

Sierra Bermeja Fire Report (Malaga) 08/09/2021



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1. AIM

This report is written in order to describe the evolution of a fire that started in Sierra Bermeja on 8 September 2021, as well as the different factors that influenced the behaviour of the fire and which determined its spread.

The Sierra Bermeja fire was detected on 08/09/2021 at 9.35 p.m. it was considered 'controlled' on 14/09/2021 at 06.45 a.m. and extinguished on 24/10/2021 at 7.00 p.m. (data from the provisional final report).

The area covered by the fire was 8401.02 ha and the perimeter of the fire had a length of 240.69 km, affecting to varying degrees the municipalities of Estepona (4117.77 ha), Casares (1305.29 ha), Jubrique (1,177.44 ha), Genalguacil (1,043.33 ha), Júzcar (471.45 ha), Faraján (285.26 ha) and Benahavís (0.48 ha).

The analysis and study of highly complex fires from the point of view of their extinguishing and the management of resources allows the development and evolution of forest fire prevention and extinguishing systems. The in-depth analysis of the behaviour of the fire and the extinguishing operations carried out in the Sierra Bermeja 2021 fire will allow the Andalusian Forest Fire Extinction Service (SEIF) to identify the strengths and weaknesses of the system, highlight the lessons learned and enhance the benefits of the system, as well as carry out the necessary corrective measures to improve as a system, both individually and as a group.

This report has been prepared with input from all personnel involved in the management and extinguishing of this emergency event.

2. DESCRIPTION OF THE SCENARIO

2.1. LOCATION

The fire was located in the southwest of the province of Malaga, in the Sierra Bermeja massif. This enclave separates the Serranía de Ronda from the Mediterranean coast and belongs to the Costa del Sol region. The municipalities affected by the fire were Benahavís, Faraján, Genalguacil, Jubrique, Casares, Júzcar and Estepona.



Figure 1: Location of the fire.

Sierra Bermeja is a massif with an average height of around 1000 m, with the highest peak at Los Reales (1,452 m), made up of steep slopes and abrupt inclines of very rocky terrain. This particular conformation is due to the geological nature of the area, which is formed by outcrops of peridotites, which has generated a high rate of plant endemism due to the difficulties that this geological environment provides for plants. (Martos, J., Sierra Bermeja and the large forest fires, 2021).

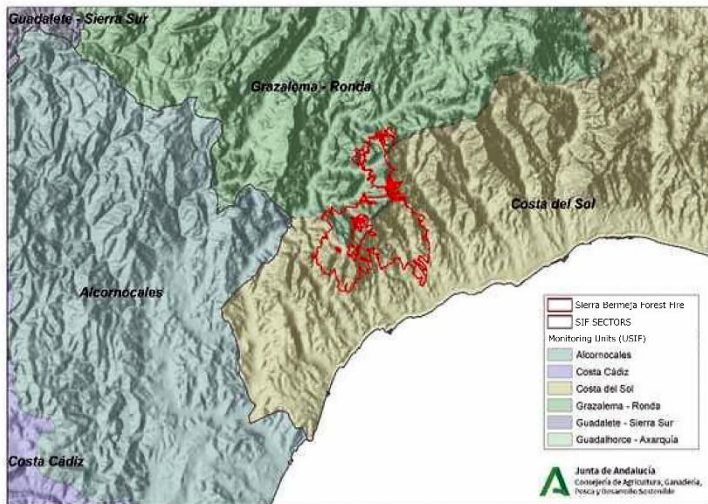


Figure 2: Monitoring Units (USIF).

Within the Monitoring Units (USIF) established by the Plan INFOCA, the fire was located in the westernmost area of the Mediterranean arc, within the Monitoring Units USIF-19 (Grazalema-Ronda) and USIF-22 (Costa del Sol). These units represent areas with a certain homogeneity in terms of fire behaviour patterns.

2.2 TOPOGRAPHY

At the macro-scale level, the area affected by the fire has two well-differentiated zones with a dividing axis, formed in the western foothills of the Los Reales peak up to the headwaters of the Genal river, located in the municipality of Igualeja. These two zones are characterised on the one hand by basins oriented S-SE towards the coast, and on the other by basins oriented N-NW, inland and bordered by the river Genal. The physiognomy of this scenario produces different environmental situations between the two orientations, which affect, depending on the conditions, the behaviour of the fire and create a different dynamic of wind conditions, both from the land and from the east.

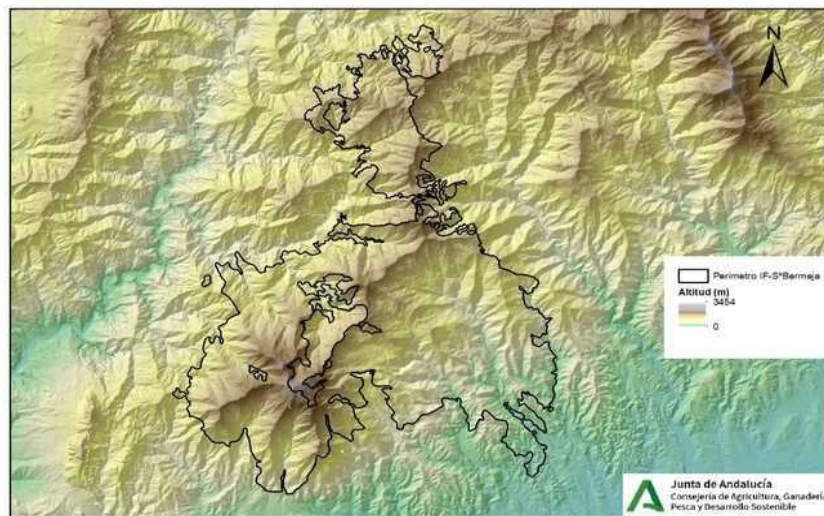


Figure 3: Topographical macro-scale.

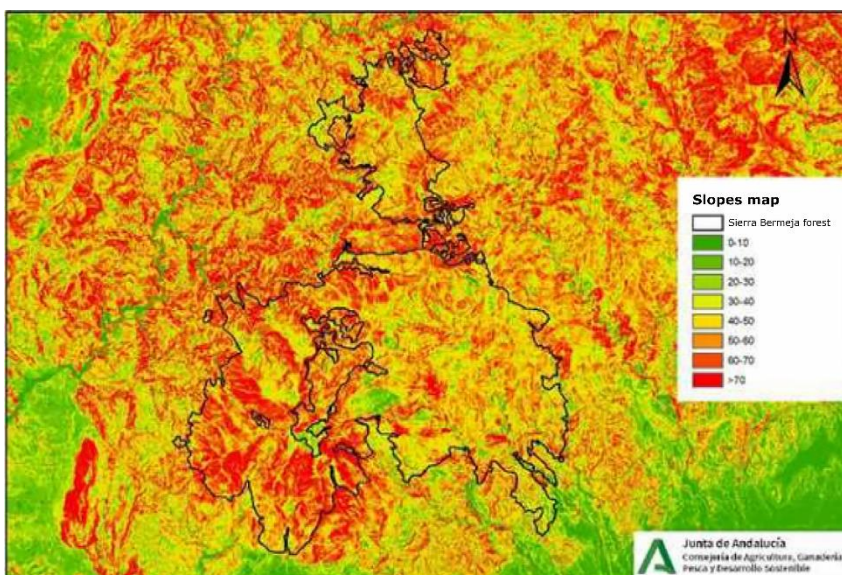


Figure 4: Slopes map.

On a local scale, the terrain has a very abrupt topography with ravines and knolls, high slopes and steep ridge axes. The steep slope, in addition to influencing fire behaviour, together with the high degree of stoniness, made ground operations and mobilisation over the terrain very difficult. The eastern area is particularly steep, with steeper slopes than the rest, mainly around the Los Reales peak.

One of the main characteristics of the geological substrate (Peridotites) is the high degree of stoniness, covering in some areas up to 60-70% of the surface, as well as a high fuel load.

The lithological component, with a predominance of peridotites, conditions practically all the abiotic and biotic characteristics - soils, modelling, vegetation, fauna. This igneous, ultramafic rock is very hard and dense, and is composed of ferromagnetic minerals generically called serpentines once they are altered by geochemical weathering processes (Gómez-Zotano et al., 2014). (Martos, J., Sierra Bermeja and the great forest fires, 2021).

2.3 FUELS

The area affected by the fire is characterised by an extreme risk due to the continuity of heavy fuels with a high probability of generating large forest fires (LFFs) as stated in the Andalusian Forest Fire Risk Study (2015) (see chapter 2.4).

The fuel models with the greatest presence in the affected area are those dominated by the tree layer, mostly with shrub understorey, which correspond to HPM models for the UCO40 classification, with models 4, 7, 8 and 10 being the predominant ones according to the Rothermel model classification. The undergrowth models under pine forest are composed of *Pinus pinaster*, *Cistus* sp., *Ulex* and *Stipa*, with a fraction of tree cover between 60-80%.

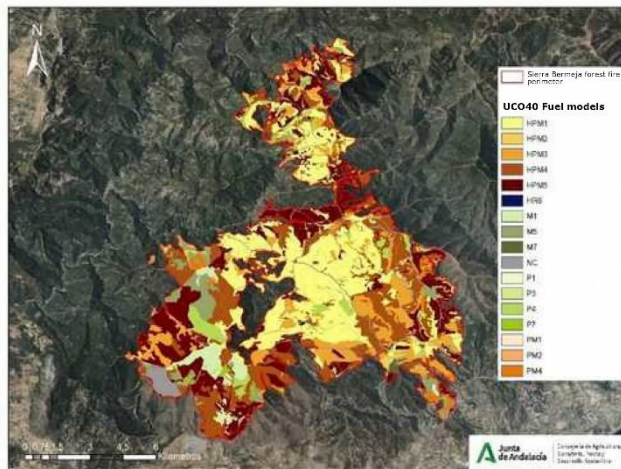


Figure 5: UCO40 fuel models.

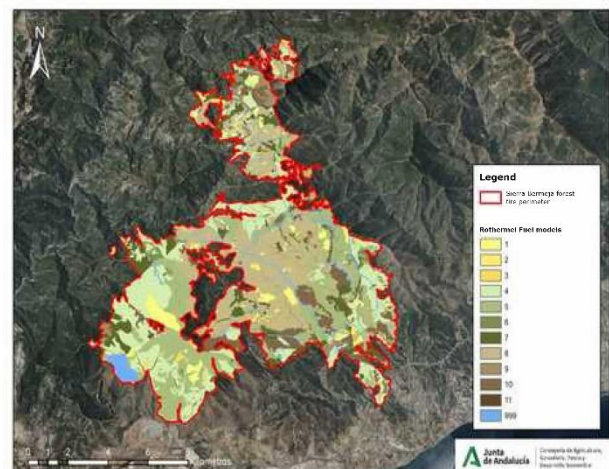


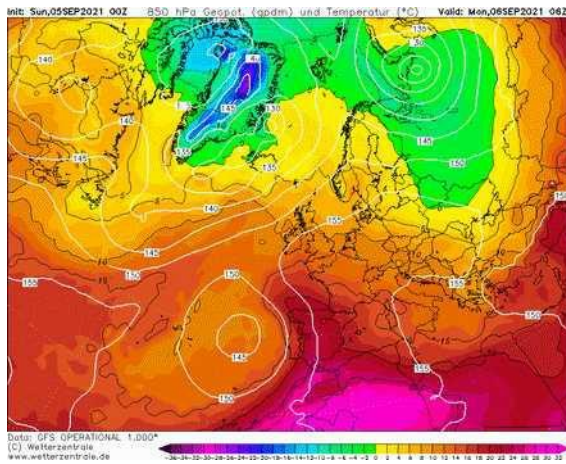
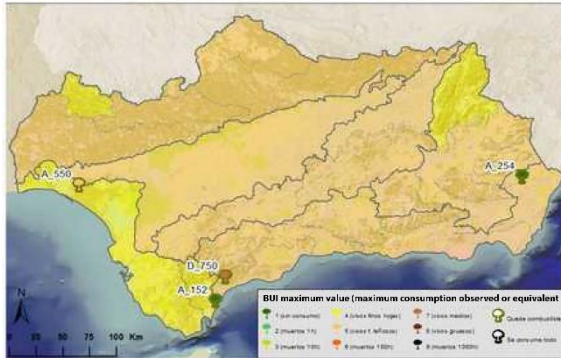
Figure 6: Rothermel fuel models.

Fuel availability in the Mediterranean arc was high due to the lack of relative humidity recovery at night during the preceding days from the beginning of September. During days 6 and 7 September 2021, the Saharan ridge rose, and the NW wind circulation on the surface on day 8 September 2021, with a ground character, contributed to the drying of the fuel, also causing the increase in severity expected in the behaviour of the fire (bottom right image).

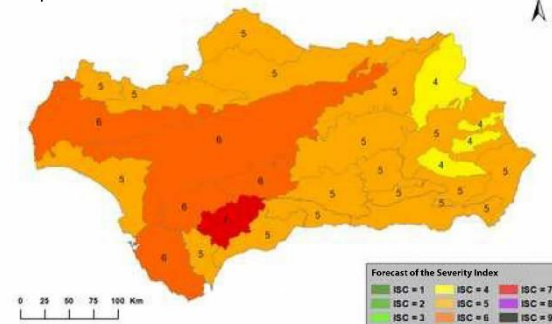
This pre-existing situation therefore conditioned the high availability of fuels, which could be seen in the behaviour of the fire in the following days.

From day 5 to 9 September 2021, alerts were issued in the daily monitoring sheet of the Plan INFOCA due to the increase in availability and severity of these units, with a "high" value in vulnerability for the urban-forest interface on day 8 September 2021. In the fire monitoring sheets, a value of 7 was obtained for the Buildup Index (BUI), which indicates a numeric rating of the total amount of fuel available for combustion (diameter of 0.6 to 2.5 cm).

MAP: Buildup Index (consolidated values)
Source: Monitoring sheets of forest fires and weather monitoring
Period: 1 to 14 September 2021



MAP: Fire behaviour Severity Index
Source: Monitoring sheets of forest fires and weather monitoring
6 September 2021



Figures 7, 8, 9 and 10: Availability of fuel for combustion, symptom status and fire severity in the preceding days.

2.4. RISK AND FIRE REGIME

Given the relevance of the fire regime in Sierra Bermeja, we include some conclusions from the chapter "Sierra Bermeja y los grandes incendios forestales una reconstrucción geohistórica (1950-2018)" de Javier Martos Martín y José Gómez Tozano in the book "Los Bosques de la Serranía de Ronda" de José Gómez Tozano y José Antonio Olmedo Cobo (2021). From this study we can draw relevant conclusions, documenting 29 forest fires (with a total of 16,500 ha) from 1956 to 2018 in Sierra Bermeja, almost half of which (14) were fires of more than 500 ha, with a recurrence for the aforementioned period of one LFF every 4.27 years. If data up to 2021 is included, the data would give an area of 25,650 ha for a total of 32 fires, of which 15 were LFFs, and a recurrence of one LFF every 4.33 years.

The most relevant risk maps for the fire area, obtained from the information of the Basic Study of Risks Associated with Forest Fires (INFOCA, 2015), are shown below. The risk map for fuel continuity associated with extreme risk (with more than 90% of the area with an Extreme risk value), and the risk map associated with topography, which combines slope and exposure (also with more than 50% of the fire with values of High and Extreme) stand out. The historical risk map (associated with the fire regime) shows large areas with more than two fires greater than 100 ha in the same area (including areas covered up to three times). It is also worth highlighting the vulnerability of the urban-forest interface, which was decisive in the initial days, mainly due to the arrival of the front to the coastal urbanisations.

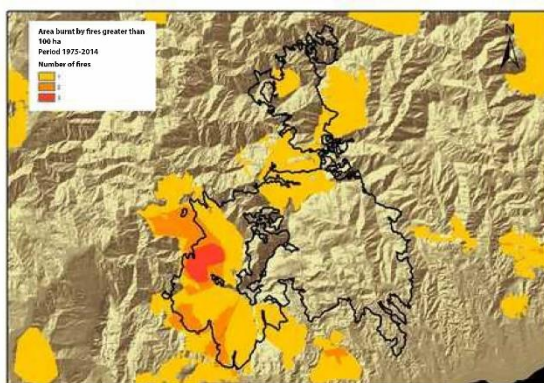


Figure 11: Historical Risk. Historic perimeters greater than 100 ha between 1975 and 2014.

