BGS JAHRESTAGUNG - 4./5. FEBRUAR 2016 IN GENF

INTERNATIONALES JAHR DES BODENS 2015
-
UND JETZT?

VISIONEN FÜR EINE NACHHALTIGE NUTZUNG DES BODENS

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SSP CONGRÈS ANNUEL - LES 4/5 FÉVRIER 2016 À GENÈVE

L'ANNÈE INTERNATIONALE DES SOLS 2015
-
ET ENSUITE?

VISIONS POUR UNE GESTION DURABLE DES SOLS


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SSP CONGRESSO ANNUALE - 4/5 FEBBRAIO 2016 A GINEVRA

L'ANNO INTERNAZIONALE DEI SUOLI 2015
-
E ORA?

VISIONI PER UN USO SOSTENIBILE DEI SUOLI


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4./5. Februar 2016 – hepia Genf

Das Jahr 2016 wird – so hoffen wir – ein wertvolles Jahr für die schweizerischen Böden. Es folgt auf das **Internationale Jahr des Bodens** und lässt uns nun die Frage stellen, was wir aus den Veranstaltungen und Aussagen des IYS2015 für die Zukunft mitnehmen.

Ausserdem neigt sich die erste Forschungsphase des Nationalen Forschungsprogramms Nachhaltige Nutzung der Ressource Boden (NFP 68) des Schweizerischen Nationalfonds dem Ende entgegen (www.nfp68.ch). Der Boden ist bedroht, weshalb die Ergebnisse von besonderem Interesse sind. Die BGS hat eine lange Tradition der Zusammenarbeit zwischen der Wissenschaft und der Praxis. Sie richtet dabei ihren Blick auf nützliche Anwendungen und auf die gesellschaftliche Relevanz. Wir stellen deshalb die Frage nach den Potenzialen der Ergebnisse der Projekte des NFP 68 für deren Verwendung in der Praxis.

Des Weiteren kandidiert die BGS im Sommer 2016 in Istanbul für die Organisation des nächsten europäischen Kongresses der Bodenwissenschaften: **Eurosoil 2020**. Die Schweiz war noch nie Gastgeberin für ein solches Ereignis. Um den Zuschlag zu erhalten, sind wir auf breite Unterstützung angewiesen. Wir stellen unsere Kandidatur unter das Thema der Beziehung zwischen Boden und Gesellschaft. Ziel ist es, neue Impulse sowohl inhaltlich als auch formal in den Kongress einzubringen. Im Hinblick auf seine Form würden wir den EUROSOIL Kongress gerne lebhafter gestalten, indem wir mehr Möglichkeiten des Austauschs einführen, die weniger formell und offener für eine junge Generation von Fachleuten und Forschenden sind. Grundsätzlich wünschen wir uns eine breitere Öffnung hin zur Gesellschaft - durch eine grössere Bandbreite an Themen und die Schaffung einer Balance zwischen Grundlagenforschung und den Bedürfnissen in der Praxis.

Es ist gewissermassen das schweizerische Modell, das wir hervorheben und propagieren möchten. Die Herausforderung ist sehr gross, denn zurzeit gibt es in Europa keine verbindliche Instanz, die Position für Tagesgeschäfte auf nationaler oder internationaler Ebene bezieht.

An der BGS Jahrestagung 2016 ziehen wir somit Bilanz aus dem UNO Jahr des Bodens 2015 und beleuchten die Kernthemen des NFP 68 „Nachhaltige Nutzung der Ressource Boden“.

UNO Jahr des Bodens 2015 - und jetzt?

Vertreterinnen und Vertreter europäischer nationaler Bodengesellschaften wurden an die BGS Jahrestagung eingeladen. An der Session am Donnerstagvormittag empfangen wir die Delegationen dieser nationalen bodenkundlichen Gesellschaften. Wir bitten diese, die nachhaltige Bodennutzung in ihrem Land vorzustellen: aktueller Stand, Probleme und Grenzen, sowie die mögliche und die wünschenswerte Zukunft. Ihre Perspektiven werden zusammen mit der schweizerischen diskutiert werden.

Nachhaltige Nutzung der Ressource Boden

Welche Visionen zeigt uns das NFP 68 auf?
Die Projekte des NFP 68 überschreiten die Grenzen der reinen Bodenwissenschaften, da sich die Forschenden auch für die Wahrnehmung des Bodens in der Gesellschaft und dessen nachhaltige Nutzung interessieren. An der BGS Tagung werden Ergebnisse des NFP vorgestellt und deren Bedeutung und Relevanz diskutiert werden. Da das NFP einen speziellen Fokus auf die Anwendung hat, möchten wir diese Resultate explizit herauskristallisieren. Am Donnerstagnachmittag und Freitagvormittag werden die Forschenden aus den verschiedenen Forschungsprojekten ihre entsprechenden Ergebnisse präsentieren.

Zukünftige Probleme und Herausforderungen
Nachdem wir die wichtigsten Botschaften, die die Projekte des NFP68 aufzeigten, gehört haben, geht der Aufruf an private und öffentliche Akteure. Wie sehen ihre Visionen zu künftigen Massnahmen aus? Mit welchen Entwicklungen ist zu rechnen? Redner und Rednerinnen aus verschiedenen Bereichen (Ingenieurwesen, Landwirtschaft, Raumplanung, etc.) werden gebeten, ihre Visionen vorzustellen.

Les 4/5 Février 2016 – hepia Genève

L'année 2016 sera, nous l'espérons, – une année aussi riche pour les sols Suisses que 2015. Elle fait suite à **l'année mondiale du sol**, ce qui oblige à se poser la question de ce que nous allons retirer pour le futur de toutes ces manifestations et déclarations.

En outre, la première phase de recherche du Programme national de recherche "Utilisation durable de la ressource sol" (PNR 68) du Fonds National Suisse de la Recherche Scientifique est prêt de s'achever (www.pnr68.ch). La ressource en sol est menacée, ces résultats nous intéressent donc particulièrement. La SSP a une longue tradition de coopération entre la science et la pratique. Elle a toujours tourné son regard vers l'application et les enjeux sociétaux. Nous poserons la question des retombées pratiques de ce PNR.

Enfin, la SSP défendra, l'été 2016 à Istanbul, la candidature de Genève pour organiser le prochain congrès européen de Science du Sol: **Eurosoil 2020**. La Suisse n'a jamais accueilli ce type d'événement. Nous avons besoin du soutien de chacun pour emporter la décision. Nous plaçons notre candidature sous l'angle de la relation sol – société avec l'ambition de rénover les congrès Eurosoil dans leur forme et leur contenu. Sur la forme nos souhaitons les rendre beaucoup plus vivants en instaurant des modes d'échange moins formels et plus ouverts aux jeunes. Sur le fond nous souhaitons une grande ouverture vers la société, par un élargissement des thèmes, et en équilibrant les interventions de recherche pure avec des interpellations venant des praticiens.

C'est un peu le modèle Suisse que nous souhaitons mettre en avant et en pratique. Les enjeux sont très grands car à ce jour, en Europe, il n'y a pas d'instance fédératrice en mesure de prendre position pour les sociétés nationales au quotidien.

Bilan de l'année internationale des sols 2015, PNR68, Gestion durable des sols en Suisse et en Europe, sont les thèmes sous lesquelles nous avons donc choisi de placer les journées SSP 2016.

L'année internationale des sols 2015 - et maintenant?

Lors de la séance du jeudi matin, nous accueillerons des représentants des sociétés nationales européennes qui ont été invitées à participer au congrès annuel de la SSP. Nous demanderons à plusieurs d'entre eux, du nord au sud et de l'est à l'ouest, de présenter la gestion des ressources en sol dans leur pays : état actuel, problèmes et limites rencontrés, futur possible et futur souhaité. La situation Suisse y sera également restituée et mise en perspective.

L'utilisation durable de la ressource sol

Quelles visions nous en donne le PNR 68?
Les projets du PNR 68 vont au-delà des limites de la science du sol purs, car les chercheurs sont aussi intéressés à la perception du sol dans la société et son utilisation durable. Ces résultats seront présentés, leur importance et leur pertinence seront discutées. Puisque le PNR met un accent particulier sur l'application, nous tenons à capitaliser explicitement ces résultats. Le jeudi après-midi et vendredi matin, les chercheurs des différents projets de recherche présenteront leurs résultats respectifs.

Quels problèmes et quel futur pour une gestion durable des sols en Suisse ?
Après avoir entendu les principaux messages renvoyés par les projets du PNR, la parole est aux acteurs privés et publics. Quelle est leur vision des cadres de mesures actuels, et des développements à envisager ? Des orateurs des différents domaines (génie civil, agriculture, aménagement du territoire) seront sollicités pour donner leur vision.

4/5 Febbraio 2016 – hepia Ginevra

L'anno 2016 sarà – speriamo – un'annata ricca per i suoli svizzeri. Essa segue **l'anno internazionale dei suoli** dichiarato dall'ONU, un evento che solleva la domanda di cosa è possibile trarre per il futuro dalle numerose manifestazioni e altre iniziative promosse in tale occasione.

