FIREURISK - DEVELOPING A HOLISTIC, RISK-WISE STRATEGY FOR EUROPEAN WILDFIRE MANAGEMENT

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Executive Summary

The FirEURisk European project organized the PS4-Barcelona Pilot Site pilot site demonstration event in Barcelona (7/6/2023), bringing together landscape, forest and fire managers to explore and evaluate key research outcomes. The event, held at a facility of the Diputació de Barcelona (Recinte Mundet), centred on the project's integrated wildfire risk strategy, showcasing a range of prevention resources and facilitating collaboration within the professional community. Project demo events aim to show how project products work jointly in integrating risk assessment, reduction and adaptation, as each product generated belongs to one of these phases. At this event, however, products presented were linked to WP1, focused on Risk Assessment, as it was the first of the six planned, and it was conducted early in the project timeline for WP5. These products and other risk product components for the three risk phases in the integrated wildfire risk strategy are addressed in later demos and the corresponding deliverables.

During the workshop, a series of sessions addressed danger assessment critical components such as fire weather and ignitions. Experts presented innovative products, estimating dead fuel moisture measurements, predicting live-woody fuel moisture content, assessing the likelihood of lightning and human-caused wildfire ignitions, and conducting product evaluation surveys. Participants responded positively to the explanations, indicating interest in additional elements such as fuel characteristics and live to dead fuel transitions. While challenges in implementation were acknowledged, particularly in technical aspects and ownership of forest land, the methodology's comprehensiveness and the products' potential integration into daily work received favourable reviews.

The workshop also delved into products related to fuels, propagation, population, and assets. Managers found these products generally suitable for their territories, despite facing challenges such as the need for high-resolution fuel maps using LiDAR data and concerns about the representativeness of fuel classifications. Despite these challenges, participants expressed a high level of interest in integrating these products into their daily risk prevention protocols and activities, underlining their perceived usability and significance in the context of landscape management.

Sessions dedicated to exposure, potential losses, and resilience products also received positive feedback, with participants expressing special interest in the potential use of the smoke modelling tool, the Suppression Difficulty Index, the Persistence Index map, and the relative Societal Vulnerability Index. Challenges in implementing products were identified, primarily tied to political factors, budget limitations, and the perception by managers of some vulnerability topics as secondary. However, the overall FirEURisk integrated strategy comprehensiveness and the applicability of the products were well-received, with participants expressing great interest in incorporating them into their risk prevention protocols and general planning activities.

Participants provided positive feedback on the FirEURisk Display Platform, praising its design, accessibility, and product mapping display. Suggestions for improvement included clearer metadata, legends, and more comprehensive product

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descriptions. The platform's positive reception underscored its potential as a valuable tool in aiding planners, policymakers, and managers' decision-making processes.

Overall, participants generally agreed that the FirEURisk project and its goals were effectively presented at the beginning of the demonstration. While products were considered adequately described, feedback indicated a desire for more detailed information, increased time for understanding product use, and improved online experiences for product validation. This overarching sentiment highlighted the importance of result dissemination, effective communication with administration, businesses, and society, and the need for clear access to up-to-date products with institutional approval, thus the importance of the project Open Platform for dissemination. The workshop successfully engaged managers and provided valuable insights to enhance the integration of research outcomes into practical wildfire prevention strategies. The positive reception of the presented products suggests their potential beneficial impact on landscape management and risk prevention efforts.

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List of Acronyms

Table 1: List of Acronyms

List of Acronyms	
BP	Burn probability
CBD	Canopy bulk density
CBH	Canopy Base Height
CEST	Central European Summer Time
CFA	Crown fire activity
CH	Canopy Height
CREAF	Center for Ecological Research and Forestry Applications, Catalonia
DE	Demonstration event
ECHO	European Civil Protection and Humanitarian Aid Operations
FARSITE	Fire Area Simulator--model development and evaluation
FIL	Fire Intensity Level
FL	Flame length
FMC	Fuel moisture content
FMD	Fuel model
GDPR	General Data Protection Regulation
GIS	Geographic Information System
IFN	National Forest Inventory
IGN	Instituto Geográfico Nacional
IP	Ignition probability
ISSN	International Standard Serial Number
LCP	Raster Lanscape file
LMS	Land Monitoring System
MODIS	Moderate Resolution Imaging Spectroradiometer
PRJ	Projection file
PS	Pilot Site
SDI	Suppression difficulty index
TIFF	Tag Image File Format
VPD	Vapor pressure deficit
WAI	Wildland agriculturl Interface
WUI	Wildland-urban interface

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1 Introduction

The main objective of FIREURISK is to develop, evaluate and disseminate a science-based integrated strategy to: 1) expand current wildland fire risk assessment systems, including critical components of risk previously not covered; 2) produce effective measures to reduce current fire risk conditions, and 3) adapt management strategies to expected future climate and socioeconomic changes. Wildfire prevention, suppression and restoration practices and policies are integrated in a holistic conceptual framework, and the implementation of an operational platform supports joint coordination, professional training and operational exercises, involving multiple stakeholders and addressing all relevant wildfire management tasks, to improve protection of citizens exposed to wildfires.

One particular project focus is on the Wildland Urban Interface. The key focus of the PS4: Mediterranean –Spain (Barcelona Province) was its WUI around the Barcelona urban area, and the need for optimized forest and fuel management within a resilient landscape paradigm. The province of Barcelona (7,726.36 km², NE Spain) encompasses many different forest types from the typical Mediterranean vegetation in lowlands to continental, subalpine or Atlantic vegetation in adequate locations. The abandonment of agriculture and the lack of forest management (up to 60% of the private forests are not managed) has turned many forests into dense, homogeneous stands with a high vulnerability to natural disturbances, mostly wildfires. The fire regime allows for large fires > 300ha, almost yearly (at least 7 in the last 10 years). Heat waves and drought spells are becoming increasingly important. The prevalence of forest fires as the main source of forest damage has led to the implementation of a well-developed fire-prevention silviculture. Fire management is highly professionalized, highly efficient, but budgets are declining. Forest management, prevention, suppression and emergency management are placed under different governance responsibility.

The products showcased during the Demonstration Event (DE) in PS4 Barcelona aimed to fulfil identified end-user needs from different institutions, as determined through an open survey previously distributed to collect user requirements (D5.1 User Requirements Data Base and Report, D5.4 Management and action plan for End-users involvement in pilots and demos). The anticipated paradigm shift in European wildfire management, emphasizing prevention over suppression, aligns with the products' overarching goal. It is crucial to identify specific products that facilitate this change within each PS and assess their validation during the DE. The key focus on the WUI around the Barcelona urban area, and the need for optimized forest and fuel management within a resilient landscape paradigm guided the selection of the products in this DE. Detailed insights of the products, the integrated FirEURisk components (Fig. 1), and the link between products and the project's objectives, are provided in this deliverable with references to supporting documentation and related publications.

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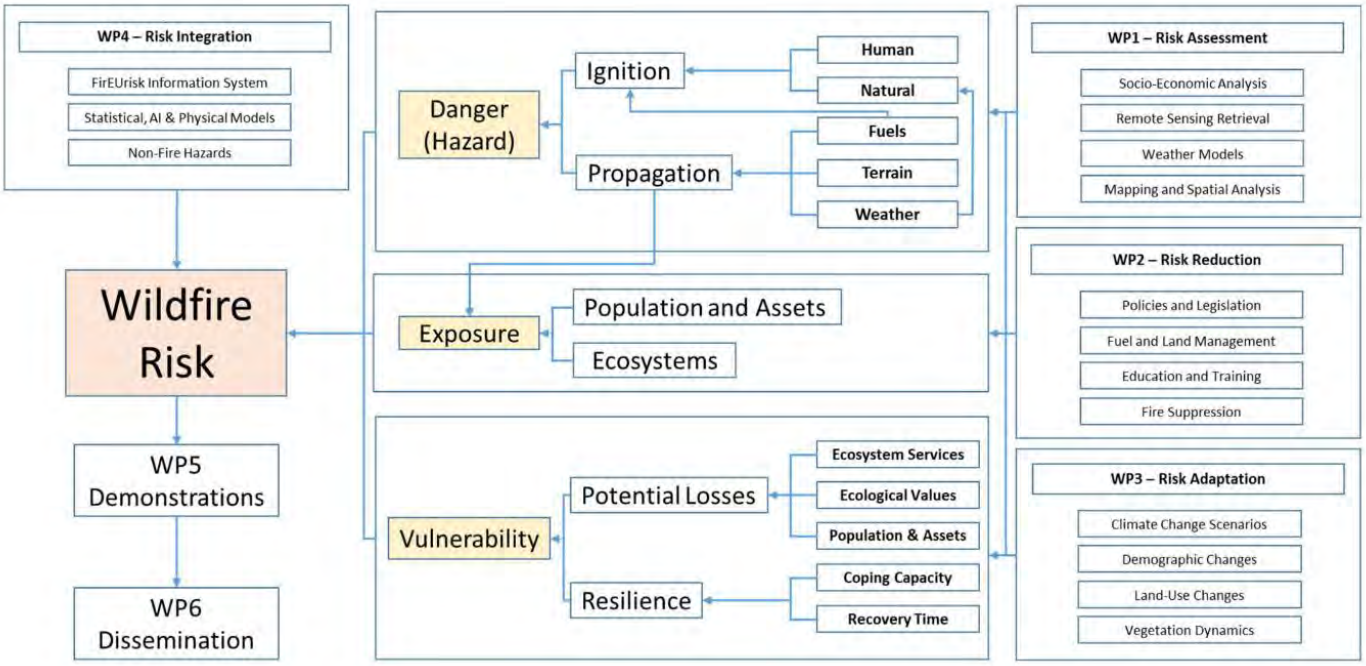


Figure 1. Conceptual integration scheme of fire risk components within the FirEUrisk project.

1.1 Purpose of the document

This document serves to comprehensively outline the context (i.e. participants), actions (i.e. presentations, round tables, surveys), results and evaluation criteria concerning selected research products developed within work packages of the project for the pilot site PS4: Mediterranean – Spain (Barcelona Province) and presented at the DE in Barcelona in June, 7th, 2023. The focus revolves around determining the suitability of these products for the Mediterranean European reality and stakeholders' needs. Specifically concentrating on Wildland-Urban Interface (WUI), forest, and fuel management, alongside resilient landscapes, the document deals with the description of actions taken at the DE for demonstrating to users the applicability of products in the Barcelona Pilot Site as part of the FirEUrisk integrated strategy for holistic risk-based fire management.

In this DE and deliverable, there is a particular emphasis on WUI and designing resilient landscapes, linked to the selection of this area as PS by the project partners for its high population values at risk. Project demo events aim to show how project products work jointly in integrating risk assessment, reduction and adaptation, as each product generated belongs to one of these phases. At this event, however, products selected and presented responded to the key focus of the PS, and were linked to WP1, focused on Risk Assessment, as it was the first of the six planned, and it was conducted early in the project timeline for WP5. These products and other risk product components for the three risk phases in the integrated wildfire risk strategy are addressed in later demos and their corresponding deliverables.

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Building upon the activities conducted in the Pilot Site and guided by the standards and reporting requirements of D5.3 Report on the Standardisation of the Demonstration Products and D5.5 Design plan for Pilot Sites and Pan European Demonstrations, this document provides insights into the use of the project's products. It delves into the achieved results and subsequent analyses, offering a comprehensive view. Furthermore, the document not only presents the outcomes of the research and implementation but also incorporates an assessment of stakeholder involvement, providing both quantitative and qualitative analyses. To enhance the validation process, interactive tools such as Mentimeter and the EU survey have been employed, with the latter explained in the lessons learned section to follow the meeting.

1.2 Structure of the Document

The document is structured to facilitate a clear understanding of the insights gathered from the DE in Barcelona. It begins by introducing the context, evaluation criteria, and the actions undertaken within the DE. This is followed by an in-depth exploration of the research products, each contributing uniquely to a holistic fire management strategy. The document then outlines a validation protocol, drawing on the lessons learned from the implemented interactive tools. Finally, the conclusions offer a synthesized view of the findings, and references and annexes provide additional resources and detailed questionnaires for further review. The structure aims to guide the reader through a comprehensive journey of understanding and evaluating the outcomes and implications of the FirEURisk DE in the PS Barcelona.

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2 Implementation of the Demonstration Event PS4

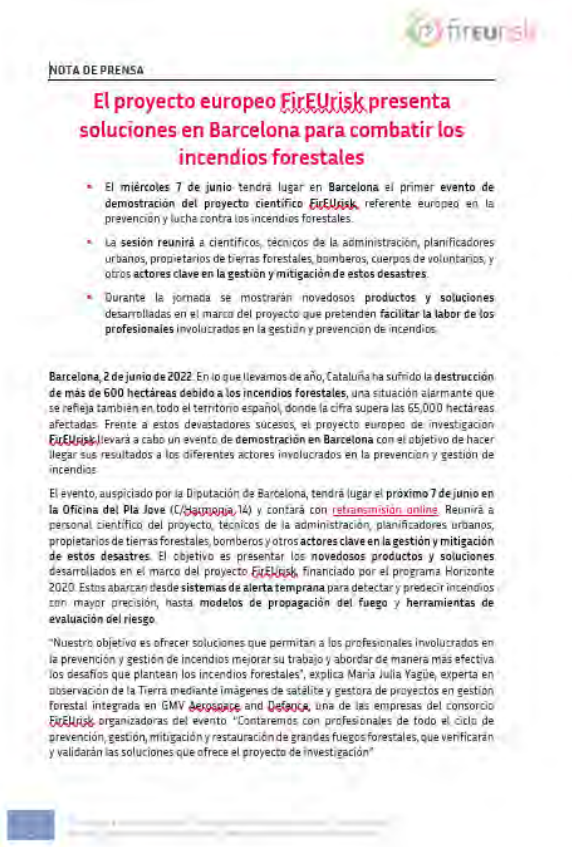
Preparations started in March 2023 at the Lleida Plenary meeting, and the event took place on June 7th, 2023, at the Recinte Mundet of the Diputació de Barcelona, in Barcelona city, from 8.45 to 15.30 CEST (Passeig Vall d'Hebron 171, Recinte Mundet, primera planta del Pavelló Migjorn, Bloc A). The number of participants registered online was over 100, while another 40 attended in person, including 6 participants from the University of Lleida and one participant from GMV, responsible for the DE. Some participants in presence did not stay for all sessions or answered all the surveys due to work or traveling issues. The participants and professional groups engaged were as follows: 22 from the scientific community (including one delegate of the project Fire-Res from the Forest Sciences Centre of Catalonia), one industry (GMV Aerospace), one weather civil society organization (Servei Meteorològic de Catalunya), 6 participants from a non-profit fire organization (Pau Costa Foundation), and 10 managers from first response and from risk prevention agencies (FORESCAT SL, ENTREARBRES SLPU, Diputació de Barcelona, Servei de Prevencio d'Incendis Forestals (DAAC), FEDERACION DE AGRUPACIONES FORESTALES DEL BAIX LLOBREGAT).
Prior to the event, a Communication Plan and Materials (press release, registration link, banner, ppt template, interviews, certificate of assistance) were designed and distributed by partner Scienseed. Social media channels, emails to Consortium members, other EU projects (i.e., Firelogue, Fire-Res), emails to targeted managers participating in the preliminary questionnaires (25) were used to disseminate the event. The format of deliverance was hybrid, both physical presence and through both a YouTube and a Zoom connection (https://us06web.zoom.us/j/81436196335?pwd=Qm51bDRjL2NId0lpbVI3eUtZYTFlUT09). The event was recorded and it is available for viewing on You Tube, @espais-naturals-diba: https://www.youtube.com/watch?v=N4ccGYnhOYc.
Interviews for dissemination after the event were prepared beforehand for the following profiles:

- 2 managers from the Diputació de Barcelona
- 1 manager from Generalitat de Catalunya, Servei de Prevenció d'Incendis Forestals
- 1 technician from Forescat SL, a company for preventive forest management
- 1 weather specialist from Servei Meteorológic de Catalunya

Expenses incurred were shared with the Diputació de Barcelona. For their contribution, costs pertained to the venue's use, translation service, streaming and online conference from the venue (3,550.00€), and for the partners: GMV travelling expenses to Barcelona (700.03€); University of Lleida, catering (1,757.8 €, VAT included) and travelling expenses (2,100.16€). The total DE expenses add up to 8,107.99 €.

A press release was coordinated by Scienseed, attached:

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NOTA DE PRENSA

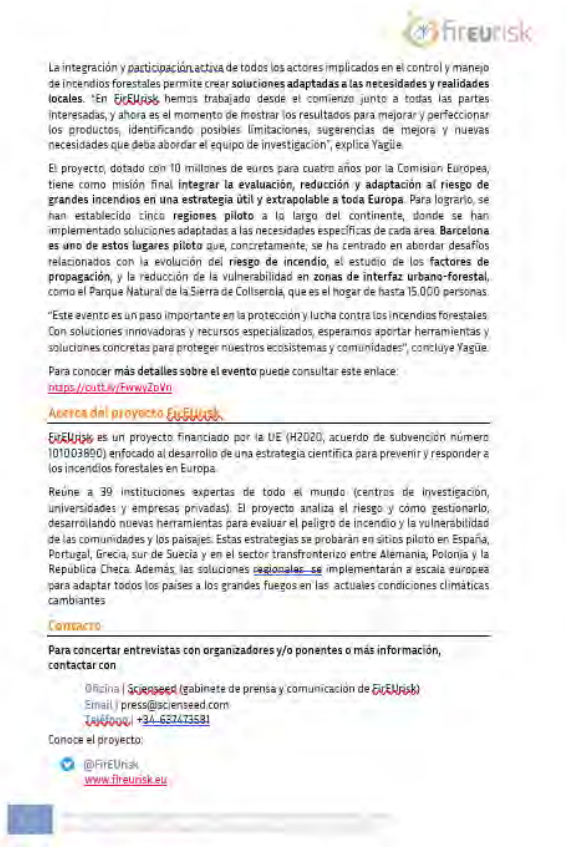
El proyecto europeo FirEURisk presenta soluciones en Barcelona para combatir los incendios forestales

- El **miércoles 7 de junio** tendrá lugar en **Barcelona** el primer **evento de demostración del proyecto científico FirEURisk**, referente europeo en la prevención y lucha contra los incendios forestales.
- La **sesión reunirá** a científicos, técnicos de la administración, planificadores urbanos, propietarios de tierras forestales, bomberos, cuerpos de voluntarios, y otros **actores clave en la gestión y mitigación de estos desastres**.
- Durante la jornada se mostrarán novedosos **productos y soluciones** desarrolladas en el marco del proyecto que pretenden **facilitar la labor de los profesionales** involucrados en la gestión y prevención de incendios.

Barcelona, 2 de junio de 2022. En lo que llevamos de año, Cataluña ha sufrido la **destrucción de más de 600 hectáreas debido a los incendios forestales**, una situación alarmante que se refleja también en todo el territorio español, donde la cifra supera las 65.000 hectáreas afectadas. Frente a estos devastadores sucesos, el proyecto europeo de investigación FirEURisk llevará a cabo un evento de **demostración en Barcelona** con el objetivo de hacer llegar sus resultados a los diferentes actores involucrados en la prevención y gestión de incendios.

El evento, auspiciado por la Diputación de Barcelona, tendrá lugar el **próximo 7 de junio en la Oficina del Pla Jove** (C/Harmonia, 14) y contará con retransmisión online. Reunirá a personal científico del proyecto, técnicos de la administración, planificadores urbanos, propietarios de tierras forestales, bomberos y otros **actores clave en la gestión y mitigación de estos desastres**. El objetivo es presentar los **novedosos productos y soluciones** desarrollados en el marco del proyecto FirEURisk, financiado por el programa Horizonte 2020. Estos abarcan desde **sistemas de alerta temprana** para detectar y predecir incendios con mayor precisión, hasta **modelos de propagación del fuego** y **herramientas de evaluación del riesgo**.

"Nuestro objetivo es ofrecer soluciones que permitan a los profesionales involucrados en la prevención y gestión de incendios mejorar su trabajo y abordar de manera más efectiva los desafíos que plantean los incendios forestales", explica María Julia Yagüe, experta en observación de la Tierra mediante imágenes de satélite y gestora de proyectos en gestión forestal integrada en GMV Aerospace and Defence, una de las empresas del consorcio FirEURisk organizadoras del evento. "Contaremos con profesionales de todo el ciclo de prevención, gestión, mitigación y restauración de grandes fuegos forestales, que verificarán y validarán las soluciones que ofrece el proyecto de investigación"



La integración y participación activa de todos los actores implicados en el control y manejo de incendios forestales permite crear **soluciones adaptadas a las necesidades y realidades locales**. "En FirEURisk hemos trabajado desde el comienzo junto a todas las partes interesadas, y ahora es el momento de mostrar los resultados para mejorar y perfeccionar los productos, identificando posibles limitaciones, sugerencias de mejora y nuevas necesidades que deba abordar el equipo de investigación", explica Yagüe.

El proyecto, dotado con 10 millones de euros para cuatro años por la Comisión Europea, tiene como misión final **integrar la evaluación, reducción y adaptación al riesgo de grandes incendios en una estrategia útil y extrapolable a toda Europa**. Para lograrlo, se han establecido cinco **regiones piloto** a lo largo del continente, donde se han implementado soluciones adaptadas a las necesidades específicas de cada área. **Barcelona es uno de estos lugares piloto** que, concretamente, se ha centrado en abordar desafíos relacionados con la evolución del **riesgo de incendio**, el estudio de los **factores de propagación**, y la reducción de la vulnerabilidad en **zonas de interfaz urbano-forestal**, como el Parque Natural de la Sierra de Collserola, que es el hogar de hasta 15.000 personas.

"Este evento es un paso importante en la protección y lucha contra los incendios forestales. Con soluciones innovadoras y recursos especializados, esperamos aportar herramientas y soluciones concretas para proteger nuestros ecosistemas y comunidades", concluye Yagüe.

Para conocer **más detalles sobre el evento** puede consultar este enlace: https://cutt.ly/FwwyZpVn

Acerca del proyecto FirEURisk

FirEURisk es un proyecto financiado por la UE (H2020, acuerdo de subvención número 101003890) enfocado al desarrollo de una estrategia científica para prevenir y responder a los incendios forestales en Europa.

Reúne a 39 instituciones expertas de todo el mundo (centros de investigación, universidades y empresas privadas). El proyecto analiza el riesgo y cómo gestionarlo, desarrollando nuevas herramientas para evaluar el peligro de incendio y la vulnerabilidad de las comunidades y los paisajes. Estas estrategias se probarán en sitios piloto en España, Portugal, Grecia, sur de Suecia y en el sector transfronterizo entre Alemania, Polonia y la República Checa. Además, las soluciones regionales se implementarán a escala europea para adaptar todos los países a los grandes fuegos en las actuales condiciones climáticas cambiantes.

Contacto

Para concertar entrevistas con organizadores y/o ponentes o más información, contactar con

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Conoce el proyecto:

@FireUrisk
www.fireurisk.eu

2.1 Meeting Agenda

The Agenda for the DE that was distributed in advance was as follows:

Timeslot	Action	Presenter	Organization
8:30 – 8:45	Registration		
8:45 – 9:00	**Opening session**. FirEURisk integration scheme	E. Chuvieco	Universidad de Alcalá
Weather and ignitions			
09:00 – 9:15	A metric capturing dead fuel moisture and atmospheric instability	V. Resco	Universitat de Lleida
09:15 – 09:30	Live-woody fuel moisture content prediction model	A. Cunill	Universitat de Lleida
09:30 – 09:45	Lightning-caused wildfire ignition likelihood	M. Rodrigues	Universidad de Zaragoza
09:45 – 10:00	Human-caused wildfire ignition likelihood	A. Jiménez	Universidad de Zaragoza
10:00 – 10:10	Product evaluation and validation survey	J. Yagüe	GMV
10:10 – 10:30	Round Table 1	*Survey 1. Evaluation and validation of the products*	

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10:30 – 10:45	Coffee break		
Fuels, propagation, population, and assets			
10:45 – 11:00	Custom fuel model characterization	A. Fontova	Universitat de Lleida
11:00 – 11:15	Custom fuel model mapping	P. Gelabert	Universitat de Lleida
11:15 – 11:30	Modelling wildfire spread and behaviour	F. Alcasena	Universitat de Lleida
11:30 – 11:45	Mapping the wildland-urban interface (*)	A. Bar Massada	University of Haifa
11:45 – 12:15	Round Table 2	*Survey 2. Evaluation and validation of the products*	
12:15 – 12:30	Coffee break		
Exposure, potential losses, and resilience			
12:30 – 12:45	Wildfire exposure of human communities (*)	A. Miranda	Universidade de Aveiro
12:45 – 13:00	Expected economic impacts and suppression difficulty index	J.R. Molina	Universidad de Córdoba
13:00 – 13:15	Wildfire resiliency index for forest ecosystems	L. Coll	Universitat de Lleida
13:15 – 13:30	Community resilience self-assessment (*)	R. Laterza	Istituto di Sociologia Internazionale di Gorizia
13:30 – 14:00	Round Table 3	*Survey 3. Evaluation and validation of the products*	
14:00 – 14:30	Stand-up lunch		
Risk reduction and end-user needs			
14:30 – 14:45	FirEURisk product viewer (*)	A. Barrios	Arbonaut
14:45 – 15:00	Socioeconomic considerations for land management to reduce fire risk (*)	M. Roberts	The James Hutton Institute
15:00 – 15: 15	End user needs and requirements		Diputació de Barcelona
15:15 –15: 30	**Closing Session**. Wrap up and work in progress	C. Vega-Garcia	Universitat de Lleida

(*) Presentation in English. If no otherwise stated, presentations were delivered in Spanish/Catalan languages. Simultaneous translation was provided at all times.

All the presentations' slides are compiled in Annex A.

3 Products Description

The products presented at the DE are listed below, in the same order of the Agenda, and with a Product Card format that allows to place each product in the corresponding task/activity within the project, and within the integrated strategy.

3.1 P1 - Weekly fire danger metric at 25 ha

- **Session:** A metric capturing dead fuel moisture and atmospheric instability. V. Resco. Universitat de Lleida, UdL.
- **Developer:** University of Lleida (UdL, Spain).
- **Activity:** "A1.1.1 Fire weather and fuel status prevention".

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- **Product description:** The Product is an algorithm for a fire danger assessment using a novel fire danger metric that couples surface and profile meteorology (different types of atmospheric stability), with dead and live fuel moisture status.
- **Methodology:**

-Rodrigues, Marcos & Resco de Dios, Víctor & Sil, Ângelo & Cunill-Camprubí, Àngel & Fernandes, Paulo. (2024). VPD-based models of dead fine fuel moisture provide best estimates in a global dataset. Agricultural and Forest Meteorology. 346. 109868. 10.1016/j.agrformet.2023.109868.

-Resco de Dios, V.; Cunill Camprubí, À.; Pérez-Zanón, N.; Peña, J.C.; Martínez del Castillo, E.; RodriguesS, M.; Yao, Y.; Yebra, M.; Vega-Garcia, C.; Boer, M. Convergence in critical fuel moisture and fire weather thresholds associated with fire activity in the pyroregions of Mediterranean Europe. Science of The Total Environment. Volume 806, Part 4. 2022, 151462. ISSN 0048-9697. https://doi.org/10.1016/j.scitotenv.2021.151462.

-Clarke, H., Nolan, R.H., Resco de Dios, V. et al. Forest fire threatens global carbon sinks and population centres under rising atmospheric water demand. Nat Commun 13, 7161 (2022). https://doi.org/10.1038/s41467-022-34966-3.

- **FirEURisk component of the integrated strategy: Danger-Weather**
- **Technical characteristics:**

Characteristics	Description
Type of products:	Algorithm / Geospatial
Units:	-
Update Frequency:	Daily-weekly
Accuracy:	-
Output Format:	R script
Fire risk component:	Weather
Temporal coverage:	2001-2020
Spatial resolution:	1km (500m)

- **Overview:**

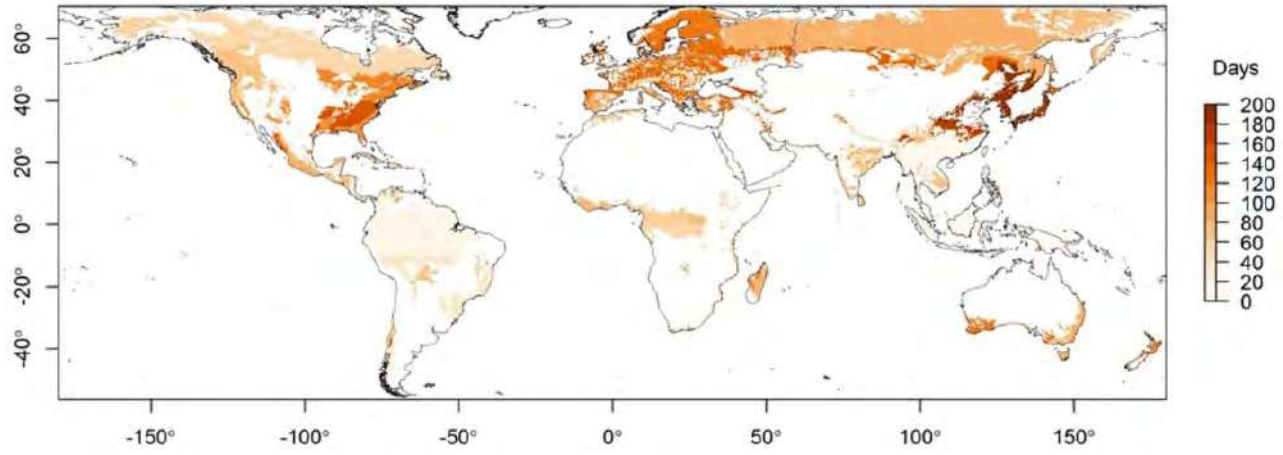


Figure 1. Current mean annual frequency of daily VPD threshold exceedances (days) for global forest biomes.

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3.2 P2 - Weekly live fuel moisture content at 25ha

- **Session:** Live-woody fuel moisture content prediction model. A. Cunill. Universitat de Lleida, UdL.
- **Developer:** University of Lleida (UdL, Spain).
- **Activity:** "A1.1.3. Human ignition drivers (D,S) & Public participation in fire prevention and preparedness".
- **Product description:** This geospatial product provides weekly maps of Live Fuel Moisture Content based on MODIS thermal and spectral imagery.
- **Methodology:** - Cunill Camprubí, À.; Gonzalez-Moreno, P.; Resco de Dios, V. Live Fuel Moisture Content Mapping in the Mediterranean Basin Using Random Forests and Combining MODIS Spectral and Thermal Data. Remote Sens. 2022, 14, 3162. https://doi.org/10.3390/rs14133162
- **FirEURisk component of the integrated strategy: Danger-Live FMC**
- **Technical characteristics:**

Characteristics	Description
Type of products:	Geospatial Product
Units:	Percent (%)
Update Frequency:	Weekly
Accuracy:	>85%
Output Format:	.netCDF
Fire risk component	Live FMC
Temporal coverage:	2001-present
Spatial resolution:	500m
Data accessibility	https://zenodo.org/record/6784663#.Y05djC8Rqkw

- **Overview:**

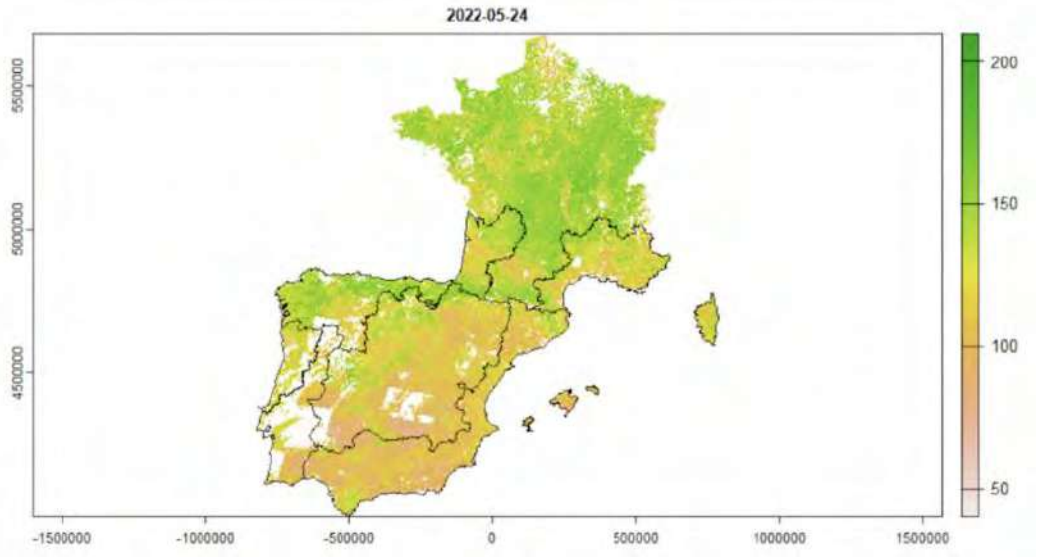


Figure 2. Weekly live fuel moisture content product output.

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3.3 P3 - Natural ignition probability

- **Session:** Lightning-caused wildfire ignition likelihood. M. Rodrigues. Universidad de Zaragoza, UNIZAR.
- **Developers:** University of Lleida (UdL) and University of Zaragoza (UNIZAR), Spain.
- **Activity:** "A1.1.2. Natural ignition probability".
- **Product description:** This product estimates the probability that a flash ignites a natural fire at the pilot site scale.
- **Methodology:** The product estimates the probability of natural-caused ignition at pilot site level. It was obtained by means of Random Forest algorithm using as inputs flashes and fire records, and six spatial drivers: drought code, dead fuel moisture, average density of flashes, terrain curvature, vegetation height and elevation. Detailed description of algorithm of calculation and data sources available here:

- Rodrigues, M.; Gelabert, P.J.; Resco de Dios, V.; Jiménez-Ruano, A.; Torres, L.; Ribalaygua, J.; Vega-García, C. (2022) High-Resolution Modeling of Lightning Ignition Likelihood in Spain. Environ. Sci. Proc. 17, 40. https://doi.org/10.3390/environsciproc2022017040
- Rodrigues M., Jiménez-Ruano A., Gelabert P. J, Resco de Dios V., Torres L., Ribalaygua J., Vega-García C. (2023) Modelling the daily probability of lightning-caused ignition in the Iberian Peninsula. *International Journal of Wildland Fire* **32**, 351-362. https://doi.org/10.1071/WF22123

- **FirEURisk component of the integrated strategy: Danger-Natural Ignition**
- **Technical characteristics:**

Characteristics	Description
Type of products:	Geospatial Product
Units:	Probability, % (for raster grid)
Update Frequency:	No updates
Accuracy:	70-80%
Output Format:	.RData (model); .tif (raster grids)
Fire risk component	Natural ignition
Temporal coverage:	2009-2015
Spatial resolution:	100 m (1 ha)

- **Overview:**

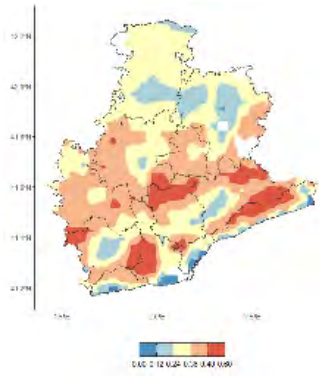


Figure 3. Lightning-caused wildfire ignition likelihood product output (Barcelona Province, Spain).

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3.4 P4 - Human ignition probability

- **Session:** Human-caused wildfire ignition likelihood. A. Jiménez. Universidad de Zaragoza, UNIZAR
- **Developer:** University of Lleida (UdL, Spain).
- **Activity:** "A1.1.3. Human ignition drivers (D,S) & Public participation in fire prevention and preparedness".
- **Product description:** This product estimates the probability that a human caused fire ignite at the pilot site scale. The final output – probabilistic raster map (scale 0 to 1) with the spatial resolution of 100 meters.
- **Methodology:** The product estimates the probability of human-caused ignition at pilot site level. It was obtained by means of Random Forest algorithm using as inputs human fire records and ten static spatial drivers: fuel types, distance to interfaces (WAI, WUI WGI), distance to roads, population density, percentage of urban/agricultural/wildland covers).

