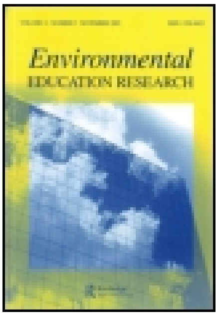

Environmental Education Research
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/ceer20

Teaching soil science and ecology in West Siberia: 17 years of field courses

Christian Siewert[a], Pavel Barsukov[b], Scott Demyan[c], Andrey Babenko[d], Nikolay Lashchinsky[e] & Elena Smolentseva[b]

[a] Fakultät VI, Institute of Ecology, Technical University Berlin, Berlin, Germany

[b] Siberian Branch of Russian Academy of Science, Institute of Soil Science and Agrochemistry, Novosibirsk, Russia

[c] Institute of Plant Production and Agroecology in the Tropics and Subtropics, University of Hohenheim, Stuttgart, Germany

[d] Biological Institute, Tomsk State University, Tomsk, Russia

[e] Central Siberian Botanical Garden, Novosibirsk, Russia
Published online: 09 Oct 2013.

Environmental Education Research, 2013
http://dx.doi.org/10.1080/13504622.2013.839778

Teaching soil science and ecology in West Siberia: 17 years of field courses

Christian Siewert[a,*], Pavel Barsukov[b], Scott Demyan[c], Andrey Babenko[d], Nikolay Lashchinsky[e] and Elena Smolentseva[b]

[a]*Fakultät VI, Institute of Ecology, Technical University Berlin, Berlin, Germany;* [b]*Siberian Branch of Russian Academy of Science, Institute of Soil Science and Agrochemistry, Novosibirsk, Russia;* [c]*Institute of Plant Production and Agroecology in the Tropics and Subtropics, University of Hohenheim, Stuttgart, Germany;* [d]*Biological Institute, Tomsk State University, Tomsk, Russia;* [e]*Central Siberian Botanical Garden, Novosibirsk, Russia*

(*Received 17 November 2012; accepted 25 August 2013*)

Since 1995, soil-ecological field courses across climatic zones in West Siberia have been organized by scientists from Russia and Germany to meet growing demands for better land use practices. They are focused on virgin landscapes and soils undisturbed by anthropogenic influences to facilitate the learning processes by excluding concealing changes and artifacts. The visited landscapes range from taiga near Tomsk and tundra in Altai mountains to desert conditions near the Mongolian border. This article describes the main features of the field courses, the organization, and changes in the content over years. This includes a short description of the field course route, teaching approaches, the dynamics in the number of participants, evaluation results, and others. To explain the successes of the field courses, we suggest that the specific organization methods and collaboration approaches, the motivation of participants by several factors, and the applied interdisciplinary teaching approach should be considered. We hope our experience will facilitate similar teaching in other regions of the world and support a future sustainable use of local human and natural resources.

Keywords: field course; professional education; Siberia; Russia; landscape management

Introduction (soil education challenges and background)

Growing globalization heightens the competition on soil use for production of food, raw material, and energy. Global land grabbing underlines a perception of soils as a natural resource with fast rising economic relevance (Borras and Franco 2012). These facts confirm findings of Montgomery (2010) about soils as a critical survival factor of human civilizations in history with implications for modern life.

This trend generates increasing needs in both soil education and soil science. Across competing demands from agriculture, forestry, horticulture, landscape planning, and other human activities, soils should become the visible base of life to the public. In contrast to water and air, soils have to be recognized as a non-renewable

*Corresponding author. Email: cs@csiewert.de

resource, that if not conserved will have long-term consequences on the quality life (Commissions of the European Communities 2002).

Similar considerations are reflected in several decisions of governmental organizations, the European Community, and FAO (Bruinsma 2011; European Commission 2012). However, in a few cases, this can have contrasting effects. For example, so-called Anthrosols and Technosols were introduced as soil types to communicate specifics of land use in urban areas (Rossiter 2007). Such soil definition fits with the idea that we are now in the Anthropocene, that human intervention is a dominant ecosystem force but can provoke misunderstandings. Both types of soils do not fit in the common concept of soil as a natural body usually formed during long-term soil evolution in ecosystems with several functions in the biosphere (Commissions of the European Communities 2002). In contrast, construction of roads and buildings, contamination, and drastic disturbances of geological material become some of the repeatable 'soil' creation processes. This may produce misunderstandings in the nature of the soil, which can be clarified by improved laboratory methods to distinguish natural soils from other soil like geological materials containing organic carbon (any mixture of organic and mineral substrates such as composts and gardening muds, or soils with ashes, charcoal, soot, etc.).

Here, we report attempts to increase knowledge about natural soils by organizing special education events by means of soil-ecological field courses in West Siberia. These field courses were focused on natural soils, undisturbed by anthropogenic influences, to facilitate their recognition as a unique base of life without modifications induced by human activities, which may conceal or cause confusion about the natural soil forming processes. Crossing a wide range of climatic zones with landscapes of extreme beauty in a relatively short time, we did not follow actual trends as described for example by Caliskan (2011) but strived to stimulate deep discussion on global challenges in natural sciences, to initiate new approaches, and to motivate the participants to use their own practical life experience to maintain our non-renewable base of life for future demands. Scientists, lecturers, and selected students of all environmental fields of studies as well as professionals, government employees, and environmental related firms were invited to participate.

The field course concept was not developed using discipline-specific teaching principles, for example as described by Field et al. (2011). It was based instead on the best Russian traditions in soil science, which have not been published in English until now. The applied approach and focus on virgin landscapes were derived from an understanding of soil formation as a product of climate and other soil forming factors, first suggested by the father of soil science, Russian Professor Dokuchaev (1879). He was inspired by the natural conditions in European Plain (western part of Russia bordered by the Ural Mountains in the east) with low variations in geological parent materials and by the absence of significant mountain ranges over a wide range of climatic conditions from north to south. Such zonal transitions make the influence of climate impact on a variety of eco-system processes simpler to recognize (s. Figure 1).

For such considerations, the specific natural conditions in the East European Plain have been used by Russian universities since the end of the nineteenth century in 'zonal training courses'. Because of the growing relevance of global climate change, we used the soils in different climatic zones as a model for climate-induced changes and as a starting point for our field courses.

