The paper presents an operational and research-oriented observation method for in-plume radiosonde profiling during extreme wildfire events. It combines direct fireline observations with atmospheric soundings to quantify fire-atmosphere effects and evaluate pyroconvective transitions in real time. The authors should be commended for their long-term field effort—150 sondes over multiple fire seasons and continents—and for demonstrating the feasibility of affordable, lightweight instrumentation for operational plume monitoring. The work addresses a long-standing gap between model-based indices of pyroconvection and field observations available to incident managers. Congratulations for the work, it is obviously a very valuable field work analyzed here, there are no other consistent direct observations dataset of so many plumes to my knowledge.

The paper is generally well structured, clearly written, and sound. It provides valuable insight into how in-plume thermodynamic profiles can be used to characterize the Atmospheric Boundary Layer (ABL), plume dilution, and potential transitions from dry to moist pyroconvection. The dataset has high potential value for model validation (e.g., Micro-HH, Meso-NH/ForeFire, WRF-Sfire) and for improving fire awareness protocols in operations. The figures are instructive, and the field documentation is impressive. The manuscript will interest both fire scientists and operational meteorologists.

*We appreciate the reviewer's positive and encouraging feedback. We are pleased that the reviewer recognizes the significance of our long-term field effort and the potential of our dataset for both research and operational applications. Our primary goal has been to connect model-based indices with real-time field observations, and we are glad that this contribution is valued by both communities.*

*We will address all specific comments and suggestions raised by the reviewer in the following point-by-point responses.*

*We will update the data availability files to ensure this aspect is well explained.*

***Old version:***

***Data availability***

*Final Dataset in EWED project data portal: http://wildfiredataportal.eu/*

*The profiles in the Figures are in DOI 10.5281/zenodo.15264835*

*New version:*

***Data availability***

*To facilitate the use in research of the in-plume radiosonde data, the dataset is organized in a data portal that includes (1) radiosonde file observations, (2) fire-spread isochrones, (3) perimeters for each fire, and(4) field-captured plume images of plumes analyzed. The information is georeferenced to facilitate further analysis with reanalysis datasets.*

*Final Dataset in EWED project data portal: [http://wildfiredataportal.eu/](http://wildfiredataportal.eu/). Please, note It is still not operational until December 2025*

*In addition to the live data portal, the paper used radiosonde files are in DOI 10.5281/zenodo.15264835*

Some minor comments: is there any way to perform quantitative uncertainty associated with in-plume sondes ? representativeness in turbulent regimes and the sensitivity of plume-top estimates, maybe discuss that (a radiosonde is a single point in space / time).

*Thanks for pointing out the need for this analysis to complement our research. Following similar comments made by CC1, we have performed a simple yet insightful uncertainty analysis by comparing sondes launched simultaneously.*

*In short, for the sondes that observed the state variables of the ambient around the fire, we analyze 5 sondes launched simultaneously (Figure S7.1).*

*For in-plume sondes, we have conducted the same analysis for those fires where we had simultaneous sondes launched (within 30 minutes of each other). We show the Casablanca III Chilean fire case in Figure S7.2*

*We have updated the proposed S7 complementary material in response to the CC1 comments by adding an uncertainty analysis of the radiosonde-plume top derived from simultaneously launched sondes. Briefly, we have normalized the sondes by height, potential temperature, and relative humidity. We have compared the mean and standard deviation of the aggregated dataset in Figure S7.3.*

***This new section has been included in the supplementary material:***

***S7.-Uncertainty assessment for the radiosonding system***

*To quantify the uncertainty in our observations from the sounding due to different trajectories, we calculated the mean and standard deviation along the vertical profile for each variable based on simultaneous sondes launched at the same location.*

*1.- Uncertainty in vertical profile measured variables*

*As shown in Table S7.1, the uncertainty observed is reduced below 1K in ϴ, 2% in RH, and 2 m·s$^{-1}$ in wind speed. The maximum uncertainty level is 3.64 K in ϴ, 7.19 in RH, and 2.43 m·s$^{-1}$ in vertical velocity. This maximum uncertainty is primarily located at the top of the mixed layer (grey shadow in Figures S7.1 and S7.2), identified as ABL top for the ambient conditions in Figure S7.1 and plume top for the in-plume conditions in Figure S7.2. This level of uncertainty is typical, as both the ABL and plume top are influenced by turbulent motions and, therefore, influenced by fluctuations.*

