FIRE-RES

WP2 - Adaptative territorial management

Designing strategic networks of managed areas to improve supresion efforts again EWE

Dr. José Ramón González-Olabarria

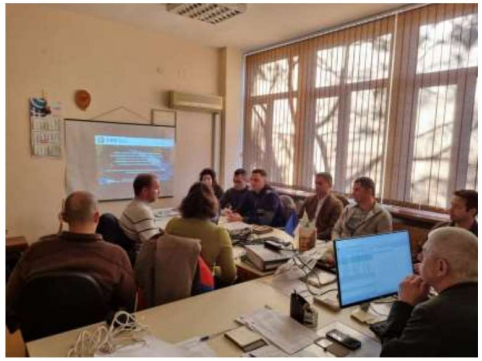
Funded by the European Union

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101037419. It does not necessarily reflect the view of the European Union and in no way anticipates the Commission's future policy in this area.

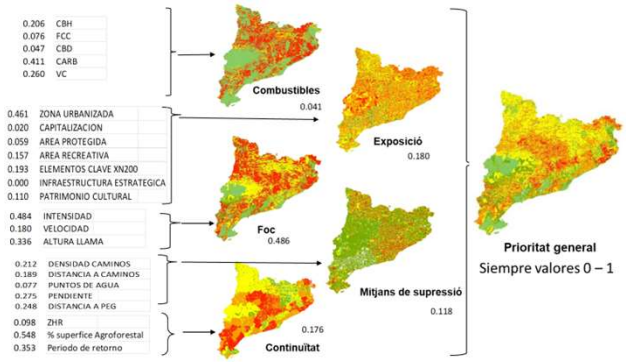
Strategic networks of managed areas to improve suppression efforts

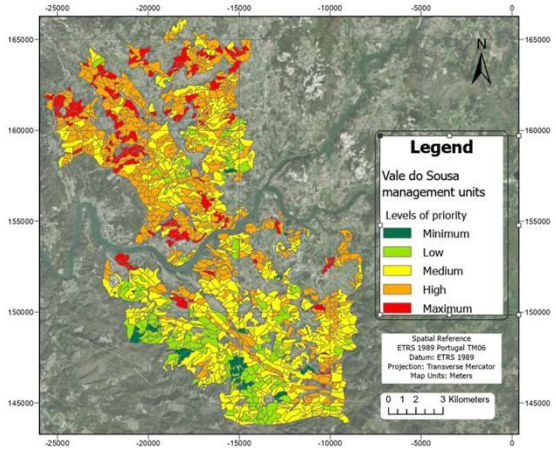
Selection and parameterization of **indicators and criteria** within a multicriteria approach for prioritizing areas to manage with the goal of preventing large forest fires, e.g., areas of high value and/or close to infrastructures that help suppression efforts.

Involvement of stakeholders



Implementation at different levels





Why??

- Most problems depend on multiple and diverse criteria
- **Multi-criteria** decision analysis (MCDA) makes stakeholder relationships more structured and transparent.
- A participatory process with different actors-DMs may help not only to obtain a more robust result, but also more acceptable
  - Acceptability in many cases translates into applicablility
- Prioritization is a need when resources are limited

Objective

Selection and parameterization of indicators and criteria for prioritizing management zones with the goal of preventing large forest fires, nearby areas of high value, and close to infrastructures that help suppression efforts.

Based on the idea that:

1) areas of high fuel hazard, where intense fire behaviour is expected should be considered first when planning fuel management activities,

2) far more emphasis should be provided when those hazardous areas are close by to valuable assets,

3) if an area is to be managed for taming fire behaviour, and infrastructures that support suppression activities are also available, the managed area can further facilitate suppression by opening “windows of opportunity” .

Steps for prioritization

- Once defined the question

1) Select criteria and related metrics (DMs + realistic view next step)
2) Gather the data (in our case spatial)
3) Harmonize metrics into comparable units (MAUT)
4) Provide weight to criteria and generate initial results
5) Evaluate results (DMs) and modify problem frame until a consensus is reached

Select criteria and related metrics

- Meeting with DMs (Prevention Service; Forest service; Fire-fighters..), to select criteria and define metrics (expert knowledge + literiature)

