Supplement to "Modeling Collision-Coalescence in Particle Microphysics: Numerical Convergence of Mean and Variance of Precipitation in Cloud Simulations Using University of Warsaw Lagrangian Cloud Model (UWLCM) 2.1" by P. Zmijewski, P. Dziekan and H. Pawlowska

S1 Introduction

This supplement to our paper (Zmijewski, Dziekan and Pawlowska., 2023) represents a time series of LR, MR, HR and D scenarios. The main paper describes the background and motivation for choosing this scenarios in more detail. In addition to the time series of results used in the main paper, we also present a time series of simulations in which the coalescence solver was turned off. All names, method and setups in this supplement follows directly the nomenclature from the paper.

S2 Time Series

In this section, we discuss temporal development of general cloud properties in the LR, MR, HR and D scenarios. In this supplement, this is done in a more expanded version than in the paper to give the readers the whole overview of how the modeled cloud develops. Time series of cloud top height (CTH), cloud cover (CC), cloud water path (CWP), rain water path (RWP) and precipitation are plotted in the following figures. In case of figures for cloud scenarios with coalescence solver turned off, the subplot showing the precipitations is omitted due to the fact that in those cases there are no precipitation at all. The results are ensemble averages for all cases with the coalescence solver turned on as well as for the D scenario with the coalescence solver turned off. For kinematic scenarios, there is no

difference between simulations within the same ensemble while the coalescence solver is turned off; that is why the presented plots are based on a single result for each $N_{\mathrm{SD}}^{(\mathrm{bin})}$.

In table S1 we are showing the ensemble size for each value of $N_{\mathrm{SD}}^{(\mathrm{bin})}$ in each scenario. The addition column with the ensemble size of *D no coal*(D scenario with the coalescence solver turned off) was added to table S1 of the paper. A brief description of each subplot

Table S1. List of simulated CC cases, with ensemble sizes.

$N_{\mathrm{SD}}^{(\mathrm{bin})}$	simulation ensemble size				
	LR	MR	HR	D	D no coal
10^1	200	191	201	600	100
$5{\cdot}10^1$	150	201	201	601	101
10^2	301	300	201	700	99
10^3	50	50	31	251	101
10^4	20	20	11	200	51
$4{\cdot}10^4$	11	10	19	232	11
10^5	6	6	11	109	0

is as follows:

(a) Cloud top height is the vertical position of the topmost cloudy cell;

(b) Cloud cover is the fraction of columns with at least one cloudy cell;

(c) Cloudy cells are cells with cloud water mixing ratio greater than 10^{-5};

(d) Cloud droplets are droplets with $0.5\,\mu\mathrm{m} \leq r_w \leq 25\,\mu\mathrm{m}$;

(e) Rain drops are droplets with $25\,\mu\mathrm{m} \leq r_w$;

(f) Surface precipitation, CWP and RWP are domain averages divided by CC in order to obtain values representative of the cloudy area.

