



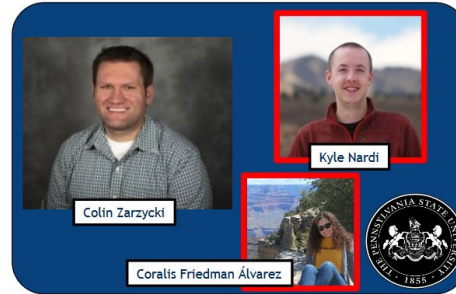
Evaluating low-level jets and boundary layer processes in CAM6 runs nudged using ERA5

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My project and position

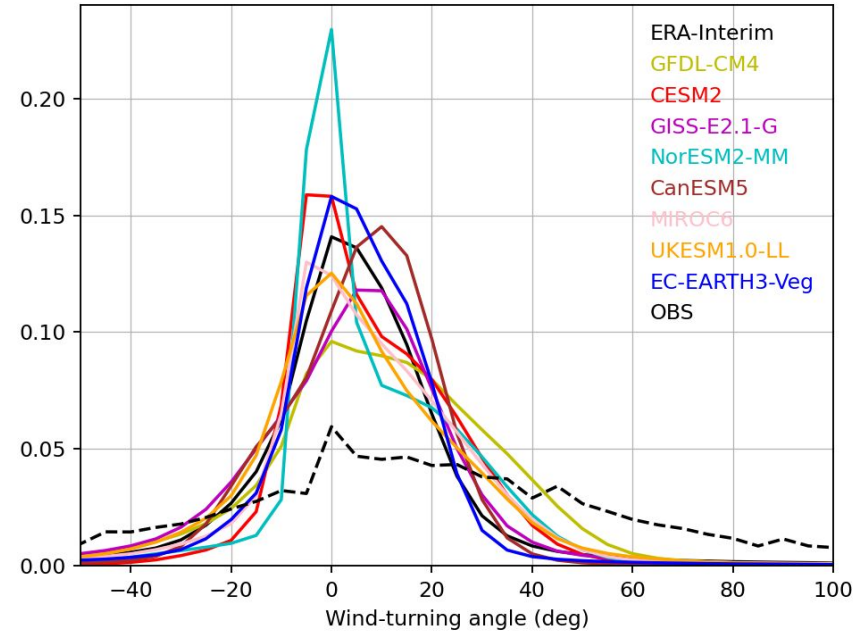
- CPT including my supervisor Gunilla Svensson
- Multiple institutions including NCAR and NOAA
- Improving momentum fluxes in the Cloud Layers Unified By Binormals (CLUBB) turbulence and cloud scheme



<https://www.cesm.ucar.edu/events/workshops/2021/files/talks/2021-cesm-workshop-amwg-zarzycki.pdf>

Motivation

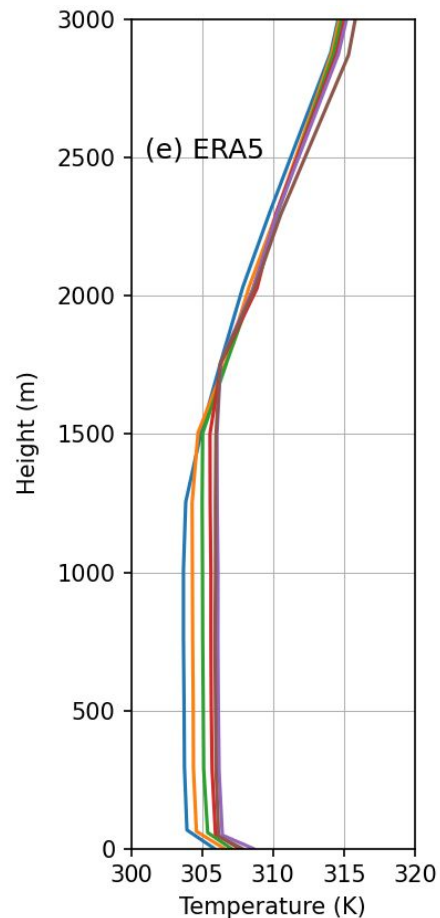
- Interest in wind-turning and cross-isobaric mass fluxes in the PBL
- Role in the CPT to evaluate the PBL processes
- Evaluate vertical profiles and low-level jets



