

**SIRWEC**

**Road Weather Information in  
Switzerland**

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**March 2004**

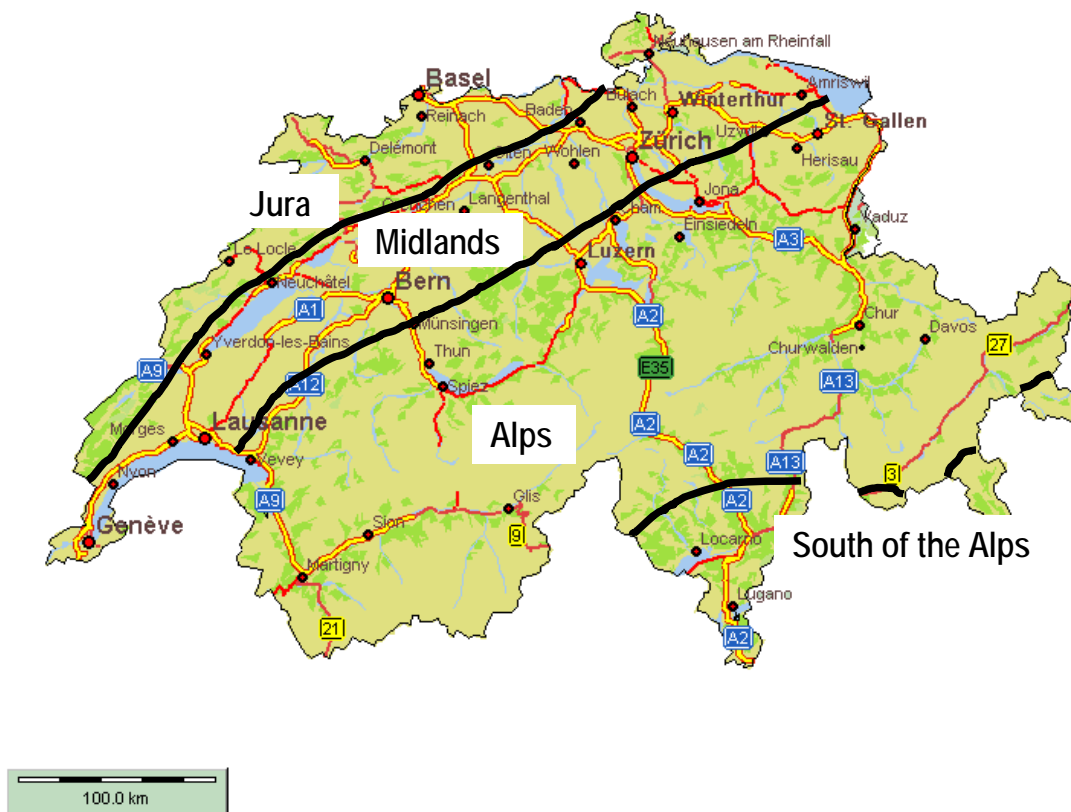
# 1. Fundamental Issues

## 1.1.1. Climatic conditions

Overview of the climatic regions

The climate in Switzerland is mainly influenced by the altitude and topographic aspects.

Switzerland can be divided in 4 climatic regions (see Figure below) with the following characteristics:



### - Jura

High-precipitation with frequent strong winds. Raw winter climate. Precipitation averages between 90 and 180 cm on 130 to 160 precipitation-days a year. Strong winds reach peak speeds up to 150 km/h and 200 km/h at the mountain tops. In winter widespread driven snow.

### - Midlands

Well-balanced precipitation distribution. Great variation of snow quantity from winter to winter. In winter fog is a frequent phenomena. Precipitation averages between 85 and 130 cm on 120 to 150 precipitation-days a year. Strong winds reach peak speeds up to 165 km/h.

**- Alps**

Pre-Alps are generally rich in precipitation.

Precipitation averages between 130 and 210 cm (in the Wallis only 55 to 120 cm) on 110 to 165 (Wallis 70 to 120) precipitation-days a year. Strong winds with peak speed up to 270 km/h are possible at the mountain tops.

Foehnstorms (hot and dry downwinds from the mountains) are frequent in N-S oriented valleys.

**South of the Alps**

High yearly precipitation up to 225 cm as a result of stationary barrage situations at the south side of the Alps occurring in springtime and autumn.

Wind-speeds up to 130 km/h in the valleys and 160 km/h on the mountain tops.

**1.1.2. Winter events to be mastered:**

- ice control
- snow clearance
- protection from avalanches
- driven snow

The **table** below shows a summary of the different Swiss climatic regions and their averages of winter climate parameters.

