Plan for Large-Eddy Simulations of POST

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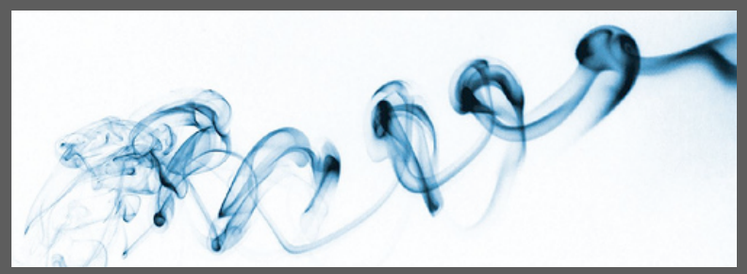
My goals (from last meeting in May 08)

- Study the interactions between CTEI and radiative cooling feedbacks.
- Study the possible role of CTEI in mesoscale convection - Large domain LES.
- Parameterize CTEI.
- Explore relevance of CTEI to entrainment in large cumulus clouds.

LESs of POST

- Benchmark simulation
  - Target resolution - 5 m grid box with 5 km horizontal domain
  - Duration - 5 hours?
    - Got computer time for two simulations with NCAR Bluefire
- Test runs, experiments with coarse resolution will be performed at CSU and Bluefire.

Improve subgrid scale representation



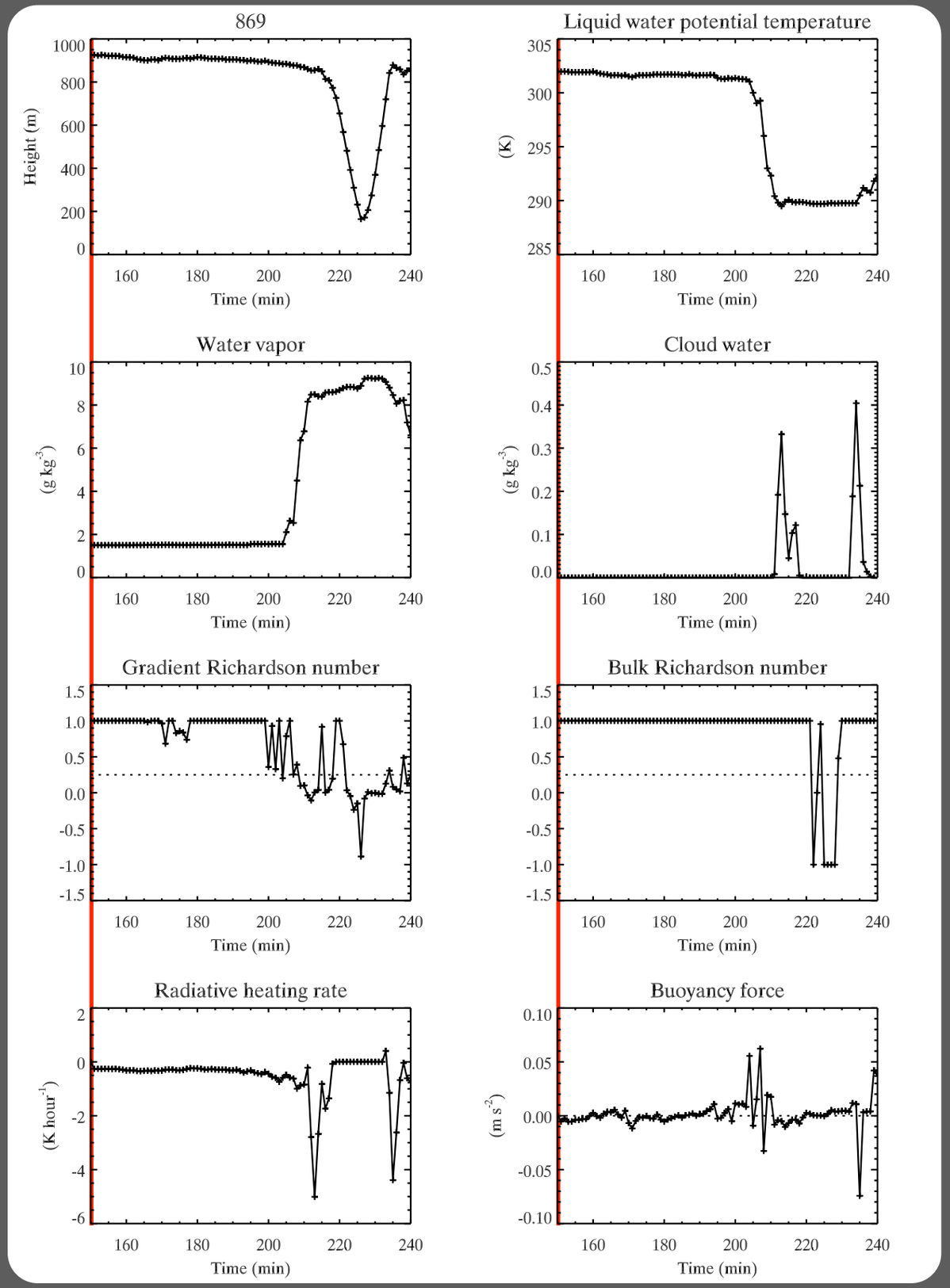
- Entrainment is under-resolved with 5 m grid box.
- Partial cloudiness exists within 5 m box.
- ➡ Implement second-order closure turbulence model with partial cloudiness parameterization
  - A SOC model is formulated with Gaussian distribution.
  - All second moments are predicted.
  - Cloud fraction and mean condensate are computed based on second moments.
- First test will be one-dimensional SOC model inside SAM without advection, then add complexity (3D, advection on/off).

