STM - Updates from CU/NASA GISS

Florian Tornow, Andrew Ackerman, Ann Fridlind, George Tselioudis, Brian Cairns
NASA GISS & Columbia University - presenting at the ACTIVATE STM, Tucson

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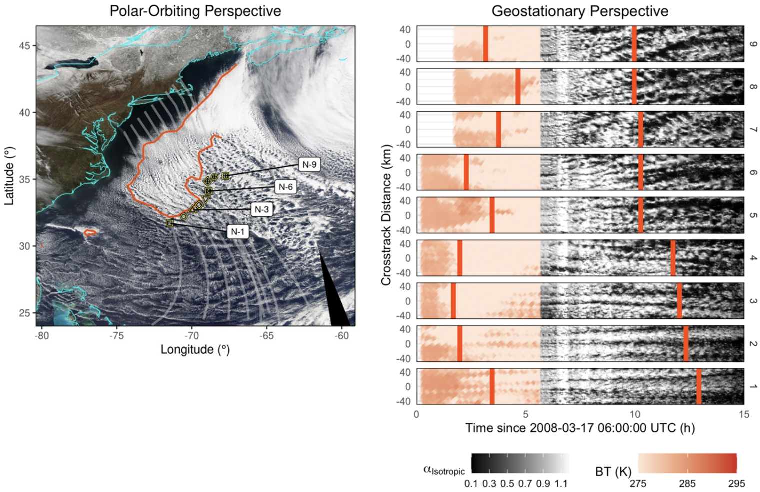
1) Dry intrusions driving CAO cloud transitions

Approach & Findings

- extract several parallel trajectories from pre-campaign case
- compare meteorological aspects from reanalysis and run Lagrangian LES for four cases:
  - variation in cloud transition speeds explained by pattern of postfrontal boundary conditions largely shaped by free-tropospheric dynamics
  - CCN and LWP budgets highlight role of various processes

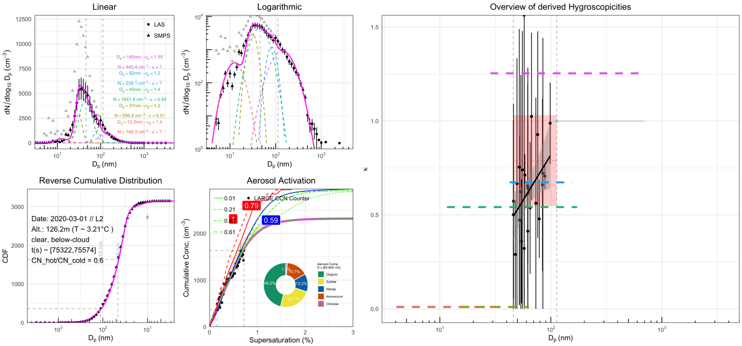


Cloud transitions seen from two satellite platforms (Tornow et al., in prep-1)

2) Aerosol hygroscopicity in evolving CAOs

Approach

- per horizontal leg, obtain size dependent κ using several methods (right):
  - (1) large-to-small bin-wise integral and CCN closure
  - (2) fit lognormal modes and estimate κ values via CCN closure
  - (3) AMS-based estimate (not shown)
- assemble estimate for quasi-Lagrangian CAO flights
- assess change in κ with fetch and per MBL and FT

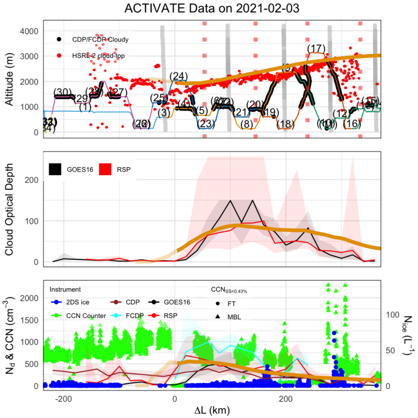


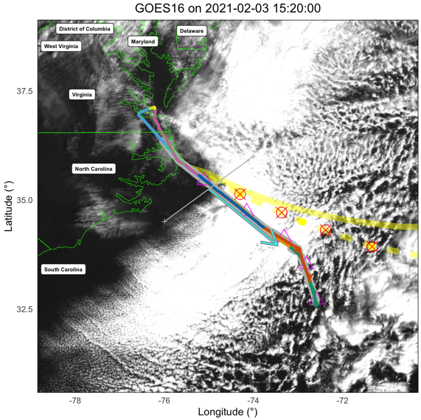
Aerosol size distributions with modal fits (top-left), CCN-closure (bottom left), and obtained hygroscopicities (right, Tornow et al., in prep-2)

