

Impacts of Aitken-mode aerosols in large-eddy simulations of boundary-layer clouds

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Aitken aerosol buffering

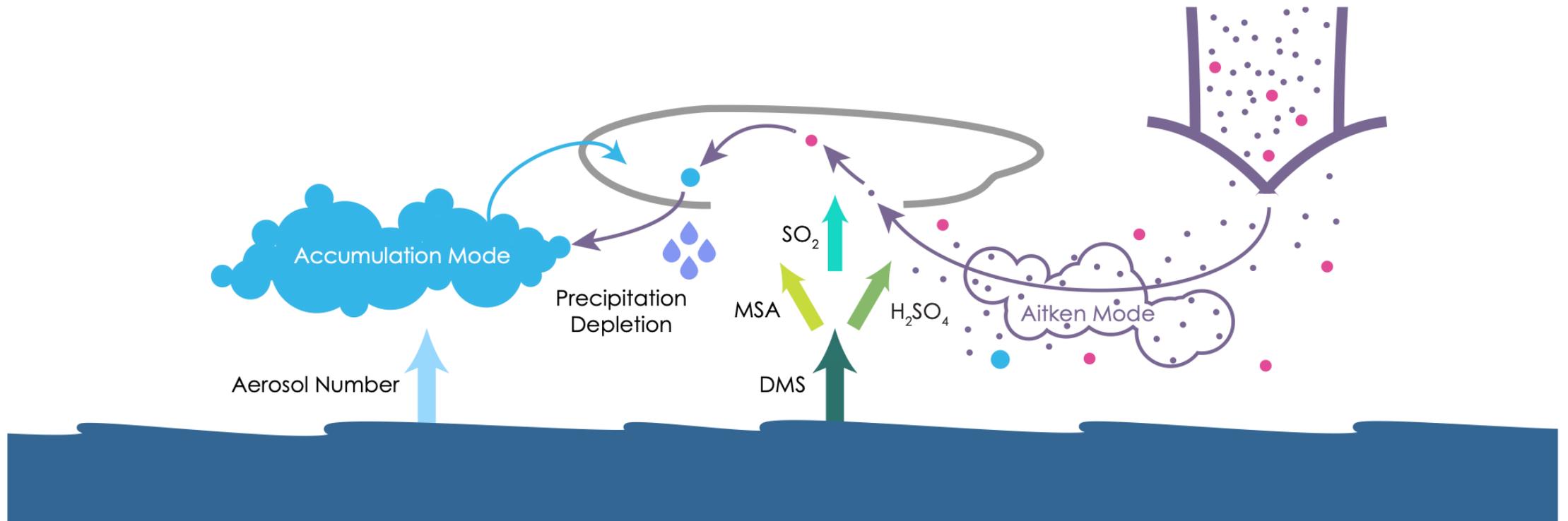


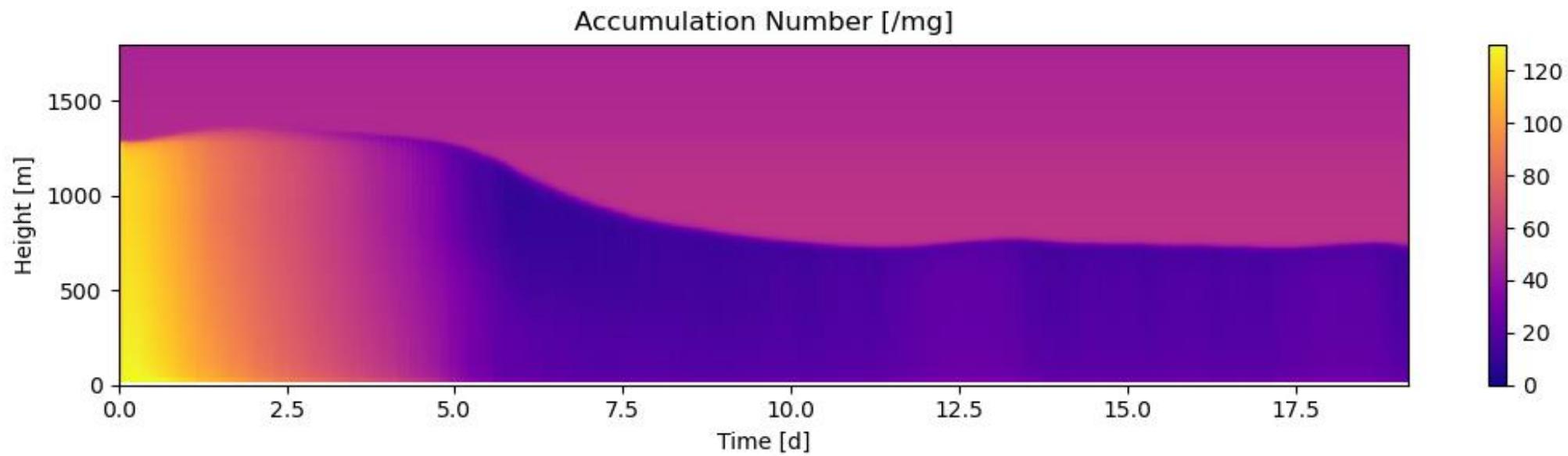
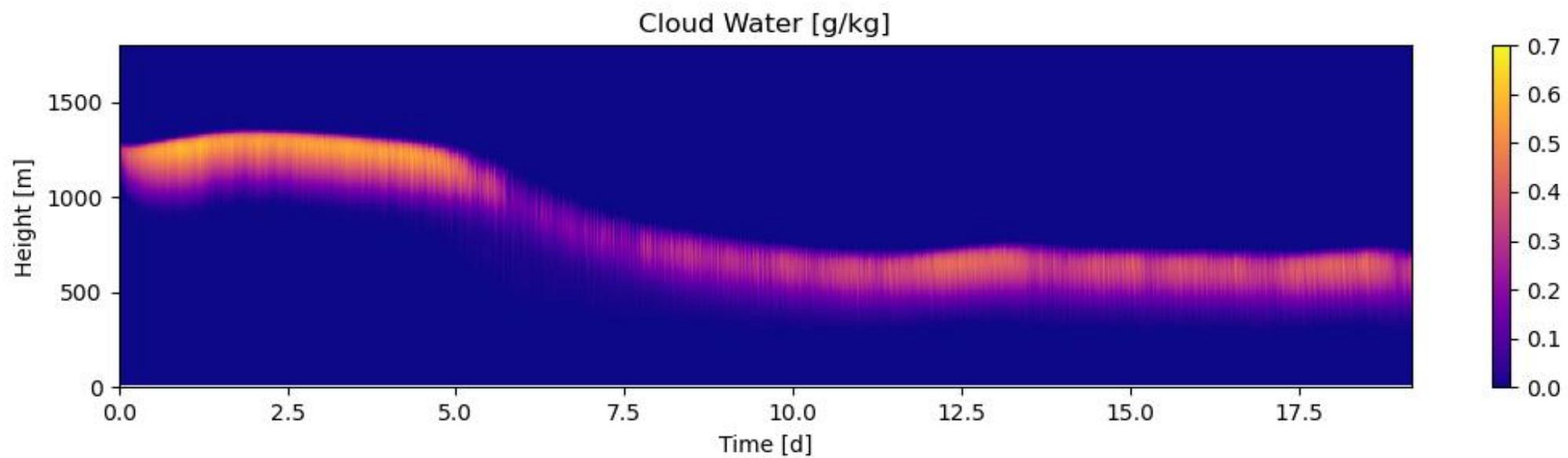
Image from McCoy et al. (2020)