Climate region	Temperature		Precipitations					
	number of days below 0° C air temperature	number of ice days (air temp. stays below 0° C)	number of days with rain	amount of rain cm/year	number of days with snow fall	snow cover	max. snowfall cm/day	Total sum of snowfall cm/year
Jura	121	30	157	140.6	64	123	55	317
Midlands	96	22	126	104.2	30	51	22	53
Alps	140	42	138	148.7	59	128	50-90	433
South of the Alps	45	4	107	184.8	14	19	63	43
Duration	1961 - 1990				1981 - 2000			

**1.1.3. Winter index**

An ongoing winter index project is based on the method of simple regression. The index is basically the correlation of specific climate factors and the costs of winter maintenance.

The climate factors taken into consideration include:

- quantity of snow
- number of days below 0° C air temperature
- number of days with snowfall
- minimum air temperature
- amount of precipitation

- days with snow cover

The winter index will be different for each of the climatic regions.

## 1.2. Regulations and codes of practice

### 1.2.1. General Regulations and codes of practice

Switzerland has a total length of roads of about	72'000 km.
- national roads ( mainly highways )	1'850 km
- cantonal roads	18'300 km
- communal roads	51'300 km

Legislation is different for each road network.

A legal obligation to do winter maintenance exists for the National Road Network (law on the National Roads, 8 March 1960).

For other roads, the obligation varies.

Besides the law, several regulations define levels of winter maintenance.

Besides these codes, the Federal Road Authority issued a directive describing the special requirements for National Roads.

Subject matters are: preparations for winter, readiness, ecology, cost minimisation, allowed time for snow removal and spreading, equipment, road weather tools.

#### Road classes

For snow removal and ice control, the following classes have been defined:

- Motorways, Highways
- Main traffic arteries, steep roads
- Roads used by public transport
- Roads leading to railway stations, hospitals, medical centres, police stations, fire departments, industrial plants
- Public transport stations
- Important pedestrian and bicycle paths, stairs

#### Service levels

All road stretches are classified in one of the following service levels:

- Level A: black roads, complete snow removal and ice control
- Level B: avoid slipperiness on the runways, medium-term black roads
- Level C: practicable roads without the use of de-icers, white roads
- Level D: no winter maintenance

#### Priority levels

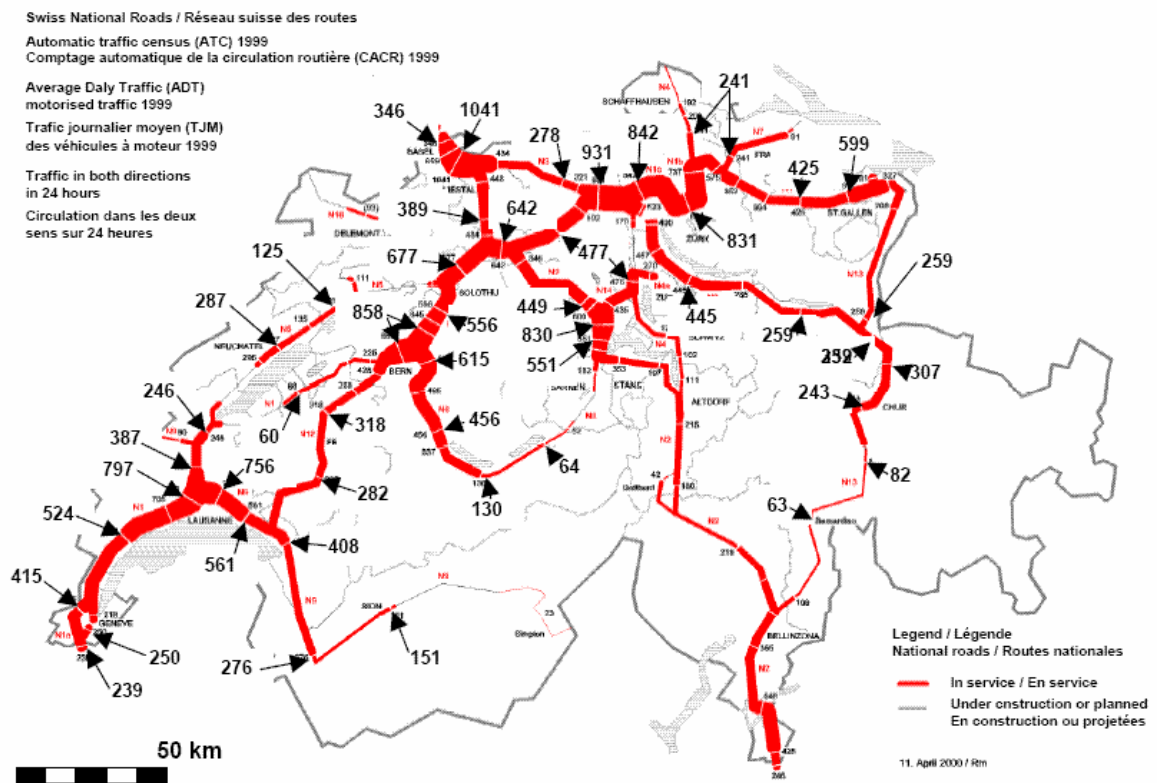
- Level 1: First passage of snow removal completed 3 hrs after mobilisation ( 2 hrs on motorways ). First passage of spreading completed 2 hrs after mobilisation.

