Comments on ‘Turbulence induced cloud voids: observation and interpretation’

This is an interesting article with some novel field data and numerical results which have been interpreted with reference to existing theoretical analysis. The extent to which this analysis is strictly applicable to real clouds is perhaps moot but it nevertheless provides a useful starting point and appropriate orders of magnitude. I would recommend publication but found aspects of the paper, particularly the summary of the analysis (§3) and its application (§4) confusing. I have a number of detailed points, mostly minor, which I would like the authors to consider especially with a view to improving the clarity of their arguments. I have also made a number of suggestions for improving the written English.

Detailed comments

p.3, l. 29 It’s not clear what ‘They’ in the sentence ‘They were smaller ...’ is referring to here: ‘Swiss cheese’ or ‘cloud holes’?

p.6, eq. (2) Could the authors provide a reference for this? Or at least some more motivation?

p.9, l. 2 What is r_0? Does it have any physical relevance? It would be helpful if $\phi(x)$ were defined so that its dependence on the parameters in the problem is made clear; it has an important role in the analysis.

p.9, l.12 I didn’t understand the sentence beginning ‘Particle motion ...’ especially ‘separated from the motion 2D space’.

p.11, eq. (9) For the linearization of eq. (6) I obtained

$$r^* \approx \frac{Sv}{A}(1 + (4\pi A)^2)^{-1/2}$$

While this differs from eq. (9) for non-zero A, it does give me $r^* \approx 4\pi Sv$ in the limit $A \to 0$ in agreement with eq. (9).

p.11, l.16 I didn’t understand the first sentence ‘... splits in parts’. Two parts?

p. 11, l. 23+ Why are the conclusions ‘rough’? I didn’t follow all of the logic here: as the influence of gravity increases i.e. $g \sin\theta \uparrow$ or the vortex size, δ, increases (or both) then B decreases. Decreasing B means decreasing $A_{\max}$ which is consistent with increasing Γ (circulation). My understanding is that $A < A_{\max}$ for void creation. So as either $g \sin\theta$ or δ (or both) increase it becomes harder for voids to form unless the circulation increases appropriately. So I agree with the first conclusion so long as increasing minimum circulation equates to decreasing $A_{\max}$.

A further consequence of decreasing B is decreasing St_1 and ΔSt since the latter is proportional to $B^{1/3}$. This implies that, for fixed τ_f (circulation), the minimum particle size decreases with decreasing B as the second point suggests though it is not written very clearly. Since ΔSt decreases with decreasing B this suggests the range of particle size decreases with decreasing B as suggested by the latter part of the third point. But decreasing B corresponds to increasing Γ which seems to contradict the first part of the third conclusion. Perhaps I have missed something in the analysis of §§3 & 4; I would welcome more explanation.

p.12, l.5 The last part of this sentence doesn't read well.

p.12, §6 Which equations are the numerical simulations solving? A Burgers vortex or the Navier-Stokes equations?

p. 12, l. 32 Z and D should be defined: are they imposed on the simulation or simply typical values?

p.16, l.14 My understanding of the analysis of §§3 & 4 is that $A < A_{\max}$ for void creation yet here you are saying the opposite.