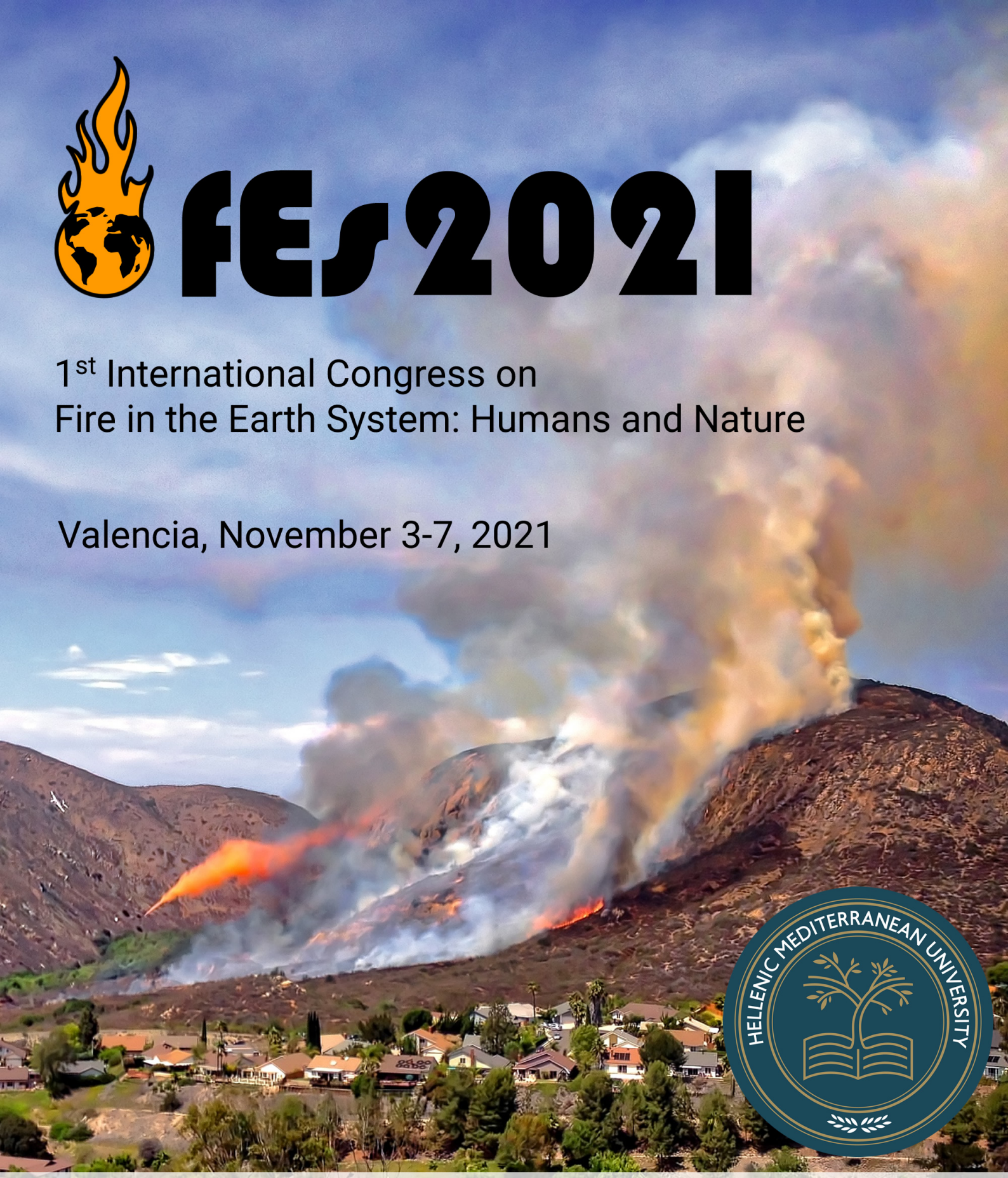
FEs2021

1st International Congress on
Fire in the Earth System: Humans and Nature

Valencia, November 3-7, 2021



Department of Agriculture
HELLENIC MEDITERRANEAN UNIVERSITY

VNIVERSITAT DE VALÈNCIA
Fac. Geografia i Història

VNIVERSITAT DE VALÈNCIA
Departament de Geografia

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ADENE en defensa de la naturaleza

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Plataforma per la defensa dels ecosistemes forestals valencians

AUTOCARES P. PUERTO-ANJUSA
Tus viajes a medida

fEs2021

1st International Congress on Fire in the Earth System: Humans and Nature

Valencia, Spain, November 3-7, 2021

Editors

Ioannis Daliakopoulos, Hellenic Mediterranean University

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The Mission of fEs2021

Fire is a key component of the Earth System and humans used as hunters and farmers. In the 21st century, fire is in the forefront of the environmental management and there is a need to find the role fire must play in our landscape. To achieve success, scientists, citizens and practitioners must interact and networking. **fEs2021** propose a hybrid conference with scientists, citizens and practitioners to share information, ideas and goals to use fire as a tool to achieve sustainability.

We invite participants with backgrounds such as fire dynamics, fire risk management, fire effects on vegetation, fauna, soil and water, and socio-economic, historical, geographical, political perception and land management approaches. We wish to connect the scientific communities from different regions of the world with the practitioners and citizens that will contribute to see different experiences and will boost the emergence of new approaches to fire research.

fEs2021 will power synergistic collaborations between research groups, citizens and stakeholders. **fEs2021** will help to synthesise the existing knowledge, to create fire-resilient landscapes based on integrated approach that include from biological, biochemical and physical research approaches, but also socio-economic, historical, geographical, sociological, perception and policy constraints.

fEs2021 will contribute to prepare society, practitioners and scientists to the intensification and geographical spreading of wildfires under the impact of Climate and Land Use Change. Global Change and fire will be two key actors for the fate of the humankind, and they will be discussed in **fEs2021**.

The president of the fEs2021 Organizing Committee,

Artemi Cerdà

Professor
University of Valencia

Scientific Committee

1. NINA DOBRINKOVA, Associate Professor, Institute of Information and Communication Technologies- Bulgarian Academy of Sciences, Bulgaria
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12. NURIA PRAT, Researcher, Pau Costa Foundation, Spain
13. ORSOLYA VALKÓ, Professor, Seed Ecology Research Group, Institute of Ecology and Botany, Centre for Ecological Research
14. DIANA VIEIRA, Assistant Researcher, University of Aveiro
15. FERNANDO T. MAESTRE, Distinguished Researcher, University of Alicante, Spain
16. JUAN RAMÓN MOLINA MARTÍNEZ, Departamento de Ingeniería Forestal Universidad de Córdoba
17. ZORICA POPOVIĆ, Department of Ecology, University of Belgrade
18. FERRAN DALMAU-ROVIRA, Director of Medi XXI GSA
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4. JESÚS RODRIGO COMINO, Junior Researcher, Soil Erosion and Degradation Research Group, Department of Geography, University of Valencia, University of Trier

Keynote speakers

Fernando T. Maestre

Distinguished Researcher, University of Alicante, Spain

Short bio

Dr. Maestre leads the Dryland Ecology and Global Change Lab at the University of Alicante (Spain), devoted to understanding how dryland ecosystems work and how they are responding to ongoing global environmental change. Beyond his research interests, he is committed to train the next generation of scientists, to promote open science by providing public access to all his research outputs, to disseminate his research to non-scientific audiences, and to create healthier, people-centred and collaborative research labs.

In the footsteps of Humboldt: Understanding the ecology of our planet through global scientific collaboration

Alexander von Humboldt (1769-1859) developed a unified vision for the environmental sciences that integrated traditional disciplines (botany, zoology, physics and astronomy) with emerging fields (ecology, climatology, geology, geography, anthropology and economics). His work launched a distinctly Humboldtian style of science, comprising vast numbers of spatially and temporally referenced observations of environmental variables and cultural practices. In this talk I will present how we are following Alexander von Humboldt´s steps in my lab to study the ecology of global drylands using a multidisciplinary approach and the power of international collaboration. Using the experience gained by coordinating multiple global networks over the years, I will provide some recommendations for those interested in setting up an international and inclusive network of researchers to address ecological questions and problems at the global scale.

Juli G. Pausas

Research scientist at Centro de Investigaciones sobre Desertificación

Short bio
Research scientist at Centro de Investigaciones sobre Desertificación (CIDE, Valencia, Spain) of the Consejo Superior de Investigaciones Cientificas (CSIC; the Spanish National Research Council). His research focuses on the Ecology and Evolution of fire-prone ecosystems, and specifically on understanding the role of fire in shaping plant species, populations, communities and landscapes

The yin and the yang in fire ecology
Fire is often viewed as a negative factor that destroys ecosystems (yin); and this view is exacerbating as the climate is warming and fires are getting larger and more intense. However, fires are a natural phenomena that has been affecting terrestrial ecosystems for many millions of years and have contributed in shaping the great biodiversity of our planet (yang). Are these two views compatible? How can we reconcile these contrasting views? In this talk I will first review evidence on how fires can shape biodiversity, and then, how global change is modifying fire regimes. There is no simple way to balance the yin and yang. Our challenge is to find ways to preserve fire as an ecological and evolutionary process even on a planet under changing conditions.

Cristina Santin Nuno

Associate Professor of Biosciences, Swansea University & UMIB-CSIC

Short Bio

I am a wildfire researcher who is passionate about her topic and about working with amazing people around the world. I did an undergraduate degree in Biology (2003) at the University of Oviedo (Spain) where I also received my PhD in 2009. In 2011, I moved to Swansea (UK) to start my work on wildfires, a subject I have always been fascinate about. I am currently a Ramón y Cajal Research Fellow at the Research Institute of Biodiversity (Spanish National Research Council & University of Oviedo) in Asturias (Spain) and an Honorary Associate Professor at Swansea University (UK). My current research focuses on the effects of fire, both wildfires and prescribed burns, on carbon dynamics. I also study fire impacts on soils and waters, social perceptions of fire, and characterization of fuels and fire behaviour. I have been lucky enough to do fieldwork in many different ecosystems across the world such as Atlantic heathlands (UK and Spain), tropical savannah (South Africa), the boreal forest (Canada) or the dry sclerophyllous forest (Australia). I am also associate editor of the Journal of Geophysical Research-Biogeosciences and book review editor for the International Journal of Wildland Fire. I am always keen on outreach activities, including talks and articles for the general public.

Fire and the Carbon cycle: What will the future bring?

Under the current climate change, a full understanding of the relationships between fire and the carbon cycle is imperative. In this talk we will discuss the main connections and feedbacks between fire and carbon and will explore how these can change in the future and the implications for the humankind.

Marc Castellnou

Associated professor, University of Lleida, Spain

Short bio

• Strategic Fire Analyst, GRAF, Catalan Fire Service (since 1999)
• Area Chief, Catalan Fire Service (since 2002)
• Inspector, Type I Incident Commander, Catalan Fire Service (since 2002)
• Founder and Chairman of Pau Costa Foundation (since 2010)
• Developer of wildfire analysis and simulation tools with Wildland Fire Analyst. Tecnosylva. Leon, Spain/San Diego, USA
• Developer of wildfire analysis tool using particle random approach. CPS and EMSYX. Los Angeles, USA. First place in the world wind challenge, NASA. Florence, June 2013.
• Coordinator of public communication sessions in key forest fires. After action reviews with forest owners and rural organitzations. Fires of Cardo 4500 ha May 2012, catalonia. Fire of la Junquera July 2012, 12000 ha.
• Member of the emergency and forest fires round table of ESRI Europe. 2011-2013
• Member of Advisory group for CREAF (Center of Ecology Research in Forestry and Agriculture of University Autonoma of BCN)
• Associated professor. University of Lleida (since 2015)

Fire, Landscapes and Management: Facts and challenges

Wildfires are becoming a faster and bigger disturbance in our protected ecosystems. Fire paradox is applying the negative selection, so the better we try, the few fires escape our control, but those that overwhelm fire services, cause tremendous damage and havoc in our society. This is driving the response crazy investing in resources almost 90% of what we invest in our ecosystems. At the same time environmentalists increase the demand to protect biodiversity and pushing harder to fire service to be more efficient although it is known this will drive to less but bigger and more destructive fires at an unprecedented scale. We are all defending, but under socioeconomic changes and climate changes, we should be adapting and creating tomorrow's landscape instead of defending the past landscape. What can we do in front of 6th generation wildfires? How we can make sure biodiversity survives? Are fire engines the solution or will come from biodiversity and mosaic landscape?. Are we being part of the problem or already starting to find a solution? Looking at the events unfolded around the world since 2016, we will go through lessons learned.

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Valencia, November 3-7, 2021

Valencia Time / GMT+2
Only presenting author shown here.

		Wednesday November 3, 2021	Thursday November 4, 2021
9:00-10:00	9:00	Opening by the Organizers	Opening by the Organizers
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	10:55	ID90: Yadav, Politics of Pixels: Role of Satellite Remote Sensing in Shaping and Sustaining Fire Suppression Policy in India	ID70: Parente, Long-term erosion and the impact of wildfires: two different approaches.
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Forest fires today. A scientific and societal challenge

Artemi Cerdà

Soil Erosion and Degradation Research Group, Department of Geography, Valencia University

Jesús Rodrigo Comino

Departamento de Análisis Geográfico Regional y Geografía Física, University of Granada

Forest fires are a global phenomenon. Climate change, land abandonment, drought, flammable forest and plantations and urban and peri-urban planning resulted in the spread of forest fires. Fire is present in all ecosystems and the management of fire-prone areas is a great debate today. The aim of this session is to share experiences between stakeholders and researchers on how to face the forest fire challenge. From suppression to prevention , field measurements, modelling, climate change impacts on fire behavior, societal impacts, awareness, etc. A wide range of topics researched in the laboratory, field experiments, or in the office will be debated.We encourage stakeholders and scientists to share their experience with study cases of countries and local forest fire examples. The debate is served.

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Fire in the Earth System: Science & Society, FIRElinks EU COST action challenges

Cerdà, Artemi

Soil Erosion and Degradation Research Group. Department of Geography. University of Valencia

Abstract

Firelinks is composed of 38 European Countries national representants (plus 12 Non EU countries members) and currently is registered 450 participants. Although based in the collaboration of scientists of different backgrounds and regions, the main objective is to share with stakeholders from different origins the past, present and future management of fire in agriculture, forest, scrub and grass lands. FIRElinks is a EU-spanning network of scientists and practitioners involved in forest fire research and land management with backgrounds such as fire dynamics, fire risk management, fire effects on vegetation, fauna, soil and water, and socio-economic, historical, geographical, political perception and land management approaches. Firelinks connect communities from different scientific and geographic backgrounds, allowing the discussion of different experiences and the emergence of new approaches to fire research. The main aim of FIRElinks is to power synergistic collaborations between European research groups and stakeholders with the objective to synthesise the existing knowledge and expertise, and to define a concerted research agenda which promotes an integrated approach to create fire-resilient landscapes, taking into account biological, biochemical and-physical, but also socio-economic, historical, geographical, sociological, perception and policy constraints. This is an urgent societal need due to expected further intensification and geographical spreading of wildfire regimes under Global Change.

Keywords: Fire, Europe, Management, Stakeholders, Sustainability

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Valencia, Spain, 3-7 November, 2021

Is enough water supplies for extinguishing forest fires in the Czech Republic?

Holusa, Jaroslav, Koren, Milan, Bercak, Roman and Trombik, Jiri

Czech University of Life Sciences

Abstract

Long periods of drought and mild winters have significantly affected the forests of the Czech Republic in recent years. If this trend continues, forest trees will be weakened and dehydrated, which will increase the probability that forest fires occur and spread. It is essential that fire managers (the Fire Rescue Service of the Czech Republic) prepare for this possibility. A main requirement for the extinguishing of large forest fires is the availability of water supplies. In this study, we determined whether the Czech Republic has enough water to fight forest fires and whether these water supplies are distributed so that all forest stands will have sufficient nearby water to fight fires. We analyzed forests, water supplies, and forest roads in three study areas. Water supplies were divided into several categories according to the database of water supplies currently used by the Fire Rescue Service of the Czech Republic; we also considered water supplies that are not currently used but that could be used. Forest roads were considered useable only if they permitted passage by commonly used firefighting equipment in the Czech Republic. Using GIS software and mathematical algorithms, we assessed the distance of forest stands (based on movement of water tanker trucks on passable road) to the nearest water supply and depending on water supply category. We found that there are currently sufficient water supplies in the studied areas of the Czech Republic to extinguish forest fires. One reservoir is sufficient to cover tens to hundreds of hectares of forest. The results indicate that any shortage in water availability can be eliminated by water supplies that are useable but that are not currently part of the database used by Fire Rescue Service of the Czech Republic. A thorough and regular updating of the database of water supplies is therefore required. This updating is especially important because some water supplies are incomprehensibly missing from the database and because some supplies in the database may disappear due to the current climatic conditions.

Keywords: water availability, Central Europe, Support decision system

Acknowledgments: The authors thank everybody who was part of this project.

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Slow emergency stabilization: limitations for the recovery of burned areas in Portuguese forests

[1]Lopes, Luis Filipe, [1]Acácio, Vanda and [2]Fernandes, Paulo M.

[1]*Centre for Applied Ecology "Prof. Baeta Neves" (CEABN/InBIO), School of Agriculture, University of Lisbon*
[2]*Centro de Investigação e de Tecnologias Agroambientais e Biológicas, Universidade de Trás-os-Montes e Alto Douro, Quinta de Prados, 5000-801 Vila Real, Portugal*

Abstract

Portugal is one of the European countries most affected by wildfires, together with Italy, Greece, France, and Spain (EUMED5), with extraordinary negative environmental, social and economic impacts, such as soil damage, disruption of the hydrological cycle, biodiversity loss, and loss of income at local and regional levels. Emergency stabilization is the first stage of burned area restoration after damage assessment and intends to stabilise the area and protect the soil in the shortest possible time, to avoid degradation processes. Emergency treatments should be implemented in the first four months after the fire, when most of the ashes and soil are lost. Public funding is available for post fire emergency stabilization through specific calls that are based on emergency stabilization reports, following large wildfires. The calls are the mechanism through which land managers can access the funding to execute the respective treatments. This is a relevant factor since the Portuguese forest area is mostly owned by private landowners (around 97%) and the majority of forest properties are smaller than 5 ha and 10 ha (85% and 93%, respectively). All these factors limit postfire emergency treatments since restoration is unlikely to be implemented by small-scale owners unless funding is readily available. The present study aims to improve understanding on the factors responsible for losses in efficiency of post-fire emergency stabilization in Portuguese forests, by analyzing administrative, technical, and financial factors related with the funding process. We analyze the process of implementation of public funding related with postfire emergency stabilization in Portugal for the period 2009-2018 using data from: (i) 134 emergency stabilization reports (ESR); (ii) 12 calls resulting from these reports, and (iii) 517 approved projects subsidized by the calls. We show that postfire emergency stabilization in Portugal is not effective due to limitations associated with the funding process and the implementations of treatments. The main limitation is not the lack of funding, but instead the difficulty to apply these funds within an acceptable time frame and the attractiveness of the funding programs. Additionally, we compare the results found for Portugal with successful case studies in similar forest ecosystems and present suggestions to improve the process of public funding and the efficiency of postfire emergency stabilization in Portugal.

Keywords: Postfire restoration, Public subsidies, Cost effectiveness analysis, Portugal,

Restoration strategy, Evaluation and monitoring, Governance and Policy

Acknowledgments: Luís Lopes is a PhD fellow funded by the FCT (PT/BD/142963/2018), under the SUSFOR - Sustainable Forests and Products Doctoral Programme.

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Acacias Control: a tool to reduce wildfires risk in unmanaged forestlands

Iryna Skulska and Conceição Colaço

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Abstract

In recent decades, changes in the wildfire regime have been caused by several factors, such as changes in land use, an increase of fuel loads in rural areas, climate changes, and the growing invasion of exotic species such as Acacias ssp. In Europe, acacias are among the most widespread invasive species, becoming an environmental issue in Southwest Europe including Portugal. According to the latest forest inventory (ICNF,2019), acacias cover about 18,500 hectares in Portugal, and it is expected that this area continues to grow significantly. This strong invasion started a few decades ago promoted by the large areas affected by wildfires (Nunes et al. 2021). High temperatures from fire effect directly the acacia seed bank in the soil, stimulating germination and resprouting. The probability that the majority of invasion by acacia occurs in private areas is very high as more than 90% of Portuguese forests are private. This situation is aggravated by the acacia control's high cost. The Acacia4FirePrev project, developed by the School of the Agriculture / University of Lisbon, is looking for viable alternatives to help manage these areas more efficiently and with fewer control costs for their owners. One of the project's tasks is the study of social involvement and the sensitization of various actors to the acacia invasion problem and its relationship with wildfires. For this purpose, a survey was developed for forest managers and owners with the aim of getting to know their practices and knowledge in the area of acacia control. The preliminary results of the survey show that respondents have some difficulty in identifying all Acacia species in Portugal. However, more than 80% of respondents consider that acacias are a serious/very serious problem, and all perform actions to control this invader. The area intervened covers the entire country. The results of the study point to the need to increase the awareness of the population about the problem of invasion of Acacias spp. This can be done, for example, by increasing the number of practical workshops in the places most affected by the invasion of acacias and the number of professional training. Furthermore, it is equally important to develop guidelines for environmental education and manuals in a clear and simple language.

Keywords: wildfires, exotic invaders, survey, forest owners, forest managers

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DISRUPTED LANDSCAPES: The representation of Mediterranean Wildfires

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Abstract

This investigation explores representation in landscape architecture as a means of integrating wildfires as a disturbance in landscape planning and management. The case study of the Sierra de Collserola in the Barcelona Metropolitan Area in Spain is developed, as a Mediterranean metropolis referent where to test representation, planning and management methodology. Wildfires are the main natural disturbance that affects the Mediterranean area and it is expected to worsen in the global climate change scenario. The fire regime has changed, mainly due to climate and human activity. The international community specialized in wildfire management recognizes the inability to solve and treat the problem strictly from the field of emergencies. The classic prevention model is being questioned, since it is not an issue of extinction capacity or economic resources destined to extinction, but an issue of landscape's ability to integrate and modulate disturbances. The perception and interpretation we make of wildfires and disturbances is sociocultural, but in turn, disruptive, and this fact influences political and scientific positions that are not exempt from these assessments. The concept of loss of value, associated with disturbances, is analyzed, to resignify loss and disturbance through the characterization of the operation of the disturbance: intensity, frequency or regime, as well as the landscape's own capacities that are activated by the disturbance, such as resistance, resilience or transformability, proposing its integration into landscape planning and management through representation. The case study develops a methodology for the integration of disturbances in planning and management in a specific territory such as the Sierra de Collserola through representation, anticipating the scenario of great wildfire and proposing the inclusion of disruptive change through management as a designed disturbance, and of wildfires through fire regime management. The representation explores the operability of the disturbance from the instrumental and the affective perspective to resignify the concept of disturbance and join a necessarily transdisciplinary reflection on the socialization of value and risk.

