Figure S1.- The measurement kit detail. a) data logger with the reception antennas. b) reusable sondes in Styrofoam cups and latex balloons. c). Detail of the sonde sensors with battery inside the Styrofoam cups. d).- Balloons and sondes attached ready to be used. On average, the system is ready in as little as 8 minutes, allowing smooth and safe operations at the fire.

Figure S.2.- Videos of the launching moment.

Appendix S3.- Numerical computation of Rib and CAPE

We use the following equations (Vila-Guerau de Arellano et al., 2015) to obtain the state variables and different levels worked on in this paper.

Potential temperature θ (K)

Defined as the temperature that the air parcel would have if it is expanded or compressed dry-adiabatically from its existing pressure p (hPa) to a standard pressure po (usually 1000 hPa).

$$\theta = T \left(\frac{p_o}{p}\right)^{R_d/\,C_p}$$

T is the absolute temperature; Rd is normally assumed to have the value of a gas constant for dry air (= 287 J K-1 kg-1) and cp is the specific heat of dry air at constant pressure (= 1004 J K-1 kg-1); consequently Rd / cp ≈ 0.286.

Specific humidity q (g·kg-1)

Defined as the amount of water vapor contained in a unit of air (dry air plus water vapor).

$$q = \; 622 \, * \, (\, e \, / \, P \,)$$

Where e (hPa) is the vapor pressure and P (hPa) is the pressure. The Vapor pressure e (hPa) is computed for values of dewpoint temperature (Td).

$$e = 6.11 \, * \, 10^{\,(7.5 \, * Td \, / \, (Td \, + \, 237.7))}$$

Virtual potential temperature θ_v (K)

Defined as the potential temperature that dry air would need to attain in order to have the same density as the moist air at the same pressure.

$$\theta_v = \langle\theta\rangle \, (1 + 0.61 \, \langle q\rangle)$$

ABL height

We use the bulk Richardson number or Rib as a dimensionless number to express where the mechanical turbulence equals the convective turbulence. This value (0,28) (Zhang et al., 2014) is usually considered a good estimation of at what height the atmospheric boundary layer (ABL) is located.

$$Ri_b = \frac{\left(\frac{g}{\theta_{v0}}\right)(\theta_{vh} - \theta_{v0})\mathrm{h}}{u_h^2 + v_h^2}$$

Here g is the gravity constant of 9.8 m·s-2, θ_{v0} and θ_{vh} are the virtual potential temperature (K) at level 0 and level h and u and v are the wind speed (m·s-1) in every wind component.

Lifting condensation level (LCL)

Although computed using the Metpy Library, a less accurate way but more appropriate to use in the field is the Bolton formula (Romps, 2017):

LCL = 125 * (Ts / T0) * np.log (Ts / Td)

Where LCL is expressed in height (m), Ts (K) is the dry Temperature, T0 (K) is the absolute Temperature and Td (K) is the moist temperature

