SSS2.7

Advancements in modeling and remote sensing assessments in soil and water degradation processes

Conveners: Robert Wells , Encarnación Taguas, Ronald L. Bingner, Gerald A Corzo P, George Karatzas, Miguel A. Campo-Bescós, Saskia Foerster, Irene Marzolff

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Displays | Chat Tue, 05 May, 14:00–15:45 (Co-organized by HS13)

The quantification and understanding of hydrological, erosive, and biogeochemical processes in catchments are essential to the sustainable management of water and soil resources. Soil-erosion studies and hydrological simulation models comprise a large range of scopes and objects of investigation with different levels of spatial and temporal scales and/or innovative approaches that are important tools to address environmental problems in a cost-effective way. Thus, for example, analyses may range from absence-presence inventories of erosion features in large areas, -such as badlands-, to detailed studies of rill and ephemeral gullies; or focus on the assessment of the overall expansion of permanent gullies and their evolution; characterization of headcut migration; or identification of downstream deposition areas after intense sheet/rill erosion; among others. Assessment of the environmental impact of economic activities in catchments should be based on the acquisition of experimental data to implement and/or to evaluate conservation practices at different scales. However, monitoring systems can be restricted by technological, economic and legal factors, spatial and temporal sampling strategies and availability, and are rarely conceived in the long term.

Remote sensing is increasingly being utilized to address a plethora of hydrological and soil erosion issues, providing highly valuable information both on surface reflection and surface heights. In fact, the continued improvement of remote sensing techniques has allowed the study of a large range of erosive processes at varying spatial and temporal scales. More sensitive and accurate sensors are available every day. In addition, the frequency of observations is rapidly increasing and new statistical analysis techniques are increasingly used.

Here, the authors are encouraged to present new environmental challenges related with the use of models, remote sensing techniques and new experiments to address hydrological and erosive issues. In addition to classical modeling procedures such as evaluation of models; new conceptualizations to address current environmental problems facing society, tools and techniques aimed to conserve water, soil and nutrients, and evaluate degradation processes of soil and water as well as analyses concerning the ways and potential of using remote-sensing techniques to assess soil erosion are also expected.

Tuesday, 05 May, 14:00–15:45

Chairperson:
Robert Wells

14:00–14:02	**EGU2020-22200** **solicited** **Visualizing resource dependencies of the urban system at multiple scales: a hydrological case study** **Héctor Angarita, Vishal Mehta, and Efraín Dominguez**
14:02–14:04	EGU2020-12287 **Modelling the responses of extreme events hydrometeorological events in the landslides and floods of the Combeima river basin.** **Laura Viviana Garzon Useche, German Ricardo Santos Granados, and Gerald Augusto Corzo Perez**
14:04–14:06	EGU2020-22024 **Spatio temporal visualization of soil critical sources areas to assess the dynamics of source pollution in agricultural management practices** **Natalia Uribe and Gerald A Corzo P**
14:06–14:08	EGU2020-8212 **Large-scale Groundwater Simulation using Artificial Neural Networks in the Danube River Basin** Illias Landros, Ioannis Trichakis, Emmanouil Varouchakis, and George P. Karatzas
14:08–14:10	EGU2020-4340 **A remote sensing approach for evaluating regional-scale topsoil loss in the Midwestern United States** **Isaac Larsen, Evan Thaler, and Qian Yu**
14:10–14:12	EGU2020-22225 **Identifying the impact of human activities on soil erosion- the case of Jiangxi Province, China** **Yanqing Lang, Xiaohuan Yang, and Hongyan Cai**
14:12–14:14	EGU2020-17972 **Forecasting landslides using a spatiotemporal analysis of remote sensing data** **Carlos Alfredo Mesa Zuluaga, German Ricardo Santos Granados, and Gerald Augusto Corzo Perez**
14:14–14:16	EGU2020-21326 **Estimating badland denudation with pin measurements and high resolution Digital Elevation Models derived from UAV image analysis** Brigitte Kuhn, Nikolaus Kuhn, John Boardman, and Vincent Schneider
14:16–14:18	EGU2020-13787 **A systematic assessment of uncertainties in large scale soil loss estimation from different representations of USLE input factors – A case study for Kenya and Uganda** **Christoph Schürz, Bano Mehdi, Jens Kiesel, Karsten Schulz, and Mathew Herrnegger**
14:18–14:20	EGU2020-17539 **Photogrammetricaly measured sheet and rill erosion on steep slopes** **Tomas Laburda, Petr Kavka, Romana Kubínová, Martin Neumann, Ond?ej Marek, and Adam Tejkl**
14:20–14:22	EGU2020-10023 **Spatiotemporal assessment of ephemeral gully characteristics using low altitude aerial imagery: an approach for quantifying** **Henrique Momm, Robert Wells, Carlos Castillo, and Ronald Bingner**
14:22–14:24	EGU2020-12788 **Impact on wheat production of anthropic soil erosion by recent gully filling at the Campiña landscape in Southern Spain** **Carlos Castillo, Rafael Pérez, and Miguel Vallejo Orti**
14:24–14:26	EGU2020-8325 Soil Cohesion Development under Different Pore and Size Characteristics **Cagla Temiz, Fikret Ari, Selen Deviren Saygin, Sefika Arslan, Mehmet Altay Unal, and Gunay Erpul**
14:26–14:28	EGU2020-3619 **Estimation of the Rates of Particle Aggregation and Disaggregation in the Mesopelagic Zone of the Eastern North Pacific** Vinicius Amaral, Olivier Marchal, Phoebe Lam, Jong-Mi Lee, Ken Buesseler, and Montserrat Roca Marti
14:28–14:30	EGU2020-13427 **Evaluation of olive grove management on various soils at the micro-catchment scale with the AnnAGNPS model to quantify their impacts on organic carbon** **Encarnación Taguas, Ronald L. Bingner, Henrique Momm, Robert R. Wells, and Martin Locke**
14:30–15:45	**Interactive comments about PICO presentations**