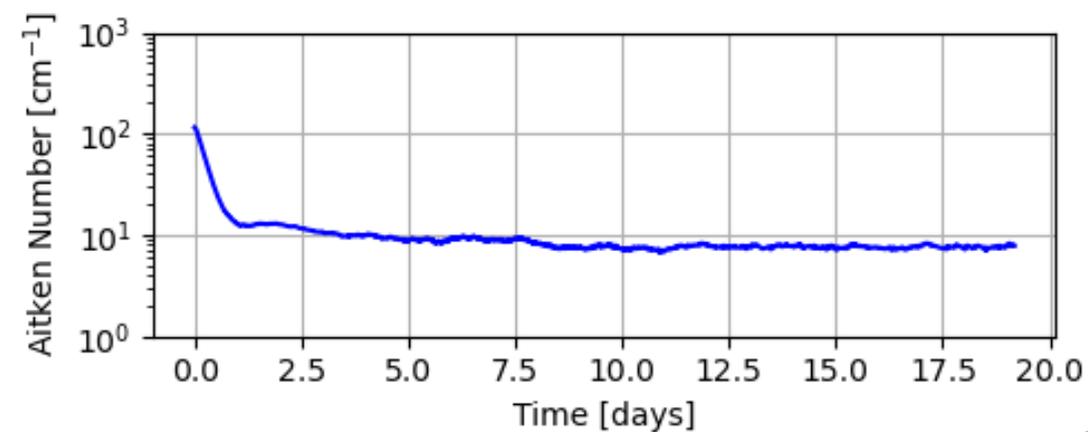
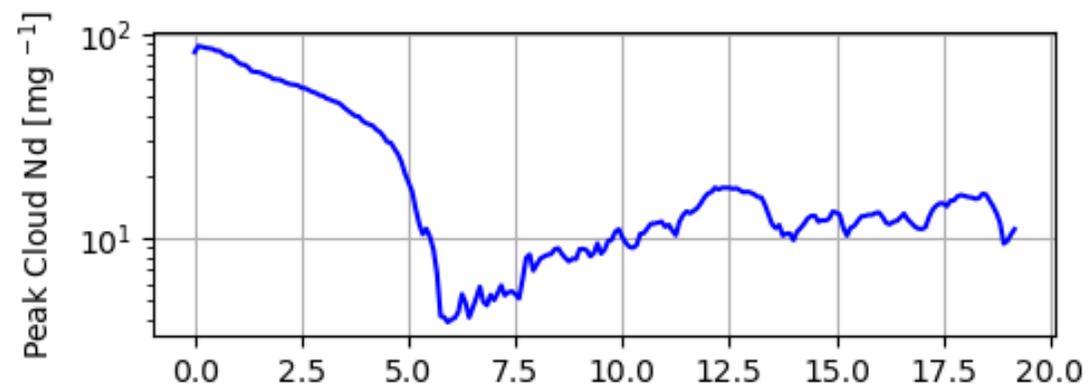
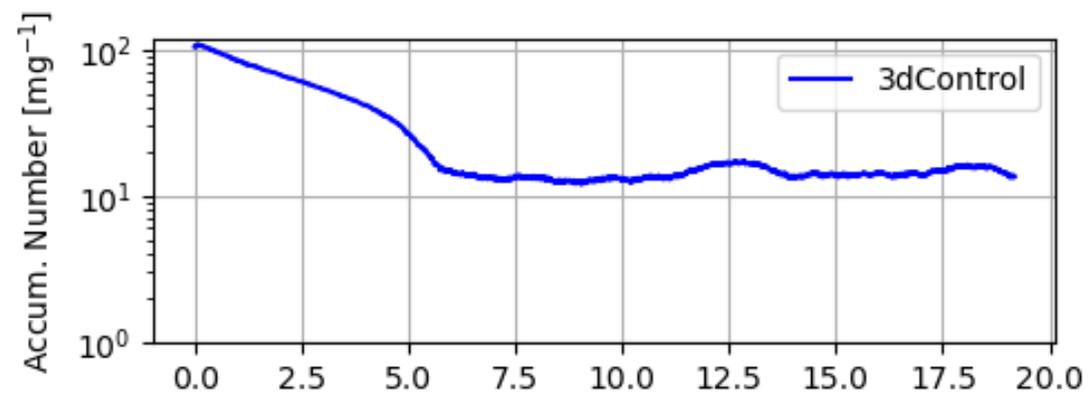