Keywords: Landscape management, landscape planning, wildfires, landscape representation

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SDGs and Wildfires: the role of soils in Sustainable fire management

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Abstract

Wildfires are part of the natural system and geology, vegetation and climate has been co-shaped by it. However, due to human action the fire frequency is much higher that would naturally occur. And moreover, climate change is bringing fire to places where it previously did not occur, or at least in lower frequency and extend. Currently, 3–4% of the Earth's surface is affected by fire each year. The majority in agricultural land where it is used as a tool for land clearing and burning of agricultural wastes. The rest are wildfires in natural grassland and forests. This number is likely to increase under the foreseen climate change and societal changes ahead. The UN Sustainable Development Goals that have been endorsed in 2015, do not take wildfire into account as part of nature, and part of society. While many Goals are affected by the beneficial and adverse effects of fire on ecosystems. Especially SDG3, good health, SDG 6, clean water, SDG 13, climate Action, SDG14, life under water, SDG15, life on land and SDG are affected by fire. Therefore, the plans to reach these goals should take fires into account.

Keywords: Sustainable development goals, climate change, land degradation, agriculture

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Fire Cube: Understanding and Communicating the Multidimensionality of Fire

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Abstract

Understanding and communicating the causes and effects of fire requires a consideration of the multidimensionality of fire: whether it is intentional or not, intensity and frequency (more broadly, fire regime), its effects on ecosystems and humans, and how these effects vary in the short-term versus long-term. When any dimension of fire is missed, an incomplete picture of fire arises; framing of fire in media and policy remains simplistic and often scientifically incorrect. This study develops 'fire cube' as a framework to understand and communicate the multidimensionality of fire. The fire cube framework is developed by drawing on three other frameworks – Pyric Phase Model (Pyne, 2001; Bowman et al., 2011), Three-Coloured World (Bond, 2005, 2019), and Fire Disturbance Continuum Framework (Jain, 2004). Fire is framed along four axes in the fire-cube: Pyric Phase, World, effects, and temporal phase. The Pyric Phase Model not only allows to distinguish between different fire-uses, but also elucidates upon the values and worldviews behind those fire-use practices. The Three-Coloured World framework explains the landscape in which fire incidents occur and distinguishes between fire incidents based on the landscapes they burn. The effects of fire are analysed in three broad categories: people (such as pollution, damage to property), biodiversity, and climate change. The temporal phase draws on the Fire Disturbance Continuum framework to analyse effects in relation to the time of fire: active fire, post-fire, and long-term perspective that looks at second-order fire effects. The fire cube allows evaluation and critique of existing knowledge, policy, and practices of fire management by seeing them through the lens of emergent fire ecology concepts developed in the last one to two decades. It can be used to analyse how dominant discourse and narratives frame fire along multiple dimensions. What becomes particularly important is the absence of some dimensions in the framing of fire. The absence of dimensions as well as incorrect understanding of certain dimensions can be used to reveal the politics of fire management. In doing so, fire cube offers a novel way to challenge the dominant discourses and narratives by exposing the gaps and inaccuracies in the framing of fire.

Keywords: wildfires, fire management, media, framing, environmental politics

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Politics of Pixels: Role of Satellite Remote Sensing in Shaping and Sustaining Fire Suppression Policy in India

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Abstract

Satellite Remote Sensing (SRS) is becoming central to the study of fires in the 21st century. Various advantages of SRS are put forward such as objectivity, neutrality and reliability of SRS data, its synoptic vision, and extensive coverage; as a result of these claims, satellite imagery acquires the power to offer information that is unmediated and free from prejudice of authorship. This study takes a critical approach, attentive to the politics of production and analysis of satellite imagery. It looks at the practice of SRS science and technology in India, in the last three decades, to examine how SRS produces the fire reality that it attempts to understand. The study finds that most SRS studies do not acknowledge the complex, diverse and often interlinked socioeconomic causes of fire and mostly rely on generalised assumptions such as an increase in population, slash and burn cultivation, carelessness, without any supporting data. Many SRS studies find a common ground in their implicit notions on seeing human use of fire, increasing fire frequency and human presence in forests as something to be always avoided. This study argues that the 'true' reality constructed using SRS imagery around forest fires is not neutral, apolitical, and simply given, but a result of subjective concepts and categories that fit well within the institutional arrangements and the dominant discourses on forest fires and indigenous fire-use. A more critical approach to SRS is needed that recognises the ecological role of fire in open ecosystems and the social dimension of indigenous burning practices.

Keywords: critical remote sensing, fire policy, environmental politics, forests, forest fire, STS

Acknowledgments: Kate Schreckenberg, Emma Tebbs

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Slash pile burning like a forest fire initiator

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Abstract

Finding out who or what causes forest fires is one of the basic preconditions for reducing the number of this destructive element. In the study, we are focusing on slash pile burning, a common part of forest management in the Czech Republic. What effect does slash pile burning have on the number of forest fires? Is it justified to prohibit slash pile burning? Or should it be a regular part of Czech forestry management still? In the Czech Republic, about 47 % of forest fires have an unidentified or unexamined initiator. Can be slash pile burning responsible for a large number of forest fires? In the GIS analysis, we compared coordinates of forest fires from a database of the Fire Rescue Service of the Czech Republic with coordinates of slash pile burning from the database of reported burning of slash piles. In the Czech Republic, it is obligatory to report each burning of slash piles in a special online form indicating the place, time of burning, and other necessary information. On the basis of field and statistical analysis, we considered that forest fires were caused by slash pile burning if the distance from the origin of forest fire and place of slash pile burning were 80 meters in maximum and forest fire initiate in the period from the beginning of the reported burning in the online system to the end of the fifth day (120 hours) from the reported end of slash pile burning. The GIS analysis showed that 5 percent of forest fires in the period 2019-2020 were caused by slash pile burning. On the basis of results, we think that slash pile burning is not necessary to prohibit. Nevertheless, it is necessary to raise the knowledge of forest workers about safety principles of slash pile burning and to ensure better control of these workers from forest managers. Also, a reasonable boundary should always be considered between the amount of material burned and the material left in the forest stand, for ecological reasons on the one hand and on the other hand, in order to avoid the overgrowth of secondary pests, usually bark beetles.

Keywords: slash pile, forest fire, forest management

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Cost-benefit comparison between fire prevention and no fire prevention scenarios: pilot analysis applied to a case study in Sardinia, Italy

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Abstract

During 2021 summer Montiferru fire spread over about 13000 ha, with impressive damages and, by consequence, a strong reaction of public opinion. When accounting for the tremendous costs due to fire suppression and forseen restoration, a key issue emerges: how much convenient is current strategy based on fire suppression respect to a long lasting prevention scenario? In this work, we propose a cost-benefit analysis for evaluating the convenience of prevention versus no prevention scenarios. Both finantial and economic analysis are applied to a case study including the area burnt by Montiferru fire in 2021, July. The convenience of long lasting prevention is found to be higher than in no prevention scenario. This methodology is proposed as a rational tool for allocating, and optimazing, finantial resources as the ones now available from the European recovery fund.

Keywords: prevention, suppression, economics, damage, cost-benefit analysis

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Recovering shrub biowaste involved in wildland fires in the South of Europe through torrefaction mobile units

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Abstract

In the last decades, longer and drier seasons, as well as human activity, increased the incidence of forest fires in the South of Europe. This phenomenon was enhanced by the accumulation of vegetal mass in forest and mountains, favoured by the decrease of agricultural and farming activities. However, it is precisely the valorisation of this abundant and cheap shrub biowaste at local scale which may provide rural areas of valuable resources, contribute to prevent fire and restore modernized rural activities. The European project MOBILE FLIP developed and demonstrated mobile conversion processes suitable with underexploited agro- and forest-based resources to produce energy carriers, chemicals and materials. Torrefaction is a mild thermochemical treatment (200 to 300 °C, default-oxygen atmosphere) producing a torrefied solid, whose properties are close to those of coal. During torrefaction, gaseous species are released, among which volatile species that may be source of green chemicals (Chen W.-H., 2015). The objective of this study is to assess the suitability of valorising through torrefaction 6 underexploited Spanish biowaste and wood samples (two brooms, fern, gorse, heather and oak), which are typically involved in fires in the region of study (Chandrexa de Queixa, Spain). Selected species were harvested and deeply characterized at lab-scale. Solid kinetics and volatile species release were studied in a thermobalance coupled to a GC/MS through a heated storage loop system (TGA-GC/MS). All species presented a high calorific value, as well as similar properties and kinetic behaviour, close to deciduous wood, except fern, close to agricultural biomass (González Martínez et al., 2018). This last material usually grows separately, in wet areas, and its fire risk is considered as low. Consequently, the direct in-situ valorisation of these biomass species seems promising and suitable without separation. The production profiles in torrefaction were studied for 23 chemical compounds released. A direct valorisation of the gaseous mixture is possible, by enhancing the production of the component of interest (such as acetic acid) through the suitable operating conditions, thanks to the obtained lab-scale results in chemical regime. A torrefaction model able to predict solid kinetics in function of the operating conditions was proposed for several biomass families (González Martínez et al., 2020). This model was also validated for predicting solid yield of shrub biowaste and oak in torrefaction, with an acceptable error margin. The use of this model would facilitate torrefaction mobile unit handling for in-situ valorisation.

Keywords: Torrefaction, Solid mass loss, Shrubs, Oak, Fire risk, Volatile species

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Evaluation of soil profiles to understand resilience in natural and anthropogenic environments after different number of wildfires

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Abstract

Understanding the connection between wildfires and soils is crucial for the successful assessment of the past, present, and future status of natural and human ecosystems. Soils are spatially heterogeneous depending on the environmental conditions but also on land management by humans. Similar to the other soil types, burned soils are needed to be assessed in order to assess their sensitivity to the wildfire effects and evaluate their recovery capacity. As a result, promoting landscape resilience throughout the different post-fire stages are peremptory as well as the so-called non-productive functions such as soil water retention capacity but also trace or deleterious elements, avoiding erosion, compaction, etc. The main aim of this research is to apply differently mapping techniques, and soil characterization to understand the soil profile status, changes, and evolution after a different number of wildfires (0, 1 and 2 times) occurred in the last 20 years in contrasting environments (abandoned agricultural terraces and natural hillslopes). The study was conducted in a representative catchment located on the island of Mallorca (Spain) through (i) an exhaustive fieldwork campaign describing 24 soil profiles; (ii) sampling and analyzing the main soil properties in each soil horizon; and, (iii) mapping the land-use changes and main geomorphological processes. The current status characterization of soil profiles allowed us to understand if the recovery or degradation due to human impacts in the past, wildfires, or both. This study pretends to fill the gap existing in the literature due to the large datasets that are usually required and specific conditions needed in the same catchment to address the wildfires-soils links.

Keywords: Soil profiles, soil geography, wildfire, resilience,

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Assessment and mapping the habitats' vulnerability to forest fires in "Rila Monastery" Natura 2000 zone (Bulgaria)

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Abstract

Fires are a natural and ecologically significant factor for forest ecosystems, which leads to changes in their physical and biological characteristics, their condition, functioning, and supply of ecosystems services. The level of vulnerability of forest territories to fires is determined by a complex of interactions between climatic factors, type of burning materials, structure, and stability of forest stands. In this study, we propose recommendations to decision-makers based on an elaborated new methodological approach for assessment of fire risk, applicable at national level. The priority of defining preventive measures in forest territories with high biological diversity and under specific regimes of protection requires recommendations based on assessment with high details and accuracy. An improved methodology is elaborated, which integrates the potential of the available data from forest inventory and the modern tools and instruments for data provisioning incl. remote sensing and spatial analyses, which resulted in the development of risk register with indicators for fire risk assessment. Assessment and mapping of vulnerability of habitats to fires in a case-study area of Natura 2000 zone "Rila Monastery" (Bulgaria) are applied based on this methodology using the conventional mapping methods.

Keywords: forest fires, risk-register, habitats, assessment, mapping

Acknowledgments: The study is performed under the project \\\"Assessment and mapping of ecosystem services in high-mountain territories in Rila and Pirin for sustainable territorial development\\\" MAPESMOUNT, funded under the contract КП-06-ОПР-03/6 from 17.12.2018 by National Science Fund, R Bulgaria.

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Forest fires risk assessment in "Yulen" Reserve in "Pirin" National Park, Bulgaria

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Abstract

Fires are an important factor for natural ecological disturbances with a strong modification effect on the spatial structure of the landscapes and long-term impact on their sustainability. Along with the climate changes and land-use changes the management of forest lands influences significantly the occurrence, behavior, and impact level of forest fires. Due to the specific geographic location of the country, the climatic conditions in the region, and biomass characteristics in mountain areas (wood stock, dead wood, health status of stands, etc.), forest fires are considered as one of the priority disasters for prevention, early warning and monitoring of forests and for sustainable management and protection of natural resources in mountain territories of Bulgaria. The present study aims to establish the degree of fire risk on the territory of the reserve "Yulen" (Pirin National Park, Bulgaria), as one of the natural and most common disasters in forest ecosystems. The national "Methodology for determining the risk of forest fires in the country" is applied following the European requirements in order to identify the zones with higher risk to forest fires. It was established that on the territory of the reserve the categories with low to medium forest fire risk predominate. Based on the results obtained an improvement of the methodology is proposed in order to provide a better assessment at a lower scale (different types of forest units) for the purposes of sustainable management of protected areas.

Keywords: forest fires, prevention, risk assessment, mountain territory, protected areas

Acknowledgments: The study is performed under the project \"Assessment and mapping of ecosystem services in high-mountain territories in Rila and Pirin for sustainable territorial development\" MAPESMOUNT, funded under the contract КП-06-ОПР-03/6 from 17.12.2018 by National Science Fund, R Bulgaria.

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Fire geographies in Sardinian landscapes: a place-name based approach.

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Abstract

Fire is an intrinsic element of terrestrial ecosystems, especially in the Mediterranean Basin, as a natural factor and above all as an anthropic tool used to manage vegetation and shape landscapes. Over time, the increasing awareness in the use of fire has affected Mediterranean ecosystems and supported the creation of settlement and agricultural practices. Rural landscapes of Sardinia (Italy) were and are frequently marked by fire occurrence. In recent decades, a mix of socio-economic and fire management factors influenced fire regimes, which presented a general decreasing trend in annual fire number and area burned. However, both land abandonment and the increasing frequency of extreme weather and climate conditions are exacerbating the risk of mega-fire occurrence, as those observed in 2009 or in 2021. This is leading to a growing attention on the role played by prevention activities in mitigating wildfire risk, and from this point of view the use of controlled fires in agreement with local communities and needs can represent a valid tool to manage fuels in specific areas. The traditional use of fire for fuel management purposes was well known in several areas of Sardinia: "narbonare" is the term used in Sardinian language to refer to this practice. Cartographic reconnaissance of ancient and modern maps has allowed to recover a heritage of over two hundred pyrotoponyms linked to the term "narbone" all over the island, presented here as a geography of the use of fire as a shaping agent of the Sardinia landscape and rural culture. In this work, we analyzed the areas in which “narbones” place-names were located, and explored their characteristics in terms of environmental factors (e.g.: topography, bio-climate, etc.) as well as of current land uses.

Keywords: firescapes, pyronomastic, Sardinia, prescribed burning

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Multi-decadal increase of forest burned area in Australia linked to climate change

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Abstract

Fire activity in Australia is strongly affected by high inter-annual climate variability and extremes, and anthropogenic climate change has now the potential to alter these fire dynamics. We compile three satellite and ground-based burned area datasets 19, 32, and 90 years long, climate and weather observations, and simulated fuel loads for Australian forests. We found that burned area in Australia's forests shows a linear positive annual trend and an exponential increase during autumn and winter. The mean number of years since the last fire has decreased consecutively in each of the past four decades, while the frequency of forest megafire years (>1 Mha burned) has markedly increased since 2000. The increase in forest burned area is consistent with the observed increasingly more dangerous fire weather conditions, increased risk factors associated with pyroconvection, including fire-generated thunderstorms, and increased ignitions from dry lightning, all associated to varying degrees with anthropogenic climate change. Analysis of trends in prescribed burnings and modelled fuel production suggest that changes in fuel loads have played a small role in the observed increasing trends in forest burned area. This analysis is the first of its kind in showing both a multi-decadal increase of forest burned area across the Australian continent and the dominant role of climate change in driving the long-term observed trends (Canadell et al. 2021).

Keywords: fire frequency, climate change, fire weather, burned area,

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Service-Learning projects to educate young generations in fighting wildfires

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Abstract

Fires represent a force of environmental change and habitat degradation worldwide. In general, fires are intrinsically related with factors as deforestation, agriculture, livestock pressure, invasive species, forestry plantations, habitat fragmentation, or climate change. A good understanding of ecological and technical aspects of fire is necessary but social aspects are less explored. Here, the reinforcement of training capacities is needed to overcome technical, social an economic limitations in fire management. Within the current context, the perception of fire as an environmental but also a social problem is increasing, and society is willing to participate in environmental actions. Thus, education and communication are essential to meet this challenge. Although limitations are numerous, new approaches increase the capacity and sensibility of the society in fire management. Multiple activities focus on education to raise public awareness but act as complements *outside the educational system*. Here, Service-Learning (S-L) represents an experiential and education methodology combining learning and community service through projects with a civic-academic base integrated *within the educational system*. S-L projects bring together students, academia and staheholders whereby all become teaching resources, problem solvers and partners. Students learn, identifying and acting to solve real-world necessities, obtaining academic credit, and integrating community service in the curriculum. Stakeholders -individuals or communities-possess large and intimate knowledge that serve to include the social perspective in fire management, increasing community engagement in environmental protection. Their perceptions, experiences and relationships are unique and differ from those of researchers and practicioners, becoming essential to design locally adapated, effective management

practices. Starting from a local initiative (Plantando Cara o Lume, 2016), the project "Plantando Cara al Fuego" (Spanish National Project, FECYT-2020) and its European counterpart "Facing Fire" (Earsmus+, 2020) are based on independent S-L projects designed to prevent, protect, and restore areas affected by forest fires in Southern Europe (Spain, Portugal, Italy, and Greece). With an important role also played by communication, S-L projects focus on different aspects of pre/post fire management: prevention through biomass removal, education in schools, social educative campaigns, restoration of burned areas, or the protection of endangered species and spaces, among others. Through the design and implementation of activities adapted to local realities, S-L projects allows future managers, ecologists, practicioners, and students from different disciplines (environmental, forestry, education, economics, communication) to learn based on real experiences. Students learn, train, and develop competences and skills for the future in collaboation with the community where they live.

Keywords: Service-Learning, student training, fire management, participative projects, community engagement

Fire and soil organic matter: relationships, impacts and novel methodologies

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Under the present scenario of global warming, it is predicted that the area burned by wildfires will increase by approximately 27% by 2050, particularly affecting humid-temperate and boreal forests. It is well-known that wildfires induce changes in the physical and chemical properties of soils, depending on fire conditions (intensity, duration), soil characteristics, climatic conditions and vegetation. Fire affects both quantity and quality of soil organic matter (SOM) by modifying existing chemical structures, forming new ones, or adding/removing materials (fresh or charred biomass). Consequently, the study of SOM is crucial for assessing of the impact of wildfires. Further, this knowledge may generate predictive models of action useful to alleviate the damage caused by the fire. Nonetheless, due to the chemical complexity of the SOM, there is not a complete vision of the different reaction mechanisms promoted by fire. This interdisciplinary session will focus on the current research and advances of innovative analytical techniques in the study of the alteration, impact and the cause-effect relationships induced by fire on soil. Submission of studies conducted by cutting-edge analytical methodologies (including chromatographic, spectroscopic, isotopic, thermal, among others) and chemometrics, such as, partial least square regression (PLS), predictive models and data mining are particularly encouraged.

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Changes in Soil Organic Carbon Pools during Long-Term Post-Fire Succession in the Khibiny Mountain Tundra Heaths

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Abstract

Fires in tundra ecosystems have long been relatively rare and poorly studied. At the same time, the increasing frequency and significant areas of tundra fires occurring in recent decades indicate that fire is becoming an important factor regulating the carbon cycle in these ecosystems. According to existing forecasts, the frequency of wildfires in the tundra during the XXI century will constantly increase. The objects of the study (dwarf shrubs heaths) were located in the Khibiny mountain tundra (Murmansk region, NW Russia). We studied ecosystems immediately after a fire of high and medium intensity, as well as 1, 2, 3, 7, 12 and 60 years after medium intensity fire influence. Medium-intensity fire does not have a statistically significant impact on the total carbon pool in the soil, but it triggers active soil erosion and ultimately the reduction of carbon stocks is comparable to direct high-intensity fire losses. During post-fire development, the type of organic carbon accumulation changes: for the control area, the accumulation occurs on the surface in the form of peat, while at the later stages of post-pyrogenic succession, up to 50% of the carbon is concentrated in the mineral horizon. A high-intensity fire results in the almost complete destruction of labile, microbial, and potentially mineralized carbon pools in soil. A medium-intensity fire does not result in a statistically significant change in these pools. The dynamics of recovery of labile and potentially mineralized pools of organic matter in post-fire soil differ: starting from the age of three years, there is a steady increase in the content of labile and microbial carbon, where for a potentially mineralized pool, the maximum falls on three-year-old carbon with consequent stabilization of values. The activity of soil water-soluble organic matter (WSOM) mineralization is determined primarily by its own properties, not by the microbial community. The dynamics of biodegradability is described by a two-component exponential model with the establishment of a statistically reliable existence of the fast-mineralized (mean residence time is less than 1 day) and slow-mineralized (mean residence time from 33 to 111 days) pools'. The maximum share of the "fast" pool is characteristic of the soil immediately after the fire and gradually decreases during further post-fire succession. In the process of WSOM biodegradability, the most resistant hydrophobic compounds of the aromatic structure are selected, while the simple nitrogen-containing components are consumed by microorganisms in the first place.

Keywords: tundra ecosystems, soil organic matter, storage C, post-fire development

Acknowledgments: This study was supported by grant MK-207.2019.5.

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UAS-bared near infrared imagery as a new fire severity metric

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Abstract

Ash and char are known as broad indicators for evaluating the impacts of fire on nutrient cycling and ecosystem recovery. Numerous studies suggested assessing fire severity by changes in ash characteristics. Traditional methods for fire severity are based on in situ observations which are time-consuming and subjective. These measures are mostly reflecting the level of consumption of organic layers, the deposition of ash, particularly its depth and colour, and fire-induced changes in the soil. Recent studies on fire severity suggested using remote sensing combined with field observations via machine learning and spectral induces approaches to obtain applicable tools for assessing the fire effects on ecosystems. While index thresholding can be easily implemented, its effectiveness over large areas is limited pattern coverage of forest type and fire regimes. The machine learning algorithms allow multivariate classifications, but in the case of space-time series, it becomes complex. Therefore, there is no complete agreement on a quantitative index that determines the severity metric. This study indicates that there is potential for low-cost multispectral imagery across visible and near-infrared regions collected by the unmanned aerial systems to determine fire severity according to the colour and chemical properties of vegetation ash. The use of multispectral imagery data might reduce impreciseness caused by manual colour matching and produce a vast and accurate spatial-temporal severity map. The suggested severity map is based on spectral information used to evaluate chemical changes in fuels by deep learning algorithms. These methods quantify losses of carbon and assessing the corresponding fire intensity that is required to form a particular residue. By designing three different learning algorithms (PLS-DA, ANN, and 1-D CNN) for two datasets (RGB images and Munsell colour versus UAS-based multispectral imagery) the multispectral prediction results show an excellent performance (optimal correction coefficient $R2 > 0.95$ for 1-D CNN), which, therefore, shows that the deep network-based near-infrared remote sensing technology has a future potential to become an alternative and reliable fire severity monitoring method.

