

Report on "Turbulence Induced Cloud Voids: Observation and Interpretation" (acp-2018-1049) by K. Karpinska et al.

This paper describes a theoretical explanation of physical mechanism of generating voids in clouds and some results of kinematic simulation. First, the authors explain the measurements of droplets inside cloud made at the top of German Alps. Then the size distribution of droplets is presented and the voids in the cloud droplet distribution are reported in figures and videos, which are very interesting. Next, the authors study the physical mechanism of void formation. Basic idea is to use the idea that an inertial particle tends to be expelled from the core of Burgers vortex. Theoretical analysis for this physics had already been done by Marqu et al. cited in the reference, and the present paper applies, in its essence, simply the results to the void formation. In order to see whether such interpretation is the case, the authors perform the kinematic simulation, to numerically integrate a set of equations of particles with different sizes in the flow field generated by the Burgers vortex. For two cases of parameters among three cases, the distribution of droplets is found to generate voids, which is consistent with Fig.5 of the theoretical prediction. Finally they argue the physical mechanism from the view points of the present analysis and visualization of voids.

The parts of the experiment and kinematic simulation are, I think, new and it is an idea to use the analysis in terms of Burgers vortex flow to explain the void formation. However, the part regarding the equilibrium positions and their stability is poorly written and hard to follow. The pages of p. 9-11 use the results of Marqu et al. without definition of some quantities, such as ϕ and r_0 . While the authors present the parameter range for stable periodic orbit in Fig.5, the kinematic simulations were done only for three points in the figure. Examination of the relevance of the simulation results by comparing to the theoretical results is not enough to convince the physical reasoning of void formation. Also in the discussion, the authors argue Mie scattering as one possibility of observing the void, but this is a speculation and lacks fundamental data or analysis. In conclusion, the present manuscript needs considerable revision.

Technical points are listed below.

1. p.8, 4th line. the authors write A as the strain parameter. I think, this is not appropriate. Γ is the circulation of the Burgers vortex so that $A = 1/Re$ where Re is the Reynolds number of the vortex.
2. p.9. What are definitions of r_0^* and $\phi(r_0^*)$? The paragraph of eqs. (7) and (8) without explanation does not make arguments useful.
3. p.11 How is A_{cr} determined?