

Review of ACP-2019-1187 : Differences in tropical high clouds among reanalyses: origins and radiative impacts.

This is a substantial comparison of five widely used reanalyses that exhibit a range of cloud behaviours near the tropical tropopause. Geographical and vertical distributions of high top cloud fractions and cloud water contents are evaluated. There is, in addition, an exploration of cloud radiative impacts and their wider influence on the atmosphere, through changes to the vertical profile of radiative heating in the tropics. The authors also take some care to investigate possible reasons for differences identified between the reanalyses as declared in their aims for the paper. As such the comparison makes informative reading for anyone interested in the relative performance of these reanalyses and their potential for estimating temperature biases or validating cloud and radiation metrics in unconstrained model simulations.

Specific / technical comments:

Page 4, l23: might it be clearer to say '... involved changes in the cloud fields which are much larger ...'?

Page 4, l32: suggest '... we stress that most ...' without 'the'.

Page 5, Table 1 / section 2.1: Table 1 provides a useful "at a glance" summary of the characteristics of the different observation datasets. There would be much to be said for extending it by the 5 or 6 lines needed to add equivalent details for the different reanalyses. I take the point made in section 2.1 that this paper provides detailed information of key aspects regarding cloud etc. and that other reviews have covered more general information, for those wishing to spend the time to track it down, but a brief summary set of 'vital statistics' would reduce the reliance the paper is otherwise placing upon a reader's prior knowledge of the reanalyses.

Page 7, l3: do you intend 'specific heat constant' rather than 'heat capacity'?

Page 14, Fig5 caption: 'with values for OLR listed above ...' actually look as though the OLR mean values on the Figure are beneath?

Page 15, Fig 6 caption: 'is marked in the upper row.' Does this refer to the violet lines with numbers beside them in A, C-G?

Page 15, l6: is 'are analogous to scatter plots containing millions of points' a roundabout way of saying 'represent a 2-dimensional probability density function'?

Page 17, l5: 'presumably owing' reads a little loosely to a reviewer. But more precisely, at the bottom of page 16 the point has been made that MERRA-2 can

persist large cloud fraction for declining cloud water, which implies reduced in-cloud water contents that might well lead to different LWCRE. It is thus unclear when the issue of characteristic lifetimes appears in the text whether this is meant to have been inferred from the differences in in-cloud water content or a separate (and presumably verifiable) behaviour of the different schemes discussed that is however (not shown). This sentence would benefit from clarification.

Page 17, l13: 'more than 140Wm^{-2} ' seems a bit redundant when sitting beside 'from -100 to $+40\text{Wm}^{-2}$ '

Page 23, Table 2 caption: 'all data points' (plural)?

Page 23, l12-13: To me, lines 10-13 'Note ... independent.' seem to follow more naturally from the statement of similarity that ends on line 4 '(Table 2).' In addition, the lines 4-7 seem to spend a lot of time simply repeating the data that readers can see in Table 2 whereas I think they would add more if they pulled out what seems to be the key message by showing the differences [Q4 –All] that appear scattered either side of the observed 1K. e.g. 'CFSR exhibits the weakest increase in SST (0.7K) between mean cloud and high ...' or 'observation ..., assigns a mean value to Q4 that is 1K warmer than the tropical mean.'

Page 25, l5: The first half of the first sentence would be better if merged into the following sentence 'Distributions of 500hPa grid-scale vertical velocity (w) for the whole tropics (Figure 9C) ...' and the second half similarly into line 2 of P26.

Page 26, l16-18: there is a lot of repetition that could be reduced by swapping the order in line 16, for instance, 'so that plumes are only permitted to reach the upper troposphere when entrainment rates are small, that is potentially smaller than the ... Tokioka parameter.'

Page 33, Figure 14 caption: are the separation lines 'Solid grey' or 'Solid black'? (I do like the plot, though!).

Page 36, l18: 'occur in ...' rather than 'into'?

Page 36, l33: I found this sentence somewhat hard to digest, especially as a finale. I would suggest putting a stop in at 'in the reanalysis models.' then rewording the rest into a following sentence as appropriate.

Page 42, l3: 'discrete' is redundant here as 'discretization' guarantees it!