Edizione 2017

Museo San Salvatore

Opening hours:
From Wednesday till Sunday
10 - 12 / 13 - 15

For those who have
a valid transport ticket
for the funicolar San Salvatore
the entrance to the museum
is included.

Exibition realized
with the scientific
consultancy by
Dr. Jürg Joss,
Intragna

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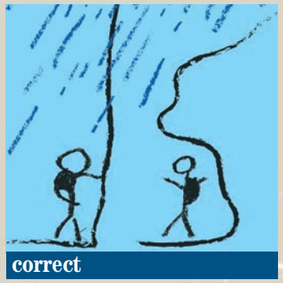
What's the lightning flash?

A lightning flash is a luminous plasma that is an ionized high-temperature gas. At temperatures up to 30'000 degrees the electrons break away from the atoms and make the gas electrically conductive. The phenomenon is called arcing, a phenomenon that makes lightning flashes complex and unpredictable.

Lightning that strikes the ground, may cause damage, but a lot of lightning does not touch the ground because it is inside the clouds or between them. Cloud-to-cloud lightning flashes can be up to 20 km long, with over 100 million Volt.

The energy of 1 gigajoule discharged in a powerful lightning flash is equivalent to that contained in 30 litres of petrol. But since all this energy is discharged almost instantaneously, in microseconds or milliseconds, the power is enormous, such as generated by very many large nuclear power plants.



correct

wrong

How to avoid being struck by lightning in the open air

People in the open air during thunderstorms are at risk of being struck by lightning. Practically all lightning-related accidents occur in the open air. So what is the best way to avoid being struck by lightning?

Lightning tends to strike preferred at points that are significantly higher than the sur- roundings, such as trees, mountain peaks, lookout towers, isolated huts and chapels. People in the vicinity of such places – also up to 30 metres away from them – are in danger during a thunderstorm.

Even partial exposure to lightning can trigger strong muscle movements that may throw you some metres away. So keep away from places where you might be thrown over a cliff!

Where to hide from lightning?

- In houses
- In sheds with interconnected metal walls and ceilings,
- In closed cars (not cabriolets), or tractors with a metal roof
- In railway trucks or coaches
- In metal cable cars, ships or trucks
- In the middle of woods and forests with trees of uniform height, not in touch with isolated trees or hanging branches.

And what in case of a sudden thunderstorm?

In emergency you may find shelter:

- Inside huts, chapels, barns, etc. (do not lean against the outer walls!)
- Under power cables, but not touching pylons
- Crouching with feet together in hollows, in sunken paths, or at the foot of rock spurs.

Which places are dangerous?

Keep away from:

- Isolated trees
- Exposed objects in open terrain such as hay carts, lookout towers, sheds, etc
- Mountain ridges and peaks
- Swimming pools and lakesides

Danger

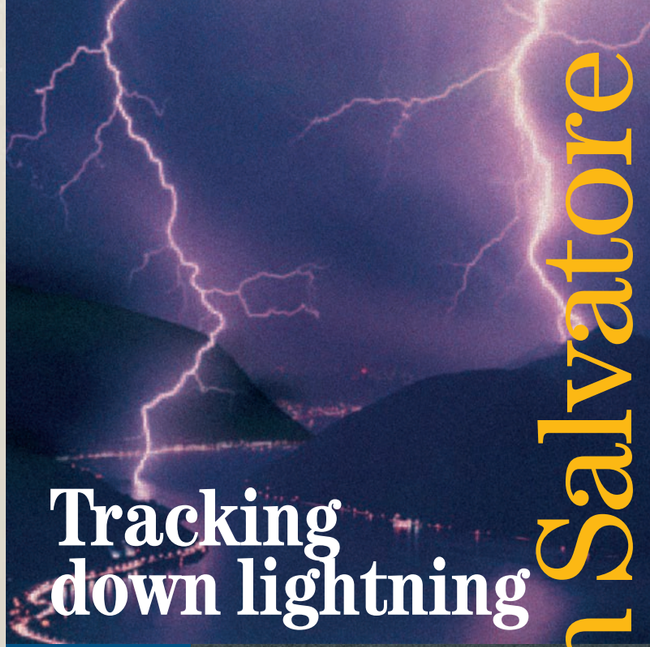
- Isolated tents
- Isolated boats with metal masts
- Never carry projecting items (pickaxe, skis, fishing rod, etc.)
- Never lean on rock faces
- Wide spacing between bodily shock-hazard contact points is dangerous.

