Response to the Editor for the Manuscript "The Boundary Layer Dispersion and Footprint Model: A fast numerical solver of the Eulerian steady-state advection-diffusion equation"

Response to the Editor

Please revise the manuscript based on the comments below.

We thank the editor for the minor review.

1. comments in Report #1: Please make sure that stability is defined as L/z, not z/L in the manuscript. Minor correction on line 268: For neutral boundary layer flow L/z_M is infinite instead of 0. Perhaps it is better to specify $z_m/L = 0$ for neutral, $z_m/L = 1$ for stable and $z_M/l = -1$ for unstable.

We updated § 7 to use z_m/L, starting with the following sentence:
"The atmospheric stability is quantified by the dimensionless stability parameter z_M/L evaluated at the measurement height, where $z_M/L = 0$ denotes neutral, $z_M/L > 0$ stable and $z_M/L < 0$ unstable stratification."

2. Please moderate the claims that BLDFM does not rely on assumptions or has no restrictions to turbulence regimes: The manuscript repeatedly emphasizes that BLDFM does not rely on asymptotic assumptions or estimates, and that it has no restrictions to certain turbulence regimes. This is too broad as currently phrased. BLDFM avoids some of the assumptions required to derive analytical closed-form footprint solutions, such as the slender-plume approximation. However, the model still relies on a steady-state Reynolds-averaged advection–diffusion equation, K-theory closure, horizontally homogeneous mean wind and diffusivity profiles that depend only on height, prescribed lateral boundary treatment, and a turbulence closure currently based on MOST.

The claim on making no assumptions / no regime restrictions has been softened in the abstract and the introduction. Furthermore, we are now explicit with the assumptions that BLDFM avoids, and we added a paragraph in § 1 listing the assumptions mentioned above that BLDFM retains.

3. Please distinguish more clearly between solver verification and model validation/evaluation: The analytical constant-coefficient test case is a useful and appropriate verification test. It demonstrates that the numerical method can reproduce a known analytical solution under idealized conditions. The convergence analysis is also useful for assessing numerical behaviour. However, these tests do not constitute validation of the physical footprint model under realistic atmospheric conditions.

We corrected "validate" to "verify" for the analytical and convergence tests throughout the manuscript; see the tracked changes version of the manuscript for more details. We also added a sentence in § 5 explicitly stating that these tests are for solver verification and do not constitute physical validation, which is left for future work.

4. Please clarify the current scope of the turbulence-closure implementation: The manuscript highlights the modularity of the framework and the possibility of using higher-order closures, measured profiles, or LES-derived profiles. This is an attractive feature. However, the actual demonstrations in the manuscript appear to rely on MOST with Businger–Dyer relationships and isotropic eddy diffusivity. Higher-order closures are described as future work.

Please separate demonstrated model capabilities from potential future capabilities. If the current code already supports alternative closure inputs, please demonstrate this with at least one example or provide explicit documentation. Otherwise, claims about closure generality should be toned down and stated as a design feature rather than a validated capability.

The current scope of the turbulence-closure implementation has been toned down to clearly state that measurements or LES input and higher-order closures are left to future work. Furthermore, we added a new § 4.1 demonstrating the 1.5-order OAAHOC [Schumann(1991)] as an alternative turbulence closure.

5. Several figures use colour maps or contour colours that appear to rely strongly on hue differences. Please check all figures with a colour-blindness simulator and revise the colour schemes if necessary. In addition, please consider using perceptually uniform and colour-vision-deficiency-friendly scientific colour maps, adding contour labels, or varying line styles so that the results remain interpretable without relying solely on colour.

All figures have been updated and should now be more assessable. The captions have also been updated accordingly.

References

[Schumann(1991)] U. Schumann. Subgrid length-scales for large-eddy simulation of stratified turbulence. *Theoretical and Computational Fluid Dynamics*, 2(5):279–290, Aug. 1991. ISSN 1432-2250. doi: 10.1007/BF00271468.