



# **ICMW2020 cumulus congestus: UWLCM results**

Piotr Dziekan, Piotr Żmijewski

# University of Warsaw Lagrangian Cloud Model

- Anelastic LES
- MPDATA for Eulerian advection
- Lagrangian microphysics (super-droplets)
- Explicitly modeled activation
- Eulerian SGS diffusion: Smagorinsky or ILES
- Lagrangian SGS diffusion: none or GA17  
(Grabowski & Abade *JAS* 2017)
- Details: Dziekan et al. *GMD* 2019

# Simulation setup

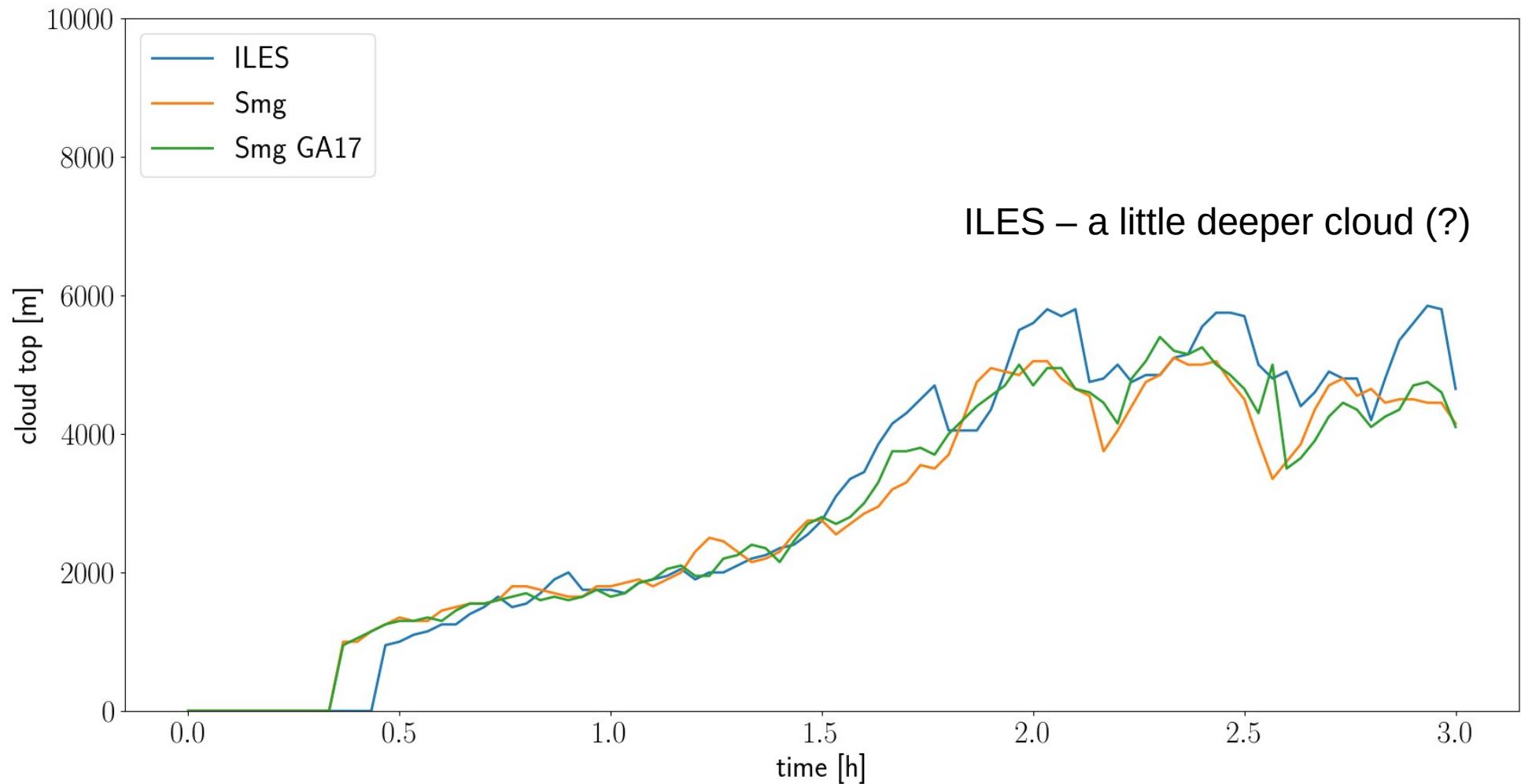
- 3D 10km x 10km x 10km
- Absorber above 9km
- 3h simulated time
- Single runs (no ensemble averaging)
- Time steps:
  - Main 0.5s
  - Condensation 0.1s
  - Coalescence 0.1s
- 2D – high variability between runs, results not shown

# List of simulations

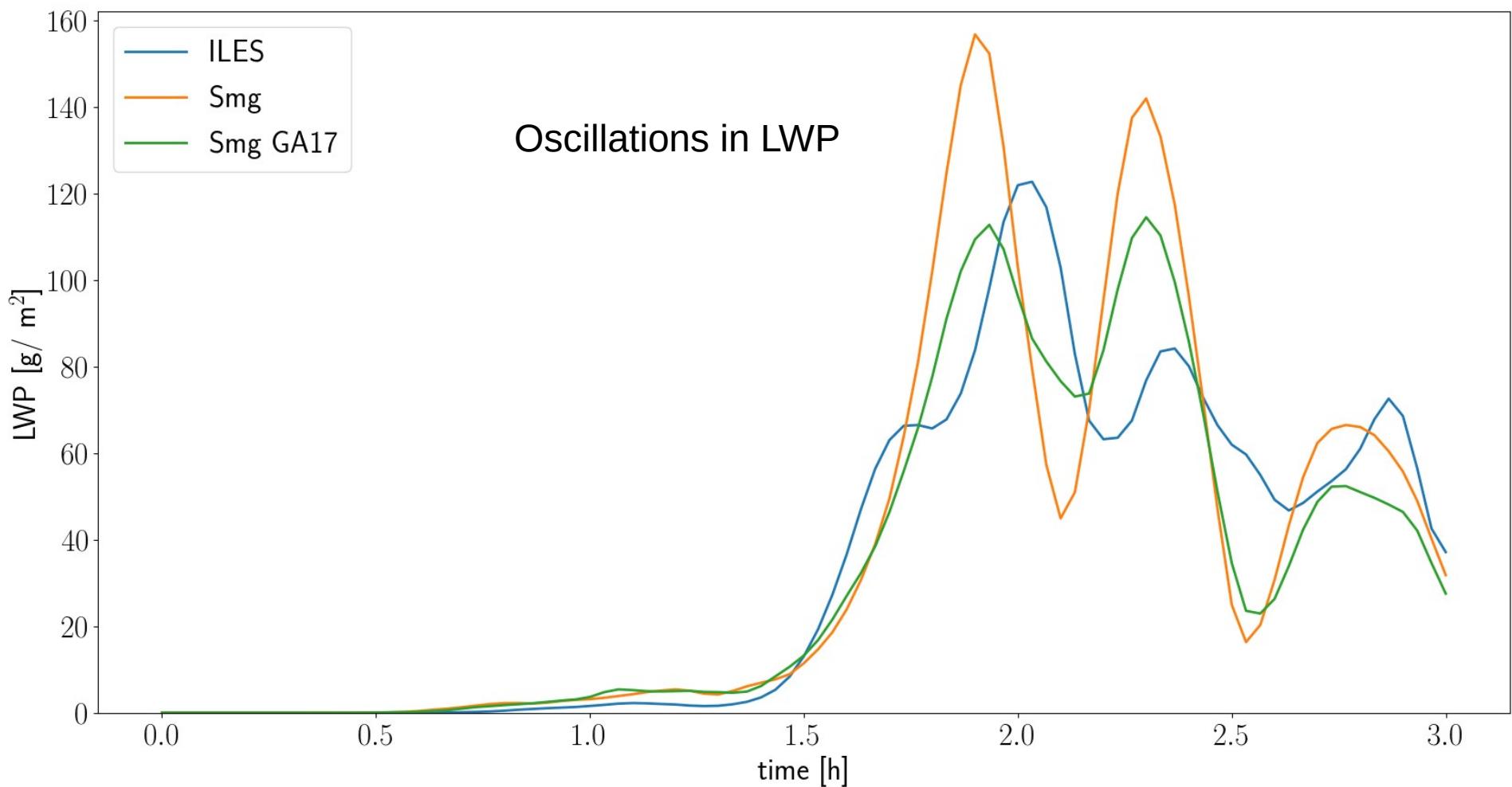
dx=dy=dz	Eulerian SGS	Lagrangian SGS	N <sub>a</sub>	#SD	coalescence
SGS model tests:					
50 m	ILES	none	11xRICO	100	0
50 m	Smg	none	11xRICO	100	0
50 m	Smg	GA17	11xRICO	100	0
Resolution tests:					
100 m	Smg	GA17	11xRICO	100	0
#SD tests:					
100 m	Smg	GA17	11xRICO	500	0
Coalescence tests:					
50 m	Smg	GA17	11xRICO	100	1
50 m	Smg	GA17	4xRICO	100	1

