Mailler et al: Settling speed of prolate spheroids in the atmosphere

The authors revisit two published results (Mallios et al 2020 and Sanjeevi et al 2022) for the drag coefficient on prolate spheroids in vertical and horizontal orientations settling in an incompressible Newtonian fluid. I would be happy to recommend the manuscript it the authors address my concerns.

Major:

First of all, I am confused whether why the authors need to explicitly calculate the velocity if the drag coefficients are already calculated as functions of two governing dimensionless quantities: Reynolds numbers and aspect ratios. Usually in simulations, equations of motion are made dimensionless and these drag coefficients can then be directly used and there is usually no need of calculating velocities. If the authors can include a justification, that would be better for the readers. Usually in fluid dynamics literature, analyses and calculations are performed in dimensionless forms and as a result one can make use of the drag coefficients themselves and one does not need to worry about the dependence of nondimensional particle velocity and its variation with d_eq. The goal of making governing variables dimensionless is to encode information in a compact form which can then be easily used in calculations. I do not think such an effort to explicitly calculate the “steady state” particle velocity as a function of d_eq is needed in the first place if one solves dimensionless equations of motion.

Instead of presenting their results a functions of d_eq, I urge the authors to first plot the drag coefficients as functions of Re for different \lambda using the results of Mallios et al 2020 and Sanjeevi et al 2022 simultaneously in a single plot. This would clearly showcase the ranges of Re these results can respectively be used and the range for which they are consistent. This eliminates the need to worry about exact values of d_eq.

What are the values of \rho, \rho_P, and \mu did the authors use for their calculations? Does \rho and \mu correspond to values of air? I think these results should equally be valid even in the case when prolate particles are settling in liquids given their Re are in the range when the expressions given by Mallios et al 2020 and Sanjeevi et al 2022 are valid. Why do then the authors focus only on atmosphere?

In addition to Re and \lambda, in the case when Re > 1 Stokes number also becomes important. The authors should comment on why they ignored it. They should also include a discussion addressing the time evolution of particle speed in the cases when particles have a finite Re.

It is well known that prolate particles (spheroidal particles in general see Ardekani et al IJMF 87 2016 PP16-34) rotate as they settle under gravity and attain a steady state orientation such that their broadside is horizontal if their R is lower than a critical value. At R above this critical value, they undergo orientation instability such that they do not have a steady a steady state orientation. In such a case, how useful are the assumptions about \phi = 0 and \pi/2?

It is well known that the earth's atmosphere has density and viscosity stratification (see Magnaudet and Mercier Annual Review of Fluid Mechanics 2020; More and Ardekani Annual Review of Fluid Mechanics 2023). In such a case how useful are these calculations? Shouldn't one need to include effects of stratification and time dependence then?

Aerosols can also mean liquid droplets suspended in air. The authors should clearly state that by aerosol they strictly focus on solid particles in air as in the case of liquid droplets, the surface boundary conditions are different and the calculations presented are not valid.

Minor:
Eq 15 should have \mu^2 in the denominator. This definition of R is equivalent to something called Archimedes number

Line 233: typo should be "expression"