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Comment on acp-2021-478

Anonymous Referee #2

Referee comment on "The foehn effect during easterly flow over Svalbard" by Anna A. Shestakova et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-478-RC2, 2021

The paper investigates a particular epsisode of easterly winds passing over and around Svalbard end of May 2017. Observations from various instruments and platforms (airborne, shipborne, and ground-based sensors as well as radiosondes) are combined to document the mesoscale processes in the vicinity of Svalbard during the easterly airflow episode.

Although the paper is generally well written, easy to understand and follow, the presentation of the material seems rather lengthy and redundant in some parts. There is a long introduction that focuses on climate impacts and Arctic amplification. Well, that's the framework, but the paper doesn't make a conclusive contribution to the issue. And then there is the leeward warming, which is looked at in too much detail for my understanding, since it is a known phenomenon. A novel aspect would be for the authors to present a Lagrangian analysis of the temperature and moisture evolution of air parcels starting upstream. This approach could really help to distinguish between the large-scale warming and the mesoscale effect due to the flow past the mountains. Indeed, the mesoscale numerical simulations are available and could easily be used to conduct such an analysis.

While browsing the literature on Svalbard, the reviewer came across a paper by Dörnbrack et al. (2010), who also studied a very similar episode of easterly airflow in this journal (Dörnbrack et al., 2010). Although they focused on aerosol distribution from airborne lidar measurements (incidentally using the POLAR 2 aircraft, a predecessor of the current AWI fleet used in the current study), they also discuss most of the phenomena studied in the current paper by Shestakova et al. (especially, the "orographic modification of the flow and of the atmospheric boundary layer during easterly flow over Svalbard." (line 94/95) as e.g. the formation of a "warm" wake in the lee of the mountains, the tipjet that forms on the northern edge of Svalbard, ...) . And there are also similarities in some of the diagrams: cf. current Fig. 7 in this paper and Fig. 9 in Dörnbrack et al. I think the authors should really try to better highlight the novelty of their analysis in a revised version of the paper. In my view, two points could be the central focus: first, the well-done energy budgets, and second, a Lagrangian analysis, as indicated above.

Minor Comments

line 170-172: this is one of the too speculative sentences that could be strengthened by a more detailed analysis (the Lagrangian analysis referred to above) and its subsequent incorporation of the results into the content of the paper

lines 194: the Kvitoya station is missing in Figure 6; generally, the temperature rise increases already before, much earlier than in the time window as shown in Figure 6, see Figure 4; so, the respective discussion should be modified

Figure 7: the labels on the left axes are misleading, since there is obviously no reference to the lines in the image

Figure 9: dotted -> dashed

line 416: Is the snow really melting there at these temperatures or it is mostly drifting away or evaporating?

References

Dörnbrack, A., Stachlewska, I. S., Ritter, C., and Neuber, R.: Aerosol distribution around Svalbard during intense easterly winds, Atmos. Chem. Phys., 10, 1473–1490, https://doi.org/10.5194/acp-10-1473-2010, 2010.