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Atmospheric Chemistry and Physics Discussions

Interactive comment on "In situ observations of "cold trap" dehydration in the western tropical Pacific" *by* F. Hasebe et al.

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This paper presents an analysis of several water vapor soundings in the tropical western Pacific, together with trajectory analyses, with the aim of demonstrating that dehydration has occurred as a result of horizontal flow through a 'cold trap'. The results are based on analysis of four water vapor soundings over Bandung and three soundings over Tarawa, with temperature and trajectory calculations based on ECMWF meteorological data. Some of the water vapor soundings use the Snow White (SW) hygrometer, some use the Cryogenic Frostpoint Hygrometer (CFH), and a few soundings use both for comparison (with substantial differences in detail between the two measurements). There is reasonable agreement between observed water vapor near the tropical tropopause and the co-located saturation mixing ratio (SMR, derived from radiosonde temperatures), suggesting the air is nearly saturated near the cold point; this

is not a new result (Vomel et al., 2002). However, because the SW water vapor data are noisy near the tropopause, the authors choose to focus on variability near 355 K potential temperature (substantially below the cold point), and compare the soundings with trajectory estimates of SMR. These comparisons show that moist soundings have somewhat higher back trajectory SMR's (and dry soundings have lower SMR's), but the differences between observations and calculations is large (as large as the differences between the moist versus dry soundings). There could be several causes of these differences: uncertainty in trajectory estimates (and strong vertical gradients), unresolved scales of motion, effects of convection, or supersaturated conditions. All of these are interesting issues, but the analyses here do not help identify which are the most important. Whatever the cause, the lack of detailed agreement, together with the availability of only a few observations, does not provide a convincing case that a 'cold trap' has occurred. The fact that water vapor generally follows the SMR along trajectories in the tropical upper troposphere is reasonably well known (see for example Dessler and Sherwood, JGR, 2000), although detailed comparisons with actual soundings would be a useful contribution (if quantitative new information is obtained). One further note is that the 'cold trap' hypothesis of Holton and Gettelman (2001) is focused on altitudes near the cold point tropopause and water vapor entering the stratosphere, and the calculations here do not address this issue (so I think 'cold trap' is inappropriate).

Overall my opinion is that the lack of quantitative agreement in the observations and trajectory calculations, together with the few available data samples, does not present a convincing case for 'cold trap' dehydration (and that nomenclature should really be reserved for dehydration near the cold point). Accordingly, I do not recommend this paper for publication.

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