SNOW

Gregor Vertačnik

Introduction

Snow is a special type of precipitation and we therefore have special measurements to quantify this meteorological phenomenon. Observers at climatological and precipitation stations take daily measurements of snow depth at 7 a.m. local time. We distinguish total snow from fresh snow measurements. Fresh snow is defined as the accumulation of snow that has fallen in the last 24 hours.

The snow cover depth is usually measured on level ground overgrown with grass. The measuring site is representative of the given environment, at least partly exposed to sunshine and not too exposed to or sheltered from the wind.

A long stick with a measure in centimetres is used to measure the total snow cover depth. Measurements are taken at a few places and then averaged. The depth of the fresh snow cover is measured by a ruler on a white board, which is slightly pressed into the old snow cover 24 hours before the measurement.

Snowfall is a seasonal phenomenon for most of Slovenia, with the exception of the lowlands in the Primorska region. It is quite frequent in interior low-lying areas from late autumn to early spring, while during summer it is only present in the mountains (Figure 1).

Because snowfall is most common in winter and very rare in summer, the season for snow elements is defined as the period from July 1 to June 30.

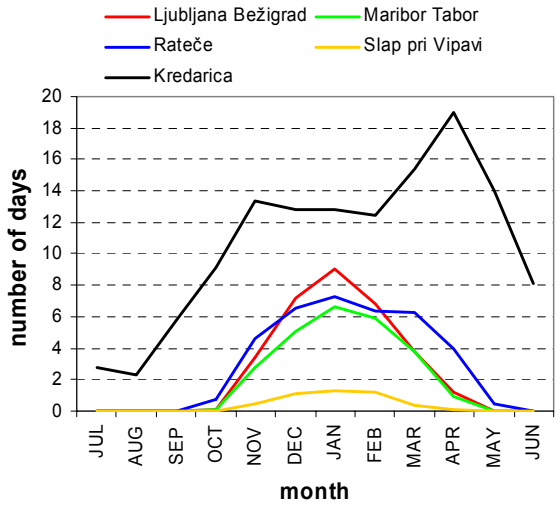

Figure 1. Average monthly number of days with snowfall 1971/1972-2000/2001

Heavy snowfall is usually connected with Mediterranean cyclogenesis. When a cyclone forms in the Gulf of Genoa, a southwesterly wind starts blowing, raising a humid air mass over the Alpine-Dinaric ridge. This often results in strong orographic precipitation in western and partly northern Slovenia. In the eastern part of the country intense snowfall sometimes occurs when humid winds blow from easterly directions.

Figure 2. Deep snow cover in the Julian Alps (Photo: Jaka Ortar)

The most devastating consequence of the huge snow amounts are avalanches. Although they are limited to very small areas in the Alps, they have caused more deaths than any other natural disaster in Slovenia.

Snow data is important for many spheres of the economy, for example in traffic, civil

engineering, tourism, agriculture etc. In traffic it is used for traffic regulation and roadway maintenance. Maximum snow loads determine the structure of constructions. Data about snow depth is very important for winter tourism in mountainous areas. Vegetation depends heavily upon the duration of snow cover and the water regime on snow accumulation and melting.

Figure 3. A snowdrift in a region with a strong bora (Photo: Marko Korošec)

Snow cover duration

Snow cover duration mostly depends on fresh snow accumulations, air temperature and sunshine. Air temperature normally decreases and the amount of fresh snow increases with an increasing altitude, which results in the longer duration of snow cover at higher altitudes. Sunshine is a more important element on the local scale. In those places more exposed to the sun the snow melts quicker and the duration is consequently shorter. On the other hand, snow cover in shady places often completely melts no earlier than in summer, especially in the mountains. Places where not all of the snow melts before the next season are called snowfields. In the course of time and if the climate is appropriate glaciers can form out of snowfields like, for example, Zeleni sneg below the top of Triglav.

The average number of days with snow cover is approximately 50 days in the interior lowlands, with a decreasing trend to the east (see the map). The duration gets longer as the altitude rises. There are around 100 days with snow covering the ground in some Alpine valleys, whereas over most of the year snow covers the highest Alpine peaks. On the contrary, in low areas west of the main Dinaric ridge snow covers the ground only a few days per season at the most.

The duration is very variable between seasons, as shown in Figure 4. Variability is relatively smaller in areas with a longer duration and more pronounced in low-lying areas.

