

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

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Executive Summary

This document describes the procedure for selecting products for DE at Pilot Sites and ET levels to reach Deliverable 5.2 (Portfolio of demonstration products for PS and pan-European demonstrations). Selection of scalable products for pan-European level is one of the important goals of the project. The main criteria for the selection are: end-user requirements, scalability and availability of products via WP4 platform, its coverage of pan-EU territory. In addition, document contains a publishable portfolio of selected products that consisting of a 1-page definition of the product, including the technical components, the methodology and proved accuracy at DA is included in this report. Description of the special products for the Chernobyl Exclusion Zone attached to the report and products description that were not selected for demonstration as well.

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List of Acronyms

Table 1: List of Acronyms

List of Acronyms	
DE	Demonstration events
DA	Demonstration area
PS	Pilot site
ET	European territory
ChEZ	Chornobyl Exclusion Zone

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1 Introduction

Selection of scalable Products for pan-European level is one of the important goals of the project. The main criteria for the selection are: end-user requirements, scalability and availability of Products via WP4 platform and its coverage of pan-EU territory. Each of those Products uses their own methodology, architecture as well as specific input data and has limitations for their usage. Developed Products also aimed to address different fire management components (Danger, Exposure and Vulnerability) of the integration scheme of the project.

Described Products features and variety require a careful approach for their evaluation and selection. Selected Products after demonstrations will be subject of further implementation by end users in all levels of horizontal and vertical hierarchy: from firefighters to decision makers and researchers.

1.1 Purpose of the document

This document describes the procedure for selecting Products for Demonstration events (DE) at Pilot Sites (PS) and European Territory (ET) levels and a Publishable portfolio of selected Products that consisting of a one-page definition of the Product, including the technical components. The methodology and proved accuracy at Demonstration Areas (DA) is included in this report.

1.2 Structure of the Document

The document consists of an introduction, three main sections (Selection framework, Selection process and Portfolio of selected services for Pilot sites and European Territory), Conclusions and two Annexes in which are described: Products developed for the Chornobyl Exclusion Zone and those Products which were not selected for DE.

2 Selection framework

This section describes a framework for Product selection and its main pillars: available Products developed in WP 1-4, scalability standards the implementation of which allows to upscale a Product's coverage to the regional and ET levels, end-user requirements that are one of the lead criteria for the selection of Products for PS demo as well as for ET level.

2.1 Products attained in WP 1-4

By Month 20 of the project the Product Portfolio contained 83 Products, developed within WP1-4. Most of Products come from WP1 (39 of them) and WP2 (27 of Products), 8 and 9 Products were prepared respectively under umbrella of WP3 and WP4. Based on the information provided by the developers, only 10 Products are suitable for testing as a global Products (ET level) and 16 at a regional level (Pilot site level). With this in mind, all 83 Products were analysed and included in the first step of selection procedure (Table 2).

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Table 2: Products distribution by local test sites

Coverage	WP1 Fire risk assessment to improve prevention	WP2 Risk reduction to improve protection	WP3 Adaptation to future fire regimes	WP4 Multi-level integration	Total
DA	12	6		1	19
PS	8	8	1	0	17
ET	7	2	1		10
N\A	12	11	6	8	37
Total	39	27	8	9	82

**N/A Products without coverage*

Nineteen Products will be tested at the demonstration area level (DA). Thirty seven Products are without clear coverage (such as References and Guidance (Table 3), specific software (Table 4) and Products with defined regional sites for upscaling (Table 5). References and Guidance that were written in English can be potentially tested in every PS as well as at ET level. Only 3 Products belonging to References and Guidance were written in a national language (Croatian) and probably will be translated into English in the future, due to this at the moment we`ve included 79 Products into next step of selection procedure (3 Products were excluded).

Table 3: Products belongings to References and Guidance without clear coverage

WP	Developer	Product name
2	FESB SPLIT	LMS strategies for Adriatic area*
2	FESB SPLIT	Guidelines for citizens involvement in wildfire risk reduction*
2	FESB SPLIT	Eruptive fire handbook*
2	METEOGRID SL	Guidelines to reduce communities' vulnerability to extreme fires and fires in WUI
2	UC	Laws, regulations, plans and programmes on fire prevention, preparedness and resilience
2	HUTTON	Analysis of potential socio-economic barriers, constrains and enables of LMS uptake to reduce fire risk
2	RISE	Effect of deciduous tree inclusion in European boreal forests
4	ADAI	Conceptual Framework for integrating risk assessment, reduction and adaptation
4	UAH	Roadmap for developing an integrated fire risk management strategy

**Products prepared in Croatian*

Table 4: Products belonging to Software/ Application

WP	Developer	Product name
4	ARBONAUT	Tool for displaying outputs from the internal platform and external platforms customised for the FirEURisk needs
4	Products at WP4 level	Web-Based Interface
4	Products at WP4 level	Internal Cooperative Platform
4	Products at WP4 level	Open Platform of models, data and knowledge

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Table 5: Product list (with defined regional sites for upscaling)

WP	Developer	Product Name
1	UdL	Human ignition probability
1	UdL	Natural ignition probability
1	UdL	Fire danger metric
1	UdL	Population and assets
1	ISIG	RESVI - Relative Societal vulnerability index (at community level)
1	UdL	Fuel type, fuel model, canopy metrics and landscape file.
1	UdL	Wildfire spread and behavior outputs, "basic mode"
1	UdL	Wildfire spread and behaviour outputs, "MTT mode"
1	HU	Wildland - Urban Interface map
1	UdL	Persistence Index Map
1	UAVR	Atmospheric emission potential
1	UdL	Custom fuel characterisation
1	UdL	Live Fuel Moisture Content dataset
1	REEFMC	Fire danger index classification /grid for ChEZ
1	REEFMC	Characterisation of fuel types and canopy metrics in wildfire simulation for the ChEZ
1	REEFMC	Online platform for fire risk assessment, dose prediction, prevention and suppression of fires in the ChEZ
2	RISE	Effect of deciduous tree inclusion in European boreal forests
2	UAH	GIS database of fire risk reduction strategies
2	STICHTING VU	Maps of suitable areas for Land Management Strategy (LMS) use
2	ADAI	Fire behaviour predictive models
2	AUTH	Fuel Management Framework for Reducing Operation-based Ignitions (FuMaF_ROI)
3	RISE	160 years of fire danger in Sweden
3	CSIC	Database of global change effects on vegetation resilience to disturbance
3	PIK	Effective adaptation to changed future fire regimes
3	PIK	Future fire regime data base
3	FMI	Two products: Fire risk & strength predictions, (i) short-term, (ii) long-term

2.2 Compliance with scalability standards

Scalability refers to the ability of a Product to perform well when applied in a wider territory (from DA level to PS, from PS to ET). Scalability defines the capacity of a Product to be upscaled for larger area and maintain its level of quality and accuracy. In the project under the term of the scalability we understand four separate parts: conceptual, data, models and knowledge (D5.1.3). The conceptual standards merely indicate that the Product aligns with the diagram of the Conceptual Integration Scheme. The data standards encompass a comprehensive enumeration of the specific data prerequisites, encompassing details about the dataset itself and the prescribed naming convention. Analogously, the model standards closely resemble the mentioned criteria, necessitating the inclusion of specific information within the

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code at its onset. On the other hand, the knowledge standards mandate the provision of an information sheet or methodology, ensuring the availability of pertinent information pertaining to the Product.

2.3 End-user requirements

PS end-user requirements are one of the lead criteria for the selection of Products for PS demo as well as for ET level. In the FirEURisk project all 5 Pilot Sites: (1) Kalmar County (Sweden), (2) Central Europe (Brandenburg and Saxony in Germany, Bohemia in Czech Republic and Silesia in Poland), (3) Central Portugal, (4) Barcelona (Spain), and (5) Attica (Greece) have special focus on one of the key issues of fire management for each region (Table 6).

Table 6: Main drivers to be showcased per region / Objectives of the demonstration events in each location

Pilot Site	Leader	Demonstration event	Driver User Needs Survey
PS1 - Northern Europe	RISE	M36	PS1 - Future fire risk scenarios
PS2 – Central Europe	TUD	M33	PS2 – Transboundary cascading effects Potentially to include fuel loads and future scenarios
PS3 – Mediterranean (Central Portugal)	ADAI	M30	PS3 – Fire risk reduction and prevention, forest management, fire behaviour modelling, WUI fire risk characterisation
PS4 – Mediterranean (Barcelona)	UdL	M27	PS4 - Fire danger assessment, WUI vulnerability and reduction
PS5 – Mediterranean (Greece)	KEMEA	M37	PS5 – Catastrophic peri-urban wildfires
ET - European Territory	UAH / ADAI	M44	ET– Fire risk assessment (WP1), reduction (WP2), adaptation (WP3) and integration (WP4). Based on results from survey

Based on results in the report “D 5. 1 –User requirements database and report”, wildfire risk reduction stands out as the most sought-after application according to public surveys, and adaptation to future wildfire regimes emerges as the foremost significant subject at the European Territory level. A meticulous examination that considers distinct target audiences and regions reveals that certain end-users hold distinct priorities (Fig.1).

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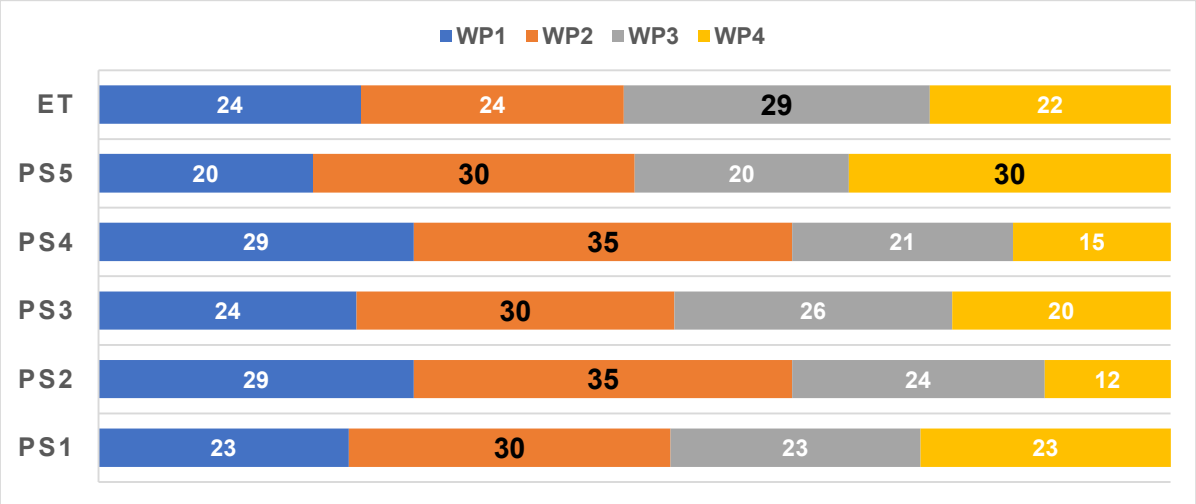


Figure 1. Bar chart of WPs expressed in the User Needs Survey by each PS (source: D 5. 1 –User requirements database and report, GMV)

According to report "D 5. 1 –User requirements database and report" regional and global (ET) interests of end-users were identified:

1) In PS1 - Northern Europe, end-users were mostly interested in wildfire risk reduction, a slightly smaller proportion of responses were belonging to wildfire risk assessment and multi-level integration, and adaptation to future wildfire regimes;

2) in PS2 - Central Europe end-users choose as a priority wildfire risk assessment and reduction, followed by adaptation to future wildfire regimes;

3) In PS3 – Mediterranean (Central Portugal), most important applications were also connected to wildfire risk reduction, followed by adaptation;

4) In PS4 – Mediterranean (Barcelona), end-users were mainly interested in risk reduction and wildfire risk assessment;

5) In PS5 – Mediterranean (Greece), most prominent topic was wildfire risk reduction and wildfire risk assessment, followed by the multi-level integration;

6) At the ET level, end-users were mostly interested in adaptation, followed by assessment and multi-level integration.

End-users defined specific technical requirements as well. In the terms of updates frequency seasonal and yearly frequency were the most demanded criteria. The most requested spatial resolutions were 10-50 m, 100-1000 m, and >1 km (here, the user requirements coincide with the agreement on the Project regarding spatial resolution: 1 ha for Pilot sites and 1 km2 for European territory). This additional information will be use for product selection.

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3 Selection process

3.1 Justification of procedure

Selection of scalable products for regional and pan-European levels is one of the important goals of the project. Each of the products aimed in different fire management issue (Danger, Exposure and Vulnerability) and has their own methodology, architecture, input data and limitations. There are next main criteria for the selection: PS end-user requirements, results on scalability, availability of products through WP4 platform and coverage of PS by products.

3.2 Description of selection procedure

To make the procedure of selection clear and easy to follow we chose a step-by-step approach where products are filtered using the main criteria of selection (PS end-user requirements, results on scalability, availability of products throughthe WP4 platform and coverage of PS by products) (Fig.2).

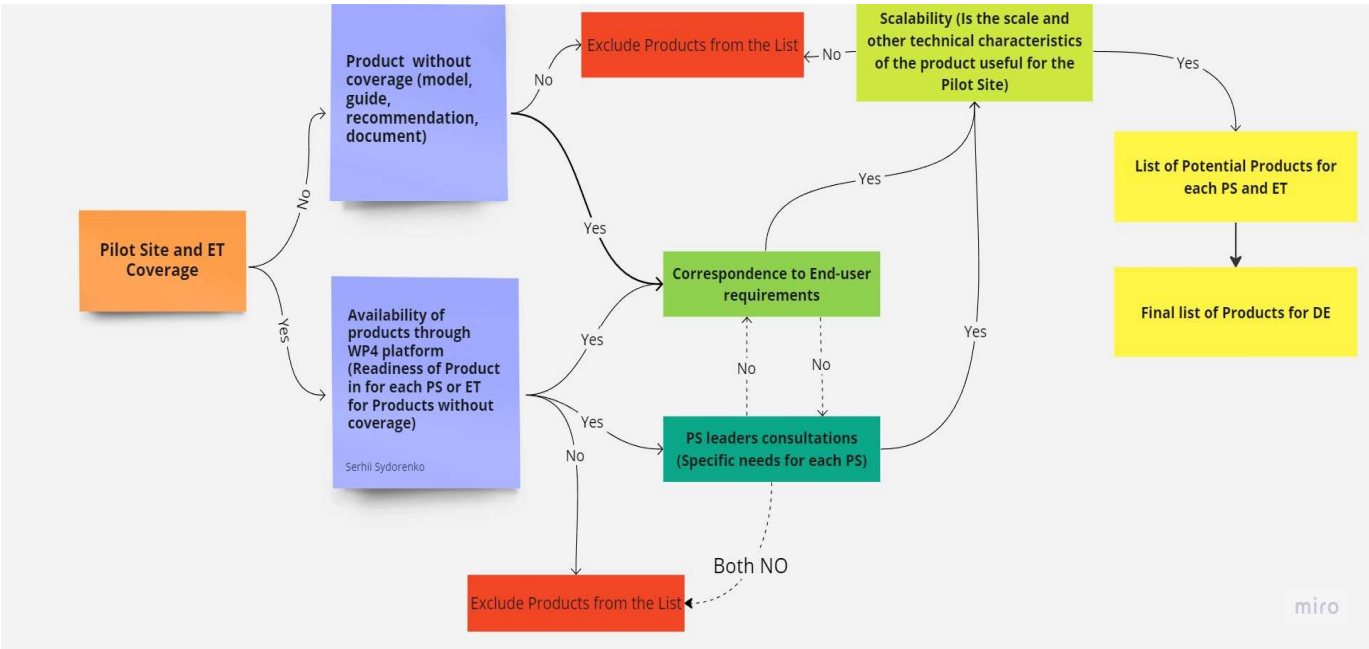


Figure 2. Scheme for filtering the products that can potentially be selected for DE

In the first step, products filtered by their coverage at PS and ET. Products that have appropriate coverage move to the next stage of selection. Products without a spatial restriction such as documents, guides, models etc. (Table 3 and Table 4) also progress to the next stage as they can potentially be demonstrated in any PS.

In the next stage products were checked for their readiness, based on their availability on the Internal Cooperative Platform and information in the Traceability Table (A5.1.3).

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In the third stage of Selection, Pilot Site Leaders were consulted about what is actually needed in their Pilot Site, in parallel with evaluating products based on user-requirements from D 5. 1 –User requirements database and report results. If the product is selected by the PS leader or meets the end-users' requirements, then it moves to the next stage of selection. The fourth stage of selection is connected with evaluation using scalability standards, meaning the scale of the product useful for the Pilot Site. In the last stage, a potential list of products created and can be sent to PS leaders and WP5 leaders for final approval.

Below we provide preliminary lists of potential products for each PS and ET (Table 7-12); these lists will be sent to PS leaders about possible inclusion/exclusion of some products from those lists. Considering the extensive range of potential products in the lists, it is essential to take into account the capacity of each demonstration event (how many products can be demonstrated in each event). This means the number of products that can be potentially showcased during the event could be reduced.

Updated will be made following suggestions from PS leaders regarding inclusion/exclusion of individual products from lists (Table 7-12).

