3 Vplivni dejavniki na vodno bilanco
Water Balance Impact Factors

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Kroženje vode poteka po vsej Zemlji, v tleh, na površju in v ozračju. Na to kroženje vplivajo najrazličnejši dejavniki, tako naravni kot družbeni. Sistem je vedno v gibanju, součinkovanju in odvisnosti.

3.1 Lega in relief

Slovenija leži na severni polobli, v geografskih širinah, ki so pod vplivom polarne fronte, kar vse neposredno vpliva na podnebje in s tem na osnovne elemente vodne bilance – padavine, izhlapevanje in odtok. Zaradi vpliva, ki ga ima relief na podnebje in neposredno na hidrološke razmere, je pomembna tudi lega na stičišču štirih velikih evropskih reliefnih enot: Alp, Dinarskega gorovja, Panonske kotline in kotanje Jadranskega morja (slika 10).

Povprečna nadmorska višina Slovenije je 557 m. Severozahodni del države – Julijske Alpe – je po nadmorski višini najvišji, s povprečno nadmorsko višino 1108 m. Na drugi strani je, s povprečno nadmorsko višino 161 m, najnižja pokrajina Krška ravan. Od štirih reliefnih enot ima alpski svet najvišjo povprečno nadmorsko višino 732 m, povprečna nadmorska višina dinarskega sveta je 580 m, sredozemskega 352 m in panonskega 261 m.

V Sloveniji je le 7 % površja nižjega od 200 m nad morjem. Največji del ima višinski pas med 200 m in 500 m, ki zavzema kar 45 % površine Slovenije; od tega je 18 % ozemlja v stometrskem pasu med 200 in 300 m, 15 % v pasu 300–400 m ter 12 % v pasu med 400–500 m. 36 % površja je visokega med 500 in 1000 m, 9 % Slovenije je višje od 1000 m in nižje od 1500 m. Slabe 3 % ozemlja je višjega od 1500 m.

Nadmorska višina vpliva med drugim tudi na oblikovanje višinskih meja. Snežna meja je približno na nadmorski višini 2700 m, zgornja gozdna meja je v Julijskih Alpah med 1600 in 1700 m, v Kamniško Savinjskih Alpah med

The circulation of water takes place across the entire Earth; under the ground, on the surface and in the atmosphere. This circulation is affected by various factors, both natural and social. The system is continuously in motion, interaction and interdependence.

3.1 Location and Relief

Slovenia lies in the northern hemisphere and in the geographical latitude that is still under the influence of the polar front. The climate and, consequently, the basic elements of the water balance – precipitation, evaporation and runoff are a reflection of this fact. An important fact is also the location of Slovenia at the junction of four European relief units – the Alps, the Dinaric Alps, the Pannonian Basin and the Adriatic Sea basin (Figure 10).

The average elevation of Slovenia is 557 m. The north-western part of the country – the Julian Alps – is the highest in terms of elevation, with an average elevation of 1108 m. The Krško-Brežice Basin, on the other hand, is the lowest-lying region with an average height of 161 m above sea level. Of the four relief units, the Alpine area has the greatest average elevation of 732 m, while the average height of the Dinaric area is 580 m above sea level, that of the Mediterranean is 352 m and that of the Pannonian is 261 m.

Only 7% of the surface of Slovenia lies below 200 m above sea level. The altitude band between 200 m and 500 m is the largest, covering as much as 45% of the surface area of Slovenia; of which 18% of the territory lies in the 100-metre band between 200 and 300 m, 15% in the 300–400 m band and 12% in the 400–500 m belt. 36% of the surface area is between 500 and 1000 m high and 9% of Slovenia lies between than 1000 m and 1500 m. Somewhat over 3% of the territory is higher than 1500 m.

MOJCA NOČ RAZINGER – SOKOL

Slika 8: *Soline*

Figure 8: *The salt works*

1700 in 1800 m, v Karavankah med 1800 in 1900 m, najnižja gozdna meja je na Snežniku, nekaj nad 1500 m.

V tesni povezavi z nadmorsko višino je naklon površja. Z večjo nadmorsko višino je praviloma večji tudi naklon. V Sloveniji je povprečni naklon 13°. Povprečni naklon alpskega sveta je dobrih 18°, dinarskega dobrih 11°, sredozemskega slabih 10° in panonskega sveta dobrih 6°. Julijske Alpe (v alpskem svetu) so najbolj strma pokrajina v Sloveniji z naklonom 26°, najbolj ravna pa je Murska ravan (v panonskem svetu) z naklonom manj kot 1°.

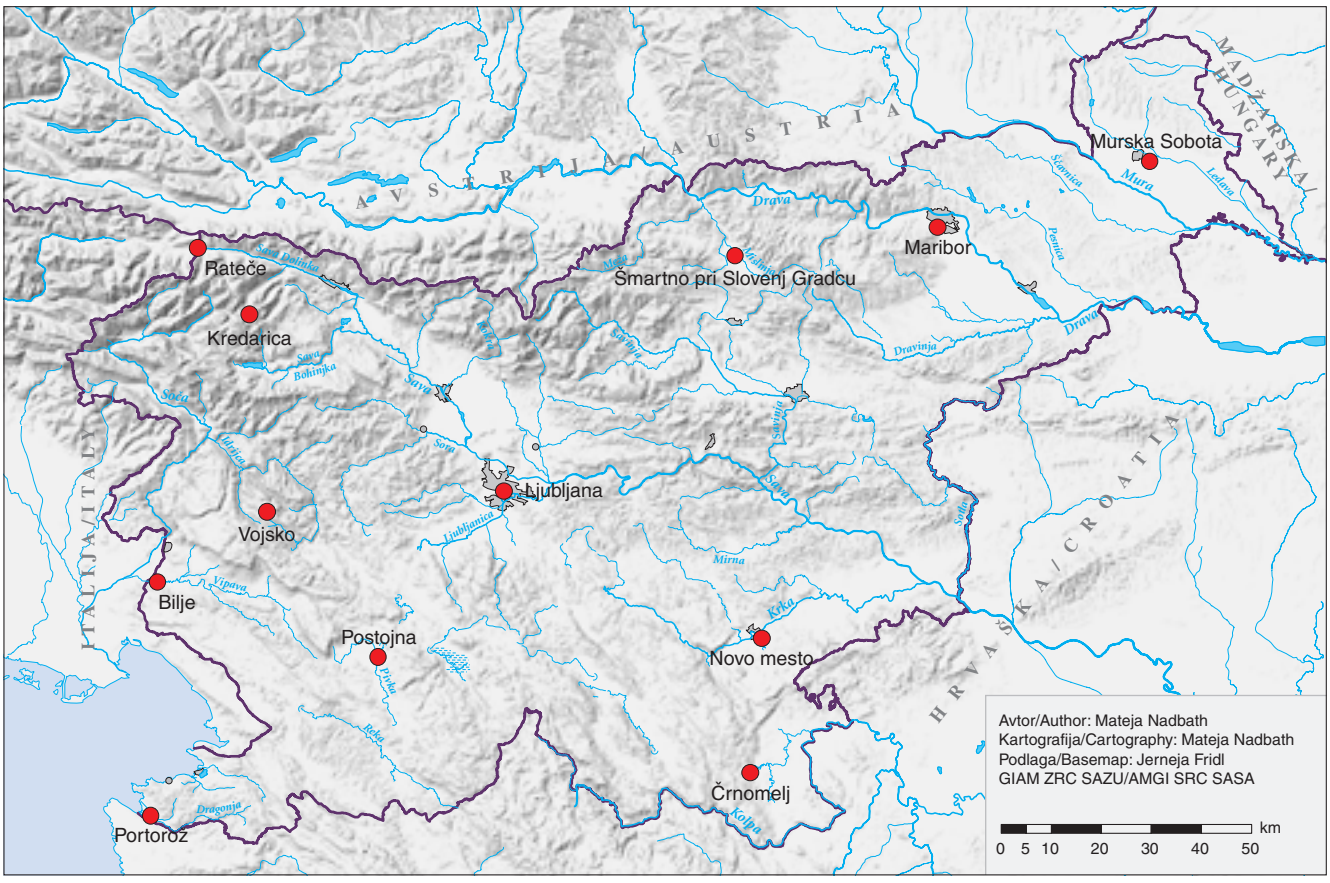
The elevation, among other things, affects the formation of elevation boundaries. The snow line lies approximately at 2700 m, with the upper tree line in the Julian Alps being between 1600 and 1700 m, in the Kamniško-Savinjske Alps between 1700 and 1800 m and in the Karavanke Mountains between 1800 and 1900 m. The lowest tree line is on Mount Snežnik at somewhat over 1500 m.

