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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Synoptic development during the ACLOUD/PASCAL field campaign near Svalbard in spring 2017" *by* Erlend M. Knudsen et al.

Anonymous Referee #2

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The manuscript presents a thorough description of synoptic-scale weather and sea ice conditions during a major field campaign in the Fram Strait region. Several complementary points of view are taken to characterize the synoptic conditions, and plenty of relevant analyses are carried out. The manuscript has a high potential to become an excellent paper, but substantial revisions are needed first.

Major comments

1. Introduction is good from the points of view of the Arctic climate system, climate modelling, small-scale physical processes, and field campaigns. However, much more attention should be put on synoptic-scale meteorology in the study region. What is

known and what are scientific challenges in the field?

2. The manuscript is entitled "Synoptic development during ACLOUD/PASCAL field campaign near Svalbard in spring 2017", but there is, in fact, very little attention to synoptic-scale dynamics. With the present title, a reader expects to learn, among others, about the mechanisms (such as baroclinic instability) affecting cyclogenesis and cyclolysis during the study period, and what was the role of the jet stream in steering the cyclone tracks. For example, on page 7, a careful description of the evolution of the synoptic situation is given, nicely linking synoptic conditions and point measurements during the campaign, but there is no deeper analysis on why the synoptic conditions developed as they did.

3. The results of the different analysis methods applied are not well linked to each other. I appreciate the analyses on in-situ and satellite observations, weather classification, air-mass distribution, atmospheric circulation and thermodynamics, clouds, and sea ice dynamics. However, the results should be put better together to summarize the synoptic development during the study period.

4. The manuscript includes a lot of information that will certainly be useful for those working with ACLOUD/PASCAL data, but its usefulness for a broader scientific community is not equally clear. To deserve publication in a high-level peer-reviewed journal, such as ACP, the manuscript should be useful for a broader community. This challenge can probably be met via a careful concern on topics 1 to 3 above and a proper discussion on the purpose of the manuscript.

Minor comments

Title: Consider replacing spring by early summer.

Page 1, line 10: . . . two cases of warm-air advection. Page 1, line 11: What is "westerly air"?

Page 2, line 6: Consider referring to Pithan and Mauritsen (2014)

Page 2, line 20: are the key

Page 3, line 21-22: Briefly describe the the “particularly marked climate changes”.

Section 2.3: were any data collected on sea ice thickness?

Page 6, line 7: . . . reanalyses and operational analysis data . . .

Page 6, lines 9-10: Unclear sentence

Page 6, line 19: ECMWF operational analysis

Page 8, line 3: Clarify the sentence with “. . . surface cooling during warm-air advection . . .”.

Page 9, line 19: objectively or subjectively chosen?

Page 11, line 26: Briefly describe what is the potential emission sensitivity.

Page 12: If airmass flows over Spitsbergen or Greenland, it first experiences adiabatic coolinf during the ascent, and then adiabatic warming during the descent. Your attention seem to be resctricted to the latter. Why? Further, do you catch the true adiabatic warming/cooling effects, if you integrate PES in the vertical?

Page 12, lines 26-28: Explain better. All radiosondes enter the free troposphere whether there are mountains or not.

Page 13, lines 8-12: The paragraph is very unclear. Clarify what is the effect of sea ice on the specific humidity in the lowermost 300 hPa.

Page 15, line 15: over the open ocean?

Section 4.4: Add brief characterization on fog conditions.

Line 17: Better explain the association with colder and wetter conditions in mid-latitudes. Which season you refer to? The all paragraph on AO makes more sense for winter than summer. In winter, Arctic cold-air outbreaks are typically associated

with cold and dry conditions in mid-latitudes.

Section 5.1. I wonder if AD, as defined by Wu et al. (2006) and Wang et al. (2009), is the best metrics to characterize meridional circulation patterns and atmospheric forcing on sea ice drift in the Arctic. See Vihma et al. (2012, GRL) for various weaknesses of AD. The Meridional Circulation Index (Francis and Vavrus, 2015, Env. Res. Lett.) may be a much more relevant metrics. Note that it can also be calculated on the basis of mean-sea-level pressure.

Page 21, lines 4-5: The sentence could be clarified. How would you characterize the long-term background forcing of the Arctic amplification on atmospheric circulation? It is fairly trivial that short-term variability in circulation is stronger than this forcing, which is not yet well known.

Page 21, lines 17-18: What do you meant by synoptic forecasting in climate models?

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