# Results – time series

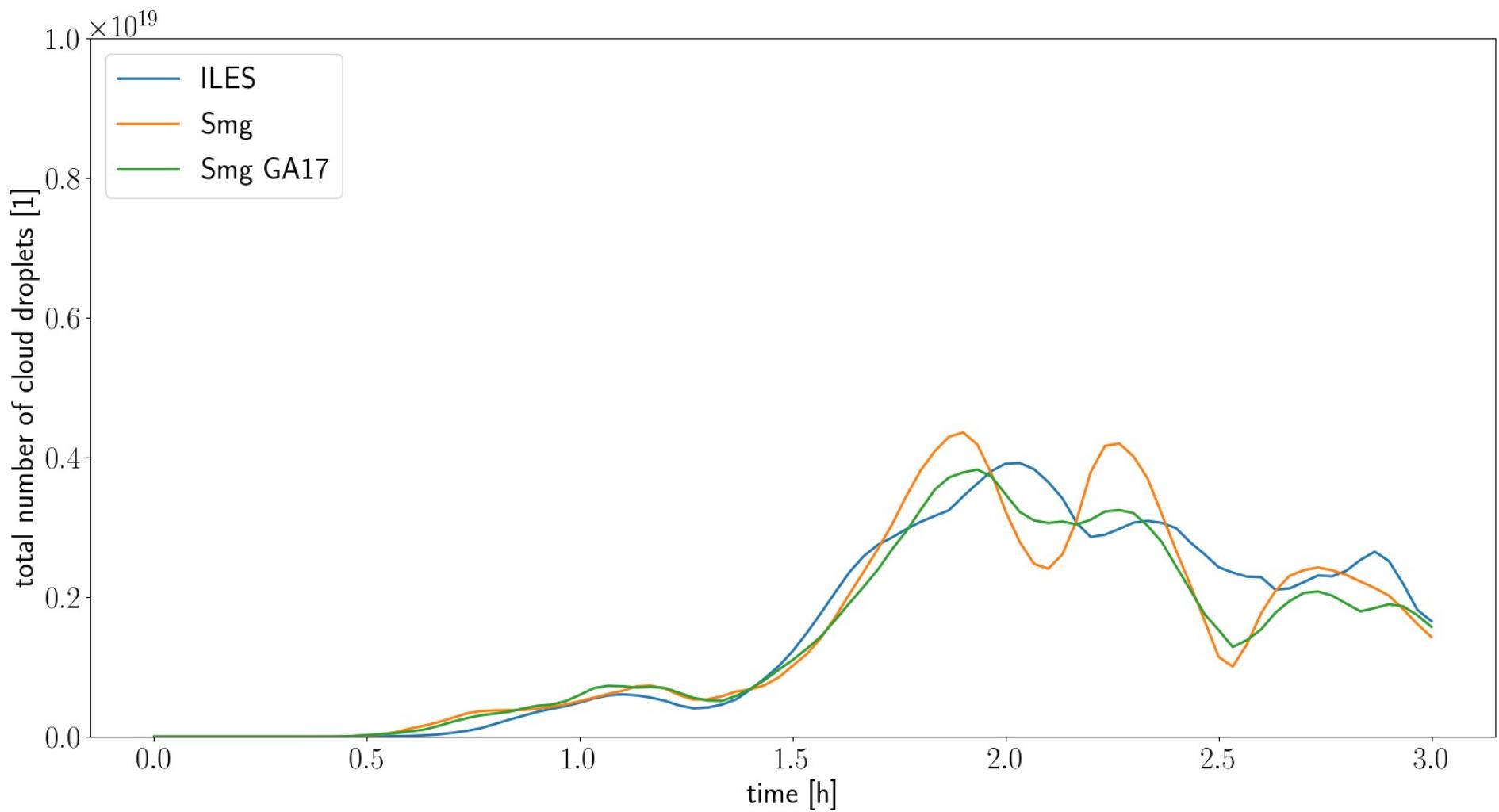
# SGS tests - cloud top



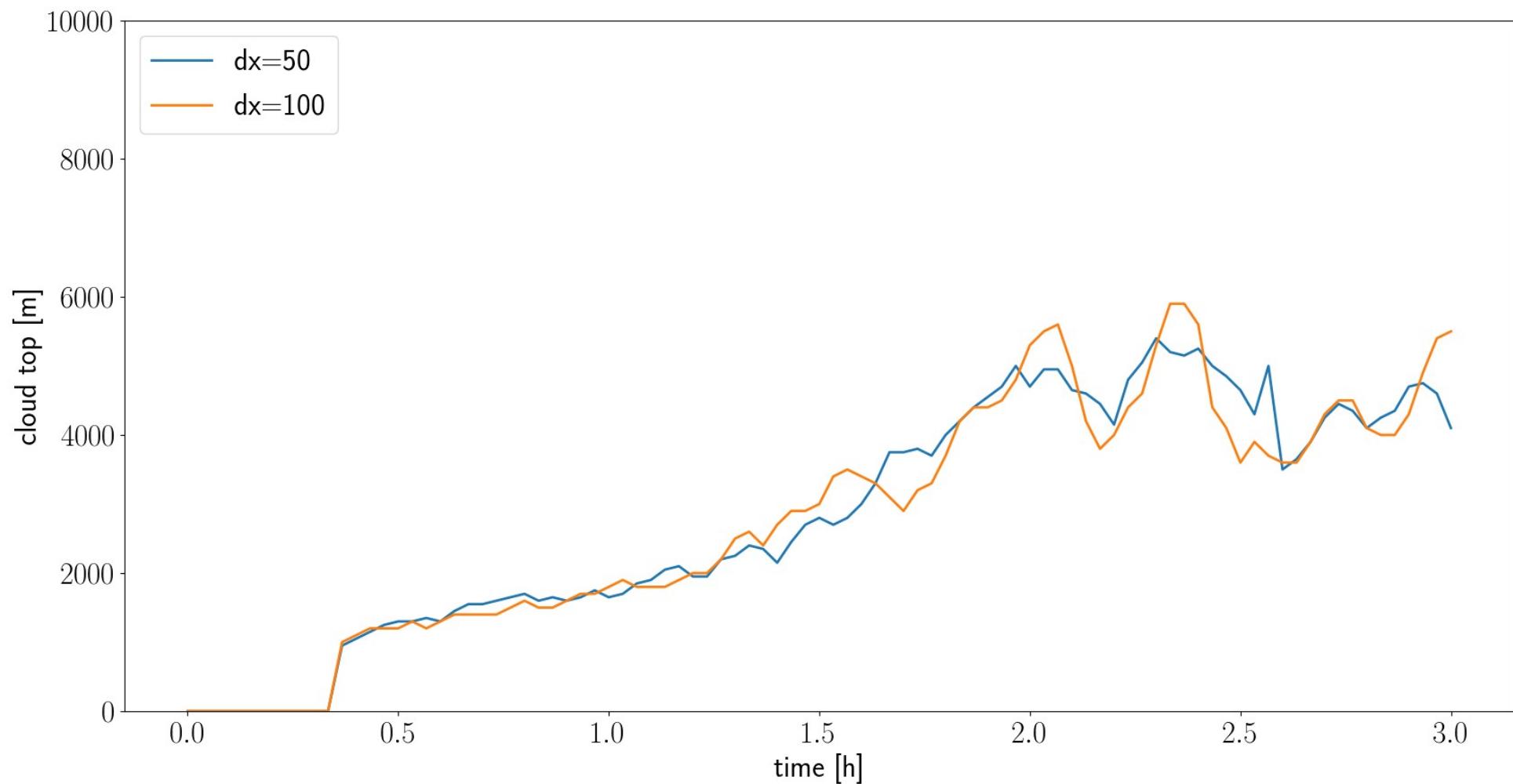