S2.1 Scenario: LR

S2.1.1 With coalescence

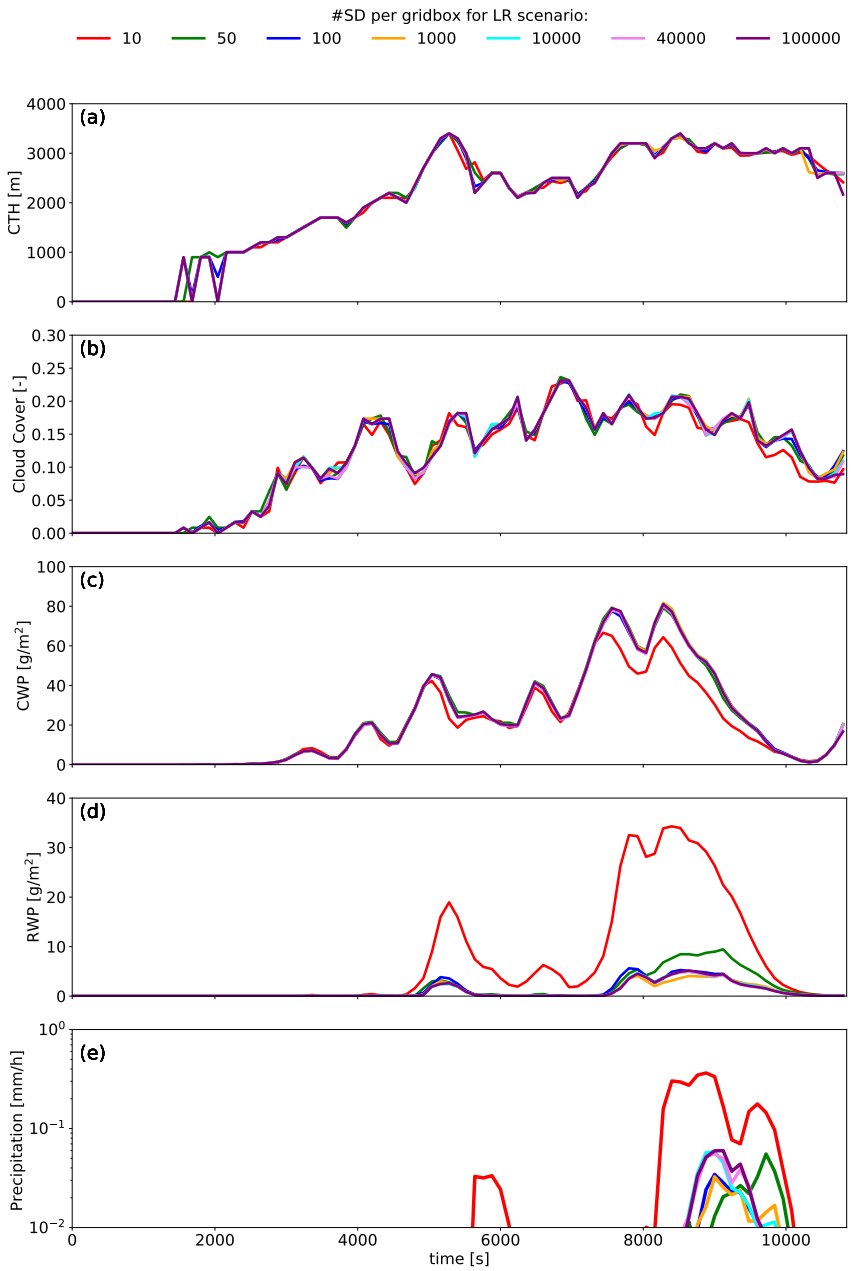

Fig. S1. Time series of ensemble averages of cloud top height, cloud cover, cloud water path, rain water path and surface precipitation for LR scenario with $N_{\mathrm{SD}}^{(\mathrm{bin})} = \{10, 50, 100, 1000, 10000, 40000, 100000\}$.

