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Competition between core and periphery-based processes in warm convective clouds – from invigoration to suppression

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"Competition between core and periphery-based processes in warm convective clouds – from invigoration to suppression"

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This work studies the effects of aerosol on warm convective clouds under different environmental conditions by using an axi-symmetric (1.5D) bin-microphysics cloud model. We propose a theoretical scheme that analyzes the evolution of key processes in warm clouds, under different aerosol loading and environmental conditions, to explain the contradicting results reported in the literature.

Figure S1 presents the aerosol size distributions. The background maritime aerosol size distribution (red curve) and two examples of polluted size distribution 1000 cm^{-3} (blue curve) and 10000 cm^{-3} (green curve) are presented.

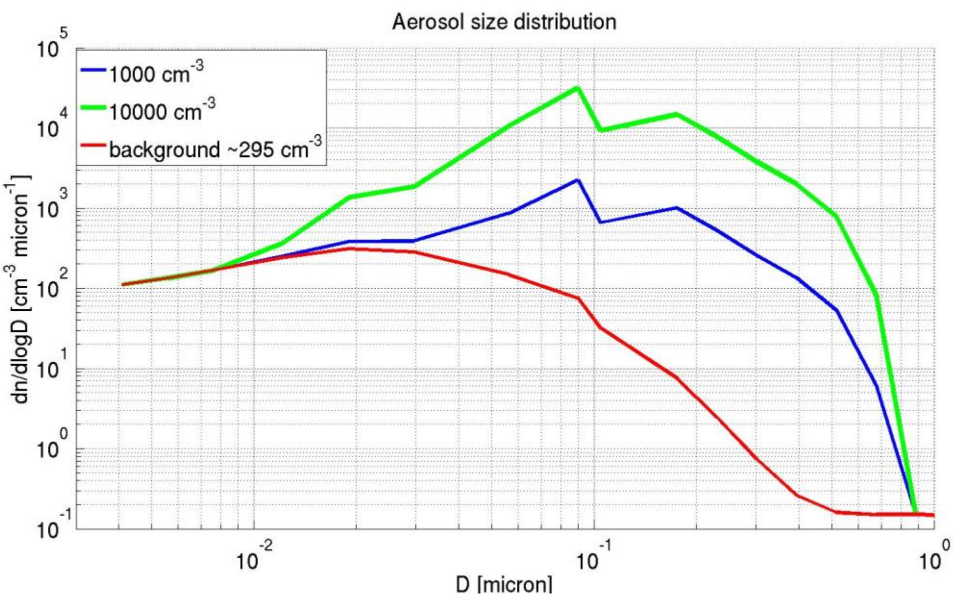

Figure S1. background (red curve) and two examples of polluted aerosol size distribution- 1000 cm^{-3} (blue curve) and 10000 cm^{-3} (green curve).

The maximum vertical velocity is presented in figure S2 for each of the simulated clouds as a function of the aerosol loading used in the simulation. The maximum vertical velocity shows a reversal in trend as a result of increasing aerosol loading (as was shown to other clouds' properties in the paper). Here as well, the aerosol concentration that corresponds to the maximum in the vertical velocity for each initialization profile depends on the environmental conditions. Higher inversion base height and higher RH value in the cloudy layer usually results in higher aerosol concentration that corresponds to the peak.