# SGS tests - LWP



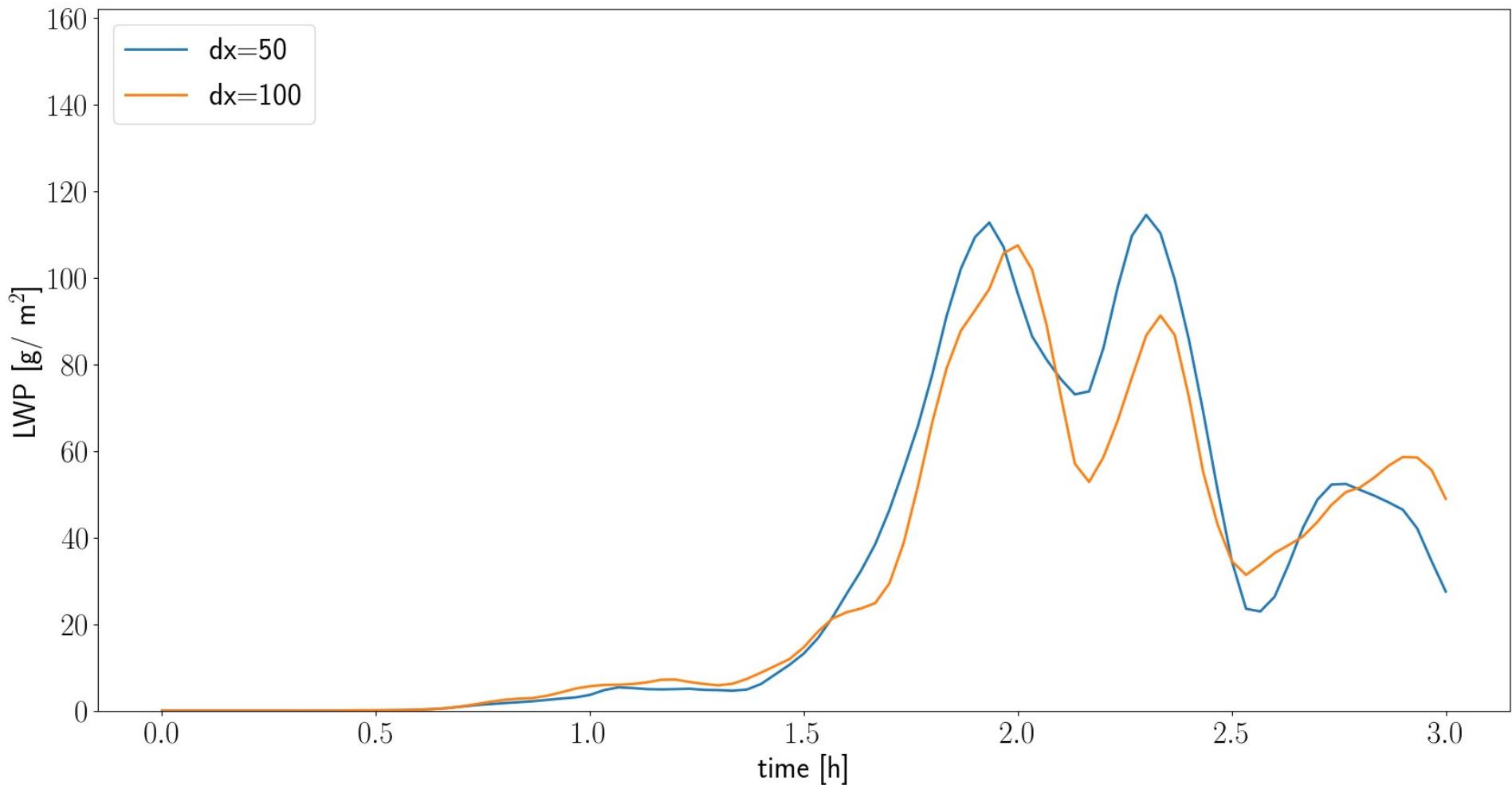
# SGS tests - #activated droplets



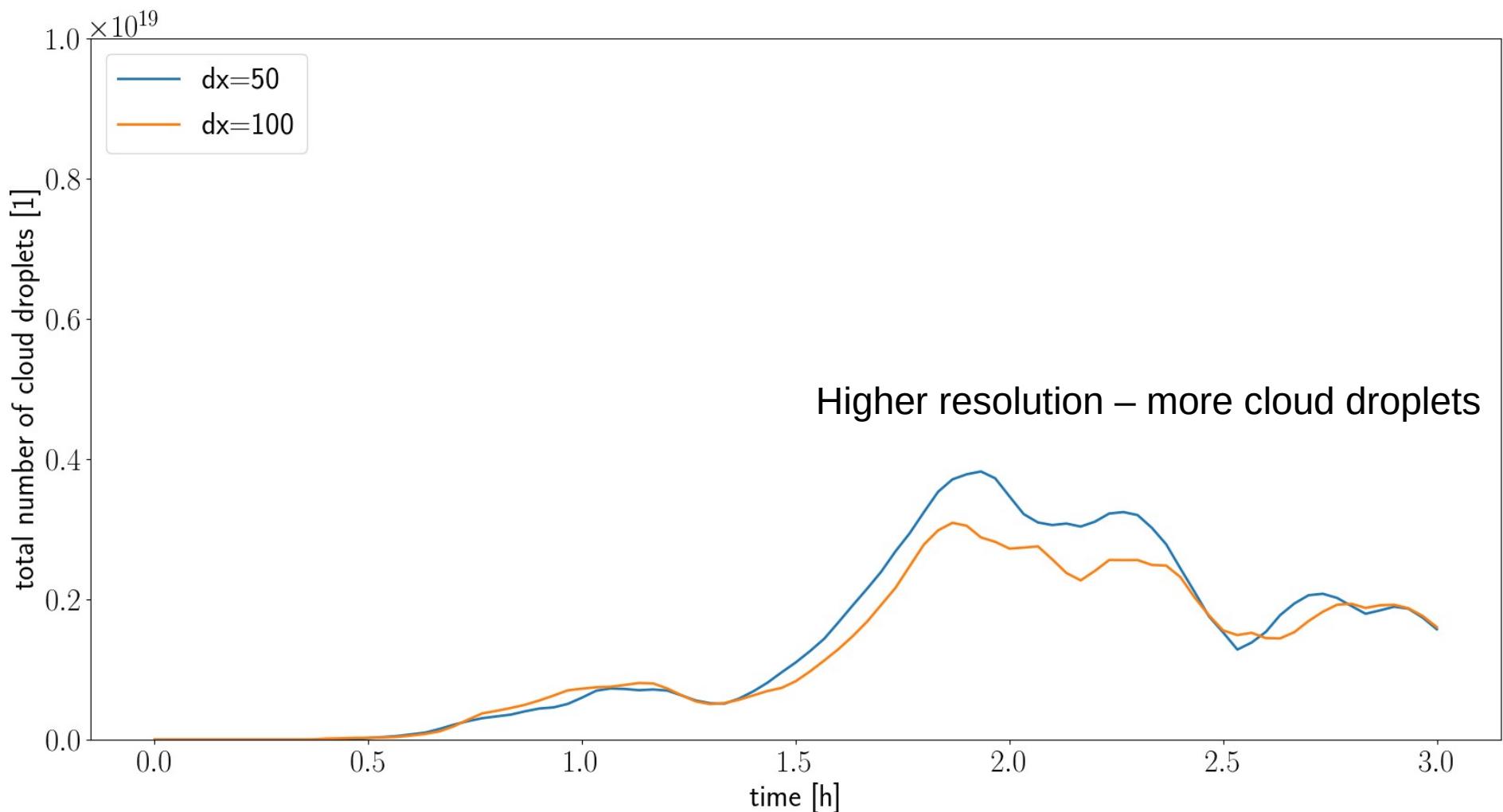
# Resolution tests - cloud top