Cone of voltage drop around the striking point. Take care of the pace voltage!

First aid for lightning victims

Being struck by lightning is not necessarily fatal. So immediately start artificial respiration and other first aid measures:

- Mouth-to-mouth respiration
- External heart massage
- Keep the patient warm
- Lay the patient on one side
- Cover burns with sterile gauze
- Call a doctor immediately; continue artificial respiration until the doctor arrives.



Tracking down lightning

English

Museo San Salvatore

Historical significance of lightning and of the lightning research

Historical significance of lightning and of the lightning research Mankind has always been fascinated by lightning. In ancient times thunder and lightning were connected with various religious and mythical concepts, such as the beatification of those struck by lightning, On the other hand, death by lightning was regarded in ancient Rome as unclean, and victims were buried without any ceremony. Fear of lightning soon developed into a search for protection against this terrifying and unfathomable natural phenomenon. Already in early history, various remedies were thought to appease or avoid the consequences of lightning.

History of the lightning research centre 1943-1982

In 1943 a lightning research centre was installed on top of Mount San Salvatore on the joint initiative of the Swiss Electro technical Association. The centre was led by Prof. Dr. h.c. Karl Berger of the Federal Institute of Technology, Zurich. Next to the little church a 70 metre timber antenna tower with a 10 metre steel top was erected. This research centre was equipped with the newest lightning measurement instruments, placing the centre among the world leaders in this field. In 1950 an antenna of the same height, made completely of steel, was erected on the "Dosso San Carlo" peak nearby. In autumn 1973 measurement work stopped, and in mid 1982 the installations were dismantled or demolished. The small building that formerly housed the installations, and is now the Museo San Salvatore, was returned to the Arciconfraternita della Buona Morte. The 80 metre antenna is now used by PTT/Swisscom for radio and TV broadcasts.

Prof. Karl Berger

Karl Berger was born on November 30, 1898 at Balgach vicarage in the St. Gall Rhine valley, Switzerland. During his schooldays, he was very keen on building generators and lighting installations. After graduating at the ETH Zurich in 1923 he spent three years with Brown Boveri in Baden near Zurich. This first professional experience in the so-called "special test facility", jokingly called the "trouble test centre", kept him in constant touch with high- tension equipment and their problems The causes of the problems were unknown at that time. It was only the fact that these problems coincided with thunderstorms that indicated the possibility of lightning as a cause for the observed damage.

Lightning research on Mount San Salvatore

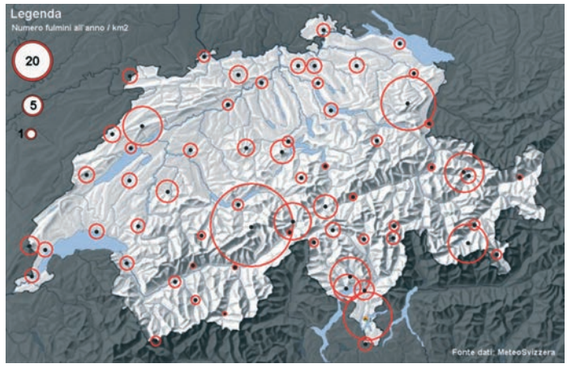
The current from direct lightning strokes are collected by two towers on mount San Salvatore and grounded via a shunt resistor. Special cables transmit the voltage signal to the oscilloscopes in the laboratory. Tower 1 is the todays Swisscom TV transmitter, and tower 2 is located further north on mount San Carlo. The measuring instruments are located inside a Faraday cage made of fine wire net, which served to protect instruments and observers.

A cathode ray oscilloscope and the exhibited mirror-galvanometer oscilloscope record the current of direct strokes to the towers. Other instruments record the negative and positive coronal discharges known as St. Elmo's fire. Thunderstorm detectors enable precise statistics to be compiled of all such activity in the vicinity of this mountain peak. Special cameras also record the chronological development of lightning flashes. Every year each of the two towers was struck by lightning up to about 100 time.

The first lightning collector tower on Mount San Salvatore, a 70 m timber mast that used to be the Berne TV transmitter.

