BOOK OF ABSTRACTS
POSTER PRESENTATIONS

P01-DRASTIC-like approach to assess specific groundwater vulnerability in areas with intensive agricultural activities

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Intense agricultural activities in developed countries commonly determine a high risk of groundwater contamination causing challenging management of groundwater resources of shallow aquifers. Among the principal origins of pollution in these areas are agricultural practices based on the amendment of soils by nitrate fertilizers, which have been recognized as one of the most severe environmental emergencies for which specific policies and regulations have been issued.

In the framework of LANDSUPPORT, a Horizon 2020 project funded by the European Community, results of a research aimed at assessing specific vulnerability of shallow alluvial aquifers to pollutant, by means of a DRASTIC-like method, are here proposed. The research is focused on studying this issue in two areas where intensive agricultural activities exist: the Telesina Valley (southern Italy) and the Marchfeld Region (Austria). Spatial density and quality of available data allowed the reconstruction of the hydrogeological map of the areas and the application of the SINTACS-R5 method, which was implemented in a GIS environment. The assessment of groundwater vulnerability was based on the definition of each parameter by analysing geological, hydrogeological, geomorphological, pedological, piezometric, climatic and land use data. For such a scope, extended bibliographic research and consultations of archives of municipalities allowed the reconstruction of a comprehensive and unpublished database. Instead, for the attribution of multiplying weights, to all five scenarios, were considered: regional map of agricultural land use; flooding areas; areas with water table depth lower than 2 m; hydrogeological map and satellite images. The resulting groundwater vulnerability map of the study areas showed intrinsic vulnerability ranging prevailingly between medium to high classes. Furthermore, highest values of vulnerability were found in the framework of the alluvial plain, where shallow depth of the water table occurs. Results obtained represent an important decision support tool for planning of land use and groundwater quality protection.

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P02-Parametric and numerical approaches to assess groundwater vulnerability to pollution in alluvial areas.

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Industrial and agricultural activities represent the main causes of decaying of hydro-chemical quality of groundwater, which represents the most important source of drinking water in developed countries. Thus, assessing of groundwater vulnerability is a crucial aspect for land management aimed at the safeguard of groundwater resources, because expressing the potential impact of pollutants, depending on hydrogeological conditions and processes occurring in the unsaturated and saturated zones. In the framework of the Horizon 2020 LandSupport project, the study presented here contributed to implement tools for a geoSpatial DSS (S-DSS) dedicated to groundwater vulnerability assessment. For such scope, the study is specifically focused on estimating groundwater vulnerability to pollution of shallow aquifers where agricultural and livestock productions cause a very high risk of groundwater pollution. The goal was to estimate and map intrinsic aquifer vulnerability to generic pollutants of representative shallow alluvial aquifer characterizing the Marchfeld region (northeast of Vienna, Austria). To reach the achievement, three different approaches were used: a parametric method, i.e., the SINTACS-R5, a transfer function approach, i.e., the TFM model and, a process-based numerical model, the Flow-Hages model. Specifically: the SINTACS method was applied to estimate intrinsic groundwater vulnerability of the shallow alluvial aquifers characterizing the area; TFM method was applied for the assessment of the mean travel times of a generic non-reactive pollutant, considering a grass cover, through the unsaturated zone till the water table depth; finally, considering the same generic non-reactive pollutant and a grass cover, the Flow-Hages model allowed to simulate the output breakthrough curves, evaluating the time arrival of the peak at the groundwater table depth.

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P03-The ecological agricultural practices contribute to maintain the soil quality: A study case on grapevine crop in a Mediterranean agroforest area.

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The agricultural soil managements have a key influence on the status of soil quality, especially in the Mediterranean area, where inadequate agricultural practices is one of the main causes of soil degradation and diminution of its biological quality, which is more fragile under the semiarid conditions.

Soil microbial populations and their functions related to nutrient cycling contribute substantially to the regulation of soil fertility and the sustainability of agroecosystems. A field experiment was performed on a forest area located in “Mas de Sella” , a mountain area in Alicante province (Spain) at 840 m a.s.l. The aim of the experiment was to evaluate the quality soil status at two different agricultural managements in a crop of grapevine: one ecological with organic application of rest of pruning branches (E), and one conventional with mineral fertilization NPK (C). Both treatments were compared with the adjacent forest soil (F) considered undisturbed and the soil reference. Different parameters that are used to evaluate the soil quality status as were analyzed: soil microbial biomass, soil microbial activity (basal respiration, and enzymatic activities: dehydrogenase, protease, urease, β-glucosidase and phosphatase), soil aggregate stability and also the organic carbon and nitrogen contents. The results have revealed that ecological management increased microbial biomass, and stimulated microbial activity, when compared with inorganic fertilization. In addition, the soil under ecological management showed better soil structure with a higher percentage of aggregate stability. The values of the soil samples from ecological management are closer to the results obtained in the same properties studied on forest soil, used as reference. This study shows that the application of organic residues in the context of ecological management represents an adequate solution for the sustainable maintenance of quality agricultural soils under Mediterranean conditions.