*Wind-turning in the planetary boundary layer in CMIP6
(submitted)*

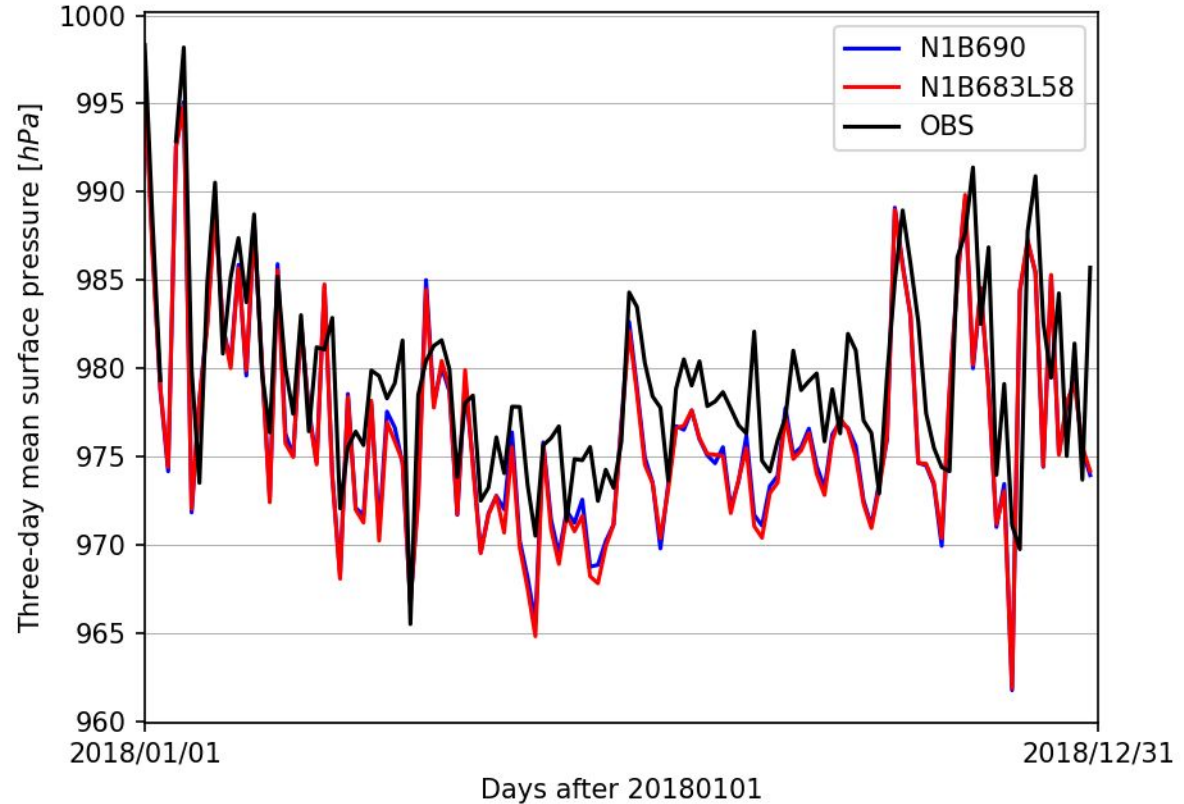
CAM6 runs nudged using ERA5

- CAM6 nudged using ERA5 above certain pressure levels
- Nudging temperature and winds
- Using 32 and 58 vertical levels
- Focus on the SGP ARM site
- Period 2018-2020