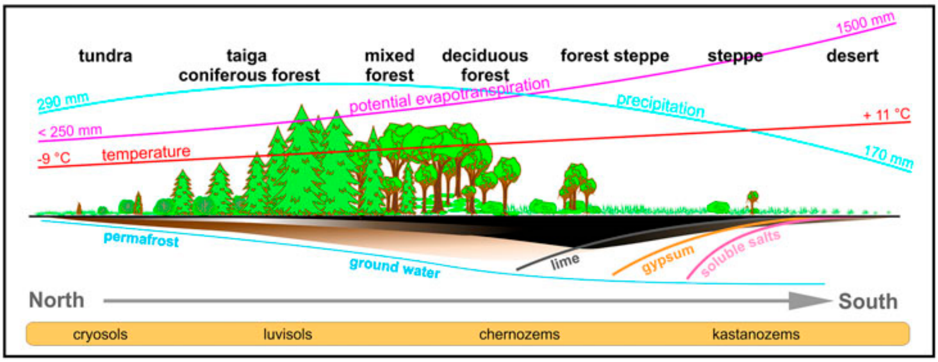

Figure 1. Climate, vegetation. and soil formation in East European Plain (modified from Walter 1968).

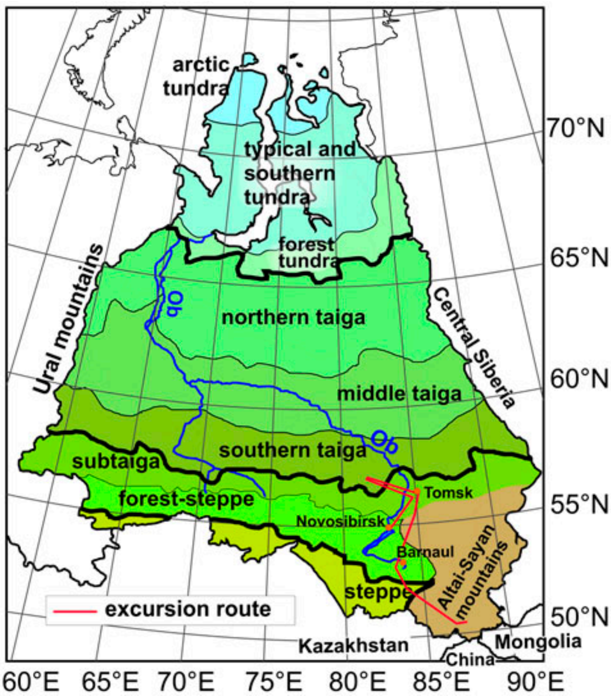

Figure 2. Bioclimatic zones and field course route in West Siberia.

The field courses took place in West Siberia (Figure 2). The region is defined as the area between the Ural Mountains and the Yenisei River. West Siberia has features similar to the East European Plain, but has a larger surface area, a stronger continental climate, larger diversity of soils, and more contrasting climate conditions due to mountains in the south. In addition, this region is characterized by several sites untouched by human activity at the same latitudes compared to Central Europe. This feature makes the region especially attractive for comparative studies.

Methods of field course organization

Due to the lack of appropriate touristic infrastructure and the specific natural conditions in Siberia, our field courses were organized as self-serving and self-sufficient expeditions. Two medium-size buses, a lorry, and a car usually accompanied the groups of participants for the whole field course period. All transportation was equipped with electricity convertors and charging devices to enable the participants to use cameras, notebooks, and mobile phones during travel. Accommodation for participants was organized in tent camps typically near water bodies (lakes or rivers) or, in a few cases, in regional research institutes or other public buildings.

A specialized Russian service team was responsible for the management of the daily challenges including completion of all bureaucratic demands (e.g. visa formalities and registration of foreigners), reliable transport, food supply, accommodation, and organization of cultural events. The team consisted of drivers, a cooking team, and several assistants under the supervision of an enterprising group of Russian scientists mostly from the Institute of Soil Science and Agrochemistry (belonging to the Siberian Branch of the Russian Academy of Science) in Novosibirsk, Russia. It was organized in close collaboration with Siberian universities, non-governmental organizations, and with most influence of the ‘Centre for Management and Quality of Education’ at Tomsk State University in last years.

We found this method of organization helpful from the very beginning to avoid possible challenges in relation to crime (very rarely in remote regions the field courses have taken place), traffic safety, and answering other local challenges. It reduces common fears and prejudices about Russia and Siberia for facilitated participation.

To meet the educational demands of participants from western countries, the field course content was adapted to the needs of universities in Germany, Austria, and partly the USA, with several collaboration agreements. These agreements included minimum qualification requirements for participants, organization specifics (amount of participants, time schedule, etc.) costs, insurance subscription, teaching content by subjects, and partly the rules for recognition of education results at universities in the home countries of the participants.

We used all available teaching methods including lectures, seminars, guided-walks, and individual instruction. In contrast to many other soil field courses or other subject-specific field courses, we tried not only to teach about soils but also to provide information from other fields of study influencing soil formation (e.g. geology, geomorphology, climatology, plant and animal ecology, agriculture, and forestry). For this purpose, the field courses were permanently presided by at least four Russian scientists from different fields of knowledge with appropriate language knowledge and excellent didactic skills, representing leading universities and research institutes in Novosibirsk, Tomsk, and Barnaul, Russia. In addition, several scientists from other local institutions were invited on a part-time basis to inform the participants about regional environmental problems, local land use traditions, and interesting ongoing research projects.

Trips to undisturbed ecosystems without any roads or trails were used to motivate the participants to experience landscapes by means of walking barefoot, touching, hearing, smelling, and even tasting. These sites were contrasted with visits to various native, low impact land uses and also areas which are still influenced by the legacies of former Soviet planning. This led to a range of sites included in the field course from (a) undisturbed reference areas of different climatic zones, (b) sites of local traditional low-input land uses (grazing on desert steppe and small scale agriculture), and (c) drastically disturbed environments (drained peatlands, surface gold mining along small river valleys and erosion gullies induced by agriculture).

The field course has been evaluated since 1997 to monitor and improve the quality of teaching. At first, we used oral surveys; later, we combined these with several anonymous questionnaires. The latest assessments included questions about the quality of teaching, most valuable natural objects, and sites, suggestions for field course improvement, and possible gaps in scientific information. For this purpose, we used the German five-grade scale from grade 1 for excellent to grade 5 for unsatisfactory.