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P04- Assessing the groundwater vulnerability to nitrate pollution within the geospatial decision support system LandSupport

Marialaura Bancheri, Alessia Perego, Marco Botta, Giuliano Langella, Federica Cavaliere, Daniele Lezzi, Daniele Dalla Torre, Carlo De Michele, Francesco Fusco, Piero Manna, Florindo Antonio Mileti, Harald Loishandl-Weisz, Tamás Hermann, Pantaleone De Vita, Vincenzo Allocca, Marco Acutis, Antonio Coppola, Fabio Terribile & Angelo Basile

This work presents the new web-based, freely-available dynamical tool, named the *nitrate fate tool*, developed within the geospatial Decision Support system (DSS) of LandSupport, for the assessment of groundwater vulnerability to nitrate pollution. The tool is based on the coupling of the ARMOSA model and the extended transfer function model (TFM-ext). The first is used to simulate the crop growth dynamics and the consequent nitrate leaching within the rooting depth of the soil, where the biological activity happens and whereby Nitrogen is converted from one form to another. Then its outcomes feed the TFM-ext model to assess the transport of nitrate through the unsaturated zone till the groundwater table depth. The tool has also been extended using the COMPSs programming framework, that allows to parallelize the execution of multiple model runs. Principal inputs of the tool are: soil physical and hydrological properties, climate, type of crops and their management (tillage, irrigation, fertilization and residual management) and the groundwater table depth. Results of the model are shown through the LandSupport GUI both as coloured maps, representing the concentration of nitrate at the arrival to the water table at the end of the simulation period, and as cumulative charts of the solute arrival at the depth of interest. The work presents the tool implementation for three case studies, with different spatial scales and pedo-climatic conditions: Regione Campania, IT, Marchfeld, AT, Zala County, HU. These are shown as examples of application of the LandSupport DSS in supporting the Water and Nitrate directives, demonstrating that it represents a valuable instrument for public authorities, environmental planners, as well as agricultural extension services.

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P05-Assessing the groundwater vulnerability to pesticide pollution within the geospatial decision support system LandSupport

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This work presents the new web-based, freely-available dynamical tool, named the *pesticide fate tool*, developed within the geospatial Decision Support system (DSS) of LandSupport, for the assessment of groundwater vulnerability to pesticides. The tool is based on the extended transfer function model, specifically expanded to consider the transport of reactive solutes, such as pesticides. The tool has also been extended using the COMPSs programming framework, that allows to parallelize the execution of multiple model runs. Principal inputs of the tool are: soil physical and hydrological properties, climate, groundwater table depth, type of crops and related pesticides in terms of their quantities and time of application. Results of the model are shown through the LandSupport GUI both as coloured maps, representing the relative concentration of pesticide at the arrival to the water table at the end of the simulation period, and as cumulative charts of the solute arrival at the depth of interest. The work presents the tool implementation for five case studies, with different spatial scales and pedo-climatic conditions: Valle Telesina and Regione Campania, IT, Marchfeld, AT, Zala County, HU, and Rmel, TU. These are shown as examples of application of the LandSupport DSS in supporting the Water and Pesticides directives, demonstrating that it represents a valuable instrument for public authorities, environmental planners, as well as agricultural extension services.

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P06-Landsupport for urban regeneration of green public spaces

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Spatial planning increasingly faces the growing complexity of the environmental problems of the territory. This requires very broad knowledge in very different fields and suitable working tools.

In this complex scenario, new opportunities are opening up today thanks to the development of geospatial decision support systems that use new IT technologies such as Geospatial CyberInfrastructure (GCI).

These platforms can support the acquisition and management of both static, advanced and dynamic geospatial data, data mining, and of scenario analysis applications. All potentially accessible via the Web and with a great potential towards trans-disciplinarity.

These systems, among which Landsupport is one of the most innovative, strongly contribute to better planning at small and large scale, to implementing urban policies, to drafting urban plans, all with the aim to reach a greater environmental sustainability. In this context, the Landsupport platform constitutes an important tool for the regeneration of public spaces and the construction of suitable policies to support their sustainable use and management. This is also in line with the 17 SDGs and the principles of the New Urban Agenda including: 14 (c) Ensure environmental sustainability by promoting clean energy and sustainable use of land and resources in urban development, by protecting ecosystems and biodiversity, including adopting healthy lifestyles in harmony with nature, by promoting sustainable consumption and production patterns, by building urban resilience, by reducing disaster risks and by mitigating and adapting to climate change.

Starting from these premises, the aims of this study are: to illustrate the keywords for the construction of a common language between those who deal with the territory and in particular with green spaces in the various disciplines; to understand how Landsupport can contribute in the construction of policies for the sustainable regeneration of green spaces; what are any obstacles or problems.

To this end, in addition to the keywords, two current methodological approaches will be illustrated, created for urban spaces, but also usable for green spaces, namely: the 15-minutes place approach that means a place able to offer to all its inhabitants everything they need to live, work and have fun to be reached on foot in no more than 15 minutes; and the flexible one that is based on dynamic tools for landscape, architectural and urban planning and design, which are able to allow changes in the course of implementation of those projects.