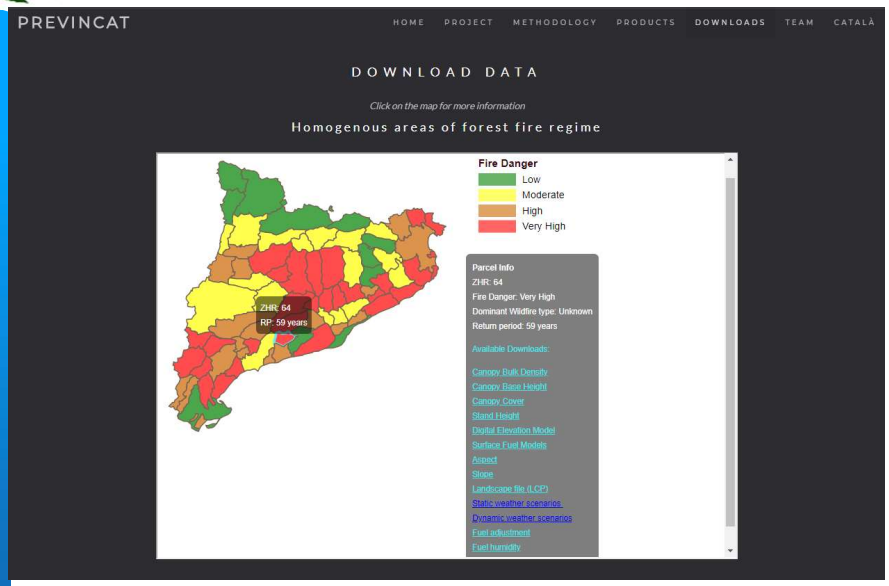
CRITERIA AND INDICATORS	DESCRIPTION	APPLIED THRESHOLD AND/OR UNIT	SOURCE
Fuel (C1)			
Canopy base height (I1)	% of the stand area with values below the established threshold	5.5 m	[34], [35]
Canopy cover (I2)	% of the stand area with values above the established threshold	50 %	[34], [35]
Canopy bulk density (I3)	% of the stand area with values above the established threshold	0.15 km/m^3	[34], [35]
Understory cover (I4)	% of the stand area with values above the established threshold	30 %	[32]
Vertical continuity (I5)	% of the stand area with values below the established threshold	5 m	[34], [35]
Fire behaviour (C2)			
Fire intensity (I6)	% of the stand area with values above the established threshold	350 Kw/m	[34]–[36]
Spread speed (I7)	% of the stand area with values above the established threshold	1.2 km/h; 0.33 m/s	[34]–[36]
Flame height (I8)	% of the stand area with values above the established threshold	3 m	[34]–[36]

Exposure (C3)			
Urbanised areas (I9)	Distance to the closest urbanised area from each stand centroid	m	[37]
Recreational areas (I10)	Distance to the closest homologated hiking trail from each stand centroid	m	[38]
Capitalisation (I11)	Comparison between mean basal area and the established threshold	40 m^2/ha	[39]
Protected nature (I12)	Distance to the closest Natura 2000 area from each stand centroid	m	[37]
Cultural heritage (I13)	Distance to the closest architectonic, archaeological or paleontological monument from each stand centroid	m	[37]
Strategic infrastructure (I14)	Distance to the closest powerline or highway from each stand centroid	m	[37]

Accessibility (C4)			
Aspect (I15)	Terrain aspect	%	[34], [35]
Road density (I16)	Density of path and roads wider than 2.5 m (suitable for fire engines) within each stand	km/km^2	[40]
Road distance (I17)	Distance to the closest path or road wider than 2.5 m (suitable for fire engines) from each stand centroid	m	[40]
Water availability (I18)	Distance to the closest water body or well with the capacity of more than 50 m^3 from each stand centroid	m	[40]
Strategical management areas (I19)	Distance to the closest area classified as strategical management area from each stand centroid	m	[40]
Continuity (C5)			
Fire risk level (I20)	Fire risk level based on intrinsic forest fire characteristics	Categorical 1-4	[41]
Agroforested areas (I21)	% of agroforested area within 1 km buffer from each stand centroid	%	[34], [35]
Return period (I22)	Return period in case of forest fire	years	[41]

Even for same gral problem they may differ depending on DMs, data availability…..

Gather the data (sometime identify prior to selection of metrics)



In the case of LL CAT fuels and fire criteria initially coming from previncat

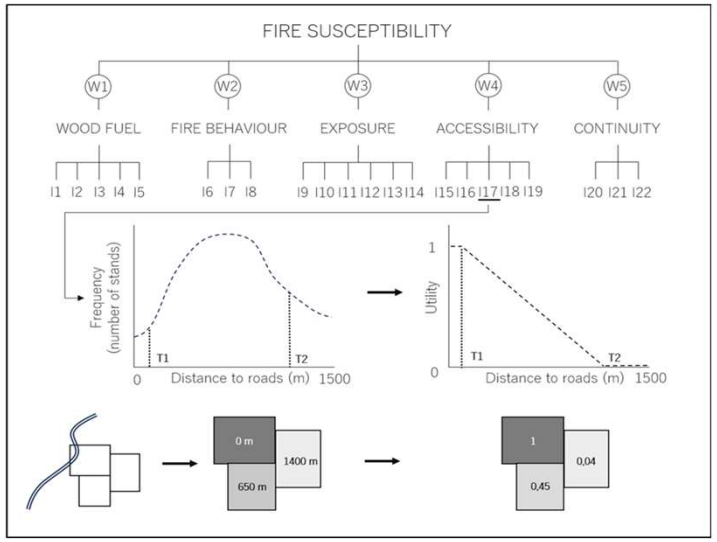
Rest of data from administration, data generated through other projects, important the data from firefighters as was not open (useful path network >2.5m amplitude, PEGs ..)