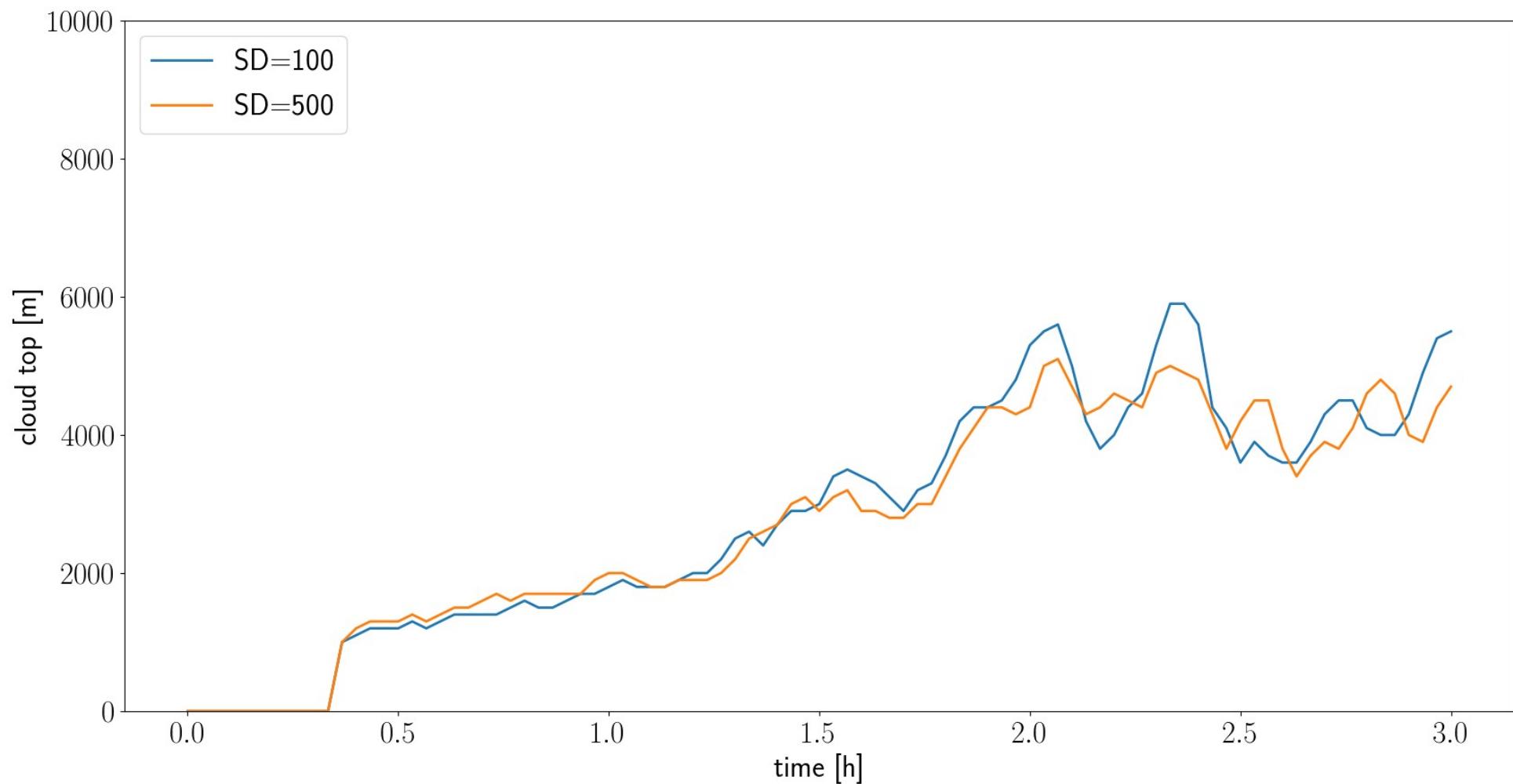
# Resolution tests - LWP



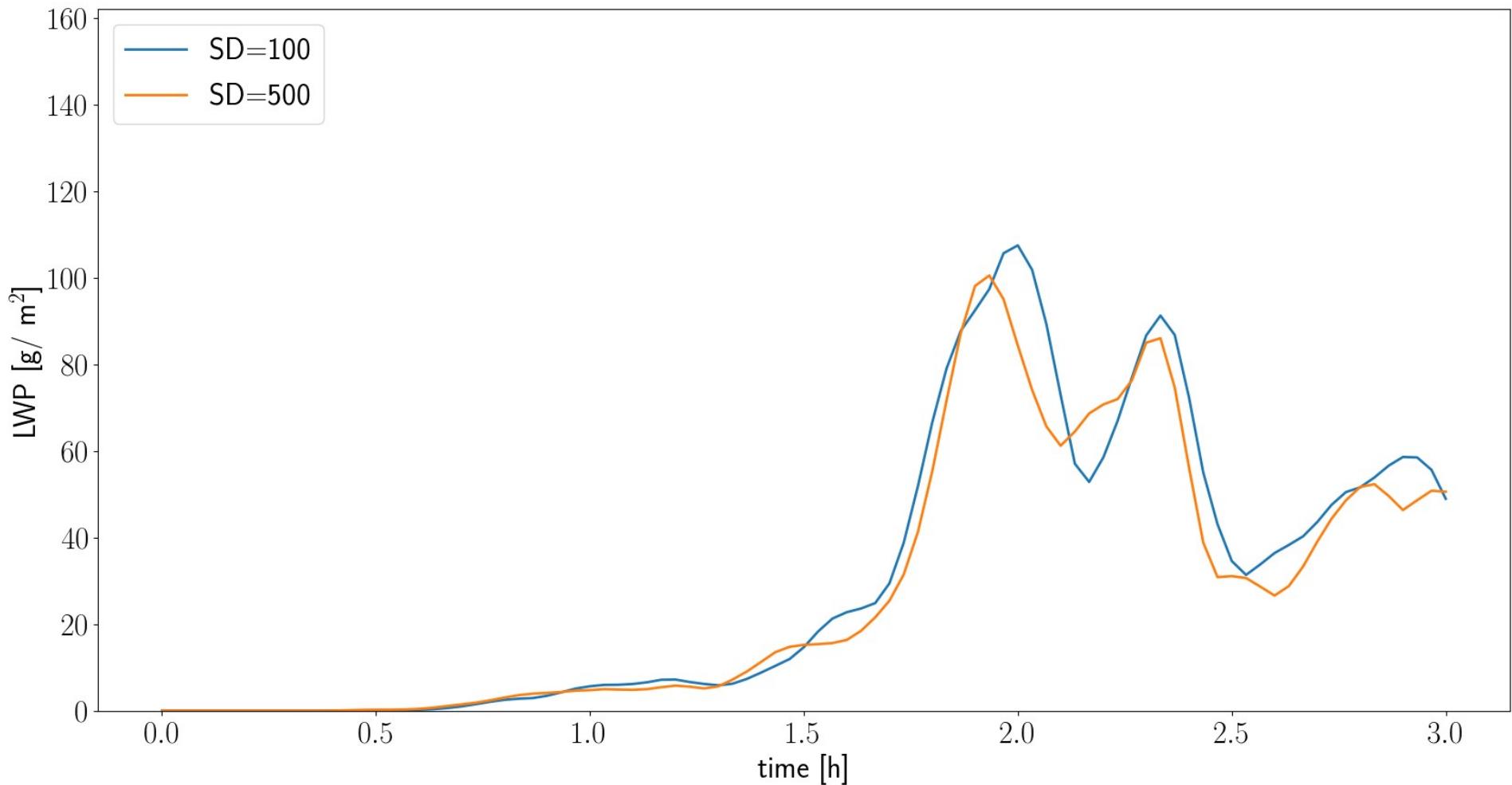
# Resolution tests - #activated droplets