The study is completed by an illustration of Landsupport's potentials for policies and some updates to the platform that could further improve its use for these features.

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P07-Machine Learning Forest Simulator (MLFS): New tool for assessing the state of future forests

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Machine Learning Forest Simulator (MLFS) is the first complete data-driven forest development model, organized as R package. The main motivation behind the development was to remove the need for model parametrization and to provide easy to use and freely available tool, applicable to all forest ecosystems, from even-aged monocultures to mixed forests with diverse vertical structures. MLFS is freely available, age- and spatially-independent forest development tool. It requires data from at least two inventory periods, which is used to 1) model basal area increments (BAI), 2) update tree and crown heights in each simulation step, 3) simulate individual tree mortality, 4) ingrowth of new trees, and 5) harvesting. The main input tables consist of forest inventory plot data, climate and site descriptors, which are used to train specific sub-models. In the Landsupport project, we used MLFS to simulate forest dynamics for Slovenian and Italian forests for the 21st century. We defined different hypothetical scenarios differing in forest management, individual mortality, and climate. We have shown that the model provides reasonable long-term predictions of forest development that can be used for better forest management decisions or as a support tool for understanding future development of analysed forests, for understanding and predicting changes in national greenhouse gas emissions, and for scientific purposes related to understanding forest development from multiple perspectives. In the future, MLFS will be further developed in collaboration with potential users to improve its performance, usefulness, and general applicability.

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P08-Empirical vs. light-use efficiency modelling for estimating carbon fluxes in a mid-succession ecosystem developed on abandoned karst grassland

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An accurate quantification of the carbon balance is essential for large scale carbon budget studies. Thanks to the good relationship between the fraction of absorbed photosynthetically active radiation (fAPAR) and vegetation indices (VIs), the gross primary production (GPP) and the net ecosystem exchange (NEE) are often estimated using different models designed to use remote sensing products. In this study conducted in a mid-succession ecosystem developed on abandoned karst grassland, two types of model were assessed, estimating GPP or NEE based on seven years eddy covariance data (2013-2019): (1) a simple quadratic VI-based empirical model with five alternative VIs as proxies of GPP and NEE, and (2) the vegetation production model (VPM) which is a light use efficiency model to estimate only GPP. The Enhanced Vegetation Index was the best proxy for both GPP and NEE in the empirical model setting. The empirical model performed better than the VPM model which tended to underestimate GPP. For this ecosystem, we therefore suggest the use of the empirical model, if the quadratic relationship observed persists. The VPM model however would be a good alternative under a changing climate, as it is rooted in the understanding of the photosynthesis process, if the scalars it involves could be improved to better estimate GPP.

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P09-_Agrochemical remediation of farm soils by combining solarization and ozonation techniques

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Project LIFE-AgRemSO$_3$il (LIFE17 ENV/ES/000203

Pesticides are widely used in farming to control pests, diseases and adventitious plants. Many of these organic compounds have serious impacts on environment and human health. Many research works confirm the generalized problem of the agricultural soil pollution by persistent pesticide products. In addition to the restrictions on the use of these compounds promoted for years by EU legislation, there is a need of implementing full-scale soil remediation strategies.

The objective of the project LIFE AgRemSO3il is to develop and demonstrate a new technology to remediate soils combining on-site solarization and ozonation techniques. A prototype was optimized under controlled conditions and tested in two commercial farms. Results show the higher pesticide degradation (63% after 40 treatment days) and a low impact on microbiologic populations when ozone is simultaneously applied on the soil surface and 15 cm depth.

Despite the promising results of this remediation technology, some barriers have arisen for its future replication: the application of ozone in agriculture seems to be subject of registration as phytosanitary product, even if is not the objective of the proposed use. The Agremsoil system could also be of a great use for other purposes, such as conversion of soil from conventional to organic farming, treatment of agricultural abandoned soils, contaminated soils with other organic persistent pollutants...

There is a need of further studies, and of an open discussion on the use of ozone for soil remediation including scientific, technical, societal and legal aspects to put in balance pro-and-con arguments to support governance issues in this regard.

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P10-_AGREMSO$_3$IL combined treatment for degrading pesticide residues in soil.

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Pesticides broad utilization has contributed to increase agricultural production globally, but at the same time negative environmental effects and health risks have arisen due to their constant application, high toxicity and persistence. Even though current policies are aimed at decreasing the levels of hazardous chemicals in the environment, it is not expected a ceasing of pesticide usage in the near future. Therefore, it is a subject of continuous relevance the development of technologies to eliminate (or at least reduce) the present levels of these potentially harmful compounds in the environment. This is the main objective of LIFE-AGREMSO3IL project, to assess the effectiveness of the combination of solarization and ozonation techniques for decontaminating soils polluted with pesticide residues. For this purpose, different experiments were performed at controlled and field conditions. For solarization treatment soils were covered with a thin film and exposed to solar irradiation during the hot season. For ozonation treatments ozone was produced in situ by means of an Osmaqua generator running at maximum efficacy. Four treatments were assayed at laboratory scale: S (solarization), SOS (solarization + surface ozone application), SOD (solarization + deep ozone application) and C (control, without any treatment). Higher degradation rates were observed when ozone was applied together with solarization, being particularly noticeable when ozone is delivered in deep mode. At field scale, three treatments were assayed: C (control), S (solarization) and SOSD (solarization + surface/deep ozone application). The larger pesticide removal was detected for SOSD treatment, because of the increment of accumulated hours at higher temperature along with ozone oxidative capacity and the intensification in the application mode.

