8TH INTERNATIONAL WILDLAND FIRE CONFERENCE

GOVERNANCE PRINCIPLES: Towards an International Framework

Workshop

Innovation in fire analysis methodologies and operational decision support
A co-creation process

Alexandre Penha[1], Fábio Silva[2], Akli Benali[3]

[1]Nat. Auth. Civil Protection & Emergency - [2]Special Civil Protection Force [3]Forest Research Center - Univ. of Lisbon

Workshop

Innovation in fire analysis methodologies and operational decision support: a co-creation process

Summary

1. Why is fire analysis important in the operational decision support process?
2. What is the fire analysis structure at ANEPC?
3. How can Science contribute?
4. How is fire analysis carried out at ANEPC? (before, during and after)
5. Key improvements needed

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Why is fire analysis important in the operational decision support process?

What changed?

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Why is fire analysis important in the operational decision support process?

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Weather

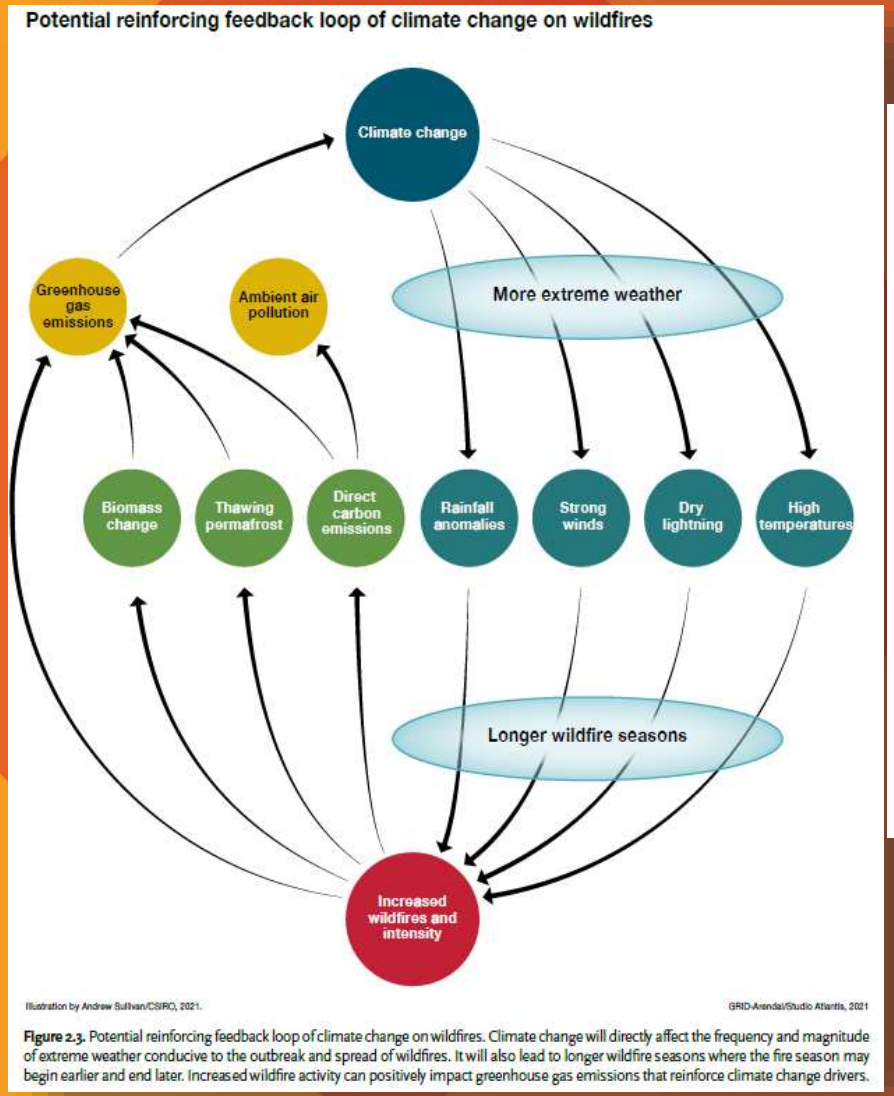
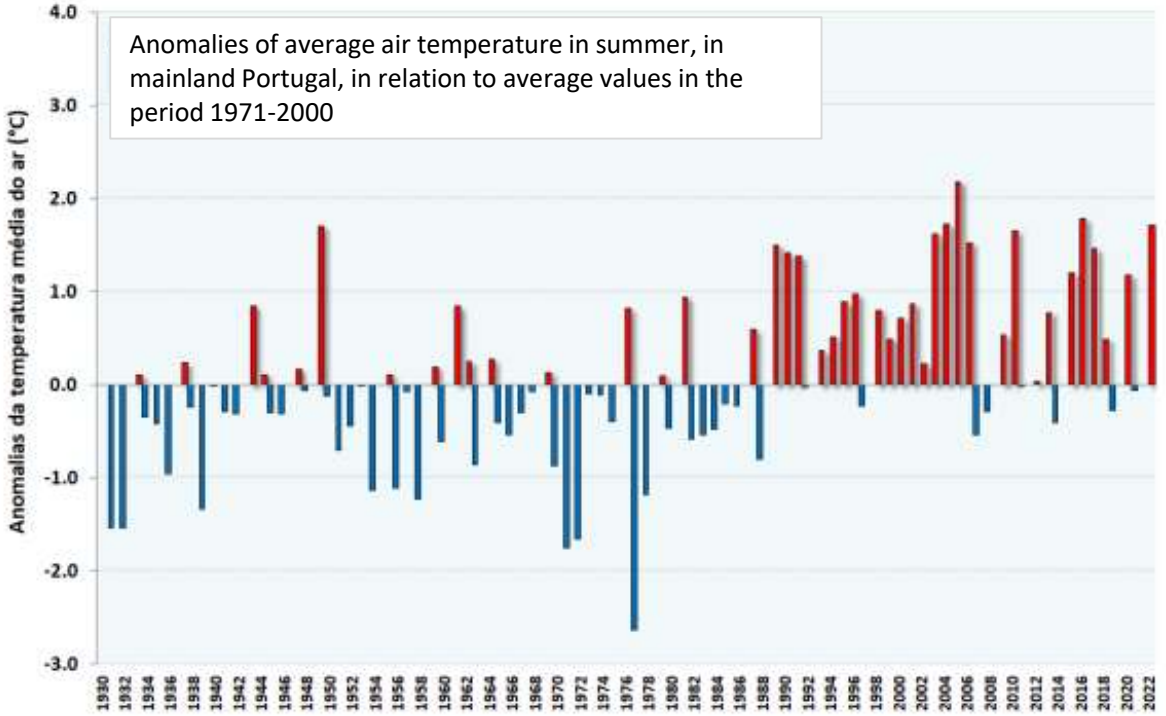


Figure 2.3. Potential reinforcing feedback loop of climate change on wildfires. Climate change will directly affect the frequency and magnitude of extreme weather conducive to the outbreak and spread of wildfires. It will also lead to longer wildfire seasons where the fire season may begin earlier and end later. Increased wildfire activity can positively impact greenhouse gas emissions that reinforce climate change drivers.



Source: Boletim Sazonal Verão 2022
https://www.ipma.pt/resources.www/docs/im.publicacoes/edicoes.online/20221219/aaOEfwPGeYtjVuhLpbcy/cli_20220801_20220831_pcl_sz_co_pt.pdf

Source: report United Nations Environment Programme: Spreading like wildfire the rising threat of extraordinary landscape fires

Why is fire analysis important in the operational decision support process?

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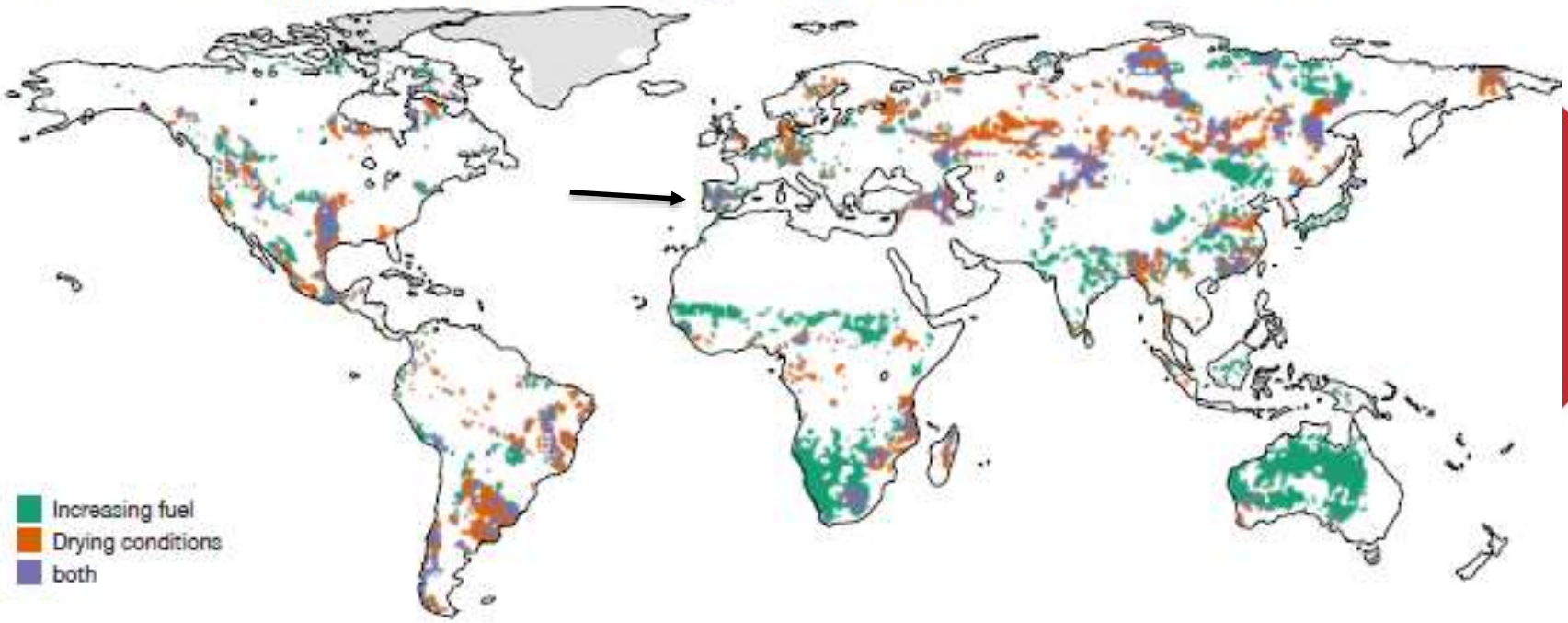
Fuel



Increases in burnt area due to changing fuel and/or moisture, 2001-2014

Figure 2.4. Areas where increases in burnt area between 2001 and 2014 were driven by changes in either fuel loads, moisture content, and/or fuel and moisture, using the same fuel and moisture controls as in Figure 1.7.