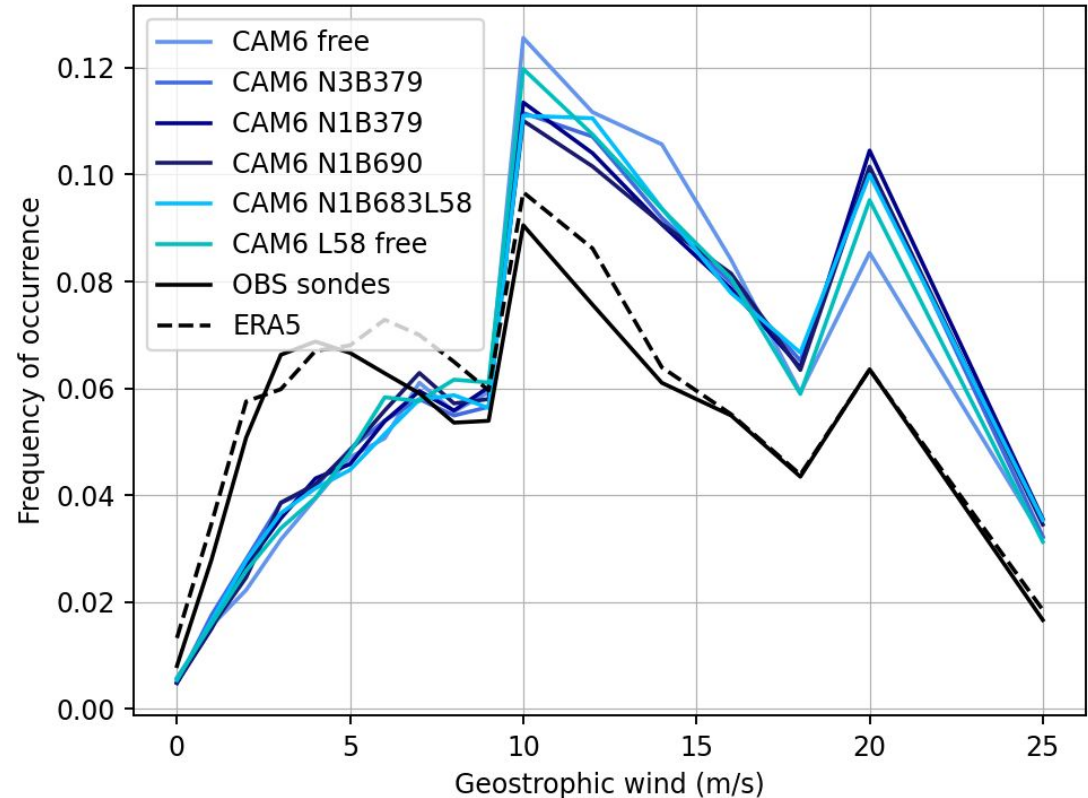
Surface pressure through 2018

- Free running with 32 and 58 vertical levels
- Two nudged runs with 32 and 58 vertical levels
- CAM6 follows observations although some differences
- Observations can be used to compare with the nudged runs