All data hat to be extracted into a common spatial frame, of potential management units (MFE25; aprox 300k polygons for CAT)

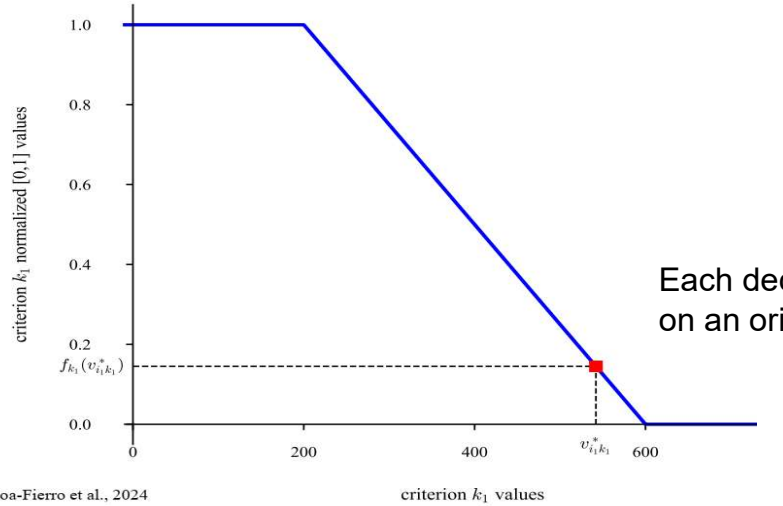
- In each case (LL or other problem?) , you have to be aware of existing data, and possibility to generate new data

- Do not ask questions that can not be solved, or put high hurdles before starting
  - Solve an initial problem and if interest grows, then go for more complex problems (a recommendation)

Harmonize metrics into comparable units



- Different criteria – has associated metrics
- Each metric has different units
  - Biomass - Tn /ha
  - Distance to road - Meters



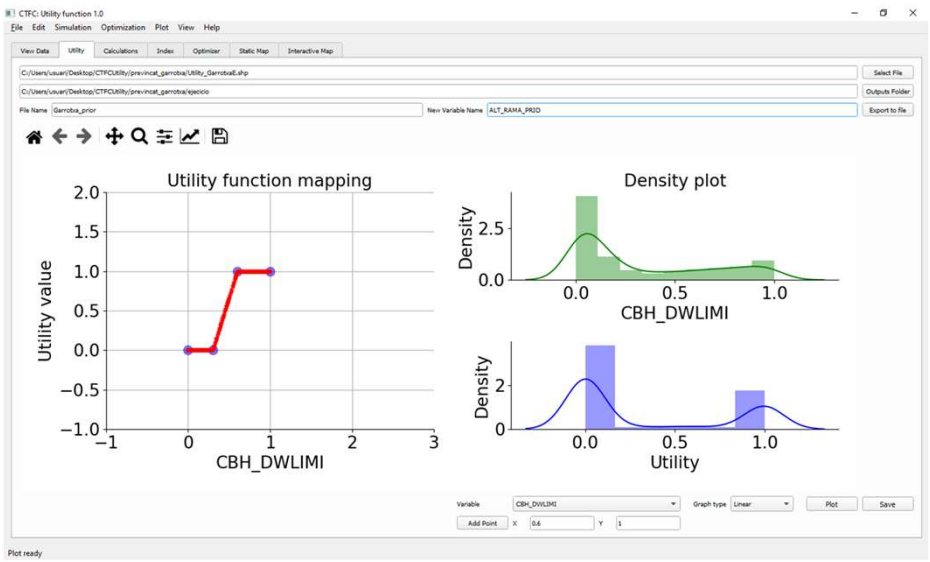
Ulloa-Fierro et al., 2024

Sometime a standardization of unit is required to compare or add multiple criterion

Each decisión unit (has a value beween 0 and 1 for each metric), depending on an original measured value and a defined utility rule/model

Each metric and criteria had to be standarized

- The original data was converted to utility, using fuctions defined by literatura and expert knowledge