Based on the agreements with German universities, participants frequently used the chance to participate in voluntary examinations in different fields of knowledge, especially in the last few years.

Results

Development of the field course route and program

Since 1995, when the first field course in Siberia took place, we have followed the same aim to present soils as a product of interactions between climate, geology, vegetation, and fauna that are unchanged by human activity, by visiting different climatic zones in the West Siberian Plain and Altai Mountains (s. Figure 3). However, the route and program have been modified several times in order to follow global trends or the wishes of participants.

For example, in the first years, only some groups visited the northern sites with southern taiga and the world's largest peat bog. Later, it became a permanent part of the field course route (sites 1, 2, and 3 in Figure 2 and Table 1) due to the growing interest in untouched by human activity wetlands.

Since 1999, the field course route has been extended from the Seminskiy Pass farther to the south along newly constructed roads, thanks to growing experience of the service team and better reliability of vehicles for transportation (sites 9–13 in Figure 3 and in Table 1).

Presently, the field course route has covered large areas of both the West Siberian Plain and the Altai Mountains. The first part included the latitudinal bioclimatic zones from the southern taiga to the typical virgin steppe ecosystems. In the second part, the field course covered all elevation belts from the mountain tundra to deserted steppes of Central Asia at an elevation of 1800 m above sea level. The most southern field course site was located in the biggest Altai Mountain depression nearby the four-corner border of Russia, Mongolia, China, and Kazakhstan.

The total distance of the field course round trip for 24–26 days was about 2900 km with stays at individual sites lasting between one and three days. A list of the main sites is given in Figure 2, and is shortly described with a few highlights in Table 1.

Several other modifications took place nearly every year (sites marked by grey circles in Figure 2), which were selected according to the wishes of participants but could not be visited every year due to time limits, high costs, or other reasons. They included places which were distinguished by excellent teaching possibilities about:

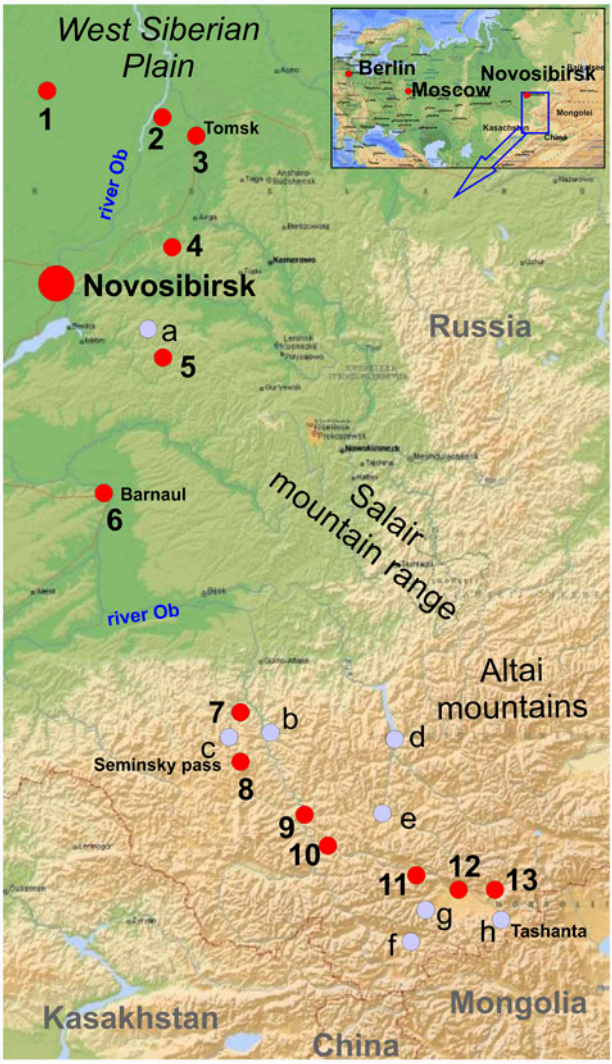

Figure 3. Route of field courses (basic map modified from Google maps). Numbers 1 to 13 represent sites described in Table 1. Temporary visited sites are a: Jurty, b: Chemal, c: Shebalino, d: Teletzkoye lake, e: Ulagan/Tschulyschman, f: Karagem pass and Karagem glacier, g: Beltir, and h: Tashanta (description in the text).

- long-term consequences of improper water resource management by renewable energy production (Jurty),
- dry meadow and steppe development on old river terraces (Chemal),
- soil and vegetation development in mountain forest-steppe and visit to regional cultural museum (Shebalino),
- Telezkoye Lake (the little brother of Lake Baikal) with unique fauna and vegetation in a very beautiful, mostly pristine environment,
- regions with natural contamination of heavy metals, deep canyons formed by

Table 1. List of main sites and with selected highlights along the field course route.

Nr.	Nearest city/village	Bioclimate zone/belt	Specifics and highlights
1	Plotnikovo	Southern taiga	Pristine taiga and southern point of the world's biggest raised bog (Big Vasjugan bog)
2	Kireevsk	Subtaiga	Old growth (natural) pine forests on sandy parent material as reference objects for European pine plantations
3	Tomsk	Subtaiga	One of the oldest Siberian cities with modern urban development
4	Chebula	Forest steppe	Naturally fragmented open park-like landscape of high aesthetically pleasure
5	Mungai	Blackish taiga	Gigantic perennial forbs on apparently poor soils with surprising similarities to tropical rain forests
6	Barnaul	Forest steppe	Natural meadow steppe ecosystems, field experiments on soil protection and large diversity of crops at the Altai Research Institute of Agriculture
7	Kamlak	Mountain forest steppe	Intact hotspots of biodiversity of higher vascular plants in a temperate climate with more than 120 species per 100 m^2
8	Seminskiy pass	Mountain forest and tundra	Cryogenic soil formation processes and landscapes of cold mountain areas with different land-uses and virgin forests of Siberian pine and subalpine meadows
9	Aktash	Mountain forest steppe	Cryogenic consequences of relief formation and vegetation in nearly undisturbed mountain river valleys
10	Kurai	Typical steppe	Large intra-mountain depression with typical steppe vegetation
11	Chagan-Uzun	Cold semi-desert	Painted deserts/coloured landscapes, desert varnish, Pleistocene lake sediments and relict Pleistocene ice, high mountain continuous permafrost
12	Ortolyk	Arid high mountain	Huge high mountain depression, deep canons, varves, typical deserted steppes of Central Asia and traditional land use
13	Kokorya	High mountain steppe	Open landscapes of extreme beauty formed by glaciation with tundra-steppe vegetation

glaciers in past and traditional land use (Aktash, Ulagan, and Tschulyschman),

- impressive Alpine meadows unchanged by human activity and of high biodiversity, landscape formation by recent glaciers, and consequences of climate change (Karagem Pass and Karagem glacier), and
- landscape transformation by recent earthquakes (in autumn 2003) and land use in dry mountain steppe conditions (Beltir).

