Uncrewed Aerial Systems for High-Resolution Modelers

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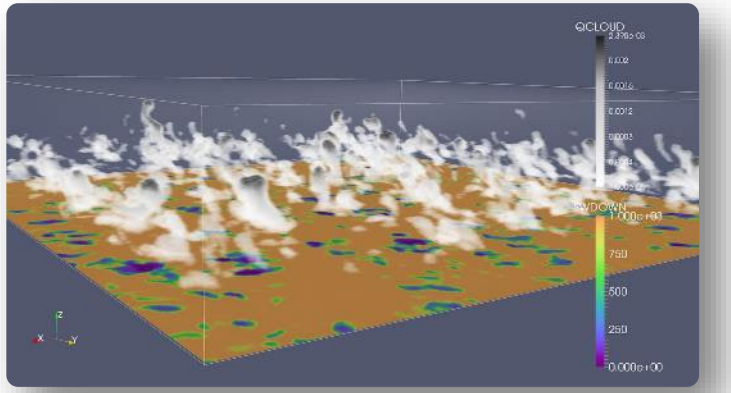
Context…

- LASSO-like, high-resolution modeling
  - Grid spacing on the order of 10–100 m
  - Domain width in range of 25–250 km
- Typical processes of interest
  - Boundary layer development and turbulence
  - Cloud lifecycle across a range of cloud types
  - Land/ocean-atmosphere interactions
  - Radiation (to a lesser extent)
  - Aerosol (maybe someday)

Real World

Model World



Quantification of cloud mixing and intra-cloud interactions

- Quantifying cloud environments as they evolve; essentially inside, around, and away from the cloud(s)
- Mixing in/out of cloud boundaries
  - How big of an area around the cloud is perturbed by detrained air?
  - How much “pure” background air makes it into the cloud from each side (top, bottom, upwind/downwind sides)?
  - How does detrained air differ with altitude and/or by cloud lifetime?
- Which clouds are impacted by their neighboring clouds?

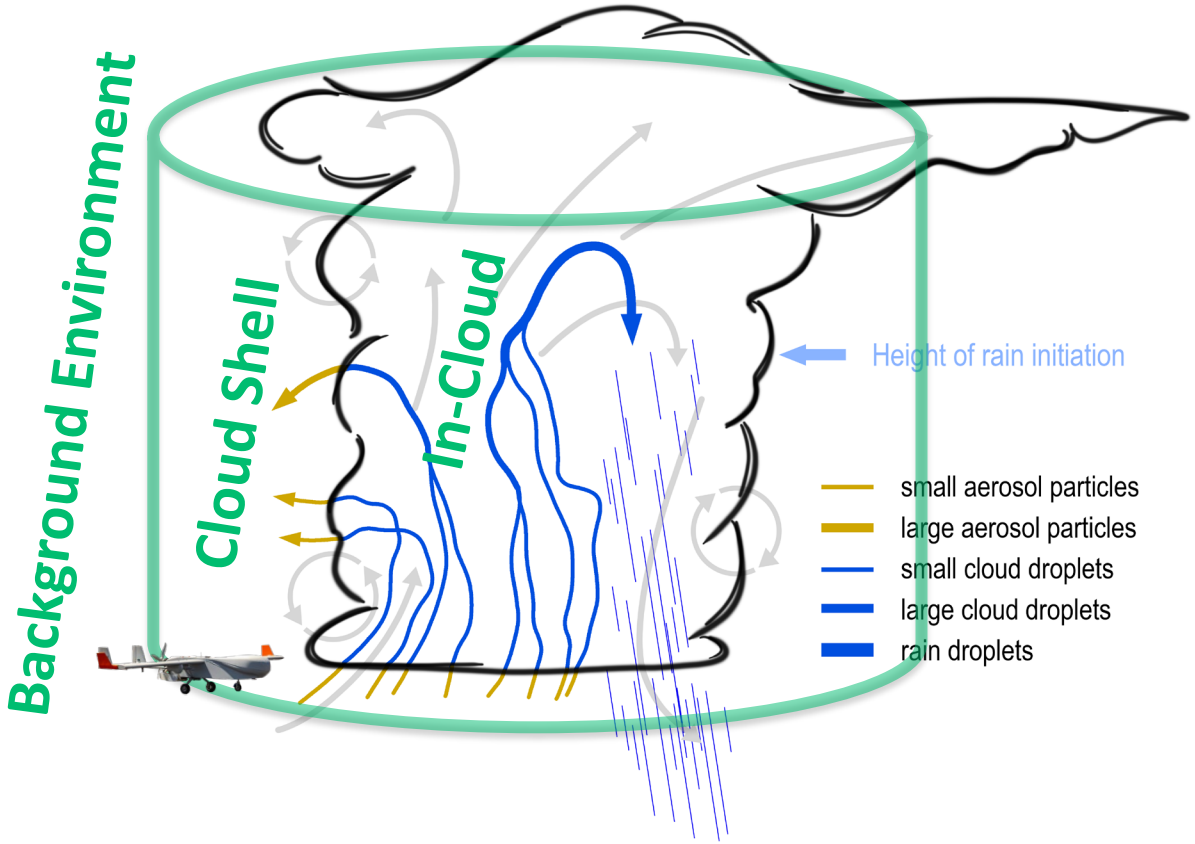


Figure adapted from Braga et al. (2022, GRL). 2 November 2022

What would be required

- Flight tracks (ideally concurrent aircraft using a drone swarm)
  - Vertical profiles in each cloud region (in-cloud, cloud shell, background environment)
    - Repeat over time throughout cloud lifecycle
    - Must track with the specific cloud as it advects
    - Issue: in-cloud and behind-cloud tracks would be tricky with line-of-sight requirement
  - Lawnmower or cloud-to-cloud pattern to quantify cloud population interdependencies

- Variables (high enough frequency to capture eddy spatial scales and to quantify fluxes)
  - Traditional meteorological variables: temperature, water vapor (or Td), 3-D winds, height/pressure
  - Cloud microphysics: droplet number, raindrop number, droplet and raindrop size distributions
  - Aerosol: CCN, particle size distribution, potentially composition