

Response to reviewer #2, second review

This is my second review of “On the impact of dropsondes on the ECMWF IFS model (Cy47r1) analysis of convection during OTREC”. The authors followed several of my concerns and I would like to thank them for the additional explanations. The revisions and revised and new Figures certainly led to an improvement of the presentation of scientific aims and data and of the discussion of the results.

The special case is much better integrated now. The paper would benefit from a connection of the special case to the findings about the cloudiness effects which would be easy to realize. The authors could show whether the profiles provide high or low brightness temperatures and how this relates to a good use of the data and a particularly strong improvement.

Response: *Thank you for the suggestion. I have updated the figure 9 (brightness-vertical departure plot) to mark the 32 points from the special case. Indeed, they show up as the majority of the largest departures in the NDPS experiment. We updated the section 4 with the discussion of these highlighted points.*

I still feel that section 5 is detached from the rest of the paper and I would have preferred more details about the special case, but these results seem to be connected with earlier work by the authors, so I understand why the section was kept.

The authors remain very vague about how the results help to improve algorithms. How can the revealed indications for an insufficient use of winds in cloudy situations be used? I guess this should be universal not only to the eastern Pacific that the highest impact is expected in low wind and divergence situations and affected by clouds?

Response: *Thank you for pointing this out. We find it is beyond the scope of this paper to address these questions in detail, and leave such work to future studies.*

When reading the paper again I found several mostly minor issues that the authors should consider:

L30f: This sentence could be deleted or write “analyses”.

Response: *Thank you for the suggestion. We summarize the “operational analysis and reanalyses” with “analyses”.*

L35f: Should be Agusti-Panareda et al. (2020)

Response: *Thank you for the suggestion, but we do not find that to be correct. The reference is from 2010.*

L45f: This sentence contains no information, neither about the models nor about the content of the reference.

Response: *Thank you for the suggestion. We specify that the authors used dropsonde assimilation (denial) experiments.*

L47: What is “accuracy of the outflow (analysis?)”?

Response: *The authors in that reference analyze outflow related parameters. We specify this in the manuscript.*

L61: “on the ECMWF analysis and tropical convection” sounds odd.

Response: *Thank you for the suggestion. We reword this to “on the ECMWF analysis and modeling of tropical convection”.*

L66ff: Please rephrase this sentence, e.g. delete “those parameters”. Rethink the position of the references – wouldn’t they fit better after “characterizing convection”?

Response: *Thank you for the correction. Implemented!*

L99: I could not find the word “suficit” in common dictionaries. I guess you mean an overestimation? Here, I also suggest to mention that a reduction of the departures after assimilating the dropsonde data means that the model is able to make use of the data and that errors are reduced.

Response: *Thank you for the suggestion. We reworded the clumsy wording to “overestimated and underestimated” instead of “deficit and suficit”, and added a sentence to the suggested effect.*

L100: “Model levels are interpolated to the location”: As I already suggested during the first review, please specify whether this is done within the 4D-VAR or by interpolating the gridded-fields. If the latter is true: 1) How is this done? (linearly in space, in time) 2) What errors do you expected?

Response: *Thank you for reiterating this point. It was done with the 4D-VAR and we indicate this in this sentence.*

L104ff: Not sure why this paragraph was added and is needed.

Response: *Ah, yes. You suggested in your previous review to put in which other fields (other than dropsondes) are used for data assimilation. We still find this useful for the reader to be aware of all the other fields assimilated in the model and leave the paragraph as is.*

L135f (and 309ff): What data is exactly used here? Operational analysis data is available only every 6 hours. Did you include FCs and when were they initialized?

Response: *Thank you for pointing this out. We use the forecast initialized at 12 UTC.*

L151: The reference Ivo (2019) cannot be correct.

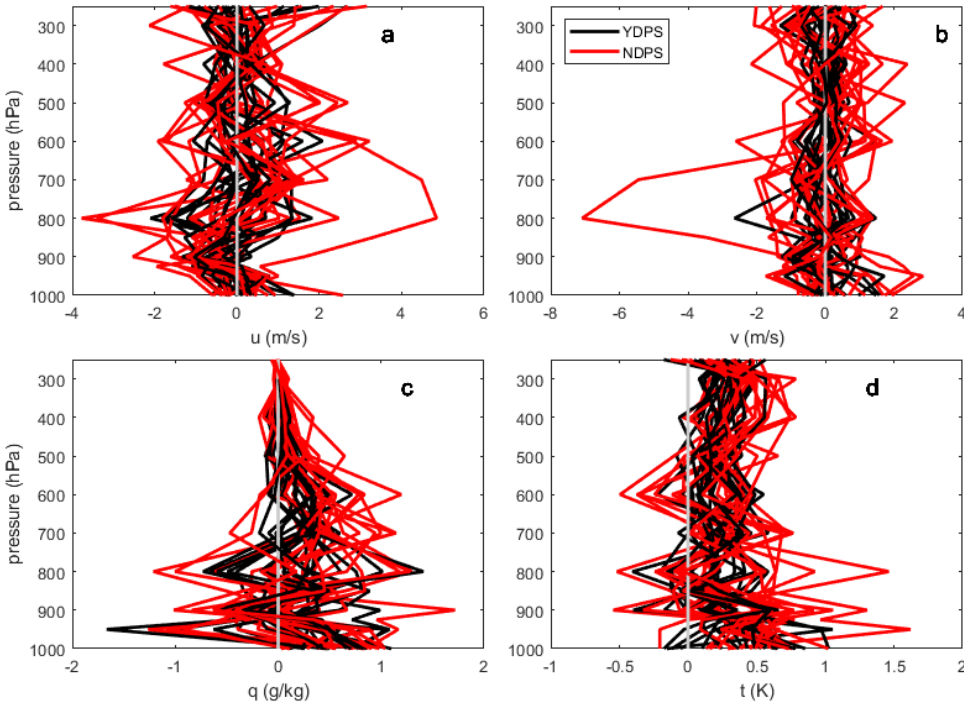
Response: *It is a reference to the year of the storm Ivo; 2019 hurricane season. We emphasize this.*

