using data from SM or to copy the forecast from a region to another one if the weather systems are not too localized.

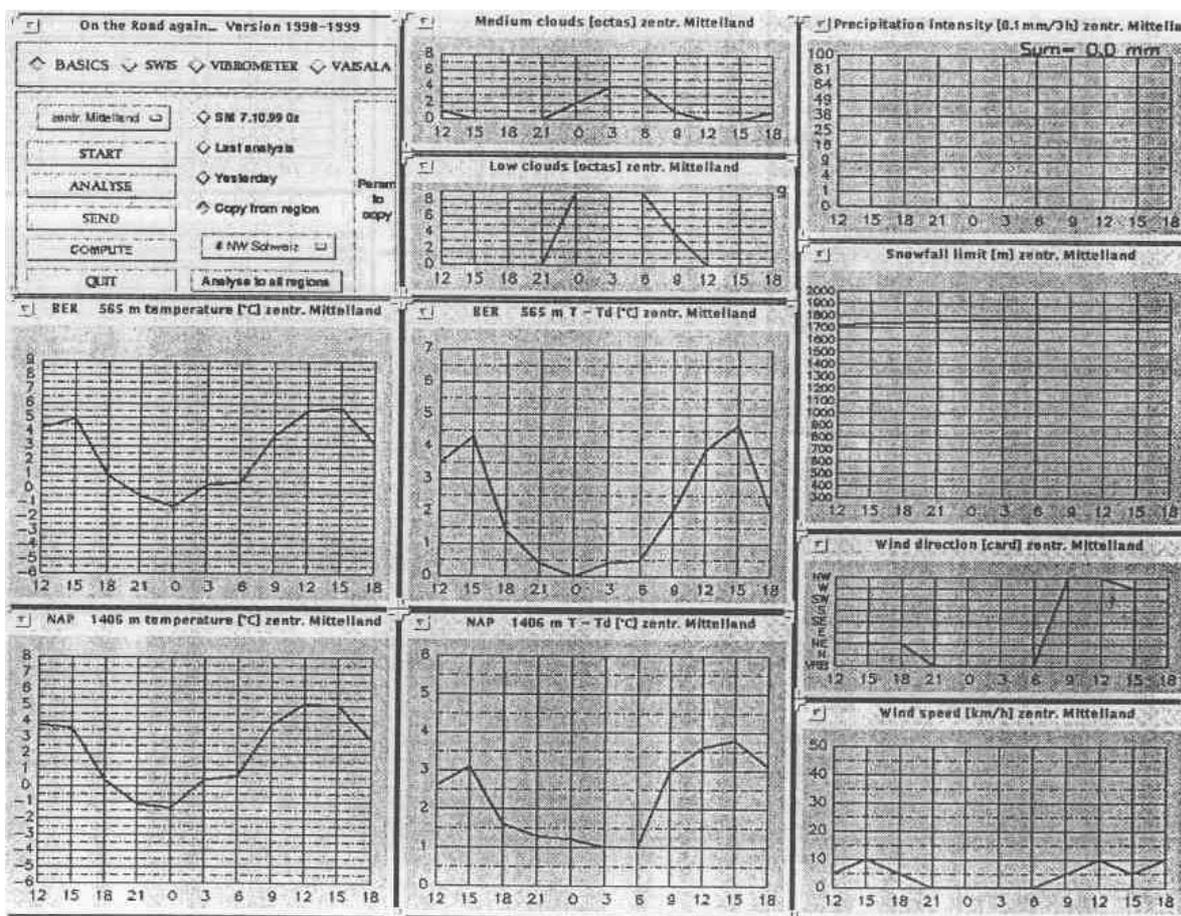


Figure 3:
The screen view of the BASIC road tool is shown. On this page forecasts for 12 regions in Switzerland are made in three forecasting centres.