Table 7: Potential product list for PS1 - Northern Europe / Future fire risk scenarios

WP	Fire risk component lvl 2	Product Name	Developer	Product Card Number
1	Population and Assets	Wildland - Urban Interface map	UH	18
1	Propagation	Propagation potential indicators for Pilot Sites (PS)	FESB SPLIT	32
1	Potential Losses	Potential Losses on Ecosystem Services affected by wildfires	UCO	38
1	Propagation	Suppression Difficulty Index Evaluation	UCO	39
1	Propagation	Canopy metrics and landscape file	ARBONAUT	61
1	Ignition	Human ignition probability	UDL	63
1	Ignition	Natural ignition probability	UDL	66
1	Propagation	Spring grass fire model for the north	RISE	69
2	Resilience	Factors for building survivability in Scandinavia	RISE	72
3	Propagation	160 years of fire danger in Sweden	RISE	74

Table 8: Potential product list for PS2 - Central- Europe / Transboundary cascading effects. Potentially to include fuel loads and future scenarios

WP	Fire risk component	Product Name	Developer	Product Card Number
1	Population and Assets	Wildland - Urban Interface map	UH	18
1	Propagation	Propagation potential indicators for Pilot Sites (PS)	FESB SPLIT	32
1	Potential Losses	Potential Losses on Ecosystem Services affected by wildfires	UCO	38
1	Propagation	Suppression Difficulty Index Evaluation	UCO	39
1	Ignition	Human ignition probability	UDL	63
1	Ignition	Live Fuel Moisture Content	SIA	64
1	Resilience	RESVI - Relative Societal Vulnerability Index (at community level)	ISIG	68
4	Propagation	Forest condition: biotic damages	GMV	34

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Table 9: Potential product list for PS3 – Mediterranean (Central Portugal) / Fire risk reduction and prevention, forest management, fire behaviour modelling, WUI fire risk characterisation

WP	Fire risk component	Product Name	Developer	Product Card Number
1	Population and Assets	Wildland - Urban Interface map	UH	18
1	Propagation	Propagation potential indicators for Pilot Sites (PS)	FESB SPLIT	32
1	Potential Losses	Potential Losses on Ecosystem Services affected by wildfires	UCO	38
1	Propagation	Suppression Difficulty Index Evaluation	UCO	39
1	Propagation	Fuel Sampling Protocol	CNR IBR	42
1	Population and Assets	Fire emissions potential	UAVR / REEFMC	59
1	Ignition	Human ignition probability	UDL	63
1	Ignition	Natural ignition probability	UDL	66
1	Resilience	RESVI - Relative Societal Vulnerability Index (at community level)	ISIG	68

Table 10: Potential product list for PS4 – Mediterranean (Barcelona) / Fire danger assessment, WUI vulnerability and reduction

WP	Fire risk component lvl 2	Product Name	Developer	Product Card Number
1	Population and Assets	Wildland - Urban Interface map	UH	18
1	Propagation	Suppression Difficulty Index Evaluation	UCO	39
1	Ignition	Fire danger metric	UDL	58
1	Propagation	Custom fuel characterisation	UDL	60
1	Propagation	Fuel type, fuel model, canopy metrics and landscape file	UDL	62
1	Ignition	Human ignition probability	UDL	63
1	Ignition	Live Fuel Moisture Content dataset	UDL	65
1	Ignition	Natural ignition probability	UDL	66
1	Resilience	Persistence Index Map	UDL	67
1	Resilience	RESVI - Relative Societal vulnerability index (at community level)	ISIG	68
1	Propagation	Wildfire spread and behaviour outputs, "basic mode"	UDL	70
1	Population and Assets	Maps of fire exposure metrics	UAVR	76
2	Population and Assets	Analysis of potential socio-economic barriers, constrains and enables of LMS uptake to reduce fire risk	JHI	29
4	Risk	Tool for displaying outputs from the internal platform and external platforms customised for the FirEUrisk needs	ARBONAUT	44
1	Potential Losses	Potential Losses on Ecosystem Services affected by wildfires	UCO	38
1	Population and Assets	Smoke potential	UAVR	78
1	Population and Assets	Population Assets	UDL	79

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Table 11: Potential product list for PS5 – Mediterranean (Greece) / Catastrophic peri-urban wildfires

WP	Fire risk component	Product Name	Developer	Product Card Number
1	Ignition	Daily Fire Danger Index (DFDI)	SIA	16
1	Population and Assets	Wildland - Urban Interface map	UH	18
1	Propagation	Propagation potential indicators for Pilot Sites (PS)	FESB SPLIT	32
1	Potential Losses	Potential Losses on Ecosystem Services affected by wildfires	UCO	38
1	Propagation	Suppression Difficulty Index Evaluation	UCO	39
1	Propagation	Fuel Sampling Protocol	CNR IBR	42
1	Propagation	Fuel type, fuel model, canopy metrics and landscape file	UDL	62
1	Ignition	Human ignition probability	UDL	63
1	Ignition	Live Fuel Moisture Content	SIA	64
1	Resilience	RESVI - Relative Societal Vulnerability Index (at community level)	ISIG	68

Table 12: Potential product list for ET - European Territory / Fire risk assessment (WP1), Reduction (WP2), Adaptation (WP3) and Integration (WP4)

WP	Fire risk component	Product Name	Developer	Product Card Number
1	Ignition	Human ignition probability map	UAH	1
1	Propagation	Live-fuel moisture content climate archive	TUD	4
1	Propagation	Fuel type and model map	UAH	5
1	Resilience	Plant trait database for European species (EuroTraits)	CSIC	6
1	Potential Losses	Fire effects on biodiversity database (FireonBio)	CSIC	7
1	Propagation	Propagation potential indicators for European Territory (ET)	FESB SPLIT	31
1	Potential Losses	Potential Losses on Ecosystem Services affected by wildfires	UCO	38
1	Ignition	Natural ignition probability	UDL	66
1	Resilience	Persistence Index Map	UDL	67
1	Population and Assets	Maps of fire exposure metrics	UAVR	76
2	Propagation	Maps of suitable areas for Land Management Strategy (LMS) use	STICHTING VU	13
3	Potential Losses	Future climate information	METEOGRID	8
3	Propagation	Continental land-use change scenarios and stylised fuel management scenarios	STICHTING VU	75
1	Population and assets	Socio-economic vulnerability	HUTTON	77
1	Population and assets	Wildland - Urban Interface map	UH	18
4	Risk	Open Platform of models, data and knowledge	ARBONAUT	54

3.3 Conclusions

The procedure describes an approach for selecting products for DE using the best currently available information. The report will be updated as new information becomes available and Product Cards will be completely filled. We will make updates after suggestions from PS leaders regarding inclusion/exclusion of individual products from the prepared lists (Table 7-12).

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4 Portfolio of selected services for Pilot Sites and European Territory

4.1 Portfolio of selected products for European Territory demonstration events

4.1.1 Danger (Hazard) > Ignition >Human

4.1.1.1 Human ignition probability map (Product Card 1)

The product enables the estimation of the probability of a human caused fire ignition for the European Territory. The final output – probabilistic raster map (scale 0 to 100) with the spatial resolution of 1 km^2. The product developed within the Activity "A1.1.3 Human ignition drivers".

Technical components

Characteristics	Description
Type of products:	Geospatial
Units:	Probability scale 0 to 100
Update Frequency:	Static layer
Accuracy:	80-95%.
Output Format:	.tiff
Fire risk component:	Ignition
Temporal coverage:	Developed for 2020
Spatial resolution:	1 km^2
Spatial coverage:	ET, PS1-5
Availability on FirEUrisk platform:	https://fireurisk.satways.net/datasets/6343d705e4b0b33bef3a249f
Developer:	University of Alcalá and University of Haifa

Methodology

The product estimates the probability that a human caused fire will be ignited. The product developed with active use of machine learning spatial-temporal empirical models of ignition probability based on socio-economic and territorial drivers of ignition from geospatial indicators and demographic databases.

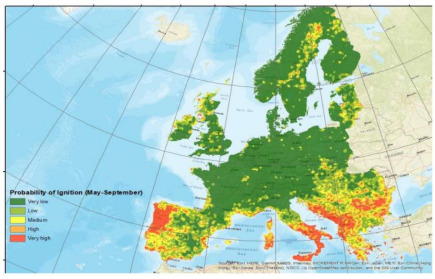


Figure 3. Human ignition probability map

Proved accuracy at Demonstration Area

The predictive performance of the model was interpreted from the confusion matrix and the OOB error for the classification and the AUC for the probability analysis. The confusion matrices show balanced commission and omission errors below 20 % in all models. The OOB for the global model is 11.8 %, for the global model only with the human components it is 11.94 %, for the Mediterranean areas it is 16.35 %, non-Mediterranean areas it is 11.06 %, and for the season from May to September is 10.85 %.

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4.1.2 Danger (Hazard) > Ignition > Natural

4.1.2.1 Natural ignition probability (Product Card 66)

This geospatial product (algorithm and raster grids.) provides daily maps of probability that a natural fire ignites at the regional scale. The product developed within the Activity "A1.1.2. Natural ignition probability".

Technical components

Characteristics	Description
Type of products:	Geospatial Product
Units:	%
Update Frequency:	Daily
Accuracy:	70-80%
Output Format:	.RData (model); .tif (raster grids)
Fire risk component:	Natural ignition
Temporal coverage:	2009-2015
Spatial resolution:	1ha
Spatial coverage:	ET, PS1, PS3, PS4
Availability on FirEUrisk platform:	https://fireurisk.satways.net/datasets/64593472e4b09e4f2e1953b1
Developer:	UdL

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 et al. (2023) doi:10.1071/WT22123.

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of Product.

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4.1.3 Danger (Hazard) > Propagation > Fuels

4.1.3.1 Live-fuel moisture content climate archive (Card 4)

The product enables the investigation of the long-term coarse-scale live-fuel moisture content derived from integrating passive microwave satellite observations of vegetation optical depth with in-situ measurements for the European territory. The final output – geospatial netCDF dataset with the daily time step (scale: %) and spatial resolution of 0.25°. The product was developed within the Activity "A1.1.1 Fire weather and fuel status prevention".

Technical components

Characteristics	Description
Type of products:	Geospatial
Units:	Percentage (%)
Update Frequency:	Historical data archive 1988-2020 with the daily step
Accuracy:	RMSE: ca. 49%
Output Format:	.nc
Fire risk component:	Propagation (Fuel Moisture)
Temporal coverage:	Developed for 1988-2017
Spatial resolution:	0.25°
Spatial coverage:	ET, PS1-5
Availability on FirEUrisk platform:	https://fireurisk.satways.net/datasets/62d5272ce4b0b33bb117af5c
Developer:	TUD (Technische Universität Dresden)

Methodology

The product interprets LFMC as a weighted combination of vegetation optical depth estimated from passive microwave satellite observations and leaf area index within a logistic regression. The derived dataset is calibrated and validated with the Globe-LFMC database as well as the MODIS LFMC based on the approach by Yebra et al. (2018). Detailed description of algorithm of calculation and data sources available here: https://hess.copernicus.org/preprints/hess-2022-121/.

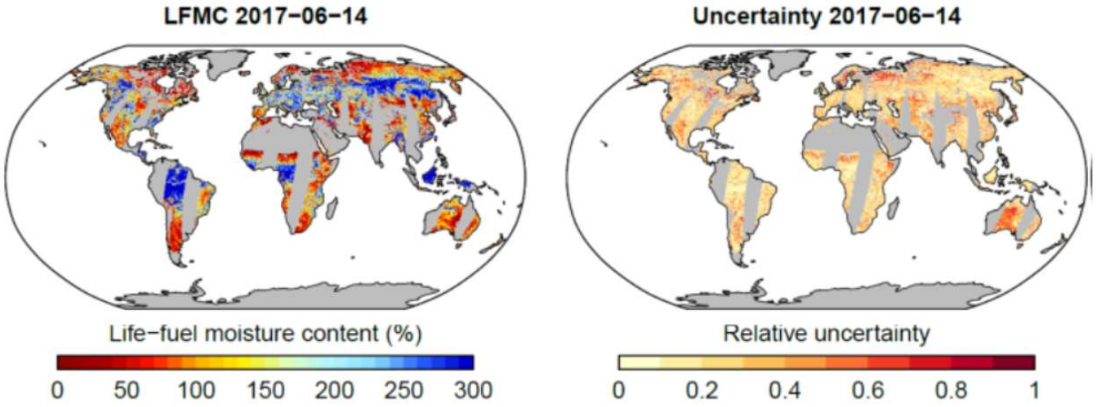


Figure 4. Example of the Live-fuel moisture content climate archive (left) and the related relative uncertainty per pixel (right)

Proved accuracy at Demonstration Area

The accuracy of the global product is estimated with a RMSE of ca. 49%. The relative uncertainty of each pixel can be estimated from the provided variables LFMC_max and LFMC_min which represent the maximum and the minimum LFMC estimation of the model per grid cell and time step.

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4.1.3.2 **Fuel type and model map (Product Card 5)**

The product includes the fuel type and parameters following the standard classification of fuels for the European territory. The final output – fuel classes and static fuel map. The product developed within the Activity "A1.1.4 Risk-wise landscape and fuel models development".

Technical components

Characteristics	Description
Type of products:	Geospatial
Units:	Fuel classes
Update Frequency:	Static layer
Accuracy:	88.4%.
Output Format:	.tiff
Fire risk component:	Propagation (fuel)
Temporal coverage:	Developed for 2020
Spatial resolution:	1 km^2
Spatial coverage:	ET, PS1-5
Availability on FirEUrisk platform:	https://fireurisk.satways.net/datasets/ 62d662b9e4b0b33bb117b801
Developer:	UAH (Universidad de Alcalá).

Methodology

Advanced classification models were applied to LiDAR (GEDI and ICESAT-2), multi and hyperspectral satellite imagery (Sentinel-2, Sentinel-3, PRISMA) for fuel type mapping, using standardised datasets from systematic field campaigns, lab experiments, forest inventory data and biophysical models. Surface fuel and canopy metrics (canopy cover, canopy height, canopy base height and canopy bulk density) are parameterised for running propagation potential (Flammap or FCCS). Custom fuel models were described for special interest ecosystems: Detailed description of algorithm of calculation and data sources available https://edatos.consorciomadrono.es/dataset.xhtml?persistentId=doi:10.21950/YABYCN

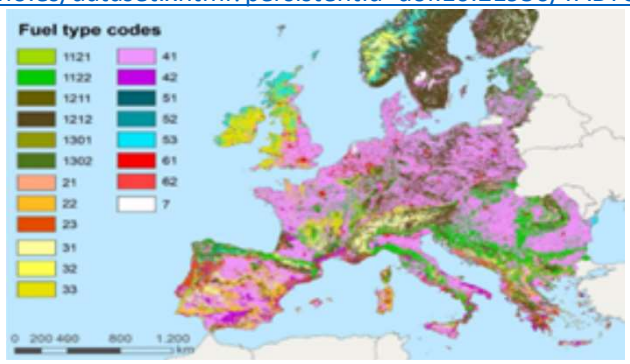


Figure 5. Fuel type map example

Proved accuracy at Demonstration Area

The validation of the European fuel map yielded a high overall agreement, 88.40 % (average commission errors of 37 %, average omission errors of 29 %) between the FirEUrisk main fuel types and the LUCAS points. Individual fuel types' accuracy ranged from 30 to 100 %. As for the second validation exercise, including all first-level mapped FirEUrisk fuel types, a medium to a high quantitative agreement was observed with an overall accuracy of 81.22 %, average commission errors of 40 % and average omission errors of 43 %. Individual fuel type's accuracy ranged from 20 to 100 %.

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4.1.3.3 Propagation potential indicators for European Territory (ET) (Product Card 31)

This product will include GeoTIFF raster maps of propagation potential indicators for European Territory, as well as report with detail description of methodology and obtained results. Propagation potential for EU territory will be calculated in 1 km^2 resolution, based past fires on EU territory from Jan, 1st 2001 to Dec, 31st 2019, fires larger then 2000 ha were selected. Outputs will be typical propagation potential indicators: Rate of Spread – R [m/s], Reaction intensity – RI [kW/m2], Fireline Intensity – FI [kW/m] and Flame Length – FL [m]. The product developed within the Activity "A1.1.5 Analysis of fire propagation, fuel consumption and smoke emission as risk factors".

Technical components

Characteristics	Description
Type of products:	Geospatial product
Units:	Not applicable
Update Frequency:	If needed
Accuracy:	To be defined
Output Format:	.tiff
Fire risk component:	Propagation / Vulnerability
Temporal coverage:	Static layers
Spatial resolution:	1 km x 1 km
Spatial coverage:	ET, PS1-5
Availability on FirEUrisk platform:	https://fireurisk.satways.net/datasets/63ff40fbe4b054e2ce418930
Developer:	FESB SPLIT

Methodology

Propagation potential for EU territory will be calculated in 1 km^2 resolution, based on custom implementation of Rothermels model (in Python) for cell-based wildland landscape fire growth simulations. From the list of past fires on EU territory from Jan, 1st 2001 to Dec, 31st 2019, fires larger then 2000 ha were selected. There were 403 of such fires. For their dates, maps of meteorological parameters were extracted from ERA5 and resampled to 1 km resolution. 10h Fuel Moisture Content and wind speed were calculated for each date, based on two weather scenarios: average weather conditions (50th percentile) and extreme weather conditions (5th percentile for fuel moisture and 95th percentile for wind speed). Propagation potential for the ET territory will be calculated for each pixel using standard Rothermel equations for surface wildfire spread modelling. Input maps were wind speed, 10h dead fuel moisture, slope and fuel models. Outputs will be typical propagation potential indicators: Rate of Spread – R [m/s], Reaction intensity – RI [kW/m2], Fireline Intensity – FI [kW/m] and Flame Length – FL [m].

Proved accuracy at European Territory

The same as accuracy of input maps (fuel maps, weather data maps).

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4.1.3.4 **Continental land-use change scenarios and stylised fuel management scenarios (Product Card 75)**

This product linked historic land use (LU) reconstructions (1960 to 2010) and future land system scenarios (2015-2050) as data inputs to Dynamic Global Vegetation Models (DGVM). The integrated 1960-2050 dataset incorporates variables critical to fuel distribution across European landscapes, such as afforestation, forest fragmentation, and land abandonment, which will in turn improve the ability of the DGVMs to forecast future fire regimes. The product developed within the Activity "3.1.2 LUC scenarios for policy implementation and fuel management"

Technical components

Characteristics	Description
Type of products:	Geospatial
Units:	Land cover classes
Update Frequency:	Static
Accuracy:	N/A
Output Format:	.tiff
Fire risk component:	Propogation-Fuels
Temporal coverage:	1960-2050 (decadal)
Spatial resolution:	9 km^2
Spatial coverage:	ET, PS1-5
Availability on FirEUrisk platform:	
Developer:	VUA

Methodology

Historic data was provided from the HILDA+ dataset (Winkler et al., 2021), which combines several open data streams (remote sensing, reconstructions and statistics) to estimate LU change. The future LU scenarios were simulated using CLUMondo, a spatially explicit and dynamic land system change model (full model details available in (Asselen and Verburg, 2013)). We adopted Shared Socioeconomic Pathways (SSP) 1 ("Sustainability") and SSP3 ("Regional rivalry") to explore the effects on LU of divergent developmental paths for Europe.

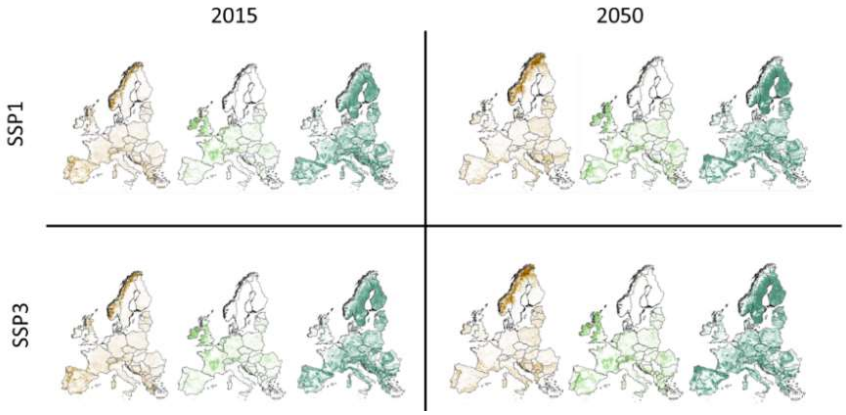


Figure 6. Comparison of changes in land cover in SSP 1 & 3 between 2015 and 2050

Proved accuracy at Demonstration Area

Not applicablefor this type of product.

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4.1.4 Exposure > Population and Assets

4.1.4.1 **Wildland - Urban Interface map (Product Card 18)**

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).

Technical components

Characteristics	Description
Type of products:	Geospatial product
Units:	Categorical: 0 - non WUI, 1 - intermix WUI, 2 - interface WUI
Update Frequency:	Static layer
Accuracy:	80-90%
Output Format:	.tiff
Fire risk component:	Exposure/vulnerability (Population-Assets)
Temporal coverage:	2020
Spatial resolution:	> 1 ha (10m)
Spatial coverage:	ET, PS1-5
Availability on FirEUrisk platform:	https://fireurisk.satways.net/collection/62bab3dee4b0b33bb116f8ea
Developer:	UH

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.

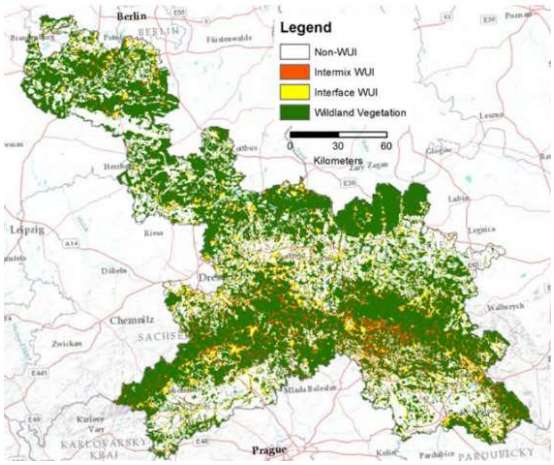


Figure 7. Example of WUI map

Proved accuracy at Demonstration Area

Not applicable for this type of product.

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4.1.4.2 Maps of fire exposure metrics (Product Card 76)

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, atmospheric emission potential, and smoke potential) in the PS3 (Mediterranean – Central Portugal) and PS4 (Mediterranean - Barcelona) pilot sites. The final output – fire exposure metrics (-) with a spatial horizontal resolution of ≤ 100 m. The product developed within the Activity "A1.2.1 Fire exposure metrics".