Keywords: Vegetation ash, severity, near infrared spectra, UAS, remote sensing, machine learning

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Dynamics of topsoil properties after a fire: small scale straw burning experiment

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Abstract

A burning experiment on a grassland was made to observe the impact of a short fire on soil hydraulic properties and composition of emergent vegetation. The three years old grass was established on a former arable soil, on an experimental site Risuty, Czech Republic. The burning experiment was performed on a 5 x 5 m large plot, another plot was kept intact and monitored as a reference state. Risuty experimental site is equipped with a meteorological station and two sets of sensors monitoring the soil temperature and soil water content (depth from 10 cm to 45 cm installed under a reference grassed plot and the burned plot). The soil is classified as Cambisol, with loamy texture and no repellency. The grass was cut, sun dried, raked together and burned. The fire had a temperature above 650 °C and duration of approximately 10 minutes. Immediately after the fire and later in approximately weekly time steps the soil samples were collected to measure depth dependent soil properties such as organic carbon content, soil structure stability, hydraulic conductivity, soil bulk density and soil texture. Soil water and temperature regime, surface runoff, soil loss and vegetation cover were monitored in situ. The contribution will present the preliminary results of the after fire monitoring.

Keywords: Fire, Soil properties, Soil water regime, Emerging vegetation, Grassland

Acknowledgments: The experimental work has been performed within a framework of project LTC20001.

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Application of Geostatistical Analysis with R Machine Learning Methodologies for Soil Organic Carbon Mapping

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Abstract

The emergence of new data processing and analysis techniques makes it possible to review and re-evaluate databases from previous projects and field campaigns. Historical data allows to know the evolution of the physical and chemical characteristics of the soil, as well as, for example, its affection after a wildfire. These techniques are being accepted and applied by the international scientific community. We are talking about Digital Soil Mapping (Malone et al., 2017) and, in our case, Soil Organic Carbon Mapping (FAO, 2018), by considering SOC as an indicator of changes in biological activity and soil productivity. Study area was the Chelva Forest Demarcation (except for the part of the Rincón de Ademuz). The methodology applied was based on the SCORPAN model (Soils, Climate, Organisms, Parent material, Age and (N) space or spatial position (Bratney et al., 2003)) as a reference framework. R and Qgis software were used for the geostatistical treatment of the data. Historical field data was converted into readable format by the software and was combined with covariates from the same period of the soil samples: digital terrain model, 20-year period mean temperature, 20-year period mean precipitation, NDVI, land use, soil type, lithology and the 7 bands of a Landsat image. The SOC mapping methods applied were Regression-Kriging (RK) and Random-Forest (RF). It has proven to be efficient for mapping soil properties across a wide range of data scenarios and scales of soil variability. This methodology allowed the mapping of SOC in the study area, which allowed to estimate SOC variations in wildfires, as well as the analysis of their impact on climate change scenarios.

Keywords: Soil organic Carbon, mapping, regression kriging, random forest

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Wildfire effects on different soil organic carbon pools in Mediterranean pine forests

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Abstract

Pine forests in the Valencian Community are often affected by severe wildfires, which can induce changes in soil organic carbon (SOC). These changes are a mainly consequence of (Certini *et al*., 2011): (1) the input of ashes and charred materials from the scorched vegetation; and (2) the removal of litter layer and some organic matter from the upper few centimeters of soil affected by high temperatures. Net fire-induced gain or loss of SOC results from the dominance of one of these processes. The Forest Chelva Demarcation suffered a huge wildfire in 2012 (Andilla fire) where 20945 ha were burned. In the REMAS project, a methodology to quantify C stock in forested areas is proposed to assess the impact of forest fires and, subsequently in the next immediate future, the application of some management practices over the burned area. In this work, sampling by volume the soil (at two depths: 0-5 cm and 5-30 cm) in both unburned and burned areas (N= 132) of *Pinus halepensis Mill* forest was carried out to assess the intensity of the fire-induced changes on different C stocks (from the more labile C organic forms to the total SOC). The results showed that there were important differences in bulk density, hot water extractable C, particulate organic carbon (POC), mineral associated organic carbon (MOC), easily oxidisable C, total organic C considering both sampling depths and the two fire scenario (burned or unburned).

Keywords: soil, bulk density, labile C forms, stock of C, Mediterranean

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Laboratory Study of Smouldering Peat with Samples from Peatlands in Flow Country, Scotland

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Abstract

Northern peatlands store approximately one-third of global terrestrial carbon and are important to maintain the global carbon cycle. As a consequence of ongoing climate change, northern peatlands are becoming more vulnerable to fires in terms of frequency and severity due to drier soil and increasing global atmospheric temperature. Smouldering is the dominant mechanism of these megafires in peatlands, but poorly studied in the literature. Scotland holds the majority of peatlands in the UK, and the blanket bog peat in Flow Country has been estimated to be the largest single expanse in Europe. In May 2019, a wildfire in Flow country burned around 53.8 km^2 of peatland, causing damage to the natural soil ecosystems and deteriorating regional air quality. Six months after the fire event, we conducted a field study in burnt areas, and collected peat samples in adjacent unaffected peatlands. Samples were taken from peatlands with three different field conditions: pristine, drained, and restored peatlands, and based on the depth of burn in the peat fire, each site in three depth ranges: shallow (0 - 10 cm), median (10 – 20 cm), and deep (20 – 30 cm). Characterisations of physical and chemical properties of each sub-sample were conducted in the lab. Samples naturally dried to 100% moisture content in dry basis were ignited in an open-top reactor (internal dimension 20×20×10 cm) under controlled laboratory conditions, measuring real-time mass loss, soil temperature profile, visual and infrared signature, transient concentrations of 20 gas emission species, and mass of size-fractioned particle emissions (PM10, PM2.5 and PM1). These measurements allow quantification of the smouldering propagation dynamics, fire severity, and emissions. The results show that drained peatland experiences the highest carbon loss and longest thermal residence time above 300 ℃, indicating higher severity and worse soil sterilization. Pristine peatland experienced lower carbon loss compared to drained and restored peatlands, but showed higher smouldering fire spread rate. The averaged emission factor of particles in the combustion of drained and restored peat was nearly twice as high as that of pristine peat. Samples from drained peatland had slightly lower averaged emission factors of CO_2 and CO and higher averaged emission factor of CH_4 compared to pristine and restored peat. This work contributes to linking lab-scale and field-scale fire dynamics and emission investigations, estimating fire severity and environmental impact, and developing

strategies to mitigate peatland fires.

Keywords: Wildfire, Peatland, Emission, Carbon Loss, Smouldering Dynamics, Fire Severity

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Soil water infiltration in the Pinet forest fire. The ephemeral impact of ash.

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Abstract

Wildfires are recurrent in Mediterranean-Type Ecosystems. Post-fire infiltration behaviour is a key factor that determines the fate of the ecosystem. Infiltration determines the soil recovery after fire, and the water available for plant development. The Pinet forest fire study site was selected to determine the impact of the surface ash layer on soil infiltration immediately after fire by means of mini-disk infiltrometer tests. Sampling and measurements were carried out in September 2018 after the forest fire in August 2018. Twenty plots were selected in a slope transect (12 % slope angle) every 10 meters. In each plot, measurement was carried out on the ash bed, and then, in the vicinity, the ash was removed until the mineral soil was exposed and the measurement was also carried out. Then 20 paired plots were established along the slope 40 mini-disk infiltrometer measurements were carried out. The results show higher infiltration rates on the ash-covered soils. Moreover, the infiltration envelopes show an increase in the infiltration rates in the plots without ash.

Keywords: Soil, Water, Infiltration, mini-disk infiltrometer, Mediterranean

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Fire legacy on dissolved organic matter (DOM) and soil properties along a fire severity gradient in two Eucalyptus ecosystems in South Western Australia

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Abstract

Fire is a major disturbance to forest soil carbon (C) and nutrient cycling due to both direct and indirect impacts on physical, chemical and biological processes. The soluble organic matter fraction - dissolved organic matter (DOM) - is likely to be a sensitive indicator of biogeochemical transformations in soils after fire. However, while DOM is generally considered the most active fraction of soil organic matter, its composition is highly variable and remains largely undescribed. In this study, we investigated changes in soil properties and differences in chemical properties of water extractable organic matter of soils from two fire prone ecosystems; Jarrah (Eucalyptus marginata) and Karri (Eucalyptus diversicolor) in a fire severity gradient, five years post fire in South Western Australia. We used fluorescence excitation-emission matrix and parallel factor analysis (EEM-PARAFAC) to characterise soil DOM (0-5 cm and 5-10 cm) from unburnt, low burnt and high severity burnt plots. Our results were distributed differently between forest types and fire severities. E2/E3 ratio and HIX values, which serve as indicators of molecular weight and humification of DOM, were higher in burnt samples of Karri forest, but not in Jarrah forest. Also, soil isotopes signatures 13C and 15N and total Carbon and Nitrogen soil content showed significant differences between fire severities.

Keywords: Dissolved organic matter (DOM), fire severity, Karri forest, Jarrah forest

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Application of vis-NIR spectroscopy for estimation of SOC and SOC fractions on soil samples burned under different laboratory conditions

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Abstract

Fire is one of the principal disturbances acting on forest soil organic carbon (SOC) (Nave et al., 2011). Fire affects both quantity and quality of SOC, with consequences depending on many fire characteristics such as duration or intensity. The impact on the SOC pools (i.e. labile, intermediate and recalcitrant pool) is also different, providing a complete vision of the real impact of fire on soils (Knicker, 2007). Laboratory analysis for the quantification of SOC and its fractions are complex and time-consuming. Alternatively, diffuse reflectance spectroscopy (DRS) has widely demonstrated its potential to estimate SOC with great accuracy in a time- and cost-effective way (Bellon-Maurel and McBratney, 2011). In this study we apply spectroscopic techniques in the vis-NIR spectral range to develop chemometric models (PLSR- partial least square regression) to estimate the oxidisable C and the three C pools. Surface (0-1 cm) and sub-surface (1-3 cm) samples (n=50) from soil monoliths burned under laboratory conditions at four levels of temperature and residence time, simulating different fire severity levels, were used. We also tested the performance of different spectral pre-treatments (i.e. derivative, absorbance transformation and normalization) for the development of the regression models. Results show the great capabilities of this technique, providing good estimates of oxidisable C and recalcitrant pool ($R^2CV \sim 0.70$) and moderate results for the intermediate pool ($R^2CV \sim 0.50$). The analysis of regression coefficients has also allowed the identification of spectral intervals for the prediction of SOC pools.

Keywords: soil carbon pools, spectroscopy, chemometric modeling

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Fire effects on soil biota

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The multiple and diversified effects of fires act on heterogeneous environments, often inducing unpredictable responses. In Mediterranean regions, both natural and human-caused fires play fundamental roles in shaping terrestrial ecosystems, also according to different plant covers. After fires, changes in soil abiotic properties (i.e., pH, water content, organic matter amount and quality, nutrient availability) strongly affect the abundance, diversity and activity of soil communities. Sometimes, changes in soil communities can be irrelevant in the short-term; whereas, they can become noticeable in the long-term also due to the aboveground and vegetation changes. Therefore, generally, deep modification in soil abiotic properties as well as in structure and functionality of communities can be expected affecting several ecosystem services, such as decomposition rate, nutrient cycles, C and N. As the lack of univocal responses of soil system to fires, implementation of the current knowledge, especially in the Mediterranean area where fires are frequent and severe, is a big challenge.

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Resistance and resilience of bacterial communities against large wildfires in heathlands ecosystems

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Abstract

Communities of bacteria present in soil play a critical role in regulating biogeochemical cycles of soil. They are fundamental in ecosystem recovery after any type of disturbance, included wildfires. These communities have traditionally been evaluated by indirect measures, such as carbon or microbial enzyme activities. However, at present the metagenomic techniques allow us to develop studies of the bacterial community directly. In this research, DNA was extracted from the soil of burned heathlands with different fire severities (Low and High) and two moments in time (one month after a large wildfire that occurred in 2017 and two years later, in 2019). It was also extracted DNA from soils of unburned heathland in the proximity of the wildfire (Control). The bacterial communities of 39 soil samples have been characterized by the amplification of the coding regions for zones V3 and V4 of the 16S rRNA. Then we have analyzed resistance and resilience of bacterial communities in low and high fire severities. Bacterial communities are resilient for most of the parameters used to characterize alpha-diversity (richness, diversity and dominance). Only the richness of the communities affected by a high fire severity has not recovered. Recovery can be considered complete for communities affected by low fire severity, but not in those affected by high fire severity. In the context of the beta-diversity analysis using the Bray-Curtis index, we can consider the communities affected by low fire severity as resilient but not those affected by high fire severity. At the phylogenetic level, analyzed using Weighted UniFrac, we found differences in the two axes for both severities, which have disappeared two years after the fire. An analysis of the resistance for each of the 7676 OTUs shows different behaviours in the two levels of severity evaluated. At both of them, we observed a decrease in abundance and its recovery two years after the fire. From the evaluation of the phyla present in the community, it can be deduced that there is a high resilience against the two levels of severity. Since despite presenting a lower resistance to high fire severity, greater recovery of abundance is observed in this case.

Keywords: Wildfire severity, Soil bacterial community composition, Diversity, Resistance, Resilience

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Alteration of soil properties by high intensity controlled burning in southern Spain

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Abstract

In the last few years, the use of fire to manage forest ecosystems has become more frequent in Europe. Fire has a great impact on the soil and therefore it is necessary to know how controlled burns affect this non-renewable resource, essential for life in forest ecosystems. This study assesses the alterations in the physic-chemical and biological indicators of the soil after a high-intensity controlled burn. A grid of 12 points, representative of 1.4 ha, was established on a hillside in Sierra Morena (Córdoba), with soil developed on sandstones, slates and lithostones. At each point, thermal sensors were placed, and soil samples were collected at two depths (0 - 2 and 2 - 5 cm), before burning, immediately after burning and eight months later (recovery). Soil pH, electrical conductivity, magnetic susceptibility, colour, nutrient content and / or availability and their spatial and time variations were analysed. Soil pH, the main driver for soil microorganisms, was substantially increased in the first centimetres of the soil (0 - 2 cm) immediately after burning up to > 2 units, and the increase was maintained one year after the burn. This may be of interest for forest management (plant species selection) and disease control and prevention. In addition, the high-intensity burn had a positive short-term effect on some of the soil properties, such as nutrient availability for plants, which was considerably increased. Available P increased in more than 30 mg kg^{-1} after the burn in the uppermost 2 cm of soil, and one year after the burn the amount of available P was still higher than before the burn. The magnitude of the alterations in soil indicators was spatially explained by the behaviour of the fire during the controlled burning. The burn also affected soil microorganisms so the intensity of the fire as well as the alterations on soil properties determined their behaviour. In conclusion, the possible immediate and short to medium term effects of burning on soil should be considered for a more holistic management of fire in forest ecosystems, as its functionality and capacity to provide ecosystem services is largely altered by these events as a function of their intensity.

Keywords: Prescribed fire, forest management , mycorrhiza , soil functionality

Acknowledgments: This study was funded by the European INTERREG-POCTEP project \\\\\\\\\\\\\\\"Centro Ibérico para la Investigación y Lucha contra Incendios Forestales\\\\\\\\\\\\\\\" (0753_CILIFO_5_E). We are also grateful for funding from the Ministry of Science and Innovation, through the State Research Agency, through its María de Maeztu programme for Units of

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The effect of different fire temperatures on the water repellency parameters of forest soil under different types of vegetation

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Abstract

Soil under specific tree forest species (e.g. pines) can be water repellent. Fire can create, strengthen or destroy soil water repellency (SWR). SWR is considered important to post-fire hydrology. The three study sites were located in the Borská nížina lowland (southwestern Slovakia). The first site SP1 was under a coniferous 100-year-old stand of Scots pine (*Pinus sylvestris*), the second site SP2 was in a 30-year-old stand of Scots pine (*Pinus sylvestris*) and the third site A1 under the deciduous stand with a predominance of alder (*Alnus glutinosa*). The disturbed mineral soil samples were taken from 2.5 - 5.0 cm depth of soil horizon. The organic horizon (0 - 2.5 cm) was sampled separately before mineral soil. In the laboratory, the mineral soil was sieved through a 2 mm sieve. After drying at 40 °C, the samples from each site in 5 replicates were placed into a muffle furnace and exposed to a temperature from 50 to 900°C for 20 minutes. The persistence of water repellency in soil samples was measured using the water drop penetration time (WDPT) test. The mean value of WDPT at SP1, measured after we dried the samples at 40 °C was 15 480 s (extremely water repellent class of WDPT); at SP2 it was 958 s (severely water repellent) and at A1 it was 146 s (strongly water repellent). Consequently, the SWR at SP1 raised slightly with the increasing heating temperature and it reached the highest value of WDPT at a temperature of 100 °C. After reaching its maximum, it dropped slightly at 350 °C and completely disappeared at 375 °C. At SP2, the SWR was decreasing to a value measured at temperature of 200 °C. At a temperature of 250 °C the SWR increased significantly and reached the maximum. The SWR disappeared at a temperature of 350 °C. At A1 the SWR after initial drying of the soil was lower than after heating in the furnace. From a temperature of 250 °C, the SWR increased significantly up to a temperature of 350 °C, when the maximum was reached. Subsequently, the SWR disappeared at 375 °C.

Keywords: soil water repellency, soil heating, water drop penetration time, forests

Acknowledgments: This contribution was supported by the Scientific Grant Agency VEGA Project No. 2/0150/20.

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Soil prokaryote community structure and C and N related biological conditions following fires in Mediterranean native forest of central Chile

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Abstract

Fires are important drivers of ecological processes in forest ecosystems. However, these events also represent an important pressure that induce land degradation worldwide, especially in regions with Mediterranean climates with dry summers and elevated temperatures. In Chile, these events have drastically raised over the last decades, and while most of the fires registered in the country are of anthropogenic origins (accidental or intentional), changes in local climatic conditions are also related to the occurrence of these events. Under this scenario, fire behavior in Chile is expected to endanger the resilience of forest ecosystems. Thus, understanding how soil biological and physicochemical conditions behave after fires is of central importance to elucidate ecosystem restoration under conditions where natural recovery is hampered. This study aimed to evaluate prokaryotic community structure and C and N related biological soil conditions of soils from fire-affected sclerophyll forests in the Mediterranean climate zone of central Chile. Molecular analyses based on 16S rRNA coding genes revealed the presence of 22 classified bacterial phyla and 2 archaeal phyla. Out of these Actinobacteria and Firmicutes phyla abundance significantly decrease in burned soils, while Acidobacteria and Rokubacteria increased significantly in fire affected soils. Among Archaea, the phylum Thaumarchaeota evidenced an increase in burned soils. Molecular analyses and culture-based techniques focusing on diazotrophic microorganisms evidenced a decrease of N fixing microorganisms following fires, with differences in relative abundances of Clostridiales, Rhizobiales, Bacillales, Fibrobacterales and Nostocales orders. Multivariate analyses showed dissimilarity of prokaryote communities according to fire occurrence, which was associated mainly with changes in soil nitrate contents. Carbon source utilization patterns of soil microbial communities assessed using Biolog EcoPlates™ (Biolog Inc., Hayward, CA, USA) reflected a decrease of C substrate utilization for recalcitrant substrates and a high L-Asparagine consumption in all soils studied, particularly in burned soils. These findings will allow to better understand microbial states over ecological succession following fires and potential resilience of prokaryote communities and diazotrophic populations at fire-prone ecosystems of central Chile.

Keywords: community-level physiological profiles, illumine sequencing, N-fixing bacteria, sclerophyll forest, wildfires.

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Fire history modulate soil biogeochemistry and microbial community in Pinus pinaster forests of central Spain

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Abstract

Mediterranean ecosystems are considered to be resilient to fire. However, changes in the fire regime (frequency, severity, etc.) may compromise the stability of these ecosystems. It is expected that, in the future, as a consequence of changes in land use and climate, fire frequency might increase. Fire is an important regulator of soil C and N accumulation and losses. However, very few studies have evaluated the effect of fire in the long term under increased fire frequency. Here, we determined the effect of the fire history (fire frequency, time since the last fire and fire return interval) on soil C and N dynamics and the main microbial groups in *Pinus pinaster* forest in central Spain. The study area is located in the southern face of the Sierra de Gredos, in central Iberian Peninsula. 28 stands were chosen differing in the number of fires (0, 1, 2 and 3) occurred between 1976 and 2018, in the time elapsed since the last fire and the interval undergone between the last two consecutive fires. Soil C and N fractions (total, organic, microbial and easily extractable) as well as their mineralization rates (i.e. heterotrophic respiration, nitrification and N mineralization rates) were analyzed. Additionally, the microbial community of these soils was characterized by analysis of fatty acid profiles (esther linked fatty acids, ELFAs). We found that, in general, most of the studied biogeochemical and microbial variables showed clear differences between unburned and burned stands. Increased wildfire frequency only modified total C and nitrification rate. The time interval between the two most recent consecutive fires was generally not a significant variable. The time elapsed since the last fire was the most important fire history variable and governed the main soil dynamics. Recovery of pre-fire values of the studied variables took about 30-40 years after fire. The fact that some stands burnt up to thrice in a period of 43 years, and that palaeoecological records hint at fire return intervals of more than a century for native *Pinus pinaster* forests, support the strong resilience of these soils to increased fire frequency. Our work supports arguing that the management of this ecosystem should concentrate on prioritizing areas based on the time since the last fire, focusing on preventing fires in stands below 40 years since the last time, to ensure the stability of this system.