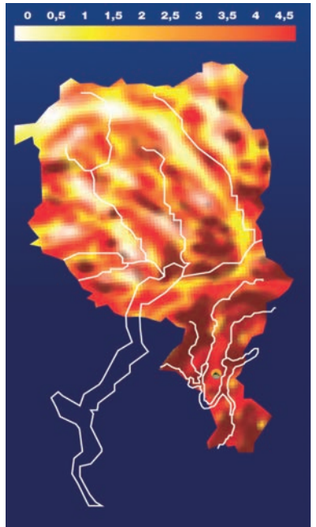
In 1950 the second 70 m lightning collector tower was erected on mount Pian San Carlo nearby.

Laboratory within the Faraday-cage we find a high speed Cathode ray oscilloscope in front and low speed mirror-galvanometer-oscilloscope in the middle. Summer 1971



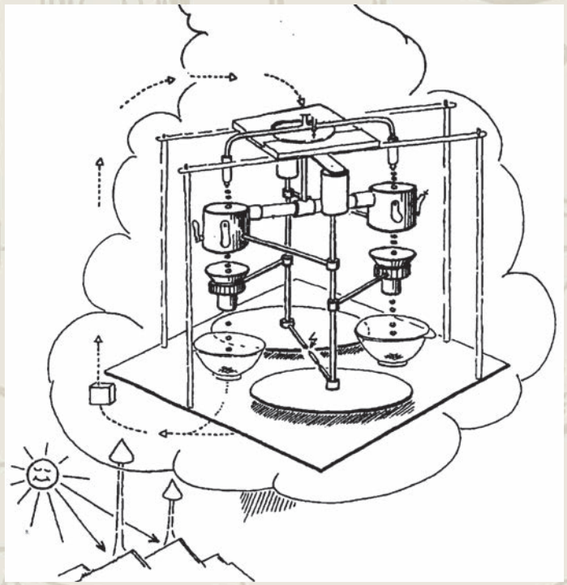
Map of Switzerland showing annual lightning densities

This map shows the mean lightning incidence per year per square kilometre as recorded by the 64 MeteoSvizzera ANETZ weather stations within 5 Km of the antenna (Nahblitze, till 5 km distance). Most lightning (in the big circles) was recorded by stations in the vicinity of mountain peaks, e.g. on Jungfraujoch, Säntis, Weissfluhjoch and Piz Corvatsch. The stations in the lower flat land record far less lightning. The comparative size of circles for stations in the Ticino with low lightning density or on the plateau shows that there is considerably more lightning in the Ticino – even at lower altitudes – than north of the Alps. The lightning density is particularly high near Lugano.



Lightning density with high resolution in the Ticino Area

Lightning density is defined as the number of strokes per year and per square kilometre. The mean lightning density in the Ticino area was recorded by Mete-Orage via MeteoCH. Clearly visible on the map is the increasing frequency near the mountain peaks and also the increased density, caused by the warmer and damper atmosphere in the south. As against the ANETZ data from 64 locations or measuring points, Mete-Orage shows the lightning stroke density over 40'000 points distributed throughout Switzerland. While the ANETZ counts the mean local lightning density over an area of about 20 km^2, the MeteOrage resolution is 1 km^2. In other words, the ANETZ cannot measure local lightning activity in 97% of Switzerland. Instead, forecasters used instead the "remote lightning detection", the results of which were not discussed here. For us humans, danger usually only comes from by cloud-to-earth lightning flashes. The much more frequent cloud-to-cloud lightning is normally harmless to us, unless we happen to be in an aircraft that is struck by lightning. But even then, we are hardly in danger compared with other risks, such as turbulence of the air. Aircraft is an excellent Faraday cage. It protects its content. The lightning density as measured by MeteOrage correspond with the ANETZ data within the limits given by the system. This is especially so, when considering the difficulties involved in precisely defining "resolution", "lightning" and "mountains". Furthermore, cloud-to-cloud lightning density is about 4 times higher than cloud-to-earth density.



Three dimensional model of a small lightning generator

This simple lightning generator (show in the museum) demonstrates how charge separation and exponential growth can cause a discharge i.e. a lightning flash. This generator was constructed by MeteoSvizzera, using metal and insulating material. Within a short time (less than 20 seconds) you will see small lightning flashes across the poles in the centre.