BOOK OF ABSTRACTS Biohydrology7: Biota, water and humans. Management for a sustainable world, Gandia 18-22 October 2023

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https://7biohydrology.webador.es/

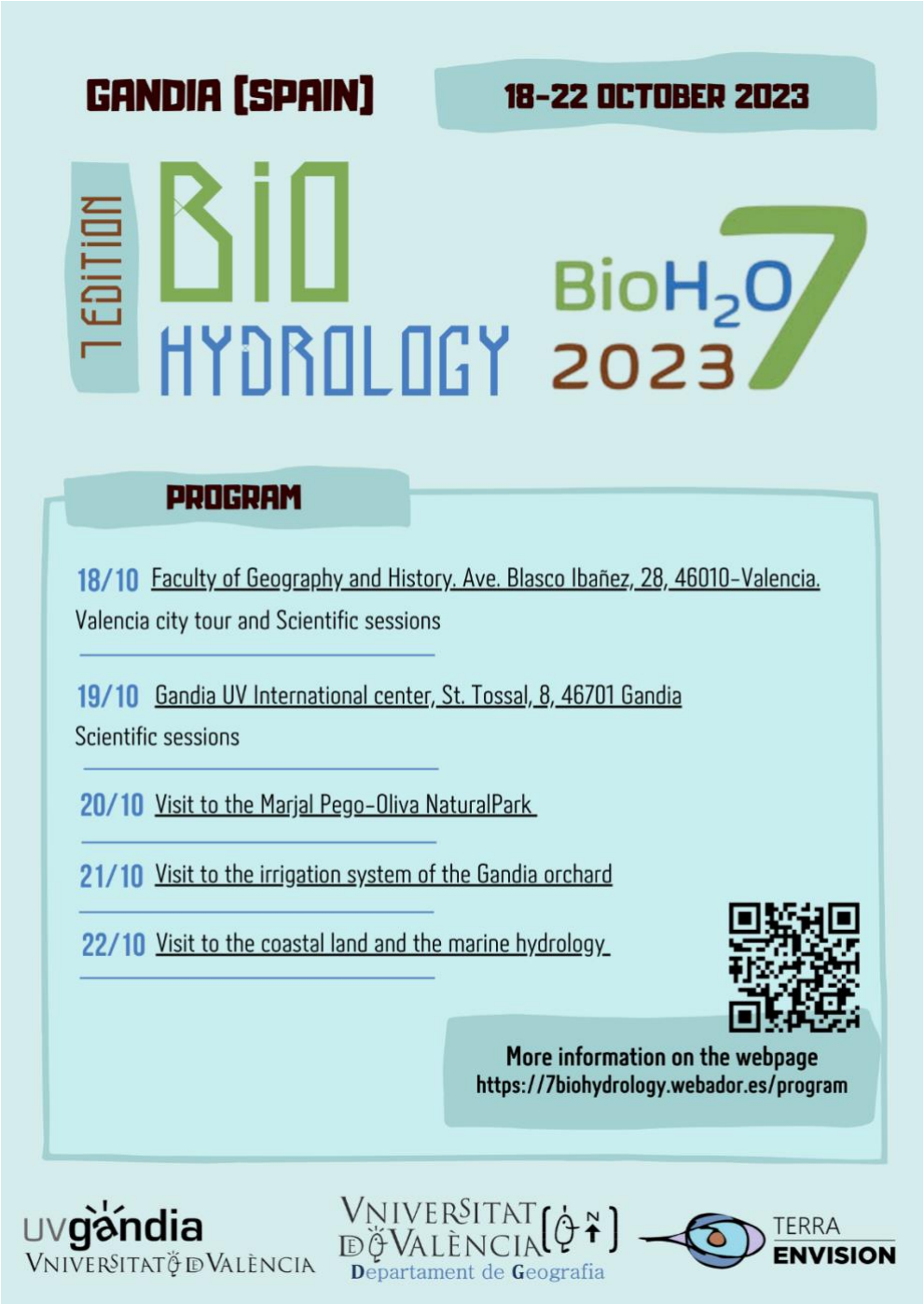
WELCOME

The Biohydrology7 meeting will be held in Gandia (Spain) in October 2023 (18th-22nd). Previous Biohydrology meetings were held in Prague (2006), Bratislava (2009), Landau (2013), Almeria (2016), Valencia (2019) and Krakow (2022). The aim of the BioHydrology conferences is to provide a forum to share knowledge and networking about any topic related to the interactions between biotic systems and hydrology. Biohydrology aims to gather scientists and practitioners dealing with issues in the field of hydrology, biohydrology, biology, ecohydrology, ecology, geography and engineering in natural, agricultural, forestry and anthropogenic areas.

The theme of the Biohydrology7 will be "Biota, water and humans. Management for a sustainable world". We are planning two conference days (posters and talks), one day of mid-conference field visit and two days for a post-conference tour.
If you would like to act as an organizer of a specific scientific session, please, share with us your ideas at biohydrology2023@gmail.com. Also if you have any questions or ideas, please do not hesitate to contact us.

Francisco Escriva & Artemi Cerdà

PROGRAM


GANDIA (SPAIN)
18-22 OCTOBER 2023
7 EDITION
BIO HYDROLOGY
BioH2O 2023
PROGRAM
18/10 Faculty of Geography and History. Ave. Blasco Ibañez, 28, 46010-Valencia.
Valencia city tour and Scientific sessions
19/10 Gandia UV International center, St. Tossal, 8, 46701 Gandia
Scientific sessions
20/10 Visit to the Marjal Pego-Oliva NaturalPark
21/10 Visit to the irrigation system of the Gandia orchard
22/10 Visit to the coastal land and the marine hydrology
More information on the webpage
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Invited speakers

Fernando Valladares. Museo de Ciencias Naturales de Madrid. Consejo Superior de Investigaciones Científicas.

Saskia Visser. Wageningen Univeristy and Climate-KIC

ABSTRACTS

La crisis climática y social nos abre las puertas a una recivilización.

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Las advertencias desde la ciencia sobre el rumbo de colisión que lleva la humanidad no acaban de ser tomadas muy en serio. Ni siquiera cuando la ecología se alía con la física y la medicina para abordar los límites planetarios y como el trasvasarlos impacta nuestra salud y la de muchos otros seres vivos se logran cambios sustanciales a la hora de mitigar el cambio climático, revertir la pérdida de biodiversidad o reducir los niveles de contaminación. La evidencia científica de que la degradación ambiental genera millones de muertes evitables y disminuye radicalmente el bienestar de más de dos tercios de la humanidad no es suficiente para que se cumpla el acuerdo de Paris o se avance en la agenda 2030 y los objetivos de desarrollo sostenible. Para favorecer el cambio de rumbo global que desde la ciencia se ve tan imprescindible como urgente es preciso aunar diversas narrativas, argumentos y motivaciones. La ciencia no basta. Tenemos una oportunidad histórica para revertir procesos perversos, para anteponer los derechos humanos y para cambiar nuestra relación con la naturaleza. Aprovechar esta oportunidad de recivilizarnos nos hará más sanos y felices. El momento es ahora.