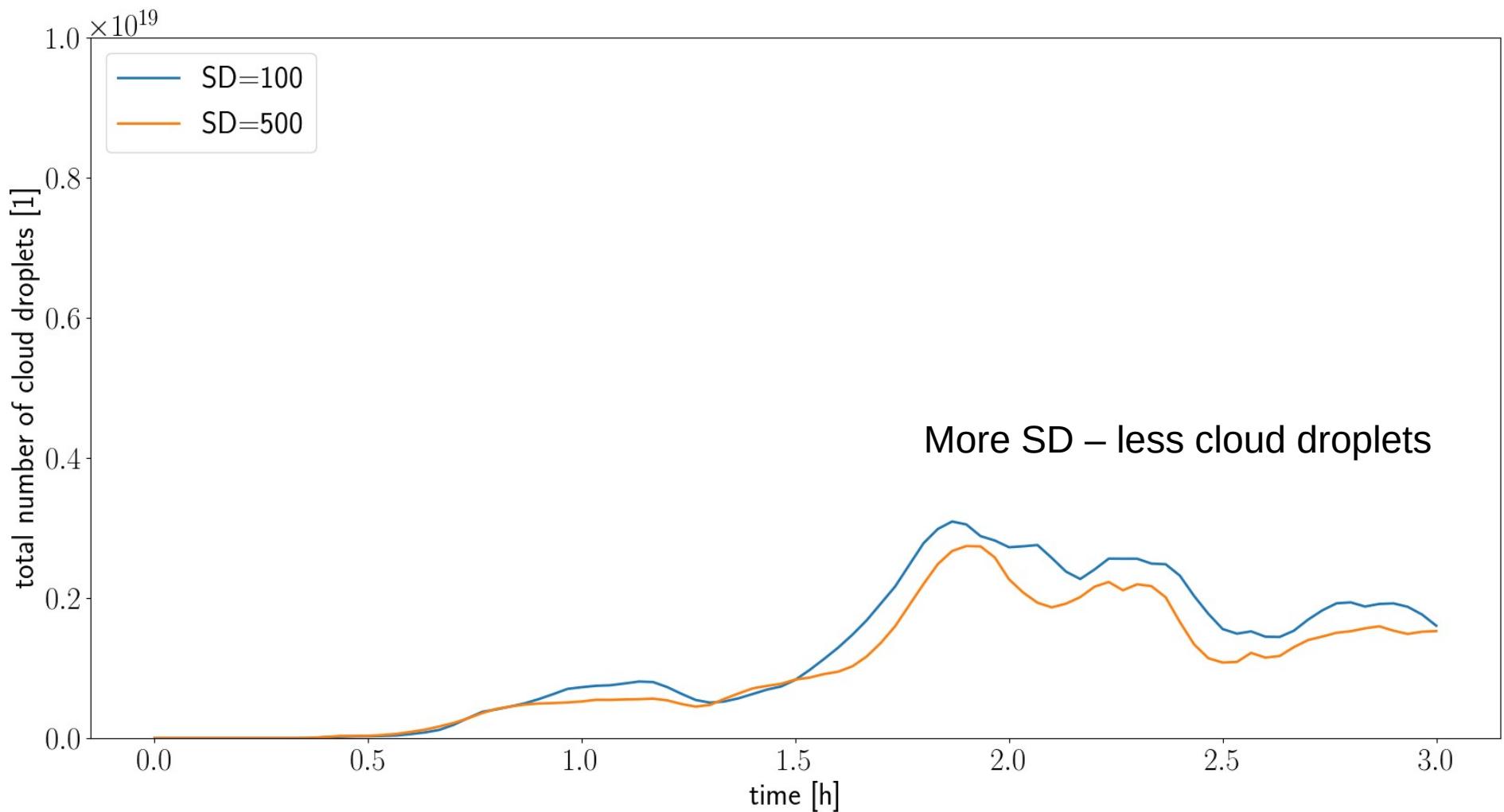
# #SD tests - cloud top



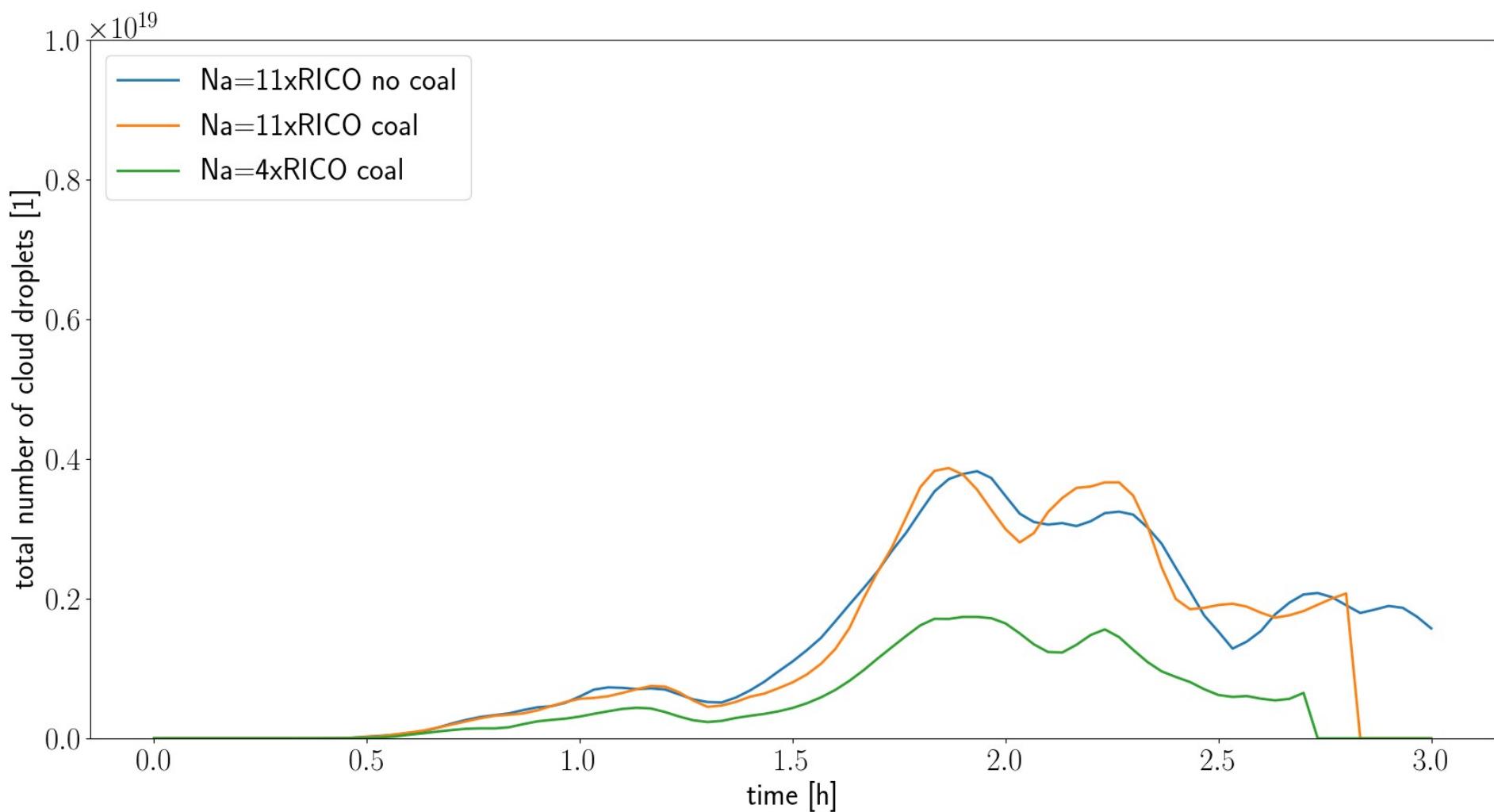
# #SD tests - LWP



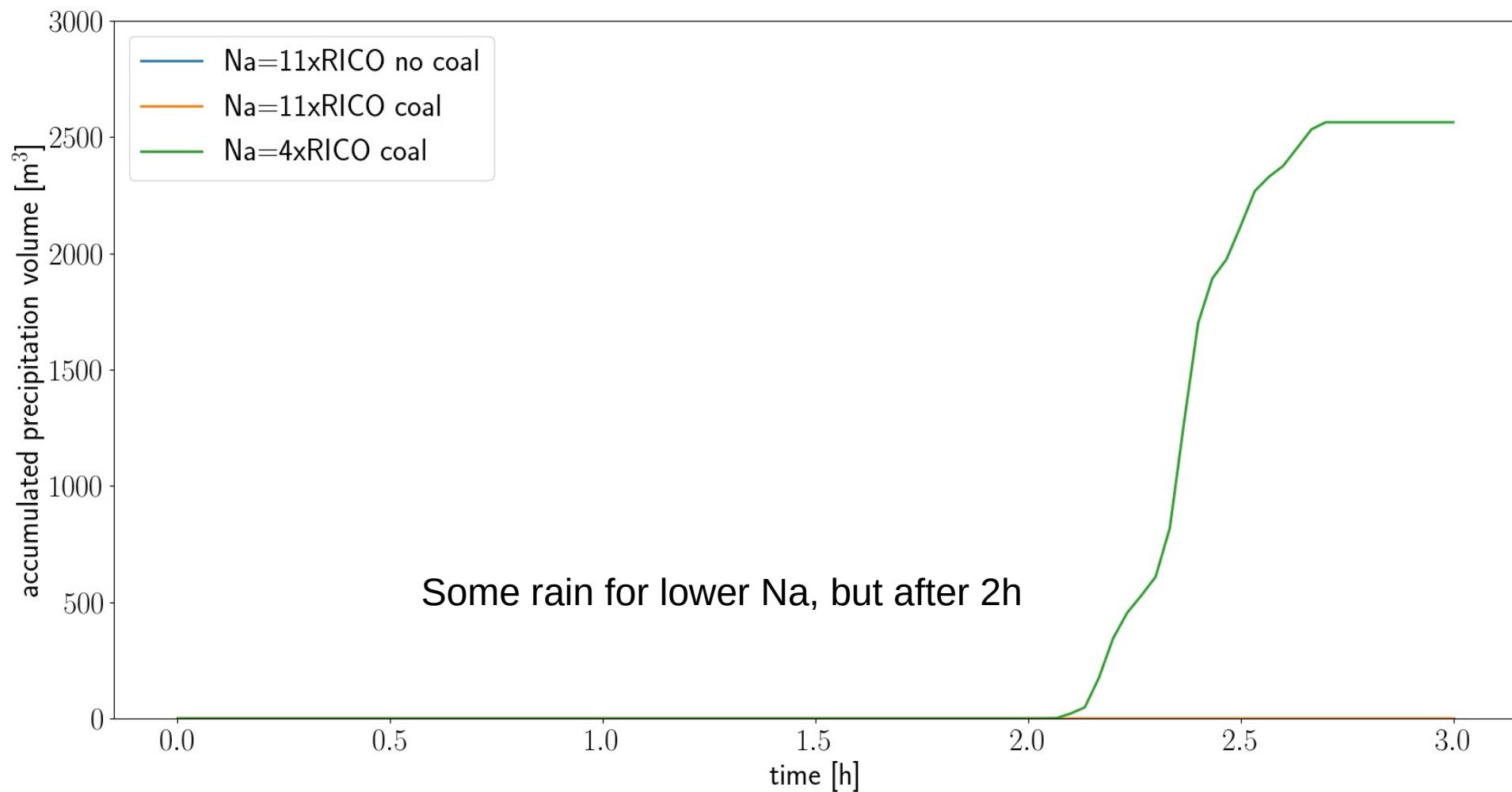