Nel contempo il programma nazionale di ricerca **«Gestione sostenibile della risorsa suolo (PNR68)»**, attuato per incarico del Fondo nazionale per la ricerca scientifica, sta volgendo al termine, per cui è arrivato il momento di fare un bilancio. I progetti PNR incentrati sul suolo sono rari, motivo per cui i risultati scaturiti da questa ricerca sono per noi di particolare interesse. La SSP vanta una lunga tradizione nell'ambito della collaborazione fra esperti accademici e professionisti sul terreno. Essa ha costantemente volto lo sguardo verso le applicazioni utili e i temi sociali. La nostra domanda riguarda pertanto le ricadute pratiche del PNR68.

Infine nell'estate 2016 ad Istambul, la SSP porrà la propria candidatura per organizzare a Ginevra il prossimo congresso europeo della scienza del suolo: **Eurosoil 2020**. Finora la Svizzera non mai ospitato un evento di questo tipo. Per ottenere l'aggiudicazione abbiamo però bisogno di un ampio sostegno. La nostra candidatura avverrà all'insegna della relazione suolo e società, con l'ambizione di rinnovare i prossimi congressi Eurosoil sia nella forma che nei contenuti. Per quanto attiene la forma intendiamo rendere questi eventi più vivaci, instaurando modalità di scambio meno formali e più accessibili alla nuova generazione di professionisti e ricercatori. L'obiettivo ricercato è quello di una maggiore apertura verso la società, attraverso un ampliamento delle tematiche trattate e la ricerca di un equilibrio fra gli interventi provenienti dalla ricerca di base e le esigenze dei professionisti sul terreno.

In un certo senso vorremmo proporre e mettere in pratica il modello svizzero. La posta in gioco è alta poiché a tutt'oggi non esiste alcuna istanza in Europa che nella sua gestione quotidiana sia in grado di patrocinare a favore delle società nazionali.

La riunione annuale SSP 2016 diventa pertanto l'occasione per tracciare un bilancio dell'anno internazionale dei suoli 2015 e soffermarsi sull'aspetto fondamentale del PNR68 ossia la gestione sostenibile della risorsa suolo.

L'anno internazionale dei suoli 2015 – e ora?

Nella sessione di giovedì mattina accoglieremo i rappresentanti delle società di pedologia nazionali d'Europa. Li inviteremo a presentare la gestione della risorsa suolo nei rispettivi Paesi: stato attuale, problemi e limiti, futuro possibile e futuro auspicabile.
Parimenti verrà presentata la situazione svizzera e le prospettive legate ad essa.

Gestione sostenibile dei suoli.

Quali prospettive per il PNR68?
I progetti del PNR68 oltrepassano ampiamente i limiti della scienza del suolo in senso stretto per interessarsi alla percezione del suolo nella società nonché alla sua gestione sostenibile. Questo PNR è degno di riconoscimento da parte della SSP che deve prendere atto di quanto fatto e dibatterne le implicazioni.
Quali risultati ha conseguito il programma in termini di riscontri pratici?
Nelle sessioni di giovedì pomeriggio e venerdì mattina chiederemo ai relatori di presentare le implicazioni pratiche dei loro studi di ricerca.

Quale futuro e quali sfide dobbiamo affrontare?
Dopo aver ascoltato i principali messaggi emanati attraverso le conclusioni dei progetti del PNR68, gli attori pubblici e privati vengono invitati a prendere la parola. Quali provvedimenti futuri intravvedono? A quali sviluppi si potrà assistere? Agli oratori attivi in vari ambiti (genio civile, agricoltura, pianificazione del territorio, ecc.) si chiede di manifestare la propria visione.

PROGRAMM | PROGRAMME | PROGRAMMA

Donnerstag, 4. Februar

Anreise	**Bahnhof Genève Cornavin** 5 min zu Fuss bis zur HEPIA – rue de la Prairie 4
09.00	**Ankunft / Anmeldung** Kaffee und Gipfeli
10.00	**Begrüssung** Y. Leuzinger, Direktor HEPIA
10.10	**Einführung** S. Burgos und P. Boivin
	Session 1: Aufschwung für den Boden 2015 – und wie weiter? Welche Herausforderungen und Lösungsansätze gibt es für eine nachhaltige Bodennutzung? Vorsitz: Präsident der BGS
10:20	Wilfred Otten – Vereinigtes Königreich
10.40	Carmelo Dazzi – Italien
11.00	Raimonds Kasparinskis – Lettland
11.20	Pavel Krasilnikov – Eurasian Center for Food Security
11.40	Bettina Hitzfeld - Schweiz
12.00	Panos Panagos – European Joint Research Center
12.20	**Diskussionsrunde** mit den Präsidenten der bodenkundlichen Gesellschaften: Herausforderungen und Lösungsansätze in der Bodennutzung.
13:00	**Mittagessen** – Cafeteria HEPIA
	Session 2: Boden und Gesellschaft – das NFP 68 Ein nationales Forschungsprogramm zur nachhaltigen Bodennutzung
14.00	**NRP 68: a national research programme towards sustainable soil management** Claire Chenu
14.30	**Using multi-temporal soil spectroscopy data to derive soil properties in an agricultural landscape in Zürich Oberland** Sanne Diek
14.50	**A regional modelling tool to assess the risk of accumulation of nutrients, trace metals and pesticides in agricultural soils (iMSoil)** Raniero Della Peruta
15.10	**Kaffeepause und Stände** (Foyer HEPIA – während der ganzen Tagungsdauer): (1) das Medienecho zum Boden 2015 (2) Vorstellung neuer Methoden zur Probenahme und Messung der Lagerungsdichte und Verdichtung (3) Buchhändler und Geräteanbieter
15.20	**Workshop: Bodenschutz, ein Vergleich der Systeme von England, Deutschland und der Schweiz.** Mit den jeweiligen bodenkundlichen Gesellschaften.
16.00	**Generalversammlung**
18.30	ENDE
19.00	**Abendessen** auf dem Schiff «Genève»

Jeudi, 4 février

Trajet	**Gare de Genève Cornavin** 5 mn à pied de hepia – 4 rue de la Prairie
09.00	**Arrivée / Inscription** Café et croissants
10.00	**Accueil** Y. Leuzinger, Directeur hepia
10.10	**Ouverture** S. Burgos et P. Boivin
	Session 1 : Soil Momentum 2015 – et ensuite ? Quels défis et quelles réponses pour des ressources en sol durables? Chair: Président de la SSP
10:20	Wilfred Otten – Royaume Uni
10.40	Carmelo Dazzi – Italie
11.00	Raimonds Kasparinskis – Lettonie
11.20	Pavel Krasilnikov – Eurasian Center for Food Security
11.40	Bettina Hitzfeld - Suisse
12.00	Panos Panagos – European Joint Research Center
12.20	**Table ronde débat** avec les présidents des sociétés européennes : défis et réponses pour la gestion des sols.
13:00	**Dîner** – Caféteria hepia
	Session 2 : Sol et société – le PNR68 Un programme national de recherche vers une gestion durable des ressources en sol
14.00	**NRP 68: a national research programme towards sustainable soil management** Claire Chenu
14.30	**Using multi-temporal soil spectroscopy data to derive soil properties in an agricultural landscape in Zürich Oberland** Sanne Diek
14.50	**A regional modelling tool to assess the risk of accumulation of nutrients, trace metals and pesticides in agricultural soils (iMSoil)** Raniero Della Peruta
15.10	**Pause-café et Stands** (hall hepia – toute la durée): (1) le soil momentum 2015 à travers les médias (2) démonstration de nouvelles techniques de prélèvement et mesures de la densité apparente et du tassement (3) libraires et revendeurs d'équipements
15.20	**Atelier: protection des sols, comparaison des systèmes anglais, allemand et suisse.** Avec les sociétés Allemandes, Anglaises et Suisses.
16.00	**Assemblée générale**
18.30	FIN
19.00	**Souper** sur le Bateau «Genève»

PROGRAMM | PROGRAMME | PROGRAMMA

Freitag, 5. Februar

09.00	**Ankunft / Anmeldung**
	Session 3: Boden und Gesellschaft – das NFP 68 Ein nationales Forschungsprogramm zur nachhaltigen Bodennutzung
09.30	**The underappreciated role of organic soils in the terrestrial C and N cycle** Jens Leifeld
10.00	**Carbon balance indicates a time limit for cultivation of organic soils in central Switzerland** Paul Sonja
10.20	**Historical land-use has a negligible effect on carbon storage in Swiss forest soils** Sia Gosheva
10.40	**Kaffeepause**
11.00	**Kartierung von Bodeneigenschaften mit statistischen Methoden - Fallstudie Landwirtschaftsfläche Kanton Zürich** Madlene Nussbaum
11.20	**Bodenfunktionen bewerten: Anwendungsbeispiel für Wasserhaushalt und landwirtschaftliche Produktion** Lucie Greiner
11.40	**Plate-forme de décision pour une utilisation durable du sol** Adrienne Grêt-Regamey
12.00	**Postersession und Stände**
12.50	**Stehlunch**
	Session 4: Offene Session – Nachhaltige Nutzung der Ressourcen Boden in der Schweiz.
13.50	**Méthode de caractérisation de la dégradation structurale des sols** Alice Johannes
14.10	**Cartographie du potentiel d'infiltration-épuration des bas-côtés des routes nationales Suisses** Karine Gondret
14.30	**AgrInnov: Identifier et valider les outils de mesure de l'impact des pratiques agricoles sur la qualité biologique des sols** Jean-François Vian
14.50	**Pause**
15.10	**Zusammenfassung & Ausblick** S. Burgos und R. Meuli
15.30	**Prämierung**
16.00	ENDE

