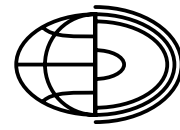


Soils in the Slovenian educational system



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Abstract. There is a considerable amount of confusion in soil-related topics at all levels of Slovenian education. The fundamental problem is the use of the term “soil”. We use several different terms for more or less the same natural phenomenon. Other problems include the lack of an official Slovenian soil classification, the occasional use of out-of-date soil topics in primary and secondary education, the inexpert use of soil names for soil types of the World, and very few higher education soil specialisations. There are a lot of existing initiatives to improve the current state, but there are still a lot of obstacles impeding this process.

Key words:
Slovenia,
education,
soil geography,
soil classification,
WRB

Introduction

Soil science in Slovenia can be dated back to the beginning of the 20th century. We can acknowledge Prof. Bogdan Vovk as the first soil scientist and the one who determined the fundamentals of Slovenian soil science. He was followed by prominent soil scientists and teachers: Dr Dušan Stepančič, Prof. Jože Sušin, Prof. Marjan Ažnik, Prof. Albin Stritar, and others (Vrščaj et al. 2017). Slovenia's soil geography began to be outlined at the beginning of the 1950s. At that time, it was clearly marked by its pedological heritage, and general geography became dominant in education at the primary and secondary levels (Vovk Korže 2003). Primary and secondary school geography curricula also provide basic soil knowledge for those who will not continue with courses in geography, agronomy, forestry, landscape architecture, geology, etc. This basic knowledge in-

cludes soil properties and processes, soil profiles and horizons, and domestic and foreign soil types. Also, at the university level, soil geography deals with soil classification outside the borders of Slovenia. Geographers are the only ones who publish expert articles about soils on all the continents (Lovrenčak 1976, 1994; Vovk Korže 2003; Vovk Korže and Lovrenčak 2004; Repe 2005a, 2005b, 2006). The majority of soil-related topics in primary and secondary schools is included into the geography curriculum; only a few are included in biology, chemistry and environmental courses.

At university level, soil science is lectured in detail within geography, agronomy and forestry courses. Students can attend soil-related courses in landscape architecture, geology or archaeology degrees, among others. Nearly all soil courses are taught by soil scientists from Biotechnical Faculties (agronomy), except for a few courses at Geography

departments. Nevertheless, the soil topics taught by Slovene geographers are colourful and quite varied.

The first true soil geographical research was carried out by Prof. Lovrenčak (Lovrenčak 1970). He attempted to find the relationships between soils and vegetation and the reasons for their formation, development, and spatial extent. Prof. Lovrenčak furthermore endeavoured to find all the possible interactions within the soil–vegetation system, and investigated soils of high altitudes and karstic areas and provided regional soil geographical descriptions of Slovenia's different regions.

At first glance soil science in Slovenia looks to be in a similar situation to that found in many European countries and their educational systems. However, there are also problems with the name of the main study object. We all teach and conduct scientific research about soils. Soil geographers and, consequently, geography teachers (on lower levels of education) use the term “*prst*” (the most closely related expression would be “soil”), while all other soil scientist use the word “*tla*” (the translation into English would be “ground”, or even more accurately, in German, “*Boden*”). To make the confusion even worse, in colloquial language most people would use “*zemlja*” (“earth”) (Fig. 1).

Slovenian soil classification

The origin of the Slovenian Soil Classification is linked to the development of the Yugoslavian Soil Classification (Čirić 1984; Škorić 1986), since Slovenia was an integral part of Yugoslavia until 1991 (Fig. 2). The first genetic soil classification for the Yugoslavian area (including Slovenia) was introduced by Gračanin in 1951. At the following congresses of Yugoslavian soil scientists, the classification was developed and changed by many authors over the next decades (Nejgebauer et al. 1963; Škorić et al. 1985). The final Yugoslavian version was accepted in 1985 (Kralj 2008). The Yugoslavian Soil Classification has always been both morphological and genetic. It was based on soil properties and soil genesis. All the properties were supposed to be visible, easily measurable and as quantitative as possible. There were six levels of classification: Division – Class – Type – Subtype – Variety – Form. Subtypes, Varieties and Forms are not subdivided in a single uniform manner; subdivisions are defined individually for each type. Still based on the same Yugoslavian Soil Classification, the soil taxonomies of the former Yugoslav republics are still being independently developed and upgraded and thus have