KEYWORDS: Cambio climático, conciencia social, soluciones, decisiones, futuro.

The Role of Soil Health Management Practices on Soil Hydrophobicity in Agroecosystems: A Review.

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Soil hydrophobicity is a natural phenomenon documented in many environments worldwide, including managed (golf courses and agriculture fields) and unmanaged (wildland and forest) systems. Soil hydrophobicity affects a soil's ability to absorb water, affecting the soil's hydrology. In agroecosystems, this is particularly important as the development and occurrence of soil hydrophobicity can impact crop growth, quality, and yields. Several scientists have focused on the occurrence, causes, impacts, measuring, and remediation methods of soil hydrophobicity. However, few studies have examined the effects of different management strategies on soil hydrophobicity in managed systems. Considering anticipated climate change, this review focuses on the relationship between soil hydrophobicity and soil health. This paper will (a) review past soil hydrophobicity research conducted in agriculture and the potential effects of climate change, (b) review how the common strategies to improve soil health in agroecosystems may influence the occurrence and development of soil hydrophobicity, and (c) review new methodology to measuring soil hydrophobicity. Common management strategies such as tillage, adding amendments, burning residue, and cover cropping all alter soil by physical, chemical, or biological means, which can influence the development and occurrence of soil hydrophobicity. Scientists can direct research efforts, and landowners and farmers will be better equipped to make management decisions regarding soil health and crop productivity by understanding how standard agroecosystem management practices influence soil hydrophobicity.

KEYWORDS: soil hydrophobicity, soil water repellency, soil health, tillage, cover crops, agroecosystem sustainability.

Cover Crops and Climate Impact Temperature and Volumetric Water Content in Southern Piedmont Soils in South Carolina, USA

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Cover crop (CC) adoption in the southern Piedmont region of South Carolina, USA, remains low due to the lack of information on CC performance including identification of specific benefits provided. A primary concern is how they impact soil physical properties. Maintaining warmer soils and adequate soil moisture in winter months will promote soil biological activity. A randomized complete block design (RCBD) with three replications was conducted twice (2021/2022= EXP A, 2022/2023=EXP B) to investigate how eight winter CC and a fallow treatment influence soil physical characteristics and CC growth in Clemson, South Carolina, USA. Soil temperature, soil volumetric water content, and % cover of CC were determined throughout the growing season. The initial ANOVA identified experiment year and measuring event (ME) as significant ($p<0.01$), thus data was analyzed by ANOVA for each ME. Even though certain CC had better growth, there was minimal impact on soil physical properties. Cover crop treatment only influenced soil volumetric water content following drier periods during EXP A. During this time, soils under the fallow treatment had the highest volumetric water content, although similar to other CC treatments. Cover crops did not influence soil temperatures during EXP A. In EXP B, the soil under the fallow/pigweed treatment had the highest soil temperatures on two (out of ten) measuring events. Due to the minimal impact on soil physical characteristics by type of CC over time, a multivariate regression model was developed to identify how % cover and climatic factors relate to soil volumetric water content and soil temperature. Different models were determined for each experiment and will be reported. This experiment will be repeated fall/winter 2023/2024.

KEYWORDS: cover crops, soil volumetric water content, temperature

Potential Use of Biochar as a Soil Amendment to Sorb Terbuthylazine and 2-Methyl-4-Chlorophenoxyacetic Acid.

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Protecting natural water resources is at the forefront of agroecosystem sustainability. The intensification of agricultural activity includes using pesticides for crop protection, but pesticides also have associated potential environmental risks. Pesticides can contaminate soils, and pesticide runoff and leaching can impact surface and groundwater quality. Terbuthylazine and 2-methyl-4-chlorophenoxyacetic acid (MCPA) are common herbicides used in olive agroecosystems in Southern Spain. Both terbuthylazine and MCPA are mobile and have a high risk as a water contaminate. Developing low-cost, effective adsorbents that sequester surplus applied pesticides not utilized by the target may reduce the potential contamination risk. Biochars, carbon-rich materials created by heating biomass in a low-oxygen environment have been shown to have a high capacity to sorb organic compounds. In this work, the terbuthylazine and MCPA sorption properties of a biochar sourced from agricultural, garden, and sustainable forestry wastes are investigated. Sorption results and cost efficiency will be discussed. Biochar sourced from agricultural waste can be a low-cost sustainable strategy to reduce pesticide leaching and runoff, decreasing the risk of groundwater and surface water contamination.

KEYWORDS: Water quality protection, biochar, MCPA, terbuthylazine, olive grove, herbicide sorption

Impact of Water on Visual and Digital Color Assessment of South Carolina USA Soils.

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The impact of water content on how soil scientists observe soil color is well documented and widely taught. When determining the Munsell color of soil, the color value is known to decrease as water content increases due to changes in the spectral reflectance of the sample. This research seeks to assess how changes in soil water content impact digital readings and visual observations of soil color across South Carolina, USA. Color assessment was determined first for field moist versus oven dried samples, and then for samples based on their gravimetric water content. Visual and digital measurements of soil color were determined from field moist samples collected from across the state in 2021. The samples were weighed in the field and oven-dried at 180 C for 48 hours. Samples were re-weighed after drying and gravimetric water content was calculated. Visual observations and digital measurements were once again determined. The region where samples were collected influenced the color differences across soil water content. Generally, samples had higher values and lower chromas after drying. The soil water content did affect the agreement between the digital measurements and visual observations, but the differences were often less than one color chip. This suggests a similar practical application of the two methods for assessing soil color. Further results on impacts across gravimetric water contents will be discussed.

KEYWORDS: Munsell, visual and digital soil color assessment, soil water content

FLORECE! Review and Opportunities for Growing Undergraduate Experiential Learning in Sustainable Agriculture

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ABSTRACT

Future Leaders Obtaining Research and Extension Career Experiences (FLORECE!) is a Food and Research Initiative grant funded by the United States Department of Agriculture. FLORECE! aims to prepare 40 undergraduate students to become globally engaged professionals with world-class research and extension skills that allow them to identify critical factors impacting agricultural systems' sustainability. Universities involved are Clemson University (Clemson, South Caroline, USA), University of Cordoba (Cordoba, Spain), University of Seville and IRNAS-CSIC (Seville, Spain), and University of Malaga and IHSM-CSIC (Malaga, Spain). We are beginning the third year of this five-year grant. Goals, past and current student experiences, and views of the program will be presented. The program's vision is to increase collaboration with other universities in Spain and elsewhere. Time for open discussion of similar current and future granting opportunities and to answer questions about the program will be provided.