Keywords: Fire recurrence, fire return interval, soil C, soil N, microbial community structure

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Effects of different fire severity on soil biogeochemistry and related feedbacks on Quercus ilex L. ecophysiological status

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Abstract

Fire is a key factor in the composition and structure of Mediterranean ecosystems that modulate vegetation patterns through direct and indirect effects on below- and above-ground components. Although forest fires are a common disturbance, little is known about how fire severity affects soil fertility under certain plant species. This is an important issue given the increase in the severity of wildfires observed in regions such as the Mediterranean, possibly linked to land abandonment and climate change. The present study evaluates the short-term effect of fire severity on the biogeochemical properties of the soil beneath *Quercus ilex* L., a dominant tree in Mediterranean landscapes, and their relationship with the ecophysiological response of this species. To achieve this, soils were sampled under the cover of 30 *Q. ilex* and in 10 open interspaces, considering different levels of fire severity (high, low and unburned), immediately and 5 and 12 months after a fire that took place in Toledo (Spain) in 2019. Soil organic matter, CEC, pH, water repellence, ammonium, nitrate and rates of respiration, nitrification and mineralization of N were measured. Likewise, the ecophysiological status of the holm oaks (water stress, gas exchange and growth rates) were measured in tree resprouts. The results showed that, immediately after fire, soil fertility was significantly affected by the fire severity, but in a different way depending on the microsite. Thus, soils under *Q. ilex* cover burned with high severity suffered the higher changes (mainly related to N cycle and soil respiration), while soils properties of the interspaces hardly changed. This short-term effect of the wildfire disappeared in most of the soil study variables one year after fire. However, soil respiration rate or organic matter content did not recover during this time, especially at microsites under plant cover affected by high fire severity. One year after fire, the burned *Q. ilex* with high severity showed lower water stress and higher gas exchange and growth rates than those of low severity or unburned. The results corroborate the post-fire resilience of below- and above-ground components of this ecosystem, under high severity scenarios. However, there are non-recovered variables that should be monitored in the longer term. Thus, this study provides evidence that future alterations in the fire regime associated with an increase in fire severity could interact with different plant canopy microsites in Mediterranean ecosystems to change certain soil properties and plant functionality.

Keywords: Fire severity, soil fertility, plant ecophysiology, soil spatial heterogeneity

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Vegetation cover and physiognomy effects on C and N in frequently burnt and unburnt soils in an African savanna

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Abstract

Fires are a common phenomenon which affects many terrestrial ecosystems. It drives ecosystem composition and structure, rendering numerous ecosystems dependent on fires for maintaining their health and functioning. Although an important process, fires are found to lead to substantial impacts on soil nutrients around the world. However, disentangling the direct effect of fires on soil nutrients versus the indirect effect via fire-induced changes in vegetation, is not often considered. Previous studies focused only under tree canopies and open areas, thus neglecting the role of shrubs (a dominant landscape vegetation type) in nutrient dynamics in burnt and unburnt sites. Therefore, we used a long-term fire experiment in a large African savanna park to investigate the effect of fire on soil total carbon (C) and nitrogen (N) under trees, open areas as well as shrubs. Soil samples (0 - 5 cm) were collected from soils burnt annually and soils which have remained unburnt for >65 years. Our results suggest that tree and shrub canopies enrich soil C and N compared to open grassy areas. In unburnt soils, mean total N under tree and shrub canopies are up to five times the concentrations of N in soils in open areas (0.07%, 0.05% and 0.015%, respectively). However, annual fires appear to homogenize N concentrations across the burned plot regardless of the vegetation type. Although not statistically significant ($p>0.05$), in unburnt areas, mean soil C concentrations in open grassy areas are lower compared to C concentrations below tree canopies. Even when burnt, soils below trees and shrubs still maintain higher concentrations of C. Elevated soil C and N under trees and shrubs could be due to leaf fall and decomposition below canopies, herbivores congregating below trees depositing faeces and urine, and a pull-effect by tree and shrub roots pulling nutrients closer towards the canopy. These results are important if one considers the broader ecological impact of bush thickening and fire exclusion on the enrichment of soil C and N, with cascading effects on other ecological processes and dynamics.

Keywords: experimental fires, soil nutrients, vegetation structure

Climate-fire links

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A substantial amount of research efforts has significantly boosted our knowledge of the links between climate and fire in the Mediterranean region. Many studies have focused on specific regions or events, while others have analysed the fire drivers using several fire-related climate metrics and expected modifications under climate change over a broad range of spatial and temporal scales. There are also some examples of studies on fire predictability at seasonal scale. Despite the considerable effort to better understand the climate-driven changes on fires, this task is still representing a research challenge owing to the complexity of the processes involved, limitations in observational data and concurrence and compounding effects of multiple drivers. This session aims to improve the understanding of the interactions between fire and climate bringing together researchers working on this issue. The session will focus on studies that help to improve our understanding of the importance of climate impacts on fire across different spatial and temporal scales. We invite contributions developing or using remote sensing datasets, in situ observations, and modeling approaches.

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Future Climate Change Impact on Wildfire Danger over the Mediterranean: the case of Greece

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Abstract

Recent studies have shown that temperature and precipitation in the Mediterranean are expected to change, indicating longer and more intense summer droughts that even extend out of season. In connection to this, the frequency of forest fire occurrence and intensity will likely increase. In the present study, the changes in future fire danger conditions are assessed for the different regions of Greece using the Canadian Fire Weather Index (FWI). Gridded future climate output as estimated from six regional climate models from the Coordinated Regional Downscaling Experiment (CORDEX) are utilized. We use three Representative Concentration Pathways (RCPs), consisting of an optimistic emissions scenario where emissions peak and decline beyond 2020 (RCP2.6), a mid-of-the-road scenario (RCP4.5) and a pessimistic scenario, in terms of mitigation, where emissions continue to rise throughout the century (RCP8.5). The FWI projections were assessed for two future time periods, 2021-2050 and 2071-2100, comparing to a reference time period in the recent past 1971-2000. Based on established critical fire risk threshold values for Greece, the future change in days with critical fire risk were calculated for different Greek domains. The results show that future fire danger is expected to progressively increase in the future, especially in the high-end climate change scenario, with southern and eastern regions of Greece exhibiting increases in the FWI that exceed 20 FWI units, on average. Furthermore, southern Crete, the Aegean Islands, the Attica region, as well as parts of eastern and southern Peloponnese are predicted to experience a larger increase in the fire danger, with an additional 12-17 potential fire days in the distant future (2070-2100) when compared to the reference period, under the RCP8.5 scenario.

Keywords: Fire danger, fire weather index, Euro-CORDEX, wildfires

Acknowledgments: This project is supported by the project/program \"National Network on Climate Change and its Impacts - Climpact\" financed by the Public Investment Program of Greece and based on the results from FWI simulations provided by Copernicus Climate Change Service. Also, this research was partially funded by the Leverhulme Centre for Wildfires, Environment, and

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Predicting the extension of the area burnt by forest fires in Italy by means of drought indicators

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Abstract

Wildfires are a serious concern for Italy, where large extensions of woods are burned every year. Although the large majority of fires has a human origin, the total burned area shows a clear dependency on weather and climate conditions. Here we statistically analyse the burned area data and explore their relationships with respect to indicators of meteorological drought, namely the Standardized Precipitation Index and the Standardized Precipitation Evapotranspiration Index, based on precipitation and temperature during summer. We show that precipitation alone can be used to build an empirical, data-driven model for burned area and used for reliable predictions on a large portion of the country. Including temperature, on the other hand, allows for a better performance of the prediction model in the southern regions. This illustrates the different relevance of the individual drivers depending on the regional climatic and ecosystem characteristics.

Keywords: Drought indicators, empirical models, prediction

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Climate Drivers of Fire Activity: a Global Assessment

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Abstract

A better understanding of the links between climate and fires in a context of global changes is still a scientific challenge. This is due to the complexity of the processes involved, the limitation of observational data and the compound effect of multiple drivers. In particular, it is still not clear enough the relative importance of the direct effect of climate change in regulating fuel moisture (e.g. warmer conditions increasing fuel dryness) and the indirect effects on fuel structure (e.g. drier conditions limiting fuel amount). Here we analyze and model the impact of coincident and antecedent climate conditions on the Burned Area (BA) across the whole global burnable area. We show a statistically significant relationship between fire activity and same-fire season fire weather index, especially over climatologically wet regions, while antecedent wet conditions play a major role over dry regions. The developed model allows a better understanding of the relationships between climate and fires, and appears to be promising for developing a seasonal forecast system that can be a very useful tool in decision-making (Turco et al., 2018).

Keywords: climate drivers, fire activity

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Climate drivers of wildfire activity in the Mediterranean

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Abstract

Observed trends towards drier and warmer climate in the Mediterranean region are projected to continue due to accelerated climate change, leading to increased fire risk. Wildfires are an integral part of Mediterranean ecosystems. Yet due to the dense population and the extent of wildland-urban interface areas, fires usually have a direct financial cost when it comes to their suppression, property and infrastructures damages, crops and livestock losses. Even more importantly, wildfires in the Mediterranean can cause human losses, injuries, and health implications from associated air quality degradation, which highlights the significance of further research on the field. Climate drivers of wildfire danger are often accounted for by using a single index. The Canadian Fire Weather Index (FWI) is probably the most extensively used fire danger index of this kind. The FWI makes use of temperature, relative humidity, wind speed at noon, as well as daily rainfall, to estimate moisture in three layers of the forest floor, and to subsequently estimate a fire danger rating. Here, we investigate how good a predictor of burned area (BA) is the FWI for the Mediterranean region. We calculate correlation coefficients between the FWI calculated using meteorological reanalysis data and the MODIS observed burned area (BA), using monthly mean data for the 2001-2015 period. Results show that the BA in non-forested types of vegetation highly correlates with the FWI, while for forests correlations are weaker. The analysis is repeated for the different climate drivers that influence the FWI to detect potentially significant correlations.

Keywords: fire weather index, burned area,

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Seasonal variations of electrical signals of Pinus halepensis Mill. in Mediterranean forests in dependence on climatic conditions

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Abstract

Electric potential differences in living plants are explained by theories based on sap flow (Fromm et al., 2007) and it could be associated with changes in water tension or ion concentrations (Oyarce et al., 2010). In order to acquire more advanced knowledge about these electric potential measures in trees, this research aims to analyse electrical signals in a population of Aleppo pines (*Pinus halepensis* Mill.) in a representative Mediterranean forest ecosystem. Carried out during a long-term campaign experiments lasting over a year, while trials with a high frequency of measurements were also performed during several days. After a statistical evaluation of the obtained results, the main conclusions of our researches are: -Tree maturity influences directly on electric potential (Zapata et al., 2020). -The distribution patterns of both voltage and short-circuit current depending on electrode placement are uniform (Zapata et al., 2020). -Day-night oscillations of the electrical magnitudes were observed. Additionally, punctual meteorological events such as rainfall and electrical storms affect the electrical signal as well (Zapata et al., 2021) . -The measured electrical intensity grows exponentially with the voltage. In fact, no electrical intensity that exceeds the threshold of 0.01 µA is gathered when voltage values are lower than 0.6 V. In general, higher electrical signals were gathered during the rainy seasons with moderate temperatures; while very low signals, including few measures of zero intensity, were obtained during the most stressful periods over the year, mainly by mid-summer (Zapata et al., 2021). These observations of the electrical signal in *Pinus halepensis*, together with sustained intensity values during the reproductive period in spring, suggests that this electrical magnitude is an indicator of the physiological state of the tree and thus be used for in situ and minimally invasive forest monitoring. Therefore, the measurement of both components of the electrical signal of trees seem to be potential estimators of the health, biological activity and moisture content of the tree and consequently bushfire risk.

Keywords: bushfire risk, plant electrophysiology, Pinus halepensis, Mediterranean forests, seasonal variation, climatic conditions

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Fires at the Wildland-Urban-Interface

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Forest fires in Europe increasingly affect populated areas, presenting a serious challenge for civil protection and intervention bodies. The population in these wildland-urban interface (WUI) areas is exposed to hazardous components, such as smoke and flame fronts, as well as homes and other facilities. The WUI fire problem is inherently complex, as it is characterized by the interaction of multiple phenomena of diverse nature occurring at different observation scales: the landscape scale, the community scale and the property scale. All three are interrelated and allow to rationalize and identify all WUI fire management aspects. The landscape is associated with large forestry and operational management strategies (e.g. landscape design, fuel reduction planning, management of strategic points for suppression, etc.); the community scale corresponds to the level where preventive and protective measures to keep settlements safe have to be planned and implemented (e.g. fuel reduced strips around communities, water supply points, etc.); and finally, the property scale is associated with preventive actions at the immediate surroundings of houses to guarantee structure integrity, create self-defensible spaces and increase safety in eventual shelter-in-place operations. In this session recent advances and innovative projects on WUI fire risk and vulnerability management (focused both on assets and population) will be presented and discussed.

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Integrated Wildland-Urban Interface Fire Management: the case study of Riba-Roja de Túria and Paterna municipalities

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Abstract

Europe is being placed in a new context of forest fires, mainly due to climate change, with an increasing risk of extreme events with fatal consequences in the wildland-urban interface (WUI) (European Commission, 2018). Over the past few years, wildfires with unprecedented intensity and destructive potential have raged across Mediterranean countries as well as new fire-prone northern regions (Vacca et al, 2020) killing people, destroying housing areas, severely affecting economic activity and impacting ecosystems. Areas at wildfire risk are expected to increase by 200% by the end of the 21st century in Europe. Furthermore, the development of urban areas in the vicinity of forests, together with a general lack of risk awareness among population will increase the exposure and vulnerability of local communities (European Commision, 2020) posing tremendous management challenges in terms of firefighting and civil protection. It has already been acknowledged (UNDRR, 2015; ESTAG, 2020) that this new paradigm requires holistic fire management strategies which go far beyond the classical approach of favouring fire suppression over other actions. The concept of integrated fire management (IFM) thus provides a very useful framework including the consideration of various socioeconomic and environmental aspects associated with fire management in its complete circle: prevention, preparedness, response, impact and restoration. The GUARDIAN project proposes an innovative integrated fire management strategy to increase fire resilience in the communities of Riba-Roja and Paterna (Spain). GUARDIAN's success lies in i) ensuring high performance of green firebreaks in WUI perimeter; ii) the use of reclaimed water for preventive irrigation, pre-suppression and direct attack with ad-hoc designed and installed infrastructure; iii) a participatory and co-implementation approach with all stakeholders; iv) a program of communication and risk awareness raising addressed to population and v) an improvement of ecosystems' quality in local natural areas. In this communication, the technical solutions developed in GUARDIAN are presented and the main implementation challenges for the subsequent upscaling to other municipalities

with fire-vulnerable urban-forest interface areas are discussed.

Keywords: fire resilience, regenerated water, circular economy, green firebreaks, GUARDIAN project

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Evaluation and prognosis of resilient landscapes to wildfires. The urban-rural interfaces of the Metropolitan Area of Concepción as Socio Ecological Systems (SES).

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Abstract

Due to anthropogenic and global climatic pressures, landscapes are losing more and more elements that make them resilient to disturbances; however, what makes a landscape effectively resilient is currently not so well defined. Therefore, for this work, a resilient landscape will be understood as one that can preserve its various components (biogeophysical and/or human) by relying on lessons learned and the ability to self-organize after repeated disruptive events. The general objective is to evaluate the landscapes of urban-rural interface areas in the Metropolitan Area of Concepción (MCA) in Chile from the perspective of SES studies with the purpose of moving towards the construction of physical-human landscapes more resilient to fire. As methodologies, an analysis in consecutive stages is used: 1) reconstruction of the socio-ecological/environmental history and the disruptive event of the MCA through a literature review, field trips, and analysis of fire points of a decade (2007-2017) that seeks to identify the interface zones to be studied; 2) apply an online DELPHI-type questionnaire to experts to validate these areas and obtain elements that compose the SES; 3) analyze resilience and SES factors obtained from literature, field trips and DELPHI; 4) generate a set of resilience indicators; and 5) a prognosis using a qualitative multi-criteria analysis. In this congress, the first findings will be presented an evaluation of the state of the SES landscapes to obtain indicators of resilience to forest fires (stages 1-3).

Keywords: resilient landscapes, wildfires, urban-rural interfaces, Metropolitan Area of Concepción, Socio Ecological Systems (SES).

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A full-scale method to classify flammability of wildland-urban interface vegetation

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Abstract

Flammability is commonly defined in the context of forest fires as the ability of vegetation to ignite and burn, and depends on the interaction between several factors such as the vegetation structure, the presence of fine dead fuels or its fuel moisture content, among others. We can study the role of some of these factors—such as chemical composition or moisture content—at bench scale (e.g. by using devices such as calorimeters and epirradiators), but the effects of other factors—such as the proportion of living and dead fuels or its spatial distribution—can only be observed at larger scales. To account for all of them, we must study flammability at full scale, i.e. testing full individuals instead of small samples of selected particles (e.g. leaves, fine dead branches, etc.). In this communication, we present a method developed to compare and classify the flammability of ornamental vegetation at large scale so that to detect significant differences in burning ability and behaviour at the wildland-urban interface. To develop our method accounting for flammability variability, we burned isolated trees and groups of trees of different species and under different levels of water stress. We selected four species frequently used in the Mediterranean wildland-urban interface as hedgerows (Leyland cypress, Arizona cypress, Northern-white cedar and Cherry laurel) and subjected them to three different levels of water stress: some of the trees were watered while we kept the others unwatered for one and three months. We monitored different fire behaviour indicators (qualitative and quantitative) and selected mass loss depletion as key variable in our analysis. We built normalized Mass Loss Rate curves dividing the Mass Loss Rate values by the initial weight of the trees and modelled these as Gaussian bell curves (here named flammability bell curves). By comparing characteristic parameters of bell curves with qualitative burning behaviour (i.e. sustained ignition and flame coverage), we could clearly classify three flammability levels (low, medium and high flammability) in our tests. Although the method developed has to be implemented in fire labs equipped with particular weighting devices (e.g. load cells) it is rather simple and affordable and provides realistic results as it directly relates flammability with observable fire behaviour.

Keywords: mass loss rate, burning behaviour, hedgerows, residential fuels

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Performance-Based Design methodology for the evaluation of WUI microscale fire hazards

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Abstract

Performance-Based Design (PBD) is an engineering approach to fire protection design based on agreed upon fire safety goals and objectives, analysis of fire scenarios, and quantitative assessment of design alternatives against the goals and objectives using accepted engineering methodologies and performance criteria (Society of Fire Protection Engineers, 2007). At the Wildland-Urban Interface (WUI), regulatory bodies, research institutions and practitioners are starting to address its fire safety challenges with the aid of PBD methods. In the USA, for example, the National Fire Protection Agency (NFPA) has recommended considering a design fire scenario of an outside fire exposure for PBD projects involving WUI structures (National Fire Protection Association, 2018). The complexity of the different interactions that can occur between fire, structures and residents can be analysed through a PBD approach for both new and existing buildings located at the WUI. The many variables and scenarios can be analysed with the help of Computational Fluid Dynamics (CFD) tools such as FDS (Fire Dynamics Simulator (NIST, 2020)). Despite the inherent and unavoidable uncertainty of CFD, this modelling approach allows for great flexibility in the definition of different configurations, materials and fire loads, which is otherwise very difficult to achieve in experimental tests or in prescribed regulations (Vacca et al., 2020). A specific WUI microscale (i.e. homeowner scale) PBD methodology has been developed within the WUIVIEW project, funded by the Directorate General for European Civil Protection and Humanitarian Aid Operations (DG ECHO). This methodology has been successfully applied to different dwellings posing mainly structure survivability objectives. A WUI PBD guideline has been subsequently created (Vacca and Planas, 2021), which follows the classic PBD steps that consist of: (i) the identification of the scope, goals and objectives of the project; (ii) the selection of the performance criteria as threshold values for the quantification of the hazard; (iii) the design of fire scenarios; (iv) the development of trial designs; (v) the evaluation of these designs. In this paper, we show the steps of the guideline by applying it to the real case study of a WUI property located in the region of Madrid (Spain). Suggestions on the selection of design fire scenarios are presented, along with the description of the needed fire, environmental, and property/plot characteristics. Selected scenarios are modelled and analysed with FDS, and the obtained results, which highlight the property's weaknesses and vulnerabilities regarding residential fuels and structural elements, are shown.

Keywords: Wildland-Urban Interface, WUIVIEW project, fire safety engineering, residential fuels

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Thermogravimetric and Differential Thermal Analysis of Sea Buckthorn from The Netherlands Compared to Common US Shrubs in Fire-Prone Ecosystems

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Abstract

In recent years, wildfires have become more frequent in Northwestern Europe, including the Netherlands, prompting greater interest in hazardous fuels reduction. In February 2019, Wolf Fire Safety, a private Netherlands wildland fire safety contractor, conducted a prescribed burn on the island of Terschelling targeting hazardous fuels near coastal recreation areas and discovered that sea buckthorn (*Hippophae rhamnoides*) burns with great intensity. To confirm this observation, this study sought to compare the fundamental thermal behavior of sea buckthorn with fire-prone shrubs of the US that included yaupon (*Ilex vomitoria*), a southeastern shrub, and chamise (*Adenostoma fasciculatum*), manzanita (*Arctostaphylos* spp.), and buck brush (*Ceanothus cuneatus*), common California chaparral shrubs. Simultaneous thermal analysis was used to estimate ignitability based on differences in heat capacity and change in heat from the onset of the first primary differential thermogravimetric (DTG) peak to roughly 280°C, maximum mass loss rate (MMLR) served as a proxy for combustibility, primary peak decomposition times approximated sustainability, and mass loss fractions for the first and second primary DTG peaks estimated consumability. Net heat content (NHC) was also assessed with oxygen bomb calorimetry. Sea buckthorn yielded comparable ignitability to chamise and produced the greatest combustibility based on gas-phase MMLR (GP-MMLR). Conversely, sea buckthorn produced the least sustainability (< GP-decomposition duration), consumability (< GP-mass loss fraction), and NHC. Although sea buckthorn yielded lower sustainability, consumability, and NHC indices, greater ignitability and combustibility estimates may potentially increase fire spread and intensity, especially in dense, contiguous stands.

Keywords: Flammability, Wildfire, Chaparral, Yaupon, Wildland fuel

Acknowledgments: Arthur Temple College of Forestry and Agriculture, Stephen F. Austin State University, and Wolf Fire Safety

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Building Damage at the Wildland-Urban Interface: Case Studies California, USA and Pedrógão Grande, Portugal

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Abstract

The wildfire risk of life and property loss is especially high in inhabited areas located adjacent to, or intermixed with, the wildlands; these areas are referred to as the wildland-urban interface (WUI). Advancing knowledge on building vulnerabilities to wildfire threats is crucial to increase buildings' ignition resistance and reduce risk. This research presents a novel comparison of two large cross-geographical post-fire building damage inspection datasets: the California Department of Forestry and Fire Protection (CAL FIRE) post-fire building inspection program dataset, including 17500 buildings, and the dataset from the published Pedrógão Grande fire complex impact on buildings investigation, including 1035 buildings (Ribeiro et al., 2020). By statistically analysing the relationship between various building characteristics and final building damage, this analysis aims to extend quantitative knowledge on how building components characteristics affect building wildfire survivability in two distinct geographical regions. The Bayes Factor is calculated to quantify the relationship strength between each individual building characteristic considered and final building damage. Results indicate extremely strong evidence of dependence between the number of windowpanes, vent presence, and exterior material, with final building damage in the Californian dataset, and extremely strong evidence of dependence between preservation level and exterior material with damage level in the Portuguese dataset. A Home Fire Resistance Index, corresponding to the number of fire-resistant building components present, is calculated for each building in the CAL FIRE dataset. Clear trends indicating an increase in wildfire building survivability percentage, and decrease in percentage of buildings destroyed by wildfire, are observed as the Home Fire Resistance Index increases. Linear models are fit to describe these trends and predict an increase in 1.66% of buildings classified as experiencing 'no damage', and a decrease in 4.72% of building classified as 'destroyed,' per each increasing value of the Home Fire Resistance Index (or each additional fire-resistant building feature present in the building). This analysis identifies the building components most strongly related to buildings' wildfire ignition resistance in the datasets considered, and emphasises the importance of holistic building fire resistance to wildfire. This is the first quantitative analysis considering and comparing two large (including over 1000 buildings) and cross-geographical wildfire building damage inspection datasets in literature.

