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Regional Superparameterization in a Global Circulation Model Using Large Eddy Simulations

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Supporting Information for "Regional superparameterization in a Global Circulation Model using Large Eddy Simulations"

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Additional Supporting Information (Files uploaded separately)

Introduction

Additional simulations

Three figures S1...S3 show additional simulations started at three different times. The figures show a time sequence of cloud liquid water and ice profiles at the grid point closest to the Cabauw measurement site. Profiles from superparameterized OpenIFS and from the standalone version are shown, together with cloud base and cloud top height measurements from Cloudnet at the Cabauw site.

For S1, the date 2012-04-18 was chosen for low cumulus clouds over the simulation area. For S2 (2010-01-30) and S3 (2013-12-15), the initial states were originally prepared for simulations in other regions. They turned out to have mostly low clouds over the present area of interest, so they were included here. We note that the clouds extend above the top of the local model in S3, which may impact the results.

In the final row of S1, the superparameterized simulation produces higher clouds than OpenIFS, as was also seen in figure 8 of the main article. At the beginning of S1 and the end of S3, the situation is reversed and standalone OpenIFS generates higher clouds than the superparameterized simulation.

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The Cloudnet measurements of cloud top and base heights were obtained with radar and lidar at Cabauw. The cloud base and top heights shown in the plots are averaged over a 30 minute time window centered at the time point of interest, and shown if there were at least 10 measurements recorded in the time window. When multiple cloud layers are present the cloud top height measurement reports the value for the highest layer, if this is above the vertical range of the graphs (4 km) the cloud top height is not shown.

Comparing this measurement and the simulation is complicated because they concern different spatial scales. The liquid water profiles from the simulations are horizontal averages over one grid column (about 40 km), while the Cloudnet instruments have fields of view of 3° or less, resulting in a length scale of 100 m at 2 km height (considerably less for the lidar).

Animations

Three movies of superparameterized simulations are included as supporting information — one for each of the runs discussed in section 4 of the main article and listed in table 3. The first movie, S4, shows the main simulation discussed in the article: the horizontal extent of the local models is 40 km × 40 km (200 × 200 grid cells), matching the grid-point distance of the global model.

The two remaining movies S5 and S6 show accelerated runs. Both of them were run with the horizontal extent of the local models reduced to 12.8 km × 12.8 km (64 × 64 grid cells). For S6, the mean-state acceleration method was applied, with an acceleration factor 2.

All three runs start at 2012-04-13, 00:00 UTC, and cover 21 h.

**Movie S4.** Superparameterized simulation with full-size local models.

Movie S5. Superparameterized simulation with reduced horizontal extent of the local models.

Movie S6. Superparameterized simulation with reduced horizontal extent of the local models and mean-state acceleration.
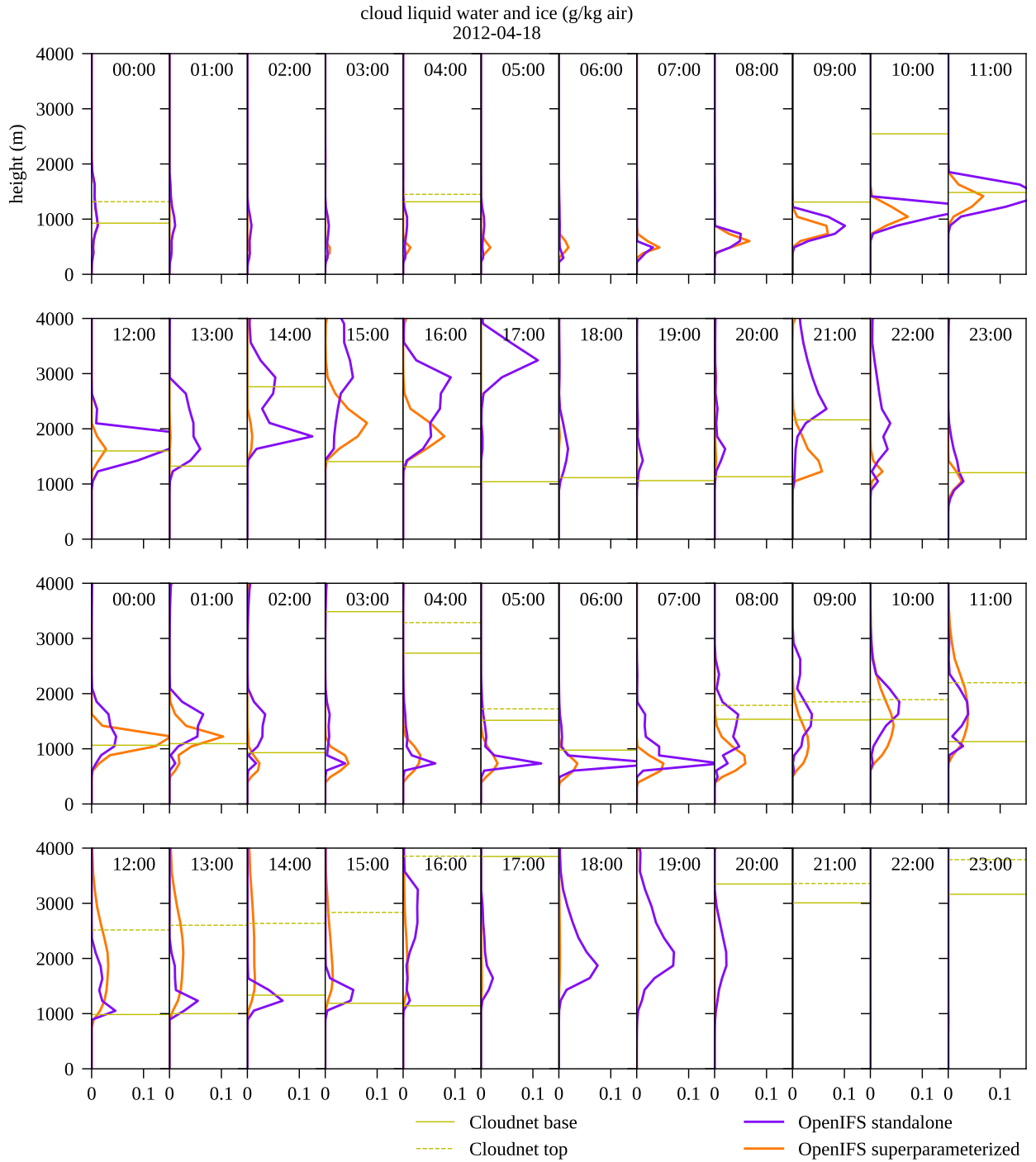
Figure S1. Vertical profiles of cloud liquid water content, for a 48 h simulation started at 2012-04-18, 00 UTC