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Visualizing resource dependencies of the urban system at multiple scales: a hydrological case study

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Freshwater is one key component of the resource dependency of urban areas, linking concentrated population centers to geophysical and ecosystem processes operating at regional and global scales. Resources like water, food, biofuels, fibers or energy that sustain cities directly depend on the productive or assimilative capacities of the hydrological system, operating at multiple nested scales (from catchment to river basins) —areas orders of magnitude greater than the extent of the built-up urban areas.

Although the freshwater systems–urban population relationship has a broad regional and sectorial scope, the quantification of the extent of regional and global impacts of cities' resource demands, and more importantly, their integration into decision-support frameworks continues to be overlooked in water-management and urban planning practice. A key limitation of understanding the scope of impacts of urban systems is the characterization of the distributed and non-linear nature of the regional relationship of water and cities, wherein a given region can simultaneously supply resources to—or be affected by—multiple urban areas (and vice-versa), and the heterogeneity of physical and biotic processes of freshwater systems.

Here we introduce a novel approach to assess and visualize the interactions between urban resource demands and the freshwater system. We propose a set of indicators that make use of freshwater drainage structure to incorporate the cumulative effects and concurrent resource dependency of urban areas across multiple nested scales. The cumulative character of the proposed indexes aims to replace the fixed control boundary (i.e. basin, sub-basin, etc -the current practice in water resources appraisals), with the (topological) integral of the process across the multiple nested scales present in a river basin. This approach allows: (i) visualizing how factors like patterns of size, spatial distribution and interconnection of urban resource demands or the nested and hierarchical character of freshwater systems, influence the cumulative pressure exerted or a urban system on the freshwater system, (ii) mapping the spatial patterns of resource import and export across different scales and regions of a freshwater system, and (iii) quantifying the scales of the process required to sustain the resource supply of the multiple cities sharing the same provisioning freshwater system. The presented advances can inform regional urban planning to determine options to avoid, minimize or offset regional impacts of urban populations. An example of this proposed approach is presented for the Magdalena River Basin (Colombia).

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Modelling the responses of extreme events hydrometeorological events in the landslides and floods of the Combeima river basin.

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The village of Juntas has a periodic sequence of hydrometeorological extreme events. The region present a tropical vegetation with a highly dynamic weather. Currently modelling of hydrological events have been limited to the use of conventional rainfall runoff models, that fail to represent accurately the moment when landslides start to occur, as well as to not be able to provide a clear spatial sensitivity of the relationship between landslide event and precipitation. This research presents a contribution in the linking of various modelling concepts to understand more the influence of the spatial variability of rain in the generation of the events. The data avaialable was daily precipitation during 15 years from de satelital imagine and the discharge of geotechnical characterizations, hydraulic analysis, ecological structures, cartography, vulnerability, flood and torrential risk maps.