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P11- SERENA Project: what is it telling us about soil ecosystem services in Europe?

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SERENA Project aims to analyze the positive contribution of data and indicators related to soil ecosystem services for supporting land planning. Main drivers, as climate change, land use and land cover trends as well as main threats, relevant functions and related indicators would be considered to better describe and to improve the knowledge of ecosystem services provision in European areas. SERENA will produce an integrated analysis of soil threats, soil ecosystem services and their bundles to provide high added-value indicators for both end users and researchers.

The enhancements on soil ecosystem service data and indicators would address the evaluation of effectiveness of soil related policies striving to achieve national and global environmental targets, including Agenda 2030 and its Sustainable Development Goals, involving broadly decision-makers and stakeholders.

The poster will describe SERENA objectives and its expected contribution to policymaking processes. Some preliminary results will be presented with an emphasis on methodological issues, such as glossary, indicators homogenization, and coherence, as preliminary elements for deep analysis and tool proposals.

SERENA started in November 2021, three years project in the frame of EJP soil European Joint Programme.

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P12- User-friendly and Integrated Simulation Tool for Support Sustainable Land Management Planning: Implementing Case in the Rmel Catchment in Tunisia

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In the watershed context, water-driven soil erosion is one of the most profound environmental flows leading to land degradation risk across the landscape. Expanding Sustainable Land Management (SLM) practices faces decision-making problems that are mainly caused by diversities of the environment and stakeholder needs/preferences, as well as difficulties in anticipating planning outcomes. This study applied Integrated LAnd Management Planning Tool (iLAMPT) to examine possible management pathways to address potential soil erosion and costs-benefits driven from different sustainable land management (SLM) planning scenarios across the Rmel catchment, Zhagouan governorate, Tunisia. The core environmental module of iLAMPT is the grid-based Revised Universal Soil Loss Equation (RUSLE) adjusted for the sediment delivery ratio (SDR). Different databases and field characterization were used to calibrate the model for the Rmel watershed in and validate model outputs at the catchment scale.

The development of the tool user interface has done through a participatory process that facilitate active participation of stakeholders in an adaptive tool development cycle. The process of tool user interface development has the following key points: (a) improve stakeholders' understanding the data input and tool use journey via direct consequential visualizations, (b) provide stakeholders with accesses to define technical parameters, as well as management factors based on their needs/preferences, (c) provide stakeholders with options to define SLM planning scenarios and observing resulting outputs in a timely fashion so that they can capture and understand the dynamics of the environmental feedback loop including changes due to different management options, and (d) presenting results in diverse and understandable forms such as tables, graphs and maps. The development of tool user interface and workflow through interactions with stakeholders is considered as a validation for the relevance of the tool to particular regional needs for decision support in SLM planning.

A participatory grid-based appraisal was applied to validate the simulated spatial patterns of soil erosion at the catchment level. The evaluation showed good matching in erosion hotspots. Since the tool allows end-users define planning scenarios/options and provide outputs in a spatially explicit and timely responsive way, it assists effective discussions over landscape planning where land degradation neutrality is the ultimate goal. The development of iLAMPT is under the framework of and supported by LANDSUPPORT project.

Keywords: Soil Erosion, Sustainable Land Management; Soil-Water Conservation, Land Degradation Neutrality, Rmel Catchment, Tunisia.

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P13- Functional Context Similarity Units for Supporting Out-scaling of Sustainable Land Management in European Mediterranean Bioregion

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It is widely recognized that Sustainable Land Management (SLM) are much needed for achieving Land Degradation Neutrality (LDN). Adoption and effectiveness of SLM depend on specific contexts. Contextual diversity makes uniform blanket policies promoting SLM less effective and out-scaling of site-specific SLM difficult. We propose the functional context similar unit (fCSU) approach to overcome these challenges by grouping common biophysical, economic and social contextual factors of land use and land management into distinct context similarity units that shape SLM adoption and resulting LDN.

The presented study focuses on the European Mediterranean Bioregion within Mediterranean basin. The socio-ecological contextual factors selected for analysis includes 25 spatial variables of biophysical condition (climate, topography, soil, land cover and livestock density), physical accessibility, demography and economic development status at the spatial resolution of 500 m. We identified and mapped context types using spatially explicit (grid-based) multivariate statistics. Core factors differentiating socio-ecological context were identified using principal component analysis (PCA). Six distinct types of socio-ecological context were defined and mapped by cluster analysis. The empirical nesting of these clusters with aggregated land cover classes resulted in 47 Context Similarity Units (CSU) in the study region.