The slope is closely connected to the elevation. The average slope in Slovenia is 13°. The average slope of the Alpine area is a good 18°, while that of the Dinaric area is a good 11°, that of the Mediterranean area is somewhat over 10° and that of the Pannonian area is a good 6°. The Julian Alps (in the Alpine area) is the steepest region in Slovenia, with a slope of 26°, and the most level is the Murska ravan plain (in the Pannonian area) with a slope of less than 1°.

The Alps extend into Slovenia from the north and the north-west. This is the high-mountain area of the Julian Alps, the Kamniško-Savinjske Alps and the Karavanke Mountains. The larger river valleys are those of the Soča, Sava Dolinka and Sava Bohinjka, Kokra, Kamniška Bistrica and Savinja rivers. The high-mountain area is enclosed by a belt of hills and basins. The larger valleys of this area are those of the Poljanska and Selška Sora, Sava, Savinja, Meža and Drava rivers. The Alpine area is characterised by high precipitation because

Slika 9: *Relief Slovenije, vodotoki in izbrane meteorološke postaje*

Figure 9: *Relief of Slovenia, streams and selected meteorological stations*



Tipi pokrajin *Landscape type*	Površina (km²) *Surface area*	Površina (%) *Surface area*	Povprečna n. v. (m) *Average elevation*	Povprečni naklon (°) *Average slope*
Alpska visokogorja *High Alpine mountains*	3062	15,1	1054,5	24,6
Alpska hribovja *Alpine hills*	4660	23,0	582,5	16,9
Alpske ravnine *Alpine plains*	819	4,0	373,4	3,9
Alpski svet ***Alpine area***	**8541**	**42,1**	**731,6**	**18,4**
Panonska gričevja *Panonnian hills*	2993	14,8	288,7	8,8
Panonske ravnine *Panonnian plains*	1296	6,4	196,0	0,8
Panonski svet ***Panonnian area***	**4291**	**21,2**	**260,7**	**6,4**
Dinarske planote *Dinaric plateaus*	3810	18,8	667,6	13,7
Dinarska podolja in ravniki *Dinaric planated lowlands and plains*	1896	9,4	403,2	6,6
Dinarski svet ***Dinaric area***	**5706**	**28,1**	**579,8**	**11,4**
Sredozemska flišna brda *Mediterranean flysch hills*	1061	5,2	305,9	11,1
Sredozemske kraške planote *Mediterranean karstic plateaus*	673	3,3	425,8	7,7
Sredozemski svet ***Mediterranean area***	**1734**	**8,6**	**352,4**	**9,8**
Slovenija ***Slovenia***	**20.272**	**100,0**	**556,8**	**13,1**

Preglednica 1: *Glavni pokrajinski tipi Slovenije (vir: Perko et al., 1998)*

Table 1: *The main landscape types of Slovenia (Source: Perko et al., 1998)*

Alpe segajo v Slovenijo s severa in severozahoda. To je visokogorski svet Julijskih Alp, Kamniško-Savinjskih Alp in Karavank. Večje rečne doline so doline rek Soče, Save Dolinke in Save Bohinjke, Kokre, Kamniške Bistrice in Savinje. Visokogorski svet obroblja pas hribovja in kotlin. Tu so večje rečne doline Poljanske in Selške Sore, Save, Savinje, Meže in Drave. Za alpski svet so značilne visoke količine padavin zaradi izpostavljenosti jugozahodnim vetrovom, orografskih dviganj, hitri odtoki zaradi velikih naklonov in majhno izhlapevanje zaradi temperaturnega vpliva višine (nižje povprečne temperature v večjih nadmorskih višinah).

Dinarsko gorovje je na jugu Slovenije. Večina sveta je kraškega, izmenjujejo se kraške planote in podolja ter ravniki; rečno omrežje je omejeno na kraške ponikalnice z izjemo dolin Idrijce, Krke in Kolpe. Kras ima vlogo kratkočasnega zadrževanja vode, zato so tudi značilnosti pretokov kraških rek prav posebne.

Svet odprt proti Jadranskemu morju je na jugozahodu države, to je mediteranski del Slovenije. Flišna brda se izmenjujejo z dolinami ter nizkimi kraškimi planotami s podolji. Tu so večje doline rek Reke, Vipave, Soče, Dragonje in Rižane.

of its exposure to south-westerly winds of the orographic lifts, rapid runoffs owing to sharp slopes and very low evaporation because of the temperature effect of the altitude (lower average temperature at higher altitudes).

The Dinaric Alps lie in the south of Slovenia. The majority of this region is karstic, with alternating karstic plateaus, planated lowlands and plains. The river network is limited to karstic disappearing streams with the exceptions of the valleys of the Idrijca, Krka and Kolpa rivers. The Karst has the role of a short-term water retention area, and therefore the characteristics of the discharges of the karstic rivers are distinctly special.

The world that opens up towards the Adriatic Sea lies in the south-west of the country and forms the Mediterranean part of Slovenia. The flysch hills alternate with valleys and low karstic plateaus with planated lowlands. The area has larger valleys of the Reka, Vipava, Soča, Dragonja and Rižana rivers.

The Pannonian part lies in the east and north-east of the country. Plains and hills prevail in this area and the river network is branched, with the larger rivers being the Mura,

Na vzhodu in severovzhodu države je njen panonski del. Prevladujejo ravnine in griči, rečno omrežje je razvejano, večje reke so Mura, Drava in Sava. Zaradi večje oddaljenosti od morja in manj izrazitega ter nižjega reliefa je tu manj padavin in več izhlapevanja.

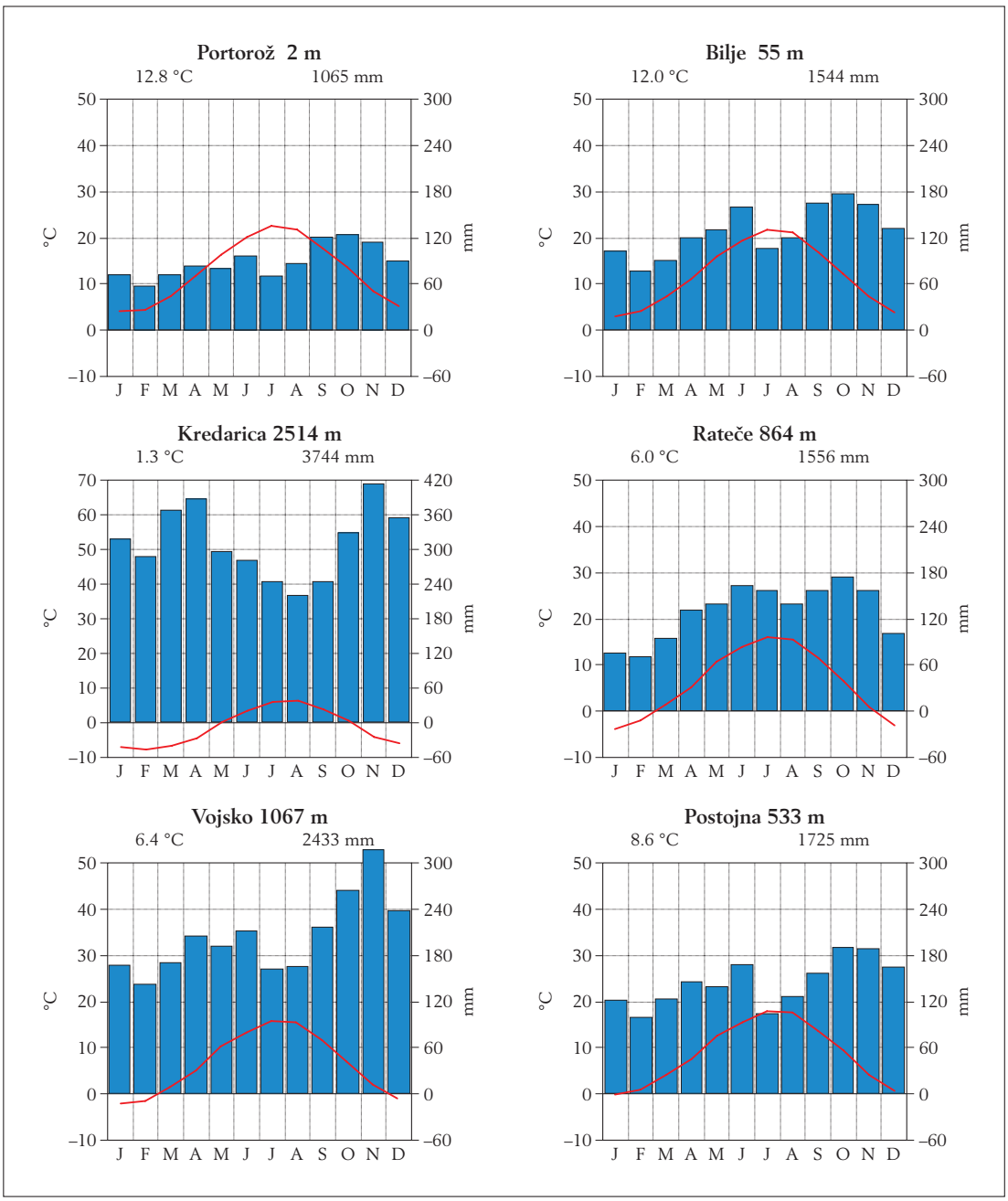
3.2 Podnebje

Podnebje je najpomembnejši dejavnik, ki vpliva na vodni krog katere koli regije. Na značilnosti podnebja v Sloveniji vpliva lega države v zmerno toplem pasu, bližina Sredozemlja in Evrazijske celine ter reliefna razčlenjenost. Delimo ga na submediteransko, zmerno celinsko in gorsko podnebje. Submediteransko podnebje je v jugozahodnem delu države; najbolj

Drava and Sava. Because of this area's greater remoteness from the sea and its less pronounced and lower relief, the area has less precipitation and more evaporation.