The analysis is done by combining the information available in remote sensing rasters and the overall temporal relation of events is mapped with a spatiotemporal analysis of the extremes. The current methodology is expected to contribute to the understanding of the sensitivity of landslides due to the spatiotemporal variation of rain in the region.

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Spatio temporal visualization of soil critical sources areas to assess the dynamics of source pollution in agricultural management practices

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Spatio temporal visualization of soil critical sources areas to assess the dynamics of source pollution in agricultural management practices

always changes aim at the reduction of nutrient pollution. Critical identification of areas that are the sources of pollution is crucial for identifying which practices provide the most substantial contamination. The dynamics of agricultural practices are complex and the precise determination of pollution concentration requires a comprehensive model. In this research, we present the results of analysing via a new visualisation technique were the critical source areas using a spatiotemporal methodology that allows for a georeferenced identification of changes. The proposed method in this research used a radial diagram to evaluate the changes in regions of pollution and makes a radial diagram formulation of intensities, location and frequency. For this location and intensity identification, a clustering process, using the Non-contiguous drought areas method and the Contrigous drought area method. This clustering groups by first mapping in one dimension the threshold that defines a change in the state of the CSA, and then groups if by its neighbours and soil characteristics. To obtain a spatially distributed data, a SWAT model was set up for two types of crops, mainly potato and tomato tree, aside, we added also Kikuyu grass as it is one of the most important in the region. The simulation period for our experiment was in an area of 103434 Ha, using daily data from 1995 to 2015. Two steps calibration was done, first with streamflow and second with an analysis of monthly nutrients. Results show a definite change in location, which will imply that a significant error could be present if the spatiotemporal relation is not analysed. The current work is part of a PhD thesis and the partial results presented here contribute to a broader formulation of the optimisation of agricultural practices to reduce the impact of the Critical Source Areas in nutrients pollution.

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Large-scale Groundwater Simulation using Artificial Neural Networks in the Danube River Basin

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In recent years, Artificial Neural Networks (ANNs) have proven their merit in being able to simulate the changes in groundwater levels, using as inputs other parameters of the water budget, e.g. precipitation, temperature, etc.. In this study, ANNs have been used to simulate hydraulic head in a large number of wells throughout the Danube River Basin, taking as inputs, precipitation, temperature, and evapotranspiration data in the region. Different ANN architectures have been examined, to minimize the simulation error of the testing data-set. Among the different training algorithms, Levenberg-Marquardt and Bayesian Regularization are used to train the ANNs, while the different activation functions of the neurons that were deployed include tangent sigmoid, logarithmic sigmoid and linear. The initial application comprised of data from 128 wells between 1 January 2000 and 31 October 2014. The best performance was achieved by the algorithm Bayesian Regularization with a error of the order based on all observation wells. A second application, compared the results of the first one, with the results of an ANN used to simulate a single well. The pros and cons of the two approaches, and the synergies of using both of them is further discussed in order to distinguish the differences, and guide researchers in the field for further applications.

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A remote sensing approach for evaluating regional-scale topsoil loss in the Midwestern United States

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Soil erosion in agricultural landscapes reduces crop yields and influences the global carbon cycle. However, the magnitude of historical topsoil loss remains poorly quantified at large, regional spatial scales, hindering predictions of economic losses to farmers and quantification of the role soil erosion plays in the carbon cycle. We focus on one of the world's most productive agricultural regions, the Corn Belt of the Midwestern United States and use a novel spectral remote sensing method to map areas of complete topsoil loss in agricultural fields. Using high-resolution satellite images and the association between topsoil loss and topographic curvature, we use high resolution LiDAR topographic data to scale-up soil loss predictions to $3.7x10^5$km ^{2}of the Corn Belt. Our results indicate 34±12% of the region has completely lost topsoil as a result of agriculturally-accelerated erosion. Soil loss is most prevalent on convex slopes, and hilltops throughout the region are often completely denuded of topsoil indicating that tillage is a major driver of erosion, yet tillage erosion is not simulated in models used to assess soil loss trends in the U.S. We estimate that soil regenerative farming practices could restore 16±4.4 Pg of carbon to the exposed subsoil in the region. Soil regeneration would offset at least $2.5±0.3 billion in annual economic losses to farmers while generating a carbon sink equivalent to 8±3 years of U.S. CO_2emissions, or ~14% of the global soil carbon lost since the advent of agriculture.