Keywords: wildland-urban interface, vulnerability, wildfire safety, building damage

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Assessment of the vulnerability of the wildland-urban interface (WUI) in the Valencian Region as a basis for the calculation of the fire severity index.

Quílez-Moraga, R., Vinué-Visús, D., Oliver-Villanueva, J.V. and Coll-Aliaga, E.

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Abstract

With the aim of improving the environmental and social management of emergencies, several newly-defined layers of cartographic information have been integrated to identify the areas with the highest concentration of population and properties. Using fuel models, digital terrain models, the national topographic base and cadastral data, the variables of "fuel danger rating", "combustible and non-combustible items", "slope hazard" and "type of infrastructure" have been obtained. By using weighted valued for each layer, a complete cartography of vulnerability for the Valencian Region has been defined, to be used as a basis for the the calculation of the fire severity index, in accordance with current forest fire legislation. The resulting map indicates the current state of the interface and its vulnerability, which can be used at a real time for extinction purposes by including dynamic biophysical factors. As an advantage for prevention purposes, this cartography has been used to calculate, by means of simulations, the propagation nodes that could affect the interface in order to propose the necessary actions to minimise the effect of the forest fires on the WUI.

Keywords: WUI, vulnerability, severity

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Historical Human System Drivers of Wildland Urban Interface Fire Risk in Spain: A Coupled Human Natural Systems Approach

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Abstract

Fire effects in European Mediterranean Basin (EMB) forests are mediated by historical management practices linked to different forms of land use and their lasting legacy effects on forest composition and structure. In this article we characterize historical management practices linked to preindustrial era pastoralist and industrial era resin tapping uses and their lasting legacy effects in two Wildland Urban Interface (WUI) sites located in Central Spain. As part of this evidence we collected complementary palynologic, dendroecological and historical archive data. We explore the hypothesis that variations in land and fire use linked to different historical forest management regimes (FMRs) have resulted in alternative ecological states defined by differences in forest structure and species composition. We find that higher fire frequency coupled with a pre-industrial era pastoralist FMR contributed to favor, in one site, the emergence and maintenance of an open canopy savanna-like heterogenous forest dominated by *Pinus pinaster* and *Quercus pyrenaica* with small fire size whereas, conversely, lower fire frequency associated with an industrial era resin tapping FMR contributed to the emergence and maintenance of a closed canopy homogeneous *Pinus pinaster* dominated forest that has experienced one large fire (>500 hectares) since 1980. These findings have important management implications for EMB forest ecosystems where there is an ongoing debate over the adequate use of pastoralism and prescribed fire for wildfire prevention while uncertainties continue to exist regarding fire and pastoralism's overall effect on forest ecosystem sustainability.

Keywords: Wildland Urban Interface, Large fires, Coupled human and natural systems

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Investigating Conifer Tree Flame Spread Under an Applied Wind Field

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Abstract

The large outdoor fire problem is a global issue that shows no signs of stopping in the future. The most well-known type of large outdoor fires are wildland fires that spread into developed, urban areas, known as wildland-urban interface (WUI) fires (Manzello et al., 2017). In the USA, the size of areas burned in 2020 is simply staggering. In California, the August Complex fire itself consumed more than 1 million acres (CALFIRE 2021). The lack of physical understanding is a major barrier to developing computational methods to be able to predict and understand how WUI fires spread. In this study, discrete fuel packages, manifested as conifer trees, were spaced apart, and the flame spread processes through these fuel packages were observed under an applied wind field. The experiments were conducted using wind facilities at the National Research Institute of Fire and Disaster (NRIFD) in Japan. Two ignition sources were utilized. The first considered a custom propane burner and the second made use of firebrand showers using a custom firebrand generator (NIST Dragon). During the subsequent flame spread processes through the discrete fuel packages, heat flux profiles, mass loss profiles, and attendant firebrand production was quantified. Results of this study will be presented.

Keywords: Firebrands, Wildland-Urban Interface (WUI) Fires, Flame Spread Processes

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Case study on a performance-based approach to wildland-urban interface (WUI) fires

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Abstract

The PBD approach in building fires is very often based in fire scenarios simulations, allowing to evaluate the effectiveness of the egress design and the fire protection means. This is normally an interactive process in which several fire protection strategies can be tested through simulations. This process allows more freedom in the definition of the fire protection systems but also a scientific design validation. The same approach can be applied to WUI fire. Our case study is a 150 hectares wildland resort in Portugal, with 130 buildings and more than 500 sleeps. The terrain is located in a natural reserve nearby the sea, covered with shrubs and pines. Since it is a natural reserve, cutting or pruning trees and shrubs to lower the fire load and create firebreaks it is not an option. The closest firefighter headquarters is 45 minutes away in the fire season, when there are more tourists, so more people exposed to WUI fires. The resort will have three trailers in different locations with wildland firefighting self-protection equipment (portable pumps, etc.), a network of fire hydrants with dedicated water supply and a small team of forest fire wardens. The assessments in the preliminary design have shown that a self-protection based in standard means of detection (visual detection by employees and occupants), standard communications (walkie-talkies and mobile) and standard fire warden team management (onsite evaluation) would not be able to contain the fire until the arrival of the firefighters. The final design solution is based on an automatic fire video detection (4 clusters of 9 cameras with real time video analysis). The system is able to detect a fire in a very early stage even without direct sightline to the fire and give an alarm for human confirmation through PTZ high-definition cameras and a drone. Once the fire is confirmed, the alarm is provided to the fire warden team through a mobile application with the fire location and video live feed from the cameras and drone. To help the firefighting management, there is software that based in the location of fire and weather conditions provides a real time prevision of the fire development in the following hour with 15 minutes isocurves. That prevision is overlapped in the resort plan, with the location of the fire hydrants and real time fire wardens GPS location (using the mobile app).

Keywords: WUI, PBD, video fire detection

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Fire Behavior Modelling and Simulations

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Global sensitivity of burned area to lightning

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Abstract

Vegetation fires start from human and lightning ignitions. Human ignition is responsible for the majority of global burned area, and land use changes drive changes in fire regimes in many ecosystems. Lightning ignition dominates burned area in many forested regions, especially in the mid and high latitudes, and lightning is increasing with climate warming in these regions. We investigated relationships between global lightning occurrence and burned area. We convolved spaceborne monthly lightning climatology data at 0.5° derived from the Optical Transient Detector and the Lightning Imaging Sensor with a monthly burned area climatology at 0.5° derived from the MCD64A1C6 product. We found a significant positive relationship ($p < 0.05$) over approximately 23% of the global land area with fire occurrence, which represents 6% of the contemporary global burned area. The majority of land where lightning and burned area climatologies aligned, were in the mid and high latitudes. While co-occurrence of lightning and human ignitions cannot be excluded in this analysis, results denote areas where lightning ignition is likely an important driver of burned area. Although large uncertainties prevail between lightning prediction models, especially in the low latitudes, lightning models generally agree that lightning regimes will intensify in the mid and high latitudes with climate warming. The mid and high latitudes are characterized by relatively high fuel consumption, and carbon emissions from intensifying lightning fire regimes in mid and high latitude forests may represent an important warming feedback. Our work-in-progress shows that improvements in lightning ignition attribution and future lightning prediction are required to accurately represent fire in fire and Earth system models.

Keywords: global, fire, lightning, burned area, ESM

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Species climatic niche explains post-fire regeneration of Pinus halepensis under compounded effects of fire and drought

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CREAF

Abstract

Fire and drought are two major agents modeling Mediterranean ecosystems. Despite the wide knowledge accumulated on their individual effects, fire-drought interactions have not yet been enough studied. We use *Pinus halepensis* as species case study to assess the influence of compound fire-drought regimes on the success of post-fire regeneration. This obligate seeder species, that produces semi-serotinous cones that release abundant seeds after being heated by wildfires, is widely distributed over the Mediterranean Basin. We set forty-three sampling areas in *P. halepensis* forests that burned between 1994 and 2013 along the Spanish east coast. In each plot we measured the density of pine recruitment in several replicates (mean = 18893 tree/ha , sd = 56401 tree/ha), avoiding burned areas close to surviving adults that may have released seeds continuously after the fire. We characterized the environmental space occupied by *P. halepensis* within the study range (i.e. bioclimatic niche) based on historical series of precipitation and temperature for the warmest quarter (period 1979-2013) to compute the centroid or distribution optimum of the species. Then, we localized the climatic coordinates of our sampling areas within the species' environmental space to compute climatic deviations concerning species' optimum for the 5 years previous and posteriors to the respective fire event. Finally, we built GLMs where *P. halepensis* density was the response variable, and pre- and post-fire climatic deviations, as well as the severity of each fire event (as DNBR), were the explanatory variables. Contrary to what might be expected we found a significant positive relationship between fire intensity and the density of pine regeneration of *P. halepensis* populations. However, the interaction of fire severity with deviations in temperature, as a drought indicator, can have opposite effects on regeneration density depending on whether they occur before or after the fire event. Although *P. halepensis* can regenerate after high-intensity fires, the interaction of fire effects with drought conditions can alter the response of this species.

Keywords: post-fire regeneration, Pinus halepensis, climatic niche

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High-resolution smoke emissions from the 2017 extreme wildfires in Portugal

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Abstract

In Portugal, wildland fires are one of the most serious natural disasters, due to their recurrent occurrence, their extension and their destructive effects. The year 2017 will be forever remembered with several lives lost during wildland fire events. In October, in particular, seven extreme wildfire events(EWE) were registered (Leiria, Lousã, Quiaios, Sertã, Oliveira do Hospital, Seia and Vouzela), which burned more than 200,000 hectares in less than 24 hours and caused a high number of victims among the civilian population, the destruction of hundreds of homes and businesses, and several environmental damages, including the degradation of air quality. The main objective of this work was to calculate and characterise the atmospheric emissions of these October EWE based on a high spatial-temporal bottom-up approach. Particulate matter (PM10 and PM2.5), nitrogen oxides (NOx), carbon monoxide (CO), sulfur dioxide (SO_2), ammonia (NH_3), carbon dioxide (CO_2) and methane (CH_4) emission factors, burning efficiency, fuel load and burnt area data were used considering the available information per EWE and by forest type. Local characteristics of the consumed forest type and shrubs were obtained from the Portuguese Nature and Forest Conservation Institute. Furthermore, fire data, such as the starting location and ignition time, propagation information and burnt area per EWE were obtained from national technical reports. The highest total emissions were estimated for the Leiria EWE, which were on average 37% higher than the sum of emissions from all other EWE. During the EWE between 15th and 16th October 2017 (≈ 48 hours) fire PM10, PM2.5 and CO_2 emissions were 117%, 158% and 259%, respectively, higher than the total anthropogenic emissions in Portugal for the entire 2017 year. Moreover, estimated values were compared with data from Moderate Resolution Imaging Spectroradiometer (MODIS) and Spinning Enhanced Visible and InfraRed Imager (SEVIRI) sensors. For PM10, this study's values were on average 3 times higher than SEVIRI ones and 2 times lower than MODIS ones. In conclusion, the high detailed spatial-temporal information allowed obtaining an improved characterization of the EWE emissions. It is important to implement this emissions estimation approach in smoke forecasting systems to timely inform stakeholders about the possible occurrence of smoke wildfire air pollution episodes and therefore to better manage human health effects.

Keywords: Extreme wildfire events, Smoke Emissions, Emission factors, fireline propagation,

Mediterranean conditions

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Decision Support System for Effective Fuel Management

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Abstract

Fuel management is currently a hot topic to overcome the large fuel loads that are present in Portuguese rural areas. Fuel management planning is complex as it must consider several socioecological needs and priorities within the area of interest, as well as limitations to perform the necessary actions. In this sense, Decision Support Systems (DSSs) may be useful tools to implement fuel management over large areas. Fuel Management DSSs are not as developed as Wildfire DSSs, since they are usually incorporated as a module of the Wildfire DSSs (Mavsar et al., 2013; Pacheco et al., 2015; Sakellariou et al., 2017). The most developed and sound Fuel Management DSSs is the 2017 North-American web-based application "Interagency Fuels Treatment Decision Support System – IFTDSS" (Drury et al., 2016; Wheeler et al., 2010). However, to our knowledge, there is no comprehensive Fuel Management DSS developed for Europe. The DSS for fuel management here proposed (PREVAIL DSS-FM), addresses research gaps found within the project PREVAIL, and it is intended to be a roadmap to help forest and fire managers by providing a clear and easy-to-apply methodology for planning fuel management activities in a particular area of interest. The area of interest is analysed as a holistic system where existing planning, management and stakeholders' perspectives are considered and integrated with landscape needs. The methodology defined is suitable for all territories and conditions and is based on a set of rules and dependent on stakeholder engagement. It is structured into three fundamental and sequential stages and inherent questions, as follows: (1) the need for fuel management: is there a need for fuel management? (2) the diagnostic for fuel management: where to treat? and (3) the actions for fuel management: how and when to treat? The roadmap of the PREVAIL DSS-FM was tested for an area within the Municipality of Cascais, Portugal, through a focus group carried out with the relevant stakeholders of the Municipality. Results showed that thorough socioeconomic analyses should be performed within the preparation steps. It was also pinpointed the need to identify who will intervene in the territory to ensure that fuel management is carried out by entities that will be able to maintain periodic interventions. Finally, stakeholder's selection should be strengthened by including population from the settlements within the area of interest into the discussions, in order to achieve a better integration and acceptability of the planned actions.

Keywords: PREVAIL project, DSS, Fuel management

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Characterizing the lifetime phases of wildland fires from the Sioux Lookout District in Ontario, Canada by utilizing mixed effects multi-state modelling techniques

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Abstract

Wildland fires can be viewed as having a “lifetime” that consists of several sequential phases. The specific sequence of phases can vary depending on how a fire is responded to (e.g., full suppression or monitoring) by a fire management agency. We investigate the lifetime distributions of these various phases for wildland fires from a study area consisting of a response sector in Ontario’s Northwest Fire Region. The progression of phases from ignition to being under control are examined using multi-state models and contrasted with models that only consider a single endpoint. Several fixed and random effects are incorporated into the models, including fire weather variables, the number of fires on the landscape, seasonality, and a shared fire-specific random effect across transitions. We identify the utility of multi-state modelling approaches for understanding the factors that drive progression through all the phases of a fire as well as those that only influence specific phases.

Keywords: fire lifetime, multi-state models

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PhyFire, an online wildfire simulation tool

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Abstract

In this work we present the wildfire spread tool PhyFire, developed by the research group on Numerical Simulation and Scientific Computation at the University of Salamanca. The PhyFire model is a simplified two-dimensional physical wildfire spread model based on the energy and mass conservation equations, that uses radiation and convection as dominant heat transfer mechanisms, and takes into account some three-dimensional effects. PhyFire is a single-phase model: only the solid phase is considered, the gaseous phase is parameterized through flame temperature and flame height in a non-local radiation term (Asensio et al., 2020). This term allows modelling the radiation from the flame above the fuel layer, enabling it to cope with the effect of wind and slope over the flame tilt. The convective term is critical, as wind is one of the most influential factors in a fire spread. The influence of fuel moisture content and heat absorption by pyrolysis are introduced in the model by means of a multivalued operator representing the enthalpy. The model also allows to simulate random phenomena such as fire-spotting (Asensio et al., 2021). In order to provide a response in a reasonable period of time, the solutions provided by the PhyFire model are approximated by using efficient numerical methods and parallel computation techniques. PhyFire is adapted to data assimilation which allow correcting the uncertainty of a forest fire during the simulation (Ferragut et al., 2015). The PhyFire model is integrated into a GIS environment (Prieto-Herráez et al., 2017) that automates the acquisition and processing of geographic information. In this way, a single environment is available in which the necessary data can be obtained to launch the model, carry out the simulations and show the results, allowing the connection of the mathematical model with the real world. This tool is accessible on a website (http://sinumcc.usal.es), and can be used to carry out a simulation by providing the simulation area, fire ignition location and meteorological data. The developed tool returns the state of landscape (burning, burned and unburned area) for several time steps. In order to adapt the simulation to real situations, fire suppression tactics can be incorporated by modifying the fuel load and type via GIS.

Keywords: fire behaviour research, wildland fire spread modelling, wildland fire spread simulator

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Semi-natural studies of a wildfire impact on air transport processes

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Abstract

Many wildfires (forest, steppe, and peat) occur every year in the world. An increase in temperature can result in an increase in the size of the burnt-out area, fire frequency, and the scale of the effects (Westerling et al., 2006; Wotton et al., 2017). In this work, we present the results of multiyear semi-natural experimental studies of the propagation of the front of a steppe fire and its effect on meteorological parameters, the formation of atmospheric turbulence due to the dissipation of turbulent structures in the flame, and the emission of gaseous combustion products and aerosols. Large-scale turbulence is observed in the front of a seminatural fire, which is absent in laboratory conditions. The predominance of large-scale turbulence in a flame results in turbulization of the atmosphere in the vicinity of a combustion center. Strong heat release in the combustion zone and flame turbulence increase the vertical component of the wind velocity and produce fluctuations in the air refractive index, which is an indicator of atmospheric turbulization. Variations in the gas and aerosol compositions of the atmosphere are measured in the vicinity of the experimental site. The related experimental data expand the fundamental knowledge about the effect of wildfires on changes in wind speed, air temperature, turbulence, and transport of combustion products. Changes in the aerosol and gas compositions of the atmosphere during a wildfire are recorded with a delay caused by atmospheric transfer processes and can be used in systems for the remote detection of wildfires.

Keywords: wildfire, atmosphere, IR thermography, combustion, turbulence

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Fire-spotting generated fires: macro- and meso-scales effects

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Abstract

Fire-spotting is one of the key aspects of the wildfire propagation since it provokes new independent ignitions and may significantly accelerate the rate of spread. It cannot be studied isolated from the main fire-front propagation. Present study is based on idea to split the fire-front motion into two parts: a drifting and a fluctuating, which includes the randomness of turbulent hot-air transport and fire-spotting. The main advantage of such approach is its versatility since it can be applied to any existing fire spread model. Fire-spotting involves aspects among scales: from the combustion chemistry in microscale, to fire-atmosphere interaction in macroscale. Hence, we aim to estimate the physical parameters of the phenomena by employing a concurrent multiscale modelling. At the meso-scale level, fire-spotting is affected by the mean wind and fireline intensity, which is found to be in a strong interaction with the surrounding factors, such as fuel and local orography. This fact allows us to study the effect of the flame length, which can be specified by the fuel and temporal characteristics, and terrain slope to the fire-spotting. Empirical relations of the flame length – fireline intensity given in literature are generalized in present study by using the energy conservation principle. Contrasting to literature, the proposed physical formulation allows stating the rate of fire spread in terms of the flame geometry factors by including the effects of the horizontal mean wind and the terrain slope. At the macroscopic level, the impact of the atmospheric conditions is considered. The depth of the atmospheric boundary layer is considered in the estimation of the smoke-injection height including the uplift against the atmospheric stratification and the plume widening due to entrainment of the surrounding air. Implicit connection between the atmospheric stability and fire propagation allows the modelling of various scenarios. Numerical simulations showed that with stable conditions turbulence is not strong enough to merge the fires and, at large elapsed times, this results into a higher number of independent fires but lower burned area with respect to unstable conditions when the push of turbulence leads to faster merging resulting into a lower number of independent fires but higher burned area. Simulations showed also that terrain slope enhances the spread of the fire at a higher rate than it augments fire-spotting generated fires, such that a rapid merging occurs among independent fires.

Keywords: Wildland fire, Fire-spotting, Atmospheric stability, Flame length, Terrain slope

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When the unpredictable comes: An approach for foreseeing the transition to chaos in wildfire propagation

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Abstract

Inspired by the success of the weather forecast, for improving the prediction of wildfire propagation, we look for uncovering its chaotic nature. Here, we specifically focus on the derivation of a Lorenz-type chaotic system from a prototypical reaction-diffusion equation for the temperature field, which is coupled with an equation of the fuel concentration and also with a Langevin-like equation for the Rate of Spread (ROS). The motion of the fire-front results into a Brownian-like motion where the Gaussian noise is replaced by a combined effect due to the temperature and the fuel concentration. By performing a preliminary study, we show that it is possible to predict under which ”environmental” changes, i.e., a variation in the mean wind or in heat of reaction, a transition to a chaotic propagation occurs for a wildfire that was initially predictable in spite of uncertainties in its initial state. The practical aim of this study is to improve the prediction of wildfire propagation by predicting the arrival of the unpredictable regimes. In fact, in spite of uncertainties in the initial state, there are certain parameter configurations that give predictable trajectories, namely the trajectories evolve closed each other for different initial conditions. Notwithstanding this, if a small change occurs in time in these parameter configurations, e.g., a change in the mean wind or in heat of reaction, then the trajectories, that here-in-before evolved closely, here-in-after turns into diverging trajectories revealing that the process is now unpredictable. Hence, by means of the proposed approach, it is possible to predict for which changes in the system a wildfire, with a predictable configuration, switches from a predictable to an unpredictable propagation. In spite of the fact that the present analysis concerns an oversimplified setting of wildfire propagation, by the proposed approach a systematic analysis of the parameters – including the possible configurations and the possible changes that they may have - leads to establish a quantitative ranking-of-risk by estimating the growth of the error. Then, this approach allows for setting an alternative method for real-time risk assessment.