Morje ravno tako redno kot kak veletok po svoji strugi teče. Zlo mnogovrstno je to potakanje vesoljnega morja. Navadni, zlasti pa nenavadni, močni vetrovi tudi morje vznemirujejo, je semtertje gonijo in večje ali manjše valove delajo.

c. Suha zemlja.

Suha zemlja ali zemlja zgoli je tisti del poveršja, ki je terd in suh in ga voda ne pokriva ampak le obdaja. Ona nam je le po verhu znana, od znotraj pa neznana. Vonder zamoremo po vnanjem in po znanem delu njedra soditi o njeni znotranji lastniji.

Poveršina zemlje obstoji iz mnogih rudnin, iz katerih je tudi njeno terdo jedro, namreč iz raznih **persti in kamen, rud in kovin (lehkih in težkih) in sploh iz raztopljivih (soli) in vnetljivih rudnin.**

Rudnine niso enako po zemlji razdeljene. Do sedaj so dajale tople dežele več dragih kamen in žlehtnih kovin, zmerno – tople pa dosti koristnih rudnin in nežlehtnih kovin.

Kako se loči kamnita zemlja od **perstene, mokra od suhe, debela od plitve, apnena od mastne, — — —?**

Velikim pokrajinam suhe zemlje pravimo suho ali celina, terdnina (*Festland, Continent*); manjšim kosovom njenim, ki je morje obdaja, pa otoki ali ostrovi (*Inseln*).

Poglavje III.

Fig. 1. One of the first Slovenian-language geography textbooks, which included soils (Jesenko 1865)

become more diverse (Čirić 1984; Škorić et al. 1985; Štepančič et al. 1986; Resulović and Čustović 2002; Urbančič et al. 2005; Kralj and Grčman 2009; Husnjak 2012). After Slovenia became an independent state, the activities related to the Slovenian Soil Classification merely continued. In part of the soil science community there is a growing need to upgrade and further improve the Slovenian Soil Classification. The main reasons are the need for the taxonomy to better reflect productivity, water holding capacity, relationships to environmental threats, and environmental protection, and to be able to be correlated to the international classification – the World Reference Base (WRB). After all these years there is still no official harmonised Slovenian Soil Classification.

Soils in Slovenian higher education

Apart from PhD courses, there are no possibilities to exclusively study soil science or soil geography in Slovenia. There are some programmes at the uni-

versity level that provide courses on soils. They are scattered across faculties and departments at the University of Ljubljana, the University of Maribor and the Environmental Protection College. Most notable is the Biotechnical Faculty and its degree in Agriculture–Agronomy, where there are special courses in Soil Science and in Land Use and Soil Protection. General soil science courses can also be attended while studying Forestry and Landscape Architecture at the same faculty and while studying Geology at the Faculty of Natural Sciences and Engineering. There are soil geography courses at both degree levels of Geography at the Faculty of Arts (Geography Department), such as Physical Geography, Soil- and Biogeography, and Applied Physical Geography. A similar situation can be found at the University of Maribor. Soil science is lectured at the Faculty of Agriculture and Life Sciences and Faculty of Arts (Geography Department). While studying Environmental Protection and Eco-technologies at the Environmental Protection College a soil-science-related course (Soil Use and Protection) is available at master's level. One could only guess that for a country as small as Slovenia with