General teaching approaches

Both the education in undisturbed ecosystems and the organization of field courses in Siberia were connected with several unique challenges and opportunities. We aimed to adjust the teaching methods to the needs of every group of participants. Nevertheless, there are some stable aspects and trends in teaching.

For example, the first field course took place in Russian language with translation of all teaching events to German. In all following years, the Russian lecturers were selected considering language knowledge or they improved their language knowledge on their own initiative. Moreover, the members of the Russian service team were also selected by their communication abilities. Despite the adoption of English as the main field course language, at least one interpreter with excellent language knowledge in Russian and English was available during the whole day with each group of participants, supporting presentations of local scientists and communication of participants during free-time activities.

Another trend in teaching was the preparation of participants prior to the field course. All teaching of the first field courses started in Siberia. Later, the field courses began to start with more and more preparation of participants in Germany. In the last few years, we used 4 to 5 months before the field course to communicate organizational specifics, compensate distinguishing knowledge in natural sciences, inform participants about wildlife rules and we also used the preparation for voting about specific wishes and for the determination of focus contents of the groups.

After the arrival of the groups in Siberia, we started with a review lecture on the biogeography of West Siberia. The participants were provided with a printed guidebook containing a basic description of all sites and the most interesting sites/features that were to be visited during the field course route. Additionally, brief safety instructions were given to every participant with emergency telephone numbers (which have not yet been used).

The main teaching events at each of the 13 main sites along the route were organized as field seminars. They usually included a theoretical part, practical exercises, walking around with additional exercises, and a synthesis at the end. These seminars were led by four or more Russian lecturers who systematically alternated with each other depending on their area of expertise and content of the lecture (e.g. climate, geomorphology, geobotany, zoology, and soils). Later, a deeper insight into geological parent material, plant and animal communities, soil formation processes, and different ecosystem adaptation processes was given with field-specific teaching methods and in a few cases in smaller groups. Since 2009, we have been selecting a special day at the beginning of the route for practical training devoted to field methods for studying and observing soils, vegetation, and soil fauna.

We explained each and every soil profile located under natural (undisturbed by human activity) conditions in its corresponding vicinity. For this purpose, every year at every site, we use freshly dug soil profiles to avoid disturbance from past profiles. Where it made sense, the explanations were extended to ecosystems and soil profiles in the vicinity forming a catena in order to illustrate variations in soil formation induced by relief patterns, different geological parent materials, changes in water supply, vegetation, or other influences.

While studying, participants learned to capture, describe, and link information from different fields of knowledge. Working in an environment undisturbed by human activities, we strived to make the perception and connection of information easier by excluding concealing changes in soils, and plant or animal communities induced by typical human influence.

Soils were classified using World Reference Base (IUSS Working Group WRB 2006), German (Eckelmann et al. 2005) and Russian classifications (Egorov et al. 1987; Kothekar 1987) to discover advantages and disadvantages of distinguishing regional and global approaches.

Walking through a landscape without any roads or trails opened the emotional access of participants to natural landscapes. We considered it as an indispensable addition to the main program that helped the participants to process and consolidate the knowledge gained during the lectures and field visits.

Typical challenges of the modern life of the local population were demonstrated by visiting neighboring landscapes under various land uses. These comparative studies helped visualize the influence of human activities on soil and vegetation, land use, water quality, and human health. This motivated the students to think about the necessity of soil conservation, keeping biodiversity and other nature protection activities together with the challenges of productive land use and of landscape management as logical applications of newly obtained knowledge.

In spite of our fears, participants easily adapted to travelling between sites at a low speed (maximum was 60 km/h). This made it possible to read the guidebook, arrange consultations, discuss questions in small groups, prepare the next sites or simply to sleep or rest. We usually did not disturb these individual habits by explanations during travelling. But, long-distance travelling was regularly interrupted by short (20–30 min) 'scientific stops' which were dedicated to observing small natural objects of special interest on the way such as unique plant communities, soils in open pits, rock outcrops, river terraces, landslides, and other features. Additional stops were initiated by wishes of the participants to take photos of beautiful landscapes or interesting natural objects.

The working day usually ended with preliminary planned investigations of plants, minerals, soil animals, and other samples collected by participants. Apart from this, Russian scientists arranged consultations at the request of individual participants or small groups of participants.

In addition, overnight stops in facilities with permanent power supply were used by Russian lecturers to give presentations on selected themes, e.g.:

- History of agriculture and rural development in Siberia and modern tendencies,
- Bogs of West Siberia,
- Siberian steppes: degradation, rehabilitation, and sustainable use for stockbreeding,
- Officinal plants in Siberia,
- Altitudinal zonality of the Altai mountains,
- Kurgans as an example of the ancient nomad culture,
- Shamanism and culture of the native Siberian peoples, and
- Nature protection systems in Russia.

Changes in the number of participants

In 1995, the field courses started with a group of 19 international participants. For the last years, one field course group had between 25 and a maximum of 32 international participants mainly to ensure the target teaching quality. For several years, the Russian service team was able to support up to two groups. The resulting number of all participants since 1995 is shown in Figure 4. It includes the number of participants in our regular field courses and in associated field courses which will be mentioned later.