Keywords: Wildland fire, Lorenz attractor, Lyapunov exponent, Chaos

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Temporal evolution of a wildland flame envelope: An experimental study on litter fires

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Abstract

This work is focused on the systematic investigation of the effects of several physical parameters on litter fires. In this context, an extensive parametric study is performed, using an inclinable fuel bed, aiming to evaluate the impact of surface slope, fuel load and fuel moisture content on the dynamic characteristics of the developing flame envelope. In total, 10 fire tests are performed; two sets of 3 identical tests are used to evaluate the "repeatability" of the testing methodology. The parametric study spans four different surface slope angles (0, 10, 20, 30 degrees), two different fuel load values (0.5, 1.0 kg/m^2) and two different fuel moisture content values (1%, 8%). The fuel used is dead "Pinus Halepensis" pine needles; particle density, surface-to-volume ratio and fuel moisture content are measured in order to establish adequate fuel homogeneity among the successive tests. A broad range of physical parameters is recorded using an extensive sensor network. The fuel bed (2 m x 2 m) is equipped with 86 thermocouples, 3 heat fluxes and 4 bi-directional Pitot tubes, aiming to record the temporal evolution of the gas and fuel temperature, the heat flux and the axial velocity. An exhaust hood is used to collect all combustion products; a gas sample is fed to an online gas analyser, thus allowing the estimation of the instantaneous Heat Release Rate, by means of oxygen calorimetry. Furthermore, the propagating flame is visually recorded using two optical cameras, located on perpendicular sides of the fuel bed. An image processing computer algorithm, developed in-house, is employed to determine the main geometrical characteristics of the flame envelope, namely flame height, length and angle. In addition, the instantaneous rate of spread of the fire is estimated using the video image sequence. The obtained results concerning the geometrical and spreading rate characteristics of the flame are, for the most part, in full agreement with relevant literature reports. Decreasing the fuel moisture content results in a significant increase of the flame height, length and rate of spread; however, the flame angle is not considerably affected. Also, doubling the fuel load leads to significantly enhanced rate of spread and substantially larger flame envelope. Finally, the gradual increase of the slope angle affects both the geometrical characteristics of the flame and its spreading rate.

Keywords: litter fire, fuel bed, flame envelope, measurements, rate of spread

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Brazil on fire: is climate the culprit?

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Abstract

Brazil is home to some of the most important ecosystems worldwide: the Amazon rainforest, the savannas of Cerrado and the Pantanal wetlands, for example. Although these biomes are quite distinct, they do have something in common: over the last decades, these biomes have seen considerable high fire activity and have been subject to extreme wildfire events. With the exception of Cerrado, and some regions of Pantanal, these are fire sensitive biomes where fire severely damages ecosystem functioning. Fire has been linked to climate patterns but, in the case of the Brazilian biomes, further research is needed to understand regional interactions. Here, we explore how climate has influenced fire activity in Brazil from 2001 to 2020. We use a fire danger index (from the Canadian Forest Fire Weather Index - FWI - System) and meteorological variables from ECMWF's ERA5 reanalysis product, compared with burned area from MODIS (the Moderate Resolution Imaging Spectroradiometer aboard the Terra and Aqua satellites) products. Relationships are modelled through simple linear regression and goodness-of-fit evaluated using the Pearson's coefficient. Results show high spatial variability within Brazil. Cerrado obtained well-defined clusters of significant correlation values during its fire season (August to October), particularly within the Arc of Deforestation (the transitional region between the Amazon and Cerrado biomes) and MATOPIBA (the confluence of states Maranhão - MA, Tocantins - TO, Piauí - PI, and Bahia - BA; and Brazil's latest agricultural frontier). The Amazon showed much fewer pixels with significant correlation values, and those obtained were mainly on the southern region of the biome, including the Arc of Deforestation. Finally, Pantanal, encompassing a much smaller area when compared to the previously mentioned biomes, does not seem to show any marked region with clustered pixels of significant correlation values. Nevertheless, most of the obtained significant pixels are located in southern Pantanal. These results pave the way to a proper understanding of the fire-climate relationship in Brazilian biomes, with potential uses in models of fire activity and future assessments under climate change.

Keywords: Fire, Fire danger, Climate, Remote Sensing

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A GIS-based cellular automata model to simulate field-scale flaming and smouldering wildfires on peatlands

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Abstract

Peatland wildfires are the largest fires on Earth and comprise both flaming and smouldering types of combustion. Smouldering is flameless, slow, has relatively low temperature but is more persistent and releases more pollutants than flaming. The smouldering behaviour is strongly determined by fuel moisture content. The fuel of smouldering in peatland wildfires is mainly the organic soil (peat) underneath surface vegetation. In natural peatlands, the peat moisture content changes significantly over time because of seasonal variations that can be strengthened by anthropogenic activities. Research on smouldering wildfires is limited, especially at the field-scale, and have not explored the effect of the temporal variation of peat moisture content. This lack of research is mainly due to the complexity, spatial extent, data availability, and computational cost of wildfire models. For the first time, we developed a cellular automata model that includes transient peat moisture content information to simulate peatland wildfires. Cellular automata are discrete models that use simple and flexible rules to simulate complex phenomena while remaining computationally light. We consider both flaming and smouldering in our model to simulate a peatland wildfire in Borneo. Model input parameters were derived from GIS data of vegetation type and density, and temporal variation of peat moisture content was simulated using a peat-specific land surface model. Once validated with the data of burn scar caused by flaming wildfire (79% accuracy), the model is used to simulate the smouldering peat and estimated that in 90 days, the smouldering could burn 54.5 ha of peat. The smouldering burnt area grows exponentially with time in the regime of smouldering hotspot creation, followed by a quadratic increase in the subsequent spread regime. Simulations with a constant peat moisture content strongly underestimate the total smouldering burnt area (12.1 ha), emphasizing the importance of temporal variation of peat moisture content. Despite being four times shorter than spread regime, the creation regime is critical in determining the overall severity of smouldering wildfires. Additional model simulations over our study area, within and across years with contrasting Oceanic Niño Indices, showed that the peat smouldering burnt area ranges from 1.3 ha to 210 ha, depending on peat moisture content variations. The novel model improves understanding of the wildfire spread in peatlands and can contribute to efforts in mitigating carbon emissions and adversities of haze from smoldering peatlands through an improved management of fire regimes in the inhabited peat-rich landscapes.

Keywords: Peatland wildfires, smouldering, flaming, cellular automata, GIS

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Terrain metrics: Directional roughness for forest fire risk mapping

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Abstract

The main factors that contribute to fire ignition and propagation are topography, vegetation, weather, human activities, fire temperature and the portion of fuel consumed. Among topographic metrics, slope, aspect, elevation, distance from road, and distance from settlement are usually considered relevant when mapping fire risk. Previous studies have proved that the risk map for a non-planar topography includes areas with a reduced risk as well as with an enhanced risk as compared to the planar case. On the other hand, the accurate assessment of surface roughness with digital elevation models (DEM) has important implications for the numerical simulation of mass movements. Natural hazards have a predominant diffusion direction identified as the combination of terrain slope and curvature. We hypothesize that fire propagation simulations and fire return interval assessments can take advantage of surface roughness algorithms to improve their predictions. In this study, we analyse the outputs of five surface roughness algorithms (standard deviation of the profile curvature, SD_PC; standard deviation of the residual topography, SD_RT; standard deviation of the slope, SD_S; terrain ruggedness index, TRI; and vector ruggedness measure, VRM) that were calculated using four moving window areas (radius: 2, 4, 8 and 10 cells). The selected study area is a medium-size sub-catchment (14.5 km^2) located in the headwater of the Igrejas River, which source area is located in Spain (province of Zamora), and drain into Onor River in north-eastern Portugal; within the Natural Park of Montesinho (Duero/ Douro River Basin). Recurrent fires have affected this area in the last decades. The results analysis include the spatial pattern of the metrics with regard to the main geomorphic elements (steep slopes, internal water divides, valley bottoms, and ravines) and land uses (forest, cropland, trails, and a specific grassland named '*lameiros*'). The evaluation of the directional roughness and the selection of the most relevant approach may help to refine fire propagation models and fire risk mapping.

Keywords: Surface roughness, Fire propagation, DEM, Mass movement

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The importance of savanna fires in the global carbon cycle: beyond direct emissions

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Abstract

Wildfires in African savannas are one of the main contributors of global fire activity, accounting for around 30% of global carbon (C) emissions from fires. They are, therefore, pivotal to understand the impact of fire on the global C budget. The immediate effects of fire on C budgets not only depend on direct emissions from burning of vegetation, but also on pyrogenic carbon (PyC) production. PyC is overall more resistant to degradation than unburnt biomass and can therefore act as an additional carbon offset mechanism. The ability of PyC to compensate C emissions will depend on the amount produced and, also, on its environmental recalcitrance. In addition, together with ash, it may also affect postfire respiration of soils. No PyC production data for African savanna ecosystems have been available to date. To address this research gap, we quantified PyC produced in four experimental savanna fires, with behaviour typical of dry-season wildfires, along a climatic N-S gradient in Kruger National Park in South Africa. This involved detailed pre-fire fuel and soil inventories, in-fire temperature monitoring and post-fire collection of PyC and remaining unburnt fuel. In addition to pre- and post-fire C stocks estimation, and associated emissions, the environmental recalcitrance of the PyC generated was quantified by means of thermogravimetry-differential scanning calorimetry and hydropyrolysis. Furthermore, the effect of PyC on post-fire soil CO2 fluxes was also assessed via short-term laboratory experiments. In this presentation, we will summarise our findings and discuss their implications in the wider context of grassland fires worldwide, which account for ~80% of the global area burned.

Keywords: carbon emissions, pyrogenic carbon, fuel consumption, prescribed burn

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Influence of different sample holders on the flammability of pine needles in the mass loss calorimeter

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Abstract

Forest fires in the last few years represent one of the main outcomes of the impact of climate change, and in this regard, a large number of researchers dedicated themselves to researching the combustion dynamics of forest vegetation. Unlike large-scale experiments, where due to limited resources in predicting forest fires, the development of fire models is a more cost-effective alternative. The required data for these models can be obtained in small-scale experiments, such as the mass loss calorimeter, which was used in this study. The concept of operation of a mass loss calorimeter consists in exposing the prepared sample in a sample holder to a certain thermal flux. By measuring the temperature of the combustion products, the heat release rate is determined, which is the most important parameter for characterizing the flammability of the materials.
The purpose of this paper is to determine the main flammability parameters that affect the combustion dynamics of forest fuel in a mass loss calorimeter. To understand the role of oxygen transport mechanisms in the combustion zone, three different configurations of sample holders were developed, which differ in dimensions and percentage of the opening of sample holder sides, to allow fresh oxygen concentration in the combustion zone. Therefore, the used types of sample holders are: two shapes of baskets with small holes in all sides (1-square shape, where the bottom is covered with aluminum foil; 2-round shape), and 3-flat square sample holder, whose surface is mostly open. The samples are exposed to a heat flux of 50 kW/m^2, the mass of the samples is fixed to 15 g, and the surface of the sample holder is evenly covered with fuel.
In this paper, the main focus is on determining the impact of different configurations of sample holders on the combustion dynamics of forest fuel. For the research, the design of the experiment was set up, which consists of 2 experimental factors, namely: types of sample holders and fuel moisture content (fresh and dried). The obtained results, such as the peak and mean value of the heat release rate, ignition time and burn duration, represent dependent variables, where the interdependence of experimental factors and statistical significance was determined using a two-way ANOVA. Among the obtained results, it was found that there is a significant difference in the combustion dynamics on different sample holders.

Keywords: pine needles, mass loss calorimeter, sample holder, flammability parameters

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Artificial Intelligence (AI) and Machine Learning (ML) for wildfires

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Forests have lost almost 100 million hectares in two decades accelerating the loss of biodiversity. Wildfires are estimated to be responsible for around 15% of global warming gas emissions. Firefighting professionals nowadays make an unsettling observation: fires are becoming increasingly difficult to suppress as they get more numerous and intense. We are talking about massive wildfires that are nearly hard to extinguish. 2019 was a record-breaking year, with recent tragedies in the Amazon, Indonesia, Australia, and even the Arctic bringing the world's attention to the fact that flames are now a big threat and an important ecological issue. Forest fires cause significant damage to humans and other living creatures. If they are not detected and extinguished before they widely spread, they can have disastrous results. AI has known impressive progress in recent years, and it can play an important role in the area of wildfires. In this session we are interested on the use of Artificial Intelligence (AI) and Machine Learning (ML) in the study and analysis of wildfires and forest fires, such as detecting and segmenting fire images, modeling and predicting fire propagation, using UAVs to monitor and fight wildland fires, remote sensing, mutimodal imaging for wildfires, etc.

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Predicting wildland fire propagation using deep learning

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Abstract

Forest fires have recently become one of the most serious hazards wreaking havoc on various parts of the globe. Recent research studies have demonstrated that examining both meteorological and terrain factors, in addition to satellite images, is critical for accurately predicting wildfire propagation (Surya et al. 2021, Khennou et al. 2021, Radke et al. 2019, Liang et al. 2019). With the recent progress in artificial intelligence, it is now more important than ever to apply effective algorithms to wildland fire science to better manage the complexity of the fire spread (Surya et al. 2021, Hodges et al. 2019). In order to limit damage and work in collaboration with fire detection systems, it is critical to track the fire spread in real time and predict its evolution over time. In contrast to detection systems, which have been widely implemented using various deep learning methodologies, we observe that there is still a gap in the research area of spread prediction using AI techniques. To this end, we introduce a new approach based on U-Net, one of the main deep neural networks' algorithms, which is widely used in satellite images applications, to automatically understand wildfire spread dynamics. In this study, we introduce FU-NetCastV2, a deep learning model based on U-Net, historical wildfire incidents, satellite maps, DEM, aspect, slope, and meteorological data from the rocky mountain region. This model is designed for forecasting the next burnt area after a 24-hour scale. The model achieved an accuracy of 94.6%, an AUC of 97.7% and an F1-score of 95.9% based on 400 fire perimeters, using the GeoMAC dataset from 2013 to 2019. This research also provides a significant performance improvement compared to the FU-Netcast model (Khennou et al., 2021), which was previously implemented based on 120 images. The proposed algorithm is well suited for assisting fire fighters in being more proactive, locating potential burnt areas and acting immediately to prevent the widespread of fires.

Keywords: Forest fires, Fire spread modelling, Deep learning, Convolutional Neural Networks, U-Net

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Wildfires detection and segmentation using deep Convolutional Neural Networks and Tranformers

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Abstract

Every year, wildfires destroy 350 million to 450 million hectares (Dimitropoulos, 2019). This natural disaster causes multiple damages such as air pollution, human death, and financial losses. In the last decade, researchers focused on improving firefighting by employing systems for fire detection at an early stage. More recently, vision-based deep learning techniques have been proposed to detect the position of the fires in images (Ghali et al., 2018). Furthermore, fire segmentation based on deep learning methods were developed to locate the fire pixels and segment the fire areas (Akhloufi et al. 2018). Nonetheless, these techniques are still limited in identifying the precise fire's shape as well as small fire areas. For such, we present in this work a forest fire segmentation framework based on recent deep learning methods. Three deep convolutional neural networks: EfficientSeg, U^2-Net, and U-Net are employed to segment fire pixels and detect fire areas. In addition, two vision Transformers, MedT and TransUNet, are also developed and adapted to this task. The proposed Transformers determine the global dependencies between input and output sequences using the self-attention mechanism in order to segment fire pixels and detect the precise shape of the fire areas. These deep models, EfficientSeg, U^2-Net, U-Net, TransUNet, and MedT obtained high F1-score values of 95.0 %, 92.0 %, 94.0 %, 97.7 %, and 96.0 %, respectively, using the CorsicanFire dataset (Toulouse et al., 2017), which is composed of 1135 RGB wildfire images with their corresponding binary masks. The experimental results show the high performance of the proposed models outperforming some recent state-of-the-art techniques and classical machine learning models such as colour fusion methods (Dzigal et al., 2019). These results also proved the reliability of deep learning methods in segmenting fire pixels and detecting the precise shape of the flame. More specifically, the analysis of the results showed that deep learning models (deep CNNs and Transformers) correctly distinguish between fire and non-fire pixels and reduce the false alarms and fire pixels misclassifications. Finally, this work shows that the deep vision Transformers techniques are very efficient in segmenting wildfire pixels and detecting the precise shape of the fire, especially for small fire areas under various conditions of weather, presence of smoke, different distances to the fire, and environment brightness.

Keywords: Forest fires, fire detection, fire segmentation, deep learning, Transformers

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Change Detection Analysis Using Sentinel 2 Multi-Temporal Satellite Imagery and its Integration for Fuel Mapping at a Municipal Scale

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Abstract

Soil covers are in constant change, due to their dynamic behavior having updated and reliable fuel model maps is an important step in forest fire prevention and defense planning procedures. The aim of this work was mapping four large types of fuel and burned areas using a multi-temporal set of multispectral satellite images in different software and web platforms for geospatial processing. And finally assess the proposed methodology as a semi-automatic tool for updating current fuel maps. Based on the type of analysis followed, the process was divided in two blocks that share some steps. An Object Based Analysis (OBIA) was performed on a multitemporal collection of Sentinel 2 MSI images in order to map four vegetation types. The images were acquired and processed before being segmented to generate the necessary data to carry out the supervised automatic classification. In the case of mapping burned areas a temporary set of Sentinel 2 MSI images was acquired and processed and then the classification was executed directly. It was not necessary to segment the images due to having followed a pixel-level analysis. Both classifications achieved high overall accuracy levels, it was 87.01 % in the fuel groups one, while it was 98.28 % in the case of burned areas. These results demonstrate that using multispectral Sentinel 2 MSI images is possible to identify different coverages reliably. This methodology proposed, based on the use of passive remote sensors and its combination with different free and commercial software, allows the existing cartography to be updated. Thus, it could be a really useful tool in planning the management and defense of forest fires.

Keywords: Fuel, Mapping, Sentinel, OBIA, update

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ETHON: unmanned aircraft for forest fire management

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Abstract

To improve both information gathering and firefighting management and to ensure the complete fire suppression, a new airborne system has been designed based on the integration of three main elements: an unmanned aircraft with a high autonomy and payload, airborne thermal sensors and micro-sensors with ground dispersion capacity. The fixed-wing aircraft is VTOL-capable, allowing its use in rough environments without airfield preparation or catapults to be launched. It has a flight range and payload capacity superior to multicopters of similar weight order. Thermal imaging is used for automatic recognition of temperature thresholds and hot-spot detection to ensure the total fire suppression and to monitor the fire edge. In addition, a dispersion system of miniaturized sensors able to record biophysical variables as temperature and gas concentrations has been included. By spreading those sensors from the UAV´s cargo hold following a controlled bombing plan it is possible to create a local network to monitor the progress of the fire. The integration of the three components has been validated under controlled conditions following the operating methods and criteria required by the fire-fighting services. An advanced type-2 aircraft model is currently being designed while linking all the physical devices into a digital environment of communications and software.

Keywords: airborne sensors, UAV, proximal & remote sensing

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Evaluating and comparing statistical and machine learning methods for fire occurrence prediction

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Abstract

Some wildland fire management agencies use fine-scale, spatio-temporal wildland fire occurrence prediction (FOP) models to predict fire occurrence potential and to create spatially-explicit maps highlighting areas that are more likely to have fires. Such FOP models can support fire management decisions such as organized detection and the positioning of suppression resources. FOP modelling techniques are typically empirically-based, including both statistical modelling and machine learning approaches. Since fire occurrences are rare events in space-time, subsampling is commonly employed to create the dataset used to train (i.e., fit) fine-scale FOP models. However, failing to properly calibrate to account for such subsampling can lead to issues, including non-optimal model selection as well as models that can be highly biased towards overprediction. Through a case-study of human-caused FOP in a provincial fire control zone in the Lac La Biche region of Alberta, Canada for 1996 through 2016, we illustrate such issues and demonstrate the need to properly calibrate fine-scale FOP models so that they output true fire occurrence probabilities, discussing methods for proper calibration and providing a set of guidelines for the effective evaluation and comparison of different candidate models. Following these methods, we compare a variety of properly calibrated FOP models for our study region, including bagged classification trees, random forests, neural networks, logistic regression models, and logistic generalized additive models. Although previous studies have suggested that machine learning approaches may outperform logistic regression models, our results show that the more flexible logistic generalized additive modelling approach can be highly competitive with machine learning methods. Moreover, since logistic generalized additive models are commonly viewed as much more interpretable than “black box” machine learning models, this statistical modelling approach may be preferred for FOP. Consequently, we advocate that the pros and cons of statistical and machine learning approaches should be discussed with fire management agencies when collaborating to develop FOP models for operational use. Additionally, future studies of FOP models should compare logistic generalized models with machine learning approaches in other wildland fire ecosystems to determine if logistic generalized additive models are consistently competitive with alternative approaches.

Keywords: artificial intelligence, calibration, forest fire occurrence, wildfire occurrence

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Contrasting patterns and interpretations between fire spread simulators and machine learning models when mapping burn probability

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Abstract

The natural and socioeconomic costs associated with wildfires led to developing tools to anticipate decisions to reduce wildfire impacts. Indeed, mapping fire-prone areas (i.e., burn probabilities) is a common practice by fire agencies to design firefighting and prevention campaigns. Two main approaches are commonly used to map burn probabilities: fire spread simulators and machine learning models. Despite they based mostly on the same environmental variables, they differ on how they handle them. Thus, since fire managers sometimes mostly focus on the outputs without acknowledging the difference between approaches, it makes worthy to assess for differences on both results and interpretations. Burn probabilities were calculated for the Apulia region, Southern Italy, using FlamMap and Random Forest (RF). Results showed that RF project more uniformly distributed results (both spatially and statistically) than FlamMap, which concentrate most of its values close to zero except for some locations with medium-high probabilities. In addition, burn probabilities from FlamMap and RF change across fuel types and environmental conditions. Interpreting results suggest that decisions based on fire simulators might be more tightly linked with actions preventing fire spread, whereas those based on machine learning might be more linked with fire occurrence that is not necessarily related to spreading, e.g., socioeconomic causes. Thus, paying attention to this, both approaches should provide complementary information for fire agencies.

Keywords: Wildfire simulators, Burn probability, Fire occurrence, Fire spread

Wildfires and Civil Protection

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The reasons behind wildfires may be as diverse as the cultures, economies, histories, and ecosystems of the countries within which they occur and have always existed, on a worldwide scale (Botelho *et al.*, 2014). Over and over we witness its occurrence and frequency, being a recurring problem in some countries (Bento-Gonçalves *et al.*, 2015). The increased frequency, magnitude, and extent of wildfires, over the past few decades, has become a major societal and environmental concern across the world. These concerns are further intensified by the likely future climate conditions, increasingly propitious to wildfire ignition and spreading (Bento-Gonçalves *et al.*, 2013). However, the increased exposure to forest fire risk and the level of vulnerability of society reflects the different degree of preparedness for these phenomena, and the effectiveness of "civil protection" is one of the key factors in explaining the intensity, size and severity that some wildfires reach. To discuss these topics, we propose a poster and an oral presentation sessions, with a Key lecture that will introduce the State-of-the-Art and will guide a discussion about the best methods and techniques, the definition of strategies, and the systemic view inherent to Civil Protection and forest fires.