Technical components

Characteristics	Description
Type of products:	Geospatial
Units:	-
Update Frequency:	Not applicable
Accuracy:	Not applicable
Output Format:	.tif
Fire risk component:	Exposed Population-Assets
Temporal coverage:	2021
Spatial resolution:	≤ 100 m
Spatial coverage:	ET, PS3, PS4
Availability on FirEUrisk platform:	https://fireurisk.satways.net/datasets/64187973e4b054e2ce426beb
Developer:	UAVR (University of Aveiro)

Methodology

The methodology is based on the juxtaposition of fire exposed related values (e.g., fireline intensity, rate of spread, fire emission potential, and smoke potential) with the spatial distribution of the fire metrics (fireline intensity, rate of spread, fire emission potential, and smoke potential).

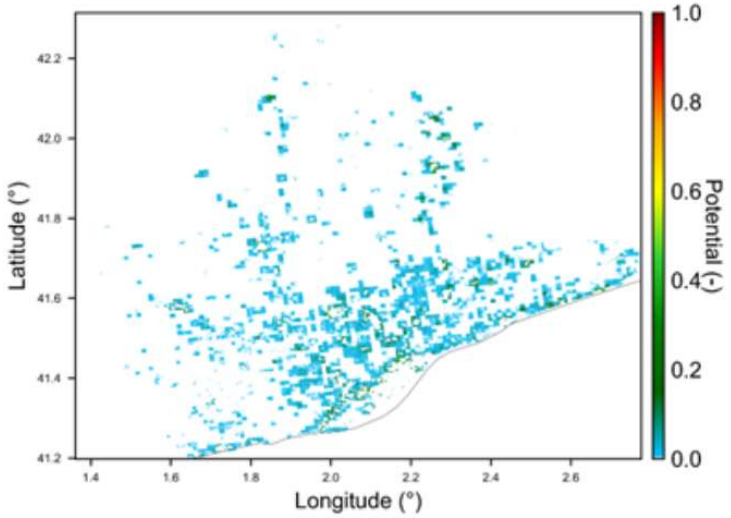


Figure 8. Map of potential exposure of population to PM10 emissions in the PS4 (Mediterranean - Spain)

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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4.1.5 Exposure >Propagation

4.1.5.1 Maps of suitable areas for Land Management Strategy (LMS) (Product Card 13)

Product assesses the potential for three land management strategies (LMS) to abate fire hazard through the management of fuels across European landscapes. The LMS assessed were herbivory (grazing and wild), mechanical fuel removal, and prescribed burning. In combination with Wildfire Danger by Thermal Anomaly (WDTA) prepared using data from the EFFIS program (Joint Research Centre (European Commission) et al., 2022) the resulting maps provide a prioritization tool for policy makers and practitioners. Developed within Activity "A2.2.4 Mapping & Guidelines for LMS".

Technical components

Characteristics	Description
Type of products:	Geospatial
Units:	Recommended areas for LMS
Update Frequency:	Static
Accuracy:	N/A
Output Format:	.tiff
Fire risk component:	Propagation-Fuels
Temporal coverage:	Current
Spatial resolution:	1 km^2
Spatial coverage:	ET, PS1-5
Availability on FirEUrisk platform:	
Developer:	STICHTING VU

Methodology

Spatial data proxies representing the LMS' adoption likelihood were gleaned from a semi-systematic review of the literature (n=123) identifying the socio-economic and biophysical adoption factors of each of the three LMS, summarised as follows: (1)*Grazing/ herbivory suitability*: Areas in which there are either domesticated or wild grazers/ browsers; are relatively accessible; have suitable pasture; located outside major settlements. (2) *Mechanical fuel removal suitability*: Areas in which there is forest biomass available for industry; which are closer to known biomass powerplants; are accessible for equipment and labour; and are not located on prohibitively steep slopes. (3) *Prescribed burn suitability*: Areas with a minimum number of prescribed burn days; adequate accessibility for equipment, labour, & emergency response; located outside of major settlements.

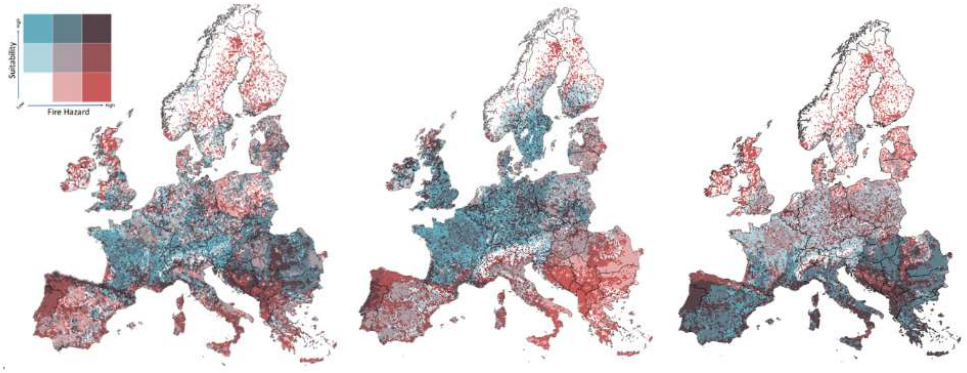


Figure 9. Bivariate choropleth maps comparing suitability of grazing, mechanical removal, & prescribed burn (respectively) with wildfire danger in Europe

Proved accuracy at Demonstration Area

Not apliciable for this type of product.

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4.1.6 Vulnerability > Potential Losses > Ecological Values

4.1.6.1 Fire effects on biodiversity database (FireonBio)(Product Card 7)

The product compiles information of wildfire effects on biodiversity (fauna and flora). All records referenced and, when possible, include geographic coordinates. The final output – database. Information from database could be used in integrated forest management programs, especially for post-fire restoration. The product developed within the Activity "A1.2.3 Environmental vulnerability and resilience assessment".

Technical components

Characteristics	Description
Type of products:	Database
Units:	not applicable
Update Frequency:	not applicable
Accuracy:	not applicable
Output Format:	.csv
Fire risk component	Vulnerability (Ecological values)
Temporal coverage:	not applicable
Spatial resolution:	not applicable
Spatial coverage:	ET
Availability on FirEUrisk platform:	
Developer:	CSIC (Agencia Estatal Consejo Superior Deinvestigaciones Cientificas)

Methodology

Response functions were developed for valued resources and assets other than vegetation (i.e. wildlife, recreation, and fungi), providing susceptibility inter-relations for different fire intensity levels (Delphi method and AHP). Assessed forest-insect interactions (pheromones, volatile compounds of plant origin).

Proved accuracy at Demonstration Area

Not apliciable for this type of product.

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4.1.6.2 Future climate information (Product Card 8)

The product provides information on the expected future climate over the EU territory. It provides projections obtained from Climate Models and climate scenarios of future greenhouse gasses concentrations. The final outputs: – document with projection graphs and geospatial product. The product developed within the Activity "A3.1.1 Climate change scenario data".

Technical components

Characteristics	Description
Type of products:	Geospatial product, document with projection graphs
Units:	Expected changes (ºC, mm, number of days or events…)
Update Frequency:	Provided once
Accuracy:	Variable uncertainty.
Output Format:	Geospatial product: raster (.tif), vector (.shp) Document: .pdf
Fire risk component:	Vulnerability (Ecological values)
Temporal coverage:	30 years averages (30 years around 2050 and for the end of the century (2070-2100)
Spatial resolution:	12.5 km^2 for ET, can be downscaled to 1 km^2
Spatial coverage:	ET
Availability on FirEUrisk platform:	
Developer:	METEOGRID SL

Methodology

High resolution climate scenarios using downscaling methods were provided using existing climate scenarios available in the COPERNICUS-C3S (AR6) platform, using ERA5-Land re-analysis as a reference (9 km x 9 km) and interpolated to a 1 km x 1 km grid. A set of at least 20 combinations (ten Earth System Models and two emission scenarios, RCP4.5 and RCP8.5) were statistically downscaled for a better estimation of the uncertainty. NCSR was develop a methodology (based on advanced extreme value and statistical tools) for specific extreme fire events. The climate scenarios were used to identify changes in meteorological drivers and teleconnections under future conditions (FMI).

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4.1.7 Vulnerability Potential Losses > Ecosystem services

4.1.7.1 Potential Losses of Ecosystem Services affected by wildfires (Product Card 38)

The Product is 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. The product is developed within the Activity "A1.2.4. Economic impacts of fire".

Technical components

Characteristics	Description
Type of products:	Geospatial product
Units:	€/ha (product at 100m of spatial resolution) €/km^2 (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:	100m/1km
Spatial coverage:	PS1-5
Availability on FirEUrisk platform:	https://fireurisk.satways.net/datasets/63d237f4e4b0b33befc8ec54
Developer:	UCO

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. Detailed description of the algorithms and data sources available here: Deliverable D1.6 - On-line methodological handbook for socio-economic assessment of fire impacts/damages.

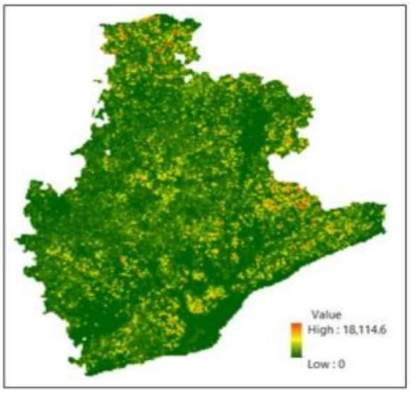


Figure 10. Example of the Product (PS4: Mediterranean-Barcelona)

Proved accuracy at Demonstration Area

Accuracy 85-90 %

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4.1.8 Vulnerability > Resilience > Coping Capacity

4.1.8.1 Plant trait database for European species (EuroTraits) (Product card 6)

The product compiles values of traits for taxa in the European Territory. It gathered information on all plant traits, but it will focus particularly on traits related to resilience to fire (resistance and post-fire regeneration traits). Trait data was obtained from a comprehensive literature review (published literature), field campaigns, and experimental observations. Information from database could be used in integrated forest management programs, especially for post-fire restoration. The product developed within the Activity "A1.2.3 Environmental vulnerability and resilience assessment".

Technical components

Characteristics	Description
Type of products:	Database
Units:	not applicable
Update Frequency:	not applicable
Accuracy:	not applicable
Output Format:	.csv
Fire risk component	Resilience (Coping capacity)
Temporal coverage:	not applicable
Spatial resolution:	not applicable
Spatial coverage:	ET
Availability on FirEUrisk platform:	
Developer:	CSIC (Agencia Estatal Consejo Superior De investigaciones Cientificas)

Methodology

Trait data was obtained from a comprehensive literature review (published literature), field campaigns, and experimental observations.

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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4.1.8.2 Persistence Index Map (Product Card 67)

This geospatial product (algorithm and raster grids) provides 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.

Technical components

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:	Resilience
Temporal coverage:	Static
Spatial resolution:	Depending on the input data on forest species distribution
Spatial coverage:	PS4
Availability on FirEUrisk platform:	
Developer:	UdL

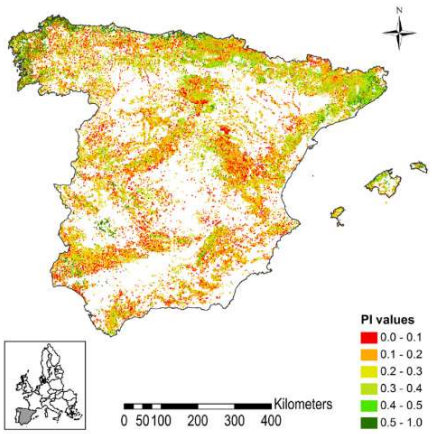


Figure 11. Example Persistence Index Map

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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4.1.8.3 Socio-economic vulnerability (Product card 77)

The product represents the sum of the capital value of human assets. The final output is a raster map with monetary units in euros per hectare with a spatial resolution of 1 km^2. The product was developed within the activity "A1.2.4 Socio-economic vulnerability".

Technical components

Characteristics	Description
Type of products:	Geospatial
Units:	Euros / ha
Update Frequency:	Static layer
Accuracy:	Not applicable
Output Format:	.tiff
Fire risk component:	Vulnerability
Temporal coverage:	2021
Spatial resolution:	1 km^2
Spatial coverage:	ET, PS1-5
Availability on FirEUrisk Plataform:	https://fireurisk.satways.net/datasets/6401ef8de4b054e2ce41a35a
Developer:	University of Alcalá and the James Hutton Institute

Methodology

The product represents the value of human assets and serves as an input to estimate the possible losses caused by fires. For its development different variables were used such as the cost of property, cost of timber, fruit trees, olive trees and the cost of livestock. More information on the methodology can be found in Deliverable D1.4 Methodological Frameworks for Vulnerability Assessment.

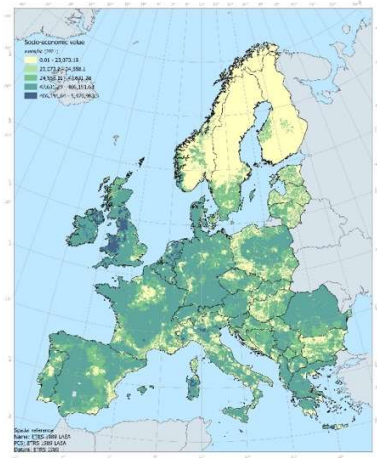


Figure 12. Socio-economic Value 2021

Proved accuracy at Demonstration Area

Not applicable for this type of Product.

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4.1.9 Open Platform of models, data and knowledge (Product Card 54)

The Product is an open platform that is freely accessible by the public. It provides a window on the project's findings; it will be compatible with other existing products at the European level. It will be the repository for all outputs from the project including models, publications, training materials etc. The product developed within the Task 4.3. Integration with external platforms and legacy systems.

Technical components

Characteristics	Description
Type of products:	Software / Web-based portal
Units:	not applicable
Update Frequency:	Regularly
Accuracy:	not applicable
Output Format:	Web-based portal
Fire risk component	not applicable
Temporal coverage:	Current and future European and territorial
Spatial resolution:	Depends of shared data spatial resolution
Spatial coverage:	Depends of shared data on PS
Availability on FirEUrisk platform:	
Developer:	Seteway

Proved accuracy at Demonstration Area

Not applicable for this type of Product.

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4.2 Portfolio of selected products for Pilot Sites demonstration events

4.2.1 Danger (Hazard) > Ignition > Human

4.2.1.1 Human ignition probability (Product Card 63)

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 100m. The product developed within the Activity "A1.1.3. Human ignition drivers & Public participation in fire prevention and preparedness".

Technical components

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:	Human ignition
Temporal coverage:	Depends on pilot site: PS2, 2008-18; PS3, 2001-21; PS4, 2008-18; PS5,2017-21
Spatial resolution:	100m (1 ha)
Spatial coverage:	PS1-5
Availability on FirEURisk platform:	https://fireurisk.satways.net/datasets/6343d705e4b0b33bef3a249f#folderId=637f9bffe4b0b33bef3c3dfb&page=0
Developer:	UdL

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).

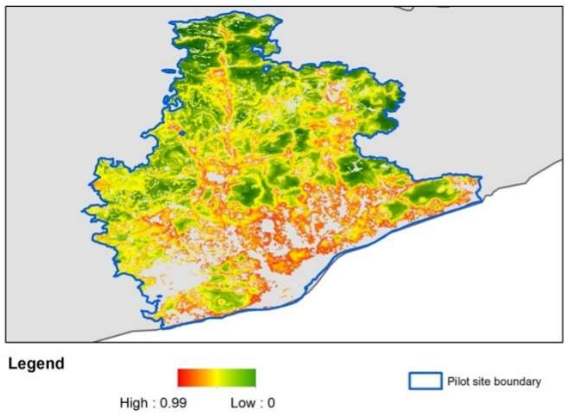


Figure 13. Human ignition probability map (Barcelona province, Spain)

Proved accuracy at Demonstration Area

Ranged from 70 to 80%.

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4.2.2 Danger (Hazard) > Ignition > Natural

4.2.2.1 Natural ignition probability (Product Card 66**)**

This geospatial product (algorithm and raster grids.) provides daily maps of probability that a natural fire ignites at the regional scale. The product developed within the Activity "A1.1.2. Natural ignition probability".

Technical components

Characteristics	Description
Type of products:	Geospatial Product
Units:	%
Update Frequency:	Daily
Accuracy:	70-80 %
Output Format:	.RData (model); .tif (raster grids)
Fire risk component:	Natural ignition
Temporal coverage:	2009-2015
Spatial resolution:	1 ha
Spatial coverage:	PS1, PS3, PS4
Availability on FirEUrisk platform:	https://fireurisk.satways.net/datasets/64593472e4b09e4f2e1953b1
Developer:	UdL

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 et al. (2023) doi:10.1071/WT22123

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of Product.

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4.2.3 Danger (Hazard) > Ignition > Fuels

4.2.3.1 Daily Fire Danger Index (DFDI) (Card 16)

The Daily Fire Danger Index (DFDI) is a novel scalable-resolution fire danger index based on weather data and satellite imagery. The product relies on Sentinel-3 SYNERGY and Sentinel-2 2A products to estimate the condition of the vegetation (available dead vegetation and the live fuel moisture content) at moderate and high resolution. Weather variables are used to calculate the dead fuel moisture content, the evapotranspiration and to obtain the wind speed. The Product provides a fire danger forecast: 1) at different times of the day and 2) for the following days. The product was developed within the Activity A1.1.1 Fire Weather and Fuel Status Prevention.

Technical components

Characteristics	Description
Type of products:	Geospatial data
Units:	Percentage danger and categorical danger rating: very low danger, low danger, medium danger, high danger, extreme danger.
Update Frequency:	Daily
Accuracy:	NA
Output Format:	.tif
Fire risk component:	Danger
Temporal coverage:	Daily
Spatial resolution:	300m (Sentinel-3), 10-20m (Sentinel-2)
Spatial coverage:	PS1-5
Availability on FirEUrisk platform:	https://fireurisk.satways.net/collection/63ce6935e4b0b33befc8dbfb
Developer:	SIA

Methodology

The DFDI derives from satellite-based fire danger indices: it starts from Burgan's Fire Potential Index (FPI) and culminates with the Italian Daily Fire Hazard Index (DFHI). The DFDI improves the DFHI by using satellite measurements of canopy reflectance to estimate live fuel moisture content (LFMC); in addition, it redefines the index calculation by incorporating wind speed data, evapotranspiration and the LFMC itself.

Proved accuracy at Demonstration Area

The product was validated using FIRMS hotspot Fire Radiative Power (FRP) historical records and burned area perimeters provided by the Sardinian Corpo Forestale di Vigilanza Ambientale. The results show that the index is capable to predict consistently which areas are more likely to ignite and support large fires: 70 % of the >10MW hotspots and ~60 % of the >10Ha burned areas in the considered timeframe (2019-2021) were rated as high or extreme danger.

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4.2.3.2 Fire danger metric (Product Card 58)

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

Technical components

Characteristics	Description
Type of products:	Algorithm / Geospatial
Units:	Will be added soon
Update Frequency:	Daily-weekly
Accuracy:	Will be added soon
Output Format:	R script
Fire risk component:	Propagation (Weather)
Temporal coverage:	2001-2020
Spatial resolution:	500 m
Spatial coverage:	ET, PS1-5
Availability on FirEUrisk platform:	
Developer:	UdL

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of Product.

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4.2.3.3 Live Fuel Moisture Content (Product Card 64)

RTM-based LFMC (Live Fuel Moisture Content) product based on the Sentinel-3 SYNERGY and Sentinel-2 L2A surface reflectance product and a LUT-based inversion procedure. The product was developed within the Activity "A1.1.1. Fire weather and fuel status prevention".