Vendredi, 5 février

09.00	**Arrivée / Inscription**
	Session 3: Sol et société – le PNR68 Un programme national de recherche vers une gestion durable des ressources en sol
09.30	**The underappreciated role of organic soils in the terrestrial C and N cycle** Jens Leifeld
10.00	**Carbon balance indicates a time limit for cultivation of organic soils in central Switzerland** Paul Sonja
10.20	**Historical land-use has a negligible effect on carbon storage in Swiss forest soils** Sia Gosheva
10.40	**Pause-café**
11.00	**Kartierung von Bodeneigenschaften mit statistischen Methoden - Fallstudie Landwirtschaftsfläche Kanton Zürich** Madlene Nussbaum
11.20	**Bodenfunktionen bewerten: Anwendungsbeispiel für Wasserhaushalt und landwirtschaftliche Produktion** Lucie Greiner
11.40	**Plate-forme de décision pour une utilisation durable du sol** Adrienne Grêt-Regamey
12.00	**Session des posters et stands**
12.50	**Dîner**
	Session 4: Opened Session - Gestion durable des ressources en sol en Suisse.
13.50	**Méthode de caractérisation de la dégradation structurale des sols** Alice Johannes
14.10	**Cartographie du potentiel d'infiltration-épuration des bas-côtés des routes nationales Suisses** Karine Gondret
14.30	**AgrInnov: Identifier et valider les outils de mesure de l'impact des pratiques agricoles sur la qualité biologique des sols** Jean-François Vian
14.50	**Pause**
15.10	**Résumé & perspectives** S. Burgos et R. Meuli
15.30	**Prix**
16.00	FIN

Using multi-temporal soil spectroscopy data to derive soil properties in an agricultural landscape in Zürich Oberland

Sanne Diek

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In densely populated Switzerland soils are a scarce resource. In order to create an integrated, sustainable and efficient system for the management of soil and land as a resource, there is a demand for full coverage spatial soil information. Remote sensing is a promising data source for this purpose, and soil spectroscopy has already shown assuring results. Within the national project NRP-68 PMSoil (Predictive Mapping of Soil Properties and Functions) we explore the use of multi-temporal spectroscopy data in heterogeneous agricultural landscapes in Zürich Oberland. Combined airborne images from September 2013, May 2014 and May 2015 have been used to create soil property maps for OM, sand, silt and clay percentages.

Carbon balance indicates a time limit for cultivation of organic soils in central Switzerland

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Peatlands serve as important carbon sinks. Globally, more than 30% of the soil organic carbon is stored in organic soils, although they cover only 3% of the land surface. The agricultural use of organic soils usually requires drainage thereby transforming these soils from a net carbon sink into a net source. Currently, about 2 to 3 Gt CO2 are emitted world-wide from degrading organic soils (Joosten 2011; Parish et al. 2008) which is ca. 5% of the total anthropogenic emissions.

Besides these CO2 emissions, the resulting subsidence of drained peat soils during agricultural use requires that drainage system are periodically renewed and finally to use pumping systems after progressive subsidence.In Switzerland, the Seeland region is characterised by fens which are intensively used for agriculture since 1900. The organic layer is degrading and subsequently getting shallower and the underlying mineral soil, as lake marl or loam, is approaching the surface. The questions arises for how long and under which land use practises and costs these soils can be cultivated in the near future.

The study site was under crop rotation until 2009 when it was converted to extensively used grassland with the water regime still being regulated. The soil is characterised by a degraded organic horizon of 40 to 70 cm. Since December 2014 we are measuring the carbon exchange (CO2 and CH4) of this grassland using the Eddy-Covariance method. Fast response gas concentrations are measured with open path devices (LI-COR LI7500A for CO2 and H2O; LI7700 for CH4). The three-dimensional wind speed is measured with a sonic anemometer (Campbell CSAT-3).

The carbon balance of the year 2015 indicates that the degraded fen is a strong carbon source, with a net annual loss of approximately 500 g C m-2. The carbon balance is dominated by CO2 exchange and harvest export. Methane emissions were found to be negligible. The gained emission factors are used to estimate the carbon loss for future. Different scenarios are compared to approach the time span for the current cultivation practise of organic soils in central Switzerland.

A regional modelling tool to assess the risk of accumulation of nutrients, trace metals and pesticides in agricultural soils (iMSoil)

Raniero Della Peruta

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Over time, large quantities of fertilizers, pesticides and soil amendments are applied onto agricultural soils. They contain nutrients as well as small quantities of contaminants. The gradual accumulation of all these substances represents a threat for soil quality and for some important soil functions. We developed a regional modelling tool for assessing element fluxes in agricultural soils for nutrients (N, P), trace metals (Cu, Zn, Cd) and pesticides. We calculated these fluxes annually for the last 15 years and we made predictions for the future (2013-2025) under various socio-economic framework conditions. Results show a spatial pattern characterized by critical areas with increased risk of contamination. Through scenario analysis, the regional tool can assess measures promoting sustainable land management.

Historical land-use has a negligible effect on carbon storage in Swiss forest soils

Sia Gosheva

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Land-use change is assumed to have a strong impact on the carbon balance of soils, with afforestation expected to endorse carbon sequestration. Over the last century, forest cover in Switzerland has increased by 22%. The objectives of this study were twofold: to determine whether historical forest cover change has an impact on soil organic carbon (SOC) storage in Swiss forests and to estimate the influence of climate, topography, and soil chemistry on SOC-stocks in the organic layer and the mineral soil.

We reconstructed forest cover changes for 1000 soil profiles with known C-stocks for the last 150 years. By evaluating historical and modern topographic maps, we estimated the minimal forest age of all sites and classified them into three classes: permanent (≥120y), mid-aged (60-120y), and young (≤60y) forest sites. The impact of forest age on C-storage was examined. Finally, we evaluated the effect of potential drivers such as climate, forest type, soil texture and chemistry.

Our results reveal no effect of forest age in the organic layer and only a negligible effect in the mineral soil. For the C-stocks in the organic layer, we observed a small peak in the mid-aged category, which we attribute to the agricultural land abandonment approximately 100 years ago. However, our model indicated non-significance for forest age. Soil chemistry, with pH explaining the most variance, soil type, mean annual temperature (MAT), and clay content were highly significant. Furthermore, forest type showed an impact, with conifer forests containing higher C-stocks than broadleaf ones. For the mineral soil (at 0-120cm soil depth), the highest C-stocks were found in the youngest sites, while the lowest ones – in the permanent ones. Soil type was highly significant and explained the most variance. Additionally, pH, slope, and mean annual precipitation (MAP) had a significant impact on carbon stocks, with C-stocks raising with an increasing MAP and a decreasing slope. Forest age indicated a marginal significance, when the means of the permanent to the youngest categories were compared.

In summary, we conclude that forest age has only a limited effect on carbon stocks stored in Swiss forest soils and that a complex combination of other factors (climate, clay content, soil chemistry) are more important for SOC-storage in Swiss forest soils.

The underappreciated role of organic soils in the terrestrial C and N cycle

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Drainage and subsequent management of peatlands accelerates decomposition of peat and converts an ecosystem that, in its natural state, accumulates organic matter, to a net carbon and greenhouse gas (GHG) source. The global contribution of drained peatlands to land-use induced GHG emissions is almost as high as that of global deforestation. Hence, a discussion about the future of these important ecosystems is urgently needed. The paper presents i) global numbers on emissions and avoided nitrogen costs of carbon sequestration by intact peatlands and discusses ii) the role of organic soils in complying with the 2°-goal, taking Switzerland as an example.

Kartierung von Bodeneigenschaften mit statistischen Methoden - Fallstudie Landwirtschaftsfläche Kanton Zürich

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Die Bearbeitung zahlreicher Fragestellungen in der Forschung und der Vollzug gesetzlicher Bestimmungen benötigen hoch aufgelöste räumliche Bodeninformation. In der Schweiz ist solche Information nur lückenhaft und unvollständig vorhanden. Die flächendeckende Erfassung von Bodenkarten mit Feldaufnahmen ist kosten- und zeitintensiv. Im Rahmen des Projekts PMSoil (NFP 68) haben wir deshalb geprüft, ob sich Bodeneigenschaftskarten mittels statistischer Modellierung erzeugen lassen. Die Karten sind Grundlage für die anschliessende Bewertung von Bodenfunktionen wie Regulierung des Wasserhaushalts oder landwirtschaftliche Produktion (siehe Beitrag Greiner et al.).

