Examining the GCSS Boundary-Layer Cloud Cases in Context of CMMAP Modeling Strategy

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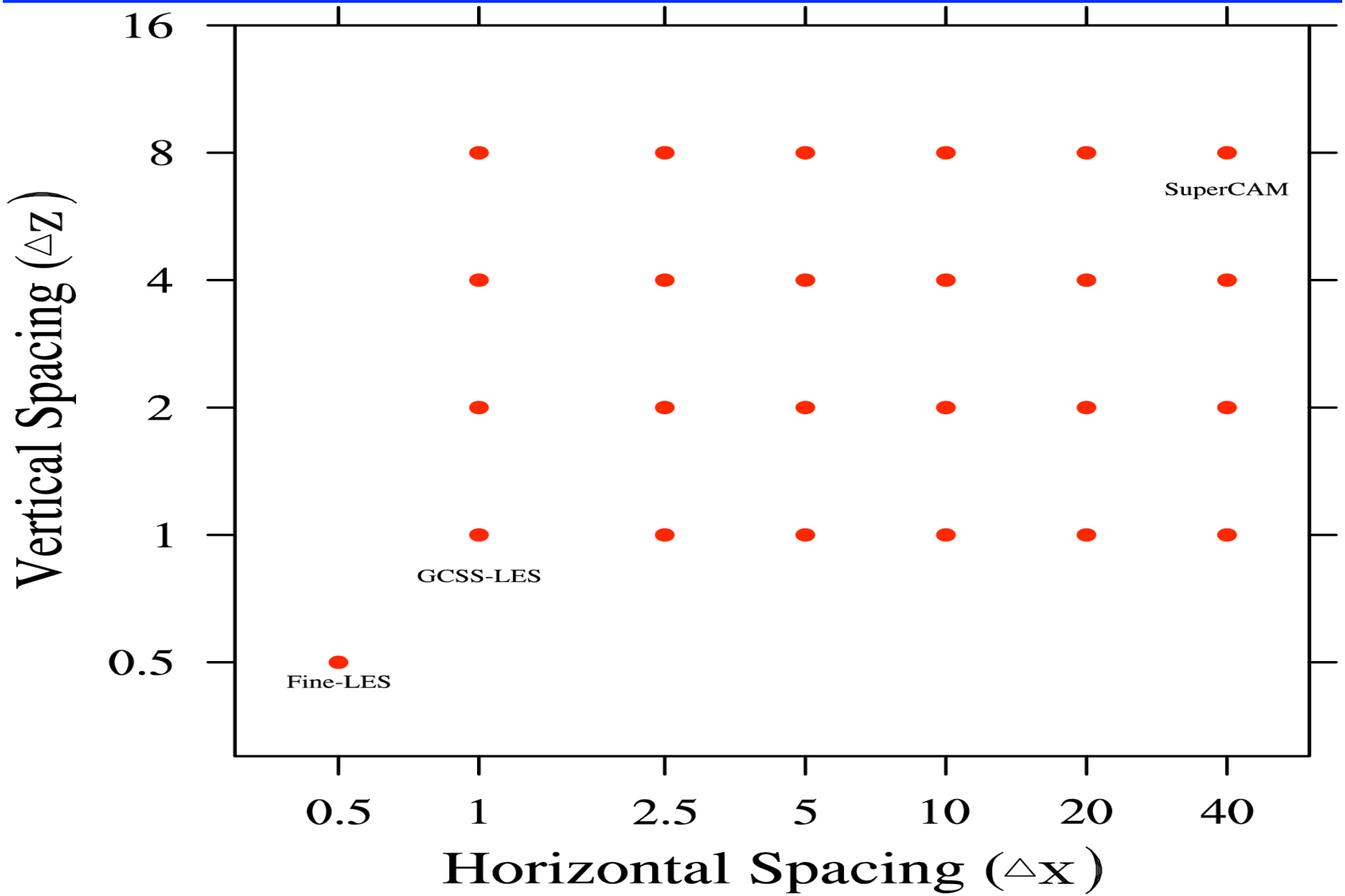
Goal

