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In situ observations of dehydrated air parcels advected horizontally in the Tropical Tropopause Layer of the western Pacific

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Abstract. Water vapor observations by chilled-mirror hygrometers were conducted at Bandung, Indonesia (6.90° S, 107.60° E) and Tarawa, Kiribati (1.35° N, 172.91° E) in December 2003 to examine the efficiency of dehydration during horizontal advection in the tropical tropopause layer (TTL). Trajectory analyses based on bundles of isentropic trajectories suggest that the modification of air parcels' identity due to irreversible mixing by the branching-out and merging-in of nearby trajectories is found to be an important factor, in addition to the routes air parcels follow, for interpreting the water vapor concentrations observed by chilled-mirror frostpoint hygrometers in the TTL. Clear correspondence between the observed water vapor concentration and the estimated temperature history of air parcels is found showing that drier air parcels were exposed to lower temperatures than were more humid ones during advection. Although the number of observations is quite limited, the water content in the observed air parcels on many occasions was more than that expected from the minimum saturation mixing ratio during horizontal advection prior to sonde observations.

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