# #SD tests - #activated droplets



# Coalescence tests - #droplets

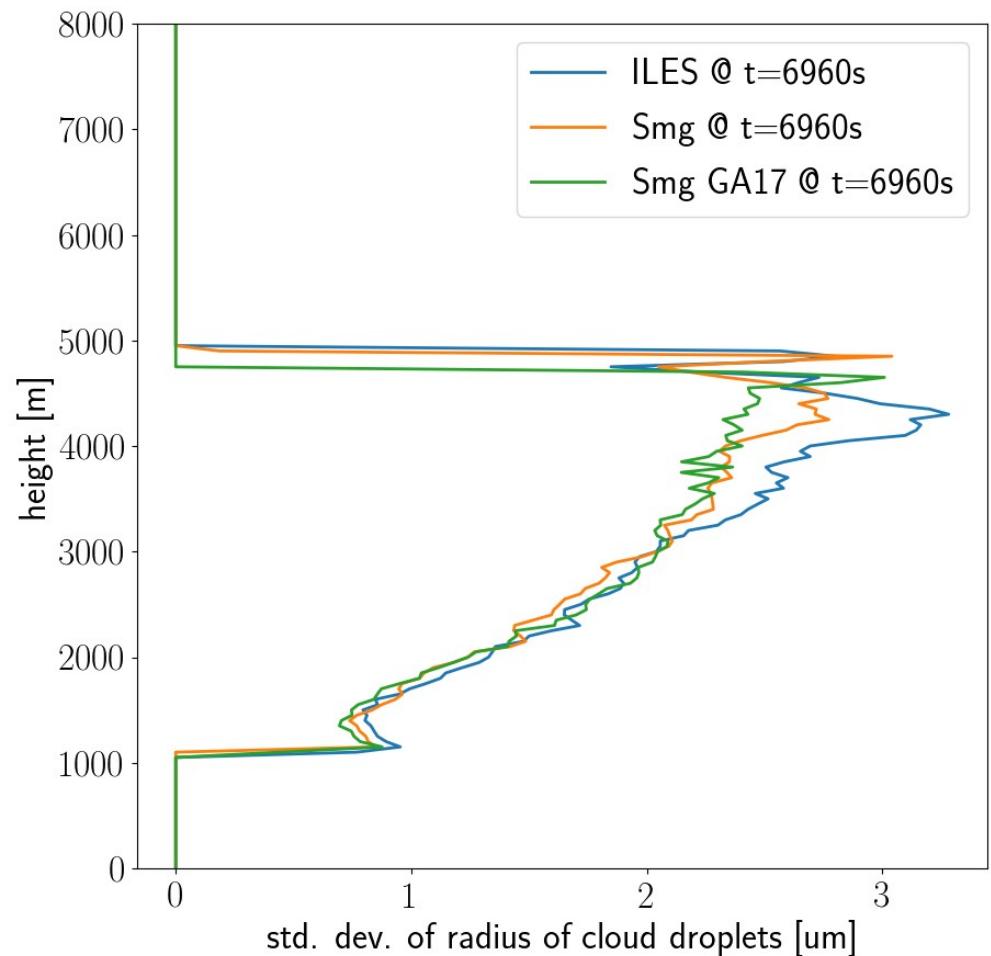
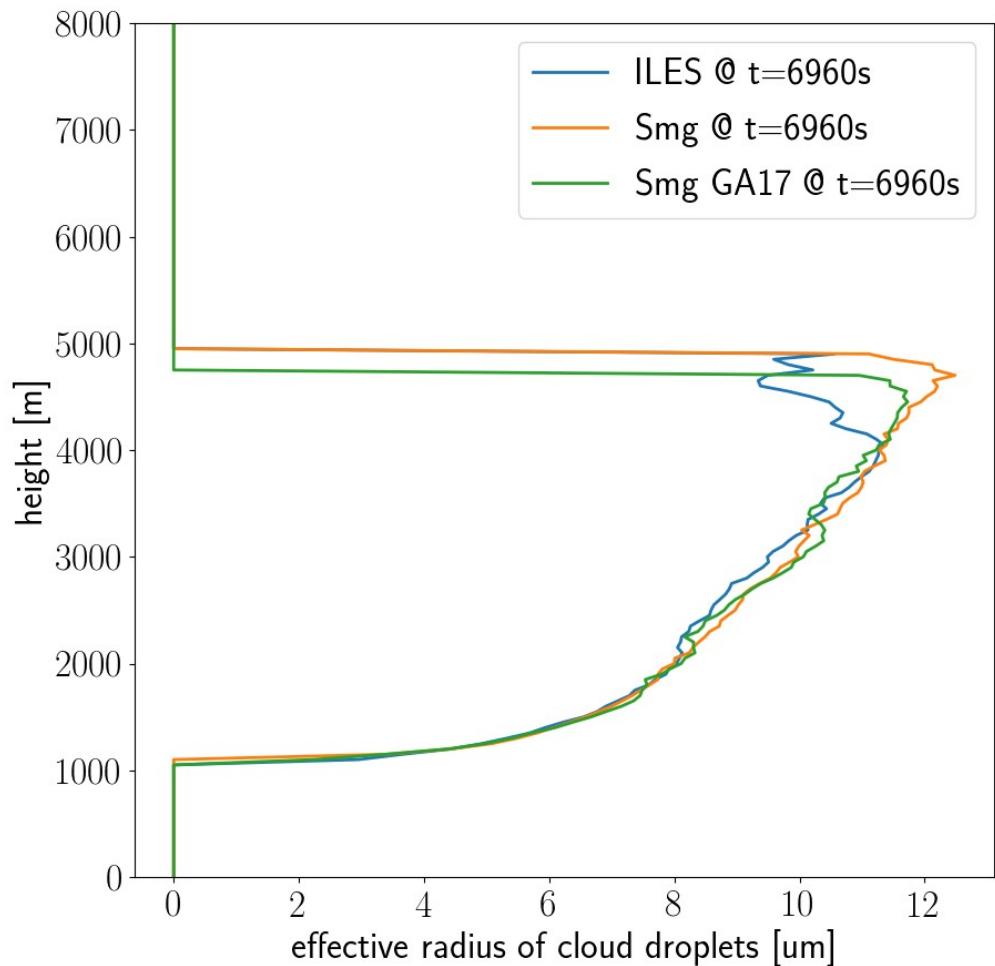