- Jiménez-Ruano, A. *et al.*, "Assessing human-caused wildfire ignition likelihood across Europe," *2023 8th International Conference on Smart and Sustainable Technologies (SpliTech)*, Split/Bol, Croatia, 2023, pp. 1-6, doi: 10.23919/SpliTech58164.2023.10193249.

- **FirEURisk component of the integrated strategy: Danger-Human Ignition**
- **Technical characteristics:**

Characteristics	Description
Type of products:	Geospatial Product
Units:	Probability, % (for raster grid)
Update Frequency:	No update
Accuracy:	70-80%
Output Format:	.RData (model); .tif (raster grids)
Fire risk component	Human ignition
Temporal coverage:	2008-2018
Spatial resolution:	100m (1 ha)

- **Overview:**

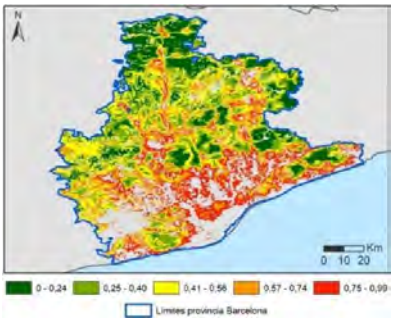


Figure 4. Human ignition probability map (Barcelona Province, Spain).

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3.5 P5 - Custom fuel characterization

- **Session:** Custom fuel model characterization. A. Fontova. Universitat de Lleida, UdL.
- **Developer:** Universitat de Lleida (UdL, Spain).
- **Activity:** "A1.1.4. Risk-wise landscape and fuel models development".
- **Product description:** A database with the fuel characteristics including dead and live fuel loads for the FirEURisk fuel types in a form of a table with fuel characteristics. Developers implemented a FirEURisk Field Sampling Protocol from the University of Sassari, Italy, to get the fuel data.
- **Methodology:** Paper in progress
- **FirEURisk component of the integrated strategy: Danger-Fuel types**
- **Technical characteristics:**

Characteristics	Description
Type of products:	Document
Units:	not applicable
Update Frequency:	No update
Accuracy:	not applicable
Output Format:	.xls
Fire risk component	Propagation - Fuel
Temporal coverage:	2021
Spatial resolution:	not applicable

- **Overview:**

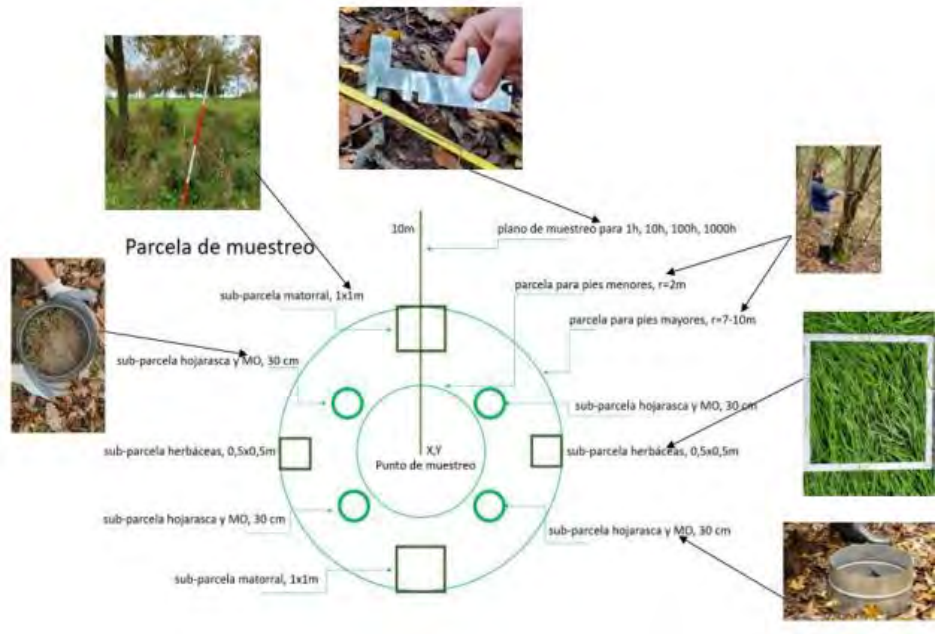


Figure 5. Custom fuel model characterization.

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3.6 P6 - Fuel type & model, canopy metrics, and landscape file

- **Session:** Custom fuel model mapping. P. Gelabert. Universitat de Lleida, UdL.
- **Developers:** University of Split (FESB, Croatia) with help of Universitat de Lleida (UdL, Spain) particularly for CBD.
- **Activity: "**A1.1.5. -Analysis of fire propagation, fuel consumption and smoke emission as risk factors".
- **Product description:** This product is a database that contains the raster grids required to generate the landscape file at 100-m resolution for Pilot Sites (PS) (without Sweden), including following raster data: Elevation (m), Slope (degrees), Aspect (azimuth), new FirEURisk Fuel Models [FM] and Canopy Cover [CC] (%), Canopy Height [CH] (m), Canopy Base Height [CBH] (m) and Canopy bulk density [CBD]. (kg/m3). The grids were downloaded from global products and resampled to 100 m resolution.
- **Methodology:** In order to run FlamMap five raster data themes are required in GeoTIFF (.TIFF) file format. This file could be created from raster Lanscape file (.LCP) used in FARSITE and FlamMap 3. Lanscape raster file in .LCP format needs separate Projection file .PRJ and in multi-bend GeoTIFF file in .TIFF format, the projection information is stored with the feature information in one file. At a minimum, five raster data themes are required: Elevation, Slope, Aspect, Fuel model [FM] and Canopy Cover [CC]. Other GIS layers are described as "optional": Canopy Height [CH], Canopy Base Height [CBH], Canopy bulk density [CBD]. "Optional" means only that they are not required to run a surface fire simulation. However, these themes are required to calculate some aspects of fire behaviour (such as crown fire) that could be very important to your analysis.
  A detailed methodology for collecting input files at 100 m resolution for all PS except Sweden is described in Technical Document: "D1.1.5. - Del.1. - Propagation potential - calculation methodology for Pilot Sites (PS)". Paper in progress
- **FirEURisk component of the integrated strategy: Danger-Fuel types-Terrain-Propagation**
- **Technical characteristics:**

Characteristics	Description
Type of products:	Geospatial Product
Units:	Depends on data in dataset
Update Frequency:	No updates
Accuracy:	Depends on data for downscaling
Output Format:	.GeoTiff
Fire risk component	Propagation – Fuel type
Temporal coverage:	Depends on data in dataset
Spatial resolution:	100m (1 ha)

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- **Overview:**

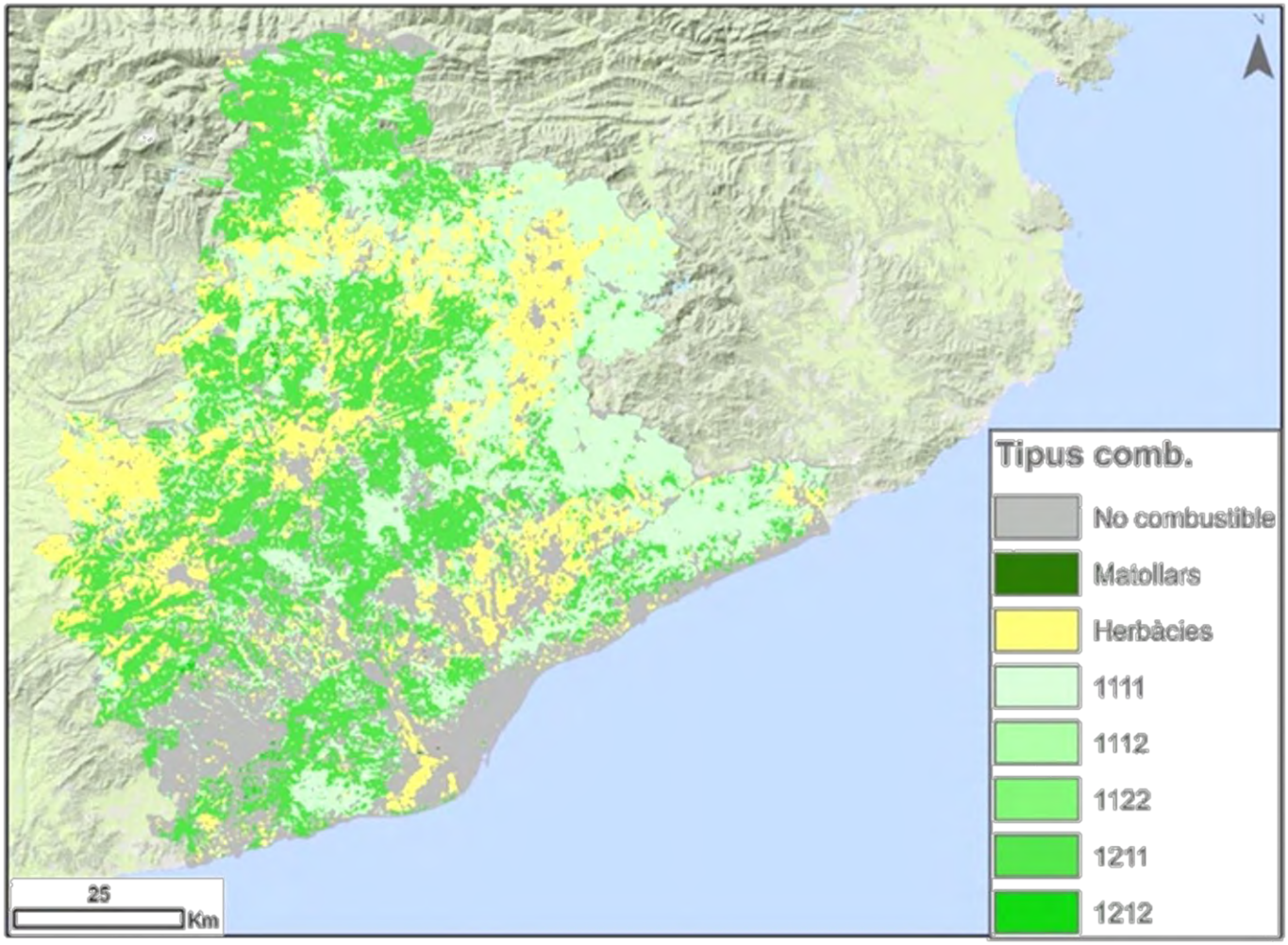


Figure 6. Custom fuel model map (Barcelona Province, Spain).

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3.7 P7 - Wildfire spread and behaviour outputs

- **Session:** Modelling wildfire spread and behavior. F. Alcasena. Universitat de Lleida, UdL.
- **Developer:** Universitat de Lleida (UdL, Spain).
- **Activity:** "A1.1.5. Analysis of fire propagation, fuel consumption and smoke emission as risk factors".
- **Product description:** This product is a geodatabase that contains the fire spread and behaviour modelling outputs for the "basic mode" runs (i.e., calculations conducted by pixel).
- **Methodology:** http://books.uc.pt/chapter?chapter=9789892622989174
- **FirEURisk component of the integrated strategy: Danger-Propagation**
- **Technical characteristics:**

Characteristics	Description
Type of products:	Geospatial product
Units:	Fire intensity (kw/m), flame length (m), rate of spread (m/min), crown fire activity (class), crown fraction burned (percentage), and heat per unit area (kJ/m2)
Update Frequency:	not applicable
Accuracy:	not applicable
Output Format:	.gdb
Fire risk component	Propagation
Temporal coverage:	2021
Spatial resolution:	100 m

- **Overview:**

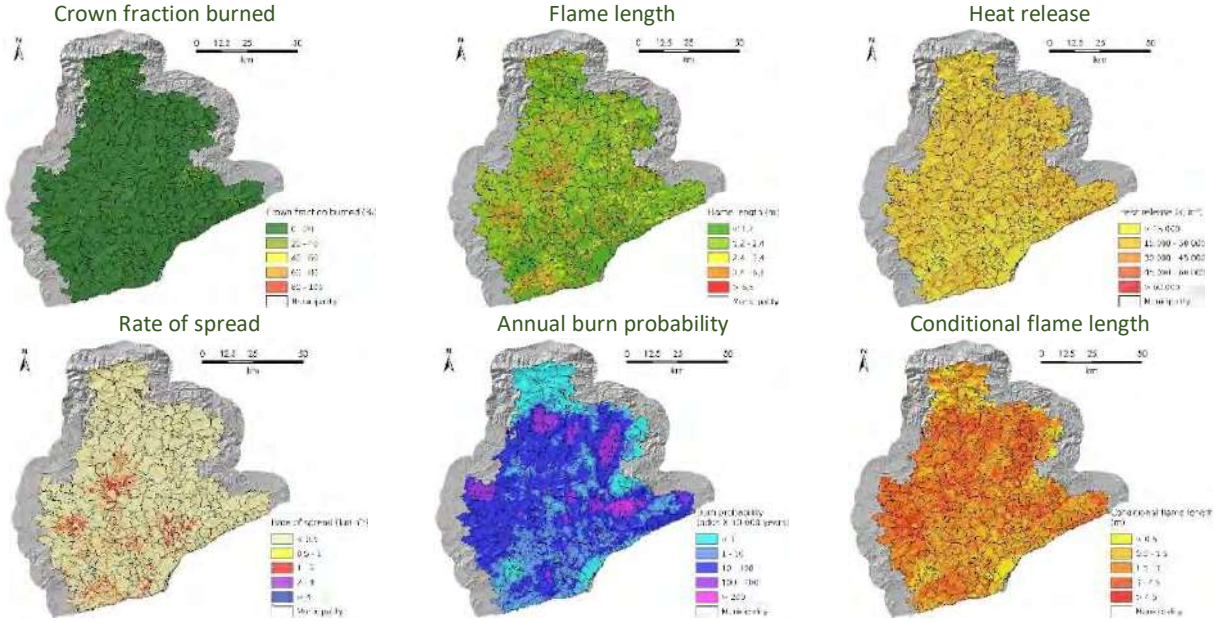


Figure 7. Wildfire spread and behaviour product outputs (Barcelona Province, Spain).

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3.8 P8- Population and assets

- **Session:** Modelling wildfire spread and behavior. F. Alcasena. Universitat de Lleida, UdL.
- **Developer:** Universitat de Lleida (UdL, Spain).
- **Activity:** "A1.2.1 Fire exposure metrics"
- **Product description**: This product is a geodatabase containing the population and infrastructure data including road network polyline, track polyline, urban road polyline, power station polygons, population data by age class attributed to Local Administrative Unit (municipalities) polygons, pilot site boundary polygon, industrial structure footprint polygons, housing structure footprint polygons, and community core polygons.
- **Methodology:** NA. Compilation of ancillary data. IGN, 2023. Base Topográfica Nacional 1:25.000 (BTN25). Instituto Geográfico Nacional. Ministerio de Fomento, Gobierno de España, Madrid.
- **FirEUrisk component of the integrated strategy: Exposure**
- **Technical characteristics:**

Characteristics	Description
Type of products:	Geospatial product
Units:	not applicable
Update Frequency:	not applicable
Accuracy:	not applicable
Output Format:	.gdb
Fire risk component	Propagation
Temporal coverage:	2022
Spatial resolution:	Scale 1:2,000 to 1:25,000

- **Overview:**

Assets Population

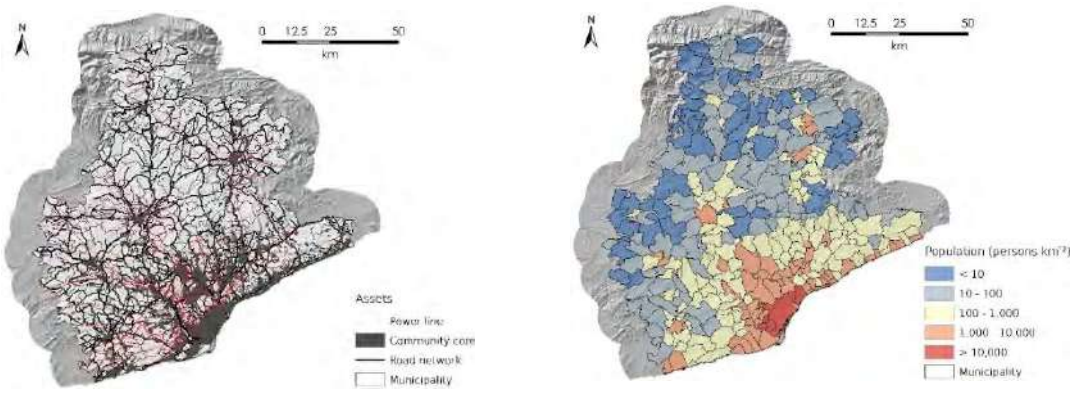


Figure 8. Assets and population product outputs (Barcelona Province, Spain).

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3.9 P9 - Wildland-urban interface map

- **Session:** Mapping the wildland-urban interface. A. Bar Massada. University of Haifa.
- **Developer:** The University of Haifa (HU, Israel).
- **Activity:** "A1.2.2 Societal vulnerability and resilience assessment"
- **Product description:** This product identifies the locations of wildland - urban interfaces (WUI) of two types, interface (where human settlements adjoin flammable vegetation) and intermix (where human settlements are interspersed with a matrix of flammable vegetation).
- **Methodology:** The mapping method builds upon the approach of Bar-Massada et al. (2012). This is a point-based (i.e., buildings) approach, which was converted here to a raster approach due to data availability on settlements. For WUI mapping purposes, only two classes of this dataset were considered: forests and shrublands.

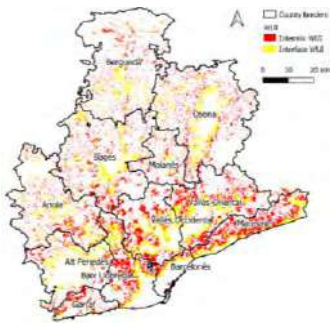
-Bar-Massada, Avi & Alcasena, Fermín & Schug, Franz & Radeloff, Volker. (2023). The wildland -urban interface in Europe: Spatial patterns and associations with socioeconomic and demographic variables. Landscape and Urban Planning. 235. 104759. 10.1016/j.landurbplan.2023.104759.

- **FirEURisk component of the integrated strategy: Exposed population and infrastructures**
- **Technical characteristics:**

Characteristics	Description
Type of products:	Geospatial product
Units:	Categorical: 0 - non WUI, 1 - intermix WUI, 2 - interface WUI
Update Frequency:	Static
Accuracy:	80-90%
Output Format:	.tiff
Fire risk component	Exposure/vulnerability (Population-Assets)
Temporal coverage:	2020
Spatial resolution:	> 1 ha (10m)

- **Overview:**

WUI map



Proportion of buildings inside intermix WUI

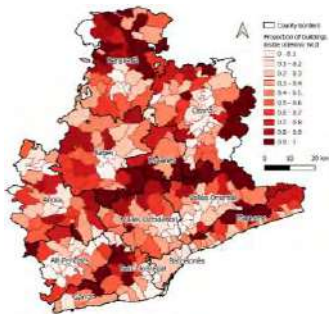


Figure 9. WUI product outputs (Barcelona Province, Spain).

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3.10 P10 - Smoke potential

- **Session:** Wildfire exposure of human communities. A. Miranda. Universidade de Aveiro.
- **Developer:** University of Aveiro (UAVR, Portugal).
- **Activity:** "A1.1.5 Analysis of fire propagation, fuel consumption and smoke emission as risk factors".
- **Product description:** The product provides the 2D air pollutant concentrations (e.g., PM10, PM2.5, NO2 and CO) for the PS3 (Mediterranean - Portugal) and PS4 (Mediterranean - Spain) pilot sites. The final output is maps of air pollutant concentrations (µg/m3) with a spatial horizontal resolution ≤ 100 m.
- **Methodology:** The methodology to estimate the smoke potential is based on the application of a Gaussian dispersion approach. The main input data required by this approach are meteorological parameters, fire rate of spread, heat per unit area, burnt area, fuel load, and fuel map.

- Osswald T., Gama,C., Fernandes A., Lopes D., Varela V., Miranda, A. (2023). Effects of the wildfires in August 2021 on the air quality of Athens through a numerical simulation. International Journal of Wildland Fire. 32. 10.1071/WF22148.

- **FirEURisk component of the integrated strategy: Danger-Propagation**
- **Technical characteristics:**

Characteristics	Description
Type of products:	Geospatial
Units:	µg/m^3
Update Frequency:	Not applicable
Accuracy:	Not applicable
Output Format:	.tif
Fire risk component	Propagation
Temporal coverage:	Not applicable
Spatial resolution:	≤ 100 m

- **Overview:**

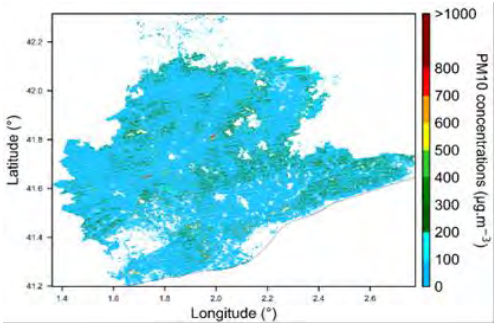


Figure 10. Smoke potential product output (Barcelona Province, Spain).

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3.11 P11 - Exposure of communities

- **Session:** Wildfire exposure of human communities. A. Miranda. Universidade de Aveiro.
- **Developer:** University of Aveiro (UAVR, Portugal).
- **Activity:** "A1.2.1 Fire exposure metrics".
- **Product description:** The product provides the fire exposure potential of fire-related values (i.e., residential structures, road network, vegetation and animals' diversity, Natura 2000 network, and population) to the fire metrics (i.e., fireline intensity, rate of spread, fire emission potential, and smoke potential) in the PS4 (Mediterranean - Spain) pilot sites. The final output – fire exposure metrics (-) with a spatial horizontal resolution of 100 m. Developer: University of Aveiro (UAVR, Portugal).
- **Methodology:** The methodology is based on the juxtaposition of fire exposed related values (e.g., fireline intensity, rate of spread, atmospheric emission potential, and smoke potential) with the spatial distribution of the fire metrics (fireline intensity, rate of spread, atmospheric emission potential, and smoke potential).

- Chuvieco E., Yebra, M., Martino S., Thonicke K., Gómez-Giménez M., San-Miguel J., Oom D., Velea R., Mouillot F., Martínez J., Miranda A., Lopes D., Salis M., Bugarić M., Sofiev M., Kadantsev E., Gitas I., Stavrakoudis, D., Eftichidis G., Viegas D.X. (2023). Towards an Integrated Approach to Wildfire Risk Assessment: When, Where, What and How May the Landscapes Burn. Fire. 6. 215. 10.3390/fire6050215.

- **FirEURisk component of the integrated strategy: Exposure-Exposed ecosystems, Exposed Population-Infrastructures**
- **Technical characteristics:**

Characteristics	Description
Type of products:	Geospatial
Units:	Not applicable
Update Frequency:	Not applicable
Accuracy:	Not applicable
Output Format:	.tif
Fire risk component	Exposed Population-Assets
Temporal coverage:	2021
Spatial resolution:	≤ 100 m

- **Overview:**

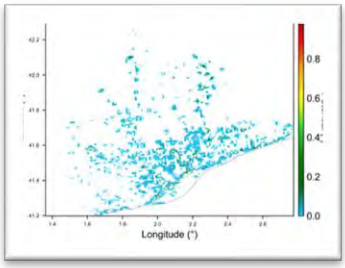


Figure 11. Potential exposure of population to PM10 emissions product output (Barcelona Province, Spain).

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3.12 P12 - Suppression Difficulty Index Evaluation

- **Session:** Expected economic impacts and suppression difficulty index. J.R. Molina. Universidad de Córdoba, UCO.
- **Developer:** University of Cordoba (UCO, Spain).
- **Activity:** "A1.1.5. Analysis of fire propagation, fuel consumption and smoke emission as risk factors".
- **Product description:** The Product describes the efficiency and limitations of suppression strategies in different landscape fire contexts, determined from productivity rates of fire control as a factor of the strategies adopted with the resources dispatched to fire.
- **Methodology: -**Rodriguez y Silva, Francisco; O Connor, Christopher D.; Thompson, Matthew P.; Martinez, Juan Ramon Molina; Calkin, David E. 2020. Modelling suppression difficulty: Current and future applications. International Journal of Wildland Fire. doi: 10.1071/WF19042.
- **FirEURisk component of the integrated strategy: Danger-Propagation, Exposure**
- **Technical characteristics:**

CHARACTERISTICS	DESCRIPTION
Type of products:	Geospatial product
Units:	Qualitative (classes: Very Low, Low, Medium, High, Very High)
Update Frequency:	Static layer
Accuracy:	85-95%
Output Format:	.GeoTiff
Fire risk component	Propagation/Exposure
Temporal coverage:	2021
Spatial resolution:	100 m

- **Overview:**

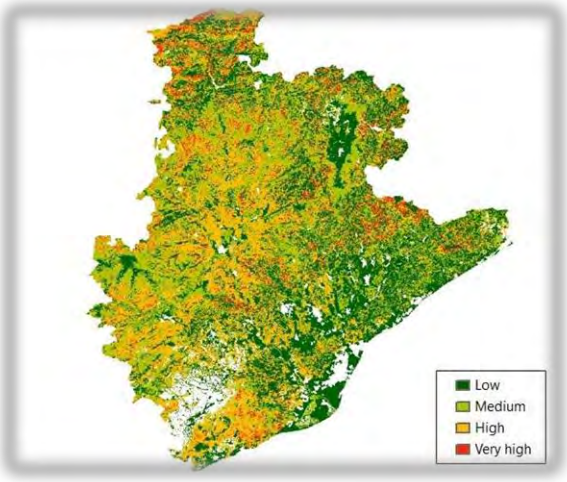


Figure 12. Suppression Difficulty Index product output (Barcelona Province, Spain).

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3.13 P13 - Potential economic losses

- **Session:** Expected economic impacts and suppression difficulty index. J.R. Molina. Universidad de Córdoba, UCO.
- **Developer:** University of Cordoba (UCO, Spain).
- **Activity:** "A1.2.4 Economic impacts of fire".
- **Product description:** The result of the integration of the assessment of economic losses in each of the natural resources of the forest landscape potentially affected by wildfires

  Methodology: Evaluation based on algorithms of economic value of resources. The economic impact is determined by the fire intensity level (FIL) that fire spread generate. The model includes a depreciation matrix based on the FIL to calculate the economic losses in each of the natural resources of the forest landscape where the fire has affected. - https://ieeexplore.ieee.org/document/10193546.
- **FirEURisk component of the integrated strategy: Vulnerability-Ecosystem Services**
- **Technical characteristics:**

Characteristics	Description
Type of products:	Geospatial product
Units:	€/ha (product at 100m of spatial resolution) €/km2 (product at 1km of spatial resolution)
Update Frequency:	Static layer
Accuracy:	85-95%
Output Format:	.tiff
Fire risk component	Vulnerability (Economical Values)
Temporal coverage:	Current
Spatial resolution:	100 m and 1 km2

- **Overview:**



Figure 13. Potential economic losses product output (Barcelona Province, Spain).

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3.14 P14 - Persistence index

- **Session:** Wildfire resiliency index for forest ecosystems. L. Coll. Universitat de Lleida, UdL.
- **Developer:** University of Lleida (UdL, Spain).
- **Activity:** "A1.2.3 Environmental vulnerability and resilience assessment".
- **Product description:** This geospatial product (algorithm and raster grids) provides a map of the Persistence Index. The Persistence Index reflects an ability of forest resistance and resilience to disturbances, based on the diversity, abundance, and redundancy of disturbance- and taxon-specific response traits. It can be applied to a broad spectrum of communities subjected to different types of stressors, making it a useful tool to guide ecosystem management decisions in a context of changing climate and uncertain disturbance regimes.
- **Methodology:**

- Sánchez-Pinillos, M., Coll Ll., De Cáceres M., Ameztegui a. 2016. Assessing the persistence capacity of communities facing natural disturbances on the basis of species response traits, Ecological Indicators 66: 76-85.
-Rodrigues, M., de la Riva, J., Domingo, D., Lamelas, T., Ibarra, P., Hoffrén, R., & García-Martín, A. (2024). An empirical assessment of the potential of post-fire recovery of tree-forest communities in Mediterranean environments. *Forest Ecology and Management*, *552*, 121587.

- **FirEURisk component of the integrated strategy: Vulnerability-Ecological values, Recovery time**
- **Technical characteristics:**

CHARACTERISTICS	DESCRIPTION
Type of products:	Geospatial Product
Units:	Ratio between 0 (no persistence) and 1 (total persistence capacity)
Update Frequency:	Static
Accuracy:	Depending on the input data on forest species distribution
Output Format:	.tif
Fire risk component	Recovery time
Temporal coverage:	Static
Spatial resolution:	Depending on the input data on forest species distribution

- **Overview:**

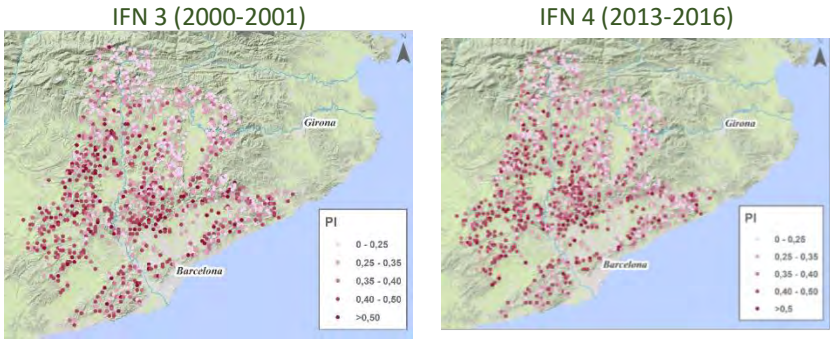


Figure 14. Persistence index product output (Barcelona Province, Spain).

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3.15 P15 – ReSVI: Relative Societal Vulnerability Index

- **Session:** Community resilience self-assessment. R. Laterza. Istituto di Sociologia Internazionale di Gorizia.
- **Developer:** Istituto di Sociologia Internazionale di Gorizia (ISIG, Italy).
- **Activity:** "A1.2.2 Societal vulnerability and resilience assessment".
- **Product description:** This product helps local communities (namely local institutions, stakeholders, and practitioners) in assessing their level of societal vulnerability vis-à-vis wildfire hazard. It also allows for the elaboration of resilience strategies tailored at the local community level. The ReSVI comprises quantitative and qualitative data for five dimensions of societal vulnerability (social, economic, institutional, human capital and environmental) and elaborates a relative index based on the comparison among similar communities and/or their higher administrative tiers.
- **Methodology:** ReSVI approach has been developed and implemented by ISIG in other projects: ECOSTRESS DG ECHO, RESILOC H2020, RESBA and RISKGEST. ReSVI has been adapted within FirEURisk project for the assessment of social vulnerability to wildfires at community level that is based on both quantitative and qualitative methods and data. The index is built within a relative perspective, given the fact that there is no absolute threshold under or above which the vulnerability of a community may be considered (in absolute terms) high or low. This instrument is thus intended to support communities in assessing their own vulnerability against other areas of reference (e.g., higher administrative tiers, or same-level administrative units), ultimately contributing to a peer-to-peer learning process across local communities in the EU.
  -ECOSTRESS Project, (2015). Relative Social Vulnerability Index and SWOT Analysis of Coastal Case Studies in the Upper Adriatic, performed by ISIG within the Project ECOSTRESS (Ecological COastal Strategies and Tools for Resilient European SocietieS) (2013-2015); project co-financed by the European Union ECHO/SUB/2013/671461
  -RESILOC Project, (2020). Analysis of Vulnerability. Performed by ISIG. Available on request.
- **FirEURisk component of the integrated strategy: Vulnerability- Human lives and assets, coping capacity**
- **Technical characteristics:**

CHARACTERISTICS	DESCRIPTION
Type of products:	Database
Units:	Dimensions, indicators, and proxies composing a relative index on a 0-1 scale
Update Frequency:	Customisable (Yearly updates based on the availability of data)
Accuracy:	Not applicable
Output Format:	.xls
Fire risk component	Coping capacity
Temporal coverage:	Not applicable
Spatial resolution:	Territorial administrative units in the area of analysis (e.g., for the Barcelona Pilot Site analysis focus on Municipalities of the Province of Barcelona + the Province of Barcelona as a whole + the State)

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- **Overview:**

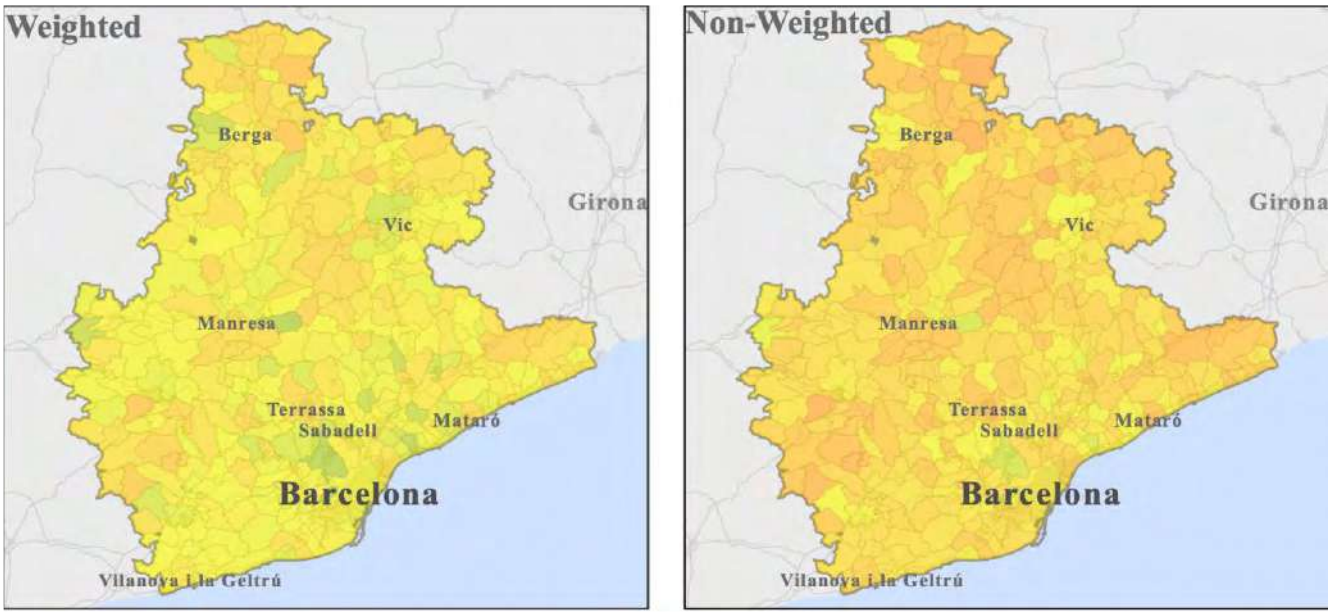


Figure 15. ReSVI product output (Barcelona Province, Spain).