L149: Please delete “in the placement of convective systems” as you never get to this point

Response: *We replace it with “modeling of convective systems”.*

L163f: This is very vague, it might also be the case that the available data wasn’t used properly and it is not clear if this holds for more than one case.

Response: *We add “for all other individual flights”. We shared the figure with the reviewer in the response document, but find it would clutter the manuscript so we omitted it. If the reviewer refers back to our response they will find this figure:*



which clearly shows our point (note the statistically significant outlier in panels a and b).

L179: “which certainly seems to happen here” This may be correct but it is not investigated so that I recommend to weaken this conclusion.

Response: We deleted “certainly” to weaken the conclusion.

L189: I guess you mean “As absolute differences these departures are ...”

Response: Correct. Corrected. Thank you for the suggestion.

L194: Why “official”? I guess you mean wind errors? Be more specific.

Response: Thank you for pointing this out. We put “official” because the reference is not peer reviewed and we wanted to give it more weight. We specify wind errors at the end of the sentence.

L205: I guess “divergent conditions” does not mean increased divergence but rather the differences between the departures? Please be specific about what you mean here. I cannot see a local jet in Fig.4. Please add a reference to the phenomenon.

Response: We do mean increased divergence. We make that clear in the manuscript. Indeed, we do not show the jet in this plot but because of the climatology of the region we assume it might influence the OTREC flight regions. We add references for the jet climatology.

L225f: What was used in case of the model data? Was the data taken from one particular time step or temporally interpolated?

Response: We used fields necessary to compute divergence and vorticity; winds and positions of dropsonde drops. As we note in the manuscript, we assume the drops were made at the same time for

the purposes of the calculation.

L263ff: What is the TIR of both soundings and where are they located in Fig. 9. Does the special case also provide a special behavior in this analysis (see remarks at the beginning)? This could be a nice way to connect these separated topics.

Response: *The reason why we use these two examples is to show the definition of the vertically integrated departure. At this point in the section we do not correlate it with TIR. But you are right, we do connect this section with the special case (see comment at the beginning of the review); we draw squares around the special case points in figure 9, and discuss this in the section. Indeed they show that the special case had larger departures in wind, and were corrected with inclusion of dropsondes.*

L277f: “q* and T* seem to perform well” makes no sense to me. Do you want to say that errors are the same inside and outside clouds while for winds the scatter increases and errors are higher?

Response: *Thank you for the suggestion, we have corrected this in the manuscript.*

L280f: I thought it is one experiment.

Response: *As figure 9 shows we have two experiments, the NDPS and the YDPS experiment (see description in the methods section).*

L281: Generally, the correlation is low which should be discussed.

Regression lines in Fig. 9 are hard to see.

Response: *Thank you for noticing this. We discuss the small values of the correlation coefficients in this paragraph.*

L289: Take care that units are correctly typeset when using the format “J/K/kg”

Response: *Thank you, we took care of the latex typesetting but await further corrections from the technical editorial staff from the journal.*

L356: “maximum departures of winds”?

Response: *Thank you for pointing this out. Corrected.*

L358: Horizontal maps don’t benefit

Response: *We disagree. Although the departures don’t seem to benefit due to the plotting boundaries for each color, the vertical departure improvements do reflect on the horizontal map improvements. Its subtle but still present in the horizontal maps.*

L359: Please be more specific why you consider these departures to be small? Shouldn’t it be mentioned that these departures aren’t corrected through dropsonde assimilation.

Response: *As we can see in the figures 2 and 3, the fractional area of “gray areas” (smaller departure) is larger. Also, large departures (red and yellow) become smaller (gray areas). So, as mentioned in the previous line response (above), While it is subtle, we do think there is improvements by assimilating dropsondes.*

L365: Rephrase “spread of the scatter”

Response: *Thank you for pointing this out. Corrected.*

L373: More scatter is not necessarily meaning larger departures

Response: *Actually, in this case it does, as it is shown with the slope of the regression line in figure 9, for cloudy regions.*

L376: please rephrase “quantifies” as this rather an indication for clouds and also the representation of clouds in the model is not treated.

Response: *Thank you for pointing this out, we rephrased it as “which we use as a measure of cloud cover”.*

L379: What “question of assimilation of moisture”?

Response: *We refer to figure 9c. There is decrease of correlation for the YDPS experiment. We clarify this in the manuscript.*

L380: Please clarify this sentence: The improvement is not only seen in the correlation.

Response: *Thank you for pointing this out. We clarified this in the manuscript.*