# Coalescence tests - precipitation

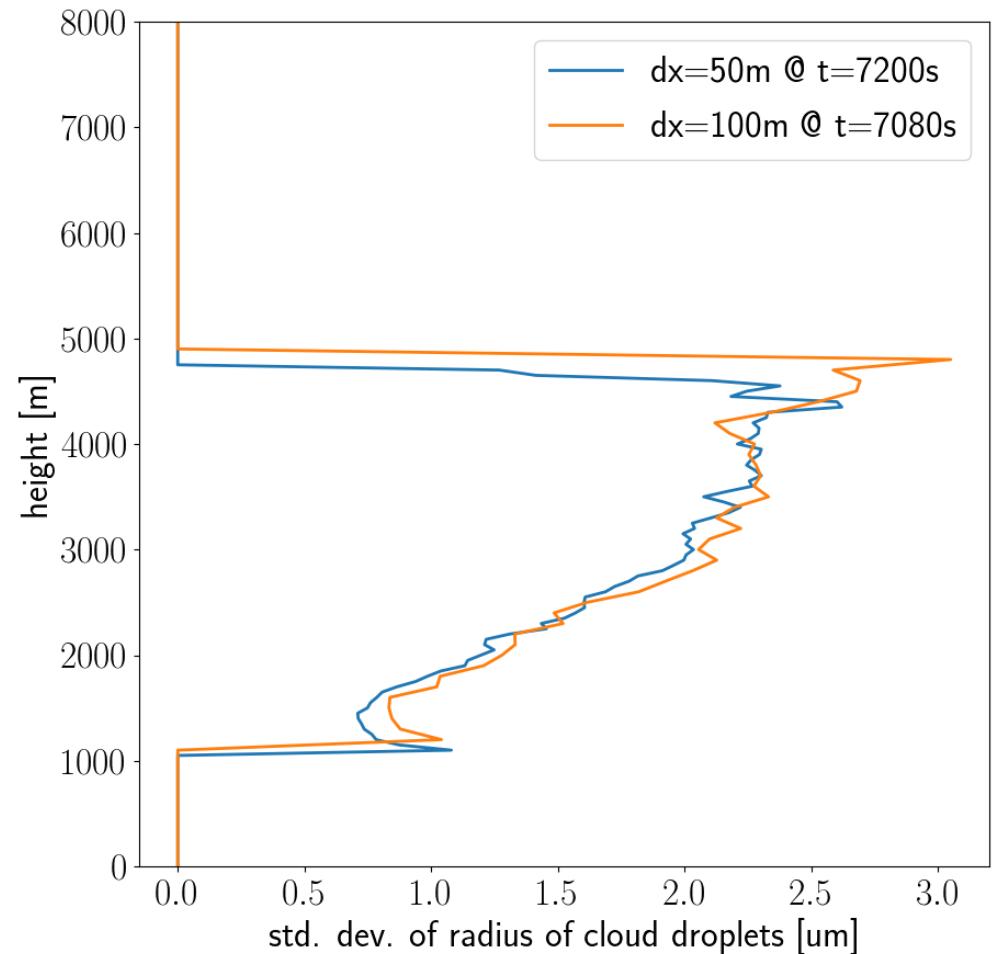
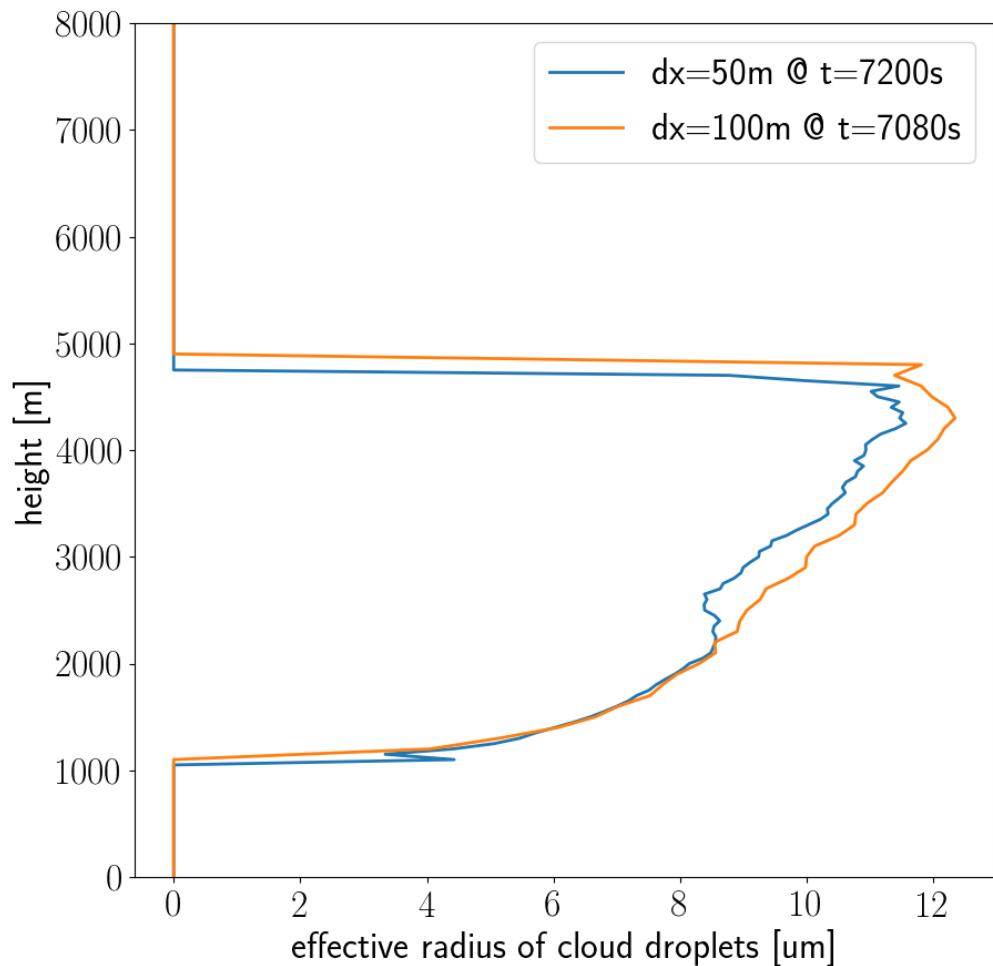