KEYWORDS: FLORECE, study abroad, sustainable agriculture education, experiential learning

Rootzone Soil Volumetric Water Content and Crop Yield from Contrasting Tillage and Cover Crop Strategies in South Carolina, USA

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ABSTRACT

A three-year experiment was conducted to investigate the effects of current tillage strategies and cover cropping on cash crop yield and soil volumetric water content (θ_v) of coarse Ultisols of the South Carolina coastal plain. Five tillage treatments, with or without cover crops, were established and maintained in a field in which no-till practices with subsoiling had been maintained for the previous 30 years. The field was previously maintained under a two-year corn-wheat-soybean rotation. Tillage treatments included no-till (NT), no-till with subsoiling (SS), strip-till with subsoiling (ST), vertical tillage with subsoiling (VT), and discing with subsoiling (D). Most θ_v at 10 and 20 cm depths (sandy loam) were between field capacity and saturation, with the majority of θ_v for the 30 and 40 cm depths (sandy clay) between wilting point and field capacity. Planting cover crops increased θ_v for specific treatments under corn and soybeans but decreased it under wheat. Increased θ_v was greatest when cover crops were used for tillage treatments with minimal surface disturbance (SS for Corn-2 and NONE for Soybean). Wheat yield was decreased by 10 kg ha-1 when planted after a cover crop. Perhaps the greater number of larger volume rain events that occurred compared to the equal number of, but smaller volume, rain events of the previous 15 years influenced θ_v the most and, subsequently, reduced CC and tillage effects.

KEYWORDS: tillage, subsoiling, soil health, cover crops, volumetric water content.

Soil Phosphorus Availability from Oat and Legume Cover Crops to a Wheat Crop in Southern Spain.

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Phosphorus (P) is an essential nutrient commonly limiting to crop growth because it is most present in insoluble and organic forms that are not plant available. The primary source of P fertilizers is phosphate rock, a non-renewable resource located in high concentrations in only a few areas worldwide. In addition, P can build up in certain subsoils and be lost with soil erosion and leaching to contaminate natural water resources. Thus, there is a need to reduce the reliance on natural P resources and to increase P nutrient resource efficiency within agroecosystems. Certain cover crops have been shown to mine and capture excess soil P and increase P availability for subsequent cash crops. The result is less need for external P fertilizers and a potential reduction of P contamination to receiving water resources. A study investigating the impact of four cover crop treatments (oat, two legumes, and an oat-legume mix) on available soil P for a subsequent wheat crop was conducted in Carmona, Spain, in 2022-2023. Soil samples were collected during cover crops decomposition and again during wheat growth. Enzymatic analysis (phosphatase) was conducted on the soil samples to determine available P. Results will be discussed.

KEYWORDS: cover crops, soil available phosphorus, natural water resource protection

The disappearance of the small wetlands on the coast of Daimús-Marenys de Rafalcaid (València, Spain)

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Abstract

The large Valencian coastal wetlands such as the Albufera or the Pego-Oliva marsh, althoughthey have lost a large part of their surface due to anthropic action, continue to be the symbol and paradigmatic example of Mediterranean wetlands. But wetlands have historically been located along the coast, being transition zones between the sea itself and the dune system with the inland areas forming a space of important symbiotic relationships between said ecosystems. A good example of these majestic transitional lands are those along the coast of Daimús beach and the Marenys de Rafalcaid de Gandia, in Valencia, Spain. The origin of these small "aiguamolls" or "ullals" is not known with certainty, that is, springs of water distributed in these swampy lands and their total disappearance makes studies of their origins difficult and their existence is known from the different chronicles and ancient observations. There are various theories of its formation, one of them is that its waters were fed by aquifers, due to its proximity to the mouth of the Serpis River and the waters that derived from its banks, but they could also be formed by marine intrusion or a conjunction of these factors. It is also theorized that its formation could be caused by excesswater from irrigating orchards. What we do know is that these humid spaces have completely disappeared; currently the space where they were located is occupied by large residential blocks and tourist apartments from the tourist product of Daimús beach, a small coastal municipality that has transformed its coast. to adapt it to sun and beach tourism and all its services. On the other hand, the Marenys de Rafalcaid area, which also experienced anurbanization process, did so to a lesser extent and a scattered urban fabric of single-family homes was established. But it was not urbanization that began to suppress the wetlands, the American flight and the aerial photograph from 1956 show how the orchards reached the coast itself, causing a drying process to take advantage of each flood in the territory for cultivation. The study of this type of wetlands should be a line of research to better understand the Mediterranean ecosystems and how to recover them.

KEYWORDS: wetlands, mediterranean, ecosystems, agriculture, tourism.

The loss of hydraulic heritage in the Valencian orchard

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Abstract
The territory where the Valencian orchard is located, on extensive coastal alluvial plains, is of great quality and fertility for cultivation, making possible an ancient agriculture that great ancient civilizations such as the Iberians, the Romans and the Muslims already began to develop. It was the latter who, to a greater extent, developed a complex irrigation system around the main rivers of the Valencian territory, resulting in a multitude of hydraulic infrastructures such as mills, ditches, weirs, brazales, splitters, cenias, qanats, wells... that They served to channel, distribute or store water to the orchards. The traditional Valencian agricultural landscape is the heritage of all this infrastructure, currently hydraulic heritage that has been used with the same efficiency to this day. But with the appearance of drip irrigation during the 20th century, and the spread of the idea that drip irrigation allowed for greater water savings, this type of irrigation began to spread throughout all orchards. The consequences on the hydraulic heritage have been notable, since the abandonment of the entire traditional irrigation system has caused its deterioration and in many cases the ruin ofbuildings, many of which have yet to be catalogued. Such has been the spread of drip irrigation that even the riverside lands closest to the rivers have incorporated this irrigation system, extending to every hanegada in the Valencian territory. Another dramatic consequence of the expansion of drip irrigation has been its development in areas where, due to their natural conditions, they have traditionally been rainfed, converting to irrigation and causing the disproportionate expansion of these types of crops. Causing the consumption of water for agricultural use to have actually increased. Due to all this, we currently find a landscape full of rubber, and with the hydraulic heritage in continuous deterioration, which is why the introduction of drip irrigation has deeply degraded the traditional Valencian garden landscape and has transformed agriculture. Investments in recovering heritage and studies that determine the suitability of the type of irrigation and cultivation based on the orchard should be key to recovering our landscape and more sustainable agriculture.

KEYWORDS: Orchard, heritage, landscape, irrigation ditch, drip, irrigation.

Soil and water losses in citrus plantations. Drip versus flood irrigation.