- Level 2: First passage of snow removal completed 4 hrs after mobilisation. First passage of spreading completed 3 hrs after mobilisation.
- Level 3: First passage of snow removal completed 5 hrs after mobilisation. First passage of spreading completed 4 hrs after mobilisation.

All road authorities are obliged to have route maps, covering the entire road network, where road classes, service levels and priority levels are indicated.

### 1.2.2. Traffic volumes on the Swiss national roads

#### Traffic volumes (Average daily traffic ADT)



The numbers in the map indicate the ADT in hundreds.

## 2. Strategic Organisation of Winter Maintenance

### 2.1. General

Organisation and responsibility for winter maintenance depend on the road class.

Road class	Road owner	Road manager
National Roads	Cantons	Cantons

Cantonal roads	Cantons	Cantons
Communal Roads	Communities	Communities

For all types of roads the listed codes of practice are compulsory. for national roads also the directives of the Federal Road Authority.

In general, the cantonal and communal maintenance centres are in charge of winter maintenance. However private companies are frequently given contracts to do part or, in some cases, all of the winter maintenance. The contracts are established between the cantonal or communal road authorities and the contractor.

The order for action is in most cases given by the maintenance centre.

## 2.2. Information provision

There exist several kinds of information to start winter maintenance operations.

### **Meteorological information**

MeteoSwiss (national Met Office) provides information for winter maintenance on several levels:

- A general road weather forecast, available to the general public on internet and radio. Free of charge.
- A 24 hrs specially designed road weather forecast for maintenance centres. This forecast is done separately for over 20 areas with different local climates. The information is distributed by phone lines and computer network and arrives directly on the RWIS-computer in the maintenance centre. The contract is established between MeteoSwiss and the maintenance centre. The accuracy lies between 86 % and 90 %.
- Weather warnings are issued 1-3 hours ahead for dangerous weather situations, e.g. sudden black ice, freezing rain, heavy snowfall in one of 15 regions. They are delivered directly on the RWIS-computer in the maintenance centre or by SMS. Free of charge.

The MeteoSwiss road weather forecasts rely on a network of automatic weather stations (ANETZ) and several forecast models. A verification is usually made with selected road sensors.