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3.16 P16 - FirEURisk Display Platform

- **Session**: FirEURisk product viewer. A. Barrios and P. Vuorine. Arbonaut
- **Developer:** Arbonaut, Finland.
- **Activity:** "A4.3.1 Integrating FirEURisk resources with other EU platforms".
- **Product description:** Tool for displaying outputs from the internal platform and external platforms customised for the FirEURisk needs**.** The tool allows visualising pre-defined spatial datasets though a WebGIS interface. It gives a possiblity for providing access to the same datasets through an Android app interface. The mobile datasets can be used in offline mode when the selected layers have been downloaded to the device in advance.
- **Methodology:** NA
- **FirEURisk component of the integrated strategy: All**
- **Technical characteristics:**

CHARACTERISTICS	DESCRIPTION
Type of products:	Software / Web application / Mobile application
Units:	Not applicable
Update Frequency:	Depends on the layer availability
Accuracy:	Not applicable
Output Format:	Online read-only access
Fire risk component	Integration
Temporal coverage:	Depends on the product
Spatial resolution:	1ha in Pilot sites and 1km2 in European territory.
FirEURisk platform:	https://test-proms.arbonaut.com/proms/

- **Overview:**



Figure 16. Example of the Product interface

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3.17 P17 - Socio-economic barriers to reduce fire risk

- **Session:** Socioeconomic considerations for land management to reduce fire risk. M. Roberts. The James Hutton Institute.
- **Developer:** The James Hutton Institute, Scotland (United Kingdom).
- **Product description:** Analysis of potential socio-economic barriers, constrains and enables of LMS uptake to reduce fire risk. The product identifies and analyse the socio-economic barriers and constrains to LMS uptake. This involves collecting through specialized literature and consultation with stakeholders and develop economic evaluation models (cost effectiveness analysis) to demonstrate feasibility of interventions to reduce the constraints (like subsidies and regulation).
- **Methodology:** NA
- **FirEURisk component of the integrated strategy: Danger-Ignition and Propagation**
- **Technical characteristics:**

CHARACTERISTICS	DESCRIPTION
Type of products:	Document
Units:	not applicable
Update Frequency:	not applicable
Accuracy:	not applicable
Output Format:	.pdf
Fire risk component	Propagation (fuel)
Temporal coverage:	not applicable
Spatial resolution:	not applicable

- **Overview:**



Figure 17. Conclusions of socio-economic considerations for undertaking land management strategies to reduce fire risk

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4 Validation protocol

The questionnaires that were posed to the audience had a twofold objective:

- A **high-level** valuation of the products and feedback about the demonstration event itself, accomplished through **MENTIMETER**. This tool is very interactive with attendants BUT does not allow full traceability of the responses to the person.
- Detailed feedback of the products presented during the demonstration event, accomplished through the on-line **EUSurvey** application. This tool allows full traceability of responses to the person, which is important to know, mostly for correlating the responses to the professional category (the response is de-personalised, and privacy always kept safe).

The questions were kept at a high level but not including technical specifications; key information to measure and retrieve was:

- **Clarity** of information provided by presenters and contents.
- **Usability** of the products presented for their daily work.
- **Quality/methodology** aspects of the product (very general).
- **Self-contained** information of the product.

Images of MENTIMETER with the questions asked can be found in Annex B. The EUSurvey application is shown in Annex C.

5 Results

Analysis of the results of the questionnaires collected during the event, and after, considering the user needs is presented below. The number of answers for each point is shown in brackets. For graded questions, the range of values goes from 0 to 5.

1. What is your organisation's name? (n= 14)
   - Universitat de Lleida
   - Diputació de Barcelona
   - SPIF-DAAC
   - CREAF
   - University of Coimbra
   - ADAI
   - CTFC
   - UNIZAR

2. What aspect of wildfire risk assessment is most important in your activity? (n= 14)

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- Ignition causes (natural/human) 14%
- Fire propagation (fuels, terrain, weather) 28%
- Population/assets exposure 8%
- Ecosystem exposure 14%
- Potential losses (Ecological/Socio-economic assets) 3%
- Resistance and response capacity 31%
- Other 3%

3. What other fire risk components do you deal with in your activity? (e.g: land mang. plans, fighter's training, residents' education) (n=10)

- Fire containment probability
- Modelling (MEDFATE)
- Awareness, educationand training of citicens
- Accessibilitat al territori
- Fuel moisture modeling
- Sensibilización de la población respecto al riesgo de incendio
- Danger prediction
- Fuel management plans
- Firefighter training
- Land management plans

4. FirEURisk products to estimate ignition danger (n=13)

(a) Weekly fire danger metric at 25ha. Combines dead-live fuel moisture + meteo profiles.
(b) Weekly live fuel moisture content at 25ha. Based on MODIS thermal + MS imagery.
(c) Natural ignition probability at 1ha. Combines Lightning, past fires, + 6 terrain variables.
(d) Human ignition probability at 1ha. Combines human caused fire records + 10 spatial variables.

4.1. Has the explanation of the weather and ignition products been sufficient? (n=13)

(a) 3.5
(b) 3
(c) 4.7
(d) 4

4.2. What other elements of weather and fire ignition do you need information about? (n=4)

- Fuel load and characteristics
- Carga de vegetation
- Live to dead fuel transitions
- Quantitatives precipitation estimates derived from weather radar are needed to complement lightning data

4.3. Can you implement and use these weather and ignition products in your daily work? (n=13)

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(a) 1.8
(b) 1.8
(c) 1.8
(d) 1.8

4.4. If you cannot implement a given product, please tell us the reason. (n=3)
- Parametric models are easier to implement
- Technical
- property of the forest land

4.5. Is the methodology of products comprehensive? (n=10)
(a) 3.8
(b) 3.7
(c) 4.4
(d) 4

4.6. How interesting are these products for you? Would you use them inyour risk prevention protocols? (n=11)
(a) High usability and high interest
(b) High usability and high interest
(c) High usability and high interest
(d) High usability and high interest

5. FirEURisk products applicable to fuels, propagation, population and assets
(a) Custom fuel characterization. 1ha. Baseline map.
(b) Fuel type & model, canopy metrics and landscape file. 1ha. Baseline map.
(c) Wildfire spread and behaviour outputs, "basic mode". 1ha. Baseline map.
(d) Wildland-urban interface map. 100m2. Baseline map.

5.1. How suitable are the fuels, propagation, population and assets products for your territory? (n=13)
(a) 4.5
(b) 4.5
(c) 4.5
(d) 4.4

5.2. Can you implement and use the fuels, propagation, population and assets products in your daily work? (n=13)
(a) 3
(b) 3.1
(c) 3.2
(d) 3.2

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5.3. If you cannot implement the fuels, propagation, population and assets products, please tell us the reason why. (n=4)

- We need to develop high resolution fuel maps using LiDAR data
- Need more detailed spatial resolution
- More provinces
- Representativeness of fuel estimations

5.4. How comprehensive is the methodology or the products? (n=11)

(a) 4.4
(b) 4.3
(c) 3.8
(d) 4.5

5.5. How interesting are these products for you? Would you use them in your risk prevention protocols? (n=12)

(a) Very high usability and very high interest
(b) Very high usability and very high interest
(c) Very high usability and very high interest
(d) Very high usability and very high interest

6. FirEURisk products for exposure, potential losses and resilience

(a) Smoke potential. 1 ha.
(b) Suppression Difficulty Index Evaluation. 1 ha.
(c) Persistence Index Map. 1 ha.
(d) ReSVI - Relative Societal Vulnerability Index at community level: municipalities. province and state.

6.1. Has the explanation of the exposure, potential losses and resilience been sufficient? (n=11)

(a) 4.2
(b) 4
(c) 4.3
(d) 4

6.2. Can you implement and use these exposure, potential losses and resilience products in your daily work? (n=13)

(a) 2.9
(b) 3.2
(c) 2.9
(d) 2.9

6.3. If you cannot implement the exposure, potential losses and resilience products, please tell us the reason why. (n=3)

- Politic
- Budget limitations

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- Secondary acting topics

6.4. Is the methodology comprehensive? (n=11)

(a) 4.1
(b) 3.6
(c) 4
(d) 4

6.5. Is the product applicability evident for your work? (n=9)

(a) 3
(b) 3.5
(c) 3.8
(d) 3.4

6.6. Are these indices interesting for you? Would you use them in your risk prevention protocols? (n=11)

(a) Neutral usability and high interest
(b) High usability and high interest
(c) High usability and high interest
(d) High usability and high interest

7.1. Please, value the following characteristics of FirEURisk Display Platform (n=10)

- Platform design 4.0
- Clear metadata 3.2
- Clear legends 3.7
- Product mapping display 3.7
- Accessibility (easy to navigate) 4.3
- Complete product description 3.3

7.2. To what extent do you agree with the following statements? (n=10)

1. Was FirEURisk project and its reasoning, objectives and goals well presented at the start of the demonstration? 4
2. Were products described in sufficient detail for my needs? 3.4
3. Did you have enough time to understand the use of the product? 3.2
4. Did you have enough time for questions about the product(s)? 4.2
5. Were questions answered satisfactorily? 4.2
6. Please value the quality of sound and video 4.5
7. The on-line experience was sufficient to validate the product 3.6

7.3. Please let us know items to improve or any question to be answered (n=3)

- Importance of transfer of results

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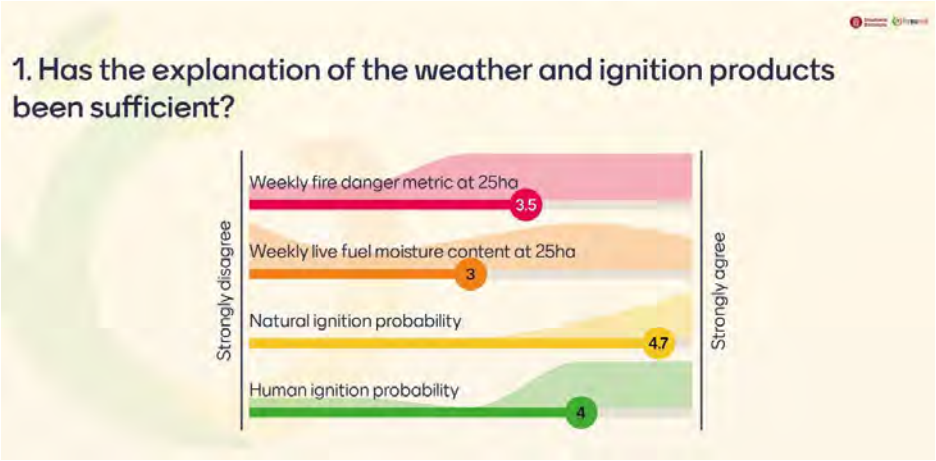
- Dissemination and information to administrations, companies and society
- How to access the actual products with institutional ok.

Summary of participation per question:

Interactive slides	Responses/participants	Participation rate
1. What is your organisation's name?	14 / 20	70 %
2. What aspect of wildfire risk assessment is most important in your activity?	14 / 20	70 %
3. What other fire risk components do you deal with in your activity? (e.g: land mang. plans, fighter's training, residents education)	10 / 20	50 %
1. Has the explanation of the weather and ignition products been sufficient?	13 / 20	65 %
2. What other elements of weather and fire ignition do you need information about?	4 / 20	20 %
3. Can you implement and use these weather and ignition products in your daily work?	13 / 20	65 %
4. If you cannot implement a given product, please tell us the reason.	3 / 20	15 %
5. Is the methodology of products comprehensive?	10 / 20	50 %
6. How interesting are these products for you? Would you use them in your risk prevention protocols?	11 / 20	55 %
1. How suitable are the fuels, propagation, population and assets products for your territory?	13 / 20	65 %
2. Can you implement and use the fuels, propagation, population and assets products in your daily work?	13 / 20	65 %
3. If you cannot implement the fuels, propagation, population and assets products, please tell us the reason why.	5 / 20	25 %
4. How comprehensive is the methodology or the products?	11 / 20	55 %
5. How interesting are these products for you? Would you use them in your risk prevention protocols?	12 / 20	60 %
1. Has the explanation of the exposure, potential losses and resilience products been sufficient?	11 / 20	55 %
2. Can you implement and use these exposure, potential losses and resilience products in your daily work?	13 / 20	65 %
3. If you cannot implement the exposure, potential losses and resilience products , please tell us the reason why.	3 / 20	15 %
4. Is the methodology comprehensive?	11 / 20	55 %
5. Is the product applicability evident for your work?	9 / 20	45 %
6. Are these indices interesting for you? Would you use them in your risk prevention protocols?	11 / 20	55 %
1. Please value the following characteristics of FirEURisk Display Platform	10 / 20	50 %
2. To what extent do you agree with the following statements?	10 / 20	50 %
3. Please let us know items to improve or any question to be answered	3 / 20	15 %

View of the look and feel of the responses during the validation exercise.

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6 Conclusions and lessons learnt from the DE

In short, the DE yielded the following key numbers:



The conclusions and lessons learnt can be synthesised in five aspects:

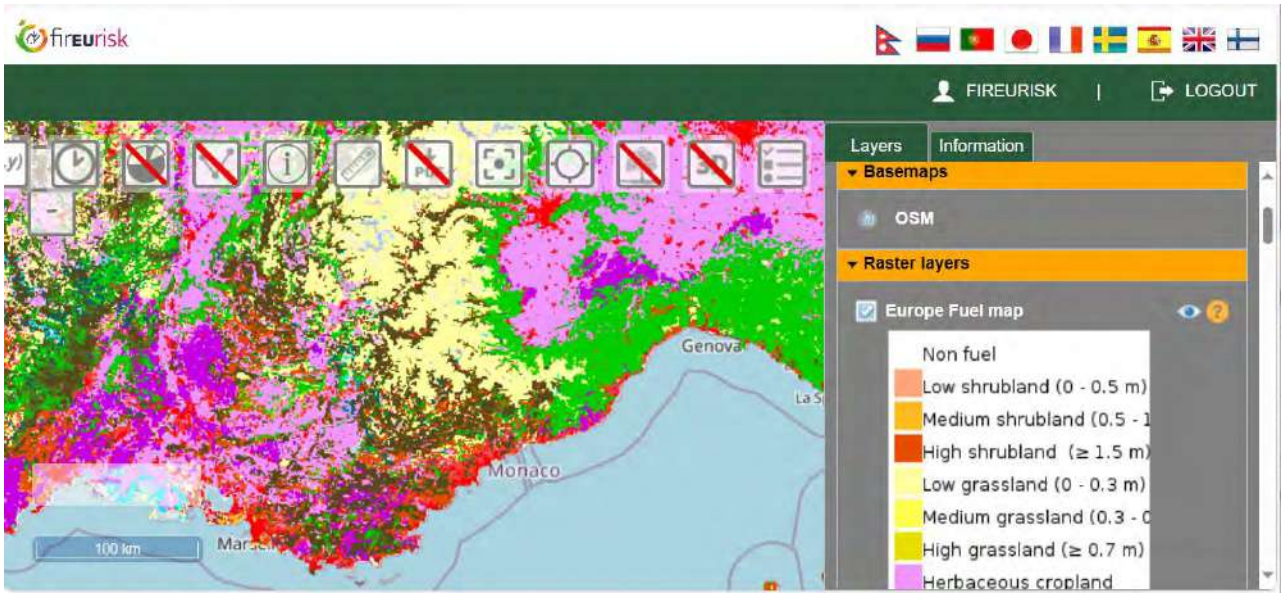
1. The analysis of the **plan of action and logistics** investigated the date, location (venue and Institutional hosting), language(s), translation, broadcast, attendants, on-line speakers and communication of the event to target attendant groups.

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It is worth highlighting the institutional role and background provided by the Generalitat de Catalunya: FirEURisk has thus counted with further scientific and technical credibility for the products presented. The hosting premises covered all possible needs relative to on-line transmission, recording, and trilingual translation (Catalan, Spanish and English). Moreover, the session counted with expert technical support for sound and image control.

We also learnt for future DE the need to maintain the planned event dates, without last-minute changes that could confuse the target audience, the need to bear in mind local festivities and the need for an earlier on-line connection to engage with the distant audience.

2. The relevance of presenting **FirEURisk** on-line viewer (https://test-proms.arbonaut.com/proms/login.jsp) at the beginning of the session to convey the message of operability and usability of the specific products to be shown afterwards.



3. The relevance of the **technical information and presentation materials** prepared in advanced, i.e.:
   - The thematic **geo-information layers** over the demonstration area **uploaded** into the viewer, bearing in mind their availability two weeks in advance for validation questions.
   - The product **definition card** (see section 3 above) so that attendants count with the technical specifications of the products they could benefit from and infer the true usability in their normal work and competences.

In this respect, since the DE in Barcelona was the first of the series, the products presented focused on the solutions developed in WP1 for fire risk assessment to improve prevention. Though Project demo events aim to show how project products work jointly in integrating risk assessment, reduction and adaptation, available products at the time did not allow to deal with all of these risk phases; the DE was conducted early in the project timeline for WP5. These

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products and other risk product components for the three risk phases in the integrated wildfire risk strategy are addressed in later DEs and the corresponding deliverables, after learning from this one.

4. The validation of products intended from the end users and stakeholders is qualitative, based on their appreciation of the products under the viewpoint of their professional expertise. To this purpose, the feedback tools used (I.e: Mentimeter and EU Survey) allowed us to have a real time feedback and a remote gathering of impressions. Mentimeter was effective (Sections 4, 5 and Annex A while the EU Survey received no answers (Annex B).
5. It appears to be convenient to link the stakeholder's validation to the products accessible on the viewer.

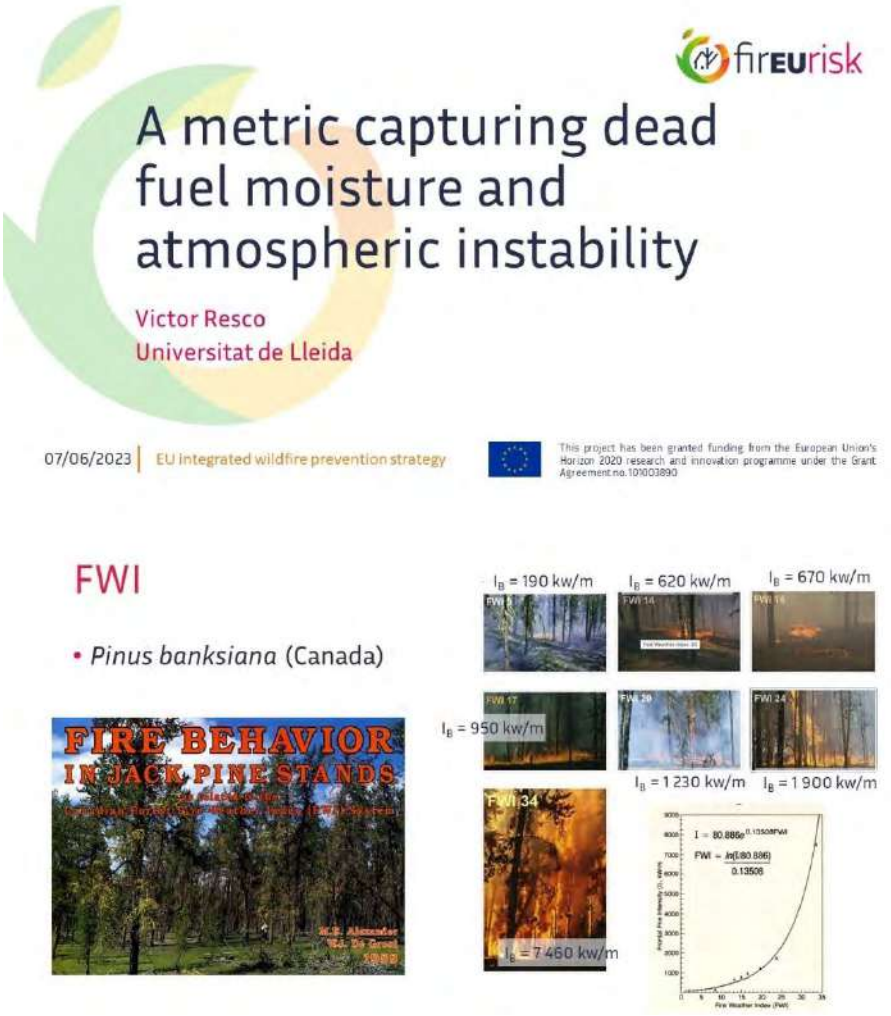
7 References

References are linked to Products descriptions above and facilitated for each product, when required.

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Annex A: PS4 demonstration event presentations

Product 58. Weekly fire danger metric at 25 ha



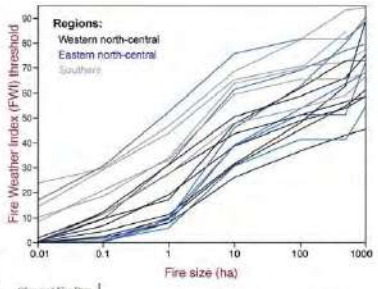
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Examples FWI-PT

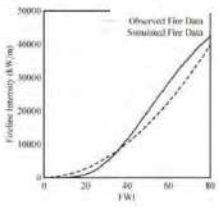
- FWI: ISI y BUI
- FWI =38->FLI >10,000kw/m

P. pinaster in PT

Lots of regional variability

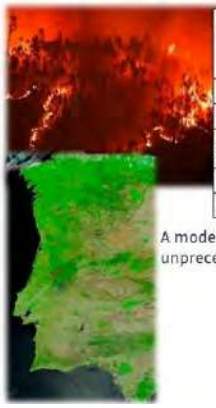


Fernandes et al 2019



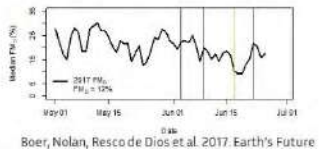
Palheiro y Fernandes

Pedrogao Grande 2017



Weather station	Elevation (m.a.s.l)	Distance and bearing from fire (Km, cardinal points)	FWI	FWI percentile
Ansião	405	22 (WSW)	36.0	73
Proença-a-Nova	379	36 (SE	48.8	83
Pampilhosa da Serra	890	29 (ENE)	54.5	92
Lousã	195	22 (NW)	39.5	88
Tomar	75	44 (SSE)	38.7	66

A model of dead fuel mioisture based on VPD (FM_D) showed unprecedented values:



Boer, Nolan, Resco de Dios et al. 2017. Earth's Future

Pedrogao Grande 2017



Earth's Future

Commentary | Open Access

Changing Weather Extremes Call for Early Warning of Potential for Catastrophic Fire

Matthias M. Boer, Rachael H. Nolan, Víctor Resco De Dios, Hamish Clarke, Owen F. Price, Ross A. Bradstock

First published: 22 December 2017 | https://doi.org/10.1002/2017EF000657 | Citations: 49





Boer, Nolan, Resco de Dios et al. 2017. Earth's Future

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Rationale - MEDEU Pyroregions

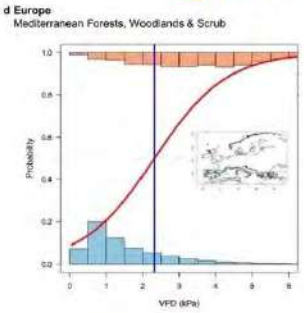


This project has been granted funding from the European Union's Horizon 2020 research and innovation programme under the Grant Agreement no.101003890

6

Fire-days

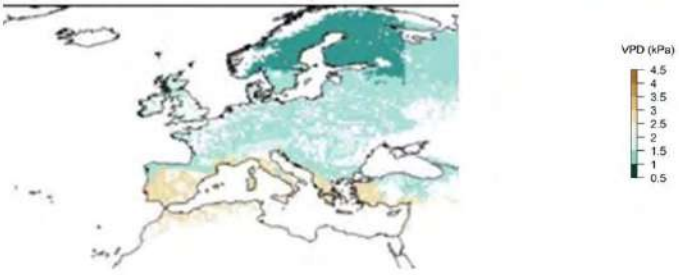




This project has been granted funding from the European Union's Horizon 2020 research and innovation programme under the Grant Agreement no.101003890

7

VPD thresholds

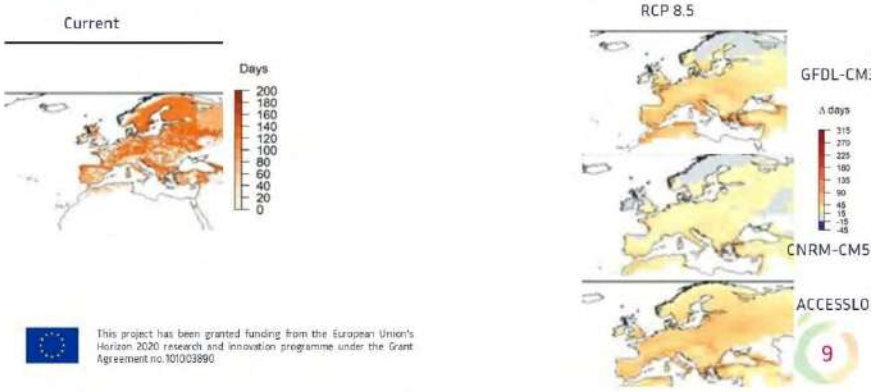


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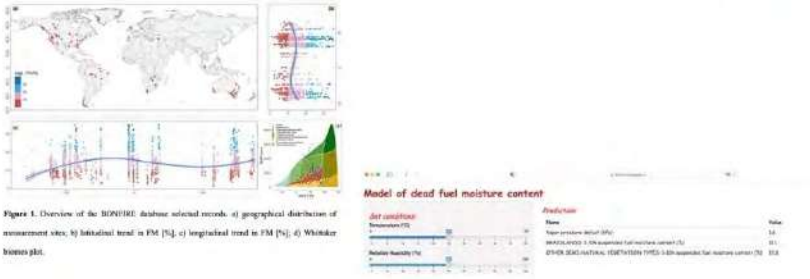
Current & future fire days (VPD exceedances)



This project has been granted funding from the European Union's Horizon 2020 research and innovation programme under the Grant Agreement no. 101003890

9

VPD as best proxy for DFMC



In review

This project has been granted funding from the European Union's Horizon 2020 research and innovation programme under the Grant Agreement no. 101003890

10

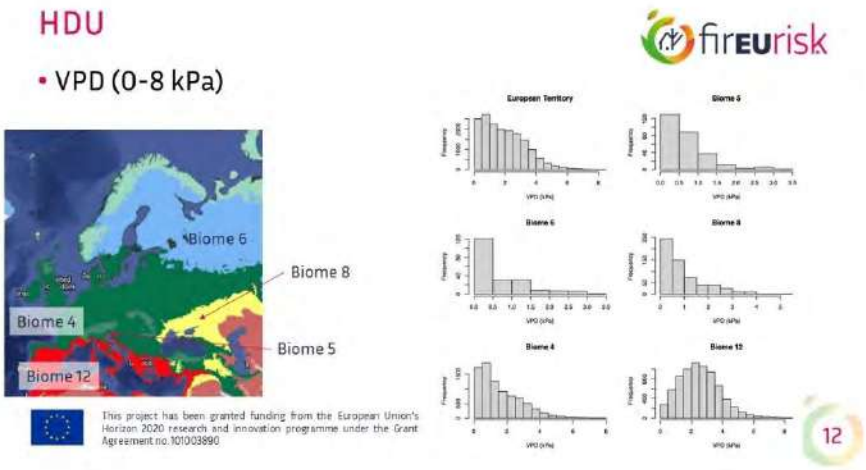
HDU (Hot-dry-unstable)

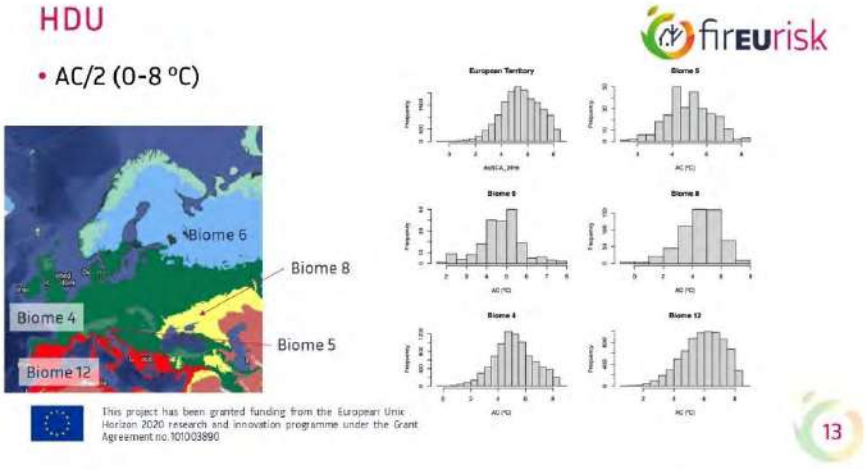
- HDU = VPD + AC/2
- VPD-> DFMC
- AC->atmospheric component: T_{800hPa}-T_{850hPa}

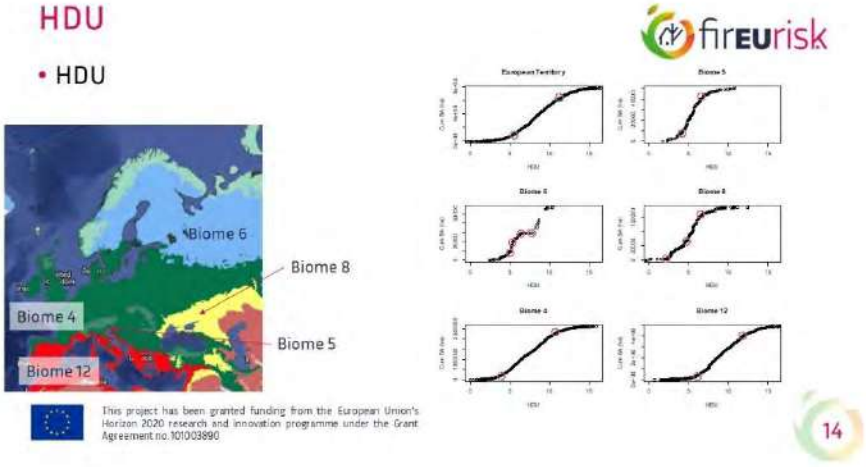
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HDU

- HDU – fire sizes (ha) associated with different HDU values across biomes
- Problems in Biome 5 & 8

Quantile	European Territory			Biome 5			Biome 6			Biome 8			Biome 4			Biome 12		
	low HDU	mid HDU	high HDU	low HDU	mid HDU	high HDU	low HDU	mid HDU	high HDU	low HDU	mid HDU	high HDU	low HDU	mid HDU	high HDU	low HDU	mid HDU	high HDU
0.5	86	150	279	85	75	65	65	43	367	86	86	86	86	108	215	107	193	387
0.75	215	365	752	172	194	129	108	173	2344	280	215	204	215	258	516	258	473	1053
0.95	838	1526	4126	796	857	403	410	593	7848	1747	1548	624	989	1011	1870	1034	1906	6928

This project has been granted funding from the European Union's Horizon 2020 research and innovation programme under the Grant Agreement no. 101003890

A metric capturing dead fuel moisture and atmospheric instability

- Definition of fire-days
- Quantifications of key drivers of fire activity in MedEU
- Determination of best DFMC model
- Development of HDU

This project has been granted funding from the European Union's Horizon 2020 research and innovation programme under the Grant Agreement no. 101003890

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Product 65. Weekly live fuel moisture content at 25ha

Article

Live Fuel Moisture Content Mapping in the Mediterranean Basin Using Random Forests and Combining MODIS Spectral and Thermal Data

Àngel Cunill Camprubí [1,2,*], Pablo González-Moreno [3] and Víctor Resco de Dios [1,2,4]

1 Joint Research Unit CTFC-AGROTECNIO-CERCA Center, 25198 Lleida, Spain; victor.resco@udl.cat
2 Department of Crop and Forest Sciences, University of Lleida, 25198 Lleida, Spain
3 Department of Forest Engineering, Grupo ERSAF, DendroDat Lab, Campus de Rabanales, Universidad de Córdoba, Crta. IV, km. 396, 14071 Córdoba, Spain; ir2gomop@uco.es
4 School of Life Science and Engineering, Southwest University of Science and Technology, Mianyang 621010, China
* Correspondence: acunill86@gmail.com

Abstract: Remotely sensed vegetation indices have been widely used to estimate live fuel moisture content (LFMC). However, marked differences in vegetation structure affect the relationship between field-measured LFMC and reflectance, which limits spatial extrapolation of these indices. To overcome this limitation, we explored the potential of random forests (RF) to estimate LFMC at the subcontinental scale in the Mediterranean basin wildland. We built RF models ($LFMC_{RF}$) using a combination of MODIS spectral bands, vegetation indices, surface temperature, and the day of year as predictors. We used the Globe-LFMC and the Catalan LFMC monitoring program databases as ground-truth samples (10,374 samples). $LFMC_{RF}$ was calibrated with samples collected between 2000 and 2014 and validated with samples from 2015 to 2019, with overall root mean square errors (RMSE) of 19.9% and 16.4%, respectively, which were lower than current approaches based on radiative transfer models (RMSE ~74–78%). We used our approach to generate a public database with weekly LFMC maps across the Mediterranean basin.