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Abstract
Citrus plantations on sloping terrain use to produce high soil and water losses. Conventional farming use herbicides to maintain the soil bare, and this results in crusted soils with low infiltration rates. The traditional flood irrigation systems use terraces to allow the controlled irrigation. Drip irrigation is use on slopes with no terraces. This paper compare by means of paired plots the runoff and erosion rates of 50 plots on drip and flood irrigation citrus orchards. Rainfall simulation experiments (55 mm h^{-1} in one hour) on 0.25 m^2 plots were established within the paired plot sampling strategy. Twenty-five plots were established in flood irrigation land and twenty-five more in drip irrigation plots. The comparison of the two data sets shows that the ponding and runoff were recorded earlier in the drip-irrigated land (65s) than in the flood-irrigated ones (245s). Runoff was initiated after 154s and 453s in average for drip and flood-irrigated citrus orchards. The runoff discharge reached 56.22 % of the rainfall in drip-irrigated plots and 15.43 % in flood-irrigated plots. Soil erosion was 3.42 Mg ha^{-1} $event^{-1}$ in the drip-irrigated plot and 0.34 Mg ha^{-1} $event^{-1}$ in the flood-irrigated land. A shift from flood to drip irritation increases the water losses by 3,64 times, but increases the soil erosion in one magnitude.

KEYWORDS: Soil, Water, Erosion, Citrus, Mediterranean, Rainfall.

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Effect of water stress combined with high photosynthetic active radiation on glucosinolate content variation in *Barbarea* spp. (Brassicaceae)

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Abstract
Barbarea vulgaris W. T. Aiton and *B. verna* Mill. Asch. (Brassicaceae) have different profile and content of glucosinolates. In *B. vulgaris* type G the main glucosinolates are glucobarbarin and glucobrassicin, while in *B. verna* the main glucosinolates are gluconasturtiin and glucobrassicin. This research reports the glucosinolate content in these two species when combining water stress and high photosyinthetic active radiation exposure, comparing it to control plants with higher irrigation and lower photosynthetic active radiation exposure. Experiments were conducted in the greenhouse. The glucosinolate content in the two treatments compared indicate that the combined treatment of water stress and high photosynthetic active radiation affected glucosinolate content in these two *Barbarea* spp. The results are discussed with regards to the biological significance of glucosinolates and their role in host-plant resistance, plant attractiveness to insects, and the use of *Barbarea* spp. in trap cropping.

KEYWORDS: Glucobarbarin, glucobrassicin, gluconasturtiin, irrigation, land cress, light, wintercress, yellow rocket

Assessment of erodibility in a vineyard in Granada through rainfall simulation and mini-disk infiltration experiments

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Abstract
Agriculture in Europe has played a fundamental role in producing food for both the population and livestock, as well as in generating employment. However, in recent decades, due to increased crop intensification, there have been numerous negative consequences, one of which is erosion. Viticulture is a crucial agricultural activity in Spain, ranking as the third-largest grape producer in the world. Nevertheless, soil erosion poses a significant problem, particularly in regions like Andalusia, where soils are of poor quality and subjected to over-tillage, leaving them vulnerable to concentrated rainfall within short timeframes.
Erodibility or susceptibility to erosion is a relatively understudied parameter in vineyards, yet it is essential for analyzing the vulnerability of this crop. Portable rainfall simulators can serve as valuable tools for assessing erodibility when used in conjunction with other methods such as soil analysis and infiltration measurements. In this study, erodibility is analyzed using a portable rainfall simulator, a mini-disk infiltration meter, and the analysis of key soil properties. A comparison is made between various sections of a vineyard located in the province of Granada. Through statistical analysis of the data, the results highlight factors that should be taken into consideration when implementing measures to reduce soil susceptibility to erosion.

KEYWORDS: Vineyards; soil erodibility; land management; rainfall simulation; runoff; soil loss.

The road towards climate-smart and sustainable management of agricultural soils in Europe: knowledge needs and research approaches

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Abstract

Current soil- and land degradation seriously challenge our societies; it contributes to climate change, loss of biodiversity and loss of agricultural productions. Yet, soils are also seen as a major part of the solution, if maintained or restored to provide ecosystem services. Climate-smart sustainable management of soils can provide options for soil health maintenance and restoration.

In the European Union, the resource management and sustainability challenge are addressed in the Green Deal that, among other goals, aspires towards a healthy climate-resilient agricultural sector that will produce sufficient products without damaging ecosystems and contribute to better biodiversity and mitigate climate change. The European Joint Programme (EJP) SOIL was set up to contribute to these goals by developing knowledge, tools and an integrated research community to foster climate-smart sustainable agricultural soil management that provides a diversity of ecosystem service, such as adapting to and mitigating climate change, allowing sustainable food production, sustaining soil biodiversity. This paper provides an overview of the potential of climate-smart sustainable soil management research to the targets of the Green Deal that are related to soils most directly, specifically the Climate Ambition, the Farm to Fork Strategy and the target to preserve and restore eco-systems and biodiversity. The EJP SOIL EU-wide consultation (interviews and questionnaires) and literature analysis (national and international reports and papers) done in the first year (2020-2021) generated a wealth of data. This data showed that there are specific manners to do research that are essential for it to be effective and efficient and that can actively contribute to the Green Deal targets set by the European Commission. We concluded that research needs to be: (i) interdisciplinary, (ii) long-term, (iii) multi-scaled, from plot to landscape, (iv) evaluating trade-offs of selected management options for ecosystem services and (v) co-constructed with key stakeholders. Research on climate-smart sustainable soil management should be developed (a) on plot scale when mobilizing soil processes and

on landscape scale when addressing sediment and water connectivity and biodiversity management; and (b) address the enabling conditions through good governance, social acceptance and viable economic conditions.

KEYWORDS: soil management knowledge, Sustainable Development Goals, (bio) diverse landscapes, soil health, soil information, science-policy interface.

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The potential role of fire management in the Green Deal

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Abstract
The perception of fire among citizens is extremely negative, in a recent study 98,5% of all interviewees said they saw fire as a very negative issue. Dangerous, death, destruction and very costly were words to describe wildfires. Therefore, it should be avoided as much as possible. However, when scientists working on fire are asked about their opinion, 80% mention that fire is part of nature. Fire is part of the erosional cycle, of the geological cycle and is even mentioned that fire should be included in the list of soil-forming factors next to 'time', 'parent material', 'climate', 'topography', and 'biota'. Fire is also part of many processes in plant development, especially in climates where fire has always been part of the ecosystem. Therefore, it is needed to improve the embedding of fire knowledge and research in the EU funded research and policies.
This paper aims to highlight research needs and promising research approaches that are required to overcome the current issues related to climate-smart sustainable fire management. Specific attention is given to how different fire research can contribute to the soil related goals of the Green Deal: Climate Action, Zero pollution for a toxic free environment, Biodiversity and Farm to Fork strategies. The role of a diverse and healthy landscape to achieve these goals will be highlighted. These insights may serve as a guidance for future research and may enable strategic decision-making in science, policy and implementation issues as well as providing the potential to create an agricultural environment that will enable farmers to once again be and be seen by the public as the stewards of land and soil resources.