SWIS, Vibrometer and Vaisala:

When BASIC has been achieved, the forecaster can begin a section by section road forecast. The road sections have been delimited by two criteria, their altitude and the operating system which manages them (Vaisala, Boschung or Vibrometer). For this part, data from BASIC are imported and the parameters calculated according to the elevation of the road. The road surface temperature is computed using a energy balance model from the German Meteorological Service (DWD) and the data from BASIC. At any time, the forecaster can recalculate the surface temperature, when other parameters have been modified. The precipitation type are directly calculated using the temperature and the snowfall limit. The graphical forecast is converted to a list which is sent to the clients, after adding the probable state of the road with eventually a small text enhancing local differences or dangers.

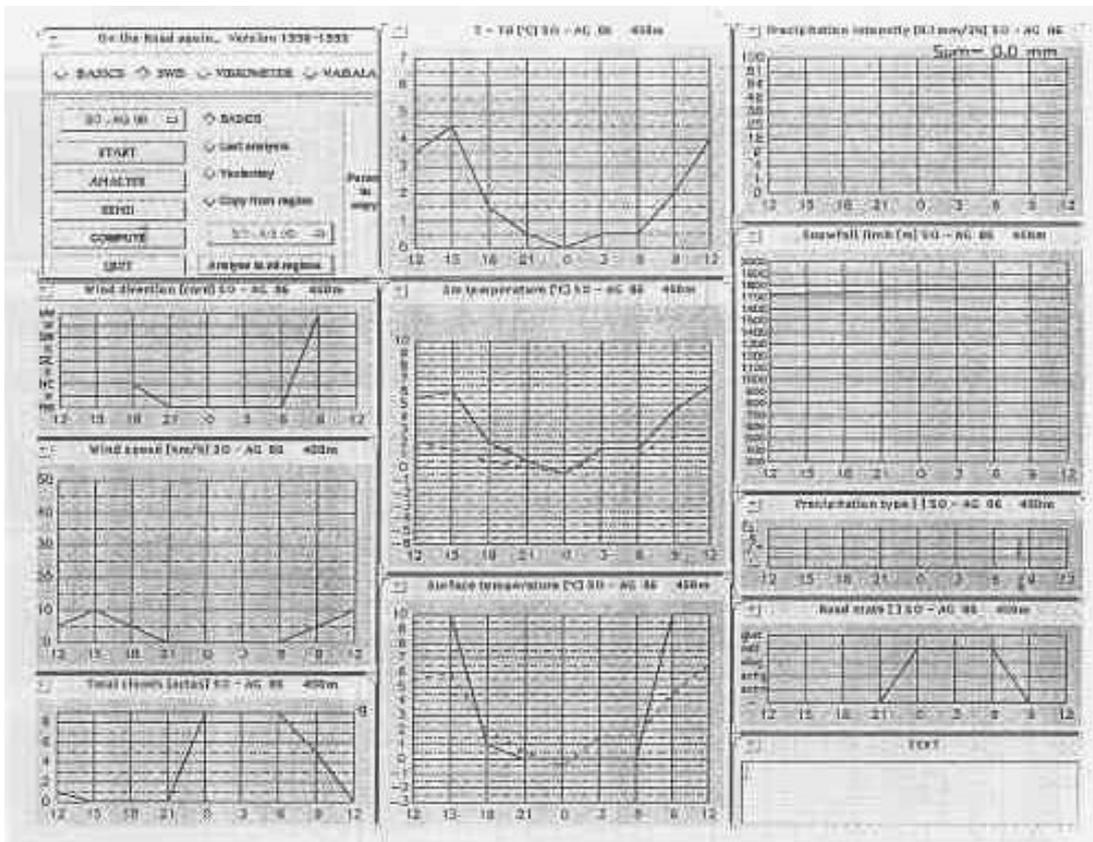


Figure 4:

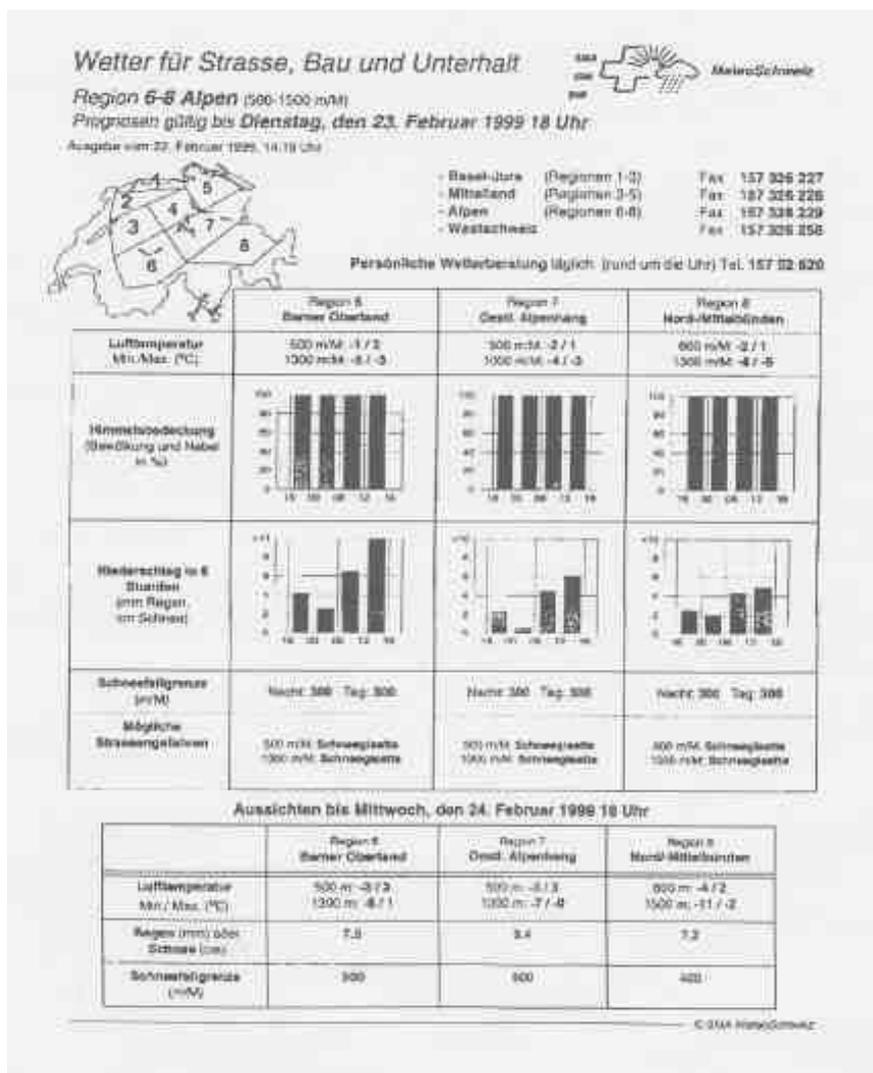
The screen view of the SWIS road tool is shown. On this page forecasts for 23 small regions in Switzerland are made. These forecasts are issued by a table and displayed on the PC of the maintenance centre by graph or table. Out of these forecasts local surface forecast can be made.

Fax polling

In Switzerland, a new way to broadcast the forecast to small maintenance centres is through fax polling. The client dials the number on his fax and the product is sent to him automatically. Alternatively, he can buy a subscription and receive his daily regional forecast on his fax.

During winter time, 5 different faxes are produced, corresponding to the climatological and language regions, the region being Base! and eastern part of the Jura, Swiss midland, eastern Prealps, the Alps and the French speaking part of Switzerland. Each of these faxes present smaller climatological areas.

The data are imported from the BASIC part of the road tool. The parameters shown are the 2m temperatures (min/max), the amount of cloudiness and precipitation in 6 hour intervals, the snowfall limit and the probable state of the road. A forecast for the following day and night is added, (see Figure 5 below)



Future

The quality of the forecast seems to be good. The clients are satisfied. Vaisala made a quality control on the frost or no frost forecast for the Luzern county forecast. The result varies from year to year but on average, the success rate is 87%.

A better and more systematic quality control is planned for the near future on which all parameters will be assessed.

Often in winter, the meteorological situation does not change significantly over long periods, for instance anticyclonic conditions with stratus at low levels. Soon, a persistence forecast will be developed using the data from the automatic stations (instead of SM).

In short future the SMI follows the way to produce regional road forecast by a man-machine-mix and to adjust the forecasts in optimum to the customers wishes.