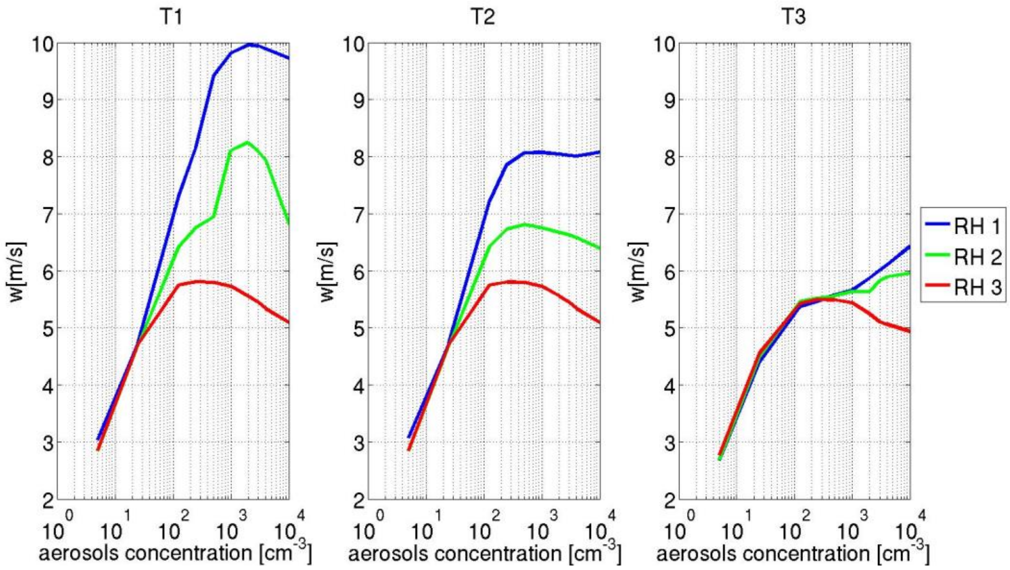

Figure S2. cloud maximum vertical velocity as a function of the aerosol loading, for each simulated cloud as a function of the aerosol concentration. Each curve represents 10 simulations performed for an initialization profile (a total of 9 profiles). T1 represents a profile with an inversion layer located at 4 km, T2 at 3 km, and T3 at 2 km. RH1 represents a profile with 95% RH in the cloudy layer, RH2-90%, and RH3-80%.

Figure S3 presents the evolution of η (cloud surface area to volume ratio) with time for three clouds that developed under different initial atmospheric profiles (T1RH1-blue, T2RH2-green and T3RH3-red) but with the same aerosol loading (4000 cm^{-3}). It demonstrates that as the inversion base height and the RH in the cloudy layer decrease the value of η increases. Please note that at the beginning and at the end of a cloud evolution the cloud is small and so its surface area to volume ratio is relatively large as shown in the case of cloud T3RH3 in fig. S3.

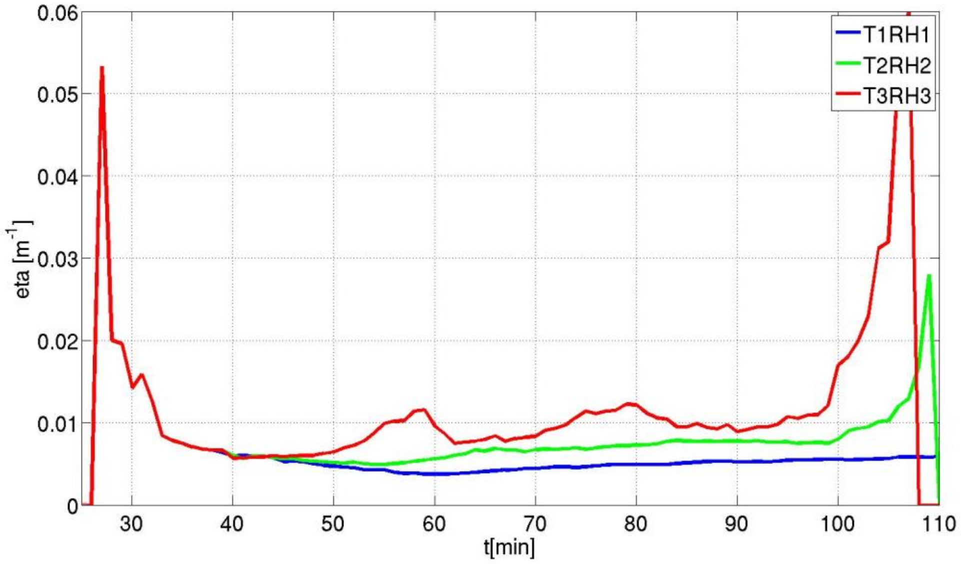

Figure S3. the evolution in time of the surface area to volume ratio (η) of three clouds that develop in different initial atmospheric profile T1RH1 (blue), T2RH2 (green) and T3RH3 (red) under the same aerosol loading conditions (4000 cm^{-3}).