Geostrophic wind speed PDFs

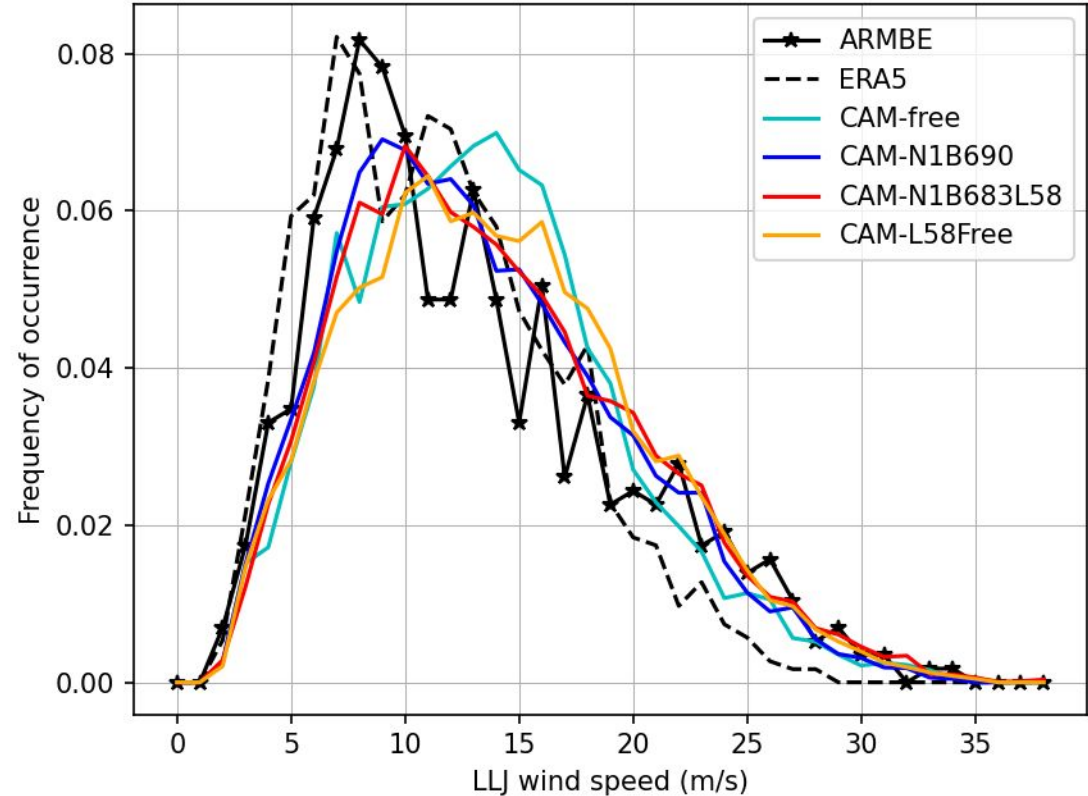
- Similar among all runs
- PBLHs diagnosed with bulk Richardson method
- Higher than observations and ERA5