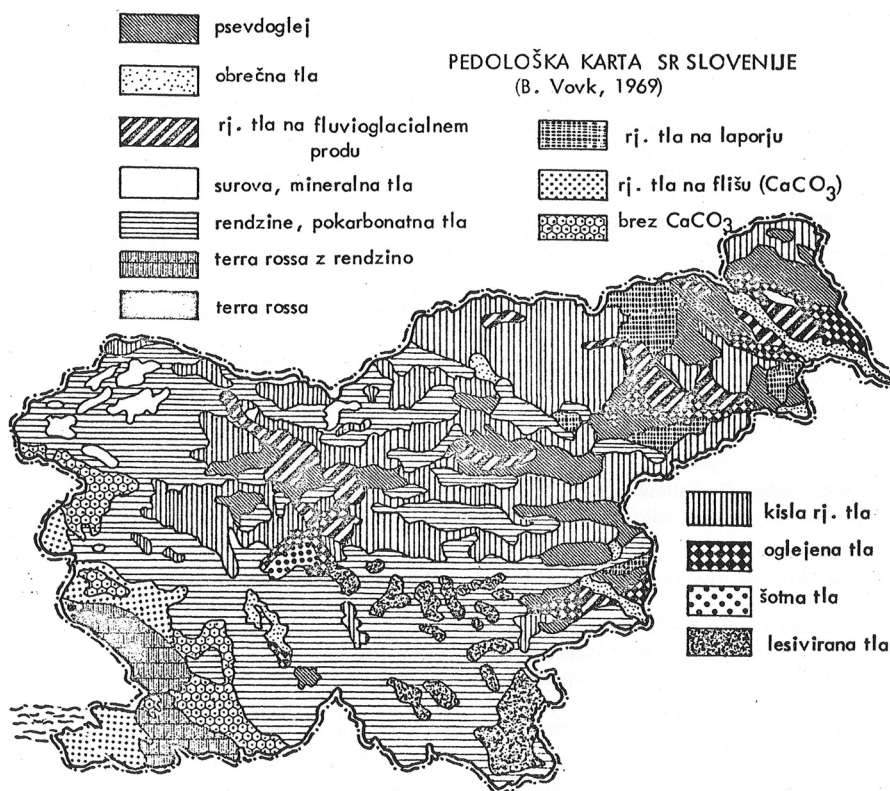


Fig. 2. Soil map of the Socialist Republic of Slovenia by prof. Vovk (Stritar 1991)

its slightly fewer than 80,000 enrolled students every year (SI-Stat Database, 2018) there would probably not be enough interest for an interdisciplinary soil science degree.

Another problem is that there is hardly any co-operation between courses and lecturers. There is an ocean of opportunities for improvement, especially in field research and trips. Maybe we should follow the example of Geography and Geology students and their Geo-Geo Camp (Geo-Geo tabor 2017) where they invite lecturers and experts from all fields of science, including soil scientists and soil geographers, to conduct field research.

There are also very few university textbooks available (Ilešič 1960; Belec 1968; Stritar 1991; Lovrenčak 1994; Vovk Korže 2015) (Fig. 3) and all except one are quite old editions. There are also some published laboratory and field research manuals (Vovk Korže and Lovrenčak 2001, 2004; Vovk Korže 2014). Unfortunately, most of the materials remain unavailable to the public in print form, and are instead given directly to students by lecturers or as internal digital documents, hidden in the protected parts of student IT systems and e-course web pages. There are no translated textbooks from other languages. At the moment, the translation of WRB (IUSS Working Group WRB 2015) into Slovenian is in the final stages.