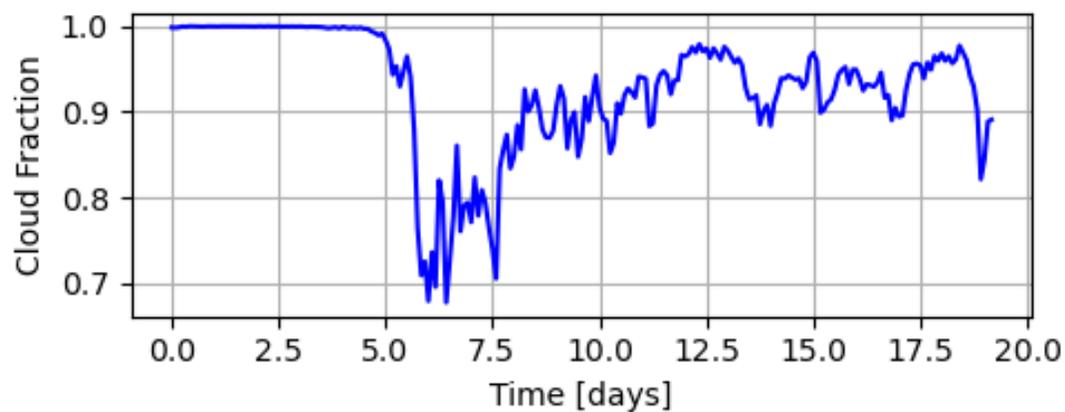
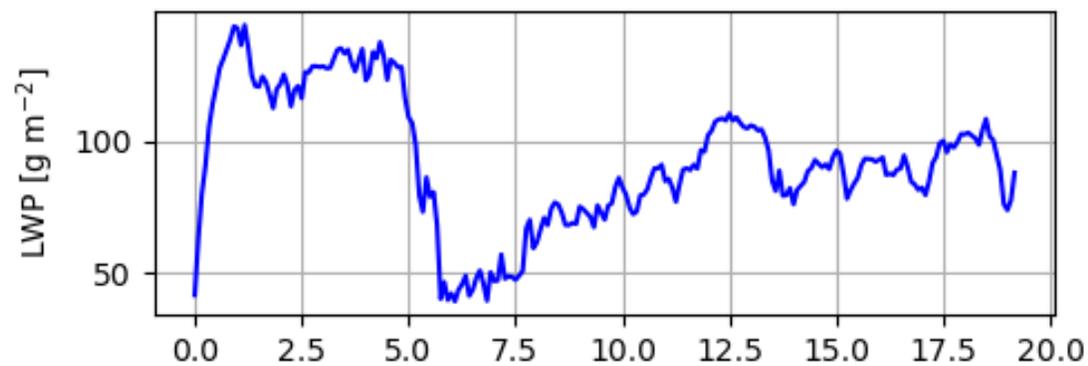
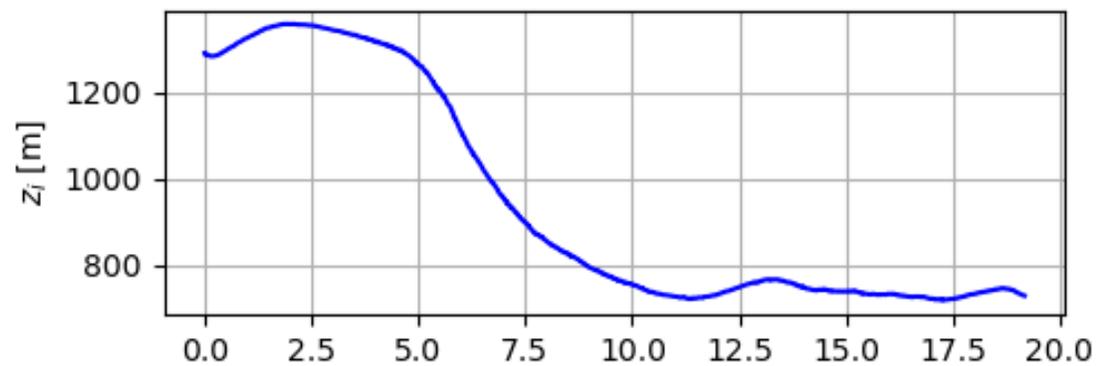
Modal Aerosol scheme in SAM