Mit harmonisierten Bodendaten von rund 1'100 Profilen und Bohrungen aus diversen Projekten haben wir für ein Fallstudiengebiet im Kanton Zürich Bodeneigenschaftskarten (Pixelweite von 20 m) berechnet. Kartiert wurden die für die Bodenfunktionsbewertung benötigen Basisbodeneigenschaften Ton-, Schluff- und Skelettgehalt, Humus sowie pH, jeweils gemessen oder geschätzt, in vier Bodentiefen (0-10, 10-30, 30-50 und 50-100 cm), weiter die pflanzennutzbare Gründigkeit und Informationen zur Vernässung, abgeleitet aus Untertypen und Horizontsymbolen. Als mögliche erklärende Umweltfaktoren standen Geodaten zum Klima (Niederschlag, Temperatur etc.), geologische Karten, Satelliten- und Luftbilder sowie zahlreiche Attribute aus der Terrain- und Oberflächenanalyse zur Verfügung.

Zur Wahl eines statistischen Modells haben wir Componentwise Gradient Boosting eingesetzt. Dieser Algorithmus erlaubt lineare sowie nicht-lineare Beziehungen zwischen Bodeneigenschaften und erklärenden Umweltfaktoren abzubilden. Zudem können die räumliche Autokorrelation zwischen gemessenen und modellierten Bodeneigenschaften und räumlich variierende Beziehungen zwischen Bodeneigenschaften und Umweltfaktoren berücksichtigt werden. Gradient Boosting vereint die Vorteile zahlreicher in der digitalen Bodenkartierung verwendeter statistischer Methoden. Lineare Regression oder Kriging mit externer Drift sind weitgehend limitiert auf die Modellierung von linearen Beziehungen zwischen Bodeneigenschaften und erklärenden Umweltfaktoren. Machine Learning-Methoden wie Random Forest ergeben Resultate, die schwierig zu interpretieren sind. Im Gegensatz dazu wählt Gradient Boosting nur relevante erklärenden Umweltfaktoren aus und verwendet diese in einem statistischen Modell mit interpretierbarer Struktur.

Dieser Ansatz erlaubte eine effiziente Modellwahl für die zahlreichen benötigten Bodeneigenschaften und -tiefen. Mit Gradient Boosting konnten ebenfalls für Kategorien der Bodenklassierung (Vernässung) Modelle erstellt und Vorhersagen berechnet werden. Die Güte der Vorhersagen haben wir mit Bodendaten von rund 20 % der Profile und Bohrungen überprüft, die wir für die Modellwahl nicht verwendet haben. Mit einem Bootstrap-Ansatz konnten wir Vorhersage-Intervalle berechnen, welche für jeden Punkt auf der Karte einen Unsicherheitsbereich angeben. Jede erstellte Bodenkarte enthält somit Informationen über deren Genauigkeit.

Bodenfunktionen bewerten: Anwendungsbeispiel für Wasserhaushalt und landwirtschaftliche Produktion

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Bodenfunktionskarten, ein Resultat der statischen Bodenfunktionsbewertung, sind besonders geeignet die Qualität der Böden in die Nutzungsabwägung bei raumplanerischen Fragen einzubringen. Sie bilden auf vereinfachte Art und Weise das Vermögen der Böden ab, bestimmte Funktionen zu erfüllen und visualisieren die räumlichen Unterschiede für Nicht-ExpertInnen. Mit Bodenfunktionskarten wird das potentielle Vermögen der Böden bewertet verschiedene Funktionen zu erfüllen. Zeitlich variable Faktoren wie beispielsweise die aktuelle Nutzung und Bewirtschaftung werden für diese Bewertungsart nicht berücksichtigt.

Im In- und Ausland wurden seit den 90iger Jahren verschiedene Methoden und Bewertungskriterien zur statischen Bewertung der Regulierungs-, Lebensraum- und Produktionsfunktion des Bodens entwickelt. In der Schweiz gibt es statische Bewertungsmethoden und -methodenansätze, jedoch existiert bisher keine nationale Methodensammlung, welche die Berücksichtigung der vielseitigen Funktionen der Böden in der Raumplanung unterstützt. Internationale Methoden können nicht ohne weiteres übernommen werden, und müssen für die Anwendung auf Bodendaten nach Schweizer Klassifikationssystem angepasst werden.

In diesem Vortrag zeigen wir für zwei Fallstudiengebiete in den Kantonen ZH und BE Ergebnisse der Anwendung internationaler und nationaler Methoden für rund 6500 Bodenprofile und für Bodeneigenschaftskarten (siehe Beitrag M. Nussbaum et al.).

Am Beispiele der Bewertung der Produktionsfunktion für die Landwirtschaft und der Wasserregulierungsfunktion zeigen wir empirische Zusammenhänge zwischen den Bewertungsergebnissen der ausländischen Methoden und Kennwerten der Schweizer Bodenklassifikation (z.B. Bodentyp, Untertypen, Wasserhaushaltgruppe, Nutzungseignungsklassen) auf. Die Umsetzung von ausgewählten internationalen Bewertungsmethoden ist Gegenstand des NFP68-Projekts PMSoil („Predictive Mapping of Soil Properties and Functions“).

Decision support system for sustainable soil resources management

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Current spatial legislation is primarily concerned with the distribution of land uses and disregards the question of availability of soil resources in space and time. If we thus consider soil as a key resource in the context of sustainable soil use, then decisions resulting in land use changes have to be taken after consideration of the functioning of soil and the related ecosystem services potentially supported by these soils. Furthermore, as decision-making on land use changes is a shared domain of multiple groups of actors on regional and local scales, sustainable soil use needs to be deliberated among heterogeneous stakeholders with different demands – a process, which requires profound knowledge on the issues at stake.

The goal of the NRP68 project OPSOL “Matching soil functions and soil uses in space and time for sustainable spatial development and land management – operationalizing cross-scale interactions in a virtual collaborative decision support system” is thus to elaborate a virtual spatial decision support system to better understand and communicate the effects of various current and innovative policies on land use distributions and related impacts on soil functions and ecosystem services. The implementation of a prototypical version of the web-based decision support system in the frame of a workshop with stakeholders shows that the consideration of ecosystem services in spatial planning and cooperation among municipalities are important steps towards securing soil resources, but the results also emphasize the crucial role of local stakeholders for meaningful trade-off assessments. The analysis of pathways of ecosystem services changes under various global change scenarios showed that the effectiveness of the policies is highly dependent on the timing of the intervention. Spatial planning instruments are for example more efficient when they are implemented as soon as possible. In contrast, the timing of structural change interventions in the agriculture sector is less important to reach sustainable soil resources management.

Méthode de caractérisation de la dégradation structurale des sols / Soil structural quality evaluation and threshold values for Swiss environmental legislation (STRUDEL project)

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Diagnosis of soil compaction and other soil structural degradation require reference threshold values defining non-degraded soil structure versus degraded soil structure. Large-scale application, e.g. for soil protection regulation, require accurate, cost-efficient and robust methods providing meaningful information with respect to soil quality. The shrinkage curve analysis (ShA) (Braudeau et al., 1999) does not only provide relevant parameters for soil functions such as water and air content of structural porosity but also holds promises to fulfil these requirements. Our objective was to test the potential of ShA to define reference values for soil structural degradation at Swiss scale.

Agricultural soils of the most common soil order on the Swiss plateau, namely brown soils, were sampled. Undisturbed samples were collected from topsoil at 200 locations from spring 2012 to fall 2014 on a large area (240 km) across Switzerland. Three types of soil managements were represented, namely permanent pasture (PP), conventional tillage and no-till. Only soils showing no evidence of structural degradation, as assessed visually and according to a VESS score smaller than 3 (Ball et al., 2007), were considered as reference soils. Compaction, erosion, waterlogging and poor degradation of organic matter were criteria to discard sampling locations. The undisturbed soil samples were analysed for SOC, texture, CEC and ShA, from which a set of parameters defining the soil porosities and hydrostructural stability was obtained.

The texture properties were similar between the different soil management, with clay content ranging from 10 to 35%. SOC content ranged from 0.5 to 4.5% and the ranges were largely overlapping amongst the 3 soil managements. ShA parameters were found to be highly determined by SOC, with the R2 of the regressions usually over 70%, regardless of soil management, large spatial coverage and time of sampling. Considering additional soil properties improved only poorly the prediction of the ShA properties.

These very accurate predictions of physical parameters by SOC are partly due to: (i) the sampling method which takes in account the shrink-swell properties, (ii) the precise volume measurement which also performs well with stony soils (ii) the standardization with respect to matric potential which allows to sharply decrease the spatial and temporal variability. Consequently, a small number of samples (3-10) should accurately determine an average value of ShA parameters, with inexpensive and simple techniques.

For the considered soil order, at Swiss scale, a unique highly determined linear relation could be defined for most of the ShA parameters with respect to SOC. This relation defines the non-degraded reference state and can be used as a prediction of an optimal soil structure. Further comparison with degraded soil structures will show to which extent unambiguous detection of structural degradation can be performed on this basis in the perspective of soil quality regulation.