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Using unmanned aerial vehicles to assist prescribed fires and detect rekindles in wildfire management

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Abstract

Forests are increasingly susceptible to wildfires due to land abandonment, fragmentation, lack of forest management, and agricultural burns. The impacts of climate change, with longer heat waves and the extension of the summer season, creates the conditions for catastrophic wildfire seasons in many countries. The drivers that increase wildfire risk are simultaneously related to vegetation, meteorology, and population (Mateus & Fernandes, 2014; Rego & Colaço, 2013). Improving tools and methods within the fire management cycle will reduce potential upcoming consequences. FoCor project focuses on the prevention, detection and mop-up phases of this cycle. Our main goal is to develop an automatic UAV based system to support prescribed fires (prevention), and detection of rekindles in the mop-up of forest fires. For both missions, we will have UAVs able to carry different cameras with different wavelengths, and/or an ignition gun to ignite fire. The mission control software will enable operators to choose the different operating modes, to delimit the area of operation, and to configure and control the mission. For prescribed fires, area coverage and analysis, ignition, and fire surveillance will be enabled. FoCor proposes a pipeline for processing RGB images to detect presence of hotspots/flame using a deep learning algorithm. The developed detector is based on a Mask R-CNN implementation that showed good accuracy with a precision of 0.92 and a recall of 0.60, for the real aerial images. While the precision value is very positive the of recall was affected by a few false negatives, such as images with a lot of smoke and with small-sized fires. The detector was run at 3.5 frames per second that showed to be enough for the desired application. We are currently expanding the dataset with multispectral images to test what are the better spectral ranges for fire detection. The UAV together with the mission control software becomes a fundamental tool to help prescribed fire personnel to successfully manage the fire during its full life cycle, preventing and alerting for possible fire projections. Simultaneously the detection of hotspots during mop-up activities, particularly in large wildfire perimeters, will allow a more efficient rekindle detection, giving support to the manual crews decreasing their physical fatigue and the number of suppression resources.

Keywords: Wildfires, UAV, Rekindles

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How to Strengthen the Capabilities of Portuguese Civil Protection. Preliminary results of the RECIPE project study.

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Abstract

Under the influence of climate change, risk management becomes more complex, and risk management decision-makers must deal with a higher level of uncertainty. Properly integrating emergency response requirements into risk assessment and planning processes strengthens disaster risk reduction strategies. Based on the above, the reinforcing civil protection capabilities into multi-hazard risk assessment under climate change (RECIPE) project, funded by the Civil Protection Mechanism of the European Commission, seeks to promote operational tools and recommendations to reinforce Civil Protection in emergency management and risk planning for different natural hazards across Europe. One of the RECIPE tasks was to carry an interview with various civil protection professionals and emergency managers about their experience in fire risk management. The objectives of these interviews in Portugal were: (i) to identify gaps and operational requirements that need to be considered in the modern risk assessment and planning process to improve civil protection capacity in Portugal, and (ii) to understand how experiences from recent extreme wildfires have helped to improve the system. The main weaknesses detected in the civil protection system were the following: a weak efficiency of the current Civil Protection Emergency Plans; little collaboration between civil protection agents at the regional and national scales; lack of collaboration and exchange of information between different agencies; inexistence of post-emergency reports and subsequent discussion in internal municipal meetings and/or with stakeholders; insufficient fuel management in forest areas and poor population capacity for self-defense and preparedness knowledge. In addition, in the Portuguese Civil Protection little attention is paid to the cascade effects of wildfires (e.g. soil erosion, flooding, flash floods, occupation of burnt areas by invaders alien woody species). The experience with the recent extreme wildfires from 2017 helped to improve a series of points, such as: devoting more attention to preventive work; include the Forestry Offices and local actors in decision-making during fire suppression; in some places, there was an increase in the population's awareness of the importance of controlling the vegetation around the houses. The results of this analysis were included in the Report on data attributes for integrated risk assessment and planning of wildfires both in Portugal and in other European countries as a whole (Hörl, et al 2020). A more detailed results analysis will be presented during the congress.

Keywords: climate change, multi-hazard risk assessment, operational requirements, planning

process

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Remote Sensing Solutions for an Efficient Support of Forest Fire Management Phases

Almer Alexander

JOANNEUM RESEARCH

Abstract

Nowadays, dramatic increases in forest fires can be observed worldwide. In order to improve the protection of human lives and resources it is mandatory to support forest firefighting strategies and management solutions with innovative technical developments. The EU has initiated international co-operations and initiatives to provide interoperable systems and information in order to support prevention and firefighting efforts. The main goal is to protect human lives and resources and to reduce the negative environmental impact to a minimum. Different innovative remote sensing technologies allow processing geo-oriented information to enable targeted support of different disaster management phases and time-critical processes (Almer et al., 2017). The ESA offer significant contributions to disaster management, whereby the Copernicus Emergency Management Service (EMS) is an important service in this context is. The EMS provides up-to-date and accurate geospatial thematic information to all actors involved in the management of natural, human-induced disasters and humanitarian crises. The Forest Fire Information System (EFFIS) is one of the components of the EMS Copernicus program. In order to support time-critical phases, information products derived from satellite data lack of the possibility to acquire data on demand and generate information products within short time frames. Several years ago, this drawback led to start the development of an airborne as well as a UAV-borne multi-sensor platform. The goal was to realize efficient and fast data processing chains for acquired optical and thermal image data to enable custom tailored support for first responders within time-critical crisis response tasks. The resulting sensor platform ARGUS-Flex uses a very high-resolution optical camera with 150 MPxl as well as an optimised, forward motion compensated thermal-infrared system with 4 combined thermal sensors. It is designed for equipping planes, helicopters, ultra-light planes and large UAVs. The system allows rapid coverage of large areas with optical and thermal data. A similar but smaller and lighter sensor platform to equip smaller UAVs is developed as part of the project "NRT-COP". Here, an optical camera with 48 Mpxl resolution and two thermal cameras are integrated. Both platform systems utilize powerful GNSS/INS modules, which enables the direct and real-time geo-processing of gathered image data (Almer et al., 2015). With an appropriate data downlink, the first geo-referenced data are available in the management system one minute after taking the images on-board. This near-real-time common operational picture increases the efficiency of firefighting operations and also the safety of the emergency forces.

Keywords: remote sensing, fire detection, time-critical phases, near-real-time processing, flexible multi-sensor platform

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Post-fire restoration management: Effects on soil, vegetation and geomorphology

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Wildfires are a natural disturbance in Mediterranean forested ecosystems in which, fire suppression has altered natural fire patterns and increased fuel densities. By removing vegetation and altering soil chemical and physical properties, wildfires modify the hydrologic regime and promote soil degradation. Mitigating these fire effects on soil has resulted in increased use of post-fire treatments, in which soil stabilization treatments are crucial for diminishing the post-fire erosion risk as exposed by many different research experiments developed in Unites States or Europe. Post-fire treatment activities are divided into three categories: emergency stabilization, rehabilitation and restoration. Emergency stabilization treatments such as mulching to prevent soil erosion are conducted within one year of a fire to stabilize the burned area and reduce additional damage to valued resources. Most post-fire stabilization and short-term rehabilitation treatments are used to mitigate the post-fire effects on physical ecosystem components, such as soil, water, and hydrologic processes. Long-term rehabilitation and restoration activities are often more focused on the biotic components of the ecosystem, such as recovery of native communities and habitat, maintenance of biodiversity, re-establishment of timber or grazing species, and control of invasive weeds. Emergency post-fire actions may therefore be critical for reducing soil erosion, especially after clearcutting in areas affected by crown-fire, where soil is exposed to the action of rainfall and the amounts of logging debris may be low. On this context, knowing the Post-fire restoration management effects on soil, vegetation and geomorphology is of paramount importance.

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Evolution of Vegetation on the Left Bank of the River Unzha (Kostroma Region, Russia) after the Fire of 1972 - Results of 30 Years of Observation

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Abstract

On the left bank of the Unzha River, in the Makaryev and Manturovo Districts of Kostroma Region, a forest plot measuring roughly 30 km by 40 km was destroyed by fire during the hot summer of 1972. In 1988, a transect about 2.5 km long was laid from the edge of the river floodplain to the watershed, to observe regeneration in the fire zone. The crowns of the trees burned during the fire, but the trunks remained. Over the next 5 years, the trees were cut down. The dead trunks began to rot and tree felling stopped. In 1978, when the authors first visited the site, it was an open space, mostly overgrown with polytrichum mosses. There were a few small areas of unburned forest, which had mostly been affected by ground fire. Here and there one could see groups of standing dry trees. We subdivided the transect into three parts: dry, boggy, and channel (catchment hollow). During the observation period (1988, 1993, 1997, 2013-14, 2019) the polytrichum cover in the dry part changed: the polytrichum was replaced with lichens; pines began to grow; and the grass-shrub cover diminished with a simultaneous increase in the proportion of bearberry in it. On the boggy part, the height of the pines increased by 2–3 times, while birches grew more slowly. The size of the Ledum palustre and lingonberry cover increased and heather began to disappear. The vegetation in the channel zone was distinguished by high diversity and species richness. The forest stand increased in height but became less dense. When observations in the forest stand began, the prevailing species was Betula alba with some black alder and aspen. The proportion of black alder and aspen has now increased, and pine trees and individual spruce trees have appeared.

Keywords: Burning overgrowth, pyrogenic succession

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Burn severity and plant regenerative traits modulate vegetation response in different fire-prone Mediterranean ecosystems of the Iberian Peninsula

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Abstract

Fire is an important ecological element in the Mediterranean Basin. However, increases in fire frequency, burned area and burn severity may have relevant implications for these ecosystems. In fact, burn severity is one of the most significant factors affecting plant communities, since it has important effects on post-fire vegetation recovery. In addition, climatic conditions also influence the response of vegetation, mainly because of their effects in the productivity of the community. Thus, fire regimes have influenced the regeneration mechanisms of many plant species in Mediterranean ecosystems, which present regenerative traits that allow them to persist after fire. Therefore, the biological potential of plants is relevant to evaluate the damage cause by fire in these ecosystems. To evaluate burn severity effects on vegetation regeneration regarding of different plant regenerative traits, we focused on two wildfires occurred in 2017 in different areas of de Iberian Peninsula: the Cabrera wildfire (NW Spain), which burned 9939 ha of ecosystems dominated by *Genista hystrix* Lange, *Erica australis* L., *Cytisus scoparius* (L.) Link, and *Quercus pyrenaica* Willd,; and the Gátova wildfire (SE Spain), which affected 1414 ha of *Pinus halepensis* Mill. forests. We randomly fixed a total of 384 and 80 field plots (2 m x 2 m) in Cabrera and Gátova, respectively, covering fire perimeters and unburned areas. After this, burn severity was evaluated at every burned plot by the application of the CBI index (Composite Burn Index). One year after the wildfires, the percentage cover of each woody species was evaluated at each plot. To analyse vegetation changes over time, burned plots were also sampled two years after fire. We classified the species according to the following regenerative traits: reproductive strategy (resprouter, obligate seeder or facultative), bud bank location (aboveground and belowground) and heat-stimulated germination (yes or no). According to the main results, vegetation cover in Cabrera tended to increase under high severity situations with respect to low and moderate severities. However, resprouters and obligate seeders with heat-stimulated germination responded better to burn severity. In Gátova, vegetation recovery showed greater variation among plant traits. In this area, facultatives and heat-stimulated species regenerated better at high severities, but the cover of the dominant vegetation decreased with burn severity. In general, we observed an increment in cover values over time in both areas, but better climatic conditions could have favored regeneration in the Cabrera study site with respect to Gátova.

Keywords: Burn severity, regeneration, reproductive strategy, wildfire

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Evaluation of soil burn severity using very high spatial resolution products from Unmanned Aerial Vehicles (UAV)

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Abstract

The evaluation of soil burn severity at fine scale is one of the main challenges in fire ecology. The innovative technology of unmanned aerial vehicles (UAV) provides highly detailed spatial information that could be used to characterize accurately different attributes of burned areas. The main purpose of this study was to assess the ability of very high spatial resolution spectral indices derived from RGB and multispectral imagery collected by UAVs to discriminate soil burn severity after a wildfire. We evaluated soil burn severity one month after a wildfire occurred in the León province (NW Spain) in August 2019, which burnt 83 ha in a heterogeneous forest area. We fixed 80 square plots of 50 cm × 50 cm where an adaptation of Composite Burn Index (CBI) was applied to estimate soil burn severity levels. Simultaneously, we operated an UAV to obtain RGB and multispectral postfire images, which allowed us to calculate six widely used spectral indices: Excess Green Index (EGI), Green Chromatic Coordinate Index (GCC) and Char Index (CI) from RGB camera, and Normalized Difference Vegetation Index (NDVI), Normalized Difference Vegetation Red Edge Index (NDVIRE) and Normalized Difference Water Index (NDWI) from Parrot Sequoia multispectral camera. We explored the relationship between spectral indices and field soil burn severity metrics by means of univariate proportional odds (PO) regression models. These models were used to establish threshold values for each soil burn severity category (low, moderate and high). These classifications were validated through confusion matrices. Results indicated that multispectral indices were more strongly related to the soil burn severity than RGB indices. NDWI featured the best performance in univariate PO models (R^2cv = 0.6893) and soil burn severity category predictions (overall accuracy (OA) and Kappa of 83% and 0.74, respectively). High NDWI values showed high probabilities to distinguish accurately severely burned areas. Regarding RGB indices, CI was the best predictor of soil burn severity (R^2cv = 0.44; OA = 58% and Kappa = 0.34). Our results showed the ability of UAV multispectral and RGB images with a very high spatial resolution to assess soil burn severity in landscapes affected by mixed-severity wildfires. UAV remote sensing technology might be a valuable tool for the identification of priority areas where restoration actions need to be applied to reduce the ecological impacts of wildfires.

Keywords: soil burn severity, Unmanned Aerial Vehicle, UAV, spectral indices, Parrot SEQUOIA

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Micromorphological changes in soil affected by a prescribed burn: the Sierra de Manantlán case, Jalisco, México.

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Abstract

Prescribed burn (PB) is a valuable management tool for reducing the probability of wildfires. PB consists of applying fire under controlled conditions to minimize the charge and the continuity of forest fuels. PB must be a low soil burn severity (SBS) event to prevent physical, chemical, and biological soil properties deterioration. Some works suggest that after a PB event, the most significant impacts on chemical soil properties are: the organic matter thermal modification due to the aromatic structures formation; the increase of the concentration soil available nutrients; the increase of pH and hydrophobicity. Physical properties are also affected (colour, structure, bulk density, among others). Changes in the soil structure have been also evaluated, but not at micromorphological level. In consequence, this work aims to assess soil micromorphological changes after a PB in the pine forest of *Reserva de la Biósfera Sierra de Mantlán*, Jalisco, México in March 2017. Unaltered samples were collected, following a SE-NW-200 m transect, every 25 m, at a depth of 10 cm, 28 h after fire. From undisturbed samples, thin sections were obtained for micromorphological analysis that was made in a petrographic microscope. The results reveal that in this thermic event, litter and soil organic matter were affected. The combustion process oxidized organic components until charred, and in some cases, ash was the final product of this process. In thin sections, numerous soil fire evidence were detected, including ashes, charcoal fragments, different charred vegetal materials, burning pellets, and charred, fractured, and reddened aggregates. The mineral soil was only affected in the first 2 cm. Mineral soil fraction exhibits reddish colour in very few punctual zones and a partial structural loss. With this microscopic evidence and field assessment, we determined that the soil burn severity level was 2 that corresponds to a low SBS with surface temperatures of < 250 °C. Therefore, this PB event accomplished its purpose.

Keywords: Prescribed burn, soil burn severity, micromorphology.

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Analysis of vegetation regeneration after a wildfire in Portugal using the Google Earth Engine (GEE) platform

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Abstract

Wildfires represent a significant risk to the environment and the population. In recent decades Portugal has been one of the European countries most affected by wildfires, and although most occurrences burn a small area, some take on large dimensions, becoming Large Wildfires (GIF), which have increased in frequency, intensity, and destructive capacity. In this paper, we analyze the regeneration of vegetation in the area affected by the GIF that runs in the municipality of Baião in 2019. Consequently, the land use and occupancy (LUC) and the vegetation regeneration after 6 months and after 1 year were mapped. The study was organized into 2 steps: in the first one we proceed with the characterization of the GIF; and in the second we performed an evaluation of the vegetation regeneration according to the land use. In the 1st step, for the fire mapping the NBR spectral index was applied on a Sentinel 2 image, and for the LUC mapping we used the COS 2018. The cartographic data were manipulated and analyzed using GIS software. In the second step Sentinel 2 images were used and dNBR spectral index application was done for the evaluation of vegetation regeneration. The processing of the images was performed on the Google Earth Engine platform (GEE). The GIF of Baião burned an area corresponding to 853ha in a single occurrence and was the third-largest GIF in 2019. Regarding the evaluation of vegetation regeneration 6 months after the fire, we identified that 40.7% of the area showed high vegetation growth and 20.8% low vegetation growth. 1 year after the fire, 62,2% of the area showed high vegetation growth and 21.1% low vegetation growth. About the land use and land cover type, 6 months after the fire, 6.3% (53.8ha) of forest and 31.8% (271.4ha) of bush showed high vegetation growth. 1 year after the fire, 17.6% (150.4ha) of forest and 43.4% (370.2ha) of bush showed high vegetation growth. We can verify that 1 year after the fire, the area occupied by the forest and bush classes, which were hit by high severity, already presents significant levels of vegetation regeneration. We can conclude that for the studied area, an increase in high regeneration was recorded, going from 15% to 42% in forest areas, from 6 months to 1 year, and from 58% to 80% in bush areas, also from 6 months to 1 year.

Keywords: Vegetation recovery, Large Wildfire, Sentinel 2, Google Earth Engine, Land use and land cover.

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Long-term erosion and the impact of wildfires: two different approaches.

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Abstract

Mediterranean countries, such as Portugal, are often associated with land degradation risks, which in association with water erosion puts an increasing pressure on ecosystem services (Grift, 2021). On those countries erosion is often driven by heavy rainfall events, steep slope angles and in some cases lack of vegetation cover (Grift, 2021). Mostly of the wildfires in Portugal occurred in forests and shrublands (Mateus and Fernandes, 2014) during the drier and warmer summer, which usually are followed by rainfall events that easily provoke runoff and erosion. In fact, generally after a wildfire three main erosion contribution processes happen: i) a reduction of interception and evapotranspiration; ii) a decrease in infiltration and soil water retention; iii) a reduction in obstacles (Grift, 2021). From a connectivity perspective, burnt areas tend to increase sediment connectivity by changing vegetation cover and physico-chemical soil properties (Grift, 2021). Connectivity indices have been proposed as a simple and fast way tool to identify erosion hotspots and prioritize soil restoration, but it is difficult to validate those indices due to the lack of spatially distributed erosion data. Taking this in mind, this study aims to assess sediment connectivity using two different approaches. The methodology comprises i) a physically based model that is able to investigate long-term and large-scale spatial landscape evolution, namely Landscape Process Modelling at Multi-dimensions and Scales; and (ii) an index that can be calculated in a geographic information system environment and represents a connectivity assessment based on local landscape's information (Borselli et al., 2008) . Results include (i) the connectivity description in the context of specific events using two different approaches; and (ii) comparison between the approaches used. The authors believe that assessing the spatial-temporal evolution of connectivity in the actual landscape with the right tool is extremely important to estimate the probability that a given part of the landscape transfer its contribution elsewhere in the catchment.

Keywords: Erosion, Sediment connectivity, post-fire, Connectivity indices, modelling approach

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Spatial-temporal variability of vegetation regrowth and topsoil elements after prescribed fire in the pre-mountain area (Croatia)

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Abstract

Prescribed fire in pre-mountain Croatia is a widespread traditional agricultural practice used in late winter or early spring mainly for weed control. Prescribed fire turns vegetation into ash, the nutrients of which are either leached into the soil or removed by erosion, depending on climatic conditions (rain and wind). The ash contains high quantities of nutrients that depend on the species burned. Although, due to its frequent use in this region, there is a lack of information on the effects of this type of fire on the spatial-temporal vegetation regrowth and soil chemical properties. To address this issue, a prescribed fire was conducted on an experimental plot (30 m long x 35 m wide) with slight differences in slope gradient on March 2, 2021. The experiment is located in the hinterland of Otočac City (44°52'N 15°14'E; 490 m a.s.l.). Soil type of study area is Cambisols. The vegetation cover consisted of various species such as meadow plants, fern (*Pteridium aquilinum*), blackberry (*Rubus fruticosus*), and dogberry tree (*Cornus mas*). Soil sampling (6 points in 5 rows) and vegetation cover monitoring were conducted immediately before fire (IBF), 7 days after fire (DAF), 1, 3, and 6 months after fire (MAF). The variables studied were: vegetation cover (VC), soil pH, EC, and total content of Al, Si, P, S, K, Ca, Ti, Cr, Mn, Fe, Ni, Cu, Zn, As, Rb, Sr, Y, Zr, Nb, Pb, and Th. After a prescribed fire, VC was gradually increased with full cover on each sampling point 3 MAF. Significantly higher increase in soil pH, EC, and P was observed 7 DAB compared to the other dates. The studied soil elements did not show much variability in spatial distribution, indicating low severity fire and low impact of erosion. Principal component analysis (PCA) was applied to identify the relationship among study soil properties and VC for each sampling date. Overall, PCA showed that prescribed fire changed the relationship between the studied variables at each date, especially in the case of VC, pH, EC, Ca, P, K, Al, Mn, and Co which can be attributed to the effects of rainfall during the study period. Due to the low impact on the spatial-temporal variability of topsoil elements and the rapid vegetation regrowth, prescribed fire can be recommended for land management.

Keywords: agricultural practice, ash, nutrients, fire, management

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Modelling Forest Fire and Post-Fire Mitigation Measures: Impacts on sediment yield

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Abstract

A forest fire may change soil properties, alter the hydrological processes, and increase soil erosion. To mitigate the effect of fire on erosion, post-fire rehabilitation measures are used. The aim of this work was to predict the effect of forest fire and post-fire mitigation measures on runoff and specific sediment yield (SSY) in a mountainous river basin (Celone, S-E Italy). The Soil and Water Assessment Tool model, calibrated with field observations, was used to evaluate runoff and SSY for the current land use (baseline) and for six post-fire scenarios. From 1990 to 2011, at the basin scale, the average annual SSY was 5.60 t ha^{-1} y^{-1} (SD = 3.47 t ha^{-1} y^{-1}). The 20% of the total drainage area showed a critical value of SSY (>10 t ha^{-1} y^{-1}). Different fire-severity levels were analysed acting on a limited burnt area (2.3% of the basin). At the basin scale, the post-fire effect on surface runoff was negligible for all the scenarios except for the high-severity fire and post-fire logging (Fr1), and the impact on SSY was an increase up to 12.05 t ha^{-1} y^{-1}. At the subbasin scale, Fr1 scenario showed the highest increase in soil loss (57.4 t ha^{-1} y^{-1}), meanwhile, the post-fire mitigation treatments such as straw mulching and erosion barriers were effective to reduce soil erosion in high- and moderate-severity fires (19.1 t ha^{-1} y^{-1} and 21 t ha^{-1} y^{-1}, respectively). At the hydrologic response unit level, SSY estimated for the forest in the baseline ranged from 1.18 t ha^{-1} y^{-1} to 2.04 t ha^{-1} y^{-1}. It increased more than one order of magnitude for the high-severity fire scenarios and ranged from 4.33 to 6.74 t ha^{-1} y^{-1} in the very low-severity fire scenarios. This work provides a contribution to post-fire risk management.