Keywords: live fuel moisture content; wildfire; MODIS; spectral indices; land surface temperature; random forests

check for updates

Citation: Cunill Camprubí, À.; González-Moreno, P.; Resco de Dios, V. Live Fuel Moisture Content Mapping in the Mediterranean Basin Using Random Forests and Combining MODIS Spectral and Thermal Data. *Remote Sens.* **2022**, *14*, 3162. https://doi.org/10.3390/rs14133162

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Product 66. Natural ignition probability



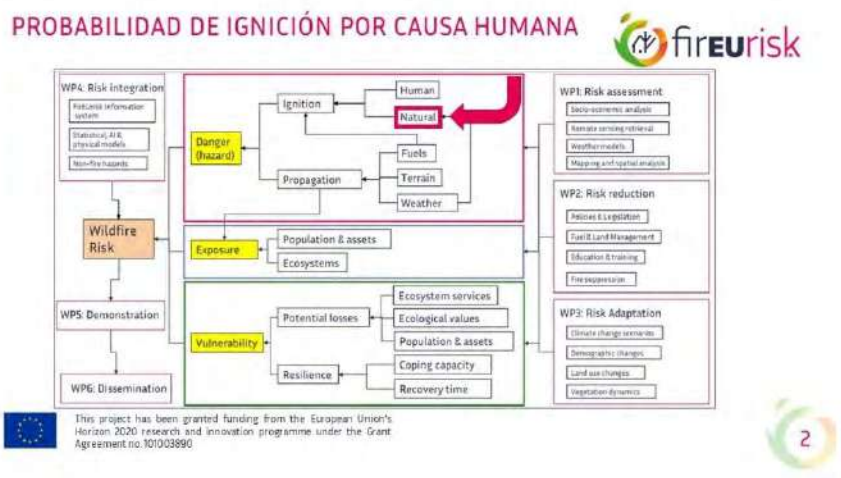
Probabilidad de ignición por rayo

Marcos Rodrigues Mimbrero

Universidad de Zaragoza

05/06/23 Event | Demostration Event
Diputació de Barcelona

This project has been granted funding from the European Union's Horizon 2020 research and innovation programme under the Grant Agreement no. 101003890

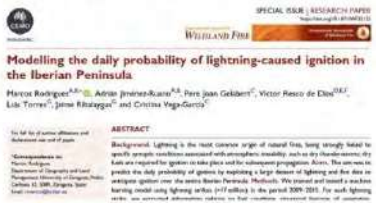


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CONTEXTO

- El objetivo ha sido desarrollar un modelo basado en la estimación de las condiciones en que el impacto de un rayo provocaría un incendio
- Se basa en identificar qué rayos dentro del periodo de análisis han provocado incendios y bajo qué condiciones
- Se ha desarrollado con Random Forest, siendo válido para la Península Ibérica
- El modelo se ha ajustado para un rango de resolución entre 50m y 1Km
- Permite resultados diarios, reconstrucciones históricas y predicciones

PRODUCTO: MAPA DE PROBABILIDAD DE IGNICIÓN POR RAYO


Modelling the daily probability of lightning-caused ignition in the Iberian Peninsula

This project has been granted funding from the European Union's Horizon 2020 research and innovation programme under the Grant Agreement no. 101003890

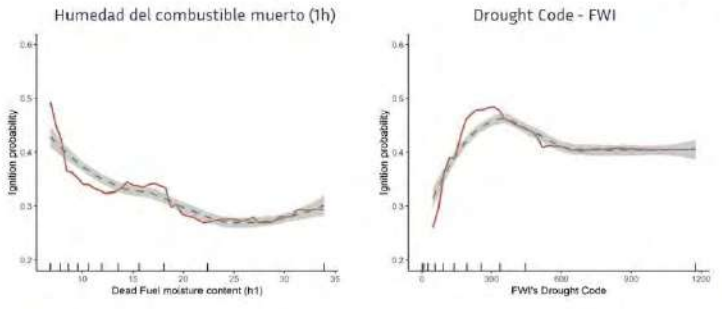
DATOS DE INCENDIOS Y RAYOS

- Localización y fecha de los incendios causados por rayo en España (obtenidos de la BBDD EGIF) – 2500 incendios emparejados a un rayo (1000m <3 días)
- Localización y fecha de los incendios causados por rayo en Portugal (obtenidos de la BBDD DECIF) – 329 incendios
- Un amplio y completo conjunto de datos de rayos nube-tierra registrados en el periodo 2009-2015 (AEMET/Meteogrid SL) – aprox. 17 mill de impactos

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VARIABLES PREDICTIVAS

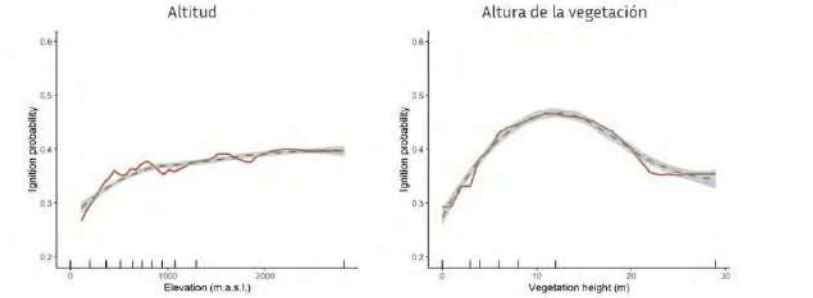


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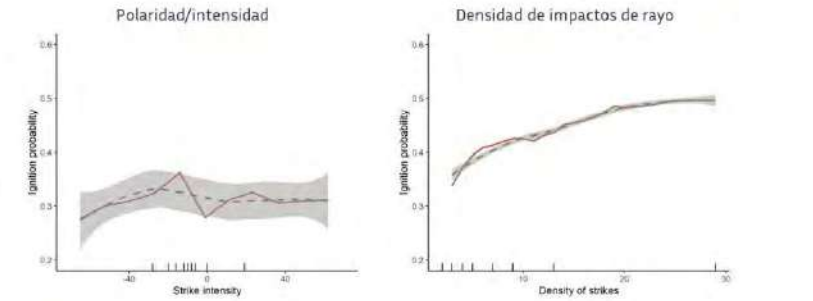
VARIABLES PREDICTIVAS



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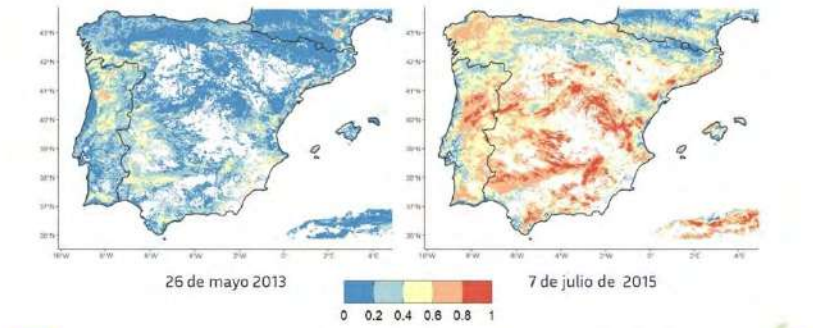
VARIABLES PREDICTIVAS



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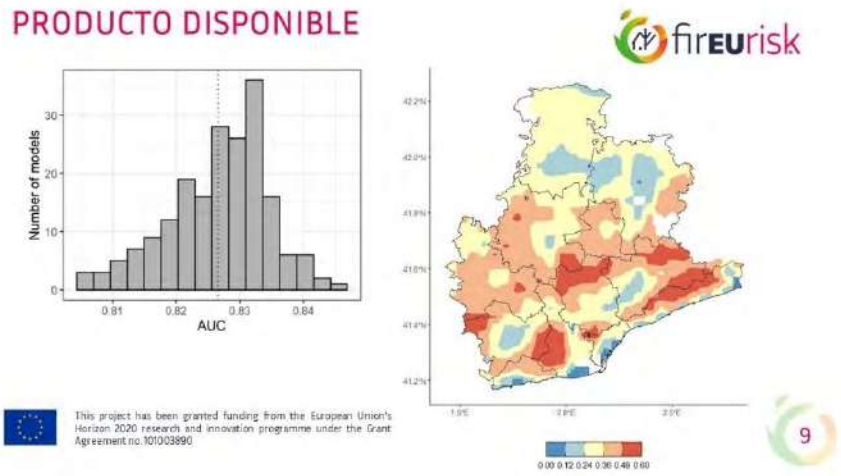
PREDICCIONES DEL MODELO



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Product 63. Human ignition probability



Probabilidad de ignición por causa humana

Adrián Jiménez Ruano
Universidad de Lleida y Universidad de Zaragoza

07/06/23 Evento | Demostración
Diputació de Barcelona

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ÍNDICE

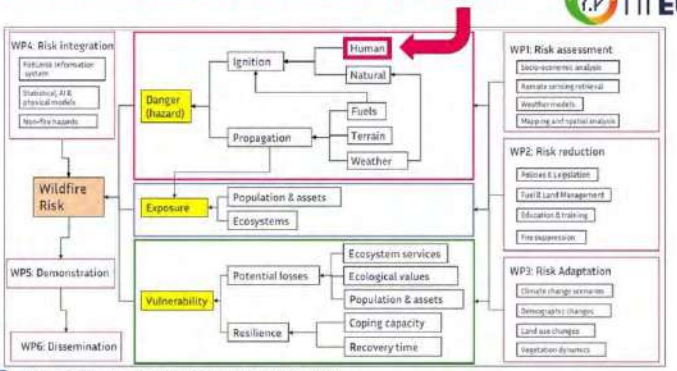
1. Base de datos de incendios (2008-2018)
2. Variables de entrada
3. Modelo (Random Forest)
4. Variables más significativas
5. **PRODUCTO: MAPA DE PROBABILIDAD DE IGNICIÓN POR CAUSA HUMANA**

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PROBABILIDAD DE IGNICIÓN POR CAUSA HUMANA

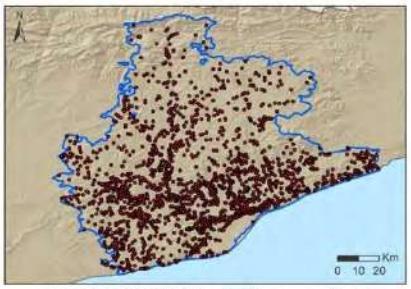


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BASE DE DATOS DE INCENDIOS

- Total incendios causa humana de la DIBA: 2.462 (2008-2018)



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VARIABLES DE ENTRADA

Variable	Año	Fuente
Densidad de población	2020	SEDAC
Distancia a carreteras	2005–2014	Global Roads Inventory Project (modelo GLOBIO)
Porcentaje población mayor 65 años	2011	EUROSTAT a nivel municipal
Distancia a interfases (WAI, WUI y WGI)	2018	Corine Land Cover
Porcentaje de cobertura urbana, agrícola y forestal	2018	Corine Land Cover

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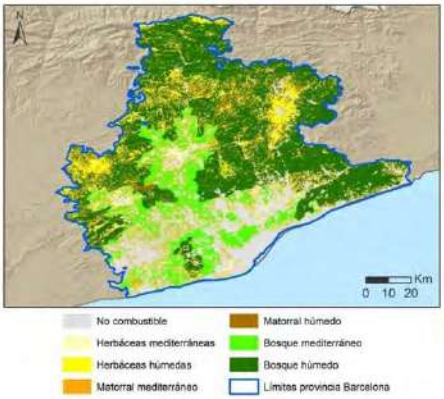
VARIABLES DE ENTRADA

Variable	Año	Fuente
Tipo de combustible	2020	Land Cover Sentinel 2, Altura de la vegetación (GEDI y Landsat)

Referencias:

Copernicus Global Land Cover Layers
Buchhorn, M. et al (2020)

Modelos de Combustible: Aragoneses y Chuvieco (2021)



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VARIABLES DE ENTRADA

- Relación entre tipo de combustible e incendios humanos históricos

Tipo de combustible	Ambiente	Número de incendios	Porcentaje
Herbáceas	Mediterráneo	382	15,51 %
	Húmedo	158	6,42 %
Matorrales	Mediterráneo	376	15,27 %
	Húmedo	154	6,25 %
Bosques	Mediterráneo	579	23,52 %
	Húmedo	400	16,25 %

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MODELO (RANDOM FOREST)

- Ajuste **100 modelos** (variabilidad = modelo robusto)
- **Máscara** de zonas de **no combustible** (excluyéndolas en todas las variables)
- **Resultado**: Ráster en formato .tif del promedio de los 100 modelos previos

Probabilidad de ignición por causa humana.

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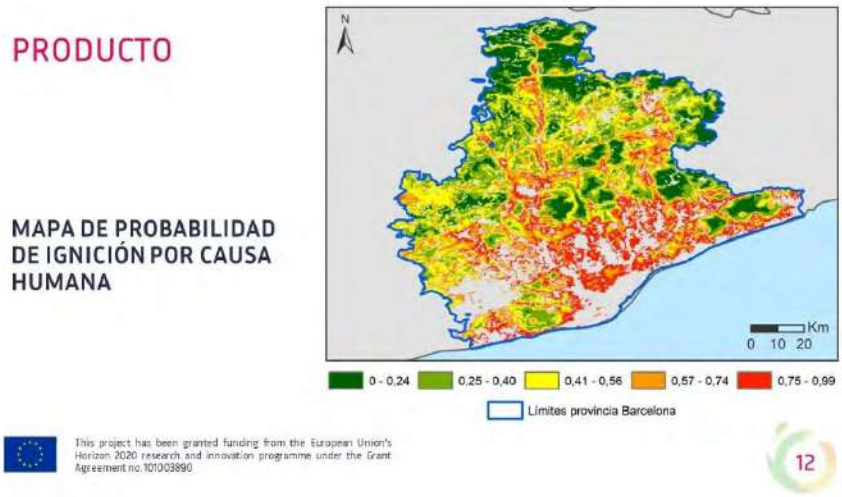
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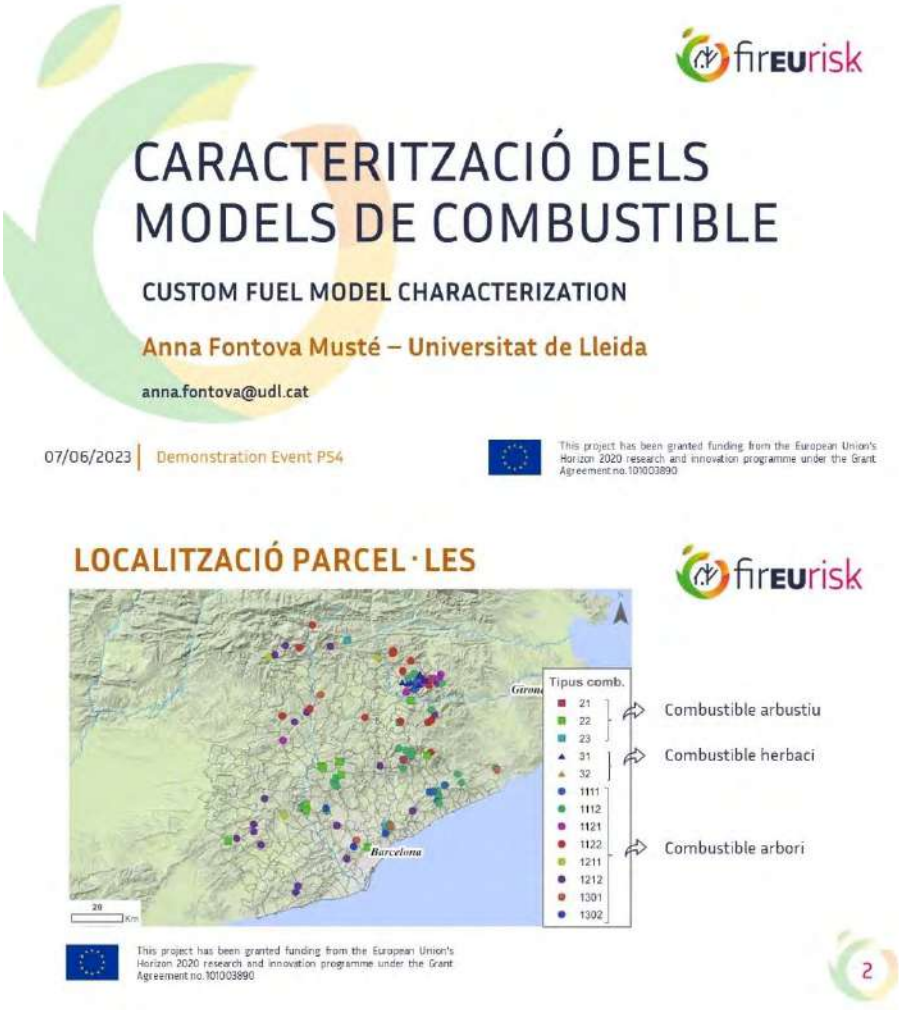
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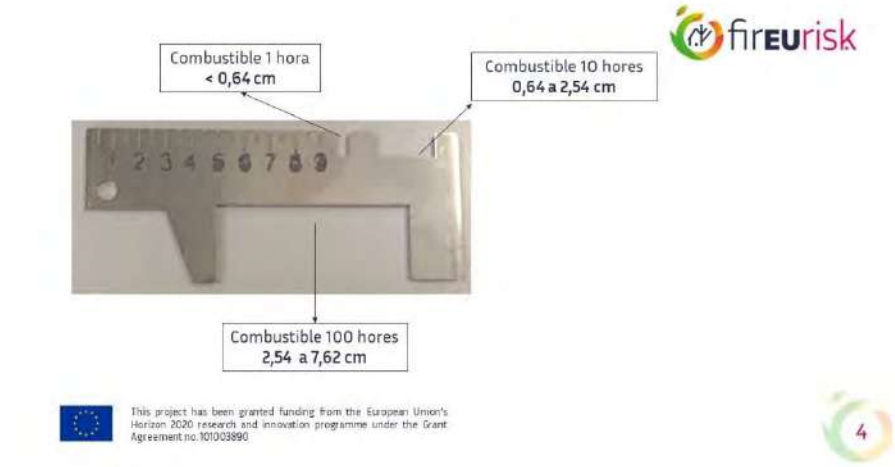
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Product 60. Custom fuel characterization



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Tipificació combustible firEURisk

1. Combustible arbori (Alçada de la copa >3m) i fcc>15%
2. Utilitzem l'espècie dominant per diferenciar entre classes (Perennes, Caduques, Angiospermes, Gimnospermes i boscos mixtos)
3. Diferenciació entre bosc obert (fcc> 15%) i tancat (fcc>70%)
4. Combustible arbustiu i herbaci segons alçada del combustible de l'estrat
5. Diferenciació en àrid i humit segons l'Índex de Martone.

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Metodologia adaptada de Aragoneses i Chuvieco, 2021

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ANGIOSPERMES CADUQUES (Broadleaf Decidious)

Massa tancada fcc ≥70% -> **1122**



Massa oberta fcc<70% -> **1121**



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ANGIOSPERMES PERENNES (Broadleaf Evergreen)

Massa tancada fcc≥70% -> **1112**



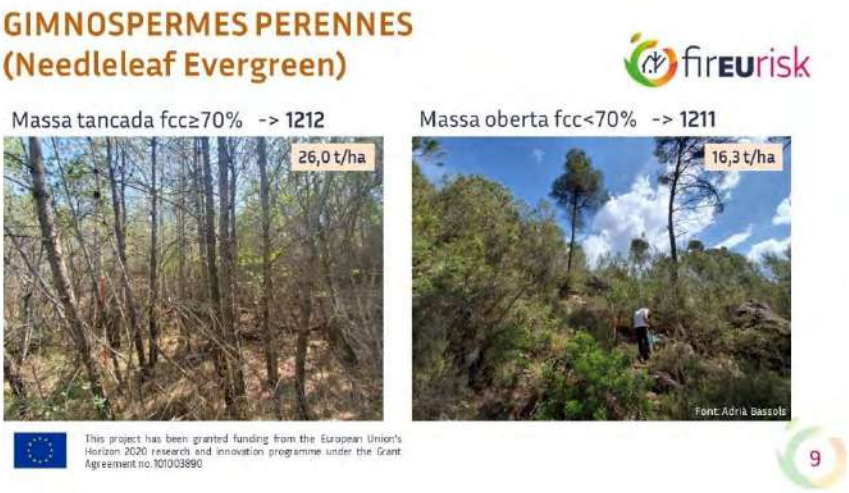
Massa oberta fcc<70% -> **1111**



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COMBUSTIBLE HERBACI (Grassland)

Alçada 0-0,3 m-> **31**



Alçada 0,3 – 0,7 -> **32**



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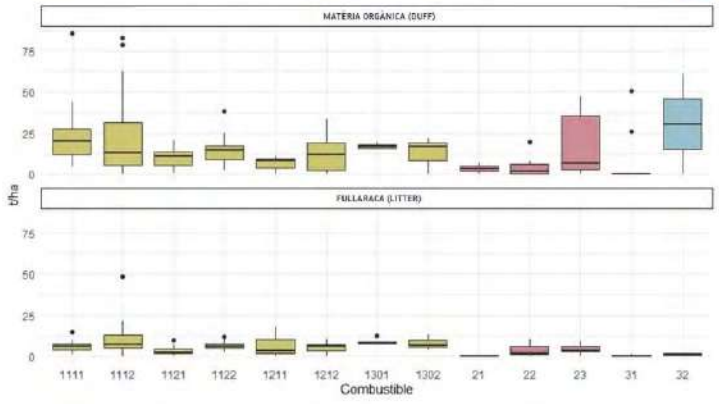
12

TAULA RESUM RESULTATS

Tipus de combustible	Matèria orgànica (t/ha)	1-h Fullaraca (t/ha)	1-h Sotabosc (t/ha)	10-h (t/ha)	100-h (t/ha)	1000-h (t/ha)	Viu herbaci (t/ha)	Viu llenyós (t/ha)	
21	3,60	0,24	0,03	0,25	0,08	0,00	0,33	0,92	Arbustiu
22	4,08	3,49	0,01	0,19	0,60	0,00	0,39	6,04	
23	18,55	4,29	0,05	1,90	0,87	2,94	0,22	6,25	
31	6,37	0,23	0,01	0,00	0,00	0,00	1,00	0,00	Herbaci
32	30,55	1,15	0,23	1,44	0,00	0,00	1,53	0,00	
1111	26,58	6,06	0,09	1,61	2,91	1,79	0,21	1,48	Arbrat
1112	22,61	10,27	0,35	2,45	2,44	0,29	0,05	0,87	
1121	10,39	3,53	0,08	0,41	0,145	0,10	1,20	0,80	
1122	14,58	6,36	0,06	1,54	2,43	0,00	0,48	1,57	
1211	6,33	6,97	0,000	0,70	1,53	0,00	0,51	0,28	
1212	12,28	5,47	0,12	1,55	1,86	2,25	0,86	1,60	
1301	17,08	8,68	0,12	1,90	4,87	8,21	0,13	3,35	
1302	12,81	7,76	0,04	2,61	5,49	34,14	0,00	2,29	

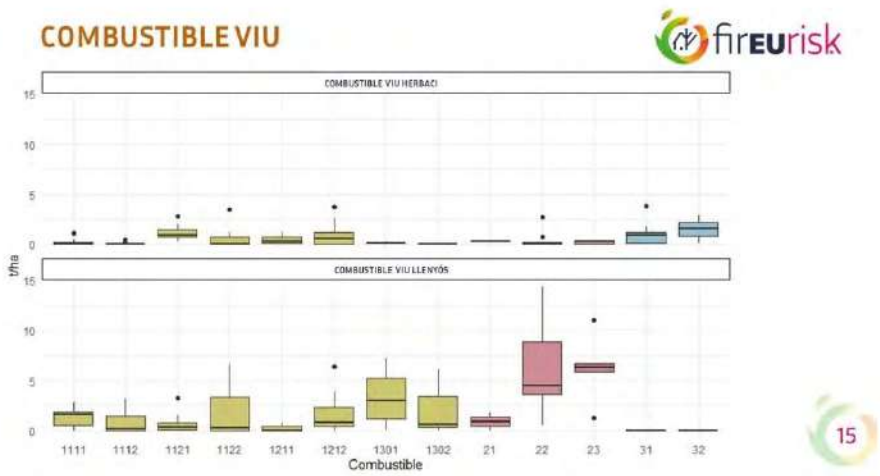
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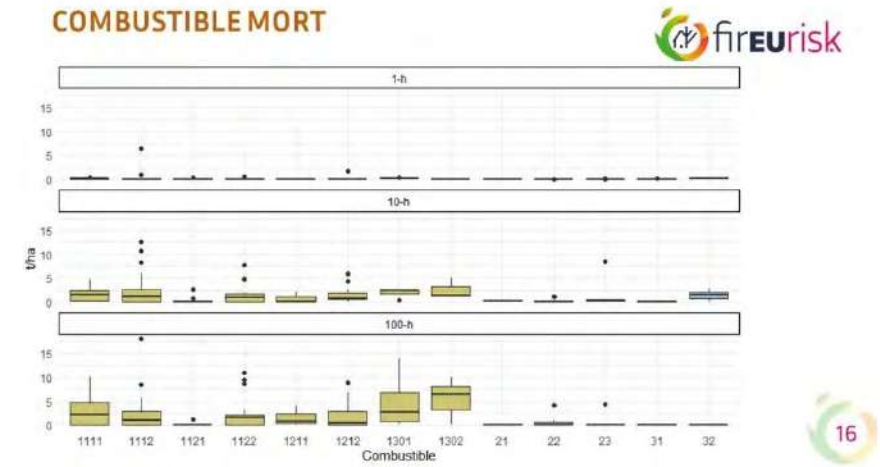
MATÈRIA ORGÀNICA I FULLARACA

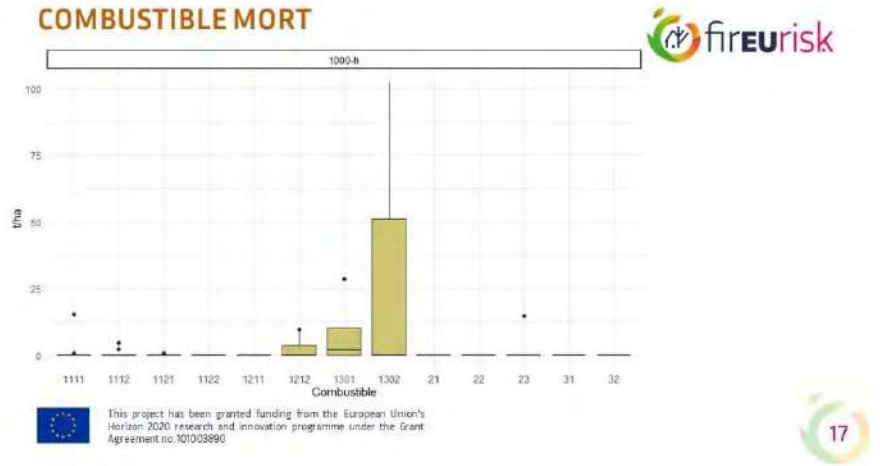


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CONCLUSIONS

1. Els valors per tipologia de combustible s'utilitzen per la simulació del comportament dels incendis
   - Valor mitjà
   - Específic per parcel·la utilitzant la fotoguia
2. La nostra aportació és significativa per la caracterització dels combustibles en el marc del projecte per la zona mediterrània
3. Ens permet adaptar els models de combustible per la província de Barcelona i fer una comparativa amb els models americans (Scott and Burgan, 2005)

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Tipologia combustible	1h	10h	100h	Viu herbaci	Viu llenyós
GR2	0,10	0,00	0,00	1,00	0,00
31 Herbaci	0,24	0,00	0,00	1,00	0,00
Variació	**-0,14**	**0,00**	**0,00**	**0,00**	**0,00**
SH2	1,35	2,40	0,75	0,00	3,85
22 Arbustiu	3,50	0,19	0,60	0,39	6,04
Variació	**-2,15**	**2,21**	**0,15**	**-0,39**	**-2,19**
TL9	6,65	3,30	4,15	0,00	0,00
1122 Arbrat	6,40	1,54	2,43	0,48	1,57
Variació	**0,25**	**1,76**	**1,72**	**-0,48**	**-1,57**

Scott and Burgan (2005)
FirEUrisk (2023)

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Moltes gràcies!

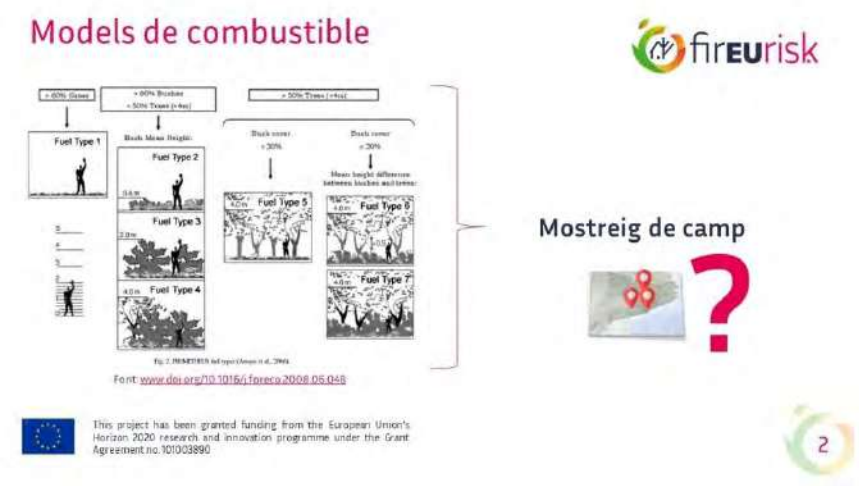
anna.fontova@udl.cat

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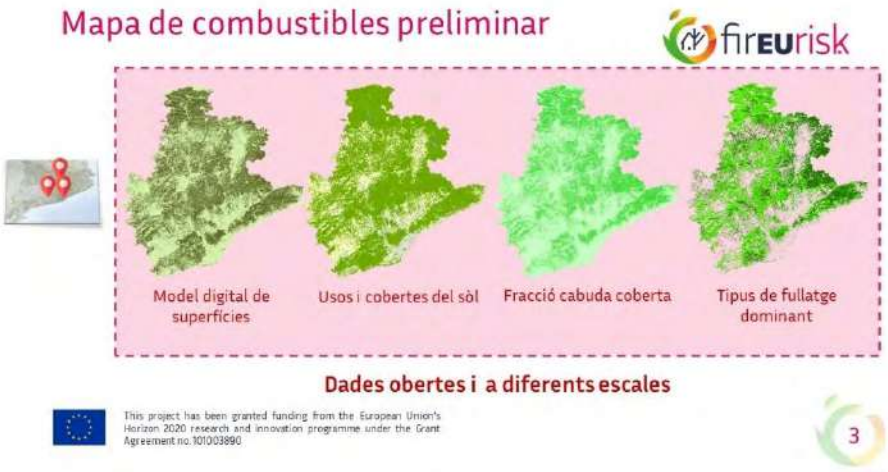
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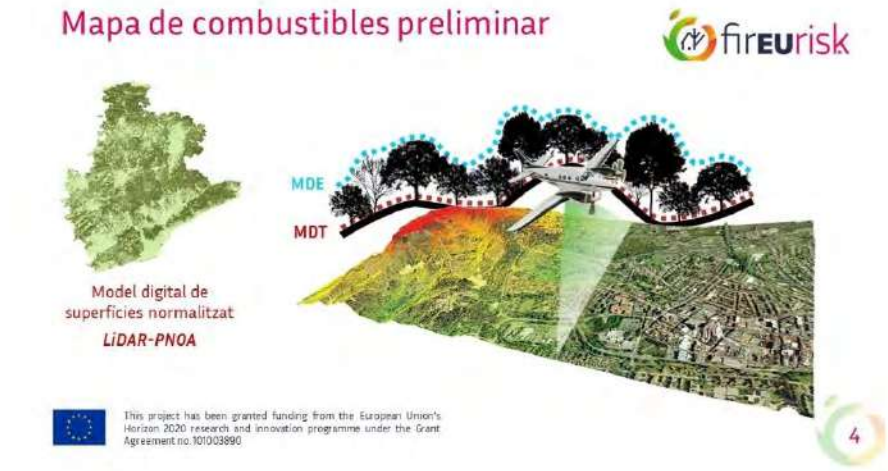
Product 62. Fuel type & model, canopy metrics, and landscape file





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Mapa de combustibles preliminar



Fracció cabuda coberta arbrada



Tipus de fullatge dominant

https://land.copernicus.eu/pan-european/high-resolution-layers/forests

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Mapa de combustibles preliminar



Àlgebra de mapes

1	4	5	5	1	3	6	5	8
5	3	2	+ 1	2	1	= 6	5	3
2	5	2	1	4	2	3	9	4

- FCC < 15%, not a forest fuel type
- **Categories arbrat (1XXX)**
  - FCC entre 15 i 70 % *"open forest"*
  - FCC > 70% *"closed forest"*
  - FCC < 15% no és considerat arbrat I s'avalua si es correspon amb matollar o herbàcies

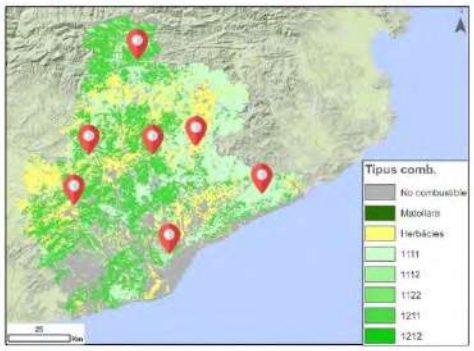
FirEUrisk fuel type	
Code	Description
1111	Open broadleaf evergreen forest
1112	Closed broadleaf evergreen forest
1121	Open broadleaf deciduous forest
1122	Closed broadleaf deciduous forest
1211	Open needleleaf evergreen forest
1212	Closed needleleaf evergreen forest
1221	Open needleleaf deciduous forest
1222	Closed needleleaf deciduous forest
1301	Open mixed forest
1302	Closed mixed forest
21	Low shrubland [0-0.5 m)
22	Medium shrubland [0.5-1.5 m)

FirEUrisk fuel type	
Code	Description
23	High shrubland [≥ 1.5 m)
31	Low grassland [0-0.3 m)
32	Medium grassland [0.3-0.7 m)
33	High grassland [≥ 0.7 m)
41	Herbaceous cropland
42	Woody cropland
51	Tree wet and peat/semi-peat land
52	Shrubland wet and peat/semi-peat land
53	Grassland wet and peat/semi-peat land
61	Urban continuous fabric
62	Urban discontinuous fabric
7	Nonfuel

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Mapa de combustibles preliminar



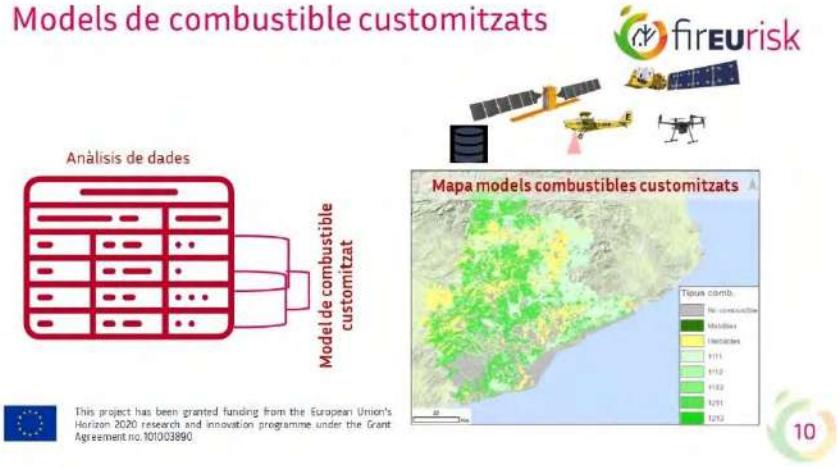
Dissenyar campanya de camp

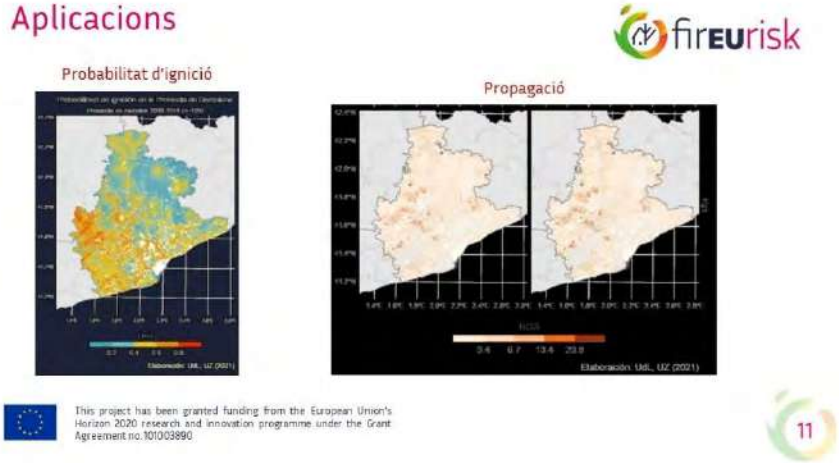
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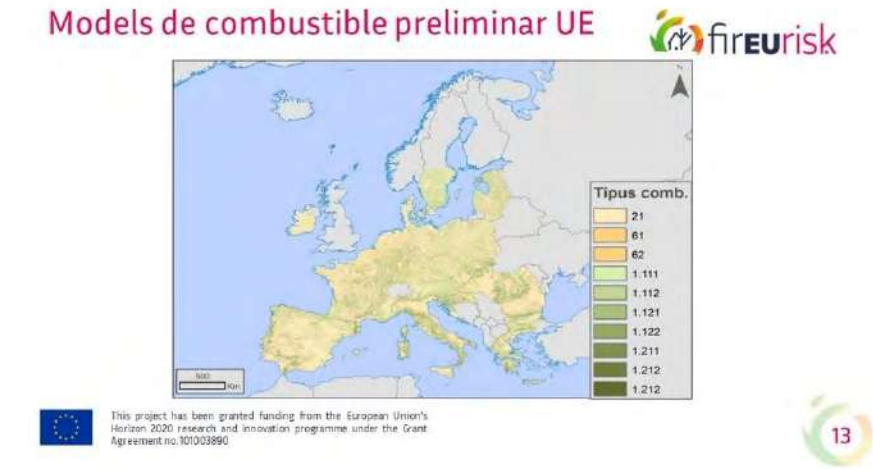






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Product 70. Wildfire spread and behaviour outputs



Modeling wildfire spread and behavior

Fermín Alcasena
fermin.alcasena@udl.cat
Universitat de Lleida

07/06/23 | PS4. Demonstration Event

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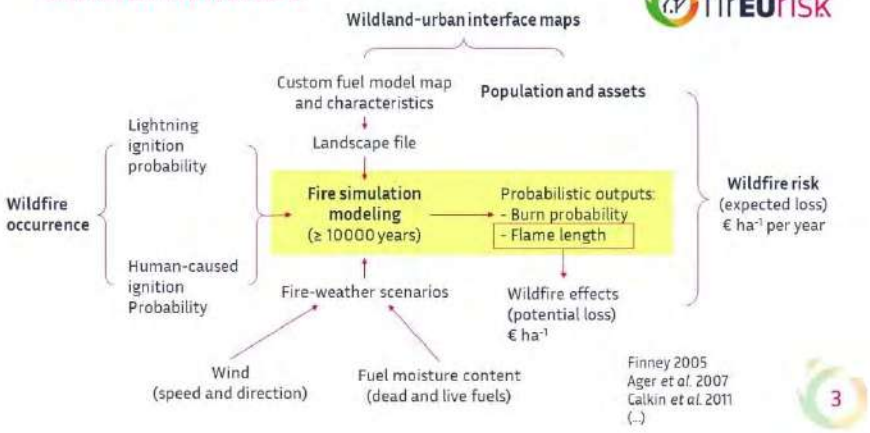
1. General flowchart
2. Population and assets
3. Methods
   - Basic fire behavior (pixel-level calculation)
   - MTT run (modeling of fire footprints for a burned area ≥ 10.000 years)
4. Results
5. What's next

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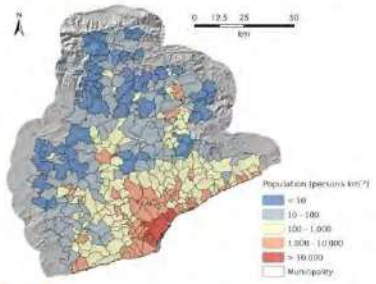
General flowchart



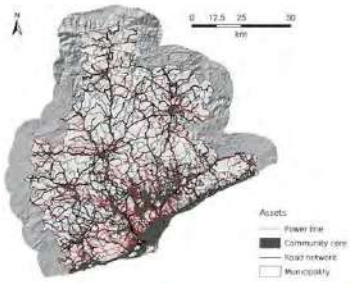
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Population and assets

Population



Assets



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Methods

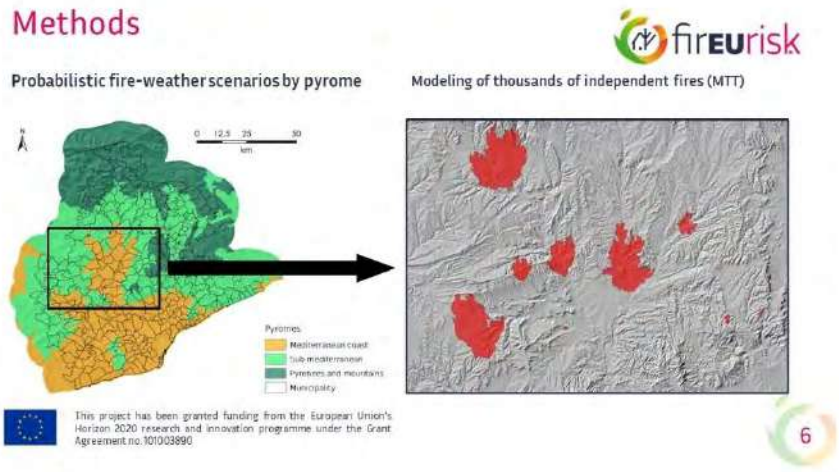
1. Basic run
- Independent fire intensity and rate of spread calculation per pixel
- Probabilistic fire-weather conditions (50, 85, and 95th perc.) per pyrome

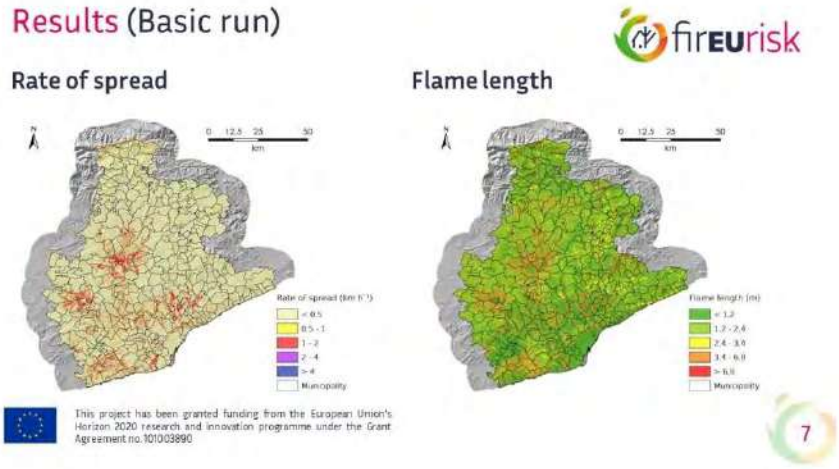
2. Minimum Travel Time (MTT; Finney 2002)
- We model a large number of fire perimeters (10,000 years or iterations)
- Ignition points from wildfire occurrence models
- Probabilistic fire-weather conditions (50, 85, and 95th perc.) per pyrome
- Independently modeled fires under constant winds and fuel moisture content

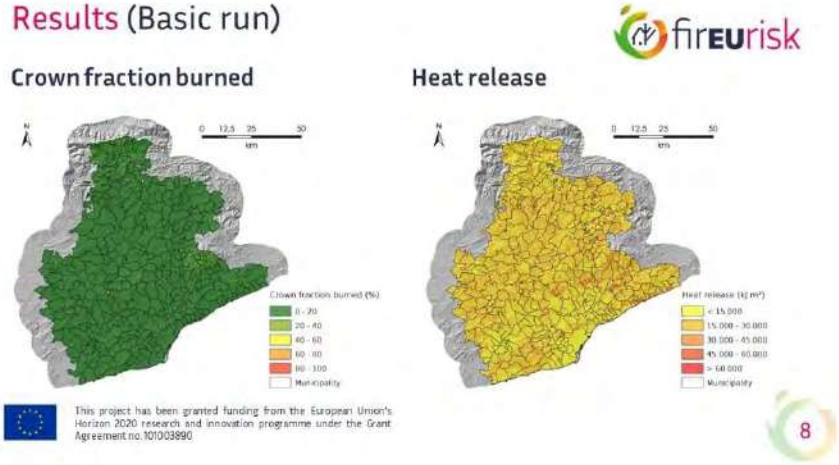
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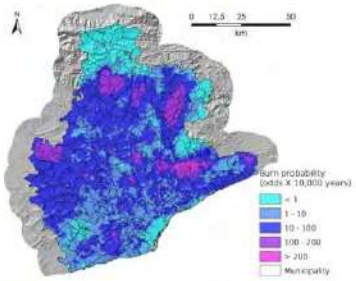




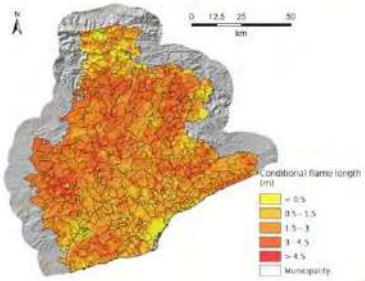
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Results (MTT)

Annual burn probability



Conditional flame length



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What's next?