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Identifying the impact of human activities on soil erosion- the case of Jiangxi Province, China

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Soil erosion is the results of the combined effects of natural factors and human activities. Since modern times, human activities are the main causes of soil erosion and plays a key role in the process of soil erosion, both promoting and inhibiting. Therefore, identifying the impact of human activities on soil erosion is of great significance to control and transform the impact of human activities reasonably and effectively. In this study, Jiangxi province is taken as the study area, the main patterns of human activities affecting soil erosion are sorted out and the spatial distribution of human activities is identified, and the impact of human activities on soil erosion is assessed. This study aims to reveal the temporal and spatial distribution of different human activities affecting soil erosion and explore the relationships between different human activities and soil erosion, and to provide data support, scientific reference and policy suggestions for soil erosion control and land resources management in Jiangxi province.

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Forecasting landslides using a spatiotemporal analysis of remote sensing data

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Forecasting landslides is highly dependent in the weather conditions and the land-soil characteristics and its state. The uncertainty present in the evaluation of precipitation and its continuous variation is always a challenge for having accurate forecast, of primary importance for risks reduction. Currently, the landslides generate an impact on the imbalance of ecosystems and their occurrence is increasing which leads to an increase in the vulnerability of man on earth. The complexity of the landslide systems requires detailed analysis of the highly dynamic information of the rain and in turn the form as the hydrology response. Being able to combine hydrological models forced by satellite information systems and put them with a soil cohesion analysis system could help improve monitoring and in a particular case forecast landslide events.

The Combeima river located at the village of Juntas with canyon type land relief currently, faces a vital challenge in the face of winter times where precipitation threaten urban zones. Current researchers have explored risk factors, however, results still are quite far from optimal.

This study develops a methodology to identify the water volume that can cause landslides over the canyon type land relief, and use it as a trigger for forecasting. Remote sensing data at the present time and projected from past data will be used to simulate forecasting situations (hidcasting). A coupled Mike SHE models and data from Google earth platform are used to analyze a period of twenty years. Local information from events and its analysis in the satellite images are used to validate the events. Finally, the results of past conditions that led to the generation of floods are used to identify the state of the soil and the volumes. A calibration and validation of a neural network model is done feeding the volumes and states. The results of the model allow us to specifically characterize the saturation limits of the soil and the maximum rainfall intensities that a soil may contain before collapsing. With this information a high performance and a design of a system to forecast in real time was proposed. This work is part of an ongoing research and partial results will be presented.

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Estimating badland denudation with pin measurements and high resolution Digital Elevation Models derived from UAV image analysis

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The denudation of soil or soft rock surfaces by non-concentrated flow is mostly estimated by relating the sediment discharge observed at the outlet of a plot or natural micro-catchment to their respective surface areas. This approach generates an average denudation rate, but ignores spatial patterns of erosion and deposition. A well established approach to capture such spatial differences are pins, which deliver a highly precise point measurement of surface elevation change. Advances in the development of Unmanned Aerial Vehicles (UAVs) and imagine processing in the past decades offer an additional tool for mapping erosion and deposition at millimetre scale for continuous surfaces. In this study, pin and UAV-derived erosion data for a badland area in the Karoo rangelands, South Africa, are compared. The results show that typical annual erosion rates in the study area are lower than the differences between two DEMs generated a year apart. This illustrates that in situations where erosion rates are low, pins still offer the faster and more reliable results. For their extrapolation, on the other hand, UAV-derived DEMs provide suitable topographic data.

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A systematic assessment of uncertainties in large scale soil loss estimation from different representations of USLE input factors – A case study for Kenya and Uganda

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The Universal Soil Loss Equation (USLE) is a standard model to assess soil erosion by water. The model equation quantifies long-term average annual soil loss as a product of the rainfall erosivity R, soil erodibility K, slope length and slope steepness LS, the soil cover C and support measures P. Several methods exist to derive each of the model inputs from readily available data. The estimated values of a model input, however, can strongly differ depending on the method that was applied. The multiplication of the input factors with the USLE eventually results in large uncertainties for the soil loss estimates. A comparison of the estimated soil loss to observation data can potentially reduce the uncertainties. Yet, for large scale soil loss estimations, in-field observations are rare and their comparability to long-term soil estimates is limited. This work puts a focus on uncertainty and sensitivity analysis in large scale soil loss estimation employing the USLE with different realizations of the USLE input factors.