Low-level jet statistics

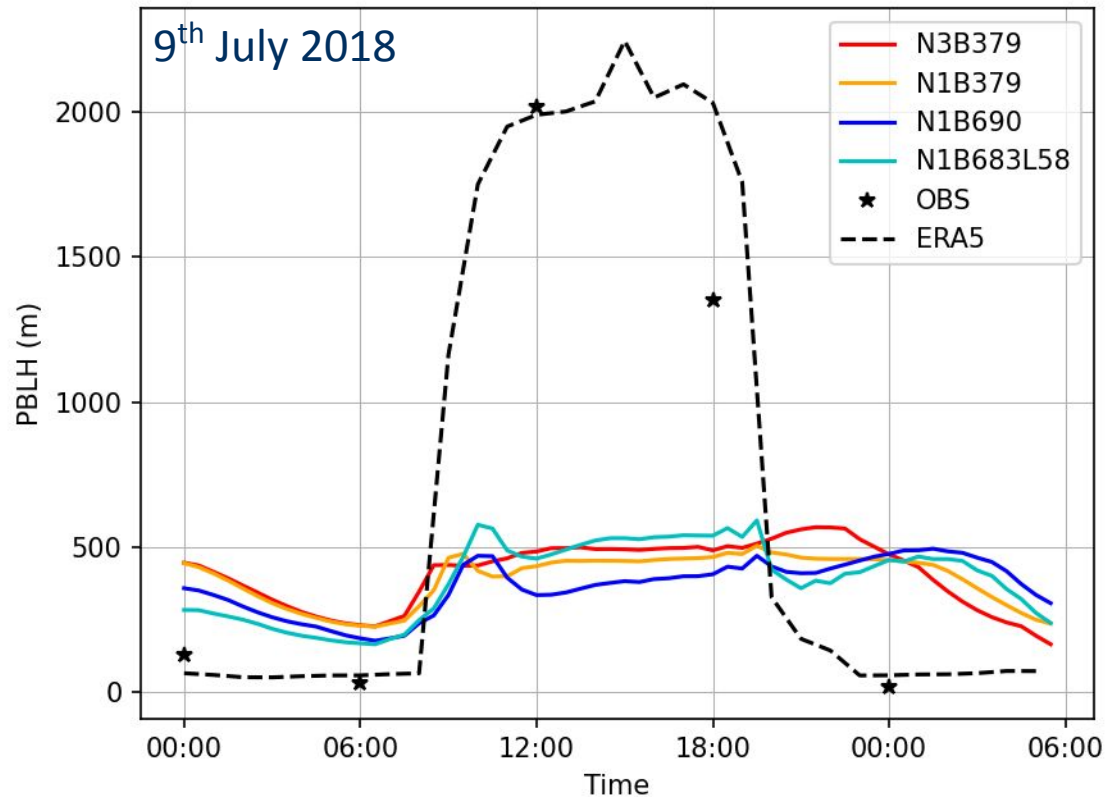


- PDFs of LLJ wind speeds
- Two runs nudged close to 690 hPa
- Two free-running model runs
- Higher wind speeds than observations and reanalysis
- Nudged runs slightly lower



PBLH evolution before LLJ event?

- Dry convective PBL
- PBL above 2000m during the day
- Nudged model runs:
 - High PBL during night
 - Low PBL during day
- PBLH found through critical bulk



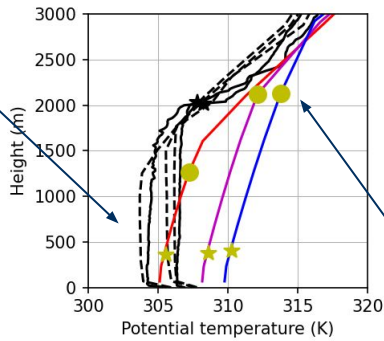
Richardson number

Bulk Richardson number method

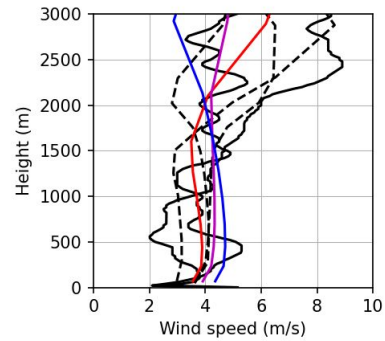
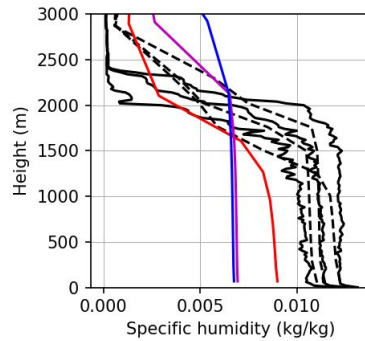
-
- $$Ri(z) = \frac{(g/\theta_{vs})(\theta_{vz}(z) - \theta_{vs})(z - z_s)}{(u(z))^2}$$
- Use u , v , T , q , and ps to calculate the Ri
- Find the first model level where $Ri > 0.25$
- Do a linear interpolation to find an estimate for the PBLH

