Interactive comment on "Confinement of air in the Asian monsoon anticyclone and pathways of convective air to the stratosphere during summer season" *by* B. Legras & S. Bucci
Answer to reviewer #2

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We thank reviewer #2 for his/her comments.

Answer to general comment

0.1 On the overall sloppiness in the layout and presentation

As the opinion of the second reviewer is quite contrasted with that of the first reviewer who wrote that the paper is well-written, we beg the second reviewer to forgive our poor English style but we disagree that our paper is not constructed. We worked on the text to improve the readability of the manuscript and, in particular, to rework the single sentence paragraphs.

0.2 On the robustness of the results

We are aware of the possible impact of the duration of numerical calculations on the statistics built from time integrals. The 2-month integration time has been precisely chosen to avoid such effects and all the displayed results are robust in this respect. The impact is shown in Fig. 5 and in Fig. S5, as a function of age, after normalization on each level. As these figures use a logarithmic scale, it is clear that very little contribution to low order moment statistics can arise from ages larger than two months except at the top levels above 380 K for EIZ and above 400 K for the other cases. In order to show this better, Fig. A2-1 compares, for the four cases of Fig. 5, the mean ages obtained by averaging over the two months period and after applying the exponential tail correction of Scheele et al. (2005),

$$\mathcal{A}_c = \frac{\mathcal{A} + \frac{F_f}{b}\left(\tau_f + \frac{1}{b}\right)}{1 + \frac{F_b}{b}}, \tag{1}$$

where $\mathcal{A}$ is the uncorrected mean age, $\mathcal{A} = \sum_{i=0}^{P-1} F_i \tau_i \delta\tau$, calculated from the normalized impact histogram $\{F_i\}$ over P bins of width $\delta\tau$ in the age between 0 and τ_f, and $-b$ is the slope of the exponential tail. Here the slope is calculated for all the levels between $\tau = 50$ days and $\tau = 62$ days and its value is averaged between 330 K and 390 K.

Figure A2-1 shows that, for all cases but EIZ, the correction is fully negligeable up to 400 K and is still small at 420 K. The results described from Sec. 3.3 onward are mostly limited to below 400 K and to the diabatic cases. EAZ results are used in

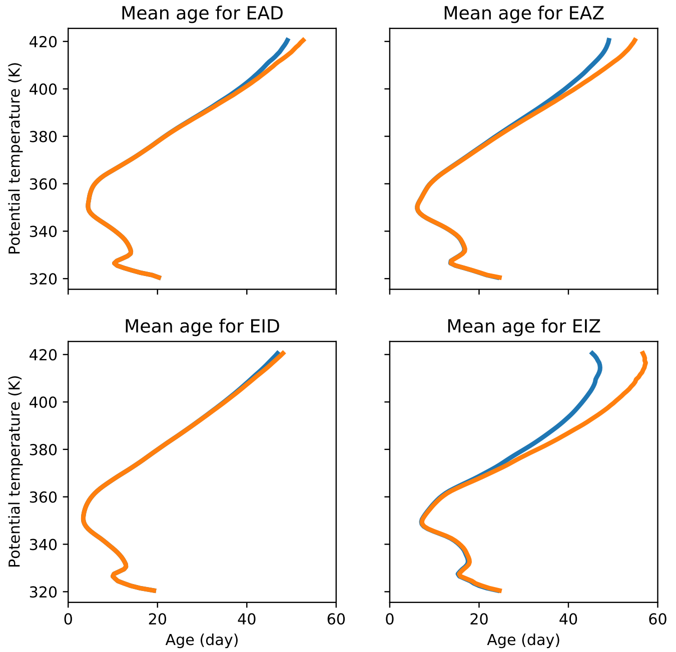

Figure A2-1. Uncorrected mean age (blue) and corrected mean age using (1) (orange) as a function of potential temperature for the four cases EAD (ERA5 diabatic), EAZ (ERA5 kinematic), EID (ERA-Interim diabatic) and EIZ (ERA-Interim kinematic).

the supplement up to 400 K and EIZ is used in Fig. S10 but to show differences between kinematic and diabatic transport in the Hadley-Walker domain, that is at low altitudes. It is also clear that estimates of the ascent rate following the modal peak are not affected, even at 420 K. Figure A2-1 has been added to the Supplement.

Figure 6 was meant to show the difficulties that arise when using average metrics. As it is unecessary to the paper and is a source of confusion, it has been removed.

0.3 On the inconsistency of vertical motion with observed clouds

The reviewer points here to an important limitation of our approach that combines analysed velocities and heating rates with observed clouds. In the present state of the art, the reanalysis do not assimilate any cloud observations (besides winds derived from cloud motion) and therefore the model clouds are generated by the model parametrization. Although extensive comparisons demonstrate the ability of NWP models to predict the cloud cover and precipitation, observed clouds and model clouds most generally do not coincide at local scale in timing, position and extent. Therefore the cloud effects on vertical and horizontal transport also differ in the model and in the real atmosphere. Our approach assumes that the relaxation time of such effects which is up to several days in the TTL, is large enough, with respect to cloud time scale, to ensure a statistical smoothing of the cloud effects that brings the transport properties of the model close to the observations. This assumption has been used already in a number of previous works (e.g. Pfister et al., 2001; Luo and Rossow, 2004; James et al., 2008; Bergman et al., 2012; Ueyama et al., 2014; Tissier and Legras, 2016). Our present approach has been recently tested in the context of the Asian monsoon by a detailed comparison of Lagrangian trajectories with airborne tracer data (Bucci et al., 2019).

0.4 On the usage of acronyms

We agree that the usage of non standard acronyms should be limited but they are somewhat necessary when the same objects are mentioned in multiple instances within a text. We use here four specific acronyms to designate the reanalyses which are each used between 20 and 30 times in the main text and the supplement and the word FullAMA that denote our main region encompassing the Asian Monsoon Anticyclone is used about 60 times. We do not think that replacing them by expanded expression would improve the manuscript. We have however expanded the EAD, EAZ, EID and EIZ acronyms in most of the captions. The AMACore acronym which was not necessary has been removed.

0.5 On the 1-D model

We consider that the 1-D model is an important part of the paper as it fulfils the demonstration that the average transport properties of the Asian Monsoon Anticyclone can be quantitatively reduced to a small set of simple parameters. Without that part, we think that the paper will be considerably weakened.

0.6 Minor comments

We have made all the required changes.

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