

Referee Comments – A comprehensive assessment of emissions from prescribed fires in two Mediterranean shrublands: chemical and morphological analysis

<https://doi.org/10.5194/egusphere-2026-952>

General Overview:

The manuscript (egusphere-2026-952) presents results from prescribed fires in two Mediterranean shrublands in 2016. The analysis includes emission factor, chemical composition, and morphology. The topic of this study falls within the scope of the journal Atmospheric Chemistry and Physics (ACP). This manuscript is generally laid out well and shows its academic value. This manuscript is recommended to be published after addressing the concerns and comments below with minor revisions.

We thank the reviewer for the positive assessment of our manuscript and for recommending publication after minor revision. We appreciate the reviewer's recognition that the topic falls within the scope of Atmospheric Chemistry and Physics and that the manuscript is generally well structured and academically valuable. We have carefully addressed all the concerns and comments raised, as detailed below.

Major Concern:

- Tables 1, 2, and 3 are mentioned but not provided in the manuscript.

We apologize for this oversight. Due to an error during manuscript preparation, Tables 1–3 were not included in the submitted version. These tables have now been added and are available in the revised manuscript.

Minor Concerns:

- Figure 1: Please provide the Direction, Scale, and Legend.

Figure 1 has been revised to include a north arrow, scale bar, and legend.

- Equation 1: The 100 on the right-hand side of the equation is suggested to be replaced with 100%.

To make the notation clearer, we have revised the equation by expressing the result explicitly as MCE (%), while keeping the multiplication factor as 100.

“The MCE, expressed as a percentage, is calculated as (1):

$$\text{MCE (\%)} = \frac{[\text{CO}_2]}{[\text{CO}_2] + [\text{CO}]} \cdot 100 \quad (1)$$

- Lines 153 - 154: How are the numbers 53.3% and 53.2% obtained? Are they obtained from the chemical analysis described in Section 2.2? If so, please specify here for clarity.

The values 53.3 % and 53.2 % correspond to the carbon mass fraction of the dry fuel for *Calluna* and *Genista*, respectively, obtained from the elemental analysis described in Sect. 2.2 and reported in Table 2. This has now been clarified in the revised manuscript.

“The carbon mass fraction of the dry fuel used in Eq. (2) was obtained from the elemental analysis described in Sect. 2.2 and reported in Table 2. The $\%C_{fuel}$ values were 53.3 % for *Calluna* and 53.2 % for *Genista*.”

- Line 161: How can the particle overlapping be avoided by estimating sampling periods? Please provide more detailed descriptions.

We agree that the original wording was not sufficiently clear. Particle overlapping was not completely avoided but minimized by limiting the SEM sampling duration in order to reduce filter loading and obtain a particle surface density suitable for single-particle observations. This approach is commonly used in individual-particle SEM/TEM analysis, where excessive filter loading can hinder the identification of particle morphology and composition. We have revised Sect. 2.4 to clarify this point.

“Sampling periods for SEM analysis were kept short and adjusted according to smoke-plume intensity to minimize filter overloading and particle overlap on the substrate, which is essential for reliable single-particle SEM/EDS analysis (Mamane et al., 2001).”

Mamane, Y., Willis, R., and Conner, T.: Evaluation of Computer-Controlled Scanning Electron Microscopy Applied to an Ambient Urban Aerosol Sample, *Aerosol Science and Technology*, 34, 97–107, <https://doi.org/10.1080/02786820118842>, 2001.

- Lines 184 - 185: How were the proportions 53.5% and 59.6% obtained? Please provide detailed descriptions.

The values 53.5 % and 59.6 % correspond to the proportion of live biomass in the total fuel load for *Genista* and *Calluna*, respectively. These proportions were obtained from pre-fire fuel-load measurements, in which live and dead biomass fractions were separated and weighed. We have revised the manuscript to clarify how these values were obtained.

“The live/dead proportion in the fuel load was determined from pre-fire vegetation sampling by separating, drying, and weighing live and dead biomass fractions. The live fraction was calculated as the dry mass of live biomass divided by the total dry fuel mass. The resulting live biomass proportions were 53.5 % for *Genista* and 59.6 % for *Calluna*.”

- Line 187: The numbers 90 and 90.6 are suggested to be replaced with 90% and 90.6%.

We have corrected these values and now report MCE consistently as a percentage throughout the manuscript, including the values 90 %, 90.6 %, and 70.8 %.

