

FIRE BEHAVIOUR AND FIRE SAFETY IN COMPLEX TOPOGRAPHY UNDER EXTREME WEATHER: THE CASE OF STUDY OF HORTA DE SANT JOAN

Marc Castellnou, Marta Miralles, Josep Pallars, Ricard Exposito



Temps passat 4 min



Temps passat 7 min



Temps passat 9 min



Temps passat	11 min
--------------	--------

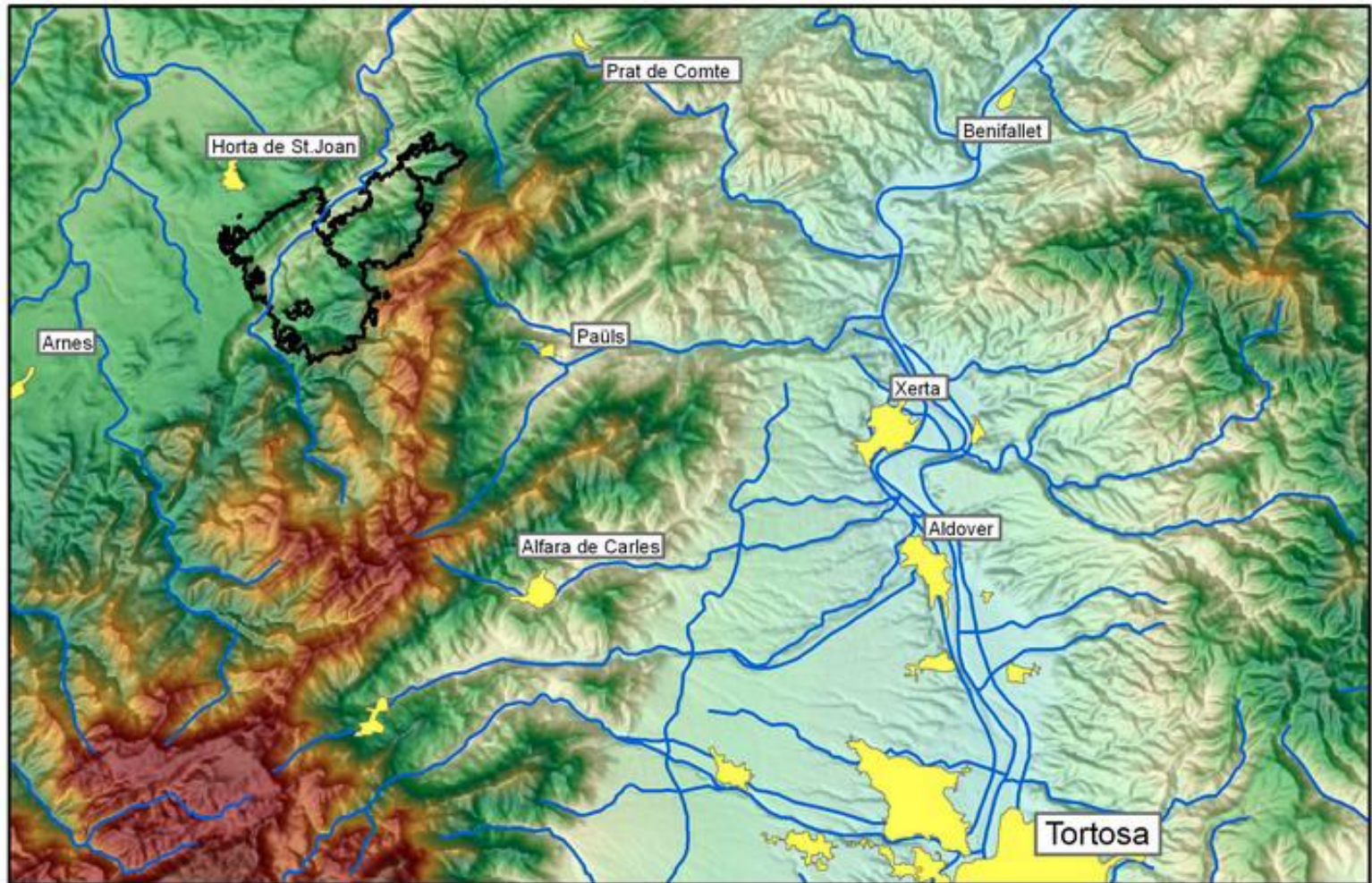
Velocitat propagació	4,9 km/h
----------------------	----------

900 m

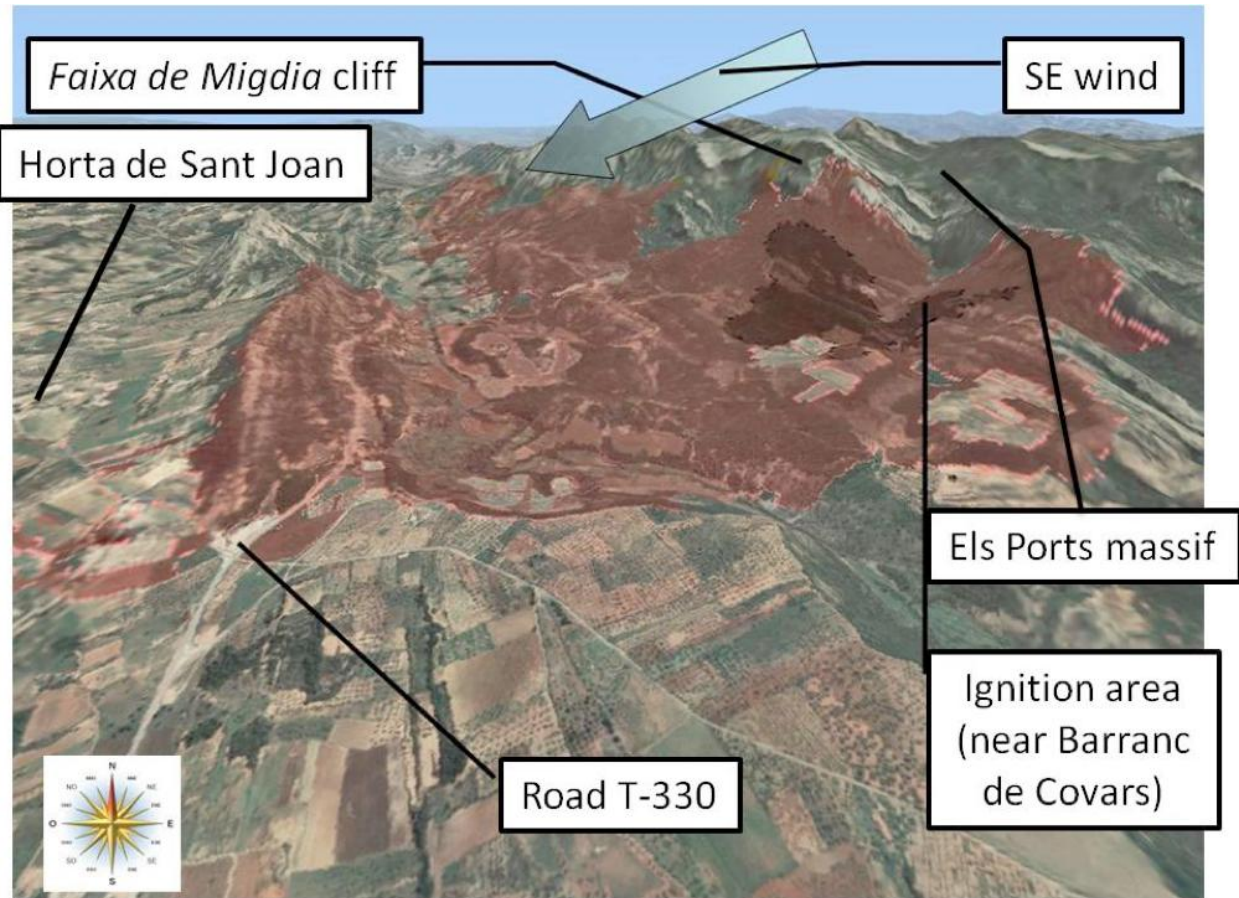
21st of July 2009
more than 80
firefighters were
trapped in several
risk situations.
5 firefighters died,
and one became
badly injured.