S2.1.2 Without coalescence

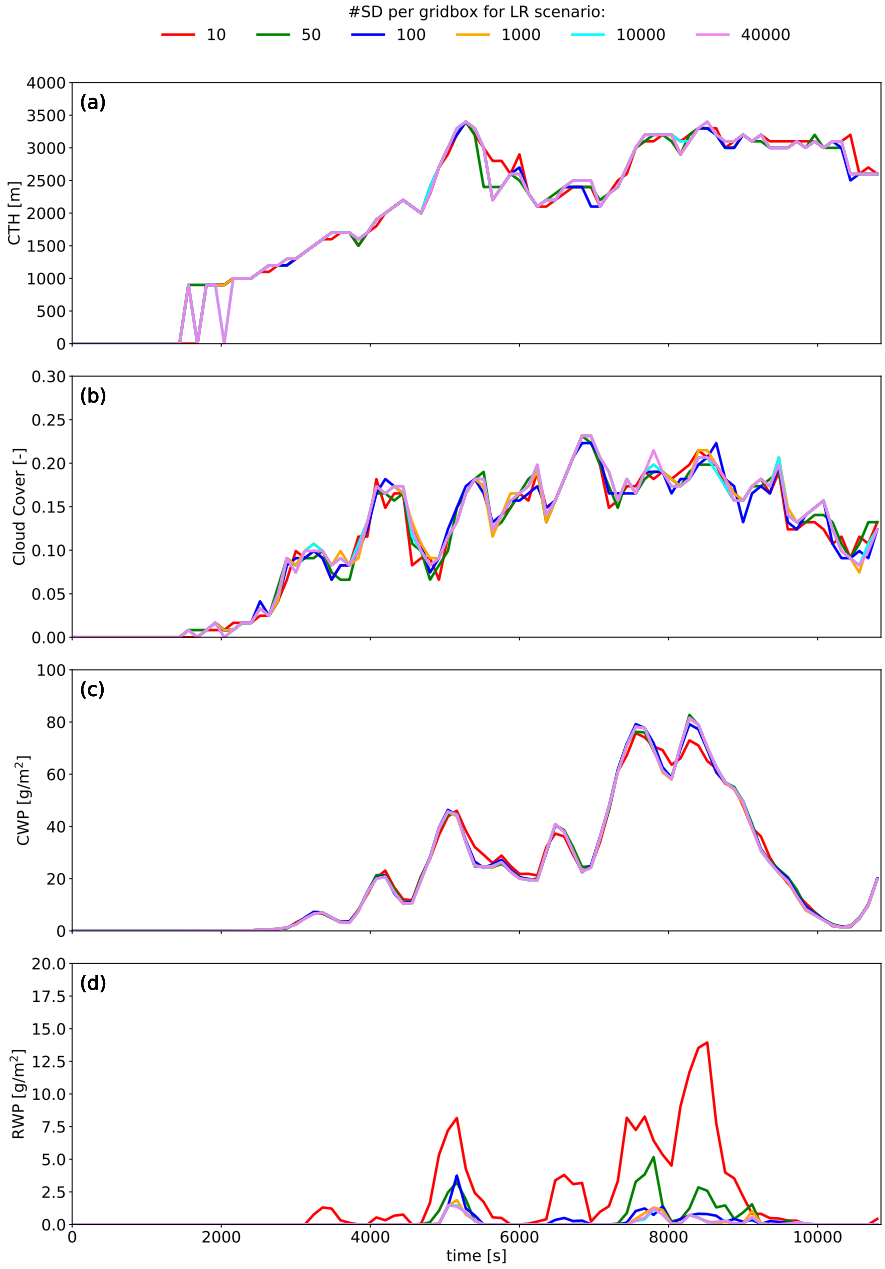

Fig. S2. Time series of ensemble of cloud top height, cloud cover, cloud water path and rain water path for LR scenario with $N_{\mathrm{SD}}^{(\mathrm{bin})} = \{10, 50, 100, 1000, 10000, 40000\}$ for the coalescence solver turned off.

