

PRECIPITATION

Mojca Dolinar

The interaction of three major climate systems (Continental, Alpine and sub-Mediterranean) in the territory of Slovenia strongly influences the country's precipitation regime. The spatial variability of precipitation is high – the annual precipitation sum varies from 800 mm in the NE part of the country to more than 3500 mm in the NW part of the country, where one of the Alpine precipitation maxima is detected. The yearly sum of precipitation (Figure 1) and number of days with precipitation (Figure 2) have changed a lot over the years, the variability is even greater when the annual precipitation cycle is under observation.

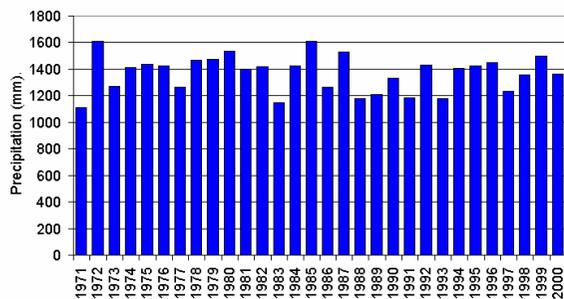


Figure 1. Annual precipitation sums in Ljubljana for the 1971-2000 period

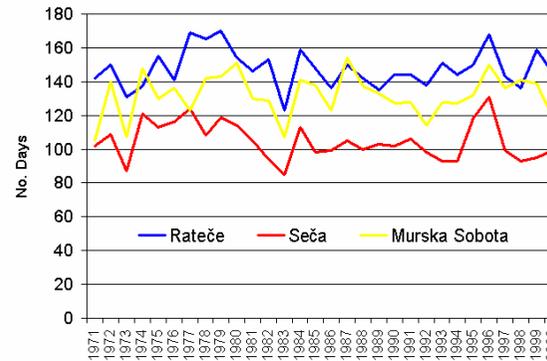


Figure 2. Yearly number of days with precipitation exceeding 0.1 mm for the 1971-2000 period for Rateče (Alpine climate), Seča (Mediterranean climate) and Murska Sobota (Continental climate).

Spatial distribution of precipitation

The spatial distribution of precipitation is highly influenced by the country's complex terrain. Due to an orographic effect the Julian Alps and the Dinaric barrier receive the highest amount of precipitation; the second maximum is recorded in the Alps above the Savinja river valley in the Kamniško-Savinjske Alps. The yearly amount of precipitation decreases with distance from the sea and the Dinaric-Alpine barrier towards the north-eastern part of the country, which is already influenced by the Continental climate. In the outmost north-eastern part of the country (Prekmurje), the

mean annual precipitation sum does not exceed 900 mm. This distribution is a consequence of the fact that the largest amount of precipitation falls during conditions of wet south-westerly winds which are perpendicular to the high Dinaric-Alpine orographical barrier.

Precipitation variability

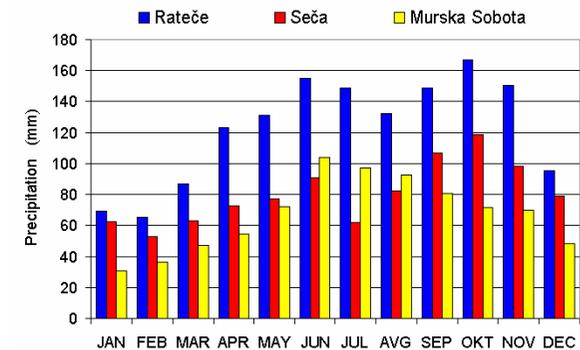


Figure 3. Monthly mean precipitation (reference period 1971-2000) for Rateče (Alpine climate), Seča (Mediterranean climate) and Murska Sobota (Continental climate).

The annual cycle of precipitation depends strongly on the major climate system that influences a specific region (Figure 3). In the Mediterranean region there are two maximums: in late spring and in autumn. In the Alpine region the most pronounced precipitation maximum is in autumn,

however, there is another maximum in late spring and early summer. Moving towards the east, where the continental influence becomes stronger, the summer maximum is the highest since in the continental climate most precipitation falls during summer's rain showers and storms.

Precipitation frequency

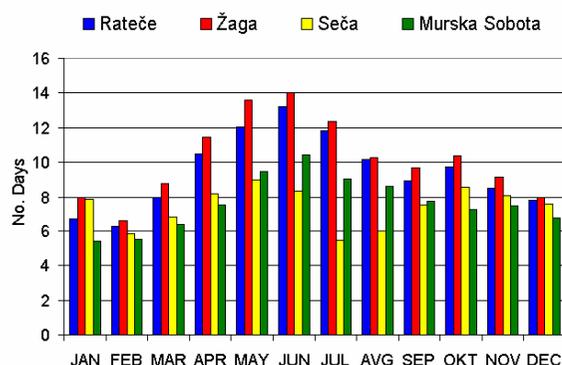


Figure 4. Number of days with precipitation exceeding 1 mm for Rateče (Alpine climate), Žaga (Alpine climate – Posočje region), Seča (Mediterranean climate) and Murska Sobota (Continental climate). (Reference period 1971-2000)

The number of days with at least 1 mm of precipitation (Figure 4) is distributed uniformly over the country and ranges between 90 days a year in the Mediterranean region and 130 days a year in the Alpine

region. It is quite the opposite to the frequency of strong precipitation (Figure 5). It is the most frequent in Posočje, the region with the maximum annual precipitation sums, where the frequency of strong precipitation exceeds 28 days per year. Strong precipitation is much less frequent in the NE region with a Continental climate influence, where the average frequency of strong precipitation is less than 18 days a year.