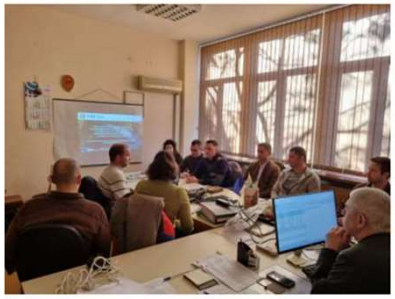


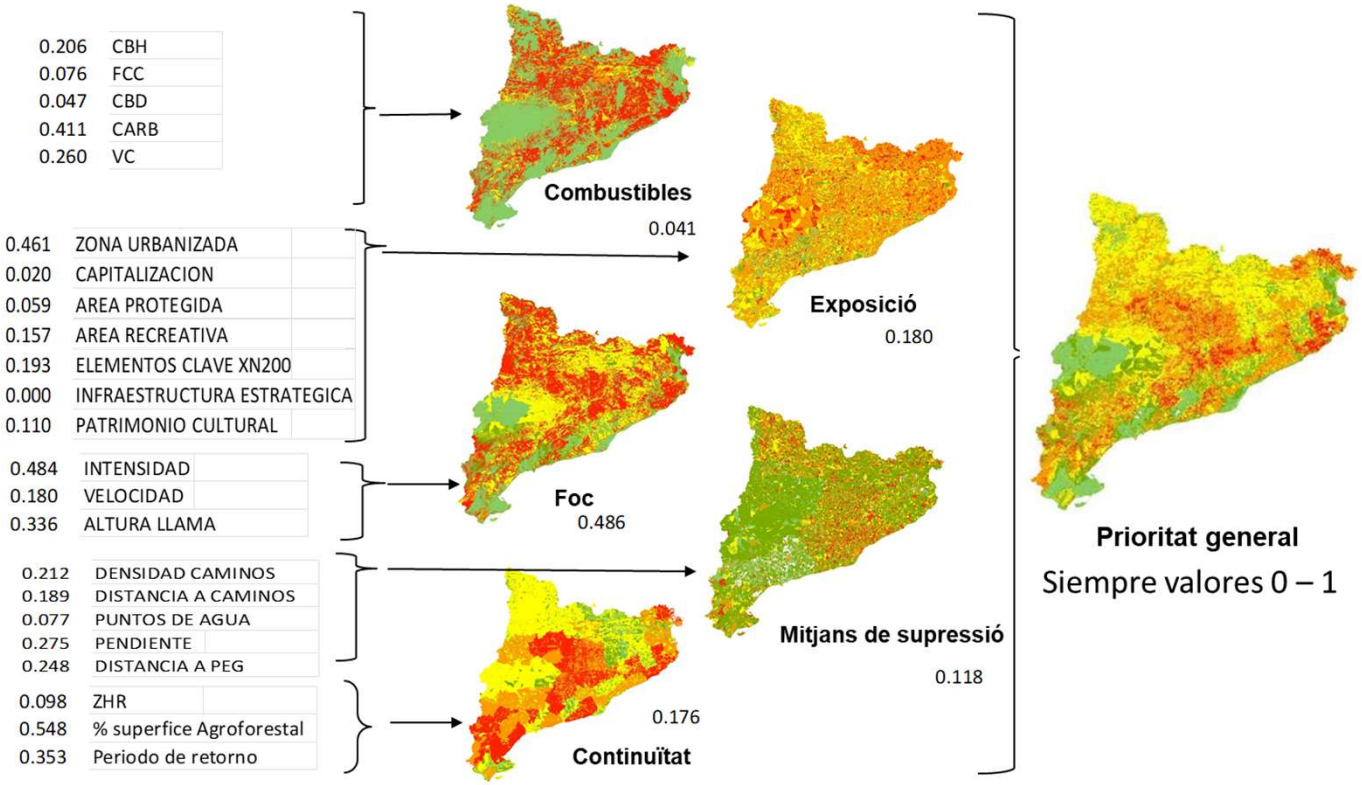
INDICATORS	UNIT	UTILITY 0 THRESHOLD	UTILITY 1 THRESHOLD
Canopy base height (I1)	%	30	60
Canopy cover (I2)	%	30	60
Canopy bulk density (I3)	%	30	70
Understory cover (I4)	%	30	70
Vertical continuity (I5)	%	0	25
Fire intensity (I6)	%	10	50
Spread speed (I7)	%	10	50
Flame height (I8)	%	10	50
Urbanised areas (I9)	metres	7500	0
Recreational areas (I10)	metres	1000	0
Capitalisation (I11)	m^2/ha	0	40
Protected nature (I12)	metres	1500	250
Cultural heritage (I13)	metres	5000	250
Strategic infrastructure (I14)	metres	2500	0

We design a tool (prototipe) for transforming the original indicators into utilities

Provide weight to criteria and generate initial results

- A set of weight was obtained through questionnaires and AHP





Combining criteria (harmonized through utility) with their respective weights, we obtained first set of results

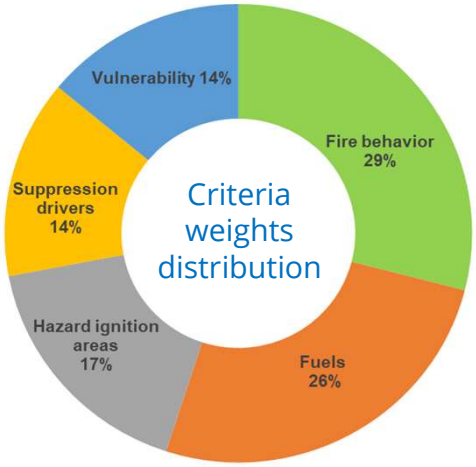
Need to evaluate and finalize participatory proses (add or remove criteria; modify weights)