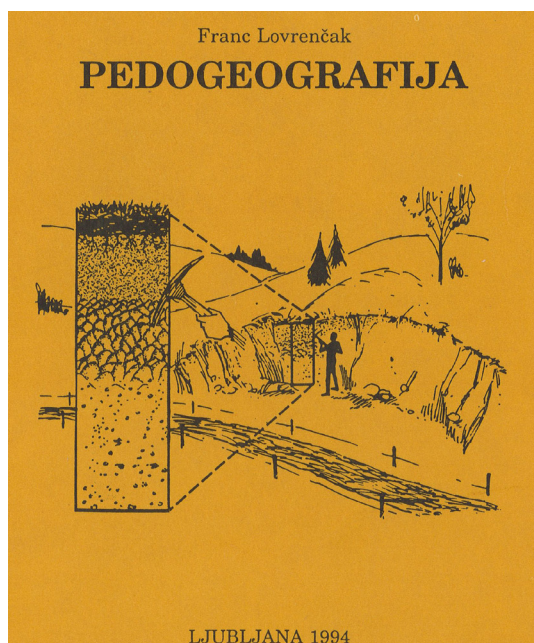


Fig. 3. Cover of Soil Geography book (Lovrenčak 1994)

Soil related topics in Slovenian primary and secondary schools

All the difficulties concerning terminology and the absence of an official soil classification are not the only problems in the country. Although there is a very long tradition of teaching soil topics within geography courses, dating back to the middle of the 19th century (Jesenko 1876), the current situation in primary and secondary schools is less than ideal. There are three very closely related main documents regarding teaching geography (and soils) at the lower levels of education: the two curricula for primary and secondary schools and the catalogue of knowledge for the *matura* examination (Lipovšek et al. 2008; Kolnik et al. 2011; Balažič et al. 2014) (Figs 4 and 5). Topics are then further reflected in the geography textbooks that teachers teach in classes, and which determine what pupils should learn about soils.

The soil-related subjects are very variable and can be found in different topics and courses:

- The majority of soil topics are located in chapters as part of general geography – physical geography – where soils are represented as one of the geospheres or as an integral part of the landscape. The topics include those connected directly to soil science (soil formation, properties, processes, profiles and horizons), soils of Slovenia and soils of the world – the importance of soil for mankind – and soil degradation.
- Soils are mentioned in some scattered places in the regional geography of Slovenia, e.g. karstic soils (*Terra rossa*), agricultural soils of the alluvial plains in the NE part of Slovenia, poorly developed mountainous soils, etc.
- Soils are also an integral part of the regional geography of Europe and the regional geography of the world, e.g. the agricultural soils of Russia and the Great Plains of the USA, soil desertification of the Sahel, etc. Soils are also mentioned (but not dealt with in detail) within the topics of agricultural production, irrigation, salinisation, volcanoes, permafrost, desertification and slope-related processes (erosion, landslides).



Kraška rdeča prst jerovica lahko v značilnih »žepih« sega tudi več metrov globoko.

Fig. 4. Soils are an integral part of regional geography in primary school, example of Terra rossa on Karst (Senegačnik et al. 2010)

In primary schools pupils should:

- learn about soils as part of the Earth's natural system (together with relief, waters, climate, plants and animals);
- know how climate, plants and soils are inter-related and how that affects the life of people;
- give a proper description of a local environment (including soils);
- describe the most typical soils of Southern Europe;
- compare soil properties to climate/plants in the Pannonian lowlands;
- indicate the negative impacts of industry on air, water and soils.

Knowledge about soils is expanded in secondary school. There, pupils should:

- understand the connections between all elements of the geosphere;
- understand what a soil profile is;
- using pictures, recognise some typical soils of Slovenia and of the world;
- gain an awareness of the importance of soil protection;
- know some soil groups of the WRB;
- be able to dig their own soil profile, and then describe horizons, recognise and determine some features (depth, pH value, texture, colour, moisture, etc.) and processes (leach-

ing, reduction, mineralisation, humification, etc.), and make a miniature replica of the profile (using plastic bags or drawing it).

There is also a plan to conduct a field research/trip together with biology and chemistry courses in the future. The secondary school curriculum is directly reflected in the "Catalogue of knowledge" for the *matura* examination (secondary school leaving exam), which includes field research.