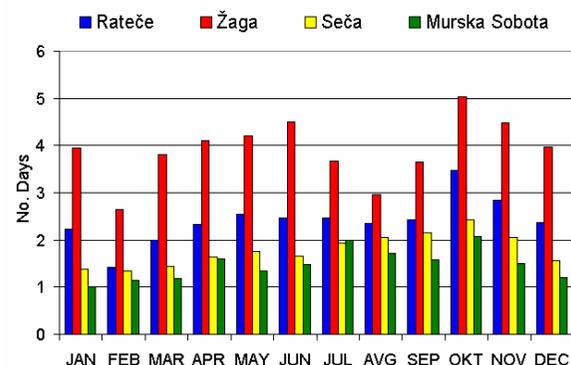


Figure 5. Number of days with precipitation exceeding 20 mm for Rateče (Alpine climate), Žaga (Alpine climate – Posočje region), Seča (Mediterranean climate) and Murska Sobota (Continental climate). (Reference period 1971-2000)

Precipitation extremes

The north-western part of the country (Posočje region) is one of the regions with the highest annual precipitation levels

in the Alps. The highest annual precipitation sum (4531 mm) was measured in 1960 in Breginj. In addition, the highest daily precipitation sums are recorded in that region – in Plužna 352.6 mm of precipitation was measured in August 1987. All over the country floods can occur during situations involving a Genova cyclone accompanied by wet southwesterlies which persist above the country for more than one day. Torrential floods are common in the warm part of the year, when very intensive showers of a short duration can appear. On such occasions rain intensities with more than 25 mm per hour are frequent all over the country.



Figure 6. After one day of heavy precipitation the Sevnica river flooded wide regions around its riverbed and caused serious damage on 21 August 2005 (Photo: Zorko Vičar)

Precipitation measurements



Figure 9. A Hellmann rain gauge at the Ljubljana meteorological station. (Photo: EARS archive)

Precipitation measurements are underestimated, especially in high and exposed mountainous regions. In Slovenia precipitation is measured with a Hellmann-type of rain gauge which underestimates precipitation, especially in weather with strong winds.

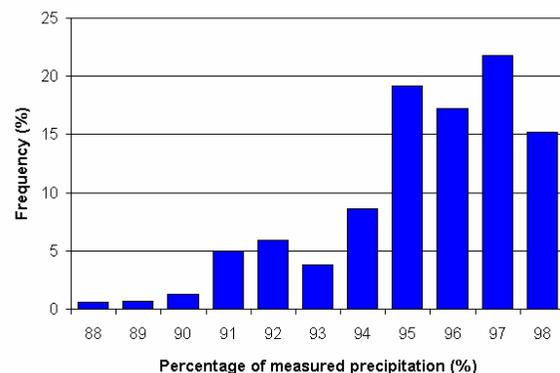


Figure 7. Distribution of the percentage of measured liquid daily precipitation according to estimated corrections due to wind, precipitation intensity and wetting.

Wind-tunnel experiments have shown that Hellmann's rain gauge in winds over 5 m/s only collects 22 % of snow and 87 % of rain. For the water balance and for other purposes precipitation measurements are corrected for systematic measuring errors, of which the largest is the wind-induced error. In the lowlands with weak winds the precipitation measurements are underestimated by up to 5%. The underestimation is a little greater in the Primorska region, with its characteristic strong Bora wind, where the estimated correction is up to 10 %. The same range of underestimation (up to 10 %) is also typical of higher exposed regions. At the highest measuring station of Kredarica (2514 m),

where strong winds and solid precipitation are frequent, on a yearly basis only 54 % of the precipitation is measured.

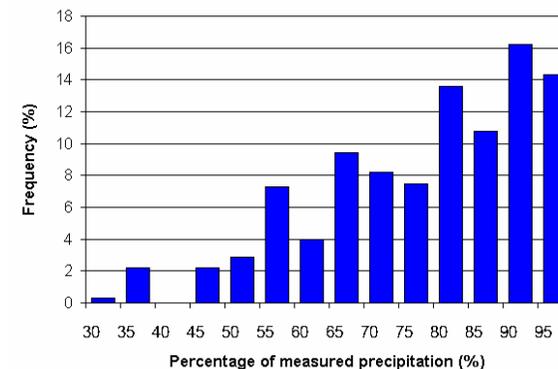


Figure 8. Distribution of the percentage of measured solid daily precipitation according to estimated corrections due to wind, precipitation intensity and wetting.