The number of potentially interested applicants is not included, as this was not regularly recorded. For example, in 2011 the number of applicants was four times as

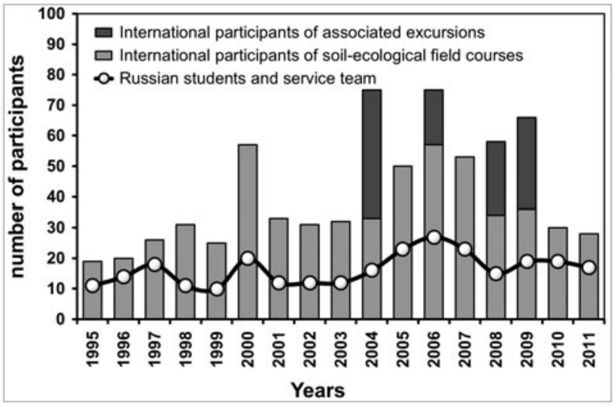

Figure 4. Number of participants in teaching projects in Siberia.

high as the amount of vacancies (about 120 registrations for 30 vacancies). We had never experienced vacant places.

The entry list of participants varies from year to year. Most international participants come from Germany and Austria, with a very few from other European countries, the USA, and Japan. The share of students among other international participants (scientists, lecturers, and employees of governmental institutions and enterprises) increased from less than 50% up to 90 % in the last years. This increase was mainly in connection with support by DAAD (German Academic Exchange Service) for German students that became very generous in 2009.

As to Russian participants, the core service team consists of permanently participating scientists (4–7), a cooking team (3–5), and drivers (3–4). However, the number of Russian students and assistants from local universities taking part in the field course changed from year to year (Figure 4). Often, they attended for a selected period for several reasons.

Field course evaluation

From the very beginning, we have collected students' impressions and feelings by talking to them. Later, we regularly organized an anonymous written questionnaire on a voluntary basis. This included questions characterizing all field course events from organization details to teaching. Here, we present results of evaluations from 2008 to 2011 which are currently in use for ongoing improvement of the field course. The number of participants varied from 28 to 35 and the percentage of respondents in a group of participants was of 75–91% of the total during these years.

Considering different traditions in western countries, difficulties encountered traveling in Siberia, and language barriers, we expected several challenges in organization and communication during the field courses. Our partners from European universities felt additional fears about safety. But, despite fears of cultural shock and lack of travel amenities, these issues never provoked negative impressions. For example, we feared the long distances and travelling on bad roads during some days of the field courses would be tiresome for the participants. However, in mean, only around 11% of the responded people mentioned 'too long of travel times' during very few days.

The Russian service team offered only typical Siberian cuisine during the field course. Nevertheless, the food supply during field courses was recognized as rather good. We never felt any challenges in this direction over years. On average, 73% participants found food 'excellent (tasty and diverse).' However, in the last two years, about 9% of participants complained of too much meat and 6% not enough meat.

It is still not usual to logistically manage the travel of foreigners in the interior of Russia. Despite this, only 17% of participants referred to a temporary lack or single gaps in everyday organizational information details. Greater than 40% of participants did not recognize any challenges in organization. When asked for assessment of German organizers and Russian team, we got grades of around 1.5 for organization and preparation in Germany and around 1.3 for the time in Siberia with low variations over years (±0.3 grades).

Asking for other possible improvements, 23% of participants cited a lack of free time or too intensive scientific and educational program. Further, approximately 20% of participants suggested larger (more spacious and comfortable) buses. And, around 10% of participants asked for closer contacts to students of local Siberian Universities. Very rarely, participants mentioned language problems that resulted in some loss of information connected with translations of presentations from the local scientists. Overall, around 45% of participants did not cite any wishes for improvement of organization and everyday life during the field courses.

Trying to improve the field course content, we asked the participants about the most valuable sites and scientific information. In the answers, we found a changing perception over the years. In the past, most participants found the exceptional beauty of the landscapes in the Altai Mountains most impressive (up to 80%). Later, the world's largest raised bog received higher praise from around half of the participants. And, the typical forest-steppe near Barnaul and the Altai Mountains were mentioned by participants with less relevance (49 and 37%, respectively). Typically, we did not get wishes to exclude sites or to add other ones when given the choice (93%). In the last few years, we registered a growing interest in geomorphology and in land use technologies. Further, around 20% of participants were interested in more details about culture and history of Siberian peoples.

As a result of invitations of former foreign participants, several Russian lecturers participated in international research projects. This led to substitutions of Russian lecturers for new ones over the years because they were busy with scientific research and could not participate on the field course. Nevertheless, the assessment of teaching quality by all participants (including employees and scientists) was every year on a quite high level (Table 2) with usually low variations (less than 0.4 grades).

In addition, the effect of teaching on student education was assessed by examination results. For this purpose, 20–35 questions for every subject were agreed on with professors from German universities who attended the field courses. Around 75% of all student participants took advantage of the suggested exams on a voluntary basis to finish diploma courses at home universities. They finished courses in up to three fields of knowledge (diploma students) or up to two modules (bachelor students, five European Credit points each).

Table 2 summarizes the marks obtained by students in exams (around 75% of student participants) and the mean grades of teaching quality assessed by all field course participants (including employees and scientists) both in the German grading

Table 2. Evaluation of teaching by subjects (teaching grade) and by examination results (examination marks) obtained by students for 2009–2011.

Subject	Teaching grade	Examination marks
Soil science	1.4	1.6
Soil zoology and animal ecology	2.0	1.5
Geobotany and vegetation ecology	1.6	2.6
Geology and geomorphology	2.0	1.9
Regional climatology	1.6	1.4
Landscape science	1.8	2.4

Note: Based on German grading system ranging from 1.0 (excellent) to 5.0 (unsatisfactory).

system (from 1 excellent to 5 unsatisfactory). So far, all examination marks were accepted by universities in all the home countries of participants without exception.