S2.2 Scenario: MR

S2.2.1 With coalescence

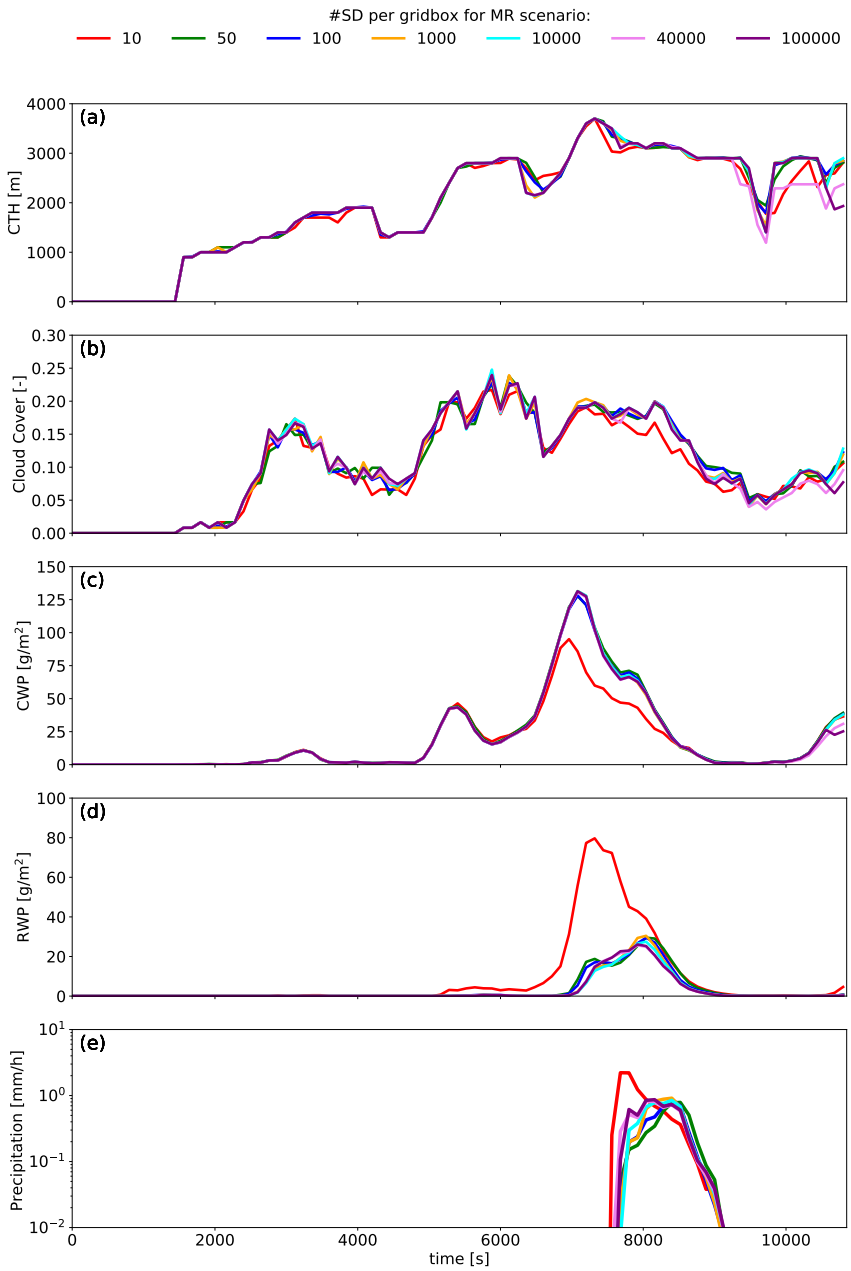

Fig. S3. Time series of ensemble averages of cloud top height, cloud cover, cloud water path, rain water path and surface precipitation for MR scenario with $N_{\mathrm{SD}}^{(\mathrm{bin})} = \{10, 50, 100, 1000, 10000, 40000, 100000\}$.