Source: report United Nations Environment Programme: Spreading like wildfire the rising threat of extraordinary landscape fires

Why is fire analysis important in the operational decision support process?

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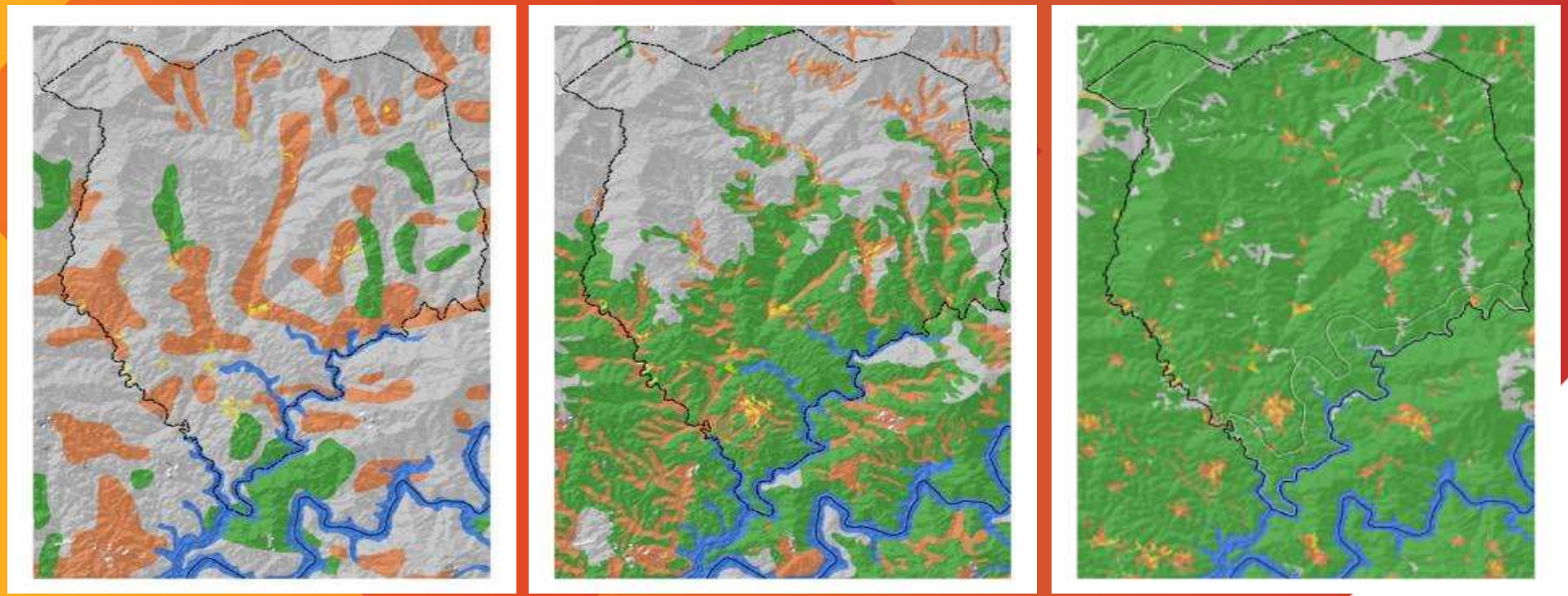
Fuel

1910 1960 2015



Source: Alvares Case Study (representative of the center of Portugal)

Why is fire analysis important in the operational decision support process?

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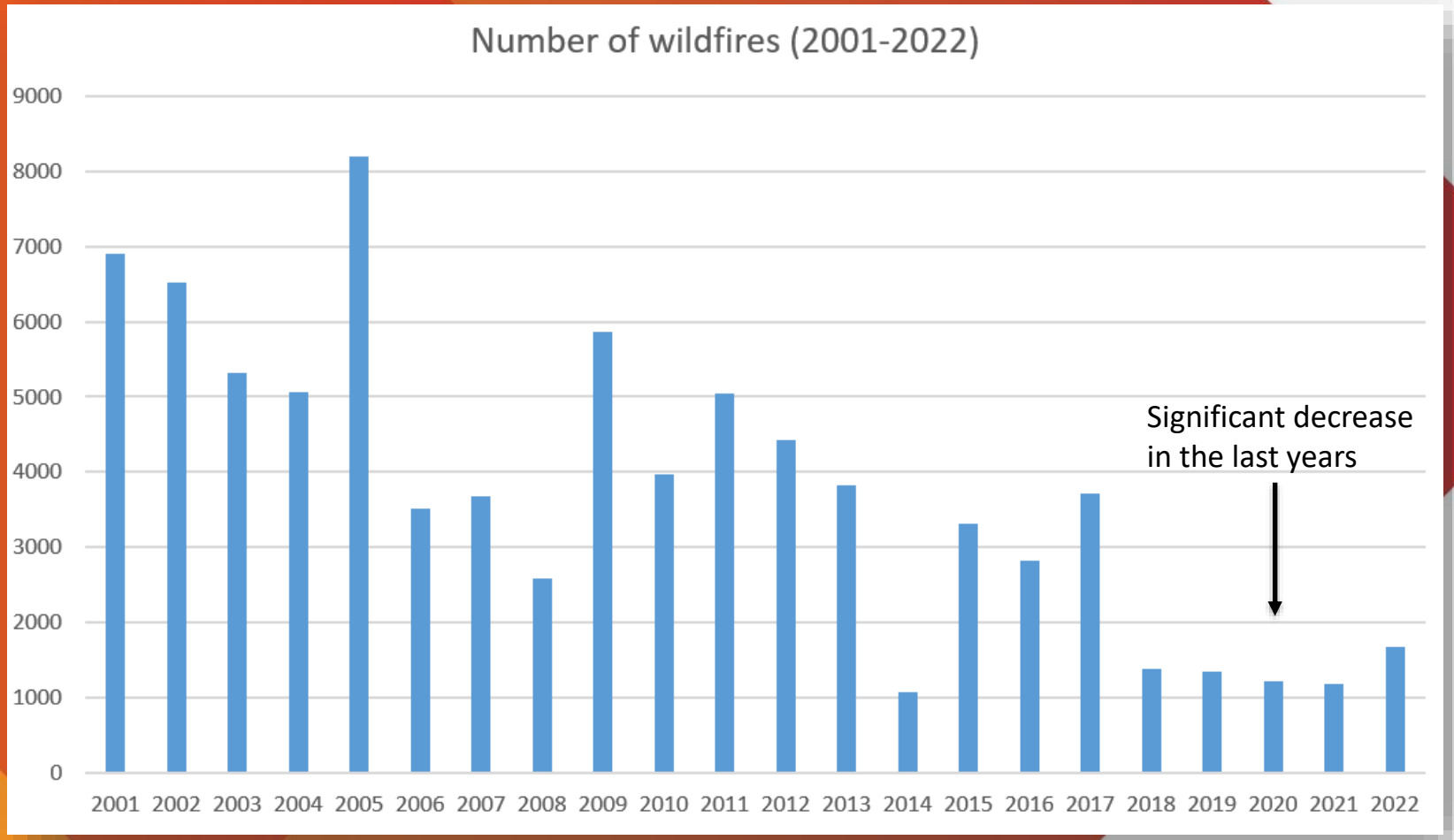
Human activity



Source: SGIF - ICNF

Why is fire analysis important in the operational decision support process?

High temperatures, low humidity, and strong wind are major wildfire climatic drivers of wildfires, together with previous weather conditions that predispose fuel available to burn

(Bradstock 2010)

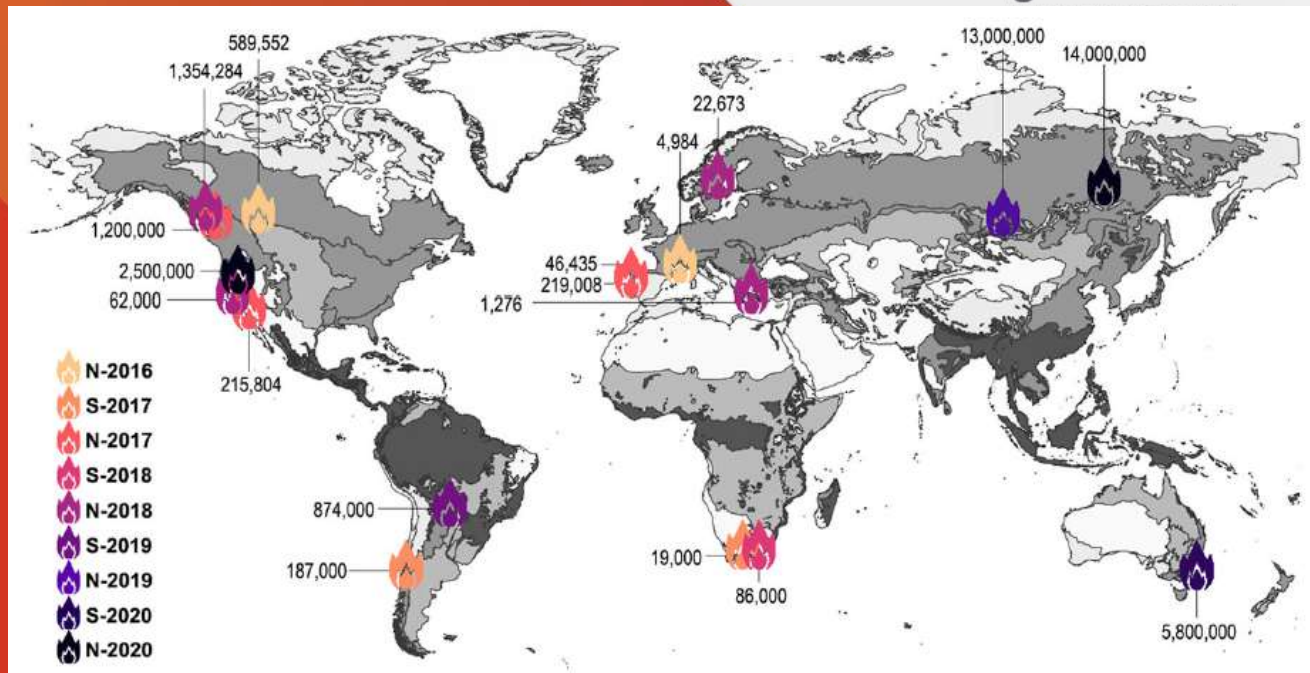


Fig. 1 Location of illustrative extreme wildfire events or episodes reviewed in this study from May 2016 to December 2020. The different flame colors indicate the temporality of the events (legend). N indicates fire season in the Northern hemisphere (~ May–October), and S fire season in the Southern hemisphere (~ November previous year–February). Numbers indicate the burnt area in each EWE according to the sources indicated in Table S1. Region limits correspond to Olson et al.'s (2001) ecoregions classification colored in 5 levels according to a productivity gradient (from darker (moister) to lighter (drier): Tropical and subtropical moist broadleaf and coniferous forests, mangroves, flooded grasslands, and savannas. Tropical and subtropical dry broadleaf forests, boreal forests/taiga, temperate conifer, broadleaf, and mixed forests. Tropical, subtropical and temperate grasslands, savannas, and shrublands. Mediterranean forests, woodlands and scrub, montane grasslands and shrublands, and tundra. Deserts and xeric shrublands, inland water, and rock and ice)

