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Sediment dynamics in a small peri-urban catchment

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Soil degradation is a global concern that impairs some of the sustainable development goals. The identification of sediment sources and understanding of sediment dynamics is relevant to support sustainable management, particularly in landscapes with complex land-use mosaics, characteristic of peri-urban catchments. This study aims to assess spatial and temporal dynamics of fluvial sediments and identify the main sediment sources in a small typical peri-urban catchment. The study was performed in Ribeira dos Covões catchment (6.2 km2), in central Portugal, under humid Mediterranean climate. The catchment has contrasting lithology, including sandstone (56%) and limestone (41%) units, as well as alluvial deposits (3%) in the main valleys. The land-use comprises 56% of woodland, 40% urban, including mainly residential areas but also an enterprise park and a major national road (covering 5% and 1% of the catchment, respectively), and 4% of agricultural fields. The study uses a multiproxy sediment fingerprinting approach, based on elemental geochemical characterization of fluvial sediment and soil samples, performed through x-ray fluorescence analysis. Thirty three composite fluvial sediment samples were taken within the stream network (including tributaries and downstream sites). These samples were collected in two contrasting periods during 2018: July, in order to sample sediments transported latter in the wet season; and November, after a large storm recorded at the end of the dry season. Composite samples of potential sediment sources were collected in July and included (i) 64 soil surface (0-2cm) samples taken over the catchment, (ii) 17 samples from eroding channel margins, and (iii) 15 samples of road sediments, accumulated in gutters. Sediment sources were collected only once due to their relatively stable chemical composition. A range of statistical techniques, including hierarchical cluster analysis, was used to identify discriminant sediment properties and similarities between fluvial sediments and sediment sources of distinct particle sizes (<63μm, 63-125μm, 125-250 μm and 250-2000μm). Lithology plays an important role on the geochemical signatures of the samples. The enterprise park, embracing a wide area of soil barely covered by vegetation, is the major sediment source within the catchment. Small forest areas clear-felled near the stream network during the spring, represent a significant source of sediments in July sampling, but not in November, indicating a quick exhaustion of sediments ready available. Sediments mobilized from paved roads comprise a relevant source of sediments in sub-catchments with larger urban areas, particularly due to high heavy metal concentrations. The contribution of distinct sources of sediments reaching the catchment outlet slightly changes for distinct particle sizes investigated. Sediment fingerprinting is a promising approach to identify the main sources of sediments, necessary to support management strategies in peri-urban catchments.

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The potential of wetland ecosystem services for achieving the Sustainable Development Goals

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The potential of wetland ecosystem services for achieving the Sustainable Development Goals
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Abstract: Wetlands are essential for local and global freshwater-related ecosystems, and sustain many of the terrestrial lifeforms. Wetlands are cost-effective nature-based solutions (NbSs), providing environmental, social and economic benefits. However, the increasing demand and exploitation of the ecosystem services adds stress on wetlands, compromising their integrity. Following a significant loss on wetlands area due to expansions of forest industries, agricultural activities, urbanizations and energy production, sustainable concerns have raised. In Sweden, for example, economic support has been provided to thrive environmental objectives for wetland conservation and restoration. Targeting such objectives and setting up relevant plans can decrease the risk of losing valuable resources, services and mitigate wetlands' degradation. The protection of wetlands have been used as NbSs for achieving multiple Sustainable Development Goals (SDGs). To make coherent policies and strategies for wetland management, it is essential to think systematically about the interactions between SDGs and their targets, beyond their synergies and trade-offs. This study classifies the SDGs and their targets according to their interactions with wetland ecosystem services and their management, applying a scoring system established to identify negative and positive connections between goals and targets. This classification helps in identifying the potential created by wetland functions, supporting conservation and restoration plans to achieve the SDGs and their targets. The scoring approach in similarity to ICSU (2017) and Nilsson et al (2016) is applied to rate seven possible types of interactions (cancelling, counteracting, constraining, consistent, reinforcing, enabling and indivisible) from the most positive (scoring +3) to the most negative (-3) between SDGs and their targets and strategies for wetland management.
The multiple services provided by wetlands as an example of NbS are essential in achieving different SDGS (e.g. good health and wellbeing, clean water and sanitation, sustainable cities and communities, climate action) , for instance by reducing greenhouse gases, environmental toxins and maintaining a stable water table and supply. To develop wetland management strategies, there is a need to end a "business as usual" approach and strive for a nexus approach, highlighting the possibilities intertwined in the wetland ecosystems to coherently address SDGs and their specific targets.

