Responses to reviewer1

The manuscript investigates the influence of turbulent inflow conditions on large eddy simulation (LES) of fire plume development near the ground. The authors compared simulations with uniform inflow and turbulent inflow generated by a divergence-free spectral representation (DFSR) method under two wind conditions. The topic is relevant for fire–atmosphere interaction modeling. The manuscript provides useful numerical experiments and shows that the effect of inflow turbulence becomes more significant under stronger wind conditions. It addresses an interesting problem related to LES modeling of fire plumes. The reviewer recommends minor revision, but the paper can be improved by addressing the following comments before been considered for publication.

1 The combustion process is modeled using a one-step global methane reaction combined with an eddy dissipation model. While this simplified approach is common in LES fire simulations, the manuscript does not discuss its potential limitations. The authors should briefly discuss the implications of this simplified combustion model and whether it could influence the comparison between turbulent and uniform inflow cases. Reply: Although more detailed chemical kinetic mechanism can be used, this one-step global reaction is widely used in fire modeling due to its simplicity and efficiency [1]. As such, it cannot predict complex flame dynamics, such as ignition and extinction process. It should not influence the comparison between the turbulent and uniform inflow cases. We have added this statement to the manuscript.

[1] Maragkos G, Verma S, Trouvé A, Merci B. Evaluation of OpenFOAM's discretization schemes used for the convective terms in the context of fire simulations. Comput Fluids 2022;232:105208. https://doi.org/10.1016/j.compfluid.2021.105208.

2 The mesh resolution near the flame is stated to be 0.25 m × 0.25 m × 0.06 m, but the manuscript does not discuss whether this resolution is sufficient for LES of the fire plume. The authors should clarify whether any grid sensitivity test has been performed. Reply: We have performed the mesh independent test in the revised version. In the original work, we only used 2 level refinements. We further refined the meshes to 3 levels and 4 levels. Results are different between 2 refinements and 3 or 4 refinements:

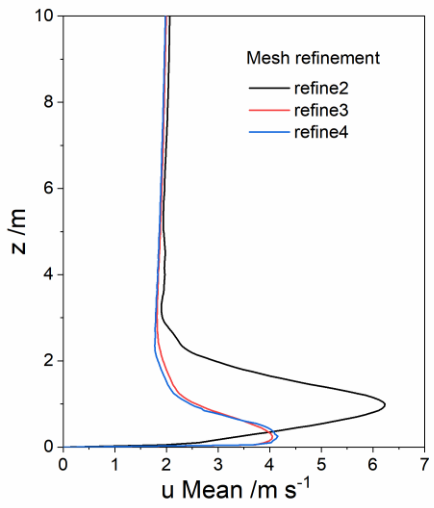

Figure Mesh independent test: Mean velocity profile at the fire front.

It can be seen that 2 refinements are not sufficient to obtain mesh-independent results, but 3 refinements are OK. Considering this, we have completely re-run all the cases and updated all the results. However, the conclusions are similar to previous results.

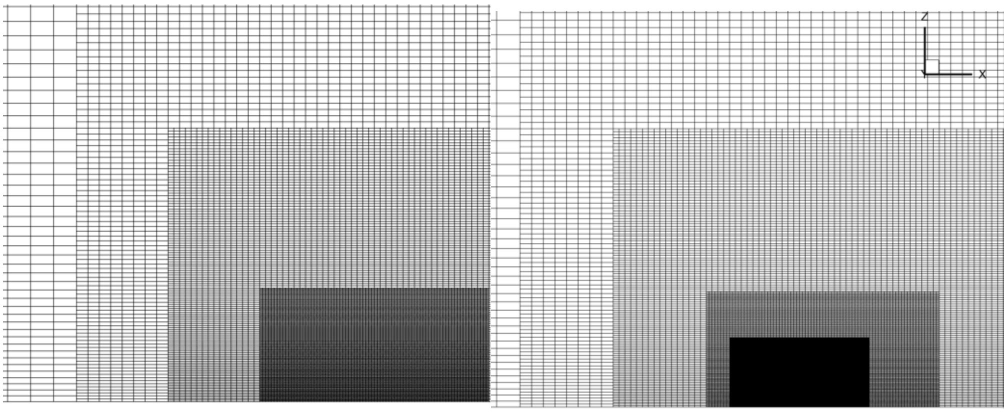

Figure 3 level refinements and 4 level refinements

3 About the averaging time, the averaging period used for statistical analysis is 240 s, which corresponds to approximately 3–8 flow-through times depending on the wind speed. This averaging window may be relatively short for obtaining statistically converged mean fields in LES of atmospheric flows. The authors mention that the averaging time is sufficient for plume statistics, but no quantitative evidence is provided.

Reply: Following figure shows the effect of ending averaging time for the TKE distribution. It is clearly that the TKE changes little after 450s, which means 240s averaging is sufficient.

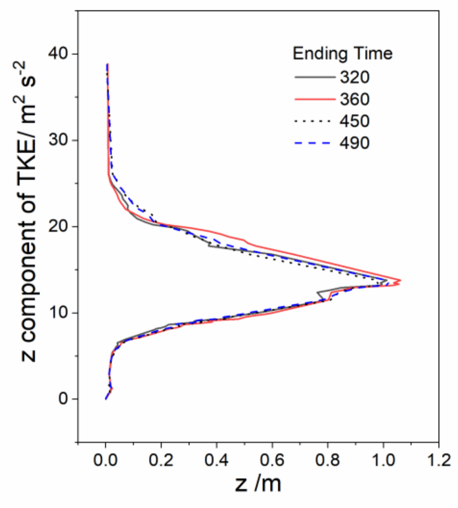

Figure Time averaging window effect

Minor comments:

The captions should specify whether the plotted quantities are time-averaged or instantaneous.
“Form Figure 4”, should be “From Figure 4”
Temperature unit in Figure 13 is missing
Legends in Figure 15 are not consistent, and some are two small.
Reply: We have revised these mistakes.