Responses to reviewer2

This manuscript addresses a critical research gap in fire plume LES modeling by investigating inlet turbulence effects under weak/moderate wind conditions, and the research topic has practical academic value for fire plume modeling. The numerical methodology is described in detail, the results are adequately analyzed and supported by sufficient data. However, the numerical methodology verification is not sufficient, and it requires more comparison and analysis.

(1) Why is the DFSR method is used? The authors should justify the choice and discuss its validity in generating turbulent ABL.

Reply: As discussed in the introduction section (From line 26-32), there are many ways to generate turbulent ABL for wind simulation, such as the precursor-successor method and the synthetic method. The DFSR method is designed for wind engineering computations and should also apply for current work. Its validity for turbulent ABL has been discussed in its original paper (Melaku and Bitsuamlak 2021) and is not discussed in this work.

(2) Add mesh sensitivity analysis (at least 3 resolutions) with quantitative comparison of key plume parameters (centerline T/velocity, TKE, etc.), and clarify grid convergence and selection rationale.

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:

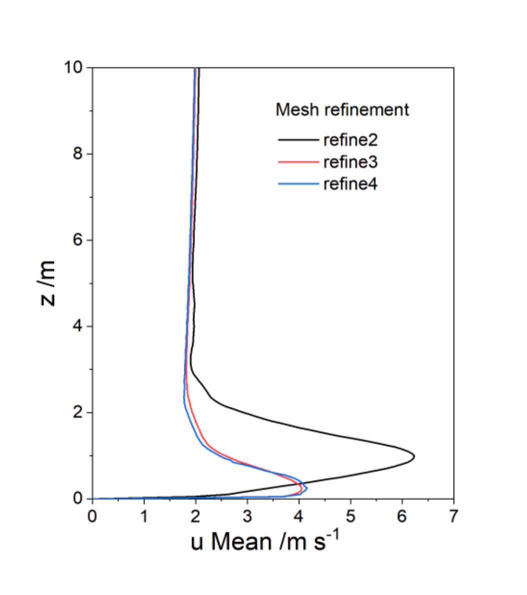

Figure Mesh independent test: Mean velocity profile at the fire front.

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.

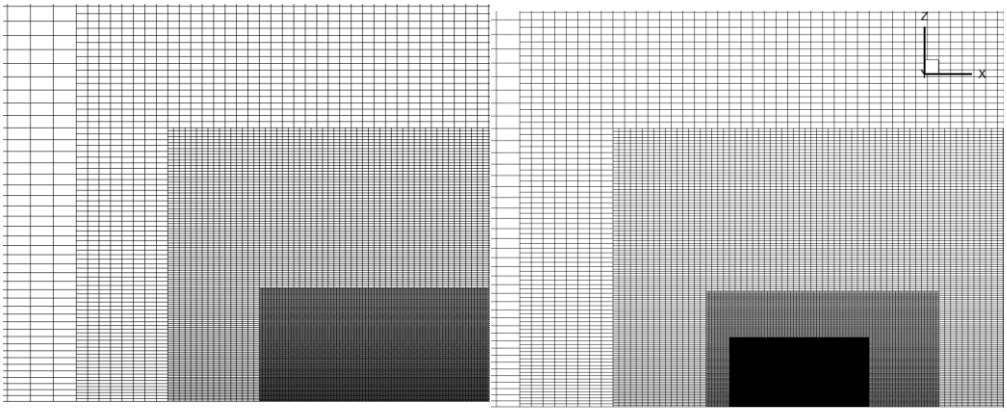

Figure 3 level refinements and 4 level refinements

(3) Provide quantitative time-averaging convergence verification (convergence curves of key statistics with averaging time) and explain the 250 s averaging start time.

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. We choose the 250 s as the averaging start time because the 50 second is usually enough to exclude the effect of the initial state on the flame temperature averaging.

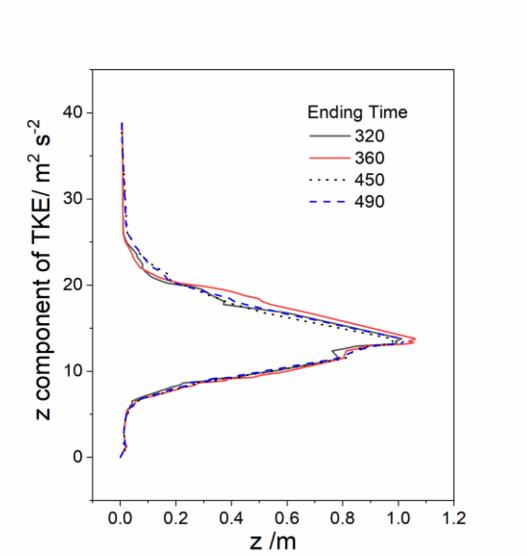

Figure Time averaging window effect

(4) Justify the models used in the work (SGS model, combustion model, radiation model, etc.) and provide the missing key model parameters (EDM empirical constants, SGS model coefficients, and so on.).

Reply: These models can also influence the results of the temperature, velocity and turbulent energy. Some of their influences have been investigated by some authors. Such as:

Maragkos G, Merci B (2020) On the use of dynamic turbulence modelling in fire applications. Combust Flame 216:9–23. https://doi.org/10.1016/j.combustflame.2020.02.012
Sun Y, Yu Y, Chen Q, et al (2022) Flow and thermal radiation characteristics of a turbulent flame by large eddy simulation. Phys Fluids 087127: https://doi.org/10.1063/5.0107876

The choices of these models have been validated by above references and those cited therein. Hence, we did not repeat the validations in this work as our focus is the turbulent effect. All the model constants can be views in the uploaded openfoam files. However, we also cited a reference for the convenience of the readers.

(5) Calculate non-dimensional numbers (Fr/Ri) to quantify the buoyancy-inertial force balance and explain the differential effect of inlet turbulence under 2/5 m·s⁻¹ wind speeds.

Reply: For both conditions, the maximum temperature T can be around 2200K, and the environmental temperature is 300K. We chose the Froude number:

$$Fr = \frac{U}{\sqrt{g'L}} = \frac{U}{\sqrt{g\frac{T - T_\infty}{T_\infty}L}}$$

The Froude numbers are about 0.179 and 0.449 for 2ms-1 and 5ms^{-1} respectively, indicating the stronger wind inertial force for the latter case, leading to more inclination of the flame for the 5ms^{-1} case.

(6) The authors should provide more information about the turbulent fluctuations in Figure 4. Why are the fluctuations much larger for 5ms-1 case?

Reply: As we stated in the paper: We collected the mean velocity profiles and turbulent fluctuations at a location before the fire source. The exact location is 38m, 2m ahead of the fire. They are larger for the 5ms-1 case because we used a similar turbulent intensity (which is the ratio of root square of turbulent fluctuations to the velocity) for both cases.