A superficial reading of curricula would give the impression that geography covers soil topics rather well and that the knowledge of students entering university is rather high and comprehensive. However, the abovementioned goals are not fully achieved (personal opinion of the author): some expectations are not realistic (e.g. recognising soil types from pictures, the ability to recognise certain processes). The curricula also express that some of the topics are out of date, they are too scattered across courses and school years and some very important topics are missing or given too little importance (soil awareness, soil functions, soil ecosystem services, soil protection, etc.). There is still much confusion related to basic soil terms. Neither topics, teachers nor pupils use the terms "soil", "earth" and "ground" consistently; sometimes they are used synonymously, sometimes as being different parts of the Earth's surface and sometimes as one being superior to the other. Some teachers still teach in the way they learned decades ago. Nearly all confuse soil fertility and soil suitability for agricultural production. One of the most problematic parts is the naming of soils from around the world. Despite the WRB being mentioned, the curricula still use colours as the most important distinguishing and naming parameter for the soils of the world (red, yellow, grey, brown and black soils). The author believes our school system should at least use some form of internationally accepted or WRB-related names (IUSS Working Group WRB, 2015).

Nevertheless, things are slowly but constantly improving. Many cases show positive results regarding teaching soils in primary and secondary schools. Among those good practices examples include:

- Constant life-long learning activities. Faculties and soil-related departments (geography, agronomy and forestry) should be organising (more) symposiums, summer schools

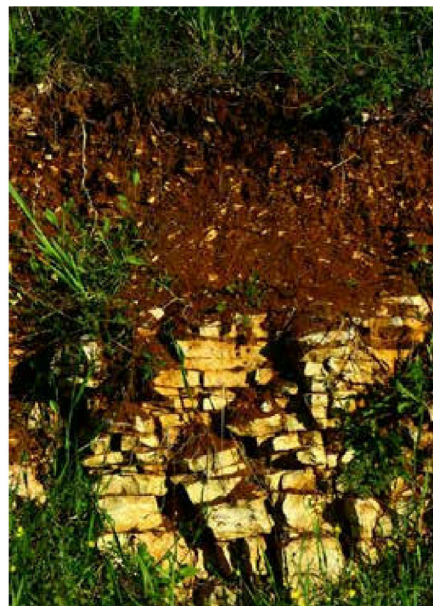
Prsti polsuhih in suhjih, tudi sredozemskih območij

Dosedanje poenostavljeno poimenovanje: puščavske prsti, rdeče in rjave sredozemske (mediteranske) prsti

Najpomembnejše skupine WRB razvrstitve prsti: Slončaki, Solonci, Arenosoli

Glavne skupne značilnosti: Nam najbližje so prsti sredozemskih območij (v Sloveniji jih imenujemo jerovica, drugod jih imenujejo terra rossa), katerih značilna rdeče in rdečerjave barva je odraz močne oksidacije železovih oksidov, ki obarvajo minerale glin. V še bolj sušnih in toplih razmerah prihaja do mehanskega preperevanja kamninske podlage, zato so prsti zelo skeletne ali peščene (npr. Arenosoli). V takšnih razmerah se organska snov hitro razkrajaja. Močno primanjkuje vode. Če je prisotna podtalnica, se ta dviguje proti površju, kjer izhlapeva in povzroča kopičenje soli v prsteh, tj. zaslanjevanje (Solončaki, Solonci).

Splošna primernost za kmetijstvo: V povezavi z visokimi temperaturami je pomanjkanje vode izrazito omejitveni dejavnik za vse oblike kmetijstva. Kjer pa je vode dovolj, so te prsti primerne za kmetijstvo. Za poljedelstvo je potrebno namakanje, zelo je razvita nomadska živinoreja. Območja ob velikih vodotokih (Nil, Mezopotamija, Ind, Ganges ...) ter območja s sredozemskim podnebjem so prav zaradi ugodnih razmer in možnosti namakanja zibelke starih civilizacij. Prsti ogrožajo vetrna erozija, zaslanjevanje, prekomerna paša, požari in širjenje puščav.



Rdečerjava jerovica, ki se je razvila v sredozemskem podnebjem (Pula) na ploščatem apnencu (Kambisol).