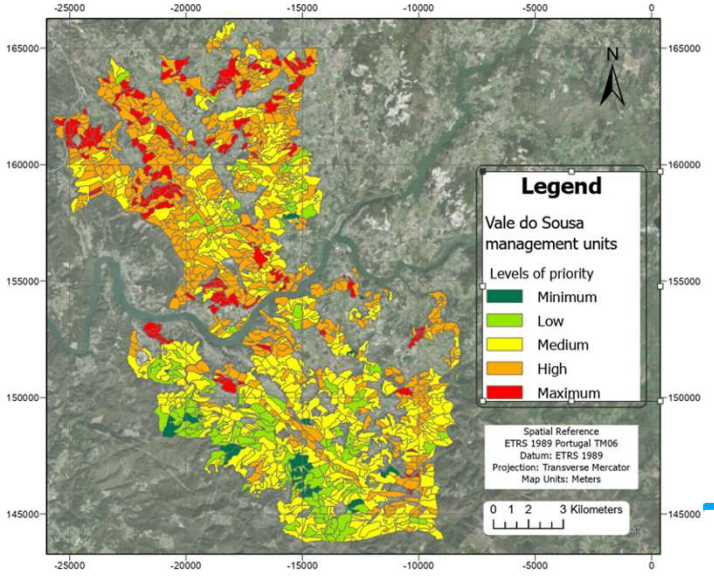
Advances in Vale do Sousa – PT LL

A MSc thesis carried out at ISA (Lisbon) achieved the next advances:

- **Adaptation** of the problem to the **PT scenario**
- Gathered the **spatial data**
- Developed a **methodology** for the **participatory process**
- **Tested** the whole methodology with scientists to obtain **draft results**

Criteria	Sub-criteria	Units
Hazard ignition areas	Population density	persons/km2
	Distance to roads	m
	Historical ignition points	m
	Distance from power lines	m
Fire behaviour	Flame length	m/min
	Rate of spread	%
	Canopy cover	
	Above ground biomass	
Fuels	Crown bulk d	

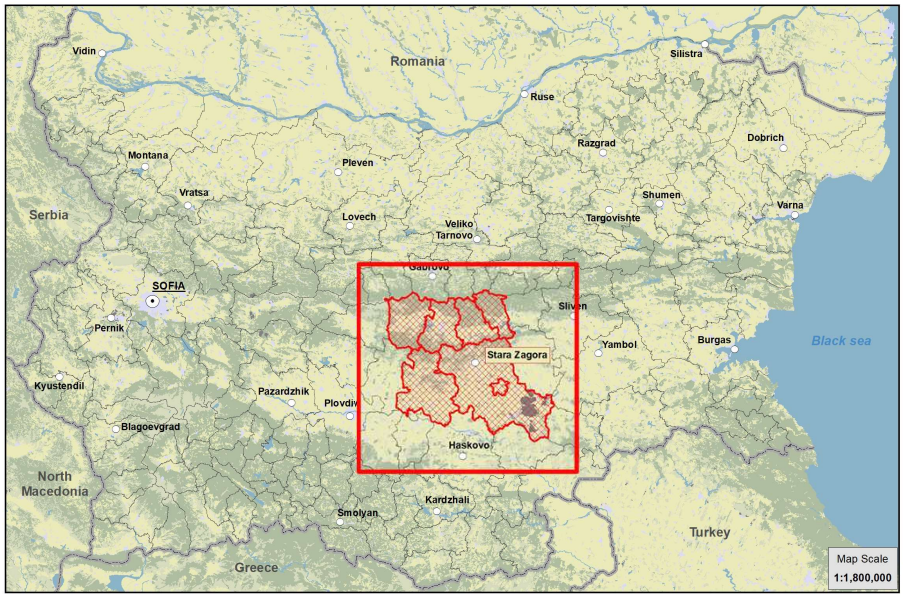




Advances in Stara Zagora – BG LL

Main topics addresses and work in progress:

- **Meeting with the local stakeholders on 27.09.2023 for discussing the requirements:** drafting the important activities on fire prevention and fire suppression and the user needs of preliminary analyses of selection of prioritizing management zones with the goal of preventing (and suppression of) large forest fires;
- **Data gathering**:
  - **Fuel Data:**
    - Data from FIRE-RES project;
    - Data from the National Forest Management Projects (FMP);
  - **Fire Behaviour Data:**
    - Outputs from FlamMap software using the above data;
  - **Exposure Data**
    - Risk Categories as defined by the Flood Risk Directive; Data collected during the last implementation of the Directive, modified and revised for forest fires analyses
  - **Accessibility Data**
    - Road infrastructure (national road network, as well as forest roads from the FMP);
    - Water network (main rivers as well as standing water bodies to supply water in case of emergency)
  - **Fire risk Data:**
    - Data from the FMPs (related with degree of fire danger);
    - Historical data for fire events (from State Forest Agency and from FIRMS)



Test area: 5145 sq.km., covering the area of 6 State Forestries within the Stara Zagora Regional Forest Directorate

A local example with all process being finalized

Regional assessments may have interests for strategic planning purposes, and to understand the overall extent of the problem