Analysis tool: Lagrangian parcel tracker

- LPT computes parcel paths, i.e., $\Delta\mathbf{x} = (\mathbf{u}_{res} + \mathbf{u}_{sfs})\,\Delta t$, during simulation.
- Velocity is diagnosed by spatial interpolation from resolved scale velocity.
- Stochastic unresolved velocity parameterization of Weil et al. (2004) has been implemented.

LPT test results

- GCSS DYCOMS-II RF01, 4 hour simulation
- 230,400 parcels are released
  - at 905, 910, 915, 920, 925 m
  - horizontally evenly spaced
  - 5 parcels per starting point
  - starting at hour 2.5
- Example: parcel #869



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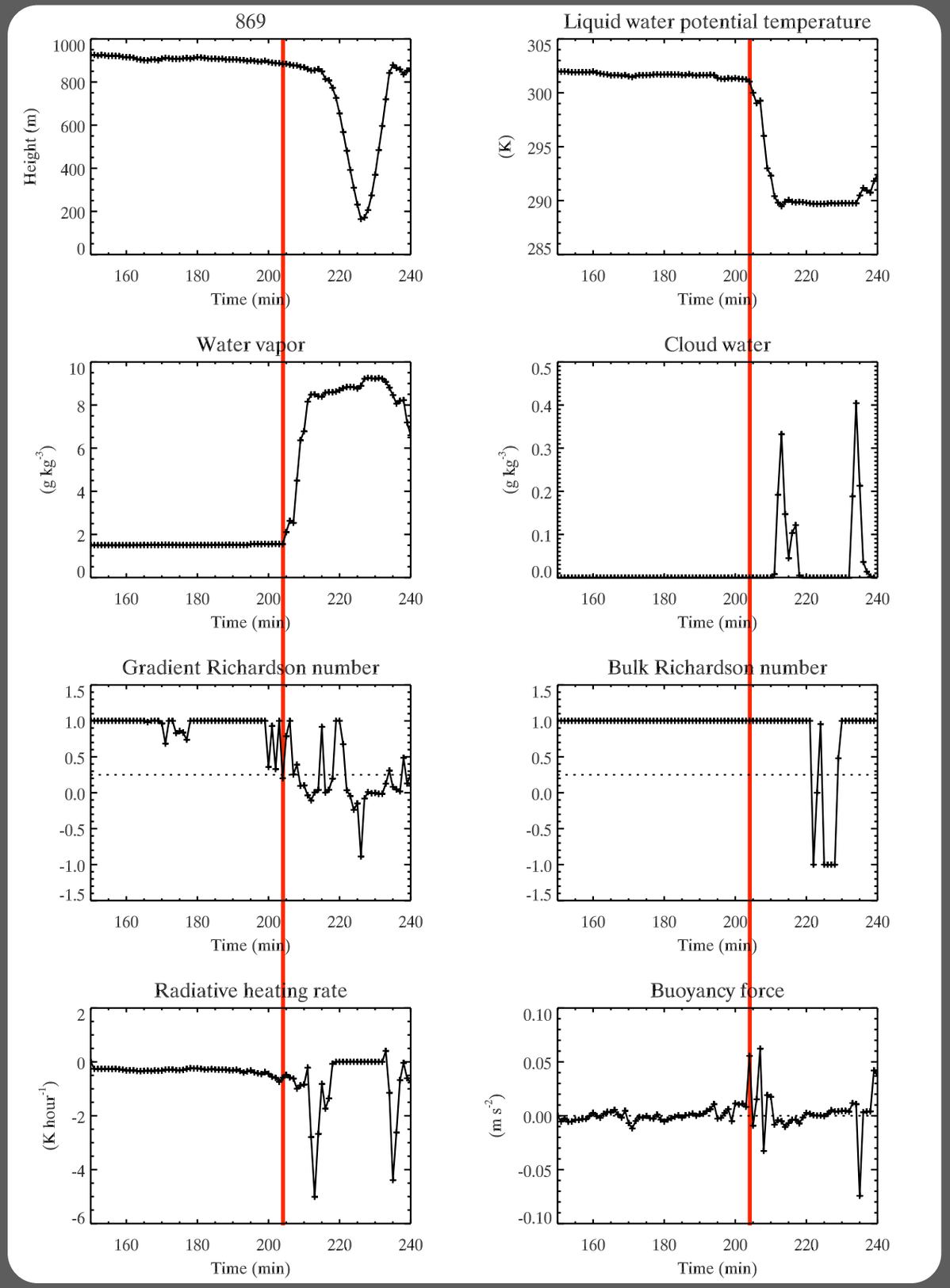

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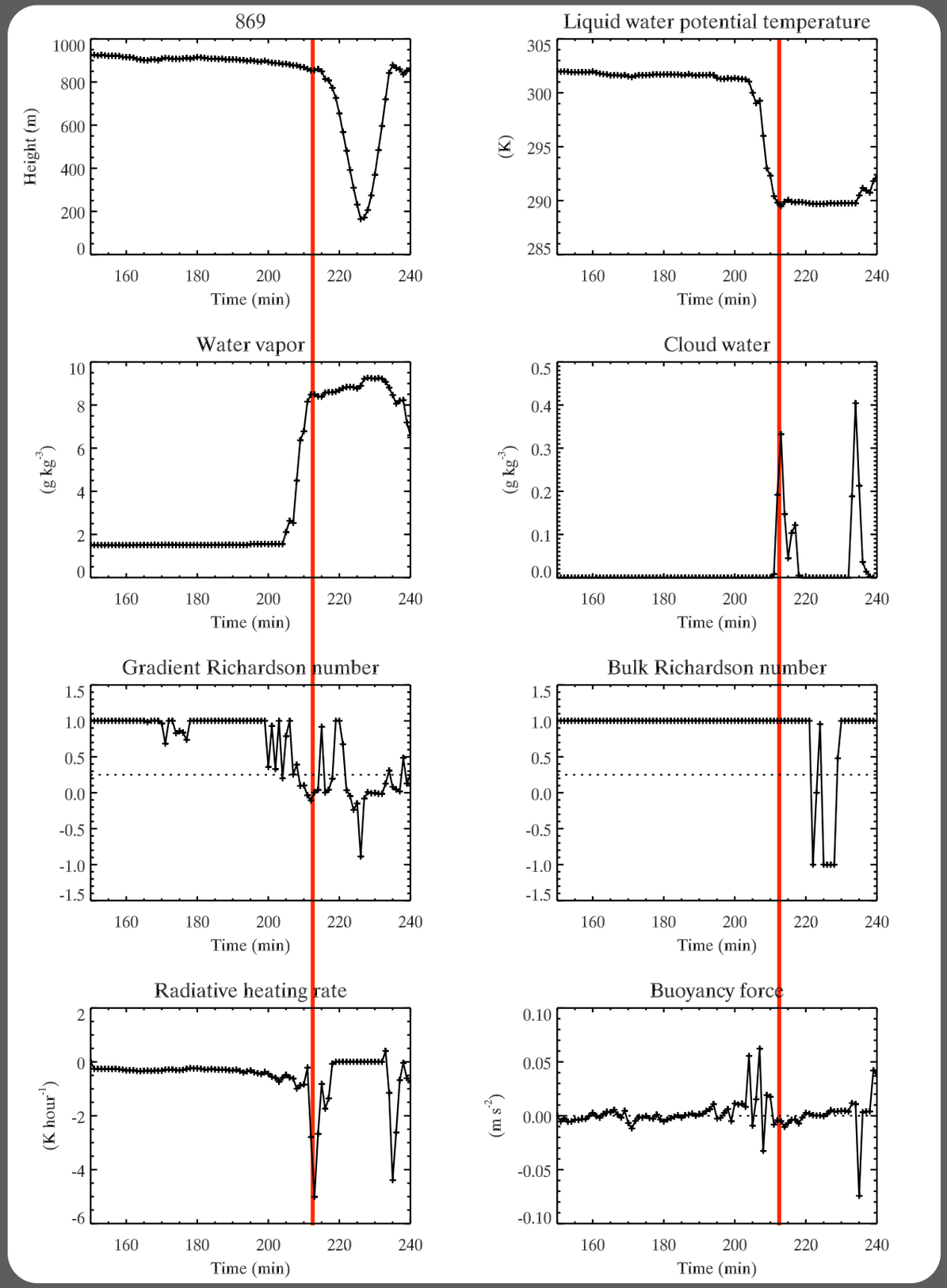