The functionality of the derived SCUs were evaluated by unbalanced, grid-based ANOVA that measured and tested the differences in inter-annual trend of Net Primary Productivity (2001-2014 period) among the SCU within each aggregated land cover type. The result demonstrates the potential of the function CSU approach to further our understanding LDN in socio-ecological contexts. The result of fCSU mapping can be directly used by LDN-oriented projects/programs and citizen scientists in the region. For example given limited resource and aims, we can know approximately where efforts should be focused by managing or coping with what drivers. The resulted fCSU is also being implemented as SLM extrapolation domains in the Geoinformatics Options by Context (GeOC) tool tailored to LANDSUPORT's S-DSS: given SLM outcomes in a number of project sites, we can identify where similar intervention options have a potential of success based on contextual similarity.

The presented study is under the framework of and supported by LANDSUPPORT project.

Keywords: Mediterranean Bioregion, Mediterranean Basin, Socio-ecological Context, Sustainable Land Management; Land Degradation Neutrality, Context Similar Unit, GeOC, Out-scaling

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P14-The potential of VIS-NIR spectroscopy as a tool to assist in the protection of agricultural soils

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Our studies indicate great potential for using the tool of VIS-NIR spectroscopy as a fast, relatively cheap method for determining various properties. Moreover, our studies indicate that the VIS-NIR method is also accurate and close to classical laboratory methods. The VIS-NIR spectroscopy method offers additional possibilities for the determination of soil properties that are important from the point of view of soil protection e.g. (organic carbon, nitrates, texture). A great advantage of this method is the possibility to mount VIS-NIR equipment e.g. on agricultural tractors and perform on-the-go measurements. With such capabilities, highly detailed field-scale maps of different soil properties can be produced (Debaene et al., 2014). In turn, a good knowledge of the spatial variation of soil properties is essential for proper soil management in the context of protecting soils from degradation. Another tool created by VIS-NIR spectroscopy are spectral soil libraries at different local and regional scales, which will enable better protection of agricultural soils. For this purpose, the IUNG-PIB Puławy is constantly developing spectral library of Polish mineral and organic soils. Already more than 3500 samples have been scanned in the laboratory and included in the spectral library (Debaene 2019). Combining spectral data of soils with data of different soil properties and scales has allowed the construction of predictive models for many soil properties. Our study indicates that VIS-NIRs is a very sensitive method for soils, thus useful for assessing and managing soil quality and protecting from soil degradation.

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Keywords: VIS-NIRs, soil spectra library, soil protection, soil assessment

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P15- Inoculation with biostimulants for improved plant performance under stress conditions

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Biostimulants as a diverse group of beneficial soil microorganisms and active natural compounds, which by modes of action, such as phytohormonal activities, mobilization of sparingly available mineral nutrients or interactions with the soil microflora can have direct positive effects on plant performance. Especially under conditions where plants are exposed to biotic and abiotic stresses, plant performance as well as the nutritional status of the plant can be promoted as observed in previous research. The application of BEs in targeted combination with mineral fertilizers could thus contribute to an optimized management of soil fertility.

In this study, beneficial effects of biostimulants was tested in maize pot experiment exposed to a phase of cold stress. Following preparations were tested: SuperFifty® (Ascophyllum nodosum; BioAtlantis, Tralee, Ireland), AvytZn/Mn®, Algafect® (short description), Proradix® (Pseudomonas sp. DSMZ 13134; Sourcon Padena, Tübingen, Germany), RhizoVital® FZB42 + R41 (Bacillus amyloliquefaciens, Bacillus simplex R41; ABiTEP, Berlin, Germany). Maize (Colisee–KWS) was cultivated in 2kg pots (silty-loam) from field-station Ihinger Hof, Renningen, Germany. The soil substrate was fertilized with 100 N, 50 P, 150 K, 50 Mg, 50 Mg mg/kg dry matter. In order to compensate for micronutrient effect of the AvytZn/Mn treatment, Zn and Mn treatment was established. The pots were installed in a cooling system to control root zone temperature. After an initial warm phase (ca. 22 °C), the cold stress phase (14 °C) began at 14 days after sowing. 1 week after of stress-phase plants showed severe symptoms of phosphorous deficiency. The stress-phase was then followed by a recovery phase, with warm temperatures (22 °C), which lasted another 3 weeks. BE treatments were applied to the soil right after sowing, 14 days after sowing and one month after sowing. A beneficial effect on plant performance was observed in response to the treatment with AvytZn/Mn. It was observed that in contrast to other treatments and the control, there were no symptoms of P deficiency. This finding indicates that AvytZn/Mn effectively improved the tolerance of maize plants to cold stress conditions. Further investigations to understand the functional mechanisms behind this phenomenon and its reproducibility under field conditions are to be elucidated within NOcsPS Project in the University Hohenheim.