***Table S7.1**. Uncertainty analysis of simultaneous radiosonde trajectory for ambient and in-plume measures for the variables used in the radiosounding methodology: ϴv (K) as virtual potential temperature, RH (%) as relative humidity, WS (m·s$^{-1}$) as wind speed, WD (º) as wind direction and in the case of in-plume sondes vertical velocity (m·s$^{-1}$).*

| Type | fire | | σ Θv (K) | σ RH (%) | σ WS ($m \cdot s^{-1}$) | σ WD (º) | σ Vertical velocity ($m \cdot s^{-1}$) |
|---|---|---|---|---|---|---|---|
| Ambient | Tivissa 08-08-2025 | mean | 0.39 | 1.61 | 1.13 | 12.89 | |
| | | max | 2.64 | 13.20 | 2.42 | 21.22 | |
| In-plume | Casablanca III 08-02-2023 | mean | 0.78 | 1.12 | 1.18 | 34.85 | 0.84 |
| | | max | 2.57 | 7.29 | 2.51 | 143.92 | 3.26 |
| In-plume | Granyena 987 ha 21-06-2025 | mean | 0.41 | 3.48 | 1.60 | | 0.53 |
| | | max | 1.17 | 13.5 | 3.10 | | 1.31 |
| In-plume | Pauls 3800 ha 07-07-2025 | mean | 0.93 | 2.53 | 2.04 | 13.47 | 1.08 |
| | | max | 6.33 | 9.54 | 5.81 | 132.63 | 5.49 |
| In-plume | Casablanca III 12073 ha 10-02-2023 | mean | 0.52 | 1.30 | 1.19 | 63 | 0.32 |
| | | max | 5.90 | 6.16 | 2.48 | 136 | 1.77 |
| In-plume | Casablanca III 12073 ha 10-02-2023 | mean | 0.95 | 1.49 | 1.63 | 22.94 | 0.88 |
| | | max | 4.18 | 6.17 | 2.51 | 61.56 | 2.31 |
| In-plume | Tortosa 280 ha 28-05-2024 | mean | 0.58 | 3.43 | 1.57 | 23.47 | 0.73 |
| | | max | 5.59 | 9.97 | 2.46 | 60.18 | 2.37 |
| In-plume | Manuel Rodriguez 370 ha 05-02-2025 | mean | 0.33 | 0.47 | 1.13 | 11.12 | 0.45 |
| | | max | 3.16 | 7.95 | 2.73 | 15.87 | 1.77 |
| In-plume | Patagual 218 ha 08-02-2025 | mean | 0.27 | 1.27 | 1.12 | 10.93 | 0.28 |
| | | max | 2.88 | 6.81 | 2.42 | 21.75 | 1.14 |
| In-plume | Vega Honda 773 ha 09-02-2025 | mean | 1.17 | 1.39 | 1.02 | 13.11 | 0.69 |
| | | max | 4.80 | 2.67 | 2.60 | 22.95 | 2.43 |
| | | Aggregated mean | 0.59 | 1.55 | 1.35 | 19.97 | 0.58 |
| | | Aggregated max | 3.64 | 7.19 | 2.83 | 54.35 | 2.18 |