S2.2.2 Without coalescence

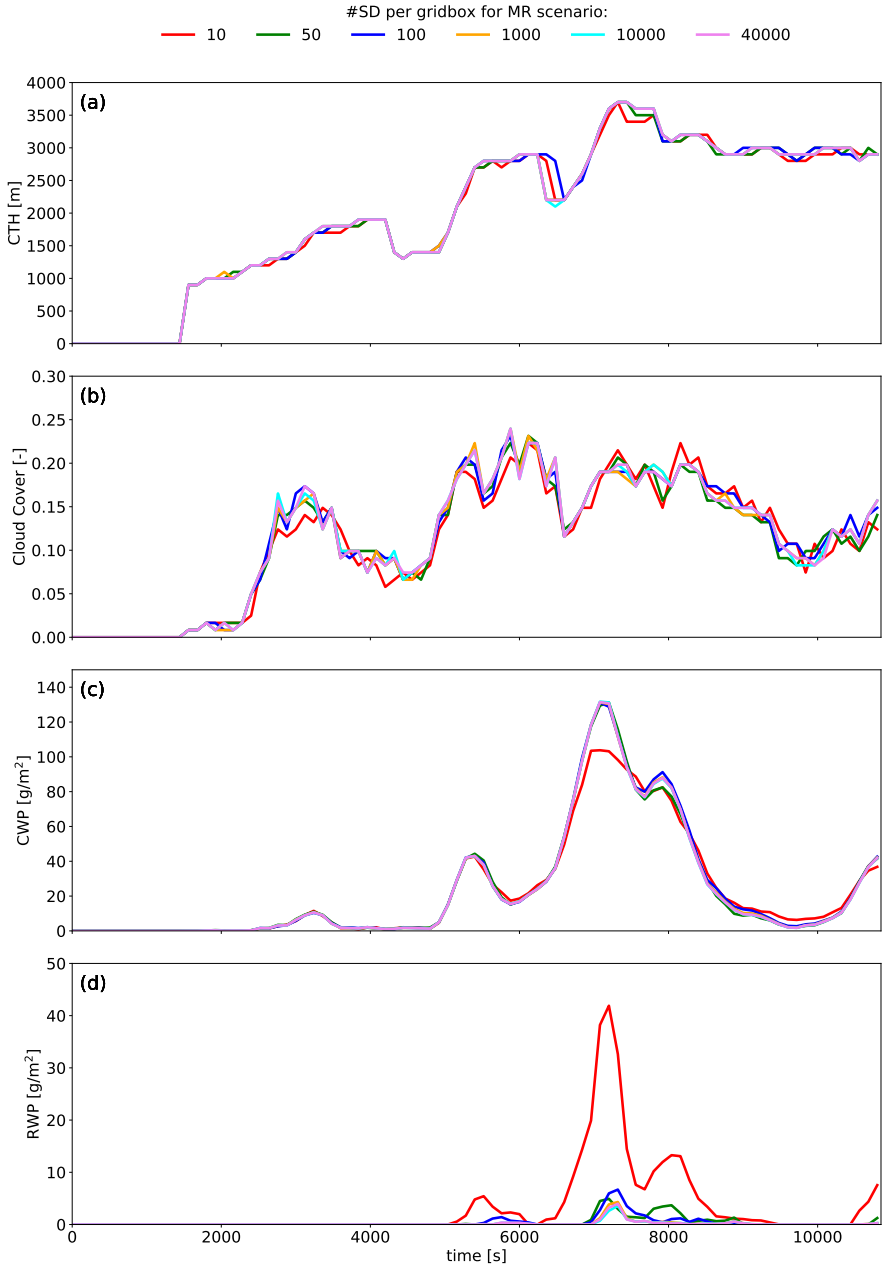

Fig. S4. Time series of ensemble of cloud top height, cloud cover, cloud water path and rain water path for MR scenario with $N_{\mathrm{SD}}^{(\mathrm{bin})} = \{10, 50, 100, 1000, 10000, 40000\}$ for the coalescence solver turned off.