Technical components

Characteristics	Description
Type of products:	Geospatial Product
Units:	% moisture content
Update Frequency:	~Daily (Sentinel 3), ~Weekly (Sentinel 2)
Accuracy:	80-90 %
Output Format:	.tiff, .nc
Fire risk component:	Prevention - Fuels
Temporal coverage:	2018-today (Sentinel-3) 2018-today (Sentinel-2)
Spatial resolution:	300m (Sentinel-3), 10-20m (Sentinel-2)
Spatial coverage:	PS1-5
Availability on FirEURisk platform:	https://fireurisk.satways.net/collection/6319b707e4b0b33bb11986d4
Developer:	SIA

Methodology

This product is based on the inversion of Look-Up Tables (LUT) created using a combination of the PROSPECT-D, 4SAIL Radiative Transfer Models (RTM) and a modified version of Huemmrich's GeoSail, and convolving the calculated reflectances in the Sentinel-3 SYNERGY and Sentinel-2 MSI channels. The LUTs change depending on the land cover type: PROSPECT-D and 4SAIL are used for grasslands and shrublands, while for forests the 4SAIL output is fed into the Geo component to simulate discontinuous vegetation. Detailed description of algorithm of calculation available here: V. Pampanoni, G. Laneve and G. Santilli, *Evaluating Sentinel-3 Viability for Vegetation Canopy Monitoring and Fuel Moisture Content Estimation*, IGARSS 2022, https://doi.org/10.1109/IGARSS46834.2022.9884150

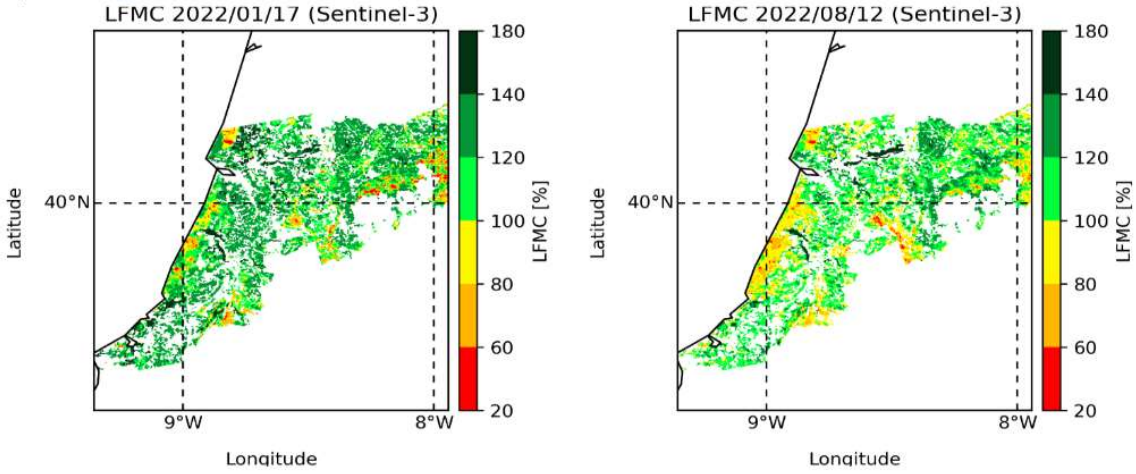


Figure 14. Example of product output on PS3 (Portugal) on January 17th and August 12th.

Proved accuracy at Demonstration Area

Validation in progress using data provided by FirEURisk partners. A preliminary validation on ADAI and CNR data returned an RMSE between 5 and 20 %, and correlation coefficients R^2 between 0.42 and 0.76.

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4.2.3.4 Live Fuel Moisture Content dataset (Product Card 65)

This geospatial product provides weekly maps of Live Fuel Moisture Content based on MODIS thermal and spectral imagery. The product developed within the Activity "A1.1.3. Human ignition drivers and Public participation in fire prevention and preparedness".

Technical components

Characteristics	Description
Type of products:	Geospatial Product
Units:	%
Update Frequency:	Weekly
Accuracy:	>85 %
Output Format:	.netcdf
Fire risk component:	Human ignition
Temporal coverage:	2001-present
Spatial resolution:	500m
Spatial coverage:	PS1-5
Availability on FirEUrisk platform:	
Developer:	UdL

Methodology

Information will be added by Product developer when the product will be completed.

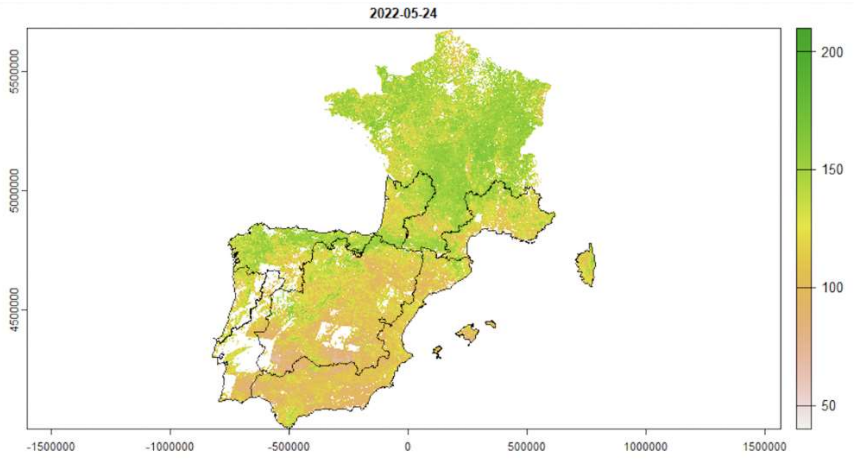


Figure 15. Live Fuel Moisture Content map

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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4.2.4 Danger (Hazard) >Propagation > Fuels

4.2.4.1 Propagation potential indicators for Pilot Sites (PS) (Product Card 32)

This product will include GeoTIFF raster maps of propagation potential indicators for Pilot Sites, as well as report with detail description of methodology and obtained results. Our intention is to use primarily FlamMap Basic Fire Behaviour to create something like 'static' propagation potential maps based on historical past fires in analysed area (Pilot Sites) for the last 20 years having as outputs: Rate of Spread (m/s), Heat per Unit Area (kJ/m^2), Flame Length (m), Fireline Intensity (kW/m), Crown Fraction Burned (%) and Crown Fire Activity. The product developed within the Activity "1.3.1. Risk assessment integration".

Technical components

Characteristics	Description
Type of products:	Geospatial product
Units:	Not applicable
Update Frequency:	If needed
Accuracy:	To be defined after implementation
Output Format:	.tiff
Fire risk component:	Propagation
Temporal coverage:	Static layers
Spatial resolution:	100 m x 100 m
Spatial coverage:	PS1-5
Availability on FirEURisk platform:	https://fireurisk.satways.net/datasets/63ff40fbe4b054e2ce418930
Developer:	FESB SPLIT

Methodology

Propagation potential is important part of Wildfire risk estimation having direct influence on Danger (hazard) and Exposure. In this document a detail methodology for propagation potential calculation on Pilot Sites (PS) level is presented, as well as analysis of all necessary input data and how they could be collected for FirEURisk Pilot Sites (PS). Well known software for wildfire behaviour simulation FlamMap has few tools that could be used for propagation potential: a) Basic Fire Behaviour (BFB) or Landscape Fire Behaviour (Basic), b) Minimum Travel Time Fire Spread (MTT) and c) Landscape Burn Probability (LBP).

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4.2.4.2 Forest condition biotic damages (Product Card 34)

This product detects the probability of a bark beetle (*Ips Typographus*) attack assessing a set of risk factors that predispose forests to pest infestations and wildfires for Central Europe Pilot Site. This technological solution aims to identify areas predisposed to bark beetle infestation using EO-based and machine learning techniques. Geospatial results will help managers optimise their resources and mitigate the negative effects of plagues and wildfires. The product developed within the Activity "4.2.3 Cascading effects and interactions with other risks".

Technical components

Characteristics	Description
Type of products:	Geospatial
Units:	Categorical (low, medium, or high probability of bark beetle infestation)
Update Frequency:	Seasonal (expected) Monthly or higher updated frequency, if necessary
Accuracy:	85-90 % (to be confirmed via validation protocol)
Output Format:	.tiff
Fire risk component:	Cascading effects
Temporal coverage:	2017 - Present.
Spatial resolution:	>1 ha (10 m)
Spatial coverage:	ET, PS2
Availability on FirEUrisk platform:	
Developer:	GMV

Methodology

GMV will estimate past, present, and future biotic damages caused by bark beetle outbreaks in Central-Eastern Europe and evaluate the influence of environmental traits that predispose forests to a bark beetle infestation. Preprocessing risk factors will involve cleaning data to fill or discard missing records (e.g., clouds), eliminate inconsistencies, and standardise datasets. Different indicators will be calculated and selected through a feature engineering process to generate the input variables. These variables will be ranked using different methods (e.g., gini impurity decrease) to understand their effect on bark beetle. Different classical and Artificial Intelligence architectures will be tested to produce a probabilistic model of bark beetle attack. Hyperparameters tuning will be carried out using iterative random search and cross-validation. The best model will be selected to produce a raster showing the probability of suffering bark beetle damage. Detailed description of algorithm of calculation and data sources available here: Commission, E., Environment, D.-G. for, Atzberger, C., Zeug, G., Defourny, P., Aragão, L., Hammarström, L., Immitzer, M., 2020. Monitoring of forests through remote sensing: final report. Publications Office. https://doi.org/doi/10.2779/175242

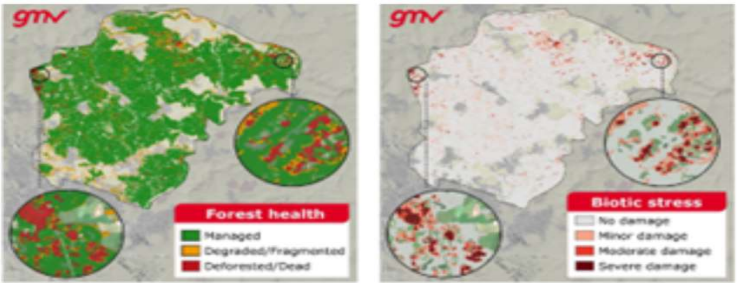


Figure 16. Forest condition biotic damages Product output example

Proved accuracy at Demonstration Area

Product validation will be carried out with ground truth data derived from field campaigns. Results will be also crosschecked with similar datasets.

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4.2.4.3 Fuel Sampling Protocol (Product Card 42)

This product describes the main methodologies applied to sample the different vegetation types to be used as input in fire behaviour modelling. The protocol will refer to the main vegetation types (grass, shrub, forest understory) and will supply the most commone methdology to measure fuel load, depht and cover.

Technical components

Characteristics	Description
Type of products:	Document
Units:	not applicable
Update Frequency:	Yearly
Accuracy:	-
Output Format:	.pdf; .docx
Fire risk component:	Propagation (Fuel)
Temporal coverage:	not applicable
Spatial resolution:	not applicable
Spatial coverage:	ET, PS1-5
Availability on FirEUrisk platform:	
Developer:	CNR IBR

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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4.2.4.4 Custom fuel characterization (Product Card 60)

This Product is a database with the characteristics including dead and live fuel loads for the FirEUrisk fuel types in a form of a table with fuel characteristics. Developers implemented the FirEUrisk Field Sampling Protocol to get the fuel data.

Technical components

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
Spatial coverage:	PS4
Availability on FirEUrisk platform:	https://fireurisk.satways.net/datasets/647b9163e4b0cdb648814b6d
Developer:	UdL

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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4.2.4.5 Canopy metrics and landscape file (Product Card 61)

This Product contains the raster grids required to generate the different canopy fuel variables as well as terrain condition at 100m and 25m resolution, including Canopy Fuel Weight (CFW, kg/ha), Canopy Bulk Density (CBD, kg/m3), Canopy Base Height (m), Digital Terrain Model (m), Vehicle Mobility, Slope (degrees), Aspect, Canopy Cover (percentage) and Canopy Height (m). The product developed within the Activity "A1.1.4. Risk-wise landscape and fuel models development".

Technical components

Characteristics	Description
Type of products:	Geospatial Product
Units:	Kg/ha, kg/m^3, m, degrees
Update Frequency:	No updates
Accuracy:	Will be added soon
Output Format:	tif.
Fire risk component:	Propagation – Fuel parameters
Temporal coverage:	Static
Spatial resolution:	100m (1 ha) and 25m
Spatial coverage:	PS1
Availability on FirEUrisk platform:	
Developer:	Arbo

Methodology

Canopy fuel and terrain variables calculated as a grids (Canopy Fuel Weight (CFW, kg/ha), Canopy Bulk Density (CBD, kg/m3), Canopy Base Height (m), Digital Terrain Model (m), Vehicle Mobility, Slope (degrees), Aspect, Canopy Cover (percentage) and Canopy Height (m)). The grids were calculated from LiDAR data using Andersen formulas. This has been developed for the Northern Europe Pilot Site (Kalmar County).

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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4.2.4.6 Fuel type, fuel model, canopy metrics and landscape file (Product Card 62)

This Product is a database contains the raster grids required to generate the landscape file at 100-m resolution, including aspect (azimuth), elevation (m), slope (degrees), canopy cover (percentage), canopy base height (m), canopy bulk density (kg/m^3), and canopy height (m). The product developed within the Activity "A1.1.4. Risk-wise landscape and fuel models development".

Technical components

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:	.gdb, .lcp
Fire risk component:	Propagation – Fuel type
Temporal coverage:	2018-2021
Spatial resolution:	100m (1 ha)
Spatial coverage:	PS4, PS4
Availability on FirEUrisk platform:	https://fireurisk.satways.net/datasets/645163f8e4b09e4f2e1910cf
Developer:	UdL

Methodology

The grids where downloaded from global products and resampled to 100 m resolution. Generated canopy base height and canopy bulk density maps used average data for different canopy cover classes and by FirEUrisk fuel type. These values were extracted from LiDAR derived canopy base height and canopy bulk density grids using n=300,000 random points.

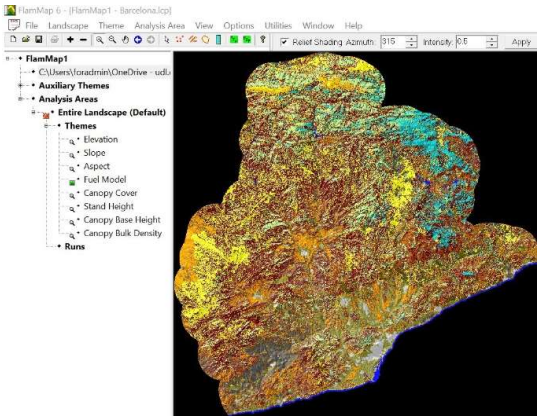


Figure 17. Fuel type, fuel model, canopy metrics and landscape file example of product output

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of Product.

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4.2.4.7 Wildfire spread and behaviour outputs, "basic mode"(Product Card 70)

This product is a geodatabase contains the fire spread and behaviour modelling outputs for the "basic mode" runs (i.e., calculations conducted by pixel). The product developed within the Activity “A1.1.5. Analysis of fire propagation, fuel consumption and smoke emission as risk factors”.

Technical components

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/m^2)
Update Frequency:	not applicable
Accuracy:	not applicable
Output Format:	.gdb
Fire risk component:	Propagation
Temporal coverage:	2021
Spatial resolution:	100 m
Spatial coverage:	ET, PS2-5
Availability on FirEUrisk platform:	
Developer:	UdL

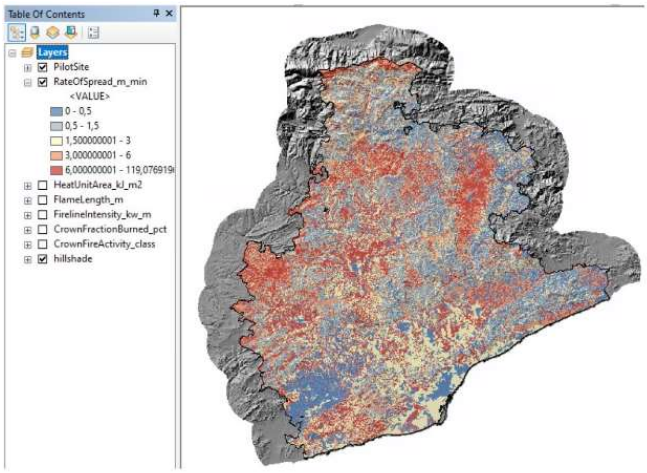


Figure 18. Example of Wildfire spread and behaviour outputs

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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4.2.5 . Danger (Hazard) > Propagation > Weather

4.2.5.1 Spring grass fire model for the North (Product Card 69)

This product is a fire danger model for North spring grasslands that produces fire danger maps with hourly temporal resolution.

Technical components

Characteristics	Description
Type of products:	Geospatial product / model
Units:	Categorical : fire danger classes
Update Frequency:	Hourly
Accuracy:	not applicable
Output Format:	.tiff
Fire risk component:	Propagation - Weather
Temporal coverage:	Forecast for five days. Model based on 1996-2021
Spatial resolution:	Territorial administrative units in the area of analysis
Spatial coverage:	PS1
Availability on FirEURisk platform:	
Developer:	RISE

Methodology

The model use 25 years of grassfire incidents in ten regions in Sweden, corrected with validated models for dead grass moisture content and wind speed to obtain a phenological measure of the new season green-up. The effect of the green-up to the rate of spread is thereafter validated using 56 experimental fires during a full season. The model is available for use in any region with winter snow cover and is available as closed form equations using only weather data from the January 1st in each grid cell.

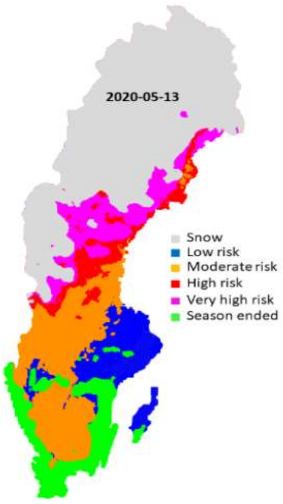


Figure 19. Example of Spring grass fire model output

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of Product.

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4.2.5.2 160 years of fire danger in Sweden (Product Card 74)

Product holds Fire danger (daily DMC) database taken observatory data on ten locations in Sweden since 1860s.

Technical components

Characteristics	Description
Type of products:	Geospatial
Units:	-
Update Frequency:	no update
Accuracy:	80 %
Output Format:	Map
Fire risk component:	Propagation - Weather
Temporal coverage:	Daily
Spatial resolution:	1 km
Spatial coverage:	PS1
Availability on FirEUrisk platform:	
Developer:	RISE

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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4.2.6 Exposure > Population and Assets

4.2.6.1 Wildland - Urban Interface map (Product Card 18)

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).

Technical components

Characteristics	Description
Type of products:	Geospatial product
Units:	Categorical: 0 - non WUI, 1 - intermix WUI, 2 - interface WUI
Update Frequency:	Static layer
Accuracy:	80-90 %
Output Format:	.tiff
Fire risk component:	Exposure/vulnerability (Population-Assets)
Temporal coverage:	2020
Spatial resolution:	> 1 ha (10m)
Spatial coverage:	PS1-5
Availability on FirEUrisk platform:	https://fireurisk.satways.net/collection/62bab3dee4b0b33bb116f8ea
Developer:	HU

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.

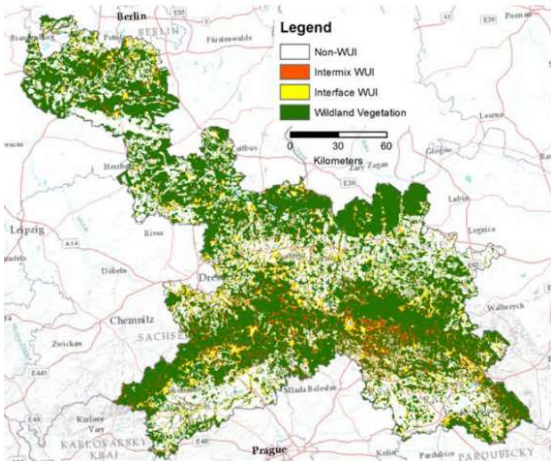


Figure 20. Example of WUI map

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of Product.