3.2 The Climate

Climate is the most important factor in the water cycle of any region. The characteristics of the climate in Slovenia are affected by the country's position in the temperate zone, the proximity of the Mediterranean and the Eurasian continent and the diversity of the relief. We have divided it into the sub-mediterranean, temperate continental and mountain climates. The sub-mediterranean climate is in the south-western part of the country; it is most pronounced



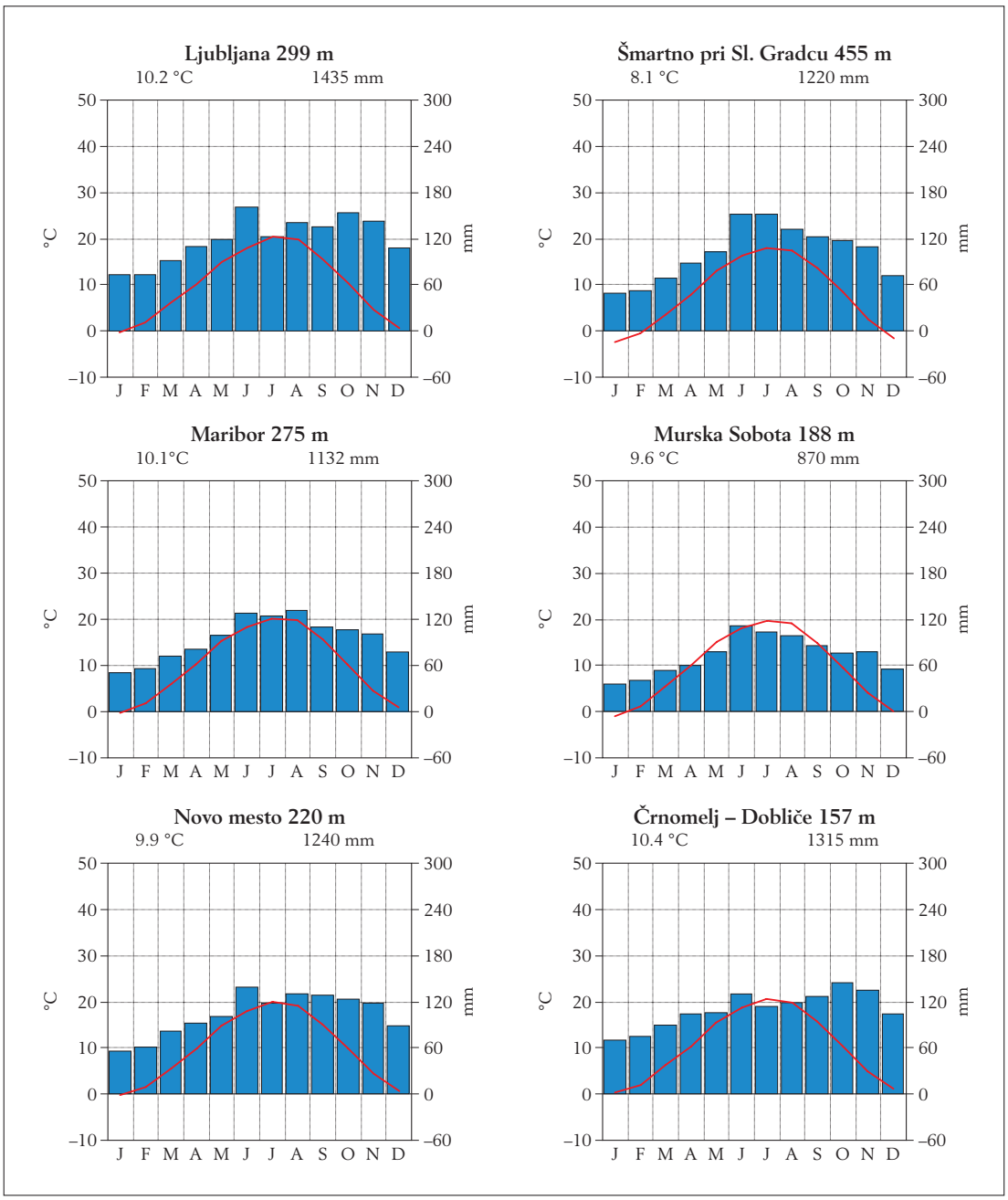
Slika 10: *Povprečna mesečna temperatura zraka (rdeča krivulja) in višina padavin (modri stolpci) v obdobju 1971–2000 na izbranih meteoroloških postajah v zahodni Sloveniji*

Figure 10: *The average monthly air temperature (red curve) and the amount of precipitation (blue columns) in the 1971–2000 period at selected meteorological stations in western Slovenia*

izrazito je v obalnem delu, njegovi vplivi se poznajo daleč v zaledju po dolini Soče. Gorsko podnebje je v Julijskih Alpah, Kamniško-Savinjskih Alpah, Karavankah in na Snežniku. Vplivi gorskega podnebja segajo še po alpskih dolinah in visokih dinarskih planotah. Na severovzhodu in vzhodu države prevladujejo značilnosti zmerno celinskega podnebja. Mediteransko zmerno celinsko podnebje, z vplivi in prehodi že naštetih, je značilno za večino Slovenije.

Temperatura zraka ima največji vpliv na izhlapevanje in tudi neposredno na odtoke, ko so negativne temperature vzrok za zadržek padavin v trdni obliki. V Sloveniji se temperatura zraka prostorsko in časovno zelo spreminja. V povprečju je najtoplejši mesec v letu julij in najhladnejši januar, z izjemo visokogorja, kjer je najhladnejši februar, avgust pa najtoplejši. Najin the coastal area, though its effects are felt deep into the interior of the country along the valley of the Soča River. The mountain climate is characteristic in the Julian Alps, the Kamniško-Savinjske Alps, the Karavanke Mountains and Mount Snežnik. The effects of the mountain climate extend to the Alpine valleys and the high Dinaric plateaus. In the north-east and east of the country the characteristics of temperate continental climate prevail. The temperate mediteranean continental climate with influence of all mentioned types is characteristic of Slovenia.

Air temperature has the strongest effect on evaporation and, indirectly, on discharges when temperature below freezing causes the retention of precipitation in solid form. Air temperature changes significantly in Slovenia, both spatially and temporally. The warmest month on average



Slika 11: *Povprečna mesečna temperatura zraka (rdeča krivulja) in višina padavin (modri stolpci) v obdobju 1971–2000 na izbranih meteoroloških postajah v vzhodni Sloveniji*

Figure 11: *The average monthly air temperature (red curve) and the amount of precipitation (blue columns) in the 1971–2000 period at selected meteorological stations in eastern Slovenia*

večja dnevna in letna temperaturna nihanja so v severovzhodni Sloveniji, kjer je močan vpliv celinskega podnebja (Murska Sobota), najmanjša pa v gorah, kjer so razmere že podobne prosti atmosferi, in na obali (Portorož), kjer nihanja blaži vpliv morja. V kotlinah in dolinah v notranjosti Slovenije je v hladni polovici leta pogost temperaturni obrat, ki lahko vztraja tudi več dni.

Najtopleje je na jugozahodu Slovenije, ob obali. Tu je povprečna letna temperatura zraka v obdobju 1971–2000 nad 12 °C (Portorož, Bilje). Najhladneje je v visokogorju (Kredarica) s srednjimi letnimi temperaturami okrog ledišča in v gorskih dolinah (Rateče, Šmartno pri Slovenj Gradcu) ter na visokih dinarskih planotah (Vojsko), kjer je povprečna letna temperatura zraka pod 8 °C. V večjem delu Slovenije je povprečna letna temperatura zraka okrog 10 °C.