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P16- A two-step global sensitivity analysis of the ARMOSA model

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ARMOSA is a process-based model that has been developed to quantify the effects of crop management practices on soil nitrogen and carbon cycles, groundwater nitrate pollution, and soil carbon sequestration. The model simulates crop growth and development by including soil water dynamics, carbon and nitrogen cycling and evapotranspiration. The processes taking place in the soil-crop continuum are described by algorithms, which are characterized by a wide set of parameters. To identify the most important processes affecting annual yield and nitrogen leaching at 1 m depth, a global sensitivity analysis of the model was carried out on the model parameters with a two-step approach. The analysis was performed on winter wheat (Triticum aestivum L.) in four soil profiles in Marchfeld (Austria) from 2010 to 2018. Among the many parameters of the model, our analysis focuses on seventy parameters which were more related to the two target variables. First, the screening method of Morris (with the improvement proposed by Campolongo and Saltelli, 2007) was adopted to obtain a first qualitative ranking of the parameters without extensive computations. Then, the more accurate Sobol method is applied to the top parameters resulting from the first screening (specifically, 11 parameters affecting the annual yield and 13 parameters influencing the nitrogen leaching at 1 m depth). Our analysis highlights that the most affecting parameters on the yield are the threshold characterizing the critical nitrogen concentration from emergence to flowering for the aboveground partition of the plant (a_{crit}) and the potential carbon assimilation rate (PCO_2), the drought sensitivity parameter (WSPar) and the maximum depth of roots. As for nitrogen leaching, the parameter related to the microbial efficiency in decomposing litter was the most impacting. Hydrological properties resulted in little impact on output variability. Given the link between parameters and processes, this analysis highlights the drivers which strongly affect yield and leaching being the best indicators of productivity and environmental impact, respectively.

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P17- An overview of the LANDSUPPORT tools for agriculture (vineyard, olive grove, agroclimatic service)

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Landsupport DSS includes several tools applied from local to regional scale thought for specific aspects in agriculture. More in detail, the DSS has the ambition to provide support to winegrowers and wine sector as well as the olive growers through tools designed to support vineyards and olive groves planning and management. The parent tool "d" named "Support Institutions in rural development plan and designation of origin" is the place where the users interested to the viticulture and olive growing can find several instruments delivering data and information in different forms, such as thematic maps, graphs, tables and technical reports. Ranging from the compilation of documents containing environmental data regarding your vineyard or olive grove, to the production of maps about bioclimatic indexes, potential risk of plant disease or viticultural zoning these instruments are able to support your choices. Several data are generated by Landsupport on the fly thanks to modelling procedures, and all the data are delivered within the area of interest drawn by the user. For example, a tool named "Agricultural and agroclimatic services" works processing on the fly weather datacubes (multi temporal raster data) from ERA5 Land and Cosmoleps services as well as local weather data, to generate in the area of interest graphs and tables reporting weather information (temperatures, rainfall and solar radiation) including past, current and forecast (five days) data. A tool named "Enotourism – cultural and environmental tool" has been recently completed and launched. It is designed to support cultural and environmental wine tourism by providing on the fly cultural or naturalistic data (i.e. historic residences, archaeological sites, monuments, museums, monumental trees, particular viewpoints, etc.) in the surroundings defined by the user of a point or place in the territory he is interested to.

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P18- Automatic soil sample analysis by computer vision

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The primary consumers of plant exudates – in exact fungi and bacteria, are representative for the soil succession level from bare soil, which is bacterial dominant to old growth forest constitute by fungal dominance. In a specified level of soil succession, a special kind of plant family benefits on the Fungal to Bacteria Ratio. The ability to determine this ratio in situ without complex chemical applications is part of the project Electronical Laboratory for Intelligent Soil Examination (ELISE). Several mechanical and optical tests on soil samples are covered within this Project. To analyze the fungal to bacteria ratio, samples are prepared automatically – in a defined and reproductive procedure – to generate slides for shadowing microscopy. The samples are observed by a camera, which is attached to a transmitted light microscope. The automatic analysis, done with computer vision algorithms, aims to quantify bacterial and fungal biomass in the actual sample view. Moreover, the algorithm can classify organisms according to their color and shape.

To get a processable picture, several images from different focal levels must be taken through the sample thickness. Parts of each image, are in focus at the actual layer, are merged to a whole depth of field picture, by focus stacking.

This produced picture is used to classify, locate and quantify – in first step filamentous organisms e.g. fungal by image sematic segmentation. The result represents an image sized mask, which indicates the class of fungi with class equivalate values at the pixel positions – covered by the organism. This information is used to calculate the fungal mass per gram soil.

To quantify the bacterial biomass two approaches are implemented. For low density of bacterial existence, the individual bacteria is counted for a part of the field of view by an image detection algorithm to be extrapolate afterwards to the mass per gram soil. For high density of bacterial occurrence, specified regions of interest with only bacteria present are chosen. An image classification which has been pretrained by pictures of bacterial density patterns – previously determent by making the sample countable due to preforming sample dilutions, is done. The second option for high density bacterial count is, to automatically preform dilutions until the image detection is confidently countable.

To ensure a usable confidence score a statistical approach of many fields of view is taken.

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P19- Vivid tool for comprehensive and statistical biological soil analysis

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Since the green revolution chemical analysis of soil properties has reached a high level of attention. In the shade of this physical and biological soil properties are often neglected. Shadowing microscopy has been used for biological soil analytics since more than 200 years but never established as standard. The sample preparation is time consuming, manual work and the outcome depends on subjective skills of the operator, furthermore the results are mostly not quantitative. Therefore, the database on biological soil properties is mostly not sufficient for an integrated modelling on an multidisciplinary scale.