In a systematic analysis we developed different representations of the USLE inputs for the study domain of Kenya and Uganda with a spatial resolution of 90 m. All combinations of the generated USLE inputs resulted in 756 USLE model setups. We assessed the resulting distributions in soil loss, both spatially distributed and on district level for Kenya and Uganda. In a sensitivity analysis we analyzed the contributions of the USLE model inputs to the ranges in soil loss and analyzed their spatial patterns. We compared the calculated USLE ensemble soil estimates to available in-field data and other study results and addressed possibilities and limitations of the USLE model evaluation.

The USLE model ensemble resulted in wide ranges of estimated soil loss, exceeding the mean soil loss by over an order of magnitude particularly in hilly topographies. The study implies that a soil loss assessment with the USLE is highly uncertain and strongly depends on the realizations of the model input factors. The employed sensitivity analysis enabled us to identify spatial patterns in the importance of the USLE input factors. The C and K factors showed large scale patterns of

importance in the densely vegetated part of Uganda and the dry north of Kenya, respectively. The LS factor estimates were mostly relevant in small scale heterogeneous patterns. Major challenges for the evaluation of the estimated soil losses with in-field data were due to spatial and temporal limitations of the observation data, but also due to measured soil losses describing processes that are different to the ones that are represented by the USLE.

Reference: *Schürz, C., Mehdi, B., Kiesel, J., Schulz, K., and Herrnegger, M.: A systematic assessment of uncertainties in large scale soil loss estimation from different representations of USLE input factors – A case study for Kenya and Uganda, Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2019-602, in review, 2019.*

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Photogrammetricaly measured sheet and rill erosion on steep slopes

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Soil erosion is a long-term problem that causes the degradation of the earth's surface depending on geomorphological and climatic conditions. Adverse combinations of these conditions can create situations where not only sheet erosion occurs, but also rill processes begin to occur due to the concentration of surface runoff. Erosion processes become undesirable and dangerous when they occur on construction sites. The presented project is basically focused on the effectiveness of protective geotextiles against soil erosion, but processes related to sheer and rill erosion were also investigated. The research was carried out on experimental plots of 4x1 meters, which were placed in the outdoor laboratory in Jirkov. These three plots were set at slopes from 22° to 34° and artificial rain was simulated on them using a rainfall simulator. A second experimental area of the same size was available at the laboratory rainfall simulator at the CTU in Prague, where a modern facility was created for the purpose of soil erosion testing on steep slopes. This device can create slopes up to 40°.

The photogrammetric method „Structure from Motion“ was used for monitoring soil surface before and after each simulation. Orthophotos and digital elevation models were compared with each other to get digital elevation models of difference. Calculation of the ratio between sheet and rill erosion was done by manually creating rill polygons and by calculating the volume changes above the polygons of these rills and over the whole surface. According to preliminary results on these 4 m long slopes, the rill volume represented approximately 30 % compared to the overall volume change.

Shifts of stabilizing natural geotextiles by surface runoff and eroded material were also monitored using photogrammetric methods. Deformations and displacements were measured from differences in the detailed images before and after the simulation. Transversal veins and their shift along the slope were evaluated.

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Spatiotemporal assessment of ephemeral gully characteristics using low altitude aerial imagery: an approach for quantifying

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In agricultural fields, ephemeral gullies are defined as erosional channels formed primarily by overland flow from rainfall events. These channels are characterized by small dimensions, approximately 0.5 to 25 cm in depth, which allows their removal during regular farming operations. This dynamic characteristic coupled with their small size often can conceal soil losses by ephemeral gullies and poses challenges to efforts devised for soil loss quantification and mitigation. In this study, novel surveying and data processing techniques were employed to capture the small scale in topographic variation between two surveys and to assure that changes were due to erosional processes rather than survey miss-alignment. An agricultural field located in Iowa, U.S.A. with an area of approximately 54,500 $m^2$was surveyed twice: right after the field was planted with corn and approximately one month later, following several rainfall events. A static benchmark point was established at the edge of the field and tied to public geodesic locations. A set of removable ground control points were spread throughout the field and surveyed in relation to the benchmark point. Low altitude aerial images were collected using a quadcopter UAS. Ground control points were used to aid in geospatial registration and to assess final survey accuracy. Standard off-the-shelf commercial software packages were unable compensate for less distortion and a new procedure using Micmac open-source photogrammetry software package was used to account for complex distortion patterns in the raw image data set. The undistorted images were then processed using Agisoft Photoscan for camera alignment, model georeferencing, and dense point cloud generation. Each point cloud representing a time period contained over 1 billion of points (file size > 100GB) and was processed using custom algorithms for filtering outliers and rasterization into a 2.5 cm raster grid (DEM). Analysis of differences between the two high spatial resolution DEMs revealed changes in the landscape due to natural (erosion/deposition) and anthropogenic (farming activities) factors. Specifically, for ephemeral gully analysis, morphological features in the form of headcut position and size, channel incision, sinuosity, lateral expansion, and depositional patterns were easily identified. Findings of this study shed light on potential pitfalls inherent to the utilization of off-the-shelf commercial software packages for such fine scale multi-temporal analysis, describe the need for standardization of procedures that assure accurate erosional response amongst different studies, and support the generation of accurate datasets critical in advancing our understanding of ephemeral gully processes needed for improved model development and validation.

