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Supplement of

Time-dependent, non-monotonic response of warm convective cloud fields to changes in aerosol loading

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S.1 Mean size and number of drops

Figure S1 presents vertical profiles of the mean concentration and mean drop size per height. It demonstrates that at the cloudy layer ($H > 500\text{m}$) the mean drop size decreases with aerosol loading, while its concentration increases (Twomey, 1977). Below cloud base the trend is reversed – larger rain drops and lower concentration under more polluted conditions (similar to what was shown in Altaratz et al., 2008).

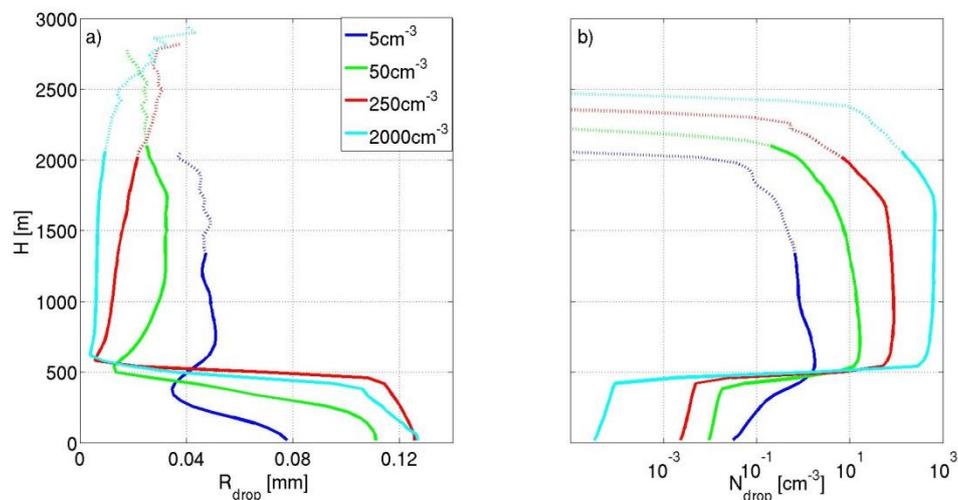


Figure S1. Vertical profiles of a) the mean (over time and domain) drop radius, and b) the mean (over the second two hours of simulation - after the spin-up time) of drop maximum concentration. These results include both cloud and raindrops for four simulations (with aerosol loading levels of 5 cm^{-3} – blue, 50 cm^{-3} – green, 250 cm^{-3} – red, and 2000 cm^{-3} – cyan). Doted parts of the curves represent heights in which the total liquid water mass was less than 1% of the maximum total mass (Fig. 4b) to avoid conclusions based on small statistics.

S.2 Mean condensation and evaporation rates

Figure S2 presents vertical profiles of the mean (over time) of the condensation and evaporation rates, per height, for four simulations with different aerosol loading. It

demonstrates the increase in both condensation and evaporation rates with aerosol loading.

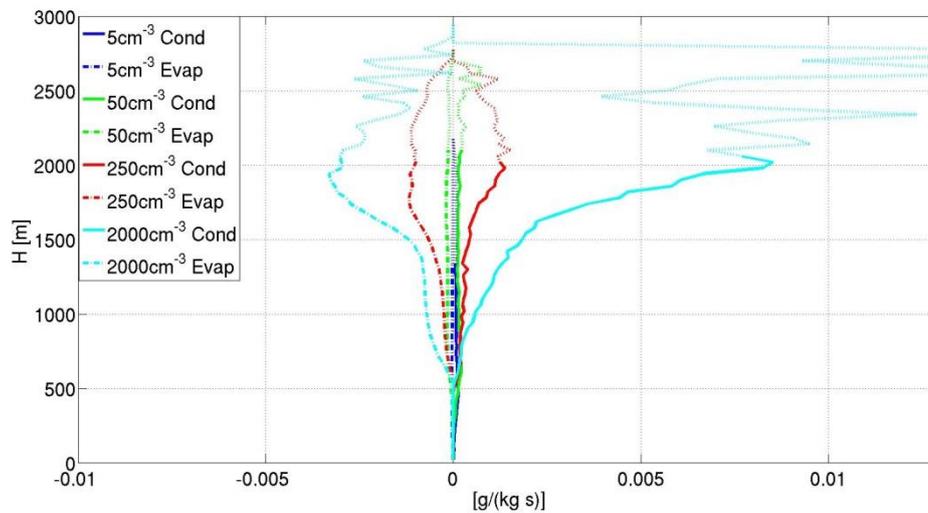


Figure S2. Domain's mean condensation (solid lines) and evaporation (dashed lines) tendencies for four different simulations conducted with different aerosol concentration levels (5 cm^{-3} blue, 50 cm^{-3} green, 250 cm^{-3} red and 2000 cm^{-3} cyan). Note that dotted parts of the curves represent heights in which the total liquid water mass was less than 1% of the maximum total mass (Fig. 4b).

S.3 Evolution of thermodynamic conditions

Figure S3 presents the temporal change in vertical profiles of the temperature (left column) and water vapor mixing ratio (right column) for clean (50 cm^{-3} – upper row) and polluted (2000 cm^{-3} – lower row) conditions. It demonstrates that under clean conditions the cloudy layer ($H \sim 500\text{-}1500\text{m}$) becomes warmer and dryer with time while the sub-cloud layer becomes colder and wetter. On the other hand, under polluted conditions the trend is different and the most significant change occurs at the inversion layer which significantly cools and becomes wetter with time

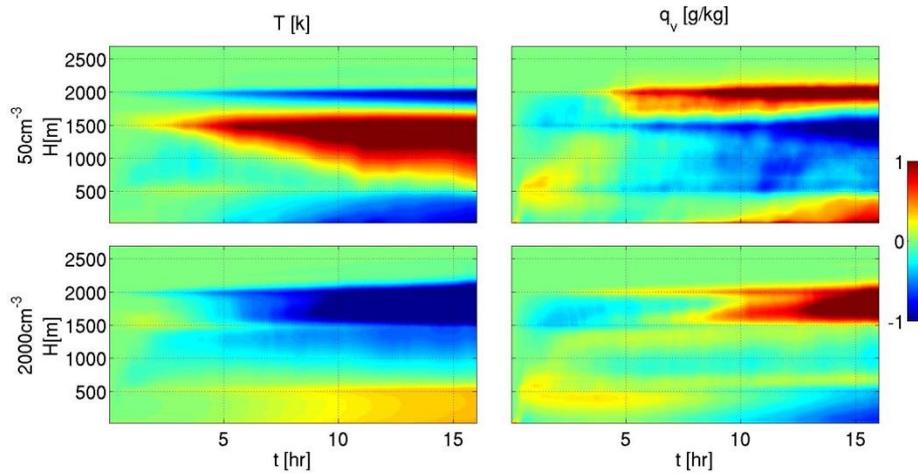


Fig. S3 Temporal changes compared to the initial profiles of mean environmental temperature [K] (left) and mean water vapor mixing ratio [g/kg] (right). For two different simulations with aerosol concentrations of 50cm^{-3} (clean – upper row) and 2000cm^{-3} (polluted – lower row).

References

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