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4.2.6.2 Analysis of potential socio-economic barriers, constrains and enables of LMS uptake to reduce fire risk (Product Card 29)

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).

Technical components

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
Spatial coverage:	not applicable
Availability on FirEUrisk platform:	
Developer:	HUTTON

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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4.2.6.3 Fire emission potential (Product Card 59)

The product provides atmospheric emission potential (e.g., PM10, PM2.5, NO_2 and CO) for the PS3 (Mediterranean – Central Portugal) and PS4 (Mediterranean - Barcelona) pilot sites. The final output – atmospheric emission potential (ton) with a spatial horizontal resolution of ≤ 100 m. The product developed within the Activity "A1.1.5 Analysis of fire propagation, fuel consumption and smoke emission as risk factors".

Technical components

Characteristics	Description
Type of products:	Geospatial
Units:	ton
Update Frequency:	Not applicable
Accuracy:	Not applicable
Output Format:	.tif
Fire risk component:	Propagation
Temporal coverage:	Not applicable
Spatial resolution:	≤ 100 m
Spatial coverage:	ET, PS3, PS4
Availability on FirEUrisk platform:	https://fireurisk.satways.net/datasets/6418723ce4b054e2ce426ae6
Developer:	UAVR (University of Aveiro)

Methodology

The methodology to estimate the atmospheric emission potential is based on fuel type, burnt area, fuel consumption, fire propagation, fire intensity, and emissions factors (by combustion phase: flaming and smoldering).

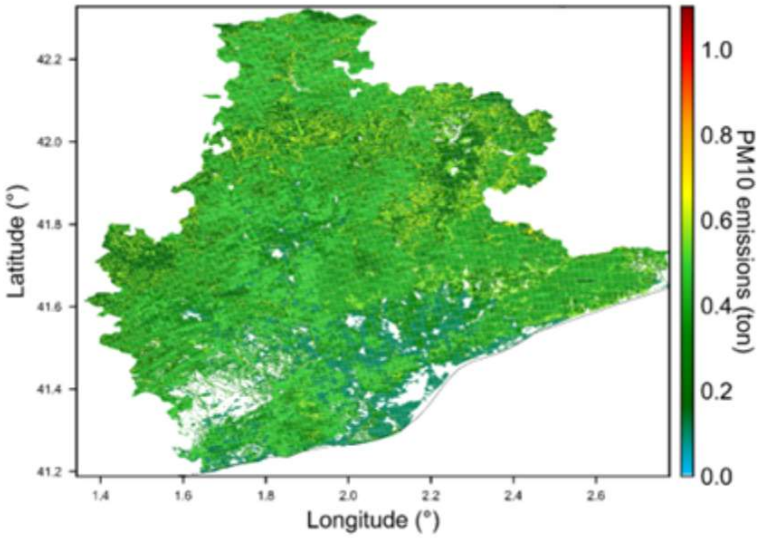


Figure 21. Atmospheric emission potential in the PS4 (Mediterranean - Barcelona)

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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4.2.6.4 Maps of fire exposure metrics (Product Card 76)

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, atmospheric emission potential, and smoke potential) in the PS3 (Mediterranean – Central Portugal) and PS4 (Mediterranean - Barcelona) pilot sites. The final output – fire exposure metrics (-) with a spatial horizontal resolution of ≤ 100 m. The product developed within the Activity "A1.2.1 Fire exposure metrics".

Technical components

Characteristics	Description
Type of products:	Geospatial
Units:	-
Update Frequency:	Not applicable
Accuracy:	Not applicable
Output Format:	.tif
Fire risk component:	Exposed Population-Assets
Temporal coverage:	2021
Spatial resolution:	≤ 100 m
Spatial coverage:	ET, PS3, PS4
Availability on FirEUrisk platform:	https://fireurisk.satways.net/datasets/64187973e4b054e2ce426beb
Developer:	UAVR (University of Aveiro)

Methodology

The methodology is based on the juxtaposition of fire exposed related values (e.g., fireline intensity, rate of spread, fire emission potential, and smoke potential) with the spatial distribution of the fire metrics (fireline intensity, rate of spread, fire emission potential, and smoke potential).

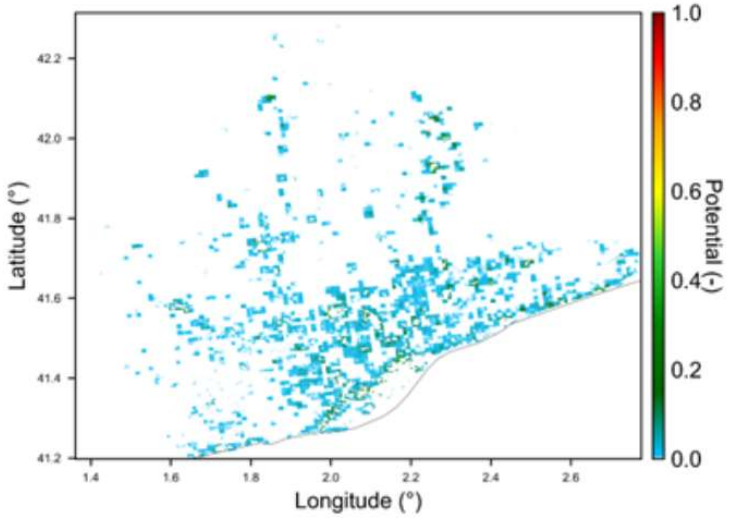


Figure 22. Map of potential exposure of population to PM10 emissions in the PS4 (Mediterranean - Barcelona)

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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4.2.6.5 Smoke potential (Product Card 78)

The product provides the 2D air pollutant concentrations (e.g., PM10, PM2.5, NO_2 and CO) for the PS3 (Mediterranean – Central Portugal) and PS4 (Mediterranean - Barcelona) pilot sites. The final output – air pollutant concentrations (µg/m³) with a spatial horizontal resolution of ≤ 100 m. The product developed within the Activity "A1.1.5 Analysis of fire propagation, fuel consumption and smoke emission as risk factors".

Technical components

Characteristics	Description
Type of products:	Geospatial
Units:	µg/m³
Update Frequency:	Not applicable
Accuracy:	Not applicable
Output Format:	.tif
Fire risk component:	Propagation
Temporal coverage:	Not applicable
Spatial resolution:	≤ 100 m
Spatial coverage:	ET, PS3, PS4
Availability on FirEUrisk platform:	https://fireurisk.satways.net/datasets/64187953e4b054e2ce426be4
Developer:	UAVR (University of Aveiro)

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.

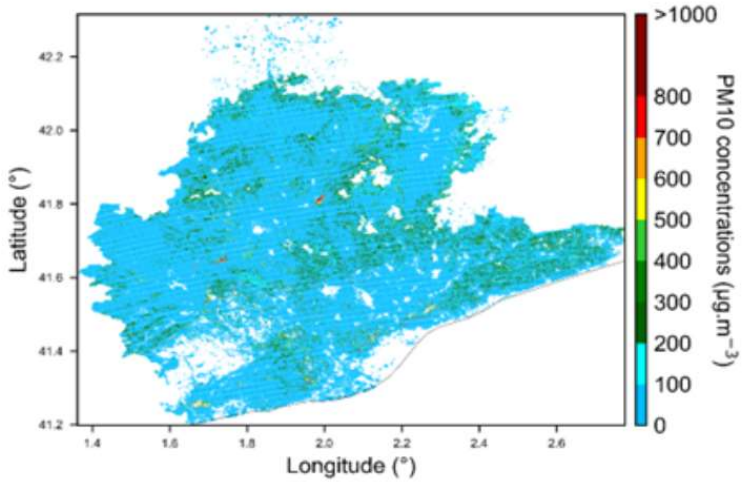


Figure 23. Smoke potential in the PS4 (Mediterranean - Barcelona)

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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4.2.6.6 Population and assets (Product Card 79)

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. The product developed within the Activity "A1.2.1 Fire exposure metrics".

Technical components

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
Spatial coverage:	PS4
Availability on FirEURisk platform:	
Developer:	UdL (University of Lleida)

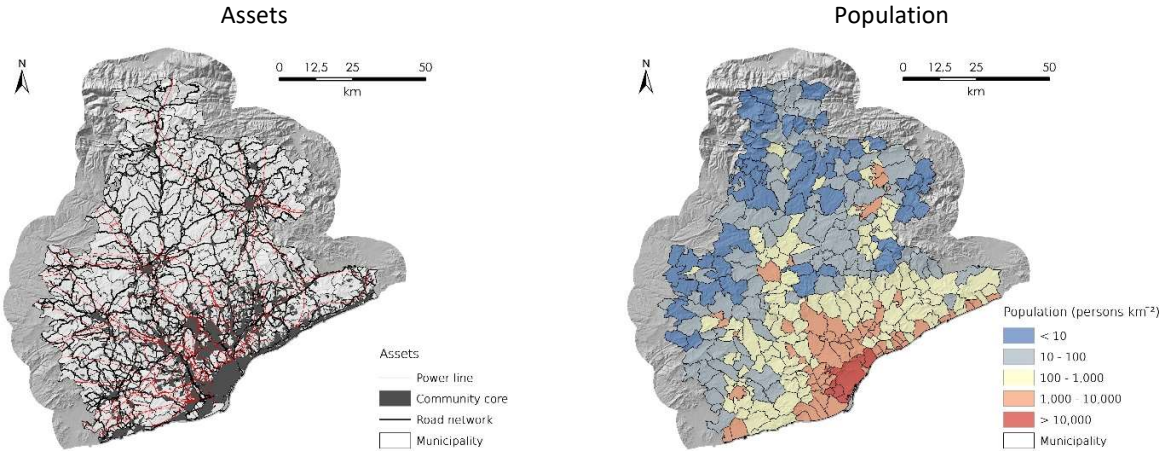


Figure 24. Assets and population product outputs (Barcelona Province, Spain)

Proved accuracy at Demonstration Area

Not applicable for this type of product.

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4.2.7 Exposure > Propagation > Exposure

4.2.7.1 Suppression Difficulty Index (Product Card 39)

The Product describes efficiency and limitations of suppression strategies in different landscape fire contexts that were determined from productivity rates of fire control depending on the strategies adopted with the resources dispatched to fire. The product developed within the Activity "A1.1.5 Analysis of fire propagation, fuel consumption and smoke emission as risk factors".

Technical components

Characteristics	Description
Type of products:	Geospatial product
Units:	Qualitative (Low, Medium, High, Very High)
Update Frequency:	Static layer
Accuracy:	85-95 %
Output Format:	.tiff
Fire risk component:	Propagation/Exposure
Temporal coverage:	Current
Spatial resolution:	100m
Spatial coverage:	PS1-5
Availability on FirEUrisk platform:	https://fireurisk.satways.net/datasets/63d7c0b0e4b0b33befc90821
Developer:	UCO

Methodology

The SDI equation is calculated as potential fire behaviour, represented as the surface fire energy behaviour sub-index (Ice), divided by suppression opportunity index (Soi), calculated as the sum of sub-indices for accessibility (Ia, road density), mobility (Im, fuel break density), penetrability (Ip, foot travel difficulty), aerial resources (Iar, cycle time) and fireline construction rate (Ic). Detailed description of algorithm of calculation available here:
Rodríguez y Silva F, O'Connor C, Thompson MP, Molina JR, Calkin DE. 2020. Modelling suppression difficulty: current and future applications. International Journal of Wildland Fire 739-751, 29(8).

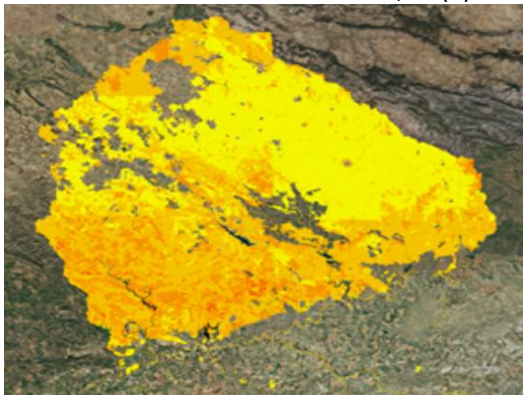


Figure 25. Example of the Product PS4: Mediterranean-(Barcelona)

Proved accuracy at Demonstration Area

Accuracy reached 85-90%.

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4.2.8 Vulnerability > Potential Losses > Ecosystem services

4.2.8.1 Potential Losses on Ecosystem Services affected by wildfires (Product Card 38)

The Product is 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. The product is developed within the Activity "A1.2.4. Economic impacts of fire".

Technical components

Characteristics	Description
Type of products:	Geospatial product
Units:	€/ha (product at 100m of spatial resolution) €/km^2 (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:	100m/1km
Spatial coverage:	PS1-5
Availability on FirEUrisk platform:	https://fireurisk.satways.net/datasets/63d237f4e4b0b33befc8ec54
Developer:	UCO

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. Detailed description of the algorithms and data sources available here: Deliverable D1.6 - On-line methodological handbook for socio-economic assessment of fire impacts/damages.

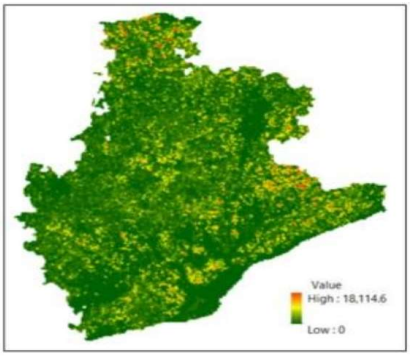


Figure 26. Potential Losses on Ecosystem Services affected by wildfires (PS4: Mediterranean-Barcelona)

Proved accuracy at Demonstration Area

Accuracy 85-90%

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4.2.9 Vulnerability > Resilience > Coping Capacity

4.2.9.1 Persistence Index Map (Product Card 67)

This geospatial product (algorithm and raster grids) provides map of the Persistence Index. The Persistence Index reflects an ability of forest resistance and resilience to disturbances, nases 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.

Technical components

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:	Resilience
Temporal coverage:	Static
Spatial resolution:	Depending on the input data on forest species distribution
Spatial coverage:	PS4
Availability on FirEUrisk platform:	https://fireurisk.satways.net/datasets/647064d0e4b0cdb64880e832
Developer:	UdL

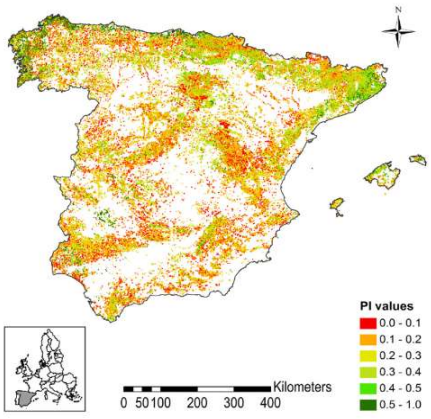


Figure 27. Example Persistence Index Map

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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4.2.9.2 RESVI - Relative Societal Vulnerability Index (at community level) (Product Card 68)

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. The product is developed within the activity 1.2.2 – Societal vulnerability and resilience assessment.

Technical components

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:	N/A
Output Format:	.xls
Fire risk component:	Coping capacity
Temporal coverage:	N/A
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)
Spatial coverage:	PS4
Availability on FirEUrisk platform:	
Developer:	ISIG

Methodology

RESVI approach has been developed and implemented by ISIG in such 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. Detailed description of algorithm of calculation available here:

1) ECOSTRESS Project, (2015). Relative Social Vulnerability Index and SWOT Analysis of Coastal Case Studies in the Upper Adriatic.

2) RESILOC Project, (2020). Analysis of Vulnerability. Performed by ISIG. Available on request.

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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4.2.10 Vulnerability > Resilience > Population and Assets

4.2.10.1 Factors for building survivability in Scandinavia (Product Card 72)

This product describes list of importance of factors for building survivability in large forest fires in Scandinavian Peninsula.

Technical components

Characteristics	Description
Type of products:	Document
Units:	not applicable
Update Frequency:	No update
Accuracy:	not applicable
Output Format:	not applicable
Fire risk component:	Vulnerability
Temporal coverage:	not applicable
Spatial resolution:	not applicable
Spatial coverage:	PS1
Availability on FirEUrisk platform:	
Developer:	RISE

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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4.2.11 Tool for displaying outputs from the internal platform and external platforms customised for the FirEURisk needs (Product Card 44)

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.

Technical components

Characteristics	Description
Type of products:	Software / Web application / Mobile application
Units:	not applicable
Update Frequency:	As needed
Accuracy:	not applicable
Output Format:	Online read-only access
Fire risk component:	not applicable
Temporal coverage:	not applicable
Spatial resolution:	not applicable
Spatial coverage:	not applicable
Availability on FirEURisk platform:	
Developer:	ARBONAUT

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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4.2.12 Open Platform of models, data and knowledge (Product Card 54)

The Product is an open platform that is freely accessible by the public. It provides a window on the project's findings; it will be compatible with other existing products at the European level. It will be the repository for all outputs from the project including models, publications, training materials etc. The product developed within the Task 4.3. Integration with external platforms and legacy systems.

Technical components

Characteristics	Description
Type of products:	Software / Web-based portal
Units:	not applicable
Update Frequency:	Regularly
Accuracy:	not applicable
Output Format:	Web-based portal
Fire risk component	Based on Integrated Scheme of the FirEUrisk project
Temporal coverage:	Current and future European and territorial
Spatial resolution:	Depends of shared data spatial resolution
Spatial coverage:	ET, PS1-4
Availability on FirEUrisk platform:	
Developer:	SATWAYS

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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5 Conclusion

In the report an approach for selection potential Products for demonstration event in regional (Pilot Site) and European Territory levels using the best currently available information was described. The main criteria that leading the selection are: end-user requirements, scalability and availability of products via WP4 platform and coverage of EU territory.

Finalised lists of products for DE are based on the necessary information according to the criteria described in A5.1.2. Up until now a total of 28 products are included in potential lists of selected products for DE : PS1 – 10 products; PS2 -8; PS3: 9; PS4: 17; PS5: 10 and 16 products for ET level.

In addition, this document contains a publishable portfolio of selected products consisting of a 1-page definition of the product, including the technical components, the methodology and proved accuracy at DA (28 products in total).

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Annex A: Products developed to improve fire management in the Chernobyl Exclusion Zone

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Fuel type maps for the Chornobyl exclusion zone (Product Card 82)

The product characterizes distributions of surface and canopy fuels within the Chornobyl exclusion zone and bordering (15-km buffer) territories. The final output – continuously updated fuel type maps and canopy fuels used in the wildfire simulation. The product developed within the Activity "A1.1.4 Risk-wise landscape and fuel models development".

Technical components

Characteristics	Description
Type of products:	Geospatial, GEE-based processing chain
Units:	Fuel classes, float values (e.g., canopy cover)
Update Frequency:	As new satellite data are available (seasonally)
Accuracy:	75%.
Output Format:	.tiff
Fire risk component:	Propagation (fuel)
Temporal coverage:	2012-2022
Spatial resolution:	30 × 30 m; 90 × 90 m;
Spatial coverage:	Only DA - Chornobyl exclusion zone
Availability on FirEUrisk platform:	
Developer:	REEFMC

Methodology

The approach combines Landsat time series and GEDI data into the processing workflow to map fuel types following the recommendations of the FirEUrisk project as well as crown fuels. The reference data for fuel types mapping have been collected during forest inventory, field sampling, and photointerpretation of high-resolution imagery. Reference characteristics of forest stand canopy were obtained from the GEDI L2A (canopy height, canopy base height) and GEDI L2B (canopy cover) products. The mapping approach was developed using the Google Earth Engine implementations of the CCDC temporal segmentation algorithm, RF classification, and GNN imputation technique.