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Figure S2. Vertical profiles of cloud liquid water content, for a 48 h simulation started at 2010-01-30, 00 UTC
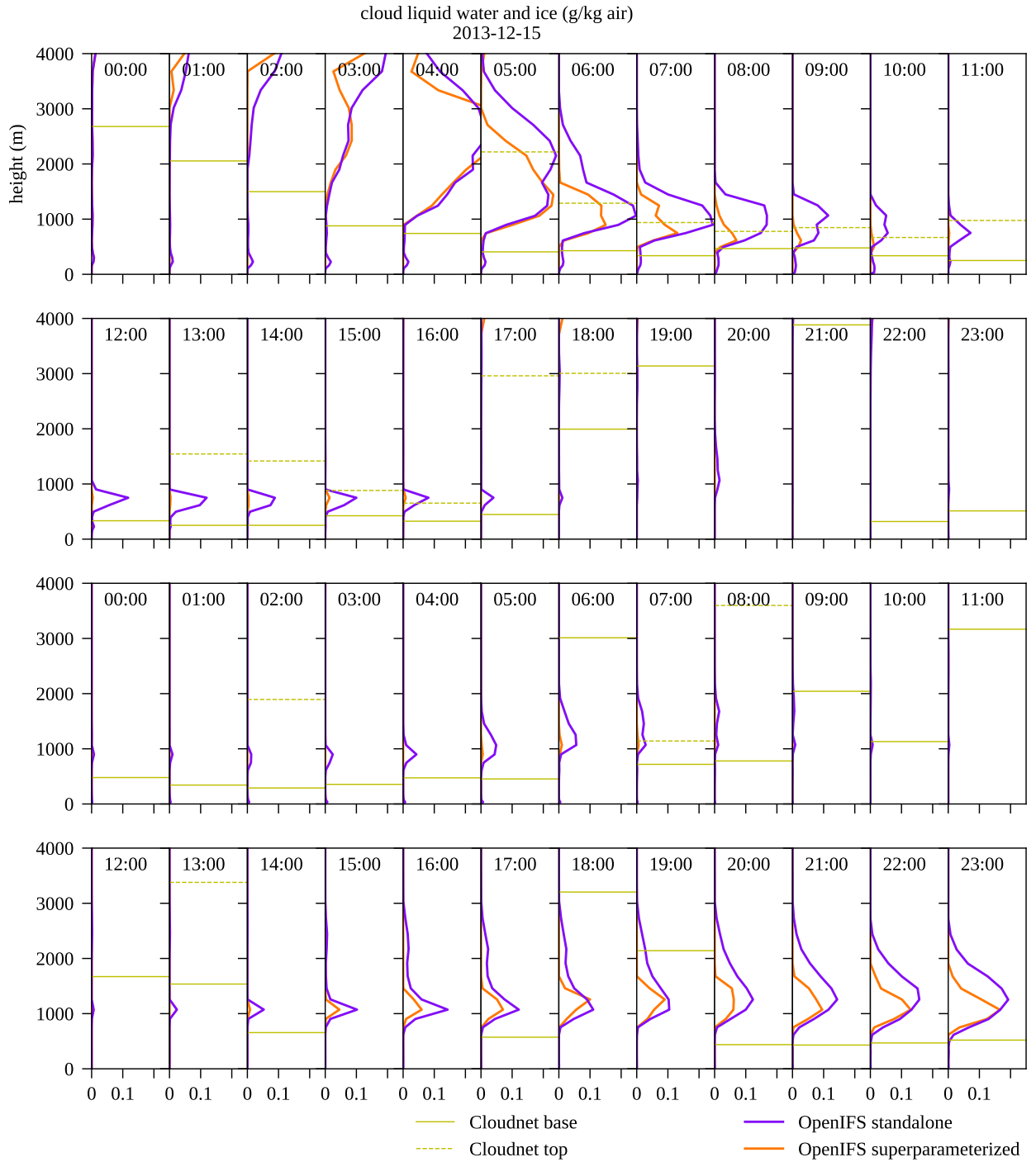
Figure S3. Vertical profiles of cloud liquid water content, for a 48 h simulation started at 2013-12-15, 00 UTC

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