

Interactive comment on “Simulation of mixed-phase clouds with the ICON-LEM in the complex Arctic environment around Ny-Ålesund” by Vera Schemann and Kerstin Ebell

Anonymous Referee #1

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General comments

This manuscript uses observations from a high-latitude site in the Arctic to determine how well high-resolution models can represent clouds in this region, especially mixed-phase clouds. The major objective is to assess the improvement that higher-resolution modelling provides for capturing mixed-phase clouds, and also investigate the spatial representativity of vertical profile measurements from a supersite, particularly in these regions with complex orography and heterogeneous surfaces. The methodology is relevant with the results of clear importance to the community, and the comparison between different forcing datasets is also of interest, although this aspect is not ex-

C1

plored deeply in this study. This manuscript is almost ready for publication, with a few technical aspects to correct and a few minor points to consider

Minor comments

It is clear that this is a preliminary study highlighting some important features rather than an exhaustive study. There is an attempt to provide quantitative rather than merely qualitative measures for assessing the improvement that higher resolution provides, however some more detail could be presented. For example, Fig. 6 shows the output of PAMTRA compared to observations and there seems to be some issues with the microphysical parametrizations used. How about checking how well bulk quantities such as cloud fraction or IWC compare? These should not be so dependent on the CCN/IN parametrizations used in PAMTRA and would show whether the model at least has the bulk properties correct.

Figure 8 shows that all model resolutions show a similar gradient in the LWP power density spectrum for high frequencies, which is presumably due to the numerical dissipation (with the gradient depending on the scheme). Can the effective grid-scale resolution be determined from these plots? I.e. what approximate multiple of the grid resolution are scales resolved? This is also useful to know when discussing representativity of individual columns.

Technical comments

Title and elsewhere: Suggest replacing 'the ICON-LEM' with 'ICON-LEM' or 'the ICON-LEM model'.

Line 2: Add hyphen to 'mixed phase'.

Line 18: Replace 'currently' with 'currently being'.

Line 28: Replace 'measurements' with 'measurement'.

Line 39: Replace 'has been' with 'was'.

C2

Line 40: Remove 'now'.

Line 42, 102: Replace 'those' with 'these'.

Lines 46-48: Suggest rephrasing this sentence.

Line 49: The 'parametrizations of CCN and IN'.

Line 59: Reference missing year.

Lines 67, 72, 81, Fig. 1 and elsewhere: To be clear, state 'horizontal resolution', especially in the setup section, and also specify the typical vertical resolution of the model at the altitudes the mixed-phase clouds are present.

Line 79: Replace 'we are showing' with 'we show'.

Line 89: Replace 'inner part of the domains' with 'inner domain'.

Line 94: Replace 'stays due' with 'stays constant due'.

Lines 110-114: Please include a reference to this instrument and the settings employed (e.g. Nomokonova et al., 2019).

Line 131: Replace 'as a first and easy' with 'for the initial'.

Line 135: Suggest rephrasing slightly; e.g. 'benefits from a a good representation of the large-scale atmospheric forcing in the NWP data'.

Line 143: Replace 'initialization' with 'model initialization'.

Line 175: Remove both commas on this line.

Line 180: Insert 'model' behaviour.

Line 181: Insert 'of' how well.

Line 184: Replace 'at the' with 'on'.

Line 187: Replace ', not only within one height' with 'at all heights simultaneously'

C3

Line 196: Insert 'number concentrations', i.e. 'ice nucleation particle (IN) and cloud condensation particle (CCN) number concentrations'.

Line 207: Replace 'increased' with 'increasing'.

Line 237: Remove comma (both sea ice and ..).

Lines 284-286: This sentence can be removed.

Acknowledgements: Include reference to ACTRIS for providing the Cloudnet output.

Line 302: Replace 'it's' with 'its'.

Figure 2: Centre panel title states 78 m whereas caption states 75 m.

Figure 4: I assume that 'latbc' in the panel titles refers to 'lateral boundary conditions'. This could be added in the figure caption.

Figure 7: For clarity, please explain in the caption that the concentric dashed circles represent the outer limits of the various domains (presumably), the coastline is indicated by the solid black line Ma, and also state that X marks the location of Ny Ålesund. The first panel is (upper) not (right), at least in this preprint.

Figure 9: Make it clear in the caption that the different symbols in the right panel refer to the surrounding grid points in each sub region. It's also challenging to identify subregion 1 in the left panel.

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C4