KEYWORDS: fire triangle, perception, circular economy, climate change, biodiversity, resource-use efficiency.

Designing of a novel methodological approach with remote sensing web platform Apps and UAVs for precision agriculture monitoring surveys of Mediterranean woody crops

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Abstract
Current agriculture is undergoing a period of transformation, shifting from traditional agronomic crop management to a focus on the sustainable management of vital natural resources such as soil and water. Achieving sustainable and efficient management poses a significant challenge for scientists, farmers, and other professionals in the agricultural sector. This communication introduces a study with the primary goal of proposing a standardized and reproducible protocol for the utilization of various precision agricultural tools in woody crops, applicable worldwide. An experimental vineyard plot in Villamena, Granada, Spain, covering approximately 9.2 hectares, was selected as the study subject. This plot is currently under conventional management. Starting from the latter half of 2022, we initiated data collection using aerial and satellite remote sensing. We employed a drone to capture high-detail orthophotography and multispectral images with a pixel size of 1-3 cm^2. To assess changes over time, we monitored the vineyard using satellite images of varying resolutions, including low, medium, and very high resolution (VHR). In January 2023, we installed soil humidity and temperature sensors, dendrometers, and a meteorological station, with the aim of interconnecting and correlating data to gain insights into the crop's evolution across different areas. Our initial findings provide a comprehensive perspective on the application of these technologies in the digitization and monitoring of woody crops. They also establish a methodology for the integrated study of all these tools in conjunction with machine learning and artificial intelligence algorithms, commonly referred to as vegetation indices.

KEYWORDS: Precision Agriculture; agriculture management; VHR satellite images (Very High Resolution); drone; vegetation index.

Extreme Precipitation in Chile: Exploring Latitudinal and Altitudinal Variations

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Abstract

Extreme precipitation events can have significant impacts on society, the economy, or the natural environment, for example, through phenomena like flooding or soil erosion. This study aims to analyze the altitudinal and latitudinal variations of extreme precipitation in Chile. To do this, it considers the concentration of precipitation and the frequency of extreme events using daily data from 87 meteorological stations distributed throughout the country over an extended period (1980-2018). The concentration of daily precipitation was determined by a relationship that reflects the relative contribution of rainy days to accumulated precipitation. The frequency of extreme events was obtained by calculating the probability of exceedance and return periods. The effect of altitudinal variation was defined by geomorphological units, while latitudinal variation was defined by geographical regions. The results showed that rainfall concentration follows an exponential curve where, in all cases, at least 10% of rainy days account for 30% of the rainiest days. This demonstrates, on the one hand, a high irregularity and, on the other hand, that most of the annual precipitation is concentrated in a few days that deliver very high amounts. For return periods < 100 years, extreme daily precipitation events could reach 109 mm and 305 mm in northern and southern Andes Mountain regions, respectively, while in northern and southern parts of the Central Depression, their values could be 70 mm and 170 mm, respectively. It is expected that the frequency and severity of extreme precipitation events will increase in some parts of South America during the 21st century, which could have significant environmental and socioeconomic implications.

KEYWORDS: Rainfall concentration, environmental impacts, return periods, geomorphological units

Assessing water quality for livestock management in mediterranean rangelands

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Abstract

The construction of small rainwater collection ponds has become a prevalent solution to combat water scarcity in Southwestern Iberian rangelands. However, ensuring the suitability of pond water for livestock consumption is essential. In this study, we analyzed the physico-chemical and microbiological quality of water from these ponds, comparing results with internationally recognized livestock water standards. Seasonal variations were observed, with water quality meeting guidelines during the rainy season but deteriorating in the dry season, notably exceeding recommended levels for oxidability (average of 75.37 mg O2 L^{-1} during dry season) and bacterial contamination (E. coli detected in 79% of dry season samples). Correlation and factor analysis revealed interrelationships among water quality variables, associating microbial pollution with organic substances and dissolved salts with non-point source contamination. Spatial analysis indicated differences among sampling sites, influenced by local factors such as tree density (negative coefficient) and agricultural activities (positive coefficient for CROP). Surprisingly, livestock density had limited influence on microbial and organic pollution. Our findings suggest the need for diversification in water sources and regular quality testing to address water quality issues in these rangelands.

KEYWORDS: water quality, livestock, Iberian rangelands, seasonal variation

Transforming agriculture systems. Systems innovation through Deep Demonstration.

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Abstract

The recent IPCC synthesis report was very clear, the 1.5 degree goal is still within our reach, but only if we *all* act now and act *at scale*. A complete transformation of our existing systems, thinking of food production and consumption, urban development, energy production and use, and mobility, is urgently required. The Deep Demonstration method developed by EIT Climate-Kic, facilitates fast transformation of systems. Deep Demonstrations start with a demand-led approach, working with organizations willing to take on the responsibility of acting as 'problem owners': city authorities, regional bodies, community organizations, governments, or industry leaders committed to zero-net emissions, resilient futures. The method uses phases of *intent* and *frame* to scope a shared vision and identify levers of change. The *portfolio development* brings together solutions that facilitate change. These innovation initiatives are supported through dynamic portfolio management and regular sense-making with the intention of accelerating the pace of learning about obstacles and barriers. Leading to the phase of *intelligence*, the ultimate objective of the Deep Demonstration process. Intelligence prepares input for decision-makers to enable action. In this keynote, both the concepts of systems innovation and the method of deep demonstration are explained and illustrated with examples of the Deep Demonstration of the Agro-Food Chain in Ireland.

KEYWORDS: Circular Economy, Agriculture, Systems, Transformation, Innovation.

Mycorrhizal fungi arbuscular in forage grasses cultivated in Cerrado soil

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Abstract
The Cerrado is one of the most important regions for agricultural development in the world and is the main productive breadbasket of the Americas. One of the main agricultural activities in the region is high-tech livestock. Cerrado soils are predominantly low in fertility, and arbuscular mycorrhizal fungi play a fundamental role in plant nutrition in this biome. Understanding the behavior of mycorrhizal fungi in the soil under pasture is essential for the development of more efficient and sustainable management practices. Thus, this work aims to verify the activity of arbuscular mycorrhizal fungi in different species of forage grasses cultivated in cerrado soil. To measure mycorrhizal activity, soil spore density factors and mycorrhizal colonization rates in roots of 14 forage grass genotypes were investigated. No significant differences were identified in spore density values between the investigated genotypes. Panicum maximum cv and Mombasa showed the lowest values of mycorrhizal colonization, and the highest values were found in the roots of Brachiaria decumbens. Among the identified genera associated with the rhizosphere of the genotypes studied, Gigaspora, Scutelospora and Sclerocysts are less frequent, which indicates that the association with these fungal genera is less recurrent than with the others.