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Ecological characterization of urban and periurban green areas in european cities from a nature based solution perspective.

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Nature can help provide viable solutions using and deploying the properties of natural ecosystems and the services provided in a smart way. These nature-based solutions provide sustainable, cost-effective, multi-purpose and flexible alternatives for various objectives, especially, more resource efficient, competitive and greener economy (European Commission, 2019). Nature based Solutions may be helpful in urban and periurban areas owing to the scarcity of green areas and the importance of provided human well-being to population. In this sense, mapping ecosystem services is essential to understand how ecosystems contribute to human well-being and to support policies that have an impact on natural resources by means of Nature based Solutions. To do this, remote sensing is widely used for land cover characterization, mapping and monitoring nature from local to global scale. Remote sensing can offer a practical and economical means to study ecological quality of cities based on the specific functions or functional groups/biodiversity, which support the supply of ecosystem services (e.g. habitats for species, maintenance of genetic diversity) .This is because many ecosystem services are ecological processes or the direct products of them. Other ecological processes can have detrimental effects on service supply. Thus, mapping the spatial distribution and the level of ecosystem functionality can provide useful information to the direct mapping or indirect modeling of ecosystem services.
This study deals with the ecological characterization of selected green areas in urban and periurban areas from 4-European cities: Coimbra (Portugal), Ghent (Belgium), Leipzig (Germany), and Vilnius (Lithuania). This ecological characterization was conducting by means of the Normalized Difference Vegetation Index and Ecological Connectivity Index. To do this, images from a GeoEye-1 Satellite sensor (0.5 m of spatial resolution) were used to map land cover and study sites by means of the object-based classification. The results indicate that the study sites provide efficient nature based solutions and ecosystem services are assured when the vegetation cover is well managed in order to maintain the ecological connectivity with other urban green areas as well as other green areas beyond the urban limits.

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Public urban green space (in)equality in Coimbra, Portugal

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Urban Green Space (UGS) provide valuable ecosystem services (ES), including, among others, climate regulation, food, and recreation opportunities. Studies show that quantity and structure of UGS in a city can have positive consequences for human well-being (Ekkel and de Vries, 2017). But studies also show inequality in the distribution of UGS (Li and Liu, 2016; McConnachie and Shackleton, 2010), with socioeconomic deprived areas usually presenting smaller UGS areas.

The study focused on the city of Coimbra, Portugal, a medium size city, hosting one of the oldest universities in the world.

We analyze the correlation between UGS parameters (abundance, quality, accessibility, ES provided) with socioeconomic indicators of the surrounding areas (wealth, occupation, education, housing).

Results suggest inequality in UGS distribution, but also a shift in UGS design and distribution, towards a more thoughtful and inclusive design, with positive impacts on ES provided.

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Spatiotemporal suspended sediment dynamics within a peri-urban Mediterranean catchment