Field course multiplier effects

Without our assistance, the field course had numerous unplanned 'multiplier-effects' mainly initiated by former participants. In relation to this, we would like to mention the following:

(1) Organization and implementation of several similar educational events in Siberia which differed from our field course in the focus on education of undergraduate and graduate students on behalf of individual universities in EU and the USA:

- Field course 'Plant Ecology and Soil Science of Siberian Tundra' of 27 days under the supervision of Professor Andreas Richter (Vienna University, Austria) in 2004 and 2009
- Field course 'Environmental Field Studies in Siberia' of 56 days lead by Professor Gregory Gangi (University of North Carolina at Chapel Hill, USA) in 2006
- Summer school 'Vegetation and Landscapes of West Siberia' of 23 days organized on behalf of Professor Joerg Pfadenhauer (Munich Technical University, Germany) in 2008 (Pfadenhauer 2009)

(2) Implementation of these studies in Siberia by international master students under the leadership of both European and Siberian scientists. A majority of the students came from Germany, Austria, and Switzerland (University of Applied Sciences Osnabrueck (Germany), Technical University Braunschweig (Germany), Technical University Berlin (Germany), Humboldt University in Germany, Vienna University (Austria), and Basel Technical University (Switzerland)).

(3) Many joint research projects have been initiated by former participants on environmental aspects in Siberia and supported by DFG (Deutsche Forschungsgemeinschaft, German Science Society), DAAD (German Academic Exchange Service), BMBF (German Federal Ministry of Education and Research), DBU (Deutsche BundesstiftungUmwelt), Austrian Academic Exchange Service (ÖAD-WTZ), and European Research Framework Program.

(4) Two conferences were organized in Germany supported by German Academic Exchange Service (DAAD) and Bavarian Ministry of Education and Research to strengthen the collaboration and communicate field course results.

Discussion of reasons for successful implementation so far and open questions

The first soil field course to Russia was organized in connection with a soil research project sponsored by DFG (German Science Foundation) in 1993. It was dedicated to a collection of soil samples in virgin landscapes and to create a reference base for different types of soil use. The surprisingly high interest in the field course along with valuable scientific results led to the organization of similar field courses in Siberia in the following years. We consider the long-term vitality of the field courses as a sign of unexpected and unplanned success. One of the reasons for this could be the growing needs in understanding regulation processes in ecosystems, and to meet the growing challenges of sustainable soil use, climate change, and world economic development (Montgomery 2010). In fact, visits to natural ecosystems seem to facilitate the understanding of interrelations between climate, geology, soil, vegetation, and fauna development by the clear visible interrelations of landscape components (e.g. natural border formation between meadow and forest vegetation and high diversity of vegetation in forest-steppe environments, s. Figure 5) and Trommer (2005).

In western Europe, all landscapes have changed during the long history of land use, and area-wide contamination by acid rain, heavy metals, and pesticides. In Siberia, the landscape has been largely isolated from these impacts. The absence of

Figure 5. Park-like forest-steppe near Chebula with natural border between old growth birch forest and meadows of high esthetic relevance and biodiversity.

concealing changes and artefacts (e.g. as described by Van Bremen 2002) makes the learning process much easier.

In fact, the population density in the region is on average two persons km^{-2} and it goes down to <0.1 persons km^{-2} in some administrative units of Siberia. It remains preserved because until now several unique natural processes have still not scientifically explored. Several of them are of very high practical relevance even for world production of food, raw materials, and fuel. One example is the giant (for unknown reasons) herbaceous vegetation in Blackish taiga on watershed sites of Salair mountains as a hint on extremely high productivity of ecosystems far from any external nutrients sources with high plant species diversity (e.g. Figure 6, Table 1, site 5). Such examples make the region attractive not only for scientists but for practical workers in agriculture, forestry, and gardening.

The exceptional beauty and wealth of undisturbed landscapes motivated the participants to new ways of thinking as it was already mentioned in publications of former field course participants (e.g. in Trommer 2012). We tried to support these processes by comparing virgin sites with the consequences of natural resource consumption in neighbouring landscapes and by combining teaching in natural sciences with regional features of cultural and historical development together with advantages and limits of regional traditions in land use.

Another advantage of our field courses could be the offering as a soil-ecological course across different bioclimatic (latitudinal) zones in the lowlands and altitudinal belts in mountains in a relatively short time. Together with visits of virgin landscapes, this makes it possible to experience the world's greatest diversity of plants, ecosystems, and landscapes in a temperate climate with unique hot spots of biodiversity (sometimes with more than 120 species 100 m^{-2}) next to managed land.

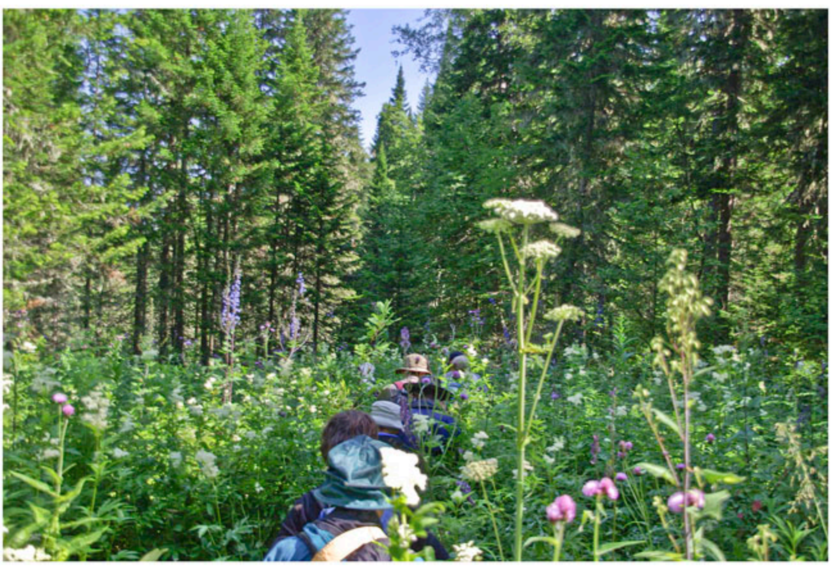

Figure 6. Blackish taiga in Salair mountains. Giant herb vegetation in old growth forest without human influence.

For scientists and other stakeholders, of course, the possibility to get information not previously published in the international scientific literature could be an additional argument for participation. They could learn much more about a region which was closed for individual access for several decades in the past and is still difficult to access for individuals.

Using these facts, one can expect fast-growing numbers of participants that seem not to fit with the changing over year's number of participants presented in Figure 4. In fact, interest in the field course increased in the past with;

- information first published on the internet (several scientific results and field course guide book, Smolentseva et al. 2003),
- the announcements in national bulletins of scientific organizations (e.g. German Ecological Society, German Soil Science Society, and Soil Science Society of America),
- publications in university journals (e.g. Babenko and Siewert 2008), and
- reports at international science conferences (Gadjiev et al. 2002; Barsukov and Siewert 2007; Barsukov 2008; Siewert et al. 2009).