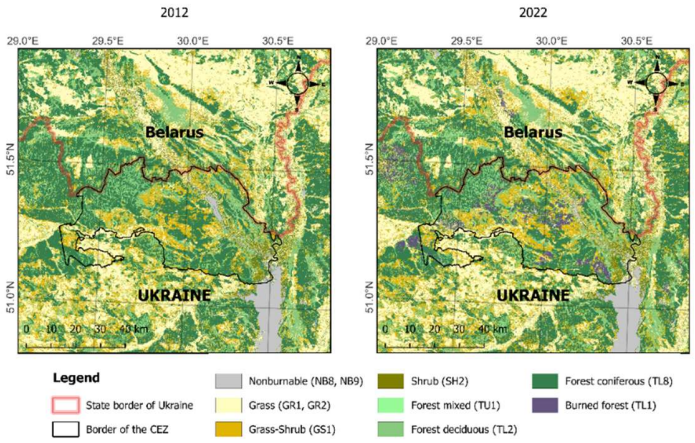


Figure X.1. Example of multitemporal fuel type maps within the Chornobyl exclusion zone

Proved accuracy at Pilot Site

The overall accuracy of the fuel type maps at 30-m spatial resolution was 75%. The user's accuracies for individual fuel types varied between 59-95%, the producer's accuracies were in a range of 24-100%. R-squares for the canopy metric modeling were estimated to be about 23-26%.

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Fire danger index classification for Chornobyl Exclusion Zone (Product Card 40)

The Product allows to use outputs from Fire danger index classification for Chornobyl Exclusion Zone. The product developed within the Activity "A1.1.1 Fire weather and fuel status prevention".

Technical components

Characteristics	Description
Type of products:	Geospatial product
Units:	Quantitative, %
Update Frequency:	Daily
Accuracy:	Not applicable
Output Format:	.tiff
Fire risk component:	Propagation
Temporal coverage:	2010-2020
Spatial resolution:	306 m
Spatial coverage:	Only DA - Chornobyl exclusion zone
Availability on FirEUrisk platform:	https://fireurisk.satways.net/files/6329d76ae4b0b33bb11b1e47?dataset=6329d465e4b0b33bb11acd66&space=
Developer:	REEFMC

Methodology

Remote sensing data were taken for the period 2006-2020 years from March to November (MODIS-based products: MOD09GA and MOD13Q1). Hourly historical meteorological data (relative humidity, temperature, wind speed) were uploaded with the use of NASA API. Extinction moisture content is taken for the exact fuel type taken from Fuel Type Map that was described in REEFMC contribution to A1.1.4. Modified version of Daily Fire Hazard Index (DFHI) provided in Laneve et al., 2020 was modified by adjusting the moisture content in dead fuel according to the field data gathered during 2015-2017 on the territory of CHEZ.

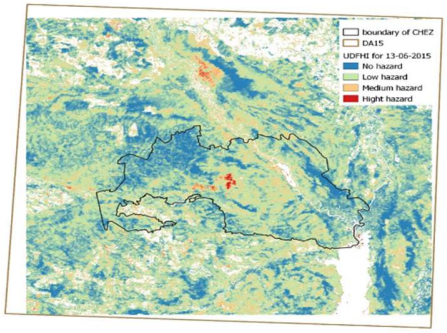


Figure 28. Map of UDFHI in DA-15 for June 13th, 2015

Proved accuracy at Demonstration Area

For assessing accuracy of UDFHI 1331 fire polygons for the period from 2010 to 2020 years were downloaded in shape format from the repository of MCD64A1 product. Fire polygons were used to build fire density maps in 10 km square cells that cover the entire study area. The assessment was made by comparing average values of the index to fire density in the cells. Averaging fire density values in five percent ranges shows clear correlation of average values of UDFHI and average fire density with coefficient of correlation 0.82.

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Online platform for fire risk assessment, dose prediction, prevention and suppression of fires (Product Card 81)

This product assesses fire danger using existing danger indices and drought codes as well as radioactive dose prediction during wildfires. Those data will be available in a free and open platform based upon the internal cooperative platform as the one-stop-shop for data, models and knowledge on fire risk in ChEZ (www.wildfires.org.ua). The product developed within the WP5.

Technical components

Characteristics	Description
Type of products:	Geospatial
Units:	Pixels/ radionuclides / doses / type of fuel
Update Frequency:	Up to request
Accuracy:	100 m
Output Format:	.tiff
Fire risk component:	Weather
Temporal coverage:	2000-2022
Spatial resolution:	30 m
Spatial coverage:	Only DA - Chornobyl exclusion zone
Availability on FirEUrisk platform:	No. www.wildfires.org.ua
Developer:	REEFMC

Methodology

The LANDSCAPE FIRE information system was designed to support fire spread modelling approach specifically incorporated in FlamMap (Finney, 2006), FARSITE (Finney, 1998) and other fire simulation software. Based on different types of spatial and non-spatial data used in this software. Landsat-based land cover map (Myroniuk et al., 2020) allows to identify primary land cover and assign to each pixel a surface fuel model (Scott & Burgan, 2005), fuel load and potential fire behavior. For the crown fuels used Global Forest Change data (Hansen et al., 2013) to extract canopy cover for 2015 and Geoscience Laser Altimeter System (GLAS) canopy height (RH100) global model (Simard et al., 2011) to map forest stands height. Another two canopy fuels characteristics namely canopy base height and canopy bulk density were derived using Random Forest (RF) regression model (Breiman, 2001) applied to the same Landsat 8 OLI data (summer, autumn, and April-October 2014–2016 cloud-free mosaics) previously introduced for land cover classification (Myroniuk et al., 2020). As input variables for canopy base height (CBH) mapping, we selected greenness, brightness, wetness Tesseled-Cap Transformation (Baig et al., 2014) bands; median, first and third quartiles of Normalized Difference Vegetation Index (NDVI). These predictors accompanied with GFC canopy cover, RH100 canopy height, and groups of forest stands (coniferous, deciduous, mixed) presented on land cover classification were used to predict canopy bulk density (CBD). We used Forest Vegetation Simulator (Dixon & Keyser, 2008) to calculate CBH and CBD (in kg·m-3) for selected from forest inventory database forest stands, and use these data as reference in our regression model. Monthly fuel moisture was adjusted for each type of surface fuel models, so that it replicates annual variation of live and dead fuel moisture content and ensure reasonable speed of fire spread under different weather scenarios. For topography and weather, we used 90-meters spatial resolution Shuttle Radar Topography Mission (SRTM) digital elevation model that covers ChEZ. All spatial layers were prepared using Google Earth Engine (GEE) cloud-based platform which accelerate data processing (Gorelick et al., 2017). The raster maps were projected into EPSG: 3857 coordinate reference system and then resampled to common 90-meters spatial resolution using nearest neighbors' algorithm. Seasonal pattern of wind maximum speed and its direction were derived from the Ukrainian State Hydrometeorological Service for 2004–2010 registered on 23 weather stations distributed within the study area. The ignition history for the study area was collected for 2001–2019 based on MODIS (MOD/MYD14) daily thermal anomalies data. We grouped ignitions pixels for every day, so they represented distinct fires. Then centroids were identified for each of them to create smoothed ignition probability grid using kernel density function in Quantum GIS with search radius of 15 km. After all data were uploaded, we tested the efficiency of web-based tools for wildfire simulation. We simulated early phase of large wildfire started near the

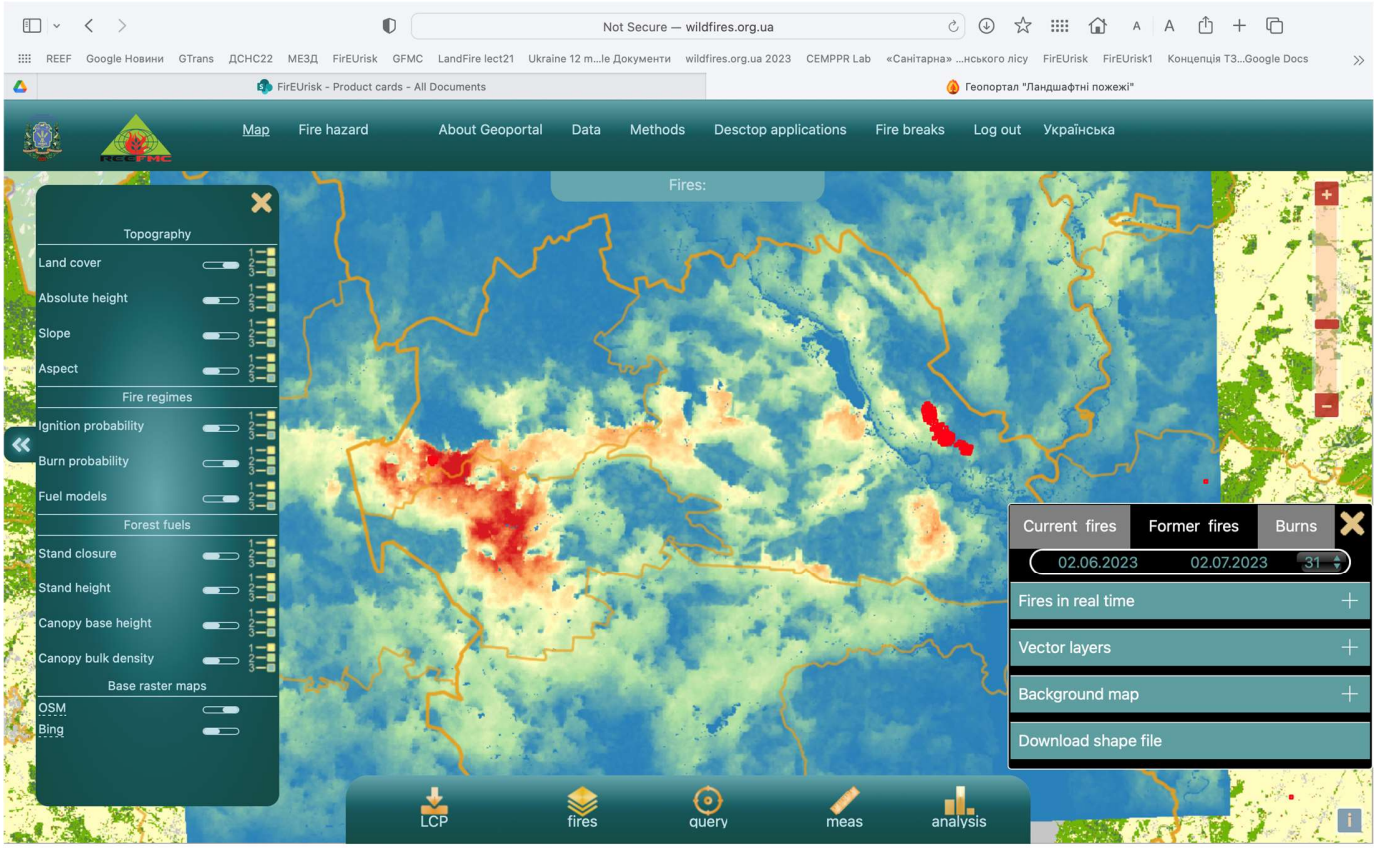
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Chernobyl Exclusion Zone on April 3, 2020 and burned within 3 weeks totally more than 64 thousand hectares. We used FARSITE 4 built within FlamMap 6.1 to model first 24 hours of burning using coordinates of ignition identified from MOD/MYD14 data and hourly weather (air temperature, relative humidity, precipitation, wind speed, and wind direction). Submodules of calculation of the expected 1-hour dose of radionuclides for firefighters on fireline, strategic location of fire engines during emergency fire weather, optimal routing for heavy and ligh fire engines, monitoring of fire development and others implemented in the portal. Later large fire in 2020 in Luhansk oblsats with area 37 000 ha was also simulated within the platform. For the moment platform used to collect data on fire history during war.

Proved accuracy at Demonstration Area

30-100 m

Product example



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Annex B: Description of Products that were not selected for DE

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Gis Geodatabase for exposure, vulnerability and risk (Product card 2)

The product allows to transform vulnerability and risk data into a common georeferenced format easy to use by a multidimensional GIS viewer. The final output – geospatial raster dataset with month time step and spatial resolution of 1 ha.

Technical components

Characteristics	Description
Type of products:	Geospatial
Units:	NA
Update Frequency:	Monthly
Accuracy:	NA
Output Format:	.tif, .shp
Fire risk component (accordingly to the Integrated Scheme of the FirEUrisk project):	Exposure, Vulnerability
Temporal coverage:	Monthly
Spatial resolution:	1 ha
Spatial coverage:	
Availability on FirEUrisk platform:	
Developer:	METEOGRID SL

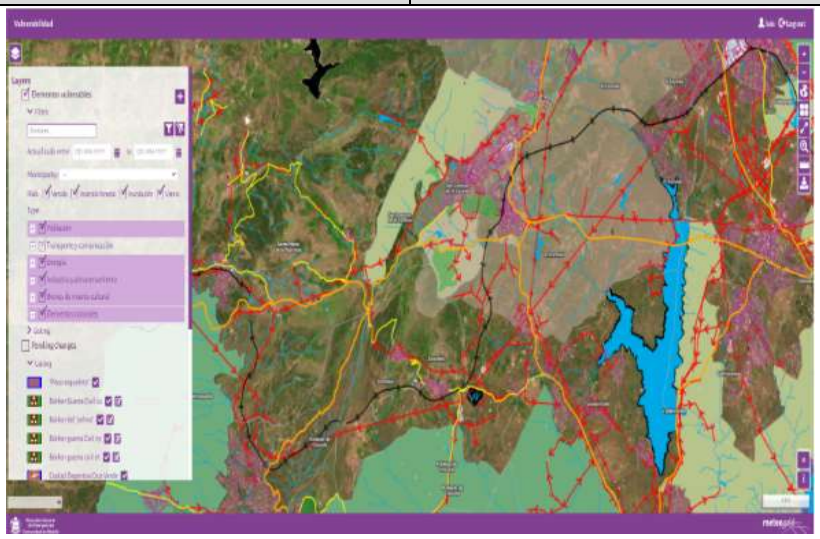


Figure 29. Gis Geodatabase for exposure, vulnerability and risk

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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Gis Geodatabase for meteorological variables and related danger indexes (Product Card 3)

The product collects raw data generated by weather prediction models, transforms them into a common format easy to use by a multidimensional GIS (with proper management of time axis for forecast and observations) viewer and calculates derived variables and hazard indices by combining weather data and other data from the natural environment. The product developed within the Activity "A1.1.1 Fire weather and fuel status prevention".

Technical components

Characteristics	Description
Type of products:	Geospatial
Units:	Percentage (%)
Update Frequency:	Daily
Accuracy:	not applicable
Output Format:	.tiff
Fire risk component:	Propagation (Weather)
Temporal coverage:	not applicable
Spatial resolution:	<1km (12 km^2)
Spatial coverage:	PS4
Availability on FirEUrisk platform:	
Developer:	METEOGRID SL

Methodology

The Product aims to improve fire weather forecasts by integration of Copernicus seasonal forecasts, short weather forecasts and high-resolution wind modelling covering the ET. Downscaling of meteorological fire-driving factors were provided by analysis of Automatic Weather Stations (AWS) records over time series at the PS level, providing weather information to assess the potential impact of fire at the WUI in the short to medium term (from daily to seasonal forecast).

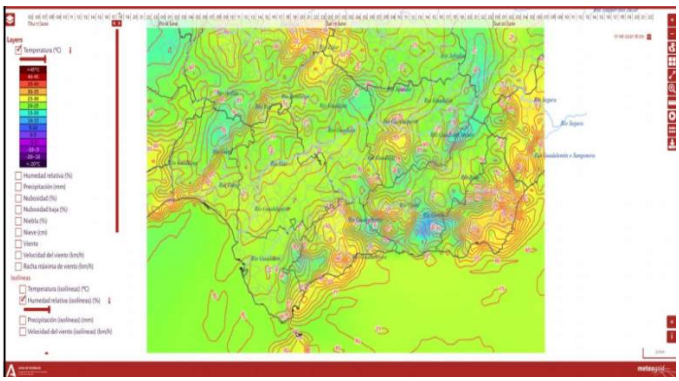


Figure 30. Gis Geodatabase for meteorological variables and related danger indexes

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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Fire risk & strength predictions, (i) short-term, (ii) long-term (Product Card 9)

A gridded product of regional-scale resolution predicting the distribution of fires and their strength at a time scale of (i) a few days, (ii) long-term scenarios, past and future over the EU territory. The final outputs: gridded space-time resolving geospatial dataset. The product developed within the Activity "A3.1.1 Climate change scenario data".

Technical components

Characteristics	Description
Type of products:	Geospatial product
Units:	MW
Update Frequency:	(i) daily, (ii) static dataset
Accuracy:	Temporal correlation coefficient with daily MODIS Fire Radiative Power product is R = 0.1 – 0.6
Output Format:	.netcdf
Fire risk component:	Propagation (Weather and Climate)
Temporal coverage:	as long as meteorological data are available
Spatial resolution:	3° temporal prediction downscaled to 0.1°
Spatial coverage:	ET
Availability on FirEUrisk platform:	
Developer:	FMI

Methodology

The statistical methodology adapted to fire forecasting has its roots in the ground-setting works of Voeikov Main Geophysical Observatory for urban air pollution. This methodology has been adapted by the FMI team with deeper modifications, to multi-model ensemble forecasting (Sofiev et al., 2017). The above-quoted methodology has a proven record of handling problems with similar difficulties. The current study aims to construct a local statistical forecasting model that takes the above peculiarities of the fire time series into account to predict the daily total release of fire radiative energy using only basic meteorological parameters. Detailed description of algorithm of calculation and data sources available here: Sofiev, M. 1994.

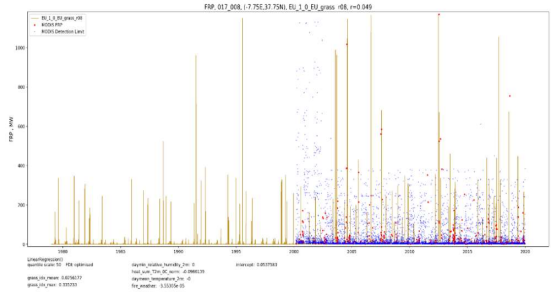


Figure 31. Example of long-term fire radiative power prediction: grassland, 1° resolution. Unit: MW

Proved accuracy at Demonstration Area

The accuracy of the approach for the European forests and grassland areas has been evaluated via temporal correlation coefficient – of the predicted daily time series against MODIS daily FRP products. For each land-use, the best setup could be chosen for practical applications – usually, it is 3 grid, r13 setup with minimal post-processing.

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Evaluation of the ecological effects of LMS to reduce wildfire risk (Product Card 10)

The product is a database for the whole European Territory with the information about effects of alternative LMS (Land Management Strategy) on biodiversity (flora, fauna). The product developed within the Activity "A2.2.3 Environmental impacts".

Technical components

Characteristics	Description
Type of products:	Database
Units:	not applicable
Update Frequency:	not applicable
Accuracy:	not applicable
Output Format:	.csv
Fire risk component:	Vulnerability (Ecological values)
Temporal coverage:	not applicable
Spatial resolution:	not applicable
Spatial coverage:	ET
Availability on FirEUrisk platform:	
Developer:	CSIC (Agencia Estatal Consejo Superior Deinvestigaciones Cientificas)

Methodology

Assessment of environmental and ecological impacts of alternative LMS was performed included experiments to assess the impact of different LMS on soil nitrogen and carbon stocks, carbon sequestration, biodiversity, and air quality. Experimental approaches were used to assess the impacts on biodiversity: both through direct impacts of LMS (e.g., comparing diversity in comparable communities subjected to different LMS) and indirectly if spatial landscape connectivity is affected. The effects of different LMS on nutrient cycling and soil C and N storage will be assessed by determining total soil C and N and mineralisation rates. Where relevant for the specific LMS other environmental/ecological impacts (e.g. smoke impact) will be assessed as well.

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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Database of global change effects on vegetation resilience to disturbance (Card 11)

The database compiles information on how future fire regimes and climate change factors (increased temperature, increased CO_2, drought) affect plant post-fire regeneration and resilience to disturbance. The product developed within the Activity "A3.2.3 Estimation of future vulnerability across spatial scales, incl. WUI".