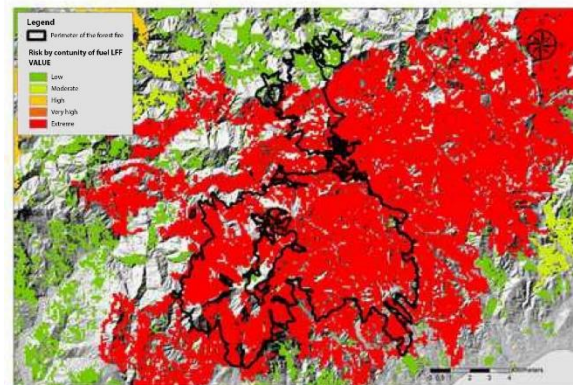


Figure 12: Fuel continuity risk associated with extreme behaviour/LFF.

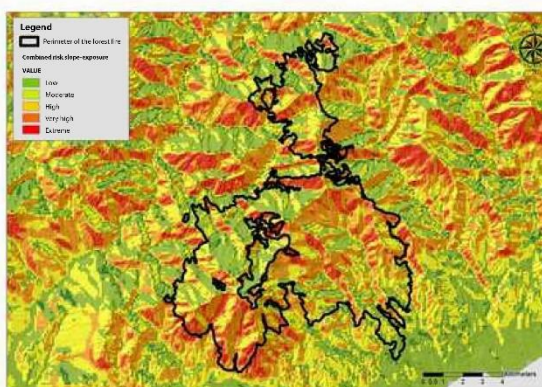


Figure 13. Combined risk of slope and exposure.

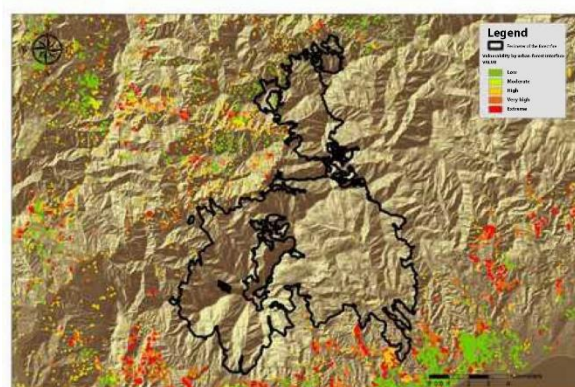
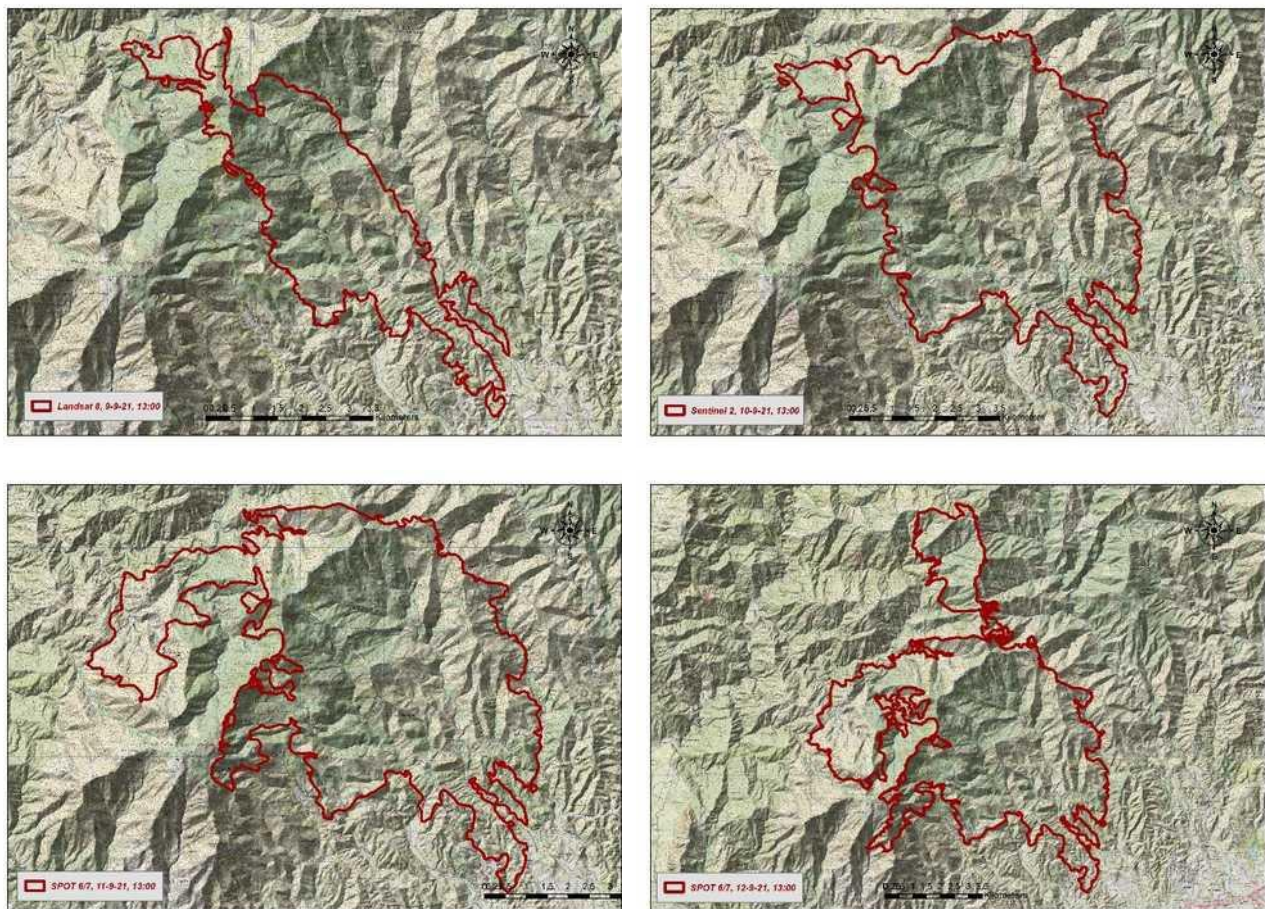


Figure 14: Vulnerability associated with the urban-forest interface.

2.5 EVOLUTION OF THE FIRE AND GENERAL DATA

While section 3 will detail the evolution and progression of the fire through its partial perimeters on the different days, those validated by remote sensing for days 9, 10, 11 and 12, through the Copernicus service (European Union's Earth Observation Programme), are shown below.



Figures 15, 16, 17 and 18: Perimeters of days 9, 10, 11 and 12 obtained by remote sensing

The final perimeter obtained through the Copernicus service, including unburnt interior islands, represents the fifth major forest fire (LFF) in 2021 in Andalusia, affecting a total of 8,401.02 hectares.

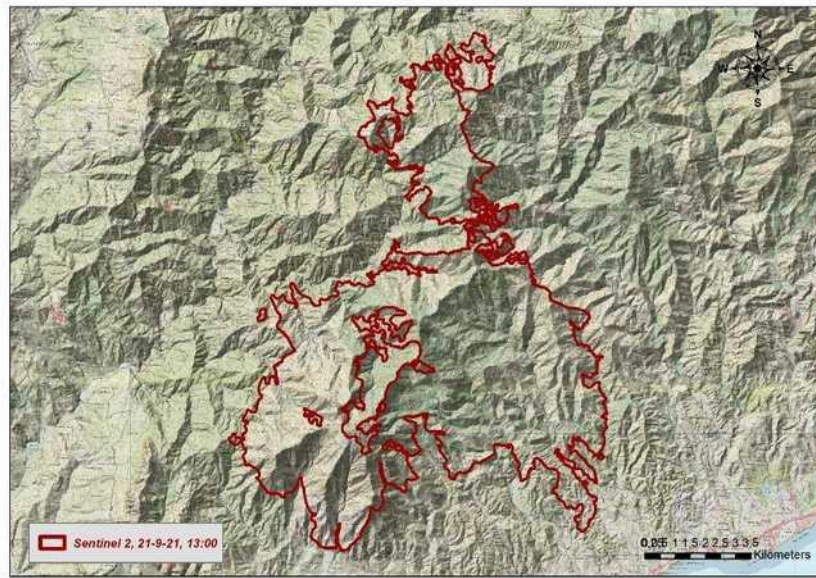


Figure 19: Final perimeter on topographical background.

Taking the central hours as a reference point, the extension affected by the fire on the different days and its growth is detailed below.

Table 1: Daily surface area covered by the fire and its growth ratio.

Date	Surface area covered by the fire (ha)	Growth ratio (ha)
08/09/2021	1,693.3	1,996.3
10/09/2021	3,689.6	
11/09/2021	4,603.4	913.7
12/09/2021	5,954.7	1,351.2
13/09/2021	7,868.1	1,913.4
14/09/2021	8,401.02	532.9

The severity analysis carried out (classified according to Key and Benson 2006 thresholds) reflects the intensity and degree of vegetation damage, as well as the return potential observed during the development of the fire and tested in different areas that the fire affected on more than one occasion.

Table 2: Severity classes and percentage.

	(Key & Benson)	Total (ha)	%
SEVERITY	Low	1,407.8	16.8
	Moderate-Low	1,982.2	23.6
	Moderate-High	2,508.5	29.9
	High	2,502.5	29.8
	Total	8,401.0	

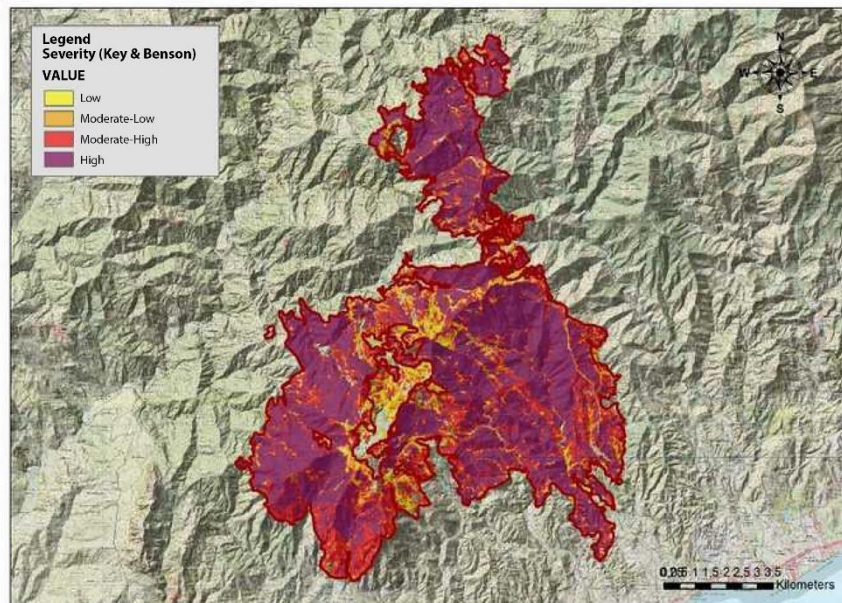


Figure 19: Severity analysis.

The breakdown of surface area by municipality and type of vegetation affected is summarised in the following figures.

AREA AFFECTED BY THE FOREST FIRE OF JUBRIQUE 08/09/2021
Information provided by the COR (INFOCA), September 2021

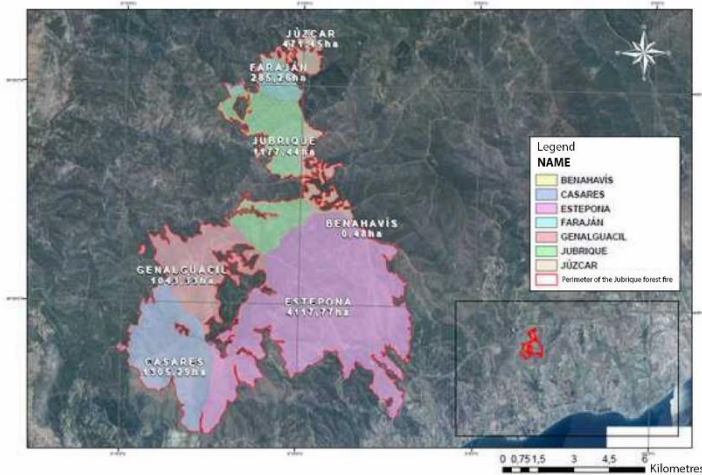


Figure 20: Affected municipalities and area.

Area affected by the forest fire Jubrique 08/09/2021	
Municipality	Area affected (ha)
Júzcar	471.45
Faraján	285.26
Benahavís	0.48
Jubrique	1,177.44
Genalguacil	1,043.33
Estepona	4,117.77
Casares	1,305.29
Total area (ha)	8,401.02

Table 3: Area by municipality.

AREA AFFECTED BY THE FOREST FIRE OF JUBRIQUE 08/09/2021
Information provided by the COR (INFOCA), September 2021

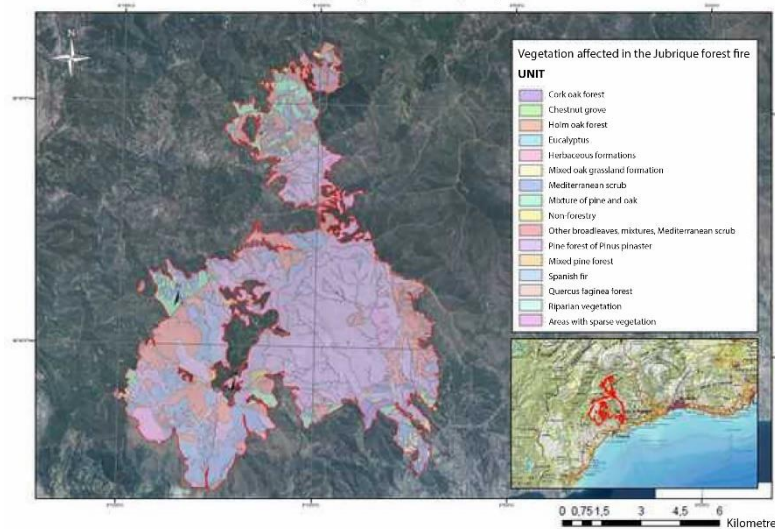


Table 4: Surface area by strata

UNIT	Area affected (ha)
Woodland	3,835.94
Scrub	3,828.75
Grassland	631.38
Agricultural	17.20
Urban	79.11
Others	9.22

Figure 21: Strata and species of affected vegetation and surface area.

The breakdown of vegetation affected by species shows *Pinus pinaster* and Mediterranean scrub as the most affected.

Table 5: Characterisation of the species affected (SIOSE).

UNIT	Area (ha)
Cork oak forest	132.17
Chestnut grove	30.75
Holm oak forest	2.13
Eucalyptus	2.77
Herbaceous formations	154.97
Mediterranean scrub	52.95
Mixed oak grassland formation	1,392.32
Mixture of pine and oak	495.05
Non-forestry	97.00
Other broadleaves, mixtures, Mediterranean scrub	1,547.25
Pine forest of Pinus pinaster	3,808.76
Mixed pine forest	61.71
Spanish fir	21.50
<i>Quercus faginea</i> forest	0.45
Riparian vegetation	87.67
Areas with sparse vegetation	513.56
TOTAL	8,401.018615

The size and complexity of the fire involved not only the participation of numerous Plan INFOCA resources, but also the activation of BRIF units from day 11, the Military Emergency Unit on day 12, as well as teams and units from MITECO and other autonomous communities.

PERSONNEL AND AIR ASSETS OF THE INTERVENTION TEAM - FIRE AT JUBRIQUE															
From ignition to control	FIREFIGHTERS ON THE GROUND									AERIAL MEANS					
	INFOCA	MALAGA FIREFIGHTERS	MITECO	UME	CASTILLA LA MANCHA	MURCIA	MADRID	CATALONIA	TOTAL	INFOCA	MITECO	CASTILLA LA MANCHA	MURCIA	EXTREMADURA	TOTAL
DAY 8	105								105						
DAY 9	522	20							542	24	8				32
DAY 10	557	38	42						637	24	16	4			44
DAY 11	892	38	42						972	24	16	4			44
DAY 12	1,090	85	65	120	18	4	20	2	1,404	24	20	4			48
DAY 13	1,153	97	65	120	18	4	20	2	1,479	24	20	4	1	1	51
DAY 14	442								442	10					10

Figure 22: Resources and personnel involved.

3. FIRE BEHAVIOUR AND OPERATIONS

This section will be structured according to the different meteorological scenarios that occurred until the fire was brought under control, each of them described by periods (indicated below) and associated operational plans. Based on this, the identification of the participating resources can be carried out by first locating the period shown, and then the detailed Operational Plan (Note: the documents shown as Operational Plans are not the complete originals, but a synthesis of the most relevant aspects).