Still to decide if priority areas are to be managed or not, a smaller and more homogeneous area seems as a more useful frame to solve the problem

-more homogeneous weather conditions

-more close to site DMs, with a clearer idea of the specifics of the problem

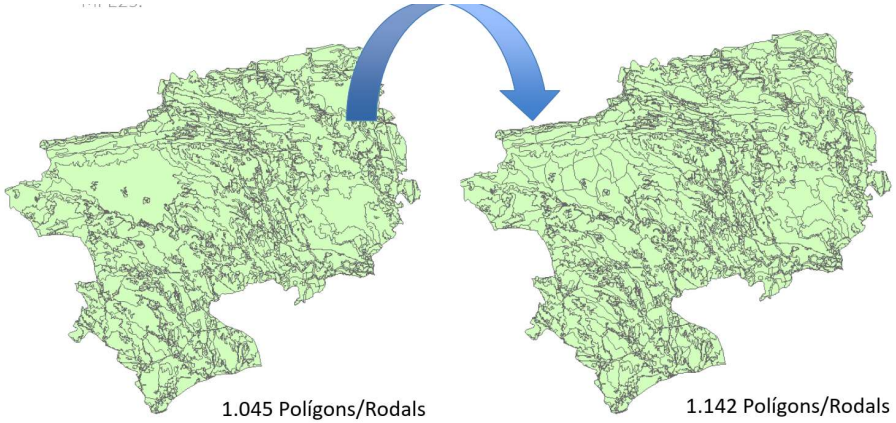
-DMs able to identify specific spatial features

the smaller scale alloed

- The smaler scale allowed produce more acurate fuel information
  - ➢ Validate information from Previncat server with field plots
  - ➢ Further adjust map creating new homogeneus patches/stands
  - ➢ Define fire weather scenarios

Punt validació g

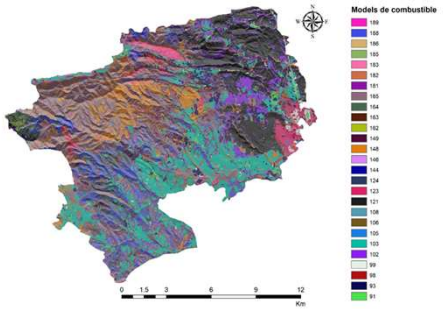
Ús del sòl	Massa mixta		Sp. Arbòries	*Pinus nigra + Quercus ilex*	
FM	SB2	202	Hm	10-12	m
HFM	0,3-0,5	m	CBH	4-6	m
CFM	100	%	Fcc	40-50	%
Sp. Arbustives/Regenerat	-				
Observacions	Els punts de validació 41 i 42 acabaran igual perquè estan fent el mateix tractament. Gran volum de restes.				