Results – profiles for similar LWC and cloud top  
near the first peak of LWC  
(averaged over cloudy cells)

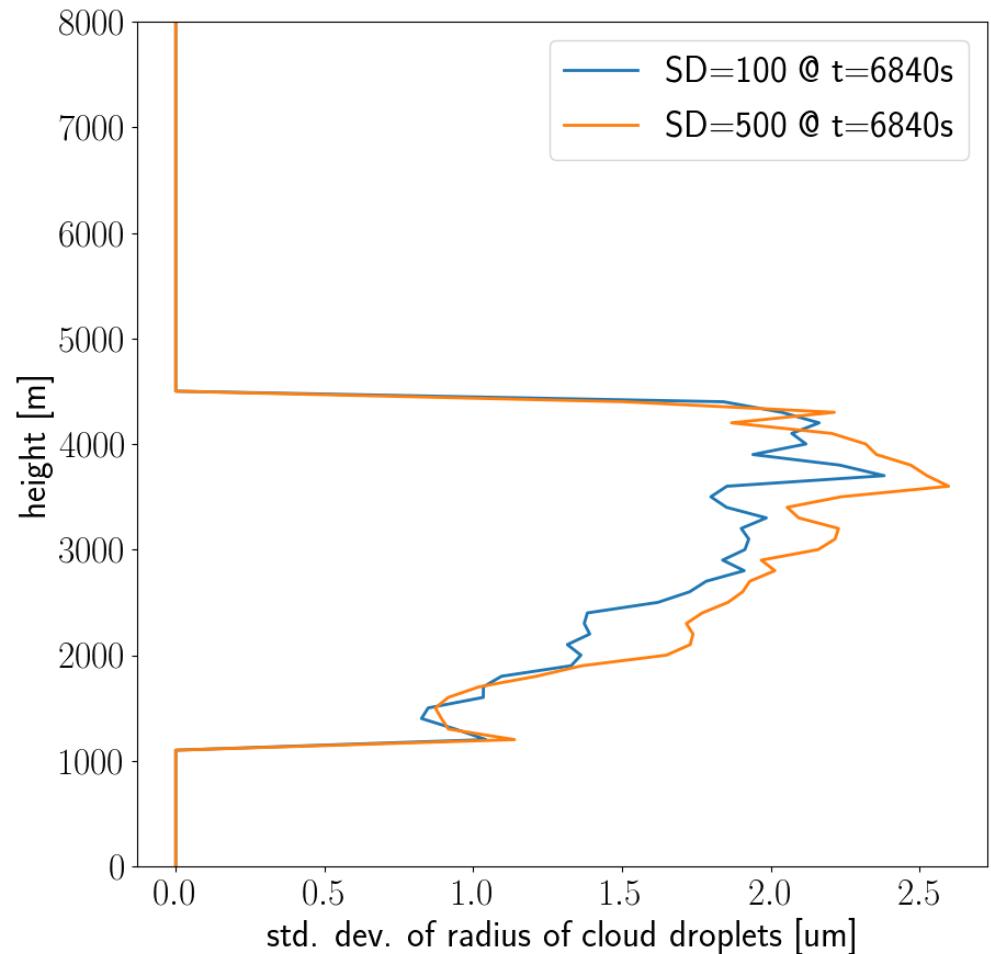
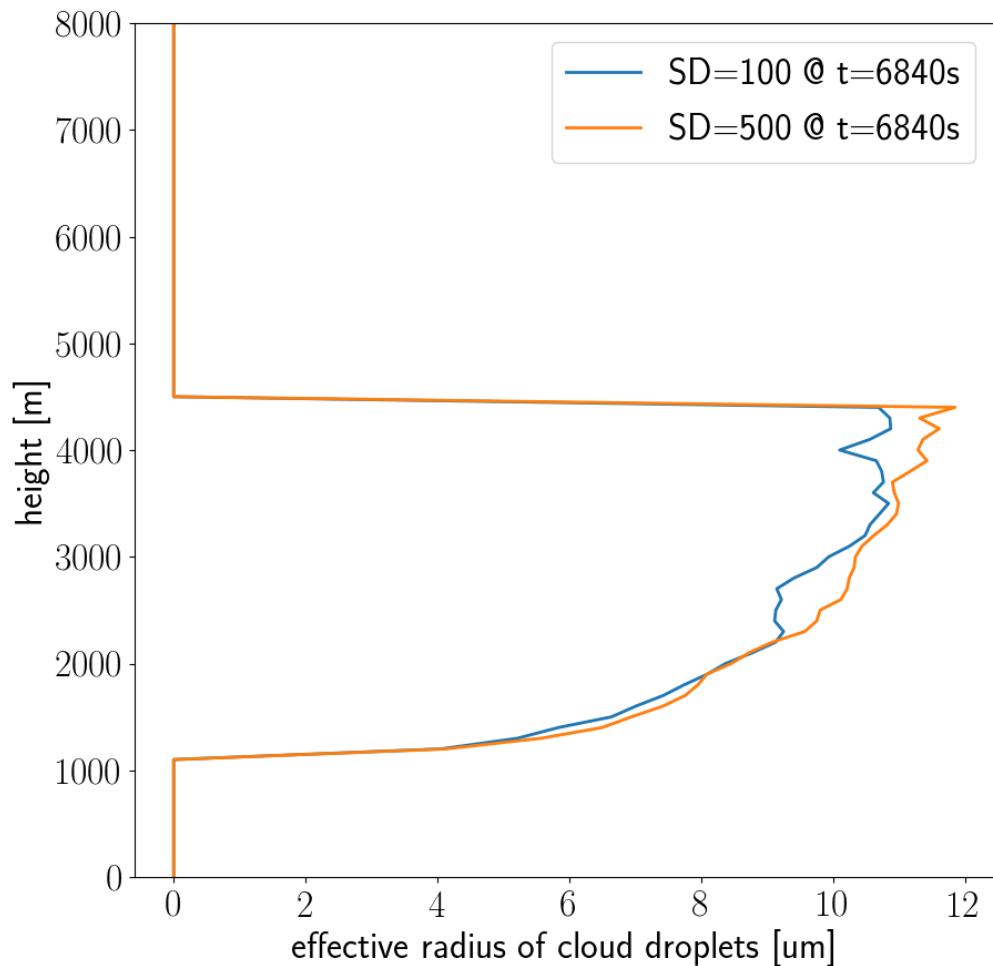
# SGS tests



# Resolution tests



# #SD tests



# Tentative conclusions

- ILES → a little deeper cloud
- Higher resolution → higher  $N_c$
- More super-droplets → lower  $N_c$

# Planned simulations

- Higher resolution, ca. 20m
- Small ensembles of simulations

# Suggestions for the comparison

- More specific definition of sensitivity tests:
  - CCN concentrations
  - Spatial resolution
- Everyone should run small ensembles, e.g. of 3 runs
- Unified output format
- DSD: when and where?
- Skip the 2D comparison