The weather conditions in each scenario greatly conditioned the development of the fire, and thus the strategies and tactics planned, as well as the actions of the different resources involved.

The synoptic situations that occurred in the first fortnight of September were:

- First week: deep trough in the Atlantic that allowed a slight increase in the intensity of the Saharan ridge.
- Second week: weak anticyclone in the Azores which in its westward retreat gives way to an Atlantic trough. Between this and a squall north of the British Isles, a small anticyclonic ridge emerges over the Iberian Peninsula.
- End of the fortnight: increased instability with rainfall alert in Western Andalusia.

Based on a retrospective analysis of the meteorology, the Sierra Bermeja fire developed over six days under three different meteorological scenarios, each with different influences on fire behaviour and fire movement, around which this section will be developed:

- Scenario 1: synoptic wind conditions (**days 8, 9 and 10**)
- Scenario 2: local wind dynamics (**day 11 and early morning of day 12**)
- Scenario 3: E and SE wind dynamics (**from morning of day 12 to fire control**)

3.1 PREVIOUS WEATHER

This section provides information on the availability of fuels (see section 2.3), the degree of stress of live fuels, and whether there was nocturnal moisture recovery from dead fuels. This availability affected a higher probability of ignition, as well as their combustibility in the process of the fire spreading.

The following figure shows the temperature and humidity conditions during the 4 and 5 days prior to fire ignition and on day 9 respectively. From day 5 onwards, there was a rise in minimum and maximum temperatures, with values of around 22°C and 32°C, respectively. The data from the Gaucín automatic station also shows a drop in relative humidity from day 6, with maximum night-time values of 50-55% and minimum daytime values of 35%. In the area where the fire originated, the period without rainfall recorded by the weather stations exceeded 60 days [Source: SIMSIF platform (Integrated Forest Fire Monitoring and Meteorological System)].

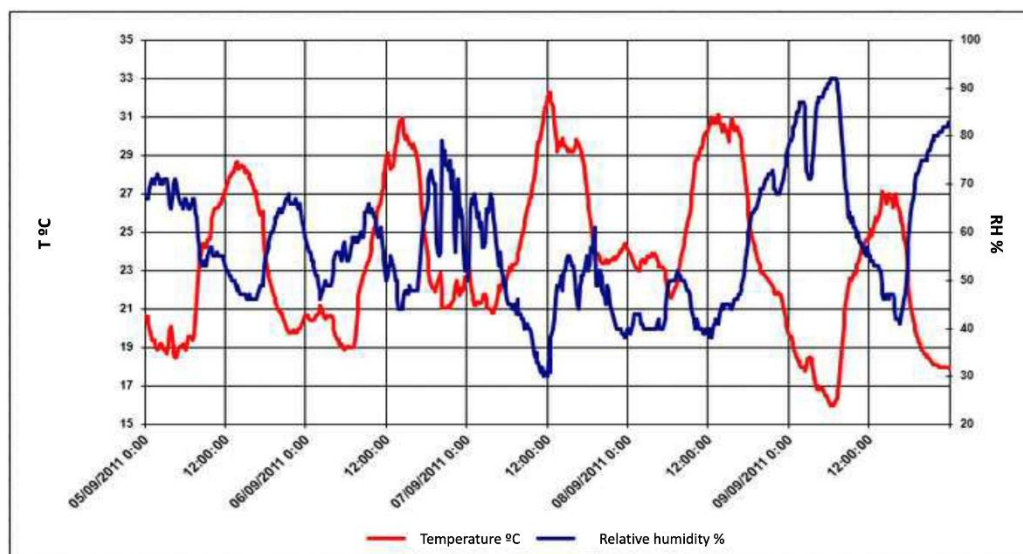


Figure 23: Meteorological data in the days prior to the fire, AEMET station in Gaucín.

3.2 WEATHER SCENARIO 1

3.2.1 SCENARIO 1 CHARACTERISATION

Considering the arrangement of the high pressures represented by the Azores anticyclone, with its axis following approximately the direction of the geographical parallels, and the isobars crossing the peninsula approximately from north to south, conditions of warm and dry air flow appeared in the area of the fire, reinforced by the obstacle represented by the orientation of Sierra Bermeja (see Topography section). To these conditions correspond the days 8, 9 and 10 September.

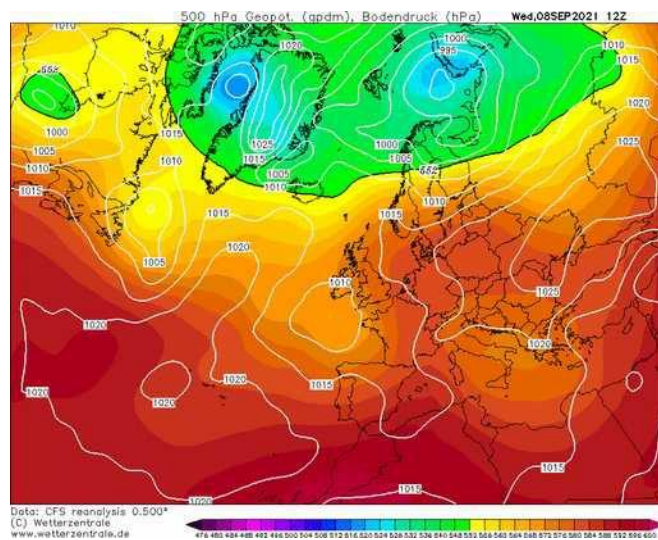
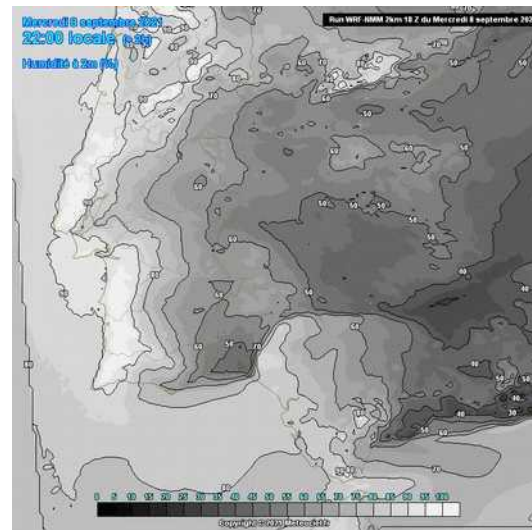
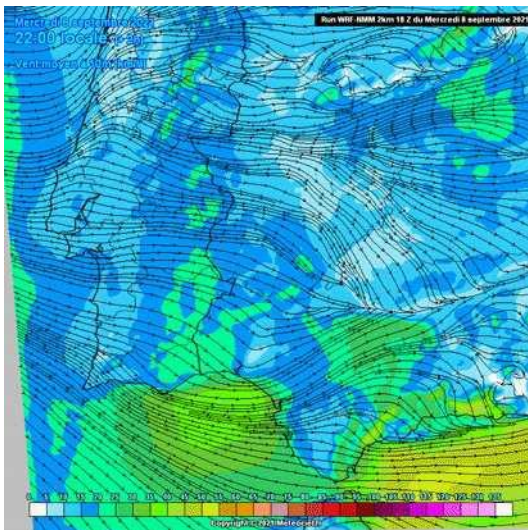
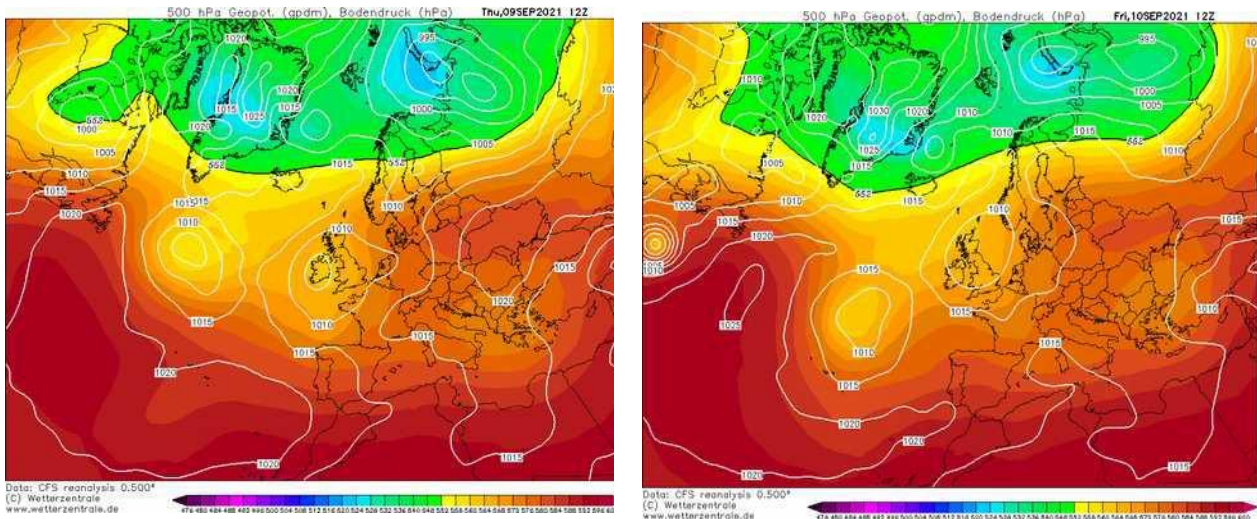


Figure 24: Geopotential height at 500 hPa corresponding to the 12Z of 8 September.



Figures 25 and 26: WRF model outputs for the 10 m wind (left) and relative humidity at 2 m (right) forecasts for 10.00 p.m. on 8 September.

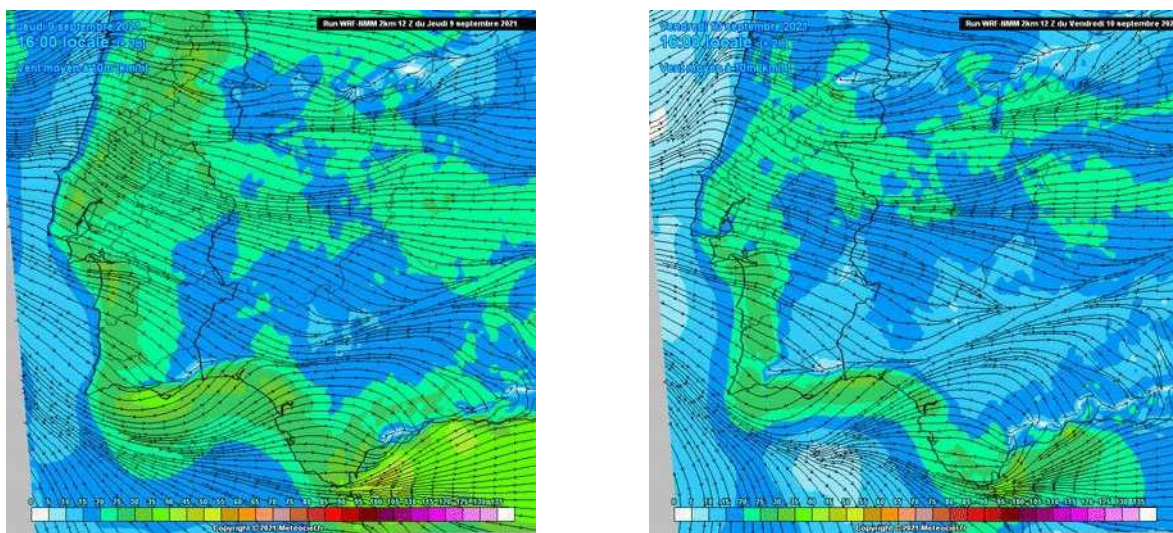
During day 10, the anticyclone was displaced by the North Atlantic squall towards lower latitudes, generating NW flow conditions to the north of the Sierra and southerly inflows from Estepona, channelled from the Strait of Gibraltar.



Figures 27 and 28. Geopotential height at 500 hPa corresponding to 12Z on ~~the~~ days 9 (left) and 10 (right).

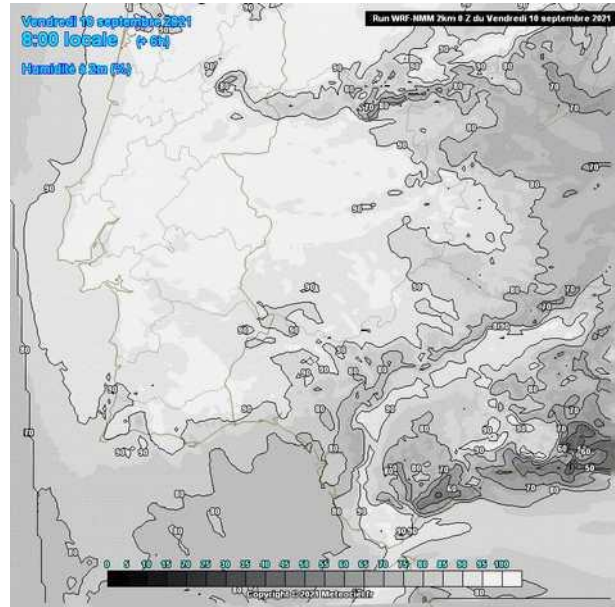
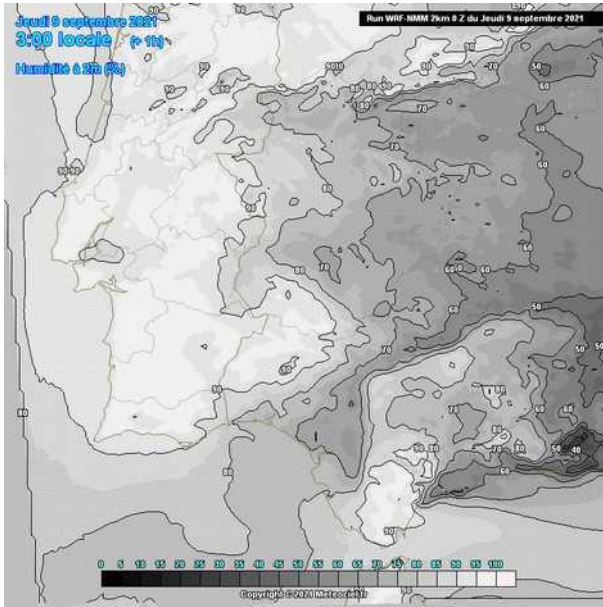
On these days, during both day and night (according to the forecasts), general wind conditions from the NW dominate, with intensities between 35-40 km/h on the night of the start of the fire (Figure 8), with maximums of 25-30 km/h during day 9, and decreasing in intensity from the night of day 10, reaching maximums of 15-20 km/h.

It is worth noting in the WRF model output at 12Z on day 10 for 4.00 p.m. how the axes of the Sierra Bermeja divides are represented, providing an obstacle, blocking the circulation of the general flow, and allowing entry from the south.



Figures 29 and 30: WRF model outputs for wind at 10 m forecasts at 4.00 p.m. on the days 9 (left) and 10 (right).

Maximum relative humidity during this scenario remained below 50-60% due to the influence of orography on the NW wind circulation.



Figures 31 and 32. WRF model outputs for relative humidity at 2 m forecasts for 3.00 a.m. on day 9 (left) and 8.00 a.m. on day 10 (right).

The evolution analysis for this first scenario is shown in the figure below.

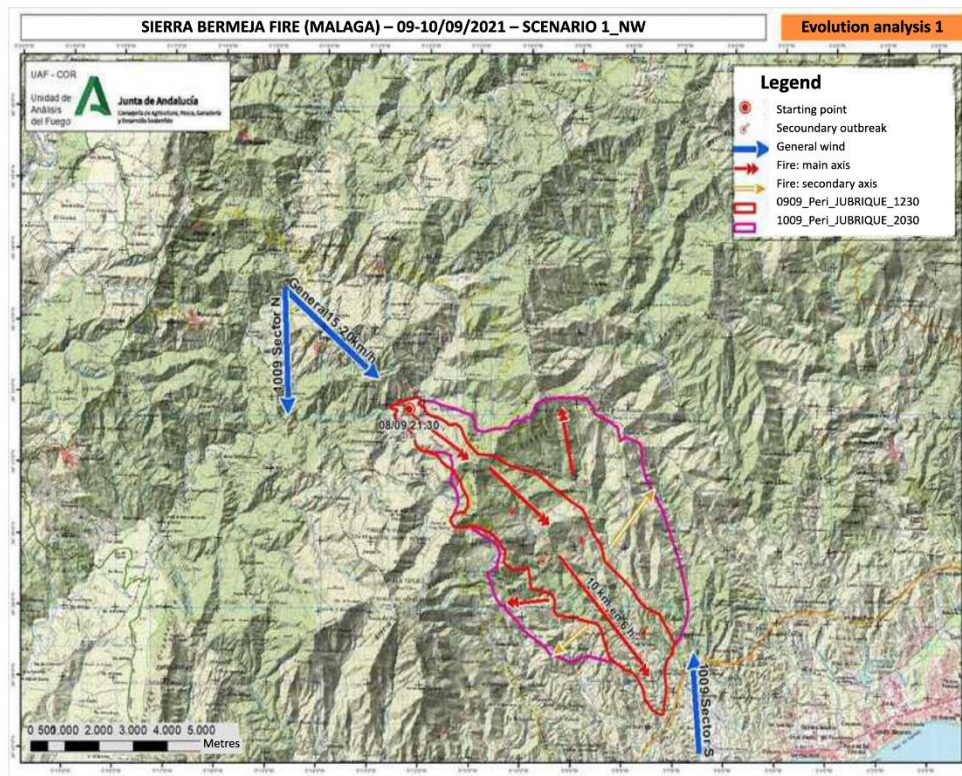


Figure 33: Scenario 1 evolution analysis.

