

Interactive comment on “Global Hawk dropsonde observations of the Arctic atmosphere during the Winter Storms and Pacific Atmospheric Rivers (WISPAR) field campaign” by J. M. Intrieri et al.

Anonymous Referee #3

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This paper describes a first application of the NOAA Global Hawk with a new dropsonde system during a flight into the Arctic at high altitude. Some comparison to reanalysis data is also given. While I think it will be a valuable contribution to this journal, the paper would benefit from a more critical discussion of some aspects of the platform and system. Also I suggest a reorganisation of the comparison to reanalysis data, and changes to of some of the figures to improve clarity of the presentation. These points are further detailed below.

Major issues:

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1. The comparison to reanalysis data is now given in the end in Sec. 4.3. It would be much clearer to move the general explanation of the reanalysis data (first paragraph of 4.3) to a new section 3. The comparison to the polar vortex and boundary layer structure can then be added as subsections to what is now 4.1 and 4.2, respectively. This is because when looking at the figures one has already done the comparison to the reanalysis by eye, and it makes sense to discuss this right away.

2. A more complete and balanced description of the capabilities of the platform (Global Hawk) should be given. Right now there are several sentences in the manuscript that read in my opinion too much like unbalanced praise, and the limitations are only mentioned on the side (such as the problems with cold temperatures). I would recommend a paragraph that more clearly describes the actual niche that can be taken by the Global Hawk, compared to manned research aircraft. This should cover aspects such as which airspace is actually available to drones according to current legislation, nationally and internationally, what the cost per flight hour is, which airports can be used, which flight levels or altitudes the drone is allowed to operate in, how much planning in advance is required. For example, is it feasible to plan a flight one day or less ahead of the launch, or is the drone more suited to pre-programmed repeatable flight patterns?

3. Give more concrete objectives for the WISPAR mission, what has been targeted, in what aspect? There is no presentation of the drop sondes from the atmospheric river in the manuscript, this should be clearly mentioned. On the same note, the title is therefore somewhat misleading in my opinion, since it prominently states "winter storms and Pacific atmospheric rivers" but nothing to that effect is actually presented. One solution may be to leave the acronym in the title, but to remove the full description. Also, in the abstract it should be clarified that no material relating to the meaning of the WISPAR acronym is presented in the manuscript.

4. I am not sure what the authors make a point about validating reanalyses. Usually one would want to ingest all available observations into the data assimilation system, rather than acquire separate data to perform validation. Data denial experiments may

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be a possibility to do such validation. Also, the data sparsity of the Arctic is not significantly larger than in many other areas of the world. For example, there are a number of regular sounding stations in the Arctic (see attached figure 1), and polar orbiting satellites provide quite dense observations due to overlapping tracks. It surely is a harsh environment, but probably more densely sampled than for example parts of the southern Pacific.

5. Fig. 4 and the respective discussion should be split into two parts. A first part could compare the (vertically enlarged) interpolated drop sonde curtains to differences for the same curtains interpolated from reanalysis data. A second part in a separate figure could focus on the 11km transects. You could make the point here what targeted observations may have to offer if the jet position or strength, for example, show marked differences to the reanalysis.

6. All figure panels should have labels, and be referred to by the panel label from the text. I suggest to use a normal weight font in all figures. Some figures are too small and need to be split and enlarged (Fig. 4-7, see detailed comments).

Detailed comments:

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L 24: This is a long list of objectives, and should be more focused - validation of reanalyses seems a bit far fetched. Most direct are rather targeted observations, i.e. (3). (2) is not exemplified in the paper altogether.

P. 4072

L. 6: Report about any general parameters (p, T, q, images, radiation) that may be measured in situ by the NOAA/NASA Global Hawk.

L. 20: give frequency in Hz

L. 22: give the exact weight

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L. 23: what is the fall speed of the sonde? At which altitudes does which vertical resolution apply? What is the vertical resolution when taking into account time constants of the sensors? A table detailing the sensor package may be helpful here.

P. 4073

L. 4: give as minimum and typical separation time

L. 9: using established post-processing methods

L. 18: which kind of hygrometer (see comment above)?

L. 25: Indicate the AR with an arrow in Fig. 2

P. 4074

L. 11: "has been corrected in future sondes" - rephrase. How has it been corrected?

Fig. 4: How have the curtains been interpolated, at which resolution have the dropsondes been used?

P. 4077

L. 26: delete "etc"

P. 4078

L. 4: delete "and more"

L. 14: As far as I know ERA-Interim has 60 vertical levels. 11 grid point - do you mean 11 vertical levels?

L. 20: "amongst other things": delete and rephrase

P. 4079

L. 26: What is the sensor uncertainty for q and RH measurements at such ambient conditions?

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L. 4: "A look at individual profiles": guide the reader, using panel labels, and mentioning colors, quantities, etc.

L. 15: The lead is most certainly a feature that is not in the reanalysis, since it is a subgrid-scale feature that would require a dedicated parameterisation. You may want to check how sea ice is assimilated in the reanalysis products.

L. 24: One critical aspect is what the cost per sonde is compared to ground based soundings, taking into account the aircraft operations overhead.

P. 4081

L. 1-5: This summary paragraph appears somewhat one-sided and overly positive for a scientific manuscript.

L. 15: It is certainly nice to have a far-reaching platform to deploy sondes, but it needs to be mentioned that there are limits with respect to the airspace where this can be done. Also, it remains a critical aspect to identify the right locations where targeted observations can be performed. Some literature references should be given here, or earlier on in the paper.

Fig. 3: I can not distinguish any sea ice features from cloud in the MODIS image. Maybe a true color composit with adjusted contrast is more helpful. Add arrow indicating flight direction. Mark sondes later on shown in other figures, e.g. by dots or crosses in the circle centers.

Fig. 5: Make top panel a separate Figure, and enlarge. Again, leads can hardly be seen in this false color composite. Enlarge panels 2-5 and arrange in a square layout.

Fig. 6: Increase vertical extent of top row panels by factor of 2

Fig. 7: There are many more panels shown than are actually discussed. Consider reducing to what is actually discussed in detail.

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Fig. 1.

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