Padavin je v Sloveniji največ na alpsko-dinarski pregradi (Kredarica 3200 mm, Vojsko, Postojna), količina se z oddaljevanjem od te proti severovzhodu in jugozahodu znižuje. Več kot 1500 mm padavin pade letno v zahodnem delu notranje Slovenije. Letno pade običajno najmanj padavin na skrajnem severovzhodu države (Murska Sobota), v povprečju pod 900 mm na leto. Ob obali pade na leto v povprečju okrog 1100 mm padavin (Portorož). Območja z vplivom submediteranskega podnebja dobijo največ padavin v jesenskih mesecih (Portorož, Bilje, Kredarica, Vojsko, Postojna), medtem imajo območja z izrazitejšim celinskim podnebjem največ padavin poleti (Šmartno pri Slovenj Gradcu, Murska Sobota, Maribor).

Snežna odeja je v Sloveniji, z izjemo Obale, običajen pojav. V pozno jesenskih mesecih z zadrževanjem padavin v obliki snega po visokogorju blaži pretočne konice, v manj vodnatem obdobju pa napaja vodotoke s snežnico. Snežna odeja je zelo odvisna od temperature, kate-

Slika 12: *Sneg v Ravenski kočni*

Figure 12: *Snow in Ravenska kočna*

MATEJ OGRIN

is July and the coldest is January, with the exception of the high mountains where the coldest month is February and warmest is August. The greatest daily and annual temperature fluctuations occur in north-eastern Slovenia, where they experience the strong effect of the continental climate (Murska Sobota). The smallest fluctuations occur in the mountains where the conditions already resemble the free atmosphere and on the coast (Portorož), where the fluctuations are mitigated by the effect of the sea. In the basins and valleys in the interior of Slovenia, the cold part of the year often brings an atmospheric inversion that can persist for days.

The warmest climate is found in the south-west of Slovenia, on the coast. In the 1971–2000 period, the average annual air temperature here exceeded 12 °C (Portorož, Bilje). The coolest climate is found in the high mountains (Kredarica), with mean annual temperature being around freezing point, in the mountain valleys (Rateče, Šmartno pri Slovenj Gradcu) and on the high Dinaric plateaus (Vojsko) where the average annual air temperature of both is under 8 °C. The average annual air temperature across the major part of Slovenia is around 10 °C.

The most **precipitation** in Slovenia occurs in the Alpine-Dinaric barrier (Kredarica with 3200 mm, Vojsko and Postojna) and the quantities diminish as we move away towards the north-east and south-west. There is more than 1500 mm of precipitation annually in the western part of the Slovenian interior. Usually, the least annual precipitation occurs in the north-eastern-most part of the country (Murska Sobota) – on average below 900 mm per year. On the coast, there is an average of around 1100 mm of precipitation (Portorož). The areas affected by the sub-mediterranean climate receive the most precipitation in the autumn months (Portorož, Bilje, Kredarica, Vojsko and Postojna), while areas with a more pronounced continental climate receive the most precipitation in the summer (Šmartno pri Slovenj Gradcu, Murska Sobota and Maribor).

With the exception of the coast, **snow cover** in Slovenia is a regular phenomenon. In the late autumn months, when precipitation accumulates in the form of snow in the high mountains, it mitigates the discharge peaks. Then, in periods with smaller discharges, it feeds the streams with snow melt. Snow cover is highly dependent on the temperature, whose trends have been positive in the recent period. Consequently this affects the discharge regimes whose autumn peak becomes more prominent (Frantar et al., 2005). Snow can persist in the mountains throughout the year, while in the lower regions it is limited to the winter. On average, the ear-

ALENKA MIHORIČ – SOKOL

Slika 13: *Črna barjanska zemlja*

Figure 13: *Black moor soil*

re trendi so v zadnjem obdobju pozitivni, kar ima posledično vpliv na pretočne režime, pri katerih je jesenski višek izrazitejši (Frantar et al., 2005). V gorah lahko sneži tekom celega leta, v nižjih legah pa je sneženje omejeno na zimo. V povprečju je po nižinah prvi mesec, ko se že lahko pojavi snežna odeja, oktober, zadnji pa maj. V dolgoletnem povprečju je na obali letno manj kot 5 dni s snežno odejo, v hribovitem delu jugozahodne in zahodne Slovenije več kot 60, v gorah pa več kot 100 dni. Osrednji del Slovenije ima 40–60 dni s snežno odejo, severovzhodna Slovenija, Krško-Brežiško polje in Bela krajina pa od 20 do 40 dni.

Trajanje sončnega obsevanja najbolj vpliva na izhlapevanje. V Sloveniji v dolgoletnem povprečju (1971–2000) sije sonce nekaj več kot pet ur na dan, izjema je Primorska, kjer sonce sije v povprečju šest ur in pol na dan kar znese čez 2400 ur na leto. V notranjosti države imamo pod 2000 sončnih ur na leto. Razlike v vrednostih med kraji niso velike, so pa posledica oblačnosti in megle. Večje razlike v osončenosti so po letnih časih. Jeseni in pozimi so dobro osončene gore, medtem ko so poleti in spomladi bolj od gora osončene nižje lege. Primorska je čez celo leto najbolj osončen del države. Velik vpliv na osončenost ima ekspozicija površja – južna pobočja so bolj osončena od severnih.

Vetrovi z zračnimi masami prenašajo vlago. Zelo lahko povečajo izhlapevanje, kar je potrebno upoštevati tako pri izračunu izhlapevanja po Sloveniji kot tudi pri korigiranju merjenih padaliest month when snow cover can occur in the lowlands is October and the latest is May. In the 1971–2000 reference period, there are less than 5 days with snow cover on the coast, more than 60 in the hilly part of south-western and western Slovenia and more than 100 days in the mountains. In the central part of Slovenia there are 40–60 days of snow cover, and in north-eastern Slovenia, the Krško-Brežice Basin and Bela krajina (White Carniola) from 20 to 40 days.

The **bright sunshine duration** affects evaporation most of all. In the reference period (1971–2000) in Slovenia, the sun shone somewhat more than five hours a day on average; with the exception of Primorska (the coastal region), where the sun shone six and half hours a day on average, totalling more than 2400 hours a year. The country's interior has less than 2000 hours of sunshine duration per year. The differences in value between the locations are not great and are the result of cloudiness and fog. Greater differences in insolation can be observed through the seasons. In the autumn and winter, the mountains are well-insolated, while in the spring and summer the lower regions get more insolation than the mountains. The Primorska region (the coast) is the most insolated region in the country throughout the year. The exposure of the surface has the greatest effect on the rate of insolation, so the southern slopes receive more insolation than the northern ones.

The winds transfer moisture with air masses. This can significantly increase evaporation, which is taken into account in the calculation of evaporation as well as in the correction of measured precipitation which is underestimated due to the wind. Winds are predominantly weak in Slovenia. The average annual speed in the lowlands rarely exceeds 2 m/s. We do have strong winds as well: the bora, the southerly and south-westerly wind and the Karavanke föhn as well as winds during storms.

3.3 Rocks and Soils

Because of their porosity, rocks slow the water discharge to a greater or lesser extent and affect the vegetation. Carbonate rocks prevail in Slovenia and, because of this, the majority of the territory is karstic – approximately 43% (Gams, 1974). The Alpine and Dinaric area is made up of primarily limestone and dolomite massifs. Valleys have formed at tectonic faults and these are filled with tertiary sediments. The basins of tectonic origin, such as the Ljubljana and Celje basins and the Krško-Brežice Basin, are covered with glacial and alluvial deposits. The Pannonian area is formed to a lesser extent by

vin, ki so zaradi vetra podcenjene. V Sloveniji so vetrovi večinoma šibki. Po nižinah povprečna letna hitrost redko preseže 2 m/s. Seveda pa imamo tudi močne vetrove: burjo, jugo in karavanški fen ter vetrove ob neurjih.

3.3 Kamnine in prsti

Kamnine zaradi vodoprepustnosti bolj ali manj upočasnijo odtok in vplivajo na rastje. V Sloveniji prevladujejo karbonatne kamnine, zaradi česar je približno 43 % ozemlja kraškega (Gams, 1974). Alpski in dinarski svet sestavljajo predvsem apnenčevi in dolomitni masivi. Ob tektonskih prelomih so nastale doline, ki so zapolnjene s terciarnimi sedimenti. Kotline tektonskega nastanka, Ljubljanska in Celjska kotlina ter Brežiško-Krško polje, so pokrite z ledeniškimi in rečnimi nanosi. Panonski svet v manjši meri tvorijo metamorfne in magmatske kamnine, prevladujejo pa terciarne sedimentne kamnine. Tudi ob Dravi in Muri so široke doline prekrite s prodom.

