Review of **"Foehn effect during easterly flow over Svalbard"**
by Shestakova, Chechin, Lüpkes, Hartmann and Maturilli, ACP

The authors document a case study of a well-defined foehn event from May 2017 over Svalbard. The event is described using an impressive array of observational platforms, including flight-level and dropsonde observations from an aircraft, surface-layer and radiosonde observations from a research vessel and surface-layer and radiosonde observations from Svalbard. The observations are complemented by output from WRF simulations.

Overall, the paper presents the most comprehensive description and analysis of a foehn event over Svalbard that I have seen, and nicely expands the locations where foehn events have been well documented. The case is compared to those found over the Antarctic Peninsula and this comparison is useful and appropriate. Overall, this is a carefully conducted study with several important findings. It is generally well written, and the quality of the presentation is excellent. I have some minor comments and suggestions, which are generally aimed at improving the presentation.

Specific Figure suggestions:

Figure 1 - Are all the place names used in this figure?

Figure 4 – I wasn't sure this figure was necessary for the paper. The Polarstern is moving a lot during this period and a shorter time series is given in Fig 5. The winds at Ny Alesund show the foehn period, but also show elevated wind speeds on 29 May, which aren't really discussed. Not sure this is needed.

Figure 6 – there is a bit of a mismatch between the names on lines 190-191 and the names in Figure 6. "Verkegenhuken" is not shown on Fig 6. You could consider showing the upstream temperature from Kvitøya on Figure 6, and changing upsteam to be blue, downstream to be red. Maybe rephrase caption, "temperature change from 'initial' time at each individual AWS station, where the initial time is 00 UTC 30 May".

Figure 7 – I'm not sure what wind speed is plotted here? Is it a 'maximum' (better than 'maximal') wind speed?

Figure 9 – I think this could be more clearly presented. Add a location map as another panel. Maybe choose colours so 'cold' colour is upstream and 3 'warm' colours are the 3 downstream locations.

Figure 10 – The layout here is a little confusing. a) and b) compare two soundings in approximately the same location. But c) compares two soundings in different locations and one of them is the same sounding as panel b). I'd be tempted to merge (b) and (c) – but make it clear in the caption that the first sounding is in a different location. I'd also redo this figure with a different colour scheme, so first profile blue, then foehn and after-foehn profiles as red and magenta (as 'warm' colours). Rephrase caption to be clear.

Figure 11 – I'd recommend adding sea-ice concentraton to 11b.

Figure 13 – I'd recommend adding a zero line to the bottom panels. Caption should mention these are net SW and net LW. I'd move 'albedo' to end of the sentence about top panels, as it is the right hand axis.

Figure A1 – The caption needs improving. Make it clear that observations are solid line and WRF simulations are dotted lines and squares for WD? You comment on fact tht WRF underestimates the air temperature. But is is also poor for wind speed at Ny Alesund for some of this period. You maybe want to comment on that? I guess it is an area of complex orography so 10-m wind speed is challenging.

Minor Suggestions

Line 1 – I'd suggest adding a "**The** foehn effect.." to the title.
L17 – "downwind of Svalbard"
L19 - "A positive… budget at the surface…"
L30 – "Altogether, this results in the highest…Europe being observed in …"
L40 – delete "the"
L53 – could also cite Elvidge et al. (2020) here, this is a relatively new paper which focuses on surface energy budget over the Antarctic Peninsula; and also Turton et al. (2018) which used AWS observations to investigate foehn winds in this area.
L69 - I'd rephrase as southern Greenland tip jets (plural) because there are both westerly jets (Doyle and Shapiro 1999) and easterly tip jets (e.g. Renfrew et al. 2009; Outten et al. 2009).
L76 – it may be pertinent to cite a more general paper, such as a review paper, when discussing hydraulic jumps, e.g. Durran (1990); Smith (1989).
L77 – the horizontal pressure gradient is down the slope. not along it.
L103 – delete "used" and, edit to be "section 2.1 and the setup… "The synoptic background…" Then each sentence is about each section.
L117 "Information about the observations…"
L121 "a series of …"
L166 "reached a maximum"
L199 – I'd rephrase "Obviously" as we are still at the beginning of the paper and you haven't presented evidence that it is obvious to the reader yet.
L217 – "over southern Svalbard"
L232 – start a new paragraph here, with "The vertical…
L261 – you cite "profile 1 in Fig 9" here, but that is the upwind profile, did you mean to cite another (downwind) profile? Incidentally, I don't think you really need Figure 2 – it is not that useful. Instead I'd consider just plotting the domains 2 and 3, as a second panel for Fig 9, so that it is easier to see where these profiles are located when looking at Fig 9.
L294 – "the North"
L295 – I would rephrase, the diagram doesn't "clearly show the downward propagation" because it is a snapshot in time.
L298 – you note the sea-ice here – I think it would be helpful to mark sea-ice concentration on Fig 11b.
L301 – "downwind of the mountains"

L303 – rather than “advective origin” perhaps you mean “large-scale flow” or something?
L306 – I’d rephrase as “increase of the BL height to the North” – so it is not ambiguous
L319 – delete “a”
L286 – I’d be clear that you are plotting **net** SW radiation
Figure 13 – I’d mark the zero line on the bottom panels, it would enable easy comparison of T_surface against 0.
L422 – “was large”
L443 – “conclude” is the wrong word here, because there is an element of hypothesis here, so I would say “we surmise”
L458 – “cloud”

References

Durran, D. R. (1990). Mountain waves and downslope winds. In *Atmospheric processes over complex terrain* (pp. 59-81). American Meteorological Society, Boston, MA.

Elvidge, A. D., P. Kuipers Munneke, J. C. King, I. A. Renfrew, E. Gilbert 2020: Atmospheric drivers of melt on Larsen C Ice Shelf: surface energy budget regimes and the impact of foehn, *J. Geophysical Research: Atmospheres,* **125,** e2020JD032463. doi:10.1029/2020JD032463

Outten S.D., I.A. Renfrew, and G.N. Petersen, 2009: An easterly tip jet off Cape Farewell, Greenland. Part II: Simulations and dynamics, *Quarterly J. Royal Meteorol. Soc.,* **135,** 1934-1949.

Renfrew, I.A., S.D. Outten and G.W.K. Moore, 2009: An easterly tip jet off Cape Farewell, Greenland. Part I: Aircraft observations, *Quarterly J. Royal Meteorol. Soc.,* **135,** 1919-1933.

Smith, R. B. (1989), Hydrostatic airflow over mountains, *Adv. Geophys.,*31, 1–41, doi:10.1016/S0065-2687(08)60052-7.

Turton, J.V., Kirchgaessner, A.,Ross, A. N.,&King, J.C. (2018). The spatial distribution and temporal variability of föhn winds over the LarsenC Ice Shelf, Antarctica. *Quarterly Journal of the Royal Meteorological Society*, 144(713), 1169–1178. https://doi.org/10.1002/qj.3284