Source: Duane et all (2021))Towards a comprehensive look at global cdrivers of novel extreme wildfire events

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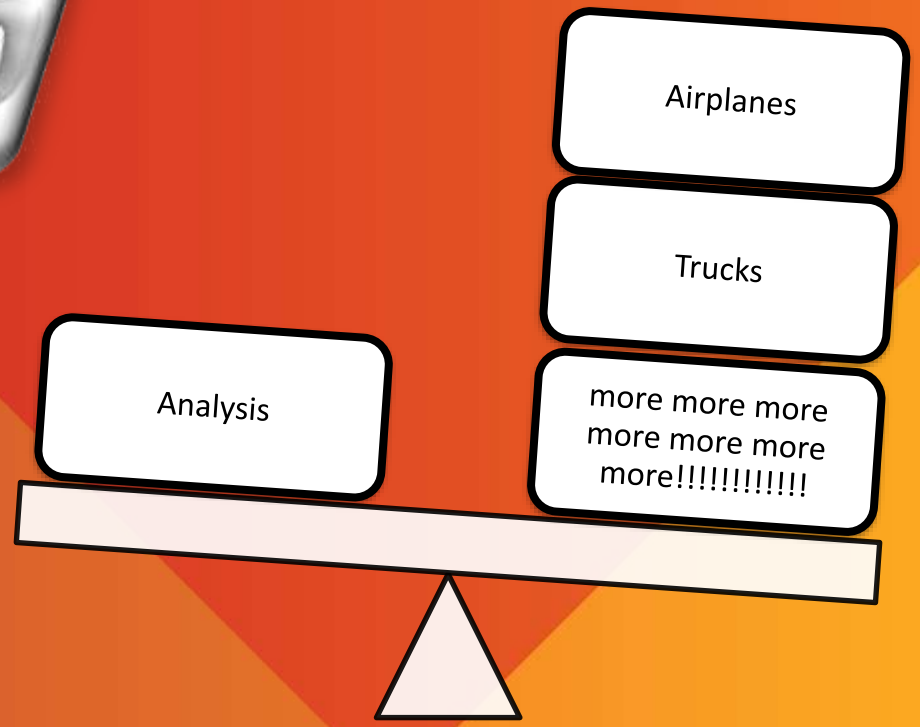
Why is fire analysis important in the operational decision support process?

more resources
does not mean being more efficient...

Specialized resources

Generic resources



What is the fire analysis structure at ANEPC?

Portuguese case

The **National Emergency and Civil Protection Authority (ANEPC)** is the national authority in terms of emergency and civil protection in Portugal. It is a central service of direct state administration, with administrative and financial autonomy and its own patrimony.

The **Special Civil Protection Force (FEPC)** has its own Command and structure, and it depends on the National Command of Emergency and Civil Protection.

The **Use of Fire and Analysis Group (GAUF)** is a group made up of 29 members of the Special Civil Protection Force, that are specialists in analysis and in the use of fire. All members are trained in prescribed burns and fire suppression.

The School of Agriculture – University of Lisbon has developed research in the last decades in the areas of wildfire behavior, remote sensing, modelling

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Science

Support developments

- Technical
- Training

Wildfires Analysis

- Strategic
- Tactic
- Maneuver

Decision

National

Regional

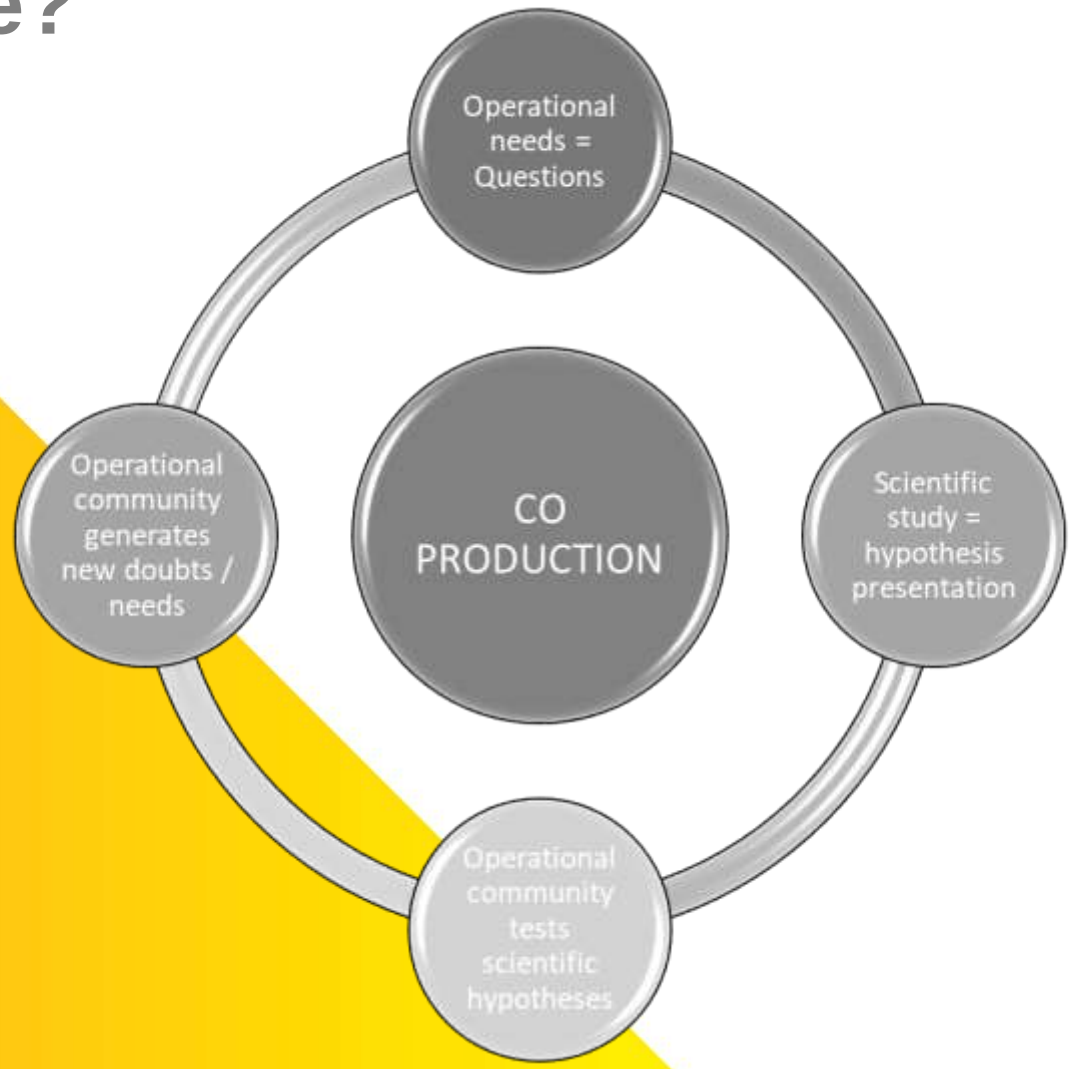
Incident Commander

How can Science contribute?

	Doesn't know he has a problem	Knows he has a problem, doesn't know the solution	Knows he has a problem, knows the solution
Doesn't want to know the practical problem	Business as usual		
Doesn't know the practical problem		Knowledge transfer	
Knows or wants to know the practical problem			**Co-creation**

How can Science contribute?

- ✓ Understand the needs of practitioners
- ✓ Develop targeted research
- ✓ Co-develop products useful to support better decision-making
- ✓ Integrate lessons learned
- ✓ Participate in capacity building
- ✓ Be presente and available



Overview

- ✓ Update information fire database
- ✓ Reports, Case Studies
- ✓ Lessons Learned
- ✓ Change procedures

- ✓ Strategic Operational Analysis
- ✓ Daily briefing at National Command
- ✓ Prescribed Burning
- ✓ Fuel data collection
- ✓ Training IC
- ✓ Product Development

- ✓ Fire Monitoring
- ✓ Support strategic and tactical suppression decisions
- ✓ Tactical fire

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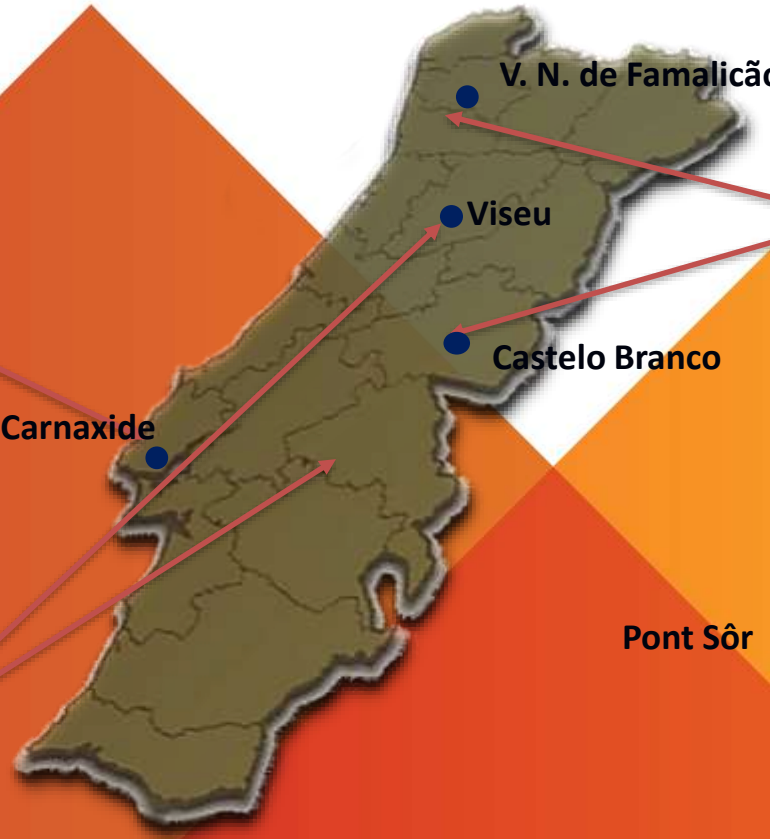
INSTITUTO SUPERIOR DE AGRONOMIA
Hinc Patriam Sustinet
Universidade de Lisboa

Decision Support Cell - Analysis of Rural Fires

NAD-AIR



Fire Analysis and Use use of technical fire

EAUF

Reconnaissance Aircraft Evaluation and Coordination

AVRAC

Portuguese case

How is fire analysis carried out at ANEPC?