- Smoke emission and wildfire exposure to communities (Miranda A., UAVE)
- Potential economic losses (Molina J.R., UCO)
- Fire risk mitigation (FirEURisk Work Package 2)

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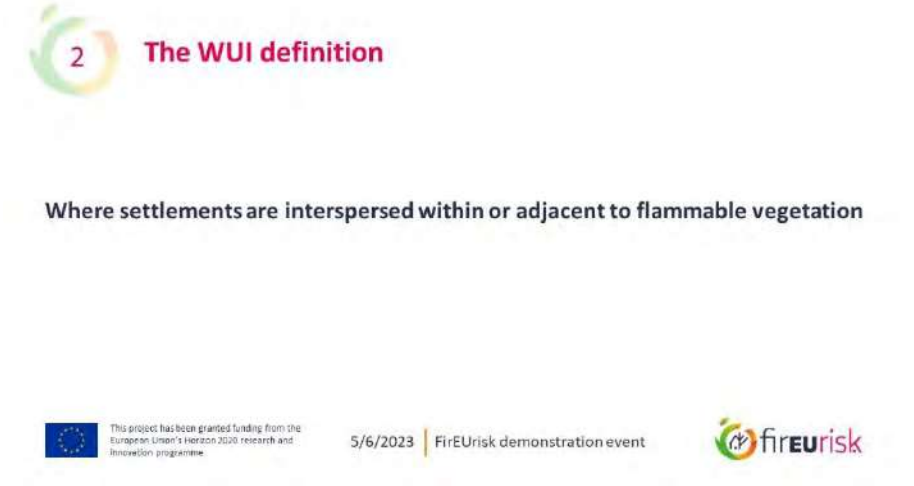


Product 79. Population and assets

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Product 18. Wildland-urban interface map

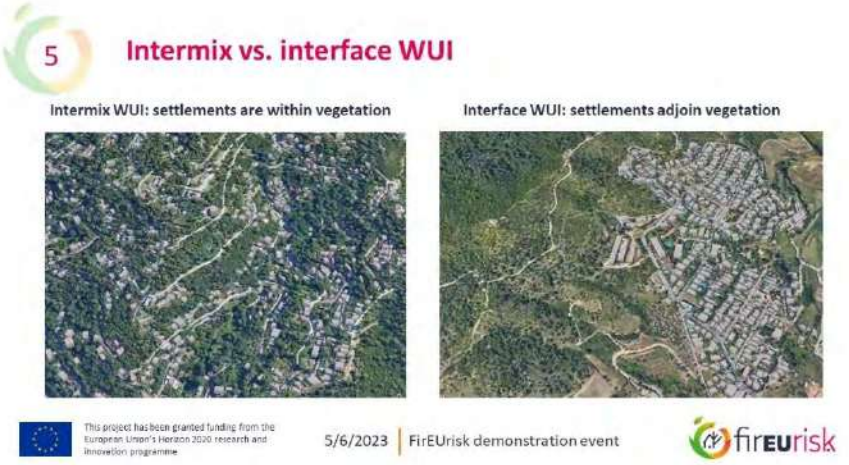




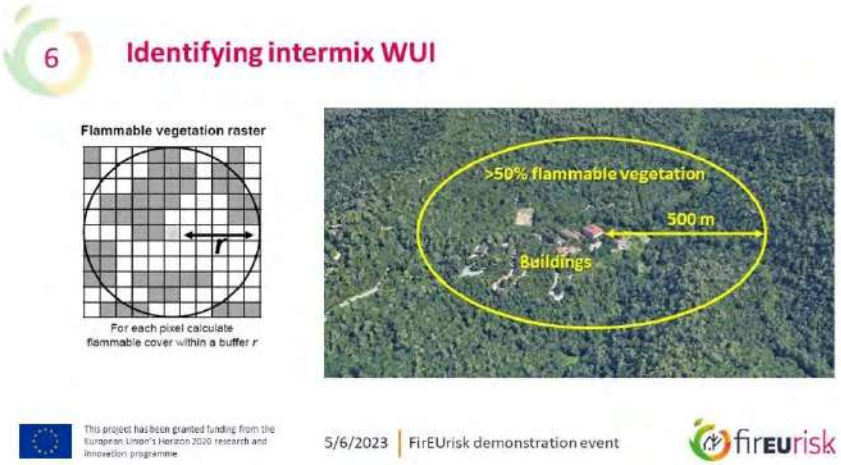
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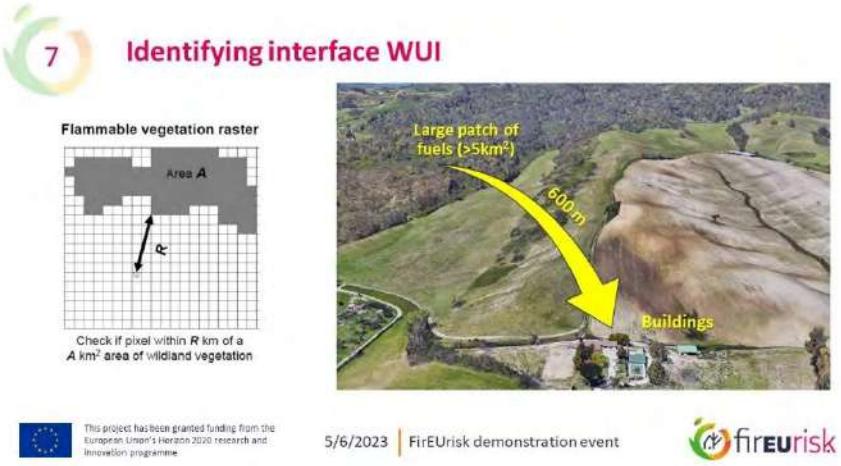


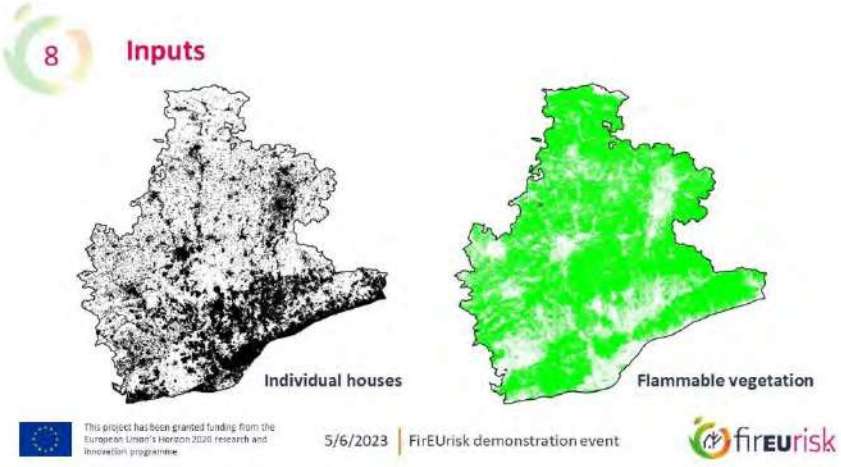




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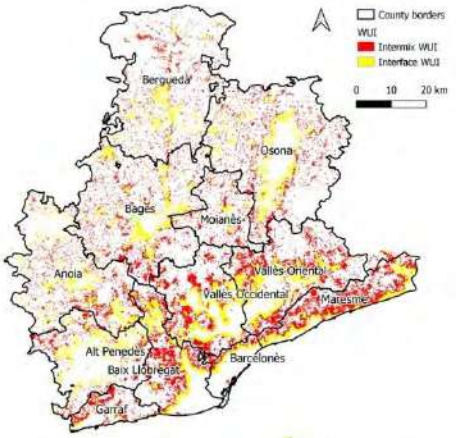


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9 **How much WUI?**

160,677 ha, or ~**20.8%** of the province

94,446 ha (**12.2%**) intermix WUI
66,231 ha (**8.6%**) interface WUI

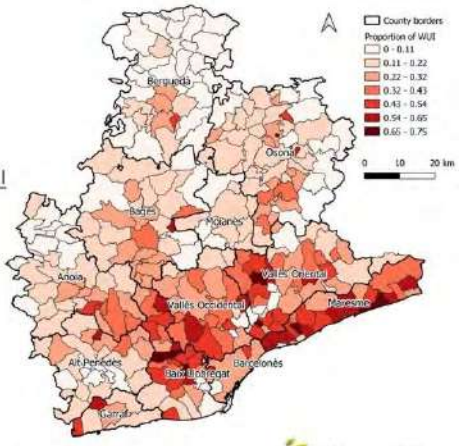


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10 **How much WUI? (municipal level)**

41 municipalities have more than 50% WUI

Four have more than 70% WUI:
Sant Hipòlit de Voltregà (75.3%)
Canet de Mar (73.5%)
Sant Pol de Mar (71.7%)
Cabrils (71.6%)



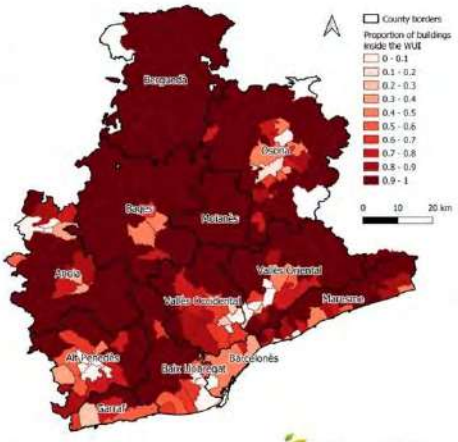
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11 **Buildings in the WUI**

There are 394,376 buildings in the WUI, which represent 78.6% of the buildings in the entire province

150 municipalities have 100% of their buildings inside the WUI

269 have more than 50% WUI buildings



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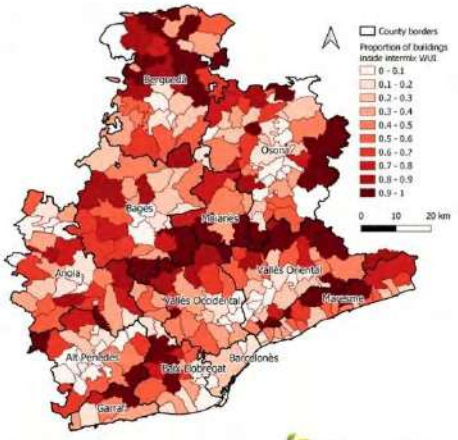
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Buildings in the WUI (intermix only)

31 municipalities have 100% of their buildings inside the intermix WUI

139 have more than 50% buildings in the intermix WUI



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Insights

Barcelona province represents an extreme case of wildfire exposure to human settlements

It is likely that our estimates of exposure are conservative, as they disregard herbaceous fuels and assume a short travel distance of flaming embers

The widespread WUI in the province, coupled with practical limitations (budget, labor) on the extent of fuel treatments, highlights the importance of mitigation activities in the home-ignition zone

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5/6/2023 | FirEUrisk demonstration event

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Thank you!

The WUI map is available via the FirEUrisk viewer (will be demonstrated in today's final session)

Feel free to contact me at: avi-b@sci.haifa.ac.il

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5/6/2023 | FirEUrisk demonstration event

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Product 78. Smoke potential



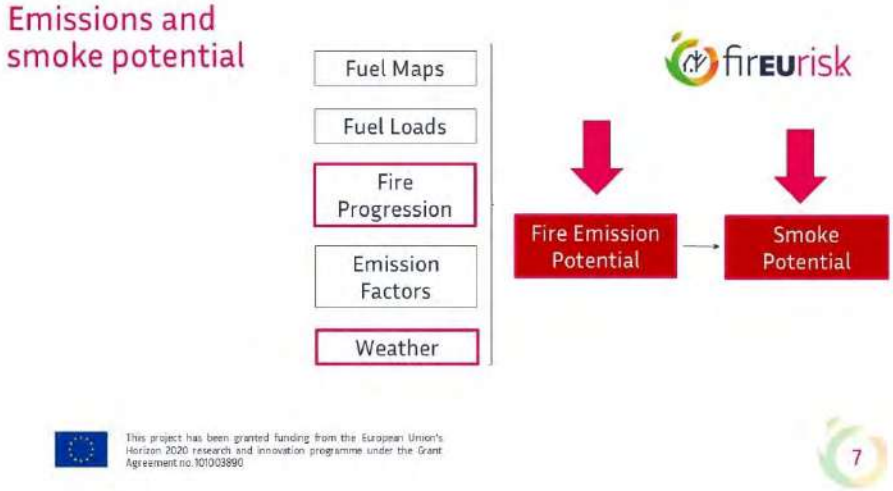


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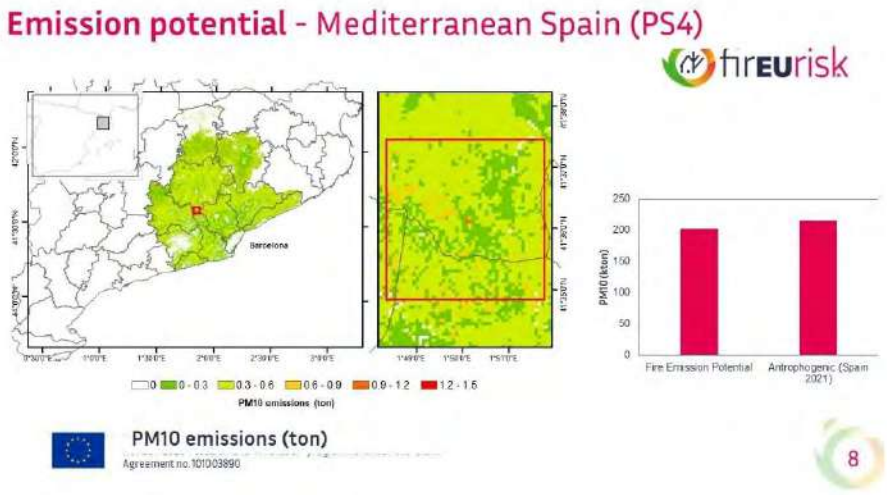


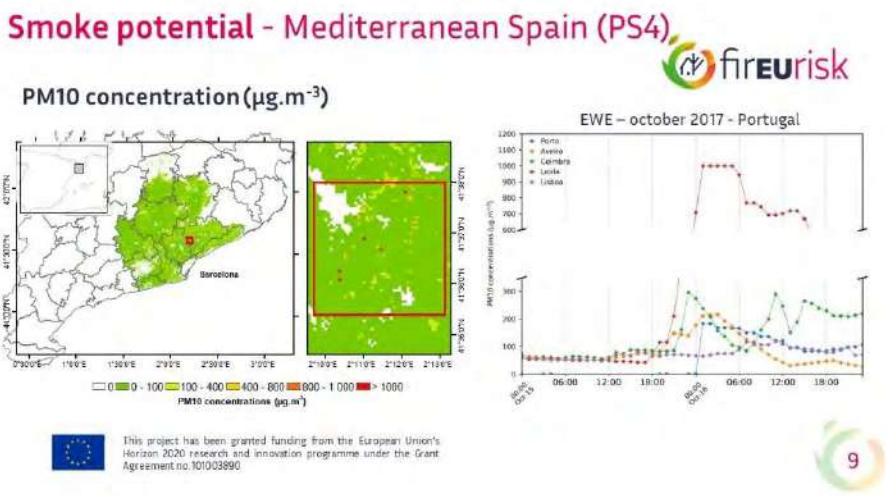
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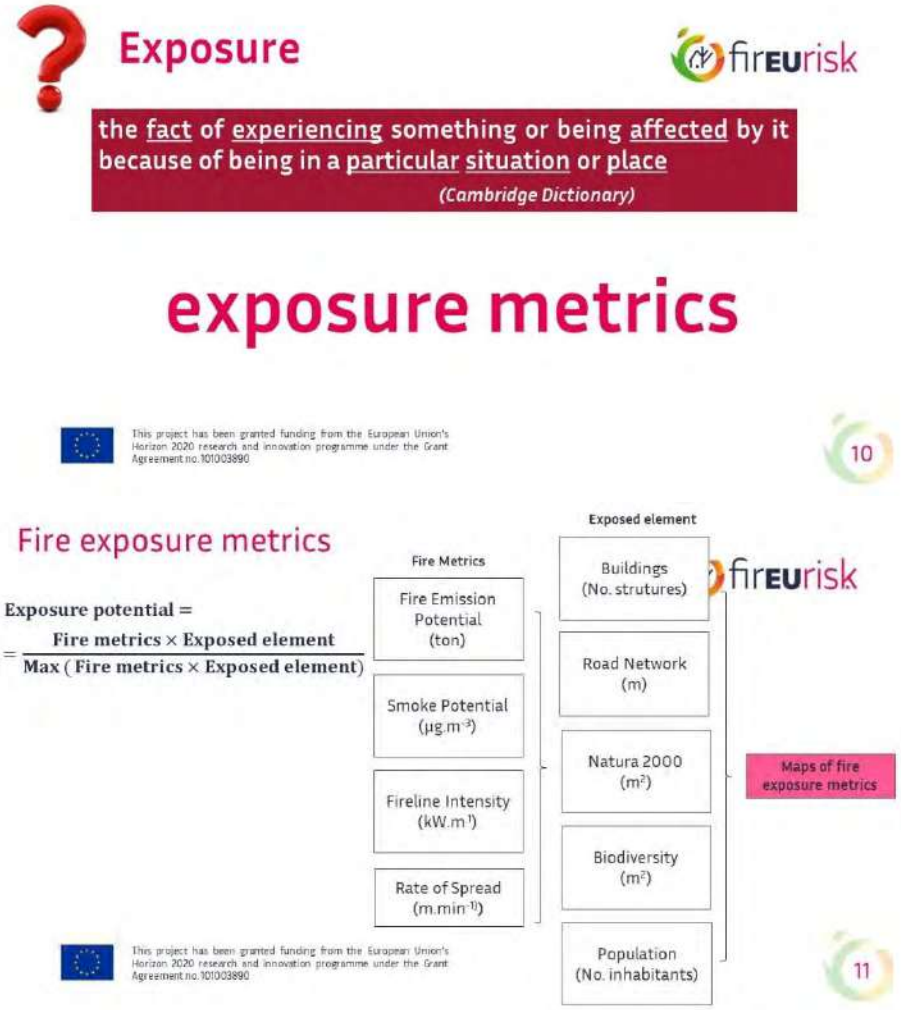
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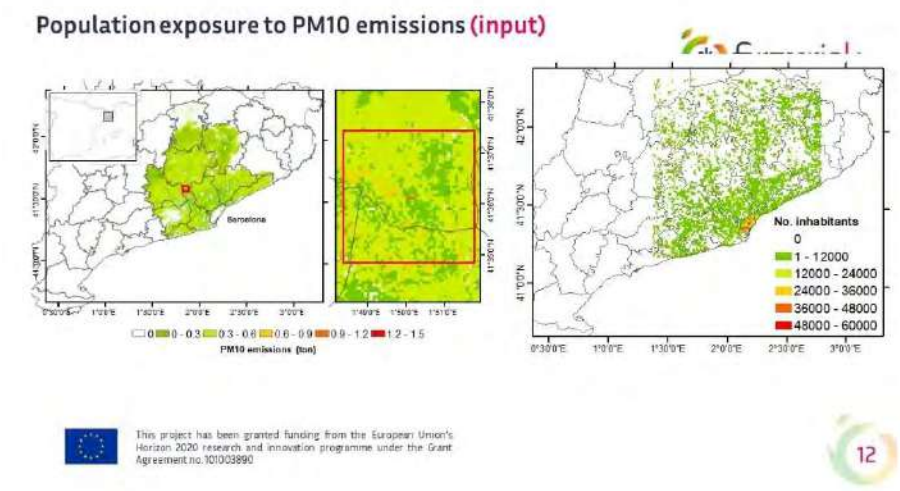


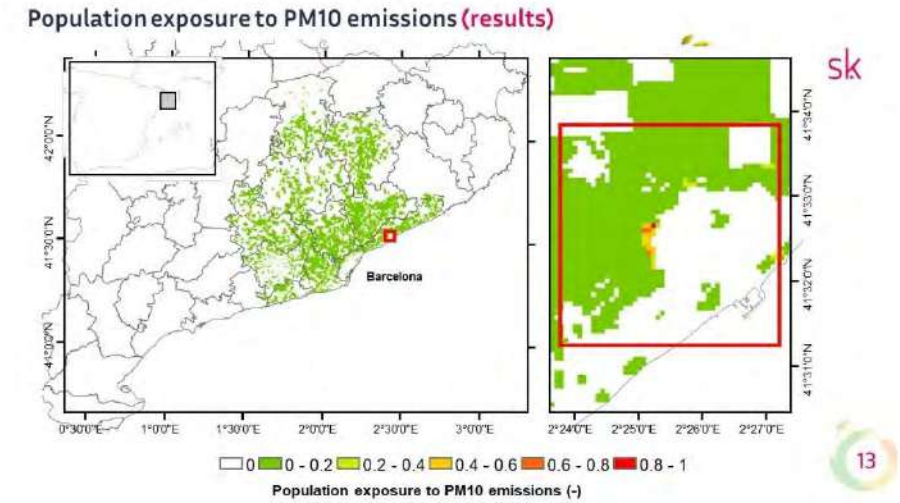
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Product 76. Exposure to communities

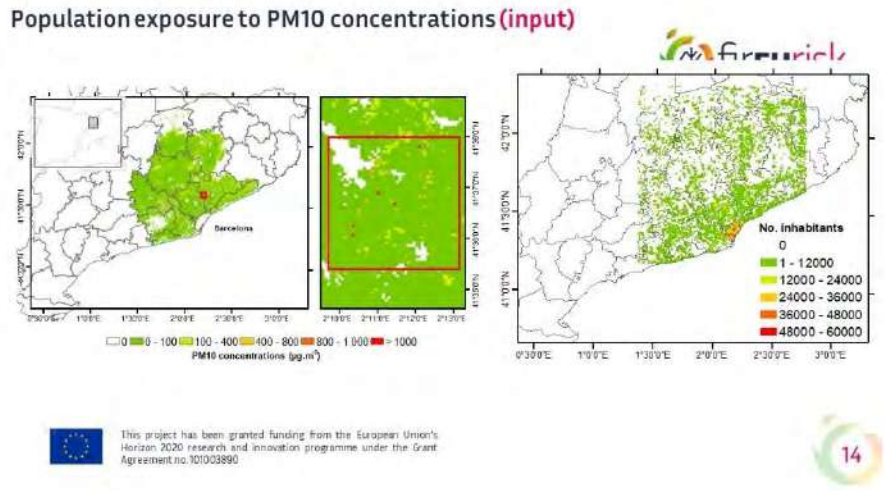


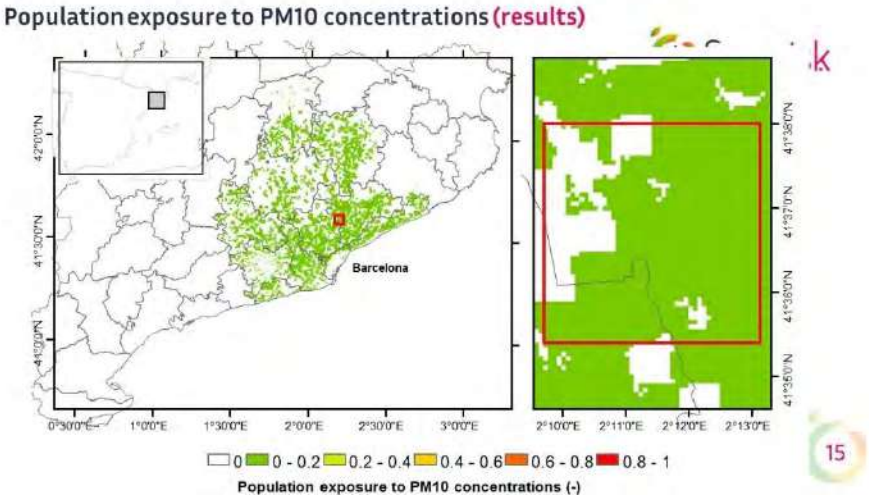
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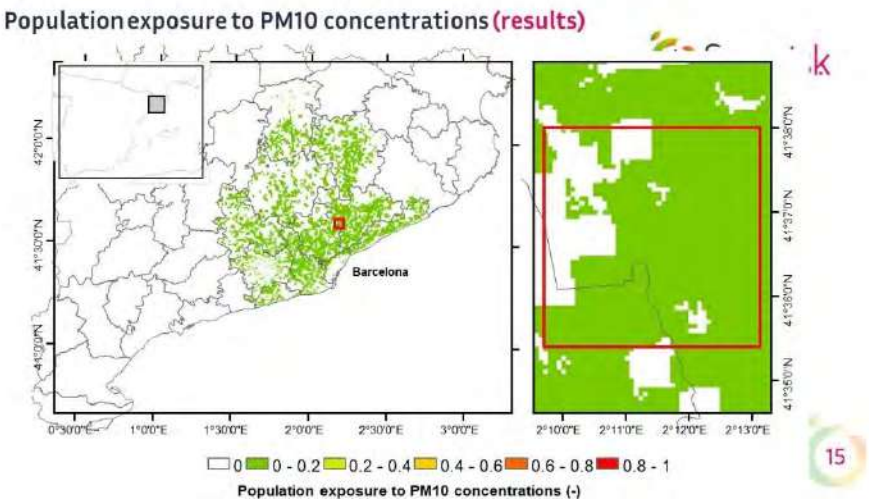




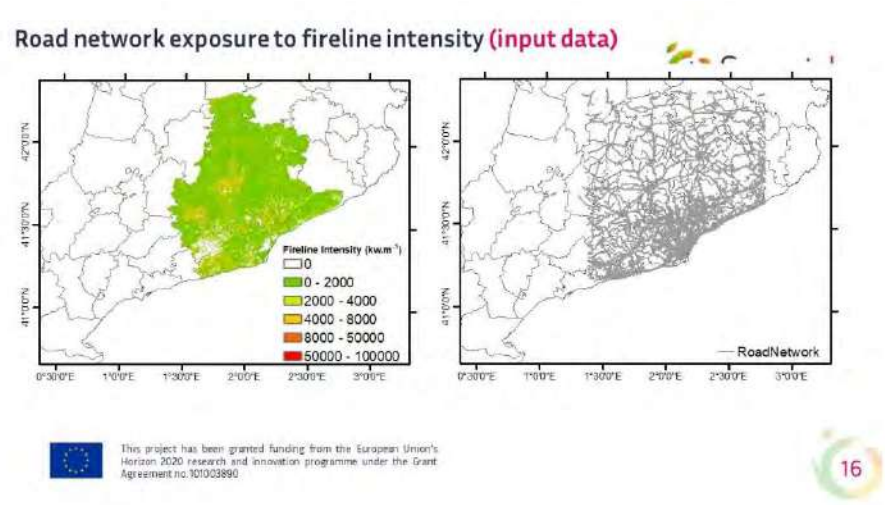
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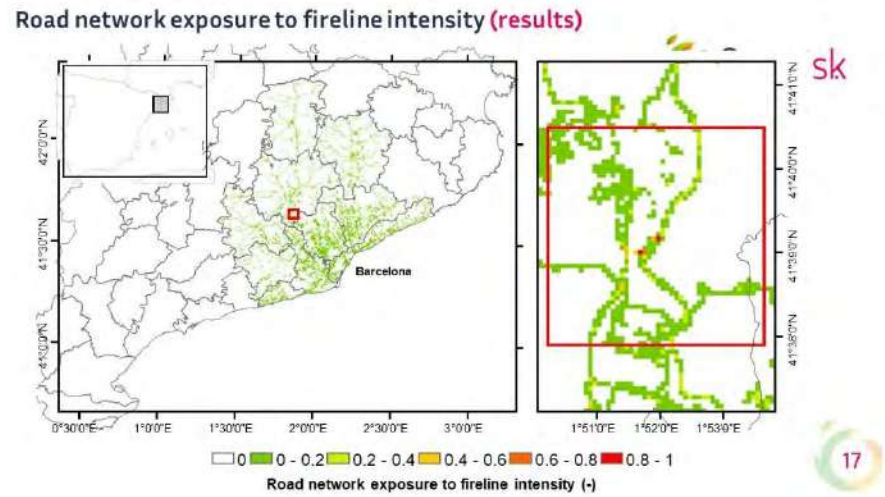






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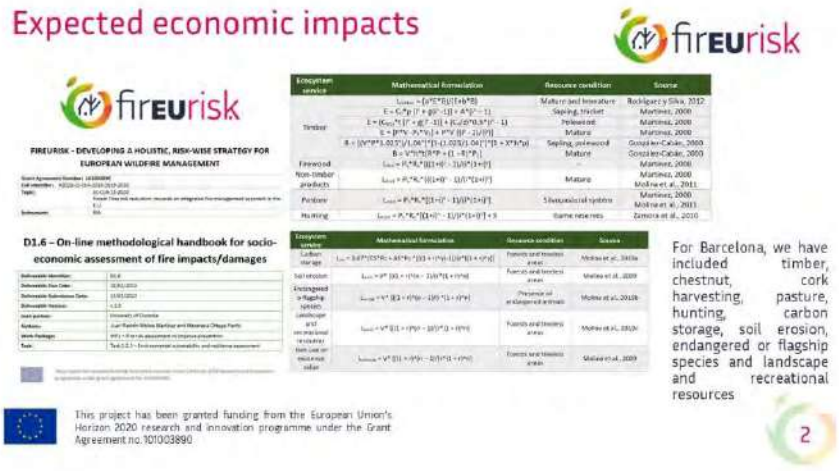




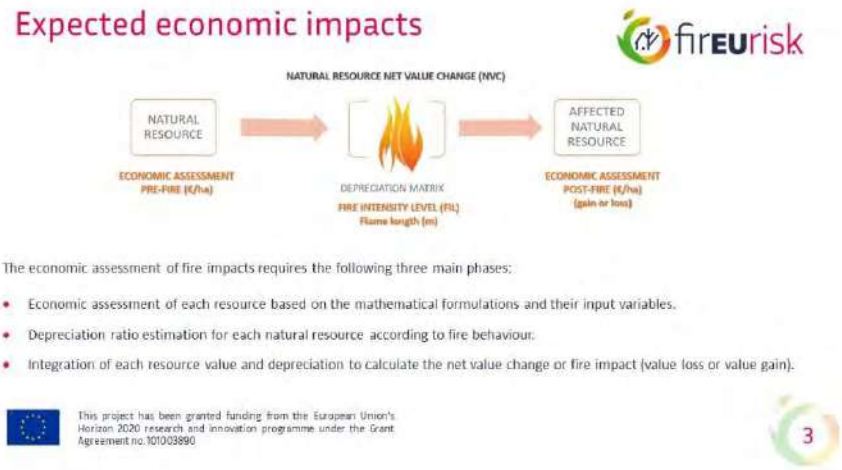
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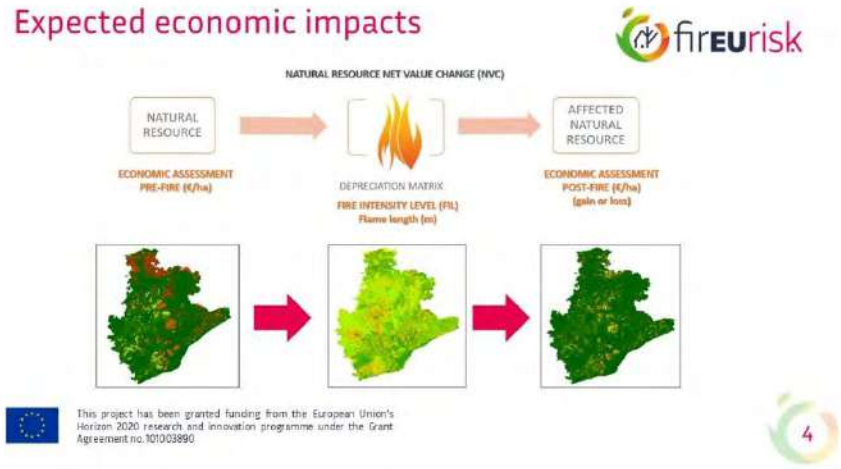
Product 39 Suppression Difficulty Index Evaluation