3.2.2 NIGHT from 8/9/2021 to 9/9/2021

The fire started at 9.35 p.m., located on the road to Genalguacil (MA8304), from two points. It spreads with an intense NW wind leaving a narrow and elongated perimeter, covering an estimated area of 1,500 ha with a main run of approximately 10,600 metres, covered in 6 hours, resulting in an approximate propagation speed of 30 m/min.

Weather forecast: anticyclonic westerly advection, surface winds of 10-12 km/h from the N-NW which maintain intensity, but from 01.00 a.m. on day 9 changes to N-NE; relative humidity values between 70-80%. The local influence together with the katabatic hillside winds and the sea breeze conditioned the speed of propagation.

Weather observation: wind measured at the forest fire above 20 km/h with gusts of 50 km/h, very complex topography with slopes above 30%, difficult access and high fuel load available.

Operational Implications: presence of two active outbreaks located on the Genalguacil road (MA-8304) separated in a straight line by a distance of 2,300 m. The first outbreak, closer to Genalguacil, evolves downwind and downhill, the second outbreak located between the two roads (MA-8304 and MA-8301) evolves topographically. When the second outbreak reaches the firebreak bordering Estepona, it turns downwind, which causes an increase in the speed of propagation in the direction of Estepona. Evolution towards a highly complex urban-forest interface.

The approximate coordinates of the two outbreaks are as follows:

Starting point 1		Starting point 2	
X: 302.523.3	Y: 4.044.940.9	X:303.937.3	4.043.091.7

List of resources assigned in the first attack:

ME-216, ME-213, ME-211, ME-111, ME-220, ME-205, ME-207, ME-204, ME-105

MP-204, MP-203, MP-104,

TOP: I. Sagües, Pepe del Río

Tactics:

Outbreak 1: Tail-to-head flanking work with defence line and hose laying.

Outbreak 2: Tail-to-head flanking work with defence line and hose line support



Figure 34: Starting points.

3.2.3 9/9/2021

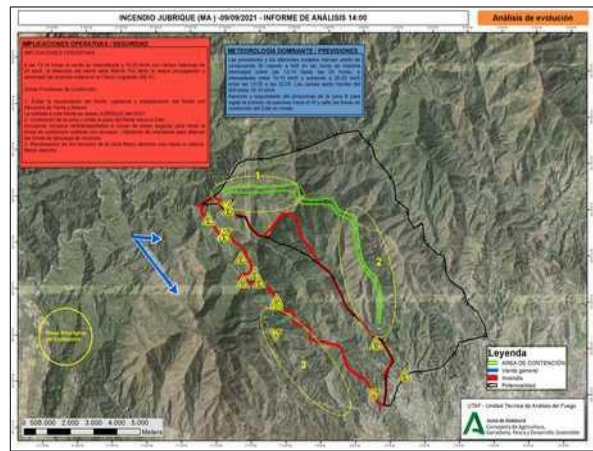
Synoptic situation: Advection from the W, with the presence of a cold air mass at altitude.

The wind component of the fire was NW. The fire spreads along NW-SE and W-S ridge axes, with maximum spread on those slopes aligned to the SE and E with the NW wind.

Continuous propagation speeds during the first 5 hours of approximately 25 m/min. Propagation during the previous night by NW-SE wind. Thermal inversion consolidates with break at 11.00 a.m.

Priorities:

1. On the urban-forest interface: Activation of level 1, with the evacuation of several housing estates.
- 2.- Containment of the eastern flank opening.



Figures 35 and 36: General photography and evolution analysis on day 9 (2.00 p.m.).

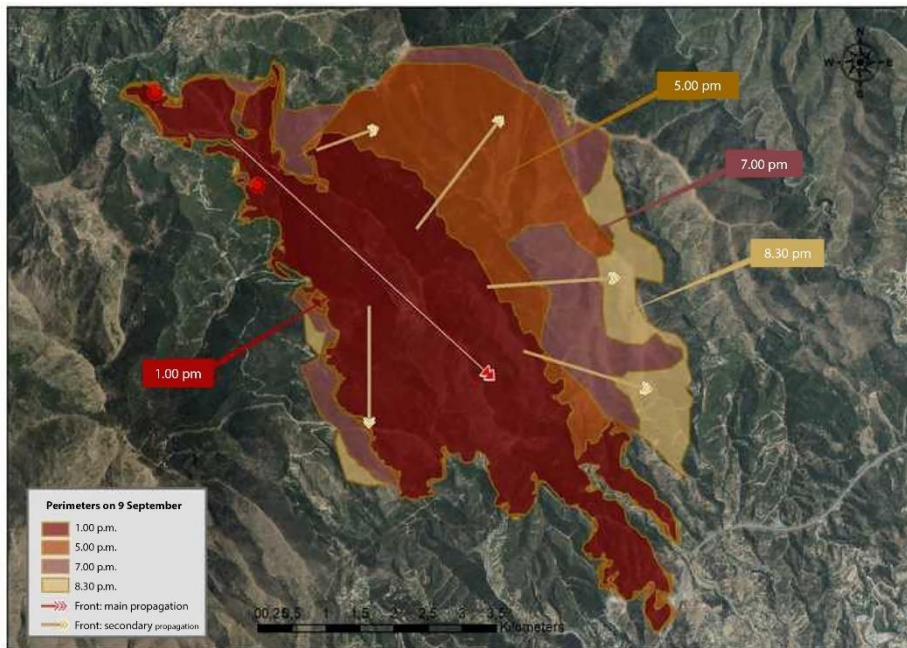


Figure 37: Partial perimeters on day 9.

Three operational plans were drawn up, valid until 10.00 p.m.

DAY9_OP 1

OPERATIONAL PLAN				Nº	1
Date of writing	09/09/21	Hour	4.00 a.m.	Lugar	Sierra Bermeja
Plan term	09/09/2021 – 8.00 a.m.				
ROOM ANALYSIS					
Meteorology					
Operational Implications					
STRATEGIC OBJECTIVES					
Eviction of housing developments located in the direction of fire advance (head), and search for areas of opportunity. Containment of the right flank to avoid affecting the Los Reales-Sierra Bermeja Natural Park.					
TACTICAL PLANNING					
SECTOR	1 right		SECTOR	2 left	
Person in charge	TOP Israel Yagues		Person in charge	AMA Diego Ruiz	
Resources allocated			Resources allocated		
ME-206, 105, 111 MP-102, 203 BRICA 701 TOP Paco Cantero			ME-211, 210, 202, 213. MP-204, 205 TOP Pepe del Río		
SECTOR			SECTOR		
Person in charge			Person in charge		
Resources allocated			Resources allocated		
TACTICS					
SECTOR					
1	Tail-to-head flanking operations. Hose-laying defence line.				
2	Tail-to-head flanking operations. Hose-laying defence line.				

DAY9_OP 2

OPERATIONAL PLAN				Nº	2
Date of writing Plan term	09/09/21	Hour	8.00 a.m.	Lugar	Sierra Bermeja
	09/09/2021 – 14.00 p.m.				
ROOM ANALYSIS					
Meteorology					
<p>The forecasts and the different models show winds from the W becoming NW. The hours of maximum intensity will be between 1.00 p.m. and 2.00 p.m. until 8.00 p.m. The intensities will be between 10-15 km/h and 20-25 km/h. Wind gusts will be strong from the NW between 30-35 km/h.</p>					
Operational Implications					
<p>Interface zone: area of Monte Mayor consisting of scattered, exposed areas. Confinement. Evacuation is recommended in time if the threat consolidates. El Alcuzcuz, La Zagaleta and El Madroñal: large area of permeable intermix, areas of discontinuity of fuel due to golf courses. Evacuations must be done in time. In case of need the area is confinable. Smoke effect.</p> <p>Priority Areas:</p> <ol style="list-style-type: none"> 1. Protection of goods and people especially on the SE flank and left flank head sector. Attention to the left flank NE-E. Prevent it from reaching the critical zone due to the NW wind forecast at 2.00 p.m. 2. Avoid repositioning the E front; surveillance and stabilisation with ground and air resources. 3. Containment of zone E to prevent it from advancing. Incorporate heliborne resources to safe areas, to have the containment line covered with resources. 4. Re-positioning of resources from the right flank tail to the right flank head. 					
STRATEGIC OBJECTIVES					
<p>Prioritise containment of the left east flank, due to wind shift to W. Ground means carry out perimetering from tail to head and head to tail.</p>					
TACTICAL PLANNING					
SECTOR	1 right		SECTOR	2 left	
Person in charge	TOP Antonio Vera		Person in charge	AMA Diego Ruiz	
Resources allocated			Resources allocated		
ME-206, 109, 102 MP-102, 203, 104 BRICA 701 TOP Paco Cantero KE-306 GP-203 GE-204, 202, 109 TOP F. Muñoz GP201 TOP I. Cantero CP-103, 113, 207			ME-211, 202 MP-204, 105 TOP Pepe del Río KE 301, 110, KP-302 TOP M.A. fdez TOP E. Gallego JE-109, 410 JP-405 TOP J. Escribano B-803 TOP Paco Peña SE-115, 110, SP-210		
SECTOR	3 head		SECTOR		
Person in charge	TOP BRICA Ruben		Person in charge		
Resources allocated			Resources allocated		
B-402, B-702					
TACTICS					
SECTOR					
1	Tail-to-head flanking, line of defence and hose-laying.				
2	Tail-to-head flanking, line of defence and hose-laying.				
3	Head control. "Two-steps" line with aerial means.				

DAY9_OP 3

OPERATIONAL PLAN				Nº	3
Date of writing Plan term	09/09/21	Hour	2.00 p.m.	Lugar	Sierra Bermeja
	09/09/2021 – 10.00 p.m.				
ROOM ANALYSIS					
Meteorology					
<p>West anticyclonic advection with cold air mass at altitude. In Malaga we will have NW component wind fire with topographic influence. Propagation along ridge axes in NW-SE and W to S direction and maximum propagation on the slopes aligned to the SE and E with the NW wind. The forecasts and the different models indicate a W wind component turning to NW at the hours of maximum intensity between 1.00 p.m. and 2.00 p.m. until 8.00 p.m., and intensities between 10-15 km/h and rising to 20-25 km/h between 2.00 p.m. and 8.00 p.m. Gusts will be strong from the NW between 30-35 km/h.</p>					
Operational Implications					
<p>1 - Avoid repositioning the front, surveillance and stabilisation of the front by ground and aerial means. The entrance to access the front is through Jubrique, road MA-8301. 2 - Containment of the area and prevent it from progressing eastwards. Incorporate heliborne resources to safe areas, to have the containment line covered by resources. 3 - Reposition resources from the right flank tail to the right flank head.</p>					
STRATEGIC OBJECTIVES					
<p>First Priority - Protection of goods and people, especially in the SE area and left flank sector, with possible spread in the direction of Benahavis. Second Priority - Attention to the left flank (NE-E) in order not to reach the Critical Zone and due to the NW wind forecast from 2.00 p.m. until 8.00 p.m. Attention to the windward areas. Attention to the repositioning of the left flank tail, limiting or containing the flank so that it does not spread further to the SE.</p>					
TACTICAL PLANNING					
SECTOR	1 right		SECTOR	2 left	
Person in charge	TOP Antonio Vera		Person in charge	TOP BRICA Paco Vera	
Resources allocated			Resources allocated		
ME-206, 109, 102 MP-102, 203 BRICA 701 TOP Paco Cantero KE-306 GP-203 GE-204, 202, 109 TOP F. Muñoz GP201 TOP I. Cantero CP-103, 113, 207			ME-211, 202 MP-204, 105 TOP Pepe del Río KE 301, 110, KP-302 TOP M.A. fdez TOP J. Escribano B-803 TOP Paco Peña SE-115, 110, SP-210 TOP P. Vera B-702-703 ME-209		
SECTOR	3 head		SECTOR		
Person in charge	TOP BRICA Ruben		Person in charge		
Resources allocated			Resources allocated		
TOP L. Resta ME-211, 217, 202 TOP E. Gallego JE-109, 410 JP-405 TOP D. Posteguillo GE-301 TOP F. Muñoz GE-109, 202					
TACTICS					
SECTOR					
1	Direct attack with air support, laying of hoses				
2	Direct attack. Support of heavy air resources				
3	Direct attack with air support, laying of hoses				

3.2.4 10/9/21

Synoptic situation: Advection from the west (W). The unstable conditions increase the fire activity from 11.00 a.m. onwards. In addition to the area with high load and the availability of fuel, it produces convective development in the areas indicated in the analysis (yellow). Spread by NW-SE wind, with greater intensity at high altitudes (interior areas) compared to the coastal area. Areas with high return potential.

Level 2 declaration, and request for external resources.

The northern sector progresses towards the Jubrique fire of July, contained by the north wind. The Eco sector evolves, favoured by the ridge axes oriented to the wind.

From 3.00 p.m. pyrocumulus formation, with monitoring for possible collapse. Staff removal is ordered for security reasons.

Increased activity with the progressive opening of the left flank towards the Eco sector and the W-NW flank towards the Los Reales pine forest to the W.



Figures 38 and 39: General photography and evolution analysis on day 10 (10.30 a.m.).

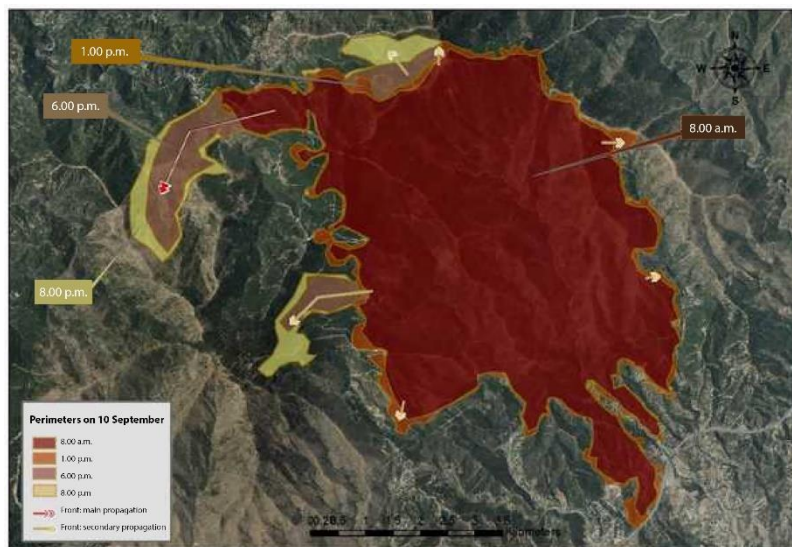


Figure 40: Partial perimeters on day 10.