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Tactical Analysis

Field intervention

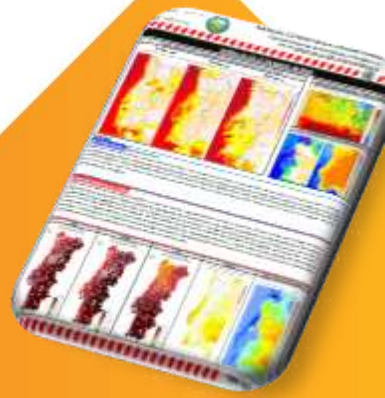
AVRAC

EAUF

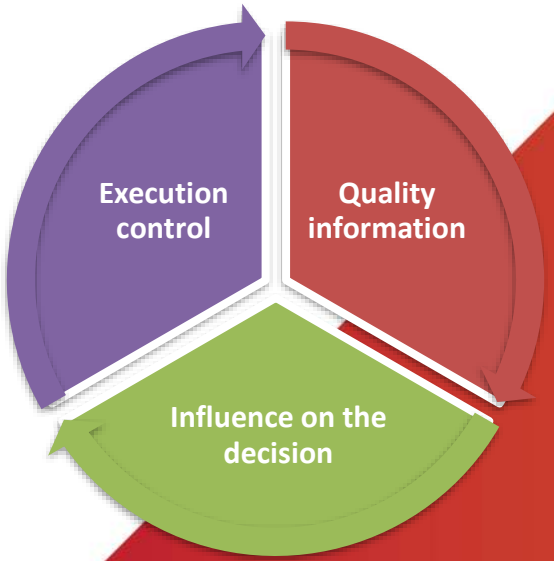
NAD-AIR

Strategical Analysis

Operational Information
(during the event)



Strategic Operational Analysis
(before the event)



Influence maneuver

Daily briefing at the National Command

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Strategic Operational Analysis

Types of Information

	what to evaluate ?	What message?
Operational Statistics	Anomaly	Where
Meteorological conditions	Maps; Indexes	change of periods
Landscape conditions	Fuel (type and moisture)	Type of combustion, Consolidation difficulty

Main Objective:
Predict the potential for fire development 3 days in advance and reduce the process of uncertainty in the operational decision

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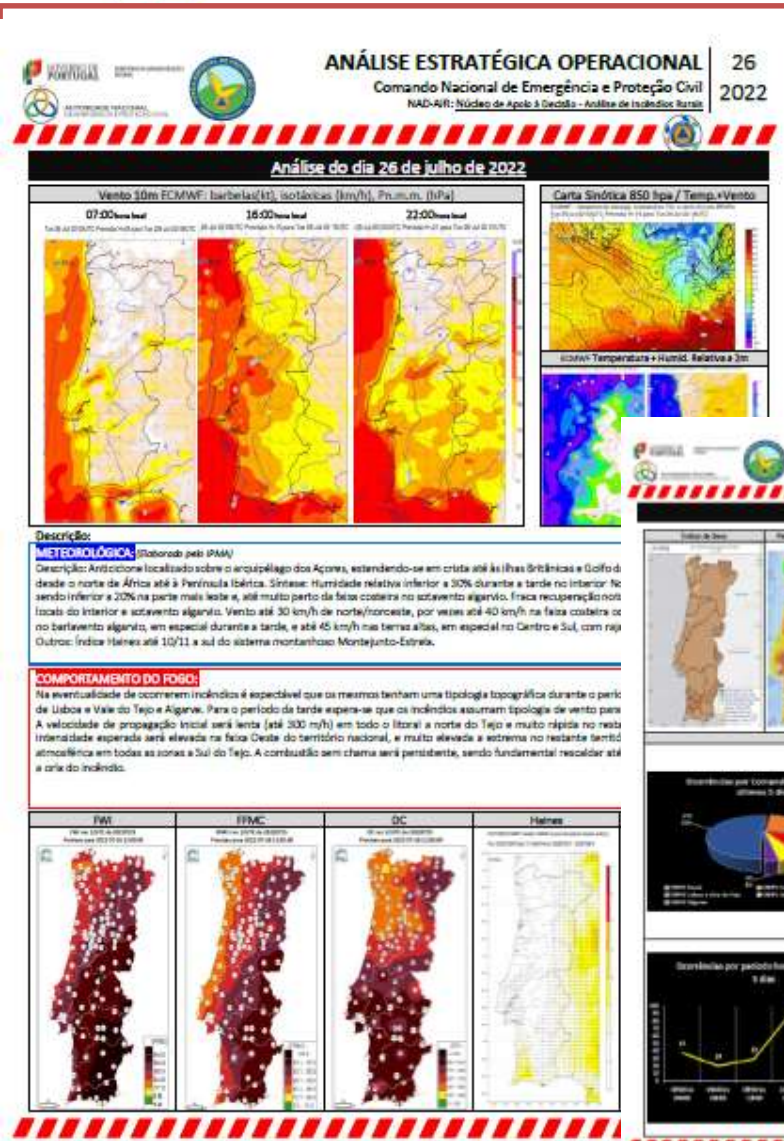
Strategic Operational Analysis

National Level


ANÁLISE ESTRATÉGICA OPERACIONAL 26 2022
Comando Nacional de Emergência e Proteção Civil
NAD-AIR: Núcleo de Apoio à Decisão - Análise de Incêndios Rurais

Análise do dia 26 de julho de 2022

Vento 10m ECMWF: barbelas(kt), isotáxicas (km/h), Pn.m.m. (hPa)

07:00 hora local | 16:00 hora local | 22:00 hora local

Carta Sinótica 850 hpa / Temp.+Vento

ECMWF-Temperatura + Humid. Relativa a 2m

Descrição:

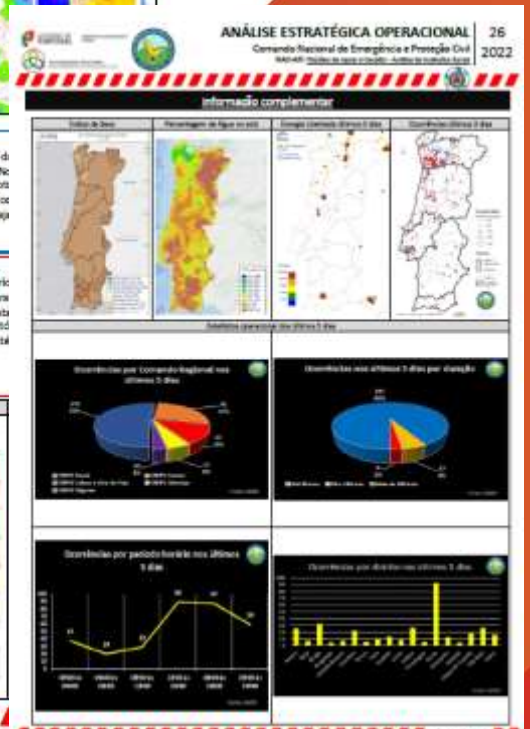
METEOROLÓGICA: (Elaborado pelo IPMA)

Descrição: Anticiclone localizado sobre o arquipélago dos Açores, estendendo-se em crista até às ilhas Britânicas e Golfo d
desde o norte de África até à Península Ibérica. Síntese: Humidade relativa inferior a 30% durante a tarde no interior. No
sendo inferior a 20% na parte mais leste e, até muito perto da faixa costeira no sotavento algarvio. Fraca recuperação nort
locais do interior e sotavento algarvio. Vento até 30 km/h de norte/noroeste, por vezes até 40 km/h na faixa costeira o
no barlavento algarvio, em especial durante a tarde, e até 45 km/h nas terras altas, em especial no Centro e Sul, com raj
Outros: Índice Haines até 10/11 a sul do sistema montanhoso Montejunto-Estrela.

COMPORTAMENTO DO FOGO:

Na eventualidade de ocorrerem incêndios é expectável que os mesmos tenham uma tipologia topográfica durante o perío
de Lisboa e Vale do Tejo e Algarve. Para o período da tarde espera-se que os incêndios assumam tipologia de vento para
A velocidade de propagação inicial será lenta (até 300 m/h) em todo o litoral a norte do Tejo e muito rápida no resto
intensidade esperada será elevada na faixa Oeste do território nacional, e muito elevada a extrema no restante territó
atmosférica em todas as zonas a Sul do Tejo. A combustão sem chama será persistente, sendo fundamental rescaldar até
a orla do incêndio.

FWI | FFMC | DC | Haines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Informação complementar

Regional Level


ANALISE ESTRATEGICA OPERACIONAL 26 2022
Comando Nacional de Emergência e Proteção Civil
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COMANDO REGIONAL ALGARVE

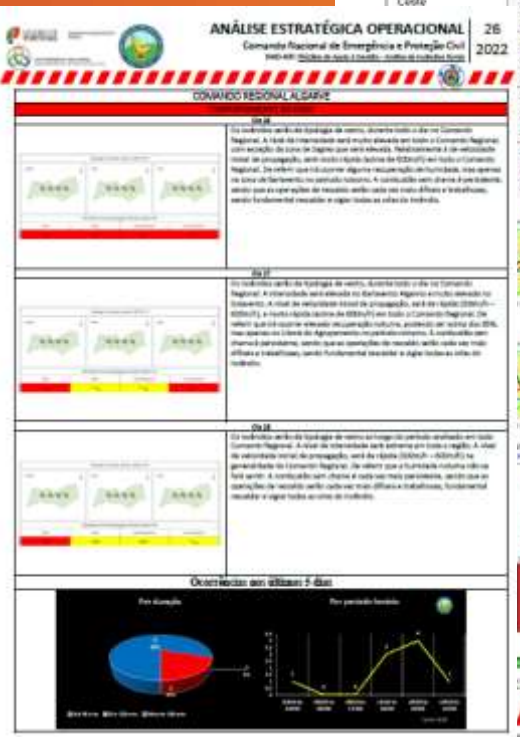
METEOROLOGIA (elaborado pelo IPMA)

Humidade relativa: valores inferiores a 20% durante as tardes, exceto na faixa costeira ocidental. Fraca recuperação noturna nas noites de 24 para 25 e de 25 para 26, com valores inferiores a 30% nas serras na noite de 24 para 25. Vento: até 30 km/h de nor-noroeste, sendo entre o meio das tardes e início das manhãs, até 40 km/h no litoral oeste e no barlavento, e até 45 km/h nas serras, por vezes com rajadas até 60 km/h, em especial nos dias 25 e 26, sendo temporariamente de sudoeste na faixa costeira do sotavento durante as tardes (brisa).
Outros: Índice Haines até 12/13, a descer gradualmente para 9/10 no dia 26.