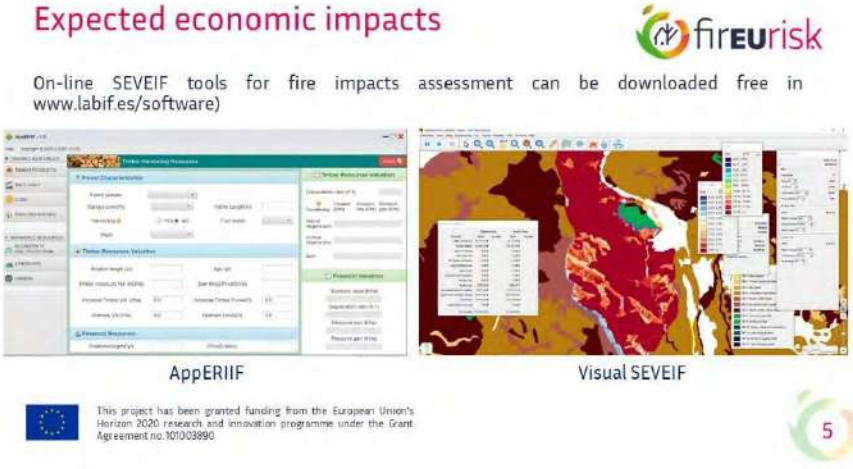




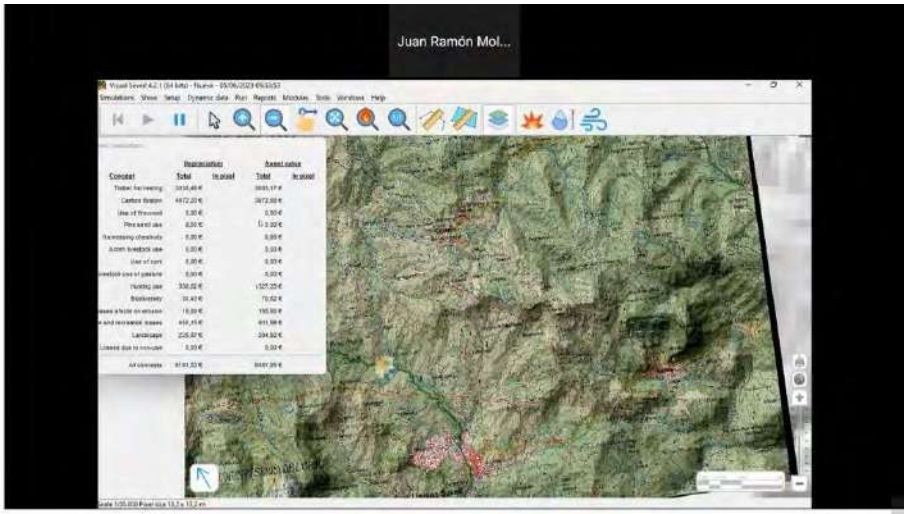
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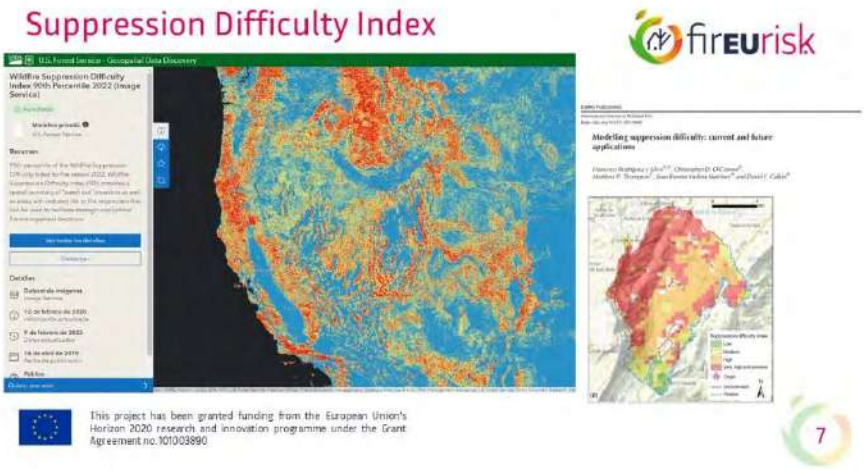


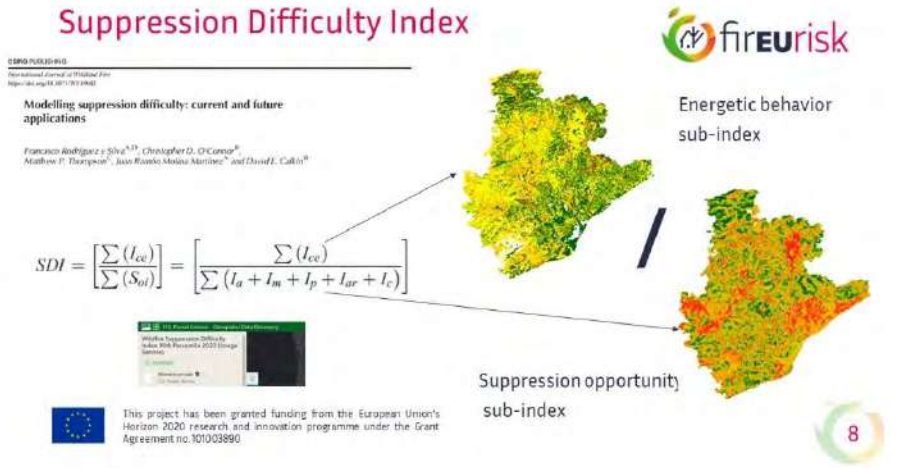




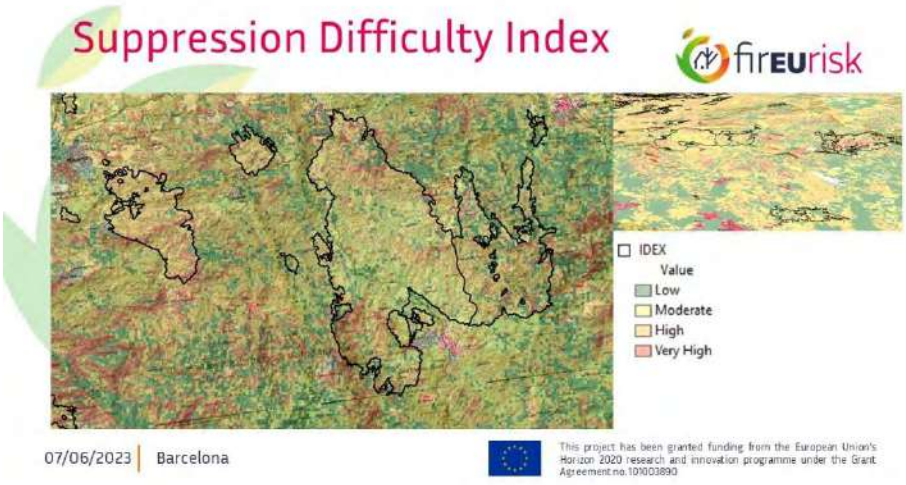
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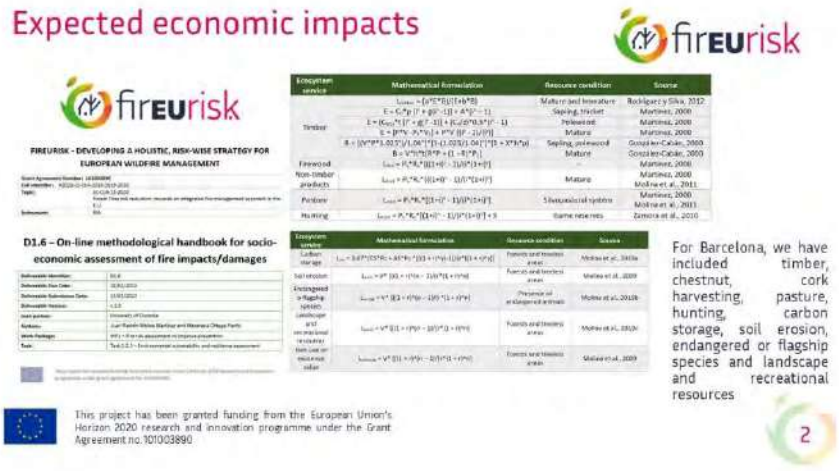




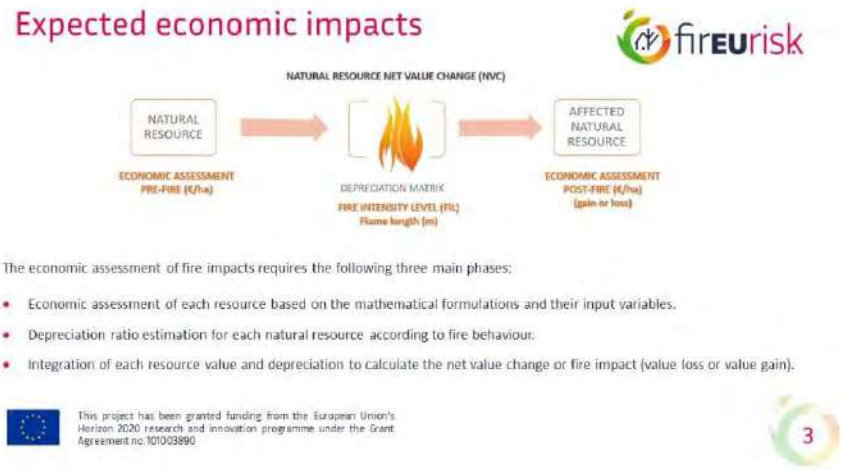
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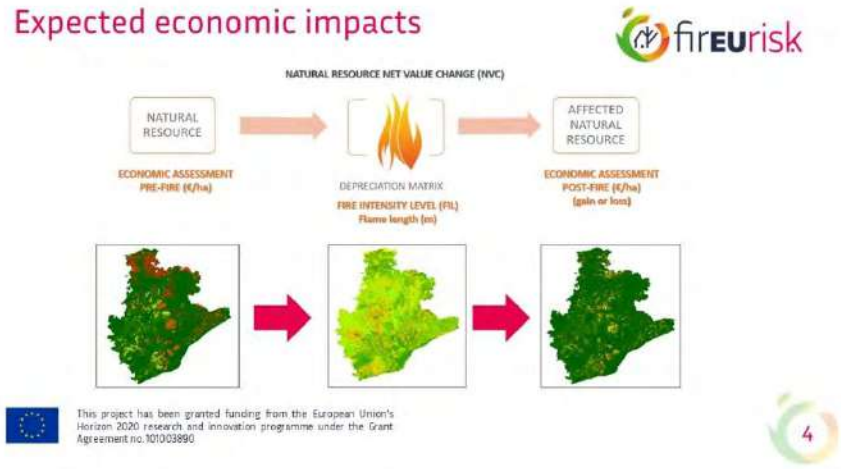
Product 38. Potential economic losses

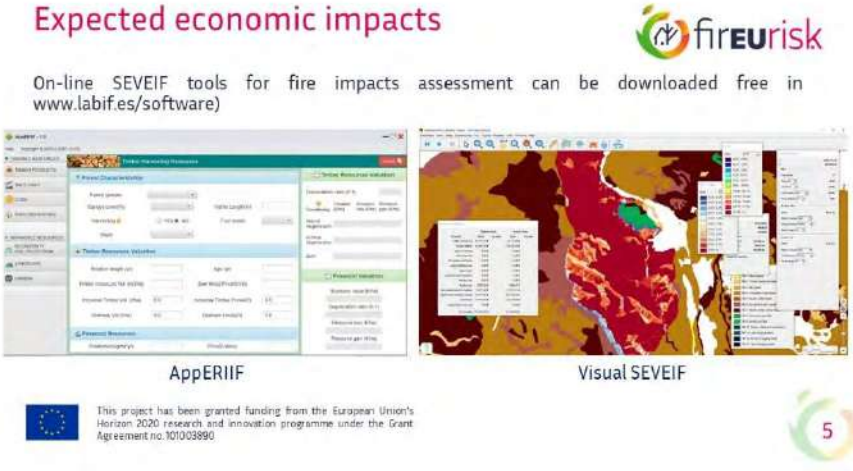




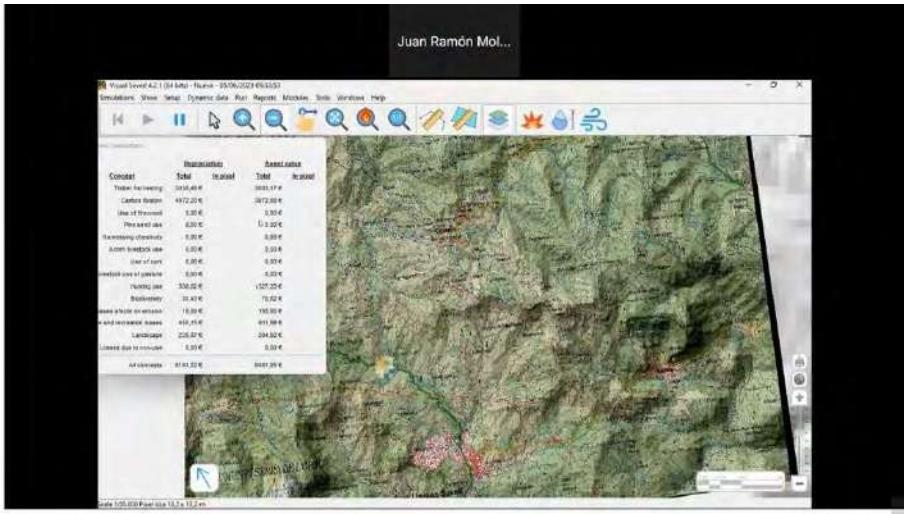
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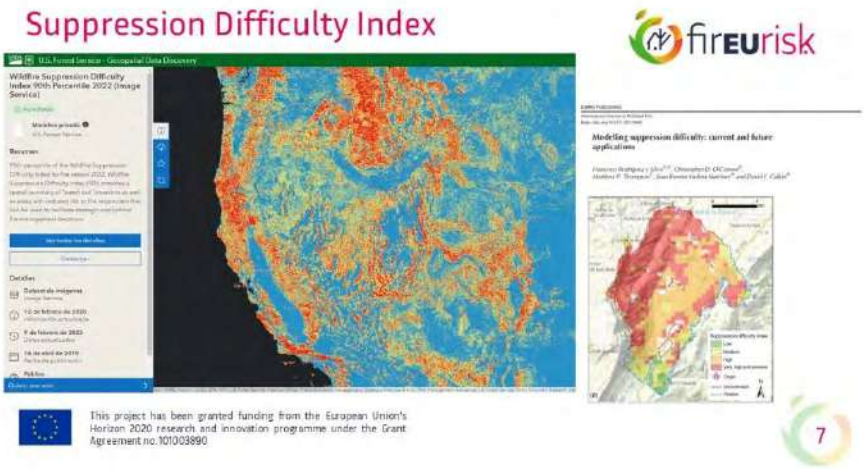


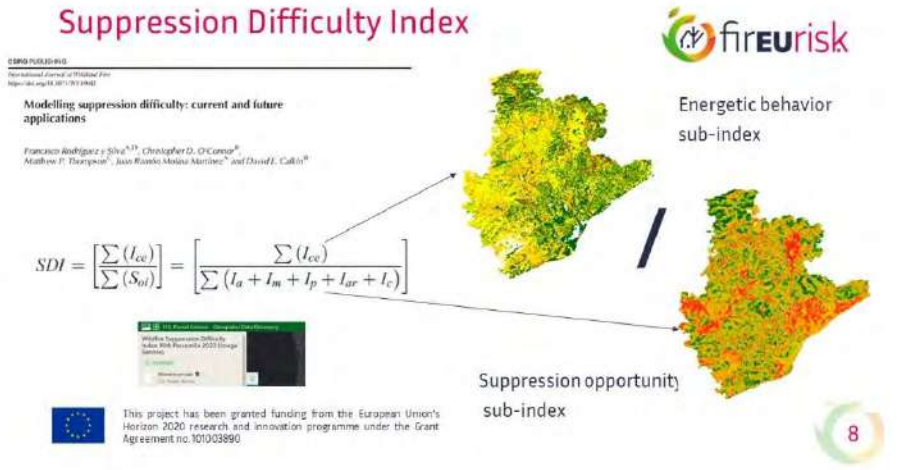




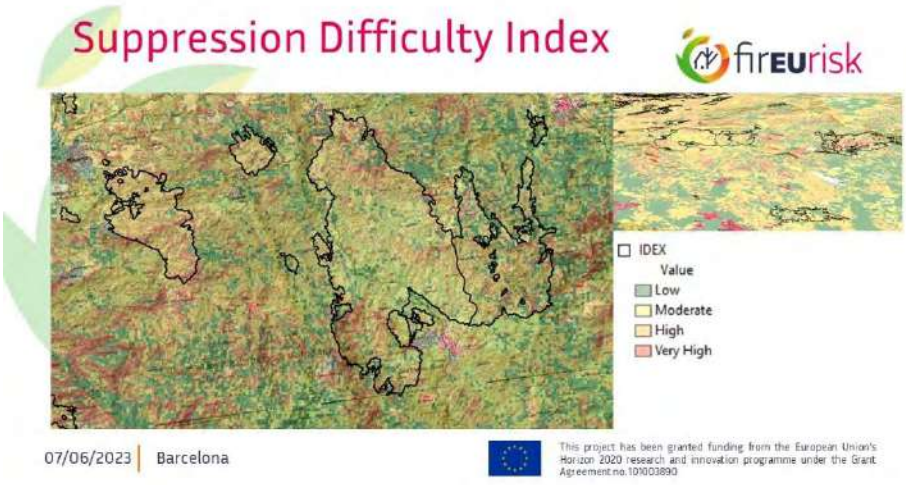
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Product 37. Persistence index



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L'índex de persistència (Sánchez-Pinillos et al. 2016)



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Índex de persistència (PI) - Formulació

$$PI = RTR \cdot RTA$$

Response Trait Richness (RTR) x Response Trait Abundance (RTA)

$$RTR = \frac{\sum_{t=1}^{M} \omega_t \cdot max(v_{1,t}, \ldots, v_{S,t})}{\sum_{t=1}^{M} \omega_t}$$

On:
ω_t és el pes assignat al tret t
$v_{i,t}$ és el valor del tret t per a l'espècie i

Proporció de trets de resposta presents en una comunitat en relació al nombre total de trets considerats

$$RTA = \frac{\sum_{t=1}^{M} \sum_{i=1}^{S} \omega_t \cdot \omega_{i,t} \cdot x_i}{\sum_{t=1}^{M} \omega_t}$$

On:
xi és l'abundància relativa de l'espècie i

Abundància del trets considerats en la comunitat

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L'índex de persistència a la província de Barcelona

SPECIES
- Arbres i matolls (IFN2, IFN3, IFN4)



PERTORBACIÓ
- Incendis



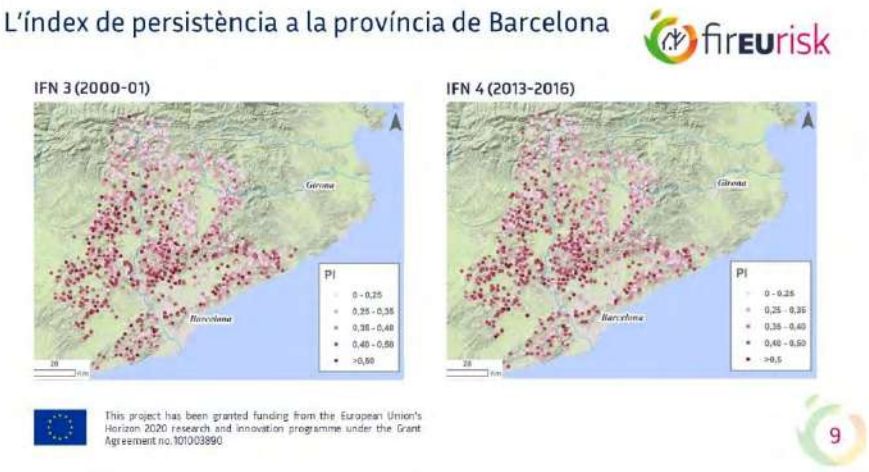
TRETS DE RESPOSTA
- Capacitat de rebrot
- Serotínia, germinació estimulada, emergència l'any després de l'incendi
- Longevitat del banc de llavors



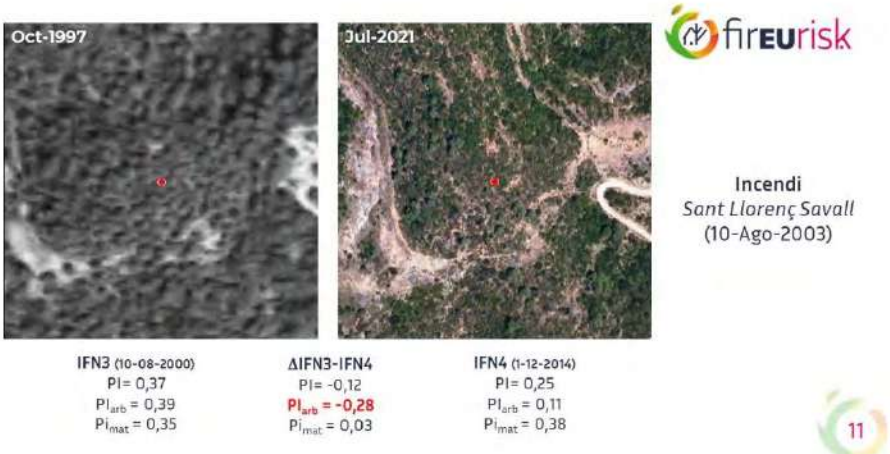
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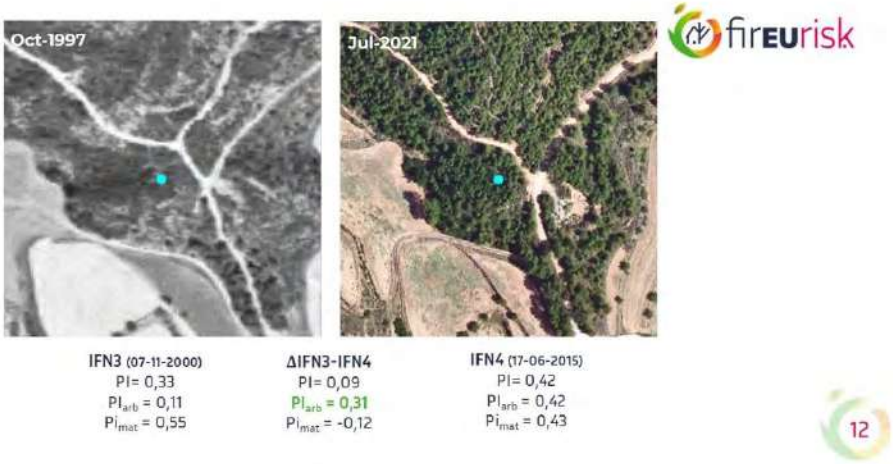
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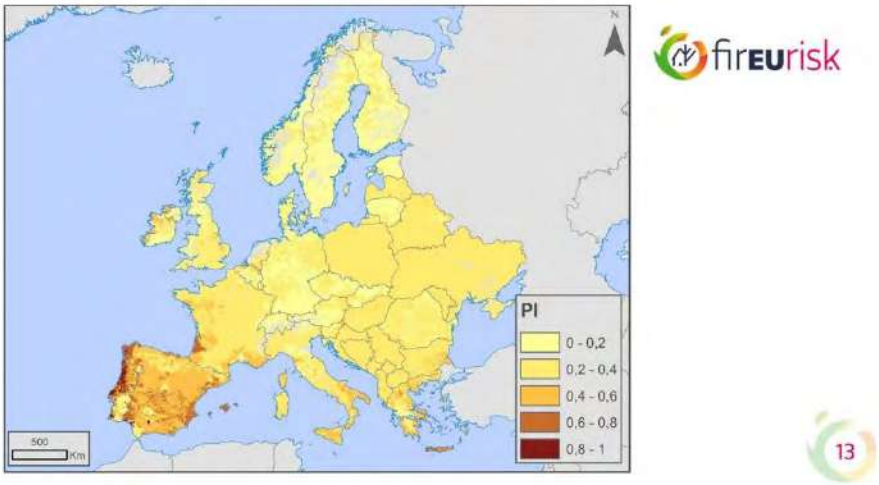






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Gràcies!

lluis.coll@udl.cat

@LColl_

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Product 68. ReSVI: Relative Societal Vulnerability Index



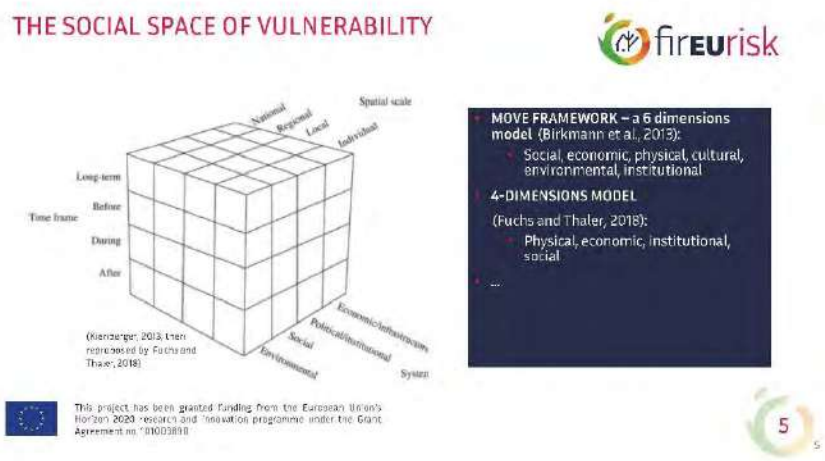


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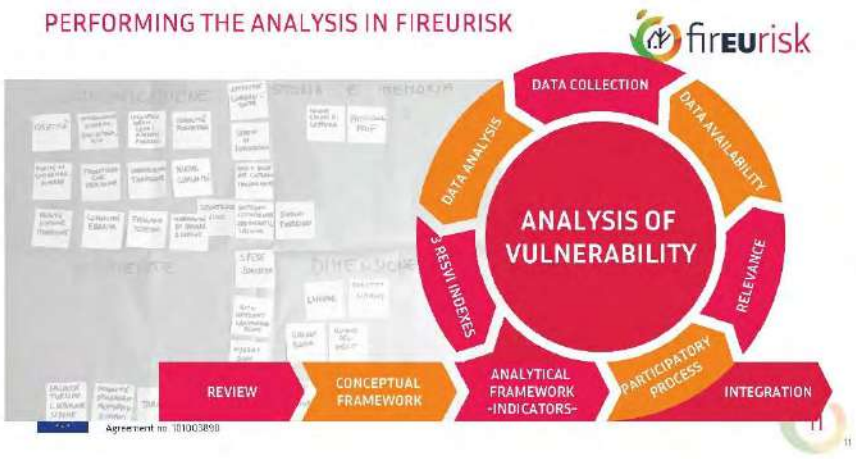
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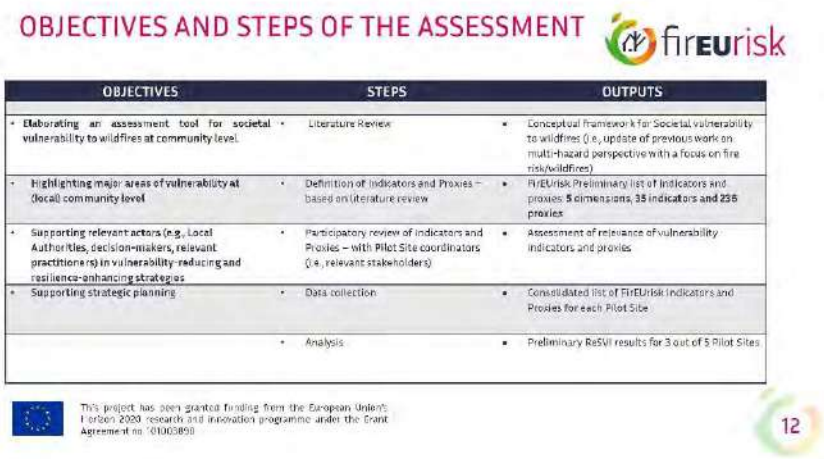


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UNITS OF ANALYSIS

- The Mediterranean Pilot Site Spain covers the whole territory of the Province of Barcelona, which is composed of 314 Municipalities.
- Within the framework of the participatory research, the Pilot Site coordinator (UdL) decided for considering all the Municipalities as the units of analyses where to apply the Societal Vulnerability Index.



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SELECTION OF INDICATORS AND PROXIES

KEY CONCEPTS:

- **DIMENSIONS**: the underlying capitals interacting and constructing the community.
- **INDICATORS**: variables that provide an operational representation of a characteristic of a community (i.e., indicators are grouped per relevant dimensions).
- **PROXIES**: indirect data sources contributing to the assessment of an indicator (i.e., proxies are grouped per relevant indicators).

RESULTS:

- 5 dimensions, 35 indicators and 236 proxies

- Indicators and Proxies have been **assessed** in terms of:
  - RELEVANCE (none, medium, high relevance)
  - ORIENTATION/VECTOR (differentiating between positive and negative impacts on the vulnerability scores).
  - DATA AVAILABILITY (crossing the proposed list with datasets available from different sources of information).

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INDEX CALCULATION

PERFORMED ACTIVTIES

- Data was gathered by UdL & ISIG (quantitative variables).
- ISIG proceeded to calculate the index (Z-score, normalized on a 0-1 scale):

$$Z = \frac{X - \mu}{\sigma} \qquad \frac{(x - m_x)}{M_x - m_x}$$

- In order to better showcase the functionality of the Relative Societal Vulnerability Index, the calculation has been made in two versions:
  - The first one considering the relevance assessment for each Proxy.
  - The second one considering all the Proxies with available data as equally (highly) relevant.

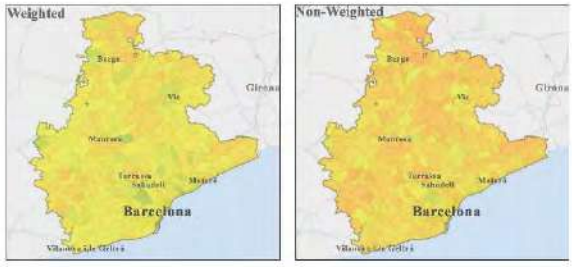
RESULTS & POTENTIALITIES

- Results obtained by the application of ReSVI in the 314 Municipalities composing the Mediterranean Spain Pilot Site (PS4) are available as part of the FirEURisk outputs.
- A more detailed analysis of the results, focussing on one or a group of the above-mentioned Municipalities, can be provided on request, also in the future stages of FirEURisk project.

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RESVI RESULTS IN BARCELONA PS



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RESVI RESULTS IN BARCELONA PS:
OVERVIEW OF SOCIETAL DIMENSION

WEIGHTED VARIABLES



NON WEIGHTED VARIABLES



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RESVI RESULTS IN BARCELONA PS:
OVERVIEW OF ECONOMIC DIMENSION

WEIGHTED VARIABLES



NON WEIGHTED VARIABLES



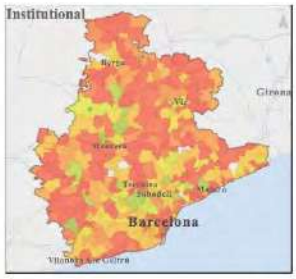
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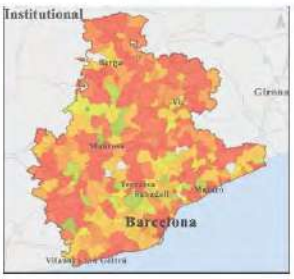
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RESVI RESULTS IN BARCELONA PS:
OVERVIEW OF INSTITUTIONAL DIMENSION

WEIGHTED VARIABLES



NON WEIGHTED VARIABLES

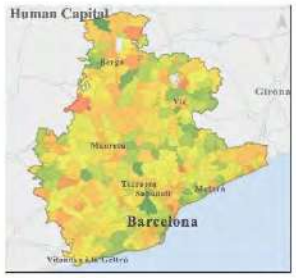


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RESVI RESULTS IN BARCELONA PS:
OVERVIEW OF HUMAN CAPITAL DIMENSION

WEIGHTED VARIABLES



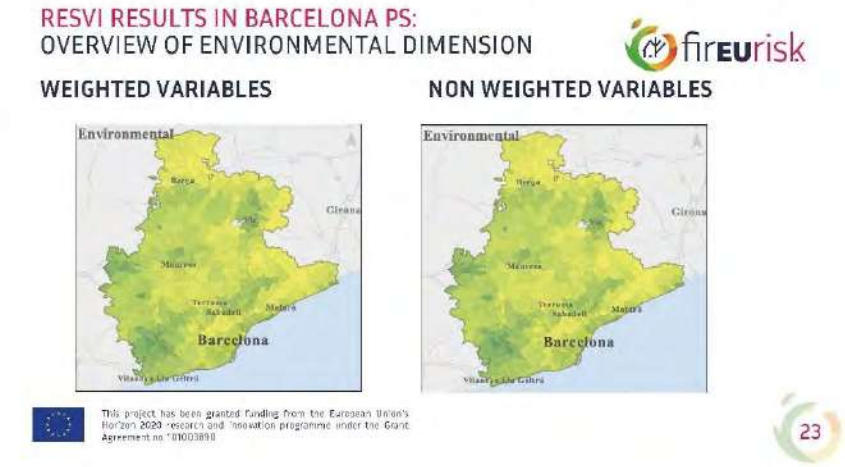
NON WEIGHTED VARIABLES

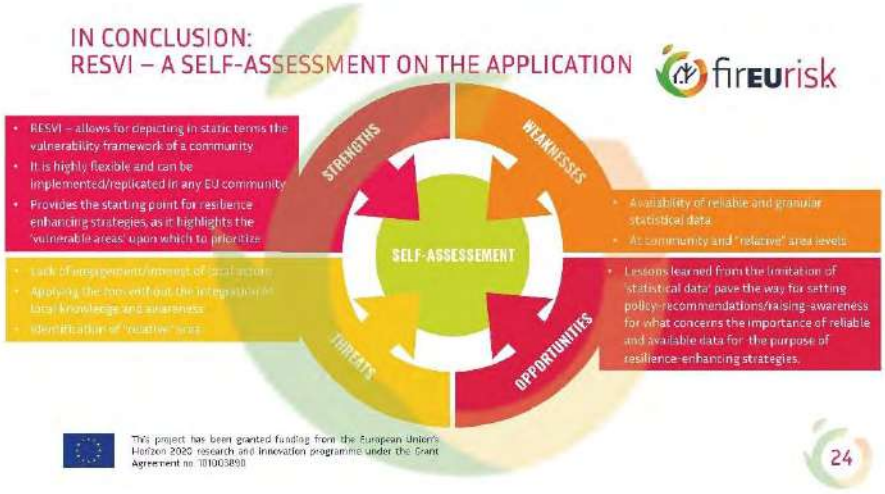


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Product 44. FirEURisk Display Platform





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Logging in

1. Using your computer's web browser, go to https://test-proms.arbonaut.com/proms/login.jsp. Log in through the "Log in" section that is found on the right side of the web page.

2. Enter your personal username and password in the login field, then click "Login". When the system has identified your information, the main map view of the ProMS system will open.