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Erosion is one of the main soil concerns identified by the European Commission. In peri-urban areas, soil erosion can often be enhanced by a variety of human activities, such as urbanization, inadequate agricultural practices and disturbances in forest environments. These disturbances can link to distinct sediment fluxes with detrimental impacts on aquatic ecosystems. This may be of particular relevance in the Mediterranean region, where relatively infrequent but intense storms affect sediment dynamics within catchments. This study investigates spatiotemporal suspended sediment dynamics in a small (615 ha) peri-urban catchment (Ribeira dos Covões) in central Portugal during an urbanization stage and a subsequent period of relative land-use stability. The catchment has undergone significant urbanization over the last few decades, culminating between 2009 and 2012 in major land-use changes associated with the construction of an enterprise park and a major road, covering 5% and 1% of the catchment area, respectively. After this period, an economic crisis put a brake on urbanization and the land-use remained relatively at 40% urban, 56% woodland and 4% agriculture. Spatiotemporal patterns of suspended sediment dynamics were assessed via water sampling in (i) 10 storms between October 2011 and March 2013, during construction works, and (ii) 10 storms between November 2017 and November 2018 during the subsequent period of land-use stability. In each storm, samples were collected over the hydrograph at four sites at the catchment outlet; and in 3 upstream sub-catchments, The latter comprised: (i) Quinta (141ha), 67% woodland, 25% urban (including the enterprise park) and 8% agriculture; (ii) Espírito Santo (54ha), 49% woodland, 46% urban and 5% agriculture; and (iii) Porto Bordalo (52ha), 55% woodland, 42% urban and 3% agriculture. Quinta recorded a significant decline in suspended sediment concentrations from the urbanization stage (up to 4320mg/l) to the stable land-use period (up to 335mg/l). This appears to be linked primarily to 5 years of vegetation recovery in the unpaved parts of the enterprise park. In the other sub-catchments, unaffected by the urbanization stage, Porto Bordalo displayed higher suspended sediments than Espírito Santo during in the 2011-2013 storms, possibly due to piping of urban runoff to the stream, whereas in Espirito Santo runoff from paved surfaces is dispersed in surrounding downslope areas of pervious soil. In 2018, however, highest suspended sediment concentrations were recorded in Espírito Santo (up to 1033mg/l) due to forest clear-felling close to the stream network. At the catchment outlet, maximum suspended sediment concentrations decreased from 1656mg/l to 810mg/l, from the urbanization to the stable land-use periods. Understanding spatiotemporal sediment dynamics and how they are influenced by land-uses and their spatial pattern within peri-urban catchments is important to support management activities to mitigate land degradation and ensure the good status of the downstream aquatic ecosystems.

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Reducing greenhouse gas emissions through urban planning and policies with nature-based solutions

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Human-induced changes affect climate change, which requires mitigation and adaptation measures to reduce the future impacts on society. This paper aims to develop and use a planning and decision support tool to understand the complex interactions between land use changes and greenhouse gas (GHG) emissions, in order to support policy and planning decisions to mitigate future GHG emissions. The tool can provide information regarding the areas where development should be prevented or allowed, the impacts of different development types, and the potential of nature-based solutions (NbS) to reduce and mitigate GHG emissions.
The study is based on coupling a GHG module to an existing Landuse Evolution and Impact Assessment Model (LEAM). LEAM uses a 30x30m grid to spatially model the urban development of an area in terms of land use change given a particular set of drivers. The modelling exercise is focused on Stockholm County, Sweden, given the expected urban development during the next years. The coupled GHG module calculates the annual net GHG emissions of those sources expected to be impacted by urban planning decisions: transportation, building, and land cover change. These emissions are offset against the carbon sink potential, also calculated for the area. The emissions from the base year (2010) are then compared to those from a possible future scenario in 2040, as forecasted by LEAM land use change model. The tool can be used to test and compare any number of possible future scenarios, in order to determine best policy decisions and practices to promote sustainable urban planning for sustainable development with NbS to effectively minimize future emissions.

Keywords: Socio-Natural Processes; Land-use; Greenhouse Gas Emissions; Nature-based Solutions; Planning Support Systems

Organization of a session: https://meetingorganizer.copernicus.org/EGU2019/session/30852

SSS9.1
Making sense of Nature-based solutions: environmental, economic and social aspects

Convener: Carla Ferreira
Co-conveners: Zahra Kalantari, Paulo Pereira, Lenka Slavíková, David C. Finger

Several types of nature-based solutions (NbS) for land and water management have been implemented. They are multi-beneficial, not only to prevent and mitigate climate-related risks, providing more resilient cities, but also to improve human well-being and further pave the way towards a more resource efficient, competitive and greener economy. However, adequate proof-of-concept for economic, social and environmental benefits provided by NbS is needed to promote their inclusion in planning and decision-making processes.
This session aims to promote exchange of knowledge regarding NbS and to discuss their relevance for sustainable development, through evidence-based and scalable case studies. The session seeks to:
• Better understand advantages and disadvantages of NbS, based on field applications;
• Provide new insights and perspectives of NbS at catchment level, particularly their role on water, sediment, nutrient and pollutant fluxes;
• Introduce new methods and tools to investigate the role of NbS in the context of climate change, namely its effectiveness for mitigation and/or adaptation to it;
• Identify opportunities and barriers driven by current regulatory frameworks and management practices, and how the former can be reaped and the latter overcome, for successful implementation of NbS;
• Present an overview of case studies and examples of NbS projects that could involve the private sector and market-based mechanisms;
• Discuss the interactions between NbS and the Sustainable Development Goals (SDGs).