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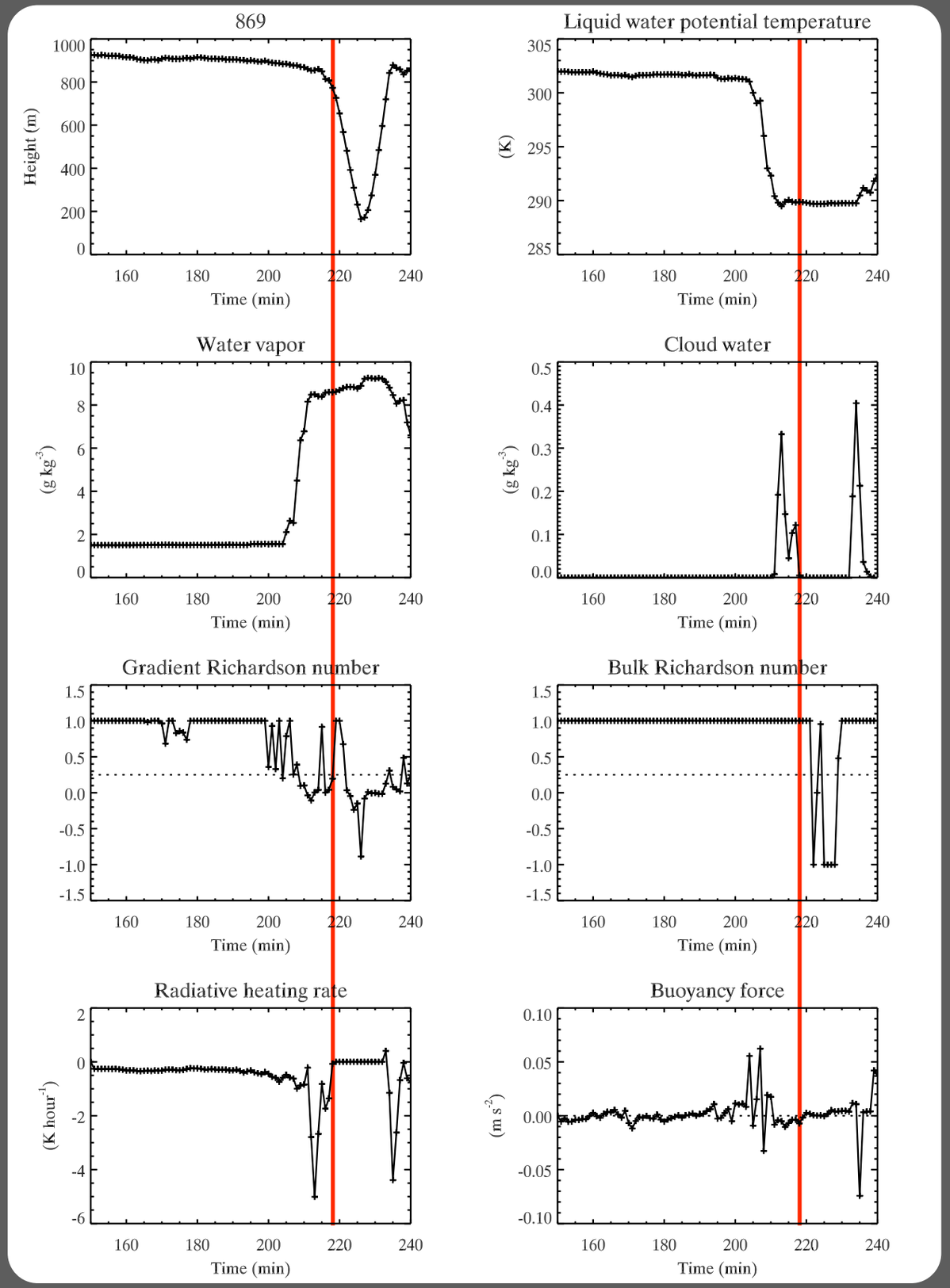