Username: FirEUrisk
Password: FirEUrisk_demo_2023

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3

Logging in



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Map navigation

Zooming the map in and out works with the + and – buttons in the left side of the map view. Zooming also works with the mouse scroll wheel.

You can pan the map view by pressing and holding on the map with the left mouse button and moving the mouse in any direction.



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Map layers

Map layers are found in the system's right-side pane (figure 3). Map layer information is divided into three sections: Project selection, Basemaps and Raster layers.

Project selection - If your account has access to multiple projects, those can be managed through this menu.

Basemaps – Choose your desired basemap by clicking on the circle next to the layer's name. The selection of basemaps can vary depending on the content of your project.

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Map layers



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Map layers

Raster layers – Choose your desired raster layer by checking the box on the left side of the layer's name.

The selection of raster layers and the amount of raster layers available can vary depending on the content of your project.

Multiple raster layers can be enabled simultaneously.

Raster layer opacity can be adjusted by clicking on the eye icon at the end of the layer's name.



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System tools

The system's toolbar is in the top right corner of the map view.

The available tools can vary depending on the content of your project.

Tools that are unavailable in your project are crossed over with a red line.



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System tools

Report – Create a report listing of your project's vector objects by activating the tool. Report format and specific attributes can vary depending on the content of your project.

Objects – create vector objects, such as storages, worksites, or tracks by activating the tool.

Background information – View the background information of raster layers by activating the tool and clicking on any location on the map.

Measurement – measure distances on the map by activating the tool and clicking on the desired points on the map.

PDF – Create a PDF image of the current map view by activating the tool.

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System tools

Center map – center the map to your project area by activating the tool.

Location – focus the map view on your current location by activating the tool. GPS tracking requires a device that supports GPS functionalities.

Cross-section view – view the cross-sections of the point cloud. Availability is limited.

3D view – view the 3D view of the point cloud. Availability is limited.

Side pane – hide or show the right-side pane by activating the tool.

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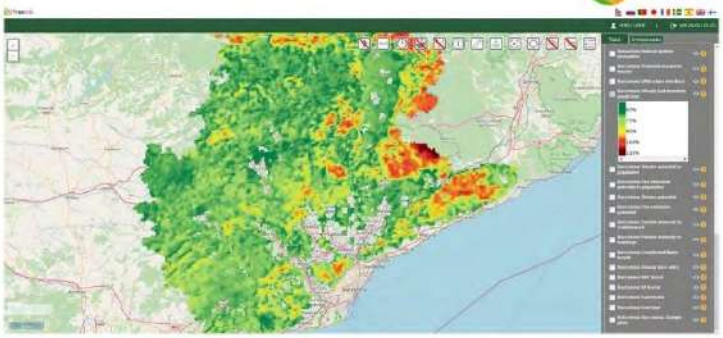


FirEURisk viewer

Barcelona maps

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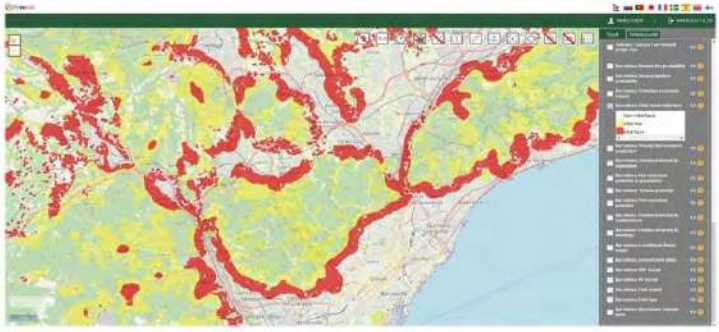
Woody fuel moisture content



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Wildland-urban interface

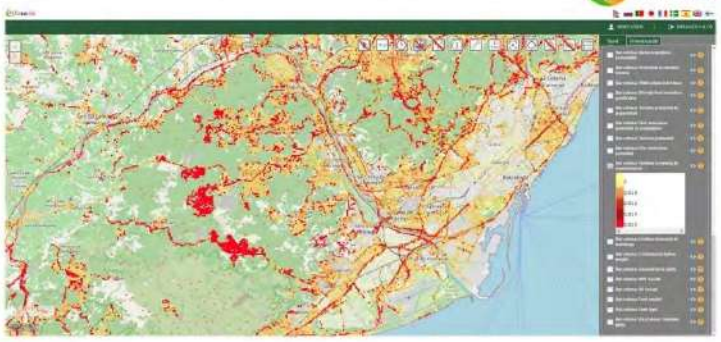


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Fireline intensity to roadnetwork



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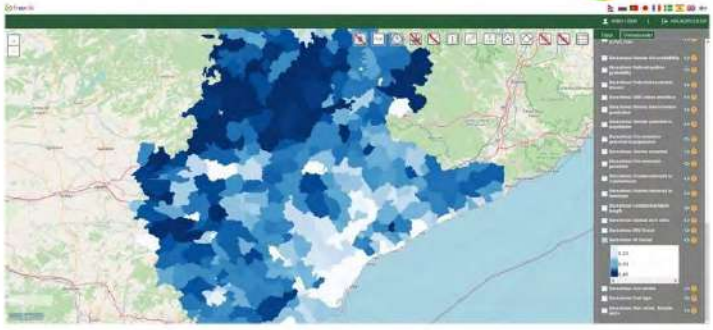
Fueltype



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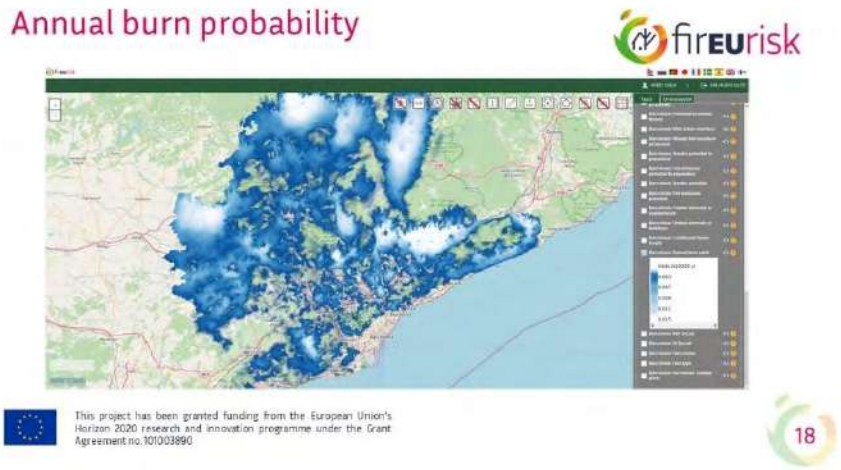
Social vulnerability



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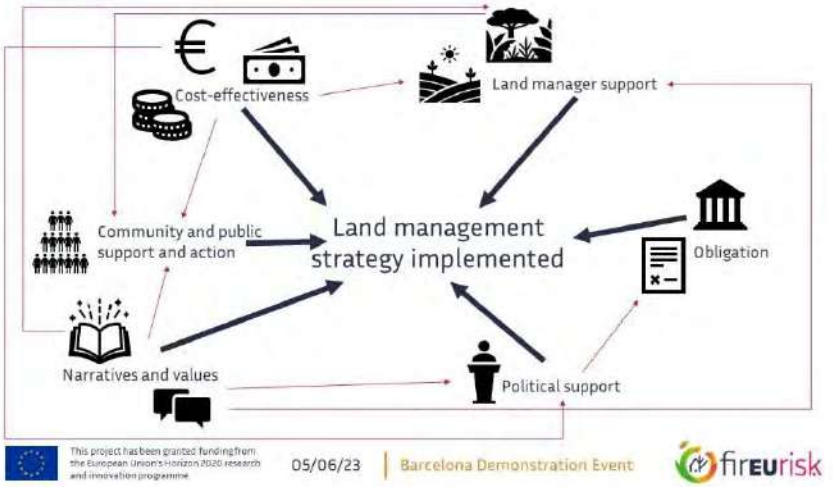
Product 29. Socio-economic barriers to reduce fire risk



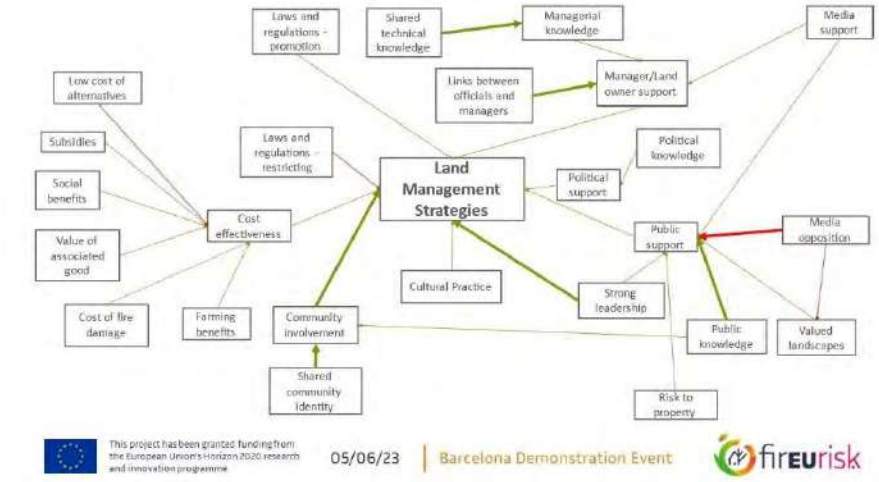
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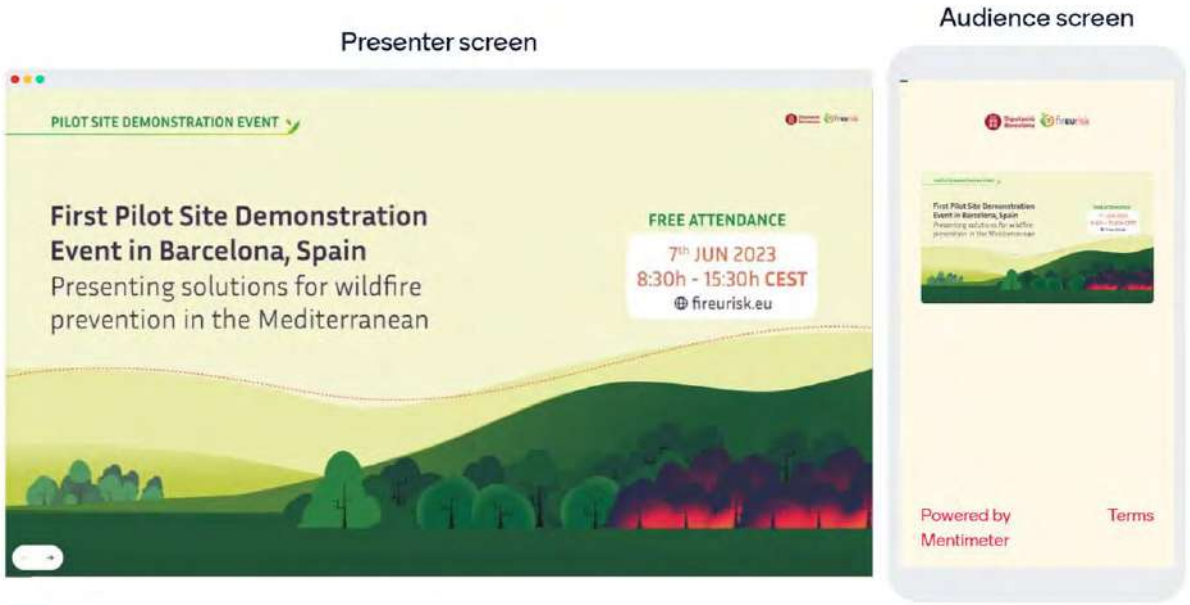




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Annex B: Mentimeter questionnaire

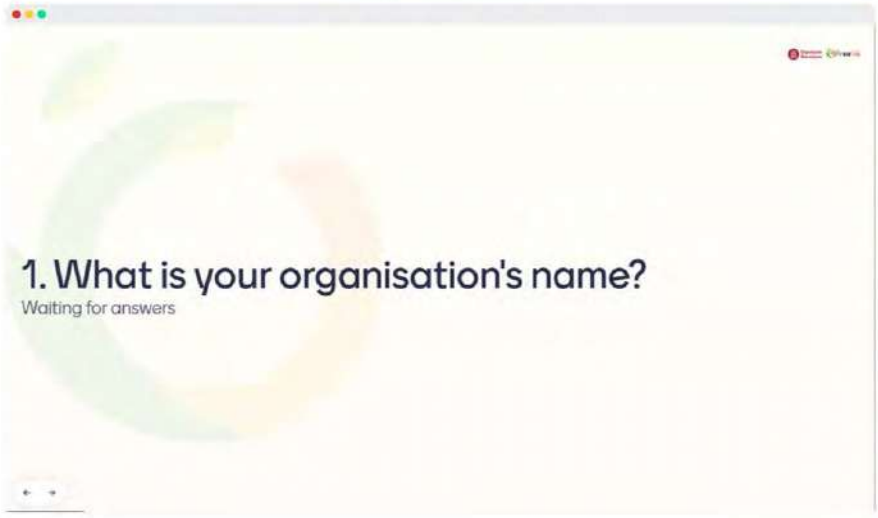
Session 4: Product evaluation and validation survey - Presentation and introduction





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Presenter screen



Audience screen



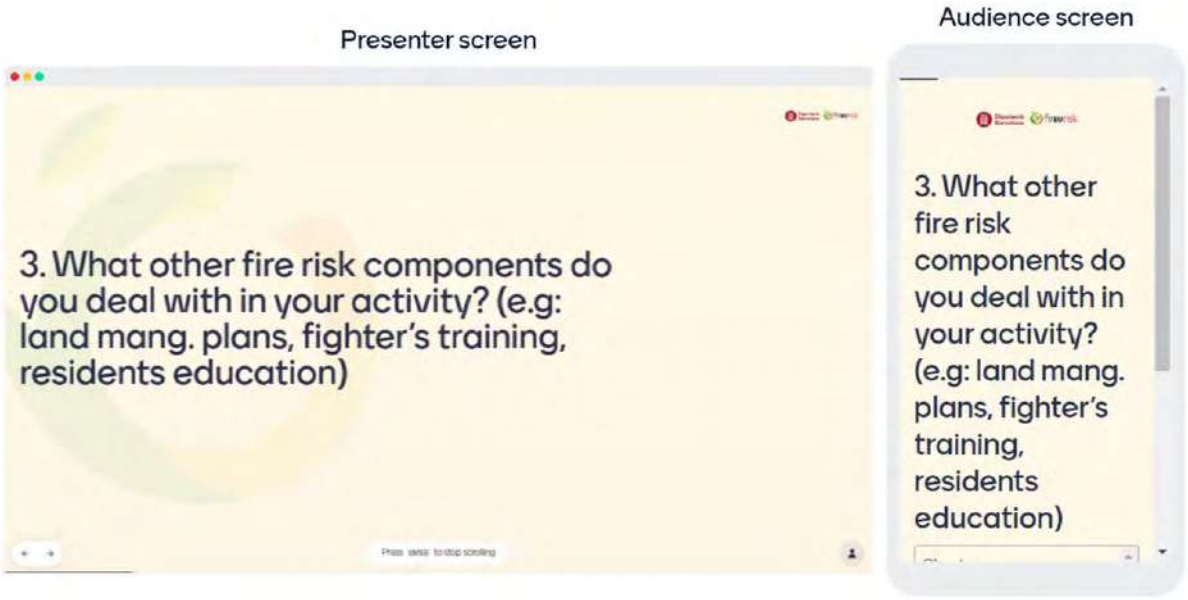
Presenter screen



Audience screen



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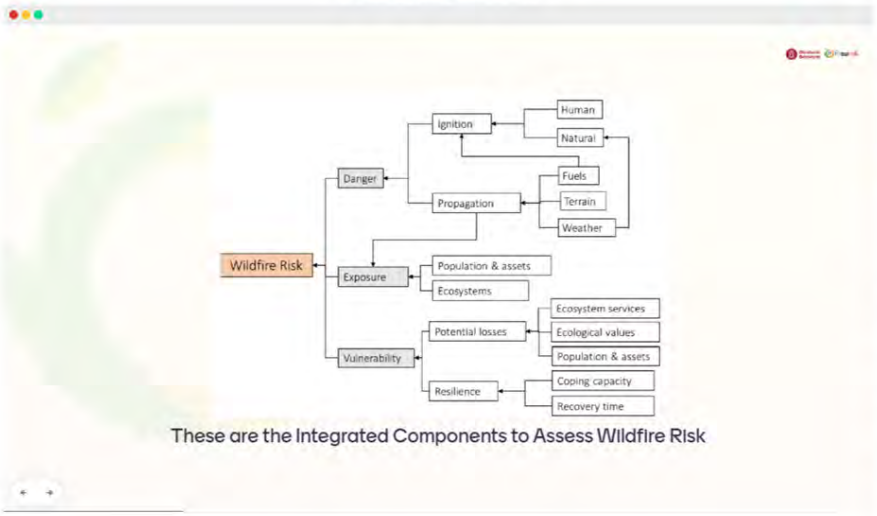


Round Table 1: Evaluation and validation of products on weather and ignitions

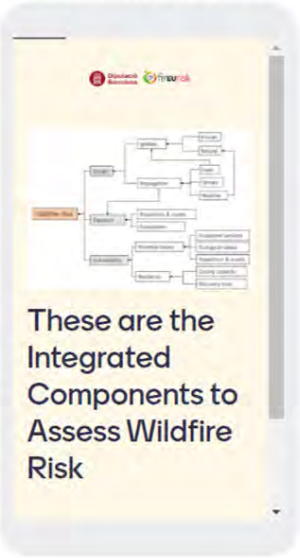


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Presenter screen



Audience screen



Presenter screen

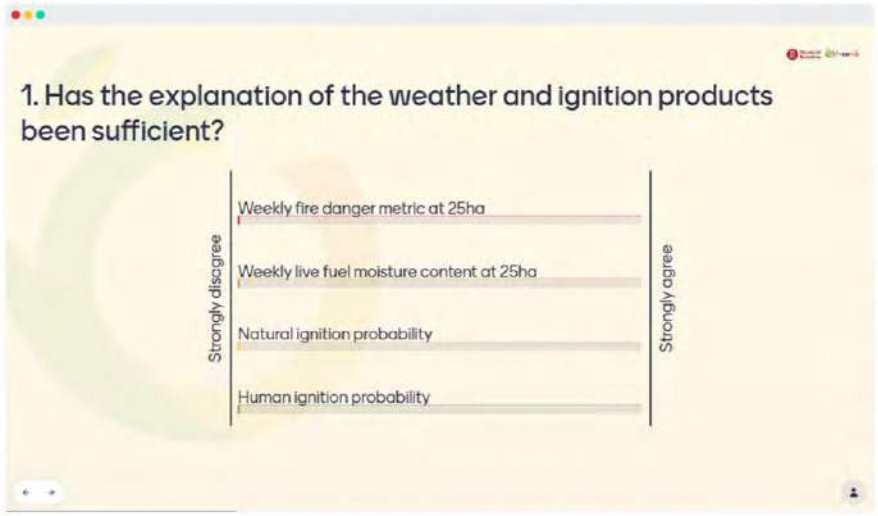


Audience screen



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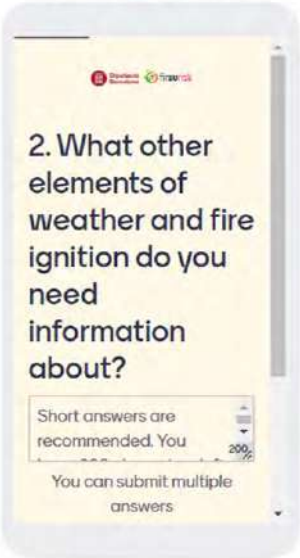
Audience screen



Presenter screen

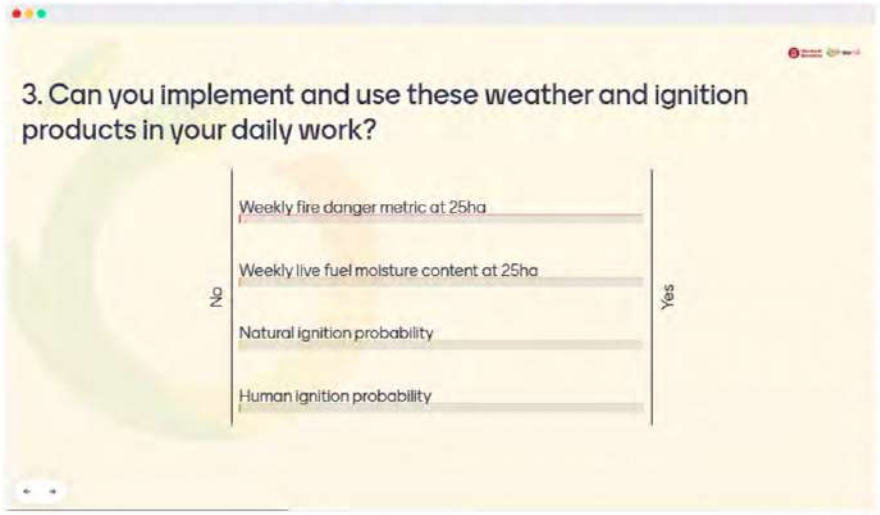


Audience screen



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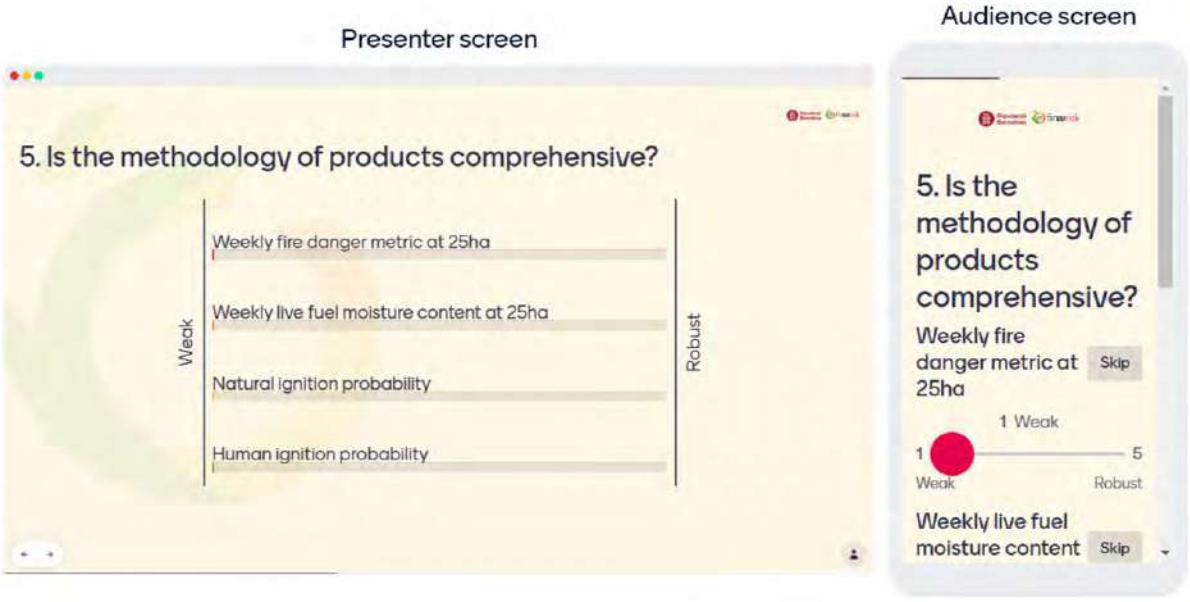
Presenter screen

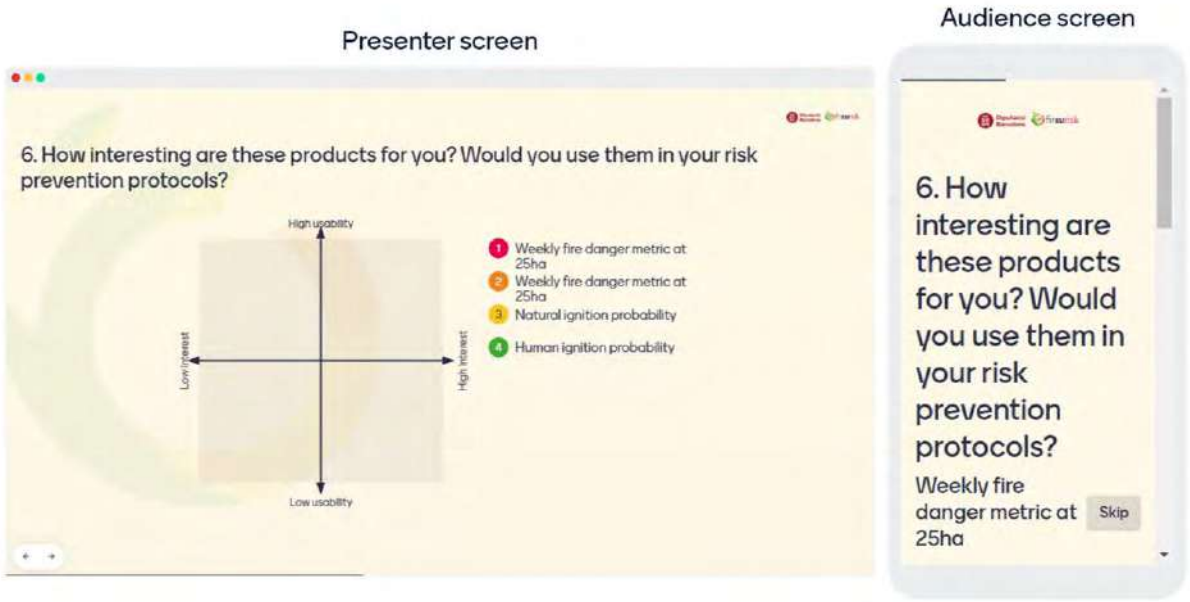


Audience screen



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Round Table 2: Evaluation and validation of products on fuels, propagation, population, and assets

Presenter screen



Audience screen



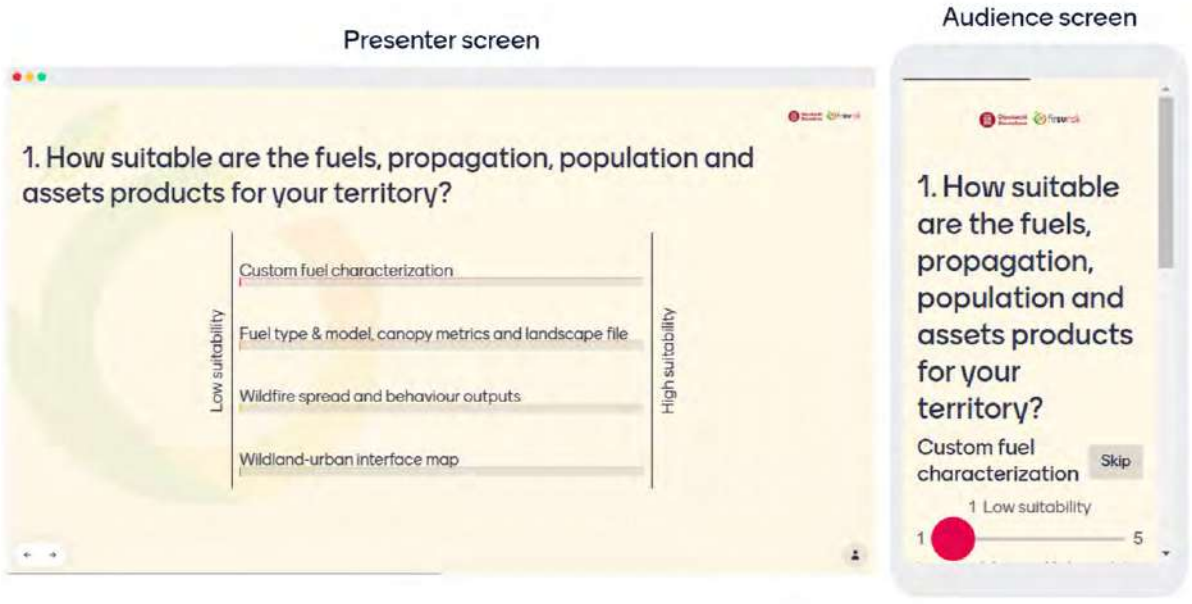
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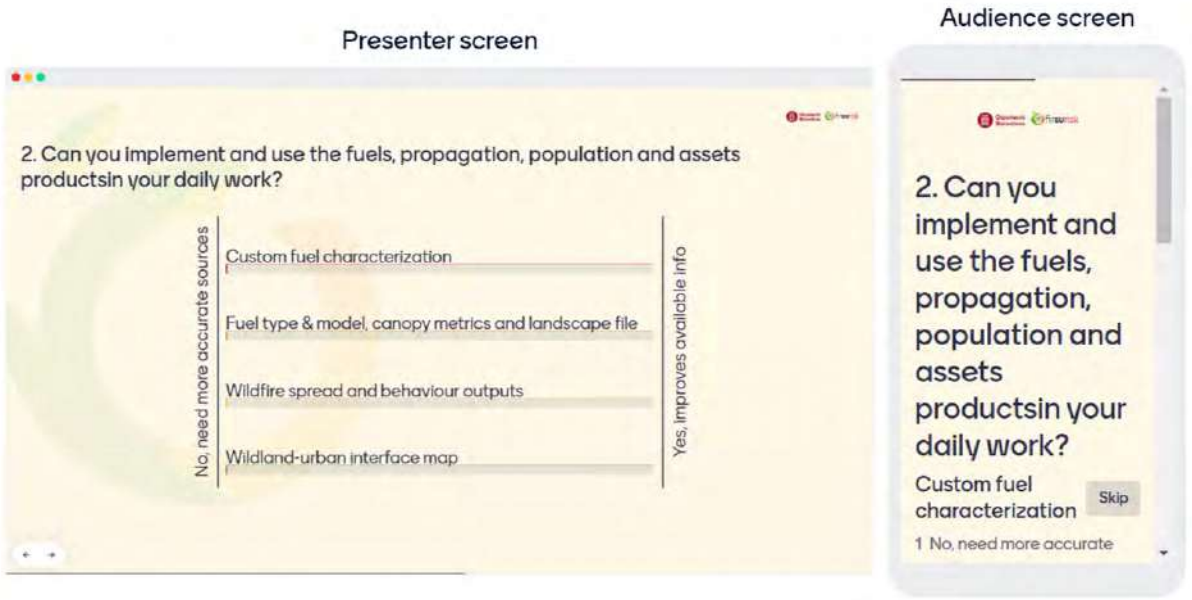


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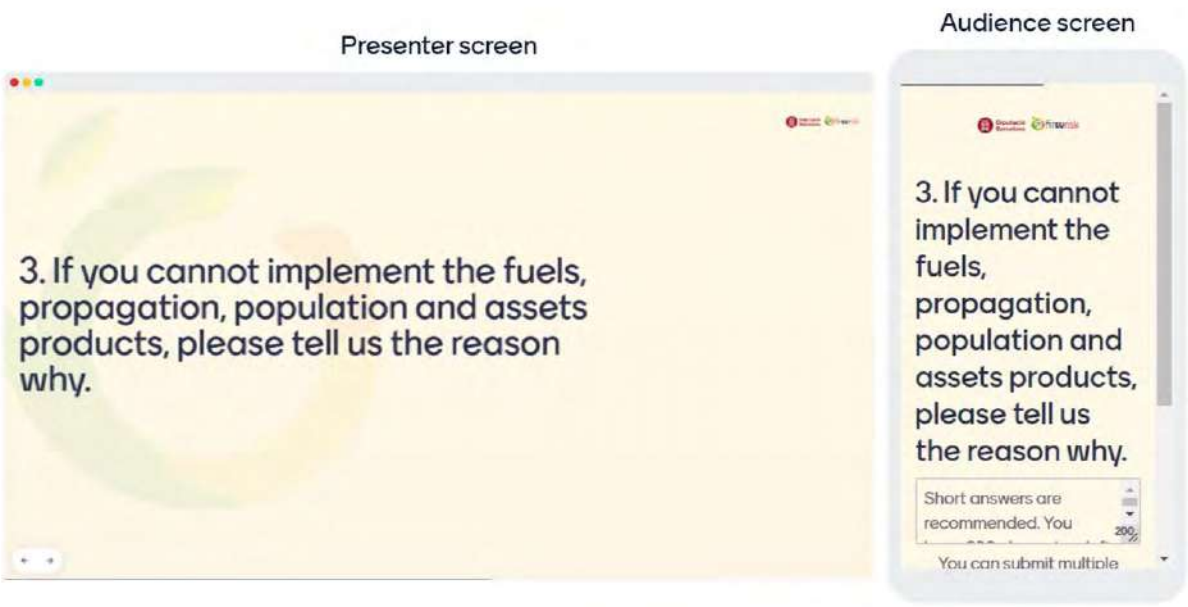


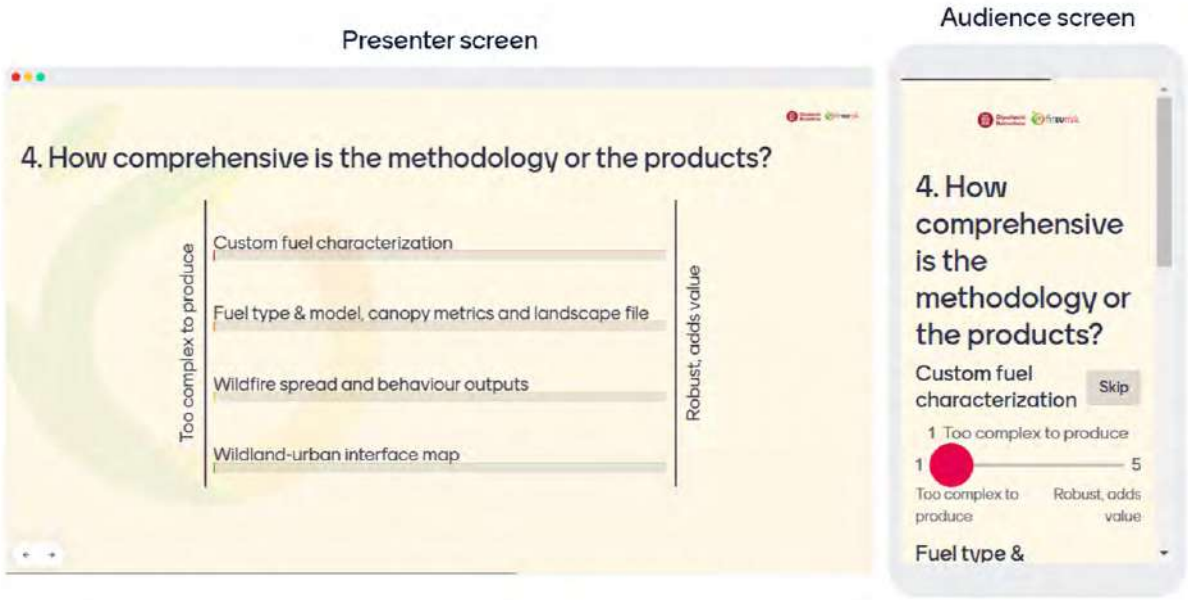
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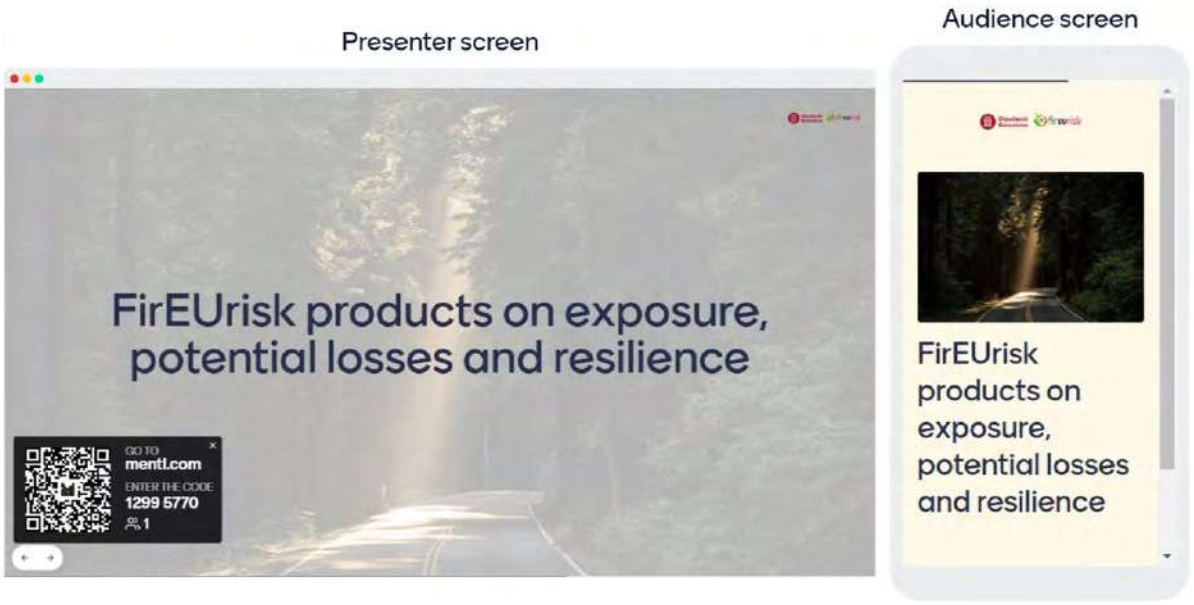