IPMA

Previsão de: 20220725 12UTC, atualizada em: 2022-07-25 22:00UTC

Zona 5 Algarve	Dia	Temperatura Ar (°C)	Humidade Rel. (%)	Vento Médio (km/h) / Rumo			FFMC (máx.)	DC (máx.)	FWI (máx.)
		valor mód	valor máx	valor mód	valor máx	manhã	tarde	noite			
Leste	26	36	38	20	26	18	55	64	20-25/ N	20-25/ NW	15-20/ NW	97	934	52
	27	34	35	18	20	23	21	69	75	15-20/ NW	15-20/ NW	20-25/ N	94	943	61
	28	34	36	20	22	26	23	51	58	20-25/ N	15-20/ NW	15-20/ N	94	982	52
	26	33	34	20	22	33	24	71	99	15-20/ N	20-25/ NW	15-20/ N	94	1031	65
	27	29	31	17	19	43	36	86	108	15-20/ NW	30-35/ NW	15-20/ N	96	1036	69
	28	30	33	17	19	43	30	73	89	20-25/ N	20-25/ NW	20-25/ N	95	1048	66
Barrocal	26	33	34	20	22	46	25	74	84	20-25/ N	25-30/ NW	15-20/ N	94	1031	65
	27	30	30	17	19	54	34	91	99	20-25/ NW	25-30/ NW	20-25/ N	96	1039	69
	28	34	33	17	19	54	35	77	86	20-25/ N	25-30/ NW	20-25/ N	96	1048	66
Serra	26	30	30	20	20	21	18	40	55	15-20/ N	20-25/ NW	15-20/ N	90	941	77
	27	32	34	20	20	27	22	64	86	10-15/ NW	15-20/ NW	15-20/ NW	93	959	54
	28	34	34	20	22	27	24	48	51	10-15/ N	10-15/ NW	15-20/ N	94	988	54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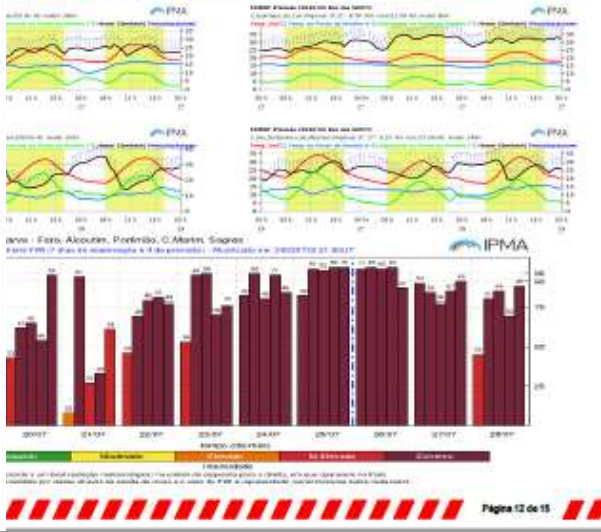
Comando Nacional de Emergência e Proteção Civil

COMANDO REGIONAL ALGARVE

Ocorrências nos últimos 5 dias


IPMA

Faro, Alcoutim, Portimão, C.Martin, Sagres

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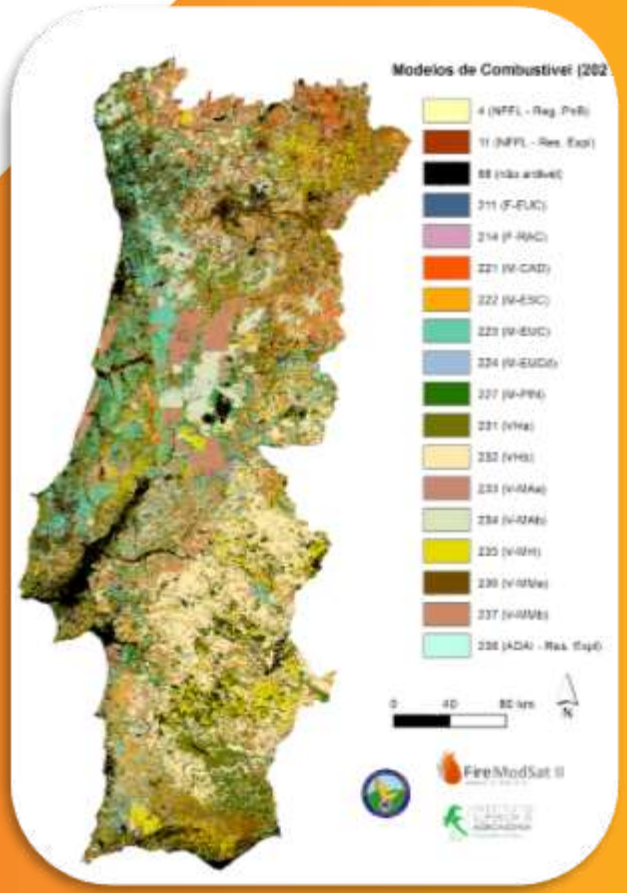
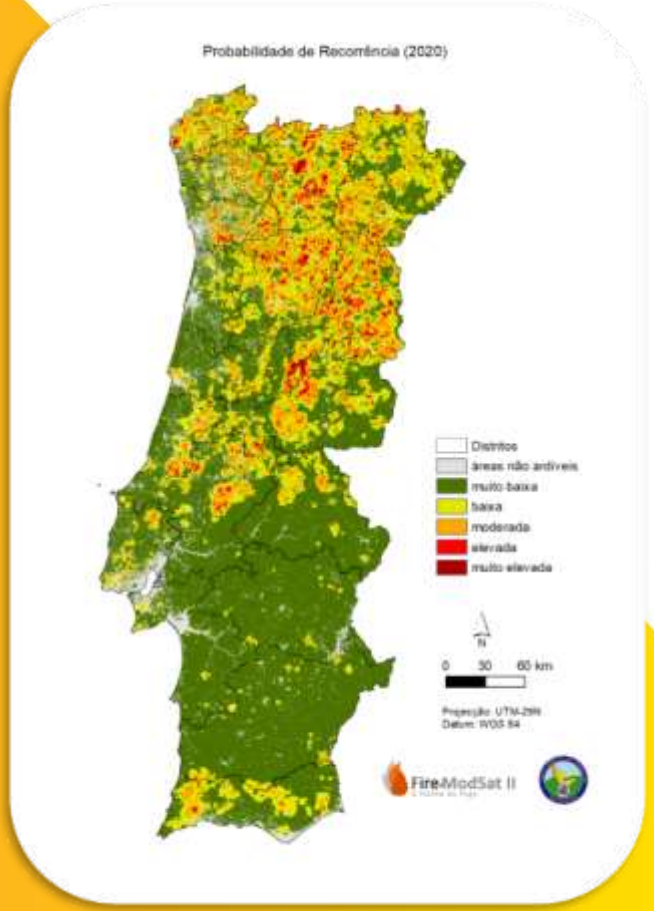
Fuel Model Map



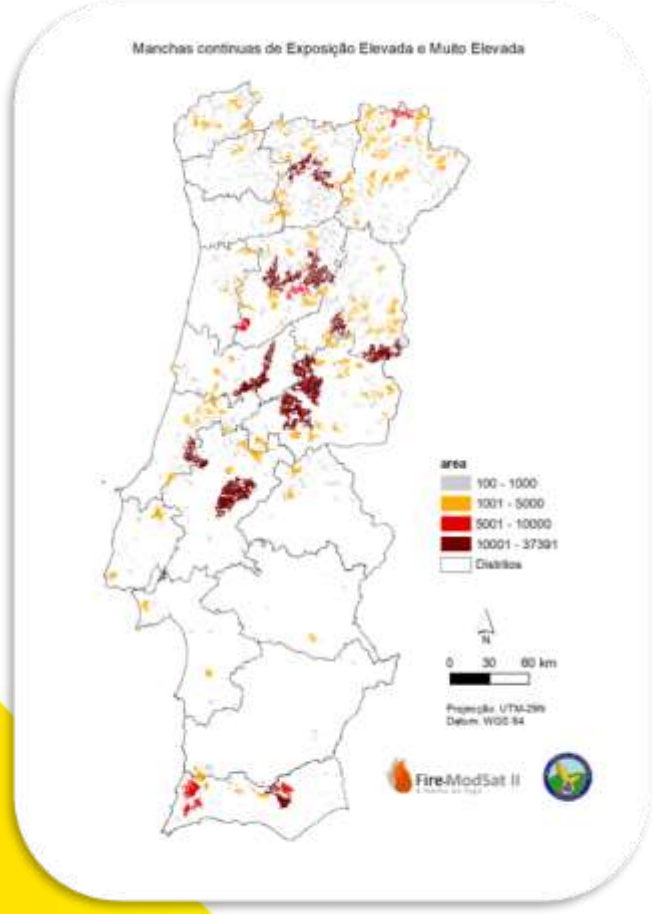
developed by Ana Sá

Fire re-occurrence probability



developed by Hugo Gonçalves

Large continuous patches of high and very high exposure



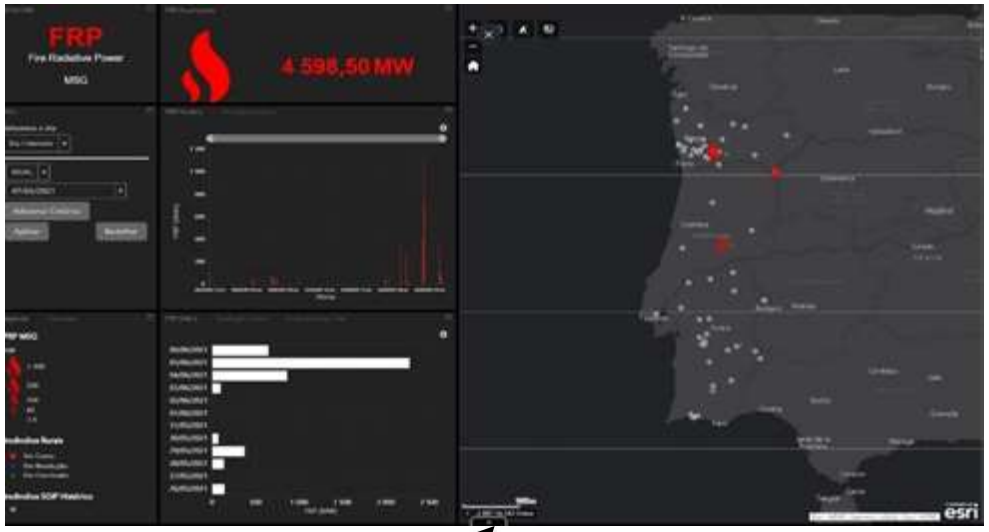
developed by Ana Sá

Collaborative fuel data collection

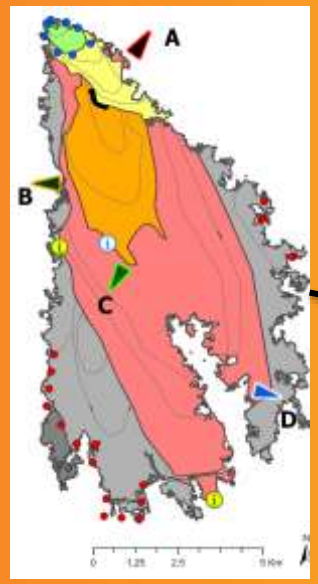
Fire released energy monitoring

- ✓ Near-real time monitoring for Fire Radiative Energy (FRE)
- ✓ Meteosat II (every 15')