Location

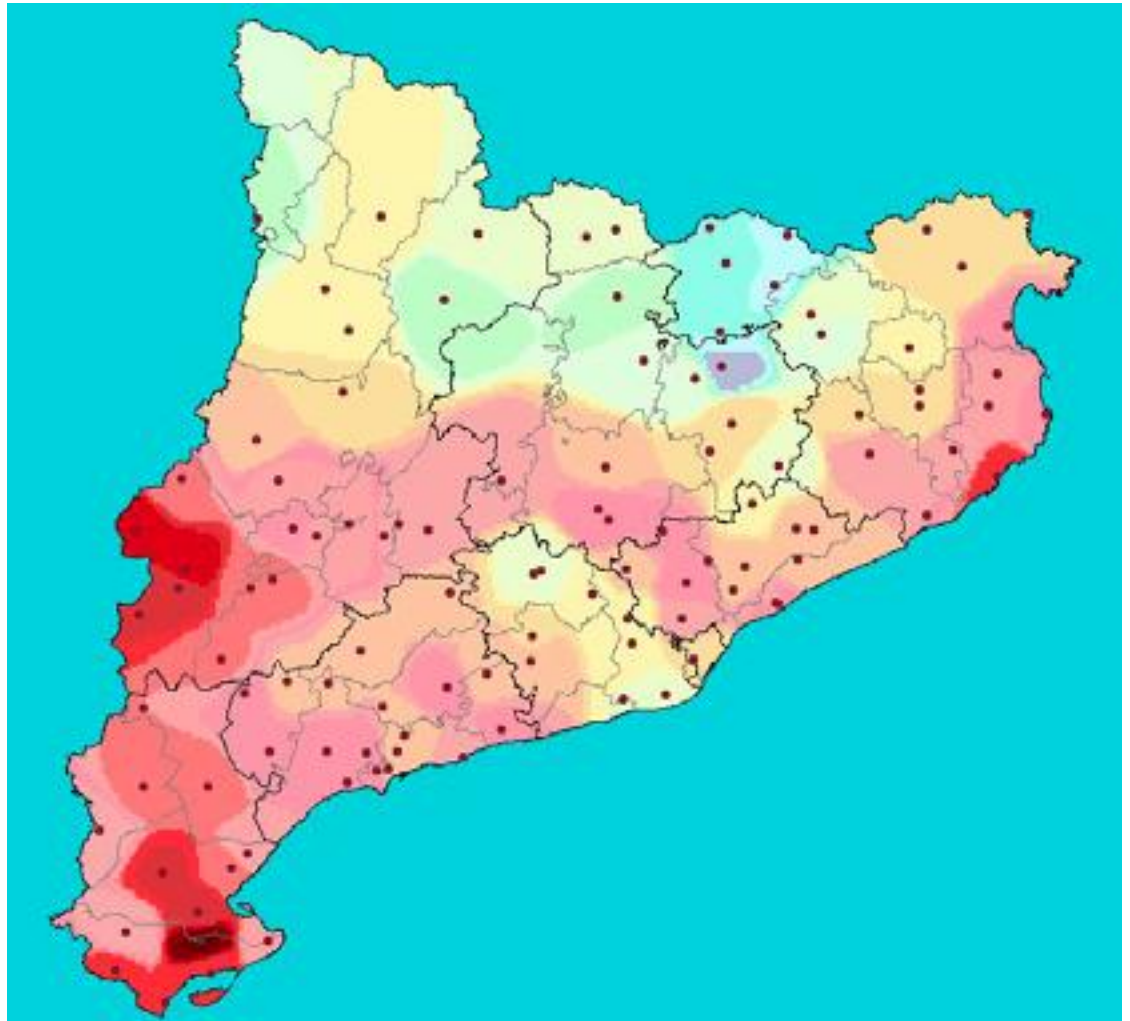


Location

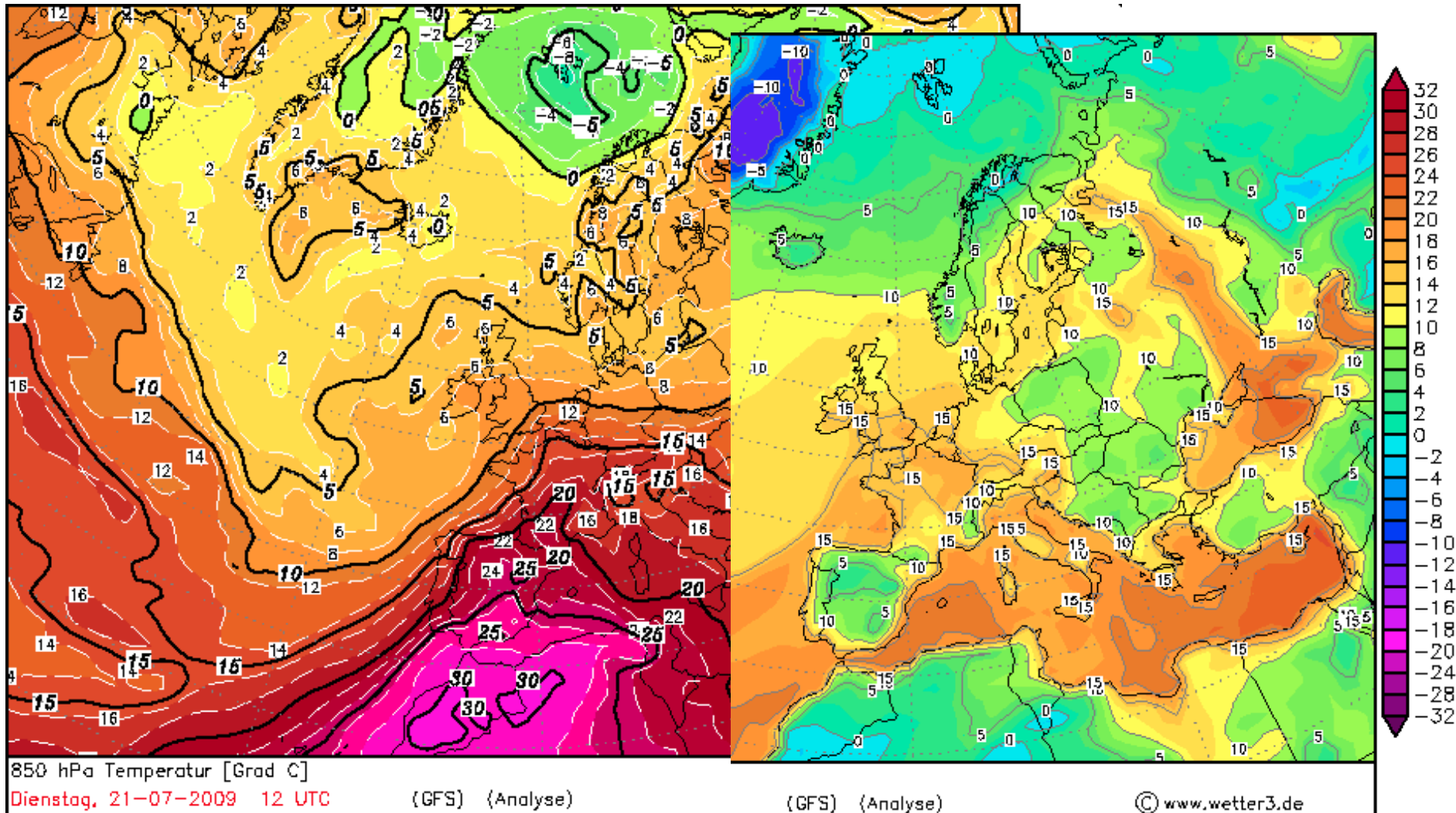