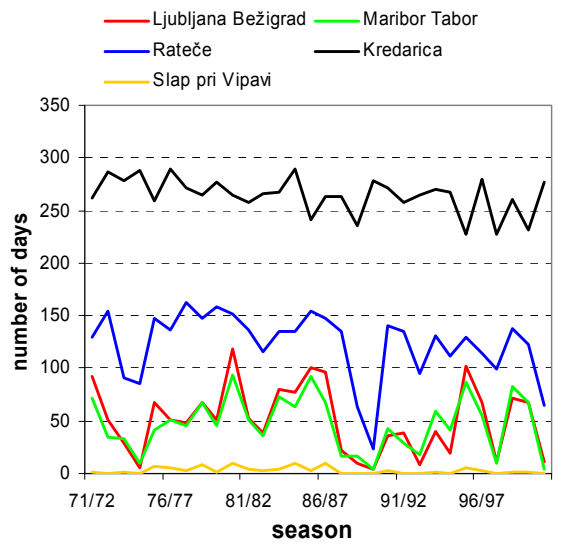

Figure 4. Snow cover duration 1971/1972–2000/2001

Fresh snow accumulation

The amount of snow that falls in a season can be described by its mass per surface unit or by the sum of fresh snow heights. Although only a rain gauge is needed to carry out measurements using the first method, it is less accurate because of the relatively large measurement errors, particularly in places exposed to the wind. For that reason we use the second method, which is more accurate but still sensitive to

wind carrying snow from one place to another.

The accumulation of fresh snow increases with altitude and precipitation so the areas of maximum fresh snow accumulation are found in the Julian Alps (see the map 'Fresh snow accumulation'). The difference in precipitation amount also explains the longer duration of snow cover in the Ljubljana valley than in the Pomurje region in the northeastern part of the country. On the contrary, huge amounts of fresh snow are rare in the upper Soča valley despite of lot of precipitation falling there in winter. Due to the influence of the Mediterranean climate, very little snow falls in the lower parts of that region.

Maximum depth of total snow cover

The seasonal maximum depth of total snow cover is another important climatic variable. Figure 5 represents a time-series in the analysed period. The relative variability is greater in areas with lower values because the snowfall in these areas is less regular than at higher altitudes.

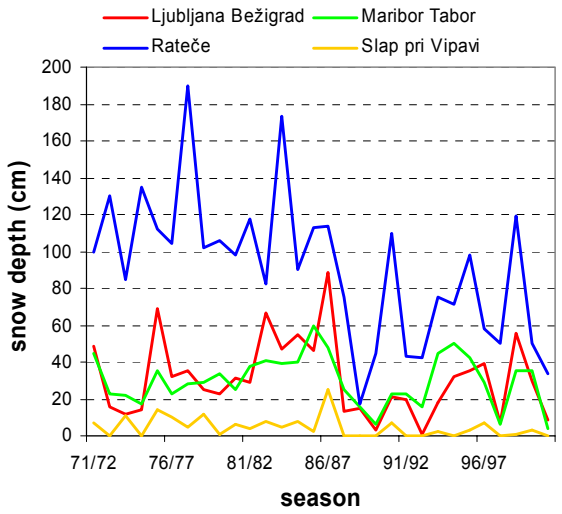

Figure 5. Maximum seasonal total snow depth 1971/1972–2000/2001

For civil engineering constructions very important information is the probability of deep and heavy snow cover, which can be calculated from the time series shown in Figure 5.

According to the map, the snow depth very rarely exceeds 50 cm in the interior lowlands east of Ljubljana. Higher values are found in the Ljubljana valley and the Koroška and Kočevje regions, where more than a metre of thick snow cover is expected a few times per century. The depth increases with altitude, reaching about 2 m at 1000 m and more than 5 metres in the highest parts of the country. At our highest station, Kredarica, 2514 m a.s.l., the maximum depth of exactly 7 m was measured in April 2001. Yet the conditions in lowlands west of the main Dinaric ridge are completely different. Snowfall there is of a short duration and frequency.

Maximum snow load

Important information for construction is an estimation of the maximum snow load in a given area. An appropriate estimation, especially in lowlands where heavy snowfall occurs infrequently, can reduce the long-term costs of building and repairing damage.

The maximum snow load with a return period of 50 years is shown on the map. The lowest values are again limited to the lower parts of the Primorska region. Slightly higher values are found in the extreme northeastern part. The lowlands in the eastern and central parts of Slovenia mostly experience maximum snow load values of 1.0-1.5 kN/m^2. The maximum snow load increases with altitude similarly as fresh and total snow and exceeds 4 kN/m^2 in the upper Sava valley and 10 kN/m^2 in the higher parts of the Alps.