Cartographie du potentiel d'infiltration-épuration des bas-côtés des routes nationales Suisses

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L'infiltration des eaux de chaussées dans les sols des bas-côtés des routes est recommandée en par la directive OFEFP 2002 [4]. Toutefois, pour éviter toutes atteintes de l'environnement cette évacuation est soumise à des conditions concernant la nature des sols et la protection des eaux souterraines. Afin d'encourager l'infiltration des eaux de chaussées dans les sols des bas-côtés des routes nationales, l'Office Fédérale Des Routes (OFROU) a mandaté hepia dans le but de cartographier le potentiel d'infiltration des eaux de chaussées le long du réseau dont il a la charge.

Cette cartographie a nécessité le développement d'une méthode semi-automatisée basée sur l'utilisation des sciences de l'information géographique (SIG). Afin d'évaluer le potentiel d'infiltration des bas-côtés quatre critères ont été caractérisés : La teneur en argile granulométrique des sols, la géométrie (remblais, déblais) et l'état de surface (enherbé, non enherbé), le statut de protection des eaux.

La fiabilité de cette méthode a été testée grâce à la vérification de 299 points de contrôle sur l'ensemble de la Suisse. Au regard des 4 critères pris en compte, 31% du réseau est potentiellement favorable, 19% représentent un potentiel incertain, tandis que 43% du réseau présente un potentiel défavorable à l'infiltration des eaux de chaussées dans les bas-côtés.

AgrInnov: Identifier et valider les outils de mesure de l'impact des pratiques agricoles sur la qualité biologique des sols

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Les sols agricoles de par i) leur superficie (40% des surfaces utiles en France), ii) leur intérêt en termes de production agricole et, iii) leur rôle dans la qualité de notre environnement en termes de réservoir de diversité, bénéficient d'un intérêt particulier de la recherche mais aussi des agriculteurs dont ils sont le support de production. Les agriculteurs sont aujourd'hui soucieux de mieux protéger leur sol pour préserver et améliorer ce patrimoine mais aussi de mieux l'utiliser pour améliorer la durabilité de leur système de production. Dans ce contexte, la recherche se doit de fournir et transférer les évolutions des connaissances en biologie du sol, mais aussi les outils de mesure récemment développés, pour finaliser un diagnostic opérationnel répondant aux attentes des agriculteurs.

Dans ce contexte, le projet AgrInnov est un projet participatif français associant chercheurs et agriculteurs et visant à développer différents outils de type bioindicateurs, pour la mise en place d'un tableau de bord opérationnel qui doit déboucher sur un diagnostic de la qualité biologique des sols agricoles permettant notamment d'évaluer l'impact des pratiques. Ce tableau de bord est constitué d'un socle d'indicateurs ciblant l'abondance et la diversité des communautés de microorganismes (bactéries, champignons), de microfaune (nématodes) et de macrofaune (lombrics). Ces organismes vivants sont reconnus pour être indispensables à la plupart des fonctions biologiques et services rendus par le sol, mais aussi pour être sensibles à certaines pratiques agricoles (travail du sol, intrants, couvert végétal, amendements). Certains indicateurs agronomiques ont aussi été sélectionnés et intégrés (structure et physico-chimie du sol, dégradation de la matière organique), afin de renforcer le diagnostic agroécologique des sols et des systèmes de production. En parallèle, l'application du tableau de bord a été accompagnée de formations nouvelles sur la biologie des sols et l'impact des pratiques agricoles afin d'équiper techniquement et intellectuellement les agriculteurs et de les rendre autonomes face au choix et l'interprétation des indicateurs. Le tableau de bord a été appliqué sur un réseau de 250 parcelles agricoles appartenant à autant d'exploitations agricoles dont la moitié était en grande culture céréalière et l'autre moitié en viticulture. Ces exploitations sont réparties sur tout le territoire national afin d'intégrer des situations pédoclimatiques et agricoles contrastées. Les agriculteurs et les viticulteurs ont réalisé eux-mêmes l'échantillonnage de sol pour les mesures en laboratoire et l'acquisition des données sur le terrain, après avoir reçu une formation et un guide pratique élaborés à cet effet.

POSTER ABSTRACTS | RÉSUMÉS DES POSTERS

Soil biota and nutrient use efficiency in cropping systems

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Efficient resource use is a key factor for sustainable agricultural production and a necessity for meeting future global food demands. However, the factors that control nutrient use efficiency in agro-ecosystems are only partly understood. Soil organisms are responsible for important nutrient cycling processes but their activities find little recognition in agricultural policy and management.

In a first step, we used an outdoor model system to investigate the influence of soil biota on nutrient cycling and plant performance. Soil treatments containing a reduced soil-life or an enriched soil-life were set up. We planted an agricultural crop rotation and assessed plant biomass, nutrient contents and nutrient losses through leaching and as N-gases (N2O and N2). The presence of an enriched soil life greatly enhanced plant growth and nutrition and strongly reduced nitrogen leaching losses, as well as emissions of N2 and the greenhouse gas N2O.

In a next set of experiments, we inoculated Swiss field soils with arbuscular mycorrhizal fungi (AMF), symbiotic soil fungi that can promote plant growth and ecosystem functioning.

We investigated effects of arable management, AMF inoculation and their interactions on plant growth and nutrient cycling. While management practices influenced nutrient leaching losses and N2O emissions, effects of AMF inoculation were small. We found a higher potential for successful AMF inoculation in tilled compared to untilled soils.

Our results indicate that soil biota bear a huge potential to enhance agricultural sustainability but that the success of field inoculations with AMF may be limited and may depend on environmental conditions.

Impact des néonicotinoïdes sur le collembole *Folsomia fimetaria* dans les sols agricoles

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Depuis leur mise sur le marché dans les années 90, les néonicotinoïdes sont devenus une des classes d'insecticides les plus utilisées niveau mondial. Les raisons de leur succès sont une haute spécificité pour les invertébrés, une protection systémique et à long terme de la plante et une polyvalence dans l'application (traitement des semences/du sol, spray, injection dans la plante), associée à une utilisation de type prophylactique. Par conséquent, ces pesticides sont largement utilisés en agriculture pour protéger plusieurs variétés végétales contre les insectes ravageurs. L'attention publique s'est récemment focalisée sur les conséquences négatives de leur utilisation sur divers groupes d'organismes non cibles, avec un fort accent sur les abeilles mellifères et autres pollinisateurs. À cause de leur application fréquente, de leur persistance dans le sol et de leur distribution dans l'eau et l'air, ces substances sont potentiellement dangereuses pour une large gamme d'organismes, vertébrés et invertébrés, qui jouent des rôles fondamentaux dans les services écologiques. En Suisse, cinq classes de néonicotinoïdes sont actuellement homologuées en agriculture. Ce projet vise à évaluer l'impact de ces pesticides dans les sols agricoles grâce à des tests de reproduction sur le collembole Folsomia fimetaria qui, par son appartenance à l'embranchement des arthropodes, est considéré comme étant un bon représentant pour l'évaluation de la toxicité des insecticides. La toxicité des néonicotinoïdes est d'abord évaluée pour des situations réelles, par exposition des collemboles en laboratoire à des échantillons de sol prélevés dans des exploitations suisses conventionnelles et à production intégrée. Ensuite, l'effet des trois substances actives les plus utilisées (imidaclopride, clothianidine et thiaméthoxame), sera également étudiée, singulièrement et en mélange, pour un sol de référence contaminé selon une gamme de concentrations définies et auxquelles les collemboles seront exposés. Les résultats des tests écotoxicologiques réalisés sur les échantillons prélevés dans des exploitations agricoles ne montrent pas d'effets sur le taux de reproduction des collemboles. Dans la suite de ce travail, les valeurs de toxicité qui seront obtenues pour les trois composés seront comparées avec les concentrations détectées dans les échantillons de terrain, avec l'appui des analyses chimiques.

The challenge of soil erosion management in Switzerland: a socio-anthropological analysis of public policy construction and implementation

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Switzerland's 2014 "Agricultural Report" asserts that the fertility of Swiss agricultural lands is compromised in the long term, and that one of the major causes is water erosion. And yet, the problem of soil erosion is not recent. It has been studied for more than fifty years by Swiss research institutes, and included in agro-environmental policy-making for more than twenty. However, despite significant improvements, experts agree that the problem persists. This worrying result suggests that agri-environmental instruments fail to induce the desired changes in society-soil interactions, and that the management of soil resources can still be improved.

The current on-going socio-anthropological research project aims at enriching the debate on the problem of water erosion of arable lands in particular, and of arable soil fertility in general, with the goal to propose new conceptual tools and methodological approaches for decision-makers. Three preliminary results are presented in this paper. (1) The management of soil erosion is characterized by complexity: scientific blind spots remain, organizational responsibilities are fragmented, and expertise in the field requires trained personnel, time and money. (2) The elaboration of public policy generally leads to negotiated solutions rather than to purely expert determinations. Swiss public policies for soil erosion prevention and mitigation are no exception. (3) Implementation instruments such as erosion control plans generate unintended consequences that reduce their effectiveness.