Further, the flexible organization and the provision of prospective participants with detailed information in Germany made it possible to invite more and more people with little and later without any outdoor experience. In addition, increased participation could be stimulated by the mitigation of typical Russian obstacles, which foreigners usually meet during travelling in remote regions in Russia such as

- bureaucratic procedures (visa application procedure, registering after crossing Russian border, access permissions to some areas, and language knowledge),
- gaps in tourist infrastructure, and
- overwhelming majority of Russians do not speak foreign languages.

The growing share of scientists among participants was mainly connected with route extensions (see Figure 2) and with inclusion of more and more interesting natural sites. In contrast to scientists and employees, the participation of students was mainly financed by support from DAAD and other foundations. Especially in later years, generous support of DAAD encouraged Germany university student participation.

At the same time, the amount of participants (Figure 4) was limited by a few factors. So, the best time period for the field course was limited to 6–8 weeks in July and August due to climate conditions in Siberia. Further, the possible amount of participants was narrowed by the number of available Russian lecturers with appropriate language knowledge and didactic skills. Any involvement of Russian lecturers in international collaborative projects (s. side effects) reduces their availability for teaching during the field course.

To compensate for these limiting effects, the Russian organizers permanently search for and recruit new lecturers. For the last years, they pay more attention to coach new, young Russian scientists to our field course with several successes.

Many other challenges were solved by the organization of the field course as a self-serving expedition with a permanent service team as a unique, traditional Russian approach. It allows independent operation from local shops, restaurants, hotels, and roads of varying quality. The approach implied close contacts of the field course participants with local people serving the field course, to their real daily life habits and this way it opened access to the best Russian traditions such as hospitality, generosity, and ability to manage daily duties quickly for participants in a reliable way. Even widely travelled people were able to gain new insights into natural ecosystems after their experiences during the field course.

Taking into account the main goals of the field course and its intensive program, we did not follow the wishes of several student participants for more free time and for spending two or more days to explore the spectacular and remote wild places. In a few other cases, it was simply not possible to meet the wishes of the participants. For example, buses that are more comfortable could essentially limit the off-road driving in Siberia and seriously increase the field course costs without improvement of scientific content.

Since we have started to evaluate the teaching quality and learning results, they confirmed a high level of education (see Table 2). Examination results were periodically reviewed in German partner universities without any negative response or hints on recognition problems. Several reasons can be given for the high level of examination marks:

- high motivation of participants paying for education,
- unique stimulation effect for learning by the exceptional beauty of landscapes together with the simplicity of visible and tactile interrelations between geology, climate, vegetation, fauna, and soil formation,
- the repeated and successive changing of given information during travelling across changeable climate conditions first in lowlands (from north to south) and later in mountain areas (from lowlands to highlands),
- practical trainings in wildlife the whole day, even outside of any teaching events,
- traditionally high level of education in natural sciences in Russia and the leading position of several Siberian universities where the Russian field course lecturers came from, and
- specific learning conditions inside of a self-serving expedition which distinguishes from usual field trips and most field courses in Europe by,
    - absence of any distraction by typical offerings of urban ‘civilized’ life,
    - considerate care of participants by the Russian service team 24 h a day,
    - excellent ratio of Russian lecturers speaking English or German to the number of foreign students in field course groups (from on average 1:4 to 1:7 in last three years).

Conclusions

We conclude from these considerations that there is the necessity to further develop the field course keeping its main unique features such as

- focus on various virgin landscapes as reference objects for changed or artificial environments,
- interdisciplinary approach to land use based on soil science,
- combination of natural sciences with modern technological development and with respect to historical, political, and social concerns of local peoples,

- sustainable motivation of participants for new thinking approaches,
- organizational approaches and skills in Russia, and
- joint travelling of local and foreign scientists and students.

Nevertheless, future field courses should:

- maintain or extend the capacity of participants,
- offer recalibrated connection to research projects for scientists and specialists; and practical trainings for students on selected sites,
- promote the closing of gaps in scientific publications about Siberia in international journals,
- provide benefits for the local communities (whether economic, cultural exchange, etc.)

Further, we hope our field course can help to eliminate still existing prejudices about Siberia, overcome gaps in political understanding between Russia and other European countries, and help to develop similar valuable joint education initiatives in other parts of the world.

Acknowledgements

We would like to express our thanks to all people who had supported the field course development especially to Dr Boris Smolentsev, Dr Svetlana Gizhitskaya, Dr Sofia Platonova, Dr Ilya Lubechanskiy, Dr Marina Dirks, Mr Sergey Loiko, and Ms Olga Rusalimova. Thanks to all open-minded participants who have used and supported our ideas for many years by their own participation. Special thanks to Ms Svetlana Gretton (Essex University, UK) for advice and support on this manuscript.

Notes on contributors

Christian Siewert is a full professor for Soil Science and plant nutrition at the Technical University of Applied Sciences Dresden (Germany). He started his soil teaching initiatives in Russia in 1993 whilst working as a scientific assistant at Technical University of Berlin, Institute of Ecology. To the present day this university hosts the excursions in Siberia and is used by Christian Siewert for other professional academic education initiatives. His scientific interests are focused on better understanding of soil formation in untouched by human activities environments as a reference for sustainable land use technologies development and on public soil awareness.

Pavel Barsukov is a leading research scientist and a scientific secretary for international cooperation at the Institute of Soil Science and Agrochemistry in Novosibirsk (Russia). His leadership in organization in Russia makes it possible to carry out the excursions in Siberia in close collaboration with increasing numbers of regional scientists and with continuous improvement of teaching quality.

Scott Demyan works currently as a postdoc at university in Hohenheim (Germany). He has supported the development of excursions in Siberia since he was one of the first participants from the United States of America and he supports the publication of the results of our common long term teaching experiment.

Andrey Babenko directs as a full professor the Department of Quality Assurance at Tomsk State University. He teaches soil zoology with scientific focus on soil invertebrates, bio-indication of land use and biological methods of waste decomposition.