Velik pomen za vodo ima prepustnost kamnin. Geološke enote, ki lahko prevajajo in akumulirajo podzemno vodo so vodonosniki z medzrnsko, razpoklinsko, kraško in mešano poroznostjo. Gradijo veliko večino površja Slovenije. Nepropustne kamnine predstavljajo zgolj 4,4 % površja Slovenije.

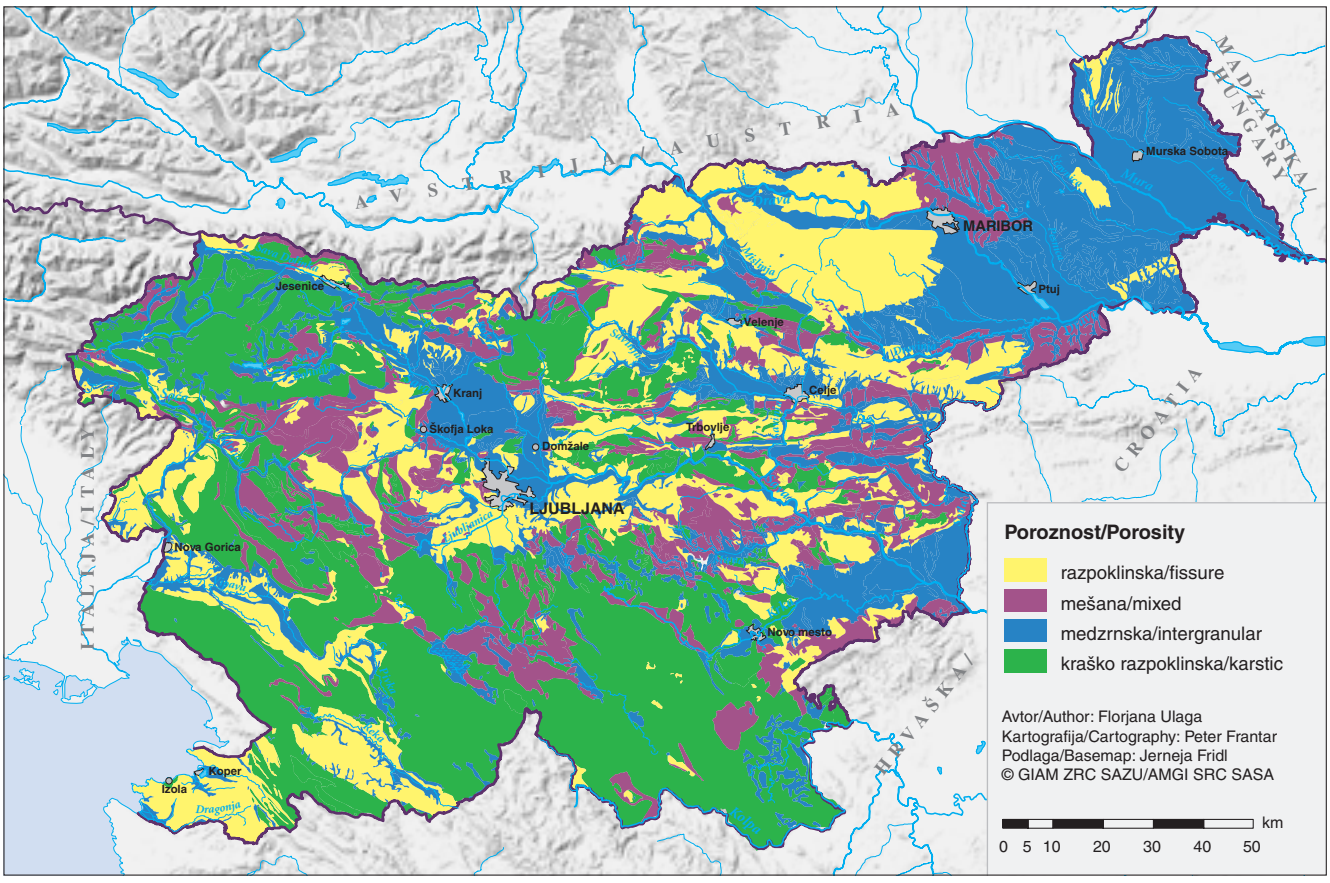
metamorphic and magmatic rocks, with the tertiary sediment rocks prevailing. Along the Drava and Mura rivers there are also wide valleys covered with gravel.

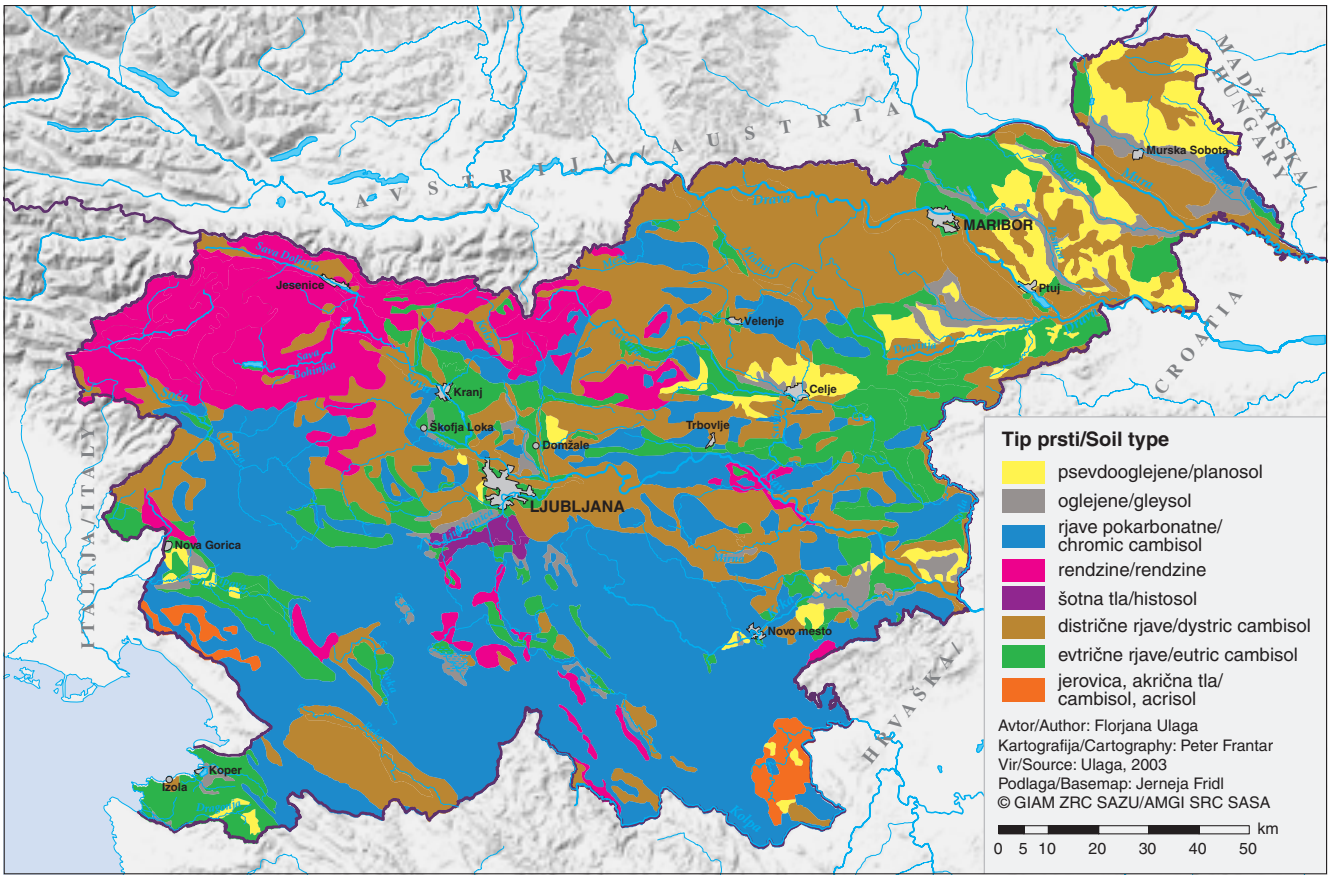
The porosity of rocks is of great importance to water. The geological entities that can transmit and accumulate groundwater are aquifers with intergranular, fissured, karstic and mixed porosity. They make up the majority of the surface of Slovenia. Impermeable rocks represent merely 4.4% of the surface.