These preliminary results demonstrate that soil erosion is both a social and an environmental problem. Moreover, they illustrate how, faced with the multifaceted nature of soil erosion (ecological, agronomical, economic, and social), scientific research is inclined to focus on some aspects of the problem (i.e. on-site damage), overlook other aspects (i.e. off-site damage), and neglect a comprehensive understanding of the issues (social science research). Finally, they suggest that the formulation of effective implementation instruments should be considered as the problem to be anticipated, studied and solved, and not as a simple technical matter.

What do pedogenic carbonate accumulations tell?

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Secondary carbonate are a part of the continental carbon cycle and the understanding of their formation processes is primordial. Accumulations of carbonate nodules have been observed along the Sudano-sahelian belt. Investigations were performed in the Far North Region of Cameroon in the Mayo Tsanaga granitic watershed. In this region, accumulations of carbonate nodules can reach 11kg/m2, which is quite unexpected in a Ca-poor landscape. Moreover, they are associated with a clay-rich sedimentary deposit extended to all the piedmont, and whose origin is unclear. Three major issues are thus addressed in this study: i) what are the conditions needed for carbonate nodule precipitation, ii) what is the origin of calcium, and, iii) what is the origin of the clay-rich sediment associated with the carbonate nodules.

Field descriptions, clay mineralogy and grain size distribution were performed to circumscribe the general settings. Strontium (87Sr/86Sr) and neodymium (Nd) isotopes were used to trace the Ca sources and the clay-rich sediment origin, respectively.

Field observations (slickensides features, high carbonate and Fe-Mn oxides nodules components), grain size distribution (dominance of clay) and clay mineralogy (smectite), lead to interpret the clay-carbonate sediment as degraded Vertisols or Vertisol relics. This degraded character is related to altitude, as and non-degraded Vertisols are observable downstream. 87Sr/86Sr ratios are homogenous for carbonate nodules and similar to 87Sr/86Sr ratios of plagioclases from the local granite. Thus, 70 to 80% Ca is provided by the plagioclases and the other part by aeolian inputs. Nd isotopes show that the clay-rich sediment is a mixed phase between an aeolian deposit and the local granitic sands.

Although, the mechanisms leading to Ca concentration and nodules precipitation are still unclear, it is likely that Vertisol pedogenesis had a primordial role. Vertisol can develop, if swelling clays (e.g. smectite) are dominant and if hydric conditions are contrasted. The presence of smectite seems to play a key role in the Ca conservation after plagioclases weathering, and seasonal contrasts may favour the dissolution-precipitation of carbonate. However, how do nodules form? The mediation of life in their formation processes is highly suspected but still needs to be confirmed.

Sustainable management of cultivated organic soils in Switzerland - Economic and policy analysis

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Cultivated peat soils are degrading, mainly because of drainage. This project aims at fulfilling identifying policy instruments effective in promoting a more sustainable land use on these peat soils.

The study investigates the effect of different forms of agri-environmental payment schemes on farmers' decision making. An economic experiment in form of an interactive computer-game-like representation of farmers' decision situations was developed. The experiment depicts the situation of vegetable producers on drained peat soils and simulates their decision situation if offered an incentive for more extensive management practices. Given the nature of the issue, the effectiveness of agglomeration payments versus individual payments is tested. The asymmetry between farmers in the long-term opportunity costs of switching peat soil use motivates to further test the effectiveness of even versus uneven payments. The experiment is being conducted with Swiss agricultural students, many of whom are farmers. Data collection will be completed by February 2016. The main hypotheses tested are 1) agro-environmental schemes are necessary to incentivize a more sustainable peat soil management, and 2) agglomeration payments following respective opportunity costs most effectively enable farmers' cooperation and peat soil preservation. Due to the farmers' heterogeneity, the results will also enable to draw conclusions on the impact of fairness preferences on policy design.

THER-SOL project: the soil as climate regulator in urban areas

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Urban soils are becoming increasingly important in a world where urbanization accelerates and where associated functions become threatened (Lehmann and Stahr, 2007, 2010). Properties of urban soils as well as their functions (economic, ecological and social functions) are the basis for maintaining and improving the quality of urban life, and have already been studied (e.g. the TUSEC-IP project, Lehmann et al., 2006; Wall et al, 2012). Moreover, soils play a key role in the overall climate regulation of cities. However little is known about intrinsic characteristics and spatial dimensions of urban soils acting as cooling effect.

The aim of this study is to better understand the impact of urban soils on temperature regulation. Particular attention is paid on the influence of the intrinsic soil characteristics, vegetation cover, spatial dimension, and their geographical location. Different soil heat fluxes and temperatures (sensible heat flux, net radiation, surface and soil temperatures) are measured during particularly hot days during summer in i) a grass zone, and in ii) a mineral permeable mixture (red crushed granite) zone, called "Beaujolais ghorr" in the "Plaine de Plainpalais", very large esplanade in the centre of the city of Geneva (Switzerland).

Results indicate that surface temperatures on ghorr zone are higher than those on grass zone, implying a greater feeling of warmth on ghorr zone. Moreover, heat absorbed as well as sensible heat flux is greater in ghorr zone leading to an increase of air temperature and to urban heat island effect. This is especially explained by the evapotranspiration effect of grass vegetation. Finally, a proportion of green areas were evaluated in the surroundings of the "Plaine de Plainpalais" allowing an estimation of cooling effects of these different green areas.

Soil Organic Matter along climatic and altitudinal gradients in Swiss forest soils

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Soil organic matter (SOM) plays a key role for numerous soil and ecosystem functions. Yet our quantitative understanding of the driving factors is uncertain. SOM consists of a continuum of compounds ranging from slightly altered plant residues, called particulate OM (POM), to mineral-associated OM (mOM). POM is the most rapidly cycling and hence labile fraction of SOM. Therefore, it might respond particularly sensitive to changes in the climatice conditions.

In our study, we explore the controlling factors of SOM stocks and the distribution of POM in the organic layer as well as within mineral soils of Swiss forests. We aimed at examining the effect of elevation on SOM storage. Furthermore, we assessed the effect of climate on SOM properties (POM contribution, C/N ratio, SOM depth distribution).

In order to do this, we examined SOM stocks in the organic layer and the mineral soil of 1000 soil profiles. A subset of mineral soils (0-20cm soil depth) from 54 sites was selected and separated into light fractions (free and occluded light fractions) and heavy fractions (fine and coarse heavy fractions). Our sites are distributed along a great altitudinal gradient ranging between 277 and 2207 m a.s.l., with mean annual temperatures (MAT) ranging between 0.6 and 11.9 °C, and mean annual precipitation (MAP) between 704 and 2340 mm.

Our results reveal an increase in C stocks (for the organic layer only) with an increasing elevation. Furthermore, MAT showed a negative relationship to C stocks in the organic layer; however, it showed no impact on C stocks in the mineral soil. MAP did not affect C stocks in the organic layer, but showed a strong positive relationship in the mineral soil. The examination of the fractions indicated that in particular, elevation, but also MAP have an impact on the labile POM fractions but not on the mOM ones. We conclude that elevational changes have larger impacts on SOM properties (POM in particular) than on SOM stocks.

TECHNOSOLS : VERS UNE MEILLEURE PROTECTION DES RESSOURCES EN SOLS ET EN EAUX NEW TECHNOSOILS : A BETTER PROTECTION OF SOIL AND WATER RESOURCES

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Les eco-fonctions des sols ne sont plus à démontrer. Les fonctions rétention et épuration des eaux par les sols sont largement plébiscitées aussi bien au niveau de l'infiltration des eaux de ruissellement (recommandations de la VSA) que pour le traitement des eaux chargées en pesticides au travers des biobeds. Malheureusement à long terme les atteintes biologiques et chimiques sont fortes sur ces sols et ne permettent pas d'envisager le développement et le maintien de ses systèmes sur le long terme. Pour répondre à ces difficultés une des solutions est la mise au point et l'usage de technosols spécifiques (« sols artificiels et renouvelables » construits par l'homme). Le laboratoire Sols et Substrats à travers différents projets de recherche teste et évalue différents technosols enrichis en biochars (déchets verts pyrolysés) et composts (fins et grossiers). Parmi ces projets, on peut citer :

- un nouveau système de traitement des eaux de chaussée sous forme de mur végétalisé modulable, appelé SMACC, formé de 10 cassettes installées en série sur un site de Fribourg et permettant d'épurer les eaux de ruissellement de chaussée. Cette installation contribue à l'amélioration de la qualité des eaux de surface, du climat urbain, à l'ornementation de la ville et à la rétention des eaux.

- un système de traitement des produits phytosanitaires appelé VG-biobedTM qui permet de maximiser l'épuration pour le traitement des effluents enrichis en pesticides au niveau de l'exploitation et pour le traitement des eaux de ruissellement des parcelles agricoles.