Fig. 5. Part of the one of the new secondary school textbook with WRB (Baloh et al. 2017)

and workshops where scientists should present the newest findings in the field of soil science and soil geography. A good example is a biennial meeting for geography teachers (Prof. Ilešič days) where new discoveries can be presented. One such case was in 2005 (Repe 2005a) that introduced the WRB to secondary school geography teachers.

- Field research. Soil scientists and experts should offer their knowledge and organise soil-related field research and trips for pupils and their teachers. Since field research is one of the most interesting parts of soil courses, it would give expert insight in the methodology and raise awareness about soils. The Center for Soil and Environmental Science (Biotechnical Faculty) and Geography Department (Faculty of Arts) offer some field research that is directly related to courses. The latter organises joint field research with university and secondary-school students as part of the *matura* examination on the one side and a course on Organisation of Field Research on the other (Fig. 6).
- An extremely good example is Nature's Classroom (<http://www.naturesclassroom.si/>) with its summer schools, field research, workshops and learning trails, and its nearly exclusively soil-related training ground near Poljčane in the Dravinja Valley in the north-east of Slovenia. They conduct soil-science and soil-geography-related education in the field for all ages, adults and preschool children included.
- Soil science and geography associations (e.g. the Soil Science Society of Slovenia and the Association of Ljubljana's Geographers) should organise more field trips with soil topics, especially for the public.
- Popular publications, papers and articles in newspapers: there are too few of these, and most are related to problems concerning soil degradation (contamination, urban sprawl, landslides, etc.) when experts give a warning or an opinion. A good example was an attempt to compile articles from soil geographers and soil scientist. This has been accomplished twice in *Geographical Horizon*. Both issues were thematically dedicated to



Fig. 6. Nature's Classroom in Poljčane (photo: Blaž Repe 2014)

soils (<http://zgs.zrc-sazu.si/en-us/publications/geographichorizon.aspx>, issues 53/1, 2006 and 63/2–3, 2015).

- There are also some occasional soil-related web conferences, chat rooms, public lectures

and even TV and radio shows in order to raise soil awareness and bring soil topics to the public or teachers (Fig. 7).



Fig. 7. Examples of promotional material for raising awareness about soils (Soil calendar 2015) Produced by the Agricultural Institute of Slovenia; (http://www.kis.si/f/docs/Mednarodno_leto_tal_Svetovni_dan_tal/MednarodnoLetoTal2015.KoledarKIS.pdf)

Conclusions

There are many obstacles to the teaching of soils at all educational levels in Slovenia. The lack of a Slovenian soil classification, the still-poor level of acceptance of WRB, the problem with basic soil terminology and consequent rivalry and arguments among soil scientists and soil geographers (i.e. teachers) certainly will not improve the situation. On the other hand, there are many activities that are steadily improving the situation. Some are mentioned above, but we have to also mention the establishment of the Global Soils Partnership (http://www.mop.gov.si/si/medijsko_sredisce/novica/article/1328/7876/) on International Soil Day in 2017 under the patronage of the Ministry of the Environment and Spatial Planning. We have set a few primary goals, including the promotion of soil topics at all levels of education and the improvement of geography curricula in primary and secondary schools so that soils are taught properly and with a modern scientific background.

There is also a new generation of younger and advanced school textbook writers (Senegačnik and Drobňak 2017) and publishing editors (Baloh et al. 2017) that are favourable to the modernisation of soil topics. We can expect new and updated textbooks to probably emerge in the near future. Specialists in soil science or geography must also contribute to writing parts about soils. On the other hand, university departments should produce new soil science and geography textbooks and manuals and make them accessible to everyone. First steps have certainly been taken with the publication of *Soils of Slovenia* (Vrščaj et al. 2017), *Soils of Slovenia With Soil Map 1:250,000* (Grčman et al. 2015) and *Fertile Earth* (Vovk Korže et al. 2017) (Fig. 8).