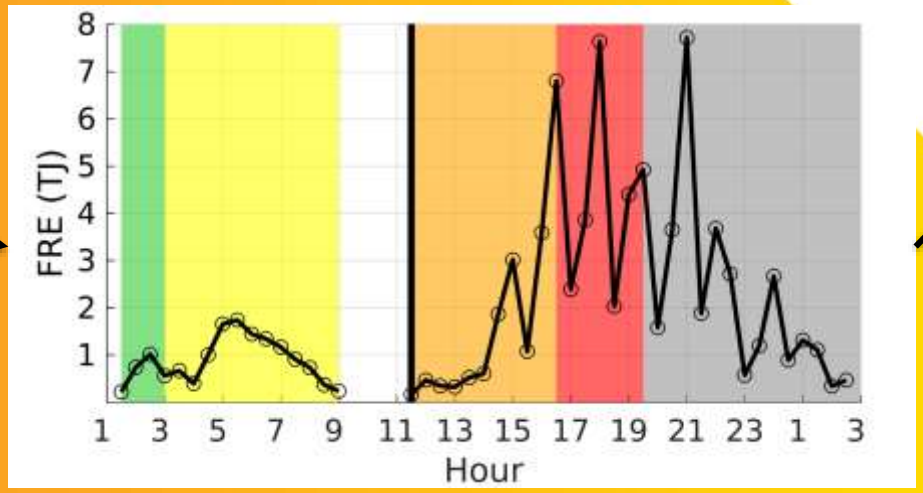
Operational platform



developed by Carlos Mota

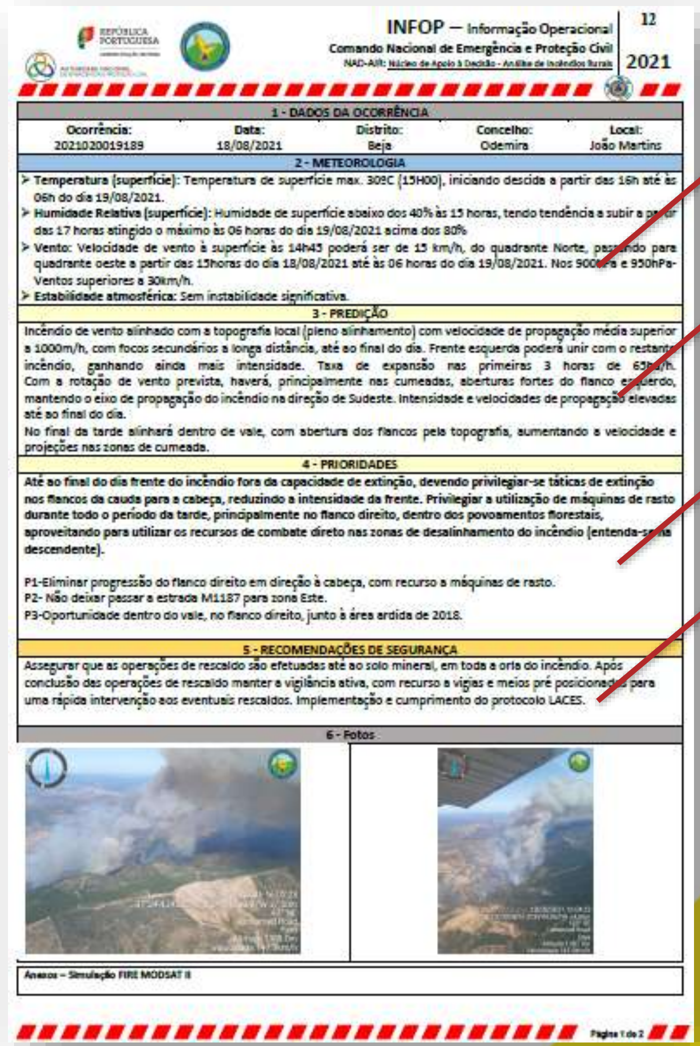


FRE temporal profile



Operational Information

The main goal is translate complex information into operational language



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NAD-AIR: Núcleo de Apoio à Decisão - Análise de Incêndios Rurais
12
2021

1 - DADOS DA OCORRÊNCIA

Ocorrência:	Data:	Distrito:	Concelho:	Local:
2021020019189	18/08/2021	Beja	Odemira	João Martins

2 - METEOROLOGIA

- **Temperatura (superfície)**: Temperatura de superfície max. 30ºC (15H00), iniciando descida a partir das 16h até às 06h do dia 19/08/2021.
- **Humidade Relativa (superfície)**: Humidade de superfície abaixo dos 40% às 15 horas, tendo tendência a subir a partir das 17 horas atingido o máximo às 06 horas do dia 19/08/2021 acima dos 80%
- **Vento**: Velocidade de vento à superfície às 14h45 poderá ser de 15 km/h, do quadrante Norte, passando para quadrante oeste a partir das 15horas do dia 18/08/2021 até às 06 horas do dia 19/08/2021. Nos 900hPa e 950hPa- Ventos superiores a 30km/h.
- **Estabilidade atmosférica**: Sem instabilidade significativa.

3 - PREDIÇÃO

Incêndio de vento alinhado com a topografia local (pleno alinhamento) com velocidade de propagação média superior a 1000m/h, com focos secundários a longa distância, até ao final do dia. Frente esquerda poderá unir com o restante incêndio, ganhando ainda mais intensidade. Taxa de expansão nas primeiras 3 horas de 65ha/h. Com a rotação de vento prevista, haverá, principalmente nas cumeadas, aberturas fortes do flanco esquerdo, mantendo o eixo de propagação do incêndio na direção de Sudeste. Intensidade e velocidades de propagação elevadas até ao final do dia.

No final da tarde alinhará dentro de vale, com abertura dos flancos pela topografia, aumentando a velocidade e projeções nas zonas de cumeada.

4 - PRIORIDADES

Até ao final do dia frente do incêndio fora da capacidade de extinção, devendo privilegiar-se táticas de extinção nos flancos da cauda para a cabeça, reduzindo a intensidade da frente. Privilegiar a utilização de máquinas de rasto durante todo o período da tarde, principalmente no flanco direito, dentro dos povoamentos florestais, aproveitando para utilizar os recursos de combate direto nas zonas de desalinhamento do incêndio (entenda-se na descendente).

P1-Eliminar progressão do flanco direito em direção à cabeça, com recurso a máquinas de rasto.
P2- Não deixar passar a estrada M1187 para zona Este.
P3-Oportunidade dentro do vale, no flanco direito, junto à área ardida de 2018.

5 - RECOMENDAÇÕES DE SEGURANÇA

Assegurar que as operações de rescaldo são efetuadas até ao solo mineral, em toda a orla do incêndio. Após conclusão das operações de rescaldo manter a vigilância ativa, com recurso a vigias e meios pré posicionados para uma rápida intervenção aos eventuais rescaldos. Implementação e cumprimento do protocolo LACES.

6 - Fotos

Anexos – Simulação FIRE MODSAT II

Página 1 de 2

Meterological predition

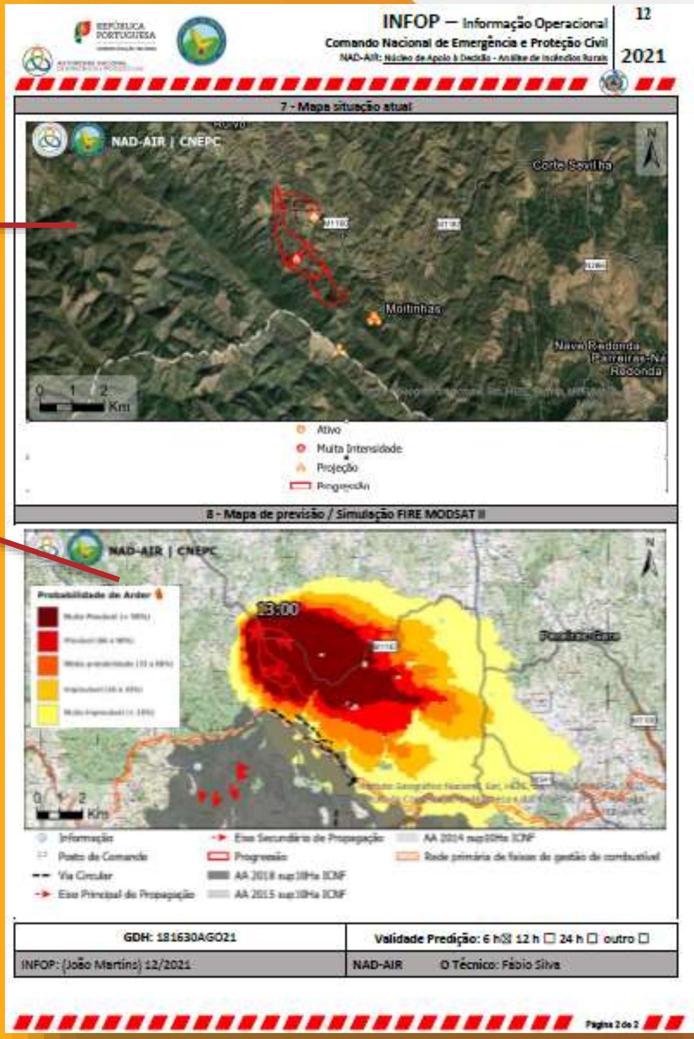
Fire behaviour predition

Tactical proposals

Safety recomendations

Characterization of reality

Forecast map and proposals



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12
2021

7 - Mapa situação atual

8 - Mapa de previsão / Simulação FIRE MODSAT II

GDH: 181630AGO21	Validade Predição: 6 h☒ 12 h ☐ 24 h ☐ outro ☐
INFOP: (João Martins) 12/2021	NAD-AIR O Técnico: Fábio Silva