S2.3 Scenario: HR

S2.3.1 With coalescence

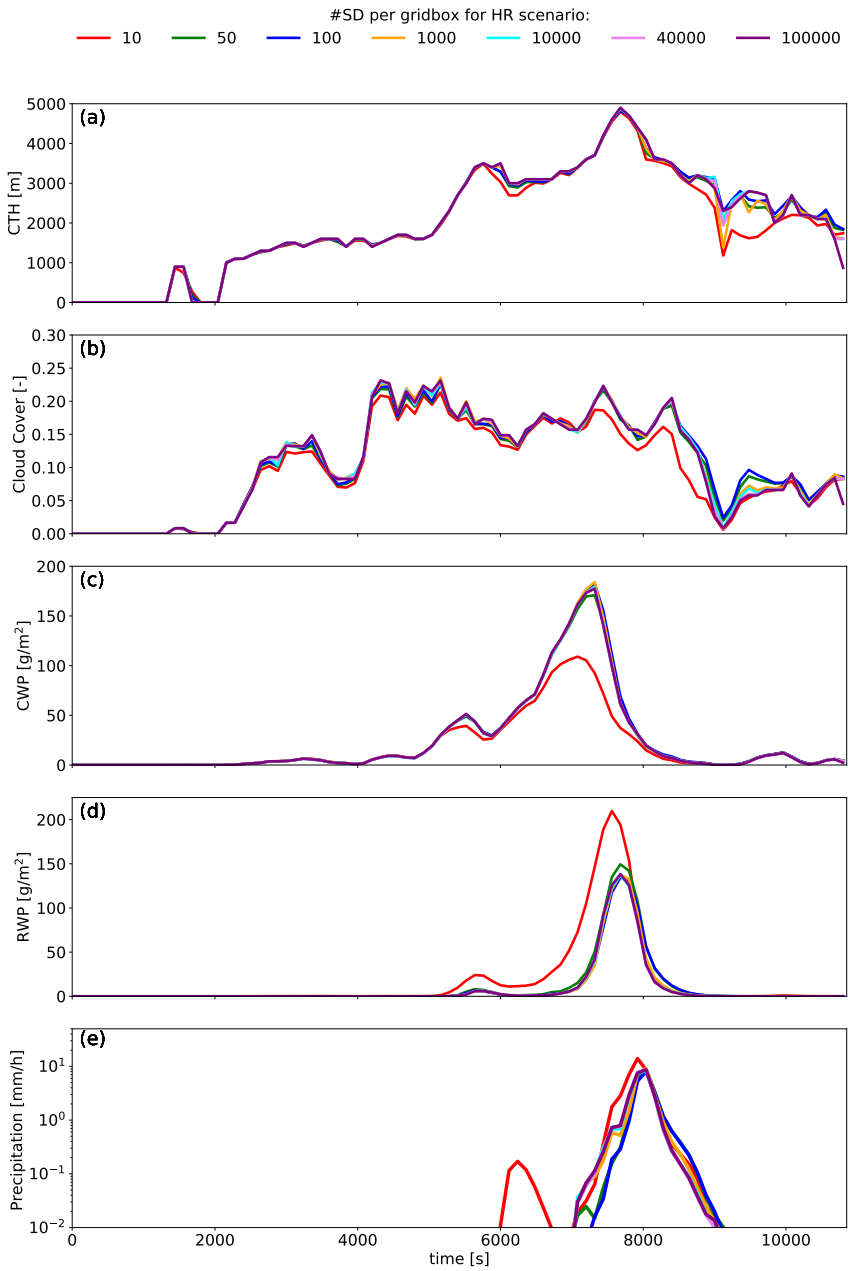

Fig. S5. Time series of ensemble averages of cloud top height, cloud cover, cloud water path, rain water path and surface precipitation for HR scenario with $N_{\mathrm{SD}}^{(\mathrm{bin})} = \{10, 50, 100, 1000, 10000, 40000, 100000\}$.