DAY10_OP 4

OPERATIONAL PLAN				Nº	4
Date of writing Plan term	09/09/21	Hour	9.00 p.m.	Lugar	Sierra Bermeja
	10/09/2021 – 11.00 a.m.				
ROOM ANALYSIS					
Meteorology					
Anticyclonic advection from the W. In Malaga, NW component more intense in central hours. Wind fire with NW influence.					
Operational Implications					
NW-SE and W to S ridge axis propagation and maximum propagation on SE and E aligned slopes with NW wind.					
STRATEGIC OBJECTIVES					
Consolidation of the fire elevation zone for subsequent flanking work from there in a safe manner. Maintenance of the MA-8301 road as a control line in the W zone. Bulldozing for access of ground operations to the left flank and mechanised firebreak widening works.					
TACTICAL PLANNING					
SECTOR	1 right flank		SECTOR	2 left flank	
Person in charge	Antonio Castillo		Person in charge	Antonio Ruiz	
Resources allocated			Resources allocated		
ME209, ME112, ME212, ME214, ME221, ME105, ME205, ME103, ME111, ME220 TOP Javier Díaz, KE202, KE205 TOP Abigail, GE104, GE304, GP 104 TOP J.M. Fuente, B801, B802 Lázaro Egea, CE107, CE212, CN201 TOP Luis Gonzalez, JE409, JE107, JP103 TOP Juan Bermejo, HE102, HE210, HE301, HP201			Pending assignment		
SECTOR			SECTOR		
Person in charge			Person in charge		
Resources allocated			Resources allocated		
TACTICS					
SECTOR					
1	Direct attack with fire fighting vehicles				
2	Tactical fire in the tail, direct attack with hose-laying elsewhere				
3	Work with heavy machinery				

DAY10_OP 5

OPERATIONAL PLAN				Nº	5
Date of writing Plan term	10/09/21	Hour	11.00 a.m.	Lugar	Sierra Bermeja
	10/09/2021 – 22.00 p.m.				
Resources					
TOP F. Vera, B702 TOP E. Resta, ME218, ME217, ME108 TOP P. Morillo, CE207, CE113, KE306, KE110, KP301, JP405, ME206 TOP F. Muñoz, MP101, B402, GE204, GE202					
ROOM ANALYSIS					
Meteorology					
Synoptic situation marked by a weak anticyclone in the Azores and a squall south of the British Isles, between both of them establishing a W-NW wind corridor over Andalusia with some instability. From 8.00 a.m. to 11.00 a.m. light winds in general, average wind <5km/h, some gusts above 10 km/h. North area: Light northerly wind, decreasing further south. From 11.00 a.m. to 5.00 p.m. south winds establish over the whole area, stronger in the east than in the west. Average wind in this area with average speeds around 10 km/h. Tendency to turn SE first (1.00 p.m.) and then SW (from 4.00 p.m.).					
Operational Implications					
There is an increasing probability (high between 12.00 p.m. and 5.00 p.m.) that the fire could become convective, with a greater potential than on the previous day to generate cumulonimbus clouds. After 5.00 p.m. the fire would progressively cease to be governed by convective parameters.					
STRATEGIC OBJECTIVES					
Confine the fire between dividers as primary control lines. Cut off fire access to the main propagation nodes. Safeguard the Spanish fir forest.					
TACTICAL PLANNING					
SECTOR	1 WEST		SECTOR	2 EAST	
Person in charge	Francisco Rueda		Person in charge	Eduardo Nicolás	
Resources allocated			Resources allocated		
TOP Cantero / B701 / ME217 / ME218 TOP Israel ME208 / ME209 TOP Jesus Escribano / B801 TOP Inma Cantero / CP103 / CE113 TOP Pablo Morillo / CE207 TOP Enrique Gallego / JP405 / JE410 MP103 / JE109 / MP203			TOP F. Vera / B702 / B703 TOP J.M. Fuentes / B802 / B804 K80 / K70 / M6 / M1 / M7 T3 / FOCA		
SECTOR			SECTOR		
Person in charge			Person in charge		
Resources allocated			Resources allocated		
TACTICS					
SECTOR					
1	Direct attack with hose-laying.				
1	Flanking supported by light and medium-heavy air assets.				
2	“Two-steps” line with aerial support.				
2	Attack with fixed-wing discharges with and without retardant				

DAY10_OP 6

OPERATIONAL PLAN				Nº	6
Date of writing Plan term	10/09/21	Hour	5.00 p.m.	Lugar	Sierra Bermeja
	10/09/2021 – 22.00 p.m.				
ROOM ANALYSIS					
Meteorology					
Synoptic situation marked by a weak anticyclone in the Azores and a squall south of the British Isles. Between them, a corridor of winds from the W-NW over Andalusia with a certain degree of instability.					
Operational Implications					
Pyrocumulus formation is observed, with some possibility of collapse, which conditions ground operations, forcing the preventive removal of all ground personnel, and only manual groundwork is performed in the area of the low area of the flank ECO. Possible return to a safe situation is foreseen for 7.00 p.m. to 8.00 p.m. Window of opportunity to work for 12 hours according to weather forecast from 10.00 p.m..					
STRATEGIC OBJECTIVES					
Personnel safety from the possibility of pyrocumulus collapse. Confine the fire between lines as primary control lines by aerial means. Cut off fire access to the main propagation nodes, exclusively with aerial means until manual work is possible. Safeguard the Spanish fir forest.					
TACTICAL PLANNING					
SECTOR	1 WEST		SECTOR	2 EAST	
Person in charge	Francisco Rueda		Person in charge	Eduardo Nicolás	
Resources allocated			Resources allocated		
T2, T3, T5, T7 and T9 6 FOCAS 4 ACT HYDROPLANES			KZ4, KA4, KA40, KA8 MA1, MA2, MA3, MA4, MA5, MA6 MA7, L7		
SECTOR	3 JUBRIQUE		SECTOR	4 GENALGUACIL	
Responsible	Abigail Mañasco		Responsible	Eduardo Resta	
Resources allocated			Resources allocated		
GE304, GE104, GE205 GP104 CE211, CE107 CP201			MP206, MP205, MP204		
TACTICS					
SECTOR					
1	Containment with fixed-wing air resources and heavy helicopters. Ground resources in secure location				
2	“Two-steps” line with air support from FOCA. Ground assets in secure location				
2	Containment with light and medium-heavy aerial assets				
3	Protection and defence around localities				

3.3 WEATHER SCENARIO 2: LOCAL WIND DYNAMICS

3.3.1 SCENARIO 2 CHARACTERISATION

Scenario corresponding to day 11 and the night of 12 September, where the high pressures represented by the Azores anticyclone are displaced by the North Atlantic squall, generating a "calm" situation, as there is no pressure gradient in the area of the fire.

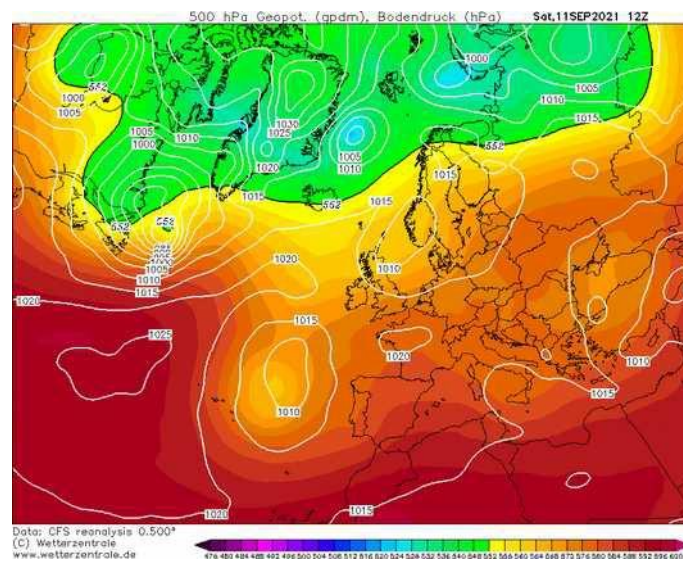
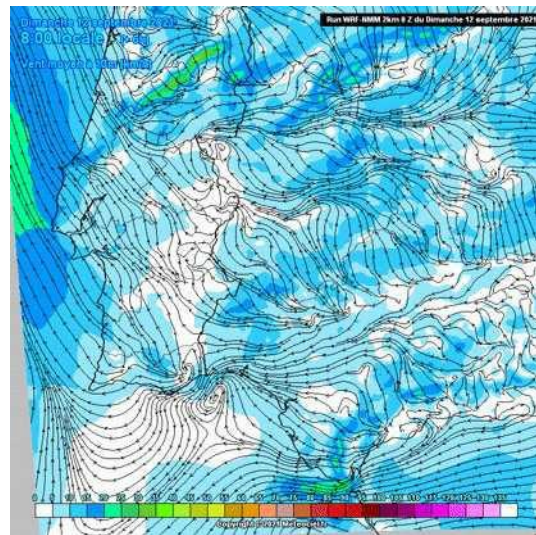
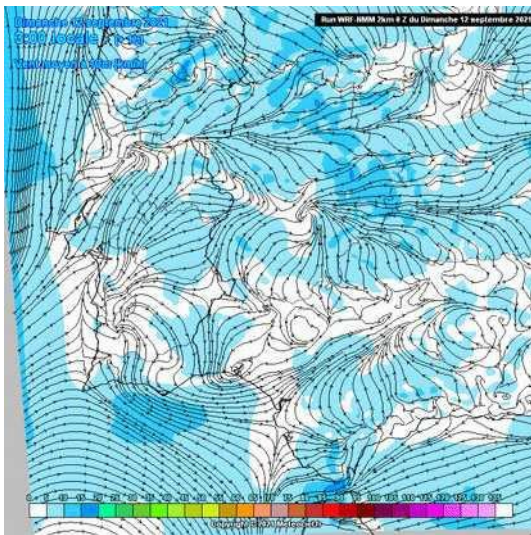
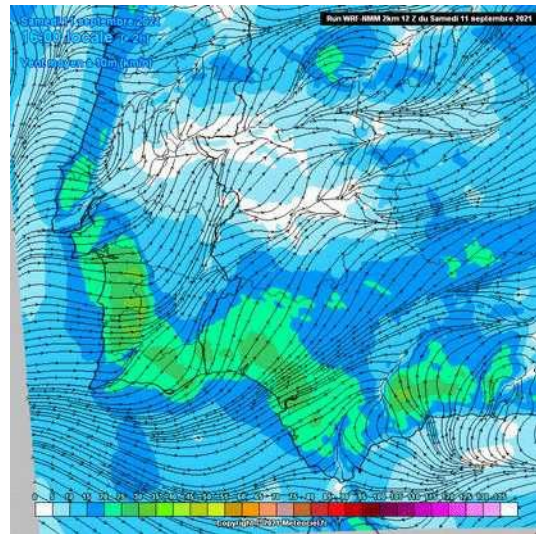
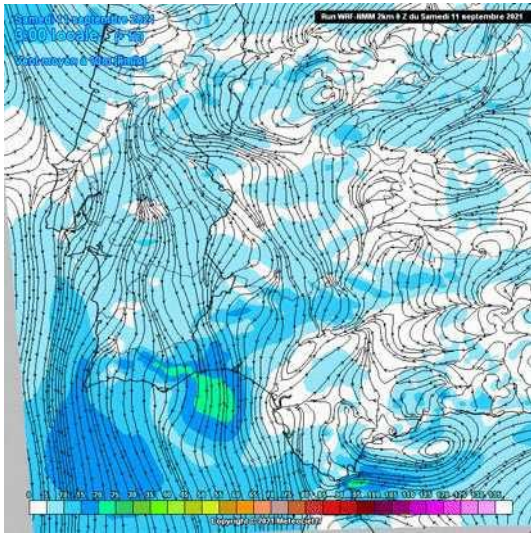


Figure 41: Geopotential height at 500 hPa corresponding to 12Z on 11 September.

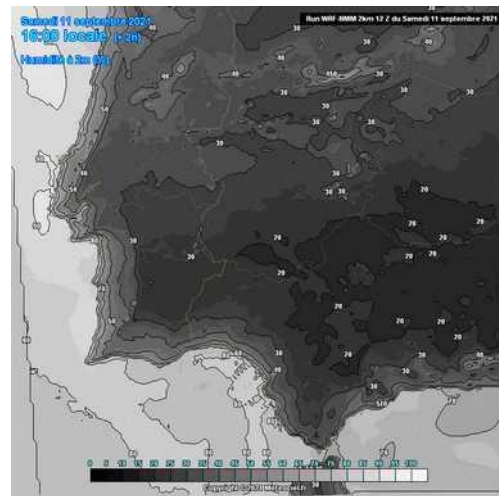
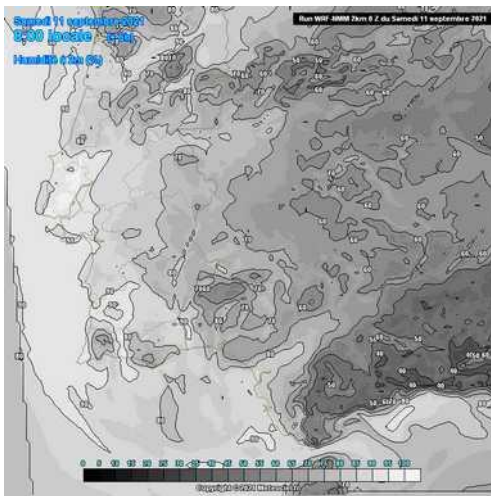
A decrease in wind intensity is imposed, reaching forecasts of calm wind (<5 km/h) in the early morning, increasing in intensity with rising temperatures (10-20 km/h). The component of air movements during this scenario corresponds to that of local winds: at night, decreasing intensity and descending slopes; increasing intensity with rising temperatures during the day.

On this dynamic of air movement at mesoscale level, the influence of the Guadalquivir valley is noticeable, generating its air flow produced by the daily thermal differences that develop throughout the valley.

Due to the air mass situation generated on this day, the maximum relative humidity during this scenario is the lowest with night values between 40 and 50%. The entry from the south, favoured during the day, also does not bring moist air to the fire, which is limited to the coastline.



Figures 42, 43, 44 and 45: WRF model outputs for wind at 10 m forecasts for 3.00 a.m. and 4.00 p.m. on day 11 (upper images) and for 3.00 and 8.00 a.m. on day 12 (lower images).



Figures 46 and 47: WRF model outputs for relative humidity at 2 m forecasts for 8.00 a.m. and 4.00 p.m. on day 11.

In the analysis of the evolution of the second scenario, the predominance of the effect of local winds can be observed.

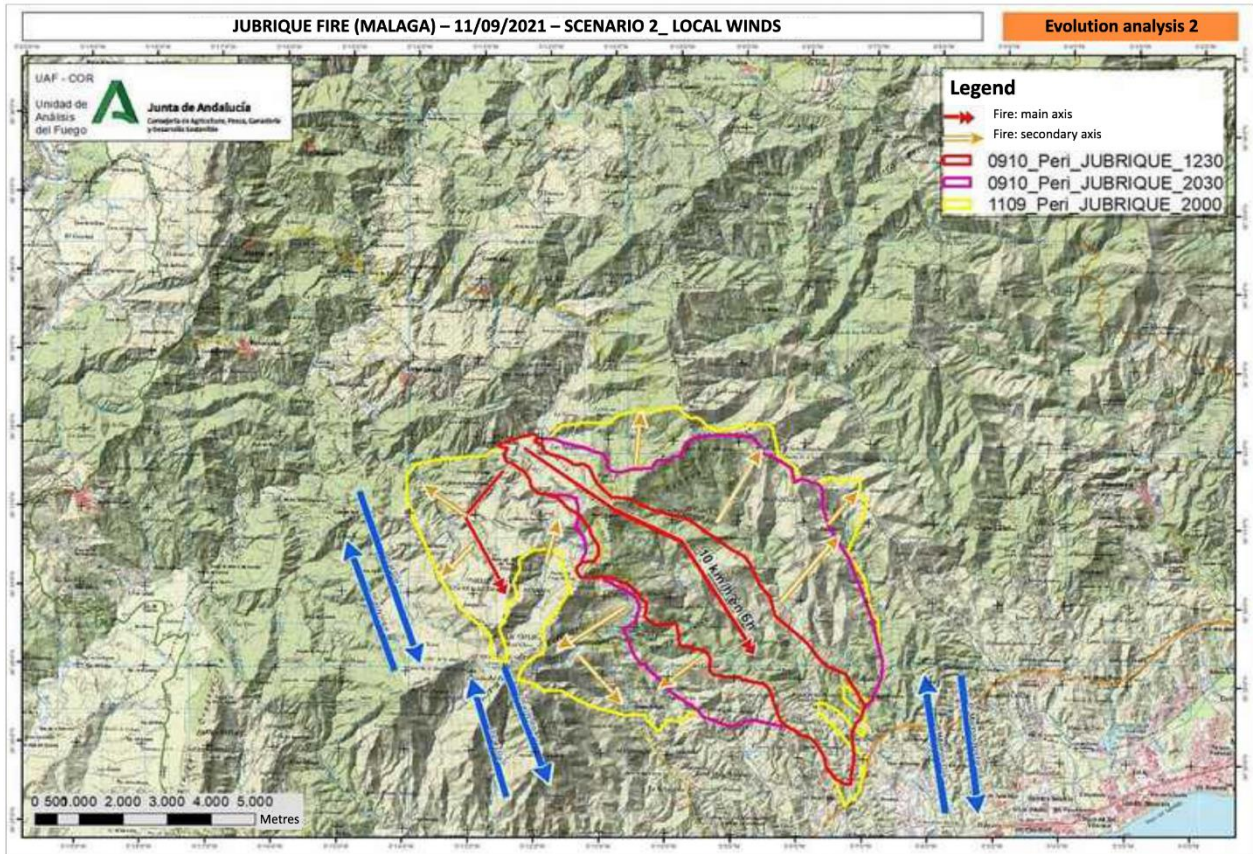


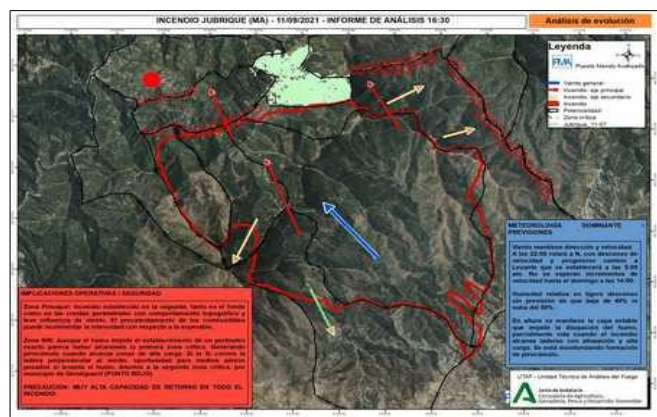
Figure 48: Scenario 2 evolution analysis.