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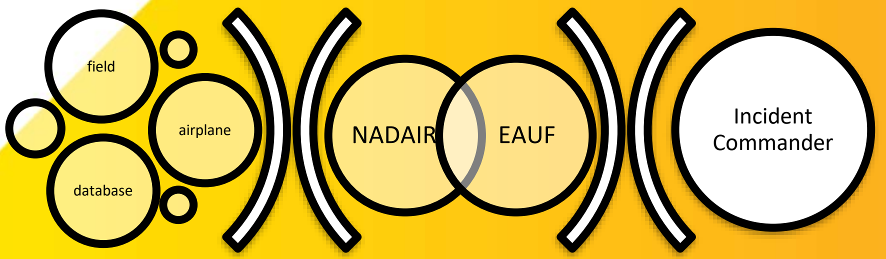
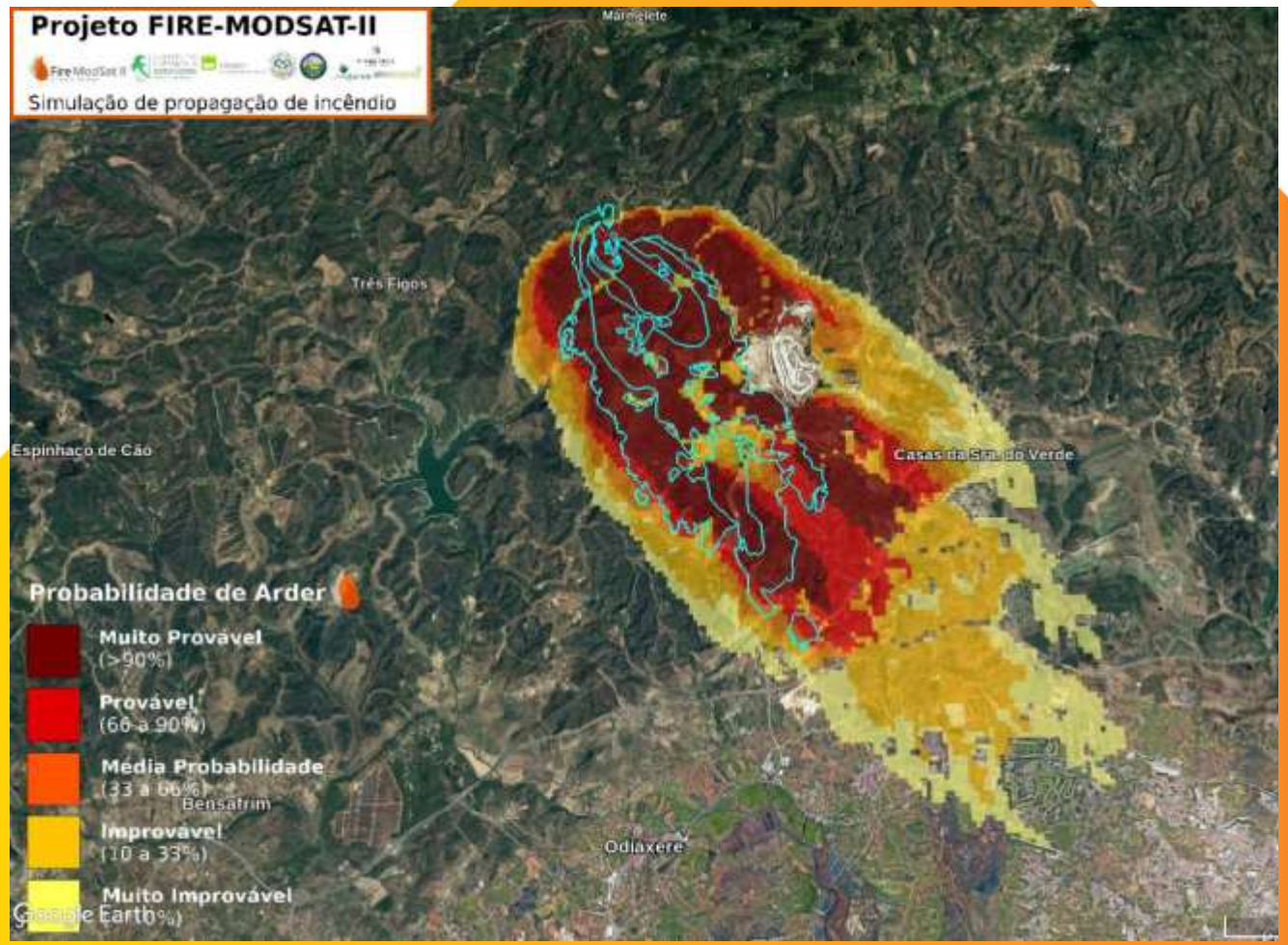


Quality information **Analysis process** **Influence decision**

Fire spread simulation

- ✓ Stochastic fire spread simulation
- ✓ Calibrated with observed fire behavior in PT
- ✓ Antecipation of potential fire behavior
- ✓ Identify windows of opportunity
- ✓ Support strategic decision-making

Monchique, 2021

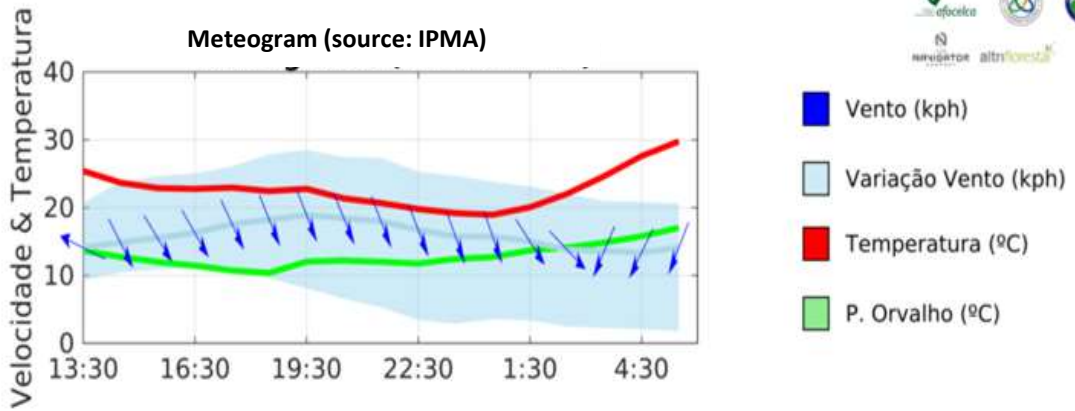


Fire spread simulation

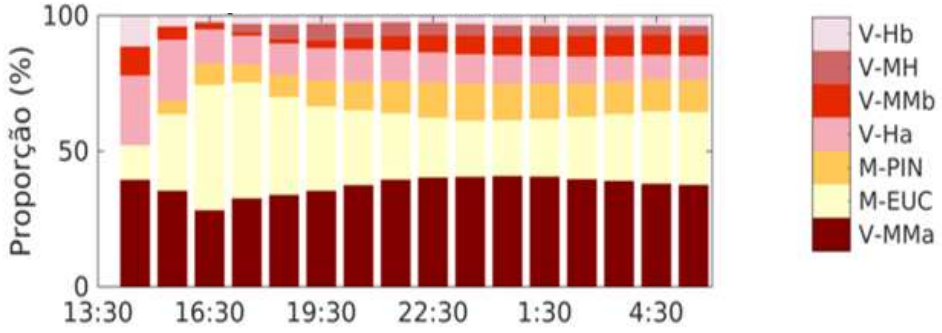
Monchique 17/7/2021 (2021080029244)

FireModSat II

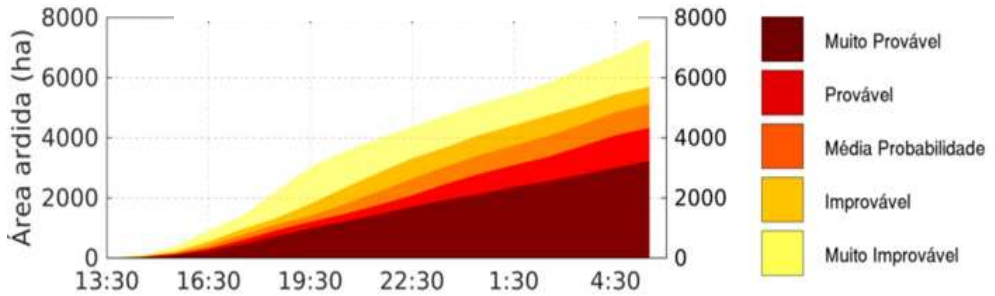
Meteogram (source: IPMA)



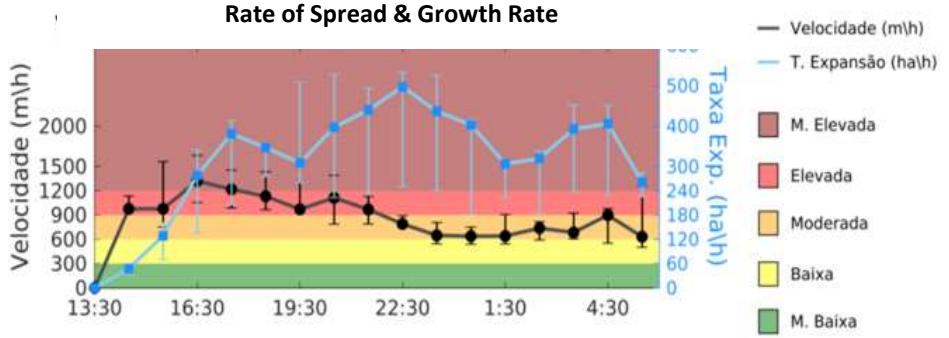
Type of fuel burned



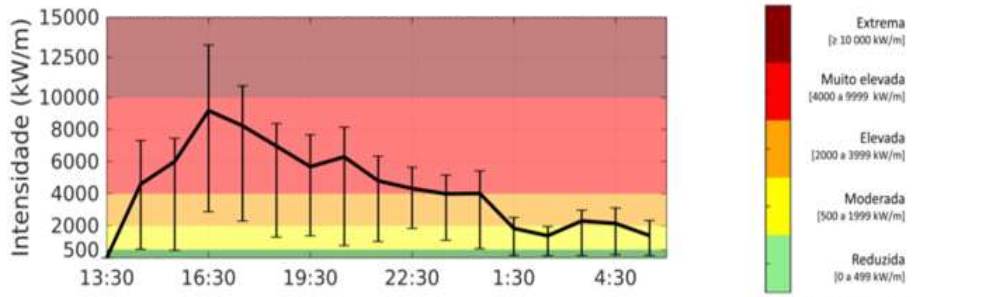
Potential burned extent (ha)