Location: one of the driest areas

20/7/2010



Fire weather: hot dry air mass in the interior of the Peninsula

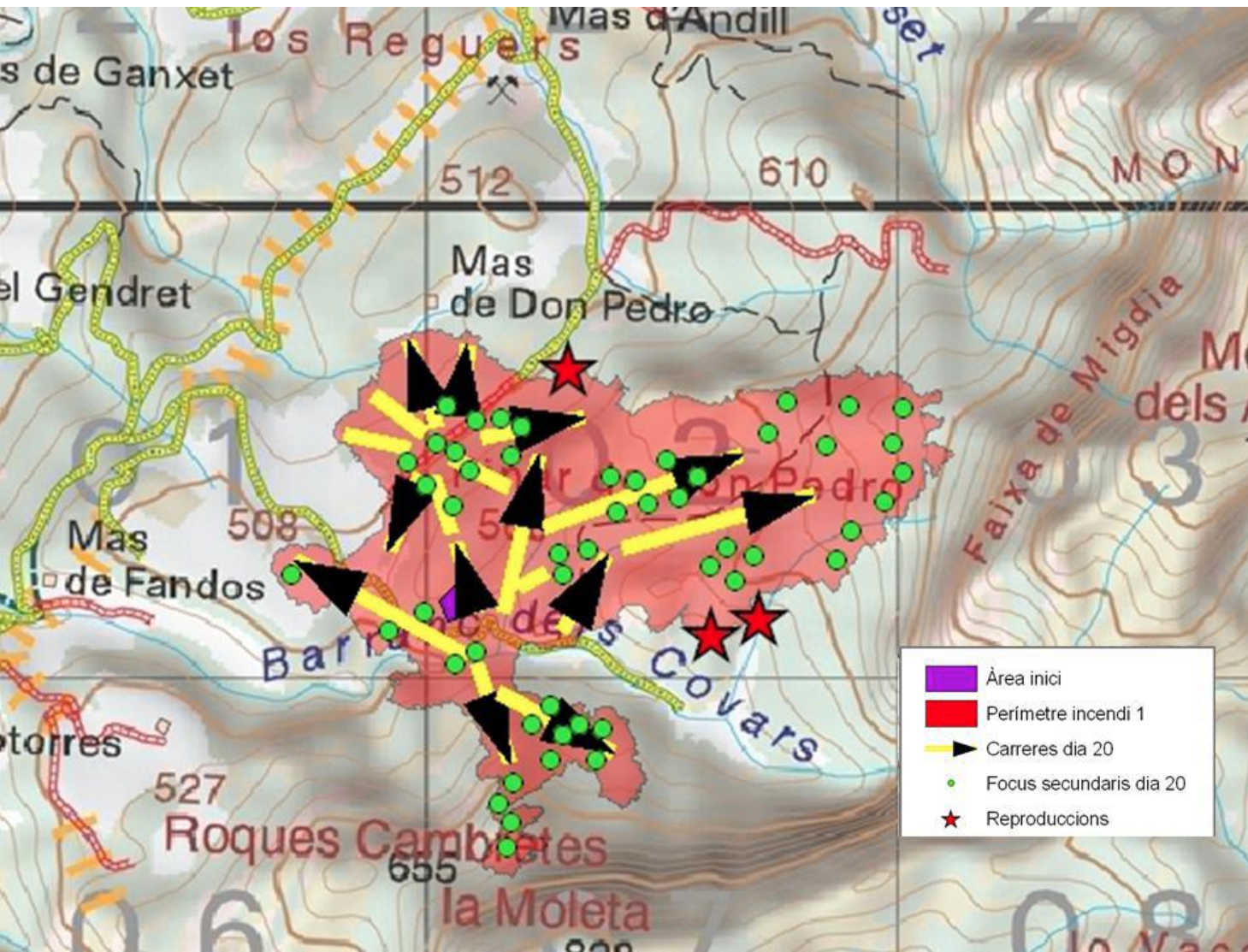




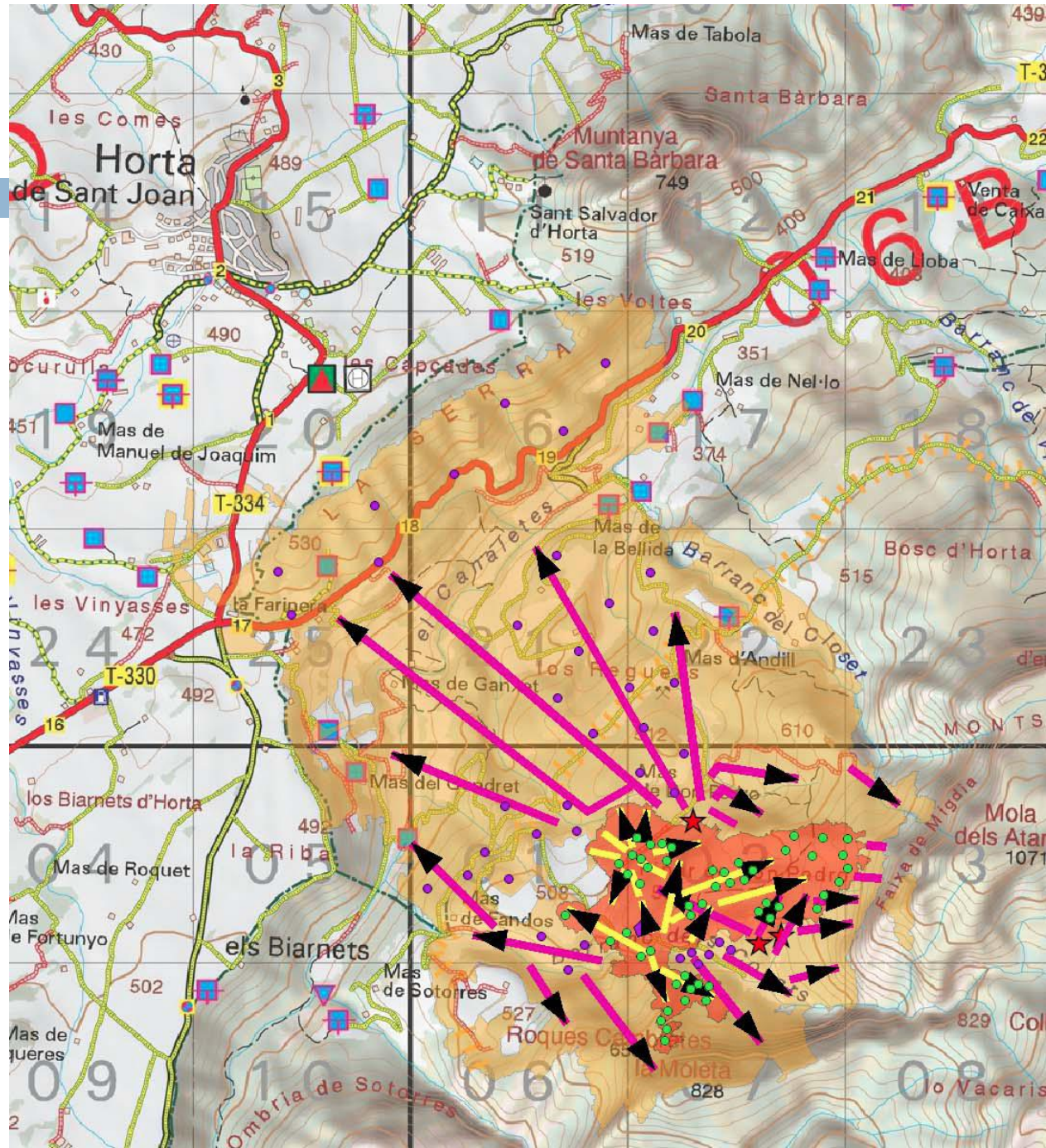
Vegetation:



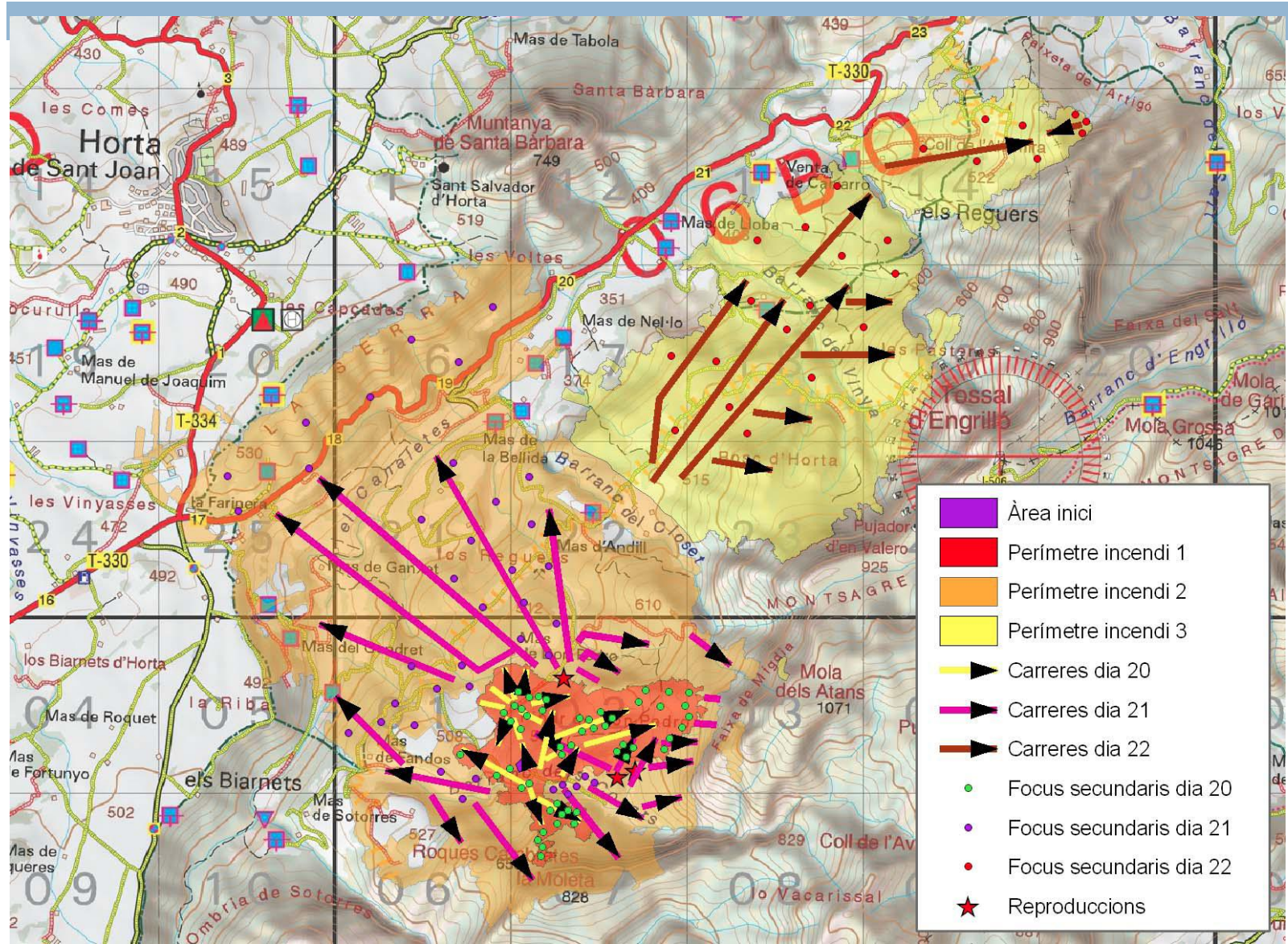
Wildfire spread: 20th



Wildfire spread: 21th



Wildfire spread

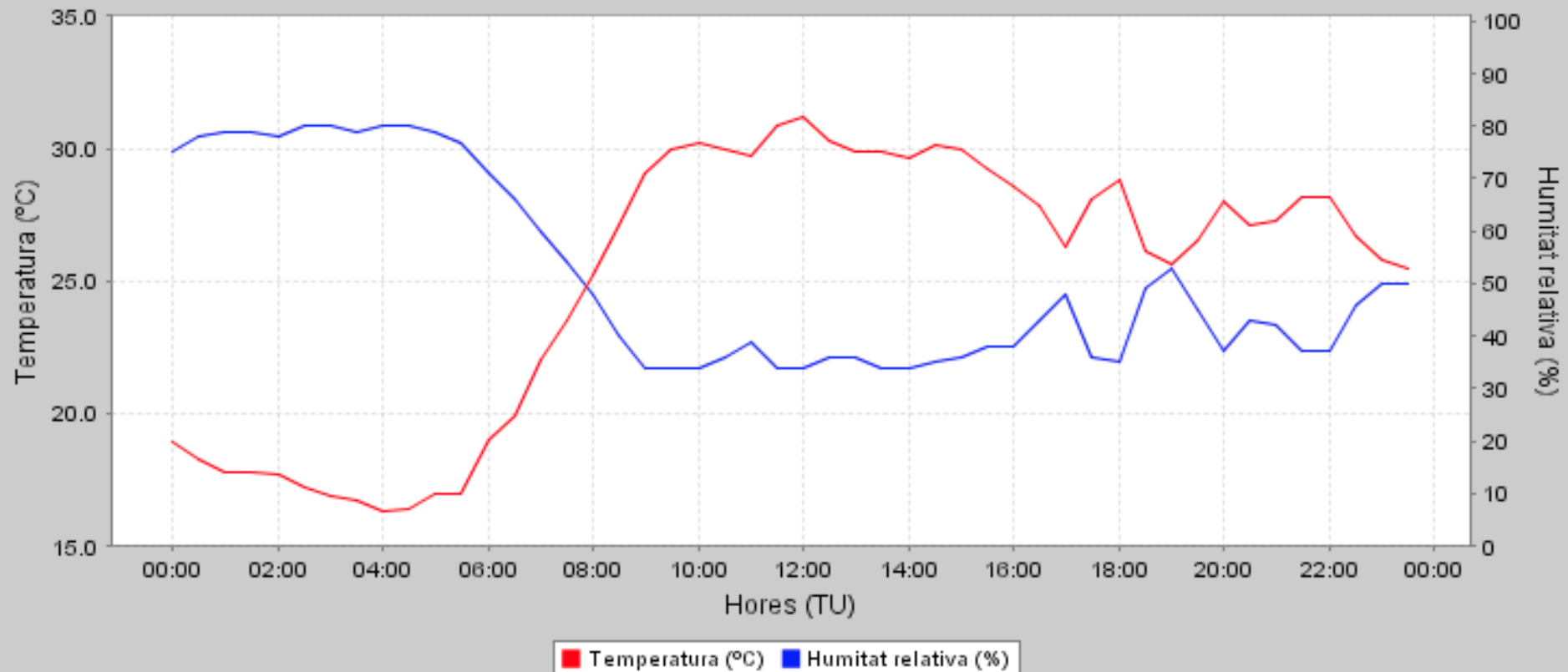


Day 21st

Temperature (red, left) and air moisture (blue right)

Horta de Sant Joan (D8)