- Study the effects of horizontal and vertical resolutions, domain size, dimensionality, subgrid-scale parameterization, microphysical processes, and numerical methods on the simulation of boundary-layer processes
- Understand how the MMF represents the boundary-layer processes
- Develop an improved parameterization of the boundary-layer processes for CRMs and MMFs

Strategy

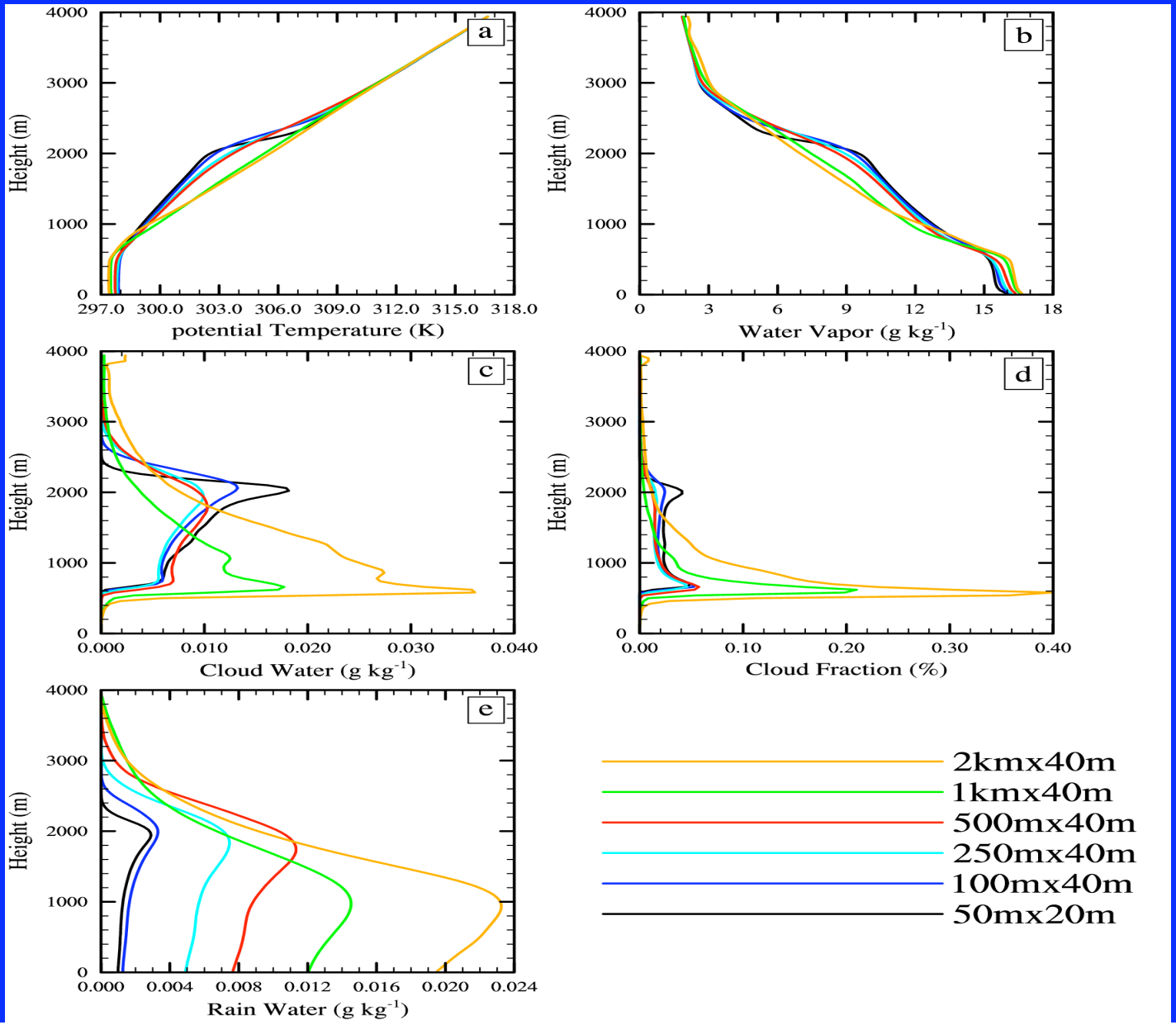
- Simulate all major GCSS boundary-layer cloud cases by changing several aspects (resolution, domain size and dimensionality) of model configurations
- Utilize a variety of models: fine-LES, LES, CRM and SCM
- Test the lower-order and higher-order turbulence closure schemes
- Test one- and two-moment microphysical schemes