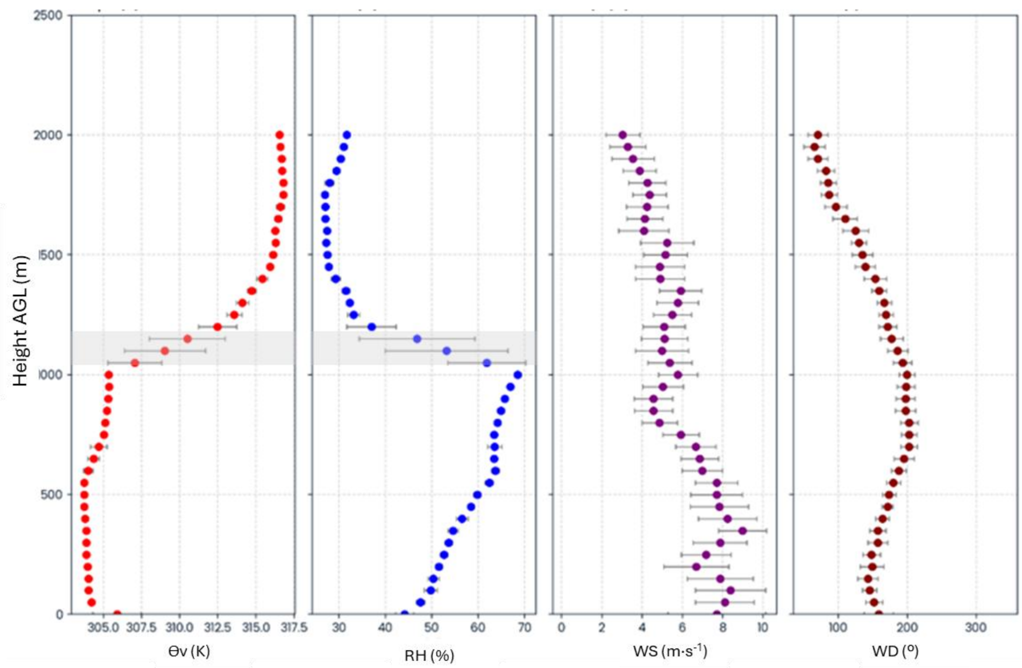


***Figure S7.1.***-*Uncertainty analysis is indicated by the bars surrounding the mean (dot) values of the profile observations taken under ambient conditions: virtual potential temperature (Θv, K), relative* *humidity (RH, %), wind speed (WS, m·s $^{-1}$), and wind direction (WD, degrees). This analysis involves calculating the uncertainty in the vertical profile measurements based on five different radiosonde trajectories launched from the same location between 16:03 and 16:11 UTC. The grey shadow area represents the uncertainty in the height estimation of ABL top.*

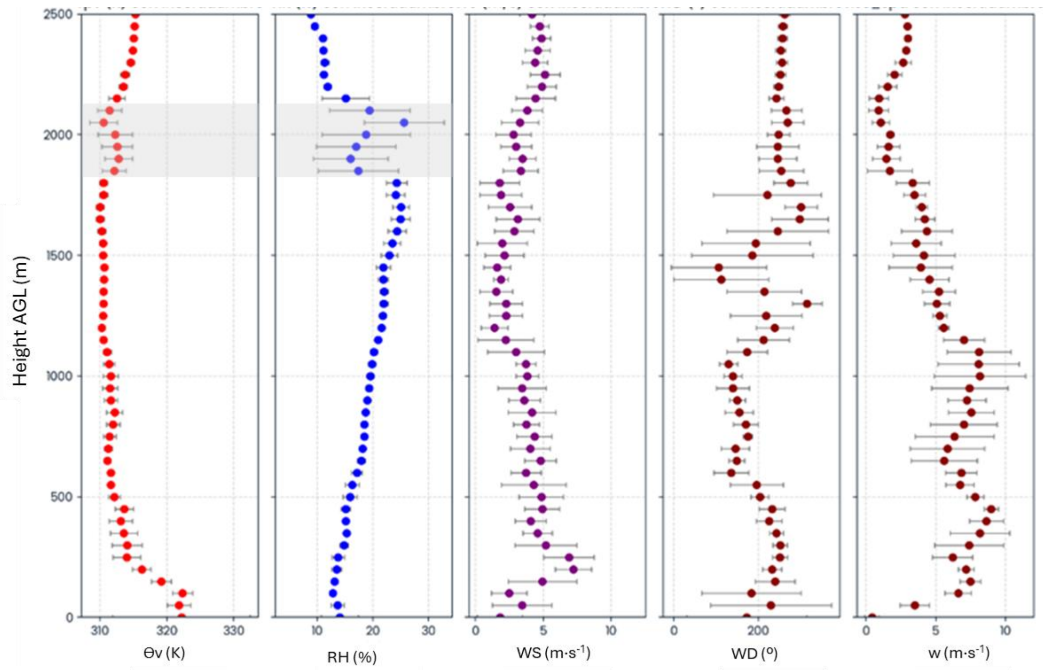


***Figure S7.2.****-Uncertainty analysis is indicated by the bars surrounding the mean (dot) values of the in-plume profile observations: virtual potential temperature (Θv, K), relative humidity (RH, %), wind speed (WS, m·s $^{-1}$), wind direction (WD, degrees) and vertical velocity (w, m·s $^{-1}$). This analysis involves calculating the uncertainty in vertical profile measurements from 3 radiosondes launched at the same location between 21:46 and 21:51 UTC during the Casablanca fire (Chile) (see Figure 11). The grey shadow area represents uncertainty in the height estimation of plume top.*