Wind shear

We use the wind speed shear to identify when the wind speed changes

$$Ws = \sqrt{u_h^2 + v_h^2}$$

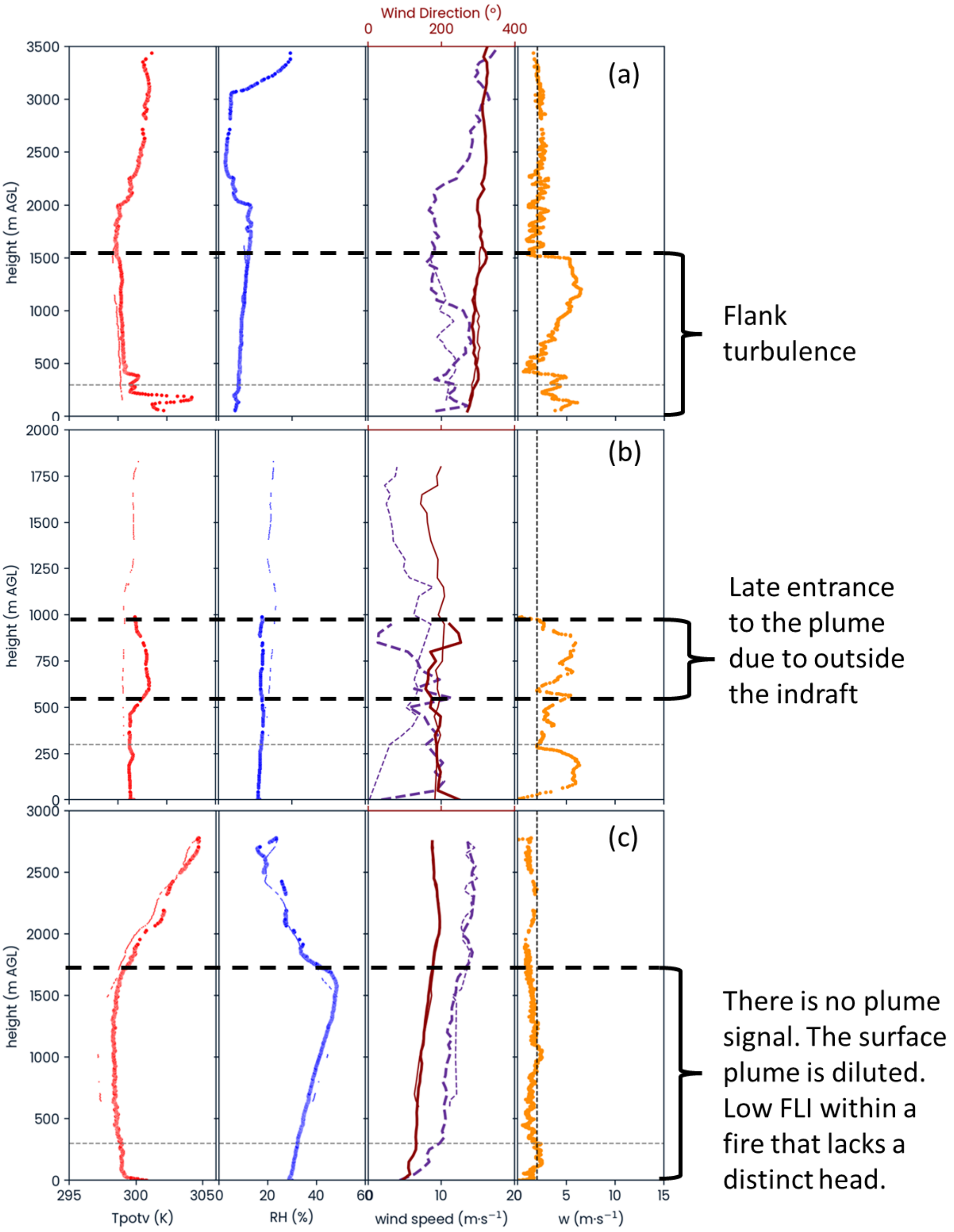
Ws in m·s-1 depends on the u and v wind components, also expressed in m· s-1

Supplementary profiles

S4.- Profile of indraft-flank sondes that had problems and failed to properly read the plume updraft state variables.

We found several cases when sondes launched into the plume failed and were not traveling within. When launched in a weak indraft far away from the plume (Figure S4a) or when launched with a fire that has lost the head fire (Figure S4b) the sondes show problems in being dragged into the plume and to properly capture the data, maintaining a in-plume values close to those of the ambient sonde. The results highlight the need to make sure we are close enough to the head fire and can feel the indraft before launching the sonde.

The flank sondes can be caught into vortexes (HRV) with rising velocity oscillations (Figure S4c), which make it difficult to identify the plume top, as proposed by Figure 6.