Strategy for testing resolution sensitivity

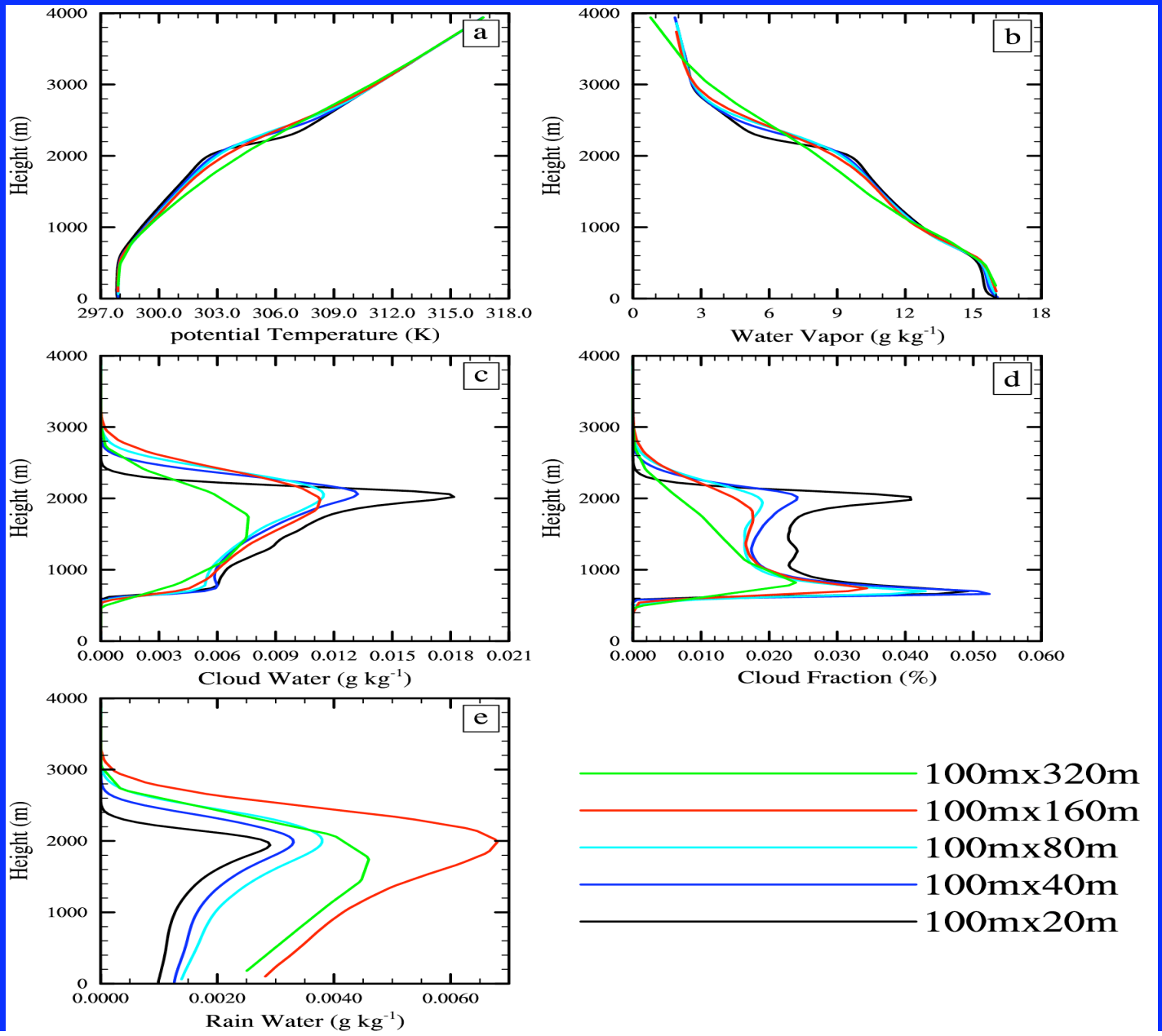


Preliminary results for the RICO precipitating cumulus case

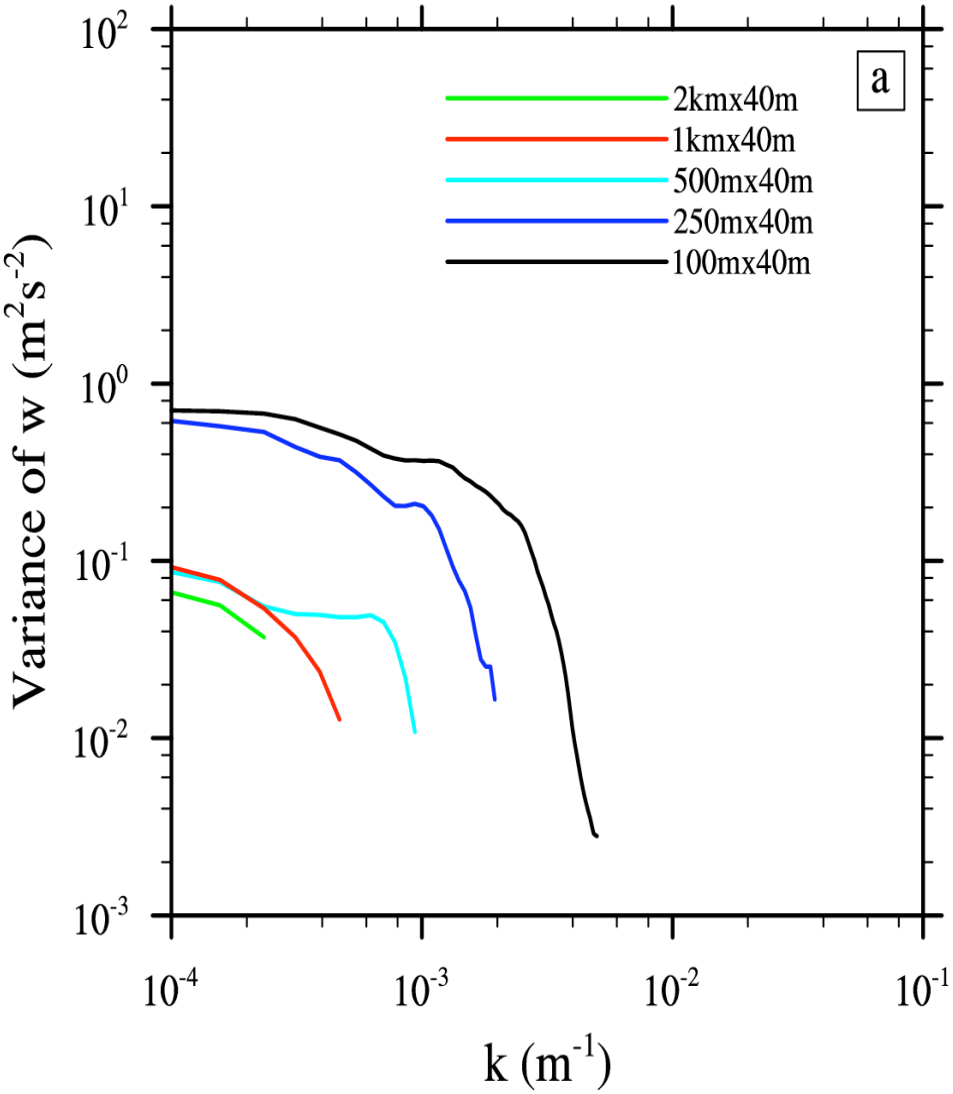
Sensitivity to horizontal resolution