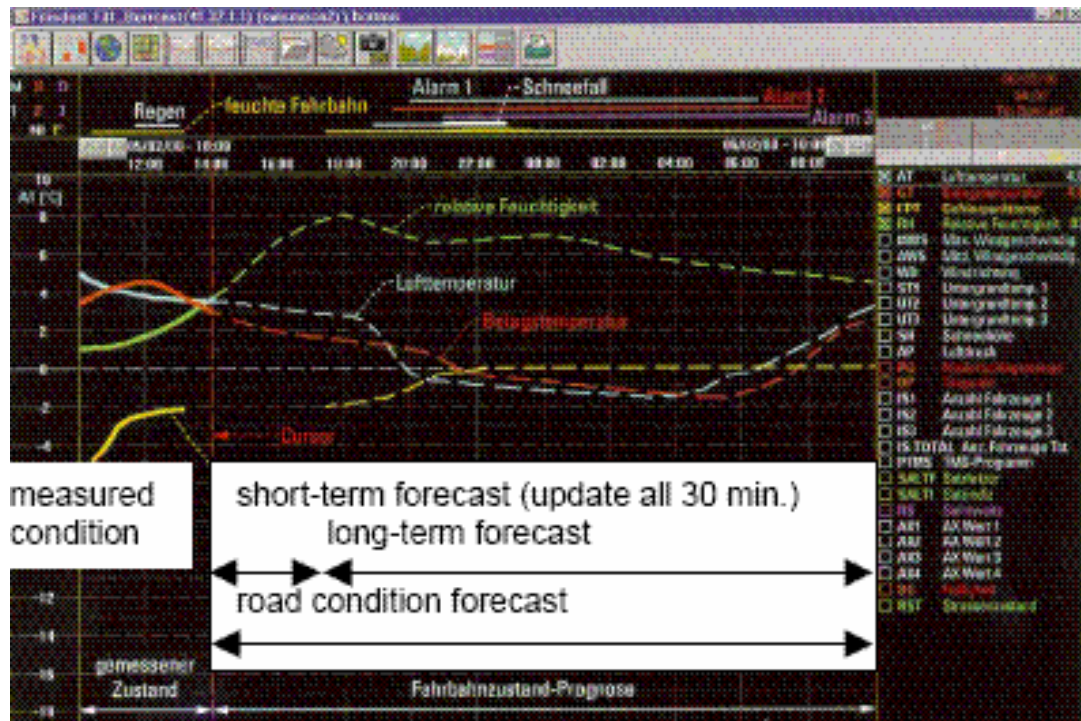
### **RWIS-system**

All maintenance centres for the national roads and some of the larger communes dispose of a RWIS-system. The system combines measurements and warnings from road sensors and road weather stations and the local road weather forecast issued by MeteoSwiss.

Road sensors and road weather stations generally provide the following parameters: air temperature 2 m above ground, surface temperature,

humidity, dew point, freezing temperature, precipitation, wind: direction and intensity, state of the road: dry or wet, residual salt (when wet).; at selected sites snow height and fog occurrence.

The RWIS local weather forecast is issued every day at 7.00, 11.00 or 15.00 hrs and covers 24 hrs. It provides: air and surface temperature, humidity and dew point, precipitation: type and quantity, limit of snowfall, wind: direction and intensity, cloud amount, state of road surface.



The forecast is updated, if a change occurs within 24 hrs.

Besides the RWIS, other forecast tools such as weather radar and some other radar derived products are used. They however require a basic knowledge of meteorology.

### Ice detection system



The national road network is equipped with ice detection systems. A total of ca. 610 road sensors are installed. The medium distance between road sensors is approximately 6 km.

The following systems are in use: Boschung Mecatronic, Vaisala, Micks.

The location of the sensors was determined by experience (usually the most dangerous spots) or by Thermal Mapping.

Thermal Mapping was done on the Vaisala stretches, serving as reference for the local RWIS-forecast.

Control posts and patrols are only used in exceptional circumstances.

### 2.3. Equipment

There are great differences between the road classes. The following information concern the national roads (mainly motorways).

The national roads (actually 1850 km after completion) dispose of 45 maintenance centres. Most of these centres also work on cantonal roads. The limits of intervention are generally defined by cantonal borders. The average length of highways is 40 km per centre plus cantonal roads. The most efficient intervention length is considered 70 – 75 km of highways per centre, the length is derived from the obligation to do the first round of winter maintenance within 2 hours.

The equipment of the centres is not standardised. Interventions are generally done with the following equipment:

- 2 – 3 lorries per direction, equipped with ploughs, width 3.5 – 6.0 m. The fixing device is standardised.
- demountable spreaders, 4 – 6 m<sup>3</sup> for salt and 2 m<sup>3</sup> brine
- 1 person per lorry



#### **Salt storage**

Salt is always stored under roof, either in barns (up to 4000 tons) or in silos (200 tons per silo). The advantage of the silos is the short time needed for loading (2 – 3 minutes), which can be done by the driver alone. With good disposition of the silos, 2 – 3 spreaders can be loaded at the same time.

#### **De-icer spraying installations**

Automatic de-icer spraying installations are in operation on specific stretches with a particular micro climate or which are particularly exposed. Two installations are on high bridges, 1 installation (length 6 km) on a stretch with heavy traffic (80'000 vehicles per day) and particular micro climate.

#### **Road heating**

Road heating is not used. There is however one exception. On a particularly exposed bridge a solar energy pilot application is in operation since 1995. A heat exchange tube system embedded in the asphalt layer of a bridge, covering a surface of 1300 m<sup>2</sup>, collects heat during summer and utilises it during frost periods in winter, to heat the bridge surface, thus preventing the formation of ice. The liquid is stored in an underground heat store.



### Verglimit

Verglimit, an ice-delaying pavement additive, is used on few stretches. The product is no substitute for winter maintenance, but can delay the formation of ice on particularly exposed stretches.