KEYWORDS: MAF, Soil Health, Savannas, biodiversity hotspot

Will forests disappear in the Inner Asian dryland under increasing extreme hot-droughts?

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Abstract

Soil water has declined significantly since the end of the last century in the drylands of Inner Asia where a massive afforestation potential was predicted. At the meantime, there has also been a significant decline in forest growth in this region. Answering the scientific question whether forests will disappear under increasing extreme hot-droughts thus becomes important to the efforts of afforestation.

Our field observations show that there are significant spatiotemporal and interspecific differences in the response of forests in semiarid regions to climate change. Ecological adaptations help maintain their long-term stability of forests in most parts of the Inner Asian semiarid region. Our research shows that trees can adapt to hot-drought through plasticity of hydraulic properties, water storage in the xylem, and accumulation of non-structural carbon. For examples, *Quercus mongolica* can adapt to drought by a transition from tree to shrub life form; Other broadleaved tree species such as *Betula, Populus* and *Ulmus* can adapt to drought through stem water storage; The content of non-structural carbohydrates in the stem of *Larix sibirica* in the semiarid region reaches~15%, which is 4-5 times the global average. In addition, in the semiarid region, the size of forest patches, soil layer thickness, and forest stand density can all affect soil moisture content, thereby affecting the response of forest ecosystems to climate change in the semiarid region. Despite the high tree mortality ratio in the arid timberline, their high regenerate ability helps maintaining forest distribution in this region.

Our recent work show that the impacts of low soil moisture (SM) and high vapour pressure deficit (VPD) on tree's photosynthesis and productivity are ultimately realized by changing canopy water content for global forests. Variations in canopy water content (CWC) that can be detected from microwave remotely sensed vegetation optical depth (VOD) have been proposed as a promising measure of vegetation water status, and we first reported that the regulation of CWC on productivity stability is universally applicable for global forests. We found no significant decrease ($p < 0.01$) of CWC for the semiarid forests in Inner Asia, implying stable canopy water content could be the key driver of stability for semiarid forest ecosystems.

KEYWORDS: Tree mortality, tree growth, adaptation, hot drought, canopy water content, soil moisture, hydraulic traits

The differential responses of tree transpiration to seasonal drought among competitive pressures in a larch plantation of northwest China

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Abstract

Climate warming will cause more frequent drought events in arid regions with rain shortage, especially seasonal droughts, with strong impacts on tree transpiration. Tree transpiration responses to drought are further affected by competition among trees that can be quantified using Hegyi competition indice (HCI). However, how seasonal drought affects tree transpiration among competitive pressures remains poorly understood. In this study, the daily transpiration of twenty-four trees with different competition pressures was monitored using the thermal dissipation probe method from May to October from 2019 to 2021 in a larch plantation in the Liupan Mountains, Northwest China. Our results showed that the daily tree transpiration normalized for the mean daytime vapor pressure deficit ($T_{i\text{-}VPD}$, $L \cdot d^{-1} \cdot kPa^{-1}$) declined during drought, especially during summer drought. Seasonal drought weakened the tree competitive effects on $T_{i\text{-}VPD}$, with spring droughts reducing the difference of $T_{i\text{-}VPD}$ in summer among different competition pressure levels, while summer droughts invalidate competitive effects, i.e., there was no significant difference ($p < 0.05$) of $T_{i\text{-}VPD}$ in summer with different competition pressure levels. In addition, low competition (LC) showed a much greater $T_{i\text{-}VPD}$ reduction than did moderate competition (MC) and heavy competition (HC) during periods of drought, suggesting that the $T_{i\text{-}VPD}$ was more sensitive to seasonal drought under lower competitive pressure. The dominant factor contributing to the changes in tree transpiration was solar radiation in spring drought (2020) and soil relative extractable water in summer drought (2021). Besides, due to the seasonal drought, the water consumed by transpiration of the LC and MC groups was significantly smaller than that of the HC groups. These results demonstrate that crop tree management can be implemented to reduce water consumption by thinning trees which are under heavy competitive pressure (i.e., DBH < 18 cm) and can be used to enhance the drought resistance of reserved trees to seasonal drought to better achieve integrated forest-water management.

KEYWORDS: Seasonal drought, competitive pressure, transpiration, *Larix principis-rupprechtii*

Reduction in soil moisture dominates progressive tree mortality in semiarid areas

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Abstract

Increasing drought stress has triggered various negative impacts on forests worldwide, including growth reduction, defoliation, crown dieback, and even tree mortality, with unavoidable consequences for forest ecosystems. However, how reductions in both precipitation and soil moisture progressively lead to tree mortality remains largely unknown. Here, we define relative soil water (RSW) as the ratio of the actual soil moisture to the field capacity, which can reflect the fraction of water in the root zone, to reveal how soil moisture reduction leads to progressive tree mortality. Based on field measurements of tree behaviors, including transpiration, tree growth, defoliation, crown dieback and other behaviors, before, during and after an extreme drought in the *Larix principis-rupprechtti* plantations in 2021, we found that the variability in precipitation and soil moisture affect tree behaviors, but soil moisture is the dominant driver of drought stress on progressive tree mortality, with prolonged and severe soil moisture reduction leading to widespread tree mortality. RSW thresholds for different stages of progressive tree mortality and drought stress levels are identified as follows: Level I (RSW > 0.7), no detectable hydraulic limitations; level II (0.7 to 0.45), persistent stem shrinkage and onset of transpiration reduction; level III (0.45 to 0.35), onset of slight discoloration and defoliation; level IV (0.35 to 0.25), onset of crown dieback and tree mortality; and level V (< 0.25), severe defoliation, 20% crown dieback and tree mortality. Our results shed light on predicting tree mortality and distribution in forests under increasing climate warming, particularly in semiarid areas with warming-induced tree mortality.