## *2.- Uncertainty in plume top height*

*Fluctuations or uncertainties in the plume top height can produce different plume top estimations. Those fluctuations have been quantified as absolute and relative error in the sondes launched simultaneously (Table S7.2) resulting in an aggregated mean absolute error of 114.4 m, with a maximum of 282 m and a standard deviation of 81.6 m.*

***Table S7.2****. Uncertainty analysis of plume top assessment by radiosonde trajectory for in-plume measures. Based on vertical velocity estimation of plume top for every sonde, we obtain the average plume top, the standard deviation, the absolute error or difference, and the relative error.*

| **Fire** | ***Date*** | ***Sonda 1 plume top*** *(m)* | ***Sonda 2 plume top*** *(m)* | ***Average*** (m) | **Standard deviation** (m) | ***Absolute*** **error** (m) | ***Relative error*** |
|---|---|---|---|---|---|---|---|
| *Granyena* | 21-06-2025 | *2744* | *2583* | *2663,5* | *113,84* | *161* | *0.06* |
| *Casablanca III* | *08-02-2023* | *1932* | *2015* | *1973,5* | *58,68* | *83* | *0.04* |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *Pauls* | 07-07-2025 | *2633* | *2768* | *2700,5* | *95,45* | *135* | *0.04* |
| *Casablanca III* | 10-02-2023 | *612* | *894* | *753* | *199,40* | *282* | *0.37* |
| *Casablanca III* | 10-02-2023 | *1308* | *1378* | *1343* | *49,49* | *70* | *0.05* |
| *Tortosa* | 28-05-2024 | *1792* | *1751* | *1771,5* | *28,99* | *41* | *0.023* |
| *Manuel Rodriguez* | 05-02-2025 | *1131* | *1054* | *1092,5* | *54,44* | *77* | *0.07* |
| *Patagual* | 08-02-2025 | *1348* | *1433* | *1390,5* | *60,10* | *85* | *0.06* |
| *Vega Honda* | 09-02-2025 | *529* | *634* | *581,5* | *74,24* | *105* | *0.18* |
| | | | | *aggregated* | ***81.6*** | ***114.4*** | ***0.1*** |

*To better quantify the uncertainty in determining the plume top by sonde trajectories we have computed an agreggated plume top probabilitydistribution (Figure S7.3 ). To aggregate all the different vertical profiles, , we use a normalized vertical profile height that extends twice the height of the measured mixed layer. We also normalized the potential temperature, and relative humidity by each profile mixing layer average. Using bins of 10% of the normalized height, we compare, for the in-plume sondes in table S7.2, the aggregated mean and standard deviation distribution of (Θv (K), RH (%), and vertical velocity (m·s$^{-1}$). The obtained probability distribution (Figure S7.3) aligns with the results shown in Figure S7.1 S7.2. It shows that despite single sonde trajectory inside a turbulent plume, the aggregated probability distribution identifies the plume top probability exactly at 100-110% of the normalized height where uncertainty of RH and Θv increases inversely to that of vertical velocity . It reliably identifies plume top height. This consistency holds true despite the singular nature of the sonde trajectory and varying fire conditions.*