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Impact on wheat production of anthropic soil erosion by recent gully filling at the Campiña landscape in Southern Spain

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Gully erosion is one of the main drivers of environmental degradation on intensively managed agricultural fields in Southern Spain. Ephemeral and permanent gullies develop after intense rainfall events, which leads to significant loss of arable land. In the study area, productivity is also affected atn gully surroundings since gully filling (by using the top soil scraped from the vicinity of the gully) is a common practice among local farmers. The aim of this communication is to analyze the impact of gully filling practices on wheat production during two growing years (2017 and 2019) in a medium-sized catchment (94 ha) at the Galapagares watershed. The study area is close to the city of Córdoba (Spain) and belongs to the Campiña landscape (rolling landscape on vertic soils). The catchment under study is divided in five subcatchments, two of them not affected by gully filling in the last eight years while in the other three, the soil was scraped and displaced into the gully within the study period (last two years).

Firstly, a series of topographic and spatial factors (insolation, topographic index, slope, aspect, drainage area, distance to the gully) and a soil-related variable calculated prior to the growing season (soil color from the Sentinel-2 visible band) were selected as posible explanatory factors for remote sensing-based Vegetation Indexes (VI) derived from Sentinel-2 (the Normalized Difference Vegetation Index - NDVI and Enhanced Vegetation Index - EVI). Both indexes were considered potential proxies for crop yield for 2017 and 2019 campaigns. Furthermore, the differences in VI were compared between potentially affected areas by soil scraping close to gullies and non-affected areas. At last, a field survey on crop production (kg of wheat grain per ha, 15 % moisture) was carried out during the harvest period to determine the relation between vegetation indexes and crop yield.

Results show that the most relevant explanatory factors for NDVI and EVI variance were solar irradiation, topographic index, aspect (positively correlated), soil colour (inverse correlation) and distance to the gully (positive correlation), in this order of importance. A general linear model explained 40% of NDVI and 55% of the EVI variances Nevertheless, when gully adjacent (<30m to the gully) and non adjacent (>30m) areas were analyzed separately, significant diferences were detected. Non-adjacent areas presented higher VI values and homogeinity pixelwise. Moreover, the distance to the gully became the second most significant explanatory factor for VI in adjacent areas (with higher VI values for more distant locations), whereas it remained non significant for non-adjacent pixels. In addition, those subcatchments impacted by recent gully filling showed larger variability in VI values before and after the operations as compared to non-affected subcatchments.

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Soil Cohesion Development under Different Pore and Size Characteristics

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Soil cohesion (Co) is one of the most important physical soil characteristics and it is closely related to the basic soil properties and physical distribution forces (e.g. particle size distribution, pore sizes, shear strength) and so it is mostly determined by experimentally approaches with the help of other soil properties in general terms. Instead of using these assumptions, the fluidized bed approach provides an opportunity for direct measurement of intrinsic soil cohesion. In this study, soil cohesion development for different soil types was investigated with the fluid-bed method by which pressure drop in soil mass measures under increasing water pressures until the cohesion between particles disappears. For this purpose, 20 different soils varying with a wide range of relevant soil physical properties were sampled; such that clay, silt and sand contents varied between 2% and 56%, 1% and 50%, and 1% and 97%, respectively while porosity values were between 0.38 and 0.92. By those textural diversities of the soils, obtained cohesion values changed between 5203 $N.m^{-3}$ and 212276 $N\ m^{-3}$. Given results from regression analysis, a significant relationship was found between cohesion values of the soils and their porosity and silt fractions (R^2: 86.6).These findings confirm that the method has a high potential to reflect differential conditions and show that soil cohesion could be modeled by such basic and easily obtainable parameters as particle size distribution and porosity, as well.