3.3.2 11/9/2021 AND EARLY MORNING OF 12/9/2021

General wind from S-SE of low intensity, with alternating south-north wind between day and night. Relative humidity remains between 40-50% all day.

The spread to the north increases the risk of damage to the municipality of Genalguacil, as well as the partial damage to the Spanish fir forest.

This disposes previously burned areas to be affected by the fire again. During the early morning of day 12, the incandescent material from the fire from the northeast area causes the consolidation of new outbreaks to the north of the area burned in July; the alignment with the slope favours this consolidation and the development of new propagation axes in a northerly direction.



Figures 49 and 50: General photography and evolution analysis on day 11 (4.30 p.m.).

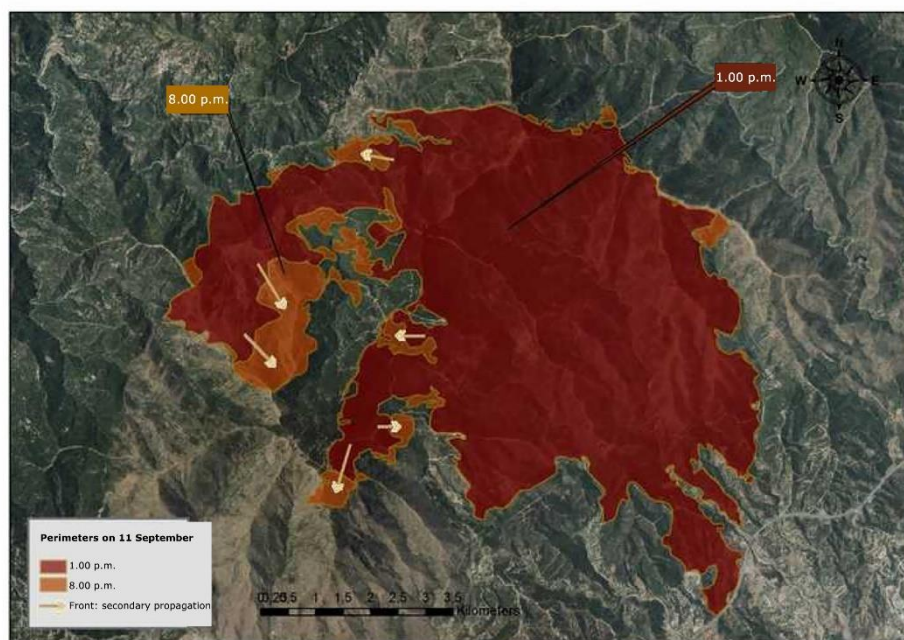


Figure 51: Partial perimeters on day 11.

DAY11_OP 7

OPERATIONAL PLAN				Nº	7
Date of writing Plan term	11/09/21	Hour	12.00 a.m.	Lugar	Sierra Bermeja
	11/09/2021 – 8.00 a.m.				
ROOM ANALYSIS					
Meteorology					
<p>During the night, a N wind is forecast with intensities of 10-15 km/h, which will drop to less than 10 km/h in the early morning and will turn to S from 10.00 a.m. onwards, maintaining this component without appreciable changes in intensity (10-15 km/h). Relative humidity will not recover as it did last night, with highs of around 40% associated with the terrestrial component of the wind in the area. On the morning of 11 September, relative humidity will decrease as the day warms up.</p> <p>As for stability/instability, conditions are worse and we will have to be alert, because tomorrow there will be a possible advection from the SW, which will bring moisture in the upper layers, so the profile will be unstable from very early on.</p>					
Operational Implications					
<p>The area on the left flank (N-E) is the sector with the least number of resources, and according to forecasts it will have a W-NW component. Therefore, the greatest reactivations and propagations will occur towards the E-SE. During the night from 2.00 a.m. to 8.00 a.m. in the S-SW area on the right flank, a N wind is forecast (Estepona area) and therefore the possibilities of reactivations and propagation will progress towards the south.</p>					
STRATEGIC OBJECTIVES					
<p>Personnel safety due to night work in sloping areas. Work in the areas of the fire that are on a downhill slope during this shift: Sector A NW (Genalguacil pond) and Sector NE (Jubrique pond). Evaluation of opportunities in SW from MA- road towards Antenas.</p> <p>Sector C. In all sectors, work opportunities and tactics (direct and/or indirect attack) will be identified.</p>					
TACTICAL PLANNING					
SECTOR	1. Genalguacil pond Right flank		SECTOR	2. Jubrique pond Left flank	
Person in charge	TOP Pepe del Rio		Person in charge	Fernando Carrasco	
Resources allocated			Resources allocated		
MP-201, 206, 202 ME-203, 221, 205, 105 MN-101 TOP Pepe del Rio CE-211			HE-102, 301		
SECTOR	3 West area		SECTOR		
Person in charge	Gema Ferrer		Person in charge		
Resources allocated			Resources allocated		
KE-204,107,104 KP15					
TACTICS					
SECTOR					
1	Operations from the M-8301 road in both directions of the perimeter.				
2	Work to the north dividing line from Jubrique pond to the East.				
3	Assessment of the work from the M-8301 road to Antenas (West)				

DAY11_OP 8

OPERATIONAL PLAN				Nº	8
Date of writing	11/09/21	Hour	08.00 a.m.	Lugar	Sierra Bermeja
Plan term	11/09/2021 – 9.00 p.m.				
ROOM ANALYSIS					
Meteorology					
<p>General wind from S-SE with low intensity. Forecast: maintains direction and increases to 10-15 km/h at 12.00 p.m. From 2.00 p.m. possible shift to E-SE, maintaining intensity. Relative humidity: 40-50%. No change forecast. During the afternoon, possible thermal inversion and calm wind at night. Atmospheric inhibition throughout the day which will limit convective development with the forecast behaviour.</p>					
Operational Implications					
<p>Spanish fir area (W): Fire established in the trough, both at the bottom of the ravine and on the perimeter ridges. Topographic behaviour with slight wind influence. Preheating of fuels may increase intensity. NW area: Low visibility due to smoke seems to have reached the critical zone, generating pyrocumulus when it reaches the high fuel load areas. Opportunity for aerial asset discharges when it crowns the front. High return potential. Evolution is towards Genalguacil. No significant wind. Precaution: In areas of greatest activity, due to the launching of sparks to the W and the presence of shear at altitude. Caution: It may reach the critical area marked, causing runs towards the municipality of Genalguacil, which may be counteracted by downdrafts. NE area: Advance against the slope. Area suitable for work with wind expected S-SE, evolving towards the SE.</p>					
STRATEGIC OBJECTIVES					
<p>Integral defence of the Spanish fir forest. Generalised containment during daylight hours. Perimeter stabilisation.</p>					
TACTICAL PLANNING					
SECTOR	Spanish fir forest		SECTOR	ECO	
Person in charge	Eduardo Nicolas		Person in charge	Francisco Rueda	
Resources allocated			Resources allocated		
<p>TOP J. Escribano / B803 TOP F. Cantero / B701 / ME206 TOP Inma CAntero / TOP Pablo Morillo CE-113, 207, CP102, 103 3 FOCA / T2 / T3 / T5 / 79</p>			<p>2 BRIF (Iglesuela and Pinofranquedo) TOP F. Vera B702 / B703 TOP Luis González / JE107 / JE409 / JP405 Fire fighters MZ1 / MZ1B / MZ0 / MZ0B K70 / M2 / M7 / L7</p>		
SECTOR	North		SECTOR	South	
Person in charge			Person in charge		
Resources allocated			Resources allocated		
<p>AMA Antonio Ruiz tOP Enma / SE206 / SE112 / SP20 TOP Cristo / KE104 / KE107 / P15 / ME217 / ME218 / MP202 / MP206 / MP204 M1 / M3 / M4 / M5 / M6 / M8</p>			<p>TOP Israel Yagues ME106 / ME108 / ME109 / MP105 / MP103 K0 / K80 / K5 / K40</p>		
TACTICS					
SECTOR					
1	Direct attack with hand tools and fixed-wing air asset support				
2	Direct attack with air asset support				
3	"Two-steps" line supported by semi-heavy air assets				
4	Direct attack with heavy air asset support				

DAY12_OP 9

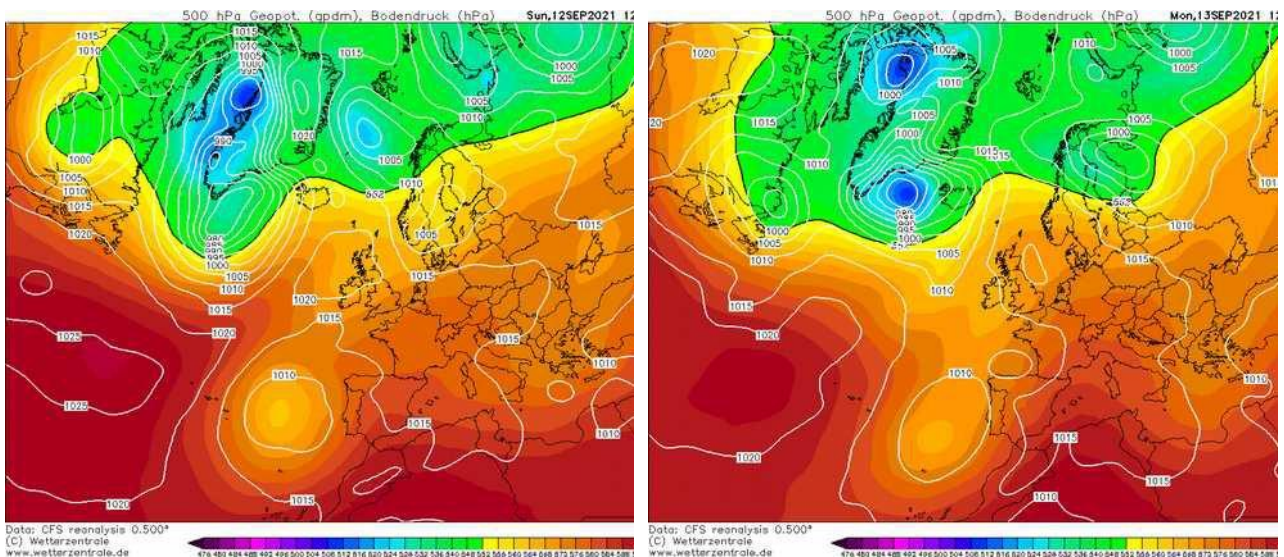
OPERATIONAL PLAN				Nº	9
Date of writing Plan term	12/09/21	Hour	12.00 a.m.	Lugar	Sierra Bermeja
	12/09/2021 – 8.00 a.m.				
ROOM ANALYSIS					
Meteorology					
<p>Wind: Throughout the night a light wind from the valley (north direction) or a calm wind is expected. Very light wind < 5 km/h from the north. From midday on Sunday, breezes from the SE are expected. At 11.00 a.m., wind from S-E with speeds of 10 km/h or slightly higher is expected. Thermal inversion will hit the ground at 10.00 p.m. on 11 September and will remain until 11.00 a.m. on Sunday, 12 September. Relative humidity will be between 40% and 60%. Wind shear at altitude.</p>					
Operational Implications					
<p>Area1 NW: The entry of wind from the N, will cause the runs to increase in intensity and speed, although they seem to be contained on the ridge. Area2 North: Area favoured by the north wind direction. The inversion will decrease fire activity. Wind shift to E-SE forecast for the morning. It is proposed to secure the area to prevent the spread towards the municipality of Genalguacil entering the NW potentials. Area3 NE: Anchor in the firebreak located on the E-NE flank, securing it with tracked machines (bulldozer). Safety: High return potential around the perimeter. Stone detachment in slope areas. Break in the thermal inversion around 11.00 a.m.</p>					
STRATEGIC OBJECTIVES					
<p>NW flank: Prevent it from touching the bottom of the ravine, of the Almanchal river and entering into alignment with wind and slope. NE flank: Contain the front towards the Resinera estate and prevent it from entering a new potential, with risk for the population of Jubrique. Ensure the safety of personnel: Apply the OACEL protocol.</p>					
TACTICAL PLANNING					
SECTOR	NW		SECTOR	NE	
Person in charge	Marco Tena		Person in charge	José Maria Egea	
Resources allocated			Resources allocated		
TOP Carlos Rey HE-303, 212, 309, 302 TOP Israel Yagues KE-204, 309, 302 TOP P. Caro- JE-206, 309, 406, JP 405-P50			TOP E. Resta ME-112, 212, 215, 213, 206 MP-201		
SECTOR	South		SECTOR		
Person in charge	Fany Archila (AMA)		Person in charge		
Resources allocated			Resources allocated		
TOP Antonio Vera ME-202, 203, 111- MP-103, 104					
TACTICS					
SECTOR					
1	Work from the M-8301 road in both directions of the perimeter.				
2	Work north of the dividing line from Jubrique pond to the east.				
3	Assessment of work from the M-8301 road towards Antenas (West).				

3.4 WEATHER SCENARIO 3: EAST AND SOUTH-EAST WIND DYNAMICS

3.4.1 SCENARIO 3 CHARACTERISATION

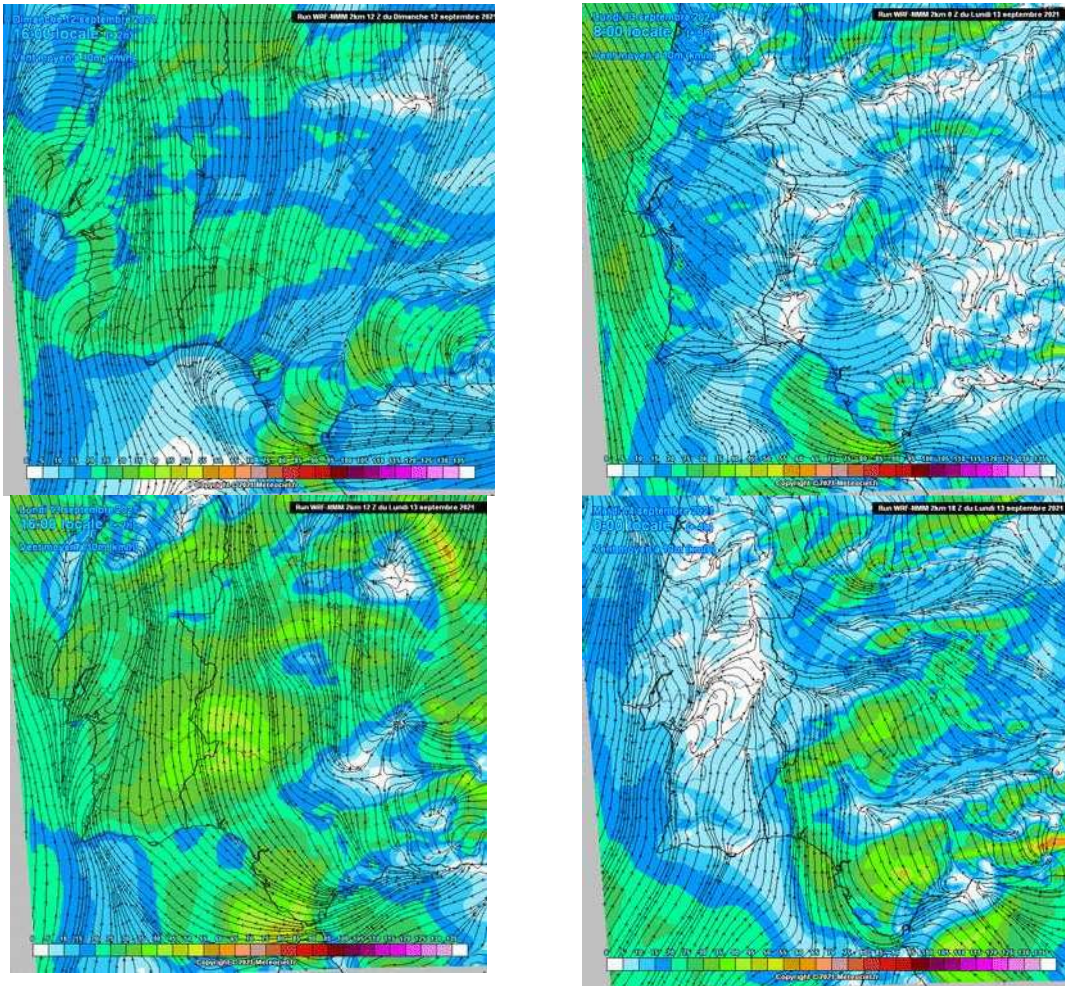
The imposition of an easterly wind in the Strait of Gibraltar from the morning of day 12 marks the beginning of this third scenario.