1.045 Polígons/Rodals

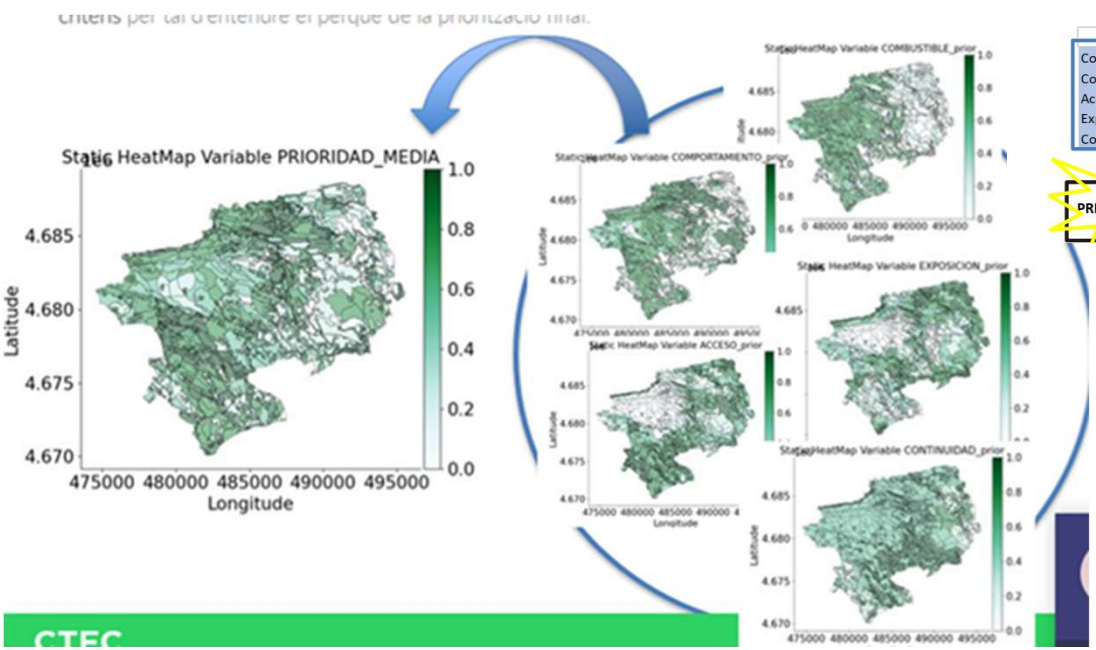
1.142 Polígons/Rodals

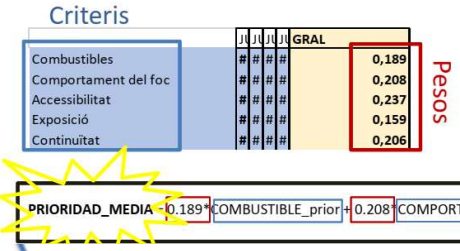
	Situació sinòptica			
	SO	N	NE	NO
Probabilitat ocurrència	37,50%	25,00%	25,00%	12,50%
Temperatura (ºC)	23,48	4,49	7,83	1,15
Humitat Relativa (%)	27,68	24,74	27,72	32,82
Velocitat de vent mitjana (Km/h)	22,06	20,55	18,32	23,50
Ràfegues de vent (Km/h)	57,52	67,46	67,64	100,80

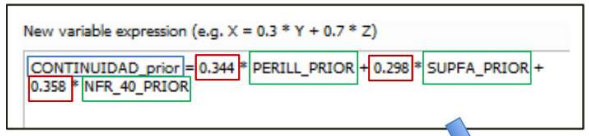


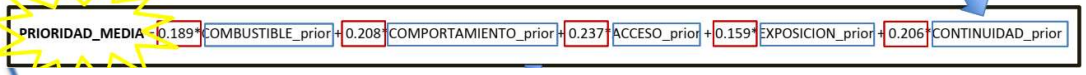
Stakeholder meeting: 2 Regional forest administration (Generalitat), 2 Local forest administration (Diputación), 1 Firefighter (GRAF), 2 Forest researchers (CTFC) and 1 Conservation administration (Generalitat)

- We check the data
- Go over the regional criteria and metrics, and discuss over the weights, until an agreement was reached







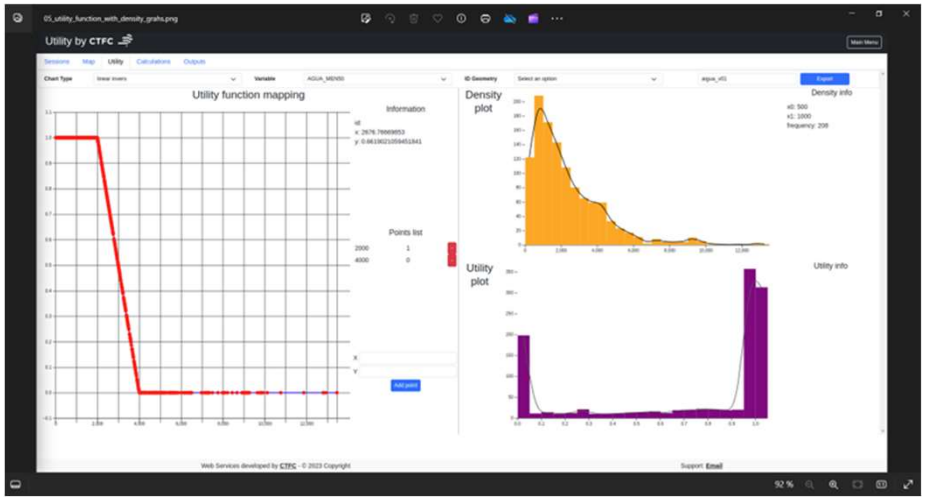


At a similar scale makes sense to make an effort to identify which are the patches to be managed and which management is to be recommended

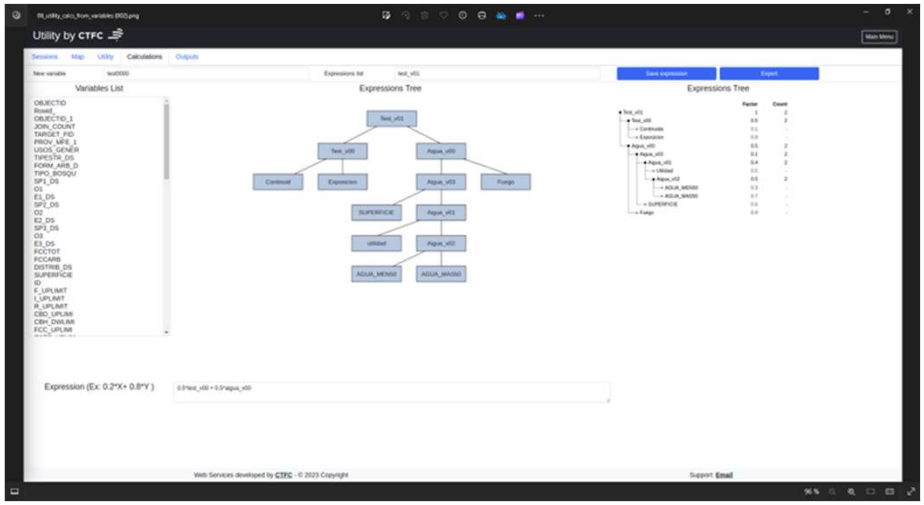
-maximize the impact (fuel and fire behavior indicators)
-considering area or and economic constraints

Whats next??