PBL vertical profiles before LLJ

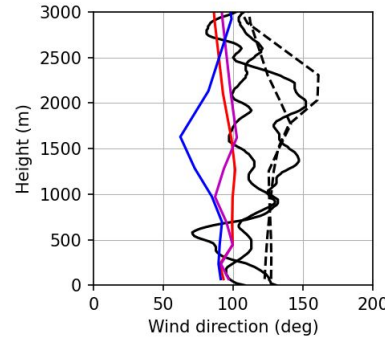
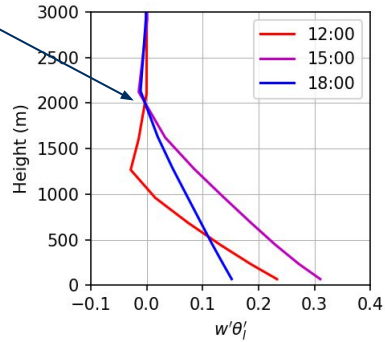
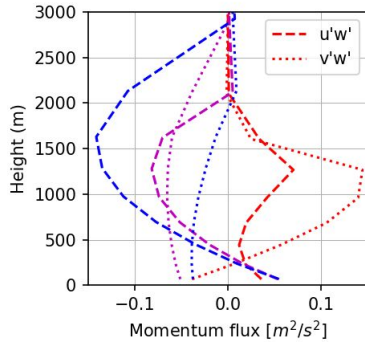
PBLH through bulk Ri



Moisture well mixed in a deeper layer but drier



PBLH through heat fluxes



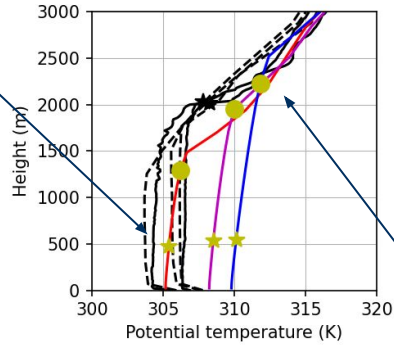
Momentum fluxes up to 1500-3000m

Heat fluxes up to 2000m

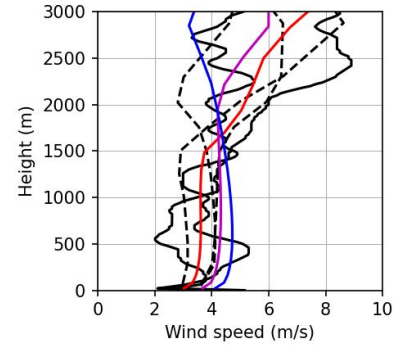
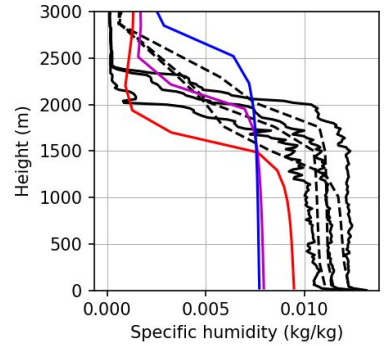
PBL vertical profiles before LLJ (58 levels)



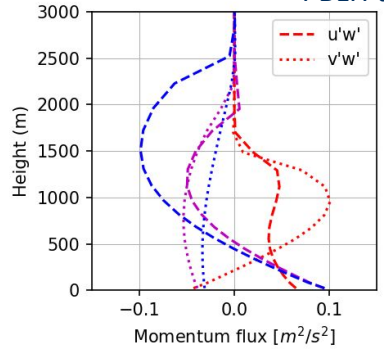
PBLH through bulk Ri



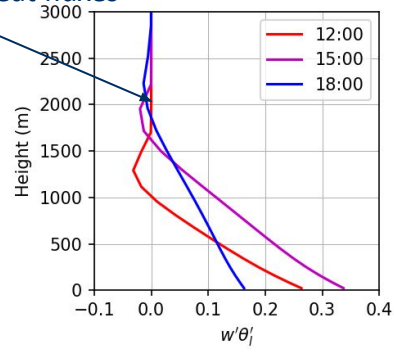
Moisture well mixed in a deeper layer but drier



