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Letter to the Editor

I would like to thank Professors Elperin, Kleeorin and Rogachevskii for the interest they have shown in my recent paper and I apologise for not referencing the important contribution these authors have made to the application of particle compressibility in the formulation of particle transport in turbulent flow particularly in relation to the phenomenon of particle clustering. I certainly did not wish to imply that I was the first to introduce compressibility into the statistical formulation. It was Maxey (1987) himself who first introduced compressibility into the formulation of gravitational settling of particles in turbulent flow, though as these authors have rightly pointed out, they have exploited and generalised its use in particle transport processes. My own derivation of passive scalar diffusion in a compressible flow field was carried out independently and although lacking Brownian diffusion is completely general.

I was made aware of the previous work in this area by Prof. Elperin who drew my attention to the Elperin, Kleeorin and Rogachevskii paper (Elperin et al., 2000) which deals with passive scalar dispersion in a compressible random velocity field with molecular diffusion: the inclusion of diffusion was meant to simulate Brownian dispersion of particles in a random velocity field made compressible through the effect of particle inertia. Although limited to a specific random velocity field, their analysis was therefore more general than mine. In the case of zero molecular diffusion, my results show the explicit absence of compressibility when the flow fields are Gaussian, homogeneous and stationary. In their case the same is true if the third order moment $\langle v_m v_n \nabla \cdot \mathbf{v} \rangle = 0$, which is equivalent to the Gaussian assumption (see Eq. (27) of Elperin et al., 2000). In both approaches, only for a non-Gaussian distribution do the diffusion coefficients depend on moments of the displacement and compressibility fields.

However that being said, I have a concern for the use of an advection diffusion equation for Brownian motion in a random flow where the inertia of the particle (Stokes number) forces the velocity field of the particle to be different from that of the underlying carrier flow. Application of the Fokker Planck equation shows that only in the case of low inertia $St \ll 1$ is simple advection diffusion (ADE) possible and in this case the velocity field of the particle is the same as that of the incompressible carrier flow (which negates the impact of any compressibility on the particle motion). I am also concerned about the use of compressibility for a white noise driving function such as the case with Brownian motion.

Elperin, Kleeorin and Rogachevskii have no doubt noticed that the only reference to my compressibility analysis is an ICMF conference paper (Reeks, 2001). I am currently turning that paper into a form suitable for journal publication and in so doing will of course make due reference to

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the contribution these authors have made to the subject. I would be very grateful for their comments and criticism.

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