KEYWORDS: Drought, mortality, defoliation, transpiration, tree growth, *Larix principis-rupprechtii*

Water yield variation with elevation, tree age and density of larch plantation in the Liupan Mountains of the Loess Plateau and its forest management implications

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Abstract

Large scale afforestation mainly for erosion control or timber production and a very strict logging ban policy in recent decades led to many over-dense stands and remarkable water yield reduction in the dryland region of the Loess Plateau in northwest China. To guide the integrated forest-water management at stand level, a study on the response of water yield from larch (*Larix principis-rupprechtii*) plantations to key stand structure and site factors was carried out in the Liupan Mountains. Models of leaf area index (LAI) of forest canopy and stand evapotranspiration (ET) in the growing season were developed and fitted. The growing season water yield was calculated based on water budget. The results showed that: (1) The LAI increases with rising tree density firstly quickly and then slowly and finally tending to its maximum; but firstly increases and then decreases with rising tree age and elevation. The LAI model coupling the effects of tree density, age, and elevation works well. (2) The ET model reflecting the coupled effects of precipitation, potential evapotranspiration, LAI and soil moisture can well predict the ET variation. (3) The water yield decreases gradually with rising tree density, but firstly decreases and then increases with rising tree age and elevation. The lowest water yield appears at the age of 30 years and at an elevation of 2420 m. (4) The implications of this study for integrated forest-water management are: defining water yield as the dominant forest service at high or low elevations, but quality timber production as the dominant service at medium elevations; arranging rational thinning for dense forests around the age of 30 years;designing a mosaic distribution of forest ages within watersheds. Applying the study outcomes can promote the
integration of water yield management with traditional forest management to ensure the sustainability of water supply in dryland regions.

KEYWORDS: Integrated forest-water management, stand structure, site condition, water yield, larch plantation, dryland regions

Effects of seasonal precipitation legacy on tree growth in semiarid areas

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Abstract

Wood growth, as one of the major components in vegetation carbon storage, is commonly described as a linear function of carbon assimilation in existing vegetation models. However, recent evidence suggests that wood growth is highly responsive to climate, particularly to soil water availability. Insufficient soil water poses a significant challenge for afforestation in semiarid regions, limiting the survival and carbon sequestration potential of plantations. Therefore, comprehending the relationship between soil water availability and tree growth is essential for evaluating the effectiveness of afforestation efforts under climate change. Using high temporal-resolution dendrometer measurements, we investigated the relationship between tree stem growth and the seasonal dynamics of soil water in plantations located in two semiarid regions characterized by different climate seasonality. Our results suggested that the daily growth rate of trees in semiarid areas is primarily influenced by the availability of soil water and the atmospheric vapor pressure deficit, resulting in discontinuous growth patterns throughout the growing season. In cold-dry regions (northern China), *Larix principis* utilizes the residual spring snowmelt in the soil to complete its growth before the peak rainfall period. In warm-dry regions (southern Israel), *Pinus halepensis* sustains its growth by tapping into the water stored in the soil after the peak rainfall period. Despite variations in climate patterns and dominant tree species, our results indicate a consistent conclusion that trees in semiarid areas can effectively harness the legacy of soil water to maximize their annual growth. This finding highlights the adaptive strategies employed by tree plantations in

semiarid regions, namely their efficient utilization of local soil water resources to maintain carbon sequestration.

KEYWORDS: Wood growth, seasonal legacy of precpitation, drylands, *Larix principis, Pinus halepensis*.

Water balance of Stagnosol and physical properties as an indicator of the need to implement complex amelioration measures

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Abstract

The research was conducted on Stagnosol type soil within the multivariate drainage experimental field Varna of Institute of Soil Science, Belgrade. In the territory of Western and Northwestern Serbia, stagnosol soils occupy an area of about 285,000 ha or 15.7%. These soils are of great importance for agricultural production due to their potential fertility, as well as the fact that they are represented mainly on flat plots suitable for the application of mechanized cultivation. The analysis of the water balance revealed large surpluses of water in the colder part of the year (from autumn to spring). The physical properties of the tested soil are unfavorable and characterized by very low permeability of the sub-oric soil horizon. The reason for this is primarily the high content of clay and dust. The consequence of the above is the stagnation of water on the surface and the impossibility of implementing agrotechnical measures in the optimal period. In order to obtain stable yields of these potentially fertile soils, it is necessary to apply complex ameliorative measures, and their effectiveness was confirmed by performing horizontal pipe drainage and supplementary measures of mulching and scattering. The obtained results indicate the necessity of applying the mentioned measures, because they regulate the water regime and achieve economic profit in agricultural production.

KEYWORDS: water balance, water-physical properties, complex ameliorative measures

Soil moisture-rainfall relationship at a farm scale

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Abstract

Soil moisture is widely known to influence biogeochemical process but its heterogeneous nature requires location/catchment specific studies. In southwest Nigeria, information on soil moisture is scanty, and there is no consensus on its relationship with rainfall. In this study, spatio-temporal variability in soil moisture content as well as its relationship with rainfall, under different landcover/use systems in a catchment in southwest Nigeria were examined. Data used were 2021-2022 field-based and 1982-2021 satellite -based rainfall, soil moisture and soil temperature records of five dominant land cover/use (arable, built-up, tree crops (cocoa and oil palm), and riparian vegetation). Data were analysed in both linear and nonlinear contexts. Stepwise regression and wavelet analysis, as well as Cross-correlation Function (CCF) and inverse distance weighting were explored. Results showed that the soil moisture-rainfall relationship differed across the different landcover/use, with a spatially ambiguous influence of antecedent soil moisture and soil temperature. The soil moisture-rainfall relationship was insignificant (R^2= 0.02–0.12, $p > 0.05$), while the antecedent soil moisture-rainfall relationship was strong, positive ($b = 0.98$), and significant (R^2 = 0.49–0.69 across different land cover and use). The study concluded that the soil moisture-rainfall relationship in the study area varied across landcover/use due to the influence of the dominant type of land cover and therefore canvases for intensive landcover/use-specific studies in the region.

KEYWORDS: Soil moisture, Rainfall, Geographic Information Systems, Land-use, Farm scale

Using fixed-wing drones and statistical-based analysis to better understand soil erosion

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Abstract
Research Aim: Headcut retreats (HR) and single sinkholes (SS) present complex challenges, and the most comprehensive way to study them is by using the modern Steganographic technique. This study aims to analyze the ecological interaction of HR and SS using spatial statistics and field surveys.
Materials and methods: To achieve the main aim of this study, a digital elevation model was created after conducting field surveys, and aerial mapping was done with a fixed-wing drone. The spatial behavior and interrelationship of these two soil landforms were then modeled using the derivative statistics of the pair correlation function, which includes the functions $g_{22}(r) - g_{11}(r)$, $g_{12}(r) - g_{11}(r)$, and $g_{1,1+2} - g_{2,1+2}$.
Findings: The results of the g_{22}-g_{11} function indicate that the observed line (black line) on the diagram is lower than the theoretical line (red line). This suggests that the spatial pattern of SS is more clustered compared to HR, and the density of SS in the study area is higher than that of HR. Additionally, the results of the g_{12}-g_{11} function show that the density of SS is higher in its surrounding areas compared to HR. This is because, as observed in the previous function, SS is formed first and then moves into areas with more waterways. Finally, the third function, $g_{1,1+2} - g_{2,1+2}$ indicates that the observed line is higher than the theoretical line. This implies that SS tends to be more distributed in the regions where SS and HR formations jointly occur.