The soils are strongly linked to the types of rocks as the distribution of the various groups and types is determined by the bedrock and the relief. Rendzine soils and eutric cambisol have developed on the carbonate deposits in the Ljubljana and Celje basins and on the Krško-Brežice Basin. The eutric cambisol also appear in the lower-lying parts of the Mediterranean area. In the Pannonian area, the Mura and Drava rivers have deposited a lot of non-carbonate gravel and here dystric cambisol have developed. Smaller streams across Slovenia, with less power to transfer rock material, have deposited fine-grained deposits, on which gleysol and planosol have developed. On higher parts of the relief – in the hills and mountains of the Alpine and Dinaric area, which is predominantly made up of limestone and dolomite – litosols, rendzines and chromic cambisol have developed. These are the most widespread in Slovenia.

Slika 14: *Hidrogeološke enote Slovenije*

Figure 14: *The hydrogeological units of Slovenia*





Slika 15:
Prsti Slovenije

Figure 15:
The soils of Slovenia

Prsti so močno navezane na tip kamnine, saj o razširjenosti različnih skupin in tipov odločata matična podlaga in relief. Tako so na karbonatnih nanosih v Ljubljanski in Celjski kotlini ter Krško-Brežiškem polju nastale rendzine in evtrične rjave prsti. Slednje se pojavljajo tudi v nižinskih predelih sredozemskega sveta. V panonskem svetu sta Mura in Drava nanesli veliko nekarbonatnega proda, na katerem so nastale distrične rjave prsti. Manjši vodotoki, ki imajo manjšo moč prenašanja kamninskega gradiva, so odložili drobno zrnate nanose, na katerih so po vsej Sloveniji nastale obrečne, oglejene in psevdooglejene prsti. Na vzpetih delih reliefa, v hribovjih in gorovjih alpskega in dinarskega sveta, ki ga sestavljata pretežno apnenec in dolomit, pa so nastali litosoli, rendzine in rjave pokarbonatne prsti. Te so v Sloveniji najbolj razširjene. Manjša območja prekrivajo še jerovica, ki je nastala na Krasu, slabo rodovitna akrična tla v Beli krajini in na glinastih usedlinah nastala šotna tla na Ljubljanskem barju ter delno na Pohorju, Jelovici in Pokljuki (Lovrenčak, 1998).

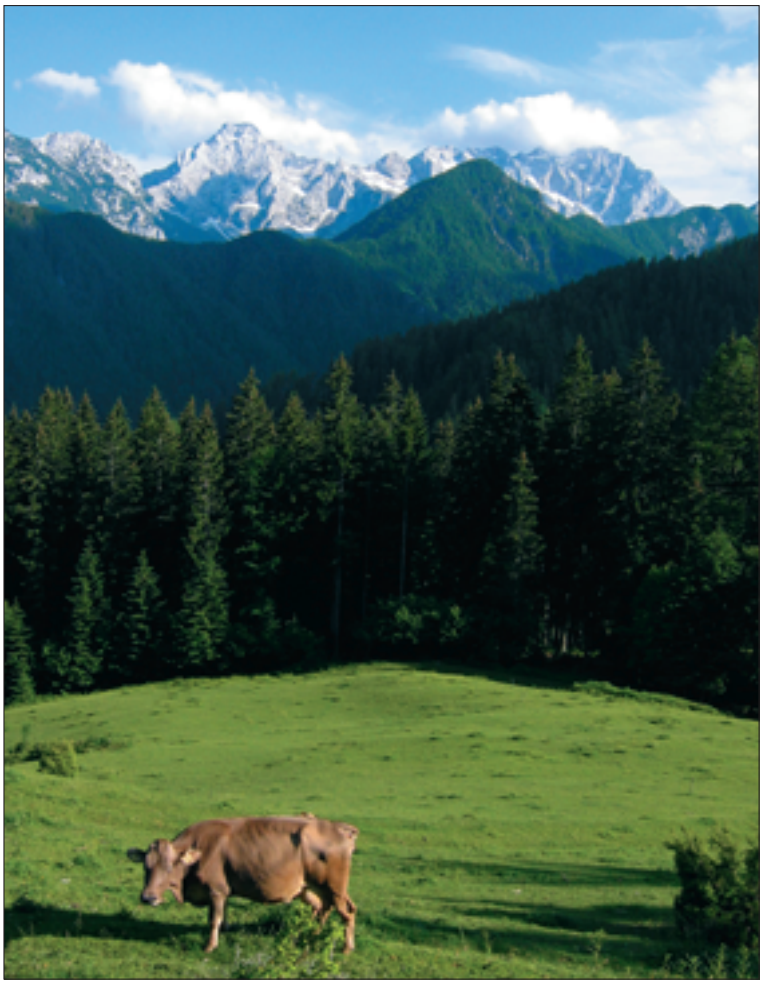
Prst zadržuje vodo – koliko in kako dolgo je odvisno od tipa in debeline. Iz peščenih prsti voda odteče hitro, že v enem dnevu, iz glinastih pa v dveh do treh dnevih.

Posebej pomembna je infiltracijska kapaciteta tal. Izraža stopnjo pronicanja vode skozi prst in je odvisna od številnih dejavnikov. Infiltracij-

Smaller areas are also covered by Terra Rossa that formed on the Karst, infertile acric soil in Bela krajina and the peat soil formed on clay deposits on the Ljubljana Marshes, partially Pohorje, Jelovica and Pokljuka (Lovrenčak, 1998).

Soil retains water – how much and for how long depends on its type and thickness. Water runs off sandy soil quickly, within a day, while it takes two to three days to run off clay soil.

The infiltration capacity of the ground is especially important. This is the rate of percolation of water through the soil and it depends on numerous factors. The infiltration capacity of the soil is especially important in areas with large amounts of precipitation. Conversely, in areas with smaller amounts of precipitation, a sufficient infiltration capacity is primarily important for the growth of vegetation (Fitz Patrick, 1980) and, consequently, for evaporation. In the longterm period water balance, the effect of the soil has a lesser importance, though it is of greater importance in the short-term water balance (e. g. over a few days). Nevertheless, we should be aware of the importance of the soil in the water cycle.



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Slika 16: *Alpe*

Figure 16: *The Alps*

ska sposobnost prsti je še posebej pomembna v območjih z veliko količino padavin. V območjih z malo padavinami je zadostna infiltracijska sposobnost pomembna predvsem za rast vegetacije (Fitz Patrick, 1980) in s tem tudi za izhlapevanje. V obdobni vodni bilanci je vpliv prsti manjšega pomena, večji pomen ima pri kratkoročni bilanci (npr. nekaj dni). Vseeno se je potrebno zavedati pomena prsti v vodnem krogu.

3.4 Rastlinstvo

Rastlinstvo je zelo odvisno od vode, saj jo potrebuje za rast. S tem zelo vplivajo na vodni krog, saj zadržujejo padavine, črpajo vodo iz prsti in vodonosnikov – jo absorbirajo in jo potem vračajo v ozračje s transpiracijo. Vsaka rastlina drugače vpliva na vodni krog. Za vodnobilančne analize je še posebej pomemben gozd.

Slovenija je gozdnata dežela. Listnati gozdovi poraščajo nižinske predele v vseh pokrajinskih enotah Slovenije. V hribovjih, gorovjih in na dinarskih visokih planotah segajo do 1500 m nadmorske višine. Prevladuje bukev, ki je najbolj razširjena drevesna vrsta v Sloveniji. V višinah med 700 in 1400 m se v dinarskem in alpskem svetu z bukvijo meša jelka. Iglasti goz-

3.4 Vegetation

Vegetation is highly dependent on the water, as it requires water for growth. At the same time, the plants significantly affect the water cycle as they retain precipitation, draw water from the soil and the aquifers, absorb it and then return it to the atmosphere through transpiration. Each plant affects the water cycle differently. Forests are especially important for water balance analyses.

Slovenia has a lot of forest. Deciduous forests cover low-lying areas in all the landscape units of Slovenia. In the hills, mountains and Dinaric high plateaus, they reach to up to 1500 m above sea level. Beech is prevalent – indeed it is the most widespread type in Slovenia. At altitudes between 700 and 1400 m, fir trees mix with the beech in the Dinaric and Alpine area. Coniferous forests form the second large group of the Alpine area forests. They grow where conditions are less favourable for deciduous trees. The group of coniferous forests that thrive on acidic soil comprises several types of fir, pine and spruce. Mixed forests grow primarily in the hilly regions of the Dinaric and Alpine area.