S2.3.2 Without coalescence

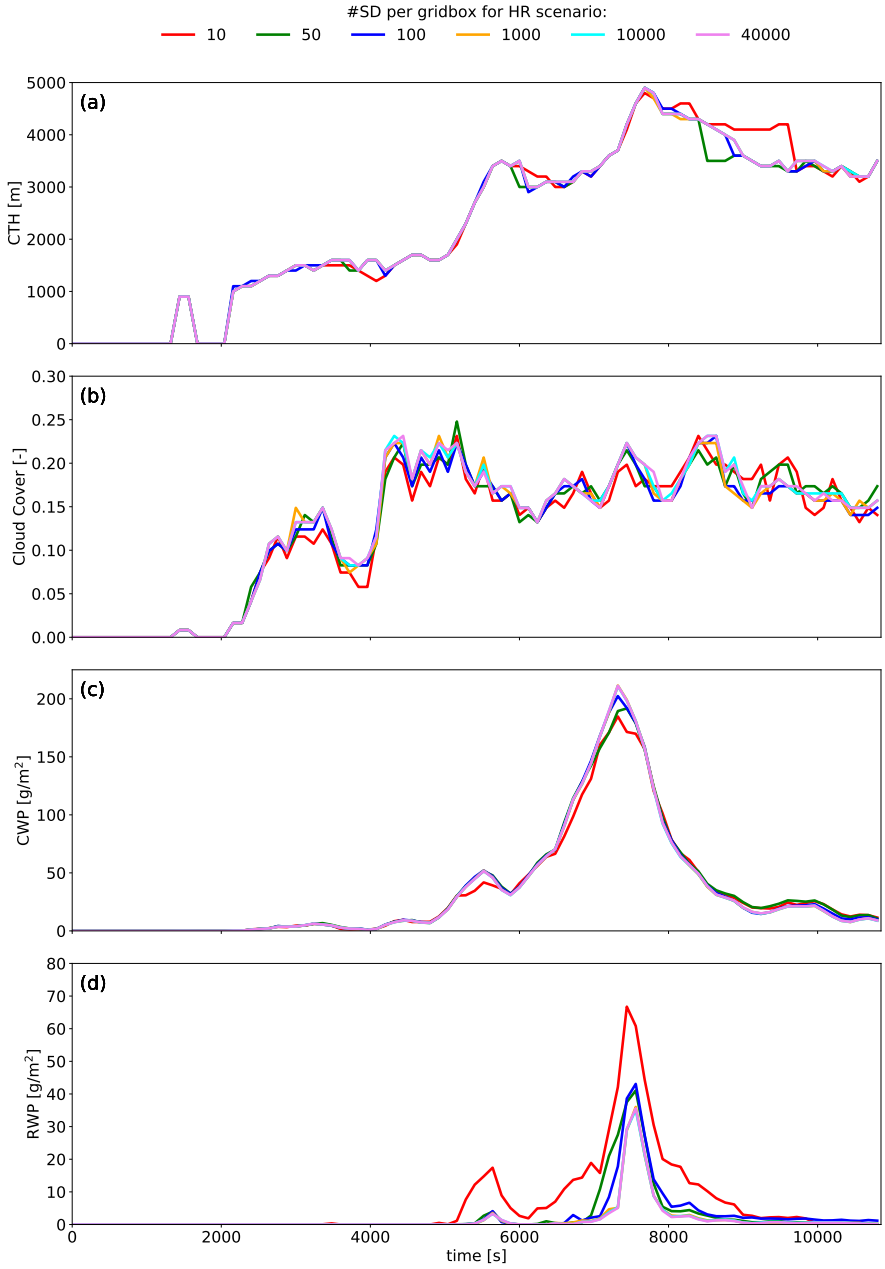

Fig. S6. Time series of ensemble of cloud top height, cloud cover, cloud water path and rain water path for HR scenario with $N_{\mathrm{SD}}^{(\mathrm{bin})} = \{10, 50, 100, 1000, 10000, 40000\}$ for the coalescence solver turned off.

S2.4 Scenario: D

S2.4.1 With coalescence

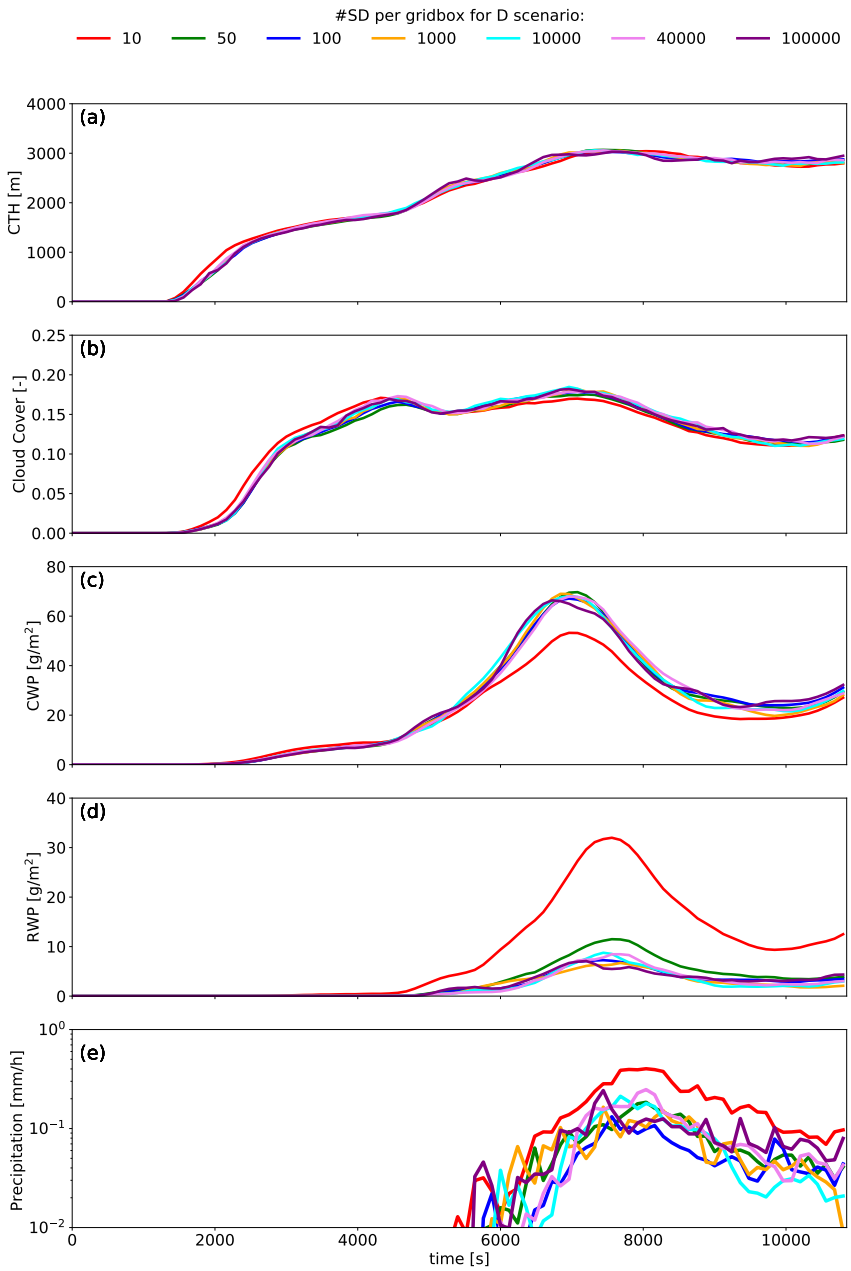

Fig. S7. Time series of ensemble averages of cloud top height, cloud cover, cloud water path, rain water path and surface precipitation for D scenario with $N_{\mathrm{SD}}^{(\mathrm{bin})} = \{10, 50, 100, 1000, 10000, 40000, 100000\}$.