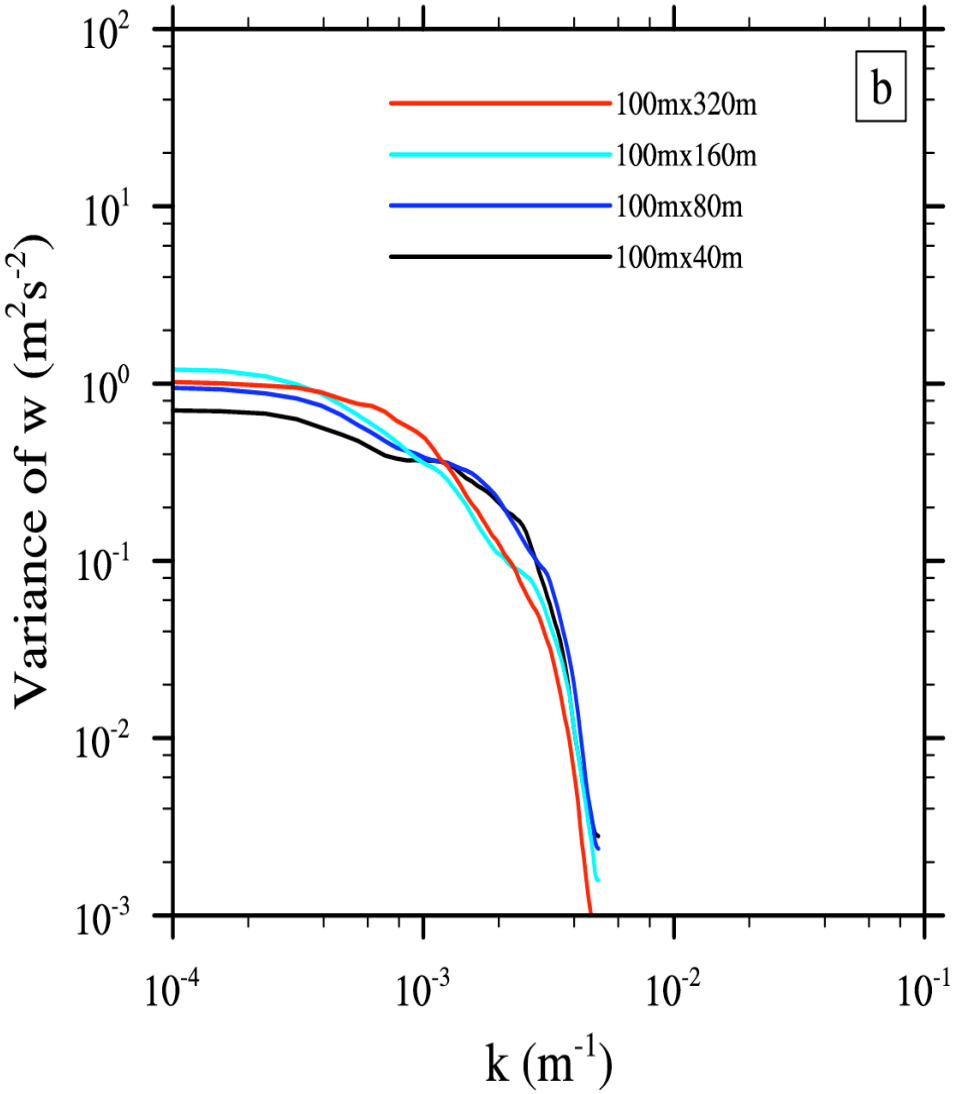


Sensitivity to vertical resolution

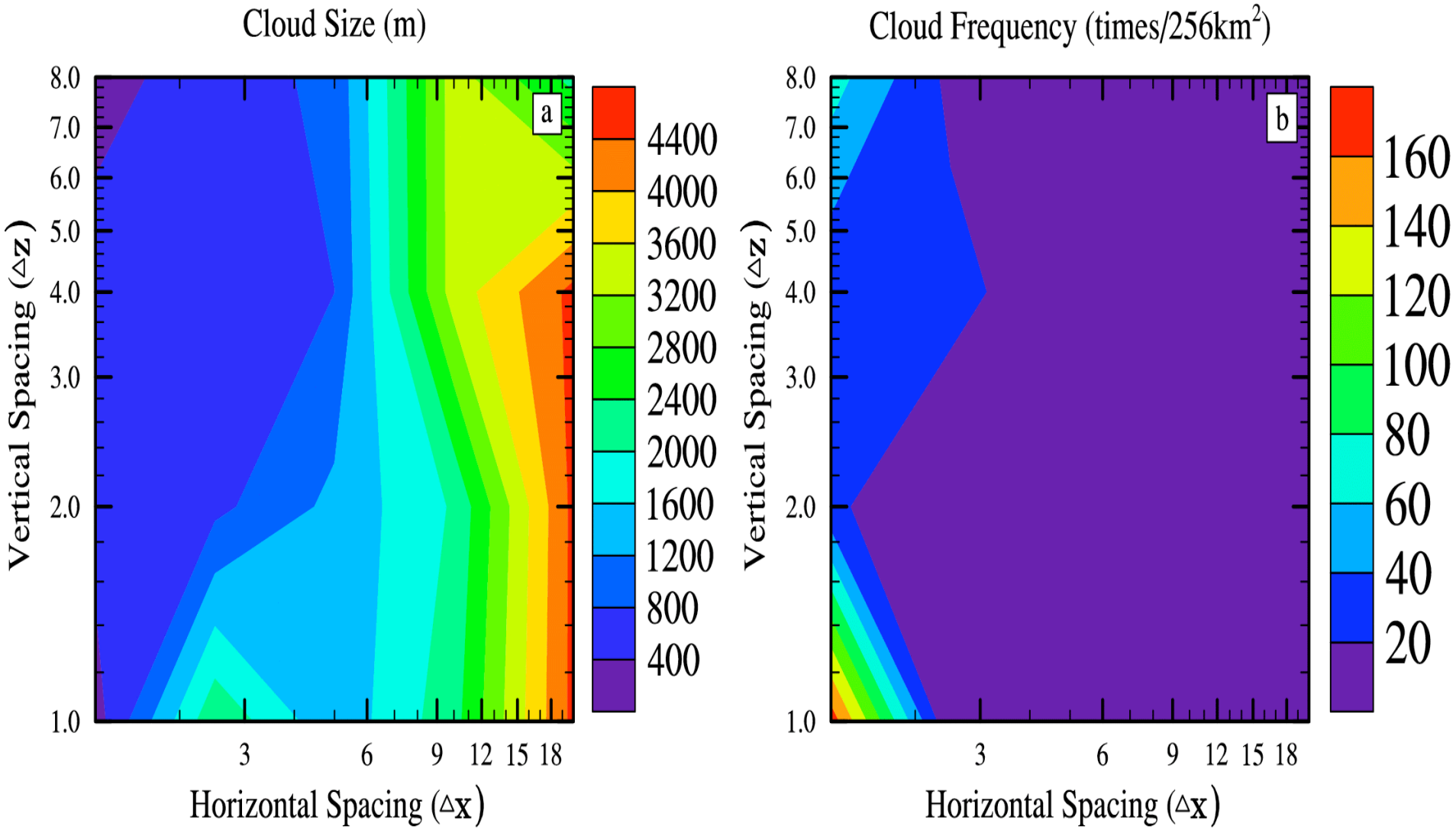


Power spectra of w at 900 m at last hour

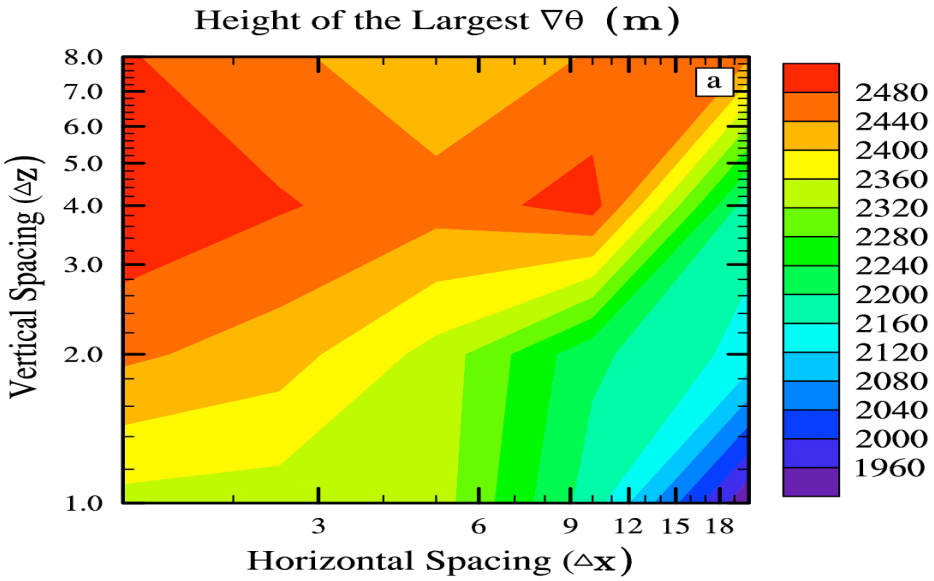


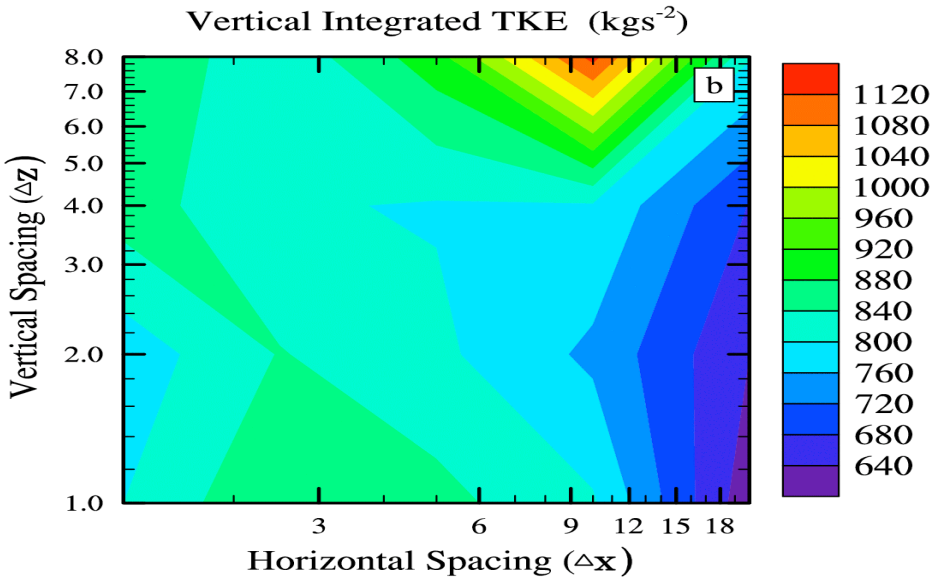