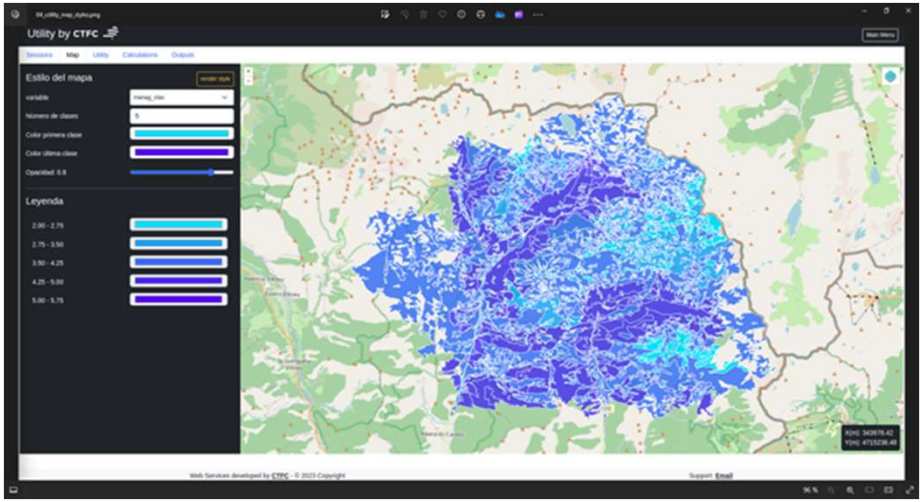
- 1) An web based priorization system



Standarize



Define relations between criteria

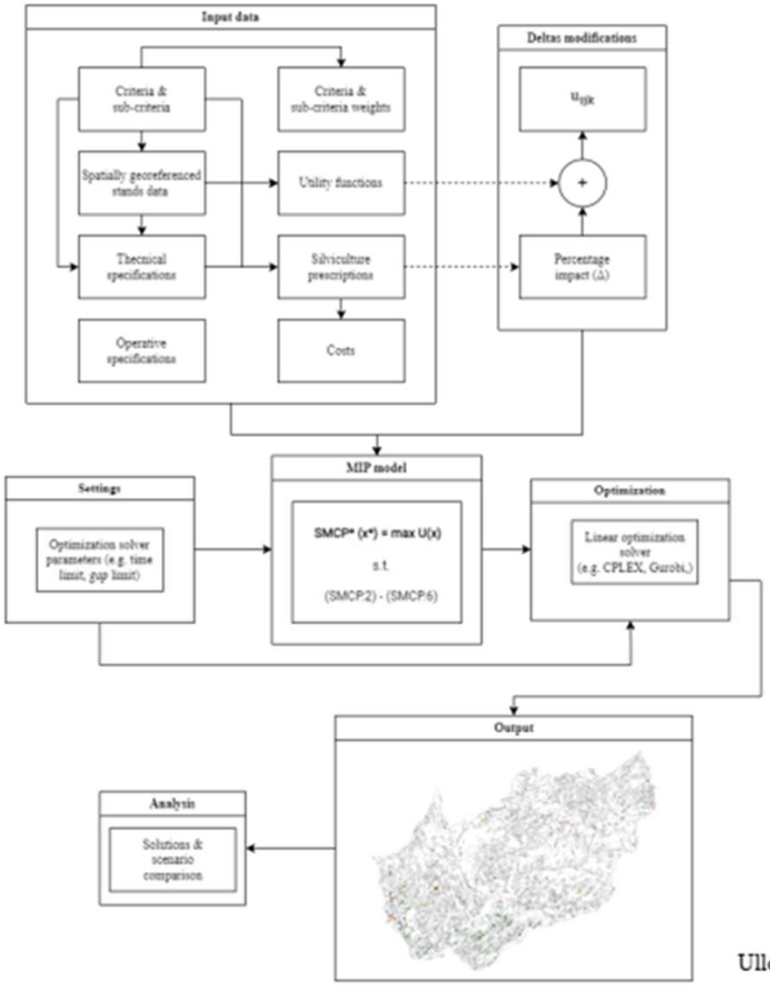


Visualize and export results

Whats next??

- 2) Create tactical plans based on prioritization
  - ➢ Where, what
    - Fuel treatments

    - Effectiveness?



Ulloa-Fierro et al.,

Reduce “priority”, using the best suited treatments

- higher efficiency
- subject to restrictions ($, Area etc… Remember prioritization because limited resources)

Thank you

CTFC

INSTITUTO SUPERIOR DE AGRONOMIA
Universidade de Lisboa

UNIVERSITY OF FORESTRY
Sofia, Bulgaria