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Collisions of cloud droplets with a rain drop investigated in the Mainz vertical wind tunnel

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Collisions of cloud droplets with rain drops and the ensuing collection of cloud droplets are important phenomena for precipitation formation. Representation of these processes in cloud and climate models, though adequate in some cases, is based on very few actual measurements to validate these parameterisations. Therefore we apply in–line holography to observe single collisions and near–collisions of cloud droplets with a rain drop in the Mainz vertical wind tunnel. So far we have measurements in a laminar flow seeded with small droplets of diameters between 20 and 70 μm. Into the stream, a single collector drop of diameter of $\sim$700 μm was injected and floated in a sample volume by adjusting the vertical velocity of the wind tunnel to match the terminal velocity of the drop ($\sim$3 m/s). With a collimated laser beam and a high speed camera, we recorded holograms of the drop and droplets in the sample volume, which after reconstruction allows us to determine 3D positions of the droplets and the collecting drop, their diameters and droplet size distributions. With the time-resolved particle positions, we connect droplets from one hologram with droplets in the next hologram, which occurs in the predicted area calculated on the basis of known mean flow velocity. Analysis of successive images allows us to obtain trajectories of cloud droplets and especially their tracks close to the collector drop. With the obtained time resolution we have about 4–5 point droplet tracks through which we document collisions. A collision appears when we see a droplet approaching the collector drop and the droplet does not continue past the drop. We present the experimental method, data processing procedure and collisions characteristic founded in a data series length of about 50 s, yielding around 70–100 collisions.