However, all this is still not enough. We should concentrate on setting up soil-related web and social media pages, producing promotional material such as soil calendars, stickers, YouTube videos, games, puzzles, memes, paper pads for food trays, etc. We should not only clearly and loudly celebrate 5th December – International Soils Day – in schools and publicly across all media, but extend it

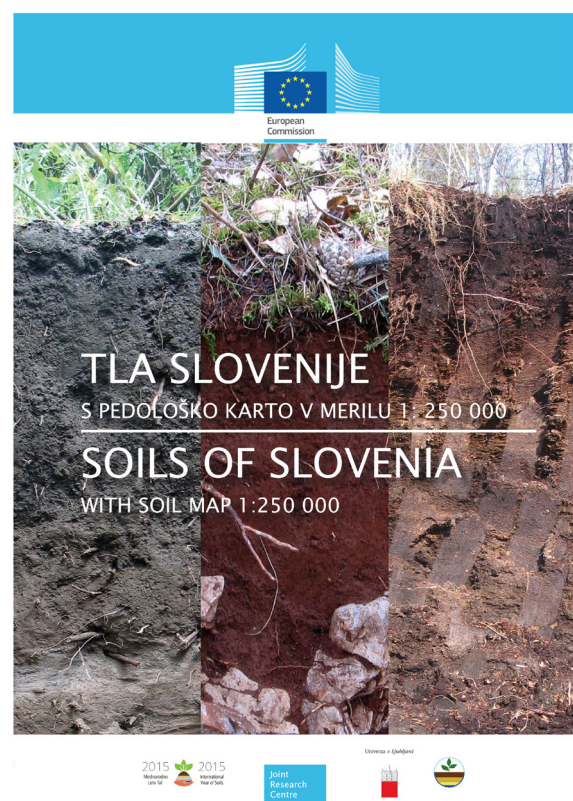
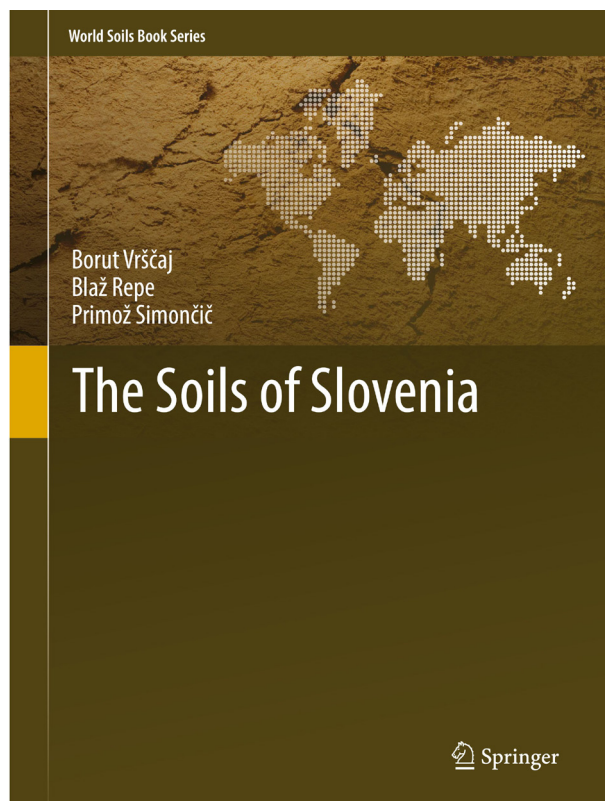


Fig. 8. Covers of two Soils of Slovenia publications

over at least a week of activities, with complete support from the government and non-governmental organisations. And above all, we have to start educating and raising awareness at the lowest age possible, in kindergarten.

Soil science and soil geography has the obligation to provide the public with lifelong education. We have to take part in every soil-related event or activity, we have to be constantly active, we have to give warnings about soil problems and its degradation and we have to do everything in order to raise public awareness of soil issues. The results may not be visible at once, but in the long term, positive changes will inevitably come.

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