This project combines three progressive approaches to develop a tool that is easy to use and gives in-situ results that can be used for many purposes.

- Field robotics is used to collect GPS assisted soil cores. This allows in a statistical way to investigate spot precise the effect of a soil treatment prior and past the application.
- Modern process engineering methods are used to prepare a sample by creating suspension to a microscope slide with cover slip.
- Computer vision methods are used to get sample in focus automatically for identification and quantification of microorganisms.

Data are extrapolated, to conclude biomass of bacteria, fungi and in future for Nematodes and Protozoa per volume soil. Due to the presence of certain bacterial species an identification of anaerobic conditions in deeper soil layers can be made.

As this tool serves data and images it´s very comprehensive and therefore ideal for soil advisers which are in charge to explain and discuss soil properties with landowners that have no or little scientific background. The statistical approach introduced with the field robotics allows a spot precise monitoring of soil regeneration projects or supports the transfer from conventional to organic farming. Using this tool for some years a knowledge database could be created how certain soils react in certain circumstances on certain treatments.

In a trans- and interdisciplinary approach this tool can be used locally for growers to implement a sustainable agriculture, for regeneration projects of heavily polluted soils, for prevention of mud- and debris flow or - on a higher scale - the data can be used for environmental policy making, agriculture and land use management.

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P20- Landsupport, a living hub for geospatial data integration and policy support

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Policy frameworks concerning land management evolved rapidly under deeply transformative policies such as the 'European Green Deal'. The experience of the WP6 allowed for an in-depth scientific and policy-oriented analysis of the Land Degradation (SDG 15.3.1 indicator), Zero Net Land Take, and Climate Change Resilience tools output to highlight the strengths of the Geospatial Cyberinfrastructure Platform and avoid shortcomings of their use.

Geospatial dashboards have been developed at the national and county levels to help users gather, visualize, analyze spatial data, and advise policy stakeholders. Landsupport tools used state of the art research findings to develop an interactive geospatial dashboard decision support and monitoring. The data sources used in the Landsupport platform are gathered from official governmental websites, public agencies and international standard methods. Engagement and collaboration with stakeholders were a pillar of the Landsupport project. This has enabled the use of detailed products for country and local scale to cope with emerging conditions that threaten public health, safety, and well-being.

Two tools, Land Degradation and Land Take come with different methodologies but with a high impact on policies and sustainable development goals SDGs. Our testing activities and interaction with partners allowed for the co-design of the tool and result that can be easily used by many stakeholders, from local to supranational scale.

The main advantage of the land take set of tools is to adapt the model to the data available at different scales. For instance, the Land take monitoring tool at the European scale used Imperviousness (EEA) for 2006-2018. In contrast, the country scale (Italy) can provide the data released by the ISPRA with a broader timeframe, better spatial resolution and an additional quality check. By analysing the 1481 tests at NUT 3 level, we highlighted some inconsistencies between the European data and Italian data; this can be seen in a test carried out in the Biella NUTS3 district (ITA). In this case, a very high share of gain in imperviousness (false positive) found in the European scale data can be recognized visually on the platform, the user can evaluate by checking the National dataset (ISPRA land take) and assess the potential soil gain visually and double-check between the two data sources (map and spreadsheet).

The Landsupport tools have an incredible media capacity to warn stakeholders of the general public and the administrative municipal and district level.

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P21- The LANDSUPPORT BEST PRACTICE tool to identify the trade-off between soil health and crop production

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The LANDSUPPORT IT group has developed the web-based "Best Practices tool" that runs on the fly to identify optimized solutions for enhancing crop production and soil fertility while reducing nitrate leaching. The tool applies a what-if scenario approach at regional scale in three case studies (Marchfeld – Austria, Campania Region – Italy, Zala County – Hungary). The target users are public authorities, such as regional environmental agencies, to find the best solutions according to a goal to be pursued in a given region of interest (ROI). The tool is dynamically linked to the ARMOSA process-based model, which simulates at daily time step combinations of farming systems (conservation, organic, conventional), crops, nitrogen fertilization rates, tillage solutions, crop residues management. The tool outcomes are the mean annual value of (1) the crop yield, (2) the nitrate leaching at the bottom of the soil profile, and (3) the change of the soil organic carbon stock in the upper soil layer (0-0.3 m). The tool also returns the value of the "best practices index" (I_{BP}) that is computed as a linear combination of the three variables and the weights that the user dynamically assigns to each of the variables according to the specific goal (e.g., increase in soil organic carbon). The user then sorts the I_{BP} values in descending order to identify the most suitable combinations of practices. The mean value of I_{BP} is plotted in charts for each of the simulated combinations.