Technical components

Characteristics	Description
Type of products:	Database
Units:	not applicable
Update Frequency:	not applicable
Accuracy:	not applicable
Output Format:	.xls
Fire risk component:	Resilience (Coping capacity)
Temporal coverage:	not applicable
Spatial resolution:	not applicable
Spatial coverage:	ET
Availability on FirEUrisk platform:	
Developer:	CSIC (Agencia Estatal Consejo Superior Deinvestigaciones Cientificas)

Methodology

The vulnerability of vegetation strongly depends on the capacity to recover from fire disturbance. Due to this database compiles information on 1) how climate change will affect post-fire regeneration mechanisms (germination, resprouting; and 2) on vegetation resilience in new fire-prone areas, particularly in Central and Northern Europe. These changes were contextualised using published literature and specific experiments by assessing effects of increased temperature on germination. From this analysis was derived effective adaptation measures for the affected ecosystems.

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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GIS database of fire risk reduction strategies (Product Card 12)

This product allows to use GIS database that containing information on land management strategies focused on fire risk reduction. The product developed within the Activity "A2.5 Integration and validation of fire risk reduction strategies".

Technical components

Characteristics	Description
Type of products:	Geospatial data
Units:	Hectares
Update Frequency:	Yearly
Accuracy:	Not apliciable
Output Format:	.gbd, .tif
Fire risk component:	Propagation
Temporal coverage:	1 year
Spatial resolution:	500 m
Spatial coverage:	Not apliciable
Availability on FirEUrisk platform:	
Developer:	UAH

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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Multidimensional Gis viewer (Product Card 14)

This product allows the transformation and advanced visualisation of multidimensional GIS information with proper management of time axis for forecast and observations. The product developed within the Activity “A1.

Technical components

Characteristics	Description
Type of products:	Software
Units:	Not applicable
Update Frequency:	Year
Accuracy:	Not applicable
Output Format:	.tif (maps); pdf (guidelines report)
Fire risk component:	Not applicable
Temporal coverage:	Not applicable
Spatial resolution:	1 ha
Spatial coverage:	PS4
Availability on FirEUrisk platform:	
Developer:	METEOGRID SL

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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Downscaling tool (Product card 15)

This product allows to downscale meteorological and danger indexes to fit modelers needs.

Technical components

Characteristics	Description
Type of products:	Software / Geospatial data
Units:	Not applicable
Update Frequency:	Daily
Accuracy:	Not applicable
Output Format:	.tif
Fire risk component:	Not applicable
Temporal coverage:	Hour / day
Spatial resolution:	1 km
Spatial coverage:	PS4
Availability on FirEUrisk platform:	
Developer:	METEOGRID SL

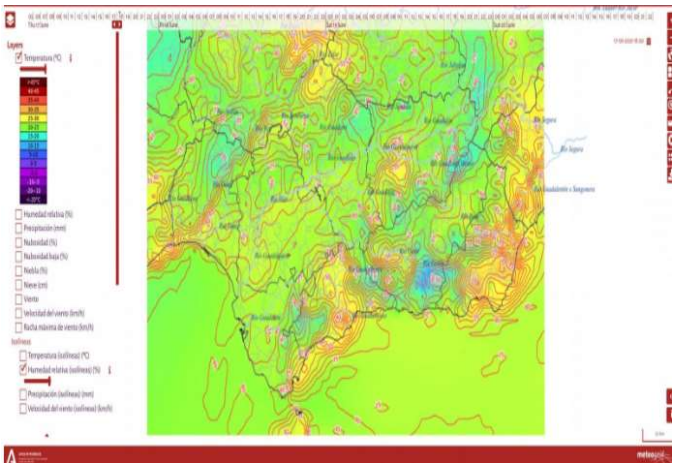


Figure 32. Exaple of Downscaling tool interface

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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Curricula for extreme fires and WUI (Product Card 19)

This product in a form of curriculum provides firefighters and managers an appropriate understanding of extreme fire behaviour and WUI challenges. This Product considers the evolution of fire risk and the transferability of strategies used in Mediterranean countries to fight fires in Northern/higher elevation contexts. The product developed within the Activity "A2.3.3 Curricula for extreme fires and WUI".

Technical components

Characteristics	Description
Type of products:	Guidelines product
Units:	not applicable
Update Frequency:	Years
Accuracy:	not applicable
Output Format:	.pdf
Fire risk component:	Coping capacity and population & assets vulnerability
Temporal coverage:	not applicable
Spatial resolution:	not applicable
Spatial coverage:	PS3-5
Availability on FirEUrisk platform:	
Developer:	SAFE CLUSTER

Methodology

Product based on regional experiences (together with Australian and North-American practices), elaborate on the way and context to use alternative techniques such as backburning, which could help addressing escalation of wildfire size and limit challenges of extreme fire behaviour. Materials were customised for the different types of users throughout Europe and to their languages.

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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Forest fire emission forecast (Product Card 20)

This product will provide atmospheric emission forecasts (e.g, PM10, PM2.5, NO_2, CO) based on fire progression simulations. The final output will be the gridded emissions of relevant gases/aerosols (kg/m^2) of each wildfire with a spatial resolution on the order of 10 m. The product is being developed within the Activity "A2.3.2 Smoke Modelling and Health Impacts".

Technical components

Characteristics	Description
Type of products:	Geospatial
Units:	kg/m^2
Update Frequency:	Near-real time after wildfire ignition
Accuracy:	Depends on fire progression forecast
Output Format:	.shp, .tif
Fire risk component:	Exposure
Temporal coverage:	Fire duration
Spatial resolution:	~10 m
Spatial coverage:	PS3, PS5
Availability on FirEUrisk platform:	
Developer:	UAVR (University of Aveiro)

Methodology

The methodology to estimate the atmospheric emissions is based on emission factors (dependent on fuel types), burning efficiency, fuel loads, and burnt area. The latter is obtained by fire progression simulations run for each wildfire. Ignition locations driving these will have to be obtained from regional agencies or satellite detections.

Proved accuracy at Demonstration Area

Accuracy of the product depends on fire progression forecast

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FPP (Fire Propagation Probability) (Product Card 21)

This product aims to identify the territorial units more prone to fires based on the topographic and phytoclimatic characteristics of the Area of Interest (AOI) and on historical records of burned areas. This product is integrated into the calculation of Prescribed Burning (PB) maps, since it allows to identify the areas where this fuel removal practice would be more helpful. The product developed within Activities "A2.1.1 Reducing Citizen-Driven Fire Ignitions" and "A2.2.4 Mapping & Guidelines for LMS".

Technical components

Characteristics	Description
Type of products:	Geospatial product
Units:	%
Update Frequency:	Year
Accuracy:	Not applicable
Output Format:	.tif
Fire risk component:	Propagation (fuel)
Temporal coverage:	Same as the DEM and Phytoclimatic Map
Spatial resolution:	30-250m
Spatial coverage:	PS5
Availability on FirEUrisk platform:	https://fireurisk.satways.net/datasets/63d2b0fbe4b0b33befc8eebb
Developer:	SIA

Methodology

The methodology takes into account a number factors that may affect the onset and spread of fires: topographic factors (altitude, slope, aspect), environmental factors (fuel type, phytoclimate type), fire occurrence history (burned areas in the last five years), land-use factors (presence of natural parks, forests, roads). These factors are used to identify Homogeneous Territorial Classes (HTC) in the AOI, i.e. territorial units characterized by different combinations of the aforementioned factors. The frequency and size of the burned areas in a given HTC and the extension of the HTC itself are then used to calculate the FPP. Detailed description of algorithm of calculation and data sources available here: Laneve, Fusilli 2020 "Preventing Forest Fires Through Remote Sensing: Achievements of the Prevention and Recovery of Forest Fires Emergency in the Mediterranean Area Project".

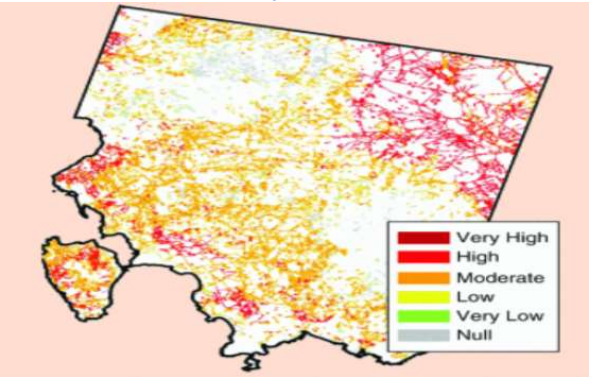


Figure 33. Example of generated FPP map

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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PBM (Prescribed Burning Map) (Product Card 22)

This product aims to identify areas and timeframes suitable for the application of the technique of Prescribed Burning (PB) as a fuel removal practice. The product is developed within Activities "A2.1.1 Reducing Citizen-Driven Fire Ignitions" and "A2.2.4 Mapping & Guidelines for LMS".

Technical components

Characteristics	Description
Type of products:	Geospatial product
Units:	None (Boolean)
Update Frequency:	Daily
Accuracy:	Not applicable
Output Format:	.tif
Fire risk component:	Propagation (fuel)
Temporal coverage:	Same as weather forecast data
Spatial resolution:	30-250m
Spatial coverage:	PS5
Availability on FirEUrisk platform:	https://fireurisk.satways.net/datasets/63d2a736e4b0b33befc8ee8e
Developer:	SIA

Methodology

In order to apply PBs safely and efficiently, it is necessary to take into account both the topographic characteristics of the Area Of Interest (AOI) and the environmental conditions determined by the weather. This product is therefore composed of two different modules, one dedicated to assessing which are the areas most susceptible to fires (**WHERE** module) and would benefit from the application of PBs, and the other dedicated to forecasting when the weather conditions are suitable for their application (**WHEN** module). The WHERE module is based on topographic parameters of the AOI (elevation, slope, aspect) and environmental parameters (phytoclimatic zones and fuel maps). The WHEN module requires weather data such as air temperature, relative humidity, total precipitation and wind speed in order to assess if the forecasted conditions will allow for safe and efficient application of the practice. Detailed description of algorithm of calculation and data sources available here: Laneve, Fusilli et al. (2020) "Preventing Forest Fires Through Remote Sensing: Achievements of the Prevention and Recovery of Forest Fires Emergency in the Mediterranean Area Project".

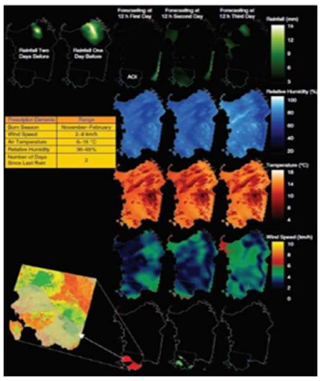


Figure 34. Example of generated PBM map

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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Fire behaviour predictive models (Product Card 23)

The product based on predictive models for extreme fire behaviour (EFB), based on historical data on fire occurrence, laboratory and field tests and identification of conditions that lead to EFB. Product provides methods to predict EFB in space and in time and provide an early warning to the authorities and population.

Technical components

Characteristics	Description
Type of products:	Empirical models
Units:	not applicable
Update Frequency:	not applicable
Accuracy:	not applicable
Output Format:	not applicable
Fire risk component:	Propagation
Temporal coverage:	Will be added by Product developer
Spatial resolution:	>1ha (30m)
Spatial coverage:	ET, PS3, PS4
Availability on FirEUrisk platform:	
Developer:	ADAI

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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Forecast of health-impacts of wildfire-smoke (Product Card 24)

This product provides forecasts of local hospital-admissions due to exposure to wildfire smoke during a given wildfire. The AirQ+ methodology from the World Health Organization (WHO) will be followed. The final output will be the expected rise in number of hospital admissions due to a wildfire smoke episode at a resolution on the order of 1 km. The product is being developed within the Activity "A2.3.2 Smoke Modelling and Health Impacts".

Technical components

Characteristics	Description
Type of products:	Geospatial
Units:	Number of hospital admission
Update Frequency:	Near-real time after wildfire ignition
Accuracy:	N/A
Output Format:	.shp, .tif
Fire risk component:	Exposure
Temporal coverage:	Fire duration (see Methodology)
Spatial resolution:	~1km
Spatial coverage:	PS5
Availability on FirEUrisk platform:	
Develper:	UAVR (University of Aveiro)

Methodology

The AirQ+ methodology from the WHO requires the smoke dispersion forecast at local scale and the population geographical distribution (if possible, including location of firefighters) and health indicators. The simulation period will span the whole fire duration and eventually also the subsequent days (until only residual air-pollutant concentrations are found in the simulated region). The output can serve as an indicator of population exposure to smoke for decision makers.

Proved accuracy at Demonstration Area

No accuracy assessment will be done. The AirQ+ methodology will be trusted. The accuracy of the air-pollutant concentrations from the smoke dispersion forecast will be a defining factor in the quality of the results.

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Smoke dispersion forecast (Product Card 25)

This product will estimate 3D air pollution concentrations (e.g., PM10, PM2.5, NO_2, CO) at a local scale based on dispersion modelling. The final output will be the gridded time-dependent ground-level concentrations of relevant gases/aerosols (µg/m^3) of each wildfire with a spatial resolution better than 1km. The product is being developed within the Activity "A2.3.2 Smoke Modelling and Health Impacts".

Technical components

Characteristics	Description
Type of products:	Geospatial
Units:	µg.m-3
Update Frequency:	Near-real time after wildfire ignition
Accuracy:	Uncertainty: 50 % to 100 %
Output Format:	.shp, .tif
Fire risk component:	Exposure
Temporal coverage:	Fire duration (see Methodology)
Spatial resolution:	<1 km
Spatial coverage:	PS5
Availability on FirEUrisk platform:	
Develper:	UAVR (University of Aveiro)

Methodology

The methodology to estimate the gas/aerosol concentrations is based on the outputs of the smoke emission forecast. Disperfire is a local lagrangean air-pollutant dispersion model and is being adapted and implemented for this purpose. It does not consider chemical reactions within the atmosphere allowing it to run in forecast mode even at finer scales. The simulation period will span the whole fire duration and eventually also the subsequent days (until only residual air-pollutant concentrations are found in the simulated region

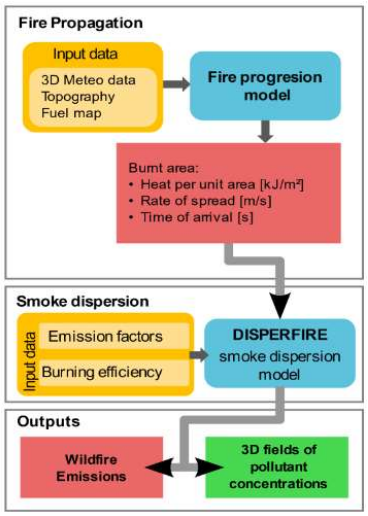


Figure 35. Smoke dispersion forecast algorithm principal scheme

Proved accuracy at Demonstration Area

Results will be validated with local air quality measurements (eventually also atmospheric optical depth).

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Catalogue of WUI mesoscale types (Product Card 26)

This product describes the factors and processes facilitating or reducing the spread of fire across WUI areas, such as fire permeability and intensity. This product is based on a Lagrangean dispersion model

Technical components

Characteristics	Description
Type of products:	Document
Units:	not applicable
Update Frequency:	not applicable
Accuracy:	not applicable
Output Format:	.pdf, .docx
Fire risk component:	Propagation
Temporal coverage:	not applicable
Spatial resolution:	not applicable
Spatial coverage:	PS4
Availability on FirEUrisk platform:	
Developer:	METEOGRID SL

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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Guidelines to reduce communities' vulnerability to extreme fires and fires in WUI (Product Card 27)

This product describes the best practices and guidelines to reduce vulnerability to extreme fires. The product developed within the Activity "A2.4.2 Strengthening resilience of WUI areas Deliverable".

Technical components

Characteristics	Description
Type of products:	Document
Units:	not applicable
Update Frequency:	not applicable
Accuracy:	not applicable
Output Format:	.pdf, .docx
Fire risk component:	Exposure
Temporal coverage:	not applicable
Spatial resolution:	not applicable
Spatial coverage:	not applicable
Availability on FirEUrisk platform:	
Developer:	METEOGRID SL

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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Fuel type and model map (Product Card 28)

The product will provide the fuel type and parameters following a standard classification of fuels agreed for the project.

Technical components

Characteristics	Description
Type of products:	Geospatial product
Units:	Categorical (fuel types)
Update Frequency:	Static layer
Accuracy:	80-95 %
Output Format:	Will be added by Product developer
Fire risk component (accordingly to the Integrated Scheme of the FirEUrisk project):	Propagation (fuel)
Temporal coverage:	2020
Spatial resolution:	>1ha (20m)
Spatial coverage:	No PS coverage
Availability on FirEUrisk platform:	
Developer:	INCDS

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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Eruptive fire handbook (Product Card 30)

Short handbook about eruptive fire danger prepared for firefighters in Croatian language. This product is close connected with results of other partners primarily ADAI in product 'Fire behaviour predictive models'. The product developed within the Activity “2.3.3. Curricula for extreme fires and WUI“

Technical components

Characteristics	Description
Type of products:	Document
Units:	not applicable
Update Frequency:	not applicable
Accuracy:	not applicable
Output Format:	.pdf
Fire risk component:	Education and training
Temporal coverage:	not applicable
Spatial resolution:	not applicable
Spatial coverage:	not applicable
Availability on FirEUrisk platform:	
Developer:	ADAI

Methodology

Based on reports from other partners particularly work of ADAI in product 'Fire behaviour predictive models', a short handbook about eruptive fire danger prepared for firefighters in Croatian language.

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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Geospatial eruptive fire risk map (Product card 33)

Dynamic on-line calculation of eruptive fire risk maps. This product is closely connected with results of other partners primarily ADAI in product 'Fire behaviour predictive models', particularly their results of predictive models for extreme fire behaviour (EFB). The product developed within the Activity “2.3.1. Extreme fire behaviour modelling”.

Technical components

Characteristics	Description
Type of products:	Geospatial product
Units:	Not applicable
Update Frequency:	Every 3 hours
Accuracy:	To be defined during implementation
Output Format:	.tiff
Fire risk component:	Exposure
Temporal coverage:	Every 3 hours
Spatial resolution:	100 m x 100 m
Spatial coverage:	No PS coverage
Availability on FirEUrisk platform:	
Developer:	FESB SPLIT.

Methodology

Eruptive fire risk factors – the calculation is performed 2 times a day for the next 12 hours using simulated meteorological data from model ALADIN in 3 hours resolution. Climatological parameters, dynamic meteorological real data, and simulated data (ALADIN) for the next 12 hours 2 times a day in time resolution of 3 hours, automatically downloaded from a server of Croatian Meteorological and Hydrological Service including FWI. Other inputs are standard terrain maps (height, slope, aspect). Product will be implemented for DA - Demonstration Area (Split - Dalmatia County, Croatia) on available data. Most maps are publicly available, but meteorological dynamic data is not publicly available. For the extension to PS similar service with the meteorological state office has to be realised.

Proved accuracy at Demonstration Area

To be defined during implementation.

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Awareness tool/Visual analysis tool (Product card 35)

This product is an advanced visualization tools for the risk assesment and awareness rising. Developer METEOGRID SL.

Technical components

Characteristics	Description
Type of products:	Software product
Units:	not applicable
Update Frequency:	not applicable
Accuracy:	not applicable
Output Format:	.mp4
Fire risk component:	not applicable
Temporal coverage:	not applicable
Spatial resolution:	not applicable
Spatial coverage:	not applicable
Availability on FirEUrisk platform:	
Developer:	METEOGRID SL

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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Future fire regime data base (Product Card 36)

This product contains changes in future fire regimes (fire ignitions, burned area, fire intensity) compiled from simulated spatio-temporal fire variables of fire-enabled DGVMs.