Les spécificités propres aux polluants, à la dynamique des eaux à traiter (flux continu ou systèmes fermés) et à la qualité et aux volumes de technosols associés sont autant de paramètres d'entrée à ajuster pour proposer des solutions adaptées à chaque application. Les résultats des différents projets au niveau de la capacité d'épuration, des performances hydrauliques et de l'aspect esthétique des solutions seront présentés ainsi que les perspectives sur l'usage des biochars dans les technosols dédiés aux plantations urbaines et aux toitures végétalisées.

Quelle est la teneur optimale en carbone organique d'un sol agricole?

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Le carbone organique des sols (COS), ainsi que l'activité biologique qui en découle, influence largement la qualité de ceux-ci en termes de fertilité (disponibilité des éléments nutritifs), d'agrégation, de stabilité hydrostructurale ou encore de résistance à la compaction et à l'érosion. Ainsi, la plupart des études montrent un accroissement linéaire des propriétés physiques des sols avec l'augmentation de leurs teneurs en COS.

En investiguant la corrélation entre le ratio argile : COS et certaines propriétés physiques des sols, Dexter et al. (2008) ont observé que ces dernières sont maximisées lorsque la fraction de carbone organique considérée est limitée à un ratio de 10. Les auteurs concluent de manière intéressante que cette fraction correspond au carbone organique qui est complexé avec l'argile (COC) et que de ce fait, un apport de COS supplémentaire « non-complexé » n'influence pas les propriétés physiques du sol aussi fortement que le COC.

Etant donné le rôle central du COS dans les diverses problématiques de gestion des sols agricoles, ainsi que son importance vis-à-vis des enjeux environnementaux actuels (séquestration du carbone par exemple), ce poster présente une adaptation de la méthode de Dexter et al. (2008). En effet, celle-ci comporte plusieurs zones d'ombre ainsi que plusieurs biais dans l'approche statistique qui ont été revus.

Ceci a été réalisé à l'aide d'une base de données regroupant 174 échantillons de sols agricoles du Plateau suisse (Cambiluvisols) prélevés dans différents systèmes de culture (cultures labourées, semis directs et prairies permanentes) et ne comportant pas de dégradations structurales visibles. Les propriétés physiques, dont les mêmes que celles utilisées par Dexter et al. (2008), ont été obtenues par l'analyse du retrait. La structure des différents échantillons a également été évaluée visuellement avec la méthode VESS de Ball et al. (2007). Cela a permis de ne garder que les échantillons ayant une « bonne » structure en tant que références. Contrairement à l'approche originale, aucun optimum n'a pu être observé sur ce groupe de sol pour la corrélation entre le COC et les diverses propriétés physiques. En revanche, les différents coefficients de corrélation augmentent lorsque les ratios argile : COS diminuent et ce jusqu'à une certaine limite au-delà de laquelle ils restent à leurs valeurs maximales.

Par ailleurs, en considérant cette fois-ci l'intégralité du COS, et non une fraction seulement, on observe effectivement une augmentation de ces mêmes corrélations jusqu'à un ratio argile :

COS de environ 7 à 8. Cela démontre que les propriétés physiques s'améliorent lorsque la teneur en COS augmente mais que cet effet est moins important à partir de cette limite. Enfin, ceci pourrait donc constituer un objectif concret à atteindre pour les agriculteurs et leurs organes de conseil.

Soil management practices effect on weed communities and soil protection in Vaud vineyards

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Green cover in vine rows provides many ecological services, but can also negatively impact the crop, depending on the weed species. The composition of a vineyard weed community is influenced by many parameters. Ensuring an evolution of the vine row flora into a desired direction is therefore very complex. A key step towards this goal is to know which factors influence the establishment of the weed community and which types of communities are best suited for vineyards.

In this study, we analysed the weed communities of several vineyards in Vaud (379 botanical surveys on 117 plots), with the aim to highlight the links between soil management practices (chemical and mechanical weeding, mowing, mulching roll) and phytosociological profiles and selected functional traits (growth forms, life strategies and soil cover).

The level of disturbance allowed to draw a clear distinction between the soil management practices: chemical and mechanical weeding (high disturbance) tended to favour ruderal to competitive ruderals strategists, mainly therophytes and geophytes. In contrast, mowing and mulching roll (lesser disturbance) tended to favour the establishment of grassland, whose plants are usually hemicryptophytes. Soil management practices also greatly impacted soil cover, with chemical weeding leading to the highest bare soil surface, followed by mechanical weeding, then mowing and mulching roller, which give the highest protection.

Further studies shall focus on soil analysis (organic carbon, density, soil fauna…) and field measurements of root depth according to soil management and on evolution dynamics of weed communities when soil management is changed.

Sequencing-based monitoring of arbuscular mycorrhiza inoculation into field soil reveals a perturbation of the native community structure

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Analyses of arbuscular mycorrhizal fungal (AMF) communities using ribosomal small subunit (SSU) or internal transcribed spacer (ITS) DNA sequences often suffer from low resolution or coverage of this group of fungi. We developed a novel sequencing based approach for a highly resolving and specific profiling of AMF communities.

We took advantage of AMF-specific PCR primers that amplify an ~1.5 kb long fragment covering parts of SSU, ITS and parts of the large ribosomal subunit (LSU) and we sequenced the resulting amplicons with single molecule real-time (SMRT) sequencing.

The method was applicable to soil and root samples, detected all major AMF families and discriminated successfully closely related AMF species, which would not be discernible using SSU sequences. In inoculation tests we could separate the introduced AMF strain from strains of the native community, indicating a resolution at strain level.

The AMF application tests revealed that a successful inoculation does not necessarily change the size of the AMF community but that community composition can change to such an extent that the inoculated strain partly replaces the native ones.

Zinc and Cadmium in soil and grain on Swiss wheat farms: Comparison of organic and conventional management

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Increasing the zinc (Zn) content of edible plant parts through crop uptake, so-called agronomic biofortification, is an important strategy to combat widespread human malnutrition in Zn. Factors influencing Zn uptake by crop plants that can be managed by farmers include practices such as manure application, fertilization and cropping system. Because of the chemical similarity between Zn and cadmium (Cd) and the widespread distribution of anthropogenic Cd in agricultural soils, it is important also to include the latter element when looking into the effects of farming practices on Zn uptake in crop plants. In this project we analysed 28 farms in the surroundings of Zurich representing three different farming systems: organic with compost (COMP), organic without compost (ORG) and conventional without compost (CONV). On these farms we studied the total Zn and Cd concentration in the soil, their phytoavailable fraction in the soil, and their accumulation in the harvested grain. We related these Zn and Cd fractions with the management characteristics on the farms.

Zn and Cd were determined by means of ICP-OES as total soil content in aqua regia digests, as phytoavailable soil fraction in DTPA-TEA extracts and as grain content in microwave digests with HNO3.

The COMP soils were fertilized with 3.5 times more C ha-1 ($p<0.01$) and 1.9 times more P ha-1 ($p<0.05$) than the ORG and CONV soils, while 1.7 times more N ha-1 was applied on the CONV than on ORG and COMP ($p<0.0001$). The soil Zn concentration increased with soil organic carbon (SOC) content ($r=0.40$, $p<0.05$) and was on average 4.5 mg kg-1 higher on COMP and ORG than on CONV farms; but the latter difference was not statistically significant. Phytoavailable Zn did not differ between the systems. The CONV farms reached a 1.7 t ha-1 higher grain yield than COMP and ORG ($p<0.05$). The grain Zn concentration was not significantly different to COMP and ORG and was on average 32 mg kg-1 for all systems. However, grain Zn was negatively correlated with N input ($r=-0.49$, $p<0.01$) indicating Zn dilution. The ORG farms yielded the most grain Zn per grain N ($p=<0.05$).

Both total ($r=0.55$, $p<0.01$) and phytoavailable ($r=0.39$, $p<0.05$) soil Cd concentrations were positively correlated with SOC and were higher on COMP than on CONV and ORG farms ($p<0.05$, $p<0.1$ respectively). This may explain why the grain Cd concentration of COMP farms was on average 10 µg kg-1 higher than 29 µg kg-1 found on ORG and CONV farms, considering only farms with livestock.

Our results suggest higher soil Zn and Cd concentrations were due to increased input of organic matter and highlight the role of N fertilizers for Zn accumulation in wheat grains.

imVisIR – high resolution physical, chemical and biological soil characterisation on the pedon scale

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The physical and chemical heterogeneities of soils are the source of a vast functional diversity of soil properties in a multitude of spatial domains. Most studies neither consider the spatial variability of soil types and diagnostic horizons nor the variability of physical, chemical and biological properties in the heterogeneous pedon. These lateral and vertical heterogeneities of soils and soil horizons are mostly neglected due to the limitations in the available soil data and missing techniques to gather the information. Imaging Vis-NIR spectroscopy (imVisIR) is a non-destructive technique that enables the spatially accurate, high resolution assessment (63×63 µm² per pixel) of complete soil profiles consisting of mineral and organic horizons. Stainless steel boxes (100×100×300 mm³) were used to sample various soil types, and the bidirectional reflectance of the samples in the visible, near and short-wave infrared (Vis-NIR-SWIR) part of the electromagnetic spectrum (400-2500 nm in 416 spectral bands) was recorded with a hyperspectral camera. Various statistical, geostatistical and image processing tools were used to 1) assess the spatial variability of the soil profiles; 2) classify diagnostic horizons; 3) extrapolate elemental concentrations of small sampling areas to the complete image and calculate high resolution chemometric maps of various elements (C, N, Al, Fe and Mn); and 4) produce maps of the quality and quantity of various soil organic matter fractions.

imVisIR has the potential to significantly improve soil classification, the assessment of elemental budgets and balances and the understanding of soil forming and biogeochemical processes and mechanisms. It will help to identify areas of interest for cutting-edge techniques working on smaller scales and enable the upscaling and referencing of this information to the complete pedon. It will add to the establishment of a quantitative soil science where each aggregate in a pedon is characterised and the precise biogeochemical modelling of a complete landscape is possible.