How does the tool work? The user sets up the combination of agronomic practices via web interface in a given ROI, whose soil properties are dynamically used by ARMOSA as input data. The possible combinations are many (up to 2520 combinations): 5 climate scenarios specific, 7 crops, 2 systems (conventional, organic), 3 fertilization rates (optimal amount, 15% and 30% reduction), 2 residues management (removal, retention), 3 tillage practices (ploughing, minimum tillage, sod seeding), and 2 uses of cover crops (yes, no). The user-friendly interface hides the high complexity of the soil and crop processes which are simulated on the fly by ARMOSA, which has many crop and soil parameters already calibrated using the dataset available in the project and in previous studies. The close link with ARMOSA allows the tool to represent actual and optimized cropping systems with the possibility of further applications in other regional case studies and in tailored scenarios uploading soil properties and climate data with a bottom-up approach.

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P22- Understanding Soil from Pixels: rasdaman Datacubes as Enabling LANDSUPPORT Platform

Peter Baumann

Rasdaman

Datacubes form an accepted cornerstone for analysis (and visualization) ready spatio-temporal data offerings such as 2-D satellite imagery, 3-D x/y/t image timeseries and x/y/z geophysical voxel data, and 4-D x/y/z/t atmospheric data. By abstracting away from the intractable zillions of files, datacubes provide a basis for services which are both richer and easier to use, enabling access and analytics to Big Earth Data without deep coding and IT skills, just as we use TV sets without the need for deep electronics know-how.

In the LANDSUPPORT project, rasdaman has contributed the datacube management and analytics platform. This pioneer datacube engine is operationally offering 100+ PB of spatio-temporal Earth data in the EarthServer federation, the worldwide largest location-transparent Earth datacube pool. The rasdaman engine offers standards-based access through a wide spectrum of own and 3rd party clients, ranging from Leaflet over NASA WorldWind and QGIS to python and R. Further distinguishing features include flexibility of any query, any time; unchallenged scalability; location-transparent federation; and more. As EarthServer federation member, LANDSUPPORT offers its data for analysis and direct mix&match with other Earth datacubes, such as DIAS Sentinel archives. Seamless integration with INSPIRE and, hence, European agencies is provided by rasdaman as the official, validated INSPIRE-WCS Good Practice.

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P23-ON THE IRRIGATION AND WATER EROSION PROCESSES

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The researching and examinations of the irrigation processes, as well the processes causing erosion of the soil furrow beds and the alteration of their state in practice is done based on the flow velocities averaged-out in time. Through the hydraulic researches, it is known however that the real, actual velocities are pulsation velocities into the cross section of the water flow, which are irregularly variable in time and different from the averaged flow velocities. It is known, that the erosion process occurs when the hydrodynamic forces of the water flow obtains values greater than the resistance forces of the flowing soil particles or aggregates. The latter depend on the physical parameters of the soil, the shape and size of the particles, the adhesion between them and others. On the other hand, hydrodynamic forces are a function of pulsating (instantaneous) velocities and their irregular, stochastic nature of alteration.

In view of this, in the present work the relations were realized on the basis of the pulsation velocities of the water flows. On this basis, a water erosion approach and method is offered for prediction of the erosive state and stability of the furrows for irrigation.

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P24-Modis-your partner in grant consultancy and project management

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Modis recognizes that innovation transforms the way we perform research, develop and market new products, deliver care, communicate with stakeholders, and adhere to regulations. Modis applies best practices and proven methodologies responding to the key business challenges in life science innovations and deliver end-to-end projects and services. Modis has vast experience in project and grant management in EU-funded projects and plays a key role in communication and dissemination activities and stakeholder engagement and alignment.

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P25- Under forest protection: Different forest types and soil erosion risk assessment - a case study from Slovenia.

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Forest biomass removal can have undesirable effects on soil functions and the hydrological cycle, and several international studies have highlighted the necessity of sustainable management practices to mitigate post-harvest impacts on forest ecological cycles. Among the various hazards to soil, soil erosion in forests has also been shown to be present in forests, but its assessment is still quite difficult due to a significant lack of data. A good risk assessment of soil erosion in forests requires detailed (1) data on the amount and seasonal intensity of precipitation, (2) data on soil texture and type, (3) data on forest communities or types, and (4) data on relief. The more detailed the data, the more accurate the soil erosion risk assessment. In developing the soil erosion risk model, we focused on selecting data such that additional field measurements and sampling were not required to build the model. The latter are a major financial and time challenge and are therefore often not feasible, especially in larger areas/countries. For data on the amount and seasonal intensity of precipitation, we focused on data from the official meteorological stations of the national meteorological network. The data on soil texture and type were taken from the national pedological map and supplemented by the results of random sampling on randomly selected plots throughout Slovenia. For data on forest communities or types, we limited ourselves to distinguishing between deciduous, mixed, and coniferous forests. Data on relief, slopes, and slope lengths were calculated from LiDAR data. Data on forest management practices are also an important imput data. However, these are generally not detailed enough to be useful. We must also point out that the RUSLE formula we used to calculate the soil erosion model is more appropriate for agricultural land. Nevertheless, it is considered useful when we have several field measurements available for the study area.

For the more detailed soil erosion map for the forest areas, we would need more detailed high-resolution data. The lack of detailed data is clearly shown when we have diverse relief and different soil and forest types which is also a case of Slovenia.

Keywords: *soil erosion, forest protection, RUSLE, risk assesment, natural hazard*

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