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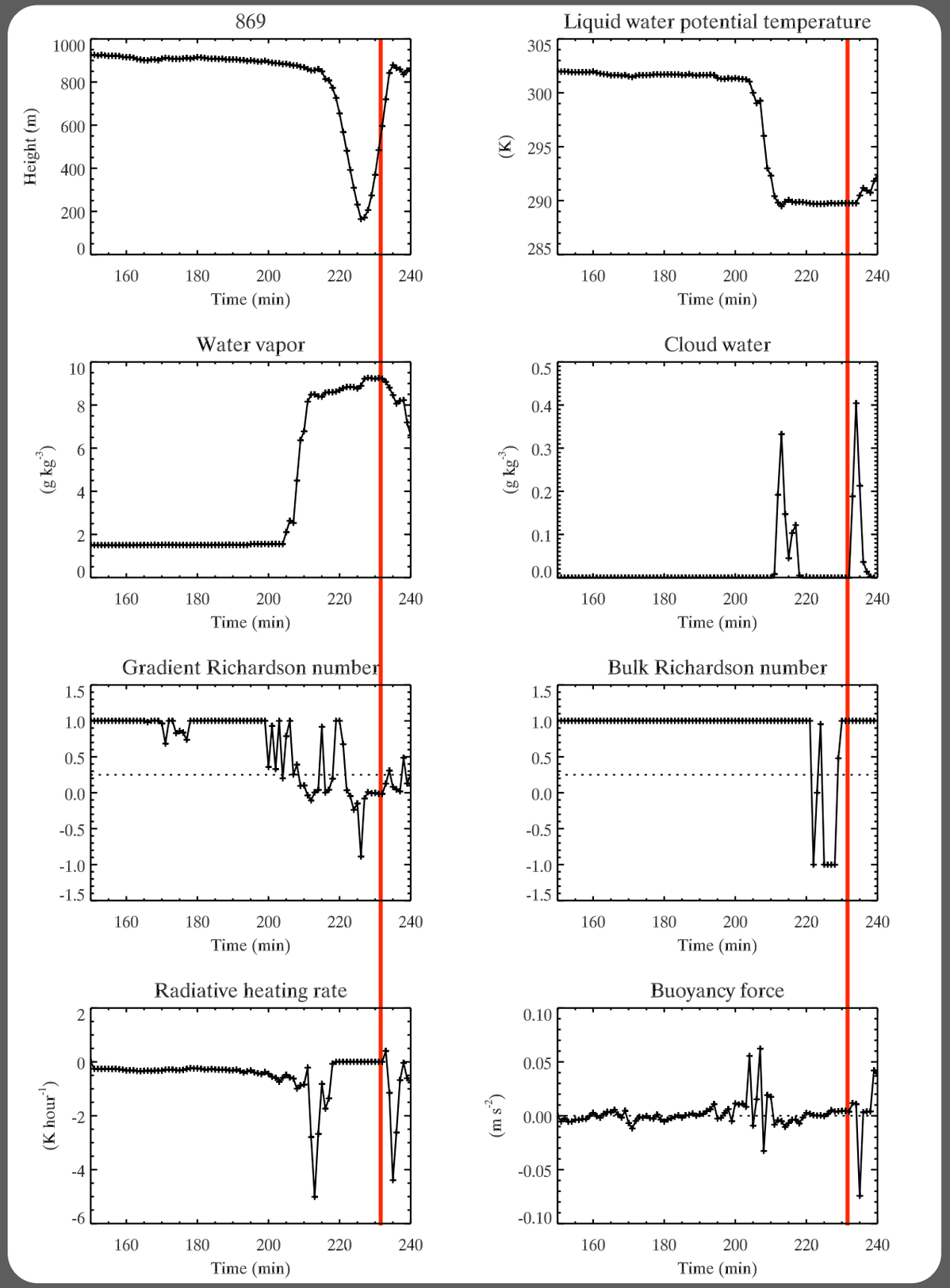
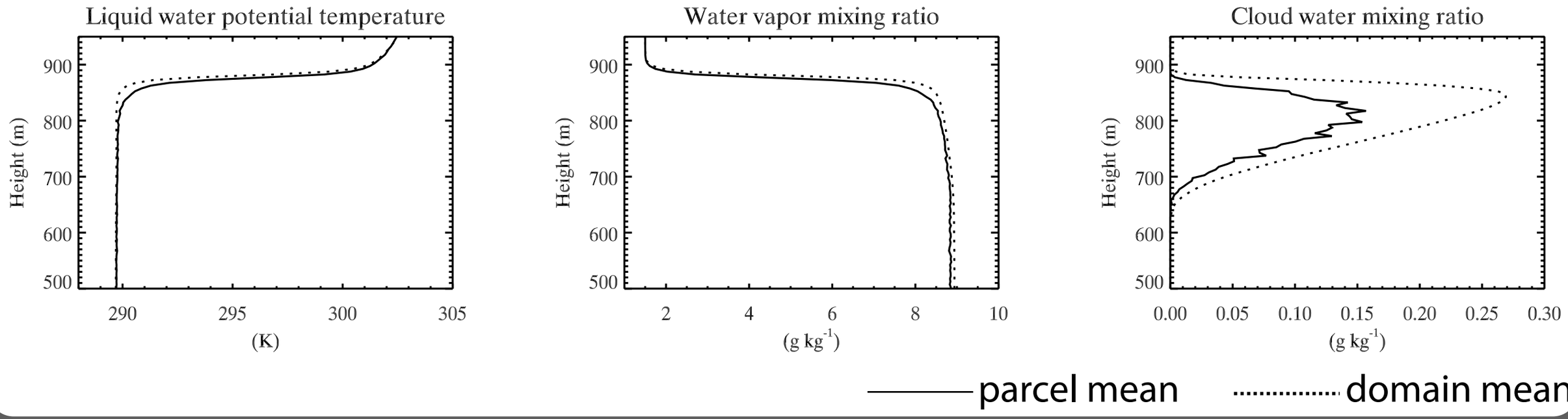


Entrained parcel statistics



- Many parcels are above 850 m at the last time step.
- Mean profile of all parcel - Parcels between $z-\Delta z/2$ and $z+\Delta z/2$ were counted for level z, then averaged. $\Delta z = 5$ m.
- Some parcels returning from the bottom were included. This can be avoided by setting lowest altitude higher.
- Statistical analysis for entrained parcels can be done.

What do we want to simulate?

- Which flight?
- Initial soundings - mean profile over a flight?
- Large scale forcing - geostrophic wind, subsidence
- Radiation - prescribed, simple code, CAM3
- Surface flux - prescribed, MO theory
- Precipitation - on / off
- Nudging?
- Output