Key words; *Mechanical soil cohesion, particle size distribution, fluidized bed approach, porosity*

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Estimation of the Rates of Particle Aggregation and Disaggregation in the Mesopelagic Zone of the Eastern North Pacific

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The processes of particle aggregation and disaggregation are of paramount importance for ocean biogeochemical cycles. Particle aggregation leads to a transfer of particulate material and of their chemical constituents into large size fractions that can settle rapidly through the water column, thereby contributing to the ocean biological pump. In contrast, particle disaggregation redistributes material into smaller size classes and places limits on the size of the largest aggregates. In spite of their preeminent importance for ocean biogeochemistry, rates of particle (dis)aggregation in the ocean cannot be measured directly and are notoriously difficult to constrain. Indeed, current estimates obtained in a variety of oceanographic environments range over several orders of magnitude and suffer from appreciable uncertainties.

The goal of the Export Processes in the Ocean from Remote Sensing (EXPORTS) program is to develop a predictive understanding of the export and fate of global ocean net primary production for present and future climates. As part of this program, an extensive oceanographic campaign took place in summer 2018 in the Gulf of Alaska, during which various measuring and sampling platforms including a large-volume filtration (LVF) system have been deployed at different depths in the euphotic and mesopelagic zones at stations centered around a drifting Lagrangian float. Here we present the status of our ongoing effort to estimate the rates of particle (dis)aggregation in the mesopelagic zone of EXPORTS stations based on concomitant measurements of the concentration of particulate organic carbon (POC), lithogenic elements (Al and Ti), and thorium-234 (a naturally-occurring particle-reactive radionuclide), in different size fractions sampled from LVF and bottles. The rates of particle (dis)aggregation, as well as remineralization and sinking, are estimated from the quantitative combination of this diverse dataset with a simplified model of the cycling of POC, Al, Ti, and Th-234 in the upper water column using a least-squares procedure that accounts for both data and model errors. Rate estimates and their errors obtained at different stations and at different depths in the upper 500 m are presented and discussed in the context of independent measurements bearing on the mesopelagic ecosystem of the eastern North Pacific.

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Evaluation of olive grove management on various soils at the micro-catchment scale with the AnnAGNPS model to quantify their impacts on organic carbon

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Soil organic carbon (SOC) stock changes are crucial to identify the risk of desertification in fragile areas such as the Mediterranean Basin and to fulfill environmental protection global conventions. In Spain, 48% of the world's olive oil is produced with 2.6 Mha dedicated to the crop and there is clear concern over the carbon balance in the context of climate change and the resulting loss of productivity. In this work, 108 scenarios were prepared with the model AnnAGNPS in a small catchment of extensive olive groves by considering the impact of soil type and management using 6 different soil types (with textures sandy, S; sandy loam, Slo; loam, L; clay loam, Clo; silty loam clay, SiLoC; clay, C), 3 different managements (no till, NT; conventional tillage, CT, and cover crop, SC), 3 types of fertilization (two organic with different rates, F2 and F3, and another inorganic F1) and 2 contrasting reach organic carbon half-life time (0.1 day-730 days). The consistency of the simulated values of annual OC attached to the sediments and of variations of ground SOC (h=200 mm) were evaluated and compared in the context of the region of Andalusia.

There were significant differences of annual values of the sediment OC for the scenarios of soil and management with a range variation between 0.0 kg.ha^{-1}and 368.9 kg.ha $^{-1}$. In addition, S and SC showed the lowest variability intervals while Clo and NT had the highest sediment OC and variation ranges. For the SOC pools, the effects of soil and fertilization types were more evident than of the management. The combination C-SC-F3 presented the maximum increase of SOC (0.150 mg OC.g^{-1}soil.y^{-1}) while the combination Slo-NT-F1 presented the minimum (0.080 mg OC.g^{-1}soil.y^{-1}). Despite specific calibrations needed to quantify OC balances, the consistency of the hydrological and erosive parameterization based on the abundance of experimental studies supports the use of AnnAGNPS for simulating the OC loss in agricultural catchments.