21/07/2009

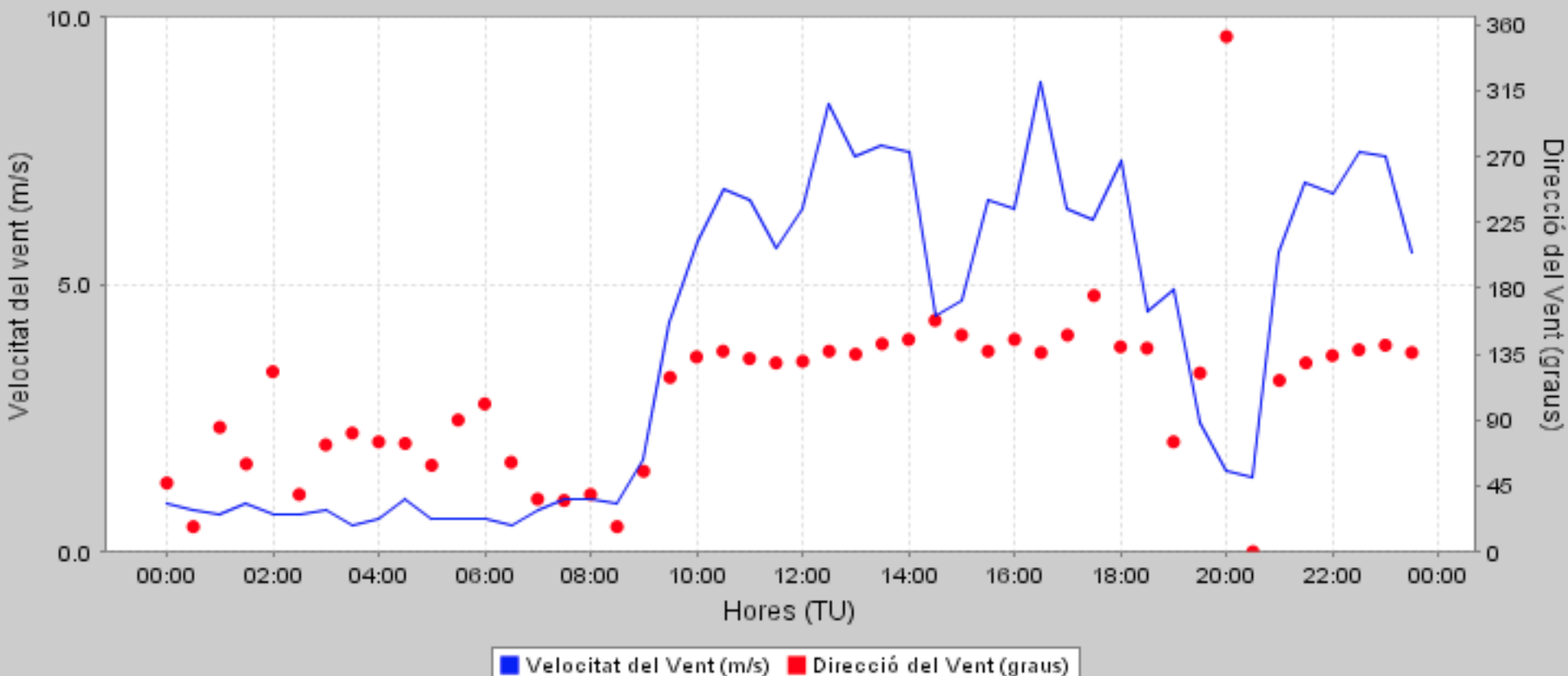


Day 21st

Wind speed (blue, left) and wind direction (red, right)

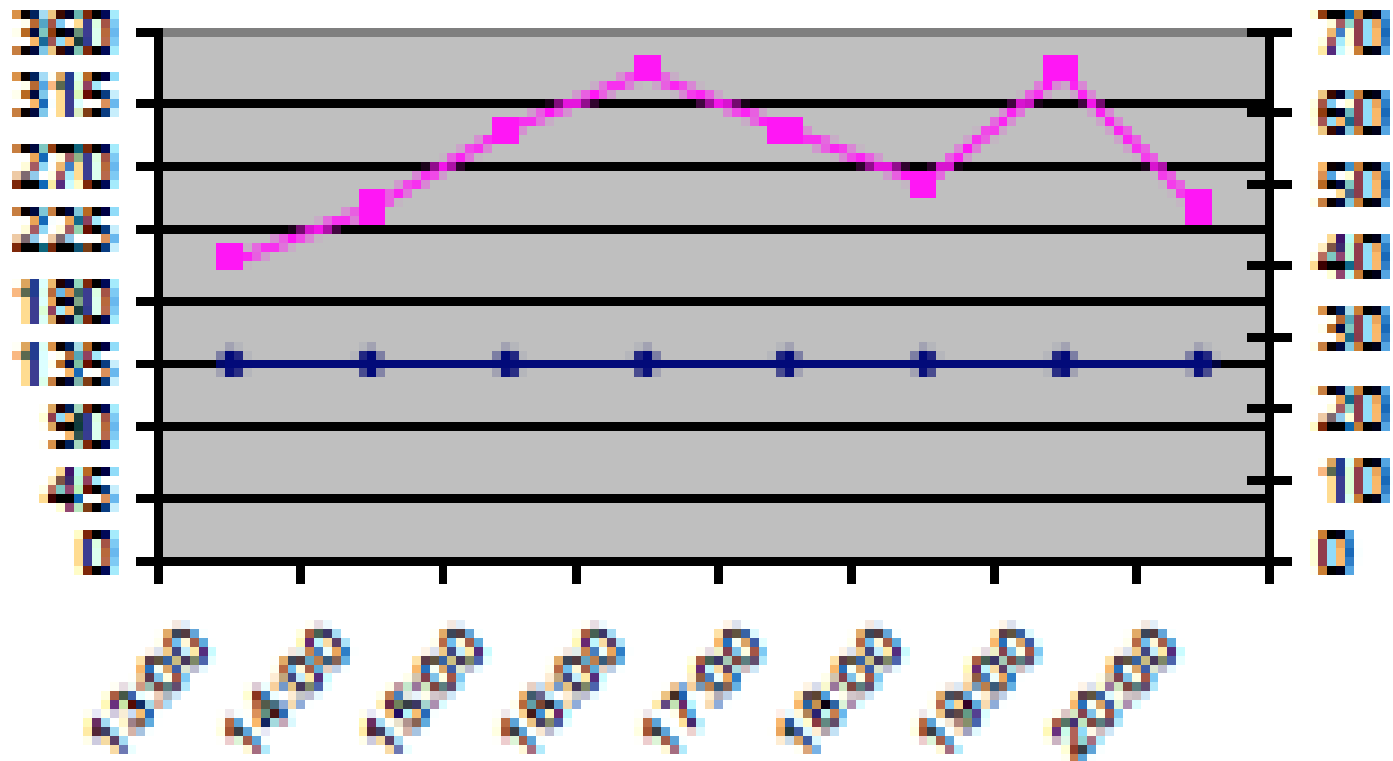
Horta de Sant Joan (D8) - Altura sensor 10m

21/07/2009



Day 21st

Wind speed (pink, right) and wind direction (blue, left) at the top of Ports de Tortosa. Fire vigilance data.