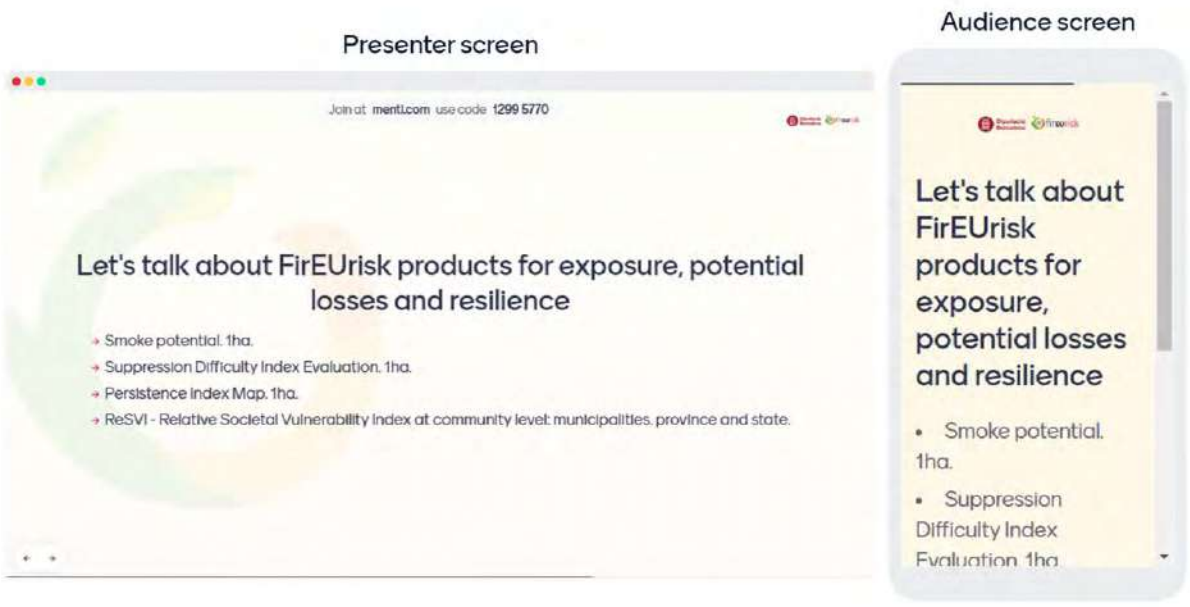
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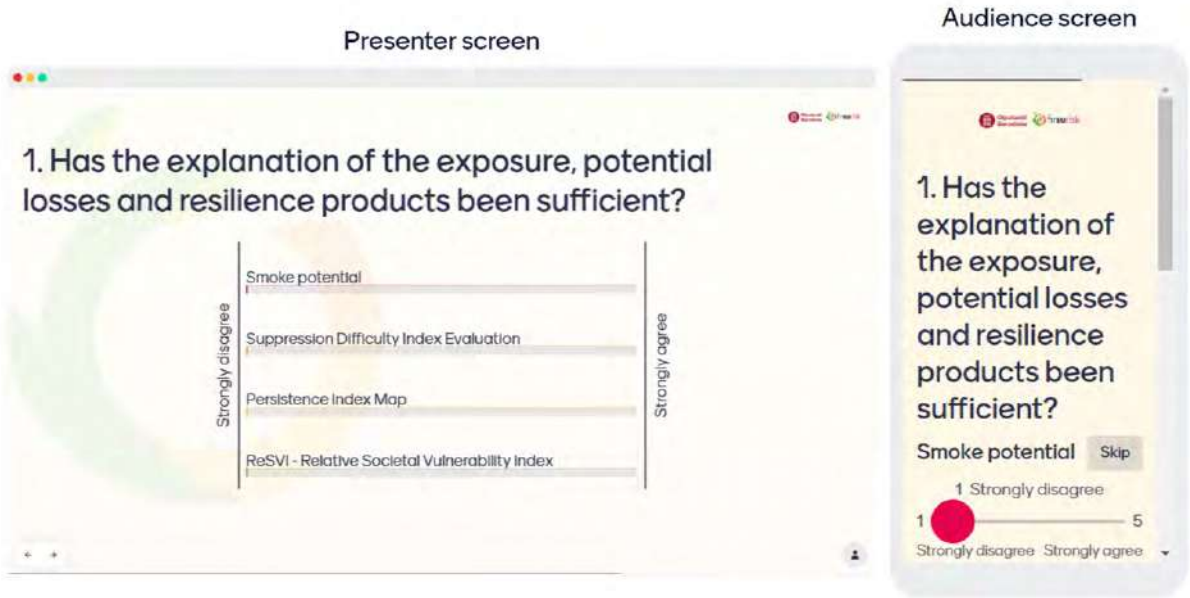


Round Table 3: Evaluation and validation of products on exposure, potential losses, and resilience

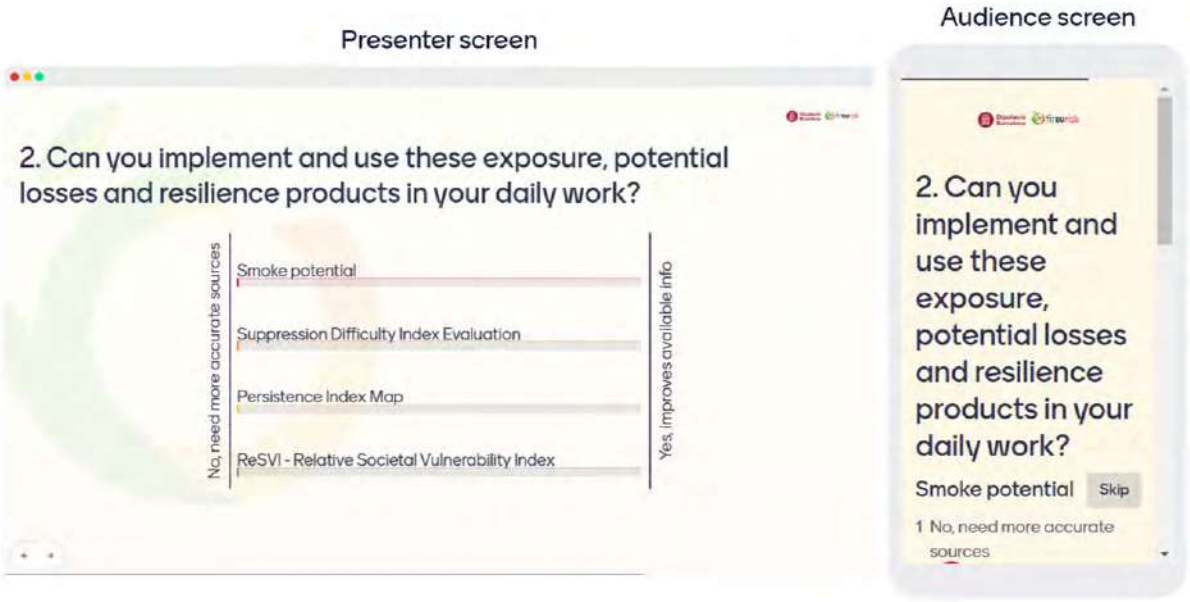


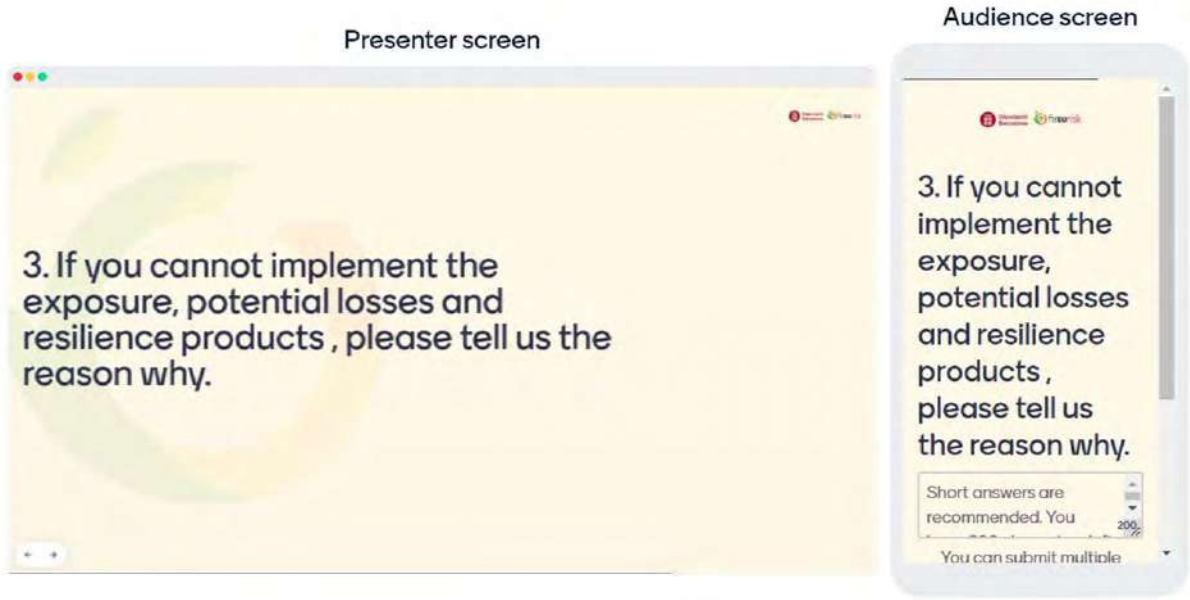
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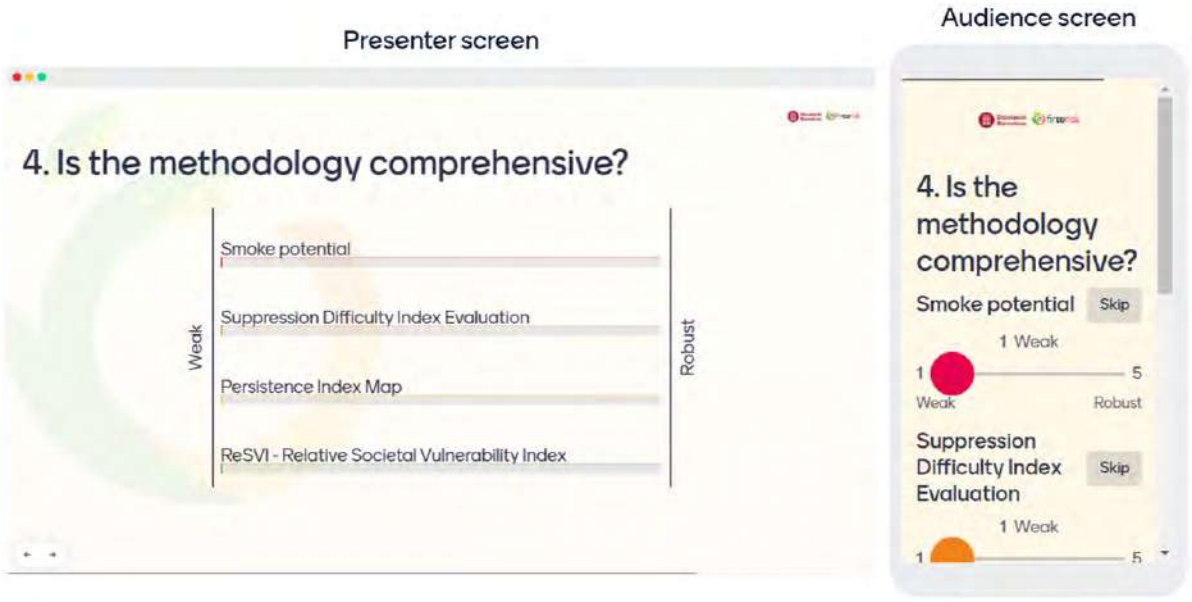


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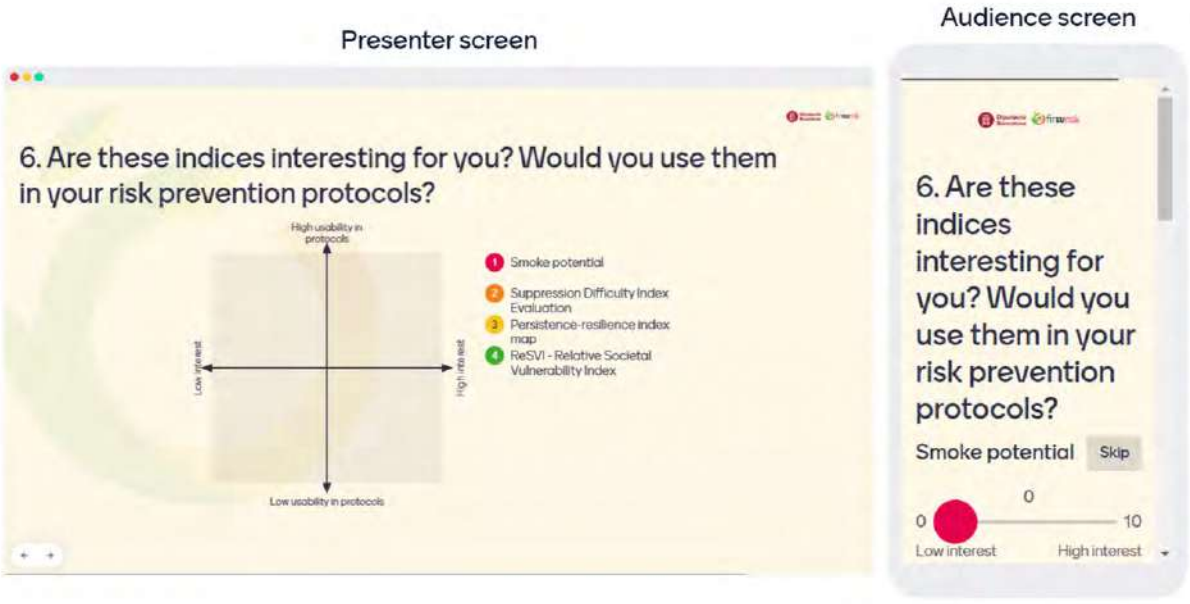


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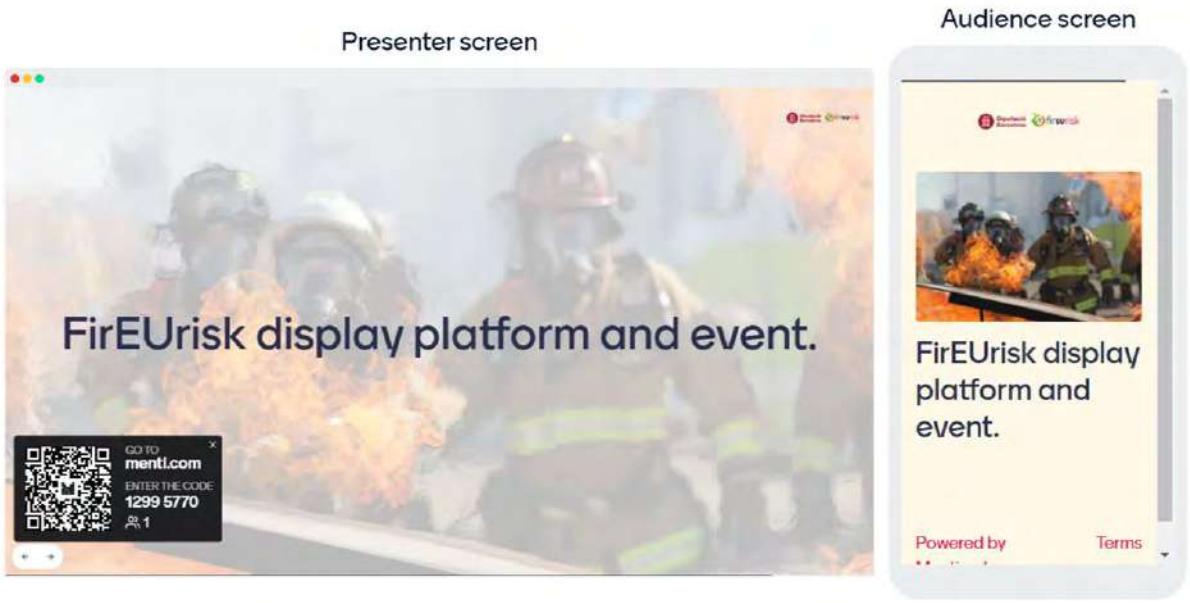




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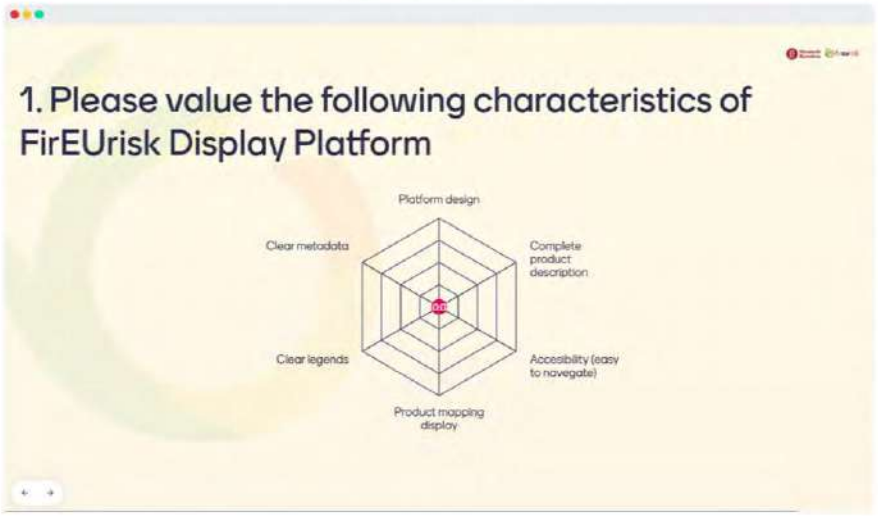


Round Table 4: Evaluation and validation of the FirEURisk display platform and event



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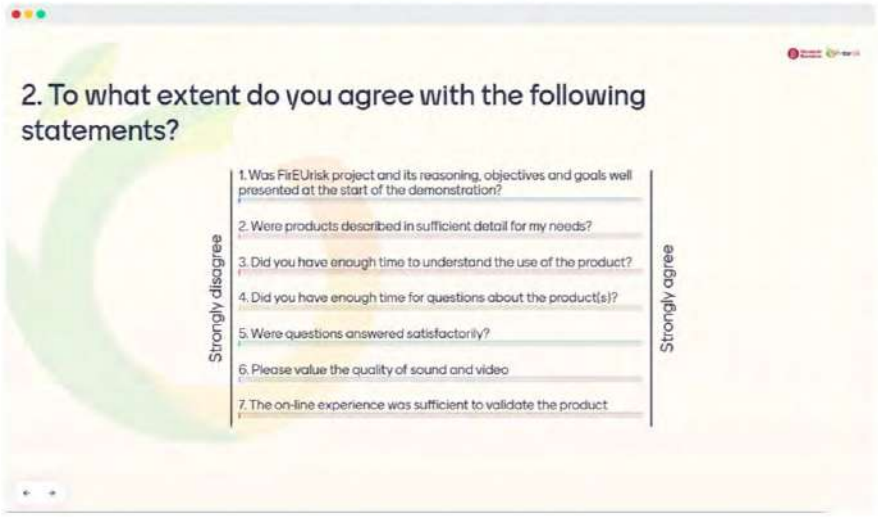
Presenter screen



Audience screen



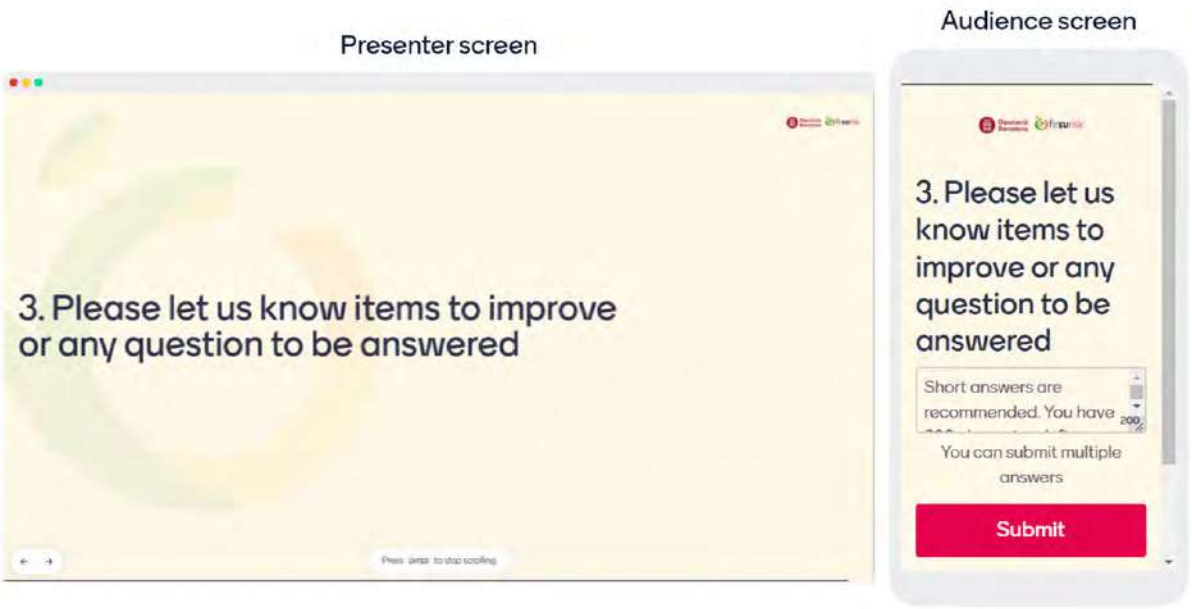
Presenter screen



Audience screen



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Annex C: EU Survey questionnaire

Pilot Site Demonstration Event in Barcelona

Fields marked with * are mandatory

Disclaimer
The European Commission is not responsible for the content of questionnaires created using the EUSurvey service - it remains the sole responsibility of the form creator and manager. The use of EUSurvey service does not imply a recommendation or endorsement, by the European Commission, of the views expressed within them.



Diputació Barcelona

Universitat de Lleida

gmv

Presenting solutions for wildfire prevention in the Mediterranean

Purpose of this questionnaire

FirEURisk project carried out the first demonstration of results in Barcelona, Spain, on June the 7th 2023. The solutions focused on four risk prevention topics, key to tackle the specific Mediterranean wildfires behavior.

- **Topic I - Weather and ignitions**
  - P1: Weekly fire danger metric at 25ha
  - P2: Weekly live fuel moisture content at 25ha
  - P3: Natural ignition probability
  - P4: Human ignition probability
- **Topic II - Fuels, propagation, population, and assets**
  - P5: Custom fuel characterization
  - P6: Fuel type & model, canopy metrics, and landscape file
  - P7: Wildfire spread and behaviour outputs
  - P8: Population and assets
  - P9: Wildland-urban interface map
- **Topic III - Exposure, potential losses, and resilience**

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- P10: Smoke potential
- P11: Exposure to communities
- P12: Suppression difficulty index evaluation
- P13: Potential economic losses
- P14: Persistence index
- P15: ReSVI - Relative Societal Vulnerability Index

- **Topic IV - Risk reduction and end-user needs**
  - P16: FirEURisk Display Platform
  - P17: Socio-economic barriers to reduce fire risk

If you are reading this questionnaire, quite possibly you attended the demonstration event. Thank you for your interest! **Now, we would like to ask you about the usability and completeness of the specific fire risk prevention products presented**. Responding to the questionnaire will take about 10 minutes of your time; for FirEURisk your responses will be most valuable! Here you have the following relevant links:

- YouTube recording of the event.
- Description of the products. (See in Background Documents)
- Access to the FirEURisk platform. **(Username: FirEURisk | Password: hKC;qMz5fuqW)**

General information

The FirEURisk project is funded by the European Commission's H2020 framework program (GA No. 101003890). The project counts with 38 partners from 18 countries and results will be produced from 2021 to 2025.

Please visit the FirEURisk website for further information: https://fireurisk.eu/

You can get in touch with us by email (info@fireurisk.eu), on Twitter (@FirEURisk) or on LinkedIn (https://www.linkedin.com/company/fireurisk/).

Data protection

According to the data protection legislation in the European Union, we inform you that personal data "processing is necessary for the performance of a task carried out in the public interest" (GDPR Article 6(1) (e)).

Personal data will be securely stored, only accessible to FirEURisk researchers and anonymized. Please contact info@fireurisk.eu if you wish your data to be erased from our records.

Contact details

1. Please enter your contact details:

* Name and surname:

* Field of expertise:

* Organisation:

* Email address:

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* Country and region:

☐ I give my consent for the FirEURisk project to use my contact details for research. I understand that my consent does not involve any other obligations and that I can withdraw it at any time by sending an email to mjyague@gmv.com.

*** 2. Select the community you belong to**

- **Scientific community:** broad scientific community in diverse fields linked to the proposal, including other related EU proposals.
- **First responders:** civil protection, firefighters, forest agents, police, military, and pilots.
- **Landowners/managers:** private and public landowners, forest managers, land tenants, and local authorities.
- **Policy and regulation makers:** local/regional, national or EU/international levels.
- **Industrial stakeholders:** pulp and paper, communication and power, furniture, house construction, service providers, tourism, insurance, and equipment developers.
- **Civil society organisations:** professional bodies, scouts, media, foundations, training centres, charities, NGOs.
- **Risk prevention communities:** local communities affected by fires, protection organisations, and local volunteer units. General public: urban and rural communities, teachers, and local leaders.

○ Scientific community
○ First responders
○ Landowners / managers
○ Policy and regulation-makers
○ Industrial stakeholders
○ Civil organisations
○ Risk prevention communities
○ General public

*** 3. Freely express your expertise and interest in wildfire risk**

*** 4. Would you like to be invited to future demonstration events held by the FirEURisk Project?** *Mediterranean Portugal, Central-Eastern Europe, Mediterranean Greece, Northern Europe, and European territory.*

○ Yes
○ No

*** 5. How often does wildfire risk assessment feature in your employment role**

○ Daily
○ Monthly
○ Annually
○ Weekly
○ Seasonally
○ Very Rarely

*** 6. How do you think the use of FirEURisk products will improve your activity?**

*** 7. Which aspects of your activity could be improved by FirEURisk products?** (e.g: optimize resources distribution through hazard maps, reduce fire incidence through land management, improve fire behaviour forecast and fighting through fuel maps, improve the planning of prevention practices, etc.)

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Product evaluation

In relation to the products presented in Barcelona, we would like to ask you about the usefulness, usability, and relevance of the product(s).

- You can find the FirEURisk product portfolio here.
- You can find the video recorded of FirEURisk Pilot Site Demonstration Event in Barcelona here.

8. Please value the completeness of the product description

FirEURisk products	Robust	Complete	Standard	Too technical	Weak
P1. Weekly fire danger metric at 25ha	○	○	○	○	○
P2. Weekly live fuel moisture content at 25ha	○	○	○	○	○
P3. Natural ignition probability	○	○	○	○	○
P4. Human ignition probability	○	○	○	○	○
P5. Custom fuel characterization	○	○	○	○	○
P6. Fuel type & model, canopy metrics and landscape file	○	○	○	○	○
P7. Wildfire spread and behaviour outputs	○	○	○	○	○
P8. Population and assets	○	○	○	○	○
P9. Wildland-urban interface map	○	○	○	○	○
P10. Smoke potential	○	○	○	○	○
P11. Exposure to communities	○	○	○	○	○
P12. Suppression Difficulty Index Evaluation	○	○	○	○	○
P13. Potential economic losses	○	○	○	○	○
P14. Persistence index	○	○	○	○	○
P15. ReSVI: Relative Societal Vulnerability Index	○	○	○	○	○
P16. FirEURisk Display Platform	○	○	○	○	○
P17. Socio-economic barriers to reduce fire risk	○	○	○	○	○

9. If your choice was weak and too technical, please specify why:

10. Please rate the usability of these products in your fire risk prevention and assessment work

FirEURisk products	Very high	High	Medium	Low	Very low
P1. Weekly fire danger metric at 25ha	○	○	○	○	○

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P2. Weekly live fuel moisture content at 25ha	○	○	○	○	○
P3. Natural ignition probability	○	○	○	○	○
P4. Human ignition probability	○	○	○	○	○
P5. Custom fuel characterization	○	○	○	○	○
P6. Fuel type & model, canopy metrics and landscape file	○	○	○	○	○
P7. Wildfire spread and behaviour outputs	○	○	○	○	○
P8. Population and assets	○	○	○	○	○
P9. Wildland-urban interface map	○	○	○	○	○
P10. Smoke potential	○	○	○	○	○
P11. Exposure to communities	○	○	○	○	○
P12. Suppression Difficulty Index Evaluation	○	○	○	○	○
P13. Potential economic losses	○	○	○	○	○
P14. Persistence index	○	○	○	○	○
P15. ReSVI: Relative Societal Vulnerability Index	○	○	○	○	○
P16. FirEURisk Display Platform	○	○	○	○	○
P17. Socio-economic barriers to reduce fire risk	○	○	○	○	○

11. If your choice was very low and low, please specify why:

12. Does the product improve existing similar resources?

FirEURisk products	Much better	Somew hat better	Almost the same	Somew hat worse	Much worse	Don't know or never used
P1. Weekly fire danger metric at 25ha	○	○	○	○	○	○
P2. Weekly live fuel moisture content at 25ha	○	○	○	○	○	○
P3. Natural ignition probability	○	○	○	○	○	○
P4. Human ignition probability	○	○	○	○	○	○
P5. Custom fuel characterization	○	○	○	○	○	○
P6. Fuel type & model, canopy metrics and landscape file	○	○	○	○	○	○
P7. Wildfire spread and behaviour outputs	○	○	○	○	○	○
P8. Population and assets	○	○	○	○	○	○
P9. Wildland-urban interface map	○	○	○	○	○	○
P10. Smoke potential	○	○	○	○	○	○
P11. Exposure to communities	○	○	○	○	○	○
P12. Suppression Difficulty Index Evaluation	○	○	○	○	○	○
P13. Potential economic losses	○	○	○	○	○	○

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FirEURisk products	Much better	Somew hat better	Almost the same	Somew hat worse	Much worse	Don't know or never used
P14. Persistence index	○	○	○	○	○	○
P15. ReSVI: Relative Societal Vulnerability Index	○	○	○	○	○	○
P16. FirEURisk Display Platform	○	○	○	○	○	○
P17. Socio-economic barriers to reduce fire risk	○	○	○	○	○	○

13. If your choice was much worse and somewhat worse, please specify why:

14. Is the spatial resolution (SR) of the products appropriate for your operational needs?

FirEURisk products	SR is adequate for my needs	SR partially covers my needs	SR is not adequate for my needs
P1. Weekly fire danger metric at **25ha**	○	○	○
P2. Weekly live fuel moisture content at **25ha**	○	○	○
P3. Natural ignition probability at **1ha**	○	○	○
P4. Human ignition probability at **1ha**	○	○	○
P6. Fuel type & model, canopy metrics and landscape file at **1ha**	○	○	○
P7. Wildfire spread and behaviour outputs at **1ha**	○	○	○
P8. Population and assets at **1ha**	○	○	○
P9. Wildland-urban interface map at **1ha**	○	○	○
P10. Smoke potential at **1ha**	○	○	○
P11. Exposure to communities at **1ha**	○	○	○
P12. Suppression Difficulty Index Evaluation at **1ha**	○	○	○
P13. Potential economic losses at **1ha**	○	○	○
P14. Persistence index at **1ha**	○	○	○
P15. ReSVI: Relative Societal Vulnerability Index at **1ha**	○	○	○

15. If the spatial resolution is not adequate for your needs, please specify why:

16. Is the temporal resolution (update frecuency) of the products appropriate for your operational needs?

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FirEURisk products	Frequency is adequate for my needs	Frequency partially covers my needs	Frequency is not adequate for my needs
P1. **Weekly** fire danger metric at 25ha	○	○	○
P2. **Weekly** live fuel moisture content at 25ha	○	○	○
P3. Natural ignition probability [**Static**]	○	○	○
P4. Human ignition probability [**Static**]	○	○	○
P5. Custom fuel characterization [**Static**]	○	○	○
P6. Fuel type & model, canopy metrics and landscape file [**Static**]	○	○	○
P7. Wildfire spread and behaviour outputs [**Static**]	○	○	○
P8. Population and assets [**Static**]	○	○	○
P9. Wildland-urban interface map [**Static**]	○	○	○
P10. Smoke potential [**Static**]	○	○	○
P11. Exposure to communities [**Static**]	○	○	○
P12. Suppression Difficulty Index Evaluation [**Static**]	○	○	○
P13. Potential economic losses	○	○	○
P14. Persistence index [**Static**]	○	○	○
P15. ReSVI: Relative Societal Vulnerability Index [**Static**]	○	○	○

17. If the temporal resolution is not adequate for your needs, please specify why:

18. Are these products innovative and a step forward for assessing wildfire risk?

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FirEURisk products	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
P1. Weekly fire danger metric at 25ha	○	○	○	○	○
P2. Weekly live fuel moisture content at 25ha	○	○	○	○	○
P3. Natural ignition probability	○	○	○	○	○
P4. Human ignition probability	○	○	○	○	○
P5. Custom fuel characterization	○	○	○	○	○
P6. Fuel type & model, canopy metrics and landscape file	○	○	○	○	○
P7. Wildfire spread and behaviour outputs	○	○	○	○	○
P8. Population and assets	○	○	○	○	○
P9. Wildland-urban interface map	○	○	○	○	○
P10. Smoke potential	○	○	○	○	○
P11. Exposure to communities	○	○	○	○	○
P12. Suppression Difficulty Index Evaluation	○	○	○	○	○
P13. Potential economic losses	○	○	○	○	○
P14. Persistence index	○	○	○	○	○
P15. ReSVI: Relative Societal Vulnerability Index	○	○	○	○	○
P16. FirEURisk Display Platform	○	○	○	○	○
P17. Socio-economic barriers to reduce fire risk	○	○	○	○	○

19. If you disagree or strongly disagree about any of the above statements, please specify why:

20. FirEURisk products are displayed on a web platform. (Username: FirEURisk | Password: hKC;qMz5fuqW)

Please rate the following features of the viewer:

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Platform **accessibility**	☆ ☆ ☆ ☆ ☆
Platform **design**	☆ ☆ ☆ ☆ ☆
Zoom in/out clicking once or drawing a polygon on the map.	☆ ☆ ☆ ☆ ☆
Pan the map by dragging.	☆ ☆ ☆ ☆ ☆
Measure tool, distance or area with a line or polygon	☆ ☆ ☆ ☆ ☆
Download map/image	☆ ☆ ☆ ☆ ☆
Display and set the **map scale**	☆ ☆ ☆ ☆ ☆
Cartographic display	☆ ☆ ☆ ☆ ☆
Product **legend**	☆ ☆ ☆ ☆ ☆
Product **metadata**	☆ ☆ ☆ ☆ ☆

21. Will you use our analysis of potential socio-economic barriers, constrains, and enables of LMS uptake to reduce fire risk in your work?

22. Let us know other comments



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