

SOWER observations of dehydration processes for air parcels advected horizontally in the tropical tropopause layer

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1. Introduction

A basic understanding of the stratospheric water vapor starts with the idea that it must reflect the temperature history the air experienced before entering the stratosphere. Among many processes hypothesized, the 'cold trap' theory in which air parcels are dehydrated during the horizontal advection in the tropical tropopause layer (TTL) of the western tropical Pacific is becoming widely accepted as a key dehydration process.

2. SOWER project

The Soundings of Ozone and Water in the Equatorial Region (SOWER) project is intended to have ozone and water vapor profiles in the troposphere and the lower stratosphere in the tropical Pacific by radiosonde observations. It has been operating chilled-mirror hygrometers such as NOAA/CMDL frostpoint hygrometer, Snow White and the University of Colorado Cryogenic Frostpoint Hygrometer to accurately measure water vapor profiles since 1998. It has also operated lidars to observe thin cirrus cloud particles simultaneously with in situ water vapor measurements.

3. Results

A bundle of isentropic trajectories are used to characterize the life history of air parcels observed by water vapor sondes. The day-to-day variations of the water vapor mixing ratio in the TTL can be interpreted on the basis of the origin of the air parcels and by the degree of coldness the air parcels are exposed to during horizontal advection. Although the number of observations is still too small, the water content in the observed air parcels on many occasions was about twice as much as that expected from the minimum saturation mixing ratio during horizontal advection prior to sonde observations. To make this argument more quantitative, the water vapor 'match' in which the same air mass is repeatedly observed by sondes following its motion is quite interesting. Preliminary 'match' results from recent campaigns will be also presented.