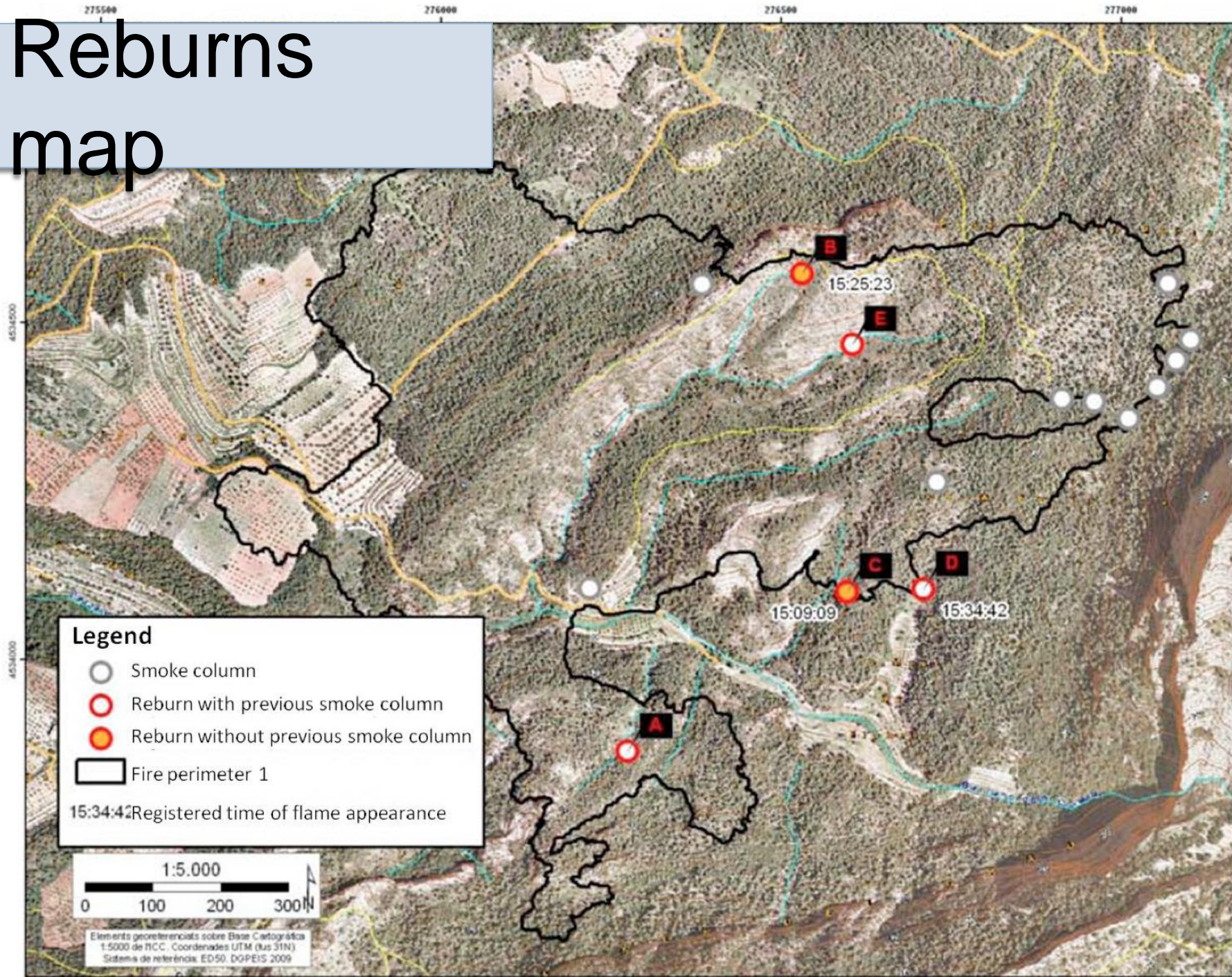
Day 21st



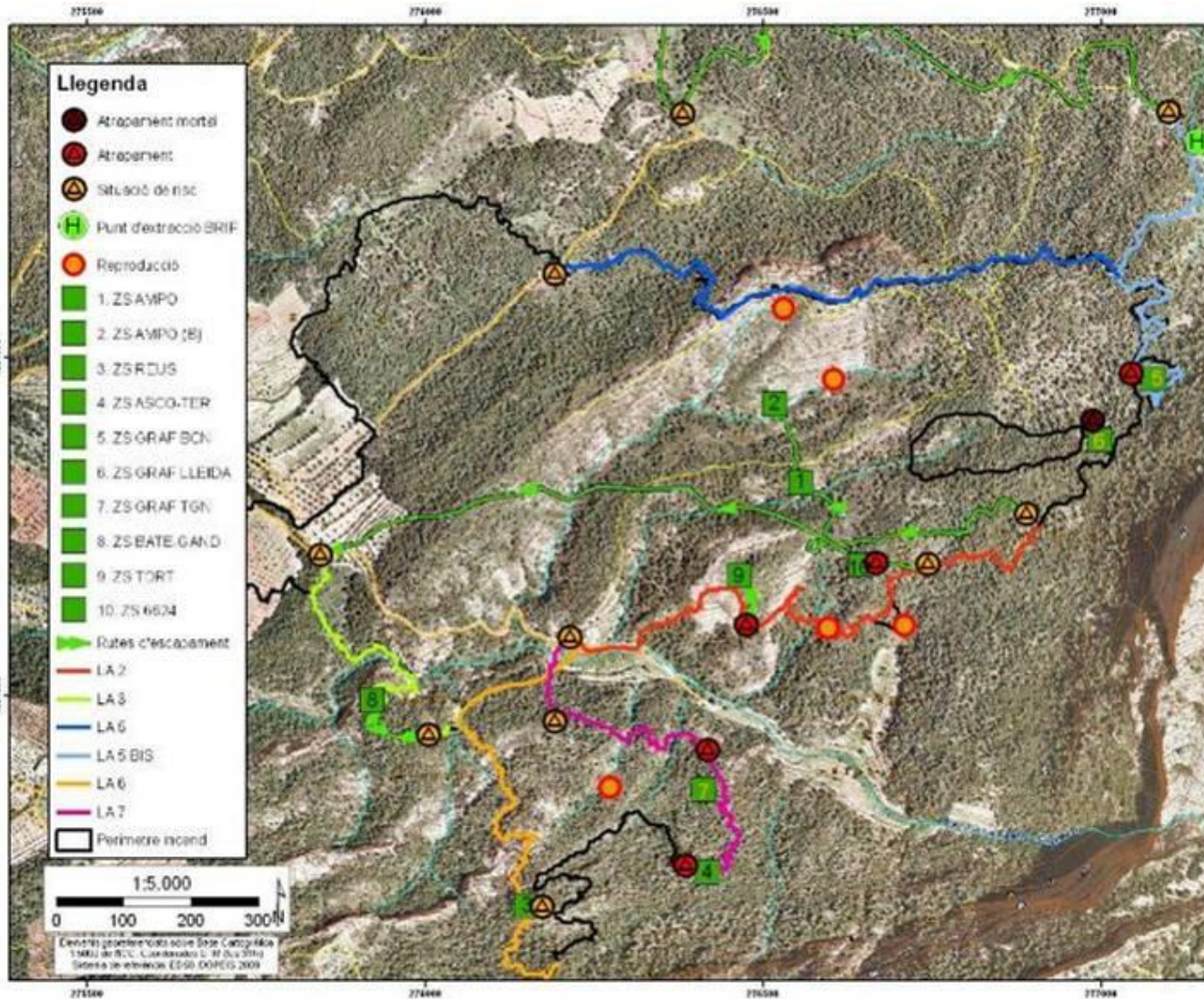
Reburns

- 14:00 Wind intensity and turbulence increases
- 14:30 – 15:30: 5 reburns , 3 towards Horta de Sant Joan in the direction of the main wind; 1 took the opposite direction, due to lee winds. 1 started towards Horta, but finally run towards the main cliff.
- 14:30 Aerial means cannot fly due to wind intensity and turbulence
- In the path of the main run towards Horta there are scattered houses with people, and road workers.