3) Improving the representation of light rain

Notes

- use ACTIVATE to initialize and evalute Lagrangian LES
  - aerosol PSDs from upwind legs in MBL and FT
  - reanalysis for meteorological forcing
- drizzle first appears much further downwind in LES than in measurements
- next steps:
  1) test alternative autoconversion formulations, and investigate with bin microphysics
  2) explore role of GCCN using bin microphysics





Comparing ACTIVATE retrievals against Lagrangian LES (Tornow et al., in prep-3)

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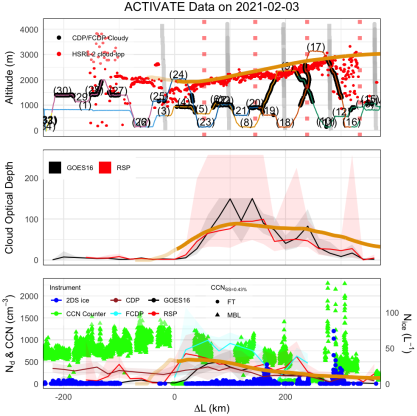

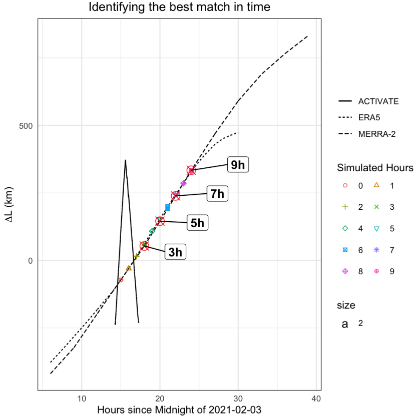

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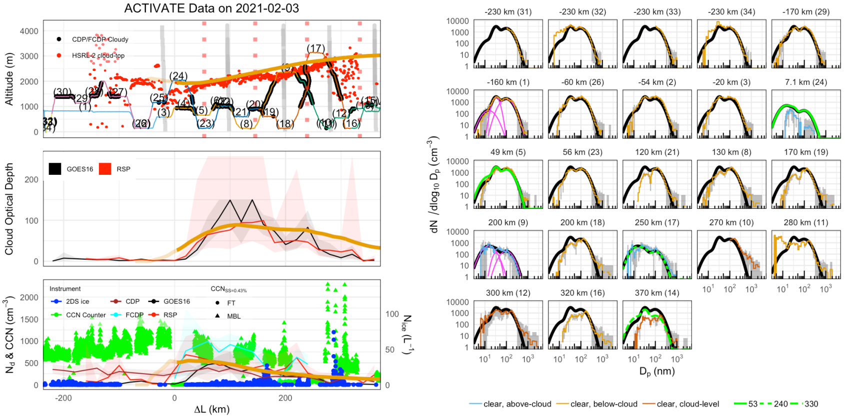

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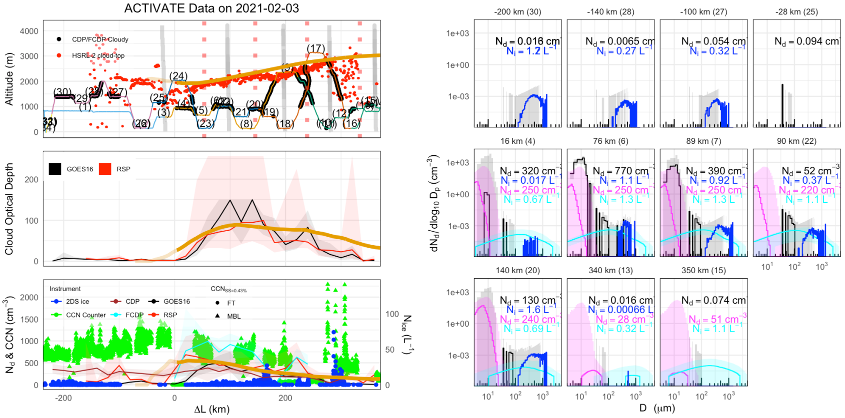