Rate of Spread & Growth Rate

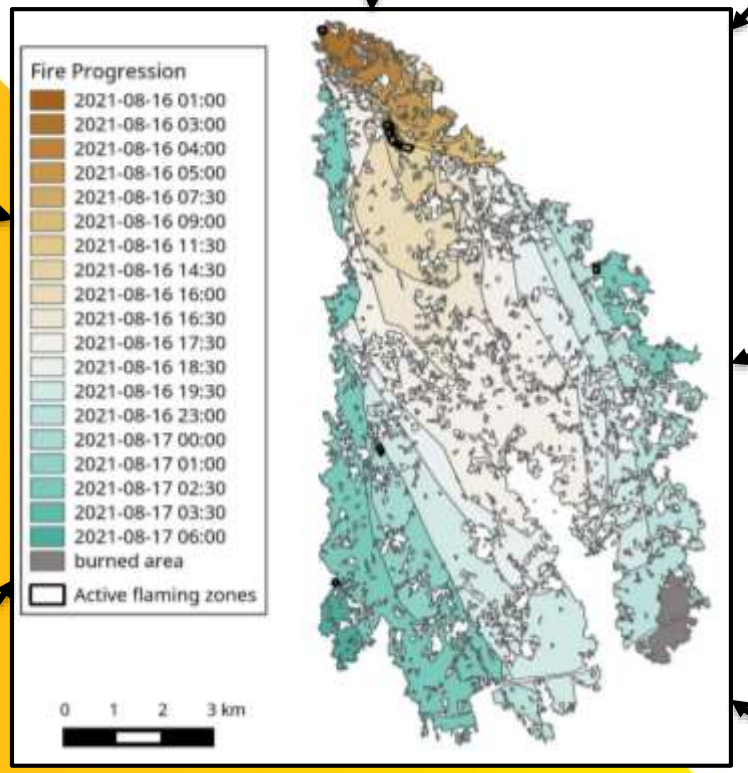


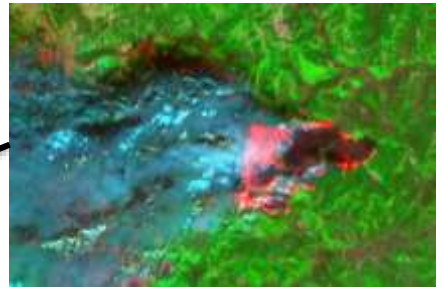
Fireline intensity

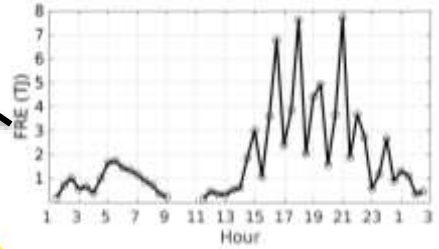


PT Fire-Spread Database

- ✓ Reconstruct the fire spread and behavior
- ✓ 81 large wildfires in Portugal (2015-2021)
- ✓ Fire behavior descriptors







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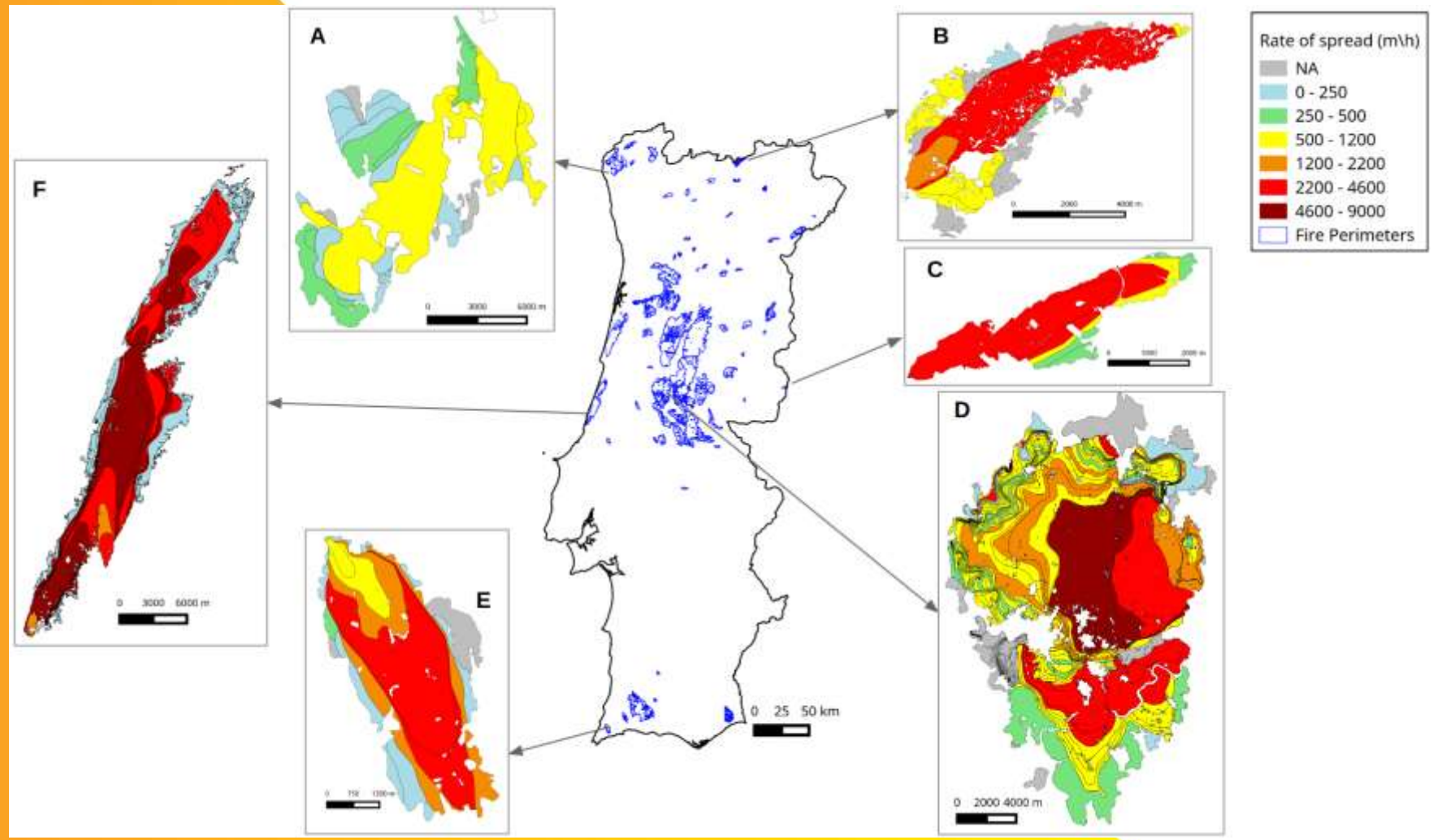

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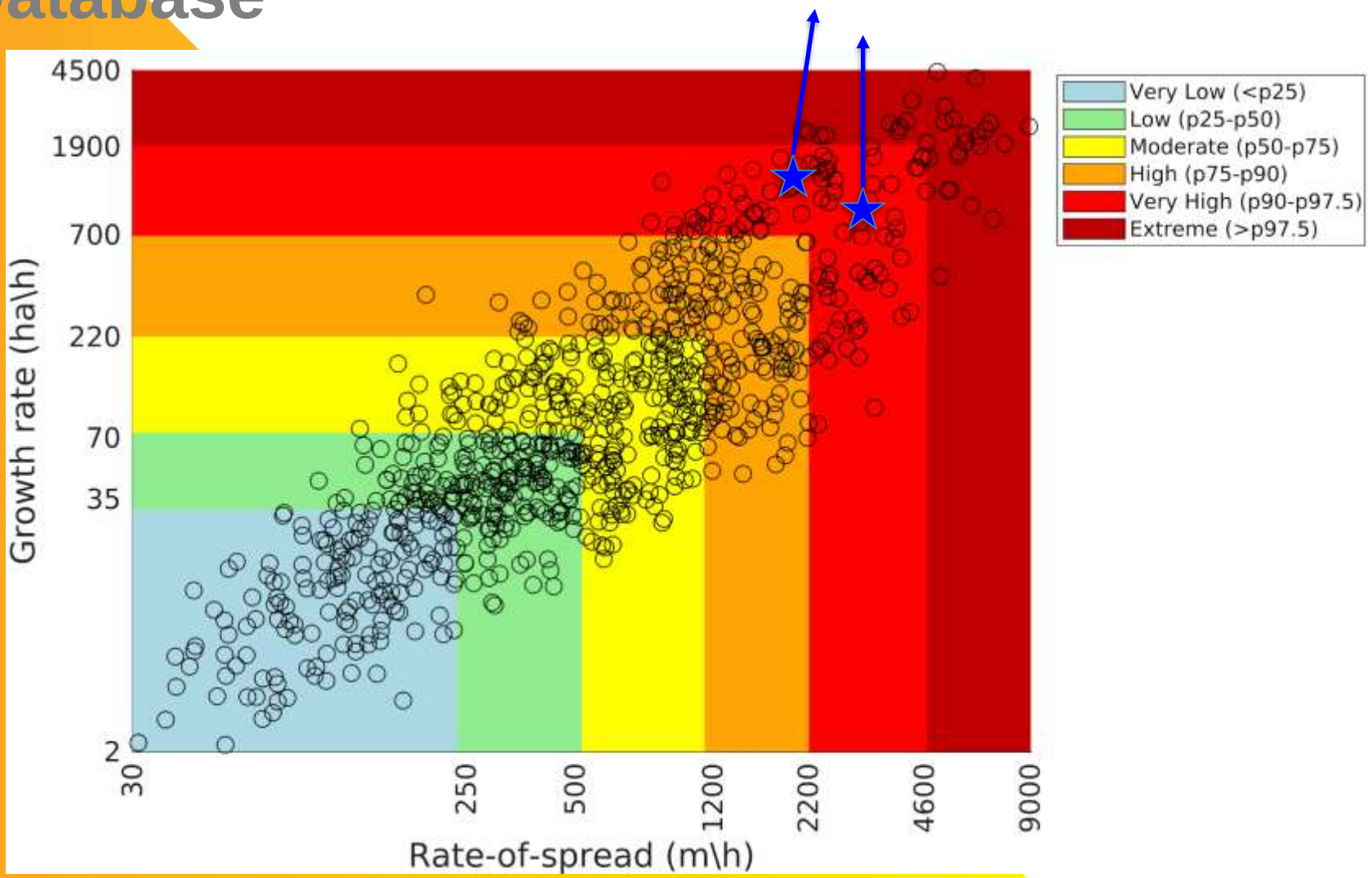

Necessary improvements

8TH INTERNATIONAL WILDLAND FIRE CONFERENCE

1. Better communication between agents
2. Better balance between specialized and general resources
3. Set up alerts and resource pre-allocation based on clear, transparent and robust fire analysis
4. Better training of the agents based on solid knowledge
5. Improve fire behavior prediction to better decision-making
6. Increased investment in applied research
7. Better and wider relation between researchers and practictioners (“Science that matters”)

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FIND OUT MORE
AND REGISTER AT:

www.wildfire2023.pt

Alexandre Penha alexandre.penha@prociv.pt

Fábio Silva fabio.silva@prociv.pt

Akli Benali aklibenali@gmail.com