

We are thankful to the reviewer for these comments which help us improve the quality of our manuscript. Our response to each comment is written below.

Anonymous Referee #1

General:

The paper presents a very comprehensive analysis comparing different re-analysis products with respect to their representation of the zonally-averaged basic dynamical quantities as well as to their representation of more sophisticated parameters like wave-forcing (EP flux and its divergence) or the diabatic 2d residual circulation. This comparison was performed within the SPARC-Reanalysis Intercomparison Project (SRIP) and the provided results are archived and available for the scientific community. The presented analysis is very clean and covers the issue from all different angles. Thus, I would like to recommend this paper for publishing in Earth System Science Data (ESSD) with only some minor points listed below.

Minor comments:

1. Captions of figures 3-6 It looks for me that solid lines are denoted with “o” and dashed lines with “x”, i.e. vice versa than the explanation in the manuscript

Thank you very much for finding this mistake. The figure captions are corrected.

2. P15 L2 “this is especially evident for ERA-20C at 300 hPa” - little bit difficult to see it

To improve clarity, we now indicate that the difference we are trying to highlight here is located at around 37°N.

3. P15 L6 “EP flux divergence also varies substantially amongst reanalyses” - maybe you should add “(not shown)”

This is shown in Figure 5 (previously Figure 6) for the North Pole. EP-flux divergence values can be quite different among data sets, especially at 300 hPa and 10 hPa.

4. P18 Figure 7 It would be also nice to plot the difference between Fig 7b and Fig 7a measuring the strength of the influence of the assimilation procedure. I.e. before during and after the sudden warming, the strongest assimilation increments are necessary to “keep the model on track”.

We have added a third panel to this figure (now Figure 6) showing the magnitude of the residual term. Although the residual term represents one estimate of the assimilation increment, its interpretation as such is not as straightforward as it initially seems. We have added a paragraph to clarify this and the reasons behind it, along with a figure showing the breakdown of the MERRA-2 heat budget into time rate of change, dynamics, residual/analysis, and diabatic terms (Figure 7). We select MERRA-2 for this illustration because it provides outputs for the dynamical, analysis, and diabatic terms, allowing us to calculate the time rate of change independently as a residual and thus permitting a direct comparison with the terms in our diagnosed heat budget.

5. P 17, Data usage It would be also great to get zonally-resolved monthly means of some of quantities discussed here like temperature, wind, GPH, but also the zonally resolved EP flux divergence as described in Plumb, JAS, 1985.

A zonally-resolved monthly data set was prepared and is available to the contributors of the S-RIP project but has not been made publicly available at this time. One has also to consider the added-value of providing monthly averages of basic fields on pressure levels considering that many reanalysis centers already provide monthly mean data. Advanced diagnostics such as the Plumb flux are certainly interesting to provide and we will consider doing so in a future iteration of the data set or in a separate data set.