Today, over 50% of the territory of Slovenia is covered by forest. It is difficult to portray the water balance of the forest in real values, as it is strongly dependent on the biological and physical make-up of the forest. The quantity of precipitation that the forest intercepts and retains (interception) depends on the species making up the forest, on the stratification and development of the plant components, the type, intensity and duration of the precipitation, winds, etc. The forest's main elements affecting the water cycle are presented in table 2 (Smolej, 1988).

Generally, tree cover retains approximately a third of the annual quantity of precipitation, though the amounts for deciduous forests are somewhat lower (15–25%) and slightly higher for coniferous forests (25–40%).

We shall only mention the main varieties of vegetation. Shrub land covers smaller areas in low-lying regions and larger areas in the mountain areas of Slovenia. Natural mountain shrub land grows predominantly above the tree line. Meadows and pastures in Slovenia belong among the secondary vegetation. Natural grasslands spread primarily above the upper line of the high-mountain thickets in the Alpine area and on Veliki Snežnik in the Dinaric area. Grassland also affects the runoff characteristics, water retention and evaporation. In addition to natural plants, cultivated plants are also char-

dovi tvorijo drugo veliko skupino gozdov alpskega sveta. Rastejo tam, kjer so rastni pogoji za listavce manj primerni. V skupini kisloljubnih iglastih gozdov ločujemo več jelovih, borovih in smrekovih združb. Mešani gozdovi rastejo predvsem v hribovitem svetu dinarskega in alpskega sveta.

Danes je v Sloveniji preko 50 % gozdne površine. V realnih vrednostih je vodno bilanco gozda težko prikazati, saj je močno odvisna od biološke in fizikalne zgradbe gozda. Količina padavin, ki jih prestreza in zadržuje gozd (intercepcija), je odvisna od vrstne sestave gozda, od zaslojenosti in razvoja rastlinskih komponent, od vrste, intenzivnosti in trajanja padavin, vetra … Glavni elementi vpliva gozda na vodni krog so prikazani v preglednici 2 (Smolej, 1988).

V splošnem velja, da drevesni zastor zadrži približno tretjino letne količine padavin, pri čemer veljajo za listnate gozdove nekoliko nižje (15–25 %), za gozdove iglavcev pa višje (25–40 %) vrednosti.

Od preostalih vrst rastlinstva omenjamo le glavne. Grmovno rastje porašča manjše površine v nižinskih delih in večje v gorskih delih Slovenije. Naravno gorsko grmovno rastje se razrašča večinoma nad gozdno mejo. Travniki in pašniki v Sloveniji spadajo v drugotno rastlinstvo. Naravna travišča se širijo v glavnem nad zgornjo mejo visokogorskih grmišč v alpskem svetu in na Velikem Snežniku v dinarskem svetu. Tudi

Smrekov sestoj ***Spruce make-up***		%
Padavine *Precipitation*		**100**
Prestrezanje *Interception*		**26**
	izhlapi *Evaporates*	20
	odteče po deblih, kaplja s krošnje *Runs off down trunks, drops from the canopy*	6
Izhlapevanje s tal *Evaporation from the ground*		**10**
Odtok *Runoff*		**48**
	površinski *Surface*	30
	v podtalnico *Into groundwater*	18
Transpiracija *Transpiration*		**22**

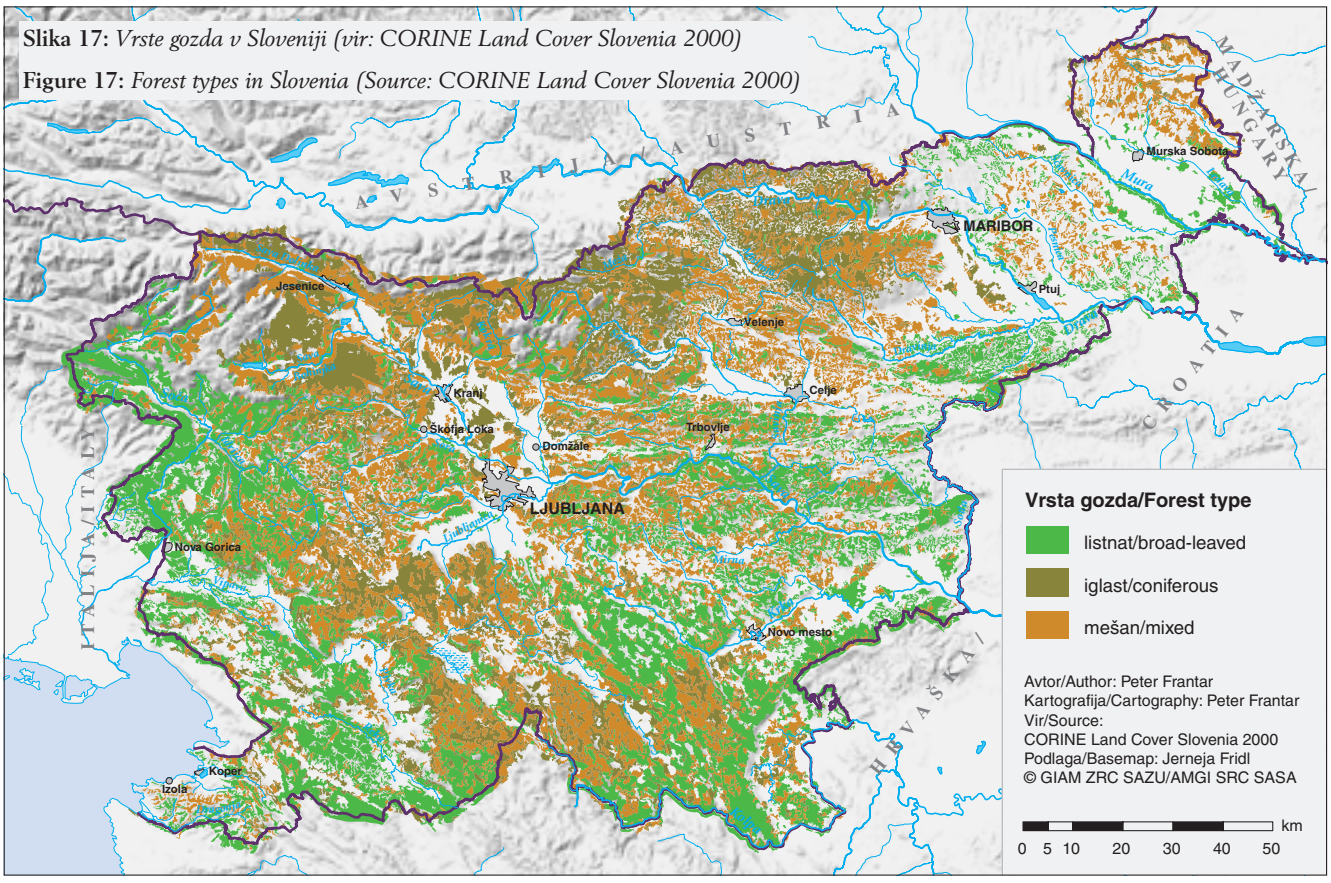
Preglednica 2: *Kroženje vode na gozdnem zemljišču (vir: Robič, 1994)*

Table 2: *The circulation of water on forested land (Source: Robič, 1994)*

acteristic of Slovenia. These cover a good third of the surface and grow primarily in pedologically suitable areas in terms of relief and climate (Lovrenčak, 1998a).

Slika 17: *Vrste gozda v Sloveniji (vir: CORINE Land Cover Slovenia 2000)*

Figure 17: *Forest types in Slovenia (Source: CORINE Land Cover Slovenia 2000)*



travinje vpliva na odtočne značilnosti, zadrževanje vode in izhlapevanje. Poleg naravnih rastlin so pomembne tudi kulturne rastline. Te pokrivajo dobro tretjino površja in se razraščajo predvsem na reliefno, klimatsko ter pedološko ustreznih območjih (Lovrenčak, 1998a).

3.5 Antropogeni dejavniki

Človek s posegi v (naravno) okolje vse bolj vpliva tudi na vodni krog. Neposredno lahko vplive vidimo v zadrževanju, črpanjih za različne namene, rabi tal, … Zaskrbljenost za naravne dobrine, med katerimi je voda nedvomno na prvem mestu, se veča. Za dosego sonaravnega razvoja moramo čim bolj spoznati pokrajino in njene elemente – torej tudi vodni krog.

Prav vsi v Sloveniji imamo svoj način vpliva na vodo. Po podatkih iz leta 2006 živi v Sloveniji 2.010.377 prebivalcev, to je 99 prebivalcev na km^2. Po zadnjem popisu iz leta 2002 je v Sloveniji živelo 1.987.971, po popisu leta 1991 pa 1.965.987 prebivalcev.

