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Cloud-clear air interfacial mixing: turbulence generated by evaporation of liquid water observed in the laboratory and modeled with high spatial resolution

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Saturated air, containing small water droplets (cloud), undergoes turbulent mixing with the unsaturated environment (clear air). Evolving cloud and clear air filaments separated by a thin interface result from this process. Two transport mechanism acting across this interface: molecular diffusion of water vapor (and heat) as well as gravitational sedimentation of cloud droplets from cloud to clear air filaments lead to evaporation of cloud droplets. This results in evaporative cooling and production of the density gradients across the interface and consequently in local production of the small-scale turbulence, which mofifies turbulence cascading down from larger scales. This process has already been investigated by two independent approaches: numerical experiments with the grid resolution as small as 2.5mm and laboratory cloud chamber measurements by means of Particle Image Velocimetry (PIV) method with 1.2mm spatial resolution. Results of both investigations has shown, that such turbulence is highly anisotropic (preferred vertical direction) substantially influences turbulence cascading down from the large scales. In the present study we show a comparison of statistical properties of turbulence observed in the cloud chamber and modeled with the numerical experiments. Both data sets: laboratory and numerical indicate significant anisotropy; consequently, <(u’)2> is about two times smaller than <(w’)2>. There u’ stays for turbulent velocity fluctuations in horizontal and w’ in vertical. In both data sets the experimental probability distribution functions of w’ have the wider spread than those of u’. In conclusion we state, that results from the numerical simu-

lations are in agreement with the experimental data. Both clearly indicate that small-scale turbulence in clouds undergoing mixing with the unsaturated environment differs significantly from the usually assumed isotropic Klomogorov turbulence.