The lowering towards lower latitudes of the low-pressure centre from the North Atlantic, which is located to the SW of the Peninsula, determines an easterly circulation in the Strait of Gibraltar that is manifested in E and SE winds in the area of Sierra Bermeja.



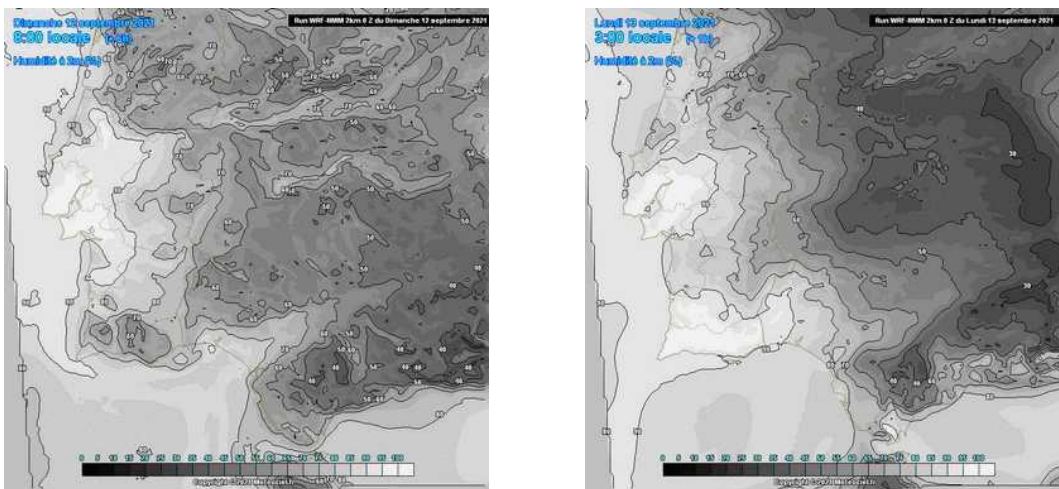
Figures 52 and 53: Geopotential height at 500 hPa corresponding to 12Z on days 12 (left) and 13 (right).

The influence of the low pressures to the SW of the Peninsula causes the air to move from the east to occupy the vacuum created by these. In the area of the fire there are winds from the E and SE that reach up to 35 km/h, strongly influenced by the low pressures that move from the west towards the east of the peninsula.



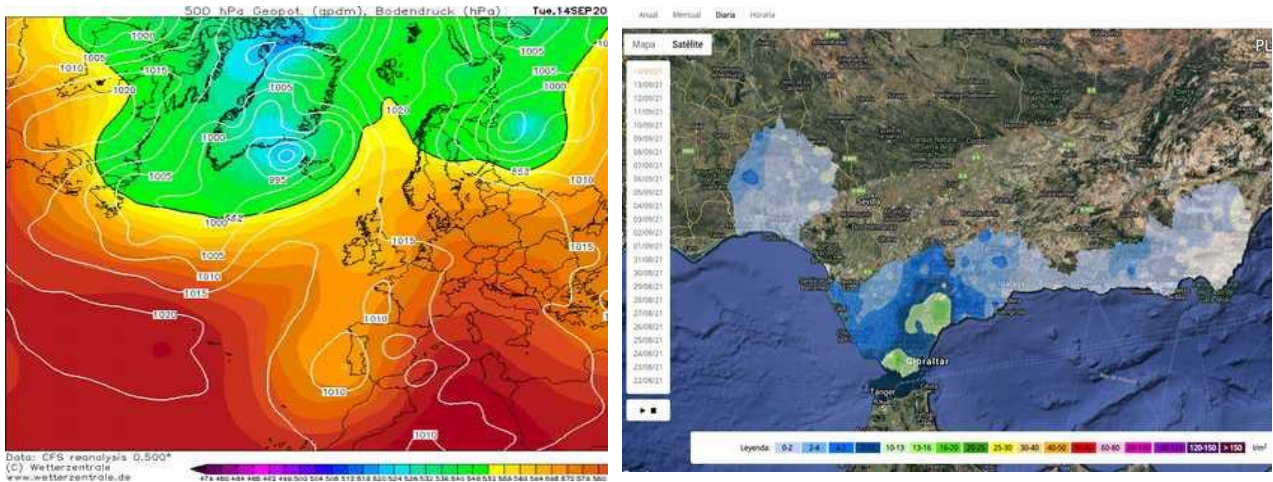
Figures 54 and 55: WRF model outputs for wind at 10 m forecasts for different times from 4.00 p.m. on day 12 to 0.00 a.m. on day 14.

With this flow dynamic, the area downwind of the peaks of Sierra Bermeja, in the Genal valley, continues without forecasts of relative humidity recovery, with maximum values close to 50%.



Figures 56 and 57: WRF model outputs for relative humidity at 2 m forecasts for 8.00 a.m. on the day 12 (left) and 3.00 a.m. on the day 13 (right).

Finally, these meteorological scenarios end with the entry of a trough from the SW of the Peninsula, manifesting itself in the form of precipitation during the early morning of day 14 with accumulated rainfall of around 10-15 litres.



Figures 58 and 59: Geopotential height at 500 hPa corresponding to 12Z on 14 September and record of rainfall during day 14 (SAIH Hidrosur).

The evolution analysis of the third scenario shows the following configuration:

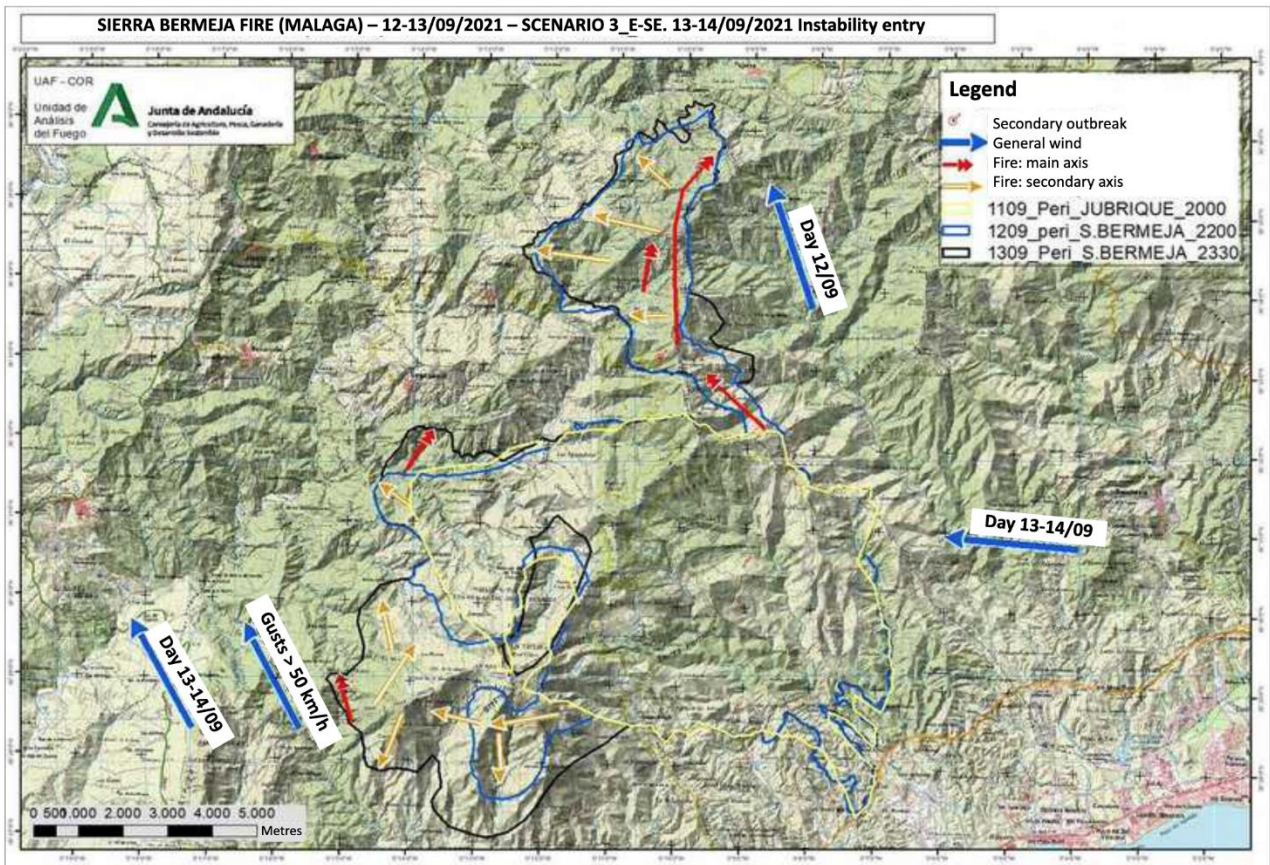


Figure 60: Scenario 3 evolution analysis.

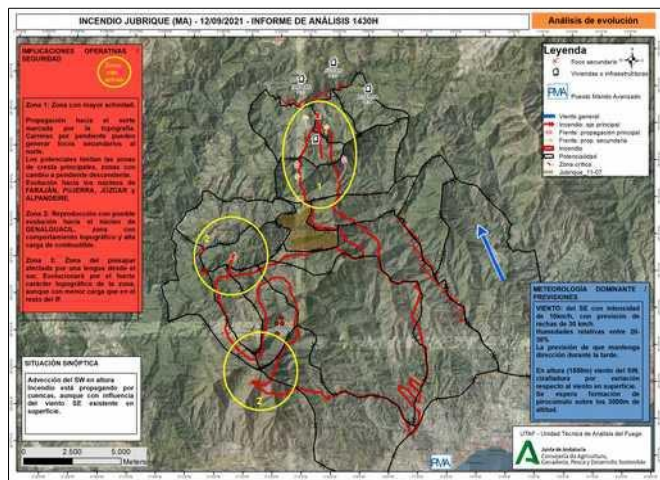
3.4.2 12/9/2021

Wind from the S-SE with low intensity, but with strong gusts of 30 km/h. Relative humidity between 20-30% which will remain throughout the day. The confluence of SE winds on the surface and SW winds at altitude will cause a northerly propagation axis, with secondary winds to the NW and NE.

Activation of the Municipal Emergency Unit for the protection of the municipalities of Jubrique and Genalguacil. Evolution towards the municipalities of Jubrique, Genalguacil, Pujerra, Fajarán and Júzcar.

Significant increase in fire activity on the NW flank with evolution towards Genalguacil.

The wind favours the evolution of the front towards the Spanish fir forest, with a marked topographic character, but decreases in intensity due to the lower fuel load.



Figures 61 and 62: General photography and evolution analysis on day 11 (4.30 p.m.).

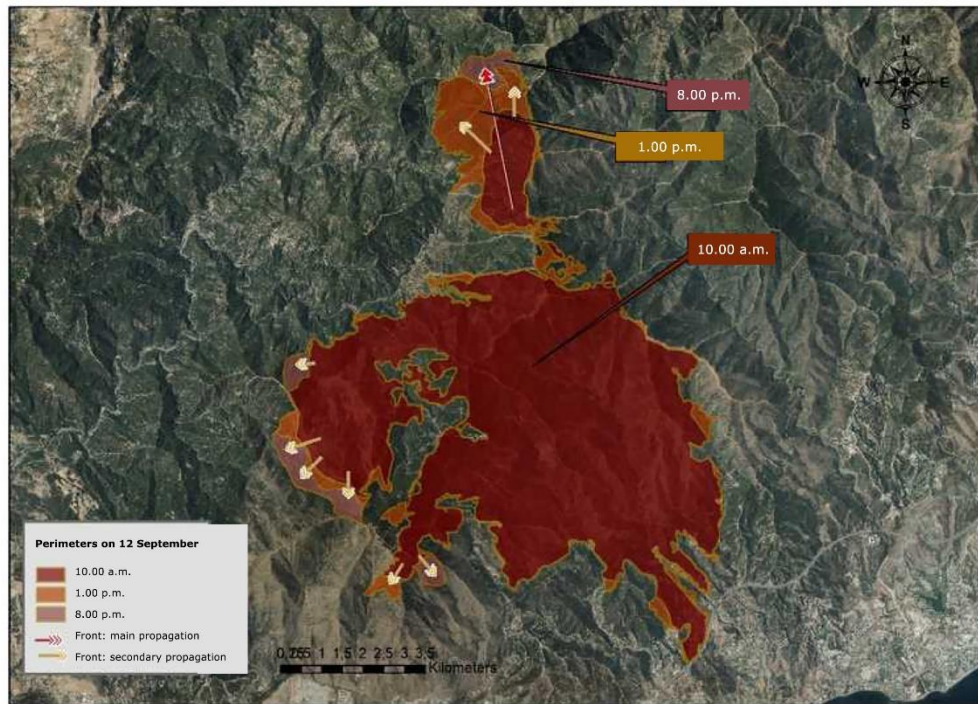
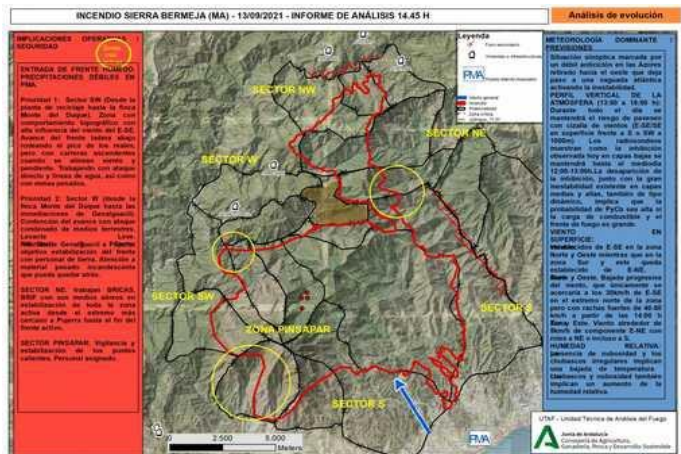


Figure 63: Partial perimeters on day 12.