Comparing ACTIVATE retrievals against Lagrangian LES (Tornow et al., in prep-3)

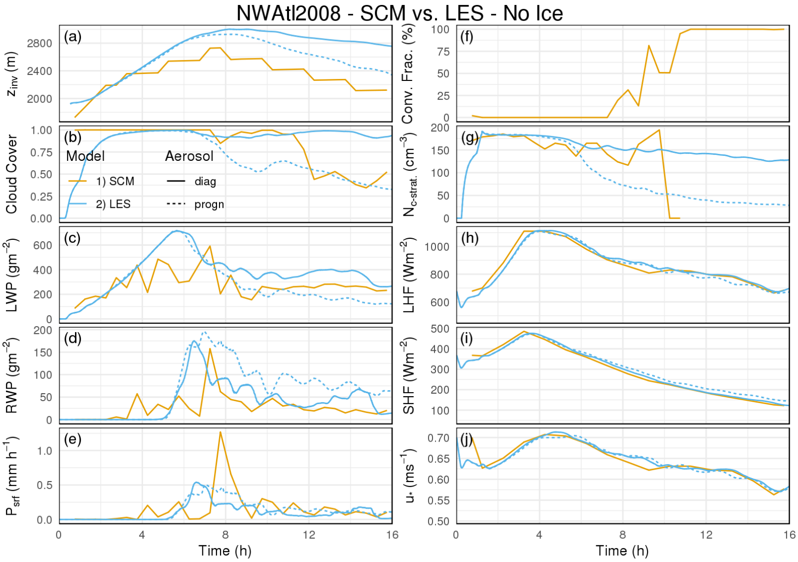
4) CAO cloud transitions in Lagrangian ModelE3 SCM

SCM Setup (preliminary)

- force SCM with LES surface fluxes
- use simplified Beers law

SCM vs. LES

- agreement better than expected
- earlier rain formation
- shallower MBL and smaller peak LWP
- cloud breakup represented as transition to convective scheme



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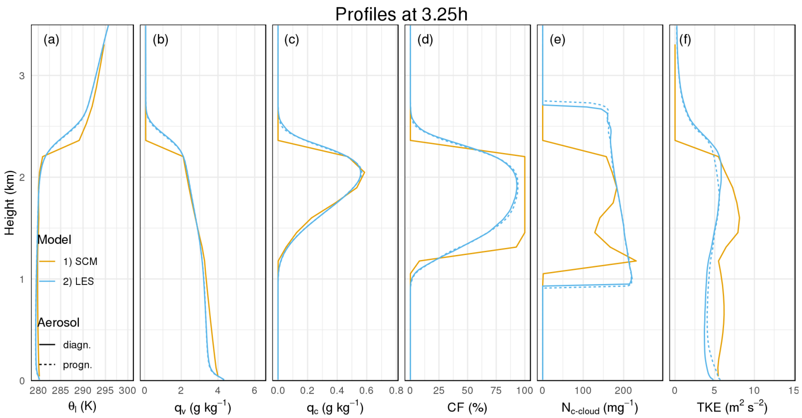

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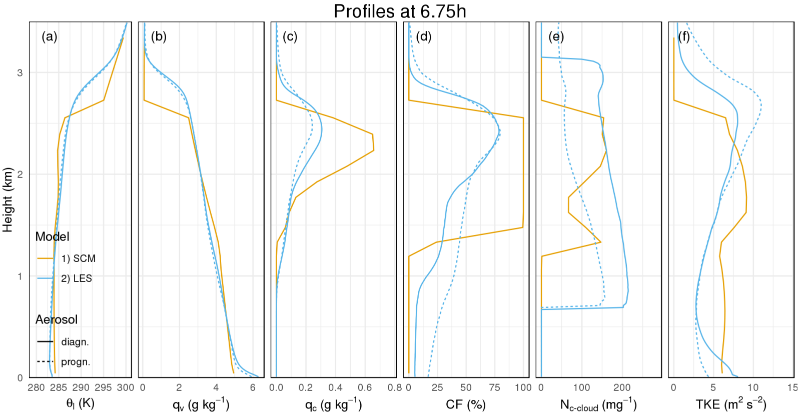

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Next Steps

- remove crutches:
  - reconcile differences in surface fluxes
- prognostic aerosol in SCM
- sensitivity to warm and cold precip. formation