Polovica prebivalcev Slovenije živi v alpskem svetu; sledi mu panonski del države, kjer živi približno četrtina prebivalcev, nato pa dinarski in primorski svet. V Sloveniji je večina industrije skoncentrirana v t. i. industrijskem polmesecu, ki je v celoti v alpskem svetu. Tu so pomembne gospodarske panoge še promet, turizem, kmetijstvo in v preteklosti tudi rudarstvo.

V sredozemskem delu države so najpomembnejše dejavnosti turizem, promet, trgovina in pristaniška dejavnost, industrija in kmetijstvo sta bolj v ozadju.

Južna Slovenija, dinarske planote in podolja so bila in so še vedno v veliki meri vezana na gozdno bogastvo. V kmetijstvu je pomembna še živinoreja, lesno industrijo pa so dopolnili še z nekaterimi drugimi dejavnostmi; prisotna sta še promet in turizem, najpomembnejši na pivškem.

Najbolj kmetijska pokrajina v Sloveniji je Panonski svet. Na polovici površine Panonskega sveta so njive, sadovnjaki in vinogradi. Poleg tega je tu še nekaj industrije, zdraviliški turizem in vedno pomembnejši promet.

Vse človekove dejavnosti imajo večji ali manjši vpliv na vodo. V alpskem svetu ima nanjo največji vpliv gospodarstvo, v panonskem in primorskem svetu pa kmetijstvo. Velik vpliv na vodni krog ima spreminjanje pokrovnosti tal. S krčenjem gozda in pozidavo se izhlapevanje zmanjšuje, vodni odtok pa se povečuje. Povečanje urbanih površin za 1 % poveča odtok za 2–4 % (Jones, 1997).

Vseh človekovih vplivov na vodno okolje ne moremo našteti. Potrebno se je zavedati, da so potrebe družbe po vodnih virih, še posebej v času pomanjkanja vedno večje.

3.5 Anthropogenic Factors

Man's encroachment into the (natural) environment is also increasingly affecting the water cycle. The effects can be seen directly in reservoirs, abstractions for various purposes, land use, etc. The concern over natural resources, where water certainly takes first place is increasing. In order to achieve sustainable development, we must get to know the landscape and its elements as closely as possible, and therefore we must also become familiar with the water cycle.

Everyone in Slovenia has their own way of affecting the water. According to the data from 2006, there are 2,010,377 inhabitants of Slovenia, namely 99 per km^2. According to the last census from 2002, there were 1,987,971 people living in Slovenia and, according to the 1991 census, the number was 1,965,987.

Half of the population in Slovenia lives in the Alpine area. This is followed by the Pannonian part of the country, where approximately a quarter of the inhabitants live, and the Dinaric and coastal areas. The majority of the industry in Slovenia is concentrated in the so-called industrial crescent that lies entirely in the Alpine area. This area is home to economic branches such as traffic, tourism, agriculture and also, in the past, mining.

In the Mediterranean part of the country, the most important activities are tourism, traffic, trade and port activity, while industry and agriculture remain in the background.

Southern Slovenia, the Dinaric plateau and the planated lowlands were and still are to a greater extent dependent on the forest. Animal husbandry is an important branch of agriculture, while the wood processing industry was supplemented by other activities. This area also has traffic and tourism activities, which are the most important in the Pivka region.

The most agriculturally-oriented region in Slovenia is the Pannonian area. Half of its surface is covered by cultivated fields, orchards and vineyards. There is also some industry, spa tourism and the increasingly important traffic.

All anthropogenic activities apply kind of impact on water. The economy has the highest impact in the Alpine area, while in the Pannonian and coastal areas has the agriculture. The fluctuation in land cover has a significant influence on the water cycle. With the deforestation and urbanization of land, evaporation is reduced and water runoff is increased. A 1% increase in urban areas increases runoff by 2–4% (Jones, 1997).

All of anthropogenic effects on the water environment cannot be enumerated. We need to be aware of the increasing need of society for water resources, especially during the shortages.

Slovenija/*Slovenia*		**Subpanonska** *Sub-Pannonian*		**Dinarska** *Dinaric*		**Submediteranska** *Sub-Mediterranean*		**Alpska in predalpska** *Alpine and pre-Alpine*			
Vodotok/*Stream*		Ščavnica	Ledava	Lahinja	Kolpa	Rižana	Vipava	Soča	Kokra	Savinja	Sava
Vodomerna postaja *Water gauging station*		Pristava	Polana	Gradac	Radenci	Kubed	Miren	Kršovec	Kranj	Celje - Brv	Litija
Nadmorska višina (m) *Elevation (m)*	Povprečna/*Average*	232.6	283	336	372.1	588.8	152.8	1366.6	675.6	491.9	403.6
	Najmanjša/*Minimum*	172	194	137	180	65	43	410	375	236	233
	Največja/*Maximum*	397	497	1038	1461	1041	1144	2794	2054	1576	908
	Relativna/*Relative*	225	303	901	1281	976	1101	2384	1679	1340	675
Naklon (°) *Slope (°)*	Povprečen/*Average*	5.9	6.1	8.1	10.6	11	9.9	34.7	14.8	14.2	11.2
	Najmanjši/*Minimum*	1	0	1	0	0	0	1	1	1	1
	Največji/*Maximum*	47	37	45	59	43	55	81	54	58	51
Padavine (mm) *Precipitation (mm)*	Povprečje na porečje *Average per river basin*	965	886	1364	1935	1635	1940	2868	1799	1497	1865
Izhlapevanje (mm) *Evaporation (mm)*	Povprečje na porečje *Average per river basin*	691	689	772	755	743	736	666	700	706	709
Hidrogeološke enote (%) – poroznost *Hydrogeological units (%) – porosity*	Mešana/*Mixed*	0.7	2.41	0	7.6	0	0	0	0.95	30.85	3.32
	Razpoklinska/*Fissured*	8.76	20.52	5.21	2.19	28.52	50.95	0	36.48	12.33	39.48
	Medzrnska/*Intergranular*	90.54	77.08	19.52	1.67	2.64	37.48	19.09	57.75	37.16	42.32
	Kraška/*Karstic*	0	0	75.27	88.54	68.84	11.57	80.91	4.82	19.65	14.89
Tip prsti (%) *Soil types (%)*	Psevdooglejene/*Planosol*	38.71	52.86	5	0	0	20.15	0	0	12.97	3.37
	Oglejene/*Gleysol*	18.94	9.73	0	1.34	0	17.51	0	0	3.93	3.83
	Rjave pokarbonatne *Chromic cambisol*	0	0	53.36	79.08	60.93	27.46	0	28.44	20.75	12.29
	Rendzine/*Rendzine*	0	0	0	4.31	0	0.56	100	23.82	1.99	0
	Distrične rjave *Dystric cambisol*	22.69	26.35	2.01	15.28	31.66	0	0	14.44	43.73	58.41
	Evtrične rjave *Eutric cambisol*	19.66	11.06	0	0	7.41	34.32	0	33.3	16.62	22.1
	Akrična tla, šotna tla *cromic cambisol and acrisol*	0	0	39.63	0	0	0	0	0	0	0
Prst in voda *Soil and water*	Povprečna infiltracijska kapaciteta (mm/uro) *Average infiltration capacity*	3.4	2.99	4.52	3.27	3.94	3.76	7.5	5.85	4.61	5.39
	Povprečna kapaciteta tal za vodo (mm/m) *Average capacity of the ground for water retention*	126.74	120.9	124.94	130.2	127.68	129.59	140	128.33	125.33	125.73
	Povprečna kapaciteta tal za vodo v porečju (mm) *Average capacity of the ground for water retention in the river basin*	47.77	45.51	52.52	58.67	48.35	48.88	53.2	54.87	53.65	50.36
Gozdne površine % *Forest surfaces %*	Negozd/*Non-forest*	61.5	61.8	39.8	24.7	60.7	61.4	60	36.2	36	49.7
	Gozd/*Forest*	38.5	38.2	60.2	75.3	39.3	38.6	40	63.8	64	50.3
Tip gozda % *Forest types %*	Listavci/*Deciduous trees*	94.1	78.3	53.6	64.2	100	100	100	58	84.1	24.3
	Iglavci/*Coniferous trees*	0	19	0	1.5	0	0	0	28.6	15.9	17.5
	Mešani/*Mixed forests*	5.9	2.7	46.4	34.3	0	0	0	13.4	0	58.3

Preglednica 3: *Glavne geografske značilnosti po makroregijah (vir: Ulaga, 2003)*

Table 3: *The main geographical characteristics arranged by macro-regions (Source: Ulaga, 2003)*

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Slika 18: *Soča* / **Figure 18:** *The Soča River*