DAY12_OP 10

OPERATIONAL PLAN				Nº	10
Date of writing Plan term	12/09/21	Hour	08.00 a.m.	Lugar	Sierra Bermeja
	12/09/2021 – 21.00 p.m.				
ROOM ANALYSIS					
Meteorology					
<p>Wind generally light from S-SE, less than 15 km/h. Relative humidity decreasing, with average lows of 30%.</p> <p>Increasing instability expected throughout the day, with a possible inversion layer at 800 hPa, with pressure breaking in high load areas for propagations in full alignment. Maximum column ceiling at 400 hPa and shear displacement to the NE (SW wind).</p>					
Operational Implications					
<p>Area1 N: Area with higher activity marked by topography. The potentials limit the main ridge zones. Evolution towards Farajan, Pujerra, Juzcar and Alpandeire.</p> <p>Area2 NW: Reproduction with possible evolution towards Genalguacil. Area with topographic behaviour and high fuel load.</p> <p>Area3 W_SW: Spanish fir area. Affected by a front coming from the south. It will evolve due to the abrupt topography of the area, although with less load.</p>					
STRATEGIC OBJECTIVES					
<p>Priority 1: Containment of fronts in the area around the towns of Jubrique, Genalguacil, Pujerra and their scattered settlements.</p> <p>Priority 2: Spanish fir forest, conditional upon operational window for safety.</p> <p>Priority 3: NE flank towards N, to limit forest areas of great value and conditioned by the W wind at altitude.</p>					
TACTICAL PLANNING					
SECTOR	NE		SECTOR	N	
Person in charge	Francisco Rueda		Person in charge	J.M. García Barranco	
Resources allocated			Resources allocated		
TOP BRICA Ruben B-402 TOP BRICA Juan David B-804_ BRIFF TOP Israel Yagues ME-105, 106, 206. TOP Pepe del Rio ME-108, 109 MP-203 AMA Antonio Tiscar_ JC Bellido ME-202, 211, 214_MP-101, 102, 104.			TOP Cristo KE-104, 107, P15-ME-209_ MP-103, 105, 203, 202. TOP Juan Diego_ GE-14, 118, 3305_GP-101. TOP BRICA Luisma B-804. Heavy machinery_ Pilar Aragon Firefighters_ME-207, 210		
SECTOR	NW		SECTOR	Spanish fir forest	
Person in charge	Salvador Benítez		Person in charge	Eduardo Herrera	
Resources allocated			Resources allocated		
TOP Juanma Dguez_ GE-105, 203, 206, 311_ GP-105 TOP BRICA Paco Cantero B-701, ME-216, 217 TOP ENMA_ SE-206, 112, SP-206_ ME-218_ MP-206. TOP José l. Montoya JE-310104, 303_ JP-304			TOP Cayetano_AE-102, 216, 304_AP-204_P17 SECTOR SOUTH (SE-S) Samuel		
TACTICS					
SECTOR					
Spanish fir forest	Extinguish isolated fronts and application of long-term retardant.				
NE	Direct attack with air support.				
N	Direct attack on discontinuous front, prioritising ravine bottoms and urban-forest interfaces.				
NW	Direct attack with heavy air support.				

Synoptic situation marked by the passage of an Atlantic trough, causing instability. This instability will provoke a risk of secondary outbreaks through the incandescent material from the fire with the existence of E-SE wind shear at the surface and S-SW at altitude. The passage of the front will cause a decrease in temperature, an increase in cloudiness, a probability of showers and an increase in humidity. The reactivation of the SW flank occurs, with a behaviour conditioned by the interaction of the SE surface wind with the orography of the Los Reales peak. The spread of the SW sector threatens the municipality of Casares. During the afternoon, the M-80 heavy helicopter crashes, with no injuries.



Figures 64 and 65: General photography and evolution analysis on day 11 (4.30 p.m.).

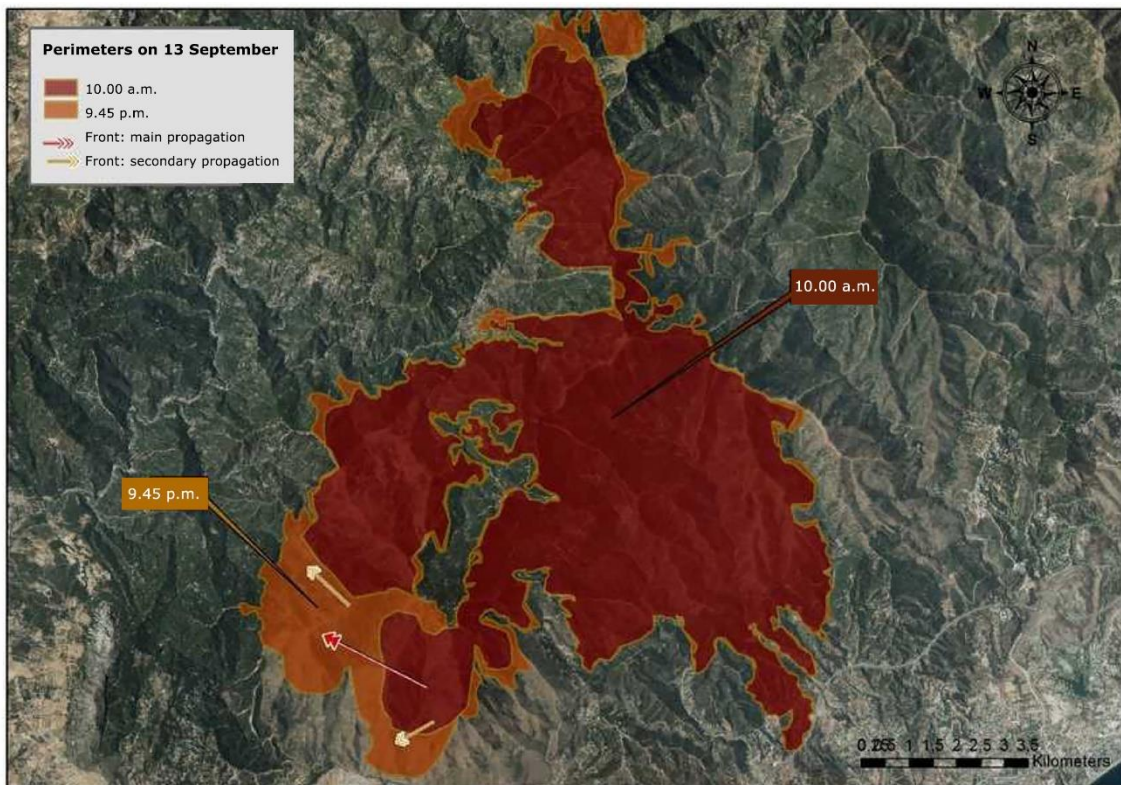


Figure 66: Partial perimeters on day 13.

DAY13_OP 11

OPERATIONAL PLAN				Nº	11
Date of writing Plan term	13/09/21	Hour	12.00 a.m.	Lugar	Sierra Bermeja
	13/09/2021 - 10.00 a.m.				
ROOM ANALYSIS					
Meteorology					
Light winds with no gusts forecast. Direction dominated by topography. Relative humidity between 40-60% in the north. On the morning of day 13, light winds from E-SE are expected until 10.00 a.m., after which the intensity is likely to increase significantly to 40 km/h from SE and gusts of 50 km/h. Heavy cloud from 3,000 m. High UNSTABLE conditions favouring fire convection, which could even generate thunderstorms. S-SW winds at high altitude (shear). Possibility of DRY BURSTS.					
Operational Implications					
NW area: Propagation to the N marked by topography. Slope runs may generate secondary outbreaks to the north. Priority area due to its effect on population settlements and potential with SE winds. W area: Priority area due to its evolution with prevailing SE wind. Tonight, topographic evolution is forecast. Risk of affecting population settlements on Genalguacil. NE area: Most active area. Basins with important fuel loads that may spread with high intensity due to topography. Spanish fir area: evolution due to topography. Area with lower fuel loads. SAFETY: In areas of slope, difficult access, and risk of landslides.					
STRATEGIC OBJECTIVES					
Guarantee the security of personnel: OACEL protocol. NW sector: Contain advance towards the towns of Jubrique, Faraján, Pujerra, and Júzcar. Priority sector due to the effect on population settlements and potential with SE winds. W sector: Protection of the centre of Genalguacil and containment of the forest fire on the Alberquillas road, descending front. NE sector: Containment of the advance supported by roads. To prevent it from entering an area of great forestry potential. Spanish fir sector: Priority due to ecological values. Protection of the Spanish fir forest.					
TACTICAL PLANNING					
SECTOR	NW		SECTOR	NE	
Person in charge	Pedro Jimenez		Person in charge	José M. Martínez Egea	
Resources allocated			Resources allocated		
TOP Antonio J-CE102, CE111, CE205, CE212, CP201, CP103 TOP Juan B. AE303, 105, AP104 TOP Francisco Sánchez CE-115, 201, 203, 117, CP203			TOP Antonio Vera, ME214, 111, 110, 213-MP206.201,101,10 TOP David L. / TOP Juanma D JE-110, 204,212, JP404, GE105, 203, 206, 311, GP 105 TOP Mario R / TOP Alejandro C GE111, 308, GP101, HE305, 106, 211, HP204		
SECTOR	W		SECTOR	Spanish fir forest	
Person in charge	Marco A. Tena		Person in charge	Laura Raya	
Resources allocated			Resources allocated		
TOP Analyst J. Galeote_ TOP JM Guerrero ME202, ME112, ME205, ME220, ME215 TOP F. Pavón SE204, 103, SP105 TOP F. Toscano KE-202, 205, 303, KP301			TOP Carlos Rey HE303, HE212, HE309, HP302		
TACTICS					
SECTOR					
NW	Burning out operations plus hose line support.				
NE	Tactical fire supported on road.				
W	Burning out operations supported by road.				

3.4.4 14/9/2021

Synoptic situation: Effect of the Atlantic trough positioned in the west; with the passage of the front, the wind will be positioned N-NW.

At 2.30 a.m. precipitation begins to fall over the fire area.

The heavy helicopter MA-80 is affected by the advance of the flames in the early hours of the morning. At 6.45 a.m. the Sierra Bermeja fire is considered under control.

Aftermath work is planned: Specifying the objectives set out in the aftermath plan with active surveillance of the different sectors of the perimeter; defining the priorities and establishing the critical areas, with the finishing off and aftermath of all the hot spots by opening a line of defence, with the support of hose lines and aerial means; increasing vigilance in the most vulnerable areas, especially in the Spanish fir forest.



Figures 67 and 68: Details of the SW area.

DAY14_OP 13

OPERATIONAL PLAN				Nº	13
Date of writing	13/09/21	Hour	9.00 p.m.	Lugar	Sierra Bermeja
Plan term	14/09/2021 – 8.00 a.m.				
ROOM ANALYSIS					
Meteorology					
<p>Atlantic trough positioned to the west of the Iberian Peninsula activating instability, with strong wind at altitude from the SW. As the hours go by, the vertical profile becomes more unstable for the appearance of pyrocumululus in case of column consolidation.</p> <p>Between 10.00 p.m. and 12.00 a.m. possible break of the thermal inversion producing greater propagations coinciding with the increase of wind. Precipitation: a front will pass through the fire area leaving weak precipitation, less than 10 mm, which will occur in the interval from 4.00 a.m. to 10.00 a.m.</p>					
Operational Implications					
<p>SW area: Perimeter with little activity in this sector.</p> <p>W area: During the night, the wind from the E, containing gusty winds, will condition the opening of this flank towards the W and may affect the urban-forest interface area.</p> <p>There may also be topographical runs to the north with the launching of secondary outbreaks caused by the effect of the Los Reales peak on the E wind.</p> <p>NE area: Containment manoeuvres.</p> <p>NW area: Perimeter contained over almost all its extension, with some hot spots.</p> <p>WARNING: significant increase in E-SE wind gusts of up to 50 km/h during the first part of the night which will increase the spread to the W-NW.</p>					
STRATEGIC OBJECTIVES					
<p>1: Close SW sector up to Chaparral harbour to prevent it from entering a new potential.</p> <p>2: Secure the perimeter of the NW sector to prevent reproduction.</p> <p>3: Secure the perimeter of the NE sector to prevent reproduction.</p>					
TACTICAL PLANNING					
SECTOR	NW		SECTOR	SW	
Person in charge	Pedro Jeménez		Person in charge	Antonio Sánchez Anguita	
Resources allocated			Resources allocated		
<p>AMA M. Santiago and A. Gomero ME207, MP202 TOP F. Muñoz, GI Granada TOP J. Segovia, GI Almería 2 platoons of the Municipal Emergency Unit</p>			<p>AMA L. Orta, V. Almoguer TOP P. del Rio, ME201, 219, MP203 TOP BRICA J. Escribano, B802, B803, B804 TOP Luisma, B404_TOP David, GI Jaén TOP Mario, GI Granada TOP F. Pavón, GI Seville</p>		
SECTOR	NE		SECTOR	Spanish fir	
Person in charge	Jose M. Martínez Egea		Person in charge	Daniel Gómez	
Resources allocated			Resources allocated		
<p>4 AMA_TOP Antonio Vera, ME212, ME214, ME103, ME104, ME110 TOP J M Miguel, GI Seville2 TOP C. Rey, GI Huelva1_TOP A. Cutanda, GI Huelva2_TOP F. Gabarro GI Huelva3</p>			<p>AMA D. Gomez and Mérida</p>		
TACTICS					
SECTOR					
NW	Monitoring and elimination of hot spots. Extinguishing of woodchip stockpiles.				
SW	Burning out operations supported by roads and manual and mechanised defence lines.				
NE	Construction of defence lines and wet lines.				
Spanish fir	Surveillance.				

DAY14_OP 14

OPERATIONAL PLAN				Nº	14
Date of writing	14/09/21	Hour	8.00 a.m.	Lugar	Sierra Bermeja
Plan term	14/09/2021 – 10.00 p.m.				
ROOM ANALYSIS					
Meteorology					
Atlantic trough positioned to the west of the peninsula. This situation will bring local heavy rainfall. Before the passage of the front, there will be moderate to strong gusty winds. During the instability, the wind will be calm; with the passage of the front the wind will be N-NW.					
Operational Implications					
Complete extinguishing of the fire, avoiding the reproduction of the fire on the perimeter.					
STRATEGIC OBJECTIVES					
Total extinguishing of the fire, avoiding reproductions on the perimeter.					
TACTICAL PLANNING					
SECTOR	NW		SECTOR	SW	
Person in charge	Guillermo Toledo		Person in charge	A. Jimenez	
Resources allocated			Resources allocated		
2 AMA (D.Vera/PJimenez) GI Córdoba_ TOP E. Exposito (JE-312,114,105 JP-102 Municipal Emergency Unit			3 AMA J.L. Ojeda-R. Reinoso, B. Martinez GI TOP F. Cabezas KE-102_KP_108,102 -P12		
SECTOR	NE		SECTOR	Spanish fir forest	
Person in charge	Jose Maria Martínez Egea		Person in charge	Joe Luis Ojeda	
Resources allocated			Resources allocated		
2 AMA D.Vera, P.Jiménez GI Córdoba TOP F. Sánchez CE-115, 201, 203, 217-CP-203 GI Córdoba TOP P. Morillo CDE-114, 214, 206_CP-201 Municipal Emergency Unit			3 AMA J.L. Ojeda-R. Reinoso, B. Martínez GI Cádiz TOP F. Cabezas KE-102_KP_108,102 -P12		
TACTICS					
SECTOR					
NW	Active perimeter surveillance and hot spot suppression.				
SW	Active perimeter surveillance and hot spot suppression.				
NE	Active perimeter surveillance and hot spot suppression.				
Spanish fir	Active perimeter surveillance and hot spot suppression.				

APPENDIX 1: STABILITY AND STRATIFICATION ANALYSIS OF THE VERTICAL PROFILE

Due to its importance in fire behaviour, this section addresses the atmospheric stability/instability conditions during the days of the Sierra Bermeja fire. Due to the duration of the fire, the situations have been grouped by homogeneous conditions to simplify the analysis and avoid redundant information. Therefore, only those relevant images representative of these homogeneous conditions are shown.

According to the GFS model soundings from 9 to 12 September, the dynamics of the atmospheric vertical profile show:

Radiative thermal inversion conditions late in the night and early in the morning in the first few metres.

With daytime warming, the first few metres of the profile become unstable, with the cloud base around 700-750 hPa depending on the day.

With the convection condensation level above 600-650 hPa for a trigger temperature of around 45 °C, and the level of free convection between 500 and 400 hPa, there were no conditions for convective developments in the absence of forcing in the middle hours of the day.

In accordance with the stratification of the atmosphere in the area, there were conditions of neutral atmosphere and even an unstable profile, reaching the level of 600 hPa, even reaching 400 hPa on day 12. The forecasts provided by the WRF model reflect these trends, sometimes increasing the thickness of the neutral layer and with variations in the level from which the profile stabilised.

The factor of instability was not present throughout the vertical of the atmospheric column, so that the development of convective clouds generated by the fire, once the height of the cloud base was reached, was manifested by forcing under high intensity burning conditions.

There were situations where neutral or stable layers were interspersed in the vertical profile following unstable layers, as well as neutral layers following the night-time thermal inversion.

At certain times, these low stable or neutral layers were not an obstacle to the development of the smoke plume due to the fire power in areas of high load.

On day 13, the entry of the front driven by the low pressure located to the SW of the Peninsula, moving from W to E, brought moisture mainly in the middle layers, lowering the height of the cloud base at 12 UTC to 850 hPa (GFS model), favouring neutral atmospheric conditions.

It was not until the early morning of day 14 that the vertical atmospheric profile became wetter, bringing significant precipitation.