Insights into soil organic matter stability from compound- and fraction-specific radiocarbon analysis

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Understanding the controls on the stability of soil organic matter (SOM) in relation to climatic, geologic and ecological factors is key to improve the understanding of potential susceptibility and vulnerability of SOM to climate and land use change.

Radiocarbon constitutes a uniquely effective tool to assess SOM dynamics and carbon turnover on both a decadal and millennial timescales. SOM however is an inherently heterogeneous mixture, which makes it challenging to understand the bulk dynamics based on bulk signature on a plot-scale level. This study combines bulk radiocarbon measurements on a regional-scale spanning wide climatic and geologic gradients with a more in-depth approach for a subset of locations. For this subset, time-series and carbon pool-specific radiocarbon data has been acquired for both topsoil and deeper soils. These well-studied sites are part of the Long-Term Forest Ecosystem Research (LWF) program of the Swiss Federal Institute for Forest, Snow and Landscape research (WSL). Results show large plot-scale variability in radiocarbon signature, which is in the same order of magnitude as the regional-wide variability.

Additionally, statistical analyses revealed that on a regional level, there is no significant correlation between Δ14C signature and environmental conditions except a weak positive correlation with mean annual temperature. Additionally, radiocarbon signatures vary significantly between time-series samples and carbon pools. Overall, this study provides a uniquely comprehensive dataset that allows for a better understanding of links between carbon dynamics and environmental settings, as well as for pool-specific and long-term trends in carbon (de)stabilization.

Cover crop root system and nutrient accumulation

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Cover crops protect the soil between two main crops and can provide many agrosystemic services including soil fertility improvement. Cover crops play a crucial role in the cycle of nutrients. They are able to accumulate large amounts of nutrients and therefore prevent their loss. After mineralization of biomass residues, the accumulated nutrients are released in highly available forms for the following crop. The objective of the current study is to characterize and to understand the nutrient uptake capacity of a wide range of cover crop species. For this purpose, a field experiment was conducted in non-limiting conditions to describe 20 species from different botanical families. We investigated then the relationships between plant characteristics, nutrient concentration and shoot biomass production, in order to better understand nutrient uptake capacity of different cover crop species. Large differences in nutrient uptake were evidenced. The most efficient species such as sunflower or phacelia accumulated about 160 kg ha-1 of nitrogen, 30 kg ha-1 of phosphorus and 250 kg ha-1 of potassium in three months. These species showed either high shoot biomass or high nutrient concentration. Contrasting root systems were also observed. Some species exhibited a big taproot with high root mass, while others were characterized by a fibrous root system with high root length. Several relationships between root characteristics and nutrient accumulation were highlighted. We observed that high shoot biomass was linked to high root mass and dense root tissues, whereas high nutrient concentration was related to large root length densities and root area. Thus, in non-limiting conditions, species producing high root mass or high root length should be favored as these root characteristics allow the highest nutrient uptake.

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TAGUNGSORT | LIEU | LOCALITÀ

HEPIA
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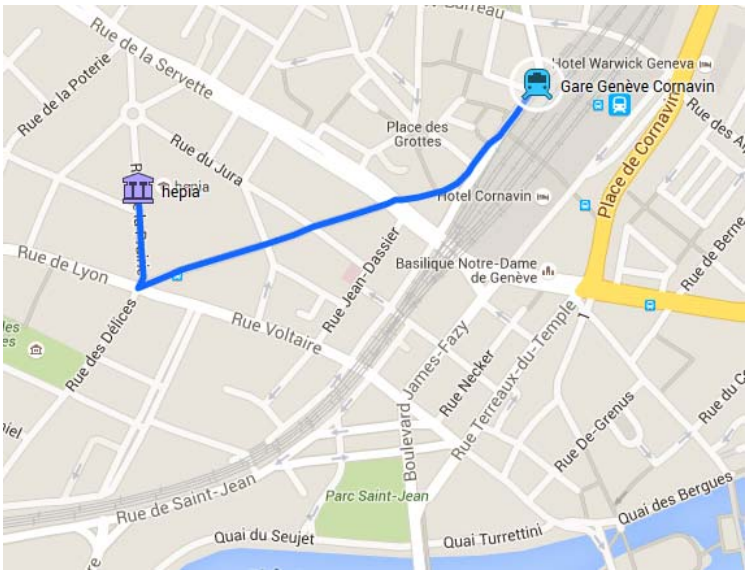
Die Buchung einer Unterkunft ist Sache der Teilnehmenden. Das Mittagessen und die Zwischenverpflegung sind inbegriffen.

La réservation de l'hébergement est à la charge du participant. Le repas de midi et les pauses-café sont inclus.

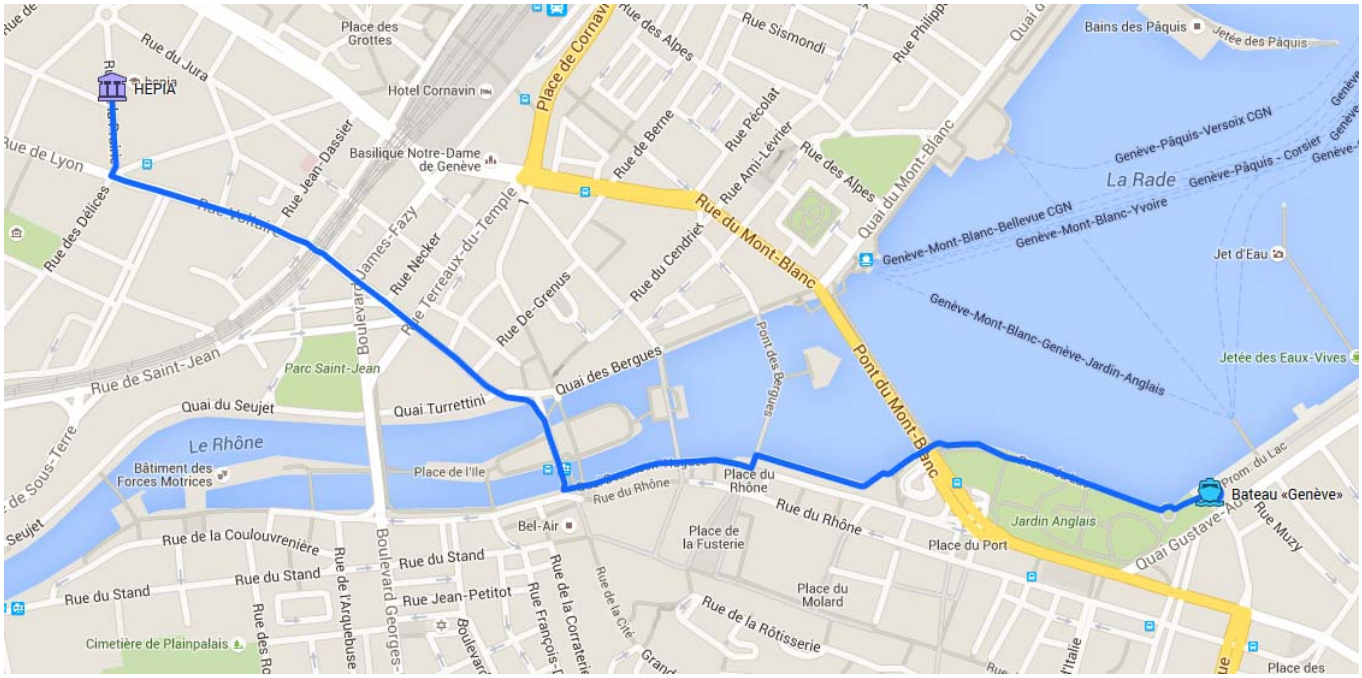
La riservazione in albergo è a carico del partecipante. Inclusi pranzo e spuntini durante le pause.



ABENDESSEN | SOUPER | CENA

Le Bateau «Genève»
Quai Gustave-Ador 7
1207 Genève

Das Abendessen wird von den Teilnehmern separat bezahlt. (Kosten pro Person 45 CHF, für Studenten 20 CHF)
Le repas du soir est à la charge des participants. (CHF 45 par personne, CHF 20 pour étudiants)
La cena è a carico dei singoli partecipanti. (CHF 45 a persona, CHF 20 per studenti)



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