S2.4.2 Without coalescence

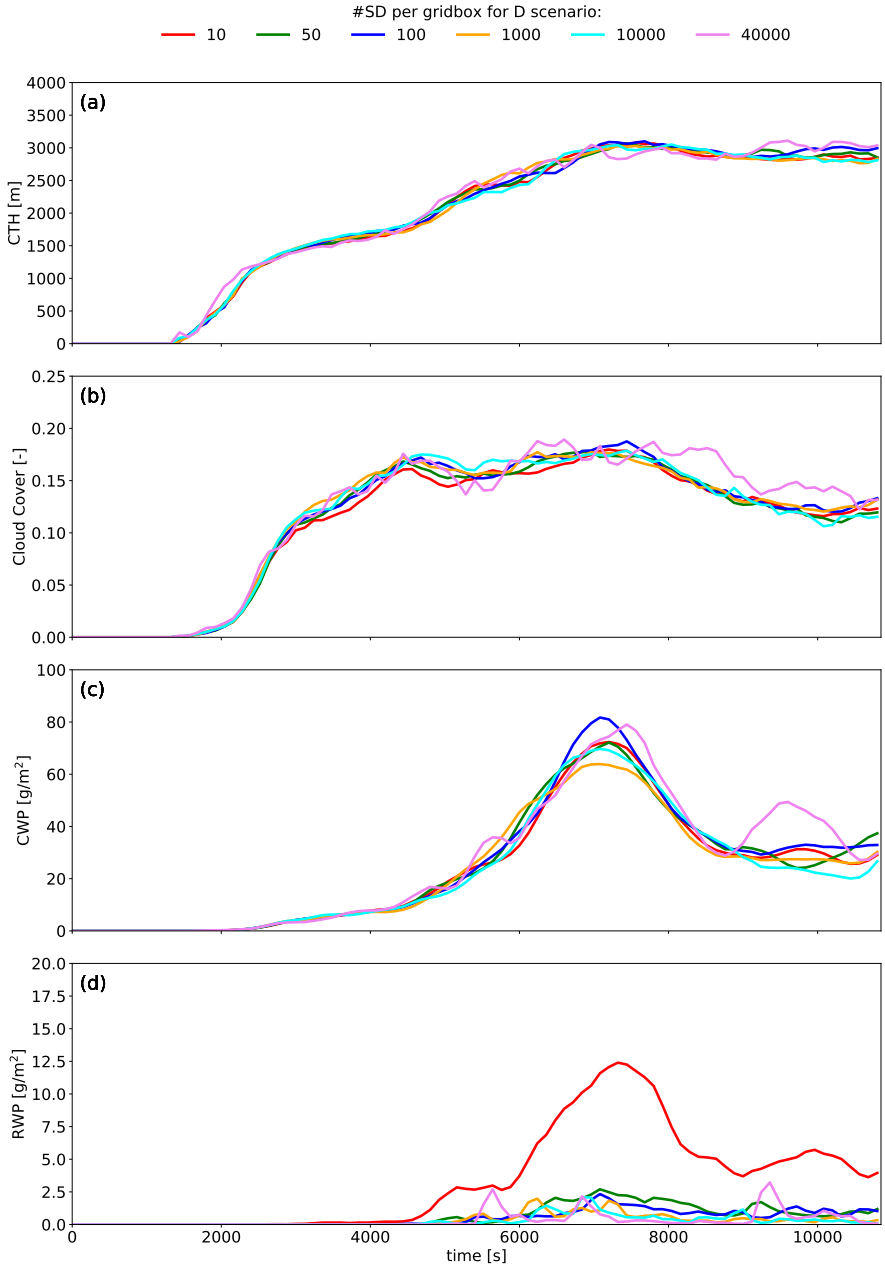

Fig. S8. Time series of ensemble of averages cloud top height, cloud cover, cloud water path and rain water path for D scenario with $N_{\mathrm{SD}}^{(\mathrm{bin})} = \{10, 50, 100, 1000, 10000, 40000\}$ for the coalescence solver turned off.