Reburns map



Firefighters at risk



- Mortal fire entrapment
- Fire entrapment
- Risk situation
- BRIF extraction point
- Reburns
- Safety zones
- Escape routes
- Hose line 1
- Hose line 2
- Hose line 3
- Hose line 4
- Hose line 5





B







G

H

J

I

L



D

G

H

J

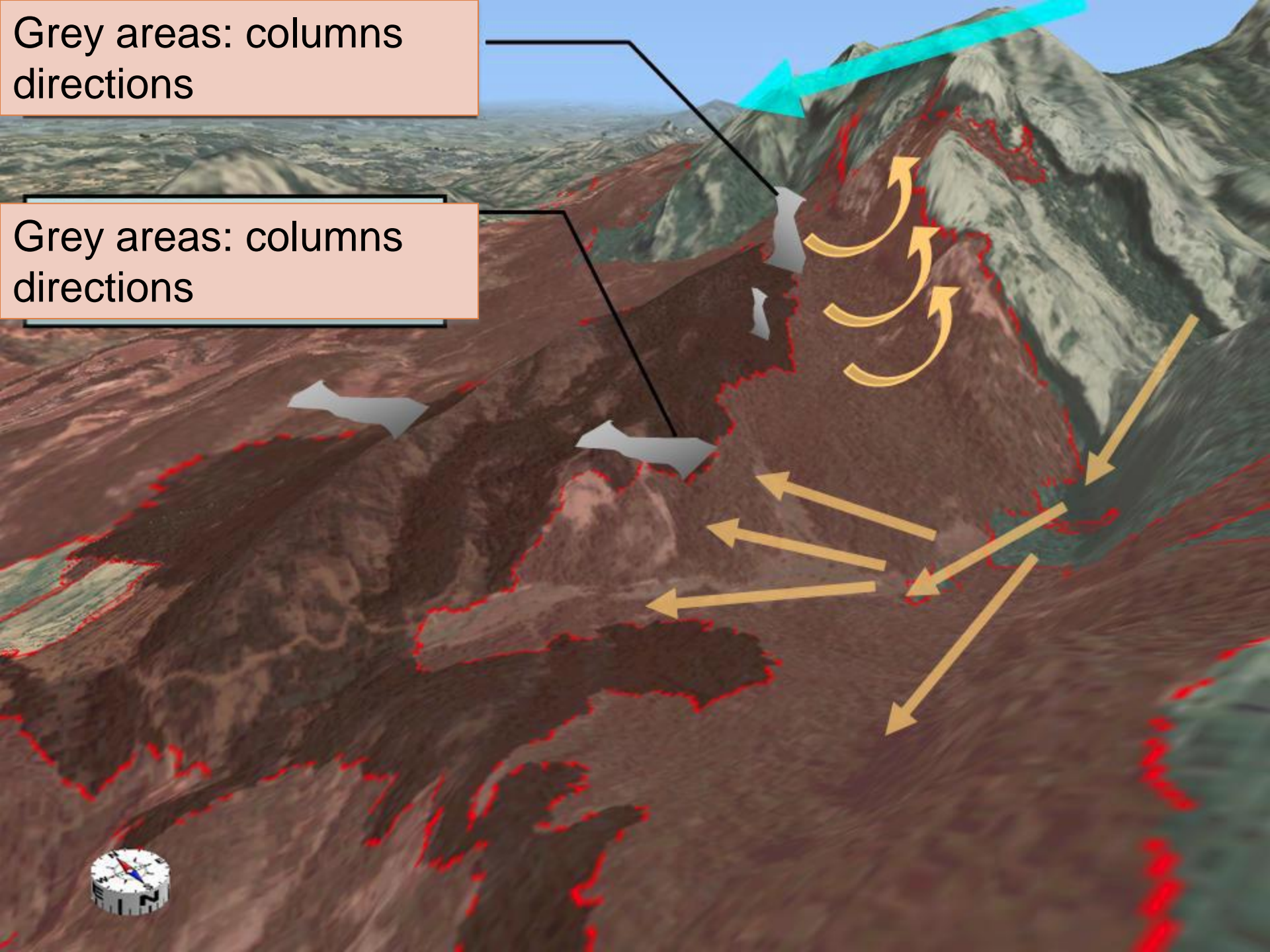
I

L



Grey areas: columns directions

Grey areas: columns directions





Fire entrapment

- 14:20 Reburn D detected
- 15:00 36 Catalan firefighters (GRAF specialists and hose line crews) decided to go to 2 separate safety zones inside the black area.
- BRIF crew (8), who were working with them, decided to leave towards another safety zone near the left flank perimeter.
- BRIF crew asked for an emergency evacuation with aerial resources. 5 flights were needed in extreme dangerous conditions.
- 15:57 Fire shelters deployed in GRAF BCN area and GRAF Lleida area.



1

2

3

J



Lee winds and unburned zone

- Emergency Safety area of GRAF Lleida was inside the underburnt area and 14 m in diameter free of vegetation. Below them, high sparse pine trees with high crowns and in one side a dense *Quercus ilex* area also underburnt.
- Under them there was an unidentified patch of unburned fuel some hundred meters below GRAF Lleida location.

Quercus ilex and *Pinus halepensis*

- A spot from the reburn D fell under this unburned patch. The fire spread very fast. Once the fire reached the black zone the fire spread through the intermediate holm oak canopies through 300 m.
- The flames spread above the area where the fire-fighters were sheltered, through the holm oaks adjacent to the safe area, letting the highest pine tree crowns bellow them (15 m patch) unaffected

Knowledge to be increased

- The coupled dynamics of extrem weather with complex topographies
- Non-linear fire behaviour dynamics when weather-fire-topography interacts
- Likelihood of fire propagation through the holm oak-dominated fuel structures
- Likelihood of crown fire occurrence in fuel structures with oak dominated ladder fuel layer above overstory canopy layer
- Independent crown fire dynamics.

Thank you