Technical components

Characteristics	Description
Type of products:	Geospatial product
Units:	Fire regime
Update Frequency:	Fire season
Accuracy:	70 %
Output Format:	.netcdf
Fire risk component:	Ignition / Propagation
Temporal coverage:	2020-2100
Spatial resolution:	> 1 km (9 km)
Spatial coverage:	ET, PS1-5
Availability on FirEUrisk platform:	
Developer:	PIK

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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Program of prescribed burnings (Product Card 41)

Handbook of prescriptions and training materials to develop prescribed burning.

Technical components

Characteristics	Description
Type of products:	Document
Units:	not applicable
Update Frequency:	Season
Accuracy:	80 %
Output Format:	.pdf
Fire risk component:	Human ignition and fuel propagation
Temporal coverage:	Month
Spatial resolution:	not applicable
Spatial coverage:	PS3
Availability on FirEUrisk platform:	
Developer:	CNR & SAFE CLUSTER

Proved accuracy at Demonstration Area

The accuracy of product is 80%.

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Guidelines for on-site surveys and subsequent data processing (Product Card 43)

Protocol guiding the procedures to be followed during the on-site analysis of wildfires during the fire event and aftermath. The guidelines oriented to carry out tasks efficiently, safely and according to legal requirements. Relevant equipment and materials for the study are also suggested, as well as software that facilitates the treatment and exploitation of the collected data. The product developed within the Activity "A2.4.1".

Technical components

Characteristics	Description
Type of products:	Document
Units:	not applicable
Update Frequency:	5 years
Accuracy:	not applicable
Output Format:	.pdf
Fire risk component:	not applicable
Temporal coverage:	not applicable
Spatial resolution:	not applicable
Spatial coverage:	not applicable
Availability on FirEUrisk platform:	
Developer:	ADAI

Methodology

This product will have the following components:

- Guidelines to get relevant data, efficiently and safely, during a fire event and aftermath – will be descriptive and will be based on the existing literature and the expertise of the consortium.
- User friendly forms to be used in gadgets to get in the field

Proved accuracy at Demonstration Area

This product does not have a clear application to the pilot sites unless a fire event occurred in these areas meanwhile.

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LMS strategies for Adriatic area (Product card 45)

The Product is a document created based on the analysis of possible LMS strategies used in various EU countries. LMS (Land Management Strategies) are activities which change vegetation or landscape structure with a (partial) aim to reduce wildfire risk. In the Product was proposed the most suitable strategies for Adriatic area with detail description how to use them. The product developed within the Activity "2.2.4. Spatial integration of best LMS strategies".

Technical components

Characteristics	Description
Type of products:	Document
Units:	not applicable
Update Frequency:	not applicable
Accuracy:	not applicable
Output Format:	.pdf
Fire risk component:	Fuel and land management strategies
Temporal coverage:	not applicable
Spatial resolution:	not applicable
Spatial coverage:	No PS coverage
Availability on FirEUrisk platform:	
Developer:	FESB SPLIT

Methodology

LMS (Land Management Strategies) are activities which change vegetation or landscape structure with a (partial) aim to reduce wildfire risk. Plan for FirEURisk project is to make inventory of possible LMS strategies used in various European Territory (ET). Our task is to analyse results of proposed LMS strategies for Croatian Adriatic region, particularly maps that have been produced by UAH in product 'GIS database of fire risk reduction strategies'. Based on this analysis we will prepare a document in Croatian language with explanation how is possible to reduce wildfire risk in Adriatic area and why certain methods are more suitable for that. Analysis will be based on FirEUrisk LMS quantitative methodology. Developer FESB SPLIT. The product developed within the Activity "2.2.4. Spatial integration of best LMS strategies".

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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Guidelines for citizens involvement in wildfire risk reduction (Product card 46)

The Product provides guideline on how to design and implement engagement strategies for 'citizen-scientists' networks, including the development of training materials. The product developed within the Activity "2.4.3 Citizens' involvement in wildfire risk reduction".

Technical components

Characteristics	Description
Type of products:	Document
Units:	not applicable
Update Frequency:	not applicable
Accuracy:	not applicable
Output Format:	.pdf
Fire risk component:	Education and training
Temporal coverage:	not applicable
Spatial resolution:	not applicable
Spatial coverage:	No PS coverage
Availability on FirEUrisk platform:	
Developer:	FESB SPLIT

Methodology

To participate in Elaboration of Guidelines on how to design and implement engagement strategies for 'citizen-scientists' networks, including the development of training materials. Our contribution will be to prepare training materials in Croatian language for 'citizen-scientist' networks.

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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Citizens/scientist network and Engagement Plan (Product Card 47)

This product proposes a structured framework for establishing citizens networks/groups at local level. In this sense it supports the design and implementation of participatory and engagement strategies by mapping and analysing local stakeholders according to their level of relevance and interest towards the issue at stake (i.e., local strategies for wildfire risk reduction). It envisages the Elaboration of an Engagement Plan for the establishment and functioning of the network making use of several communication channels and tools, from face-to-face interaction in public events and initiatives, to social media, and capitalising the existing knowledge and resources within and outside the partnership (e.g., promote synergies with other networks of citizen-scientist, with events and initiatives dedicated to scientific promotion). The product is developed within the Activity A2.4.3 – Citizen's involvement in wildfire risk reduction.

Technical components

Characteristics	Description
Type of products:	Document/Guidelines and training
Units:	N/A
Update Frequency:	Yearly
Accuracy:	N/A
Output Format:	.pdf
Fire risk component:	Coping capacity
Temporal coverage:	N/A
Spatial resolution:	N/A
Spatial coverage:	not applicable
Availability on FirEUrisk platform:	
Developer:	ISIG

Methodology

The tool suggests how to structure Citizens/scientist networks through the following steps: 1) Set the scope of inquiry (Elaborate a Community Evaluation, Elaborate a Stakeholder Evaluation); 2) Identify the most adequate participation strategies and tools in order to engage with stakeholders (following Information, Consultation, Dialogue, Partnership strategies). It also provides for guidelines for Monitoring and Evaluation activities, ensuring feedback on the effectiveness of implemented actions. The tool is based upon the following main sources: Council of Europe/ISIG. (2017; 2020). Toolkit for Civil Participation in decision making. Strasbourg: CoE; Council of Europe/CINGO. (2019). Code of Good Practice for Civil Participation in the Decision Making Process. Strasbourg: CoE

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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Guidelines to reduce communities' vulnerability to extreme fires and fires in WUI (Product card 48)

The Product is a document that describes risk-smart practices for spatial planning (urbanism), building fire codes, artificial planting (gardening), fuel treatments, sheltering methods, evacuation issues and innovative options were developed as technical solutions to improve the protection of people, structures and reduce vulnerability.

Technical components

Characteristics	Description
Type of products:	Document
Units:	not applicable
Update Frequency:	5 year
Accuracy:	not applicable
Output Format:	.pdf
Fire risk component:	Prevention
Temporal coverage:	not applicable
Spatial resolution:	not applicable
Spatial coverage:	not applicable
Availability on FirEUrisk platform:	
Developer:	METEOGRID SL

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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Laws, regulations, plans and programmes on fire prevention, preparedness and resilience (Product Card 49)

This product consists of a searchable catalogue of legal norms, principles and strategies to frame public and private stakeholders' role in the prevention of fire risk, in supporting preparedness, training, empowerment, resilience and liability.

Technical components

Characteristics	Description
Type of products:	Document
Units:	not applicable
Update Frequency:	1 year
Accuracy:	not applicable
Output Format:	.docx, .xls
Fire risk component:	Legislation
Temporal coverage:	not applicable
Spatial resolution:	not applicable
Spatial coverage:	PS5
Availability on FirEUrisk platform:	
Developer:	UC

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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Web-based interface (Product card 50)

This Product is a tool for displaying outputs from the internal platform and external sources, made avaiable on the internet and enabled for most mobile devices.

Technical components

Characteristics	Description
Type of products:	Software / Application
Units:	not applicable
Update Frequency:	Fire season
Accuracy:	not applicable
Output Format:	Web-based application
Fire risk component	Prevention
Temporal coverage:	not applicable
Spatial resolution:	not applicable
Spatial coverage:	not applicable
Availability on FirEUrisk platform:	
Developer:	Setways

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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Laws, regulations, plans and programmes on fire prevention, preparadeness and resilience (Product card 51)

This product consists on a conceptual framework that incorporate all the projects's findings, models, systems and results, integrating them and aiming at proposing an integrated strategy to cope with all phases of fire risk management.

Technical components

Characteristics	Description
Type of products:	Document
Units:	not applicable
Update Frequency:	not applicable
Accuracy:	not applicable
Output Format:	.pdf, .tif
Fire risk component:	Legislation
Temporal coverage:	Fire season
Spatial resolution:	100 m
Spatial coverage:	not applicable
Availability on FirEUrisk platform:	
Developer:	ADAI

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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Conceptual Framework for integrating risk assessment, reduction and adaptation (Product card 52)

The product is a review of the current state of fire risk in Europe at different spatial and political levels. It covers weather and climate, vegetation cover and management, land-use and socio-economic policies associated or pertaining to fire risk, mitigation and adaptation.

Technical components

Characteristics	Description
Type of products:	Document
Units:	not applicable
Update Frequency:	not applicable
Accuracy:	not applicable
Output Format:	.pdf, .tif, .jpg
Fire risk component:	Risk assessemnt
Temporal coverage:	Portugal
Spatial resolution:	100 m
Spatial coverage:	ET
Availability on FirEUrisk platform:	
Developer:	ADAI

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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Internal Cooperative Platform (Product card 53)

This product is a Web-based portal for the sharing of information, data, codes and models within the FirEURisk project partnership.

Technical components

Characteristics	Description
Type of products:	Software / Web-based portal
Units:	not applicable
Update Frequency:	Updateable until the end of the project run-time
Accuracy:	Dependant on data being shared
Output Format:	Platform
Fire risk component:	Integration
Temporal coverage:	Fire season
Spatial resolution:	Dependant on data being shared
Spatial coverage:	not applicable
Availability on FirEURisk platform:	
Developer:	Setways

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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Fuel Management Framework for Reducing Operation-based Ignitions (FuMaF_ROI) (Product card 55)

The Product is a document that implement a fuel management framework, including procedures, rules-of-thumb, methods and spatial data layers specifications, for the reduction of operation-based ignitions. The product developed within the Activity "A2.1.2 – Reducing operations-based fire ignitions".

Technical components

Characteristics	Description
Type of products:	Document describing the framework (inputs, methodology, outputs)
Units:	Not applicable
Update Frequency:	The framework will be developed once within FirEUrisk and can be subsequently applied whenever is required (e.g., changes in the input data, application to a new AoI, etc.)
Accuracy:	Not applicable
Output Format:	Guidelines, accompanied by auxiliary raster data layers in GeoTIFF format.
Fire risk component	Propagation / Fuel
Temporal coverage:	The framework will be applied to input spatial data in the selected Demonstration Areas, assuming current conditions. The outputs will be valid until significant changes in the input data occur (e.g., significant changes in fuel types and/or load, infrastructure, land use etc.) in the area of interest.
Spatial resolution:	1–20 m
Spatial coverage:	No PS coverage
Availability on FirEUrisk platform:	
Developer:	AUTH

Methodology

The FuMaF_ROI (Fuel Management reduction oF Operations-based Ignitions) product is built on top of a methodology developed in the PREFER project for depicting and prioritising areas that require fuel treatment. In FirEUrisk, the envisaged methodology focuses and is properly adapted to operation-based ignitions. By operations we means critical infrastructures and essential networks (lifelines), such as power grid, road and railway networks, which are linked with several ignitions of wildfires. The methodology is elaborated by the partners involved in A2.1.2 (AUTH, SIA, ADAI, ARBO and CNR as the Leader of T2.1).

The methodology includes 3 different steps:

A. On a larger scale, overlay the layers of the networks (power grid, road and railway, since telecommunications no longer use surface networks) or point assets (installations, stations) on the vegetation layers (fuel map and / or satellite images) in order to identify the areas (lines or polygons) where the vegetation crosses a concrete buffer zone (specified for the different type of network) across the path of the network.

B. On a smaller scale, in the areas that have been identified in step A, which are the ones challenged by the presence of vegetation being very close to the operational network (lifelines), use drone flights along the network line to identify the places that need fuel treatment (using the same rules as in A, but in much higher resolution).

C. The information derived from step B will be elaborated to prioritize the interventions and define the type of treatments that should be applied in different cases based on gathered data on the type and volume of vegetation, topography, accessibility, distance from network, etc.

Proved accuracy at Demonstration Area

Not applicable. Indirect assessment will be performed informally via feedback from stakeholders.

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Roadmap for Integrated Strategy for Fire Risk Management (Product card 56)

The Product is a document that describes roadmap for the development of an integrated fire risk management strategy for Europe.

Technical components

Characteristics	Description
Type of products:	Document
Units:	not applicable
Update Frequency:	Year
Accuracy:	-
Output Format:	.pdf, .tif, ,.jpeg
Fire risk component:	Risk
Temporal coverage:	Season
Spatial resolution:	not applicable
Spatial coverage:	PS5
Availability on FirEUrisk platform:	
Developer:	AUTH

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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Roadmap for developing an integrated fire risk management strategy (Product Card 57)

The Product is a document that summarise the results of WPs 1, 2 and 3, and propose "good practices" for fire risk management at European Scale, proposing future improvements and fire policies.

Technical components

Characteristics	Description
Type of products:	Document
Units:	not applicable
Update Frequency:	Static
Accuracy:	not applicable
Output Format:	Roadmap
Fire risk component:	Integrated risk
Temporal coverage:	not applicable
Spatial resolution:	not applicable
Spatial coverage:	not applicable
Availability on FirEUrisk platform:	
Developer:	UAH

Methodology

Will be added by Product developer.

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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Eruptive fire handbook (Product card 71)

Short handbook about eruptive fire danger prepared for firefighters in Croatian language. Maybe not only eruptive fires but other dangerous wildfire behaviour could be added although they are not so presented in our areas (crown fires, spot fires, fire whirls and merging fires). This task is connected with other partners where similar handbook has to be prepared.

Technical components

Characteristics	Description
Type of products:	Document
Units:	not applicable
Update Frequency:	No update
Accuracy:	not applicable
Output Format:	.pdf
Fire risk component:	not applicable
Temporal coverage:	not applicable
Spatial resolution:	not applicable
Spatial coverage:	No PS coverage
Availability on FirEUrisk platform:	
Developer:	FESB SPLIT

Methodology

Will be added by Product developer.

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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High resolution future climate information for Greece (Product Card 73)

Product is a high-resolution future climate (maximum and minimum temperature, precipitation, relative humidity, wind speed) datasets in daily temporal resolution for MED-Greece at 5 km resolution, using dynamical downscaling methodology.

Technical components

Characteristics	Description
Type of products:	Geospatial
Units:	depends on climate variable
Update Frequency:	no update
Accuracy:	not applicable
Output Format:	rdata
Fire risk component:	Resilience
Temporal coverage:	historical (1980–2004), midcentury (2025–2049), and end of century (2075–2099) periods
Spatial resolution:	5 km
Spatial coverage:	PS5
Availability on FirEUrisk platform:	
Developer:	NCSR

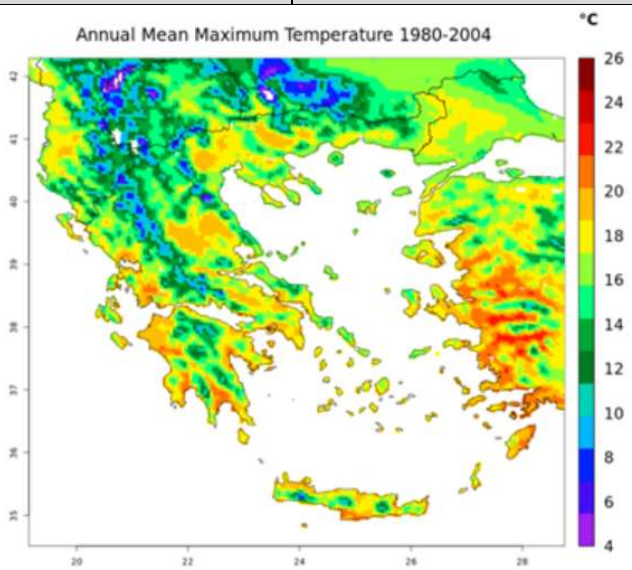


Figure 36. Example of output from future climate information model for Greece

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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Effect of deciduous tree inclusion in European boreal forests (Product Card 80)

This product describes how aspen, birch and oak inclusion can affect the fire spread potential on confireuous European boreal forests.

Technical components

Characteristics	Description
Type of products:	Fuel model and relative scale of flame spread
Units:	not applicable
Update Frequency:	Year
Accuracy:	not applicable
Output Format:	BEHAVE fuel model
Fire risk component:	Propagation / Resilience
Temporal coverage:	Vegetation season
Spatial resolution:	100 m
Spatial coverage:	PS1
Availability on FirEUrisk platform:	
Developer:	RISE

Proved accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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Effective adaptation to changed future fire regimes (Product Card 37)

This product describes impacts of changed future fire regimes on provision of ecosystem services. In comparison of the different scenarios, areas are identified where a restoration or reforestation efforts might be exposed to a higher fire risk.

Technical components

Characteristics	Description
Type of products:	Geospatial product
Units:	Province
Update Frequency:	Fire season
Accuracy:	90 %
Output Format:	Maps
Fire risk component:	Vulnurability/Exposure
Temporal coverage:	2020-2100
Spatial resolution:	> 1 km (9 km)
Spatial coverage:	ET, PS1-5
Availability on FirEUrisk platform:	
Developer:	PIK

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WEPPcloud-EU-WATAR (Product Card 82)

The product is a probabilistic runoff and erosion model designed for quantification of post-fire soil, ash, water, nutrient, carbon and pollutant transport from burned hillslopes into stream channels and water bodies for a given burn area and fire severity. The product was developed within the Activity "A1.2.3 Environmental vulnerability and resilience assessment".

Technical components

Characteristics	Description
Type of products:	Geospatial
Units:	kg/ha, tonne/yr
Update Frequency:	Not applicable
Accuracy:	Not applicable
Output Format:	Open-access online interface
Fire risk component:	Exposure/Vulnerability
Temporal coverage:	Applicable to actual or potential fires
Spatial resolution:	25 m (European Digital Elevation Model)
Spatial coverage:	Potentially PS1-5
Availability on FirEUrisk platform:	
Developer:	SU (Swansea University, United Kingdom)

Methodology

The model automatically accesses and processes specific European datasets for the required input data (climate, topography, soil type, and land use and ash chemical composition), limiting input data from the end-user and simplifying its application. The only external input required by the model is a burn severity map, which end-users can develop from satellite images according to Parsons et al. (2010). Detailed description of model capabilities and data sources are available in Neris et al. (2021). Ash composition data is based on Sanchez-Garcia et al. (2023).

References: Neris J. et al. (2021) Integrated Environmental Assessment and Management (https://doi.org/10.1002/ieam.4406); Parsons A. et al. (2010). Field guide for mapping post-fire soil burn severity; Sánchez-García C. et al. (2023) Environment International (https://doi.org/10.1016/j.envint.2023.108065).

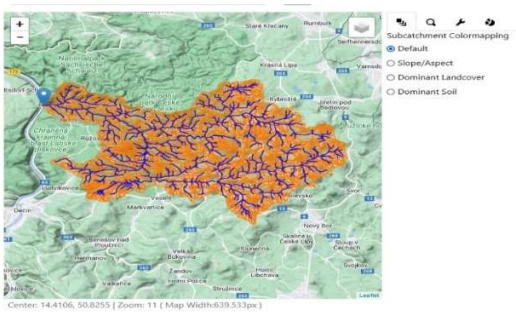


Figure 37. Sub-catchment delineation for the area partially affected by the 2022 Bad Schandau fire

Proven accuracy at Demonstration Area

The accuracy assessment is not applicable for this type of product.

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