## 2.4. Materials

Up to now there is a salt monopoly in Switzerland. Only vacuum salt is used. Neither maritime nor rock salt is imported.

Salt consumption varies a lot and depends on the winter intensity. The average consumption on highways is 600 grams per m<sup>2</sup> and year.

The dosage of de-icing agents and abrasives is defined in the codes of practice

Spreading	Temperatures °C	
	0°C to -8°C	-8°C to -20°C
	g / m <sup>2</sup>	g / m <sup>2</sup>
dry salt	7 – 15	10 – 20
pre wetted salt (wet salt technique)	7 – 15	10 – 20
brine in automatic spraying installation	5 - 10	5 - 10
abrasives	≤ 200	≤200
mixing ratio	only NaCl	2/3 NaCl 1/3 CaCl <sub>2</sub>

Certain surface conditions may require a higher salt dosage.

The use of the wet salt technique (salt and brine are mixed on the spinner of the spreader) is progressing. In 2000 this technique is used by 85 % of all highway maintenance centres.

## 2.5. Manpower, training and privatisation

### 2.5.1. Specific jobs

The staff of a maintenance centre usually consists of

- road master, responsible of the centre
- administrator, responsible for accountancy and administration
- 2 – 3 group leaders
- crews, drivers and other profession categories
- 2 – 3 vehicle mechanics
- 1 – 4 electricians, depending on the electro-mechanical installations along the highway

The group leaders are responsible for the operational tasks. They decide on interventions, based on the RWIS-system.

### **2.5.2. Training and education**

There is no special organisation for winter maintenance training. At the beginning of winter, MeteoSwiss organises instruction courses for road masters and group leaders on basic meteorology, forecast technology and working with RWIS and weather radar. Other courses cover the handling of the ice detection systems.

### **2.5.3. Privatisation**

In general, the cantonal and communal maintenance centres are in charge of winter maintenance. However private companies are frequently given contracts to do part or, in some cases, all of the winter maintenance. The contracts are established between the cantonal or communal road authorities and the contractor.

## **3. Operational Organisation of Winter Maintenance**

### **3.1. Getting Information**

For information provision see chapter 2.2.

The maintenance centre disposes of the following information:

- general and regional weather forecasting on radio, TV and internet
- bulletin for road conditions, internet [www.meteoswiss.ch](http://www.meteoswiss.ch)
- RWIS-forecast
- ice detection system
- weather warnings issued by MeteoSwiss
- telephon contact to MeteoSwiss for specific information
- "MeteoSoff" a product of MeteoSwiss, provides satellite and radar images, data from ANETZ-stations, risk warnings, warnings on pager
- "ComMet" a product from MeteoNews, provides forecasts, actual data and other tools
- control post and patrols in exceptional circumstances

All information is available on the central computer in the maintenance centre. During night-time, the group leader on call can get the information at his home on a laptop.

All warnings issued by any of the systems, are forwarded to the group leader on call.

The decision for any kind of intervention is taken by the group leader or the roadmaster.

In some cases information at night is given by police patrols. The group leader then checks with his RWIS information before taking any action.

### 3.2. Methods, equipment and materials for special problems

Special problems are caused by snow drifts, avalanches and porous asphalt.

To reduce the amount of snow blown on the road, **snow fences** are put up where the phenomena regularly occurs. The fences are made of wood and recently of plastic material. On some locations, the terrain on the side of the road is not accessible to put up fences, a fact that leads sometimes to the closure of certain mountain roads.

In some winters **avalanches** cause a severe problem for the road authorities. In all mountainous regions, a special avalanche task force is organised. Their duty is to observe the characteristics and the amount of snow and to issue warnings and in some cases to close the road.

A special avalanche bulletin is issued daily the Swiss Avalanche Research Institute.

Above main traffic arteries and highways, special installations for avalanche protection have been constructed. These constructions, which also protect settlements, railway lines and forests, are of different shape, size and material. Most common are timber and steel constructions and metal nets. On some locations, automatic warning devices are installed.

**Porous asphalt** is not widely used in Switzerland up to now. In general, it is not used above 600 m altitude.

The stretches with porous asphalt have sometimes a length of only a few kilometres, which is an inconvenience for the road maintenance, as the method has to be changed. As a rule, preventive and curative salting is 40 % higher than on common asphalt.

## 4. Information of Drivers

Information concerning weather forecast and road practicability is available on several dissemination systems:

- radio broadcast
- television, teletext
- Internet
- telephone
- VIZ ( traffic information central )

There also exist variable message signs which give information about closures of mountain passes and prescriptions concerning winter tires or chains.