

Interactive comment on “Is there a stratospheric fountain?” by J.-P. Pommereau and G. Held

Anonymous Referee #4

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Review of

Is there a Stratospheric Fountain?

by J.-P. Pommereau and G. Held.

General:

Pommereau and Held present an analysis of temperature soundings over Baura (22S) complemented with some radar observations. They show that there is a distinct pattern in the diurnal cycle of temperatures in relation to the occurrence of deep convection. In particular, they find that enhanced convection is associated with warming of the troposphere (which is well known) and cooling between about 15-21km. To my knowledge this is the first time that this pattern is demonstrated from the diurnal cycle of temperatures. The interpretation of this result is of great importance to our under-

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standing of the heat budget of the 'tropical tropopause layer', and has implications for tropical troposphere-to-stratosphere transport. However, the paper has some severe shortcomings:

(i) It is not possible from observations at one place (Bauru) of one process (convective overshoot) to make a strong statement about the (global) role of tropopause-penetrating convection relative to that of radiatively balanced ascent. No mass flux calculations at all are given in the paper. The paper cited in support (Zipser et al.) actually is much more careful about statements of cross-tropopause transport.

(ii) I am not convinced that the only interpretation of the observed temperature response is irreversible mixing with overshooting convection. I had great difficulty following the arguments presented on p8941. Certainly, the arguments put forward by Sherwood et al. (2003) are much stronger than the more qualitative assessment presented here. (I see that Steve Sherwood has written a comment on that as well, and fully agree with his comments on the paper's treatment of gravity waves.)

(iii) How does the diurnal cycle of cooling relate to the pattern found between average profiles from convective and non-convective periods? It seems that the first are weaker (as stated on p.8940/127) and somewhat shallower (comparing Figs. 2 and 3). Do the latter then represent the time-averaged effect in a larger region?

(iv) Fountain and water vapour. First, one should clarify what the 'maritime continent' is. According to my understanding, and that of the papers I've found that use the term, the maritime continent is the region between about 95East and 140East, explicitly including, for example, Indonesia. In contrast, the authors seem to equate the maritime continent with Micronesia (p9844,11) - a serious misunderstanding. They argue that convection over Indonesia is very vigorous (p8943,127) which would in fact fit nicely to the original description of the 'fountain region' by Newell and Gould-Stewart (1981). Further, the manuscript runs into some problems when it comes to stratospheric water vapour. Clearly, if tropopause-penetrating convection would constitute the major path-

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way into the stratosphere, and this convection is loaded with ice, then we would have again the same problem that Newell and Gould-Stewart were facing: How should we explain the observed dryness? To me, the following scenario would make much more sense: tropopause penetrating convection exists, but is not the major pathway into the stratosphere. Because properties of air masses injected by convection differ from those of radiative ascent across the tropopause (e.g. in terms of water vapour, or also other tracers), we can see the effect of tropopause penetrating convection as 'perturbations'. If the major pathway were tropopause penetrating convection, we could not see the effect of this convection in the form of, for example, moist filaments! (Please note that one need not to adopt an extreme scenario like Holton and Gettelmann (2001) - convection can detrain at all altitudes up to the tropopause; and it may be that convection over maritime regions, despite being less vigorous, accounts for most of the mass flux up to levels above the levels of zero net radiative heating.)

To summarise, the paper presents some interesting observations, but fails to present sufficient evidence for the main hypothesis put forward, namely that tropopause penetrating, overshooting convection is the major pathway into the stratosphere.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 8933, 2007.

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