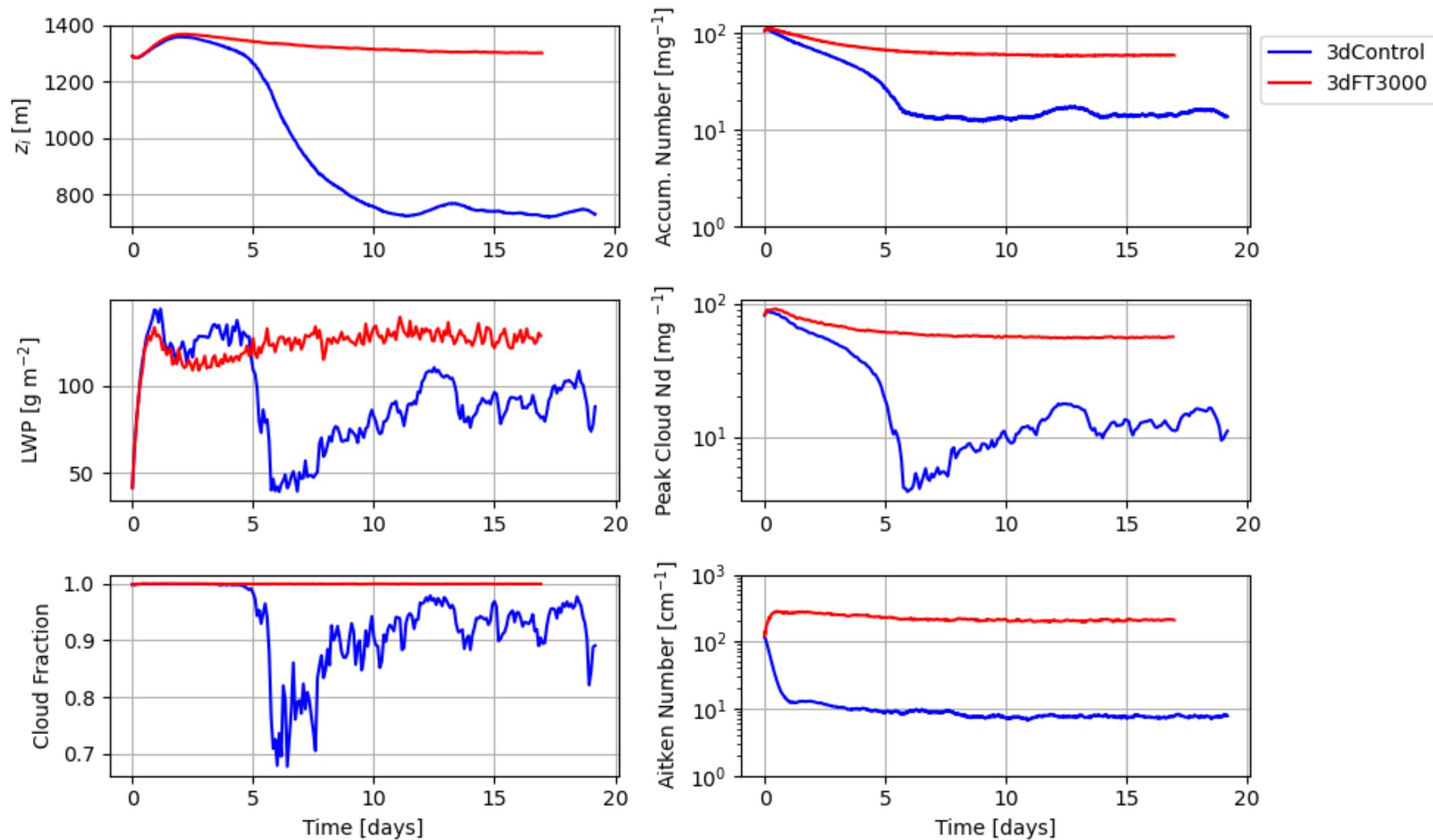
- SAM (System for Atmospheric Modeling, Khairoutdinov and Randall, 2004)
- Builds off of Berner single-mode scheme (Berner et al. 2014)
- 2 lognormal aerosol modes, predicting mass, number
- Morrison bulk 2-mode microphysics
- Aerosol coagulation
- Scavenging of aerosol by cloud droplets and rain
- Abdul-Razzak and Ghan (2000) aerosol activation
- Simple sulfur chemistry:
 - SO_2 , H_2SO_4 , DMS gases
 - Surface fluxes of DMS and Aerosols
 - Aerosol sulfate mass grows via oxidation of SO_2 and/or condensation of $\text{H}_2\text{SO}_4(\text{g})$
 - No gas to particle conversion