“iii) Combustion efficiency was evaluated by calculating the MCE (Sect. 2.3). In the prescribed fires on the *Calluna* plots, the MCE was higher than 90 % (90.6 %), indicating that more than 50 % of the emissions were produced by flaming combustion. On the other hand, in the *Genista* plots, the MCE was lower than 90 % (70.8 %)”

- Lines 191 - 192: Is there a way to quantitatively estimate the amount and effect of litter and mulch? If so, please provide relevant descriptions. If not, how can this statement be convincing with academic rigor? Please make revisions accordingly.

We agree that the effect of litter and mulch cannot be quantitatively assessed because their loads were not measured separately during the field campaign. Therefore, we have revised the statement to avoid overinterpretation. In the revised manuscript, litter and mulch are mentioned only as a possible qualitative factor that may have contributed to the lower MCE observed for *Genista*, together with fuel structure and combustion conditions.

“Differences in combustion efficiency may be related to variations in fuel humidity and fuel packing, given that it has been argued that MCE increases with decreasing biofuel packing (Soares Neto et al., 2009). The lower MCE observed for *Genista* may also be partly associated with the presence of litter and mulch beneath the shrub layer, which may favour smouldering combustion. However, because litter and mulch loads were not quantified separately, this interpretation should be considered qualitative.”

- Lines 192 - 196: How can the residence time and the rate of spread be both higher at the same time?

We agree that the original wording could be clearer. Rate of spread and residence time describe different aspects of fire behaviour: the rate of spread refers to the horizontal advance of the fire front, whereas residence time refers to the duration for which temperatures remained above 300 °C at a given location. Therefore, both parameters can be higher simultaneously when combustion is more intense and the heated zone associated with the fire front is broader or persists longer. We have revised the manuscript to clarify this point.

“Fires on the *Genista* plots were characterised by a rate of spread of 0.40 m min⁻¹, a mean maximum temperature of 454 °C at ground level and a residence time of 23.7 s, defined as the period where temperatures exceeded 300 °C (Wotton et al., 2012). *Calluna* burning was the most intense, presenting higher values of mean rate of spread (4.23 m min⁻¹), mean maximum temperature (809 °C) and residence time (103.3 s). Rate of spread and residence time describe different aspects of fire behaviour: the former represents the horizontal advance of the fire front, whereas the latter represents the duration of heating above 300 °C at the measurement point. Thus, a faster-spreading fire may also show a longer residence time when the flaming zone is broader or combustion is more intense”

- Line 207: Is the “subtracted from” meant to be “subtracted by” or not? Please double check.

The intended meaning was that background concentrations were subtracted from the concentrations measured in the smoke plume. To avoid ambiguity, we have revised the sentence accordingly.

“Net concentrations (concentrations measured in the smoke plume minus the corresponding background concentration) of gases obtained through high-resolution Fourier transform infrared (FTIR) analysis of combustion products collected from *Calluna* and *Genista* burnings are shown in Table 3.”

- Lines 287 - 289: Does this statement mean that 0.104 is higher than 3.4, and that 0.241 is higher than 4.2? If not, please revise the statement to improve clarity and readability. Make sure to provide descriptions on how to determine if the K⁺/EC values are considered high or not.

The original statement did not intend to compare K⁺/EC directly with Cl⁻/EC. To improve clarity and avoid an unsupported interpretation of the K⁺/EC values as “high”, we have revised the sentence. In the revised version, we simply state the Cl⁻/EC and K⁺/EC ratios separately and interpret the presence of K⁺ relative to EC as evidence of biomass-burning influence, since water-soluble potassium is widely used as a biomass-burning tracer.

“The Cl⁻/EC ratios were 3.4 ± 2.0 for *Genista* and 4.2 ± 2.1 for *Calluna*, while the K⁺/EC ratios were 0.104 ± 0.071 and 0.241 ± 0.045, respectively. The presence of K⁺ relative to EC supports the influence of biomass combustion, as water-soluble potassium is widely used as a tracer of biomass-burning aerosol (Andreae, 2019; Yu et al., 2018). Together with the observed Cl⁻ levels, this suggests the possible presence of potassium-containing salts such as KCl internally mixed with carbonaceous particles. These species may act as cloud condensation nuclei (CCN), contributing to regional indirect radiative forcing in Mediterranean regions (Alves et

al., 2010a; Petters et al., 2009).”

- Line 346: The 90.6 and 70.8 are suggested to be replaced with 90.6% and 70.8%.

We have corrected these values and now express MCE consistently as a percentage throughout the manuscript, including the values 90.6 % and 70.8 %.

- Line 365: The word “though” seems to be a typographical error of “through”.

The word “though” has been corrected to “through” in the revised manuscript.