Keywords: forest fire, sediment yield, runoff, SWAT model, post-fire mitigation measures

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TERRAMATER project: A tool for post-fire rehabilitation and restoration of soils

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Abstract

In recent years the risk of wildfires in the regions located in the Portuguese-Spanish border varied between moderate to high or very high. The loss of the vegetation cover and the presence of huge areas of unprotected soil due to the occurrence of large wildfires, as well as the limited post-fire protection actions, have increased the risk of soil erosion to catastrophic levels. Thus, it is crucial to act immediately to restore the ecosystem, avoid or minimize the soil erosive processes and the impact to the forest masses in the affected areas. The main objective of the TERRAMATER project is the recovery of the environmental, ecological and productive functions of burnt areas, reducing soil losses due to erosion and increasing soil resilience to future episodes of wildfire. The improvement of ecological functions in the recovered areas also aims to reduce the threat of pests in the neighboring forest masses. This will be achieved by remediation actions conducted in soils affected by wildfires or prescribed fires, including the application of soil amendments based on the use of technosols obtained from organic wastes and industrial byproducts. The soil plots selected for the study correspond to areas in the north of Portugal and northwest of Spain, dominated by either Atlantic-type or Mediterranean-type shrublands. The amendments will be previously formulated and tested under controlled conditions according to the soil information obtained and the local knowledge of post-fire ecological conditions. Also, the biogeochemical processes associated with the recovery and improvement of the quality of the affected soils will be taken into account. The application of the technosol amendments, will produce an increase in the organic carbon pools and promote the protection and improvement of the soil quality, which will result in an opportunity for ecological restoration of burnt areas and the subsequent reduction in emissions of greenhouse gases. Finally, this application will help to minimize the pollution of water bodies close to the burnt areas resulting from the runoff of nutrients and suspended materials from ashes.

Keywords: post-fire, soil rehabilitation, soil management, technosol, amendment

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Prescribed fire and soil mulching with fern in Mediterranean forests: Effects on surface runoff and erosion

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Abstract

Prescribed burning is increasingly used to reduce the wildfire risk, and the need to limit runoff and erosion suggest treating burned soils with mulching. To this aim, fern residues may be more advisable compared to the commonly used straw, since this material is directly available in forests and has lower drawbacks. However, the post-fire hydrological effects of both prescribed fire and soil mulching are contrasting in literature, and fern has not previously experimented as mulching material in Mediterranean forests. To fill these gaps, this study has evaluated the soil hydrological response in small plots installed in three Mediterranean forests (pine, chestnut and oak) after a prescribed fire and mulching treatment with fern. Compared to the unburned soils, runoff and erosion significantly increased immediately after fire (by 150% to 375% for the runoff coefficients, and by 100% to 800% for the soil losses). However, these increases are much lower compared to the highest values reported by some studies. The negative impacts on the hydrological response in burned soils were limited to three-four months. Subsequently, the pre-fire runoff and erosion rates of the burned soils were practically restored, and the hydrological changes were not significant compared to the unburned soils. In the short term after prescribed fire application, soil mulching with fern residues was effective to limit the increase in the hydrological response of the burned and not treated soils, since runoff coefficients and erosion were reduced by 25-30% in oak soils and 70-80% in chestnut and pine forests. The changes surveyed in soil hydrology were associated with variations in the infiltration rates and water repellency immediately after fire, previously detected in the same experimental site. The restoration of water infiltration rates and disappearance of soil repellency gained importance over time, and the incorporation of mulch residues become beneficial in driving the short-term runoff and erosion response of the burned soils.

Keywords: ecological engineering techniques, post-fire management, hydrological response, pine, chestnut, oak.

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Short-term hydrological response of soil after wildfire in a semi-arid landscape covered by Macrochloa tenacissima (L.) Kunth

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Abstract

A proper management of semi-arid landscapes affected by wildfire is needed to reduce its effects on the soil hydrological response in the wet season. Despite ample literature on the post-fire forest hydrology, it is not well documented how the hydrologic processes respond to changes in vegetation cover and soil properties of semi-arid lands after wildfire. To fill this gap, this study evaluates soil hydrology in a semi-arid soil of Central Eastern Spain dominated by *Macrochloa tenacissima* (a widely-spread species in Northern Africa and Iberian Peninsula) after a wildfire. Rainfall simulations were carried out under three soil conditions (bare soil, and burned or soils with unburned vegetation) and low-to-high slopes, and infiltration, surface runoff and erosion were measured. Infiltration rates did not noticeably vary among the three soil conditions (maximum variability equal to 20%). Compared to the bare soil, the burned area (previously vegetated with *M. tenacissima*) produced a runoff volume lower by 27%, while, in the area covered by the same species but not burned, the runoff was lower by 58%. The burned areas with *M. tenacissima* produced soil losses that were similar as those measured in bare soils, and, in steeper slopes, even higher. Erosion was instead much lower (-83%) in the sites with unburned vegetation. Overall, the control of erosion in these semi-arid lands is beneficial, to reduce the possible hydrological effects downstream of these fire-prone areas, and, in this direction, the establishment of vegetation strips of *M. tenacissima* in large and steep drylands with bare soil left by fire may be suggested to land managers.

Keywords: water infiltration, bare soil, runoff, soil loss, rainfall simulator.

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Effect of fire on the composition of flowering plants and the abundance of pollinators in a Mediterranean ecosystem

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Abstract

Flowering plants and pollinators were surveyed along the perimeter of a burned area resulting from a fire that occurred in august 2018, and which affected approximately 3270 ha in the municipalities of Gandía, Llutxent, Pinet, Ador, Barx, and Quatretonda (Valencia). Three different sites were surveyed, two were located in the municipality of Pinet, and one was located at the border between the municipalities of Barx and Quatretonda. Plants and pollinators were surveyed approximately 50-100 m along the fire perimeter, and up to approximately 100 m from the fire perimeter into burned and unburned areas. Here we present a subset of the data collected during surveys conducted from October 2018 to December 2020. There were significant differences in the species composition of flowering plants as well as in the abundance of pollinators between burned and unburned areas. In unburned areas, the most attractive flowering plants to pollinators were nanophanerophytes in the families Lamiaceae and Ericaceae, while in burned areas, the most-visited plants by pollinators were hemicryptophytes and terophytes, such as some species in the families Apiaceae and Resedaceae. The most common pollinator was the honey bee, *Apis mellifera* L.

Keywords: Floral visitors, flowers, insect pollinators, wildfire

Acknowledgments: We thank Emili Laguna and Josep Oltra for help with plant identification. Funding provided by the Spanish Ministry of Science, Innovation, and Universities, grant PGC2018-096569-B-I00.

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Evaluating the potential of prescribed burning for the biodiversity conservation of European grasslands

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Abstract

Prescribed burning, the planned and controlled application of fire, is a well-established tool for biodiversity conservation in a plethora of habitats globally. In European grasslands that are threatened hotspots of biodiversity, prescribed burning management has the potential to address challenges related to several threats such as abandonment, climate change, or invasive species. However, its potential is seldom realized both in experimental and real-world conditions. We reviewed the European studies on prescribed burning in grasslands and evaluated the potential contributions of prescribed burning to the conservation of European grasslands (Valkó & Deák 2021). None of the reviewed studies applied natural-like fire regimes, but used either yearly burning of the same parcels for many years or tested the effect of a single prescribed fire event. Too frequent burning does not resemble natural fire regimes and does not allow the regeneration of the vegetation between burns, hence many of these studies found several negative effects of fire on biodiversity. Studies on single prescribed fires often had more promising results than those applying yearly burning, however the favourable short-term effects are less persistent than in case of a complex fire regime with well-suited fire return intervals. To increase the potential of prescribed burning in the management of European grasslands, we suggest adapting the fire regime concept in future studies to determine optimal PB regimes based on experimental approaches, paleo-data, and the disappearing traditional ecological knowledge.

Keywords: biodiversity conservation, European grasslands, grassland management, prescribed fire, review

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Valkó, O., Deák, B. (2021): Increasing the potential of prescribed burning for the biodiversity conservation of European grasslands. Current Opinion in Environmental Science & Health 22: 100268

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Fire on the screen: media, cinema and video-storytelling

Enric Castelló

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Media and popular culture are paying increasing attention to wildfires. Television and cinema, in particular, are reporting and representing forest fires in a variety of genres and formats. In recent years, with the proliferation of superfires, these representations also involve the spectacularization of forest fires by exploiting dramatic perspectives and the mediatization of firefighting. As well as providing entertainment, television networks and media spend an enormous amount of time and effort on reporting the tragedies caused by forest fires, sometimes replicating the aesthetics of drama and fiction. How do all these productions interact with scientific efforts to prevent and extinguish wildfires? Are journalistic or entertainment productions in tune with risk communication premises? This session is open to research work and reflections on how forest fires have been represented on screen. A call is made for studies on television coverage, reports and documentaries, as well as in-depth readings of cinematographic productions or more ethnographic approaches to working with video-storytelling. The session is also open to journalists, filmmakers, or producers who will talk about their experiences in covering forest fires. The call is open to: - Analyses of audiovisual journalistic coverage of forest fires. - Studies on the spectacularization or journalistic frames of wildfires. - Close reading of documentaries and fictions focused on wildfires. - Scientific evidence on the impact and influence on audiences. - Studies on audiovisual, TV or cinema productions, from documentaries to fictions.

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‘Firestorm’, beyond the attraction for devastation: Context, scientific information and emotion to shape a compelling multimedia story

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Abstract

The framing of environmental issues performs a leading role in understanding the dimension and ways to respond to natural and man-made disasters (Pantti, 2019), mainly linked to global warming. Research revealed the trend of turning them into a “media spectacle” (Schröder, 2010, 190), focusing on the catastrophe and the “visual pleasure that makes it possible to enjoy the disaster as a spectacle” (Nusser, 2015, 129). This paper analyses the multimedia Firestorm, launched by The Guardian in 2013, to reconstruct how a family faced one of the bushfires which occurred in Tasmania, Australia, in 2013. This case study delves into the journalists role as “moral story-tellers” in “interpreting disasters, their causes, and their effects, as well as in facilitating adequate responses” (Pantti, 2019). Firestorm is an nonfiction visual storytelling that allows an immersive reading experience (Dowling & Vogan, 2015). Using a qualitative methodology, this research answers these RQ: How is the human story embedded in the broader context of the history of bushfires in Tasmania and global climate change?; Is this production in tune with scientific efforts to prevent and extinguish wildfires? Preliminary conclusions show that Firestorm makes use of audio, video, writing, photography and maps to produce a compelling story. Taking the iconic smartphone pictures by a Tasmanian grandfather who escaped from fire, Firestorm balances personal and contextual information. It benefits from the involvement of citizens in making more human and accessible environmental disasters (Pantti, 2019). Unlike other media coverage, it is beyond the narratives purely centered on destruction. It relies on the role of emotion (Wahl-Jorgensen, 2013), linked to a scientific and technical explanation on how climate change fueled forest fires. The multimedia also opens the debate about the mismatch between the nowadays life and the flammable environment.

Keywords: environment, wildfire, media spectacle, multimedia storytelling, Firestorm

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Valencia, Spain, 3-7 November, 2021

Improving Wildfire TV Coverage: Lessons from a Spanish summer (2021)

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Abstract

This paper studies TV coverage of wildfires in Spain. The research contributes to previous studies on wildfire media coverage (e.g. Fabra-Crespo & Rojas-Briales, 2015; Karyotakis, 2021; Morehouse & Sonnett, 2010), and on public framing on the issue (e.g. Castelló & Montagut, 2019; Seijo, 2009). The aim was to identify salient topics in the stories and innovative ways of reporting. The research focused on two public channels (TVE/TV3) and covered one month (15th July to 15th August). The corpus was selected using the search engine of the corporations' online platforms. The search terms were 'incendio'/'incendi' and the corpus (59 pieces, 101 min and 14 sec) only included reports on Spanish cases. The study applied a textual analysis that recorded the aspects highlighted in the reports. The results reveal that recurrent aspects are the cause of the fires, the extent of the fire damage, the direction of the fire and the weather conditions, the evacuation of people, and the firefighting equipment. Secondary issues were the natural value of the area, the height of the flames and smoke columns, and material losses. Common images were of the burning forest, air support and the damaged areas. Some of the footage was provided by institutions (importantly for the Catalan case by the Firefighters of Catalonia [Bombers de Catalunya]). The research shows that short reporting consistently follows a pattern of topics and images. However, it also detected innovative ways to supplement these reports on the extinction of the fires, especially on the Catalan public channel. These were more explanatory pieces focusing on such aspects as wood management, forest property or rural investment as long-term causes of the fires. Despite the little time dedicated to it and the TV format, wildfire coverage is increasing more reflective perspectives and broader approaches to fire suppression and prevention, which now is including such aspects as forest management, environmental policies and property structure. The author suggests that quality journalism should pay attention to aspects of fire prevention before and after fire seasons and this trend of improvement, especially detected for the Catalan public television, should be reinforced soon in wildfire coverage and reporting. Stressing on previous recommendations for journalists (Ballart et al., 2016; Plana, 2011), it is also suggested that the media should make greater effort to deseasonalize news production on wildfire management and prevention.

Keywords: wildfire reporting, crisis reporting, risk communication, wildfire journalism

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Disinformation Analysis on Wildfires Through Fact-Checking Verification in Spain

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Abstract

The media ecosystem where citizens must coexist and in which the amount of information that arrives through multiple platforms can generate 'infoxication' is denominated 'information disorder' by the UNESCO (2018). Within this 'disorder', false information deliberately distributed by political, social and media actors to obtain all kinds of revenues is increasingly generating a public health risk, where citizens do not have all the relevant information to make informed decisions on various issues. Popularly called 'fake news', the disinformation phenomenon generates misperceptions that benefits whoever distributes it. In the case of wildfires and their media coverage, the interpretative frameworks available in each context have led to highly divergent views, focusing on causes such as: a) the individual responsibility of an arsonist; b) the economic motivations of political parties and lobby groups; and c) the political and collective responsibilities in relation to climate change and forest management (Castello & Montagut, 2019). In this context, disinformation related to wildfires confuses and polarizes the public debate, generating erroneous and banal views. This study analyses the types of disinformation present in false publications –texts, pictures, graphics– detected by fact-checkers in Spain –Maldita, Newtral, Verificat– regarding the topic 'wildfire'. A total of 41 verifications collected by these media between 2017 and 2021 have been analysed. Findings show that the most common type of falsehoods are false context and manipulated content. Furthermore, results also reveal the misinformation strategies present in sample (that is, content that is not intended to deceive but which can be confusing or misleading). In this case, the most common type of falsehoods are false connection and misleading content. Similarly, findings indicate that Spanish fact checkers not only verify false, partially false, and confusing information regarding wildfires in Spain, but their work also focus on global natural disasters such as the great fires of the last 3 years in Australia and Brazil. Therefore, this shows how false content produced in other media contexts can also become viral in Spain, thus connecting the disinformation phenomenon between different cultural environments.

Keywords: wildfires disinformation misinformation fact-checker Spain

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Valencia, Spain, 3-7 November, 2021

Round table with filmmakers and media professionals

Enric Castelló (Coord.)

Universitat Rovira i Virgili

Abstract

In this round table we talk with filmmakers and photojournalists who cover wildfires and their consequences. The session consists of short presentations in which they explain their projects and impact. The aim is to collectively reflect on the mission of audiovisual work on wildfires, and on aspects surrounding the production of their works. The session will also focus on the social impact of fire coverage and the increasing importance that media put on wildfires. We shall discuss the extent to which reporting is contributing to better public understanding and awareness of risk, and how people can activate their agency to transform wildfire realities. We will also talk about aesthetics, ethics and the media, and documentaries as tools for popular science and the spread of knowledge. Before the session, we recommend that you watch the works by the participants and the projects they have taken part in.

Participants:
- Enric Castelló, associate professor at Universitat Rovira i Virgili (Tarragona, Spain), researching on wildfires and the media.
- Lucy Walker, filmmaker and director of Bring your own brigade (2021)
- Patrick Ryan, co-founder and director of Vulcan Wildfire Management and professional image maker focussed on capturing the essence of wildfires
- Josh Edelson, internationally published freelance photojournalist specialized in wildfires and natural disasters.
- Eduard Plana, forest engineer and co-author of forest fires guidelines for journalists

Keywords: Wildfires documentary, wildfires photography, wildfires media coverage, wildfires communication

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Valencia, Spain, 3-7 November, 2021

Takes two to tango: Making sense of the California 2020 wildfire season Trump-Newsom political blame game

Seijo, Francisco

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Abstract

The 2020 wildfire season in California was exceptional for various reasons. First it shattered various statistical records in terms both of the number of fire incidents reported, 8,420 as well as burnt acres, 3,704,195; both were the highest reported figures since 1987. Second, it was also marked by an unprecedented political controvery between the then president of the United States Donald Trump and the governor of California Gavin Newsom. While the former argued that the California wildfires were the result of negligent fire management on the part of the state government the latter blamed the presidential administration's inaction regarding climate change as the main underlying driver of what both described as "the most destructive wildfire seasons in recent history". In this study we use framing and fire ecology theory to make sense of the political controversy surrounding the 2020 California wildfire season finding, like Buffalo Springfield, that "nobody's right if everybody's wrong". We specifically explore the issue in light of the current debate concerning "directional motivated reasoning" versus "accuracy motivated reasoning" in the interpretation of climate change related scientific evidence and point to the need for building an epistemic community frame that can effectively offset the increasing flammability of escalating political rhetoric regarding wildfires and their connection to the overarching climate change issue.

Keywords: Framing theory, California 2020 wildfire season, Fire ecology

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Round table with filmmakers and media professionals

1ST INTERNATIONAL CONGRESS ON FIRE IN THE EARTH SYSTEM: HUMANS AND NATURE. 3-7 NOV 2021. VALÈNCIA (SPAIN)

ROUND TABLE WITH FILMMAKERS AND MEDIA PROFESSIONALS

NOVEMBER 4TH, 18.20 PM (CEST) ON-LINE

In this round table we talk with filmmakers and photojournalists who cover wildfires and their consequences. The session consists of short presentations in which they explain their projects and impact. The aim is to collectively reflect on the mission of audiovisual work on wildfires, and on aspects surrounding the production of their works. The session will also focus on the social impact of fire coverage and the increasing importance that media put on wildfires. We shall discuss the extent to which reporting is contributing to better public understanding and awareness of risk, and how people can activate their agency to transform wildfire realities. We will also talk about aesthetics, ethics and the media, and documentaries as tools for popular science and the spread of knowledge. Before the session, we recommend that you watch the works by the participants and the projects they have taken part in.

Enric Castelló, associate professor of Communication Studies at Universitat Rovira i Virgili, researching on wildfires and media (Coord.)

Enric Castelló is Associate Professor at the Department of Communication Studies and member of Asterisc Communication Research Group at Universitat Rovira i Virgili. He is actively engaged in research on rural studies and communication. He is now starting a new research line on media and wildfires. He was invited researcher at Glasgow Caledonian University and Loughborough University. Among his recent studies, he is coauthor jointly with Marta Montagut of Framing Forest Fires and Environmental Activism: A Storytelling Contest about Human Intervention in Nature.

Lucy Walker, filmmaker and director of *Bring your own brigade* (2021)

Lucy Walker is an Emmy winning, two-time Oscar-nominated director renowned for creating riveting, character-driven nonfiction that delivers emotionally and narratively. Her latest film *Bring your own brigade* (2021), about wildfires in California, was released theatrically by Paramount. Her previous films include *Buena Vista Social Club Adios* (2017), *The Lion's Mouth Opens* (2014), Emmy-winning *The Crash Reel* (2013), Oscar-nominated *Waste Land* (2010), Oscar-nominated double-Emmy-nominee *The Tsunami and the Cherry Blossom* (2011), *Countdown to Zero* (2010), *Blindsight* (2006), and triple-Emmy-nominated *Devil's Playground* (2002). *Ram Dass, Going Home* (2018), which Lucy Executive Produced, and *Click Bait* (2021) which Lucy produced, are currently on Netflix. For her television directing Lucy has been nominated for three Emmys. She curates TEDxVeniceBeach. She grew up in London and graduated from Oxford before winning a Fulbright to earn her MFA in Film at NYU. She also had a successful career as a DJ.

Patrick Ryan, cofounder and director of Vulcan Wildfire Management, professional image maker focussed on capturing the essence of wildfires and their management

Patrick Ryan is not only an image maker with a focus on wildfires but is also a professional wildfire manager/firefighter and executive director of Vulcan Wildfire Management. Over the years his image work has received Nominations and an Honourable Mention in the International Colour Awards. He assessed and narrated the documentary *Walking with Fire* (2019), directed by Justin Sullivan, that focussed on wildfire management in South Africa. He also narrated and created the shorts/playlist *Knysna Fires* 2017 (2017,2020) to accompany the Situational Analysis of the Knysna Fires 2017: Lesson Learned Report for the Western Cape Government. His photographic works are also available: *The Line*, *Ashes*. You can view more work on Instagram @patrickryanimages.

Josh Edelson, internationally published freelance photojournalist specialized in wildfires and natural disasters

Josh Edelson is a freelance photographer and specializes in wildfires and natural disasters. His pictures are published in the most important media and news agencies, including The Wall Street Journal, The Los Angeles Times, Associated Press, Agence France-Presse and Getty Images among others. His work on wildfires and their effects is a powerful and touching first-hand view of the climate crisis in action. Fires are one of his favorite things to cover. He is winner of the 2021 Covering Climate Now Journalism Awards in the section of Photography for his job for AFP Heart of Fire about the California wildifres in 2020. When he is not photographing wildfires or natural disasters, Edelson can be found shooting CEO headshots, corporate events, and advertising for fortune 500 companies throughout California and beyond.

Eduard Plana, forest engineer and co-author of forest fire guidelines for journalists

Eduard Plana is a forest engineer and Msc. in Wildfires Management and is heading the Forest Policy and Risk Governance department at the Forest Sciences and Technology Centre of Catalonia. He approaches wildfire risk management from an integrated and inclusive perspective, where risk awareness and culture, planning and governance, and socioeconomic and environmental dimensions area cross-linked. He is co-author of a document with guidelines for communicators and journalists covering wildfires and booklet on myths and facts about wildfires in the Mediterranean. He has been interviewed in several media programs leaded several EU R+D project in the field of civil protection, with a specific focus on the changing impacts of natural hazards to society in a climate change context.

Conference tours

November 5, 2021

Visit to the Chulilla and Dos Aguas forest fire (2012). Raül Quilez and Artemi Cerdà. The dynamics of the fire and the recovery of the Mediterranean maquis. How forest fires teach us. Lunch with stakeholders.

November 6, 2021

Vist to the Replana (Beneixama) forest fire (2019). Emili Pons, Ferran Gandia and Artemi Cerdà. What should be not do after a forest fire. Lunch with stakeholder.

November 7, 2021

Visit to the Pinet forest fire (2018). Artemi Cerdà. The recovery of the natural vegetation and the restoration works. Cork oaks as an adapted tree. A debate. Lunch with stakeholders.

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