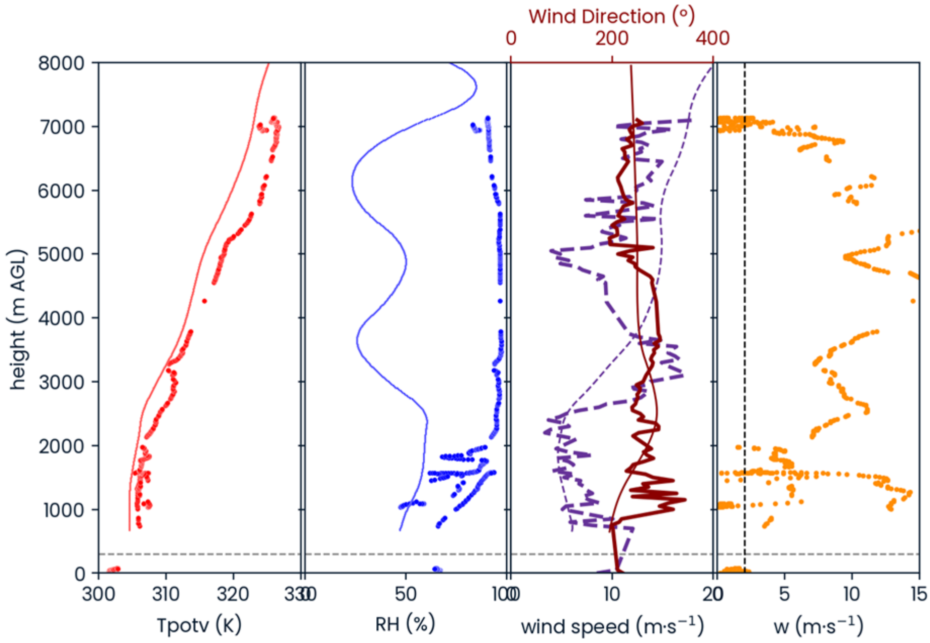


Fire event	Reg	Fuel	in-plume hour (UTC)	Ambient hour (UTC)	area (ha), (Total / hour)	FLI (kW·m-1)	ROS (m·s-1)	FRE (TJ)	Prototype
Granja Escarp 03-07-2024	ME	SH	18:48	18:57	118 / 48	26741	1.05	2.1	Convective
Drunen 12-04-2025	AE	SH	16:51	19:21	52/2	4811	0.05	n.a.	Surface
Pont Vilomara 17-07-2022	ME	TU	15:02	15:36	1200/112	22587	0.3	7	Convective

Figure S4.- Vertical profiling methodology for sondes failed to capture the plume. c) Sonde caught in a HRV during la Granja d'Escarp, 3rd July 2024 at 16:48 UTC. It is a flank sonde that was caught inside an HRV in the flank of the plume, as signaled by the oscillating and even negative rising velocities the first 500 m AGL. b) Sonde launched at the flank of the Pont de Vilomara fire in 17th of July 2022. The sonde was launched too fra away to be dragged into the plume. Finally, the sonde entered the plume at 600 m as signaled by the increased Tª and lower RH. c).- Sonde launched at the rear indraft under windy conditions when the fire has lost the front of the head fire due to lack of fuel, when the fire hit a no-fuel area. The remaining plume was too weak and rapidly diluted. The profile is notr capturing differences between in-plume and ambient sondes. Profiles use a thin line for the ambient sonde and a thick line for the updraft representing Θv (K, red), Relative humidity (% blue), wind direction (°, violet), wind speed (m·s-1, dark red) and vertical speed w (m·s-1, orange). The horizontal thin and dashed grey line indicates the 300 m AGL needed to confirm an in-plume sonde as in Figure 7. Wildfire information below: Region, total and current hour burnt area (ha) , launching hour for in-plume and ambient sonde, Fireline intensity (FLI, kW·m-

[1]), rate of spread (ROS, m·s⁻¹), heat flux captured by satellite infrared sensors (FRE, TJ), and the observed pyroconvection prototype as in Table 3.

S5.- Profile of a sonde launched into a 8000 m AGL pyroCb prototype.



Fire event	Reg	Fuel	in-plume hour (UTC)	Ambient hour (UTC)	area (ha), (Total / hour)	FLI (kW·m⁻¹)	ROS (m·s⁻¹)	FRE (TJ)	Prototype
SCQ 25-07-2021	ME	TU	18:14	-	2800 / 458	47331	8.1	11.2	pyroCb

Figure S5S.- PyroCb vertical profiling during the Santa Coloma de Queralt fire, 25th July 2021at 18:19 UTC. It is a rear indraft sonde that went into the plume and ascended to a pyroCb top at 8000 m AGL. Profiles use a thin line for the ambient sonde and a thick line for the updraft representing Θv (K, red), Relative humidity (% blue), wind direction (°, violet), wind speed (m·s-1, dark red) and vertical speed w (m·s-1, orange). The horizontal thin and dashed grey line indicates the 300 m AGL needed to confirm an in-plume sonde as in Figure 7. Wildfire information below: Region, total and current hour burnt area (ha), launching hour for in-plume and ambient sonde, Fireline intensity (FLI, kW·m⁻¹), rate of spread (ROS, m·s⁻¹), heat flux captured by satellite infrared sensors (FRE, TJ), and the observed pyroconvection prototype as in Table 3.