

Interactive comment on “Observations of ozone-poor air in the Tropical Tropopause Layer” by Richard Newton et al.

Richard Newton et al.

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We thank the reviewer for their comments on the paper. We respond below to the specific comments made.

1. *[The authors] should acknowledge a number of other papers that describe NH-SH ozone gradients (from surface and aircraft) and/or very low ozone in the upper troposphere and TTL throughout the tropical Pacific. The latter includes PEM-Tropics (1990s) and TC4 (2007).*

The introduction has been expanded to include discussion of TC4. The PEM series of flights only measured up to 12 km [Hoell et al., 1999; Raper et al., 2001] and are not relevant to a discussion of the TTL. We refer to PEM-West and PEM-

tropics in section 4.4 of the paper where we discuss boundary-layer ozone. The following passage has been added to the introduction:

Bubbles of relatively low ozone have also been observed in other parts of the world. During the TC4 campaign, anomalously low ozone concentrations of ~ 60 ppbv were found at 14–16 km altitude in the TTL off the coast of Ecuador—typical values of ozone at this altitude in this region were measured to be ≥ 100 ppbv. These low-ozone bubbles were also shown to be a result of non-local convection followed by advection to where it was measured by the NASA DC-8 aircraft [Petropavlovskikh et al., 2010].

2. *The very important motivating question posed on page 2, namely, “do enough reactive species penetrate the lower stratosphere to perturb the composition?” is not really answered. It is recommended that the authors conclude the paper with summarizing how their findings address this issue.*

The focus of this paper, and the objective described on page 2, was to “corroborate the ozonesonde measurements with other measurements and to determine how widespread these bubbles of low-ozone air over the Warm Pool,” rather than whether reactive species penetrate into the lower stratosphere. The key question posed in the introduction was “whether deep convection is nevertheless capable of lifting very short-lived halogenated species near enough to the tropopause that their breakdown products reach the stratosphere” rather than direct penetration of the lower stratosphere. We don’t think that the reviewer has read this part of the paper correctly and therefore do not make any changes to the paper.

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