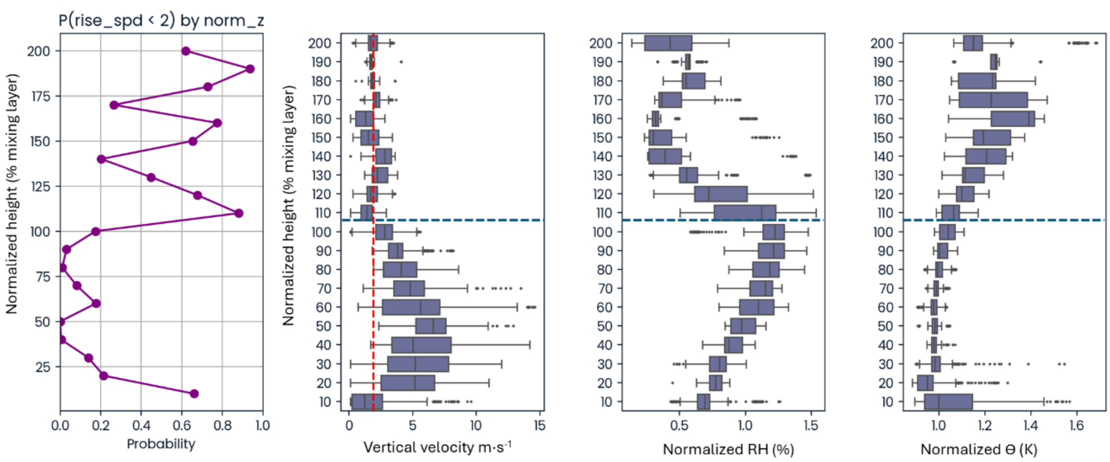


*Figure S7.3.-- Probability of plume top distribution based on uncertainty in simultaneous in-plume profiles of virtual potential temperature (Θv, K), relative humidity (RH, %), and vertical velocity (w, m·s $^{-1}$). We analyzed 18 radiosondes across 9 sets of simultaneous launches (within 30 minutes). RH and Θv were normalized by the average mixing-layer value, and profile height by the mixing layer height. Uncertainty is quantified as the standard deviation of the mean at every 10% ofthe normalized height. Results show a consistent plume assessment (high plume top probability) between 100-110% of the* *vertical profile (indicated by the dark blue dashed line), demonstrating the methodology's accuracy despite radiosonde measurement uncertainties.*

Also, among 150+ events, is there any availability on some on weather radar data ? a brief comparison of measured plume heights with radar would help to contextualize accuracy beyond the few examples shown.

*Unfortunately, as stated in the paper, mobile radar, or a permanent network of radar Doppler, was not available in the regions where we have launched the sondes. However, a new set of radars is being installed in our region that will facilitate such data availability. Indeed, in 2026, we will start deploying mobile radar to the wildfires. These measurements will complement our sounding analysis and will reinforce each other!*

*In the current study, we used the echotop archive of weather radars to compare the sonde-estimated plume top with 12 dBZ radar echotops (Figure 8a). The figure enables us to quantify the uncertainty of plume top estimation when comparing radar data with radiosonde to an average error of 166.82 m. However, it is important to note that the divergence between radiosonde and radar-measured heights increases with plume top height above 6000 m AGL.*

*In the revised manuscript, and following the comments of CC5, we have clarified the issue and cited the previous work of reference:*

*Krishna, M., Saide, P. E., Ye, X., Turney, F. A., Hair, J. W., Fenn, M., & Shingler, T. (2024). Evaluation of wildfire plume injection heights estimated from operational weather radar observations using airborne Lidar retrievals. Journal of Geophysical Research: Atmospheres, 129(9), e2023JD039926.*

***Old version:***

***'2.5.2 Data collection for post-analysis and research***

- *Radar measured echotop. It is a proxy measure for the plume top. We analyze the radar echotop height (m) using radar data from the Servei Català de Meteorologia (www.meteo.cat). We filter the radar echotop data and define the estimated plume top as the maximum height where the reflectivity value equals or is higher than 12 dBZ. Unfortunately, the data for all fires is not available. This dataset is utilized to validate the estimates of plume tops collected from in-plume radiosondes during 18 wildfires'.*

***New version:***

***'2.5.2 Data collection for post-analysis and research***

- *Radar measured echotop. It is a proxy measure for the plume top height. We analyze the radar echotop height (m) using radar data from the Servei Català de Meteorologia (www.meteo.cat). We filter the radar echotop data and define the estimated plume top as the maximum height at which the reflectivity equals or exceeds 12 dBZ (Krishna et al., 2023). Unfortunately, the data for all fires is not available. However, the available dataset is utilized to validate and to corroborate* *the estimates of plume tops collected from in-plume radiosondes during 18 wildfires.*

Minor:

Ensure consistent notation for potential temperature (θ) and virtual potential temperature (θv).

line 467 - “opyroCu” with “pyroCu”

*Thanks for the comment. We have gone through the document again and ensured consistency on such terms.*

This is a well-executed and highly relevant contribution that bridges operational practice and research in pyroconvection monitoring. I recommend minor revision to address the small editorial and methodological clarifications listed above. Once revised, the manuscript will constitute an important reference for both field operations and coupled fire-atmosphere modeling.