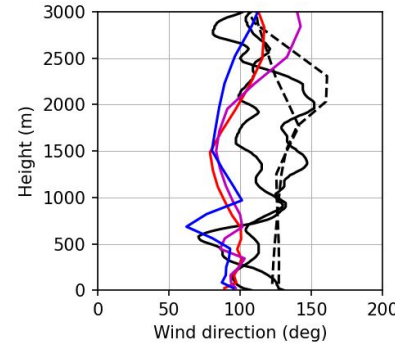
PBLH through heat fluxes



Momentum fluxes up to 1500-2500m

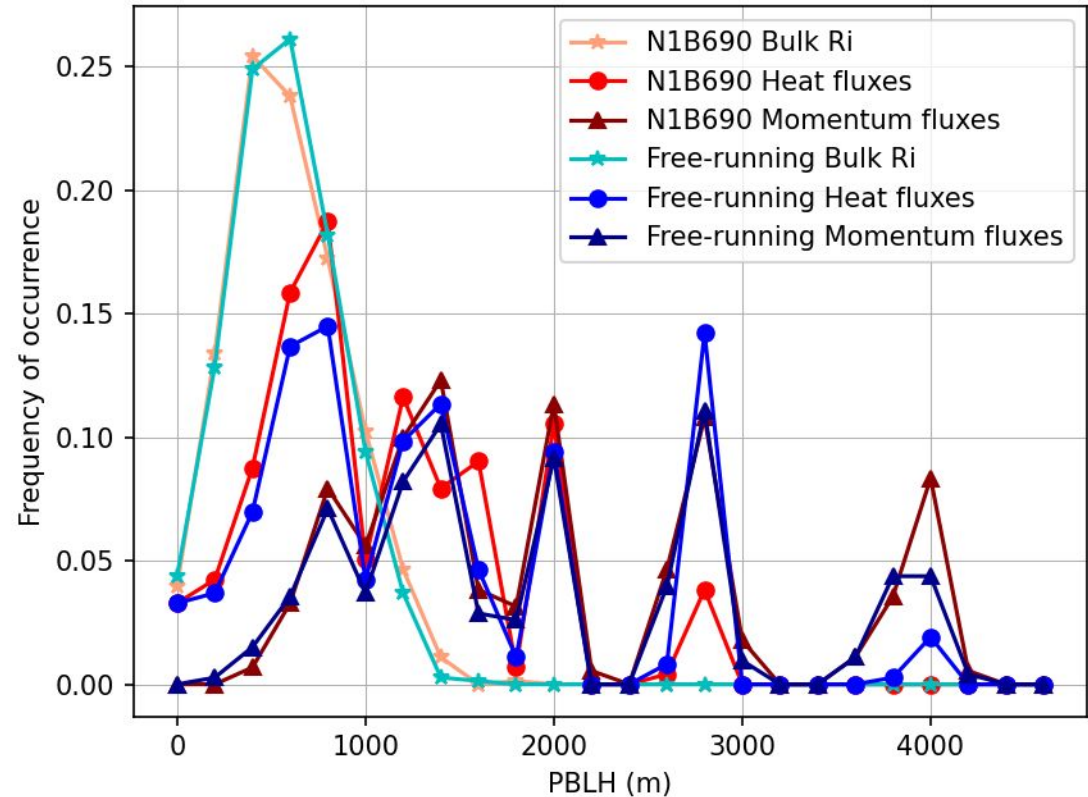


Heat fluxes up to 2000m



PBLH diagnosed through different methods

- PDFs of PBLH through three methods:
 - Critical Bulk Ri
 - Heat fluxes
 - Momentum fluxes
- Two runs: one nudged and one free run
- Mostly small difference between the two runs



Speculations and future work

- The nudging does not ruin the PBL structure
- Too much stability during convective cases giving low PBLH during the daytime
- Possibly due to subsidence
- Too large LLJ heights
- Continue analyzing LLJs knowing the PBL evolution
- Set up single-column model for this case
- Change vertical winds and see the effect on the stability