VOCALS RF06 Stratocumulus Case Setup

- 6km x 6km domain
- 5m vertical, 125m horizontal grid resolution
- Ocean surface fluxes of heat, moisture, momentum, aerosols, DMS
- Diurnally averaged shortwave radiation
- Accumulation conc. 100 mg^{-1} in boundary-layer, 50 mg^{-1} above
- Aitken concentration 100 mg^{-1} everywhere
- Aitken perturbation experiment: 3000 mg^{-1} in free troposphere





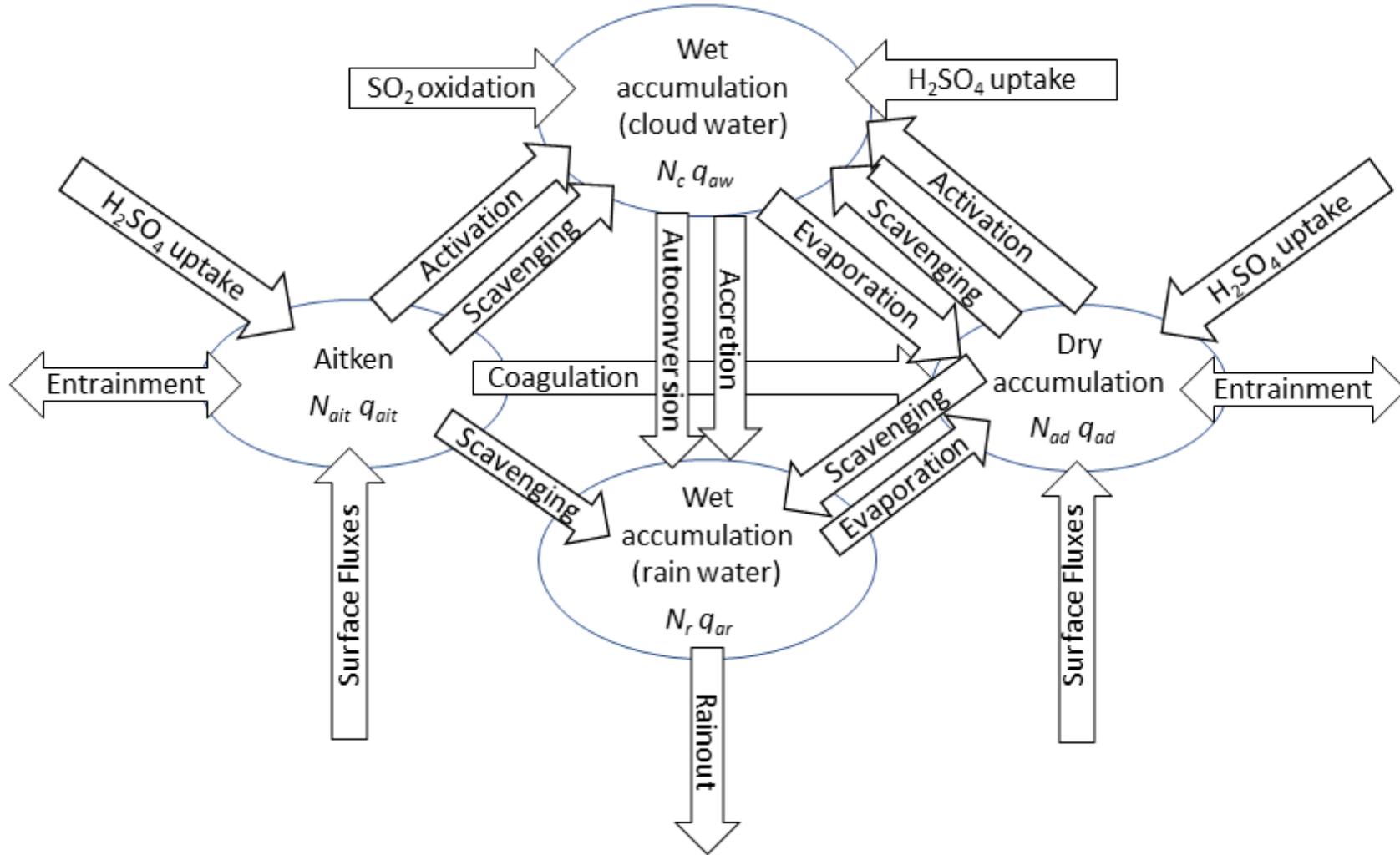


Conclusions and Ongoing Work

- In an idealized VOCALS case, Aitken buffering prevents boundary layer collapse.
- Larger entrained Aitken aerosols become activated and are transferred to the accumulation mode.
- How important is Aitken buffering in a wider variety of cases?
 - ACE-ENA July 15 decoupled BL case
 - SOCRATES cases
- Are the rapid losses of Aitken particles due to Brownian diffusion onto droplets realistic?
- See Wyant et al. 2020 to be submitted to ACP or JAMES.

Extra slides

Aerosol scheme categories



Control Run Mean Soundings