Conclusion: By utilizing quantitative statistics, we can gather and analyze numerical data to gain valuable insights into ecological behaviors and the underlying processes that shape soil landforms. This deeper understanding allows us to make more accurate predictions about natural risks. With this knowledge, we can effectively anticipate and prepare for potential environmental challenges, ultimately leading to better risk management and protection of our natural world.

KEYWORDS: Headcut retreats, Single sinkholes, Fixed-wing drone.

The importance of flood irrigation in Mediterranean-type ecosystems.

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Abstract
Flood irrigation has been seen as an old and inefficient technique to water the soils for agricultural production. However, the use of flood irrigation is millennia old and demonstrated to be sustainable. The use of flood irrigation developed a landscape of channels and weirs that developed orchards and gardens considered beautiful landscapes. The use of flood irrigation is based on gravity, and there is another energy involved. Flood irrigation contributes to reducing the flood peaks and drainage of the area affected by flooding. A cultural heritage was also developed as a body of laws was developed. Moreover, a social network was created using flood irrigation that shows a strong community. The loss of flood irrigation will increase the risk of flooding in the nearby areas and the agricultural land, a loss of cultural heritage and a sustainable agriculture system, and a shift in the social network of farmers.

KEYWORDS: Soil, Water, Erosion, Citrus, Mediterranean, Rainfall.

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Water scarcity, soil quality, peri-urban agriculture, forest fires and desertification under the lens of economic crisis

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Abstract
While urbanization has been closely related to economic development and demographic change, heterogeneous patterns and processes of regional growth and change reflect the uneven distribution of urbanization, the subtle impact of demographic dynamics and the consequent implications for land resource management and environmental sustainability. Differences in patterns of urban growth and change in a paradigmatic region such as the Mediterranean basin —often masked by statistics indicating a net increase in urban population—reflect regional divides in socio-demographic, economic and environmental variables. To better understand the impacts of these regional differences, interdisciplinary research should better link socio-demographic and economic patterns from the one side - and environmental dynamics from the other side - to urbanization and regional/local processes of change. Going from regional to local, multi-scale analysis of environmental change gives more opportunities to ascertain the combined effect of demographic dynamics on urbanization, evidencing the role of social transformations and the latent linkage with 'hegemonic' concepts such as that of land degradation, which is intimately related with both socioeconomic dynamics and environmental sustainability. Reconnecting impacts of regional-scale socioeconomic change with local-scale ecological dynamics definitely contributes to an enriched knowledge of environmental histories, outlining how a study of differences under assumptions of non-linearity and complex system thinking is key to understand future socio-environmental trends in the study region. This contribution finally encourages studies within a multi-disciplinary arena, stimulating further literature reviews aimed at discussing these deserving issues - proposing new theoretical frameworks at the same time, with empirical approaches, comparative works and case studies providing the necessary, informed ground to science and policy.

KEYWORDS: Mediterranean, Desertification, urban, crisis

Water scarcity, soil quality, peri-urban agriculture, forest fires and desertification under the lens of economic crisis

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Abstract

Shrubland is a Mediterranean biome characterized by densely growing evergreen shrubs adapted to fire events. To date, scientific research has focused on the impact of vegetation on soil erosion mainly through the control that plant biomass or plant cover exerts on sediment delivery and runoff discharge, being the individual plant species influence on hydrological and erosional processes not achieved in detail. The objective of this research is to determine: i) runoff and soil losses in a shrubland-covered rangeland at Sierra de Enguera, Spain; and ii) how four plant species affect soil and water losses. We measured soil cover, soil properties, runoff discharge and sediment yield under natural rainfall for five years (2010-2014) in a typical shrubland burnt in 1999. Four plant species were selected with 4 plots each: *Ulex parviflorus* Pourr., *Pistacia lentiscus* L., *Quercus coccifera* L. and *Rosmarinus officinalis* L. Despite that the soil properties and plant cover did not exhibit statistically significant differences among plant species, the runoff discharge was lower on *Q. coccifera* (4.87 %, SE 0.24) and *P. lentiscus* (6.24 %, SE 0.51) than on *U. parviflorus* (13.41 %, SE 0.58) and *R. officinalis* (13.84 %, SE 1.23). Sediment concentrations were, respectively, 3.91, 4.33, 4.31 and 4.88 g l^{-1}, and the differences between *R. officinalis* and the other species were statistically significant. The runoff discharge determined differences in soil erosion rates amongst the plant species with lower rates on *P. lentiscus* (1.36 Mg ha^{-1} y^{-1}) and *Q. coccifera* (1.53 Mg ha^{-1} y^{-1}), than on *U. parviflorus* (3.17 Mg ha^{-1} y^{-1}) and *R. officinalis* (3.85 Mg ha^{-1} y^{-1}). This long term *in situ* study indicated that *Q. coccifera* and *P. lentiscus* are more efficient in controlling runoff discharge and soil losses than *U. parviflorus* and *R. officinalis* one decade after a fire. We discuss these results in light of the recent findings by the scientific community of the role of the canopy cover (rainfall interception), soil macropore and root system, and the water

repellency that control the hydrological response of the soil (e.g. runoff generation, infiltration). The information supplied by 5 years of research is relevant for restoration and rehabilitation programs and advise that *Q. coccifera* and *P. lentiscus* are the most efficient plant species to control soil and water losses within the Mediterranean shrubland. This is an applied science approach for a better management of rangelands.

KEYWORDS: plants, shrubland, plots, rainfall, runoff, soil erosion, sediment; Mediterranean

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The role of extreme rainfall events on soil erosion on plots under tillage and plant covered treated management. A 7-year assessment under Mediterranean climatic conditions

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Abstract
Low frequency – high magnitude rainfall events are a threat to soil conservation as they can induce high erosion rates that wash the upper fertile layers of the soil. To understand the role of those extreme rainfall events on Mediterranean agriculture land we set up 8 plots in the Sierra de Enguera Soil Erosion Experimental Station from 2008 till 2014. Each rainfall event was measured in a raingauge. Runoff discharge was collected in each plot (1, 2, 4, and 16 m^2) under 5 years abandonment conditions and under tillage. The results have shown that runoff was 3,1 higher, sediment concentration 1,6 and soil erosion 4,3 for the whole data set (204 rainfall events). The rainfall events with rainfall higher than 50 mm contributed with 91% of the soil losss. The differences between management are more contrasted under high magnitude – low rainfall events.

KEYWORDS: plants, shrubland, plots, rainfall, runoff, soil erosion, sediment; Mediterranean

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