

Review of “Processes contributing to Arctic cloud dissipation and formation events that bookend clear sky periods” by J. Sedlar, A. Igel, and H. Telg.

Submitted manuscript version 2.

Ian M. Brooks

Overview

This revised manuscript is a significant improvement on the original. The major issues raised in my original review have been addressed. The result remain somewhat inconclusive, but nevertheless the extensive documentation of cloud, aerosol, thermodynamic, and large scale dynamic conditions are a useful contribution to the field.

I recommend that the manuscript is suitable for publication after minor revision. Detailed comments to be addressed are noted below.

Detailed comments

Line 11 – “A suite of remote sensing and in situ instrumentation from the high-latitude observatory are analysed;...” -> “Measurements from a suite of...are analysed;...” – the measurements are analysed not the instruments.

Line 14-15 – “the clear period bookends” – ‘bookends’ here is a rather casual, and not entirely clear, term. Maybe rephrase to something like ‘...aerosol....is relatively invariant during the periods bookending clear sky conditions’

Line 20 – “aerosol particles concentrations changed by a factor” – a factor of what? Need a value (and sign) of the change here

Line 40 – “effective infrared cooling from the surface results in near-surface temperatures to drop” – grammar, ‘to drop’ doesn’t fit with the rest of this statement -> “effective infrared cooling from the surface results in near-surface temperatures decreasing”

Line 108 – “tropospheric clouds were common” – tense doesn’t match first part of sentence -> “tropospheric clouds are common”

Line 137 - “although some concentrations may” – a very vague statement, need more detail. ‘some’ concentrations...high, low, variable but under some particular conditions?

Line 141 – “its measurement is sensitive volume squared” – grammar – “its measurement is sensitive to particle volume squared”

Methods

Line 172 – “...condition was not met, the clear period was discarded...” – suggest changing wording to “...condition was not met, the period was discarded...”, if the period is discarded because of intermittent cloud then it’s not really a ‘clear’ period for the purposes of this study.

Line 228-238, discussion of figure 3 – the processes mentioned as possible causes of the drop in aerosol backscatter between BL and overlying air are all reasonable. An additional factor may be the typical decrease in humidity across BL top. For hygroscopic aerosol, particle size can change significantly with relative humidity (ballpark values are a doubling between ‘dry’ and 80% RH, and another doubling between 80% and ~100% RH for particles such as sea salt), this might lead to a drop in backscatter across BL top even for an aerosol population that was uniform in concentration and dry radius across the inversion. This is, of course, highly dependent on aerosol chemistry, and change in RH across BL top, and not quantifiable here, but worth keeping in mind.

Figure 4 – some of the panels show colours (at high backscatter) outside the range indicated on the colour bar.

Line 347 – “...these clouds often modulate the stratification due to cloud top radiative cooling and induced turbulence...”

- i) This phrasing is ambiguous – not clear if the meaning is that the stratification itself, or the modulation of the stratification, is due to cloud-top radiative cooling,
- ii) The stratification referred to (or implied by the preceding statement) is the ‘static stability near the surface’ – I’m not sure that cloud-top radiative cooling and associated turbulent mixing impacts strongly (or in some cases at all) on the near surface stratification. That is much more strongly influenced by the simple presence of cloud and whether the surface itself is cooling radiatively (clear skies) or not (cloudy skies). Cloud driven turbulence will certainly impact BL thermodynamic structure as a whole, and might extend to the near-surface layer, but is only one of several factors affecting surface stability.

Line 354 – ‘950 hPa level is generally around 500 m AGL in the Arctic, which *frequently* encompasses all, or a fraction of, the Arctic atmospheric boundary layer and the sub-cloud mixed layer’ – rather loose and partly redundant phrasing. The lowest 500m must always encompass at least part of the BL. It will often encompass at least part of the sub-cloud mixed layer – though since your focus here is on cases where cloud base is $\leq 400\text{m}$, it must also always encompass the sub-cloud layer for all cases considered here.

Line 485 – ‘Little changes in the vertical structure...’ -> ‘Little change in the vertical structure...’

Line 525 – ‘...prior in...’ -> ‘...prior to...’