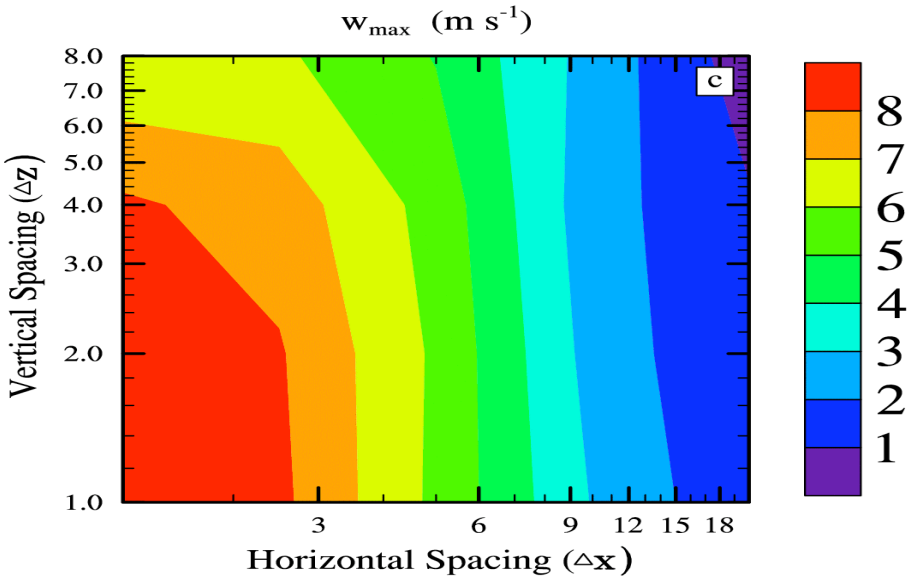
Sensitivity of cloud statistics to both horizontal and vertical resolutions

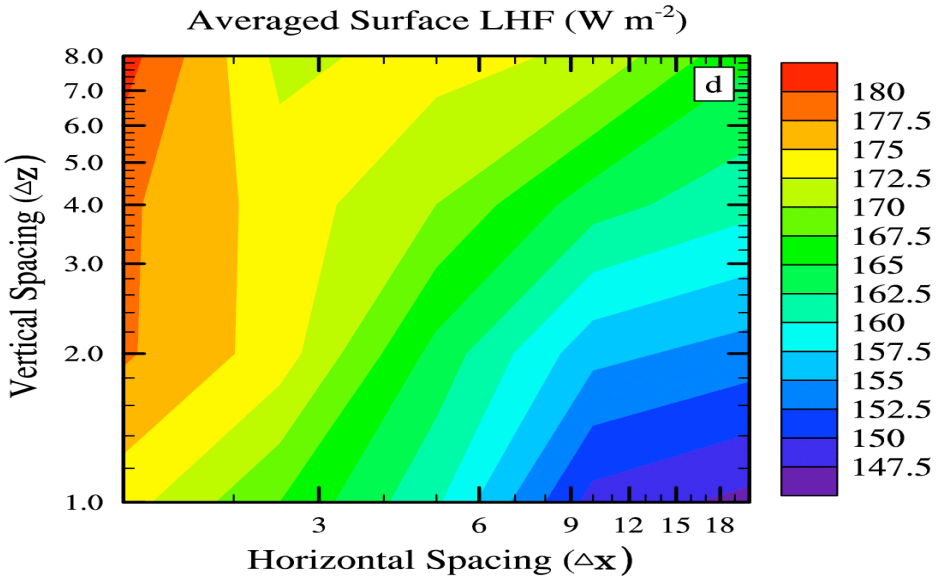


Sensitivity of Z_i, TKE, W_{max} and LHF to horizontal and vertical resolutions









Summary and discussion

- Summary for RICO precipitating cumulus

✓ Sensitivity of the mean profiles and other cloud statistics to the horizontal grid spacing is much greater than to the vertical grid spacing

✓ At coarse resolutions, the simulated mean profiles and cloud statistics are very different from the benchmark LES simulation

✓ Dependencies of the 2-D results on both horizontal and vertical resolutions are similar to those of the 3-D results (not shown)

- Next step

✓ Simulations and analyses of other GCSS cases

✓ Analysis of updraft and downdraft properties, entrainment rate, buoyancy and circulations

✓ Improving subgrid-scale parameterizations in CRMs

Thank You!