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# Modeling cumulus clouds in a two-phase wind tunnel

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Experiments in wind-tunnels concerning meteorological flows are not very frequent in the literature. However, they are indispensable for a well-controlled and accurate investigation of turbulence–droplet interactions at the micro-scale. Of course it is impossible to reproduce perfectly the turbulent properties of clouds in a comparatively small wind-tunnel. The enormous length scales that are predominant in nature (integral length scale of typically 100 meters) lead to very high Reynolds numbers, roughly $10^7$ calculated with the cloud dimensions or $10^4$ as Taylor Reynolds number $\mathrm{Re}_\lambda$. Nevertheless, it is not necessary to reproduce exactly the whole turbulence spectrum to investigate the issue of rain formation in cumulus clouds. Only those scales and turbulence properties should be reproduced in the wind tunnel, which are physically important for the droplet population.

In this work the key properties of cumulus clouds will be identified and implemented in a two-phase wind tunnel, allowing reproducible and accurate measurements. These properties are in particular the droplet number density, the turbulent kinetic energy and its dissipation rate. It is demonstrated by means of non-intrusive optical measurement techniques that the flow velocity, droplet number density, and key turbulence properties have been matched and are in the right order of magnitude. In this manner wind-tunnel investigations become possible and deliver realistic information concerning the interaction between droplets and turbulence in cumulus clouds.