Nikolay Lashchinsky is a leading scientist at the Central Siberian Botanical Garden in Novosibirsk. He is well-known in Russia as a teacher in botany, is experienced in giving lectures in several parts of the world and has a scientific focus on botany, geography of vegetation cover and land use changes.

Elena Smolentseva works as scientific researcher at the Institute of Soil Science and Agrochemistry, Novosibirsk. She teaches soil science during excursions in fluent German and in English. She leads several international research projects about desertification, fertility indicators of agricultural soils and climate change impacts in boreal and subarctic ecosystems on soil functions and water quality.

References

Babenko, A., and C. Siewert. 2008. "Landscape Ecological Excursions: Experience in International Collaboration of Universities in Russia and Germany [Landschaftsökologische Exkursionen: Erfahrungen in der internationalen Zusammenarbeit von Universitäten in Russland und Deutschland.]." *Ekologia* 1: 88–175 (in Russian), Tomsk.

Barsukov, P., and C. Siewert. 2007. "Soil Teaching at Annual Soil-Ecological Summer Schools in Siberia." *Mitteilungen der Deutschen Bodenkundlichen Gesellschaft* Band 110 (Heft 2): S. 781–782.

Barsukov, P., T. Watanabe, and T. Kosaki. 2008. "Soil Teaching at Annual Soil-Ecological Excursion in Siberia." Abstracts of the Annual Meeting. Japanese Society of Soil Science and Plant Nutrition, Nagoya. vol. 54, 203.

Borras Jr, Saturnino M., and Jennifer C. Franco. January 2012. "Global Land Grabbing and Trajectories of Agrarian Change: A Preliminary Analysis." *Journal of Agrarian Change* 12 (1): 34–59.

Bruinsma, Jelle. 2011. *World Agriculture: Towards 2015/2030. An FAO Perspective*. London: Earthscan.

Caliscan, O. 2011. "Virtual Field Trips in Education of Earth and Environmental Sciences." *Procedia Social and Behavioral Sciences* 15 (2011): 3239–3243.

Commissions of the European Communities. 2002. "Towards a Thematic Strategy for Soil Protection. Communications from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions." *Bruessels*. Accessed April 16, 2002. COM (2002) 179 final.

Dokuchaev, V. V. 1879. "Abridged Historical Account and Critical Examination of Principal Soil Classifications Existing." *Transactions of the Petersburg Society of Naturalists* 10: 64–67 (in Russian).

Eckelmann, Wolf, H. Sponagel, W. Grottenthaler, and K.-J. u.a. Hartmann. 2005. *Bodenkundliche Kartieranleitung* [Instructions for Soil Mapping]. Ad-hoc-Arbeitsgruppe Boden der Geologischen Landesämter und der Bundesanstalt für Geowissenschaft und Rohstoffe der BRD. 5. verbesserte und erweiterte Auflage. Hannover: Schweitzerbart-Verlag.

Egorov, V. V., V. M. Fridland, E. N. Ivanova, N. N. Rozov, V. A. Nosin, and T. A. Friev. 1987. *Classification and Diagnostics of Soils of the USSR*. Moscow: Pochvennyi institut imeni V.V. Dokuchaeva. Moscow: ISBN 90-6191-465-5.

European Commission. 2012. "Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of Regions. "The implementation of the Soil Thematic Strategy and ongoing activities." Brussels, COM. 46 final.

Field, Damien J., Anthony J. Koppi, Lorna E. Jarrett, Lynn K. Abbott, Stephen R. Cattle, Cameron D. Grant, Alex B. McBratney, Neal W. Menzies, and Anthony J. Weatherley. 2011. "Soil Science Teaching Principles." *Geoderma* 167–168 (2011): 9–14.

Gadjiev, I. M., C. Siewert, and P. Barsukov. 2002. "Annual Soil-Ecological Field Course across West-Siberia." *Bulletin of the International Union of Soil Science* 1 (101): 58–59.

IUSS Working Group WRB. 2006. *World Reference Base for Soil Resources 2006*. World Soil Resources Reports No. 103. Rome: FAO.

Kothekar, V. S. 1987. *Classification and Diagnostics of Soils of the USSR*. Moscow: CRC Press. ISBN-13: 9789061914655.

Montgomery, David. 2010. *Dirt: The Erosion of Civilizations*. London: University of California.
Pfadenhauer, J. 2009. "Notes on the Vegetation of the Russian Altai." [Anmerkungen zur Vegetation des russischen Altai.] *Berichte der Reinh.-Tüxen-Ges* 21: 211–225. Hannover, Freising.
Rossiter, D. G. 2007. "Classification of Urban and industrial soils in the World Reference Base for Soil Resources." *Journal of Soils and Sediments* 7 (2): 96–100.
Siewert, C., H. Paillan, and P. Barsukov. 2009. "Detactability of Soil Changes." [Nachweisbarkeit von Bodenveränderungen.] *Mitteilungen der Deutschen Bodenkundlichen Gesellschaft*, Boon, September 2009 [*Bulletin of German Soil Science*].
Smolentseva, E., K. Lashinskij, A. Babenko, P. Barsukov, and C. Siewert. 2003. *Guide-Book of the Annual Soil-Ecological Excursion across Western Siberia*. 2nd ed. Novosibirsk: Institute of Soil Science and Agrochemistry.
Trommer, G. 2005. "Informelles zu Natur und Landschaft. [Informations about nature and landscape]." In *Exkursionen – Kolloquium zur Verabschiedung von Gerhard Trommer* [Excursions – Colloquium in Honor of Gerhard Trommer], edited by N. Grootjohann and H. P. Klein, 75–88. Frankfurter Beiträge zur Biologischen Bildung 5, Shaker: Aachen.
Trommer G. 2012. *Schön wild! Warum wir und unsere Kinder Natur und Wildnis brauchen* [Pretty wild! Why Do We and Our Children Need Nature and Wildlife]. München: oekom verlag. ISBN-13: 978-3-86581-295-7.
Van Bremen. 2002. "Natural Organic Tendency." *Nature* 415: 381–382.
Walter H. 1968. *Die Vegetation der Erde in ökophysiologischer Betrachtung. Bd. II: Die gemäßigten und arktischen Zonen*. [The Earth Vegetation from Ecophysiological Point of View. Volume II: The Temperate and Arctic Zones]. Jena: Fischer Verlag.